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Test Requirements:

Steady operating 8 to 18V.

18 to 26V for 2 minutes.

26 to 40 (60) V for 500ms max. No operation, just survival without damage.

6 to 8V for max 2sec.

Loading:

1.06V core: 2.5A approximated with 5x 80mOhms plus 1x 20mOhm or 420mOhms in all

5V can: 100mA with 2x 100 ohms in parallel

1.2V memory: 260mA approximated with 4.7 ohm single resistor

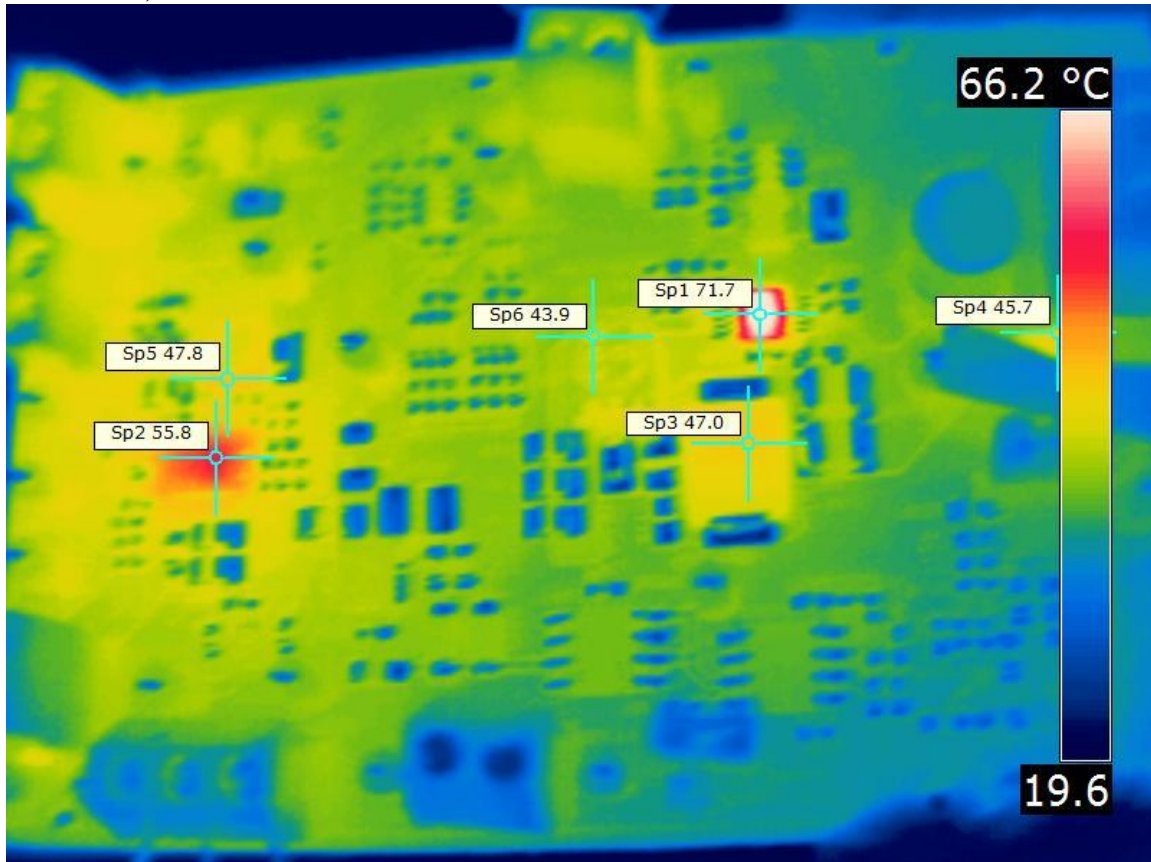
1.8V I/O: 140mA with 3.9+3.9+3.9+1.0 string

3.3V Vdd\_shv: 90mA with 3x 110 ohms in parallel (36.7 ohms)

1.8V analog: 60mA with 20//20 plus 20 for 30 ohms in all

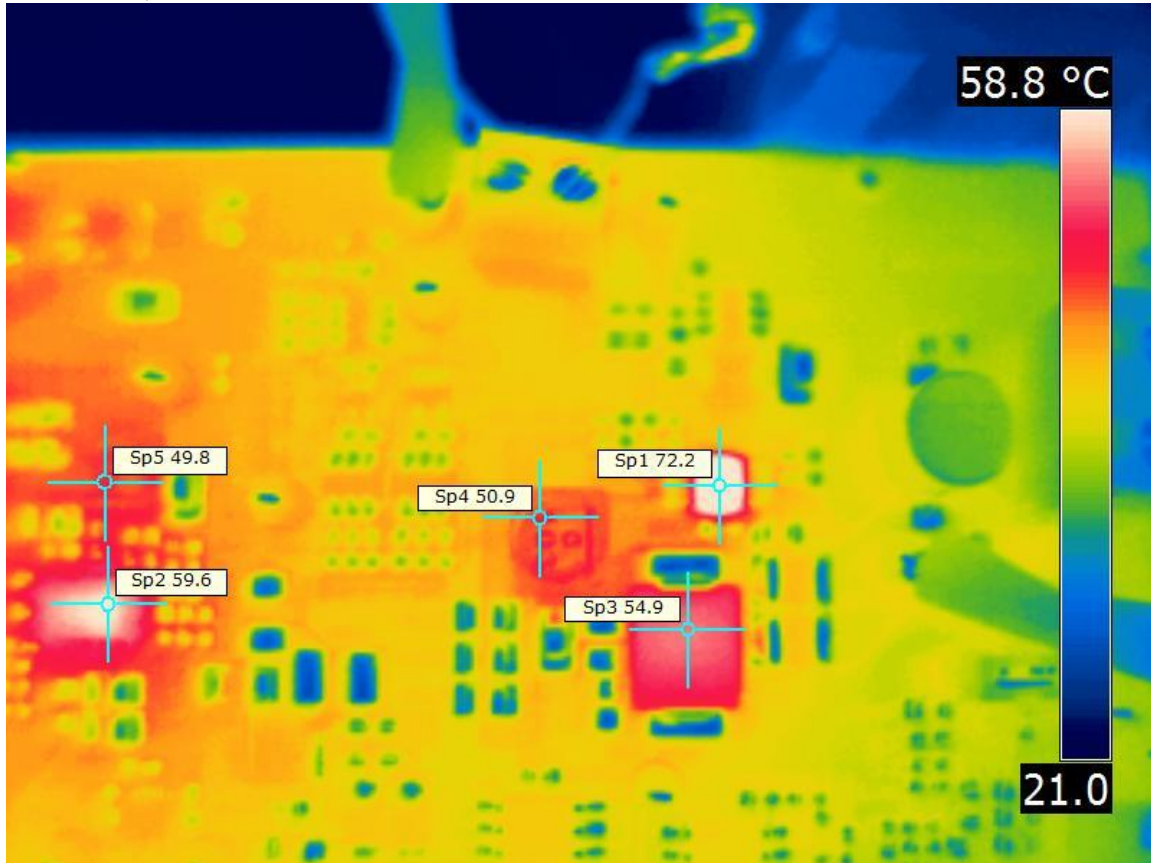
U600 and U610 for future use and will require higher current capability from the main 3.3V converter (U100). From thermal images on next 3 pages with ~ 50 degrees C rise on part vs. ambient in steady state, further loading cannot be advised.

Main 3.3V at 340kHz: 2.647W+522mW+304mW+657mW  
1.0588V actual; 5.110V actual; 1.1944V actual ; 1.78935 actual; 3.319V actual; 1.7869  
actual; main 3.3V at 3.323V with no other loading; 7.986Vin after diode 0.7785 Ain  
IR756 with 72 max on TPS54240  
8Vin PMP10411 all loads room 21-23 ambient  
U100 at 72, U400 at 56, D100 at 47, D90 at 46  
L400 at 48, L100 at 44



Q

Now 28.08Vin doo3&4 for MW 0.2320ain  
1.0587V actual; 5.110V actual; 1.1941V actual ; 1.7894 actual; 3.320V actual; 1.7869  
actual; main 3.3V at 3.324V with no other loading; IR757 at 72 degrees C  
28Vin PMP10411 all loads room 21-23 ambient  
U100 at 72, U400 at 60, D100 at 55  
L400 at 50, L100 at 51



Q  
28.2Vin all loads full  
D009 is main waveform at 42Vin  
D010-012 ripple on 1.06V at C406  
D014 is 3.3V ripple  
D015 is 5V ripple  
D016 is 1.2V ripple  
D017 is MW for the 1.06V  
D018 is main waveform U200 for 5V  
D020 is mw for 1.2V

D006 mw at 8Vin; doo7 at 6Vin

6.00vin 1.0422Ain: about 10 degrees rise IR760 about 3-4 seconds after Vin dropped to 6V

PMP10411 several seconds after Vin dropped from 8V to 6V main U100 at 84 degrees C

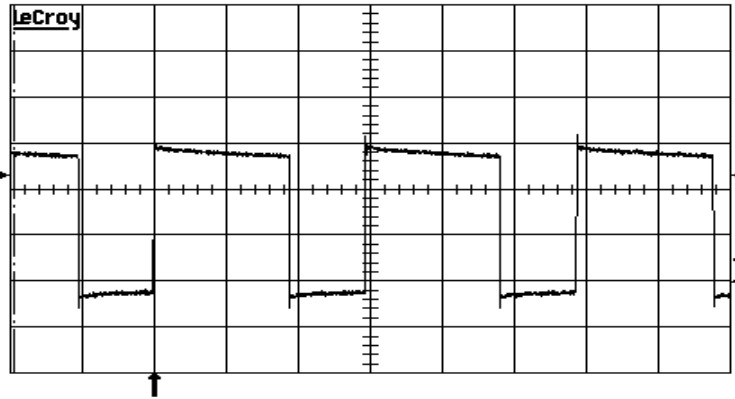


Q

Major waveforms: TPS54240 U100 PH pin for 3.3V with all output loaded as on page 1:  
 Current off 3.3V about 1.6 – 1.7 A: 500 MHz scope / 10x probe

6 Vin:  
 16-Dec-14  
 17:25:11

1 1  $\mu$ s  
 2.00 V



minimum(1) -1.19 V  
 Freq(1) 340.263 kHz  
 Fall(1) 4.7 ns  
 maximum(1) 6.37 V  
 rise(1) 3.4 ns

1  $\mu$ s  
 1 .2 V DC  $\times$   
 2 20 mV DC  
 3 .5 V DC  
 4 50 mV AC

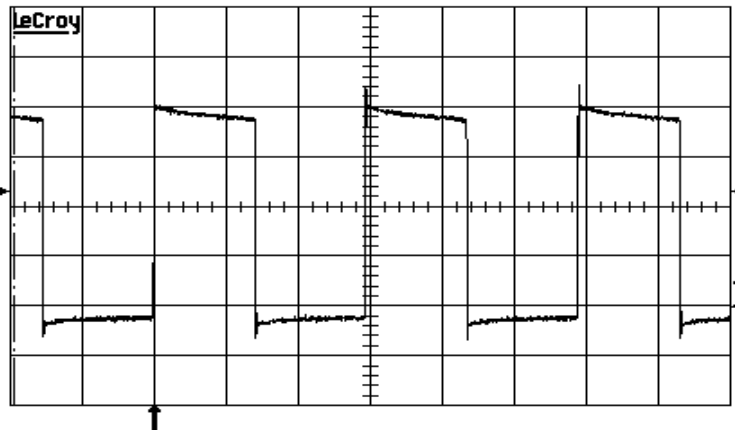
1 DC 4.64 V

1 GS/s

STOPPED

Q  
 8 Vin:  
 16-Dec-14  
 17:24:34

1 1  $\mu$ s  
 2.00 V



minimum(1) -1.38 V  
 Freq(1) 338.902 kHz  
 Fall(1) 4.6 ns  
 maximum(1) 8.94 V  
 rise(1) 3.1 ns

1  $\mu$ s  
 1 .2 V DC  $\times$   
 2 20 mV DC  
 3 .5 V DC  
 4 50 mV AC

1 DC 4.64 V

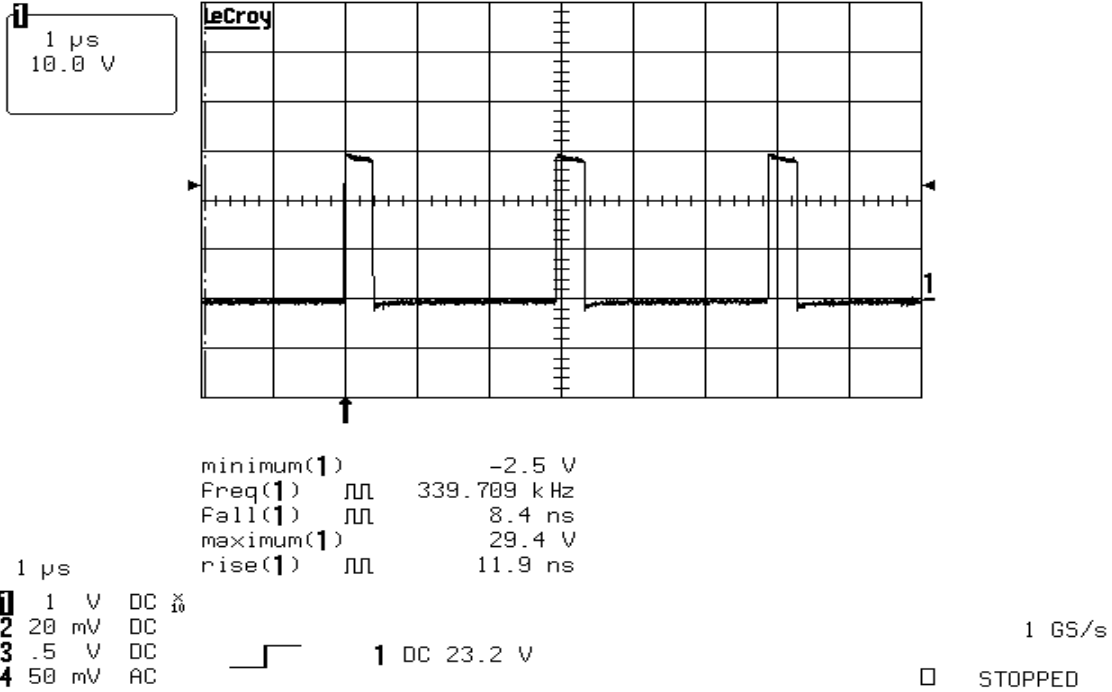
1 GS/s

STOPPED

Q

TPS54240 U100 PH pin for 3.3V with all output loaded as on page 1:  
 Current off 3.3V about 1.6 – 1.7 A: 500 MHz scope / 10x probe (continued)  
 28Vin:

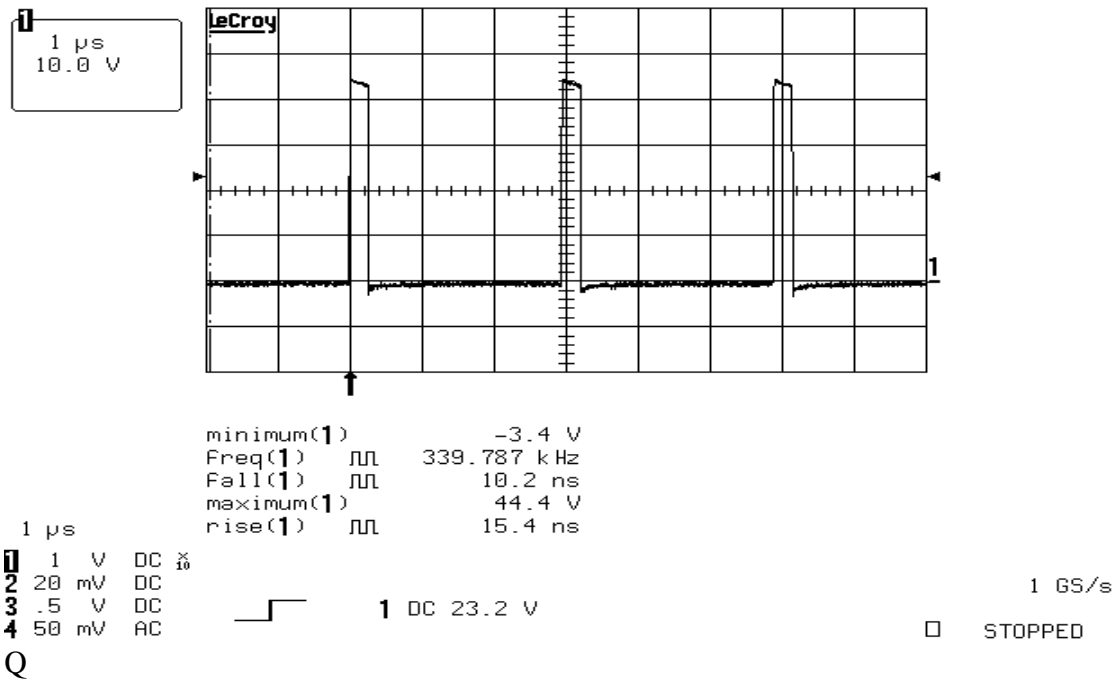
16-Dec-14  
 17:17:24



And

42Vin: **Lack of significant over / undershoot shows that snubber not needed**

16-Dec-14  
 18:25:34

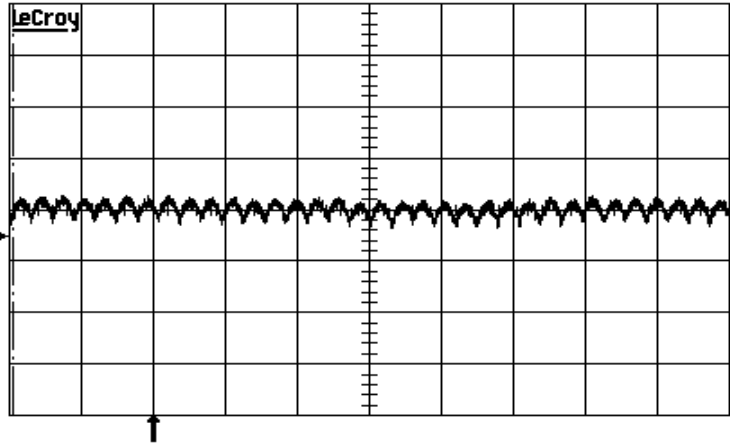


Q

Ripple on 3.3V output with all outputs loaded (1.6 – 1.7A off 3.3V)

16-Dec-14  
18:40:32

10  $\mu$ s  
20.0mV



pkpk(1) 13.1mV  
Freq(1) 354.988 kHz  
rms(1) 2.29mV  
mean(1) 0.13mV  
rise(1) 1.1945  $\mu$ s

10  $\mu$ s BWL  
1 2 mV AC  $\times$   
2 20 mV DC  
3 .5 V DC  
4 50 mV AC



1 DC -10.0mV

1 GS/s

AUTO

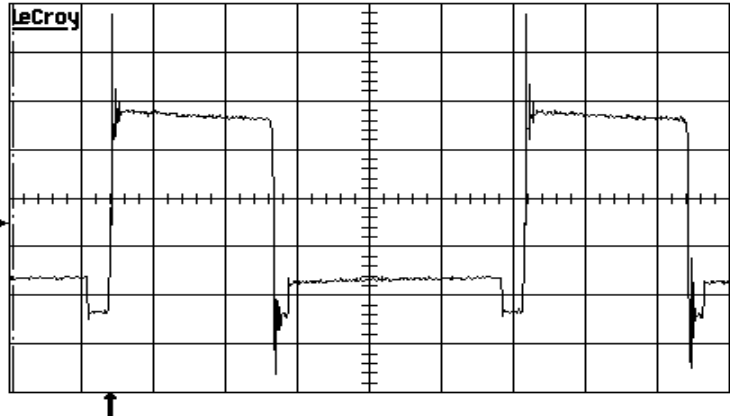
Q

1.06V 2.5A off the 3.324V

Main waveform: 500 MHz BW scope / 10x probe: period points to 1.74 MHz operation

16-Dec-14  
18:51:00

.1  $\mu$ s  
1.00 V



maximum(1) 5.28 V  
minimum(1) -2.13 V  
rise(1) 1.3 ns  
Fall(1) 225.3 ns  
p@1v(1) 575.10 ns

.1  $\mu$ s  
1 .1 V DC  $\times$   
2 20 mV DC  
3 .5 V DC  
4 50 mV AC



1 DC 1.00 V

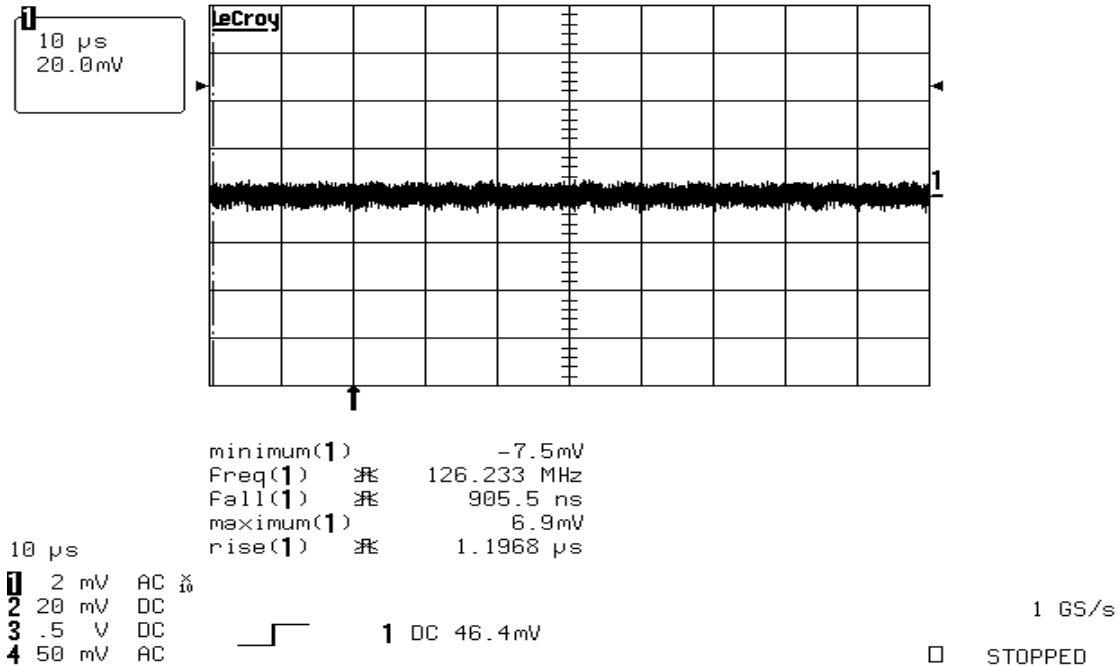
1 GS/s

STOPPED

Q

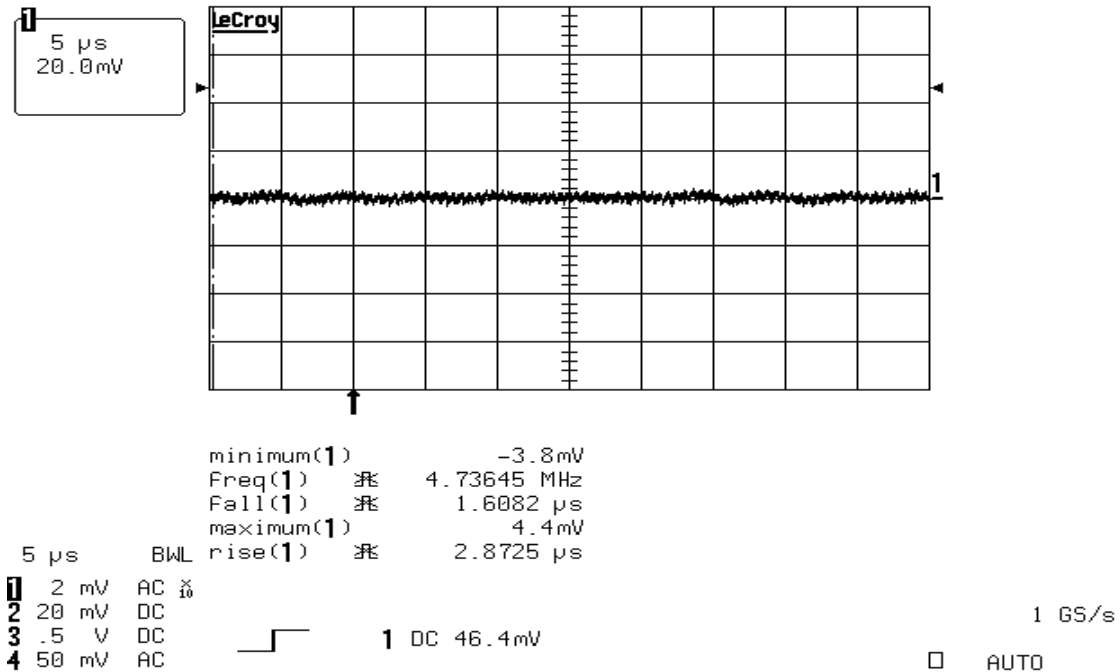
And now ripple out at the 1.06V with 500 MHz BW scope setting

16-Dec-14  
18:29:25



Q  
Same, but 20 MHz BW scope setting:

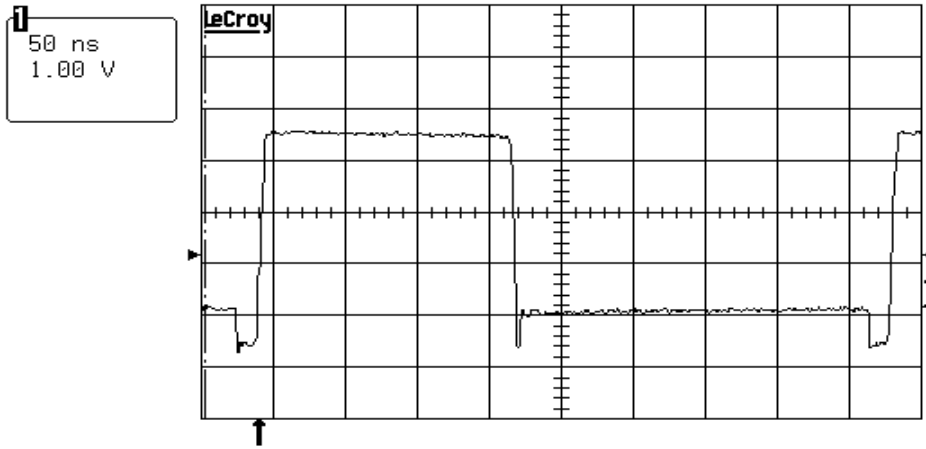
16-Dec-14  
18:30:01





1.2V 260mA off 3.3V: Main waveform with 500 MHz BW scope / probe:  
 one period of 439 nsec shown (2.28 MHz)

16-Dec-14  
 19:00:59



maximum(1) 3.36 V  
 minimum(1) -0.92 V  
 rise(1) 4.7 ns  
 Fall(1) 2.8 ns  
 p@lv(1) 438.67 ns

50 ns

- 1 .1 V DC  $i_b$
- 2 20 mV DC
- 3 .5 V DC
- 4 50 mV AC

1 DC 1.00 V

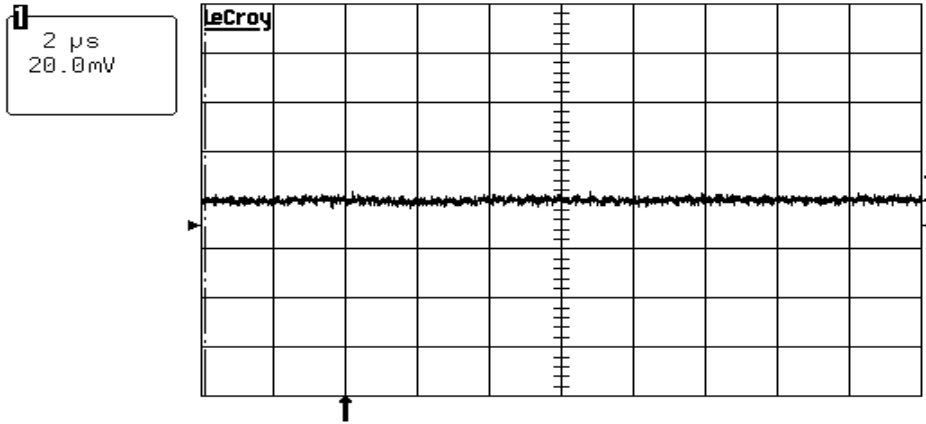
1 GS/s

STOPPED

Q

And now output ripple of same 1.2V with 20 MHz BW setting:

16-Dec-14  
 18:43:32



pkpk(1) 7.5 mV  
 Freq(1) 10.3908 MHz  
 rms(1) 0.90 mV  
 mean(1) -0.07 mV  
 rise(1) 3.7353 μs

2 μs

- 1 2 mV AC  $i_b$
- 2 20 mV DC
- 3 .5 V DC
- 4 50 mV AC

1 DC -10.0 mV

1 GS/s

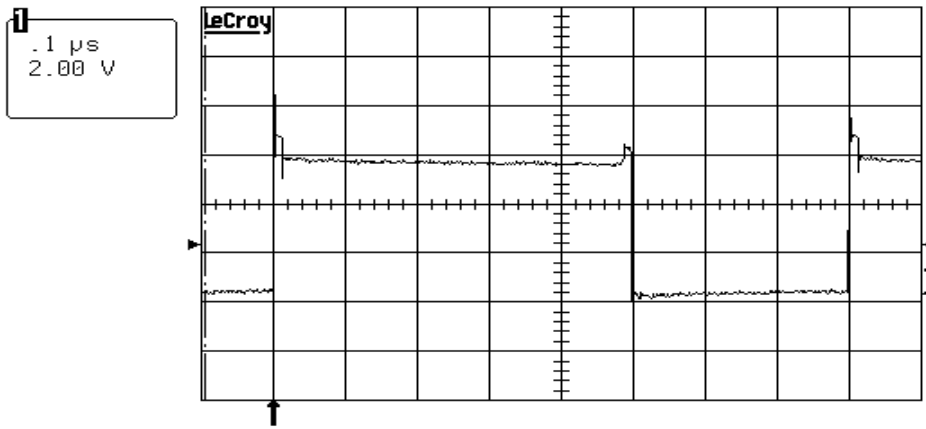
AUTO

Q

5V 100mA off 3.3V with TPS61071:

Main waveform with 500 MHz scope / probe: one 800 nsec cycle shown for 1.25 MHz

16-Dec-14  
 18:56:52



maximum(1) 8.04 V  
 minimum(1) -0.40 V  
 rise(1) 1.3 ns  
 Fall(1) 1.8 ns  
 p@lv(1) - - -

.1 μs  
 1 .2 V DC  $\tilde{x}$   
 2 20 mV DC  
 3 .5 V DC  
 4 50 mV AC

1 DC 2.00 V

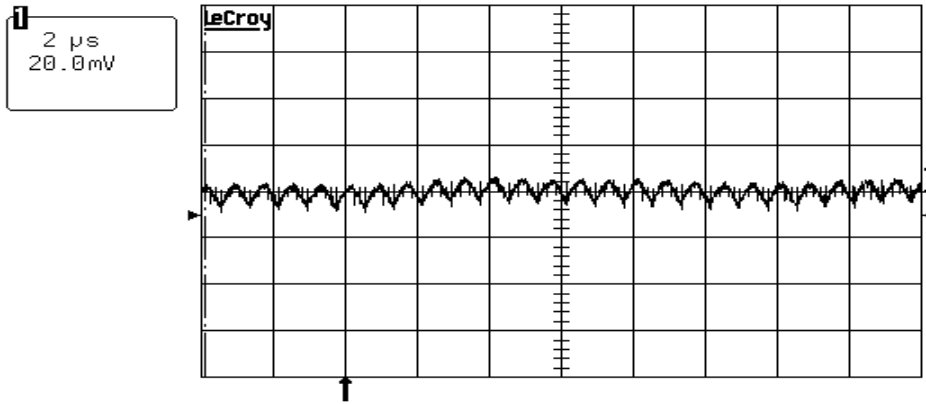
1 GS/s

STOPPED

Q

And the output ripple of the 5V at 100 mA: 25 cycles in 20 usec

16-Dec-14  
 18:41:49



pkpk(1) 15.6 mV  
 Freq(1) 5.30525 MHz  
 rms(1) 2.91 mV  
 mean(1) -0.29 mV  
 rise(1) 5.8839 μs

2 μs BWL  
 1 2 mV AC  $\tilde{x}$   
 2 20 mV DC  
 3 .5 V DC  
 4 50 mV AC

1 DC -10.0 mV

1 GS/s

STOPPED

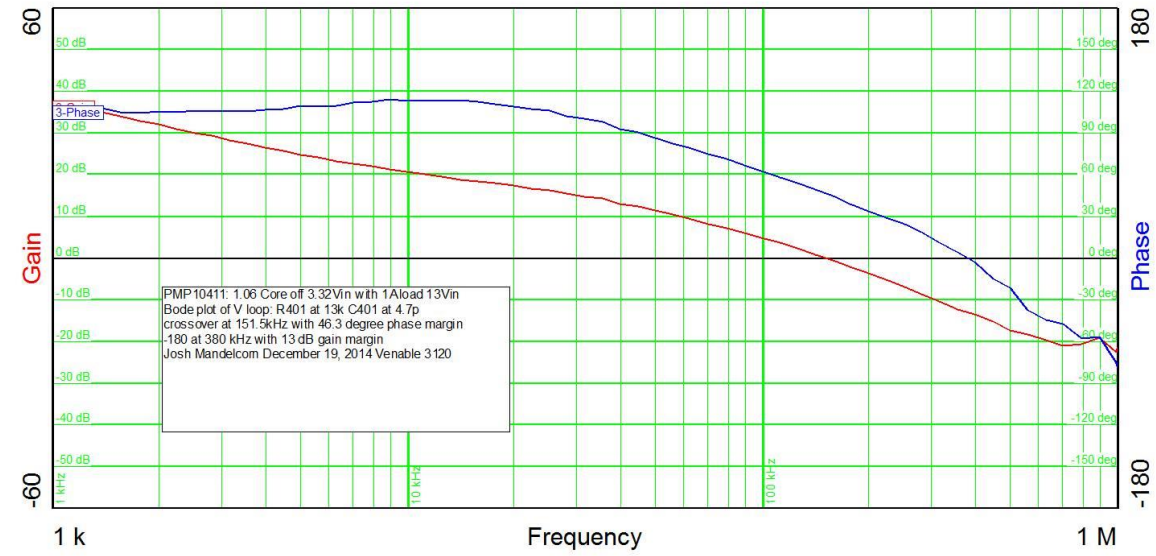
Q

Efficiency and Losses: model t1: Only 3.3V loaded and Vin measured after D90:

Vin Volts	Iin A	Vout Volts	Iout A	% Effi ciency	Losses in W	Power out of the 3.3V in Watts
5.016	1.2583	3.325	1.5687	82.6	1.096	5.22
6.000	1.0377	3.3245	1.5686	83.8	1.011	5.21
7.981	0.7792	3.324	1.5686	83.8	1.005	5.21
13.011	0.4838	3.324	1.5688	82.8	1.080	5.21
18.011	0.3533	3.324	1.5687	81.9	1.149	5.21
28.09	0.2320	3.325	1.5684	80.0	1.302	5.21
42.05	0.1610	3.325	1.5687	77.0	1.554	5.22
5.023	0.9330	3.325	1.2058	85.6	0.677	4.01
6.003	0.7802	3.325	1.2053	85.6	0.676	4.01
7.985	0.5910	3.324	1.205	84.9	0.714	4.01
13.04	0.3686	3.325	1.2045	83.3	0.802	4.00
18.03	0.2705	3.325	1.2045	82.1	0.872	4.00
28.04	0.17845	3.325	1.2032	80.0	1.003	4.00
42.05	0.1240	3.326	1.204	76.8	1.210	4.00
4.988	0.6148	3.326	0.8015	86.9	0.401	2.67
6.000	0.5144	3.325	0.8012	86.3	0.422	2.66
8.00	0.3917	3.325	0.8012	85.0	0.470	2.66
13.00	0.2474	3.325	0.8007	82.8	0.554	2.66
18.02	0.1820	3.325	0.8006	81.2	0.618	2.66
28.06	0.1207	3.326	0.8005	78.6	0.724	2.66
42.05	0.08435	3.326	0.8005	75.1	0.884	2.66
4.992	0.3152	3.3255	0.4028	85.1	0.234	1.34
6.003	0.26565	3.3255	0.4024	83.9	0.257	1.34
7.992	0.2044	3.325	0.4024	81.9	0.296	1.34
13.02	0.1306	3.326	0.4022	78.7	0.363	1.34
18.02	0.0970	3.326	0.4020	76.5	0.411	1.34
28.03	0.06546	3.326	0.4017	72.8	0.499	1.34
42.0	0.0465	3.326	0.4017	68.4	0.617	1.34
4.995	0.028	3.326	0	0.0	0.140	0.00
5.976	0.0243	3.326	0	0.0	0.145	0.00
7.985	0.0195	3.326	0	0.0	0.156	0.00
13.02	0.0131	3.326	0	0.0	0.171	0.00
18.03	0.0107	3.326	0	0.0	0.193	0.00
28.08	0.0081	3.326	0	0.0	0.227	0.00
42.01	0.0062	3.326	0	0.0	0.260	0.00

Q

Bode Plot of main 1.06V 2.5A for core:

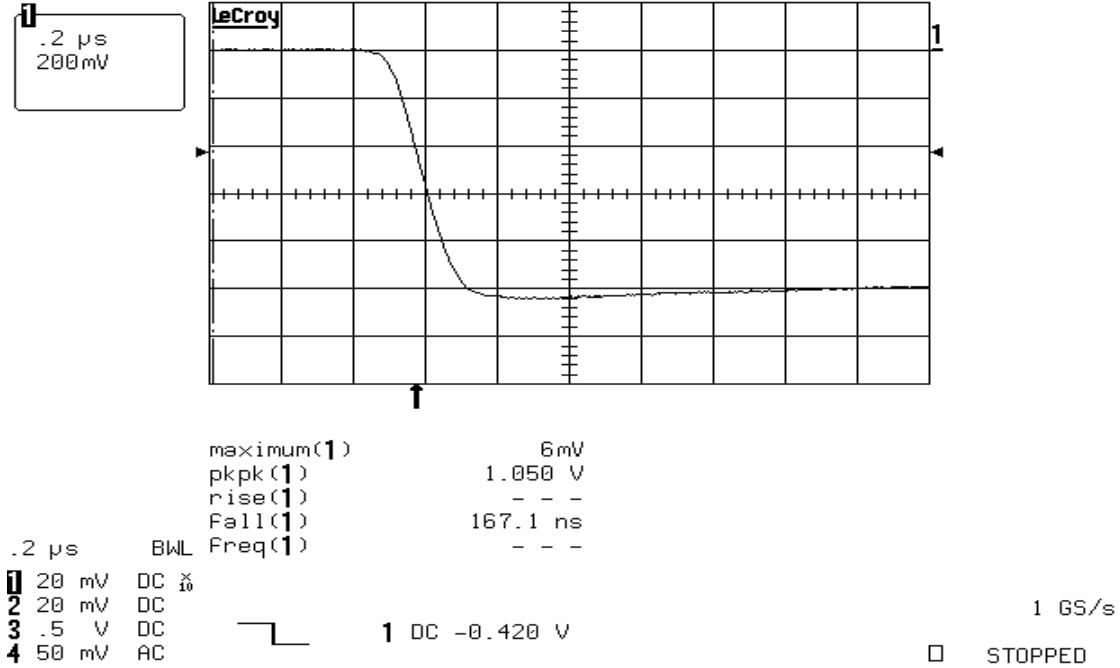


Q

Load dynamics on the 1.06V core:

Waveform across 0.68 ohms dynamic load resistor when load applied with scope ground on Vout side of it: 1V applied in about 250 nsec or 1.5A applied in 250 nsec for 6A/usec slew rate

19-Dec-14  
 17:30:52

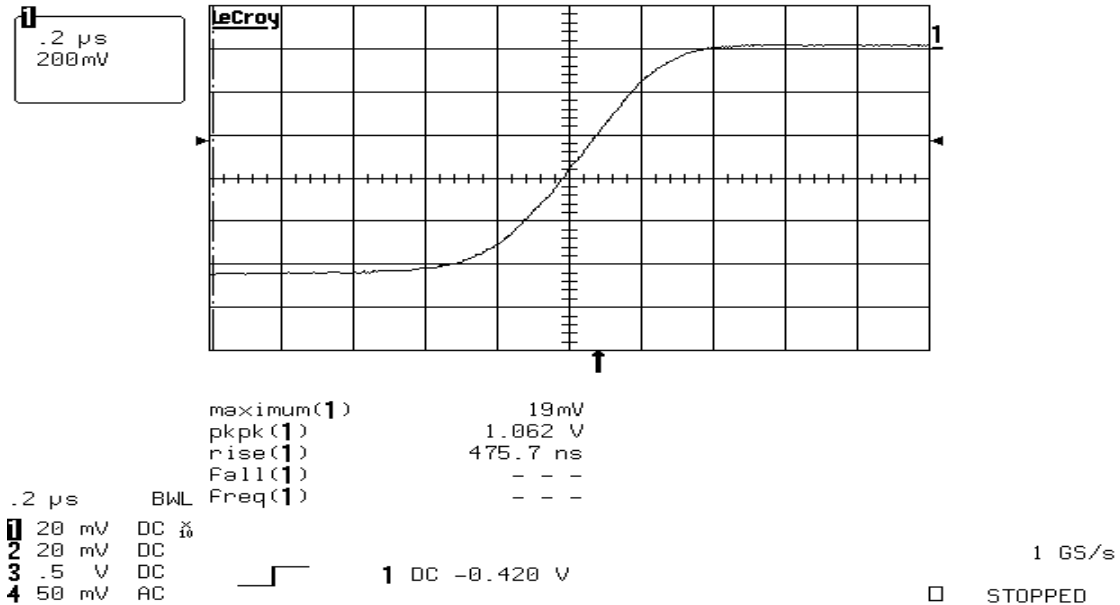


Q

And now load dump across same 0.68 ohm:

1.5A dump in about 700 nsec or -2A/usec slew rate

19-Dec-14  
 17:31:22

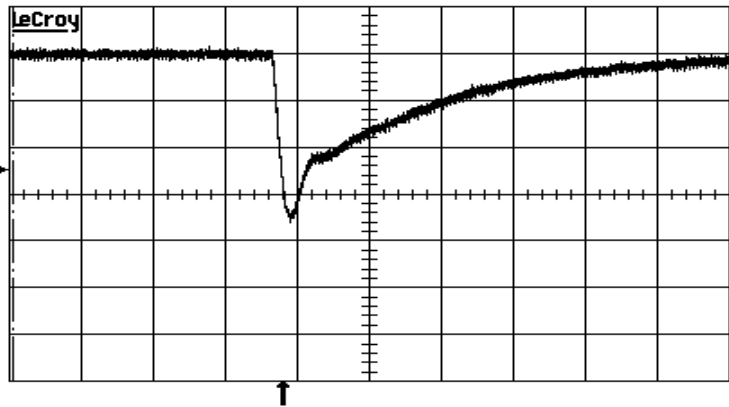


Q

Load dynamics on the 1.06V core: Actual step load response at core Vout:  
 Step Load response to this 1.5A in 250 nsec from zero load starting: 70 mV undershoot

19-Dec-14  
 19:08:25

10  $\mu$ s  
 20.0mV



maximum(1) 3.1mV  
 pkpk(1) 75.6mV  
 rise(1) 35.6746  $\mu$ s  
 Fall(1) 1.5764  $\mu$ s  
 Freq(1) - - -

10  $\mu$ s BWL  
 1 2 mV AC  $i_o$   
 2 20 mV DC  
 3 .5 V DC  
 4 50 mV AC



1 DC -48.8mV

1 GS/s

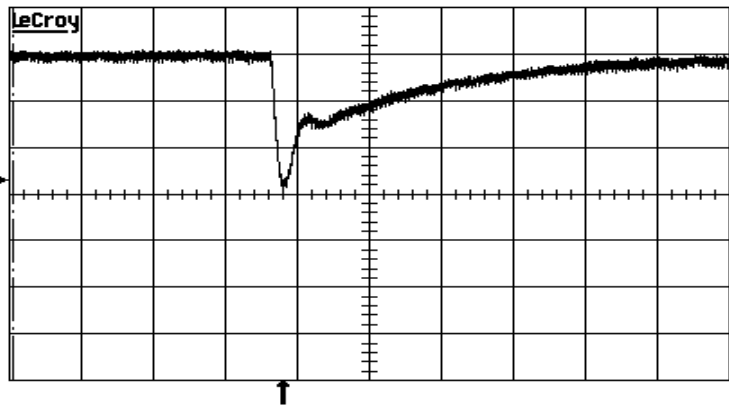
STOPPED

A

And now same step load, but with 1.0A load already on 1.06 Vcore: ~55 mV undershoot

19-Dec-14  
 19:07:16

10  $\mu$ s  
 20.0mV



maximum(1) 1.9mV  
 pkpk(1) 60.0mV  
 rise(1) 41.0728  $\mu$ s  
 Fall(1) 1.1999  $\mu$ s  
 Freq(1) - - -

10  $\mu$ s BWL  
 1 2 mV AC  $i_o$   
 2 20 mV DC  
 3 .5 V DC  
 4 50 mV AC



1 DC -53.6mV

1 GS/s

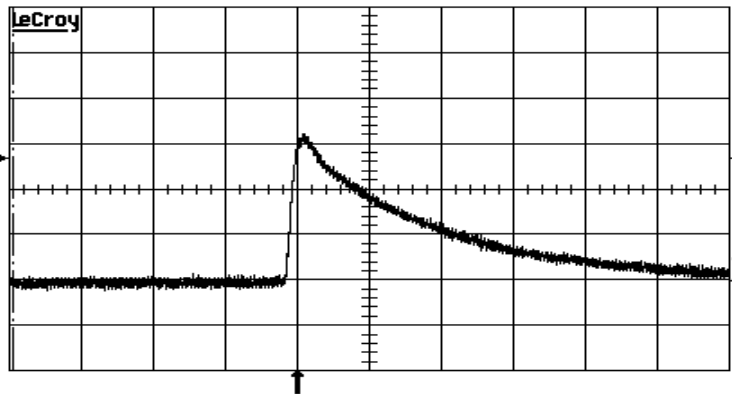
STOPPED

Q

Load dynamics on the 1.06V core: Actual load dump response at core Vout:  
Load dump response from 1.5A going to zero load in 700 nsec: 65 mV overshoot

19-Dec-14  
19:09:56

10  $\mu$ s  
20.0mV



maximum(1)	64.4mV
pkpk(1)	69.4mV
rise(1)	1.4670 $\mu$ s
Fall(1)	39.0040 $\mu$ s
Freq(1)	- - -

10  $\mu$ s BWL  
1 2 mV AC  $\ddot{x}$   
2 20 mV DC  
3 .5 V DC  
4 50 mV AC



1 DC 54.0mV

1 GS/s

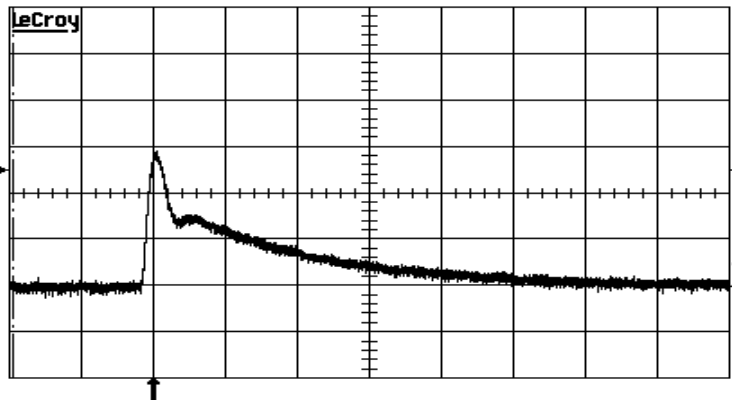
STOPPED

Q

Load dump response from 2.5A going to 1.0A load in 700 nsec: 55 mV overshoot

19-Dec-14  
19:11:24

10  $\mu$ s  
20.0mV



maximum(1)	58.1mV
pkpk(1)	63.8mV
rise(1)	1.4557 $\mu$ s
Fall(1)	44.6166 $\mu$ s
Freq(1)	- - -

10  $\mu$ s BWL  
1 2 mV AC  $\ddot{x}$   
2 20 mV DC  
3 .5 V DC  
4 50 mV AC



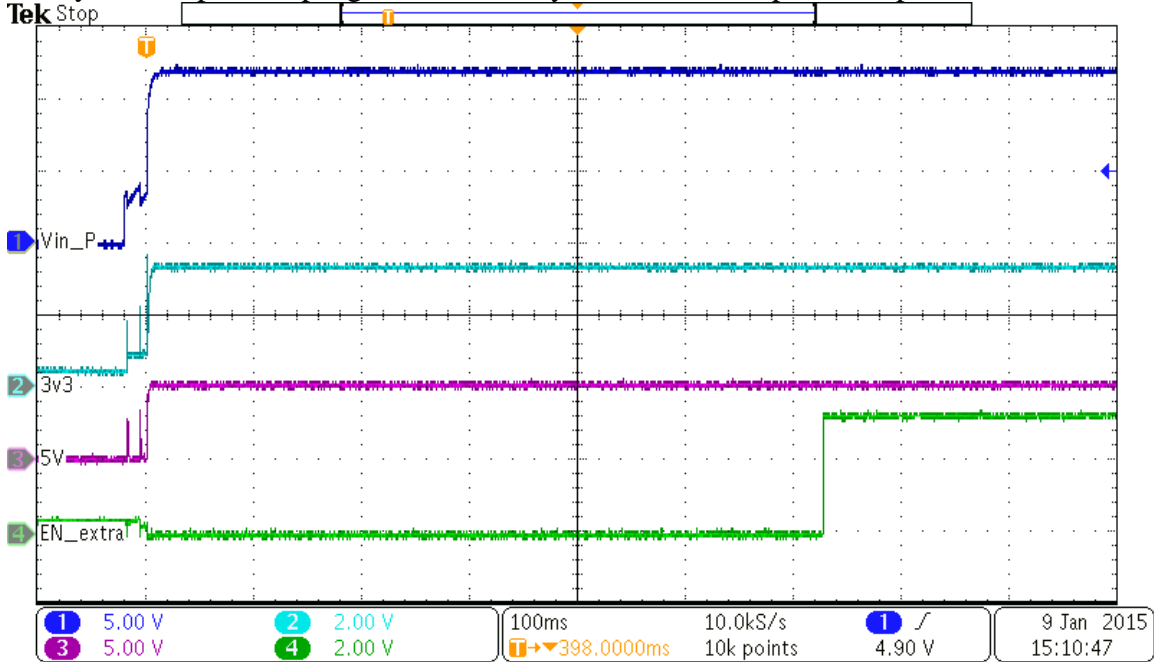
1 DC 50.4mV

1 GS/s

STOPPED

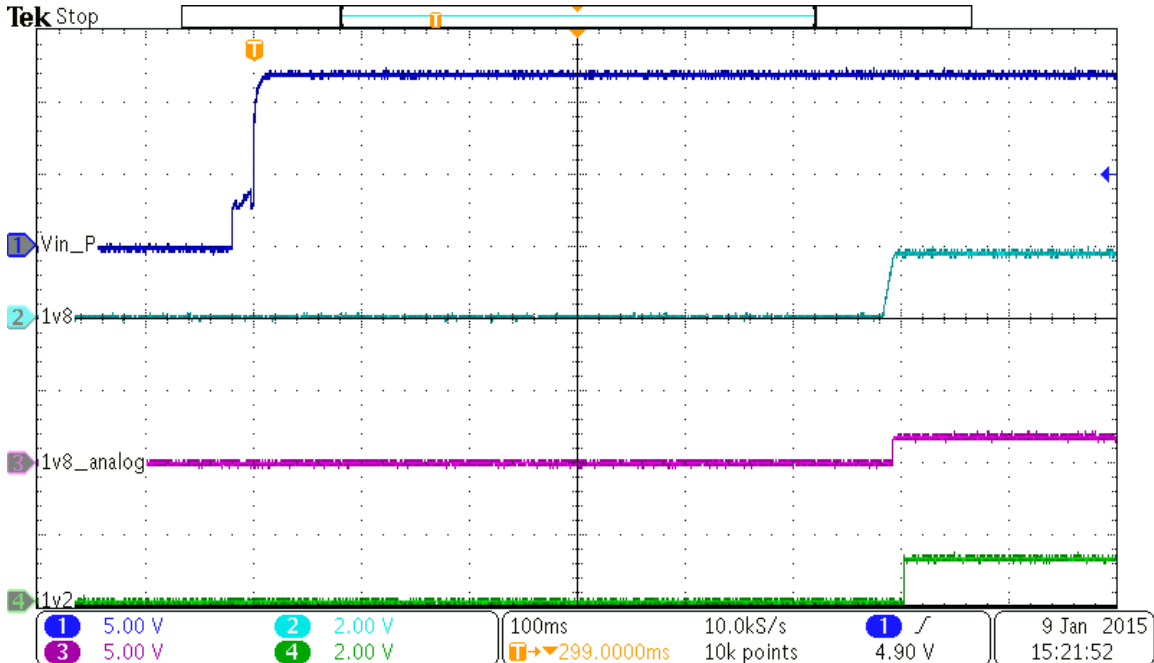
Q

Sequencing: First showing 12Vin applied and “always on” 3.3V & 5V coming up, and finally the last power up signal to inform system that all outputs are up called EN\_extra:



Q

Now showing Vin and first 3 of the sequenced outputs upon power up, overall delay of about 600ms seen

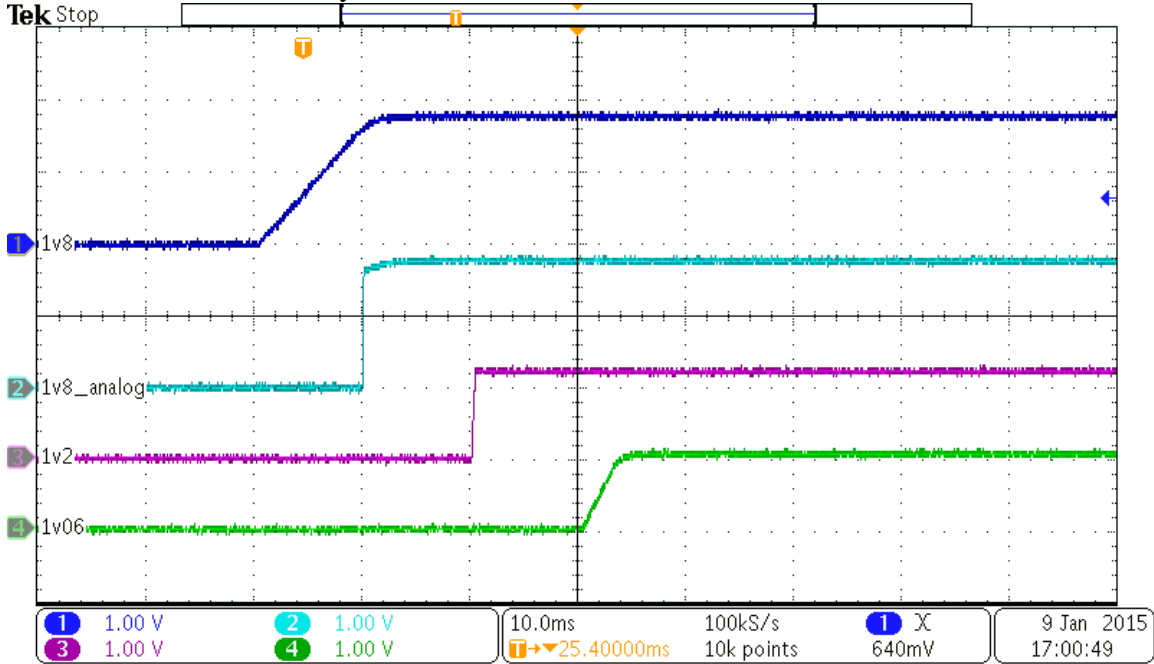


Q



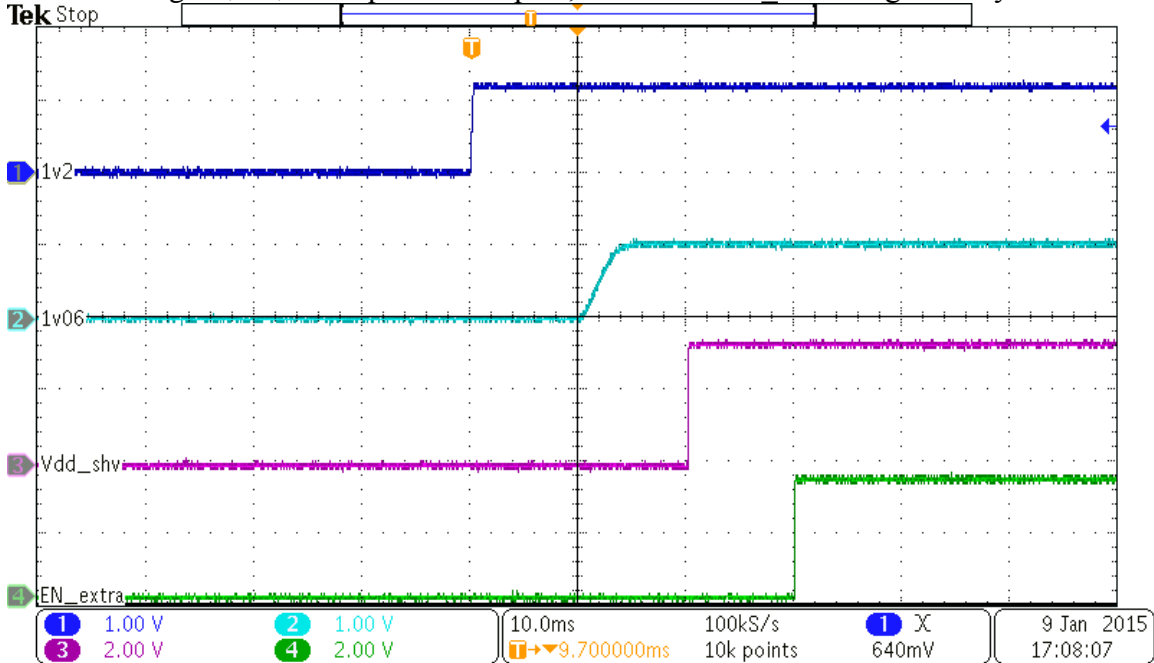
Sequencing – power up continued:

Now showing detailed sequencing of the first 4 sequenced signals at 10 ms per division to show their relative delays:



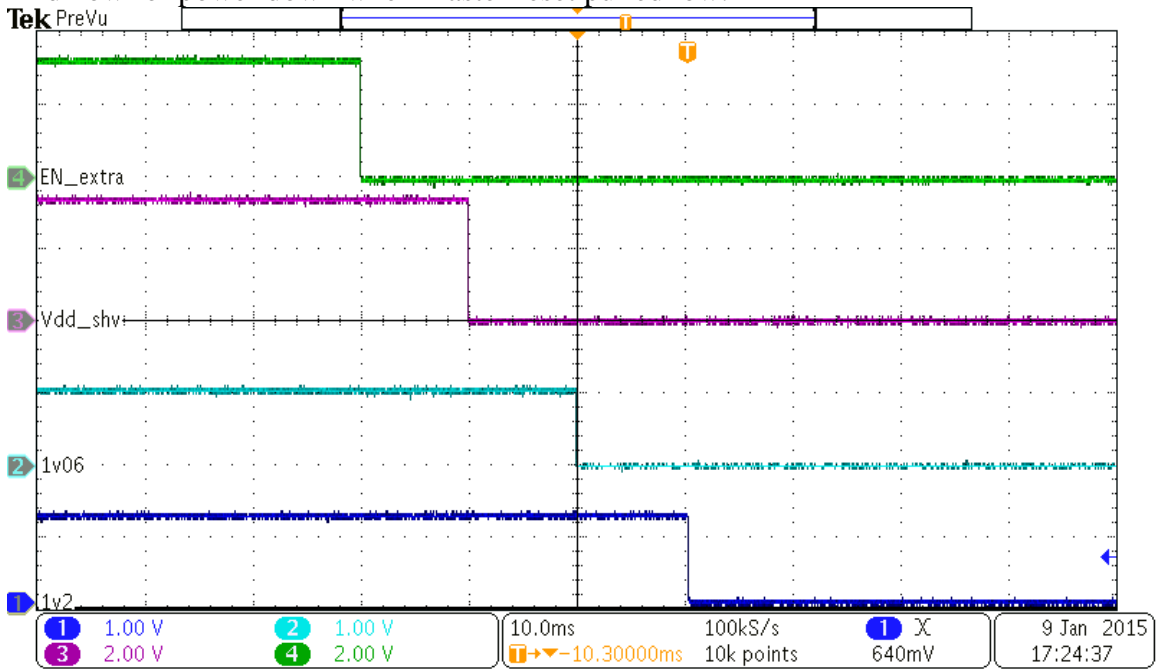
Q

Now showing 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> sequenced outputs, and final “EN\_extra” signal to system



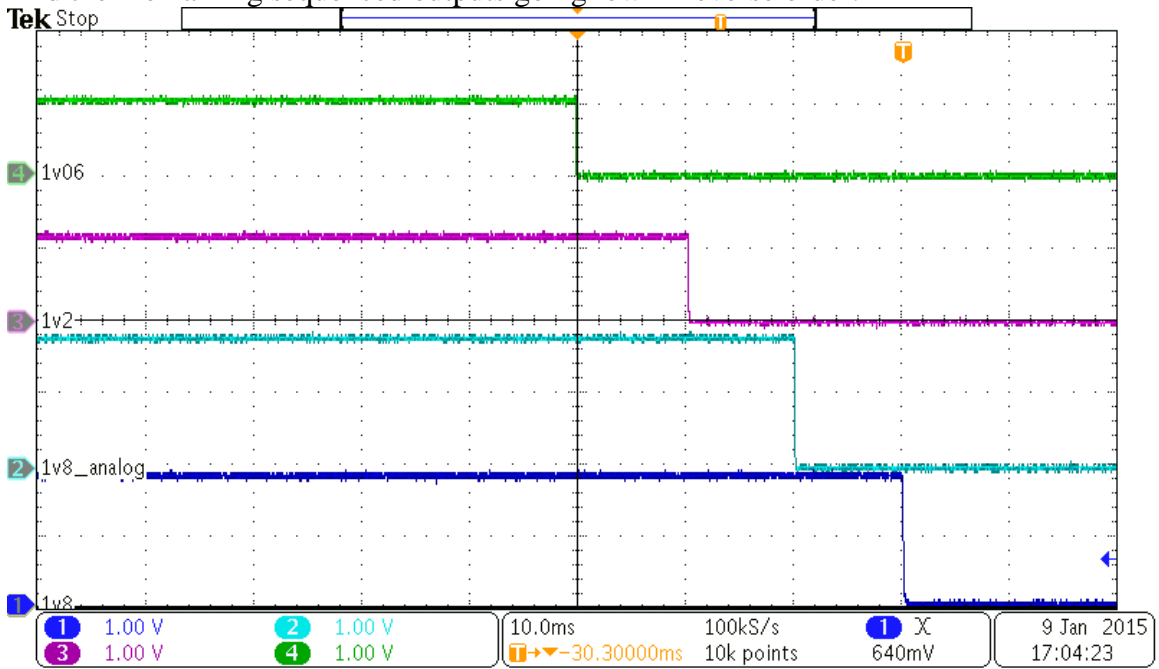
Q

And now for power down when master reset pulled low:



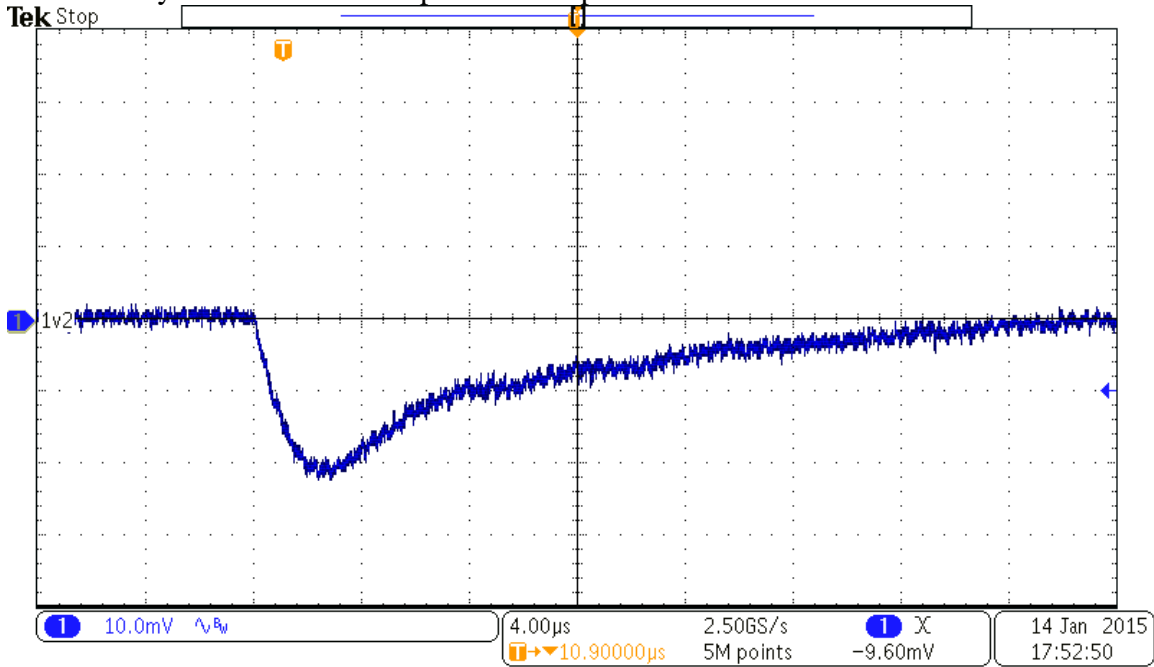
Q

And then remaining sequenced outputs going low in reverse order:

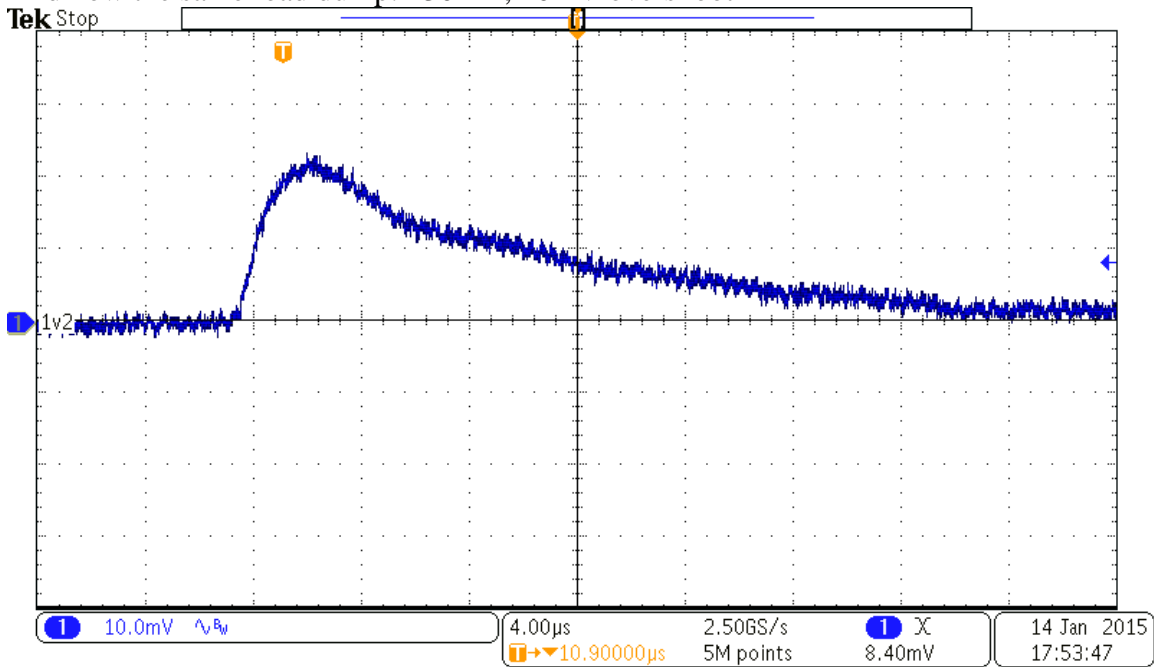


Q

1.2V load dynamics: 130mA step load / dump to no load: 20mV overshoot

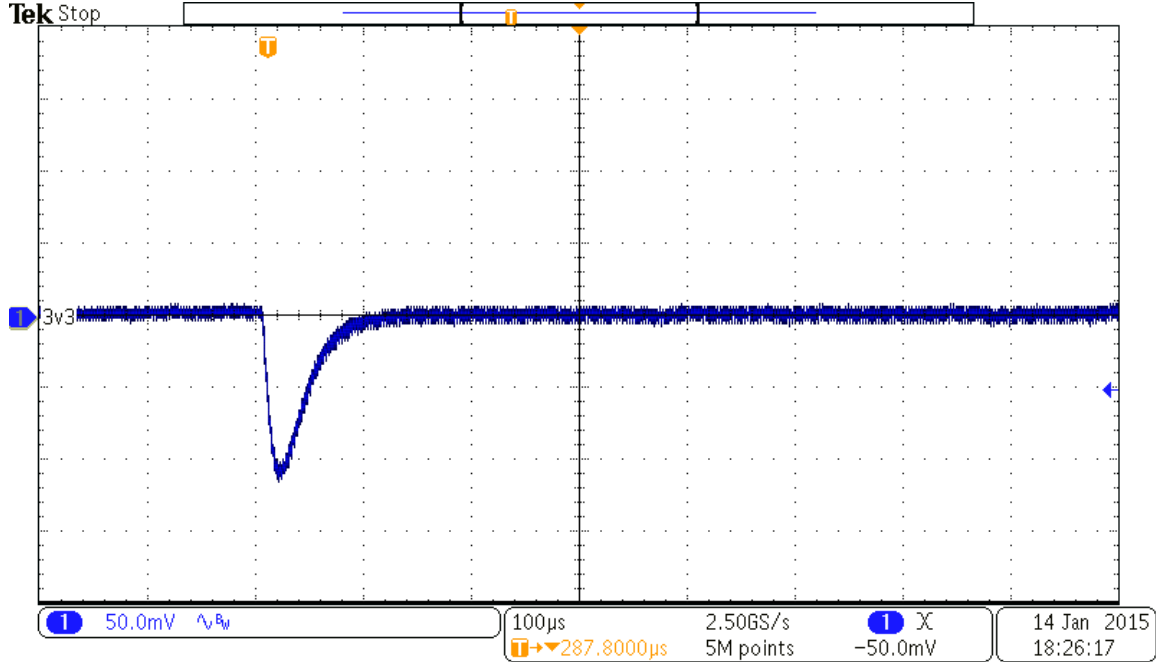


Q  
And now the same load dump: 130mA; 20mV overshoot

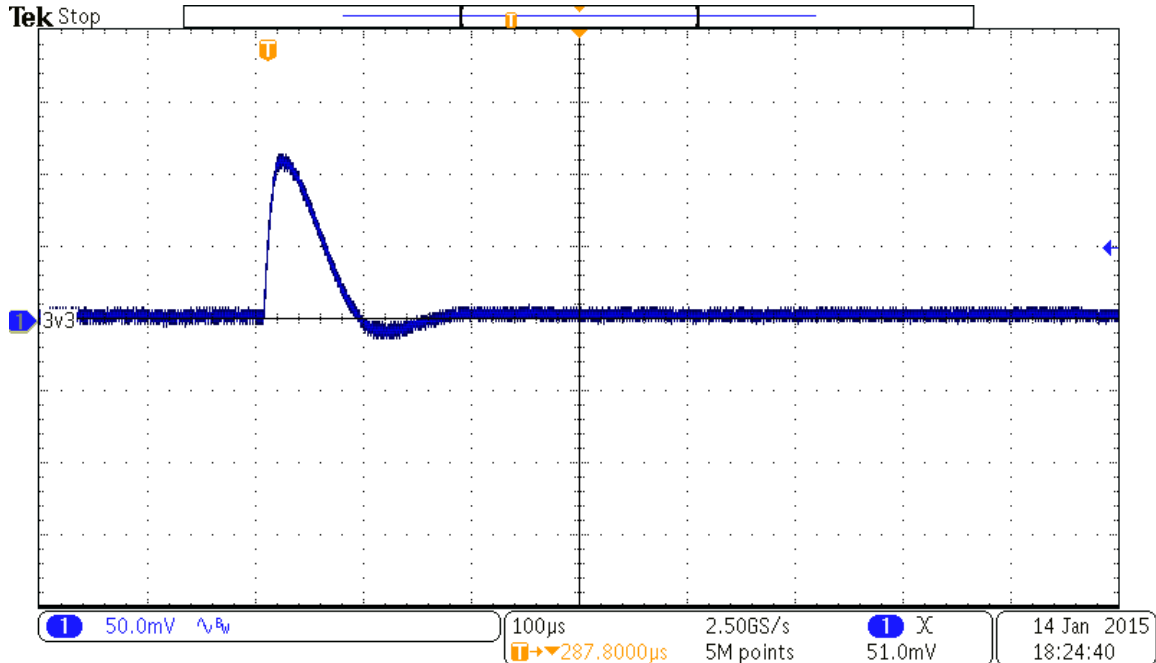


Q  
**Less than 2% over / undershoot well within 5% generally allowed for Memory.**

3.3V 1.0 A step load & dump to about 90mA static load off the 3.3V with 12Vin:  
~110mV undershoot



q  
And now same 1.0A load dump to 90mA static load  
About 115mV overshoot or 3.5%



**Target is max deviation of +/-5% including dynamics. Passed:**

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