JKL COMPONENTS CORPORATION

TECH BRIEF

MINIMIZING CCFL/RFI

Inverter Lamp Operation

A CCFL (Cold Cathode Fluorescent Lamp) requires the use of an inverter to provide the high voltage required for the lamp's ignition and operation. A royer oscillator type inverter typically drives the CCFL's with a quasi-sinusoidal waveform with a nominal frequency of 20-100 kHz (see Figure 1). A sinusoidal type waveform will help to minimize RFI emissions although the lamp and the associated wiring will produce harmonic emissions. The typical royer oscillator CCFL inverter of Figure 1 uses capacitor C1 and inductor L1 for waveform shaping on the primary side of the high-voltage step-up transformer T1.

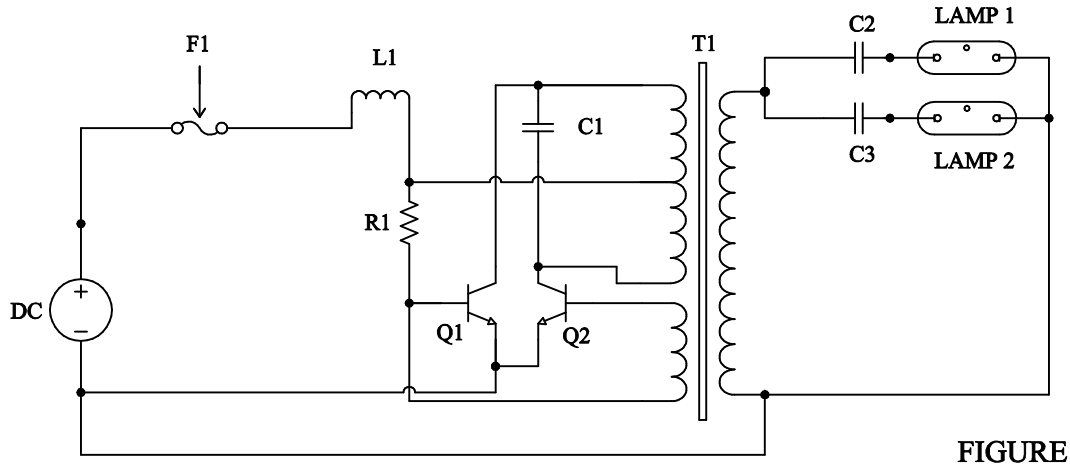
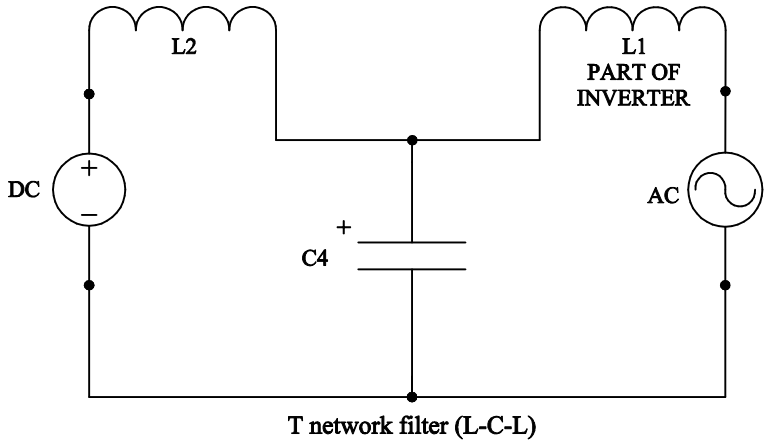


FIGURE 1

Conducted RFI

The inverter can conduct RFI back to the power supply and to other associated circuits. In applications sensitive to electrical noise, it may be necessary to de-couple the inverter circuit from the power supply. To de-couple the inverter from the power supply, an inductor and capacitor can be added on the input lines to the inverter forming an L-C filter. The added inductor (L2) and capacitor (C4) will form a T network filter (L-C-L) in combination with the inductor (L1) of the inverter circuit (see Figure 2).



T network filter (L-C-L)

FIGURE 2

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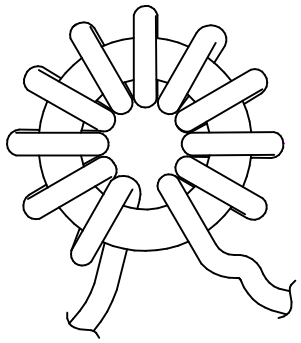
Filter Design

Consideration needs to be given to assembly and space constraints when designing an external filter for an inverter. A ferrite toroidal core of high permeability provides good RFI reduction and ease of installation by winding the + volts supply wire to the inverter through the core (see Figure 3).



$$fr = \frac{1}{6.28\sqrt{LC}}$$

LC RESONANT FREQUENCY

FIGURE 3

To provide a significant amount of attenuation of the rms voltage noise, the L-C filter component values need to be selected to provide a resonant frequency considerably lower than the inverter oscillation frequency. A reasonable design goal is for a resonant frequency below 1 kHz. Test filters using an Amidon FT-50A-W core with 10 turns of wire for an inductance of 60mH for L and a 47uf electrolytic capacitor for C result in a resonant frequency calculation of 95 Hz.

A reduction of -30 dB is achieved with an L-C filter at a frequency of about 6 times that of resonance, which is 570 Hz for the chosen L-C filter values. If too low of a resonant frequency is chosen for the filter network, the physical size of the inductor and capacitor may become too large to be feasible for use in a design. The toroidal core types are often desirable for inductors used in RFI filters in that the magnetic flux lines are confined within the circular core and reduce radiated noise.

Filter Function

In the T filter network of Figure 2, the DC voltage has a low resistance path to the inverter through the inductors. The AC voltage on the inverter side of the network encounters high impedance from the inductors and a low impedance path to ground through the capacitor. The results are a high degree of attenuation of AC voltage and a minimal DC voltage drop.

Filtered Inverter Performance

Using the filter design of the 60 mH inductor and a 47uf capacitor on the input to JKL inverter BXA-12529 driving two 4.8mm X 140mm CCFLs, the rms voltage on the power supply line is reduced -29 dB. The noise level was further reduced to a -32 dB level by increasing the value of the filter capacitor to 100uf. In testing of various lamp diameters and lengths on the BXA-12529 inverter, rms noise on the power supply lines with the filter network installed is less than 6mv.