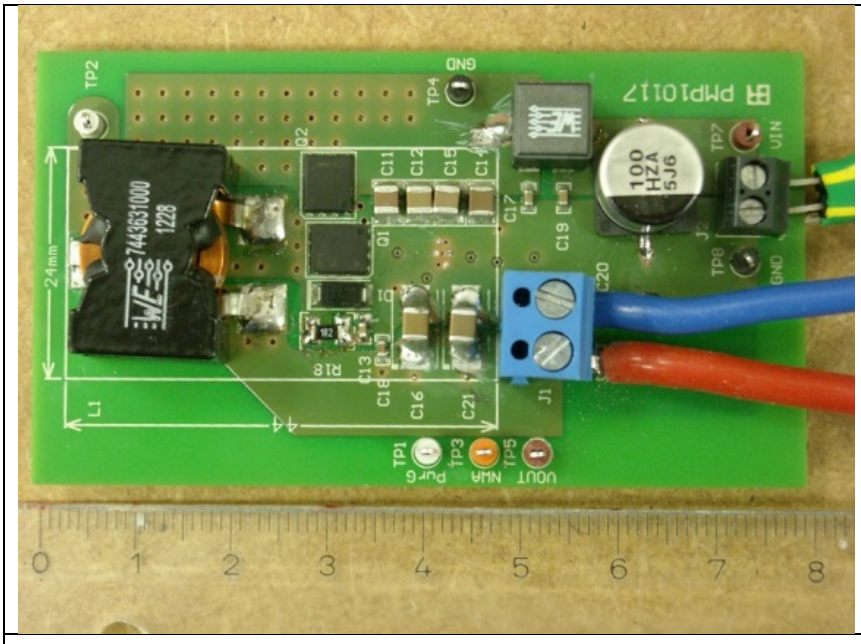
PMP30101RevA Test Results

Topology: Buck
Device: TPS40170
Unless otherwise mentioned the output current was set to 8A (with electronic load) and the input voltage 13.8V

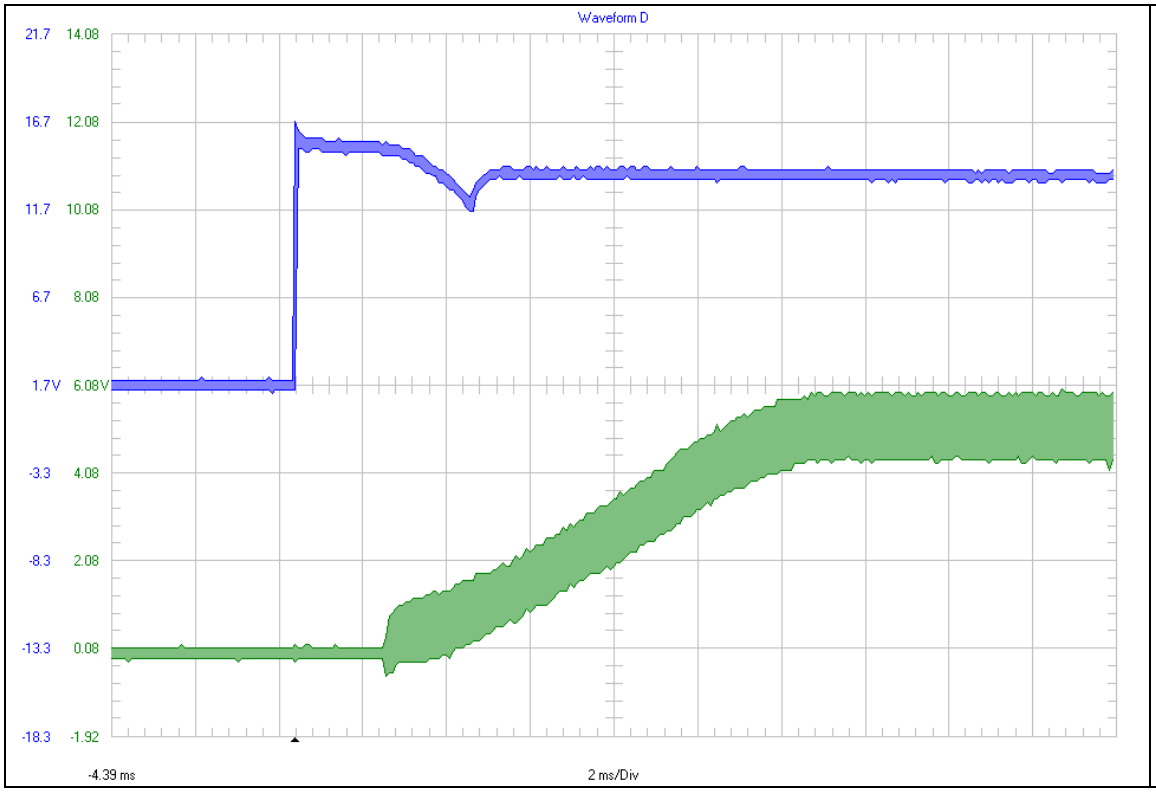
UVLO: ON 8.5V; OFF 5.3V Fsw: 318kHz



This design has been built for **hight temperature environment**, so at nominal continuous load 5.5A efficiency is at it's maximum >96% (filter INCLUDED) and temperature rise is around +20K. (At peak load 8A the temperature rise is around +30K, at 10A around +40K, see thermal pics)

1 Startup

The startup waveform is shown in the Figure 1.



Ch1=> input voltage 5V/div

Ch2=> output voltage 2V/div

2ms/div

Figure 1

2 Shutdown

The shutdown waveform is shown in the Figure 2.

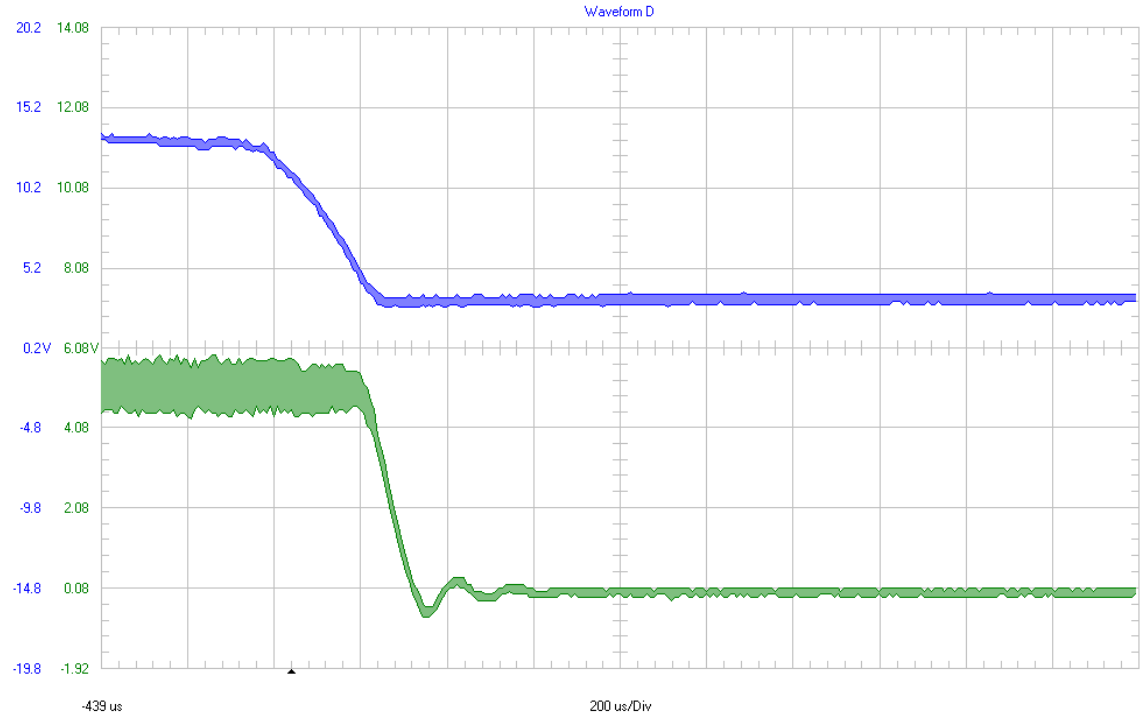


Figure 2

3 Efficiency

The efficiency is shown in the Figure 3 below.

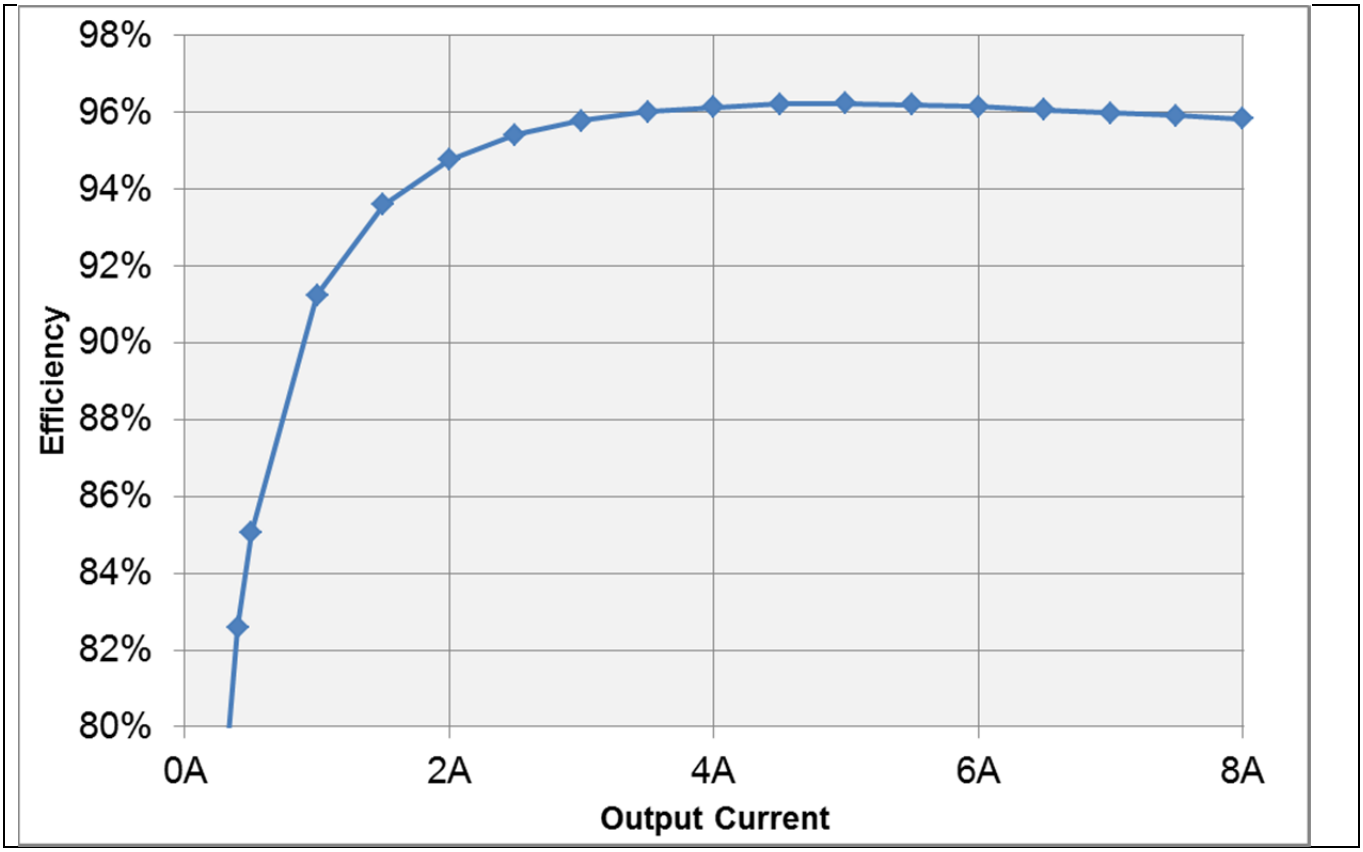


Figure 3

Flat efficiency curve ensures around 96% in a wide load range 3A to 8A; maximum efficiency in load range 4A to 6A.

4 Load Regulation

The load regulation of the output is shown in the Figure 4 below.

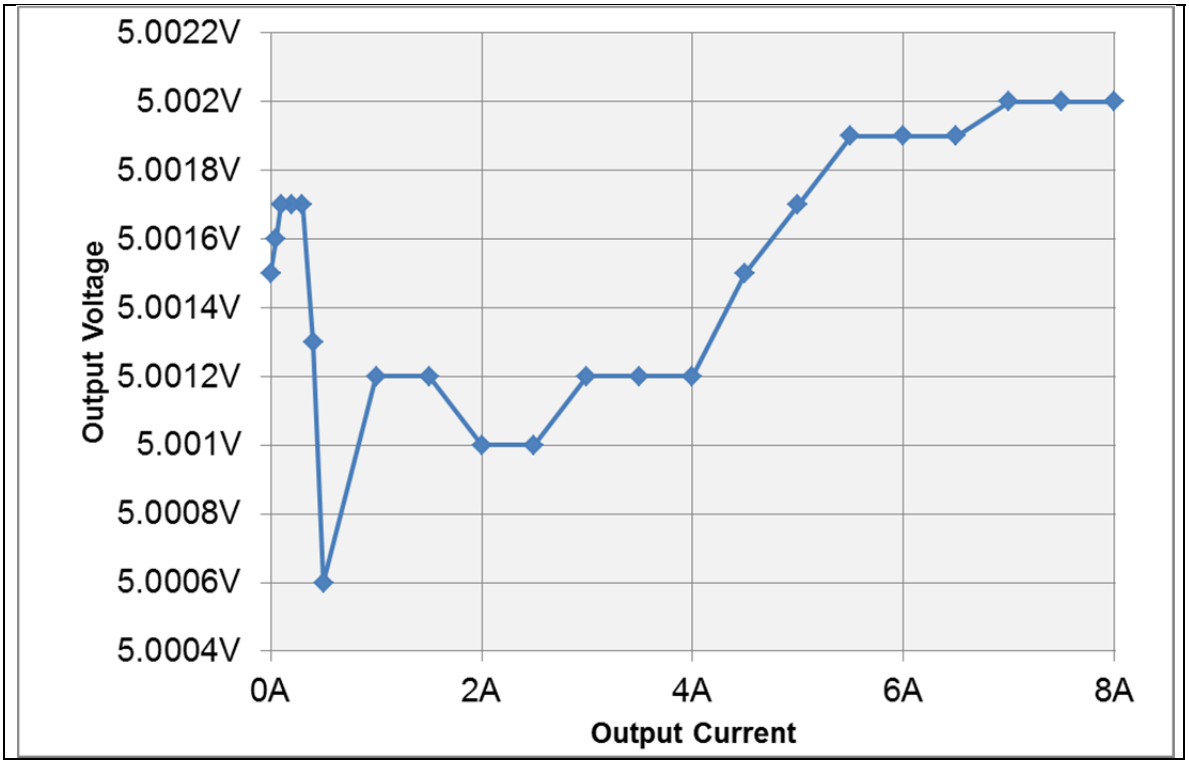


Figure 4

5 Output Ripple Voltage

The output ripple voltage is shown in Figure 5.

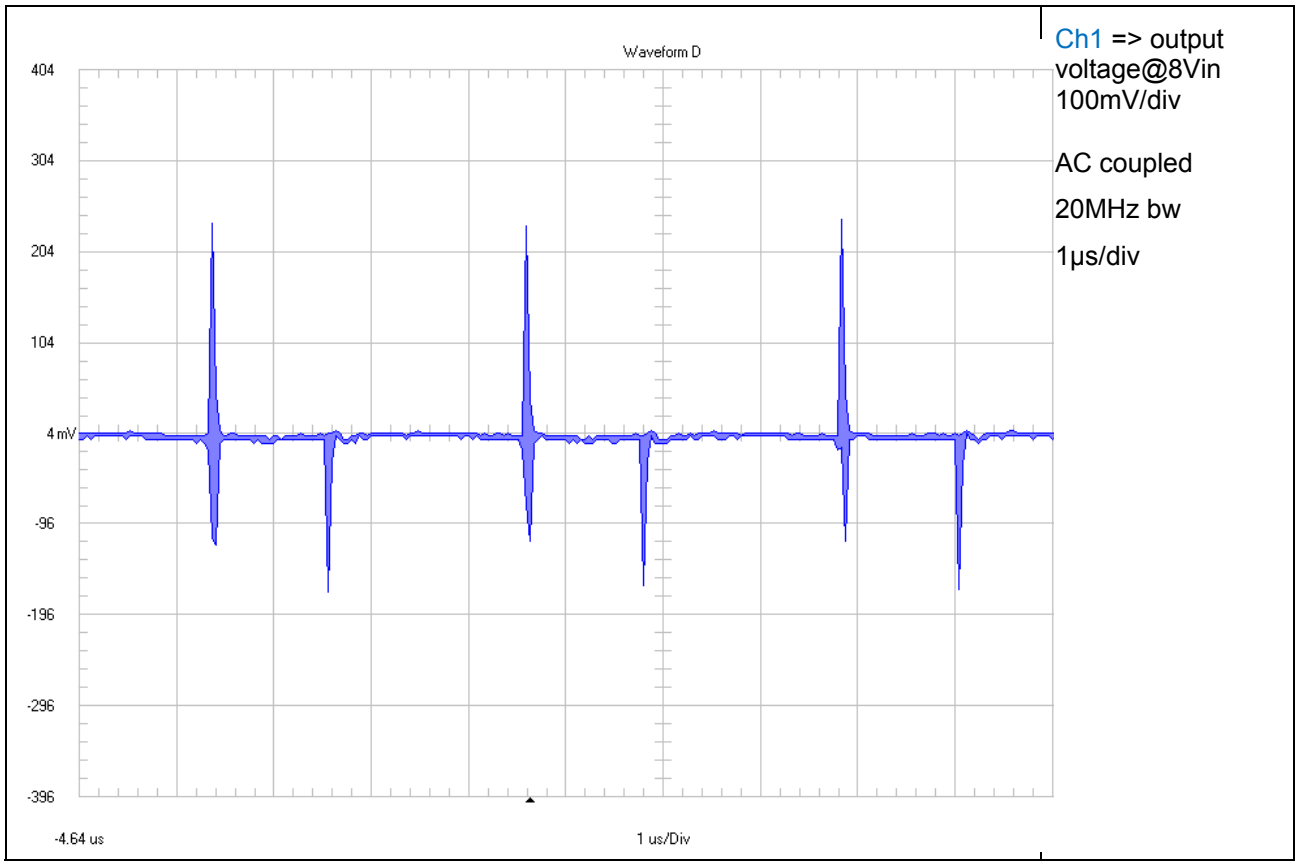


Figure 5

High interwindings capacitance results in cross talking from switchnode to output across inductor; to minimize this RF peaks another windings geometry or ferrite beads at the output might be benefitial.

For a circuitry here intended as pre regulator it's a minor issue.

6 Input Ripple Voltage

The input ripple voltage is shown in Figure 6. Measured at J2

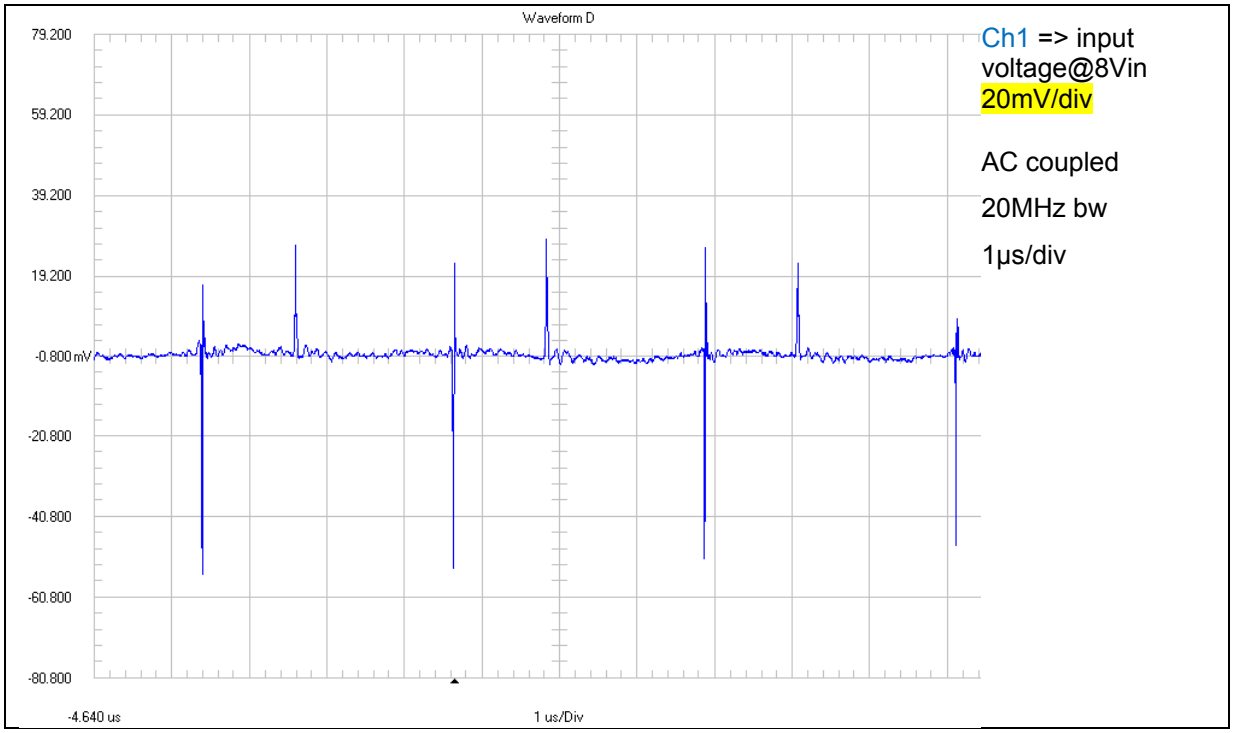


Figure 6

The input ripple voltage is shown in Figure 7. Measured before the input filter.

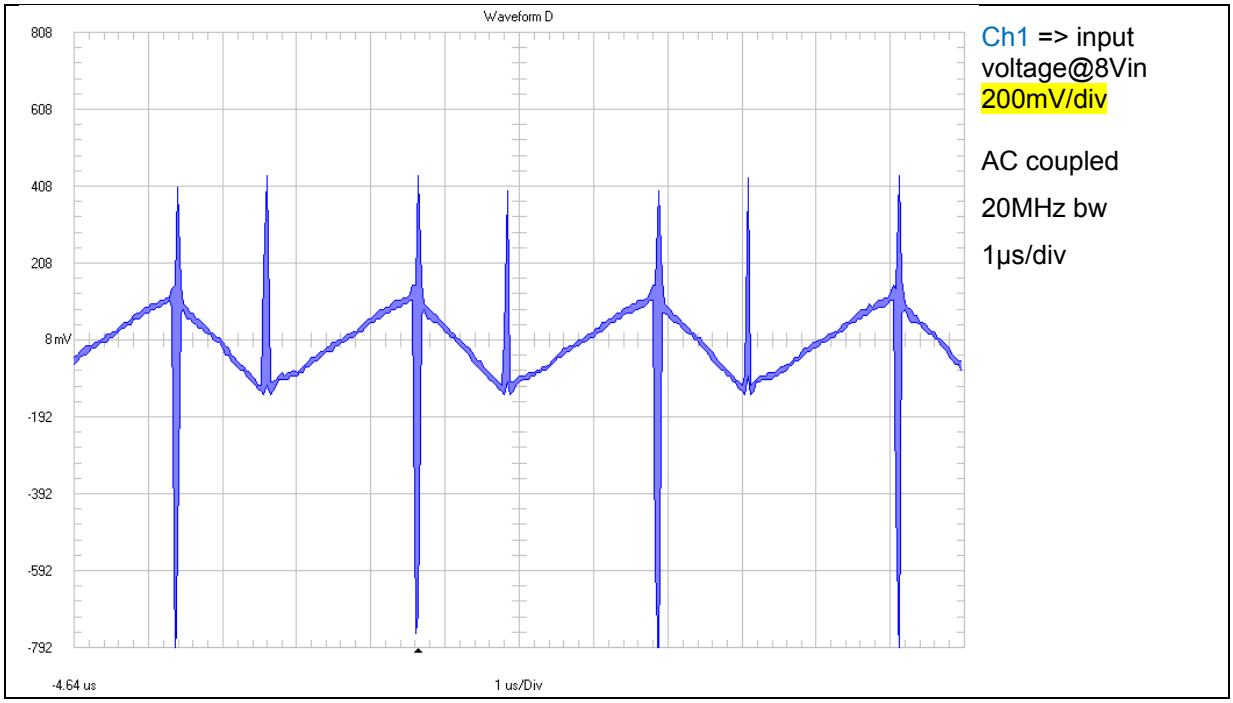


Figure 7

The EMI input filter lowers the reflected ripple (= conducted emmissions) from 250mVpp to 4mVpp, the overall noise from to1200mVpp to 80mVpp.

7 Control Loop Frequency Response

Figure 8 shows the loop response. Resistors were adjusted to get 8A output current

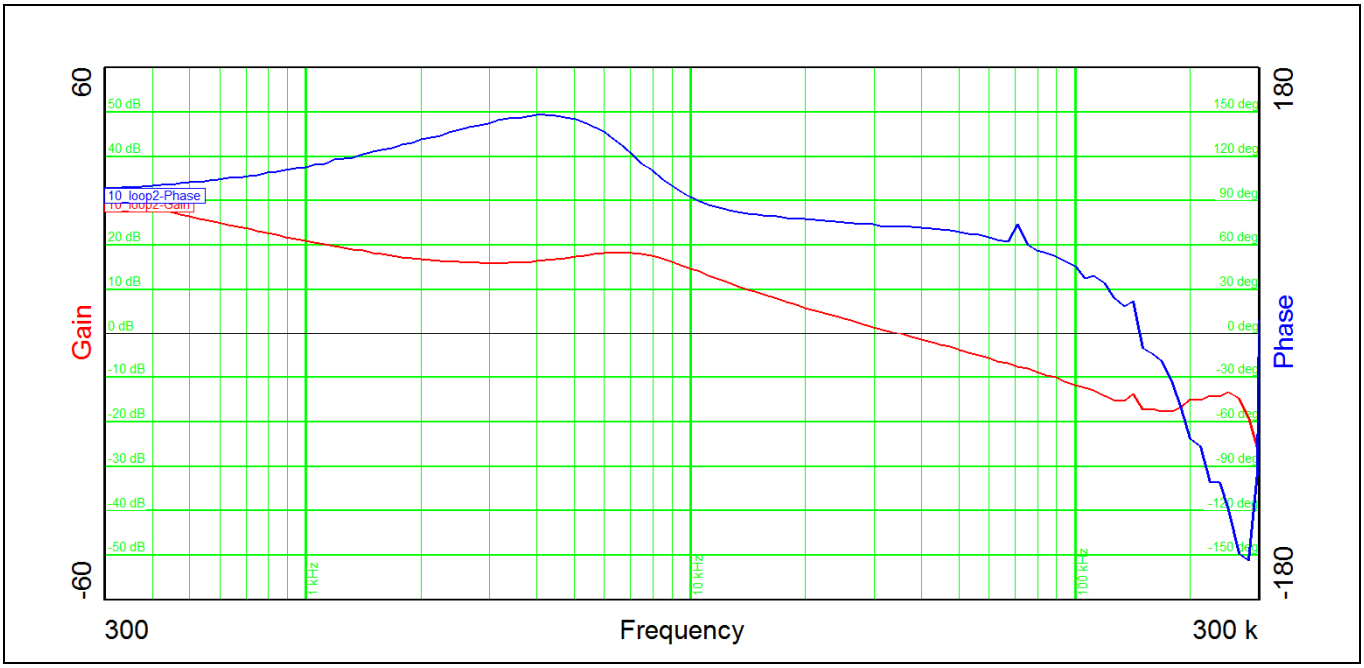


Figure 8

Figure 9 shows the loop response with electronic load N3305 (8A output current).

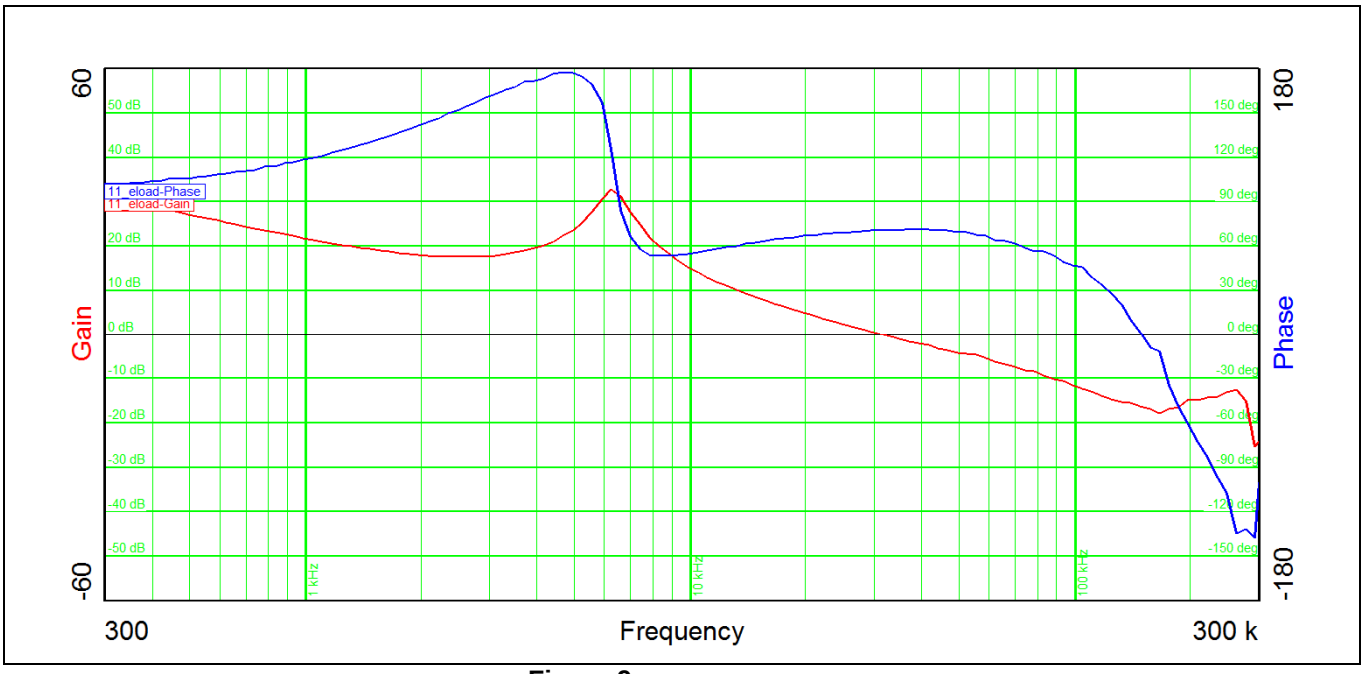


Figure 9

Load	Resistor	N3305
Bandwidth (kHz)	34.6	31
Phase margin	72.9°	70.2°
slope (20dB/decade)	-0.81	-1.19
gain margin (dB)	-16.2	-16.4
slope (20dB/decade)	-7.11	-1.21
freq (kHz)	147	149

Table 1

8 Miscellaneous Waveforms

Switchnode (Q1 drain-GND) waveform is shown in Figure 10.

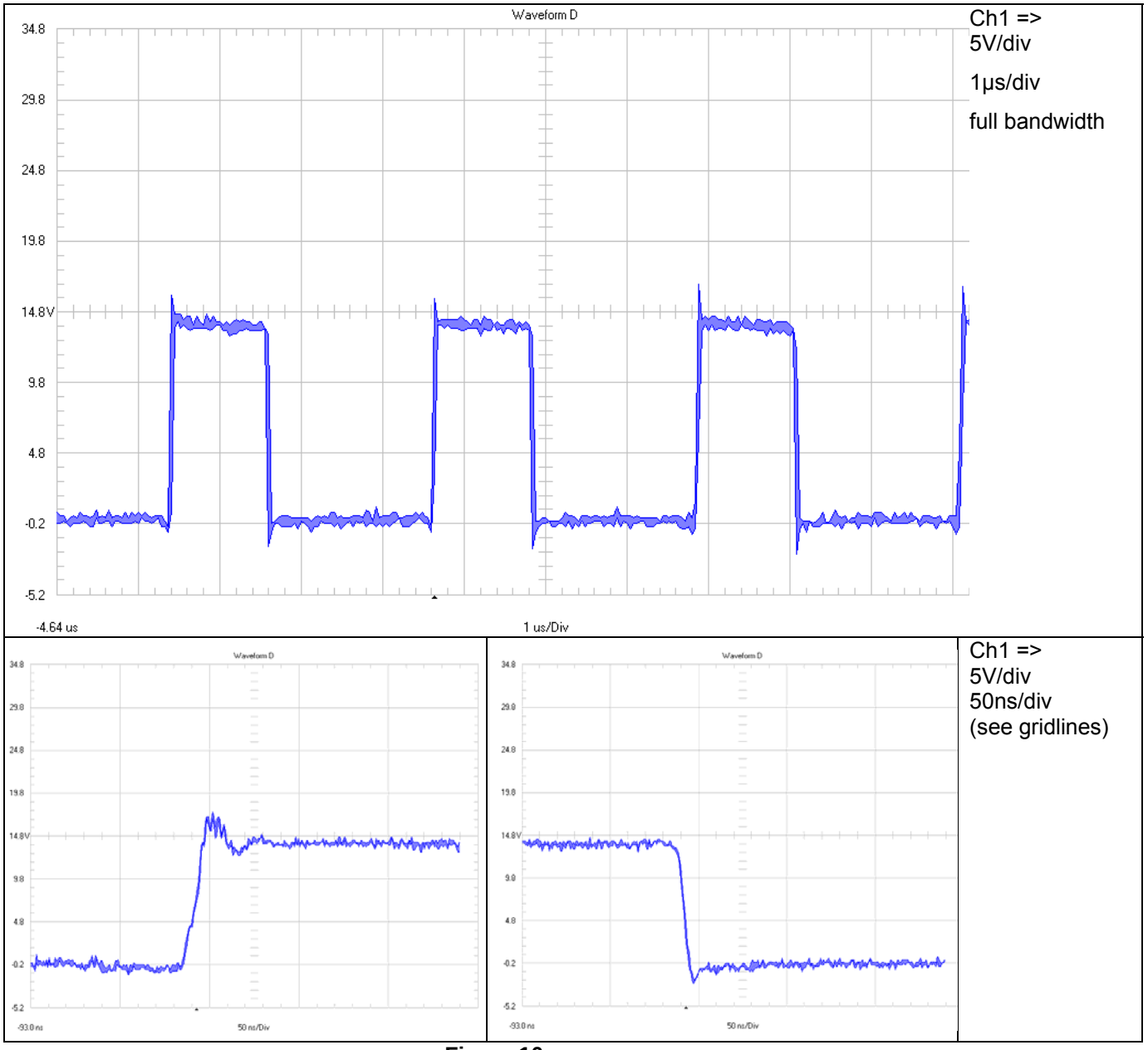
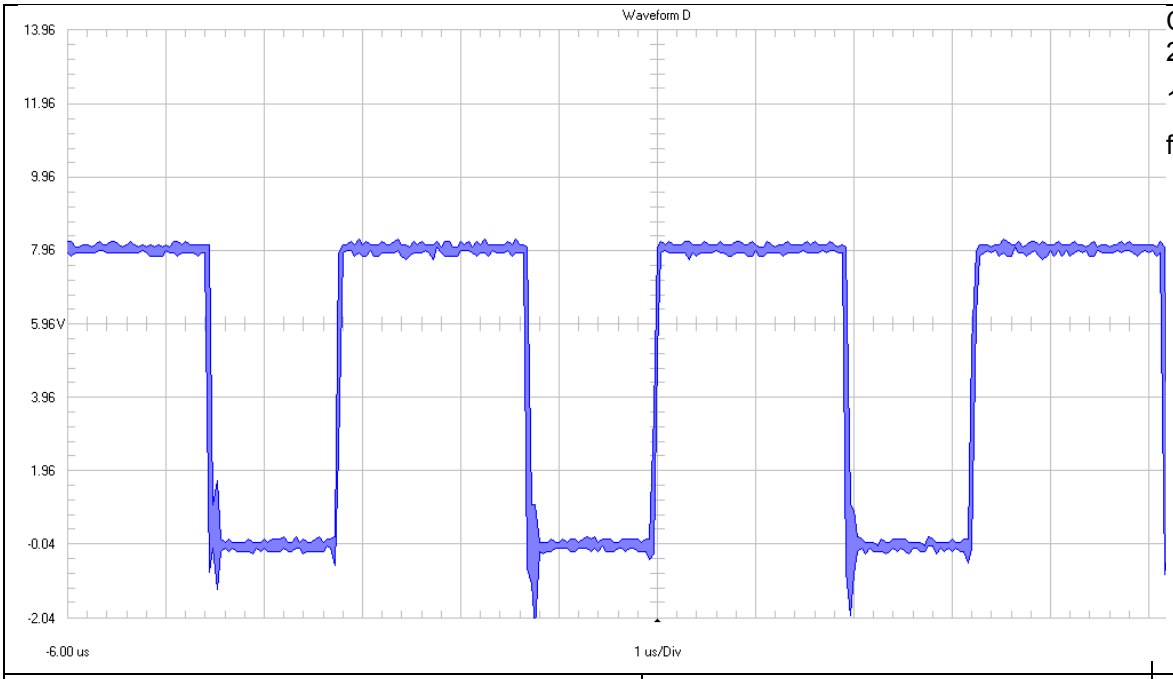


Figure 10

The RC snubber circuit lowers RF noise at switch node by reducing the overshoot – see appendix.

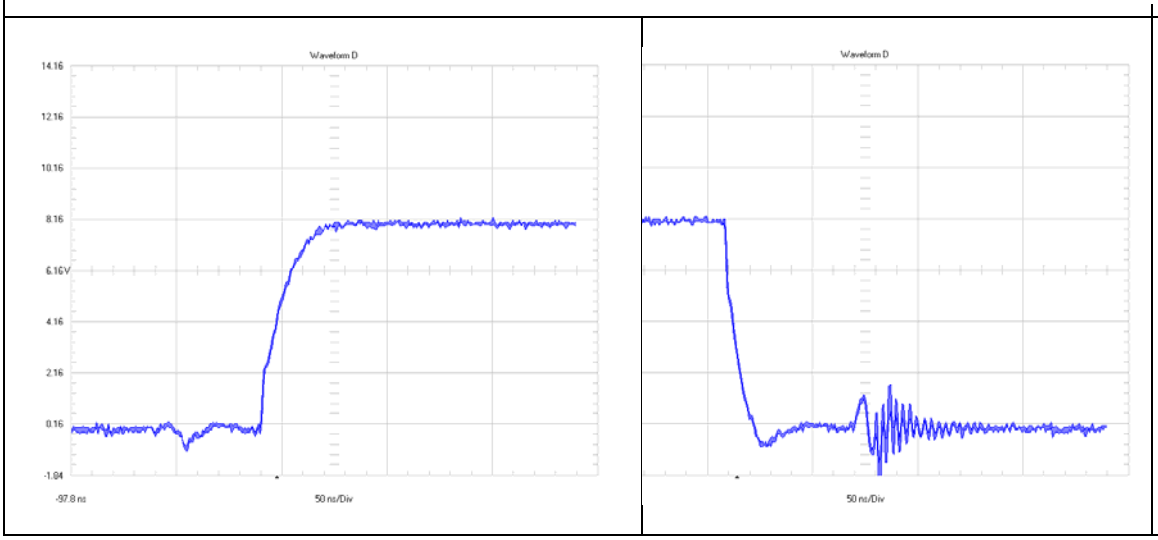
Q1 Gate to GND
The waveform of the voltage on Q1 (gate-GND) is shown in Figure 11.



Ch1 =>
2V/div

1µs/div

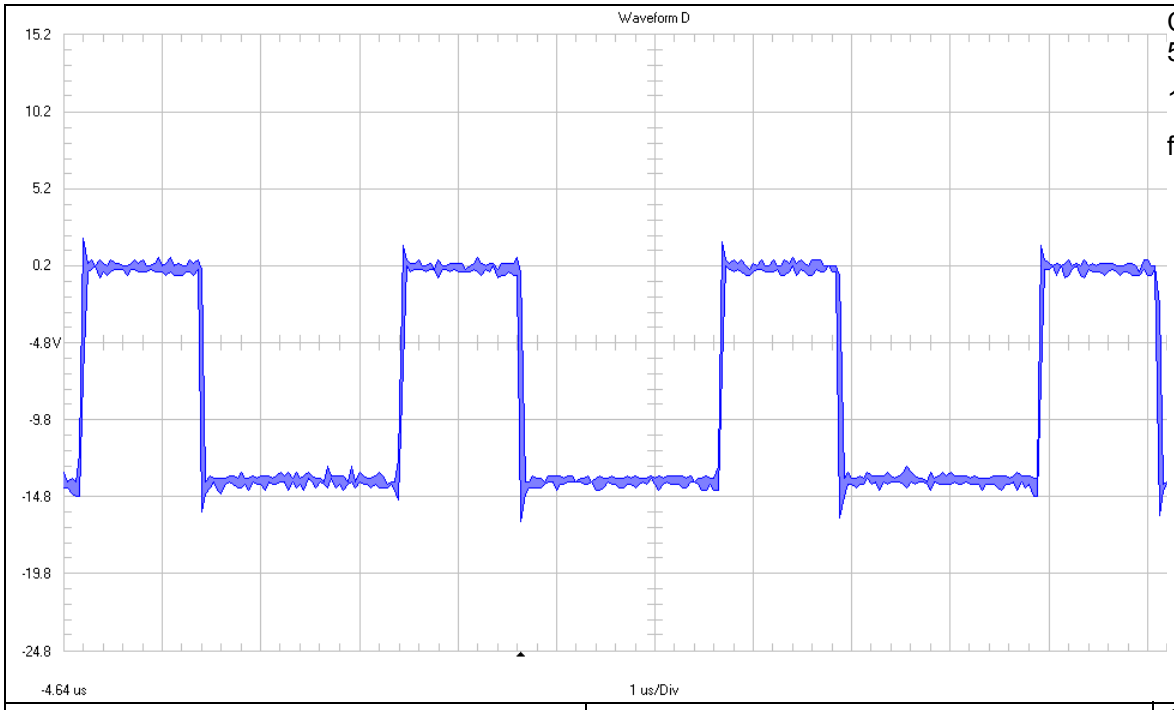
full bandwidth



Ch1 =>
2V/div
50ns/div
(see gridlines)

Figure 11

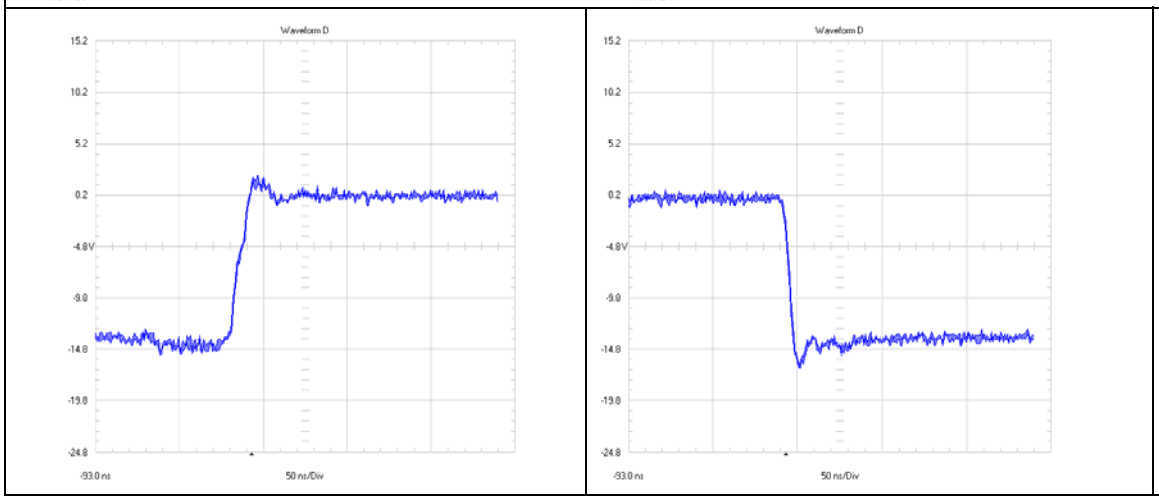
Q2 (HiSide FET) waveform is shown in Figure 12. (referenced to VIN)



Ch1 =>
5V/div

1µs/div

full bandwidth



Ch1 =>
5V/div
50ns/div
(see gridlines)

Figure 12

Q2 Gate to Switchnode
The waveform of the voltage on Q1 (gate-GND) is shown in Figure 13.

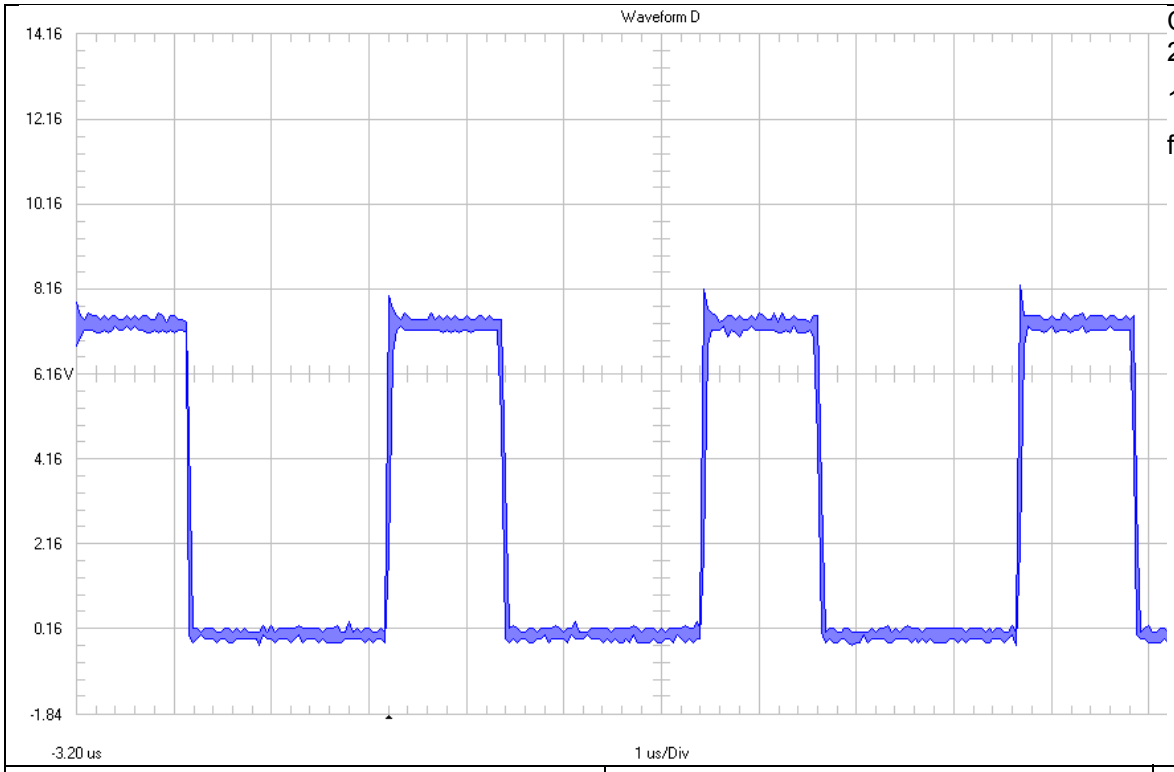


Figure 13

9 Load Transient Response

The load transient response from a load step from 4 to 8A is shown in Figure 14

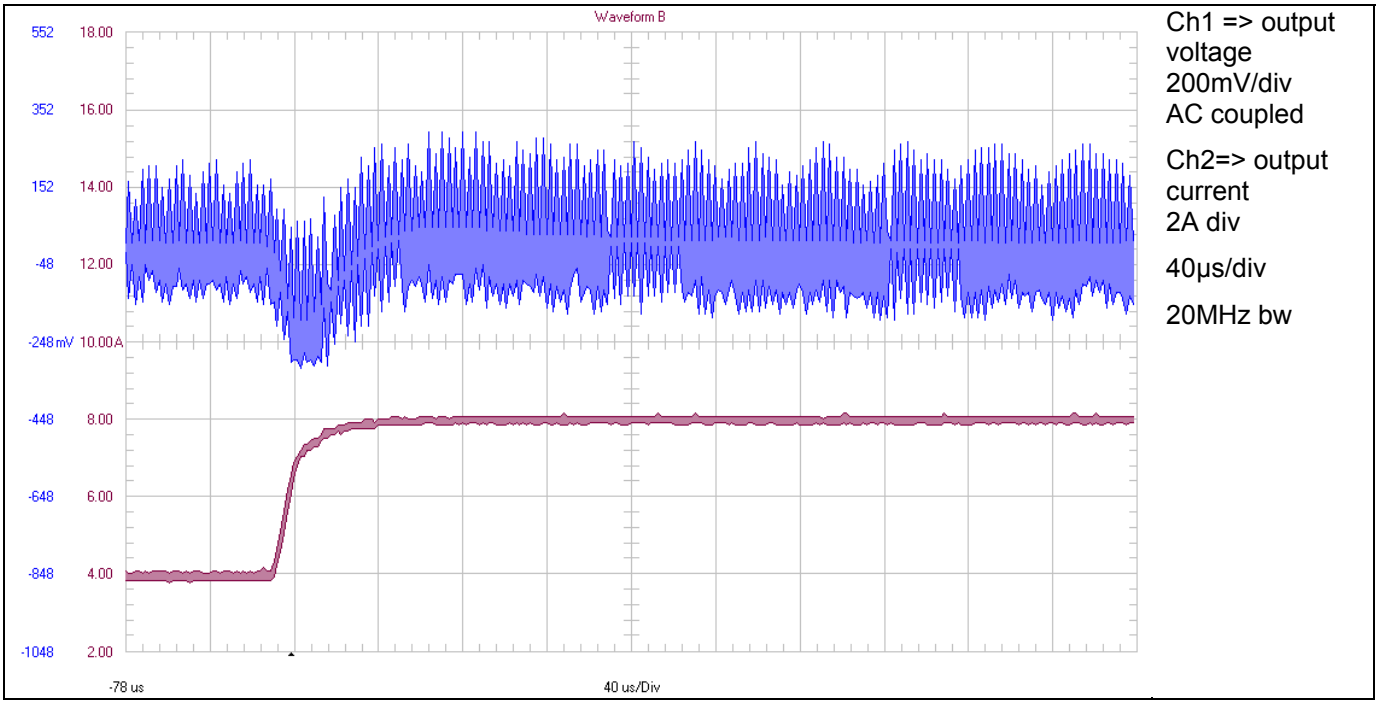


Figure 14

The load transient response from a load step from 8 to 4A is shown in Figure 14

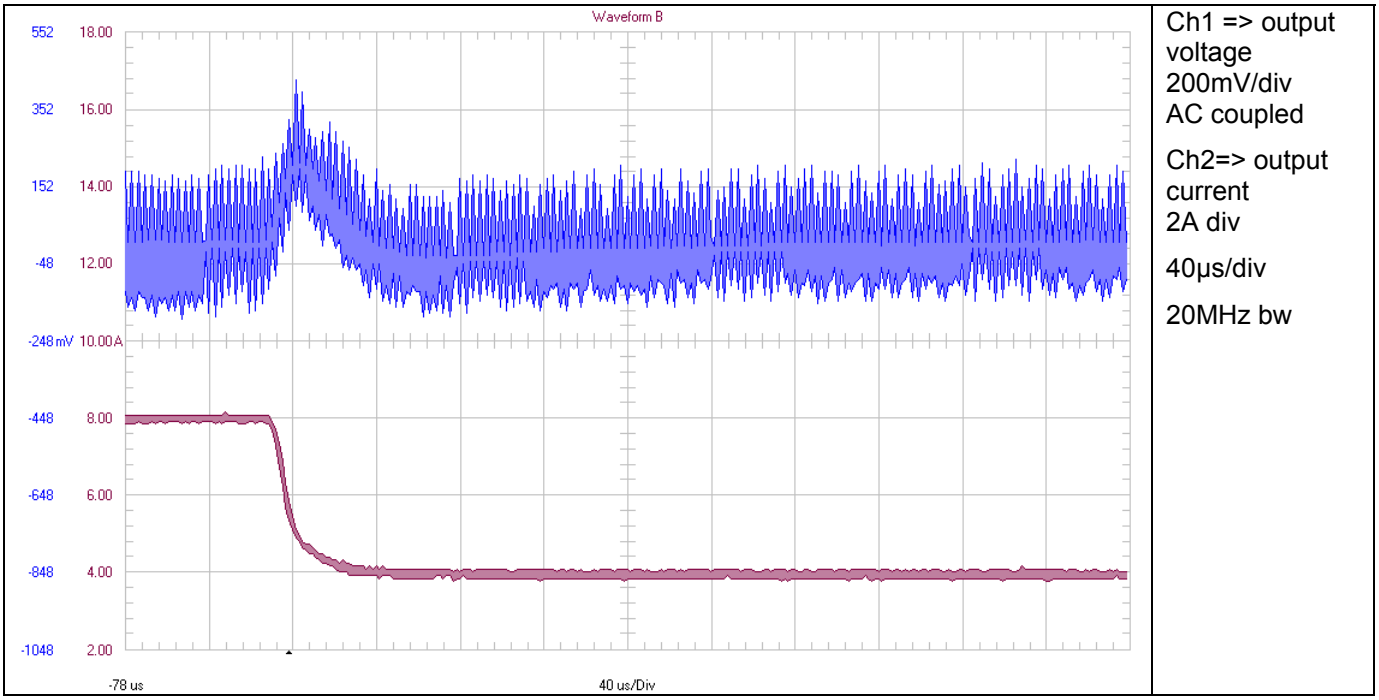


Figure 15

Due to small output capacitance for a pre regulator circuitry the transient response is still around 200mVpk for a 50% standard transient, means 4% deviation.

The load transient response from a load step from 1 to 8A is shown in Figure 16

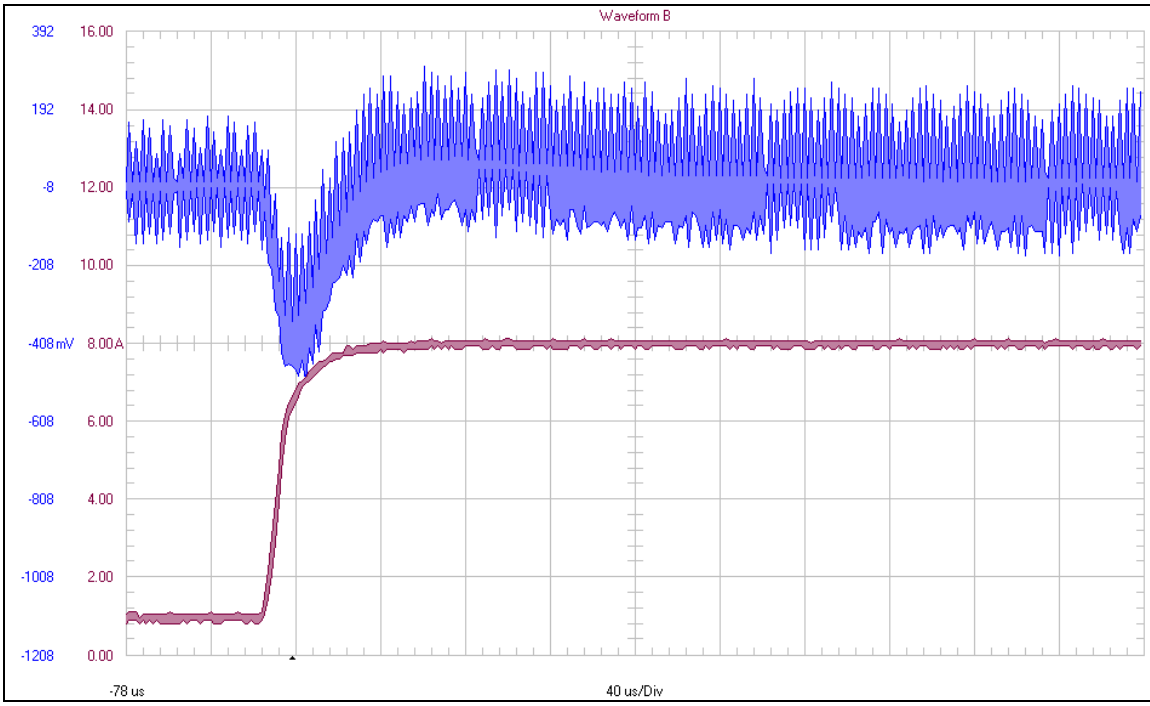


Figure 16

The load transient response from a load step from 8 to1A is shown in Figure 17

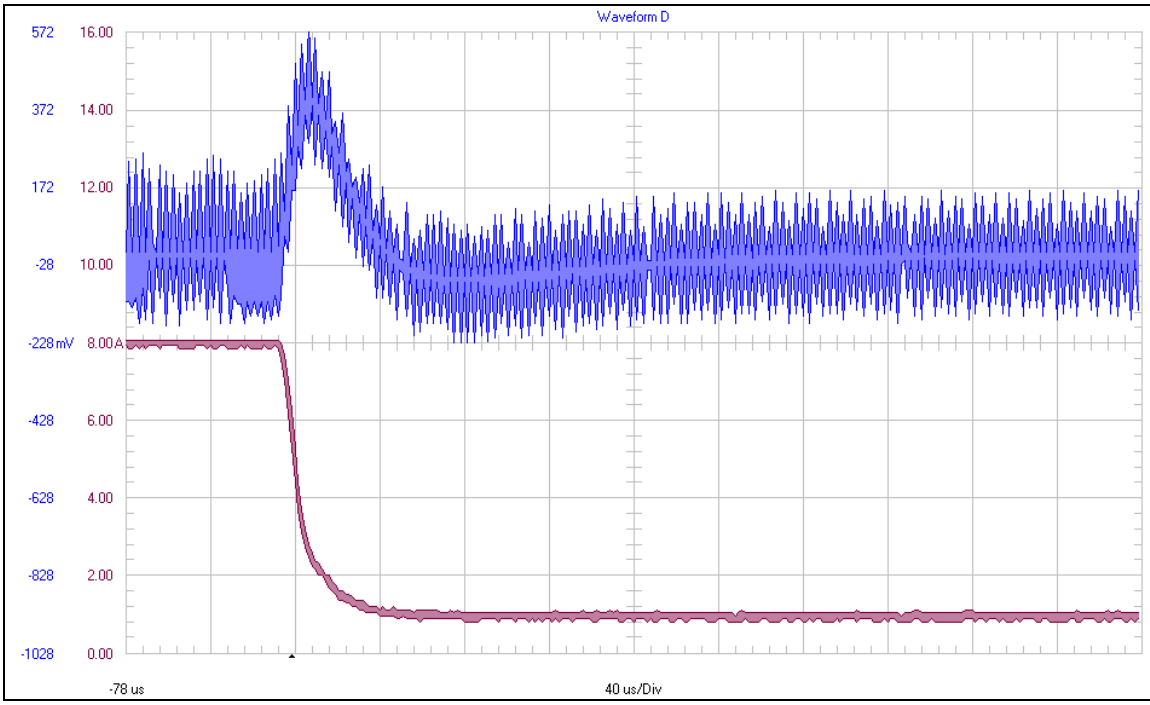


Figure 17

For a 90% transient (!) the transient response is 400mV, so 8% deviation.

10 Thermal Image

Table 2 summarizes the thermal images in Figure 18, Figure 19 and Figure 20

Iout	5.5A	8A	10A
R18	**46.2°C**	53.6°C	62.3°C
Q1	**43.6°C**	52.0°C	61.9°C
Q2	**42.6°C**	50.5°C	60.0°C
D1	**43.8°C**	51.6°C	59.9°C
L1	**43.7°C**	53.7°C	65.1°C

Table 2

Figure 18 shows the thermal image with 5.5A output current

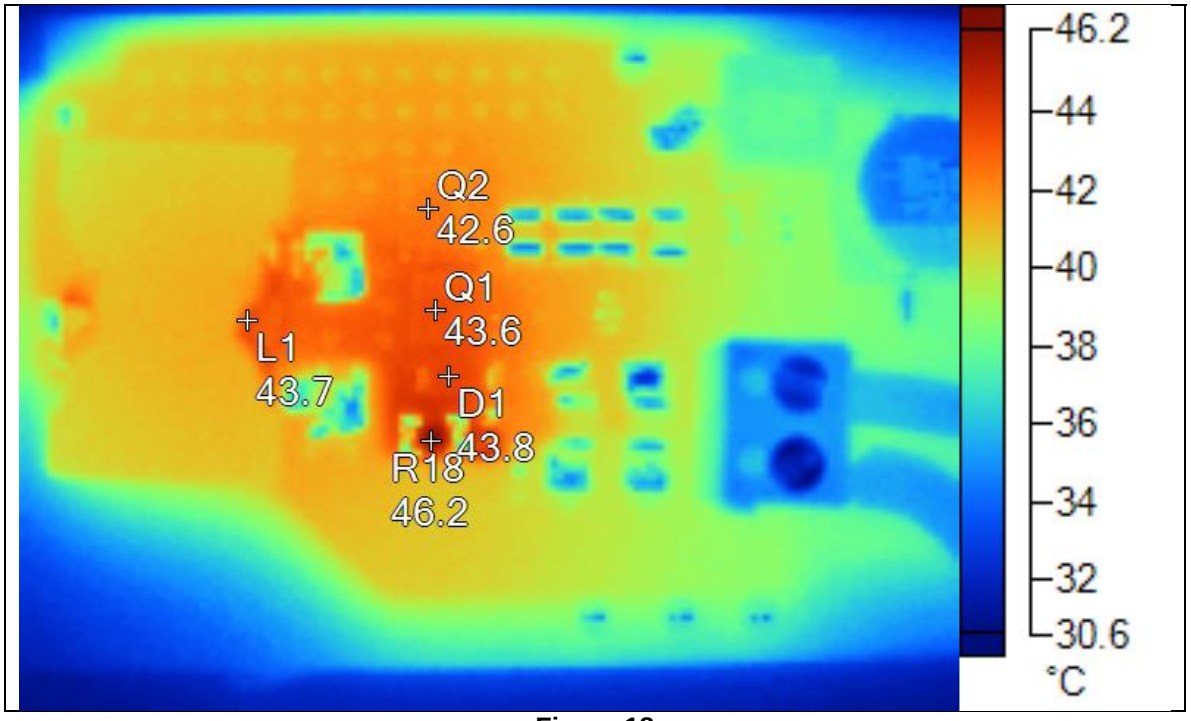


Figure 18

Hot Spot is the snubber resistor.

Figure 19 shows the thermal image with 8A output current

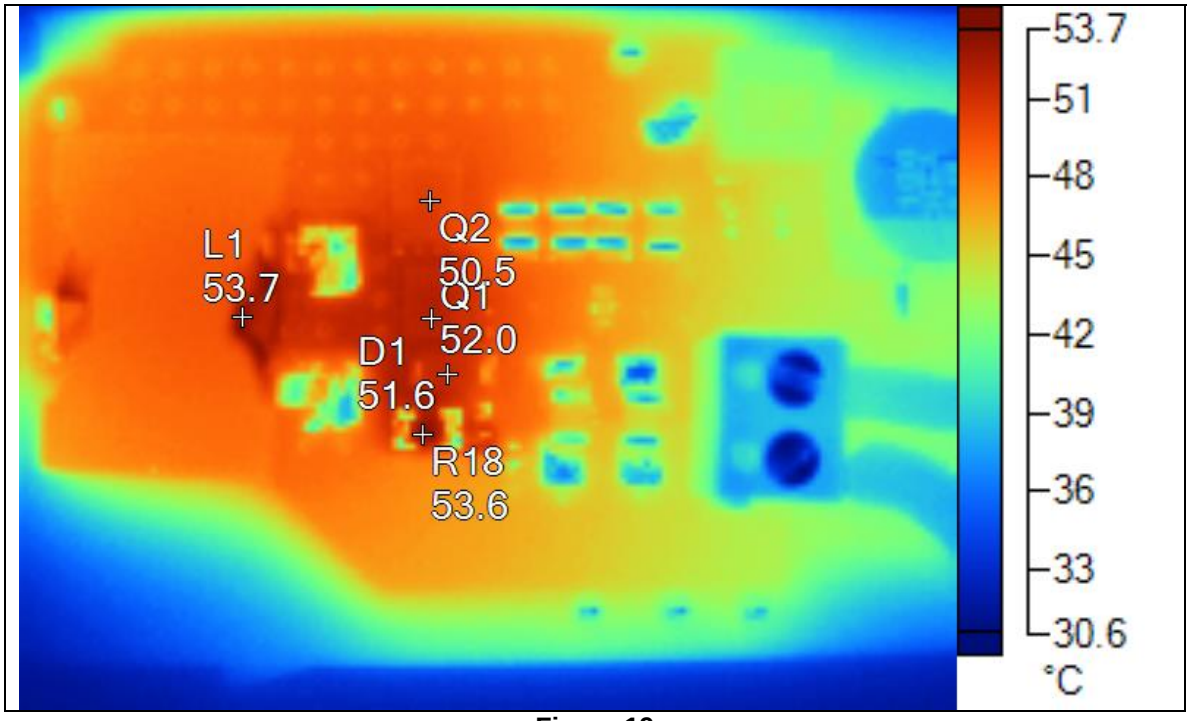


Figure 19

Figure 20 shows the thermal image with 10A output current

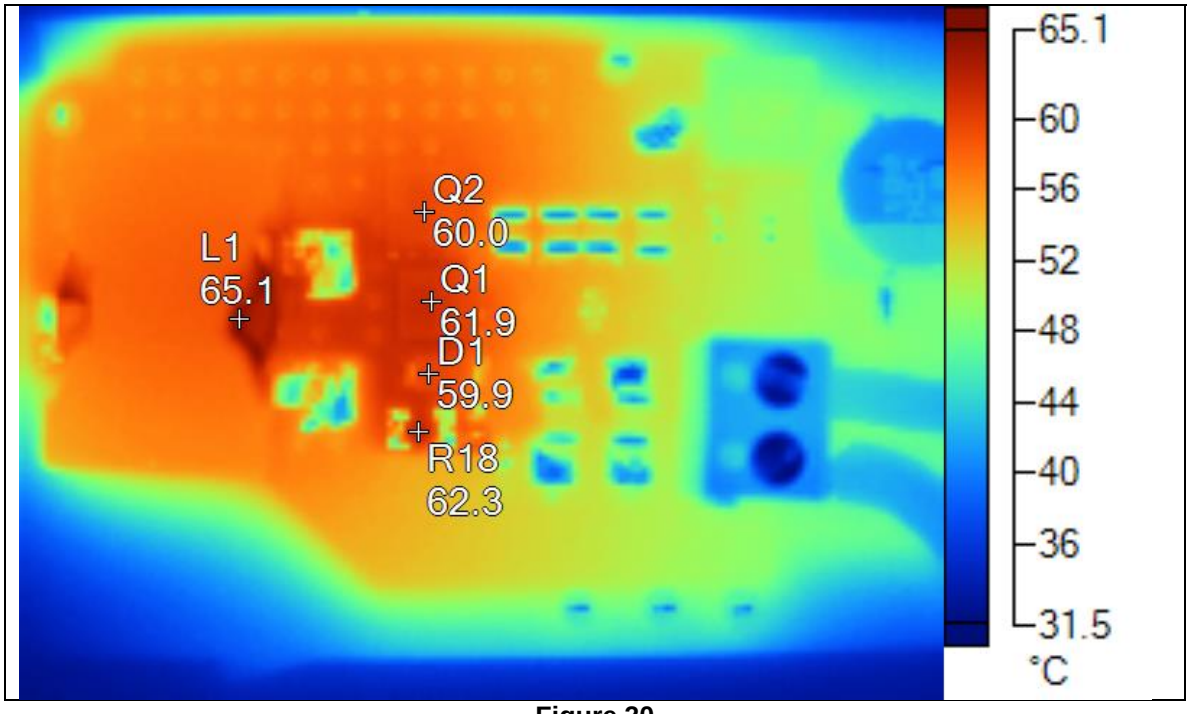


Figure 20

11 Appendix

11.1 Snubber Evaluation

Switchnode without snubber

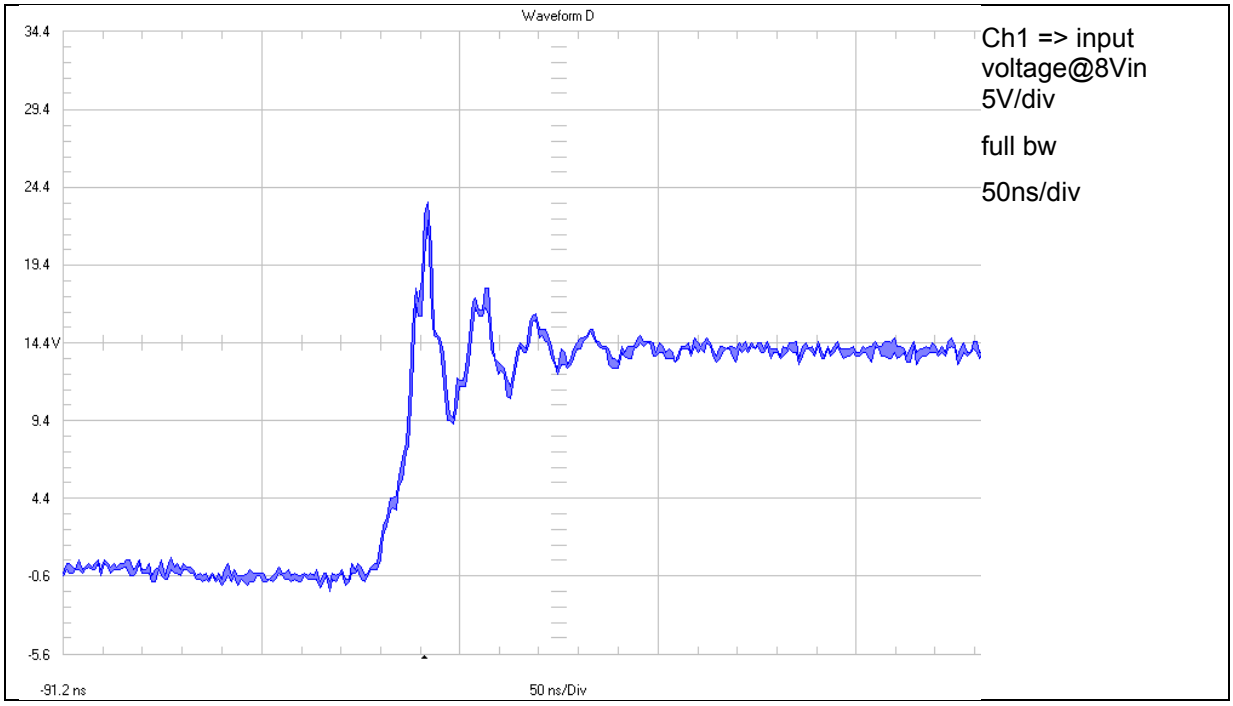


Figure 21

ringing frequency=71MHz, so close to FM band (!)

Switchnode 1.5nF to GND

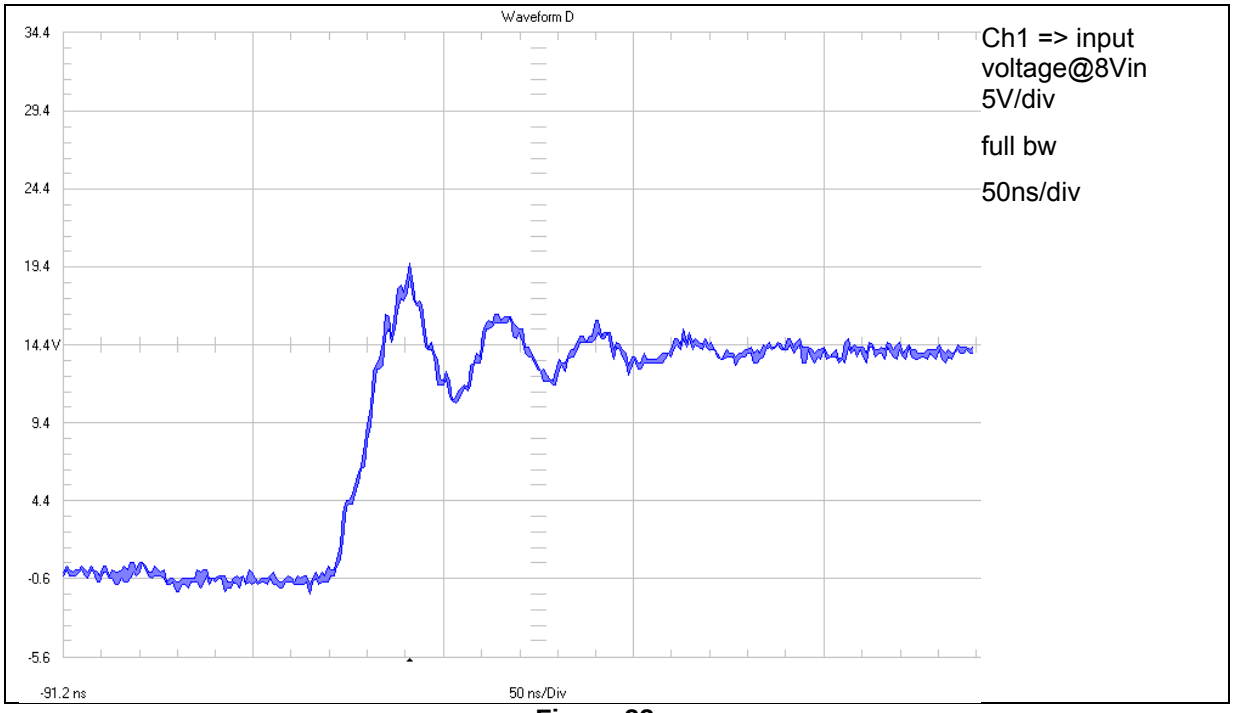


Figure 22

ringing frequency = 40.3MHz

Switchnode 1.5nF and 1.2Ω

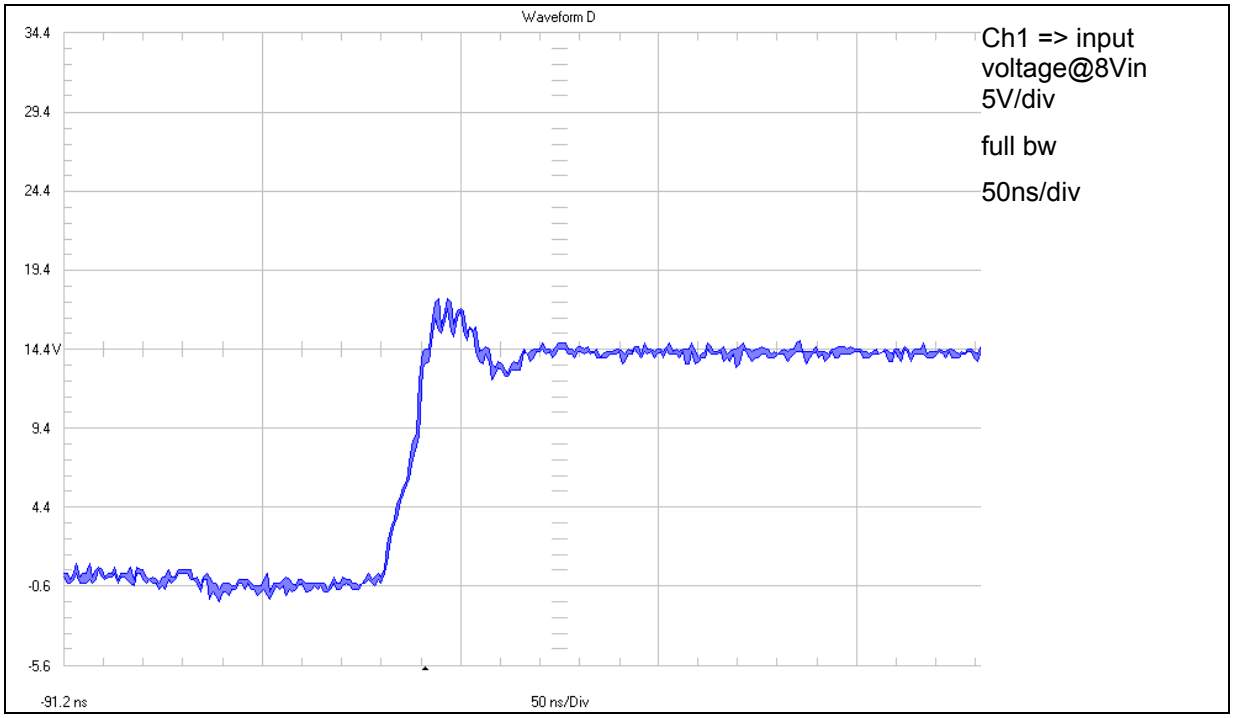


Figure 23

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