1. What this device does

This system replaces a short USB cable with a beam of safe light (an optical link) so you can use common USB devices (such as a mouse, keyboard or USB stick) across a small gap (across 2 metres). To the computer it should act as a normal, wired USB connection.

2. System contents

Table 1: System Contents for Module.

Module/Accessory	Function	Notes
Transmitter assembly (enclosure and PCB)	Laser driver, USB device interface.	Battery-powered module.
Receiver assembly (enclosure and PCB)	Photodetector, transimpedance amplifier, comparator, USB bridge.	Mains (5V input).
USB type-A/C cable(s)	Host connection(s).	Certified hi-speed cable.
Alignment aid (steel rods and paper target)	Coarse alignment.	Paper or acetate target.

3. Safety summary (READ BEFORE USE)

(i) Laser classification: Class 1M under AS/NZS IEC 60825-1. Do not view the beam with any optical instruments, avoid specular reflections and operate only with the supplied enclosure and apertures.

(ii) Electrical: handle the printed circuit boards (PCBs) gently. Follow ESD precautions when handling PCBs and only use specified power sources.

(iii) Environmental: operate in laboratory setting with a stable bench and no direct sunlight on the receiving aperture.

4. Pre-use checklist

Table 2: Pre-use Checklist for System Operation.

Check	Pass criteria

Enclosure set up, apertures unobstructed	No exposed optics or loose fasteners.
Working distance	Transmitter and receiver separation within 2m; line of sight clear.
Power state	Transmission battery module sufficiently charged. Receiver module receives stable 5V supply.
Host connection	Correct USB port and cable. Operating system recognises device class.
Lighting	No direct light into receiver.

1. First-time setup
   (i)   Place the receiver on a stable surface. Aim its front opening along the intended path.
   (ii)   Place the transmitter about 2m away, facing the receiver. Use the supplied rods for quick coarse aim.
   (iii)   Power the receiver: plug its USB into a 5V source (5V adapter provided).
   (iv)   Connect to your computer: plug the receiver's data cable into the computer. Wait for the computer to be ready.
   (v)   Power the transmitter: turn it on (battery powered). Any on-device status lights should come on.
   (vi)   Fine alignment: adjust the transmitter (and/or receiver) left or right and up or down to maximise the link. Use the device indicators if present, otherwise, use the quick tests below.

6. Quick test (make sure it works)

HID test (mouse/keyboard)

- Plug a USB mouse or keyboard into the transmitter. On the computer, move the mouse or type and it should behave as if it's directly plugged in. No drivers are needed.

7. Normal Operation

Mouse or keyboard should operate as a regular, USB-connected device in terms of functionality. Verify the keyboard by opening a terminal or text editor and verifying that whatever is typed shows up on the computer screen in real time.

Reminder: Keep the two modules within 2m and facing each other. Typical sessions should run 30 minutes or more without dropouts when set up as above.

8. Shutdown

(i) Safely eject USB drive from your computer.

(ii) Turn off the transmitter.

(iii) Unplug the receiver from the computer when finished.

(iv) Put equipment back into boxing.

9. Troubleshooting

Table 3: Troubleshooting.

Issue	Likely causes	Corrective action
Nothing happens when connected (no mouse/drive appears)	Wrong port or cable used; receiver not powered; transmitter off or battery flat.	Check the receiver's 5 V power; try a known-good USB cable/port; turn on/charge the transmitter.
Cursor/typing lags or stops	Misalignment; too much ambient light; distance too great.	Re-aim for maximum alignment; reduce direct light on receiver; keep within 2 m.
USB drive appears but file copies are slow/unstable	Doing large transfers over low-speed link; alignment marginal.	Use smaller files; avoid big copies while using a mouse; improve alignment
USB drive appears but file copies are slow/unstable	Transmitter off/flat; beam blocked by cap/cover.	Turn transmitter on or charge; remove any protective cap; ensure aperture is clear.

10. Acceptance tests

Table 4: Acceptance Criteria for Design Operation.

Prior to Assembly		
Test No.	Instruction	Test description
1	Component verification and visual inspection	Confirm all electrical, optical and mechanical components match the bill of materials, check to see if free from physical damage and do small functionality tests.

2	Photodiode sensitivity characterisation	Validate photodiode response and sensitivity to ensure adequate detection over a 2m range once assembled.
3	Software Compliance Audit	Confirm all firmware and software used are open-source and appropriately documented prior to flashing.

During Assembly

Test No.	Instruction	Test description
4	Power Supply Integration Test	Verify correct voltage levels and isolation for the standalone power supply before connecting optical components.
5	PCB Continuity and Signal Integrity Test	Check PCB traces, solder joints, and interconnections to ensure signal integrity between MCU, laser, and photodiode circuits.
6	Partial System Functional Test	Validate subsystem operation (laser modulation, UART link and communication state machine) before enclosure finalisation

After Assembly

Test No.	Instruction	Test description
7	USB communication and transparency Test	Connect modules between a PC and peripheral to confirm 1.5 Mbps USB low-speed operation and transparent device behaviour
8	Laser Power Classification Test	Measure each laser diode's optical output to verify compliance with Class 1M limits prior to installation.
9	Error Correction Performance Test	Introduce optical noise and verify correct Hamming (7,4) encoding and decoding
10	Latency Test	Measure end-to-end latency between peripheral input and host response to confirm < 10 ms performance

11	Reflection Immunity and stability Test	Expose system to reflective surface and ambient light to verify no false triggering or signal interference occurs.
12	Operational Duration and Thermal Compliance Test	Operate system continuously for 2 hours with distances over 2m while monitoring temperature stability.