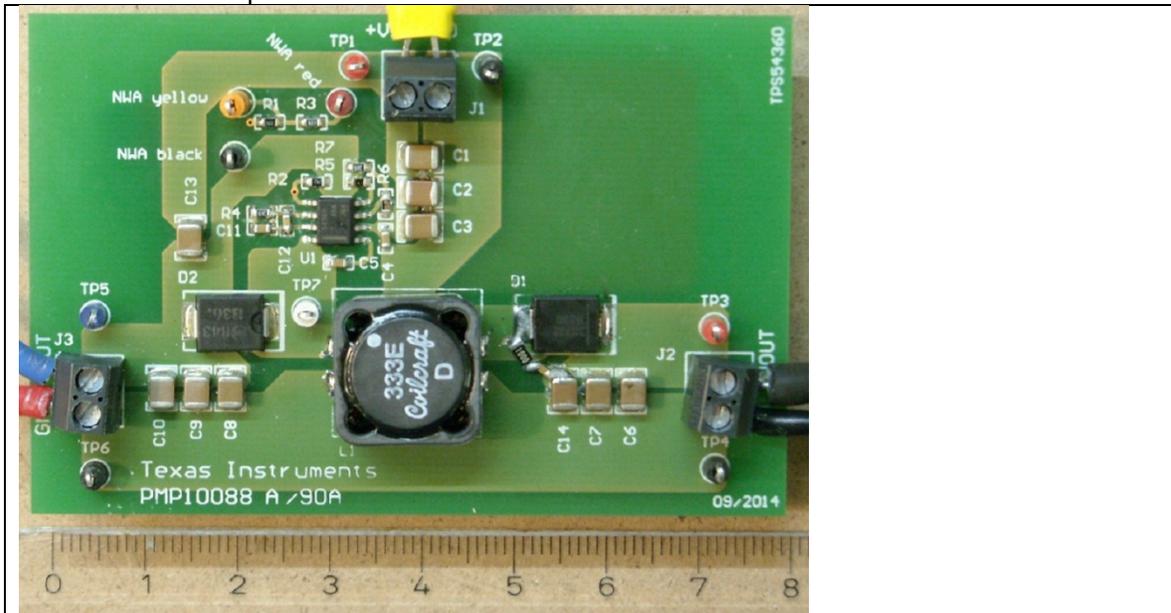


# PMP10088RevB Test Results

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Topology: Dual Inverting Buck-Boost (negative and positive output on second winding).  
Device: TPS54360

Unless otherwise mentioned all measurements were done with 24V input voltage and 0.7A output current on each output



## 1 Startup

The startup waveform is shown in the Figure 1. The input voltage was set at 24V, with 0.7A load at the output on each output. Power supply was connected.

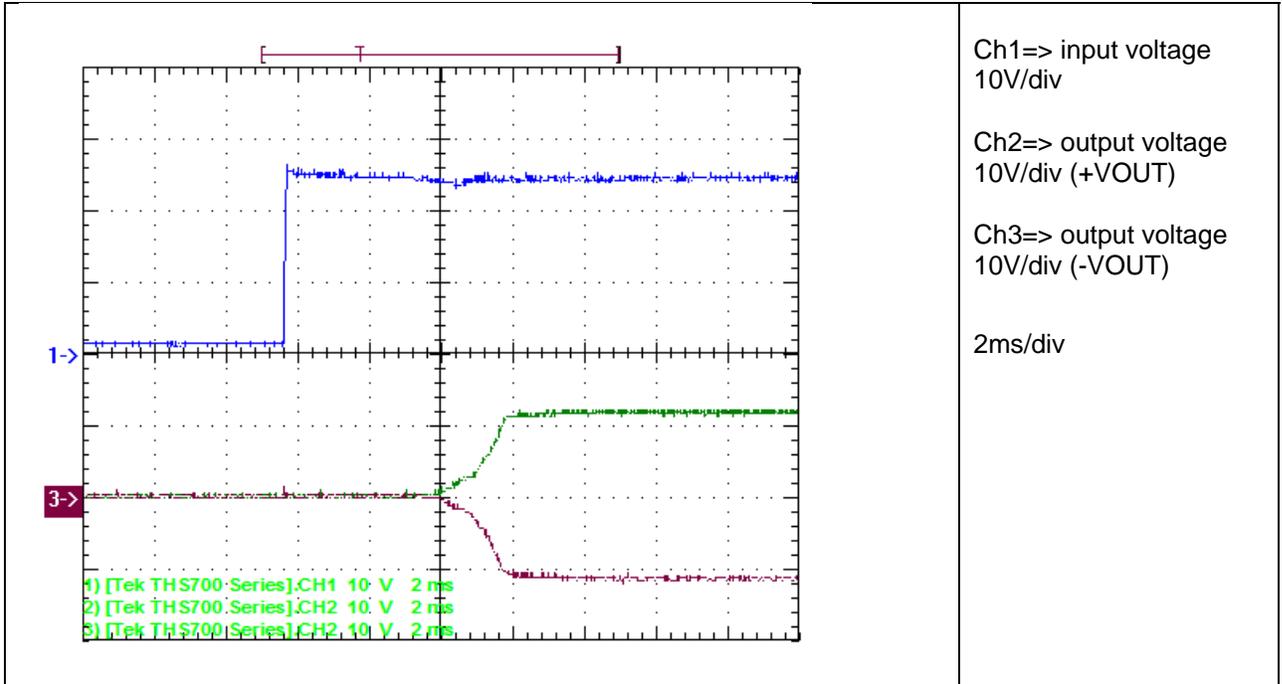


Figure 1

## 2 Shutdown

The shutdown waveform is shown in the Figure 2. The input voltage was set at 24V, with 0.7A load on each output. Power supply was disconnected.

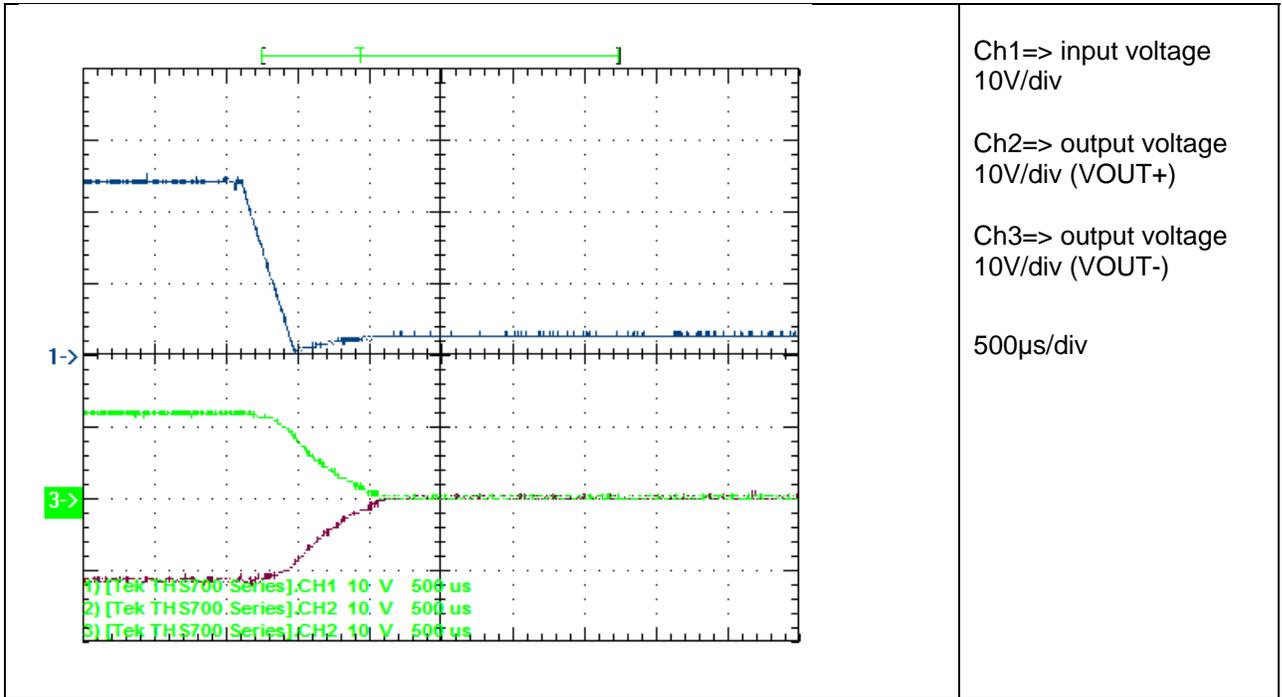


Figure 2

### 3 Efficiency

The efficiency is shown in the Figure 3 below. The input voltage was set to 24V. The output currents were modified simultaneous (-IOUT = +IOUT). The discontinuity in the curve reflects the transition from discontinuous to continuous mode.

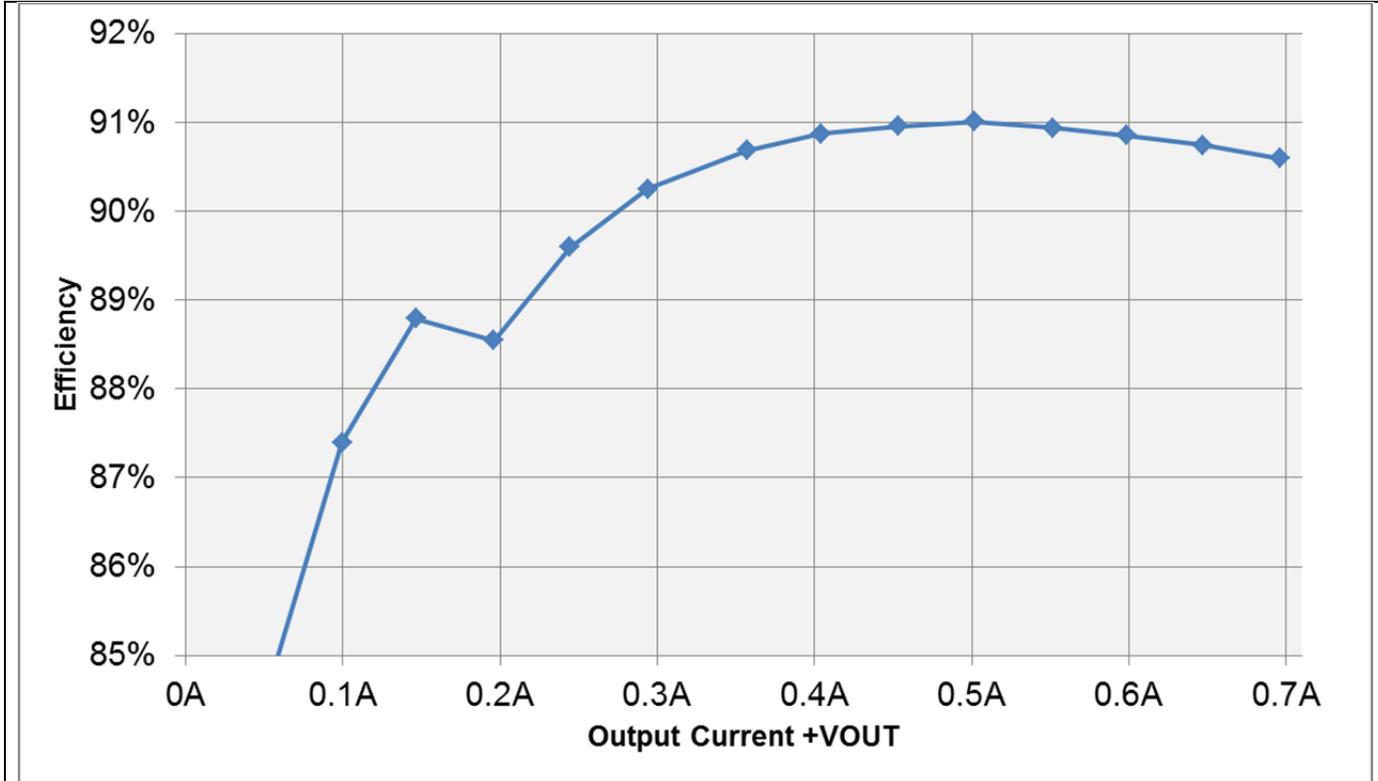


Figure 3

## 4 Load Regulation

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

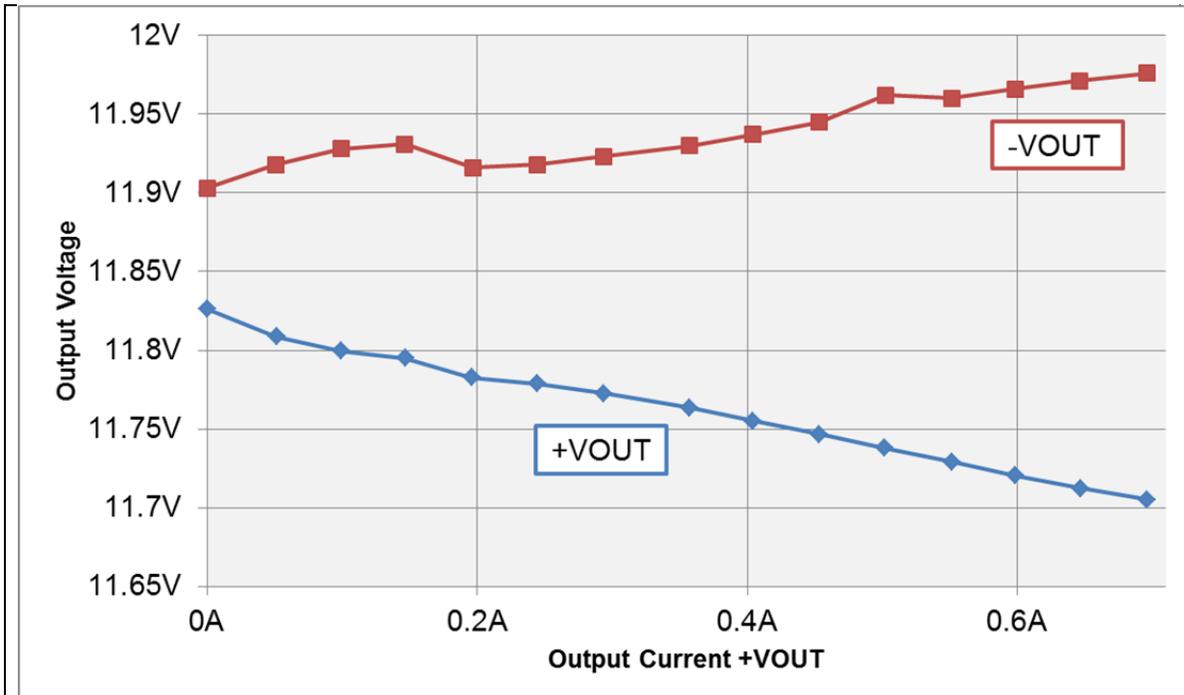


Figure 4

Deviation on load of negative rail <100mV, less than 1%  
Deviation of positive rail around 120mV, roughly 1%

## 5 Line Regulation

Line regulation at 0.7A output current is shown in Figure 5

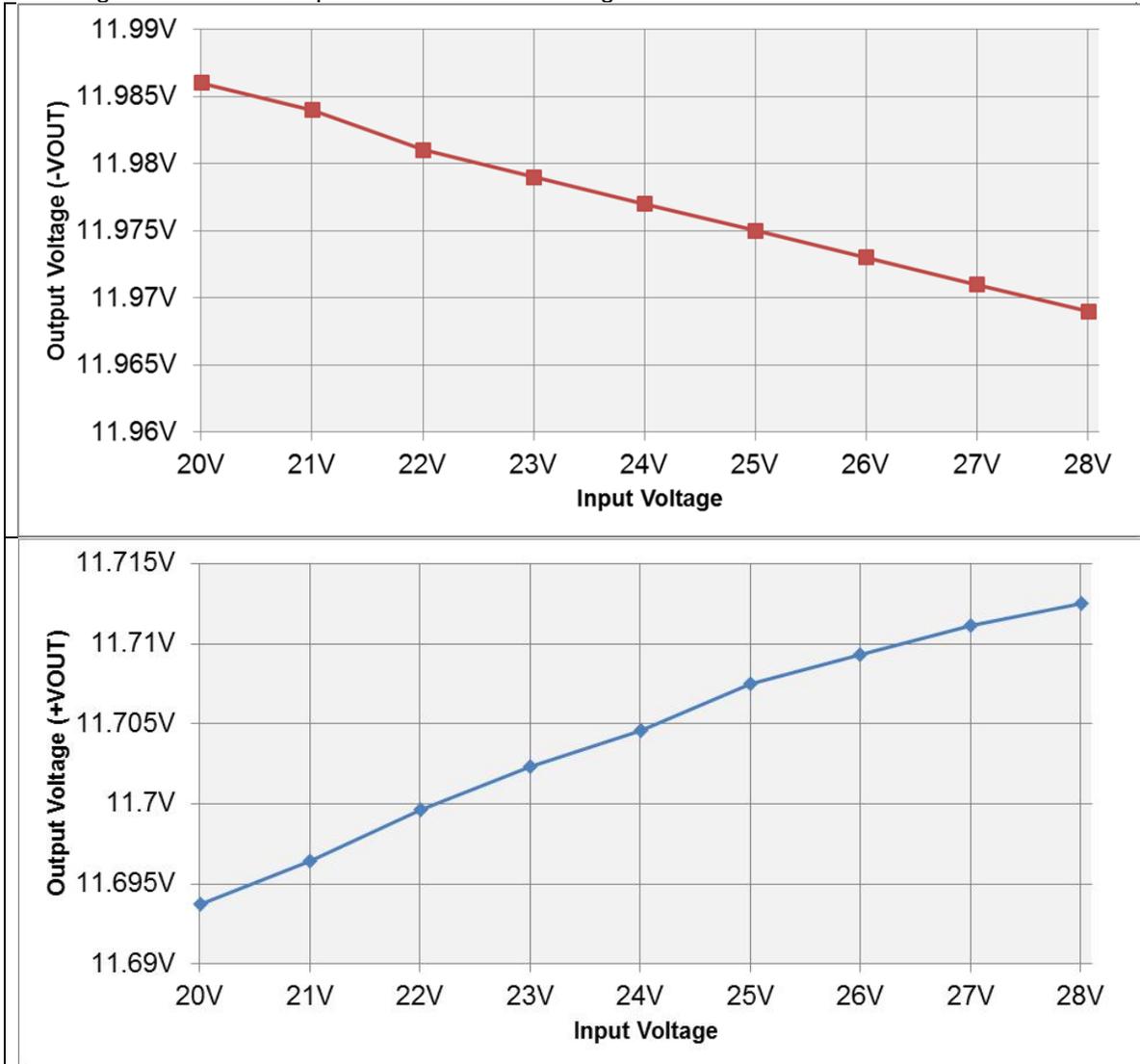
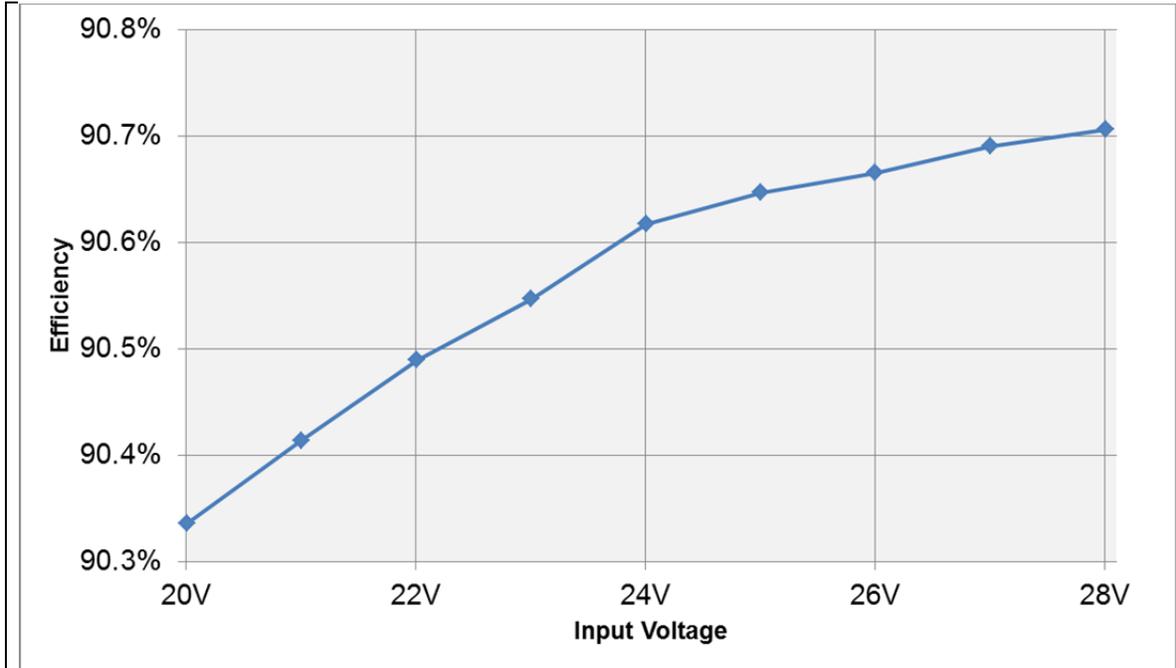


Figure 5

Deviation on input voltage is around 20mV, insignificant low.

With the same measurement the full load efficiencies across input voltage were calculated



**Figure 6**

Full load efficiency across input voltage range +90%.

## 6 Cross Regulation

The output currents were changed separately (0A, 0.2A, 0.4A, 0.7A)

Figure 7 shows the effects on the positive output voltage, if the negative output current is varied. The different curves represent the positive output current settings

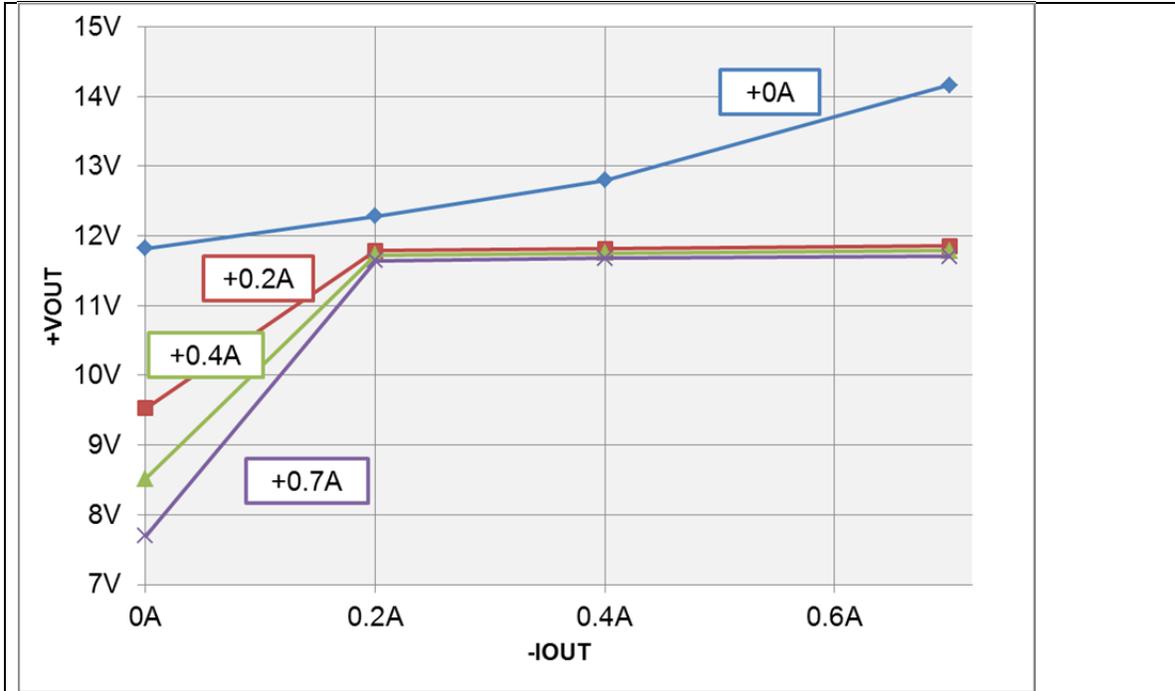


Figure 7

Figure 8 shows the effects on the negative output voltage, if the positive output current is varied. The different curves represent the negative output current settings.

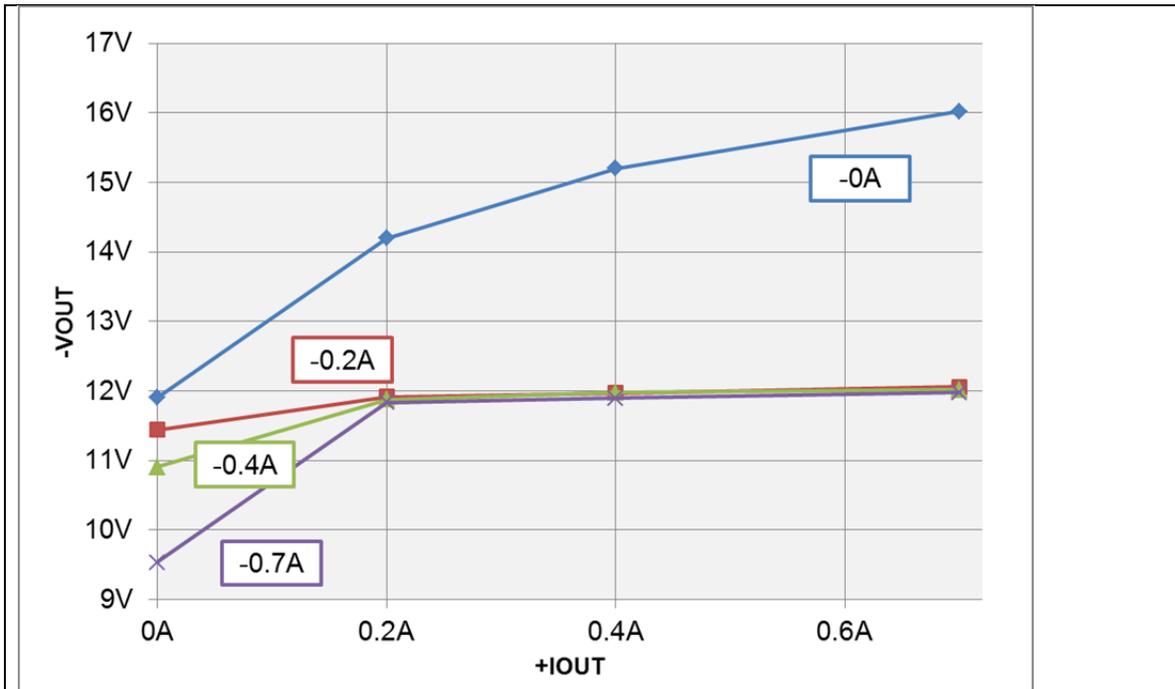


Figure 8

## 7 Ripple Voltage

### 7.1 Positive Output

The output ripple voltage is shown in Figure 9. The image was taken with a 0.7A and 24V at the input.

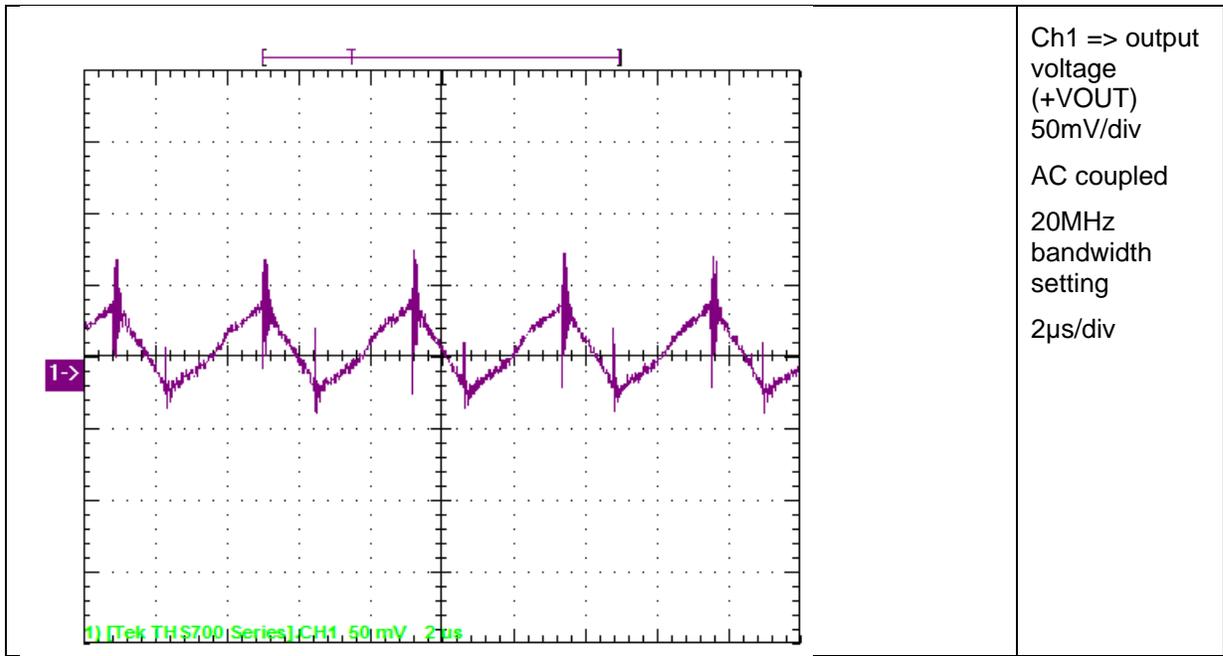


Figure 9

Output ripple around 100mVpp, so less than 1% of output voltage.

## 7.2 Negative Output

The negative output ripple voltage is shown in Figure 10. The image was taken with a 0.7A load 24V at the input.

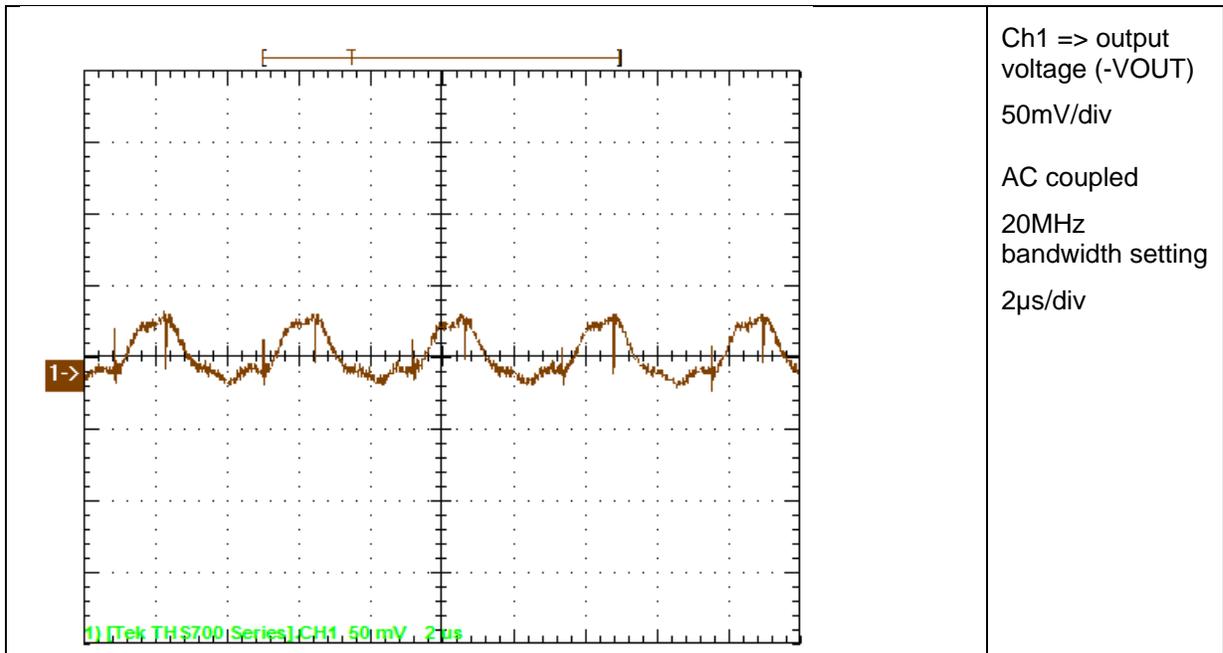


Figure 10

Output ripple around 50mVpp, so less than 1% of output voltage.

## 7.3 Input Voltage

The input ripple voltage is shown in Figure 11.

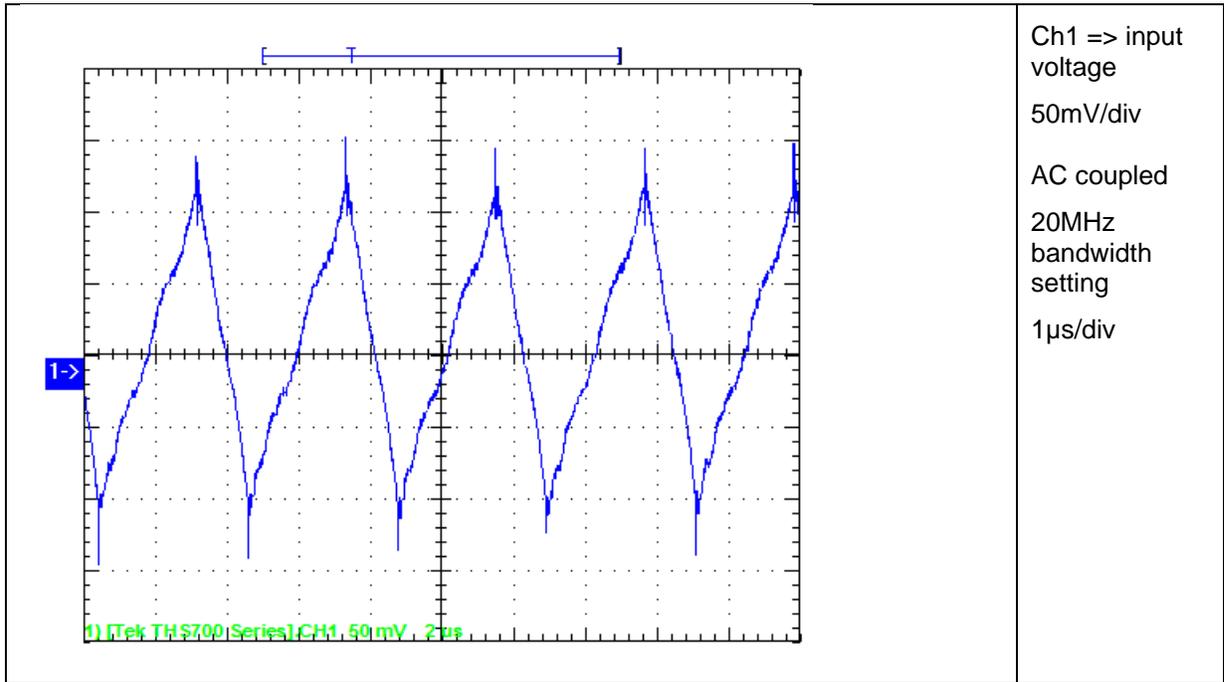


Figure 11

## 8 Control Loop Frequency Response

Figure 12 shows the loop response with 0.7A load and 20V,24V and 28V input.

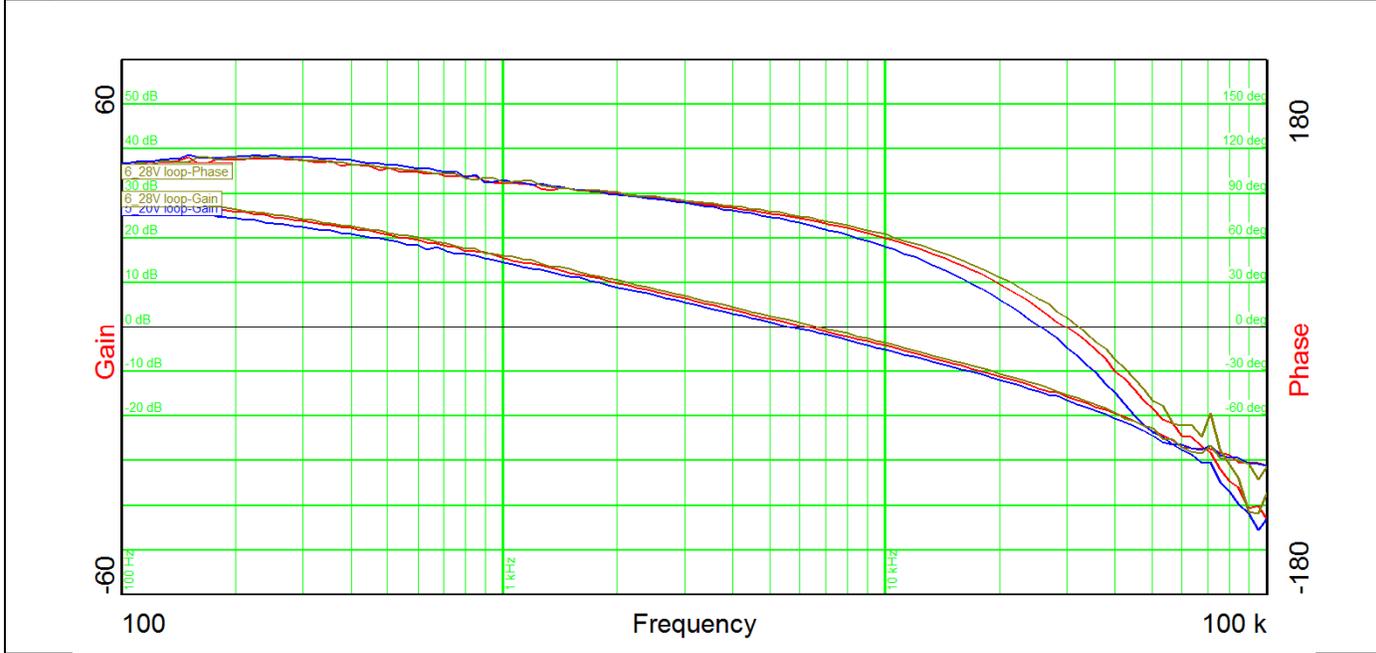


Figure 12

Table 1 summarizes the results

	20V	24V	28V
<b>Bandwidth (kHz)</b>	5.65	6.2	6.65
<b>Phasemargin</b>	71°	72.4°	72.5°
<b>slope (20dB/decade)</b>	-1.2	-1	-1.1
<b>gain margin (dB)</b>	-14.67	-15.7	-16.1
<b>slope (20dB/decade)</b>	-1.44	-2.15	-1.5
<b>freq (kHz)</b>	25.5	29.9	32.1

Table 1

The loop was designed for PM>65degs and GM around -15dB;  
 The bandwidth of 6kHz for the flyback topology is fair, the slope of -1 at Fco is perfect.

## 9 Load Transients

### 9.1 Transient applied at negative VOUT (-VOUT)

The Figure 13 shows the response to load transients. The load is switching from 0.35A to 0.7A (50 Hz). Negative VOUT was measured

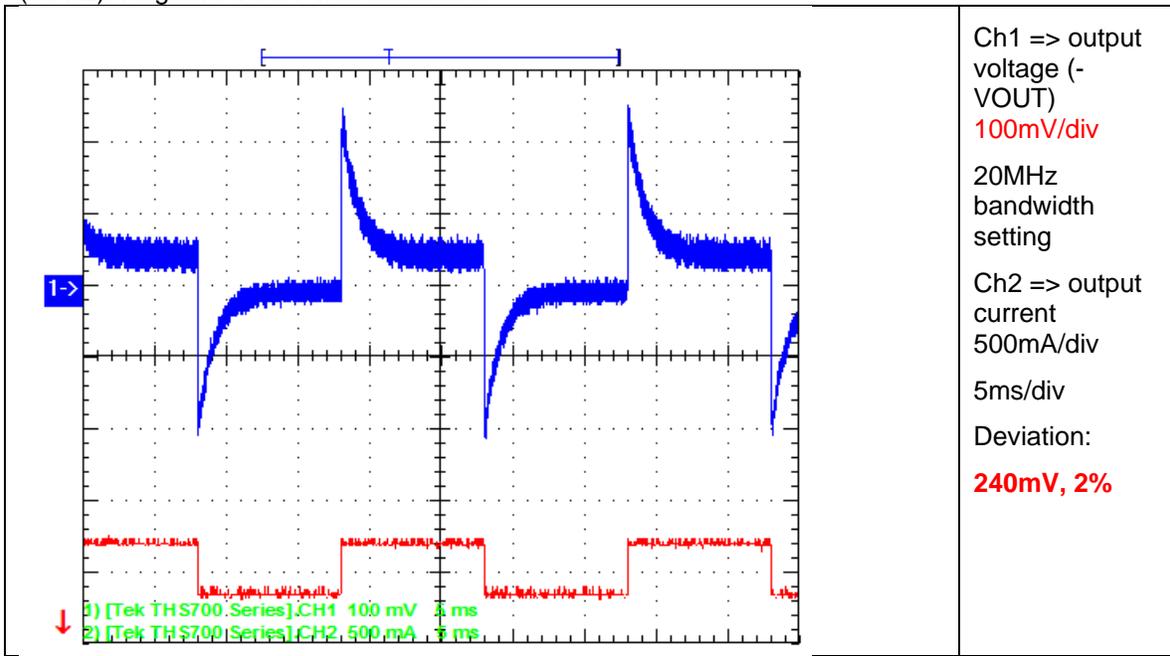


Figure 13

The Figure 14 shows the response to load transients. The load is switching from 0.35A to 0.7A (50 Hz). Positive VOUT was measured

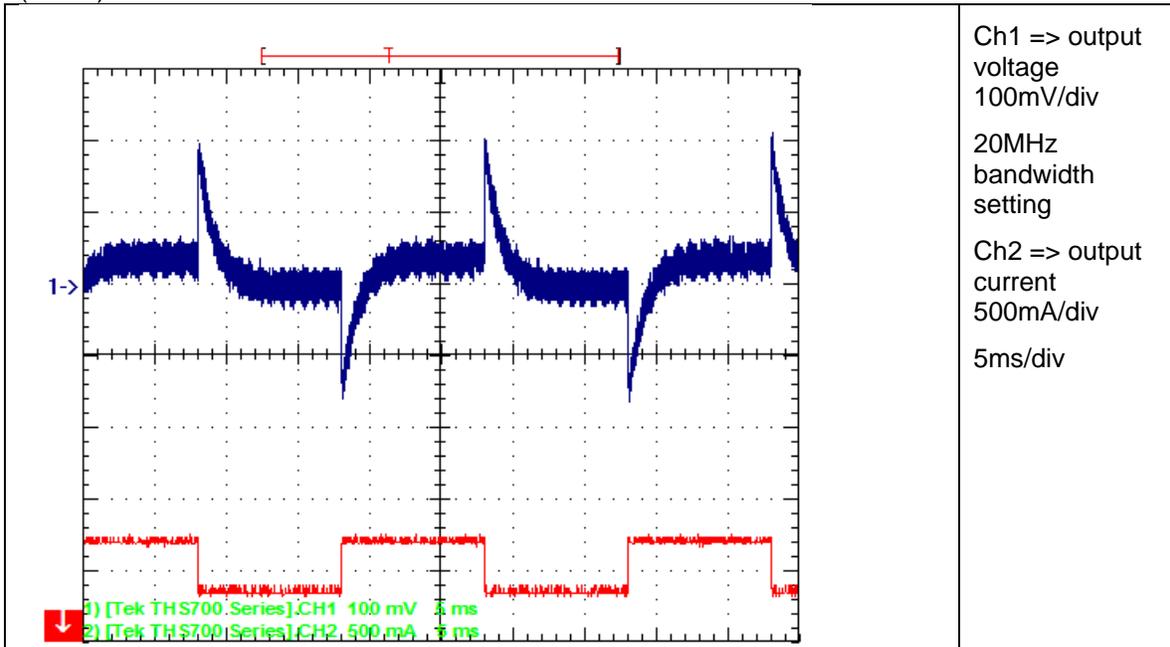
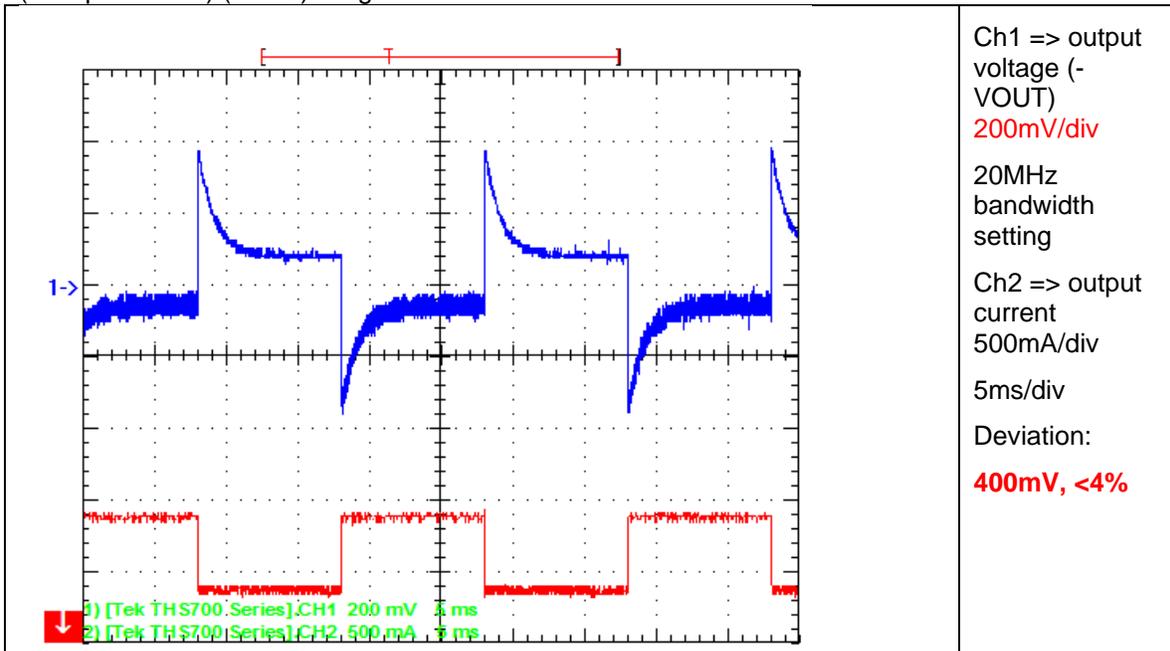


Figure 14

## 9.2 Transient applied at positive VOUT (+VOUT)

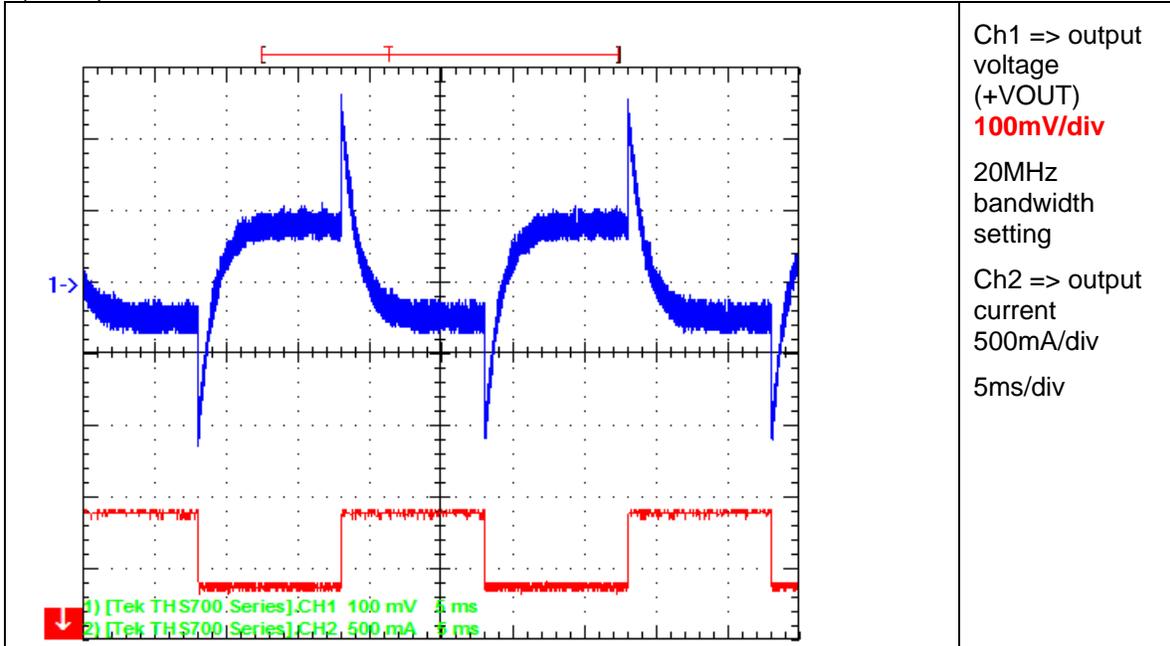
The Figure 13 shows the response to load transients. The load is switching from **0.36A to 0.87A** (load precision !) (50 Hz). Negative VOUT was measured



Ch1 => output voltage (-VOUT)  
 200mV/div  
 20MHz bandwidth setting  
 Ch2 => output current  
 500mA/div  
 5ms/div  
 Deviation:  
**400mV, <4%**

Figure 15

The Figure 14 shows the response to load transients. The load is switching from **0.36A to 0.87A** (50 Hz). Positive VOUT was measured



Ch1 => output voltage (+VOUT)  
 100mV/div  
 20MHz bandwidth setting  
 Ch2 => output current  
 500mA/div  
 5ms/div

Figure 16

## 10 Miscellaneous Waveforms

Switch node ("SW" to -VOUT)) waveform shown in Figure 17

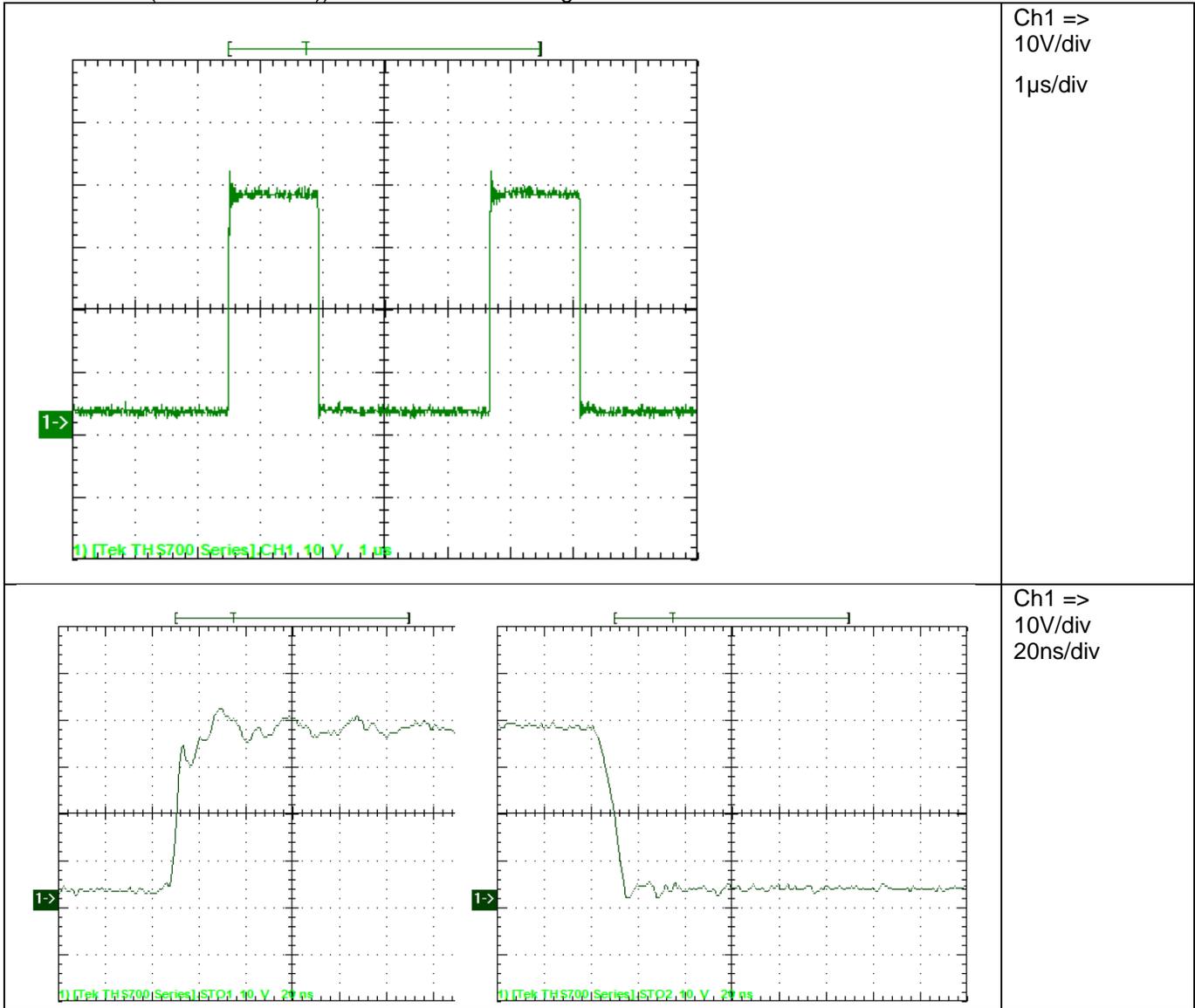


Figure 17

Switchnode ("SW" to GND measured at the inductor pads) results in the waveform shown in Figure 18.

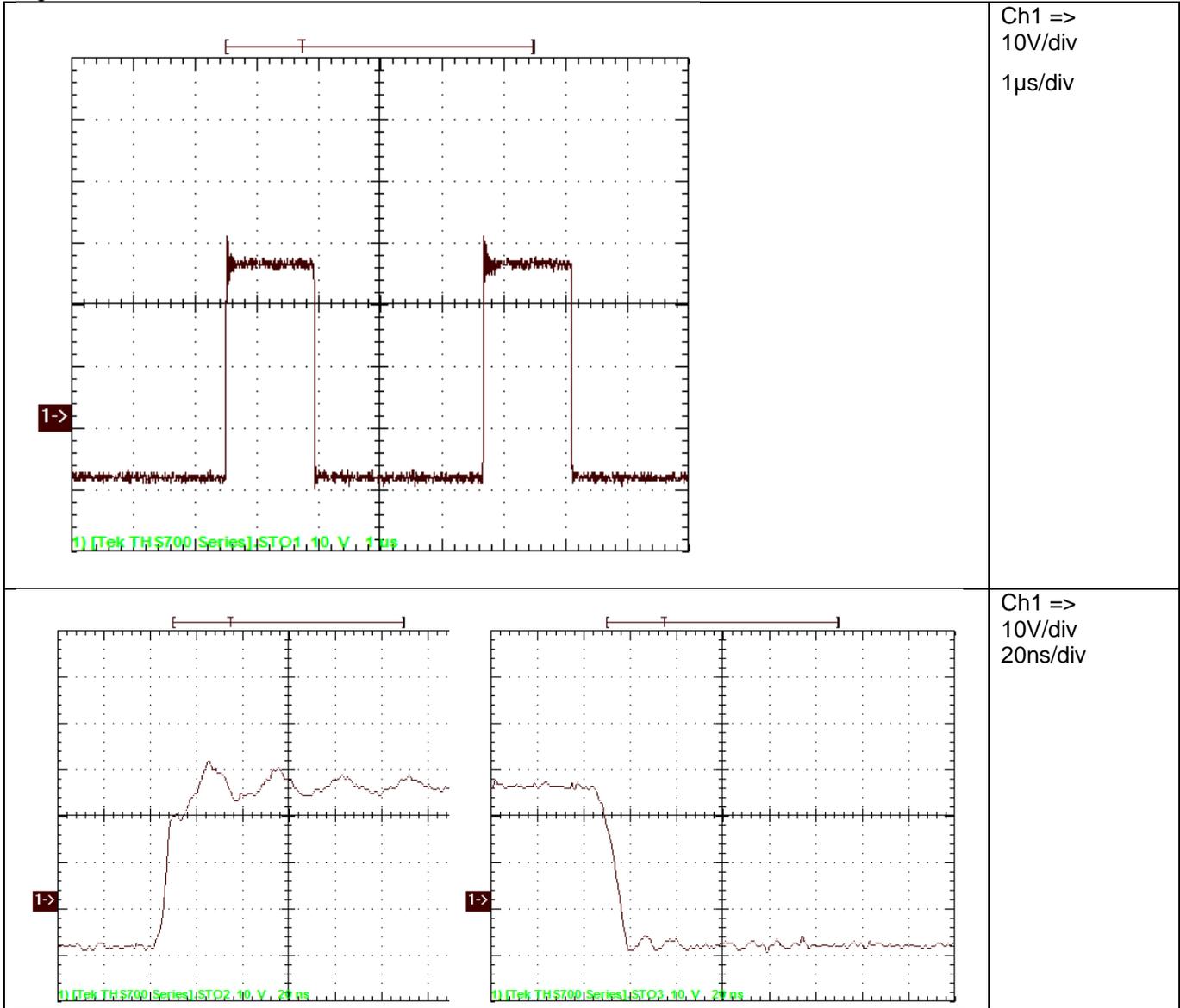
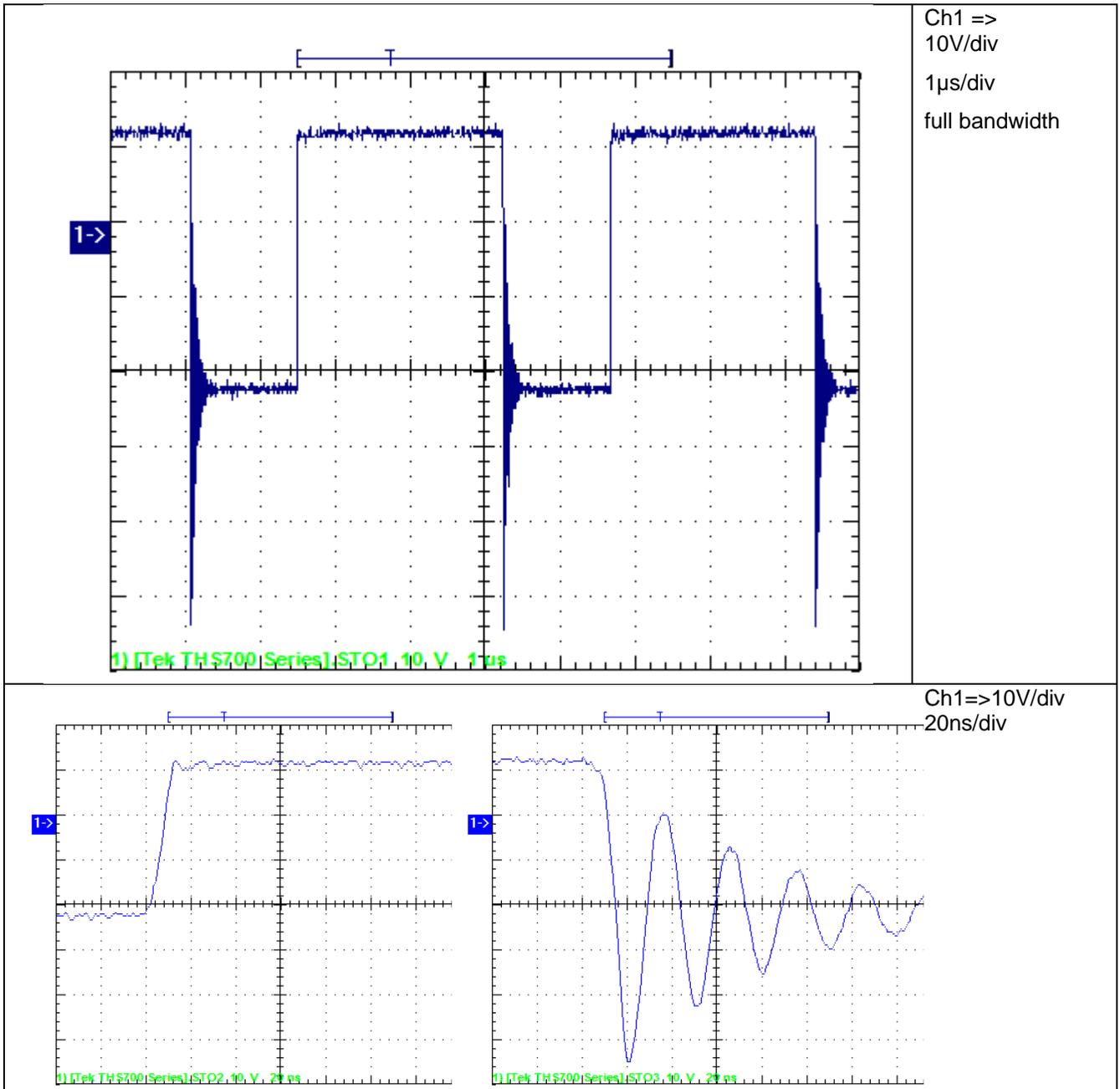


Figure 18

"Secondary" switchnode (measured at the inductor pads): the waveform is shown in **Figure 19**.  
Measured without snubber.



**Figure 19**

Secondary switchnode (SW2 to +VOUT) the waveform is shown in Figure 20.  
Applied RC snubber across diode D1 (100Ohm + 470pF in series)

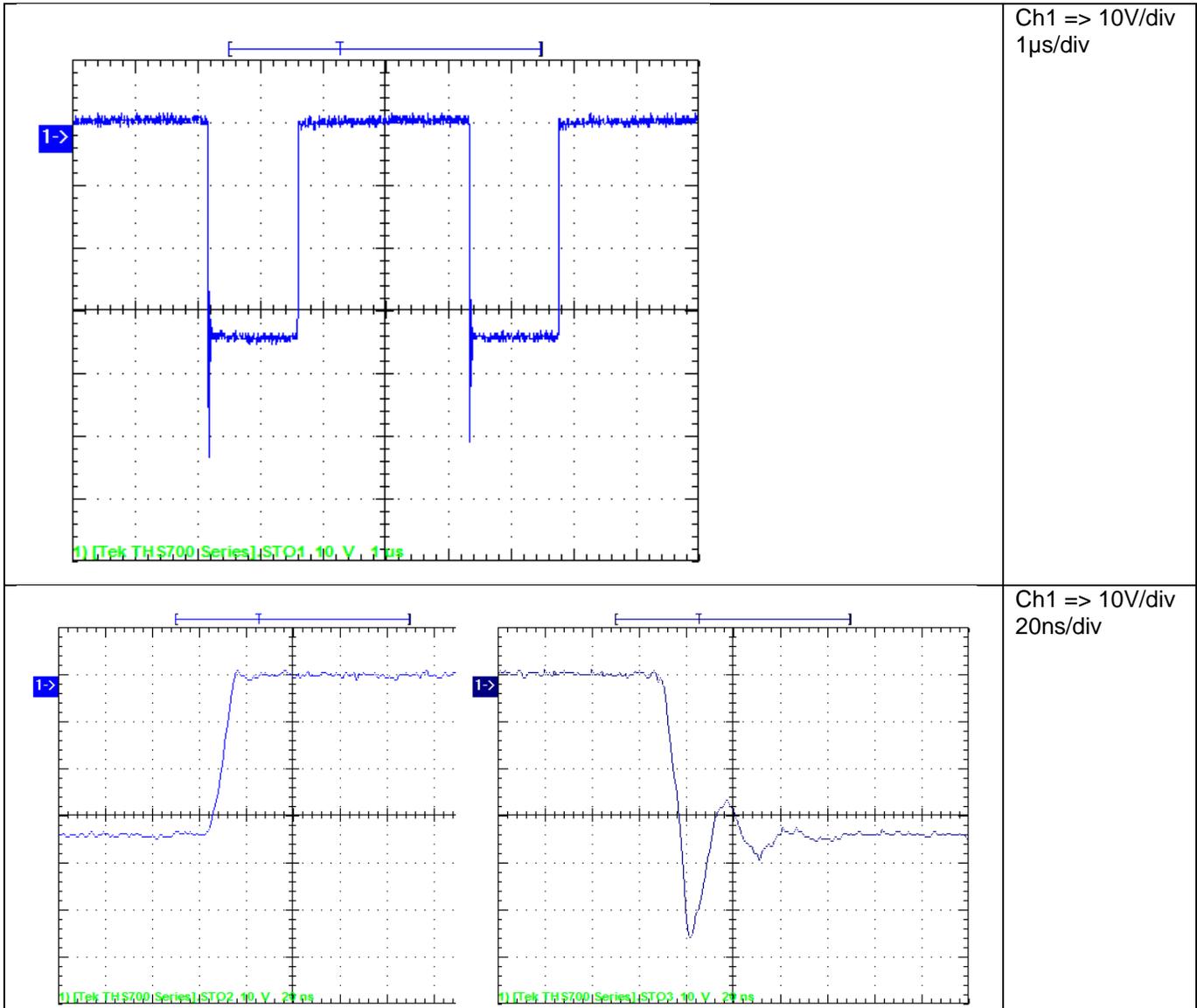


Figure 20

RC snubber deduced voltage stress below 60Vpk

### 11 Thermal Image

Thermal image is shown in Figure 21. Input voltage was set to 24V and both output currents at full load 700mA for more than 30minutes:

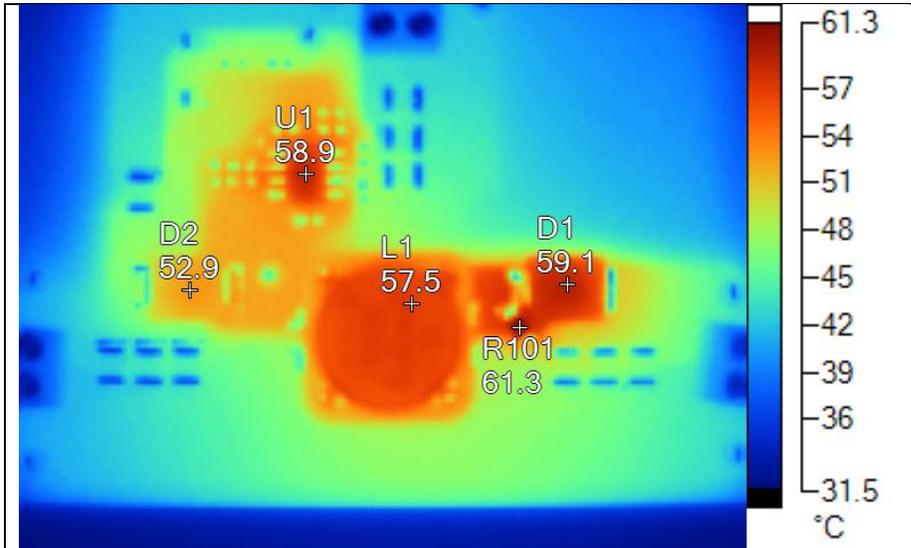


Figure 21

Name	Temperature
R101	61.3°C
U1	58.9°C
D1	59.1°C
L1	57.5°C
D2	52.9°C

Table 2

Thermal stress at the semiconductors is low,  $dT < 40K$

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