Test Report: PMP23397

Wide-Input 6-W Non-synchronous Buck Converter Reference Design

Description

This reference design uses the UCC28C52 configured as a non-synchronous buck converter to convert a wide 20-V to 150-V input to a 12-V output capable of 6-W loading. The approach minimizes the number of parts required which enables a compact design size.

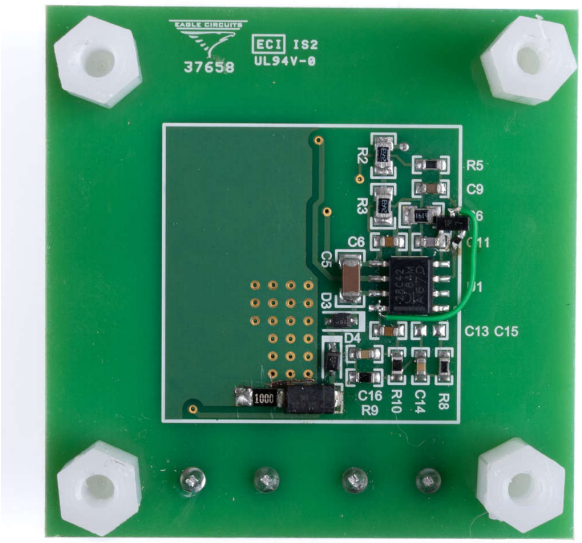
Features

- Compact 1-in by 1-in design size with a 0.3-in maximum component height
- Less than 100-mV peak-to-peak ripple voltage

Applications

- DC wallbox charger
- Battery energy storage system
- Fault indicator (FI)

Top of Board



Bottom of Board

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input Voltage Range	20 Vdc to 150 Vdc
Output Voltage	12 Vdc (nominal)
Maximum Output Current	500 mA

1.2 Dimensions

The PCB is a two-layer, 1-oz per layer design. The dimensions are 1 in × 1 in with a maximum component height of 0.3 in.

2 Testing and Results

2.1 Efficiency Graphs

Figure 2-1 shows the efficiency graph.

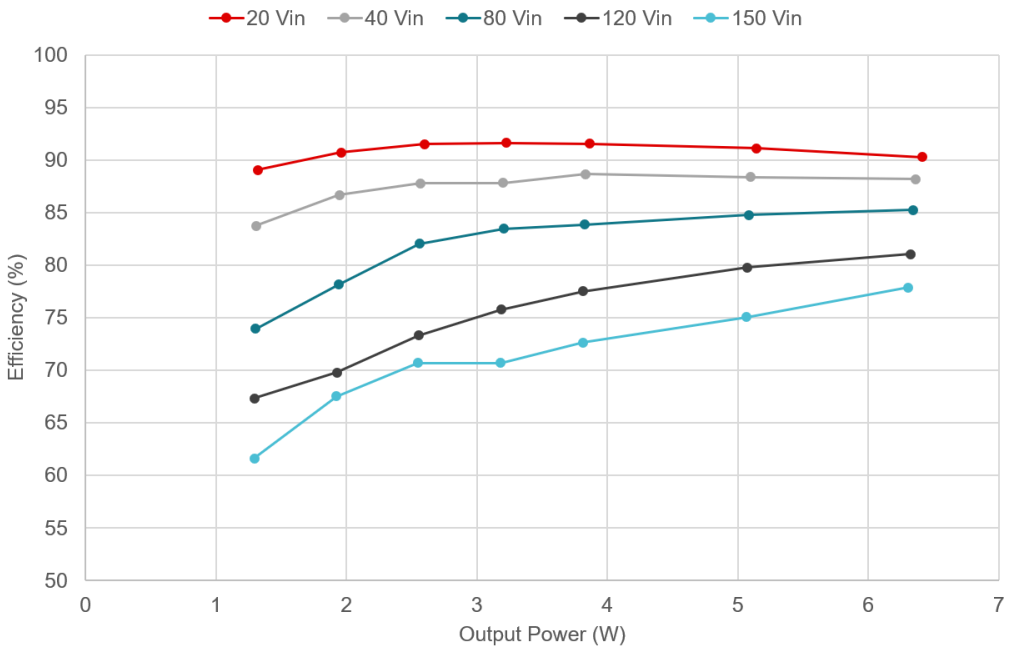


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

Efficiency data is shown in the following tables.

Table 2-1. 20-Vdc Input

V_{IN} (V)	I_{IN} (mA)	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	P_{OUT} (W)	Loss (W)	Efficiency (%)
20.000	17.04	0.341	16.528	0	0.000	0.341	0.000
20.001	74	1.480	12.923	102	1.318	0.162	89.059
20.001	108	2.160	12.893	152	1.960	0.200	90.724
20.001	142	2.840	12.871	202	2.600	0.240	91.543
20.001	176	3.520	12.854	251	3.226	0.294	91.653
20.001	211	4.220	12.84	301	3.865	0.355	91.579
20.002	282	5.641	12.817	401	5.140	0.501	91.119
20.003	355	7.101	12.798	501	6.412	0.689	90.293

Table 2-2. 40-Vdc Input

V_{IN} (V)	I_{IN} (mA)	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	P_{OUT} (W)	Loss (W)	Efficiency (%)
40.029	2.46	0.098	13.711	0	0.000	0.098	0.000
40.051	39	1.562	12.824	102	1.308	0.254	83.742
40.051	56	2.243	12.794	152	1.945	0.298	86.706
40.052	73	2.924	12.773	201	2.567	0.356	87.810
40.053	91	3.645	12.756	251	3.202	0.443	87.844
40.054	108	4.326	12.741	301	3.835	0.491	88.654
40.056	144	5.768	12.715	401	5.099	0.669	88.396
40.059	180	7.211	12.693	501	6.359	0.851	88.192

Table 2-3. 80-Vdc Input

V_{IN} (V)	I_{IN} (mA)	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	P_{OUT} (W)	Loss (W)	Efficiency (%)
80.061	2.10	0.168	14.576	0	0.000	0.168	0.000
80.004	22	1.760	12.765	102	1.302	0.458	73.975
80.004	31	2.480	12.756	152	1.939	0.541	78.178
80.005	39	3.120	12.737	201	2.560	0.560	82.051
80.007	48	3.840	12.721	252	3.206	0.635	83.474
80.008	57	4.560	12.708	301	3.825	0.735	83.876
80.013	75	6.001	12.686	401	5.087	0.914	84.771
80.021	93	7.442	12.665	501	6.345	1.097	85.262

Table 2-4. 120-Vdc Input

V_{IN} (V)	I_{IN} (mA)	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	P_{OUT} (W)	Loss (W)	Efficiency (%)
120.09	2.26	0.271	15.475	0	0.000	0.271	0.000
120.00	16	1.920	12.676	102	1.293	0.627	67.341
120.00	23	2.760	12.675	152	1.927	0.833	69.804
120.00	29	3.480	12.694	201	2.551	0.929	73.319
120.01	35	4.200	12.684	251	3.184	1.017	75.796
120.01	41	4.920	12.673	301	3.815	1.106	77.526
120.01	53	6.361	12.654	401	5.074	1.286	79.777
120.01	65	7.801	12.621	501	6.323	1.478	81.059

Table 2-5. 150-Vdc Input

V_{IN} (V)	I_{IN} (mA)	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (mA)	P_{OUT} (W)	Loss (W)	Efficiency (%)
150.11	2.74	0.411	16.134	0	0.000	0.411	0.000
150.00	14	2.100	12.686	102	1.294	0.806	61.618
150.00	19	2.850	12.660	152	1.924	0.926	67.520
150.01	24	3.600	12.665	201	2.546	1.055	70.708
150.01	30	4.500	12.678	251	3.182	1.318	70.710
150.01	35	5.250	12.670	301	3.814	1.437	72.636
150.00	45	6.750	12.637	401	5.067	1.683	75.073
150.00	54	8.100	12.590	501	6.308	1.792	77.871

2.3 Thermal Images

Thermal images in Figure 2-2 and Figure 2-3 were captured after 10-minutes of operation at full loading conditions.

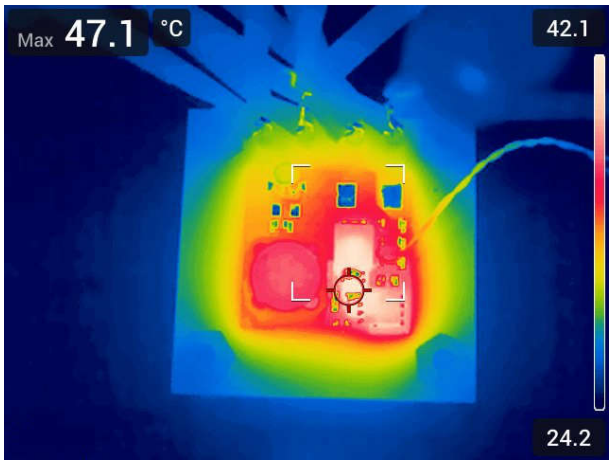


Figure 2-2. Thermal Image 40-Vdc Input

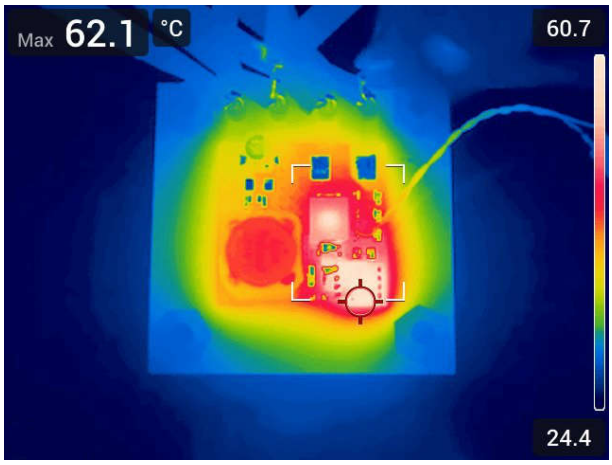


Figure 2-3. Thermal Image 150-Vdc Input

3 Waveforms

3.1 Switching

The following switching node image was captured at full loading conditions.

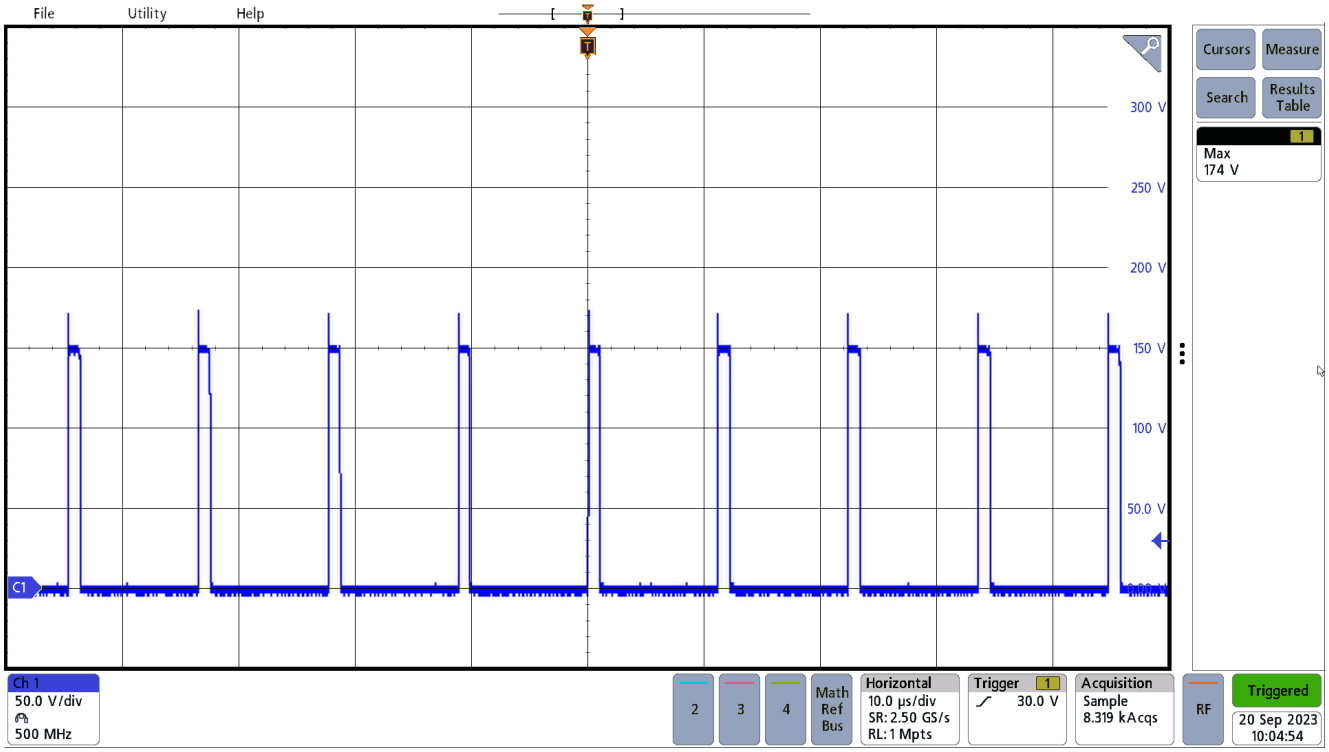


Figure 3-1. 150-Vdc Input

3.2 Output Voltage Ripple

Output voltage waveforms along with switching node are shown in the following images.

- Channel 1 (blue): Switching node
- Channel 2 (cyan): Output (AC coupled)

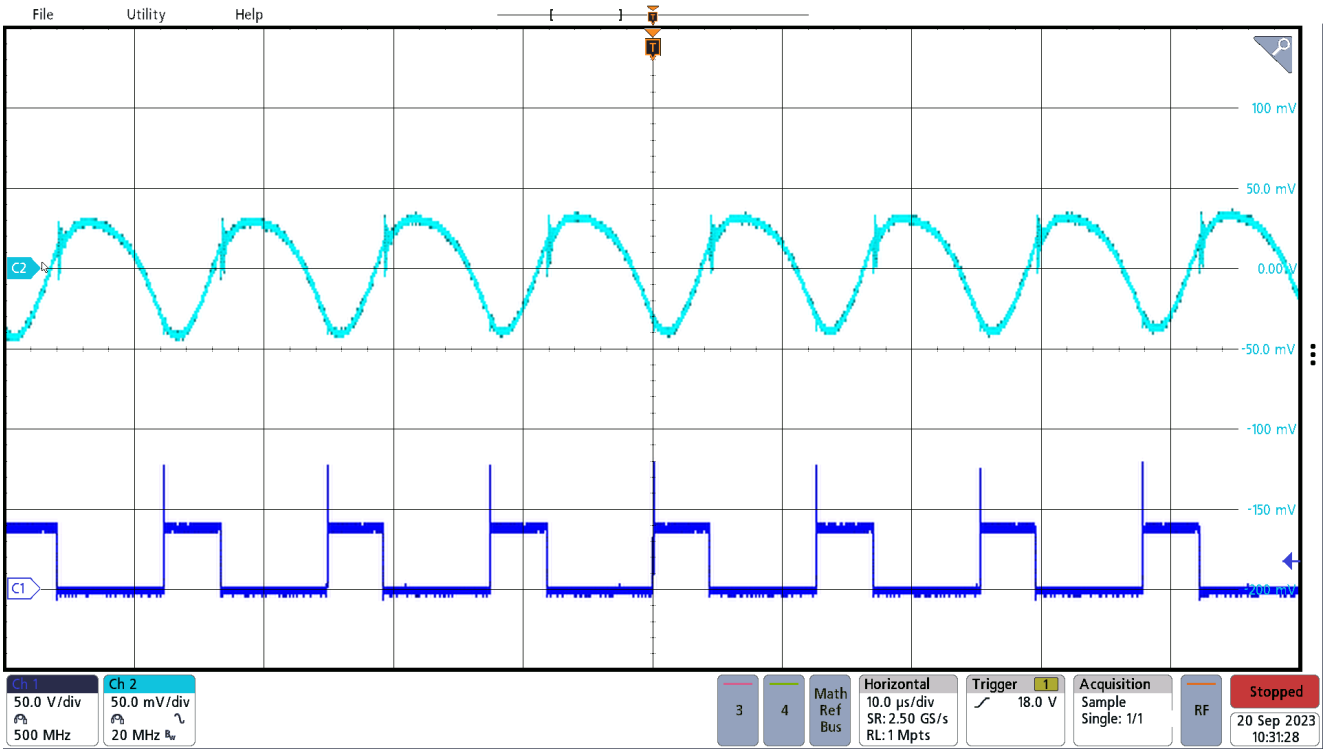


Figure 3-2. 40-Vdc Input

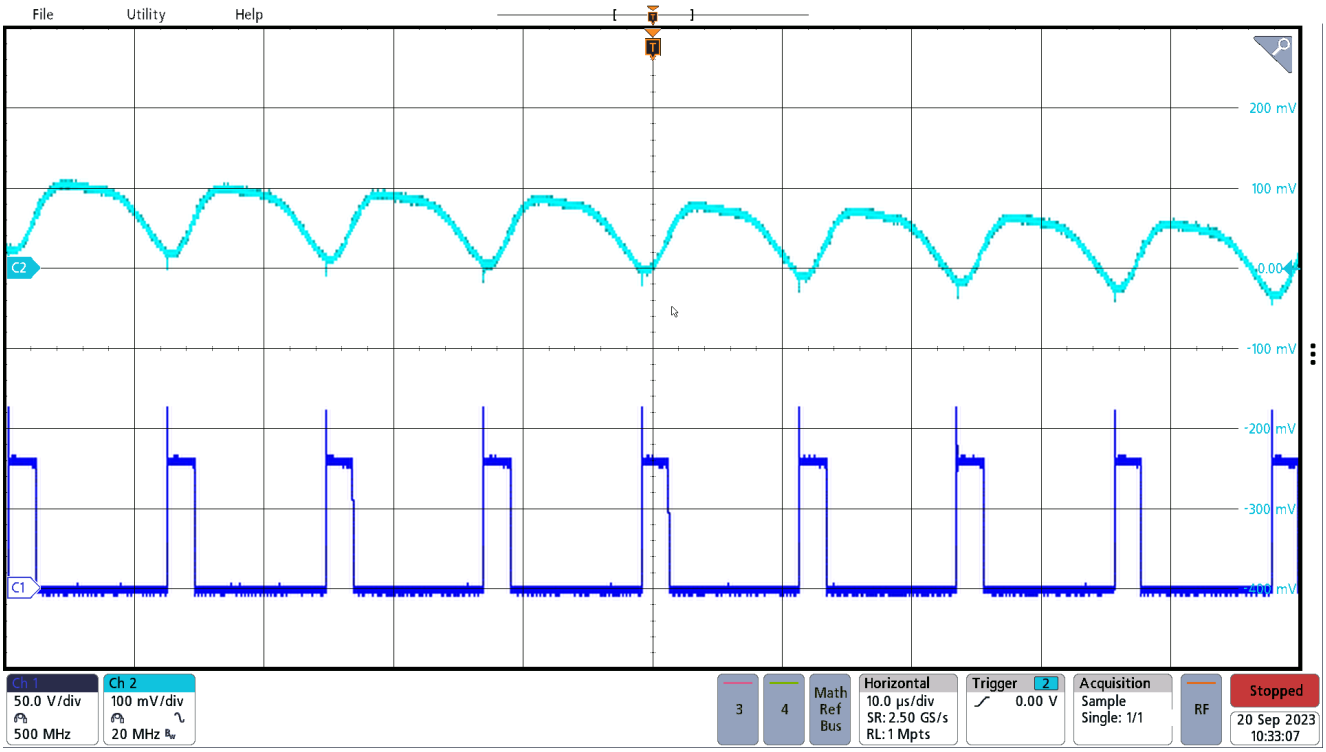


Figure 3-3. 80-Vdc Input

3.3 Load Transients

The following waveform illustrates the PMP23397 stepping between 0.15 A and 0.4 A.

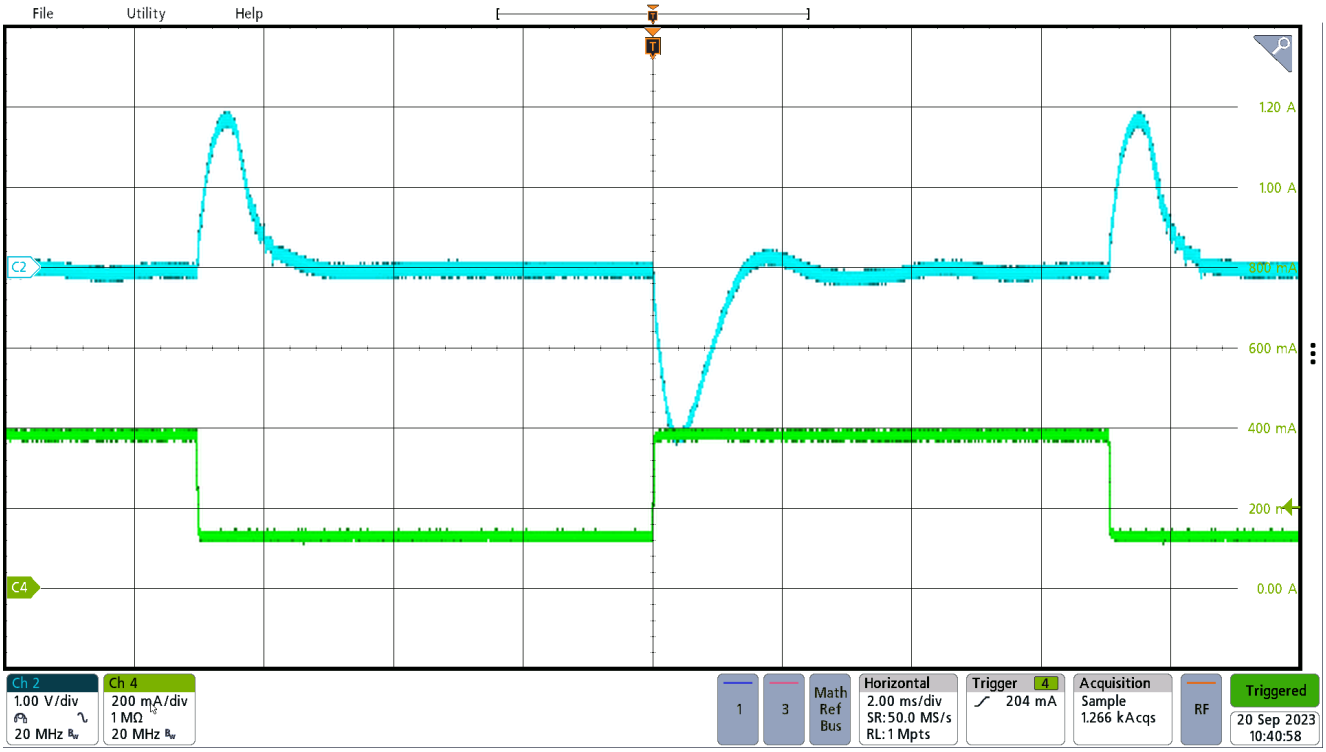


Figure 3-4. Load Transient

3.4 Start-up Sequence

The following images illustrate the start-up sequence waveforms.

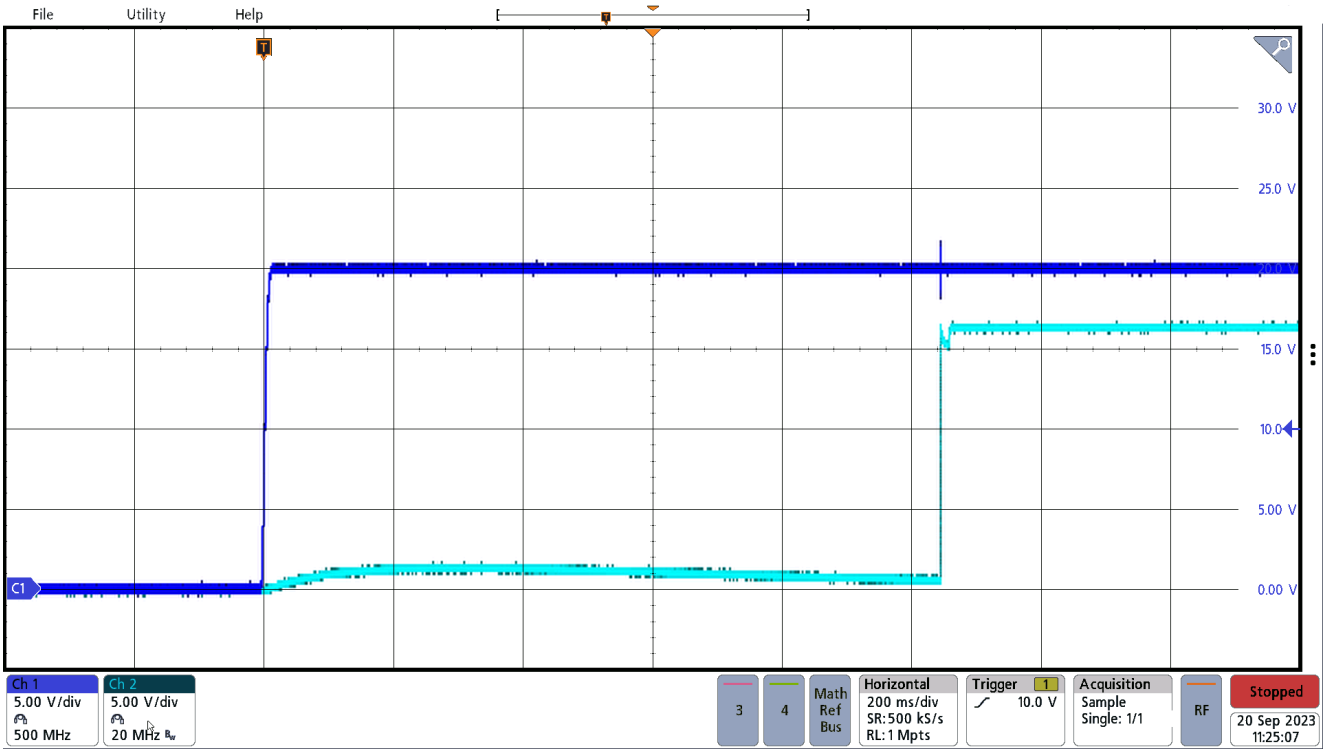


Figure 3-5. 20-Vdc Input

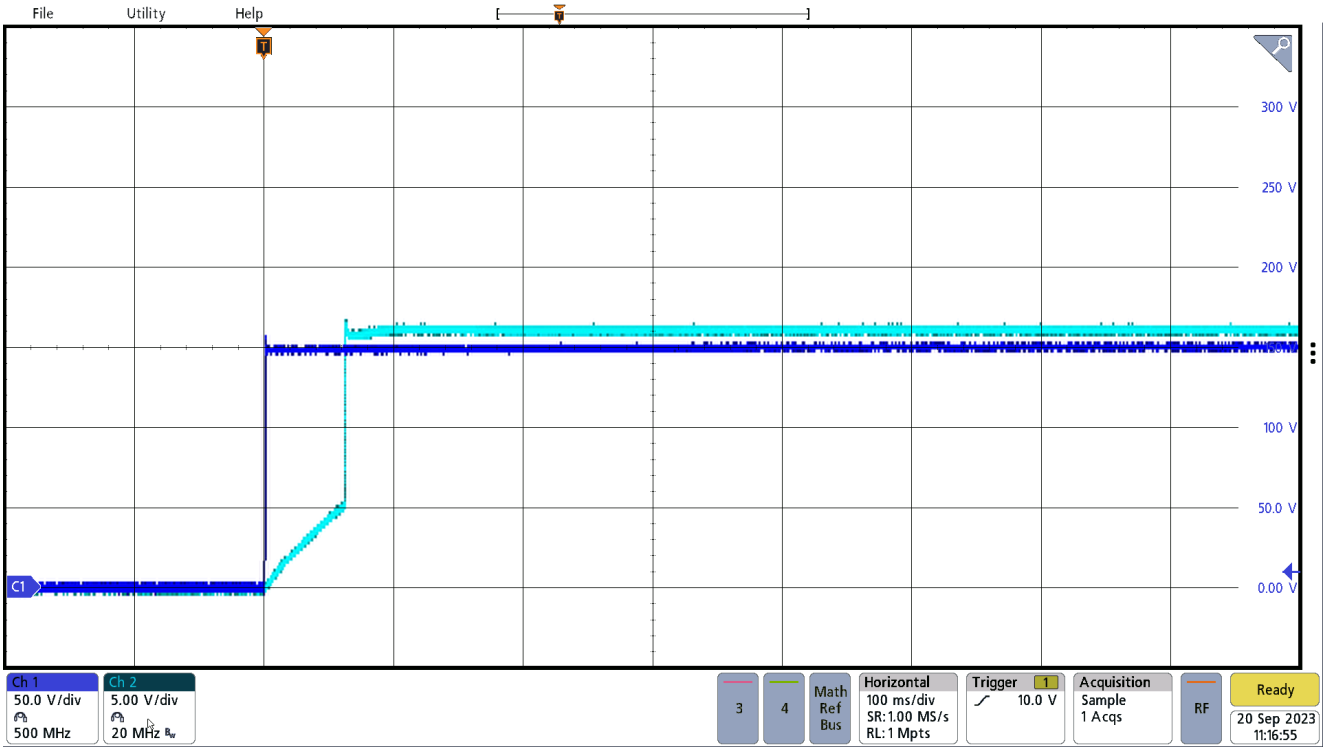


Figure 3-6. 150-Vdc Input

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