

ENVISIONING • EMPOWERING • EXCELLING



Quad MxL7225
200A Multiphase
EVK User Manual

Revision History

| Document No. | Release Date | Change Description |
|--------------|--------------|--------------------|
| 021UMR01 | 12/7/20 | Initial Release |

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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 \pm 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 100 μ A 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 \pm 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.

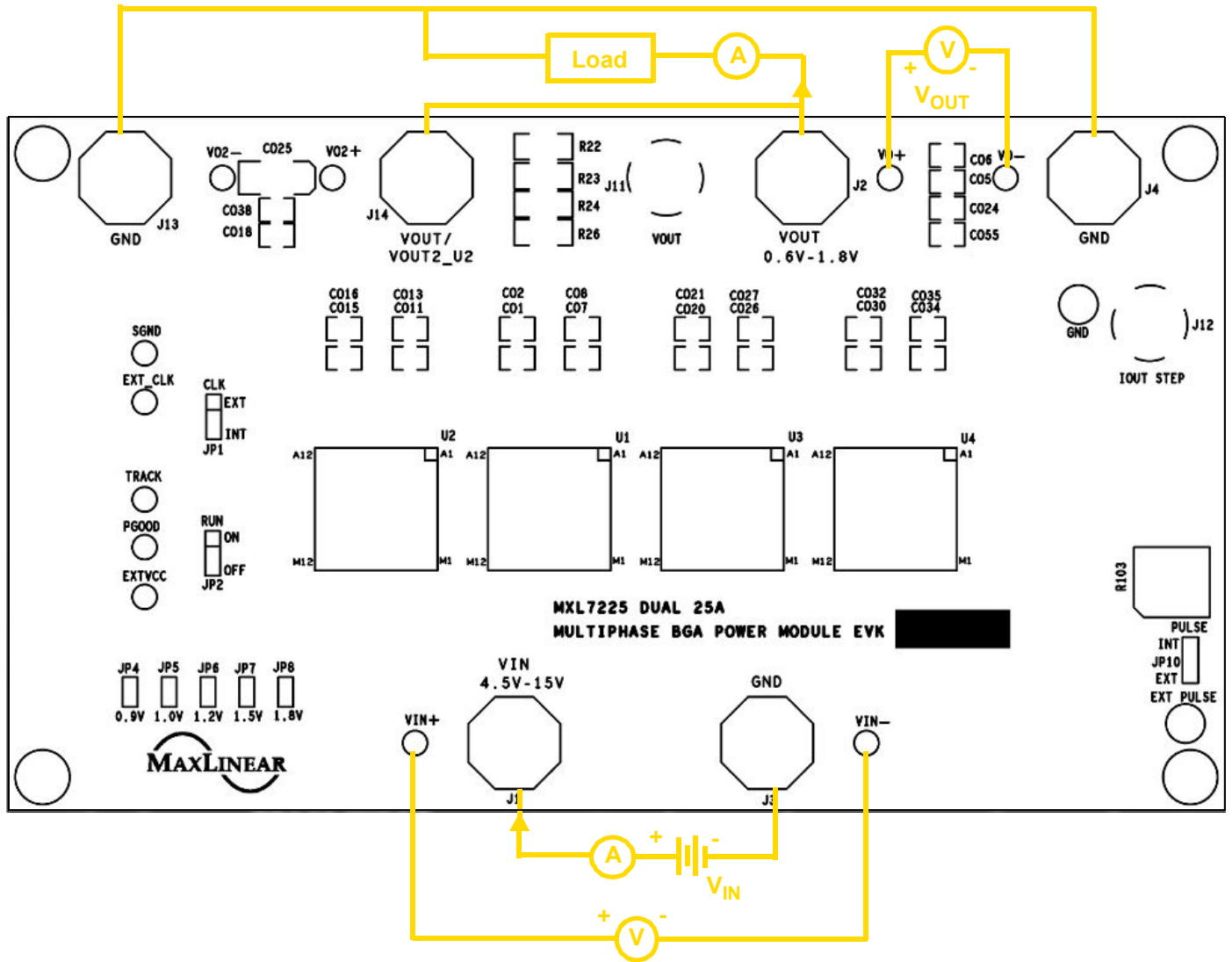


Figure 1: Monitoring V_{IN} and V_{OUT}

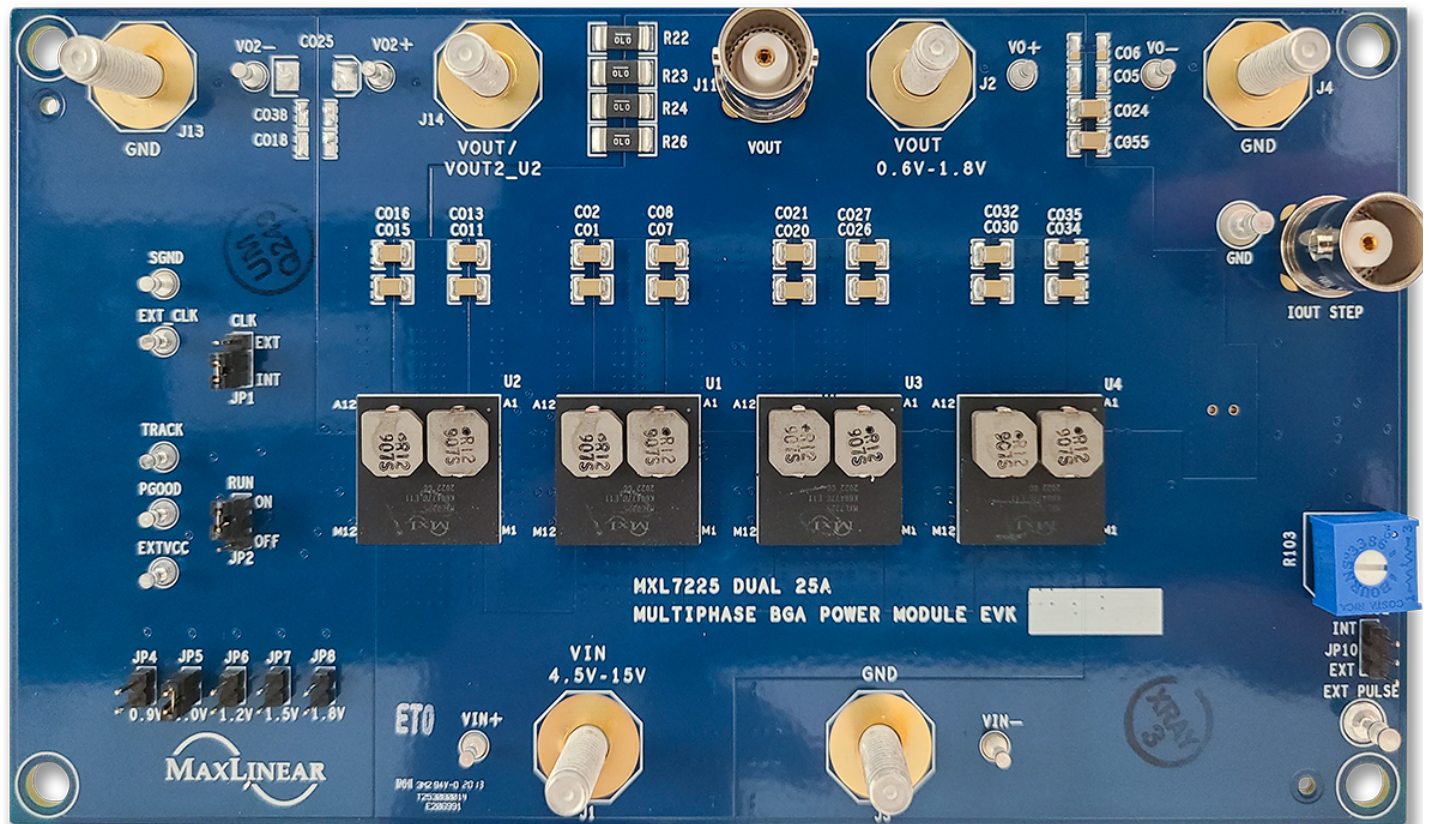


Figure 2: Top View of MxL7225 200A Multiphase EVK

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

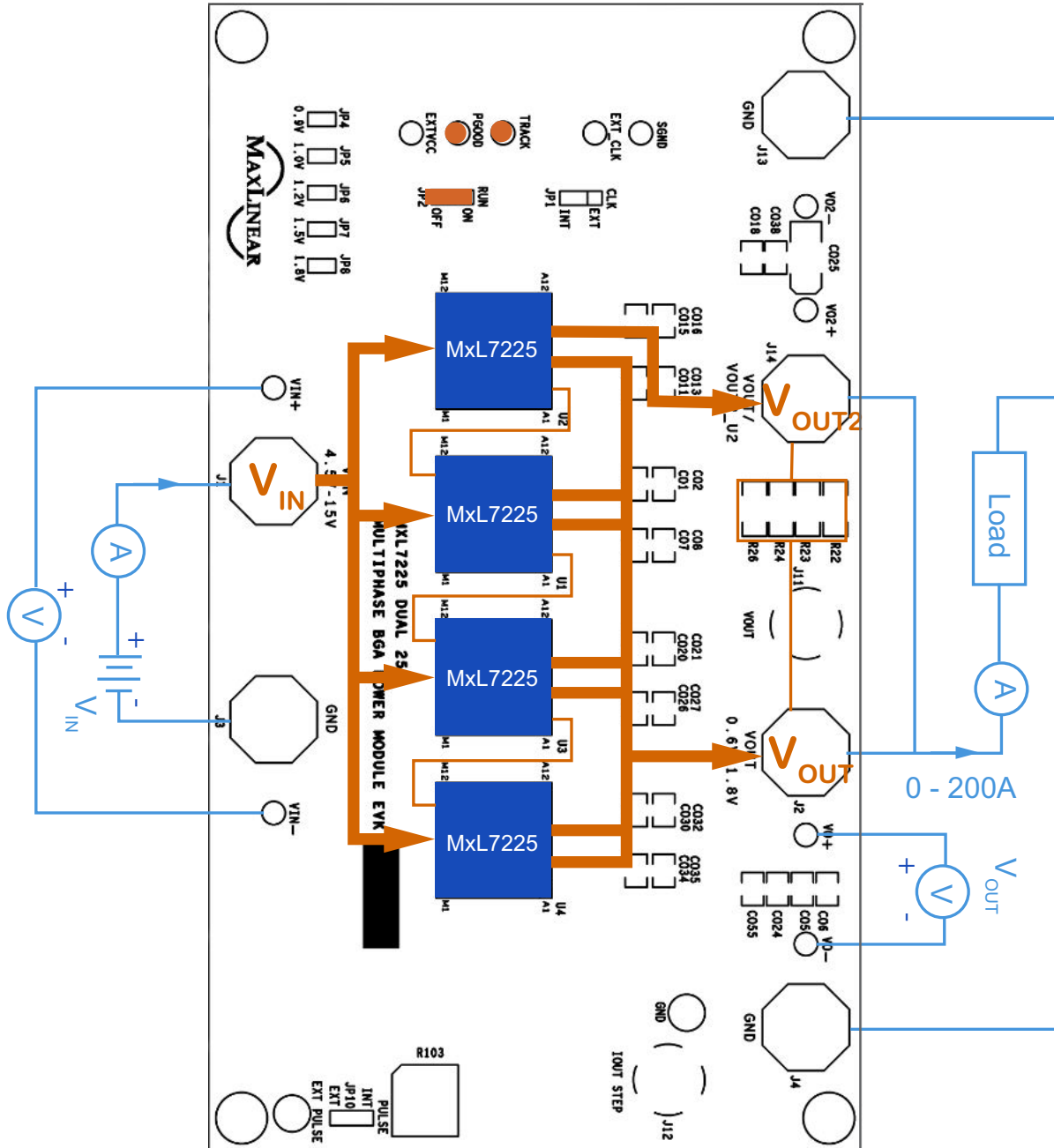
Table 1: Evaluation Board Ordering Part Number⁽¹⁾

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

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 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 10k Ω 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 $>40\text{A}/\mu\text{s}$ 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 ($\sim 1\%$). 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 IOOUT STEP (J12) voltage. The load current at IOOUT STEP (J12) is $5\text{mV}/\text{A}$. For an example, a 100A load will occur when a 500mV pulse is observed at J12.

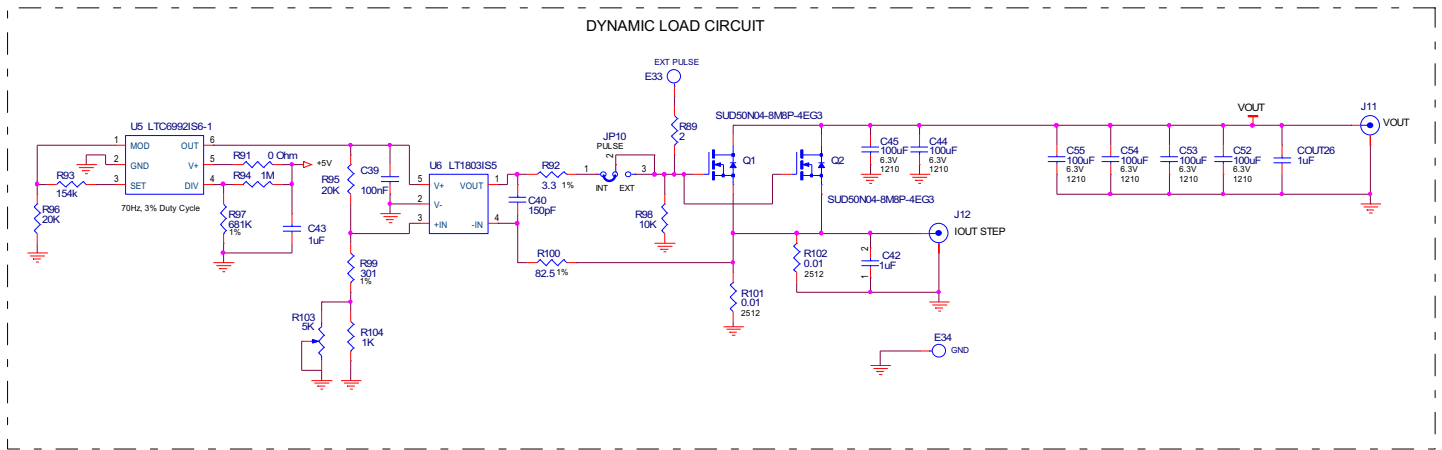


Figure 4: Load Transient Circuit

Performance

Efficiency

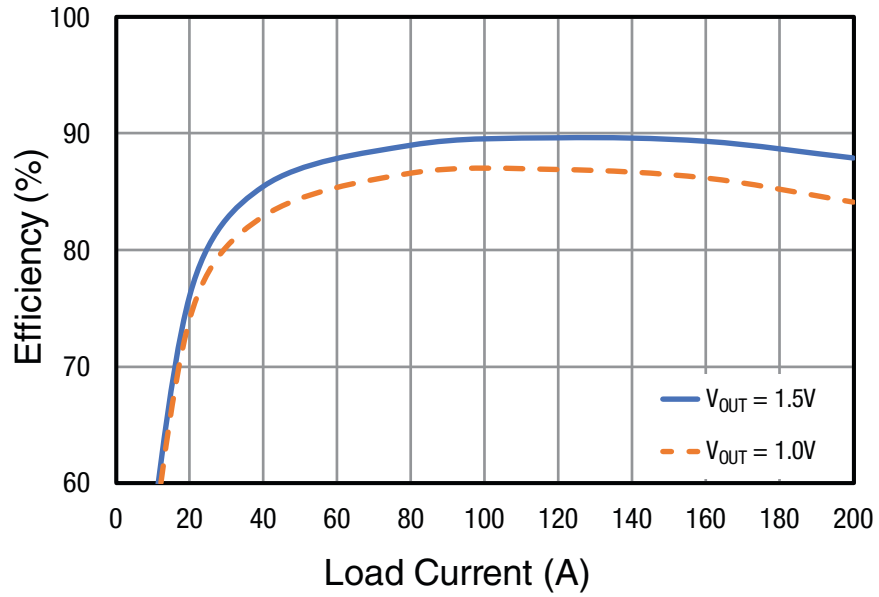


Figure 5: Measured Efficiency ($V_{IN} = 12V$, $f_{SW} = 500kHz$)

Load Transient Response

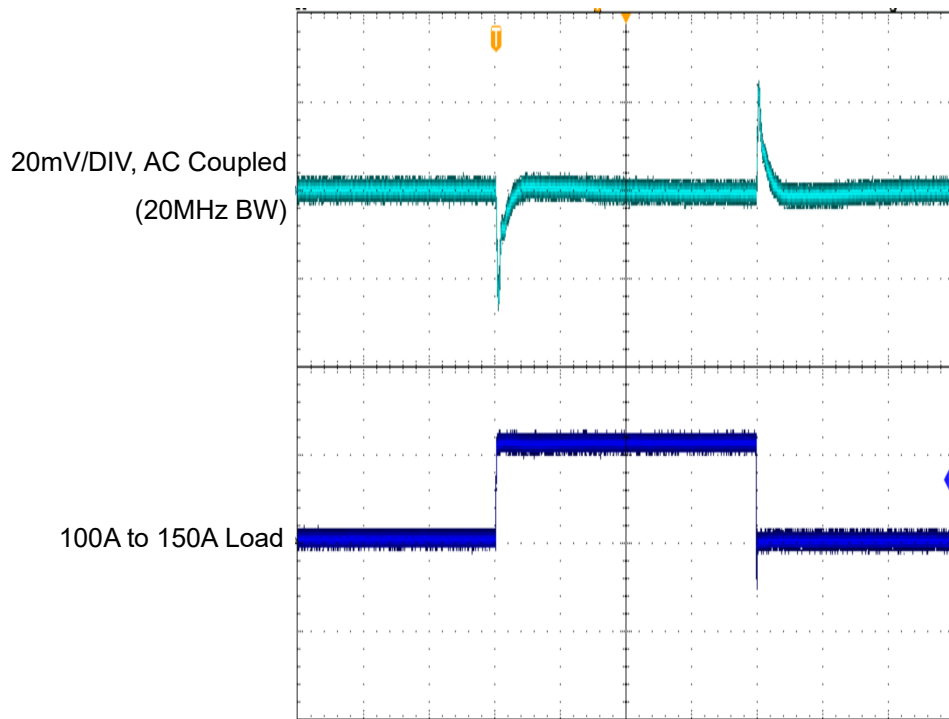
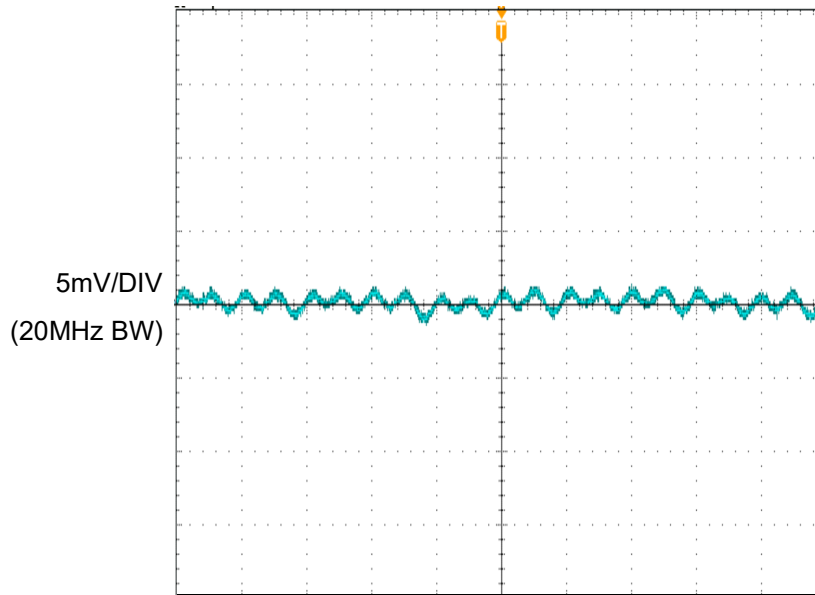


Figure 6: Load Transient Response, 100A to 150A ($V_{IN} = 12V$, $V_{OUT} = 1V$, $f_{SW} = 500kHz$)

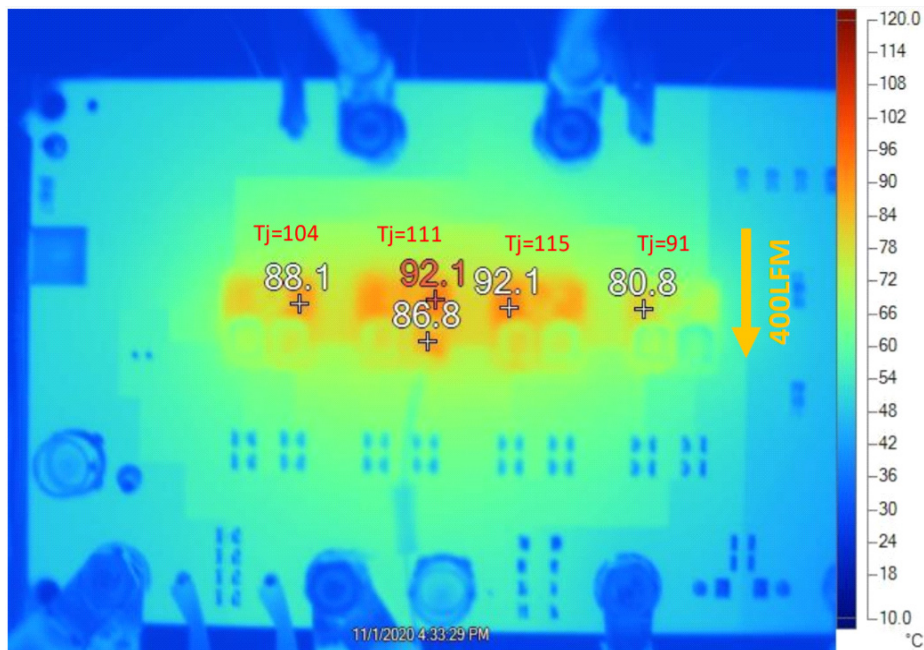
Output Ripple



2. 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



3. 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

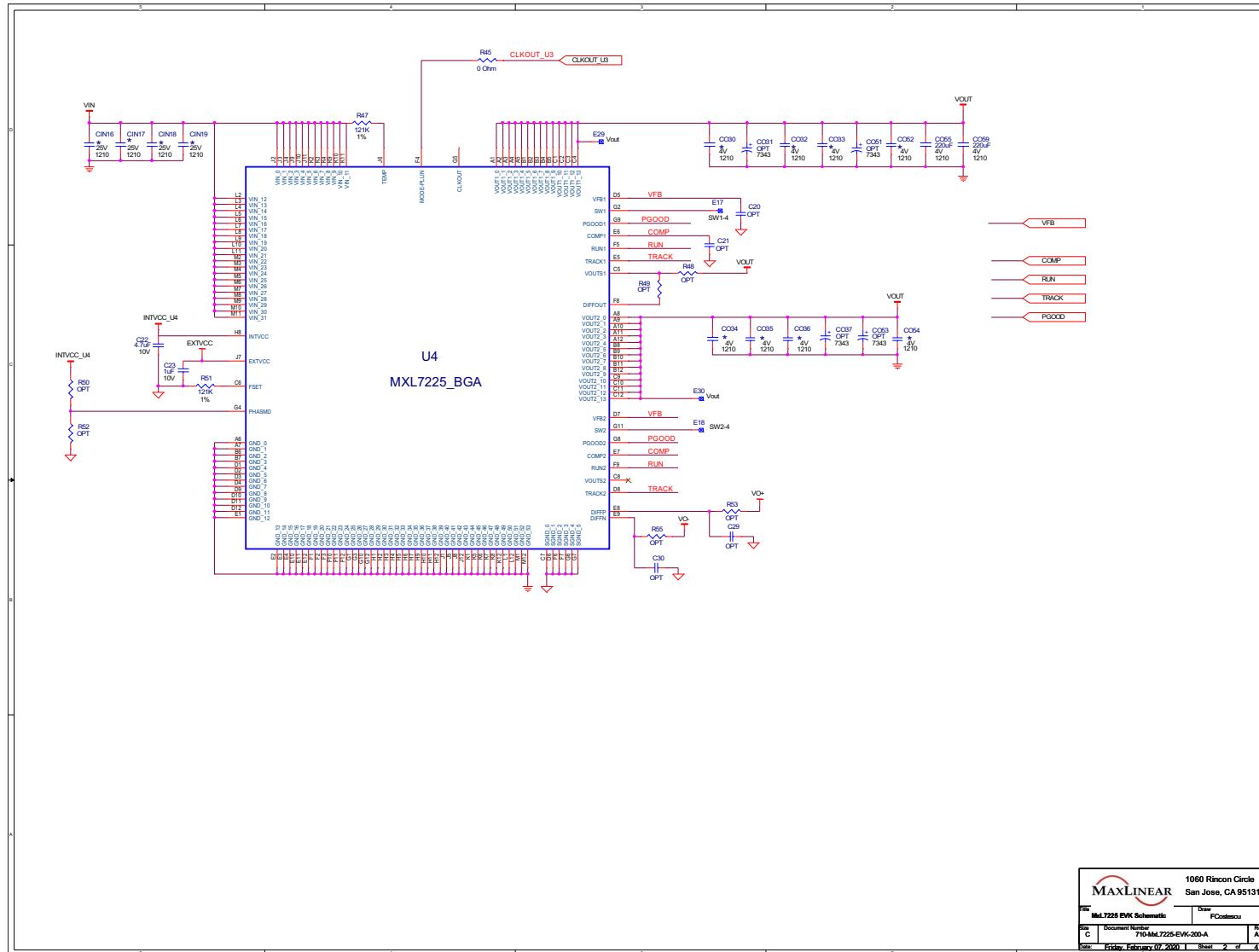


Figure 9: EVK Schematic

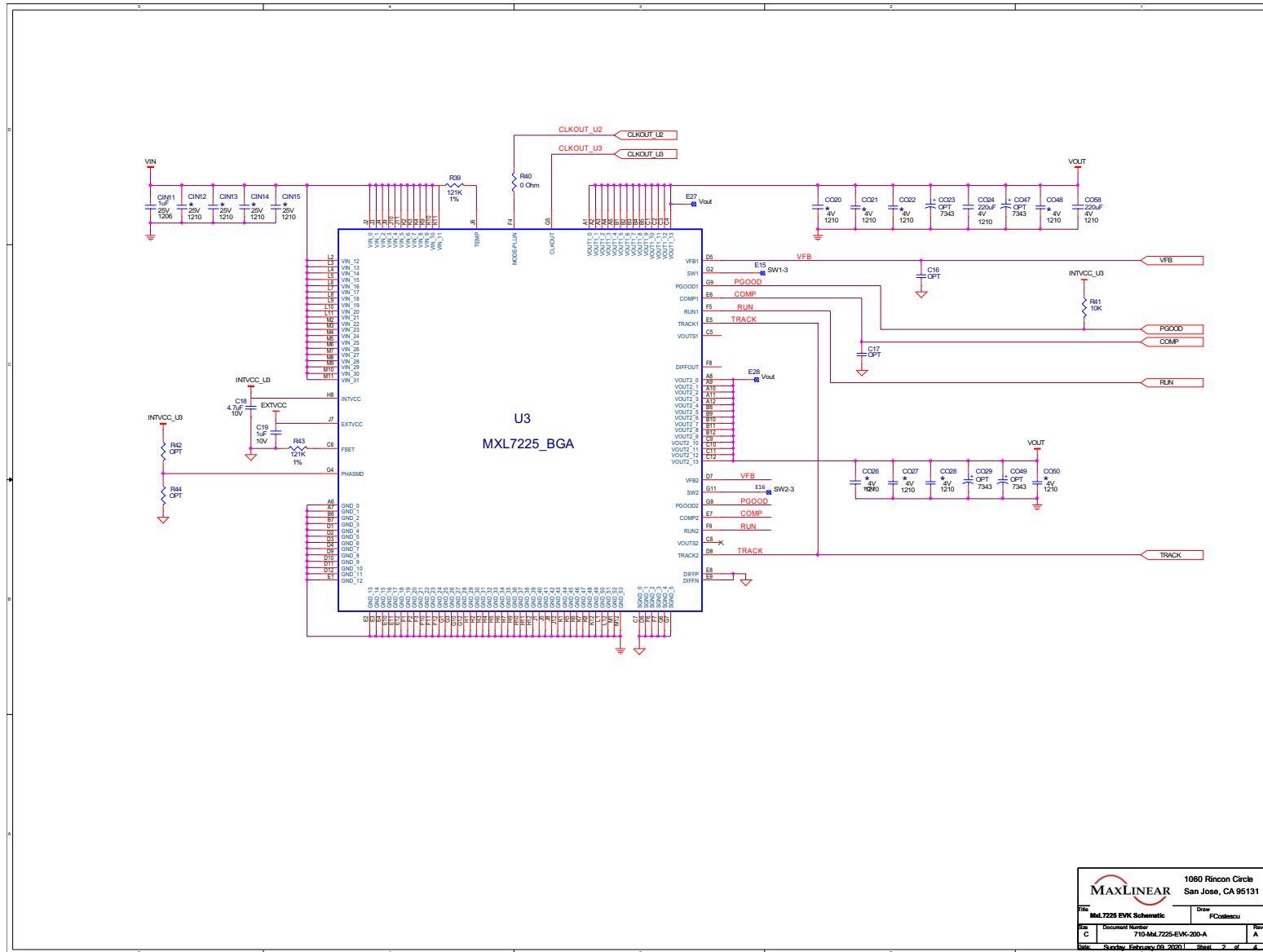


Figure 10: EVK Schematic, Continued

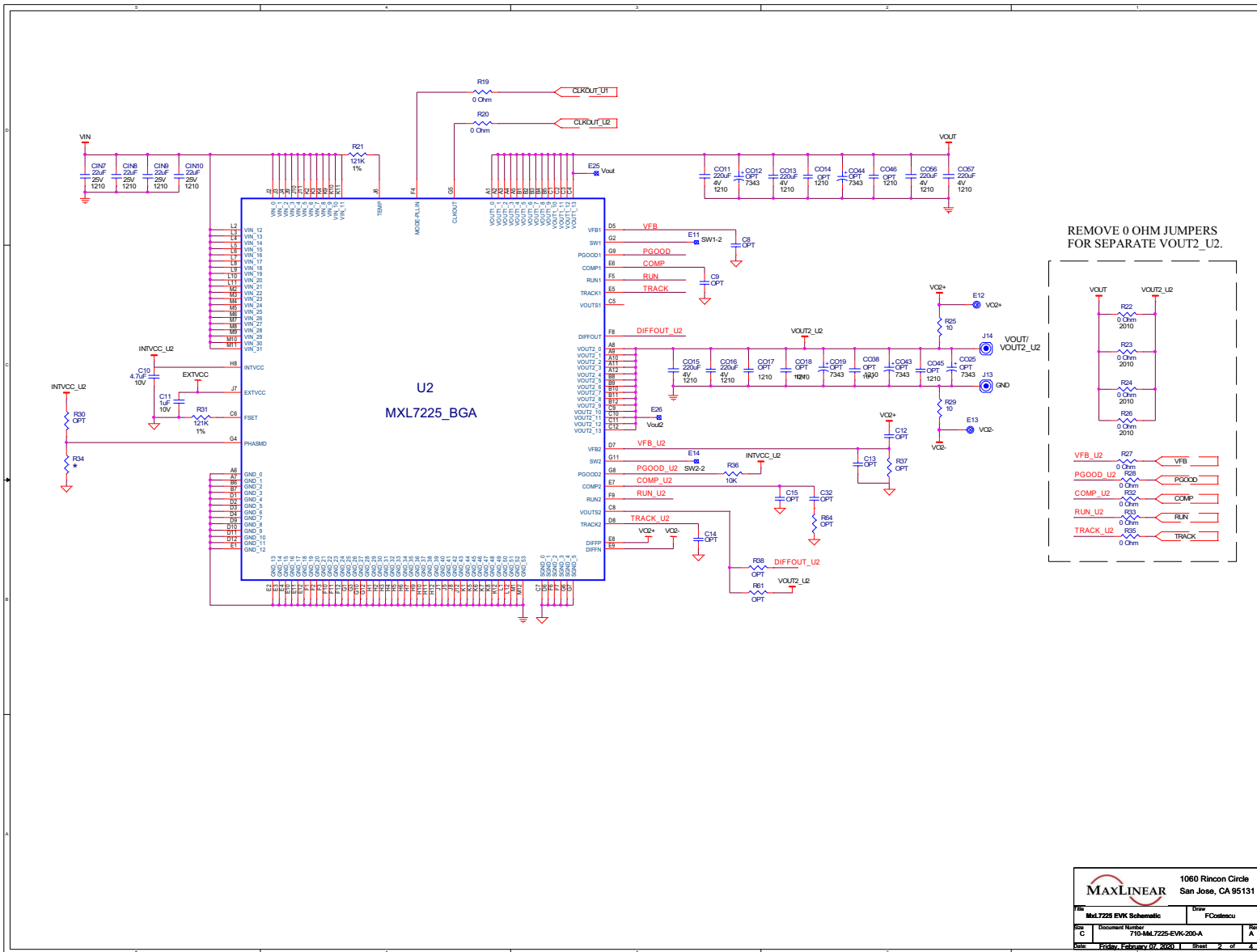


Figure 11: EVK Schematic, Continued

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MAXLINEAR

| | | | |
|---------|---------------------------|------------------|-----------------------|
| Doc No: | MxL7225 EVK Schematic | Drawn: | F. Costescu |
| Rev: | C | Document Number: | 710-MxL7225-EVK-200-A |
| Date: | Friday, February 07, 2020 | Sheet: | 2 of 4 |

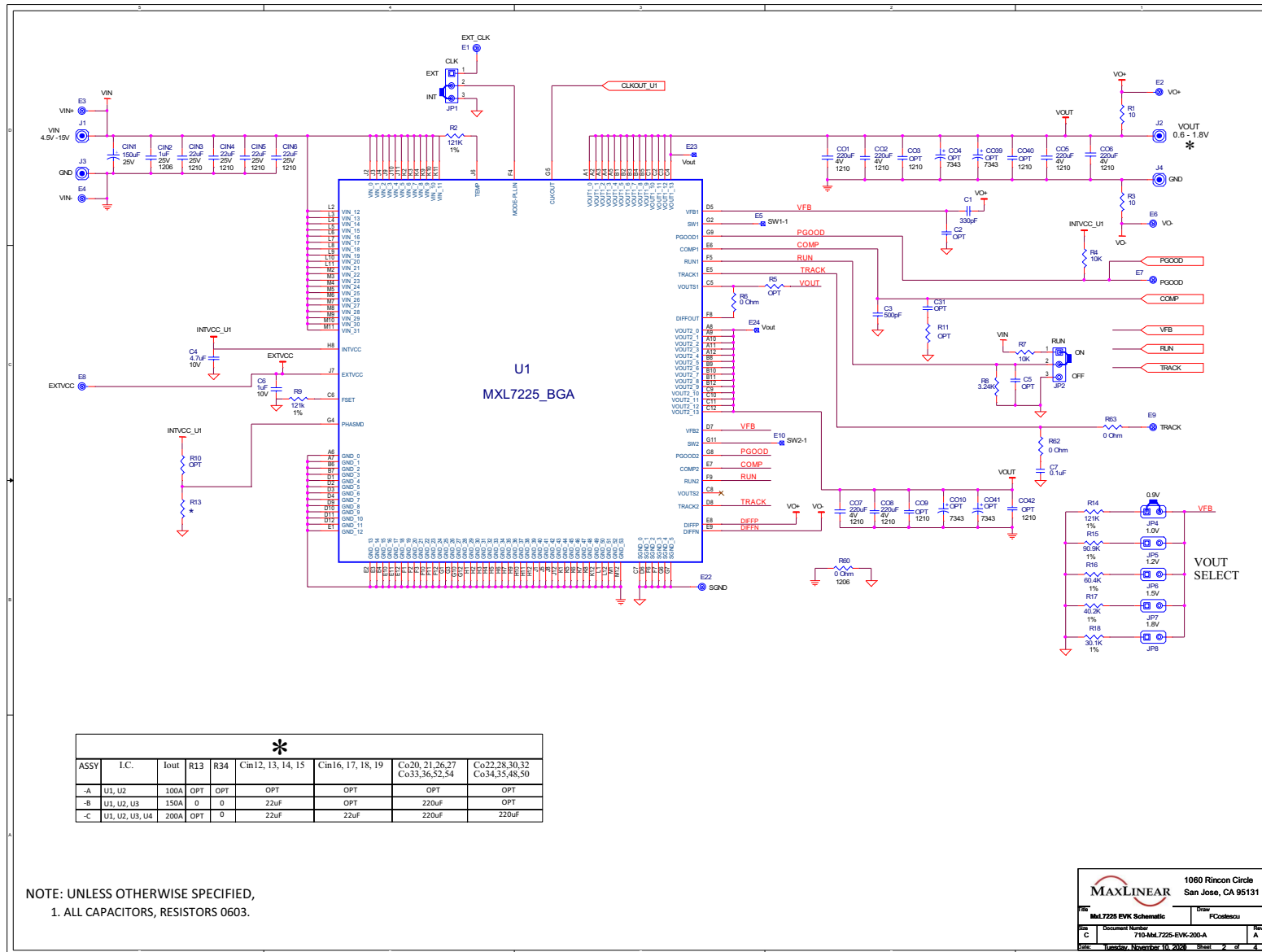


Figure 12: EVK Schematic, Continued

Quad MxL7225 EVK PCB Layers

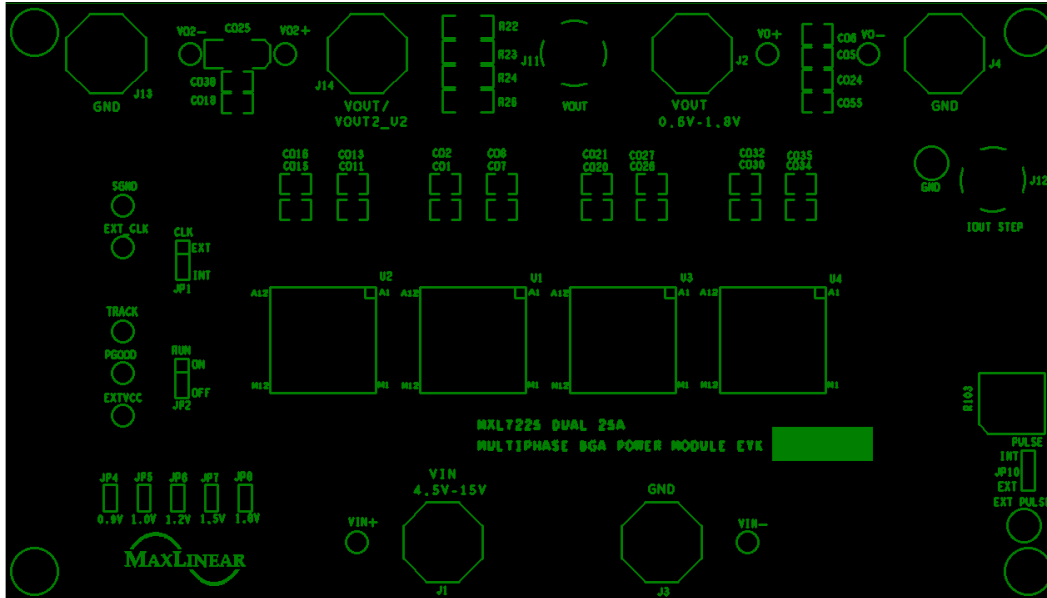


Figure 13: EVK PCB Silkscreen Top

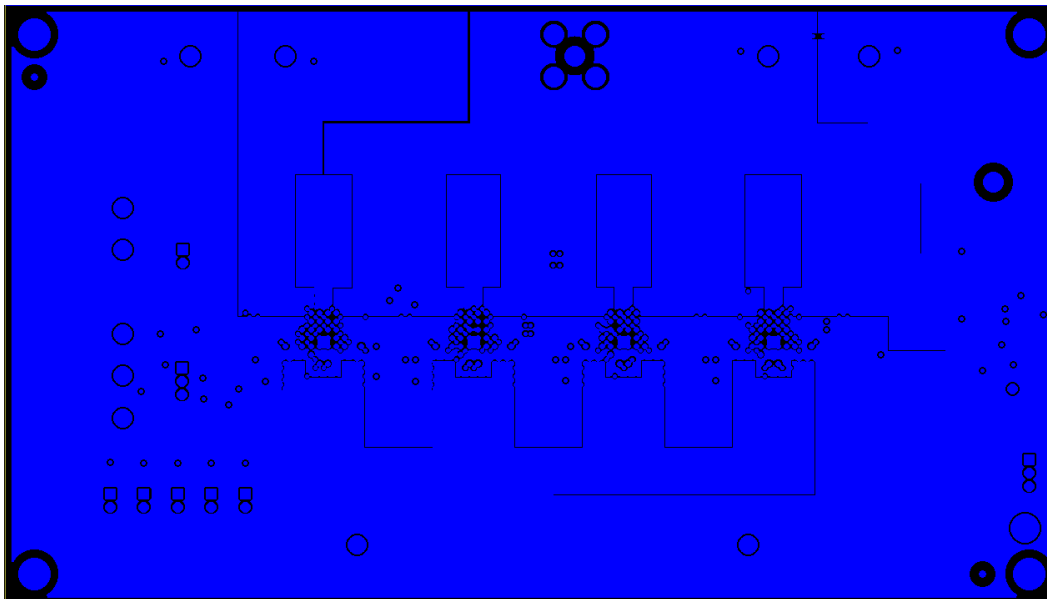


Figure 14: EVK PCB Layer 1

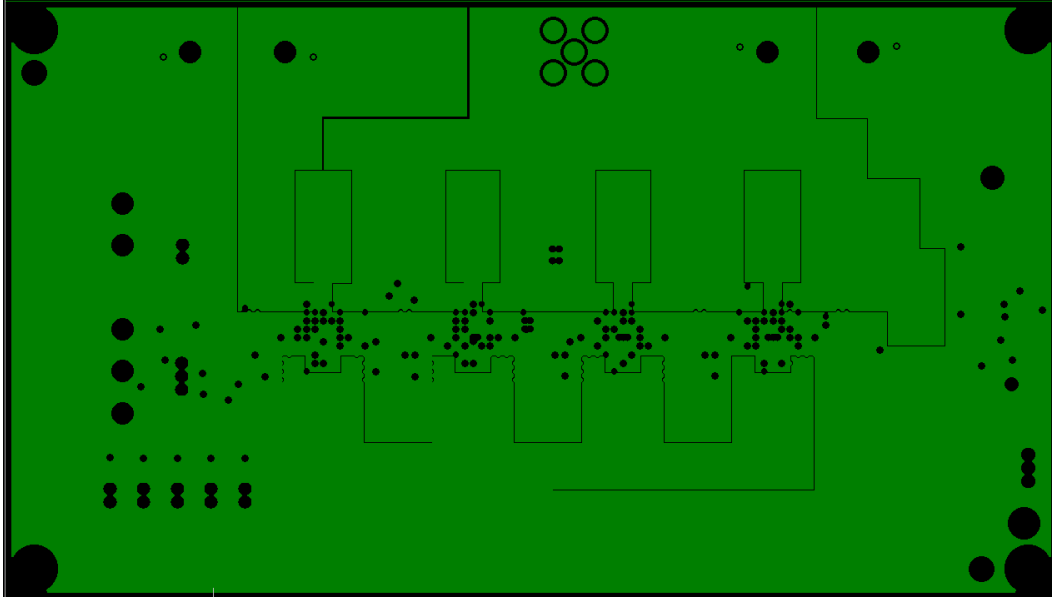


Figure 15: EVK PCB Layer 2

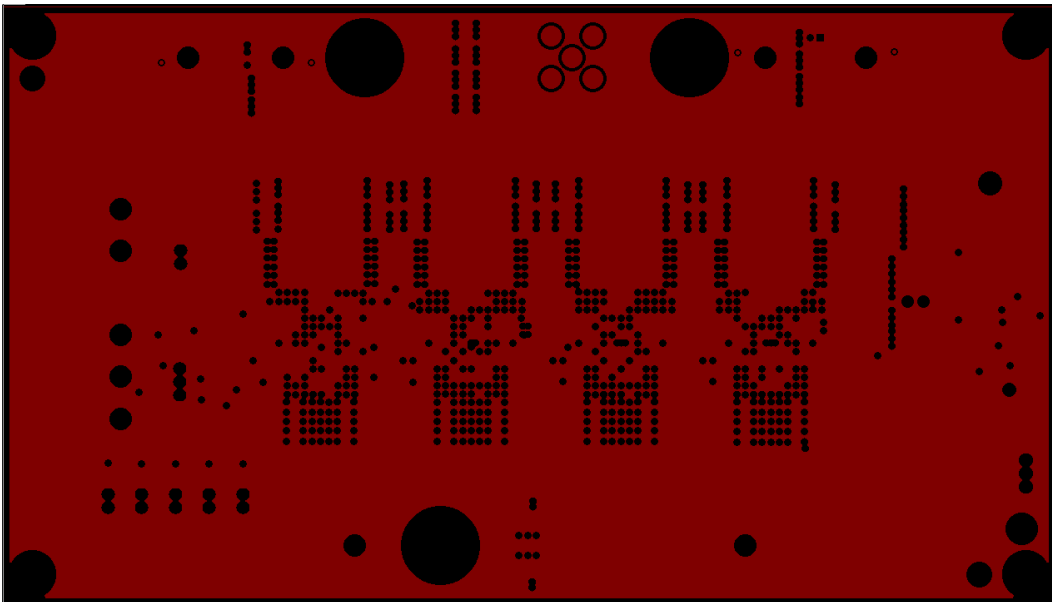


Figure 16: EVK PCB Layer 3

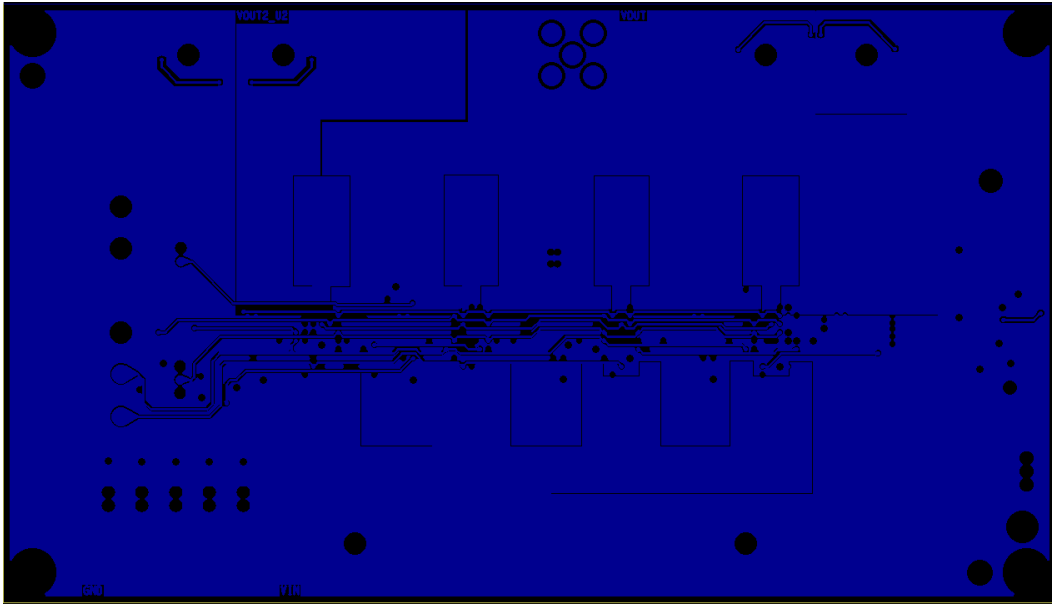


Figure 17: EVK PCB Layer 4

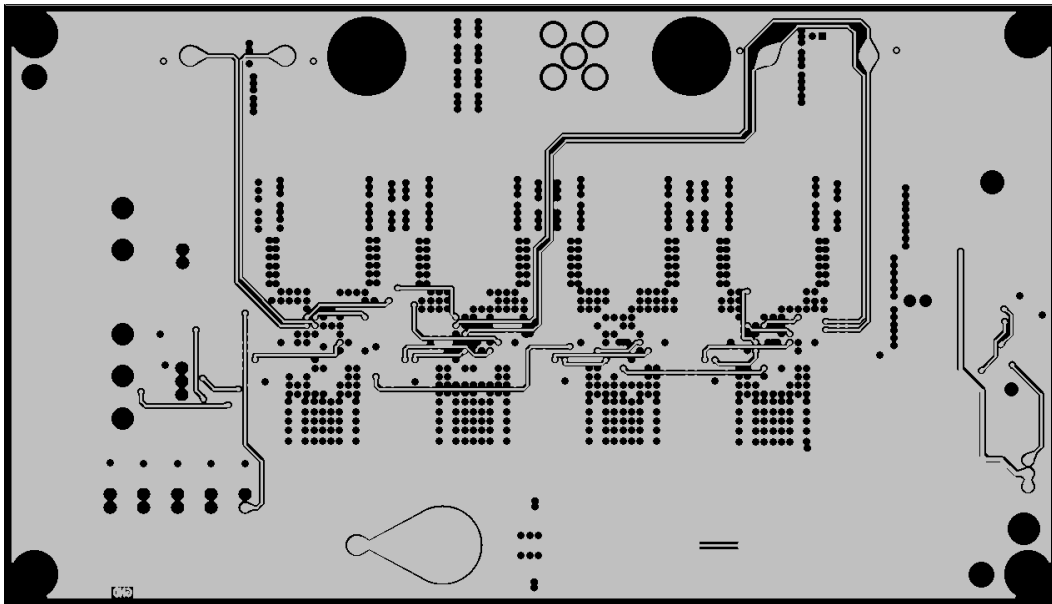


Figure 18: EVK PCB Layer 5

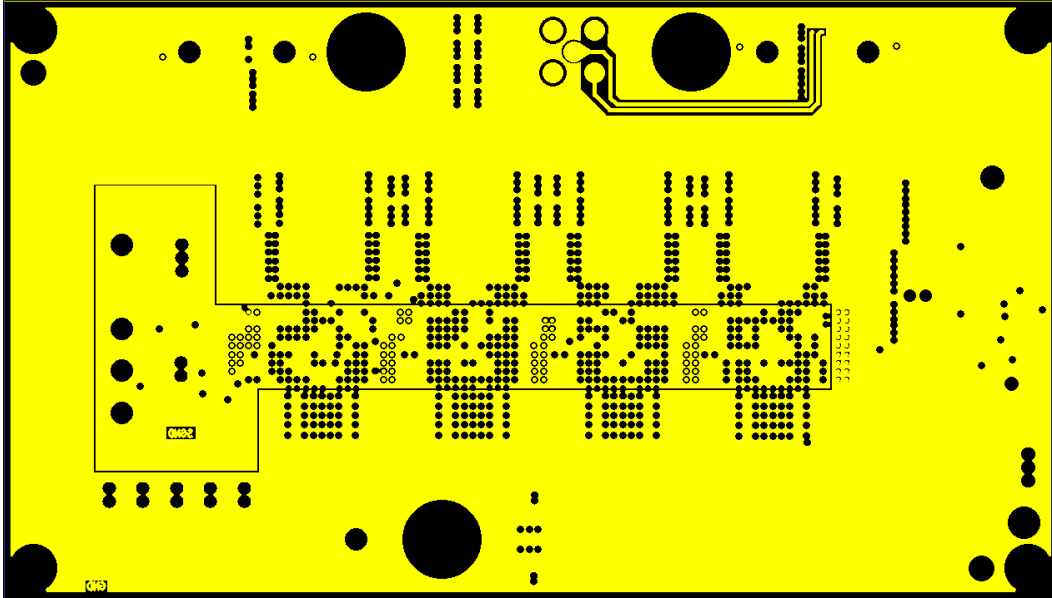


Figure 19: EVK PCB Layer 6

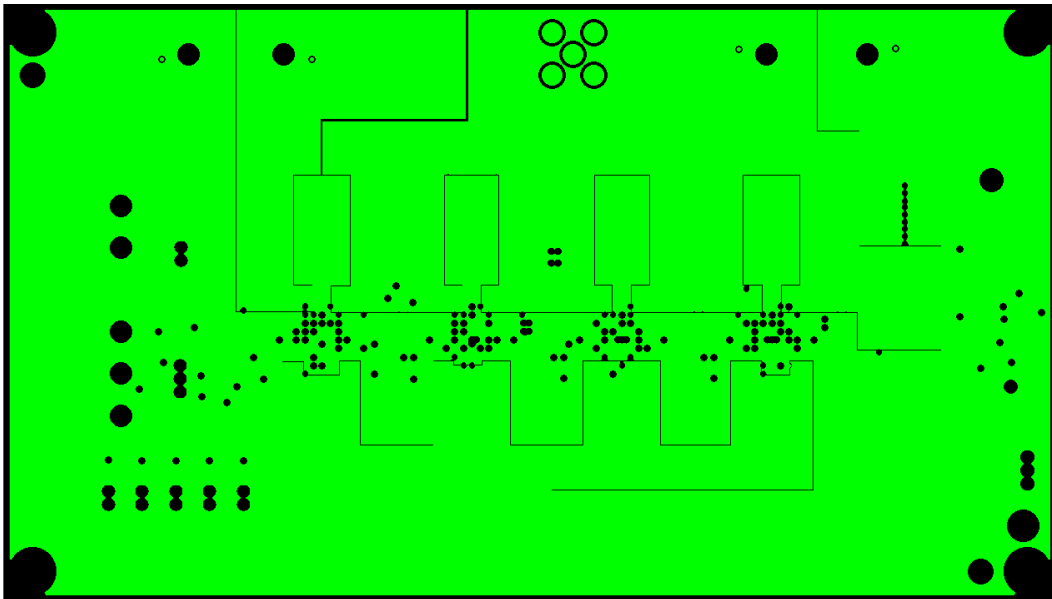


Figure 20: EVK PCB Layer 7

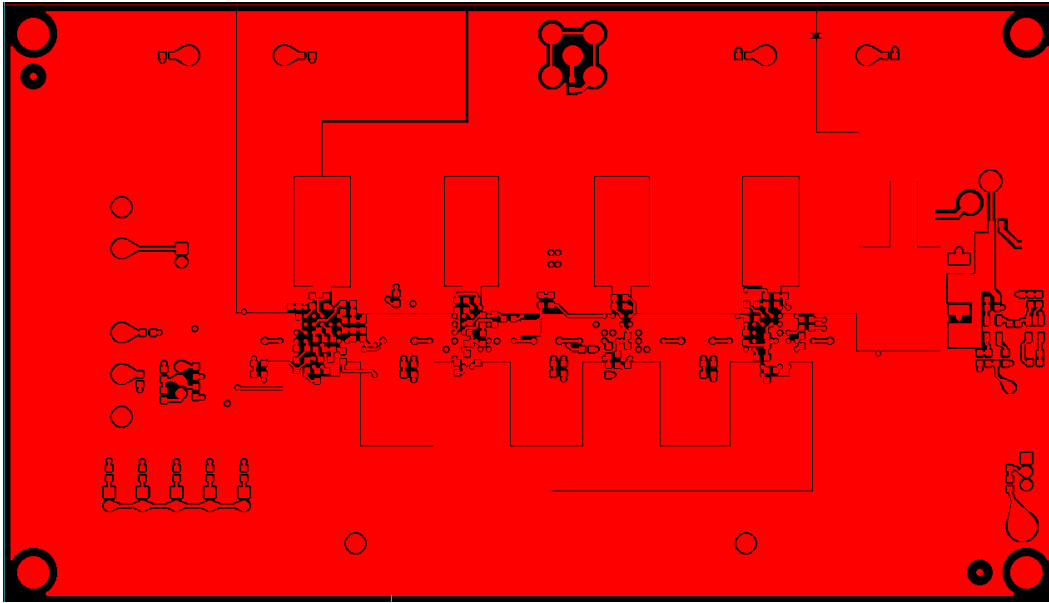


Figure 21: EVK PCB Layer 8

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 | 7 | C6, C11, C19, C23, COUT26, C42, C43 | CERAMIC CAP. 1.0uF, 10V, X7R, 10% | Wurth Elektronik 885012206026 | 0603 |
| 11 | 2 | C7, C39 | 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 | 1 | C40 | CERAMIC CAP. 150pF, 5%,50V, C0G | Wurth Elektronik 885012006058 | 0603 |
| 15 | 6 | C44, C45, C52, C53, C54, C55 | CERAMIC CAP., 100uF, 6.3V, X5R, 10% | MURATA GRM32ER60J107ME20L | 1210 |
| 16 | 4 | R1, R3, R25, R29 | RES, 0603, 10 Ohm, 5%, 1/10W | VISHAY CRCW060310R0JNEA | 0603 |
| 17 | 9 | R2, R9, R14, R21, R31, R39, R43, R47, R51 | RES, 0603, 121k Ohm, 1%, 1/10W | VISHAY CRCW0603121KFKEA | 0603 |
| 18 | 3 | R4, R7, R98 | RES, 0603, 10k Ohm, 5%, 1/10W | VISHAY CRCW060310K0JNEA | 0603 |
| 19 | 1 | R8 | Resistor 3.24K Ohm, 1/10W,1%,SMD | PANASONIC ERJ-3EKF3241V | 0603 |

Table 6: EVK Bill of Materials (Continued)

| Item | Qty | Reference Designator | Description | Manufacturer / Part Number | Package Size |
|------|-----|---|------------------------------------|---|--------------|
| 20 | 1 | R15 | RES, 0603, 90.9k Ohm, 1%, 1/10W | VISHAY CRCW060390K9FKEA | 0603 |
| 21 | 1 | R16 | RES, 0603, 60.4k Ohm, 1%, 1/10W | VISHAY CRCW060360K4FKEA | 0603 |
| 22 | 1 | R17 | RES, 0603, 40.2k Ohm, 1%, 1/10W | VISHAY CRCW060340K2FKEA | 0603 |
| 23 | 1 | R18 | RES, 0603, 30.1k Ohm, 1%, 1/10W | VISHAY CRCW060330K1FKEA | 0603 |
| 24 | 1 | R89 | RES, 0603, 2 Ohm, 1%, 1/10W | VISHAY CRCW06022R00FNEA | 0603 |
| 25 | 2 | R101, R102 | RES, 2512, 0.010 Ohm, 1%, 1W | VISHAY WSL2512R01000FEA | 2512 |
| 26 | 14 | R6, R19, R20, R27, R28, R32, R33, R34, R35, R40, R45, R62, R63, R91 | RES, 0603, 0 Ohm, JUMPER | VISHAY CRCW06030000Z0EA | 0603 |
| 27 | 4 | R22, R23, R24, R26 | RES 0 OHM JUMPER 2010 | VISHAY WSL201000000ZEA9 | 2010 |
| 28 | 1 | R60 | RES, 1206, 0 Ohm, JUMPER | VISHAY CRCW12060000Z0EA | 1206 |
| 29 | 1 | R92 | RES, 0603, 3.3 Ohm, 1%, 1/10W | PANASONIC ERJ-3RQF3R3V | 0603 |
| 30 | 1 | R93 | RES, 0603, 154K Ohm, 1%, 1/10W | PANASONIC ERJ-3EKF1543V | 0603 |
| 31 | 1 | R94 | RES, 0603, 1M Ohm, 1%, 1/10W | PANASONIC ERJ-3EKF1004V | 0603 |
| 32 | 2 | R95, R96 | RES, 0603, 20k Ohm, 1%, 1/10W | PANASONIC ERJ-3EKF2002V | 0603 |
| 33 | 1 | R97 | RES, 0603, 681k Ohm, 1%, 1/10W | PANASONIC ERJ-3EKF6813V | 0603 |
| 34 | 1 | R99 | RES, 0603, 301 Ohm, 1%, 1/10W | PANASONIC ERJ-3EKF3010V | 0603 |
| 35 | 1 | R100 | RES, 0603, 82.5 Ohm, 1%, 1/10W | PANASONIC ERJ-3EKF82R5V | 0603 |
| 36 | 1 | R103 | RES, POT, 5k Ohm | BOURNS 3386P-1-502LF | |
| 37 | 1 | R104 | RES, 0603, 1k Ohm, 1%, 1/10W | PANASONIC ERJ-3EKF1001V1 | 0603 |
| 38 | 1 | U5 | IC OSC SILICON PROG | LT LTC6992IC6-#TRMPBF | TSOT23-6 |
| 39 | 1 | U6 | IC OPAMP 1 CIRCUIT | LT LT1803IS5#TRMPBF | TSOT23-5 |
| 40 | 11 | E1 - E4, E6 - E9, E12, E13, E22 | TERM. TURRET SINGLE | MILL-MAX CORP. 2308-2-00-80-00-00-07-0 | 0.063" |
| 41 | 2 | E33, E34 | TERM. TURRET SINGLE, L=5.56MM THIN | MILL-MAX CORP. 2501-2-00-80-00-00-07-0 | 0.094" |

Table 6: EVK Bill of Materials (Continued)

| Item | Qty | Reference Designator | Description | Manufacturer / Part Number | Package Size |
|------|-----|----------------------------------|-------------------------------|------------------------------------|--------------|
| 42 | 2 | J11, J12 | CONN. BNC RCPT. | Amphenol RF 112404 | BNC |
| 43 | 6 | J1, J2, J3, J4, J13, J14 | BROACHINHG STUD, TYPE KFH | PEMNET KFH-032-10 | 0.189" |
| 44 | 5 | JP4, JP5, JP6, JP7, JP8 | Header, 2Pin, 2mm, Single Row | Würth Elektronik 620-002-111-21 | 2mm |
| 45 | 5 | XJP1, XJP2, XLP4, XJP9, XLP10 | Shunt 2mm | Würth Elektronik 608-002-134-21 | 2mm |
| 46 | 4 | JP1, JP2, JP9, JP10 | Header, 3Pin, 2mm, Single Row | Würth Elektronik 620-003-111-21 | 2mm |



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