Test Report: PMP22680

40-W, ±15-V Flyback With Magnetic Feedback Reference Design

Description

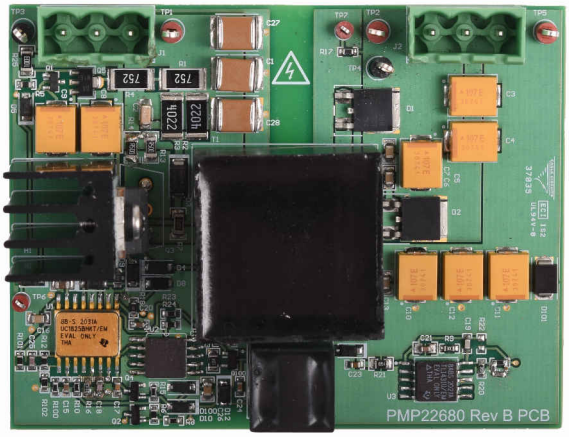
This reference design generates an isolated ±15 V at 40 W from a 70-V to 120-V DC input voltage. The design uses a magnetic feedback circuit to replace the function of an optocoupler.

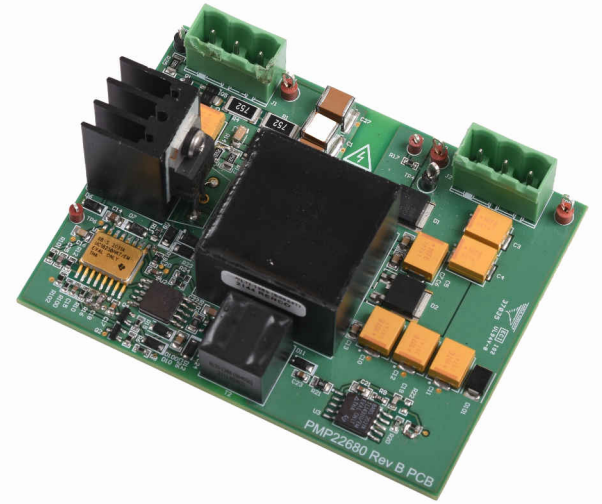
Features

- Use of 100-krad ICs and magnetics
- Magnetic feedback used to replace optocoupler
- Operation with external supply or self-bias

Applications

- Satellite buses and payloads
- Communications payload
- Optical imaging payload
- Radar imaging payload
- Space launch vehicles





1 Test Prerequisites

1.1 Input and Output Specifications

Table 1-1. Input and Output Specifications

Parameter	Specifications
V_{IN}	70–120 VDC
V_{OUT}	±15VDC
I_{OUT}	2.666 A for both rails
P_{OUT}	40 W Max. Loading single rail: 32 W (then 8 W other rail)

1.2 Dimensions

The board dimensions are 85 mm × 65 mm × 25.4 mm.

2 Testing and Results

2.1 Efficiency Graphs

Efficiency and power loss is shown in the following figures.

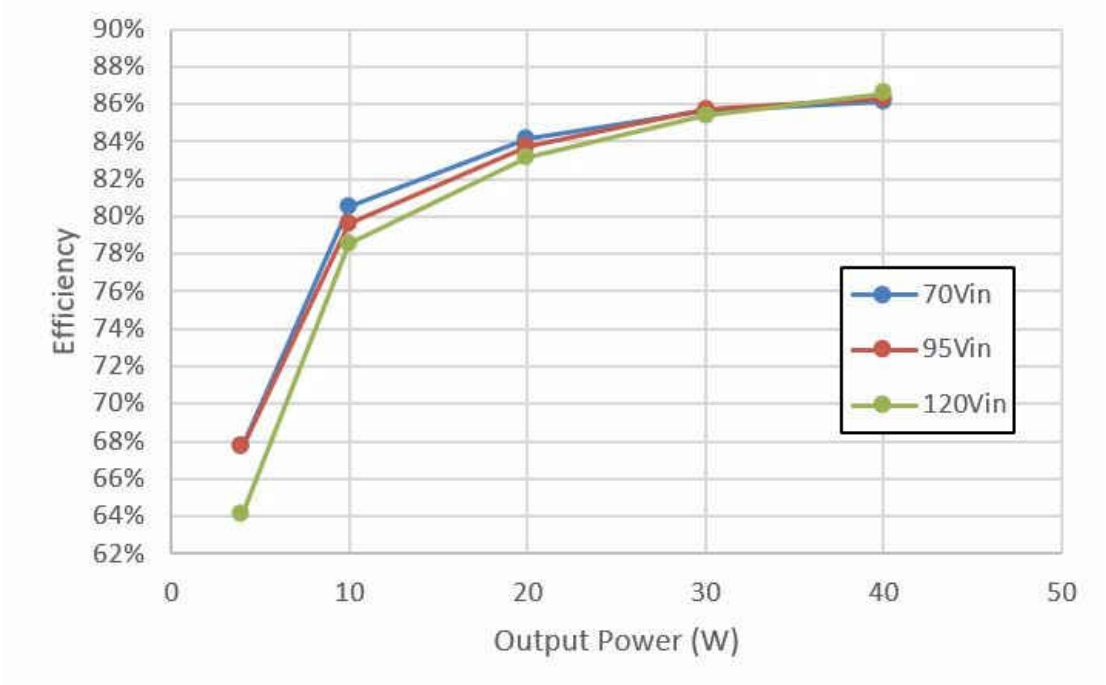


Figure 2-1. Efficiency

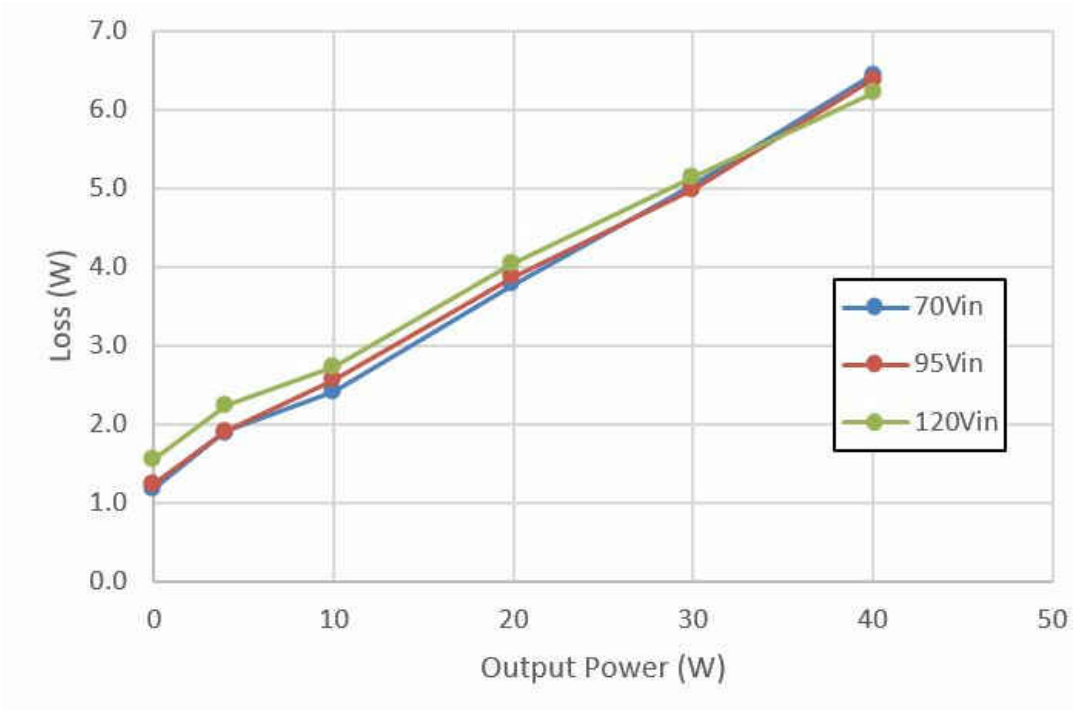


Figure 2-2. Power Loss

2.2 Efficiency Data

Efficiency data at 70 VDC, 95 VDC, and 120 VDC is shown in the following tables.

I-15p (A)	V-15p (V)	I-15n (A)	V-15n (V)	V-in (V)	I-in (A)	P-out (W)	P-in (W)	P-loss (W)	Efficiency
0	15.02	**0**	15.02	70.16	0.017	0.00	1.19	1.19	0.00%
0.133	15.02	**0.133**	14.98	70.14	0.084	3.99	5.89	1.90	67.72%
0.333	15.02	**0.333**	15.00	70.12	0.177	10.00	12.41	2.41	80.55%
0.666	15.01	**0.666**	15.00	70.08	0.339	19.99	23.76	3.77	84.13%
0.999	15.01	**0.999**	15.01	70.05	0.500	29.99	35.03	5.04	85.62%
1.333	15.00	**1.333**	15.00	70.01	0.663	39.99	46.42	6.43	86.15%

I-15p (A)	V-15p (V)	I-15n (A)	V-15n (V)	V-in (V)	I-in (A)	P-out (W)	P-in (W)	P-loss (W)	Efficiency
0	9	**0**	15.09	95.14	0.013	0.00	1.24	1.24	0.00%
0.133	15.02	**0.133**	14.99	95.13	0.062	3.99	5.90	1.91	67.67%
0.333	15.02	**0.333**	14.99	95.11	0.132	9.99	12.55	2.56	79.60%
0.666	15.01	**0.666**	15.00	95.07	0.251	19.99	23.86	3.88	83.76%
0.999	15.01	**0.999**	15.00	95.03	0.368	29.98	34.97	4.99	85.73%
1.333	15.00	**1.333**	15.00	95	0.488	39.99	46.36	6.37	86.26%

I-15p (A)	V-15p (V)	I-15n (A)	V-15n (V)	V-in (V)	I-in (A)	P-out (W)	P-in (W)	P-loss (W)	Efficiency
0	15.02	**0**	15.05	120.13	0.013	0.00	1.56	1.56	0.00%
0.134	15.02	**0.133**	14.98	120.12	0.052	4.01	6.25	2.24	64.12%
0.333	15.02	**0.333**	15.00	120.11	0.106	10.00	12.73	2.73	78.52%
0.666	15.01	**0.666**	14.99	120.08	0.200	19.98	24.02	4.04	83.20%
0.999	15.01	**0.999**	15.00	120.04	0.2925	29.98	35.11	5.13	85.38%
1.333	15.01	**1.333**	15.00	120.02	0.385	40.00	46.21	6.20	86.57%

2.3 Output Voltage Cross Regulation

Figure 2-3 shows cross regulation with a 95 VDC.

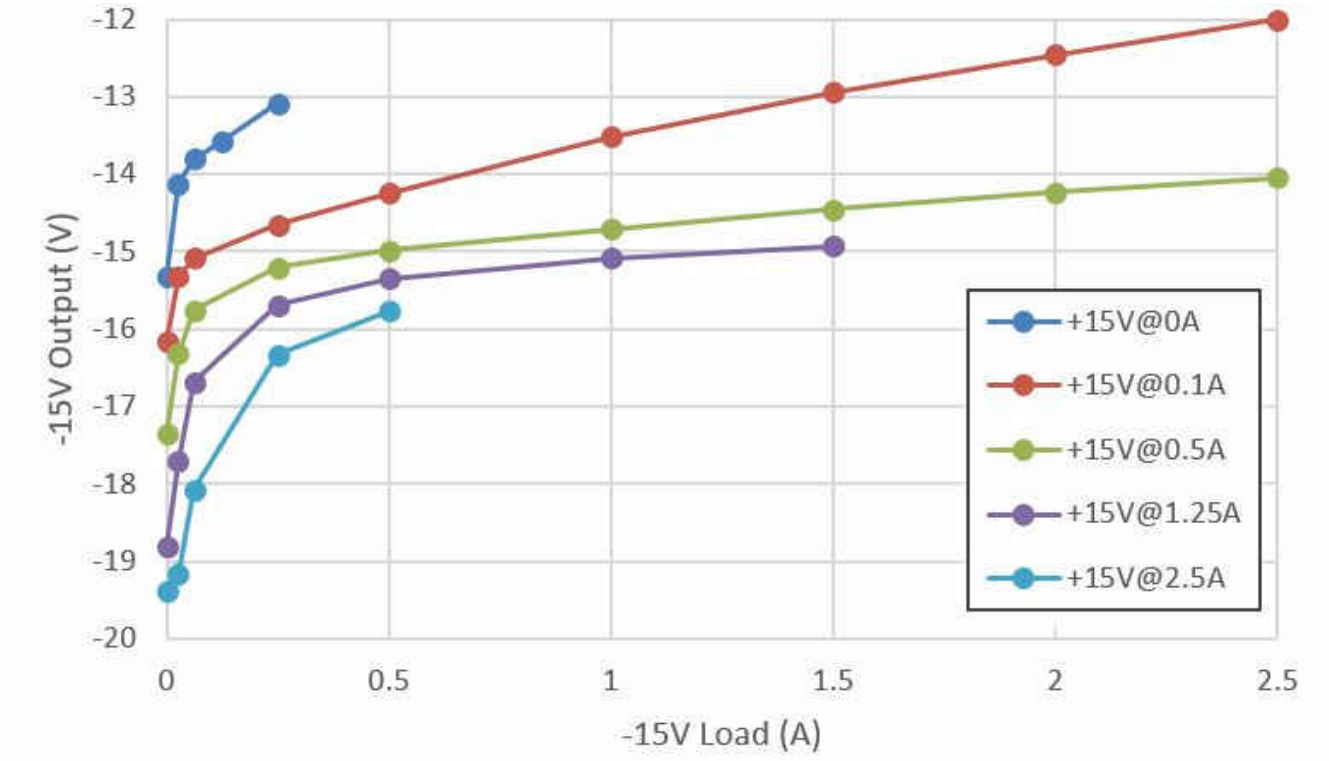


Figure 2-3. Cross-Regulation, 95 VDC Input

2.4 Thermal Images

All images captured with the DUT at 25ºC ambient, after a 30-minute warm up. The output was loaded with 40 W.

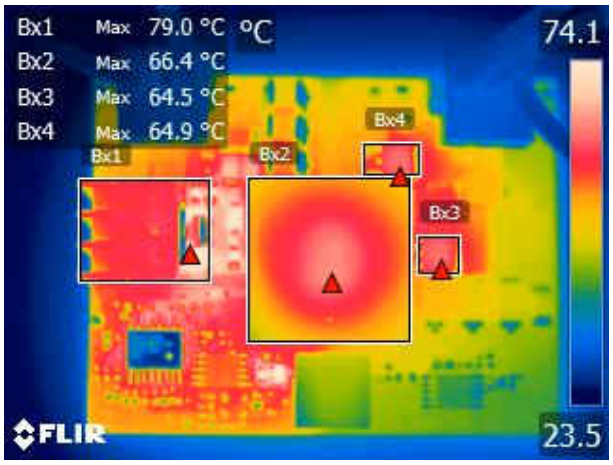


Figure 2-4. 70-VDC Input

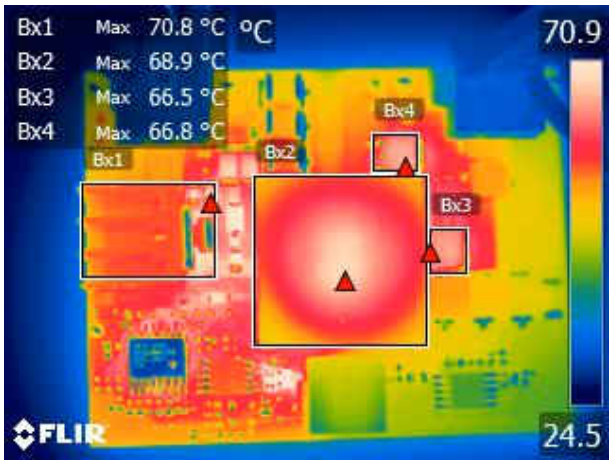


Figure 2-5. 95-VDC Input

Figure 2-6. 120-VDC Input

2.5 Loop Response

Loop response was captured with 32 W loaded on +15-V rail.

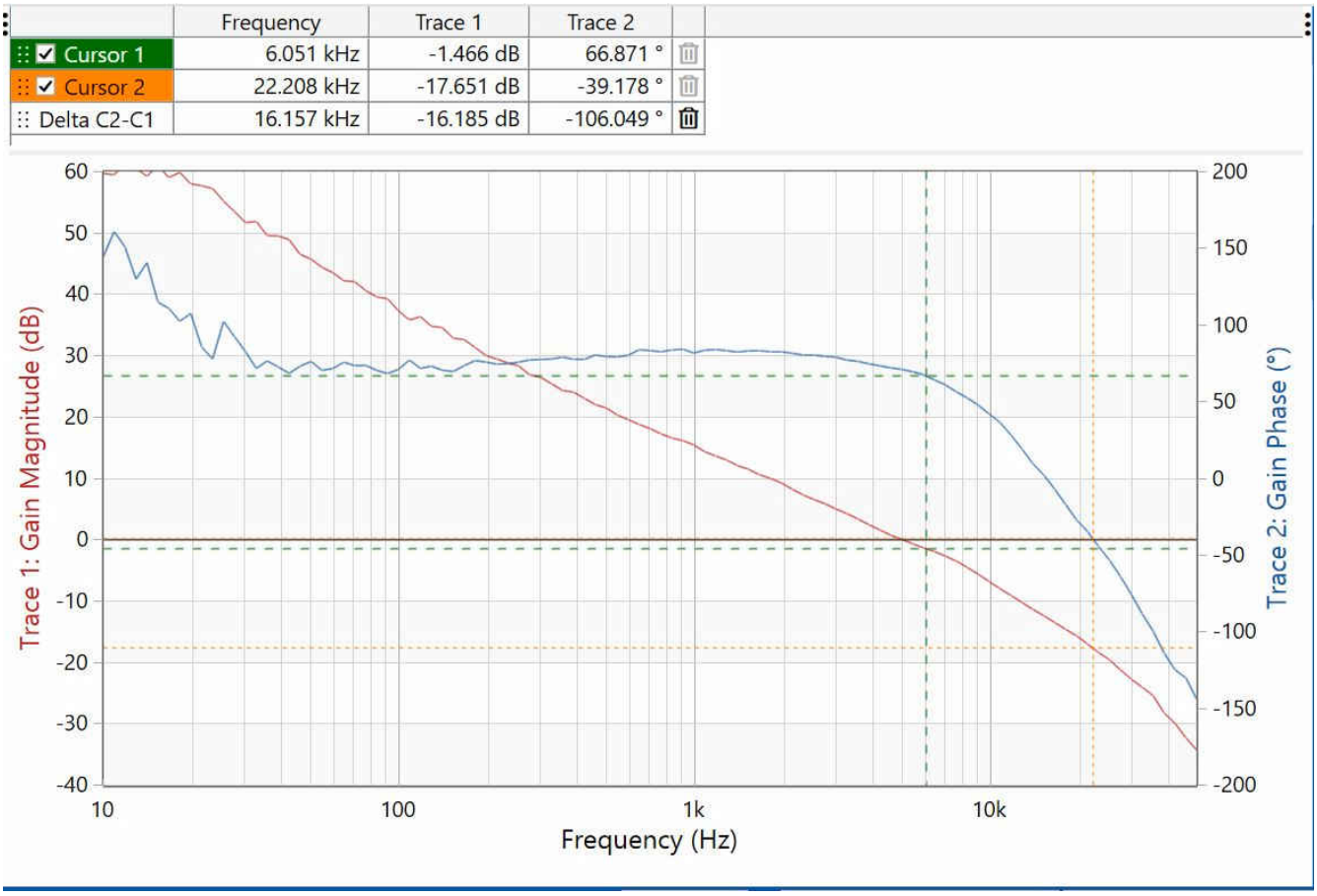


Figure 2-7. 70-VDC Input

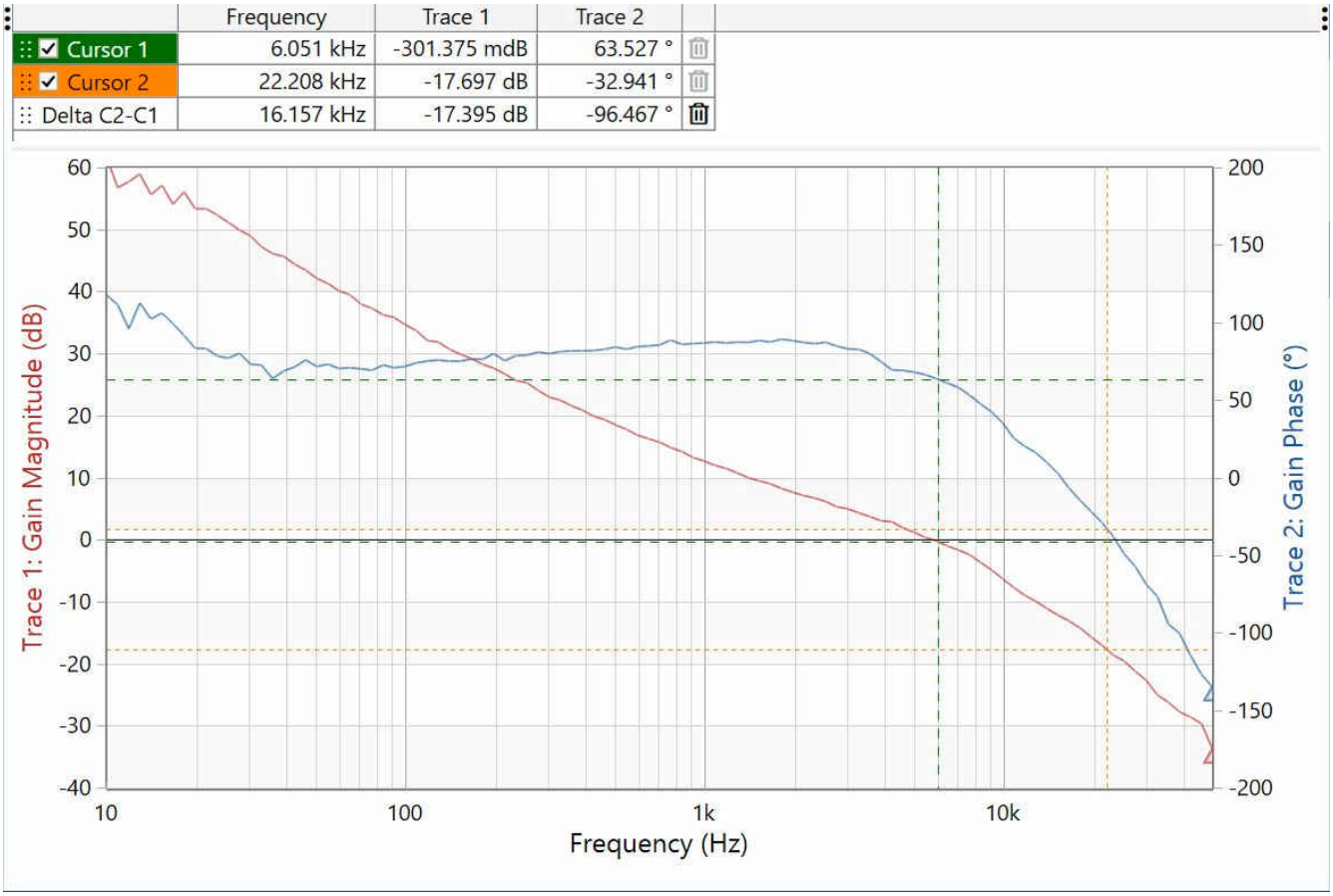


Figure 2-8. 95-VDC Input

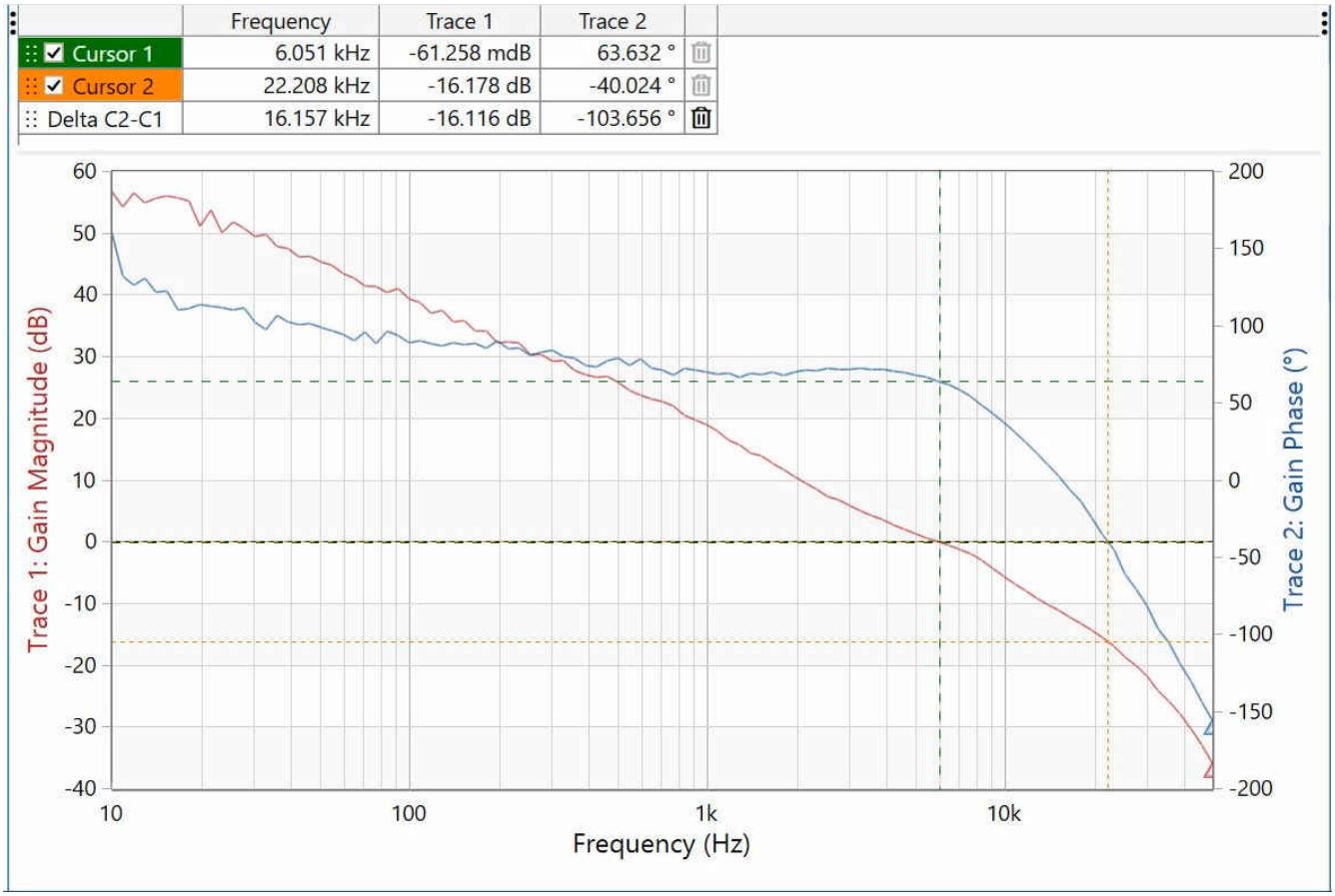


Figure 2-9. 120-VDC Input

3 Waveforms

3.1 Switching

Switching behavior is shown in the following figures.

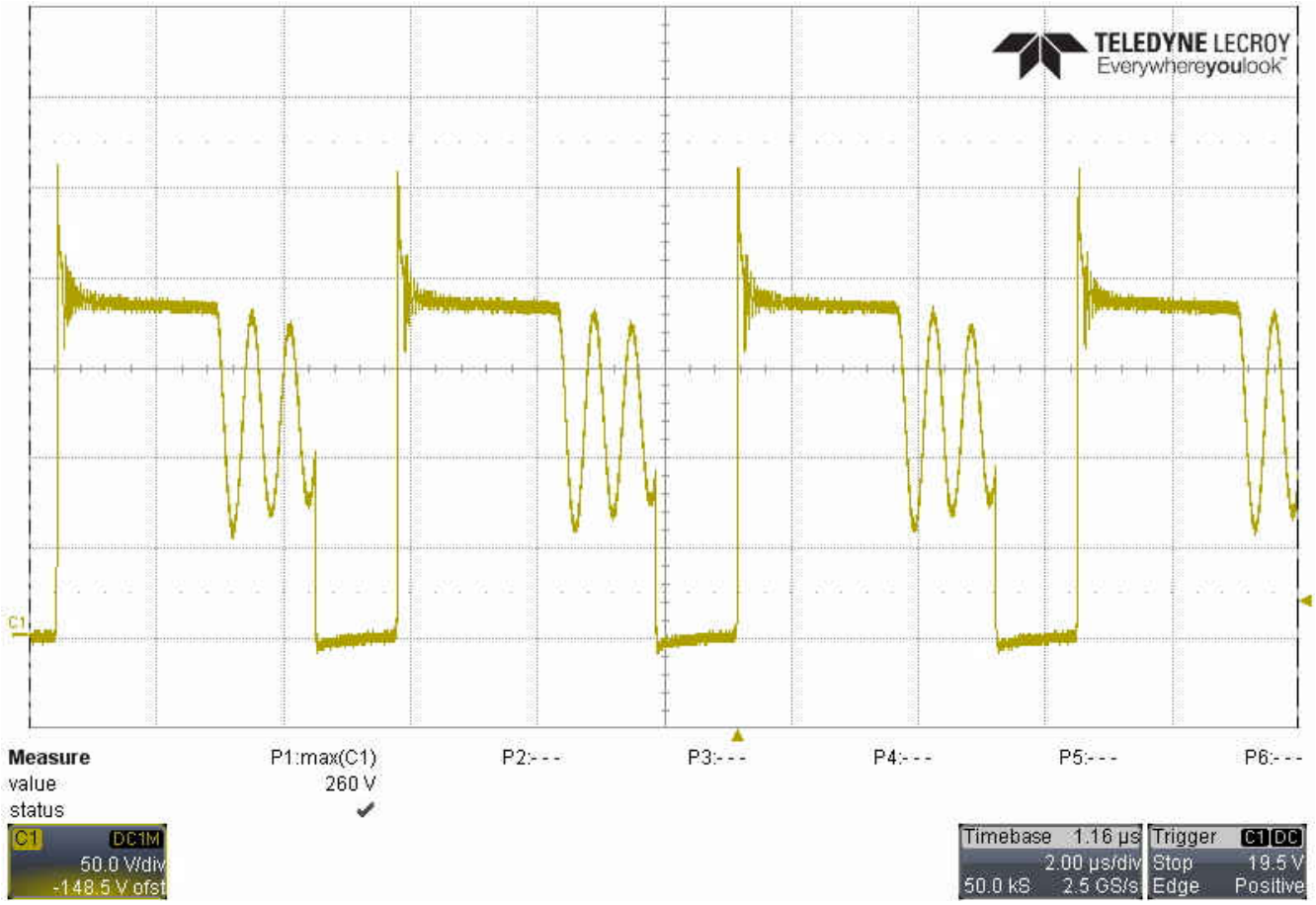


Figure 3-1. Vds of Primary FET (Q3), 120-VDC Input, 40-W Output

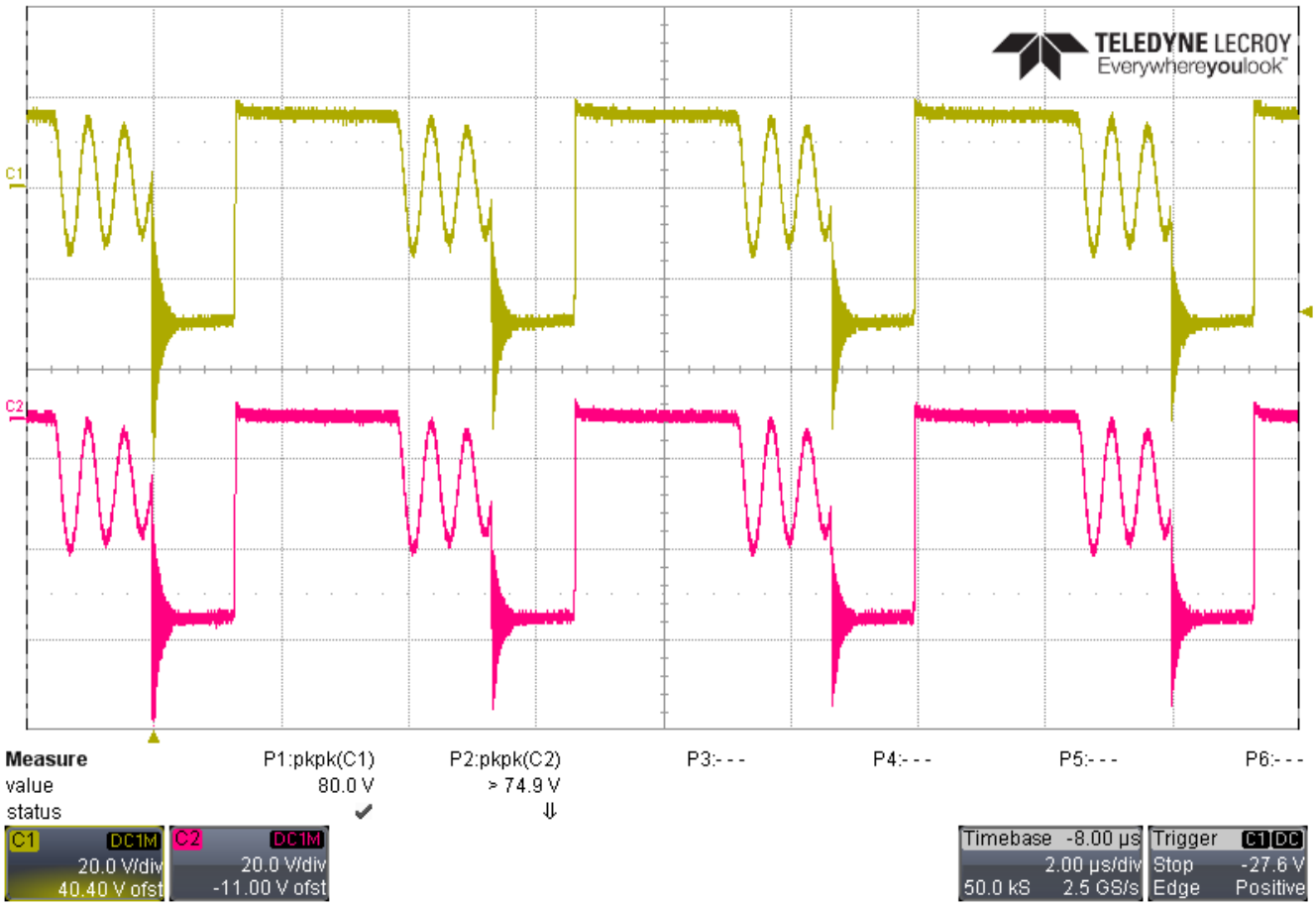


Figure 3-2. Voltage on Anodes of Output Diodes (D1 on Ch1, D2 on Ch2), 120-VDC Input, 20-W Each Output

3.2 Output Voltage Ripple

Output voltage ripple is shown in the following figures.

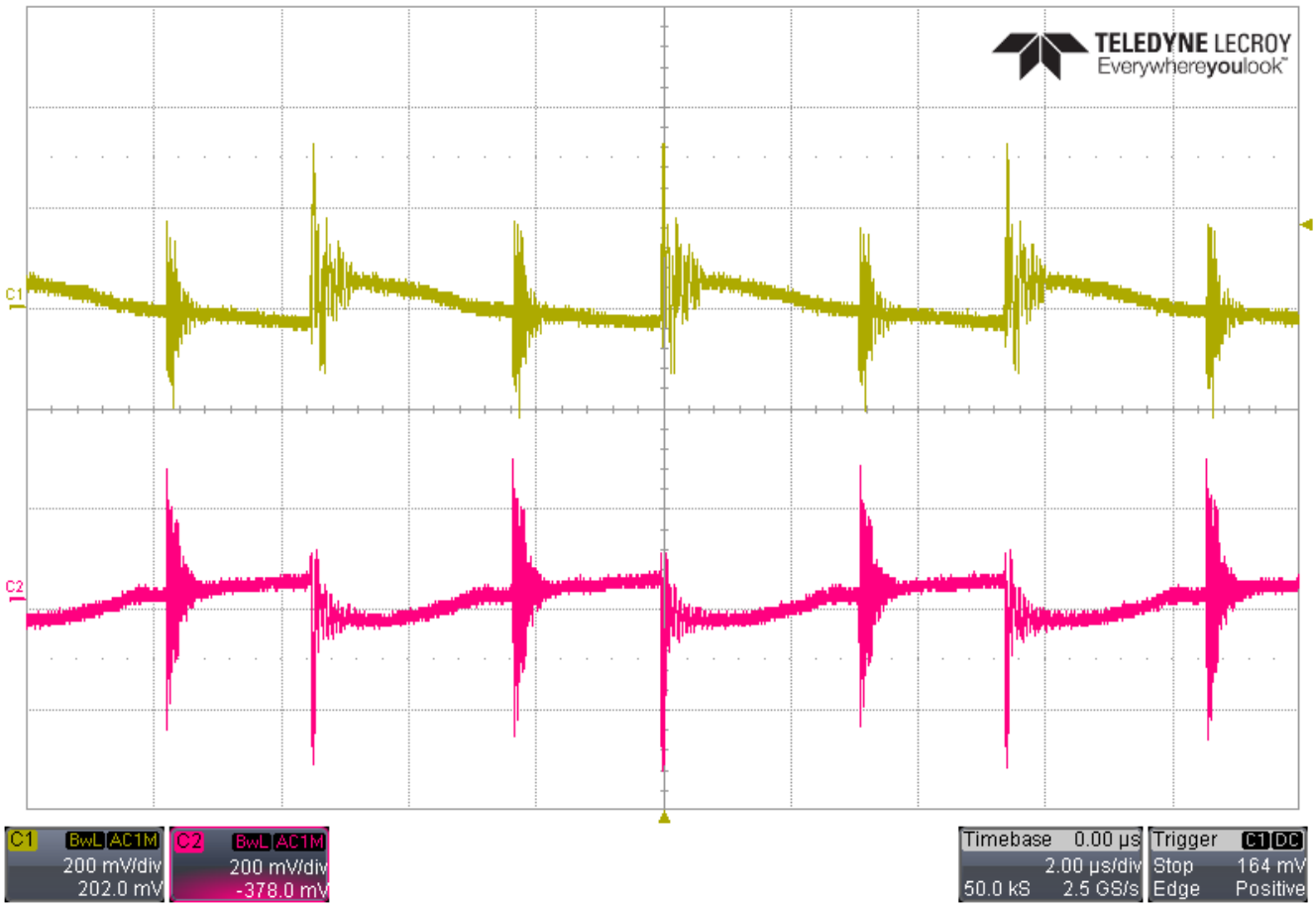


Figure 3-3. 70-VDC Input, +15 V on Ch1, –15 V on Ch2

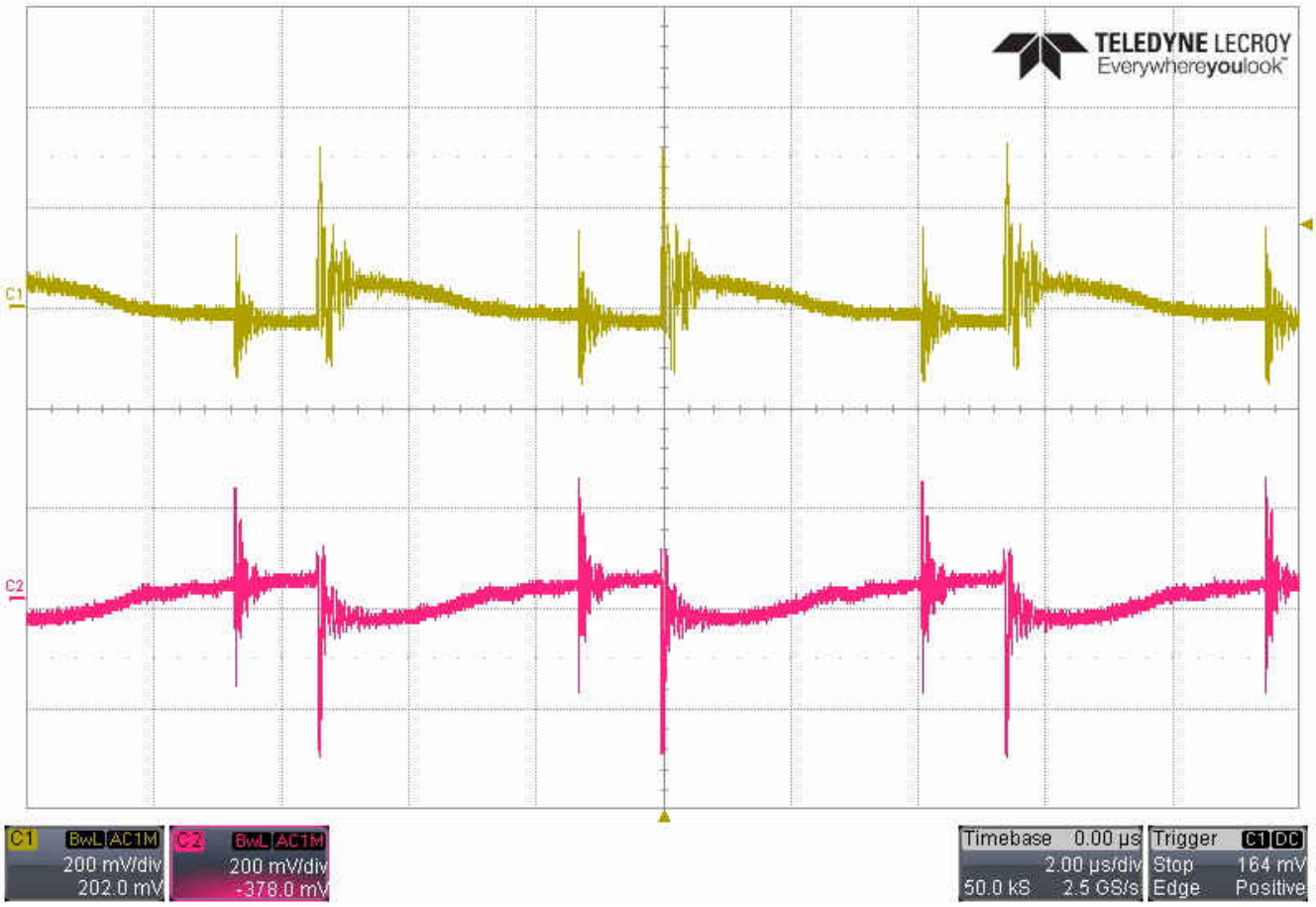


Figure 3-4. 95-VDC Input, +15 V on Ch1, –15 V on Ch2

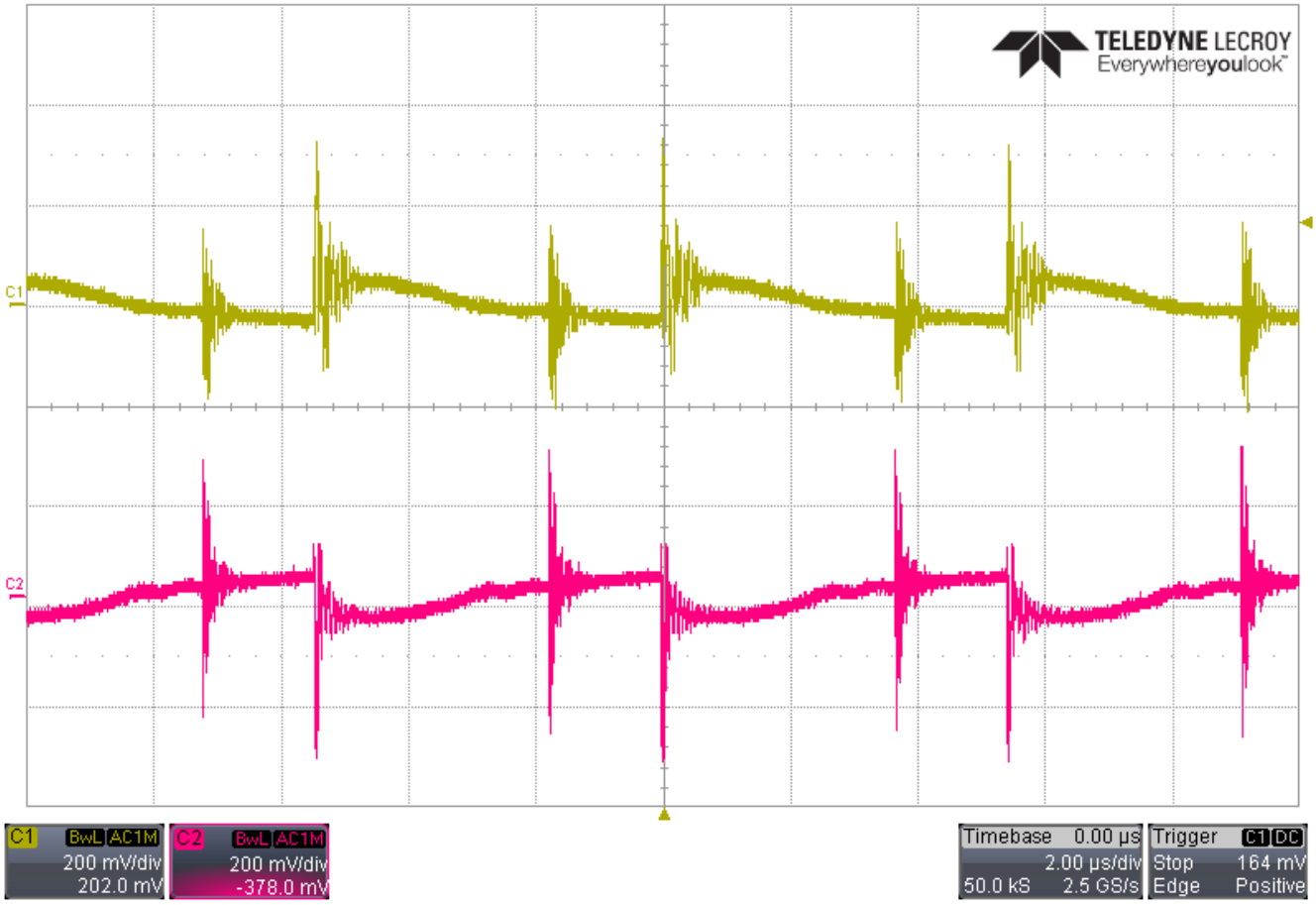


Figure 3-5. 120-VDC Input, +15 V on Ch1, –15 V on Ch2

3.3 Output Load Transients

Load transient responses are shown in the following figures.

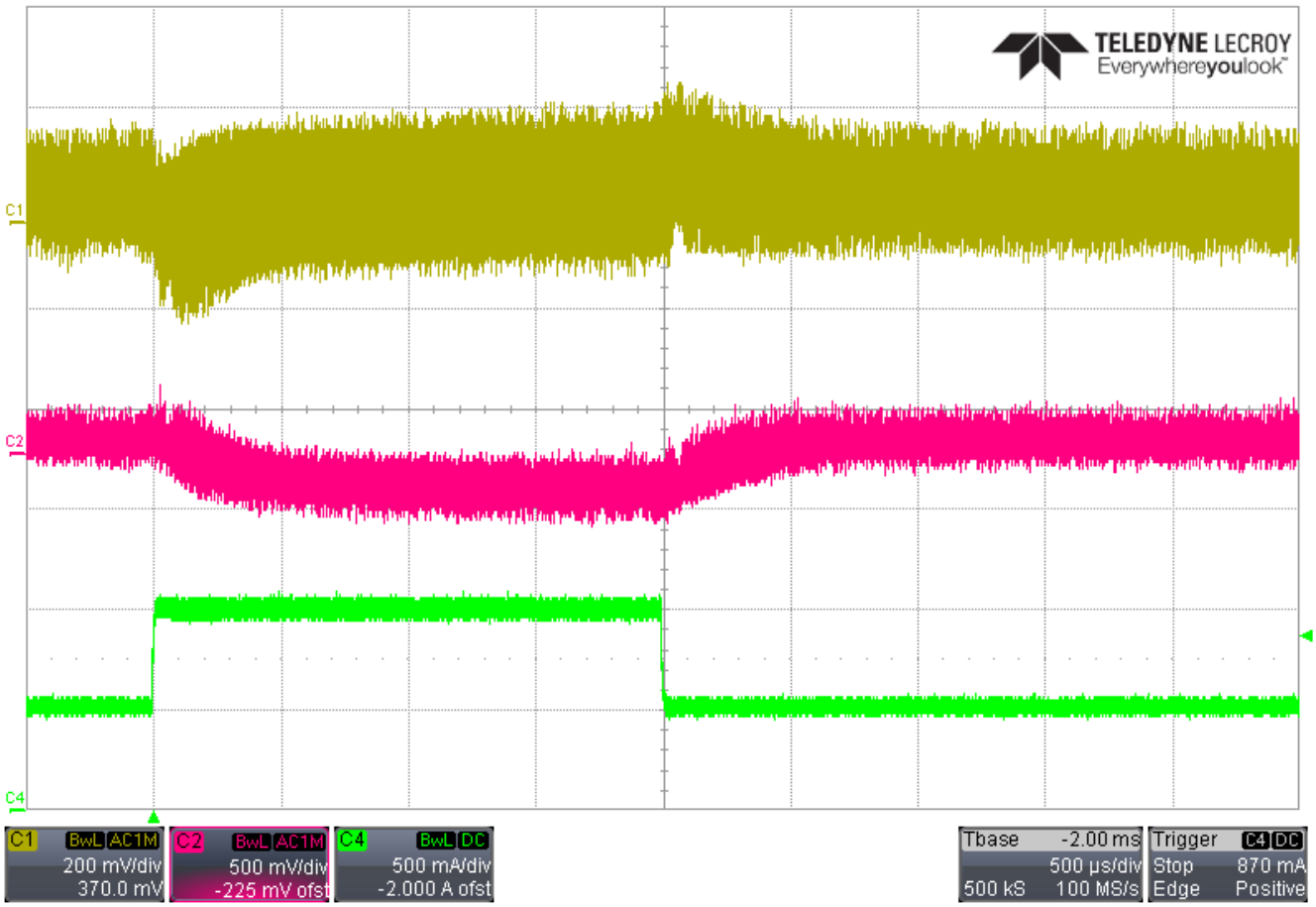


Figure 3-6. 0.5-A to 1-A Step on +15 V, 95-VDC input, –15 V Loaded With 0.5 A; +15 V on Ch1, –15 V on Ch2, +15-V Load Current on Ch4

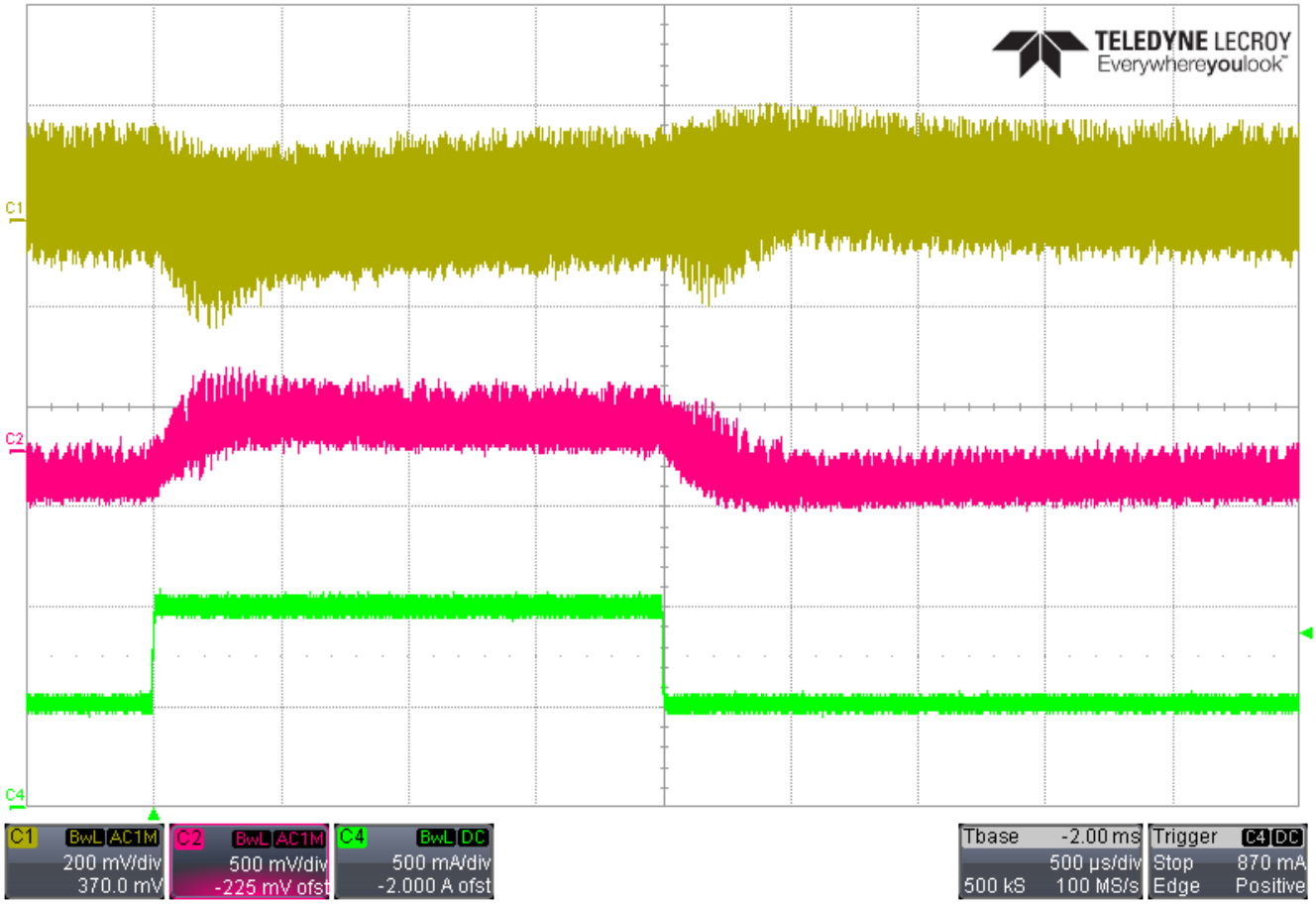


Figure 3-7. 0.5-A to 1-A Step on –15 V, 95-VDC Input, +15 V Loaded With 0.5 A; +15 V on Ch1, –15 V on Ch2, –15-V Load Current on Ch4

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