PHILIPS
bodine

Philips Emergency Lighting

AC Line Harmonics and Bodine Fluorescent Emergency Ballasts

Electronic equipment can impact powerline quality adversely through low power factor, high line current harmonics and voltage waveform distortion. With the increased usage of electronic equipment in commercial, industrial and institutional buildings comprising a growing percentage of the total electrical load, the issue of powerline quality needs attention.

Historically, power factor was expressed as the cosine of the phase angle between the voltage and current waveforms. The current could be leading (capacitive load), in-phase (resistive load) or lagging (inductive load). This method of expressing power factor is valid for linear loads such as motors, heater coils, incandescent lamps, etc. The key is that the voltage and current waveform have the same shape; namely, the sine wave developed by the utility company's generators. If the power factor of a particular load is low due to phase shift, then it can be corrected by the addition of a counterbalancing reactive load. Usually capacitors are needed to correct the lagging currents of magnetic coil-containing devices.

With nonlinear electronic equipment, current is drawn from the AC line near the peaks of the voltage waveform. Very little current flows at or near the zero-crossings. This also leads to low power factor (which means poor utilization of the power transmission equipment - transformers, panels, branch circuit wiring, etc.). Because the power factor is low due to the voltage and current waveforms being different in shape, not just in time, it cannot be corrected through the addition of passive, reactive components. The current waveform also contains frequency components at odd harmonics (multiples) of 60 Hz that do not cancel in balanced, three-phase power systems. This leads to unexpectedly high currents flowing in unbreakered neutral conductors and overheating of transformers that weren't designed to handle high-frequency power.

If the current is drawn from the line in big enough peaks (rather than in a smoothly changing sine wave) the line voltage may sag at the peaks. This distorted voltage applied to other loads may cause them to operate improperly. So, the importance of maintaining high power factor and low harmonics is multifaceted.

Philips Bodine fluorescent emergency ballasts are electronic equipment. However, the high-frequency switching inverter is powered from the internal battery, not the AC line. The only current drawn from the line is for the battery charger. Input power and current are quite low because the nicad battery is being continuously trickle-charged in a standby mode.

Most Philips Bodine models use a capacitive charging circuit that pulls 280 mA, 3.5 to 4.0 Watts in a substantially sinusoidal wave with THD of 26%. The 3rd, 5th, 7th and 9th harmonics are 14%, 17%, 7.0% and 5.5%, respectively. No higher harmonic exceeds 5%. The power factor of the capacitive charger is approximately 10% (leading).

Due to the low currents and powers of these products, coupled with their relatively low THD, the impact on powerline quality should be minimal. The harmonic currents are measured in milliamperes and the input powers are just a few Watts. The capacitive input charger used on most models should serve to increase overall building power factor in most installations.

A Division Of Philips Lighting Electronics North America
236 Mt. Pleasant Road • 38017 • P.O. Box 460 • Collierville, TN 38027-0460 • 800-223-5728 • 901-853–7211 • FAX 901-853–5009
www.philips.com/bodine