User Manual
Analog Automatic Solar Tracker

1 Introduction

This User Manual provides installation, operation, calibration, and maintenance instructions for the Analog Automatic Solar Tracker. The system is a fully analog, single-axis solar tracking platform designed to orient photovoltaic panels toward maximum solar irradiance using differential light sensing and analog control circuitry.

2 Package Contents

The following items are included with the Analog Automatic Solar Tracker:

- Fully assembled tracker enclosure with internal analog control PCB
- Integrated battery pack consisting of eight 3.7 V, 1000 mAh Li-ion cells
- DC geared motor (12 V, 50 rpm) pre-mounted to the mechanical structure
- Dual LDR sensors embedded on both sides of the solar panel
- Two additional spare LDR sensors
- Mechanical mounting brackets (pre-installed)
- User Manual

Note: No external power adapter is supplied. Batteries are user-replaceable via the battery enclosure.

3 Safety Information

- **Maximum Input Voltage:** The system must not be operated beyond **+35 V and −35 V** under any circumstances, as this may cause permanent damage to the analog circuitry.
- **Reverse Polarity:** The tracker **does not include reverse polarity protection**. Ensure correct battery orientation before powering the system.
- **Motor Operation:** Risk of motor overheating is minimal, as the DC motor operates only intermittently during solar tracking and remains idle once alignment is achieved.
- **Short-Circuit Risk:** Short circuits may occur if the system is exposed to rain or moisture. The tracker is **not designed for wet or outdoor environments**.
- **Environmental Exposure:** Do not operate the system in rainy conditions or high-humidity environments without proper enclosure sealing.
- **Maintenance Safety:** Always switch OFF the power using the DPDT switch before handling internal components or replacing batteries.

4 Mechanical Installation

The solar tracker can be installed on a table-top, rooftop, or ground-mounted surface where direct sunlight is available.

1. Secure the tracker base to a stable surface using M3 bolts.
2. Mount the solar panel firmly onto the rotating bracket.
3. Ensure that no mechanical obstruction restricts the panel movement.
4. Verify that the panel rotation is limited to approximately $\pm 45^\circ$ to $\pm 60^\circ$ as designed.

5 Electrical Connections

1. The system is powered by eight 3.7 V Li-ion batteries configured to provide +12 V, –12 V, and ground rails.
2. Power is controlled using the DPDT switch connected to the battery holders.
3. The DC motor is driven directly from the control PCB via an L298N motor driver.
4. LDR sensors are wired directly to the PCB through dedicated sensor inputs.

Note: No external fuse is used in the current design.

6 Operation

Once powered ON using the DPDT switch, the solar tracker begins automatic operation. The system continuously compares light intensity detected by the LDR sensors and rotates the panel accordingly.

The tracker initially hunts for the direction of maximum light intensity and gradually stabilizes. Once the incident sunlight becomes approximately perpendicular to the panel surface, the motor stops automatically. An onboard indicator LED on the L298N motor driver provides basic operational feedback.

7 Calibration Procedure

Calibration is required only once during initial setup.

1. Place the tracker under uniform sunlight or ambient lighting.
2. Adjust the fixed potentiometers on the PCB to balance both LDR sensor outputs.
3. Shade one LDR sensor slightly and observe motor response.
4. Fine-tune gain adjustment potentiometers until smooth and stable tracking is achieved.

8 Maintenance

Routine maintenance requirements are minimal.

- Clean the LDR sensors if dust, dirt, or rain residue accumulates.
- Inspect the mechanical structure periodically for loosened bolts.
- Battery replacement should be performed when tracking response becomes sluggish.

9 Troubleshooting

Issue	Possible Cause	Corrective Action
Motor does not rotate	Battery depleted or switch OFF	Recharge or replace batteries, check switch
Panel moves in wrong direction	LDR polarity mismatch	Swap LDR connections or recalibrate
Continuous oscillation	Excessive gain setting	Reduce gain using potentiometer
No stabilization	Unequal sensor exposure	Re-align LDR placement