

ISL85012EVAL1Z

12A Evaluation Board User Guide

UG093
Rev.0.00
Oct 3, 2016

Description

The [ISL85012](#) features integrated power switches that are capable of delivering 12A of continuous current within a 3.5mmx3.5mm package. The board is used to evaluate the performance of the ISL85012, high efficiency synchronous buck regulator.

Specifications

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

- V_{IN} = 4.5V to 18V
- V_{OUT} = 1.8V
- I_{OUTmax} = 12A
- f_{SW} = 600kHz
- Peak efficiency = 90%
- Output ripple <1% of the output voltage
- Transient response: $\pm 5\%$ (25% to 75% load 1.6A/ μ s)
- Operating junction temperature range: -40°C to +125°C

Key Features

- Small, compact design
- Switch selectable EN (enabled/disabled)
- Jumper selectable MODE (auto-DCM/forced-PWM)
- Jumper selectable OCP MODE (hiccup/latch-off)
- Jumper selectable default frequency (600kHz/300kHz)
- Connectors and test points for easy probing

Related Literature

- For a full list of related documents please visit our web page - [ISL85012](#) product page

Ordering Information

| PART NUMBER | DESCRIPTION |
|----------------|-------------------------------|
| ISL85012EVAL1Z | Evaluation Board for ISL85012 |

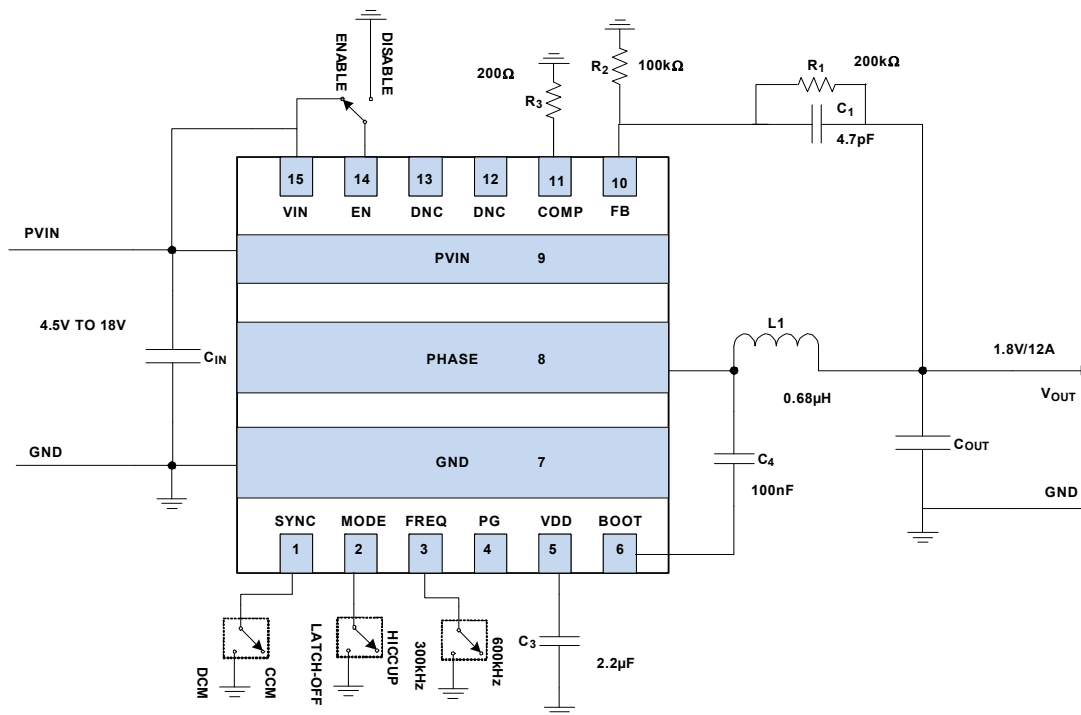


FIGURE 1. BLOCK DIAGRAM

Quick Setup Guide

1. Ensure that the circuit is correctly connected to the supply (PVIN/GND) and loads (VOUT/GND) prior to applying any power.
2. Verify there is no jumper connected.
3. Verify that the switch is enabled.
4. Turn on the power supply setting at 12V.
5. Verify the output voltage is 1.8V.

Recommended Equipment

The following materials are recommended to perform testing:

- 0V to 25V power supply with at least 15A source current capability
- Electronic loads capable of sinking current up to 20A
- Digital Multimeters (DMMs)
- 100MHz quad-trace oscilloscope
- Signal generator

Evaluating Other Output Voltages

The ISL85012EVAL1Z output is preset to 1.8V. The output voltages are programmable by the external resistor divider that scales the feedback relative to the internal reference voltage. The output voltage programming resistor, R_5 , will depend on the value chosen for the feedback resistor, R_4 , and the desired regulator output voltage, V_{OUT} . The value for the feedback resistor, R_4 , is typically between 10k Ω and 400k Ω , as shown in [Equation 1](#).

$$R_2 = \frac{R_1 \cdot 0.6V}{V_{OUT} - 0.6V} \quad (\text{EQ. 1})$$

If the output voltage desired is 0.6V, then R_5 is left unpopulated. R_1 is still required to set the low frequency pole of the modulator compensation. The recommended values for different output applications are summarized in [Table 2](#).

Switch/Jumper Control

The ISL85012EVAL1Z evaluation board contains a switch and jumpers for various controls of the ISL85012 circuitries. [Table 1](#) details this function.

TABLE 1. SWITCH SETTINGS

| SW/JUMP | FUNCTION |
|---------|--|
| SW5 | Enable/Disable |
| J10 | Select frequency 600kHz/300kHz |
| J16 | Select OCP behavior Hiccup/Latch-off |
| J17 | Select light-load operation mode CCM/DCM |

TABLE 2. DESIGN TABLE FOR DIFFERENT OUTPUT VOLTAGE

| V _{OUT} (V) | 0.9 | 1 | 1.2 | 1.5 | 1.8 | 2.5 | 3.3 | 5 |
|------------------------------|---------------|---------------|---------------|-----------|-----------|-----------|-----------|----------|
| V _{IN} (V) | 4.5 to 18 | 4.5 to 18 | 4.5 to 18 | 4.5 to 18 | 4.5 to 18 | 4.5 to 18 | 4.5 to 18 | 6 to 18 |
| Frequency (kHz) | 300 | 300 | 300 | 600 | 600 | 600 | 600 | 600 |
| Compensation | Internal | Internal | Internal | Internal | Internal | Internal | Internal | Internal |
| C _{IN} (μ F) | 3x22 | 3x22 | 3x22 | 3x22 | 3x22 | 3x22 | 3x22 | 3x22 |
| C _{OUT} (μ F) | 2x560 + 4x100 | 2x330 + 3x100 | 2x330 + 3x100 | 4x100 | 3x100 | 4x47 | 4x47 | 4x47 |
| L ₁ (μ H) | 0.68 | 0.68 | 1 | 0.68 | 0.68 | 1 | 1 | 1.5 |
| R ₁ (k Ω) | 100 | 100 | 147 | 150 | 200 | 301 | 365 | 365 |
| R ₂ (k Ω) | 200 | 150 | 147 | 100 | 100 | 95.3 | 80.6 | 49.9 |
| C ₁ (pF) | DNP | DNP | DNP | 10 | 4.7 | 4.7 | 3.3 | 3.3 |

NOTES:

1. The design table is referencing the schematic shown in [Figure 1](#).
2. Ceramic capacitors are selected for 22 μ F and 100 μ F in the table.
3. 560 μ F (14m Ω) and 330 μ F (10m Ω) are selected low ESR conductive polymer aluminum solid capacitors.
4. Inductor 7443340068 (0.68 μ H), 7443340100 (1 μ H) and 7443340150 (1.5 μ H) from Wurth Electronics are selected for the above applications.
5. Recommend to keep the inductor peak-to-peak current less than 5A.

PCB Layout Consideration

A multilayer printed circuit board is recommended. [Figure 2](#) shows the recommended top layer layout.

1. Place the input ceramic capacitors between PVIN and GND pins. Put them as close to the pins as possible.
2. A 1 μ F decoupling input ceramic capacitor is recommended. Place it as close to the VIN pin as possible.
3. A 2.2 μ F decoupling ceramic capacitor is recommended for VDD pin. Place it as close to the VDD pin as possible.
4. The entire inner Layer 1 is recommended to be GND plane in order to reduce noise coupling.
5. The switching node (PHASE) plane needs to be kept away from the feedback network. Place the resistor divider close to the IC.
6. Put three to five VIAs on the GND pin to connect the GND plane of other layers for better thermal performance. This allows the heat to move away from the IC. Keep the VIAs small, but not so small that their inside diameter prevents solder wicking through the holes during reflow. An 8 mil hole with 15 mil diameter VIAs are used on the evaluation board. Do not use "thermal relief" patterns to connect the VIAs. It is important to have a complete connection of the plated through-hole to each plane.

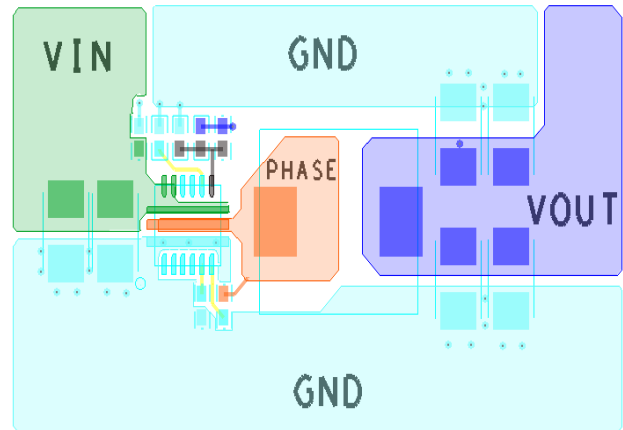


FIGURE 2. RECOMMENDED TOP LAYER LAYOUT

ISL85012EVAL1Z Evaluation Board

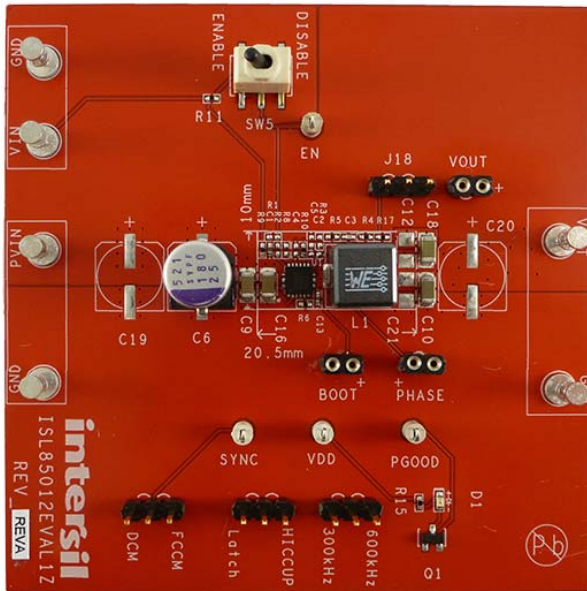


FIGURE 3. TOP VIEW



FIGURE 4. BOTTOM VIEW

ISL85012EVAL1Z Schematic

4.5-18V --> 1.8V10A _ 600kHz default
-40C-85C Operating Temperature

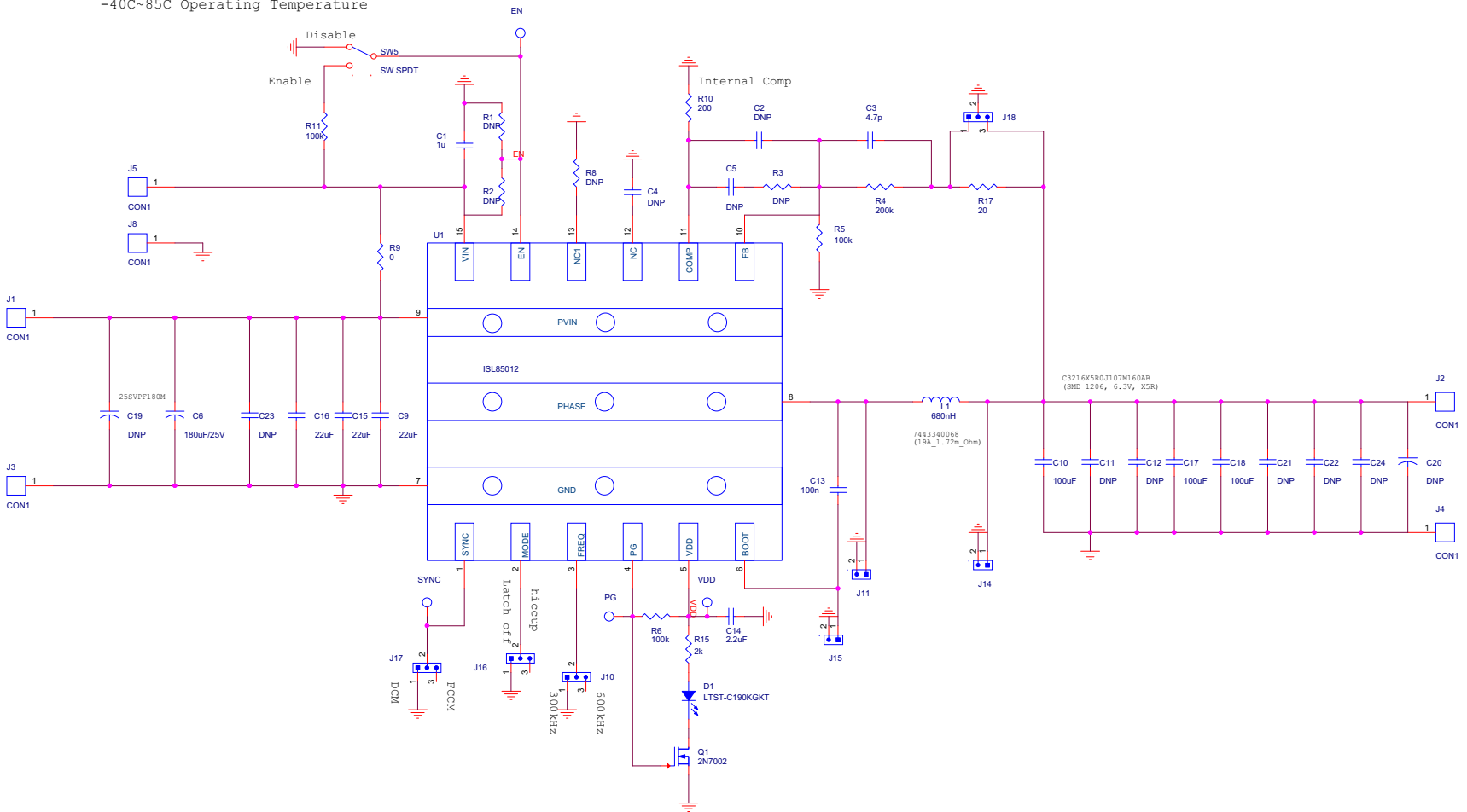


FIGURE 5. SCHEMATIC

Bill of Materials

| MANUFACTURER PART | QTY | UNIT | REFERENCE DESIGNATOR | DESCRIPTION | MANUFACTURER |
|-------------------------|-----|------|------------------------------|---|---|
| ISL85012EVAL1ZREVE01PCB | 1 | ea | SEE LABEL-GENERIC | PWB-PCB, ISL85012EVAL1Z, REVE01, ROHS | SHENZHEN MULTILAYER PCB TECHNOLOGY CO., LTD |
| 25SVPF180M | 1 | ea | C6 | CAP-OSCON, SMD, 8.3x9, 180µF, 25V, 20%, 16mΩ, ROHS | SANYO |
| C1005X7R1H104K | 1 | ea | C13 | CAP, SMD, 0402, 0.1µF, 50V, 10%, X7R, ROHS | TDK |
| C1005X5R1E105K050BC | 1 | ea | C1 | CAP, SMD, 0402, 1.0µF, 25V, 10%, X5R, ROHS | TDK |
| C1005X5R1E225K050BC | 1 | ea | C14 | CAP, SMD, 0402, 2.2µF, 25V, 10%, X5R, ROHS | TDK |
| 04025A4R7CAT2A | 1 | ea | C3 | CAP, SMD, 0402, 4.7PF, 50V, 0.25pF, NPO, ROHS | AVX |
| | 0 | ea | C2, C4, C5 | CAP, SMD, 0402, DNP-PLACE HOLDER, ROHS | |
| GRM31CR60J107ME39L | 3 | ea | C10, C17, C18 | CAP, SMD, 1206, 100µF, 6.3V, 20%, X5R, ROHS | MURATA |
| GRM31CR61E226KE15L | 3 | ea | C9, C15, C16 | CAP, SMD, 1206, 22µF, 25V, 10%, X5R, ROHS | MURATA |
| | 0 | ea | C11, C12, C21, C22, C23, C24 | CAP, SMD, 1206, DNP-PLACE HOLDER, ROHS | |
| 1514-2 | 6 | ea | J1, J2, J3, J4, J5, J8 | CONN-TURRET, TERMINAL POST, TH, ROHS | KEYSTONE |
| 310-43-164-41-001000 | 3 | ea | BOOT, PHASE, VOUT | CONN-BRD-BRD, TH, 1x2, SKTSTRIP-1x64, 2.54mm, TIN, ROHS | MILL-MAX |
| 5002 | 4 | ea | VDD, SYNC, PGOOD, EN | CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS | KEYSTONE |
| NRPN401PAEN-RC | 4 | ea | J10, J16, J17, J18 | CONN-HEADER, 1x3, BRKAWY-1x40, 2mm PITCH, 3.6MATINGx2.8, GOLD, ROHS | SULLINS |
| LTST-C190KGKT | 1 | ea | D1 | LED, SMD, 0603, GREEN CLEAR, 2V, 20mA, 571nm, 35mcd, ROHS | LITEON/VISHAY |
| 7443340068 | 1 | ea | L1 | COIL-PWR CHOKE, SMD, 8.4x7.9, 0.68µH, 20%, 19A, 1.78mΩ, ROHS | WURTH ELEKTRONIK |
| ISL85012FRZ | 1 | ea | U1 | IC-12A BUCK REGULATOR, 15P, TDFN, 3.5x3.5, ROHS | INTERSIL |
| 2N7002-7-F | 1 | ea | Q1 | TRANSISTOR, N-CHANNEL, 3LD, SOT-23, 60V, 115mA, ROHS | DIODES, INC. |
| ERJ2RKF20R0 | 1 | ea | R17 | RES, SMD, 0402, 20Ω, 1/16W, 1%, TF, ROHS | PANASONIC |
| CR0402-16W-00T | 1 | ea | R9 | RES, SMD, 0402, 0Ω, 1/16W, 5%, TF, ROHS | VENKEL |
| ERJ2RKF1003 | 3 | ea | R5, R6, R11 | RES, SMD, 0402, 100K, 1/16W, 1%, TF, ROHS | PANASONIC |
| ERJ-2RKF2000X | 1 | ea | R10 | RES, SMD, 0402, 200Ω, 1/16W, 1%, TF, ROHS | PANASONIC |

Bill of Materials

| MANUFACTURER PART | QTY | UNIT | REFERENCE DESIGNATOR | DESCRIPTION | MANUFACTURER |
|-------------------|-----|------|--|--|-----------------------------|
| ERJ-2RKF2001 | 1 | ea | R15 | RES, SMD, 0402, 2k, 1/16W, 1%, TF, ROHS | PANASONIC |
| MCR01MZPF2003 | 1 | ea | R4 | RES, SMD, 0402, 200k, 1/16W, 1%, TF, ROHS | ROHM |
| | 0 | ea | R1, R2, R3, R8 | RES, SMD, 0402, DNP, DNP, DNP, TF, ROHS | |
| GT11MSCBE | 1 | ea | SW5 | SWITCH-TOGGLE, SMD, 6PIN, SPDT, 2POS, ON-NONE-ON, ROHS | ITT INDUSTRIES/C&K DIVISION |
| SJ-5003SPBL | 4 | ea | Bottom four corners w/o covering silkscreen. | BUMPONS, 0.44inW x 0.20inH, DOMETOP, BLACK | 3M |
| 212403-013 | 1 | ea | Place assy in bag | BAG, STATIC, 5x8, ZIPLOC, ROHS | INTERSIL |
| | 0 | ea | C19, C20 | DO NOT POPULATE OR PURCHASE | |
| LABEL-DATE CODE | 1 | ea | AFFIX TO BACK OF BOARD. | LABEL-DATE CODE_LINE 1: YRWK/REV#, LINE 2: BOM NAME | INTERSIL |
| | 1 | ea | RE-LABEL REV_E01 SILKSCREEN TO: REVA. | LABEL, GENERIC | |

PCB Layout

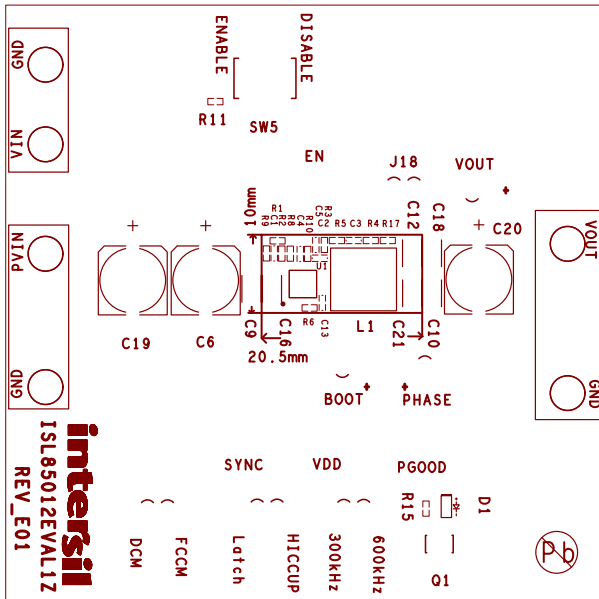


FIGURE 6. SILKSCREEN LAYER

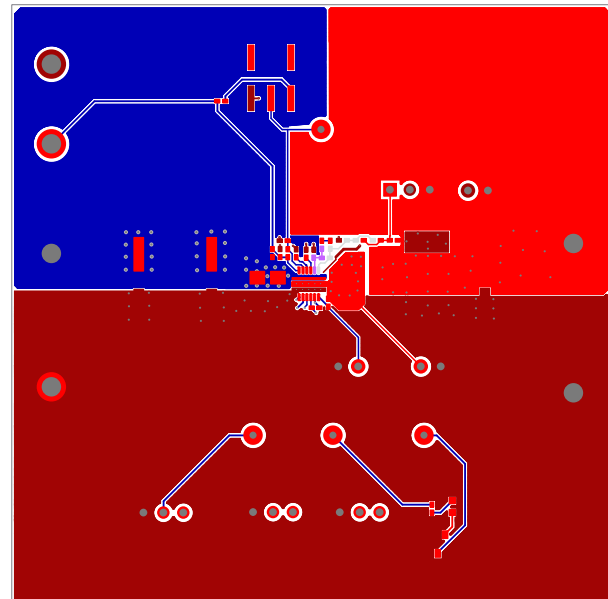


FIGURE 7. TOP LAYER

PCB Layout (Continued)

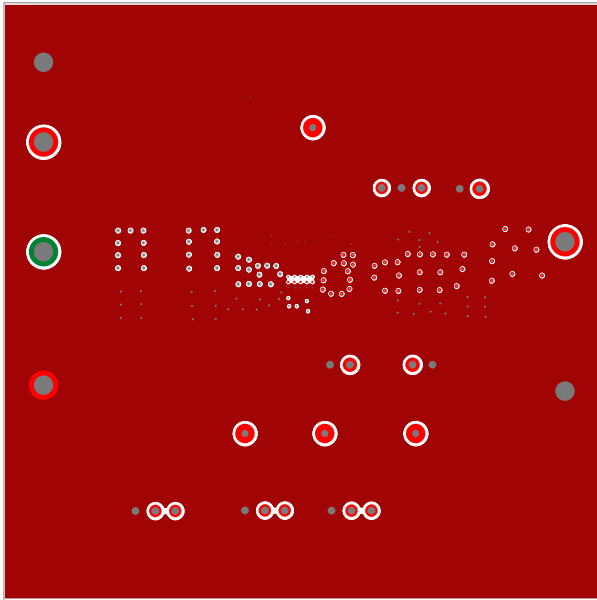


FIGURE 8. LAYER 2

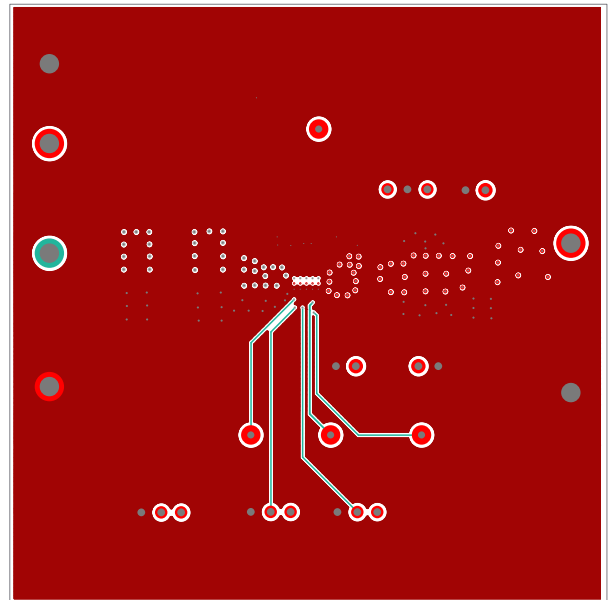


FIGURE 9. LAYER 3

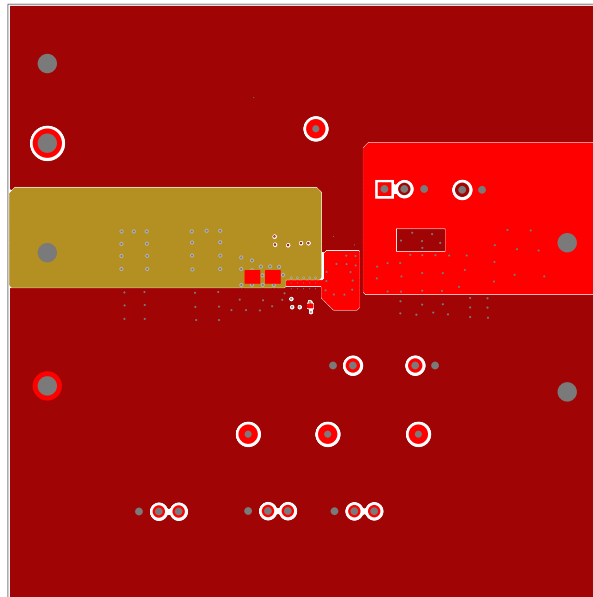


FIGURE 10. BOTTOM LAYER

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Typical Performance Curves

$V_{IN} = 12V$, $V_{OUT} = 1.8V$, Frequency = 600kHz, CCM, $T_J = -40^\circ C$ to $+125^\circ C$ unless otherwise noted. Typical values are at $T_A = +25^\circ C$.

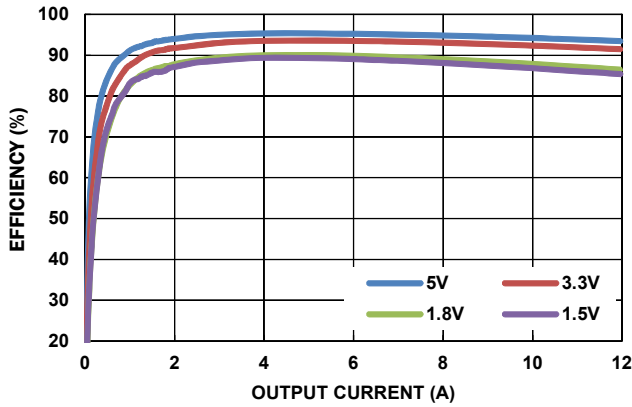


FIGURE 11. EFFICIENCY vs LOAD ($V_{IN} = 12V$, CCM, 600kHz)

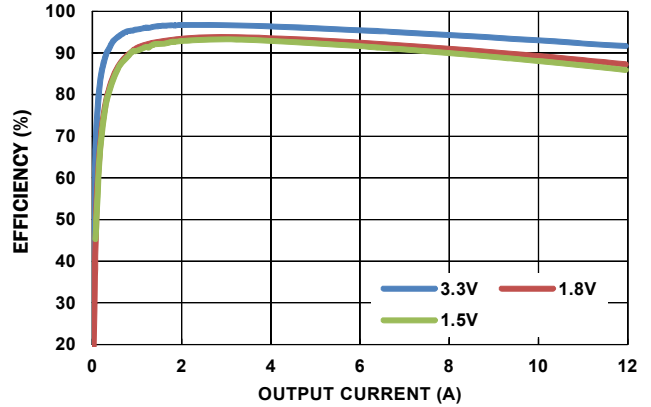


FIGURE 12. EFFICIENCY vs LOAD ($V_{IN} = 5V$, CCM, 600kHz)

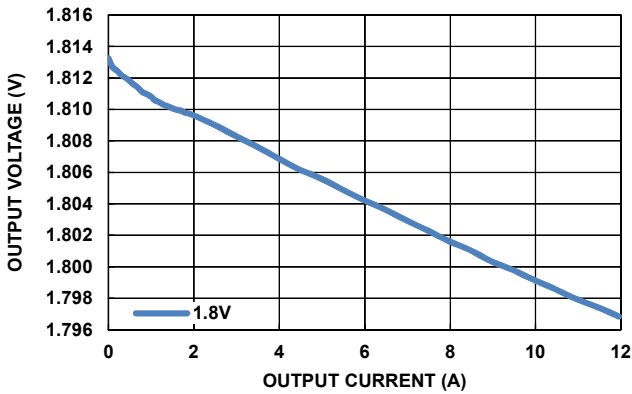


FIGURE 13. V_{OUT} REGULATION vs LOAD ($V_{IN} = 12V$, CCM, 600kHz)

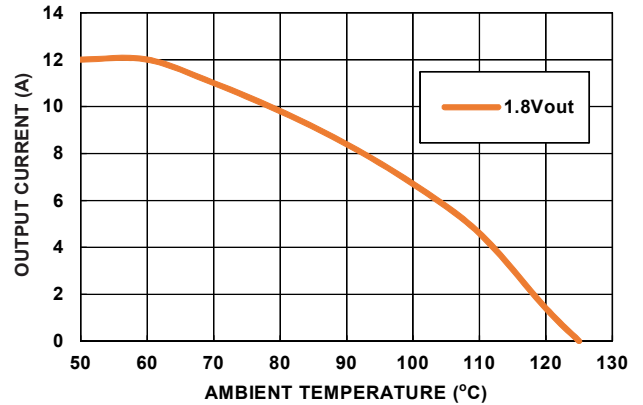


FIGURE 14. DE-RATING CURVE (NO AIRFLOW)

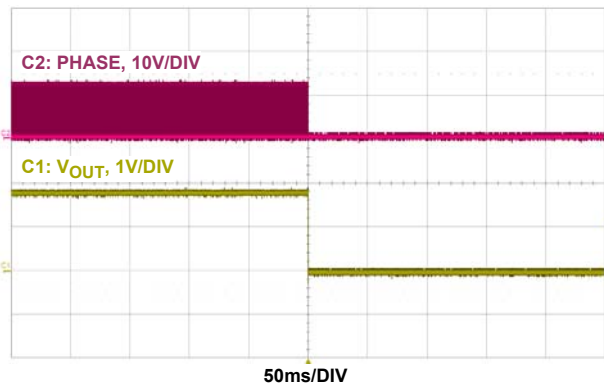


FIGURE 15. LATCH-OFF OCP ($V_{IN} = 12V$, $V_{OUT} = 1.8V$, 600kHz, CCM)

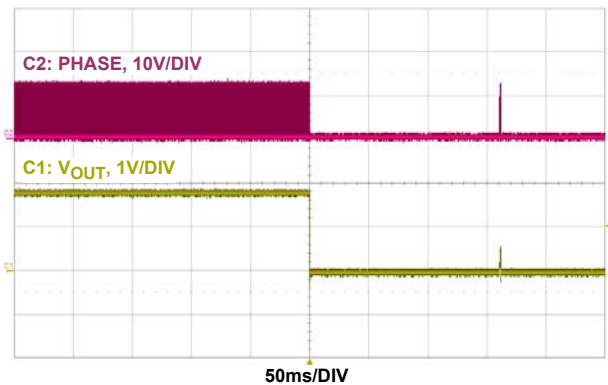


FIGURE 16. HICCUP OCP ($V_{IN} = 12V$, $V_{OUT} = 1.8V$, 600kHz, CCM)

Typical Performance Curves $V_{IN} = 12V$, $V_{OUT} = 1.8V$, Frequency = 600kHz, CCM, $T_J = -40^\circ C$ to $+125^\circ C$ unless otherwise noted. Typical values are at $T_A = +25^\circ C$. (Continued)

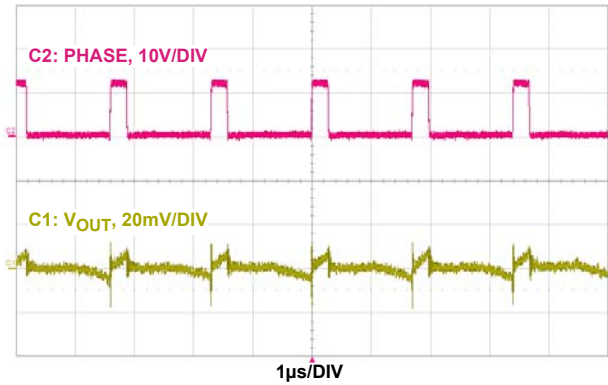


FIGURE 17. OUTPUT VOLTAGE RIPPLE ($V_{IN} = 12V$, $V_{OUT} = 1.8V$ AT 12A, 600kHz, CCM)

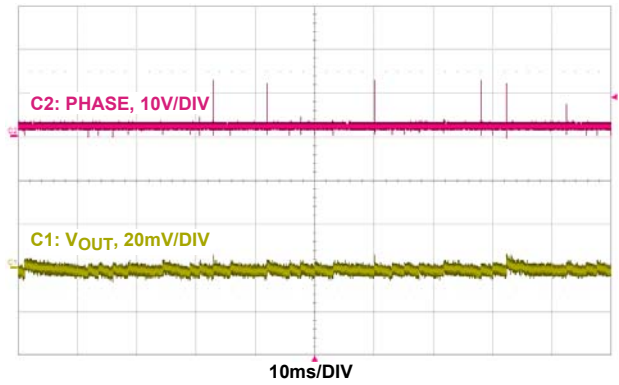


FIGURE 18. OUTPUT VOLTAGE RIPPLE ($V_{IN} = 12V$, $V_{OUT} = 1.8V$ AT 0A, 600kHz, DCM)

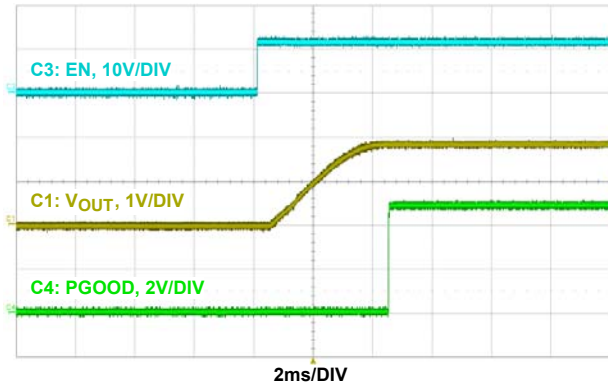


FIGURE 19. START-UP BY EN ($V_{IN} = 12V$, $V_{OUT} = 1.8V$ AT 12A, 600kHz, CCM)

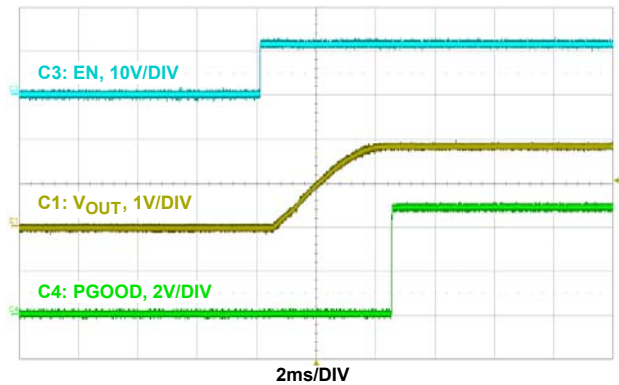


FIGURE 20. START-UP BY EN ($V_{IN} = 12V$, $V_{OUT} = 1.8V$ AT 0A, 600kHz, DCM)

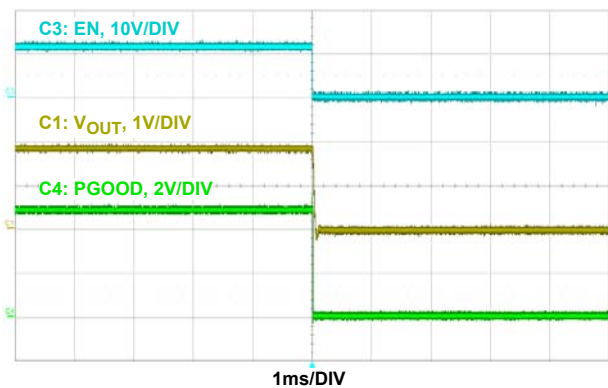


FIGURE 21. SHUTDOWN BY EN ($V_{IN} = 12V$, $V_{OUT} = 1.8V$ AT 12A, 600kHz, CCM)

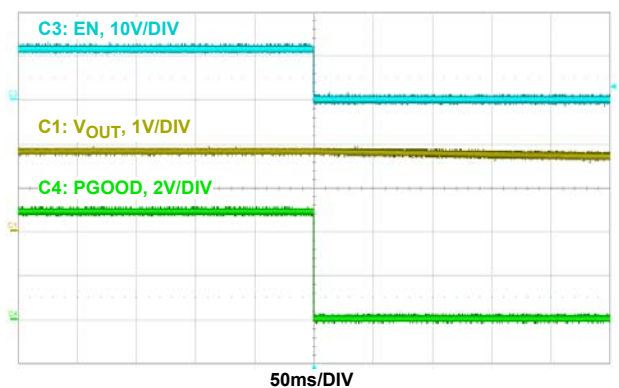


FIGURE 22. SHUTDOWN BY EN ($V_{IN} = 12V$, $V_{OUT} = 1.8V$ AT 0A, 600kHz, DCM)