Test Report: PMP30930

Reference Design With EMI-Optimized Buck Solutions

Description

This design consists of three separable boards optimized for low EMI. The three boards are labeled

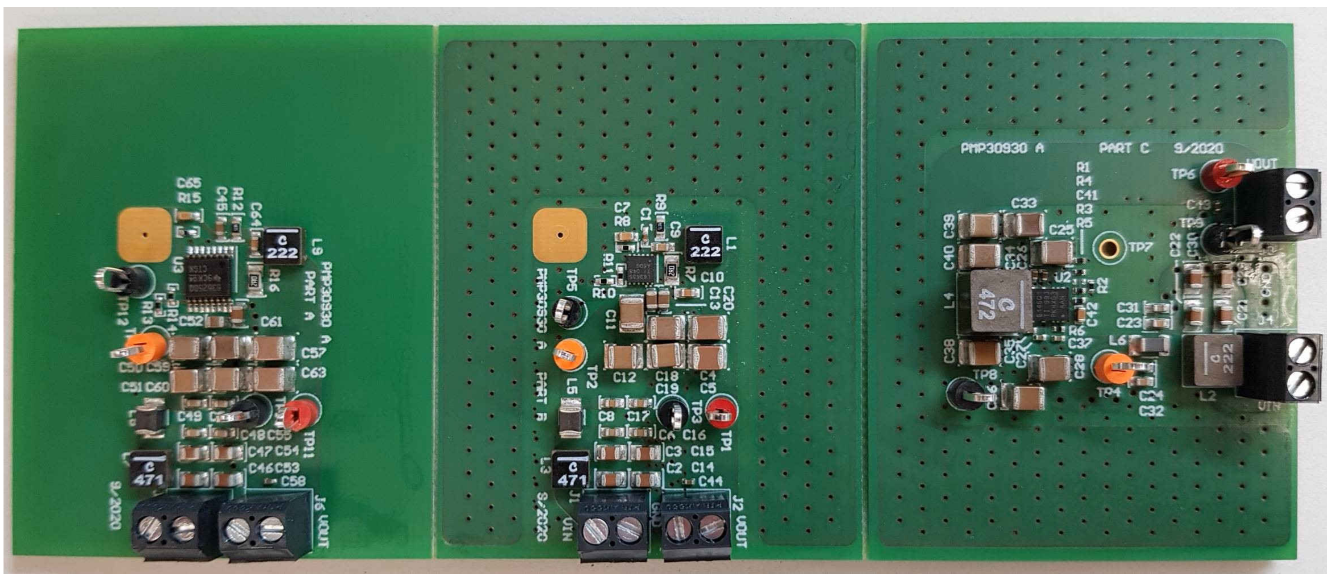
- PMP30930 Part A
  (using LM63635-Q1, PW package)
- PMP30930 Part B
  (using LM63635-Q1, DR package)
- PMP30930 Part C
  (Using LM61460-Q1)

Features

- Two and four layer designs for cost and performance optimization

Applications

- Automotive buck regulators



Two-Layer PCB for Part A, Four Layers for Parts B and C
Standard FR4, 1.6-mm Thickness, 35-µm Copper

1 Test Prerequisites

DNP capacitors C43, C44, and C58 are populated on the tested boards.

Conducted EMI measurements were taken with an input voltage of 13 V and a resistive load of 2R for all converters.

Part C was tested with 400-kHz and 2.1-MHz switching frequency.

2 Voltage and Current Requirements

Table 2-1. Voltage and Current Requirements

Parameter	Specifications
V_{IN} – Part A	7.5 V to 18 V, 32-V surge
V_{IN} – Part B	7.5 V to 18 V, 32-V surge
V_{IN} – Part C	6 V to 16 V, 36-V surge
V_{OUT} – Part A	6.1 V at 2.2 A continuous, 3-A peak
V_{OUT} – Part B	6.1 V at 2.2 A continuous, 3-A peak
V_{OUT} – Part C	5 V at 4 A continuous, 6-A peak

3 Thermal Images

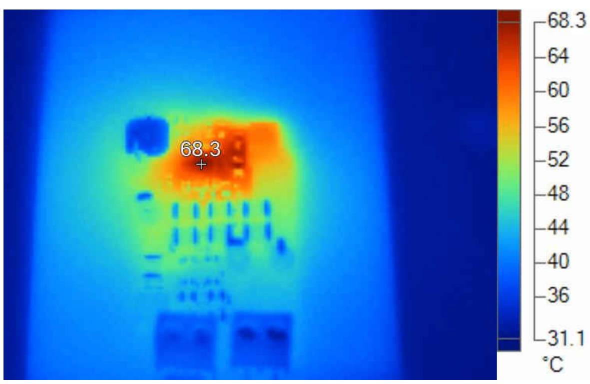


Figure 3-1. Part A – V_{IN} 12 V, I_{OUT} 2.2 A

Figure 3-2. Part B – V_{IN} 12 V, I_{OUT} 2.2 A

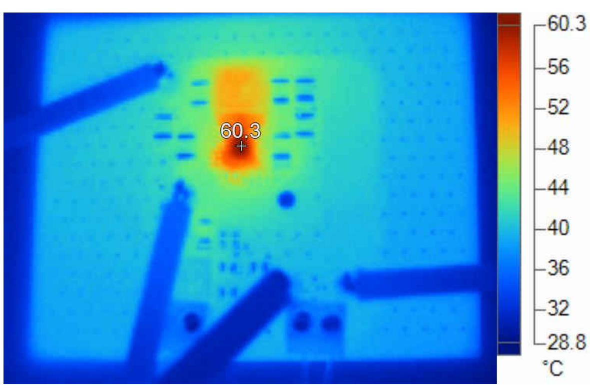


Figure 3-3. Part C – V_{IN} 12 V, I_{OUT} 4 A, 400 kHz

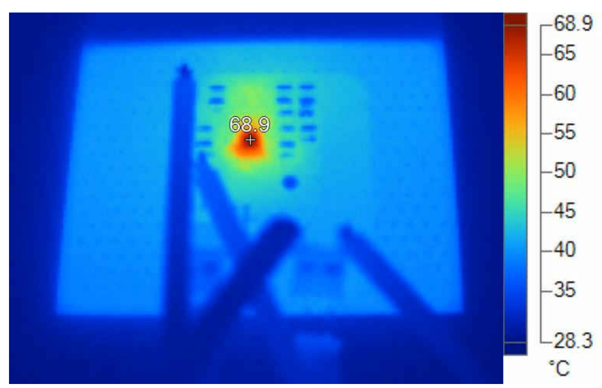


Figure 3-4. Part C – V_{IN} 12 V, I_{OUT} 3.65 A, 2.1 MHz

4 Efficiency Graphs

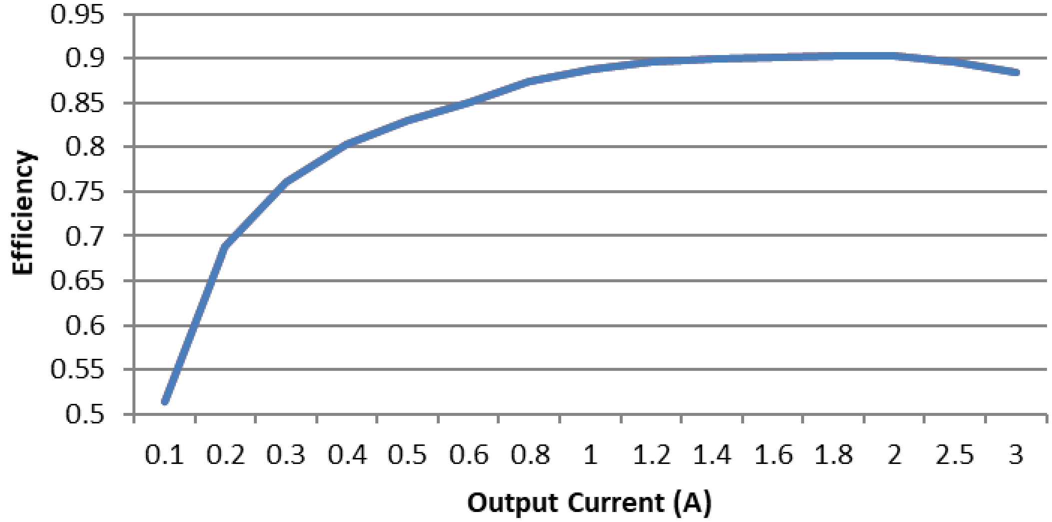


Figure 4-1. Part A – V_{IN} 12 V

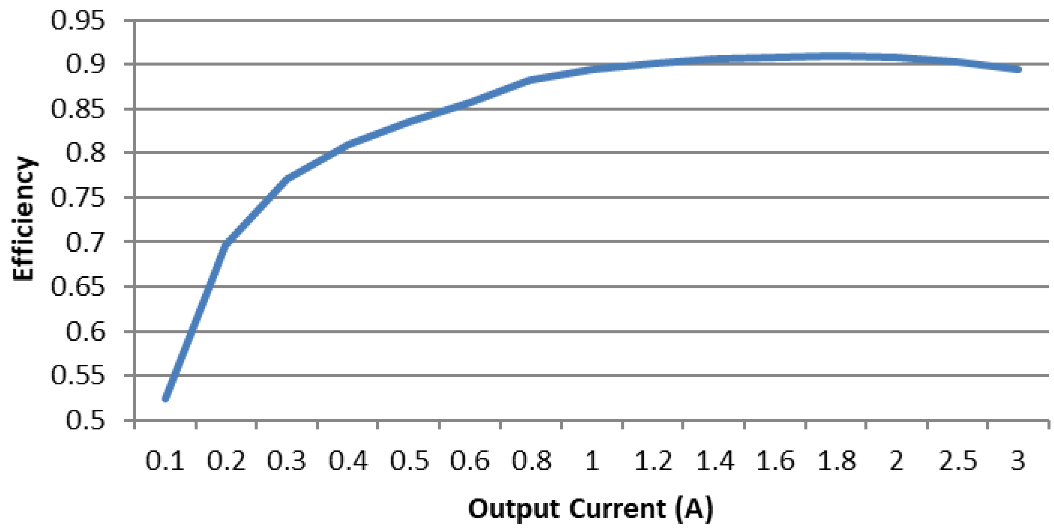


Figure 4-2. Part B – V_{IN} 12 V

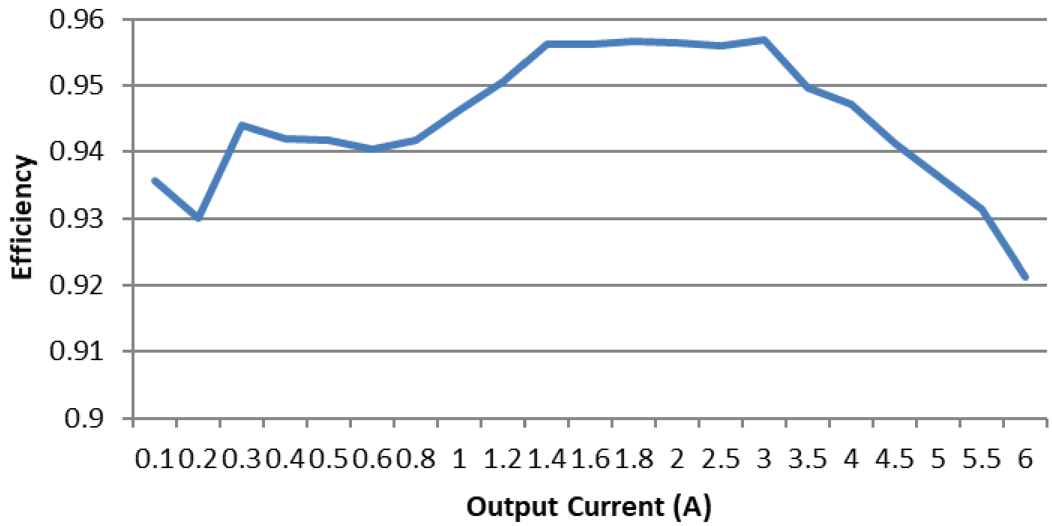


Figure 4-3. Part C – V_{IN} 12 V, 400 kHz

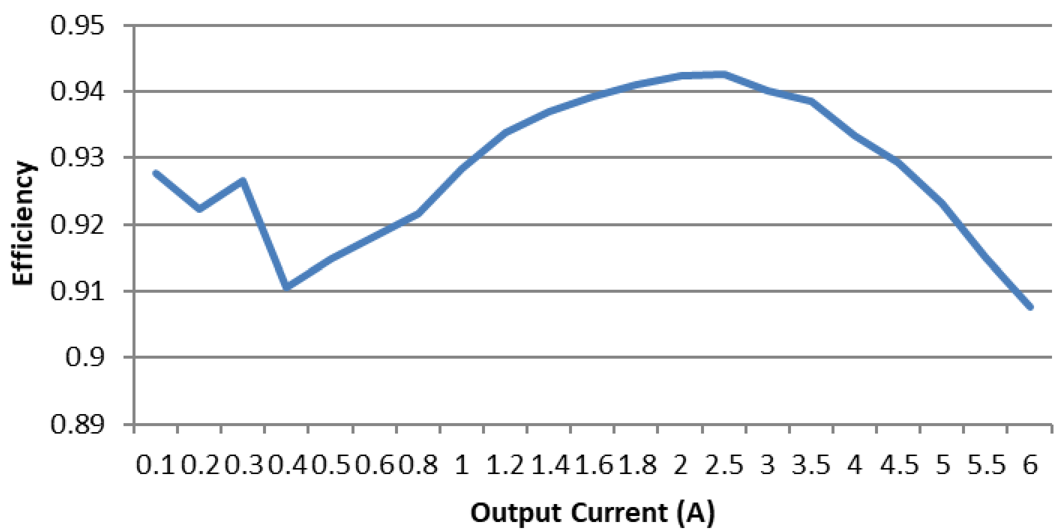


Figure 4-4. Part C – V_{IN} 12 V, 2.1 MHz

5 Conducted Emissions

Figure 5-1 and Figure 5-2 show the test setup with 13-V input voltage. All tests were performed with 2R load resistance.

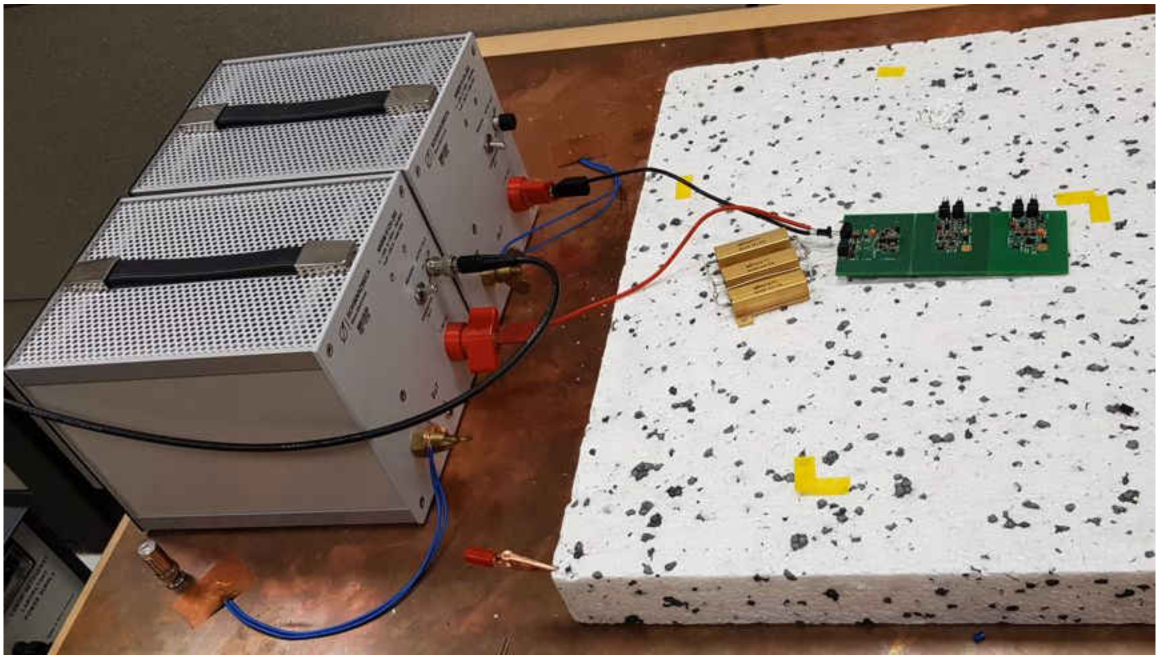


Figure 5-1. Test Setup

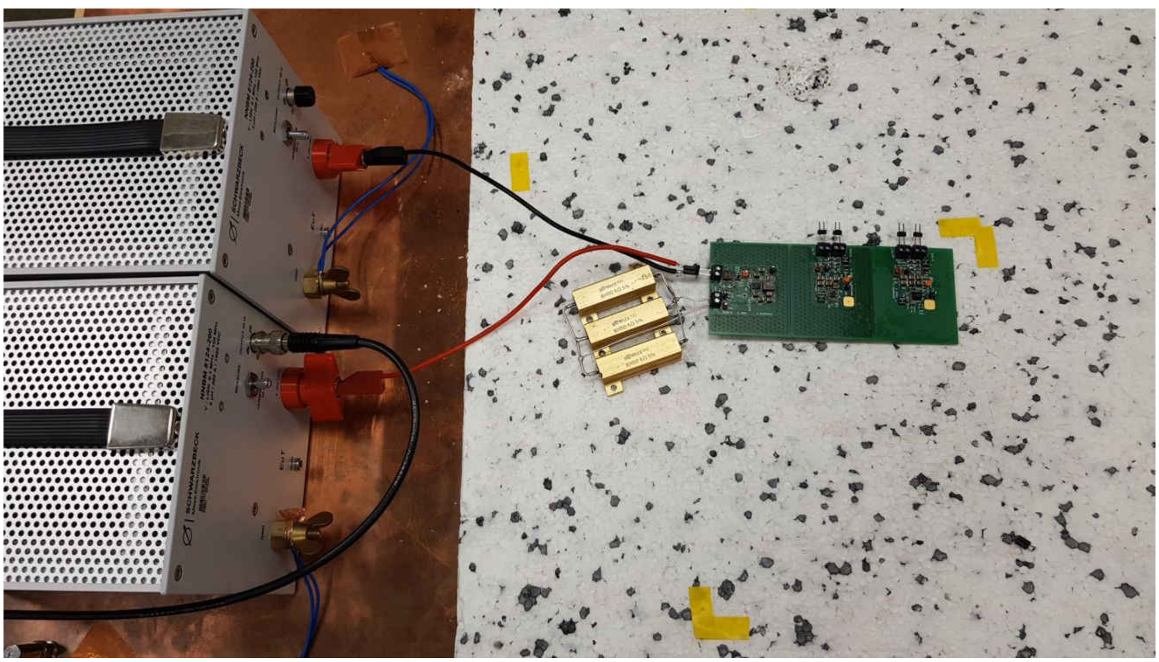


Figure 5-2. Test Setup - Top View

5.1 Conducted Emissions – Test Results

Figure 5-3 and Figure 5-4 illustrate the low- and high-frequency range scopes for part A.

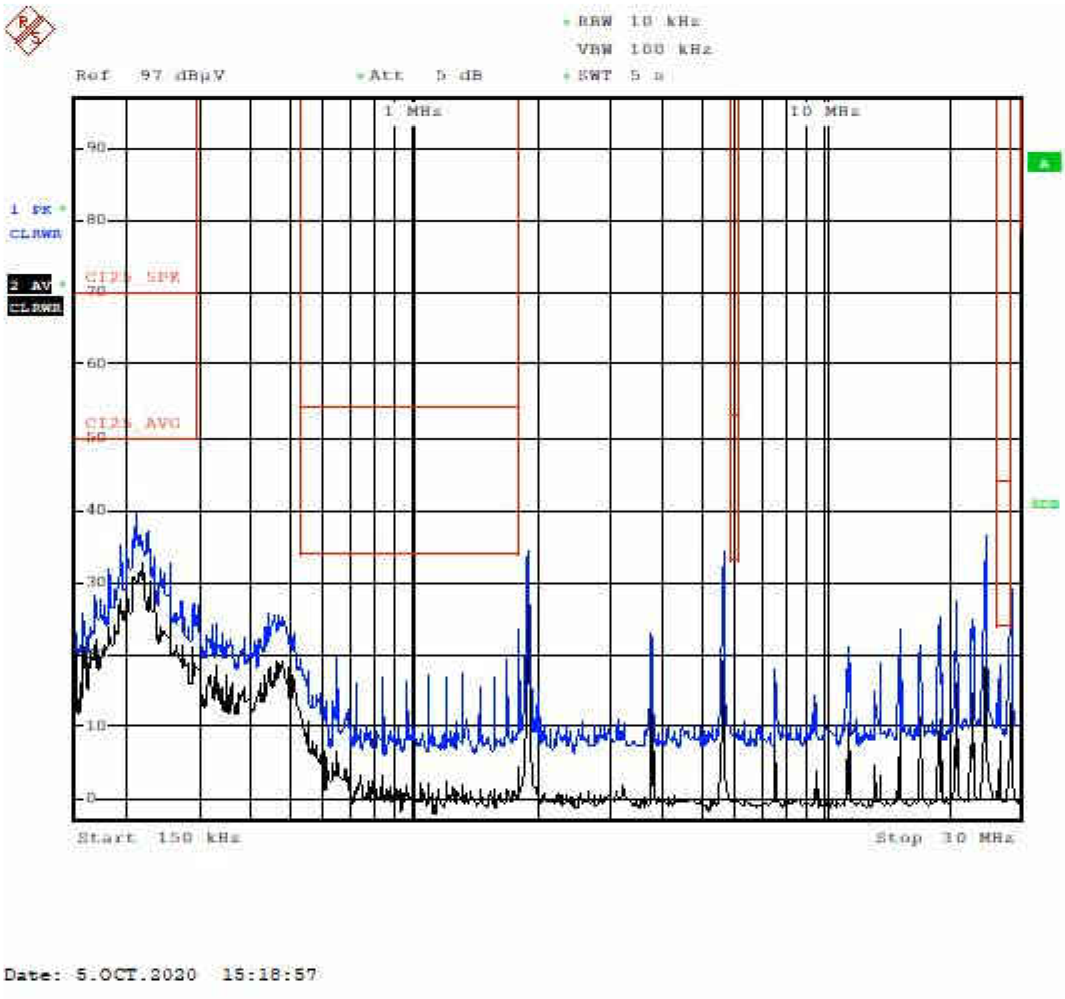


Figure 5-3. Part A – Low-Frequency Range

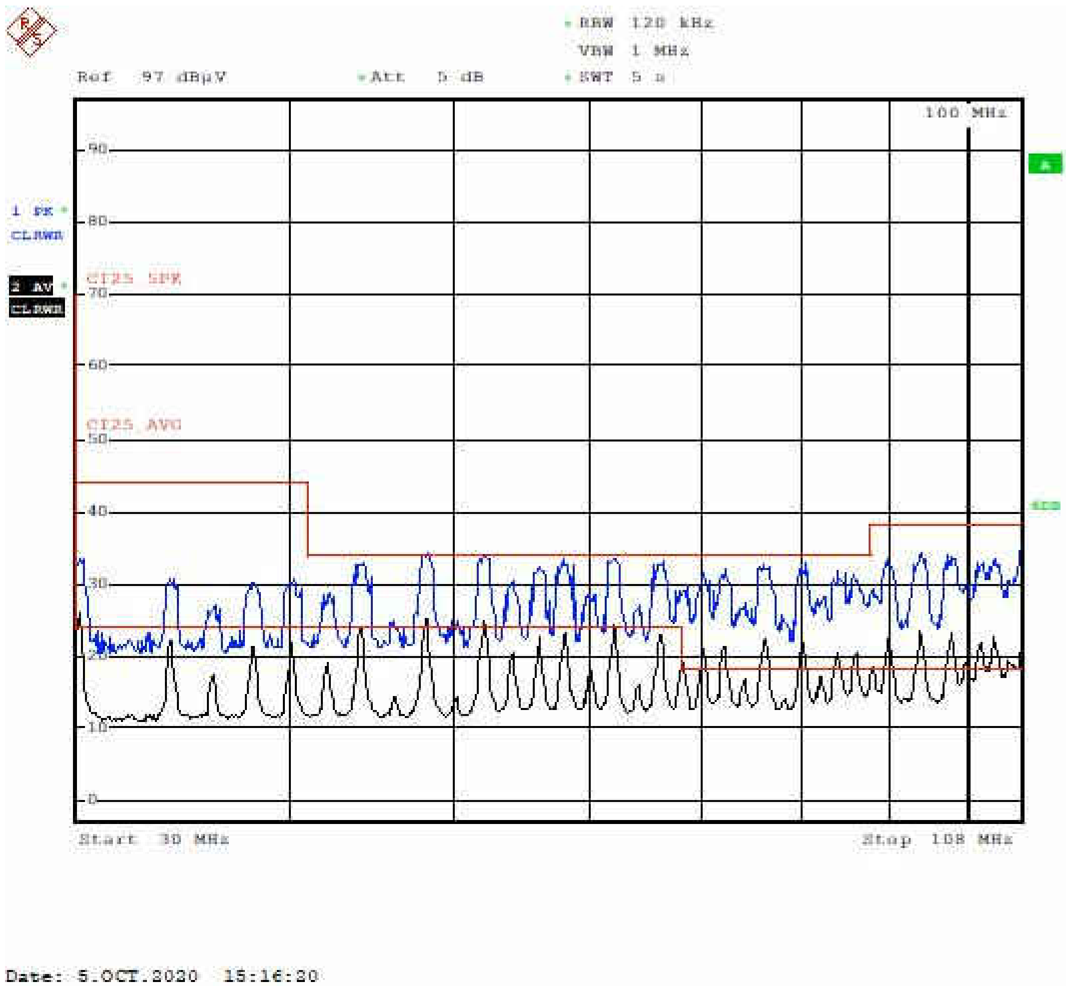


Figure 5-4. Part A – High-Frequency Range

Figure 5-5 and Figure 5-6 illustrate the low- and high-frequency range scopes for part B.

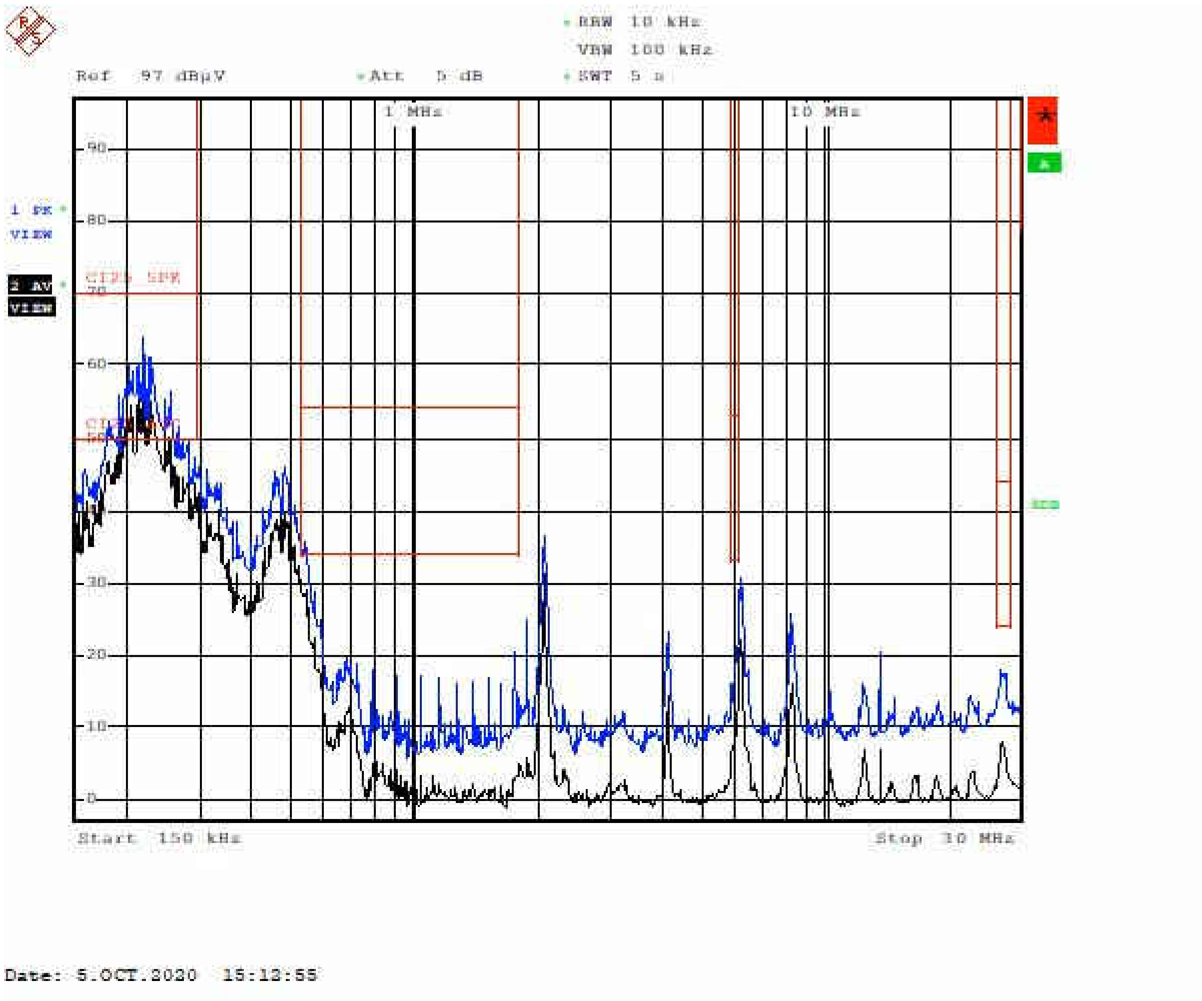


Figure 5-5. Part B – Low-Frequency Range

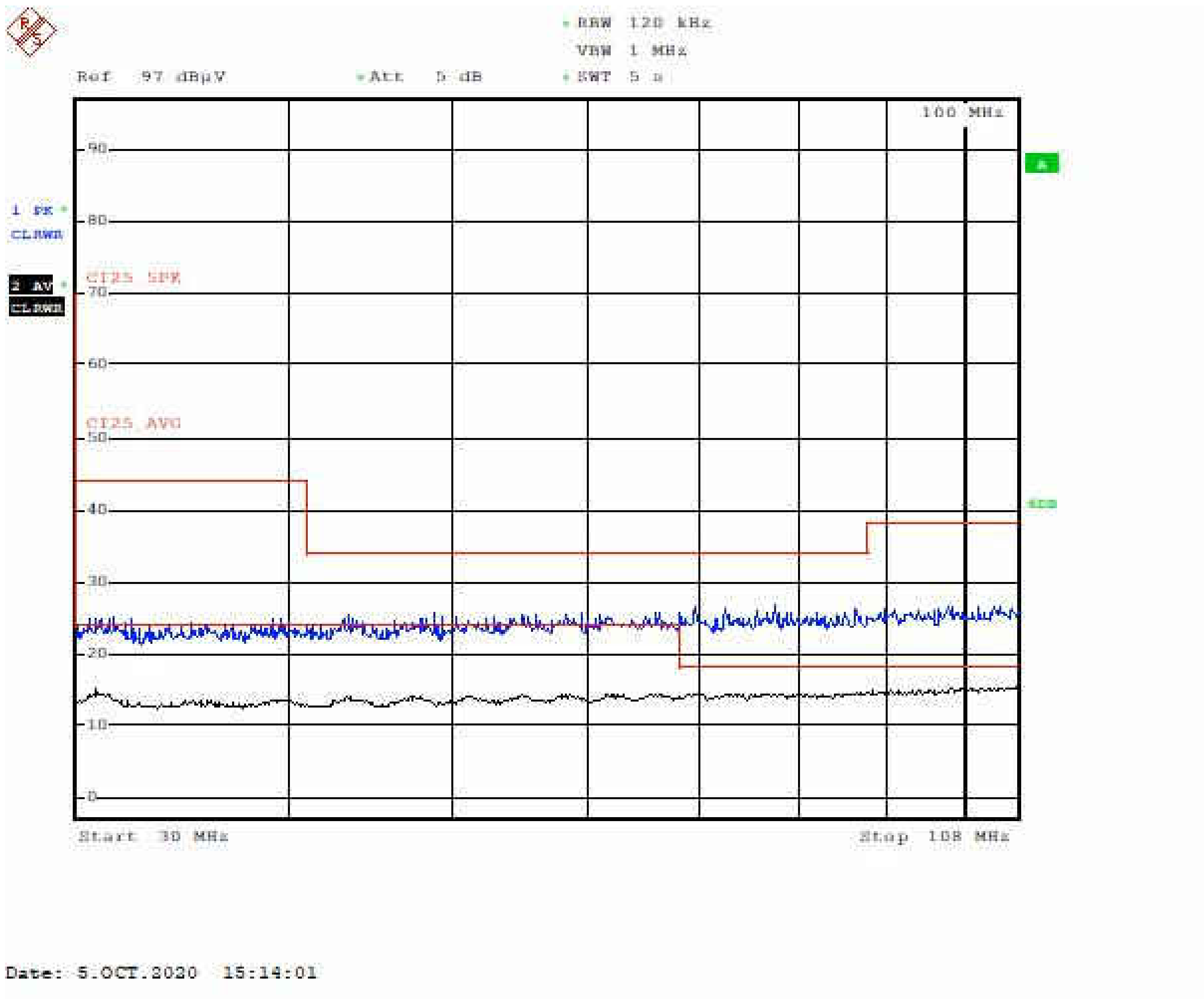


Figure 5-6. Part B – High-Frequency Range

Figure 5-7 through Figure 5-10 illustrate the low- and high-frequency range scopes for part C.

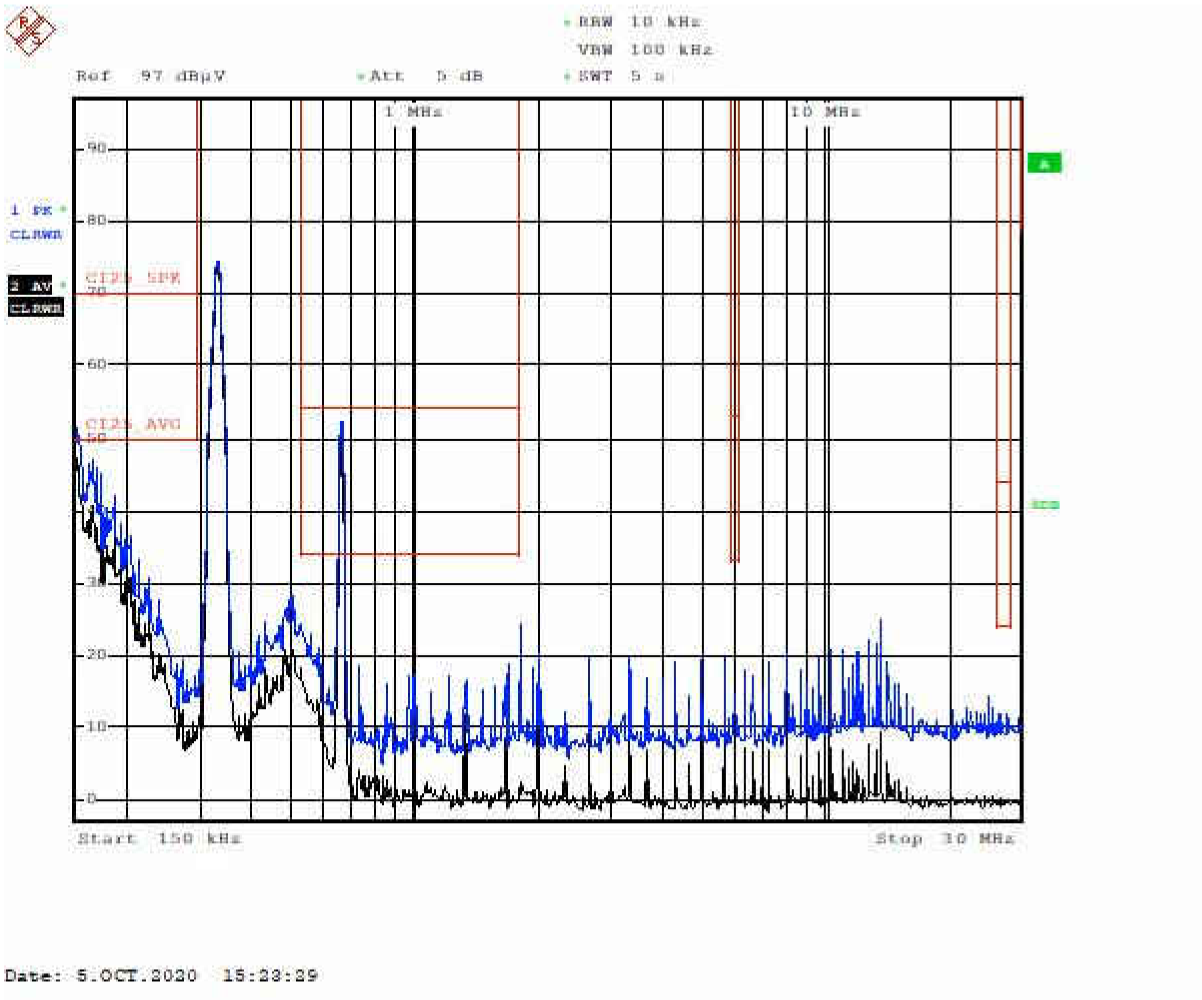


Figure 5-7. Part C – Low-Frequency Range, 400 kHz

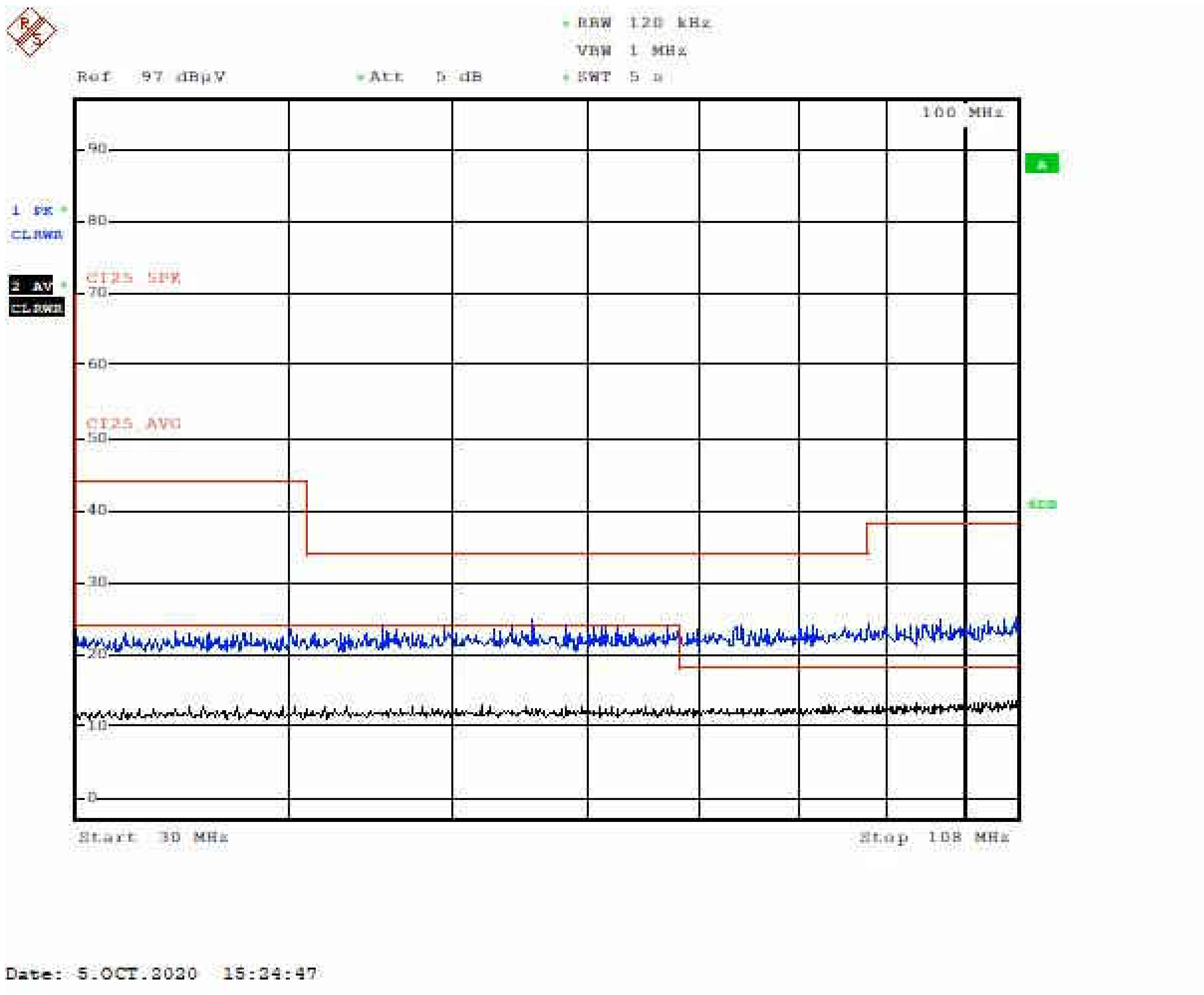


Figure 5-8. Part C – Low-Frequency Range, 400 kHz

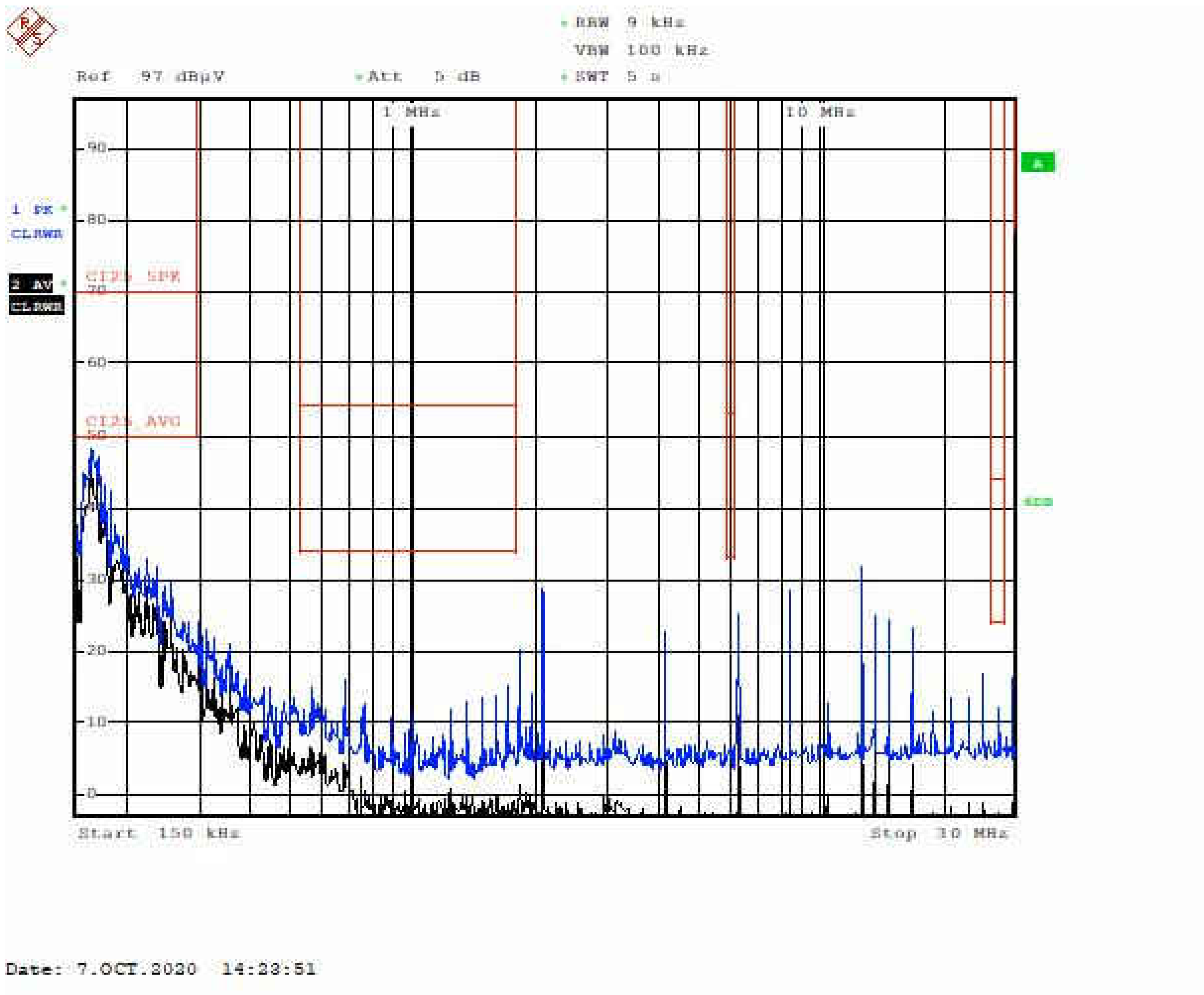


Figure 5-9. Part C – Low-Frequency Range, 400 kHz

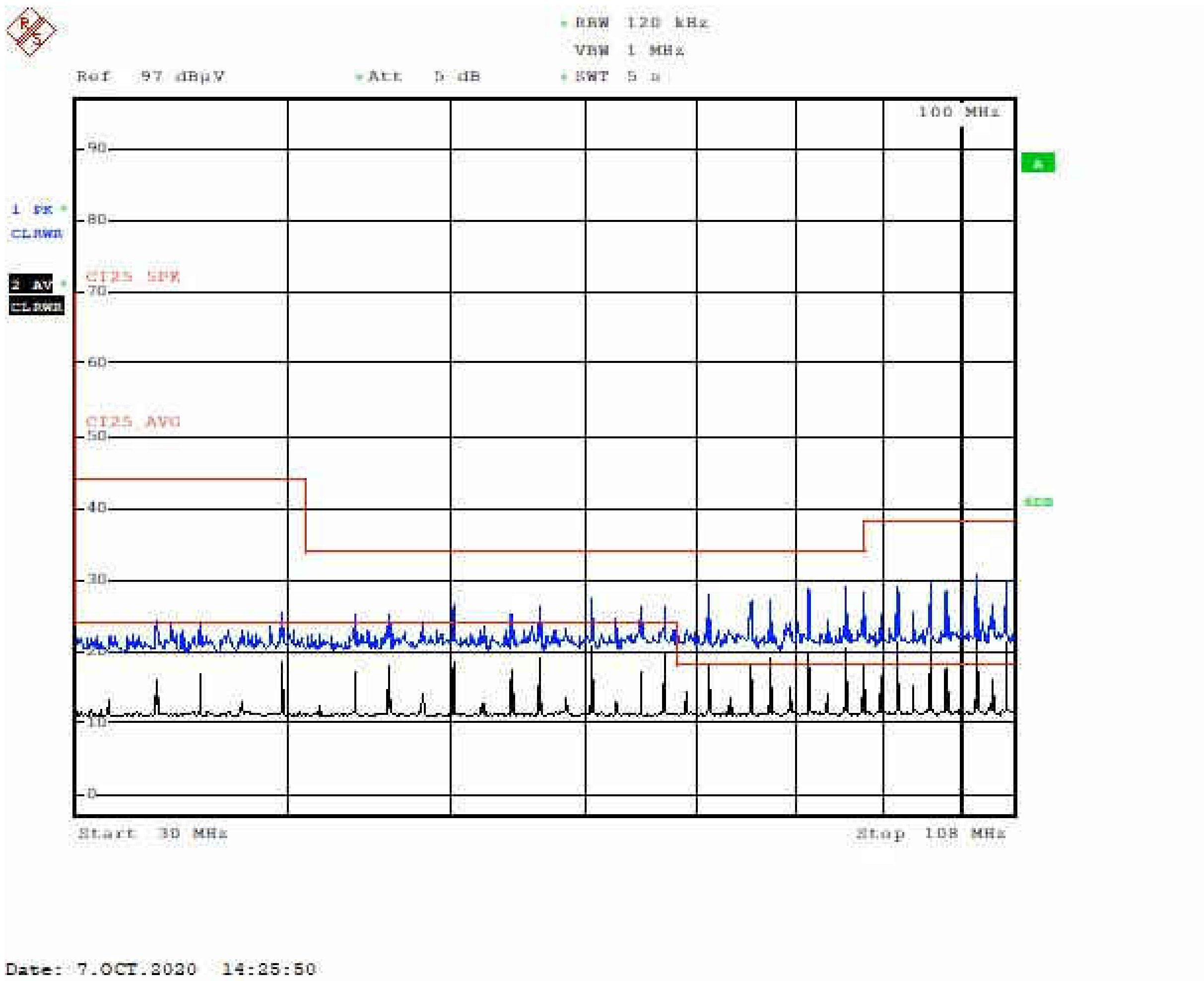


Figure 5-10. Part C – High-Frequency Range, 2.1 MHz

6 Switching

The waveforms in Figure 6-1 through Figure 6-4 were tested with 12-V input voltage.

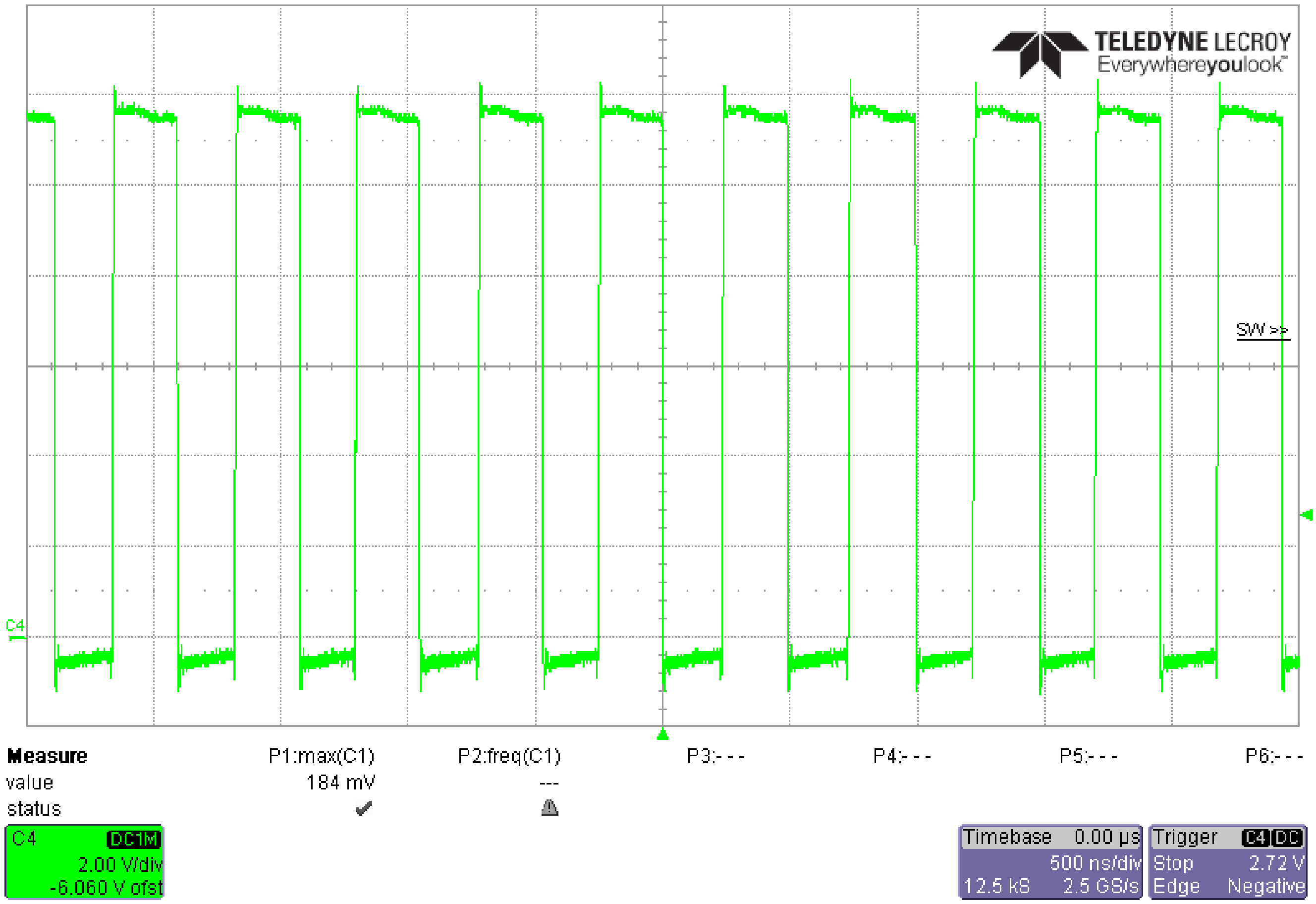


Figure 6-1. Part A – 3-A Load Current, 2.1 MHz

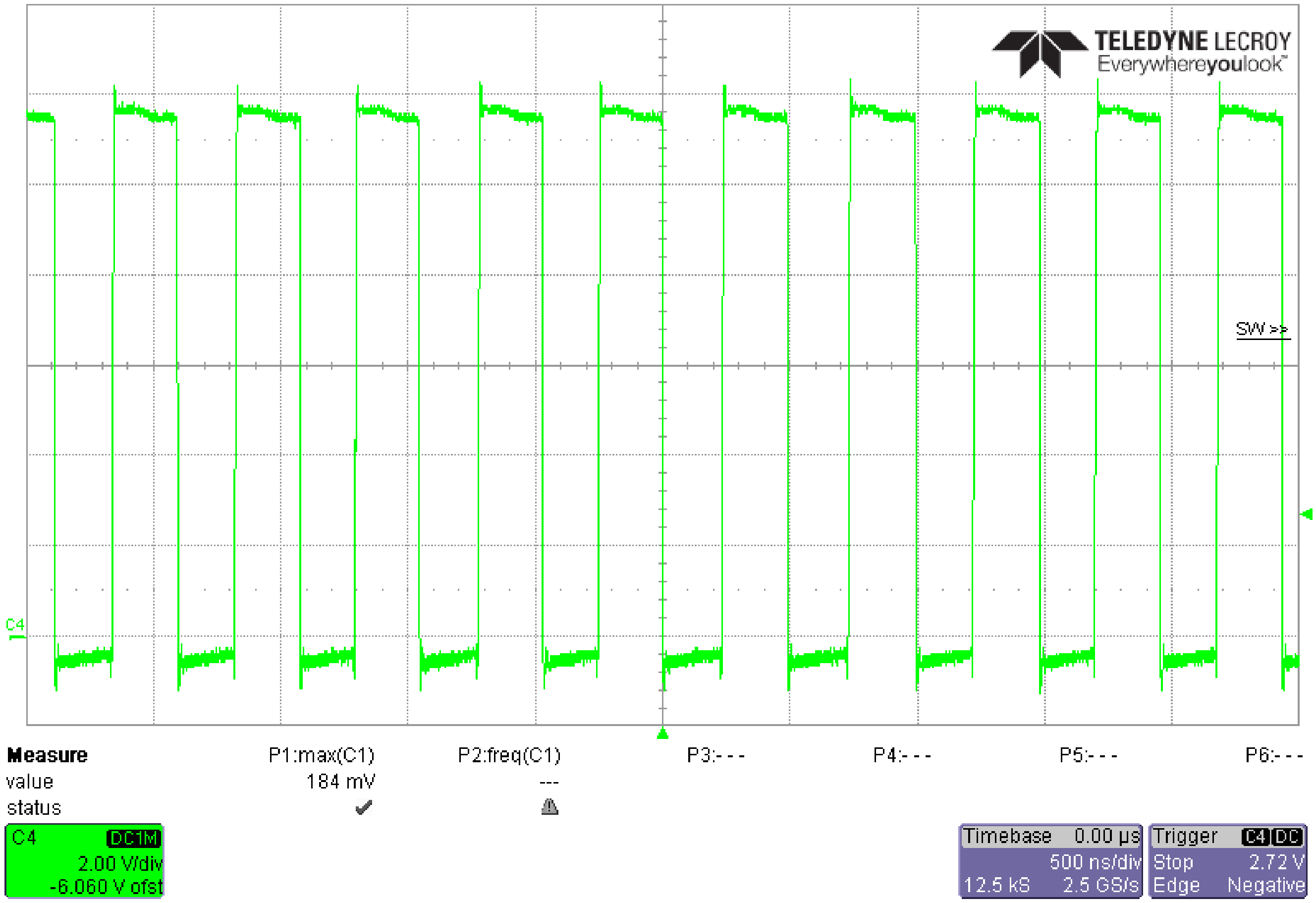


Figure 6-2. Part B – 3-A Load Current, 2.1 MHz

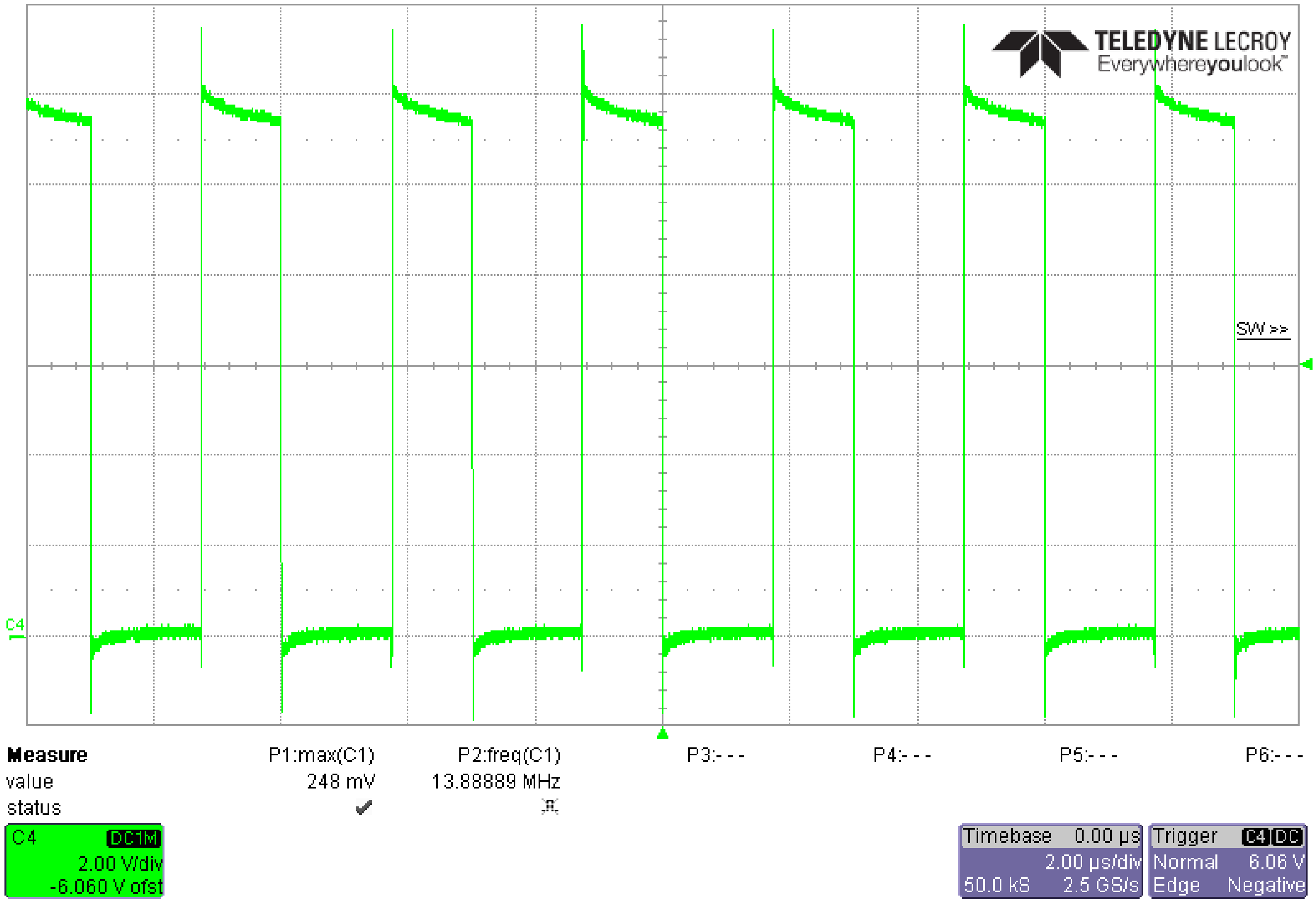


Figure 6-3. Part C – 6-A Load Current, 400 kHz

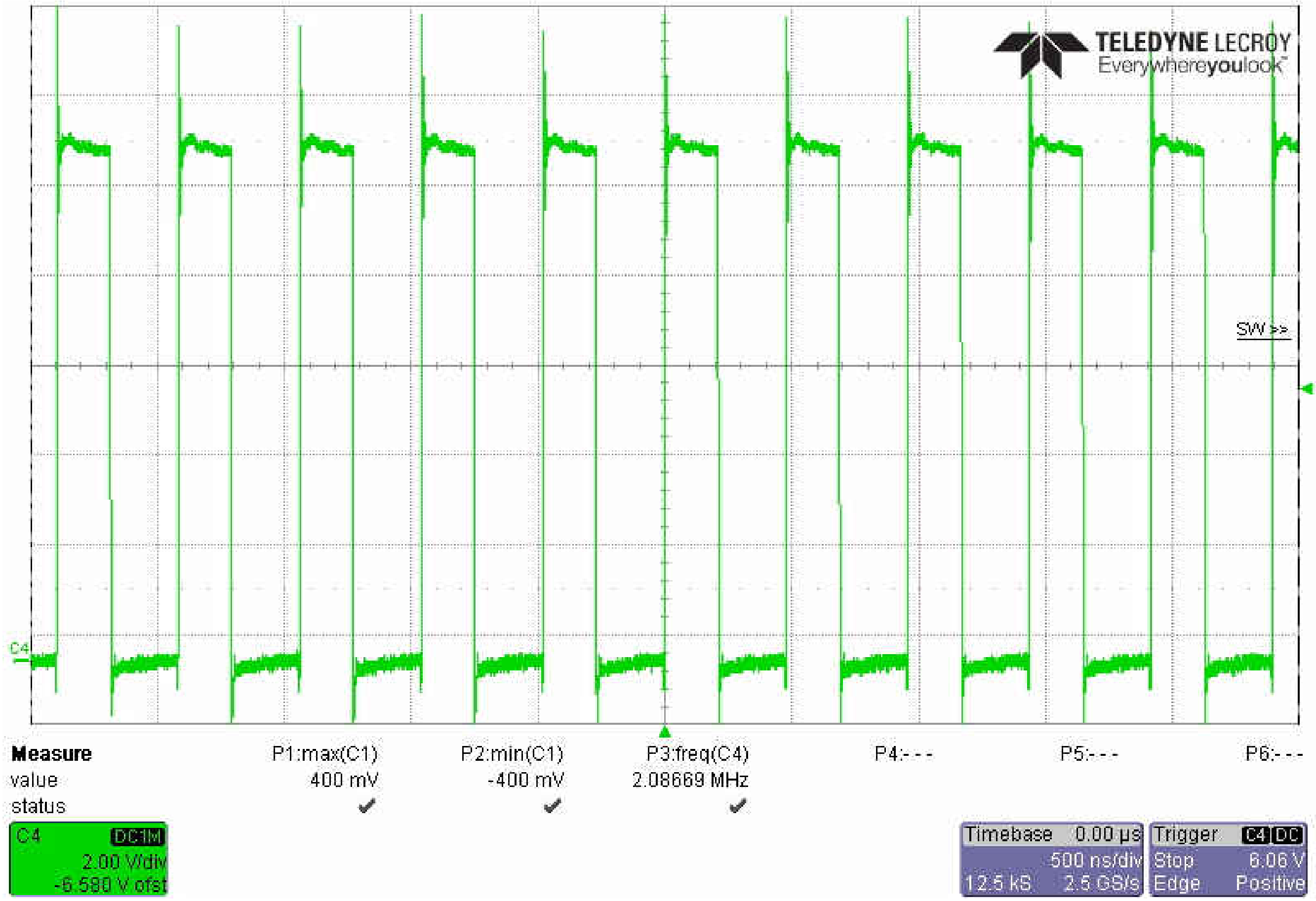


Figure 6-4. Part C – 6-A Load Current, 2.1 MHz

7 Load Transients

Figure 7-1 through Figure 7-5 show the scope trace images at load step, 10% to 90% to 10% of maximum output current.

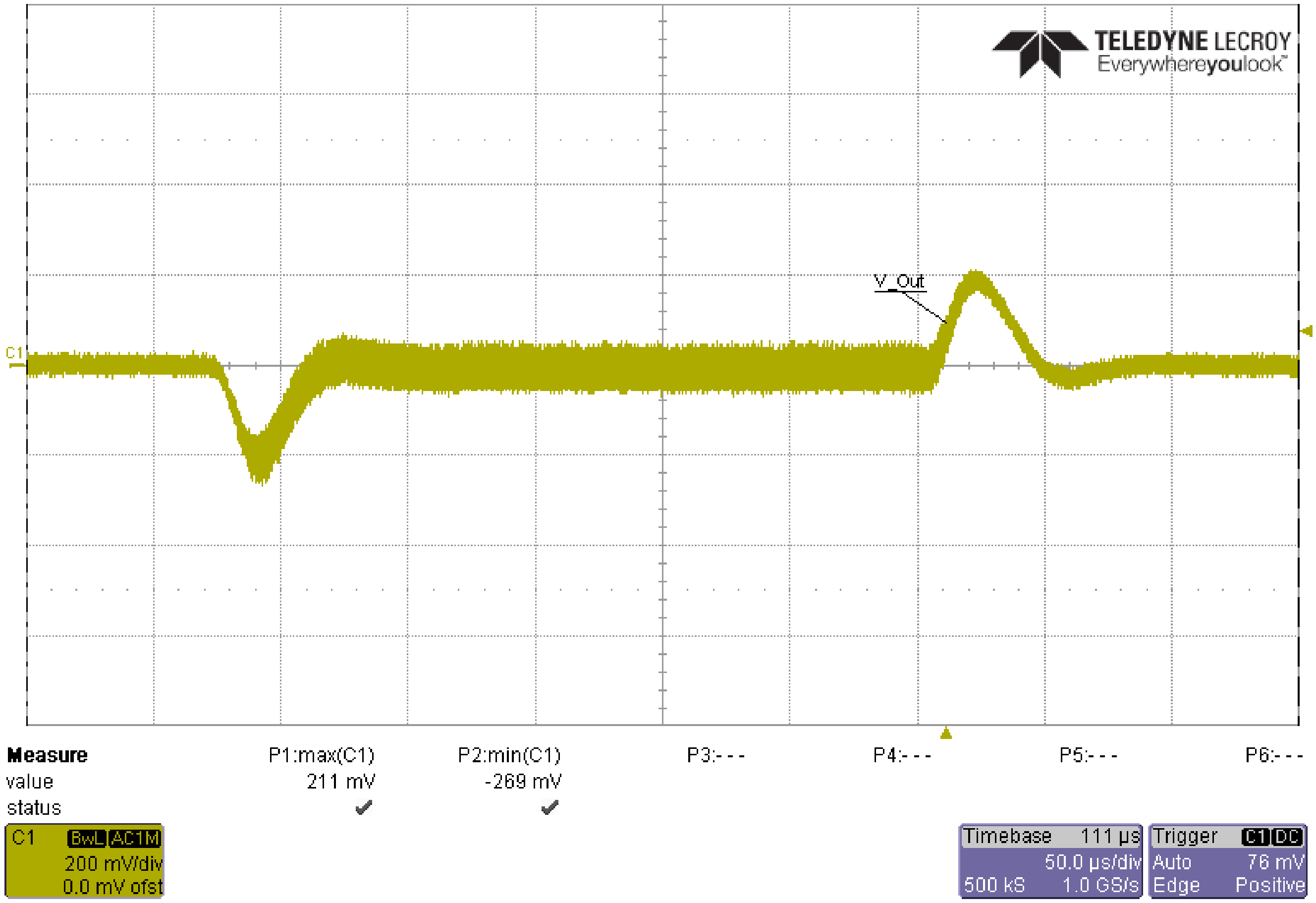


Figure 7-1. Part A – 2.1 MHz

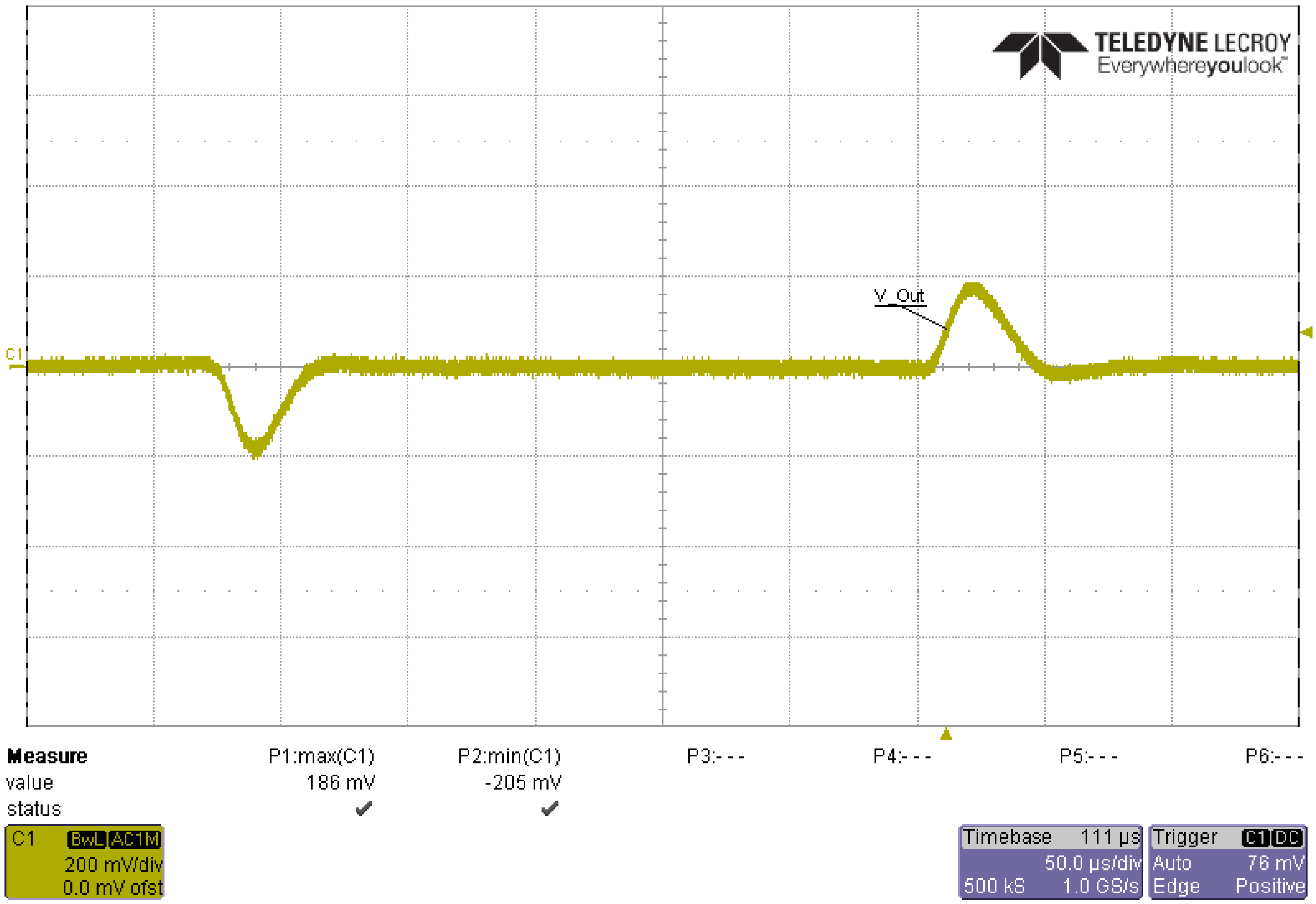


Figure 7-2. Part B – 2.1 MHz

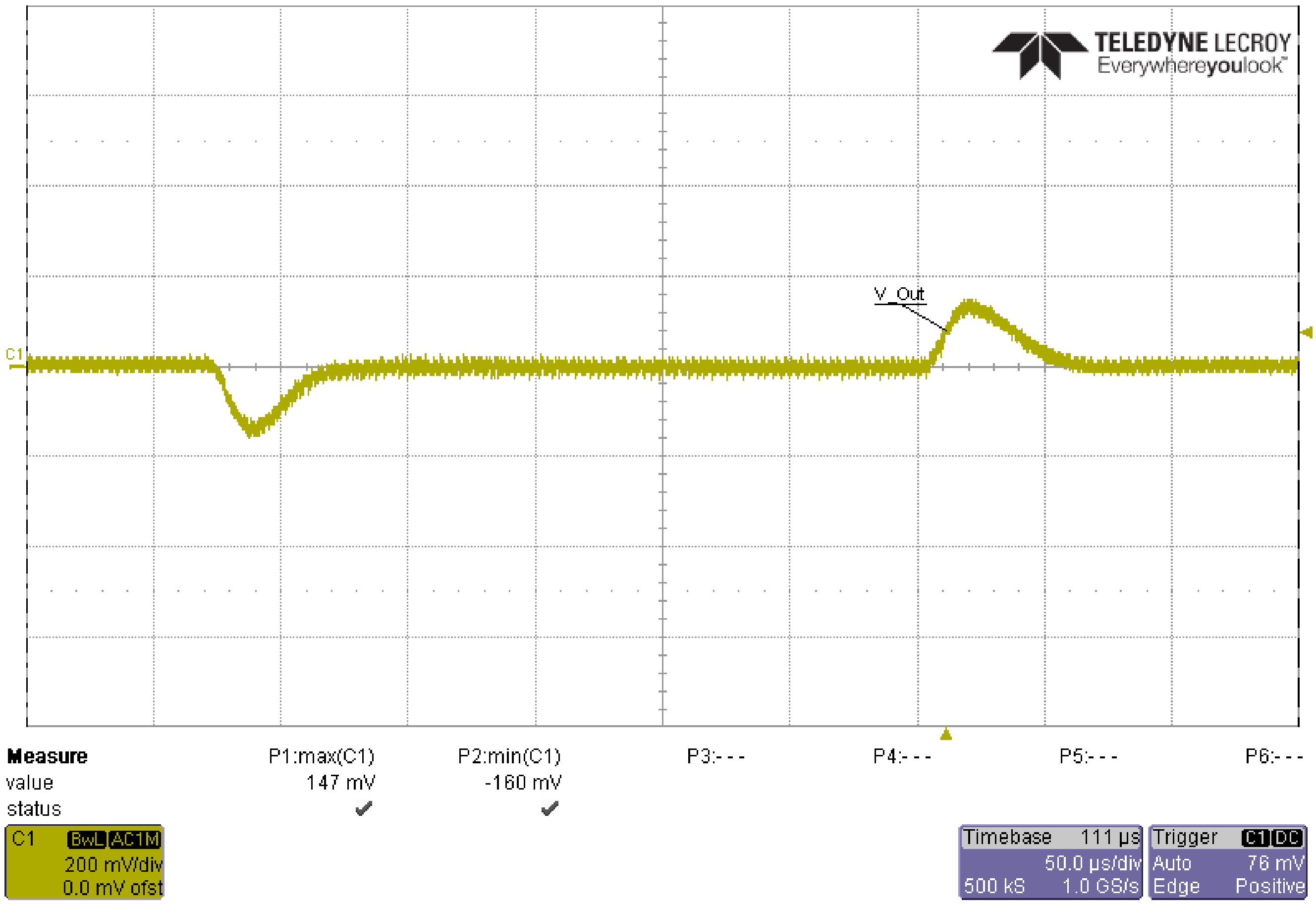


Figure 7-3. Part C – 400 kHz

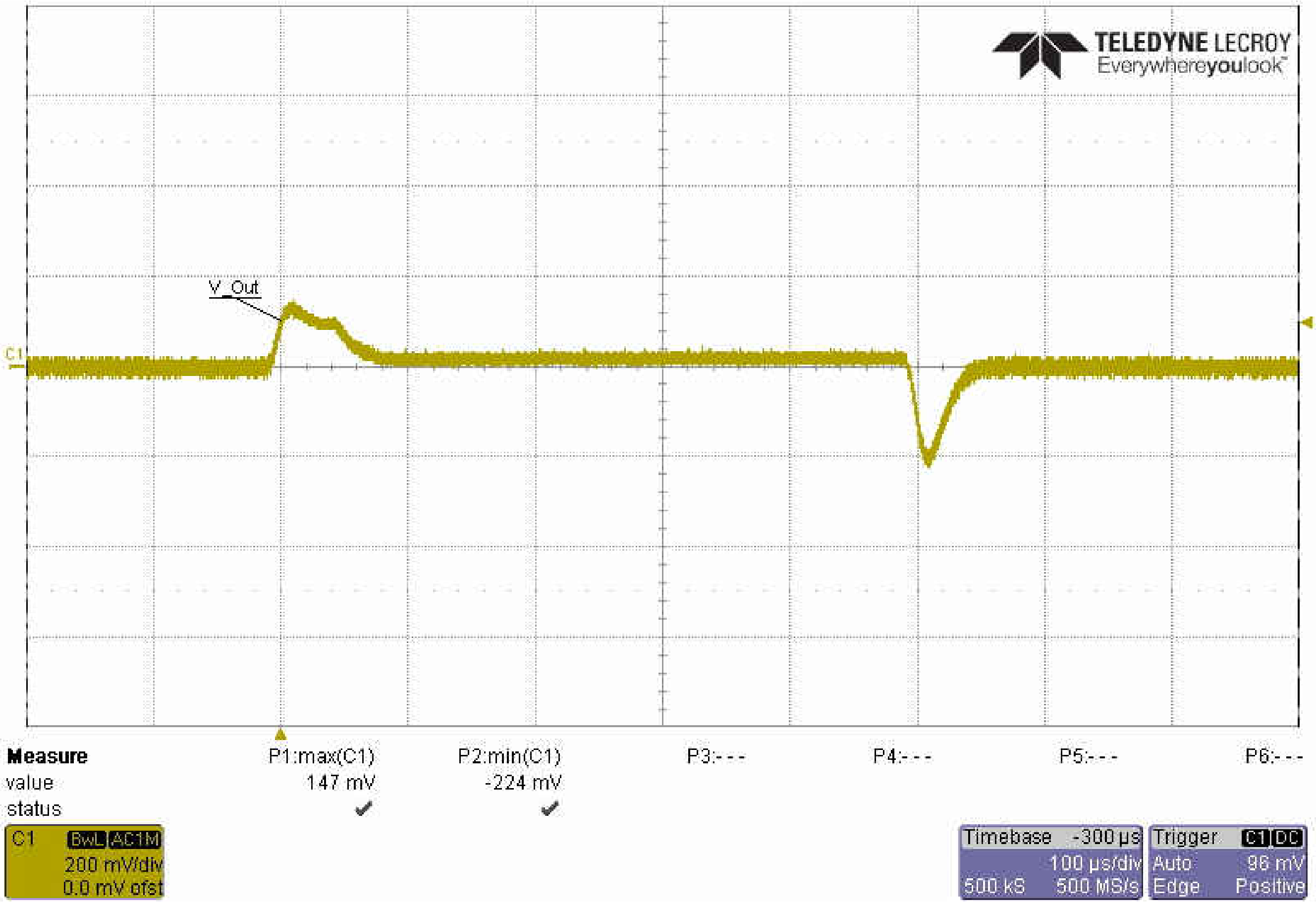


Figure 7-4. Part C – 2.1 MHz

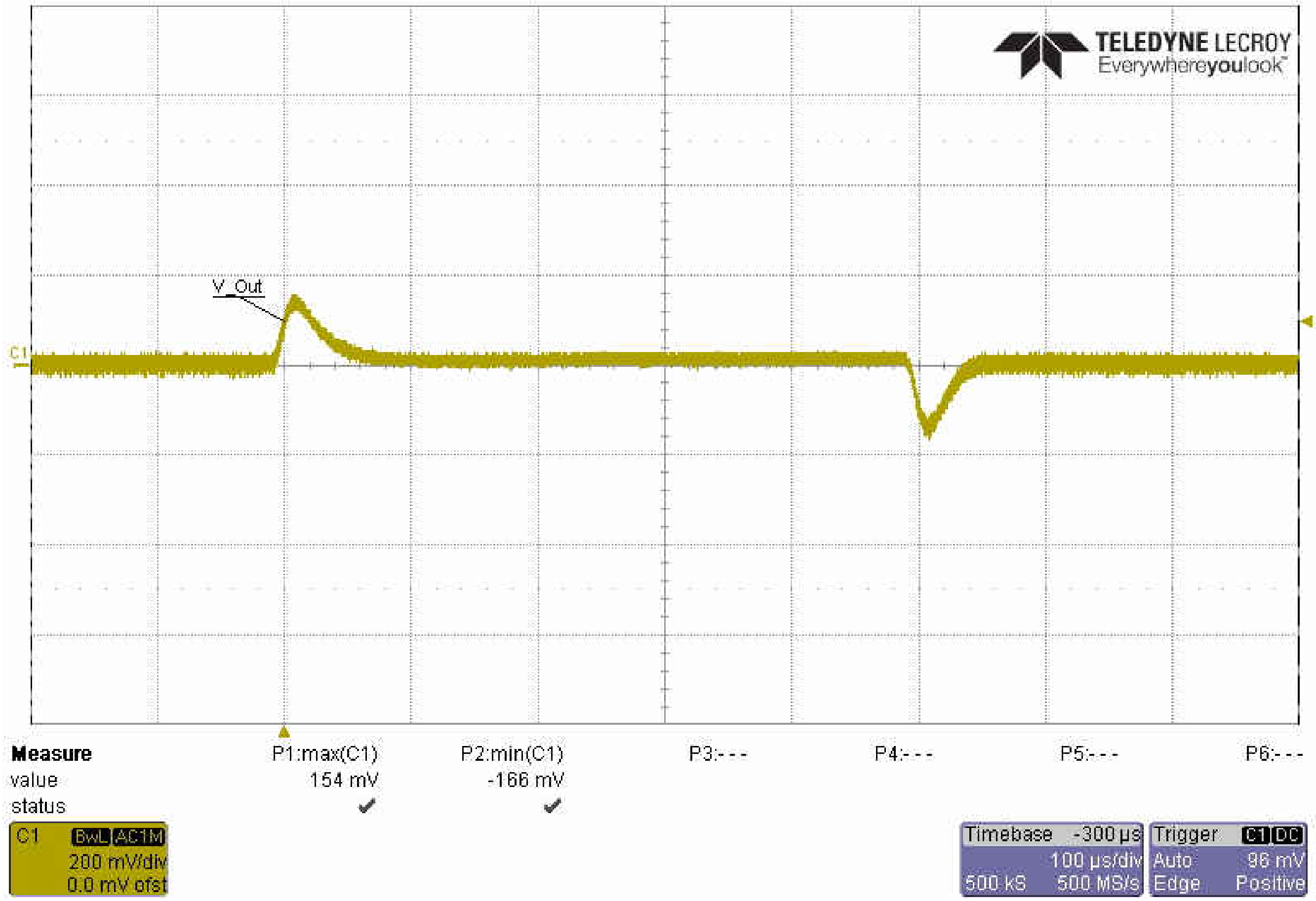


Figure 7-5. Part C – 2.1 MHz, 1 A to 6 A to 1 A

8 Start-up Sequence

Figure 8-1 through Figure 8-4 illustrate the start-up waveforms at no load.

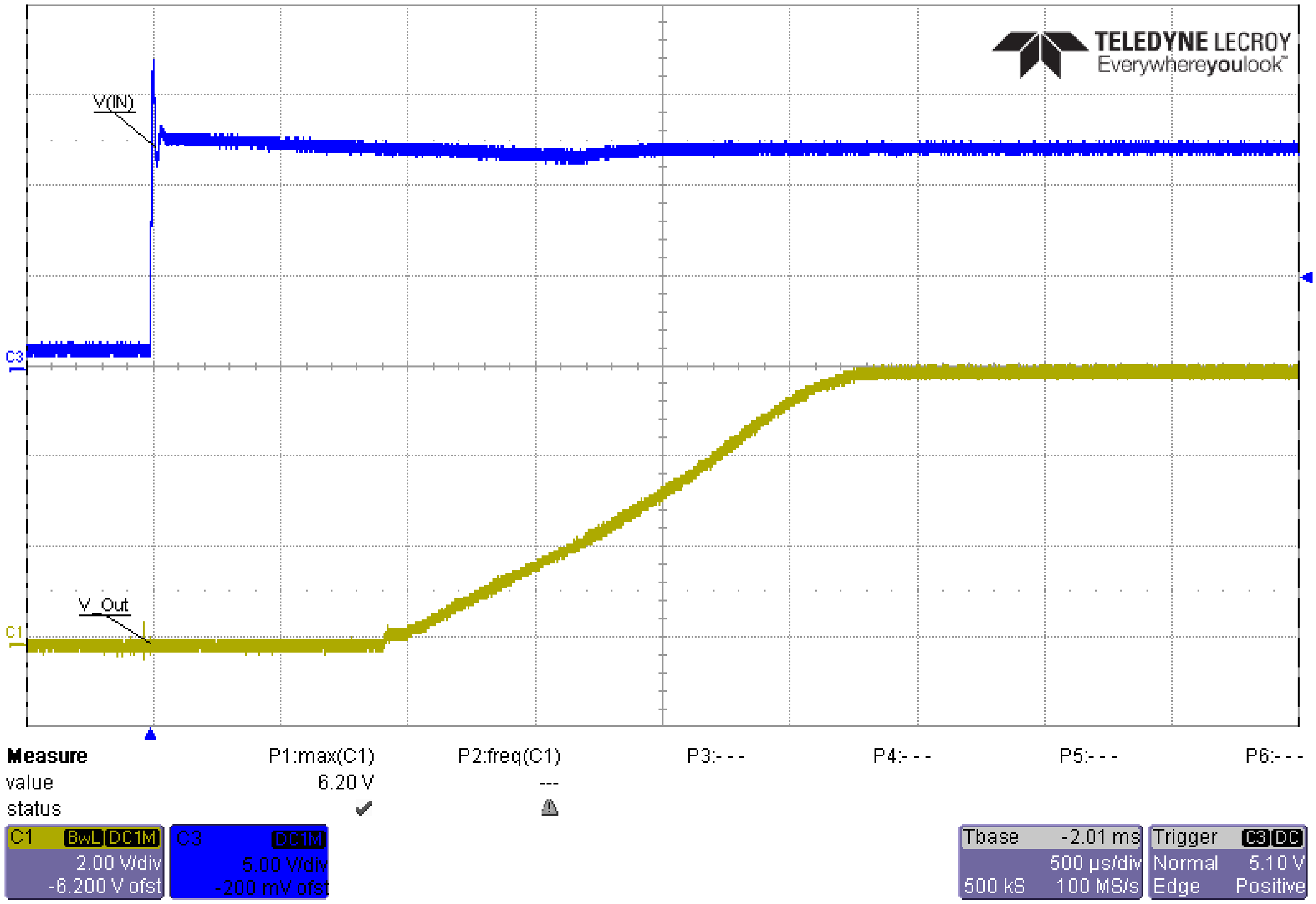


Figure 8-1. Part A – 2.1 MHz

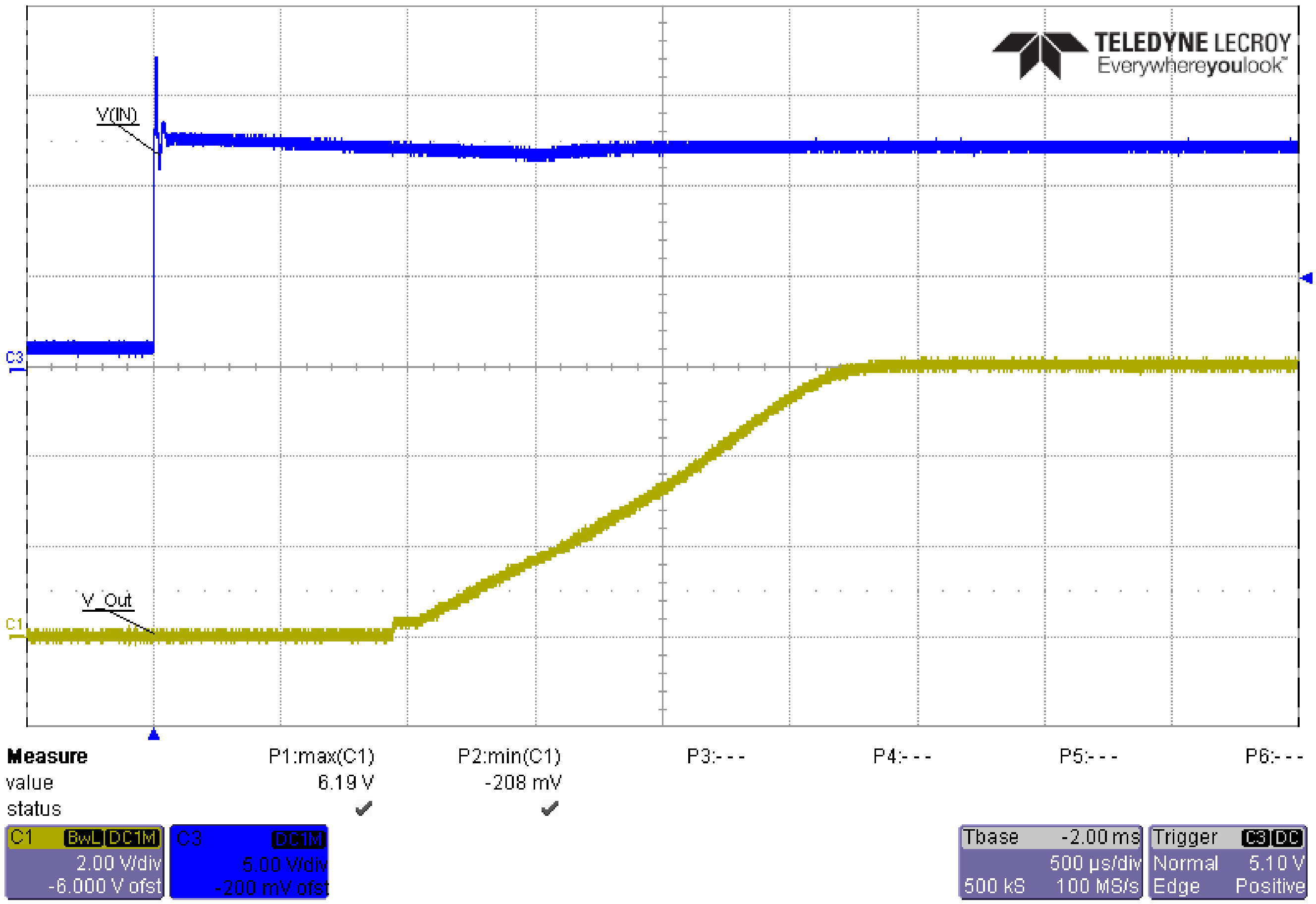


Figure 8-2. Part B – 2.1 MHz

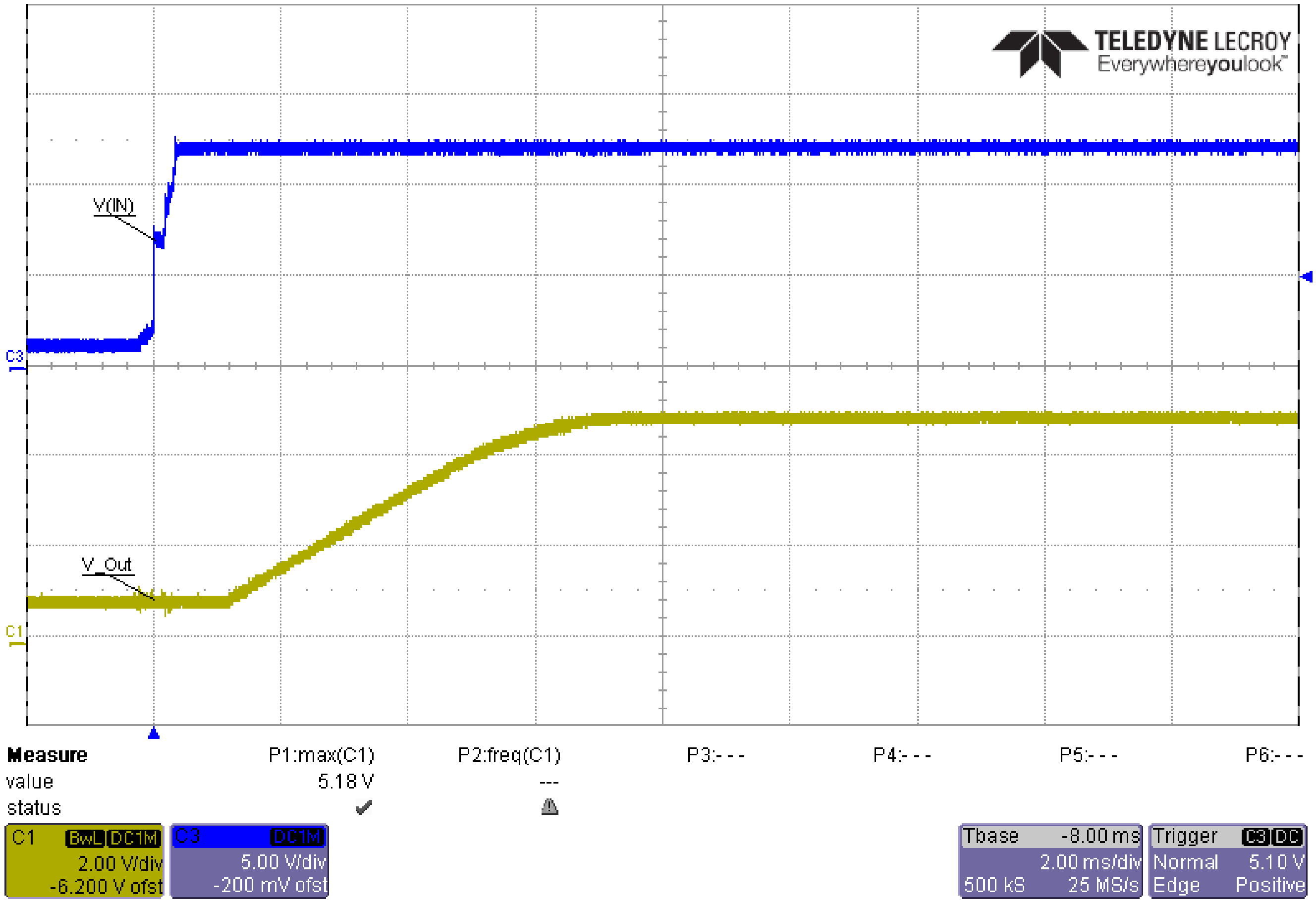


Figure 8-3. Part B – 2.1 MHz

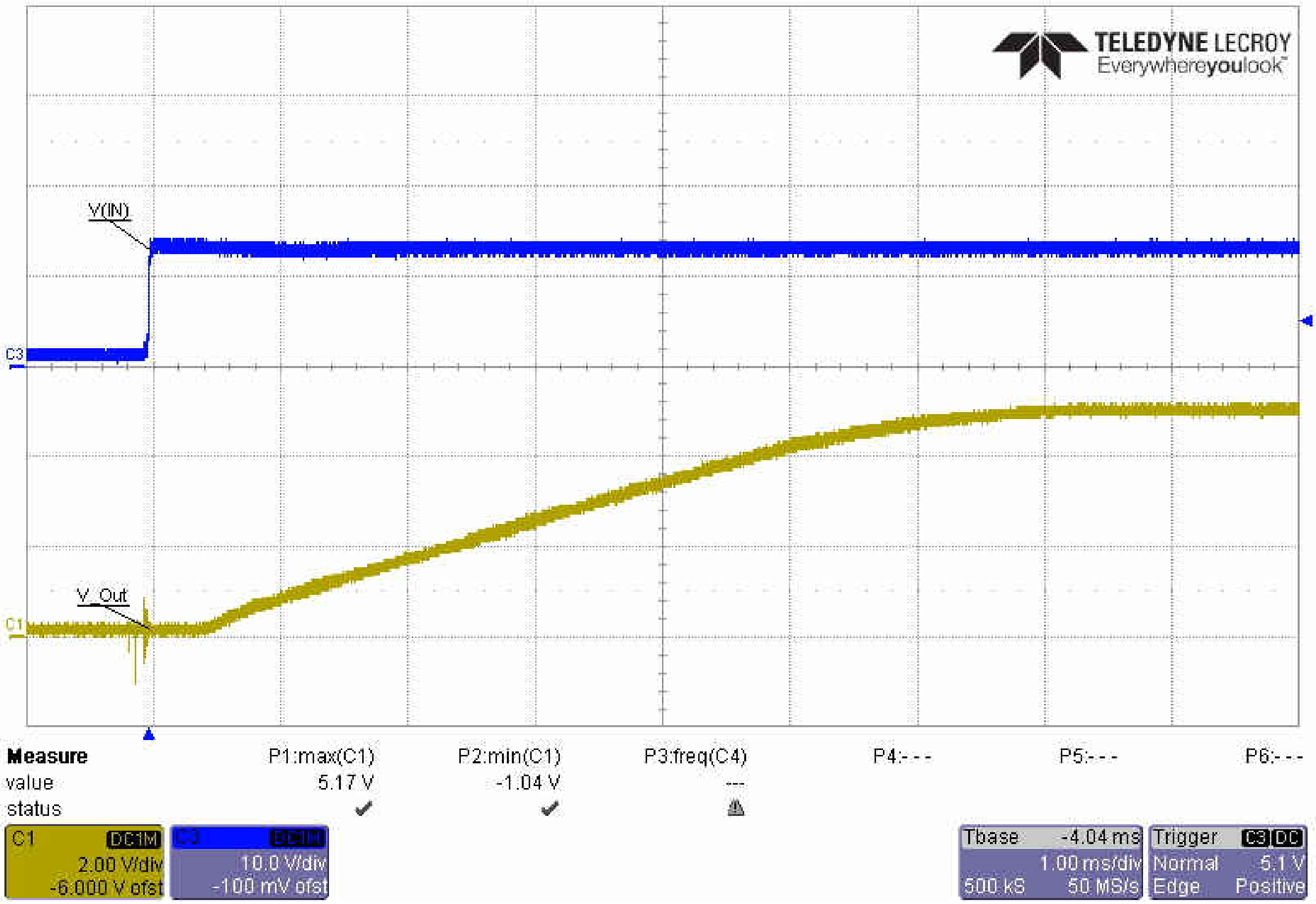


Figure 8-4. Part C – 2.1 MHz

9 Shutdown Sequence

Figure 9-1 through Figure 9-4 illustrate the shutdown waveforms at full load.

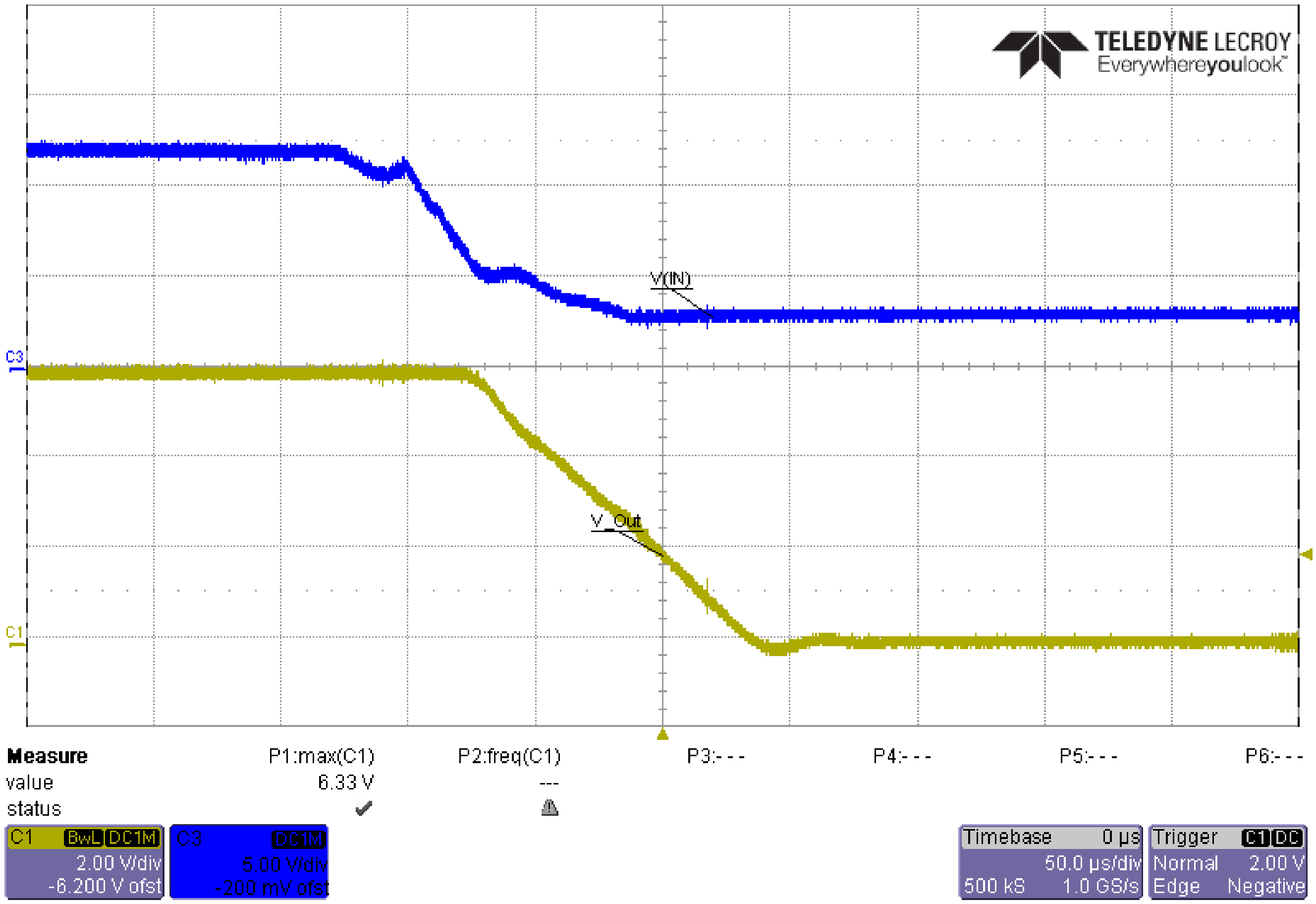


Figure 9-1. Part A – 2.1 MHz

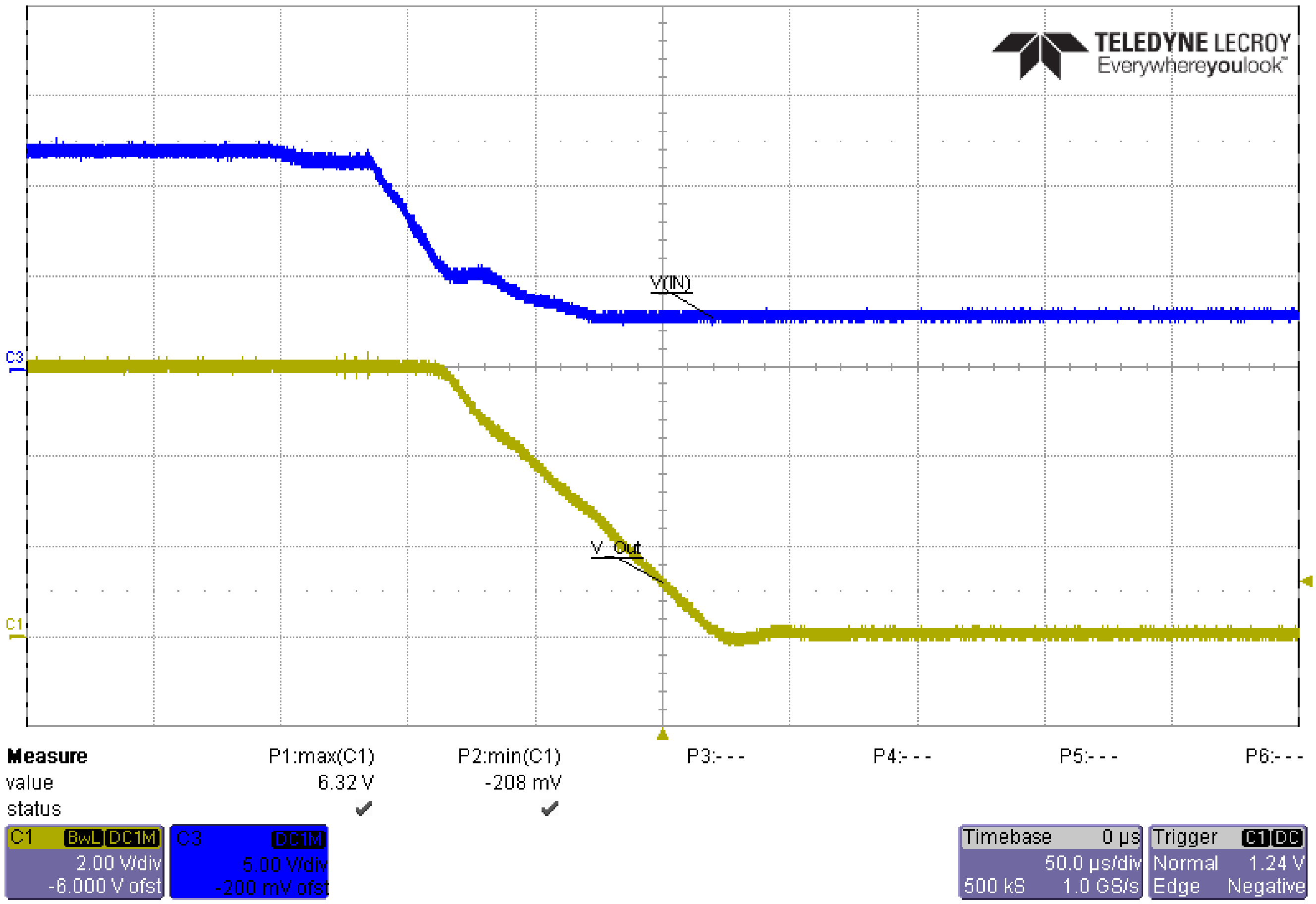


Figure 9-2. Part B – 2.1 MHz

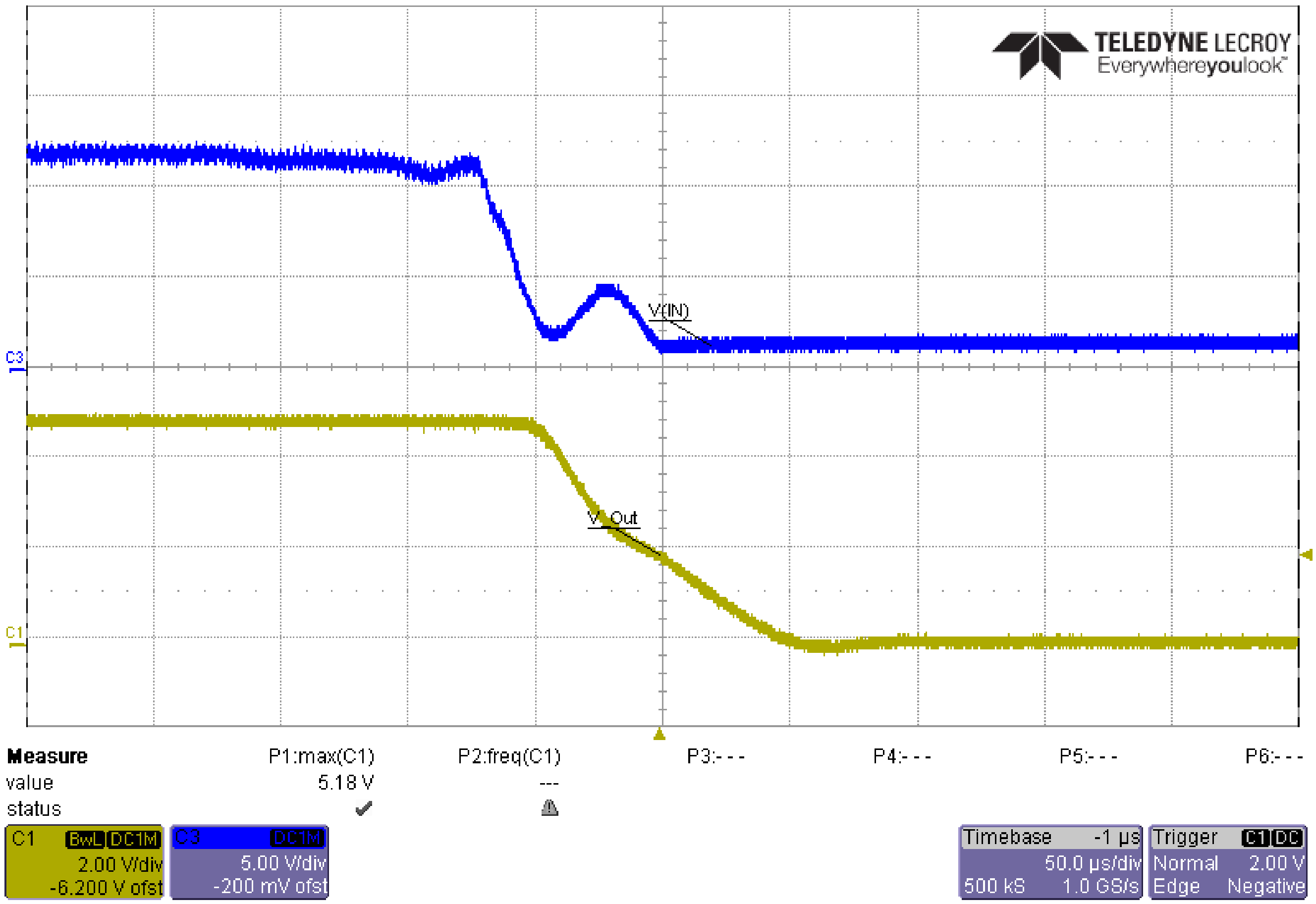


Figure 9-3. Part C – 400 kHz

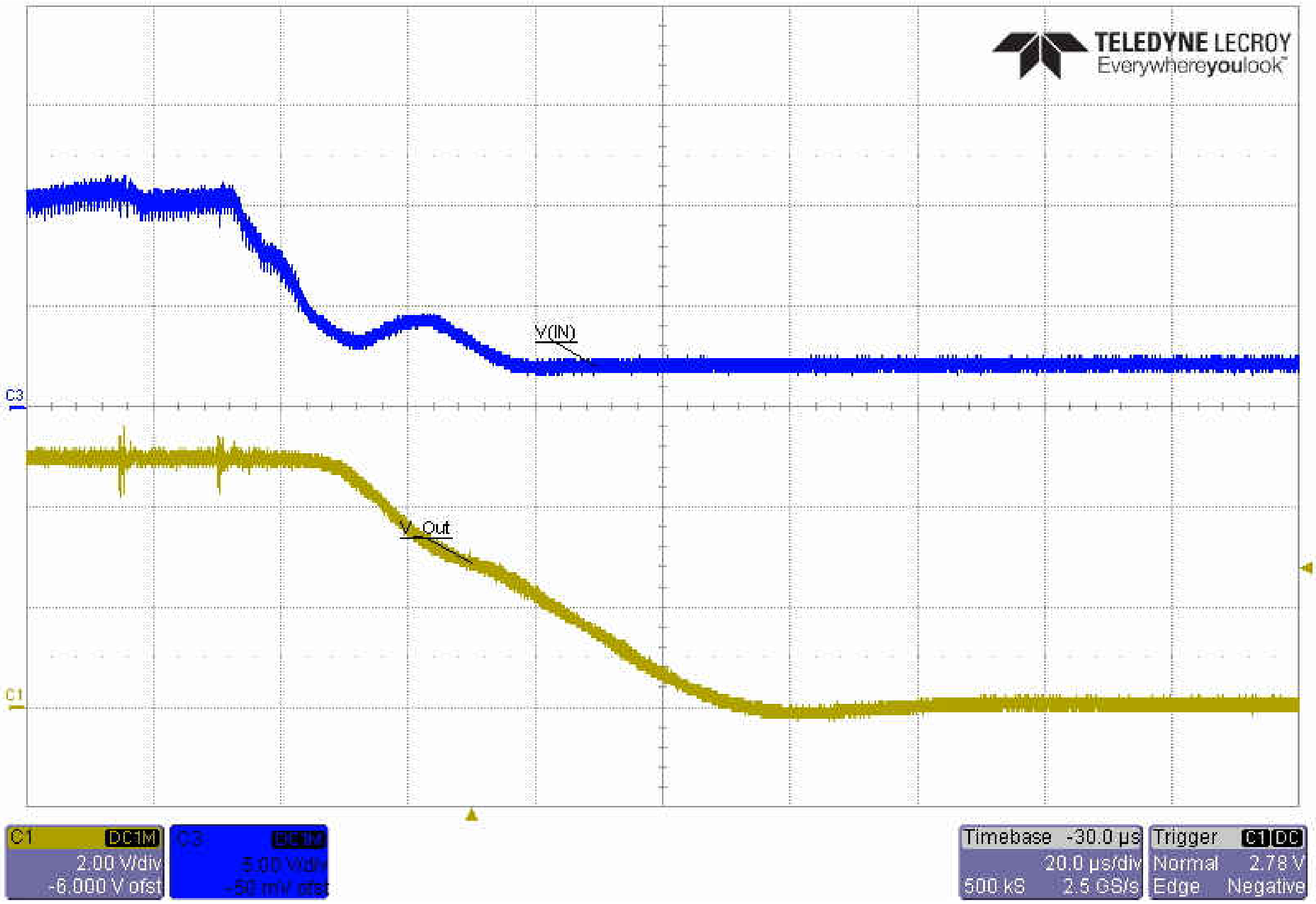


Figure 9-4. Part C – 2.1 MHz