

# Designing a Solar-Powered, Rechargeable Lantern for Developing Nations Using NI Multisim and Ultiboard



K-Light is a solar-powered, rechargeable lantern that provides an environmentally friendly, economical, and safe alternative to fuel-based lighting for individuals in developing nations.

"The NI Circuit Design Suite contained the design tools required to effectively take our project from a conceptual circuit to a production-ready PCB."

- Ashley Garrigan, [Koinonia Foundation](#)

## The Challenge:

Creating a clean, renewable light source to replace fuel-based lanterns used in developing countries.

## The Solution:

Using the NI Multisim and Ultiboard circuit design environments to design the K-Light, a solar-powered, rechargeable lantern that provides an environmentally friendly, economical, and safe alternative to fuel-based lighting for individuals in developing nations.

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## PiSAT Solar and the K-Light

Fuel-based lighting is inefficient and requires continual replenishment. Also, it can be dangerous to operate with the potential for burns and fuel spills, contributions to indoor air pollution, and the emission of millions of tons of greenhouse gases annually. On the other hand, battery-powered devices generally require replacement batteries to continue functionality, resulting in additional costs and environmental impact.

Pan's Innovative Science and Technology ([PiSAT](#)) created a more efficient lighting system by using solar energy to develop a solar-powered rechargeable lantern – the K-Light.

The device is comprised of 16 energy-efficient LEDs, a rechargeable 7.2 V, 1.6 Ahr NiMH battery, and a 1.5 W solar panel. The entire product meets the hazardous substances (RoHS) compliance restriction standards and is waterproof, easily portable, and safe to operate. The lantern operates as a flashlight and provides 10 to 20 hours of light per charge, depending on setting (high or low). As a daily source of light, PiSAT designed the K-Light to last 10 years. For recreational purposes, it is a lifetime light. This level of longevity, flexibility, and safety lends itself to being a long-term lighting solution, particularly in areas with developing power infrastructure.

The K-Light was initially designed as an alternative to the hazards of fuel-based lighting used in developing countries. PiSAT formed a joint-venture company in Africa to sell K-Lights across the continent. Additionally, domestic interest has led PiSAT to sell the K-Light commercially. Through its Light for Africa program, PiSAT donates a portion of its proceeds from commercial K-Light sales to the [Koinonia Foundation](#), a non-profit organization dedicated to the eradication of poverty in the developing world through modernizing education, implementing renewable and clean energy sources including solar projects, and creating strong communities that promote a safe and healthy standard of living.

The Foundation works to enhance educational opportunities through the implementation of solar power projects that provide a safe and lit educational environment for communities in Rwanda, Africa. The Foundation's efforts have led to the construction of seven schools and adjacent clinics outfitted with solar power systems that run computers so students can study safely in the dark.

## Designing the K-Light

The lead engineer had previous experience using the [NI Circuit Design Suite](#), which includes the [Multisim](#) circuit design and simulation environment and [Ultiboard](#) layout. The ease of use and flexibility of this environment was useful in developing the circuitry needed to power the solar lantern. To create an efficient light source, PiSAT used NI design tools to quickly capture, simulate, and layout the printed circuit board (PCB) that interfaces to energy-efficient LEDs.

The company's goal was to design an energy-efficient light source for individuals without access to a clean, affordable, and rugged power source. Because the success of the K-Light project is directly driven by the efficiency and reliability of the underlying lantern circuitry, PiSAT used the NI Circuit Design Suite to effectively create a production-ready PCB from a conceptual circuit.

In the Multisim environment, PiSAT easily captured the conceptual circuit and simulated its performance to characterize the behavior of the circuit through multiple improvement and optimization iterations without having to physically prototype the PCB. This saved time and helped avoid unnecessary prototype iterations during the circuit validation and optimization process. We imported the completed schematic into Ultiboard for the PCB design layout.

The fully integrated circuit design suite that was simple and intuitive to use helped ensure the success of the K-Light project. The first prototype PCB had the ability to identify and resolve performance issues through simulation, pass performance testing, and enter production. Today, individuals in Rwanda, Kenya, and Uganda have a reliable, environmentally friendly, and safe lighting solution with the K-Light solar rechargeable lantern.

## The Future of the K-Light Project

The success of the K-Light lantern project opened up new opportunities for improving day-to-day tasks with solar energy. For example, 16,000 health workers with Phones for Health, a project designed to give health agencies and workers communication access and data collection capabilities in remote areas, are set to receive the K-Light and K-Light cell phone charger. The charger solution takes advantage of the K-Light lantern design and the NI Circuit Design Suite so workers can recharge cell phones, communicate, and collect data in areas without a power distribution network.

In addition, the Koinonia Foundation uses the K-Light as the basis for its Beacon Program, which encourages economic growth and poverty reduction by helping unemployed mothers begin sustainable businesses. The Foundation formed the Ingenzi K-Light Cooperative, a government-registered cooperative in Rwanda within which program members can begin and grow their small businesses. The Foundation also provides women in the cooperative with business training so that they can collect and handle their own funds and grow their business successfully.

The Koinonia Foundation grants each woman in the program six K-Lights as the capital with which to start her business. After selling the initial grant of K-Lights, the women can invest their profits as they see fit. They can grow their business by purchasing additional K-Lights at a reduced cost from a company in Rwanda. The Foundation plans to use its experiences in Rwanda to scale up the program and expand its operation to surrounding countries in East Africa and into other developing countries worldwide.

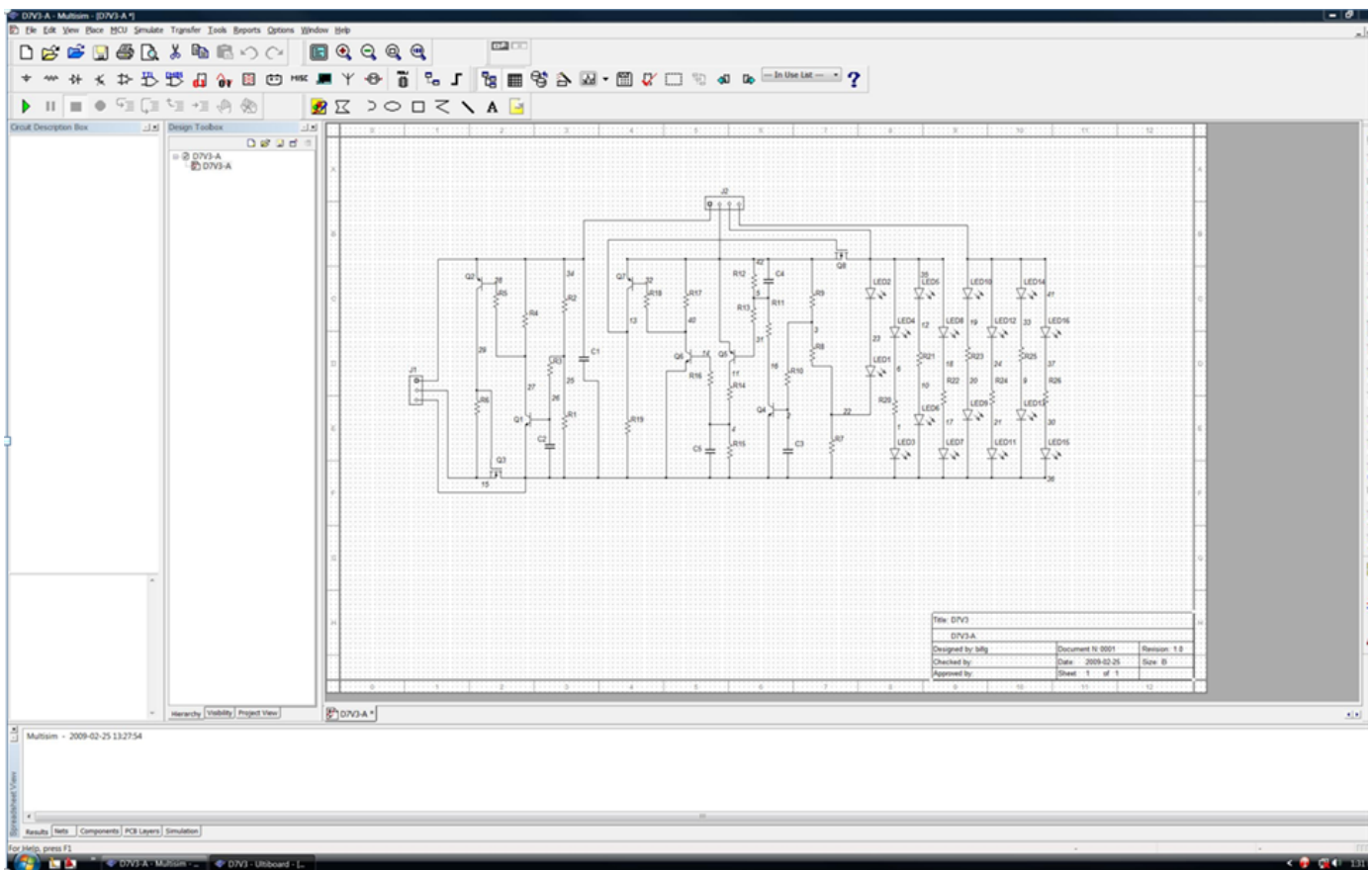
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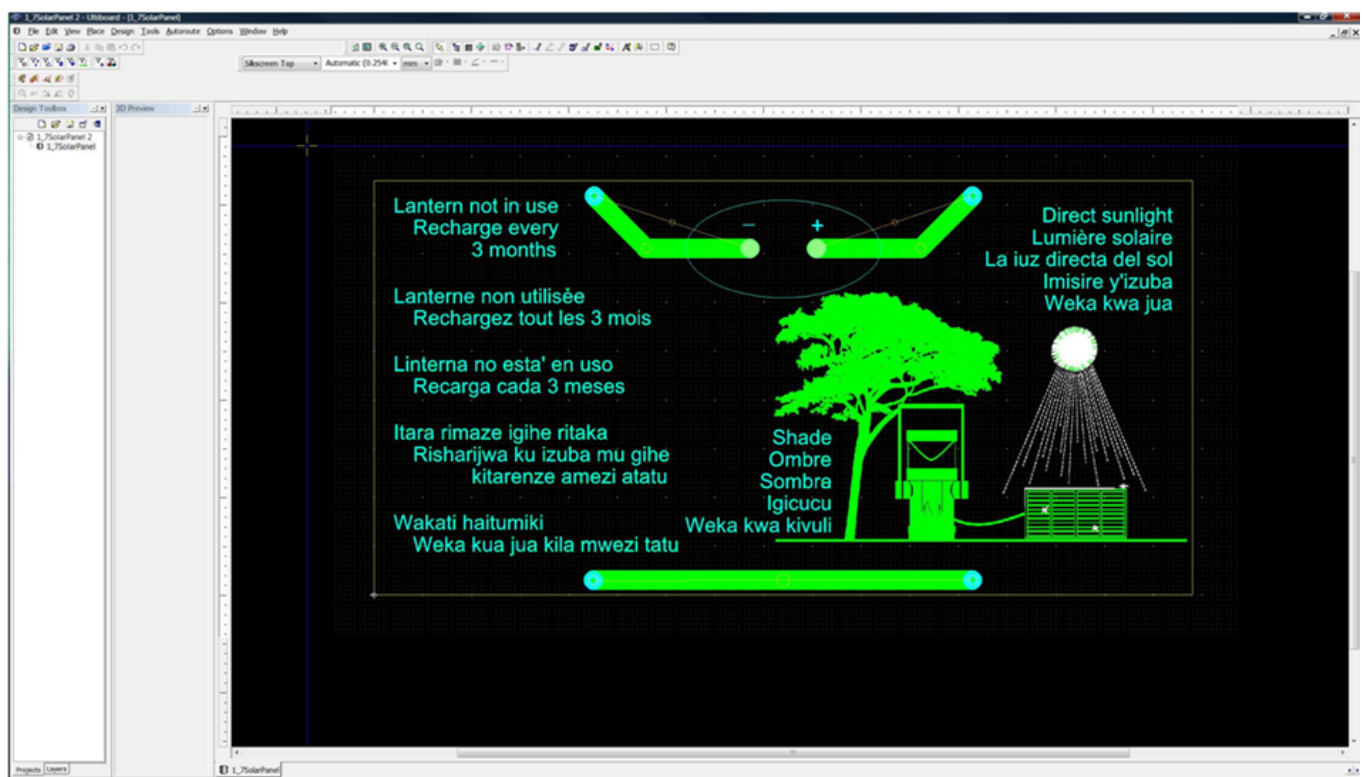
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PiSAT used NI design tools to quickly capture, simulate, and layout the printed circuit board (PCB) for K-Light.



Screenshot of K-Light's simulated circuitry in Multisim.



A system diagram of K-Light depicted in Ultiboard software.

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