

ISL8225MEVAL4Z Evaluation Board User Guide

The [ISL8225M](#) is a complete, dual step-down switching mode DC/DC power module. The dual outputs can easily be paralleled for single-output, high current use. It is easy to apply this high-power, current sharing DC/DC power module to power-hungry datacom, telecom and FPGA applications. All that is needed in order to have a complete, dual 15A design ready for use are the ISL8225M, a few passive components and V_{OUT} setting resistors.

The simplicity of the ISL8225M is its off-the-shelf, unassisted implementation. Patented current sharing in multiphase operation greatly reduces ripple currents, BOM costs and complexity. The ISL8225M has a thermally enhanced, compact 17mmx17mmx7.5mm QFN package that operates at full load and over-temperature without requiring forced-air cooling. Easy access to all pins, with few external components, reduces PCB design to a component layer and a simple ground layer.

This ISL8225MEVAL4Z evaluation board is designed for dual 15A output applications. Optionally, this board can easily be converted for 30A single output use. Multiple ISL8225MEVAL4Z boards can be cascaded through the SYNC and CLKOUT pins to operate with phase shifting, for paralleling or multiple output use. The input voltage of this board is 4.5V to 20V and the default outputs on this board are set at 1.2V and 1.5V.

Related Resources



See how-to video at intersil.com/evic03

Related Literature

- [ISL8225M](#) datasheet

Specifications

This board has been configured and optimized for the following operating conditions:

- $V_{IN} = 4.5V$ to $20V$, $V_{O1} = 1.2V$, $V_{O2} = 1.5V$
- $I_{O1} = 15A$, $I_{O2} = 15A$
- $f_{SW} = 500kHz$

Key Features

- Full encapsulated dual step down switching power supply
- Up to 100W output
- Dual 15A or single 30A output
- 4.5V to 20V input range
- 0.6V to 7.5V output range
- 1.5% output voltage accuracy
- Up to 95% conversion efficiency

Ordering Information

| PART NUMBER | DESCRIPTION |
|----------------|---|
| ISL8225MEVAL4Z | Dual 15A/Optional 30A Cascadable Evaluation Board |

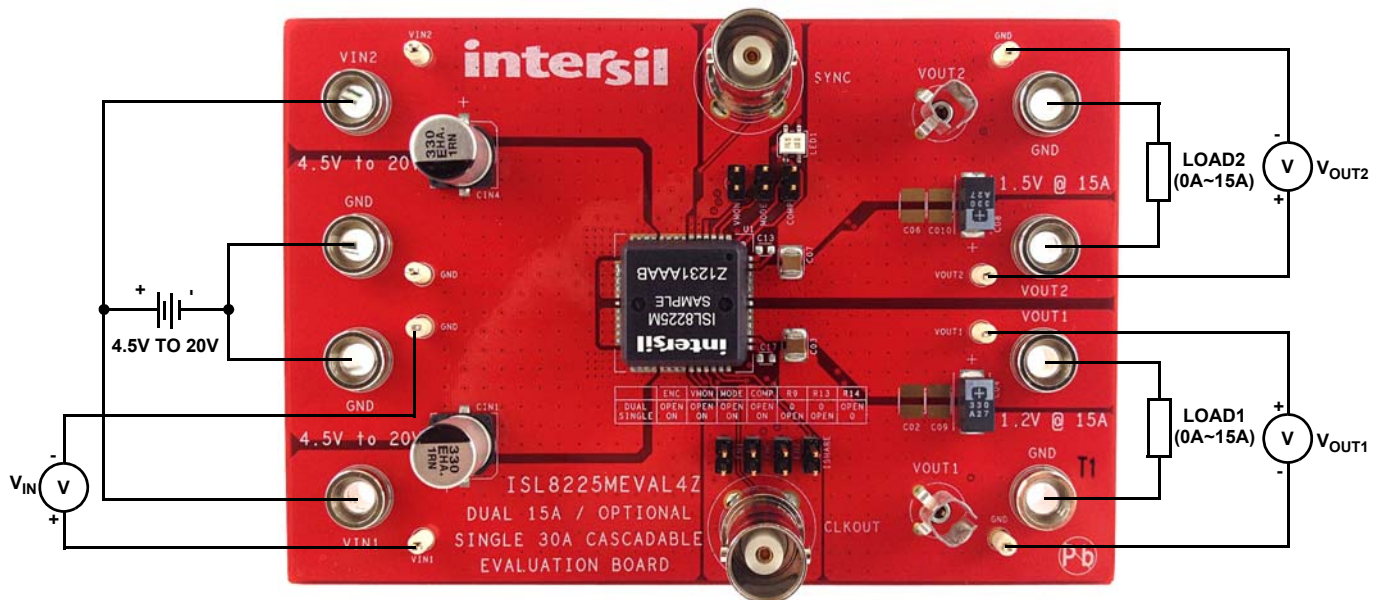


FIGURE 1. ISL8225MEVAL4Z BOARD IMAGE

Recommended Equipment

- 0V to 20V power supply with at least 5A source current capability
- Electronic load capable of sinking current up to 30A
- Digital multimeters (DMMs)
- 100MHz quad-trace oscilloscope

High Output Voltage Operation

The evaluation board is designed for output voltage below 5.5V. For output voltage higher than 6V, please refer to [Table 1](#) in the [ISL8225M](#) datasheet for selections of output capacitors, input capacitors and switching frequency. The maximum load capability of each phase is 10A for 6.5V output and 7A for 7.5V output.

Quick Start

For dual output operation, the inputs are BA7 (VIN1), BA8 (GND), BA3 (VIN2) and BA4 (GND). The outputs are BA5 (VOUT1), BA6 (GND), BA1 (VOUT2) and BA2 (GND).

For paralleled single output operation, the inputs are BA7 (VIN1) and BA8 (GND). The outputs are BA5 (VOUT1) and BA6 (GND) with BA5 and BA1 shorted.

Dual Output Mode

1. Connect a power supply capable of sourcing at least 5A to the inputs BA7 (VIN1), BA8 (GND), BA3 (VIN2) and BA4 (GND) of the ISL8225MEVAL4Z evaluation board, with a voltage between 4.5V to 20V. VIN1 and VIN2 can be different with R18 and R19 open.
2. Connect an electronic load or the device to be powered to the outputs BA5 (VOUT1) and BA6 (GND), BA1 (VOUT2) and BA2 (GND) of the board. All connections, especially the low voltage, high current V_{OUT} lines, should be able to carry the desired load current and should be made as short as possible.
3. Make sure that the setup is connected correctly. Turn on the power supply. If the board is working properly, the green LED will illuminate; if not, the red LED will illuminate (recheck the wire/jumper connections in this case). Measure the output voltages, V_{OUT1}, which should be at 1.2V and V_{OUT2}, which should be at 1.5V
4. If different output voltages are desired, board resistors can be exchanged to provide the desired V_{OUT}. Please refer to [Table 1](#) for R₂/R₄ resistor values, which can be used to produce different output voltages.

For 12V V_{IN} and V_{OUT} more than 1.5V, the switching frequency will need to be adjusted, as shown in [Table 1](#). The resistor R_{FSET} can be adjusted for the desired frequency. No frequency adjustments are necessary for V_{OUT} below 1.5V. For 5V V_{IN}, the frequency does not need to be adjusted and the module default frequency can be used at any allowed V_{OUT}. If the output voltage is set to more than 1.8V, the output current will need to be derated to allow for safe operation. Please refer to the derating curves in the [ISL8225M](#) datasheet.

TABLE 1. VALUE OF BOTTOM RESISTOR (TOP RESISTOR R₁, R₃ = 1kΩ) AND FREQUENCY SELECTION FOR DIFFERENT OUTPUT VOLTAGES

| V _{OUT} (V) | R ₂ /R ₄ (Ω) | FREQUENCY (kHz) | R _{FSET} (Ω) (V _{IN} = 12V) |
|----------------------|------------------------------------|-----------------|---|
| 1.0 | 1500 | DEFAULT | OPEN |
| 1.2 | 1000 | DEFAULT | OPEN |
| 1.5 | 665 | DEFAULT | OPEN |
| 2.5 | 316 | 650 | 249k |
| 3.3 | 221 | 800 | 124k |
| 5.0 | 137 | 950 | 82.5k |
| 5.5 | 121 | 950 | 82.5k |
| 6.5 | 102 | 750 | 147k |
| 7.5 | 86.6 | 750 | 147k |

Optional Paralleled Single Output Mode

1. To set up the parallel mode, short JP1 (ENC), JP2 (VMON) and JP3 (COMP) with a jumper. To set up 180° interleaving phase between 2 channels, short the MODE pin and GND pin of JP6 with a jumper.
2. Remove R₉ and R₁₃. Change R₁₄ to 0Ω. Change R₁₈ and R₁₉ to 0Ω. Short V_{OUT1} to V_{OUT2} using short wires or copper straps. Add C₂ for a 470pF capacitor.
3. Connect a power supply capable of sourcing at least 5A to the inputs BA7 (VIN1), BA8 (GND), BA3 (VIN2) and BA4 (GND) of the ISL8225MEVAL4Z evaluation board, with a voltage between 4.5V to 20V. VIN1 and VIN2 need to be shorted together.
4. Connect an electronic load or the device to be powered to the outputs BA5 (V_{OUT1}) and BA6 (GND) of the board. All connections, especially the low voltage, high current V_{OUT} lines, should be able to carry the desired load current and should be made as short as possible.
5. Make sure the setup is connected correctly prior to applying any power to the board. Adjust the power supply to 12V and turn on the input power supply. If the board is working properly, the green LED will illuminate; if not, the red LED will illuminate (recheck the wire/jumper connections in this case). Measure the output voltages, V_{OUT1}, which should be at 1.2V.
6. Apply any load that is less than 30A for normal steady state operation. Refer to [Table 1](#) to change the output voltage by changing resistor R₂.

TABLE 2. BOARD CONFIGURATION FOR SINGLE OUTPUT 30A APPLICATION

| | ENC | VMON | MODE | COMP | R ₉ | R ₁₃ | R ₁₄ |
|--------|------|------|------|------|----------------|-----------------|-----------------|
| Dual | OPEN | OPEN | OPEN | OPEN | 0 | 0 | OPEN |
| Single | ON | ON | ON | ON | OPEN | OPEN | 0 |

Optional Cascadable Mode

Cascadable mode is needed when multiple evaluation boards are used for paralleling or multiple output use. To demo the parallel features, it is recommended to use the ISL8225MEVAL2Z 6-phase evaluation board for an easy and efficient setup (see [AN1789](#) "ISL8225MEVAL2Z Evaluation Board User Guide"). Otherwise, follow the following steps:

1. In order to generate CLKOUT at a shifted phase clock signal, the control loop of V_{OUT2} needs to be disabled by connecting VSEN2- to VCC.
2. Program MODE and VSEN2+ pin voltages to set the CLKOUT signal and the shifted degrees between two phases on the board (refer to [Table 3 on page 4](#)).
3. Use a coaxial cable to connect CLKOUT (J5) to SYNC (J2) of the next evaluation board, which can be programmed for parallel or dual output use.
4. If the second board is programmed for parallel use, the ISHARE pins of the first and second boards need to be tied together. Using two twisted wires, short two different jumpers of JP7 (ISHARE/SGND) on two evaluation boards. Add 1nF capacitors of C_{14} for different boards to decouple the noise.
5. If the third board is used in cascadable mode, the second board can only be used in the parallel mode to generate the CLKOUT signal for the SYNC pin on the third board.
6. Follow the instructions from Steps 1 through 5 for more cascadable boards.

PCB Layout Guidelines

The evaluation board size is 114.3mmx76.2mm. It is a 4-layer board, containing 2-oz copper on all layers. The board can be used as a dual 15A reference design. Refer to "[ISL8225MEVAL4Z Board Layout](#)" on page 6. The board is made of FR4 material and all components, including the solder attachment, are lead-free.

Thermal Considerations and Current Derating

For high current applications, board layout is very critical in order to make the module operate safely and deliver maximum allowable power. To carry large currents, the board layout needs to be designed carefully to maximize thermal performance. To achieve this, select enough trace width, copper weight and the proper connectors.

This evaluation board is designed for running dual 15A at room temperature without additional cooling systems needed. However, if the output voltage is increased or the board is operated at elevated temperatures, then the available current is derated. Refer to the derated current curves in the [ISL8225M](#) datasheet to determine the output current available.

For layout of designs using the ISL8225M, the thermal performance can be improved by adhering to the following design tips:

1. Use the top and bottom layers to carry the large current. V_{OUT1} , V_{OUT2} , Phase 1, Phase 2, PGND, VIN1 and VIN2 should have large, solid planes. Place enough thermal vias to connect the power planes in different layers under and around the module.
2. Phase 1 and Phase 2 pads are switching nodes that generate switching noise. Keep these pads under the module. For noise-sensitive applications, it is recommended to keep phase pads only on the top and inner layers of the PCB; do not place phase pads exposed to the outside on the bottom layer of the PCB. To improve the thermal performance, the phase pads can be extended in the inner layer, as shown in Phase 1 and Phase 2 pads on layer 2 ([Figure 5 on page 6](#)) for this dual 15A evaluation board. Make sure that layer 1 and layer 3 have the GND layers to cover the extended areas of phase pads at layer 2 to avoid noise coupling.
3. Place the modules evenly on the board and leave enough space between modules. If the board space is limited, try to put the modules with low power loss closely together (i.e. low V_{OUT} or I_{OUT}) while still separating the module with high power loss.
4. If the ambient temperature is high or the board space is limited, airflow is needed to dissipate more heat from the modules. A heatsink can also be applied to the top side of the module to further improve the thermal performance (heatsink recommendation: Aavid Thermalloy, part number 375424B00034G, www.aavid.com).

Application Note 1793

TABLE 3. ISL8225M OPERATION MODES

| 1ST MODULE (I = INPUT; O = OUTPUT; I/O = INPUT AND OUTPUT, BI-DIRECTION) | | | | | | | | | | MODES OF OPERATION | | OUTPUT (SEE DESCRIPTION FOR DETAILS) |
|--|--|----------------|------------------------|-----------------|-----------------|---|------------------------|---|--|---|---|---|
| MODE | EN1/FF1 (I) | EN2/FF2 (I) | VSEN2- (I) | MODE (I) | VSEN2+ (I) | CLKOUT/REFIN WRT 1 ST (I OR O) | VMON2 (Note 2) | VMON1 OF 2 ND MODULE (Note 2) | 2 ND CHANNEL WRT 1 ST (O) (Note 1) | OPERATION MODE OF 2 ND MODULE | OPERATION MODE OF 3 RD MODULE | |
| 1 | 0 | 0 | - | - | - | - | - | - | - | - | - | Disabled |
| 2A | 0 | 1 | Active | Active | Active | - | Active | - | VMON1 = VMON2 to Keep PGOOD Valid | - | - | Single Phase |
| 2B | 1 | 0 | - | - | - | - | - | - | VMON1 = VMON2 to Keep PGOOD Valid | - | - | Single Phase |
| 3A | 1 | 1 | <V _{CC} -0.7V | Active | Active | 29% to 45% of V _{CC} (I) | Active | - | 0° | - | - | Dual Regulator |
| 3B | 1 | 1 | <V _{CC} -0.7V | Active | Active | 45% to 62% of V _{CC} (I) | Active | - | 90° | - | - | Dual Regulator |
| 3C | 1 | 1 | <V _{CC} -0.7V | Active | Active | >62% of V _{CC} (I) | Active | - | 180° | - | - | Dual Regulator |
| 4 | 1 | 1 | <V _{CC} -0.7V | Active | Active | <29% of V _{CC} (I) | Active | - | -60° | - | - | DDR Mode |
| 5A | 1 | 1 | V _{CC} | GND | - | 60° | VMON1 or Divider | - | 180° | - | - | 2-Phase |
| 5B | 1 | 1 | V _{CC} | GND | - | 60° | Divider | Divider | 180° | 5B | 5B | 6-Phase |
| 5C | 1 | 1 | V _{CC} | GND | - | 60° | VMON1 or Divider | Active | 180° | 5C | 5C | 3 Outputs |
| 6 | 1 | 1 | V _{CC} | V _{CC} | GND | 120° | 953Ω //22nF | Active | 240° | 2B | - | 3-Phase |
| 7A | 1 | 1 | V _{CC} | V _{CC} | V _{CC} | 90° | 953Ω //22nF | Divider | 180° | 7A | - | 4-Phase |
| 7B | 1 | 1 | V _{CC} | V _{CC} | V _{CC} | 90° | 953Ω //22nF | Active | 180° | 7B | - | 2 Outputs (1 st module in Mode 7A) |
| 7C | 1 | 1 | V _{CC} | V _{CC} | V _{CC} | 90° | 953Ω //22nF | Active | 180° | 3, 4 | - | 3 Outputs (1 st module in Mode 7A) |
| 8 | Cascaded Module Operation MODEs 5B+5B+7A+5B+5B+5B/7A, No External Clock Required | | | | | | | | | | | 12-Phase |
| 9 | External Clock or External Logic Circuits Required for Equal Phase Interval | | | | | | | | | | | 5, 7, 8, 9, 10, 11, or (PHASE >12) |

NOTES:

1. "2ND CHANNEL WRT 1ST" means "second channel with respect to first;" in other words, Channel 2 lags Channel 1 by the degrees specified in this column. For example, 90° means Channel 2 lags Channel 1 by 90°; -60° means Channel 2 leads Channel 1 by 60°.
2. "VMON1" means that the pin is tied to the VMON1 pin of the same module.
 "Divider" means that there is a resistor divider from VOUT to SGND; refer to Figure 26 in the [ISL8225M](#) datasheet.
 "953Ω//22nF" means that there is a 953Ω resistor and a 22nF capacitor connecting the pin to SGND; refer to Figure 24 in the [ISL8225M](#) datasheet.

ISL8225MEVAL4Z Board Schematic

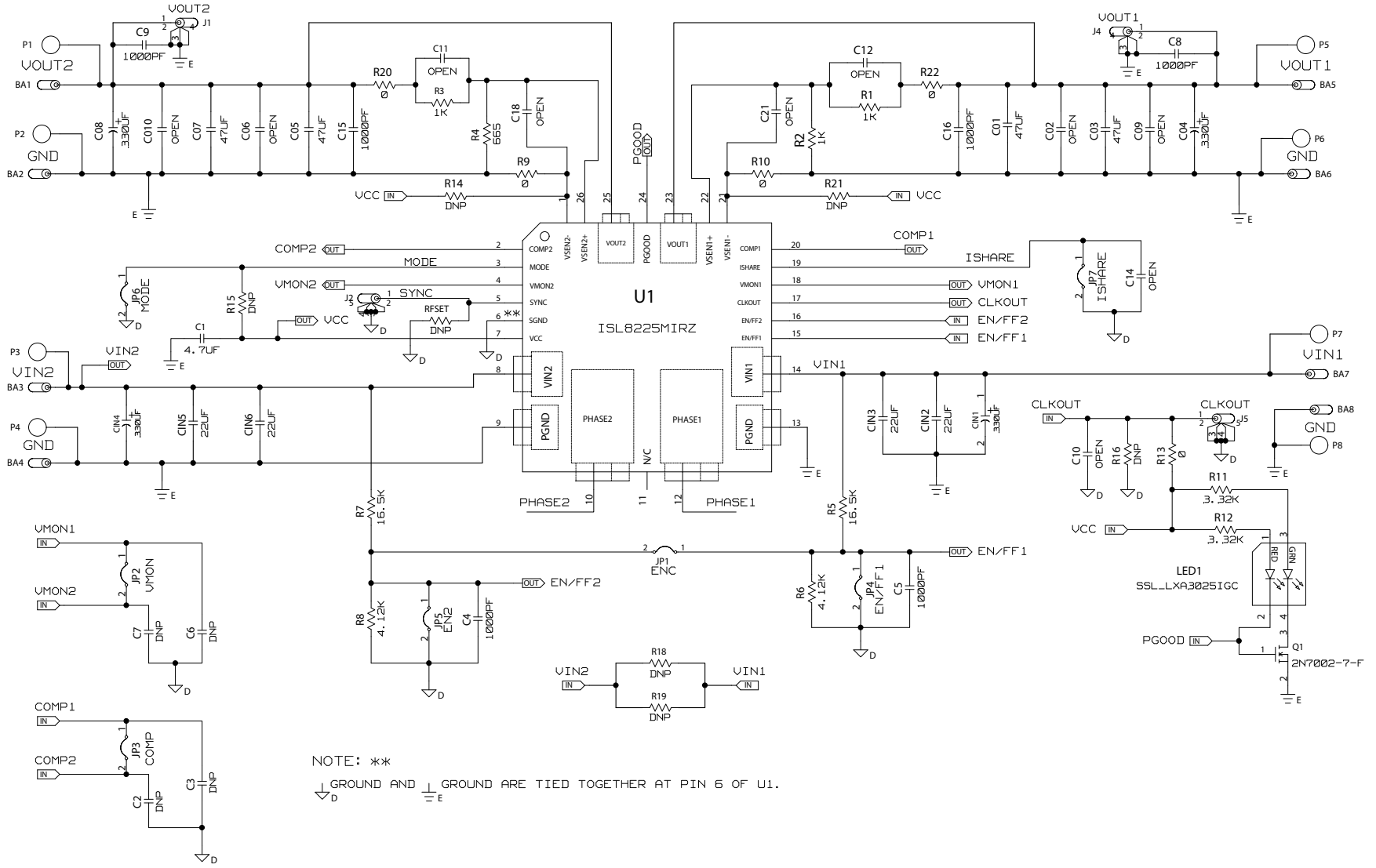


FIGURE 2. ISL8225MEVAL4Z BOARD SCHEMATIC

ISL8225MEVAL4Z Board Layout

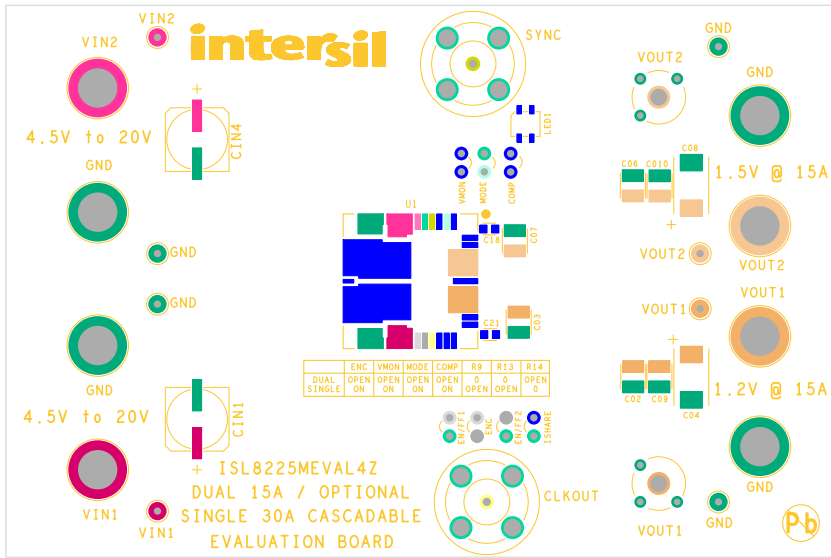


FIGURE 3. TOP SILK SCREEN

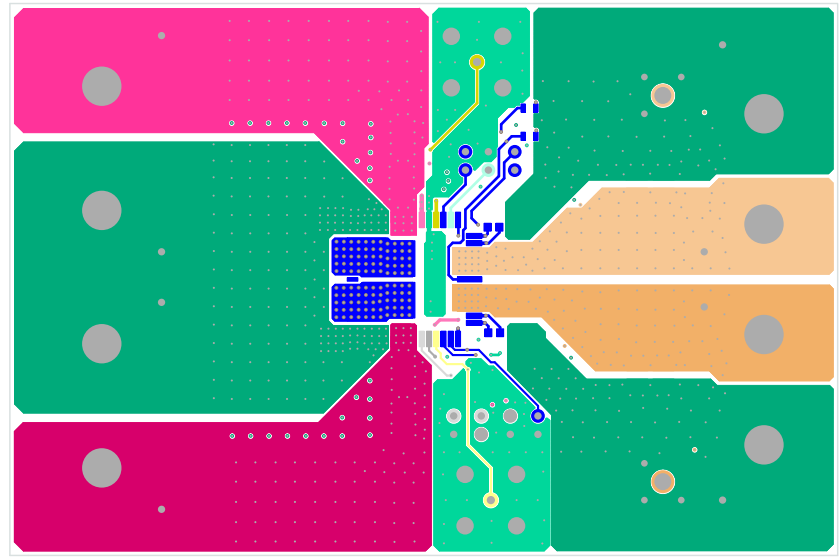


FIGURE 4. TOP LAYER COMPONENT SIDE

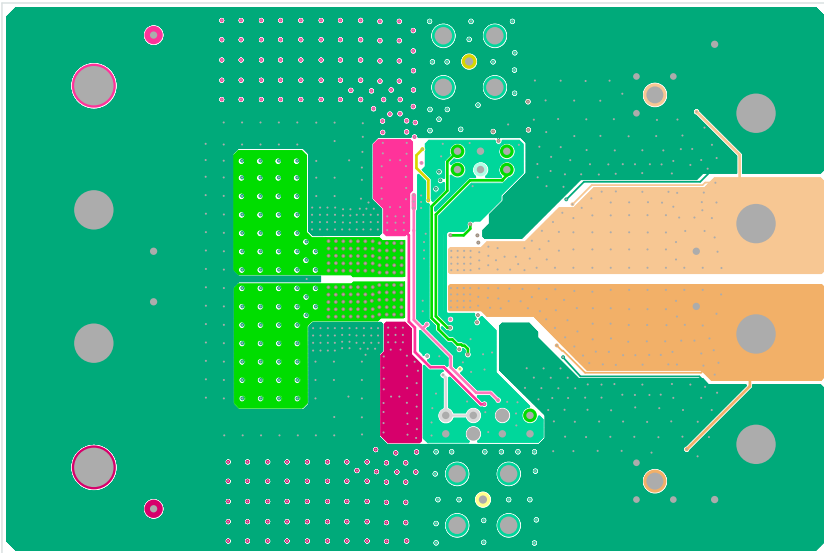


FIGURE 5. LAYER 2

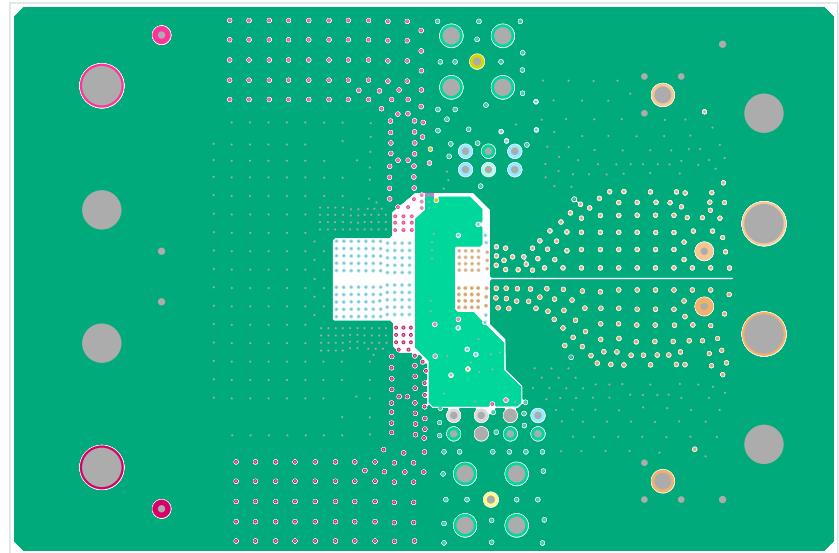


FIGURE 6. LAYER 3

ISL8225MEVAL4Z Board Layout (Continued)

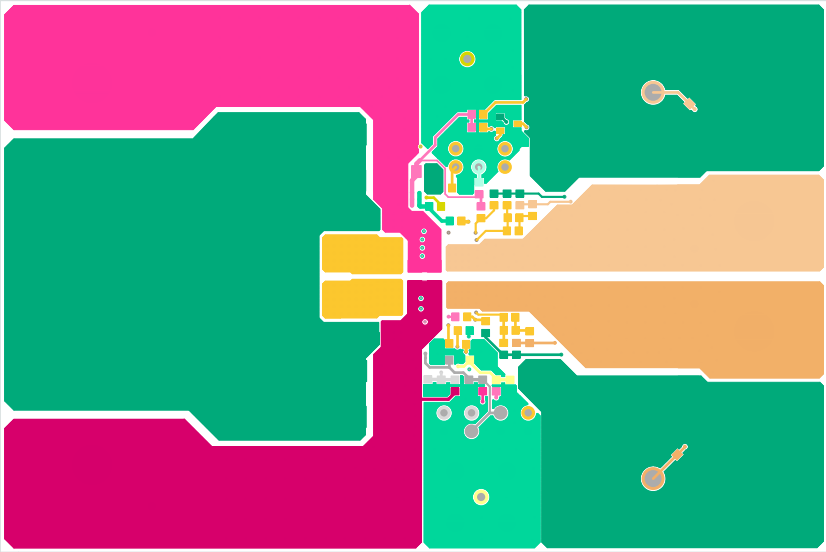


FIGURE 7. BOTTOM LAYER SOLDER SIDE

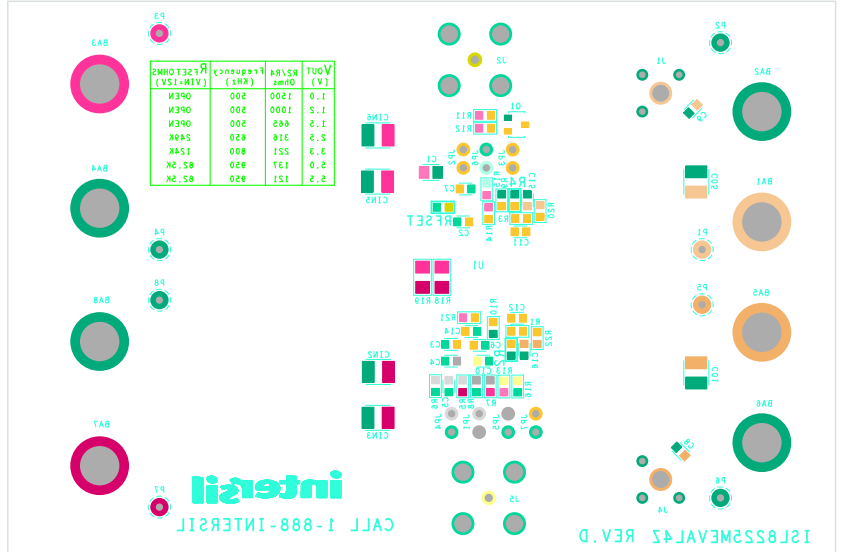


FIGURE 8. BOTTOM SILK SCREEN

Bill of Materials

| PART NUMBER | REFERENCE DESIGNATION | QTY | VALUE | TOL | VOLTAGE | POWER | PACKAGE TYPE | JEDEC TYPE | MANUFACTURER | DESCRIPTION |
|--------------------|------------------------|-----|----------------|-----|---------|-------|--------------|------------------------|--------------|------------------------|
| 10TPB330M | C04, C08 | 2 | 330 μ F | 20% | 10V | | SMD | CAP_7343_149 | | |
| 131-4353-00 | J1, J4 | 2 | | | | | CONN | TEK131-4353-00 | | |
| 2N7002-7-F | Q1 | 1 | | | | | SOT23 | SOT23 | | |
| 31-5329-52RFX | J2, J5 | 2 | | | | | CONN | CON_BNC_31_5329_52RFX | | |
| 5002 | P1-P8 | 8 | | | | | THOLE | MTP500X | | |
| 575-4 | BA1-BA8 | 8 | | | | | CONN | CON_BAN_575 | | |
| EEVHA1E331UP | CIN1, CIN4 | 2 | 330 μ F | 20% | 25V | | SMD | CAPAE_315X402 | | |
| GRM21BR71C475KA73L | C1 | 1 | 4.7 μ F | 10% | 16V | | 805 | CAP_0805 | Murata | Ceramic Capacitor |
| GRM32ER71A476KE15L | C01, C03, C05, C07 | 4 | 47 μ F | 10% | 10V | | 1210 | CAP_1210 | Murata | Ceramic Chip Capacitor |
| H1045-OPEN | C2, C3, C6, C7 | 4 | OPEN | 5% | OPEN | | 603 | CAP_0603 | Generic | Multilayer Capacitor |
| H1045-00102-16V10 | C15, C16 | 2 | 1000pF | 10% | 16V | | 603 | CAP_0603 | Generic | Multilayer Capacitor |
| H1045-00102-50V10 | C4, C5, C8, C9 | 4 | 1000pF | 10% | 50V | | 603 | CAP_0603 | Generic | Multilayer Capacitor |
| H1045-OPEN | C10, C11, C12, C14 | 6 | OPEN | 5% | OPEN | | 603 | CAP_0603 | Generic | Multilayer Capacitor |
| H1082-OPEN | C02, C06, C09, C010 | 4 | OPEN | 10% | OPEN | | 1210 | CAP_1210 | Generic | Ceramic Chip Capacitor |
| H2505-DNP-DNP-1 | R14-R16, R21, RFSET | 5 | DNP | 1% | | DNP | 603 | RES_0603 | | |
| H2511-00R00-1/16W1 | R9, R10, R13, R17, R20 | 5 | 0 Ω | 1% | | 1/16W | 603 | RES_0603 | | |
| H2511-01001-1/16W1 | R1, R2, R3, R6, R8 | 4 | 1k Ω | 1% | | 1/16W | 603 | RES_0603 | | |
| H2511-03321-1/16W1 | R11, R12 | 2 | 3.32k Ω | 1% | | 1/16W | 603 | RES_0603 | | |
| H2511-16501-1/16W1 | R5, R7 | 2 | 16.5k Ω | 1% | | 1/16W | 603 | RES_0603 | | |
| H2511-04121-1/16W1 | R6, R8 | 2 | 4.12k Ω | 1% | | 1/16W | 603 | RES_0603 | | |
| H2511-06650-1/16W1 | R4 | 1 | 665 Ω | 1% | | 1/16W | 603 | RES_0603 | | |
| H2512-OPEN | R18, R19 | 2 | OPEN | 0% | | 1/10W | 805 | RES_0805 | | |
| ISL8225MIRZ | U1 | 1 | | | | | QFN | QFN26_670X670_ISL8225M | | |
| JUMPER2_100 | JP1-JP7 | 7 | | | | | THOLE | JUMPER-1 | | |
| SSL-LXA3025IGC | LED1 | 1 | | | | | SMD | LED_3X2_5MM | | |
| TMK325B7226MM-TR | CIN2, CIN3, CIN5, CIN6 | 4 | 22 μ F | 20% | 25V | | 1210 | CAP_1210 | Taiyo Yuden | Ceramic Chip Capacitor |

ISL8225MEVAL4Z Efficiency Curves

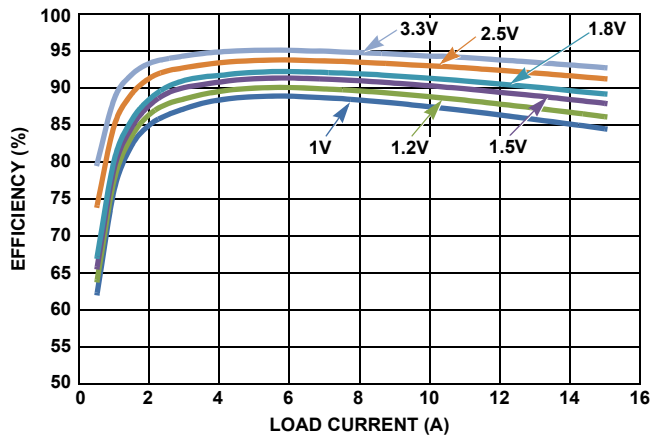


FIGURE 9. EFFICIENCY vs LOAD CURRENT ($5V_{IN}$ AT 500kHz)

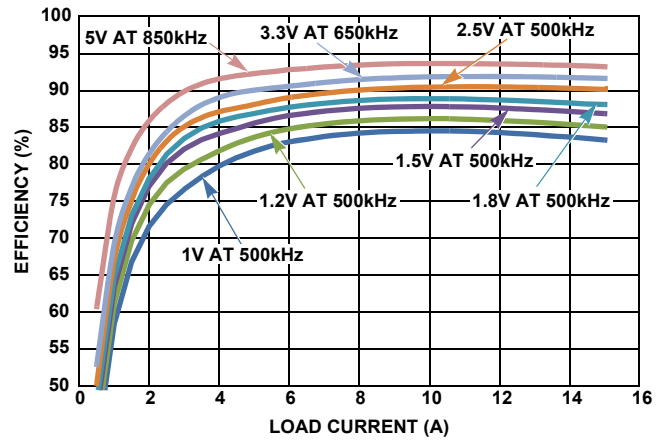


FIGURE 10. EFFICIENCY vs LOAD CURRENT ($12V_{IN}$)

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