Test Report: PMP21030

20-48-Vdc Input Isolated Flyback Reference Design With a 48-V, 1.25-A Output

Description

This reference design uses the LM3481 to provide an isolated 48 V output from a DC input ranging from 20 to 48 V. Its low profile design makes it suitable for end applications where small solution size is critical. The design achieves over 91% efficiency at a nominal 0.8 A load, and can provide a pulse up to 1.25 A.

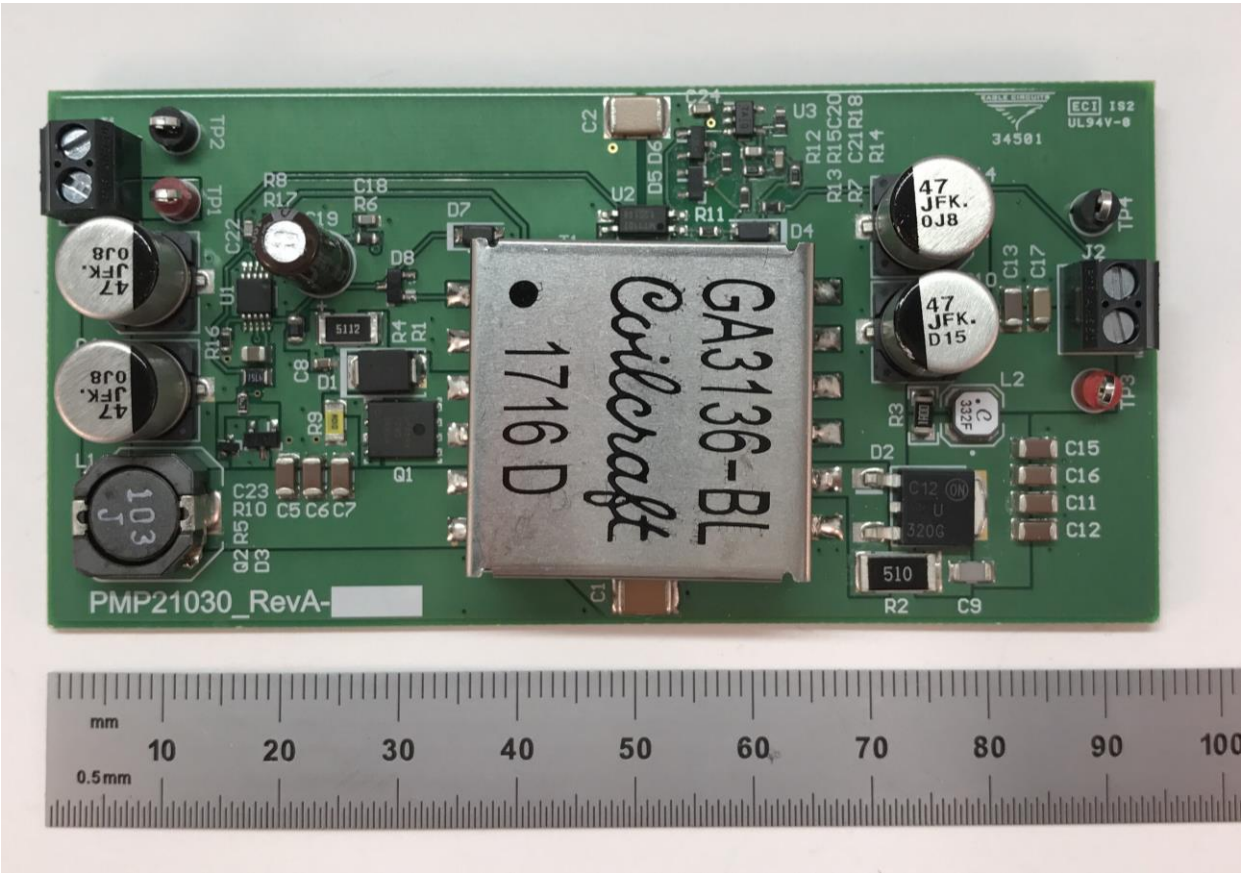

Figure 1. Board Top

1 Test Prerequisites

1.1 Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input Voltage Range	20 Vdc – 48 Vdc
Output Voltage 1	48V +/- 1%
Output Current 1	0.8 A nominal, 1.25 A max for 30s
Switching Frequency	150kHz

2 Testing and Results

2.1 Efficiency Graph

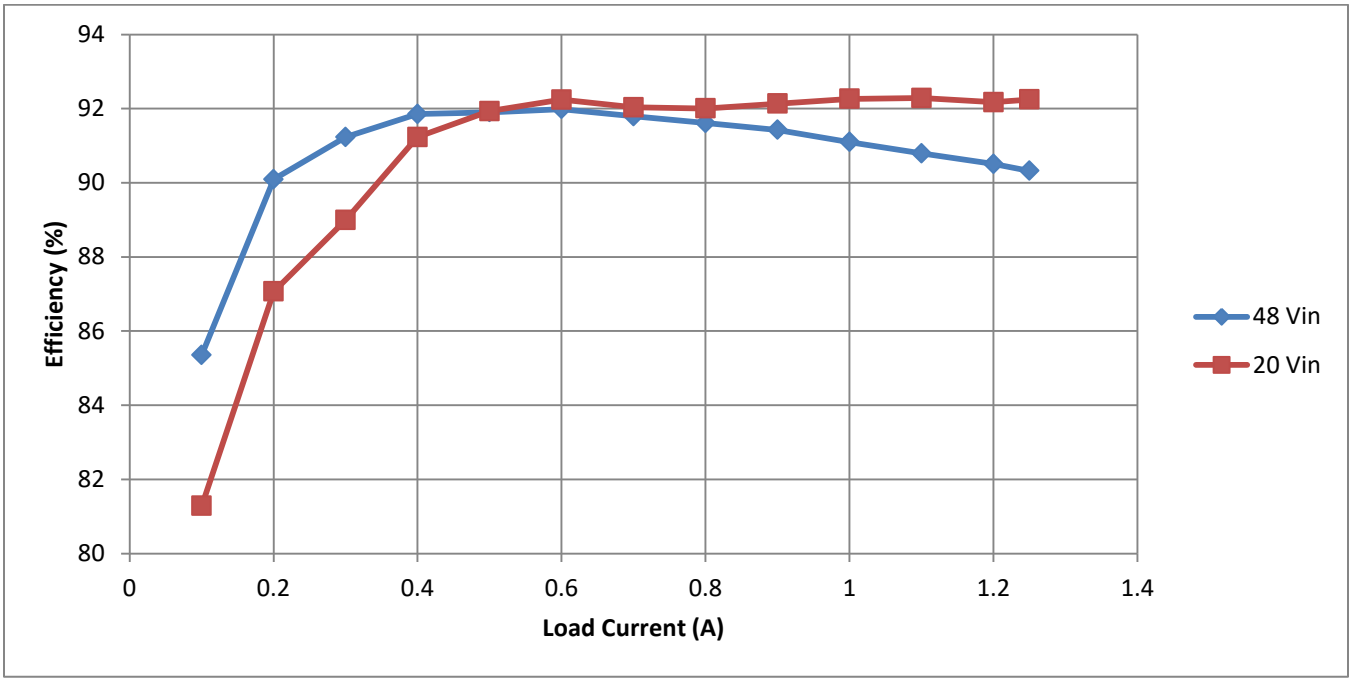

Figure 2. Efficiency for a 20 Vdc and 48 Vdc Input

2.2 Power Loss

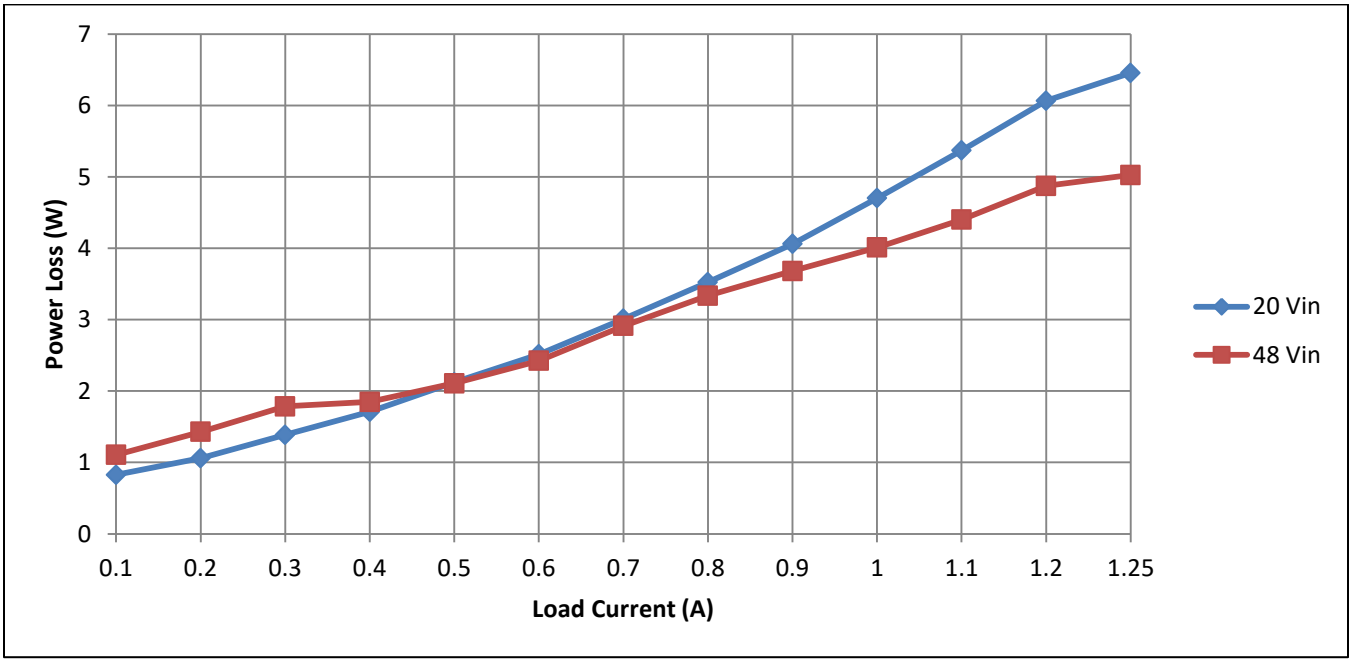

Figure 3. Power loss for a 20 Vdc and 48 Vdc Input

2.3 Efficiency Data

Vin (V)	Iin (A)	Pin (W)	Vout (V)	Iout (A)	Pout (W)	Efficiency (%)	Power loss (W)
20.00	0.027	0.54	48.07	0	0	0	0.54
20.00	0.282	5.64	48.14	0.1	4.814	85.35461	0.826
20.00	0.534	10.68	48.11	0.2	9.622	90.09363	1.058
20.00	0.791	15.82	48.11	0.3	14.433	91.23262	1.387
20.00	1.048	20.96	48.13	0.4	19.252	91.85115	1.708
20.00	1.309	26.18	48.12	0.5	24.06	91.90222	2.12
20.00	1.569	31.38	48.11	0.6	28.866	91.98853	2.514
20.00	1.834	36.68	48.1	0.7	33.67	91.79389	3.01
20.00	2.101	42.02	48.12	0.8	38.496	91.61352	3.524
20.00	2.367	47.34	48.09	0.9	43.281	91.42586	4.059
20.00	2.640	52.8	48.1	1	48.1	91.09848	4.7
20.00	2.915	58.3	48.12	1.1	52.932	90.79245	5.368
20.00	3.194	63.88	48.18	1.2	57.816	90.5072	6.064
20.00	3.334	66.68	48.18	1.25	60.225	90.31944	6.455
48.01	0.013	0.62413	48.06	0	0	0	0.62413
48.00	0.123	5.904	47.99	0.1	4.799	81.28388	1.105
48.00	0.230	11.04	48.06	0.2	9.612	87.06522	1.428
48.00	0.338	16.224	48.13	0.3	14.439	88.99778	1.785
48.00	0.439	21.072	48.06	0.4	19.224	91.23007	1.848
48.00	0.544	26.112	48.01	0.5	24.005	91.93091	2.107
48.00	0.651	31.248	48.04	0.6	28.824	92.2427	2.424
48.00	0.762	36.576	48.09	0.7	33.663	92.03576	2.913
48.00	0.869	41.712	47.97	0.8	38.376	92.0023	3.336
48.00	0.975	46.8	47.91	0.9	43.119	92.13462	3.681
48.00	1.080	51.84	47.83	1	47.83	92.26466	4.01
48.00	1.188	57.024	47.84	1.1	52.624	92.28395	4.4
48.00	1.297	62.256	47.82	1.2	57.384	92.17425	4.872
48.00	1.350	64.8	47.82	1.25	59.775	92.24537	5.025

3 Waveforms

3.1 Switching

The switch node was measured across Q1 with the 48 V output at full load.

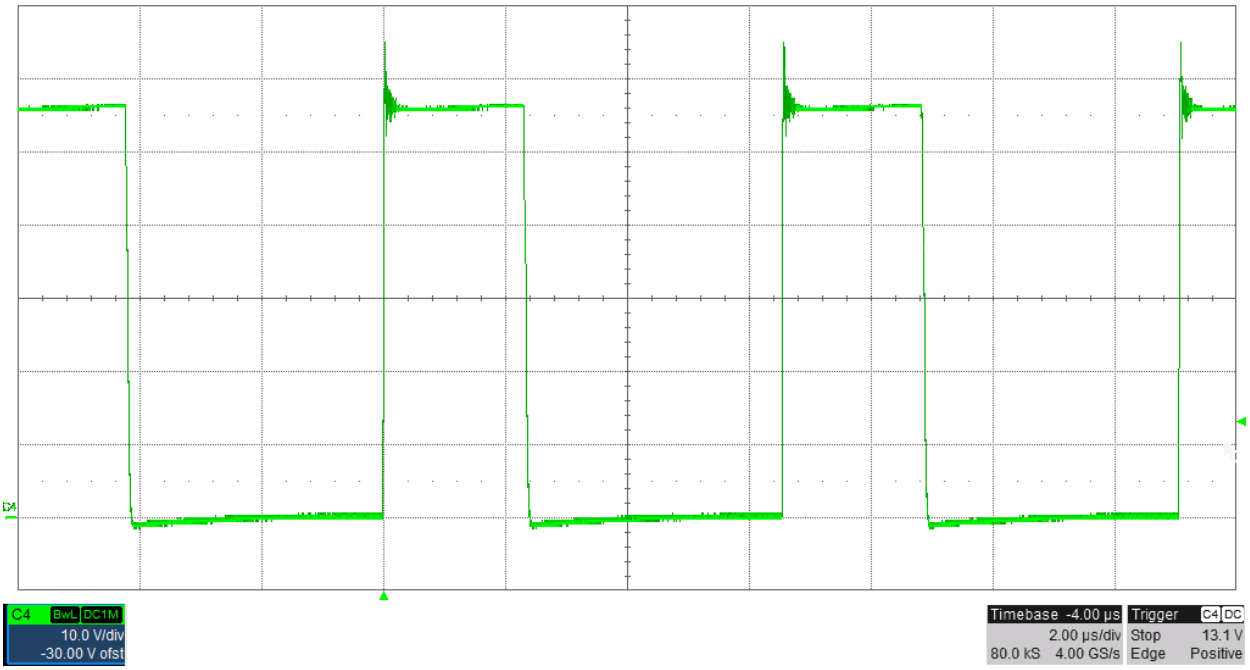

Figure 4. Switching waveform with 20 V input

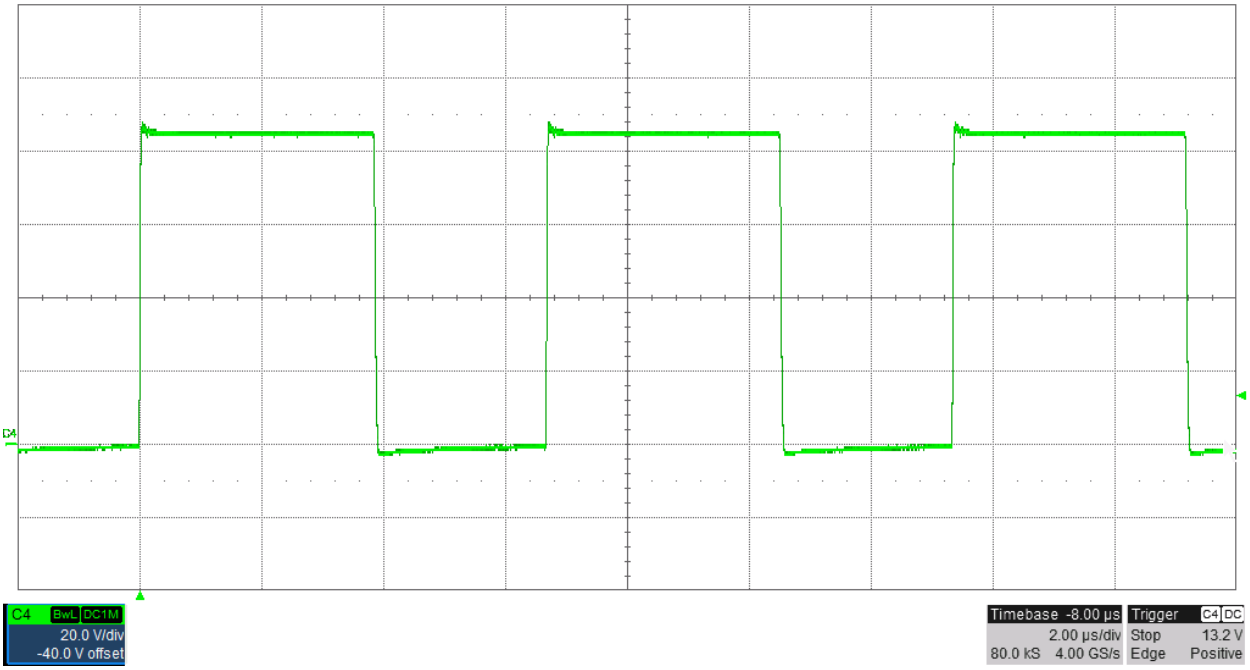

Figure 5. Switching waveform with 48 V input

3.2 Output Voltage Ripple

Measurements were taken using the tip and barrel method across C17 with the 48 V output at full load

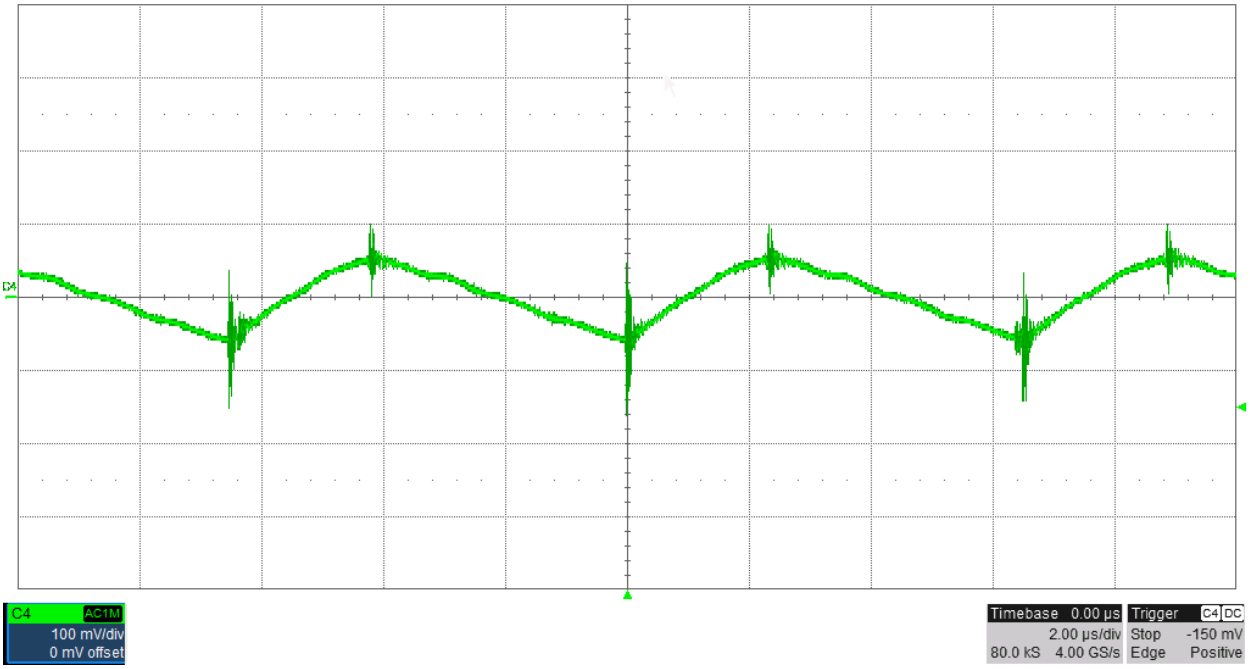

Figure 6. Output ripple with 20 V input

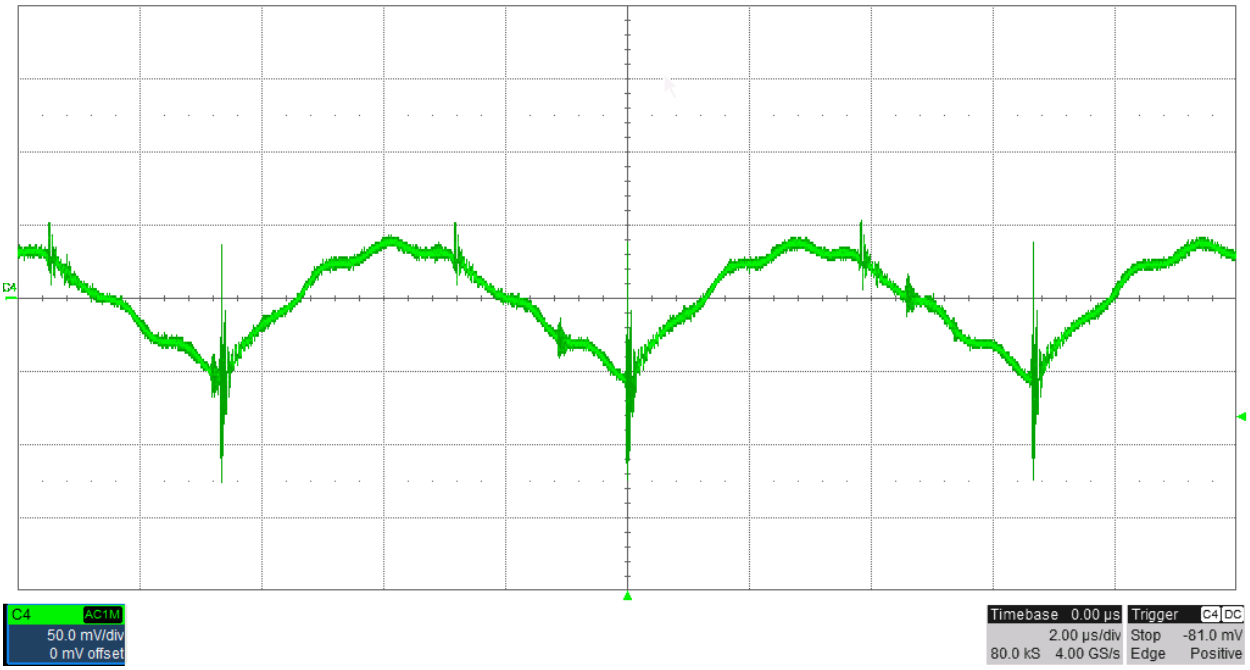

Figure 7. Output ripple with 48 V input

3.3 Bode Plot

Figures 8 and 9 show the frequency response for the 48 V output at full load for a 20 V and 48 V input, respectively. For 20 V input, the loop had a bandwidth of 3.602 kHz and a phase margin of 65°. For 48 V input, the loop had a bandwidth of 5.401 kHz and a phase margin of 75°.

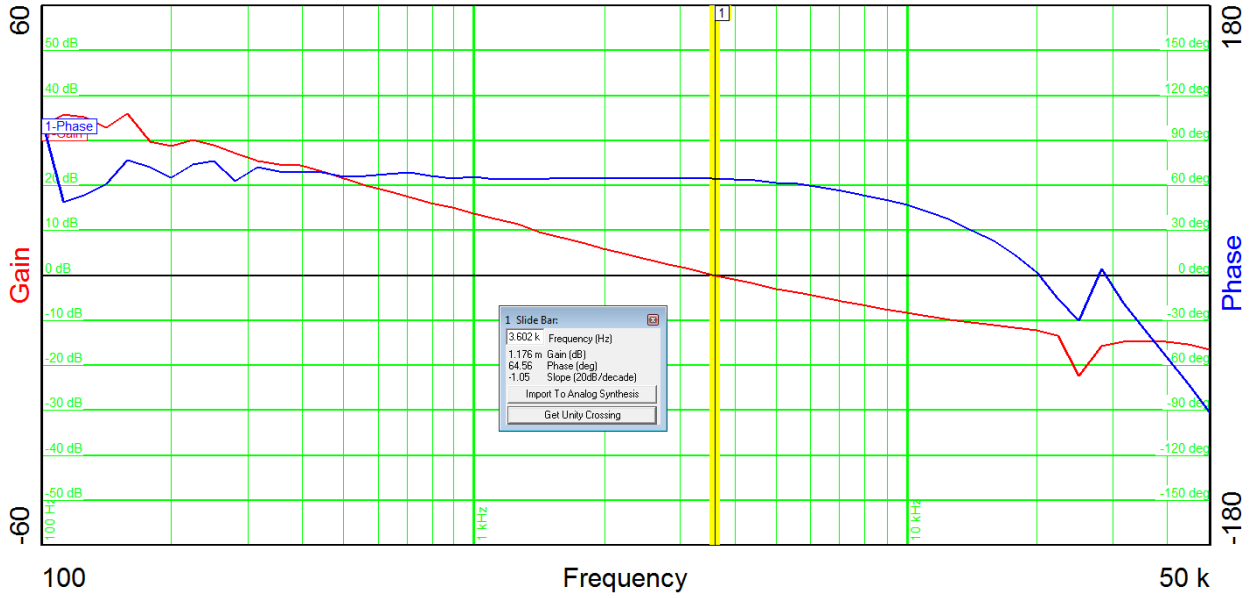

Figure 8. Frequency response with 20 V input

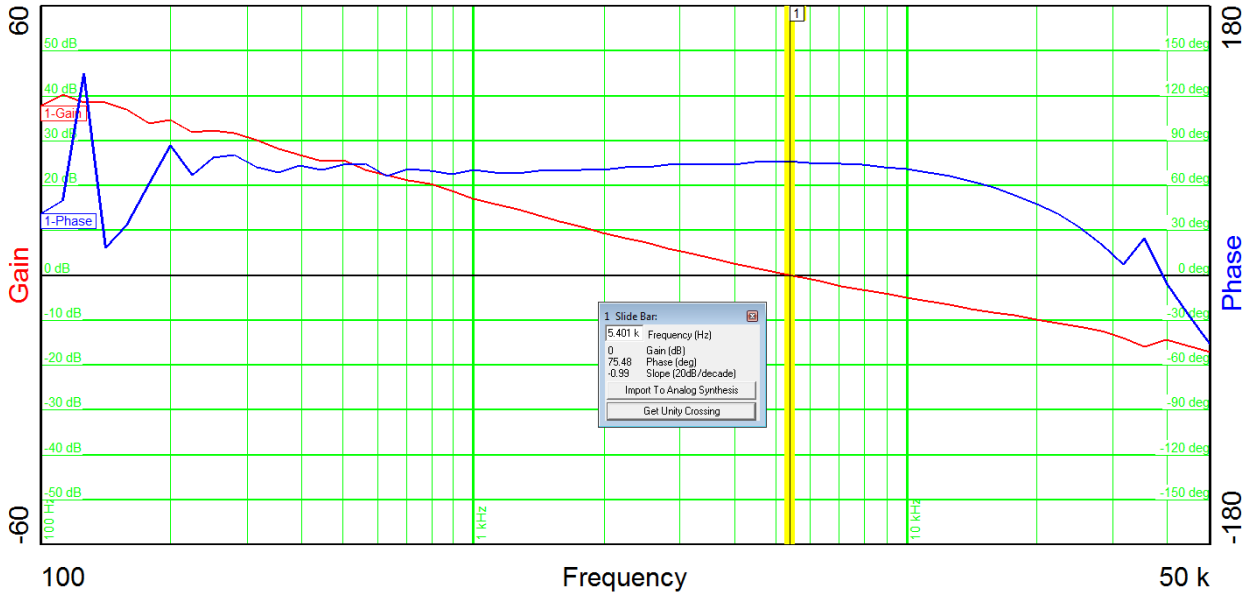

Figure 9. Frequency response with 48 V input

3.4 Load Transients

For these tests the load current on the 48 V output was stepped between 0.2 A and 0.8 A. The output voltage (AC coupled) shows the response of the converter.

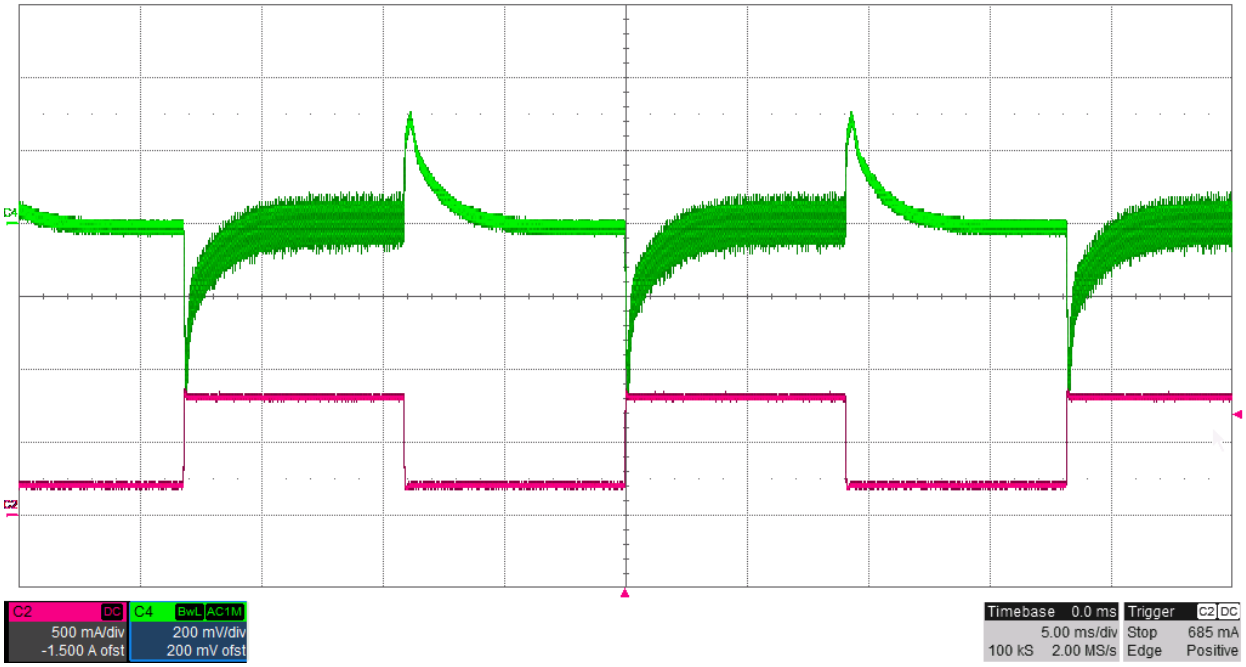

Figure 10. Load step with 20 V input

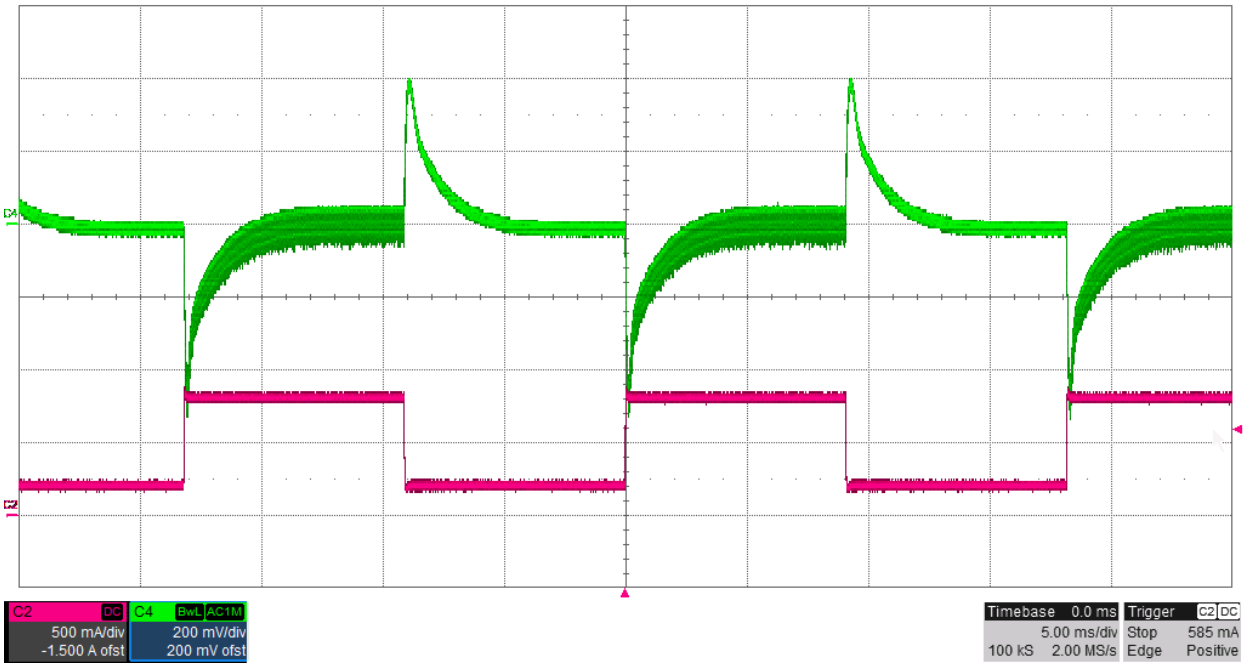

Figure 11. Load step with 48 V input

3.5 Startup Sequence

Startup sequencing was measured by applying a 48 Vdc source to the input. A load resistor was attached to the output to simulate starting with a 0.8 A load.

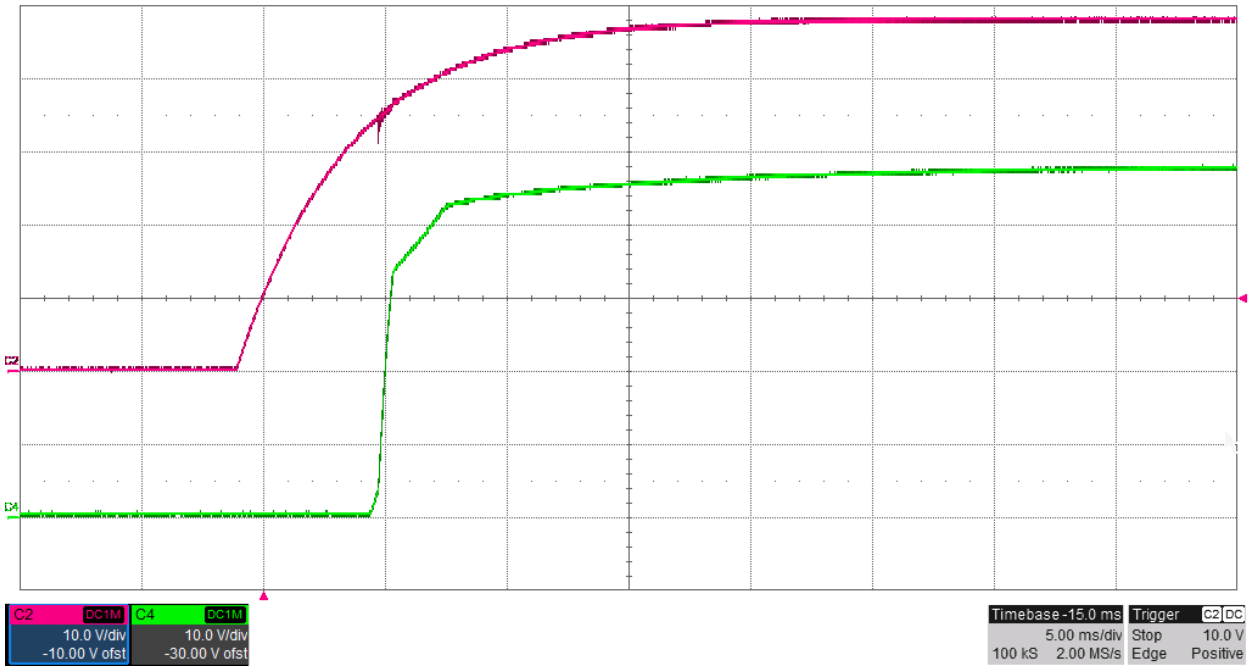

Figure 12. Startup Sequence

3.6 Thermal Image

Thermal images were captured after 15 minutes of operation with a 0.8 A load on the 48 V output. Room temp was 25° C and no airflow was present.

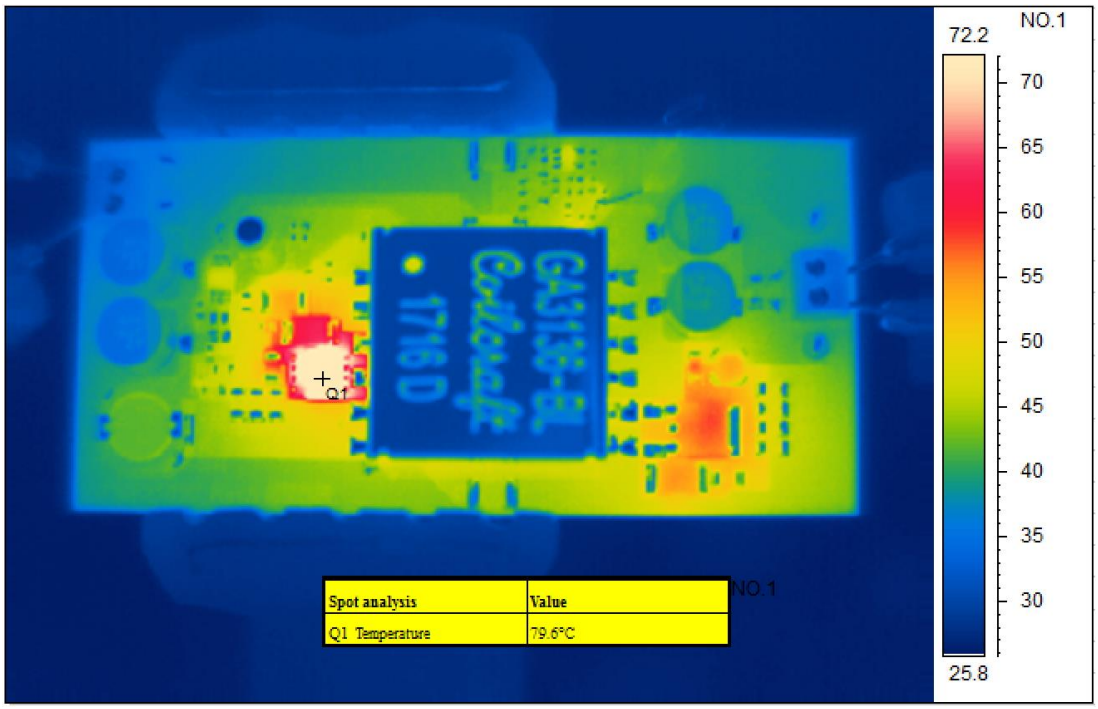

Figure 13. Thermal image with 20 V input

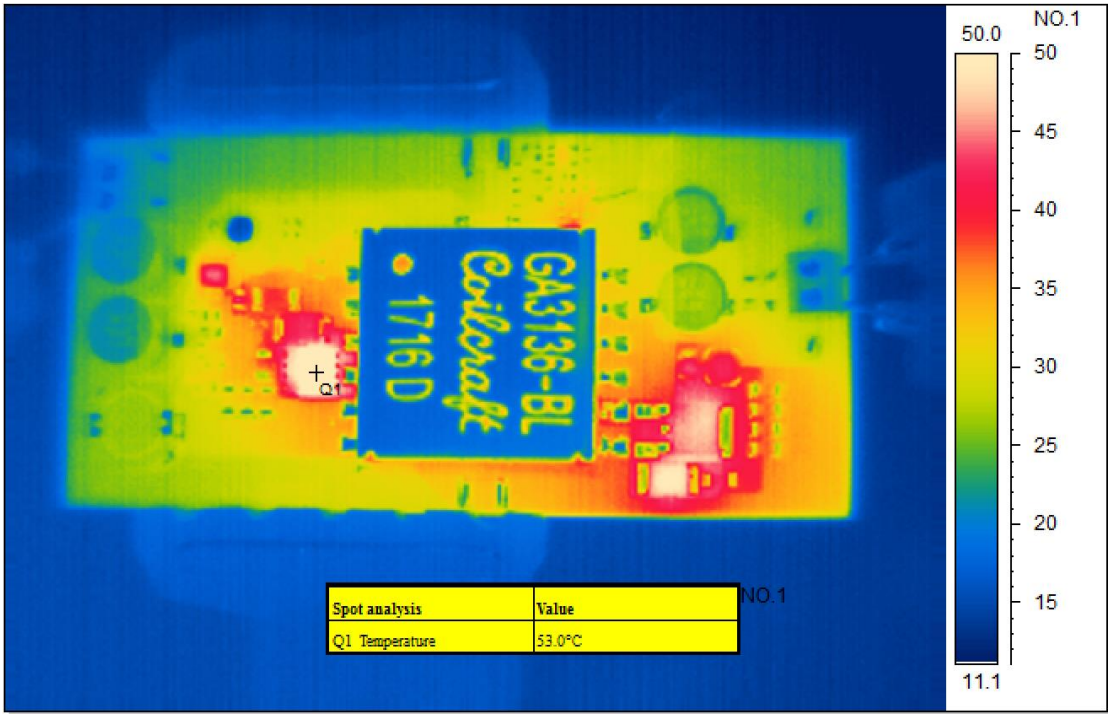

Figure 14. Thermal image with 48 V input

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