

Project: Back Light Fluorescent Lamp Ballast

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Abstract

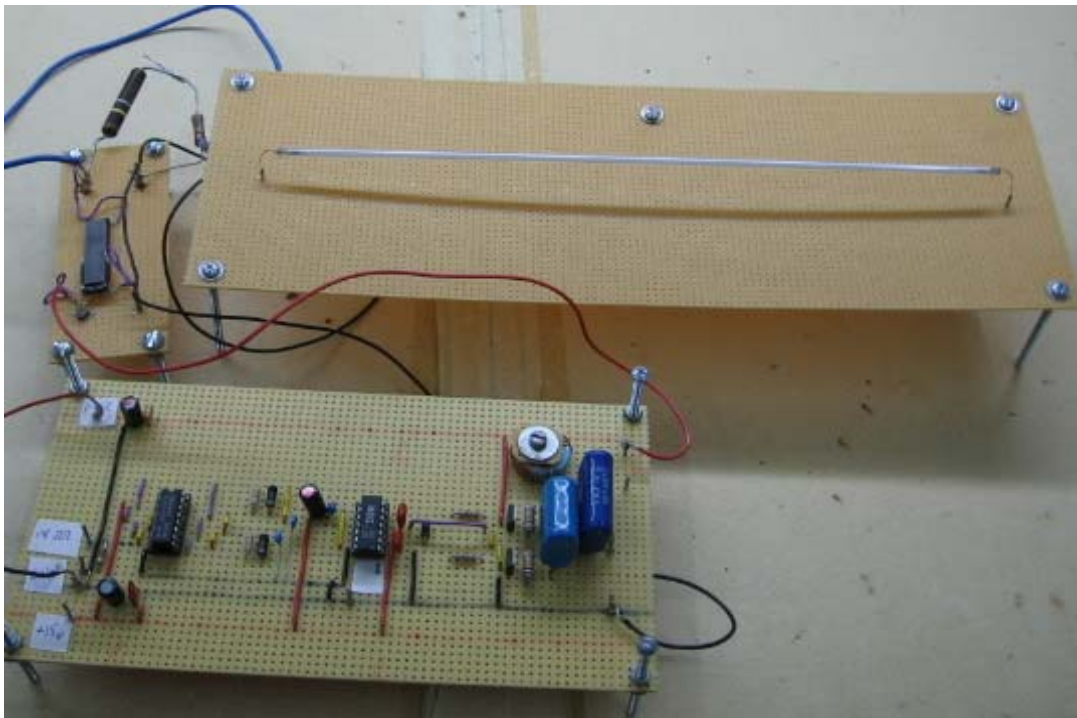
Cold Cathode Fluorescent Lamps (CCFL) are used as backlight for LCD monitors. Due to the fact that CCFL is a gas discharge lamp, increasing current causes resistance to decrease, and as long as there is adequate voltage, current will climb uncontrollably. This instability requires special attention while designing the driver.

In this project, we considered a piezoelectric transformer (PT) based driver. Piezoelectric transformers have important advantages over low power electromagnetic transformers. In particular, they have high power density, small size and weight, while maintaining high throughput efficiency. They could be designed to have very high voltage isolation between primary and secondary, can operate at high frequencies, and do not generate electromagnetic noise.

Piezoelectric transformer-based drivers are commercially manufactured, but their design is mainly based on trial and error, rather than satisfying algorithm.

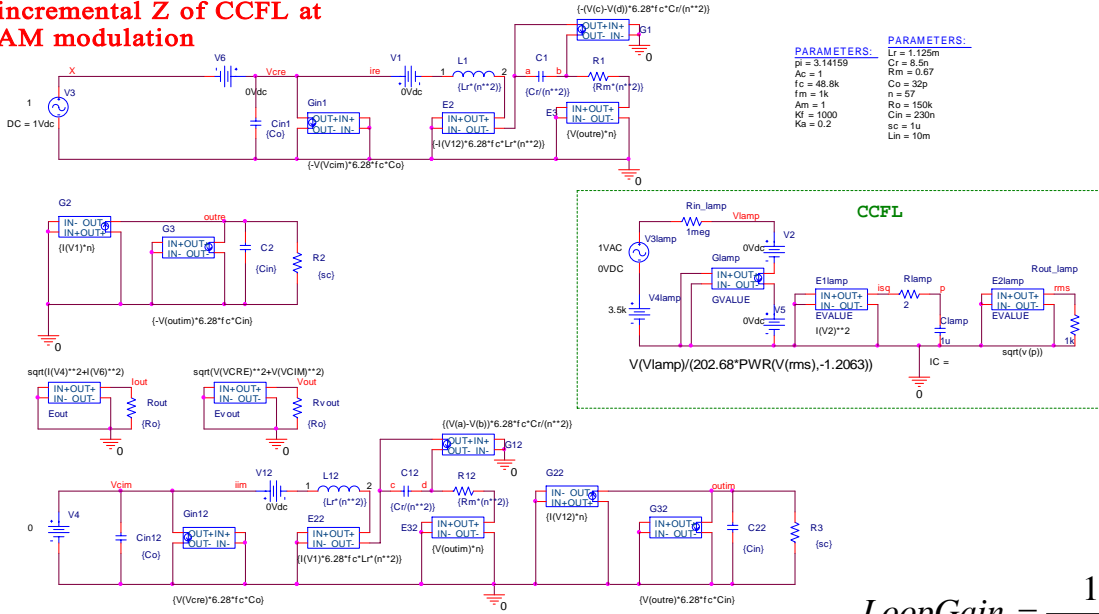
The objective of this project was to understand the interactions between the CCFL and the PT which cause instability in the CCFL current. The project includes design, simulation, and construction of a working prototype.

The circuit



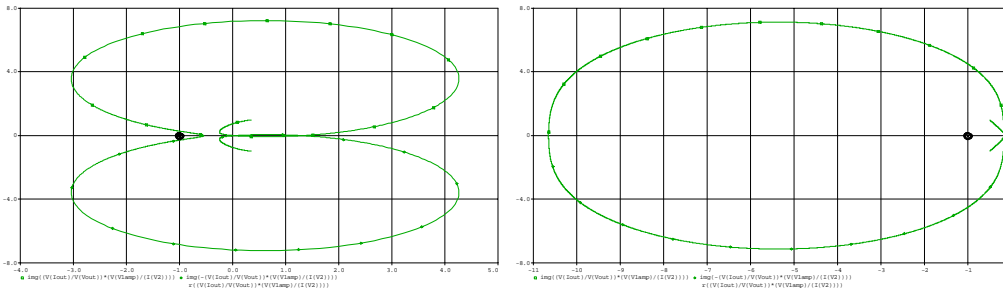
Envelope simulation of CCFL and PT (SPICE)

NYQUIST (LOOP-GAIN):
incremental Y of piezo +
incremental Z of CCFL at
AM modulation



$$LoopGain = \frac{1}{Z_{ballast}} \cdot Z_{lamp}$$

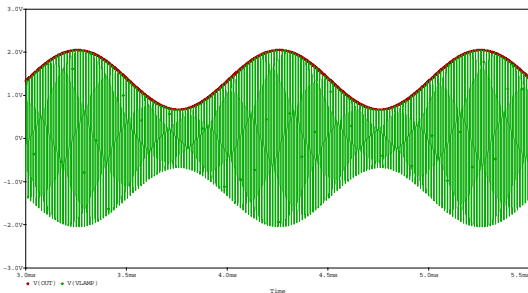
Simulation – Nyquist plots of CCFL and PT and the stability issue

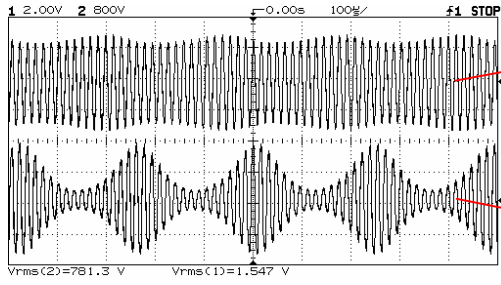


Stable

Unstable

Instability of the lamp (simulated and measured)





Lamp Voltage

Lamp Current