

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 (R³) 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 300μs pulse of 4.5A load across V_{O1} and GND, and it applies a 300μs pulse of 5A load across V_{O2} and GND.

Contents of this document include:

- Recommended Test Equipment
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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

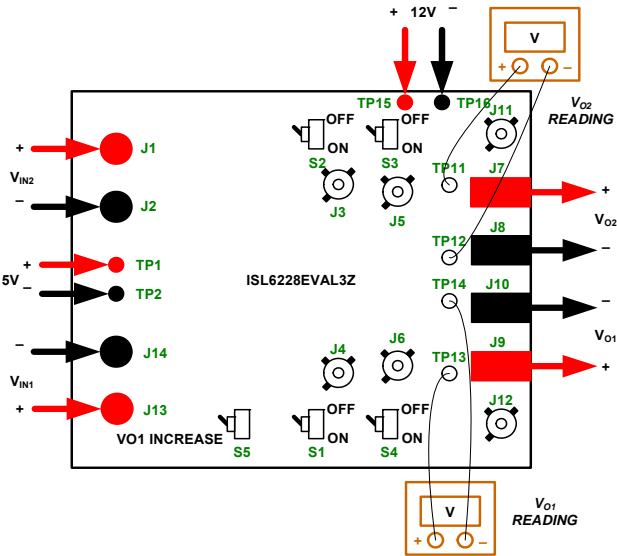


FIGURE 1. TEST SET-UP

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_{O1} 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_{18}
- TP19: Monitor the EN2 pin
- TP20: Monitor the V_{IN2} positive input
- TP21: Monitor the V_{IN2} return input

Typical Performance

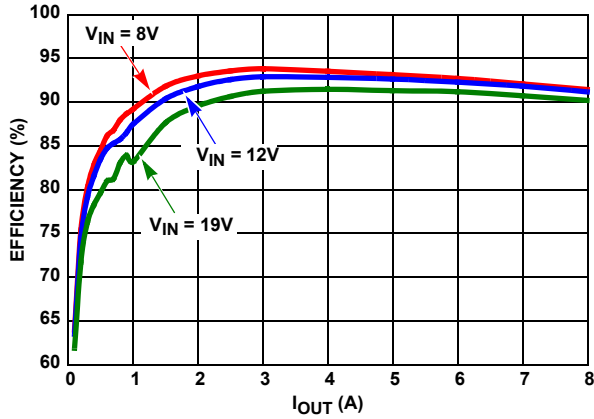


FIGURE 2. CHANNEL-1 EFFICIENCY AT $V_O = 1.5V$

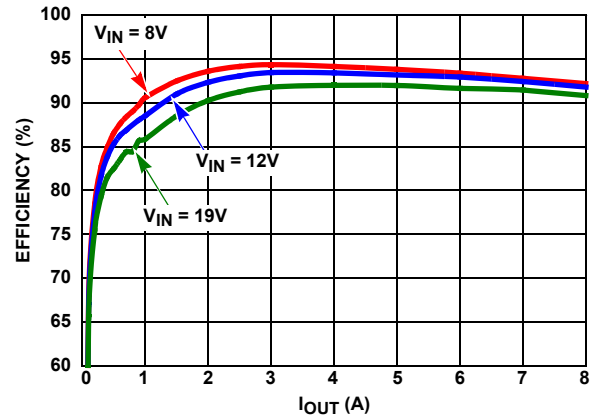


FIGURE 3. CHANNEL-2 EFFICIENCY AT $V_O = 1.8V$

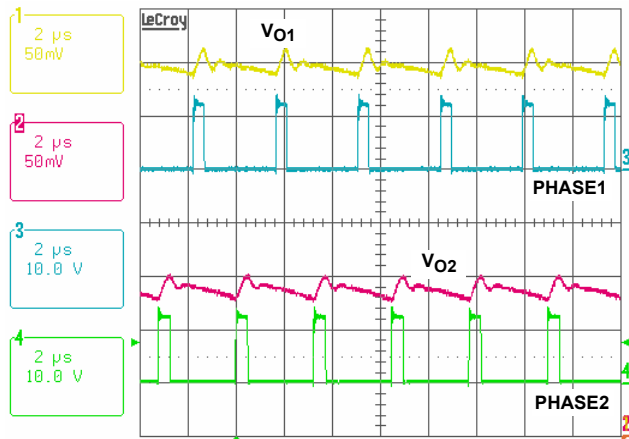


FIGURE 4. CCM STEADY-STATE OPERATION, $V_{IN} = 12V$, $V_{O1} = 1.5V$, $I_{O1} = 3A$, $V_{O2} = 1.8A$, $I_{O2} = 4A$

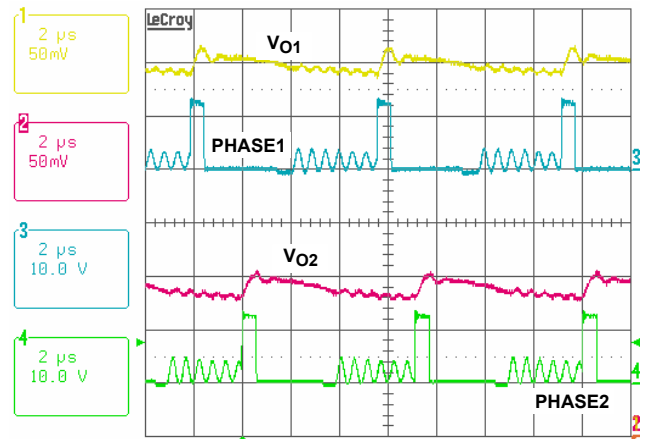


FIGURE 5. DCM STEADY-STATE OPERATION, $V_{IN} = 12V$, $V_{O1} = 1.5V$, $I_{O1} = 0.5A$, $V_{O2} = 1.8V$, $I_{O2} = 0.5A$

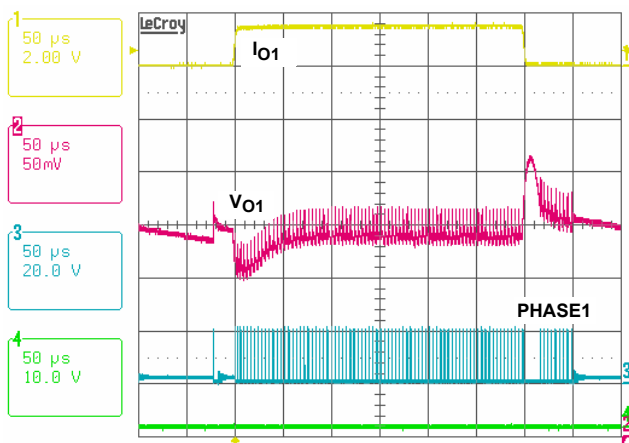


FIGURE 6. TRANSIENT RESPONSE, $V_{IN} = 19V$, $V_O = 1.5V$, $I_O = 0.1A/4.6A @ 2.55A/μs$

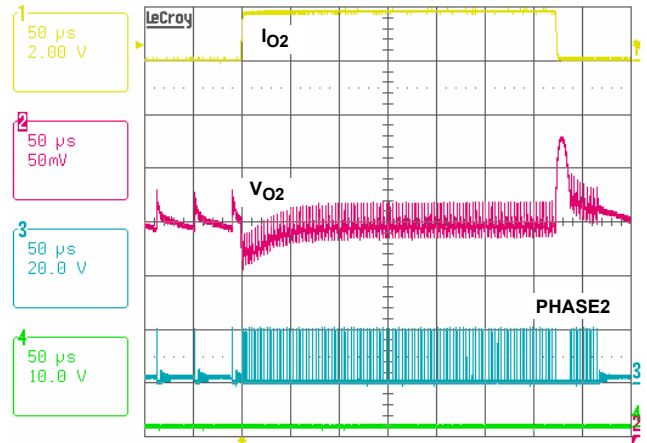


FIGURE 7. TRANSIENT RESPONSE, $V_{IN} = 19V$, $V_O = 1.8V$, $I_O = 0.1A/5.1A @ 2.55A/μs$

Typical Performance (Continued)

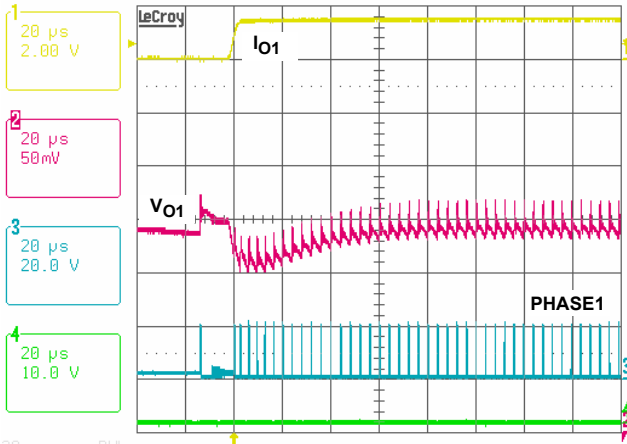


FIGURE 8. LOAD INSERTION RESPONSE, $V_{IN} = 19V$, $V_O = 1.5V$, $I_O = 0.1A/4.6A @ 2.55A/\mu s$

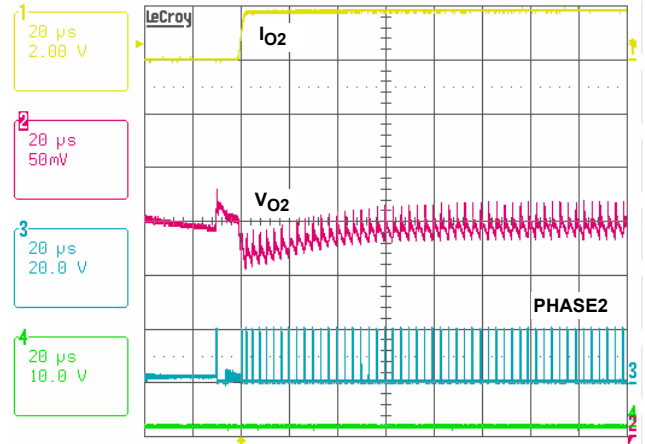


FIGURE 9. LOAD INSERTION RESPONSE, $V_{IN} = 19V$, $V_O = 1.8V$, $I_O = 0.1A/5.1A @ 2.55A/\mu s$

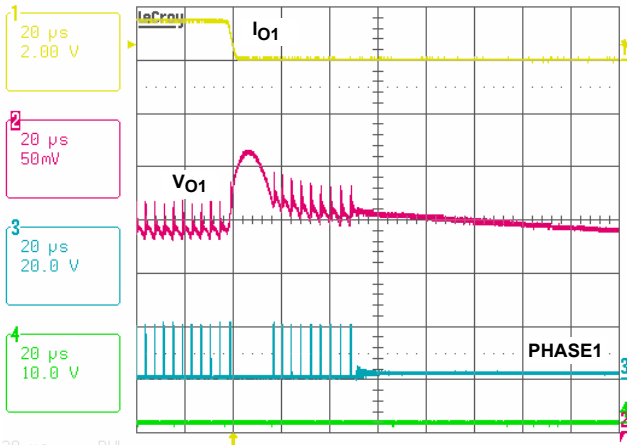


FIGURE 10. LOAD RELEASE RESPONSE, $V_{IN} = 19V$, $V_O = 1.5V$, $I_O = 0.1A/4.6A @ 2.55A/\mu s$

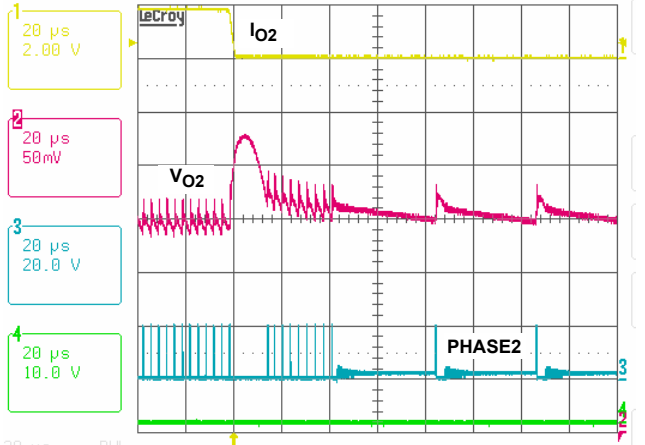


FIGURE 11. LOAD RELEASE RESPONSE, $V_{IN} = 19V$, $V_O = 1.8V$, $I_O = 0.1A/5.1A @ 2.55A/\mu s$

Bill of Materials

| QTY | REFERENCE | DESCRIPTION | MANUFACTURER | PART NUMBER |
|-----|------------------------------------|---|-------------------------|----------------------|
| 0 | DNP (C8, C9) | CAP, RADIAL, 56 μ F, 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, 0.1 μ F, 16V, 10%, X7R, ROHS | MURATA | H1045-00104-16V10-T |
| 6 | C2, C7, C30, C31, C36, C39 | CAP, SMD, 0603, 1 μ F, 16V, 20%, Y5V, ROHS | MURATA | H1045-00105-16V20-T |
| 2 | C18, C19 | CAP, SMD, 0603, 10 μ F, 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, 0.22 μ F, 16V, 10%, X7R, ROHS | TDK | H1045-00224-16V10-T |
| 2 | C4, C38 | CAP, SMD, 0603, 0.22 μ F, 25V, 20%, X7R, ROHS | VENKEL | H1045-00224-25V20-T |
| 2 | C34, C35 | CAP, SMD, 0805, 4.7 μ F, 16V, 10%, X5R, ROHS | PANASONIC | H1046-00475-16V10-T |
| 0 | DNP (C32, C33) | CAP, SMD, 0805, 4.7 μ F, 16V, 10%, X5R, ROHS | PANASONIC | H1046-00475-16V10-T |
| 2 | C16, C17 | CAP, SMD, 1206, 1 μ F, 25V, 20%, X5R, ROHS | PANASONIC | H1065-00105-25V20-T |
| 4 | C10 to C13 | CAP, SMD, 1206, 10 μ F, 25V, 20%, X5R, ROHS | PANASONIC | H1065-00106-25V20-T |
| 2 | C24, C27 | CAP-LOW ESR, SMD, D3L, 330 μ F, 6.3V, 20%, POSCAP, ROHS | SANYO | 6TPF330M9L |
| 0 | DNP (C22, C23, C25, C26, C28, C29) | CAP-LOW ESR, SMD, D3L, 330 μ F, 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, 3.3 μ H, 20%, 18A, ROHS | Vishay | IHLP5050FDER3R3M01 |
| 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, 9.1m Ω RDS, ROHS | INTERNATIONAL RECTIFIER | IRF7821PBF |
| 2 | Q1, Q6 | TRANSISTOR-MOS, N-CHANNEL, 8P, SOIC, 30V, 9.1m Ω RDS, ROHS | INTERNATIONAL RECTIFIER | IRF7821PBF |
| 0 | DNP (Q4, Q9) | TRANSISTOR-MOS, N-CHANNEL, 8P, SOIC, 30V, 4.0m Ω RDS, ROHS | INTERNATIONAL RECTIFIER | IRF7832PBF |
| 2 | Q3, Q8 | TRANSISTOR-MOS, N-CHANNEL, 8P, SOIC, 30V, 4.0m Ω 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, 2 Ω , 1/10W, 1%, TF, ROHS | YAGEO | H2511-00020-1/10W1-T |
| 0 | DNP (R12, R13, R57, R58) | RESISTOR, SMD, 0603, 0 Ω , 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, 0 Ω , 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, 499 Ω , 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, 590 Ω , 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, 1.5 Ω , 1/4W, 1%, TF, ROHS | VENKEL | H2513-001R5-1/4W1-T |
| 4 | R41, R43, R45, R47 | RES, SMD, 1206, 1.5 Ω , 1/4W, 1%, TF, ROHS | VENKEL | H2513-001R5-1/4W1-T |
| 5 | R38, R40, R42, R44, R46 | RES, SMD, 1206, 1.8 Ω , 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 |

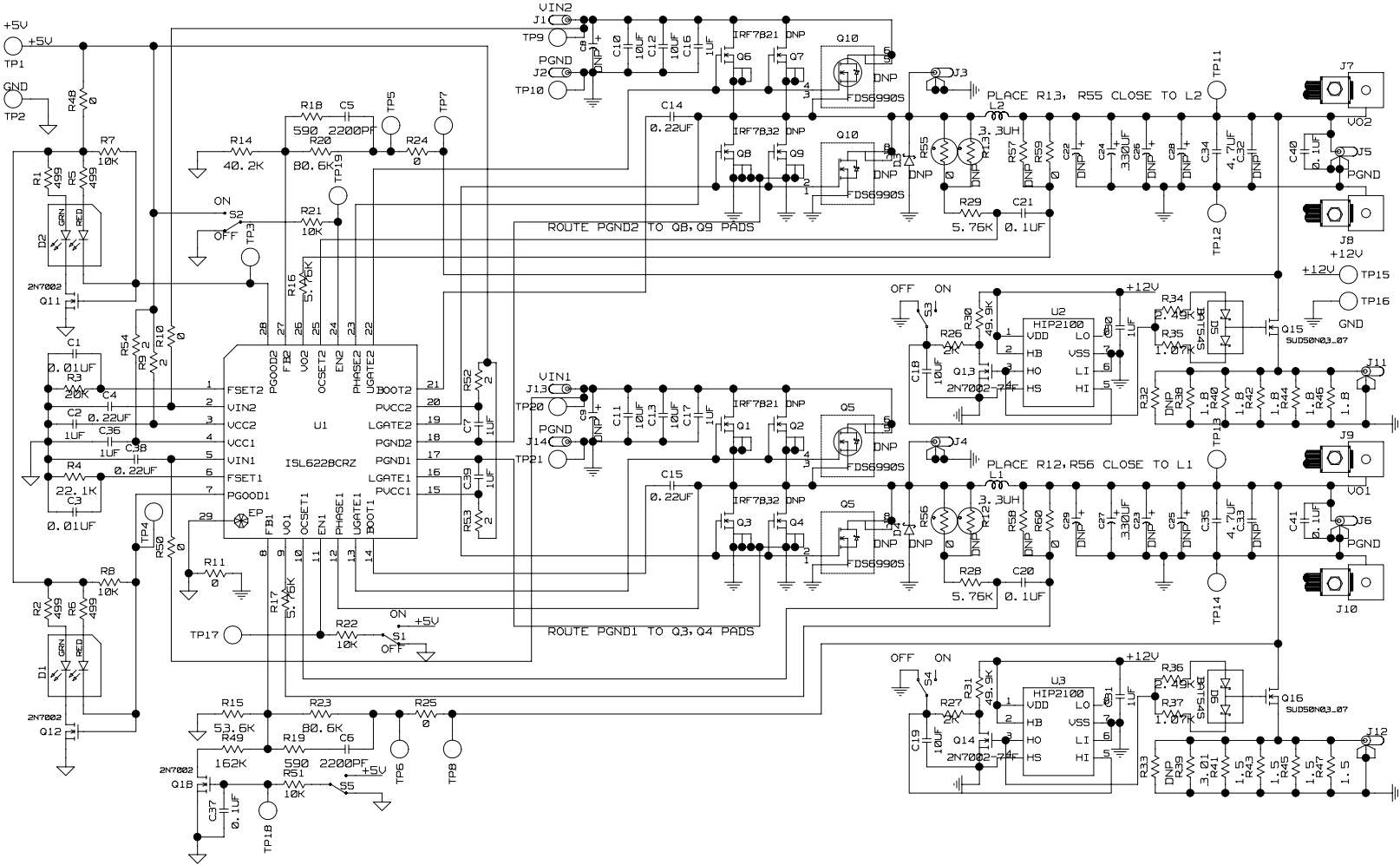


FIGURE 12. ISL6228EVAL3Z SCHEMATIC

ISL6228EVAL3Z Evaluation Board Schematic

ISL6228EVAL3Z Evaluation Board Layout

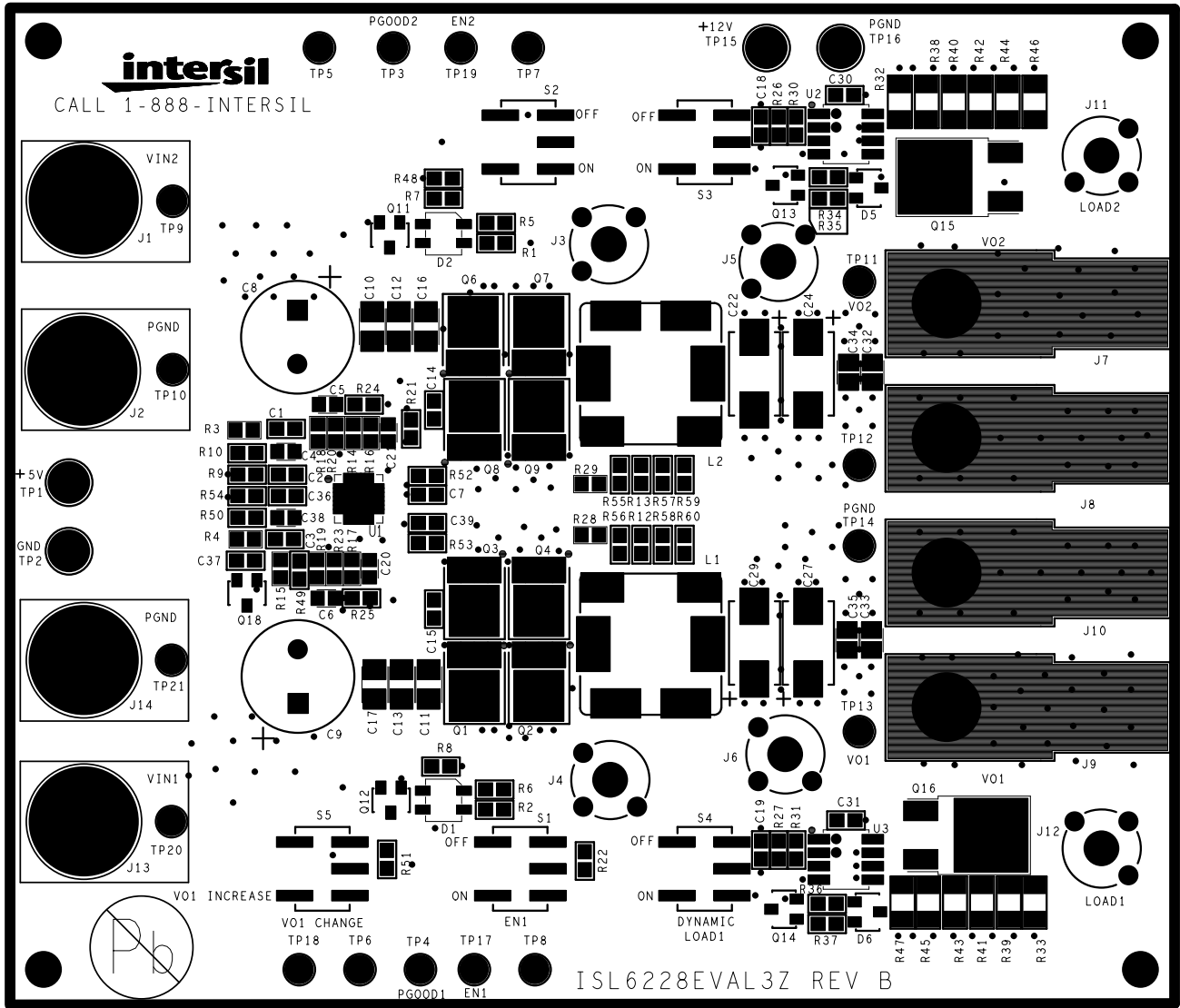


FIGURE 13. TOP SILKSCREEN

ISL6228EVAL3Z Evaluation Board Layout (Continued)

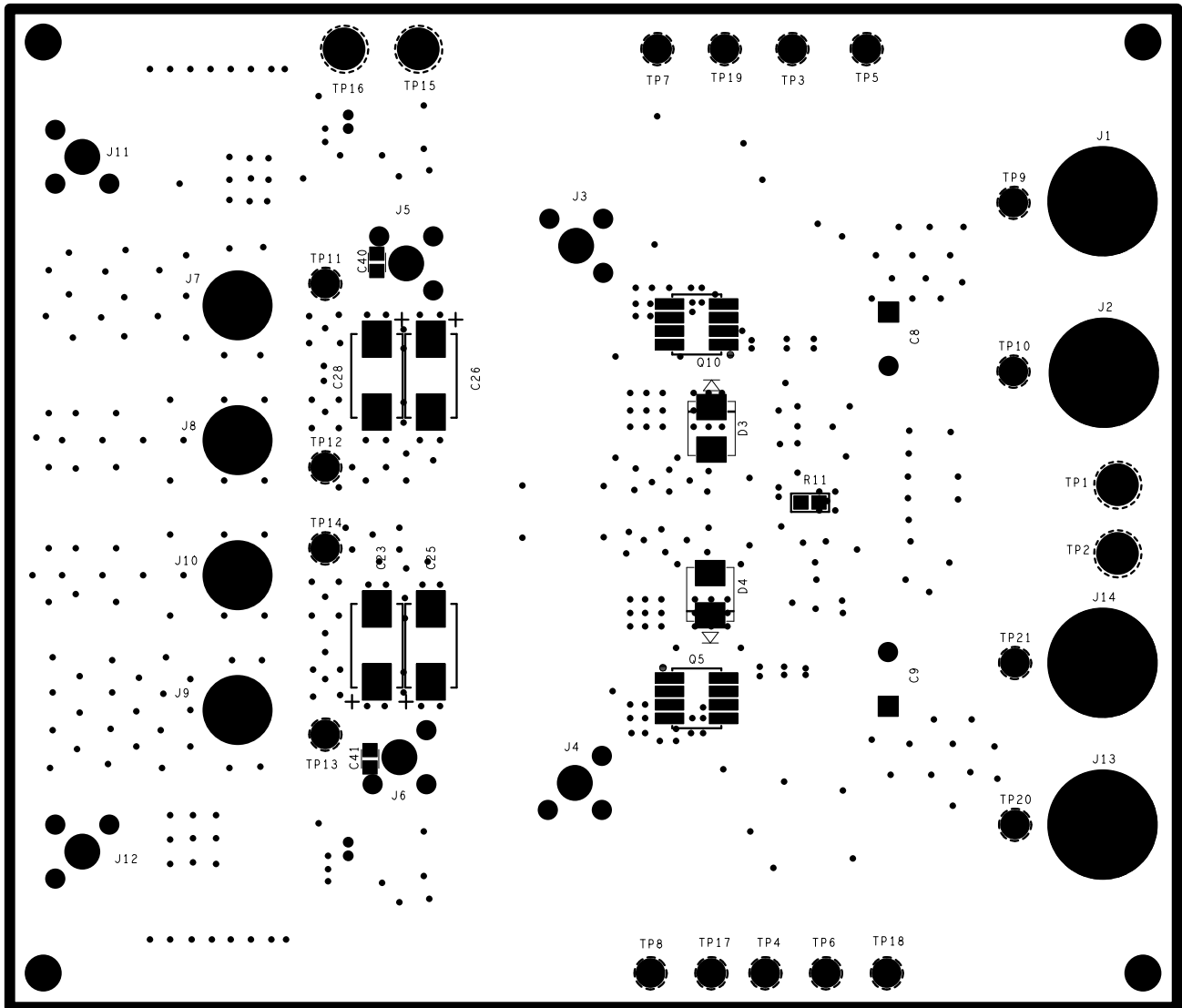


FIGURE 14. BOTTOM SILKSCREEN

ISL6228EVAL3Z Evaluation Board Layout (Continued)

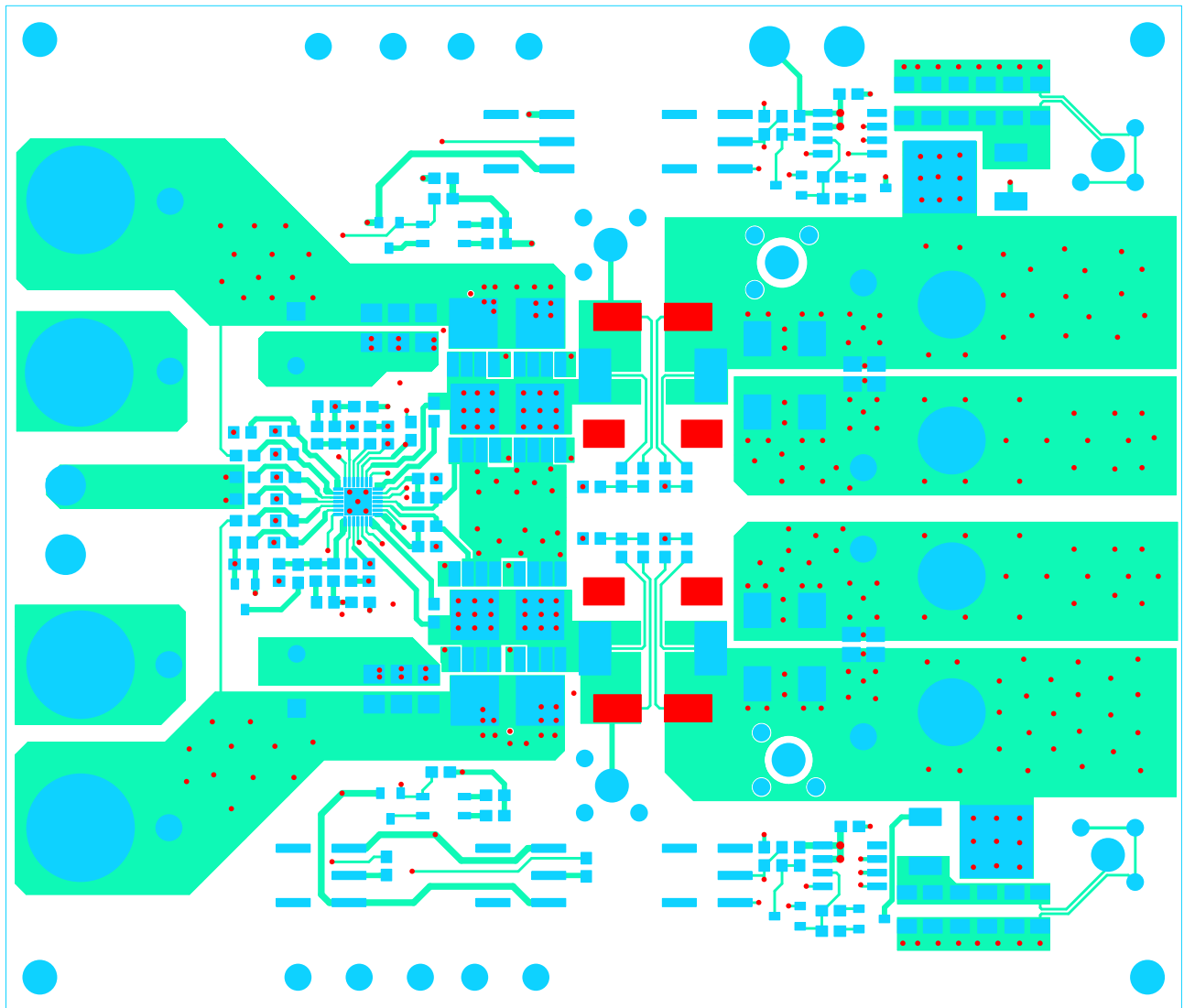


FIGURE 15. LAYER 1

ISL6228EVAL3Z Evaluation Board Layout (Continued)

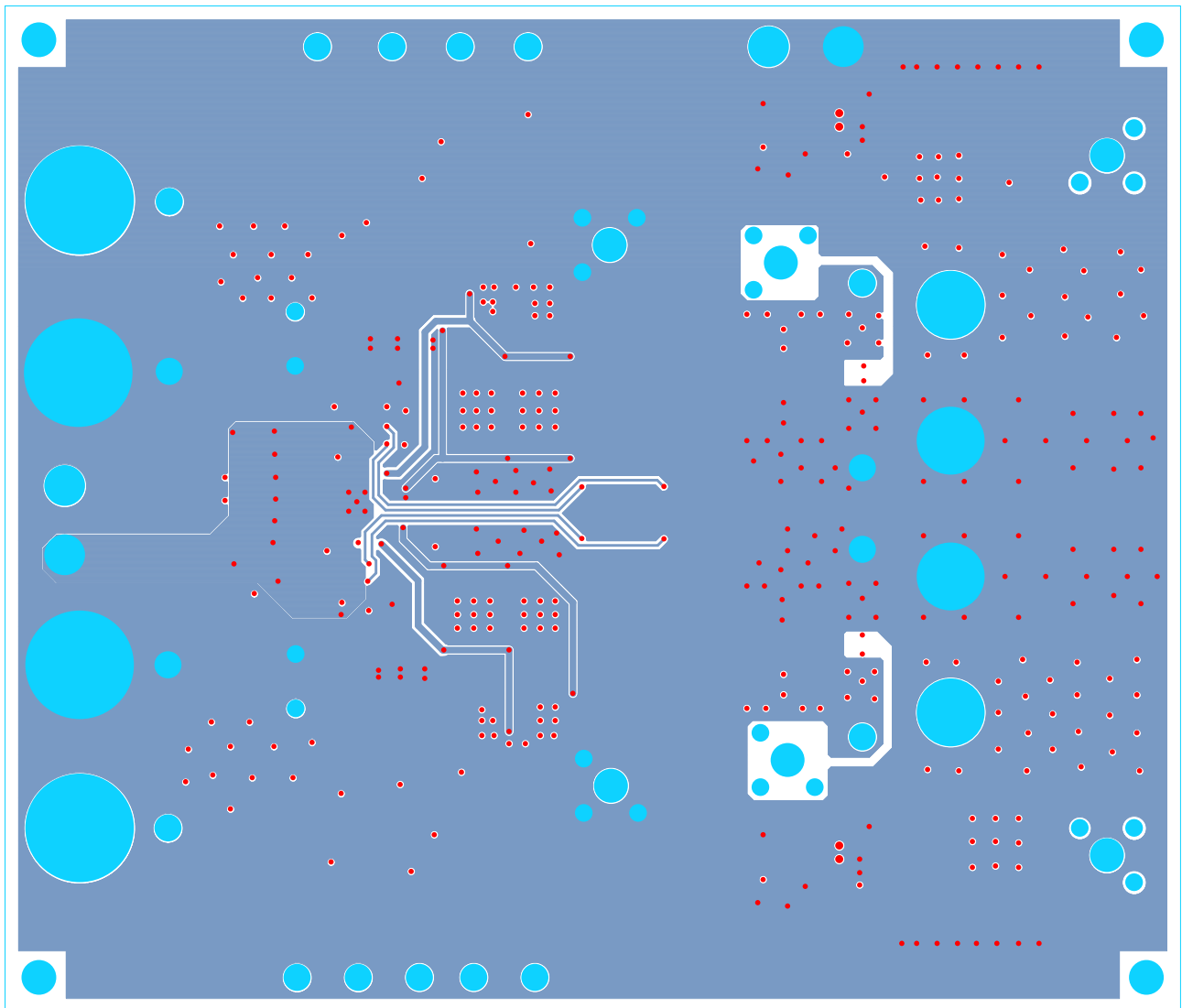


FIGURE 16. LAYER 2

ISL6228EVAL3Z Evaluation Board Layout (Continued)

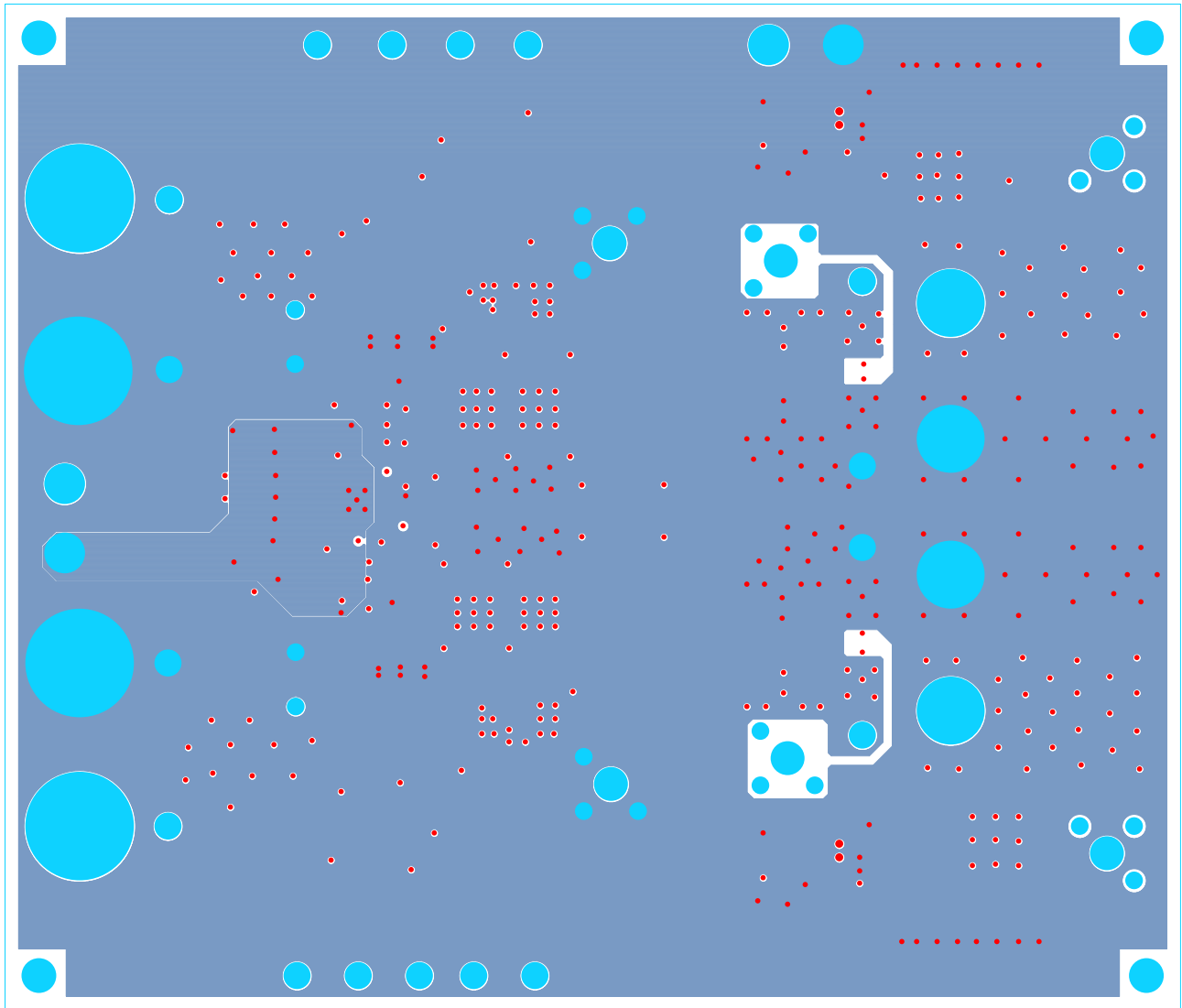


FIGURE 17. LAYER 3

ISL6228EVAL3Z Evaluation Board Layout (Continued)

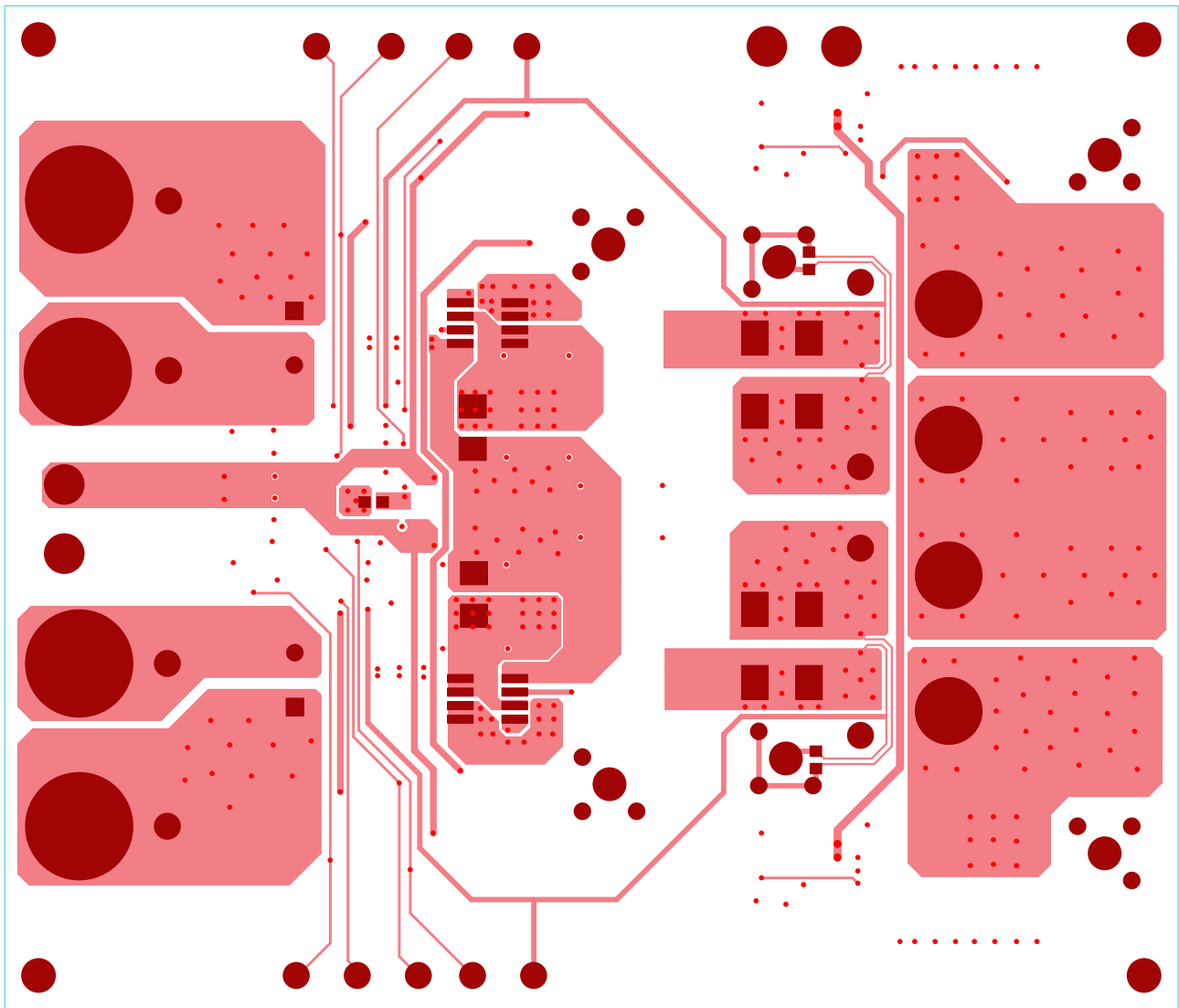


FIGURE 18. LAYER 4

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SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

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Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852-2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338