Test Report: PMP41012

200-V to 480-V DC Input, 22-W Flyback Isolated Power Supply Reference Design

Description

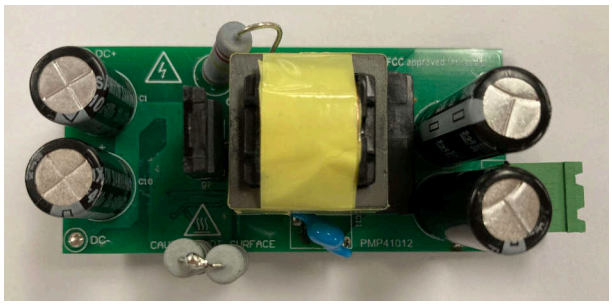
This reference design provides an isolated +15-V, 22-W output with a flyback topology with the LM51561-Q1 controller. The power supply can be powered in a range from 200-V to 480-V DC input. This design is primary-side regulation without optocoupler and uses a dual random spread spectrum which reduces the EMI.

Features

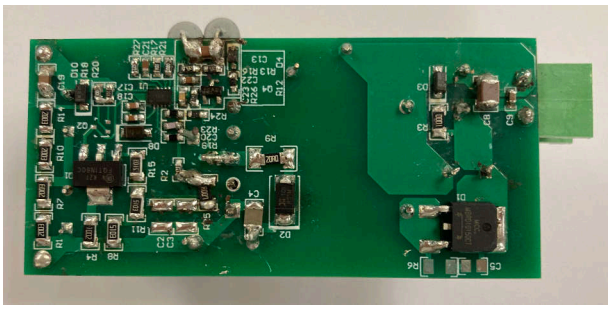
- Wide input range: 200-V to 480-V DC
- Primary-side regulation without optocoupler
- Compact form factor with isolated flyback
- Dual random spread spectrum to reduce the EMI

Applications

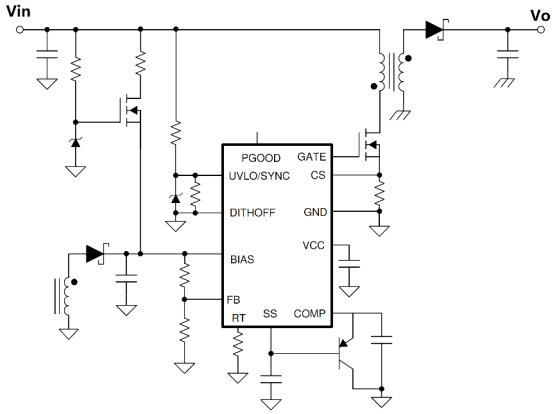
- Auxiliary-power supplies



Board Photo (Top)



Board Photo (Bottom)



Block Diagram

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input voltage range	200 V–480 V DC
Output voltage	15 V
Maximum Output current	1.5 A

1.2 Required Equipment

- Chroma DC Source 62024P-600-8
- Chroma DC E-load Model 6314A
- Tektronix DPO 3054
- Multimeter: Fluke 287C
- Electrical Thermography: Fluke TiS55

1.3 Dimensions

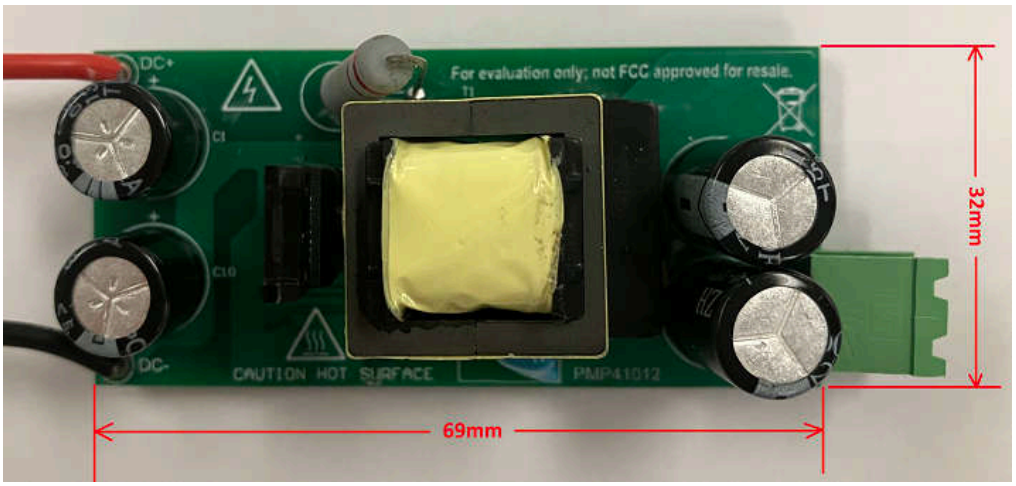


Figure 1-1. Board Dimension

The board dimensions are 69 mm (length) × 32 mm (width) × 20 mm (height).

2 Testing and Results

2.1 Efficiency Graphs

Efficiency is shown in the following figure.

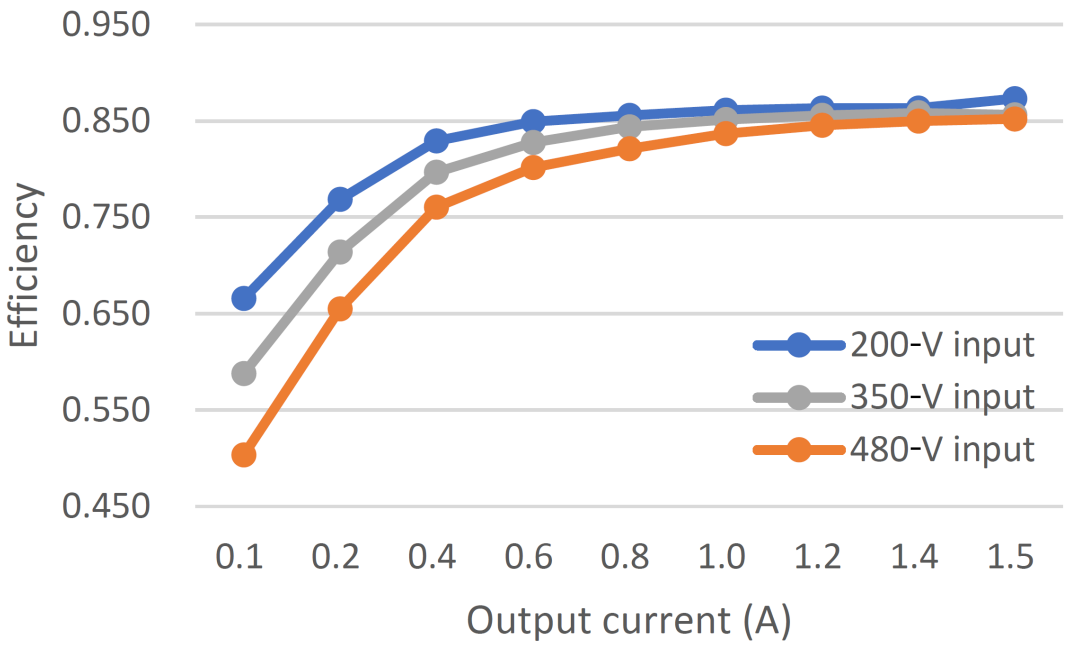


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

Efficiency data is shown in Table 2-1 through Table 2-3.

Table 2-1. 200-V Input Efficiency

V_{IN} (V)	I_{IN} (mA)	V_O (V)	I_O (A)	Ploss (W)	Efficiency
200.6	11.74	16.00	0.098	0.787	0.666
200.6	20.06	15.66	0.198	0.931	0.769
200.59	36.9	15.39	0.399	1.265	0.829
200.58	53.35	15.21	0.597	1.615	0.849
200.59	69.89	15.02	0.799	2.019	0.856
200.58	86.03	14.90	0.998	2.397	0.861
200.57	100.85	14.57	1.199	2.760	0.864
200.56	114.4	14.18	1.398	3.133	0.863
200.56	119.64	13.97	1.500	3.041	0.873

Table 2-2. 350-V Input Efficiency

V_{IN} (V)	I_{IN} (mA)	V_O (V)	I_O (A)	Ploss (W)	Efficiency
350.12	7.57	15.98	0.098	1.092	0.588
350.13	12.32	15.63	0.197	1.234	0.714
350.14	21.9	15.34	0.398	1.558	0.797
350.14	31.26	15.18	0.597	1.884	0.828
350.14	40.68	15.05	0.798	2.226	0.844
350.16	49.88	14.92	0.997	2.595	0.851
350.16	58.55	14.64	1.198	2.955	0.856
350.2	66.24	14.25	1.397	3.287	0.858
350.21	70.24	14.05	1.499	3.535	0.856

Table 2-3. 480-V Input Efficiency

V_{IN} (V)	I_{IN} (mA)	V_O (V)	I_O (A)	Ploss (W)	Efficiency
480.57	6.48	16.03	0.098	1.546	0.503
480.56	9.83	15.67	0.197	1.630	0.655
480.56	16.79	15.39	0.399	1.933	0.760
480.57	23.6	15.21	0.598	2.251	0.802
480.56	30.42	15.02	0.799	2.618	0.821
480.57	36.97	14.90	0.998	2.898	0.837
480.56	43.22	14.65	1.199	3.212	0.845
480.56	49.05	14.34	1.398	3.535	0.850
480.56	51.87	14.16	1.500	3.684	0.852

2.3 Thermal Images

Figure 2-2 and Figure 2-3 show the thermal images.

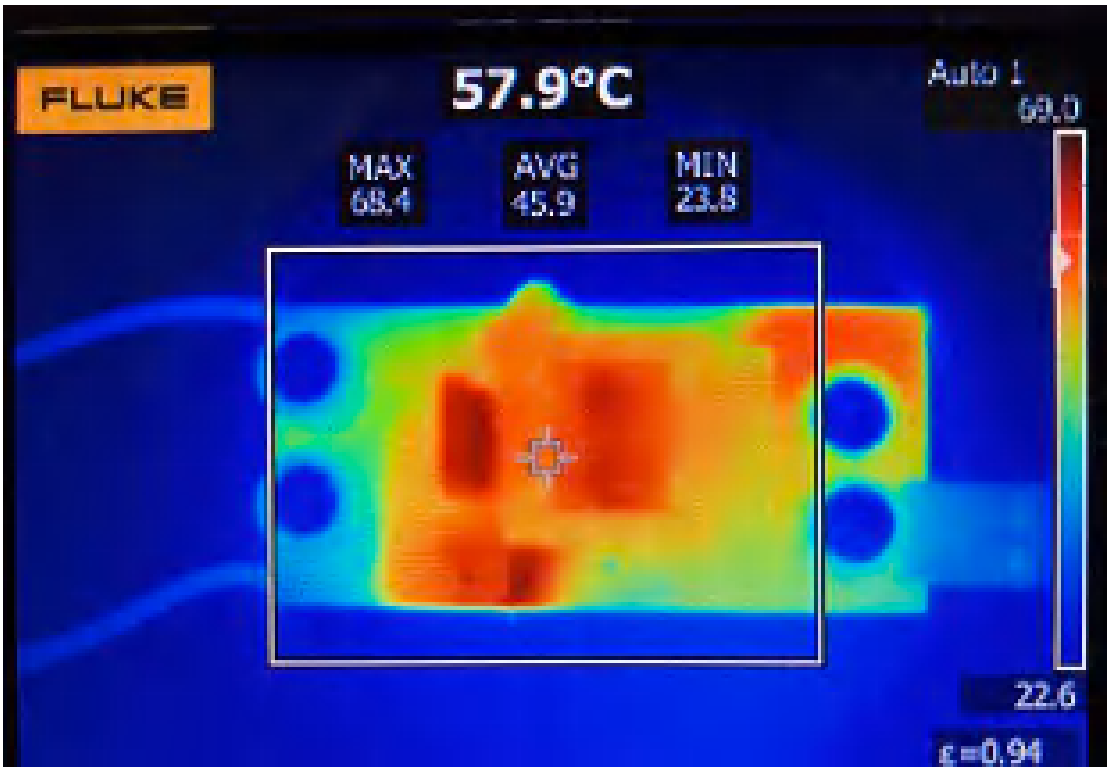


Figure 2-2. Top Thermal Image, V_{IN} = 480 V, Io = 1.5 A

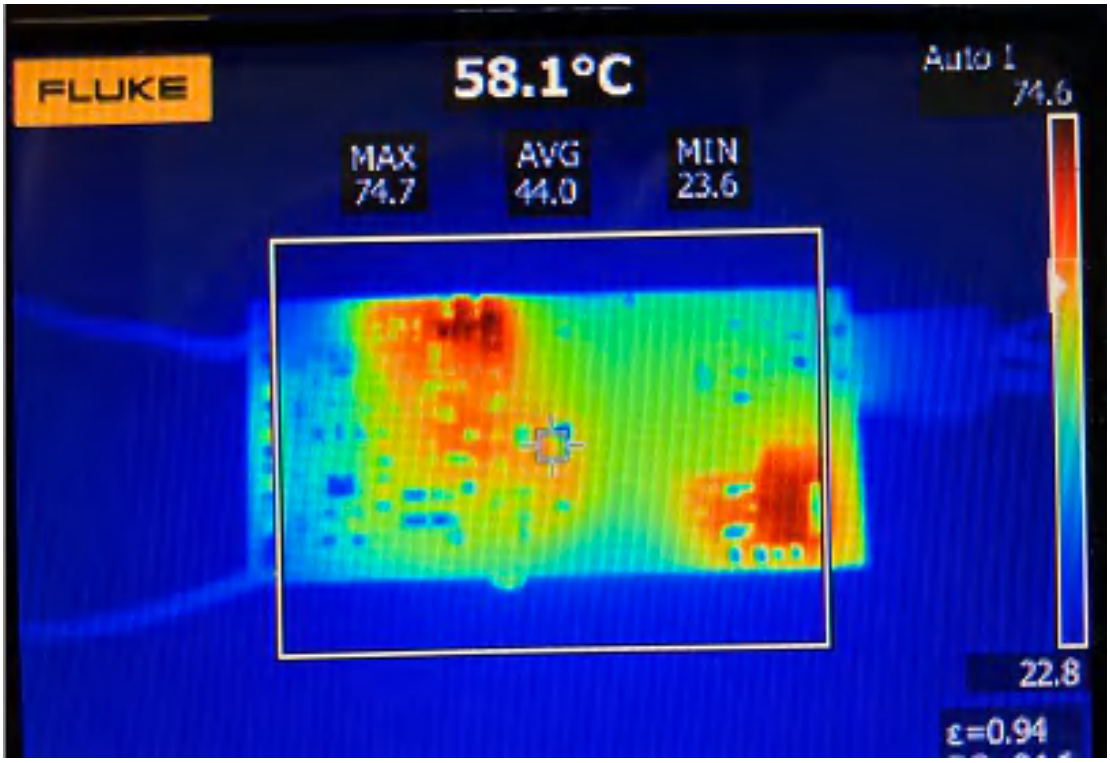


Figure 2-3. Bottom Thermal Image, V_{IN} = 480 V, Io = 1.5 A

3 Waveforms

3.1 Switching

Switching behavior is shown in the following figures.

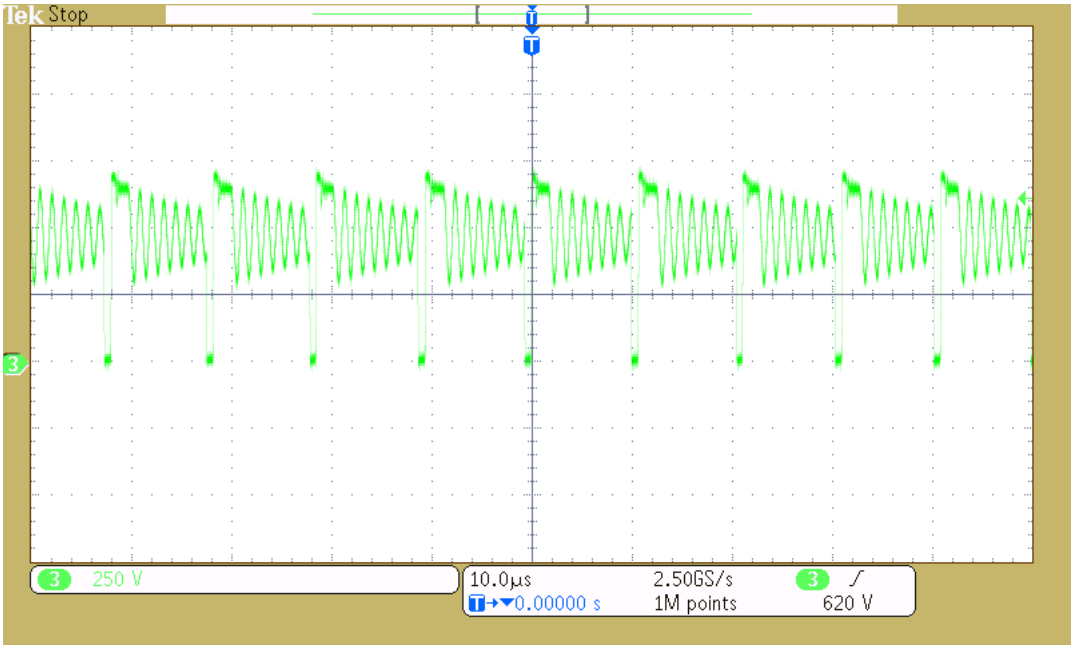


Figure 3-1. Switch Node Voltage, V_{IN} = 480 V, Io = 0.2 A

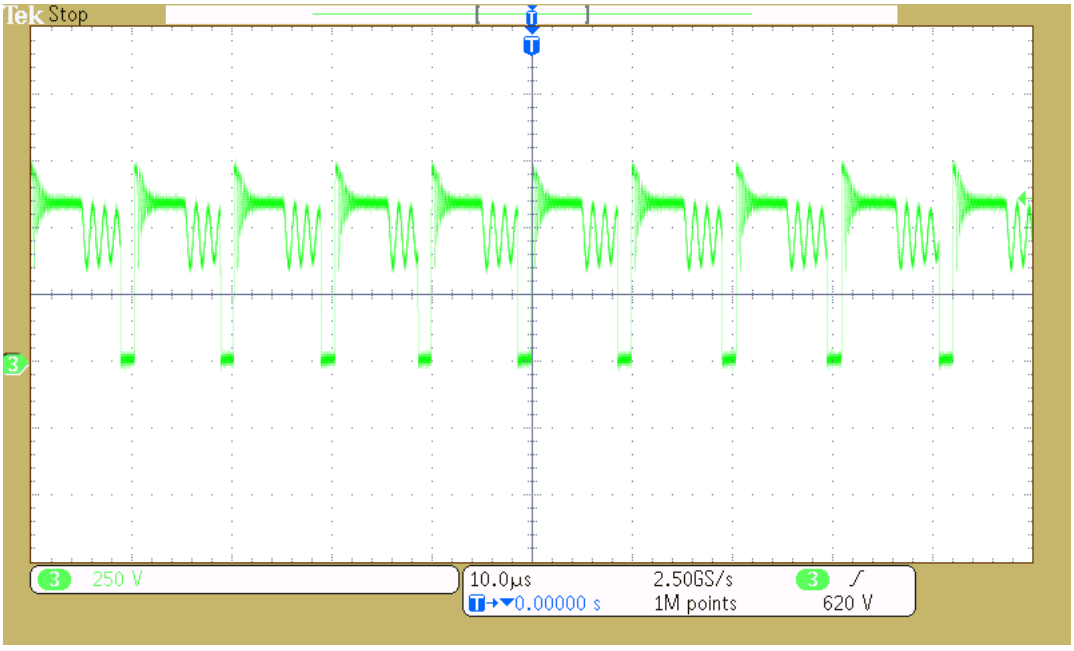


Figure 3-2. Switch Node Voltage, V_{IN} = 480 V, Io = 1.5 A

3.2 Output Voltage Ripple

Output voltage ripple is shown in the following figures.

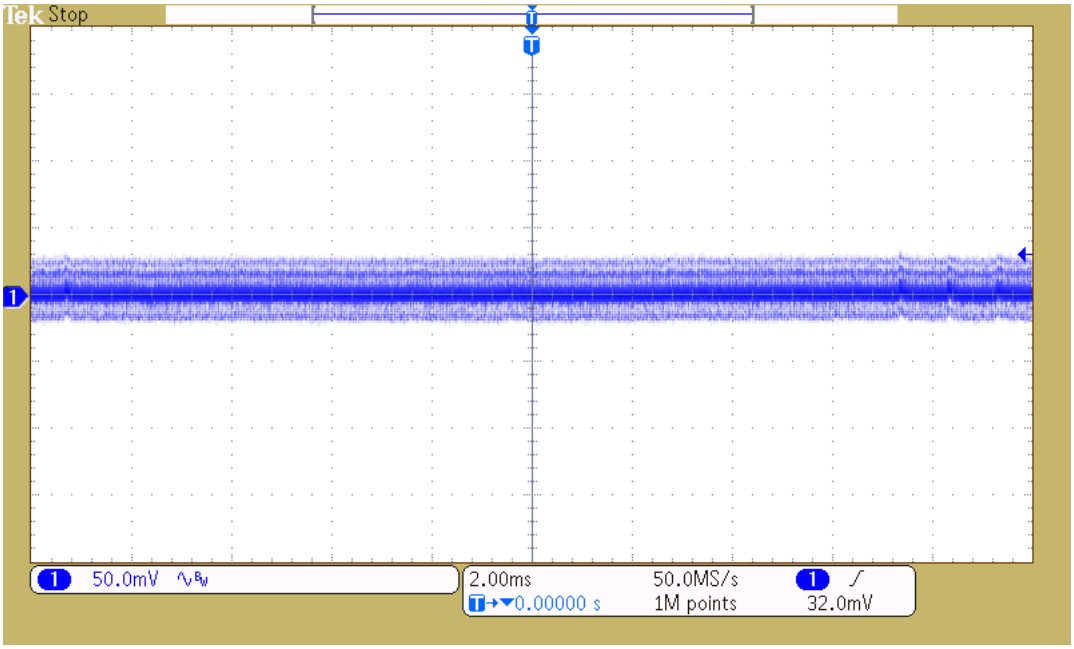


Figure 3-3. Output Voltage Ripple, V_{IN} = 200 V, Io = 0.1 A

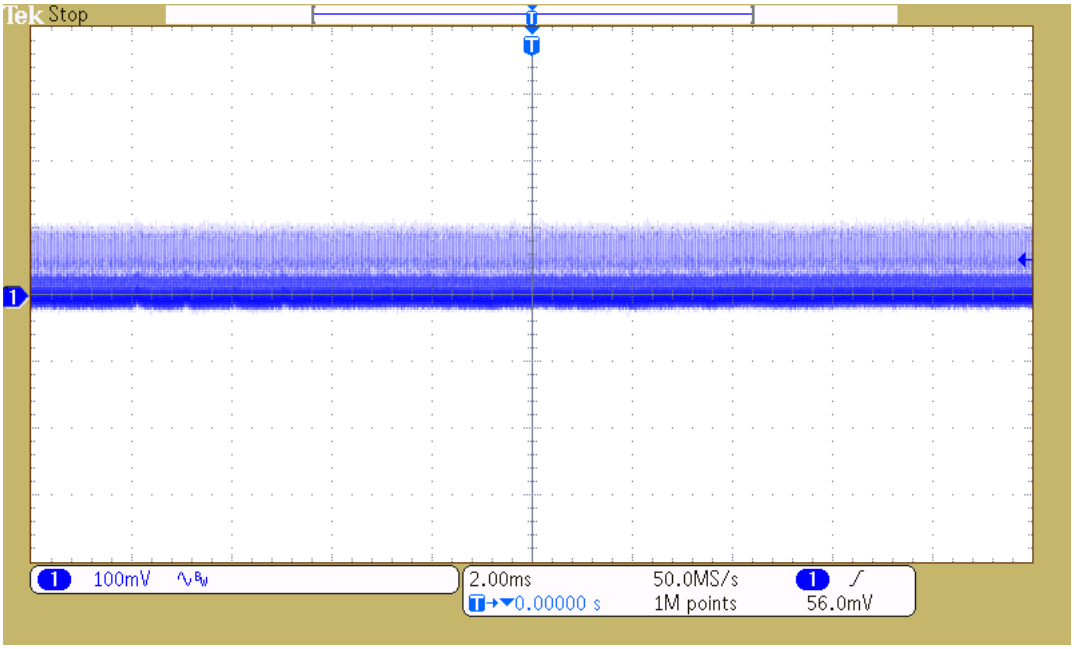


Figure 3-4. Output Voltage Ripple, V_{IN} = 200 V, Io = 1.5 A

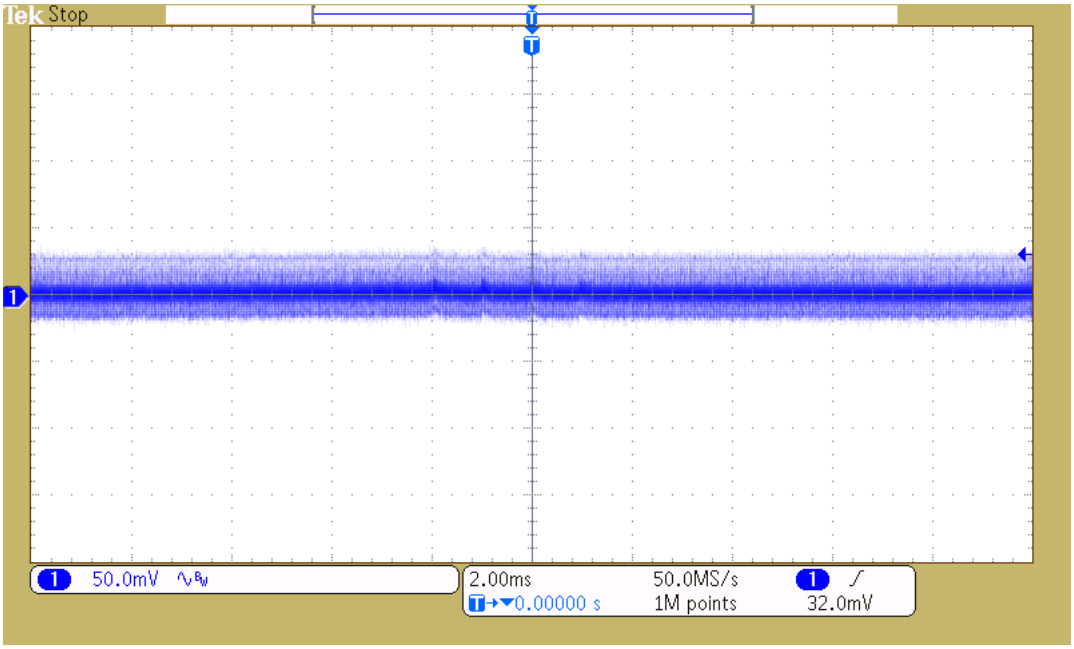


Figure 3-5. Output Voltage Ripple, V_{IN} = 480 V, Io = 0.1 A

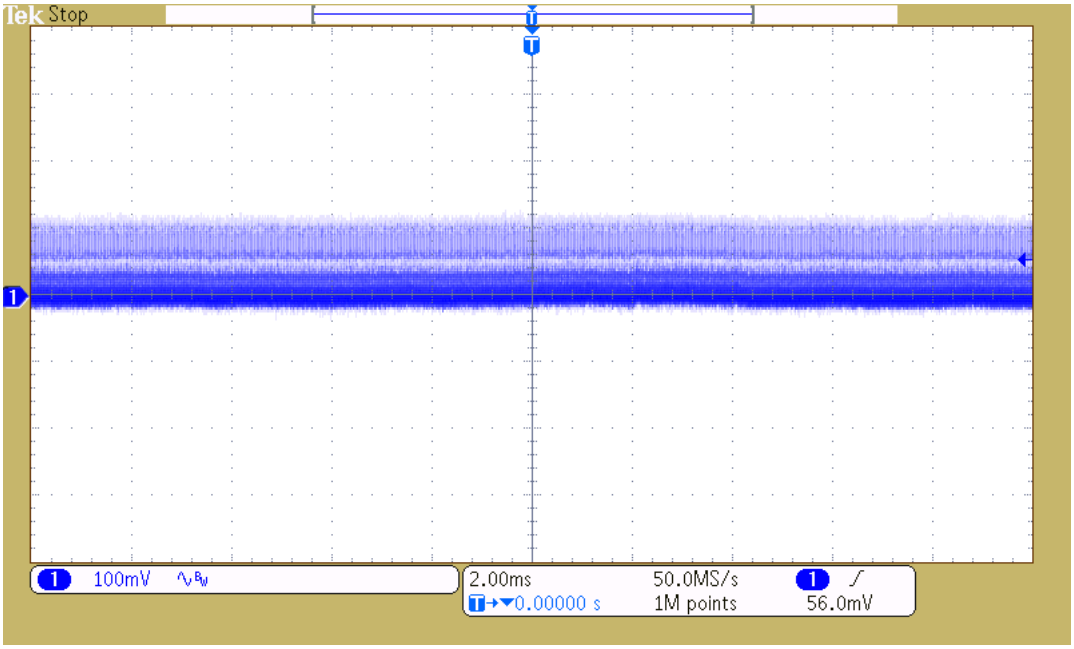


Figure 3-6. Output Voltage Ripple, V_{IN} = 480 V, Io = 1.5 A

3.3 Load Transients

Load transient response is shown in the following image.

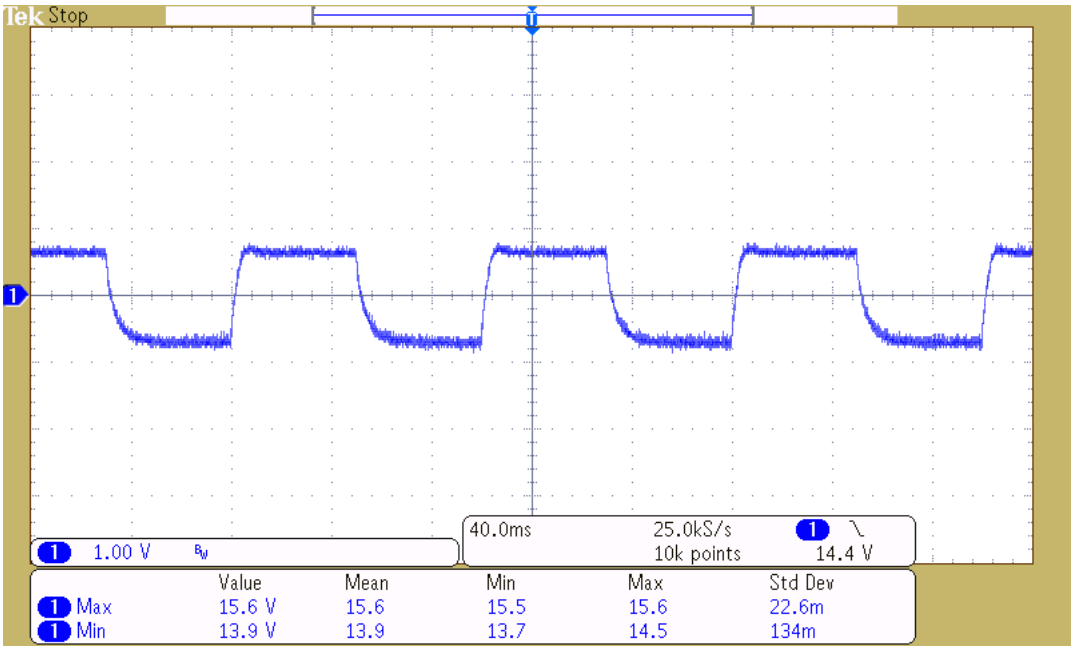


Figure 3-7. Load Transient, V_{IN} = 200 V, 0.5-A to 1.5-A Load Transient, 1 A/µs

3.4 Start-Up Waveform

Start-up behavior is shown in the following figures.

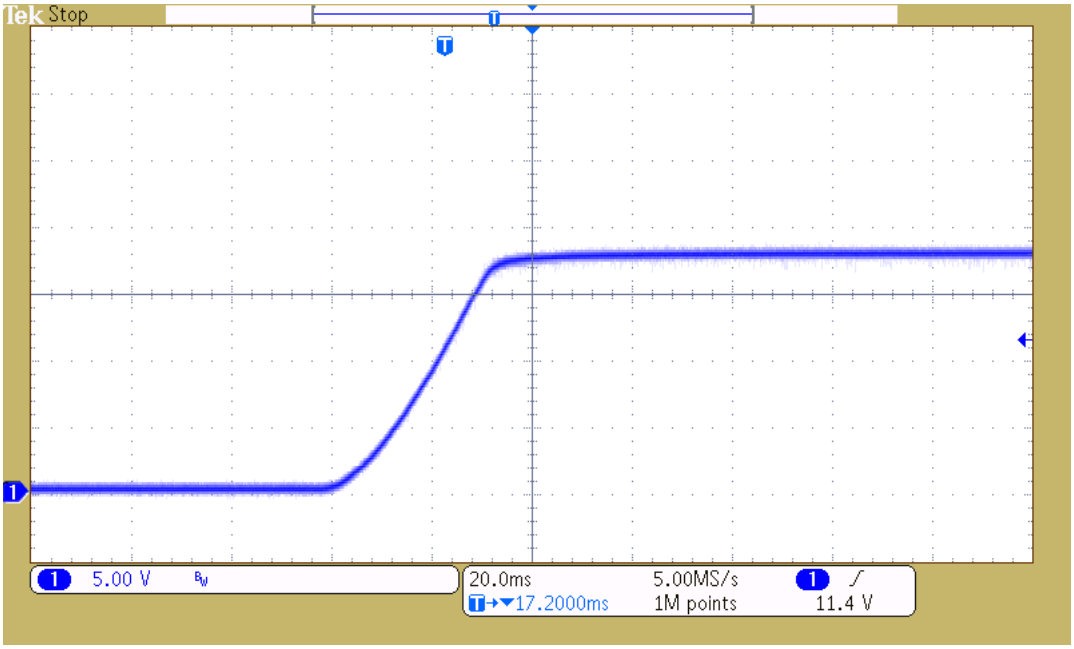


Figure 3-8. Output Voltage Start-Up, V_{IN} = 200 V, Io = 0.2 A

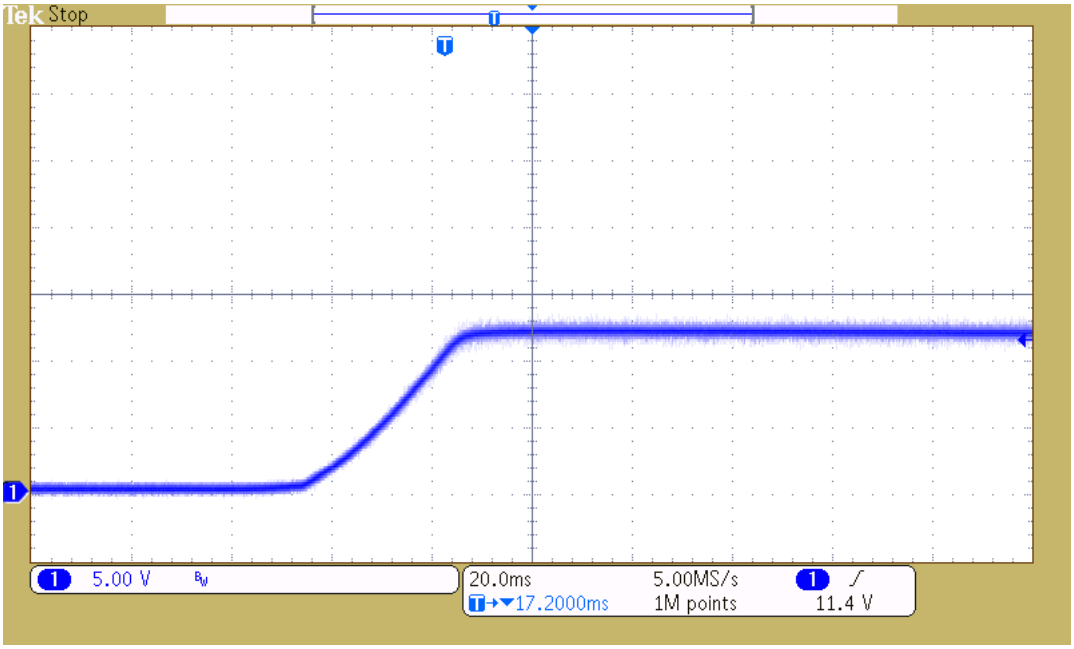


Figure 3-9. Output Voltage Start-Up, V_{IN} = 200 V, Io = 1.5 A

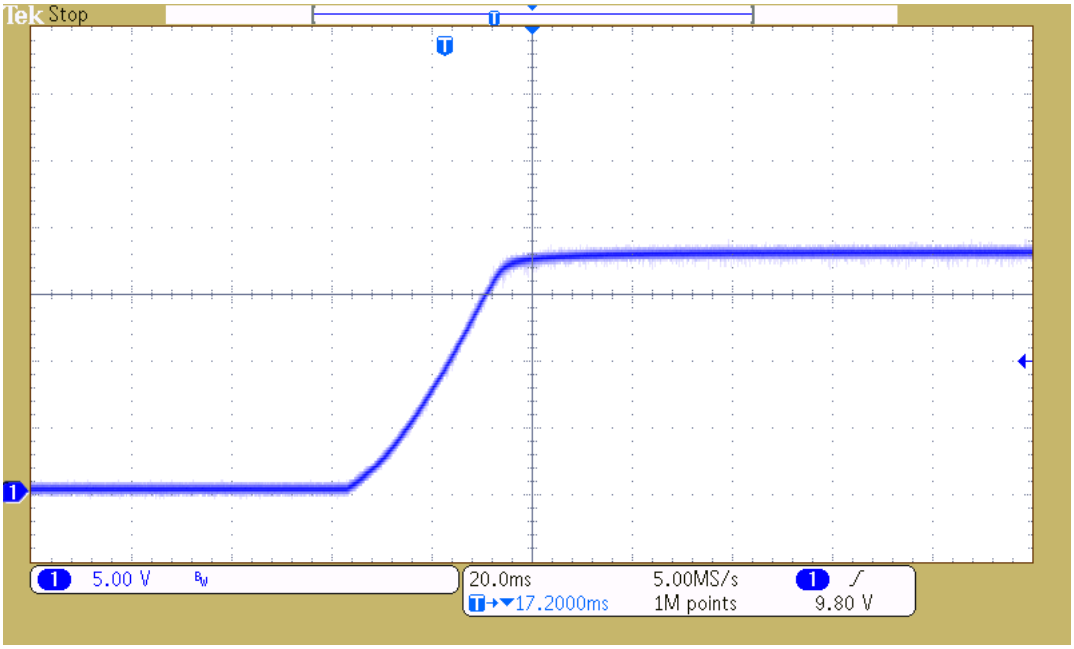


Figure 3-10. Output Voltage Start-Up, V_{IN} = 480 V, Io = 0.2 A

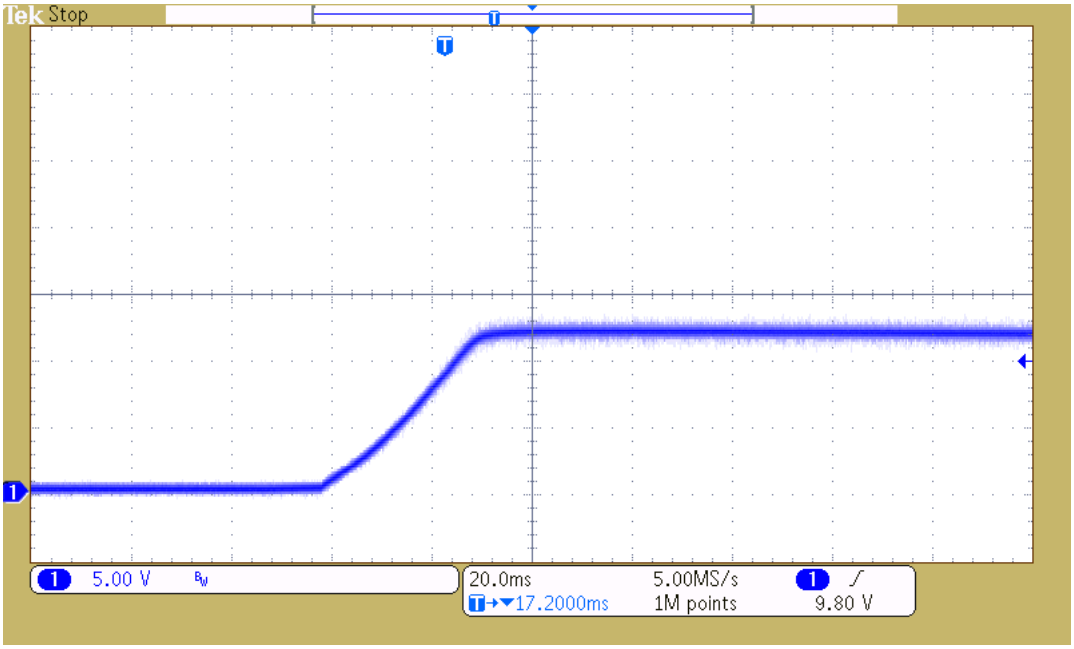


Figure 3-11. Output Voltage Start-Up, V_{IN} = 480 V, Io = 1.5 A

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