

Introduction

The rapid adoption of High Brightness LEDs (HBLEDs) for general lighting applications is challenging the designers of the lighting fixtures or luminaires with the need to develop low cost, efficient, low voltage, constant current drivers. Depending on the application, number of LEDs and their configuration in series and parallel strings, the number of designs required is exploding. Being able to rapidly test these power supplies with a flexible, programmable load that simulates the particular LED configuration is of increasing importance. This is especially the case if the driver design precedes the availability of the actual LED assembly in design. Being able to simulate anomalous operation such as a shorted or open diode in a series string, parallel string or matrix connection can save time and money in the qualification of the power supply.

In this application note, we explore using an electronic load (eLOAD1) as an HBLED load simulator. This note details how to use a simple standard feature of the AMREL load functionality, "V(on)" or otherwise referred to as "under voltage lockout protection" (UVL), to simulate the forward voltage turn on of the HBLED string. The constant resistance control mode is then used to set the nominal operating point. In addition, the note briefly explores the use of multiple loads to simulate more complex parallel string and matrix configurations.

The test setup and results are presented along with a brief discussion of some of the considerations when specifying equipment for testing.

Application Requirement

The application statement is simply to simulate a simple series string connection of HBLEDs with a forward voltage threshold of 40 volts DC and specified operating voltage and current of 42.2 V and 3 A DC, respectively. For application simplicity, a standard lab power supply will be used to simulate the HBLED driver (DUT).

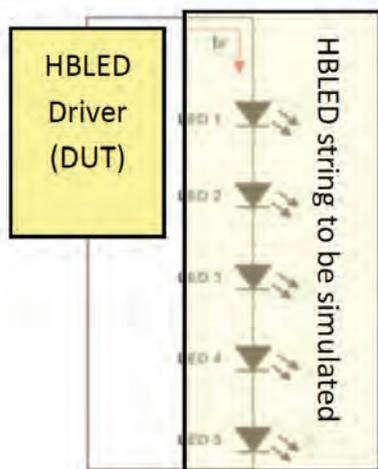


Fig. 1 HBLED String

Application Solution

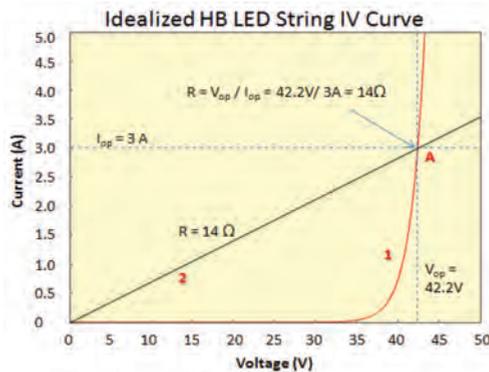
The standard programmable function being used to set the simulated V(fwd) of the string is called V(on) or undervoltage lockout "UVL". This function allows the user to set a trigger point between zero and the load's full-scale voltage. The input will remain off until the input voltage is greater than the pre-programmed value (V(on) = Voltage threshold). For the V(on) (UVL) feature, there are two modes that can be set. In "continuous" mode, the UVL detection will remain active, and each time the voltage drops below the set threshold voltage, the function will shut off the input. When in "input on" mode, the function will only trigger once to shut down the input and will reset each time the input is cycled.

Refer to the VI chart below. The two curves illustrate an idealized diode string curve (1) and a constant resistance profile (2). To establish the operating point, the constant resistance control mode will be used with the resistance value set to be that where the DUT specified operating voltage and current intersect (A). That is, $R = V(op)/I(op)$

The simulation test setup consists of a Sorensen XG 60-14, a 0 to 60 Vdc, 0-14A, 850 W DC programmable supply set at 45 Vdc. to simulate the driver DUT. The supply will be set to operate in constant current mode at 3A. The load being used here to simulate the HB LED string is the AMREL bench load series model BPL400-400-30.

The eLOAD is set to operate in constant resistance mode with a $R = V(op) / I(op) = 42.2V/3.0A = 14\Omega$. The V(on) function is set to trigger at 40V.

Fig. 2 Typical IV Chart



Simulating HBLEDs for Driver Testing

Results

In summary, as can be seen from the scope capture below (figure 3), the load turns on at the set $V_{(on)}$ point (trace 2) and the current (trace 1) rises to the designed operating point. This illustrates how the standard functionality of the eLOAD can be used to simulate diode characteristic loads including, but not limited to, HBLEDs.

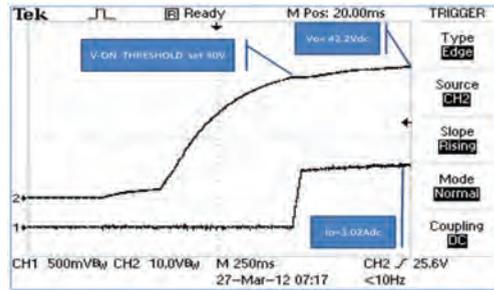


Fig. 3 eLOAD Scope Trace

For more complex connection schemes including parallel strings and matrix configurations (figures Y and Z), multiple eLOADs can be used. To simulate shorted or open circuit diodes or strings, the individual eLOADs can be set to toggle between various resistance values to provide the desired anomalous conditions to observe the operation of the driver under test.

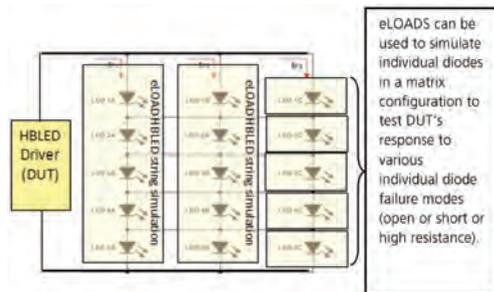


Fig. 4 Simplified Matrix Configuration

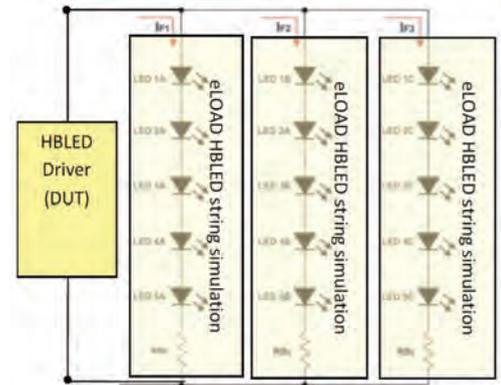


Fig. 5 Parallel String Configuration

Conclusions

It has been demonstrated that load simulation of HBLEDs in various configurations, for testing of HBLED driver supplies can be achieved quite simply using the standard functionality of the AMREL eLOADs

In addition, the use of off-the-shelf power products affords flexibility for configuring the equipment for specific test requirements. Careful consideration should be given to sizing the equipment appropriately for the DUT and type of test to be conducted. For example the eLOAD for simulating individual diodes may require an understanding of the forward threshold voltage to be modeled and require a "zero" volt type of eLOAD:

About AMETEK Programmable Power

AMETEK PPD is a division of AMETEK Inc, a multi-billion dollar manufacturer of differentiated technology solutions, and designs and manufactures advanced programmable DC, AC and eLOAD products under the well known and respected Sorensen, California Instruments, Elgar and AMREL brands.

For more than forty years AMETEK has supplied precision programmable power products and systems to diverse industries for test and measurement needs, ATE systems, R&D, process control, power bus simulation and power conditioning. Its products and services are recognized around the world for robust performance, high quality, reliability and economic value.

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