User's Manual

# ISL8212MEVAL1Z

## User's Manual: Evaluation Board

Industrial Analog and Power

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# 1. Overview

The ISL8212MEVAL1Z evaluation board (shown in Figures 4 and 5) is designed for evaluating the ISL8212M. The ISL8212M is a single channel, synchronous step-down DC/DC power supply module that is capable of delivering up to 15A of continuous current. The proprietary Renesas R4 Technology control scheme has extremely fast transient performance, accurately regulated frequency control, and all internal compensation. The ISL8212M includes four setting up pins (SETx) for module configuration and allows for easy R4 loop optimization that results in fast transient performance across a wide range of applications, including all ceramic output filters. The ISL8212M integrates the controller, all power components, and most passive components. The device requires only a few external components to operate, which significantly reduces design complexity and board space, and it optimizes for high power density applications without the need for airflow or a heatsink.

The ISL8212MEVAL1Z evaluation board is a 3 x 3 inch six-layer FR4 board with 2oz. copper on all layers. The ISL8212MEVAL1Z operates from a single 4.5V to 15V wide input power rail and offers adjustable output voltages down to 0.5V and efficiencies of up to 95%. The ISL8212MEVAL1Z comes with placeholders for pin-strap resistors to set up output voltage, PFM/PWM mode, temperature compensation (TCOMP), switching frequency ($f_{SW}$), AV gain, OCP retry/latch-off, ultrasonic PFM enable, soft-start ramp rate, RR impedance, and AV gain multiplier (1x or 2x).

By default, the ISL8212MEVAL1Z is set to a 1V output voltage with a 400kHz switching frequency, 49 AV gain, and 200kΩ RR.

## 1.1 Key Features

- Input voltage range: 4.5V to 15V, capable of delivering up to 15A of continuous current and up to 95% conversion efficiency
- Adjustable output voltage: 0.5V to 5V with ±1.5% load/line/temperature regulation with remote sense
- Proprietary Renesas R4 Technology
- Programmable $V_{OUT}$, PFM/PWM mode, TCOMP, $f_{SW}$, AV gain, OCP retry/latchoff, ultrasonic PFM enable, soft-start ramp rate, RR, and AV gain multiplier
- Startup into precharged load
- Dedicated enable pin and PGOOD indicator
- Comprehensive fault protection for high system reliability: over-temperature protection, output overcurrent and short-circuit protection, output overvoltage and undervoltage protection, open remote sense protection, input UVLO and power sequence, and fault reset
- Thermally enhanced 12mmx11mmx5.3mm HDA package

## 1.2 Specifications

The ISL8212MEVAL1Z is configured and optimized for the following operating conditions:

- $V_{IN}$ = 4.5V to 15V
- $V_{OUT}$ = 1V
- $I_{OUT-MAX}$ = 15A
- $f_{SW}$ = 400kHz
- AV gain multiplier = 2x, AV gain = 49, RR = 200kΩ
- TCOMP = +5°C

## 1.3 Ordering Information

| Part Number | Description |
|---|---|
| ISL8212MEVAL1Z | 15A high efficiency step-down power module evaluation board |

## 1.4 Related Literature

For a full list of related documents, visit our website:

- ISL8212M device page

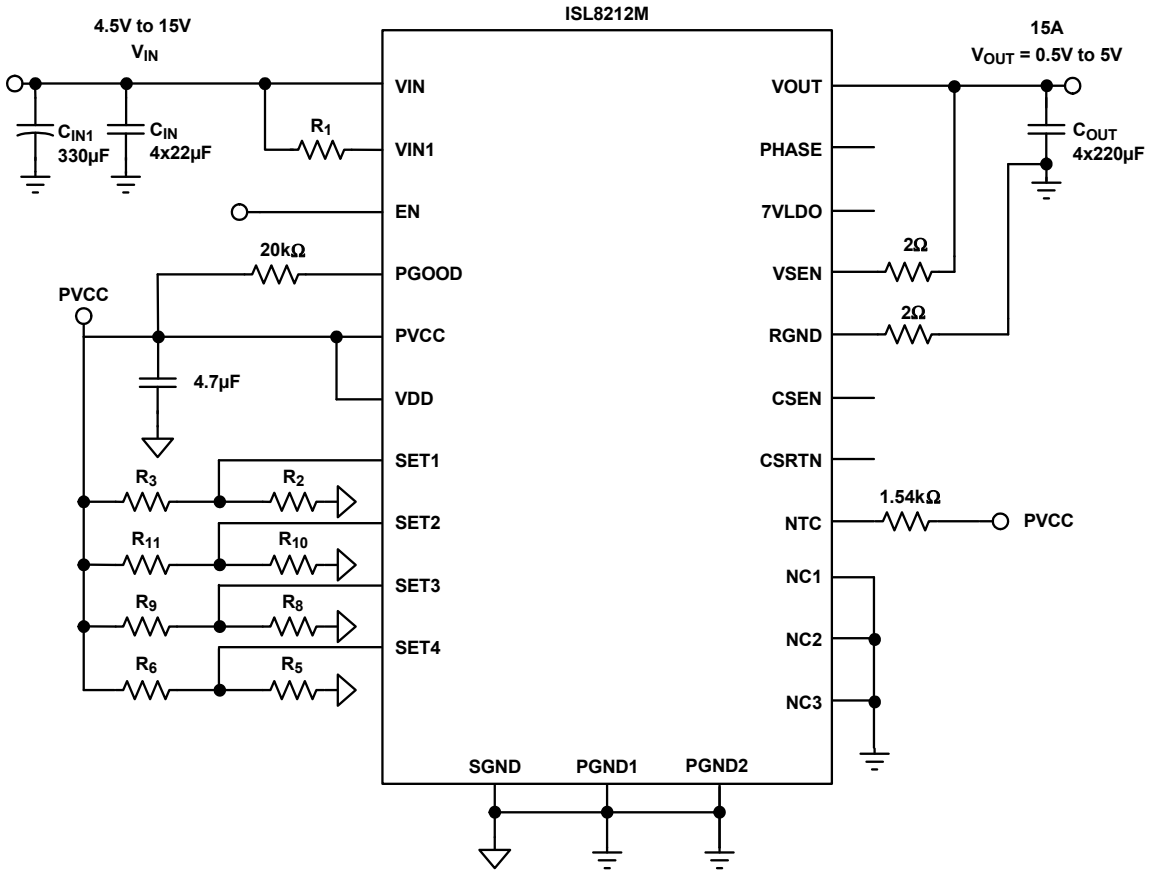


**Figure 1. ISL8212MEVAL1Z Block Diagram**

## 1.5 Recommended Testing Equipment

- DC power supply with minimum 15V/12A source current capability
- Electronic loads capable of sinking current up to 15A
- Digital Multimeters (DMMs)
- Oscilloscope with bandwidth greater than 100MHz

# 2. Functional Description

The ISL8212MEVAL1Z evaluation board provides the peripheral circuitry to evaluate the ISL8212M feature set. The ISL8212MEVAL1Z includes several connectors, test points, and external pin-strap resistors that simplify ISL8212M validation. Figure 4 on page 23 shows the top of the ISL8212MEVAL1Z. Figure 5 on page 23 shows the bottom of the ISL8212MEVAL1Z.

## 2.1 Quick Start Guide

(1) Disable the module by toggling the mechanical switch $SW_1$ to **2-3** as shown in Figure 4.

(2) Connect the DC input power supply to banana sockets $J_4$ and $J_3$ and the electronic load to sockets $J_{14}$ and $J_{15}$. Ensure that the polarity for the power leads is correct and the input voltage is within the ISL8212MEVAL1Z's operating range of 4.5V to 15V. Use test points $TP_1$ (VIN) and $TP_3$ (GND) to accurately measure the input voltage.

(3) Toggle the mechanical switch $SW_1$ to **1-2** to enable the module.

(4) Turn on the DC input power supply.

(5) Probe test points $TP_3$ (VOUT) and $TP_4$ (PGND) to observe the output voltage. The output voltage should read 1V.

(6) Adjust the input voltage, $V_{IN}$, within the specified range and observe the output voltage. The output voltage variation should be within ±1.5%.

(7) Adjust the load current to within the specified range of 0A to 15A and observe the output voltage. The output voltage variation should be within ±1.5%.

(8) To change $V_{OUT}$, disconnect the ISL8212MEVAL1Z from the setup and populate 1% standard 0402 resistors at the $R_2$ and $R_3$ placeholder locations on the bottom layer. Use Table 1 on page 5 as a reference for programming different output voltages. See the "ISL8212M Design Guide Matrix of Typical Applications" table in the ISL8212M datasheet for recommended values in typical applications.

(9) To change PFM/PWM mode and TCOMP, disconnect the ISL8212MEVAL1Z from the setup and populate 1% standard 0402 resistors at the $R_{10}$ and $R_{11}$ placeholder locations on the bottom layer. Use Table 2 on page 10 as a reference for customizing module specifications. Renesas recommends using +5°C as the TCOMP.

(10) To change OCP retry/latchoff, $f_{SW}$, AV gain and ultrasonic PFM enable, disconnect the ISL8212MEVAL1Z from the setup and populate 1% standard 0402 resistors at the $R_8$ and $R_9$ placeholder locations on the bottom layer. Use Table 3 on page 17 as a reference for customizing module specifications. See the "ISL8212M Design Guide Matrix of Typical Applications" table in the ISL8212M datasheet for recommended values in typical applications.

(11) To change the soft-start ramp rate, RR, and AV gain multiplier, disconnect the ISL8212MEVAL1Z from the setup and populate 1% standard 0402 resistors at the $R_5$ and $R_6$ placeholder locations on the bottom layer. Use Table 4 on page 20 as a reference for customizing module specifications. See the "ISL8212M Design Guide Matrix of Typical Applications" table in the ISL8212M datasheet for recommended values in typical applications.

## 2.2 Thermal Considerations and Current Derating

Proper board layout is critical so that the module can operate safely and deliver the maximum allowable power. For the board to operate properly at high ambient temperature environments and carry full load current, carefully design the board layout to maximize thermal performance. For best thermal performance, use enough trace width, copper weight, and proper connectors.

The ISL8212MEVAL1Z is capable of operating at 15A full load current at room temperature without the need for additional cooling systems. However, if the ISL8212MEVAL1Z needs to operate at elevated ambient temperatures, the available output current needs to be derated. See the derated current curves in the ISL8212M datasheet to determine the maximum output current that the ISL8212MEVAL1Z can supply.

## 2.3 Programming the Resistor Reader

This section contains information about operating the resistor reader with the ISL8212M's four setting up pins (SET1, SET2, SET3, and SET4) to customize module specifications. See the "Definition of SET Pins" table in the ISL8212M datasheet for detailed descriptions of each setting up pin.

**Table 1. SET1 Resistor Reader**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | $V_{OUT}$(V) |
|---|---|---|
| 49.9 | 12.4 | 0.500 |
| 45.3 | 12.7 | 0.508 |
| 42.2 | 13.3 | 0.516 |
| 38.3 | 13.3 | 0.523 |
| 35.7 | 13.7 | 0.531 |
| 34 | 14.3 | 0.539 |
| 31.6 | 14.7 | 0.547 |
| 29.4 | 15 | 0.555 |
| 28 | 15.4 | 0.562 |
| 26.7 | 16.2 | 0.570 |
| 25.5 | 16.5 | 0.578 |
| 24.3 | 17.4 | 0.586 |
| 23.2 | 17.8 | 0.594 |
| 22.1 | 18.2 | 0.602 |
| 21 | 19.1 | 0.609 |
| 20 | 19.6 | 0.617 |
| 19.6 | 20.5 | 0.625 |
| 18.7 | 21.5 | 0.633 |
| 18.2 | 22.6 | 0.641 |
| 17.4 | 23.2 | 0.648 |
| 16.9 | 24.3 | 0.656 |
| 16.5 | 26.1 | 0.664 |
| 15.8 | 26.7 | 0.672 |
| 15.4 | 28.7 | 0.680 |
| 15 | 30.1 | 0.688 |
| 14.7 | 32.4 | 0.695 |
| 14 | 34 | 0.703 |
| 13.7 | 36.5 | 0.711 |
| 13.3 | 39.2 | 0.719 |
| 13 | 43.2 | 0.727 |
| 107 | 26.7 | 0.734 |
| 97.6 | 27.4 | 0.742 |
| 90.9 | 28.7 | 0.750 |
| 82.5 | 28.7 | 0.758 |
| 76.8 | 29.4 | 0.766 |
| 71.5 | 30.1 | 0.773 |
| 68.1 | 31.6 | 0.781 |

**Table 1. SET1 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | $V_{OUT}$(V) |
|---|---|---|
| 63.4 | 32.4 | 0.789 |
| Open | 10 | 0.797 |
| 57.6 | 34.8 | 0.805 |
| 54.9 | 35.7 | 0.812 |
| 52.3 | 37.4 | 0.820 |
| 49.9 | 38.3 | 0.828 |
| 47.5 | 39.2 | 0.836 |
| 45.3 | 41.2 | 0.844 |
| Open | 21.5 | 0.852 |
| 42.2 | 44.2 | 0.859 |
| 40.2 | 45.3 | 0.867 |
| 39.2 | 48.7 | 0.875 |
| 37.4 | 49.9 | 0.883 |
| 36.5 | 52.3 | 0.891 |
| Open | 34.8 | 0.898 |
| 34 | 57.6 | 0.906 |
| 33.2 | 61.9 | 0.914 |
| 32.4 | 66.5 | 0.922 |
| 30.9 | 68.1 | 0.930 |
| 30.1 | 73.2 | 0.938 |
| 29.4 | 78.7 | 0.945 |
| Open | 52.3 | 0.953 |
| 28 | 93.1 | 0.961 |
| 174 | 43.2 | 0.969 |
| 158 | 44.2 | 0.977 |
| 147 | 46.4 | 0.984 |
| 133 | 46.4 | 0.992 |
| Open | 75 | 1.000 |
| 118 | 49.9 | 1.008 |
| 110 | 51.1 | 1.016 |
| 102 | 52.3 | 1.023 |
| 97.6 | 53.6 | 1.031 |
| 93.1 | 56.2 | 1.039 |
| Open | 105 | 1.047 |
| 84.5 | 60.4 | 1.055 |
| 80.6 | 61.9 | 1.062 |
| 76.8 | 63.4 | 1.070 |
| 73.2 | 66.5 | 1.078 |
| 69.8 | 68.1 | 1.086 |
| 68.1 | 71.5 | 1.094 |
| Open | 147 | 1.102 |

**Table 1. SET1 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | $V_{OUT}$(V) |
|---|---|---|
| 63.4 | 78.7 | 1.109 |
| 60.4 | 80.6 | 1.117 |
| 59 | 84.5 | 1.125 |
| 57.6 | 90.9 | 1.133 |
| 54.9 | 93.1 | 1.141 |
| 53.6 | 100 | 1.148 |
| 52.3 | 105 | 1.156 |
| 49.9 | 110 | 1.164 |
| 48.7 | 118 | 1.172 |
| 47.5 | 127 | 1.180 |
| 46.4 | 137 | 1.188 |
| 45.3 | 150 | 1.195 |
| Open | 499 | 1.203 |
| 237 | 66.5 | 1.211 |
| 221 | 69.8 | 1.219 |
| 200 | 69.8 | 1.227 |
| 187 | 71.5 | 1.234 |
| 178 | 75 | 1.242 |
| 165 | 76.8 | 1.250 |
| 154 | 78.7 | 1.258 |
| 147 | 80.6 | 1.266 |
| 140 | 84.5 | 1.273 |
| 133 | 86.6 | 1.281 |
| 127 | 90.9 | 1.289 |
| 121 | 93.1 | 1.297 |
| 115 | 95.3 | 1.305 |
| 110 | 100 | 1.312 |
| 105 | 102 | 1.320 |
| 102 | 107 | 1.328 |
| 97.6 | 110 | 1.336 |
| 95.3 | 118 | 1.344 |
| 10 | Open | 1.352 |
| 88.7 | 127 | 1.359 |
| 86.6 | 137 | 1.367 |
| 82.5 | 140 | 1.375 |
| 80.6 | 150 | 1.383 |
| 78.7 | 162 | 1.391 |
| 75 | 165 | 1.398 |
| 73.2 | 178 | 1.406 |
| 71.5 | 191 | 1.414 |
| 69.8 | 205 | 1.422 |

**Table 1. SET1 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | $V_{OUT}$(V) |
|---|---|---|
| 68.1 | 226 | 1.430 |
| 374 | 93.1 | 1.438 |
| 340 | 95.3 | 1.445 |
| 316 | 100 | 1.453 |
| 287 | 100 | 1.461 |
| 267 | 102 | 1.469 |
| 255 | 107 | 1.477 |
| 237 | 110 | 1.484 |
| 221 | 113 | 1.492 |
| 21.5 | Open | 1.500 |
| 200 | 121 | 1.508 |
| 191 | 124 | 1.516 |
| 182 | 130 | 1.523 |
| 174 | 133 | 1.531 |
| 165 | 137 | 1.539 |
| 158 | 143 | 1.547 |
| 150 | 147 | 1.555 |
| 147 | 154 | 1.562 |
| 140 | 158 | 1.570 |
| 137 | 169 | 1.578 |
| 130 | 174 | 1.586 |
| 127 | 182 | 1.594 |
| 124 | 196 | 1.602 |
| 118 | 200 | 1.609 |
| 115 | 215 | 1.617 |
| 113 | 232 | 1.625 |
| 110 | 243 | 1.633 |
| 105 | 255 | 1.641 |
| 102 | 274 | 1.648 |
| 100 | 294 | 1.656 |
| 97.6 | 324 | 1.664 |
| 523 | 130 | 1.672 |
| 475 | 133 | 1.680 |
| 442 | 140 | 1.688 |
| 402 | 140 | 1.695 |
| 374 | 143 | 1.703 |
| 357 | 150 | 1.711 |
| 332 | 154 | 1.719 |
| 309 | 158 | 1.727 |
| 294 | 162 | 1.734 |
| 280 | 169 | 1.742 |

**Table 1. SET1 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | $V_{OUT}$(V) |
|---|---|---|
| 267 | 174 | 1.750 |
| 255 | 182 | 1.758 |
| 243 | 187 | 1.766 |
| 232 | 191 | 1.773 |
| 221 | 200 | 1.781 |
| 210 | 205 | 1.789 |
| 34.8 | Open | 1.797 |
| 196 | 226 | 1.805 |
| 191 | 237 | 1.812 |
| 182 | 243 | 1.820 |
| 178 | 255 | 1.828 |
| 174 | 274 | 1.836 |
| 165 | 280 | 1.914 |
| 162 | 301 | 1.992 |
| 158 | 324 | 2.070 |
| 154 | 340 | 2.148 |
| 147 | 357 | 2.227 |
| 143 | 383 | 2.305 |
| 140 | 412 | 2.383 |
| 137 | 453 | 2.461 |
| 732 | 182 | 2.469 |
| 665 | 187 | 2.477 |
| 619 | 196 | 2.484 |
| 576 | 200 | 2.492 |
| 52.3 | Open | 2.500 |
| 499 | 210 | 2.508 |
| 464 | 215 | 2.516 |
| 432 | 221 | 2.523 |
| 412 | 226 | 2.602 |
| 392 | 237 | 2.68 |
| 374 | 243 | 2.758 |
| 357 | 255 | 2.836 |
| 340 | 261 | 2.914 |
| 324 | 267 | 2.992 |
| 75 | Open | 3.000 |
| 309 | 280 | 3.070 |
| 301 | 294 | 3.148 |
| 287 | 301 | 3.227 |
| 274 | 309 | 3.281 |
| 267 | 332 | 3.289 |

**Table 1. SET1 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | $V_{OUT}$(V) |
|---|---|---|
| 105 | Open | 3.297 |
| 249 | 357 | 3.305 |
| 243 | 383 | 3.312 |
| 232 | 392 | 3.320 |
| 226 | 422 | 3.328 |
| 221 | 453 | 3.406 |
| 215 | 475 | 3.484 |
| 205 | 499 | 3.562 |
| 200 | 536 | 3.641 |
| 196 | 576 | 3.719 |
| 191 | 634 | 3.797 |
| 1000 | 249 | 3.875 |
| 909 | 255 | 3.953 |
| 845 | 267 | 4.031 |
| 768 | 267 | 4.109 |
| 715 | 274 | 4.188 |
| 665 | 280 | 4.266 |
| 634 | 294 | 4.344 |
| 590 | 301 | 4.422 |
| 562 | 309 | 4.500 |
| 536 | 324 | 4.578 |
| 511 | 332 | 4.656 |
| 487 | 348 | 4.734 |
| 464 | 357 | 4.812 |
| 442 | 365 | 4.891 |
| 422 | 383 | 4.969 |
| 402 | 392 | 4.977 |
| 392 | 412 | 4.984 |
| 374 | 422 | 4.992 |
| 147 | Open | 5.000 |
| 348 | 464 | 5.008 |
| 499 | Open | 0.000 |

**Table 2. SET2 Resistor Reader**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 29.4 | 15 | Enabled | +30 |
| 28 | 15.4 | Enabled | +30 |
| 26.7 | 16.2 | Enabled | +30 |
| 25.5 | 16.5 | Enabled | +30 |
| 24.3 | 17.4 | Enabled | +30 |
| 23.2 | 17.8 | Enabled | +30 |

**Table 2. SET2 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 22.1 | 18.2 | Enabled | +30 |
| 21 | 19.1 | Enabled | +30 |
| Open | 10 | Enabled | +30 |
| Open | 10 | Enabled | +30 |
| 45.3 | 12.7 | Enabled | +30 |
| 42.2 | 13.3 | Enabled | +30 |
| 38.3 | 13.3 | Enabled | +30 |
| 35.7 | 13.7 | Enabled | +30 |
| 34 | 14.3 | Enabled | +30 |
| 31.6 | 14.7 | Enabled | +30 |
| 20 | 19.6 | Enabled | +30 |
| 19.6 | 20.5 | Enabled | +30 |
| 18.7 | 21.5 | Enabled | +30 |
| 18.2 | 22.6 | Enabled | +30 |
| 17.4 | 23.2 | Enabled | +30 |
| 16.9 | 24.3 | Enabled | +30 |
| 16.5 | 26.1 | Enabled | +30 |
| 15.8 | 26.7 | Enabled | +30 |
| 15.4 | 28.7 | Enabled | +30 |
| 15 | 30.1 | Enabled | +30 |
| 14.7 | 32.4 | Enabled | +30 |
| 14 | 34 | Enabled | +30 |
| 13.7 | 36.5 | Enabled | +30 |
| 13.3 | 39.2 | Enabled | +30 |
| 13 | 43.2 | Enabled | +30 |
| 10 | Open | Enabled | +30 |
| 63.4 | 32.4 | Enabled | +15 |
| 60.4 | 33.2 | Enabled | +15 |
| 57.6 | 34.8 | Enabled | +15 |
| 54.9 | 35.7 | Enabled | +15 |
| 52.3 | 37.4 | Enabled | +15 |
| 49.9 | 38.3 | Enabled | +15 |
| 47.5 | 39.2 | Enabled | +15 |
| 45.3 | 41.2 | Enabled | +15 |
| Open | 21.5 | Enabled | +15 |
| 107 | 26.7 | Enabled | +15 |
| 97.6 | 27.4 | Enabled | +15 |
| 90.9 | 28.7 | Enabled | +15 |
| 82.5 | 28.7 | Enabled | +15 |
| 76.8 | 29.4 | Enabled | +15 |
| 71.5 | 30.1 | Enabled | +15 |

**Table 2. SET2 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 68.1 | 31.6 | Enabled | +15 |
| 43.2 | 42.2 | Enabled | +15 |
| 42.2 | 44.2 | Enabled | +15 |
| 40.2 | 45.3 | Enabled | +15 |
| 39.2 | 48.7 | Enabled | +15 |
| 37.4 | 49.9 | Enabled | +15 |
| 36.5 | 52.3 | Enabled | +15 |
| 34.8 | 54.9 | Enabled | +15 |
| 34 | 57.6 | Enabled | +15 |
| 33.2 | 61.9 | Enabled | +15 |
| 32.4 | 66.5 | Enabled | +15 |
| 30.9 | 68.1 | Enabled | +15 |
| 30.1 | 73.2 | Enabled | +15 |
| 29.4 | 78.7 | Enabled | +15 |
| 28.7 | 84.5 | Enabled | +15 |
| 28 | 93.1 | Enabled | +15 |
| 21.5 | Open | Enabled | +15 |
| 102 | 52.3 | Enabled | +5 |
| 97.6 | 53.6 | Enabled | +5 |
| 93.1 | 56.2 | Enabled | +5 |
| 88.7 | 57.6 | Enabled | +5 |
| 84.5 | 60.4 | Enabled | +5 |
| 80.6 | 61.9 | Enabled | +5 |
| 76.8 | 63.4 | Enabled | +5 |
| 73.2 | 66.5 | Enabled | +5 |
| Open | 34.8 | Enabled | +5 |
| 174 | 43.2 | Enabled | +5 |
| 158 | 44.2 | Enabled | +5 |
| 147 | 46.4 | Enabled | +5 |
| 133 | 46.4 | Enabled | +5 |
| 124 | 47.5 | Enabled | +5 |
| 118 | 49.9 | Enabled | +5 |
| 110 | 51.1 | Enabled | +5 |
| 69.8 | 68.1 | Enabled | +5 |
| 68.1 | 71.5 | Enabled | +5 |
| 64.9 | 73.2 | Enabled | +5 |
| 63.4 | 78.7 | Enabled | +5 |
| 60.4 | 80.6 | Enabled | +5 |
| 59 | 84.5 | Enabled | +5 |
| 57.6 | 90.9 | Enabled | +5 |
| 54.9 | 93.1 | Enabled | +5 |

**Table 2. SET2 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 53.6 | 100 | Enabled | +5 |
| 52.3 | 105 | Enabled | +5 |
| 49.9 | 110 | Enabled | +5 |
| 48.7 | 118 | Enabled | +5 |
| 47.5 | 127 | Enabled | +5 |
| 46.4 | 137 | Enabled | +5 |
| 45.3 | 150 | Enabled | +5 |
| 34.8 | Open | Enabled | +5 |
| 154 | 78.7 | Enabled | OFF |
| 147 | 80.6 | Enabled | OFF |
| 140 | 84.5 | Enabled | OFF |
| 133 | 86.6 | Enabled | OFF |
| 127 | 90.9 | Enabled | OFF |
| 121 | 93.1 | Enabled | OFF |
| 115 | 95.3 | Enabled | OFF |
| 110 | 100 | Enabled | OFF |
| Open | 52.3 | Enabled | OFF |
| 261 | 64.9 | Enabled | OFF |
| 237 | 66.5 | Enabled | OFF |
| 221 | 69.8 | Enabled | OFF |
| 200 | 69.8 | Enabled | OFF |
| 187 | 71.5 | Enabled | OFF |
| 178 | 75 | Enabled | OFF |
| 165 | 76.8 | Enabled | OFF |
| 105 | 102 | Enabled | OFF |
| 102 | 107 | Enabled | OFF |
| 97.6 | 110 | Enabled | OFF |
| 95.3 | 118 | Enabled | OFF |
| 90.9 | 121 | Enabled | OFF |
| 88.7 | 127 | Enabled | OFF |
| 86.6 | 137 | Enabled | OFF |
| 82.5 | 140 | Enabled | OFF |
| 80.6 | 150 | Enabled | OFF |
| 78.7 | 162 | Enabled | OFF |
| 75 | 165 | Enabled | OFF |
| 73.2 | 178 | Enabled | OFF |
| 71.5 | 191 | Enabled | OFF |
| 69.8 | 205 | Enabled | OFF |
| 68.1 | 226 | Enabled | OFF |
| 52.3 | Open | Enabled | OFF |
| 221 | 113 | Disabled | +30 |

**Table 2. SET2 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 210 | 115 | Disabled | +30 |
| 200 | 121 | Disabled | +30 |
| 191 | 124 | Disabled | +30 |
| 182 | 130 | Disabled | +30 |
| 174 | 133 | Disabled | +30 |
| 165 | 137 | Disabled | +30 |
| 158 | 143 | Disabled | +30 |
| Open | 75 | Disabled | +30 |
| 374 | 93.1 | Disabled | +30 |
| 340 | 95.3 | Disabled | +30 |
| 316 | 100 | Disabled | +30 |
| 287 | 100 | Disabled | +30 |
| 267 | 102 | Disabled | +30 |
| 255 | 107 | Disabled | +30 |
| 237 | 110 | Disabled | +30 |
| 150 | 147 | Disabled | +30 |
| 147 | 154 | Disabled | +30 |
| 140 | 158 | Disabled | +30 |
| 137 | 169 | Disabled | +30 |
| 130 | 174 | Disabled | +30 |
| 127 | 182 | Disabled | +30 |
| 124 | 196 | Disabled | +30 |
| 118 | 200 | Disabled | +30 |
| 115 | 215 | Disabled | +30 |
| 113 | 232 | Disabled | +30 |
| 110 | 243 | Disabled | +30 |
| 105 | 255 | Disabled | +30 |
| 102 | 274 | Disabled | +30 |
| 100 | 294 | Disabled | +30 |
| 97.6 | 324 | Disabled | +30 |
| 75 | Open | Disabled | +30 |
| 309 | 158 | Disabled | +15 |
| 294 | 162 | Disabled | +15 |
| 280 | 169 | Disabled | +15 |
| 267 | 174 | Disabled | +15 |
| 255 | 182 | Disabled | +15 |
| 243 | 187 | Disabled | +15 |
| 232 | 191 | Disabled | +15 |
| 221 | 200 | Disabled | +15 |
| Open | 105 | Disabled | +15 |
| 523 | 130 | Disabled | +15 |

**Table 2. SET2 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 475 | 133 | Disabled | +15 |
| 442 | 140 | Disabled | +15 |
| 402 | 140 | Disabled | +15 |
| 374 | 143 | Disabled | +15 |
| 357 | 150 | Disabled | +15 |
| 332 | 154 | Disabled | +15 |
| 210 | 205 | Disabled | +15 |
| 205 | 215 | Disabled | +15 |
| 196 | 226 | Disabled | +15 |
| 191 | 237 | Disabled | +15 |
| 182 | 243 | Disabled | +15 |
| 178 | 255 | Disabled | +15 |
| 174 | 274 | Disabled | +15 |
| 165 | 280 | Disabled | +15 |
| 162 | 301 | Disabled | +15 |
| 158 | 324 | Disabled | +15 |
| 154 | 340 | Disabled | +15 |
| 147 | 357 | Disabled | +15 |
| 143 | 383 | Disabled | +15 |
| 140 | 412 | Disabled | +15 |
| 137 | 453 | Disabled | +15 |
| 105 | Open | Disabled | +15 |
| 432 | 221 | Disabled | +5 |
| 412 | 226 | Disabled | +5 |
| 392 | 237 | Disabled | +5 |
| 374 | 243 | Disabled | +5 |
| 357 | 255 | Disabled | +5 |
| 340 | 261 | Disabled | +5 |
| 324 | 267 | Disabled | +5 |
| 309 | 280 | Disabled | +5 |
| Open | 147 | Disabled | +5 |
| 732 | 182 | Disabled | +5 |
| 665 | 187 | Disabled | +5 |
| 619 | 196 | Disabled | +5 |
| 576 | 200 | Disabled | +5 |
| 523 | 200 | Disabled | +5 |
| 499 | 210 | Disabled | +5 |
| 464 | 215 | Disabled | +5 |
| 301 | 294 | Disabled | +5 |
| 287 | 301 | Disabled | +5 |
| 274 | 309 | Disabled | +5 |

**Table 2. SET2 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 267 | 332 | Disabled | +5 |
| 255 | 340 | Disabled | +5 |
| 249 | 357 | Disabled | +5 |
| 243 | 383 | Disabled | +5 |
| 232 | 392 | Disabled | +5 |
| 226 | 422 | Disabled | +5 |
| 221 | 453 | Disabled | +5 |
| 215 | 475 | Disabled | +5 |
| 205 | 499 | Disabled | +5 |
| 200 | 536 | Disabled | +5 |
| 196 | 576 | Disabled | +5 |
| 191 | 634 | Disabled | +5 |
| 147 | Open | Disabled | +5 |
| 590 | 301 | Disabled | OFF |
| 562 | 309 | Disabled | OFF |
| 536 | 324 | Disabled | OFF |
| 511 | 332 | Disabled | OFF |
| 487 | 348 | Disabled | OFF |
| 464 | 357 | Disabled | OFF |
| 442 | 365 | Disabled | OFF |
| 422 | 383 | Disabled | OFF |
| Open | 499 | Disabled | OFF |
| 1000 | 249 | Disabled | OFF |
| 909 | 255 | Disabled | OFF |
| 845 | 267 | Disabled | OFF |
| 768 | 267 | Disabled | OFF |
| 715 | 274 | Disabled | OFF |
| 665 | 280 | Disabled | OFF |
| 634 | 294 | Disabled | OFF |
| 402 | 392 | Disabled | OFF |
| 392 | 412 | Disabled | OFF |
| 374 | 422 | Disabled | OFF |
| 365 | 453 | Disabled | OFF |
| 348 | 464 | Disabled | OFF |
| 340 | 487 | Disabled | OFF |
| 324 | 511 | Disabled | OFF |
| 316 | 536 | Disabled | OFF |
| 309 | 576 | Disabled | OFF |
| 301 | 604 | Disabled | OFF |
| 287 | 634 | Disabled | OFF |
| 280 | 681 | Disabled | OFF |

**Table 2. SET2 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | PFM | Temp Comp (°C) |
|---|---|---|---|
| 274 | 732 | Disabled | OFF |
| 267 | 787 | Disabled | OFF |
| 261 | 866 | Disabled | OFF |
| 499 | Open | Disabled | OFF |

**Table 3. SET3 Resistor Reader**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | Ultrasonic PFM | Fault Behavior | $f_{SW}$(kHz) | AV Gain | |
|---|---|---|---|---|---|---|
| | | | | | 1x | 2x |
| Open | 10 | Disabled | Retry | 300 | 42 | 84 |
| 49.9 | 12.4 | Disabled | Retry | 300 | 36.5 | 73 |
| 45.3 | 12.7 | Disabled | Retry | 300 | 30.5 | 61 |
| 42.2 | 13.3 | Disabled | Retry | 300 | 24.5 | 49 |
| 38.3 | 13.3 | Disabled | Retry | 300 | 19 | 38 |
| 35.7 | 13.7 | Disabled | Retry | 300 | 13 | 26 |
| 34 | 14.3 | Disabled | Retry | 300 | 7 | 14 |
| 31.6 | 14.7 | Disabled | Retry | 300 | 1 | 2 |
| 29.4 | 15 | Disabled | Retry | 400 | 42 | 84 |
| 28 | 15.4 | Disabled | Retry | 400 | 36.5 | 73 |
| 26.7 | 16.2 | Disabled | Retry | 400 | 30.5 | 61 |
| 25.5 | 16.5 | Disabled | Retry | 400 | 24.5 | 49 |
| 24.3 | 17.4 | Disabled | Retry | 400 | 19 | 38 |
| 23.2 | 17.8 | Disabled | Retry | 400 | 13 | 26 |
| 22.1 | 18.2 | Disabled | Retry | 400 | 7 | 14 |
| 21 | 19.1 | Disabled | Retry | 400 | 1 | 2 |
| 20 | 19.6 | Disabled | Retry | 500 | 42 | 84 |
| 19.6 | 20.5 | Disabled | Retry | 500 | 36.5 | 73 |
| 18.7 | 21.5 | Disabled | Retry | 500 | 30.5 | 61 |
| 18.2 | 22.6 | Disabled | Retry | 500 | 24.5 | 49 |
| 17.4 | 23.2 | Disabled | Retry | 500 | 19 | 38 |
| 16.9 | 24.3 | Disabled | Retry | 500 | 13 | 26 |
| 16.5 | 26.1 | Disabled | Retry | 500 | 7 | 14 |
| 15.8 | 26.7 | Disabled | Retry | 500 | 1 | 2 |
| 15.4 | 28.7 | Disabled | Retry | 600 | 42 | 84 |
| 15 | 30.1 | Disabled | Retry | 600 | 36.5 | 73 |
| 14.7 | 32.4 | Disabled | Retry | 600 | 30.5 | 61 |
| 14 | 34 | Disabled | Retry | 600 | 24.5 | 49 |
| 13.7 | 36.5 | Disabled | Retry | 600 | 19 | 38 |
| 13.3 | 39.2 | Disabled | Retry | 600 | 13 | 26 |
| 13 | 43.2 | Disabled | Retry | 600 | 7 | 14 |
| 10 | Open | Disabled | Retry | 600 | 1 | 2 |
| Open | 21.5 | Disabled | Retry | 700 | 42 | 84 |

**Table 3. SET3 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | Ultrasonic PFM | Fault Behavior | $f_{SW}$(kHz) | AV Gain | |
|---|---|---|---|---|---|---|
| | | | | | 1x | 2x |
| 107 | 26.7 | Disabled | Retry | 700 | 36.5 | 73 |
| 97.6 | 27.4 | Disabled | Retry | 700 | 30.5 | 61 |
| 90.9 | 28.7 | Disabled | Retry | 700 | 24.5 | 49 |
| 82.5 | 28.7 | Disabled | Retry | 700 | 19 | 38 |
| 76.8 | 29.4 | Disabled | Retry | 700 | 13 | 26 |
| 71.5 | 30.1 | Disabled | Retry | 700 | 7 | 14 |
| 68.1 | 31.6 | Disabled | Retry | 700 | 1 | 2 |
| 63.4 | 32.4 | Disabled | Retry | 850 | 42 | 84 |
| 60.4 | 33.2 | Disabled | Retry | 850 | 36.5 | 73 |
| 57.6 | 34.8 | Disabled | Retry | 850 | 30.5 | 61 |
| 54.9 | 35.7 | Disabled | Retry | 850 | 24.5 | 49 |
| 52.3 | 37.4 | Disabled | Retry | 850 | 19 | 38 |
| 49.9 | 38.3 | Disabled | Retry | 850 | 13 | 26 |
| 47.5 | 39.2 | Disabled | Retry | 850 | 7 | 14 |
| 45.3 | 41.2 | Disabled | Retry | 850 | 1 | 2 |
| 43.2 | 42.2 | Disabled | Retry | 1000 | 42 | 84 |
| 42.2 | 44.2 | Disabled | Retry | 1000 | 36.5 | 73 |
| 40.2 | 45.3 | Disabled | Retry | 1000 | 30.5 | 61 |
| 39.2 | 48.7 | Disabled | Retry | 1000 | 24.5 | 49 |
| 37.4 | 49.9 | Disabled | Retry | 1000 | 19 | 38 |
| 36.5 | 52.3 | Disabled | Retry | 1000 | 13 | 26 |
| 34.8 | 54.9 | Disabled | Retry | 1000 | 7 | 14 |
| 34 | 57.6 | Disabled | Retry | 1000 | 1 | 2 |
| Open | 34.8 | Disabled | Latch | 300 | 42 | 84 |
| 174 | 43.2 | Disabled | Latch | 300 | 36.5 | 73 |
| 158 | 44.2 | Disabled | Latch | 300 | 30.5 | 61 |
| 147 | 46.4 | Disabled | Latch | 300 | 24.5 | 49 |
| 133 | 46.4 | Disabled | Latch | 300 | 19 | 38 |
| 124 | 47.5 | Disabled | Latch | 300 | 13 | 26 |
| 118 | 49.9 | Disabled | Latch | 300 | 7 | 14 |
| 110 | 51.1 | Disabled | Latch | 300 | 1 | 2 |
| 102 | 52.3 | Disabled | Latch | 400 | 42 | 84 |
| 97.6 | 53.6 | Disabled | Latch | 400 | 36.5 | 73 |
| 93.1 | 56.2 | Disabled | Latch | 400 | 30.5 | 61 |
| 88.7 | 57.6 | Disabled | Latch | 400 | 24.5 | 49 |
| 84.5 | 60.4 | Disabled | Latch | 400 | 19 | 38 |
| 80.6 | 61.9 | Disabled | Latch | 400 | 13 | 26 |
| 76.8 | 63.4 | Disabled | Latch | 400 | 7 | 14 |
| 73.2 | 66.5 | Disabled | Latch | 400 | 1 | 2 |
| 69.8 | 68.1 | Disabled | Latch | 500 | 42 | 84 |

**Table 3. SET3 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | Ultrasonic PFM | Fault Behavior | $f_{SW}$(kHz) | AV Gain | |
|---|---|---|---|---|---|---|
| | | | | | 1x | 2x |
| 68.1 | 71.5 | Disabled | Latch | 500 | 36.5 | 73 |
| 64.9 | 73.2 | Disabled | Latch | 500 | 30.5 | 61 |
| 63.4 | 78.7 | Disabled | Latch | 500 | 24.5 | 49 |
| 60.4 | 80.6 | Disabled | Latch | 500 | 19 | 38 |
| 59 | 84.5 | Disabled | Latch | 500 | 13 | 26 |
| 57.6 | 90.9 | Disabled | Latch | 500 | 7 | 14 |
| 54.9 | 93.1 | Disabled | Latch | 500 | 1 | 2 |
| 53.6 | 100 | Disabled | Latch | 600 | 42 | 84 |
| 52.3 | 105 | Disabled | Latch | 600 | 36.5 | 73 |
| 49.9 | 110 | Disabled | Latch | 600 | 30.5 | 61 |
| 48.7 | 118 | Disabled | Latch | 600 | 24.5 | 49 |
| 47.5 | 127 | Disabled | Latch | 600 | 19 | 38 |
| 46.4 | 137 | Disabled | Latch | 600 | 13 | 26 |
| 45.3 | 150 | Disabled | Latch | 600 | 7 | 14 |
| 34.8 | Open | Disabled | Latch | 600 | 1 | 2 |
| Open | 52.3 | Disabled | Latch | 700 | 42 | 84 |
| 261 | 64.9 | Disabled | Latch | 700 | 36.5 | 73 |
| 237 | 66.5 | Disabled | Latch | 700 | 30.5 | 61 |
| 221 | 69.8 | Disabled | Latch | 700 | 24.5 | 49 |
| 200 | 69.8 | Disabled | Latch | 700 | 19 | 38 |
| 187 | 71.5 | Disabled | Latch | 700 | 13 | 26 |
| 178 | 75 | Disabled | Latch | 700 | 7 | 14 |
| 165 | 76.8 | Disabled | Latch | 700 | 1 | 2 |
| 154 | 78.7 | Disabled | Latch | 850 | 42 | 84 |
| 147 | 80.6 | Disabled | Latch | 850 | 36.5 | 73 |
| 140 | 84.5 | Disabled | Latch | 850 | 30.5 | 61 |
| 133 | 86.6 | Disabled | Latch | 850 | 24.5 | 49 |
| 127 | 90.9 | Disabled | Latch | 850 | 19 | 38 |
| 121 | 93.1 | Disabled | Latch | 850 | 13 | 26 |
| 115 | 95.3 | Disabled | Latch | 850 | 7 | 14 |
| 110 | 100 | Disabled | Latch | 850 | 1 | 2 |
| 105 | 102 | Disabled | Latch | 1000 | 42 | 84 |
| 102 | 107 | Disabled | Latch | 1000 | 36.5 | 73 |
| 97.6 | 110 | Disabled | Latch | 1000 | 30.5 | 61 |
| 95.3 | 118 | Disabled | Latch | 1000 | 24.5 | 49 |
| 90.9 | 121 | Disabled | Latch | 1000 | 19 | 38 |
| 88.7 | 127 | Disabled | Latch | 1000 | 13 | 26 |
| 86.6 | 137 | Disabled | Latch | 1000 | 7 | 14 |
| 82.5 | 140 | Disabled | Latch | 1000 | 1 | 2 |

**Table 4. SET4 Resistor Reader**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | SS Rate (mV/µs) | RR(Ω) | AVMLTI |
|---|---|---|---|---|
| Open | 105 | 0.157 | 200k | 1 |
| 332 | 154 | 0.157 | 200k | 2 |
| 309 | 158 | 0.157 | 400k | 1 |
| 221 | 200 | 0.157 | 400k | 2 |
| 210 | 205 | 0.157 | 600k | 1 |
| 165 | 280 | 0.157 | 600k | 2 |
| 162 | 301 | 0.157 | 800k | 1 |
| 105 | Open | 0.157 | 800k | 2 |
| Open | 147 | 0.315 | 200k | 1 |
| 464 | 215 | 0.315 | 200k | 2 |
| 432 | 221 | 0.315 | 400k | 1 |
| 309 | 280 | 0.315 | 400k | 2 |
| 301 | 294 | 0.315 | 600k | 1 |
| 232 | 392 | 0.315 | 600k | 2 |
| 226 | 422 | 0.315 | 800k | 1 |
| 147 | Open | 0.315 | 800k | 2 |
| Open | 499 | 0.625 | 200k | 1 |
| 634 | 294 | 0.625 | 200k | 2 |
| 590 | 301 | 0.625 | 400k | 1 |
| 422 | 383 | 0.625 | 400k | 2 |
| 402 | 392 | 0.625 | 600k | 1 |
| 316 | 536 | 0.625 | 600k | 2 |
| 309 | 576 | 0.625 | 800k | 1 |
| 499 | Open | 0.625 | 800k | 2 |
| Open | 10 | 1.25 | 200k | 1 |
| 31.6 | 14.7 | 1.25 | 200k | 2 |
| 29.4 | 15 | 1.25 | 400k | 1 |
| 21 | 19.1 | 1.25 | 400k | 2 |
| 20 | 19.6 | 1.25 | 600k | 1 |
| 15.8 | 26.7 | 1.25 | 600k | 2 |
| 15.4 | 28.7 | 1.25 | 800k | 1 |
| 10 | Open | 1.25 | 800k | 2 |
| Open | 21.5 | 2.5 | 200k | 1 |
| 68.1 | 31.6 | 2.5 | 200k | 2 |
| 63.4 | 32.4 | 2.5 | 400k | 1 |
| 45.3 | 41.2 | 2.5 | 400k | 2 |
| 43.2 | 42.2 | 2.5 | 600k | 1 |
| 34 | 57.6 | 2.5 | 600k | 2 |
| 33.2 | 61.9 | 2.5 | 800k | 1 |
| 21.5 | Open | 2.5 | 800k | 2 |

**Table 4. SET4 Resistor Reader (Continued)**

| $R_{UP}$ (kΩ) | $R_{DW}$ (kΩ) | SS Rate (mV/µs) | RR(Ω) | AVMLTI |
|---|---|---|---|---|
| Open | 34.8 | 5 | 200k | 1 |
| 110 | 51.1 | 5 | 200k | 2 |
| 102 | 52.3 | 5 | 400k | 1 |
| 73.2 | 66.5 | 5 | 400k | 2 |
| 69.8 | 68.1 | 5 | 600k | 1 |
| 54.9 | 93.1 | 5 | 600k | 2 |
| 53.6 | 100 | 5 | 800k | 1 |
| 34.8 | Open | 5 | 800k | 2 |
| Open | 52.3 | 10 | 200k | 1 |
| 165 | 76.8 | 10 | 200k | 2 |
| 154 | 78.7 | 10 | 400k | 1 |
| 110 | 100 | 10 | 400k | 2 |
| 105 | 102 | 10 | 600k | 1 |
| 82.5 | 140 | 10 | 600k | 2 |
| 80.6 | 150 | 10 | 800k | 1 |
| 52.3 | Open | 10 | 800k | 2 |

# 3. PCB Layout Guidelines

The ISL8212MEVAL1Z is a 3x3 inch six-layer FR-4 board with 2oz. copper on all layers. The board can be used as a single 15A reference design. For board layout information, see Figures 7 through 14 starting on page 26.

The ISL8212MEVAL1Z board layout is optimized for electrical performance, low loss, and good thermal performance. For similar performance in designs using the ISL8212M, use the following layout design tips:

## 3.1 Layout Considerations

(1) Renesas recommends using a six-layer PCB board. Use the top and bottom layer to route VIN and VOUT. Use a full ground plane in the internal layers (underneath the module) with shared SGND and PGND to simplify the layout design. Use another full ground plane directly above the bottom layer. Use the other internal layers to route the remote sense and PGOOD signals.

(2) Place the input capacitors and high frequency decoupling ceramic capacitors between VIN and PGND as close to the module as possible. The loop formed by the input capacitors, VIN, and PGND must be as small as possible to minimize high frequency noise. Place the output ceramic capacitors close to VOUT. Use a copper plane to connect the output ceramic capacitors to the load to avoid any parasitic inductances and resistances. See Figures 2 and 3 for an example layout.

(3) Use large copper planes for power paths (VIN, VOUT, and PGND) to minimize conduction loss and thermal stress. Use multiple vias to connect the power planes in different layers.

(4) Do not oversize the copper planes for the PHASE planes. Because the PHASE planes are subjected to very high dv/dt, the parasitic capacitor formed between these planes and the surrounding circuitry tends to couple the switching noise. Ensure that none of the sensitive signal traces are routed close to the PHASE plane.

(5) Place the PVCC and VIN1 bypass capacitors underneath the PVCC and VIN1 pins and connect their grounds to the SGND. For the external pin-strap resistor dividers connected to SET1, SET2, SET3, and SET4, connect the low side dividers' ground to the SGND. If a local decoupling capacitor is used to bias these resistor dividers, place the decoupling capacitor close to the dividers and connect the capacitor's ground to the SGND. See Figure 3 for an example layout.

(6) Connect remote sensing traces to the regulation point to achieve a tight output voltage regulation. Route the remote sensing traces in parallel underneath the PGND layer and avoid routing the sensing trace near noisy planes such as PHASE. Place 2Ω resistors close to both VSEN and RGND to dampen the noise on the traces.

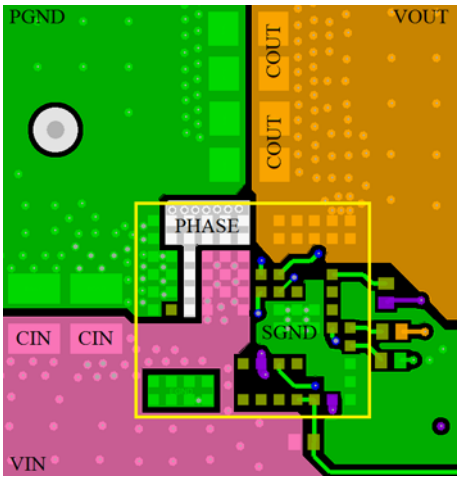


**Figure 2. Layout Example - Top Layer**

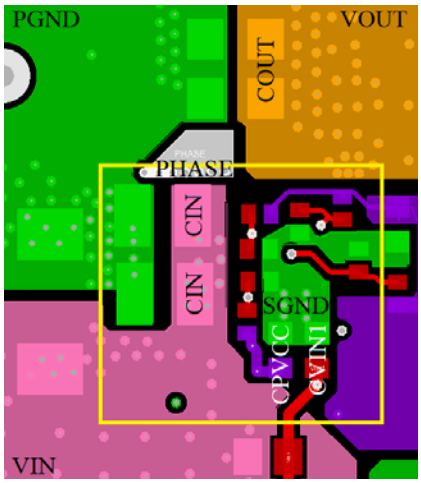


**Figure 3. Layout Example - Bottom Layer**

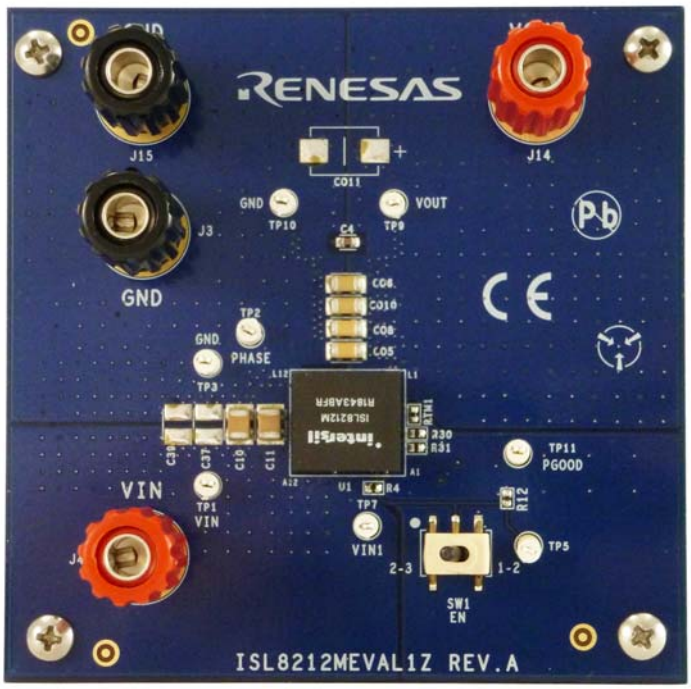


**Figure 4. Top of Board**

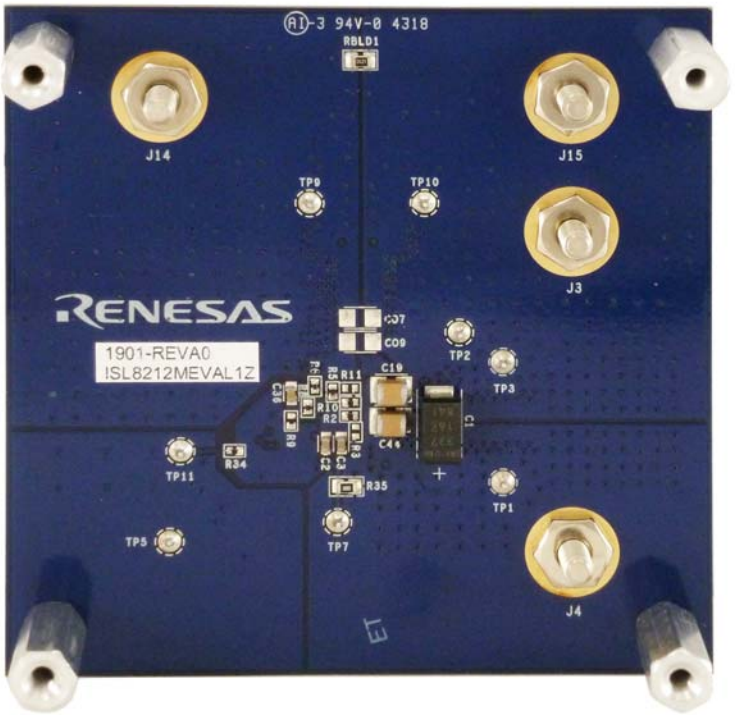


**Figure 5. Bottom of Board**

## 3.2 Schematic

RESISTOR READER

SET1 BOOT VOLTAGE=1V, R3=OPEN; R2=75K OHMS

SET2 PFM DISABLED, TCOMP=5C, R11=OPEN; R10=147K OHMS

SET3 RETRY,400KHZ,AV49 AND 25KHZ CLAMP DISABLED, R9= 25.5K OHMS; R8= 16.5K OHMS

SET4 SS= 0.157MV/US, RR=200KOHM AND AVMULTI=2X, R6= 332K OHMS;R5=154K OHMS

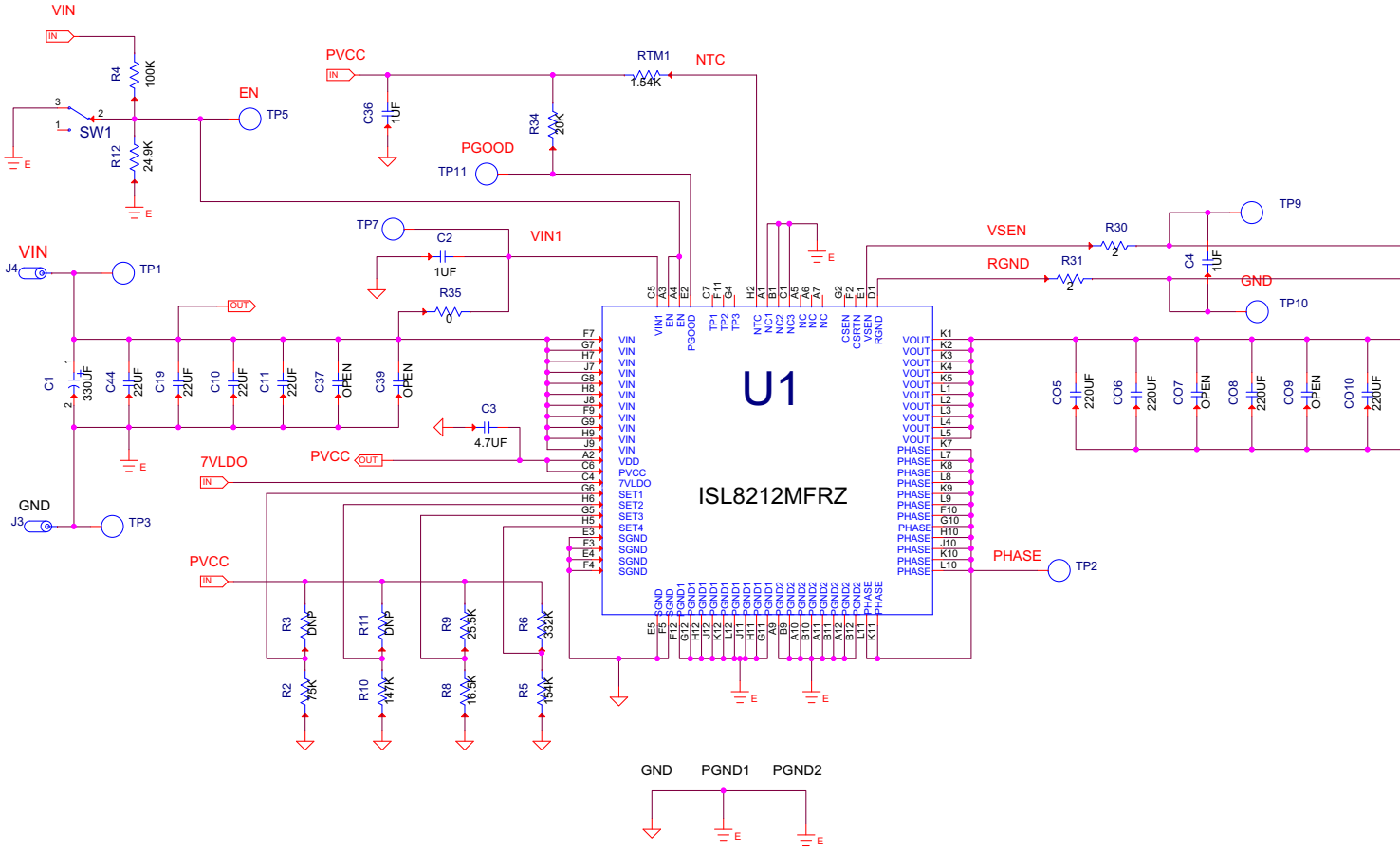


**Figure 6. Schematic**

## 3.3 Bill of Materials

| Reference Designators | Qty | Value | Tol. | Voltage | Power | Package Type | Manufacturer | Part Number | Description |
|---|---|---|---|---|---|---|---|---|---|
| C1 | 1 | 330µF | ±20% | 16V | | 2917 | Kemet | T521X337M016ATE025 | POSCAP |
| C2, C36 | 2 | 1µF | ±10% | 25V | | 0603 | Taiyo Yuden | TMK107BJ105KA-T | Ceramic Capacitor |
| C10, C11, C19, C44 | 4 | 22µF | ±10% | 25V | | 1210 | Murata | GRM32ER71E226KE15L | Ceramic Capacitor |
| C3 | 1 | 4.7µF | ±10% | 10V | | 0603 | | | Ceramic Capacitor |
| C4 | 1 | 1µF | ±10% | 16V | | 0603 | TDK | C1608X7R1C105K | Ceramic Capacitor |
| CO5, CO6, CO8, C10 | 4 | 220µF | ±20% | 6.3V | | 1206 | Murata | GRM31CR60J227ME11L | Ceramic Capacitor |
| C37, C39, CO7, CO9, CO11 | 5 | | | | | | | | DNP |
| J3, J15 | 2 | | | | | | Cinch Connectivity Solutions | 111-0703-001 | Binging Post (Black) |
| J4, J14 | 2 | | | | | | Cinch Connectivity Solutions | 111-0702-001 | Binging Post (Red) |
| RBLD1 | 1 | 121Ω | ±1% | | 1/10W | 0805 | | | Thick Film Chip Resistor |
| RTM1 | 1 | 1.54kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R2 | 1 | 75kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R4 | 1 | 100kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R5 | 1 | 154kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R6 | 1 | 332kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R8 | 1 | 16.5kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R9 | 1 | 25.5kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R10 | 1 | 147kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R12 | 1 | 24.9kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R30, R31 | 2 | 2Ω | ±1% | | 1/16W | 0402 | Vishay | CRCW04022R00FKED | Thick Film Chip Resistor |
| R34 | 1 | 20kΩ | ±1% | | 1/16W | 0402 | | | Thick Film Chip Resistor |
| R35 | 1 | 0Ω | ±1% | | 1/10W | 0805 | | | Thick Film Chip Resistor |
| R3, R11 | 3 | | | | | | | | DNP |

| Reference Designators | Qty | Value | Tol. | Voltage | Power | Package Type | Manufacturer | Part Number | Description |
|---|---|---|---|---|---|---|---|---|---|
| SW1 | 1 | | | | | | C&K | GT11MSCBE | Switch Toggle SPDT 0.4VA 20V |
| TP1-TP3, TP5, TP7, TP9-TP11 | 8 | | | | | Through Hole | Keystone | 5002 | Miniature PC Test Point, Silver Plating 0.040" (1.02mm) Hole Diameter Mounting Type |
| U1 | 1 | | | | | 12x11 HDA | Renesas | ISL8212MFRZ | 15A Step-Down Power Module |

## 3.4 Board Layout

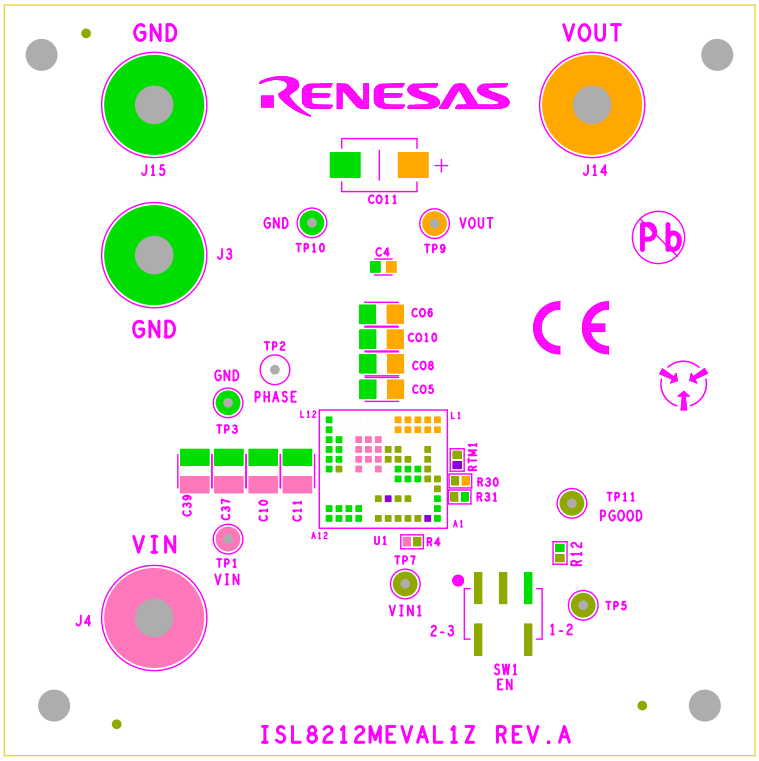


**Figure 7. Silkscreen Top**

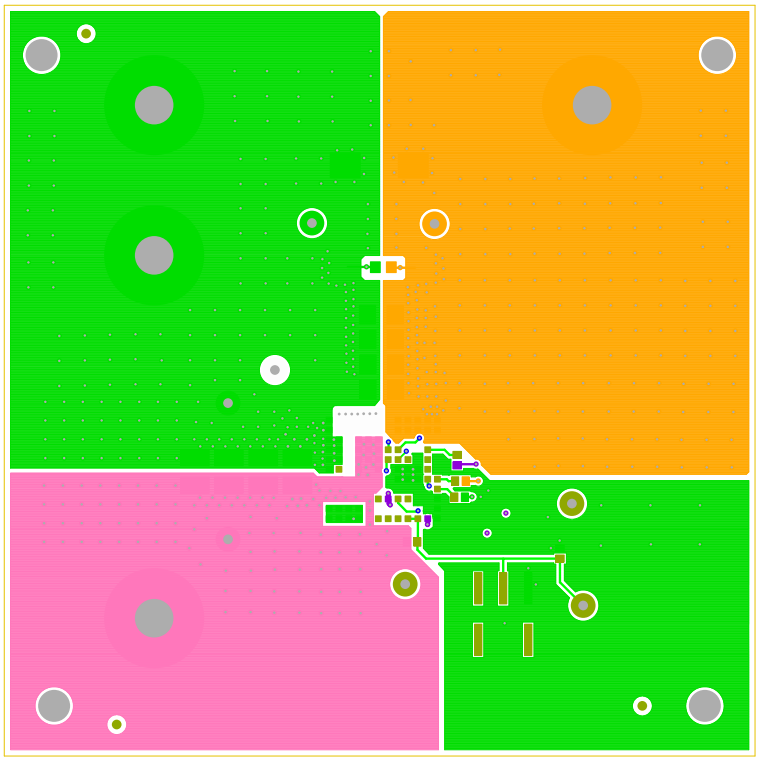

**Figure 8. Top Layer Component Side**

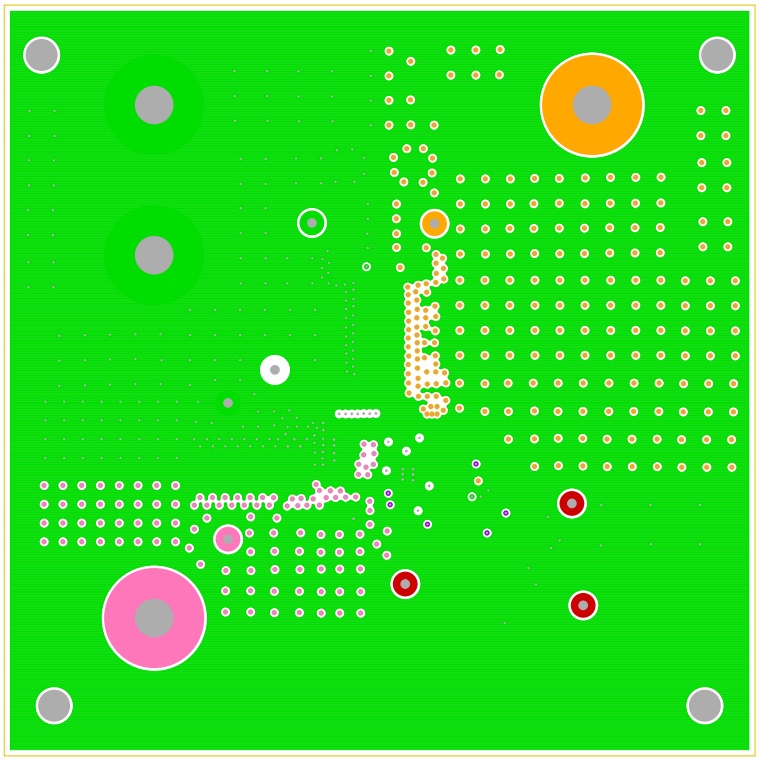

**Figure 9. Inner Layer 2**

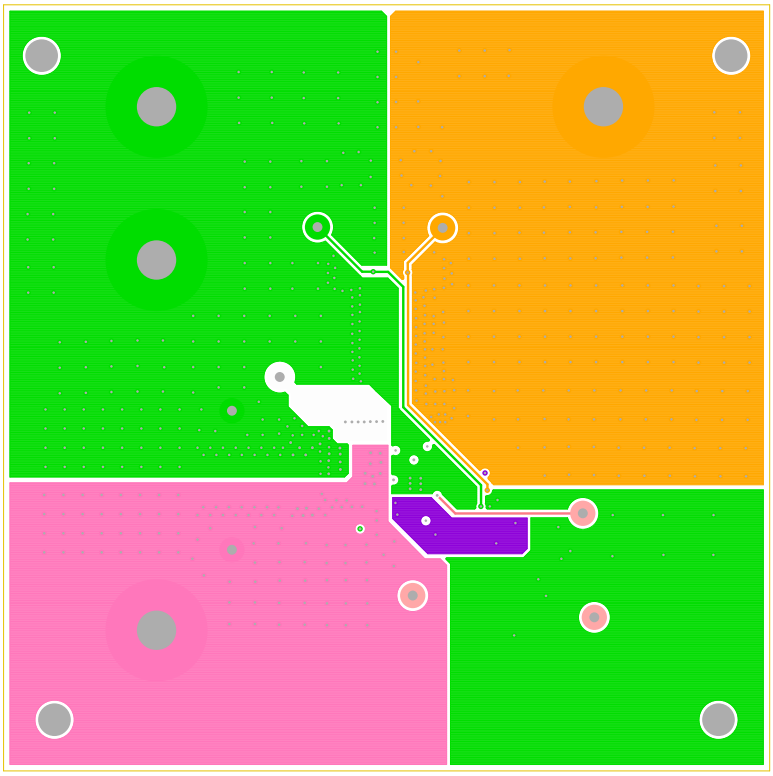

**Figure 10. Inner Layer 3**

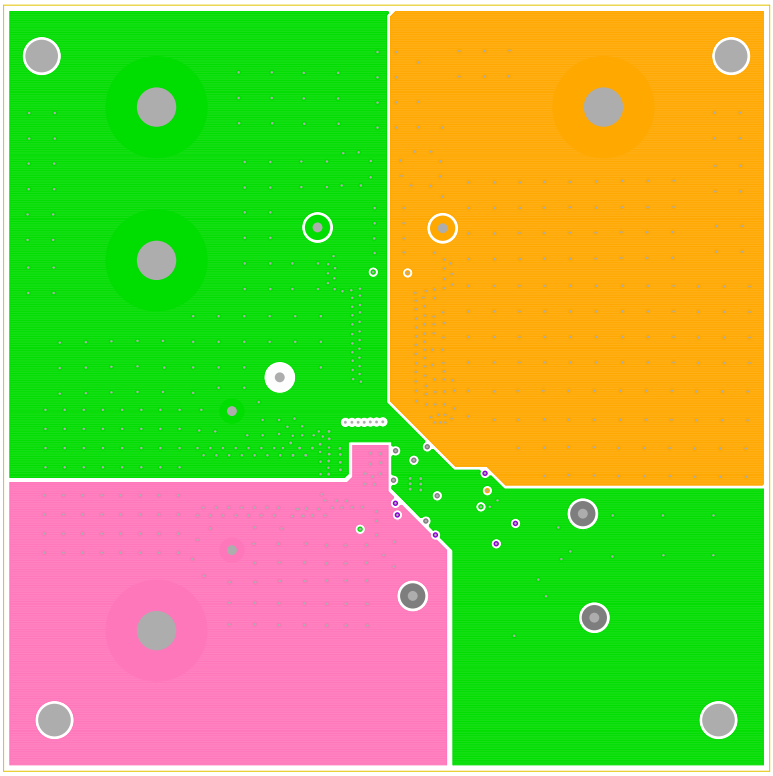

**Figure 11. Inner Layer 4**

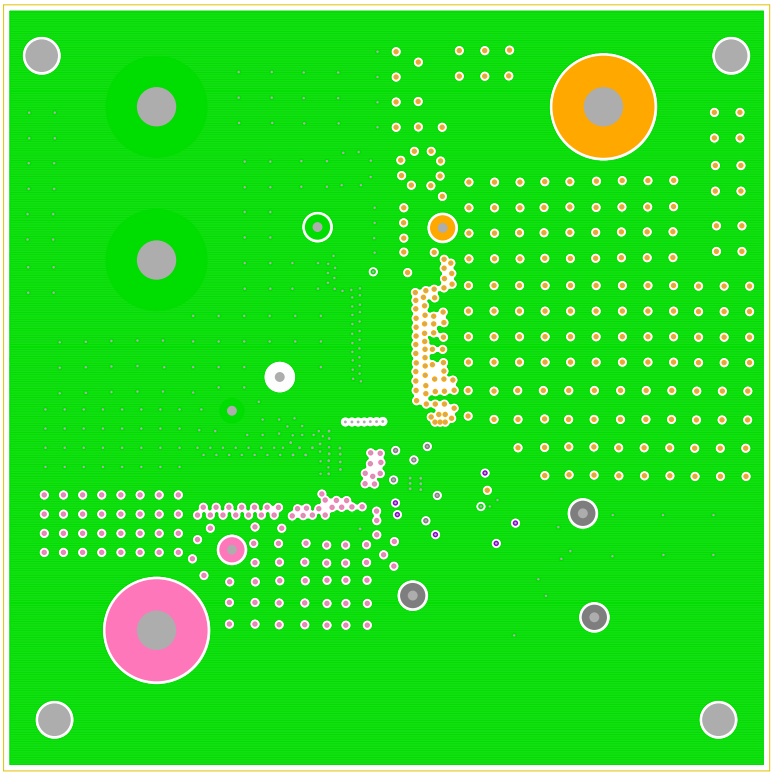

**Figure 12. Inner Layer 5**

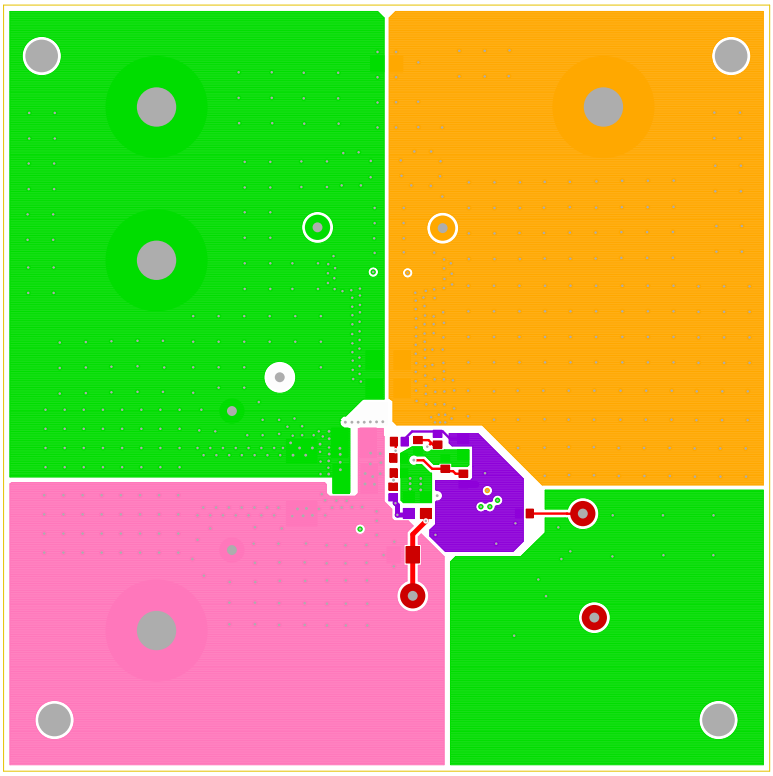

**Figure 13. Bottom Layer Solder Side**

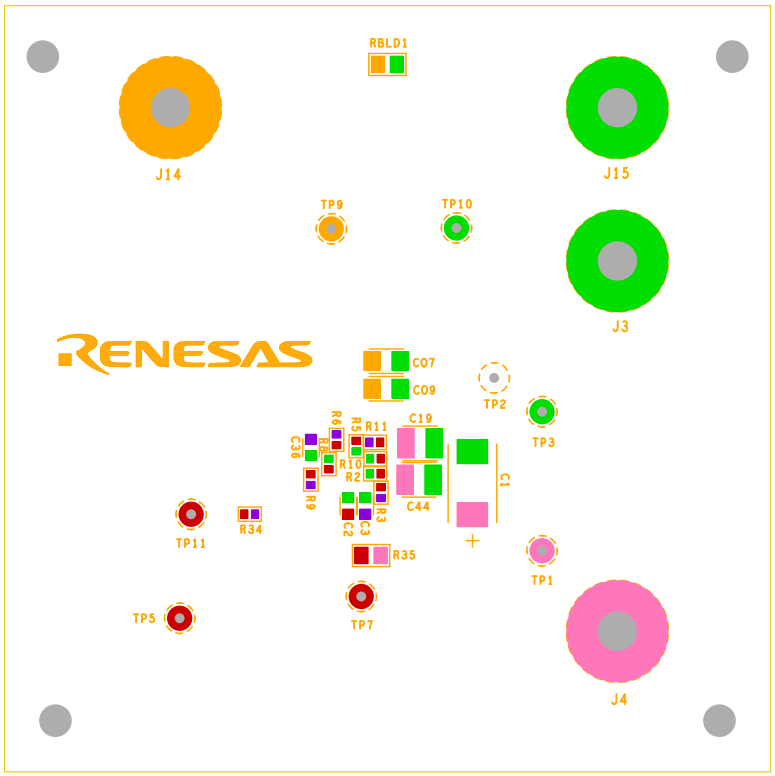


**Figure 14. Silkscreen Bottom**

# 4. Typical Performance Data

The following data was acquired using the ISL8212MEVAL1Z at +25°C ambient temperature and free air 0LFM. See the "ISL8212M Design Guide Matrix of Typical Applications" table in the ISL8212M datasheet for recommended configurations of different output voltages.

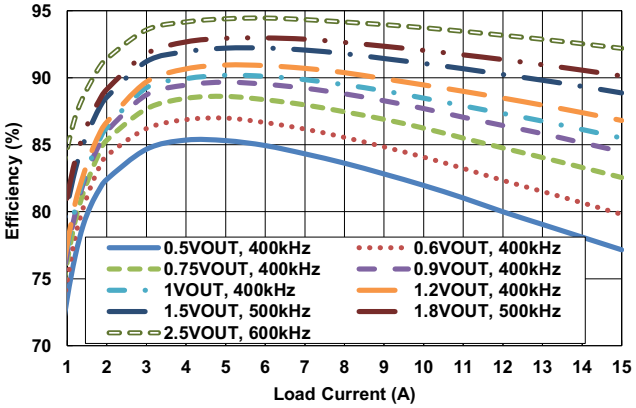


**Figure 15. Efficiency vs Load Current at $5V_{IN}$ (PWM)**

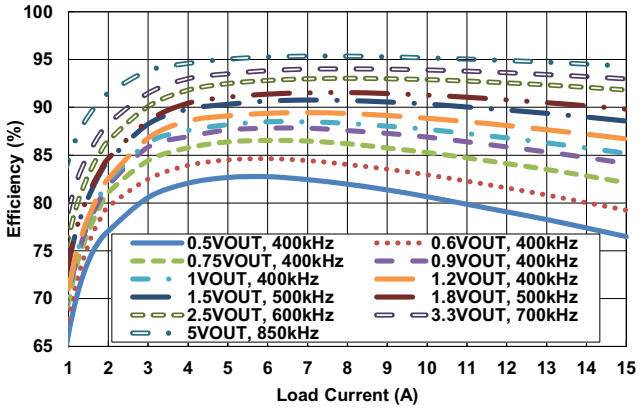


**Figure 16. Efficiency vs Load Current at $8V_{IN}$ (PWM)**

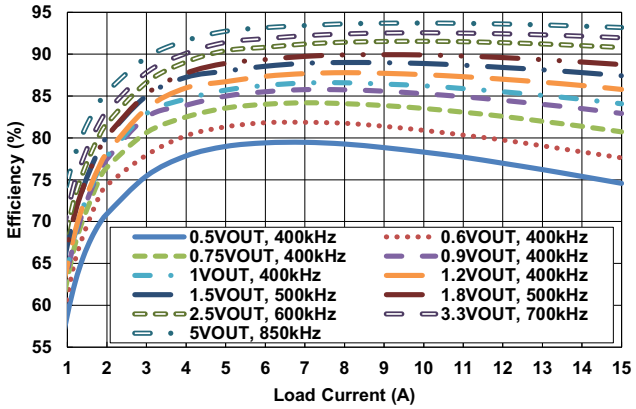


**Figure 17. Efficiency vs Load Current at $12V_{IN}$ (PWM)**

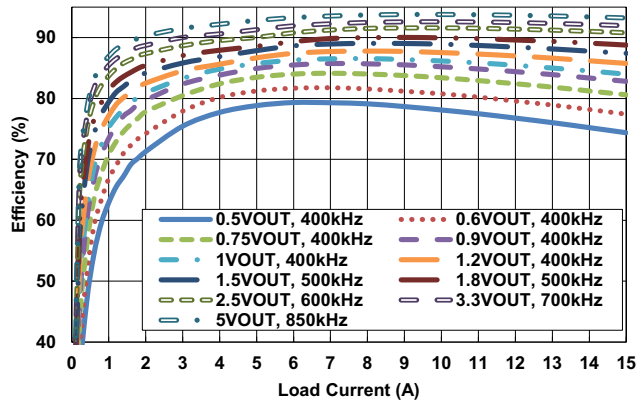


**Figure 18. Efficiency vs Load Current at $12V_{IN}$ (PFM)**

# 5. Typical Performance Curves

Operating conditions: $V_{IN}$ = 12V, $f_{SW}$ = 400kHz, AV gain = 49, RR = 200kΩ, $C_{OUT}$ = 4 x 220µF Ceramic, PWM mode, unless otherwise noted.

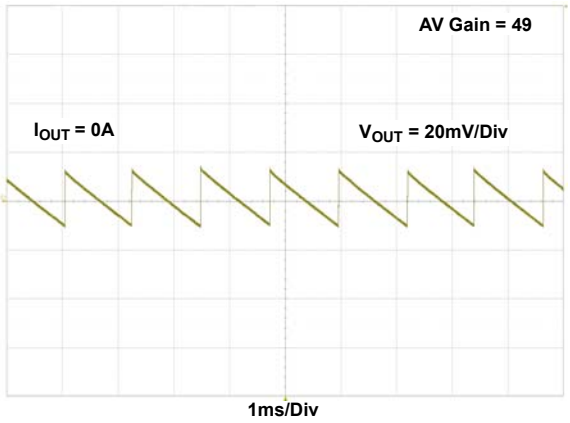


**Figure 19. Output Ripple, $V_{IN}$ = 12V, $V_{OUT}$ = 1V, PFM Mode**

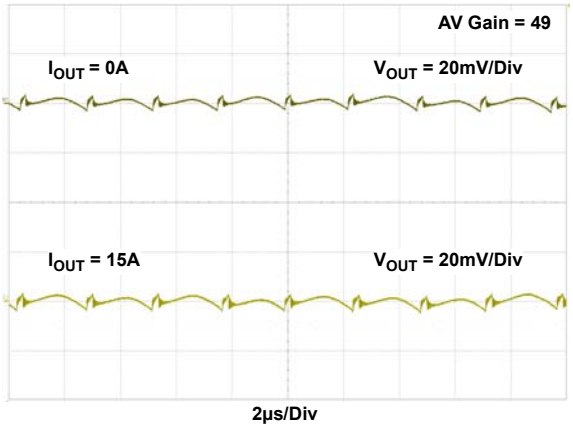


**Figure 20. Output Ripple, $V_{IN}$ = 12V, $V_{OUT}$ = 1V**

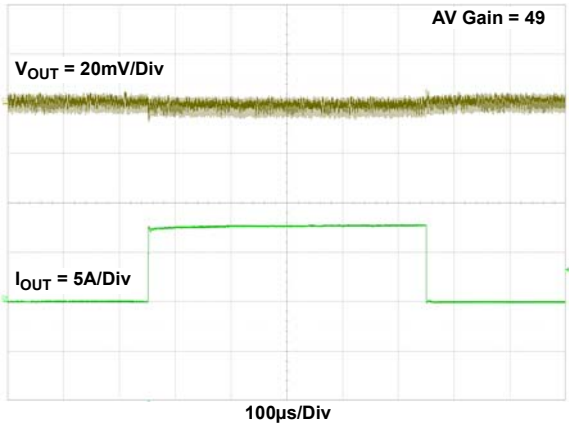


**Figure 21. Transient Response, $V_{OUT}$ = 1V, 0A to 7.5A, 7.5A/µs Step Load**

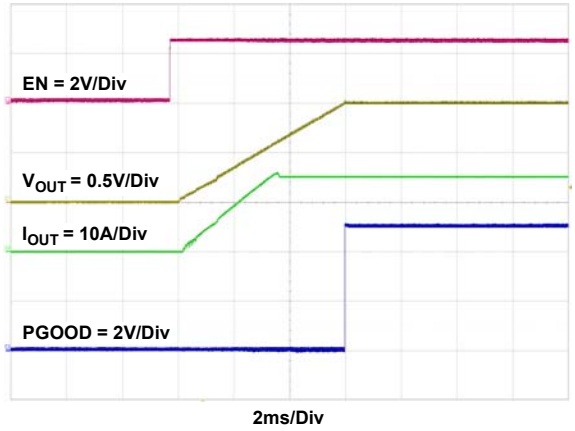


**Figure 22. Startup Waveform, $V_{OUT}$ = 1V, $I_{OUT}$ = 15A**

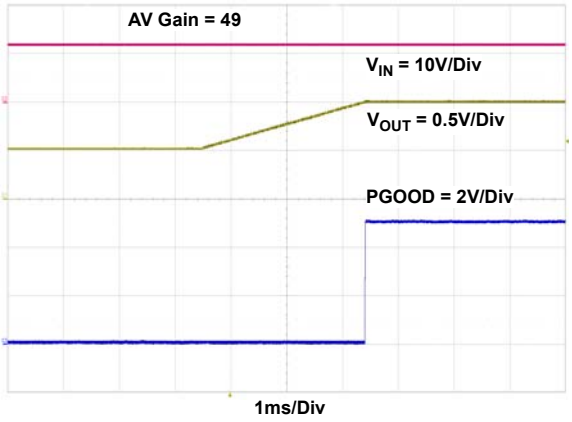


**Figure 23. Prebiased Power-Up Waveform, Prebiased Voltage = 0.5V, $V_{OUT}$ = 1V, $I_{OUT}$ = No Load**

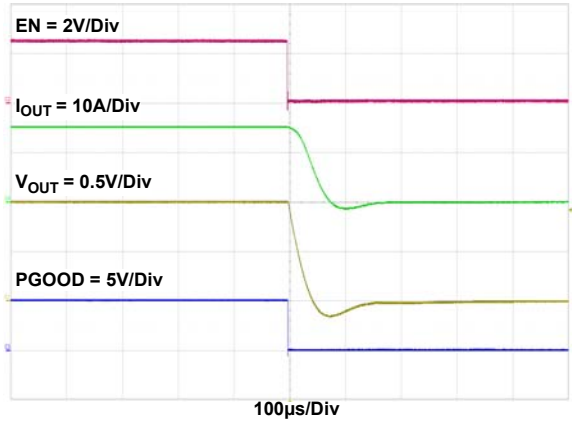


**Figure 24. Shutdown Waveform, $V_{OUT}$ = 1V, $I_{OUT}$ = 15A**

Operating conditions: $V_{IN}$ = 12V, $f_{SW}$ = 400kHz, AV gain = 49, RR = 200kΩ, $C_{OUT}$ = 4 x 220µF Ceramic, PWM mode, unless otherwise noted. **(Continued)**

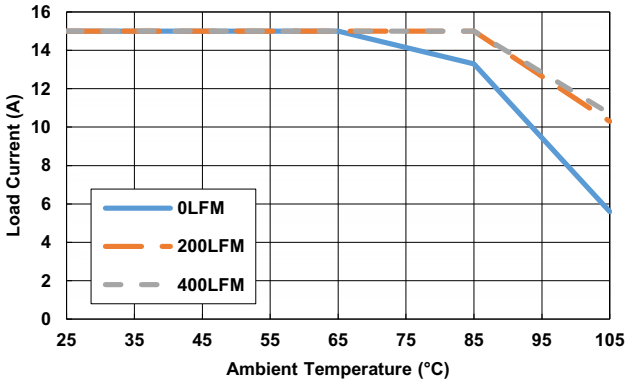


**Figure 25. Derating Curve, $V_{OUT}$ = 1V**

# 6. Revision History

| Rev. | Date | Description |
|---|---|---|
| 1.02 | Feb 15, 2019 | Updated Figure 1. |
| 1.01 | Feb 13, 2019 | Updated Figures 1, 2, and 3. |
| 1.00 | Jan 31, 2019 | Initial release |

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