

ISL854102DEMO2Z

User's Manual: Demonstration Board

Industrial Analog and Power

ISL854102DEMO2Z

Demonstration Board

UG138
Rev.0.00
Aug 16, 2017

1. Overview

The ISL854102DEMO2Z board uses the [ISL854102](#) in an isolated buck configuration. The primary output is configured to be 12V and the dual secondary outputs are +12V and -12V, respectively. The board is used to demonstrate the performance of the ISL854102, wide V_{IN} synchronous buck regulator configured to support a primary output, and a dual inverting and non-inverting secondary output.

The ISL854102 is the higher current version of the family of ISL85410 (1A), ISL854102 (1.2A), and ISL85418 (0.8A), which are offered in a 4mmx3mm 12 Ld DFN package with 1mm maximum height.

1.1 Key Features

- Wide input voltage range up to 40V
- Synchronous operation for high efficiency
- Integrated high-side and low-side NMOS devices
- Internal fixed (500kHz) or adjustable (300kHz to 2MHz) switching frequency
- Continuous output current up to 0.8A at primary output and ± 150 mA at secondary outputs
- Internal or external soft-start
- Minimal external components required
- Power-good and enable functions available

1.2 Specifications

These boards have been configured and optimized for the following operating conditions:

- $V_{IN} = 24$ V
- $V_{OUT_PR} = +12$ V, $V_{OUT_SC} = -12$ V
- $I_{MAX_PR} = 0.8$ A, $I_{MAX_SC} = 150$ mA
- $f_{SW} = 500$ kHz

1.3 Ordering Information

| Part Number | Description |
|-----------------|---------------------|
| ISL854102DEMO2Z | Demonstration board |

1.4 Related Literature

- For a full list of related documents, visit our website
 - [ISL854102](#) product page

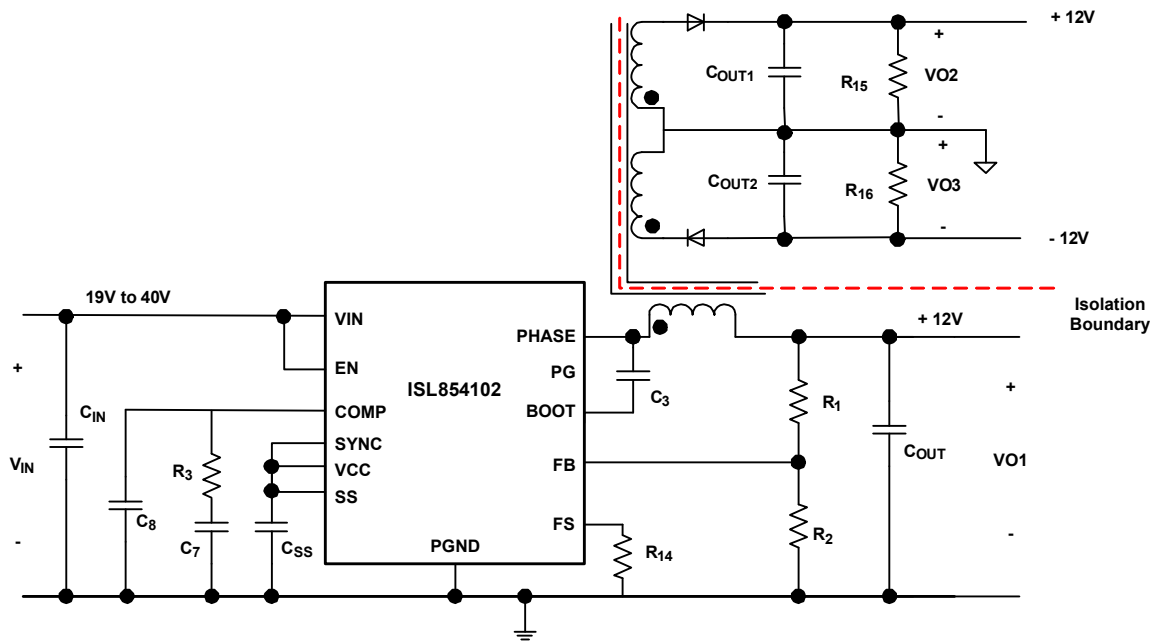


Figure 1. Block Diagram

2. Functional Description

2.1 Recommended Equipment

The following materials are recommended for testing:

- 0V to 50V power supply with at least 2A source current capability
- Electronic loads capable of sinking current up to 2A
- Digital Multimeters (DMMs)
- 100MHz quad-trace oscilloscope
- Signal generator

2.2 Quick Setup Guide

- (1) Ensure that the circuit is correctly connected to the supply and loads before applying any power.
- (2) Connect the bias supply to VIN, the plus terminal to VIN (P4), and the negative return to GND (P5).
- (3) Verify that SW1 is in the ON position.
- (4) Turn on the power supply.
- (5) Verify the output voltage is 12V for V_{OUT_PR}.

2.3 Frequency Control

The ISL854102 has an FS pin that controls the frequency of operation. Programmable frequency allows for optimization between efficiency and external component size. It also allows low frequency operation for low V_{OUTs} when minimum on-time would otherwise limit the operation. The default switching frequency is 500kHz when FS is tied to V_{CC} (R₁₃ = 0). By removing R₁₃, the switching frequency can be changed from 300kHz (R₁₄ = 340k) to 2MHz (R₁₄ = 32.4k). Refer to the [ISL854102](#) datasheet for information about calculating the value of R₁₄. Do not leave this pin floating.

2.4 Switch Control

The ISL854102DEMO2Z board contains an SW1 switch that enables or disables the part, thus allowing low quiescent current state. [Table 1](#) details this function.

TABLE 1. Switch Settings

| SW1 | On/Off Control |
|-----|--------------------------|
| ON | Enable V _{OUT} |
| OFF | Disable V _{OUT} |

2.5 SYNC Control

The ISL854102DEMO2Z board has a SYNC pin that allows an external synchronization frequency to be applied. The default board configuration has R₉ = 200k to V_{CC}, which defaults to PWM operation mode and also to the preselected switching frequency set by R₁₄. Refer to the [ISL854102](#) datasheet and previous section “[Frequency Control](#)” for details. If this pin is tied to GND, the IC will operate in PFM mode. This is not recommended for this board since the purpose of this board is to demonstrate generating multiple secondary outputs, which does not work well in PFM mode.

2.6 Soft-Start/Comp Control

R_{11} selects between internal ($R_{11} = 0$) and external soft-start. R_8 selects between internal ($R_8 = 0$) and external compensation. For applications in which repetitive restarts of the IC are required, it is recommended to add a 350k Ω resistor in parallel to C_{SS} to allow its fast discharge. Refer to the pin description table of the [ISL854102](#) datasheet.

2.7 Secondary Isolation

The R_{12} resistor, which shorts the PGND and the ISOGND on the ISL854102DEMO2Z board, can be replaced with a 2200pF ceramic capacitor (C2012X5R2E222K085AA) to isolate the secondary output from the primary output.

3. PCB Layout Guidelines

The ISL854102DEMO2Z PCB layout has been optimized for electrical and thermal performance. Proper layout of the power converter will minimize EMI and noise while ensuring first pass success of the design.

A multilayer printed circuit board with GND plane is recommended. The most critical connections are to tie the PGND pin to the package GND pad and then use vias to directly connect the GND pad to the system GND plane. This connection of the GND pad to system plane insures a low impedance path for all return current, as well as an excellent thermal path to dissipate heat.

With this connection made, place the high frequency MLCC input capacitors C_1 , C_2 near the VIN pin and use vias directly at the capacitor pads to tie the capacitors to the system GND plane. Also, use vias directly at the C_5 and C_6 output capacitor pads to tie the capacitors to the system GND plane and C_{11} to C_{14} to the ISO_GND plane. These measures will minimize the high dV/dt and dI/dt loops. Minimize the PHASE connection by placing L_1 very close to the IC. Place a $1\mu\text{F}$ MLCC near the VCC pin and directly connect its return with a via to the system GND plane. Keep the power components path (L_1 , C_1 , C_2 , C_3 , C_5 , C_6 , C_{11} to C_{14}) separated from the small signal node (FB) by placing the feedback divider close to the FB pin and do not route any feedback components near PHASE or BOOT. Keep the FB trace as short as possible.



Figure 2. Top of Board



Figure 3. Bottom of Board

3.1 Schematic

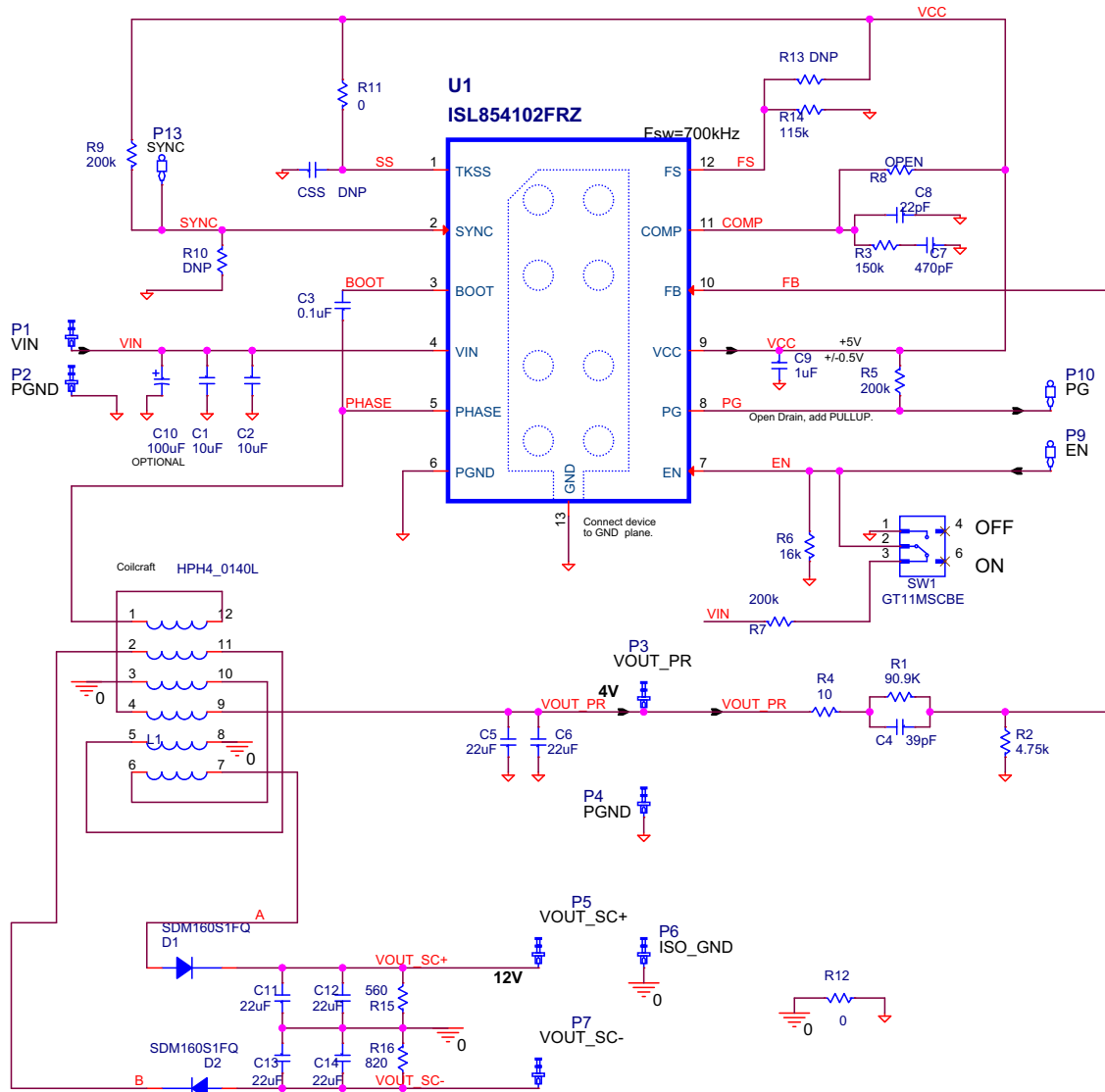


Figure 4. ISL854102DEMO2Z Schematic

3.2 Bill of Materials

| Qty | Reference Designator | Description | Manufacturer Part | Manufacturer |
|-----|----------------------|--|----------------------|--------------|
| 1 | C10 (OPTIONAL) | CAP ALUM 100µF 20% 50V SMD | EEE-FTH101XAP | PANASONIC |
| 2 | C1, C2 | CAP, SMD, 1206, 10µF, 50V, 10%, X5R, ROHS | C3216X5R1H106K | TDK |
| 1 | C3 | CAP, SMD, 0603, 0.1µF, 50V, 10%, X7R, ROHS | 06035C104KAT2A | AVX |
| 1 | C4 | CAP, SMD, 0402, 39pF, 50V, 1%, NP0, ROHS | 04025A390FAT2A | AVX |
| 6 | C5, C6, C11-C14 | CAP, SMD, 1206, 22µF, 16V, 20%, X5R, ROHS | CGA5L1X5R1C226M160AC | TDK |
| 1 | C7 | CAP, SMD, 0402, 470pF, 50V, 5%, NP0, ROHS | 04025A471JAT2A | AVX |
| 1 | C8 | CAP, SMD, 0402, 22pF, 50V, 1%, NP0, ROHS | 04025U220FAT2A | AVX |

| Qty | Reference Designator | Description | Manufacturer Part | Manufacturer |
|-----|----------------------|--|-------------------------------------|-----------------------------|
| 1 | C9 | CAP, SMD, 0603, 1 μ F, 16V, 10%, X5R, ROHS | GRM188R61C105KA12D | MURATA |
| 7 | P1-P7 | CONN-TURRET, TERMINAL POST, TH, ROHS | 1514-2 | KEYSTONE |
| 3 | P9, P10, P13 | CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS | 5002 | KEYSTONE |
| 2 | D1, D2 | SCHOTTKY DIODE, SMD, 2P, SOD-123F, 60V, 1A, ROHS | SDM160S1FQ | DIODES, INC. |
| 1 | U1 | IC 40V BUCK REGULATOR, 12P, DFN, 3x4, ROHS | ISL854102FRZ for ISL854102DEMO2Z | INTERSIL |
| 1 | L1 | CONFIGURABLE TRANSFORMER, SMD, 12P, 23.7 μ H, ROHS | HPH4_0140L | COILCRAFT |
| 1 | R1 | RES, SMD, 0402, 90.9k, 1/16W, 1%, TF, ROHS | CRCW040290K9FKED | VISHAY/DALE |
| 1 | R2 | RES, SMD, 0402, 4.75k, 1/16W, 1%, TF, ROHS | CRCW04024K75FKED | VISHAY/DALE |
| 1 | R3 | RES, SMD, 0402, 150k, 1/16W, 1%, TF, ROHS | CR0402-16W-1503FT | VENKEL |
| 1 | R4 | RES, SMD, 0402, 10 Ω , 1/10W, 1%, TF, ROHS | ERJ-2RKF10R0X | PANASONIC |
| 3 | R5, R7, R9 | RES, SMD, 0402, 200k, 1/16W, 1%, TF, ROHS | MCR01MZPF2003 | ROHM |
| 1 | R6 | RES, SMD, 0402, 16k Ω , 1/16W, 1%, TF, ROHS | CRCW040216K0FKED | VISHAY/DALE |
| 0 | R8, R10, R13 | RES, SMD, 0402, DNP-PLACE HOLDER, ROHS | | |
| 1 | R11 | RES, SMD, 0402, 0 Ω , 1/16W, TF, ROHS | CR0402-16W-000T | VENKEL |
| 1 | R12 | RES, SMD, 0805, 0 Ω , 1/8W, TF, ROHS | CR0805-10W-000T | VENKEL |
| 1 | R14 | RES, SMD, 0402, 115k, 1/16W, 1%, TF, ROHS | CRCW0402115KFKED | VISHAY/DALE |
| 1 | R15 | RES, SMD, 0805, 560 Ω , 1/2W, 1%, TF, ROHS | ERJ-P6WF5600V | PANASONIC |
| 1 | R16 | RES, SMD, 0805, 820 Ω , 1/2W, 1%, TF, ROHS | ERJ-P6WF8200V | PANASONIC |
| 1 | SW1 | SWITCH-TOGGLE, SMD, 6PIN, SPDT, 2POS, ON-NONE-ON, ROHS | GT11MSCBE | ITT INDUSTRIES/C&K DIVISION |

3.3 Board Layout

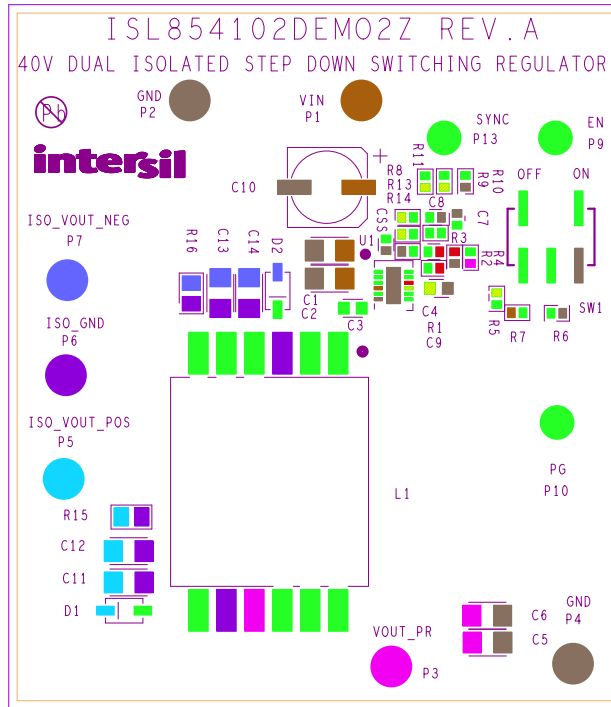


Figure 5. Silk Screen Top

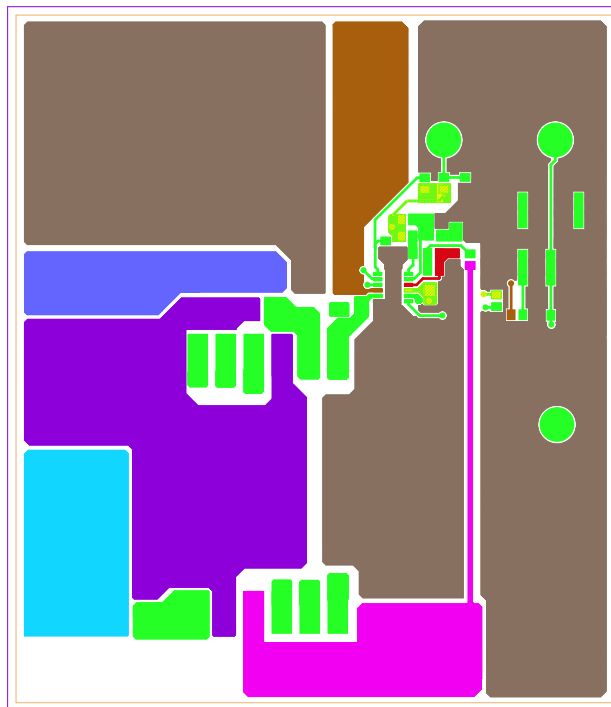


Figure 6. Layer 1

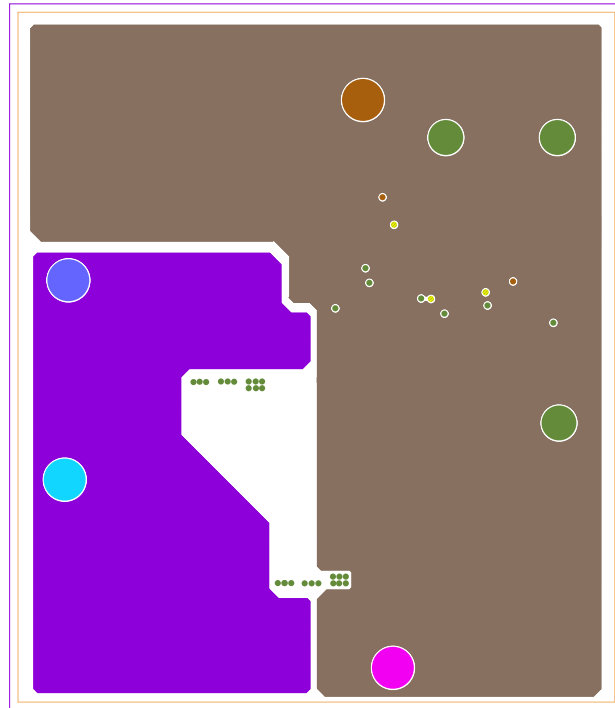


Figure 7. Layer 2

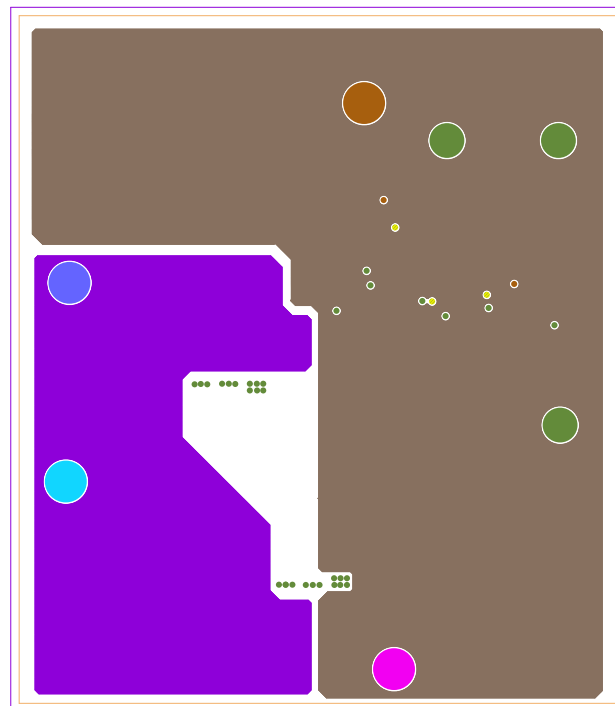


Figure 8. Layer 3

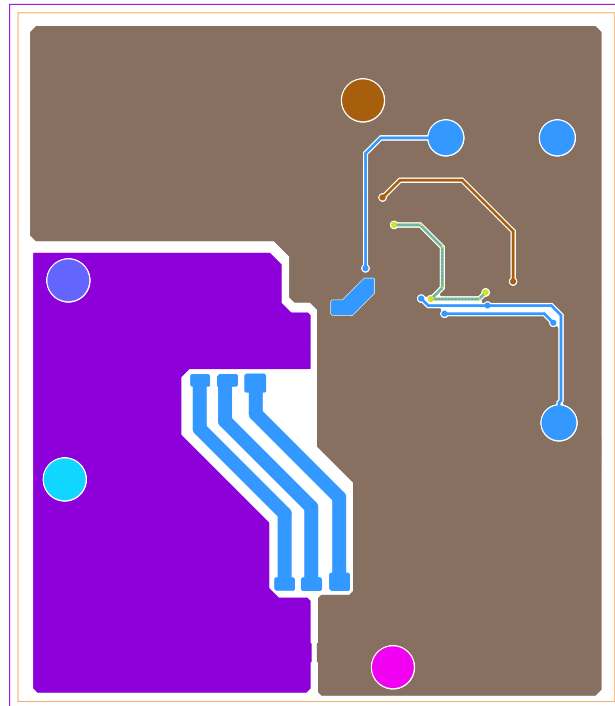


Figure 9. Layer 4

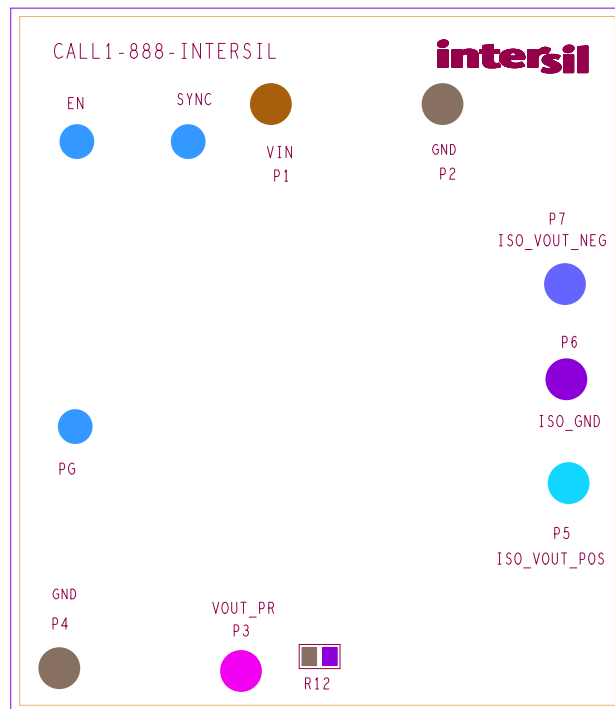


Figure 10. Silk Screen Bottom

4. Typical Performance Curves

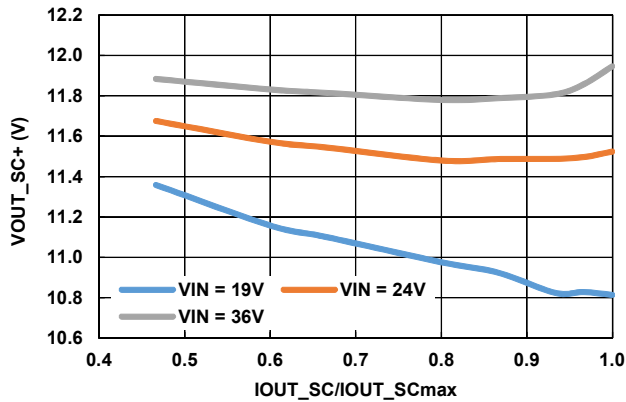


Figure 11. VOUT_SC+ Regulation vs IOUT_SC/IOUT_SCmax (VOUT = ±12V)

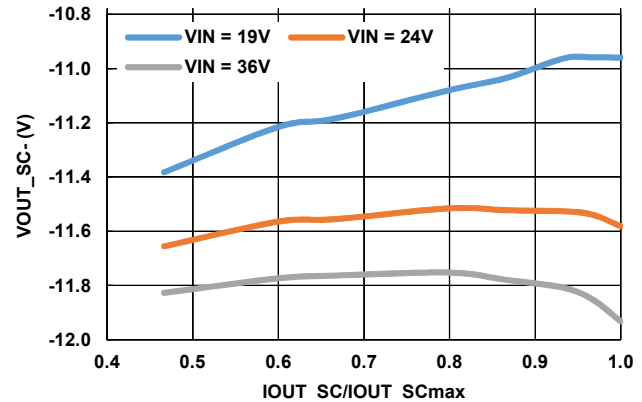


Figure 12. VOUT_SC- Regulation vs IOUT_SC/IOUT_SCmax (VOUT = ±12V)

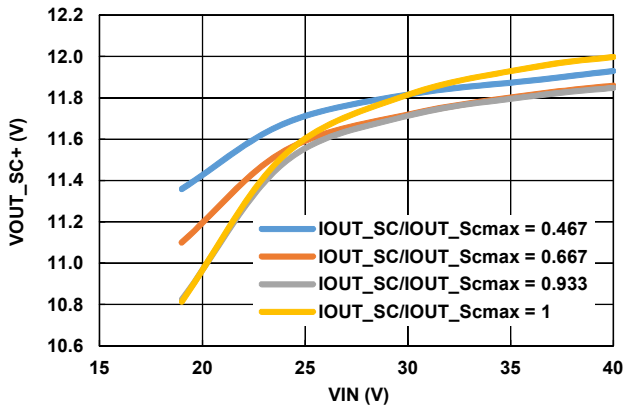


Figure 13. VOUT_SC+ Regulation vs VIN (VOUT = ±12V)

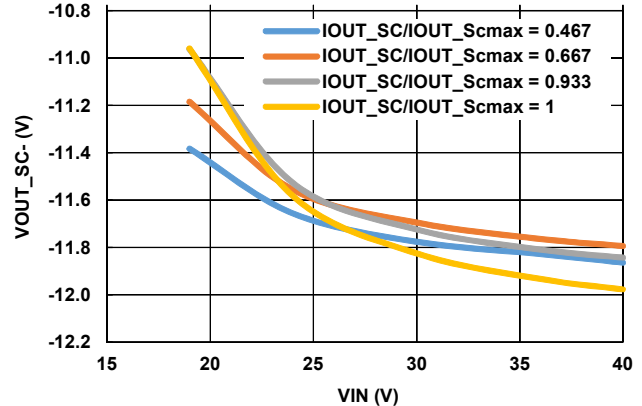


Figure 14. VOUT_SC- Regulation vs VIN (VOUT = ±12V)

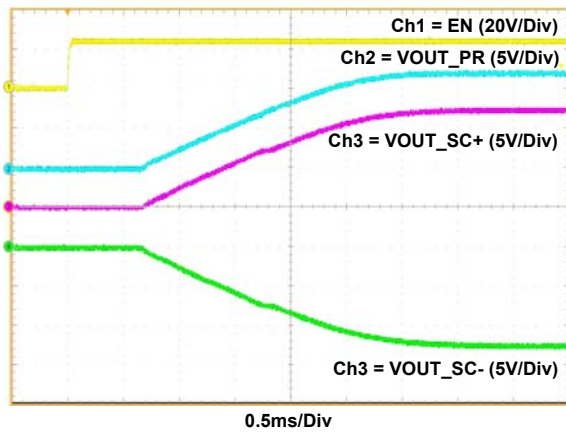


Figure 15. Start-Up by Enable (VIN = 24V, VOUT_PR = +12V, VOUT_SC± = ±12V, IOUT_PR = 0.8A, IOUT_SC± = 150mA, FCCM)

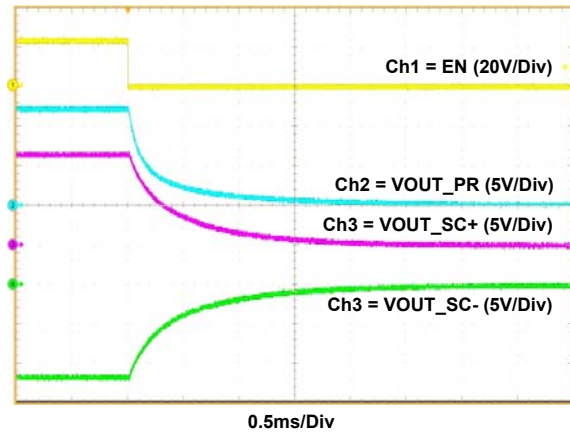


Figure 16. Shutdown by Enable (VIN = 24V, VOUT_PR = +12V, VOUT_SC± = ±12V, IOUT_PR = 0.8A, IOUT_SC± = 150mA, FCCM)

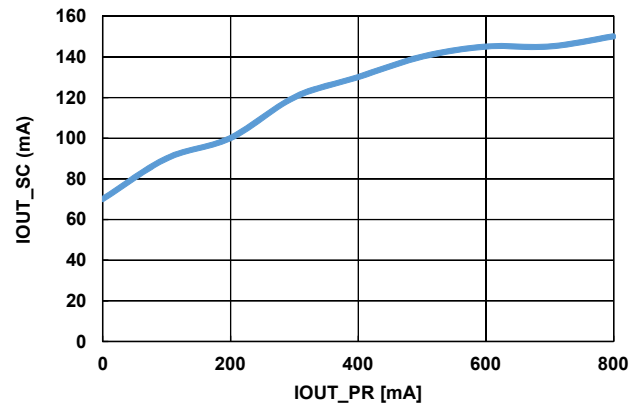


Figure 17. IOUT_SC± vs Corresponding IOUT_PR ($V_{OUT} = 12V$)

5. Revision History

| Rev. | Date | Description |
|------|--------------|-----------------|
| 0.00 | Aug 16, 2017 | Initial release |

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