

2-Way Free Space Optical Communications System

User Manual

Version 1.0



PLEASE READ AND SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE



WARNING – Class 1M Laser Radiation

This system uses a 650 nm visible laser. Although classified as safe under normal operation, direct viewing of the beam through optical instruments or lenses may cause eye injury.

- **Do not look directly into the laser beam.**
- **Do not point the laser at people, reflective surfaces, or exposed skin.**
- **Only operate the system in a controlled indoor environment.**

1. Introduction

1.1 Purpose of the System

This manual provides instructions for operating and maintaining the two-way free-space optical (FSO) communication system, which enables wireless USB data transmission using a 650 nm laser link.

1.2 Intended Use

The system is designed as a prototype to demonstrate short-range optical data communication between two devices without physical cables. It is intended for laboratory use, research demonstrations, and educational applications under controlled indoor conditions.

1.3 Target Users

This manual is intended for technical users such as engineering students, laboratory technicians, and research personnel with a basic understanding of electronic systems and optical safety practices.

1.4 System Overview

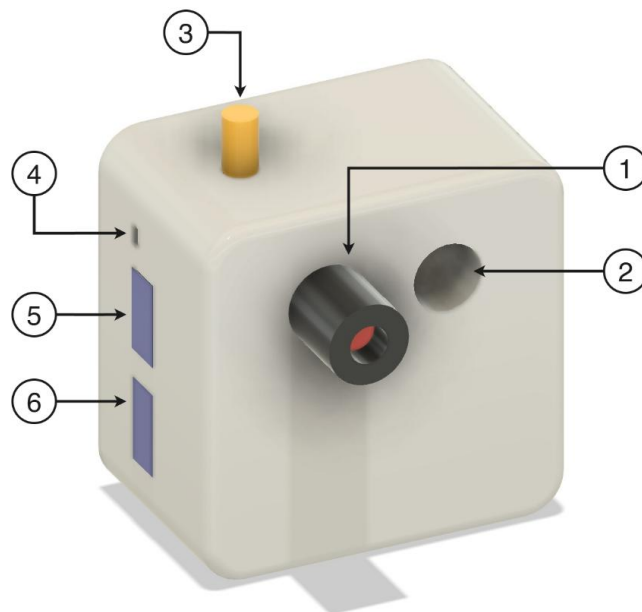
The system consists of a transmitter unit and a receiver unit, each equipped with a laser diode, photodetector, optical alignment mechanism, microcontroller, and USB interface. When powered on and aligned, the units establish a two-way communication link that transfers USB data across an optical channel. The prototype operates under Class 1M laser safety standards and is designed for intuitive alignment and stable data transmission.

2. Follow Safety Information

- ❖ **Ensure laser modules are powered off before performing any alignment or maintenance.**
- ❖ **Use appropriate laser safety eyewear if alignment adjustments are required with the beam active.**
- ❖ **Avoid placing reflective objects in the optical path.**
- ❖ **Do not modify the laser driver circuitry, as this may increase output power beyond safe limits.**
- ❖ **For Emergency Shutdown disconnect USB power input.**

3. System Description

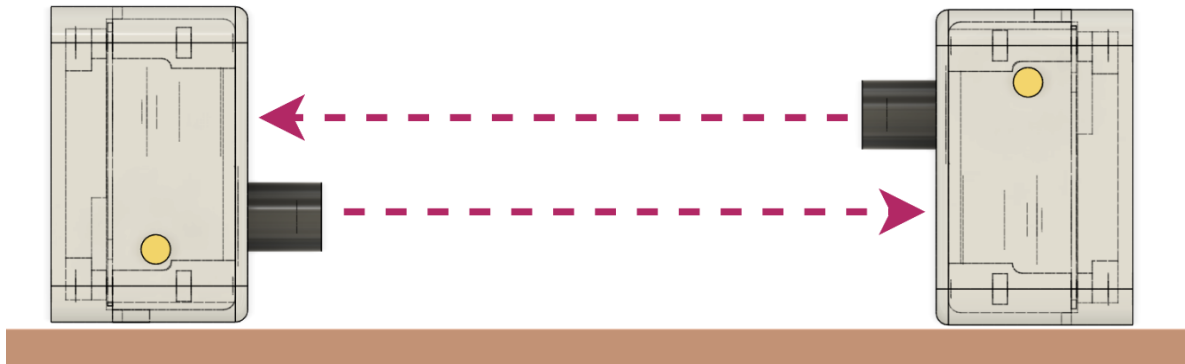
Note: Both modules have same functionality and operation. **Max supply voltage is 5V only** and use standard USB connections as power source.



- ① ➔ **Laser Lens with Focus Ring:** Use to control laser beam size operating distance.
- ② ➔ **Laser Detector Sensor:** Detect incoming laser beam.
- ③ ➔ **Laser Power Controller:** Adjusts the laser output intensity.
- ④ ➔ **Power ON Indicator:** Confirms that the system is powered and operational.
- ⑤ ➔ **Power Input:** USB Type-A port, connect to the Powerbank if it doesn't connect to a PC.
- ⑥ ➔ **USB Connection:** USB Type-A port, provides data input/output between the module and external USB devices.

3. Operating Instructions Step by Step Guide

1. Place the transmitter and receiver units on a flat surface and align them using the table edge or a wall (Top alignment view shown below).



2. Adjust the transmitter focus ring until the laser beam is sharply focused on the detector of the receiver unit.
3. Connect the device-side **USB Type-A** cable to the PC; connect any peripherals to the USB connector on the unit as required.
4. Connect the host-side power bank to the host unit.
5. Adjust the laser power controller to the minimum level that maintains a reliable signal and reduces reflections.
6. Verify operation by confirming that USB device is recognized and functioning correctly on the PC.

4. Troubleshooting Guide

Issue	Possible Cause	Solution
No device shown in the PC	Misalignment of the link.	Adjust optical path Reconnect USB Device
LED not turning on	Power supply failure	Check Power bank charge. Reconnect the USB power
