PTC Application Lighting

Ceramic PTC thermistors are widely used in CFL lamp ballast designs to regulate the preheating and ignition timing of the lamp. To properly design-in a PTC element, one needs to know specific design parameters of the lamp to make the right selection.

Some parameters have a direct influence on the pre-heating time of the lamps filament. Some of them are related to the lamp circuit, some of them are related to the PTC parameters. To align them, a good understanding of how they work together is needed.

Here is a description of the main parameters that will determine pre-heat time:

- PTC related items:
  - Cold resistance of the PTC (R25): lower values will increase the trip or pre-heat time.
  - PTC ceramic volume: smaller parts will decrease the trip-time.
  - Curie or switching temperature: the point where the PTC resistance value will sharply increase will determine the initial ignition time. The higher this temperature, the longer it will take.
  - PTC materials used: good thermal conducting lead-wires like copper will slightly increase trip-times. Also coating material on the PTC will lengthen somewhat the ignition time. High thermal conductive leadwires, seating plane distance to the ceramic body and the use of coating will also determine partly the power consumption of the PTC when in the operating “hot” state.

- Ambient and environment related items:
  - Ambient temperature: lower ambient temperature inside the lamp ballast will increase lamp ignition time.
- Lamp circuit related items:
  - The amplitude of pre-heat current (effective value) that is generated and is dependent on the load (PTC + filament resistance + eventual parallel or serial capacitor impedance) and max. output current that can be produced: the higher this current, the faster the PTC will heat-up, although the PTC itself will partly determine the current flow. Only the portion of the current that runs through the PTC will determine the ignition time.
  - The frequency of the initial pre-heat current: as this frequency is usually lower than the lamp operating voltage frequency, it can have an influence on the pre-heat time, taken into account that ceramic PTC’s have a certain parallel capacitance value that will determine which part of the current will generate the necessary Joule effect to heat-up the PTC.

As many parameters influence pre-heat or ignition time, it is advisable to take some reference when choosing a specific PTC for such an application. All published PTC’s are specified at 25 °C and with trip-times measured at the moment of sharp resistance increase or lamp-ignition, currents being standardized at 50 Hz/60 Hz. Typically lamp design engineers are looking for standard pre-heat times between 0.5 s and 1.0 s. Longer ignition times have the negative effect of giving rise to subjective impression that the lamp has a starting problem. At extremely low ambient temperatures this can result in a lamp that will not ignite. Too short ignition times will lead to shortened life time of the lamp.

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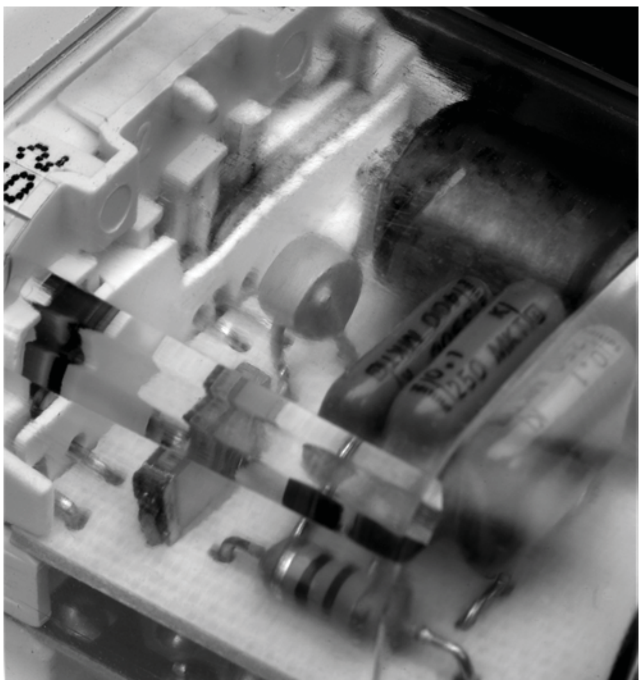
A suggested design sequence first selects PTC (R25) resistance to obtain desired pre-heat filament current. Next, select PTC mass (diameter) and/or Curie switch temperature for proper cathode pre-heat (pre-ignition) timing. A wide variety of standard Vishay PTC Lighting Thermistors are available for laboratory experimentation.

Since many parameters are influencing each other, trip or pre-heat times can only be estimated. As a reference, typical trip-times are specified at a certain current which needs to be checked if it is a valid value in the application. When the pre-heat current for a certain load resistance (PTC + lamp filament + other impedances) is known, a trip-time can be found in the relevant specifications of the Vishay PTC products.



For proper design-in of Ceramic PTC's into HF lamp ballasts, other factors will determine lamp and PTC life. Among these factors are the wearing of solder-joints due to repetitive cold-heat cycles. For the mostly used PTC's with the relatively low Curie or switching temperatures, cycling time or number of switch-on cycles can easily go up to 50k cycles or more. In some lamp ballast designs it is important to know what will happen when the lamp itself is at end of life and will not ignite anymore. In that case a relatively high voltage can become present on the PTC for a prolonged time. When selecting a device, this should be taken into account as well as maximum peak ignition voltage.

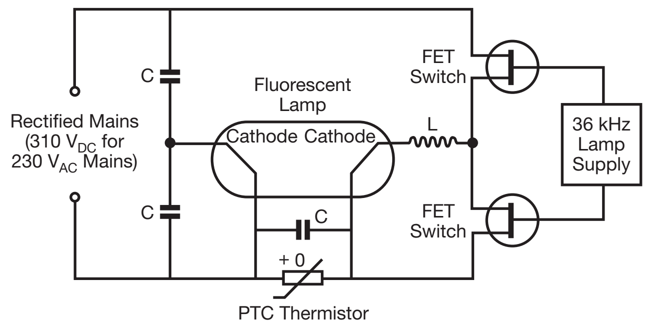


Fig. 1 - Typical Electronic Ballast Circuit

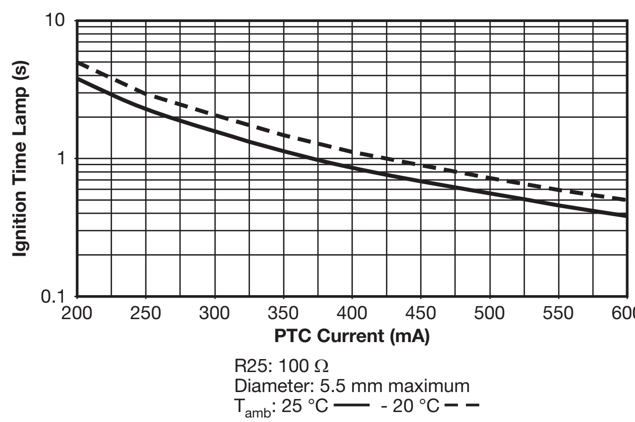


Fig. 2 - Typical Current-Time Characteristic

More information on product selection can be found on: www.vishay.com/thermistors/lighting/