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Using LEDs as Programmable Load

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ABSTRACT

Typical programmable loads use a pass element such as a transistor to sink a certain amount of power from a target source. The pass element can get very hot and require a heat-sink and active cooling to maintain it within operating temperature. Active cooling solutions can be expensive and require maintenance. This disclosure describes programmable loads constructed out of LEDs. By replacing the pass element with an LED, during the test process, electric energy is converted to light instead of heat. By thus reducing the heat load, thermal management needs for the programmable load are reduced, thus reducing the need for expensive and maintenance-intensive active cooling solutions.

KEYWORDS

- Light emitting diode (LED)
- Programmable load
- Electronic load
- DC load
- Battery testing
- Battery characterization
- Device under test (DUT)
- Active cooling
- Passive cooling

BACKGROUND

A programmable load is an instrument that offers the user various modes of control such as constant voltage, constant current, constant power, or constant resistance. Programmable loads

are used to test various equipment. Typical programmable loads use a pass element such as a transistor to sink a certain amount of power from a target source.

During testing, the pass element can get very hot and require a heat-sink and active cooling (fan) to maintain it within operating temperature. Active cooling solutions can be expensive, and, being mechanical in nature, require maintenance. Their limited life-cycles can necessitate frequent replacement.

DESCRIPTION

Light emitting diodes (LEDs) convert electricity into light with high efficiency. LEDs emit less heat during the electric-to-light energy conversion process. This disclosure describes programmable loads constructed out of LEDs. By replacing the pass element with LEDs, a substantial portion of electric energy is converted to light instead of heat. The higher the LED efficiency, the lower the heat generation. By thus reducing the heat load, thermal management needs for the programmable load are reduced, thus reducing the need for expensive and maintenance-intensive active cooling solutions.

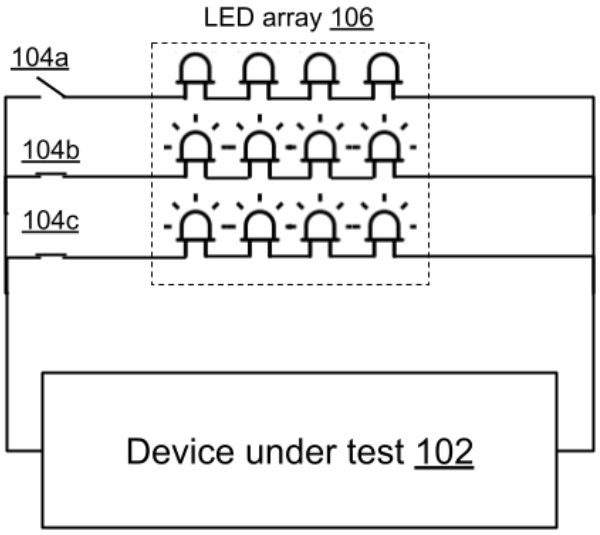

Fig. 1: Programmable load using LEDs

Fig. 1 illustrates an example of programmable loads constructed using LEDs. The programmable load can be used as part of a battery emulator to predictably measure and characterize battery performance, e.g., for batteries of devices such as laptops. Battery emulators allow a device operating system to measure and characterize the battery performance on a device in production and/or under development. The battery emulator can be used to emulate both charging and discharging a battery.

In an example, the array of LEDs (106) is used as a programmable load that acts as a pass element for the battery emulator. The programmable load is used to burn off the energy that the device under test (DUT, 102) provides to the emulator. In this case, the functionality of the DUT of charging a battery is tested. The LED array converts the received energy into light (plus heat).

In another example, the DUT can be a laptop or other device that is being charged. In this case, the LED array can be used to simulate a battery that is charged using the charging circuitry of the laptop. While in actual operation a true battery stores energy sent its way by the laptop, in the test setup, the simulated load (the LED array) simulates battery charging by dissipating incoming electric energy as light. In this case, the LEDs are used to burn-off the excess energy so that the emulated battery can control the voltage ramp as seen on an actual battery.

The LED array can include one or more rows of LEDs, each row comprising one or more LEDs. Programmability in loading levels can be achieved using programmable switches (104a-c) that can either connect or disconnect a row of LEDs from the DUT. The DUT can include onboard sensors or software that can measure or characterize its performance under varying load conditions.

In contrast to a traditional simulated load, which comprises a pass element that dissipates incoming electric energy as heat, the described simulated load dissipates incoming electric

energy as light. In contrast to the traditional simulated load, the described simulated load requires no active cooling. Rather, it is a solid-state, passive cooling mechanism with no moving parts and a much longer, maintenance-free lifetime.

CONCLUSION

This disclosure describes programmable loads constructed out of LEDs. By replacing the pass element with an LED, during the test process, electric energy is converted to light instead of heat. By thus reducing the heat load, thermal management needs for the programmable load are reduced, thus reducing the need for expensive and maintenance-intensive active cooling solutions.