

PMP30159 Test Results

1	Startup	2
2	Shutdown	4
3	Efficiency	6
4	Load Regulation	7
5	Line Regulation	8
6	Output Ripple Voltage	9
7	Input Ripple Voltage	9
8	Load Transients	10
9	Control Loop Frequency Response	12
10	Miscellaneous Waveforms	14
	10.1 Switch Node (Drain-ground)	14
	10.2 Gate – Ground	17
	10.3 Voltage D1 (referenced to VOUT)	20
11	Thermal Image	23
12	Snubber Evaluation	26
13	Influence of the Pre Gate Resistor	29

Topology: SEPIC; Device: TPS40210; Switching Frequency: 340kHz;
 With output current of 2A circuit switches off at 2.85V and on at 4.37V
 Unless otherwise mentioned measurements were done with resistive load
 Sloppy layout might need a 40V Schottky rectifier or a small RC snubber across this Schottky



1 Startup

The startup waveform is shown in the Figure 1. The input voltage was set to 4.5V, with 2A load at the output.

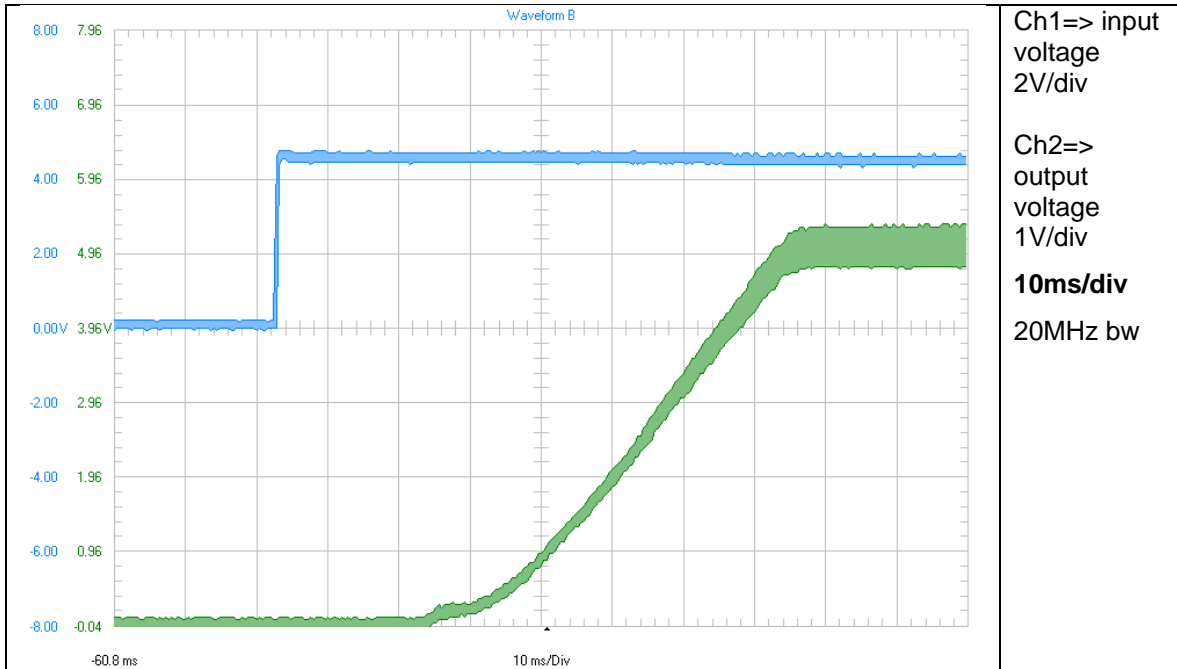


Figure 1

The startup waveform is shown in the Figure 2. The input voltage was set to 6V, with 2A load at the output.

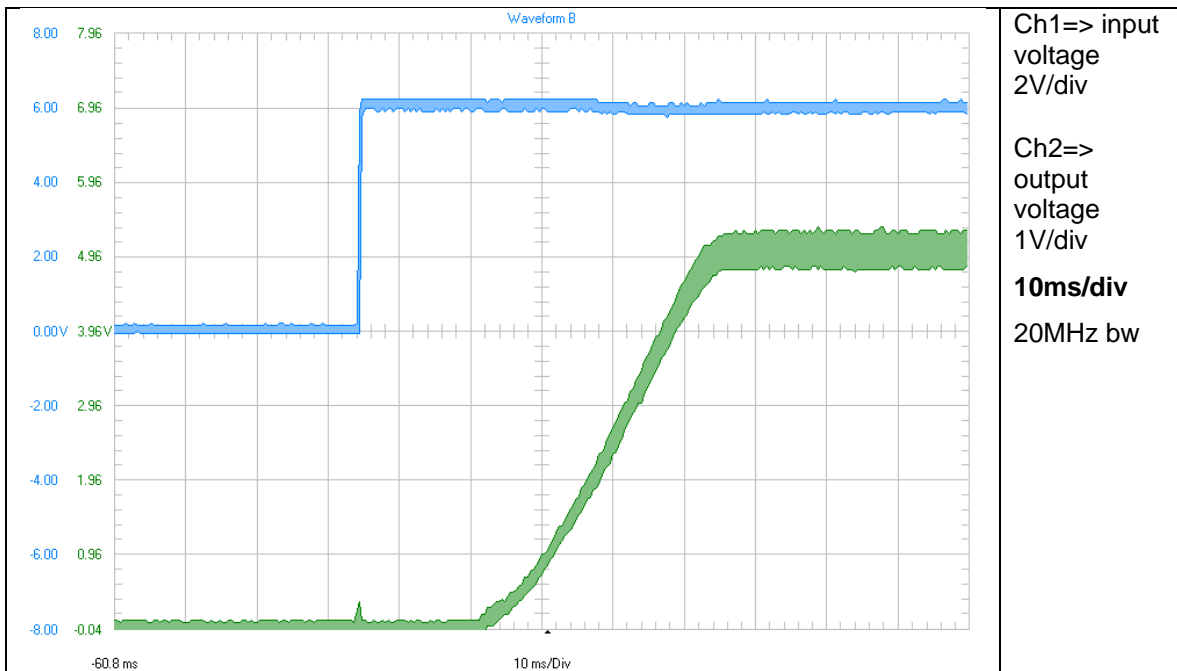


Figure 2

The startup waveform is shown in the Figure 3. The input voltage was set to 12.0V, with 2A load at the output.

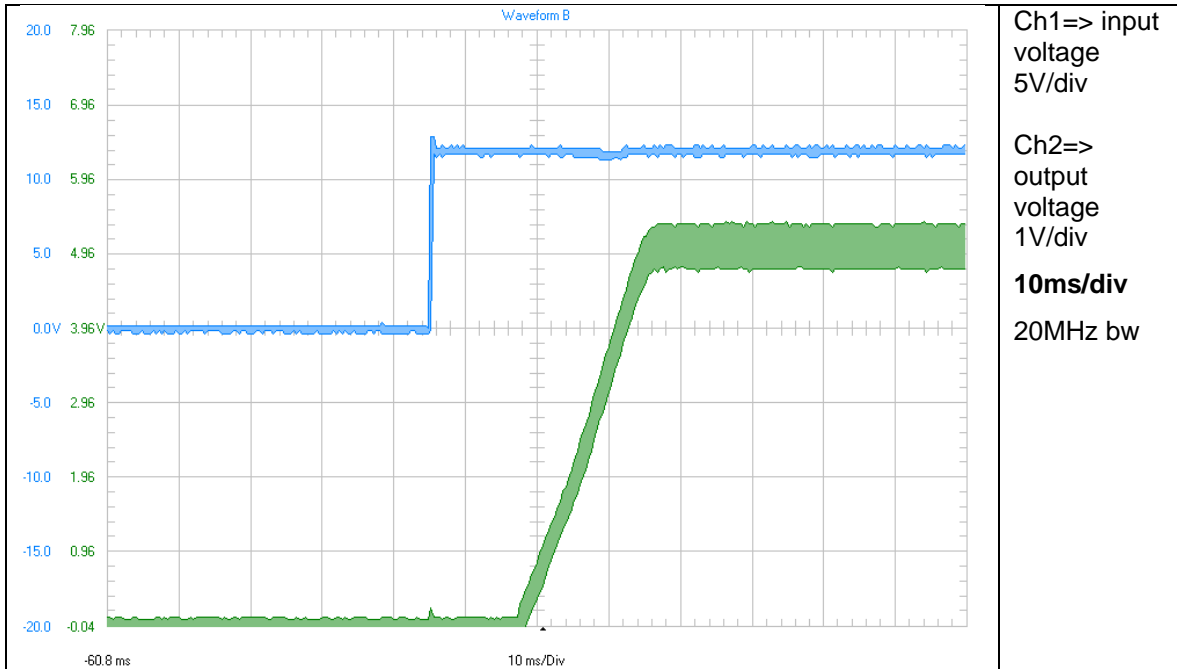


Figure 3

2 Shutdown

The shutdown waveform is shown in the Figure 4. The input voltage was set to 3 V, with 2A load on the output. The power supply was disconnected.

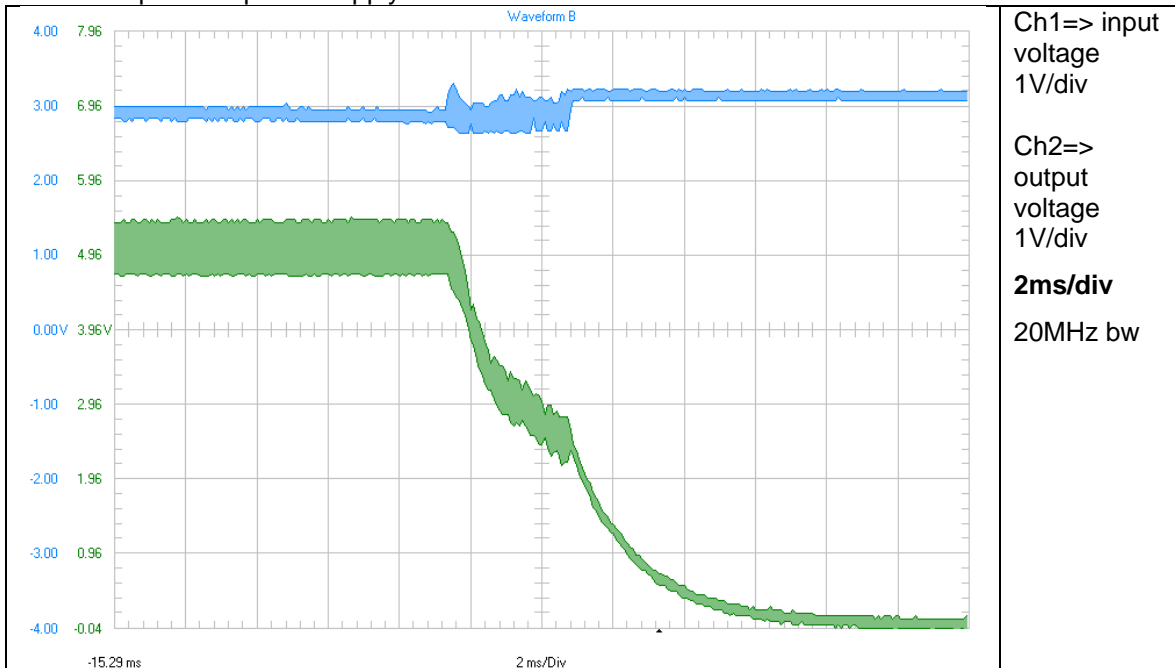


Figure 4

The shutdown waveform is shown in the Figure 5. The input voltage was set to 6.0V, with 2A load on the output. The power supply was disconnected.

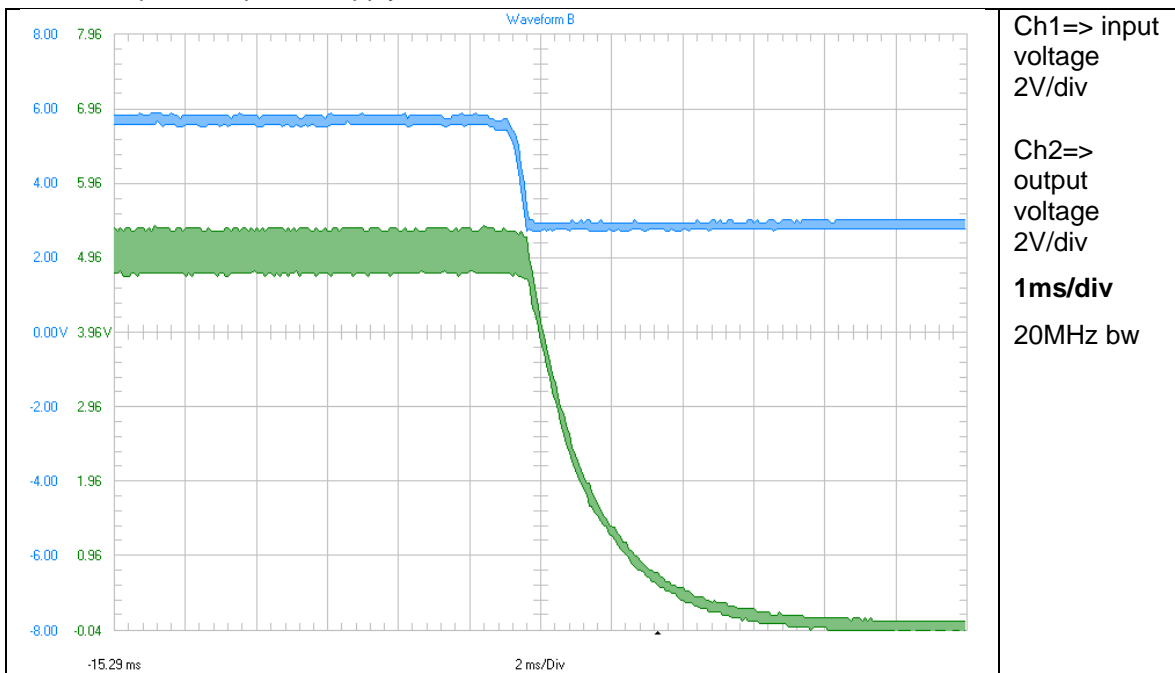


Figure 5

The shutdown waveform is shown in the Figure 6. The input voltage was set to 12V, with 2A load on the output. The power supply was disconnected.

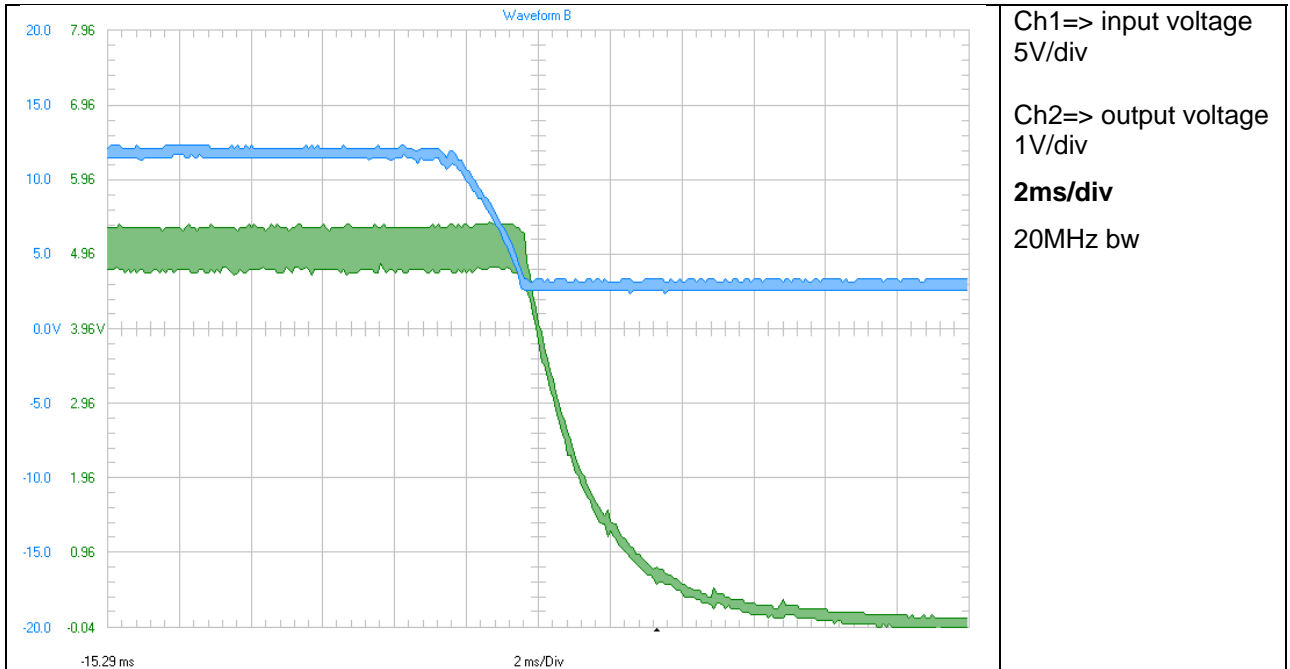


Figure 6

3 Efficiency

The efficiency is shown in the Figure 7 below. The input voltage was set to 3V, 6V and 12V.

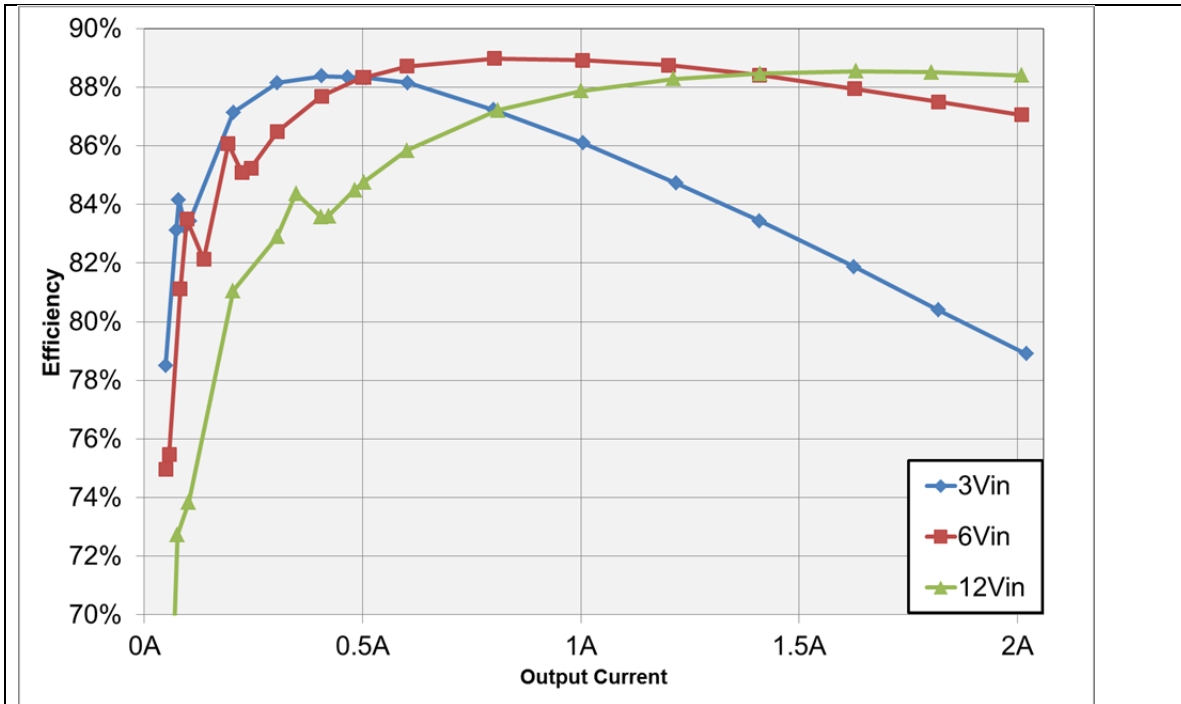


Figure 7

Figure 8 show the losses (Pin - Pout) with input voltage 3V, 6V and 12V

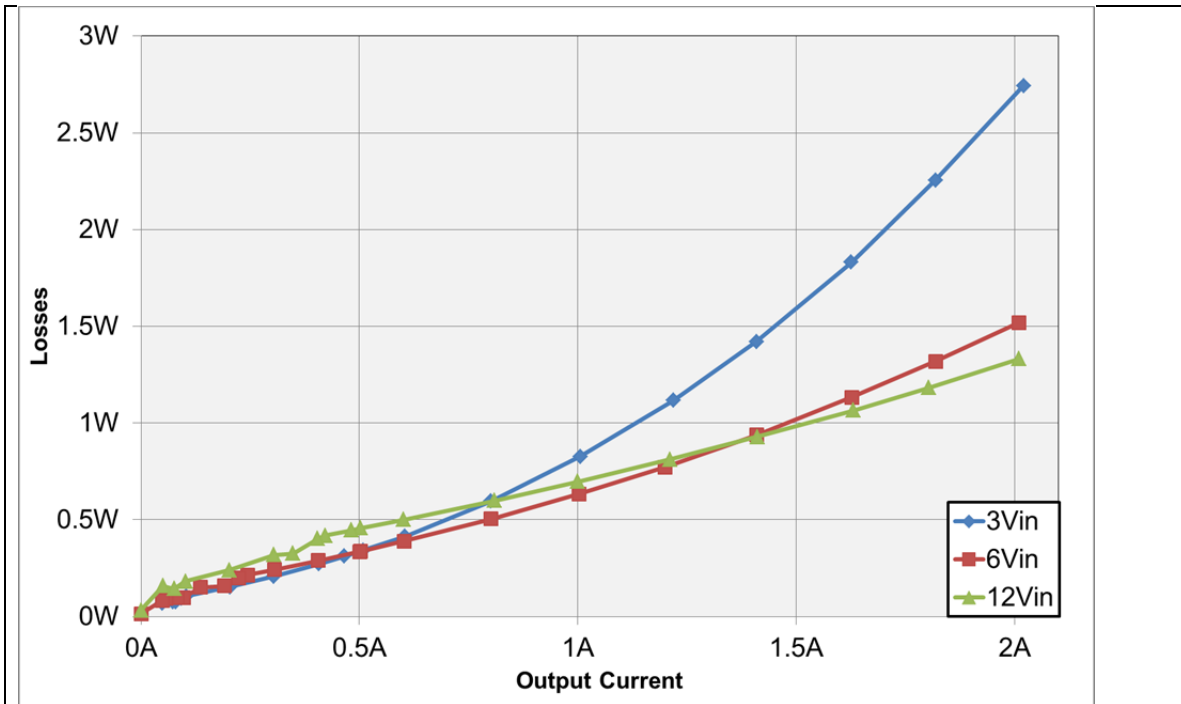


Figure 8

4 Load Regulation

The load regulation of the output is shown in the Figure 9 below. The input voltage was set to 3V, 6V and 12V.

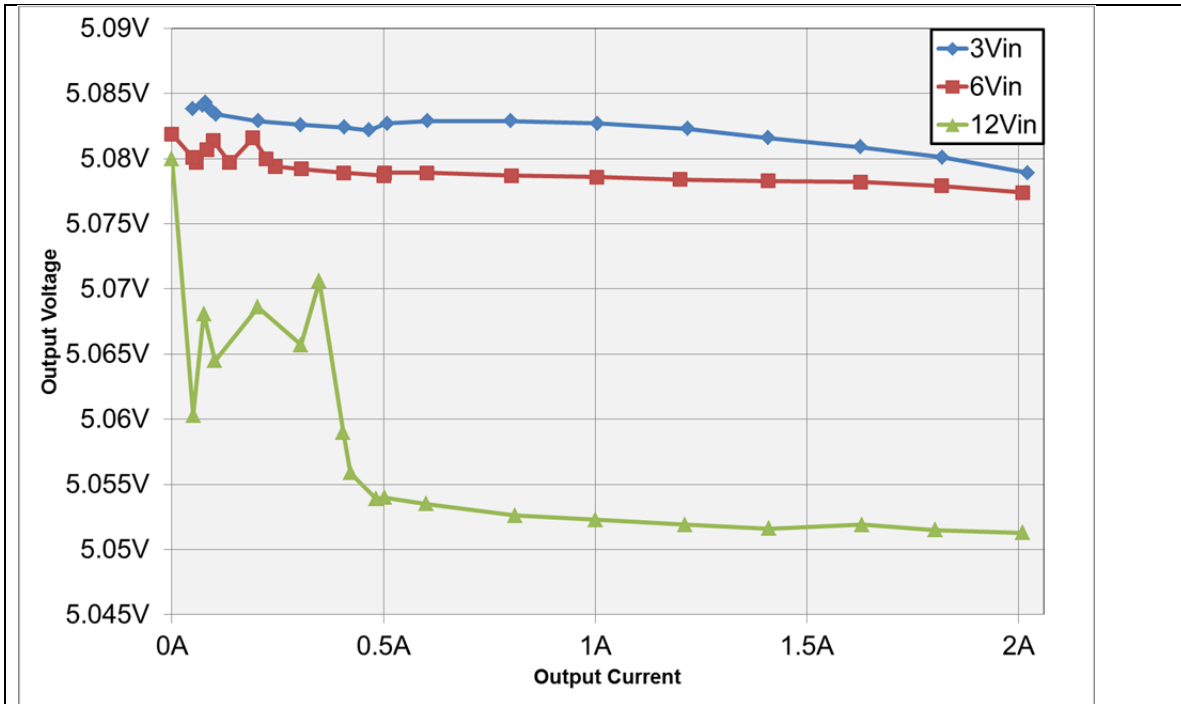


Figure 9

At 0.5A the variable resistor was changed from 100 Ohms to 10 Ohms.

5 Line Regulation

The line regulation is shown in Figure 10. The output current was set about 2A.

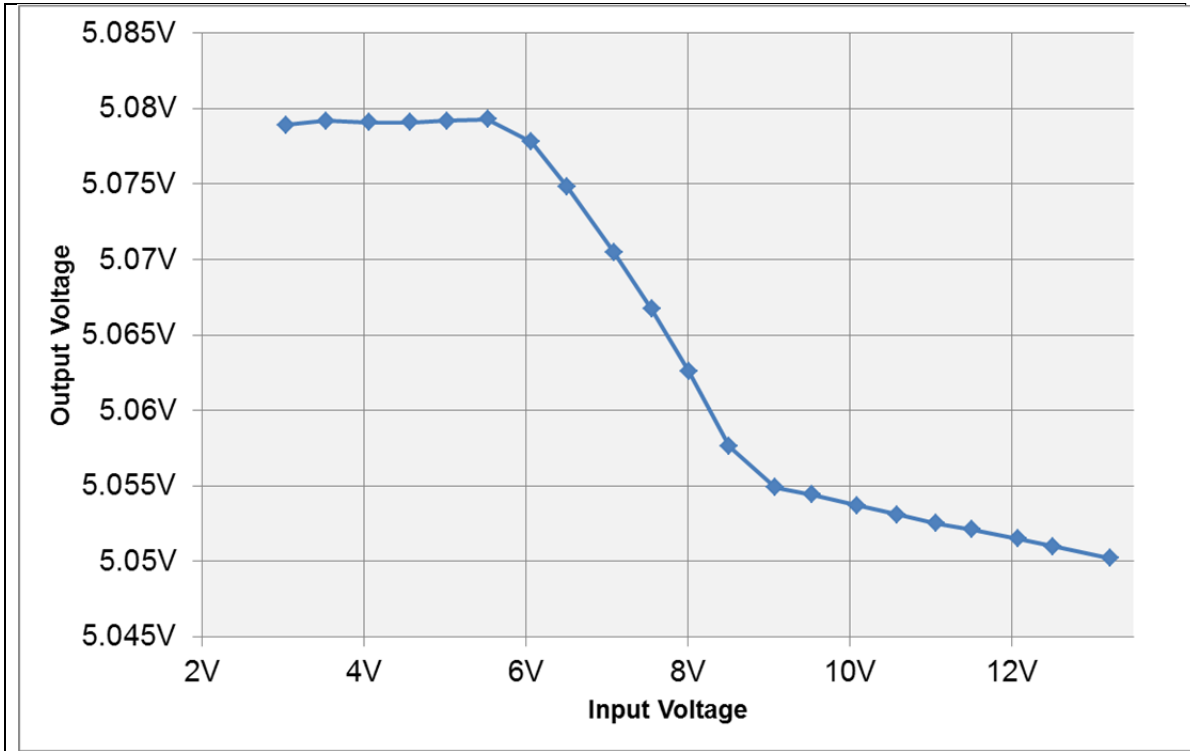


Figure 10

With the same setup efficiencies were calculated. This is shown in Figure 11

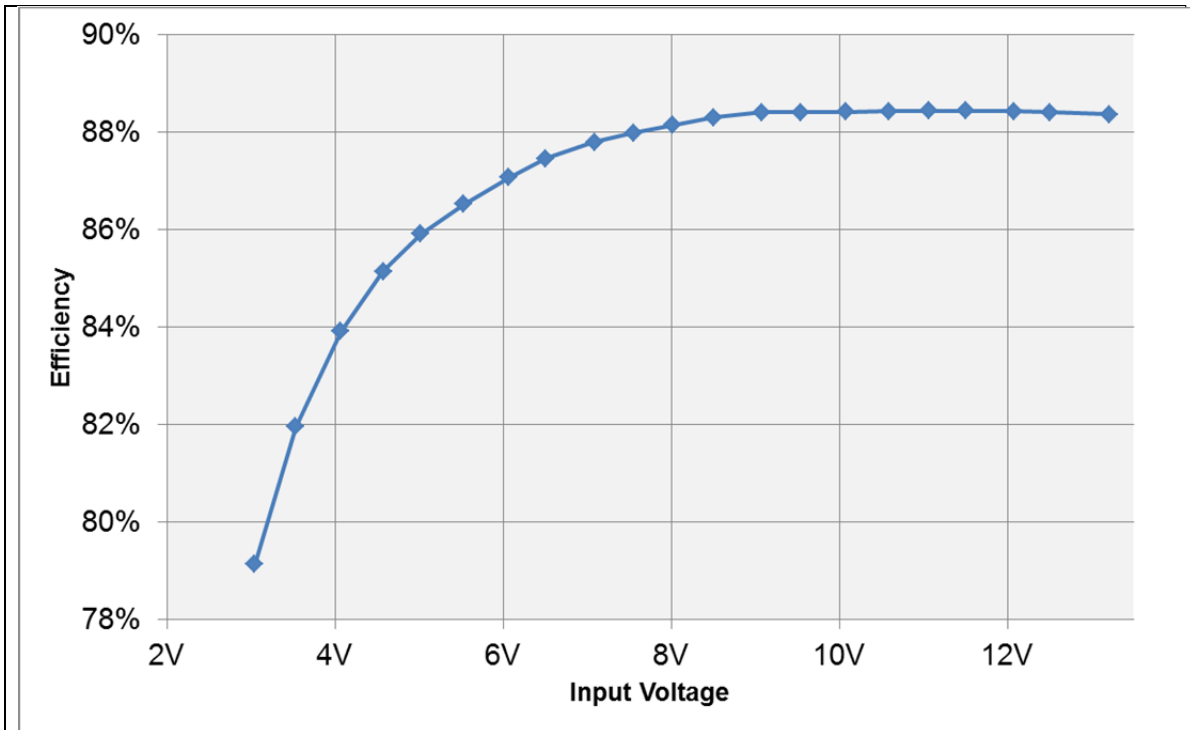


Figure 11

6 Output Ripple Voltage

The output ripple voltage is shown in Figure 12.

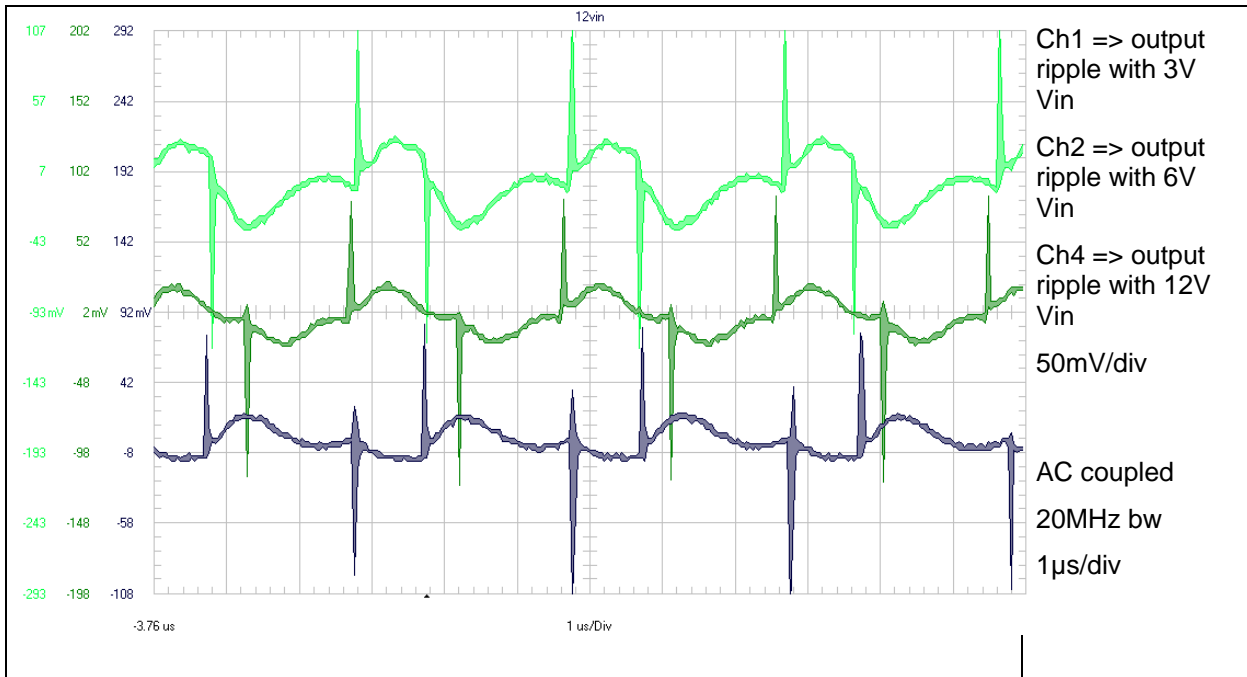


Figure 12

7 Input Ripple Voltage

The input ripple voltage is shown in Figure 13.

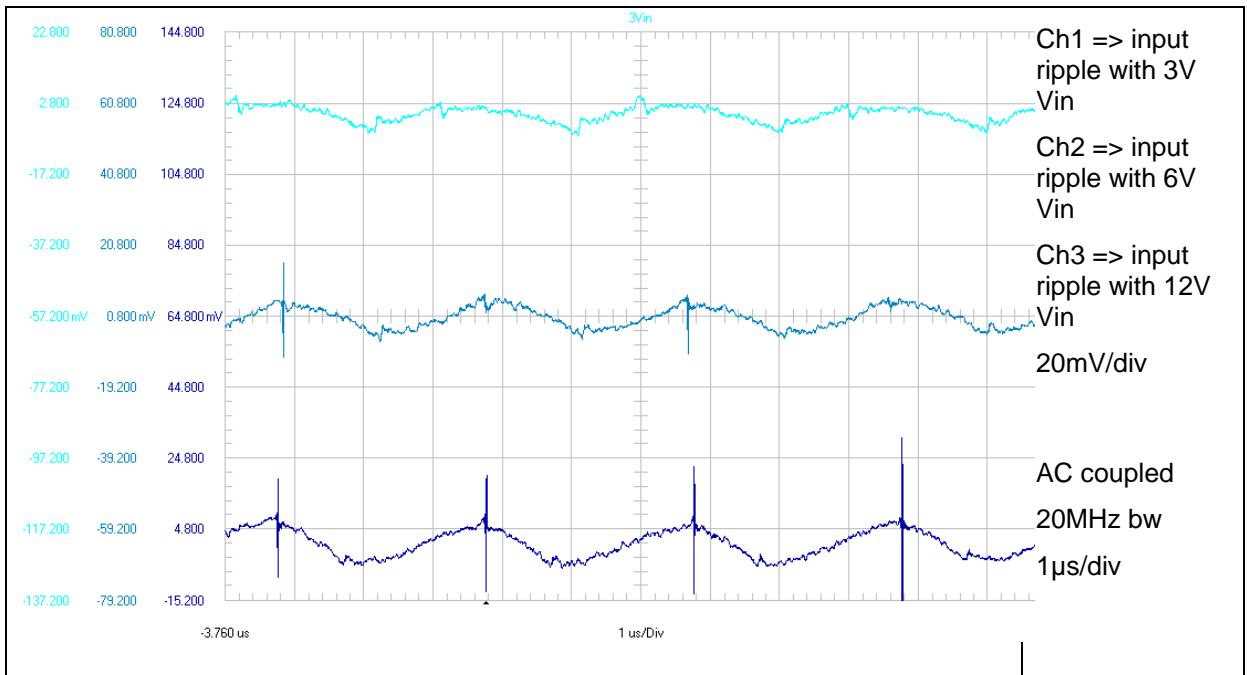


Figure 13

8 Load Transients

The Figure 14 shows the response to load transients for 3V input voltage. The load is switching from 1A to 2A (80Hz)
Electronic load was used

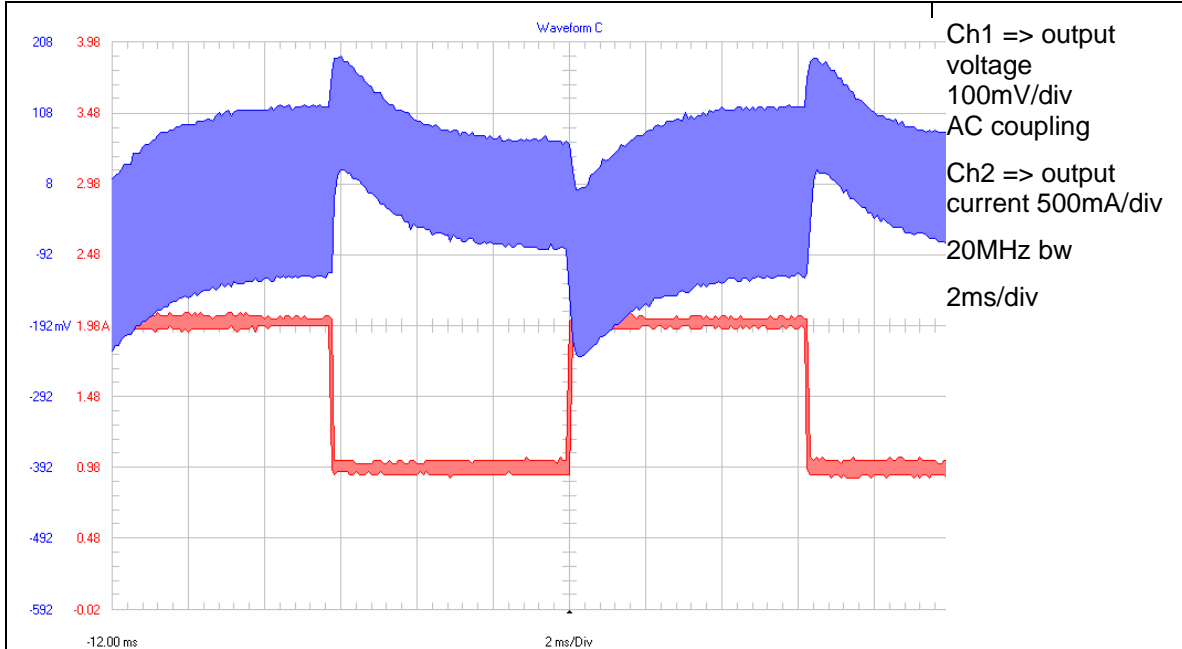


Figure 14

The Figure 15 shows the response to load transients for 6V input voltage. The load is switching from 1A to 2A,
Electronic load was used

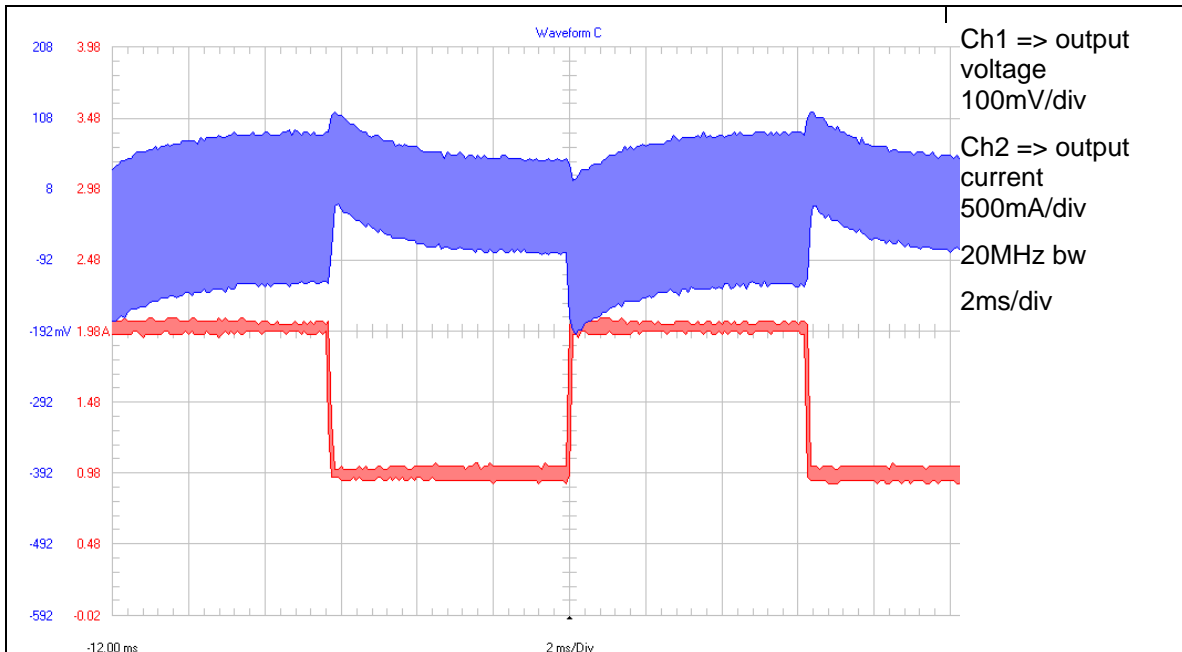


Figure 15

The Figure 16 shows the response to load transients for 12V input voltage. The load is switching from 1A to 2A
Electronic load was used.

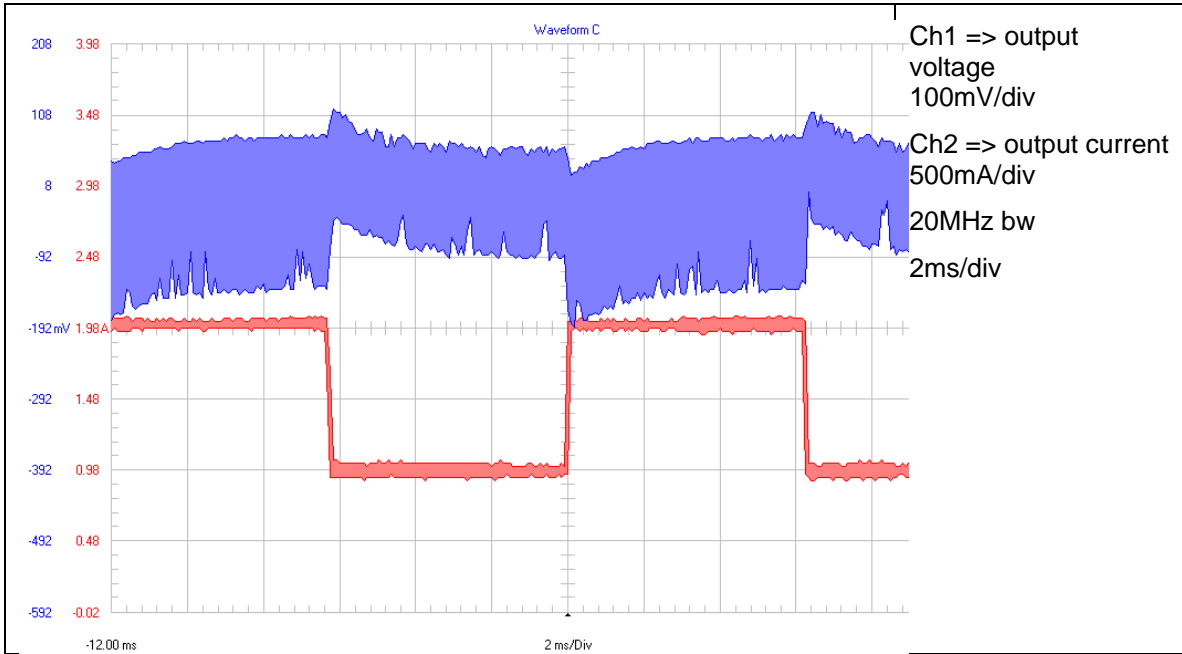


Figure 16

9 Control Loop Frequency Response

Figure 17 shows the loop response for 3V. Load is 2A.

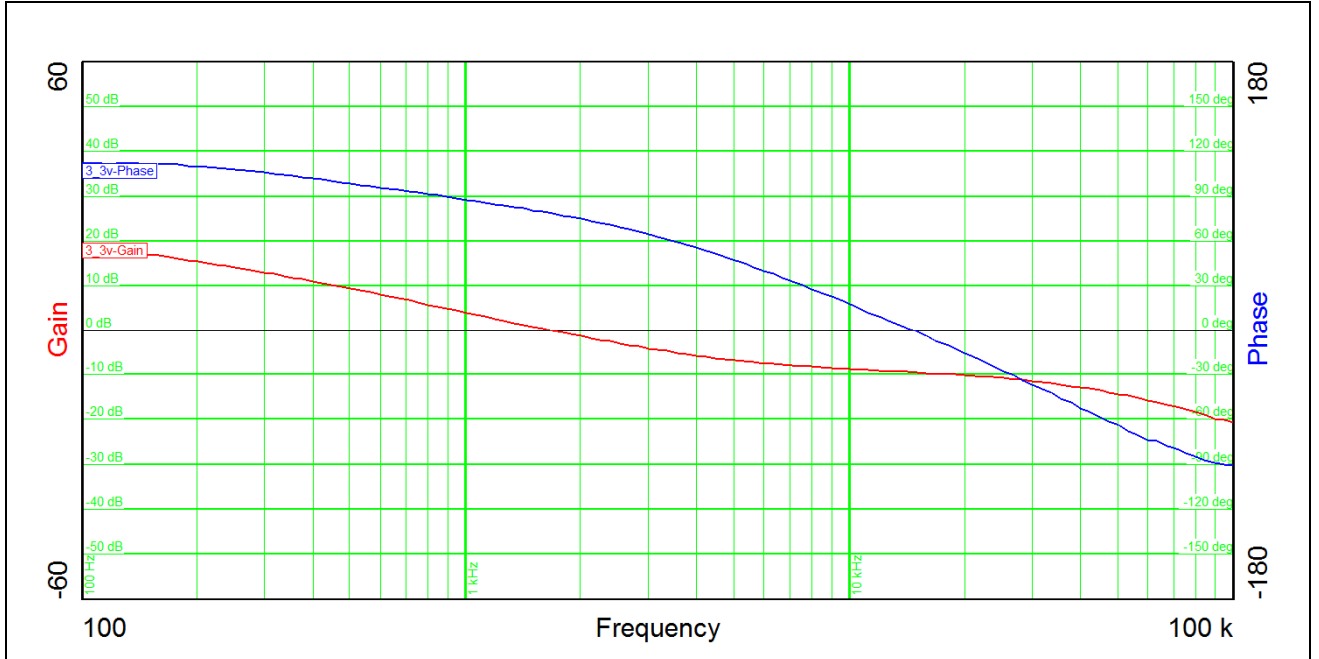


Figure 17

Figure 18 shows the loop response for 6V. Load is 2A.

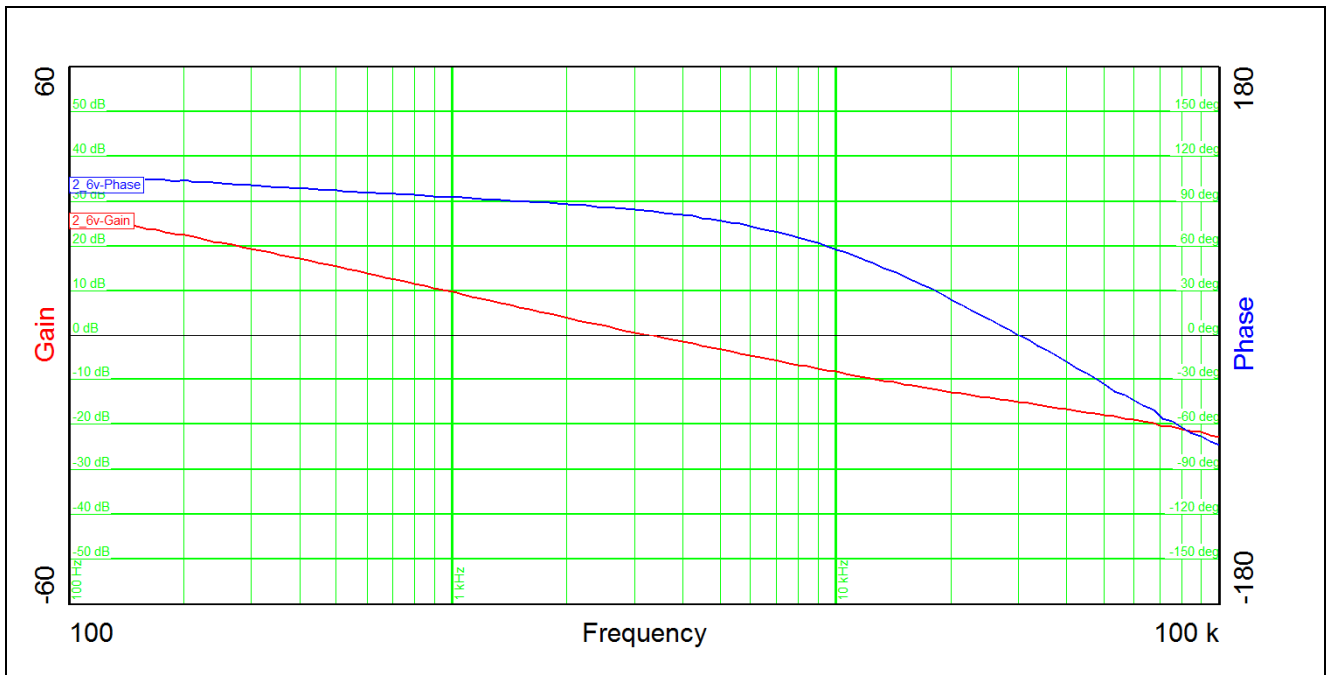


Figure 18

Figure 19 shows the loop response for 12V. Load is 2A.

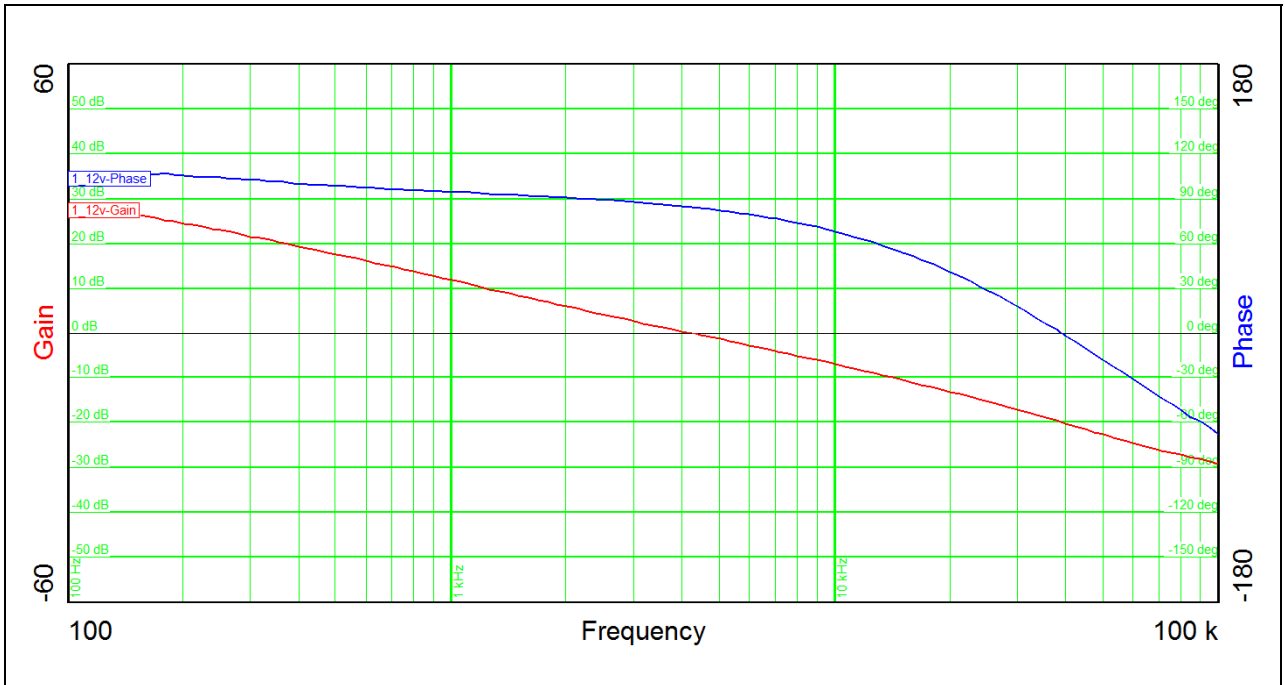


Figure 19

Table 1 summarizes the results of the above measurements

Vin	3V	6V	12V
Bandwidth (kHz)	1.67	3.27	4.26
Phase margin	78.6°	83.4°	84.5°
slope (20dB/decade)	-0.88	-0.89	-0.94
gain margin (dB)	-9.5	-15	-20
slope (20dB/decade)	-0.17	-0.65	-1.3
freq (kHz)	14.7	30.1	39.2

Table 1

10 Miscellaneous Waveforms

10.1 Switch Node (Drain-ground)

The waveform of the voltage on switchnode is shown in Figure 20. Input voltage was set to 3V and output current to 2A.

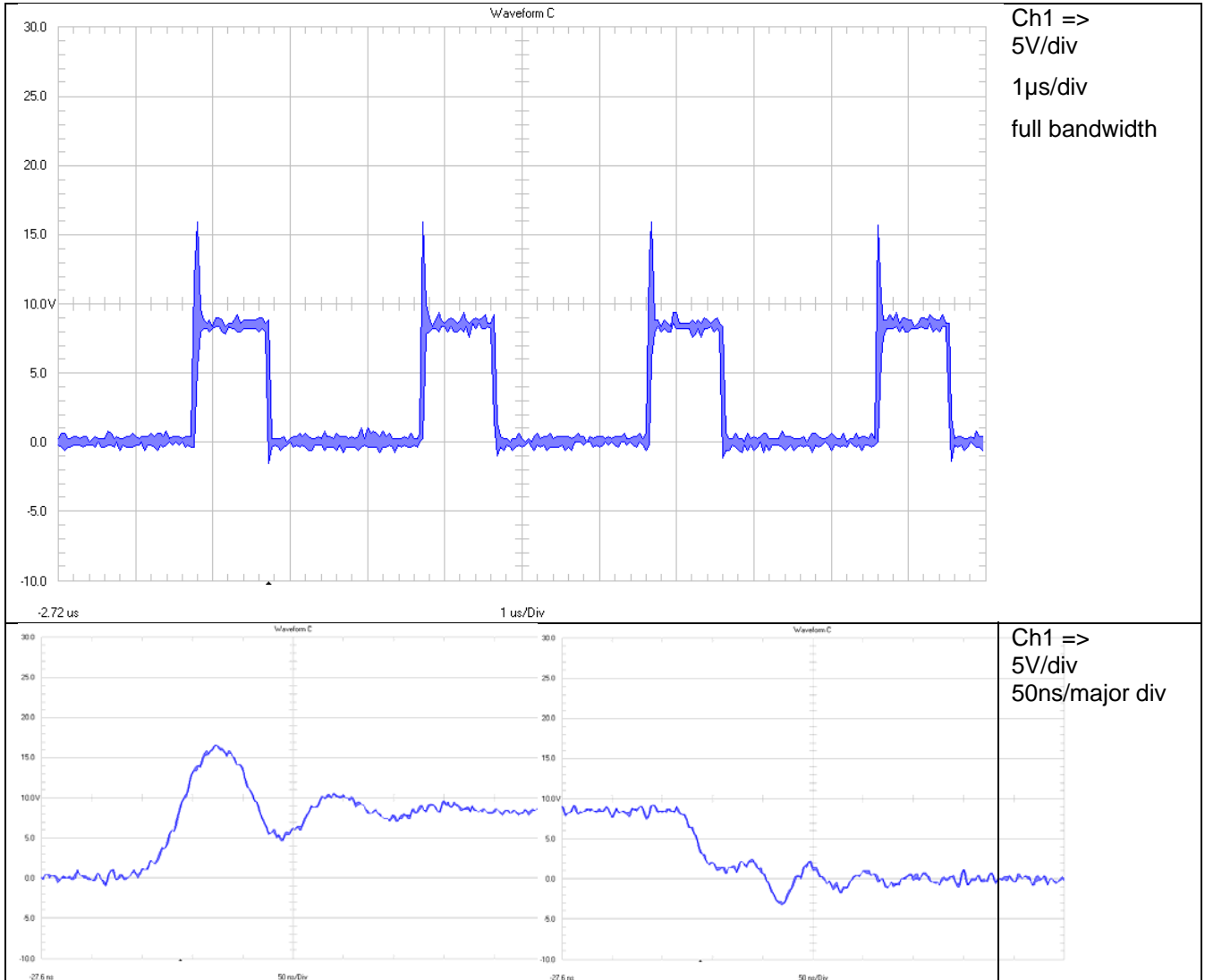


Figure 20

The waveform of the voltage on the switchnode is shown in Figure 21. Input voltage was set to 6V and output current to 2A.

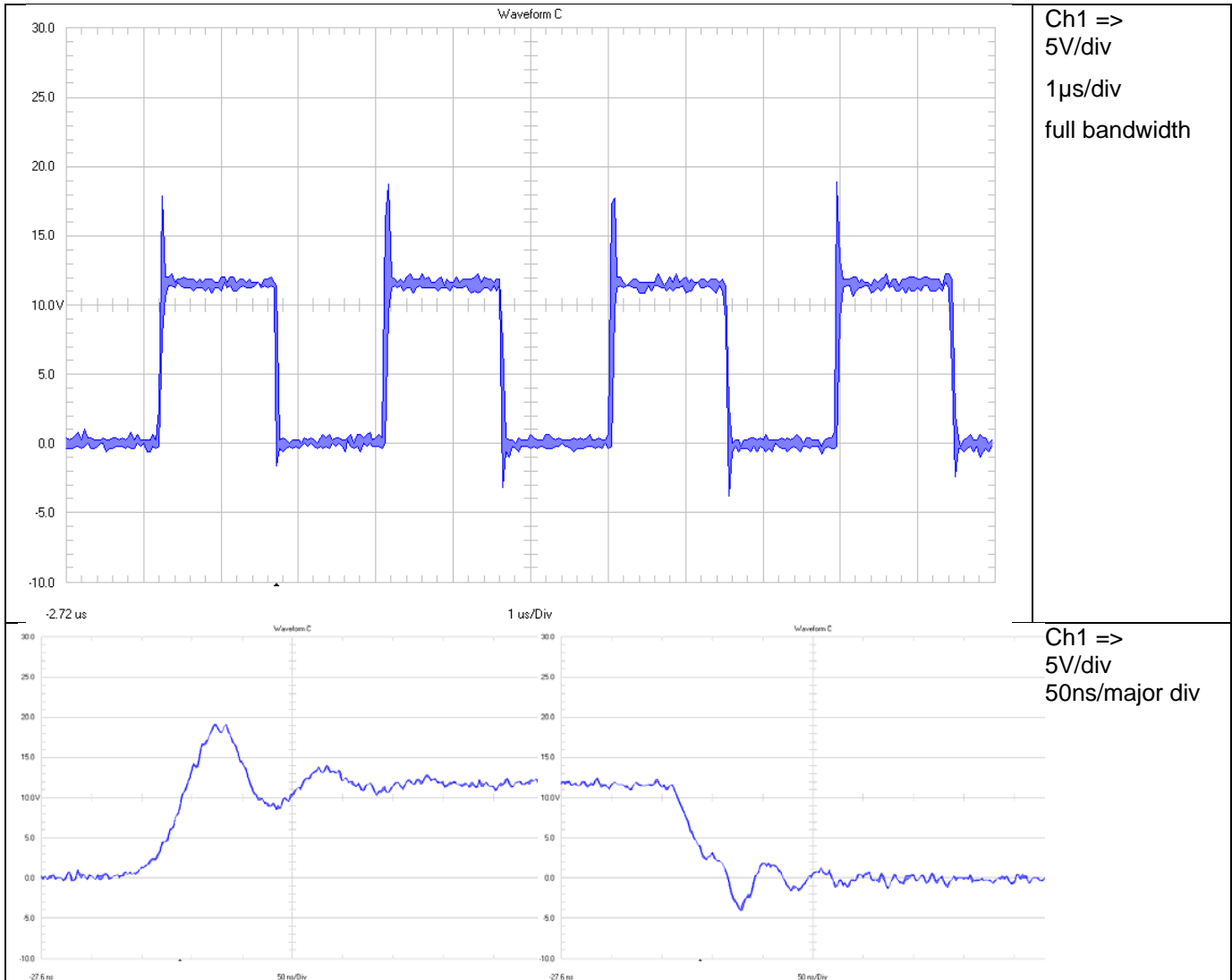


Figure 21

The waveform of the voltage on switchnode is shown in Figure 22. Input voltage was set to 12V and output current to 2A.

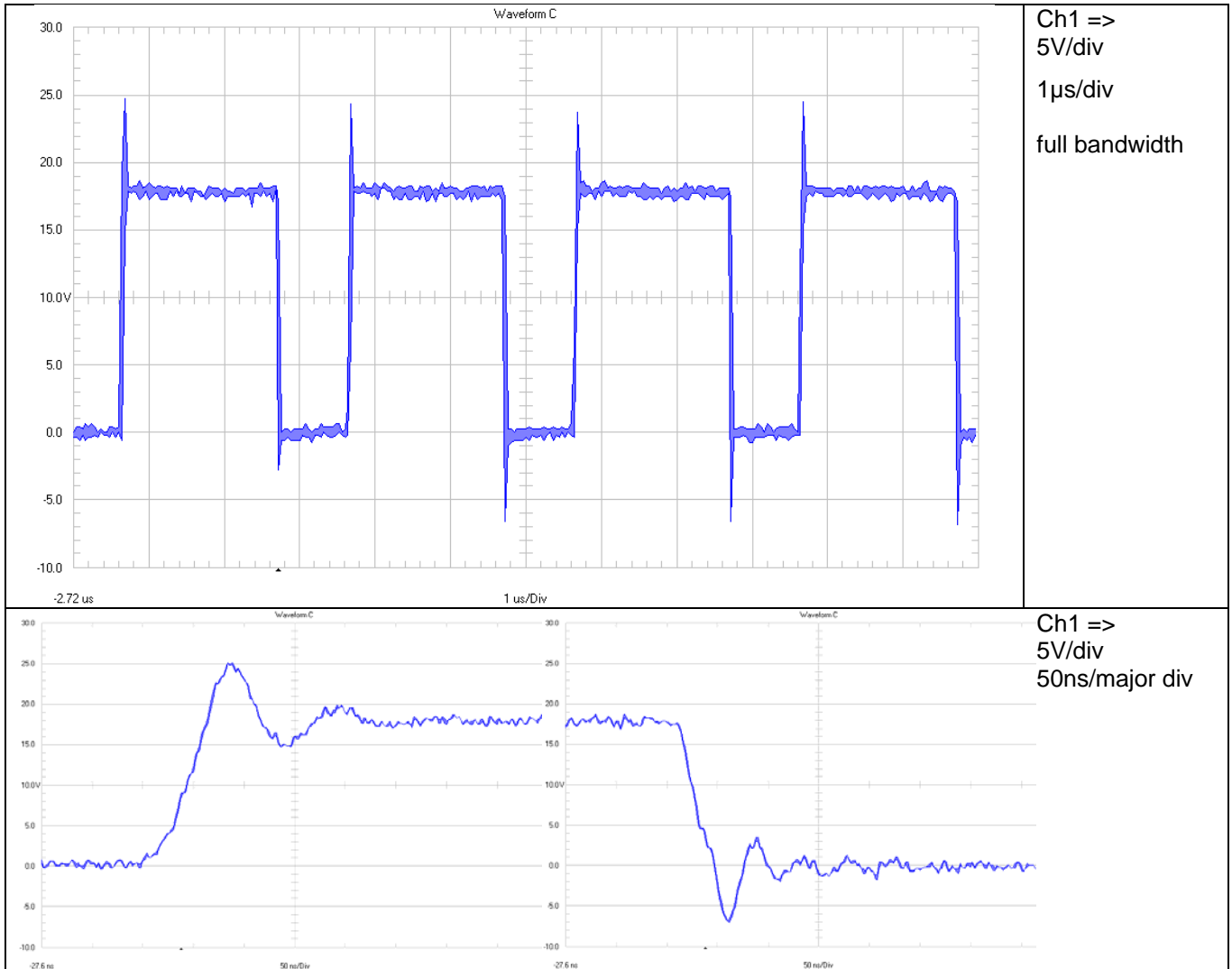


Figure 22

10.2 Gate – Ground

The waveform of the voltage on gate to ground is shown in Figure 23. Input voltage was set to 3V and output current to 2A.

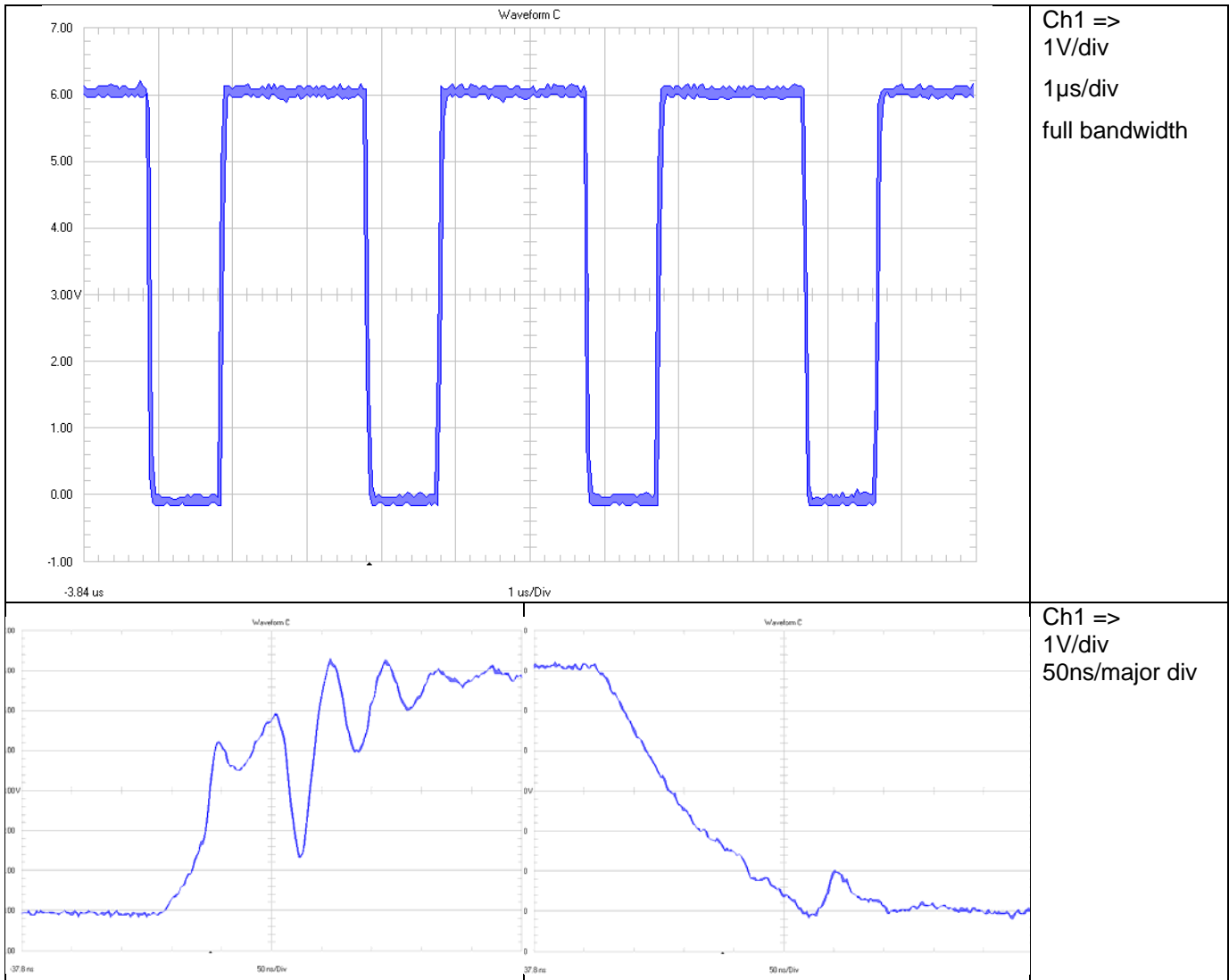


Figure 23

The waveform of the voltage on gate to ground is shown in Figure 24. Input voltage was set to 6V and output current to 2A.

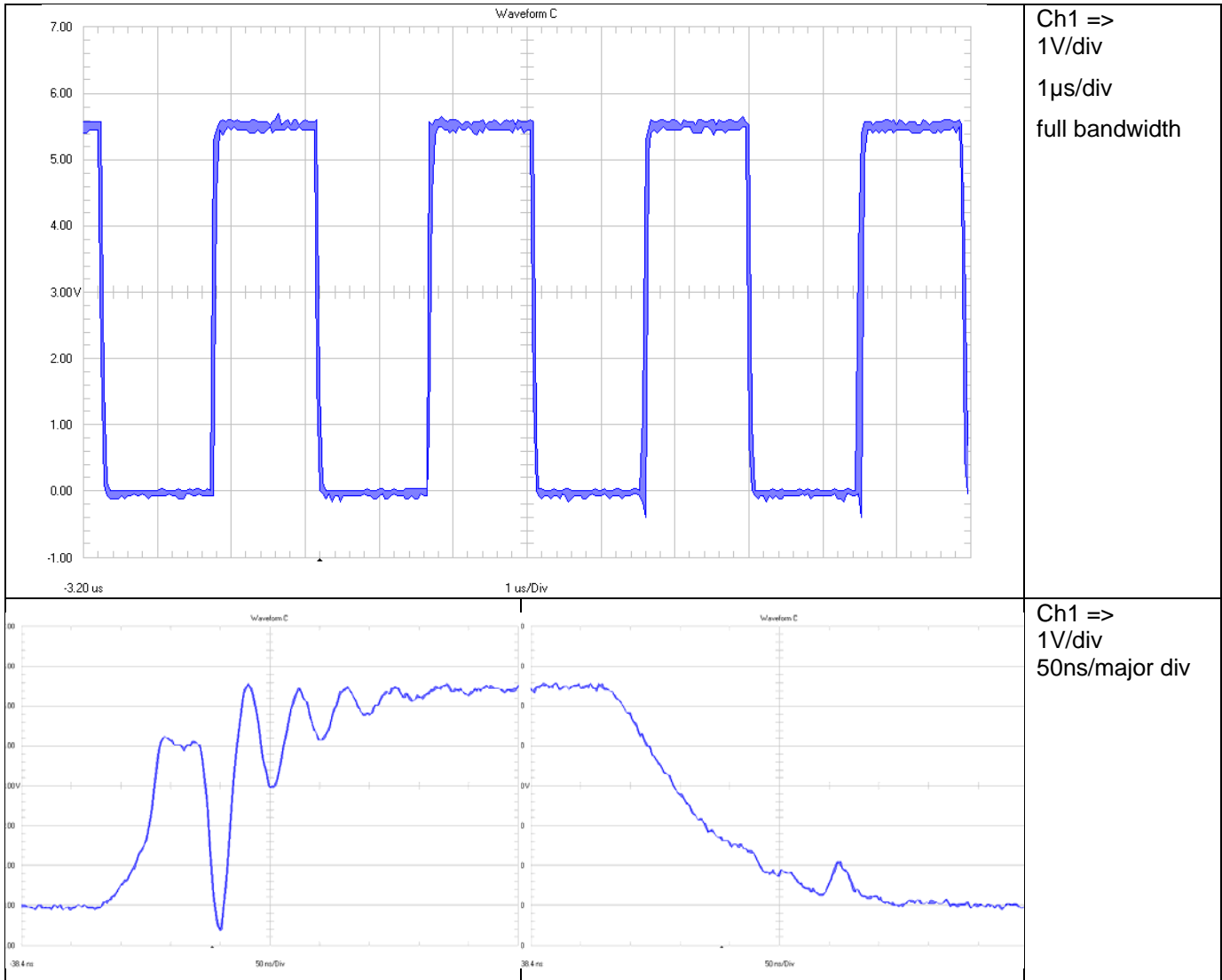


Figure 24

The waveform of the voltage on gate to ground is shown in Figure 25. Input voltage was set to 12V and output current to 2A.

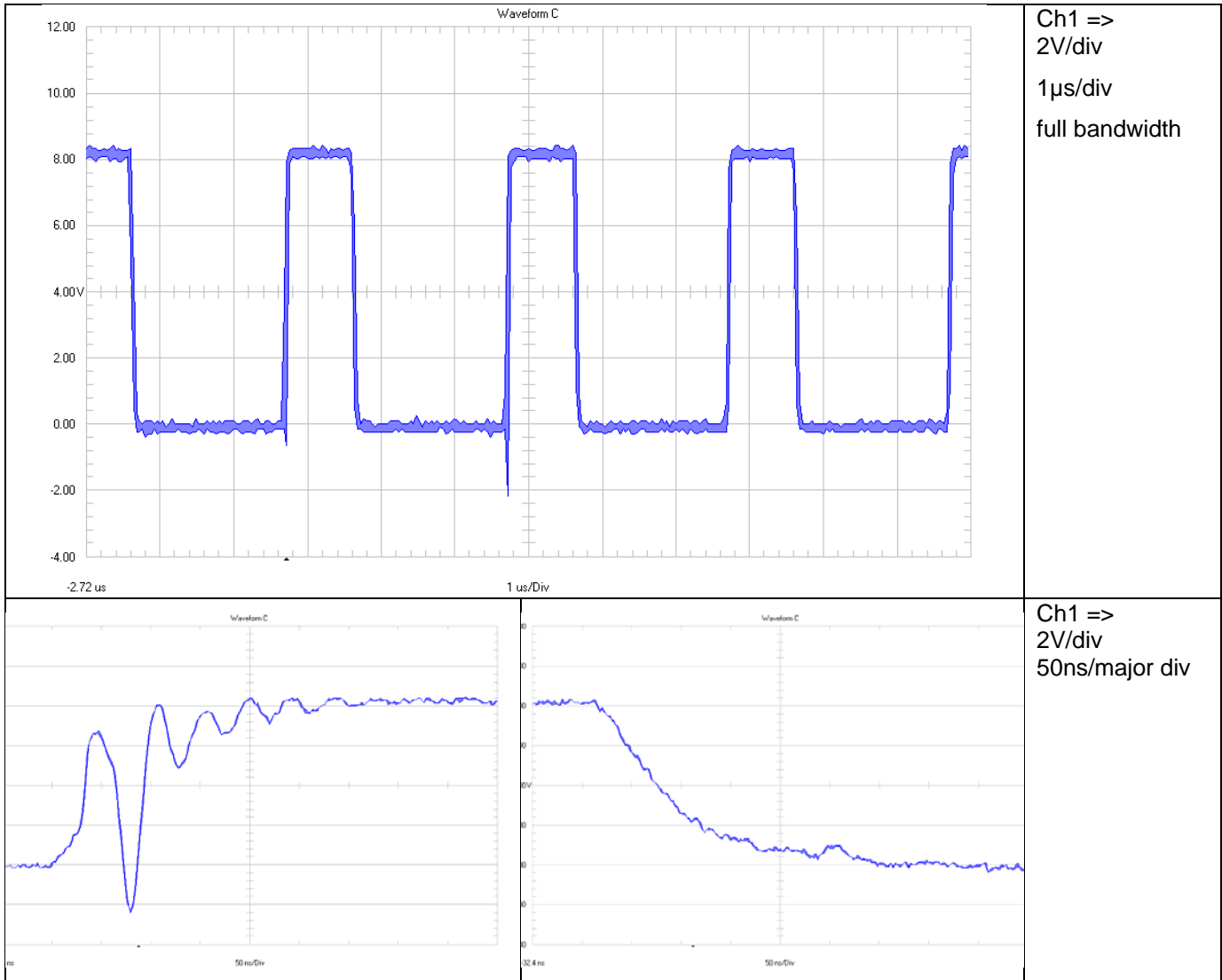


Figure 25

10.3 Voltage D1 (referenced to VOUT)

The waveform of the voltage is shown in Figure 26. Input voltage was set to 3V and output current to 2A.

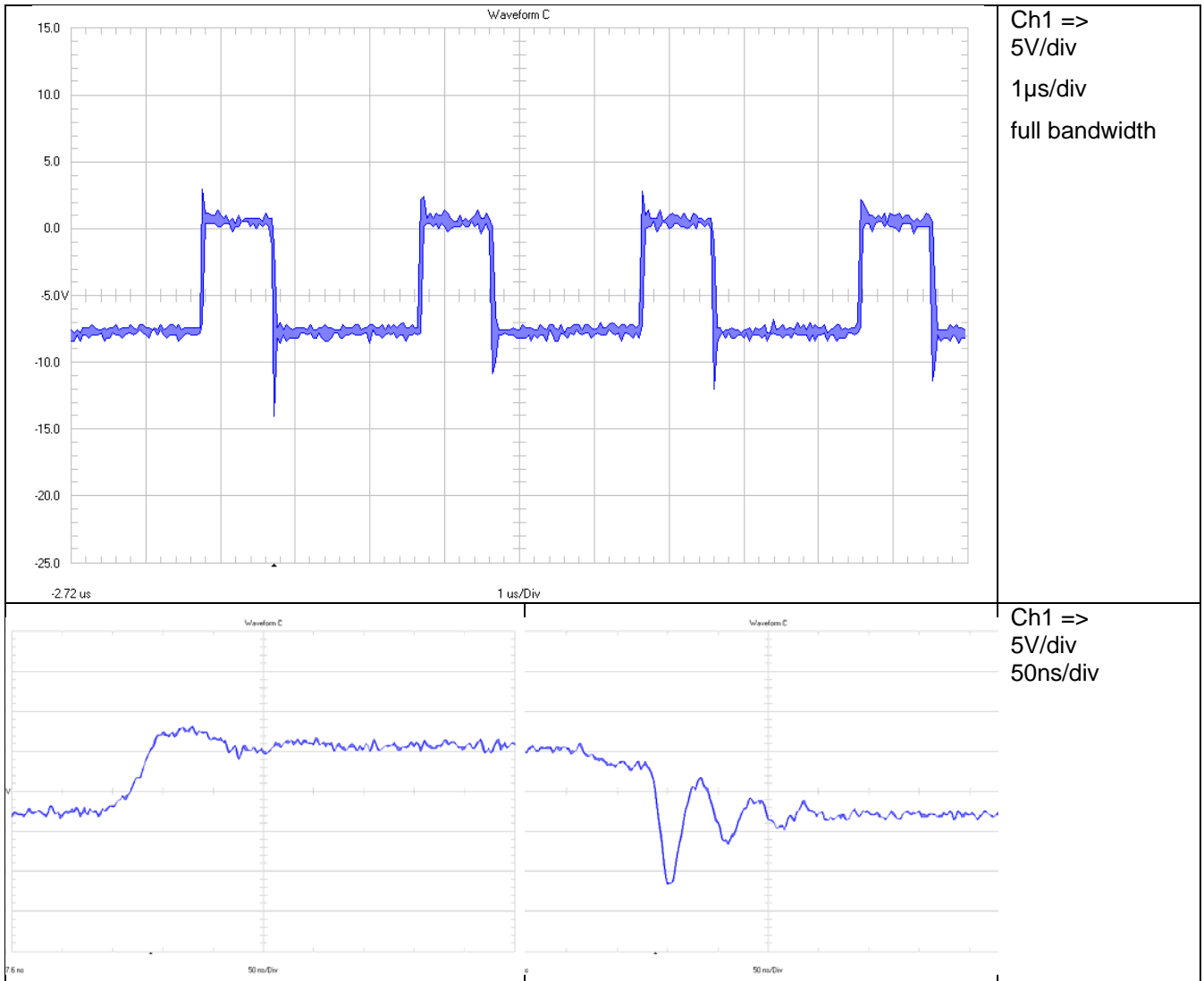


Figure 26

The waveform of the voltage is shown in Figure 27. Input voltage was set to 6V and output current to 2A.

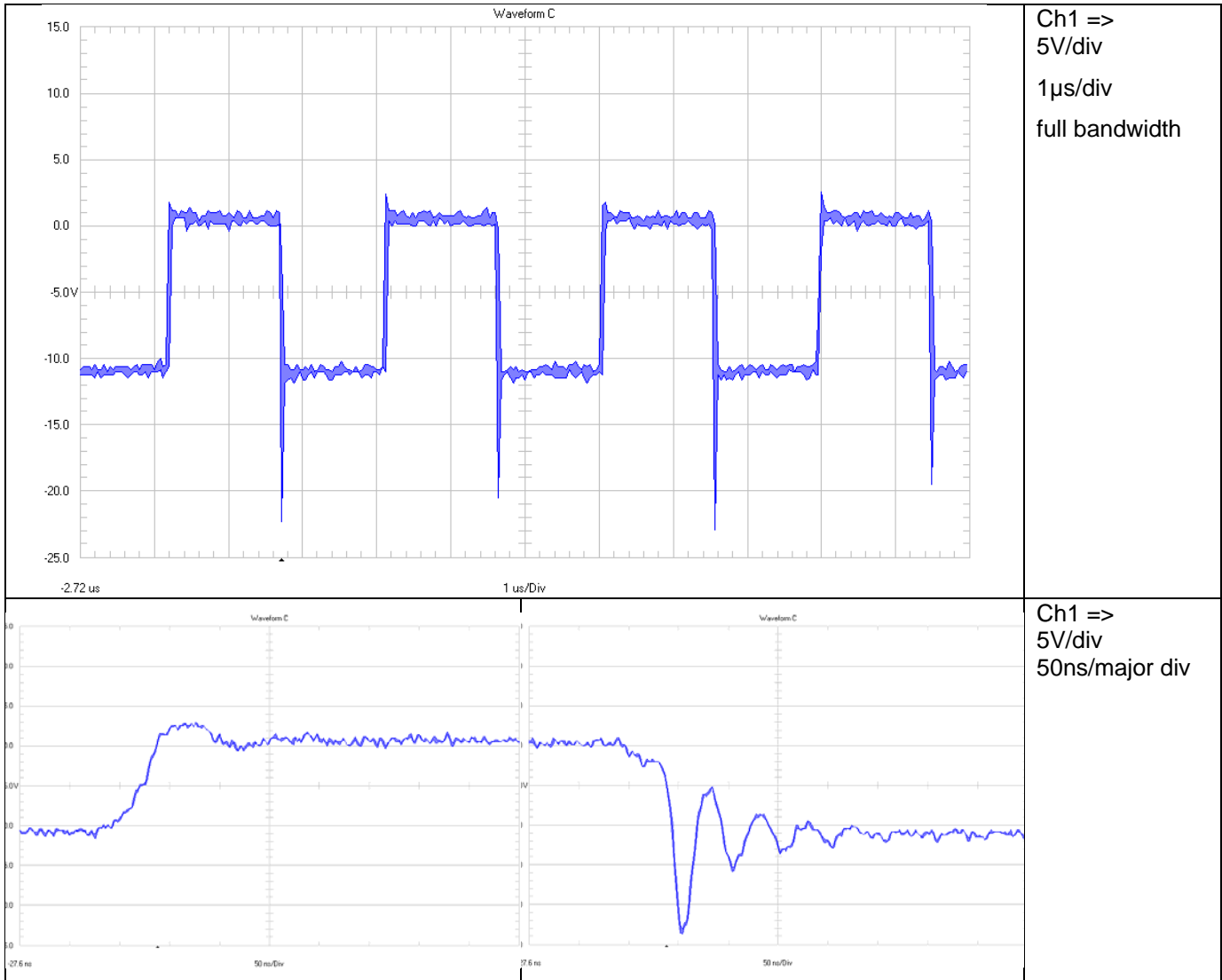


Figure 27

The waveform of the voltage is shown in Figure 28. Input voltage was set to 12V and output current to 2A.

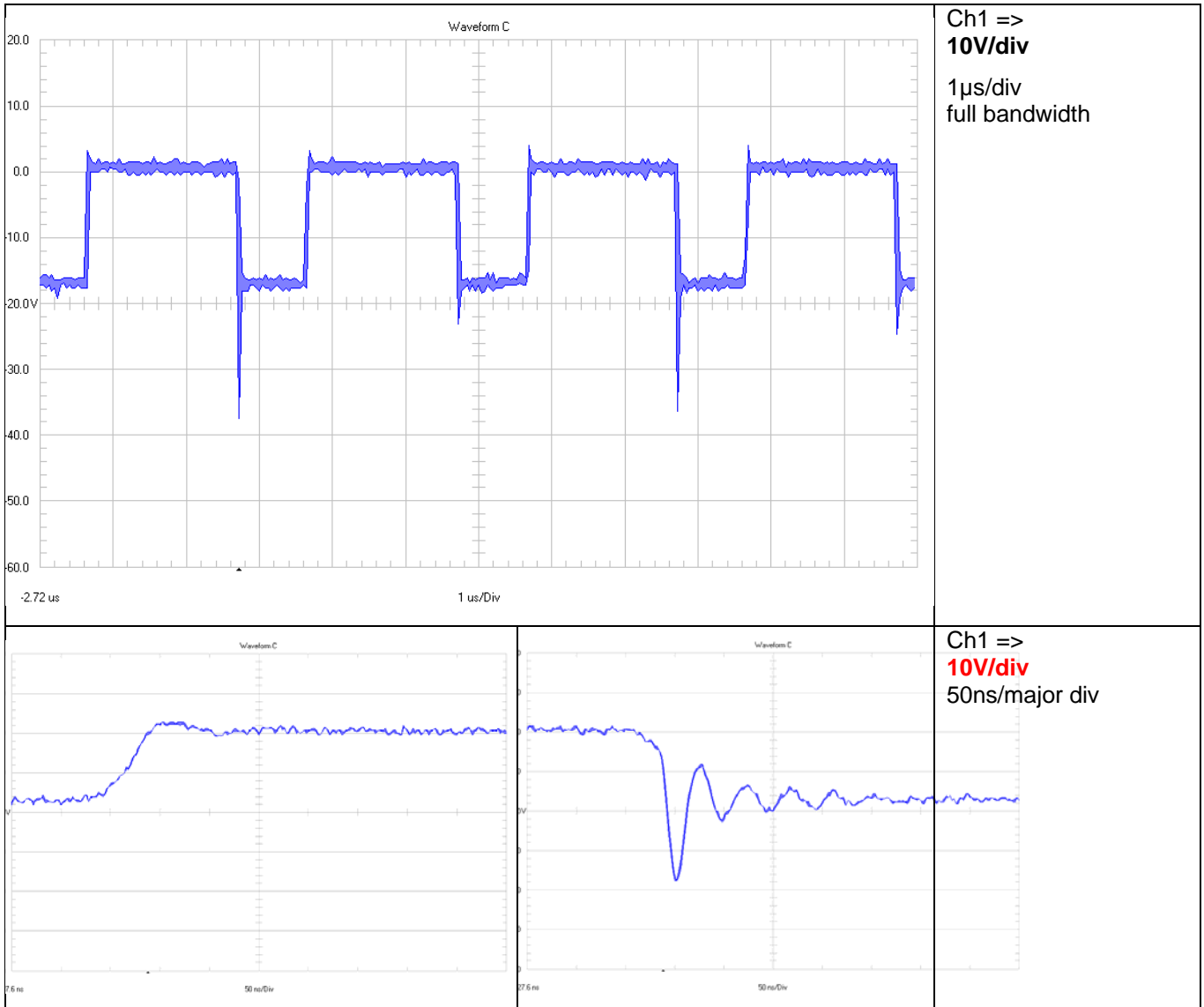


Figure 28

This design is built on an universal board for boost/sepic/flyback; layout is not the optimum; at your design check reverse voltage at Schottky rectifier – sloppy layout might need a 40V Schottky rectifier or a small snubber 100pF/100 Ohms across the rectifier itself.

11 Thermal Image

Figure 29 shows the thermal image at 3V input voltage and 2A output current (electronic load)

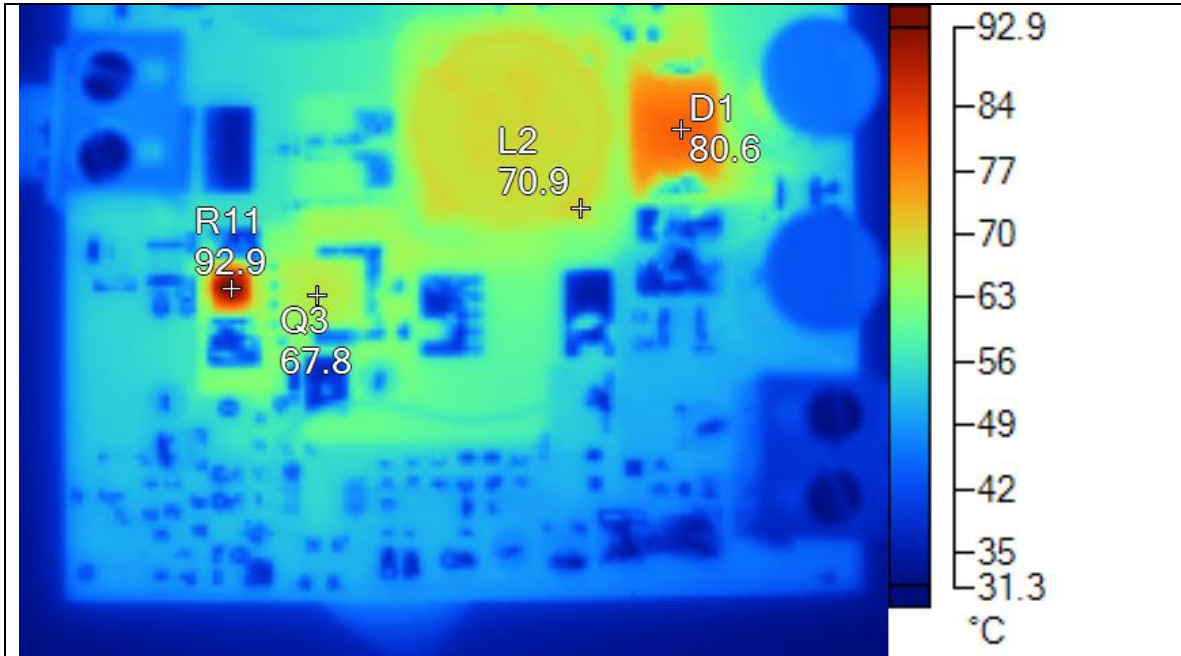


Figure 29

Name	Temperature
R11	92.9°C
D1	80.6°C
L2	70.9°C
Q3	67.8°C

Figure 30 shows the thermal image at 6V input voltage and 2A output current (electronic load)

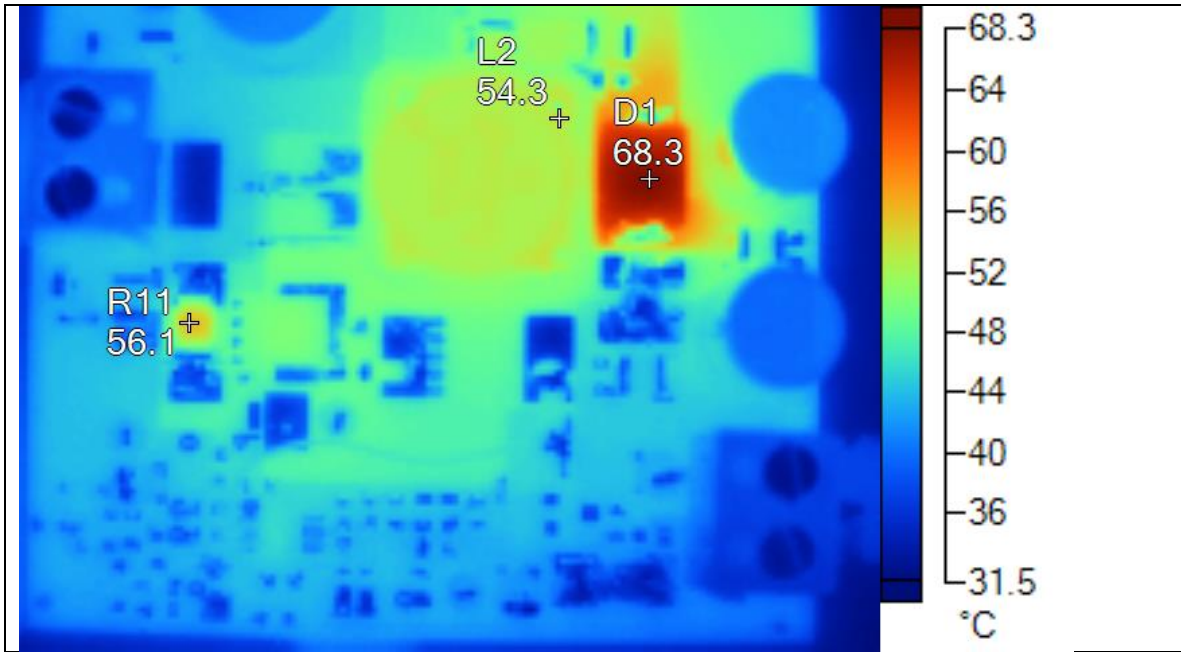


Figure 30

Name	Temperature
D1	68.3°C
R11	56.1°C
L2	54.3°C

Figure 31 shows the thermal image at 12V input voltage and 2A output current (electronic load)

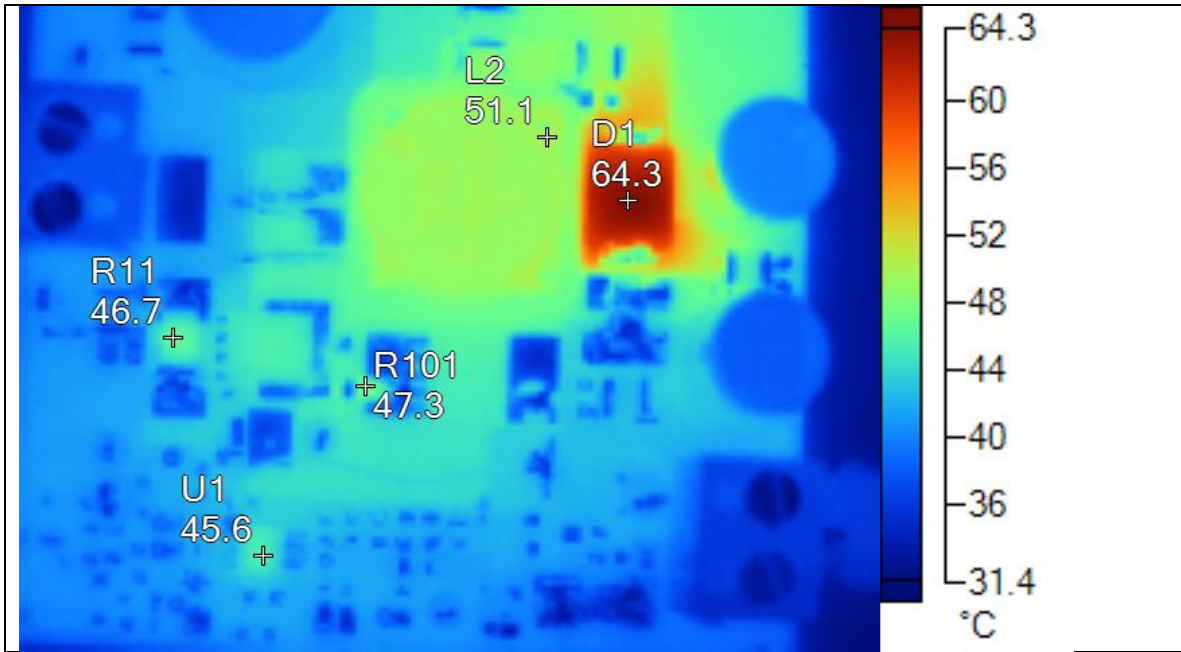


Figure 31

Name	Temperature
D1	64.3°C
R11	46.7°C
L2	51.1°C
U1	45.6°C
R101	47.3°C

12 Snubber Evaluation

Figure 31 shows the switchnode waveform without snubber. The ringing is around 84 MHz.

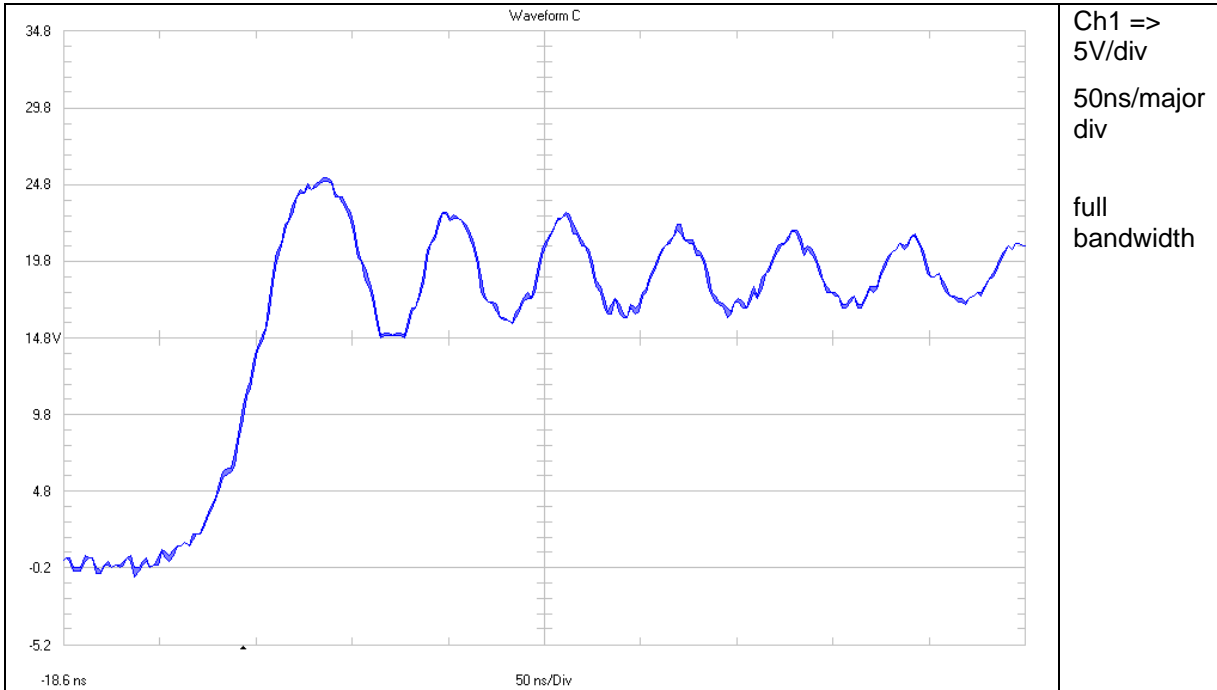


Figure 32

Figure 33 shows the switchnode waveform with 470pF. The ringing is around 57MHz.

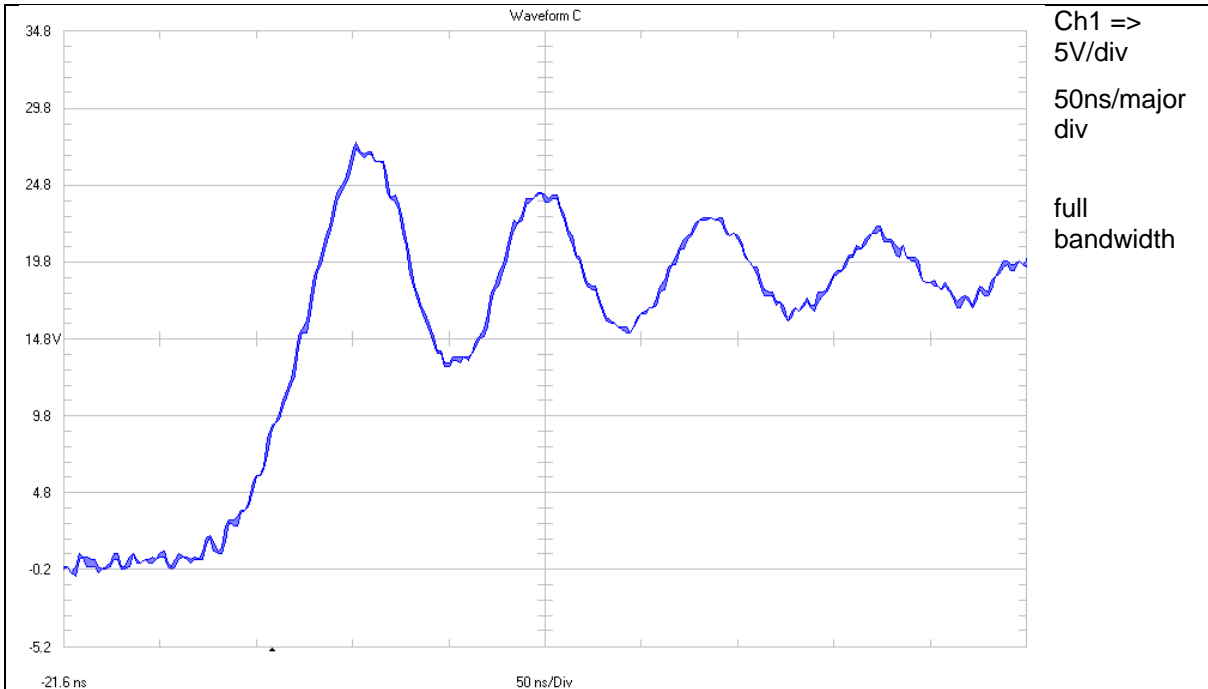


Figure 33

Figure 34 shows the switchnode waveform with 820pF. The ringing is about 46MHz.

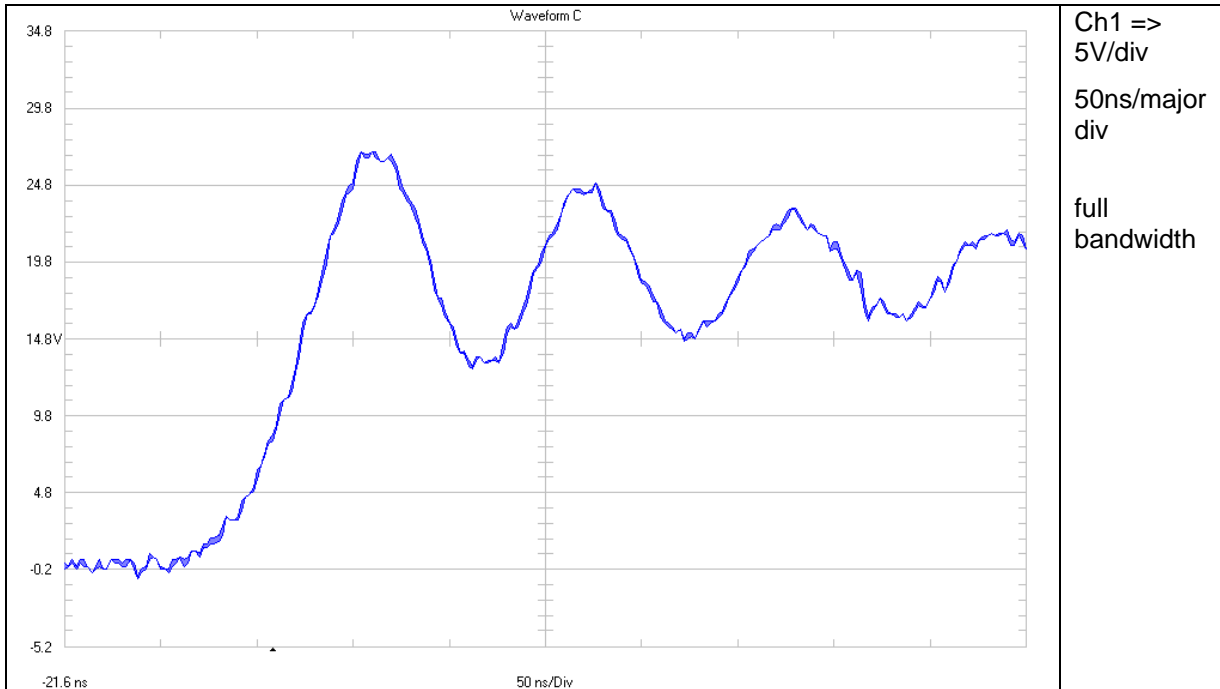


Figure 34

Figure 35 shows the switchnode waveform with 820pF and 3.3Ohms. The ringing is about 64MHz.

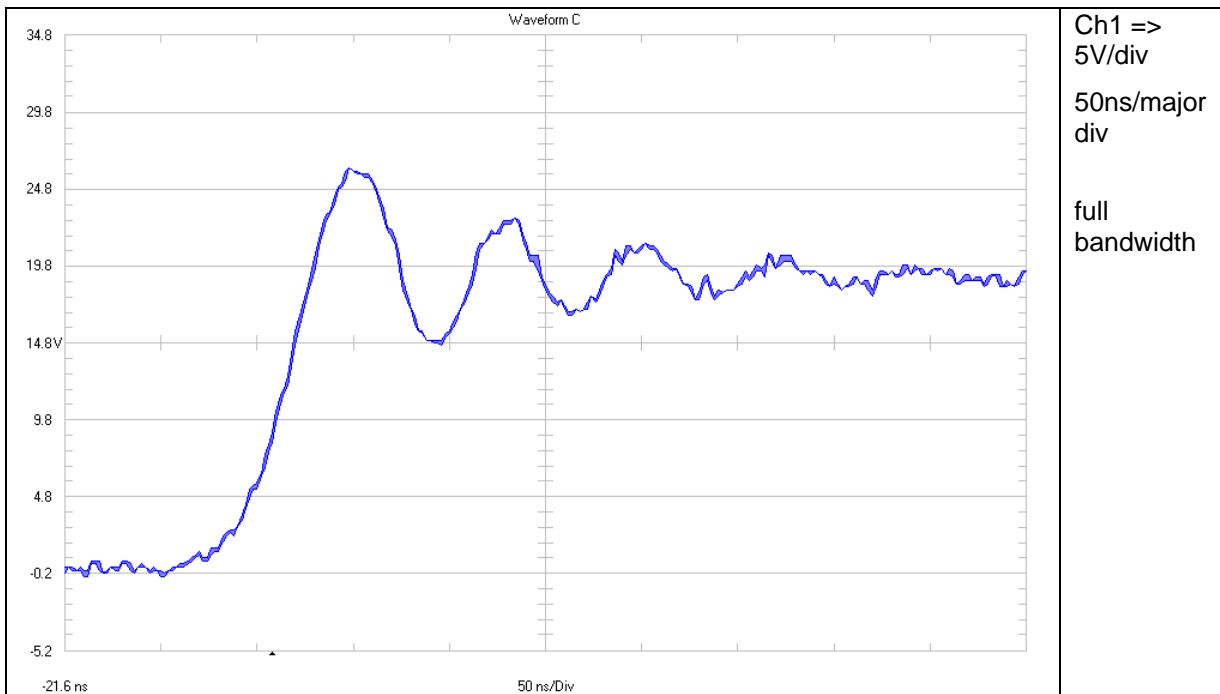


Figure 35

Figure 36 shows the switchnode waveform with 820pF and 2.2Ohms.

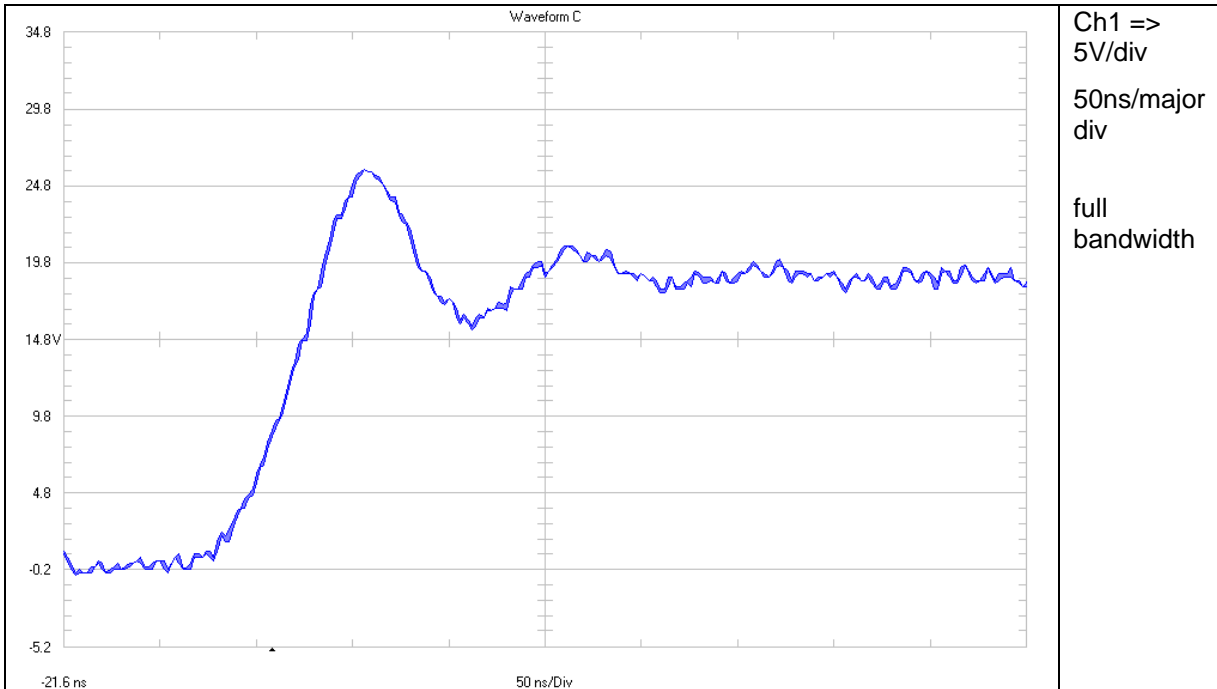


Figure 36

Figure 37 shows the switchnode waveform with 820pF and 1.5Ohms.

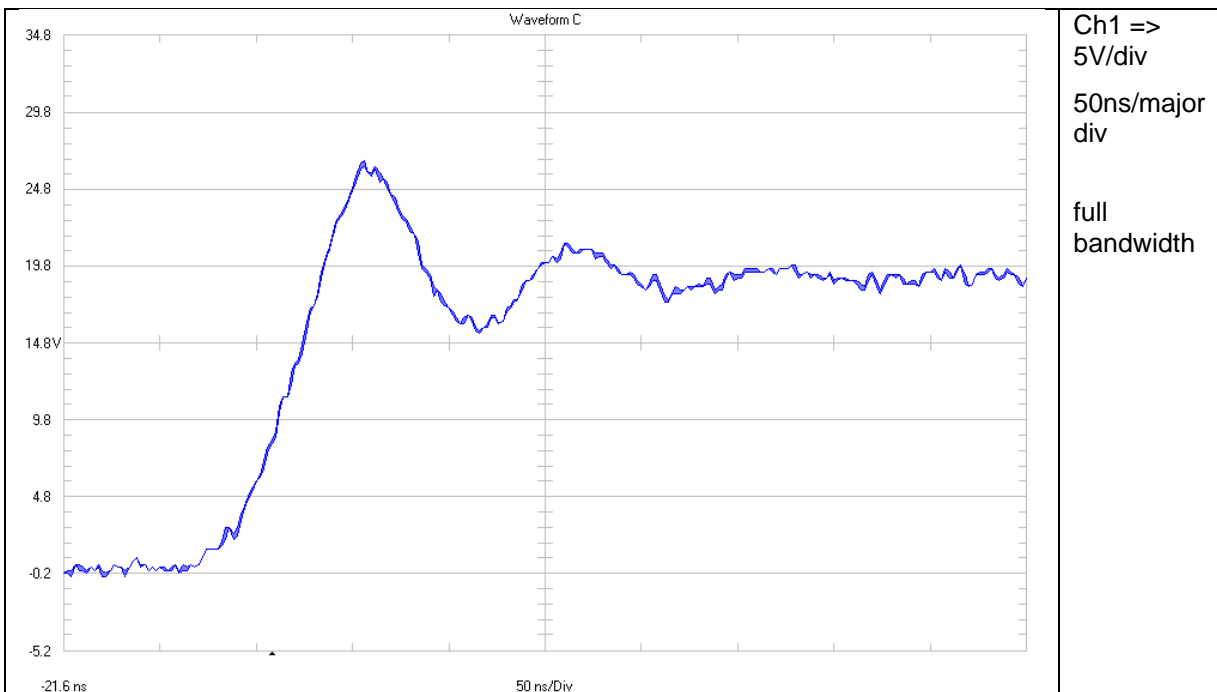


Figure 37

2.2Ohms is used in the circuit

13 Influence of the Pre Gate Resistor

Figure 38 is a comparison of the output voltage with 10R and 2.21R pre gate resistor

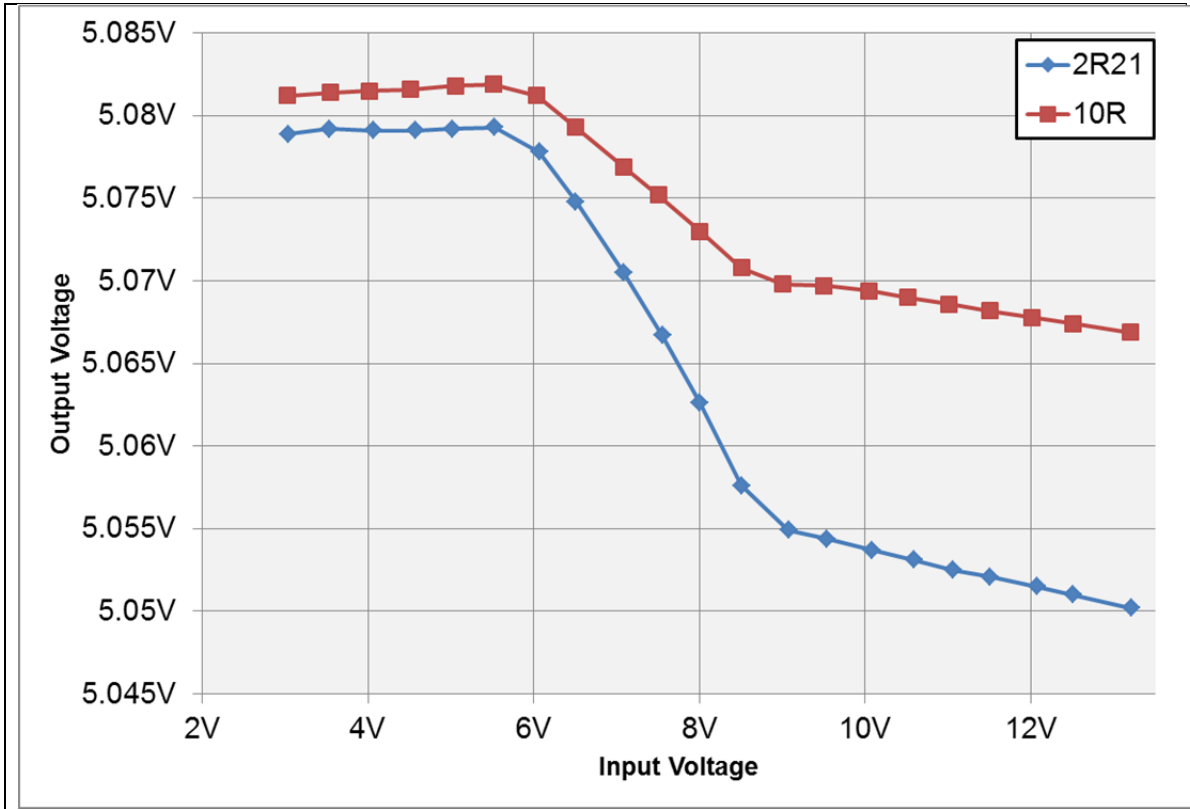


Figure 38

Figure 39 shows the waveforms of the gate-ground signal at 12 V input voltage

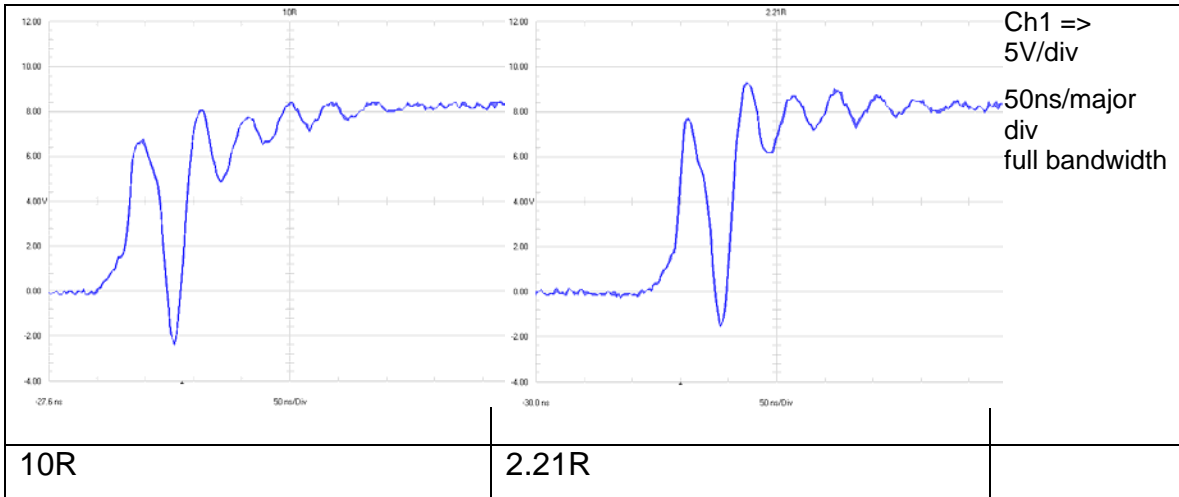


Figure 39

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (<https://www.ti.com/legal/termsofsale.html>) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2021, Texas Instruments Incorporated