


Artifact ID: TP-003	Artifact Title: Test Procedure, Thermal Camera Validation on Drone with Raspberry Pi 5 Running ROS 2		
Revision: 01	Revision Date: 2025-04-06		
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Purpose: The purpose of this test is to validate the functionality of a thermal camera connected to a Raspberry Pi 5 running ROS 2, ensuring compatibility, power adequacy, and proper video feed visualization. This test does not evaluate any image processing algorithms but focuses solely on the operational aspects of the camera.			

Revision History			
Revision	Revised by	Checked by	Date
01	Joshua Crookston	Jacob Wilkins	2025-04-06

Test Procedure

Thermal Camera Validation on Drone with Raspberry Pi 5 Running ROS 2

1. Test Objective

The purpose of this test is to validate the functionality of a thermal camera connected to a Raspberry Pi 5 running ROS 2, ensuring compatibility, power adequacy, and proper video feed visualization. This test does not evaluate any image processing algorithms but focuses solely on the operational aspects of the camera.

2. Test Equipment & Setup

2.1 Required Equipment

- Thermal camera
- Raspberry Pi 5 with ROS 2 installed
- Power source (ensure sufficient wattage for Raspberry Pi 5 and camera)
- Drone (if applicable) or stable mounting platform
- Computer with ROS 2 and GUI for monitoring
- Fire source (controlled, 2 ft (0.6 m) in diameter)

- Safety equipment for fire handling

2.2 Setup Steps

1. Verify Camera Compatibility:

- Confirm that the thermal camera is supported by ROS 2 and Raspberry Pi 5.
- Install necessary ROS 2 packages and drivers.
- Verify camera recognition in ROS 2 using the following commands:

```
ros2 topic list
```

```
ros2 topic echo /<camera_topic>
```

- Ensure the camera streams data properly in ROS 2.

2. Power Verification:

- Connect the camera to Raspberry Pi 5 and ensure sufficient power supply.
- Monitor voltage and current consumption to confirm stable operation.

3. Mounting and Connectivity:

- Securely attach the camera to the Raspberry Pi and ensure a stable data connection.
- Mount the Raspberry Pi onto the drone or a stationary platform.

3. Test Execution

3.1 Fire Setup & Observation Distance

- Safely ignite a controlled fire measuring **2 ft (0.6 m) in diameter**.
- Move **200 ft (61 m) away** from the fire while maintaining line-of-sight.
- Ensure environmental safety and confirm wind conditions do not interfere with the test.

3.2 Live Video Feed Verification

- Open the ROS 2 GUI to display the live thermal feed.
- Verify that the camera is streaming properly by observing:
 - Unfiltered video** (raw thermal data).
 - Filtered video** (preliminary filtering applied).
 - Auto-scaled video** (adjusted contrast for better visibility).
- Observe the fire in the live feed and confirm visibility.

3.3 Filter Adjustment & Parameter Tuning

Using real-time feed adjustments, modify the following parameters to isolate fire visibility:

Parameter	Description	Adjustment Steps
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Grayscale Threshold	Cuts out pixels below a certain grayscale value	Increase until only fire remains visible
Value Addition	Adds a constant value to unfiltered pixels	Adjust to enhance contrast
Gaussian Blur	Applies a blur based on a sigma value	Tune to reduce noise while maintaining fire visibility
Final Threshold	Cuts out pixels below a new grayscale threshold	Fine-tune for optimal fire isolation

- Adjust parameters incrementally while monitoring live feed until only the fire remains visible.

4. Test Validation Criteria

Test Step	Expected Outcome
Camera initialization	Camera is detected by ROS 2 and streams data
Power verification	Camera operates without power failures
Live feed display	Unfiltered, filtered, and auto-scaled video feeds are viewable
Fire detection	Fire is visible at 200 ft (61 m) distance
Parameter tuning	Fire is isolated using filter adjustments

5. Test Completion & Documentation

- Record Observations:** Document test results, including screenshots of video feeds at different filter settings.
- Log Errors & Issues:** Note any hardware/software failures, latency, or video quality problems.
- Save Configuration Settings:** Store optimal parameter values for future reference.
- Shutdown Procedures:** Safely power down the Raspberry Pi and camera.

6. Safety Considerations

- Ensure fire safety measures are in place (fire extinguisher, controlled burn area).
- Maintain a safe distance from the fire.
- Verify drone stability (if applicable) before flight.

7. Test Status & Reporting

Upon test completion, document results and submit a test report detailing:

- Camera functionality status
- Observed video feed quality
- Optimal filter parameters
- Identified issues and recommendations