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MxL7225-1
25A Dual Phase
EVB User Manual

Revision History

Document No.	Release Date	Change Description
024UMR00	10/21/20	Initial release.

Table of Contents

Introduction	1
Quick EVB Set Up and Start Up.....	1
Factory Settings	1
Quick Start Up	1
Reference Documentation	4
Ordering Information	4
Evaluation Board Overview	5
Configuration and I/O Interfaces	6
MODE.....	6
RUN1, RUN2	6
TRACK1 SEL, TRACK2 SEL	6
PHASMD	6
EXTVCC.....	6
TEMP	6
PGOOD1, PGOOD2.....	6
SW1, SW2.....	6
Set-Up Options	7
Jumper J44 MODE	7
Jumpers J30 RUN1 and J29 RUN2.....	7
Jumper J26 TRACK1 SEL.....	7
Jumper J25 TRACK2 SEL.....	8
Jumper J45 PHASMD	8
Test Interfaces	9
Load Transient Circuit	9
MxL7225-1 EVB Mode Selection	10
Performance	12
Efficiency	12
Load Transient Response	13
Output Ripple	14
Thermal	15
MxL7225-1EVB Schematic	16
MxL7225-1EVB PCB Layers	19
MxL7225-1EVB Bill of Materials	21

List of Figures

Figure 1: Monitoring V_{IN} and V_{OUT}	2
Figure 2: Top View of MxL7225-1 25A Dual Phase BGA EVB.....	3
Figure 3: Block Diagram MxL7225-1 Two Channel EVB.....	5
Figure 4: Load Transient Circuit	9
Figure 5: Mode 1 Block Diagram	11
Figure 6: Mode 2 Block Diagram	11
Figure 7: Mode 3 Block Diagram	11
Figure 8: Mode 4 Block Diagram	11
Figure 9: Mode 5 Block Diagram	11
Figure 10: Mode 6 Block Diagram	11
Figure 11: Channel 1 Measured Efficiency ($V_{OUT} = 1.5V$, $f_{SW} = 500kHz$, Ch 2 Disabled).....	12
Figure 12: Channel 2 Measured Efficiency ($V_{OUT} = 1.0V$, $f_{SW} = 500kHz$, Ch 1 Disabled).....	12
Figure 13: Load Transient Response ($V_{OUT} = 1.5V$, $V_{IN} = 12V$).....	13
Figure 14: Load Transient Response ($V_{OUT} = 1.0V$, $V_{IN} = 12V$).....	13
Figure 15: Channel 1 Output Voltage Ripple ($V_{IN} = 12V$, $V_{OUT} = 1.5V$, Load = 25A).....	14
Figure 16: Channel 2 Output Voltage Ripple ($V_{IN} = 12V$, $V_{OUT} = 1.0V$, Load = 25A).....	14
Figure 17: Thermal Capture ($V_{IN} = 12V$, $V_{OUT1} = 1.5V$ at 25A and $V_{OUT2} = 1V$ at 25A, 500kHz, Airflow = 200LFM).....	15
Figure 18: EVB Schematic	16
Figure 19: EVB Schematic, Continued	17
Figure 20: EVB Schematic, Continued	18
Figure 21: EVB PCB BGA Silkscreen Top	19
Figure 22: EVB PCB BGA Layer 1	19
Figure 23: EVB PCB BGA Layer 2	19
Figure 24: EVB PCB BGA Layer 3	19
Figure 25: EVB PCB BGA Layer 4	20
Figure 26: EVB PCB BGA Layer 5	20
Figure 27: EVB PCB BGA Layer 6	20
Figure 28: EVB PCB BGA Silkscreen Bottom	20

List of Tables

Table 1: Evaluation Board Ordering Part Number.....	4
Table 2: Factory Settings.....	7
Table 3: J44 Options	7
Table 4: J30, J29 Options.....	7
Table 5: J26 Options	7
Table 6: J25 Options	8
Table 7: JP45 Options.....	8
Table 8: Board Stuffing for Operation Mode Selection	10
Table 9: EVB BGA Bill of Materials	21

Introduction

The MxL7225-1 evaluation board provides a platform to evaluate the features and performance of the MxL7225-1. The MxL7225-1 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 Evaluation Board for the MxL7225-1 25A Dual Phase Module with external compensation.

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 MxL7225-1 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 MxL7225-1 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 [MxL7225-1 EVB Mode Selection](#).

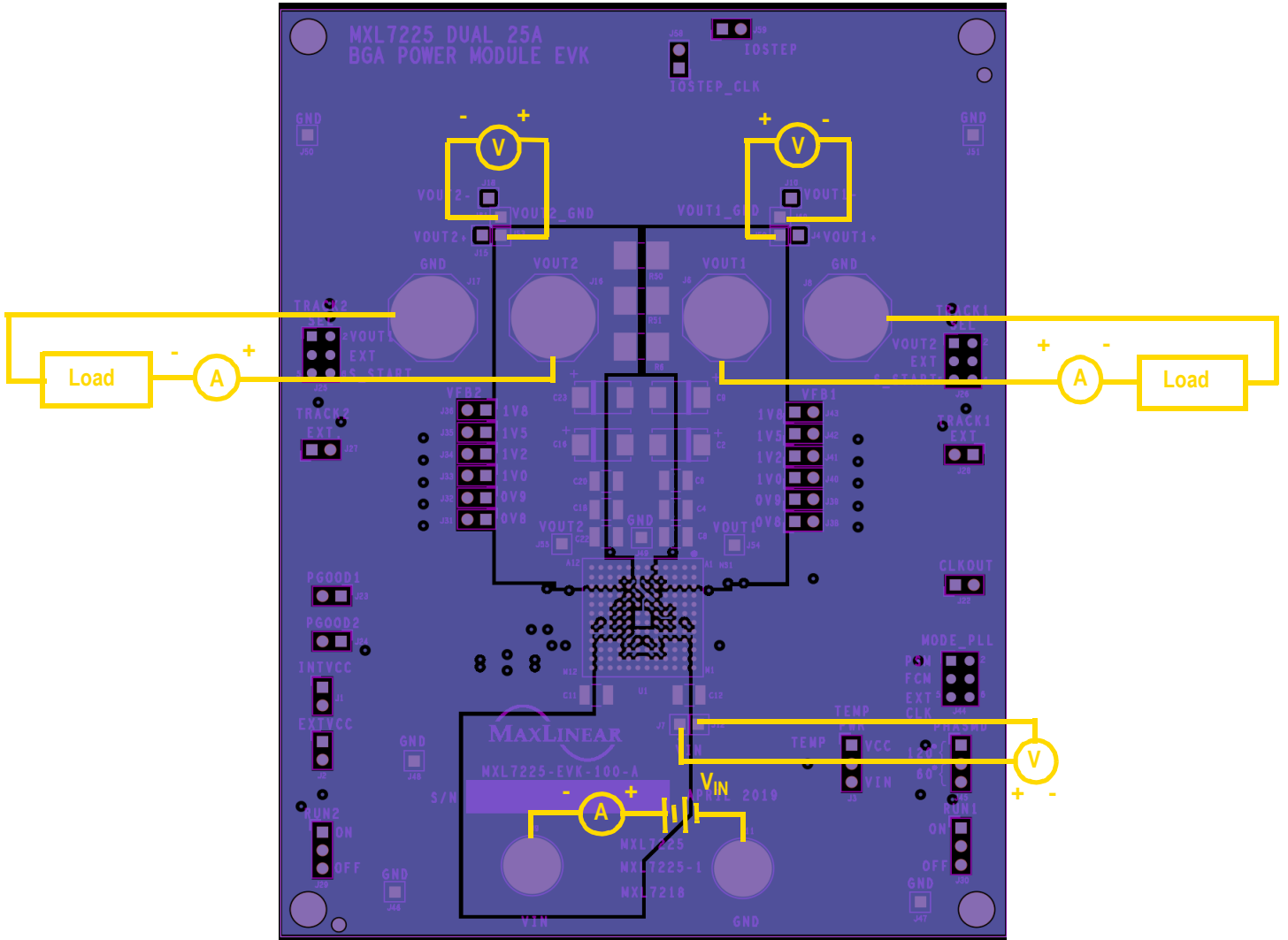


Figure 1: Monitoring V_{IN} and V_{OUT}

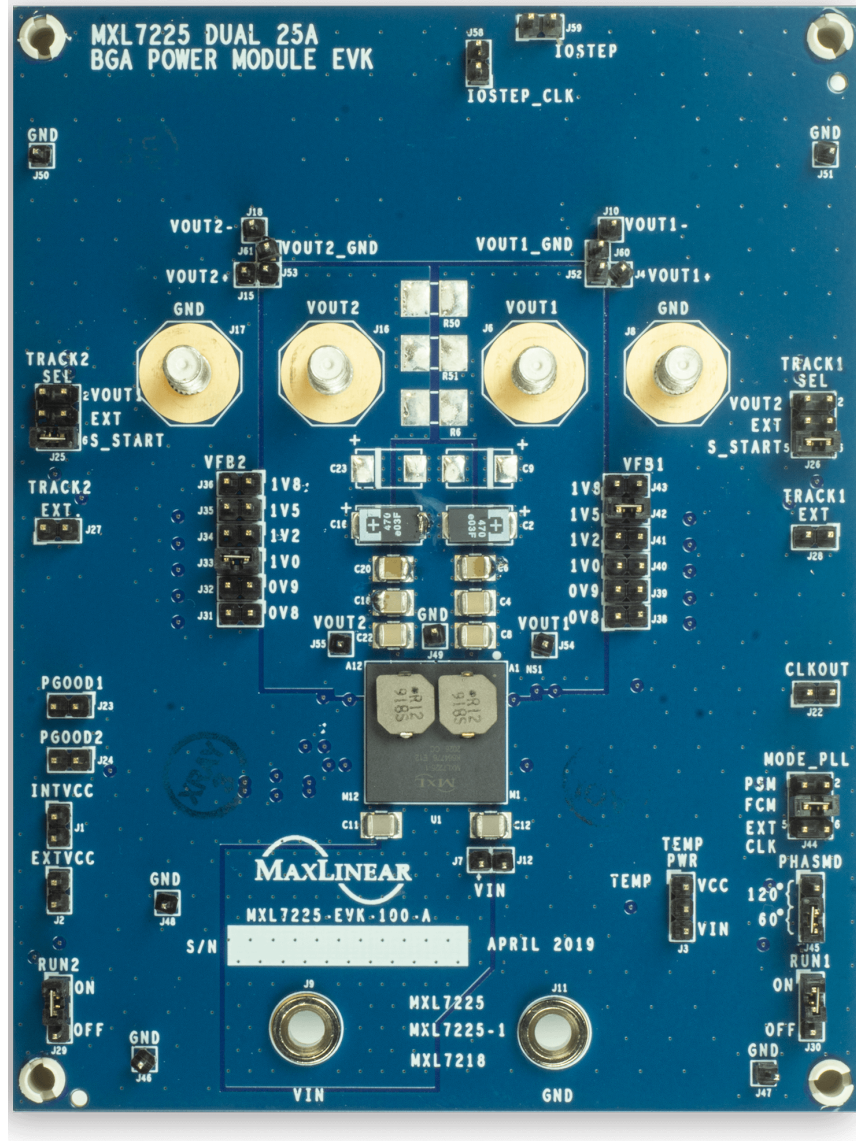


Figure 2: Top View of MxL7225-1 25A Dual Phase BGA EVB

Reference Documentation

Please refer to the [MxL7225-1 Data Sheet](#) for additional information about the MxL7225-1, 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 MxL7225-1 product page.

Ordering Information

Table 1: Evaluation Board Ordering Part Number

Power Module	Evaluation Board	Description
MxL7225-1-ABA-T	MxL7225-1-EVK-1	MxL7225-1 BGA Power Module Dual-Phase EVB

1. Refer to 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.

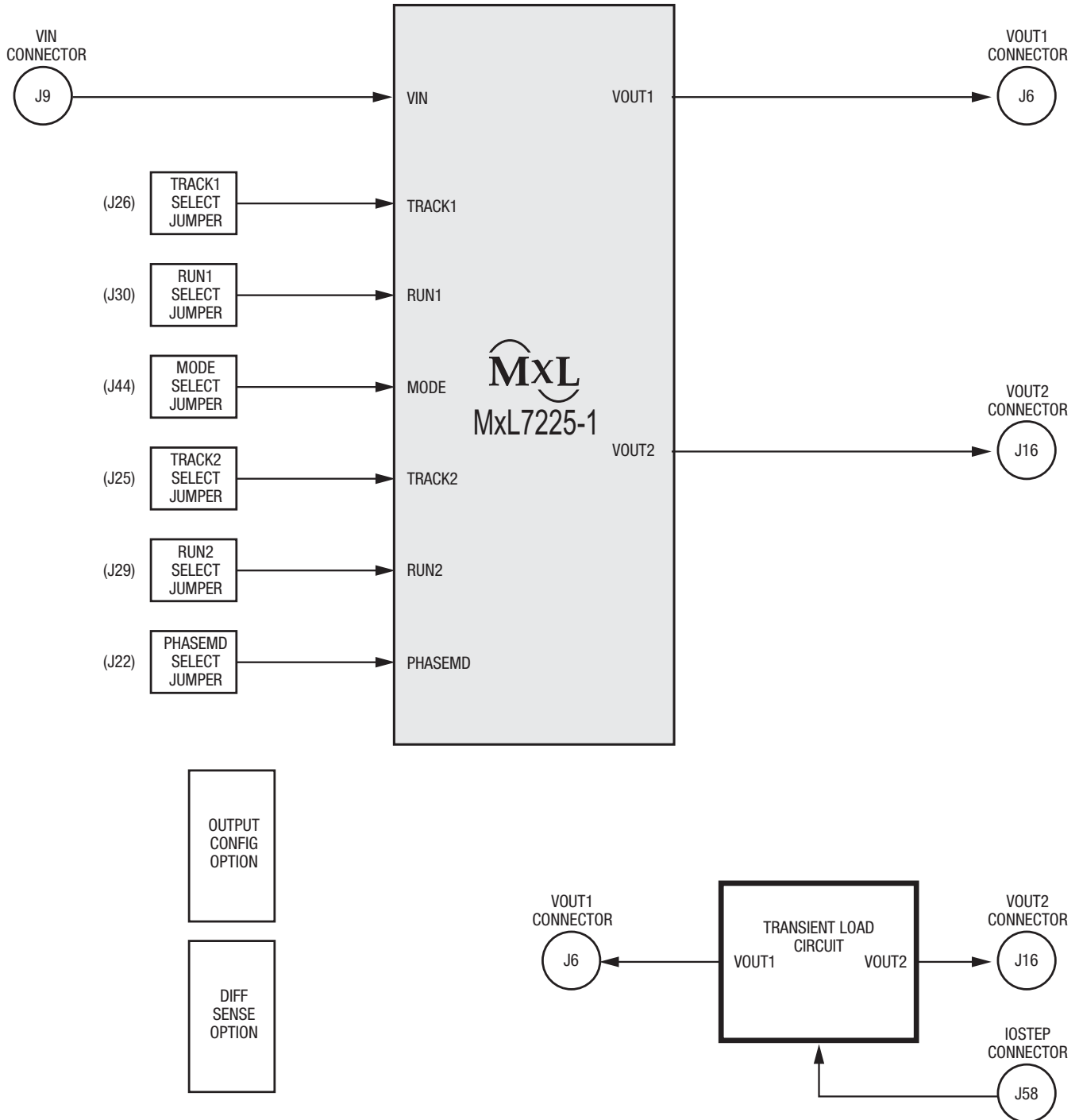


Figure 3: Block Diagram MxL7225-1 Two Channel EVB

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 Ω 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 _{OUT2} 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 _{OUT1} 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.

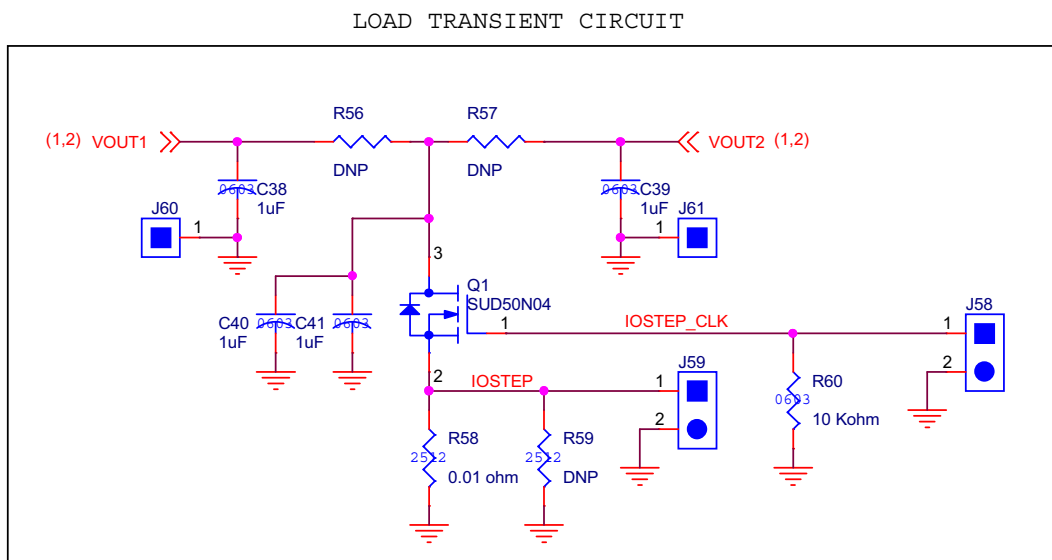


Figure 4: Load Transient Circuit

MxL7225-1 EVB Mode Selection

The MxL7225-1 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 (V_{OUT1})	R5	DNP	DNP	DNP	0 Ω	0 Ω	0 Ω
2-Phase (V_{OUT2})	R6	DNP	DNP	DNP	0 Ω	0 Ω	0 Ω
V_{OUTS1}	R4	0 Ω	DNP	0 Ω	0 Ω	DNP	DNP
V_{OUTS2}	R7	0 Ω	0 Ω	DNP	DNP	DNP	DNP
DIFFP (V_{OUT1+})	R34	DNP	0 Ω	DNP	DNP	0 Ω	DNP
DIFFP (V_{OUT2+})	R40	DNP	DNP	0 Ω	DNP	DNP	0 Ω
DIFFN (V_{OUT1-})	R54	DNP	0 Ω	DNP	DNP	0 Ω	DNP
DIFFN (V_{OUT2-})	R55	DNP	DNP	0 Ω	DNP	DNP	0 Ω
DIFFOUT (V_{OUTS1+})	R41	DNP	0 Ω	DNP	DNP	0 Ω	DNP
DIFFOUT (V_{OUTS2+})	R42	DNP	DNP	0 Ω	DNP	DNP	0 Ω
TRACK	R45	DNP	DNP	DNP	0 Ω	0 Ω	0 Ω
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	0 Ω	0 Ω	0 Ω
COMP	R44	DNP	DNP	DNP	0 Ω	0 Ω	0 Ω
PGOOD	R47	DNP	DNP	DNP	0 Ω	0 Ω	0 Ω
VFB	R46	DNP	DNP	DNP	0 Ω	0 Ω	0 Ω

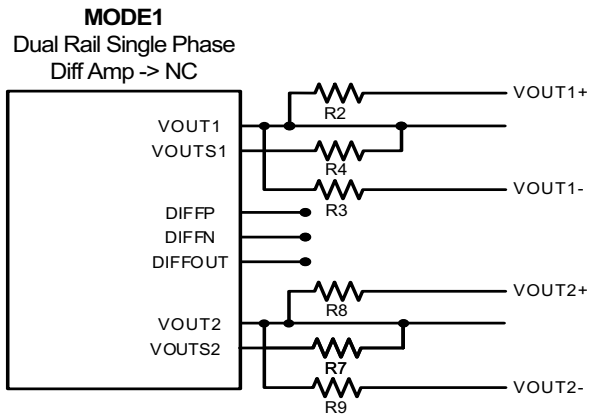


Figure 5: Mode 1 Block Diagram

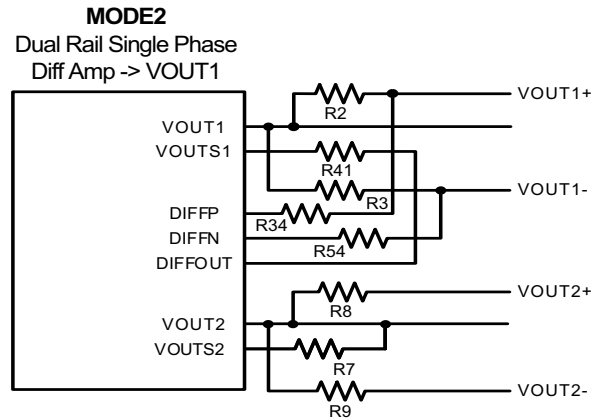


Figure 6: Mode 2 Block Diagram

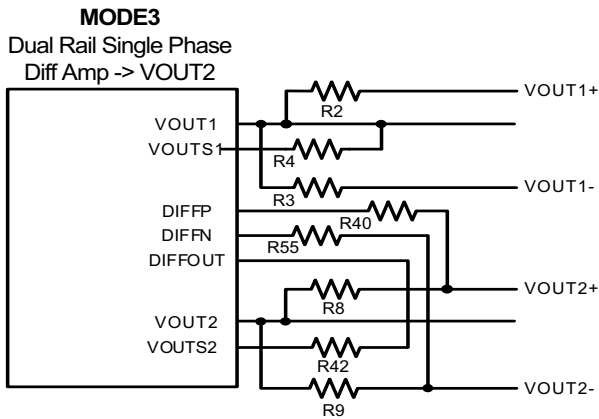


Figure 7: Mode 3 Block Diagram

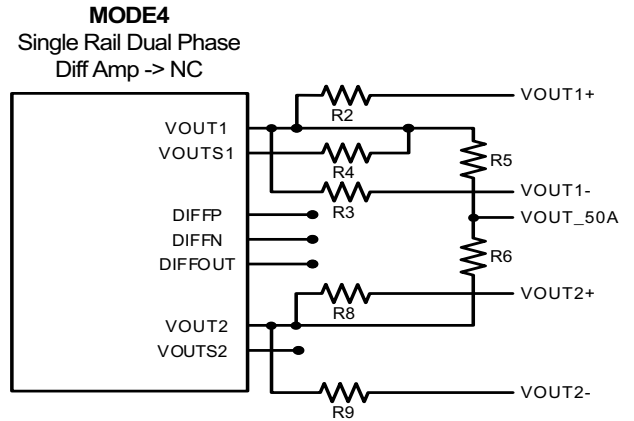


Figure 8: Mode 4 Block Diagram

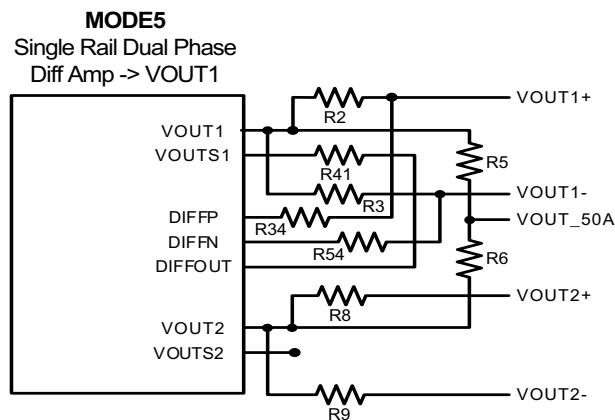


Figure 9: Mode 5 Block Diagram

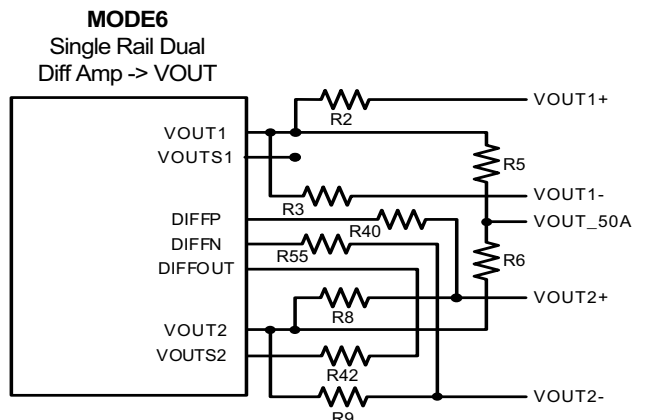


Figure 10: Mode 6 Block Diagram

Performance

Efficiency

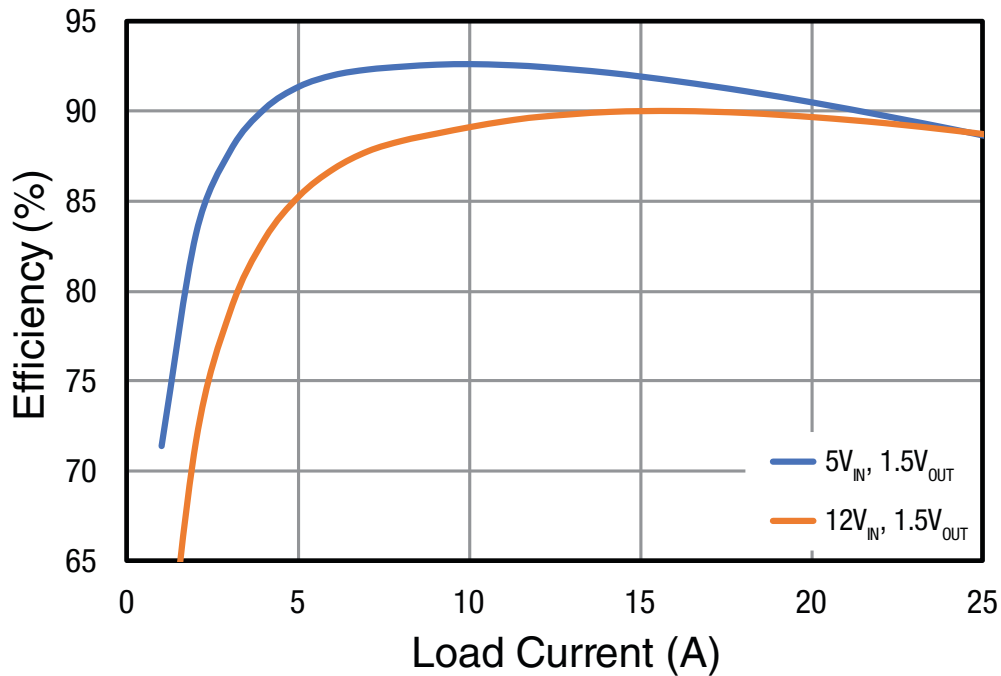


Figure 11: Channel 1 Measured Efficiency ($V_{OUT} = 1.5V$, $f_{SW} = 500kHz$, Ch 2 Disabled)

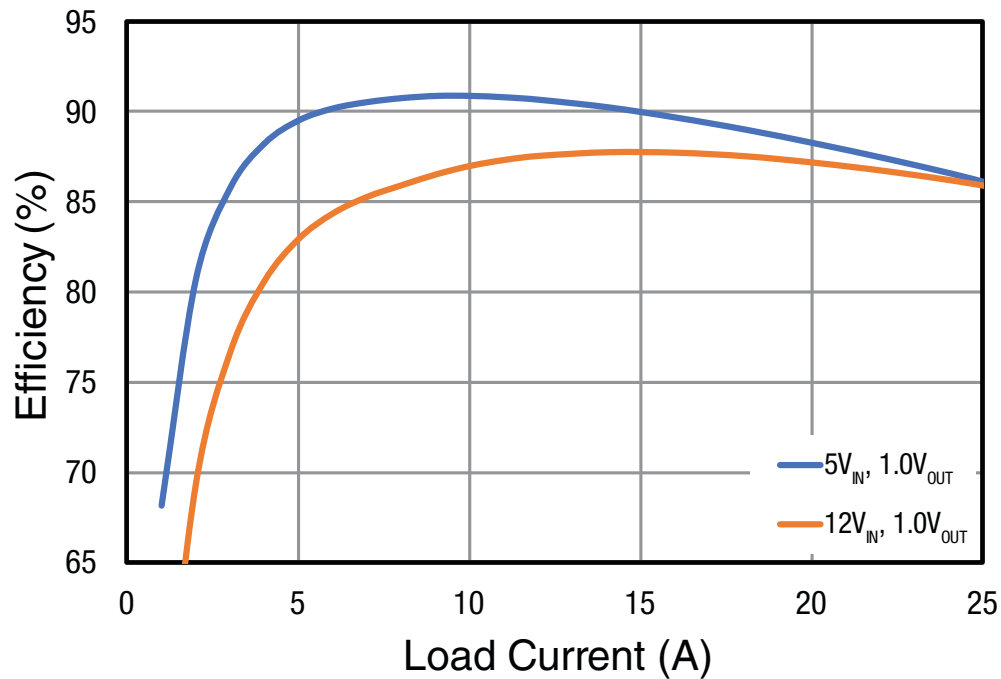


Figure 12: Channel 2 Measured Efficiency ($V_{OUT} = 1.0V$, $f_{SW} = 500kHz$, Ch 1 Disabled)

Load Transient Response

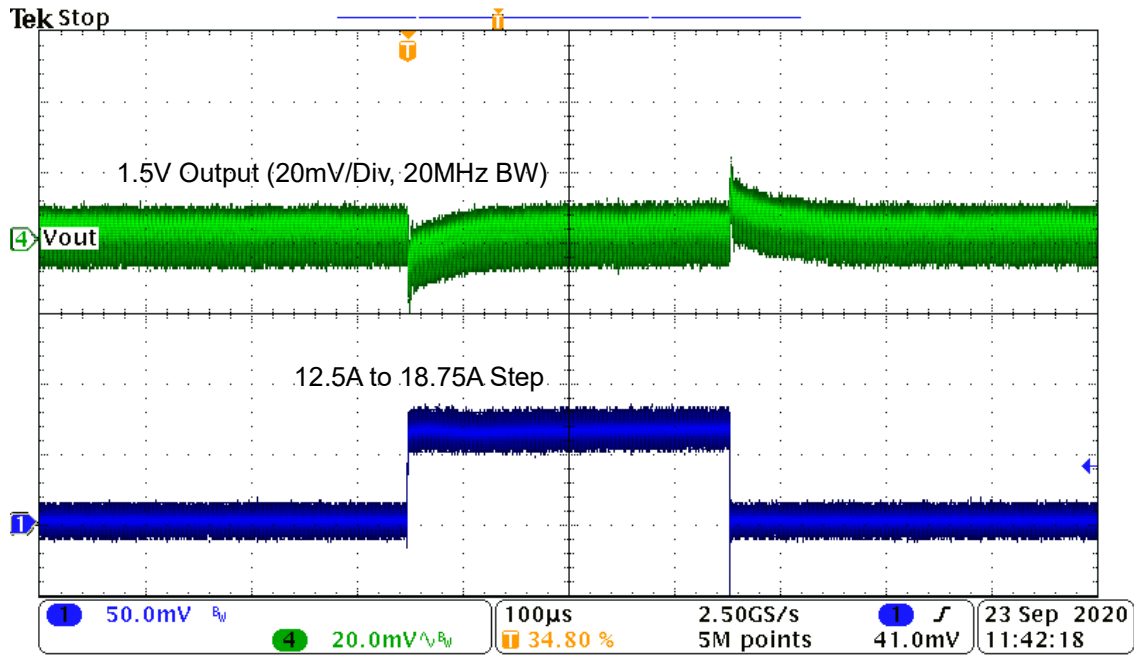


Figure 13: Load Transient Response ($V_{OUT} = 1.5V$, $V_{IN} = 12V$)

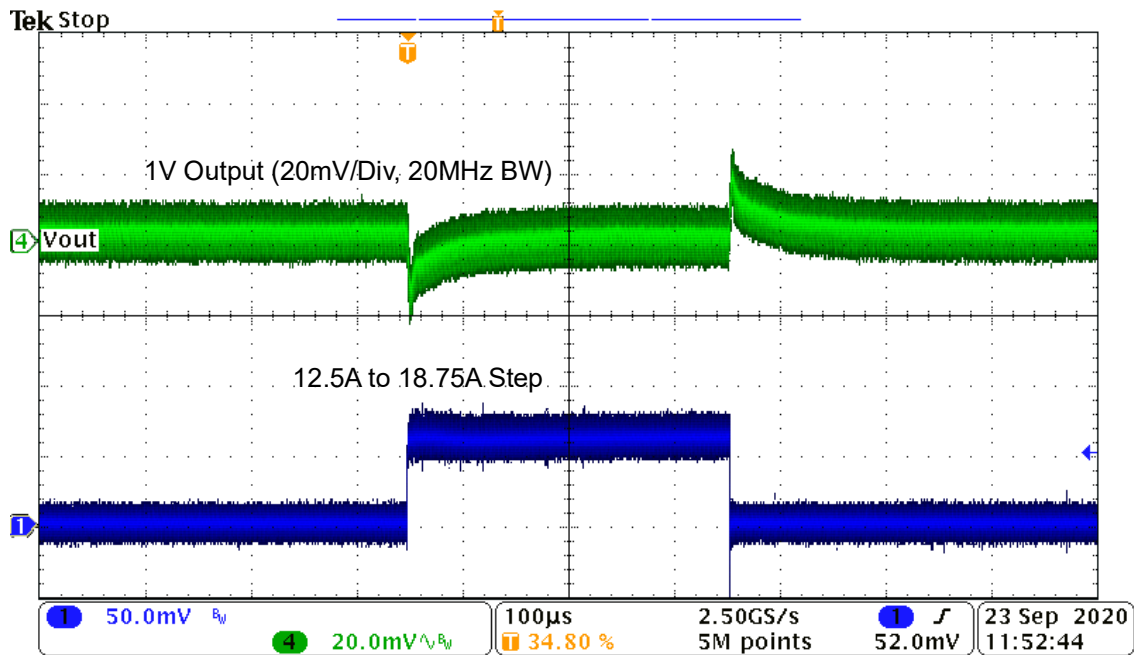
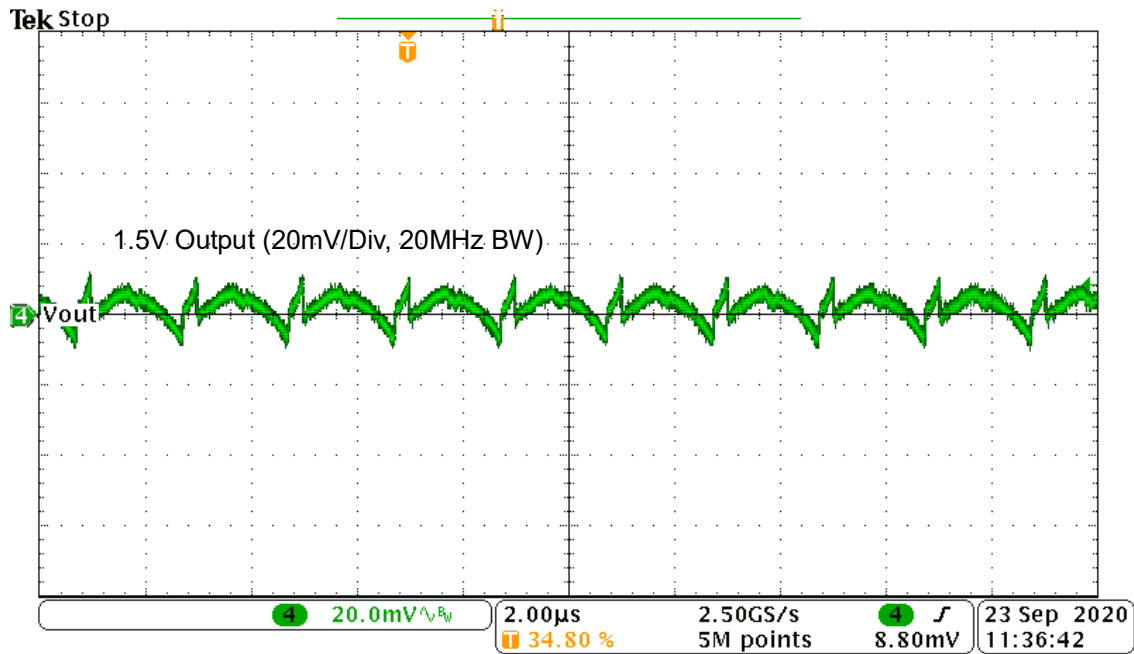


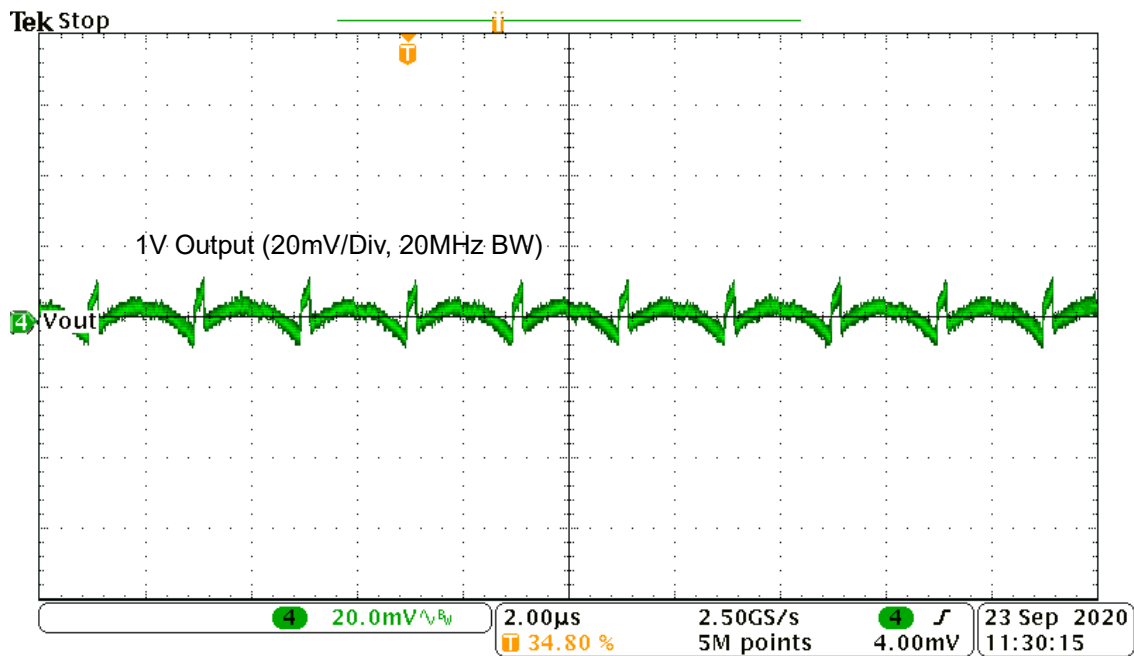
Figure 14: Load Transient Response ($V_{OUT} = 1.0V$, $V_{IN} = 12V$)

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 MxL7225-1, 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 MxL7225-1, C22.

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

Thermal

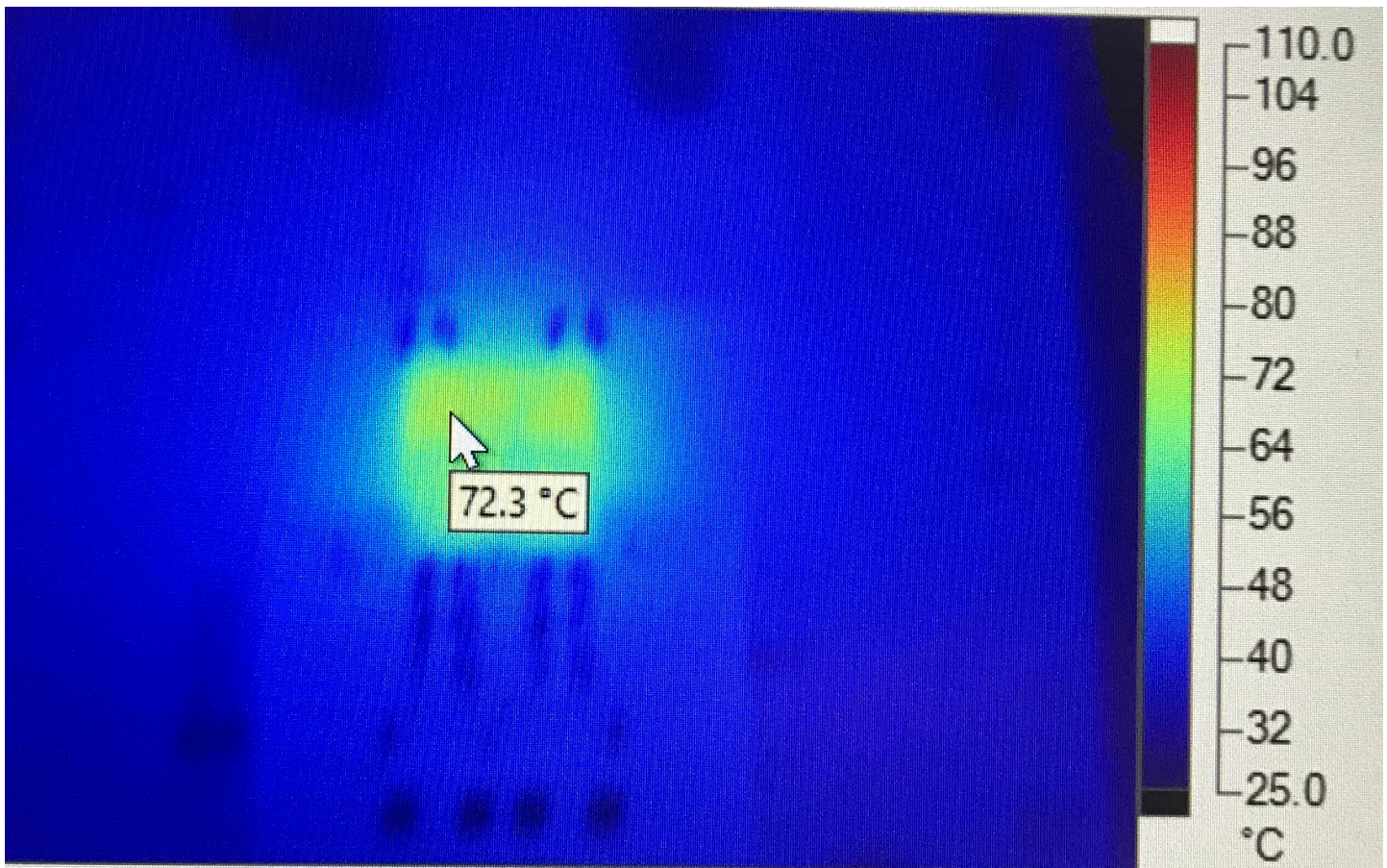


Figure 17: Thermal Capture ($V_{IN} = 12V$, $V_{OUT1} = 1.5V$ at 25A and $V_{OUT2} = 1V$ at 25A, 500kHz, Airflow = 200LFM)

MxL7225-1EVB Schematic

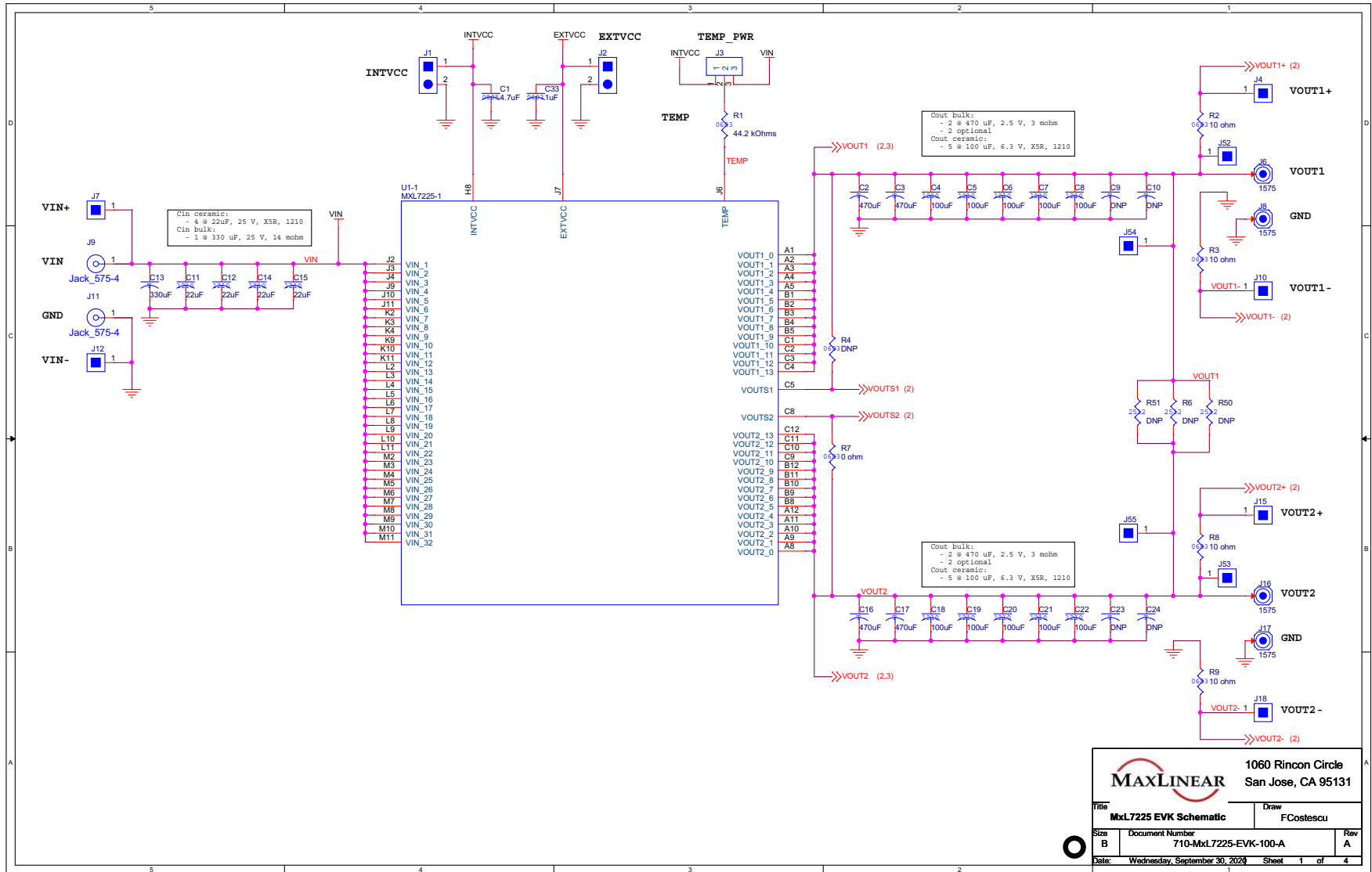


Figure 18: EVB Schematic

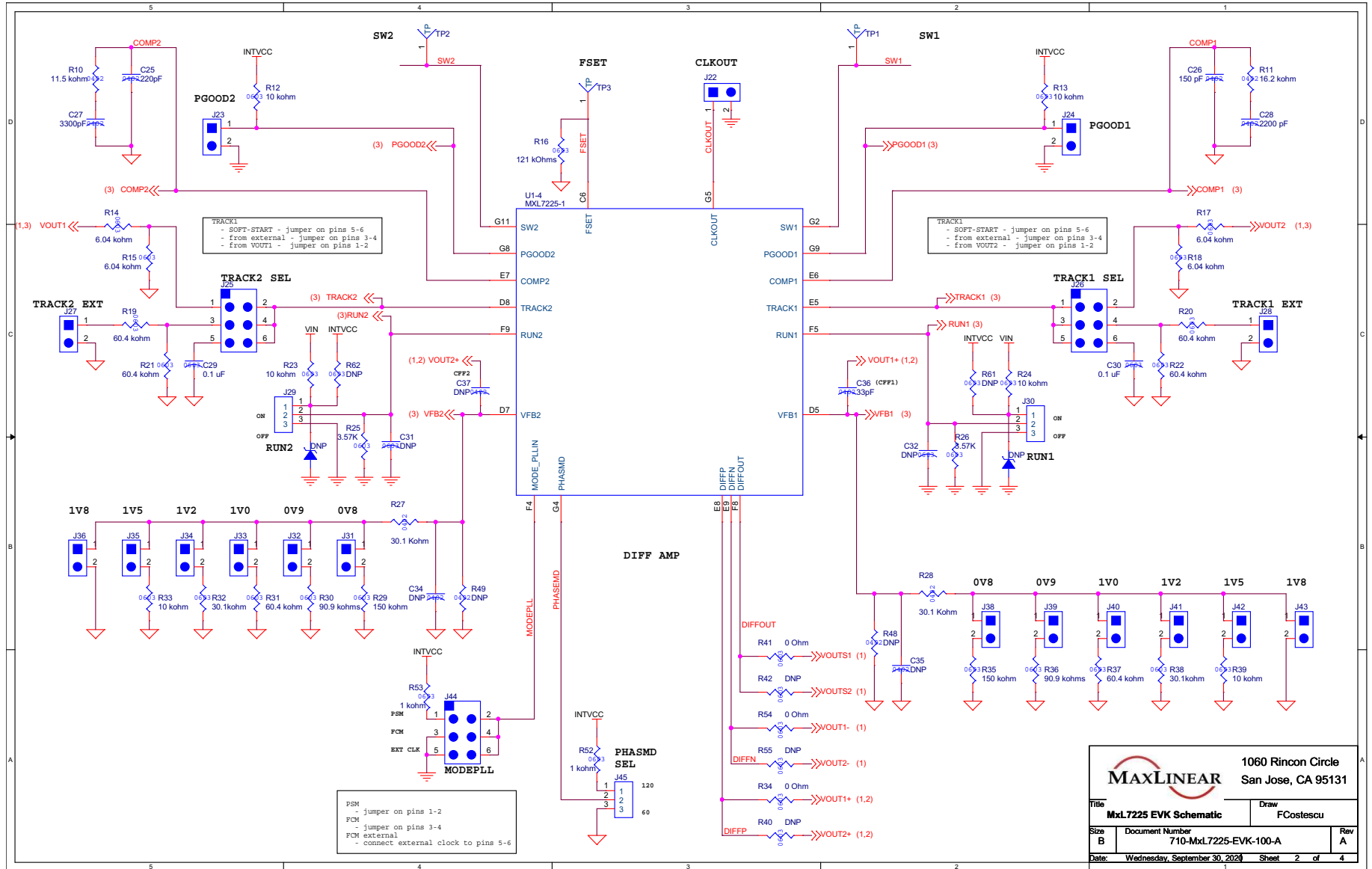
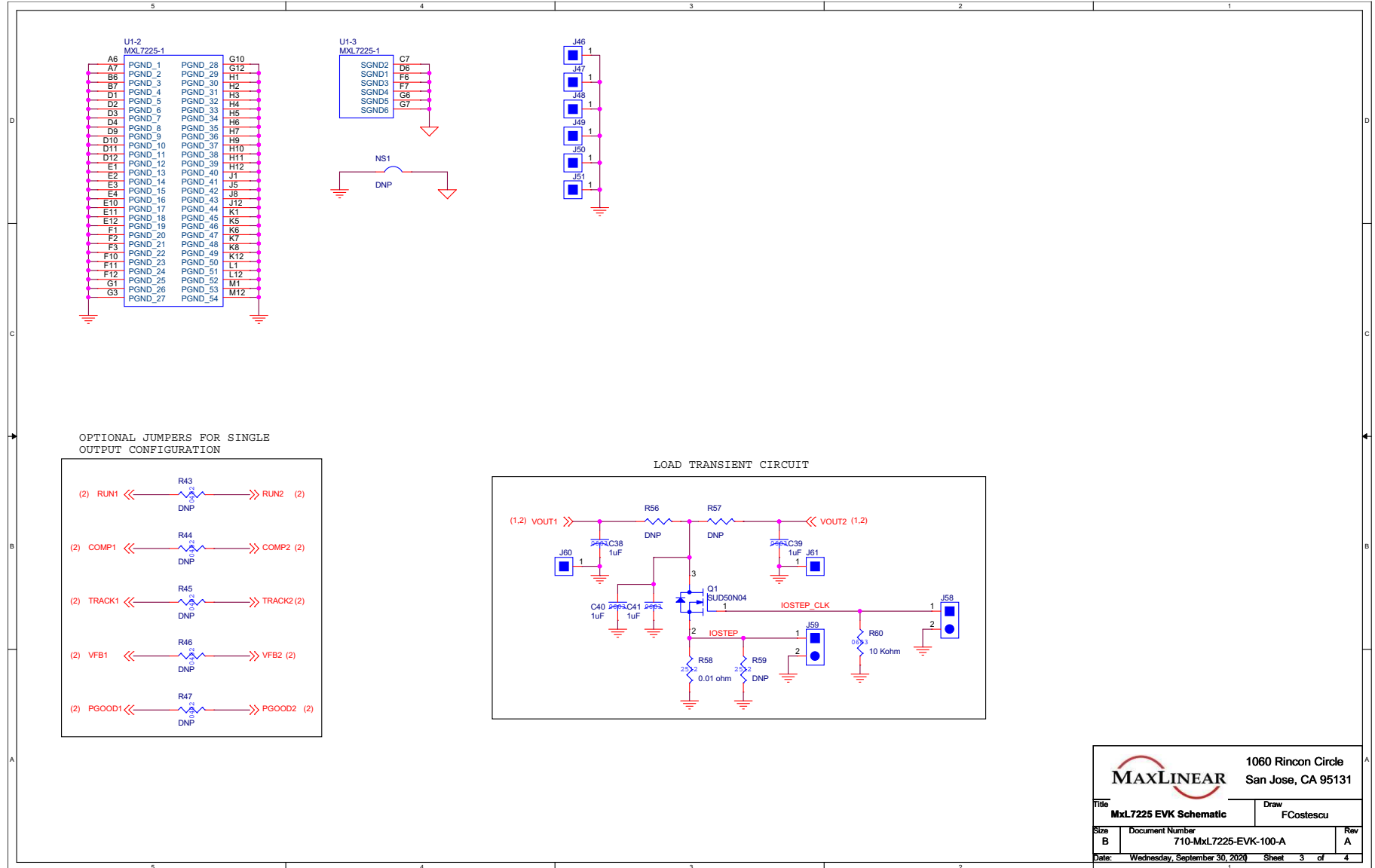


Figure 19: EVB Schematic, Continued



MAXLINEAR		1060 Rincon Circle San Jose, CA 95131	
Title MxL7225 EVK Schematic		Draw FCostescu	
Size B	Document Number 710-MxL7225-EVK-100-A	Rev A	
Date: Wednesday, September 30, 2020		Sheet	3 of 4

Figure 20: EVB Schematic, Continued

MxL7225-1EVB PCB Layers

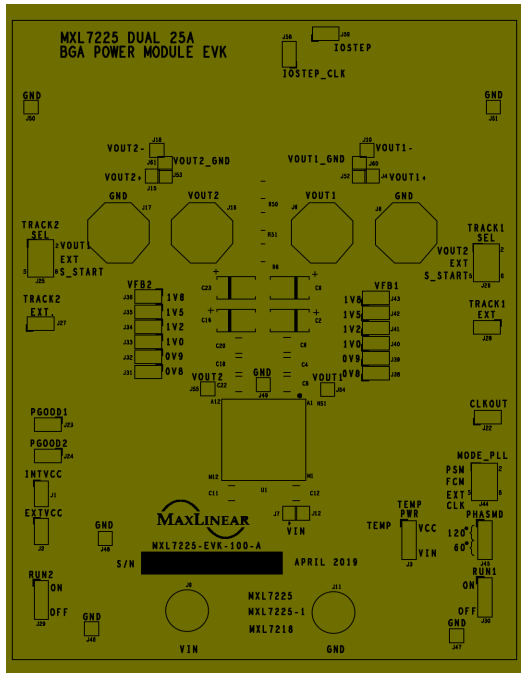


Figure 21: EVB PCB BGA Silkscreen Top

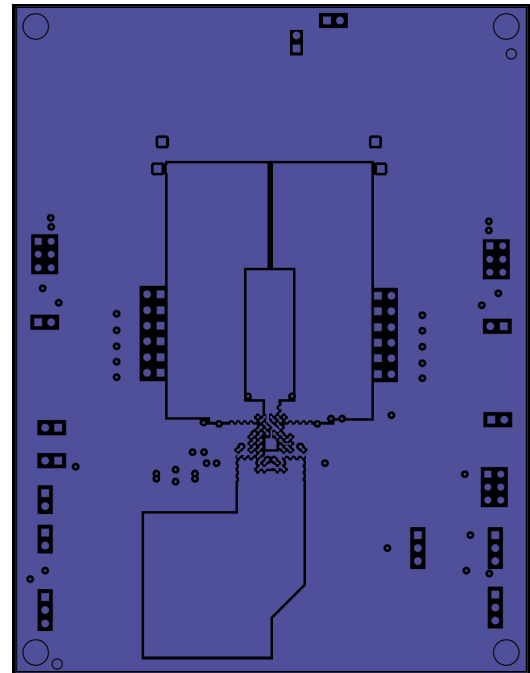


Figure 22: EVB PCB BGA Layer 1

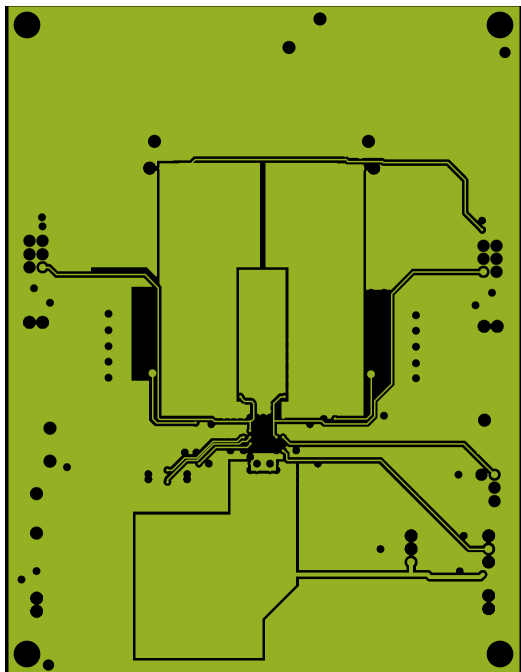


Figure 23: EVB PCB BGA Layer 2

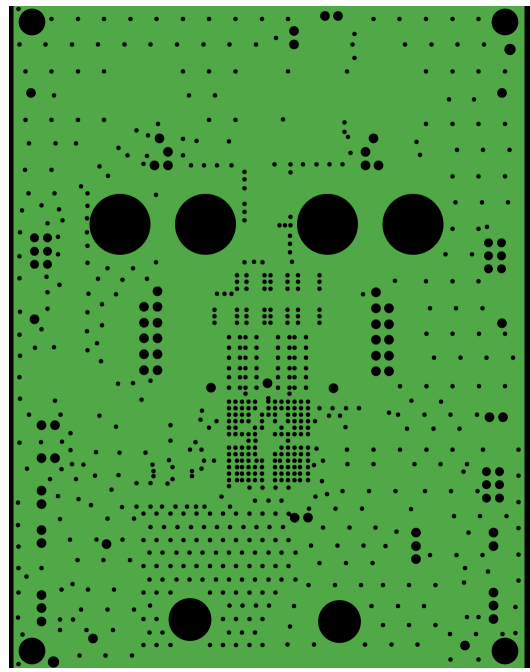


Figure 24: EVB PCB BGA Layer 3

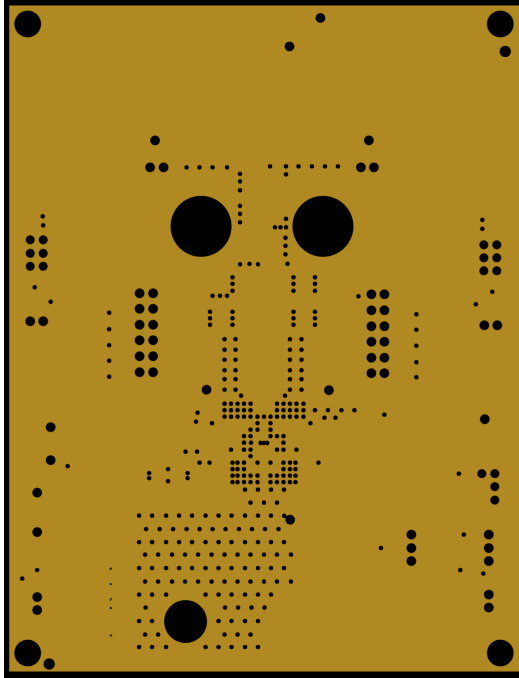


Figure 25: EVB PCB BGA Layer 4

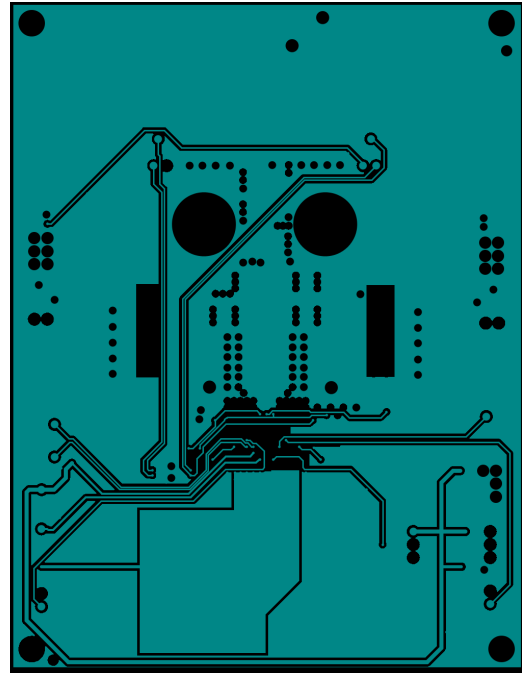


Figure 26: EVB PCB BGA Layer 5

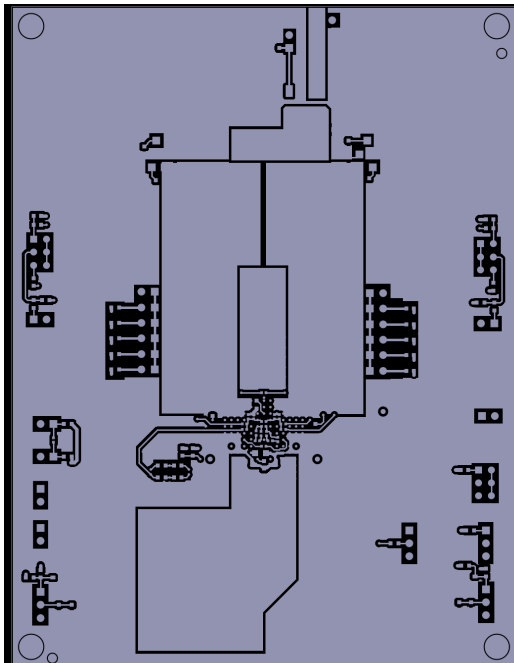


Figure 27: EVB PCB BGA Layer 6

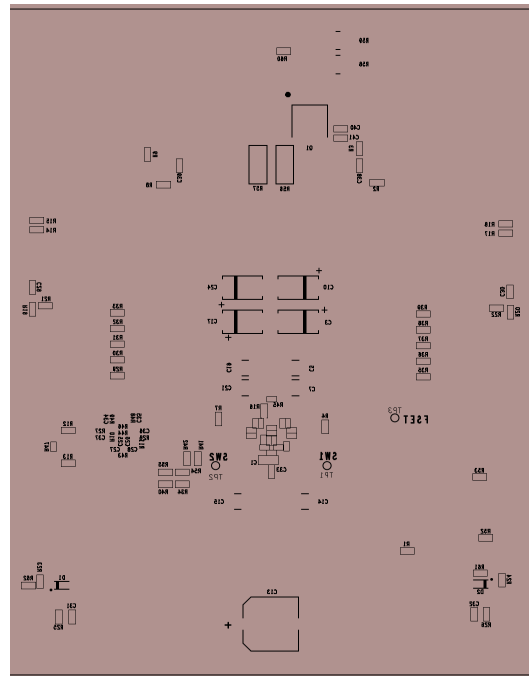


Figure 28: EVB PCB BGA Silkscreen Bottom

MxL7225-1EVB 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 μ F	10%	CAP CER 4.7UF 16V 10% X7R 0805	Wurth Electronics 885012207053	0805
2	4	C2, C3, C16, C17	470 μ F	20%	CAP TANT POLY 470UF, 2.5V, 5m Ω	Panasonic ETPF470M5H	4.3x7.3mm
3	10	C4, C5, C6, C7, C8, C18, C19, C20, C21, C22	100 μ F	10%	CAP CER 100uF 6.3V 20% X5R 1210	Wurth Electronics 885012109004	1210
4	4	C9, C10, C23, C24	DNP		CAP TANT POLY DNP		4.3x7.3mm
5	4	C11, C12, C14, C15	22 μ F	10%	CAP CER 22uF 10% 25V X5R 1210	Wurth Electronics 885012109014	1210
6	1	C13	330 μ F	20%	CAP., ALUM. ELECT., 330 μ F, 25V, 20%	Panasonic 25SVPF330M	SMD
7	1	C25	220pF		CAP, Ceramic, 220pF 10% X7R, 0402	Wurth Electronics	0402
8	1	C26	150pF		CAP, Ceramic, 150pF 10% X7R, 0402	Wurth Electronics	0402
9	1	C27	3300pF		CAP, Ceramic, 3300pF 10% X7R, 0402	Wurth Electronics	0402
10	1	C28	2200pF		CAP, Ceramic, 2200pF 10% X7R, 0402	Wurth Electronics	0402
11	2	C34, C35	DNP		CAP, Ceramic, SMD, DNP, 0402		0402
12	2	C29, C30	10nF	10%	CAP CER, 0.01UF, 50V, 10%, X7R, 0603	Wurth Electronics 885382206002	0603
13	2	C31, C32	DNP		CAP, Ceramic, SMD, DNP, 0603		0603
14	5	C33, C38, C39, C40, C41	1 μ F	10%	CAP CER 1uF +/-10% 16V X7R 0603	Wurth Electronics 885012206052	0603
15	1	C36	33pF	10%	CAP, Ceramic, 330pF 10% X7R, 0402		0402
16	1	C37	DNP			Wurth Electronics	0402
17	2	D1, D2	DNP				
18	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	Wurth Electronics 61300211121	TH
19	4	J3, J29, J30, J45	HEADER_1X3_2.54 mm_M		HDR,2.54mm Single Row/ Male 1X3 GOLD	Wurth Electronics 61300311121	TH

Table 9: EVB BGA Bill of Materials (Continued)

Item	Qty	Reference Designator	Value	Tol.	Description	Manufacturer / Part Number	Package Type
20	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	Wurth Electronics 61300111121	TH
21	4	J6, J8, J16, J17	KFH		Broaching Stud , KFH #10-32, Phosphor Bronze	PennEngineering KFH-032-10ET	TH
22	2	J9, J11			CONN. BANANA JACK	Keystone Electronics 575-4	
23	3	J25, J26, J44	HEADER_2x3_0.1"		HDR, 0.1" Double Row/2x3	Wurth Electronics 61300621121	TH
24	1	Q1	SUD50N04		MOSFET N-CH 40V 14A TO-252	Vishay SUD50N04	SMD
25	1	R1	44.2kΩ	1%	RES SMD 44.2 KOHM 1% 1/10W 0603	KOA Speer RK73H1JTDD4422F	0603
26	4	R2, R3, R8, R9	10Ω	1%	RES, Thin Film, 10 ohm, 1%, 1/10W, SMD, 0603	Vishay CRCW060310R0FKEB	0603
27	4	R7, R34, R41, R54	0Ω	1%	RES, Thick Film, 0 ohm, 1%, 1/10W, 50V, SMD, 0603	Yageo RC0603FR-070RL	0603
28	4	R6, R50, R51, R59	DNP				2512
29	1	R10	11.5kΩ		RES SMD 11.5K OHM 1% 1/10W 0402		0402
30	1	R11	16.2kΩ		RES SMD 16.2K OHM 1% 1/10W 0402		0402
31	7	R43, R44, R45, R46, R47, R48, R49	DNP				0402
32	5	R12, R13, R23, R24, R60	10kΩ	1%	RES SMD 10K OHM 1% 1/10W 0603	Panasonic ERJ-3EKF1002V	0603
33	2	R17, R18	6.04kΩ		RES SMD 6.04K OHM 1% 1/10W 0603		
34	2	R14, R15	DNP				0603
35	1	R16	121kΩ	1%	RES SMD 121K OHM 1% 1/10W 0603	Yageo RC0603FR-07121KL	0603
36	6	R19, R20, R21, R22, R31, R37	60.4kΩ	1%	RES SMD 60.4K OHM 1% 1/10W 0603	Panasonic ERJ-3EKF6042V	0603
37	6	R4, R40, R42, R55, R61, R62	DNP				0603
38	2	R25, R26	3.57kΩ	1%	RES SMD 3.57K OHM 1% 1/10W 0603		0603

Table 9: EVB BGA Bill of Materials (Continued)

Item	Qty	Reference Designator	Value	Tol.	Description	Manufacturer / Part Number	Package Type
39	2	R27, R28	30.1k Ω	1%	RES 30.1K OHM 1/16W 1% 0402 SMD	Yageo RC0402FR-0730K1L	0402
40	2	R29, R35	150k Ω	1%	RES, Thin Film, 150 Kohm, 1%, 1/10W, SMD, 0603	Vishay CRCW0603150KFKEA	0603
41	2	R30, R36	90.9k Ω	1%	RES SMD 90.9K OHM 1% 1/10W 0603	Panasonic ERJ-3EKF9092V	0603
42	2	R32, R38	30.1k Ω	1%	RES SMD 30.1K OHM 1% 1/10W 0603	Yageo RC0603FR-0730K1L	0603
43	2	R33, R39	10k Ω	1%	RES SMD 10K OHM 1% 1/10W 0603	Yageo RC0603FR-0710KL	0603
44	2	R52, R53	1k Ω	1%	RES SMD 1K OHM 1% 1/10W 0603	Panasonic ERJ3EKF1001V	0603
45	1	R56	0 Ω		Resistor 0 Ohm Jumper 1W,SMD	Vishay CRCW20100000Z0EFHP	2010
46	1	R57	DNP			Vishay CRCW20100000Z0EFHP	2010
47	1	R58	0.010 Ω	1%	RES., HIGH POWER, 0.01 Ω , 2W, 1%, 2512	Rohm PMR100HZPFU10L0	2512
48	1	R59	DNP				2512
49	1	U1	MxL7225-1_BGA		MXL IC MxL7225-1 144P 16X16X5.21-BGA	Maxlinear MxL7225-1-ABA-T	BGA



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