



National Aeronautics and
Space Administration

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Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, TX 77058

TEST REPORT ELECTROMAGNETIC INTERFERENCE For The Mochii

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Summary Information Sheet

TASK PERFORMANCE SHEET (TPS): 19-TPS-00054605

Mochii Microscope
P/N vx-032; S/N vx-032-sn007

EQUIPMENT UNDER TEST: Mochii Metal Coater
P/N vx-032-2102; S/N vx-032-2102-sn007

Mochii Pwr/Vac Supply
P/N vx-032-0300; S/N vx-032-2100-sn007

PROJECT MANAGER: VOXA/Chris Own, 415-858-0393

TEST DATE: August 27 - 30, 2019

TEST LOCATION: NASA, Johnson Space Center, Houston, TX
Primary EMI Laboratory

EMC PROJECT ENGINEER: Hoai Ngo, 281-483-8088

TEST MANAGER: Xiang Ni, 281-483-0186

1.0 INTRODUCTION

This test report details the preparation for, and results of, electromagnetic interference (EMI) testing accomplished on the Certification of the Mochii Payload.

2.0 APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this Test Report to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this report, this document shall have precedence.

SSP 30237, Rev. T
Dated: 02 February 2010

Space Station Electromagnetic Interference Emission
and Susceptibility Requirements

SSP-57000, Rev. R

Pressurized Payloads Interface Requirements
Document

JSC 27933, Rev. E
Dated: January 2018

EMI/EMC Laboratory Configuration Document

3.0 CONFIGURATION OF THE EQUIPMENT UNDER TEST

The EMI test configuration for Mochii is shown in Figure 3.1.



Figure 3.1 EMI Test Configuration for Astrobee FF with Mochii.

4.0 TEST RESULTS

Table 4-1 below documents the results of each test performed per the requirements of SSP 57000. The Mochii hardware was found to be in compliance with ISS EMI requirements. The complete formal data package is located in the attached appendices.

TABLE 4-1: SSP 57000, rev. R

EMI TEST	DESCRIPTION	COMPLY? Y/N
RE02	Radiated Emissions, Electric Field, 14 kHz-10 GHz, 13.5-15.5 GHz	N
Time Varying Magnetic Field	7 cm	Y
Static Magnetic Field	7 cm	Y
RS03	Tested on Engineering Unit for Engineer evaluation purposes	N/A

4.1 RE02, Radiated Emission, 100 MHz – 10 GHz; 13.5 – 15.5 GHz

Figures 4.1.1 – 4.1.3 show that ambient data met the requirements as stated in SSP 30238, para 3.1.1.1, Ambient Electromagnetic levels: “Conducted and radiated ambient levels shall be at least 6dB below the applicable limits of SSP 30237. Ambient conditions shall be determined prior to the beginning of measurements on the energized Equipment Under Test (EUT)”. The test data shown in Sections 4.1.1 through 4.1.6 demonstrate the Mochii is non-compliant with RE02 test requirements in ISS SSP 57000. Photographs of the radiated emissions test set up for the Mochii also are shown in section 4.1.7.

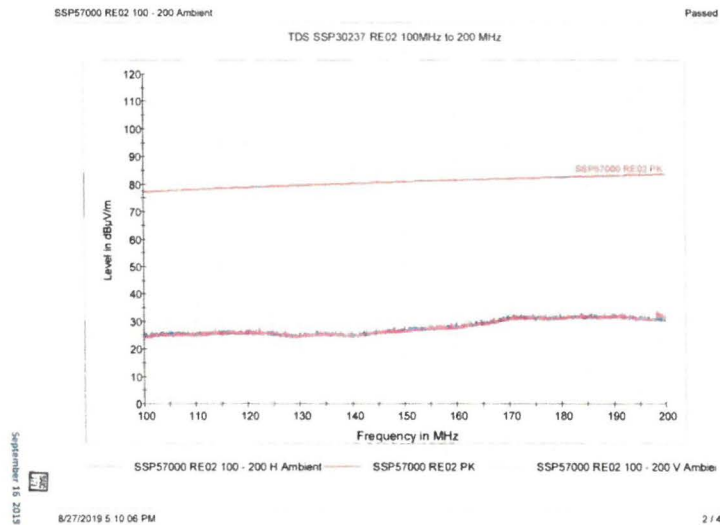


Figure 4.1.1: RE02 Ambient – 100 MHz – 200 MHz

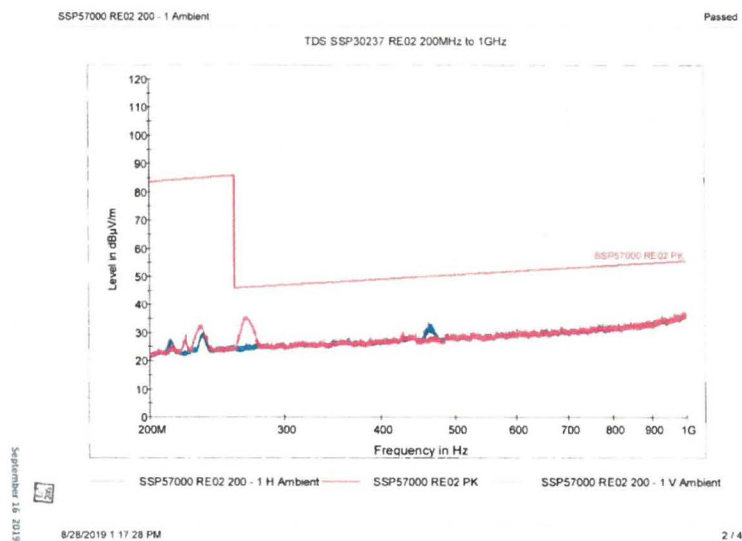


Figure 4.1.2: RE02 Ambient – 200 MHz – 1000 MHz

SSP57000 RE02 1 - 15.5 Ambient

Passed

TDS SSP30237 RE02 1GHz to 15.5GHz

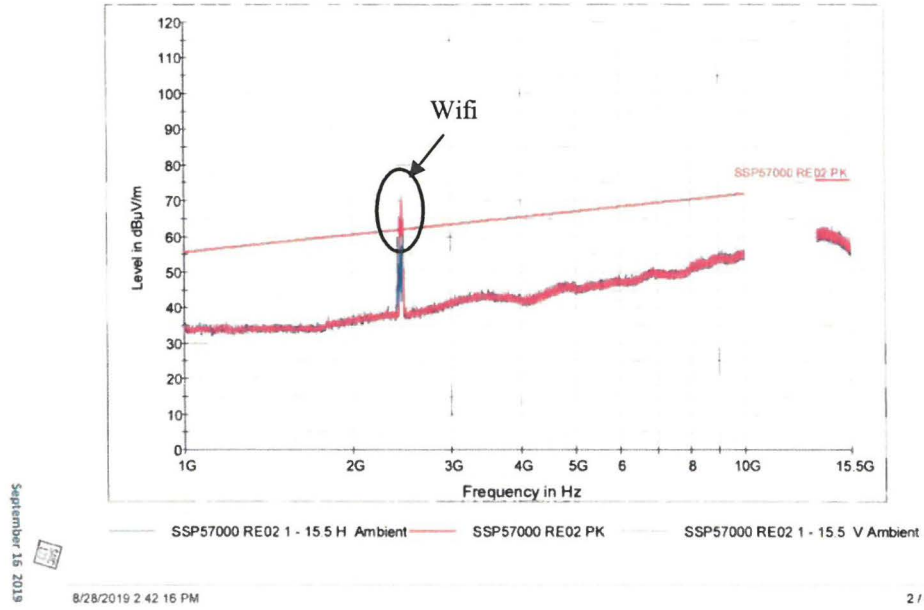


Figure 4.1.3: RE02 Ambient – 1 GHz – 15.5 GHz

4.1.1 RE02, Radiated Emission, 100 MHz – 10 GHz; 13.5 – 15.5 GHz, Mode 1 – Power on/Init

The Mochii tested in the Poweron/Init (Mode 1) configuration is noncompliant with the RE02 test requirement, as shown in Figures 4.1.1.1 and 4.1.1.2.

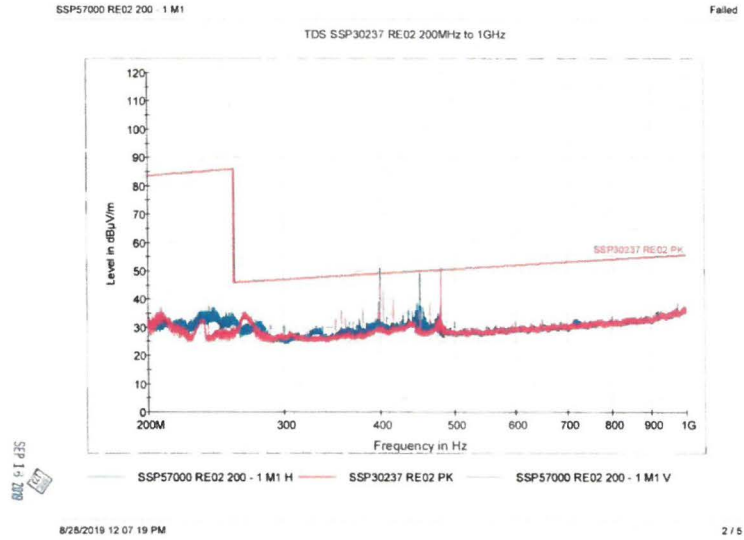


Figure 4.1.1.1: RE02 measured data – 200 MHz – 1 GHz; Mode 1 – Poweron/Init

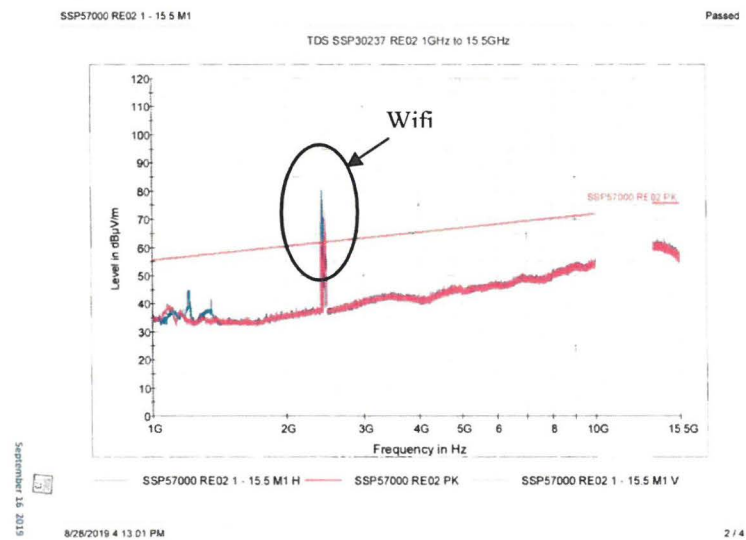


Figure 4.1.1.2: RE02 measured data – 1 GHz – 15.5 GHz; Mode 1 – Poweron/Init

4.1.2 RE02, Radiated Emission, 100 MHz – 10 GHz; 13.5 – 15.5 GHz, Mode 2 – Pumpdown

The Mochii tested in the Pumpdown (Mode 2) Configuration is incompliant with the RE02 test requirement, as shown in Figures 4.1.2.1 and 4.1.2.2.

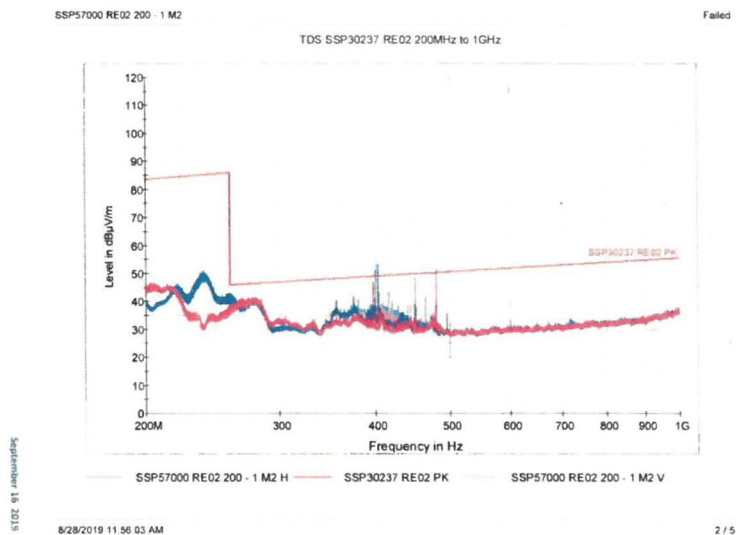


Figure 4.1.2.1: RE02 measured data – 200 MHz – 1 GHz; Mode 2 – Pumpdown

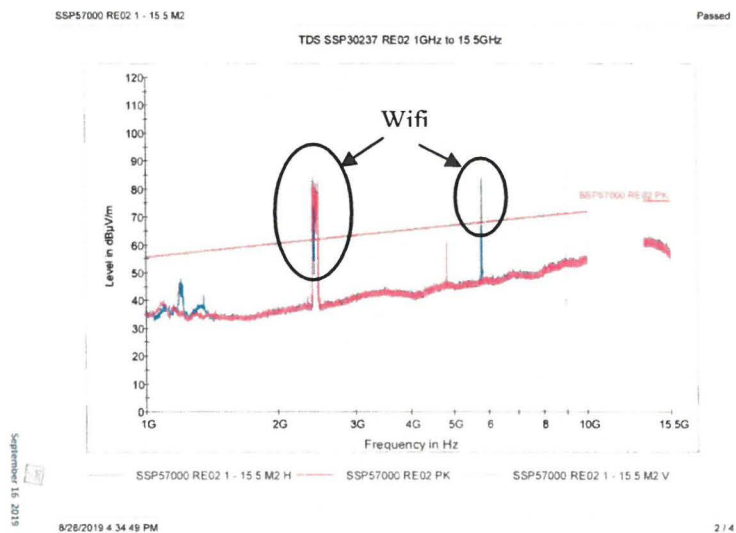


Figure 4.1.2.2: RE02 measured data – 1 GHz – 15.5 GHz; Mode 2 – Pumpdown

4.1.3 RE02, Radiated Emission, 100 MHz – 10 GHz; 13.5 – 15.5 GHz, Mode 3 – Idle, steady state

The Mochii tested in the Idle Steady State (Mode 3) configuration is incompliant with the RE02 test requirement, as shown in Figures 4.1.3.1 and 4.1.3.2.

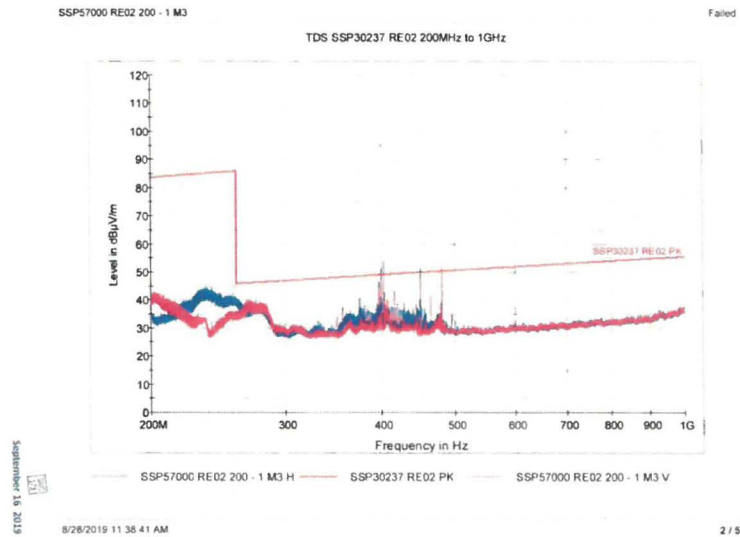


Figure 4.1.3.1: RE02 measured data – 200 MHz – 1 GHz; Mode 3 – Idle Steady State

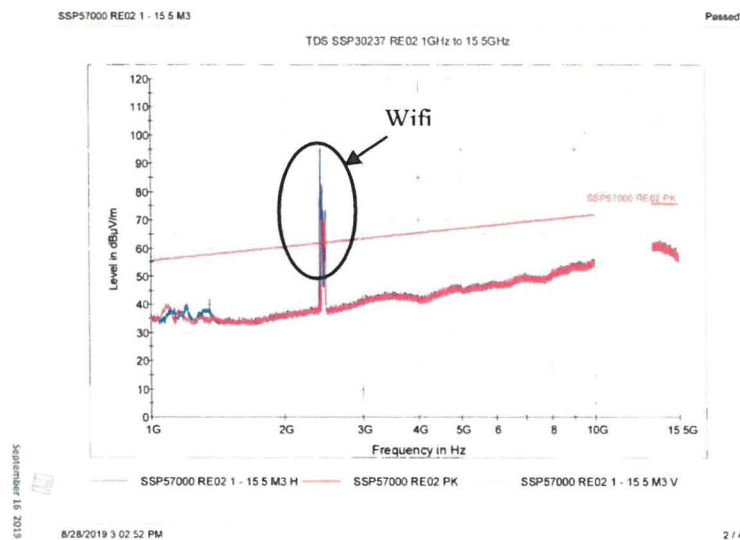
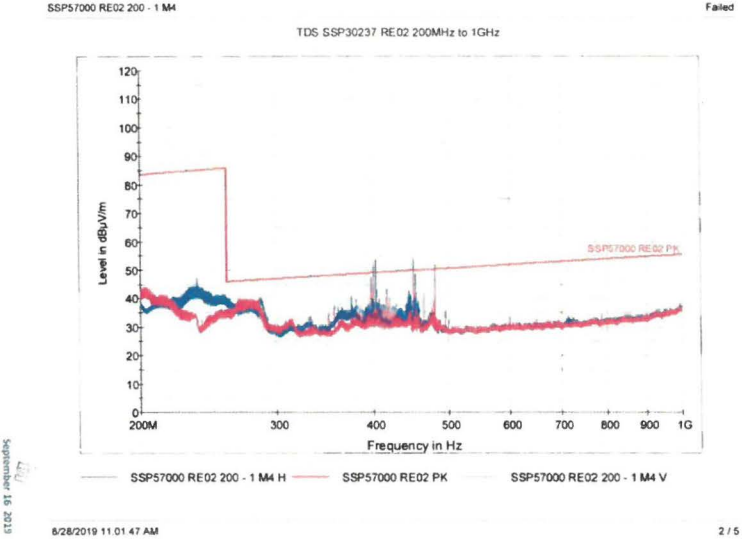


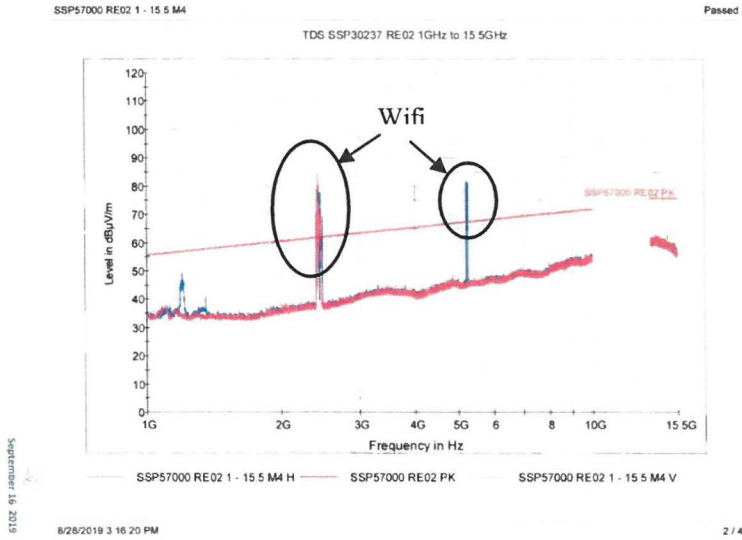
Figure 4.1.3.2: RE02 measured data – 1 GHz – 15.5 GHz; Mode 3 – Idle Steady State

4.1.4 RE02, Radiated Emission, 100 MHz – 10 GHz; 13.5 – 15.5 GHz, Mode 4 – Imaging

The Mochii tested in the Imaging (Mode 4) configuration is incompliant with the RE02 test requirement, as shown in Figures 4.1.4.1 and 4.1.4.2.



**Figure 4.1.4.1: RE02 measured data – 200 MHz – 1 GHz;
Mode 4 – Imaging**



**Figure 4.1.4.2: RE02 measured data – 1 GHz – 15.5 GHz;
Mode 4 – Imaging**

4.1.5 RE02, Radiated Emission, 100 MHz – 10 GHz; 13.5 – 15.5 GHz, Mode 5 – Spectroscopy

The Mochii tested in Spectroscopy (Mode 5) configuration is incompliant with the RE02 test requirement as shown in Figures 4.1.5.1 and 4.1.5.2.

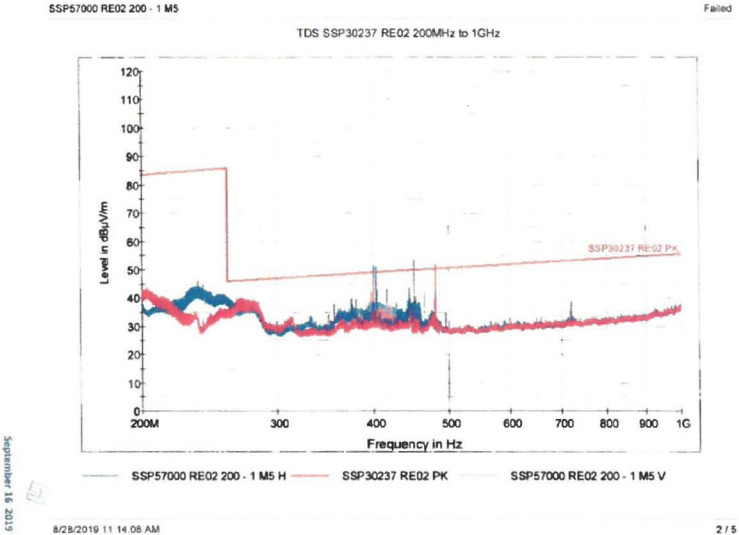


Figure 4.1.5.1: RE02 measured data – 200 MHz – 1 GHz; Mode 5 – Spectroscopy

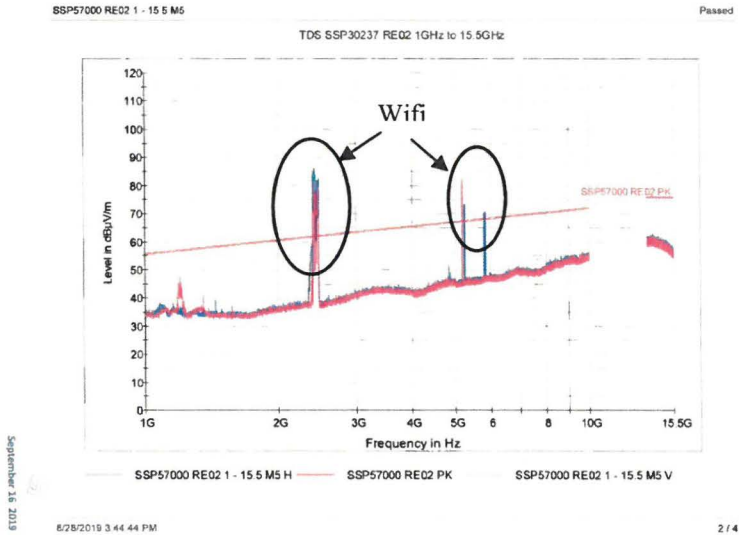


Figure 4.1.5.2: RE02 measured data – 1 GHz – 15.5 GHz; Mode 5 – Spectroscopy

4.1.6 RE02, Radiated Emission, 100 MHz – 10 GHz; 13.5 – 15.5 GHz, Mode 6 – Metal Coating

The Mochii tested in the Metal Coating (Mode 6) configuration is incompliant with the RE02 test requirement, as shown in Figures 4.1.6.1 and 4.1.6.2.

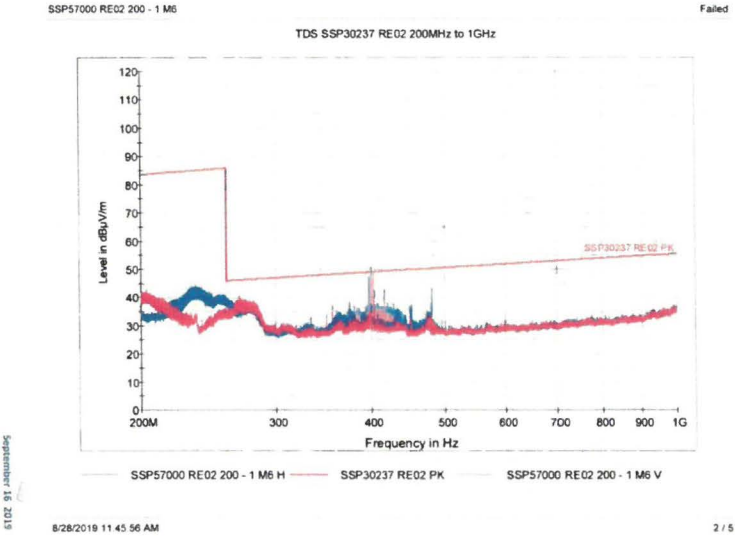


Figure 4.1.6.1: RE02 measured data – 200 MHz – 1 GHz; Mode 6 – Metal Coating

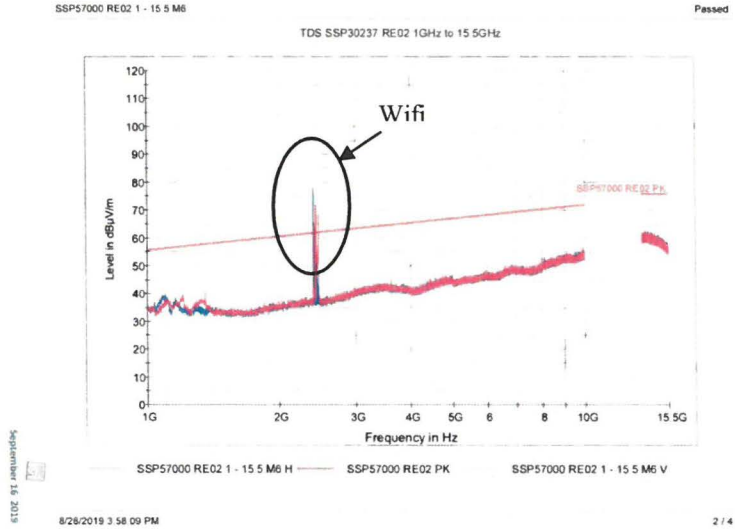


Figure 4.1.6.2: RE02 measured data – 1 GHz – 15.5 GHz; Mode 6 – Metal Coating

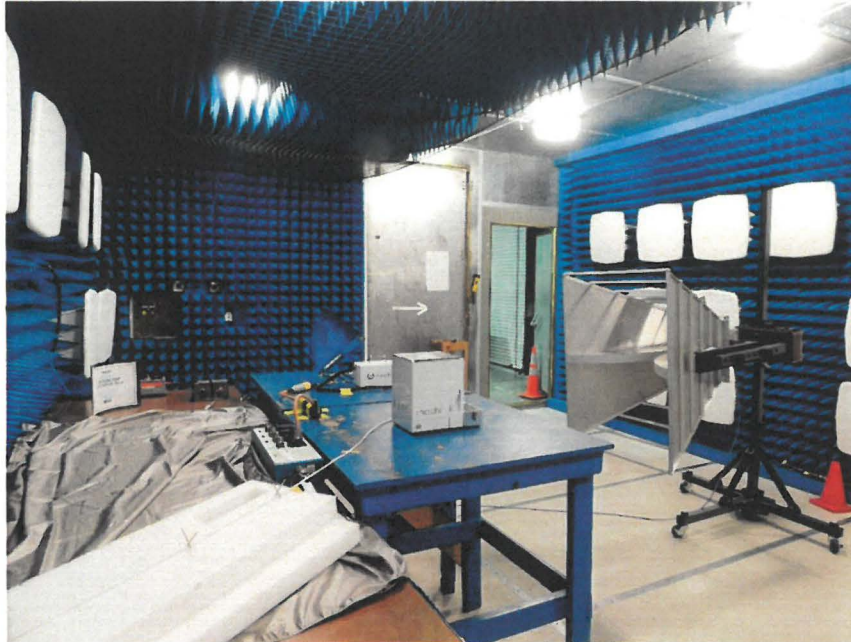
4.1.7 RE02 – photos of the test set up



Figure 4.1.7.1: RE02 Test set up – Semi anechoic chamber, Biconical Antenna Horizontal Polarization, 100 MHz – 200 MHz



Figure 4.1.7.2: RE02 Test set up – Semi anechoic chamber, Biconical Antenna Vertical Polarization, 100 MHz – 200 MHz



**Figure 4.1.7.3: RE02 Test set up – Semi anechoic chamber, Horn Antenna
Horizontal Polarization, 200 MHz – 1 GHz**



**Figure 4.1.7.4: RE02 Test set up – Semi anechoic chamber, Horn Antenna
Vertical Polarization, 200 MHz – 1 GHz**



**Figure 4.1.7.5: RE02 Test set up – Semi anechoic chamber, Horn Antenna
Horizontal Polarization, 1 GHz – 15.5 GHz**



**Figure 4.1.7.6: RE02 Test set up – Semi anechoic chamber, Horn Antenna
Vertical Polarization, 1 GHz – 15.5 GHz**

5.0 DISCUSSION OF RESULTS

EMI measured data indicate the Mochii is in full compliance with the SSP 57000 requirements for both Static Magnetic Field and Time varying Magnetic Field tests, as shown in the complete formal data package located in the attached appendices.

Measured data indicate non-compliance with SSP 57000 requirements for Radiated Emissions (RE02). The graphic illustrations in section 4.1 show that the non-compliances exceed the allowable limit. Boeing report, D684-10579-07, indicates two levels of attenuation for radiated EM fields based on location (10 dB shielding effectiveness (SE) for internal equipment near large windows, and 20 dB SE for internal equipment away from large windows). Using that information, the radiated emissions data collected for all 6 mode operations can be reduced between 10 dB and 20 dB, as shown in Tables 5-1. These new levels are adjusted for shielding effectiveness and are compliant with Radiated Emission requirements stated in SSP 57000. These frequencies do not fall within Space Station receiver bandwidths, therefore no interference is expected as a result of normal use of this equipment.

TABLE 5-1: Applied Shielding to RE02 Non-Compliances

Frequency (MHz)	Collected Data (dBuV/m)	Applied Shielding		Limit Line (dBuV/m)
		Far window (dBuV/m)	Near window (dBuV/m)	
400.00	51.4	31.4	41.4	49.09
403.20	53.9	33.9	43.9	49.15
451.20	54.0	34.0	44.0	49.95
479.97	51.3	31.3	41.3	50.39
479.975	51.8	31.8	41.8	50.39

A Tailoring and Interpretation Agreement (TIA) will be necessary to formally document the non-compliances and the rationale for acceptance without further mitigation.

6.0 APPENDIX

The appendix contains copies of the following documents:

- Test Readiness Review Board – Form EA-005
- TRR Attendance Sheet
- TRR Checklist
- Test Request
- Test Readiness Review Summary Sheet (form 1850)
- EMG EMC/EMI Chamber Test Facility Authorized Operator list
- EMG EMC/EMI Facility Readiness Statement Sheet
- Authorization Personnel Sheet
- Pre-Test Checklist
- EMI Lab Safety Briefing
- EMI Testing Sign-In Sheets
- Task Performance Sheet – 19-TPS-00054605
- Test Plan, EV5-19-EMC-008P
- Measured Data

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