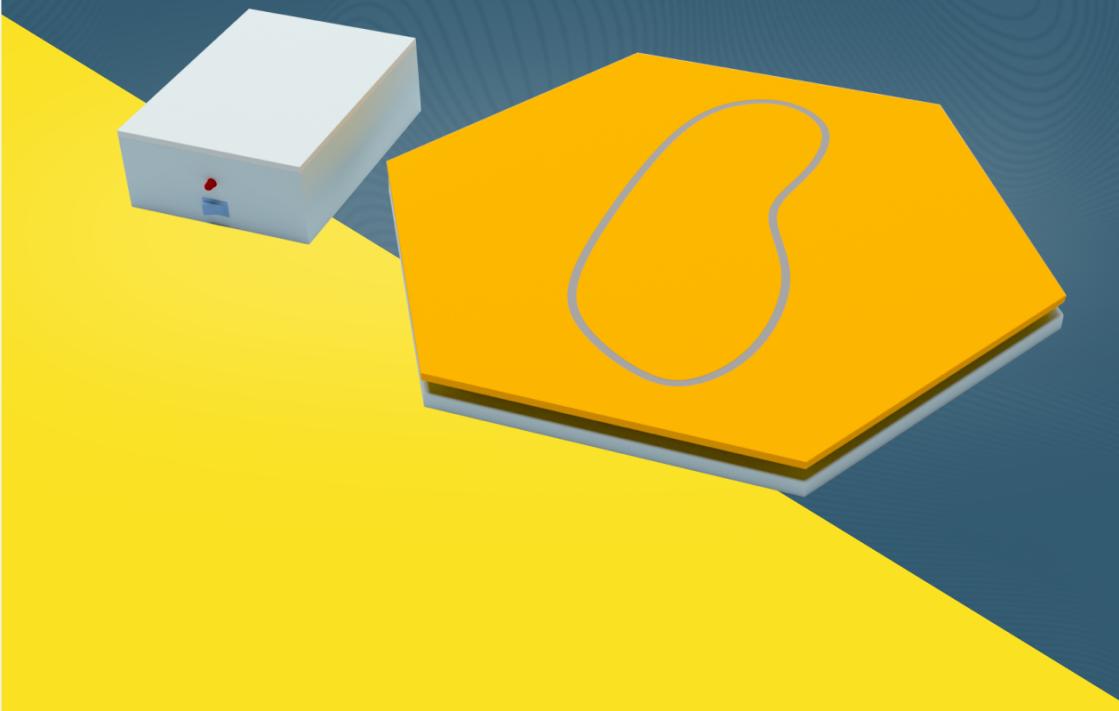


# PIEZOELECTRIC POWERED LED LIGHTING

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Operational Background



# Preface

Please read this manual thoroughly before operating the Piezoelectric Powered LED Lighting. Proper handling and understanding of the device will help ensure safe and optimal use. Failure to comply with operational procedures may result in damage to the device or potential harm to the user.

The Piezoelectric Powered LED Lighting is a mechanical-electrical device designed to generate light through mechanical pressure, such as foot steps. It consists of two main systems: the mechanical surface area embedded with piezoelectric sensors, and the electrical circuitry responsible for converting the energy into LED illumination.

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# Table of Contents

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Safety Instructions .....	01
Installation Guide of the Piezoelectric Powered LED Lighting	04
I. Operational Guide of the Piezoelectric Powered LED Lighting	06
II. Maintenance Guide .....	07
III. Troubleshooting Guide .....	08
Environmental Information .....	09
Disclaimer .....	10
Key Contacts .....	11

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# SAFETY INSTRUCTIONS



## User Awareness

- Read and understand all instructions before operating the device.



## Placement Safety

- Ensure the device is placed on a flat, dry, and stable surface before use.



## Footwear Safety

- Wear proper footwear when testing the device (avoid sharp heels or spikes).



## Environmental Safety

- Use only in dry environments. Do not operate in wet or damp conditions.



## Surface Safety

- Do not jump or apply excessive force beyond normal walking pressure.

# SAFETY INSTRUCTIONS



## Electrical Safety

- Keep all electrical components away from moisture and heat.



## Tampering Warning

- Do not disassemble or alter any internal components unless authorized



## Child Safety Precaution

- Children should not tamper with the device's connections without adult supervision.



## Emergency Stop Procedure

- Immediately stop operation if any unusual sounds, smells, or sparks are detected.



## WARNING!

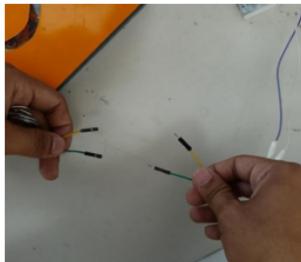
- DO NOT MODIFY THE DEVICE OR ITS COMPONENTS WITHOUT PROPER AUTHORIZATION.
- DO NOT APPLY EXCESSIVE FORCE BEYOND NORMAL WALKING PRESSURE.
- ALWAYS SUPERVISE USE WHEN DEMONSTRATING TO CHILDREN OR UNTRAINED INDIVIDUALS.

# INSTALLATION GUIDE OF THE PIEZOELECTRIC POWERED LED LIGHTING

This guide helps the user to understand how to appropriately set-up the device before starting the charging operation.



## Step 1



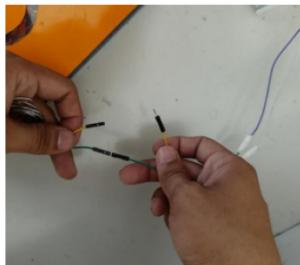
Position the device on a flat, even surface, ensuring it is kept away from any areas with bumps, humps, or cracks.

## Step 2



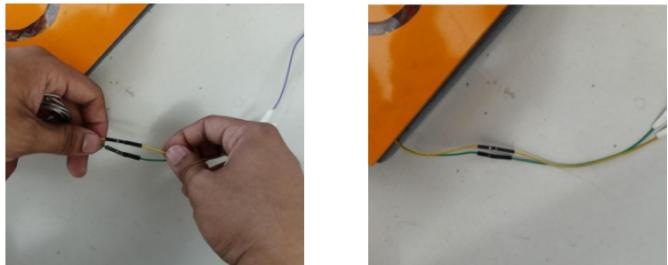
Locate the wire terminal of the series - parallel transducers and securely connect it to the main circuit.

## Step 3



Connect the (+) positive male green jumper wires of the LED Lighting Circuit towards the positive female green jumper wires of the Piezoelectric Footstep.

## Step 4



Connect the (-) negative male yellow jumper wires of the LED Lighting Circuit towards the positive female yellow jumper wires of the Piezoelectric Footstep.

## Step 5



Mount the acrylic surface atop of the transducers.

# I. OPERATIONAL GUIDE OF THE PIEZOELECTRIC POWERED LED LIGHTING

## Step 1

To start the charging process, step on the foot shape illustration of the acrylic plate. This ensures proper distribution of force on the piezoelectric discs.



## Step 2

After letting the device charge for a while you may turn on the LED Lighting circuit using the switch in front of it.



### III. MAINTENANCE GUIDE

To ensure optimal performance of the Piezoelectric Powered LED Lighting, follow these guidelines for maintaining critical components before and after operation.

Need To Maintain	Results if not Maintained	Required Actions
❖ Piezoelectric transducers	The overall electric power produced would be lowered as the broken Piezoelectric discs would act as a resistance in the overall flow of the circuit.	Replace if the Piezoelectric transducers are cracked
❖ Wirings & Connections	The electric current would not flow properly leading to reduced electrical output or zero output.	Look for loose wires, broken solder joints, or corrosion on terminals. Re-solder or replace connectors as needed.
❖ Bridge Rectifier (Diodes)	LEDs are polarity-sensitive. If AC is going directly to the LED due to a faulty bridge, the reverse voltage might damage or shorten the LED's lifespan.	Ensure that the AC-DC rectifier and voltage regulation components are working properly. If the LED isn't lighting up as expected, check diodes and capacitors. Replace if needed.
❖ Capacitor	Piezo elements generate spiky, high-voltage pulses. Without a working capacitor to absorb and smooth those spikes, sensitive components (like LEDs or micro-controllers) can get fried or behave erratically.	Regularly check for bulging tops, leaks, discoloration, or burn marks—these are signs the capacitor is failing. Use a multi-meter to test capacitance if performance seems off. Replace if needed.
❖ Resistors	Current can't flow to the LED and the LED won't light up at all. If the resistors are shorted too much current might reach the LED, burning it out.	Look for discoloration: Burn marks or darkening could mean overheating. Replace if needed.
❖ LED	Low light or might not light up at all.	Make sure the LED hasn't burnt out or come loose. Replace if necessary.
❖ Switch	A degraded or broken switch might internally short potentially damaging components like the LED or capacitor.	Clean or replace if faulty

### III. TROUBLESHOOTING GUIDE

Here are troubleshooting methods for the Piezoelectric Powered LED Lighting system to resolve any operational issues that may arise.

Issue/Problem	Possible Cause	Required Action
a) LED not lighting up	<ul style="list-style-type: none"> <li>➤ Piezoelectric transducers are damaged</li> <li>➤ Loose wiring/soldering</li> <li>➤ Capacitor discharged</li> </ul>	<ul style="list-style-type: none"> <li>✓ Apply mechanical force to transducers. If no light is detected when using a multi-meter, then your LED is faulty and should be replaced with a brand new one.</li> <li>✓ Inspect and re-solder loose connections.</li> <li>✓ Wait for capacitor to charge or replace if faulty.</li> </ul>
b) No charge generated from Piezoelectric Footstep to LED Lighting Circuit or Circuit towards LED.	<ul style="list-style-type: none"> <li>➤ Broken wire/solder joint.</li> <li>➤ Faulty diodes in bridge rectifier.</li> <li>➤ Insufficient capacitor charge</li> </ul>	<ul style="list-style-type: none"> <li>✓ Inspect &amp; re-solder connections</li> <li>✓ Replace damaged diodes.</li> <li>✓ Check the condition of the capacitors and replace if deemed faulty. Ensure to use a larger capacitor (e.g., 20,000 <math>\mu</math>F) when replacing.</li> </ul>
c) Components shorted	<ul style="list-style-type: none"> <li>➤ Faulty diodes in bridge rectifier</li> <li>➤ Shorted Capacitor</li> </ul>	<ul style="list-style-type: none"> <li>✓ Replace damaged diodes.</li> <li>✓ Replace capacitor</li> </ul>
d) Capacitor tor swelling/leaking	<ul style="list-style-type: none"> <li>➤ Overvoltage issue.</li> <li>➤ Incorrect polarity connection.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Use capacitor rated above 16V when replacing.</li> <li>✓ Ensure correct capacitor polarity (+ and -)</li> </ul>
e) Resistor Overheating	<ul style="list-style-type: none"> <li>➤ Incorrect resistor value</li> </ul>	<ul style="list-style-type: none"> <li>✓ Always ensure to use recommended resistance (<math>470\Omega + 1k\Omega</math>) when replacing capacitors.</li> </ul>
f) LED very dim	<ul style="list-style-type: none"> <li>➤ Low voltage generation</li> <li>➤ Insufficient capacitor charge</li> </ul>	<ul style="list-style-type: none"> <li>✓ Increase force on piezoelectric transducers.</li> <li>✓ Check the condition of the capacitors and replace if deemed faulty. Ensure to use a larger capacitor (e.g., 20,000 <math>\mu</math>F) when replacing.</li> </ul>
g) LED not lighting up but electricity is generated and capacitor is charged	<ul style="list-style-type: none"> <li>➤ Faulty Switch</li> </ul>	<ul style="list-style-type: none"> <li>✓ Replace Switch</li> </ul>

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## ENVIRONMENTAL INFORMATION

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The Piezoelectric Powered LED Lighting prototype prioritizes sustainability by harnessing renewable energy without emitting pollutants. Designed for low-energy environments and emergencies, it generates light without external electricity, though its short illumination time presents opportunities for improvement. Built using recyclable materials like acrylic panels and piezoelectric discs, the device minimizes environmental impact. With zero carbon emissions and a low-impact design, it supports eco-friendly lighting solutions. While further enhancements are needed, the prototype demonstrates a commitment to renewable energy innovation and sustainable design.

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## DISCLAIMER

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The researchers in this study used piezoelectric-powered LED lighting, which is merely regarded as a medium or a tool for data gathering and processing. Despite the efforts made to guarantee appropriate and correct operation, it is crucial to realize that this machine is not error-free and that faults or deviations may occasionally occur because no machine is ever regarded perfect.

Therefore, it is important to consider the device's limits and potential margin of error when interpreting the findings and conclusions presented in this research paper.

Any unforeseen effects resulting from the use of this machine during research or operations related to its installation are not the responsibility of the researchers.



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## KEY CONTACTS

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Please refer to the technical staff and designer contact information below if you require more assistance troubleshooting a sophisticated issue or problem with the machine's functionality and structure.

### Technical Personnel's Contact

**Contact Person :** Brosnan F. Nadal

**Email :** [broskie.nadal@gmail.com](mailto:broskie.nadal@gmail.com)

**Cell Number :** 09936914929

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**Name :** Nash Ashley B. Duhaylungsod

**Email :** [nashoyyy@gmail.com](mailto:nashoyyy@gmail.com)

**Contact Number :** 09934008591

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**Name :** Matthew Seth Molero

**Email :** [matthewsethmolero0710@gmail.com](mailto:matthewsethmolero0710@gmail.com)

**Contact Number :** 09569855735

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**Name :** Vincent R. Colorito

**Email :** [vincentruiz012@gmail.com](mailto:vincentruiz012@gmail.com)

**Contact Number :** 0962309891

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**Name :** Joevic L. Pitogo

**Email :** [joevicoypitogo@gmail.com](mailto:joevicoypitogo@gmail.com)

**Contact Number :** 09164432076



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## KEY CONTACTS

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### Designer Personnel's Contact

Contact Person : Janica Kate E. Ortigas  
Cell Number : 09692815140  
Email : janicaortigas40@gmail.com

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Contact Person : Tim David L. Mayol  
Cell Number : 09058042309  
Email : timmayol0@gmail.com

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Contact Person : Kevin Balansag  
Cell Number : 09208083650  
Email : kevinkevz0808@gmail.com

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Contact Person : Jesse Angelo A. Maraat  
Cell Number : 09609295374  
Email : jessemaraat@gmail.com

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Contact Person : Andrea Marie Amistoso  
Cell Number : 09605157131  
Email : amistosoandrea0@gmail.com

# User Manual

A. Y. 2024-2025