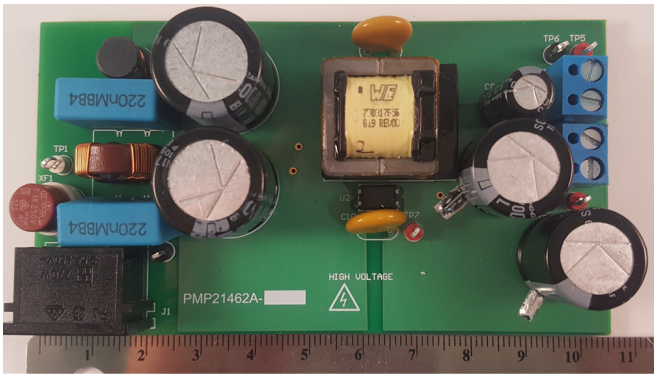
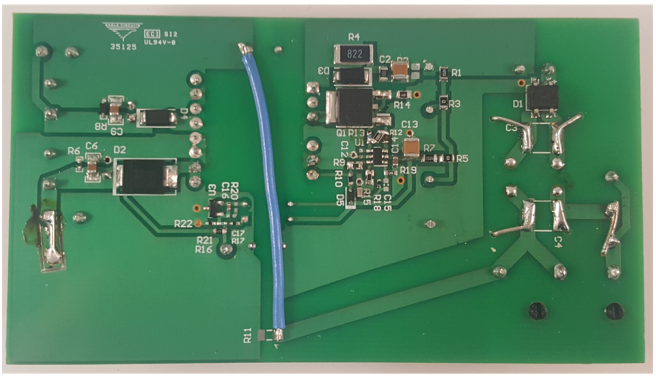
Test Report: PMP21462
12-Watt, Magnetically Resistant, Quasi-Resonant Flyback Reference Design

Description

PMP21462 is a quasi-resonant flyback developed to be resistant to large magnetic fields near the transformer. It has a regulated 4-V output that can handle up to 2 A of current and secondary 10-V output that can handle 0.4 A.





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1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
V_{IN}	90-490 V_{AC}
V_{OUT}	4 V / 2 A , 10 V / 400 mA
Nominal switching frequency	26 kHz

1.2 Considerations

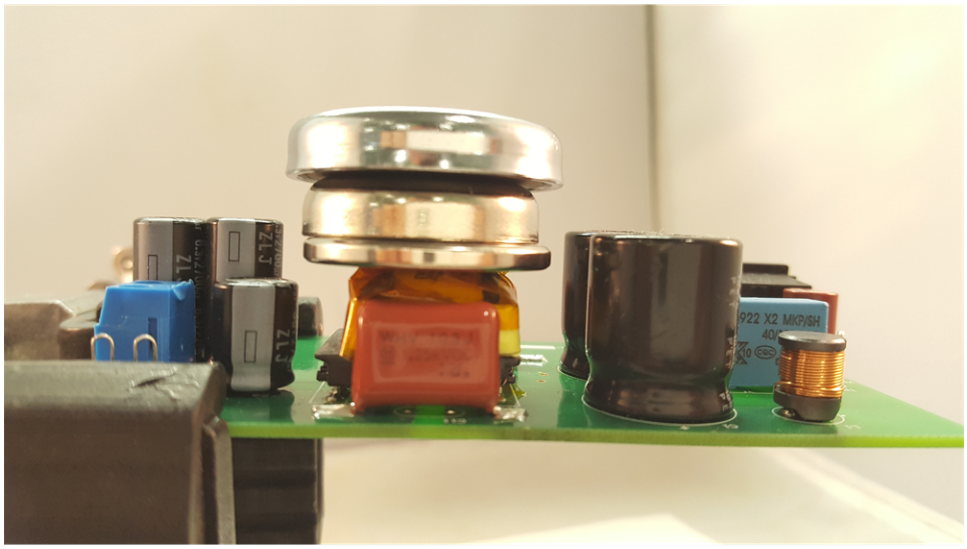

Figure 1. Magnets on Top of Transformer

2 Testing and Results

2.1 Efficiency Graphs

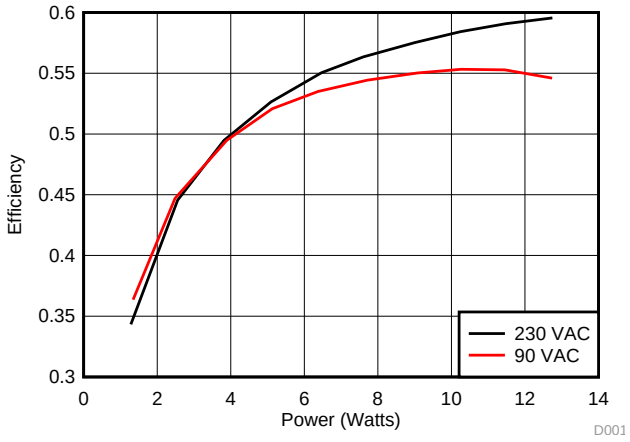

Figure 2. Efficiency of Design at Various Loads

2.2 Efficiency Data

Table 2. 230-V_{AC} Efficiency Data

V_{in} (V_{rms})	I_{in} (mArms)	P_{in} (W)	PF	V_{out} (4 V)	I_{out} (A)	V_{out} (10 V)	I_{out} (a)	P_{out} (W)	EFFICIENCY
230.9	53.99	3.741	0.3	4.081	0.2	11.7	0.04	1.284	0.343
230.9	73.18	5.736	0.34	4.069	0.392	11.71	0.082	2.555	0.445
230.9	92.36	7.712	0.362	4.063	0.593	11.72	0.12	3.816	0.495
230.9	111.43	9.672	0.376	4.059	0.798	11.72	0.158	5.091	0.526
230.9	131.37	11.757	0.388	4.057	1.012	11.71	0.202	6.471	0.550
230.9	147.89	13.494	0.396	4.055	1.178	11.68	0.242	7.603	0.563
230.9	168.43	15.674	0.403	4.054	1.41	11.67	0.283	9.019	0.575
230.9	185.91	17.538	0.409	4.053	1.599	11.66	0.323	10.247	0.584
230.9	203.7	19.432	0.414	4.053	1.792	11.65	0.362	11.480	0.591
230.9	222	21.4	0.418	4.052	2.002	11.64	0.398	12.745	0.596

Table 3. 90-V_{AC} Efficiency Data

V_{in} (V_{rms})	I_{in} (mArms)	P_{in} (W)	PF	V_{out} (4 V)	I_{out} (A)	V_{out} (10 V)	I_{out} (a)	P_{out} (W)	EFFICIENCY
90.4	92.95	3.695	0.44	4.086	0.211	11.74	0.041	1.343	0.364
90.36	134.14	5.562	0.459	4.074	0.38	11.73	0.08	2.487	0.447
90.31	184.32	7.869	0.473	4.065	0.614	11.75	0.119	3.894	0.495
90.26	226.7	9.846	0.481	4.061	0.798	11.72	0.161	5.128	0.521
90.22	269.9	11.909	0.489	4.059	1.006	11.73	0.195	6.371	0.535
90.17	313.8	14.169	0.501	4.057	1.214	11.71	0.238	7.712	0.544
90.13	354.4	16.496	0.517	4.056	1.423	11.68	0.283	9.077	0.550
90.09	389.7	18.549	0.528	4.055	1.605	11.66	0.322	10.262	0.553
90.05	427.7	20.72	0.538	4.054	1.789	11.64	0.361	11.455	0.553
90	474.2	23.33	0.546	4.052	2	11.64	0.398	12.737	0.546

2.3 Thermal Images

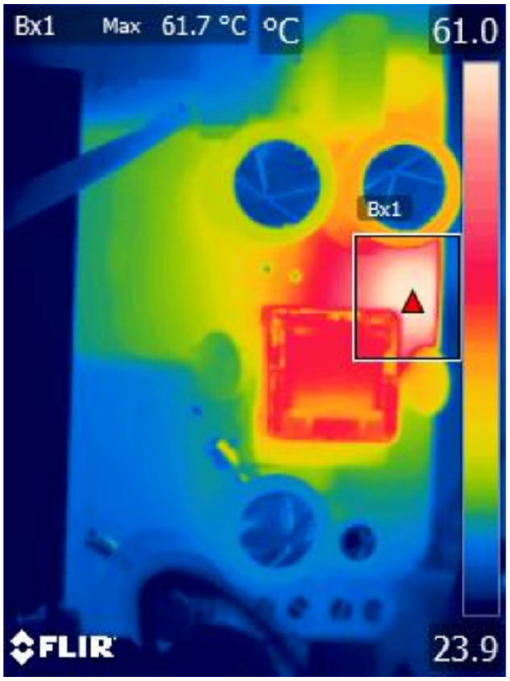

Figure 3. 90-V_{AC}, 60 Hz Front Side Thermal Picture

Figure 3 shows testing done at a nominal load of 4 V/0.2 A and 10 V/ 0.02 A.

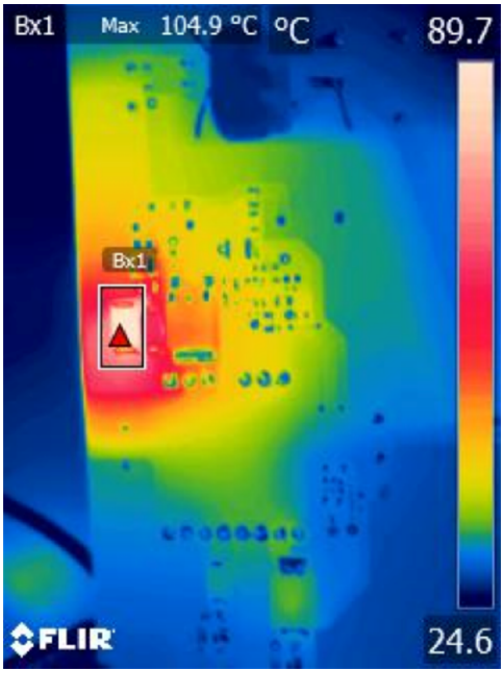

Figure 4. 90-V_{AC}, 60 Hz Back Side Thermal Picture

Figure 4 shows testing done at a nominal load of 4 V/0.2 A and 10 V/0.02 A.

3 Waveforms

3.1 Switching

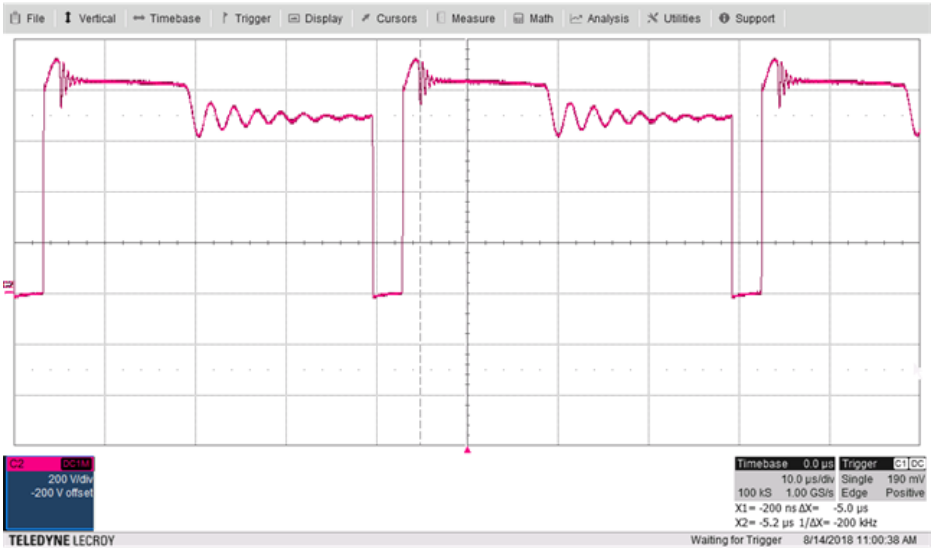

Figure 5. Switch Node Tested at 690 V_{DC}

Measurement was taken across the drain to source voltage of primary side MOSFET (Q1) in Figure 5.

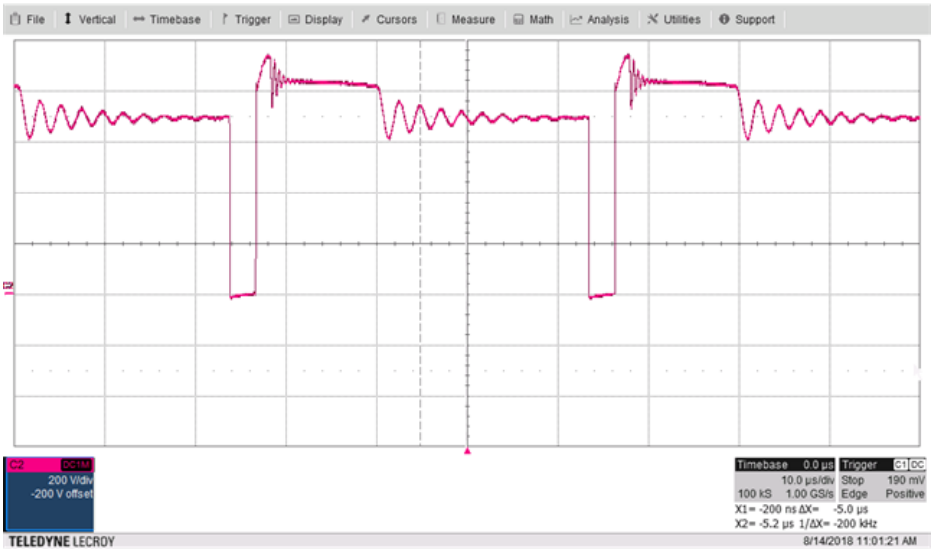

Figure 6. Switch Node Tested at 690 V_{DC} With Applied Magnetic Field

Measurement was taken across the drain to source voltage of primary side MOSFET (Q1) in Figure 6.

3.2 Diode Stress

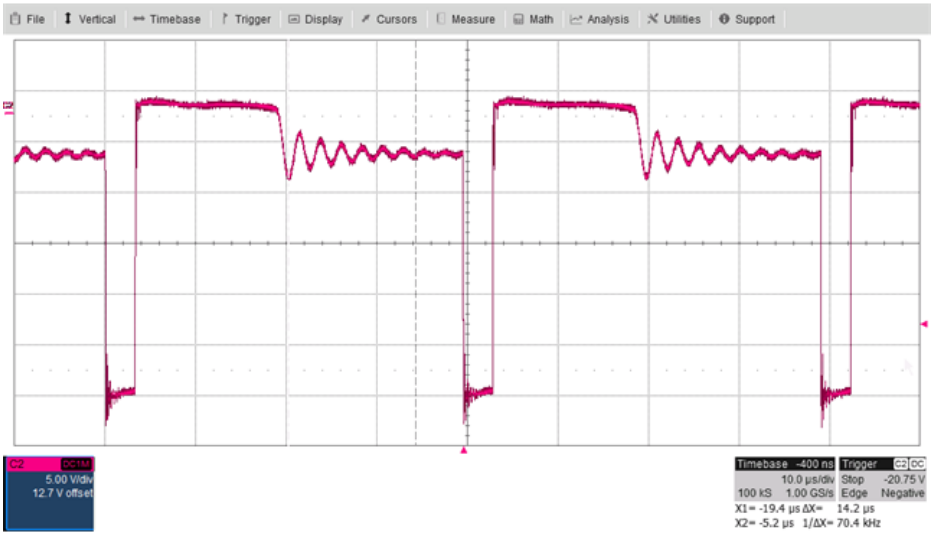

Figure 7. 4-V Output Diode (D2) Voltage Stress

Figure 7 shows testing done at 690-V_{DC} input with fully loaded output.

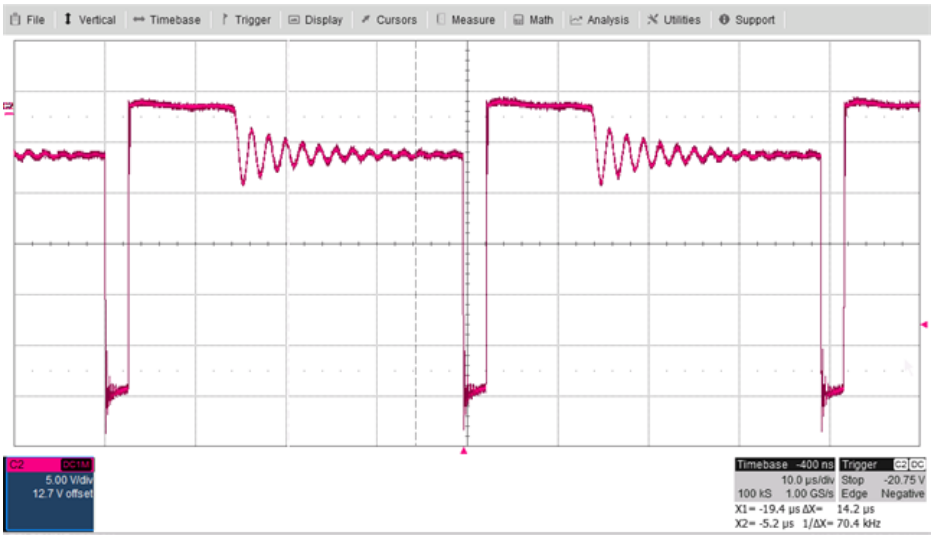

Figure 8. 4-V Output Diode (D2) Voltage Stress With Applied Magnetic Field

Figure 8 shows testing done at 690-V_{DC} input with fully loaded output.

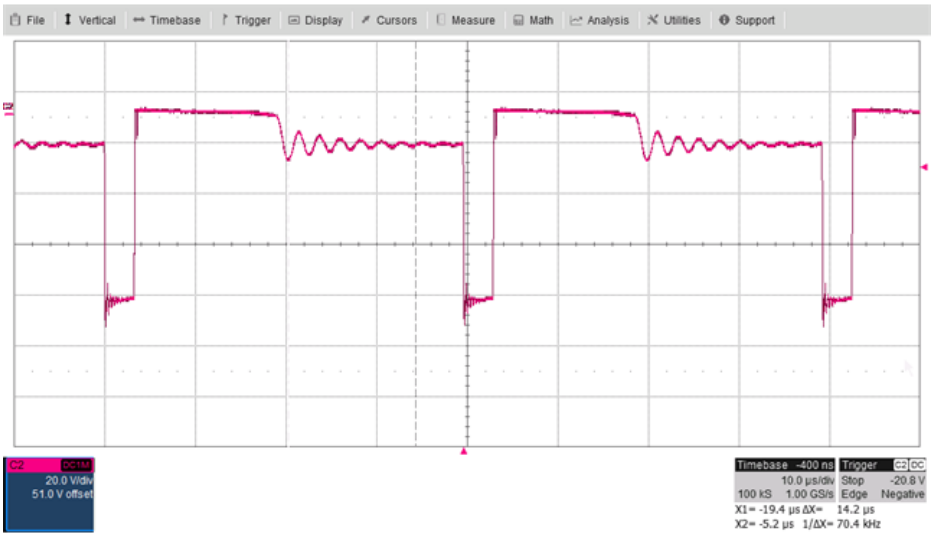

Figure 9. 10-V Output Diode (D4) Voltage Stress

Figure 9 shows testing done at 690-V_{DC} input with fully loaded output.

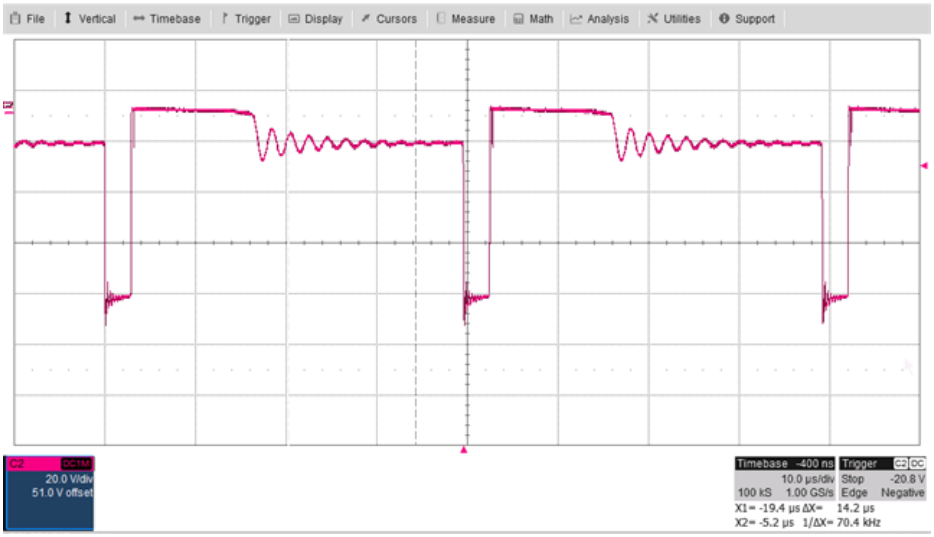

Figure 10. 10-V Output Diode (D4) Voltage Stress With Applied Magnetic Field

Figure 10 shows testing done at 690-V_{DC} input with fully loaded output.

3.3 Output Voltage Ripple

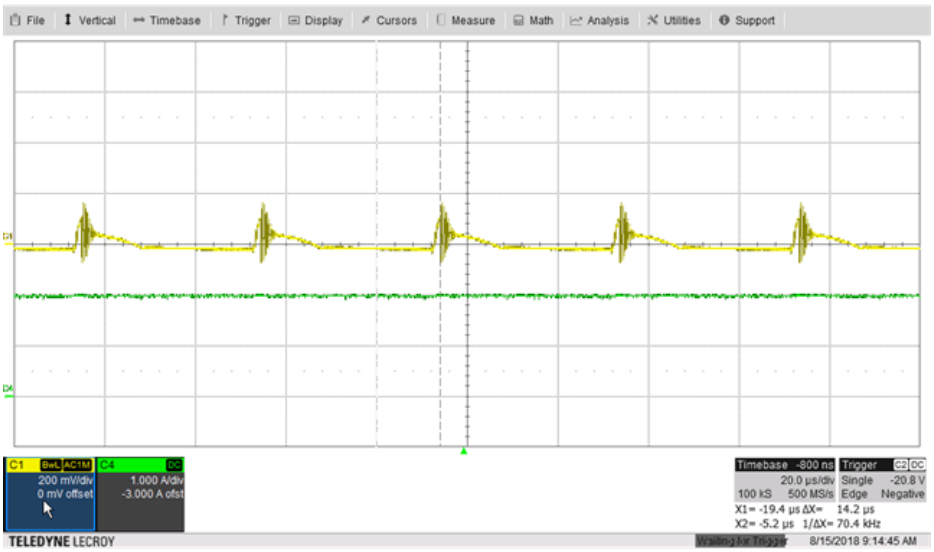

Figure 11. Ripple on 4-V Line

Figure 11 shows ripple tested at 230-V_{AC} input and fully loaded output.

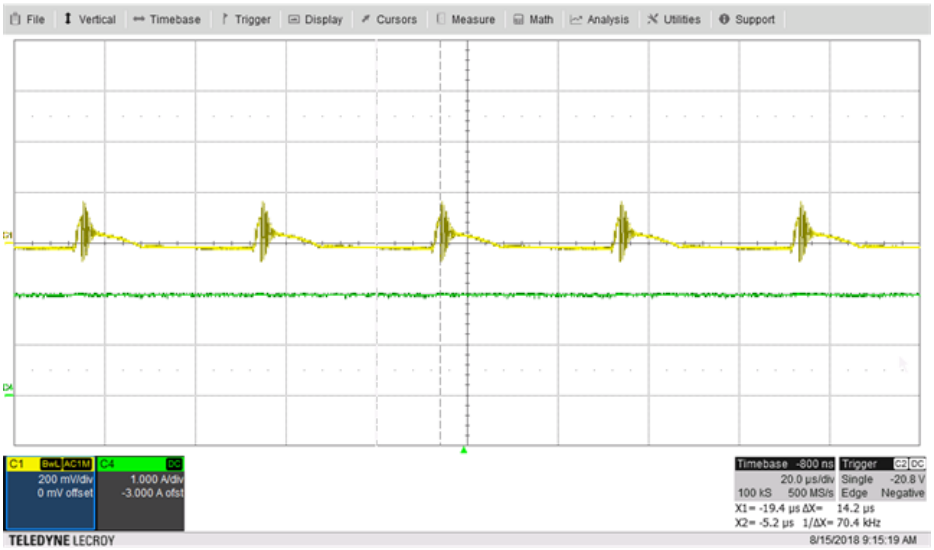

Figure 12. Ripple on 4-V Line With Applied Magnetic Field

Figure 12 shows ripple tested at 230-V_{AC} input and fully loaded output.

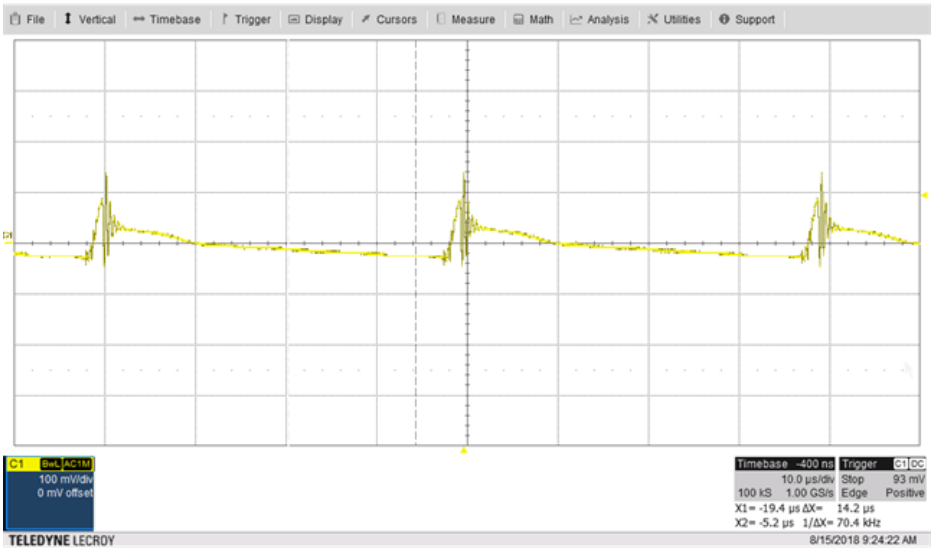

Figure 13. Ripple on 12-V Line

Figure 13 shows ripple tested at 230-V_{AC} input and fully loaded output.

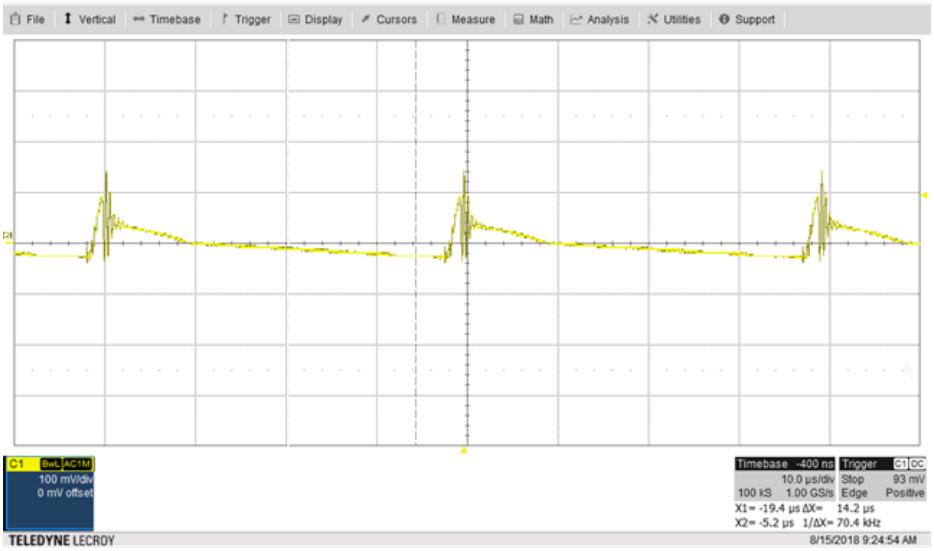

Figure 14. Ripple on 12-V Line With Applied Magnetic Field

Figure 14 shows ripple tested at 230-V_{AC} input and fully loaded output.

3.4 Bode Plot

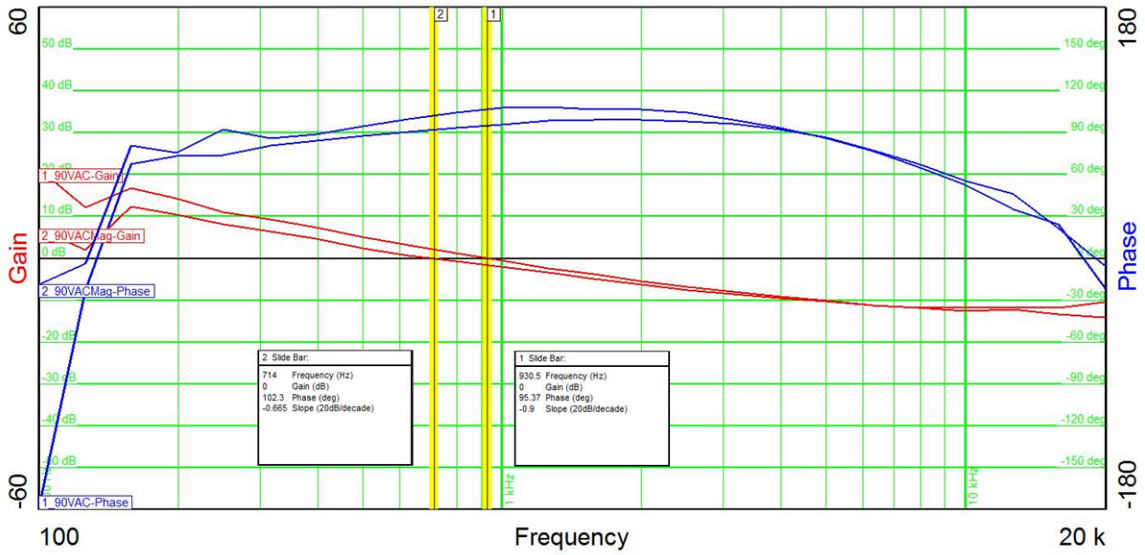

Figure 15. Bode Plot at 90 V_{AC}

Figure 15 shows testing done at 90-V_{AC} input and fully loaded output.

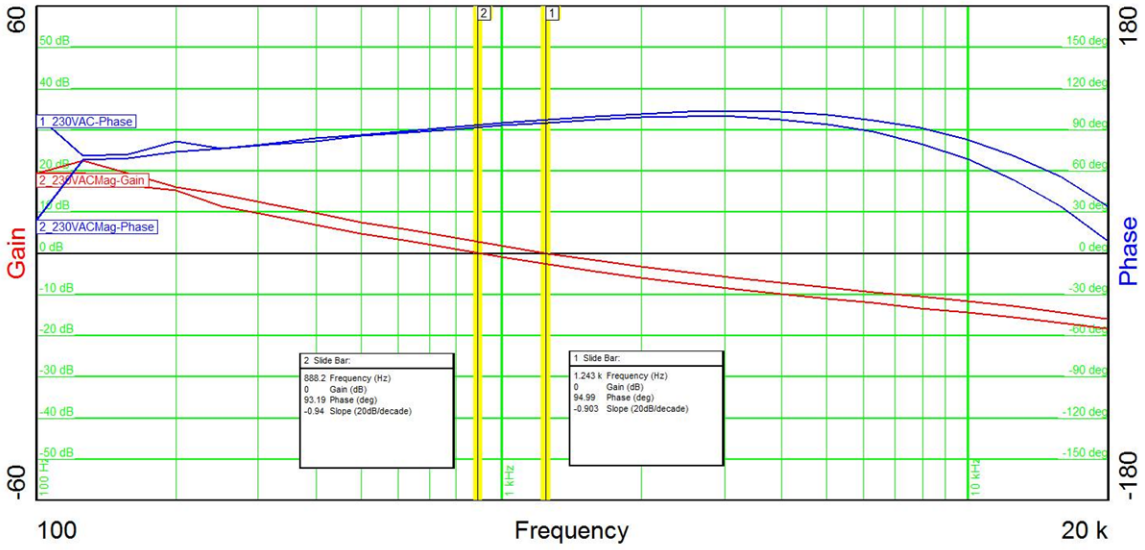

Figure 16. Bode Plot at 230 V_{AC}

Figure 16 shows testing done at 230-V_{AC} input and fully loaded output.

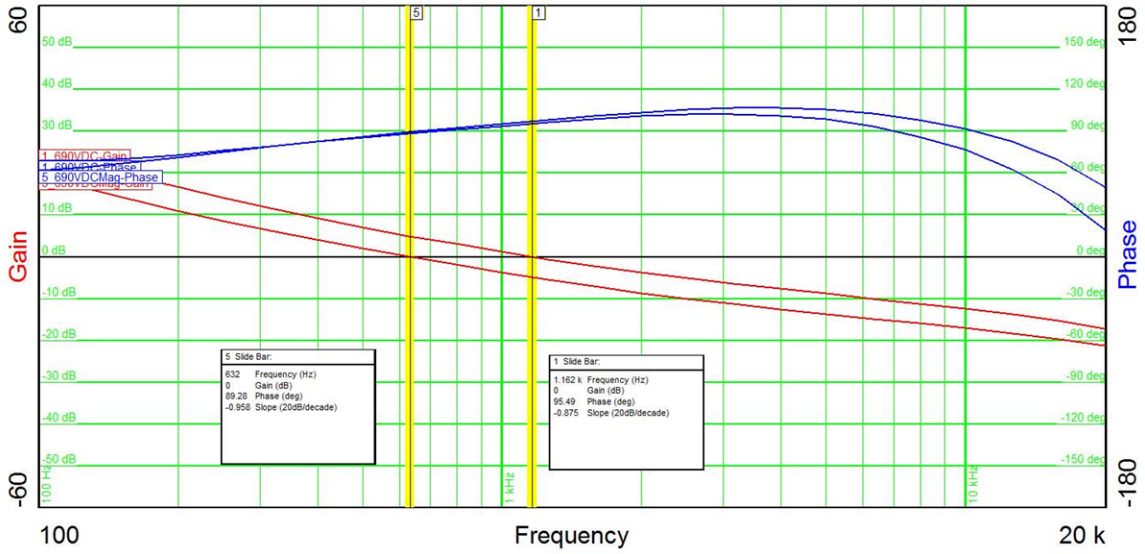

Figure 17. Bode Plot at 690 V_{DC}

Figure 17 shows testing done at 690-V_{DC} input and fully loaded output.

3.5 Load Transients

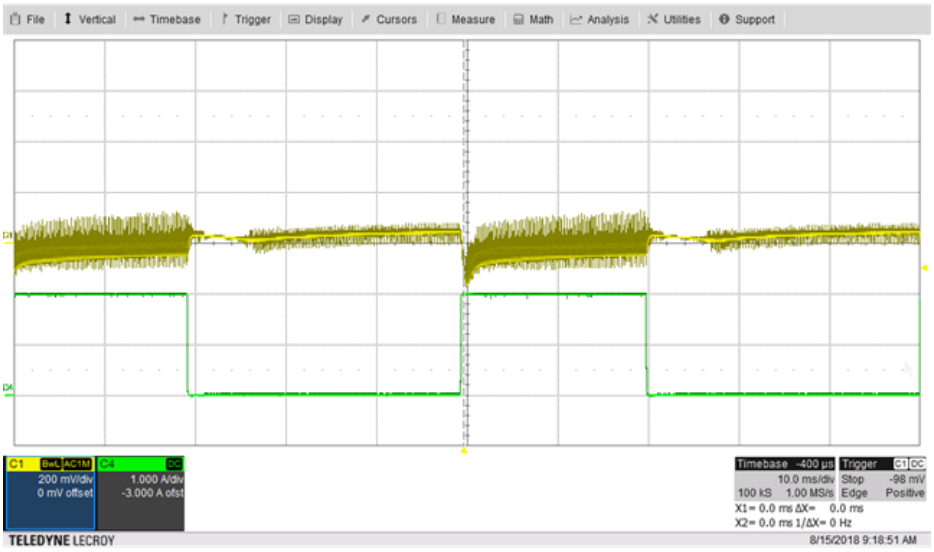

Figure 18. Load Transient on 4-V Line

Figure 18 shows load transient on a 4-V line switching between 0 A and 2 A.

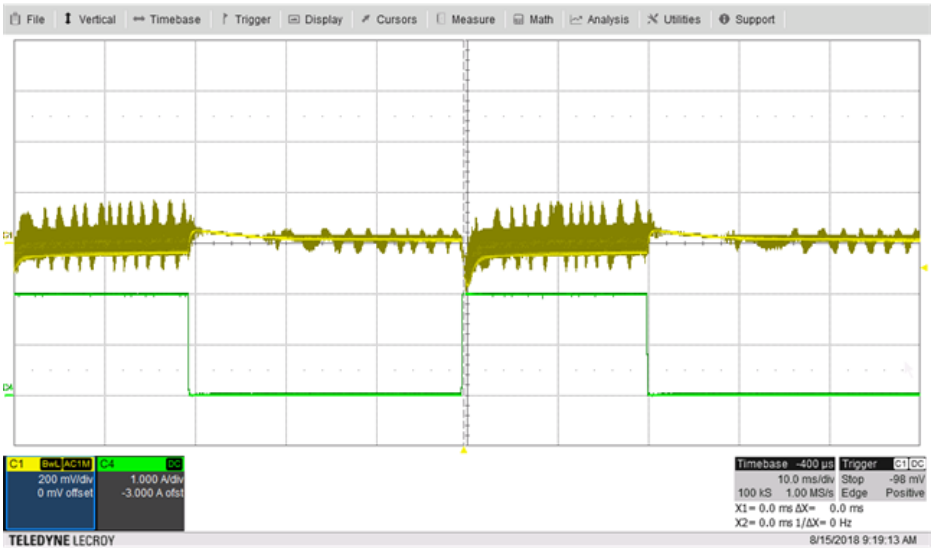

Figure 19. Load Transient on 4-V Line With Applied Magnetic Field

Figure 19 shows load transient on a 4-V line switching between 0 A and 2 A.

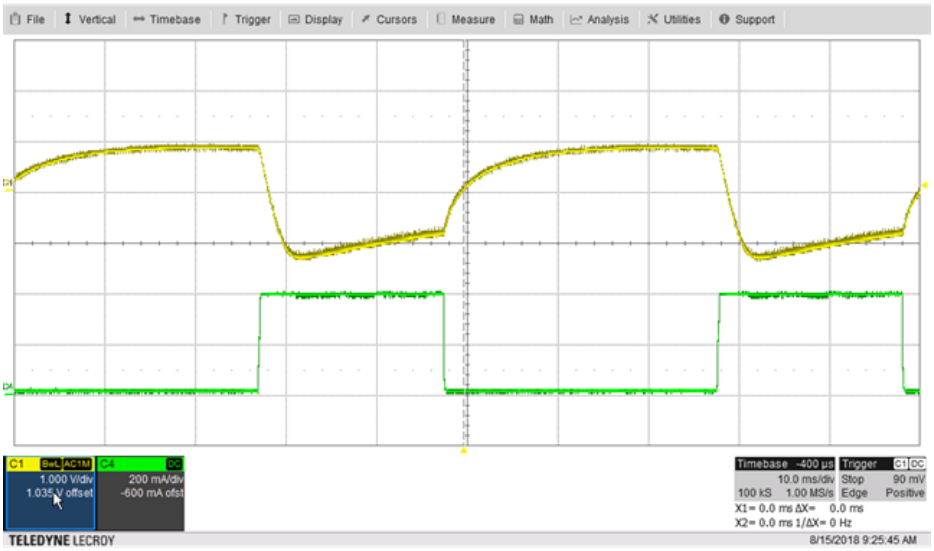

Figure 20. Load Transient on 10-V Line

Figure 20 shows load transient on a 10-V line switching between 0 A and 400 mA.

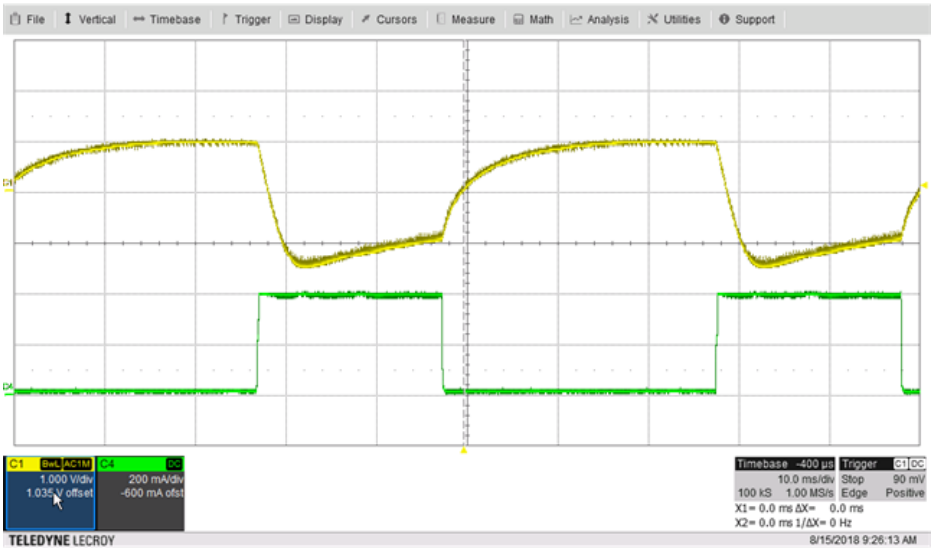

Figure 21. Load Transient on 10-V Line With Applied Magnetic Field

Figure 21 shows load transient on a 10-V line switching between 0 A and 400 mA.

3.6 Start-up and Shutdown

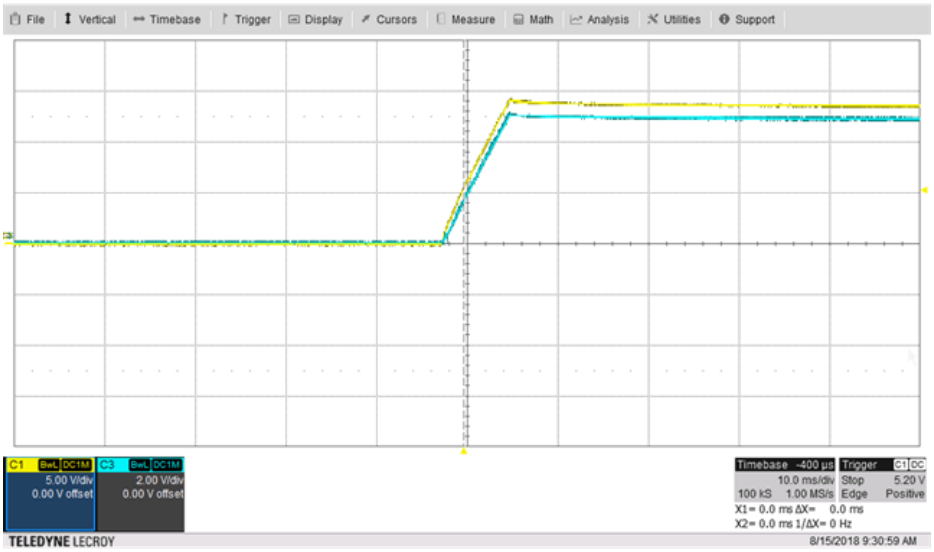

Figure 22. Start-up With No Load

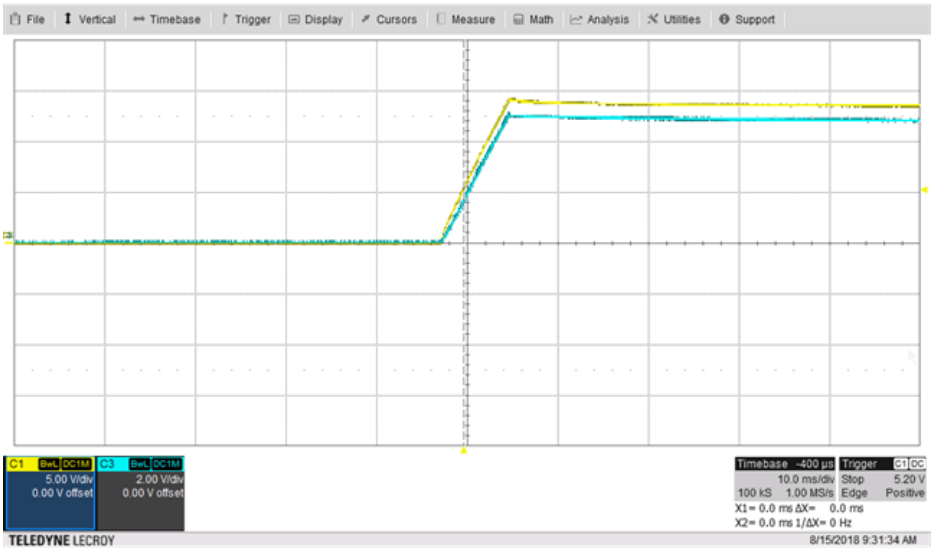

Figure 23. Start-up With No Load With Applied Magnetic Field

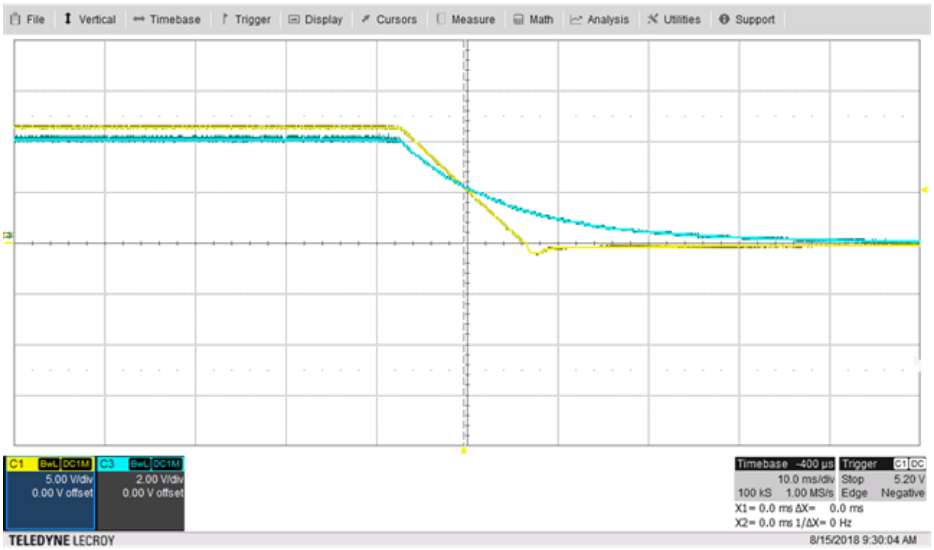

Figure 24. Shutdown With Full Load

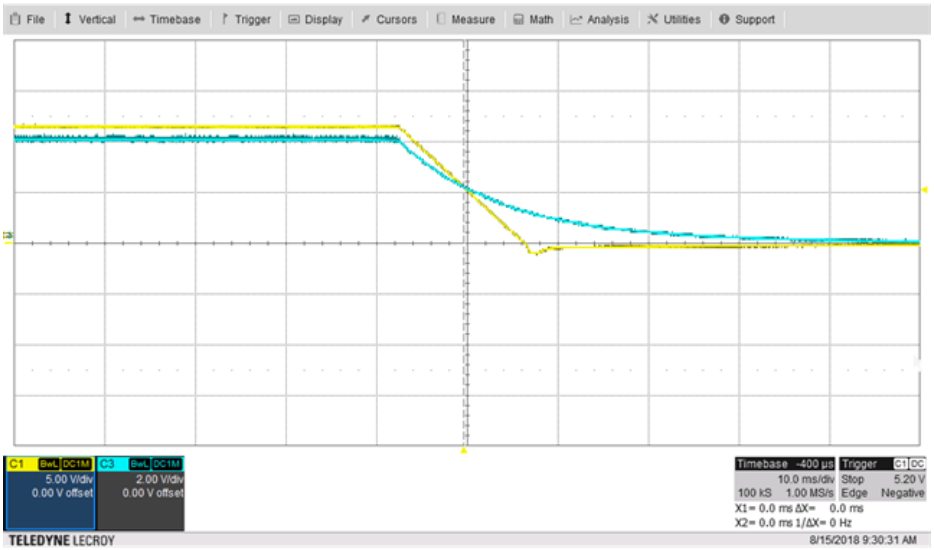

Figure 25. Shutdown With Full Load With Applied Magnetic Field

3.7 Conducted EMI

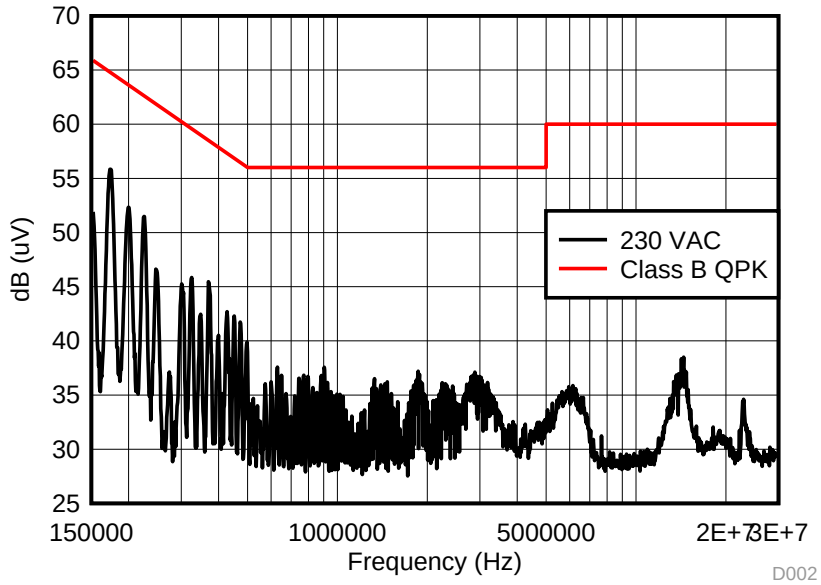

Figure 26. EMI at 230 V_{AC}

Figure 26 shows testing done at 230-V_{AC} input and fully loaded output.

3.8 Short Circuit Recovery

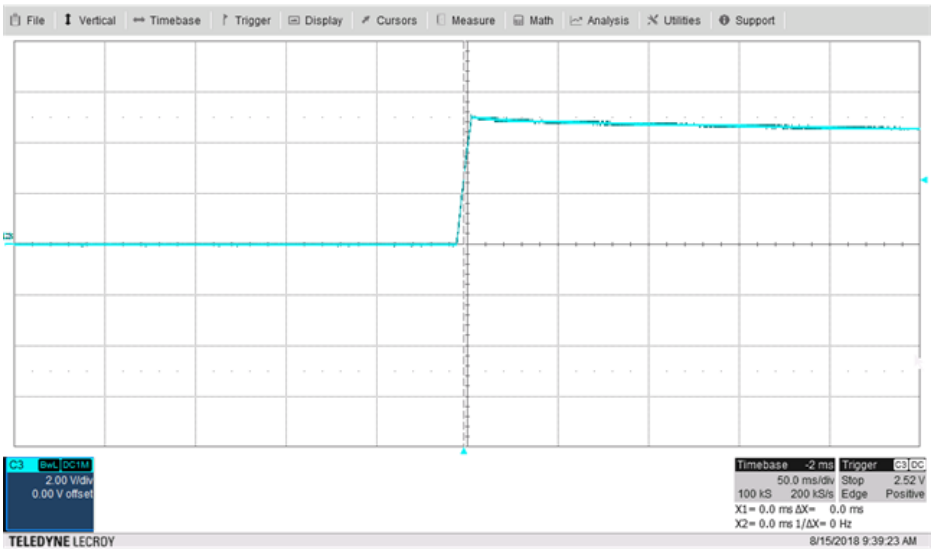

Figure 27. Short Circuit Recovery

Figure 27 shows testing done at 230-V_{AC} input.

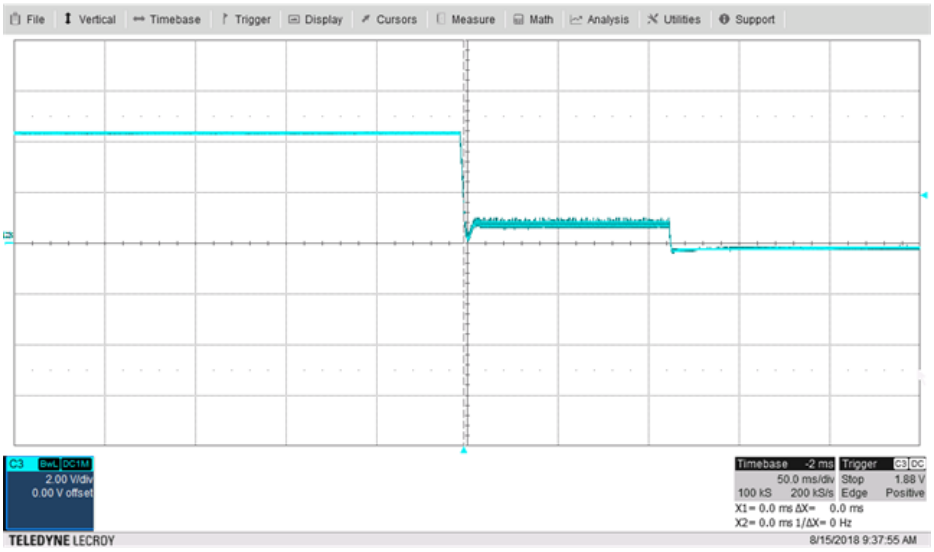

Figure 28. Short Circuit Applied

Figure 28 shows testing done at 230-V_{AC} input.

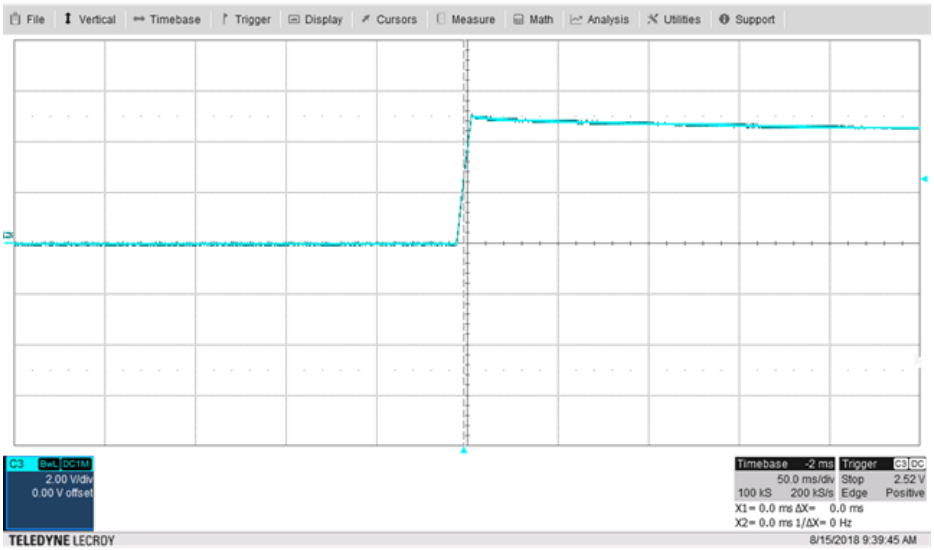

Figure 29. Short Circuit Recovery With Applied Magnetic Field

Figure 29 shows testing done at 230-V_{AC} input.

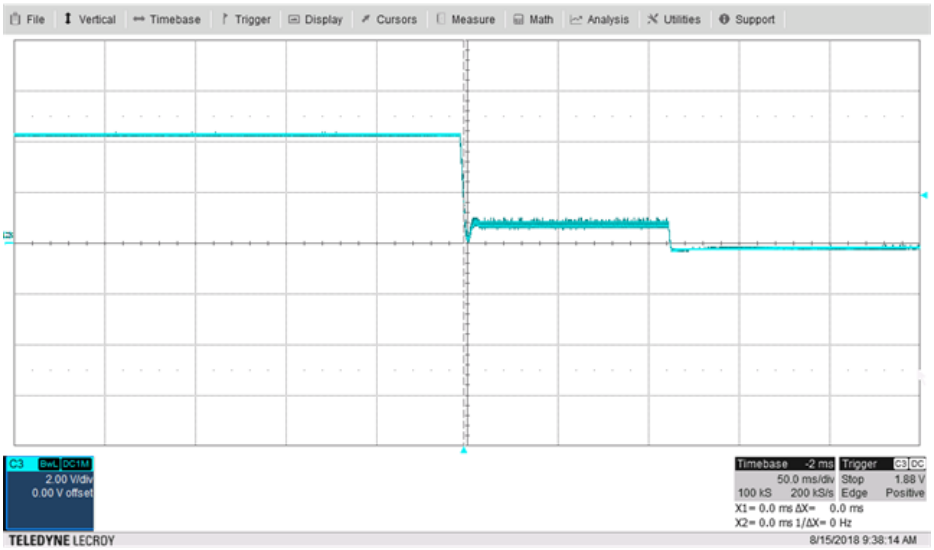

Figure 30. Short Circuit Applied With Applied Magnetic Field

Figure 30 shows testing done at 230-V_{AC} input.

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