ROHM Nano Energy™ Switching Regulator Solutions

BD70522GUL Ultra-Low Iq Buck Converter Evaluation Board

Introduction

This application note will provide the steps necessary to operate and evaluate ROHM's synchronous buck DC/DC converter using the BD70522GUL evaluation board. Component selection and operating procedures are included.

Description

The BD70522GUL converter is a power supply solution designed for battery powered devices. 180nA quiescent current and ULP (Ultra Low Power) mode enable excellent light load efficiency at 10µA load, extending battery life, while output currents up to 500mA are supported. Users can select from among 9 preset output voltages via the VSEL pin. And when the input voltage gets close to the output voltage, the IC enters 100% ON mode that stops switching operation.

Applications

Smoke detectors
Thermostats
Portable devices
Wearables
Low-Iq sets without standby switcher
Energy harvesting

Features

Nano Energy™
Up to 90% efficiency at 10µA output current
9 selectable output voltages (1.2V, 1.5V, 1.8V, 2.0V, 2.5V, 2.8V, 3.0V, 3.2V, 3.3V)
Power Good output
100% ON Mode for low input voltage
Discharge function on VOUT.

Key Specifications

Input voltage range	2.5 to 5.5V
Output voltage range	1.2 to 3.3V
Maximum output current	500mA
Operation quiescent current	180nA
Standby current	50nA
VCSP50L1C package	

Evaluation Board Operating Limits and Absolute Maximum Ratings

Parameter	Symbol	Limit			Unit	Conditions
		MIN	TYP	MAX		
Supply Voltage	VSYS	2.5	-	5.5	V	
Output Current	I_{OUT}	-	-	0.5	A	
PG Sink Current	I_{PG}	-	-	10	mA	

Evaluation Board

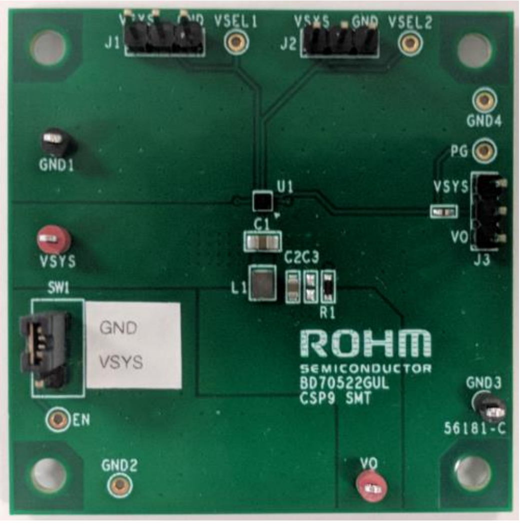

Figure 1: BD70522GUL Evaluation Board

Board Schematic

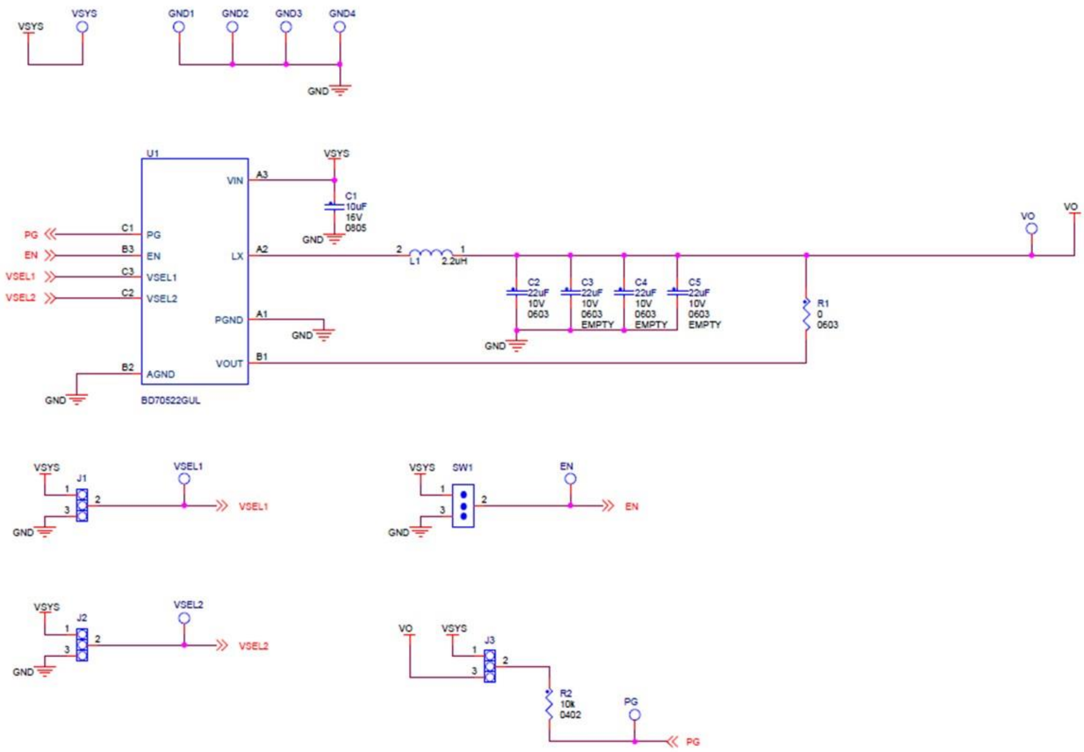

Figure 2: BD70522GUL Evaluation Board Schematic

Output Voltage Settings

Below is a table of output voltages selectable using the VSEL1 and VSEL2 pins.

V_{SET}	VSEL1	VSEL2
1.2V	GND	OPEN
1.5V	OPEN	GND
1.8V	GND	GND
2.0V	V_{IN}	GND
2.5V	OPEN	V_{IN}
2.8V	V_{IN}	OPEN
3.0V	OPEN	OPEN
3.2V	GND	V_{IN}
3.3V	V_{IN}	V_{IN}

Table 1: Output Voltage Settings

EN Pin	BD70522GUL Condition
High	Enable
GND	Shutdown

Table 2: EN Pin Settings

Evaluation Board BOM

Below is a table showing the Bill of Materials. Part numbers and suppliers are included.

Reference	Part Number	Manufacturer	Description [Unit: inch]	Qty.
U1	BD70522GUL	ROHM		1
C2	JMK107BBJ226MA	TAIYO YUDEN	22uF, 10V, X5R, 0603	1
C3,C4,C5	JMK107BBJ226MA	TAIYO YUDEN	22uF, 10V, X5R, 0603	3
C1	EMK212ABJ106KD-T	TAIYO YUDEN	10uF, 16V, X5R, 0805	1
L1	MAMK2520H2R2M	TAIYO YUDEN	2.2uH, 2.8A, 2520	1
R1	PMR03EZPJ000	ROHM	0, 0603	1
R2	MCR01MRTF1002	ROHM	10k, 0402	1
J1,J2,J3, SW1	61300311121	Wurth Electronics	2.54mm, 3pin, straight	4
SW1	N/A			
VSYS, VO	5000	Keystone Electronics	Red Test Point	2
GND1,GND3	5001	Keystone Electronics	Black Test Point	2
EN,GND2,GND4,PG,VSEL1,VSEL2	N/A			

Table 3: Bill of Materials

Board Operating Procedure

1. Set the output voltage using the jumper settings at J1 and J2. (refer to Table 1)
2. Disable the IC by setting the SW1 jumper to the upper position (EN → GND).
3. Connect the power supply's GND terminal to the GND1 or GND3 test point on the evaluation board.
4. Connect the power supply's V_{CC} terminal to the Vsys test point on the evaluation board. This will provide V_{IN} to the IC. Please note that V_{IN} should be in the range of 2.5V to 5.5V.
5. Connect the electronic load to GND1 or GND3 and VO. Connect the voltmeter to GND1 or GND3 and VO.
6. Turn on the power supply and enable the IC by setting the jumper at SW1 to the lower position (EN → VSYS). The output voltage can be measured at test point VO. Now turn on the load. The load can be increased up to 0.5A (max.).

Reference Application Data

The following are graphs of the hot plugging test, efficiency, switching frequency, load response, output voltage, ripple, startup and shutdown.

Typical Performance Curves (Unless otherwise indicated, L=2.2uH, Cout=22μF×1, Ta=25°C)

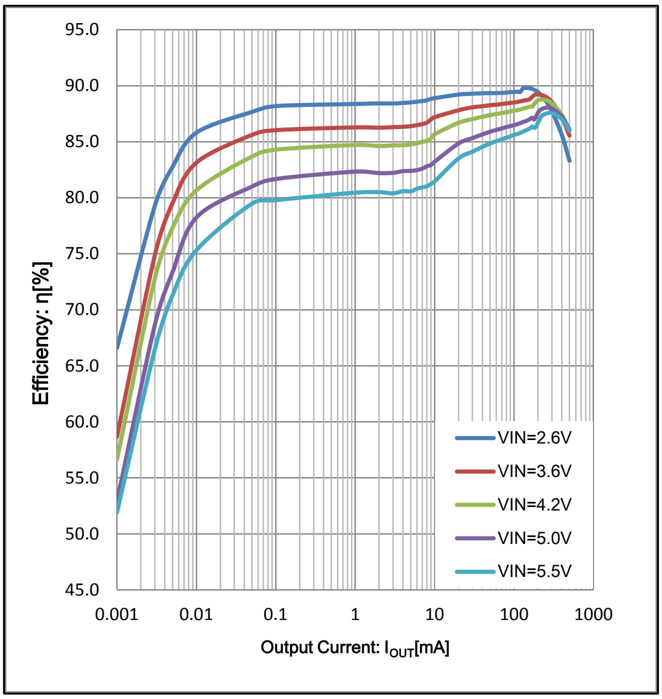

Figure 3. Efficiency vs Output Current (V_{OUT}=1.2V)

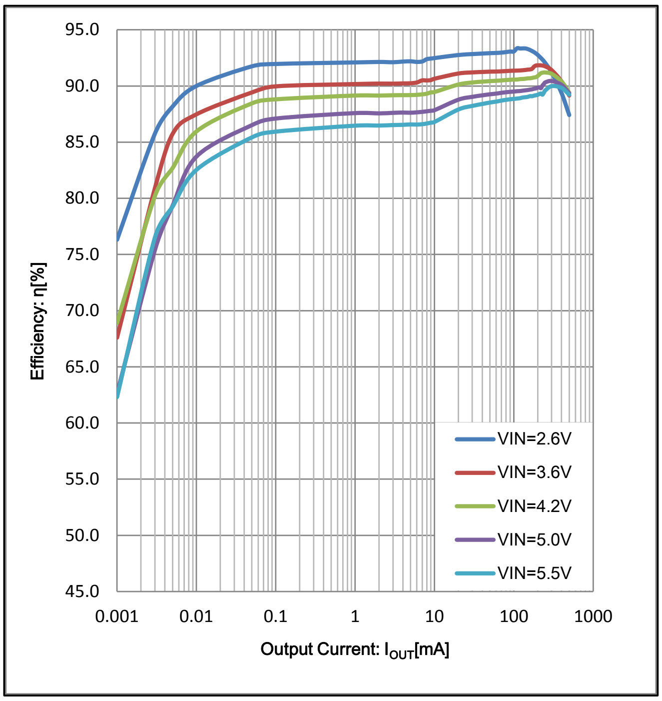

Figure 4. Efficiency vs Output Current (V_{OUT}=1.8V)

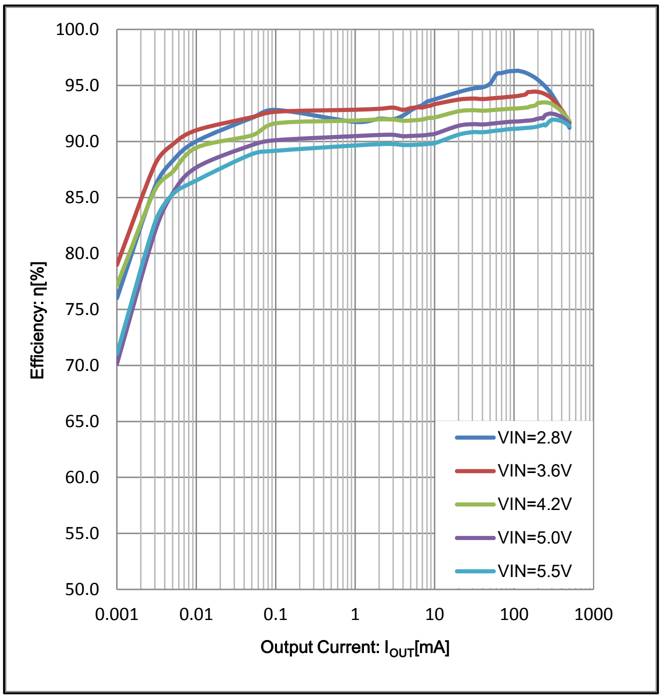

Figure 5. Efficiency vs Output Current (V_{OUT}=2.5V)

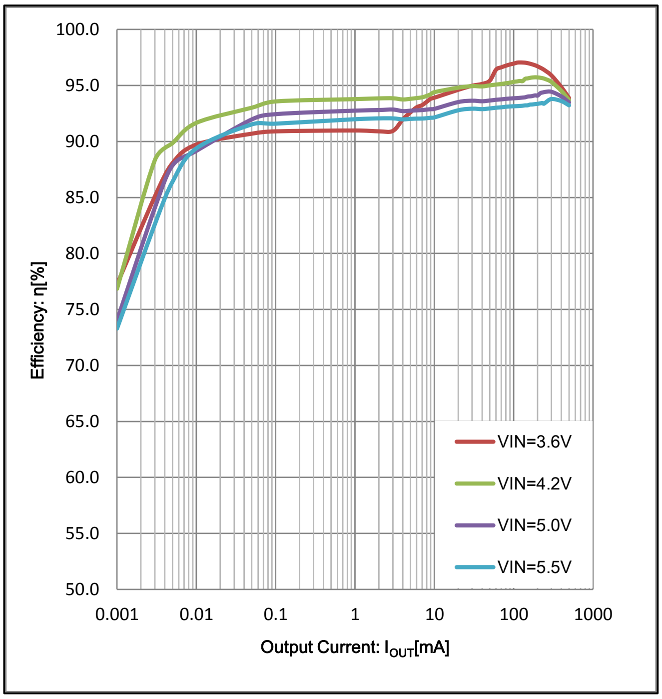

Figure 6. Efficiency vs Output Current (V_{OUT}=3.3V)

Typical Performance Curves (continued)

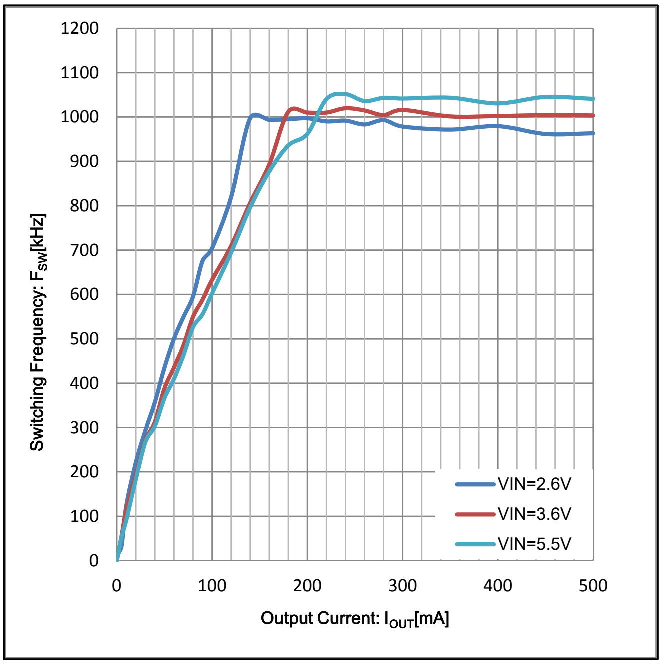

Figure 7. Switching Frequency vs Output Current
(V_{OUT}=1.2V)

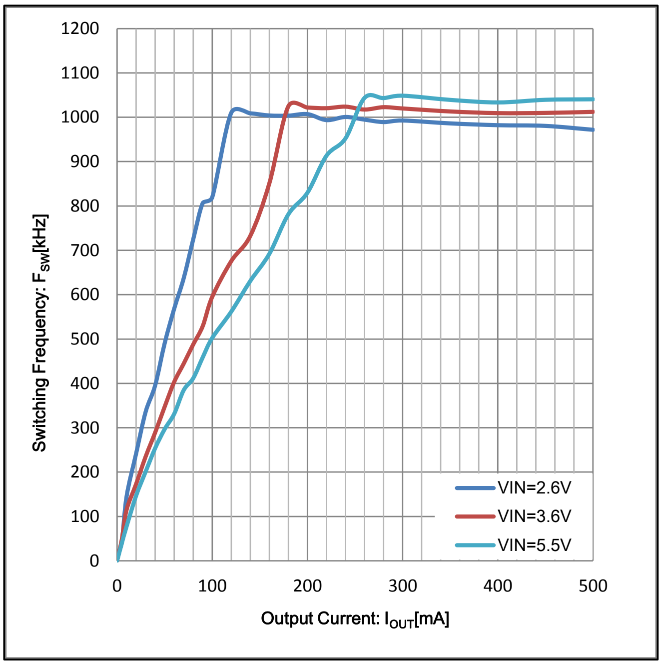

Figure 8. Switching Frequency vs Output Current
(V_{OUT}=1.8V)

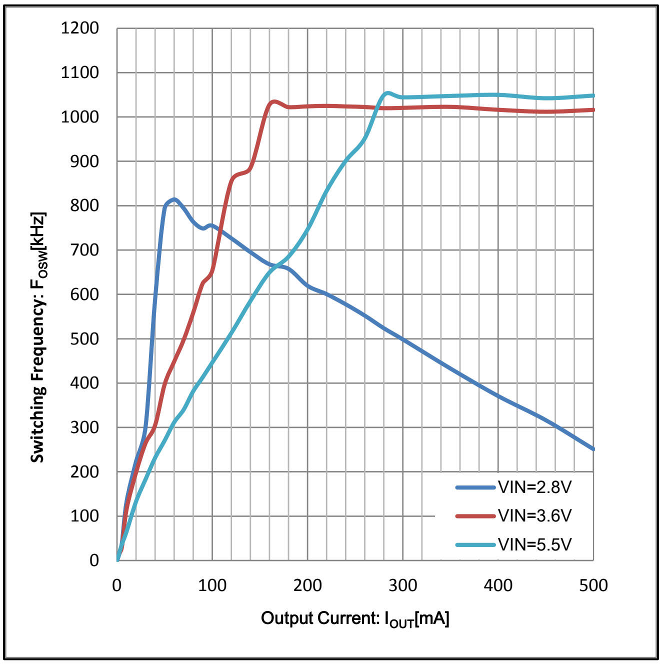

Figure 9. Switching Frequency vs Output Current
(V_{OUT}=2.5V)

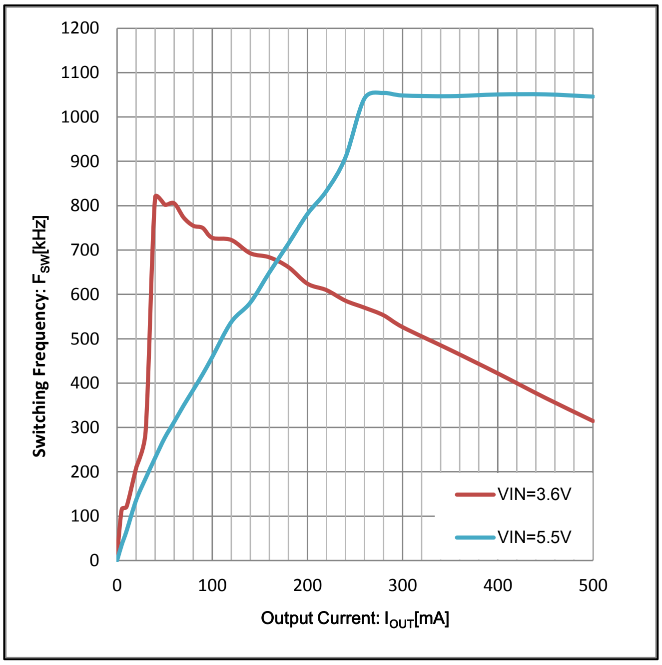

Figure 10. Switching Frequency vs Output Current
(V_{OUT}=3.3V)

Typical Performance Curves (continued)

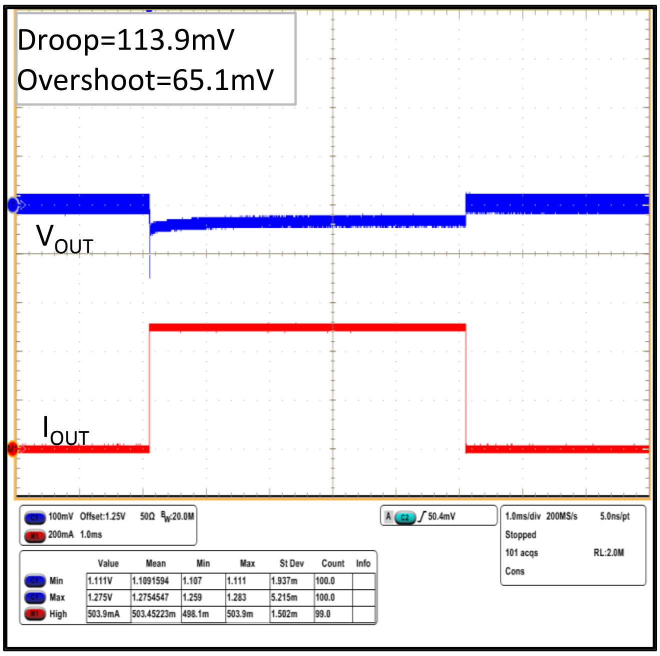

Figure 11. Load Transient Response
(V_{IN}=3.6V, V_{OUT}=1.2V, I_{OUT}=1uA⇔500mA, t_r=t_f=1μs)

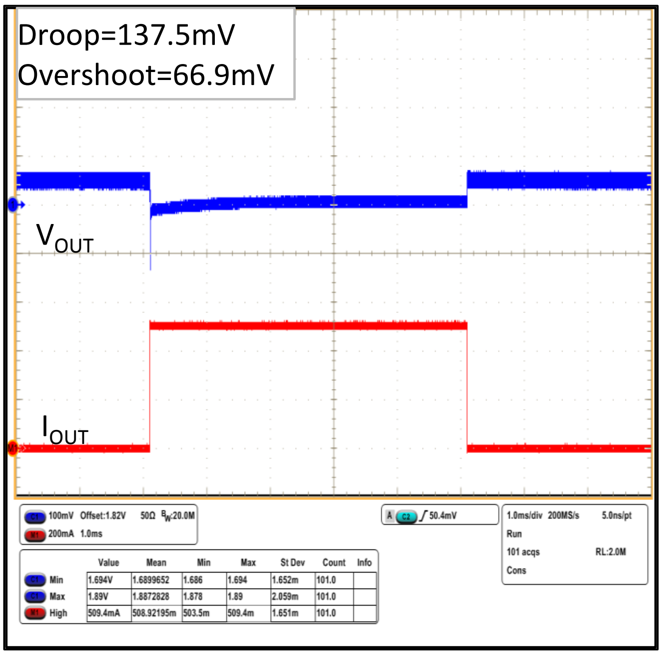

Figure 12. Load Transient Response
(V_{IN}=3.6V, V_{OUT}=1.8V, I_{OUT}=1uA⇔500mA, t_r=t_f=1μs)

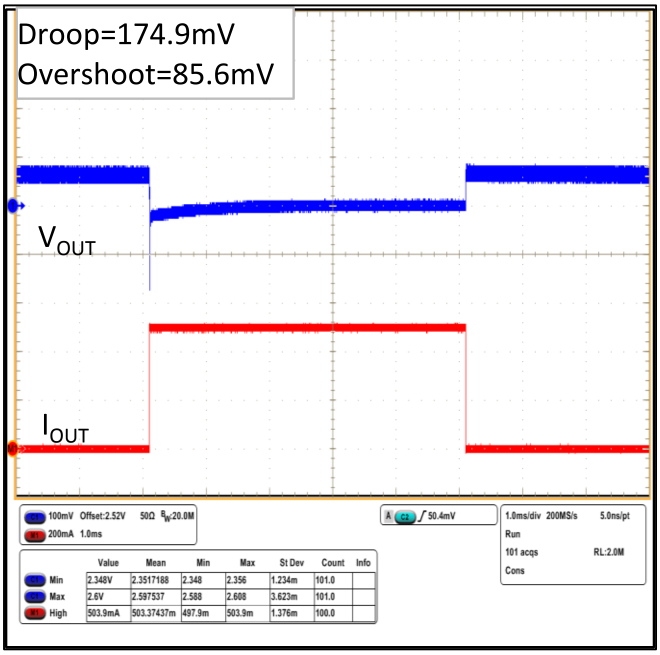

Figure 13. Load Transient Response
(V_{IN}=3.6V, V_{OUT}=2.5V, I_{OUT}=1uA⇔500mA, t_r=t_f=1μs)

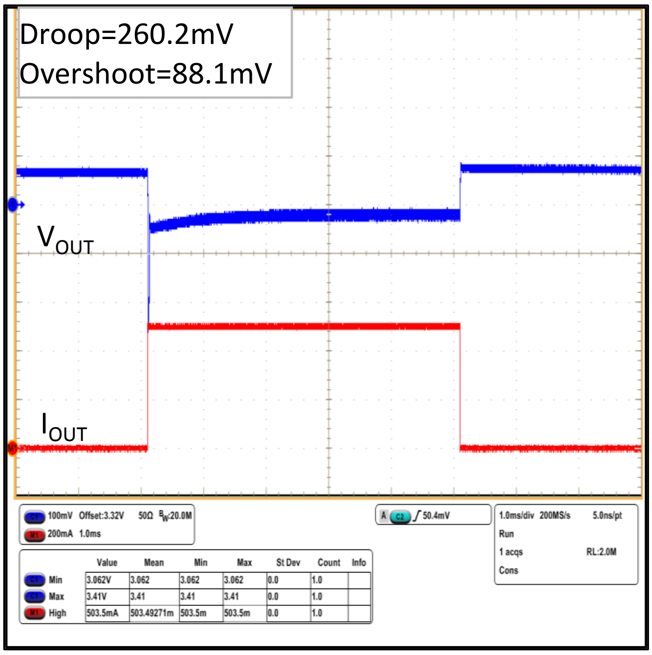

Figure 14. Load Transient Response
(V_{IN}=3.6V, V_{OUT}=3.3V, I_{OUT}=1uA⇔500mA, t_r=t_f=1μs)

Typical Performance Curves (continued)

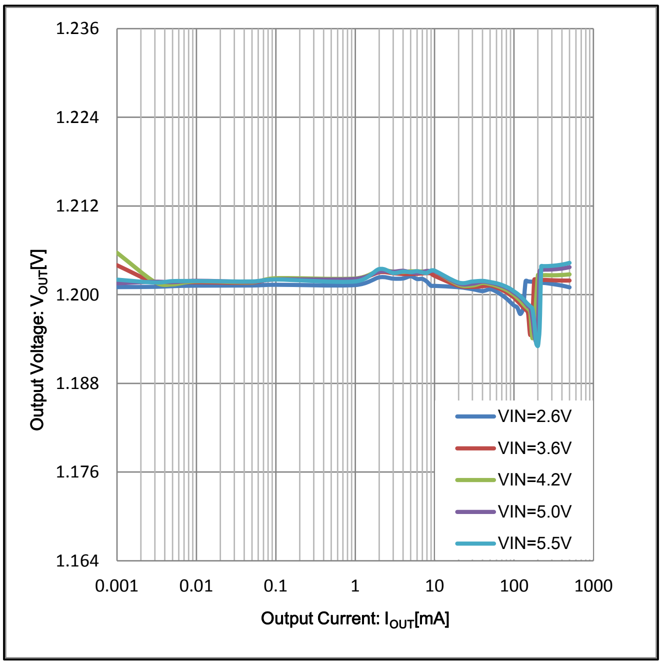

Figure 15. Output Voltage vs Output Current (Load Regulation, V_{OUT}=1.2V)

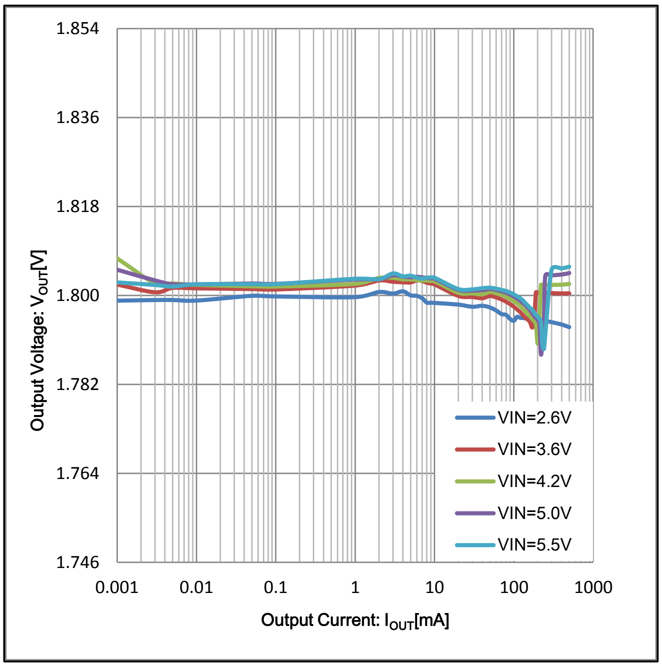

Figure 16. Output Voltage vs Output Current (Load Regulation, V_{OUT}=1.8V)

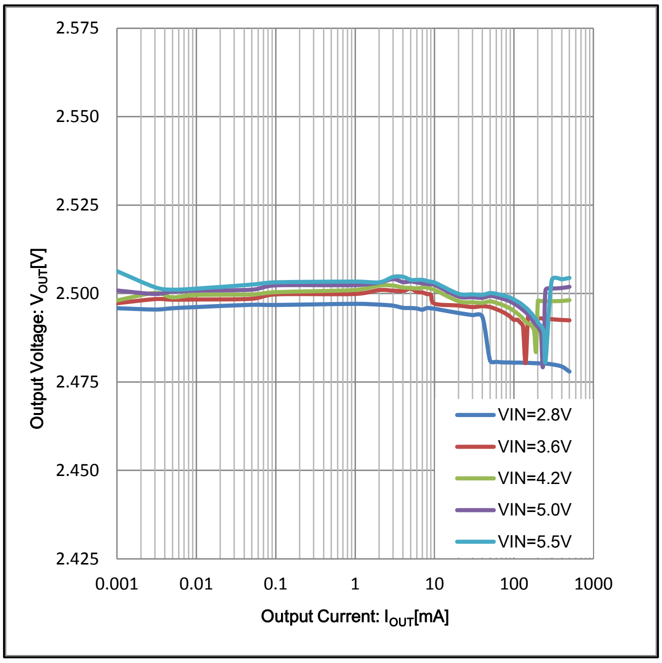

Figure 17. Output Voltage vs Output Current (Load Regulation, V_{OUT}=2.5V)

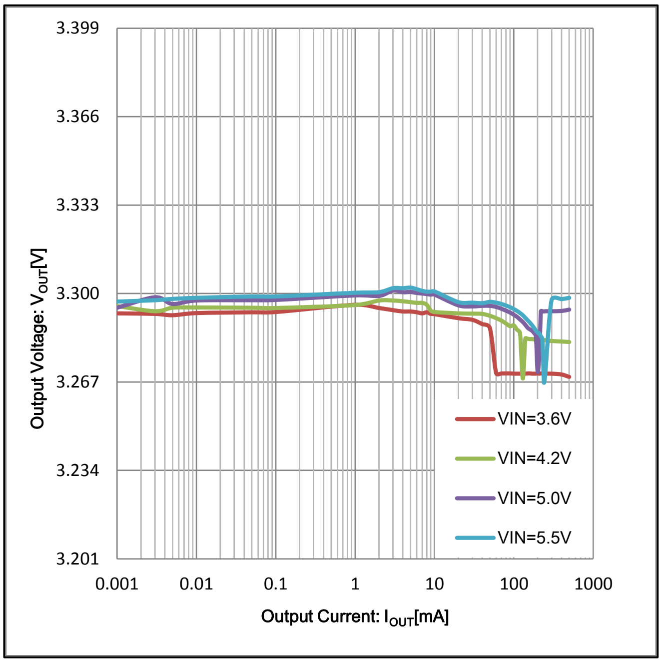

Figure 18. Output Voltage vs Output Current (Load Regulation, V_{OUT}=3.3V)

Typical Performance Curves (continued)

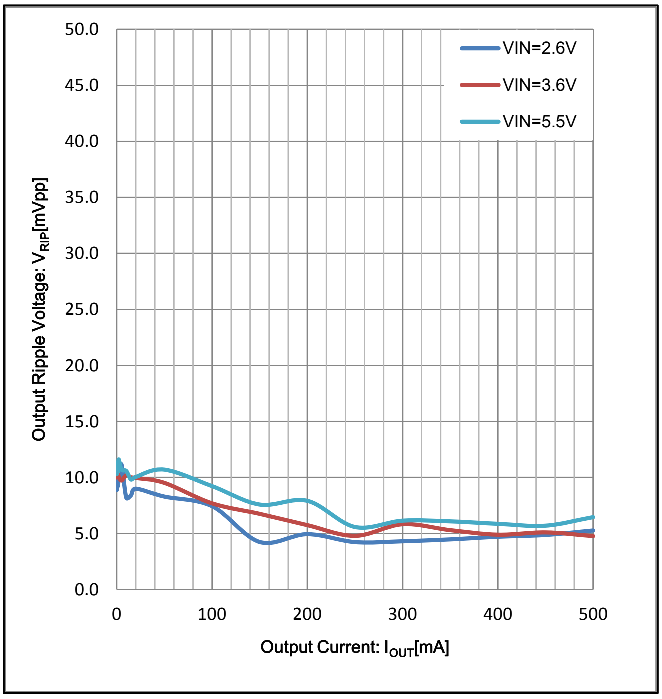

Figure 19. Output Ripple Voltage vs Output Current
(Peak to Peak Output Ripple Voltage, V_{OUT}=1.2V)

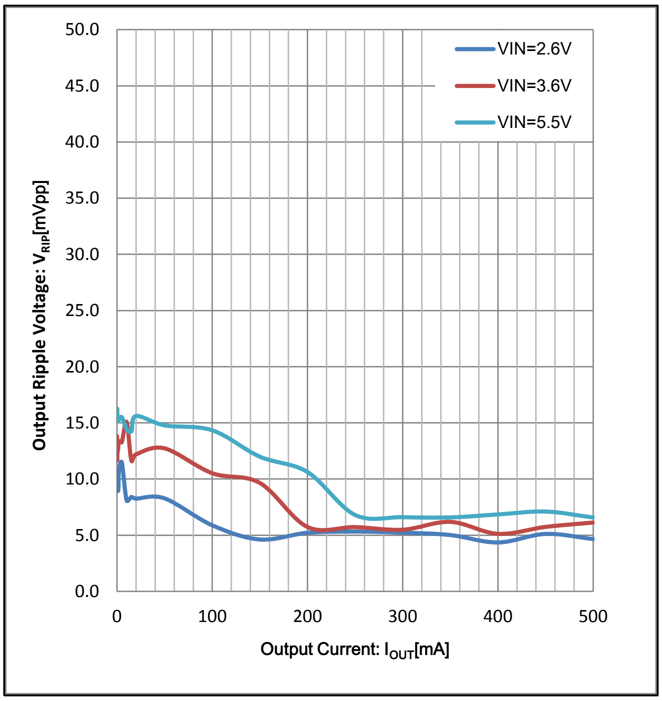

Figure 20. Output Ripple Voltage vs Output Current
(Peak to Peak Output Ripple Voltage, V_{OUT}=1.8V)

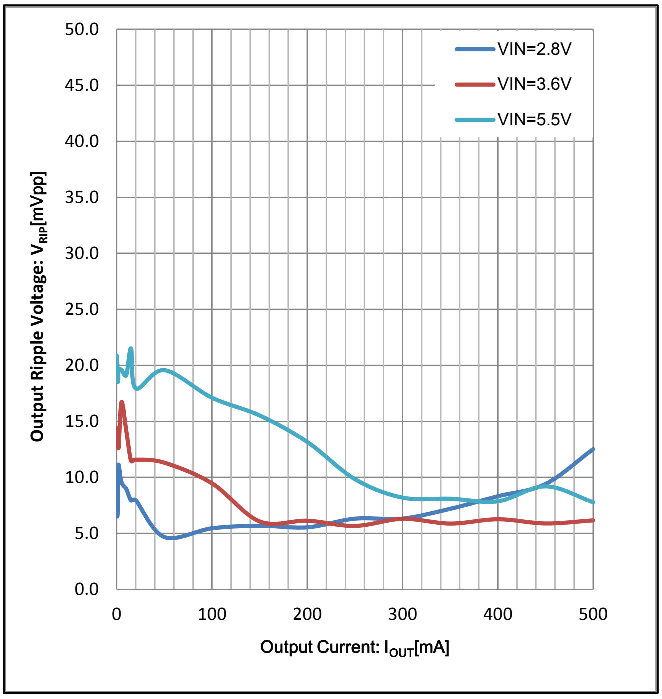

Figure 21. Output Ripple Voltage vs Output Current
(Peak to Peak Output Ripple Voltage, V_{OUT}=2.5V)

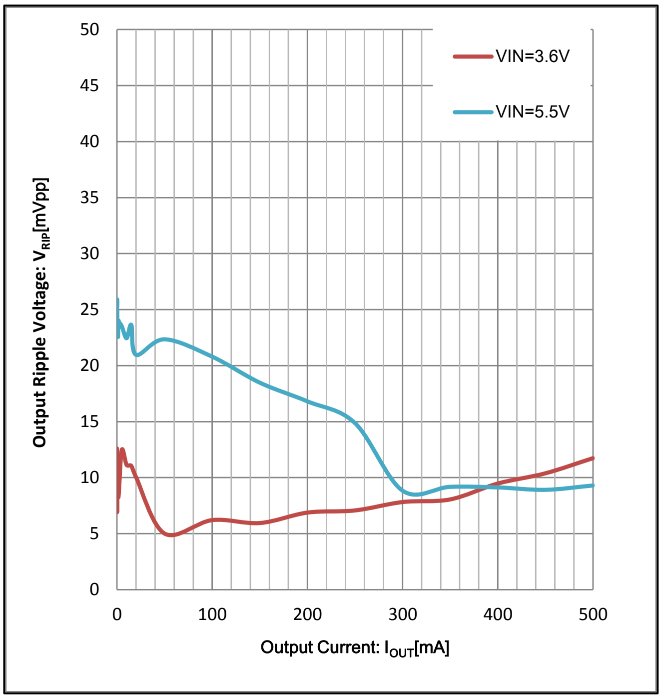

Figure 22. Output Ripple Voltage vs Output Current
(Peak to Peak Output Ripple Voltage, V_{OUT}=3.3V)

Typical Performance Curves (continued)

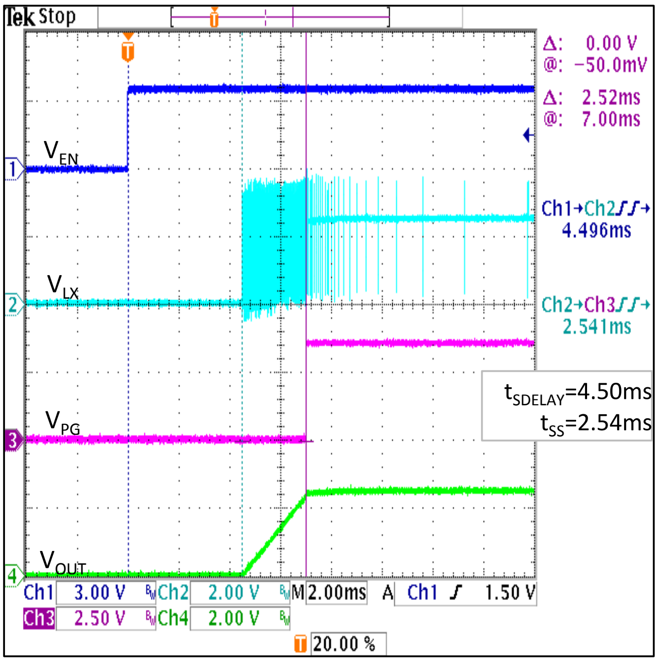

Figure 23. Startup
(V_{IN}=3.6V, V_{OUT}=2.5V, I_{OUT}=0mA, EN=0→V_{IN})

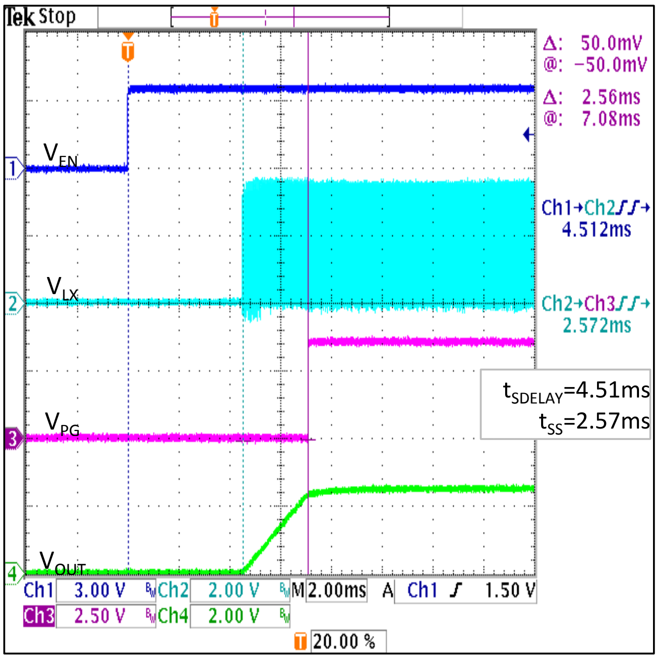

Figure 24. Startup
(V_{IN}=3.6V, V_{OUT}=2.5V, I_{OUT}=500mA, EN=0→V_{IN})

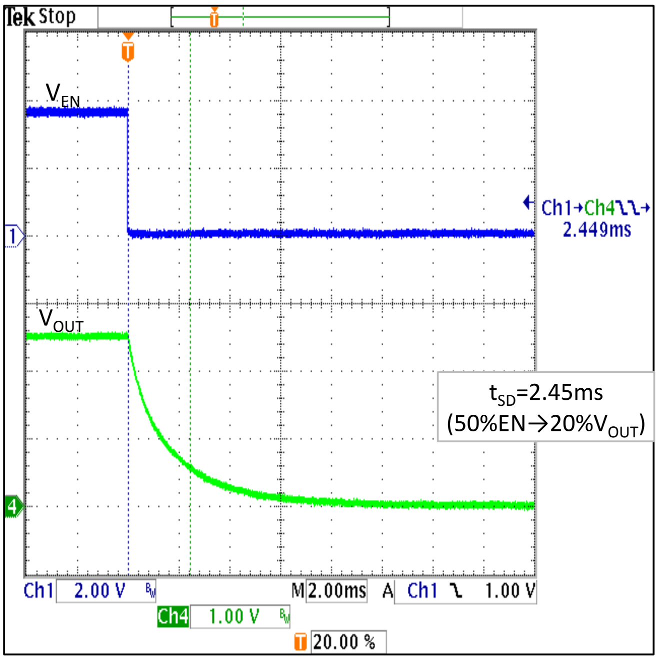

Figure 25. Shutdown
(V_{IN}=3.6V, V_{OUT}=2.5V, I_{OUT}=0mA, EN=V_{IN}→0)

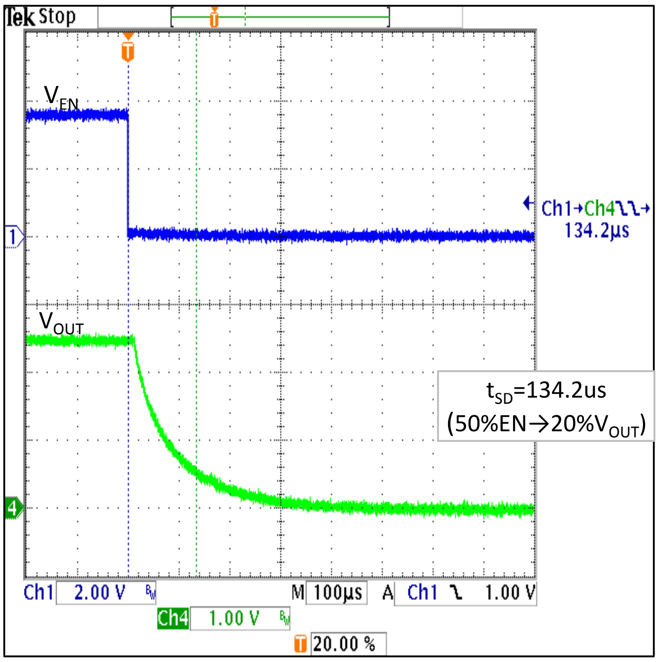

Figure 26. Shutdown
(V_{IN}=3.6V, V_{OUT}=2.5V, I_{OUT}=500mA, EN=V_{IN}→0)

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