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**MxL7225**  
**25A Dual Phase**  
EVB User Manual

## Revision History

Document No.	Release Date	Change Description
006UMR02	10/5/20	Initial release.

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## Introduction

The MxL7225 evaluation board provides a platform to evaluate the features and performance of the MxL7225. The MxL7225 is a dual 25A Power Module optimized for powering Telecom, Networking and Industrial equipment. There are multiple EVBs for the MxL7225. This manual covers the 25A Dual Phase BGA Evaluation Boards.

## Quick EVB Set Up and Start Up

### Factory Settings

In addition to utilizing the 4.5V to 15V input voltage range and dual 25A maximum load current rating capabilities of the MxL7225 Power Module, the Evaluation Board has been set up with the factory default configurations shown below for quick set up and operation. **Do not exceed the EVB maximum load current rating.**

The factory default configuration ([Table 2](#)) for the MxL7225 Evaluation Board is:

- $V_{OUT1} = 1.5V \pm 1.5\%$
- $V_{OUT2} = 1.0V \pm 1.5\%$
- 500kHz Switching Frequency
- CCM mode. For other modes, see [Jumper J44 MODE](#).
- Run is enabled for both channels. See [Jumpers J30 RUN1 and J29 RUN2](#).
- Soft-start is selected for both channels. See [Jumper J26 TRACK1 SEL](#) and [Jumper J25 TRACK2 SEL](#).
- CLKOUT phase is 90 degrees, see [Jumper J45 PHASMD](#).

### Quick Start Up

To quickly see the regulator in operation:

1. Use the factory settings and default configuration. If other settings or components are desired, apply them before the next steps and see [Set-Up Options](#) for more.
2. Connect a turned-off power supply that is within a  $V_{IN}$  specification of 4.5V to 15V, (12V typical) to VIN and GND with short, thick leads. Use test pins VIN+ and VIN- to monitor VIN and GND respectively. See locations in [Figure 1](#).
3. For the channel 1 output, connect an electronic load initially set to 0A, that will be no more than the above maximum  $I_{OUT}$  (25A), to VOUT1 and GND with short / thick leads. Use test pins VOUT1 (J52) and VOUT1\_GND (J60) to monitor VOUT1 and GND respectively. See locations in [Figure 1](#).
4. For the channel 2 output, connect an electronic load initially set to 0A, that will be no more than the above maximum  $I_{OUT}$  (25A), to VOUT2 and GND with short, thick leads. Use test pins VOUT2 (J53) and VOUT2\_GND (J61) to monitor VOUT2 and GND respectively. See locations in [Figure 1](#).
5. Turn on the power supply and check  $V_{OUT}$  of both channels. The EVB will power up and (factory default) regulate the channel 1 output at  $1.5V \pm 1.5\%$  (1.4775V to 1.5225V) and channel 2 output at  $1.0V \pm 1.5\%$  (0.985V to 1.015V). Output ripple should be measured across the output capacitors for each channel: C8 for VOUT1 and C22 for VOUT2. Test points J52 and J53 can be used to monitor VOUT1 and VOUT2, respectively.
6. Set or vary the load (do not exceed the maximum  $I_{OUT}$ ) and check  $V_{OUT}$  and other desired performance levels such as regulation and efficiency.

See [Configuration and I/O Interfaces](#) and [Load Transient Circuit](#) for more on testing and monitoring. For Single Rail Dual Phase 50A Operation and to vary  $V_{OUT}$  see [MxL7225 EVB Mode Selection](#).

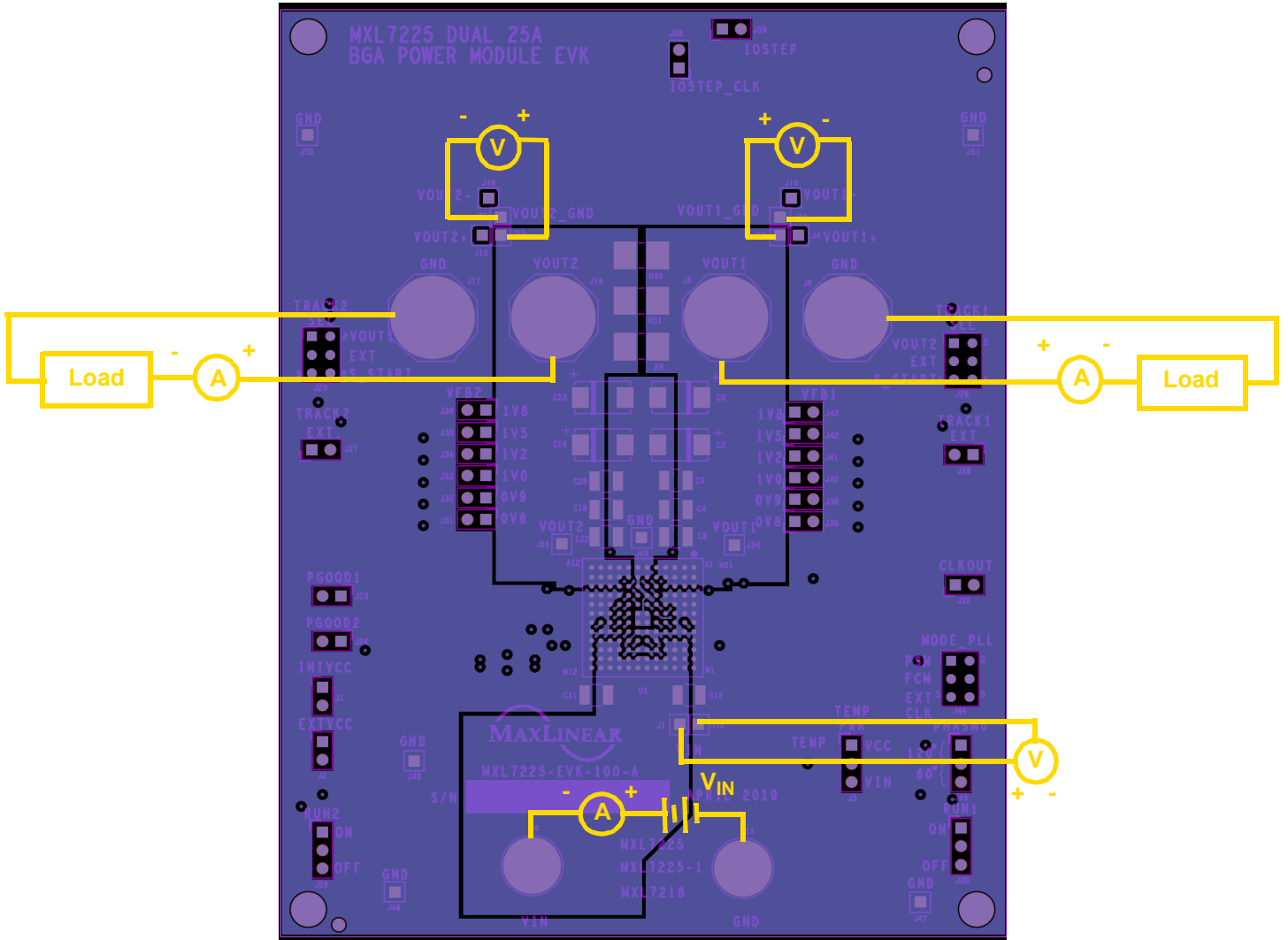
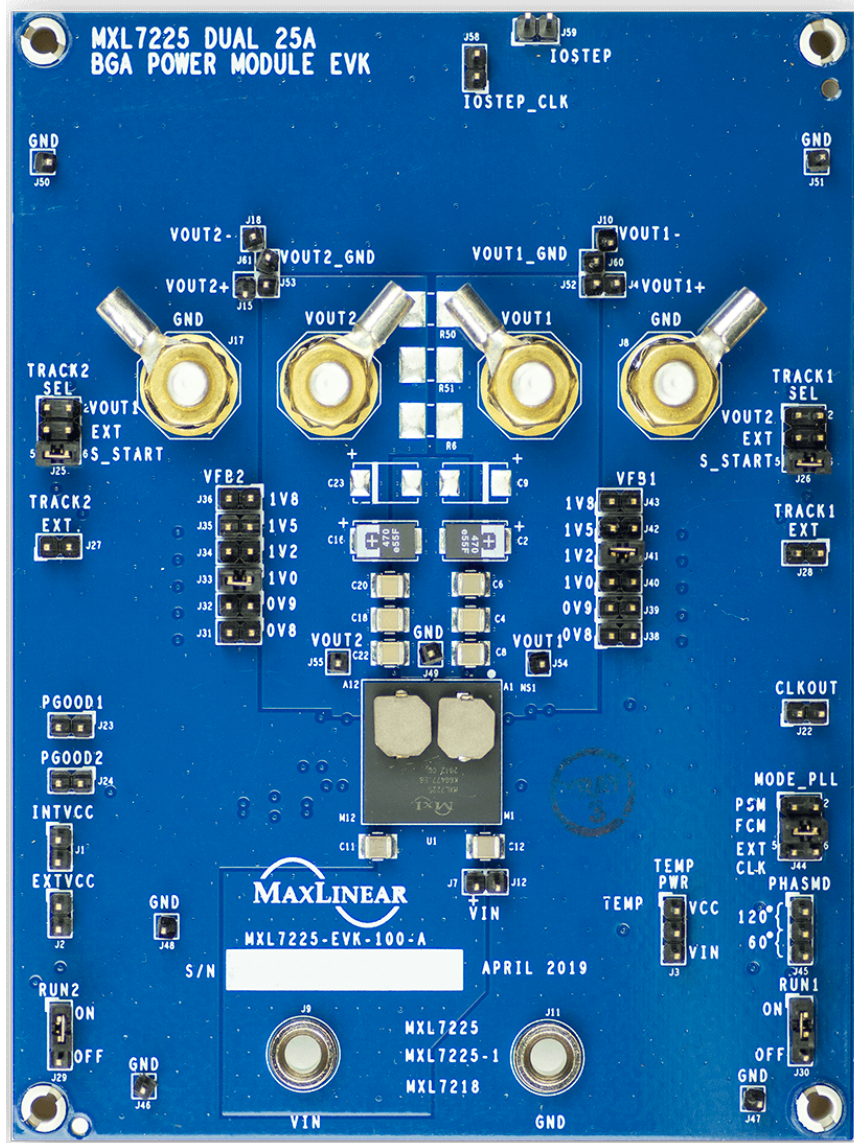


Figure 1: Monitoring  $V_{IN}$  and  $V_{OUT}$



**Figure 2: Top View of MxL7225 25A Dual Phase BGA EVB**



## Reference Documentation

Please refer to the [MxL7225 Data Sheet](#) for additional information about the MxL7225, including efficiency curves for this configuration with  $V_{IN} = 12V$ . The datasheet also includes a full list of IC features, pinout, pin descriptions, typical performance characteristics and external component calculations. This manual is meant to be used in conjunction with the datasheet.

This manual provides EVB schematics, PCB layout and bill of materials that can be utilized to assist in your board design. The schematics are also available on the MxL7225 product page.

## Ordering Information

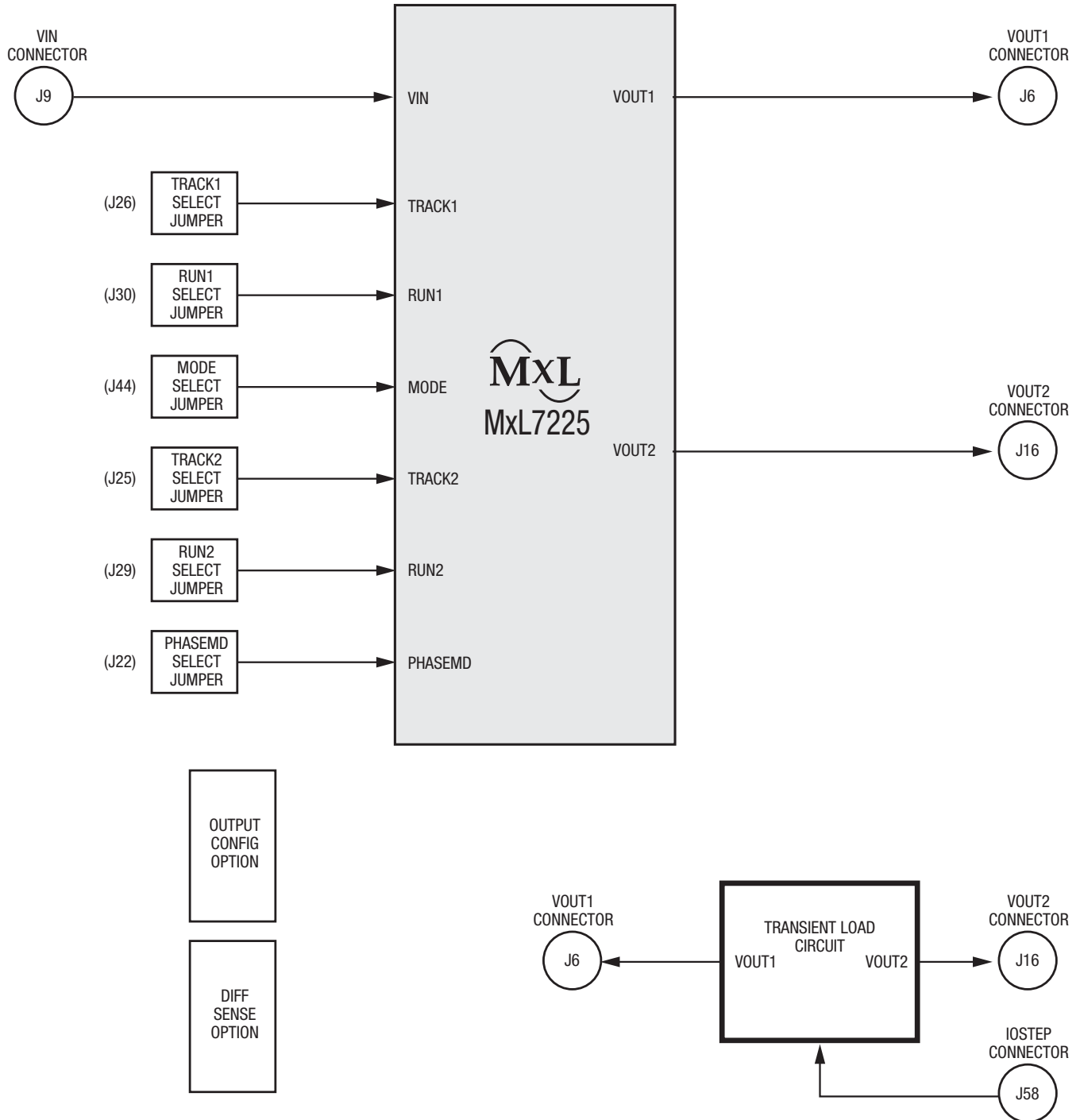
**Table 1: Evaluation Board Ordering Part Number**

Power Module	Evaluation Board	Description
MxL7225-ABA-T	MxL7225-EVK-1	MxL7225 Evaluation Board, Single Device, Dual Output

1. Refer to [www.maxlinear.com/MxL7225](http://www.maxlinear.com/MxL7225) for most up-to-date Ordering Information.

## Evaluation Board Overview

The block diagram shown in **Figure 3** illustrates the connection points for the VIN, VOUT1, VOUT2, TRACK, MODE\_PLL and RUN pins.



**Figure 3: Block Diagram MxL7225 Two Channel EVB**

## Configuration and I/O Interfaces

### MODE

The MODE (J44) jumper is provided for overall device configuration:

Force Continuous Mode, Pulse-Skipping Mode and External Synchronization are selectable.

### RUN1, RUN2

A RUN jumper is provided for both channels (J30 for RUN1 and J29 for RUN2).

### TRACK1 SEL, TRACK2 SEL

A TRACK jumper is provided for both channels.

VOOUT, EXT and SOFTSTART are selectable.

Test points are allocated for probing of TRACK1 (J26) and TRACK2 (J25).

### PHASMD

A CLKOUT (J45) jumper is provided for clock phase selection.

60, 90 or 120 degrees of phase offset is configurable.

### EXTVCC

An EXTVCC test point (J2) is provided to monitor or inject EXTVCC.

### TEMP

A TEMP test point (J3) is provided to monitor temperature.

### PGOOD1, PGOOD2

A PGOOD test point is provided for both channels (J24 for PGOOD1 and J23 for PGOOD2).

Both PGOOD signals are tied to INTVCC through 10k $\Omega$  resistors.

**Note:** The silkscreen on the evaluation board is reversed for PGOOD1 and PGOOD2.

### SW1, SW2

A SW test point is provided for both switching signals (TP1 for SW1 and TP2 for SW2).

## Set-Up Options

Jumpers are factory installed per Table 2 to configure the EVB for operation. Jumper and testing options are described in the next sections. Refer to the product datasheet for additional information.

**Table 2: Factory Settings**

Jumper	Label	Factory Setting	Description
J44	MODE	Jumper 3-4	FCM
J30	RUN1	Jumper 1-2	On
J29	RUN2	Jumper 1-2	On
J26	TRACK1	Jumper 5-6	Soft-Start
J25	TRACK2	Jumper 5-6	Soft-Start
J45	PHASEMD	No Jumper	90°

### Jumper J44 MODE

**Table 3: J44 Options**

Jumper Options	Description
Jumper 1-2	PSM - Pulse Skipping Mode.
Jumper 3-4	FCM - Force Continuous Mode.
Pin 6	Apply an external clock to pin 6 to put both channels into continuous mode, synchronized to the applied clock.

### Jumpers J30 RUN1 and J29 RUN2

**Table 4: J30, J29 Options**

Jumper Options	Description
Jumper 1-2	On. RUN1/2 connected to VIN.
Jumper 2-3	Off. RUN1/2 connected to GND.

### Jumper J26 TRACK1 SEL

**Table 5: J26 Options**

Jumper Options	Description
Jumper 1-2	V <sub>OUT2</sub> master track mode.
Jumper 3-4	External master track mode.
Jumper 5-6	Soft start. Track1 connected to cap to GND.

## Jumper J25 TRACK2 SEL

**Table 6: J25 Options**

Jumper Options	Description
Jumper 1-2	V <sub>OUT1</sub> master track mode.
Jumper 3-4	External master track mode.
Jumper 5-6	Soft start. Track1 connected to cap to GND.

## Jumper J45 PHASMD

**Table 7: JP45 Options**

Jumper Options	Description
Jumper 1-2	120°
No Jumper	90°
Jumper 2-3	60°

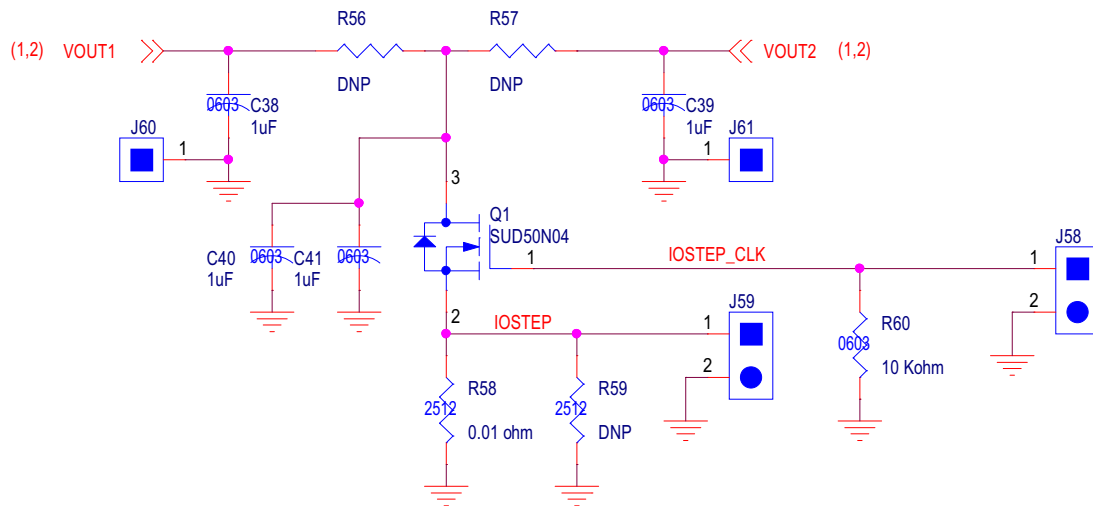
## Test Interfaces

### Load Transient Circuit

A load transient circuit is provided to allow optional testing of load transients. The IOSTEP clock input is used to drive the transient signal. The load step generated by the FET (Q1) is very fast; the step slew rate is  $>40A/\mu s$  for a 12.5A transient load test case.

To measure load transient response for either channel, use the circuit shown in **Figure 4**. To test CH1, populate R56 and depopulate R57 and apply a small duty cycle pulse signal to IOSTEP CLK input ( $\sim 1\%$ ). Adjust the amplitude of the IOSTEP CLK pulse to set the load current. Start at a pulse amplitude of 2V and increase while monitoring the IOSTEP (J59) voltage. The load current at IOSTEP (J59) is 10mV/A. For an example, a 12.5mA load will occur when a 125mV pulse is observed at J59.

To test load transient response on CH2, depopulate R56 and populate R57 and repeat procedure.



**Figure 4: Load Transient Circuit**

## MxL7225 EVB Mode Selection

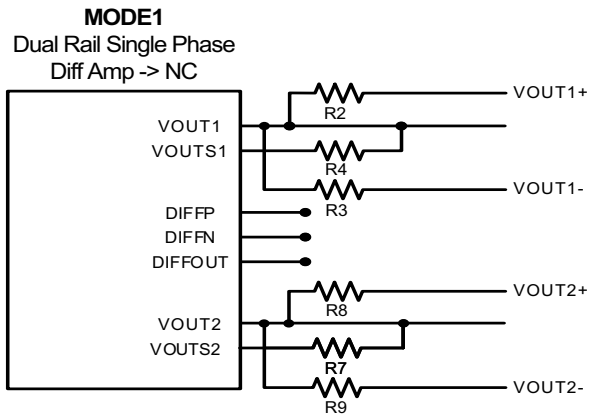
The MxL7225 EVB can be configured for 6 different modes of operation:

- Mode 1: Dual 25A with no remote sense amplifier
- Mode 2: Dual 25A with remote sense amplifier on  $V_{OUT1}$
- Mode 3: Dual 25A with remote sense amplifier on  $V_{OUT2}$
- Mode 4: Single 50A with no remote sense amplifier
- Mode 5: Single 50A with remote sense amplifier on  $V_{OUT1}$
- Mode 6: Single 50A with remote sense amplifier on  $V_{OUT2}$

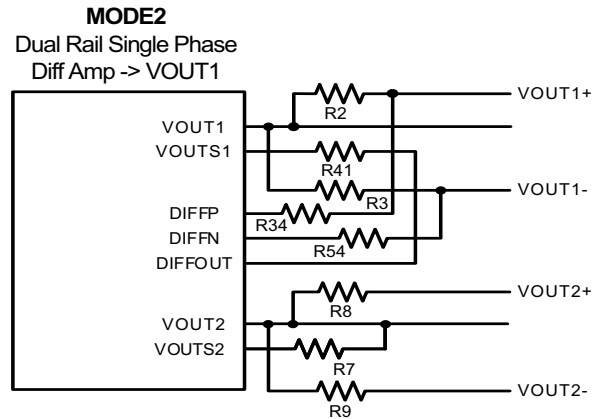
The stuffing options to configure the EVB into each of the 6 modes are shown below with the block diagram for each mode on the next page.

**Table 8: Board Stuffing for Operation Mode Selection**

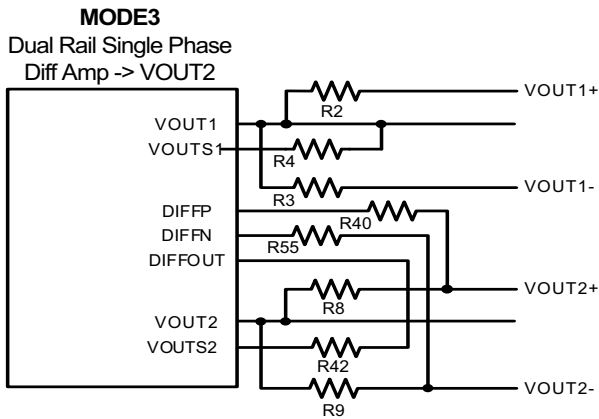
Pin Function	Component	Mode 1 Dual Rail Single Phase Diff Amp NC	Mode 2 Dual Rail Single Phase Diff Amp $V_{OUT1}$	Mode 3 Dual Rail Single Phase Diff Amp $V_{OUT2}$	Mode 4 Single Rail Dual Phase Diff Amp NC	Mode 5 Single Rail Dual Phase Diff Amp $V_{OUT1}$	Mode 6 Single Rail Dual Phase Diff Amp $V_{OUT2}$
2-Phase (VOUT1)	R5	DNP	DNP	DNP	0Ω	0Ω	0Ω
2-Phase (VOUT2)	R6	DNP	DNP	DNP	0Ω	0Ω	0Ω
VOUS1	R4	0Ω	DNP	0Ω	0Ω	DNP	DNP
VOUS2	R7	0Ω	0Ω	DNP	DNP	DNP	DNP
DIFFP (VOUT1+)	R34	DNP	0Ω	DNP	DNP	0Ω	DNP
DIFFP (VOUT2+)	R40	DNP	DNP	0Ω	DNP	DNP	0Ω
DIFFN (VOUT1-)	R54	DNP	0Ω	DNP	DNP	0Ω	DNP
DIFFN (VOUT2-)	R55	DNP	DNP	0Ω	DNP	DNP	0Ω
DIFFOUT (VOUS1+)	R41	DNP	0Ω	DNP	DNP	0Ω	DNP
DIFFOUT (VOUS2+)	R42	DNP	DNP	0Ω	DNP	DNP	0Ω
TRACK	R45	DNP	DNP	DNP	0Ω	0Ω	0Ω
TRACK1	J15 (5-6)	On	On	On	On	On	On
TRACK2	J32 (5-6)	On	On	On	Off	Off	Off
RUN	R43	DNP	DNP	DNP	0Ω	0Ω	0Ω
COMP	R44	DNP	DNP	DNP	0Ω	0Ω	0Ω
PGOOD	R47	DNP	DNP	DNP	0Ω	0Ω	0Ω
VFB	R46	DNP	DNP	DNP	0Ω	0Ω	0Ω



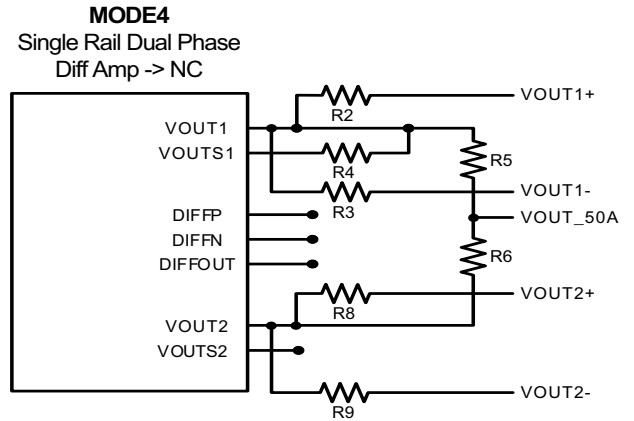
**Figure 5: Mode 1 Block Diagram**



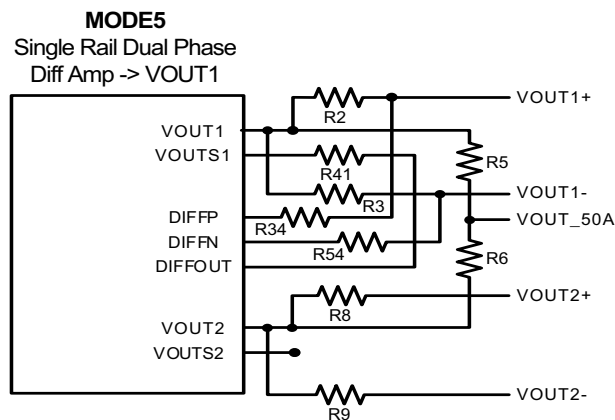
**Figure 6: Mode 2 Block Diagram**



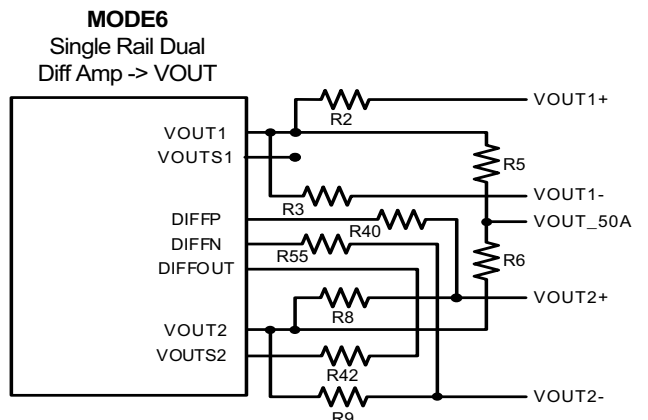
**Figure 7: Mode 3 Block Diagram**



**Figure 8: Mode 4 Block Diagram**



**Figure 9: Mode 5 Block Diagram**

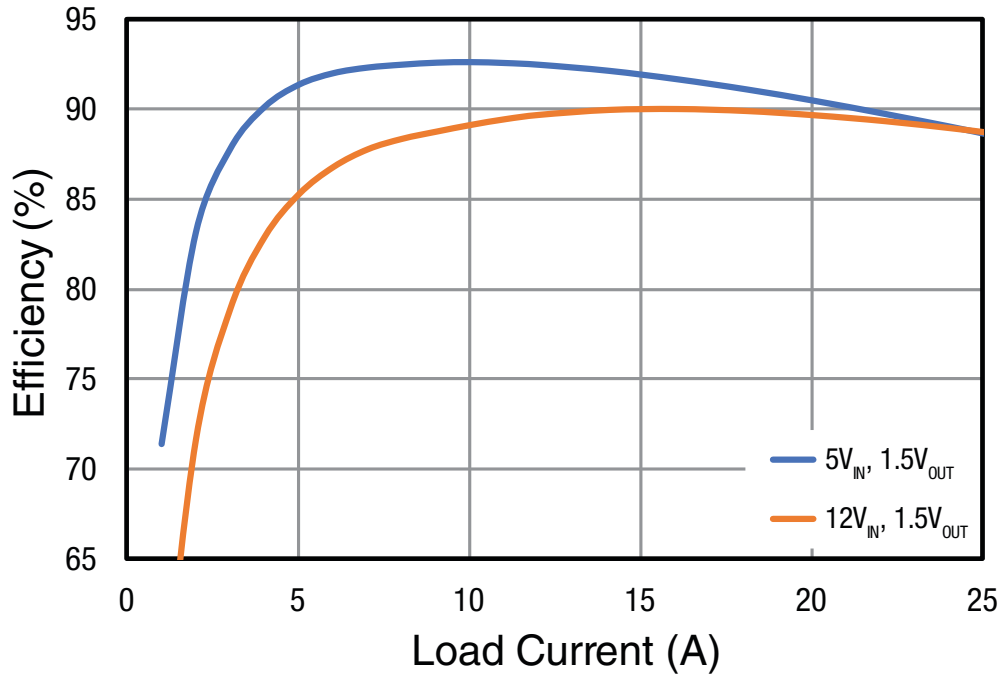


**Figure 10: Mode 6 Block Diagram**

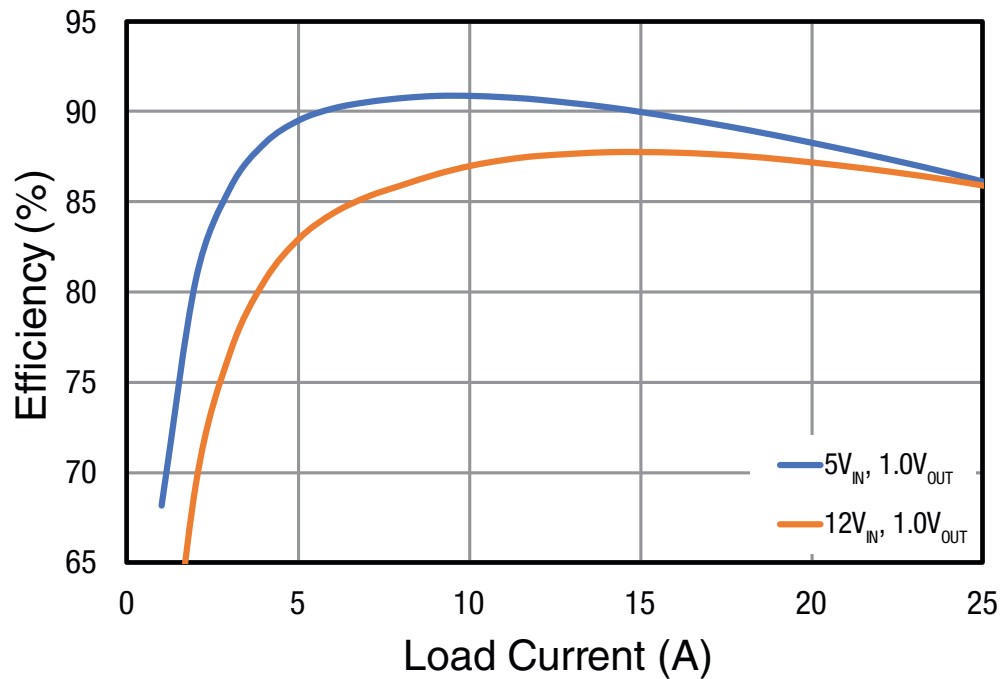


## Performance

### Efficiency

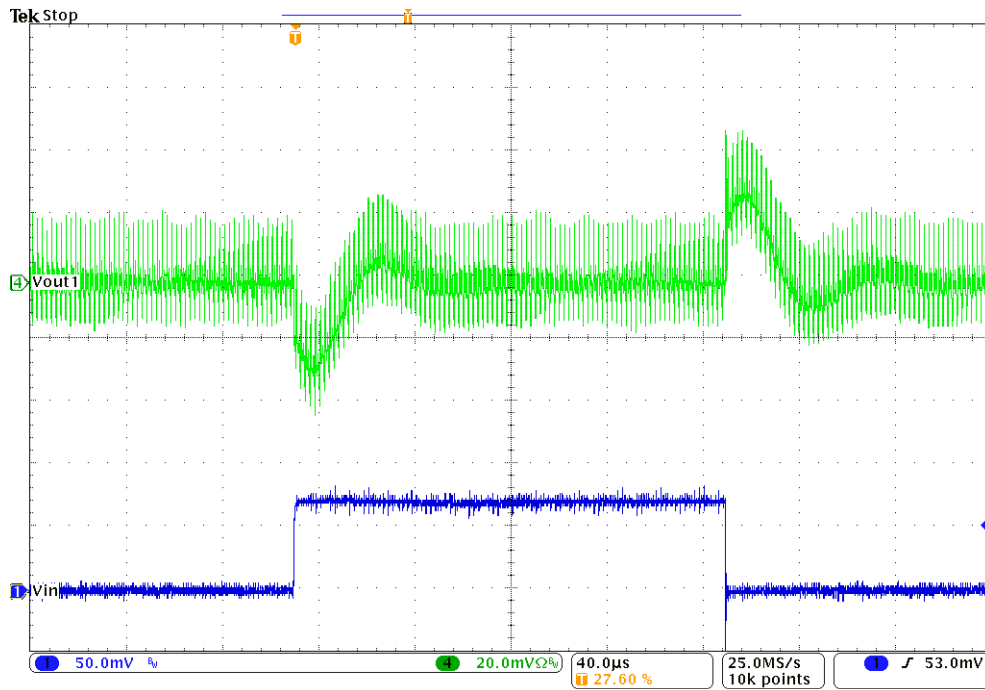


**Figure 11:** Channel 1 Measured Efficiency ( $V_{OUT} = 1.5V$ ,  $f_{SW} = 500kHz$ , Ch 2 Disabled)

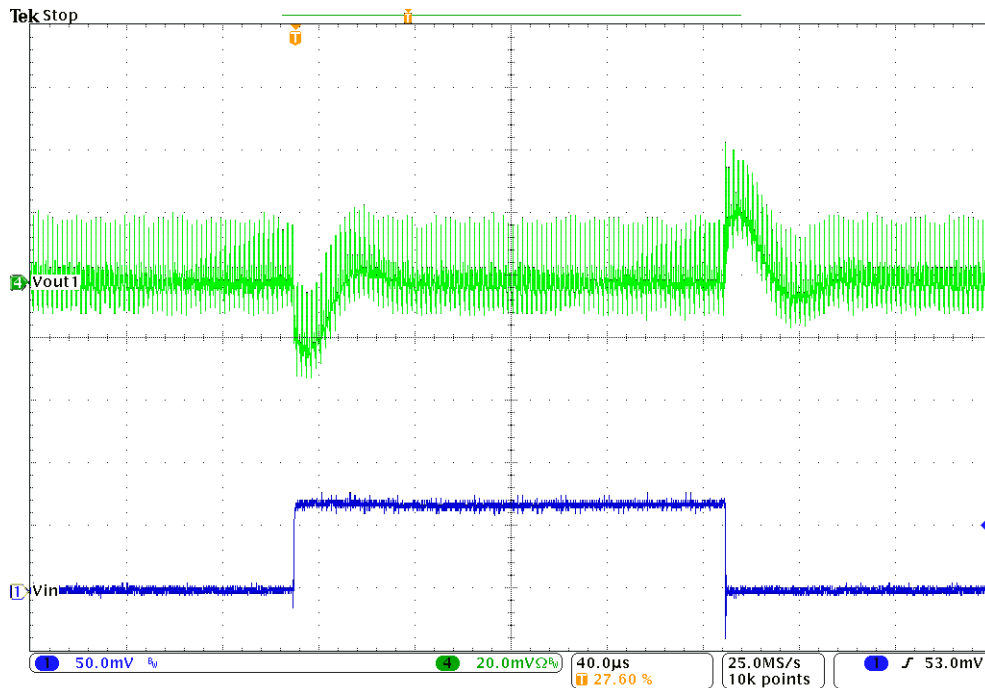


**Figure 12:** Channel 2 Measured Efficiency ( $V_{OUT} = 1.0V$ ,  $f_{SW} = 500kHz$ , Ch 1 Disabled)

# Load Transient Response

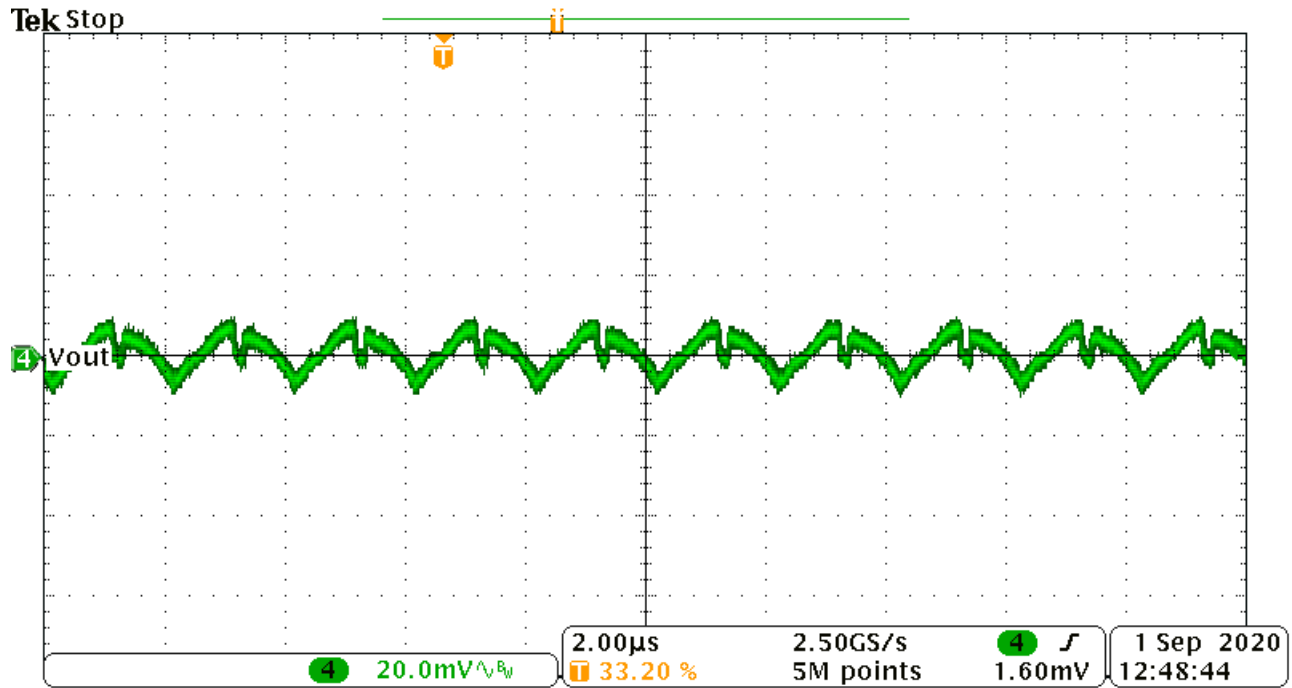


**Figure 13: Load Transient Response ( $V_{OUT} = 1.5V$ ,  $V_{IN} = 12V$ )**



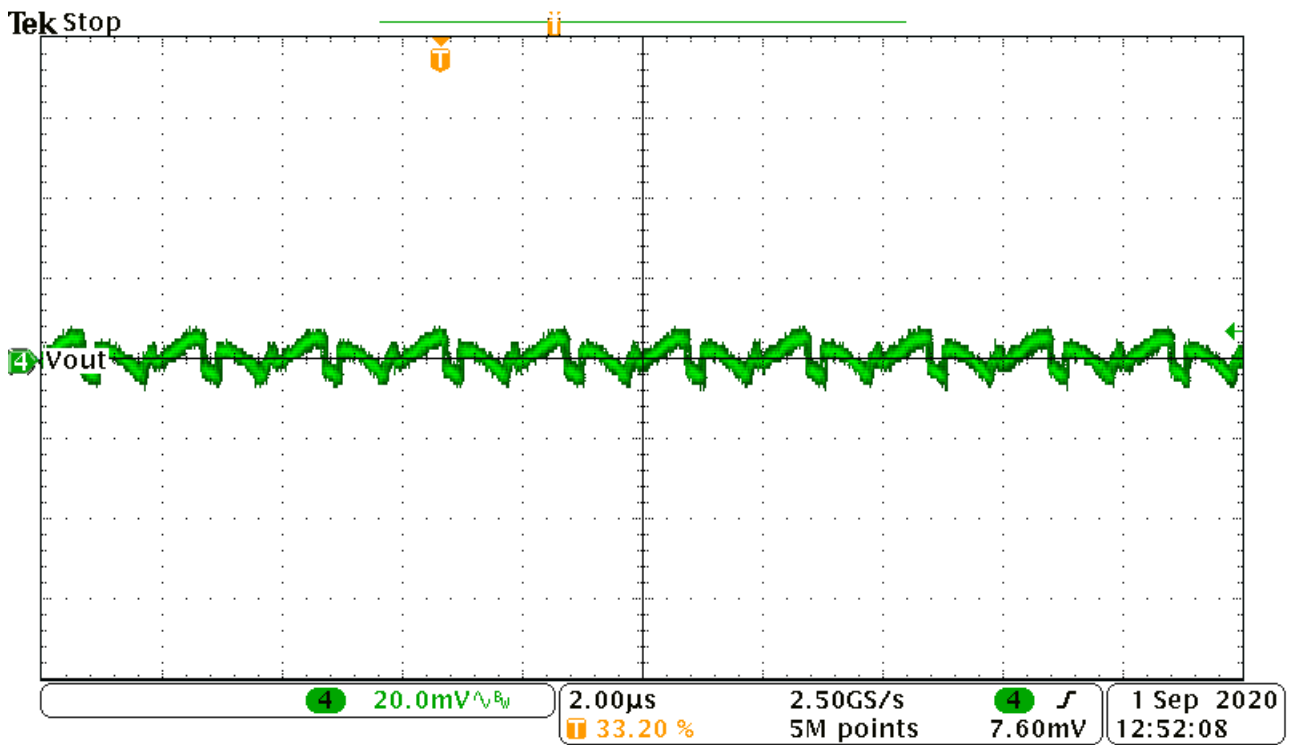
**Figure 14: Load Transient Response ( $V_{OUT} = 1.0V$ ,  $V_{IN} = 12V$ )**

## Output Ripple



2. Ripple waveform shown, measured at VOUT1 (J54). The ripple waveform characteristics ideally should be observed at the output capacitor closest to the MxL7225, C8.

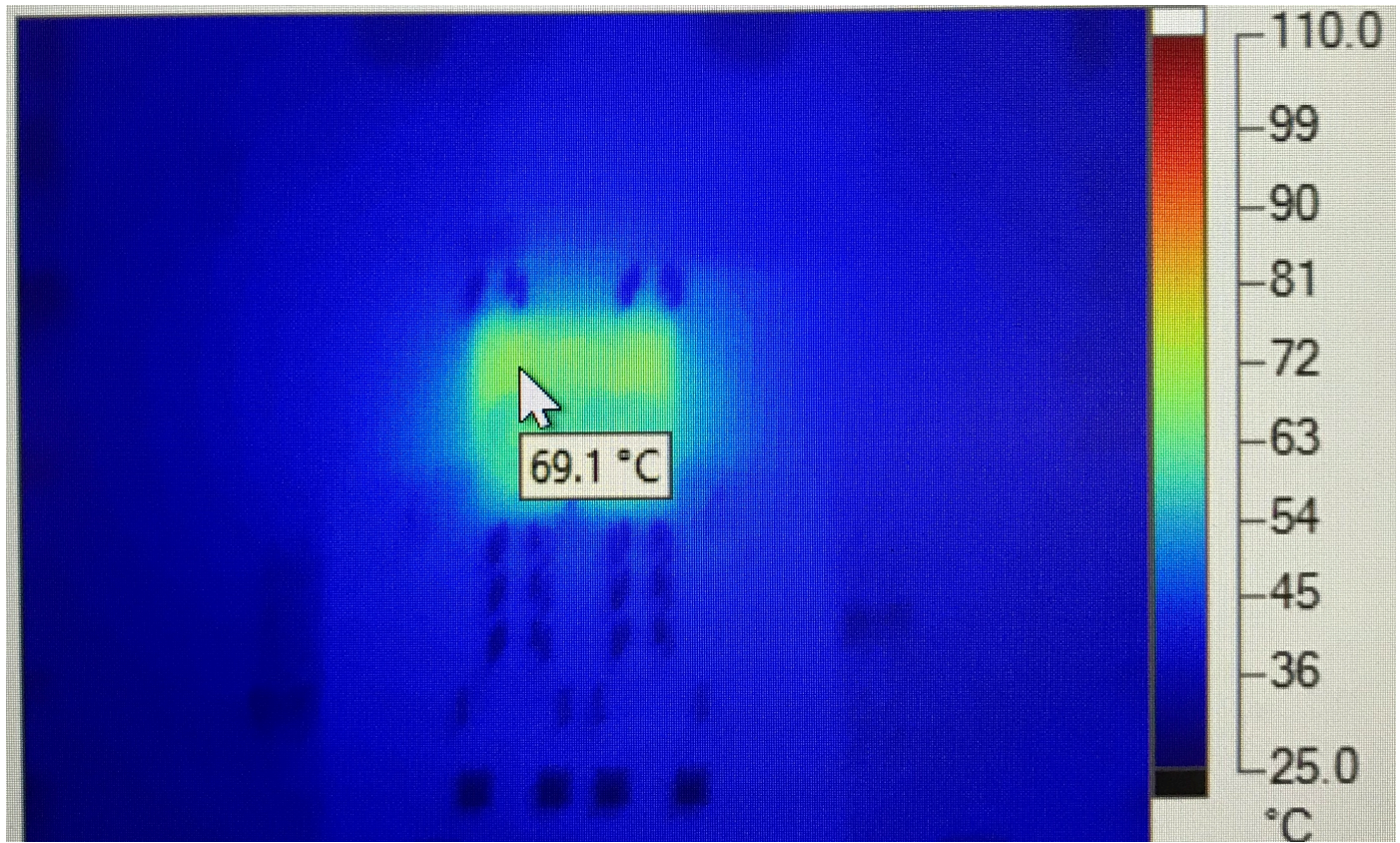
**Figure 15: Channel 1 Output Voltage Ripple ( $V_{IN} = 12V$ ,  $V_{OUT} = 1.5V$ , Load = 25A)**



3. Ripple waveform shown, measured at VOUT2 (J55). The ripple waveform characteristics ideally should be observed at the output capacitor closest to the MxL7225, C22.

**Figure 16: Channel 2 Output Voltage Ripple ( $V_{IN} = 12V$ ,  $V_{OUT} = 1.0V$ , Load = 25A)**

## Thermal



**Figure 17:** Thermal Capture ( $V_{IN} = 12V$ ,  $V_{OUT} = 1.5V$ , Load = 25A, 500kHz, Airflow = 200LFM)

# MxL7225EVB Schematic

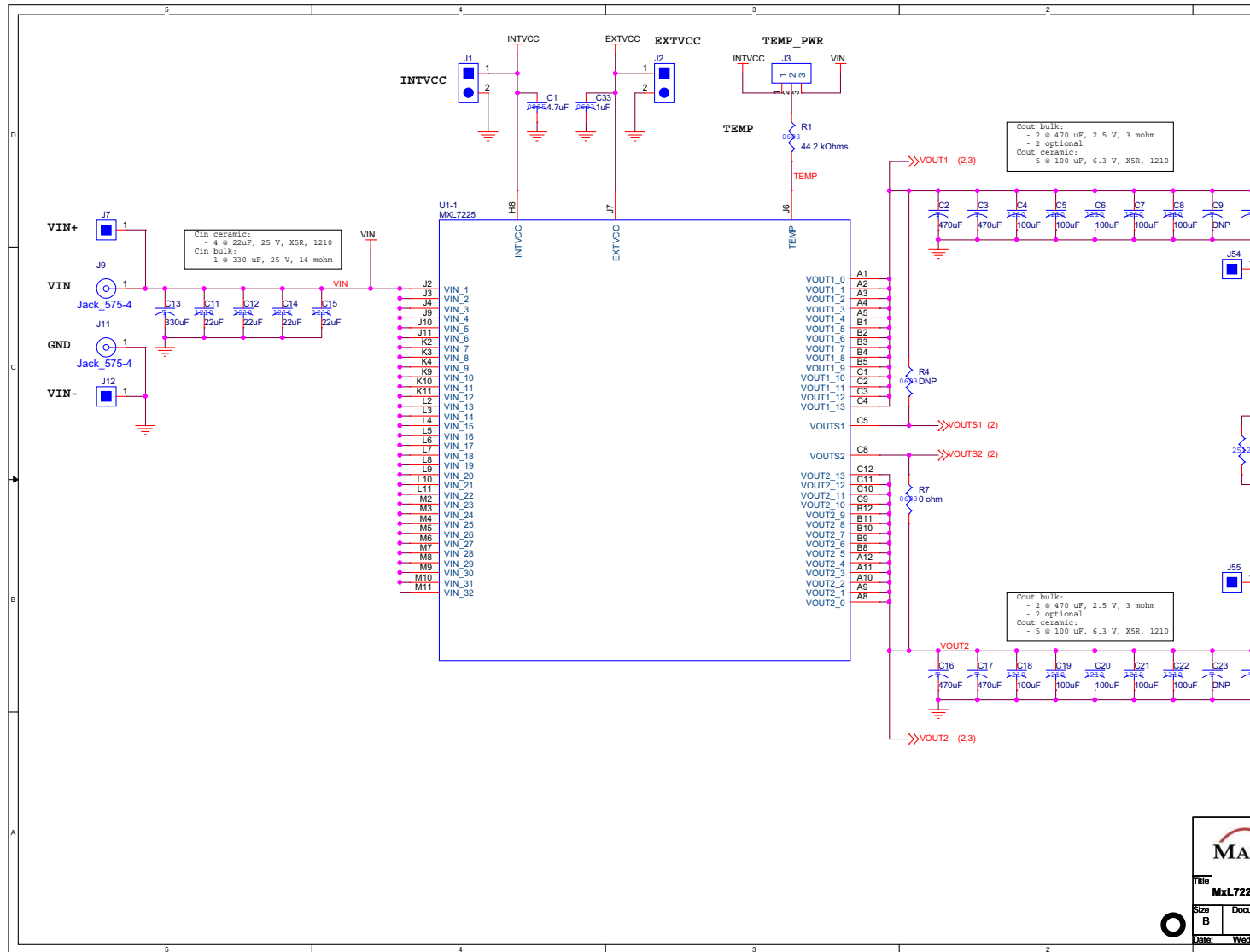


Figure 18: EVB Schematic

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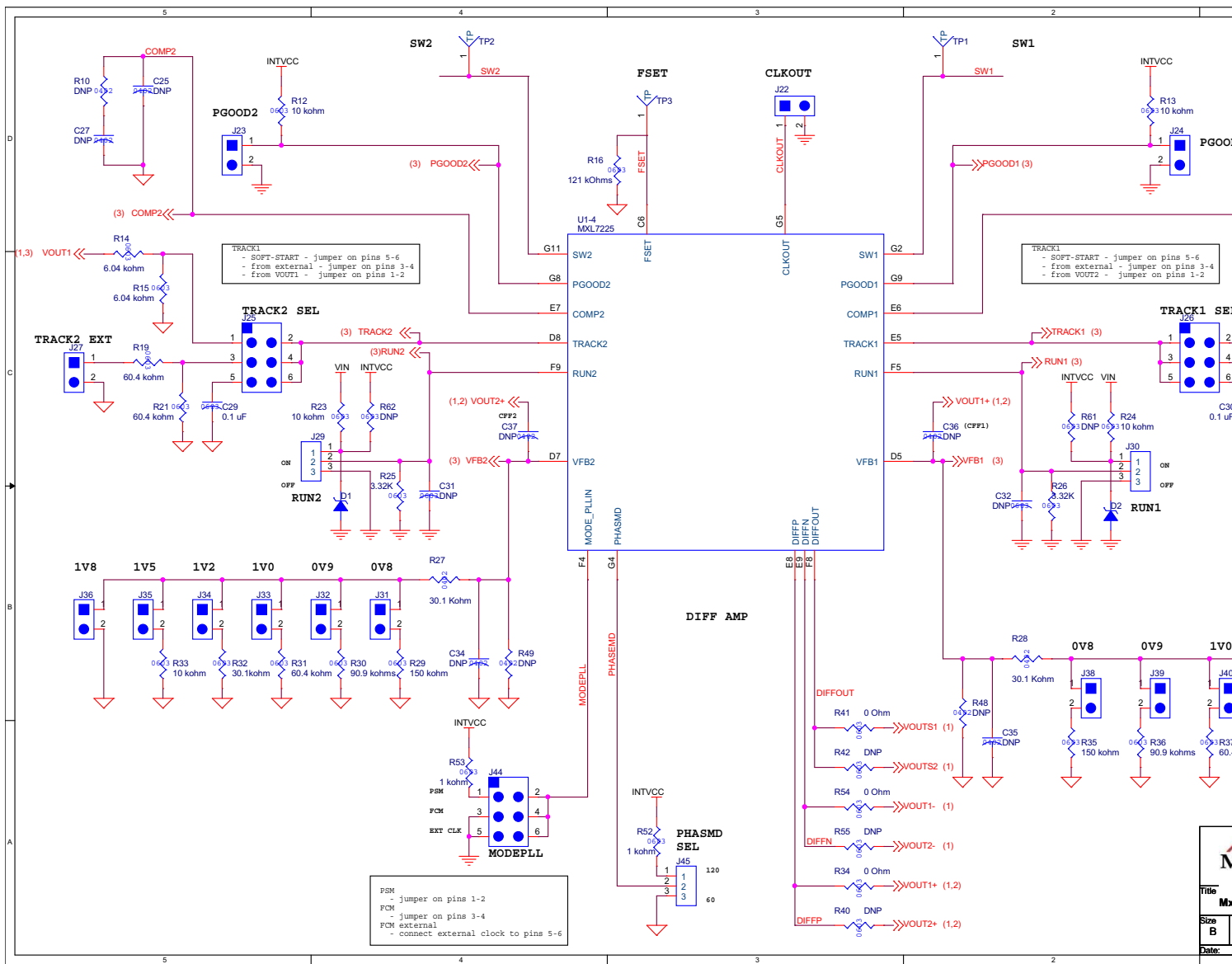
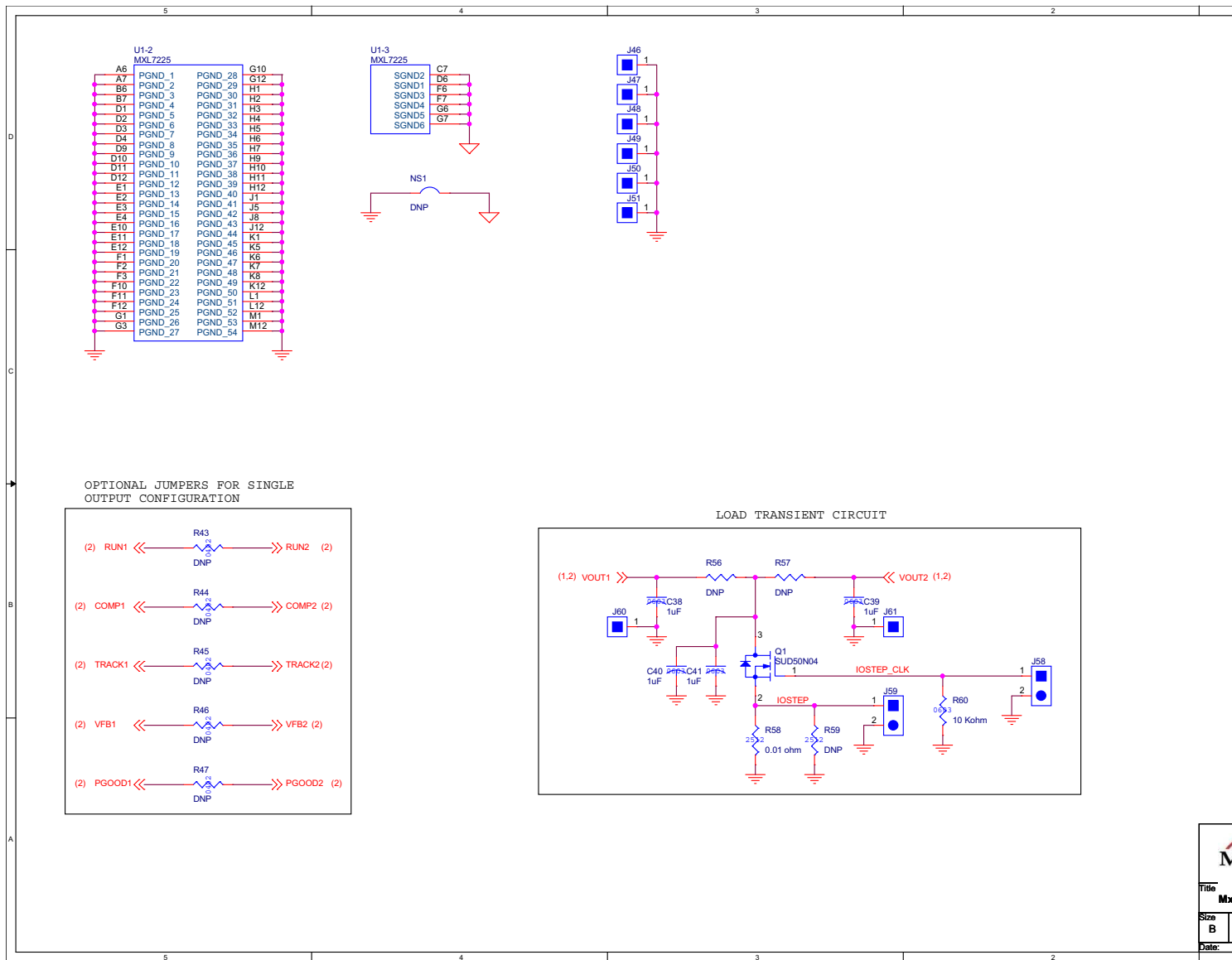


Figure 19: EVB Schematic, Continued



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**Figure 20: EVB Schematic, Continued**

# MxL7225EVB PCB Layers

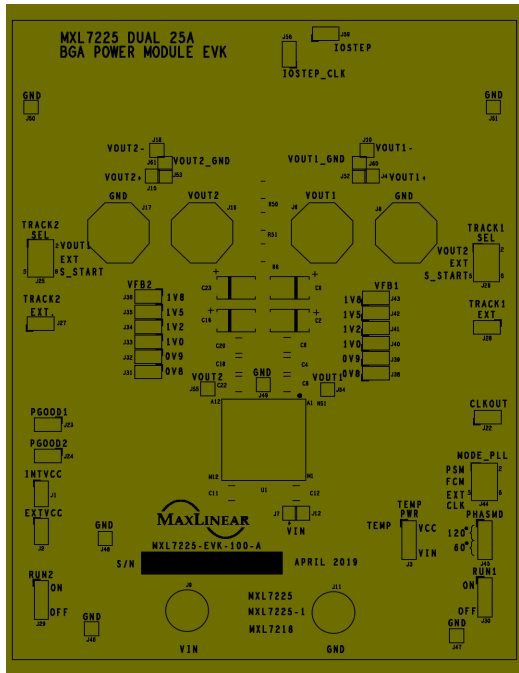


Figure 21: EVB PCB BGA Silkscreen Top

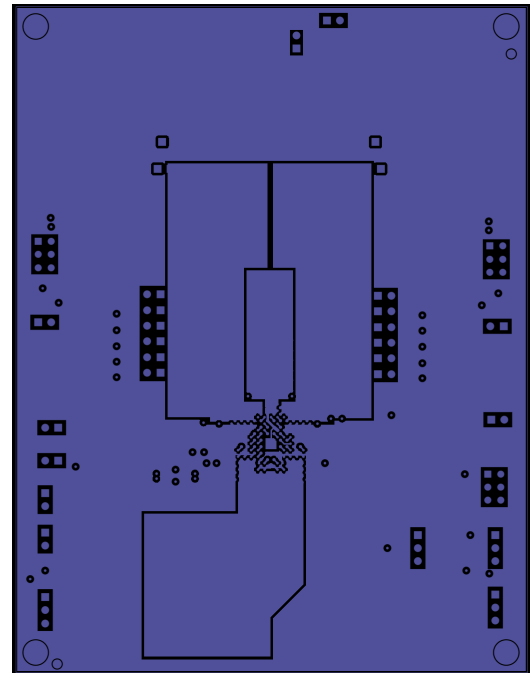


Figure 22: EVB PCB BGA Layer 1

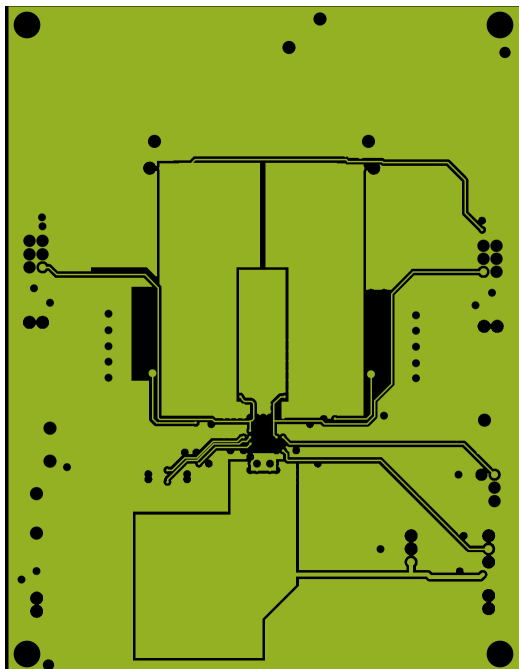


Figure 23: EVB PCB BGA Layer 2

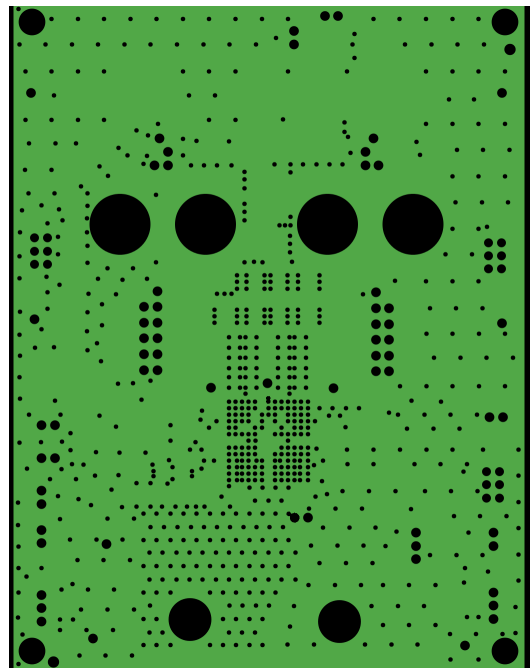
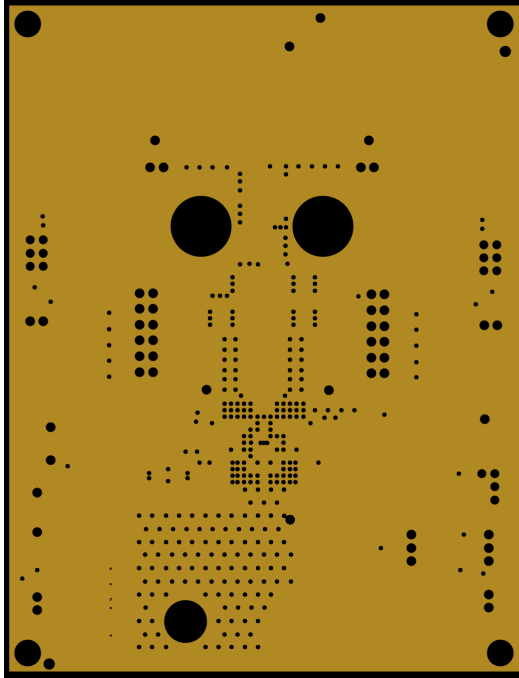
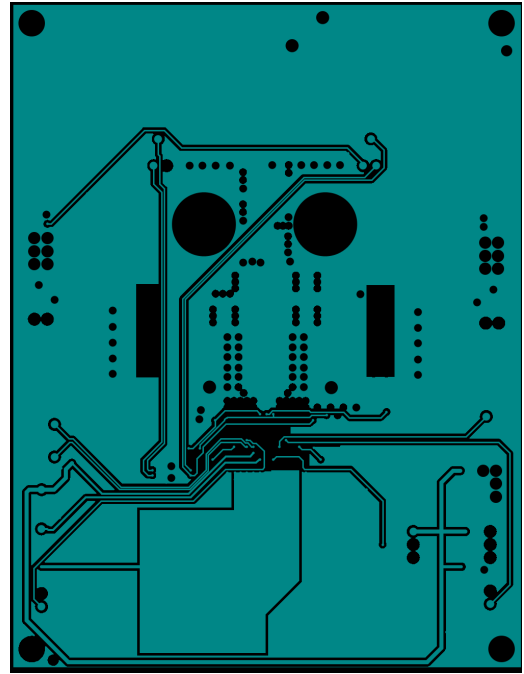


Figure 24: EVB PCB BGA Layer 3

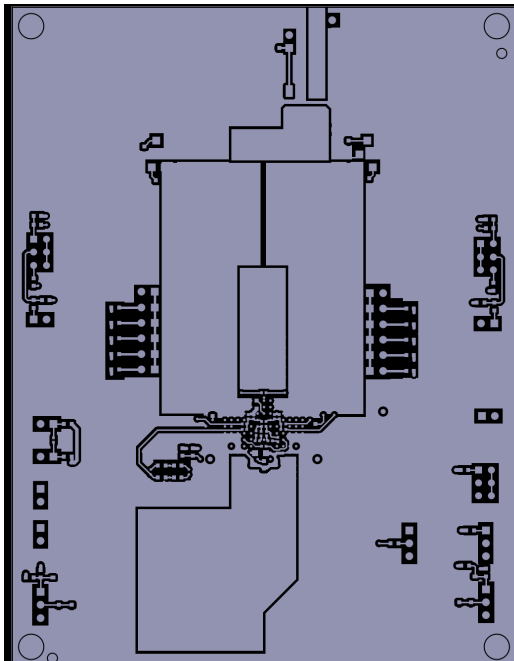




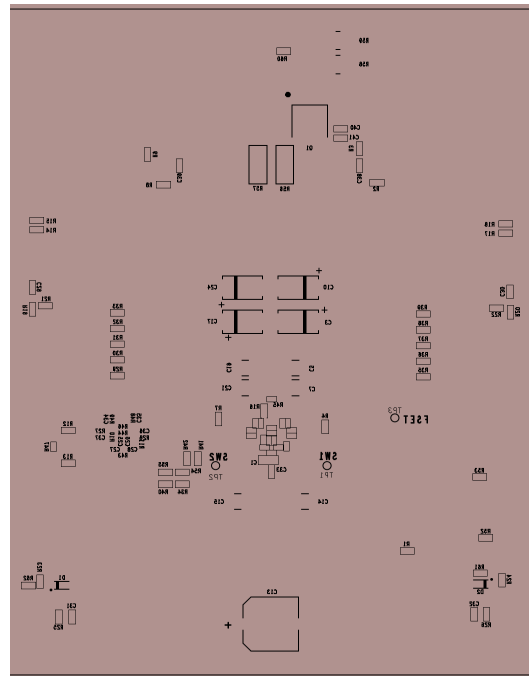
**Figure 25:** EVB PCB BGA Layer 4



**Figure 26:** EVB PCB BGA Layer 5



**Figure 27:** EVB PCB BGA Layer 6



**Figure 28:** EVB PCB BGA Silkscreen Bottom

## MxL7225EVB Bill of Materials

**Table 9: EVB BGA Bill of Materials**

Item	Qty	Reference Designator	Value	Tol.	Description	Manufacturer / Part Number	Package Type
1	1	C1	4.7 $\mu$ F	10%	CAP CER 4.7UF 16V 10% X7R 0805	Würth Elektronik 885012207053	0805
2	4	C2, C3, C16, C17	470 $\mu$ F	20%	CAP TANT POLY 470UF, 2.5V, 5m $\Omega$	Panasonic ETPF470M5H	4.3x7.3mm
3	10	C4, C5, C6, C7, C8, C18, C19, C20, C21, C22	100 $\mu$ F	10%	CAP CER 100uF 6.3V 20% X5R 1210	Würth Elektronik 885012109004	1210
4	4	C9, C10, C23, C24	DNP		CAP TANT POLY DNP		4.3x7.3mm
5	4	C11, C12, C14, C15	22 $\mu$ F	10%	CAP CER 22uF 10% 25V X5R 1210	Würth Elektronik 885012109014	1210
6	1	C13	330 $\mu$ F	20%	CAP., ALUM. ELECT., 330 $\mu$ F, 25V, 20%	Panasonic 25SVPF330M	SMD
7	6	C25, C26, C27, C28, C34, C35	DNP		CAP, Ceramic, SMD, DNP, 0402		0402
8	2	C29, C30	10nF	10%	CAP CER, 0.01UF, 50V, 10%, X7R, 0603	Würth Elektronik 885382206002	0603
9	2	C31, C32	DNP		CAP, Ceramic, SMD, DNP, 0603		0603
10	5	C33, C38, C39, C40, C41	1 $\mu$ F	10%	CAP CER 1uF +/-10% 16V X7R 0603	Würth Elektronik 885012206052	0603
11	2	C36, C37	DNP				0402
12	2	D1, D2	MMSZ5226B		DIODE ZENER 3.3V 500MW SOD123	ON Semiconductor MMSZ5226B	SMD
13	21	J1, J2, J22, J23, J24, J27, J28, J31, J32, J33, J34, J35, J36, J38, J39, J40, J41, J42, J43, J58, J59	HEADER_1X2_2.54 mm_M		HDR, 2.54mm Single Row/ Male 1X2 GOLD	Würth Elektronik 61300211121	TH
14	4	J3, J29, J30, J45	HEADER_1X3_2.54 mm_M		HDR, 2.54mm Single Row/ Male 1X3 GOLD	Würth Elektronik 61300311121	TH
15	18	J4, J7, J10, J12, J15, J18, J46, J47, J48, J49, J50, J51, J52, J53, J54, J55, J60, J61	HEADER_1X1_2.54 mm_M		HDR, Single Pin/Male 1X1 GOLD	Würth Elektronik 61300111121	TH
16	4	J6, J8, J16, J17	KFH		Broaching Stud , KFH #10-32, Phosphor Bronze	PennEngineering KFH-032-10ET	TH
17	2	J9, J11			CONN. BANANA JACK	Keystone Electronics 575-4	

**Table 9: EVB BGA Bill of Materials (Continued)**

Item	Qty	Reference Designator	Value	Tol.	Description	Manufacturer / Part Number	Package Type
18	3	J25, J26, J44	HEADER_2x3_0.1"		HDR, 0.1" Double Row/2x3	Wurth Electronics 61300621121	TH
19	1	Q1	SUD50N04		MOSFET N-CH 40V 14A TO-252	Vishay SUD50N04	SMD
20	1	R1	44.2k $\Omega$	1%	RES SMD 44.2 KOHM 1% 1/10W 0603	KOA Speer RK73H1JTDD4422F	0603
21	4	R2, R3, R8, R9	10 $\Omega$	1%	RES, Thin Film, 10 ohm, 1%, 1/10W, SMD, 0603	Vishay CRCW060310R0FKEB	0603
22	4	R7, R34, R41, R54	0 $\Omega$	1%	RES, Thick Film, 0 ohm, 1%, 1/10W, 50V, SMD, 0603	Yageo RC0603FR-070RL	0603
23	4	R6, R50, R51, R59	DNP				2512
24	9	R10, R11, R43, R44, R45, R46, R47, R48, R49	DNP				0402
25	5	R12, R13, R23, R24, R60	10k $\Omega$	1%	RES SMD 10K OHM 1% 1/10W 0603	Panasonic ERJ-3EKF1002V	0603
26	2	R17, R18	6.04k $\Omega$				
27	2	R14, R15	DNP				0603
28	1	R16	121k $\Omega$	1%	RES SMD 121K OHM 1% 1/10W 0603	Yageo RC0603FR-07121KL	0603
29	6	R19, R20, R21, R22, R31, R37	60.4k $\Omega$	1%	RES SMD 60.4K OHM 1% 1/10W 0603	Panasonic ERJ-3EKF6042V	0603
30	8	R4, R40, R42, R55, R61, R62	DNP				0603
31	2	R25, R26	3.32k $\Omega$	1%	RES SMD 3.32K OHM 1% 1/10W 0603		
32	2	R27, R28	30.1k $\Omega$	1%	RES 30.1K OHM 1/16W 1% 0402 SMD	Yageo RC0402FR-0730K1L	0402
33	2	R29, R35	150k $\Omega$	1%	RES, Thin Film, 150 Kohm, 1%, 1/10W, SMD, 0603	Vishay CRCW0603150KFKEA	0603
34	2	R30, R36	90.9k $\Omega$	1%	RES SMD 90.9K OHM 1% 1/10W 0603	Panasonic ERJ-3EKF9092V	0603
35	2	R32, R38	30.1k $\Omega$	1%	RES SMD 30.1K OHM 1% 1/10W 0603	Yageo RC0603FR-0730K1L	0603
36	2	R33, R39	10k $\Omega$	1%	RES SMD 10K OHM 1% 1/10W 0603	Yageo RC0603FR-0710KL	0603
37	2	R52, R53	1k $\Omega$	1%	RES SMD 1K OHM 1% 1/10W 0603	Panasonic ERJ3EKF1001V	0603
38	1	R56	0 $\Omega$		Resistor 0 Ohm Jumper 1W,SMD	Vishay CRCW20100000Z0EFHP	2010

**Table 9: EVB BGA Bill of Materials (Continued)**

Item	Qty	Reference Designator	Value	Tol.	Description	Manufacturer / Part Number	Package Type
39	1	R57	DNP			Vishay CRCW20100000Z0EFHP	2010
40	1	R58	0.010Ω	1%	RES., HIGH POWER, 0.01Ω, 2W, 1%, 2512	Rohm PMR100HZPFU10L0	2512
41	1	R59	DNP				2512
42	1	U1	MXL7225_BGA		MXL IC MXL7225 144P 16X16X5.21-BGA	Maxlinear MXL7225_BGA	BGA



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