

Modeling of a Projector Lamp Operated by a U-Drive Pulse Power Source

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Extremely high-pressure mercury lamps, which operate at a pressure of around 20 MPa, have been into significant use in today's projector-lighting. These lamps are found to provide outstanding performance and hence have been grabbing the market very rapidly. In developing such specialty lamps, the companies have been facing a key-problem of sustaining the electrodes because they become over-heated during operation. This immense heating of the electrodes causes to raise the tip temperature, especially of the anodic-phase electrode during an alternating-current operation, far above the melting point, and as a result, electrodes' damage/evaporation is significant. Such a situation is very detrimental to the lamp performance and longevity. A frequency modulated power supply, U-drive pulse power source¹, has been reported to improve electrodes and lamp performance. A U-drive source superimposes a low frequency current-pulse within a fundamental high-frequency current-pulse intermittently (Fig. 1).

This article is devoted for developing a mathematical model to simulate ultra-high-pressure lamp, which is operated by an alternating current from a U-drive source. The lamp is filled with mercury gas of 10 MPa operating pressure. The model solves the complete

set of magnetohydrodynamics within the fluid domain, radiation-considered and radiation-less energy balance equation in the semi-transparent (glass) and opaque (electrodes) domains, respectively. Essential features of the model are discussed in previous report². A square-wave pulse current (of an amplitude of 1.4 A) is taken to have the regular frequency of 400 Hz and the superimposed slower pulse is of 90 Hz. Evaluated time-dependent electrode temperatures for the regular and superimposed frequencies have been found to be consistent with those reported experimentally. The model, thus, demonstrates suitability in predicting performance of a prospective new lamp, subsiding expensive developments of many prototypes and difficult tests.

1. T.Tsukamoto, Y.Horikawa, and A.Sugitani, "Current waveform optimization of AC-operated short arc ultra high pressure mercury lamps for projection applications", 11th International Symposium on Science & Technology of Light Sources, May 20-24, 2007, pp.249-250.
2. K.C.Paul, T.Takemura, T.Hiramoto, and T.Igarashi, 11th International Symposium on Science & Technology of Light Sources, May 20 - 24, 2007, pp. 419 - 420.

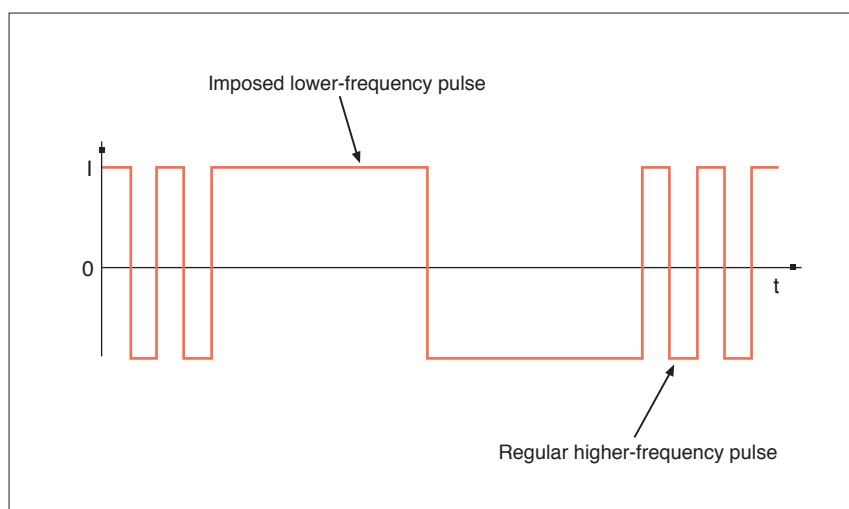


Fig.1 : Current pulse of the U-drive pulse power source.