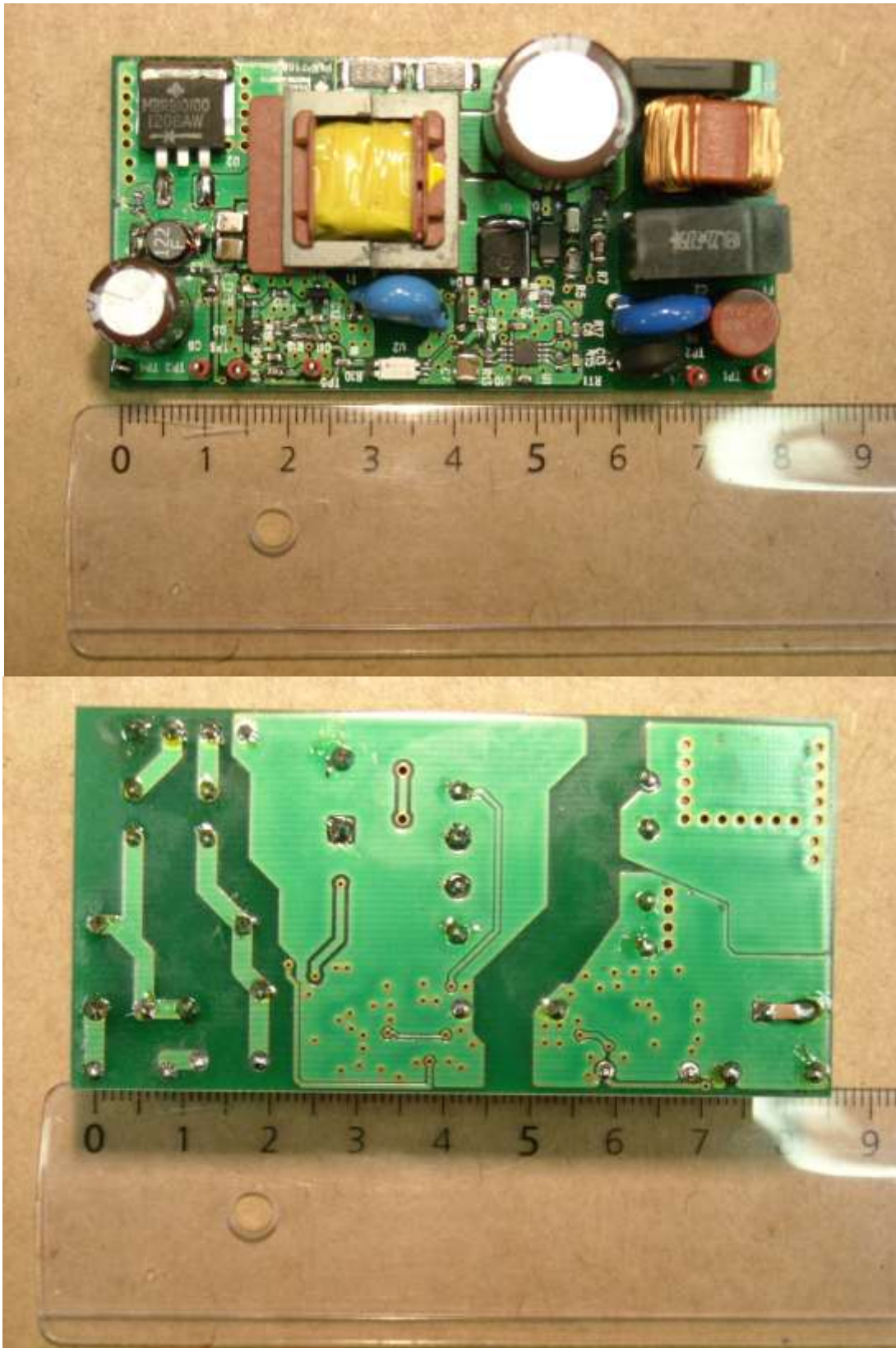


**PHOTO OF THE PROTOTYPE:**

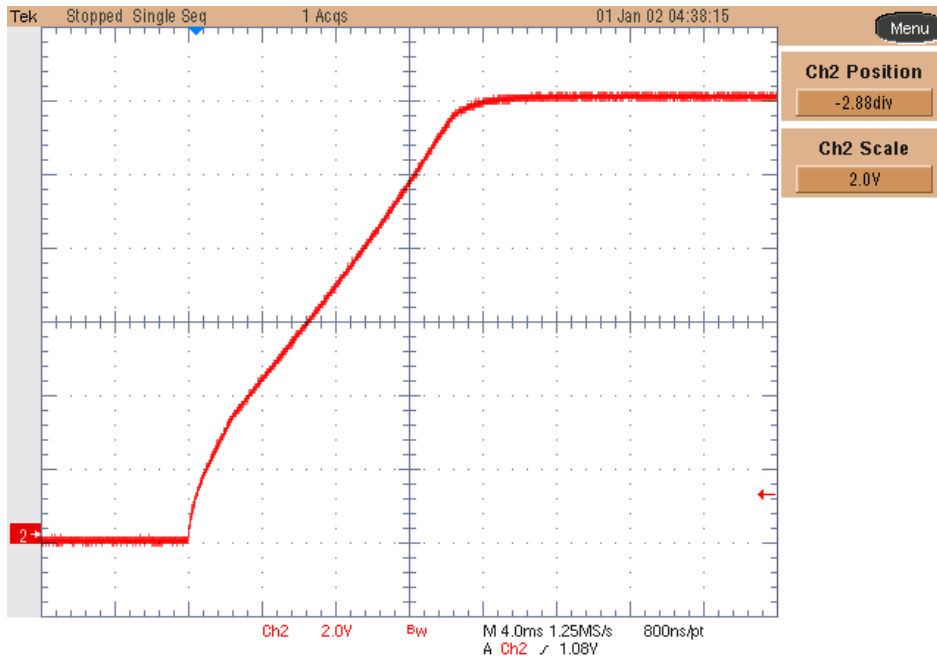


## 1 Startup

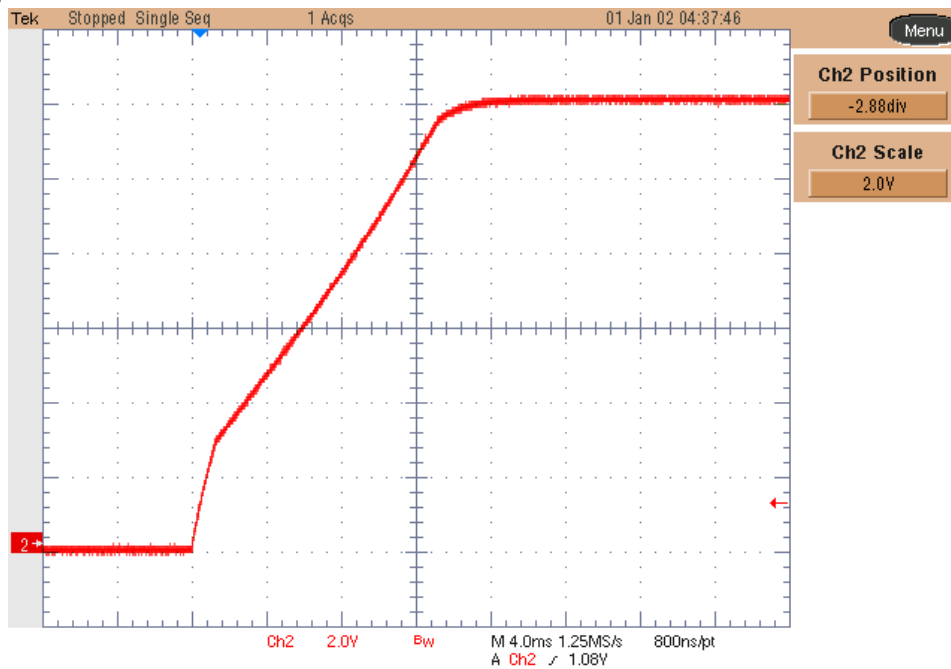
The output voltage behavior at startup is shown in the images below. The input voltage was set to 320Vdc. The output fully loaded in the upper picture and unloaded for the bottom one.

**Ch.2: Output voltage (2V/div, 4ms/div, DC coupling, 20MHz BWL)**

**I<sub>out</sub> = 2A;**

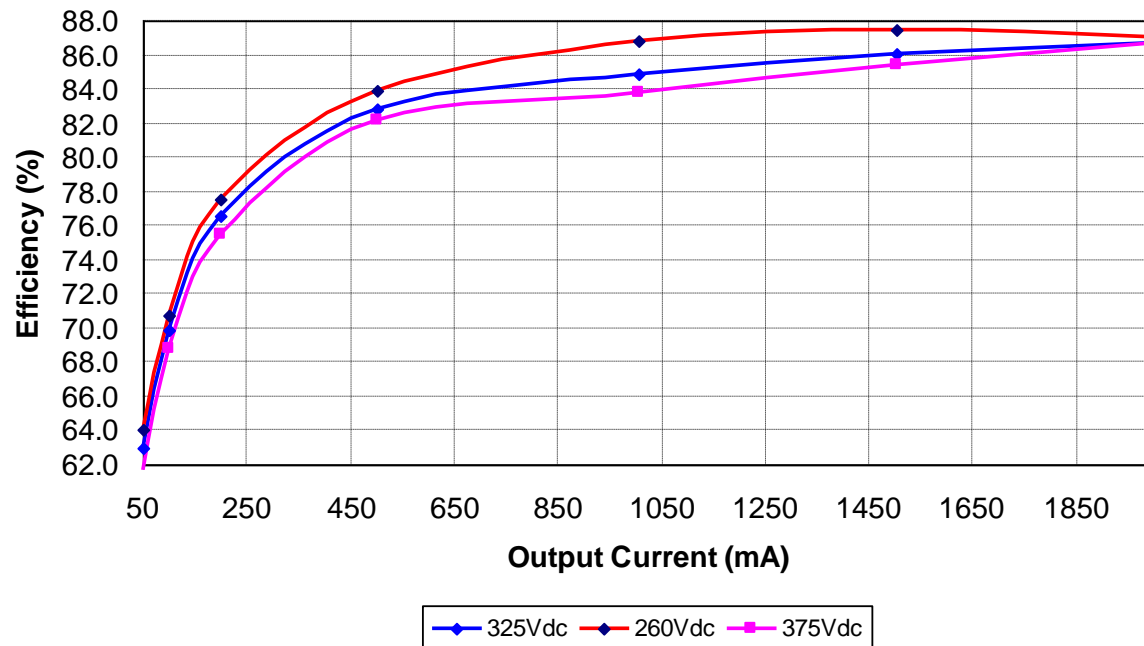


**I<sub>out</sub> = 0A;**



## 2 Efficiency

The efficiency data are shown in the tables and graph below. In order to get an accurate measure of the input power, a DC voltage source has been employed, set to the peak value of the three nominal input voltages: 184Vac, 230Vac and 265Vac (260Vdc, 325Vdc and 375Vdc).



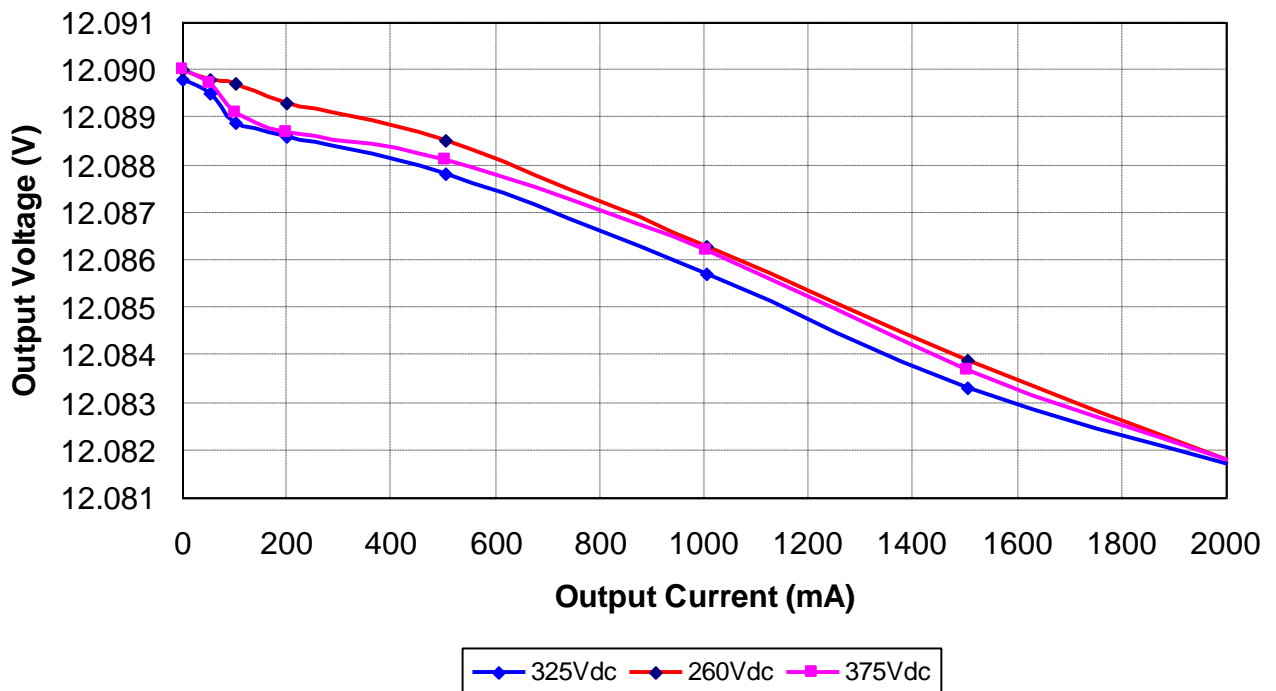
| Iout (mA) | Vout (V) | Pout (W) | Iin (mA) | Vin (Vdc) | Pin (W) | Ploss (W) | Eff (%) |
|-----------|----------|----------|----------|-----------|---------|-----------|---------|
| 0.0       | 12.0900  | 0.00     | 0.446    | 260.2     | 0.12    | 0.116     | 0.00    |
| 51.4      | 12.0898  | 0.62     | 3.73     | 260.2     | 0.97    | 0.35      | 64.03   |
| 100.1     | 12.0897  | 1.21     | 6.57     | 260.2     | 1.71    | 0.50      | 70.79   |
| 200.0     | 12.0893  | 2.42     | 11.98    | 260.2     | 3.12    | 0.70      | 77.57   |
| 502.3     | 12.0885  | 6.07     | 27.83    | 260.2     | 7.24    | 1.17      | 83.85   |
| 1004.5    | 12.0863  | 12.14    | 53.8     | 260.1     | 13.99   | 1.85      | 86.76   |
| 1502      | 12.0839  | 18.15    | 79.8     | 260.1     | 20.76   | 2.61      | 87.44   |
| 2002      | 12.0818  | 24.19    | 106.9    | 260.0     | 27.79   | 3.61      | 87.03   |

| Iout (mA) | Vout (V) | Pout (W) | Iin (mA) | Vin (Vdc) | Pin (W) | Ploss (W) | Eff (%) |
|-----------|----------|----------|----------|-----------|---------|-----------|---------|
| 0.0       | 12.0898  | 0.00     | 0.411    | 325.0     | 0.13    | 0.134     | 0.00    |
| 51.5      | 12.0895  | 0.62     | 3.04     | 325.1     | 0.99    | 0.37      | 63.00   |
| 100.1     | 12.0889  | 1.21     | 5.33     | 325.1     | 1.73    | 0.52      | 69.84   |
| 200.0     | 12.0886  | 2.42     | 9.71     | 325.1     | 3.16    | 0.74      | 76.59   |
| 502.3     | 12.0878  | 6.07     | 22.55    | 325.0     | 7.33    | 1.26      | 82.85   |
| 1004.5    | 12.0857  | 12.14    | 44.0     | 325.0     | 14.30   | 2.16      | 84.90   |
| 1502      | 12.0833  | 18.15    | 64.9     | 324.9     | 21.09   | 2.94      | 86.07   |
| 2002      | 12.0817  | 24.19    | 85.9     | 324.9     | 27.91   | 3.72      | 86.67   |

| Iout (mA) | Vout (V) | Pout (W) | Iin (mA) | Vin (Vdc) | Pin (W) | Ploss (W) | Eff (%) |
|-----------|----------|----------|----------|-----------|---------|-----------|---------|
| 0.0       | 12.0900  | 0.00     | 0.428    | 375.0     | 0.16    | 0.161     | 0.00    |
| 51.5      | 12.0897  | 0.62     | 2.69     | 375.0     | 1.01    | 0.39      | 61.72   |
| 100.1     | 12.0891  | 1.21     | 4.69     | 375.0     | 1.76    | 0.55      | 68.81   |
| 200.0     | 12.0887  | 2.42     | 8.54     | 375.0     | 3.20    | 0.78      | 75.50   |
| 502.3     | 12.0881  | 6.07     | 19.71    | 375.0     | 7.39    | 1.32      | 82.15   |
| 1004.5    | 12.0862  | 12.14    | 38.6     | 375.0     | 14.49   | 2.35      | 83.81   |
| 1502      | 12.0837  | 18.15    | 56.7     | 375.0     | 21.26   | 3.11      | 85.36   |
| 2002      | 12.0818  | 24.19    | 74.4     | 374.9     | 27.89   | 3.70      | 86.72   |

### 3 Output Voltage Regulation

The output voltage variation as function of load and input voltage is shown below:

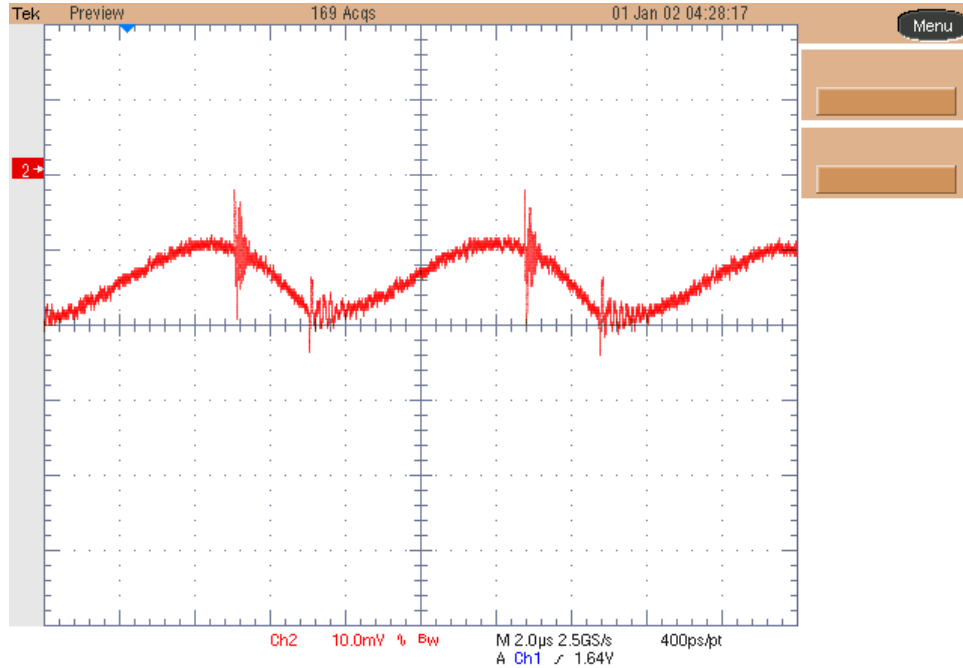


### 4 Output Ripple Voltage

The output ripple voltage is shown in the plot below. The input was set to 320Vdc and the output respectively to 2A, 100mA and no load.

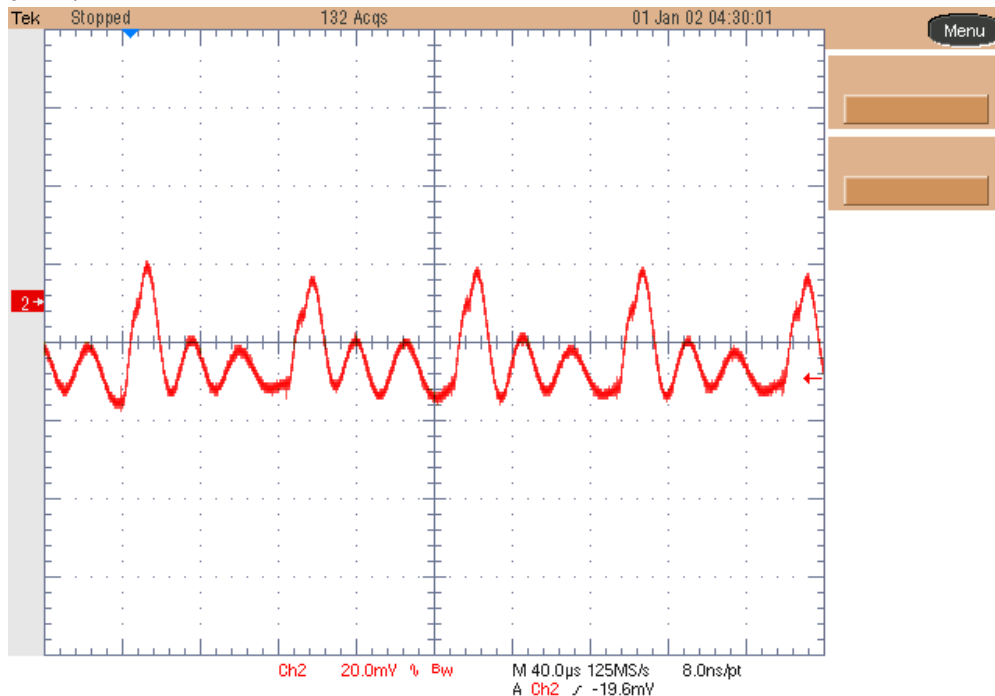
**Ch.2: Output Voltage (10mV/div, 2us/div, AC coupling, 20MHz BWL)**

**I<sub>out</sub> = 2A.**

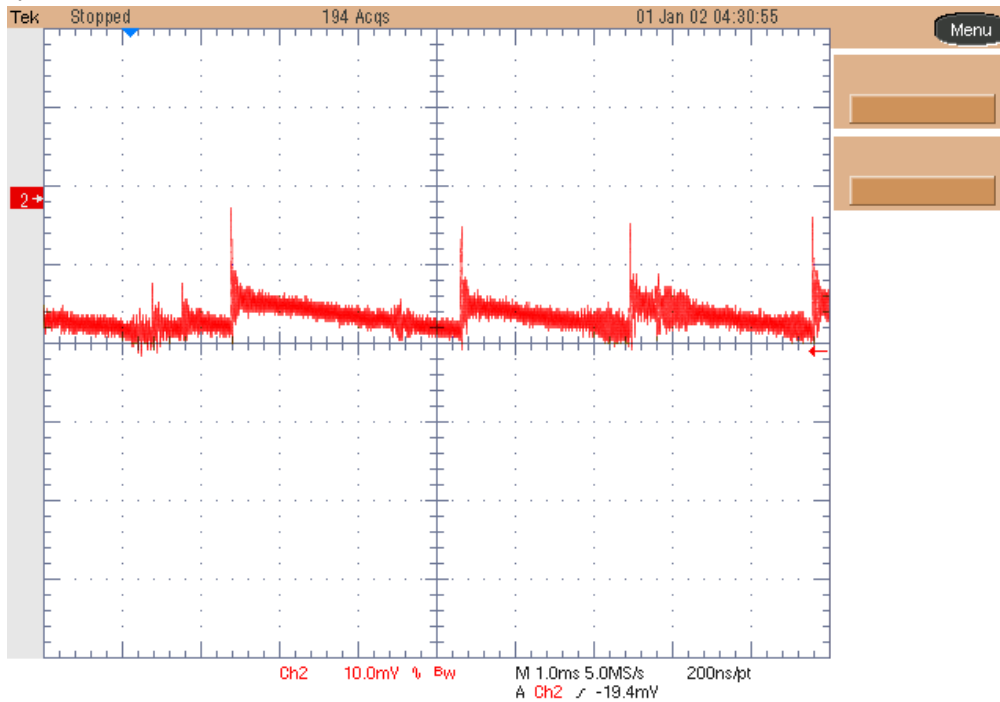


**Ch.2: Output Voltage (20mV/div, 40us/div, AC coupling, 20MHz BWL)**

**I<sub>out</sub> = 100mA.**



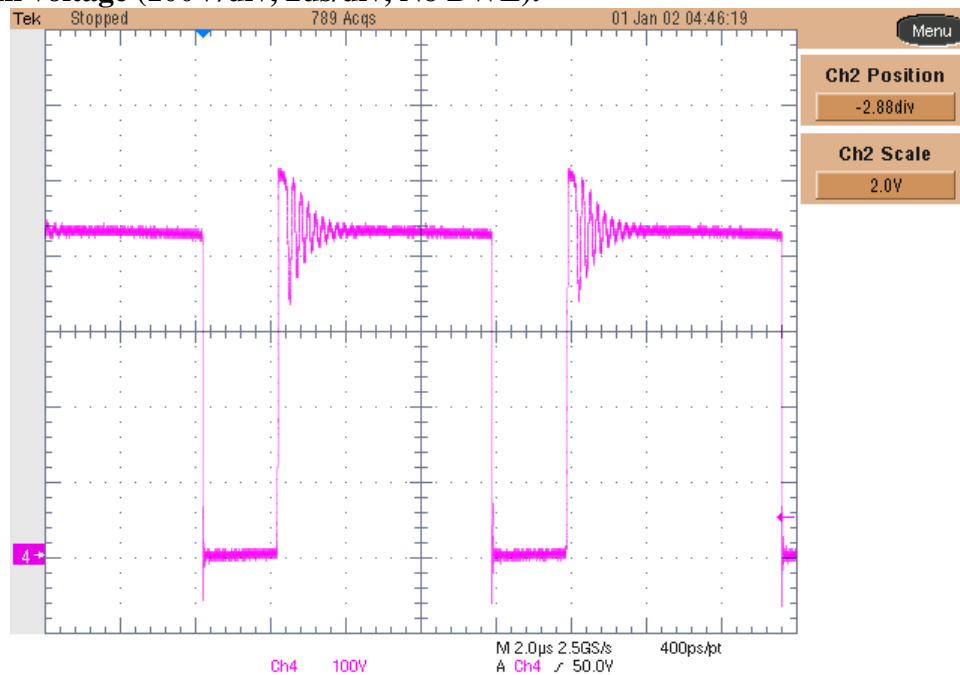
**Ch.2: Output Voltage (10mV/div, 1ms/div, AC coupling, 20MHz BWL)**  
**Iout = 0A.**



## 5 Switching Node Waveform

The image below shows the peak voltage on the drain of the Mosfet Q1 with a 320Vdc input, and full load.

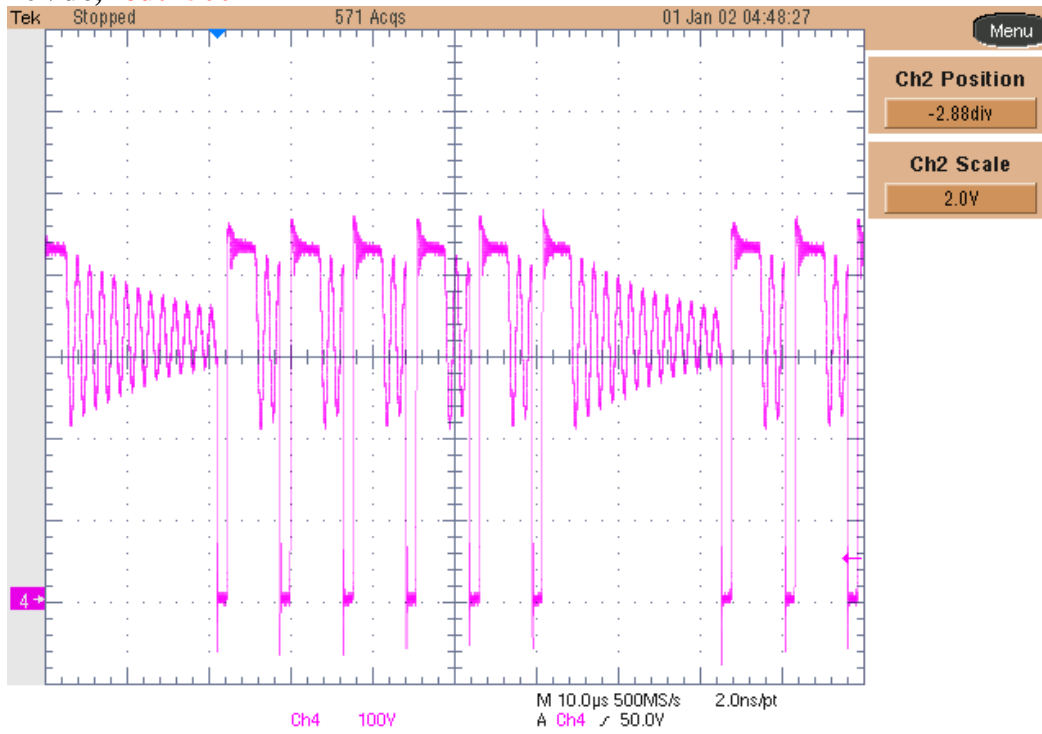
**Ch4: Drain voltage (100V/div, 2us/div, No BWL).**



By reducing the load, the converter enters the skip-cycle mode, as shown in the picture below.

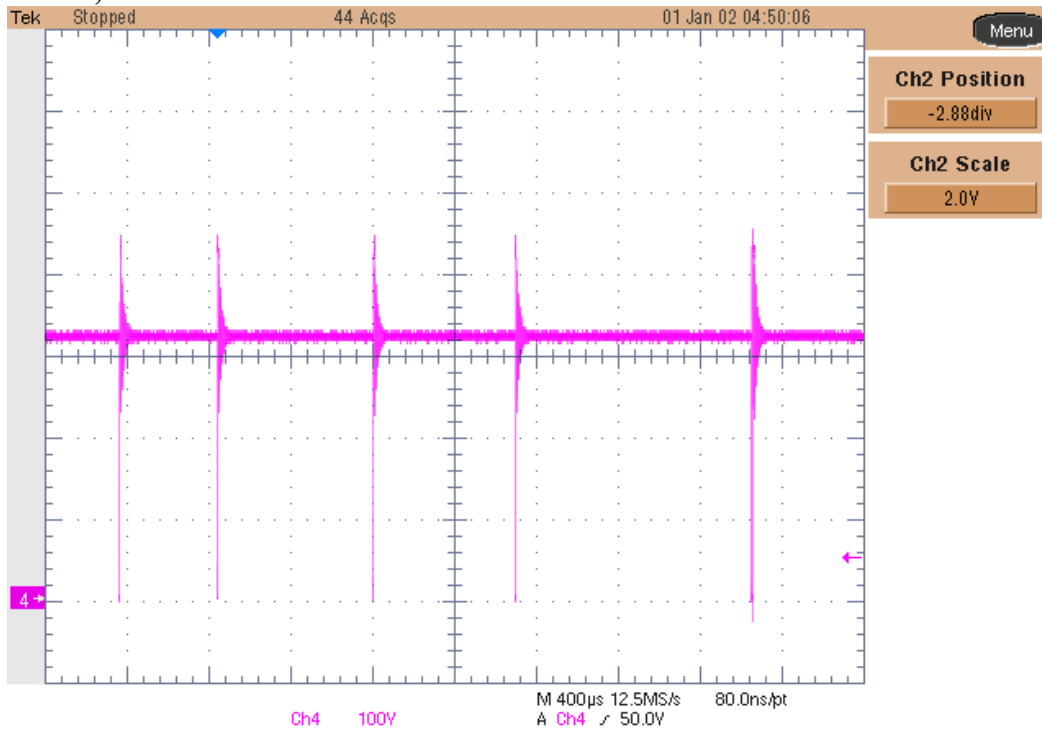
**Ch4: Drain voltage (100V/div, 10us/div, No BWL).**

**Vin = 320Vdc, Iout=500mA**



**Ch4: Drain voltage (100V/div, 400usec/div, No BWL).**

**Vin = 320Vdc, No Load**

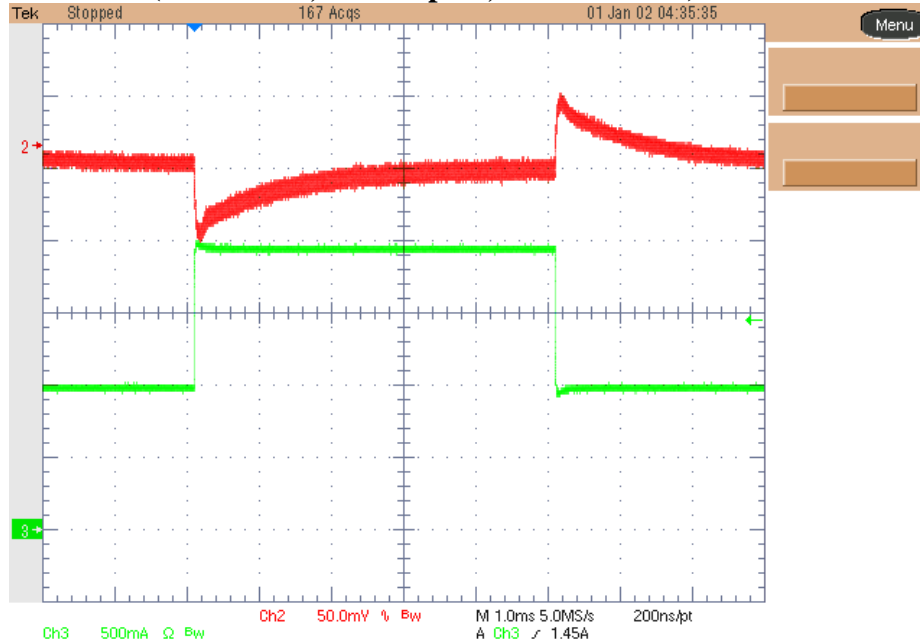


## 6 Transient Response

The image below shows the transient response of the output voltage when the load has been switched between 1A and 2A. The input voltage was set to 320Vdc.

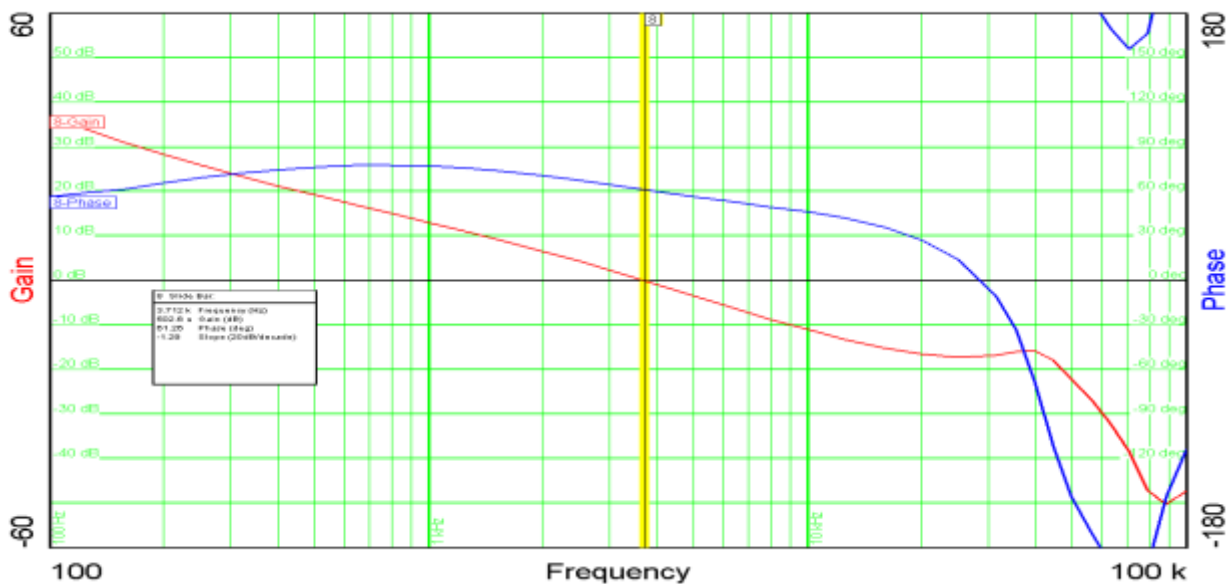
**Ch2: Output Voltage (50mV/div, 1ms/div, AC coupled, 20MHz BWL).**

**Ch3: Output Current (500mA/div, DC coupled, 20MHz BWL)**



## 7 Loop Response

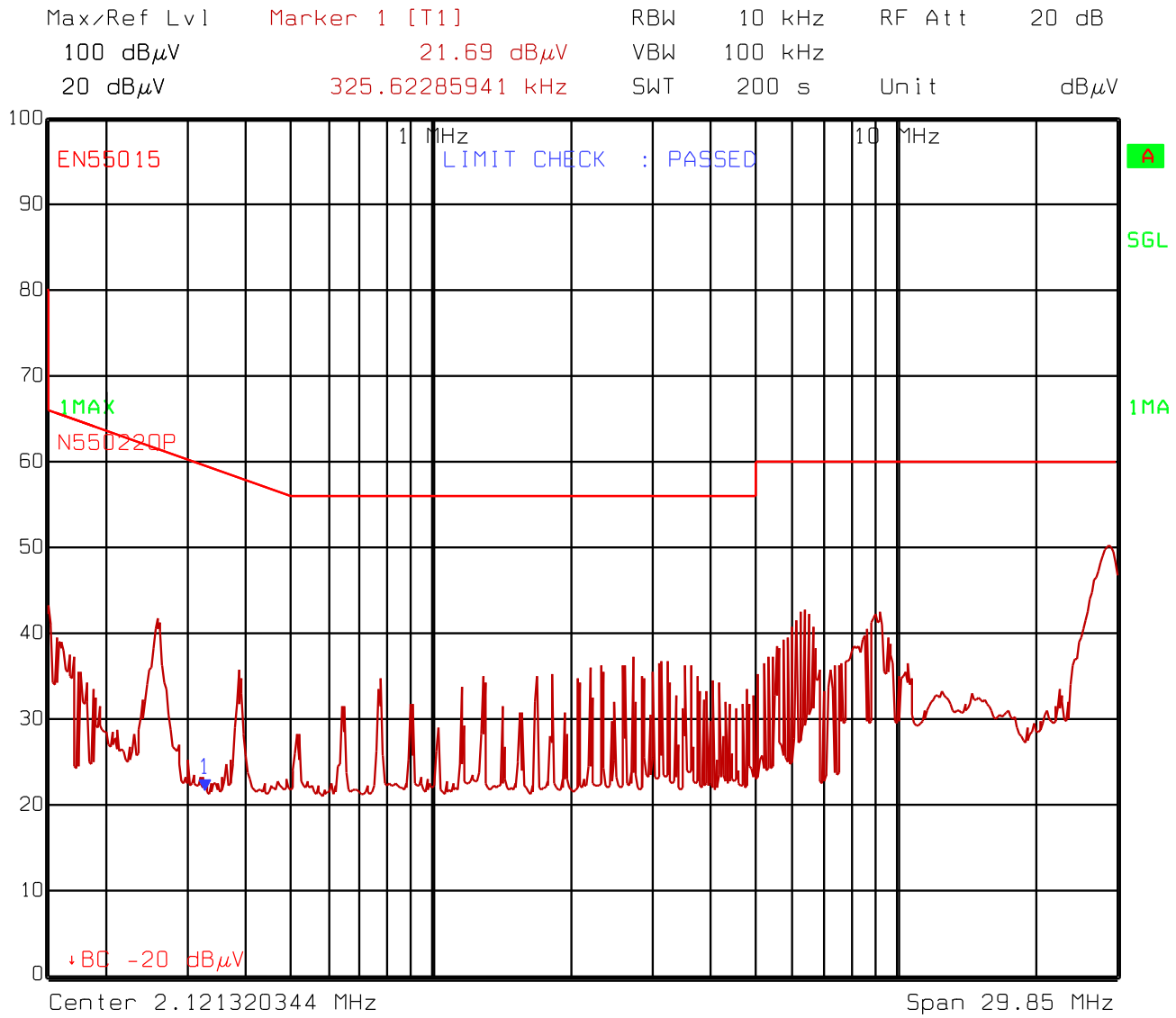
The graph below shows the bode-plot analysis. The input voltage was set to 320Vdc and the load to 2A. The crossover frequency was 3.71KHz and the phase margin 61.2 deg., while the gain margin was 17dB.





### 8 EMI Measurement

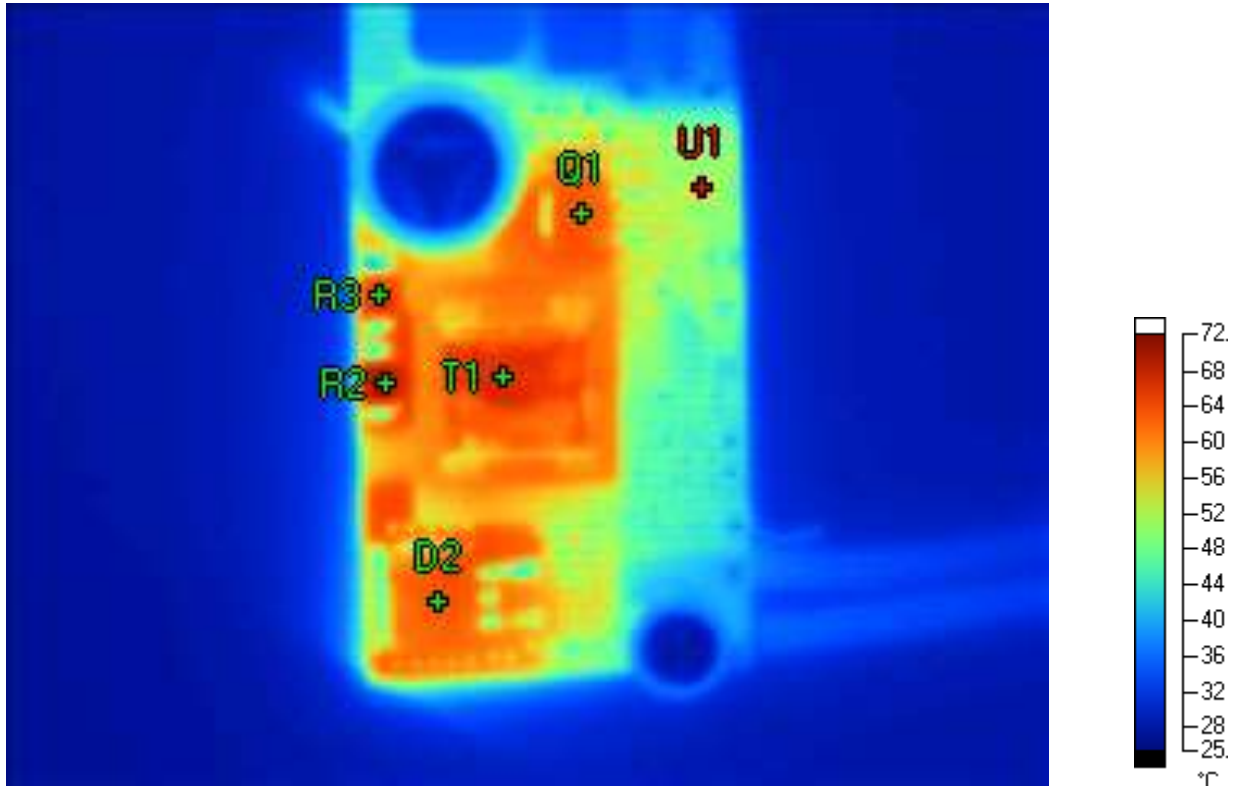
The graph below shows the conducted emission EMI noise and the EN55022 Class-B Quasi-Peak limits. The load was connected to a LISN and an isolation transformer; the load was a power resistor, set to 6 Ohm (2A load), while the input voltage was 230Vac. The receiver was set to Quasi-peak detector, 10 KHz bandwidth.



Title: FF1o1  
Date: 26.JUL.2012 15:19:33

## 9 Thermal Analysis

The graph and data below show the thermal image taken on the prototype when supplied with 320Vdc input and fully loaded. The board has been placed horizontally on the bench, without any air flow. The ambient temperature was 25C.



### Image Info

|                      |                      |
|----------------------|----------------------|
| Background           | 25.0 °C              |
| Average Temperature  | 35.7 °C              |
| Calibration Range    | -20.0 °C to 350.0 °C |
| Camera Model         | Ti40FT               |
| Image Range          | 26.3 °C to 71.3 °C   |
| Image Time           | 7/24/2012 4:29:40 PM |
| Manufacturer         | Fluke                |
| Camera Serial Number | Ti40FT-070263        |

### Markers

| Label | Temperature | Emissivity | Background |
|-------|-------------|------------|------------|
| R2    | 71.3 °C     | 0.95       | 25.0 °C    |
| T1    | 66.7 °C     | 0.95       | 25.0 °C    |
| D2    | 63.6 °C     | 0.95       | 25.0 °C    |
| Q1    | 63.8 °C     | 0.95       | 25.0 °C    |
| R3    | 66.5 °C     | 0.95       | 25.0 °C    |
| U1    | 54.5 °C     | 0.95       | 25.0 °C    |

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