Project: Incandescent lamps dimmer

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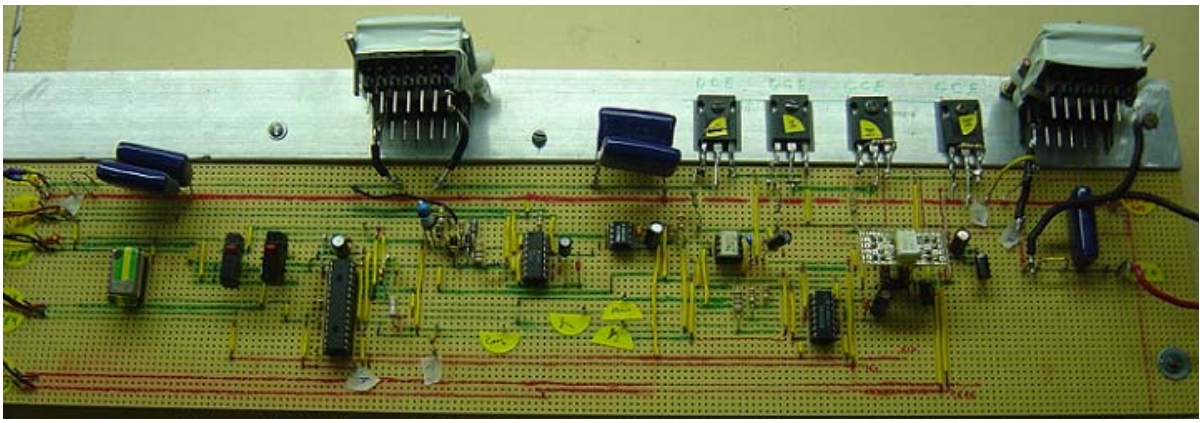
Abstract

Line current harmonics is one of the major issues in the design of a dimmer. The harmonics problem increases when attempting to achieve a modulation frequency at a “low” frequency (up to 20 KHz). The objective of this project was to design and build a dimmer that complies with the line harmonic standard but with low switching frequency.

The problem of eliminating harmonics in a switching converter at a given desired fundamental output voltage was to find the switching times (angles) that produce the the optimum switching angles for the converter. This optimization eliminated some higher order harmonics while maintaining the required fundamental voltage.

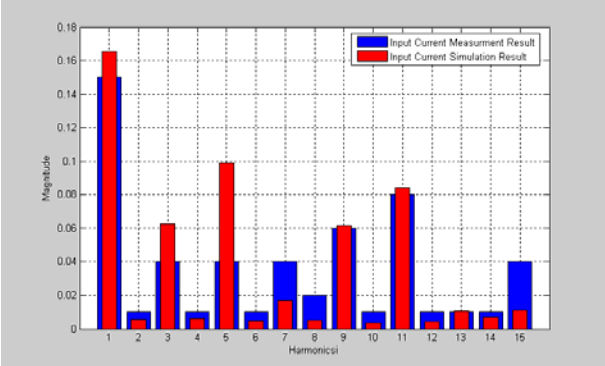
The control circuit we built eliminates up to the tenth harmonic with exact switching angles .The switching frequency is 1.3 KHz.

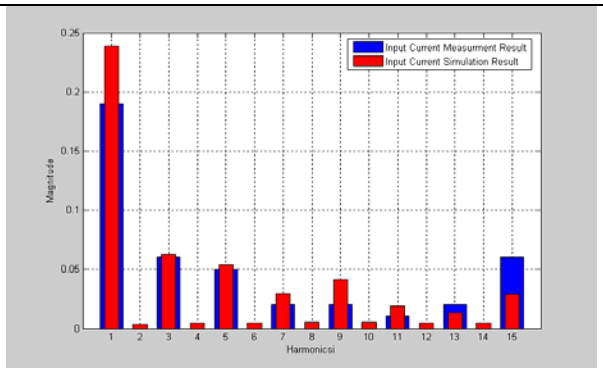
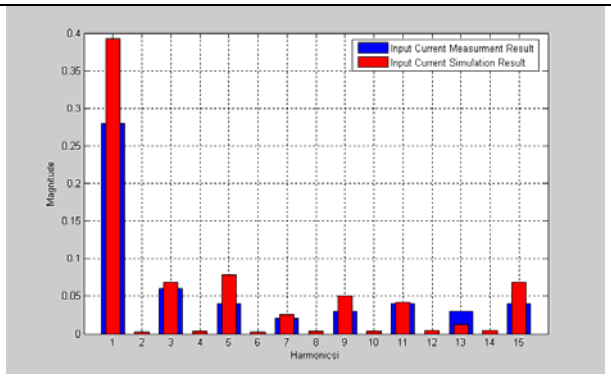
The final circuit



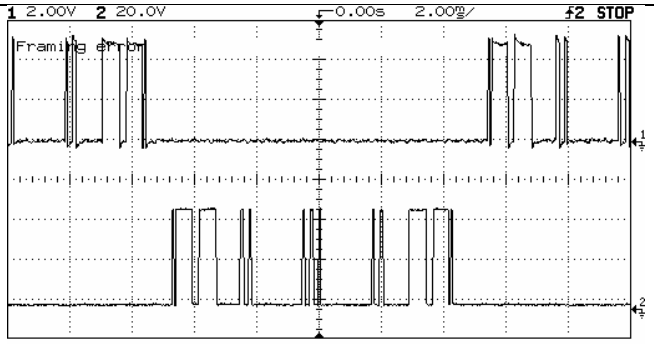
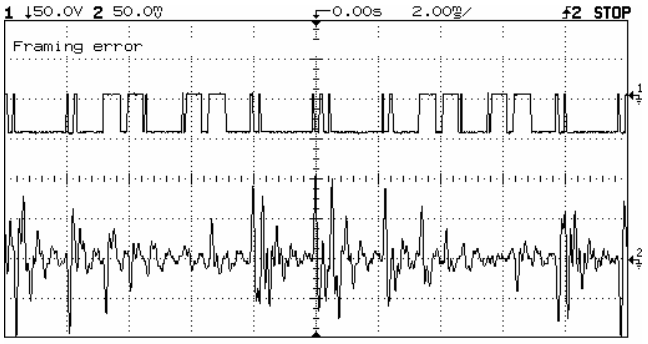
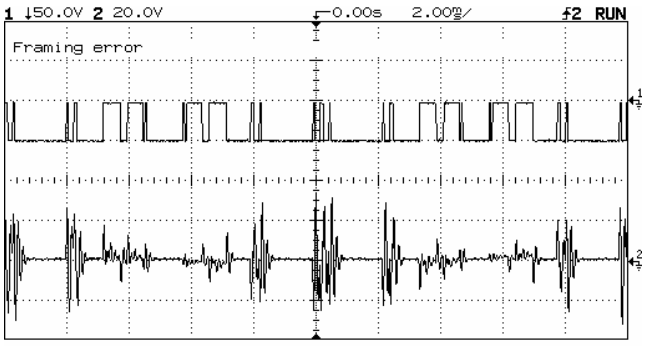
Some of the measurements we took:

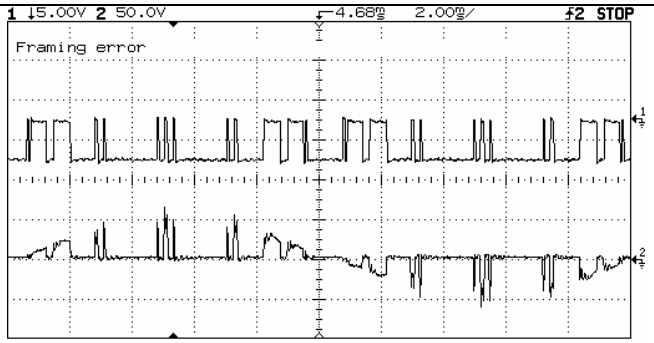
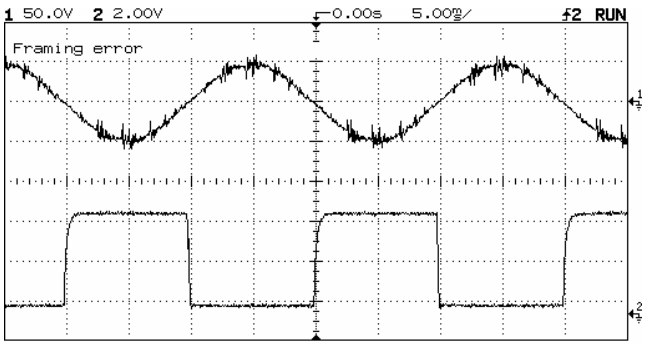
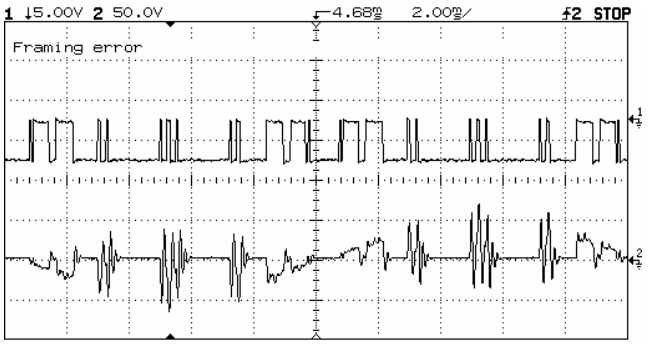
1) Measurements of the line current harmonics

Line current harmonics	Planned Output Power $(\frac{P_{out}}{P_{out_{\max}}}\Big\vert P_{out_{\max}} = 500w)$	Input voltage Vin [V]
 $I_{rms_{measured}} = 0.19[A]$ $I_{rms_{simulation}} = 0.23[A]$	23%	30

 $I_{rms_{measured}} = 0.21[A]$ $I_{rms_{simulation}} = 0.27[A]$	45%	
 $I_{rms_{measured}} = 0.29[A]$ $I_{rms_{simulation}} = 0.41[A]$	85%	

2) Wave forms with input voltage of 30Vrms

Graph	Channels	Output power
	**Upper channel** Control signal for Q3 Vs. time	Switching for 23% of the max planned output **(115W)**
	Lower channel Control signal for Q4 Vs. time	
	**Upper channel** PWM Signal Vs. time	
	Lower channel Line current Vs. time	
	**Upper channel** PWM Signal Vs. time	
	Lower channel Coil current Vs. time	

Graph	Channels	Output power
	**Upper channel** PWM signal Vs. time **Lower channel** Coil voltage Vs. time	Switching for 23% of the max planned output **(115W)**
	**Upper channel** Vin Vs. time **Lower channel** Zerocross detector signal Vs. time	
	**Upper channel** PWM signal Vs. time **Lower channel** Output voltage Vs. time	