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MAXLINEAR

Quad MxL7225 200A Multiphase

EVK User Manual

Revision History

Document No.	Release Date	Change Description
021UMR02	March 9, 2023	**Updated:** ■ "Ordering Information" section. ■ "Load Transient Circuit" figure. ■ "EVK Bill of Materials" table.
021UMR01	12/7/20	Initial Release

Table of Contents

List of Figures

List of Tables

Introduction

The Quad MxL7225 200A Multiphase Evaluation Board provides a platform to evaluate the features and performance of four MxL7225 Power Modules connected in parallel to supply up to a 200A load. Each MxL7225 is a dual 25A Power Module which are optimized for powering Telecom, Networking and Industrial equipment. This manual covers both the BGA and LGA evaluation boards versions of this 200A multiphase application.

Quick EVK Set Up and Start Up

Factory Settings

In addition to utilizing the 4.5V to 15V input voltage range of the MxL7225's and the 200A maximum load current rating capabilities of using the four MxL7225 Power Modules together, the evaluation board has been set up with the factory default configurations shown below for quick set up and operation. **Do not exceed the EVK maximum load current rating.**

The factory default configuration (Table 2) for the Quad MxL7225 Evaluation Board is:

- V_{IN} = 4.5V to 15V
- V_{OUT} = 1.0V ±1.5%. For other V_{OUT} see Jumpers JP4 - JP8 VOUT SELECT.
- I_{OUT} = 0A to 200A
- 500kHz switching frequency
- Run is enabled for both channels of all 4 of the MxL7225's (all 8 channels). See RUN, Jumper JP2.
- Continuous current mode using internal clock. To use an external clock, see EXT_CLK, Jumper JP1
- One pin output voltage ramp up and down tracking programmability
- A 6.5ms soft-start is selected for all channels
- Sensing diode biasing at 100µA for internal temperature sense

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. With a power supply turned off and within a V_{IN} specification of 4.5V to 15V (12V typical), connect it 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 output, connect a meter and electronic load initially set to 0A, that will be no more than the above maximum I_{OUT} (200A), to VOUT and GND with short / thick leads capable of this current. See setup and locations in Figure 1.
4. Turn on the power supply and check V_{OUT}. Check to make sure that JP2 is on the ON position. The EVK will power up and (factory default) regulate the output at 1V ±1.5% (0.985V to 1.015V).
5. 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.

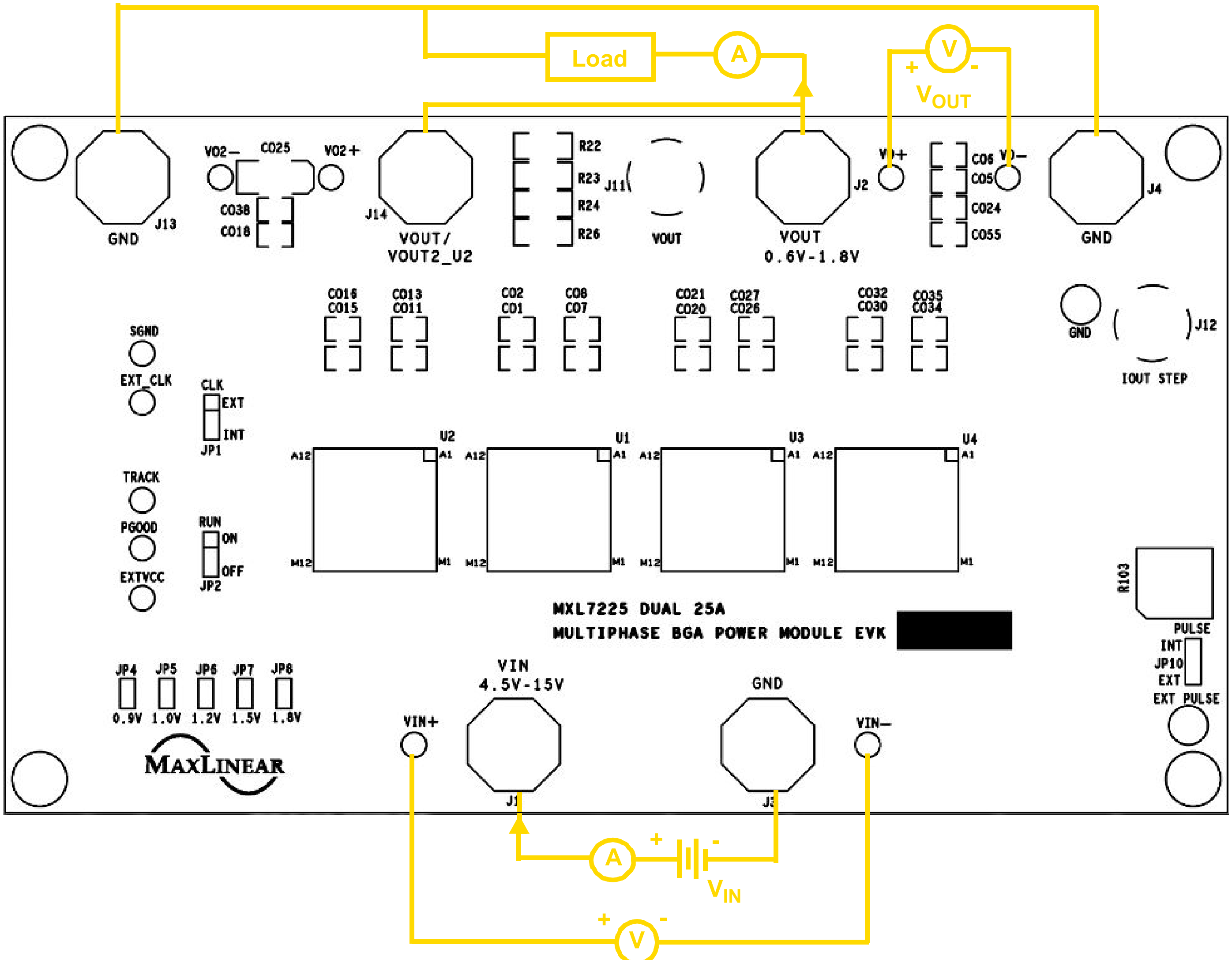


Figure 1: Monitoring V_{IN} and V_{OUT}

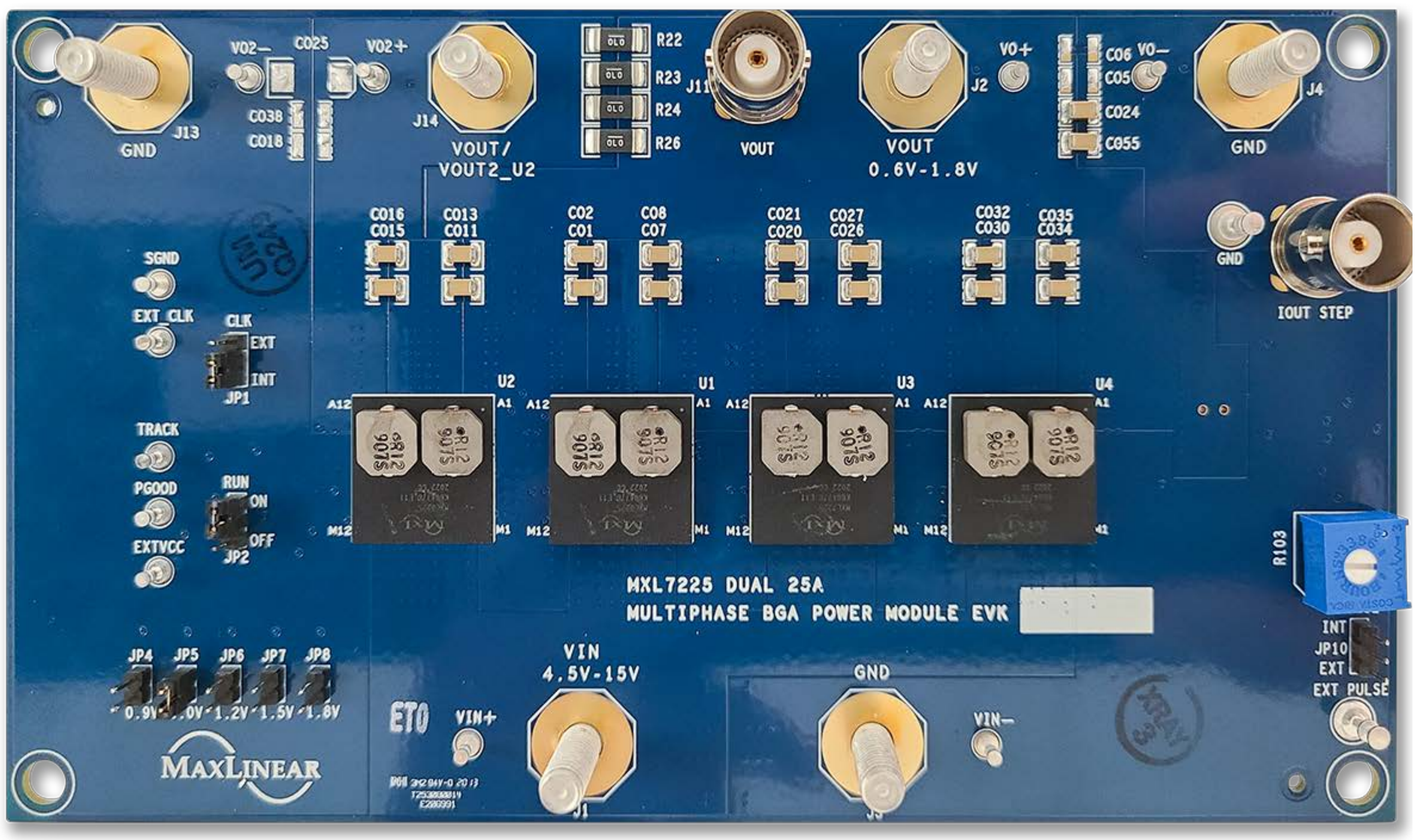


Figure 2: Top View of MxL7225 200A Multiphase EVK

Reference Documentation

Please refer to the MxL7225 Data Sheet for additional information about the MxL7225. The datasheet 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 Quad MxL7225 EVK Schematic, Quad MxL7225 EVK PCB Layers and Quad MxL7225 EVK 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

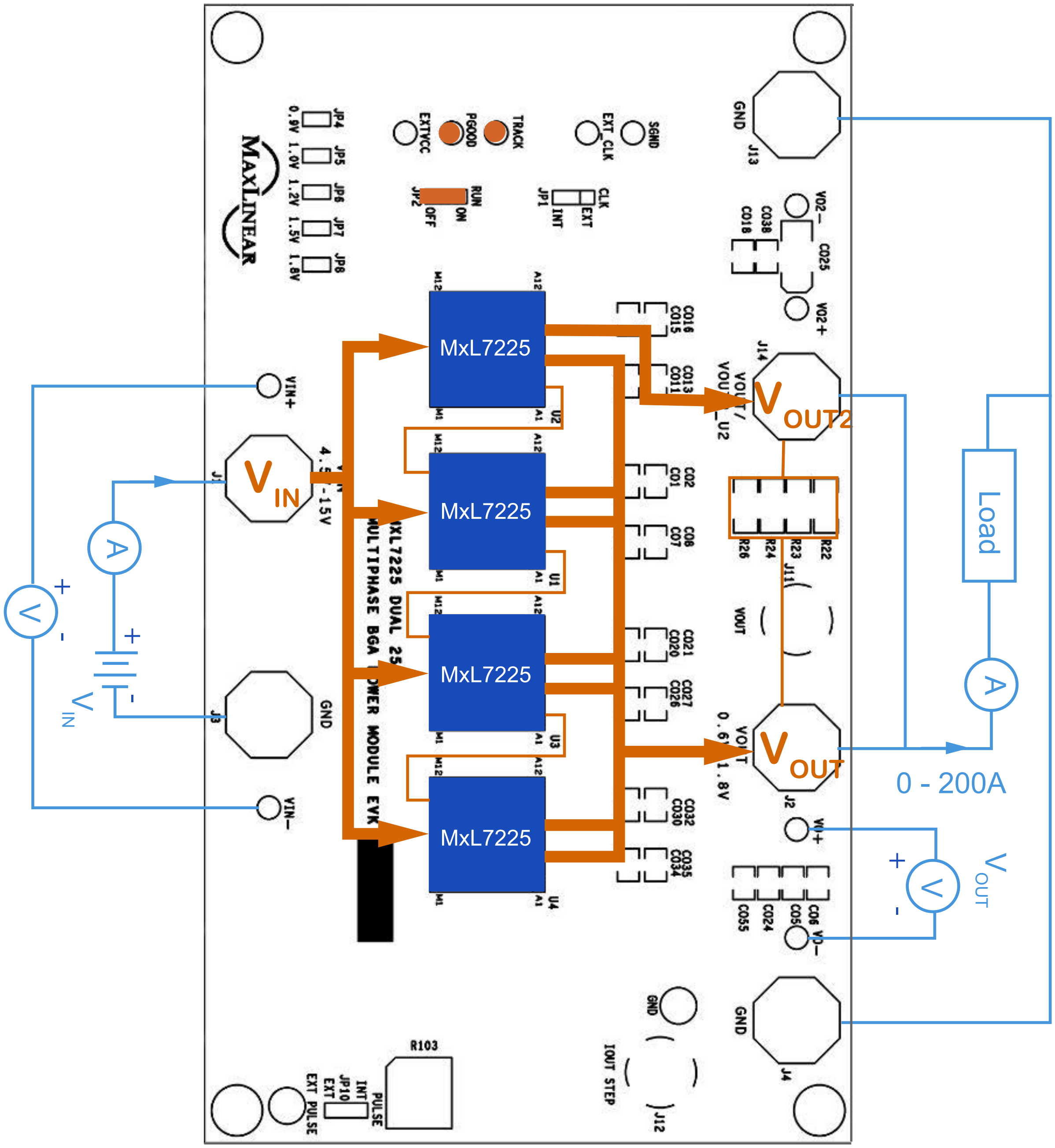
Table 1: Evaluation Board Ordering Part Number

Power Module	Evaluation Board	Description
MXL7225-ABA-T	MXL7225-EVK-2	Quad MxL7225 BGA Power Module Multiphase EVK

Note: For more information about part numbers, as well as the most up-to-date information and addiitional information on environmental rating, go to www.maxlinear.com/MxL7225.

Evaluation Board Overview

The block diagram shown in Figure 3 illustrates the 7 MxL7225 channels connected in parallel with the 8th channel as the master and the connection points for V_{IN}, V_{OUT}, and V_{OUT2}. Also represented are the CLKOUT to MODE_PLLIN connections between the 4 MxL7225 ICs.



V_{OUT} and V_{OUT2} connected via R22, R23, R24 and R26

VFB of all 8 channels connected

RUN of all 8 channels connected and connected to JP2

TRACK of all 8 channels connected and connected to TRACK_CONTROL point on board

PGOOD of all 8 channels (with pullups) connected and connected to PGOOD point on board

Figure 3: Quad MxL7225 200A Multiphase EVK Block Diagram

Configuration and I/O Interfaces

EXT_CLK, Jumper JP1

Jumper J1 provides an option to connect and synchronize to an external clock or use an internal clock (default). See EXT_CLK, Jumper JP1.

RUN, Jumper JP2

Jumper JP2 enables (ON) or disables (OFF) all 8 channels. See RUN, Jumper JP2.

TRACK_CONTROL

The board's output voltage tracks the voltage on the TRACK_CONTROL test point when applied.

PGOOD

A PGOOD test point is provided for all 8 channels. PGOOD signals are tied to INTVCC through 10kΩ resistors.

EXTVCC

A connection point is provided to inject EXTVCC, if desired.

EXT PULSE

Used to test load transients. See Load Transient Circuit.

Set-Up Options

Jumpers are factory installed per Table 2 to configure the EVK 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
JP1	CLK	Jumper 2-3	Internal clock
JP2	RUN	Jumper 1-2	On
VOUT SELECT			
JP4	0.9V	No Jumper	V_{OUT} = 1.0V selected
JP5	1.0V	Jumper 1-2	
JP6	1.2V	No Jumper	
JP7	1.5V	No Jumper	
JP8	1.8V	No Jumper	

Jumper JP1 CLK

Table 3: JP1 Options

Jumper Options	Description
Jumper 1-2	External clock may be applied to synchronize to.
Jumper 2-3 (default)	Internal clock.

Jumper JP2 RUN

Table 4: JP2 Options

Jumper Options	Description
Jumper 1-2 (default)	On, all channels are enabled.
Jumper 2-3	Off, all channels are disabled.

Jumpers JP4 - JP8 VOUT SELECT

Table 5: JP4 - JP8 Options

Jumper	Jumper Options	Description
JP4	Jumper 1-2	V_{OUT} = 0.9V selected only.
	No jumper (default)	V_{OUT} = 0.9V not selected.
JP5	Jumper 1-2 (default)	V_{OUT} = 1.0V selected only.
	No jumper	V_{OUT} = 1.0V not selected.
JP6	Jumper 1-2	V_{OUT} = 1.2V selected only.
	No jumper (default)	V_{OUT} = 1.2V not selected.
JP7	Jumper 1-2	V_{OUT} = 1.5V selected only.
	No jumper (default)	V_{OUT} = 1.5V not selected.
JP8	Jumper 1-2	V_{OUT} = 1.8V selected only.
	No jumper (default)	V_{OUT} = 1.8V not selected.

Test Interfaces

Load Transient Circuit

A load transient circuit is provided to allow optional testing of load transients. The EXT PULSE (E33) clock input is used to drive the transient signal. The load step generated by the FETs (Q1 and Q2) is very fast; the step slew rate is >40A/µs for a 50A transient load test case.

To measure load transient response, use the circuit shown in Figure 4. Populate R101 and R102 and apply a small duty cycle pulse signal to the EXT PULSE (E33) input (~ 1%). Adjust the amplitude of the EXT PULSE (E33) pulse to set the load current. Start at a pulse amplitude of 2V and increase while monitoring the IOUT STEP (J12) voltage. The load current at IOUT STEP (J12) is 5mV/A. For an example, a 100A load will occur when a 500mV pulse is observed at J12.

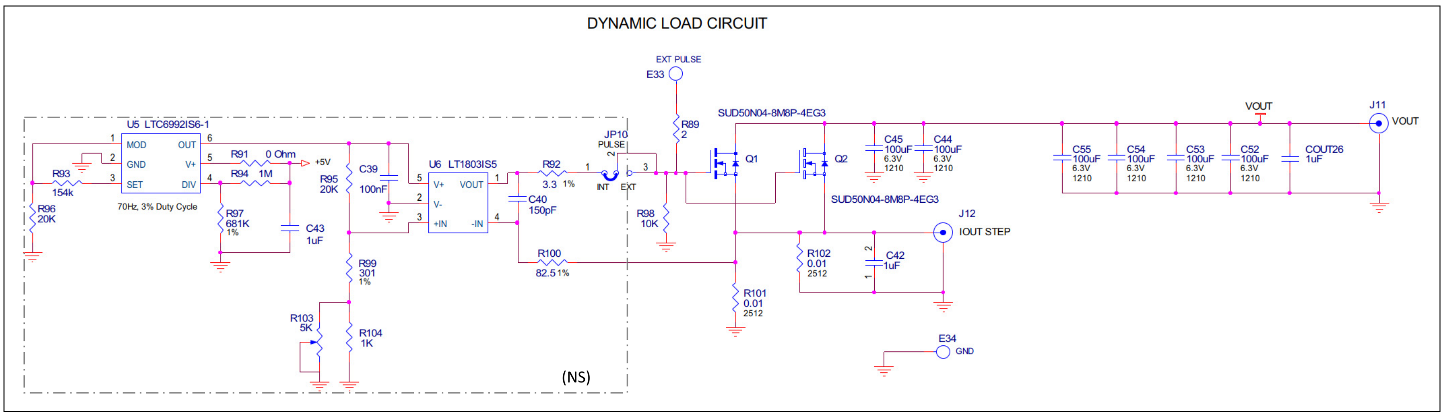


Figure 4: Load Transient Circuit

Performance

Efficiency

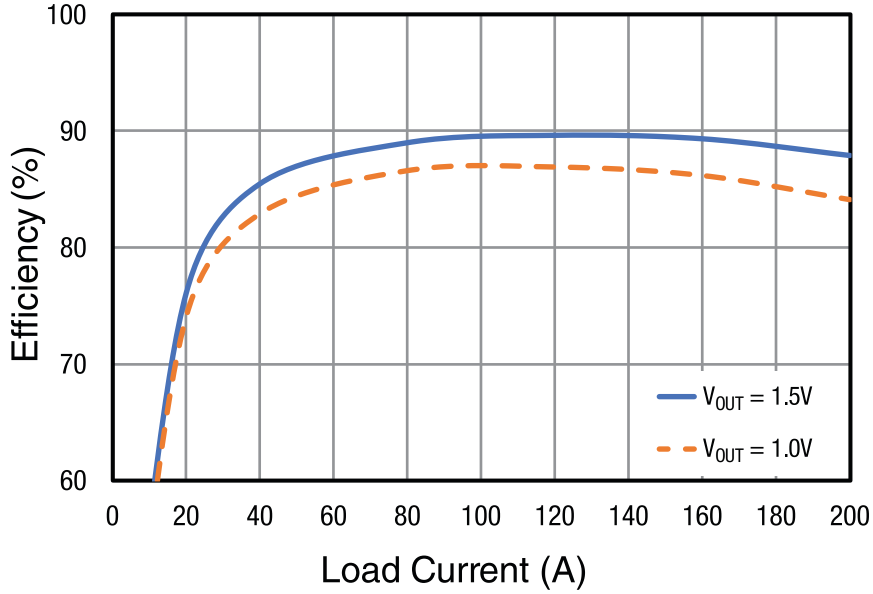


Figure 5: Measured Efficiency (V_{IN} = 12V, f_{SW} = 500kHz)

Load Transient Response

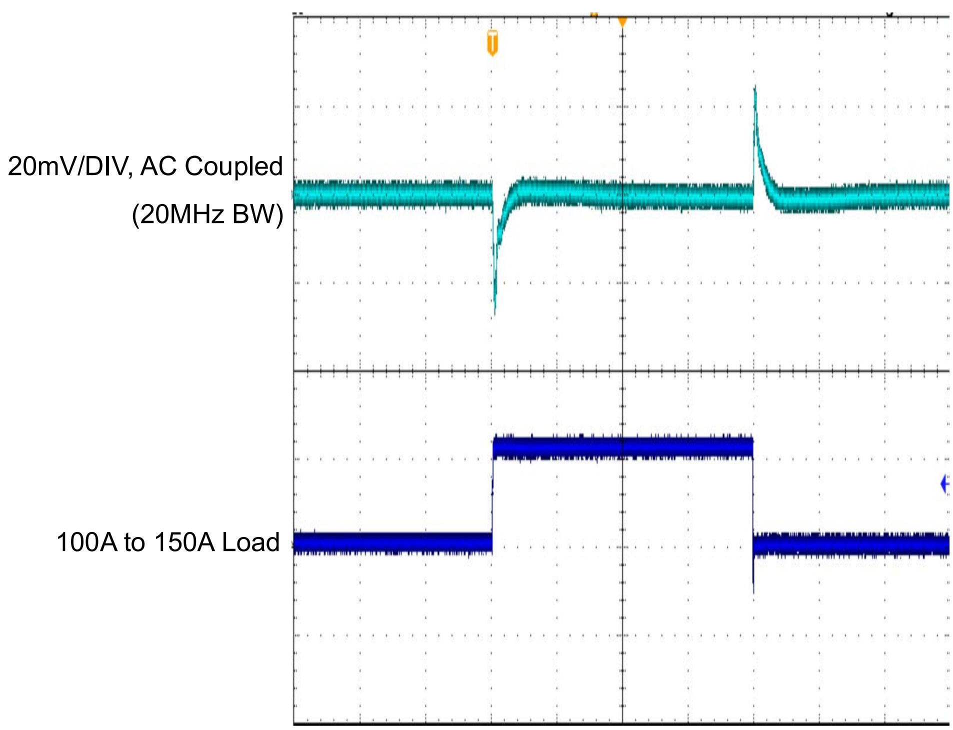
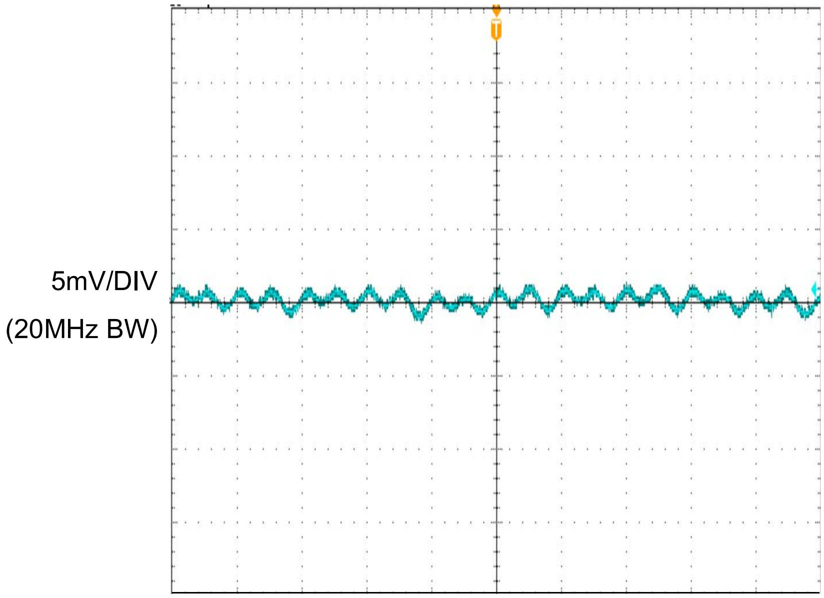


Figure 6: Load Transient Response, 100A to 150A (V_{IN} = 12V, V_{OUT} = 1V, f_{SW} = 500kHz)

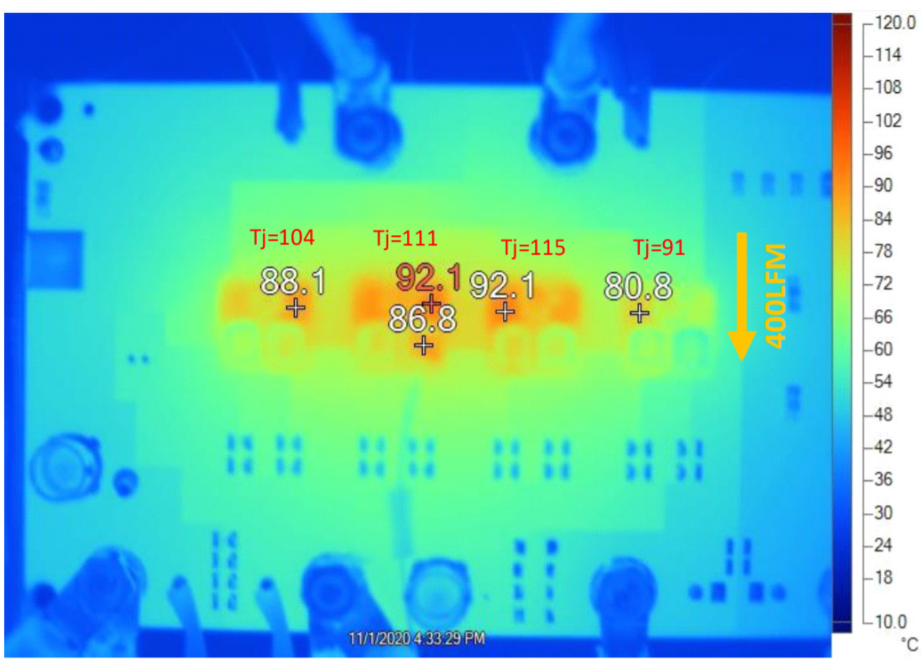
Output Ripple



1. 200A load on J7 with standard demo circuit default setup.

Figure 7: Measured Output Voltage Ripple (V_{IN} = 12V, V_{OUT} = 1V, Load = 200A, f_{SW} = 500kHz)

Thermal



2. Ambient temperature = 23.3°C, airflow = 400LFM, no heat sink.

Figure 8: Thermal Capture (V_{IN} = 12V, V_{OUT} = 1V, Load = 200A, f_{SW} = 500kHz, 400LFM)

Quad MxL7225 EVK Schematic

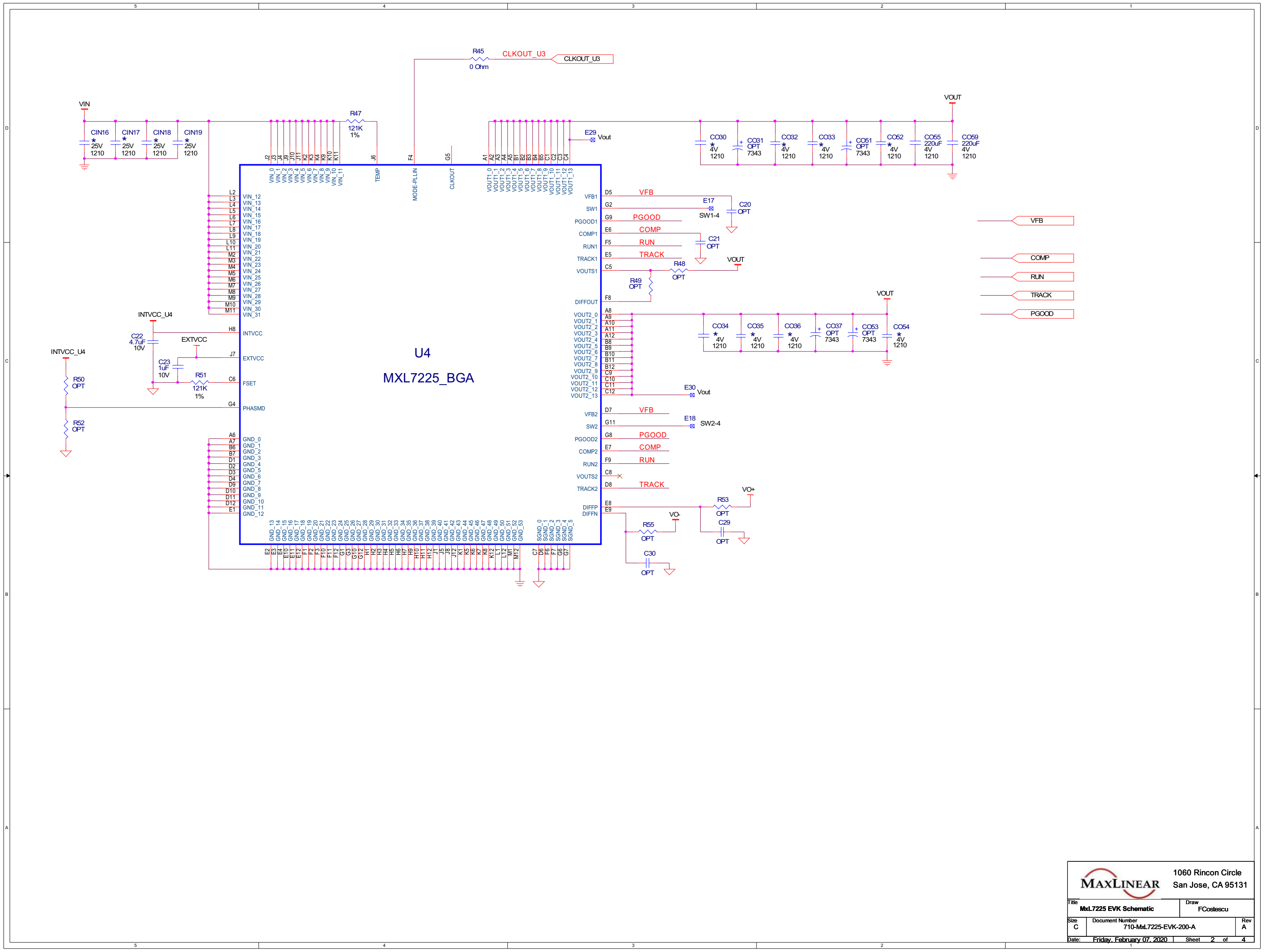


Figure 9: EVK Schematic

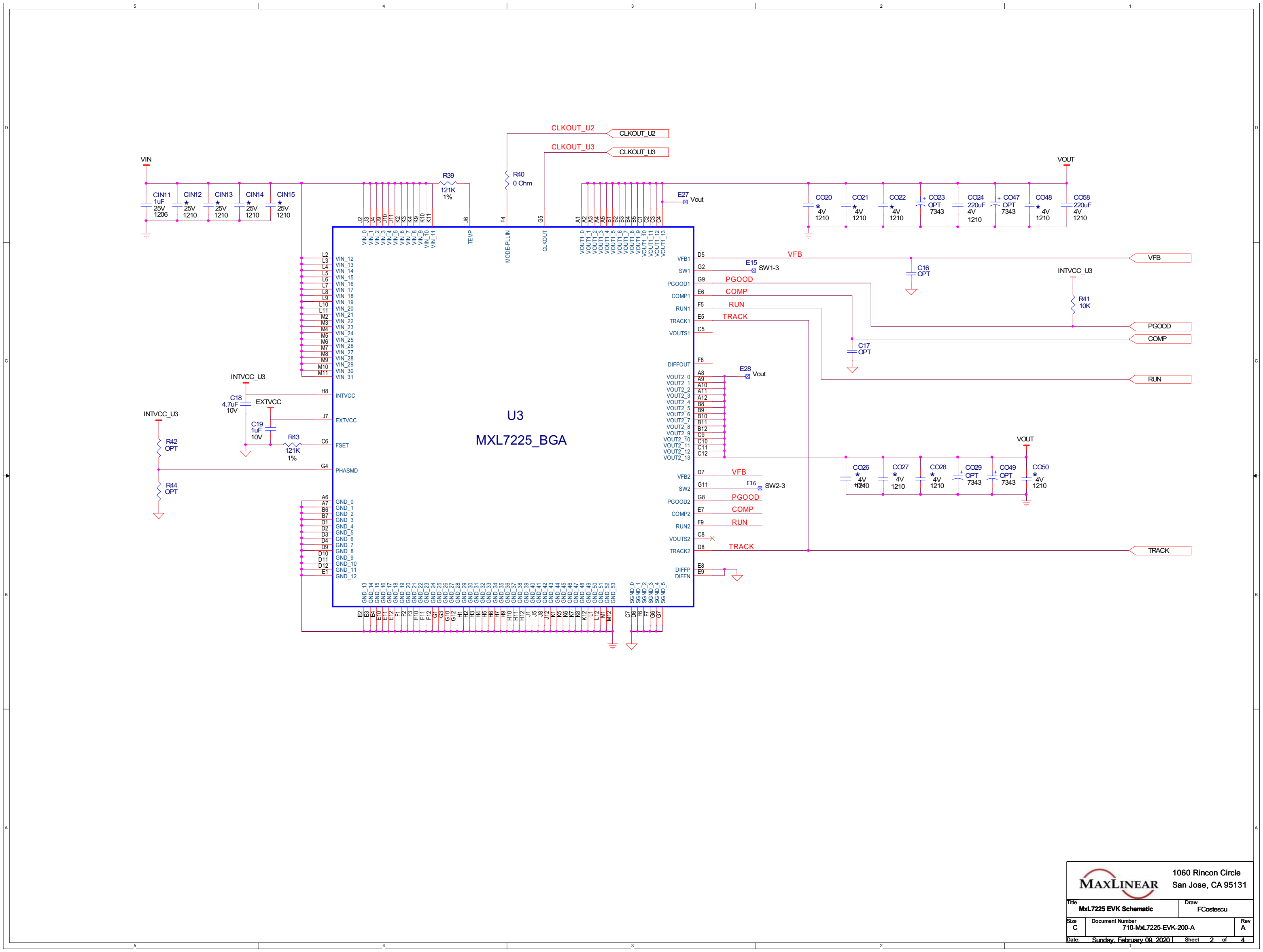


Figure 10: EVK Schematic, Continued

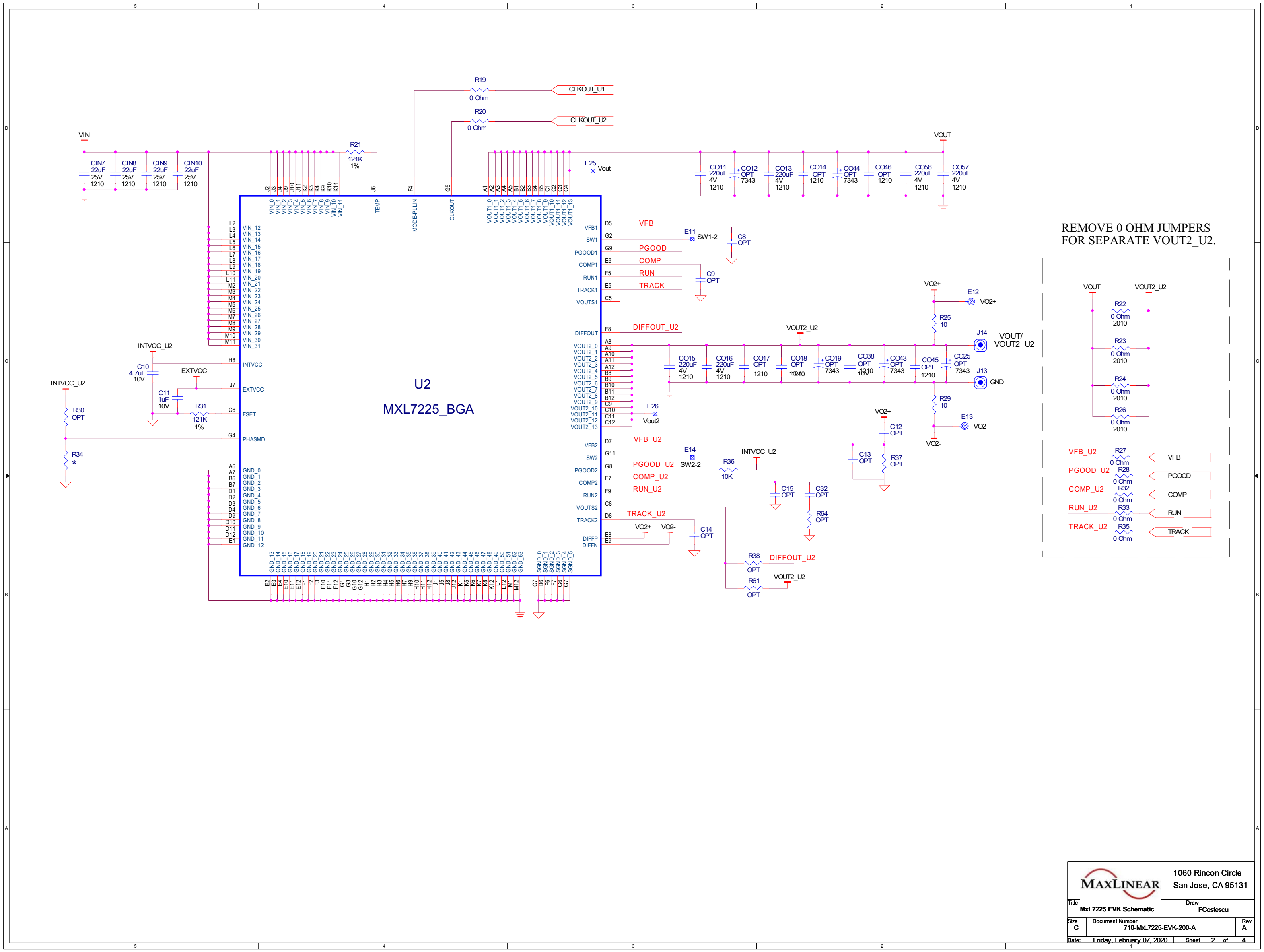
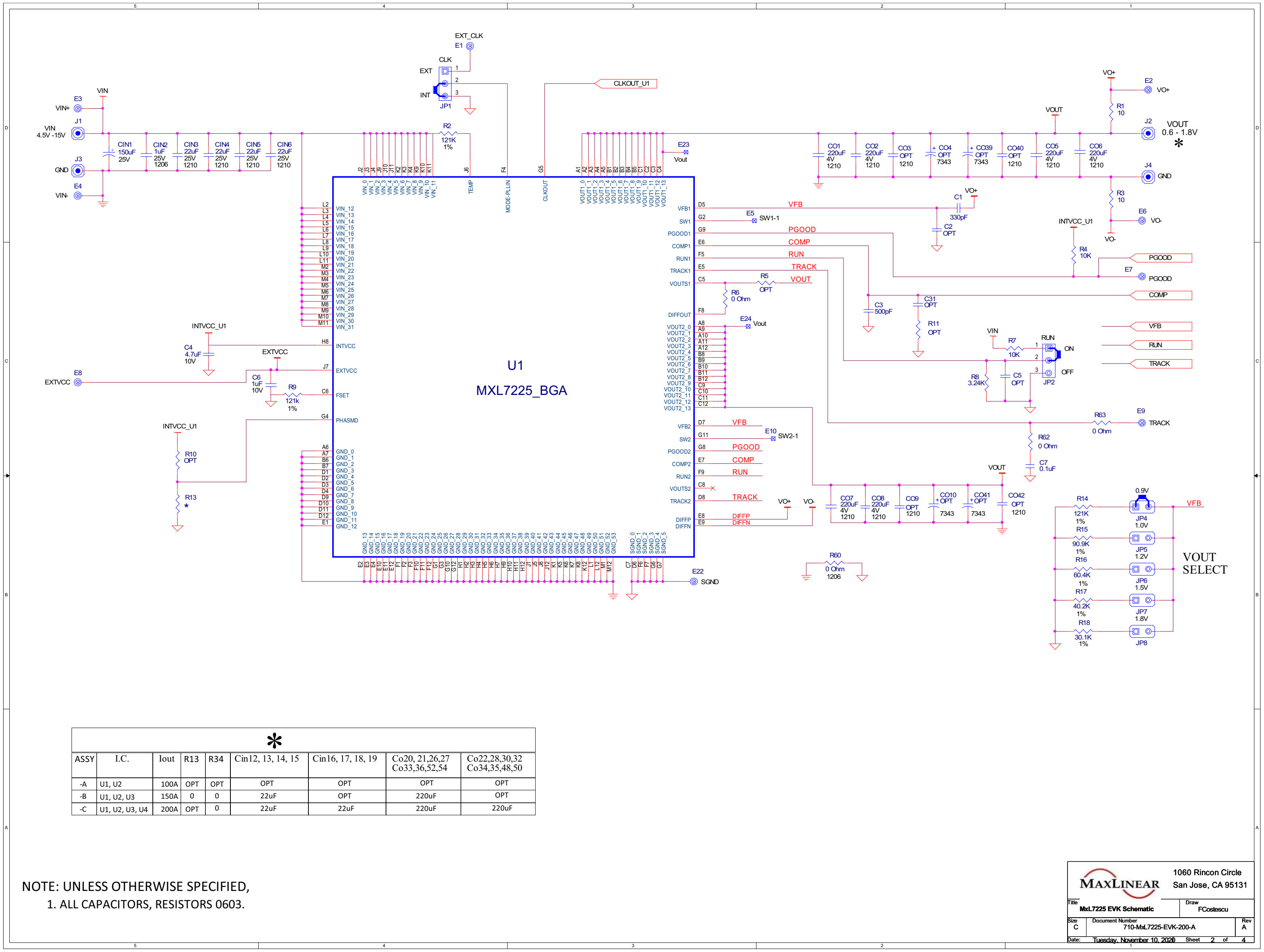


Figure 11: EVK Schematic, Continued



*

ASSY	I.C.	Iout	R13	R34	Cin12, 13, 14, 15	Cin16, 17, 18, 19	Co20, 21,26,27 Co33,36,52,54	Co22,28,30,32 Co34,35,48,50
-A	U1, U2	100A	OPT	OPT	OPT	OPT	OPT	OPT
-B	U1, U2, U3	150A	0	0	22uF	OPT	220uF	OPT
-C	U1, U2, U3, U4	200A	OPT	0	22uF	22uF	220uF	220uF

NOTE: UNLESS OTHERWISE SPECIFIED,
1. ALL CAPACITORS, RESISTORS 0603.

Figure 12: EVK Schematic, Continued

Quad MxL7225 EVK PCB Layers

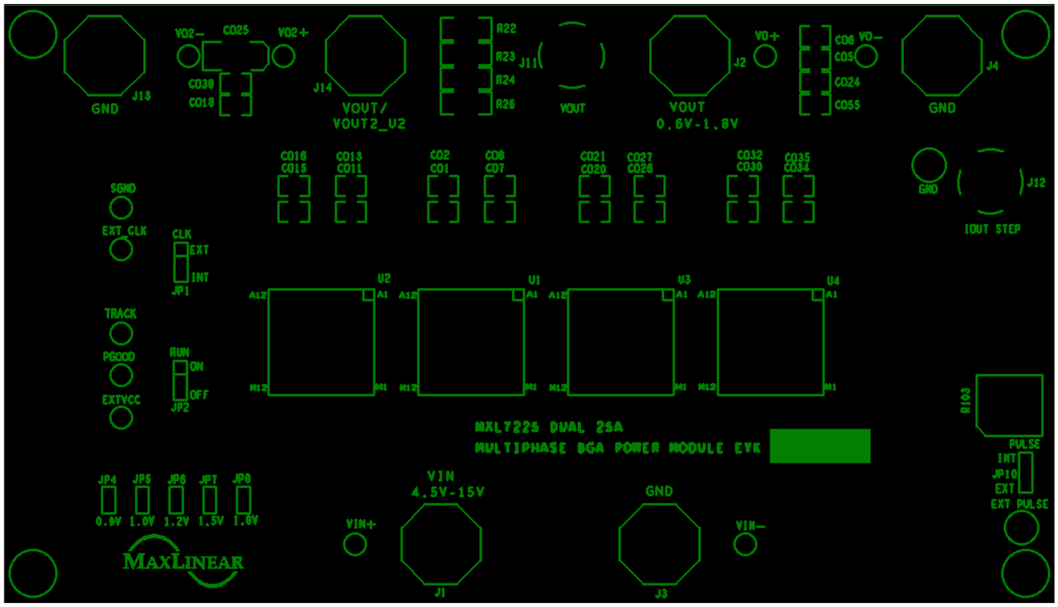


Figure 13: **EVK PCB Silkscreen Top**

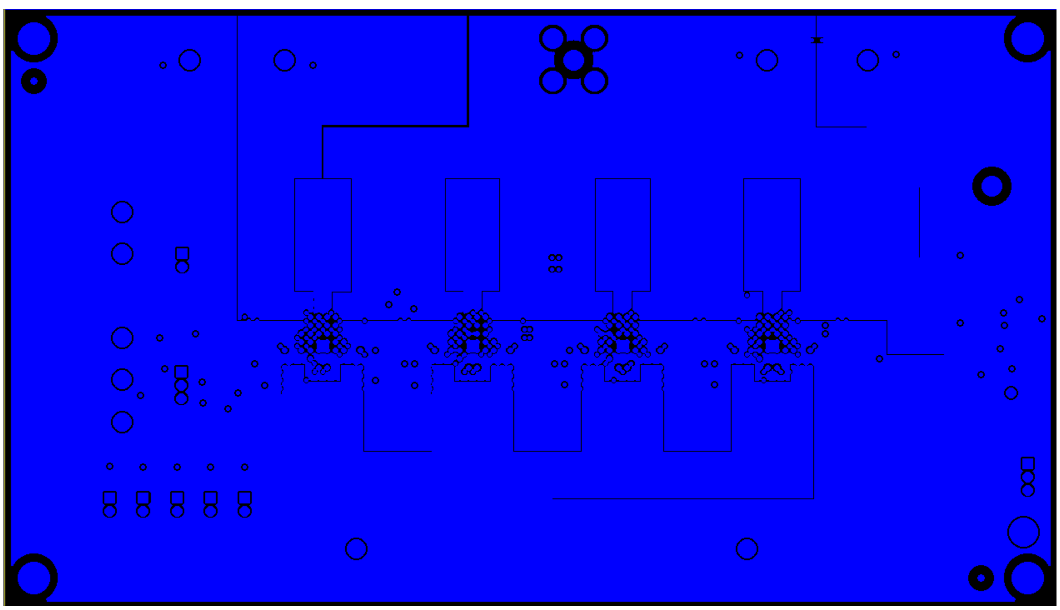


Figure 14: **EVK PCB Layer 1**

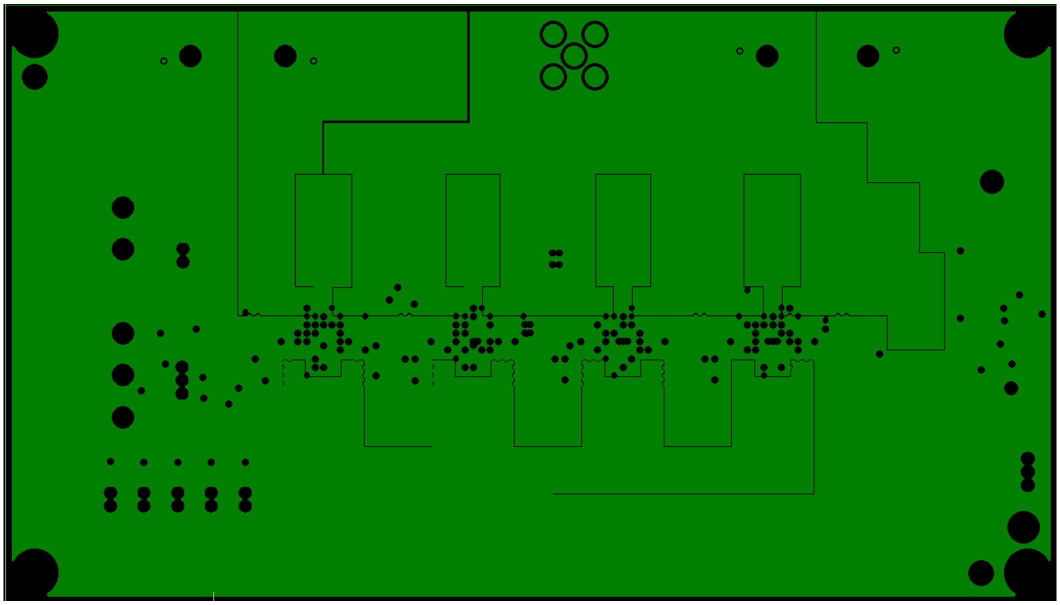


Figure 15: **EVK PCB Layer 2**

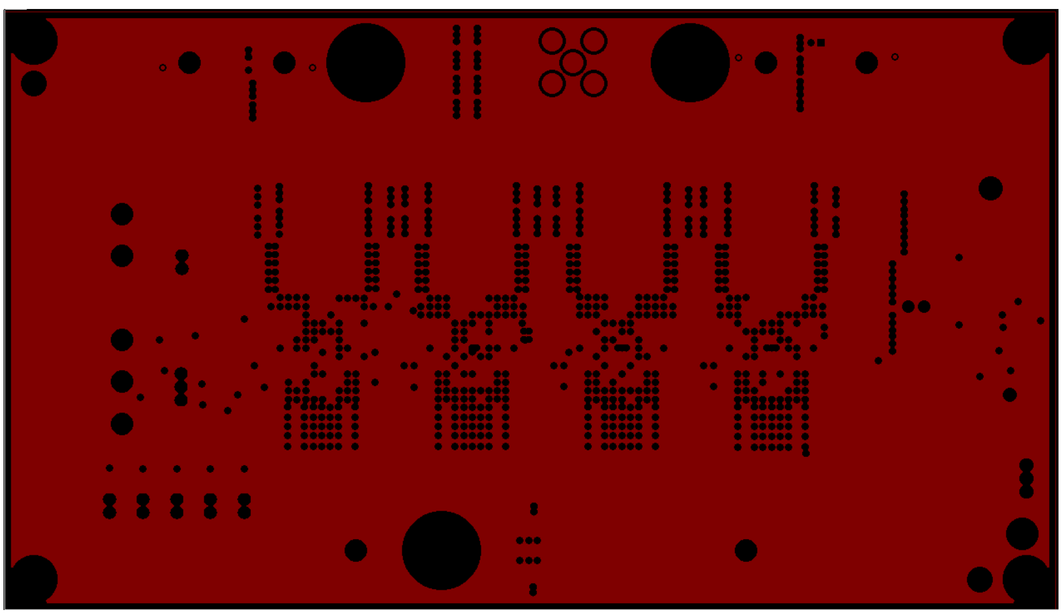


Figure 16: **EVK PCB Layer 3**

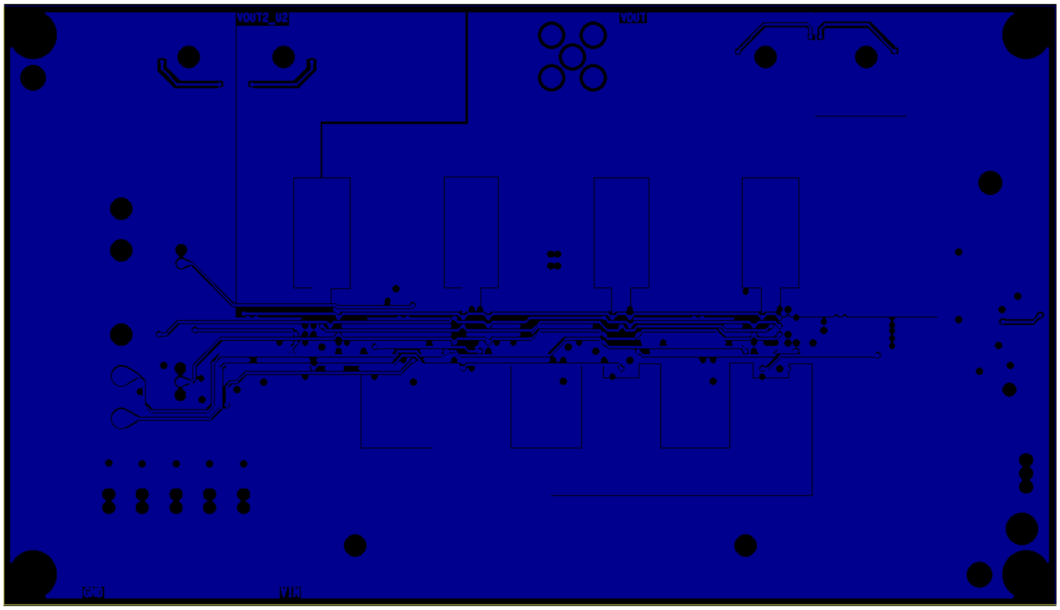


Figure 17: EVK PCB Layer 4

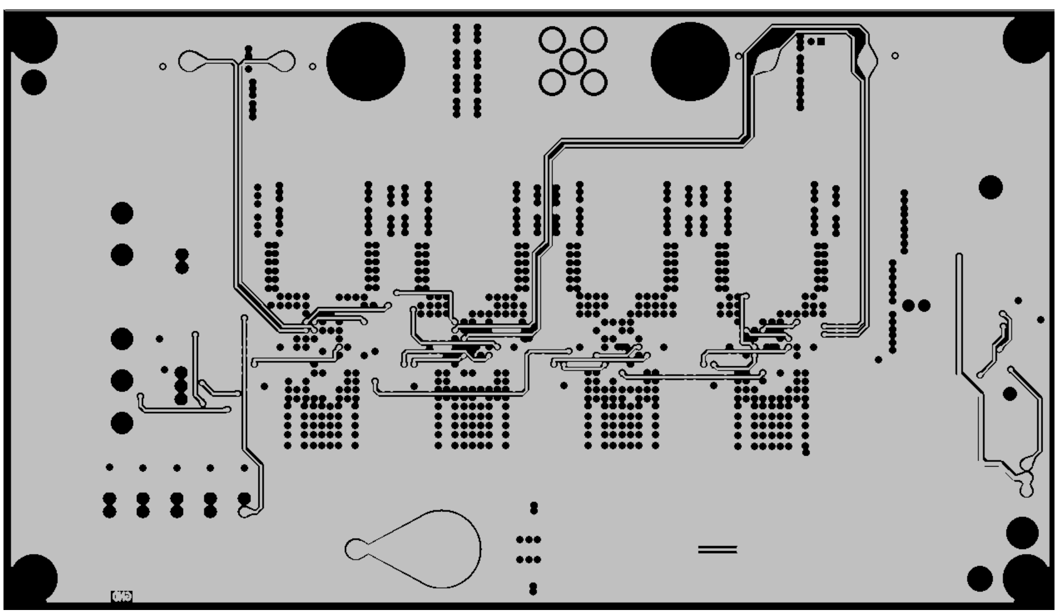


Figure 18: EVK PCB Layer 5

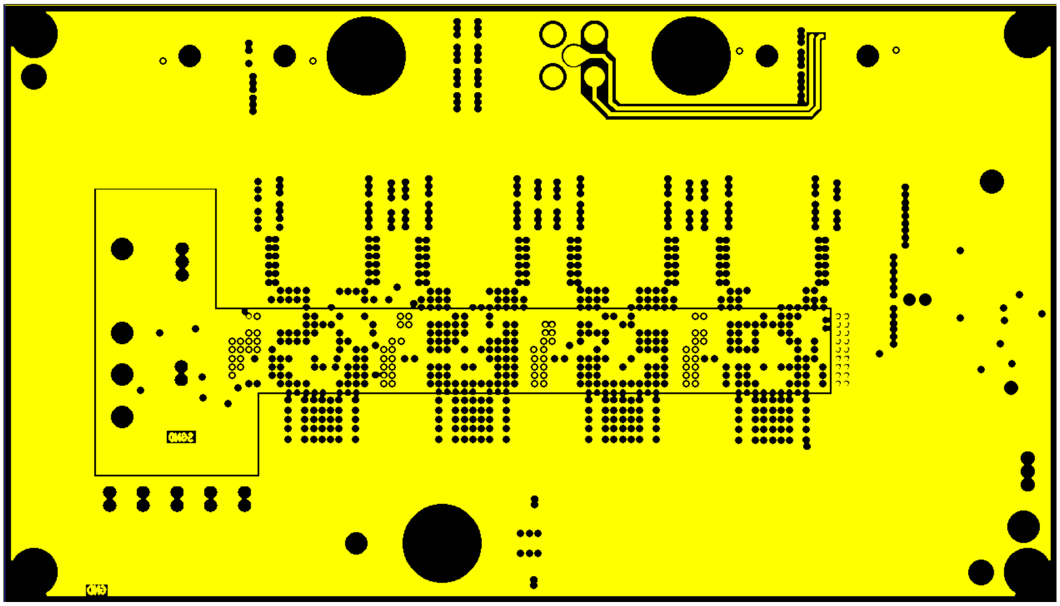


Figure 19: **EVK PCB Layer 6**

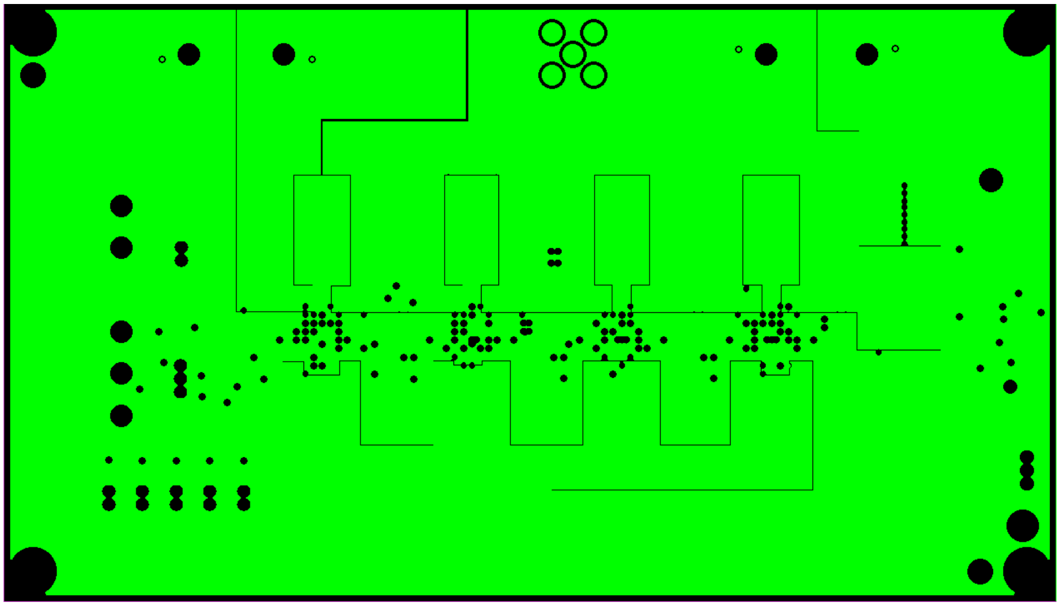


Figure 20: **EVK PCB Layer 7**

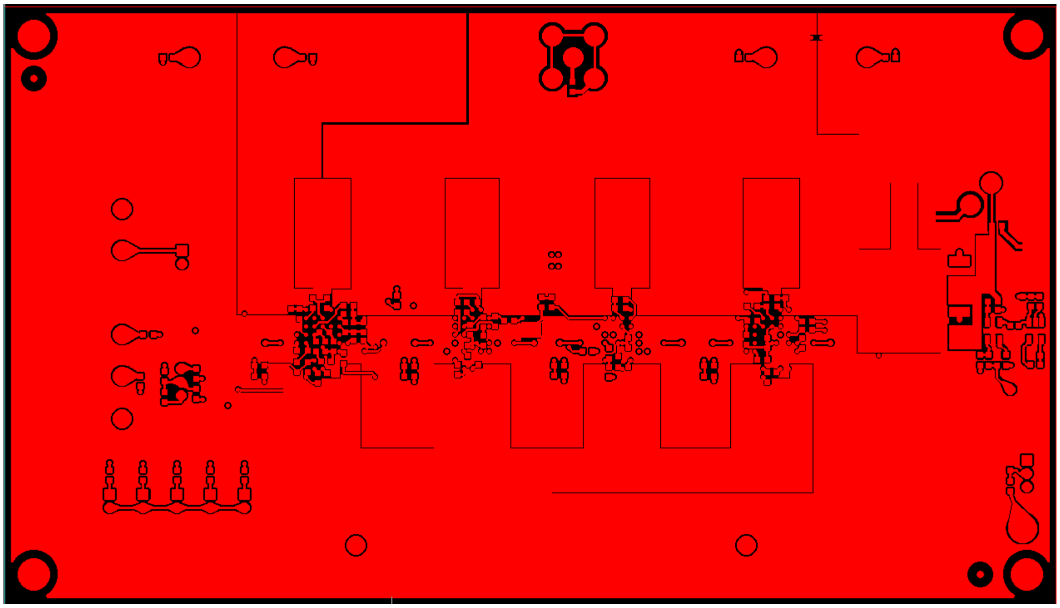


Figure 21: **EVK PCB Layer 8**

Quad MxL7225 EVK Bill of Materials

Table 6: EVK Bill of Materials

Item	Qty	Reference Designator	Description	Manufacturer / Part Number	Package Size
1	1	PCB	MXL7225 Evaluation Board	MAXLINEAR	
2	4	U1, U2, U3, U4	BGA-144	MAXLINEAR MXL7225	15 X 15 X 4.41
3	2	Q1, Q2	MOSFET, N-CH, 40V, 14A	VISHAY SUD50N04	TO-252
4	1	CIN1	CAP ALUM, 150UF,25V, 20%	Nichicon UCD1E151MNL1GS	8.3 X 8.3MM
5	16	CIN3 - CIN10, CIN12 - CIN19	CERAMIC CAP. 22uF, 25V, X5R, 10%	Wurth Elektronik 885012109014	1210
6	2	CIN2, CIN11	CERAMIC CAP. 1uF, 25V, X7R, 10%	Wurth Elektronik 885012208064	1206
7	16	CO1, CO2, CO5, CO6, CO7, CO8, CO11, CO13, CO15, CO16, CO24, CO55, CO56, CO57, CO58, CO59	CERAMIC CAP. 220uF, 4V, X5R, 20%	MURATA GRM31CR60G227ME11L	1206
8	16	CO20 - CO22, CO26 - CO28, CO30, CO32 - CO35, CO36, CO48, CO50, CO52, CO54	CERAMIC CAP. 220uF, 4V, X5R, 20%	MURATA GRM31CR60G227ME11L	1206
9	4	C4, C10, C18, C22	CERAMIC CAP. 4.7uF, 10V, X5R, 20%	Wurth Elektronik 885012106012	0603
10	6	C6, C11, C19, C23, COUT26, C42	CERAMIC CAP. 1.0uF, 10V, X7R, 10%	Wurth Elektronik 885012206026	0603
11	1	C7	CERAMIC CAP. 0.1uF, 25V, X7R, 10%	Wurth Elektronik 885012206071	0603
12	1	C1	CERAMIC CAP., 330pF, 50V, X7R, 10%	Wurth Elektronik 885012206080	0603
13	1	C3	CERAMIC CAP., 500pF, 50V, X7R, 10%	Yageo CC0603KRNPO9BN471	0603
14	6	C44, C45, C52, C53, C54, C55	CERAMIC CAP., 100uF, 6.3V, X5R, 10%	MURATA GRM32ER60J107ME20L	1210
15	4	R1, R3, R25, R29	RES, 0603, 10 Ohm, 5%,1/10W	VISHAY CRCW060310R0JNEA	0603
16	9	R2, R9, R14, R21, R31, R39, R43, R47, R51	RES, 0603, 121k Ohm, 1%, 1/10W	VISHAY CRCW0603121KFKEA	0603
17	3	R4, R7, R98	RES, 0603, 10k Ohm, 5%, 1/10W	VISHAY CRCW060310K0JNEA	0603
18	1	R8	Resistor 3.24K Ohm, 1/10W,1%,SMD	PANASONIC ERJ-3EKF3241V	0603
19	1	R15	RES, 0603, 90.9k Ohm, 1%, 1/10W	VISHAY CRCW060390K9FKEA	0603

Table 6: EVK Bill of Materials (Continued)

Item	Qty	Reference Designator	Description	Manufacturer / Part Number	Package Size
20	1	R16	RES, 0603, 60.4k Ohm, 1%, 1/10W	VISHAY CRCW060360K4FKEA	0603
21	1	R17	RES, 0603, 40.2k Ohm, 1%, 1/10W	VISHAY CRCW060340K2FKEA	0603
22	1	R18	RES, 0603, 30.1k Ohm, 1%, 1/10W	VISHAY CRCW060330K1FKEA	0603
23	1	R89	RES, 0603, 2 Ohm, 1%, 1/10W	VISHAY CRCW06022R00FNEA	0603
24	2	R101, R102	RES, 2512, 0.010 Ohm, 1%, 1W	VISHAY WSL2512R01000FEA	2512
25	13	R6, R19, R20, R27, R28, R32, R33, R34, R35, R40, R45, R62, R63	RES, 0603, 0 Ohm, JUMPER	VISHAY CRCW06030000Z0EA	0603
26	4	R22, R23, R24, R26	RES 0 OHM JUMPER 2010	VISHAY WSL201000000ZEA9	2010
27	1	R60	RES, 1206, 0 Ohm, JUMPER	VISHAY CRCW12060000Z0EA	1206
28	11	E1 - E4, E6 - E9, E12, E13, E22	TERM. TURRET SINGLE	MILL-MAX CORP. 2308-2-00-80-00-00-07-0	0.063"
29	2	E33, E34	TERM. TURRET SINGLE, L=5.56MM THIN	MILL-MAX CORP. 2501-2-00-80-00-00-07-0	0.094"
30	2	J11, J12	CONN. BNC RCPT.	Amphenol RF 112404	BNC
31	6	J1, J2, J3, J4, J13, J14	BROACHINHG STUD, TYPE KFH	PEMNET KFH-032-10	0.189"
32	5	JP4, JP5, JP6, JP7, JP8	Header, 2Pin, 2mm, Single Row	Wurth Elektronik 620-002-111-21	2mm
33	5	XJP1, XJP2, XLP4, XJP9, XLP10	Shunt 2mm	Wurth Elektronik 608-002-134-21	2mm
34	3	JP1, JP2, JP9	Header, 3Pin, 2mm, Single Row	Wurth Elektronik 620-003-111-21	2mm
35	17	C39, C40, C43, JP10, R91, R92, R93, R94, R95, R96, R97, R99, R100, R103, R104, U5, U6	-	-	-

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