

ISL62391xxEVAL1Z, ISL62392xxEVAL1Z

ISL62391, ISL62392 Triple-Output Evaluation Board

AN1397  
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The ISL62391 and ISL62392 evaluation boards demonstrate the performance of ISL62391 and ISL62392 triple-output controllers. The ISL62391 and ISL62392 controllers include two pulse-width modulation (PWM) controllers featured with Intersil's patented R<sup>3</sup> technology, output adjustable from 0.6V to 5.5V, and a linear regulator (LDO3) that generates a fixed 3.3V output and can deliver up to 100mA.

The evaluation board includes two Enable switches, an LED Power-Good indicator and various test points. Each switching channel has an on-board dynamic load generator for evaluating the transient-load response. There are four different evaluation boards which provide flexible evaluation options. Table 1 shows a brief description of the evaluation boards.

TABLE 1. EVALUATION BOARD DESCRIPTION

EVALUATION BOARD	CHANNEL-1	CHANNEL-2	OCP
ISL62391LOEVAL1Z	3.3V/8A	5V/8A	~10A
ISL62391HIEVAL1Z	1.05V/15A	1.5V/15A	~20A
ISL62392LOEVAL1Z	3.3V/8A	5V/8A	~10A
ISL62392HIEVAL1Z	1.05V/15A	1.5V/15A	~20A

**What's Inside**

The Evaluation Board Kit contains the following materials:

- ISL6239xxxEVAL1Z Evaluation Board
- ISL62391, ISL62392 Datasheet
- ISL62391, ISL62392 Evaluation Board User Guide (this document)

**What's Needed**

The following materials will be needed in order to perform testing:

- Adjustable +25V, 30A Power Supply
- +12V, 100mA Power Supply
- Precision Digital Multimeter
- 3 Electronic Loads
- 4-Channel Oscilloscope

**Enable Control**

The evaluation board provides flexible control logic to enable or disable the outputs, and to program the two PWM channels' start-up sequence. For start-up timing sequence, please refer to the ISL62391, ISL62392 datasheet waveforms. Table 2 is the Enable controller truth table.

TABLE 2. ENABLE TRUTH TABLE

EN1	EN2	START-UP SEQUENCE
Low	Low	Both Channel outputs OFF simultaneously
Low	Float	Both Channel outputs OFF simultaneously
Float	Low	Both Channel outputs OFF simultaneously
Float	Float	Both Channel outputs OFF simultaneously
Low	High	Channel-1 OFF, Channel-2 ON
High	Low	Channel-1 ON, Channel-2 OFF
High	High	Both Channel outputs ON simultaneously
Float	High	Channel-1 enabled after Channel-2 is in regulation
High	Float	Channel-2 enabled after Channel-1 is in regulation

**Resistor Current Sense Configuration**

The evaluation board is pre-configured with inductor DCR current sense. For more precise overcurrent protection, it also provides the option of resistor current sense. Figure 1 shows the configuration for resistor current sense.

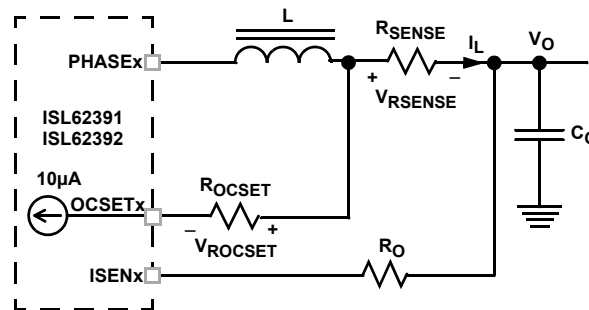


FIGURE 1. RESISTOR CURRENT SENSE CIRCUIT

For Channel-1, the ISL62391 and ISL62392 monitor the OCSET1 pin and the ISEN1 pin voltages. Once the OCSET1 pin voltage is higher than the ISEN1 pin voltage for more than 10µs, the ISL62391 and ISL62392 declare an overcurrent fault. For a chosen overcurrent set point I<sub>OC</sub> and current sense resistor R<sub>SENSE</sub>, the value of R<sub>OCSET</sub> is determined by Equation 1:

$$R_{OCSET} = \frac{I_{OC} \cdot R_{SENSE}}{10\mu A} \quad (EQ. 1)$$

Where:

- R<sub>OCSET</sub> (Ω) is the resistor used to program the overcurrent setpoint
- I<sub>OC</sub> is the output current threshold that will activate the OCP circuit
- R<sub>SENSE</sub> is current sense resistor (R<sub>3</sub> for Channel-1 and R<sub>25</sub> for Channel-2)

Take Channel-1 as an example, once the value of  $R_{OCSET}$  is calculated, follow the following procedure to configure the resistor current sense circuit:

- Step 1:** Open the “DCR SENSE” solder bridge and connect the “RESISTOR SENSE” solder bridge on the PCB bottom layer;
- Step 2:** Remove  $R_7$  ( $R_{22}$  for Channel-2);
- Step 3:** Replace  $R_3$  ( $R_{25}$  for Channel-2) with  $R_{SENSE}$ ;
- Step 4:** Replace  $C_6$  ( $C_{25}$  for Channel-2) with  $R_{OCSET}$ ;
- Step 5:** Replace replace  $R_{19}$  ( $R_{18}$  for Channel-2) with  $R_{OCSET}$ .

## Dynamic Load Generator

The evaluation board provides each PWM channel an on-board dynamic load generator for evaluating the transient-load response, which are controlled by SW1 and SW2 respectively. The dynamic load generator applies a 300 $\mu$ s pulse load across  $V_{OUT}$  and GND. The transient load slew-rate can be trimmed by adjusting the resistors  $R_{28}$ ,  $R_{34}$  for the rising edge, and  $R_{29}$ ,  $R_{35}$  for the falling edge. A +12V power supply is needed to power the dynamic load generator.

## Connections and Test Points

The following table describes the function and operation of the evaluation boards.

NUMBER	NAME	FUNCTION/OPERATION
<b>INTERFACES AND CONNECTIONS</b>		
TP3	VBAT	$V_{IN}$ positive power input
TP4	GND	$V_{IN}$ return power input
TP1	VOUT1	Channel-1 positive power output
TP2	GND	Channel-1 return power output
TP11	VOUT2	Channel-2 positive power output
TP12	GND	Channel-2 return power output
TP14	+12V	+12V positive power input, used for the power supply of the on-board dynamic-load generator
TP15	GND	+12V return power input
<b>TEST POINTS</b>		
J3	PHASE1	Scope-probe socket for measuring Channel-1 phase node
J6	PHASE2	Scope-probe socket for measuring Channel-2 phase node
J2	VOUT1	Scope-probe socket for measuring Channel-1 output
J5	VOUT2	Scope-probe socket for measuring Channel-2 output
J4	FLOAT_FCCM	Remove the jumper will float the FCCM pin
J7	FLOAT_EN1	Remove the jumper will float the EN1 pin
J1	FLOAT_EN2	Remove the jumper will float the EN2 pin
TP13	EN1	Test point of EN1 pin
TP8	EN2	Test point of EN2 pin
TP9	LDO3EN	Test point of LDO3EN pin
TP10	FCCM	Test point of FCCM pin
<b>POWER-GOOD INDICATOR</b>		
TP5	PGOOD	Test point of PGOOD pin
D1		Power-Good indicator. Green when VOUT1 and VOUT2 are both in regulation.
<b>LINEAR REGULATOR</b>		
TP6	LDO3	LDO3 linear regulator positive power output
TP7	GND	LDO3 linear regulator return power output
<b>SWITCHES</b>		
SW1		ON/OFF control of channel-2 dynamic-load generator. Toggle to ON will enable the dynamic load, toggle to OFF will disable the transient load
SW2		ON/OFF control of channel-1 dynamic-load generator. Toggle to ON will enable the dynamic load, toggle OFF will disable the transient load
U2		ON: High level for EN1, EN2, LDO3EN and FCCM, respectively OFF: Low level for EN1, EN2, LDO3EN and FCCM, respectively

### Test Set-up

Figure 2 shows a typical test configuration.

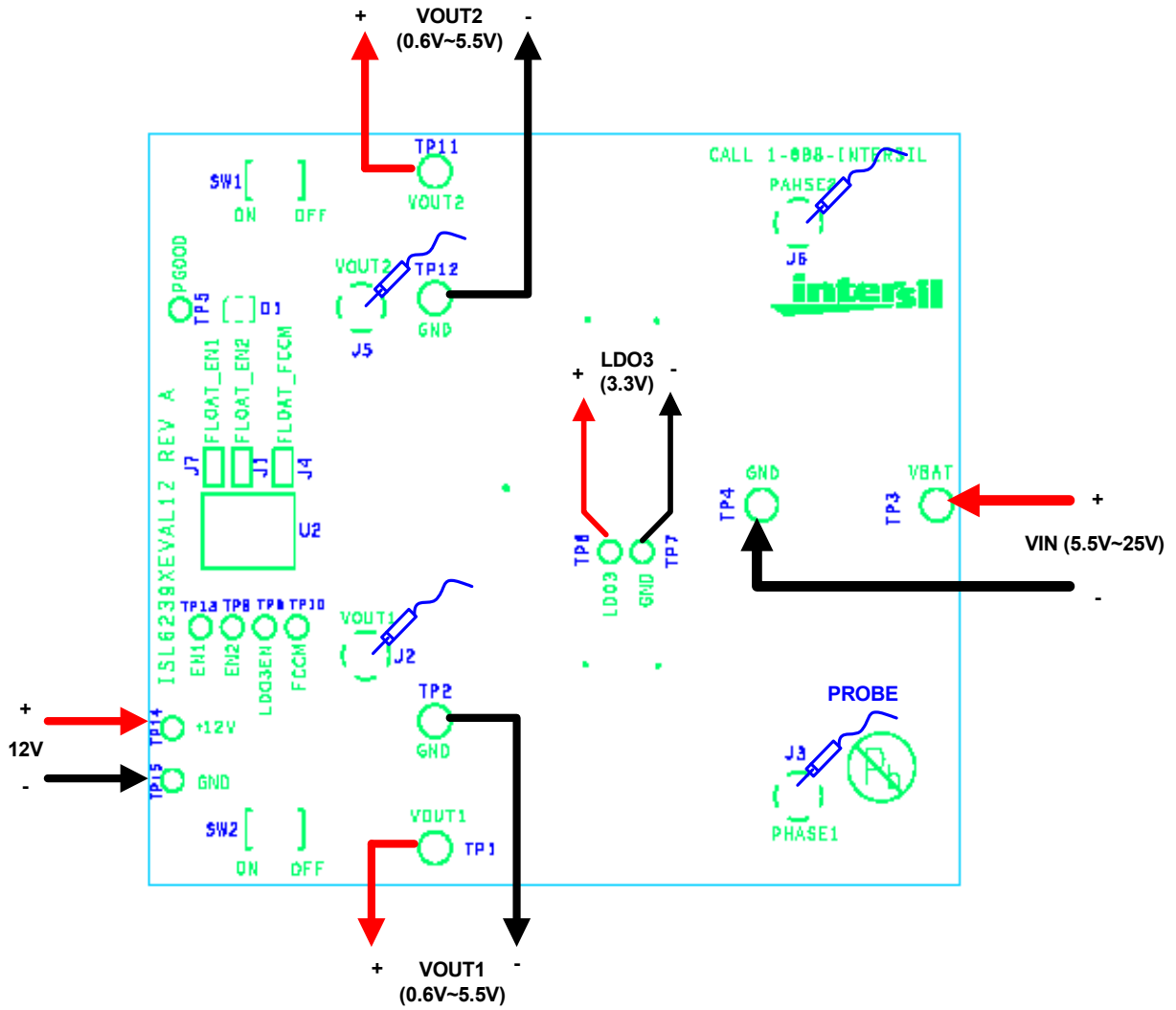


FIGURE 2. TYPICAL TEST CONFIGURATION

**ISL62391LOEVAL1Z, ISL62392LOEVAL1Z Evaluation Board Bill of Materials**

ISL62391LOEVAL1Z and ISL62392LOEVAL1Z evaluation boards use the same PCB and schematic, thus the same bill of materials except for the controller U1.

NO	REFERENCE DESIGNATOR	QTY	VALUE	VOLTAGE/ POWER	TOL. (%)	MANUFACTURER	DESCRIPTION
1	C6, C25	2	0.022 $\mu$ F	25V	10	GENERIC	SM_CAP_0603, 0.022 $\mu$ F, 25V, 10%, X7R, ROHS
2	C8, C9	2	0.01 $\mu$ F	16V	10	GENERIC	SM_CAP_0603, 0.01 $\mu$ F, 16V, 10%, X7R, ROHS
3	C17, C19	2	0.22 $\mu$ F	16V	10	GENERIC	SM_CAP_0603, 0.22 $\mu$ F, 16V, 10%, X7R, ROHS
4	C13, C15, C22, C23	4	10 $\mu$ F	25V	10	GENERIC	SM_CAP_1206, 10 $\mu$ F, 25V, 10%, X7R, ROHS
5	C12, C14	2	1200pF	16V	10	GENERIC	SM_CAP_0603, 1200PF, 16V, 10%, X7R, ROHS
6	C7, C21	2	1 $\mu$ F	10V	10	GENERIC	SM_CAP_0603, 1 $\mu$ F, 10V, 10%, X7R, ROHS
7	C11, C24	2	1 $\mu$ F	25V	10	GENERIC	SM_CAP_1206, 1 $\mu$ F, 25V, 10%, X7R, ROHS
8	C1, C2, C10, C28	4	4.7 $\mu$ F	10V	10	GENERIC	SM_CAP_0805, 4.7 $\mu$ F, 10V, 10%, X7R, ROHS
9	C20	1	4.7 $\mu$ F	10V	10	GENERIC	SM_CAP_1206, 4.7 $\mu$ F, 10V, 10%, X7R, ROHS
10	C16, C18, C29, C30	4	10 $\mu$ F	16V	10	GENERIC	SM_CAP_0805, 10 $\mu$ F, 16V, 10%, X5R, ROHS
11	C3	1	56 $\mu$ F	25V	20	SANYO-OSCON	RADIAL_POLCAP_RADIAL, 25SP56M, 56 $\mu$ F, 25V, 20%, CASE-CC
12	C4, C26	2	330 $\mu$ F	6.3V	10	SANYO-POSCAP	SM_POLCAP_SMD, 6TPF330M9L, 330 $\mu$ F, 6.3V, 10%, CAP_7343
13	R12, R15	2	750	1/10W	1	GENERIC	SM_RES_0603, 750, 1/10W, 1%, TF, ROHS
14	R11	1	10k	1/10W	1	GENERIC	SM_RES_0603, 10k, 1/10W, 1%, TF, ROHS
15	R14	1	9.09k	1/10W	1	GENERIC	SM_RES_0603, 9.09k, 1/10W, 1%, TF, ROHS
16	R13	1	68.1k	1/10W	1	GENERIC	SM_RES_0603, 68.1k, 1/10W, 1%, TF, ROHS
17	R7, R18, R19, R22	4	15.8k	1/10W	1	GENERIC	SM_RES_0603, 15.8k, 1/10W, 1%, TF, ROHS
18	R8	1	19.6k	1/10W	1	GENERIC	SM_RES_0603, 19.6k, 1/10W, 1%, TF, ROHS
19	R9	1	24.3k	1/10W	1	GENERIC	SM_RES_0603, 24.3k, 1/10W, 1%, TF, ROHS
20	R16	1	45.3k	1/10W	1	GENERIC	SM_RES_0603, 45.3k, 1/10W, 1%, TF, ROHS
21	R27, R29, R33	3	1k	1/10W	1	GENERIC	SM_RES_0603, 1k, 1/10W, 1%, TF, ROHS
22	R35	1	1.58k	1/10W	1	GENERIC	SM_RES_0603, 1.58k, 1/10W, 1%, TF, ROHS
23	R26, R32	2	48.7k	1/10W	1	GENERIC	SM_RES_0603, 48.7k, 1/10W, 1%, TF, ROHS
24	R1, R2	2	0	1/10W	1	GENERIC	SM_RES_0603, 0, 1/10W, 1%, TF, ROHS
25	R28, R34	2	200	1/10W	1	GENERIC	SM_RES_0603, 200, 1/10W, 1%, TF, ROHS
26	R5	1	499	1/10W	1	GENERIC	SM_RES_0603, 499, 1/10W, 1%, TF, ROHS
27	R6, R10, R21, R23, R24	5	100k	1/10W	1	GENERIC	SM_RES_0603, 100k, 1/10W, 1%, TF, ROHS
28	R30	1	0.7	1W	1	GENERIC	SM_RES_2512, 0.7, 1W, 1%, TF, ROHS
29	R37	1	0.5	1W	1	GENERIC	SM_RES_2512, 0.5, 1W, 1%, TF, ROHS
30	D1	1	SSL_LXA3025IGC			LUMEX	SSL_LXA3025IGC_SMD-SSL-LXA3025IGC,LED_3X2_5MM
31	D2, D3	2	BAT54S			DIODES	SM_SCHOTTKY_BAT54S-BAT54S, SOT23
32	Q2, Q4	2	IRF7821PBF			IR	30V 13.6A N-Channel HEXFET Power MOSFET (Pb-free)
33	Q3, Q5	2	IRF7832PBF			IR	30V 20A N-Channel HEXFET Power MOSFET (Pb-free)
34	Q1, Q10, Q12	3	2N7002-7-F			FAIRCHILD	2N7002_SOT23-2N7002-7-F, SOT23

**ISL62391LOEVAL1Z, ISL62392LOEVAL1Z Evaluation Board Bill of Materials**

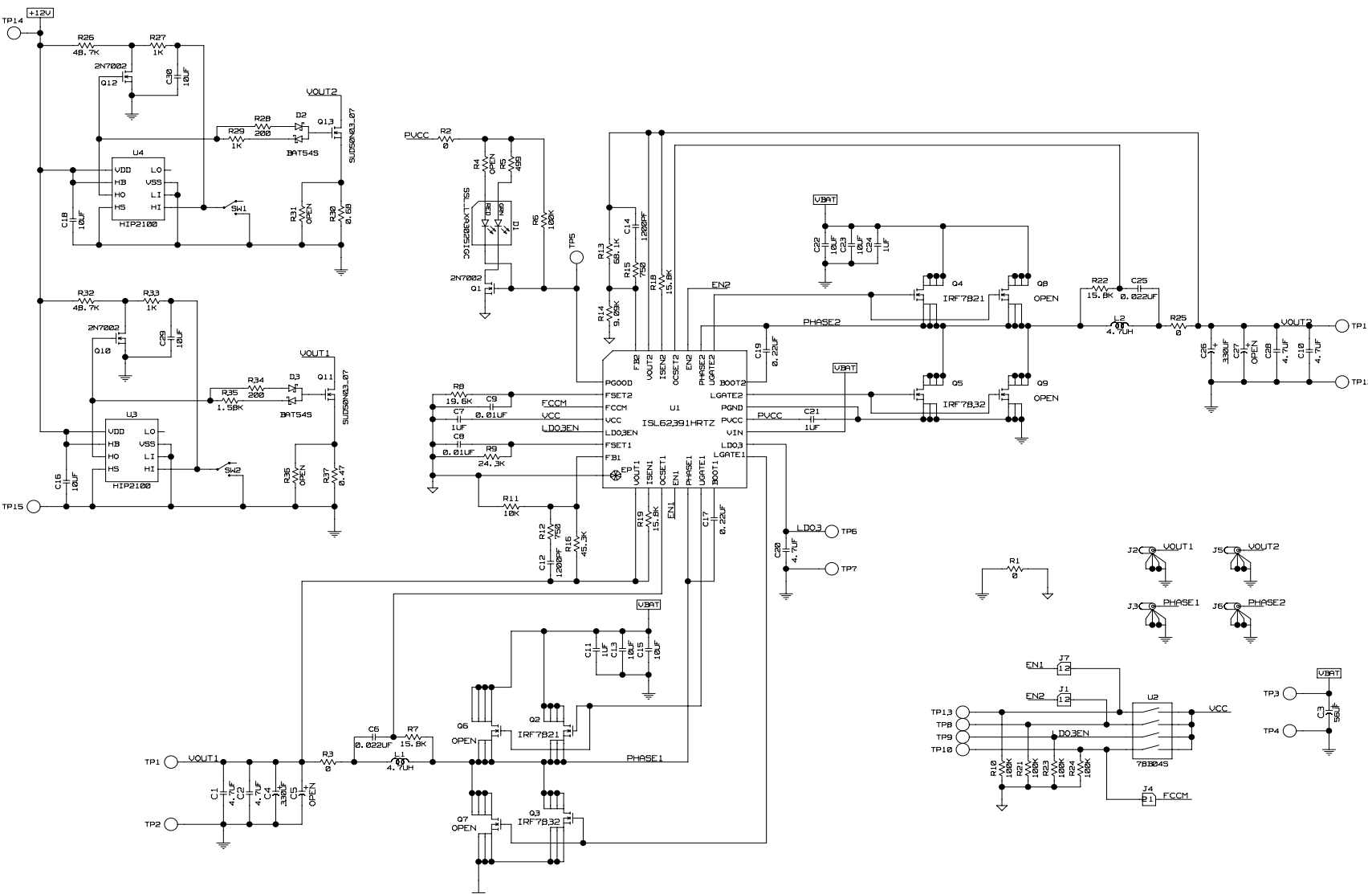
ISL62391LOEVAL1Z and ISL62392LOEVAL1Z evaluation boards use the same PCB and schematic, thus the same bill of materials except for the controller U1. (Continued)

NO	REFERENCE DESIGNATOR	QTY	VALUE	VOLTAGE/ POWER	TOL. (%)	MANUFACTURER	DESCRIPTION
35	Q11, Q13	2	SUD50N03-07			VISHAY	SUD50N03_07_TO252-SUD50N03-07, TO-252AA
36	SW1, SW2	2	GT11MSCBE-T			C&K	GT11MSCKE_SMT-GT11MSCBE-T, GT13MSCKE
37	TP5, TP6, TP7, TP8, TP9, TP10, TP13, TP14, TP15	9	5002			KEYSTONE	TEST_POINT_THOLE-5002, MTP500x
38	TP1, TP2, TP3, TP4, TP11, TP12	6	1514-2			KEYSTONE	TEST_POINT_THOLE-1514-2, TP-150C100P
39	J2, J3, J5, J6	4	131-5031-00			TEKTRONIX	SCOPE_PROBE_5P_CONN-131-5031-00, TEK131-5031-00
40	J1, J4, J7	3	68000-236			FCI	CONN2_DIP2-68000-236, CONN2
41	U2	1	78B04S			GRAYHILL	DIP_SW4_SPST_DIP-78B04S, DIP8-SW4
42	U1	1	ISL62391HRTZ, ISL62392HRTZ			INTERSIL	ISL62391HRTZ, 28 Ld 4x4 TQFN (ISL62392HRTZ, 28 Ld 4x4 TQFN)
43	U3, U4	2	HIP2100IBZ			INTERSIL	HIP2100_SOIC-HIP2100IBZ, SOIC8_150_50
44	L1, L2	2	4.7 $\mu$ H		20	VISHAY	VISHAY_IHLP_5050CE_SMT-20%-IHLP-5050CE-01-4R7M, 4.7 $\mu$ H, 24A, 20%, VISHAY_IHLP-5050CE
45	R3, R25	2	Wire			GENERIC	Wire short
46	DCR SENSE	4	Wire			GENERIC	Wire short
47	Jumper Connector	3	SPC02SYAN			SULLINS	Connector Jumper for J1, J4, J7
48		1	PCB			TBD	ISL6239xEVAL1ZREVA PCB
49		1	Label			TBD	LABEL, FOR SERIAL NUMBER AND BOM REV #
50	C5, C27	2	No-pop				
51	R4, R31, R36	3	No-pop				
52	Q6, Q7, Q8, Q9	4	No-pop				

**ISL62391HIEVAL1Z, ISL62392HIEVAL1Z Evaluation Board Bill of Materials**

The ISL62391HIEVAL1Z, ISL62392HIEVAL1Z evaluation boards use the same PCB and schematic as the ISL62391LOEVAL1Z, ISL62392LOEVAL1Z evaluation board but different bill of materials (BOM). The following table shows the BOM difference of ISL62391HIEVAL1Z, ISL62392HIEVAL1Z in comparison with ISL62391LOEVAL1Z, ISL62392LOEVAL1Z.

NO.	REFERENCE DESIGNATOR	QTY	VALUE	VOLTAGE /POWER	TOL. (%)	MANUFACTURER	DESCRIPTION
1	Q6, Q8	2	IRF7821PBF			IR	30V 13.6A N-Channel HEXFET Power MOSFET (Pb-free)
2	Q7, Q9	2	IRF7832PBF			IR	30V 20A N-Channel HEXFET Power MOSFET (Pb-free)
3	R8	1	14k	1/10W	1	GENERIC	SM_RES_0603, 14k, 1/10W, 1%, TF, ROHS
4	R9	1	17.4k	1/10W	1	GENERIC	SM_RES_0603, 17.4k, 1/10W, 1%, TF, ROHS
5	R11	1	23.2k	1/10W	1	GENERIC	SM_RES_0603, 23.2k, 1/10W, 1%, TF, ROHS
6	R16	1	17.8k	1/10W	1	GENERIC	SM_RES_0603, 17.8k, 1/10W, 1%, TF, ROHS
7	R13	1	15k	1/10W	1	GENERIC	SM_RES_0603, 15k, 1/10W, 1%, TF, ROHS
8	R14	1	10k	1/10W	1	GENERIC	SM_RES_0603, 10k, 1/10W, 1%, TF, ROHS
9	R7, R18, R19, R22	4	16.2k	1/10W	1	GENERIC	SM_RES_0603, 16.2k, 1/10W, 1%, TF, ROHS
10	R30	1	0.2	1W	1	GENERIC	SM_RES_2512, 0.2, 1W, 1%, TF, ROHS
11	R37	1	0.1	1W	1	GENERIC	SM_RES_2512, 0.1, 1W, 1%, TF, ROHS
12	R35	1	4.02k	1/10W	1	GENERIC	SM_RES_0603, 4.02k, 1/10W, 1%, TF, ROHS
13	R12, R15	2	590	1/10W	1	GENERIC	SM_RES_0603, 590, 1/10W, 1%, TF, ROHS
14	C12, C14	2	1800pF	16V	10	GENERIC	SM_CAP_0603, 1800PF, 16V, 10%, X7R, ROHS
15	C5, C27	2	330µF	6.3V	10	SANYO-POSCAP	SM_POLCAP_SMD, 6TPF330M9L, 330µF, 6.3V, 10%, CAP_7343
16	L1, L2	2	2.2µH		20	VISHAY	VISHAY_IHLP_5050CE_SMT-20%-IHLP-5050CE-01-2R2M,2.2µH, 29A, 20%, VISHAY_IHLP-5050CE



# ISL6239xxx EVAL1Z Evaluation Board Schematic

### ISL6239xxxEVAL1Z Evaluation Board Layout

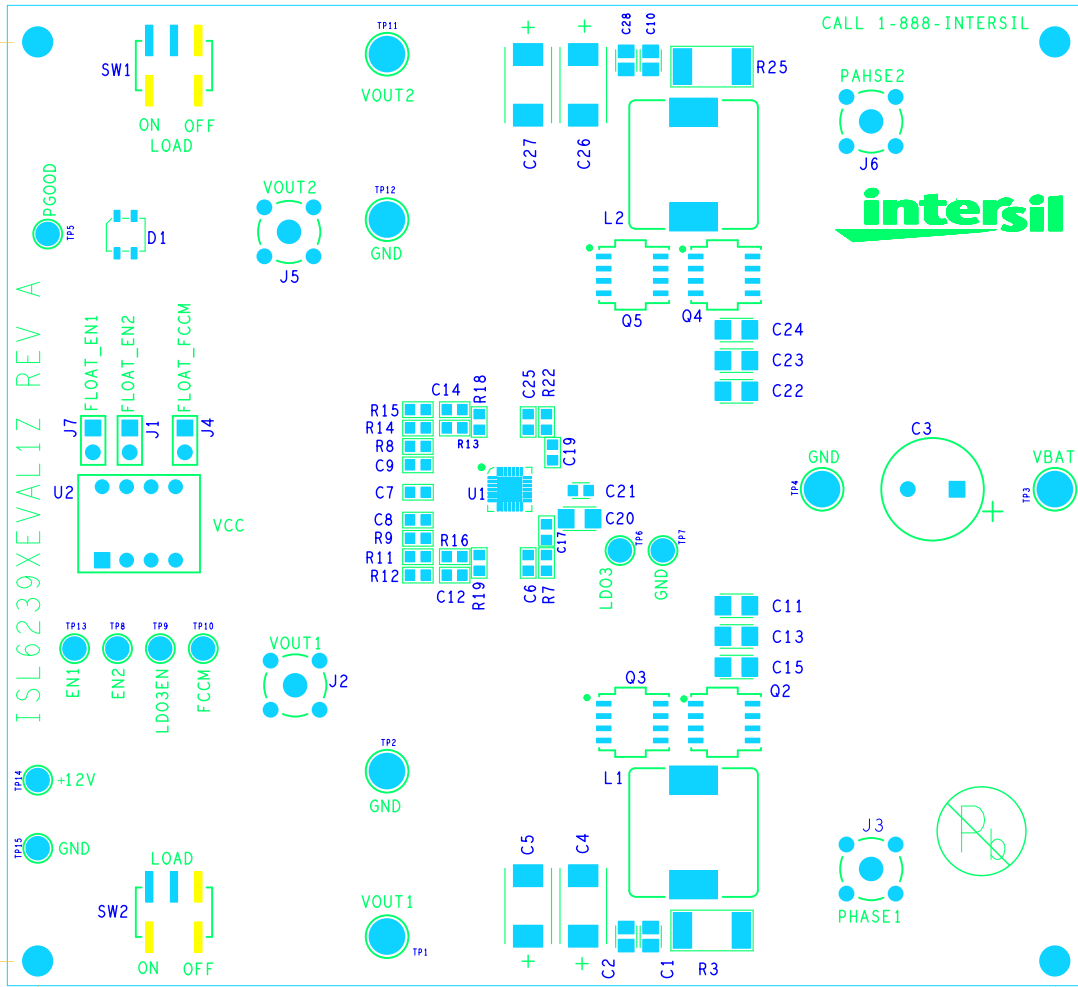
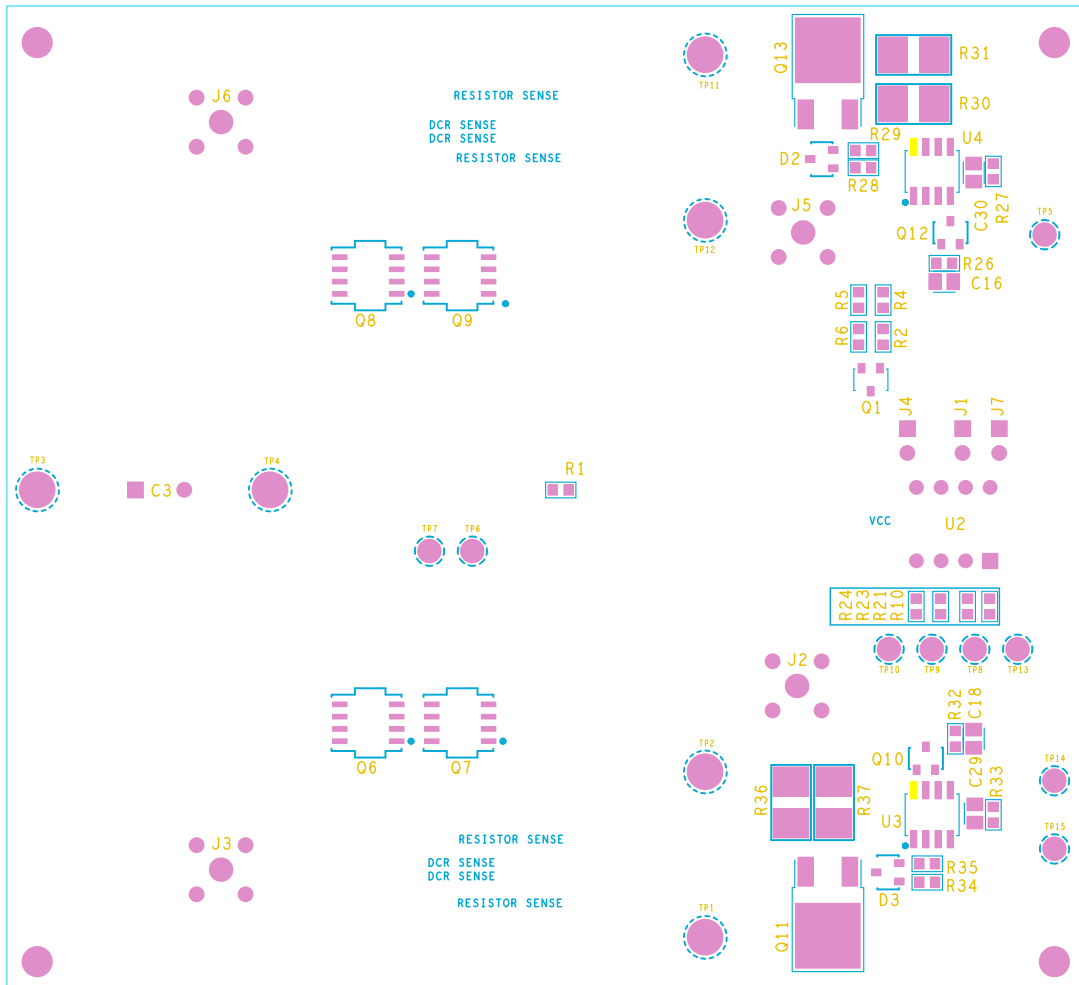


FIGURE 3. TOP SILKSCREEN



**ISL6239xxxEVAL1Z Evaluation Board Layout (Continued)**



**FIGURE 4. BOTTOM SILKSCREEN**

**ISL6239xxxEVAL1Z Evaluation Board Layout** (Continued)

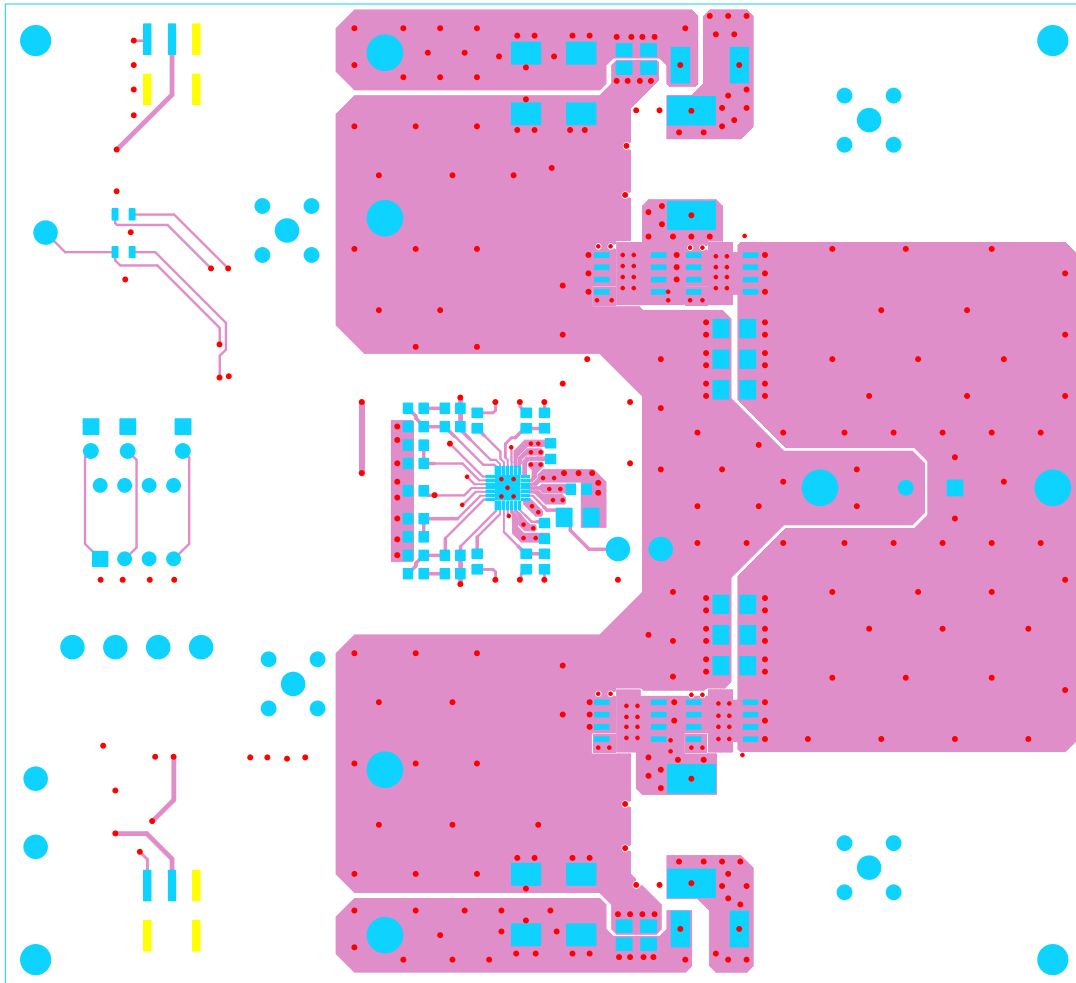


FIGURE 5. LAYER 1

**ISL6239xxxEVAL1Z Evaluation Board Layout** (Continued)

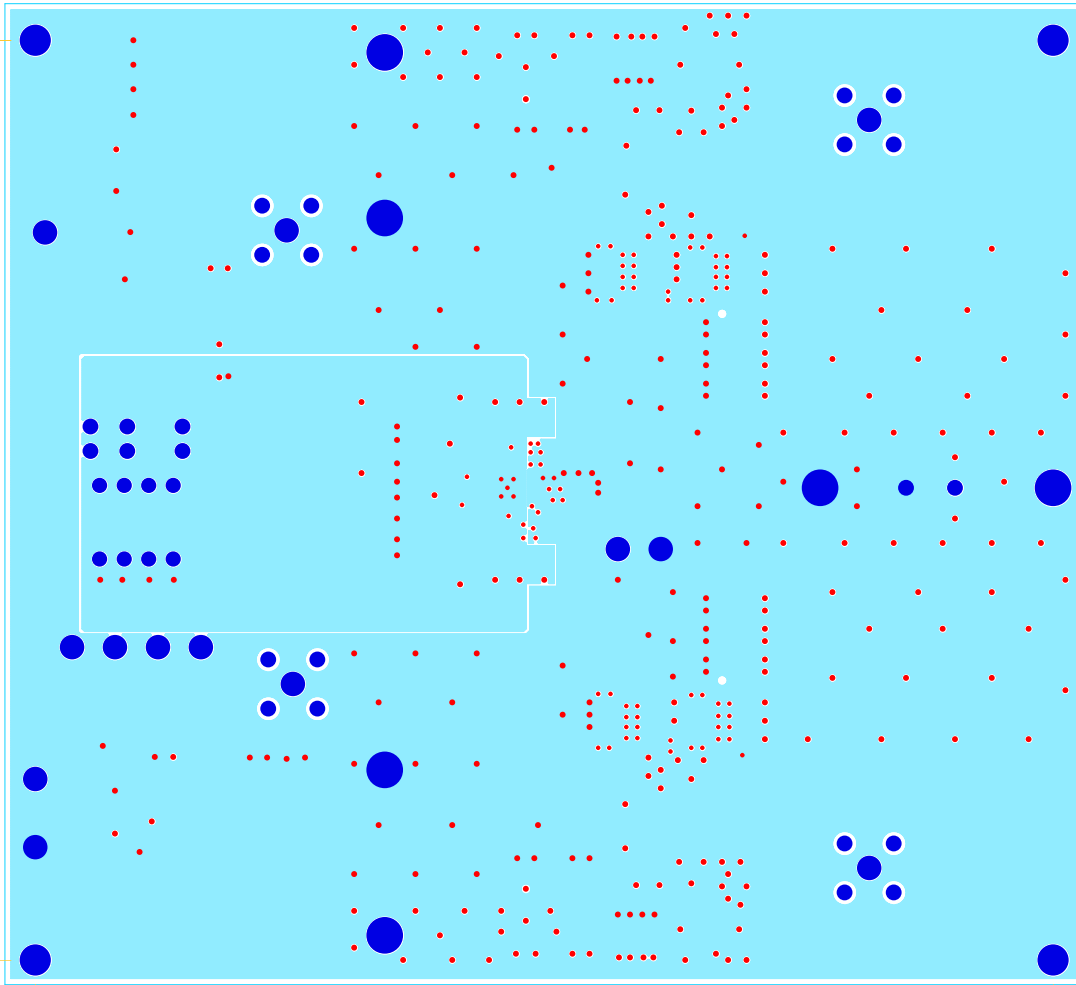


FIGURE 6. LAYER 2

**ISL6239xxxEVAL1Z Evaluation Board Layout** (Continued)

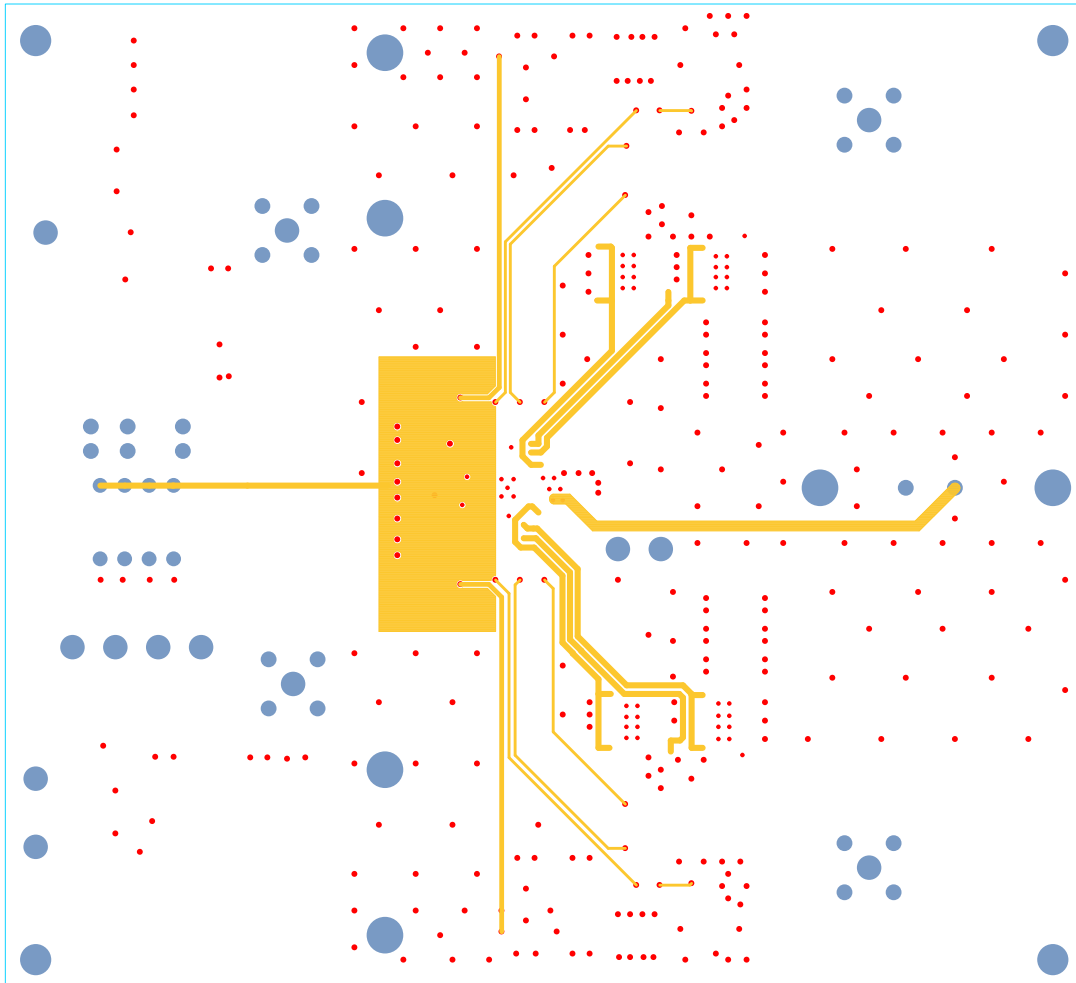


FIGURE 7. LAYER 3

**ISL6239xxxEVAL1Z Evaluation Board Layout** (Continued)

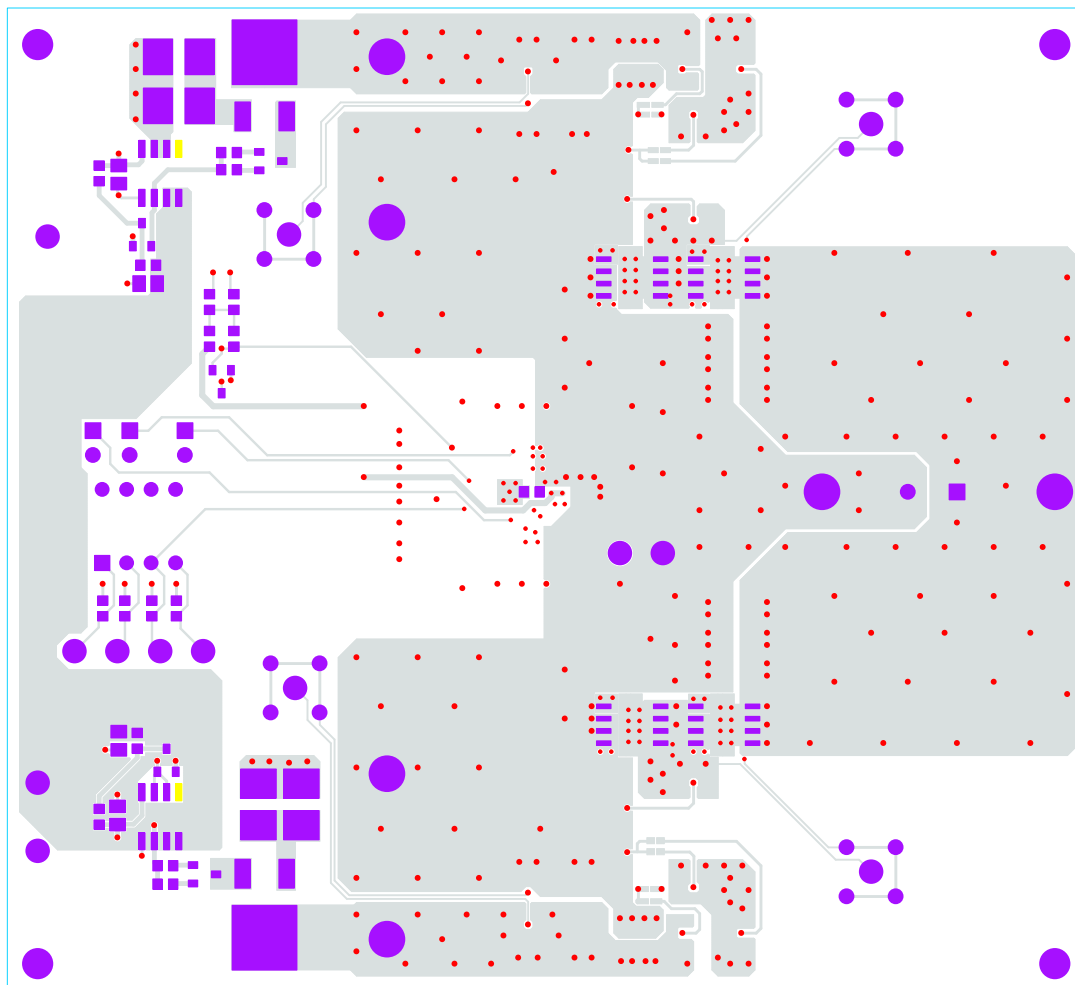


FIGURE 8. LAYER 4

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