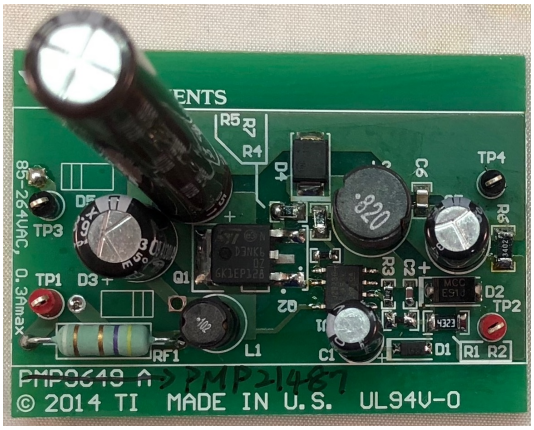
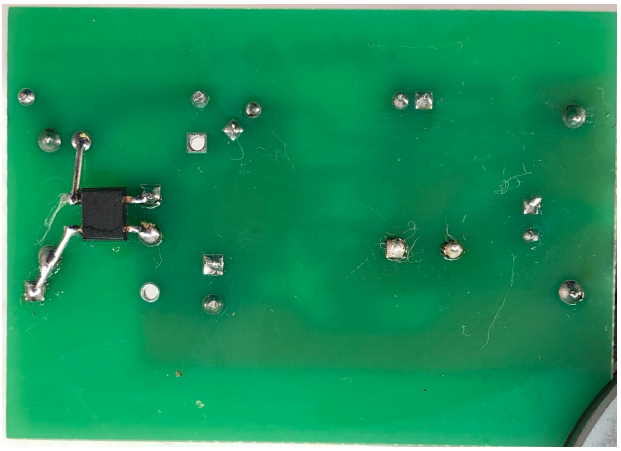
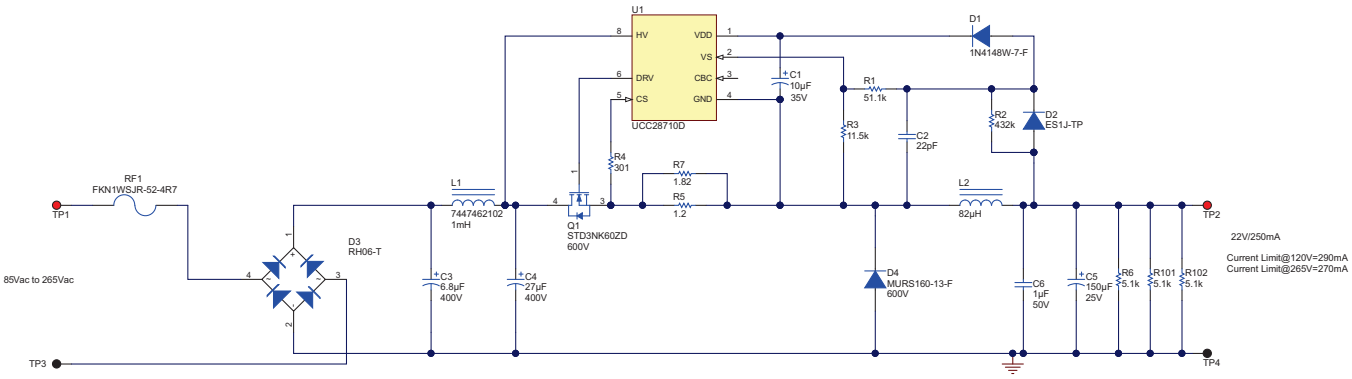
Test Report: PMP21487
Universal AC Input High-Side Buck Converter Reference Design

Description

This reference design is a simple, low-cost, high-side buck converter to convert universal AC input voltage (85 V_{AC} to 265 V_{AC}) to a non-isolated 22 V/250 mA DC output with a UCC28710 controller.







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1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
V_{IN}	85 V_{AC}–265 V_{AC}
V_{OUT}	22 V
I_{OUT}	250 mA

2 Testing and Results

2.1 Efficiency Graphs

Figure 1 shows the converter efficiency for a 120-V and 265-V input with a 22-V output.

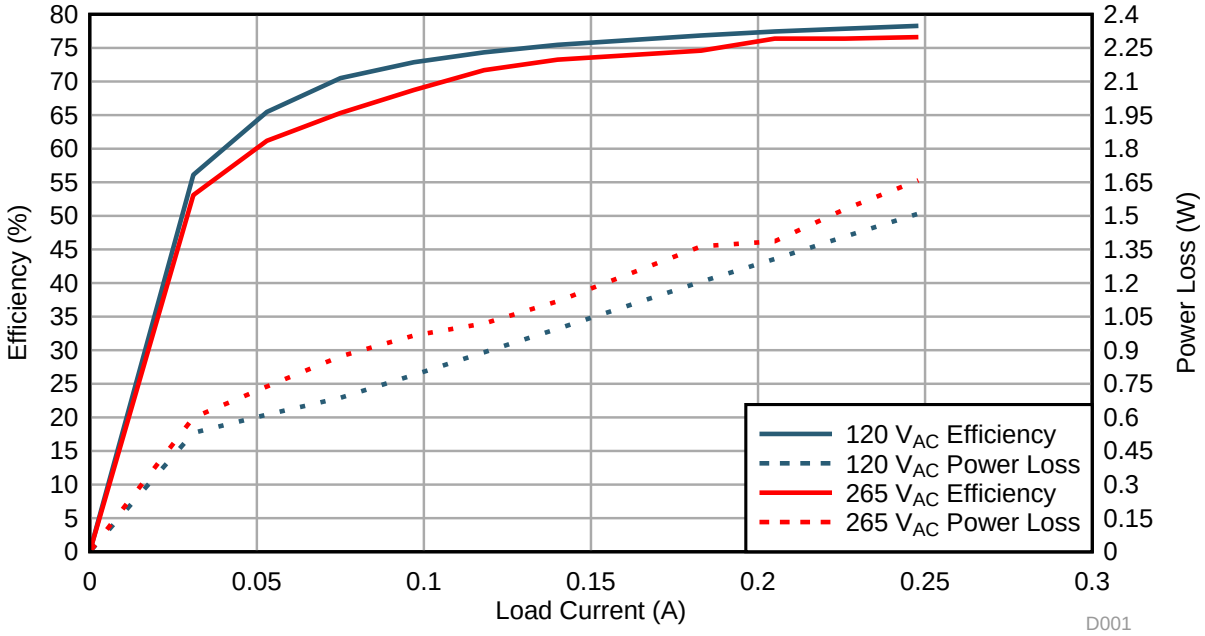

Figure 1. Converter Efficiency

2.2 Efficiency Data

Table 2 and Table 3 show the efficiency data for a 120-V and 265-V input, respectively, with a 22-V output.

Table 2. Efficiency Data 120-V Input, 22-V Output

I_{OUT}	V_{OUT}	V_{IN} AC	I_{IN} Arms (mA)	P_{IN}	P_{OUT}	Losses	Efficiency
0.000	21.860	120.0	8.20000	0.0000	0.00	0.00	0%
0.031	21.900	120.0	25.8400	1.2100	0.68	0.53	56.1%
0.053	21.900	120.0	36.210	1.7730	1.16	0.61	65.5%
0.075	21.900	120.0	45.900	2.3300	1.64	0.69	70.5%
0.097	21.860	120.0	55.410	2.9100	2.12	0.79	72.9%
0.118	21.860	120.0	65.000	3.4700	2.58	0.89	74.3%
0.140	21.860	120.0	74.140	4.0560	3.06	1.00	75.5%
0.183	21.880	120.0	92.110	5.2100	4.00	1.21	76.9%
0.205	21.900	120.0	100.000	5.7970	4.49	1.31	77.4%
0.226	21.900	120.0	108.600	6.3570	4.95	1.41	77.9%
0.248	21.940	120.0	117.200	6.9510	5.44	1.51	78.3%

Table 3. Efficiency Data 265-V Input, 22-V Output

I_{OUT}	V_{OUT}	V_{IN} AC	I_{IN} Arms (mA)	P_{IN}	P_{OUT}	Losses	Efficiency
0.000	21.860	265.0	5.30000	0.0000	0.00	0.00	0%
0.031	21.870	265.0	14.5500	1.2770	0.68	0.60	53.1%
0.053	21.930	265.0	21.100	1.9000	1.16	0.74	61.2%
0.075	21.900	265.0	26.600	2.5150	1.64	0.87	65.3%
0.097	21.880	265.0	32.160	3.0880	2.12	0.97	68.7%
0.118	21.870	265.0	37.460	3.6000	2.58	1.02	71.7%
0.140	21.870	265.0	42.600	4.1800	3.06	1.12	73.2%
0.183	21.880	265.0	52.980	5.3680	4.00	1.36	74.6%
0.205	21.880	265.0	57.800	5.8720	4.49	1.39	76.4%
0.226	21.890	265.0	62.800	6.4770	4.95	1.53	76.4%
0.248	21.900	265.0	67.990	7.0900	5.43	1.66	76.6%

2.3 Thermal Images

The thermal image in Figure 2 shows operation at a 120-V input and 22-V at 250-mA output, with no airflow. The board ran for 20 minutes with these conditions before the thermal image was taken.

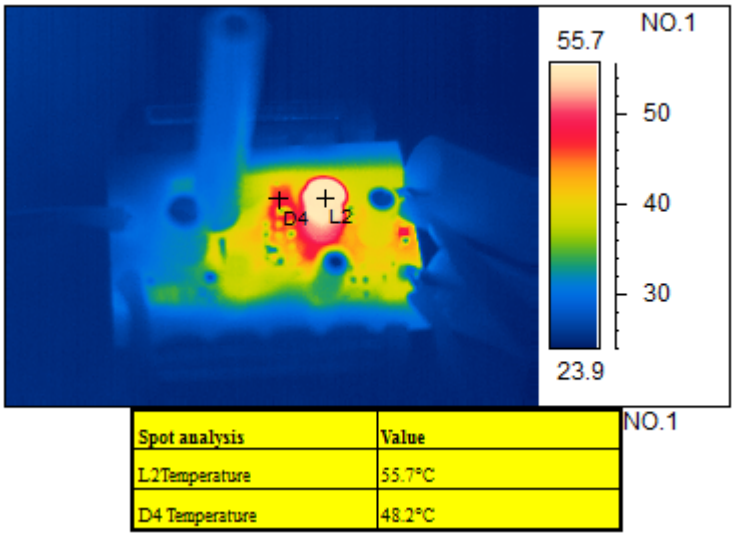

Figure 2. Thermal Image

2.4 Dimensions

Figure 3 illustrates the PMP21487 board.

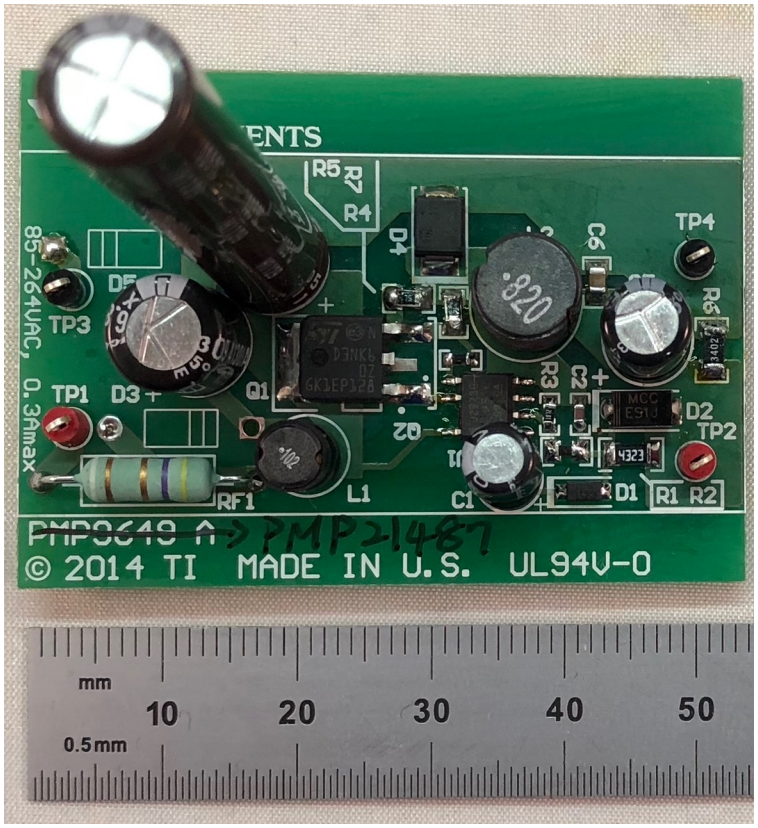

Figure 3. PMP21487 Board (Top View)

3 Waveforms

3.1 Switching

Figure 4 shows the switch node voltage with an input voltage of 120 V and the 22-V output loaded to 250 mA.

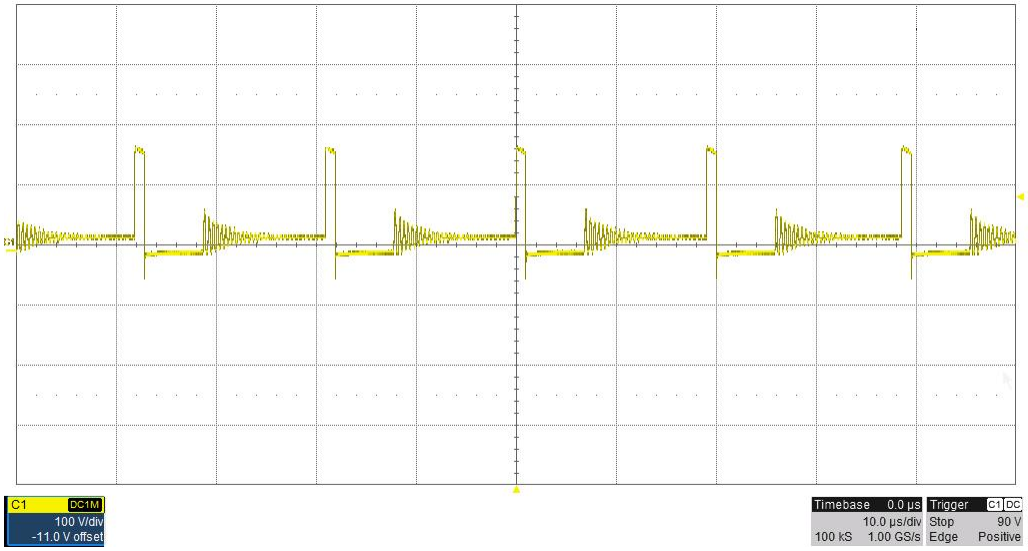

Figure 4. Switch Node Voltage, V_{IN} = 120 V, 22-V V_{OUT} = 250-mA Load

Figure 5 shows the switch node voltage with an input voltage of 265 V and the 22-V output loaded to 250 mA.

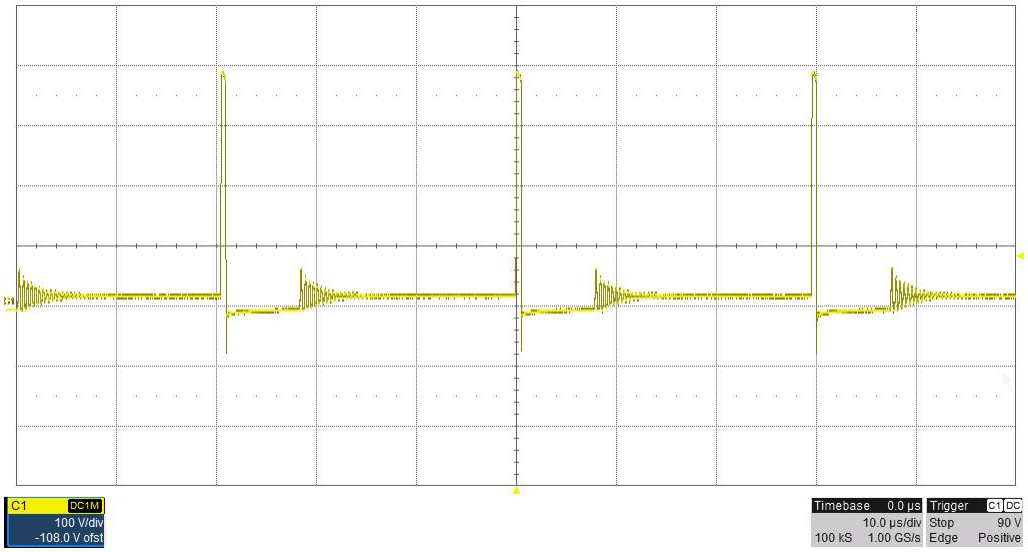

Figure 5. Switch Node Voltage, V_{IN} = 265 V, 22-V V_{OUT} = 250-mA Load

3.2 Output Voltage Ripple

Figure 6 shows the output ripple voltage with an input voltage of 120 V and the 22-V output loaded to 0 mA.

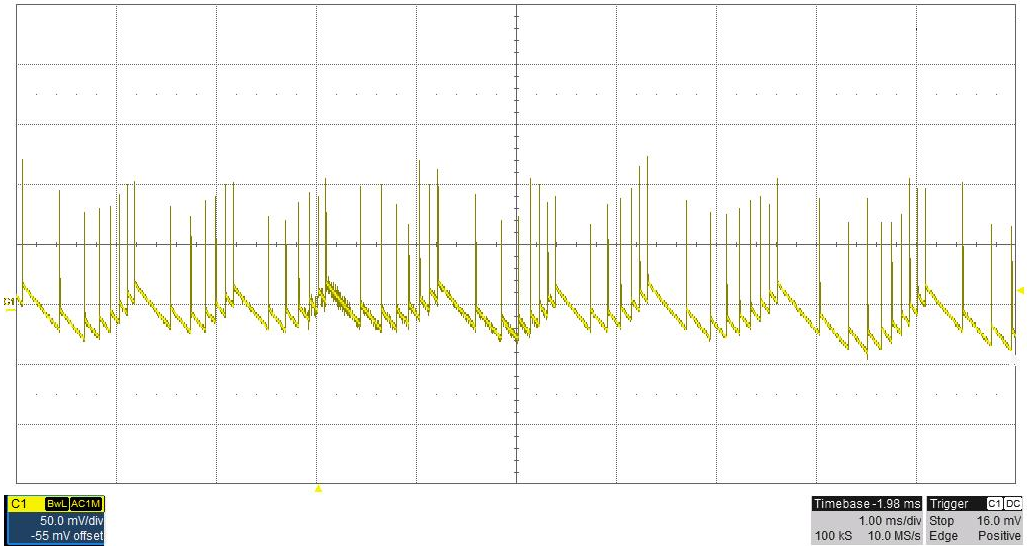

Figure 6. Output Voltage Ripple, V_{IN} = 120 VAC, 22-V V_{OUT} = 0-mA Load

Figure 7 shows the output ripple voltage with an input voltage of 120 V and the 22-V output loaded to 250 mA.

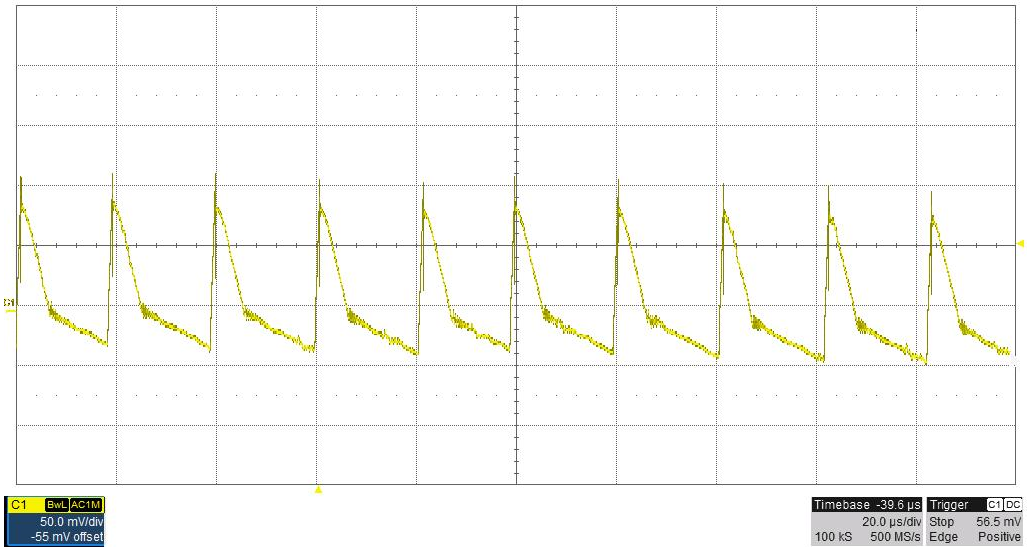

Figure 7. Output Voltage Ripple, V_{IN} = 120 VAC, 22-V V_{OUT} = 250-mA Load

Figure 8 shows the output ripple voltage with an input voltage of 265 V and the 22-V output loaded to 0 mA.

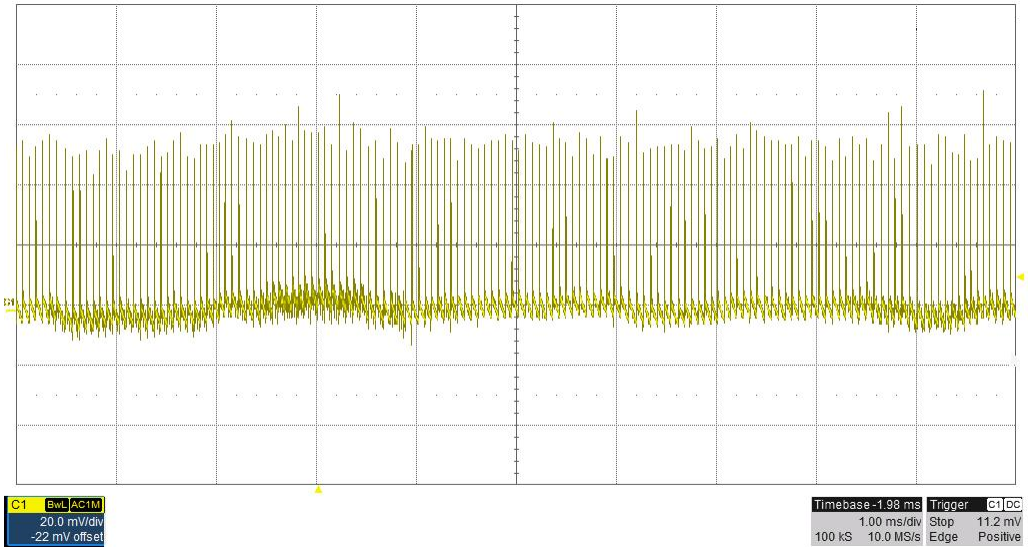

Figure 8. Output Voltage Ripple, V_{IN} = 265 VAC, 22-V V_{OUT} = 0-mA Load

Figure 9 shows the output ripple voltage with an input voltage of 265 V and the 22-V output loaded to 250 mA.

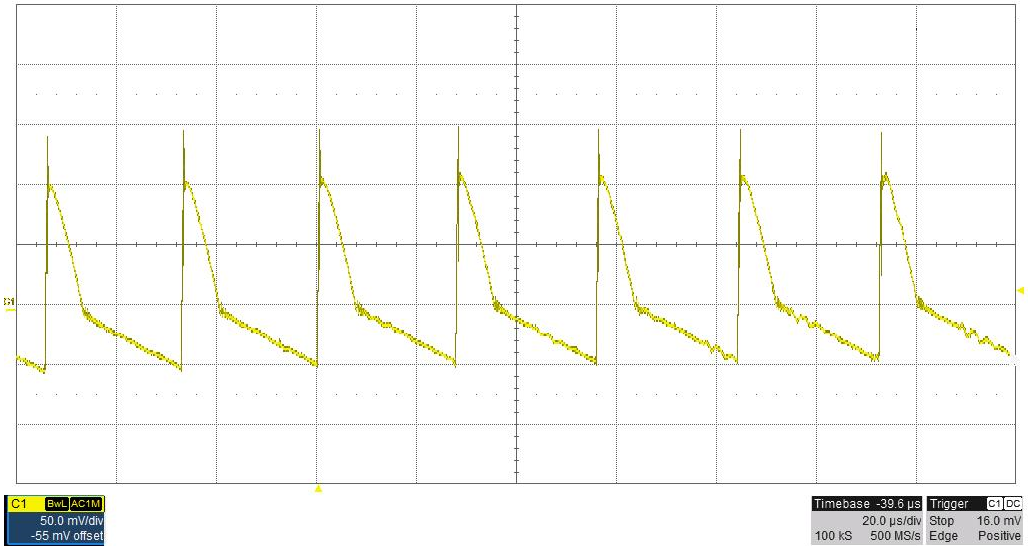

Figure 9. Output Voltage Ripple, V_{IN} = 265 VAC, 22-V V_{OUT} = 250-mA Load

3.3 Start-Up Sequence

Figure 10 shows the output voltage startup waveform after the application of 120 V in with the 22-V output loaded to 0 A.

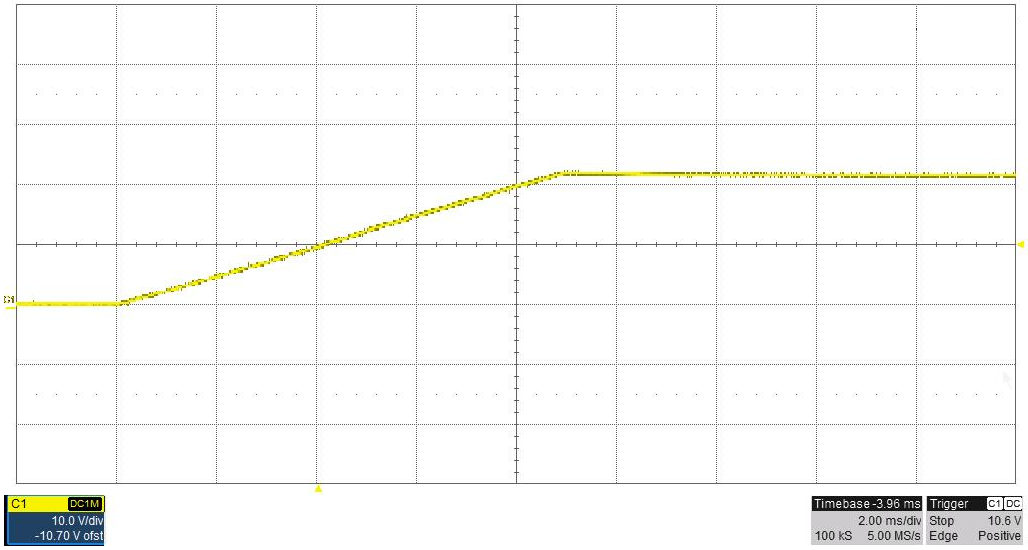

Figure 10. Output Voltage Startup Waveform, V_{IN} = 120 V, 22-V V_{OUT} = 0-mA Load

Figure 11 shows the output voltage startup waveform after the application of 120 V in with the 22-V output loaded to 250 A.

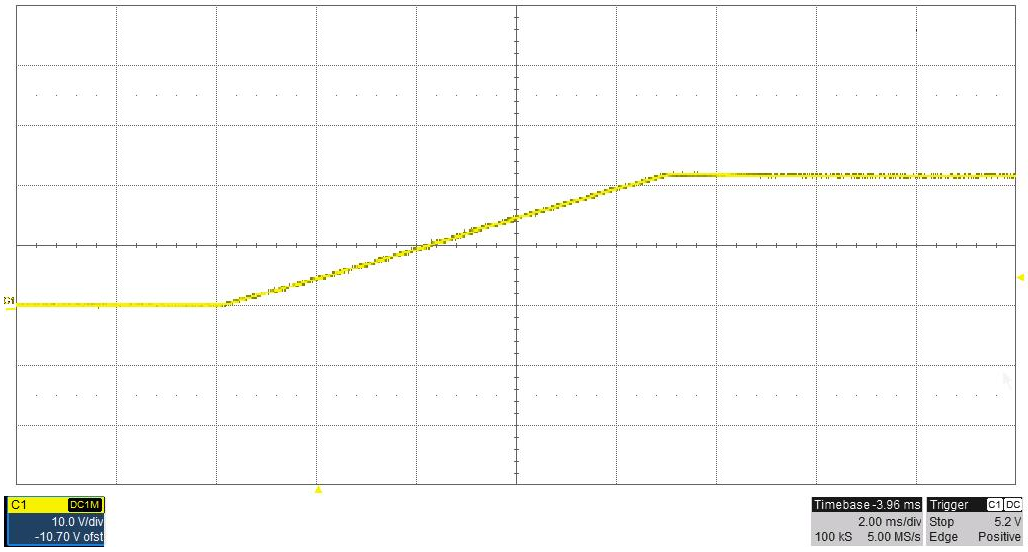

Figure 11. Output Voltage Startup Waveform, V_{IN} = 120 V, 22-V V_{OUT} = 250-mA Load

Figure 12 shows the output voltage startup waveform after the application of 265 V in with the 22-V output loaded to 0 A.

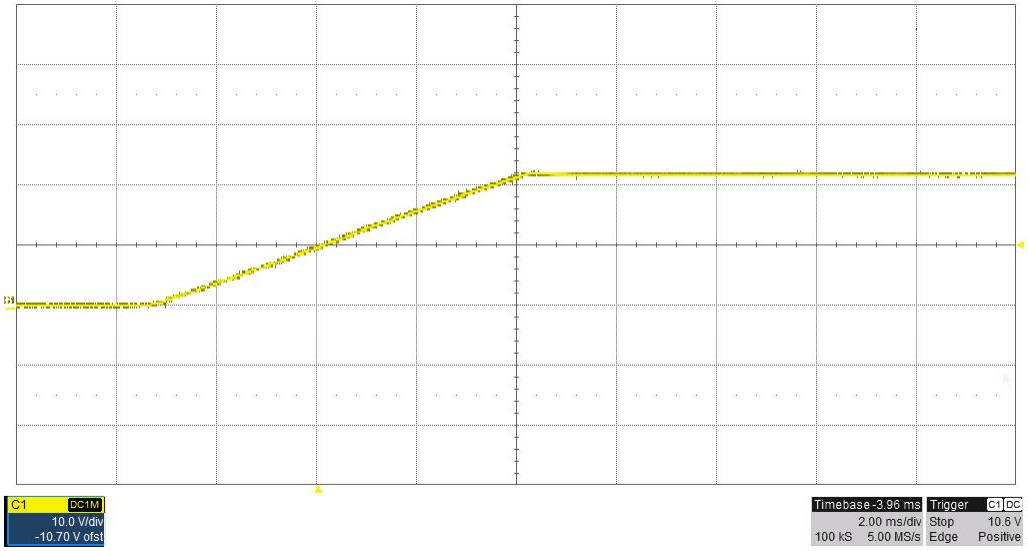

Figure 12. Output Voltage Startup Waveform, V_{IN} = 265 V, 22-V V_{OUT} = 0-mA Load

Figure 13 shows the output voltage startup waveform after the application of 265 V in with the 22-V output loaded to 250 A.

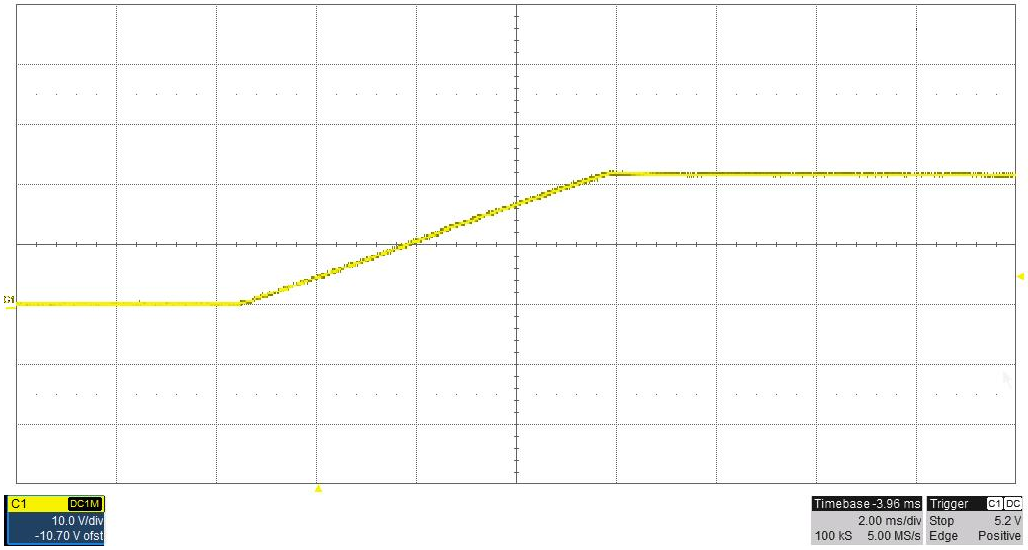

Figure 13. Output Voltage Startup Waveform, V_{IN} = 265 V, 22-V V_{OUT} = 250-mA Load

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265