

# 1 Abstract

Humanity is facing an evergrowing crisis. The demand for energy is rising day by day and an end is not in sight. Scientists are researching every imaginable possibility. One of those possible solutions is solar energy, however before this technology can be commercially used it needs further testing, yet this proves difficult since solar light is needed to operate a solar panel, which is difficult to reproduce in a laboratory environment. To measure a solar panel and thus optimize it, a testing unit is needed, which is difficult to design due to the aforementioned problems. A solution to this is to simulate the output of a solar panel. This leads to the main objective, the development of a simulator, which emulates a real photovoltaic cell. This comes with the benefits of not needing sunlight in order to operate. Furthermore, the possibility exists to simulate different operation modes of a solar panel such as “defect” or “dirty” without the need of damaging or soiling the solar cell. In addition it is possible to mimic a change on the intensity of the light which falls onto the solar panel. In summary a simulation is vastly superior when compared to a real photovoltaic panel in regards to testing a measurement unit for the mentioned panel since no environment factors have to be considered and the susceptibility to faults is much smaller.

The simulation device converts the power supply voltage to 24VDC and 3.5A. A step down converter further regulates this voltage to the desired value according to characteristic curve of a solar cell. This process is efficient, wasting close to no power due to heat generation, fast and adjustable, since a micro-controller is controlling the step down converter with a small voltage in relation to the operating mode of the device and the light intensity. The output voltage and current is measured via hall-sensor, which is then sent back to the controller to adjust the regulation voltage to the step down converter. The current measurement values can be seen on an LCD Display at the front of the package. Furthermore, the operation mode and the light intensity can be seen on said screen. The beforementioned modes and intensity are adjusted with three buttons below the display.

To verify the functionality of VirtualSun a multitude of tests had to be done. The used methods include the measurement of the no load voltage as well as the short cut current. In addition, the output current and voltage in dependence of the load resistor was recorded and compared to the characteristic curve provided by the client. Moreover, the influence of the light intensity on the output had to be registered as well as the two operating modes. Another important factor was the heat generation of the voltage converter, which can affect the longevity of the aforementioned converter and therefore had to be annealed in order to ensure smooth operating over a long duration. This was done with by installing a heat sink onto the voltage converter and a fan in the casing, which dissipates the heat within the device.

The device could not be finished within the time frame of the project. Currently the measurement of the voltage converter output is not working as intended, as well as the regulation of said controller via the micro controller. However, the beforementioned measurements could still be conducted on the step down converter to verify its function and its suitability for this project's purpose. It was found out that the regulator is capable of producing the desired current and voltage levels of 3.09A and 22V. In addition, the ripple voltage was measured and for the greater part of the spectrum was sufficient.

Although the project could not be finished according to the clients wishes, the foundation to make this device successful are laid out. In the next step the measurement circuit would need to be revised. The software code which controls the DA-converter should also be reviewed since it is the most essential part of regulating the step down converter with the use of a micro controller. If this has been checked, it would be advisable to install a filter at the output of the voltage converter circuit in order to reduce the ripple voltage.