

## Introduction

The ISL62381 and ISL62382 evaluation boards demonstrate the performance of ISL62381 and ISL62382 Quad-output controllers. The ISL62381 and ISL62382 controller include two pulse-width modulation (PWM) controllers featured with Intersil's patented R<sup>3</sup> technology, adjustable from 0.6V to 5.5V, and two linear regulators, LDO5 and LDO3, that generate a fixed 5V and an adjustable output respectively.

The evaluation board includes two independent Enable switches, two LED Power-Good indicators and various test points. Included with each switching channel is 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  |
|------------------|-----------|-----------|------|
| ISL62381LOEVAL1Z | 3.3V/8A   | 5V/8A     | ~10A |
| ISL62381HIEVAL1Z | 1.05V/15A | 1.5V/15A  | ~20A |
| ISL62382LOEVAL1Z | 3.3V/8A   | 5V/8A     | ~10A |
| ISL62382HIEVAL1Z | 1.05V/15A | 1.5V/15A  | ~20A |

## What's Inside

The Evaluation Board Kit contains the following materials:

- ISL6238xxxEVAL1Z Evaluation Board
- ISL62381 and ISL62382 Datasheet
- ISL62381 And ISL62382 Evaluation Board User Guide (this document)

## What's Needed

The following materials will be needed to perform testing:

- Adjustable +25V, 30A Power Supply
- +12V, 100mA Power Supply
- Precision digital multi-meter
- 4 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 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.

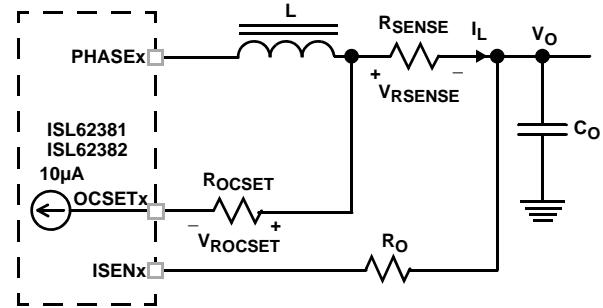


FIGURE 1. RESISTOR CURRENT SENSE CIRCUIT

For Channel-1, the ISL62381 and ISL62382 monitors 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 ISL62381 and ISL62382 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

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

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)

## Application Note 1396

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  $R_{34}$ ,  $R_{40}$  for the rising edge, and  $R_{38}$ ,  $R_{39}$  for the falling edge. +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   |
| TP20                              | +12V       | +12V positive power input, used for the power supply of the on-board dynamic-load generator                                 |
| TP19                              | GND        | +12V return power input   |
| <b>TEST POINTS</b>                |            |   |
| J1                                | PHASE2     | Scope-probe socket for measuring Channel-2 phase node   |
| J3                                | PHASE1     | Scope-probe socket for measuring Channel-1 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   |
| J6                                | FLOAT_EN1  | Remove the jumper will float the EN1 pin  |
| J7                                | FLOAT_EN2  | Remove the jumper will float the EN2 pin  |
| TP17                              | 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 INDICATORS</b>      |            |   |
| TP13                              | PGOOD1     | Test point of PGOOD1 pin  |
| TP5                               | PGOOD2     | Test point of PGOOD2 pin  |
| D1                                |            | Channel-1 Power-Good indicator. Green when VOUT1 is in regulation.  |
| D2                                |            | Channel-2 Power-Good indicator. Green when VOUT2 is in regulation.  |
| <b>LINEAR REGULATORS</b>          |            |   |
| TP14                              | LDO5       | LDO5 linear regulator positive power output   |
| TP15                              | GND        | LDO5 linear regulator return power output   |
| TP16                              | LDO3IN     | Input of LDO3 linear regulator. Connect to connected to a voltage greater than the LDO3 set point plus the dropout voltage. |
| TP18                              | LDO3FB     | LDO3 linear regulator output voltage feedback test point  |
| TP6                               | LDO3       | LDO3 linear regulator positive power output   |
| TP7                               | GND        | LDO3 linear regulator return power output   |

**Connections and Test Points**

The following table describes the function and operation of the evaluation boards. **(Continued)**

| SWITCHES |  |  |
|----------|--|--|
| 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<br>OFF: Low level for EN1, EN2, LDO3EN and FCCM, respectively                     |

**Test Set-up**

Figure 2 shows a typical test configuration.

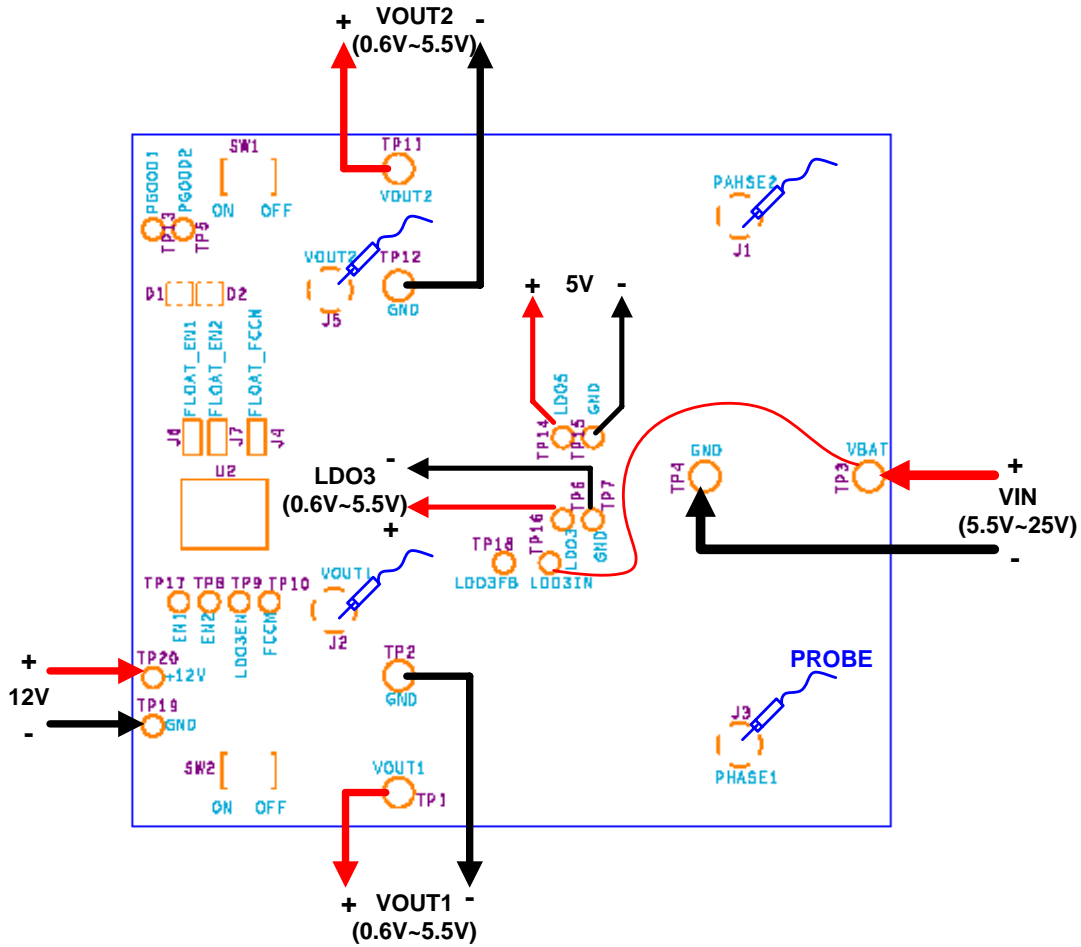


FIGURE 2. TYPICAL TEST CONFIGURATION

## Application Note 1396

### ISL62381LOEVAL1Z, ISL62382LOEVAL1Z Evaluation Board Bill of Materials

ISL62381LOEVAL1Z and ISL62382LOEVAL1Z 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/<br>POWER | TOL.<br>(%) | 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, C10                     | 2   | 1 $\mu$ F      | 10V               | 10          | GENERIC      | SM_CAP_0603, 1 $\mu$ F, 10V, 10%, X7R, ROHS                  |
| 7   | C30                         | 1   | 1 $\mu$ F      | 25V               | 10          | GENERIC      | SM_CAP_0805, 1 $\mu$ F, 25V, 10%, X7R, ROHS                  |
| 8   | C11, C24                    | 2   | 1 $\mu$ F      | 25V               | 10          | GENERIC      | SM_CAP_1206, 1 $\mu$ F, 25V, 10%, X7R, ROHS                  |
| 9   | C1, C2, C28, C29            | 4   | 4.7 $\mu$ F    | 10V               | 10          | GENERIC      | SM_CAP_0805, 4.7 $\mu$ F, 10V, 10%, X7R, ROHS                |
| 10  | C20, C21                    | 2   | 4.7 $\mu$ F    | 10V               | 10          | GENERIC      | SM_CAP_1206, 4.7 $\mu$ F, 10V, 10%, X7R, ROHS                |
| 11  | C16, C18, C31, C32          | 4   | 10 $\mu$ F     | 16V               | 10          | GENERIC      | SM_CAP_0805, 10 $\mu$ F, 16V, 10%, X5R, ROHS                 |
| 12  | C3                          | 1   | 56 $\mu$ F     | 25V               | 20          | SANYO-OSCON  | RADIAL_POLCAP_RADIAL, 25SP56M, 56 $\mu$ F, 25V, 20%, CASE-CC |
| 13  | C4, C26                     | 2   | 330 $\mu$ F    | 6.3V              | 10          | SANYO-POSCAP | SM_POLCAP_SMD, 6TPF330M9L, 330UF, 6.3V, 10%, CAP_7343        |
| 14  | R12, R15                    | 2   | 750            | 1/10W             | 1           | GENERIC      | SM_RES_0603, 750, 1/10W, 1%, TF, ROHS                        |
| 15  | R11, R30                    | 2   | 10k            | 1/10W             | 1           | GENERIC      | SM_RES_0603, 10k, 1/10W, 1%, TF, ROHS                        |
| 16  | R14                         | 1   | 9.09k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 9.09k, 1/10W, 1%, TF, ROHS                      |
| 17  | R13                         | 1   | 68.1k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 68.1k, 1/10W, 1%, TF, ROHS                      |
| 18  | R7, R18, R19, R22           | 4   | 15.8k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 15.8k, 1/10W, 1%, TF, ROHS                      |
| 19  | R29                         | 1   | 17.4k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 17.4k, 1/10W, 1%, TF, ROHS                      |
| 20  | R8                          | 1   | 19.6k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 19.6k, 1/10W, 1%, TF, ROHS                      |
| 21  | R9                          | 1   | 24.3k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 24.3k, 1/10W, 1%, TF, ROHS                      |
| 22  | R16                         | 1   | 45.3k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 45.3k, 1/10W, 1%, TF, ROHS                      |
| 23  | R20, R33, R39               | 3   | 1k             | 1/10W             | 1           | GENERIC      | SM_RES_0603, 1k, 1/10W, 1%, TF, ROHS                         |
| 24  | R38                         | 1   | 1.58k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 1.58k, 1/10W, 1%, TF, ROHS                      |
| 25  | R17, R32                    | 2   | 48.7k          | 1/10W             | 1           | GENERIC      | SM_RES_0603, 48.7k, 1/10W, 1%, TF, ROHS                      |
| 26  | R1, R2, R10                 | 3   | 0              | 1/10W             | 1           | GENERIC      | SM_RES_0603, 0, 1/10W, 1%, TF, ROHS                          |
| 27  | R34, R40                    | 2   | 200            | 1/10W             | 1           | GENERIC      | SM_RES_0603, 200, 1/10W, 1%, TF, ROHS                        |
| 28  | R5, R27                     | 2   | 499            | 1/10W             | 1           | GENERIC      | SM_RES_0603, 499, 1/10W, 1%, TF, ROHS                        |
| 29  | R6, R21, R23, R24, R28, R31 | 6   | 100k           | 1/10W             | 1           | GENERIC      | SM_RES_0603, 100k, 1/10W, 1%, TF, ROHS                       |
| 30  | R35                         | 1   | 0.7            | 1W                | 1           | GENERIC      | SM_RES_2512, 0.7, 1W, 1%, TF, ROHS                           |
| 31  | R37                         | 1   | 0.5            | 1W                | 1           | GENERIC      | SM_RES_2512, 0.5, 1W, 1%, TF, ROHS                           |
| 32  | D1, D2                      | 2   | SSL_LXA3025IGC |                   |             | LUMEX        | SSL_LXA3025IGC_SMD-SSL-LXA3025IGC, LED_3x2_5MM               |
| 33  | D3, D4                      | 2   | BAT54S         |                   |             | DIODES       | SM_SCHOTTKY_BAT54S-BAT54S, SOT23                             |
| 34  | Q2, Q4                      | 2   | IRF7821PBF     |                   |             | IR           | 30V 13.6A N-Channel HEXFET Power MOSFET (Pb-free)            |

## Application Note 1396

### ISL62381LOEVAL1Z, ISL62382LOEVAL1Z Evaluation Board Bill of Materials

ISL62381LOEVAL1Z and ISL62382LOEVAL1Z 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/<br>POWER | TOL.<br>(%) | MANUFACTURER | DESCRIPTION   |
|-----|--|-----|-----------------------------|-------------------|-------------|--------------|---|
| 35  | Q3, Q5   | 2   | IRF7832PBF                  |                   |             | IR           | 30V 20A N-Channel HEXFET Power MOSFET (Pb-FREE)   |
| 36  | Q1, Q6, Q10, Q12   | 4   | 2N7002-7-F                  |                   |             | FAIRCHILD    | 2N7002_SOT23-2N7002-7-F,SOT23   |
| 37  | Q11, Q13   | 2   | SUD50N03-07                 |                   |             | VISHAY       | SUD50N03_07_TO252-SUD50N03-07, TO-252AA   |
| 38  | SW1, SW2   | 2   | GT11MSCBE-T                 |                   |             | C&K          | GT11MSCKE_SMT-GT11MSCBE-T, GT13MSCKE  |
| 39  | TP5, TP6, TP7, TP8, TP9, TP10, TP13, TP14, TP15, TP16, TP17, TP18, TP19, | 14  | 5002                        |                   |             | KEYSTONE     | TEST_POINT_THOLE-5002,MTP500X   |
| 40  | TP1, TP2, TP3, TP4, TP11, TP12   | 6   | 1514-2                      |                   |             | KEYSTONE     | TEST_POINT_THOLE-1514-2,TP-150C100P   |
| 41  | J1, J2, J3, J5   | 4   | 131-5031-00                 |                   |             | TEKTRONIX    | SCOPE_PROBE_5P_CONN-131-5031-00, TEK131-5031-00   |
| 42  | J4, J6, J7   | 3   | 68000-236                   |                   |             | FCI          | CONN2_DIP2-68000-236, CONN2   |
| 43  | U2   | 1   | 78B04S                      |                   |             | GRAYHILL     | DIP_SW4_SPST_DIP-78B04S, DIP8-SW4   |
| 44  | U1   | 1   | ISL62381HRTZ (ISL62382HRTZ) |                   |             | INTERSIL     | ISL62381HRTZ, 32 LD 5x5 TQFN (ISL62382HRTZ, 32 LD 5x5 TQFN)                               |
| 45  | U3, U4   | 2   | HIP2100IBZ                  |                   |             | INTERSIL     | HIP2100_SOIC-HIP2100IBZ,SOIC8_150_50  |
| 46  | 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 |
| 47  | R3, R25  | 2   | Wire                        |                   |             | GENERIC      | Wire short  |
| 48  | DCR SENSE  | 4   | Wire                        |                   |             | GENERIC      | Wire short  |
| 49  | Jumper Connector   | 3   | SPC02SYAN                   |                   |             | SULLINS      | Connector Jumper for J4, J6, J7   |
| 50  |  | 1   | PCB                         |                   |             | TBD          | ISL62381EVAL1ZREVA PCB  |
| 51  |  | 1   | Label                       |                   |             | TBD          | LABEL, FOR SERIAL NUMBER AND BOM REV #  |
| 52  | C5, C27, C33, C34, C35, C36  | 6   | No-pop                      |                   |             |              |   |
| 53  | R4, R26, R36, R41  | 4   | No-pop                      |                   |             |              |   |
| 54  | Q7, Q8, Q9, Q14  | 4   | No-pop                      |                   |             |              |   |

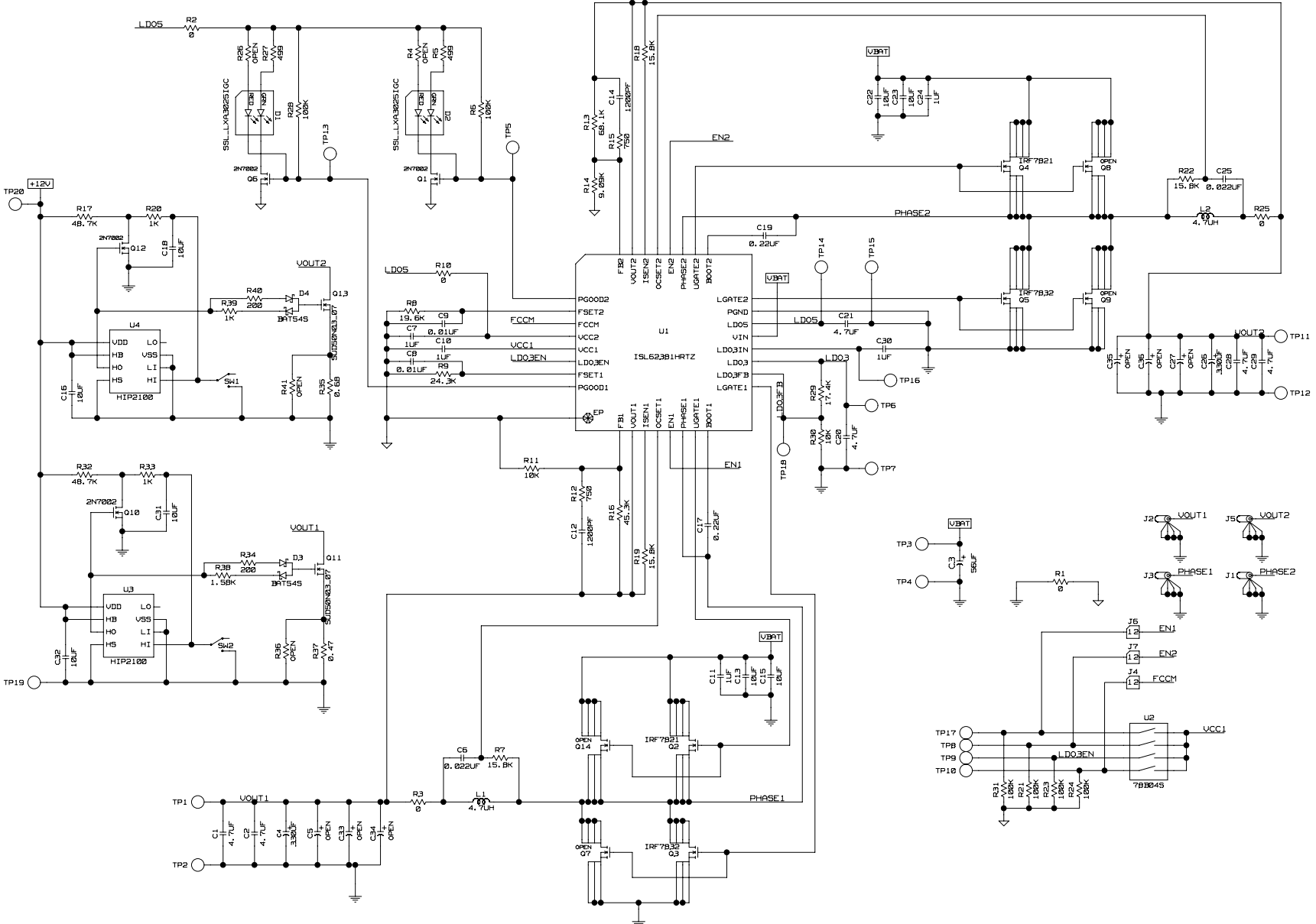
## Application Note 1396

### **ISL62381HIEVAL1Z, ISL62382HIEVAL1Z Evaluation Board Bill of Materials**

The ISL62381HIEVAL1Z, ISL62382HIEVAL1Z evaluation boards use the same PCB and schematic as the ISL62381LOEVAL1Z, ISL62382LOEVAL1Z evaluation boards but different bill of materials (BOM). The following table shows the BOM difference of ISL62381HIEVAL1Z, ISL62382HIEVAL1Z in comparison with ISL62381LOEVAL1Z, ISL62382LOEVAL1Z.

| NO. | REFERENCE DESIGNATOR | QTY | VALUE      | VOLTAGE /POWER | TOL. (%) | MANUFACTURER | DESCRIPTION  |
|-----|----------------------|-----|------------|----------------|----------|--------------|--|
| 1   | Q8, Q14              | 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  | R35                  | 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  | R38                  | 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  | C33, C36             | 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 |

# ISL6238xxxEVAL1Z Evaluation Board Schematic



ISL6238xxxEVAL1Z Evaluation Board Layout

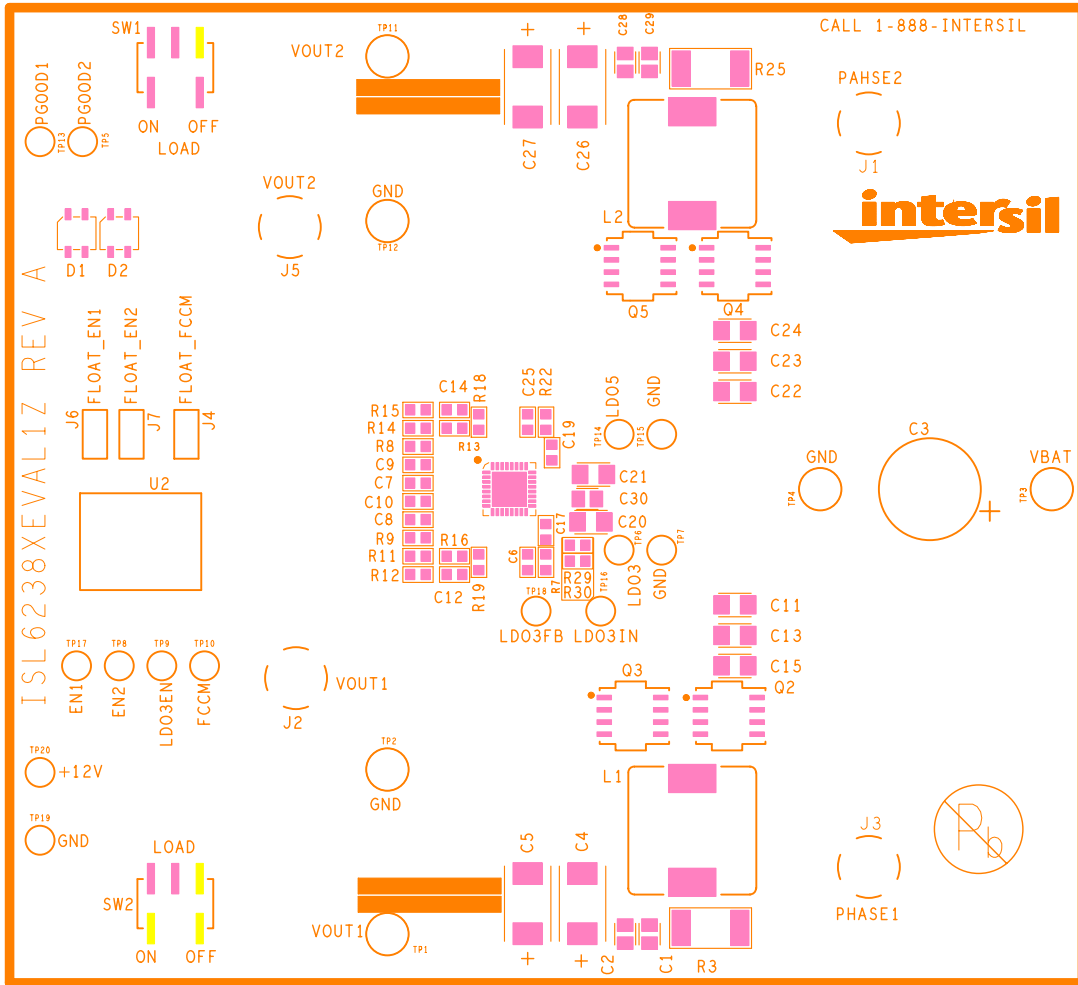


FIGURE 3. TOP SILKSCREEN



ISL6238xxxEVAL1Z Evaluation Board Layout (Continued)

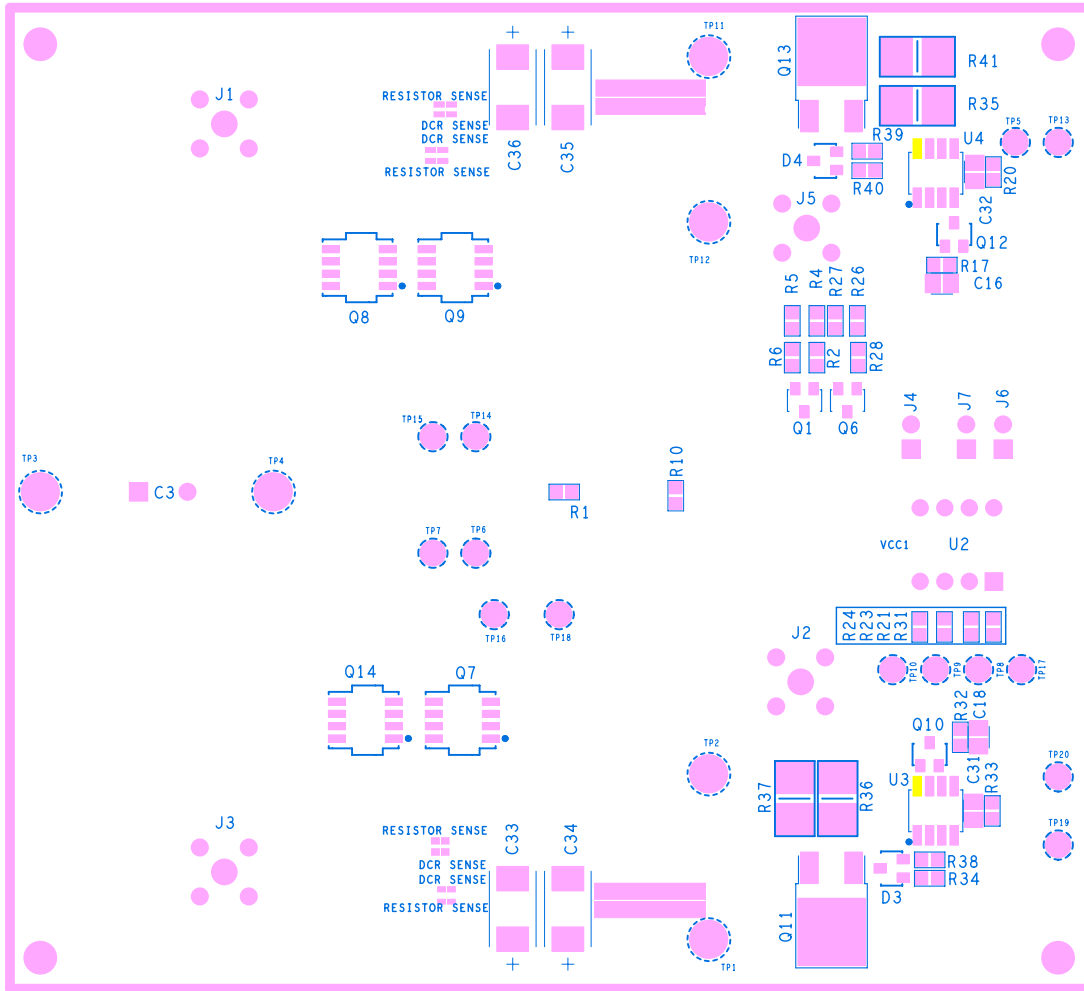


FIGURE 4. BOTTOM SILKSCREEN

ISL6238xxxEVAL1Z Evaluation Board Layout (Continued)

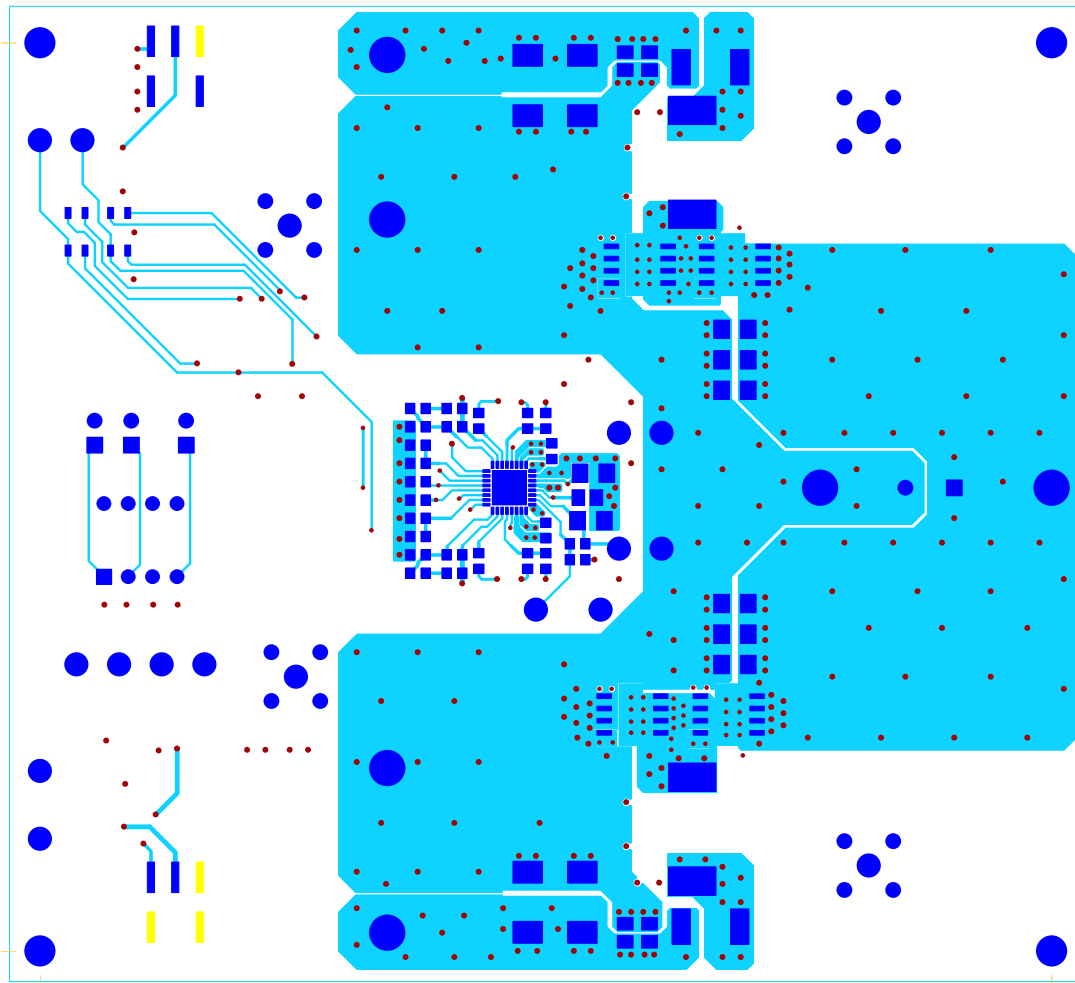


FIGURE 5. LAYER 1

ISL6238xxxEVAL1Z Evaluation Board Layout (Continued)

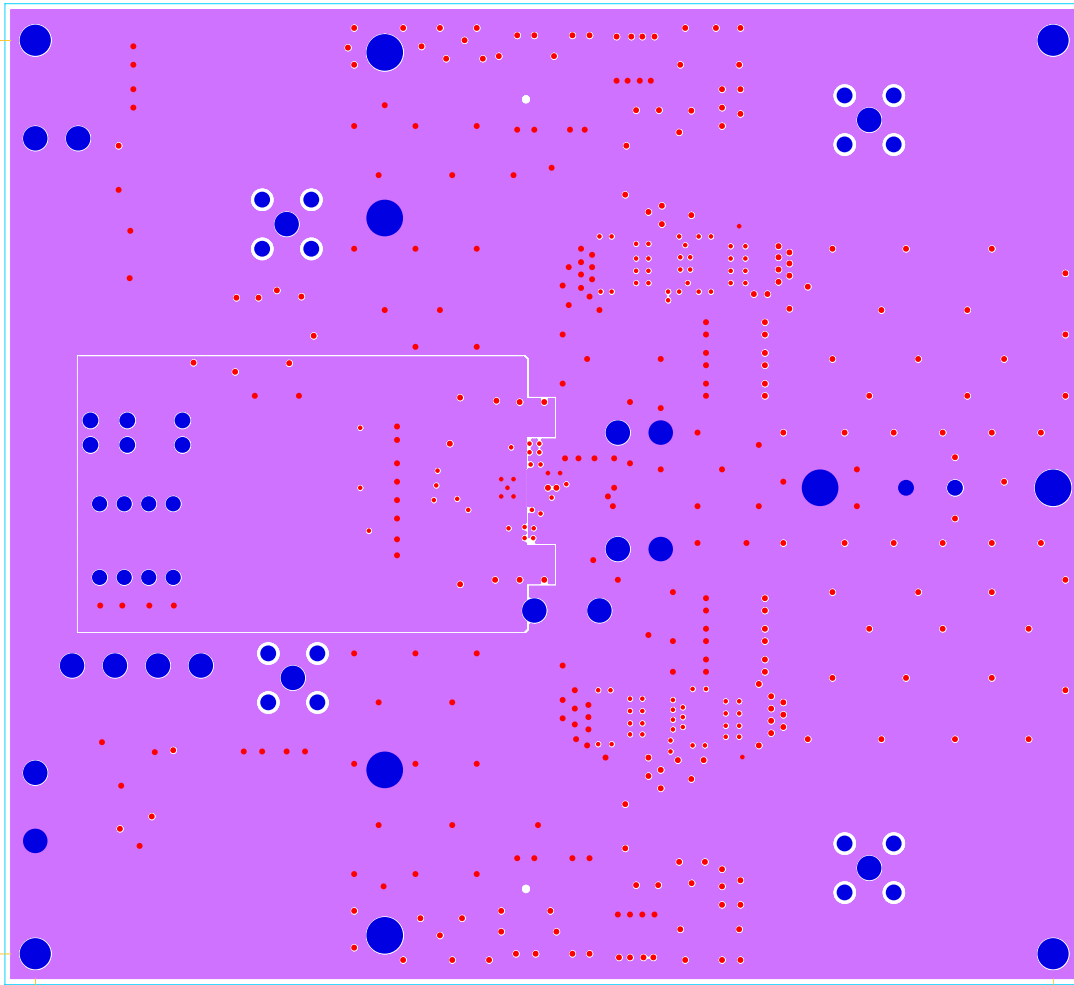


FIGURE 6. LAYER 2

ISL6238xxxEVAL1Z Evaluation Board Layout (Continued)

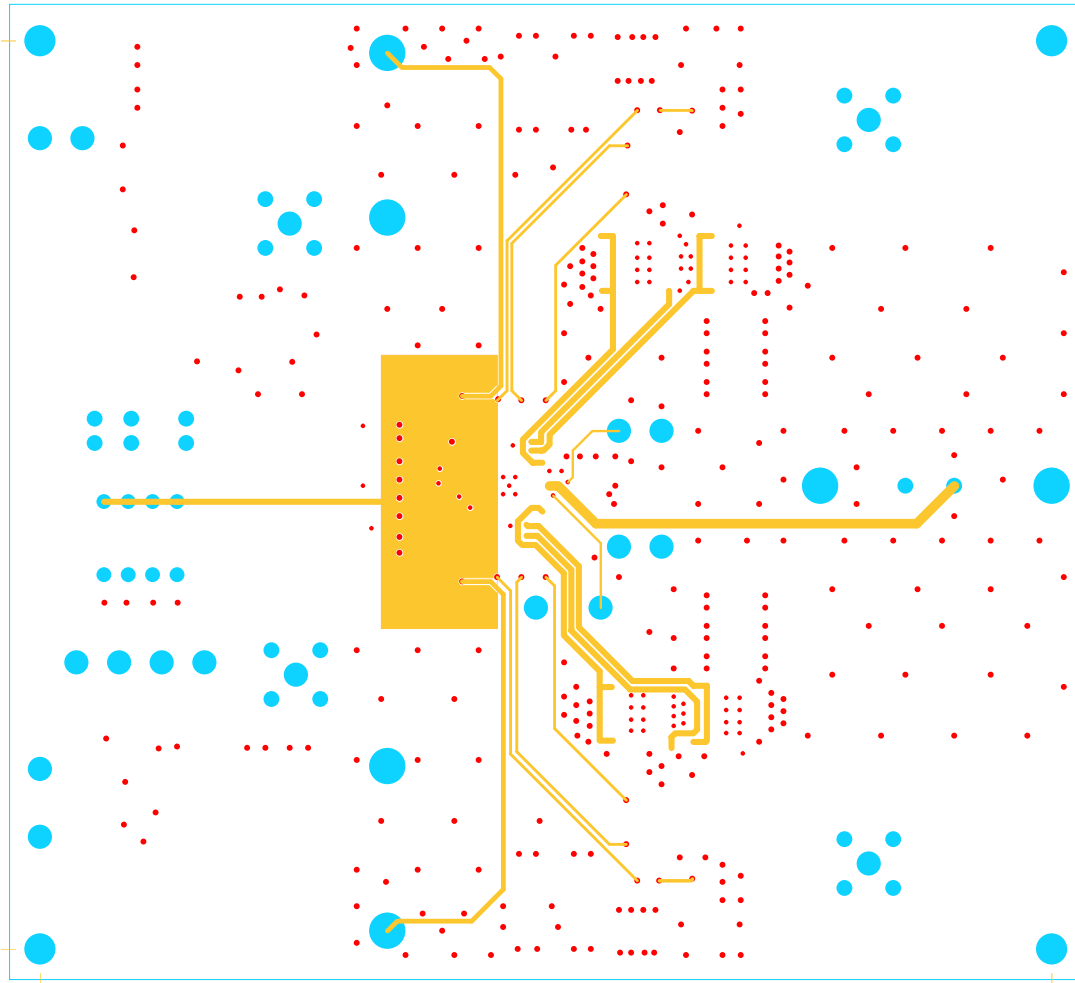


FIGURE 7. LAYER 3

ISL6238xxxEVAL1Z Evaluation Board Layout (Continued)

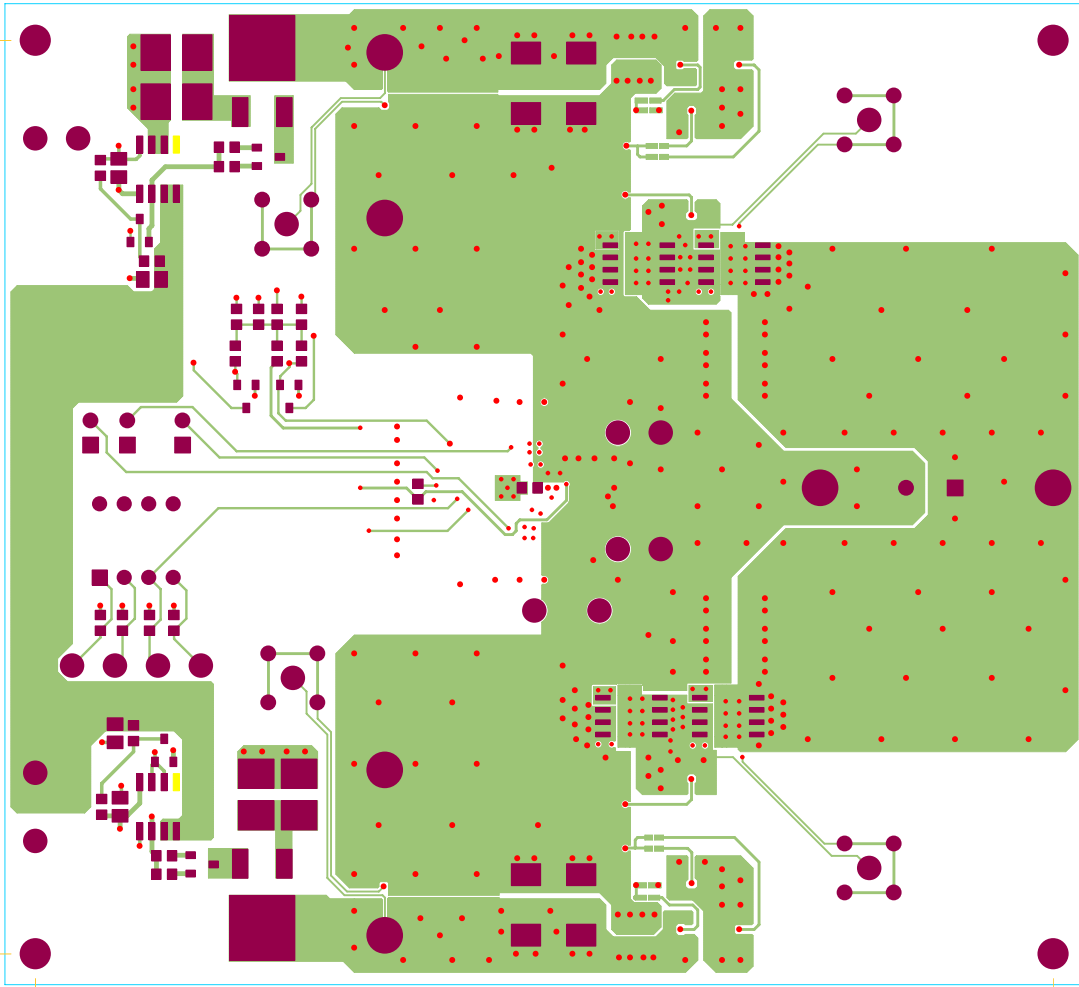


FIGURE 8. LAYER 4

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.

For information regarding Intersil Corporation and its products, see [www.intersil.com](http://www.intersil.com)