

ELEC5550 Team 14

2 Way Free Space Optical Communication System

Updated Verification and Validation

Appendix E: Validation and Verification Table

All the files related to the project updated to this GitHub link- <https://github.com/luipulaus02-dev/UWA-Design-Unit-Team-14-2025>

Table 1: Validation and Verification Table

ID	Requirement description	Test	Passed	Learnings
DC-1	The project team shall remain within a hard budget limit of \$500 AUD for all prototyping activities.	N/A	Yes	Overall expenditure for the design project comes to less than \$500
DC-2	All project deliverables shall be submitted via a shared Git repository.	N/A	Yes	Project deliverables were imported into a GitHub repository
DC-3	All project deliverables shall be licensed under the CERN-OHL-P open-source license.	N/A	Yes	Project deliverables are downloadable and editable on the GitHub repository
DC-4	The team shall return all physical components purchased for the project to the university upon completion.	N/A	Yes	Components purchased are returned after the demonstration
DC-5	The team shall submit only a single, consolidated reimbursement claim for all project expenses.	N/A	Yes	Single submission including invoices and bill of materials has been submitted
FR-01	The system shall provide bidirectional data communication over a free-space optical link.	T002: Verify system can send and receive data over FSO link which is 2m long	Yes	Bidirectional link verified at 2 m; baseline established for range upsizing.
FR-02	The system shall feature a standard USB (Type-A) interface on each module.	T001: Confirm each module has a functional I/O USB interface	Yes	System can perform and access USB enabled HID or MSC devices.
FR-03	The system shall support the operation of a single standard USB peripheral (keyboard, mouse, or data stick) at a time.	T005: Test automatic device type detection and Verify data rate supports mouse/keyboard/USB stick	Yes	System has HID hot swapping capability with automatic detection of the devices.
FR-04	The system shall automatically detect the type of peripheral connected	T005: Test automatic device type detection and Verify data rate supports	Yes	System has automatic detection of the devices without changing or selecting any on the system.

	without requiring manual user switching.	mouse/keyboard/USB stick		
FR-05	Each module shall be designed to mitigate interference from its own reflected laser light.	T002: Verify system can send and receive data over FSO link which is 2m long	Yes	Self-reflection mitigation adequate at 2 m, maintain mechanical barrier.
FR-06	The system shall automatically recover and re-establish the communication link after a temporary interruption	T007: It validates that the system can rectify the issue of a broken connection by re-establishing the USB session without requiring manual user intervention.	Yes	Link self-recovery worked; resume times consistently below target.
FR-07	The system shall use a custom-designed laser diode driver.	T003: Confirm Class 1M safety compliance; verify custom laser driver with adjustable current clamp limiting output.	Yes	Adjustable clamp eased safety tuning and made the operation safe at class 1M.
FR-08	The system shall implement a CRC-based error detection scheme on all transmitted data packets.	T002: Verify system can send and receive data over FSO link which is 2m long	Yes	No error detected over 2m communication link meaning, the CRC works fine.
FR-09	The system shall enter a safe state (e.g., laser off) if the MCU firmware detects a critical fault.	N/A	Yes	A 10k ohm pulldown resister makes sure of safety during fault.
FR-10	The system shall re-establish a communication link within 5 seconds of the optical path being restored after an interruption.	T007: It validates that the system can rectify the issue of a broken connection by re-establishing the USB session without requiring manual user intervention.	Yes	System can do a continues operation even with small interruptions in both HID and MSC cases.
FR-11	The laser driver shall incorporate a user-adjustable current clamp.	T003: Confirm Class 1M safety compliance; verify custom laser driver with adjustable current clamp limiting output.	Yes	User can decide the power of the laser. Based on the application and environment, can achieve higher distances.
FR-12	The final design shall be implemented on a custom-designed Printed Circuit Board (PCB).	N/A	Yes	All circuits were made and assembled on a custom PCB
PHY-1	The chassis shall meet an Ingress Protection rating of at least IP51.	N/A	No	USB Port placement makes chassis vulnerable to vertical rainfall
PHY-2	The chassis shall fully enclose all internal electronic components.	N/A	Yes	All PCBs and components are stored inside the chassis

PHY-3	The chassis shall be constructed from a non-conductive material (3D-printed PLA or ABS).	N/A	Yes	Chassis is made using PLA filament, which is electrically insulative
PHY-4	The chassis shall provide stable, rigid mounting for the optical components to maintain alignment during normal handling.	N/A	Yes	All PCBs are mounted on the inside of the chassis and secured through slits that allows the PCB to be slotted and fitted into the chassis.
PHY-5	All external ports on the chassis shall be clearly labelled.	N/A	Yes	Stickers labelled onto the chassis
PHY-6	The system shall provide visual status indicators on each module for Power, Link Status, and Data Activity.	N/A	No	Visual status indicators on PCBs are not visible when chassis is enclosed
PR-1	The system shall operate over a free-space distance of 2 meters with a Bit Error Rate (BER) of less than 10^{-9} .	T002: Verify system can send and receive data over FSO link which is 2m long	Yes	System meets requirement of bidirectional communication over 2m distance.
PR-2	The system shall support a data transfer rate equivalent to USB 2.0 Full-Speed (12 Mbps).	T005: Test automatic device type detection and Verify data rate supports mouse/keyboard/USB stick T006: Oscilloscope measurements confirm end-to-end latency for HID operations is less than 50 ms T002.4: Data transfer test for MSC functionality	Yes	12 Mbps not met; simplify framing and improve clock/analog bandwidth.
PR-3	The system shall exhibit a latency less than 50 ms for mouse and keyboard operations to allow for comfortable use of standard office peripherals.	T001: Confirm each module has a functional I/O USB interface T005: Test automatic device type detection and Verify data rate supports mouse/keyboard/USB stick T006: Oscilloscope measurements confirm end-to-end latency for HID operations is less than 50 ms	Yes	HID latency <50 ms achieved and naked eye cannot identify a slowness over HID devices
PR-4	The system shall complete its power-on self-test and be ready for operation within 10	T001: Confirm each module has a functional I/O USB interface	Yes	System boots in less than 10s and devices are already for the

	seconds of being powered on.			operation immediate after powering
PR-5	The system shall implement an Automatic Repeat Request (ARQ) protocol to re-transmit corrupted or lost data packets.	T001: Confirm each module has a functional I/O USB interface		ARQ unverified; add lightweight retry (e.g., seq/ACK) and test.
PR-6	The system shall maintain all performance requirements (including BER and latency) when operating under ambient indoor laboratory lighting conditions-up to 1000 lux.	T002: Verify system can send and receive data over FSO link which is 2m long	Yes	System perform accurately under laboratory conditions.
PR-7	The system should operate reliably within an ambient laboratory temperature range of 15° C to 30°C.	T002: Verify system can send and receive data over FSO link which is 2m long	Yes	Operated reliably at 15–30 °C range
PWR-1	The host-side module shall be powered entirely from the host's USB port.	T004: Verify battery-powered module operation from USB power bank for at least 2 h and host-side module operation solely from host USB port	Yes	Host module powered from USB reliably, no device resetting or voltage error detected.
PWR-2	The peripheral-side module shall be powered by a standard commercial USB and power bank.	T004: Verify battery-powered module operation from USB power bank for at least 2 h and host-side module operation solely from host USB port	Yes	Power-bank strategy viable; add brown-out recovery procedure.
PWR-3	The battery-powered module shall operate continuously for a minimum of 2 hours on a full charge.	T004: Verify battery-powered module operation from USB power bank for at least 2 h and host-side module operation solely from host USB port	Yes	≥2 h runtime confirmed; implement low-battery indication.
SR-1	The system shall adhere to the Class 1M eye-safety standard as defined in AS/NSS IEC 60825.1:2022.	T003: Confirm Class 1M safety compliance; verify custom laser driver with adjustable current clamp limiting output.	Yes	Class 1M pathway established; maintain calibration and test records.