Test Report: PMP31257

Split-Rail Converter With Configurable Dual, Positive and Negative Outputs Reference Design

Description

The LM2733 boost converter design generates a positive and negative output. An analog dc input voltage can be used to configure the outputs. Both outputs can be dynamically changed using an external voltage.

Features

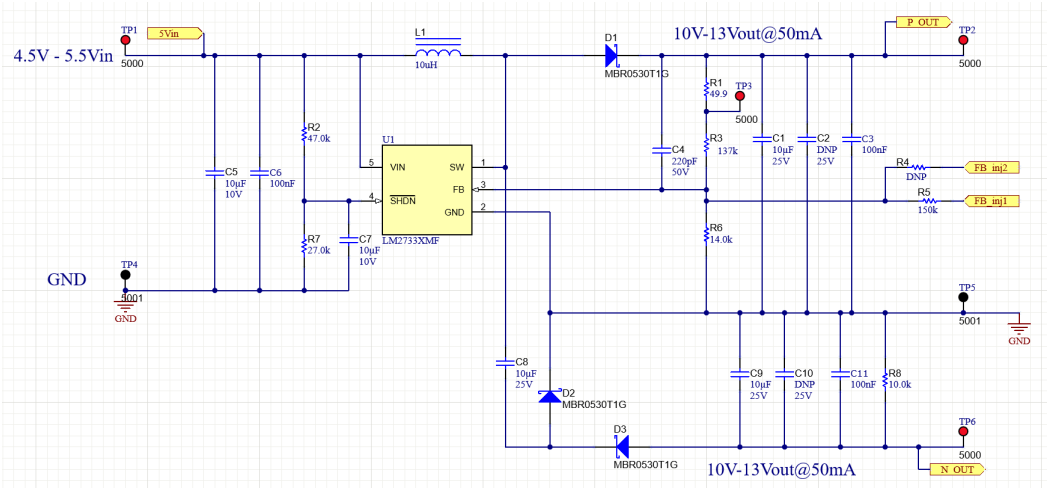
- Current mode boost converter
- Configurable outputs
- Negative and positive output
- High 1.6-MHz switching frequency

Applications

- Robot servo drive

Top Photo

Angled Photo



Schematic

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input voltage Range	4.5 V to 5.5 V
Output Voltage 1	10 V to 13 V
Maximum Output Current 1	50 mA
Maximum Output Voltage 2	–13 V to –10 V
Maximum Output Current 2	50 mA
IC	LM2733X
Switching Frequency	1.6 MHz (data sheet)
Topology	Boost

1.2 Considerations

All testings were done with 5-V input voltage. Unless otherwise indicated, resistors were used as load.

1.3 Dimensions

The size of the two-layer board is 32.4 mm × 30.5 mm.

2 Testing and Results

2.1 Efficiency and Load Regulation Graphs

2.1.1 Symmetrical Load

2.1.1.1 Efficiency and Loss

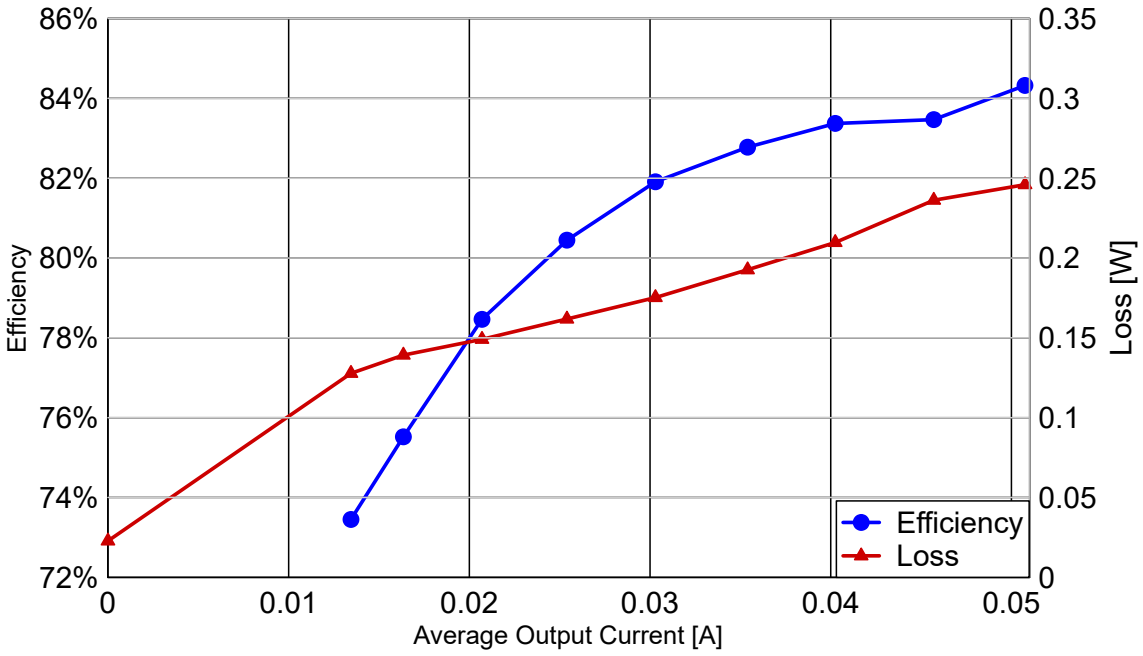


Figure 2-1. Efficiency and Loss vs Average Output Current (Symmetrical Load)

2.1.1.2 Load Regulation

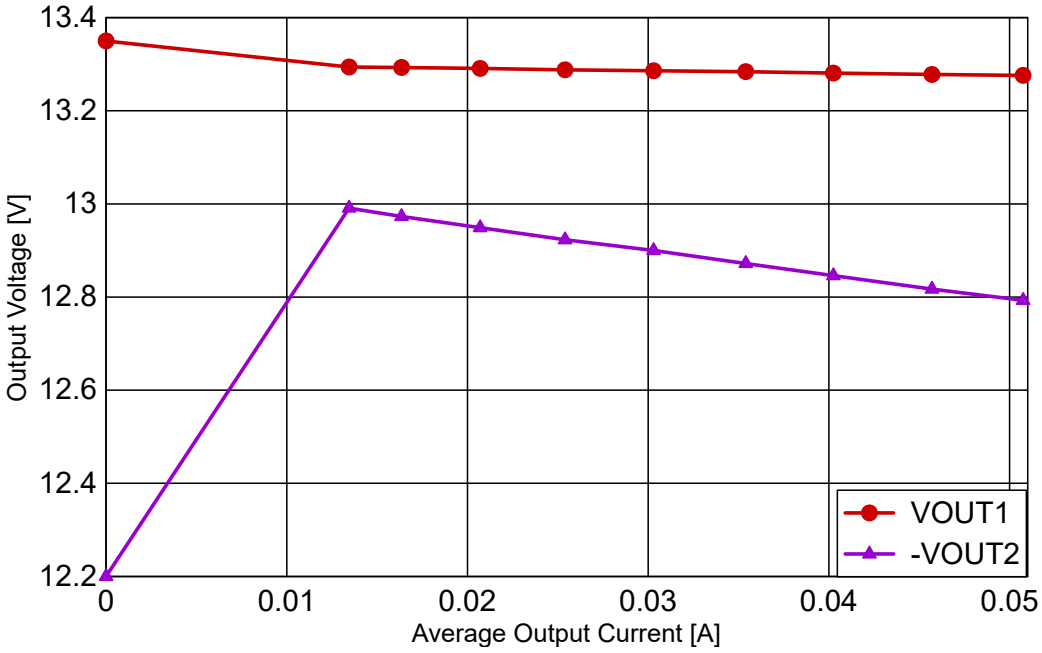


Figure 2-2. Load Regulation (Symmetrical Load)

2.1.2 Nonsymmetrical Load

2.1.2.1 One Output 50 mA, Other Output Varying

2.1.2.1.1 Efficiency

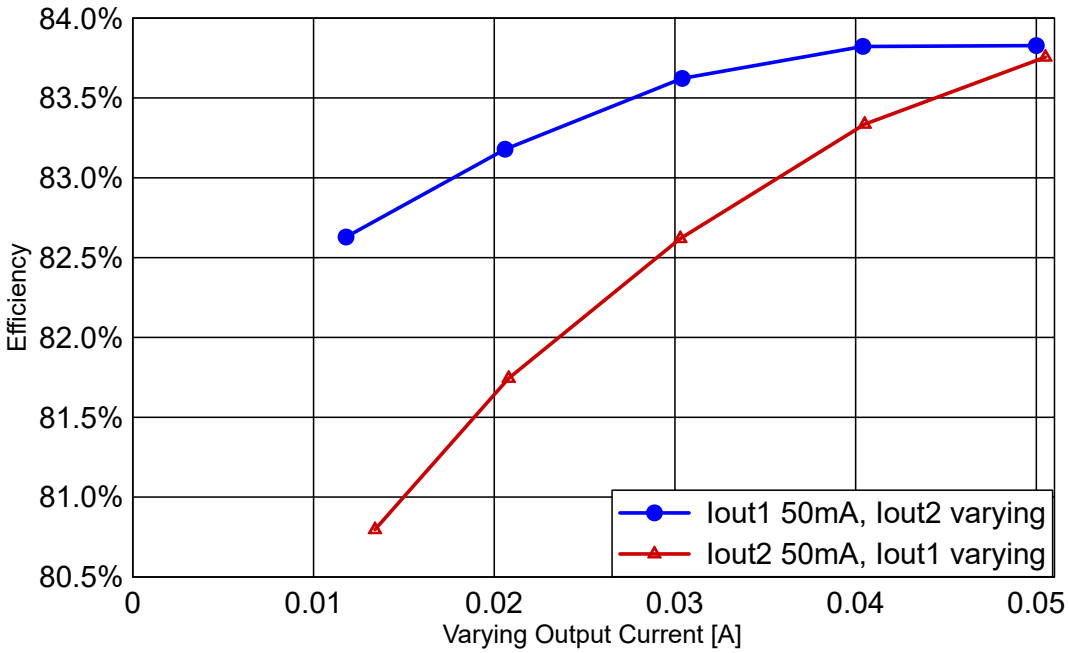


Figure 2-3. Efficiency ⇒ One Output 50 mA, Other Output Varies

2.1.2.1.2 Loss

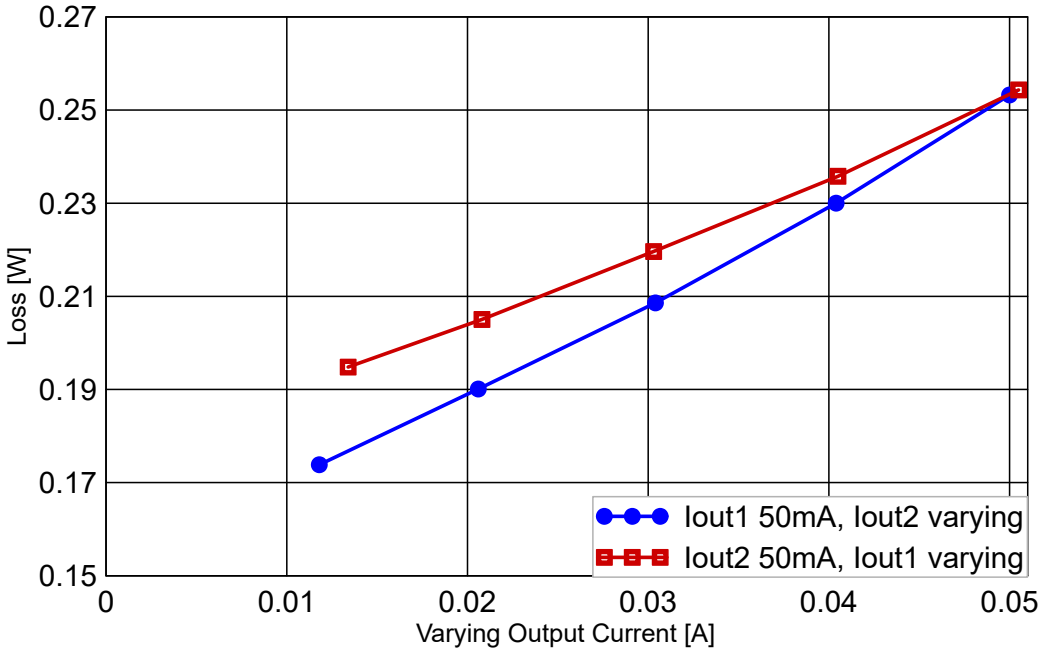


Figure 2-4. Loss ⇒ One Output 50 mA, Other Output Varies

2.1.2.1.3 Load Regulation

2.1.2.1.3.1 Positive Output Voltage

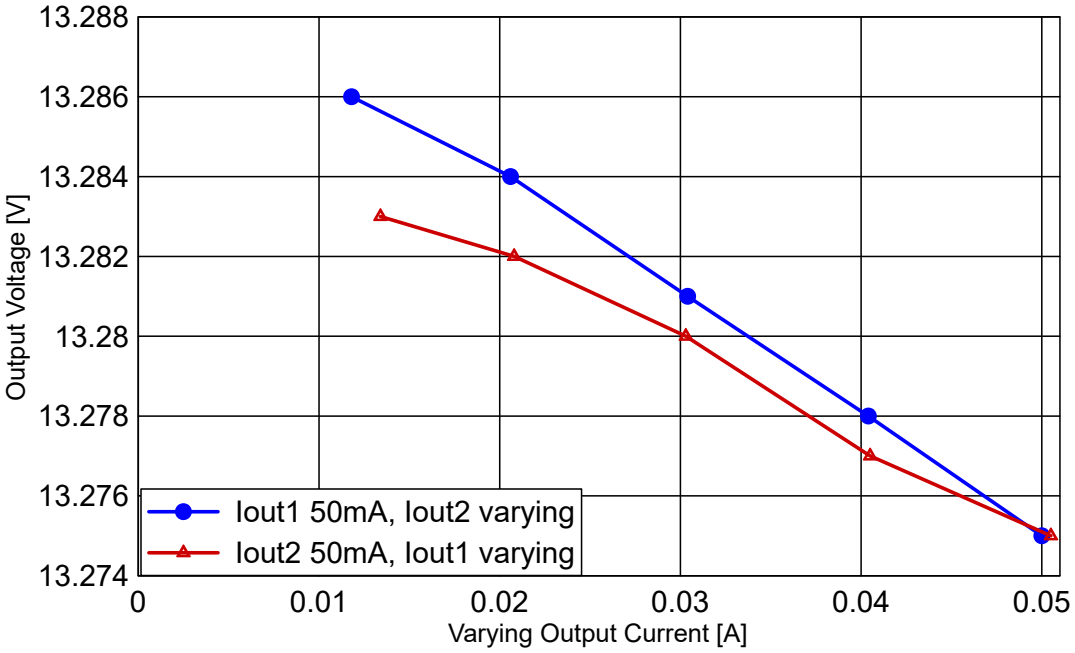


Figure 2-5. Positive Output ⇒ One Output 50 mA, Other Output Varies

2.1.2.1.3.2 Negative Output Voltage

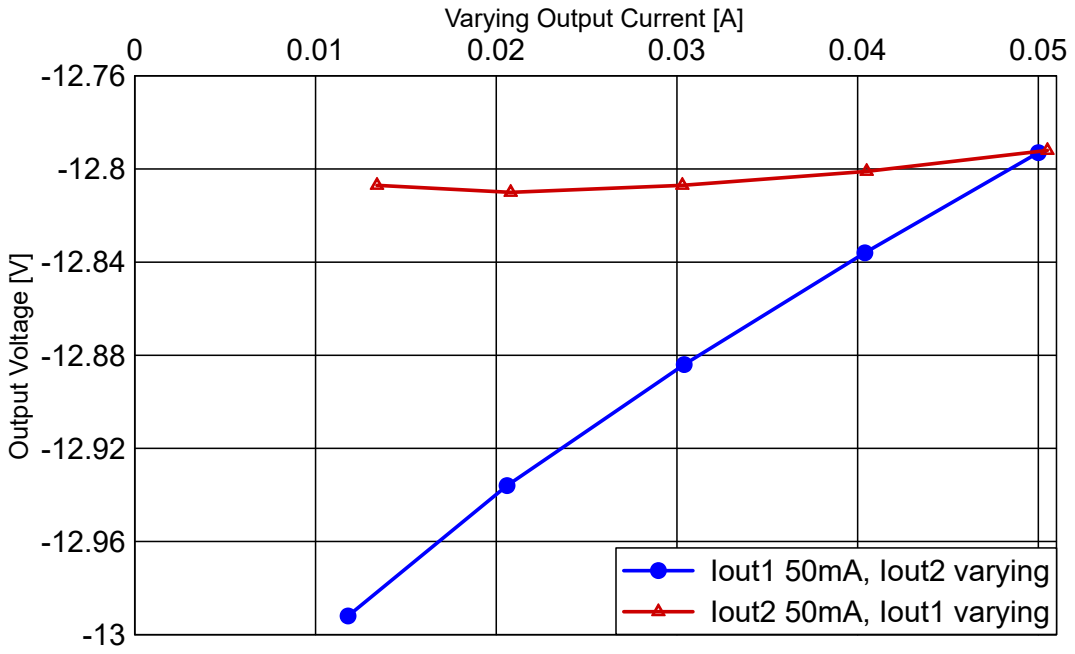


Figure 2-6. Positive Output ⇒ One Output 50 mA, Other Output Varies

2.1.2.2 One Output Loaded With 1 kΩ, Other Output is Varying

2.1.2.2.1 Efficiency

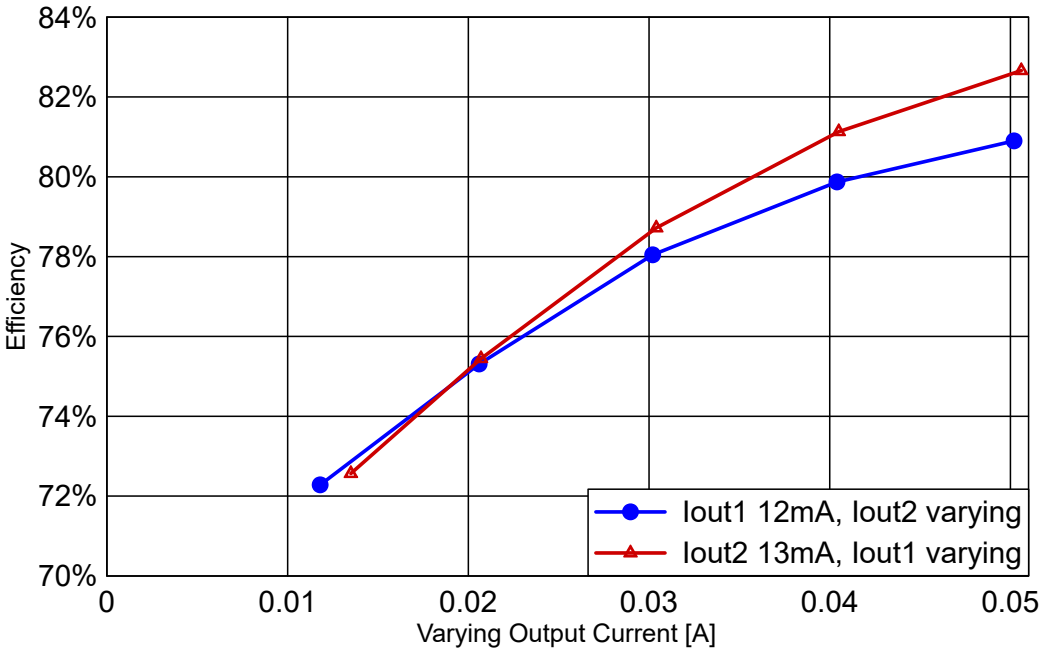


Figure 2-7. Efficiency ⇒ One Output 1-kΩ Load, Other Output Varies

2.1.2.2.2 Loss

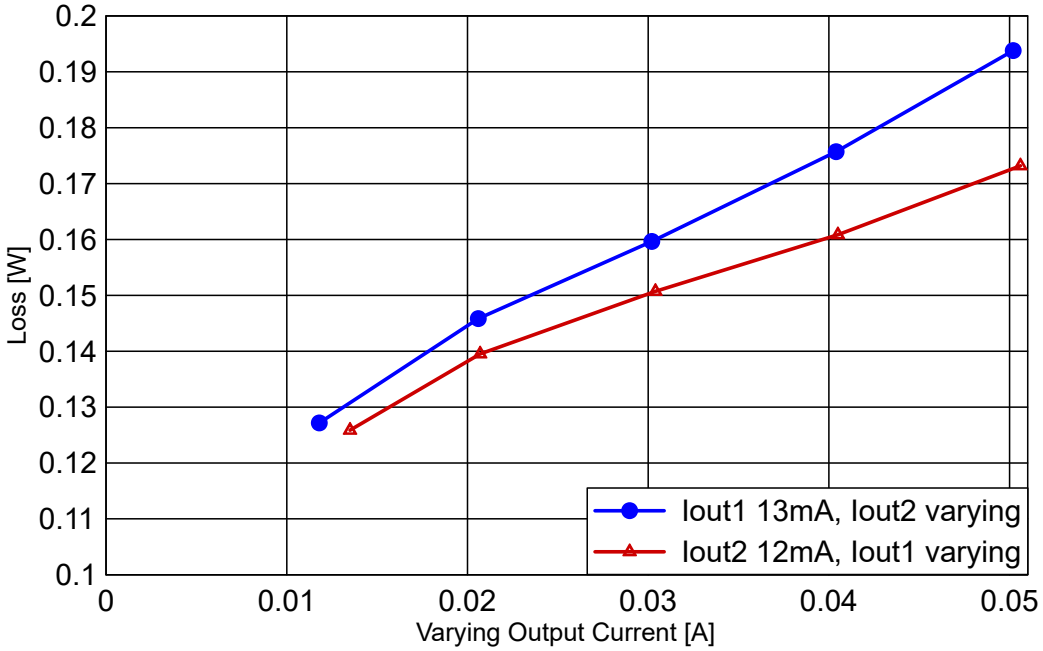


Figure 2-8. Loss ⇒ One Output 1-kΩ Load, Other Output Varies

2.1.2.2.3 Load Regulation

2.1.2.2.3.1 Positive Output Voltage

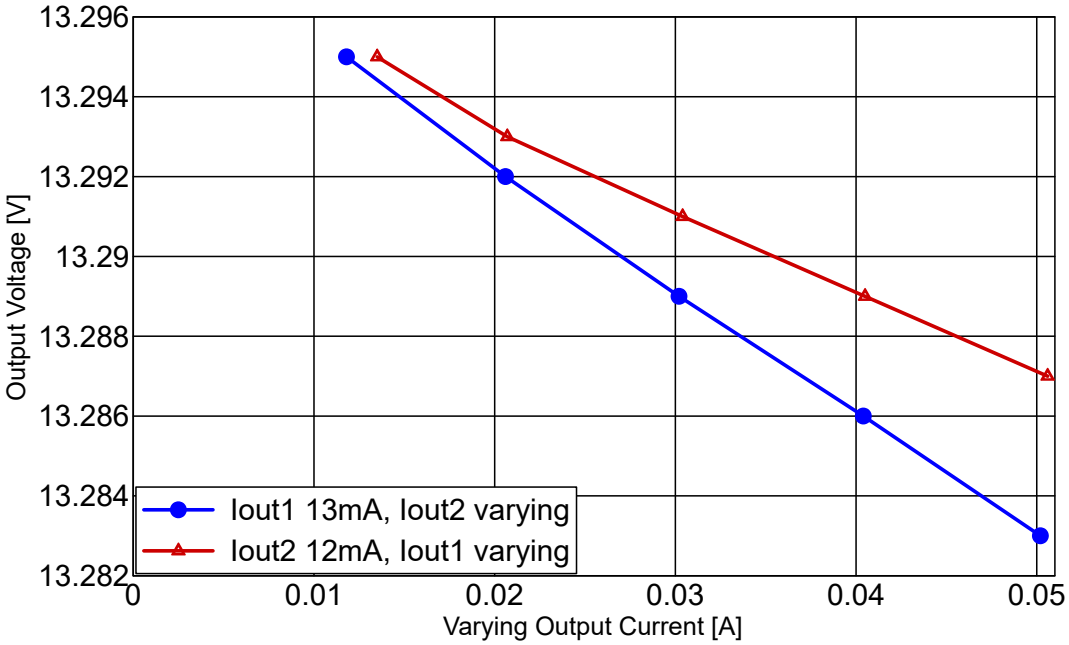


Figure 2-9. Positive Output ⇒ One Output 1-kΩ, Other Output Varies

2.1.2.2.3.2 Negative Output Voltage

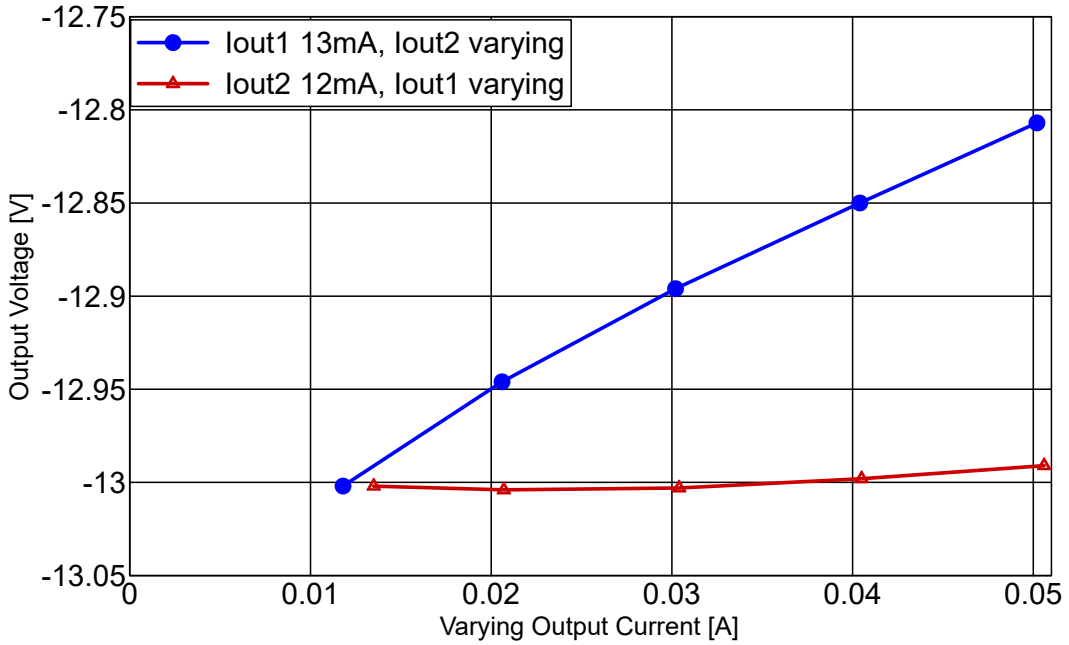


Figure 2-10. Negative Output ⇒ One Output 1-kΩ, Other Output Varies

2.1.3 Scaling the Output Voltage

The output is scalable by injecting a voltage at the FB-pin thru a resistor.

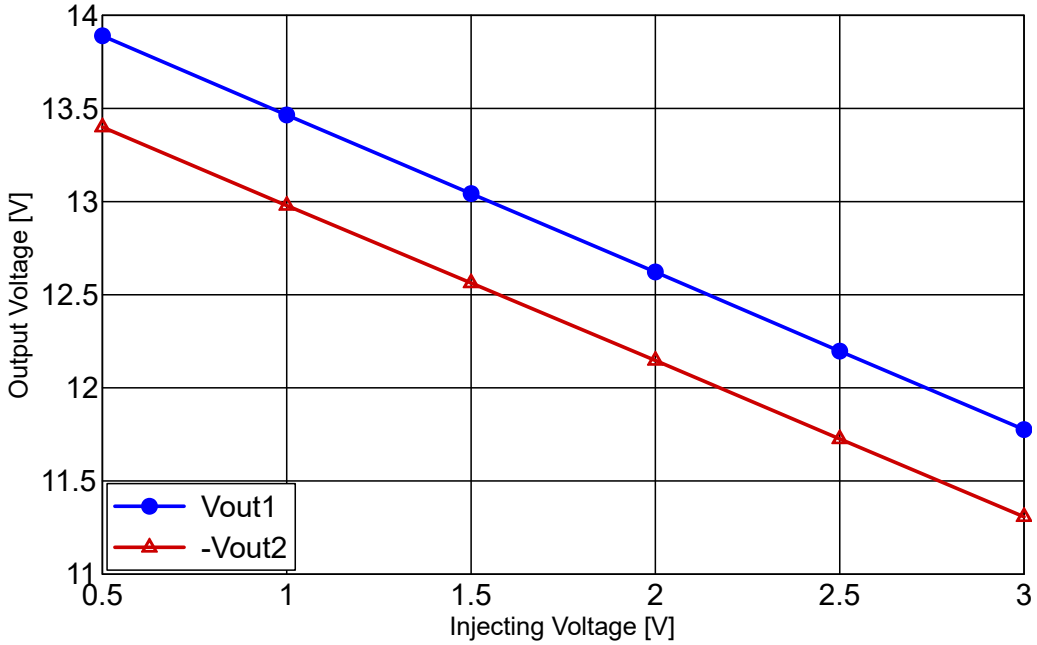


Figure 2-11. Output Voltage vs Injecting Voltage

During the measurement for Figure 2-11 the values for efficiency and loss were obtained. The result is seen in Figure 2-12.

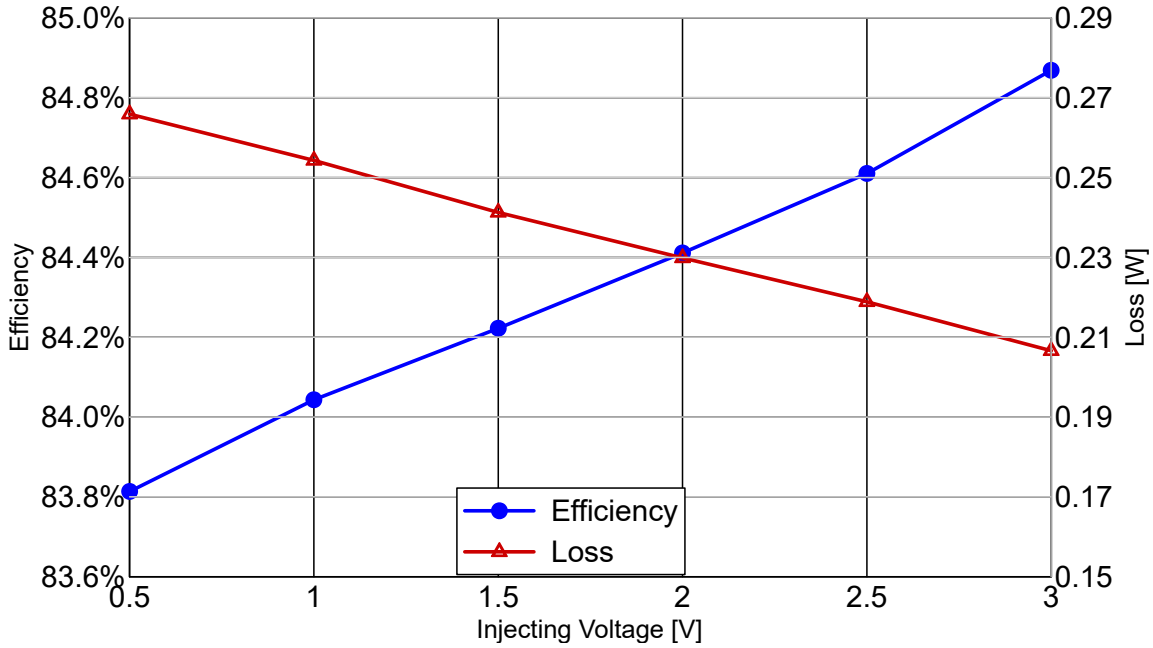


Figure 2-12. Efficiency and Loss vs Injecting Voltage

2.2 Thermal Images

The thermal image is shown in the following figure.

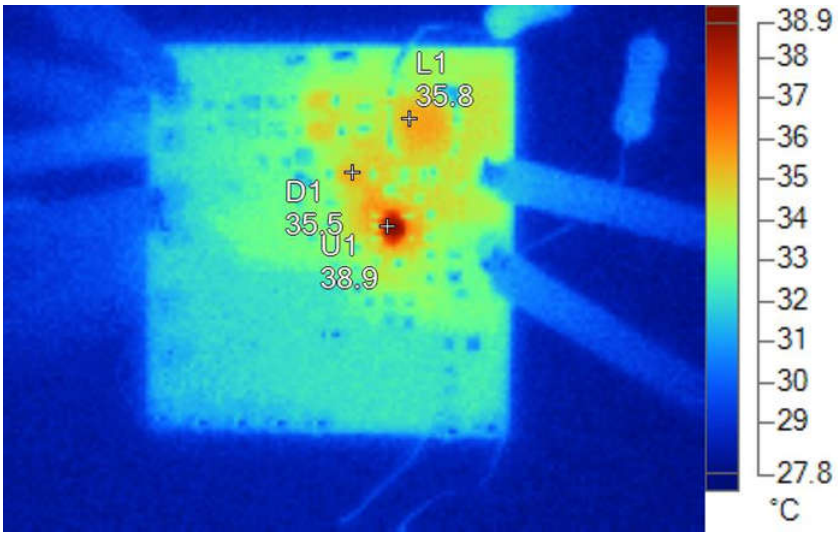


Figure 2-13. Thermal Image 50-mA Output Current on Each Output

Table 2-1. Summery of the Thermal Image

Name	Temperature
D1	35.5°C
L1	35.8°C
U1	38.9°C

2.3 Bode Plots With Dynamic Voltage Scaling

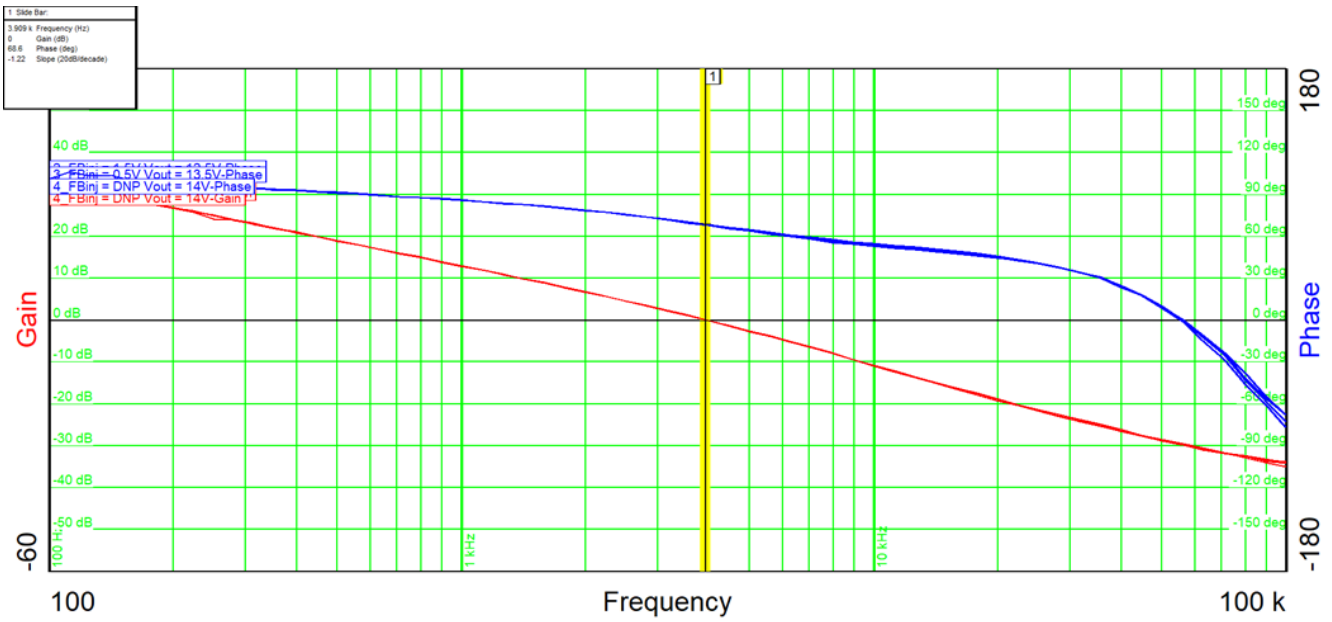


Figure 2-14. Bode Plot

Table 2-2. Summary of Measurement 1

Measurement 1	
Injection voltage TP8	open
Input voltage	5 V
Output voltage	14 V
Load current	full load
Bandwidth	3.9 kHz
Phase margin	68°
Gain margin	29 dB

Table 2-3. Summary of Measurement 2

Measurement 2	
Injection voltage TP8	3.3 V
Input voltage	5 V
Output voltage	11 V
Load current	full load
Bandwidth	3.9 kHz
Phase margin	69°
Gain margin	29 dB

3 Waveforms

3.1 Switching

3.1.1 Switchnode SW-GND

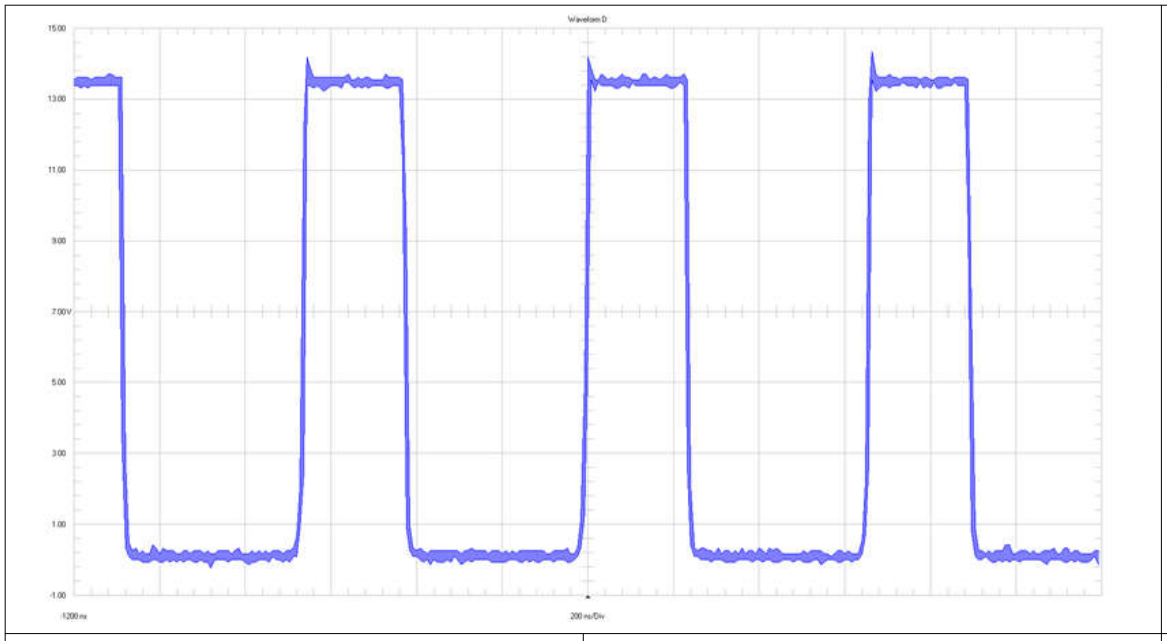


Figure 3-1. Waveform SW-GND

3.1.2 SW to P_OUT (D1)

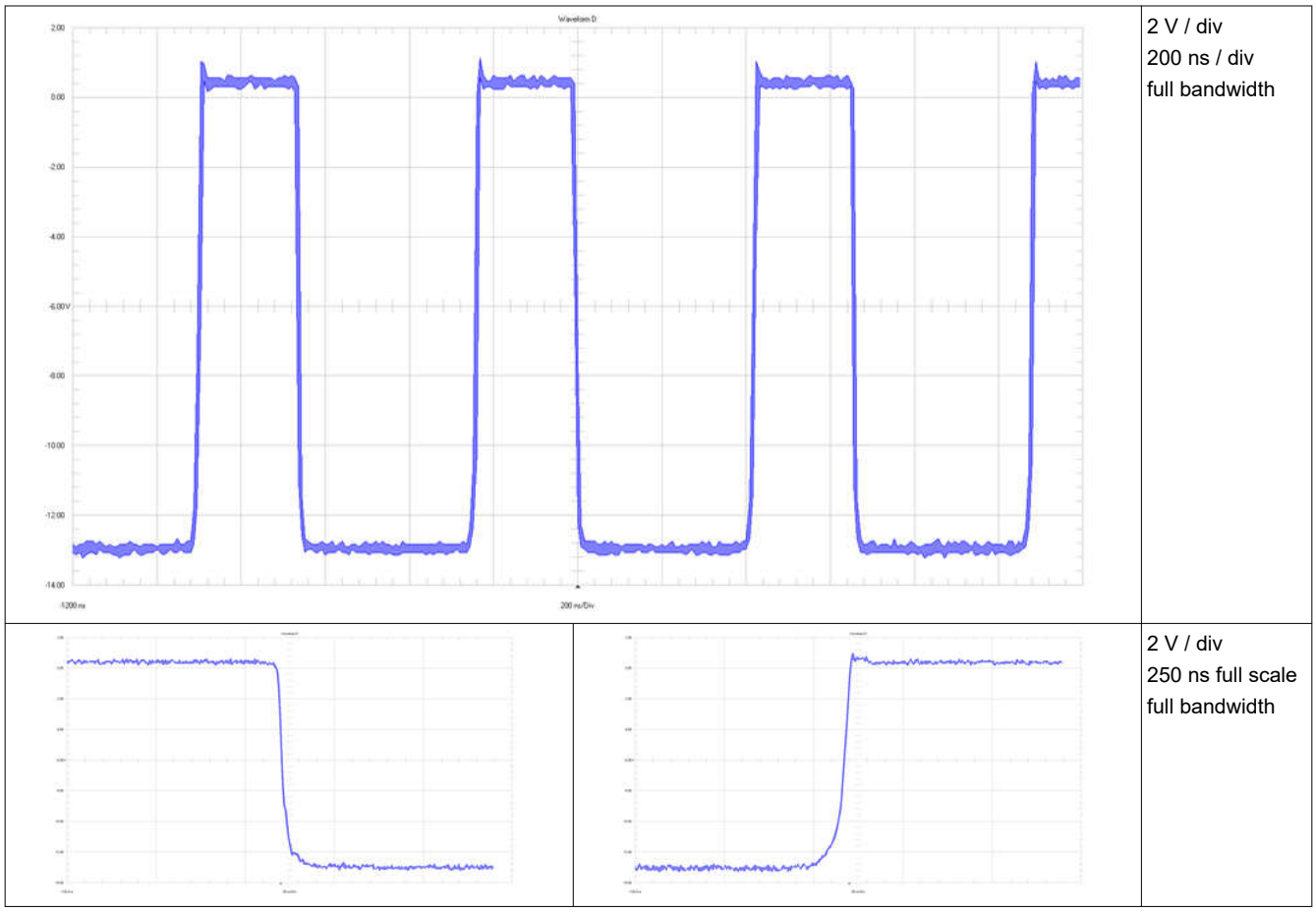


Figure 3-2. Waveform SW to P_OUT

3.1.3 Waveform on D3 Referenced to N_OUT

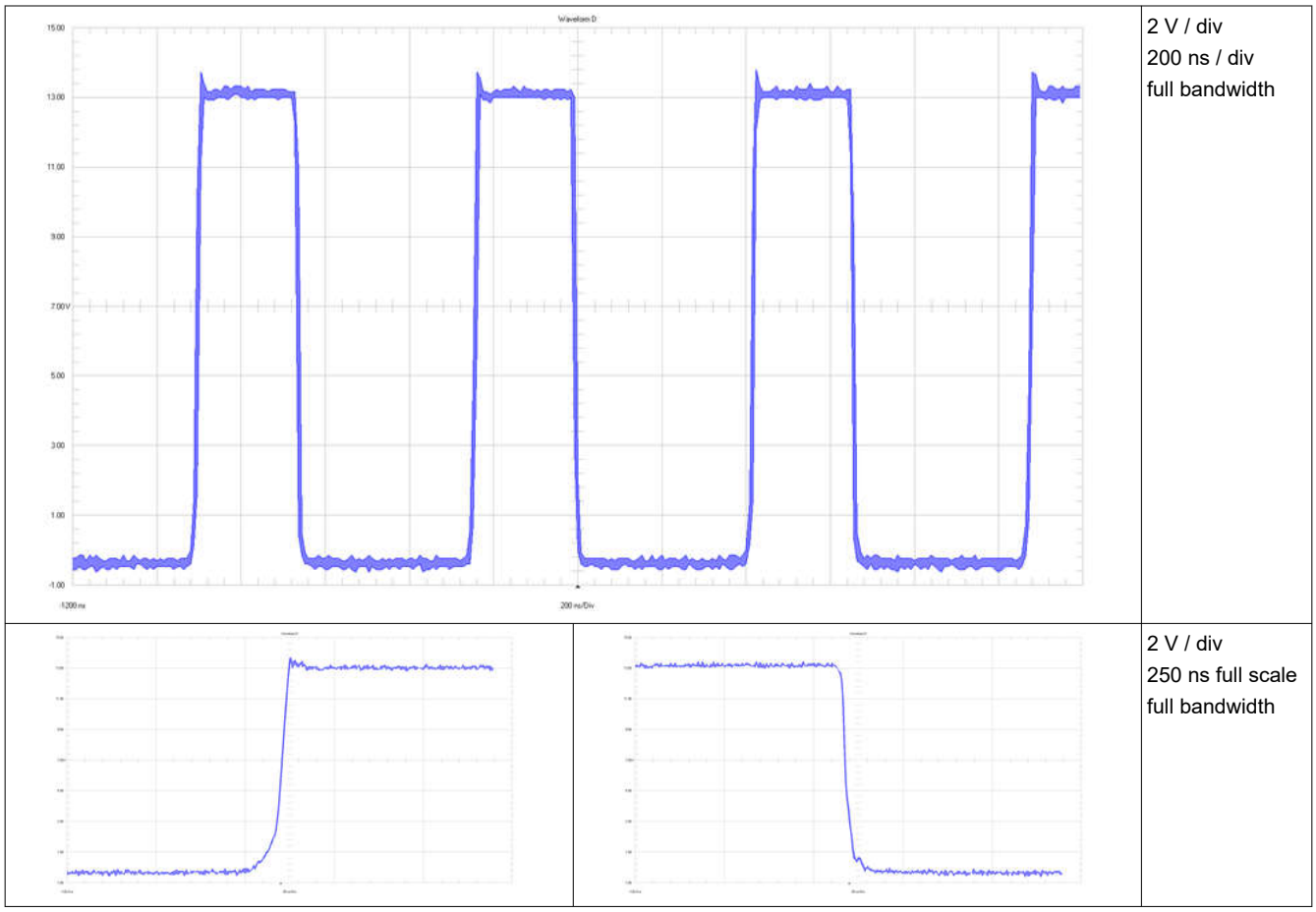
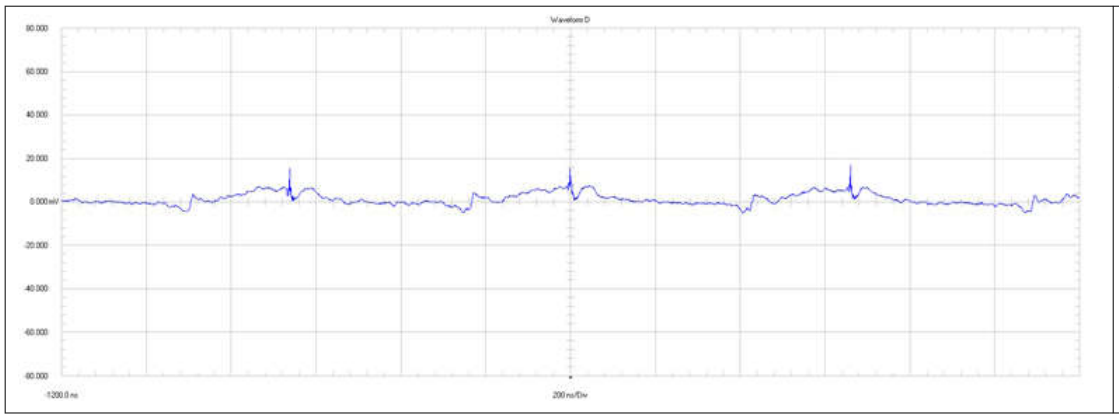


Figure 3-3. Waveform Measured on D3

3.2 Output Voltage Ripple

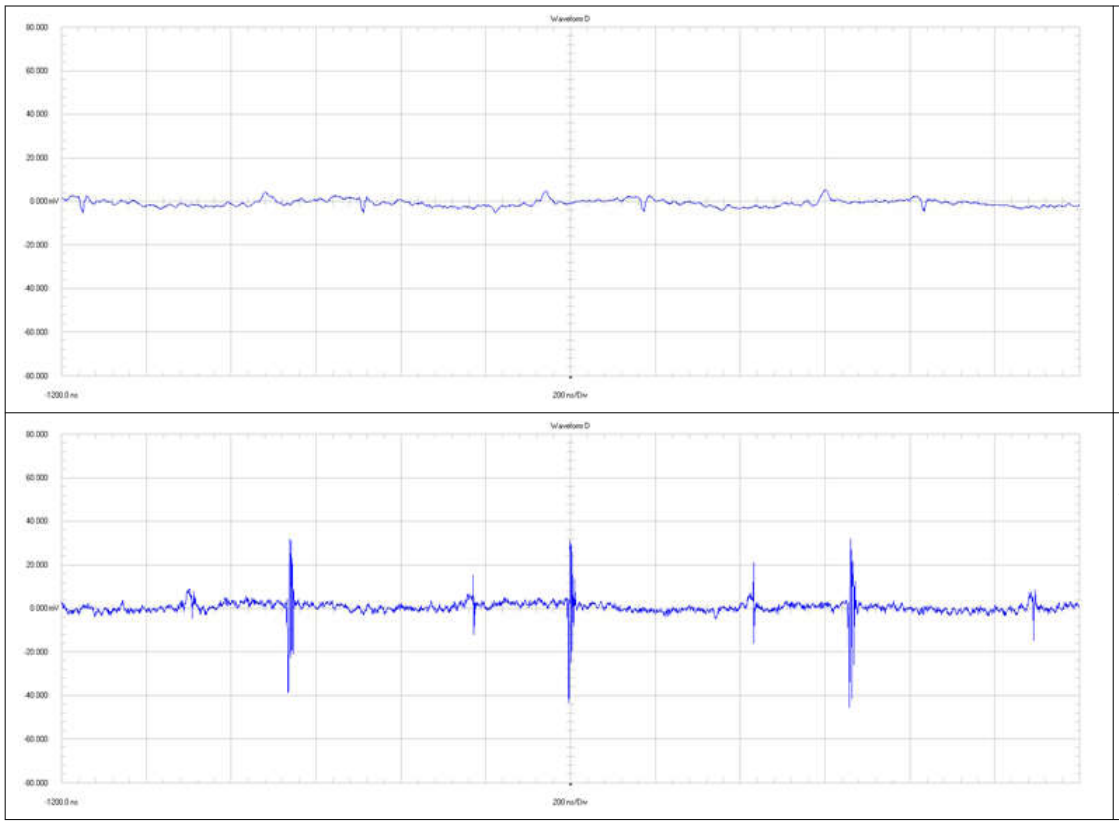
3.2.1 Positive Output Voltage (P_OUT)



20 mV / div
200 ns / div
full bandwidth

Figure 3-4. Positive Output Voltage Ripple (P_OUT)

3.2.2 Negative Output Voltage (N_OUT)



20 mV / div
200 ns / div
20-MHz bandwidth

20 mV / div
200 ns / div
full bandwidth

Figure 3-5. Negative Output Voltage Ripple (N_OUT)

3.3 Input Voltage Ripple

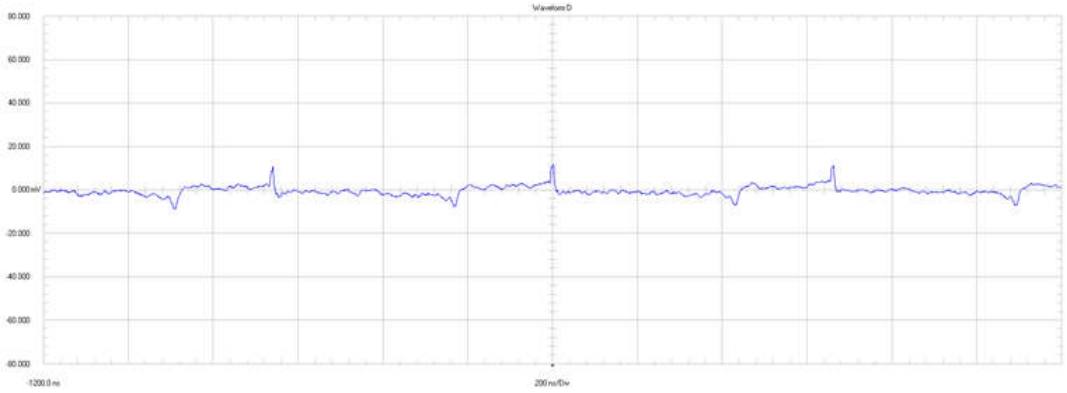
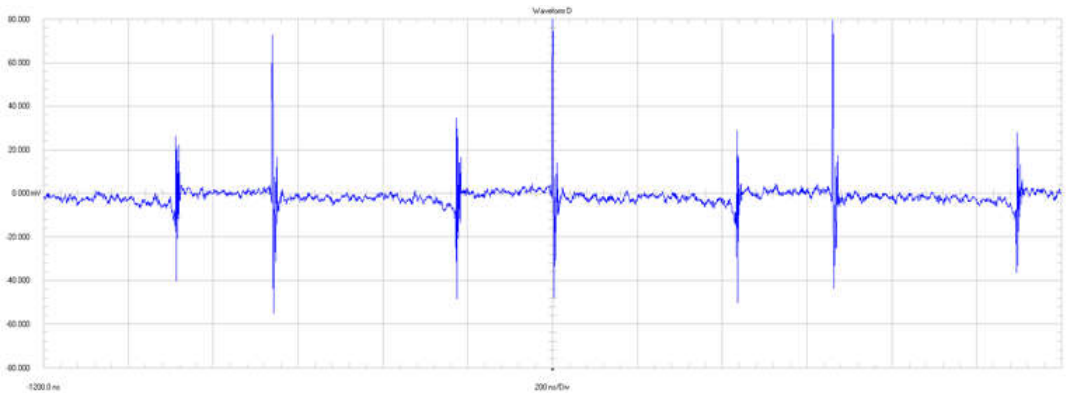
	20 mV / div 200 ns / div 20-MHz bandwidth
	20 mV / div 200 ns / div full bandwidth

Figure 3-6. Input Voltage Ripple

3.4 Load Transients

The electronic switches between 27-mA and 51-mA output current with a frequency of 100 Hz.

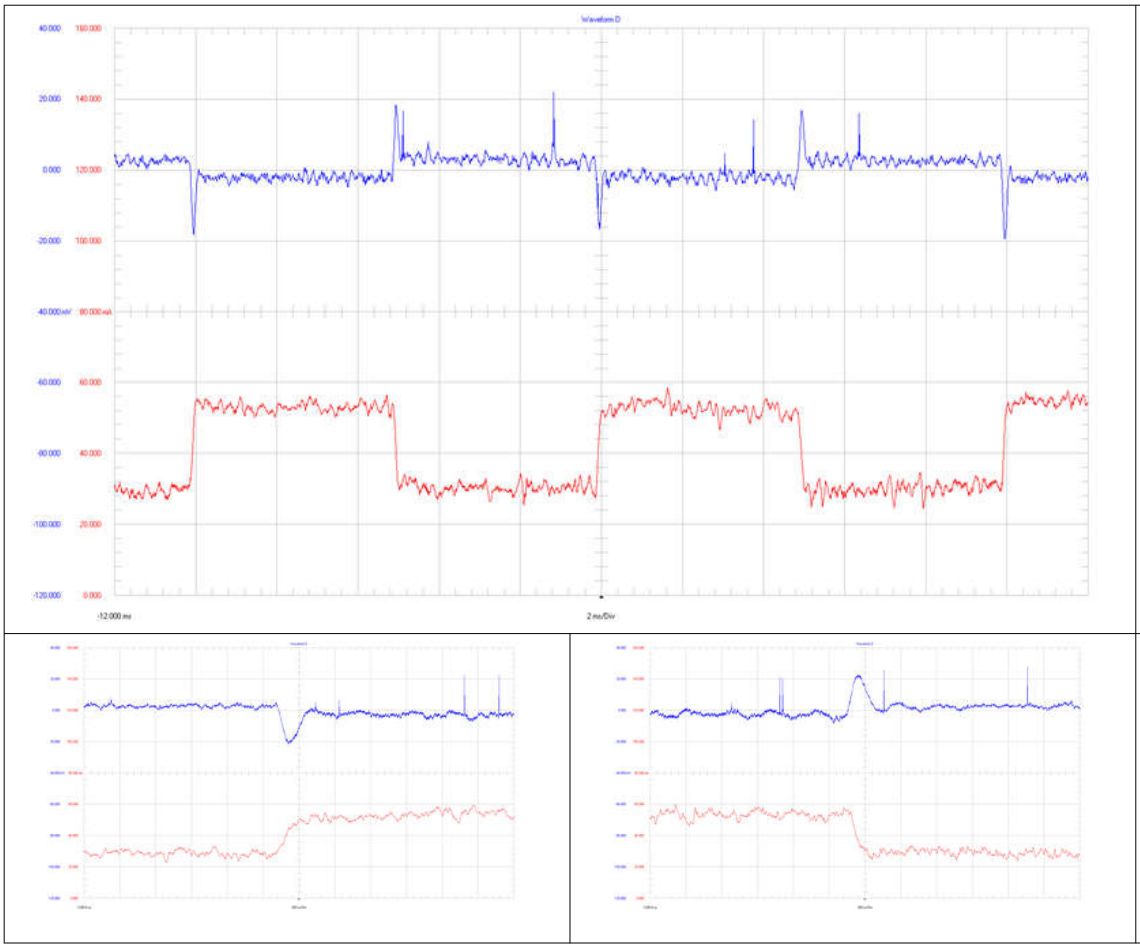
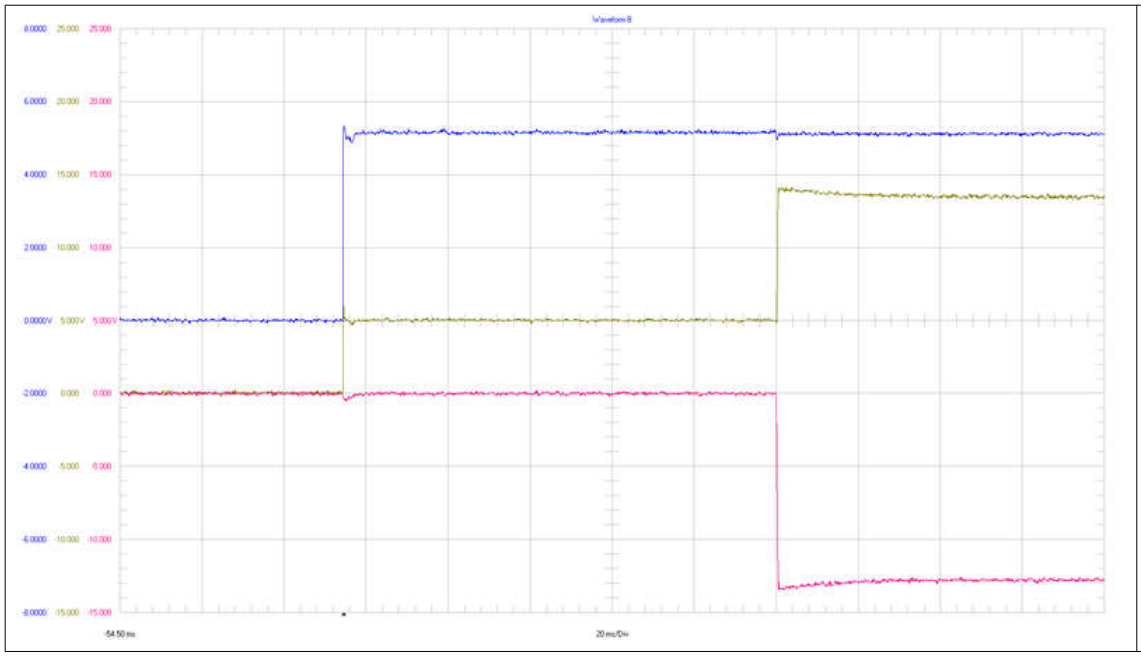


Figure 3-7. Transient

3.5 Start-Up Sequence



Input Voltage (blue)
2 V / div

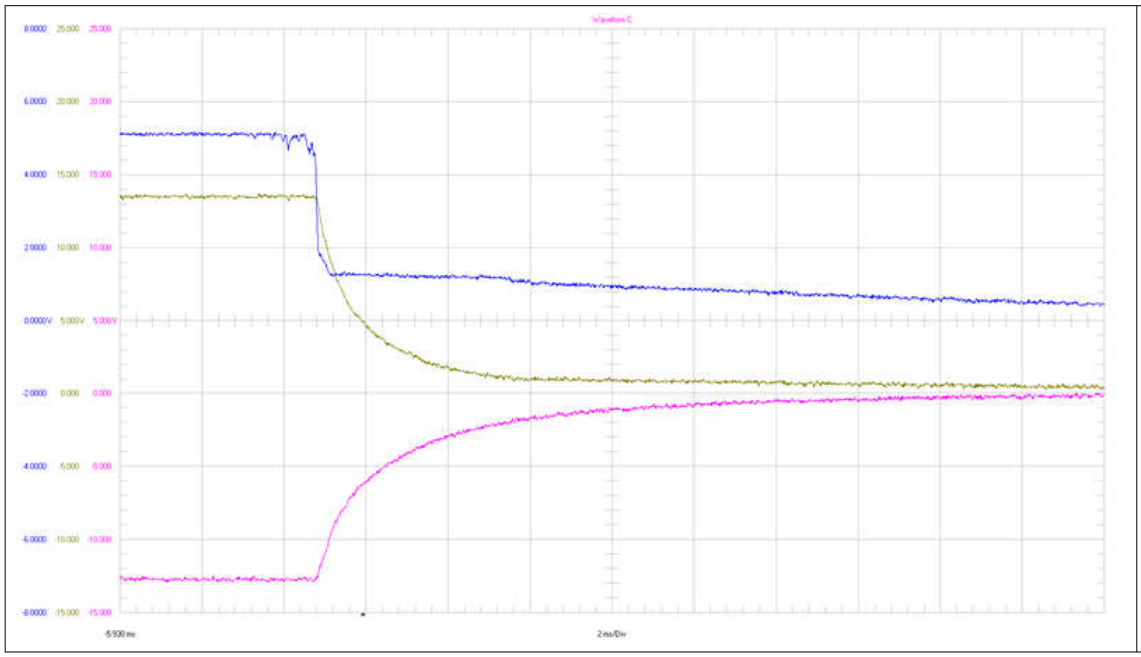
Output P_OUT
5 V / div

Output N_OUT
5 V /div

20 ms / div
20-MHz bandwidth

Figure 3-8. Start-Up Sequence

3.6 Shutdown Sequence



Input Voltage (blue)
2 V / div

Output P_OUT
5 V / div

Output N_OUT
5 V / div

2 ms / div
20-MHz bandwidth

Figure 3-9. Shutdown Sequence

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