# ISL8271MEVAL1Z

Evaluation Board

AN1925
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The ISL8271M is a 33A step-down DC/DC power supply module with integrated digital PWM controller, synchronous power switches, an inductor and passives. Only bulk input and output capacitors are needed to finish the design. The 33A of continuous output current can be delivered without a need of airflow or a heatsink. The ISL8271M uses ChargeMode™ control architecture, which responds to a transient load within a single switching cycle.

The ISL8271MEVAL1Z evaluation board is a 3inx4.5in 4-layer FR4 board with 2 oz. in all layers. This evaluation board comes with a placeholder for pin-strap resistors to adjust output voltage, switching frequency, input undervoltage (UVLO) protection threshold, and device PMBus™ address. More configuration such as soft-start, and fault limits can be easily programmed or changed via PMBus compliant serial bus interface.

ZLUSBEVAL3Z (USB to PMBus adapter) is provided with this evaluation kit, which connects the evaluation board to a PC to activate the PMBus communication interface. The PMBus command set is accessed by using the PowerNavigator™ evaluation software from a PC running Microsoft Windows.

## References

"ISL8271M" datasheet

## Ordering Information

| PART NUMBER | DESCRIPTION |
|---|---|
| ISL8271MEVAL1Z | ISL8271M Kit (EVB, ZLUSBEVAL3Z Adapter, USB Cable) |

## Key Features

- $V_{IN}$ range of 4.5V to 14V, $V_{OUT}$ adjustable from 0.6V to 5V
- Programmable $V_{OUT}$, margining, UV/OV, $I_{OUT}$ limit, soft-start/stop, sequencing, and external synchronization
- Monitor: $V_{IN}$, $V_{OUT}$, $I_{OUT}$, temperature, duty cycle, switching frequency and faults
- ChargeMode™ control tunable with PMBus
- Mechanical switch for enable and power-good LED indicator

## Recommended Equipment

- DC power supply with minimum 15V/25A sourcing capacity
- Electronic load capable of sinking current up to 33A
- Digital multimeters (DMMs)
- Oscilloscope with higher than 100MHz bandwidth

## Functional Description

The ISL8271MEVAL1Z provides all circuitry required to evaluate the features of the ISL8271M. A majority of the features of the ISL8271M, such as compensation-free ChargeMode™ control, soft-start delay and ramp times, supply sequencing, and voltage margining are available on this evaluation board. For sequencing evaluation, the board can be connected to any Intersil digital module evaluation board that supports the Digital-DC™ (DDC) bus.

Figure 1 shows a board image of the ISL8271MEVAL1Z evaluation board.

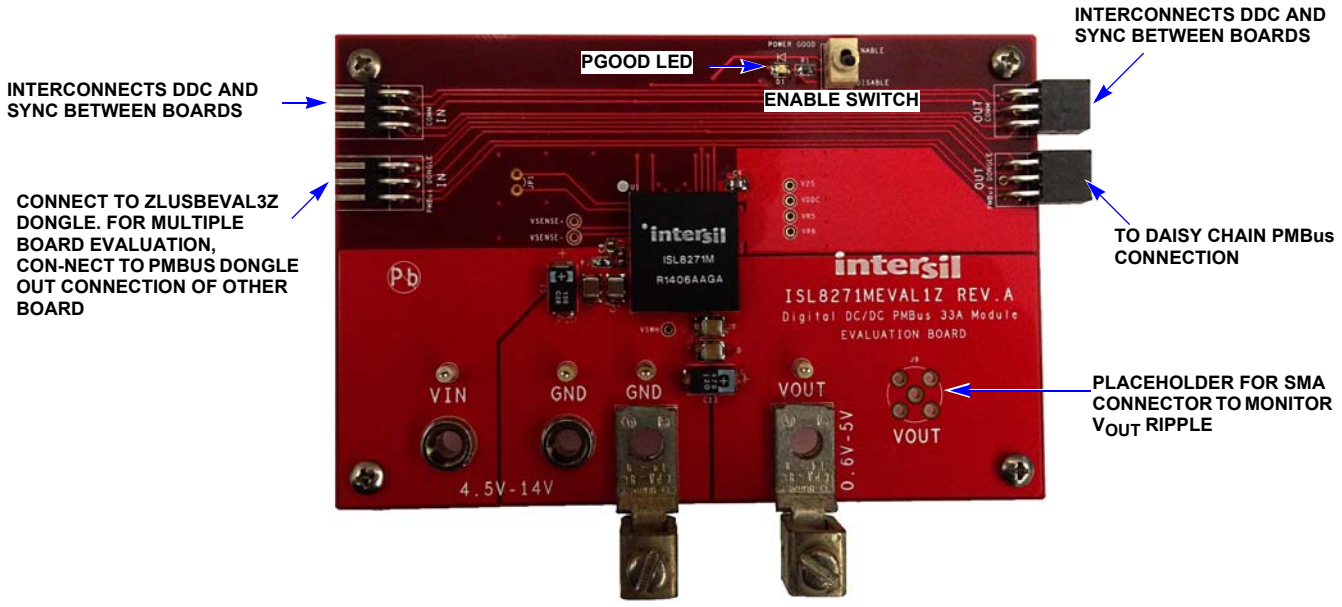


FIGURE 1. ISL8271MEVAL1Z EVALUATION BOARD IMAGE

# Operation

## PMBus Operation

The ISL8271M utilizes the PMBus protocol. The PMBus functionality can be controlled via ZLUSBEVAL3Z dongle from a PC running the PowerNavigator™ evaluation software in a Windows XP or Windows 7 operating systems.

Install the evaluation software from the following Intersil website: www.intersil.com/powernavigator

For board operation, connect the included ZLUSBEVAL3Z dongle to the 6-pin male connector labeled as “PMBus DONGLE IN”. Connect the desired load and an appropriate power supply to the input and connect the included USB cable to the PC running the PowerNavigator™ evaluation software. Place the ENABLE switches in “DISABLE” before turning on the power.

The evaluation software allows modification of all ISL8271M PMBus parameters. The ISL8271M device on the board has been pre-configured as described in this document, but the user may modify the operating parameters through the evaluation software or by loading a predefined set-up from a configuration file. A sample “Configuration File” on page 5 is provided and can be copied to a notepad editor to make desired changes.

The ENABLE switch can then be moved to “ENABLE” and the ISL8271MEVAL1Z board can be tested. Alternately, the PMBus ON_OFF_CONFIG and OPERATION commands may be used from the PowerNavigator™ GUI.

# Quick Start Guide

## Pin-Strap Option

The ISL8271MEVAL1Z can be configured in pin-strap mode with standard 1% 0603 resistors. PMBus interface is not required to evaluate ISL8271M in pin-strap mode. Output voltage ($V_{OUT}$), switching frequency ($F_{SW}$), input undervoltage protection (UVLO) threshold and device PMBus address can be changed by populating recommended resistors at placeholders provided in the evaluation board. By default, the evaluation board is programmed to regulate at $V_{OUT}$ = 1.2V, $F_{SW}$ = 533kHz, UVLO = 4.5V, and PMBus address = 28h. Follow these steps to evaluate ISL8271M in pin-strap mode.

1. Set ENABLE switch to “DISABLE”.
2. Connect Load to VOUT lug connectors (J7 and J8).
3. Connect power supply to VIN connectors (J3 and J4). Make sure power supply is not enabled when making connection.
4. Turn power supply on.
5. Set ENABLE switch to “ENABLE”.
6. Measure 1.2V VOUT at probe points (TP10 and TP11)
7. Observe switching frequency of 533kHz at probe point labeled VSWH (TP1).
8. To change VOUT, disconnect board from the set up and populated 1% standard 0603 resistor at R6 placeholder location on bottom layer. Refer to the “Output Voltage Resistor Settings” table in the ISL8271M datasheet for recommended values. By default, VOUT_MAX is set to 110% of VOUT set by the pin-strap resistor.
9. To change switching frequency, disconnect board from the setup and populated 1% standard 0603 resistor at R2 placeholder location on bottom layer. Refer to the “Switching Frequency Resistor Settings” table in the ISL8271M datasheet for recommended values.
10. To change UVLO, disconnect board from the setup and populated 1% standard 0603 resistor at R7 placeholder location on bottom layer. Refer to the “UVLO Resistor Settings” table in the ISL8271M datasheet for recommended values.

## PMBus Option

ISL8271MEVAL1Z can be evaluated for all features using the provided ZLUSBEVAL3Z dongle and PowerNavigator™ evaluation software. Follow these steps to evaluate ISL8271M with PMBus option.

1. Install PowerNavigator™ software.
2. Set ENABLE switch to “DISABLE”.
3. Connect Load to VOUT lug connectors (J7 and J8).
4. Connect power supply to VIN connectors (J3 and J4). Make sure power supply is not enabled when making connection.
5. Turn power supply on.
6. Connect ZLUSBEVAL3Z dongle (USB to PMBus™ adapter) to ISL8271MEVAL1Z board to the 6-pin male connector labeled as “PMBus DONGLE IN”.
7. Connect supplied USB cable from computer to USB to ZLUSBEVAL3Z dongle.
8. Launch PowerNavigator™ software.
9. Set ENABLE switch to “ENABLE”.
10. Monitor and configure the ISL8271MEVAL1Z board using PMBus commands in the evaluation software.
11. PowerNavigator™ tutorial videos are available at Intersil website. www.intersil.com/powernavigator
12. For sequencing via Digital-DC Bus (DDC) or to evaluate multiple Intersil digital power products using a single ZLUSBEVAL3Z dongle, ISL8271M can be daisy chained with other digital power evaluation boards. PMBus address can be changed by placing a 1% standard 0603 resistor at the R5 placeholder location on the bottom layer. Refer to the “SMBus Address Resistor Selection” table in the ISL8271M datasheet for recommended values.

# Thermal Considerations and Current Derating

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

The ISL8271MEVAL1Z evaluation board is designed for running 33A 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 ISL8271M datasheet to determine the maximum output current the evaluation board can supply. $\theta_{JA}$ is measured by inserting thermocouple inside the module to measure peak junction temperature.

# ISL8271MEVAL1Z Board Schematic

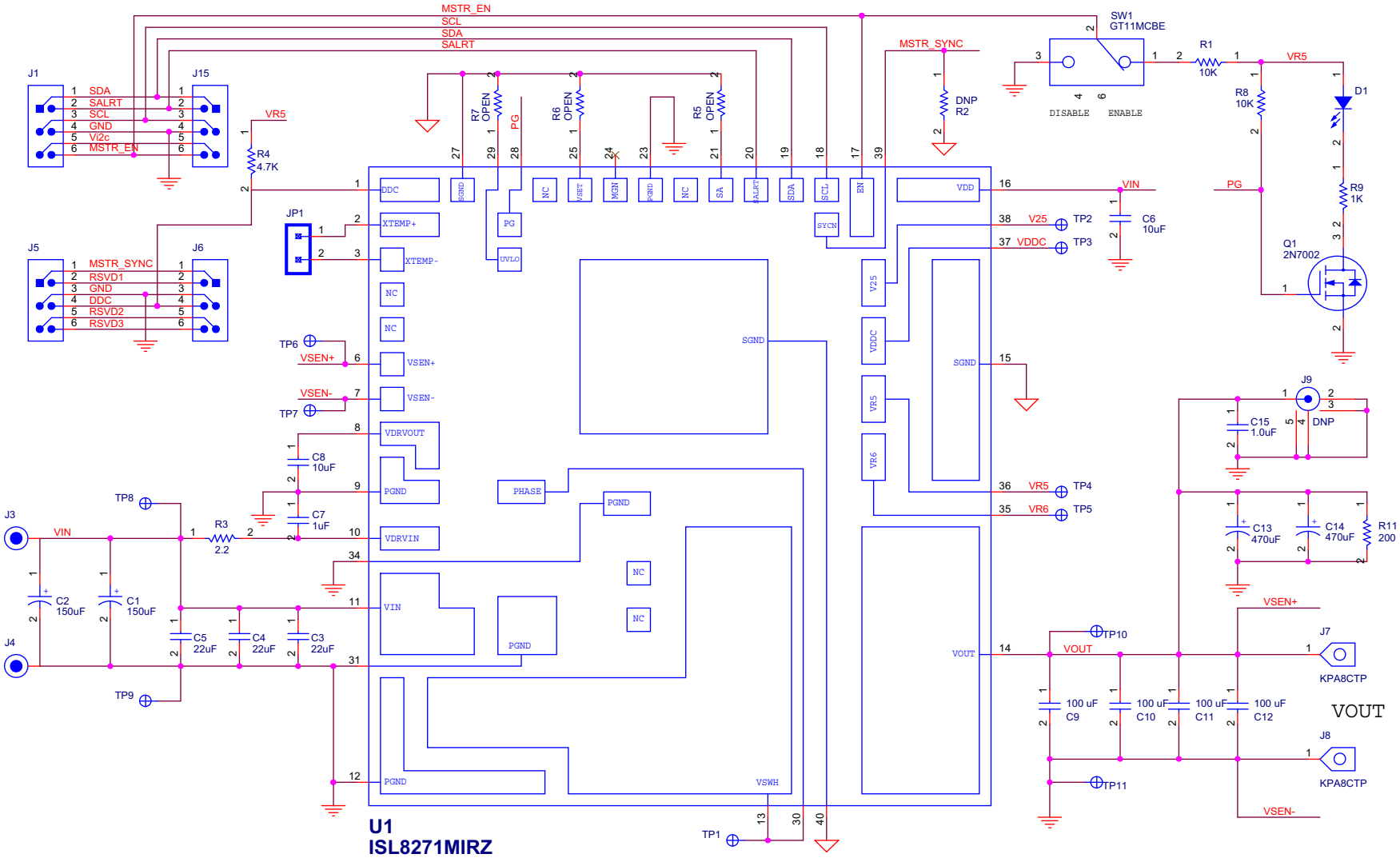


**FIGURE 2. APPLICATION CIRCUIT**

# Bill of Materials

| REFERENCE DESIGNATOR | QTY | MANUFACTURER | MANUFACTURER PART | DESCRIPTION |
|---|---|---|---|---|
| C7 | 1 | MURATA | GRM188R71E105KA12D | CAP, SMD, 0603, 1µF, 25V, 10%, X7R, ROHS |
| C3-C5 | 3 | MURATA | GRM32ER71E226KE15L | CAP, SMD, 1210, 22µF, 25V, 10%, X7R, ROHS |
| C15 | 1 | PANASONIC | ECJ-0EB0J105K | CAP, SMD, 0402, 1µF, 6.3V, 10%, X5R, ROHS |
| C8 | 1 | PANASONIC | ECJ-1VB1A106M | CAP, SMD, 0603, 10µF, 10V, 20%, X5R, ROHS |
| C6 | 1 | TDK | C2012X5R1E106K | CAP, SMD, 0805, 10µF, 25V, 10%, X5R, ROHS |
| C9, C10, C11, C12 | 4 | TDK | C3225X5R0J107M | CAP, SMD, 1210, 100µF, 6.3V, 20%, X5R, ROHS |
| C1, C2 | 2 | SANYO/PANASONIC | 16TQC150MYF | CAP-POSCAP, SMD, 7.3x4.3, 150µF, 16V, 20%, 50mΩ, ROHS |
| C13, C14 | 2 | SANYO/PANASONIC | 6TPF470MAH | CAP TANT 470µF 6.3V 20% |
| TP8, TP10 | 2 | KEYSTONE | 5000 | CONN-MINI TEST PT, VERTICAL, RED, ROHS |
| TP9, TP11 | 2 | KEYSTONE | 5001 | CONN-MINI TEST PT, VERTICAL, BLK, ROHS |
| J3, J4 | 2 | KEYSTONE | 575-4 | CONN-JACK, MINI BANANA, 0.175 PLUG, NICKEL/BRASS, ROHS |
| J2, J6 | 2 | SAMTEC | SSQ-103-02-T-D-RA | CONN-SOCKET STRIP, TH, 2X3, 2.54mm, TIN, R/A, ROHS |
| J1, J5 | 2 | SAMTEC | TSW-103-08-T-D-RA | CONN-HEADER, 2X3, BRKAWY, 2.54mm, TIN, R/A, ROHS |
| D1 | 1 | CHICAGO MINIATURE | CMD17-21VGC/TR8 | LED, SMD, 0805, GREEN, CLEAR, 10mcd, 2.1V, 20mA, 570nm, ROHS |
| U1 | 1 | INTERSIL | ISL8271MIRZ | IC-25A DIGITAL DC/DC PMBUS MODULE, 26P, QFN, ROHS |
| Q1 | 1 | ON SEMICONDUCTOR | 2N7002LT1G | TRANSISTOR-MOS, N-CHANNEL, SMD, SOT23, 60V, 115mA, ROHS |
| R4 | 1 | YAGEO | 9C06031A4701FKHFT | RES, SMD, 0603, 4.7k, 1/10W, 1%, TF, ROHS |
| R2, R5, R6, R7 | 0 | | | RESISTOR, SMD, 0603, 0.1%, MF, DNP-PLACE HOLDER |
| R3 | 1 | PANASONIC | ERJ-3RQF2R2V | RES, SMD, 0603, 2.2Ω, 1/10W, 1%, TF, ROHS |
| R9 | 1 | PANASONIC | ERJ-3EKF1001V | RES, SMD, 0603, 1k, 1/10W, 1%, TF, ROHS |
| R1, R8 | 2 | KOA | RK73H1JT1002F | RES, SMD, 0603, 10k, 1/10W, 1%, TF, ROHS |
| R11 | 1 | PANASONIC | ERJ-8ENF2000V | RES, SMD, 1206, 200Ω, 1/4W,1%, TF, ROHS |
| SW1 | 1 | ITT CANNON | GT11MCBE | SWITCH-TOGGLE, THRU-HOLE, SPDT, 5P, ROHS |
| J7, J8 | 2 | BERG/FCI | KPA8CTP | HDWARE, MTG, CABLE TERMINAL, 6-14AWG, LUG and SCREW, ROHS |
| J9 | 0 | TE CONNECTIVITY | 5-1814832-1 | DO NOT POPULATE |
| JP1 | 0 | | | DO NOT POPULATE |
| TP1-TP7 | 0 | | | DO NOT POPULATE |

# Configuration File

Sample Configuration File for ISL8271M Module. Copy and paste (from RESTORE_FACTORY TO ### End User Store) to a notepad and save it as Confile_file_name.txt. The # symbol is used for a comment line. Following settings are already loaded to ISL8271M module as factory defaults.

| | | |
|---|---|---|
| RESTORE_FACTORY | # reset device to the factory setting | |
| STORE_USER_ALL | # Clears user memory space | |
| **# VOUT Related** | | |
| VOUT_COMMAND | 0x2666 | # 1.2 V |
| VOUT_MAX | 0x2a3c | # 1.32 V |
| VOUT_MARGIN_HIGH | 0x2851 | # 1.26 V |
| VOUT_MARGIN_LOW | 0x247a | # 1.14 V |
| VOUT_OV_FAULT_LIMIT | 0x2c28 | # 1.38 V |
| VOUT_OV_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| VOUT_OV_WARN_LIMIT | 0x2a3c | # 1.32 V |
| VOUT_UV_WARN_LIMIT | 0x228f | # 1.08 V |
| VOUT_UV_FAULT_LIMIT | 0x20a3 | # 1.02 V |
| VOUT_UV_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| POWER_GOOD_ON | 0x228f | # 1.08 V |
| VOUT_TRANSITION_RATE | 0xba00 | # 1 mV/us |
| VOUT_DROOP | 0x0000 | # 0 mV/A |
| VOUT_CAL_OFFSET | 0x0000 | # 0 mV/A |
| **# IOUT Related** | | |
| IOUT_CAL_GAIN | 0xb2ae | # 0.67 mV/A |
| IOUT_CAL_OFFSET | 0x0000 | # 0 A |
| IOUT_OC_FAULT_LIMIT | 0xe280 | # 40 A |
| IOUT_UC_FAULT_LIMIT | 0xe57f | # -40A |
| MFR_IOUT_OC_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| MFR_IOUT_UC_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| ISENSE_CONFIG | 0x05 | # 256ns Blanking time, Mid-Range |
| **# Other Faults** | | |
| OT_FAULT_LIMIT | 0xebe8 | # 125 °C |
| OT_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| OT_WARN_LIMIT | 0xeb70 | # 110 °C |
| UT_WARN_LIMIT | 0xdc40 | # -30 °C |
| UT_FAULT_LIMIT | 0xe530 | # -45 °C |
| UT_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| VIN_OV_FAULT_LIMIT | 0xd380 | # 14 V |
| VIN_OV_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| VIN_OV_WARN_LIMIT | 0xd327 | # 12.609 V |
| VIN_UV_WARN_LIMIT | 0xca79 | # 4.945 V |
| VIN_UV_FAULT_LIMIT | 0xca40 | # 4.5 V |
| VIN_UV_FAULT_RESPONSE | 0x80 | # Disable and no retry |
| **#Enable, Timing and Sequence Related** | | |
| ON_OFF_CONFIG | 0x17 | # Pin Enable, Immediate Off |
| TON_DELAY | 0xca80 | # 5 ms |
| TON_RISE | 0xca80 | # 5 ms |
| TOFF_DELAY | 0xca80 | # 5 ms |
| TOFF_FALL | 0xca80 | # 5 ms |
| POWER_GOOD_DELAY | 0xba00 | # 1 ms |
| FREQUENCY_SWITCH | 0x0215 | # Sequence Disabled |
| SYNC_CONFIG | 0x00 | # Use Pin-strap for $F_{SW}$ setting |
| SEQUENCE | 0x0000 | # 533 kHz |
| **# Manufacturer Related** | | |
| MFR_ID | Intersil Corp | # Example Only |
| MFR_MODEL | ISL8271MEVAL1Z | # Example Only |
| MFR_REVISION | Rev-1 | # Example Only |
| MFR_LOCATION | Milpitas, CA | # Example Only |
| MFR_DATE | 3/14/2014 | # Example Only |
| MFR_SERIAL | 1234 | # Example Only |
| USER_DATA_00 | Module | # Example Only |
| **# Advance Settings** | | |
| USER_CONFIG | 0x00 | # Open Drain PG, XTEMP Disabled |
| DDC_CONFIG | 0x01 | # DDC rail ID = 1 |
| DDC_GROUP | 0x00000000 | # All Broadcast disabled |
| **# Loop Compensation** | | |
| ASCR_CONFIG | 0x15a0100 | # ASCR gain = 256, Residual = 90 |
| STORE_USER_ALL | # Store all above settings to NVRAM | |
| **### End User Store** | | |

## Measured Data

The following data was acquired using a ISL8271MEVAL1Z evaluation board.

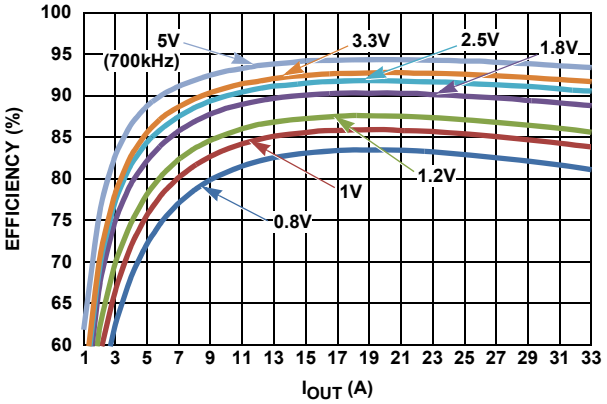


FIGURE 3. EFFICIENCY vs OUTPUT CURRENT AT $V_{IN}$ = 12V AND $F_{SW}$ = 533kHz FOR VARIOUS OUTPUT VOLTAGES

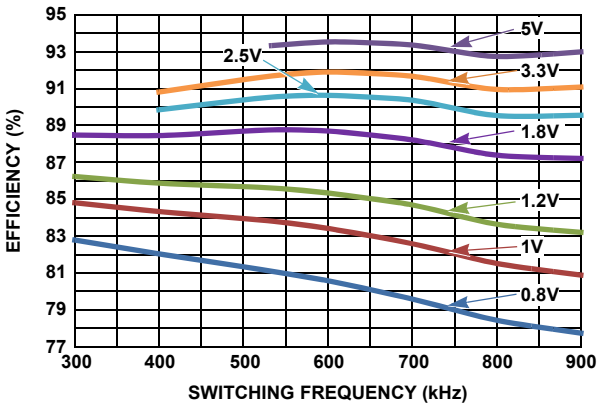


FIGURE 4. EFFICIENCY vs SWITCHING FREQUENCY AT $V_{IN}$ = 12V AND $I_{OUT}$ = 33A FOR VARIOUS OUTPUT VOLTAGES

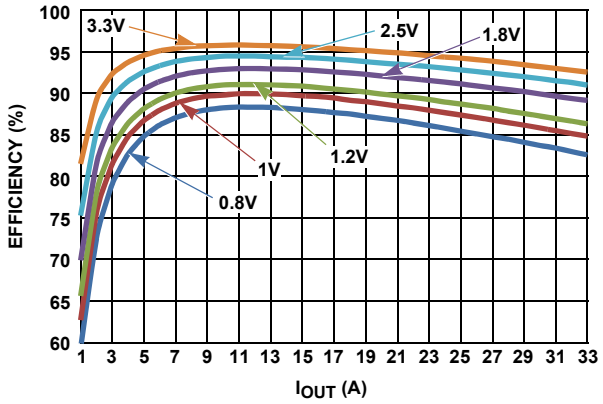


FIGURE 5. EFFICIENCY vs OUTPUT CURRENT AT $V_{IN}$ = 5V AND $F_{SW}$ = 533kHz FOR VARIOUS OUTPUT VOLTAGES

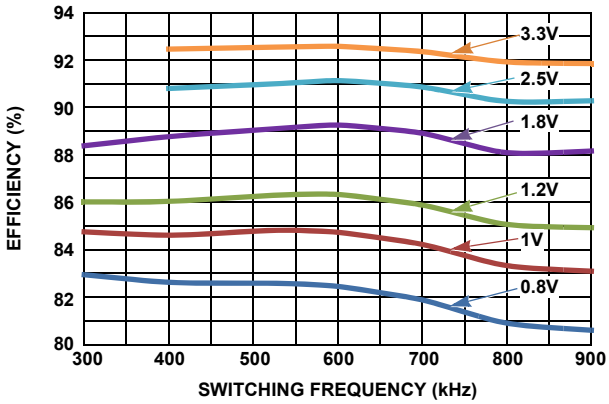


FIGURE 6. EFFICIENCY vs SWITCHING FREQUENCY AT $V_{IN}$ = 5V AND $I_{OUT}$ = 33A FOR VARIOUS OUTPUT VOLTAGES

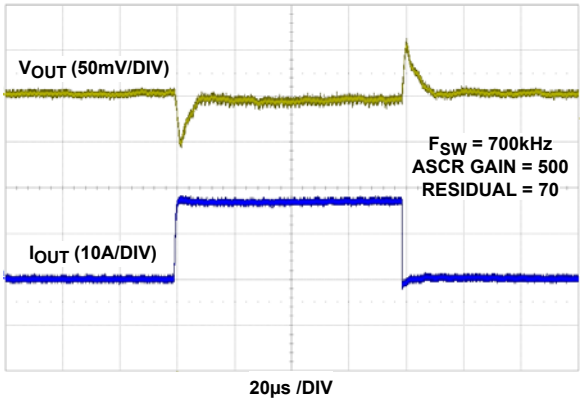


FIGURE 7. LOAD TRANSIENT RESPONSE AT $V_{IN}$ = 12V, $V_{OUT}$ = 2.5V WITH HIGH BANDWIDTH ASCR PARAMETERS

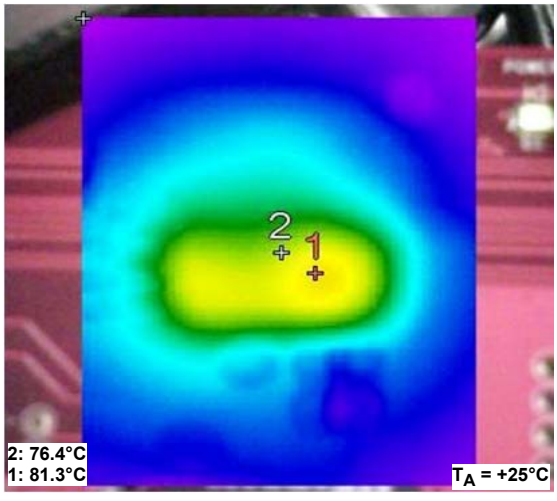


FIGURE 8. THERMAL IMAGE, 12$V_{IN}$ TO 1.2$V_{OUT}$, $I_{OUT}$ = 33A, TA = +25°C, $F_{SW}$ = 533kHz, NO AIR FLOW.

# ISL8271MEVAL1Z Board Layout

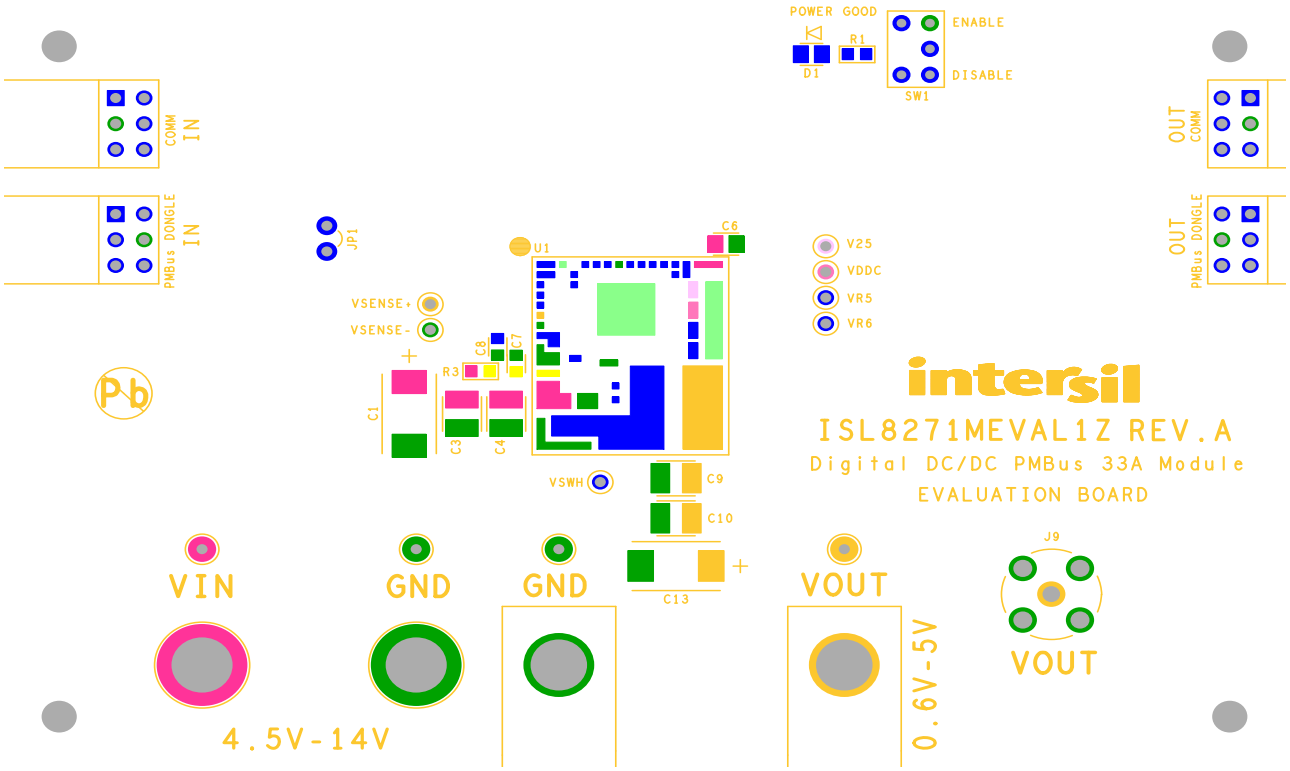


**FIGURE 9. PCB - TOP SILK SCREEN**

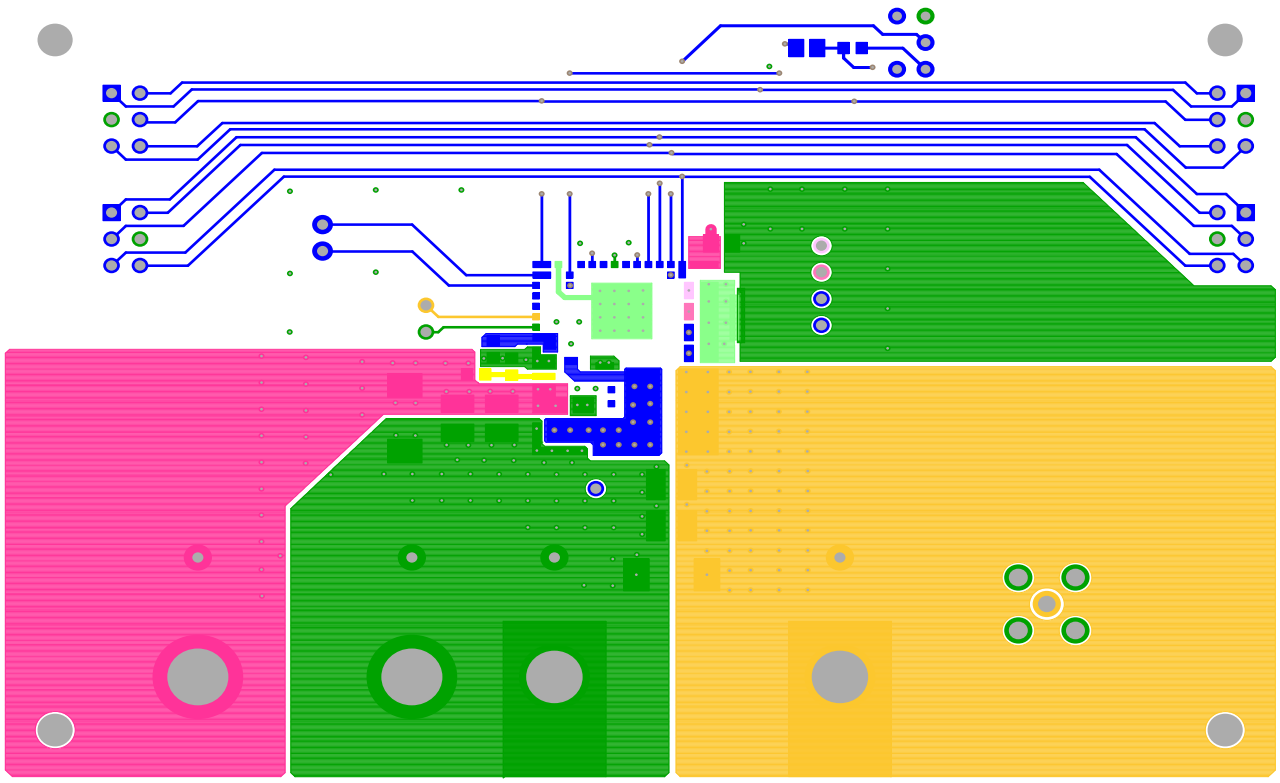

**FIGURE 10. PCB - TOP LAYER**

# ISL8271MEVAL1Z Board Layout (Continued)

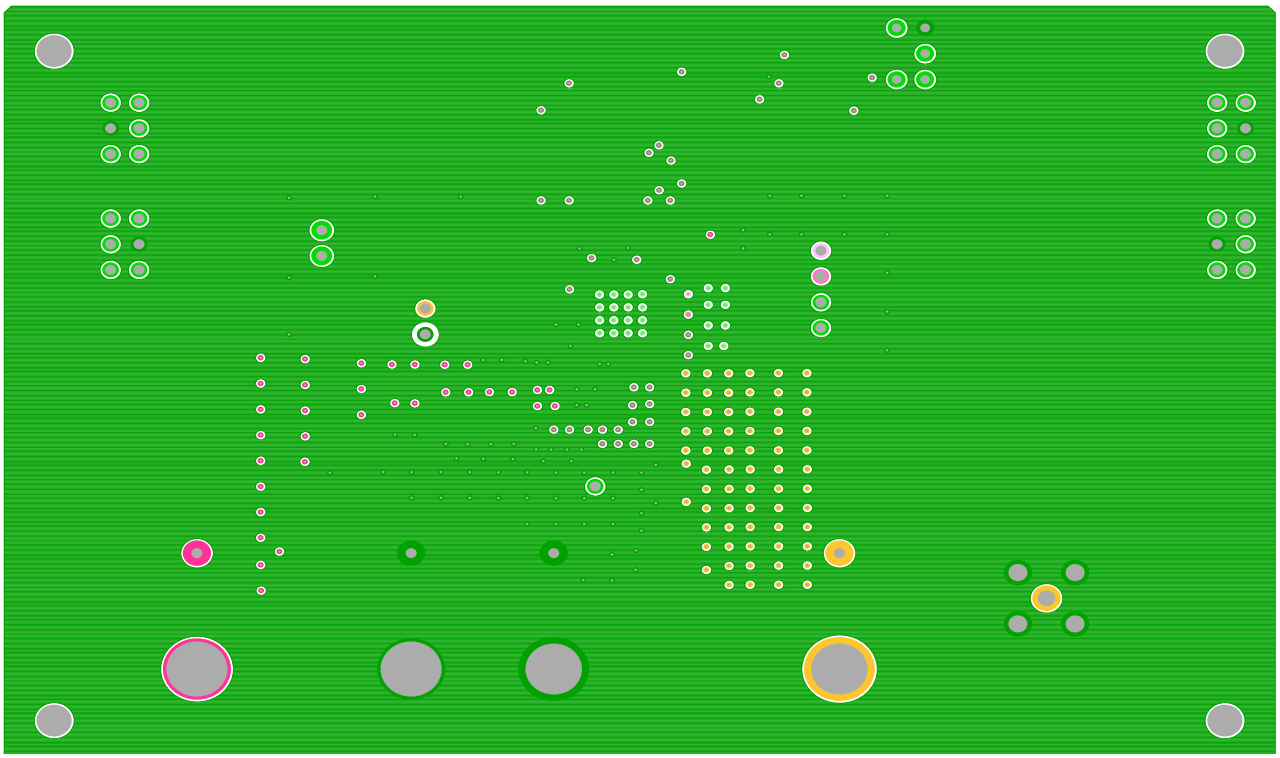

FIGURE 11. PCB - INNER LAYER - LAYER 2 (TOP VIEW)

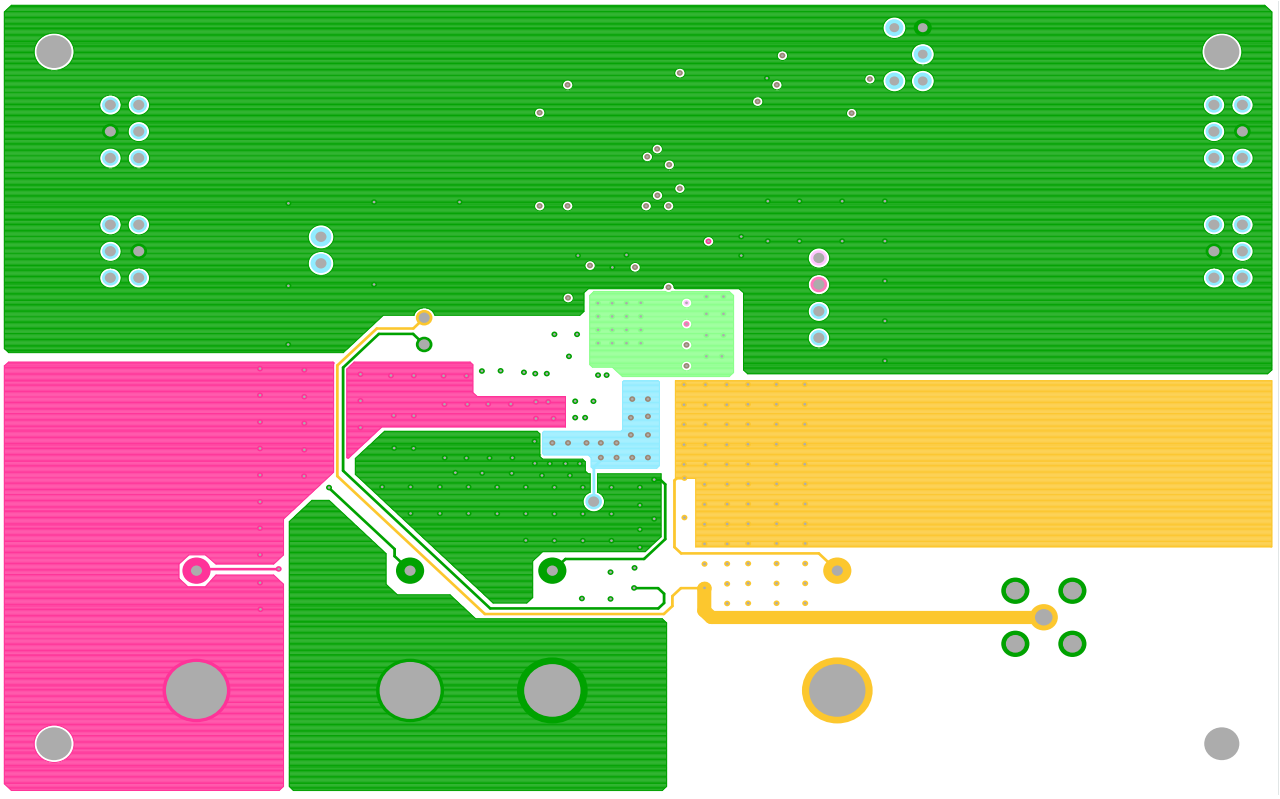

FIGURE 12. PCB - INNER LAYER - LAYER 3 (TOP VIEW)

# ISL8271MEVAL1Z Board Layout (Continued)

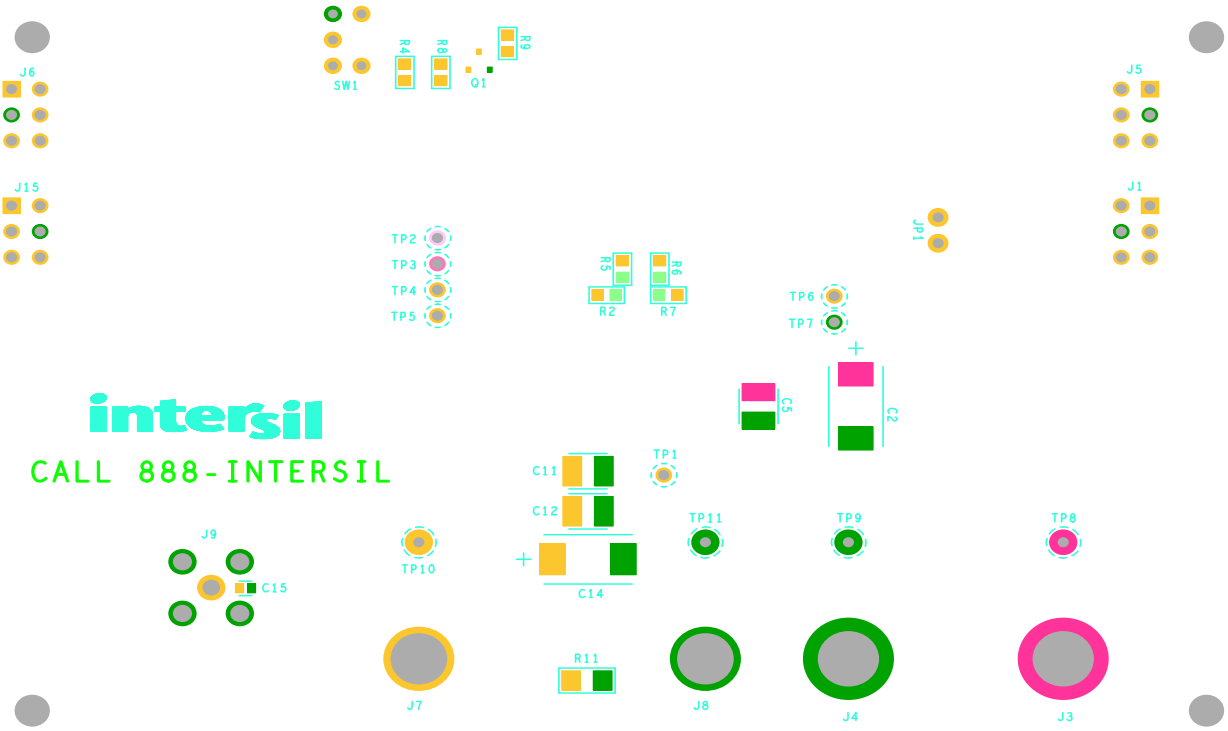


FIGURE 13. PCB - BOTTOM LAYER (BOTTOM VIEW)

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(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

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RENESAS

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