

Introduction

The ISL6268EVAL1Z evaluation board demonstrates the performance of the ISL6268HZ single-phase synchronous-buck PWM controller featuring Intersil's Robust Ripple Regulator (R³) technology. The evaluation DC/DC converter design criteria is located in Table 1. An on-board dynamic-load generator is included for evaluating the transient-load response. The dynamic-load applies a 2.5ms pulse of 250mΩ across VOUT and GND every 30ms. Contents of this document include:

- Recommended Test Equipment
- Interface Connections
- Switch Descriptions
- Jumper Descriptions
- Test Point Descriptions
- Typical Waveforms
 - Start-up
 - Shut-down
 - Diode-emulation
 - Load-transient response
 - Line-transient response
 - Overvoltage protection
 - Undervoltage protection
 - Overcurrent protection
- Evaluation Board Documentation
 - Schematic
 - Bill of materials
 - Silk-screen plots
 - Board layer plots

TABLE 1. DC/DC DESIGN CRITERIA

| PARAMETER | VALUE | UNITS |
|---------------|---------|-------|
| VIN | 7 to 25 | VDC |
| VOUT | 1.20 | VDC |
| FULL-LOAD | 5.0 | ADC |
| PWM FREQUENCY | 300 | kHz |

Recommended Equipment

- (QTY 1) Adjustable 25V, 3A Power Supply
- (QTY 1) Fixed 12V, 100mA Power Supply
- (QTY 1) Fixed 5V, 100mA Power Supply
- (QTY 1) Adjustable 10A Constant Current Electronic Load
- (QTY 1) DVM
- (QTY 1) Four Channel Oscilloscope

Interface Connections

- VIN: Input voltage to the power stage of the converter
 - J1: VIN positive power input
 - TP1: VIN positive voltage sense
 - J2: VIN return power input
 - TP2: VIN return voltage sense
- VOUT: Regulated output voltage from the converter
 - J3: VOUT positive power output
 - TP3: VOUT positive voltage sense
 - J4: VOUT return power output
 - TP4: VOUT return voltage sense
- VCC: +5V input voltage for VCC, PVCC, PGOOD-LED and pull-up voltage rail
 - J5: 5V positive input
 - J6: 5V return input
- +12V: Input voltage for the dynamic-load generator
 - J7: 12V positive input
 - J8: 12V return input

Switch Descriptions

- S1: ENABLE
 - OFF: Shorts the EN pin to GND (disable PWM)
 - ON: Allows the EN pin to pull-up to +5V (enable PWM)
- S2: DYNAMIC LOAD
 - OFF: Load disabled
 - ON: Load enabled

Jumper Descriptions

- JP1: Connects +5V supply to the PGOOD LED circuit. The shunt jumper is normally installed. Remove the shunt jumper when making low power efficiency measurements
- JP2: Isolates the EN pin from switch S1 so that it can be externally driven

Test-point Descriptions

- P1: Scope-probe socket for measuring the PHASE node
- P2: Scope-probe socket for measuring VOUT
- P3: Scope-probe socket for measuring voltage across the dynamic-load resistors (hence load current)
- TP5: Monitor the PGOOD pin
- TP6: Monitor or drive the EN pin
- TP7: Monitor the COMP pin (SENSITIVE!)
- TP8: Monitor the FB pin (SENSITIVE!)
- TP9: Monitor the FSET pin
- TP10: Monitor the PVCC pin
- TP11 to TP16: Signal Ground

Typical Waveforms

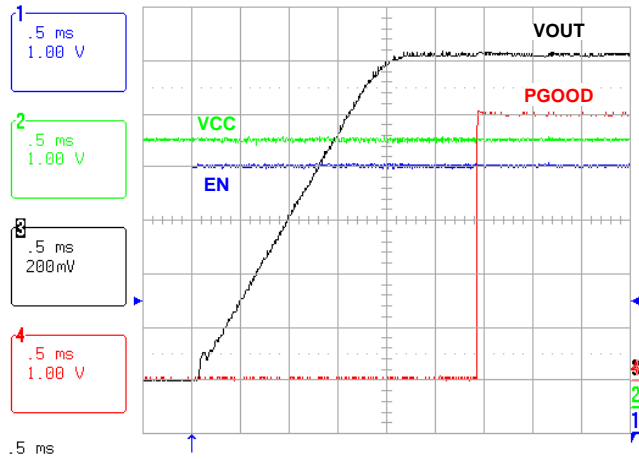


FIGURE 1. SOFT-START: NO LOAD

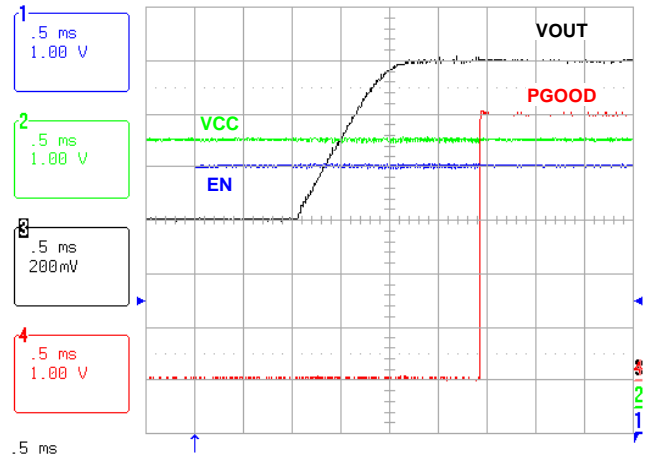


FIGURE 2. SOFT-START: NO LOAD, 50% VOUT-PREBIAS

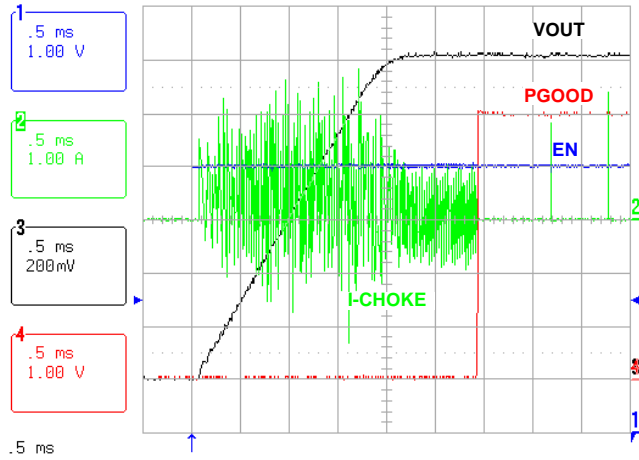


FIGURE 3. IN-RUSH CURRENT: NO LOAD

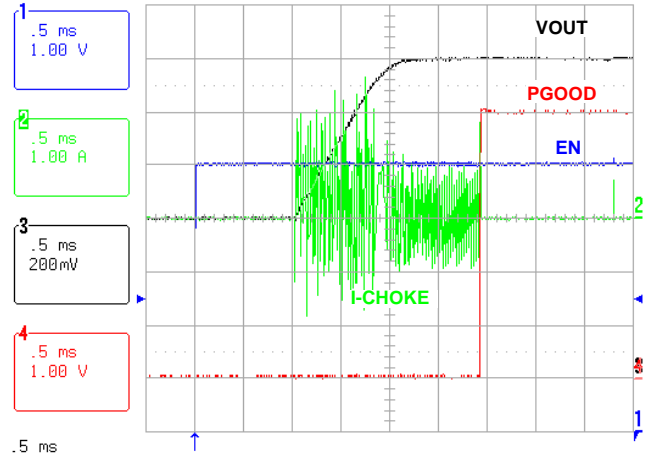


FIGURE 4. IN-RUSH CURRENT: NO LOAD, 50% VOUT-PREBIAS

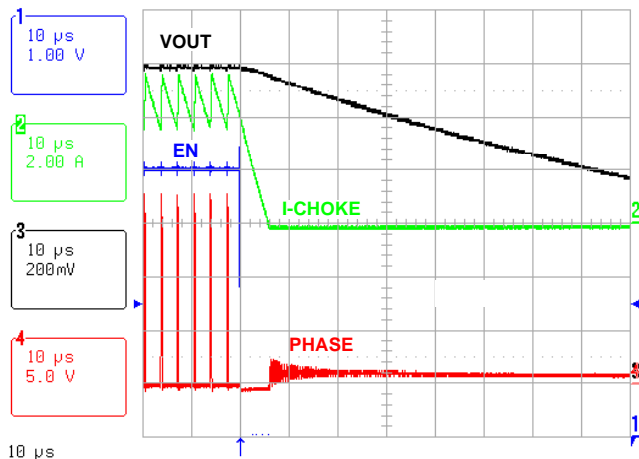


FIGURE 5. SHUTDOWN: EN FALLING, 250mΩ LOAD

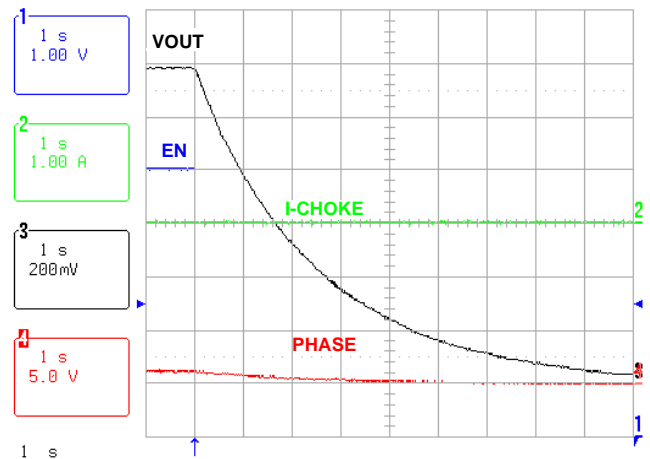


FIGURE 6. SHUTDOWN: EN FALLING, NO LOAD

Typical Waveforms (Continued)

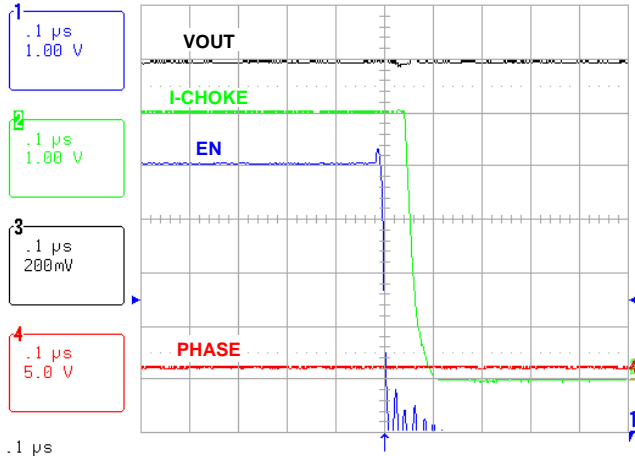


FIGURE 7. SHUTDOWN: EN-FALLING TO PGOOD-FALLING, NO LOAD

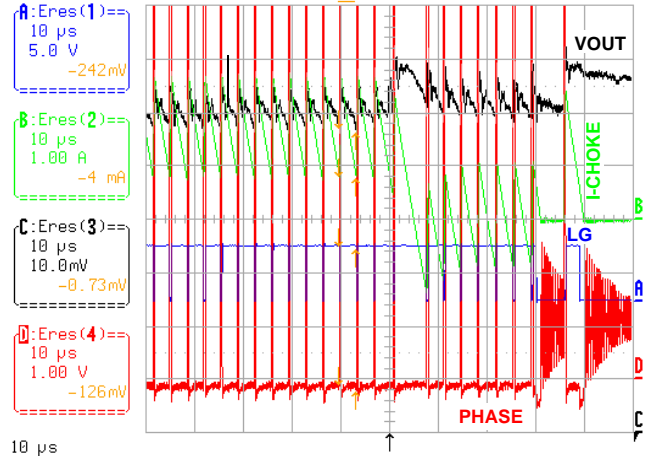


FIGURE 8. ENTERING DEM: 750mΩ LOAD DUMP, 100mA DC STATIC LOAD

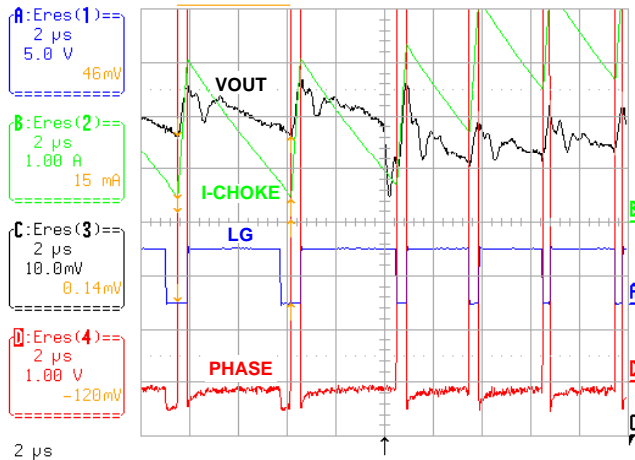


FIGURE 9. EXITING DEM: 750mΩ LOAD STEP, 1.75A DC STATIC LOAD

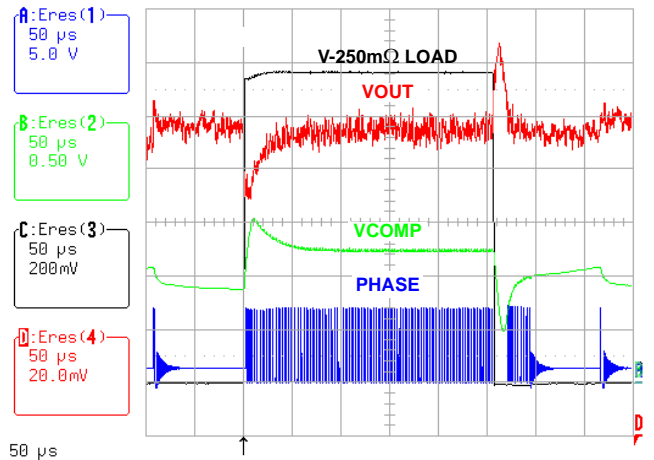


FIGURE 10. LOAD TRANSIENT: 250mΩ LOAD STEP, 10mA DC STATIC LOAD

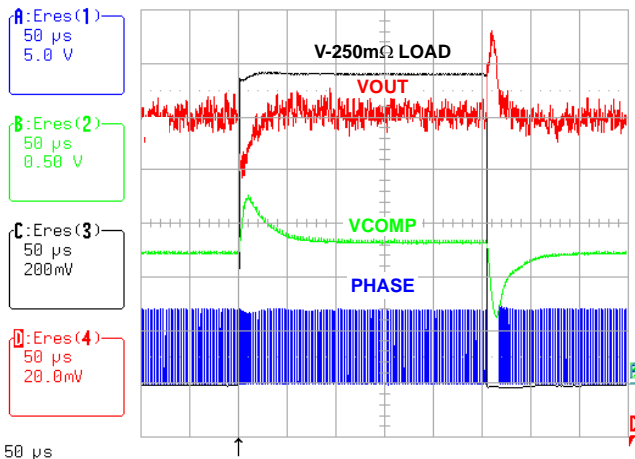


FIGURE 11. LOAD TRANSIENT: 250mΩ LOAD STEP, 5A DC STATIC LOAD

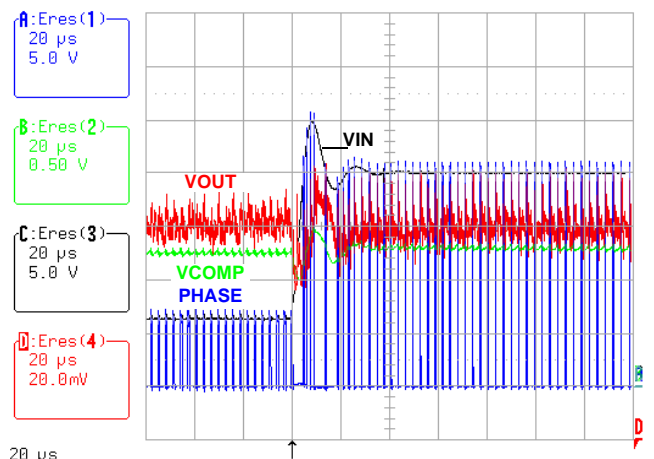
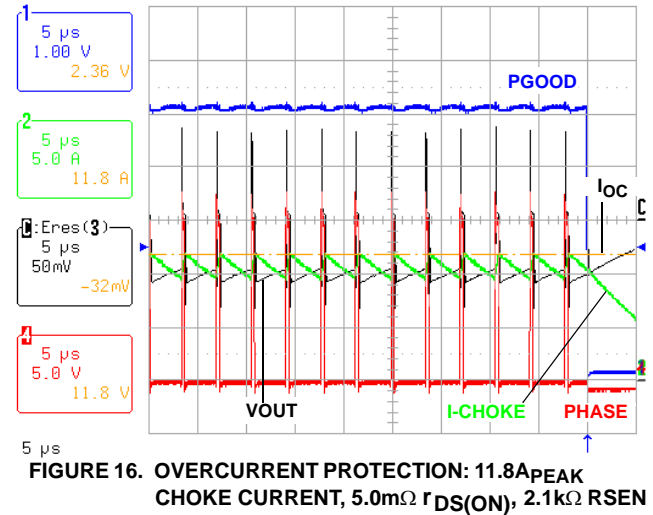
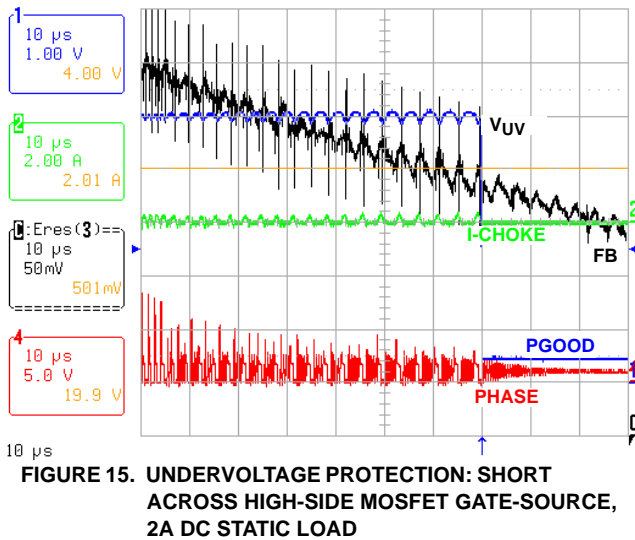
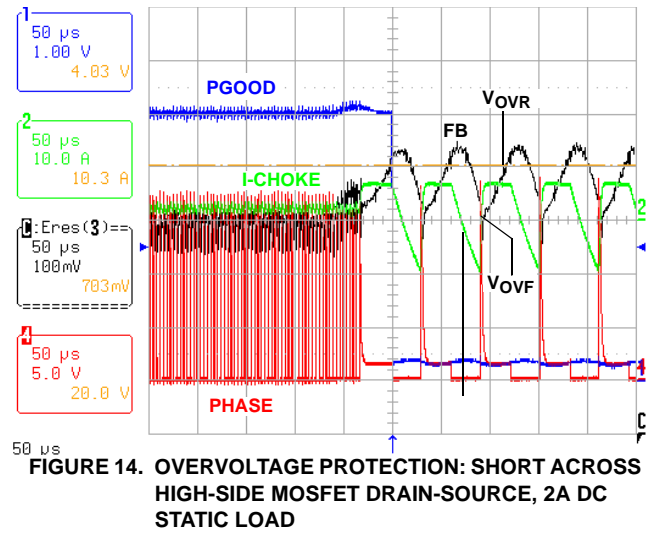
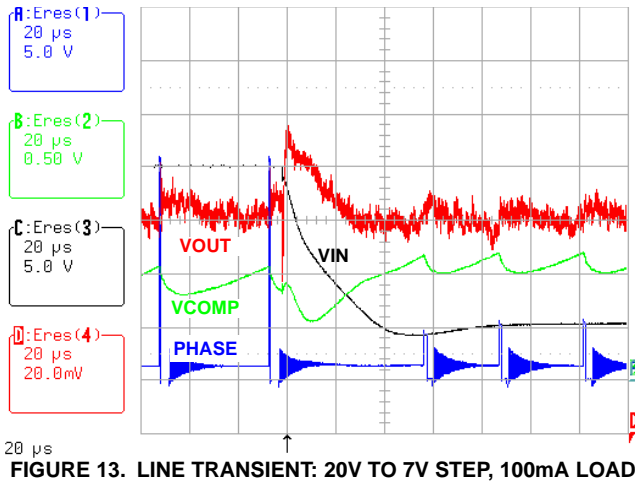


FIGURE 12. LINE TRANSIENT: 7V TO 20V STEP, 5A LOAD

Typical Waveforms (Continued)



The value of the OCP overcurrent programming resistor R_{SEN} is calculated using Equation 1:

$$R_{SEN} = \frac{(I_{FL} + \frac{I_{PP}}{2}) \cdot OC_{SP} \cdot r_{DS(ON)}}{I_{OC}} \quad (EQ. 1)$$

where:

- r_{DS(ON)} is the on-state resistance of the low-side MOSFET
 - I_{OC} is the I_{SEN} threshold current that trips the OCP circuit
 - I_{FL} is the maximum continuous design load current
 - I_{PP} is the inductor peak-to-peak ripple current
 - OC_{SP} is the desired OCP setpoint multiplier relative to I_{FL}
- The ISL6268EVAL1Z delivers 5A I_{FL} with approximately 30% inductor ripple current (1.5A_{p-p}). The low-side MOSFET has 5mΩ r_{DS(ON)}. The OCP setpoint should be chosen to avoid nuisance tripping due to component tolerances and temperature effects. The ISL6268EVAL1Z is programmed to 190% (OC_{SP} = 1.9). Using Equation 1 finds R_{SEN} = 2.1kΩ.

The value of the frequency programming resistor R_{FSET} is calculated using Equation 2:

$$R_{FSET} = \frac{1}{K \cdot f_{SW}} \quad (EQ. 2)$$

where:

- f_{SW} is the PWM switching frequency
- K = 66 × 10⁻¹²

The ISL6268EVAL1Z is programmed for 300kHz. Using Equation 2 finds R_{FSET} = 49.9kΩ.

The regulation voltage setpoint programming resistors R_{TOP} and R_{BOTTOM} are calculated using Equation 3:

$$V_{REF} = V_{OUT} \cdot \frac{R_{BOTTOM}}{R_{TOP} + R_{BOTTOM}} \quad (EQ. 3)$$

where:

- V_{REF} = 600mV

The ISL6268EVAL1Z is programmed for 1.20V, therefore, R_{TOP} = R_{BOTTOM}. The loop compensation is usually responsible for selecting R_{TOP}, which in this case is 2.49kΩ.

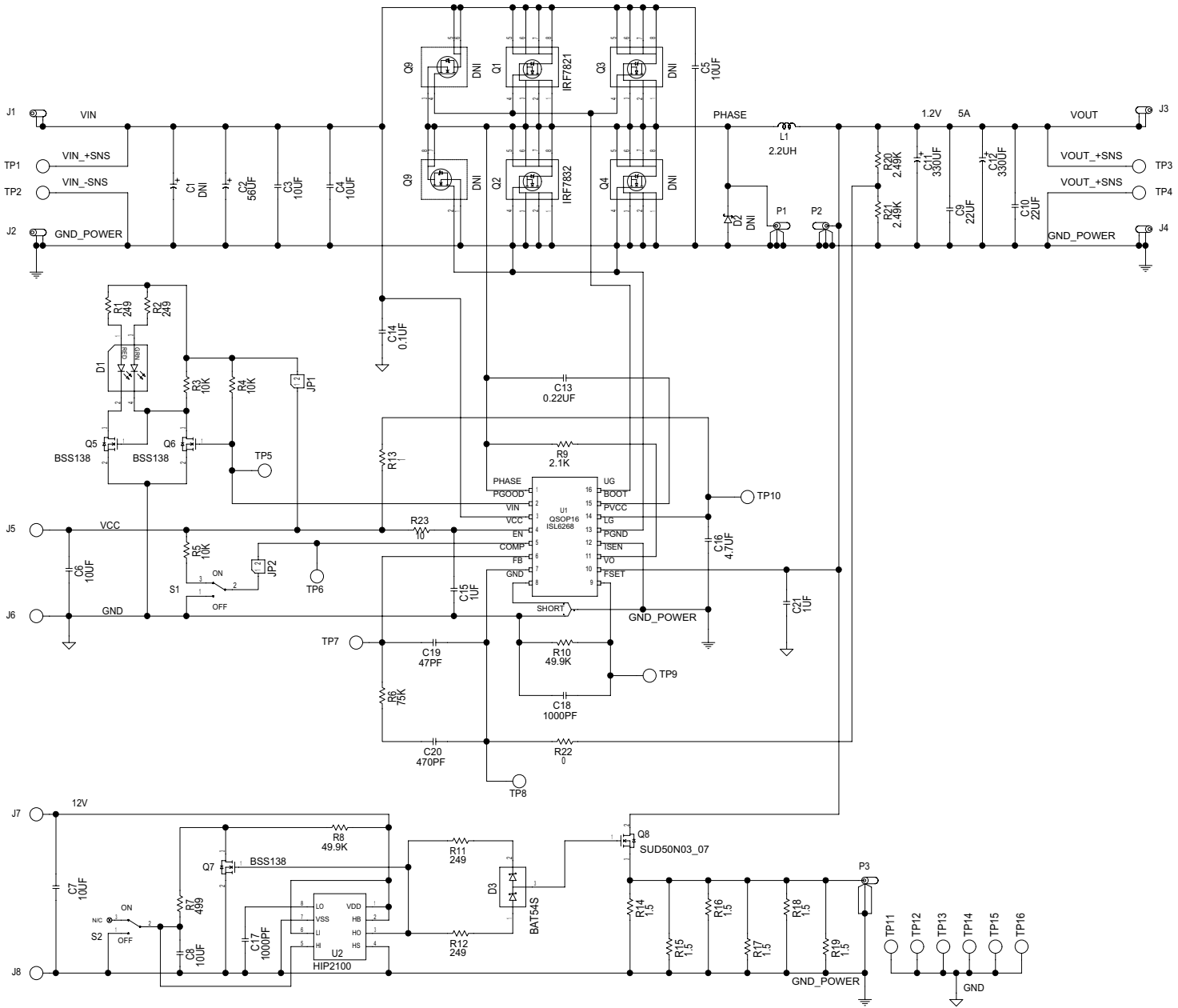


FIGURE 17. ISL6268EVAL1Z REV B CIRCUIT SCHEMATIC

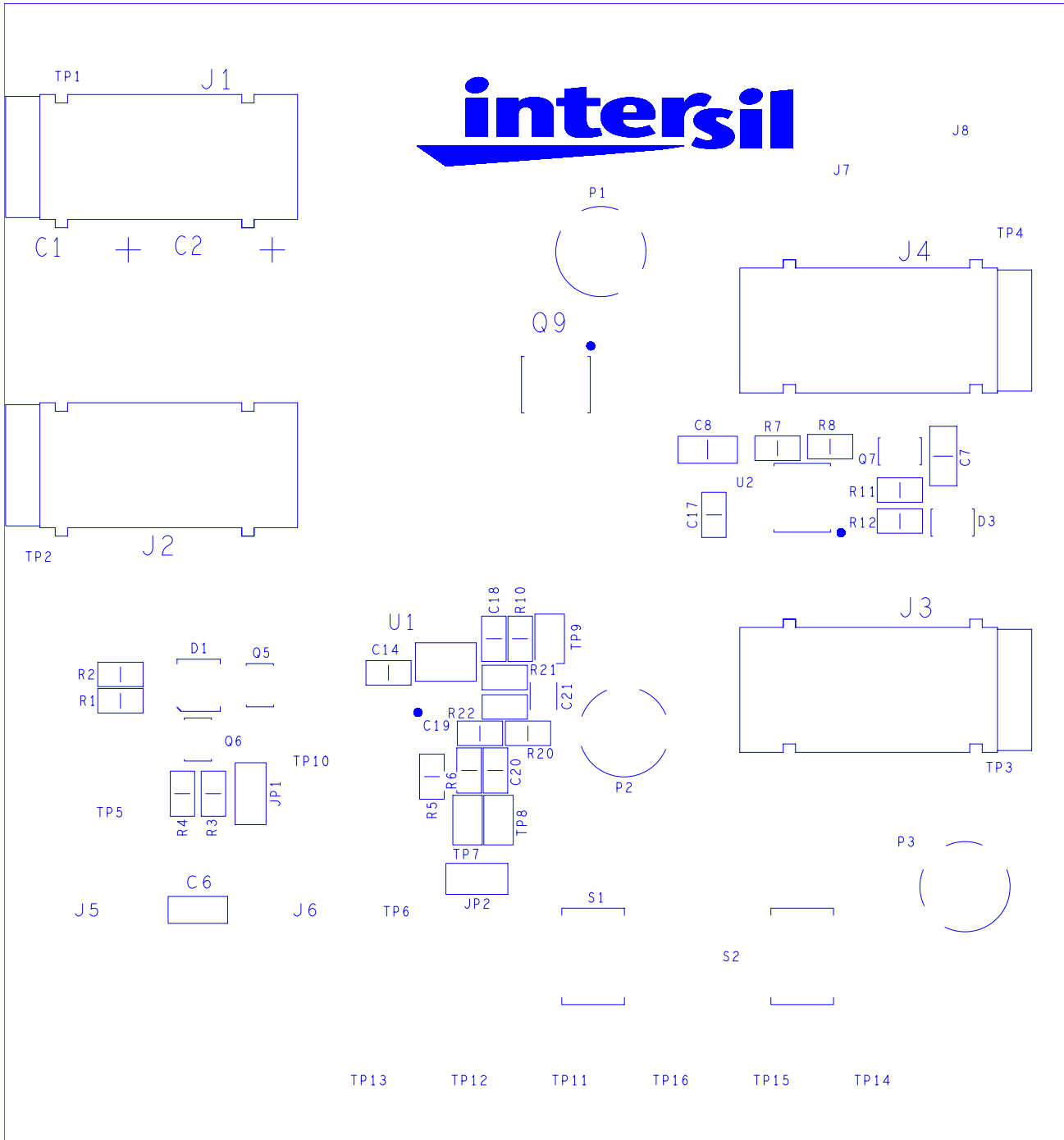


FIGURE 18. PCB TOP SILK SCREEN

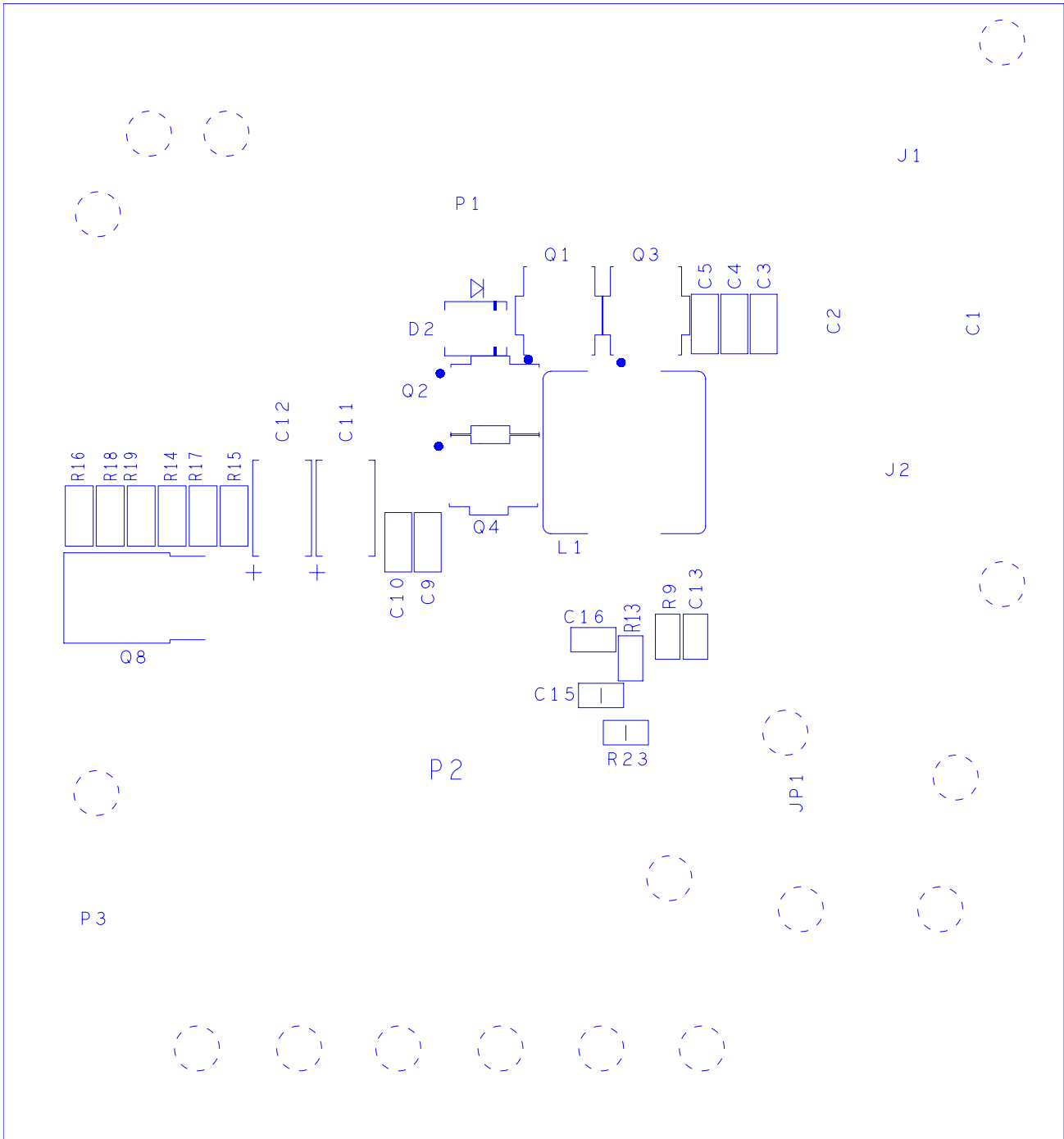


FIGURE 19. PCB BOTTOM SILK SCREEN (MIRRORED)

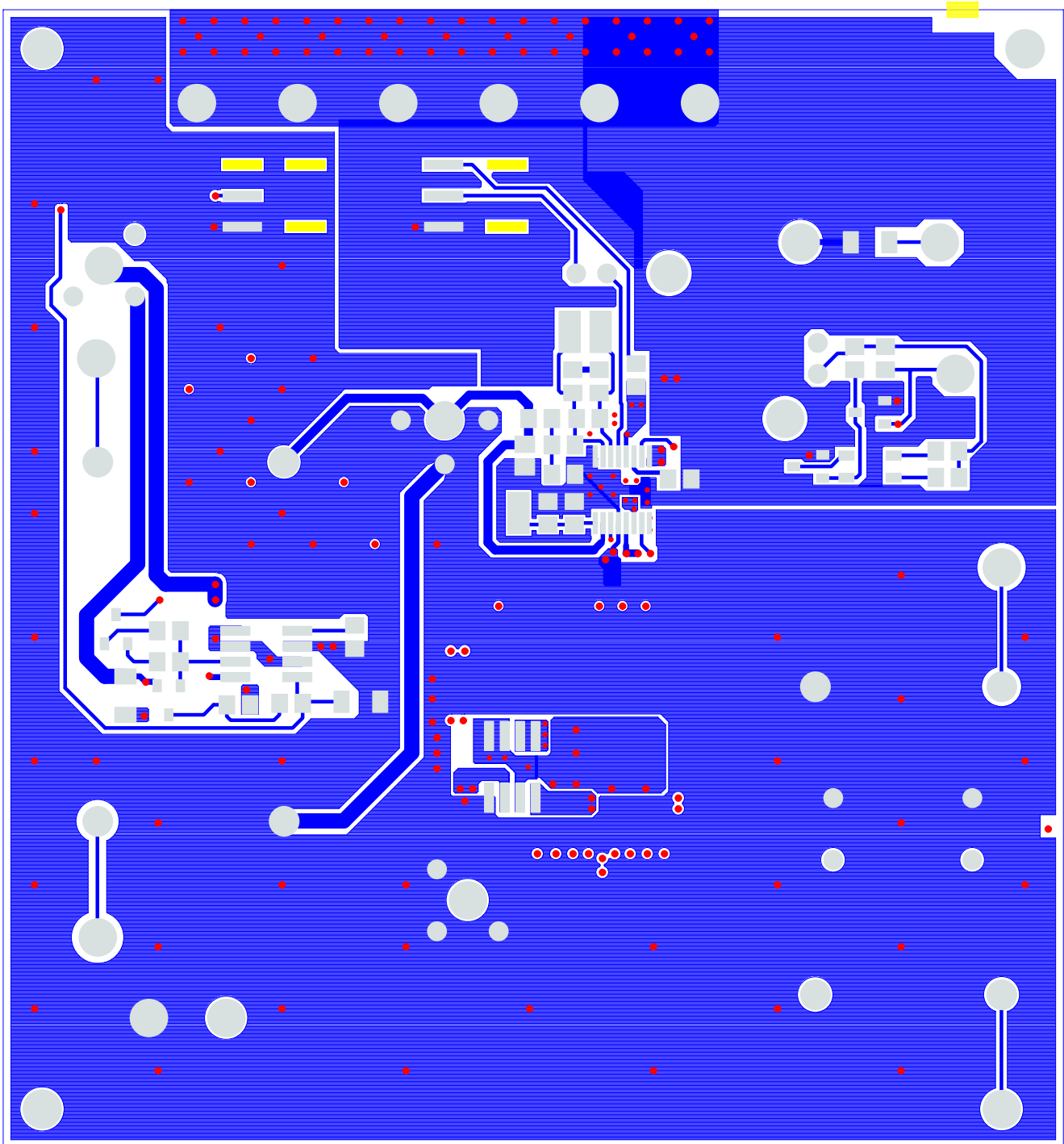


FIGURE 20. PCB TOP LAYER ETCH

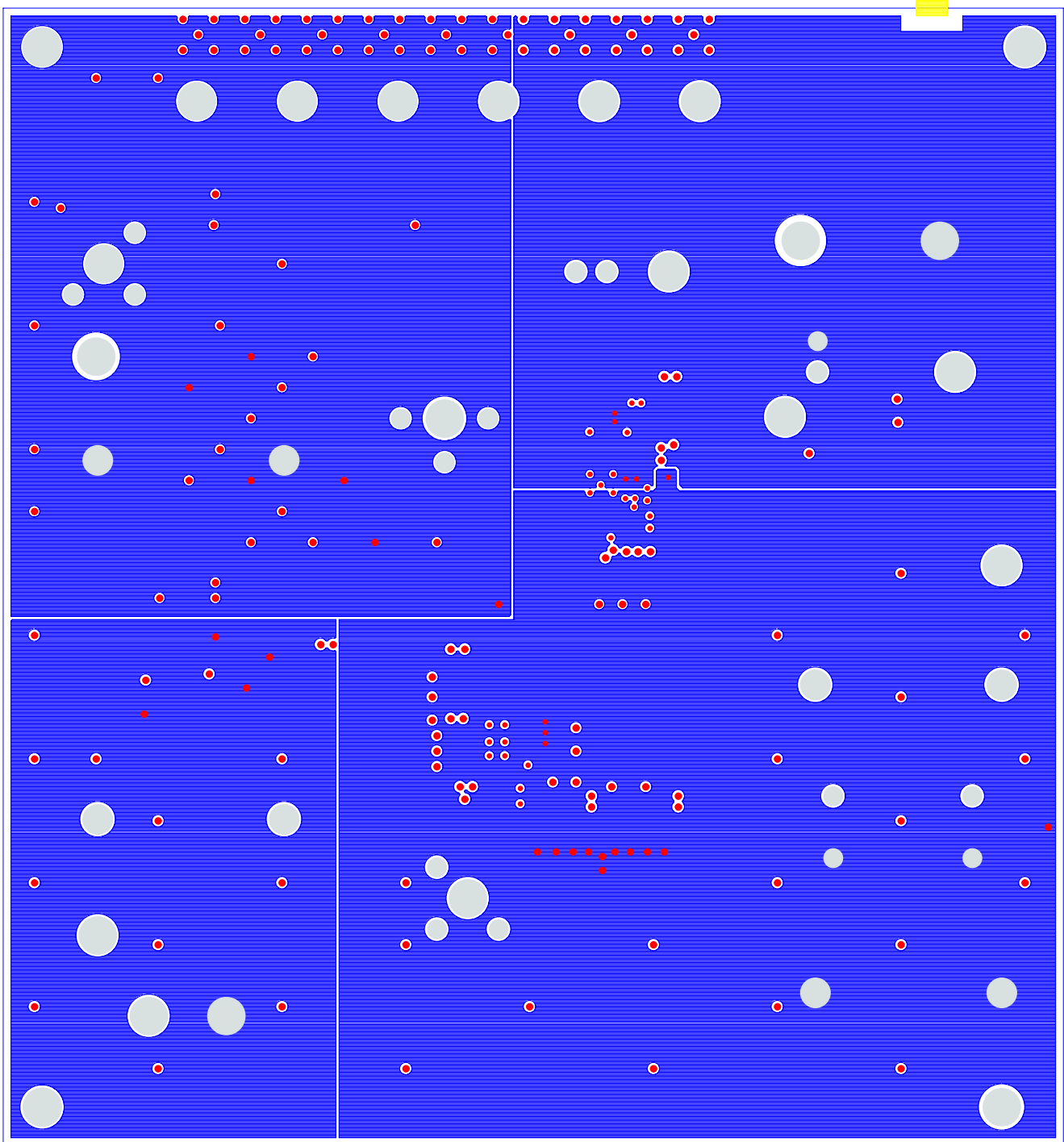


FIGURE 21. PCB LAYER 2 ETCH

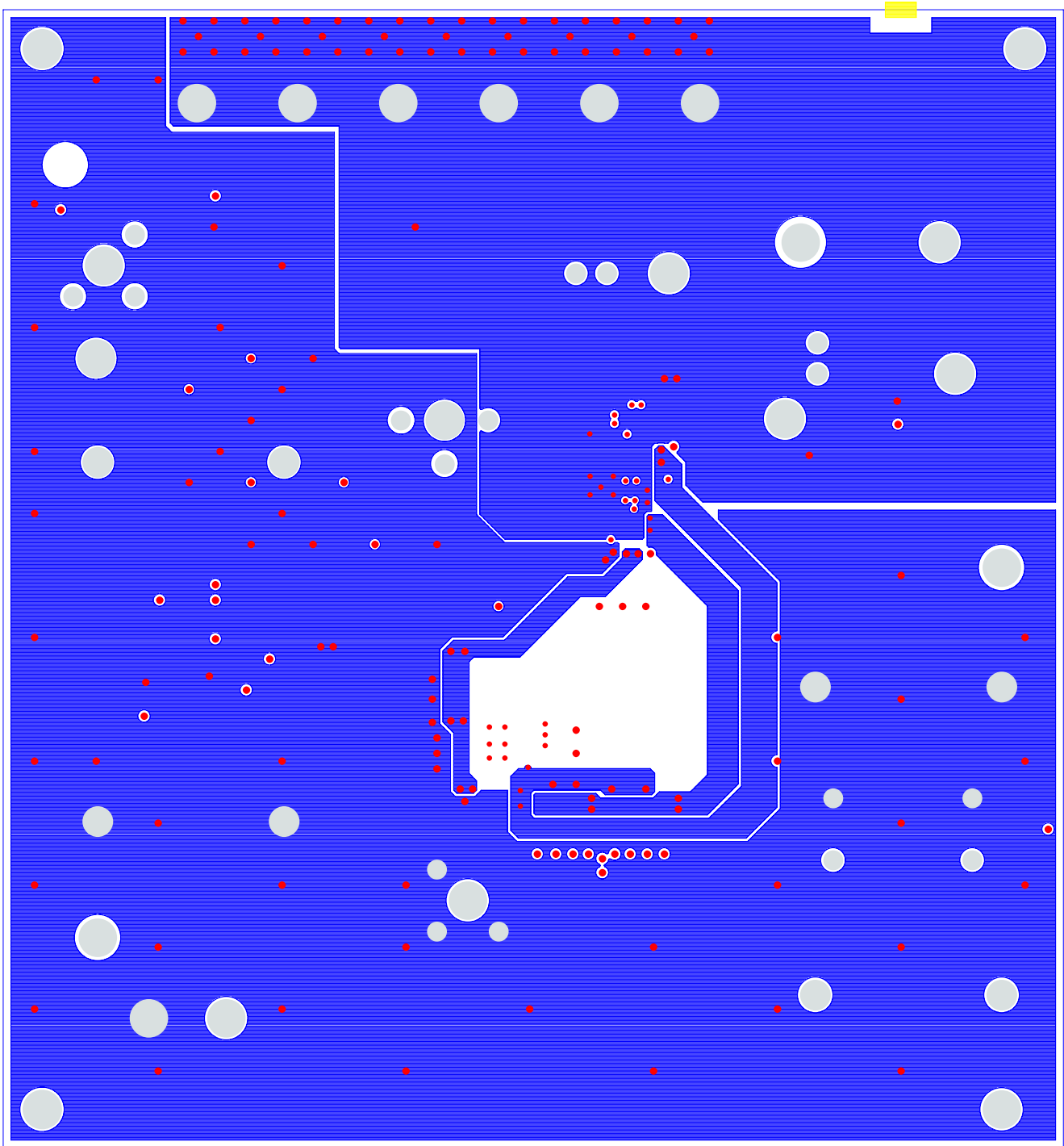


FIGURE 22. PCB LAYER 3 ETCH

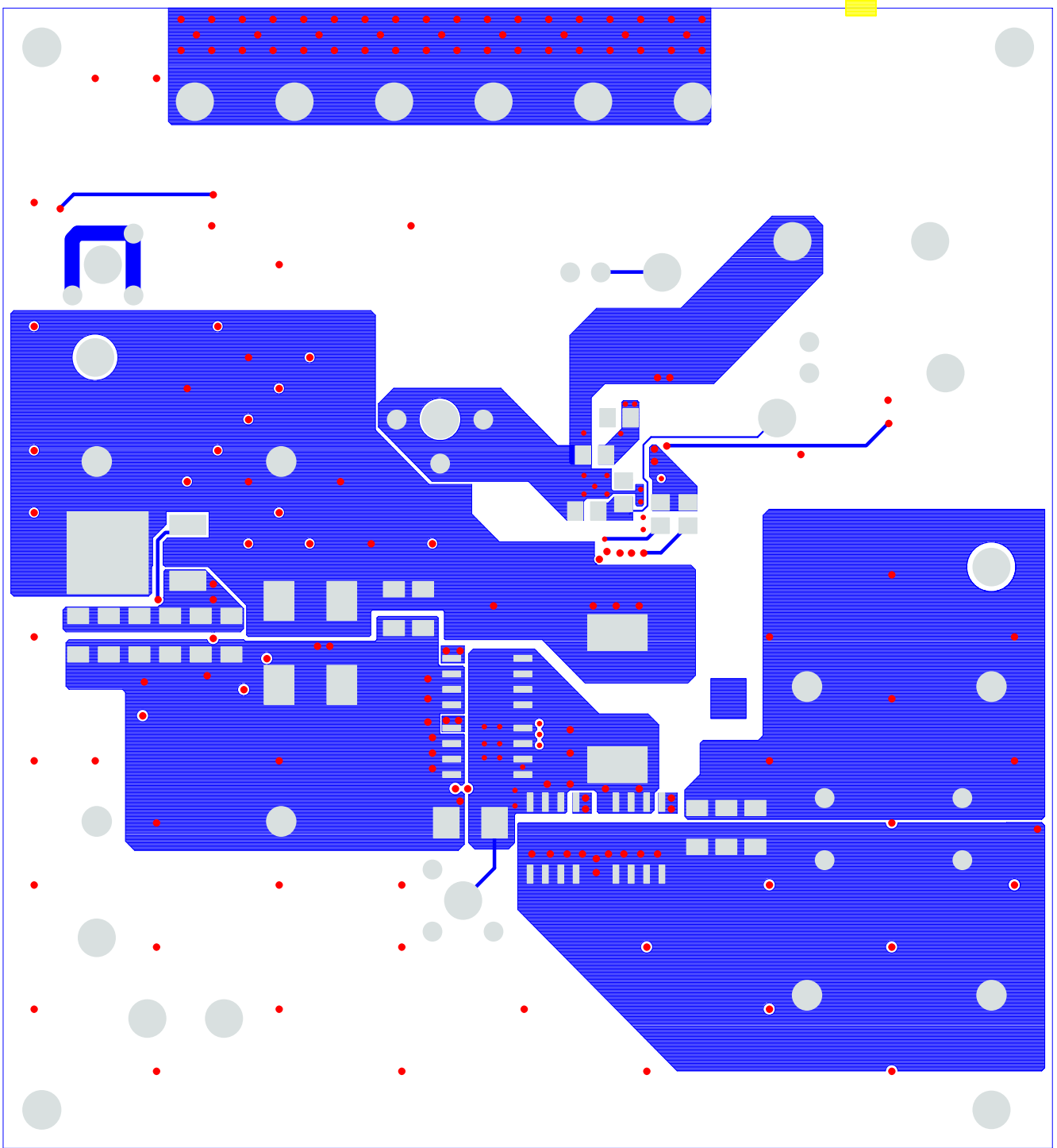


FIGURE 23. PCB BOTTOM LAYER ETCH

Application Note 1274

Bill of Materials

| QTY | REFERENCE | DESCRIPTION/COMMENT | MFG NAME | MFG NUMBER |
|-----|--------------------------------|---|-----------|---------------------|
| 1 | C2 | CAP, RADIAL, 56 μ F, 25V, OSCON | SANYO | 25SP56M |
| 2 | C11, C12 | CAP, SMD, [7.3mmx4.3mm], 330 μ F, 2V, 7m Ω , 20%, SP-CAP | PANASONIC | EEF-SD0D331R |
| 1 | C13 | CAPACITOR, 0805, 0.22 μ F, 16V, 20%, X7R | GENERIC | NA |
| 1 | C14 | CAPACITOR, 0805, 0.1 μ F, 50V, 20%, X7R | GENERIC | NA |
| 2 | C15, C21 | CAPACITOR, 0805, 1 μ F, 6.3V, 20%, X5R | GENERIC | NA |
| 1 | C16 | CAPACITOR, 0805, 4.7 μ F, 6.3V, 20%, X5R | GENERIC | NA |
| 2 | C17, C18 | CAPACITOR, 0805, 1000pF, 50V, 10%, X7R | GENERIC | NA |
| 1 | C19 | CAPACITOR, 0805, 47pF, 50V, 5%, X7R | GENERIC | NA |
| 1 | C20 | CAPACITOR, 0805, 470pF, 50V, 5%, X7R | GENERIC | NA |
| 2 | C9, C10 | CAPACITOR, 1206, 22 μ F, 6.3V, 20%, X5R | GENERIC | NA |
| 6 | C3 to C8 | CAPACITOR, 1206, 10 μ F, 25V, 20%, X5R | GENERIC | NA |
| 1 | D1 | LED, SMD, 3mmx2.5mm, 4P, RED/GREEN, 12/20MCD, 2V | LUMEX | SSL-LXA3025IGC-TR |
| 1 | D3 | DIODE, SCHOTTKY, DUAL, SOT23, 30V, 200mA | ON-SEMI | BAT54S |
| 3 | TP7, TP8, TP9 | TEST-POINT, SMD, 0.070x0.135 PAD | KEYSTONE | MTP5015SM |
| 2 | J1, J3 | PLUG, BANANA, THRU-HOLE, RED, 4.23mm | MOUSER | 164-6219 |
| 2 | J2, J4 | PLUG, BANANA, THRU-HOLE, BLK, 4.23mm | MOUSER | 164-6218 |
| 4 | J5, J7, TP1, TP3 | TEST-POINT, VERTICAL, RED | KEYSTONE | CTP5005 |
| 10 | J6, J8, TP2, TP4, TP11 to TP16 | TEST-POINT, VERTICAL, BLACK | KEYSTONE | CTP5006 |
| 3 | TP5, TP6, TP10 | TEST-POINT, VERTICAL, WHITE | KEYSTONE | CTP5007 |
| 2 | JP1, JP2 | HEADER, 1x2, RETENTIVE, 2.54mm | FCI | 68000-236 |
| 1 | L1 | INDUCTOR, SMD, 13mm, 2.2 μ H, 20%, 29A, SHIELDED | VISHAY | IHLP-5050CE-01-2R2M |
| 1 | Q1 | MOSFET, N-CH, SMD, 8P, SO8, 30V, 9.5m Ω | IR | IRF7821 |
| 1 | Q2 | MOSFET, N-CH, SMD, 8P, SO8, 30V, 4m Ω | IR | IRF7832 |
| 3 | Q5-Q7 | MOSFET, N-CH, SMD, 3P, SOT23, 50V, 200mA | FAIRCHILD | BSS138LT1 |
| 1 | Q8 | MOSFET, N-CH, SMD, TO-252AA, 30V, 7m Ω | SILICONIX | SUD50N03-07 |
| 4 | R1, R2, R11, R12 | RESISTOR, 0805, 249 Ω , 1% | GENERIC | NA |
| 2 | R8, R10 | RESISTOR, 0805, 49.9k Ω , 1% | GENERIC | NA |
| 1 | R13 | RESISTOR, 0805, 1 Ω , 5% | GENERIC | NA |
| 6 | R14 to R19 | RESISTOR, 1206, 1.5 Ω , 1% | GENERIC | NA |
| 1 | R22 | RESISTOR, 0805, 1k Ω , 1% | GENERIC | NA |
| 3 | R3 to R5 | RESISTOR, 0805, 10k Ω , 1% | GENERIC | NA |
| 1 | R6 | RESISTOR, 0805, 75k Ω , 1% | GENERIC | NA |
| 1 | R7 | RESISTOR, 0805, 499 Ω , 1% | GENERIC | NA |
| 1 | R9 | RESISTOR, 0805, 2.1k Ω , 1% | GENERIC | NA |
| 2 | R20, R21 | RESISTOR, 0805, 1.5k Ω , 1% | GENERIC | NA |
| 2 | S1, S2 | TOGGLE-SWITCH, SPDT, On-None-On, SMT | C&K | GT13MSCKE |
| 1 | U1 | IC, PWM-CONTROLLER, 1CH, 16P, SSOP | INTERSIL | ISL6268 |
| 1 | U2 | IC, DRIVER, BRIDGE, 8P, SOIC, 100V | INTERSIL | HIP2100B |
| | C1, D2, P1, P2, P3, Q3, Q4, Q9 | NOT POPULATED | | |

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