Chapter 12

Design, Measurements and Characterization of Smart Electronic Board for PV Streetlight based on LED and High Intensity Discharge Lamps

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ABSTRACT

This work presents an electronic board for driving and control of High Intensity Discharge (HID) lamps and Light Emitting Diode (LED) lamps. The proposed electronic board is able to drive HID or LED lamps by means of a reconfigurable output. This feature allows using the ballast in lighting systems that currently use traditional discharge lamps, as well as keeping the same ballast when discharge lamps are replaced by LED modules in the near future, when LED street lighting systems will be more affordable. Additionally, since the lighting system is designed to be used in rural areas where there is no public electricity, each lighting point incorporates a system to convert solar energy into continuous voltage by means of photovoltaic panels. In this work, energy saving issues are taken into account.

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1. INTRODUCTION

The future of public lighting will be the white LED based lamps. Essentially, LED technology has got several advantages with respect to old HID technology. First of all the operational life of these lamps is about 100,000 hours, actually, more than six times the operational life of HID lamps (typically 15,000 hours). Another important aspect to be taken into account is the power consumption; the LED technology allows getting higher efficiency (lm/W) than High Pressure Sodium (HPS) lamps. Moreover, LED lamps turn on instantaneously and do not need a warm-up period. This technology is spreading in new systems and applications as well as in power saving intelligent systems. Due to a very expensive installation cost, the old lighting systems should not be replaced but just retrofitted by adding the power saving intelligent systems.

For these reasons, an electronic board which can drive both HID and LED lamps will assume a crucial relevance in the public lighting systems. Moreover if the electronic board would also provide a remote control for dimming and powering on/off of the lighting points, the control system might be more interesting. In many rural areas that are not crossed by power distribution lines, the street lights cannot be installed, even if they are very important and necessary for avoiding street accidents and assuring people life safety. For this reason we have also provided the opportunity to supply the individual lighting points through the solar energy produced by a photovoltaic panel.

2. ELECTRONIC BOARD BLOCK DIAGRAM

The general architecture of an electronic ballast for high intensity discharge lamps (Rashid, 2007) is shown in Figure 1.

An EMI filter connected to the power line is responsible for limiting electromagnetic interference. After the bridge rectifier that converts AC into DC voltage, a device called Power Factor Corrector (PFC) optimizes power consumption by the power line, avoiding unnecessary loss of power, and provides a high voltage (Vbus). The
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