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SOLAR STREET LIGHTING SOLUTION

Custom MPPT Solar Charge Controller with LED Driver

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CUSTOMER BACKGROUND

Solar Street Light OEM

Background

The customer, a solar street lighting manufacturer, is a significant player in the global renewable energy lighting sector. They are particularly interested in emerging markets where traditional grid infrastructure may be lacking and specialize in the design, manufacturing, and distribution of solar-powered street lighting solutions. Their manufacturing facilities are located in Asia, with additional assembly plants in key markets across Africa and South America. They maintain a direct sales force for major projects, while working with regional distributors for smaller installations.

The solar street light industry has seen significant growth in the past decade, with increased competition from both established lighting manufacturers entering the solar space and new solar-specific companies. Despite this, the customer continues to differentiate their business from the competition through technological innovation and quality control.

Products

The customer's product line includes integrated solar streetlights, split-type solar streetlights, and smart solar lighting systems. Their portfolio ranges from basic 20W units suitable for residential areas to high-powered 200W systems for highways and industrial complexes. Each system typically includes solar panels, LED lights, batteries, charge controllers, and mounting hardware. They also provide smart control systems, monitoring software, and replacement components.

Replacement parts and maintenance services represent approximately 25% of the customer's revenue, with particularly high margins on proprietary battery and charge controller components. Their smart lighting solutions, which include remote monitoring and automated dimming capabilities, represent their fastest-growing product segment.

Distribution

The customer operates through a hybrid distribution model, utilizing both direct sales for large government contracts and infrastructure projects, and a network of certified distributors for commercial and smaller municipal projects. They maintain regional warehouses in major markets to ensure quick delivery of replacement parts and complete systems.

Technical support and installation training are provided through regional technical centers, while routine maintenance is handled by certified local partners. This structure allows the customer to maintain quality control while providing responsive local service. However, this creates challenges in inventory management across diverse markets with different seasonal demands.

Customer

The primary customer base for this solar street light manufacturer services consists of municipal governments, property developers, and infrastructure contractors. Purchase decisions typically involve multiple stakeholders, including city planners, energy efficiency consultants, and financial controllers.

Key purchasing criteria include total cost of ownership (including energy savings), product reliability, warranty terms, local support availability, and compliance with regional lighting standards. Government customers often prioritize initial cost and local content requirements, while private developers typically focus more on long-term performance and smart features. The growing emphasis on sustainable urban development has also made environmental impact and energy efficiency increasingly important decision factors.

CUSTOMER'S **PAIN POINTS & DESIRES**

The following are the issues and needs the customer asked the Phocos team to address in this project, which guided every decision made by the team during the design process.

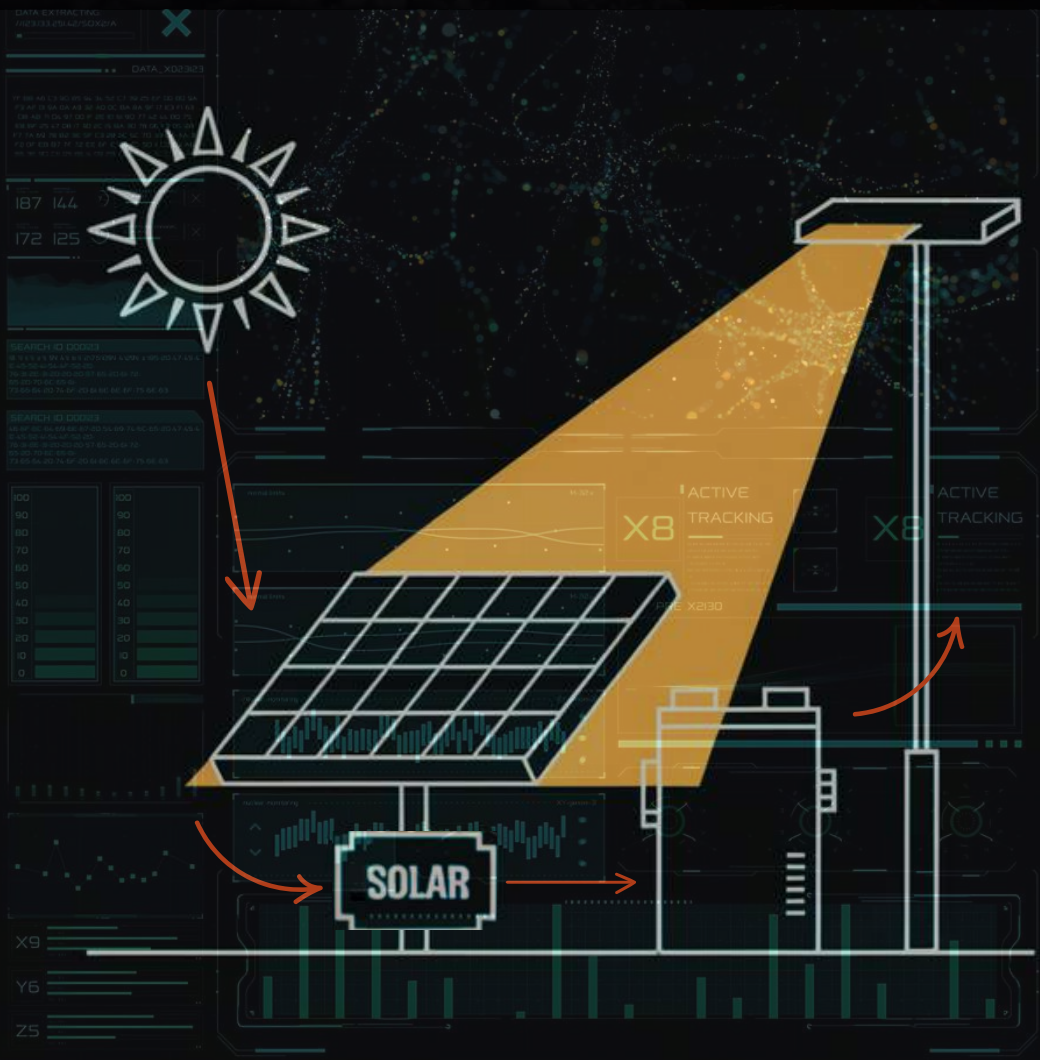
✕ Pain Points in Existing Products

- **High Failure Rate:** Current products suffered from frequent failures, particularly power electronics, which significantly impacted reliability and customer satisfaction.
- **Fragmented Product Offering:** Many SKUs were required to accommodate different light engines, which complicated inventory management and product planning.
- **Complex Device Sourcing for System Design:** Components were sourced from multiple manufacturers, leading to logistical challenges, such as ensuring compatibility between products, and inefficiencies in the installation process, which created difficulties for installers.
- **Engineering Complexity:** Bridging multiple communication protocols demanded significant engineering effort and resources.
- **High Capital Expenditure:** Developing a custom-designed wireless communication solution required substantial upfront investment.

✓ Desires for an Ideal New Product

- **Increased Durability:** A solar charge controller with enhanced longevity and fewer maintenance cycles, ensuring lower total cost of ownership.
- **Integrated Communication System:** A fully integrated solution where the solar charge controller, LED driver, and battery could communicate effortlessly, streamlining operation and control.
- **Smart City Compatibility:** A forward-compatible solar solution with emerging smart city initiatives, ensuring long-term viability.
- **All-in-One Design:** A unified design that combined solar charging and LED driving functionality into a single solution, reducing complexity and costs.

CUSTOMER'S **BACKGROUND**



CUSTOMER JOURNEY PART 1

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Initial Contact

The customer began their search for a reliable solution by conducting online research, which led them to discover the CIS-N-MPPT-LED Solar Charge Controller in the Phocos product catalog.

This product stood out as a compelling option, aligning closely with their needs. Recognizing the potential fit, the customer reached out to Phocos, initiating a dialogue to discuss their RFP (Request for Proposal).

During the meeting with Phocos' cross-functional Product Development team, the customer shared a detailed overview of their requirements, challenges, and aspirations. Drawing on their technical expertise, the Phocos team engaged in a series of collaborative discussions, gathering insights and refining potential solutions. This iterative process allowed the Phocos team to craft a cutting-edge, customized solution tailored to the customer's unique pain points and specifications.

The Phocos team provided the customer a Product Proposal which detailed how the solution addressed the customer's key priorities, including enhanced reliability, superior performance, and cost efficiency. The Product Proposal outlined the entire product development process and clearly defined key project milestones and deliverables. This allowed the customer to visualize the project from start to finish, setting a realistic timeline and expectations for the development process and beyond.

Once the customer approved the Statement of Work (SOW), the Phocos team established weekly touchpoints to provide regular project updates. This ensured seamless execution and fostered trust and transparent communication between the two parties. Later during the design phase, the solution underwent a comprehensive review by the customer to confirm alignment with their expectations.

CUSTOMER JOURNEY PART 2

Development & Validation Process

After the design phase, which ended with the customer reviewing and approving the final design proposal submitted by the Phocos team, development on the custom MPPT solar charge controller with LED driver began. Following extensive in-house verification testing, the customer received fully working prototypes on which to perform their own validation testing. After validation testing was completed, the customer launched a pilot program where 50 units were deployed in the field for real-world testing.

Manufacturing Excellence

The customer chose the CIS-N-MPPT-LED solar charge controller from the Phocos catalog as their reference design. This product has been proven to be reliable, certifiable, and robust through rigorous testing in diverse environmental conditions as well as validated through accelerated life testing, making it an excellent reference design for the Phocos team to build upon.

Phocos' proprietary calibration and testing software, deployed at contract manufacturing facilities, ensured rigorous quality control throughout the production process. Each unit underwent automated testing and verification, with full parameter validation and traceability through unique unit identification. This guaranteed that only products meeting Phocos' stringent quality standards would reach customers.

Phocos' solution was compliant with industry standards for mass production and featured a comprehensive design for manufacturing optimization, which made for a seamless transition to mass production. They also developed custom software tools and testing procedures to ensure a high level of quality, internal compliance, and excellent performance before any units left the factory.

Phocos provided their expertise in supply chain management, from sourcing the raw materials necessary for manufacturing from their trusted suppliers, ensuring minimal setbacks and delays during production, to logistics and delivery.

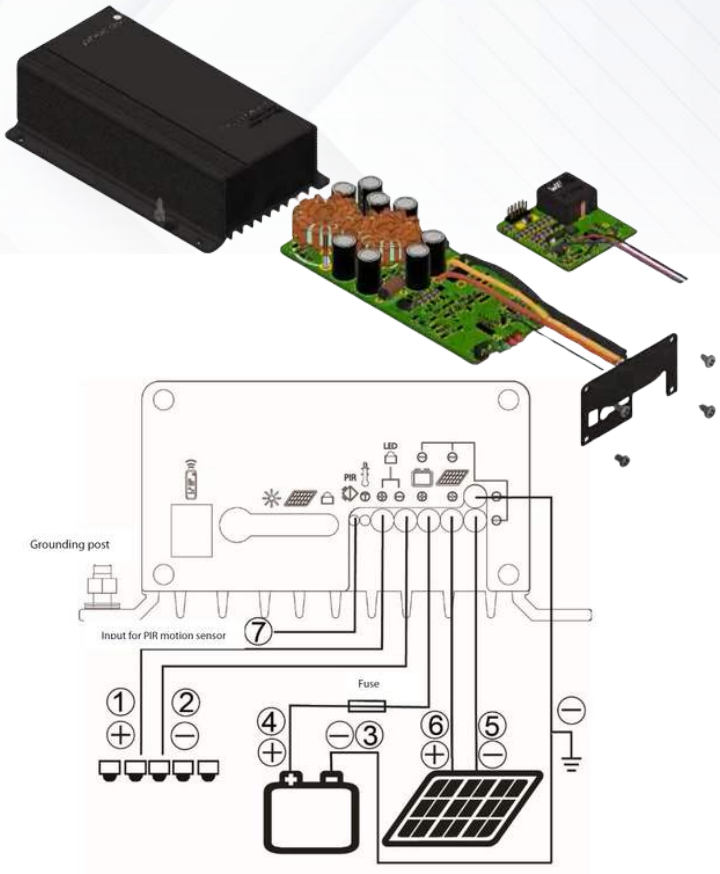
Continuous Support & Evolution

Phocos' commitment not only extends from design to after-sales support. It also promises continuous management and optimization throughout the product's lifecycle. Once the product has been delivered, the Phocos team continues to identify optimization opportunities and proposes enhancements to meet evolving market requirements. This is complemented by a comprehensive after-sales support system featuring dedicated technical assistance and rapid issue resolution. The team will also conduct Value Analysis / Value Engineering (VAVE) efforts to pass savings to the customer whenever possible. Through ongoing customer engagement and systematic feedback integration, the Phocos team will continue to provide the customer with sustained product excellence and customer satisfaction throughout the product's operational life.

THE SOLUTION MAIN FEATURES

The Phocos team designed, developed and delivered a custom MPPT solar charge controller with LED driver perfectly tailored to the customer's unique requirements. Below are the main features of the solar charge controller.

Main Features:



Enclosure

- Waterproof IP68-rated design utilizing custom aluminum extrusion housing.
- Full encapsulation/potting of PCBAs provides superior environmental protection.
- Optimized thermal management with vertically mounted heatsink and temperature-based power derating.
- Thermally robust for high and low ambient temperature operation.
- Comprehensive electronic protection features (reverse polarity, overcurrent, etc.).
- Custom form factor allows for custom dimensions based on customer requirements.

MPPT Charge Controller Board

- High conversion efficiency Max Power Point Tracking (MPPT), DC-DC converter, synchronous/asynchronous, and single/multiphase.
- Ultra-low idle power consumption.
- Industry-leading Mean Time Between Failures (MTBF) and system uptimes.
- Standardized connectors for plug-and-play installation
- Compliant with industry EMI standards like CE.
- With comprehensive EMI filtering.

LED Driver Board

- Programmable LED current with high resolution PWM dimming
- Powerful, compact, efficient DC-DC boost LED driver
- Unified design that combines a solar charge controller and LED driver into single compact PCBA
- Reduced assembly complexity and improved reliability through fewer interconnections

Interface Through Communication Connector

- Zhaga-D4i (DALI) compliance provides seamless integration with compatible communication busses and systems for remote control and monitoring of the LED driver.
- Integrated RS485, CAN, UART, and IR interfaces provide means for easy firmware updates and futureproofing.
- Integrated RS485 interface enables real-time battery monitoring and management
- Closed-loop communication with lithium battery BMS.
- Compatible with all certified wireless control adapters and luminaires.
- Includes PIR input for motion sensor to trigger full brightness.

THE SOLUTION BREAKDOWN

The Goal

The customer required a highly reliable, integrated solution that would seamlessly combine a solar charge controller and an LED driver. This solution had to enhance operational efficiency and simplify their product offering. Their goal was to elevate their product portfolio through improved reliability, energy efficiency, and advanced connectivity features that would enable real-time energy monitoring, dynamic lighting schedules, and fault alerts via the cloud. Below are the ways in which the Phocos team's solution addressed each of the customer's pain points and desires.

Pain Points, Desires & Their Solutions

01 High Failure Rate

The customer experienced a very low failure rate after launch, as well as low power consumption of onboard power supplies, high power conversion efficiency (98% peak), robust performance across a wide temperature range, and industry-leading High Mean Time Between Failures (MTBF). This increased the product's reliability, which lead to increased customer satisfaction and enhanced brand equity.

02 Complications in Inventory Management and Product Planning

The Phocos team's solution featured a simplified design with a programmable LED driver, which made one solar charge controller compatible with multiple LED engines. This meant that one LED driver could accommodate for different current needs and requirements, making product planning easier and quicker. It also ensured SKU consolidation and simplified installation and supply chain.

03 Complex Device Sourcing for System Design

Phocos designed a product that consolidated many different functions into one and expertly sourced all components from trusted manufacturers, ensuring smooth logistics, compatibility between products, and eliminating any inefficiencies in installation steps.

04 Smart City Compatibility

The product's Zhaga-D4i (DALI) compliance ensured forward-compatibility with emerging smart city initiatives and guaranteed long-term viability.

05 Engineering Complexity - Integrated Communication System

The Phocos engineering team designed the solution to be Zhaga-D4i (DALI) compliant, which not only simplified testing and implementation. It also optimized the solution for system integrations and made it compatible with third-party remote monitoring solutions.

06 High Capital Expenditure

The Phocos team utilized a VAVE design method to provide an exceptional product at the lowest possible cost without sacrificing functionality.

07 Increased Durability

With features such as superior environmental protection (IP68), comprehensive electronic protection, and optimized thermal management, the solution was designed to be robust and reliable, with enhanced longevity and fewer maintenance cycles. This led to reduced need for replacement, lower lifecycle costs, and higher profitability.

08 All-in-One Design

Using the CIS-N-MPPT-LED as a reference design guaranteed seamless communication between the solar charge controller and integrated LED driver, as this is the catalog product's primary purpose. Choosing to use one of Phocos' catalog products as a reference design simplified the design process, reduced development and testing time as well as cost, and optimized performance.

RESULTS & IMPACT

After the product launch, the customer experienced the following benefits and results:

- ✓ Upgrading to a highly reliable solar charge controller with LED driver drastically increased customer satisfaction, which lead to increased trust and enhanced brand equity.
- ✓ The improved durability of the product ensured lower maintenance costs, a higher return on investment, and increased overall profitability.
- ✓ An enhanced product improved the end-user's trust in the customer, which lead to more repeat business, more upsell opportunities, and stronger customer retention. It also improved competitiveness in the market, which created more differentiation, enhanced the customer's value proposition, and increased their ability to win larger contracts.
- ✓ Seamless Communication and Interoperability made possible by DALI compliance allowed for a simplified design, which reduced development and testing time, lowered cost, and optimized performance. It also created new market opportunities, particularly in the solar street lighting market, where remote monitoring and control capabilities are standard requirements.
- ✓ The solution's extensive list of technical features, detailed design, and rigorous testing guarantee long-term sustainability and growth.

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For more information on how Phocos can assist you with your product needs, please contact us at

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