## Introduction

## System overview and verification are critical to ensure that the MATS performs as intended. This document outlines the testing procedures for the Power Subsystem, which is responsible for converting the system’s 12–24 V input into regulated voltage rails required by all other subsystems. The Power Subsystem provides 7.5 V, 5 V, and 3.3 V outputs to support the Rotator, Receiver, and User Interface subsystems. This test plan aims to verify the proper functionality and reliability of the Power Subsystem independently, prior to integration into the full MATS system.

## Subsystem Requirements and Specifications

Using MP2329C buck converters, the design generates 7.5 V, 5 V, and 3.3 V outputs to supply the Rotator, Central Receiver, and User Interface. To ensure reliable operation, the subsystem must meet requirements for voltage accuracy, current delivery, ripple and noise, efficiency, and fault protection. System requirements can be found in Table 1.

Table 1: Rotator Subsystem Requirements

|  |  |
| --- | --- |
| **Requirement** | **Expectation** |
| Input Voltage Range | 12-24 VDC |
| Output Rails | 7.5V, 5V, 3v3 |
| Maximum Current | 6A, 5A, 5A |
| Voltage Accuracy | ± 5% of nominal |
| Ripple Voltage | ≤ 50 mVpp |
| Protection | Overcurrent and short-circuit safe |

## Objectives

The objectives to test and verify operation for include:

1. Verify each output rail maintains voltage within tolerance across the load
2. Confirm maximum current delivery for each rail
3. Measure and evaluate ripple/noise
4. Validate startup, shutdown, and sequencing behavior
5. Test protection circuitry to ensure safe fault handling

## Required Equipment

The following is a list of the equipment needed to carry out the tests and verification plans for the Power Subsystem of the MATS.

* Programmable DC power supply
* Adjustable resistive loads
* Digital multimeter
* Oscilloscope

## Testing Procedure

This section covers in detail the testing procedure for each part of the Power Subsystem.

## Input Verification

**Setup:** Connect a programmable DC power supply to the subsystem input. Use a DMM to measure applied voltage and input current.

**Procedure:**

1. Start at 12 V input and increment in 2 V steps up to 24 V.
2. At each step, record input voltage and current draw with no load and with a representative load on each rail.

**Acceptance Criteria:** The subsystem powers on without fault at every step, and outputs remain stable within tolerance.

## Voltage Accuracy

**Setup:** Connect DMM probes to each output rail (7.5 V, 5 V, 3.3 V).

**Procedure:**

1. Apply nominal input voltage (e.g., 12V – 24V)
2. With no load, record output voltages.
3. Apply the rated load on each rail and record voltages of each rail.

**Acceptance Citeria:** Output voltages remain within ±5% (or tighter spec) of nominal.

## Load Regulation and Current Capacity

**Setup:** Connect adjustable resistive loads to each output rail.

**Procedure:**

1. Gradually increase load current on one rail up to its rated limit while monitoring voltage
2. Repeat for each rail independently, then with all rails loaded simultaneously.

**Acceptance Criteria:** Voltage deviation stays within limits, and subsystem does not shut down or overheat at rated load.

## Ripple and Noise

**Setup:** Connect an oscilloscope across each rail.

**Procedure:**

1. Apply nominal input voltage.
2. Record peak-to-peak ripple voltage for each rail.

**Acceptance Criteria:** Ripple and noise do not exceed spec (e.g., ≤ 50 mVpp or ≤ 100 mVpp for higher rails).

## Protection Testing

**Setup:** Use electronic loads for controlled overcurrent, and jumper wires for safe short-circuit testing.

**Procedure:**

1. Slowly increase load current beyond rated limit and observe whether the subsystem limits/shuts down safely.
2. Short each rail briefly (using current-limited setup) and confirm recovery behavior.

**Acceptance Criteria:** Protections engage without damage; system recovers after fault is removed.

## Conclusion

This test and verification plan defines the steps required to validate the MATS Power Subsystem against its design specifications. Successful completion will demonstrate that the subsystem can reliably provide regulated 7.5 V, 5 V, and 3.3 V rails from a wide input range, supply continuous load currents, maintain acceptable ripple, and withstand fault conditions without damage. The results will ensure the Power Subsystem meets the operational needs of MATS and provides a robust foundation for system integration.