LM34919C-Q1 Ultra Small 50V, 600mA Constant On-Time Buck Switching Regulator

TI reference design number: PMP9271 Rev A

Input: 6V – 50V
Output: 3.3V@ 400mA

DC – DC Test Results

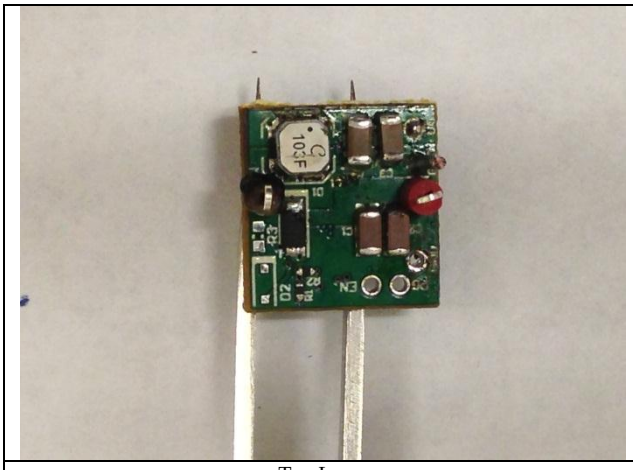
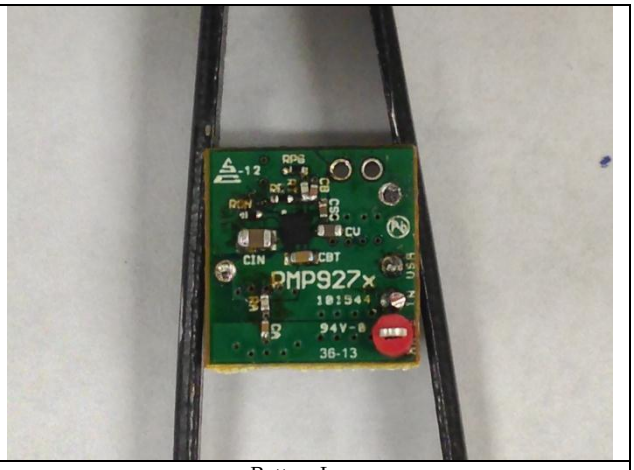
Table of Contents

1 Circuit Description

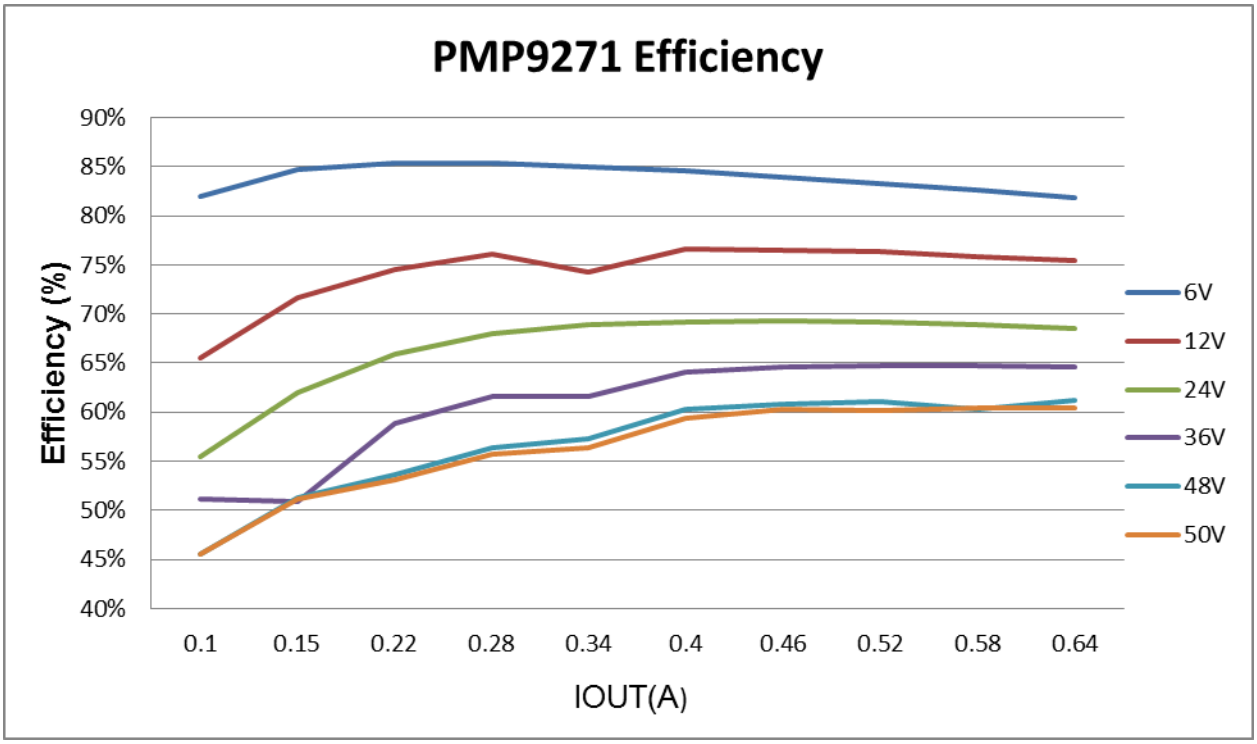
PMP9271 is a buck converter which can be used for a wide range of input voltages and different output power levels. The design will start up at a minimum input voltage of 6V and has been tested from 6V to 50V. The output is set for 3.3V at 0.4A and a maximum peak output current of 0.6A. The LM34919 uses a constant on time feedback regulation scheme and does not require loop compensation. A minimum ripple configuration for feedback was used in this design.
All tests were performed at room temperature on an open bench.

2 Photos

The LM34919 buck circuit was built on PMP9271 Rev A printed circuit board. This is a four layer board with overall dimensions of 0.565” (14.99mm) x 0.590” (14.35mm). The copper weight is 1oz on the outer layer and 0.5oz the inner layer. The overall height, including the inductor is ~0.135 (3.429mm).

	
Top Layer	Bottom Layer

3. Efficiency



3.1 LM34919 Buck Efficiency Data

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
6	0.067022	3.326794	0.1	83%	0.402608	0.332679	0.069928
6	0.104428	3.325801	0.16	85%	0.627012	0.532128	0.094884
6	0.142061	3.324569	0.22	86%	0.852587	0.731405	0.121182
6	0.181073	3.323291	0.28	86%	1.086197	0.930521	0.155676
6	0.220425	3.321914	0.34	85%	1.321621	1.129451	0.192171
6	0.260993	3.320566	0.4	85%	1.564078	1.328226	0.235852
6	0.302219	3.319751	0.46	84%	1.810162	1.527086	0.283076
6	0.34423	3.318709	0.52	84%	2.060725	1.725729	0.334996
6	0.387272	3.317736	0.58	83%	2.317124	1.924287	0.392838
6	0.431206	3.31611	0.64	82%	2.578578	2.12231	0.456268
6	0.302478	1.741527	0.7	67%	1.811727	1.219069	0.592658

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
12	0.041633	3.275255	0.1	65.56%	0.499596	0.327525	0.17207
12	0.060891	3.274261	0.16	71.70%	0.730697	0.523882	0.206815
12	0.080563	3.273281	0.22	74.49%	0.966762	0.720122	0.24664
12	0.100422	3.272299	0.28	76.03%	1.205064	0.916244	0.28882
12	0.121091	3.271297	0.33	74.29%	1.453097	1.079528	0.373569
12	0.142199	3.270272	0.4	76.66%	1.706384	1.308109	0.398276
12	0.163744	3.269311	0.46	76.54%	1.964927	1.503883	0.461044
12	0.185524	3.2684	0.52	76.34%	2.22629	1.699568	0.526722
12	0.208253	3.267632	0.58	75.84%	2.49904	1.895227	0.603813
12	0.230958	3.267041	0.64	75.44%	2.771496	2.090906	0.68059
12	0.248757	3.136608	0.7	73.55%	2.985084	2.195626	0.789458

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
24	0.024585	3.278746	0.1	55.47%	0.59113	0.327875	0.263255
24	0.0352	3.27696	0.16	61.95%	0.846322	0.524314	0.322008
24	0.045514	3.275876	0.22	65.86%	1.094271	0.720693	0.373579
24	0.05608	3.274676	0.28	68.01%	1.34827	0.916909	0.431361
24	0.067132	3.273418	0.34	68.96%	1.613938	1.112962	0.500976
24	0.078655	3.272054	0.4	69.22%	1.890899	1.308821	0.582077
24	0.090251	3.270644	0.46	69.35%	2.169566	1.504496	0.66507
24	0.102292	3.269384	0.52	69.14%	2.458966	1.70008	0.758886
24	0.114391	3.268167	0.58	68.94%	2.74971	1.895537	0.854173
24	0.126838	3.267412	0.64	68.59%	3.048796	2.091144	0.957653
24	0.139212	3.267832	0.7	68.36%	3.346116	2.287483	1.058633

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
36	0.01779	3.282352	0.1	51.25%	0.640443	0.328235	0.312208
36	0.026864	3.283819	0.15	50.93%	0.9671	0.492573	0.474527
36	0.034032	3.282612	0.22	58.95%	1.225155	0.722175	0.502981
36	0.041354	3.281491	0.28	61.72%	1.488757	0.918817	0.56994
36	0.048677	3.280198	0.33	61.77%	1.752359	1.082465	0.669894
36	0.056785	3.278951	0.4	64.16%	2.044277	1.31158	0.732697
36	0.064716	3.277557	0.46	64.71%	2.329773	1.507676	0.822097
36	0.072946	3.276307	0.52	64.88%	2.62607	1.70368	0.92239
36	0.081355	3.275192	0.58	64.86%	2.92879	1.899612	1.029178
36	0.089918	3.274476	0.64	64.74%	3.237055	2.095665	1.14139
36	0.098538	3.275368	0.7	64.63%	3.547364	2.292758	1.254606

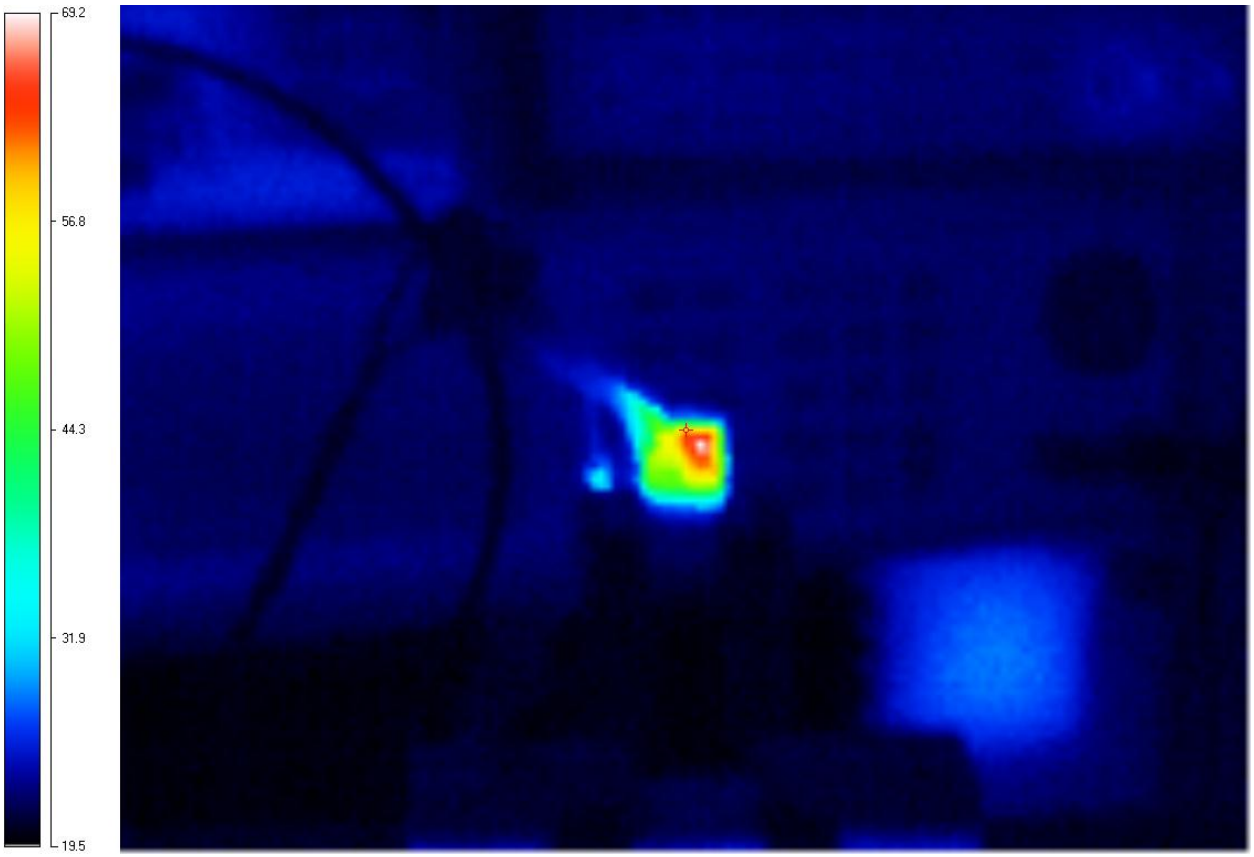
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
48	0.015017	3.284882	0.1	45.57%	0.72081	0.328488	0.392322
48	0.021342	3.285892	0.16	51.32%	1.024405	0.525743	0.498662
48	0.028032	3.288405	0.22	53.77%	1.345514	0.723449	0.622065
48	0.033951	3.28713	0.28	56.48%	1.629648	0.920396	0.709252
48	0.0394	3.285936	0.33	57.34%	1.891207	1.084359	0.806848
48	0.045328	3.284674	0.4	60.39%	2.17573	1.313869	0.86186
48	0.051677	3.283465	0.46	60.89%	2.480492	1.510394	0.970098
48	0.058115	3.282285	0.52	61.19%	2.789536	1.706788	1.082748
48	0.064432	3.28118	0.57	60.47%	3.092742	1.870273	1.222469
48	0.071341	3.280286	0.64	61.31%	3.42436	2.099383	1.324977
48	0.078428	3.28131	0.7	61.01%	3.764542	2.296917	1.467625

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
50	0.014376	3.284194	0.1	45.69%	0.718814	0.328419	0.390394
50	0.020531	3.284402	0.16	51.19%	1.026544	0.525504	0.50104
50	0.027213	3.288529	0.22	53.17%	1.360628	0.723476	0.637152
50	0.032978	3.287223	0.28	55.82%	1.648898	0.920423	0.728475
50	0.038427	3.285973	0.33	56.44%	1.921354	1.084371	0.836983
50	0.044136	3.284583	0.4	59.54%	2.206785	1.313833	0.892952
50	0.050007	3.28325	0.46	60.40%	2.500325	1.510295	0.99003
50	0.056623	3.281913	0.52	60.28%	2.831165	1.706595	1.12457
50	0.062827	3.280793	0.58	60.58%	3.141329	1.90286	1.238468
50	0.069314	3.280093	0.64	60.57%	3.465682	2.09926	1.366422
50	0.075736	3.281199	0.7	60.65%	3.786792	2.296839	1.489953

4. Thermal

4.1 50V input, 3.3Vout with a 400mA load

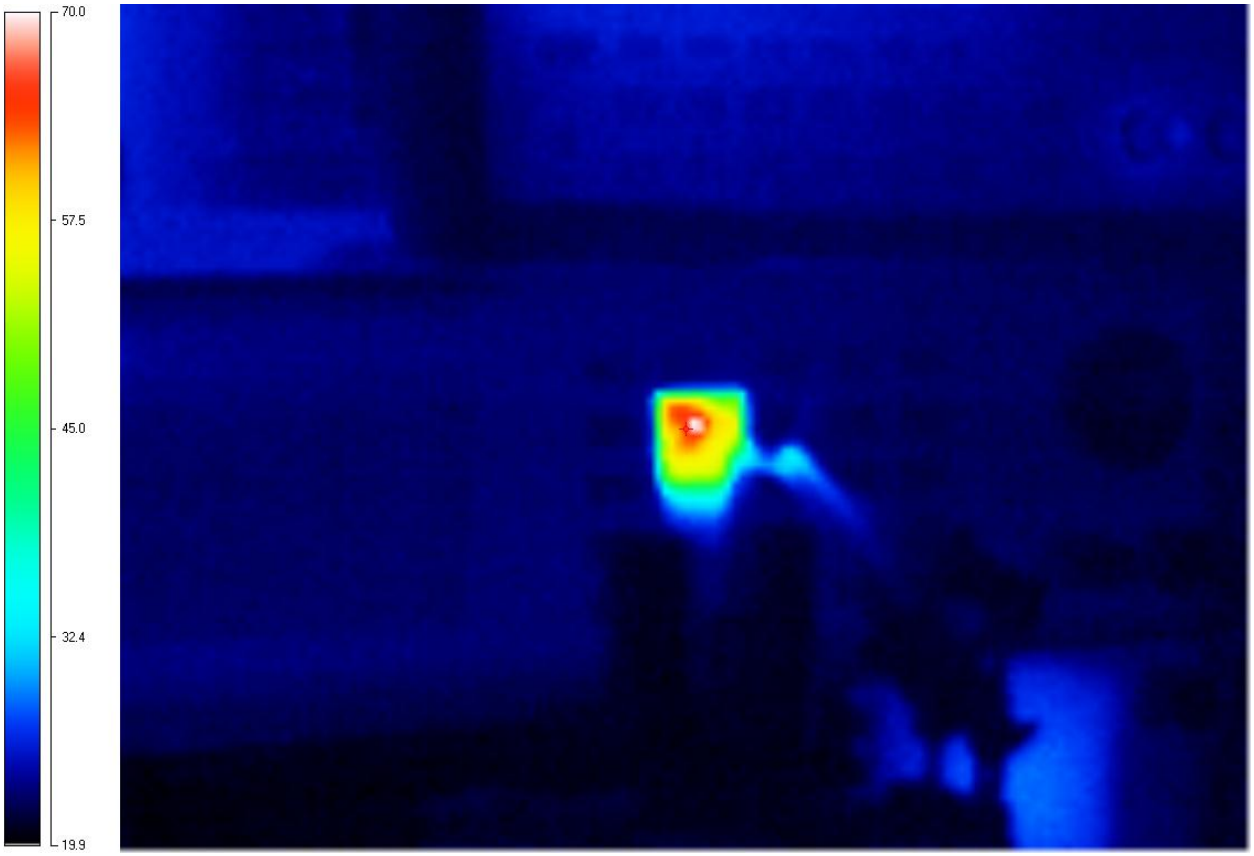
Top View



The inductor is the hottest component at ~ 69°C

4.2 50V input, 3.3Vout with a 400mA load

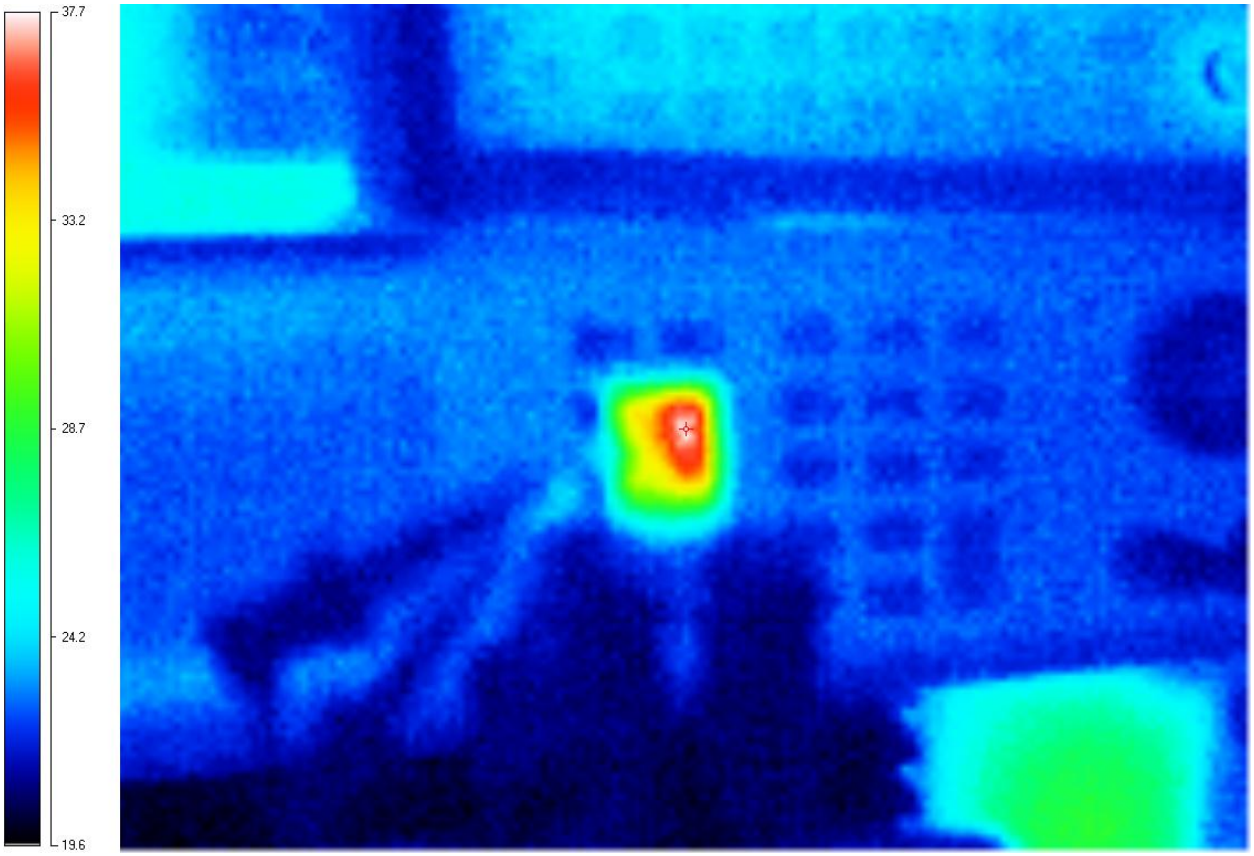
Bottom View



The inductor is the hottest component at ~ 70°C

4.3 12V Input, 3.3Vout @ 330mA load

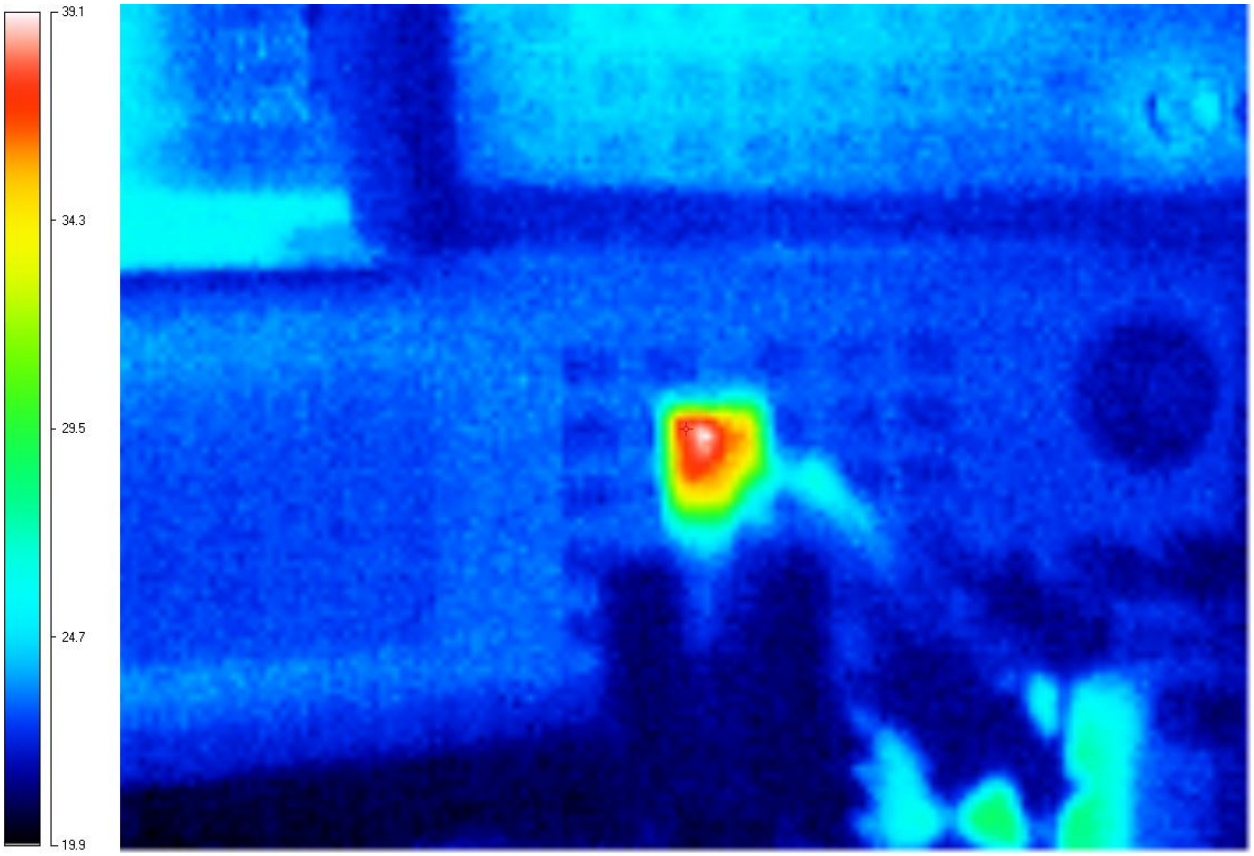
Top View



The inductor is the hottest component at ~ 38°C

4.4 12V Input, 3.3V out @ 330mA Load

Bottom View

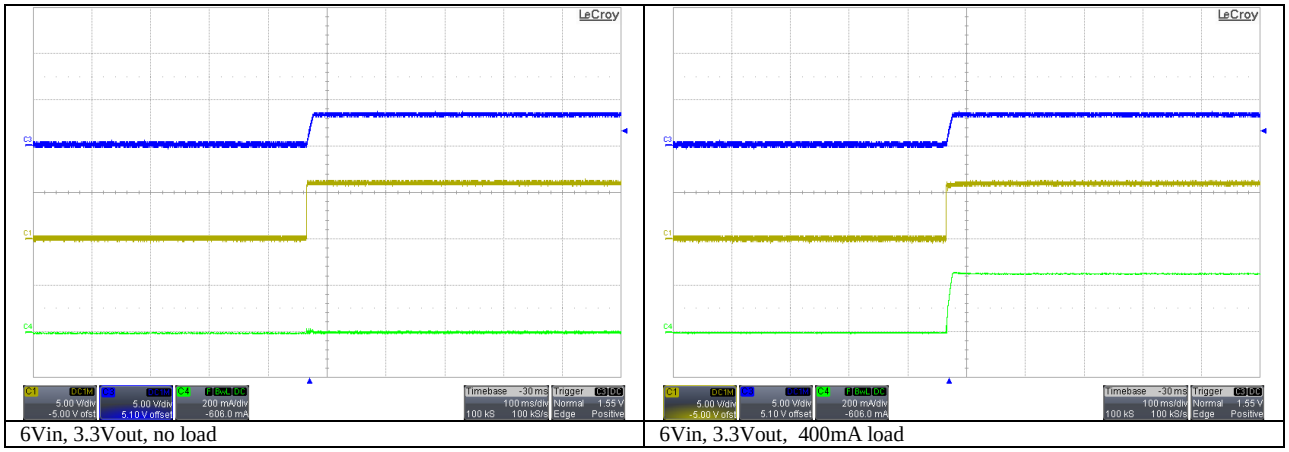


The inductor is the hottest component at ~ 39°C

5. Power Up

5.1 Power Up at 6V Input – No Load

Power Up at 6V Input – 400mA



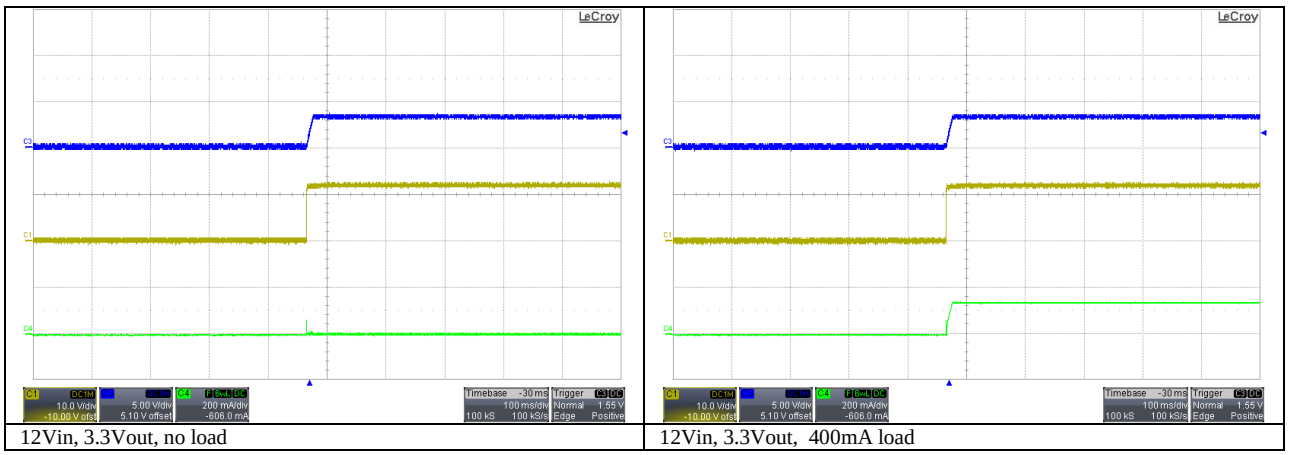
6Vin, 3.3Vout, no load

6Vin, 3.3Vout, 400mA load

Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.2 Power Up at 12V Input – No Load

Power Up at 12V Input – 400mA



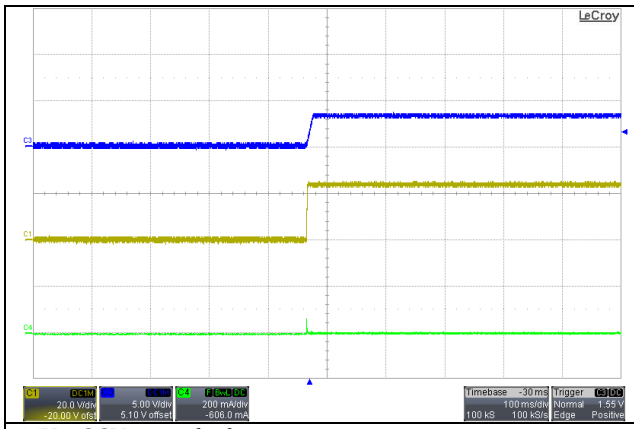
12Vin, 3.3Vout, no load

12Vin, 3.3Vout, 400mA load

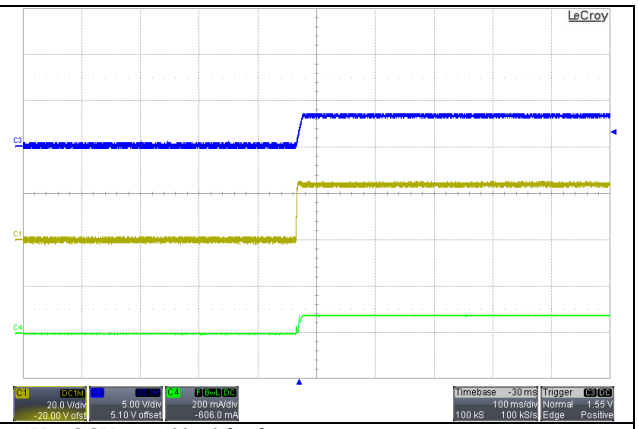
Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.3 Power Up at 24V Input – No Load

Power Up at 24V Input – 400mA



24Vin, 3.3Vout, no load

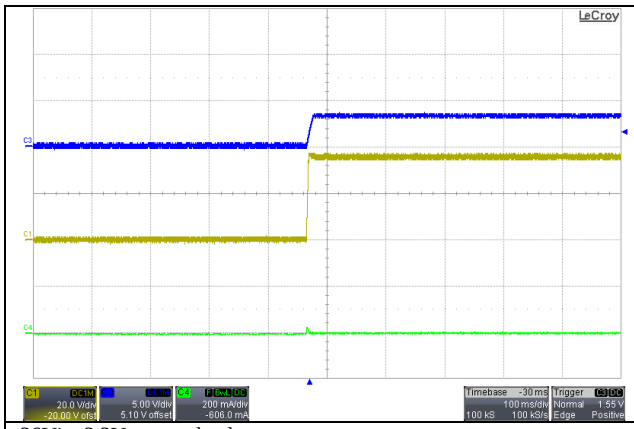


24Vin, 3.3Vout, 400mA load

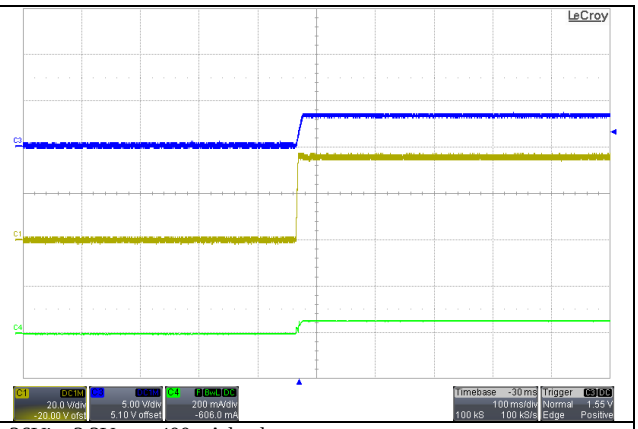
Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.4 Power Up at 36V Input – No Load

Power Up at 36V Input – 400mA



36Vin, 3.3Vout, no load

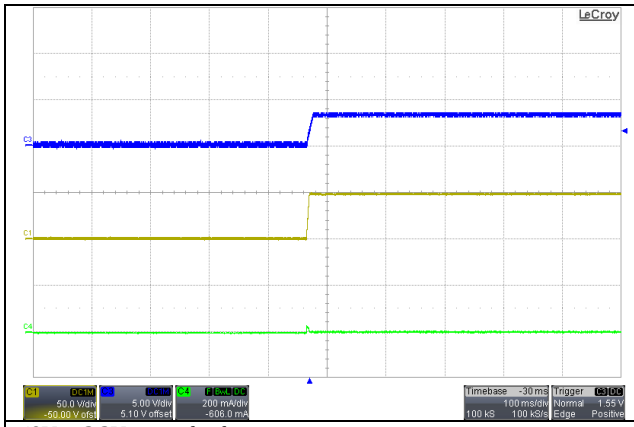


36Vin, 3.3Vout, 400mA load

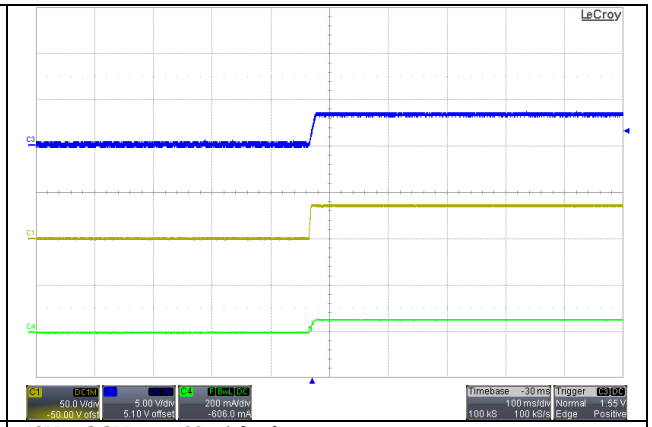
Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.5 Power Up at 48V Input – No Load

Power Up at 48V Input – 400mA



48Vin, 3.3Vout, no load

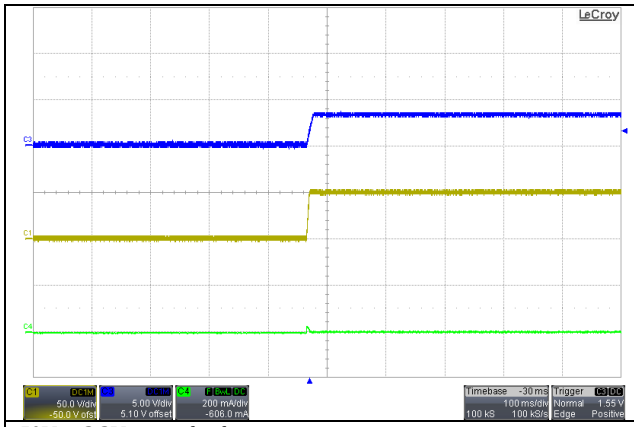


48Vin, 3.3Vout, 400mA load

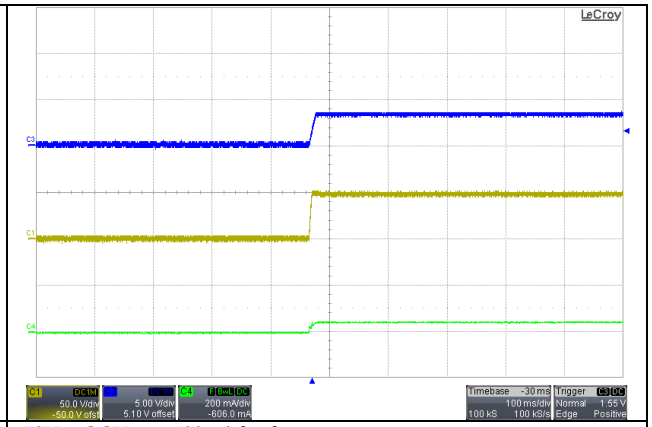
Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.6 Power Up at 50V Input – No Load

Power Up at 50V Input – 400mA



50Vin, 3.3Vout, no load

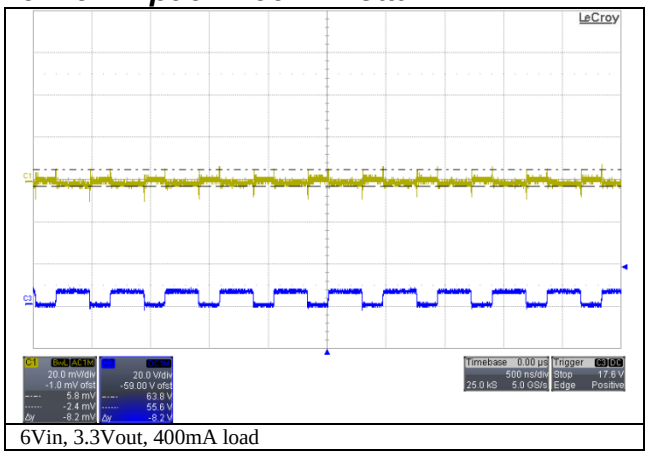


50Vin, 3.3Vout, 400mA load

Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

6. Switch Node voltage and Output Ripple voltage

6.1 6V Input – 400mA load

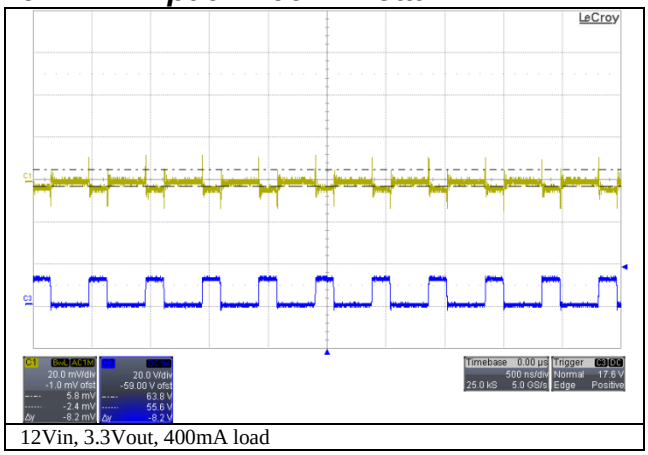


6Vin, 3.3Vout, 400mA load

Less than 10mV p-p Ripple

Channel 1 VOUT
Channel 3 VSW

6.2 12V Input – 400mA load

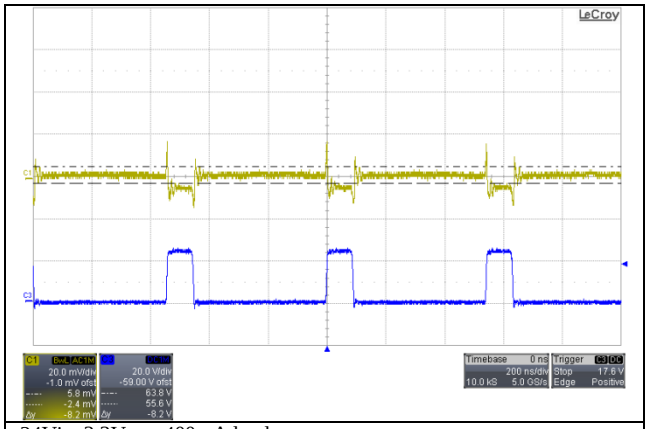


12Vin, 3.3Vout, 400mA load

Less than 10mV p-p Ripple

Channel 1 VOUT
Channel 3 VSW

6.3 24V Input – 400mA load

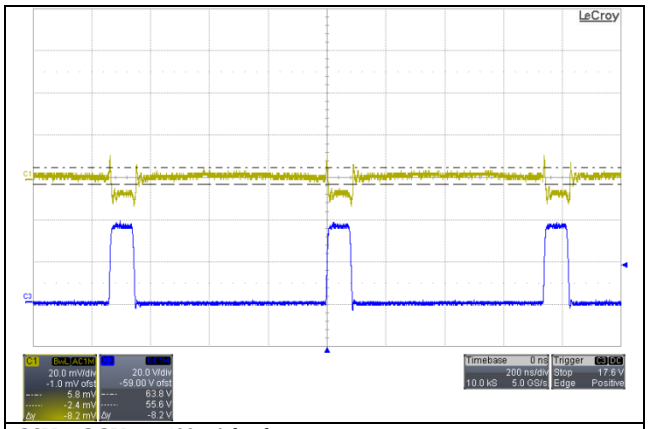


24Vin, 3.3Vout, 400mA load

Less than 10mV p-p Ripple

Channel 1 VOUT
Channel 3 VSW

6.4 36V Input – 400mA load

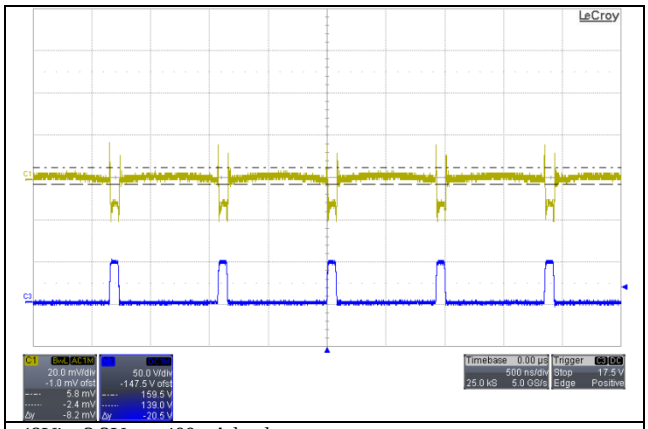


36Vin, 3.3Vout, 400mA load

Less than 10mV p-p Ripple

Channel 1 VOUT
Channel 3 VSW

6.5 48V Input – 400mA load

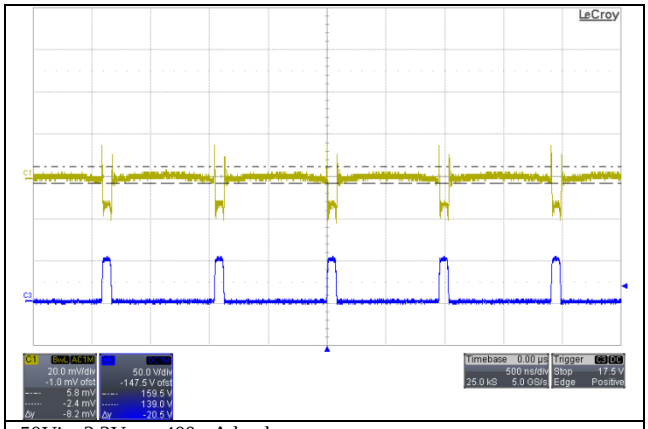


48Vin, 3.3Vout, 400mA load

Less than 10mV p-p Ripple

Channel 1 VOUT
Channel 3 VSW

6.6 50V Input – 400mA load



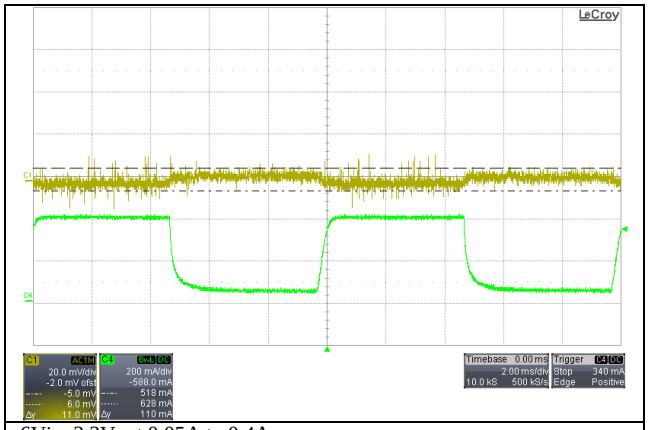
50Vin, 3.3Vout, 400mA load

Less than 10mV p-p Ripple

Channel 1 VOUT
Channel 3 VSW

7. Transient Response

7.1 6V Input – Load Step 100 Hz, 1800mA per us, 0.05A to 0.4A

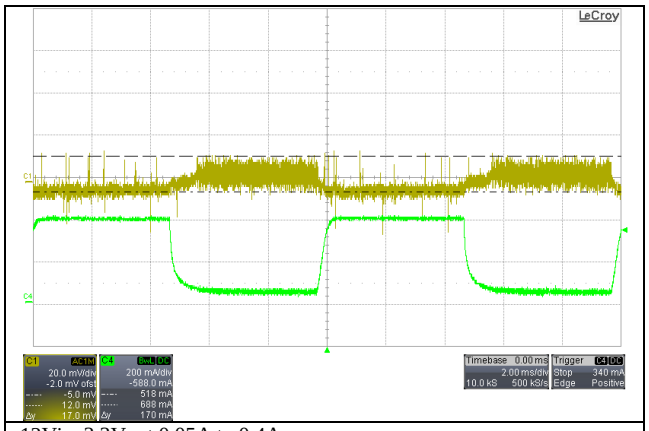


6Vin, 3.3Vout 0.05A to 0.4A

Cursors indicate ~11mV maximum deviation across output capacitor.

Channel 1 VOUT
Channel 4 IOUT

7.2 12V Input – Load Step 100 Hz, 1800mA per us, 0.05A to 0.4A

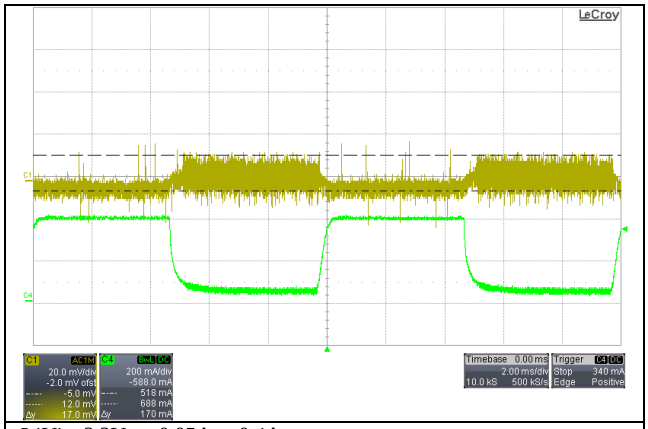


12Vin, 3.3Vout 0.05A to 0.4A

Cursors indicate ~17mV maximum deviation across output capacitor.

Channel 1 VOUT
Channel 4 IOUT

7.3 24V Input – Load Step 100 Hz, 1800mA per us, 0.05A to 0.4A

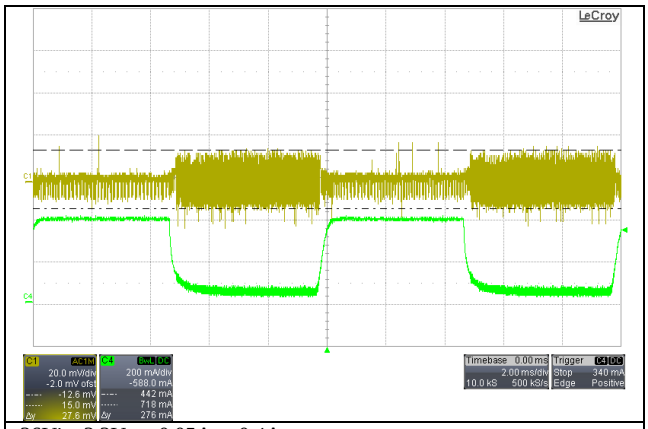


24Vin, 3.3Vout 0.05A to 0.4A

Cursors indicate ~17mV maximum deviation across output capacitor.

Channel 1 VOUT
Channel 4 IOUT

7.4 36V Input – Load Step 100 Hz, 1800mA per us, 0.05A to 0.4A

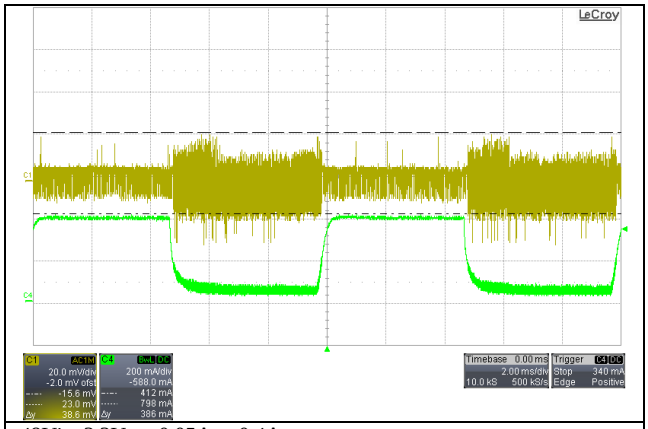


36Vin, 3.3Vout 0.05A to 0.4A

Cursors indicate ~27mV maximum deviation across output capacitor.

Channel 1 VOUT
Channel 4 IOUT

7.5 48V Input – Load Step 100 Hz, 1800mA per us, 0.05A to 0.4A

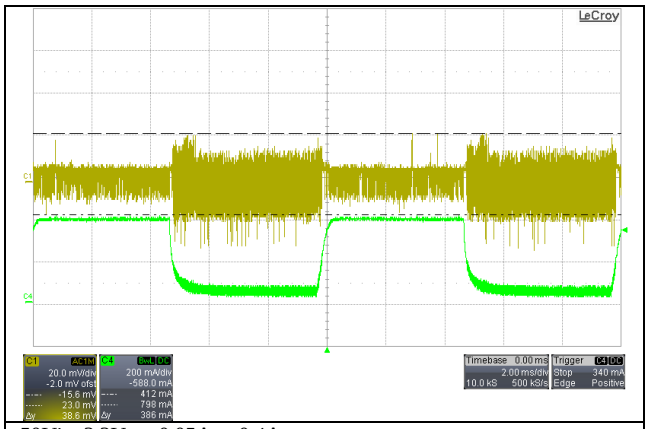


48Vin, 3.3Vout 0.05A to 0.4A

Cursors indicate ~39mV maximum deviation across output capacitor.

Channel 1 VOUT
Channel 4 IOUT

7.6 50V Input - Load Step 100 Hz, 1800mA per us, 0.05A to 0.4A



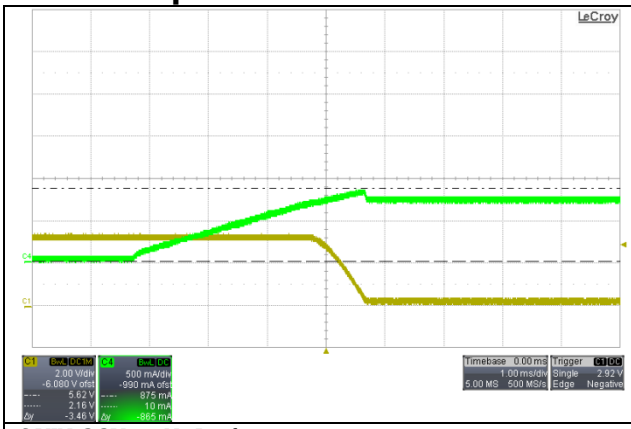
50Vin, 3.3Vout 0.05A to 0.4A

Cursors indicate ~39mV maximum deviation across output capacitor.

Channel 1 VOUT
Channel 4 IOUT

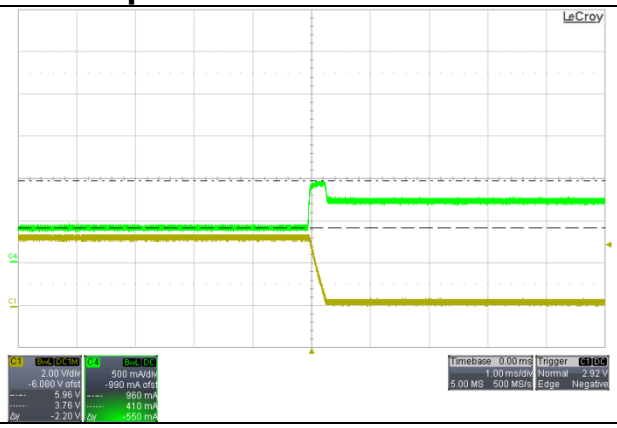
8. Short Circuit Tests

8.1 6V input - no load



6 VIN, 3.3Vout, No Load

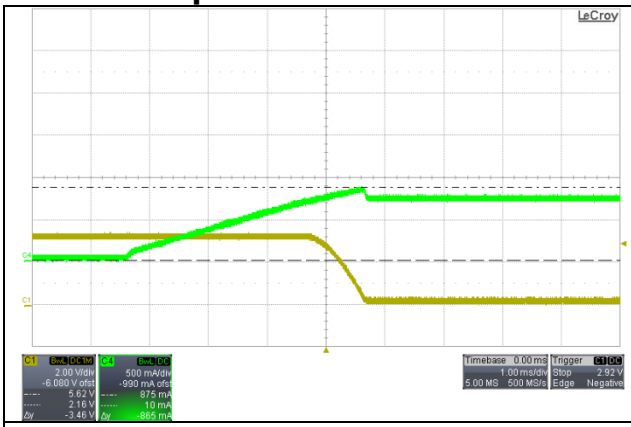
6V input - 400mA load



6 VIN, 3.3Vout, 400mA Load

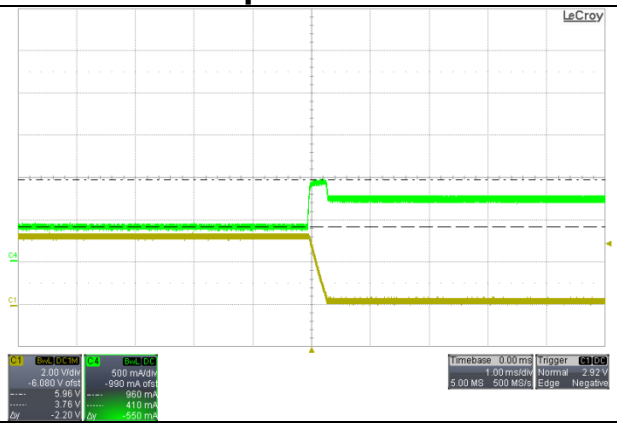
Channel 1 VOUT
Channel 4 IOUT

8.2 12V input - no load



12 VIN, 3.3Vou t, No Load

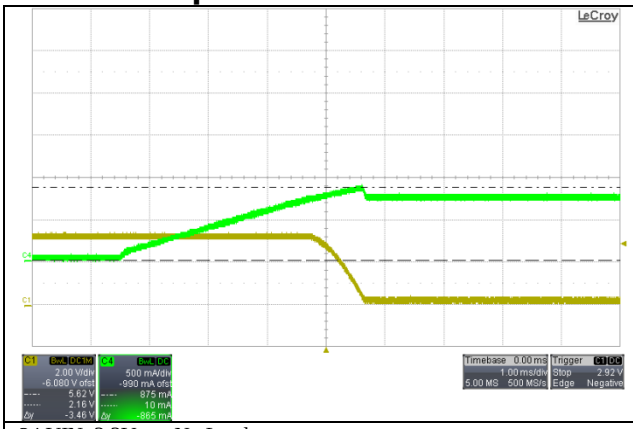
12V input - 400mA



12 VIN, 3.3Vout, 400mA Load

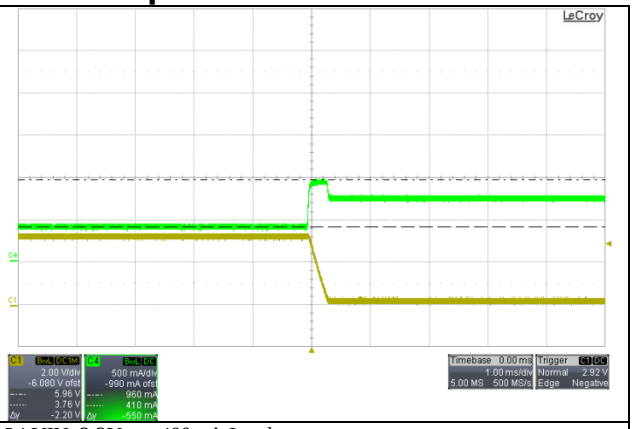
Channel 1 VOUT
Channel 4 IOUT

8.3 24V input – no load



24 VIN, 3.3Vout, No Load

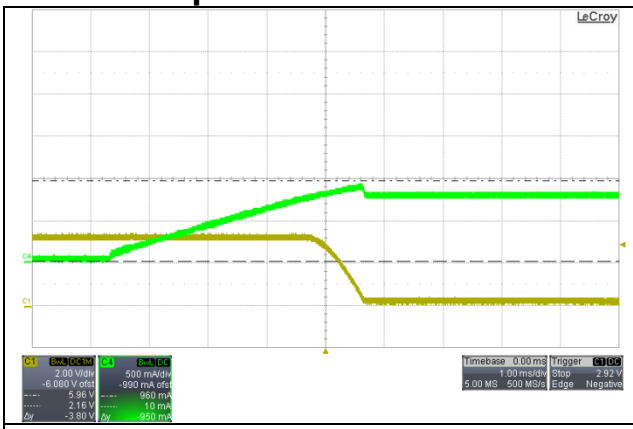
24V input – 400mA load



24 VIN, 3.3Vout, 400mA Load

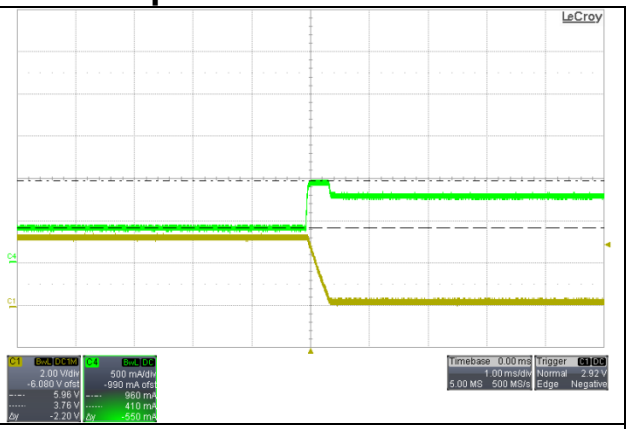
Channel 1 VOUT
Channel 4 IOUT

8.4 36V input – no load



36 VIN, 3.3Vout, No Load

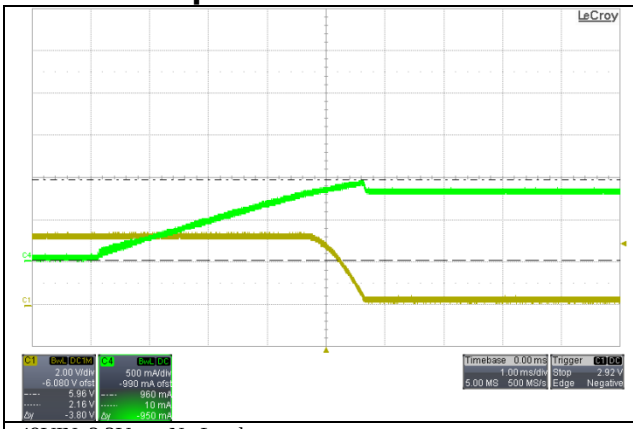
36V input – 400mA load



36 VIN, 3.3Vout, 400mA Load

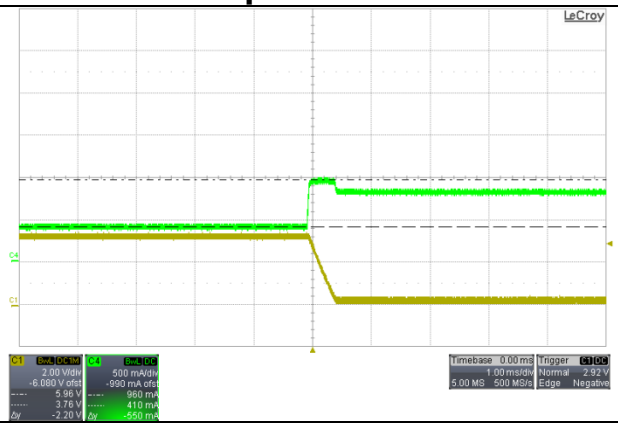
Channel 1 VOUT
Channel 4 IOUT

8.5 48V input – no load



48VIN, 3.3Vout, No Load

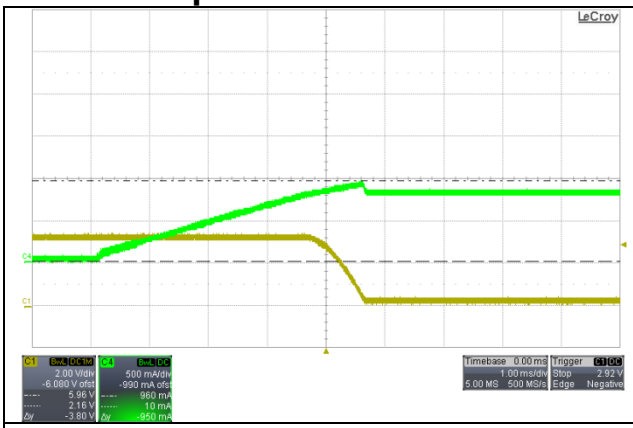
48V input – 400mA load



48 VIN, 3.3Vout, 400mA Load

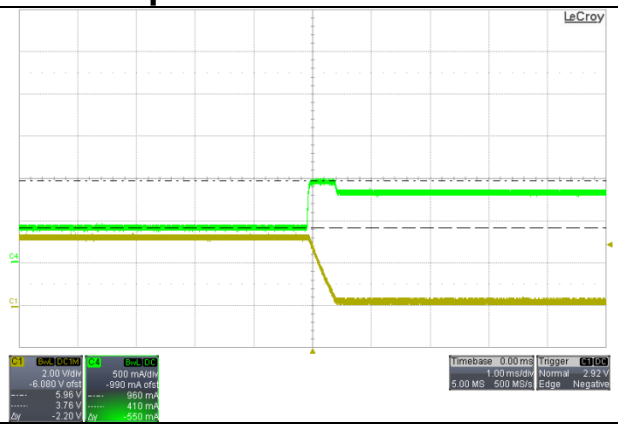
Channel 1 VOUT
Channel 4 IOUT

8.6 50V input – no load



50 VIN, 3.3Vout, no load

50V input – 400mA load

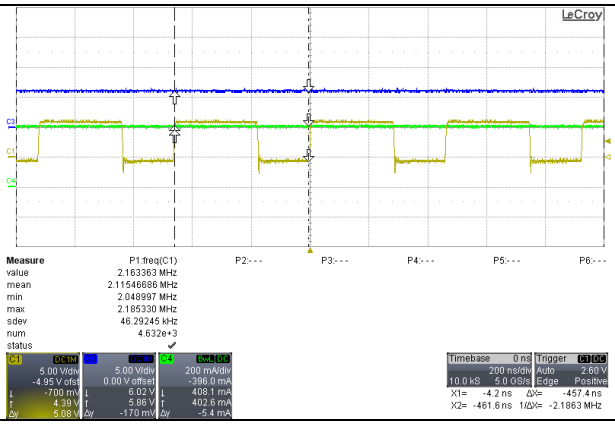


50 VIN, 3.3Vout, 400mA Load

Channel 1 VOUT
Channel 4 IOUT

9. Frequency variation Vs. Vin

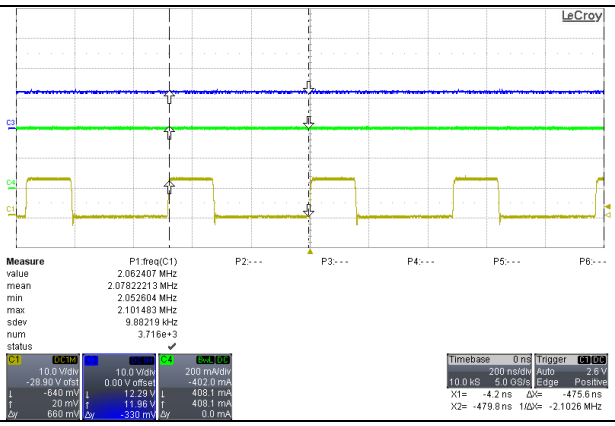
9.1 6VIN



6V in ~ 2.2 MHz

Channel 1 VSW
Channel 3 VIN
Channel 4 IOUT

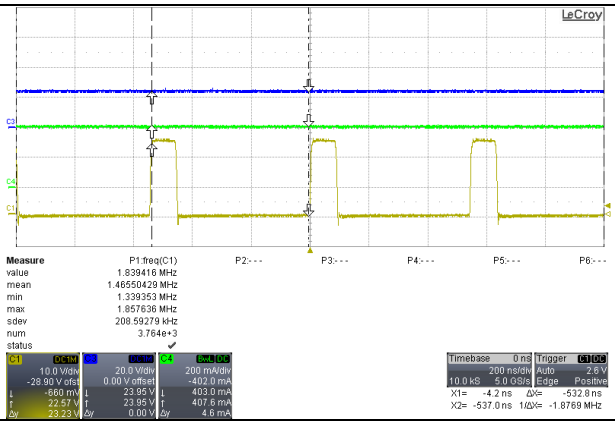
9.2 12VIN



12V in ~ 2.06 MHz

Channel 1 VSW
Channel 3 VIN
Channel 4 IOUT

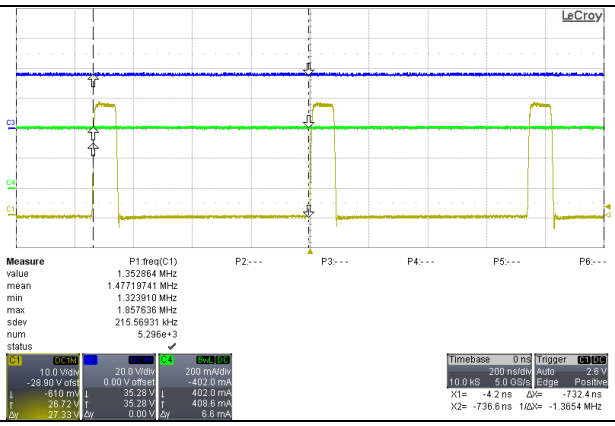
9.3 24VIN



24V in ~ 1.839 MHz

Channel 1 VSW
Channel 3 VIN
Channel 4 IOUT

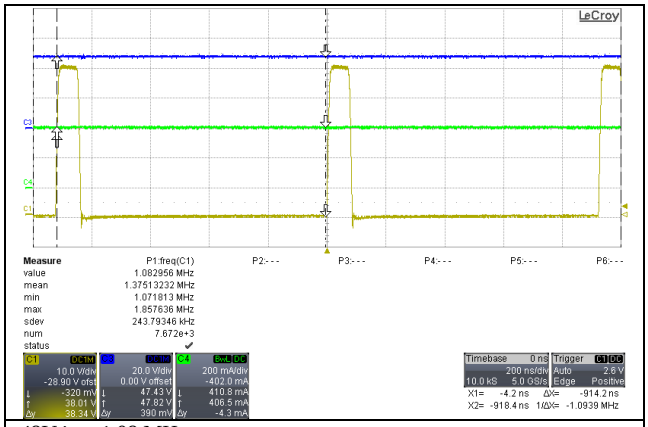
9.4 36VIN



36V in ~ 1.352 MHz

Channel 1 VSW
Channel 3 VIN
Channel 4 IOUT

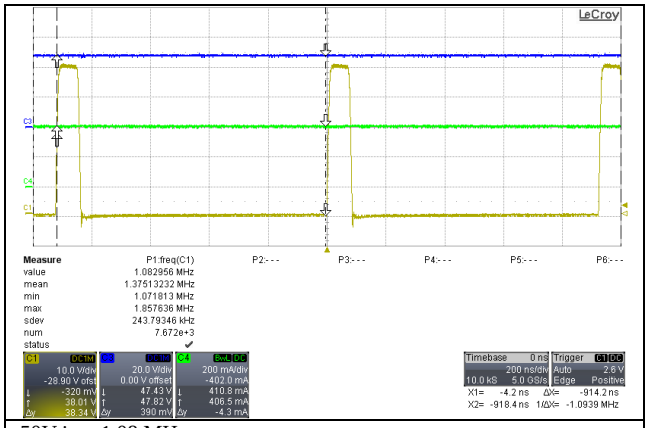
9.5 48VIN



48V in ~ 1.08 MHz

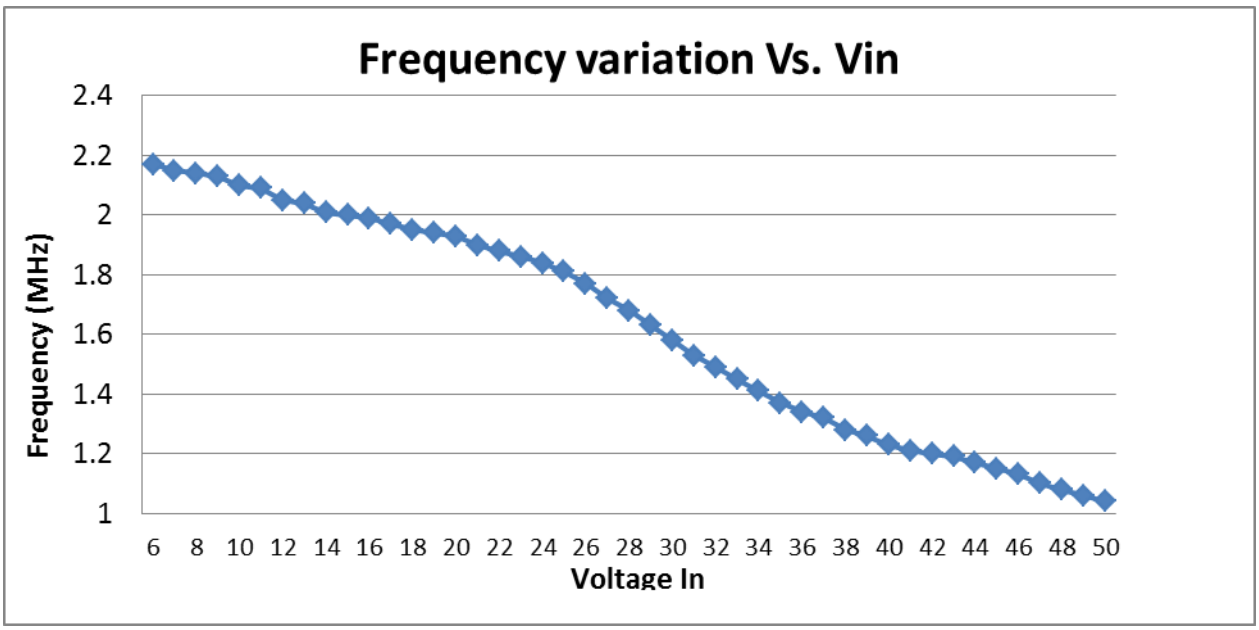
Channel 1 VSW
Channel 3 VIN
Channel 4 IOUT

9.5 50VIN



50V in ~ 1.08 MHz

Channel 1 VSW
Channel 3 VIN
Channel 4 IOUT


Frequency variation Vs. Vin
Frequency (MHz)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
Voltage In

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265