

## ISL6228EVAL3Z

Evaluation Board

AN1291  
Rev 0.00  
May 17, 2007**Introduction**

The ISL6228EVAL3Z evaluation board demonstrates the performance of the ISL6228 dual-channel PWM controller. The ISL6228 features Intersil's Robust Ripple Regulator ( $R^3$ ) technology. Channel-1 output voltage is 1.5V or 1.8V, pending the state of switch S5. Channel-2 output voltage is 1.8V. Each channel has an on-board dynamic-load generator included for evaluating the transient-load response. It applies a 300 $\mu$ s pulse of 4.5A load across  $V_{O1}$  and GND, and it applies a 300 $\mu$ s pulse of 5A load across  $V_{O2}$  and GND.

Contents of this document include:

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- Switch Descriptions
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TABLE 1. DC/DC DESIGN CRITERIA

PARAMETER	VALUE	UNITS
$V_{IN}$	3.3 to 25	VDC
$V_O$	0.6 to 5	VDC
Full-load	8	ADC
PWM Frequency	270, 300	kHz

**Recommended Equipment**

- (QTY 2) Adjustable 25V, 3A Power Supply
- (QTY 1) Fixed 5V, 100mA Power Supply
- (QTY 1) Fixed 12V, 100mA Power Supply
- (QTY 1) Adjustable 20A Constant Current Electronic Load
- (QTY 1) Digital Voltmeter
- (QTY 1) Four-Channel Oscilloscope

**Interface Connections**

- $V_{IN1}$ : Input voltage to the power stage of Channel-1
  - J14:  $V_{IN1}$  positive power input
  - TP20:  $V_{IN1}$  positive voltage sense
  - J14:  $V_{IN1}$  return power input
  - TP21:  $V_{IN1}$  return voltage sense
- $V_{IN2}$ : Input voltage to the power stage of Channel-2
  - J1:  $V_{IN2}$  positive power input
  - TP9:  $V_{IN2}$  positive voltage sense
  - J2:  $V_{IN2}$  return power input
  - TP10:  $V_{IN2}$  return voltage sense
- $V_{O1}$ : Regulated output voltage from Channel-1
  - J9:  $V_{O1}$  positive power output
  - TP13:  $V_{O1}$  positive voltage sense
  - J10:  $V_{O1}$  return power output
  - TP14:  $V_{O1}$  return voltage sense
- $V_{O2}$ : Regulated output voltage from Channel-2
  - J7:  $V_{O2}$  positive power output
  - TP11:  $V_{O2}$  positive voltage sense
  - J8:  $V_{O2}$  return power output
  - TP12:  $V_{O2}$  return voltage sense
- VCC: +5V input voltage
  - TP1: 5V positive input
  - TP2: 5V return input
- +12V: Input voltage for the dynamic-load generator
  - TP15: 12V positive input
  - TP16: 12V return input

## Test Set-up

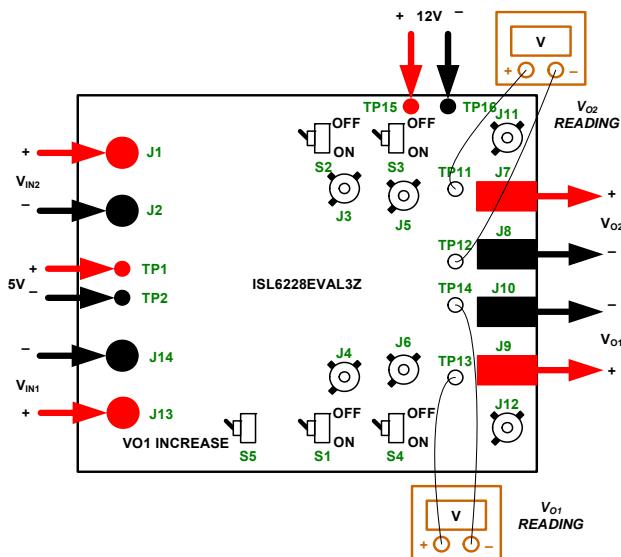


FIGURE 1. TEST SET-UP

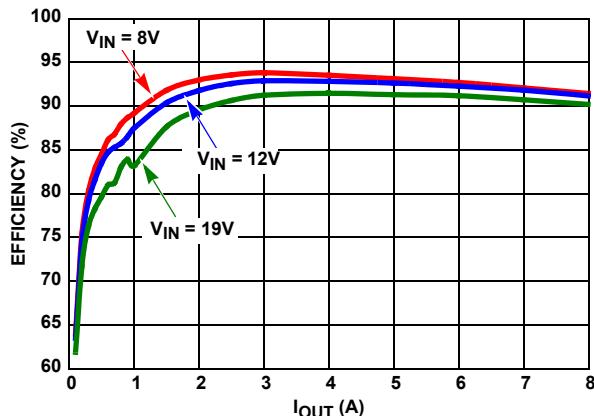
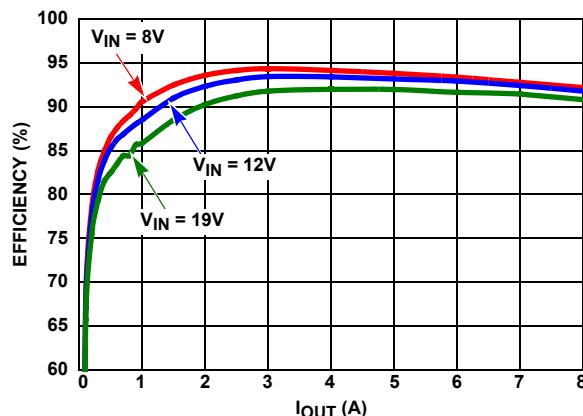
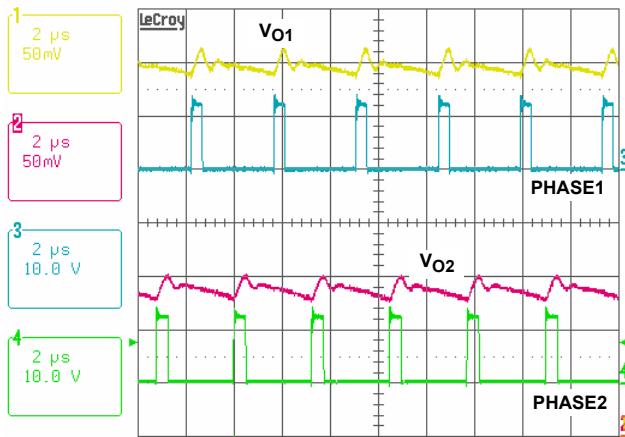
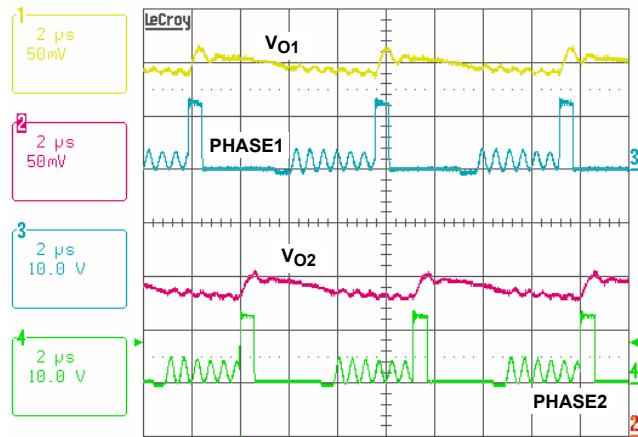
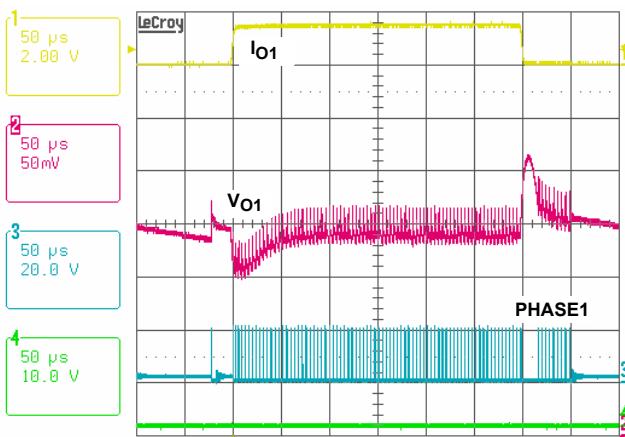
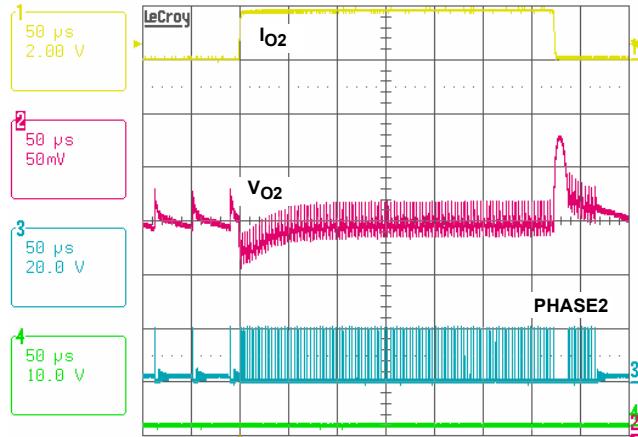
## Switch Descriptions

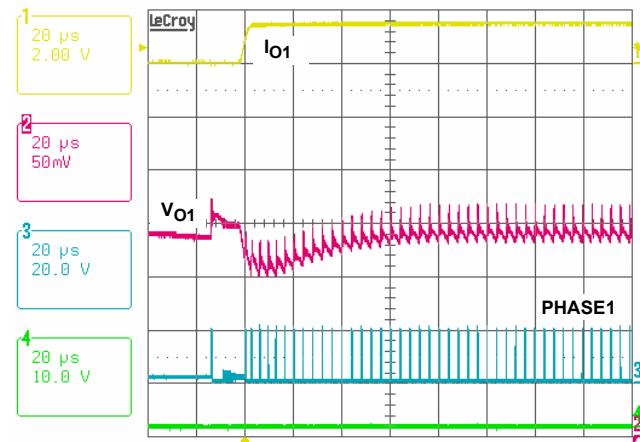
- S1: Channel-1 Enable
  - OFF: Short the Channel-1 EN pin to GND (disable PWM)
  - ON: Allow the Channel-1 EN pin to pull-up to +5V (enable PWM)
- S4: Channel-1 Dynamic Load
  - OFF: On-board Channel-1 dynamic load disabled
  - ON: On-board Channel-1 dynamic load enabled
- S5: Channel-1  $V_O$  Increase
  - OFF:  $V_O1$  is 1.5V, determined by  $R_{15}$  and  $R_{23}$ .
  - ON: Parallel  $R_{49}$  with  $R_{15}$ .  $V_O1$  is 1.8V.
- S2: Channel-2 Enable
  - OFF: Short the Channel-2 EN pin to GND (disable PWM)
  - ON: Allow the Channel-2 EN pin to pull-up to +5V (enable PWM)
- S3: Channel-2 Dynamic Load
  - OFF: On-board Channel-2 dynamic load disabled
  - ON: On-board Channel-2 dynamic load enabled

## Test-point Descriptions

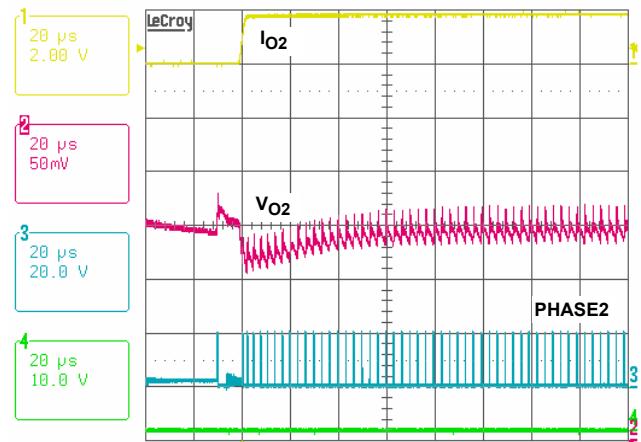
- J4: Scope-probe socket for measuring PHASE1
- J6: Scope-probe socket for measuring  $V_{O1}$
- J12: Scope-probe socket for measuring the current of the Channel-1 on-board transient-load emulator
- J3: Scope-probe socket for measuring the PHASE2 node
- J5: Scope-probe socket for measuring  $V_{O2}$
- J11: Scope-probe socket for measuring the current of the Channel-2 on-board transient-load emulator
- TP1: Monitor the 5V positive input
- TP2: Monitor the 5V return input
- TP3: Monitor the PGOOD2 pin
- TP4: Monitor the PGOOD1 pin
- TP5: The common node of  $R_{24}$  and  $R_{20}$ ; Useful for Channel-1 loop gain measurement.
- TP6: The common node of  $R_{25}$  and  $R_{23}$ ; Useful for Channel-2 loop gain measurement.
- TP7: The  $V_{O1}$  side of  $R_{24}$ ; Useful for Channel-1 loop gain measurement.
- TP8: The  $V_{O2}$  side of  $R_{25}$ ; Useful for Channel-1 loop gain measurement.
- TP9: Monitor the  $V_{IN1}$  positive input
- TP10: Monitor the  $V_{IN1}$  return input
- TP11: Monitor the positive  $V_{O1}$  output
- TP12: Monitor the  $V_{O1}$  return output
- TP13: Monitor the positive  $V_{O2}$  output
- TP14: Monitor the  $V_{O2}$  return output
- TP15: Monitor the 12V positive input
- TP16: Monitor the 12V return input
- TP17: Monitor the EN1 pin
- TP18: Monitor the gate of transistor Q<sub>18</sub>
- TP19: Monitor the EN2 pin
- TP20: Monitor the  $V_{IN2}$  positive input
- TP21: Monitor the  $V_{IN2}$  return input

## Typical Performance

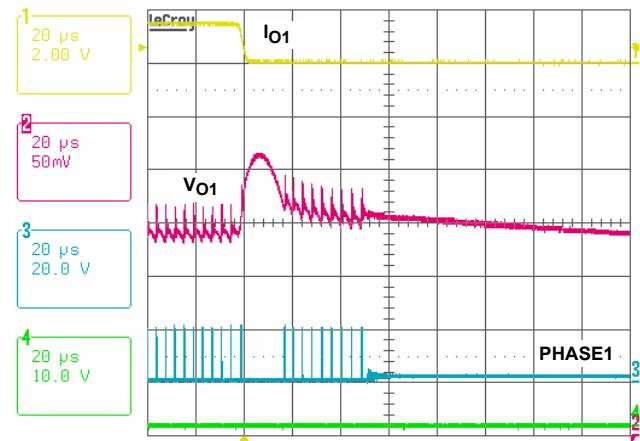
FIGURE 2. CHANNEL-1 EFFICIENCY AT V<sub>O</sub> = 1.5VFIGURE 3. CHANNEL-2 EFFICIENCY AT V<sub>O</sub> = 1.8VFIGURE 4. CCM STEADY-STATE OPERATION, V<sub>IN</sub> = 12V, V<sub>O1</sub> = 1.5V, I<sub>O1</sub> = 3A, V<sub>O2</sub> = 1.8A, I<sub>O2</sub> = 4AFIGURE 5. DCM STEADY-STATE OPERATION, V<sub>IN</sub> = 12V, V<sub>O1</sub> = 1.5V, I<sub>O1</sub> = 0.5A, V<sub>O2</sub> = 1.8V, I<sub>O2</sub> = 0.5AFIGURE 6. TRANSIENT RESPONSE, V<sub>IN</sub> = 19V, V<sub>O</sub> = 1.5V, I<sub>O</sub> = 0.1A/4.6A @ 2.55A/μsFIGURE 7. TRANSIENT RESPONSE, V<sub>IN</sub> = 19V, V<sub>O</sub> = 1.8V, I<sub>O</sub> = 0.1A/5.1A @ 2.55A/μs

**Typical Performance (Continued)**

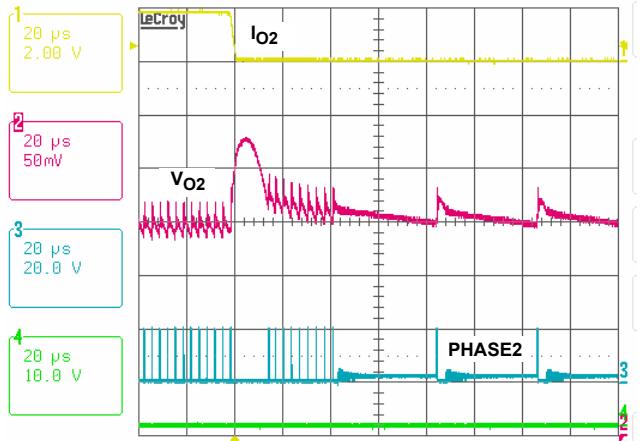
**FIGURE 8. LOAD INSERTION RESPONSE,  $V_{IN} = 19V$ ,  
 $V_O = 1.5V$ ,  $I_O = 0.1A/4.6A @ 2.55A/\mu s$**



**FIGURE 9. LOAD INSERTION RESPONSE,  $V_{IN} = 19V$ ,  
 $V_O = 1.8V$ ,  $I_O = 0.1A/5.1A @ 2.55A/\mu s$**



**FIGURE 10. LOAD RELEASE RESPONSE,  $V_{IN} = 19V$ ,  
 $V_O = 1.5V$ ,  $I_O = 0.1A/4.6A @ 2.55A/\mu s$**



**FIGURE 11. LOAD RELEASE RESPONSE,  $V_{IN} = 19V$ ,  
 $V_O = 1.8V$ ,  $I_O = 0.1A/5.1A @ 2.55A/\mu s$**

**Bill of Materials**

QTY	REFERENCE	DESCRIPTION	MANUFACTURER	PART NUMBER
0	DNP (C8, C9)	CAP, RADIAL, 56µF, 25V, ROHS	SANYO	25SP56M
2	C1, C3	CAP, SMD, 0603, 1000pF, 16V, 10%, X7R, ROHS	VENKEL	H1045-00102-16V10-T
5	C20, C21, C37, C40, C41	CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS	MURATA	H1045-00104-16V10-T
6	C2, C7, C30, C31, C36, C39	CAP, SMD, 0603, 1µF, 16V, 20%, Y5V, ROHS	MURATA	H1045-00105-16V20-T
2	C18, C19	CAP, SMD, 0603, 10µF, 6.3V, 20%, X5R, ROHS	TDK	H1045-00106-6R3V20-T
2	C5, C6	CAP, SMD, 0603, 2200pF, 50V, 10%, X7R, ROHS	MURATA	H1045-00222-50V10-T
2	C14, C15	CAP, SMD, 0603, 0.22µF, 16V, 10%, X7R, ROHS	TDK	H1045-00224-16V10-T
2	C4, C38	CAP, SMD, 0603, 0.22µF, 25V, 20%, X7R, ROHS	VENKEL	H1045-00224-25V20-T
2	C34, C35	CAP, SMD, 0805, 4.7µF, 16V, 10%, X5R, ROHS	PANASONIC	H1046-00475-16V10-T
0	DNP (C32, C33)	CAP, SMD, 0805, 4.7µF, 16V, 10%, X5R, ROHS	PANASONIC	H1046-00475-16V10-T
2	C16, C17	CAP, SMD, 1206, 1µF, 25V, 20%, X5R, ROHS	PANASONIC	H1065-00105-25V20-T
4	C10 to C13	CAP, SMD, 1206, 10µF, 25V, 20%, X5R, ROHS	PANASONIC	H1065-00106-25V20-T
2	C24, C27	CAP-LOW ESR, SMD, D3L, 330µF, 6.3V, 20%, POSCAP, ROHS	SANYO	6TPF330M9L
0	DNP (C22, C23, C25, C26, C28, C29)	CAP-LOW ESR, SMD, D3L, 330µF, 6.3V, 20%, POSCAP, ROHS	SANYO	6TPF330M9L
2	J1, J13	CONN-GEN, BIND.POST, INSUL-RED, THMBNUT-GND	JOHNSON COMPONENTS	111-0702-001
2	J2, J14	CONN-GEN, BIND.POST, INSUL-BLK, THMBNUT-GND	JOHNSON COMPONENTS	111-0703-001
0	J3 to J6, J11, J12	CONN-SCOPE PROBE TEST POINT, PCB MNT	TEKTRONIX	131-4353-00
4	TP1, TP2, TP15, TP16	CONN-TURRET, TERMINAL POST, TH, ROHS	KEYSTONE	1514-2
15	TP3 to TP14, TP17 to TP19	CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS	KEYSTONE	5002
0	DNP (D3, D4)	DIODE-SCHOTTKY, SMD, SMB, 2P, 40V, 3A LOW VF, Pb-FREE	DIODES INC.	B340LB-13-F-T
2	D5, D6	DIODE-SCHOTTKY, SMD, SOT23, 3P, 30V, 200mA, DUAL DIODE	FAIRCHILD	BAT54S-T
2	D1, D2	LED, SMD, 4P, OTHER, POLARIZEDRED/GRN	LUMEX	SSL-LXA3025IGC
2	L1, L2	PWR CHOKE COIL, SMD, 13x12.9, 3.3µH, 20%, 18A, ROHS	Vishay	IHL5050FDER3R3M01
2	U2, U3	IC-HI FREQ BRIDGE DRIVER, 8P, SOIC, 100V, ROHS	INTERSIL	HIP2100IBZ
1	U1	IC-DUAL CHANNEL CONTROLLER, 28P, QFN, ROHS	INTERSIL	ISL6228HRZ
5	Q11 to Q14, Q18	TRANSISTOR, N-CHANNEL, 3LD, SOT-23, 60V, 115mA, ROHS	DIODES INC.	2N7002-7-F-T
0	DNP (Q5, Q10)	TRANSISTOR-DUAL N-CHANNEL, 8P, SOIC, 30V, 7.5A, ROHS	FAIRCHILD	FDS6990AS
0	DNP (Q2, Q7)	TRANSISTOR-MOS, N-CHANNEL, 8P, SOIC, 30V, 9.1mΩ RDS, ROHS	INTERNATIONAL RECTIFIER	IRF7821PBF
2	Q1, Q6	TRANSISTOR-MOS, N-CHANNEL, 8P, SOIC, 30V, 9.1mΩ RDS, ROHS	INTERNATIONAL RECTIFIER	IRF7821PBF
0	DNP (Q4, Q9)	TRANSISTOR-MOS, N-CHANNEL, 8P, SOIC, 30V, 4.0mΩ RDS, ROHS	INTERNATIONAL RECTIFIER	IRF7832PBF
2	Q3, Q8	TRANSISTOR-MOS, N-CHANNEL, 8P, SOIC, 30V, 4.0mΩ RDS, ROHS	INTERNATIONAL RECTIFIER	IRF7832PBF
2	Q15, Q16	TRANSISTOR-MOS, N-CHANNEL, SMD, TO-252, 30V, 20A, ROHS	VISHAY	SUD50N03-07-E3
4	R9, R52, R53, R54	RES, SMD, 0603, 2Ω, 1/10W, 1%, TF, ROHS	YAGEO	H2511-00020-1/10W1-T
0	DNP (R12, R13, R57, R58)	RESISTOR, SMD, 0603, 0Ω, 1/10W, TF, ROHS	KOA	H2511-00R00-1/10W-T

***Bill of Materials (Continued)***

QTY	REFERENCE	DESCRIPTION	MANUFACTURER	PART NUMBER
10	R10, R11, R24, R25, R48, R50, R55, R56, R59, R60	RESISTOR, SMD, 0603, 0Ω, 1/10W, TF, ROHS	KOA	H2511-00R00-1/10W-T
5	R7, R8, R21, R22, R51	RES, SMD, 0603, 10k, 1/10W, 1%, TF, ROHS	KOA	H2511-01002-1/10W1-T
2	R35, R37	RES, SMD, 0603, 1.07k, 1/10W, 1%, TF, ROHS	PANASONIC	H2511-01071-1/10W1-T
1	R49	RES, SMD, 0603, 162k, 1/10W, 1%, TF, ROHS	YAGEO	H2511-01623-1/10W1-T
2	R26, R27	RES, SMD, 0603, 2k, 1/10W, 1%, TF, ROHS	KOA	H2511-02001-1/10W1-T
1	R3	RES, SMD, 0603, 20k, 1/10W, 1%, TF, ROHS	KOA	H2511-02002-1/10W1-T
1	R4	RES, SMD, 0603, 22.1k, 1/10W, 1%, TF, ROHS	PANASONIC	H2511-02212-1/10W1-T
2	R34, R36	RES, SMD, 0603, 2.49k, 1/10W, 1%, TF, ROHS	KOA	H2511-02491-1/10W1-T
1	R14	RES, SMD, 0603, 22.6k, 1/16W, 1%, TF, ROHS	VENKEL	H2511-02262-1/10W1-T
4	R1, R2, R5, R6	RES, SMD, 0603, 499Ω, 1/10W, 1%, TF, ROHS	KOA	H2511-04990-1/10W1-T
2	R30, R31	RES, SMD, 0603, 49.9k, 1/10W, 1%, TF, ROHS	VENKEL	H2511-04992-1/10W1-T
1	R15	RES, SMD, 0603, 53.6k, 1/10W, 1%, TF, ROHS	YAGEO	H2511-05362-1/10W1-T
4	R16, R17, R28, R29	RES, SMD, 0603, 5.76k, 1/10W, 1%, TF, ROHS	ROHM	H2511-05761-1/10W1-T
2	R18, R19	RES, SMD, 0603, 590Ω, 1/10W, 1%, TF, ROHS	VENKEL	H2511-05900-1/10W1-T
2	R20, R23	RES, SMD, 0603, 80.6k, 1/10W, 1%, TF, ROHS	VENKEL	H2511-08062-1/10W1-T
0	DNP (R32, R33)	RES, SMD, 1206, 1.5Ω, 1/4W, 1%, TF, ROHS	VENKEL	H2513-001R5-1/4W1-T
4	R41, R43, R45, R47	RES, SMD, 1206, 1.5Ω, 1/4W, 1%, TF, ROHS	VENKEL	H2513-001R5-1/4W1-T
5	R38, R40, R42, R44, R46	RES, SMD, 1206, 1.8Ω, 1/4W, 1%, TF, ROHS	VENKEL	H2513-001R8-1/4W1-T
5	S1 to S5	SWITCH-TOGGLE, SMD, ULTRAMINI, 1P, SPST MINI	C&K COMPONENTS	GT11MSCBE-T
4	J7 to J10	MTG HDWR, CBL.TERMINAL-LUG and SCREW, 6 to 14AWG	BERG/FCI	KPA8CTP

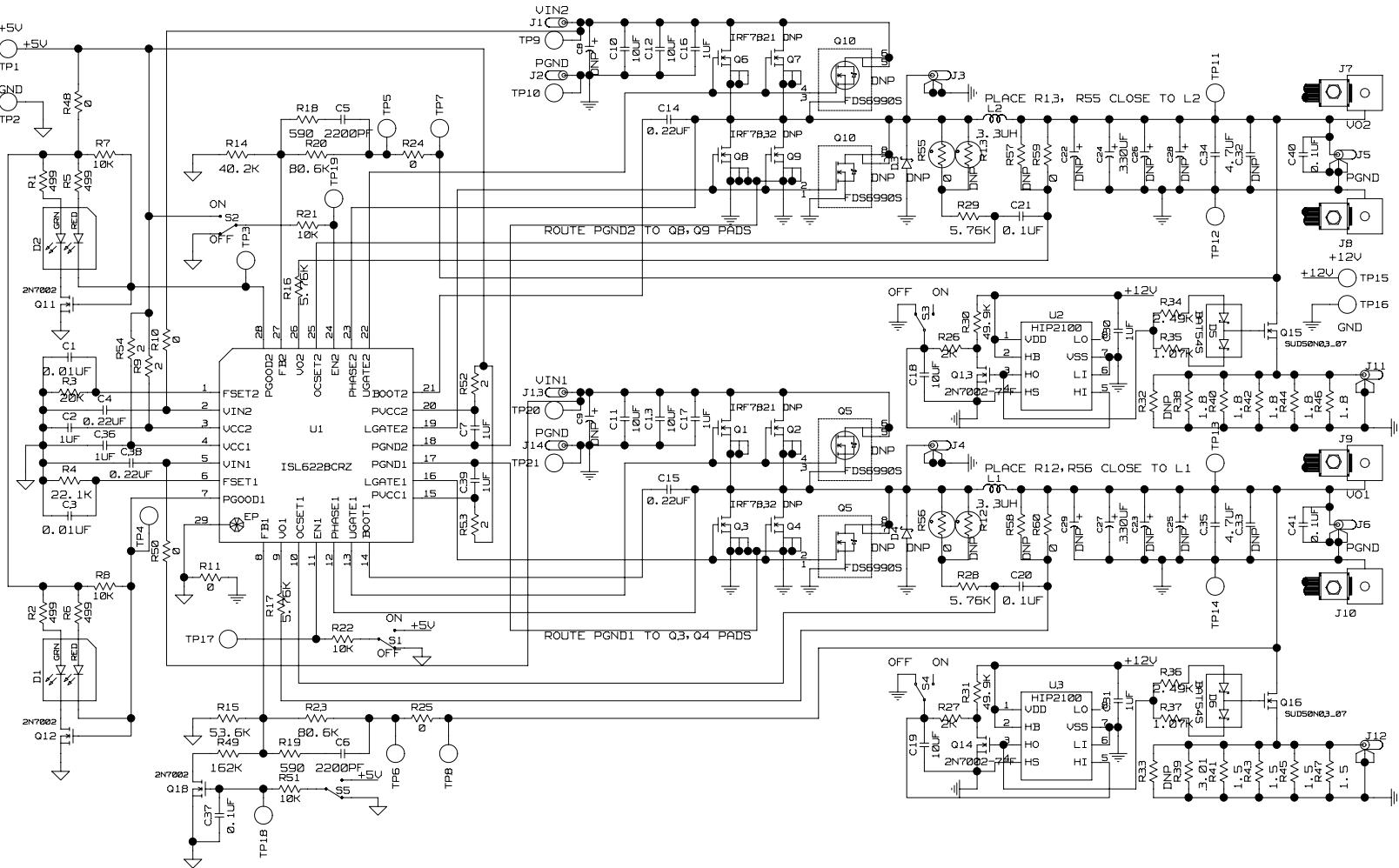
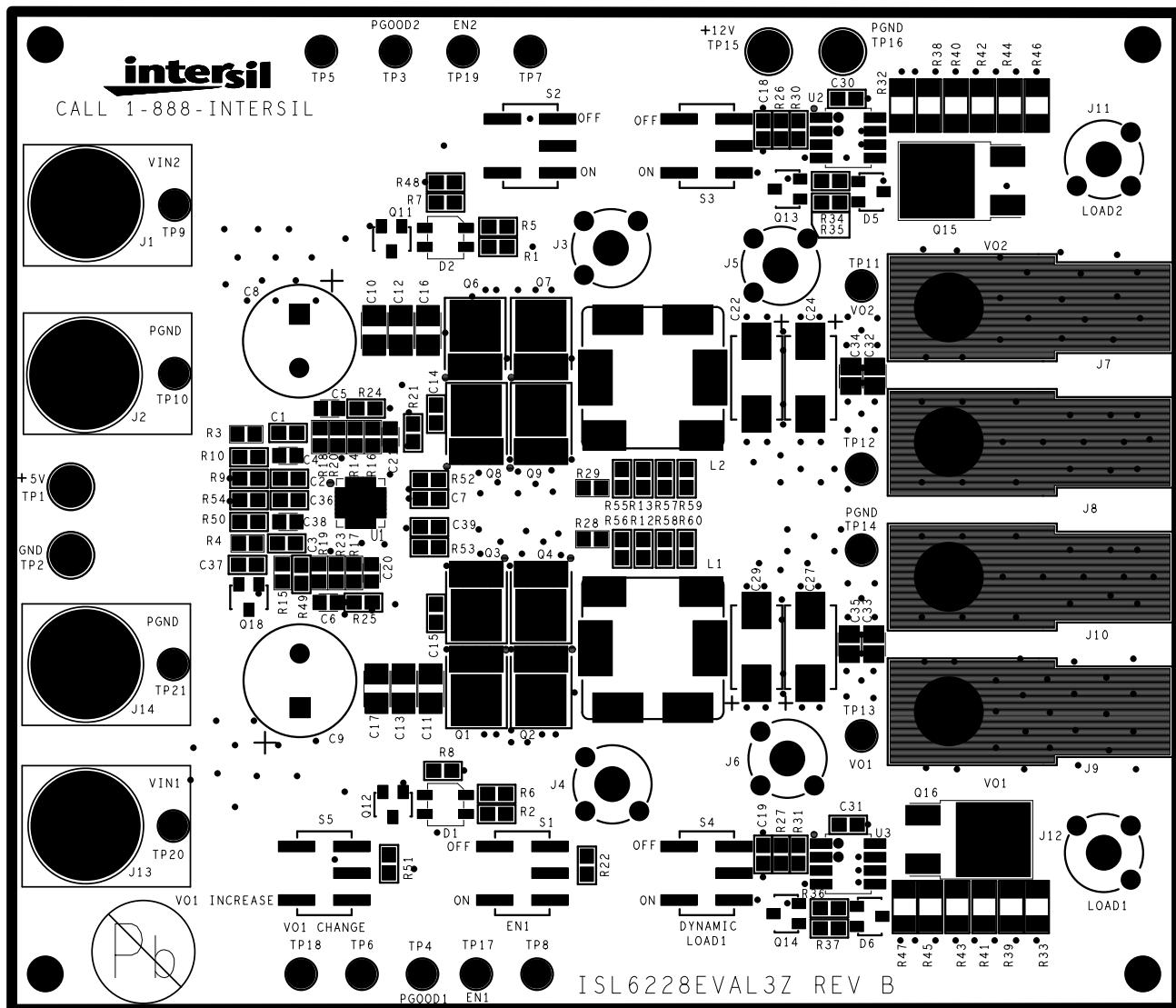
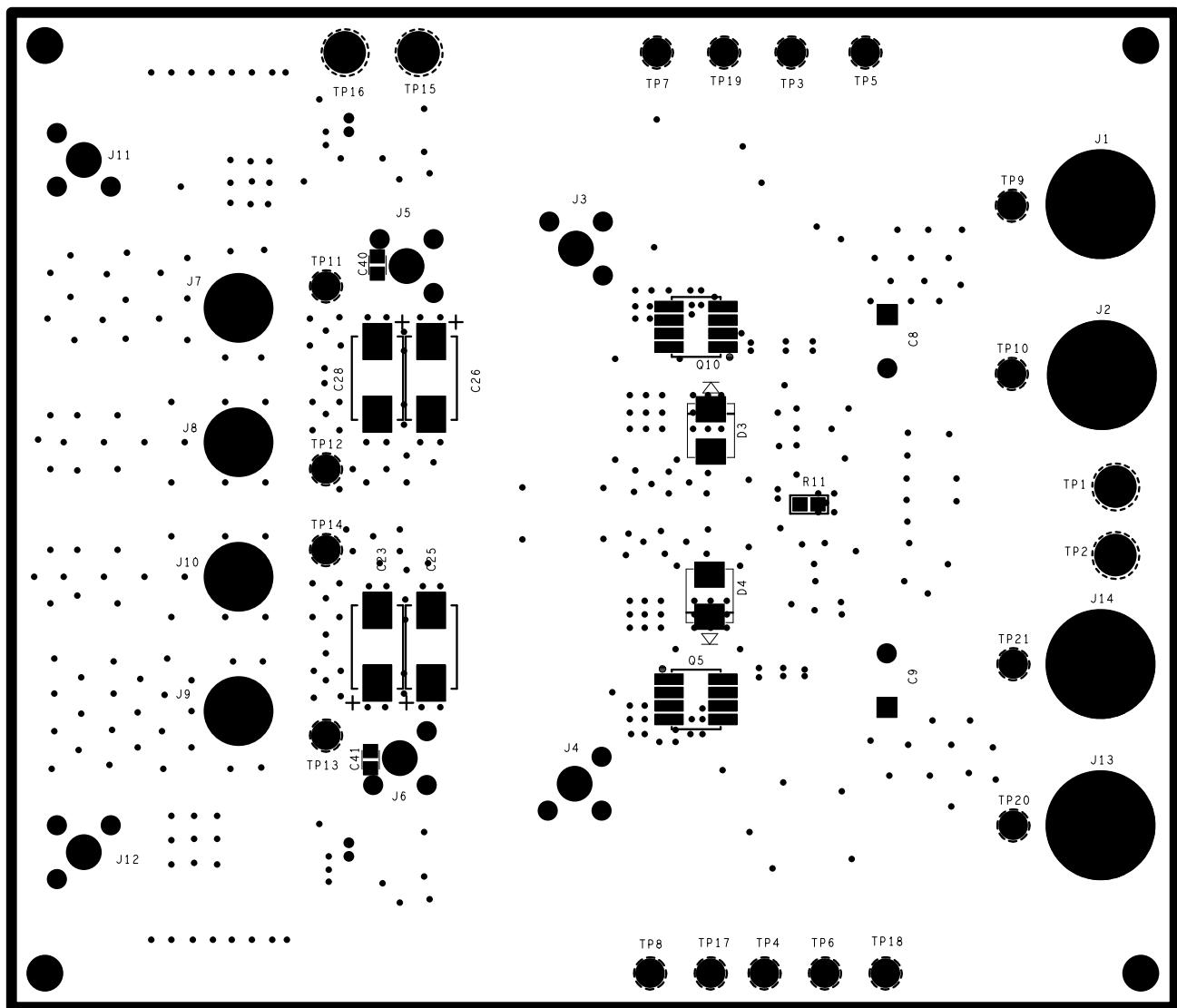
**ISL6228EVAL3Z Evaluation Board Schematic**

FIGURE 12. ISL6228EVAL3Z SCHEMATIC

***ISL6228EVAL3Z Evaluation Board Layout*****FIGURE 13. TOP SILKSCREEN**

***ISL6228EVAL3Z Evaluation Board Layout (Continued)*****FIGURE 14. BOTTOM SILKSCREEN**

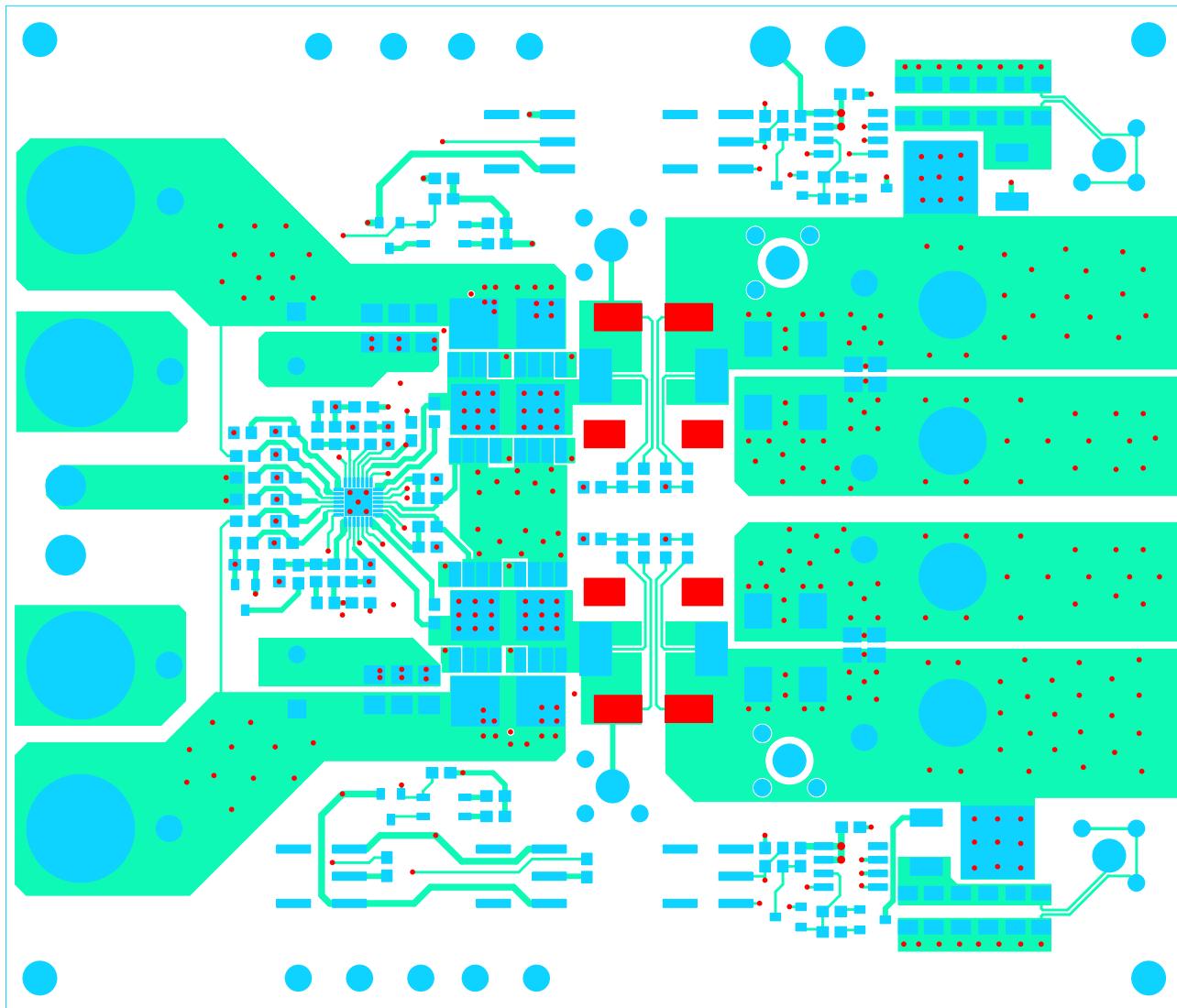
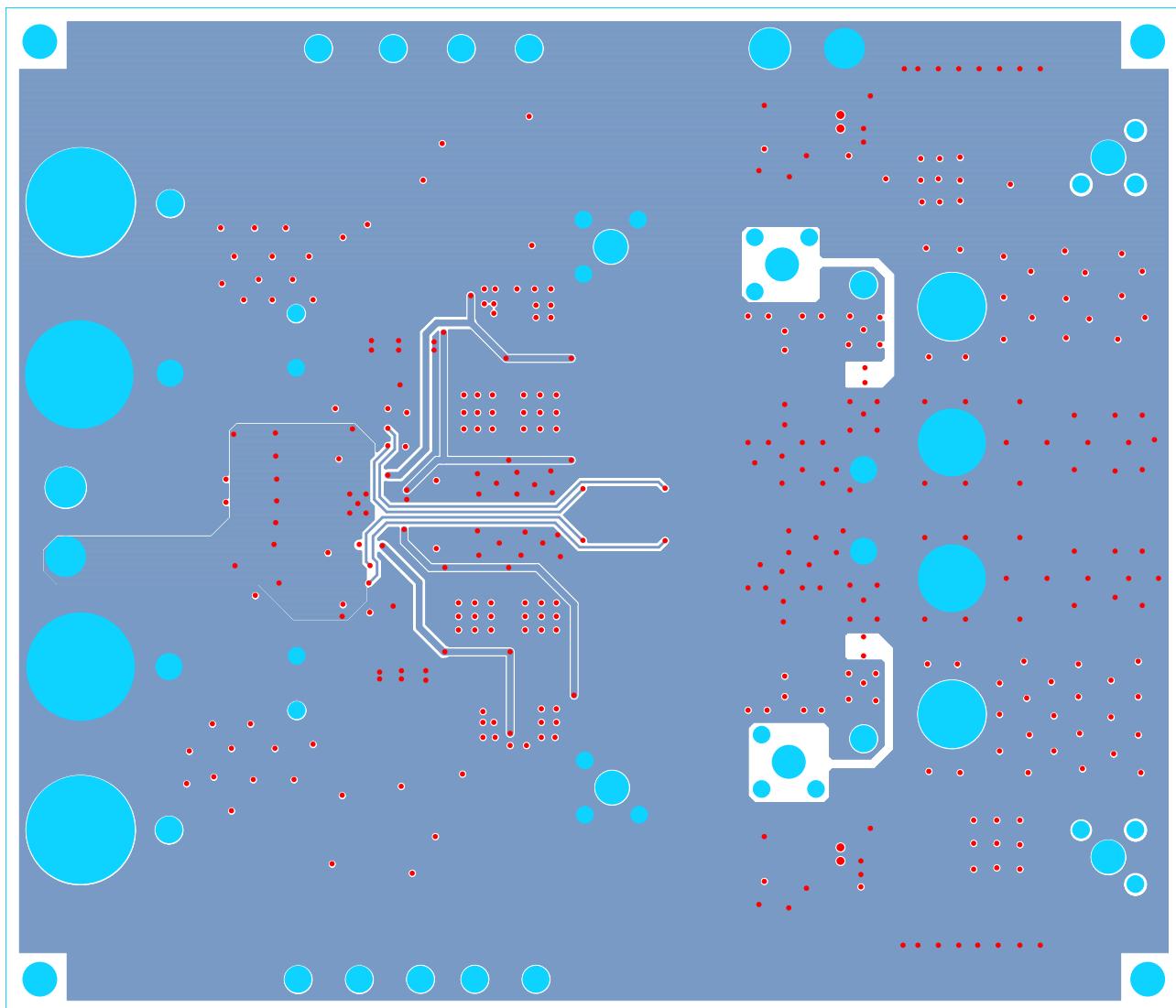
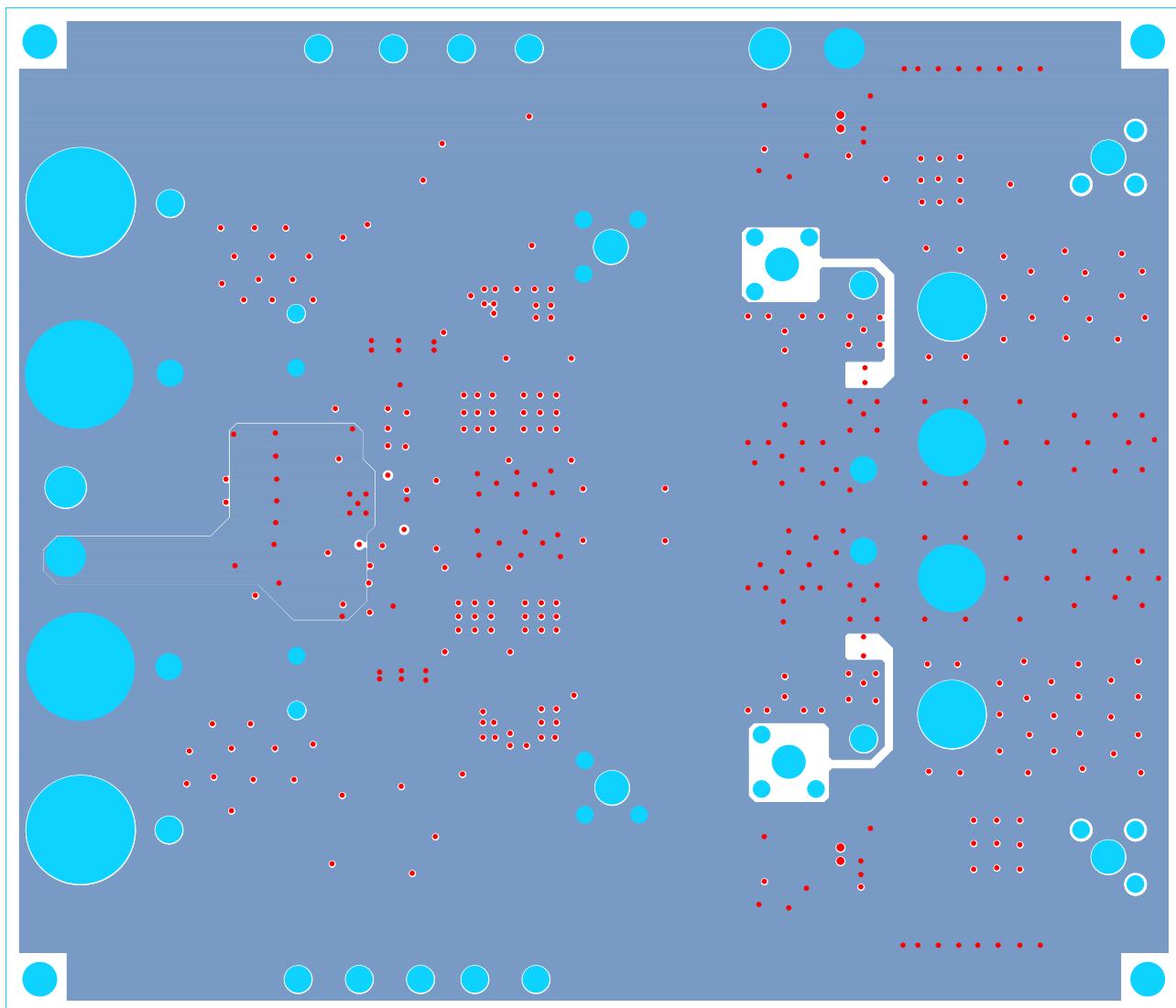
***ISL6228EVAL3Z Evaluation Board Layout (Continued)***

FIGURE 15. LAYER 1

***ISL6228EVAL3Z Evaluation Board Layout (Continued)*****FIGURE 16. LAYER 2**

***ISL6228EVAL3Z Evaluation Board Layout (Continued)***



**FIGURE 17. LAYER 3**

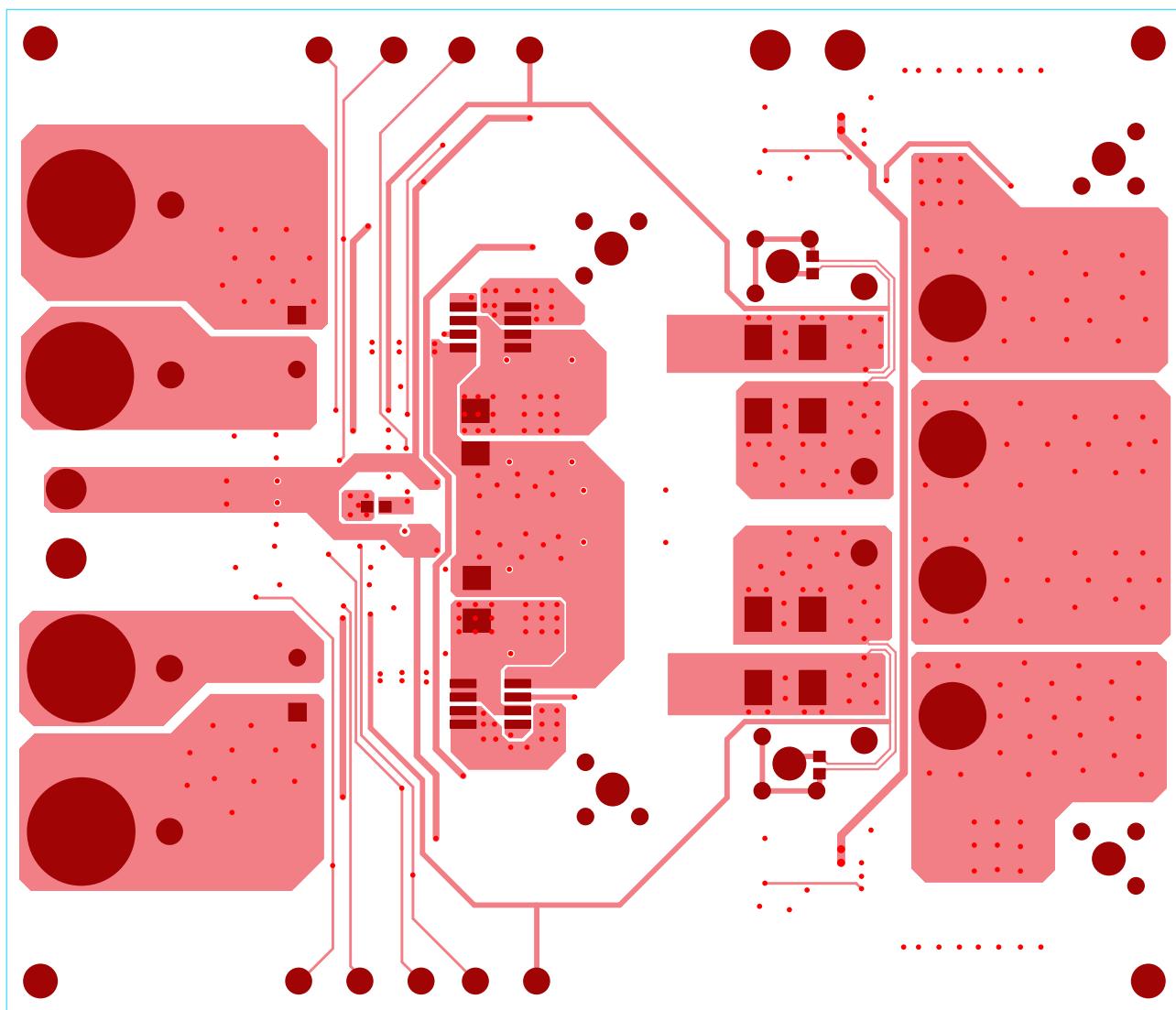
***ISL6228EVAL3Z Evaluation Board Layout (Continued)***

FIGURE 18. LAYER 4

## Notice

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