

Solar Charger Controller Relay Board — Detailed Project Requirements

1. Functional Requirements

Solar Input Management

- Accept solar panel input voltage ranging from 8V to 32V.

Battery Charging Control

- Support two independent lithium-ion batteries.
- Battery capacity: 75 Wh to 100 Wh.
- Charge one battery at a time, prioritizing the battery with the lowest voltage.
- Maximum charging current: 4 A per battery.
- Automatically switch charging to the second battery once the first is fully charged.

Power Distribution and Relay Control

- Relays to control power and ground connections to external instruments.
- Disconnect Solar charging during measurement periods to prevent power noise.
- Reconnect Solar charging after measurements are complete.

MCU (Microcontroller Unit) Integration

- Incorporate an industrial-grade STM32 microcontroller (-20°C to +85°C).
- Keep MCU operation alive powered by a battery.
- Allow user-defined wakeup times for powering instruments using SMS

Solar Charging Module

- Support input voltage range of 10V to 32V.
- Configurable output voltage: 12.6V (for 3S batteries) or 16.8V (for 4S batteries).

Control and Measurement Cycle

- On wake-up, disconnect solar charger and connect battery to instruments.
- During measurements, maintain isolation between charger and instruments.
- After measurements, reconnect charger to batteries.

- Repeat cycle to maintain battery health and power availability.
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2. Safety and Protection Requirements

- Overvoltage Protection: Safeguard against solar input spikes.
 - Current Limiting: Restrict charging current to prevent battery damage.
 - Thermal Monitoring: Monitor system temperature to prevent overheating.
 - Battery Management System (BMS) Integration:
 - Use SMBus for battery health and status monitoring.
 - React to BMS alerts such as over-temperature or fault conditions.
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3. Environmental and Reliability Requirements

- Operating Temperature Range: -20°C to +85°C.
 - Use only industrial-grade components.
 - Ensure durability for at least two years of daily outdoor cycles.
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4. User Interface and Configuration Requirements

- Wakeup Time Configuration: User-defined schedule for instrument activation.
 - Charging Voltage Selection: Choose between 12.6V or 16.8V outputs.
 - Status Monitoring: Indicate charging status, measurement mode, and system faults via LEDs or UART log.
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5. Electrical and Mechanical Requirements

- PCB Design:
 - Easy battery connection.
 - Proper isolation between high-power and low-noise circuits.
- Power Connectors:

- Input: Solar connector rated for 32V, 5A.
 - Output: Battery/instrument connectors rated for 16.8V, 4A.
 - Relays:
 - Minimum 5A switching capacity to support peak and startup loads.
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Summary of Key Requirements

Category	Specification
Solar Input Voltage	8–32V
Battery Capacity Supported	75–100 Wh
Max Charging Current	4 A
Charging Output	12.6V or 16.8V
MCU	Industrial STM32 (-20°C to +85°C)
Relay Control	Power/ground switching for instruments
Protection	Overvoltage, Current Limiting, Thermal Monitoring
Environmental	Operate -20°C to +85°C
Configuration	Wakeup time, Charging voltage