

Introduction

The ISL6228LOEVAL3Z 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 8A load across V_{O1} and GND, and also a 300µs pulse of 8A load across V_{O2} and GND.

Contents of this document include:

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- Interface Connections
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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

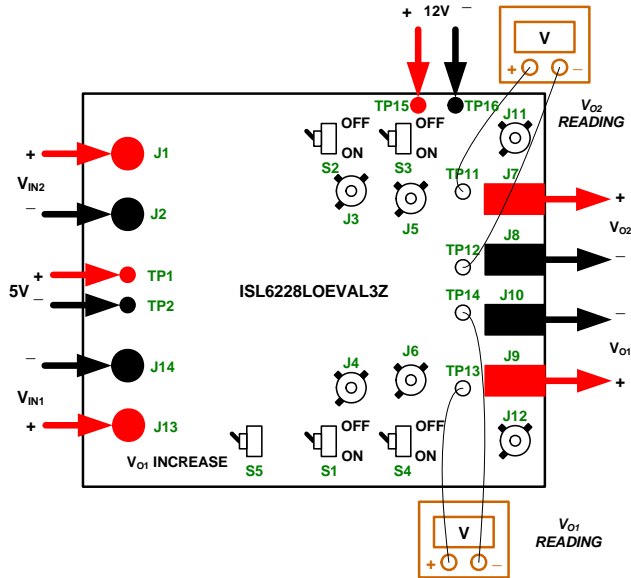


FIGURE 1. TEST SET-UP

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

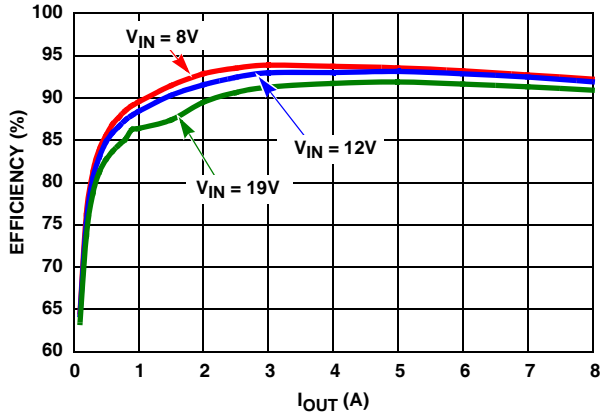


FIGURE 2. CHANNEL-1 EFFICIENCY AT $V_O = 1.5V$

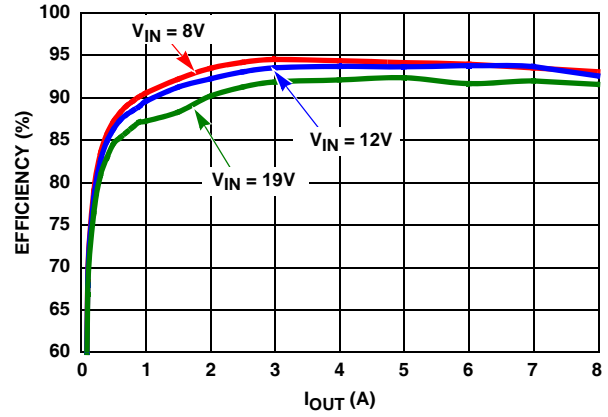


FIGURE 3. CHANNEL-2 EFFICIENCY AT $V_O = 1.8V$

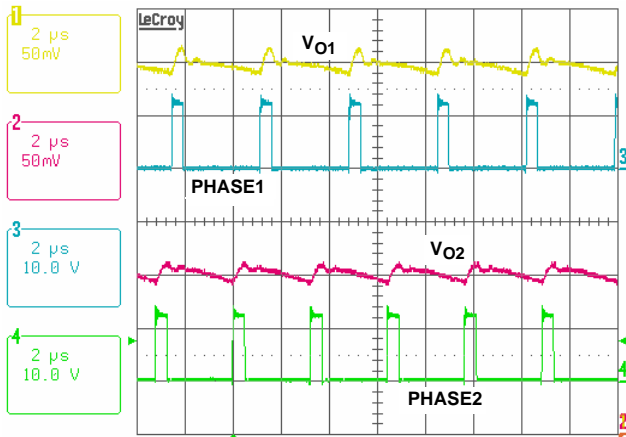


FIGURE 4. CCM STEADY-STATE OPERATION, $V_{IN} = 12V$, $V_{O1} = 1.5V$, $I_{O1} = 3A$, $V_{O2} = 1.8A$, $I_{O2} = 4A$

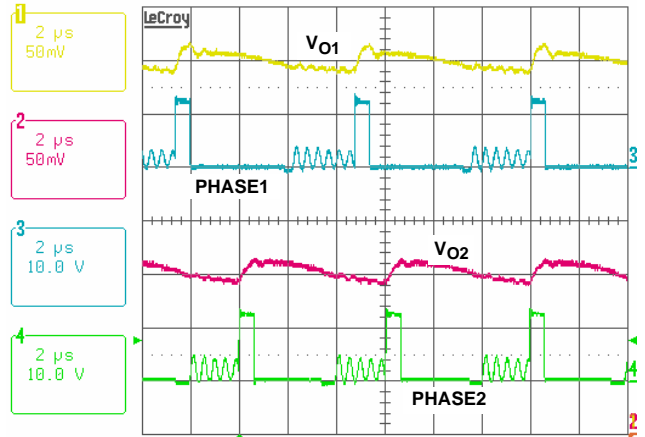


FIGURE 5. DCM STEADY-STATE OPERATION, $V_{IN} = 12V$, $V_{O1} = 1.5V$, $I_{O1} = 1A$, $V_{O2} = 1.8V$, $I_{O2} = 1A$

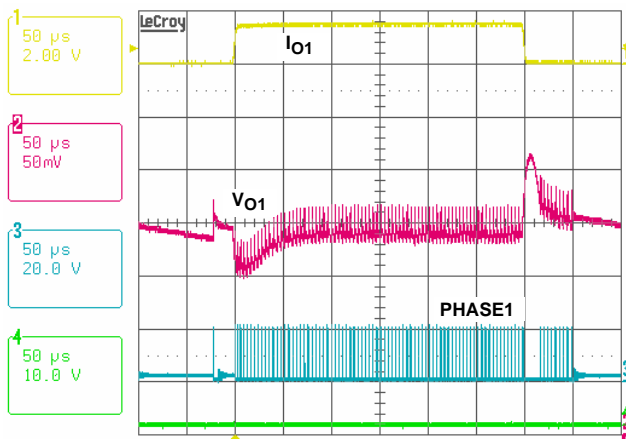


FIGURE 6. TRANSIENT RESPONSE, $V_{IN} = 19V$, $V_O = 1.5V$, $I_O = 0.1A/8.1A @ 2.55A/μs$

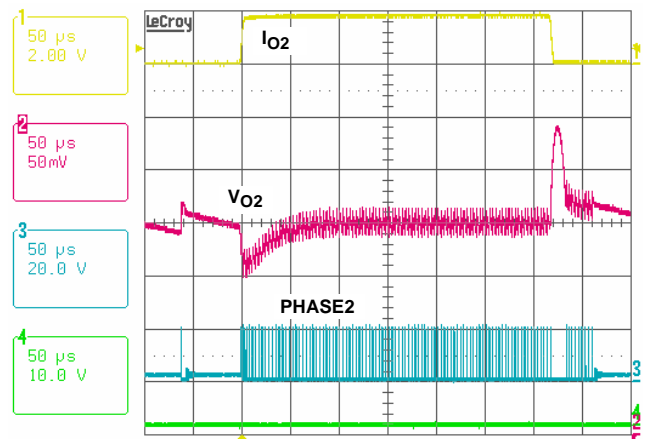


FIGURE 7. TRANSIENT RESPONSE, $V_{IN} = 19V$, $V_O = 1.8V$, $I_O = 0.1A/8.1A @ 2.55A/μs$

Typical Performance (Continued)

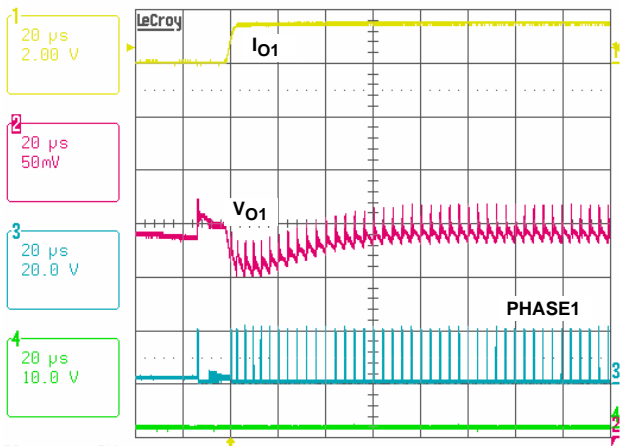


FIGURE 8. LOAD INSERTION RESPONSE, $V_{IN} = 19V$, $V_O = 1.5V$, $I_O = 0.1A/8.1A @ 2.55A/\mu s$

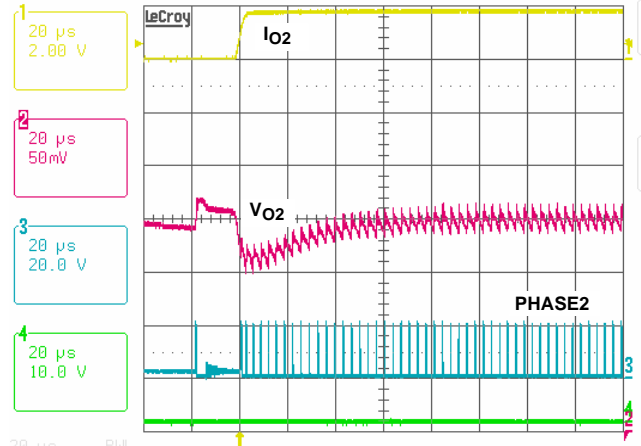


FIGURE 9. LOAD INSERTION RESPONSE, $V_{IN} = 19V$, $V_O = 1.8V$, $I_O = 0.1A/8.1A @ 2.55A/\mu s$

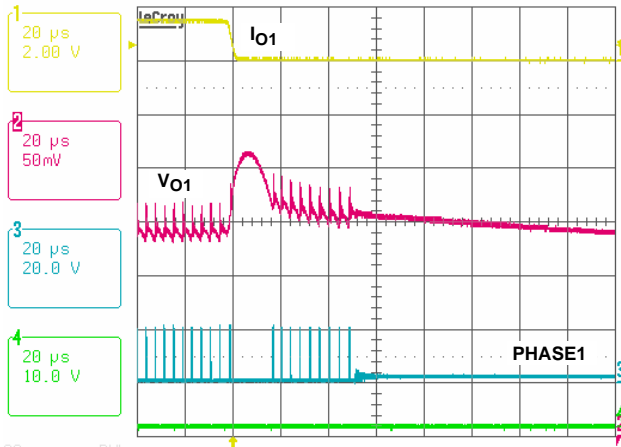


FIGURE 10. LOAD RELEASE RESPONSE, $V_{IN} = 19V$, $V_O = 1.5V$, $I_O = 0.1A/8.1A @ 2.55A/\mu s$

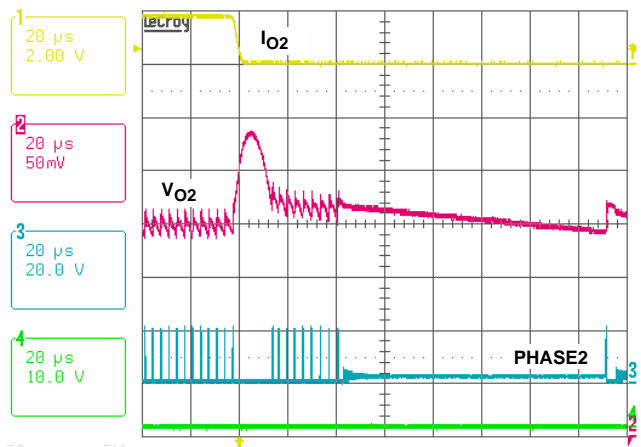


FIGURE 11. LOAD RELEASE RESPONSE, $V_{IN} = 19V$, $V_O = 1.8V$, $I_O = 0.1A/8.1A @ 2.55A/\mu s$

Application Note 1321

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 |
| 3 | 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 | C20, C21 | CAP, SMD, 0603, 0.15µF, 16V, 10%, X7R, ROHS | VENKEL | H1045-00154-25V10-T |
| 2 | C14, C15 | CAP, SMD, 0603, 0.22µF, 25V, 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 | C27, C29 | CAP-LOW ESR, SMD, D3L, 330µF, 6.3V, 20%, POSCAP, ROHS | SANYO | 6TPF330M9L |
| 2 | C22, C24 | CAP-LOW ESR, SMD, D3L, 220µF, 6.3V, 20%, POSCAP, ROHS | NEC | PSLV0J227M(12) |
| 0 | DNP (C23, C25, C26, C28) | 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, 2.2µH, 20%, 18A, ROHS | Vishay | IHLP5050FDER2R2M01 |
| 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 | TRANSIST-MOS, N-CHANNEL, 8P, SOIC, 30V, 9.1mΩ RDS, ROHS | INTERNATIONAL RECTIFIER | IRF7821PBF |

Application Note 1321

Bill of Materials (Continued)

| QTY | REFERENCE | DESCRIPTION | MANUFACTURER | PART NUMBER |
|-----|--|---|-------------------------|----------------------|
| 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 |
| 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 | R20, R23 | RES, SMD, 0603, 105k, 1/10W, 1%, TF, ROHS | PANASONIC | H2511-01053-1/10W1-T |
| 2 | R35, R37 | RES, SMD, 0603, 1.62k, 1/10W, 1%, TF, ROHS | PANASONIC | H2511-01621-1/10W1-T |
| 1 | R49 | RES, SMD, 0603, 210k, 1/10W, 1%, TF, ROHS | YAGEO | H2511-02103-1/10W1-T |
| 2 | R26, R27 | RES, SMD, 0603, 2k, 1/10W, 1%, TF, ROHS | KOA | H2511-02001-1/10W1-T |
| 1 | R3 | RES, SMD, 0603, 19.6k, 1/10W, 1%, TF, ROHS | KOA | H2511-01962-1/10W1-T |
| 1 | R4 | RES, SMD, 0603, 24.3k, 1/10W, 1%, TF, ROHS | PANASONIC | H2511-02432-1/10W1-T |
| 2 | R34, R36 | RES, SMD, 0603, 4.02k, 1/10W, 1%, TF, ROHS | KOA | H2511-04021-1/10W1-T |
| 1 | R14 | RES, SMD, 0603, 52.3k, 1/16W, 1%, TF, ROHS | VENKEL | H2511-05232-1/10W1-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, 69.8k, 1/10W, 1%, TF, ROHS | YAGEO | H2511-06982-1/10W1-T |
| 4 | R16, R17, R28, R29 | RES, SMD, 0603, 3.83k, 1/10W, 1%, TF, ROHS | ROHM | H2511-03831-1/10W1-T |
| 2 | R18, R19 | RES, SMD, 0603, 845Ω, 1/10W, 1%, TF, ROHS | VENKEL | H2511-08450-1/10W1-T |
| 2 | R20, R23 | RES, SMD, 0603, 80.6k, 1/10W, 1%, TF, ROHS | VENKEL | H2511-08062-1/10W1-T |
| 1 | R32 | RES, SMD, 1206, 1Ω, 1/4W, 1%, TF, ROHS | VENKEL | H2513-001R0-1/4W1-T |
| 9 | R38, R40 to R47 | RES, SMD, 1206, 1.5Ω, 1/4W, 1%, TF, ROHS | VENKEL | H2513-001R5-1/4W1-T |
| 2 | R33, R39 | RES, SMD, 1206, 0.75Ω, 1/4W, 1%, TF, ROHS | SUSUMU | RL1632R-R750-F |
| 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 |

ISL6228LOEVAL3Z Evaluation Board Schematic

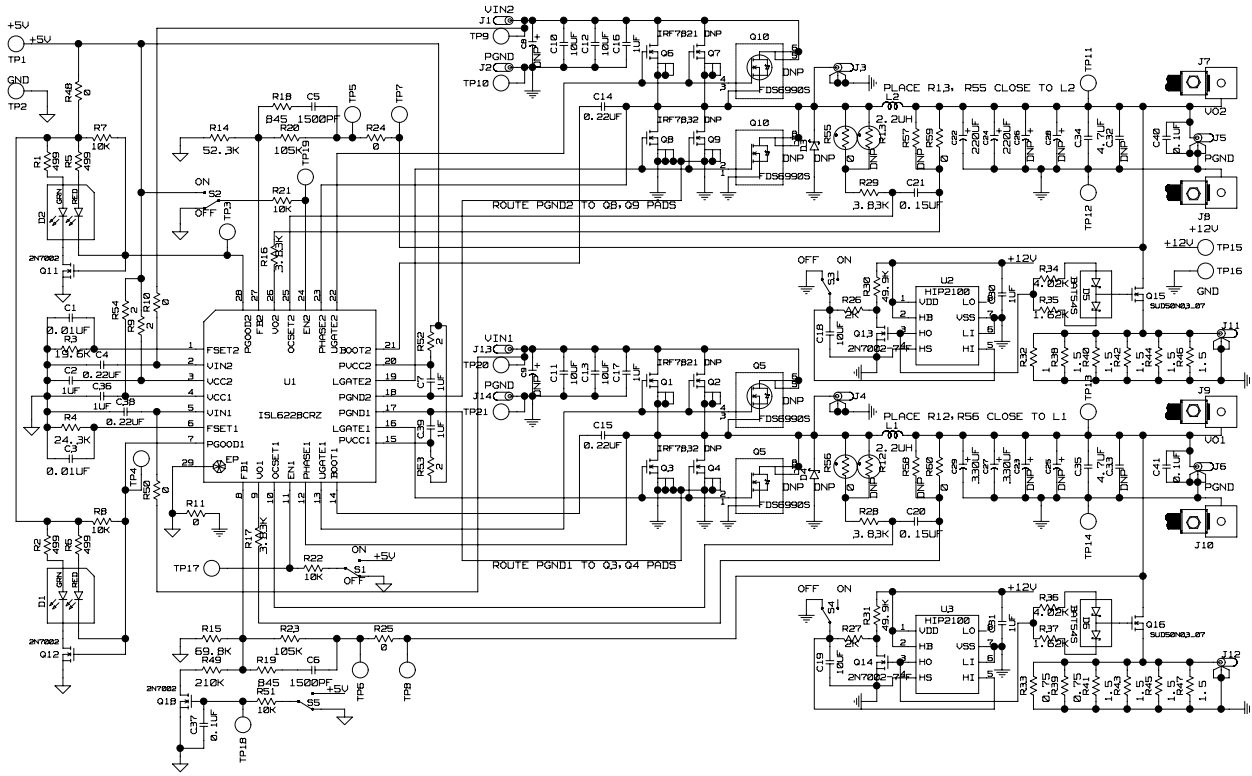


FIGURE 12. ISL6228LOEVAL3Z SCHEMATIC

ISL6228LOEVAL3Z Evaluation Board Layout

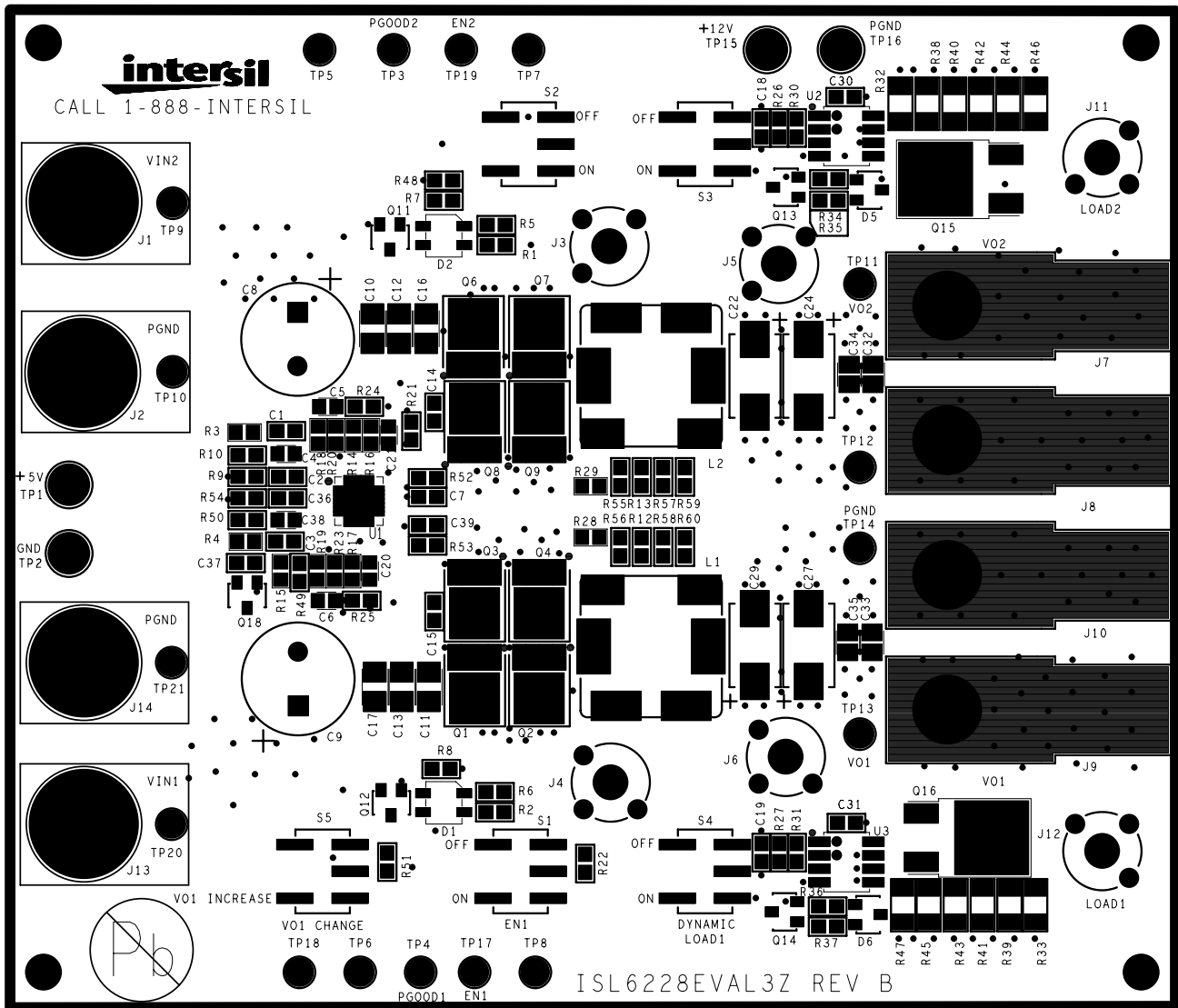


FIGURE 13. TOP SILKSCREEN

ISL6228LOEVAL3Z Evaluation Board Layout (Continued)

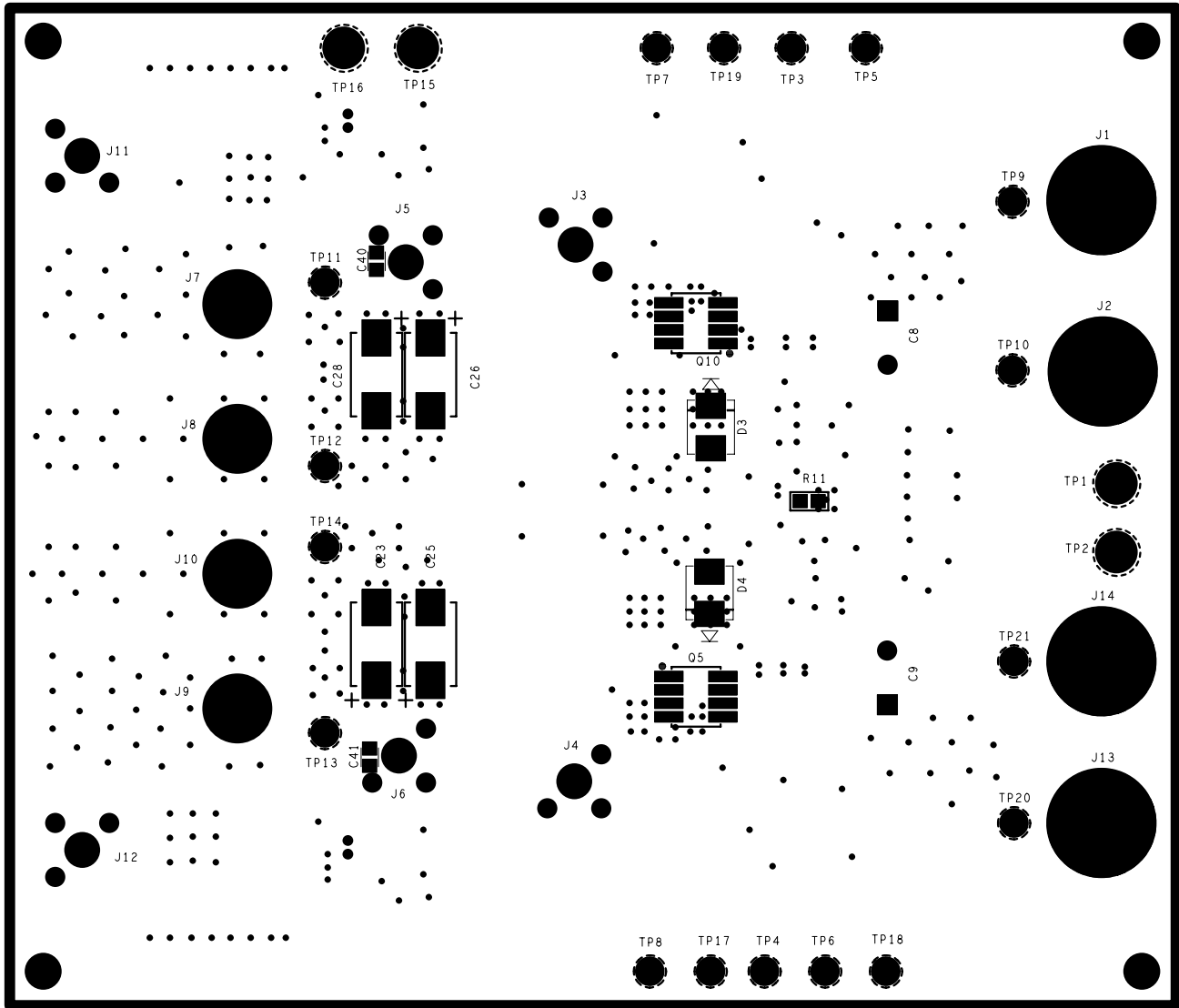


FIGURE 14. BOTTOM SILKSCREEN

ISL6228LOEVAL3Z Evaluation Board Layout (Continued)

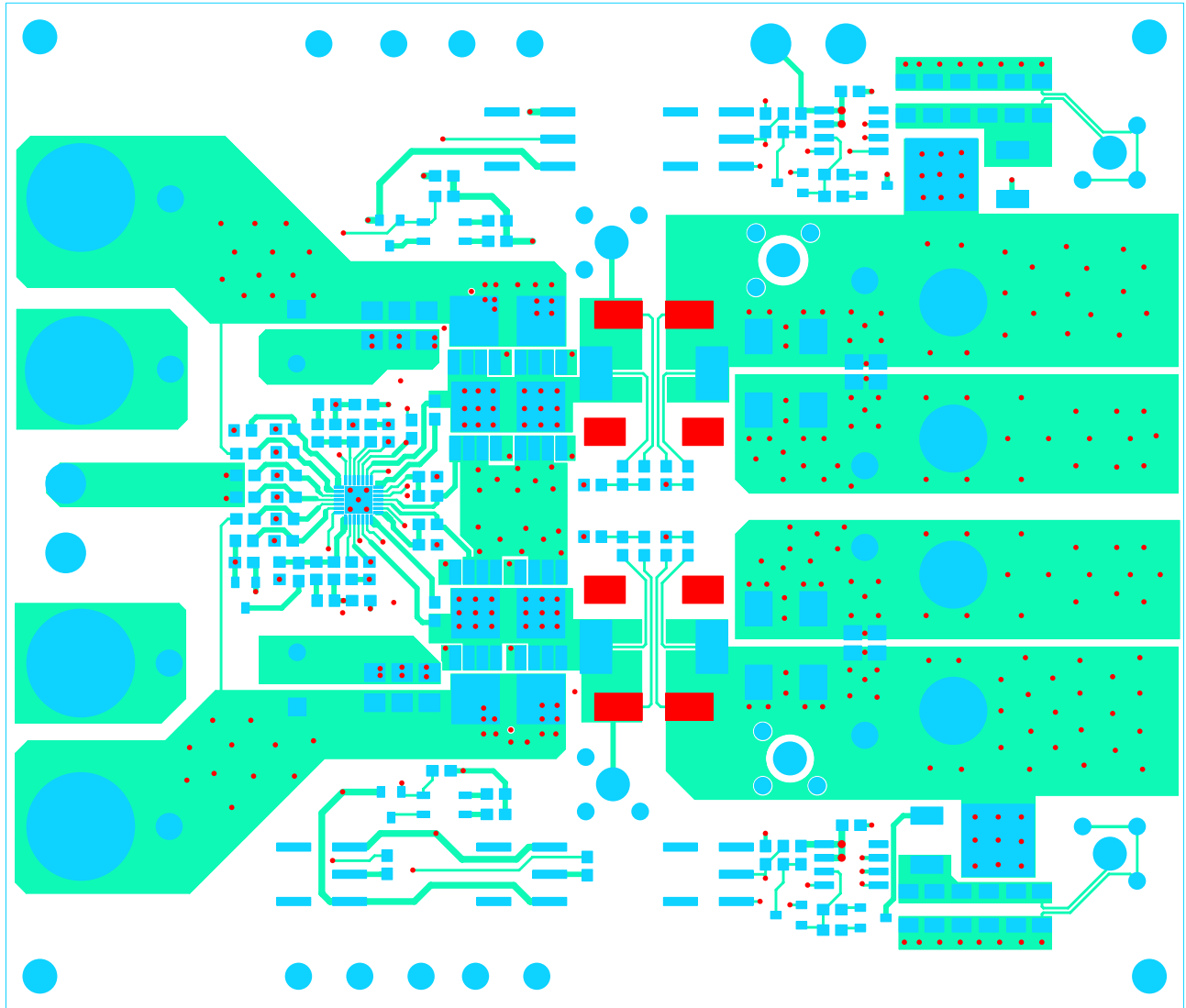


FIGURE 15. LAYER 1

ISL6228LOEVAL3Z Evaluation Board Layout (Continued)

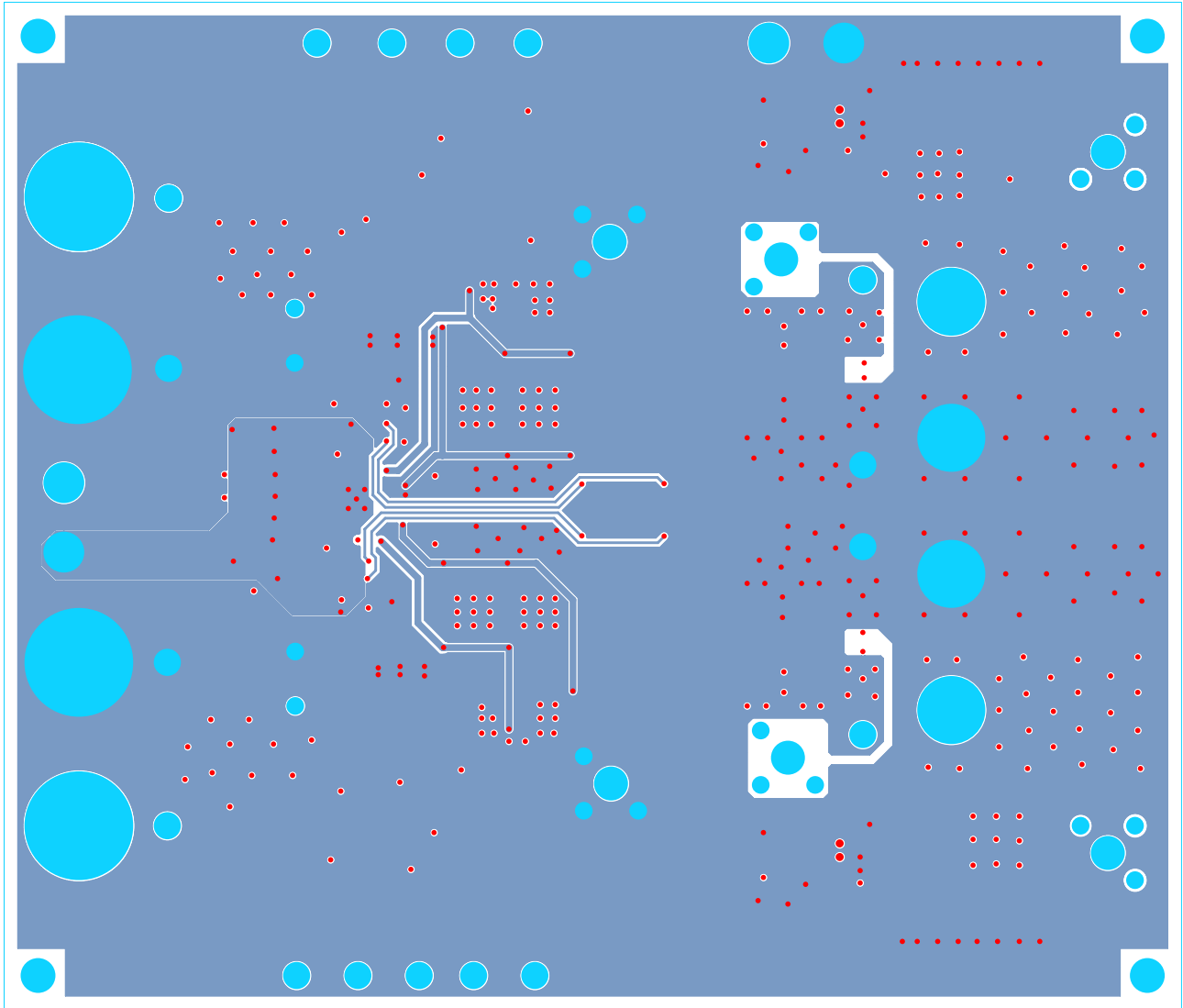


FIGURE 16. LAYER 2

ISL6228LOEVAL3Z Evaluation Board Layout (Continued)

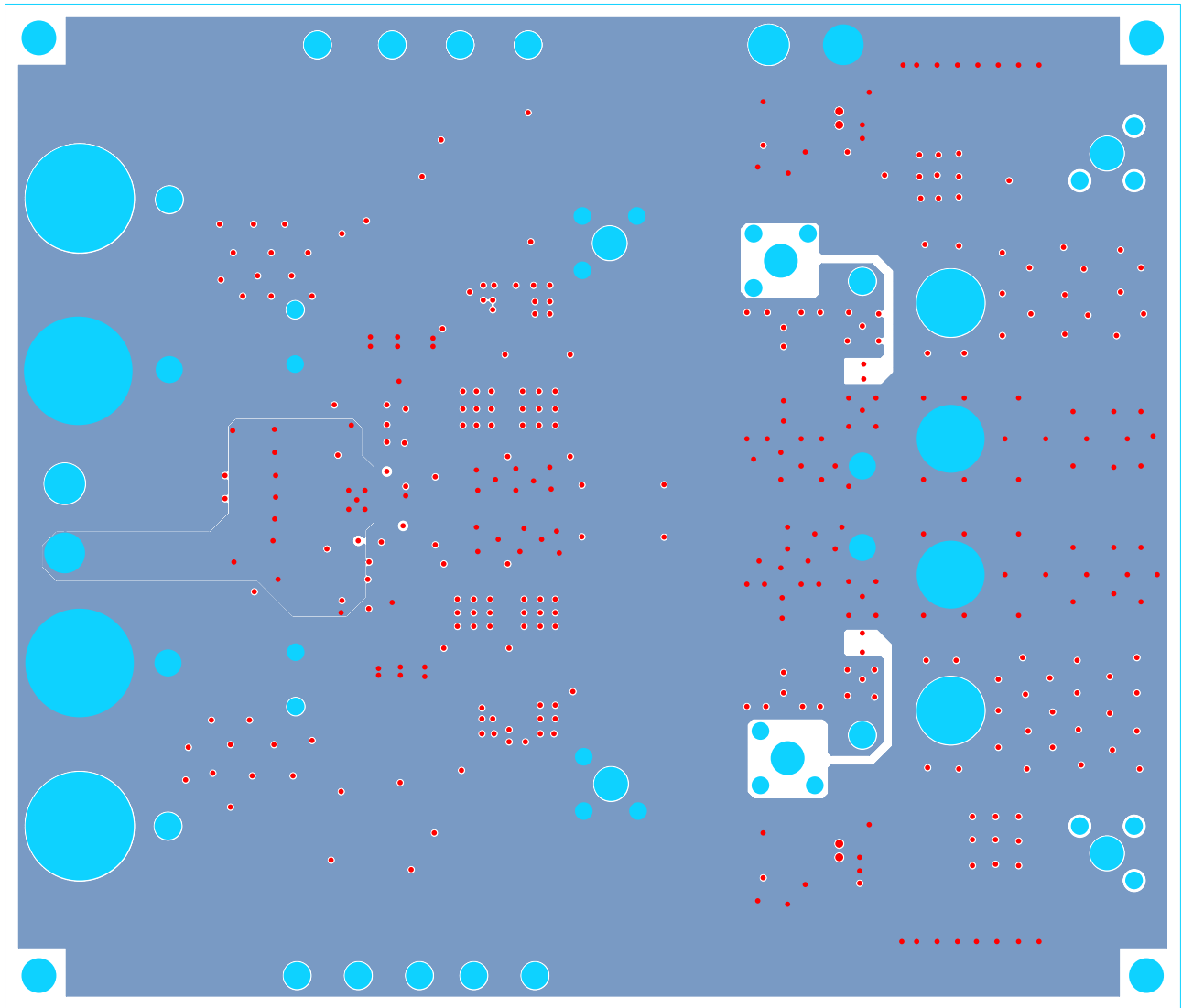


FIGURE 17. LAYER 3

ISL6228LOEVAL3Z Evaluation Board Layout (Continued)

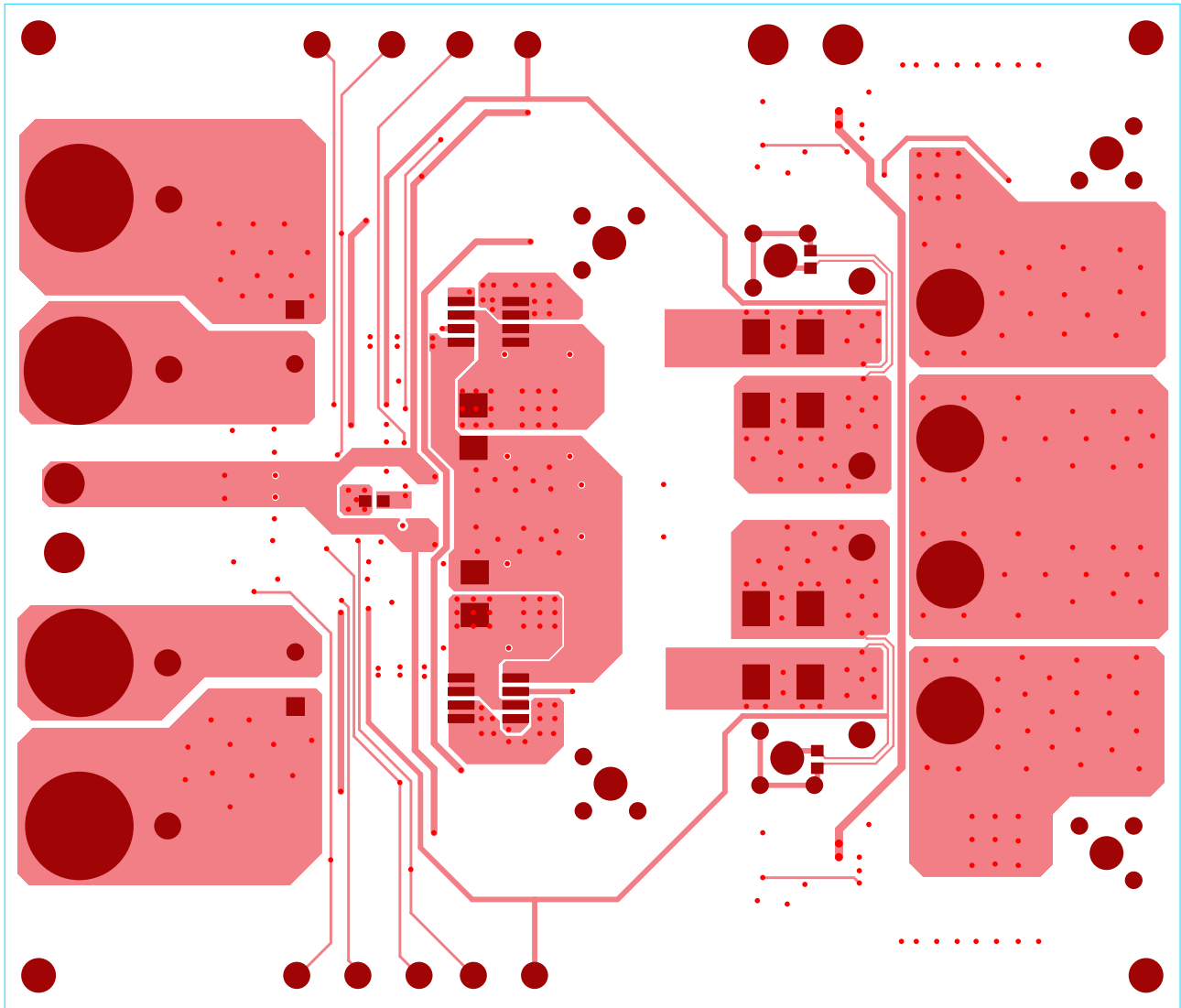


FIGURE 18. LAYER 4

Intersil Corporation reserves the right to make changes in circuit design, software and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that the Application Note or Technical Brief is current before proceeding.

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