Optical Communications Low-Cost Payload System Test Plan

Version 2.7

04/15/2025

Document Control

Distribution List

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Change Summary

The following table details changes made between versions of this document:

Version	Date	Modifier	Description
1.0	12/02/2024	Lexi Colebank	Create an initial document and add information to each section. Fill out the beginning of section 1 except 3 parts being saved for after other sections are complete.
1.1	12/03/2024	Jessica Sammons	Added Requirements IDs and Requirements to section 4 Traceability Matrix table. Added Testing Environment paragraph.
1.2	12/04/2024	Jessica Sammons	Added Resumption Requirements paragraph, initial Functionality Testing, Testing Assumptions paragraph, and Testing Risks and Contingencies

			paragraph. Created Test case objectives, test case titles, filled out traceability matrix to align with test cases. Added defects in the proper severity rows within the Defect Severity Definitions section. Completed the Document Overview section in Section 1, added reference documents.
1.3	12/05/2024	Jessica Sammons	Added Testing Approach Overview section, added system overview section with diagrams, updated scope section to better align with prior documentation, wrote test cases in Section 5, added schedule to Section 3.
1.3	12/05/2024	Lexi Colebank	Update test case with information on tests done and operators actions, purpose, and expected results for HW01-HW21. Change objectives for GEN03-GEN22 that match requirements.
1.3	12/05/2024	Brian Barker	Formatted the document for consistency and readability. Fixed table of contents and edited hierarchal structure of headers and corrected multiple typos throughout the document. Updated sections 2.2.1 and 2.2.2 with more realistic laser diode power values for criteria.
2.0	03/25/2025	Jessica Sammons	Updating the requirements in Section 4 Traceability to match the current version of the SRS.
2.0	3/25/2025	Lexi Colebank	Added comments from previous version 1.4 into the document.
2.0	03/25/2025	Brian Barker	Corrected the formatting of the test cases in section 5. Added the SOP document as a reference in section 1.7.
2.1	04/01/2025	Jessica Sammons	Updated the Introduction sections and Testing Approach sections in accordance with the feedback received from the TA.
2.2	04/03/2025	Jessica Sammons	Added Test Cases to correspond to the new requirements added from the updated version of the SRS.
2.2	04/03/2025	Lexi Colebank	Going through current test cases and adding new requirements. Combining old test cases if we test them together. Updated Section 4 traceability table with current requirements and new test cases. Started going through new test cases and add objective and test
2.3	04/08/2025	Jessica Sammons	Finished adding all Test Cases to section 5 so they correspond correctly to the Traceability Matrix in section 4 and the

			new requirements added from the SRS. Began writing GEN test cases.
2.4	04/09/2025	Brian Barker	Worked on writing test cases in section 5. Added header sections for sections 5.1-5.3. Formatted test cases throughout section 5 for readability.
2.4	04/09/2025	Jessica Sammons	Completed writing of all GEN test cases in section 5. Also wrote all SW test cases.
2.5	04/10/2025	Jessica Sammons	Updated the Test Plan table and the Traceability Matrix table, removing duplicate test cases. Updated all test case numbering to align with the cleaned Test Plan table and Traceability Matrix table.
2.5	04/10/2025	Brian Barker	Minor spelling corrections and formatting in sections 5.2 and 5.3. Wrote new test cases in section 5.1.
2.6	04/11/2025	Brian Barker	Performed the remaining test cases in sections 5. Wrote concluding remarks for all tests that didn't pass. Updated section 2.6 with new test results.
2.7	04/15/2025	Brian Barker	Updated test dates in respective tests and section 2.6. Minor formatting.
2.7	04/15/2025	Lexi Colebank	Added Defected Items to the defected list with description and date. Went through all test cases and added steps for procedures.

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1. Introduction

1.1. Purpose

The purpose of this document is to provide a detailed test plan that can be used to verify the implementation of the Optical Communication System (OCS). It describes the testing strategy and approach the team will use to verify established requirements prior to release. All requirements have been preset in the SRS and will be referenced throughout the document.

1.2. Scope

The scope of this test plan encompasses validation and verification of the OPTICS system to establish and maintain optical communication through varying conditions, including different distances, environmental factors, and operational scenarios. The optical communication system is designed for reliable communication across free space. In order to appropriately verify and validate this functionality, the test plan covers functional, performance, reliability, and integration testing on the system. This test plan does not cover external network dependencies or components beyond the scope of the system design.

1.3. System Overview

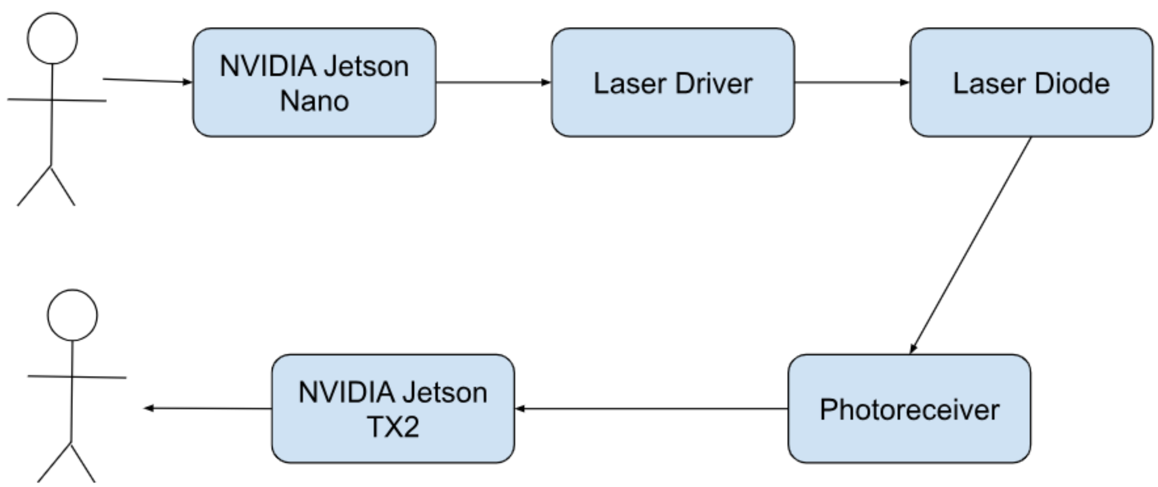

Figure 1. High Level System Architecture

This project is focused on developing a Low-Cost Optical Communication System capable of one-way communication using a laser and laser driver across free space. The system consists of a transmitting device, an NVIDIA Jetson Nano as well as a receiving device, an NVIDIA Jetson TX2. The communication is done through a laser and laser driver over up to a 1-foot range over free space. The current scope involves increasing the data rate to 1Mbps transmitting across a 1-foot range.

Figure 1 shows the overarching High Level System Architecture of the system. The NVIDIA Jetson Nano board converts an image file which is provided by the user into a binary data stream. The binary data stream is transmitted using On-Off Keying of a laser and laser driver across free space. The light from the laser is detected using a photodetector which is connected to the NVIDIA Jetson TX2 board. The NVIDIA Jetson TX2 board then decodes the binary data stream back into the original image file, displaying the final image onto the corresponding monitor.

Each of the hardware components must be tested for proper functionality in accordance with the specification documentation provided for each component. The hardware components to be tested are shown in Figure 2.

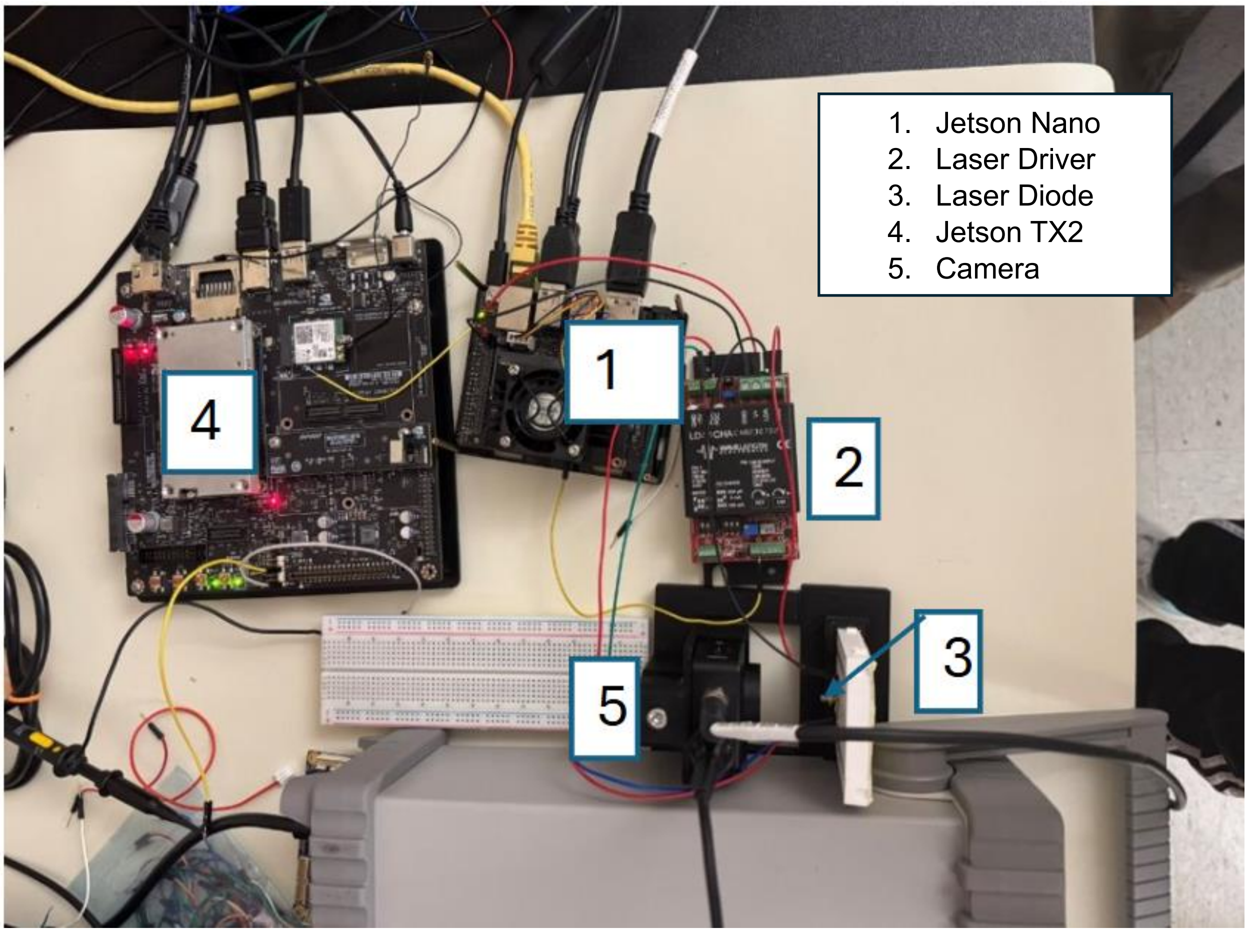

Figure 2. Hardware Components.

The interface between each of the hardware components will be tested to ensure that the integration of the system functions as expected in accordance with the requirements provided in the System Requirements Specifications (SRS). This includes the wired connections through the UART pins for each of the Jetson boards.

1.4. Testing Approach Overview

The testing approach for the system is designed to verify functionality, usability, and performance of the system as a whole as well as for each system component. The testing will be done in such a way that each requirement outlined in the System Requirement Specification (SRS) can be traced directly to at least one test case provided in this document. The test approach implements a multilevel testing strategy to evaluate individual components, system integration, and overall system performance under specified conditions. The testing is divided into unit testing, integration testing, system testing, and performance testing.

Unit testing: Testing the functionality of individual components with each subsystem isolated to confirm that it meets the design specifications. Tests on the NVIDIA Jetson boards as well as the laser and laser driver will be run to ensure proper functionality according to design specifications.

Integration testing: Testing the interaction between subsystems. This includes testing the communication between the transmitting and receiving Jetson boards, mainly focusing on the UART-based communication and signal transmission path.

System testing: Testing of the end-to-end functionality of the system, including data transmission, error detection, and display of the received image.

Performance testing: Testing of the system’s ability to meet performance metrics including transmission of data at 1Gbps over a 1-foot range, staying within the power budget, and achieving a latency below 1 second.

1.5. Testing Entrance Criteria

Prior to initial testing, specific entrance criteria must be met to ensure safety and readiness. All team members must complete a laser safety quiz and laser protection equipment provided by the customer. Laser warning signage must be displayed on the door to caution anyone entering the area following the Standard Operating Procedure (SOP) approved by the customer. These steps are essential to establish a successful testing environment.

1.6. Document Overview

This Test Plan is written with the intent of describing each of the tests being run on the Optical Communication system. The test plan details the testing approach, followed by the test schedule, the traceability matrix of each test case to a corresponding requirement, and finally each test case to be run. To gain a better understanding of the testing being run as well as the assumptions and environment in which the tests are run, it is suggested that the reader begin at Section 2, Testing Approach. If the reader is inquiring about the schedule of the system testing, it is recommended to begin at Section 3, Test Schedule. A product owner is suggested to begin Section 4, which details the relationship between each requirement and its corresponding test cases. An engineer running tests should begin at Section 5, reading through each test case to properly test the system.

1.7. References

System Design Document v1 - OPTICS.docx

System Requirements Specification - OPTICS.docx

SOP - Optical Communications.docx

2. Testing Approach

2.1. Testing Types

The testing types for this OCS include functionality testing. Functionality testing assesses the software to ensure it operates correctly and meets the required specifications, verifying that it produces the expected results.

2.1.1. Functionality Testing

The testing is divided into unit testing, integration testing, system testing, and performance testing.

Unit testing:

- NNVIDIA Jetson Nano board powers on
- Laser Driver powers on
- NVIDIA Jetson TX2 powers on

Integration testing:

- UART pins are correctly placed
- Jetson Nano board transmits a bitstream
- Jetson TX2 receives a bitstream

System testing:

- Image selected at the start of operation is displayed on the Jetson TX2 at the end of operation

Performance testing:

- Transmission of data within 1Mbps
- Transmission of data over a 1-foot range
- Hardware components remain within power budget
- System latency remains below 1 second

2.2. Testing Suspension Criteria and Resumption Requirements

2.2.1. Suspension Criteria

Testing will be suspended if the incidents found will not allow further testing of the system/application under test. If testing is halted, and changes are made to the hardware, software, or database, it is up to the Testing Manager to determine whether the test plan will be re-executed, or part of the plan will be re-executed. Incidents that would require suspension include:

- Diode burns out or begins smoking
- NVIDIA Jetson Nano burns out or begins smoking
- NVIDIA Jetson TX2 burns out or begins smoking

2.2.2. Resumption Requirements

Testing will resume once the subsystem, or hardware component, which entered critical or unsafe conditions passes individual safety and operational checks. Meaning that if a subsystem experiences a malfunction, the subsystem will continue to be retested through each of its test cases until all test cases pass. This will be done for each of the subsystems in the system. Once all of the subsystems have passed their test cases, the system integration as a whole will be tested in a similar fashion. Resumption of testing will occur when:

- The diode transmits between 3 mW and 7 mW of power, ensuring it does not exceed safe operational limits
- The sensor reliably detects the transmitter signal without intermittent failures that could indicate hardware instability
- The NVIDIA Jetson Nano demonstrates stable signal modulation without overheating or electrical faults
- The NVIDIA Jetson TX2 receives OOK modulated signal from the photodetector, confirming there is no risk of data corruption or hardware damage
- The system operates without unexpected power surges, laser misalignments, or other hazards that could endanger personnel or equipment

2.3. Testing Environment

The system will be tested within the designated lab (currently Lehman Building room 331), where the temperature will not exceed 65-80 degrees Fahrenheit. The system will be tested in accordance with the Standard Operating Procedure (SOP) document. In order to test the proper function of the laser and laser driver, the system will be tested in the dark, with the lights in the lab off. The system hardware will be sitting atop a table in the lab and will not be touched through the testing of the laser and laser driver components.

2.4. Testing Assumptions

The design of this test plan relies on several assumptions that are outside the direct control of the testing team. The testing assumptions include:

- All hardware components meet the performances specifications provided by their manufacturers, such as power ratings, signal modulation capabilities, and detection thresholds
- The testing equipment is properly calibrated and functioning within its specified tolerances throughout testing
- The lab’s electrical infrastructure delivers stable power without fluctuations that could affect system performance

- Software libraries and drivers provided by NVIDIA perform as documented without undisclosed bugs or compatibility issues
- Environmental conditions remain within operational limits specified by the component manufacturers

2.5. Testing Risks and Contingencies

Possible risks to testing include laser safety violations, software bugs, data loss, varying environmental factors, and hardware malfunctions. To mitigate the risk of laser safety violations, we have implemented an SOP which will be followed through each testing process. Contingencies for software bugs include unit testing of the software before implementation of the software into the system. The mitigate data loss, the software contains built-in error detection mechanisms. The environmental factors of the lab will be monitored and checked before each test is run to ensure the environment meets the expected temperature and lighting. Finally, to mitigate hardware malfunctions, spare hardware components will be maintained with pre-test inspections performed to identify potential failure risks.

2.6. Test Plan

Table 1: Test Plan

ID	Test	Status[1]	Date	Notes
HW01	Powering on the laser and laser driver.	Passed	04/10/25	
HW02	NVIDIA Jetson TX2 UART pins connection.	Passed	04/10/25	
HW03	Laser Driver power input inspection.	Passed	04/10/25	
HW04	Laser Driver current inspection.	Passed	04/10/25	
HW05	Replacement of laser driver upon transmission greater than 1Mbps.	Unwritten	N/A	Current speed does not support this test.
HW06	Replacement of photoreceiver upon transmission greater than 5Mbps.	Unwritten	N/A	Current speed does not support this test.
HW07	Serial bitstream to the NVIDIA Jetson TX2 through UART.	Passed	11/05/24	
HW08	HDMI cable connection: NVIDIA Jetson TX2 to the physical display monitor.	Passed	10/28/24	
HW09	Physical display of image on monitor.	Passed	04/10/25	
HW10	Transmitting board (NVIDIA Jetson Nano) writes an image.	Passed	11/05/24	
HW11	ttyS0 driver sends image data.	Passed	11/05/24	
HW12	Data received through “ttyTHS2”.	Passed	11/05/24	
HW13	Laser transmission through free space.	Passed	04/10/25	
HW14	Optical sensor interception of laser.	Passed	12/03/24	

[1] Unwritten, Incomplete, Passed, Failed

HW15	System UART communication criteria.	Failed	04/10/25	
HW16	Photodetector recording of data.	Passed	04/10/25	
HW17	Input image file transmission through UART.	Passed	04/15/25	
HW18	Bitstream reading through UART device driver.	Passed	11/05/24	
HW19	Laser diode output voltage.	Passed	04/10/25	
HW20	Bitstream transmitted at a rate of 1Gb/s.	Failed	04/11/25	Current speed does not support this test.
HW21	Bitstream received at a rate of 1Gb/s.	Failed	04/11/25	Current speed does not support this test.
HW22	Transmission speed allows adequate decoding of data.	Passed	04/10/25	
HW23	95% data transmission without errors.	Passed	04/10/25	
HW24	15-watt power draw; transmitter system.	Passed	04/10/25	
HW25	Possible shorting hazards check.	Passed	04/10/25	
HW26	Exposed wiring check.	Failed	04/10/25	
HW27	Secure connection inspection.	Passed	04/10/25	
HW28	Laser diode power; trimpot adjustment.	Passed	04/10/25	
HW29	Laser diode current; trimpot adjustment.	Passed	11/21/24	
HW30	95% availability operation.	Failed	04/10/25	
HW31	Burnt out diode replacement	Passed	11/21/24	
HW32	Laser driver – hardware device connection.	Passed	11/21/24	
HW33	NVIDIA Jetson Nano transmission	Passed	04/10/25	

HW34	NVIDIA Jetson TX2 receiving.	Passed	04/10/25	
HW35	Transmitting laser wavelength.	Passed	04/10/25	
HW36	Transmitting laser driver wavelength.	Passed	04/10/25	
HW37	Laser Diode input current.	Passed	04/10/25	
HW38	Laser Diode transmitting range of error.	Passed	04/15/25	
HW39	Laser Diode receiving pin.	Passed	04/10/25	
SW01	Image file upload.	Passed	04/10/25	
SW02	System activation.	Passed	04/10/25	
SW03	NVIDIA Jetson TX2 data decoding.	Passed	04/10/25	
SW04	Transmission of image as buffer.	Passed	04/10/25	
SW05	Data transmission initialization speed.	Passed	04/10/25	
SW06	Input image file transmitted as char pointer.	Passed	04/10/25	
SW07	Bitstream received as char pointer.	Passed	04/10/25	
SW08	Received file written as proper file type.	Passed	04/10/25	
SW09	Code written in C++.	Passed	04/10/25	
SW10	Data stream transmission initiation.	Passed	04/10/25	
SW11	Data stream transmission termination	Failed	04/10/25	
SW12	Access UART using Linux and the Jetson Nano.	Passed	04/10/25	
SW13	Image name and size written to a Jetson Nano device file.	Passed	04/10/25	
SW14	Image device file on Jetson Nano closes when done writing to UART.	Passed	04/10/25	

SW15	Jetson TX2 opens the image device file.	Failed	04/10/25	
SW16	Jetson TX2 reads the image device file.	Passed	04/10/25	
SW17	Jetson TX2 saves data read to heap-based array.	Failed	04/10/25	
SW18	Jetson TX2 prints image transfer elapsed time and data rate.	Passed	04/10/25	
SW19	Jetson TX2 closes image device file.	Failed	04/10/25	
SW20	Jetson TX2 writes image file to specified directory.	Passed	04/10/25	
SW21	Transmission of images in any file format.	Failed	04/10/25	
SW22	Received image file viewable in Jetson TX2 folder.	Passed	04/10/25	
SW23	User manual provided through terminal interface.	Failed	04/10/25	
SW24	UART library consistency across transfer rates.	Failed	04/10/25	
SW25	Dynamic communication protocol across transfer rates.	Failed	04/10/25	
SW26	System code portable to Ubuntu 18.04 AARCH64 systems.	Passed	04/10/25	
SW27	Data sent through nonblocking code using single thread.	Failed	04/10/25	
SW28	Data transmission without additional encoding.	Failed	04/10/25	
SW29	Received data is output without decoding.	Failed	04/10/25	
GEN01	Free space transmission through dust.	Passed	04/10/25	
GEN02	Minimum free space transmission distance.	Passed	04/10/25	
GEN03	Carrier signal orientation.	Failed	04/10/25	

GEN04	Safe laser operation by team members.	Passed	04/10/25	
GEN05	Powering off of system when not in use.	Passed	04/10/25	
GEN06	System within height, length, and width maximum.	Failed	04/10/25	
GEN07	System within $20,000 budget.	Passed	04/10/25	
GEN08	System remains under 20 pounds.	Passed	04/10/25	
GEN09	System operation between 65-80 degrees Fahrenheit.	Passed	04/10/25	
GEN10	System operation on Earth's surface.	Passed	04/10/25	
GEN11	System testing using Safety Glasses.	Passed	04/10/25	
GEN12	System operation in testing environments.	Passed	04/10/25	
GEN13	System component approval.	Passed	04/10/25	
GEN14	COTS components are used in system.	Passed	04/10/25	
GEN15	Increasing receiver distance through development.	Failed	04/10/25	
GEN16	Laser sends static amounts of data.	Failed	04/10/25	
GEN17	NVIDIA Jetson Nano power input accessibility.	Passed	04/10/25	
GEN18	NVIDIA Jetson TX2 power button accessibility.	Passed	04/10/25	
GEN19	Laser Receiver power input accessibility.	Passed	04/10/25	

3. Test Schedule

Document Event	Date
Test Plan Released	12/05/2024
Test Plan Updates	03/25/2025
Test Plan v2 Released	04/15/2025

4. Traceability Matrix and Defect Tracking

4.1. Traceability Matrix

Table 2: Traceability Matrix

Req. ID	Requirement	Test Case
Req. 3.1.1	The user shall plug in the power source through the computer	HW01
Req. 3.1.2	Activate the laser using the laser driver.	HW01
Req. 3.1.3	The user shall provide input into the NVIDIA Jetson.	SW01
Req. 3.1.4	All activation of the system shall be performed via startup script in the Terminal.	SW02
Req. 3.1.5	The user shall be able to select an image through the terminal shell by calling out the image file in the main transmission code.	SW01
Req. 3.1.6	The user shall view the image from the NVIDIA Jetson TX2 output directory.	SW08
Req. 3.2.1	The system shall use an NVIDIA TX2 to transcode the received serial bitstream back into an image.	SW03
Req. 3.2.1.1	The NVIDIA TX2 shall take the 3.4V signal and convert to a 1-bit signal.	HW34
Req. 3.2.2	The NVIDIA Jetson TX2 shall connect to the optical sensor through UART pins to receive image input.	HW02
Req. 3.2.3	The optical sensor shall send the received serial bitstream to the NVIDIA Jetson TX2 through UART pins on the TX2.	HW07
Req. 3.2.4	The system shall use an HDMI cable to send image data to the physical display monitor.	HW08
Req. 3.2.5	The system shall use a physical display monitor to show the received image feed to the user.	HW09
Req. 3.3.1	The transmitting board (NVIDIA Jetson Nano) shall write an image as a buffer to the ttyS0 device by using standard Linux file operation system calls (open(), read(), write(), close()).	HW10, SW04
Req. 3.3.2	The Jetson Nano shall open the file “/dev/ttyS0” using the Linux system call “open()” to gain access to UART device “ttyS0”.	SW12
Req. 3.3.3	The Jetson Nano shall use the Linux system call “write()” to write the name and size of the image before transmitting the image data	SW13
Req. 3.3.4	The Jetson Nano shall use the Linux system call “write()” to write the image data all at once to the UART device “ttyS0”.	SW14
Req. 3.3.5	The Jetson Nano shall use the Linux system call “close()” to release the UART device “ttyS0” when the Nano is done writing the full image.	SW14
Req. 3.3.6	The Jetson TX2 shall open the file “/dev/ttyTHS2” using the Linux system call “open()” to gain access to UART device “ttyTHS2”.	SW15

Req. 3.3.7	The Jetson TX2 shall use the Linux system call “read()” to read the name and size of the image before reading the transmitted image data.	SW16
Req. 3.3.8	The Jetson TX2 shall use the Linux system call “read()” to read image data from the UART device “ttyTHS2” in 4095-byte chunks.	SW16
Req. 3.3.9	The Jetson TX2 shall put all data read in from “ttyTHS2” into a heap-based byte array the size of the image.	SW17
Req. 3.3.10	The Jetson TX2 shall print the elapsed time in seconds and data rate in Mbps of the full image transfer.	SW18
Req. 3.3.11	The Jetson TX2 shall use the Linux system call “close()” to release access to the “ttyTHS2” device once it is done reading all the image data.	SW19
Req. 3.3.12	The Jetson TX2 shall write the image file to the directory “/home/amarjon/OPTICS Fall 2024/receive” under the name of the original file.	SW20
Req. 3.3.13	The Jetson TX2 shall write the image file to directory stated using standard Linux system calls “open()”, “close()”, and “write()”.	SW20
Req. 3.3.14	The ttyS0 driver shall send the image data serially through the UART pins found on the bottom of the NVIDIA Jetson Nano.	HW11
Req. 3.3.15:	The receiving board (NVIDIA Jetson TX2) shall receive data in a buffer through the ttyTHS2 device driver.	HW12
Req. 3.3.16	The ttyTHS2 device driver shall receive data through the third pin from right in pin section J17 on the NVIDIA Jetson TX2.	HW07
Req. 3.3.17	The system shall be able to transmit images of any format	SW21
Req. 3.4.1	The system shall use a laser to transmit the serial bit stream through free space.	HW13
Req. 3.4.2	The PDA20C2 photoreceiver shall intercept the laser.	HW14
Req. 3.4.3	The system shall communicate asynchronously using UART with 1000000 Hz baud rate with the 8N1 (1 start bit, 8 data bits, 1 end bit) packet format from the transmitter to the receiver module by an optical communication system.	HW15
Req. 4.1.1	The system shall initiate data transmission within 5 seconds of receiving a compressed image file from the NVIDIA Jetson Nano.	SW05
Req. 4.1.2	The system shall begin recording received bitstream data using the photodetector once detecting the first packet transmission light by the laser diode.	HW16
Req. 4.1.3	The Jetson TX2 shall always listen for data until it receives the size of the incoming image through UART transmission, at which point it will begin attempting to receive the image.	HW16
Req 4.2.1	The system shall transmit an image file as a bitstream using the laser driver and diode.	HW13, HW20, HW21, HW23, HW24, GEN03
Req 4.2.1.1	The laser driver shall be within the line-of-sight (LOS) of the receiver at the start of transmission.	GEN03
Req 4.2.2	The system shall store the transmitted bitstream as an image	SW08

Req 4.2.2.1	The system shall allow users to open the received image in the Jetson TX2's folder "/home/amarjon/OPTICS Fall 2024/receive".	SW22
Req 4.2.3	The system shall provide troubleshooting steps through the terminal interface.	SW23
Req 4.2.3.1	The system shall provide instructions to ensure proper transmission to receiver alignment.	SW23
Req 4.2.3.2	The system shall provide instructions to ensure that the system is receiving power.	SW23
Req 4.2.3.3	The system shall provide instructions to ensure proper wiring between hardware devices.	SW23
Req. 4.3.1	The input image file shall be read into the transmitting process's heap memory.	SW17
Req. 4.3.2	The input file image shall be transmitted through the UART TX pin on the transmitting board (NVIDIA Jetson Nano).	SW06, HW17
Req. 4.3.3	The bitstream read from the laser by the optical receiver shall be read through a UART device driver on the receiving board (NVIDIA Jetson TX2) to a char pointer.	SW07, HW18
Req. 4.3.4	The system shall send data bits serially through the UART device driver using nonblocking code using a single thread.	SW27
Req. 4.3.5	The system shall transmit data without applying additional encoding of the transmitted bitstream.	SW28
Req. 4.3.6	The system shall output the received bitstream without performing decoding of the received bitstream.	SW29
Req. 5.1.1	The hardware shall transmit the serial bitstream at a rate of at least <TBD.1>.	HW20
Req. 5.1.1.1	The serial bitstream shall be received at a rate of at least <TBD.2>.	HW21
Req. 5.1.2	The hardware shall transmit a signal at a speed that the receiving computer is able to adequately decode all data.	HW22
Req. 5.1.3	The hardware shall transmit at least 95% of the data without errors or loss.	HW23
Req. 5.1.4	The system shall transmit data through at least <TBD.5> inches of free space.	GEN02
Req. 5.1.5	The transmitter system shall not draw any more than 20 mW.	HW25
Req. 5.1.6	The RX shall receive the serial bitstream through free space without outside interference through air with less than or equal to 8 micrograms/cubic meter of dust.	GEN01
Req. 5.2.1	The carrier signal (laser) shall be oriented directly to the centerline within 1 degree of the receiving photodetector.	GEN03
Req. 5.2.2	The laser shall not be operated without a member of the project team to verify its proper use.	GEN04
Req. 5.2.3	The system shall have no possible shorting hazards.	HW25
Req. 5.2.3.1	The system shall have no exposed wiring.	HW26
Req 5.2.3.2	The system shall be inspected to be secure at all connection points prior to operation.	HW27
Req. 5.2.4	The laser diode power shall not exceed 5 mW.	HW28
Req. 5.2.5	The laser diode current shall not exceed 40 mA.	HW29
Req 5.2.6	The laser driver's current shall be limited to ensure laser diode maximum power is not reached.	HW03

Req 5.2.7	The laser driver's current limit shall be set to 20mA using a test circuit.	HW04
Req. 5.2.8:	The system shall be turned off when not in use.	GEN04
Req. 5.2.9	The system shall be tested in an enclosed space while wearing LG16B - Laser Safety Glasses (1550 nm) eye protection.	GEN11
Req. 5.3.1	The system shall operate at 95% availability during its lifetime.	HW30
Req. 5.3.1.1	The system shall only be used by authorized project members defined in a personnel control document.	GEN04
Req. 5.3.2.1	The operator shall replace the system diode in the occurrence of burnout.	HW31
Req. 5.3.2.2	The operator shall connect the laser driver to the corresponding hardware devices according to the Hardware User Manual.	HW32
Req. 5.2.2.4	The software developer shall be able to use the same UART library when increasing the data transfer rate of the system up to 12.5 Mbps.	SW24
Req. 5.3.2.5	The software developer shall have to use a new communication protocol, like USB 3.0, and shall use the appropriate library for communicating with such hardware when increasing the data transfer rate past 12.5 Mbps.	SW25
Req. 5.3.4.4	The hardware developer shall have to replace the laser driver when increasing the data transfer rate of the system past 1 Mbps.	HW05
Req. 5.3.5.5	The hardware developer shall have to replace the photoreceiver when increasing the data transfer rate of the system past 5 Mbps.	HW06
Req. 5.3.3.1	The system code shall only be portable to systems running on Ubuntu 18.04 with a processor architecture of AARCH64.	SW26
Req. 5.4.1.1	The optical communication system shall fit within 1U (10x10x10 in <TBD.3>).	GEN06
Req. 5.4.1.2	The system shall cost under $20,000 USD.	GEN07
Req. 5.4.1.3	The optical communication system shall weigh less than 20 pounds.	GEN08
Req. 5.4.1.4	The system shall operate between 65-80 degrees Fahrenheit. Low-Cost Optical Communication Payload System Requirements Specification Page 15	GEN09
Req. 5.4.1.5	The system shall operate using the NVIDIA Jetson Nano to transmit data.	HW33
Req. 5.4.1.6	The system shall operate using the NVIDIA Jetson TX2 to decode data.	HW34
Req. 5.4.1.7	The system shall operate on Earth's surface within the current laboratory decided upon by the Product Owner.	GEN10, GEN12
Req. 5.4.1.8	The system components to be purchased shall be approved or denied by Dr. Rojas and shall be purchased from the vendor (likely through a website) upon approval.	GEN13
Req. 5.4.1.9	The system shall constantly maintain Line of Sight (LOS) between transmitter and receiver when operating.	GEN05
Req. 5.4.2.1	The system shall use COTS components.	GEN14
Req. 5.4.2.2	The transmitting laser shall use a 1550 nm wavelength Diode.	HW35

Req. 5.4.2.3	The transmitting laser shall use a 1550 nm wavelength laser driver (IR-B class).	HW36
Req. 5.4.2.4	All system code implementation shall be done in C++ and C.	SW09
Req. 6.1.1	The user shall initiate the data stream transmission using the software interface.	SW10
Req. 6.1.2	The data stream transmission shall stop once all sent data is received.	SW11
Req. 6.1.3	The system shall be tested by increasing laser diode/optical receiver distances up to 1 foot.	GEN15
Req. 6.1.4	The laser shall send static data at the final stages of development.	GEN16
Req. 6.1.5	The NVIDIA Jetson Nano shall have a power input accessible to the user for use and operation.	GEN17
Req. 6.1.6	The NVIDIA Jetson TX2 shall have a power button accessible to the user for use and operation.	GEN18
Req. 6.1.7:	The laser receiver shall have a power input accessible to the user for use and operation.	GEN19
Req. 6.1.8	The laser driver shall be powered on with a 5V source through the NVIDIA Jetson Nano.	HW03
Req. 6.1.9	The laser diode shall output no more than 10 mW.	HW19
Req. 6.1.10	The laser diode shall receive no more than 35 mA.	HW37
Req. 6.1.11	The laser diode shall output <TBD.5> with a range of 5% error.	HW38
Req. 6.1.12	The laser diode shall receive <TBD.6> with a range of 5% error.	HW38
Req. 6.1.13	The laser diode shall receive data through the “MOD INPUT” pin on the laser driver	HW39

4.2. Defect Severity Definitions

Table 3: Defect Severity

Critical	The defect causes a catastrophic or severe error that results in major problems and the functionality is rendered unavailable to the user. A manual procedure is impossible to implement, or high effort is required to remedy the defect. Critical defects are as follows: • Laser fails to transmit serial bitstream resulting in complete data transmission failure • Photodetector does not detect transmitted laser signal • NVIDIA Jetson TX2 fails to decode receive data or crashes during operation • System exceeds power consumption limit
Medium	The defect does not seriously impair system function can be categorized as a medium defect. A manual procedure requiring medium effort can be implemented to remedy the defect. Medium defects are as follows: • UART pins misconfigured leading to inconsistent data transfer • Misalignment of laser and photodetector reducing transmission reliability • HDMI monitor shows image with incorrect scaling or formatting

Low	The defect is cosmetic or has little to no impact on system functionality. A manual procedure requiring low effort can be implemented to remedy the defect. Low defects are as follows: • Inconsistent labels or spelling errors in terminal outputs • Unappealing cable management that does not affect functionality • Status LEDs are dim or not visible but do not affect system operation

4.2.1. Defect Tracking

Table 4: Defect List

Number	Defect Severity	Defect Description	Date
1.	Medium	Exposed wiring can cause short circuits and unsecure connections.	04/14/2025
2.	Low	Photoreceiver and photodiode alignment causes pointing error.	04/14/2025
3.	Critical	Due to current hardware constraints, transition speed cannot reach 1 Gbps.	04/14/2025

5. Test Cases

5.1. Hardware Test Cases

Test Case HW01

Objective: *Laser and Laser Driver are powered on.*

Notes: Before the laser can be powered, all personnel must have proper safety equipment, and a current approved SOP.

Test No.: HW01		*Current Status: Passed*		
Test title: Powering on Laser and Laser Driver.				
Testing approach: Supply power to the Laser and Laser driver through the NVIDIA Jetson Nano with a 22 AWG wire.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	The laser driver is connected to the Jetson Nano, which supplies 5 V of power through its 5 V and GND pins to the driver's V+ and GND pins. The driver is then linked to the laser diode using its PDA (pin 2), PDC (pin 4), LDA (pin 3), and LDC (pin 1) connections.	This is to power the Laser and Laser drive.	The Laser and Laser Drive should be turned on and can be tested with a digital Multimeter. The voltage should be reading 5V. This will complete Req. 3.1.1.	
Concluding Remarks: The laser driver powers the laser with 20 mA when on, which equates to roughly 5 mW. This keeps the laser diode in the safe operating range, so that it does not burn out and so that its danger classification does not increase.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/25		

Test Case HW02

Objective: NVIDIA Jetson TX2 connects to the optical sensor through UART pins.

Notes:

Test No.: HW02		*Current Status: Passed*		
Test title: NVIDIA Jetson TX2 UART Pins Connection.				
Testing approach: Connect cable from the Receiver to the NVIDIA Jetson TX2 ground and UART pin. Demonstrate that this connection will allow an image input to be received.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect the cable from the Receiver to the NVIDIA Jetson TX2 ground and UART pin. Make sure there is a stable connection, and nothing is loose.	A sturdy connection helps keep equipment safe and limits potential issues. This will allow the image input to be received.	Cables are connected securely.	
2.	With the remaining system components turned on, transmit an image by typing *./receive.exe* on the receiving Jetson TX2, and *sudo transmit.sh* on the transmitting Jetson Nano.	Transmits the image.	Image will begin transmitting.	
3.	Verify that the image was transmitted successfully.	This ensures the image was sent successfully.	Image will be received.	
Concluding Remarks: UART TX and RX pins are connected correctly, and GND pins are connected across the board correctly.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/25		

Test Case HW03

Objective: Laser driver's input voltage does not exceed 5V.

Notes:

Test No.: HW03	*Current Status: Passed*			
Test title: Laser Driver Input Power Inspection.				
Testing approach: Measure laser driver input voltage using a multimeter.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Plug in USB-M to power the Jetson Nano.	Provides power to the Jetson Nano.	The Jetson Nano displays a green indicator light.	
2.	Connect female-to-male wire from the laser driver V+ pin to +5V Nano pin.	Provides power.	The wire is connected securely.	
3.	Connect another female-to-male wire from the laser driver GND pin to the Jetson Nano GND pin.	Grounds the laser driver and Jetson Nano.	The wire is connected securely.	
4.	Connect GND (black) multimeter cable to Step 3 wire and PWR (red) to Step 2 wire.	Sets up multimeter for measuring.	The multimeter is securely connected.	
5.	Verify multimeter reads approximately 5V.	To measure the laser driver input voltage.	The multimeter will read approximately 5V.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025			

Test Case HW04

Objective: The laser driver’s current does not exceed 20 mA.

Notes:

Test No.: HW04	*Current Status:* Passed
Test title: Laser Driver Current Inspection.	

Testing approach: Using a multi-meter, measure the laser driver's current during use.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Ensure the laser driver is plugged into a +5V power source.	Provides sufficient power to the laser driver.	The laser driver is provided with +5V of power.	
2.	Ground the Not Enable pin.	Turns on the laser driver.	The laser driver is enabled.	
3.	Using a multi-meter, measure across the 1 Ohm resister in the test circuit.	Measures the current of the laser driver.	The current shown is at or below 20 mA and should approximate the IMON pin.	
Concluding Remarks: Passed				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case HW05

Objective: Laser driver is replaced when attempting to transmit data faster than 1 Mbps

Notes:

Test No.: HW05			*Current Status: Unwritten*	
Test title: Replacement of Laser Driver Upon Transmission Greater Than 1 Mbps.				
Testing approach: Transmission speed is calculated and monitored within the software. When transmission speed reaches 0.75 Mbps, the system warns the user to change the laser driver for faster transmission speeds.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.				
Concluding Remarks: Transmitted data cannot yet reach 0.75 Mbps.				

Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* N/A

Test Case HW06

Objective: Photoreceiver is replaced when attempting to transmit data faster than 5 Mbps.

Notes:

Test No.: HW06			*Current Status: Unwritten*	
Test title: Replacement of Photoreceiver Upon Transmission Greater Than 5 Mbps.				
Testing approach: Transmission speed is calculated and monitored within the software. When transmission speed reaches 4.75 Mbps, the system warns the user to change the photoreceiver for faster transmission speeds.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.				
Concluding Remarks: Transmission speed cannot yet reach 4.75 Mbps.				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* N/A	

Test Case HW07

Objective: The optical sensor sends the received serial bitstream to the NVIDIA Jetson TX2 through UART pins on the TX2.

Notes:

Test No.: HW07			*Current Status: Passed*	
Test title: Serial Bitstream to the NVIDIA Jetson TX2 Through UART.				
Testing approach: Test that the serial bitstream data can be sent through the UART pin to the NVIDIA Jetson TX2.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Connect a wire between the UART Tx and Rx pins on the Nano and TX2 respectively.	Verify Nano can communicate with TX2 through UART pins.	Wires are connected securely.	
2.	Connect a wire between the GNDs of the Nano and TX2 respectively.	Grounds the system.	System is grounded.	
3.	Ensure the optical sensor is receiving a serial bitstream and sending it through the UART.	Verifies the serial bitstream is being received and sent correctly.	NVIDIA Jetson TX2 receives bitstream of data with a consistently low error rate, completing requirement 3.2.6.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 11/05/24		

Test Case HW08

Objective: An HDMI cable connects the NVIDIA Jetson TX2 to the physical display monitor.

Notes:

Test No.: HW08		*Current Status: Passed*		
Test title: HDMI Cable Connection: NVIDIA Jetson TX2 to the Physical Display Monitor.				
Testing approach: Inspect that the NVIDIA Jetson TX2 has a proper connection to the HDMI port on the monitor.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect the HDMI cord from the NVIDIA Jetson TX2 to the Monitor. Verify that there is a proper connection.	Connects the Monitor to the TX2.	Properly connect the TX2 to the Monitor to allow for a signal to go through. This completes Req 3.2.7.	

Concluding Remarks: TX2 displays an Ubuntu desktop on a monitor.	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 10/28/24

Test Case HW09

Objective: A physical display monitor shows the received image feed.

Notes:

Test No.: HW09	*Current Status: Passed*
Test title: Physical Display of Image on Monitor.	
Testing approach: Test that the connection from the TX2 and the Monitor will show a received image.	

STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Test that the serial bitstream from the TX2 can go through the HDMI cord to show the image received.	Shows the received image on the Monitor.	Once the image is received and shown on the monitor Req 3.2.8 will be complete.	

Concluding Remarks: TX2 displays Ubuntu desktop on a monitor.	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case HW10

Objective: The transmitting board (NVIDIA Jetson Nano) writes an image as a buffer to the ttyS0 device driver.

Notes:

Test No.: HW10	*Current Status: Passed*
Test title: Transmitting Board (NVIDIA Jetson Nano) Writes an Image.	

Testing approach: Test that the Jetson Nano can write data to its UART output pin, which is device ttyS0.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Write the image file into a memory buffer.	Writes the image into the memory buffer and prepares it to be sent.	Image file successfully loaded into memory buffer.	
2.	Write data in the memory buffer to device ttyS0.	Verifies that the Jetson Nano can write a buffer containing image data to its UART output pin.	The function writing the data buffer to the device should output 6990 bytes written, completing Req 3.3.1.	
Concluding Remarks: The writing function outputs that it writes the whole image buffer.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 11/05/24		

Test Case HW11

Objective: The ttyS0 driver sends image data serially through the UART pins found on the bottom of the NVIDIA Jetson Nano.

Notes:

Test No.: HW11		*Current Status: Passed*		
Test title: ttyS0 Driver Sends Image Data.				
Testing approach: Nano writes data through its UART output pin.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Run the receiving software on the TX2.	Prepares the system to receive the data.	The receiving software begins.	

2.	Run the transmitting software on the Nano.	Begins transmitting the data to the receiver.	The selected image begins transmitting.	
3.	Look to see the image produced on the TX2.	Ensure that the Nano can send data through its UART pin.	The TX2 produces an image, completing Req 3.3.2.	
Concluding Remarks: The TX2 produces the top half of the image sent from the Nano.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 11/05/24		

Test Case HW12

Objective: The receiving board (NVIDIA Jetson TX2) receives data in a buffer through the "ttyTHS2" device driver.

Notes:

Test No.: HW12		*Current Status: Passed*		
Test title: Data Received Through "ttyTHS2".				
Testing approach: Verify that data can be received through the TX2's UART input pin.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Run the receiving software on the TX2.	Prepares the system to receive the data.	The receiving software begins.	
2.	Run the transmitting software on the Nano.	Begins transmitting the data to the receiver.	The selected image begins transmitting.	
3.	Look to see the image produced on the TX2.	Ensure that the Nano can send data through its UART pin.	The TX2 produces an image that has at least portions of the image being sent from the Nano, completing Req 3.3.3.	

Concluding Remarks: The TX2 produces the top half of the image sent from the Nano.	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 11/05/24

Test Case HW13

Objective: A laser is used to transmit the serial bit stream through free space.

Notes:

Test No.: HW13			*Current Status: Passed*	
Test title: Laser Transmission Through Free Space.				
Testing approach: Demonstrate a Laser is being used to transmit serial bitstream through a free space.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Set laser up with correct voltages to transmit serial bitstream data over a free space.	Send data over a free space.	Having laser turn on and off shows that data is being transmitted over a free space completing Req 3.4.1.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case HW14

Objective: An optical sensor intercepts the laser.

Notes:

Test No.: HW14	*Current Status: Passed*
Test title: Optical Sensor Interception of Laser.	

Testing approach: Analyze that that the optical sensor can receive the data from the laser.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Turn on the laser and observe the voltage across the photoreceiver's nodes.	Measures the voltage of the photoreceiver.	The photoreceiver should output approximately 3.5V.	
2.	Turn off the laser and observe the voltage across the photoreceiver's nodes.	Confirm data can be received from Laser.	The photoreceiver should output approximately 0V, completing Req. 3.4.2.	
Concluding Remarks: Photoreceiver outputs correct voltages at correct laser states.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 12/03/24		

Test Case HW15

Objective: The system shall communicate asynchronously using UART with 1000000 8E2 frame format.

Notes:

Test No.: HW15		*Current Status: Failed*		
Test title: System UART Communication Criteria.				
Testing approach: Ensure data can be sent with a low error rate using a UART protocol with 1,000,000 Hz baud rate, and even parity bit, and 2 stop bits.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Run the receiving software on the TX2.	Prepares the system to receive the data.	The receiving software begins.	
2.	Run the transmitting software on the Nano.	Begins transmitting the data to the receiver.	The selected image begins transmitting.	

3.	Look to see the image produced on the TX2.	Ensure data can be consistently sent faster than previous iterations of the product.	The TX2 produces an image that has at least portions of the image being sent from the Nano, completing Req 3.4.3.	
Concluding Remarks: The TX2 produces the top half of the image sent from the Nano.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case HW16

Objective: Recording of received bitstream data using the photodetector begins upon detection of the first packet transmission light.

Notes:

Test No.: HW16		*Current Status: Passed*		
Test title: Photodetector Recording of Data.				
Testing approach: Using a bitstream of data, observe that the photodetector accurately records data without error.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Transmit a single bitstream packet and monitor the photodetector's output to ensure it identifies the start of the light signal. Verify that the recording system starts capturing data.	Verify recorded data is consistent with the transmitted bitstream.	Recorded data matches the transmitted data without error.	
Concluding Remarks:				

Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case HW17

Objective: The input file image is transmitted through the UART TX pin on the NVIDIA Jetson Nano board.

Notes:

Test No.: HW17	*Current Status: Passed*
Test title: Input Image File Transmission Through UART.	
Testing approach: Test that a selected image can be loaded and transmitted through UART.	

STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power and turn on the Jetson Nano.	Provides power and turns the Nano on.	The Nano is on and displays a green indicator light.	
2.	Connect female-to-male wire to +5V Nano pin.	Connects wire to Nano for multimeter to measure.	Wire is connected securely to the Nano.	
3.	Connect another female-to-male wire to Nano GND pin.	Connects wire to Nano for multimeter to measure.	Wire is connected securely to the Nano.	
4.	Connect GND (black) multimeter cable to Step 3 wire and PWR (red) to Step 2 wire.	Setup of multimeter.	Multimeter is connected properly and ready to measure.	
5.	Verify multimeter reads approximately 5V.	Tests power level to ensure it does not exceed 5V.	Multimeter reads approximately ~5V.	
6.	Connect +5V Nano pin to V+ pin on the laser driver.	Provides power to Nano.	Wire is connected securely from the laser driver to the Nano.	
7.	Connect Nano GND pin to the laser driver GND pin.	Provides grounding to Nano.	Wire is connected securely from the laser driver to the Nano.	

8.	Connect a female-to-male wire from the Nano 8-pin to Mod Input pin on the laser driver.	Connects wire from the Nano to the laser driver.	Wire is connected securely between the Nano and laser driver.	
9.	Using two male-to-male wires, connect laser diode 3 pin to the laser driver anode and the laser diode 1 pin to the laser driver cathode pin.	Connects wires from the laser diode cathode and anode to the laser driver.	Wires are securely connected between the laser diode and laser driver.	
10.	Verify that the photoreceiver and the photodiode are aligned.	Ensures proper alignment for the system to work properly.	The photoreceiver and photodiode are aligned.	
11.	Send data through the Jetson Nano and laser/laser driver.	Ensure that the data is transmitted.	Data is transmitted from the Jetson Nano.	
12.	Record received data with the Jetson TX2.	Ensure that the Jetson TX2 decodes data received.	Data received by the Jetson TX2 is properly decoded.	
13.	Inspect data received on the Jetson TX2 for properly decoded data.	Ensure that the Jetson TX2 decodes data received.	Data received by the Jetson TX2 is properly decoded.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/15/2025	

Test Case HW18

Objective: The bitstream read from the laser by the optical receiver is read through a UART device driver on the receiving board (NVIDIA Jetson TX2).

Notes:

Test No.: HW18	*Current Status: Passed*
Test title: Bitstream Reading Through UART Device Driver.	

Testing approach: Analyze that the input image file is being read into the ttyTHS2 device driver on the TX2.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Run the receiving software on the TX2.	Prepares the system to receive the data.	The receiving software begins.	
2.	Run the transmitting software on the Nano.	Begins transmitting the data to the receiver.	The selected image begins transmitting.	
3.	Look to see the image produced on the TX2.	Ensure that the Nano can send data through its UART pin.	The TX2 produces an image that has at least portions of the image being sent from the Nano, completing Req 4.3.3.	
Concluding Remarks: The TX2 produces the top half of the image sent from the Nano.				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 11/05/24	

Test Case HW19

Objective: The laser diode output power does not exceed 10 mW.

Notes:

Test No.: HW19			*Current Status: Passed*	
Test title: Laser Diode Output Power.				
Testing approach: The laser diode power is measured using an optical power meter during use to ensure it stays below 10 mW.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Power and turn on the Jetson Nano.	Provides power and turns the Nano on.	The Nano is on and displays a green indicator light.	
2.	Connect female-to-male wire to +5V nano pin.	Prepares power delivery to external components.	Wire is securely connected to Nano's +5V pin.	
3.	Connect another female-to-male wire to Jetson Nano GND pin.	Provides a ground reference for the circuit.	Wire is securely connected to Nano's GND pin.	
4.	Connect GND (black) multimeter cable to Step 3 wire and PWR (red) to Step 2 wire.	Allows voltage measurement.	Multimeter is connected correctly.	
5.	Verify multimeter reads approximately 5V.	Confirms power output is at correct level.	Multimeter reads close to 5 volts.	
6.	Connect +5V Nano pin to V+ pin on the laser driver.	Supplies power to the laser driver.	Laser driver receives 5V input.	
7.	Connect Nano GND pin to the laser driver GND pin.	Completes power circuit to the laser driver.	Laser driver has a complete circuit and shared ground.	
8.	Connect a female-to-male wire from the Nano 8-pin to MOD INPUT pin on the laser driver.	Connects a controlling wire from the Nano to the laser driver.	Laser driver receives control signal from Nano.	
9.	Using two male-to-male wires, connect laser diode 3 pin to the laser driver anode and the laser diode 1 pin to the laser driver cathode pin.	Connects laser diode to driver.	Laser diode is properly connected to driver.	
10.	Put on infrared safety equipment (goggles).	Protects eyes from infrared laser exposure.	Operator is safely equipped with protective gear.	

11.	Using a male-to-male wire, connect the Not Enable pin on the laser driver to GND on the laser driver.	Enables the laser driver by grounding the enable pin.	Laser is enabled.	
12.	Ensure the green light turns on.	Confirms laser driver is operational.	Green indicator light is illuminated.	
13.	Using the optical power meter lens, measure the peak power approximately 1 foot away by aligning the power meter lens and the laser diode.	Measures output power for safety and verification.	Power meter reads laser output power.	
14.	Verify that the power measured is at or below 10 mW.	Ensures safe operating levels of the laser.	Laser output is confirmed to be ≤ 10 mW.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case HW20

Objective: The hardware transmits the serial bitstream at a rate of at least 1 Gb/s.

Notes:

Test No.: HW20			*Current Status: Failed*	
Test title: Bitstream Transmitted at a Rate of 1 Gb/s.				
Testing approach: Test that the bitsream of data was transmitted from the photodiode at a rate of 1 Gb/s.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power and turn on the Jetson Nano.	Provides power and turns the Nano on.	The Nano is on and displays a green indicator light.	

2.	Connect female-to-male wire to +5V nano pin.	Prepares power delivery to external components.	Wire is securely connected to Nano's +5V pin.	
3.	Connect another female-to-male wire to Jetson Nano GND pin.	Provides a ground reference for the circuit.	Wire is securely connected to Nano's GND pin.	
4.	Connect GND (black) multimeter cable to Step 3 wire and PWR (red) to Step 2 wire.	Allows voltage measurement.	Multimeter is connected correctly.	
5.	Verify multimeter reads approximately 5V.	Confirms power output is at correct level.	Multimeter reads close to 5 volts.	
6.	Connect +5V Nano pin to V+ pin on the laser driver.	Supplies power to the laser driver.	Laser driver receives 5V input.	
7.	Connect Nano GND pin to the laser driver GND pin.	Completes power circuit to the laser driver.	Laser driver has a complete circuit and shared ground.	
8.	Connect a female-to-male wire from the Nano 8-pin to MOD INPUT pin on the laser driver.	Connects a controlling wire from the Nano to the laser driver.	Laser driver receives control signal from Nano.	
9.	Using two male-to-male wires, connect laser diode 3 pin to the laser driver anode and the laser diode 1 pin to the laser driver cathode pin.	Connects laser diode to driver.	Laser diode is properly connected to driver.	
10.	Put on infrared safety equipment (goggles).	Protects eyes from infrared laser exposure.	Operator is safely equipped with protective gear.	
11.	Using a male-to-male wire, connect the Not Enable pin on the laser driver to GND on the laser driver.	Enables the laser driver by grounding the enable pin.	Laser is enabled.	
12.	Ensure the green light turns on.	Confirms laser driver is operational.	Green indicator light is illuminated.	

13.	Verify that the photoreceiver and the photodiode are aligned.	Ensures proper alignment for the system to work properly.	The photoreceiver and photodiode are aligned.	
14.	Select and load the image into the buffer.	Prepares the image to be sent.	The selected image is loaded into the buffer.	
15.	Select a speed of 1 Gb/s.	Selects the speed and rate the image is transmitted at.	The settings are successfully acknowledged by the system.	
16.	Run the receiving software on the TX2.	Prepares the system to receive the data.	The receiving software begins.	
17.	Run the transmitting software on the Nano.	Begins transmitting the data to the receiver.	The selected image begins transmitting.	
18.	Verify that the image was successfully transmitted at 1 Gb/s.	Ensure data can be sent at the selected speed.	The TX2 produces an image at a speed that can be decoded.	
Concluding Remarks: The transmitted data cannot yet reach 1 Gb/s.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/11/2025		

Test Case HW21

Objective: The serial bitstream is received at a rate of at least 1 Gb/s.

Notes:

Test No.: HW21	*Current Status: Failed*
Test title: Bitstream Received at a Rate of 1 Gb/s.	
Testing approach: Test that the received bitsream of data was transmitted from the photodiode to the photoreceiver at a rate of 1 Gb/s.	

STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power and turn on the Jetson Nano.	Provides power and turns the Nano on.	The Nano is on and displays a green indicator light.	
2.	Connect female-to-male wire to +5V nano pin.	Prepares power delivery to external components.	Wire is securely connected to Nano's +5V pin.	
3.	Connect another female-to-male wire to Jetson Nano GND pin.	Provides a ground reference for the circuit.	Wire is securely connected to Nano's GND pin.	
4.	Connect GND (black) multimeter cable to Step 3 wire and PWR (red) to Step 2 wire.	Allows voltage measurement.	Multimeter is connected correctly.	
5.	Verify multimeter reads approximately 5V.	Confirms power output is at correct level.	Multimeter reads close to 5 volts.	
6.	Connect +5V Nano pin to V+ pin on the laser driver.	Supplies power to the laser driver.	Laser driver receives 5V input.	
7.	Connect Nano GND pin to the laser driver GND pin.	Completes power circuit to the laser driver.	Laser driver has a complete circuit and shared ground.	
8.	Connect a female-to-male wire from the Nano 8-pin to MOD INPUT pin on the laser driver.	Connects a controlling wire from the Nano to the laser driver.	Laser driver receives control signal from Nano.	
9.	Using two male-to-male wires, connect laser diode 3 pin to the laser driver anode and the laser diode 1 pin to the laser driver cathode pin.	Connects laser diode to driver.	Laser diode is properly connected to driver.	
10.	Put on infrared safety equipment (goggles).	Protects eyes from infrared laser exposure.	Operator is safely equipped with protective gear.	

11.	Using a male-to-male wire, connect the Not Enable pin on the laser driver to GND on the laser driver.	Enables the laser driver by grounding the enable pin.	Laser is enabled.	
12.	Verify that the photoreceiver and the photodiode are aligned.	Ensures proper alignment for the system to work properly.	The photoreceiver and photodiode are aligned.	
13.	Ensure the green light turns on.	Confirms laser driver is operational.	Green indicator light is illuminated.	
14.	Select and load the image into the buffer.	Prepares the image to be sent.	The selected image is loaded into the buffer.	
15.	Select a speed of 1 Gb/s.	Selects the speed and rate the image is transmitted at.	The settings are successfully acknowledged by the system.	
16.	Run the receiving software on the TX2.	Prepares the system to receive the data.	The receiving software begins.	
17.	Run the transmitting software on the Nano.	Begins transmitting the data to the receiver.	The selected image begins transmitting.	
18.	Verify that the image was successfully received at 1 Gb/s.	Ensure data can be decoded.	The TX2 produces an image at a speed that can be decoded.	
Concluding Remarks: The transmitted data cannot yet reach 1 Gb/s.				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/11/2025	

Test Case HW22

Objective: The hardware transmits a signal at a speed such that the receiving computer is able to adequately decode all data.

Notes:

Test No.: HW22	*Current Status: Passed*			
Test title: Transmission Speed Allows Adequate Decoding of Data.				
Testing approach: Test that the selected transmission speed allows the system to decode the transmitted data without errors.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power and turn on the Jetson Nano.	Provides power and turns the Nano on.	The Nano is on and displays a green indicator light.	
2.	Connect female-to-male wire to +5V nano pin.	Prepares power delivery to external components.	Wire is securely connected to Nano's +5V pin.	
3.	Connect another female-to-male wire to Jetson Nano GND pin.	Provides a ground reference for the circuit.	Wire is securely connected to Nano's GND pin.	
4.	Connect GND (black) multimeter cable to Step 3 wire and PWR (red) to Step 2 wire.	Allows voltage measurement.	Multimeter is connected correctly.	
5.	Verify multimeter reads approximately 5V.	Confirms power output is at correct level.	Multimeter reads close to 5 volts.	
6.	Connect +5V Nano pin to V+ pin on the laser driver.	Supplies power to the laser driver.	Laser driver receives 5V input.	
7.	Connect Nano GND pin to the laser driver GND pin.	Completes power circuit to the laser driver.	Laser driver has a complete circuit and shared ground.	
8.	Connect a female-to-male wire from the Nano 8-pin to MOD INPUT pin on the laser driver.	Connects a controlling wire from the Nano to the laser driver.	Laser driver receives control signal from Nano.	
9.	Using two male-to-male wires, connect laser diode 3 pin to the laser driver anode and the laser diode 1 pin to the laser driver cathode pin.	Connects laser diode to driver.	Laser diode is properly connected to driver.	

10.	Put on infrared safety equipment (goggles).	Protects eyes from infrared laser exposure.	Operator is safely equipped with protective gear.	
11.	Using a male-to-male wire, connect the Not Enable pin on the laser driver to GND on the laser driver.	Enables the laser driver by grounding the enable pin.	Laser is enabled.	
12.	Ensure the green light turns on.	Confirms laser driver is operational.	Green indicator light is illuminated.	
13.	Select and load the image into the buffer.	Prepares the image to be sent.	The selected image is loaded into the buffer.	
14.	Select a speed of 4800 bps.	Selects the speed and rate the image is transmitted at.	The settings are successfully acknowledged by the system.	
15.	Run the receiving software on the TX2.	Prepares the system to receive the data.	The receiving software begins.	
16.	Run the transmitting software on the Nano.	Begins transmitting the data to the receiver.	The selected image begins transmitting.	
17.	Look to see the image that is fully produced on the TX2.	Ensure data can be sent and decoded.	The TX2 produces an image at a speed that can be decoded.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case HW23

Objective: The hardware transmits at least 95% of the data without errors or loss.

Notes:

Test No.: HW23	*Current Status: Passed*

Test title: 95% Data Transmission Without Errors.				
Testing approach: 95% of the transmission data that was received from the photoreceiver and decoded will not contain any errors.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Turn on Jetson Nano and TX2.	Powers up both devices for operation.	Both devices are on and ready for program execution.	
2.	Load transmit and receive programs.	Prepares the system for data transmission and reception.	Programs are loaded without errors.	
3.	Prepare system for testing (reference HW19 for setup).	Ensures hardware is properly configured for communication.	System is correctly set up as per HW19.	
4.	Initiates receive program.	Starts the process to listen for incoming data.	Receiver is running and waiting for transmission.	
5.	Initiate transmission program.	Begins data transmission from the transmitter.	Transmitter is actively sending data.	
6.	Verify Alright.jpg is in the receiver’s directory.	Confirms the image was successfully received.	"Alright.jpg" is present in the specified directory.	
7.	Compare sent and received images and verify 95% of received bits match transmitted bits.	Validates integrity of the received image.	Bit comparison confirms ≥ 95% match between images.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case HW24

Objective: The transmitter system draws less than 15 watts.

Notes:

Test No.: HW24			*Current Status: Passed*	
Test title: 15-watt Power Draw; Transmitter System.				
Testing approach: To verify that the total power draw of the transmission system does not exceed 15 watts total.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Look at data sheets for system transmission components.	To obtain accurate power specifications for each component.	All relevant power ratings are identified from datasheets.	
2.	Add up the total power draw per respective data sheets.	Calculates total system power requirements.	A total power value is calculated.	
3.	Verify that the total power draw does not exceed 15 watts.	Ensures the system is within safe power limits.	Confirmed that total power is ≤ 15 watts.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case HW25

Objective: The system has no possible shorting hazards.

Notes:

Test No.: HW25	*Current Status: Passed*
Test title: Possible Shorting Hazards Check.	

Testing approach: Inspect each of the wires for possible shorts. Replace any wires that have possible shorts.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Inspect all wires used in the system and validate that connections are accurate as per component schematics.	To inspect the condition of the wires in the system.	All wires inspected are undamaged and connected properly.	
2.	Verify that no wires are loose or damaged.	Verifies the condition of the wires in the system.	All wires are secure and undamaged.	
3.	Replace damaged wires (if applicable).	To replace damaged wires with new, functioning ones.	Replace old, damaged wires with new wires.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case HW26

Objective: The system has no exposed wiring.

Notes:

Test No.: HW26		*Current Status: Failed*		
Test title: Exposed Wiring Check.				
Testing approach: Inspect All Wires to Ensure That Wiring Is Not Exposed.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Verify that no wires are exposed while system cover is used.	To ensure no wires are exposed.	No wires should be caught or exposed with the cover placed on the system.	

Concluding Remarks: The system hardware enclosure is not yet created and implemented. Rerun when enclosure is done.	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case HW27

Objective: The system is inspected to be secure at all connection points prior to each test run.

Notes:

Test No.: HW27			*Current Status: Passed*	
Test title: Secure Connection Inspection.				
Testing approach: Inspect connection points to ensure secure connections.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Inspect all wires used in the system and validate that connections are accurate as per component schematics.	To inspect the condition of the wires in the system.	All wires inspected are undamaged and connected properly.	
2.	Verify that no wires are loose or damaged.	Verifies the condition of the wires in the system.	All wires are secure and undamaged.	
3.	Replace damaged wires (if applicable).	To replace damaged wires with new, functioning ones.	Replace old, damaged wires with new wires.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case HW28

Objective: The laser diode power does not exceed 7 mW by setting the laser driver's current limit to 20 mA by adjusting the relevant trimpot, which results in a power around 5 mW.

Notes:

Test No.: HW28		*Current Status: Passed*		
Test title: Laser Diode Power; Trimpot Adjustment.				
Testing approach: Ensure that the laser diode maintains an output power around 5 mW, give or take 0.9 mW.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect a DMM between GND and the LIM MON pin on the laser driver.	To set up the multimeter to begin measuring.	The multimeter should be hooked up.	
2.	Turn on the laser.	To turn on the laser so the diode can be measured.	The laser should be enabled.	
3.	Read the voltage measured by the DMM.	To make sure the laser diode operates at its typical power so that it produces sufficient power but doesn't burn out.	The measured voltage should be 0.2V, completing Req 5.2.5.	
Concluding Remarks: The measured voltage is correct.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case HW29

Objective: The laser diode current does not exceed 40 mA by setting the laser driver's current limit to 20 mA by adjusting the relevant trimpot, which results in a power around 5 mW.

Notes:

Test No.: HW29			*Current Status: Passed*	
Test title: Laser Diode Current; Trimpot Adjustment.				
Testing approach: Ensure that the laser diode maintains a constant current of 20 mA.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect a DMM between GND and the LIM MON pin on the laser driver.	To set up the multimeter to begin measuring.	The multimeter should be hooked up.	
2.	Turn on the laser.	To turn on the laser so the diode can be measured.	The laser should be enabled.	
3.	Read the current measured by the DMM.	To make sure the laser diode operates at its typical power so that it produces sufficient power but doesn't burn out.	The measured current should be below 20 mA, completing Req 5.2.6. and Req 5.2.7.	
Concluding Remarks: The measured current is correct.				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 11/21/24	

Test Case HW30

Objective: The system operates at 95% availability during its lifetime.

Notes:

Test No.: HW30	*Current Status: Failed*
Test title: 95% Availability Operation.	
Testing approach: The system should be operational for 95% of the time by keeping the system on and working for a day with 1.2 hours of rest	

STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	The system will be turned on for 22.8 hours and operating without being turned off.	Make sure the system can operate at 95%.	The system is fully functional at 95%. Without breaking or crashing.	
Concluding Remarks: Laser driver cannot risk being enabled for that long.				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/25	

Test Case HW31

Objective: The operator replaces the system diode in the occurrence of burnout.

Notes:

Test No.: HW31			*Current Status: Passed*	
Test title: Burnt Out Diode Replacement.				
Testing approach: Inspection of diode upon powering on of the system. Replacement of burnt-out diode upon inspection of burnt-out diode.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect a DMM across the leads of the photoreceiver.	To ensure that the diode is not burnt out.	DMM allows us to check the voltage of the photoreceiver.	
2.	Point the laser diode at the photoreceiver.	To align the optical path for signal transmission.	The laser beam is directed accurately at the photoreceiver.	
3.	Turn on the laser.	To activate the laser and allow transmission.	Laser is enabled.	

4.	Read the voltage measured by the DMM.	To verify that the photoreceiver's condition.	DMM measures 3.5V if the laser diode is not burnt out while the laser driver is on. Otherwise, the DMM measures roughly 0V if the laser diode is burnt out.	
5.	Replacement of burnt-out diode.	To ensure that the diode transmits the bit stream.	Burnt out diode is replaced, and new diode is ready for use.	
Concluding Remarks: DMM measured the correct voltage for a working diode.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 11/21/24		

Test Case HW32

Objective: The operator connects the laser driver to the corresponding hardware devices according to the Hardware User Manual.

Notes:

Test No.: HW32		*Current Status: Passed*		
Test title: Laser Driver – Hardware Device Connection.				
Testing approach: Inspection of proper connection of each hardware device.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Inspect each hardware device (Jetson Nano, Jetson TX2, Laser Driver, Laser Diode, Photodetector) and compare the connections to the connections described in the Hardware User Manual.	Ensure proper connection of each hardware component.	Each hardware component is properly connected prior to testing the system as a whole, completing Req 5.4.2.2.	

Concluding Remarks: All components could turn on and output expected voltages.

Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 11/21/24

Test Case HW33

Objective: The system operates using the NVIDIA Jetson Nano to transmit data.

Notes:

Test No.: HW33	*Current Status: Passed*
Test title: NVIDIA Jetson Nano Transmission	
Testing approach: NVIDIA Jetson Nano is transmitting data through the laser driver and laser diode.	

STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Send data through the NVIDIA Jetson Nano.	Ensure data is being sent from the Jetson Nano.	Data is being sent from the Jetson Nano.	
2.	Inspect the Laser driver and Laser diode to ensure transmission of data from the Jeston Nano.	Ensure the Jetson Nano properly interfaces with the Laser Driver and Laser Diode.	The Laser Driver and Laser Diode interface with the Jetson Nano which properly transmits data.	

Concluding Remarks:

Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case HW34

Objective: The system operates using the NVIDIA Jetson TX2 to decode data.

Notes:

Test No.: HW37			*Current Status: Passed*	
Test title: NVIDIA Jetson TX2 Receiving.				
Testing approach: Test that that the Jetson TX2 decodes the received data.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Send data through the Jetson Nano and laser/laser driver.	Ensure that the data is transmitted.	Data is transmitted from the Jetson Nano.	
2.	Record received data with the Jetson TX2.	Ensure that the Jetson TX2 decodes data received.	Data received by the Jetson TX2 is properly decoded.	
3.	Inspect data received on the Jetson TX2 for properly decoded data.	Ensure that the Jetson TX2 decodes data received.	Data received by the Jetson TX2 is properly decoded.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case HW35

Objective: The transmitting laser uses a 1550 nm wavelength Diode.

Notes:

Test No.: HW35			*Current Status: Passed*	
Test title: Transmitting Laser Wavelength.				
Testing approach: Reading through the laser diode specification information to ensure that the laser diode transmits 1550 nm wavelength.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Read through the laser diode specification information to ensure that the laser diode reaches 1550 nm wavelength.	To ensure that the laser diode reaches up to 1500 nm wavelength.	The laser diode reaches up to 1500 nm wavelength.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case HW36

Objective: The transmitting laser uses a 1550 nm wavelength laser driver (IR-B class).

Notes:

Test No.: HW36		*Current Status: Passed*		
Test title: Transmitting Laser Driver Wavelength.				
Testing approach: Reading through the laser driver specification to ensure that the laser driver uses 1550 nm wavelength.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Read through the laser driver specification to ensure that the laser driver reaches up to 1550 nm wavelength.	Ensure that the laser driver reaches up to 1550 nm wavelength.	The laser driver reaches up to 2500 nm wavelength.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case HW37

Objective: The laser diode input current does not exceed 35 mA.

Notes:

Test No.: HW37			*Current Status: Passed*	
Test title: Laser Diode Input Current.				
Testing approach: The laser diode input current is measured by connecting a multimeter to the input pins leading to the laser diode.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect the Digital Multimeter to the input pins for the laser diode.	Measure the current out of the laser driver input.	The measured laser diode input current is below 35 mA.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case HW38

Objective: The laser diode transmitting range of error does not exceed 5%.

Notes:

Test No.: HW38			*Current Status: Passed*	
Test title: Laser Diode Transmitting Range of Error.				
Testing approach: Checks the laser diode range of error by checking the even parity bit in the log file.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Send data through the Jetson Nano and laser/laser driver.	Ensure that the data is transmitted.	Data is transmitted from the Jetson Nano.	
2.	Record received data with the Jetson TX2.	Ensure that the Jetson TX2 decodes data received.	Data received by the Jetson TX2 is properly decoded.	

3.	Inspect data received on the Jetson TX2 for properly decoded data.	Ensure that the Jetson TX2 decodes data received.	Data received by the Jetson TX2 is properly decoded.	
4.	Check the received data bit log file and ensure the parity bits were correct.	Analyze the received parity bits.	The parity bits received match the parity bits that were transmitted.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/15/2025		

Test Case HW39

Objective: The laser diode receives the bitstream through the "MOD INPUT" pin on the laser driver.

Notes:

Test No.: HW39		*Current Status: Passed*		
Test title: Laser Diode Receiving Pin.				
Testing approach: The laser diode is inspected visually for connection to the correct laser driver pin. The laser diode is then connected to an oscilloscope to measure whether the bitstream is being sent through the laser driver pin to the laser diode.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Hook up oscilloscope to the mod input pin and common ground.	Determine if bitstream data is being sent through the laser driver.	You should see a waveform on the oscilloscope if bitstream is being sent.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

5.2. Software Test Cases

Test Case SW01

Objective: Image file input uploaded to NVIDIA Jetson Nano software.

Notes:

<table>
<tr><td colspan="2">Test No.: SW01</td><td colspan="3">Current Status: Passed</td></tr>
<tr><td colspan="5">Test title: Image File Upload.</td></tr>
<tr><td colspan="5">Testing approach: Ensure the image used for data transmission testing is on the Nano.</td></tr>
<tr><td>STEP</td><td>OPERATOR ACTION</td><td>PURPOSE</td><td>EXPECTED RESULTS</td><td>COMMENTS</td></tr>
<tr><td>1.</td><td>Power and turn on the Jetson Nano.</td><td>Provides power and turns the Nano on.</td><td>The Nano is on and displays a green indicator light.</td><td></td></tr>
<tr><td>2.</td><td>Open the “Senior Design 2024” folder on the SoM’s desktop.</td><td>Locate the image for testing.</td><td>The folder is available on the SoM’s desktop.</td><td></td></tr>
<tr><td>3.</td><td>Ensure that “compressed_image.jpg” is in that folder.</td><td>A small image is required for preliminary data transmission testing.</td><td>The file “compressed_image.jpg” exists in the “Senior Design 2024” folder, completing Req 3.1.2.</td><td></td></tr>
<tr><td colspan="5">Concluding Remarks: The image exists in the expected spot.</td></tr>
<tr><td colspan="2">Testing Team:
Korey Kelley, Mosely Tector</td><td colspan="3">Date Completed: 04/10/2025</td></tr>
</table>

Test Case SW02

Objective: System activation upon running software startup script.

Notes:

<table>
<tr><td>Test No.: SW02</td><td>Current Status: Passed</td></tr>
<tr><td colspan="2">Test title: System Activation.</td></tr>
</table>

Testing approach: Run startup script and observe Jetson Nano monitor for a "system boot completed" message.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Run the startup script.	To test if the system starts upon running the activation script.	The startup script is running.	
2.	Observe Jetson Nano monitor for "system boot complete" message.	To ensure system is running after running the startup script.	The system is running after the startup script has completed.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW03

Objective: NVIDIA Jetson TX2 software decodes data stream.

Notes:

Test No.: SW03		*Current Status: Passed*		
Test title: NVIDIA Jetson TX2 Data Decoding.				
Testing approach: Send the Jetson TX2 a predetermined encoded data stream, observe that the Jetson TX2 software can properly decode the data from the data stream.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson TX2.	The TX2 must be powered on in order to test the software running on it.	The TX2 is powered on.	

2.	Select a data stream to send to the TX2.	The operator must know what the original data stream is in order to know what the expected outcome is.	A data stream is selected by the operator.	
3.	Encode the selected data stream using a predefined encoding algorithm.	To use the same algorithm to encode and decode data streams.	The data stream is encoded according to the predefined algorithm.	
4.	Send the encoded data stream to the TX2.	To test that the TX2 can decode received data streams.	The encoded data stream is sent to the TX2.	
5.	Observe the TX2 monitor for display of the decoded data stream.	Ensure that the displayed data stream matches the originally selected data stream.	The displayed data stream matches the originally selected data stream.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW04

Objective: The transmitting board (NVIDIA Jetson Nano) writes an image with a buffer.

Notes:

Test No.: SW04	*Current Status: Passed*
Test title: Transmission of Image with Buffer.	

Testing approach: The operator sends an image file through the Jetson Nano, writing the image through a UART pin as a buffer. Once the image writing is completed, a "image written as buffer" message appears on the Jetson Nano monitor.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Select an image file to send through the Jetson Nano.	To have an image file to load onto the Jetson Nano device.	An image file is selected.	
2.	Send the image file through the Jetson Nano with the "send" command.	To ensure that the image file is sent through Jetson Nano.	The selected image file is sent through the Jetson Nano.	
3.	Observe the Jetson Nano monitor for error message and the "image written as buffer" verification message.	To validate that the Jetson Nano is sending the image through the UART pin as a buffer.	The Jetson Nano monitor does not display any error message, and the verification message is displayed.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW05

Objective: Data transmission occurs within 5 seconds of receiving a compressed image file from the NVIDIA Jetson Nano code segments which contain the user uploaded image file.

Notes:

Test No.: SW05		*Current Status: Passed*		
Test title: Data Transmission Initialization Speed.				
Testing approach: A timer is started within the code when the user presses "send" for the image file. The timer stops when the Jetson Nano receives confirmation from the laser driver that the transmission has begun. A message is displayed to the user of "transmission occurred in ____ seconds".				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Select an image file to send through the Jetson Nano.	To send an image through the Jetson Nano to the laser driver.	The user selects an image file to be sent.	
2.	Ensure the Jetson Nano and laser driver are connected securely.	To ensure that the transmission of the laser driver is recorded by the Jetson Nano.	The Jetson Nano and laser driver are connected securely.	
3.	Power on Jetson Nano and laser driver.	To test that the Jetson Nano transmits to the laser driver within 5 seconds.	The Jetson Nano and laser driver are powered on.	
4.	Send the selected image file through the Jetson Nano to the laser driver.	To test the transmission speed for the selected image file.	The selected image is sent through the Jetson Nano to the laser driver.	
5.	Observe the Jetson Nano display for the elapsed time message “transmission occurred in ____ seconds”.	To ensure that the Jetson Nano transmits the data stream through the laser driver within 5 seconds.	The elapsed time message shows an elapsed time of transmission of less than 5 seconds.	

Concluding Remarks:	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case SW06

Objective: The input image file is transmitted as a char pointer.

Notes:

Test No.: SW06	*Current Status: Passed*

Test title: Input Image File Transmitted as Char Pointer.				
Testing approach: The image file is sent through the Jetson Nano to the UART pins as a char pointer. The software displays a message upon sending the image file through the UART pin as a char pointer "image transmitted as char pointer".				
STEP	OPERATOR ACTION	PURPOSE	EXPECTED RESULTS	COMMENTS
1.	Power on Jetson Nano.	To test the Jetson Nano device.	The Jetson Nano is powered on.	
2.	Select image file to be sent.	To send the desired image file through the Jetson Nano.	An image is selected to be sent through the Jetson Nano.	
3.	Send image file, selecting "send as char pointer" specification in the software.	To test that the image file can be sent as a char pointer through the Jetson Nano UART pins.	The image file is sent using the "send as char pointer" specification.	
4.	Observe Jetson Nano monitor, looking for the statement "image transmitted as char pointer".	To ensure that the image file was sent as a char pointer through the Jetson Nano UART pins.	The "image transmitted as char pointer" verification message is displayed on the Jetson Nano monitor.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		Date Completed: 04/10/2025		

Test Case SW07

Objective: The bitstream read from the laser by the optical receiver is read as a char pointer.

Notes:

Test No.: SW07	Current Status: Passed
Test title: Bitstream Received as Char Pointer.	

Testing approach: Jetson TX2 will display a message when receiving the bit stream. When a bit stream is received from the photo receiver, the Jetson TX2 monitor will display a message to begin reading. The software will read the bit stream as a char pointer, displaying a message when the char pointer is done being read.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect the photoreceiver to the Jetson TX2.	To ensure that the Jetson TX2 receives the char pointer from the photo receiver.	The Jetson TX2 and photo receiver are connected.	
2.	Power on the photo receiver and Jetson TX2.	To test the photo receiver and Jetson TX2.	The Jetson TX2 and photoreceiver are powered on.	
3.	Send a predetermined bit stream to the photoreceiver.	To send a bit stream to test the photoreceiver to Jetson TX2 connection.	A predetermined bit stream is sent to the photo receiver.	
4.	Observe the Jetson TX2 monitor for a verification message of “char pointer received from photo receiver”.	To ensure that the Jetson TX2 is receiving the char pointer from the photo receiver.	The Jetson TX2 monitor displays a message of “char pointer receiver from photo receiver”	
5.	Observe the Jetson TX2 monitor for a verification message of “char pointer done being read”.	To ensure that the Jetson TX2 is reading the char pointer from the photo receiver.	The Jetson TX2 monitor displays a message of “char pointer done being read”.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW08

Objective: *Files shall be written in a proper file type for the computer to read.*

Notes:

Test No.: SW08	*Current Status: Passed*
Test title: Received File Written as Proper File Type.	
Testing approach: The operator selects an image file type upon startup of the Jetson TX2. The Jetson TX2 writes the received char pointer as the selected file type.	

STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson TX2.	To test the Jetson TX2 software.	The Jetson TX2 is powered on.	
2.	Select an image file output on the TX2 software.	To specify the type of image file the Jetson TX2 software should output the char pointer as.	The image file output type is selected by the operator.	
3.	Send a test char pointer through the file output function.	To easily test the file output function without the need for external components.	The test char pointer is sent through the file output function.	
4.	Check the output file folder for proper saving/outputting of the file.	To ensure that the TX2 outputs the correct file type into the current working directory.	The current working directory folder contains the test image file of the correct file type.	

Concluding Remarks:	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case SW09

Objective: All system code implementation is done in C++.

Notes:

Test No.: SW09			*Current Status: Passed*	
Test title: Code Written in C++.				
Testing approach: Observe all code used for both the Jetson Nano and Jetson TX2 devices to ensure that it is written in C++.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Inspect the Jetson Nano code.	Ensure that the code is written in C++.	All Jetson Nano code is written in C++.	
2.	Inspect the Jetson TX2 code.	Ensure that the code is written in C++.	All Jetson TX2 code is written in C++.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case SW10

Objective: Data stream transmission is initiated using the software interface.

Notes:

Test No.: SW10			*Current Status: Passed*	
Test title: Data Stream Transmission Initiation.				
Testing approach: Initiate transmission of the data stream using the Jetson Nano software interface. Observe the Jetson Nano monitor for a statement of initiation.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson Nano.	To test the Jetson Nano transmission initiation.	The Jetson Nano is powered on.	

2.	Input the “send” command in the Jetson Nano command line interface.	To test the command line interface with transmission initiation.	Transmission of an empty char pointer begins.	
3.	Observe the Jetson Nano monitor for the “transmission initiated” statement.	To ensure that transmission is initiated using the command line (software) interface.	The “transmission initiated” statement appears on the Jetson Nano monitor.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW11

Objective: Data stream transmission is stopped using the software interface.

Notes:

Test No.: SW11		*Current Status: Failed*		
Test title: Data Stream Transmission Termination				
Testing approach: The command line interface (software interface) will be constantly polling starting when transmission is started. When the operator input the “stop” command into the command line interface, transmission of the bit stream stops, and the Jetson Nano monitor displays a message “transmission stopped”.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson Nano.	To test the Jetson Nano software.	The Jetson Nano is powered on.	
2.	Begin transmission.	To be able to stop a transmission using the command line (software) interface.	Transmission has started.	

3.	Use the command line interface to stop transmission.	To stop the transmission of the bit stream.	The operator enters the stop command into the command line interface.	
4.	Observe the Jetson Nano monitor for the “transmission stopped” message.	To ensure that the transmission of the bit stream stops after entering the stop command into the software interface.	Transmission stops and the “transmission stopped” message is displayed on the Jetson Nano monitor.	
Concluding Remarks: Feature is currently not implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW12

Objective: The Jetson Nano opens the image device file using the Linux system call open() to gain access to the UART device “ttyS0”.

Notes:

Test No.: SW12		*Current Status: Passed*		
Test title: Access UART Using Linux and the Jetson Nano.				
Testing approach: The Jetson Nano software receives signals when the Linux system call open() is used, as well as when the Jetson Nano gains access to the UART device. The Jetson Nano displays “file opened” message when the Jetson Nano receives the signal of gaining access to the UART device.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson Nano.	To test the Jetson Nano software.	The Jetson Nano is powered on.	
2.	Select an image to transmit through the Jetson Nano.	To send an image through the Jetson Nano.	An image is selected to be sent through the Jetson Nano.	

3.	Send the selected image through the Jetson Nano.	To test the image opening function in the Jetson Nano software.	The selected image is sent through the Jetson Nano using the software.	
4.	Observe the Jetson Nano monitor for the “file opened” message.	To ensure that the Jetson Nano is using Linux to open the file on the UART device driver.	The Jetson Nano monitor displays the “file opened” message.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW13

Objective: The Jetson Nano uses a Linux system call write() to write the name and size of the image being transmitted.

Notes:

Test No.: SW13		*Current Status: Passed*		
Test title: Image Name and Size Written to a Jetson Nano Device File.				
Testing approach: After opening the file, the Jetson Nano software writes the name and size of the image. Once this is done, the software displays a message stating “file name and size written to device”.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson Nano.	To test the Jetson Nano software.	The Jetson Nano is powered on.	
2.	Select an image to be sent through Jetson Nano.	To send an image through the Jetson Nano.	An image is selected to transmit through the Jetson Nano.	

3.	Send image through Jetson Nano using the software interface.	To test the write() function in the Jetson Nano software.	The selected image is sent through the Jetson Nano.	
4.	Observe the Jetson Nano monitor for the “file name and size written to device” message and prints the name and file size.	To ensure that the Jetson Nano is using the Linux command, properly writing the size and name of the file.	The Jetson Nano monitor displays the “file name and size written to device” message and displays the file name and size.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW14

Objective: The Jetson Nano then uses the close() command to release the UART device “ttyS0” when the image is done being written.

Notes:

Test No.: SW14		*Current Status: Passed*		
Test title: Image Device File on Jetson Nano Closes When Done Writing to UART.				
Testing approach: The programmer places print statements when signals are received from the UART device. The operator observes the Jetson Nano monitor for the statement which prints when the Jetson Nano detects that the device has been closed.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson Nano.	To test the Jetson Nano software.	The Jetson Nano is powered on.	
2.	Select image to send through Jetson Nano.	To send and image through the Jetson Nano.	An image is selected to be sent through the Jetson Nano.	

3.	Send selected image through Jetson Nano.	To test the close() function is being called and completed.	The selected image is sent through the Jetson Nano.	
4.	Observe the Jetson Nano monitor for the statement “device closed”.	To ensure that the device is being closed by the Jetson Nano using the Linux close() command.	The Jetson Nano monitor displays the “device closed” message.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW15

Objective: The Jetson TX2 opens the image device file “ttySH2” using the Linux system call open().

Notes:

Test No.: SW15		*Current Status: Failed*		
Test title: Jetson TX2 Opens the Image Device File.				
Testing approach: The Jetson TX2 software receives signals when the Linux system call open() is used, as well as when the Jetson TX2 gains access to the UART device. The Jetson TX2 displays “file opened” message when the Jetson TX2 receives the signal of gaining access to the UART device.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson TX2.	To test the Jetson TX2 software.	The Jetson TX2 is powered on.	
2.	Select an image to transmit to the Jetson TX2.	To send an image to the Jetson TX2.	An image is selected to be sent to the Jetson TX2.	
3.	Send the selected image to the Jetson TX2.	To test the image opening function in the Jetson TX2 software.	The selected image is sent to the Jetson TX2 using the software.	

4.	Observe the Jetson TX2 monitor for the “file opened” message.	To ensure that the Jetson TX2 is using Linux to open the file on the UART device driver.	The Jetson TX2 monitor displays the “file opened” message.	
Concluding Remarks: The message and feature is not currently implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW16

Objective: The Jetson TX2 reads the name and size of the image before reading the transmitted data.

Notes:

Test No.: SW16		*Current Status: Passed*		
Test title: Jetson TX2 Reads the Image Device File.				
Testing approach: After opening the file, the Jetson TX2 software reads the name and size of the image. Once this is done, the software displays a message stating “file name and size has been read”.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson TX2.	To test the Jetson TX2 software.	The Jetson TX2 is powered on.	
2.	Select image to be sent to Jetson TX2.	To send an image to the Jetson TX2.	An image is selected to be sent to the Jetson TX2.	
3.	Send image through Jetson TX2 using the software interface.	To test the read() function in the Jetson TX2 software.	The selected image is sent to the Jetson TX2.	

4.	Observe the Jetson TX2 monitor for the “file name and size has been read” message and prints the name and file size.	To ensure that the Jetson TX2 is using the Linux command, properly reading the size and name of the file.	The Jetson TX2 monitor displays the “file name and size has been read” message and prints the file name and size.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW17

Objective: The Jetson TX2 saves all data read from the UART device “ttySH2” into a heap-based byte array the size of the image.

Notes:

Test No.: SW17		*Current Status: Failed*		
Test title: Jetson TX2 Saves Data Read to Heap-Based Array.				
Testing approach: The heap-based byte array in which the data is saved is printed to the Jetson TX2 monitor upon closing of the UART device.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson TX2.	To test the Jetson TX2 software.	The Jetson TX2 is powered on.	
2.	Select an image to be sent to the Jetson TX2.	To send an image to the Jetson TX2.	An image is selected to be sent to the Jetson TX2.	
3.	Send the selected image to the Jetson TX2.	To test saving the data stream to a heap-based byte array in the Jetson TX2 software.	The selected image is sent to the Jetson TX2.	

<table>
<tr><td>4.</td><td>Observe the Jetson TX2 monitor for the heap-based byte array which is displayed using a print statement within the software.</td><td>To ensure that the heap-based byte array in which the image data is saved is not empty.</td><td>The Jetson TX2 monitor displays the heap-based byte array contents, not “None” or empty.</td><td></td></tr>
<tr><td>5.</td><td>Observe the Jetson TX2 monitor for the size of the heap-based byte array, comparing the size of the array to the original image size.</td><td>To ensure that the heap-based byte array in which the image data is saved is the correct size.</td><td>The Jetson TX2 monitor displays the size of the heap-based byte array and the array is the same size as the original image size.</td><td></td></tr>
<tr><td colspan="5">Concluding Remarks: Feature not currently implemented.</td></tr>
<tr><td colspan="2">Testing Team:
Korey Kelley, Mosely Tector</td><td colspan="3">Date Completed: 04/10/2025</td></tr>
</table>

Test Case SW18

Objective: The Jetson TX2 prints the elapsed time in seconds and the transmission data rate in Mbps on the corresponding computer monitor.

Notes:

<table>
<tr><td colspan="2">Test No.: SW18</td><td colspan="3">Current Status: Passed</td></tr>
<tr><td colspan="5">Test title: Jetson TX2 Prints Image Transfer Elapsed Time and Data Rate.</td></tr>
<tr><td colspan="5">Testing approach: The Jetson TX2 code starts recording the elapsed time and calculates the data rate, printing both to the Jetson TX2 monitor. The operator observes the monitor and verifies that the elapsed time and data rate are printed on the monitor.</td></tr>
<tr><td>STEP</td><td>OPERATOR ACTION</td><td>PURPOSE</td><td>EXPECTED RESULTS</td><td>COMMENTS</td></tr>
<tr><td>1.</td><td>Power on the Jetson TX2.</td><td>To test the Jetson TX2 software.</td><td>The Jetson TX2 is powered on.</td><td></td></tr>
<tr><td>2.</td><td>Send a test bit stream to the Jetson TX2.</td><td>To test that the Jetson TX2 software displays the elapsed time and data rate.</td><td>The test bit stream is sent to the Jetson TX2.</td><td></td></tr>
</table>

3.	Observe the Jetson TX2 monitor, ensuring that the elapsed time and data rate are printed.	To ensure that the Jetson TX2 software displays the elapsed time and data rate.	The elapsed time and data rate are printed on the Jetson TX2 monitor.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case SW19

Objective: The Jetson TX2 uses the Linux command close() to close the image device file "ttySH2".

Notes:

Test No.: SW19			*Current Status: Failed*	
Test title: Jetson TX2 Closes Image Device File.				
Testing approach: The programmer places print statements when signals are received from the UART device. The operator observes the Jetson TX2 monitor for the statement which is printed when the Jetson TX2 detects that the device has been closed.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson TX2.	To test the Jetson TX2 software.	The Jetson TX2 is powered on.	
2.	Select image to send to the Jetson TX2.	To send an image to the Jetson TX2.	An image is selected to be sent through the Jetson TX2.	
3.	Send selected image through Jetson TX2.	To test the close() function is being called and completed.	The selected image is sent to the Jetson TX2.	

4.	Observe the Jetson TX2 monitor for the statement “device closed”.	To ensure that the device is being closed by the Jetson TX2 using the Linux close() command.	The Jetson TX2 monitor displays the “device closed” message.	
Concluding Remarks: Feature not currently implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW20

Objective: The Jetson TX2 uses the Linux command write() to write the image file data to a specified directory.

Notes:

Test No.: SW20		*Current Status: Passed*		
Test title: Jetson TX2 Writes Image File to Specified Directory.				
Testing approach: After reading the file, the Jetson TX2 software writes the name and size of the image to the current working directory. Once this is done, the software displays a message stating “file name and size written to current working directory”.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson TX2.	To test the Jetson TX2 software.	The Jetson TX2 is powered on.	
2.	Select image to be sent to Jetson TX2.	To send an image to the Jetson TX2.	An image is selected to transmit to the Jetson TX2.	
3.	Send image to Jetson TX2 using the software interface.	To test the write() function in the Jetson TX2 software.	The selected image is sent to the Jetson TX2.	

4.	Observe the Jetson TX2 monitor for the “file name and size written to current working directory” message and prints the name and file size.	To ensure that the Jetson TX2 is using the Linux command, properly writing the size and name of the file.	The Jetson TX2 monitor displays the “file name and size written to device” message and displays the file name and size.	
5.	Observe the current working directory folder for the file name and size.	To ensure that the name and file size are written in the current working directory	The Jetson TX2 working directory contains the image file name and size.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW21

Objective: The system transmits image files of any format.

Notes:

Test No.: SW21		*Current Status: Failed*		
Test title: Transmission of Images in any File Format.				
Testing approach: Each image format is tested by the operator, including PNG, JPEG, and GIF. The Jetson Nano software interface is used to select the image and transmit the image through the Jetson Nano. When the Jetson Nano successfully transmits the image, the Jetson Nano monitor displays a “successful transmission” statement.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson Nano.	To test the Jetson Nano software.	The Jetson Nano is powered on.	
2.	Select the image file to be transmitted.	To send the image file through the Jetson Nano.	The image file is selected by the operator.	Repeat steps 2-4 for each image file type.

3.	Send image file through Jetson Nano.	To test the transmission of varying file types through the Jetson Nano.	The selected image file is sent to the Jetson Nano to be transmitted.	
4.	Observe the Jetson Nano monitor for the "successful transmission" statement.	To ensure that each file type is successfully transmitted through the Jetson Nano.	The Jetson Nano displays the "successful transmission" statement and successfully transmits the image file.	
Concluding Remarks: Feature not currently implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW22

Objective: Users can open the received image in the Jetson TX2 folder.

Notes:

Test No.: SW22		*Current Status: Passed*		
Test title: Received Image File Viewable in Jetson TX2 Folder.				
Testing approach: Observe Jetson TX2 current working directory folder for the received image file.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Open the Jetson TX2 current working directory folder.	To ensure that the received image file is in the Jetson TX2 folder.	The Jetson TX2 working directory folder is open.	
2.	Inspect the folder for the received image file, opening the image file.	To ensure that the received image file can be opened.	The received image file is seen in the current working directory folder. The image file can be opened.	

Concluding Remarks:	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case SW23

Objective: The system provides troubleshooting steps, instructions through terminal interface.

Notes:

Test No.: SW23		*Current Status: Failed*		
Test title: User Manual Provided Through Terminal Interface.				
Testing approach: The operator will start up the Jetson Nano software, inspecting the terminal interface for user instructions and troubleshooting steps.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson Nano board.	The Jetson Nano board must be powered on to test the software.	The Jetson Nano board is powered on.	
2.	Send startup script to Jetson Nano board.	The Jetson Nano board must run the bootstrap program before displaying the terminal interface.	The Jetson Nano board runs bootstrap programming upon receiving startup script.	
3.	Inspect the terminal interface for user instructions and troubleshooting steps.	To ensure the terminal interface displays the user instructions and troubleshooting steps.	User instructions and troubleshooting steps are present in the terminal interface.	

Concluding Remarks: Feature not currently implemented.	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case SW24

Objective: The software developer can use the same UART library when data transfer rate is increased up to 12.5 Mbps.

Notes:

Test No.: SW24		*Current Status: Failed*		
Test title: UART Library Consistency Across Transfer Rates.				
Testing approach: The operator will increase the data transfer rate to at least 12.5 Mbps, inspecting the terminal for error and warning messages informing the user to change the UART library (these should not be present).				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson Nano.	To test the Jetson Nano software.	The Jetson Nano is powered on.	
2.	Run Jetson Nano start up script.	To ensure that the Jetson Nano transfer rate is cleared and ready to be set by the operator.	The Jetson Nano bootstrap program runs.	
3.	Set the data transfer rate to at least 12.5 Mbps.	To test the new transfer rate with the UART library.	The data transfer rate is set to at least 12.5 Mbps.	

4.	Inspect the terminal for error or warning messages informing the user to change the UART library.	To ensure that the Jetson Nano software does not inform the user to change the UART library when the data transfer rate is greater than or equal to 12.5 Mbps.	The terminal does not display any error or warning messages pertaining to changing the UART library.	Error messages should not be present for this test, the UART library can handle transfer rates over 12.5 Mbps.
Concluding Remarks: Feature not currently implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW25

Objective: When the data transfer rate is greater than 12.5 Mbps, the developer is notified to use a new communication protocol.

Notes:

Test No.: SW25		*Current Status: Failed*		
Test title: Dynamic Communication Protocol Across Transfer Rates.				
Testing approach: The operator will increase the data transfer rate to at least 12.5 Mbps, inspecting the terminal for error and warning messages informing the user to change the communication protocol.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on Jetson Nano.	To test the Jetson Nano software.	The Jetson Nano is powered on.	
2.	Run Jetson Nano start up script.	To ensure that the Jetson Nano transfer rate is cleared and ready to be set by the operator.	The Jetson Nano bootstrap program runs.	

3.	Set the data transfer rate to at least 12.5 Mbps.	To test if the new transfer rate is compatible with the communication protocol.	The data transfer rate is set to at least 12.5 Mbps.	
4.	Inspect the terminal for error or warning messages informing the user to change communication protocol	To ensure that the Jetson Nano software informs the user to change the communication protocol when the data transfer rate is greater than or equal to 12.5 Mbps.	The terminal displays error or warning messages pertaining to changing the UART library. The program does not continue running until a new communication protocol is used.	
Concluding Remarks: Transfer rates cannot achieve the speeds required for the tests. Features not currently implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW26

Objective: The system code is portable to systems using Ubuntu 18.04 AARCH64.

Notes:

Test No.: SW26		*Current Status: Passed*		
Test title: System Code Portable to Ubuntu 18.04 AARCH64 Systems.				
Testing approach: Upload the current system code to Ubuntu 18.04 AARCH64 systems, verifying that the code runs as expected.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Upload current system code to Ubuntu 18.04 AARCH64 systems.	To ensure that the code can be uploaded to Ubuntu 18.04 AARCH64 systems.	The current system code uploads without errors.	
2.	Verify that the code continues to run as expected on new systems.	To ensure that the code runs as expected on Ubuntu 18.04 AARCH64 systems.	The current system code runs without errors.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW27

Objective: The system sends data bits serially through the UART device driver using nonblocking code and a single thread.

Notes:

Test No.: SW27		*Current Status: Failed*		
Test title: Data Sent Through Nonblocking Code Using Single Thread.				
Testing approach: Send data through the Jetson Nano UART pins without encoding and using a single thread.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson Nano board.	The Jetson Nano board must be powered on to run software tests.	The Jetson Nano board is powered on.	
2.	Run the Jetson Nano startup script.	The Jetson Nano startup script must be run to begin software tests.	The Jetson Nano bootstrap program runs to completion.	

3.	Select the serial data stream to send through the Jetson Nano UART pins.	The serial data stream must be sent through the Jetson Nano to test that the data stream is transmitted.	The serial data stream is sent through the Jetson Nano to the UART pins.	
4.	Send the serial data stream without encoding and using a single thread.	The serial data stream must be sent without encoding and using a single thread to ensure a proper test.	The serial data stream is sent without encoding and using a single thread.	
5.	Inspect the terminal for error messages when transmitting the serial data stream.	The terminal must contain no error messages pertaining to transmission of the serial data stream to ensure the data stream was properly transmitted.	The terminal displays no error messages when transmitting the serial bit stream.	
Concluding Remarks: Feature not currently implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case SW28

Objective: Data is transmitted without applying additional encoding of the transmitted bitstream.

Notes:

Test No.: SW28	*Current Status: Failed*
Test title: Data Transmission Without Additional Encoding	

Testing approach: A test serial data stream is sent through the Jetson Nano, which transmits the data directly, printing the transmitted data to the terminal. The operator inspects the printed data stream, verifying that the data streams are the same.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson Nano board.	To run the Jetson Nano software test.	The Jetson Nano board is powered on.	
2.	Run the Jetson Nano startup script.	To send a raw data stream through the Jetson Nano board.	The Jetson Nano bootstrap program runs to completion.	
3.	Send the test data stream through the Jetson Nano board.	To verify that the Jetson Nano board can transmit a bit stream without encoding.	The data test stream is sent through the Jetson Nano board.	
4.	Inspect the data stream printed to the Jetson Nano terminal for differences to the original data stream.	To verify that the Jetson Nano correctly transmits the test data stream without encoding.	The data stream displayed on the Jetson Nano terminal is identical to that of the original data stream.	
Concluding Remarks: Testing feature not currently supported.				

Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case SW29

Objective: The received data is displayed to the user without performing decoding of the received bitstream.

Notes:

Test No.: SW29	*Current Status: Failed*
Test title: Received Data is Displayed to User Without Decoding.	

Testing approach: A test serial data stream is sent to the Jetson TX2, which reads the data stream directly and prints the data stream to the terminal. The operator inspects the printed data stream, verifying that the data streams are the same.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power on the Jetson TX2 board.	To run the Jetson TX2 software test.	The Jetson TX2 board is powered on.	
2.	Run the Jetson TX2 startup script.	To send a raw data stream to the Jetson TX2 board.	The Jetson TX2 bootstrap program runs to completion.	
3.	Send the test data stream to the Jetson TX2 board.	To verify that the Jetson TX2 board can receive the test bit stream without decoding.	The data test stream is sent to the Jetson TX2 board.	
4.	Inspect the data stream printed to the Jetson TX2 terminal for differences to the original data stream.	To verify that the Jetson TX2 correctly receives the test data stream without decoding.	The data stream displayed on the Jetson TX2 terminal is identical to that of the original data stream.	
Concluding Remarks: Testing feature not currently supported.				

Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

5.3. General Test Cases

Test Case GEN01

Objective: The receiver receives the serial bitstream through free space without outside interference.

Notes:

Test No.: GEN01	*Current Status: Passed*

Test title: Free Space Transmission Through Dust.				
Testing approach: Observation of an oscilloscope connected to the photoreceiver.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Connect the oscilloscope to the photoreceiver and jetson TX2.	The photoreceiver and Jetson TX2 must be connected to the oscilloscope in order to measure the received bitstream values.	The oscilloscope is connected to the photoreceiver and Jetson TX2 devices with no loose connection points.	
2.	Power on the system.	The system must be powered on to test that the received bitstream is correct.	The Jetson Nano, Jetson TX2, Laser Driver, and Photoreceiver are powered on (signified by the power LED on each device).	
3.	Send the desired bitstream through the transmitting Jetson Nano and laser driver/laser.	The system must have transmitted a bitstream to test that the bitstream is being received.	The system transmits the desired bitstream without error.	
4.	Observe the oscilloscope readings, verifying that the response coincides with the desired high/low values in the transmitted bitstream.	The tester must observe the oscilloscope to verify that the system passes the test and receives the bitstream.	The received serial bitstream high/low values are accurately displayed on the oscilloscope.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN02

Objective: The system transmits an image file as a bitstream over a distance of at least 3 inches.

Notes:

Test No.: GEN02		*Current Status: Passed*		
Test title: Minimum Free Space Transmission Distance.				
Testing approach: A testing track with premeasured distance markers is used to measure the distance between the laser and the photoreceiver.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Place the photo receiver on one end of the testing track.	The photo receiver must be placed on the testing track to properly measure the transmitting distance.	The photo receiver is placed on one end of the testing track.	
2.	Place the laser and laser driver on the testing track at least 3 inches from the photo receiver.	The laser must be placed at least 3 inches from the photoreceiver on the testing track in order to pass the test.	The laser and laser driver are placed at least 3 inches from the photo receiver.	Use the hash marks on the testing track to determine the 3-inch minimum from the photoreceiver.
3.	Power on the system.	The system must be powered on in order to determine whether the system transmits/receives an image.	The system is powered on.	
4.	Send desired bitstream through Jetson Nano and Laser Driver/laser.	A bitstream must be transmitted to determine whether the system transmits across at least 3 inches of free space.	The desired bitstream is sent through the Jetson Nano and Laser driver/laser.	

5.	Observe Jetson TX2 display to determine whether the bitstream was received over a distance of at least 3 inches.	The Jetson TX2 display must be observed to verify that the bitstream is being transmitted and received across at least 3 inches of free space.	The Jetson TX2 displays the received bitstream which was sent through the Jetson Nano and laser driver/laser.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN03

Objective: The carrier signal (laser) is oriented directly at the receiving photodetector.

Notes:

Test No.: GEN03		*Current Status: Failed*		
Test title: Carrier Signal Orientation.				
Testing approach: The laser is placed in the test track mount, keeping the laser stable and directed toward the photo receiver.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Place the photo receiver in the mount on one end of the test track.	The photo receiver must be in the test track to verify that the laser is in the correct orientation.	The photo receiver is in the mount on one end of the test track.	
2.	Place the laser in the laser mount on the testing track.	The laser must be in the test track mount to verify that the orientation will remain stable throughout testing.	The laser is in the laser mount on the test track.	

3.	Observe that the laser orientation is stable and directed toward the photo receiver.	The laser must be observed by the operator to verify that the carrier signal will reach the photo receiver in the current orientation.	The laser is in the correct orientation on the laser mount on the test track.	
Concluding Remarks: Testing track not yet created.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN04

Objective: The laser is not operated without a member of the project team to verify its proper use.

Notes:

Test No.: GEN04		*Current Status: Passed*		
Test title: Safe Laser Operation by Team Members.				
Testing approach: The lab in which the system is tested has controlled access. Each member of the project team is given access to the lab upon completion of the safety training.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	The system is placed in an access-controlled testing lab by the product owner.	This verifies that the system cannot be used by someone who does not have access to the testing lab.	The system is in an access-controlled lab.	

2.	Safety training completed by project team members.	The safety training ensures that everyone who has access to the testing lab is capable of safely testing the system.	Each project member completes the required safety training.	
3.	Lab access granted by the product owner to those who complete safety training.	Granting lab access to those who complete the training ensures safe use of the system and verifies proper use of the system.	Project members who have completed the safety training are granted access to the lab in which the system is located.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case GEN05

Objective: The system is powered off when not in use.

Notes:

Test No.: GEN05			*Current Status: Passed*	
Test title: Powering Off System When Not in Use.				
Testing approach: Each component of the system is observed to ensure that the power LED is off.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	For the respective components, use the terminal to shut down the Jetson Nano and Jetson TX2. Press the power button on the photo receiver and unplug the laser driver.	The components must be turned off by the user with the power buttons and inputs.	Each component is powered off.	
2.	Observe each component to ensure that the power for each component is off.	Each component must be observed to verify that it is powered off upon completion of testing.	Each component is verified to be powered off.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN06

Objective: The optical communication system fits within 1U (10x10x10 in)

Notes:

Test No.: GEN06		*Current Status: Failed*		
Test title: System Within Height, Length, and Width Maximum.				
Testing approach: Use a measuring tape to measure the system height, length, and width.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Measure the length of the system with a measuring tape.	This ensures that the system is within the required length.	The system is within the required length.	

2.	Measure the width of the system with a measuring tape.	This ensures that the system is within the required width.	The system is within the required width.	
3.	Measure the height of the system with a measuring tape.	This ensures that the system is within the required height.	The system is within the required height.	
Concluding Remarks: System is not yet in an enclosed system to be measured.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN07

Objective: The system costs under $20,000 USD.

Notes:

Test No.: GEN07		*Current Status: Passed*		
Test title: System Within $20,000 Budget.				
Testing approach: The system Bill of Materials is calculated to be less than $20,000.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Record each item purchased or to be purchased for the system (with prices) in the Bill of Materials document.	To ensure the cost of the system does not exceed the $20,000 budget.	The system is within the required budget.	
2.	Calculate the sum of the bill of materials, ensuring that the sum is less than $20,000.	To ensure the cost of the system does not exceed the $20,000 budget.	The system is within the required budget.	

Concluding Remarks:	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case GEN08

Objective: The optical communication system weighs less than 20 pounds.

Notes:

Test No.: GEN08		*Current Status: Passed*		
Test title: System Remains Under 20 Lbs.				
Testing approach: The system is placed on a scale.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Place the system on a scale.	The system must be placed on a scale to measure the weight.	The system is placed on a scale.	
2.	Verify that the weight of the system is less than the maximum allowable weight.	The system weight must be verified by an operator to ensure it is within the allowable maximum weight.	The system is within the allowable weight restrictions.	Verify that the weight of the system is less than the maximum allowable weight.
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN09

Objective: The system operates between 65-80 degrees Fahrenheit.

Notes:

Test No.: GEN09			*Current Status: Passed*	
Test title: System Operation Between 65-80 Degrees Fahrenheit.				
Testing approach: Transmit and receive a bitstream in a lab environment in which the temperature is between 65-80 degrees Fahrenheit.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Ensure the thermostat reading of the lab is between 65-80 degrees Fahrenheit.	To ensure that the lab testing environment is between 65-80 degrees Fahrenheit.	The lab testing environment is between 65-80 degrees Fahrenheit.	
2.	Power on the system.	To ensure the system is transmitting and receiving within the desired temperature.	The system is transmitting and receiving within the desired temperature.	
3.	Transmit a desired bitstream through the Jetson Nano and laser driver/laser.	To ensure the system transmits within the desired temperature.	The system transmits data within the desired temperature.	
4.	Observe the received bitstream to verify proper sending and receiving in temperature between 65-80 degrees Fahrenheit.	To ensure the system receives within the desired temperature.	The system receives data within the desired temperature.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case GEN10

Objective: The system operates on Earth's surface within the designated test laboratory.

Notes:

Test No.: GEN10		*Current Status: Passed*		
Test title: System Operation on Earth's Surface.				
Testing approach: Operate the system on Earth's surface, ensuring proper function of the system as a whole.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Power system on.	To ensure proper functioning of the system during operation.	The system powers on.	
2.	Ensure system elements operated as expected.	To ensure the system is operating as expected on Earth's surface.	The system operates as expected.	"as expected" here means in accordance with their component data sheets.
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN11

Objective: Operators wear LG16B - Laser Safety Glasses (1550 nm) eye protection while operating the laser.

Notes:

Test No.: GEN11		*Current Status: Passed*		
Test title: System Testing Using Safety Glasses.				
Testing approach: System operators wear safety glasses during testing.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Put on safety glasses.	To safely test the system, verifying safe operation of laser.	The operator is wearing proper safety glasses.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN12

Objective: The system operates in all environments tested.

Notes:

Test No.: GEN12		*Current Status: Passed*		
Test title: System Operation in Testing Environments.				
Testing approach: System operation is verified in the lab environment.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Ensure secure connection of cables.	To ensure that the system is connected properly, and unsecure connections are not causing system failure.	Each of the cables in the system are securely connected.	
2.	Power on system.	To ensure the system is receiving power during the test.	The system is powered on.	
3.	Send bit stream through Jetson Nano, laser driver/laser.	To transmit the bit stream to the receiver.	A bit stream is sent through the Jetson Nano and laser driver/laser.	

4.	Observe Jetson TX2 display for received bitstream.	To ensure the system is receiving the bit stream.	The photoreceiver and Jetson TX2 receive a bitstream.	
5.	Observe components for hazards caused by testing environment.	To ensure each component is unaffected by the lab environment.	The components in the system do not have any hazard caused by the testing environment.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	

Test Case GEN13

Objective: The system components are purchased from a vendor and approved by the product owner (Dr. Rojas).

Notes:

Test No.: GEN13			*Current Status: Passed*	
Test title: System Component Approval.				
Testing approach: Send an updated bill of materials to Dr. Rojas, the current product owner, for approval and purchase of any new items each time new items are needed.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Update bill of materials document with new items upon need to purchase.	To ensure proper tracking of the components purchased for the project and their purpose.	The bill of materials is up to date with the most current version of the project.	
2.	Send the updated bill of materials to the current product owner.	Allows approval of purchase by the current product owner.	The most updated bill of materials is sent to the product owner when new purchases are needed.	

3.	The current product owner approves/denies and purchases/does not purchase the added components.	To ensure that the new items are acceptable for project use and purchase.	The product owner either approves or denies new purchase requests for the project.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN14

Objective: The system uses COTS components.

Notes:

Test No.: GEN14			*Current Status: Passed*	
Test title: COTS Components Use in System.				
Testing approach: Each item used in the system is added to a bill of materials document which tracks whether the parts are COTS components.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Add each item used in the project to a bill of materials document.	To easily track each item used in the project.	Each item used in the system is added to the bill of materials document.	
2.	Verify that each item is classified as a “COTS” component via the component data sheet or the company website.	To verify that the system uses COTS components.	Each item in the bill of materials document is researched to determine COTS classification.	
3.	Add COTS verification to the bill of materials list.	To easily track which components within the system are COTS components.	Each component in the bill of materials has a COTS verification column which is checked yes or no.	

Concluding Remarks:	
Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case GEN15

Objective: The system receiver distance is increased up to 1-foot at the end of development.

Notes:

Test No.: GEN15		*Current Status: Failed*		
Test title: Increasing Receiver Distance Through Development.				
Testing approach: The laser driver/diode and the photoreceiver are placed on a test track which expands up to 1-foot in distance. The system is tested from end-to-end to verify transmitter and receiver distance.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Place the photoreceiver in the photoreceiver mount on one end of the test track.	The photoreceiver must be placed in its proper mount to ensure the correct measurement of receiving distance.	The photoreceiver is placed in the proper mount on the testing track.	
2.	Place the laser driver/diode on the opposite end of the track in the laser driver/diode mount.	The laser driver/diode must be placed in the proper mount on the test track to ensure the correct measurement of transmitting distance.	The laser driver/diode is placed in the proper mount on the testing track.	

3.	Move the photoreceiver mount and laser driver/diode mount to the desired distance as marked on the testing track.	The photoreceiver and laser driver/diode must be moved to the desired distance on the test track to ensure that the system transmits and receives at distances of up to 1-foot.	The photoreceiver and laser driver/diode are moved to the desired distance apart based on the test track measuring lines.	
4.	Run the full end-to-end system test.	The full system test must be completed to ensure that the system both transmits and receives at the desired distance, up to 1-foot.	The system transmits and receives at a distance of 1-foot.	
Concluding Remarks: Testing track not currently created.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN16

Objective: The laser sends live and static amounts of data.

Notes:

Test No.: GEN16		*Current Status: Failed*		
Test title: Laser Sends Static Amounts of Data.				
Testing approach: A static bit stream is sent through the Jetson Nano to the laser driver/diode. A live bit stream is sent through Jetson Nano to the laser driver/diode. The laser driver is connected to an oscilloscope to ensure that the driver is receiving the bit streams.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Connect an oscilloscope to the laser driver.	To view the bitstream which the laser driver is receiving.	The oscilloscope is connected to the laser driver.	
2.	Select a bitstream to send through Jetson Nano.	To send a bitstream to the laser driver using the Jetson Nano.	A bitstream (either static or live) is selected from the Jetson Nano device folder.	Repeat steps 2-4 for both static and live bit streams.
3.	Send the bitstream through the Jetson Nano to the laser driver.	To send a bitstream to the laser driver using the Jetson Nano.	The selected bitstream is sent through the Jetson Nano to the laser driver.	
4.	Observe the oscilloscope for proper waveforms upon sending of the bitstream.	To ensure that the laser driver is receiving the proper bitstream as is sent from the Jetson Nano.	The oscilloscope shows a proper, expected waveform in accordance with the bitstream which was sent to the laser driver.	
Concluding Remarks: Feature not currently implemented.				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN17

Objective: The NVIDIA Jetson Nano’s power is accessible to the user.

Notes:

Test No.: GEN17		*Current Status: Passed*		
Test title: NVIDIA Jetson Nano Power Accessibility.				
Testing approach: Observe the Jetson Nano for a power source. Power the Jetson Nano to ensure the power port is easily accessible.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*

1.	Observe the Jetson Nano for a power input.	To ensure that the Jetson Nano has a power input.	The Jetson Nano has a power input.	
2.	Plug in the Jetson Nano power source.	To ensure that the user can easily access the Jetson Nano power input.	The Jetson Nano power input is easily accessible.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector		*Date Completed:* 04/10/2025		

Test Case GEN18

Objective: The NVIDIA Jetson TX2 power button is accessible to the user.

Notes:

Test No.: GEN18		*Current Status: Passed*		
Test title: NVIDIA Jetson TX2 Power Button Accessibility.				
Testing approach: Observe the Jetson TX2's power button. Press the Jetson TX2 power button to ensure the button is easily accessible.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Observe the Jetson TX2's power button.	To ensure that the Jetson TX2 has a power button.	The Jetson TX2 has a power button.	
2.	Press the Jetson TX2 power button.	To ensure that the user can easily access the Jetson TX2 power button	The Jetson TX2 power button is easily accessible.	
Concluding Remarks:				

Testing Team: Korey Kelley, Mosely Tector	*Date Completed:* 04/10/2025

Test Case GEN19

Objective: The laser receiver power input is accessible to the user.

Notes:

Test No.: GEN19			*Current Status: Passed*	
Test title: Laser Receiver Power Input Accessibility.				
Testing approach: Observe the laser receiver for a power input. Press the laser receiver power input to ensure the input is easily accessible.				
STEP	*OPERATOR ACTION*	*PURPOSE*	*EXPECTED RESULTS*	*COMMENTS*
1.	Observe the laser receiver for a power input.	To ensure that the laser receiver has a power input.	The laser receiver has a power input.	
2.	Press the laser receiver power input.	To ensure that the user can easily access the laser receiver power input.	The laser receiver power input is easily accessible.	
Concluding Remarks:				
Testing Team: Korey Kelley, Mosely Tector			*Date Completed:* 04/10/2025	