LM5026 Active Clamp Forward Converter

TI reference design number: PMP7892 Rev A

Input: 9.6V – 60V
Output: 12V @ 3.5A

DC – DC Test Results

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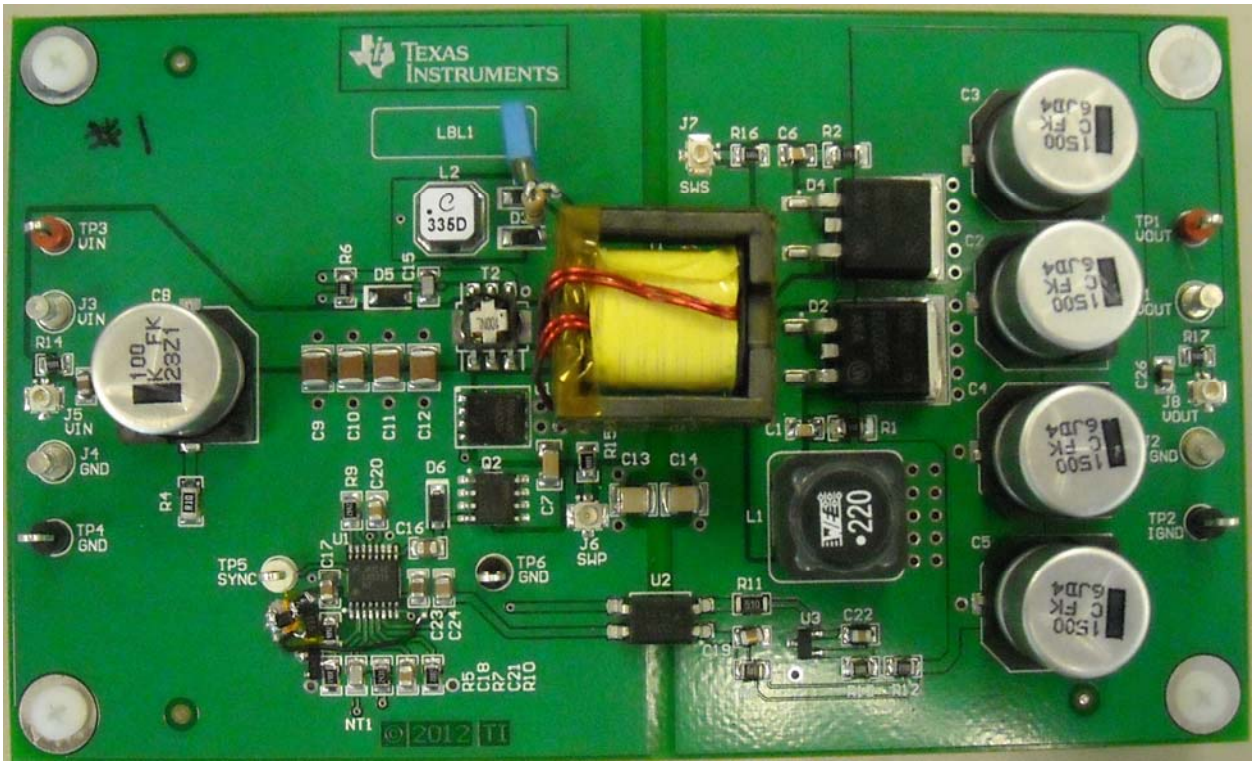
1 Circuit Description

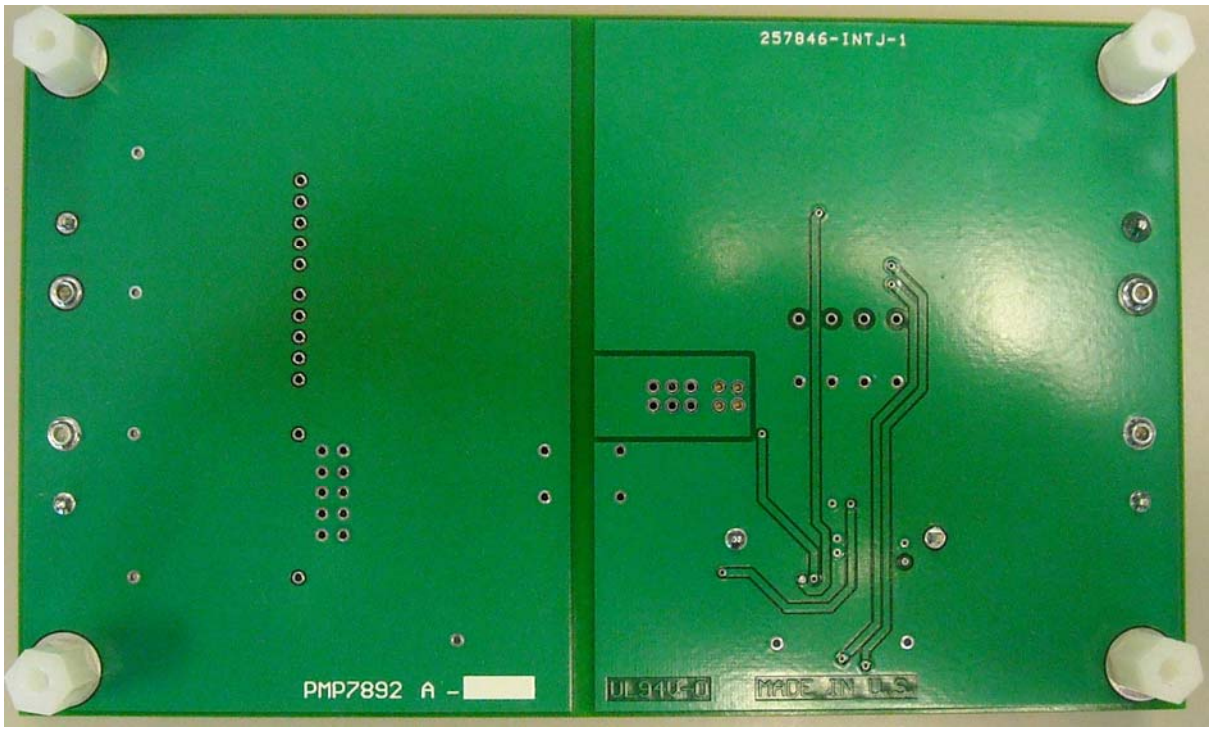
PMP7892 is an isolated active clamp forward converter capable of 42W output power. This design uses the LM5026 active clamp current-mode controller. Output voltage regulation is maintained using an LMV431 shunt regulator and opto-coupler feedback. Schottky rectifiers allow for holdup of 10ms using the stored charge of the output capacitors. The isolation voltage is 2250 VDC meeting basic insulation requirements.

All tests were performed at room temperature on an open bench.

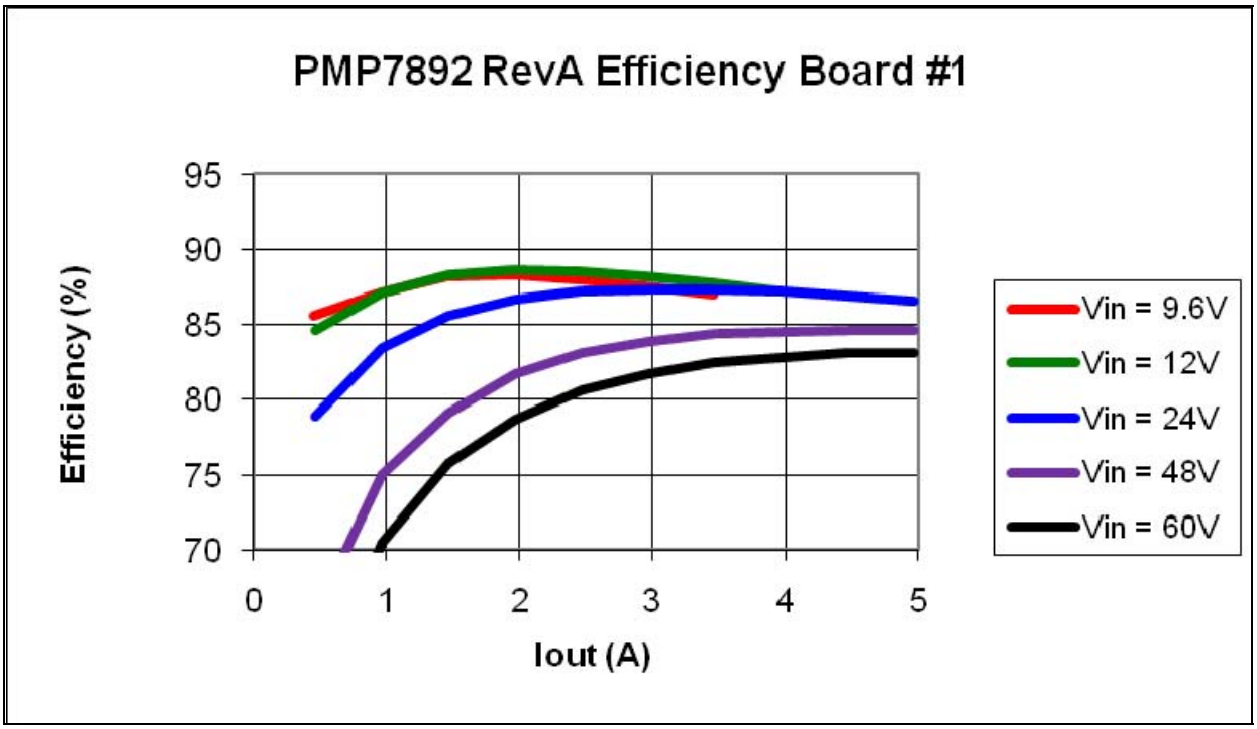
2 Photos

The circuit was built on PMP7892 Rev A printed circuit board. This is a four layer board with one ounce copper on all layers. The overall dimensions are 3” x 5”. All components are mounted on the top side of the board.





3 Efficiency



3.1 Efficiency Data

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
9.600	0.021	11.886	0.000	0.000	0.20	0.00	0.20
9.600	0.670	11.886	0.463	85.560	6.43	5.50	0.93
9.599	1.368	11.886	0.963	87.167	13.13	11.45	1.69
9.599	2.055	11.886	1.463	88.154	19.73	17.39	2.34
9.599	2.754	11.886	1.963	88.260	26.44	23.33	3.10
9.599	3.466	11.887	2.464	88.036	33.27	29.29	3.98
9.599	4.190	11.887	2.964	87.601	40.22	35.23	4.99
9.599	4.927	11.887	3.464	87.065	47.29	41.18	6.12
9.587	0.865	2.479	0.004	0.120	8.29	0.01	8.28
9.600	0.751	0.000	1.768	0.000	7.21	0.00	7.21
9.600	0.579	0.000	1.871	0.000	5.56	0.00	5.56

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
11.999	0.021	11.889	0.000	0.000	0.25	0.00	0.25
11.999	0.548	11.889	0.468	84.619	6.58	5.56	1.01
11.999	1.099	11.889	0.966	87.092	13.19	11.48	1.70
11.999	1.644	11.889	1.466	88.355	19.73	17.43	2.30
11.999	2.197	11.889	1.965	88.620	26.36	23.36	3.00
11.998	2.760	11.889	2.466	88.536	33.11	29.32	3.80
11.998	3.333	11.889	2.966	88.180	39.99	35.26	4.73
11.998	3.913	11.889	3.466	87.772	46.95	41.21	5.74
11.998	4.507	11.888	3.967	87.212	54.07	47.16	6.92
11.999	0.758	2.213	1.462	35.573	9.10	3.24	5.86
11.999	0.660	0.000	1.904	0.000	7.92	0.00	7.92

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
24.003	0.015	11.890	0.000	0.000	0.67	0.10	0.57
24.003	0.294	11.890	0.468	78.852	5.83	5.07	0.76
24.003	0.574	11.890	0.967	83.451	11.14	10.06	1.08
24.003	0.850	11.889	1.469	85.602	16.41	15.06	1.36
24.003	1.124	11.889	1.967	86.680	21.77	20.07	1.70
24.003	1.401	11.888	2.466	87.176	27.14	25.04	2.09
24.002	1.682	11.888	2.967	87.368	32.59	30.04	2.54
24.002	1.966	11.887	3.468	87.362	38.12	35.06	3.07
24.001	2.256	11.887	3.971	87.177	43.67	40.03	3.63
24.001	2.548	11.886	4.472	86.918	49.32	45.02	4.30
24.000	2.843	11.886	4.970	86.577	55.00	49.98	5.02

PMP7892 Rev A Test Results

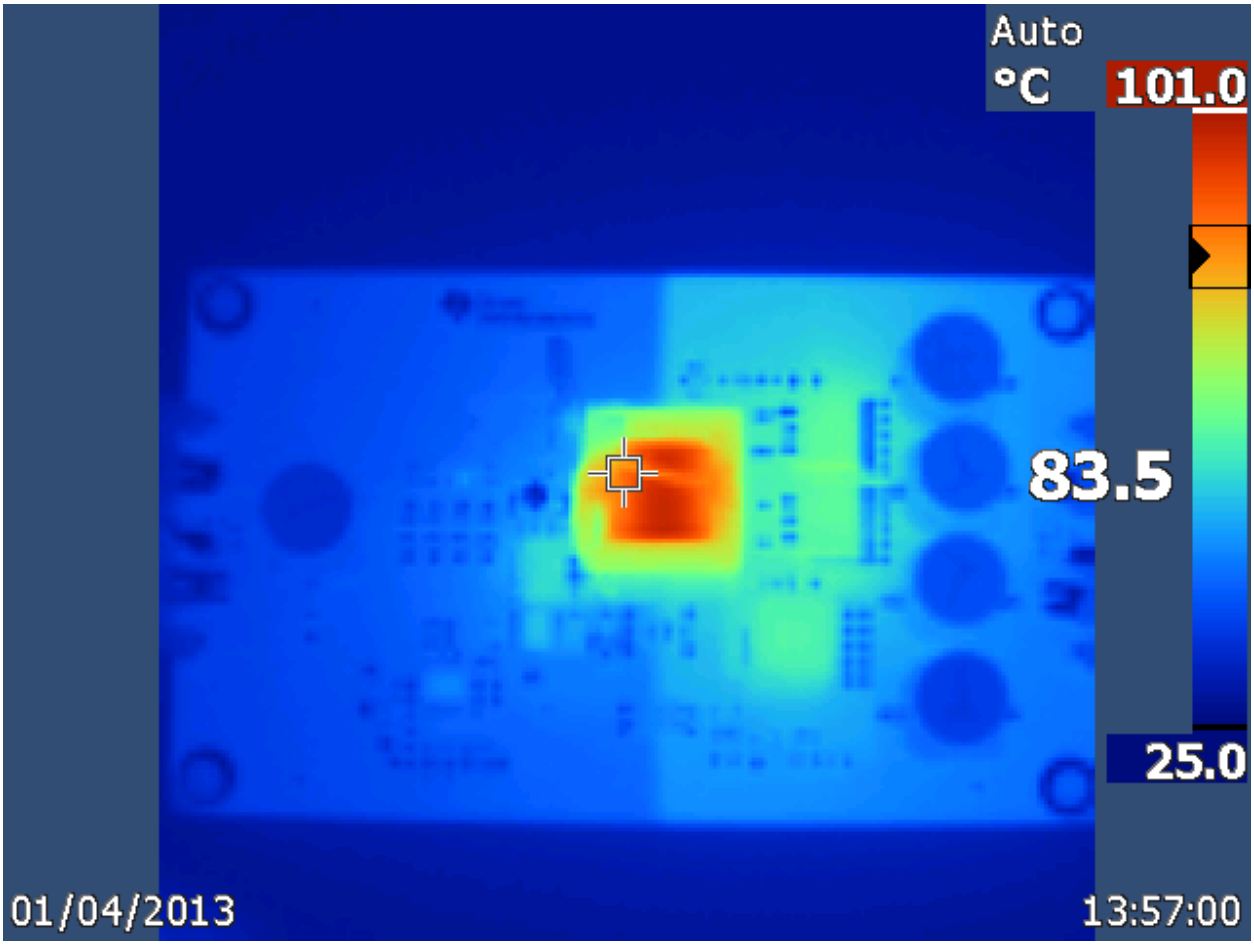
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
48.013	0.011	11.887	0.000	0.000	0.53	0.00	0.53
48.012	0.176	11.886	0.467	65.689	8.45	5.55	2.90
48.012	0.319	11.886	0.967	75.045	15.32	11.49	3.82
48.012	0.459	11.885	1.468	79.170	22.04	17.45	4.59
48.011	0.596	11.885	1.967	81.699	28.61	23.38	5.24
48.010	0.735	11.884	2.467	83.083	35.29	29.32	5.97
48.010	0.876	11.883	2.968	83.860	42.06	35.27	6.79
48.009	1.017	11.883	3.468	84.404	48.83	41.21	7.61
48.008	1.162	11.882	3.971	84.580	55.79	47.18	8.60
48.007	1.307	11.881	4.470	84.641	62.75	53.11	9.64
48.006	1.453	11.880	4.970	84.647	69.75	59.04	10.71

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
60.016	0.011	11.881	0.000	0.000	0.66	0.00	0.66
60.015	0.155	11.881	0.470	60.029	9.30	5.58	3.72
60.015	0.272	11.880	0.969	70.520	16.32	11.51	4.81
60.015	0.384	11.880	1.470	75.778	23.05	17.46	5.58
60.014	0.495	11.879	1.969	78.735	29.71	23.39	6.32
60.013	0.606	11.879	2.469	80.646	36.37	29.33	7.04
60.012	0.719	11.878	2.968	81.703	43.15	35.25	7.89
60.011	0.832	11.878	3.466	82.455	49.93	41.17	8.76
60.010	0.948	11.877	3.968	82.841	56.89	47.13	9.76
60.009	1.064	11.876	4.467	83.086	63.85	53.05	10.80
60.008	1.182	11.875	4.966	83.141	70.93	58.97	11.96

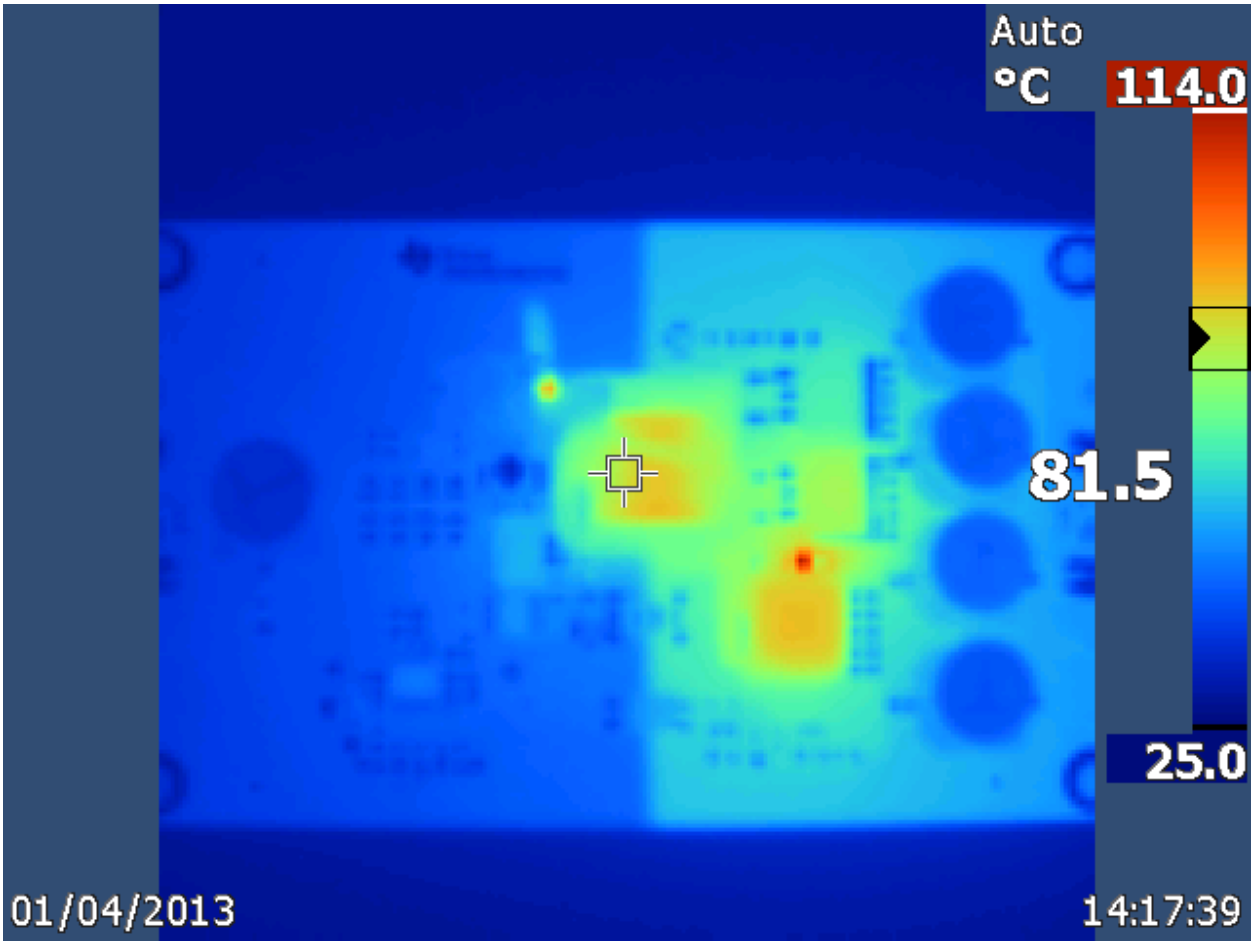
4 Thermal Tests

Thermal tests were performed at 25°C ambient.

4.1 12V Input – 3.5A Load

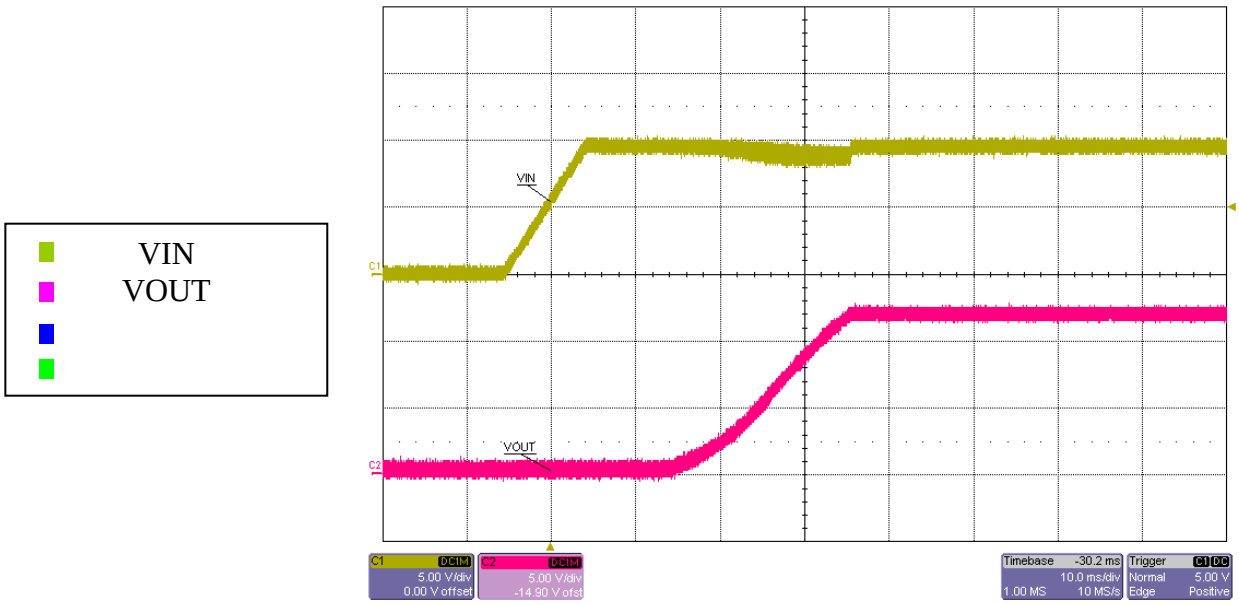


4.2 48V Input – 3.5A Load

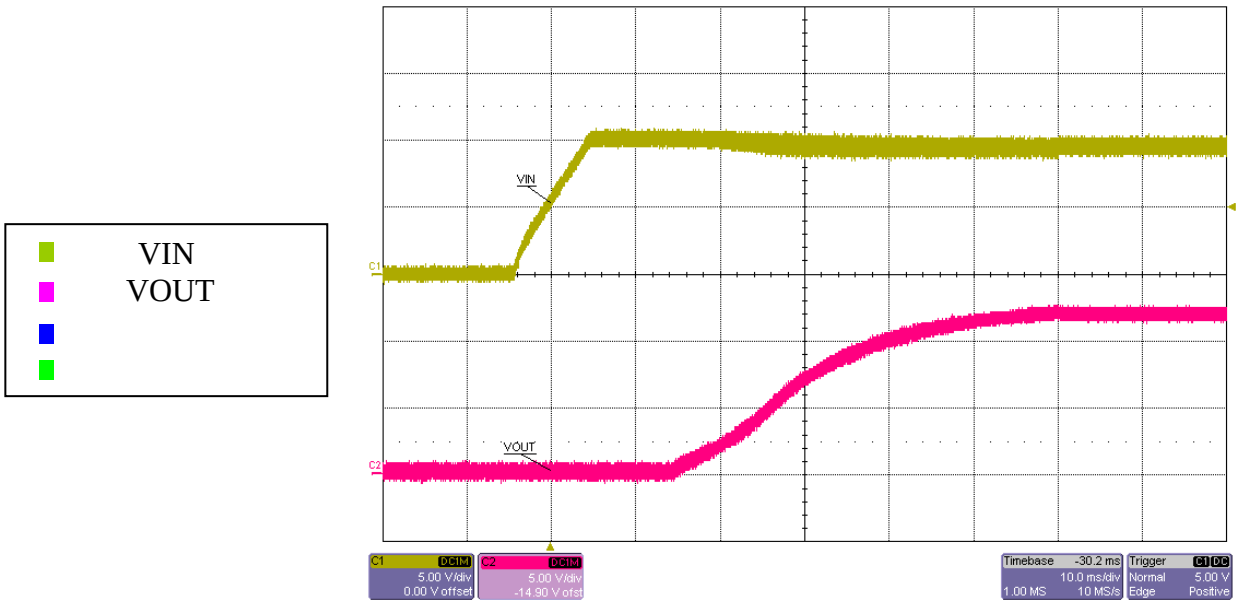


5 Power Up and Power Down

5.1 Power Up at 9.6V Input – No Load

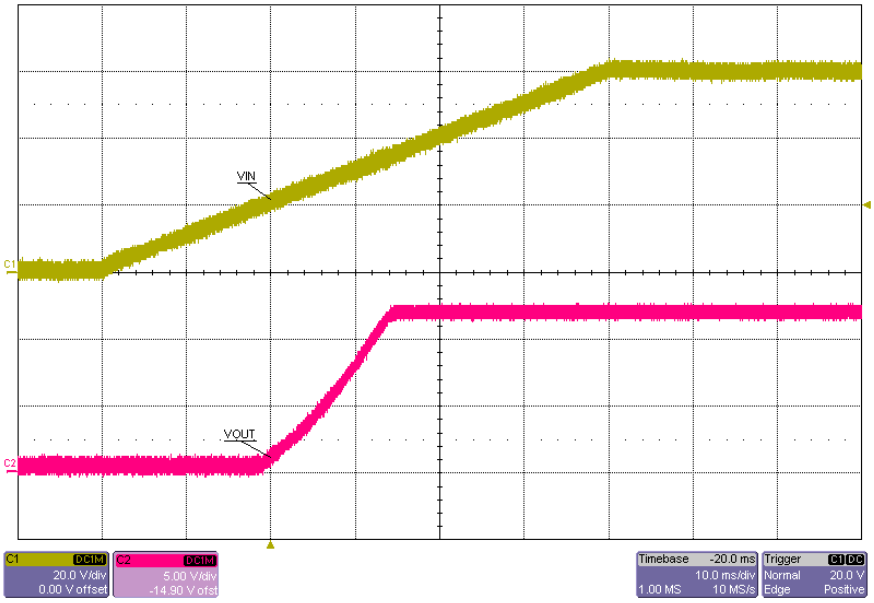


5.2 Power Up at 9.6V Input – 3.5A Load



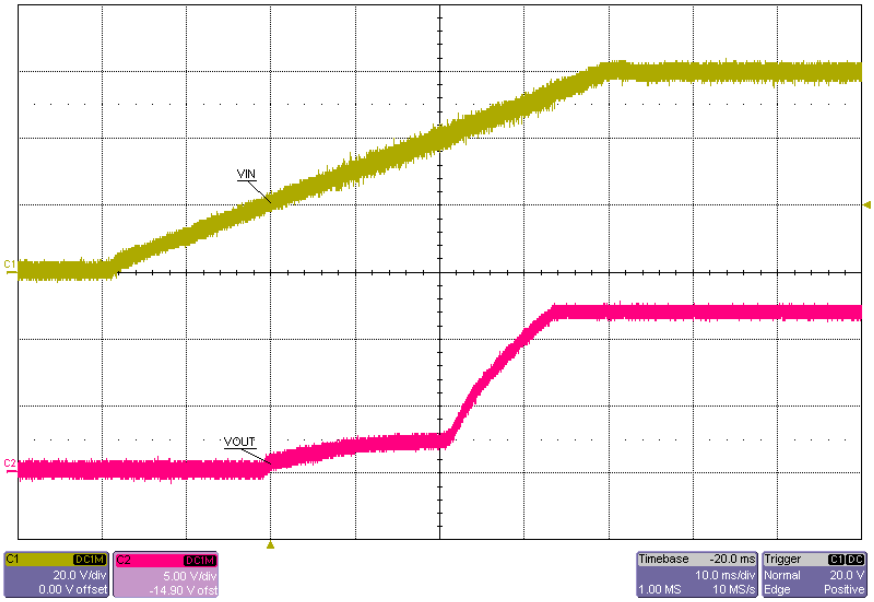
5.3 Power Up at 60V Input – No Load

VIN
VOUT

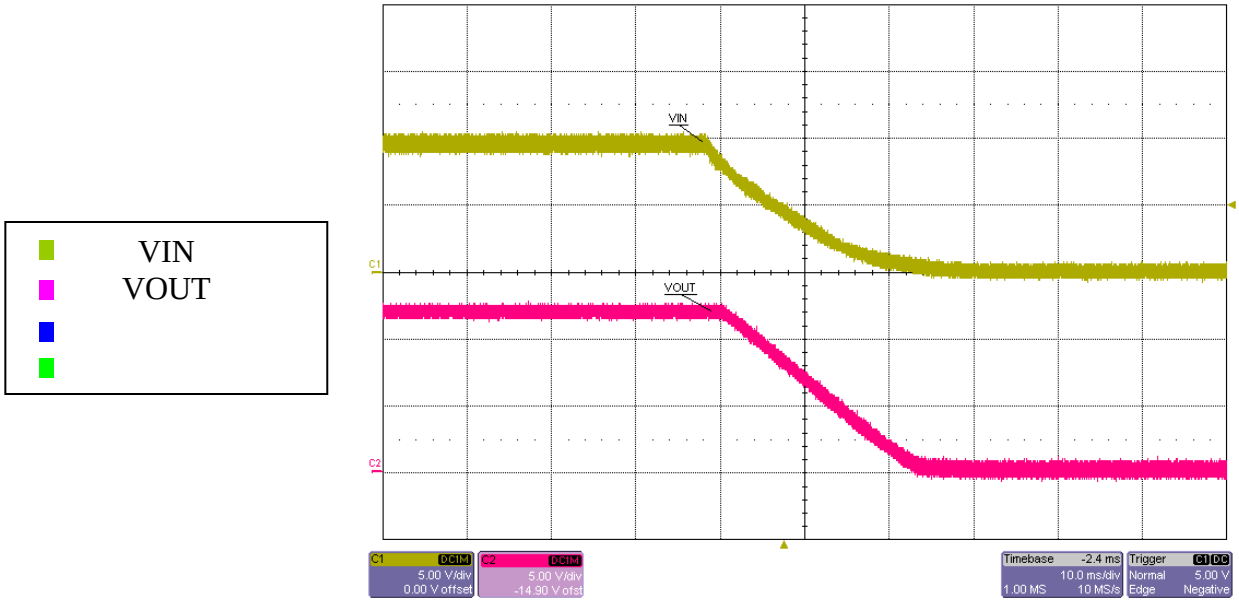


5.4 Power Up at 60V Input – 3.5A Load

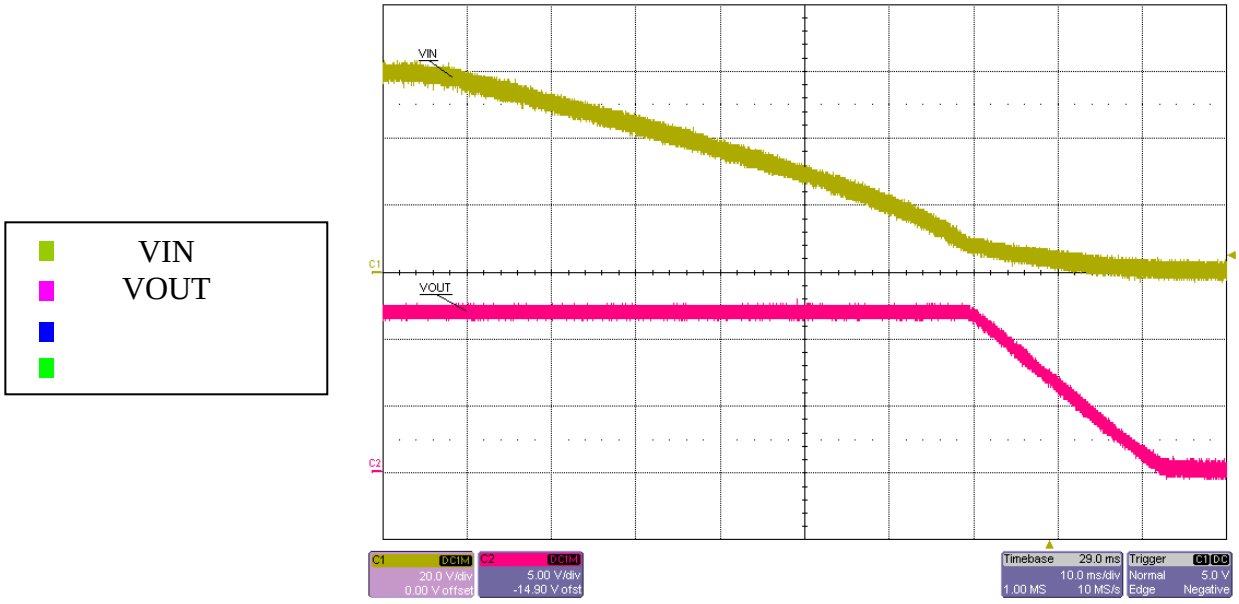
VIN
VOUT



5.5 Power Down at 9.6V Input – 3.5A Load



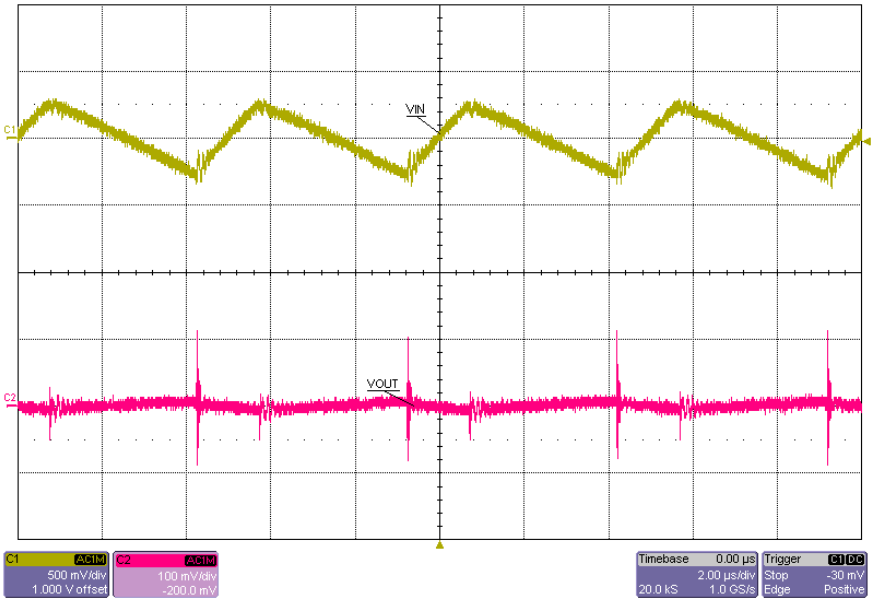
5.6 Power Down at 60V Input – 3.5A Load



6 Ripple and Switching Voltages

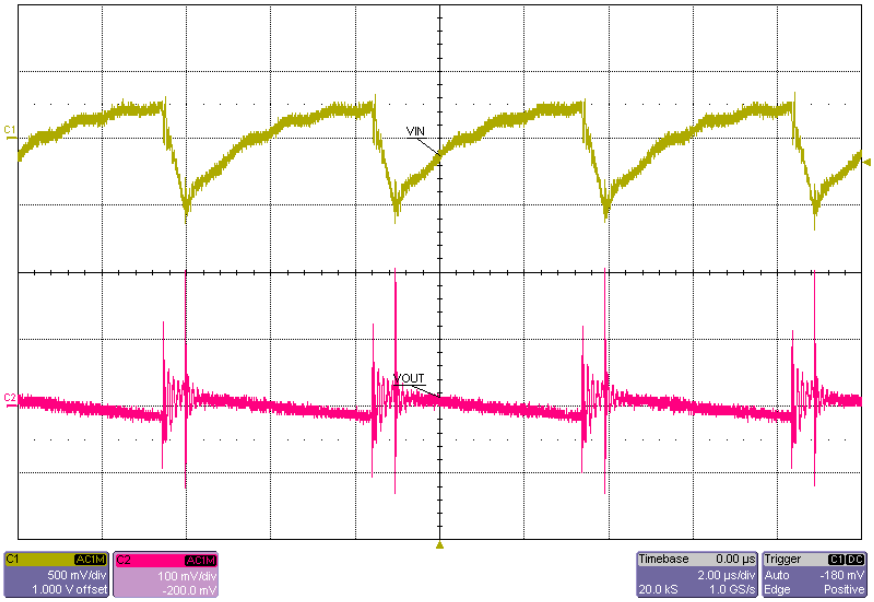
6.1 9.6V Input – 3.5A Load

VIN
VOUT



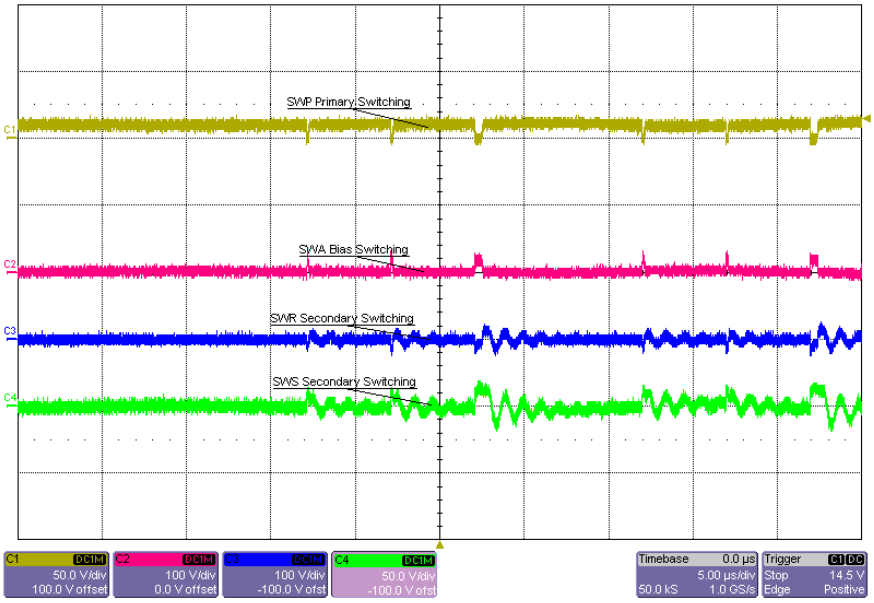
6.2 60V Input – 3.5A Load

VIN
VOUT



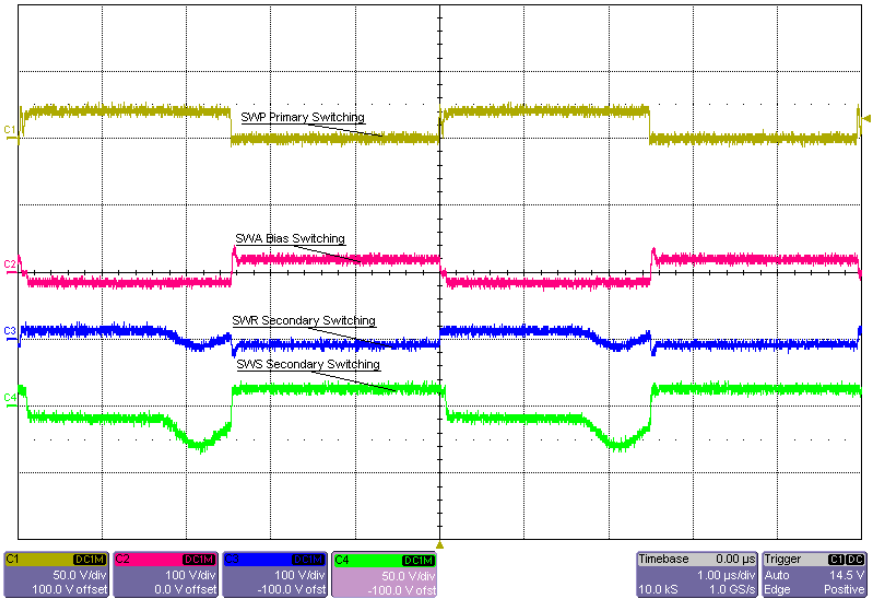
6.3 9.6V Input – No Load

SWP
SWA
SWR
SWS



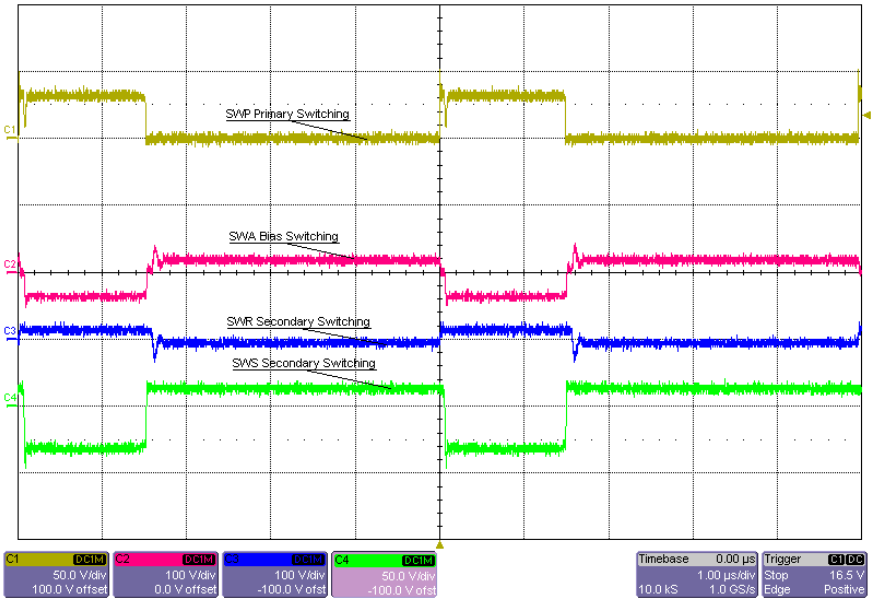
6.4 9.6V Input – 0.5A Load

SWP
SWA
SWR
SWS



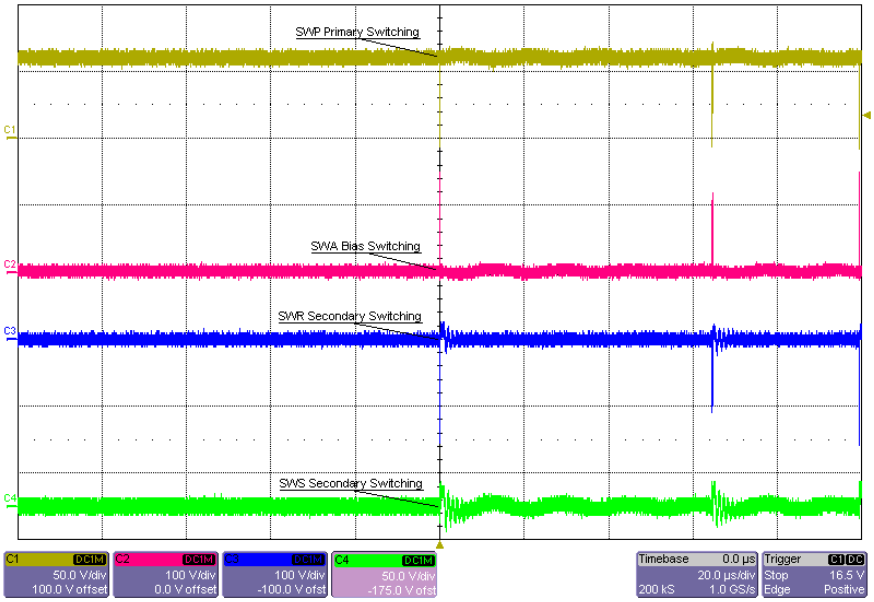
6.5 9.6V Input – 3.5A Load

SWP
SWA
SWR
SWS



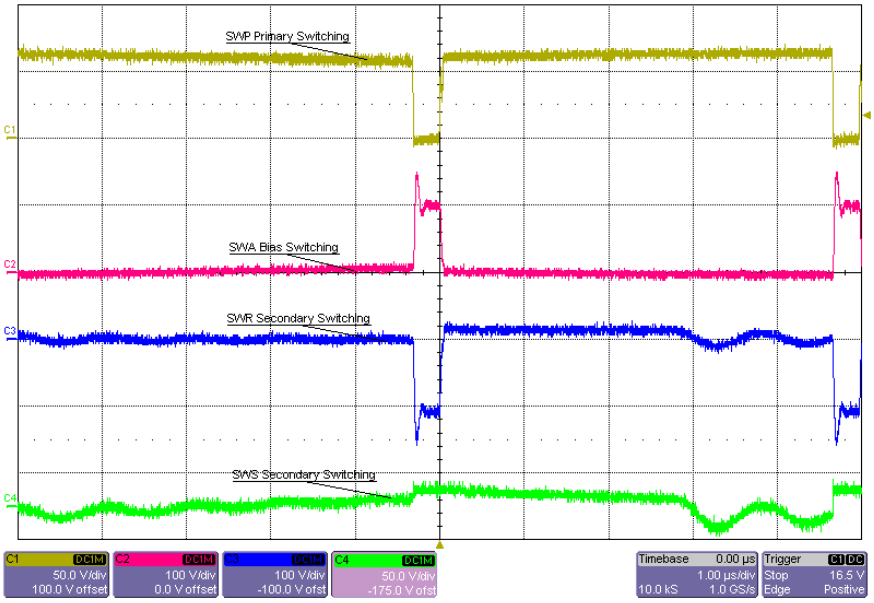
6.6 60V Input – No Load

SWP
SWA
SWR
SWS



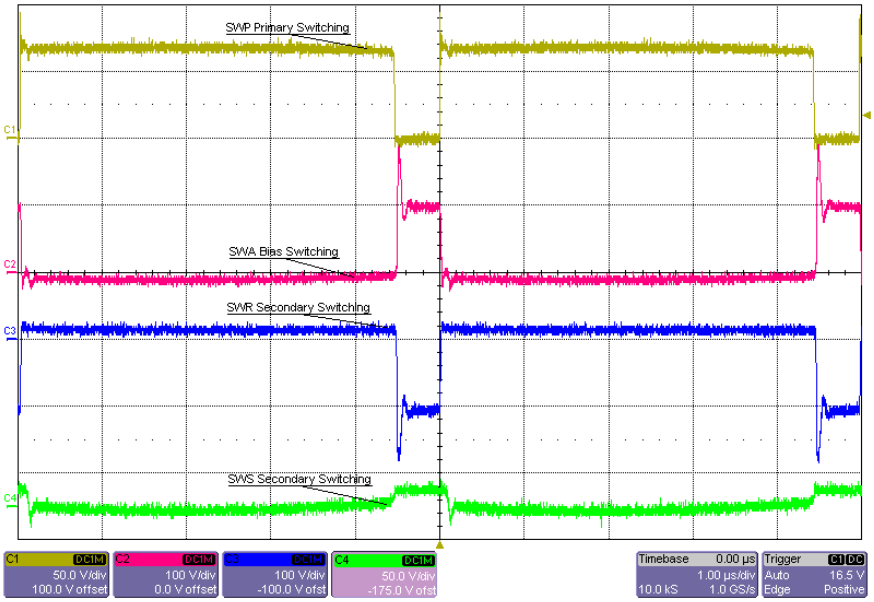
6.7 60V Input – 0.5A Load

SWP
SWA
SWR
SWS



6.8 60V Input – 3.5A Load

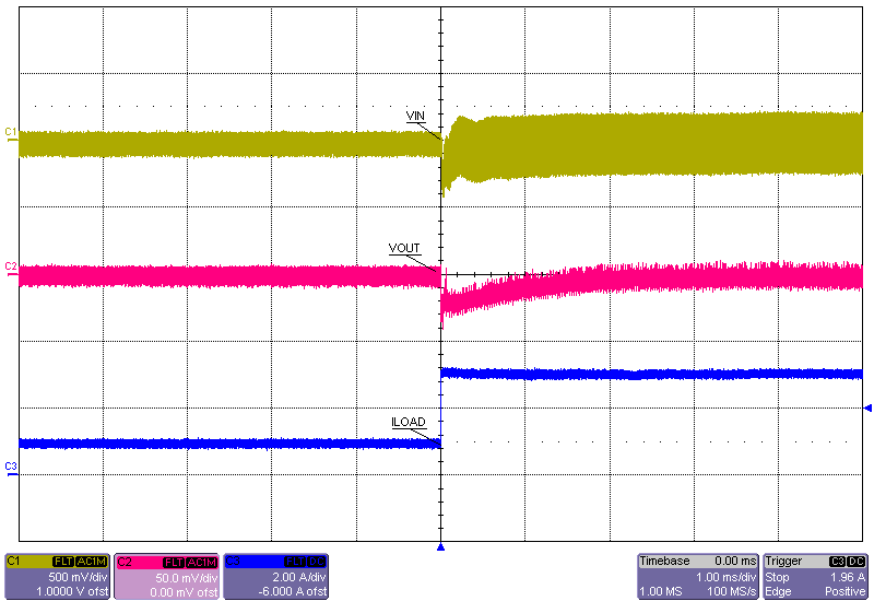
SWP
SWA
SWR
SWS



7 Transient Response

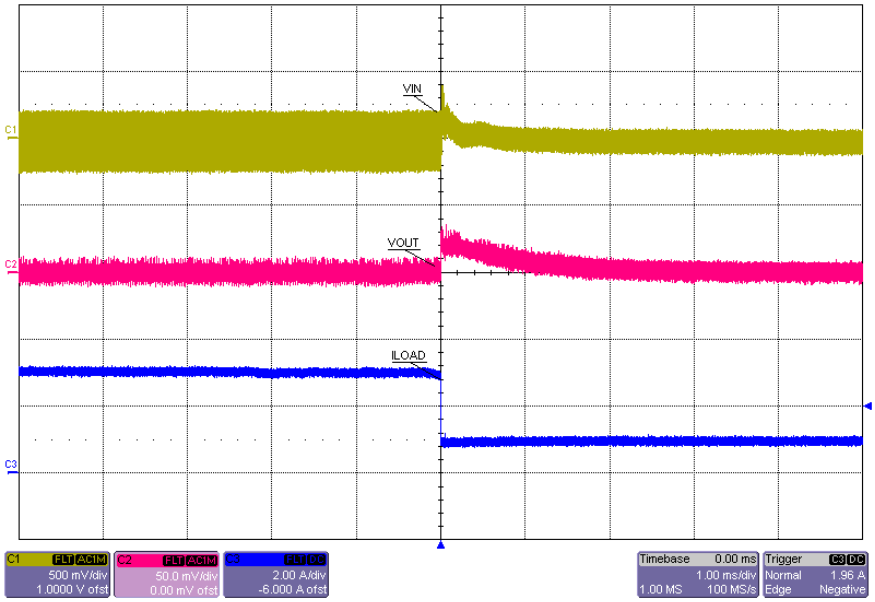
7.1 9.6V Input – 2A Load Step

VIN
VOUT
ILOAD



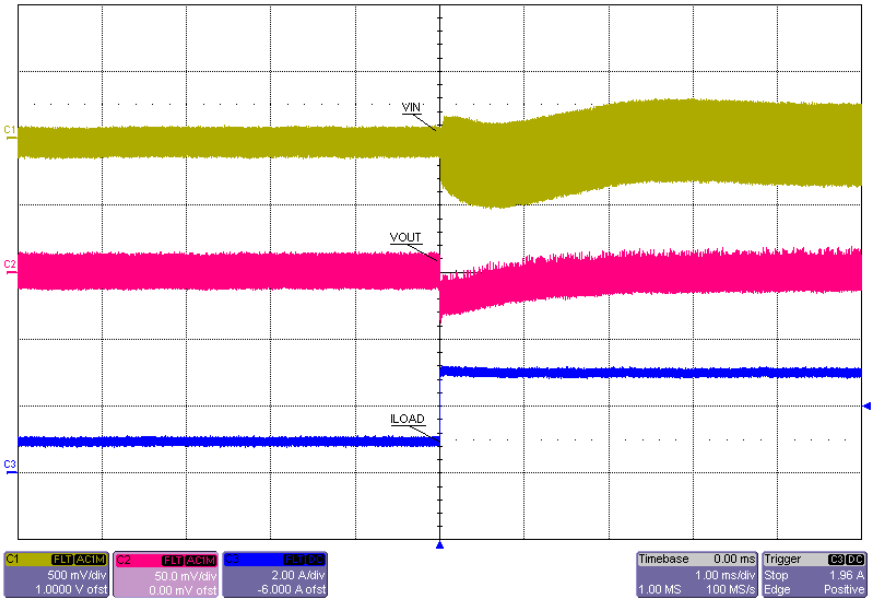
7.2 9.6V Input – 2A Load Step

VIN
VOUT
ILOAD



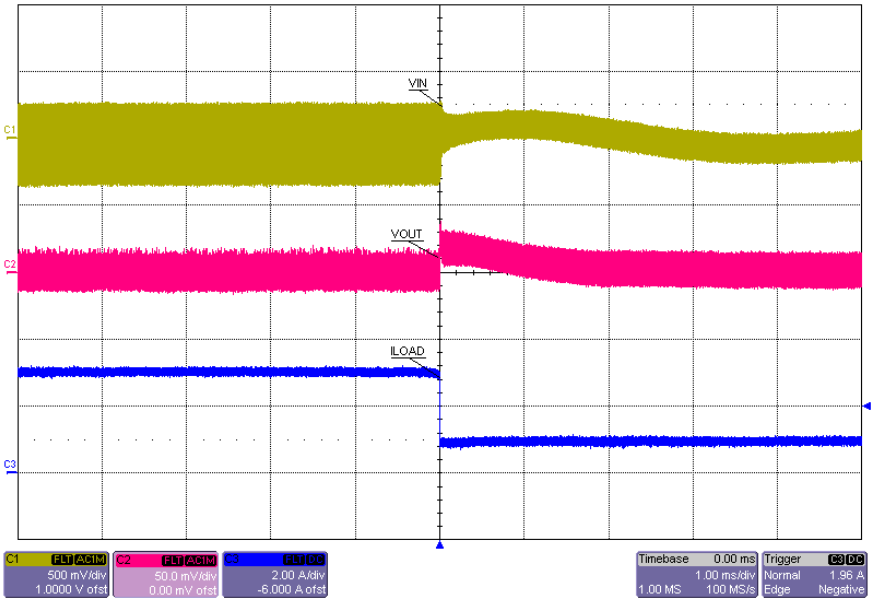
7.3 24V Input – 2A Load Step

VIN
VOUT
ILOAD



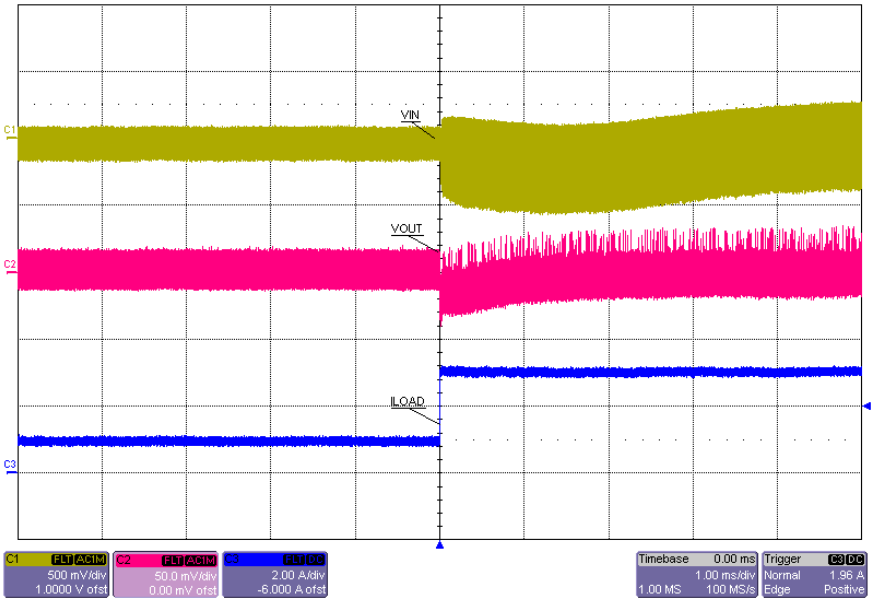
7.4 24V Input – 2A Load Step

VIN
VOUT
ILOAD



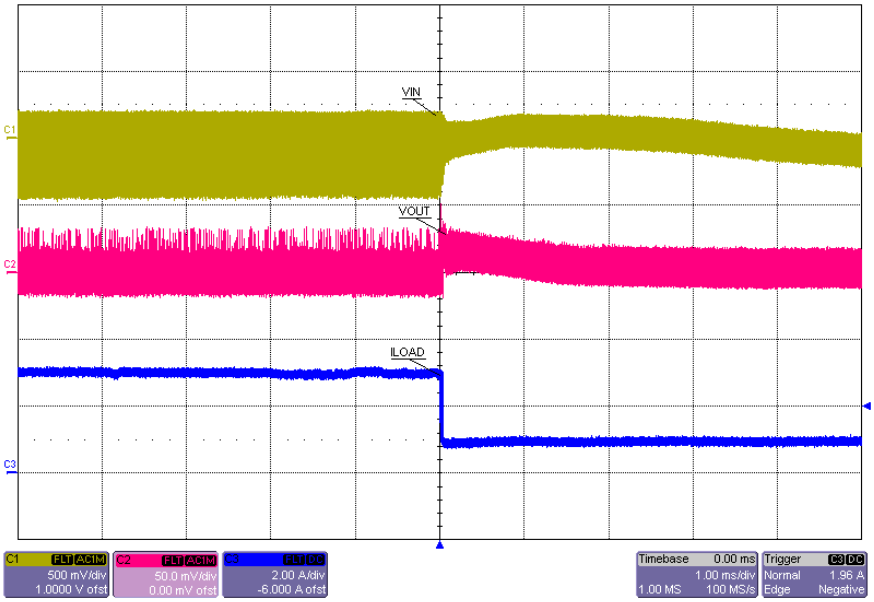
7.5 60V Input – 2A Load Step

VIN
VOUT
ILOAD



7.6 60V Input – 2A Load Step

VIN
VOUT
ILOAD



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