User's Manual

ISL85413DEMO3Z

User's Manual: Demonstration Board

Industrial Analog and Power

Rev.0.00 July 2017

ISL85413DEMO3Z

Demonstration Board

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1. Overview

The ISL85413DEMO3Z board uses the ISL85413 in an isolated buck configuration. It replaces the filter inductor with a coupled inductor (or transformer) to produce a primary output and an inverting secondary output. The board is used to demonstrate the performance of the ISL85413 wide V_{IN} low quiescent current, high efficiency, synchronous buck regulator to produce a positive primary output and a negative isolated secondary output.

The ISL85413 is offered in a 3mmx3mm 8 Ld TDFN package with 1mm maximum height. The converter occupies $3.3cm^2$ area.

1.1 Key Features

- Wide input voltage range of 3.5V to 40V
- Synchronous operation for high efficiency
- Integrated high-side and low-side NMOS devices
- Internal switching frequency (700kHz)
- Continuous output current up to 150mA (refer to Figures 10, 12, and 14 on page 10)
- Internal soft-start
- No compensation required
- Minimal external components required
- Power-good and enable functions available for primary output

1.2 Specifications

- This board has been configured and optimized for the following operating conditions:
- V_{IN} = 9V to 40V
- V_{OUT} = ±5V, typical
- I_{MAX_PR} = $-I_{MAX\_SC}$ up to 150mA (at V_{OUT} = ±5.0V, V_{IN} = 24V)

1.3 Recommended Equipment

The following materials are recommended to perform testing:

- 0V to 50V power supply with at least 1A source current capability
- Resistive loads capable of sinking current up to 1A
- Digital Multimeters (DMMs)
- 100MHz quad-trace oscilloscope

1.4 Ordering Information

Part Number	Description
ISL85413DEMO3Z	Demonstration board with Isolated Outputs

1.5 Related Literature

- For a full list of related documents, visit our website
  - ISL85413 product page

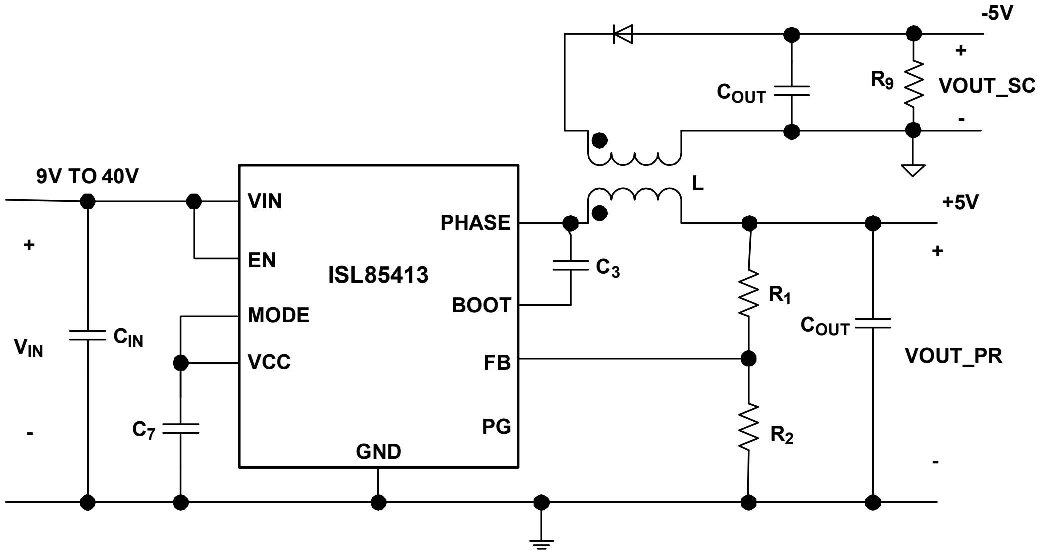

Figure 1. Block Diagram

2. Functional Description

2.1 Quick Setup Guide

- Ensure that the circuit is correctly connected to the supply and loads prior to applying any power.
- Connect the bias supply to VIN, the plus terminal to VIN (P4) and the negative return to GND (P5).
- Turn on the power supply.
- Without any load applied on the output, verify that the output voltage is 5.0V for V_{OUT_PR} (P7) and between 5.0 to 5.5V for V_{OUT_SC} (P11).

2.2 Switch/Jumper Control

The ISL85413DEMO3Z demonstration board contains SW1 for controlling the ON/OFF setting of the converter and JP1 to select between PFM and PWM modes. Turn switch SW1 to the ON position to enable the converter and the OFF position to disable the converter. The jumper is connected between Pins 1 and 2 to select the PWM operation by default for better coupling between the primary and secondary windings. Table 1 summarizes the switch and jumper settings.

Table 1. Switch and Jumper Setting

Switch/Jumper	Function
SW1	Enable/Disable
JP1	Select between PFM and PWM mode

2.3 Operating Range

The ISL85413DEMO3Z board can be configured to operate at various output voltages. Table 2 shows the operating range for each output voltage. Table 3 on page 5 shows the recommended component selection for each V_{OUT}.

Table 2. Operating Range for Output Voltages

V_{OUT} (V)	V_{IN} (V)	$I_{OUT\_PR} = I_{OUT\_SC}$ (mA)
±12	18-40	Up to 150mA
±5	9-40	Up to 150mA
±3.3	5-40	Up to 150mA

2.4 Evaluating Other Output Voltages

The ISL85413DEMO3Z board output is preset to 5.0V. However, output voltages can be adjusted from 0.6V to 15V. The output voltage programming resistor, R_2, will depend on the desired output voltage of the regulator and the value of the feedback resistor R_1, as shown in (EQ. 1).

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

If the output voltage desired is 0.6V, then R_1 is shorted. Please refer to datasheet ISL85413 for further information.

Table 3 shows the external component selection for different V_{OUT}.

The curves in Figure 12 on page 10 indicate the secondary output voltage regulation versus the load applied in the secondary output, without any load on the primary output for V_{OUT} = 5.0V, at different input voltages. The curves in Figure 13 on page 10 indicate the secondary output voltage regulation versus V_{IN}, without any load on the primary output for V_{OUT} = 5.0V, at different load applied in the secondary output.

2.5 Secondary Isolation

The R_{10} resistor, which shorts the PGND and the ISOGND on the ISL85413DEMO3Z board, can be replaced with a 2200pF ceramic capacitor (C2012X5R2E222K085AA) to isolate the secondary output from the primary output.

3. PCB Layout Guidelines

The ISL85413DEMO3Z 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.

PCB layout is provided on the Intersil web site. 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 the system plane ensures 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, and 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. 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 1µF 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) 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.

Table 3. External Component Selection

V_{OUT} (V)	L_1 (µH)	C_{OUT} (µF)	R_1 (kΩ)	R_2 (kΩ)	C_{FB} (pF)	R_9 (kΩ)
±12	100	10	90.9	4.75	10	5
±5	47	22	90.9	12.4	68	1
±3.3	33	22	90.9	20	100	0.825

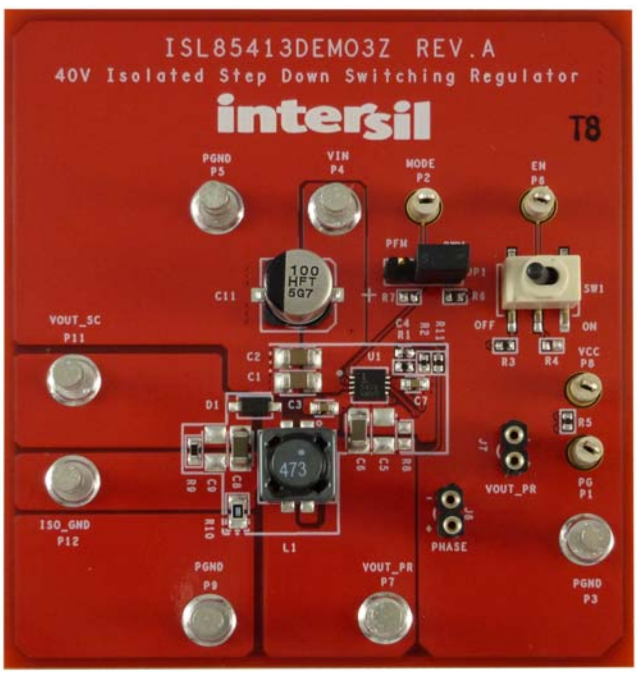

Figure 2. ISL85413DEMO3Z Evaluation Board Top View

Figure 3. ISL85413DEMO3Z Evaluation Board Bottom View

3.1 ISL85413DEMO3Z Schematic

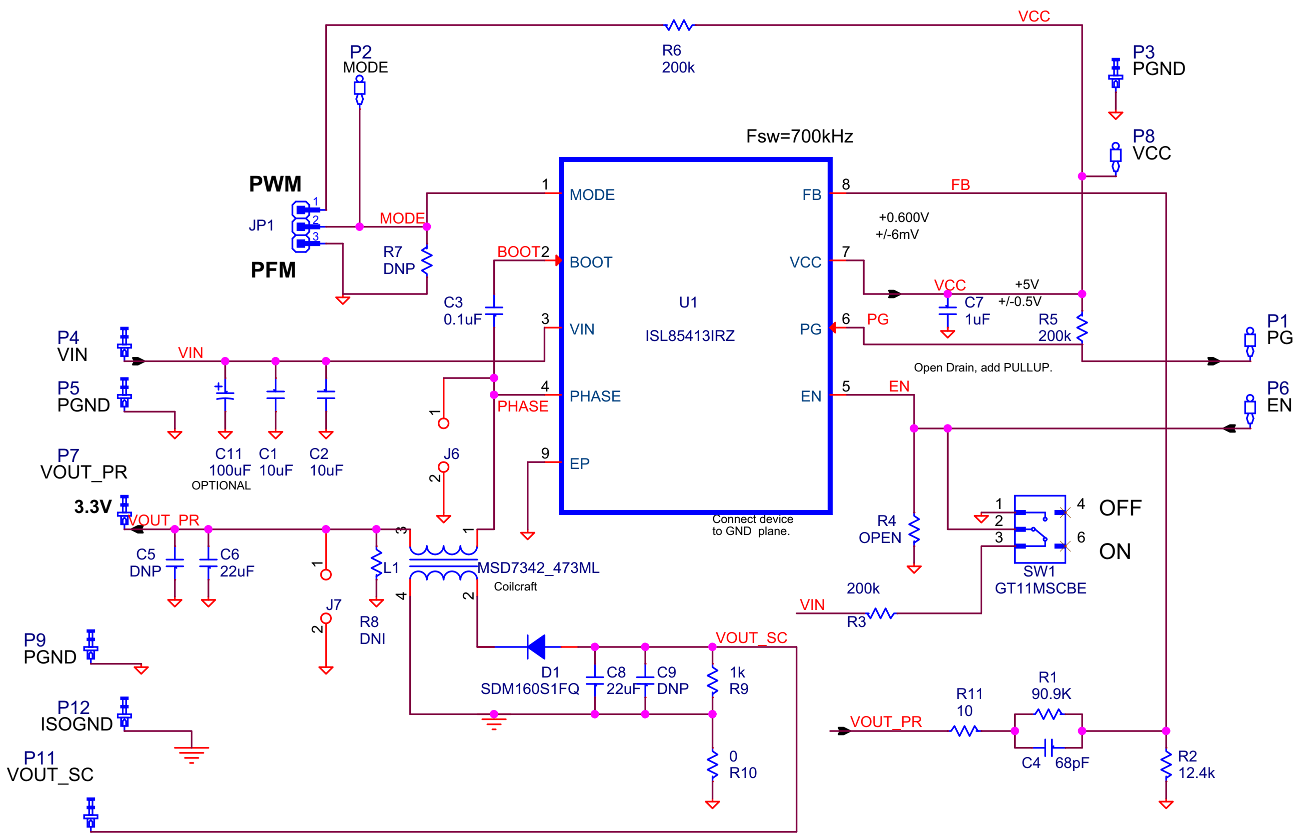

Figure 4. Schematic

3.2 ISL85413DEMO3Z Bill of Materials

Manufacturer Part	Qty	Reference Designator	Description	Manufacturer
EEE-FTH101XAP	1	C11 (OPTIONAL)	CAP ALUM 100µF 20% 50V SMD	PANASONIC
C3216X5R1H106K	2	C1, C2	CAP, SMD, 1206, 10µF, 50V, 10%, X5R, ROHS	TDK
06035C104KAT2A	1	C3	CAP, SMD, 0603, 0.1µF, 50V, 10%, X7R, ROHS	AVX
ECJ-0EC1H680J	1	C4	CAP, SMD, 0402, 68pF, 50V, 1%, NP0, ROHS	PANASONIC
ECJ-DV50J226M	2	C6, C8	CAP, SMD, 1206, 22µF, 6.3V, 20%, X5R, ROHS	PANASONIC
GRM188R61C105KA12D	1	C7	CAP, SMD, 0603, 1µF, 16V, 10%, X5R, ROHS	MURATA
1514-2	7	P3-P5, P7, P9, P11, P12	CONN-TURRET, TERMINAL POST, TH, ROHS	KEYSTONE
5002	4	P1, P2, P6, P8	CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS	KEYSTONE
SDM160S1FQ	1	D1	SCHOTTKY DIODE, SMD, 2P, SOD-123F, 60V, 1A, ROHS	DIODES, INC.
ISL85413FRZ	1	U1	IC-300mA BUCK REGULATOR, 12P, DFN, 3x3, ROHS	INTERSIL
MSD7342-473ML	1	L1	COUPLED INDUCTOR, SMD, 4P, 47µH, 10%, 2.5A, ROHS	COILCRAFT
CRCW040290K9FKED	1	R1	RES, SMD, 0402, 90.9k, 1/16W, 1%, TF, ROHS	VISHAY/DALE
CRCW040212K4FKED	1	R2	RES, SMD, 0402, 12.4k, 1/16W, 1%, TF, ROHS	VISHAY/DALE
MCR01MZPF2003	3	R3, R5, R6	RES, SMD, 0402, 200k, 1/16W, 1%, TF, ROHS	ROHM
ERJ-3EKF1001V	1	R9	RES, SMD, 0603, 1k, 1/10W, 1%, TF, ROHS	PANASONIC
ERJ-6GEY0R00V	1	R10	RES, SMD, 0805, 0, 1/8W, 1%, TF, ROHS	PANASONIC
CRCW040210R0FKED	1	R11	RES, SMD, 0402, 10, 1/16W, 1%, TF, ROHS	VISHAY/DALE
GT11MSCBE	1	SW1	SWITCH-TOGGLE, SMD, 6PIN, SPDT, 2POS, ON-NONE-ON, ROHS	ITT INDUSTRIES/ C&K DIVISION
68001-203HLF	1	JP1	CONN-HEADER, 1x3, BRKAWY 1x3, 2.54mm, ST	Amphenol FCI
SPC02SYAN	1	JP1-Pins 1 and 2	CONN-JUMPER, SHORTING, 2PIN, BLACK, GOLD, ROHS	SULLINS
310-43-164-41-001000	2	J6, J7	CCONN-BRD-BRD, TH, 1x2, SKTSTRIP-1x64, 2.54mm, TIN, ROHS	MILL-MAX
	0	C5, C9	CAP, SMD, 1206, DNP-PLACE HOLDER, ROHS	
	0	R4, R7	RESISTOR, SMD, 0402, MF, DNP-PLACE HOLDER	
	0	R8	RESISTOR, SMD, 0603, MF, DNP-PLACE HOLDER	
D810 (212403-012)	1	PLACE ASSY IN BAG	BAG, STATIC, 3x5, ZIP LOC	INTERSIL COMMON STOCK
LABEL-DATE CODE	1	AFFIX TO BACK OF PCB	LABEL-DATE CODE_LINE 1: YRWK/REV#, LINE 2: BOM NAME	INTERSIL
ISL85413DEMO3ZREVAPCB	1		PWB-PCB, ISL85413DEMO3Z, REVA, ROHS	IMAGINEERING INC

3.3 ISL85413DEMO3Z Board Layout

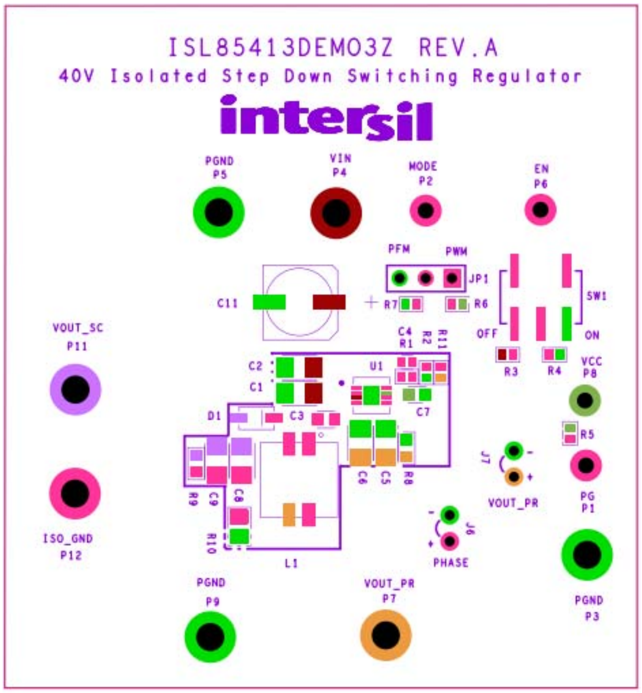

Figure 5. Silkscreen Top

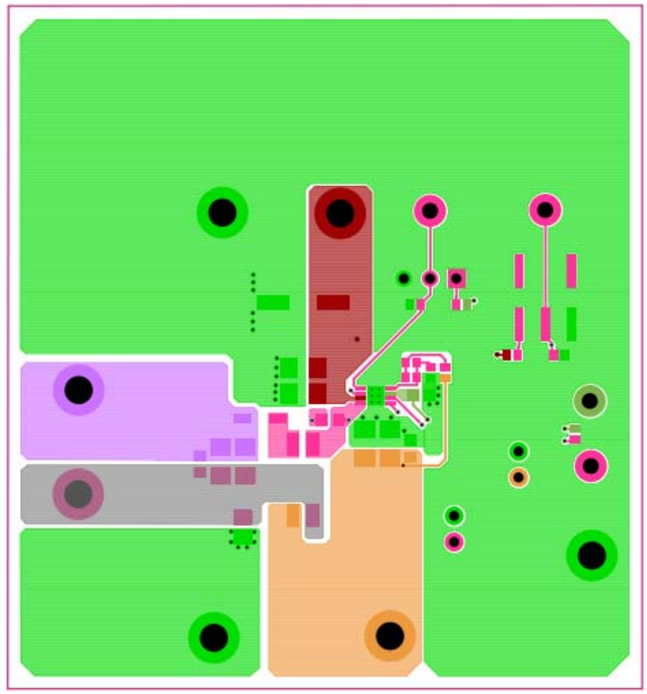

Figure 6. Top Layer

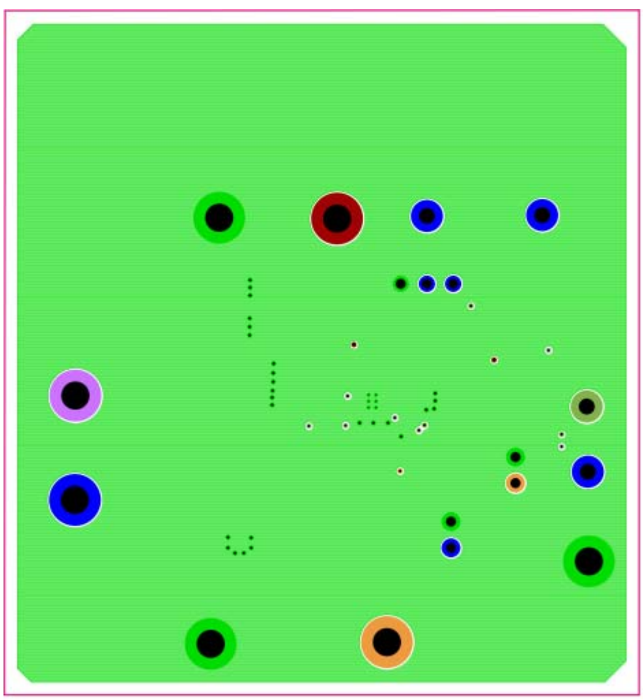

Figure 7. Layer 2 and Layer 3

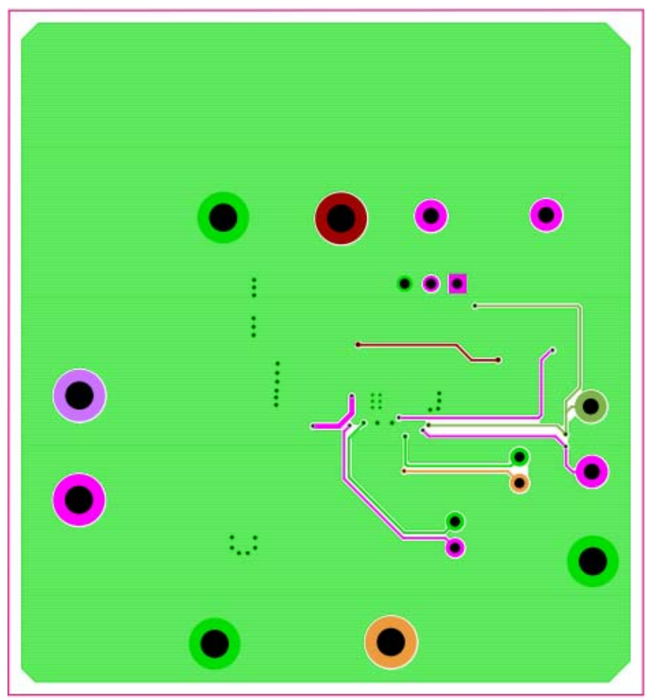

Figure 8. Bottom Layer

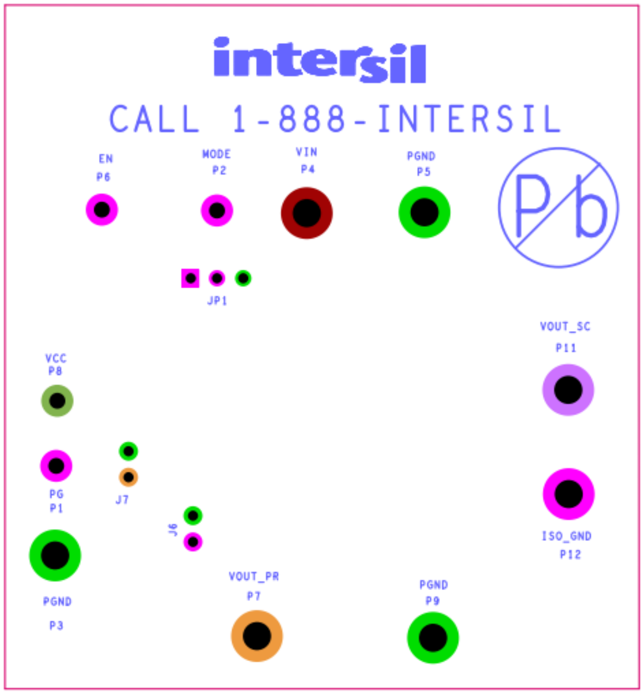

Figure 9. Silkscreen Bottom

4. Typical Performance Curves

f_{SW} = 700kHz, T_A = +25°C.

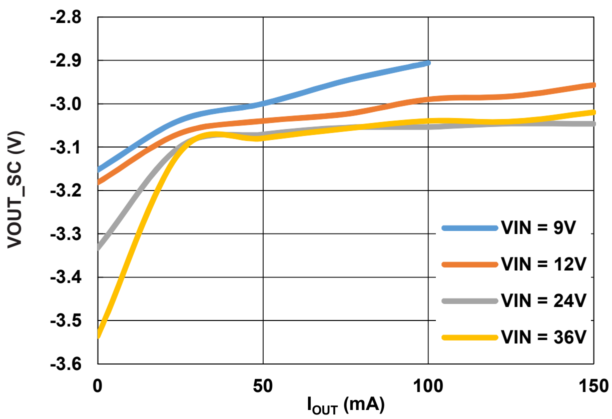

Figure 10. V_{OUT_SC} Regulation vs I_{OUT}, V_{OUT} = ±3.3V

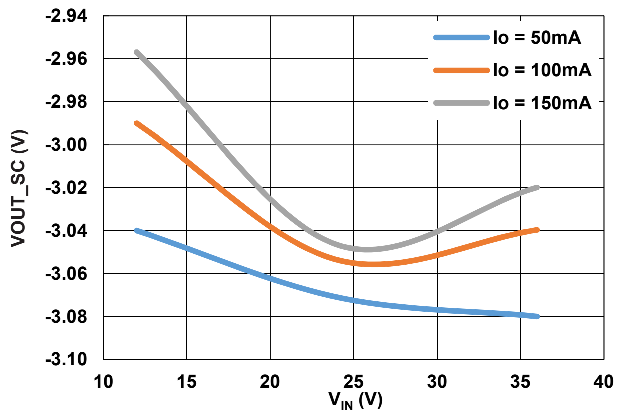

Figure 11. V_{OUT_SC} Regulation vs V_{IN}, V_{OUT} = ±3.3V

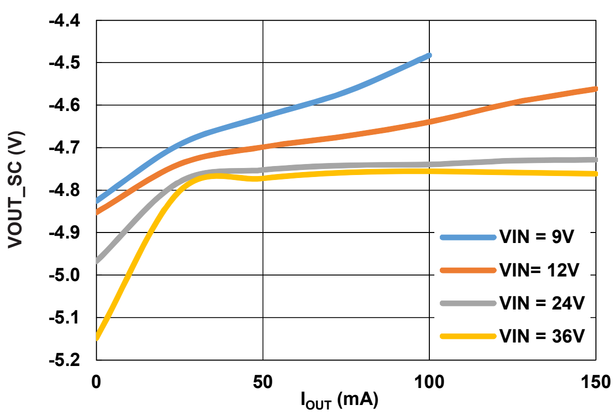

Figure 12. V_{OUT_SC} Regulation vs I_{OUT}, V_{OUT} = ±5V

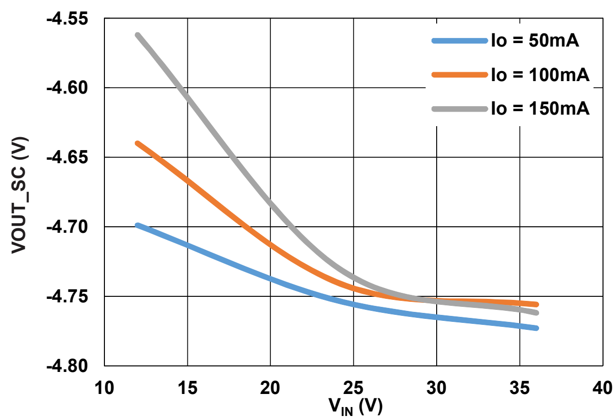

Figure 13. V_{OUT_SC} Regulation vs V_{IN}, V_{OUT} = ±5V

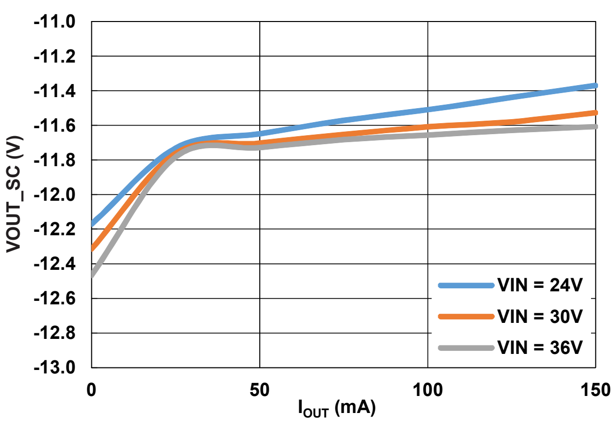

Figure 14. V_{OUT_SC} Regulation vs I_{OUT}, V_{OUT} = ±12V

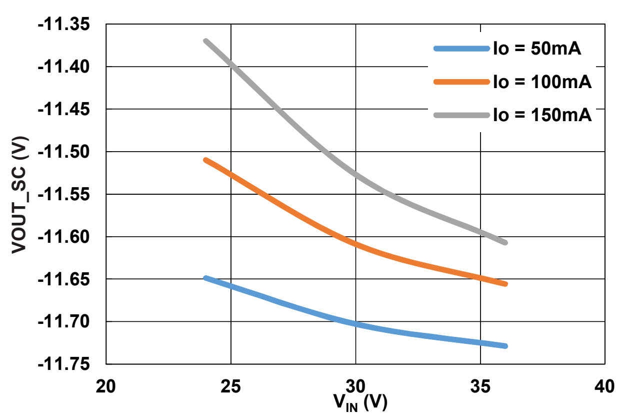

Figure 15. V_{OUT_SC} Regulation vs V_{IN}, V_{OUT} = ±12V

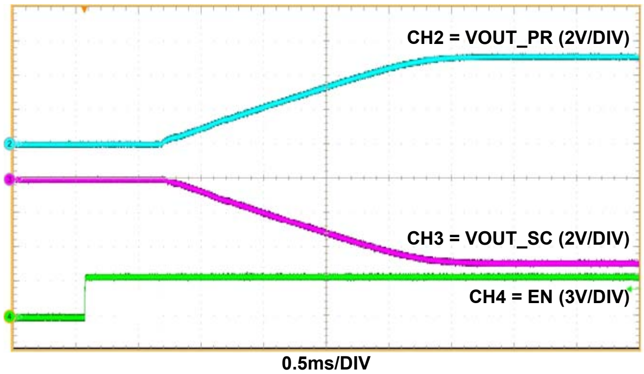

Figure 16. Start-Up by EN (V_{IN} = 24V, VOUT_PR = 5V, VOUT_SC = -5V at IOUT_PR = 0.1A, IOUT_SC = 0.1A, 700kHz, FCCM)

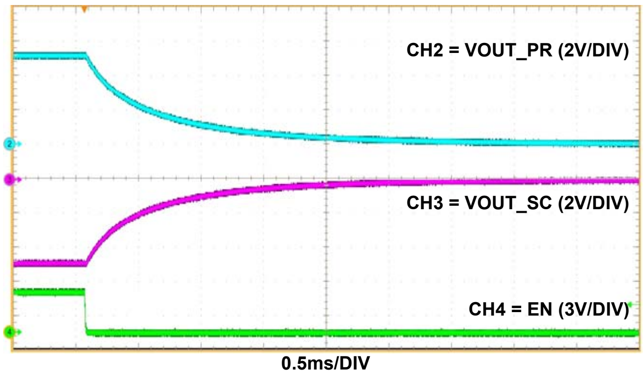

Figure 17. Shutdown by EN (V_{IN} = 24V, VOUT_PR = 5V, VOUT_SC = -5V at IOUT_PR = 0.1A, IOUT_SC = 0.1A, 700kHz, FCCM)

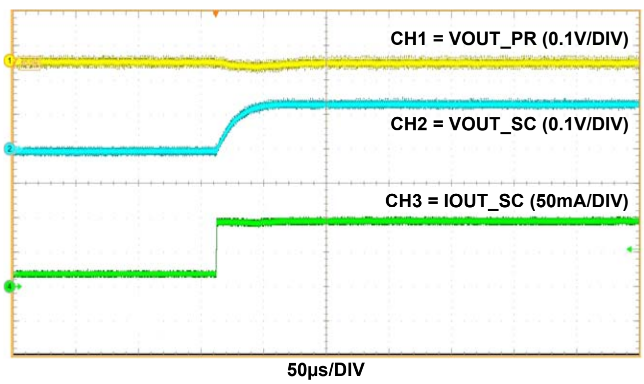

Figure 18. Loading Transient (V_{IN} = 24V, VOUT_PR = 5V, VOUT_SC = -5V at IOUT_PR = 0A, IOUT_SC = 25mA to 75mA, 700kHz, FCCM)

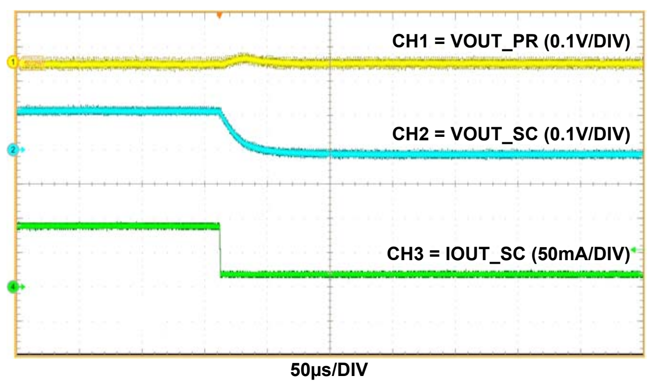

Figure 19. Unloading Transient (V_{IN} = 24V, VOUT_PR = 5V, VOUT_SC = -5V at IOUT_PR = 0A, IOUT_SC = 75mA to 25mA, 700kHz, FCCM)

5. Revision History

Rev.	Date	Description
0.00	Jul 14, 2017	Initial release

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Refer to "http://www.renesas.com/" for the latest and detailed information.

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