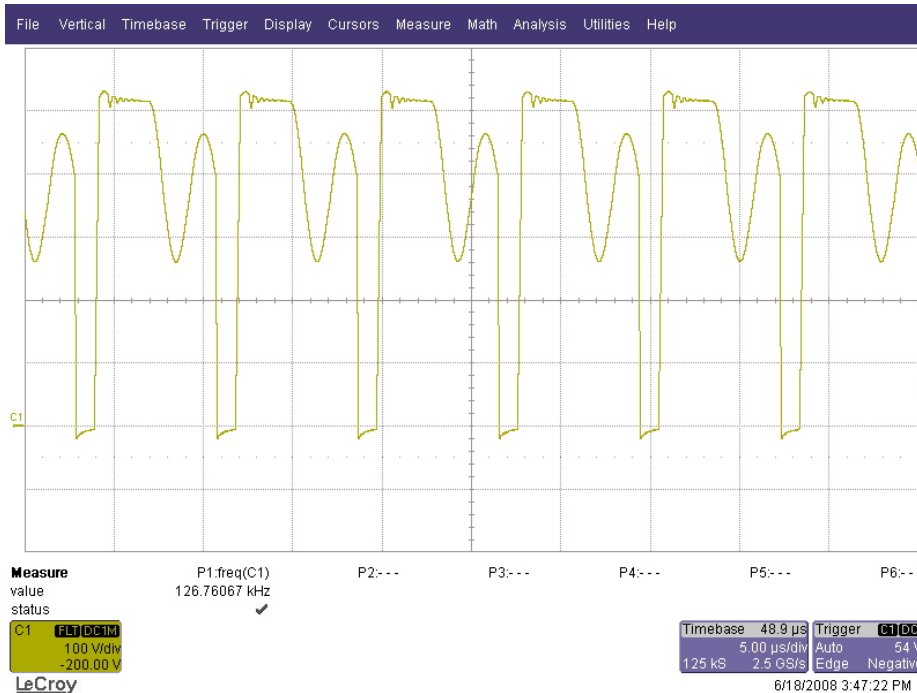


1 Main Waveforms

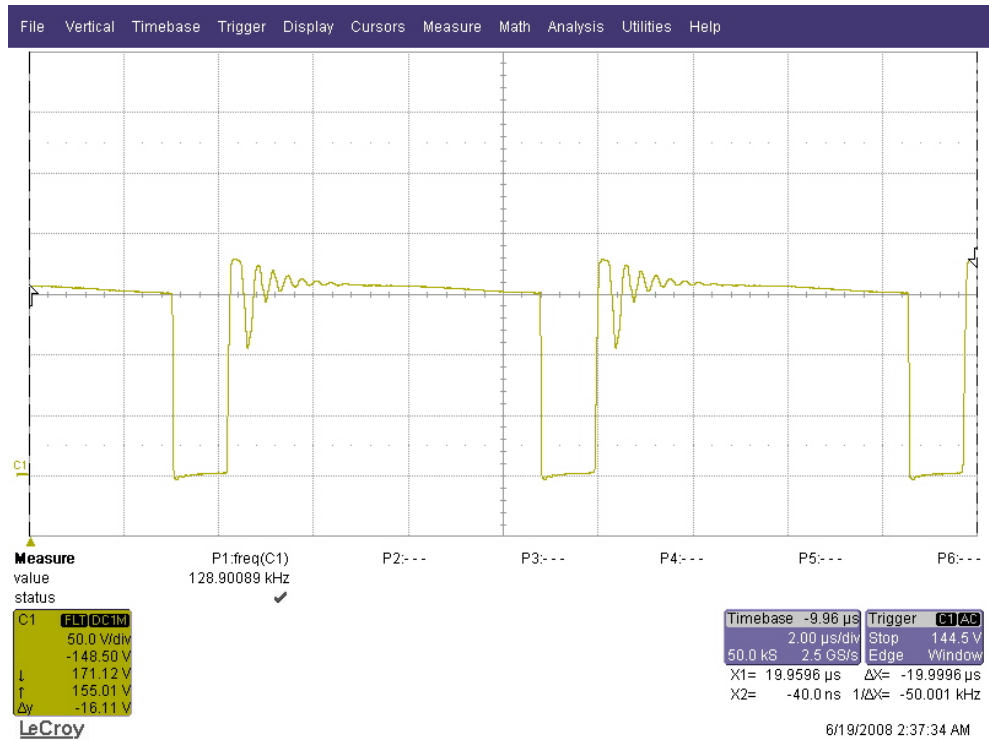
The converter is operating in Discontinuous Mode in all its range of operation, from minimum to maximum main peak input Voltage, at full Output load, 50mA Output1 (5V), 100mA Output2 (13.5V). Switching frequency is $f_s=125\text{kHz}$. Duty cycle is $D=0.37$ at 120V peak input, $D=0.11$ at 375V peak input.



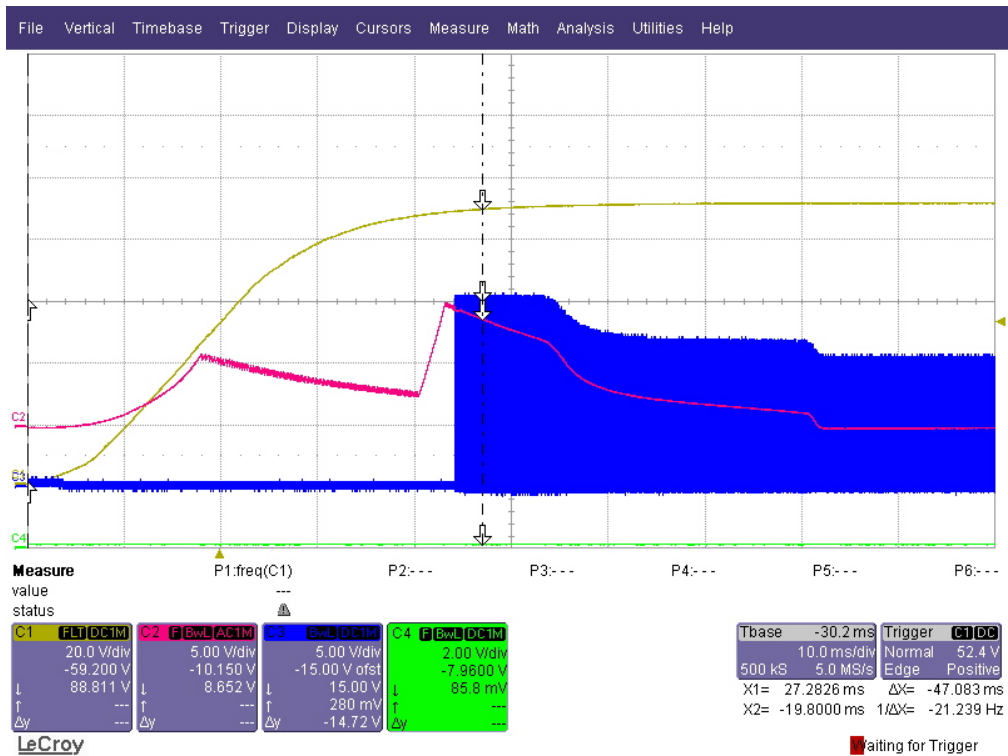
Primary Drain Voltage @ Vin peak=120V, 5V-50mA, 13.5V-100mA output



Primary Drain Voltage @ Vin peak=375V, 5V-50mA, 13.5V-100mA output



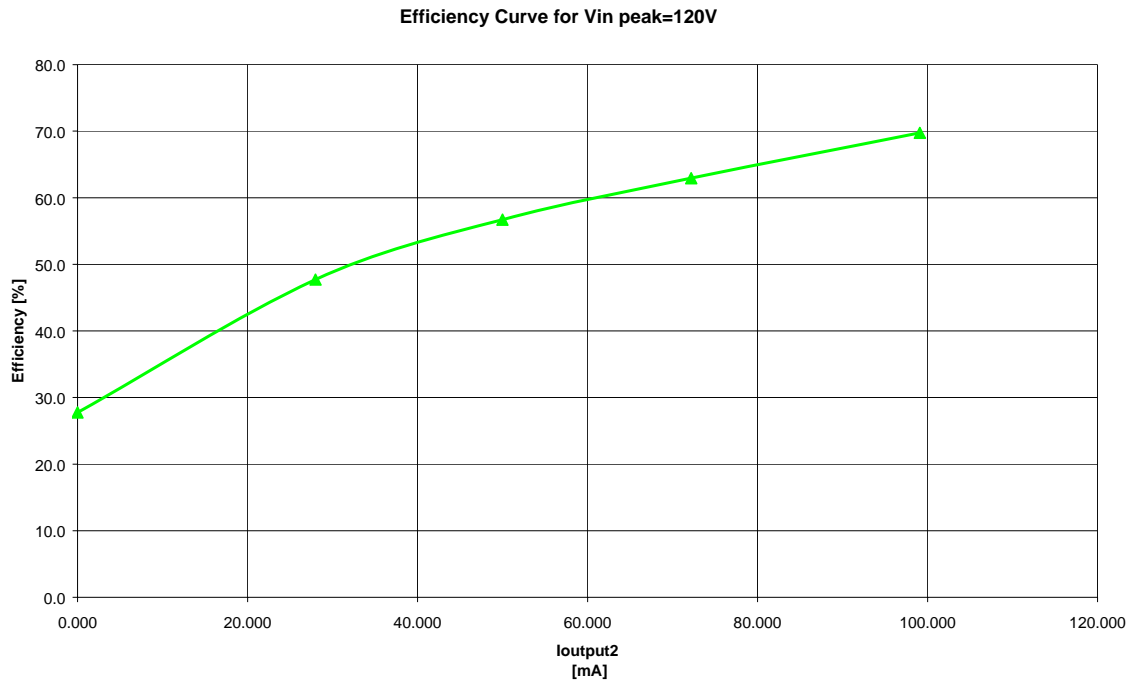
Primary Drain Voltage @ Vinpeak=120V, 5V-50mA, 13.5V-100mA Output when Output1 is shorted (Vout1<0.2V). The current limitation is set at Iout1=250mA @ Iout2=100mA. Same value for Iout2 limitation @ Iout1=50mA



Start-up waveforms of the circuit, with connected Output full loads @ Vinpeak=90V. CH1 is Input Voltage (DC), CH2 is BIAS, CH3 is Primary Mosfet Gate pulsing

2 Efficiency and Load Regulation

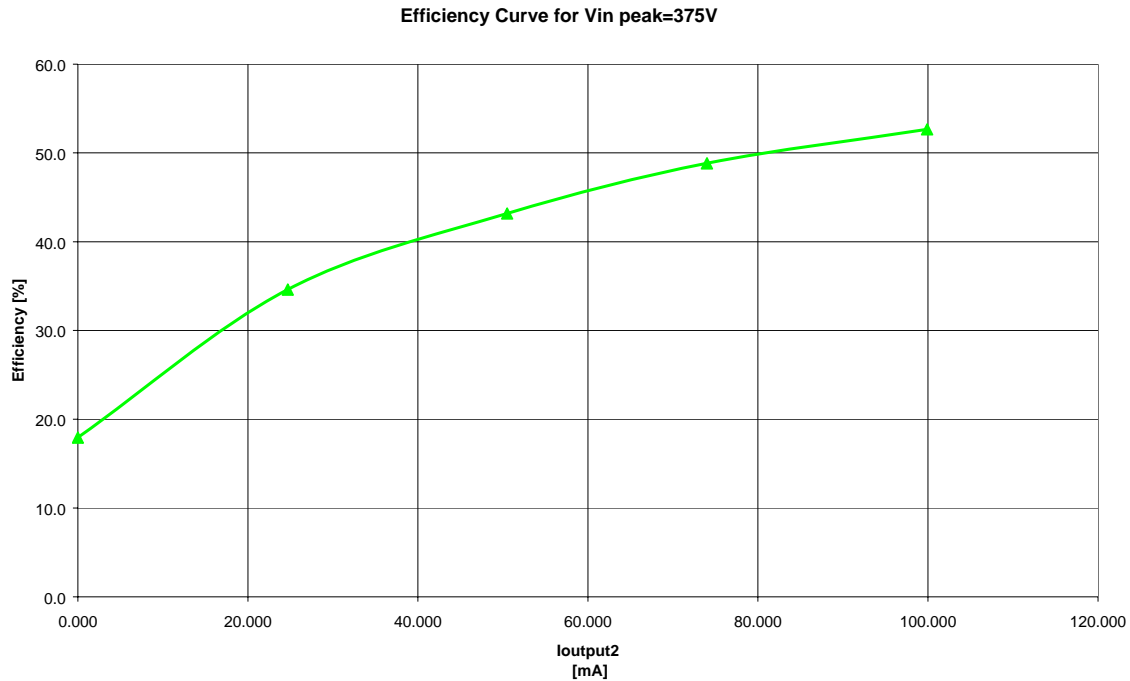
The efficiency diagrams are shown in the figures below for the minimum (120V), and maximum (375V) peak Input Voltage, as a function of the Output2 current.



The following table shows the measured values for Vin peak=120V:

Vin[V]	Iin[mA]	Vout1[V]	Vout2[V]	Iout1[mA]	Iout2[mA]	Pin[W]	Pout1[W]	Pout2[W]	η %
119.90	7.700	5.157	13.810	49.700	0.000	0.923	0.256	0.000	27.8
120.20	11.200	5.156	13.710	50.100	28.000	1.346	0.258	0.384	47.7
119.90	13.800	5.158	13.640	49.700	50.000	1.655	0.256	0.682	56.7
120.20	16.400	5.156	13.610	50.100	72.200	1.971	0.258	0.983	63.0
119.90	19.100	5.157	13.530	49.700	99.100	2.290	0.256	1.341	69.7
119.00	18.700	5.156	13.340	25.400	107.600	2.225	0.131	1.435	70.4
120.10	4.200	5.157	13.300	0.000	0.000	0.504	0.000	0.000	0.0

Last value is taken with both Outputs open to verify Output Voltage Regulation in that condition.

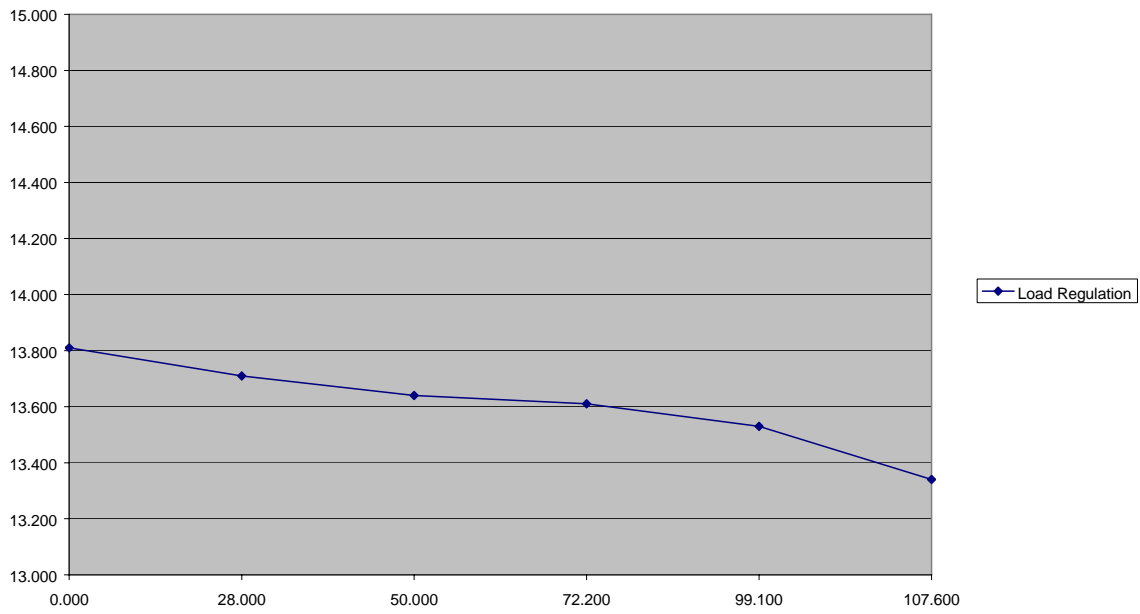


The following table shows the measured values for **Vin peak=375V**:

Vin[V]	Iin[mA]	Vout1[V]	Vout2[V]	Iout1[mA]	Iout2[mA]	Pin[W]	Pout1[W]	Pout2[W]	η %
376.70	3.800	5.157	13.780	49.800	0.000	1.431	0.257	0.000	17.9
374.20	4.600	5.157	13.660	50.100	24.700	1.721	0.258	0.337	34.6
376.70	5.800	5.158	13.590	49.800	50.500	2.185	0.257	0.686	43.2
374.20	6.900	5.158	13.550	50.100	74.000	2.582	0.258	1.003	48.8
376.70	8.100	5.158	13.510	49.800	99.900	3.051	0.257	1.350	52.7
374.20	7.900	5.156	13.240	25.400	107.600	2.956	0.131	1.425	52.6
375.20	3.100	5.159	13.300	0.000	0.000	1.163	0.000	0.000	0.0

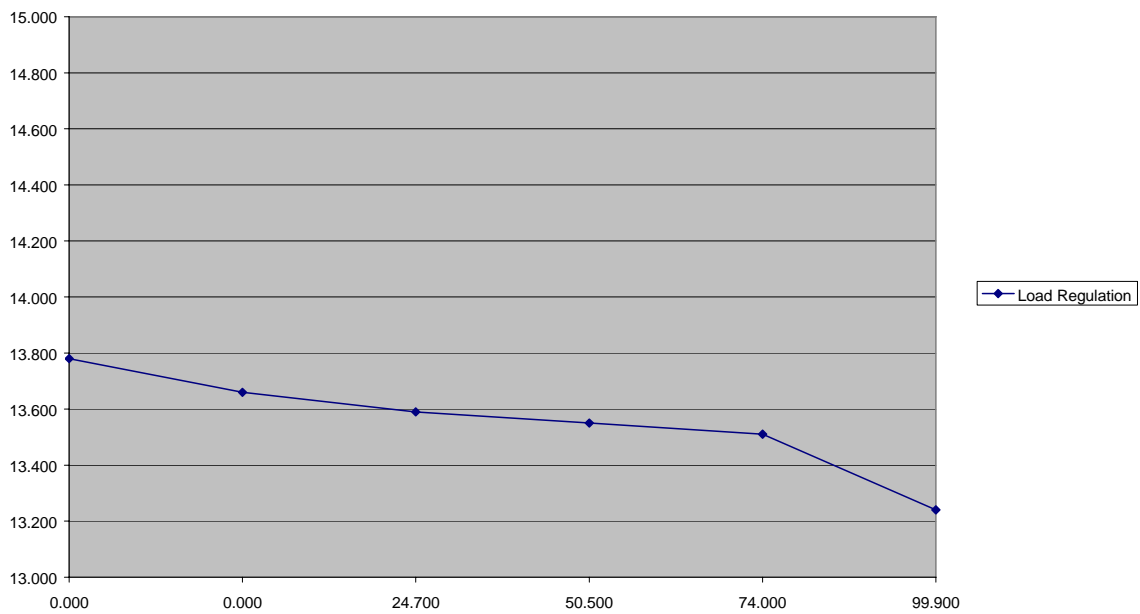
Last value is taken with both Outputs open to verify Output Voltage Regulation in that condition.

Output2 Load Regulation for Vinpeak=120V



@ Vinpeak=120V, 5V-50mA Output1

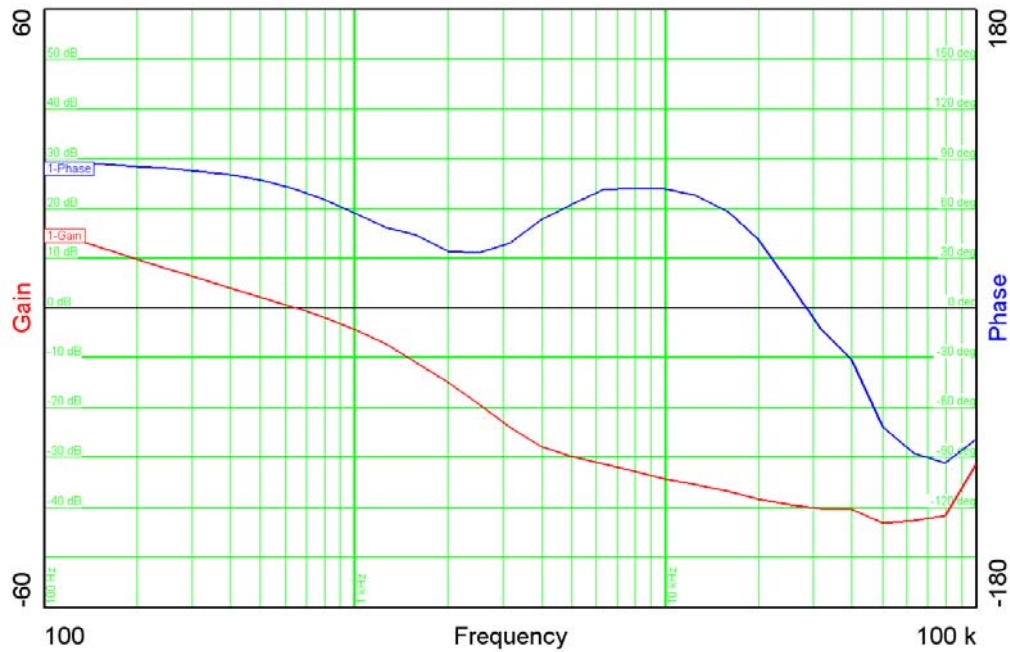
Output2 Load Regulation for Vinpeak=375V



@ Vinpeak=375V, 5V-50mA Output1

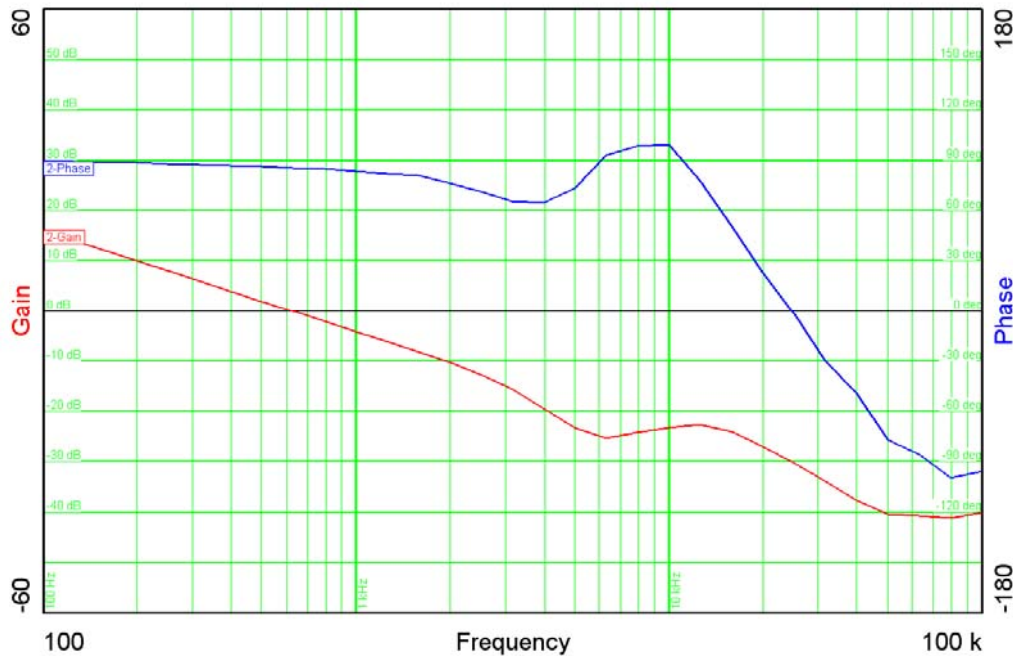
3 Control Loop Frequency Response

The figures below show the open loop response at full load on Output1 and Output2, for the minimum, at $V_{in\ peak}=200V$, $V_{in\ peak}=300V$ and maximum peak Input Voltages.



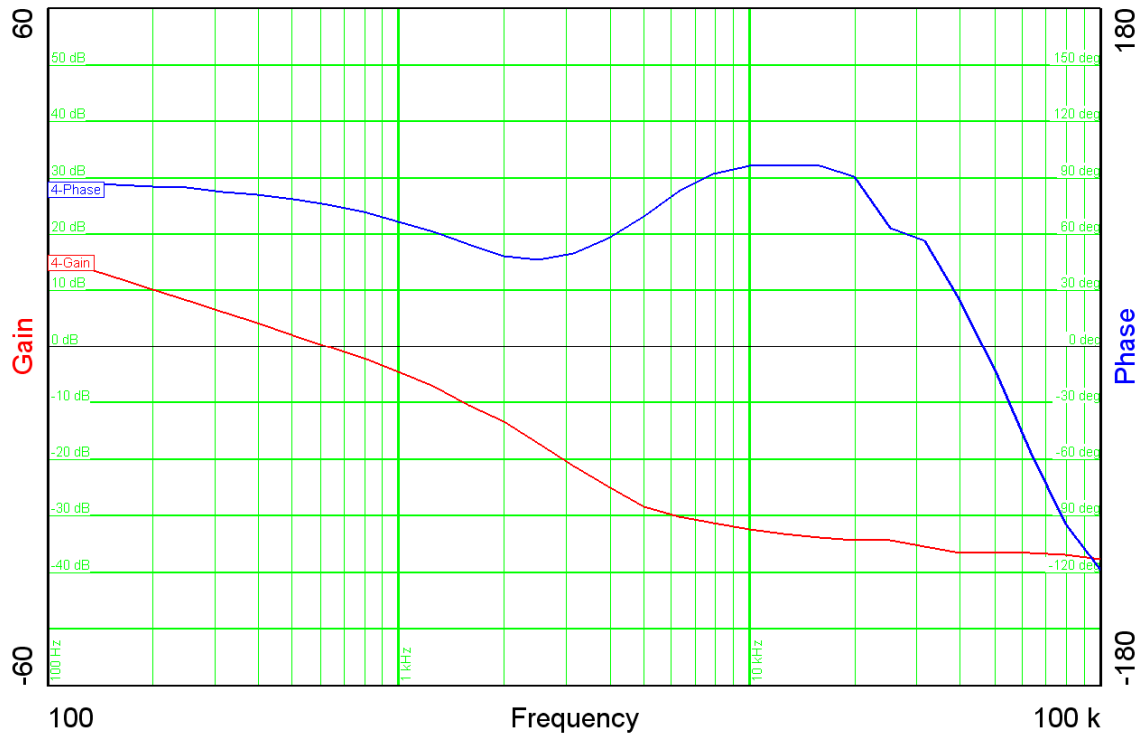
$V_{in\ peak}=120V @ 5V-20mA\ Output1, 13.5V-100mA\ Output2$

double-click to insert text



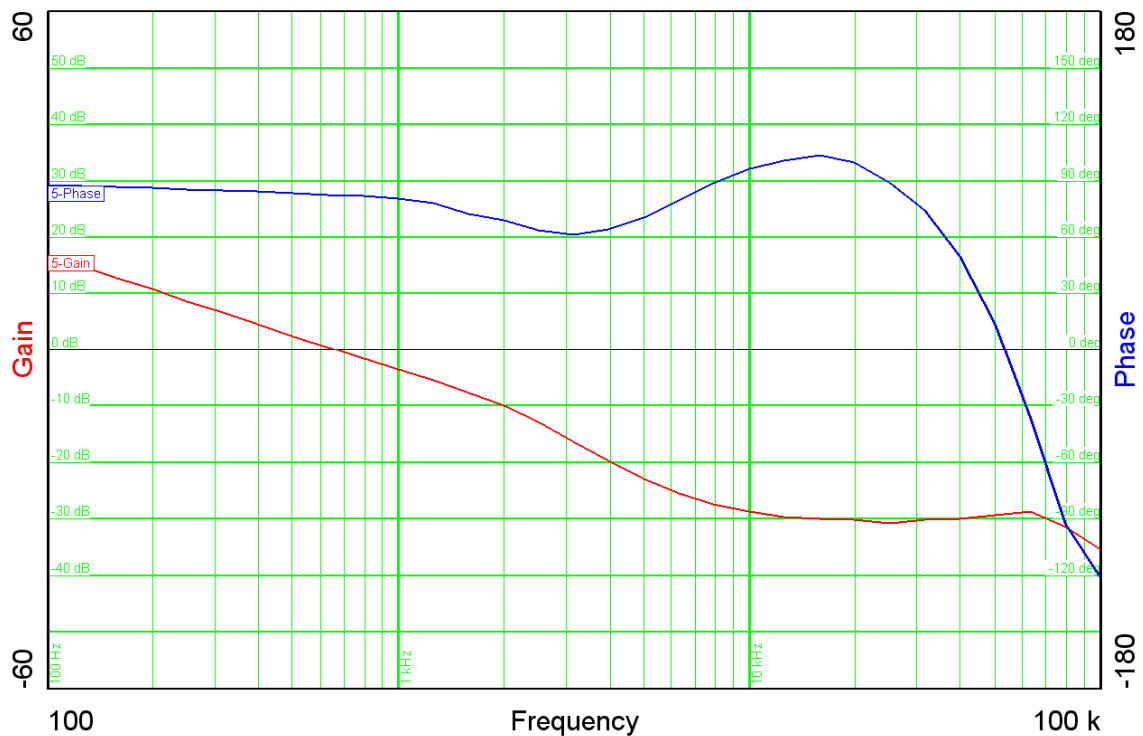
$V_{in\ peak}=200V @ 5V-20mA\ Output1, 13.5V-100mA\ Output2$

double-click to insert text



Vin peak=300V @ 5V-20mA Output1, 13.5V-100mA Output2

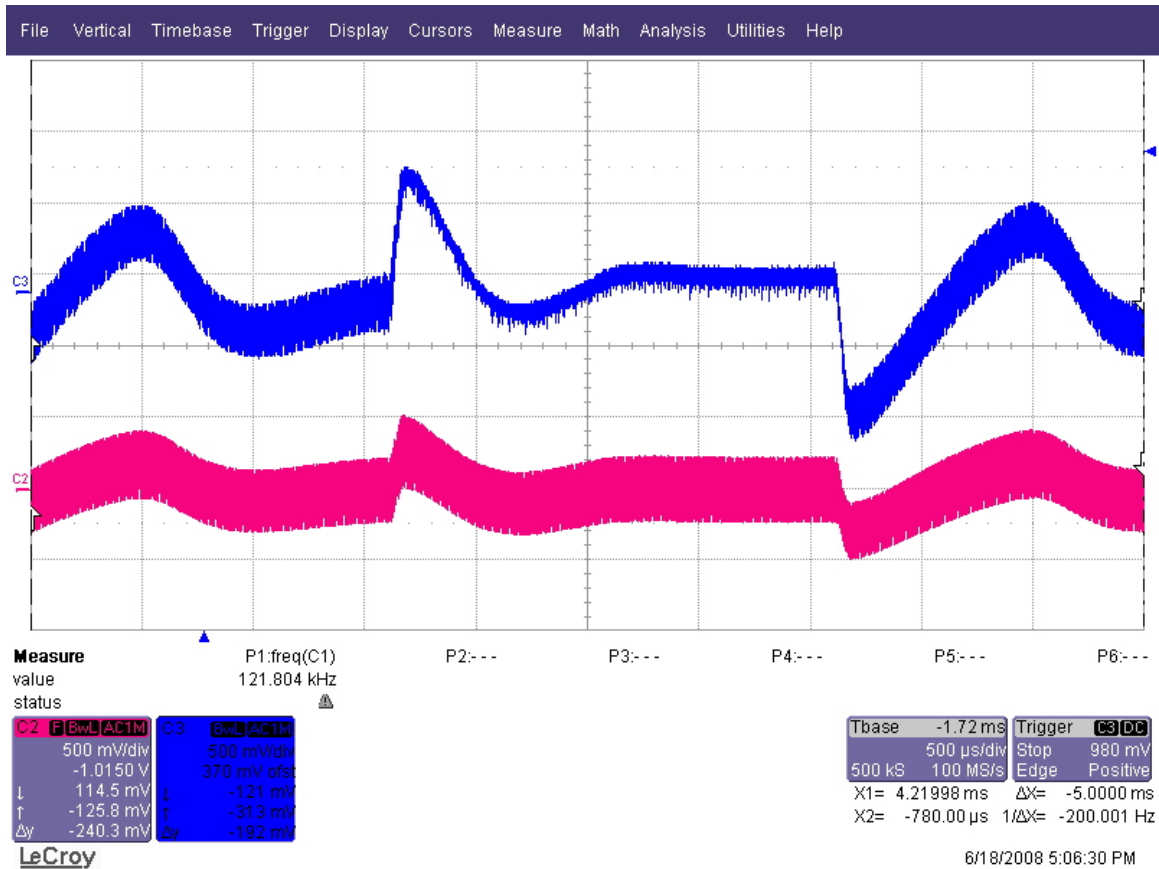
double-click to insert text



Vin peak=375V @ 5V-20mA Output1, 13.5V-100mA Output2

4 Load Transients

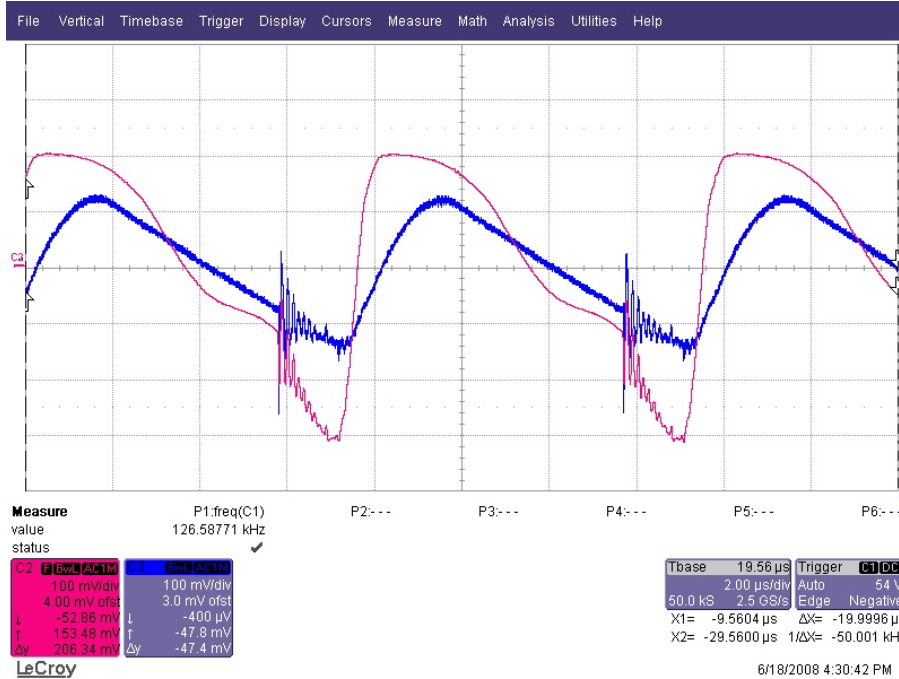
The figures below show the response to load transients. The current on Output2 is stepping from no load to full 100mA load and viceversa, with Output1 at full load.



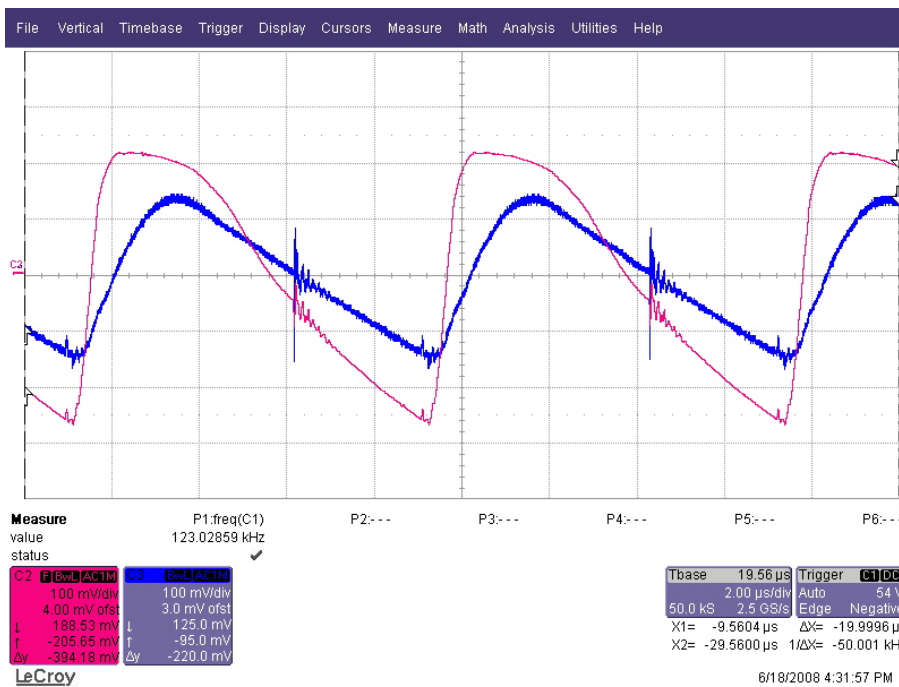
CH2 5V-20mA Output1, CH3 13.5V stepping load Output2

5 Output Ripple Voltage

The output ripple voltage is shown in the figure below, for the two Outputs at full load.



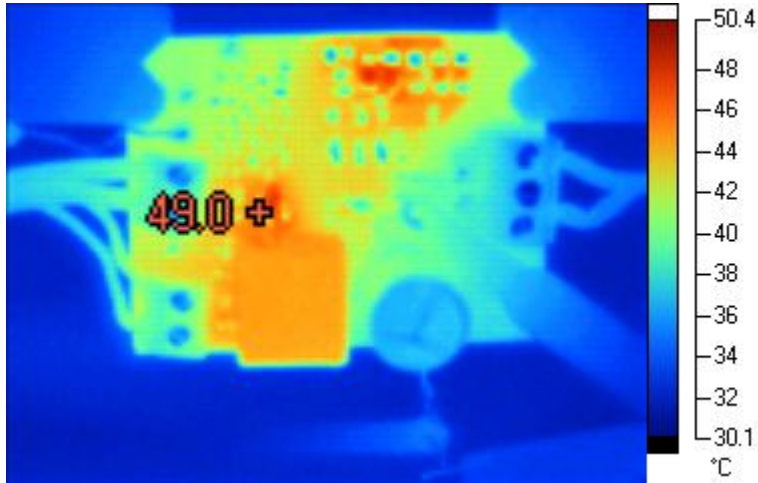
CH3: Output1 Voltage Ripple, CH2: Output2 Voltage Ripple @ Vin peak=120V



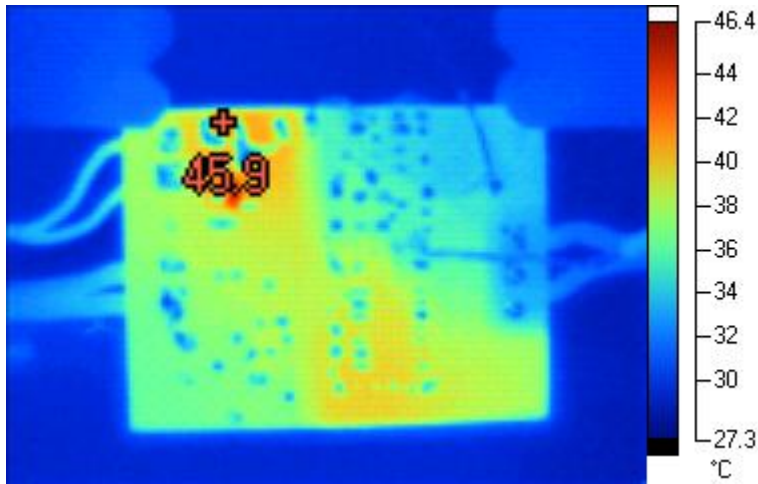
CH3: Output1 Voltage Ripple, CH2: Output2 Voltage Ripple @ Vin peak=375V

5 Thermal Images

The thermal images of board (top and bottom) are shown in the following pictures at minimum and maximum Input Voltage and Output1 and Output2 full load, with evidence of the hottest point. Tamb=25°C.



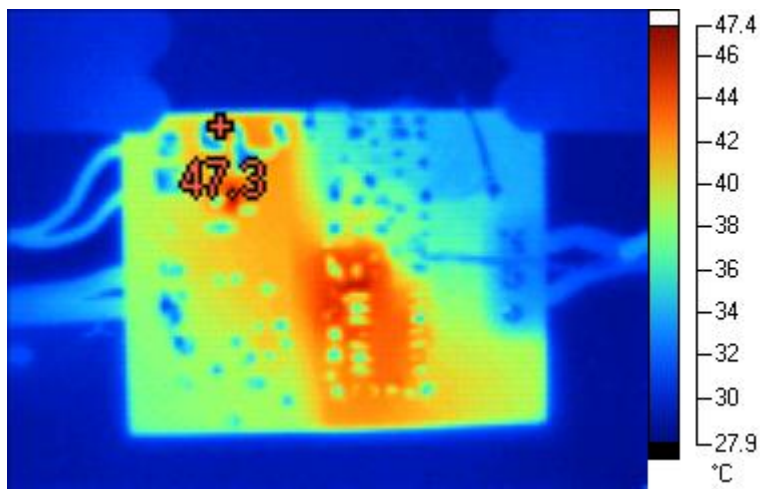
TOP Side Vin=120V peak, full Outputs Load



BOTTOM Side Vin=120V peak, full Outputs Load



TOP Side Vin=375V peak, full Outputs Load



BOTTOM Side Vin=120V peak, full Outputs Load

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