August 12, 2021

Trackonomy Systems
Saurabh Sanghai
1828 Bering Drive
San Jose, CA 95112

Dear Saurabh Sanghai,

Enclosed is the Electromagnetic Compatibility for the Trackonomy Systems, GBP-2002, tested to the requirements of:

- FCC Part 15 Subpart B
- Innovation, Science, and Economic Development (ISED) Canada ICES-003 Issue 6

Thank you for using the services of Eurofins Electrical and Electronic Testing NA, Inc. Please contact me if you have any questions regarding these results or if Eurofins E&E can be of further service to you.

Sincerely,

Rheine Nguyen

Documentation Department
Eurofins Electrical and Electronic Testing NA, Inc.

Reference: EMCS113706-FCC-IC Rev 1

A2LA ACCREDITED
TESTING CERT #0591.02

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	07/20/2021	Initial Issue.
1	08/12/2021	Review Updates

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1.0 Testing Summary

The Trackonomy Systems, GBP-2002 was found to be compliant to the following specification(s).

- FCC Part 15 Subpart B
- Innovation, Science, and Economic Development (ISED) Canada ICES-003 Issue 6

Camilo Obana
EMC Laboratory Engineer

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements.

Joe Vang
EMC Laboratory Manager, California

2.0 Overview

Eurofins Electrical and Electronic Testing NA, Inc. was contracted by Trackonomy Systems to perform testing on the GBP-2002, under purchase order number T210625SS5.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of Trackonomy Systems, GBP-2002.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	GBP-2002
Equipment Emissions Class:	B

2.1 Test Site

All testing was performed at Eurofins Electrical and Electronic Testing NA, Inc., 3162 Belick St. Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology. Eurofins Electrical and Electronic Testing NA, Inc. has been accredited by the American Association for Laboratory Accreditation (A2LA) (Certificate #: 0591.02) in accordance with ISO/IEC 17025:2017.

2.2 Measurement Uncertainty

Measurement uncertainty calculated as per NIST Technical Note (TN) 1297 and ANSI / NCSL Z540-2, as equivalent to EN 55016-4-2 / IEC CISPR 16-4-2.

Test Method	Typical Expanded Uncertainty (dB)	K	Confidence Level
Radiated Emissions, (30 MHz – 1 GHz)	±3.24	2	95%
Radiated Emissions, (1 GHz – 6 GHz)	±3.92	2	95%
Conducted Emission Voltage	±2.44	2	95%
Conducted Emission Telecom	±3.53	2	95%

Measurement Uncertainty

2.3 Equipment Overview and Test Configuration

Name of EUT/Model:	GBP-2002
Description of EUT and its intended use:	GBP wireless communication device
Selected Operation Mode(s):	Nominal operation mode
Rationale for the selection of the Operation Mode(s):	Only mode supported by the device
Monitoring Method(s):	LED based visual feedback. Three Audio beep on successful startup.
Emissions Class Declaration:	Cellular, 900 MHz ISM band, BLE
Configuration(s):	With internal and External Antenna
EUT Power Requirement:	
Voltage:	120 V
AC or DC:	AC
Voltage Frequency:	60 Hz
Number of Phases:	1
Current:	0.3 Amp
Physical Description	
EUT Arrangement:	Tabletop
System with Multiple Chassis:	Nc
Size (HxWxD) inches:	9 x 9 x 4 inches
Weight (lbs):	0.5
Highest Internal Frequency (MHz):	2500
Other Info	
EUT Software (internal to EUT):	Functional Firmware v2
Support Software (used by support PC to exercise EUT):	NA
Firmware:	Functional Firmware v2
Transmitter Parameters	
Description of your unit:	Multi-radio, multi-protocol wireless device.
Modulation Type:	Cellular, BLE, 902-928 MHz ISM
Number of Channels:	
Frequency range (MHz):	Cell: FDD LTE frequency bands of B1/B2/B3/B4/B5/B7/B8/B12/B13/B18 /B19/B20/B25/B26/B28, TDD LTE bands of B38/B39/B40/B41, WCDMA bands of B1/B2/B4/B5/B6/B8/B19 and quad-band GSM/EDGE.

	BLE: 2.4 to 2.5 GHz ISM: 902 to 928 MHz
Antenna Type:	Cell: External ISM: External BLE: External
Antenna Gain (db):	Cell low band: 2.7 dBi (peak) Cell high band: 2.8 dBi (peak) ISM: 2.7 dBi (peak) BLE: 1.5 dBi (peak)
PMN:	GBP-2002
HVIN:	GBP-2002
FVIN:	Functional FW v2
HMN:	GBP-2002
Data Rates:	Variable, Network service dependent
Expected Power Level:	Cell: 23 dBm ISM: 23 dBm BLE: 3 dBm
Number of Antenna:	4
Number of Intentional Transmitters:	3
Number of	3

EUT List

Ref.ID	Slot#	Name/Description	Model Number	Part Number	Serial Number	Rev. #
EU01	1	DUT1	GBP-2002	--	--	--

*There is no port and cabling information for the EUT.
*No support equipment list is required for testing.

2.4 Modifications to the EUT

No modifications were made to the EUT.

2.5 Modifications to the Standard

No modifications were made to the Test Standard.

2.6 Disposition of EUT

The test sample including all support equipment (if any), submitted to the Electromagnetic Compatibility Lab for testing was returned to Trackonomy Systems upon completion of testing.

3.0 Electromagnetic Compatibility Emission Criteria

3.1 Limits for Conducted Disturbance at Mains Terminals

Test Method: ANSI 63.4:2014

Sample Calculation:

$$R_f - S = M$$

where:

R_f = Receiver Reading in dBuV
S = Specification Limit in dBuV
M = Margin to Specification in +/- dB

Sample formula for calculating the Corrected Data for the Conducted Emissions Measurements:

Line	Freq (MHz)	Uncorrected QP** Amplitude (dBµV)	LISN IL (dB)	CBL (dB)	Corrected QP** Amplitude (dBµV)	QP** Limit (dBµV)	Delta (dB)	Results
XYZ	0.18	42.65	10	0.58	53.23	79	-25.77	Pass

*Corrected QP** Amplitude (dBµV) = Uncorrected Amplitude (dBµV) +LISN IL (dB) + CBL (dB) =42.65+10+0.58=53.23*
*** Same Calculation applies to Corrected Avg. amplitude as well.*

Test Requirement(s): The following standards specified below are covered in the scope of this section of the test report:

- FCC Part 15 Subpart B
- Innovation, Science, and Economic Development (ISED) Canada ICES-003 Issue 6

The EUT shall meet the Class B limits shown in the table below.

Frequency Range (MHz)	Class A Limits(dBµV)		Class B Limits (dBµV)	
	Quasi-Peak	Average	Quasi- Peak	Average
0.15 - 0.5	79	66	66 to 56	56 to 46
0.5 - 5	73	60	56	46
5 - 30	73	60	60	50
Note 1 – The lower limit shall apply at the transition frequencies. Note 2 – The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.				

Conducted Emissions - Limits

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane and 40 cm away from the vertical reference ground plane . The method of testing, test conditions, and test procedures of ANSI C63.4-2014 were used. The EUT was powered through a 50Ω/50µH LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate. Any measured frequency that exhibits a margin of compliance that is less than 3 dB below the specification limit is marked. MET recommends that every emission measured, has at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process. Photographs of test setup are presented below.

Test Software Used: PMM Release Suite Rev 2.04 and Jamila CE Rev 5.3 was used to perform this test.

Test Results:

Test Standard:	FCC Part 15 Subpart B Innovation, Science, and Economic Development (ISED) Canada ICES-003 Issue 6 Class B
Test Name	Conducted Emissions
Test Dates:	07/02/2021
Laboratory	Eurofins Electrical and Electronic Testing NA, Inc.
Test Engineer:	Camilo Obana
Test Results:	Compliant

Test Summary

Frequency Range	Specification	Measurement (MHz)	Margin (dBµV)	Class	Compliance
0.15 – 30 MHz (120 VAC, 60 Hz)	FCC Part 15 Subpart B (per-ANSI C63.4: 2014), ICES-003 Issue 7, October 2020	0.185	-20.863	B	**Pass**

Test Data

Freq (MHz)	QP Amplitude (dBµV)	QP Limit (dBµV)	Delta (dB)	Results	Average Amplitude (dBµV)	Average Limit (dBµV)	Delta (dB)	Results
0.155	49.63	65.728	-16.098	Pass	30.7	55.728	-25.028	Pass
0.165	47.72	65.211	-17.491	Pass	25.04	55.211	-30.171	Pass
0.185	47.51	64.263	-16.753	Pass	33.4	54.263	-20.863	Pass
0.21	41.98	63.213	-21.233	Pass	19.47	53.213	-33.743	Pass
0.225	41.77	62.641	-20.871	Pass	25.01	52.641	-27.631	Pass
0.235	40.23	62.281	-22.051	Pass	22.92	52.281	-29.361	Pass
Note(s): * - At this frequency, the measured conducted emission exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, has at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.								

Table 1. Conducted Emissions (120 VAC, 60 Hz), Phase Test Results

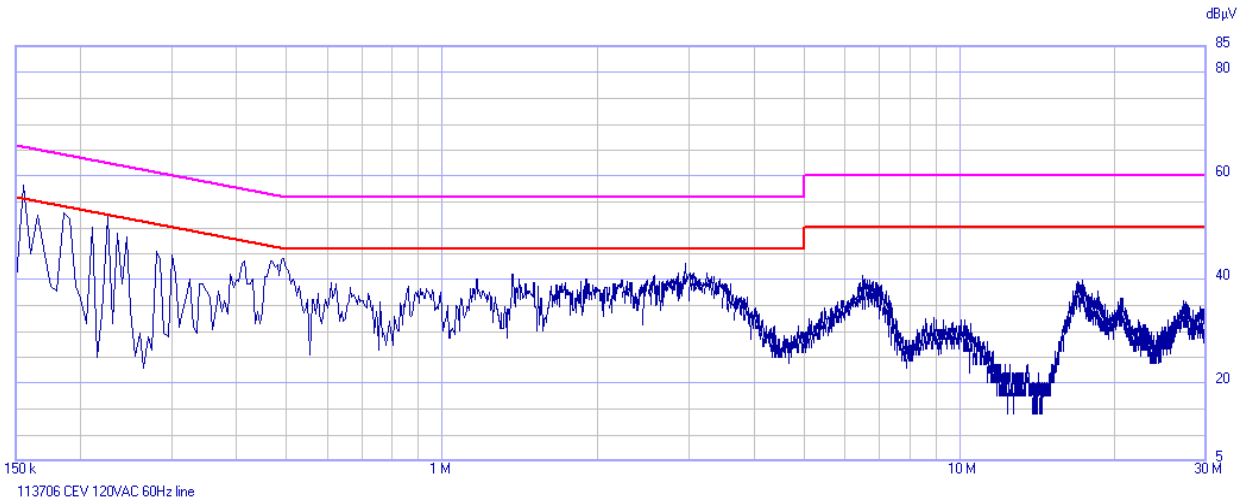

Figure 1. Conducted Emissions (120 VAC, 60 Hz), Phase Plot

Freq (MHz)	QP Amplitude (dBµV)	QP Limit (dBµV)	Delta (dB)	Results	Average Amplitude (dBµV)	Average Limit (dBµV)	Delta (dB)	Results
0.155	49.41	65.728	-16.318	Pass	27.37	55.728	-28.358	Pass
0.165	46.21	65.211	-19.001	Pass	23.81	55.211	-31.401	Pass
0.18	48.12	64.49	-16.37	Pass	32.89	54.49	-21.6	Pass
0.215	41.36	63.018	-21.658	Pass	22.65	53.018	-30.368	Pass
0.235	40.47	62.281	-21.811	Pass	22.47	52.281	-29.811	Pass
0.155	49.41	65.728	-16.318	Pass	27.37	55.728	-28.358	Pass
Note(s): * - At this frequency, the measured conducted emission exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, has at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.								

Table 2. Conducted Emissions (120 VAC, 60 Hz), Neutral Test Results

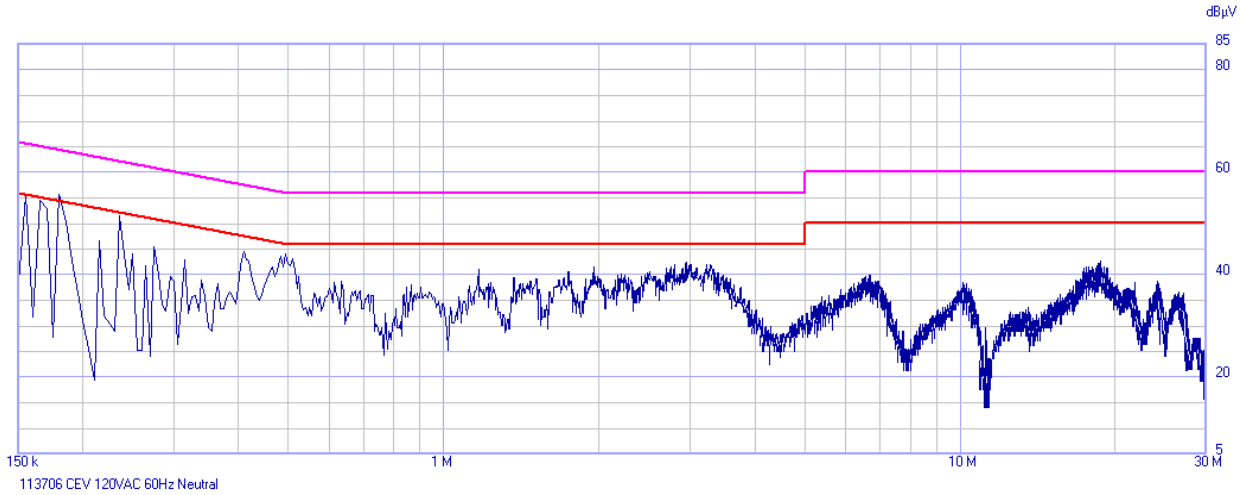

Figure 2. Conducted Emissions (120 VAC, 60 Hz), Neutral Plot

Figure 3. Conducted Emissions (AC), Test Setup

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Test Name: CE Voltage – AC Power Port			**Test Date(s):** 07/02/2021		
Asset	**Equipment**	**Manufacturer**	**Model**	**Calibration Date**	**Calibration Due Date**
1S2805	Radio Communication Tester	Rohde & Schwarz	CMW500	01/14/2021	01/14/2022
1U0336	LISN	Com-Power	LI-215A	10/06/2020	10/06/2021
1S4764	EMI Receiver	Narda	PMM 9010	04/01/2021	04/01/2022
1S2743	Spikeguard	FCC	FCC-450B-2.4-N	Functional Check	
Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.					

Table 3. Conducted Emissions, Test Equipment

3.3 Radiated Emissions: Limits of Electromagnetic Radiation Disturbance

Test Method: ANSI C63.4-2014

Test Requirement(s): The following standards specified below are covered in the scope of this section of the test report:

- FCC Part 15 Subpart B
- Innovation, Science, and Economic Development (ISED) Canada ICES-003 Issue 6

§15.109 (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field Strength (dBµV/m)
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Sample Calculation for Distance Correction factor (DCF) measurement:

$F_d = 20*LOG_{10}(D_m/D_s)$

where:

F_d = Distance Factor in dB
D_m = Measurement Distance in meters
D_s = Specification Distance in meters

Sample formula for calculating the Corrected Data for the Radiated Emissions Measurements:

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBµV)	ACF (dB/m) (+)	Pre Amp Gain (dB)(-)	CBL (dB) (+)	DCF (dB) (+)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
249.99	V	359.9	240.7	55.46	11.4	28.335	0	0	***38.505***	47	-8.495

Corrected Amplitude (dBµV/m) = Uncorrected Amplitude (dBµV) +ACF (dB/m) - Preamp Gain (dB) + CBL (dB) +DCF (dB)
= 55.46 + 11.4 - 28.355 + 0 + 0 = ***38.505***

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing, test conditions, and test procedures of ANSI C63.4-2014 were used. Any measured frequency that exhibits a margin of compliance that is less than 3 dB below the specification limit is marked. MET recommends that every emission measured, has at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

For emissions between 30 MHz and 1000 MHz, a biconilog antenna was located 3m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz resolution bandwidth.

For emission between 1 GHz and 18 GHz, a double ridged guide horn was located 3 m from the EUT on an adjustable mast. A pre-scan was performed and used to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied depending on the geometry of the EUT. In order to ensure maximized emissions, the horn antenna was positioned both vertically and laterally. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a peak and average detector with a 1 MHz resolution bandwidth.

For emission between 18 GHz and 40 GHz, a high frequency standard gain horn antenna was used. The horn antenna was located in the far field, however, it was close enough to the EUT so that the resulting measurement had a noise floor lower than the applicable limit. A pre-scan was performed and used to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied depending on the geometry of the EUT. In order to ensure maximized emissions, the horn antenna was positioned in both vertical and horizontal positions. In the event that the mixer cable length does not allow for total EUT coverage by the horn, the entire measurement system shall be raised and lowered as necessary. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using an average detector with a 1 MHz resolution bandwidth.

Test Software Used: Jamila RE Rev 4.0 was used to perform this test.

Test Results:

Test Standard:	FCC Part 15 Subpart B Innovation, Science, and Economic Development (ISED) Canada ICES-003 Issue 6 Class B
Test Name	Radiated Emissions
Test Dates:	07/01/2021
Laboratory	Eurofins Electrical and Electronic Testing NA, Inc.
Test Engineer:	Camilo Obana
Test Results:	Compliant

Test Summary

Frequency Range	Specification	Measurement (MHz)	Margin (dBµV)	Class	Compliance
30 MHz – 1 GHz	FCC Part 15 Subpart B (per ANSI C63.4: 2014), ICES-003 Issue 7, October 2020	309.6	0.313	B	**Compliant**
1 - 18 GHz	FCC Part 15 Subpart B (per ANSI C63.4: 2014), ICES-003 Issue 7, October 2020	5295	42.793		**Compliant**

Test Data

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
158.76	V	0	118.23	20.1	15.224	0	2.447	0	37.771	43.5	-5.729
306.44	V	293	175.82	20.82	17.8	0	3.246	0	41.866	46	-4.134
482.36	V	217	115.11	16.79	21.5	0	4.103	0	42.393	46	-3.607
212.8	H	68	144.41	19.51	14.3	0	2.755	0	36.565	43.5	-6.935
309.6	H	26	100	24.1	18.3	0	3.287	0	45.687	46	-0.313
480	H	265	100	16.5	22.1	0	4.08	0	42.68	46	-3.32

Note(s): * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

Table 4. Radiated Emissions (30 MHz – 1 GHz), Test Results

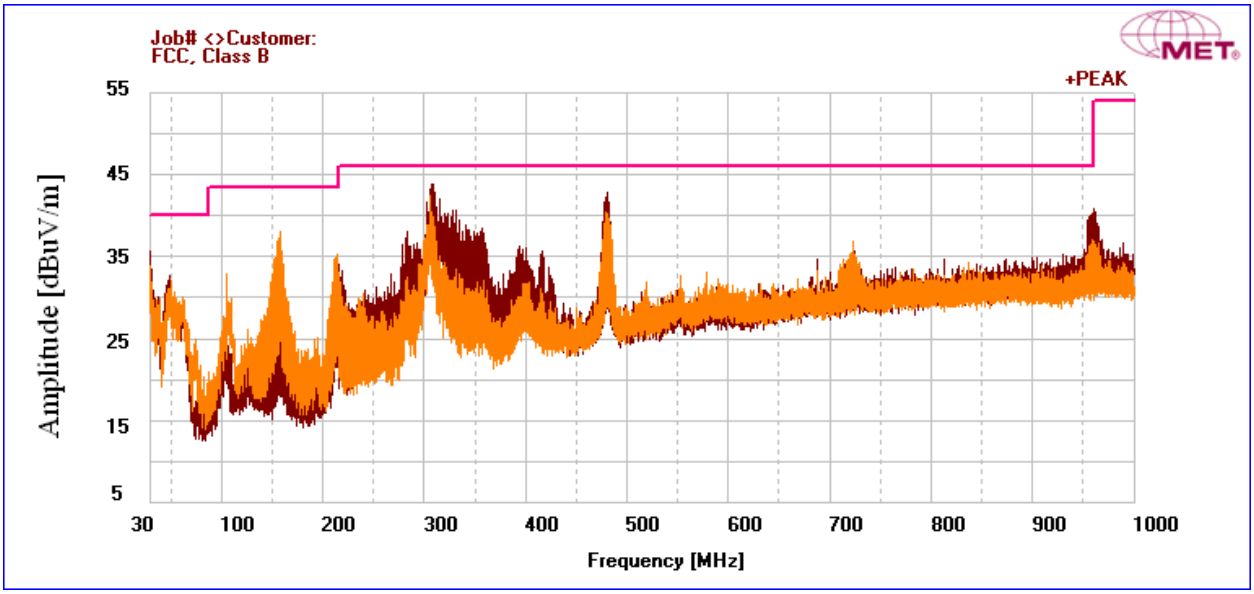

Figure 4. Radiated Emissions (30 MHz – 1 GHz), Plot

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
5295	V	0	100	12.76	34.36	36.026	0	0	11.094	54	-42.906
5295	H	0	100	12.75	34.463	36.026	0	0	11.187	54	-42.813

Note(s): * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.

The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: 20log (3 m/10 m) as expressed in the 'Distance Correction' column.

Table 5. Radiated Emissions (1 – 18 GHz), Test Results

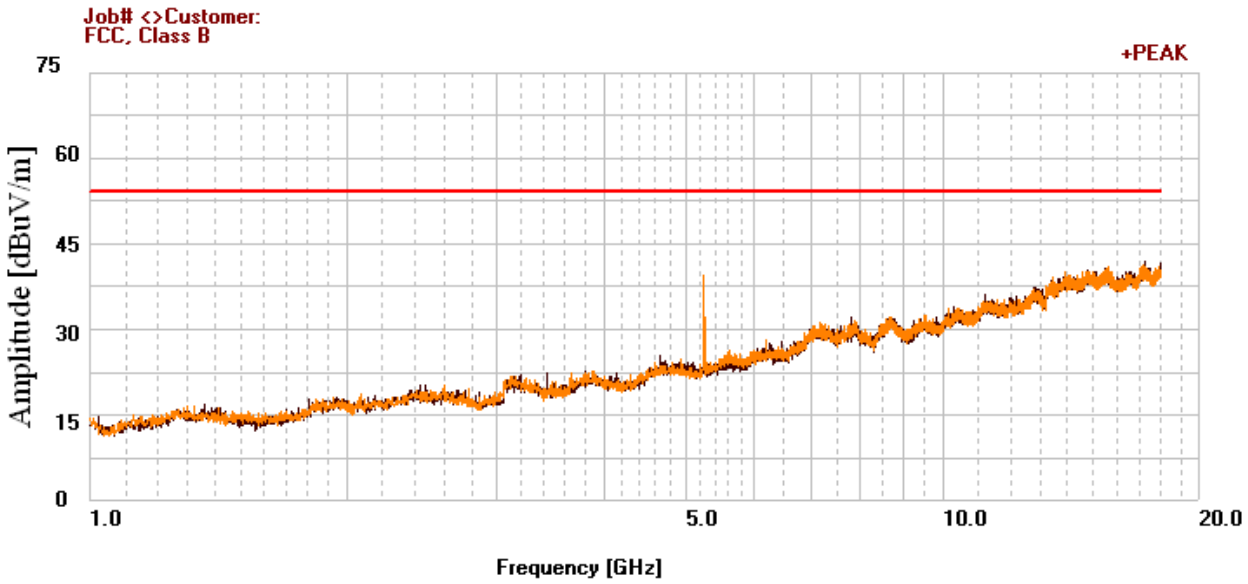

Figure 5. Radiated Emissions (1 – 18 GHz), Plot

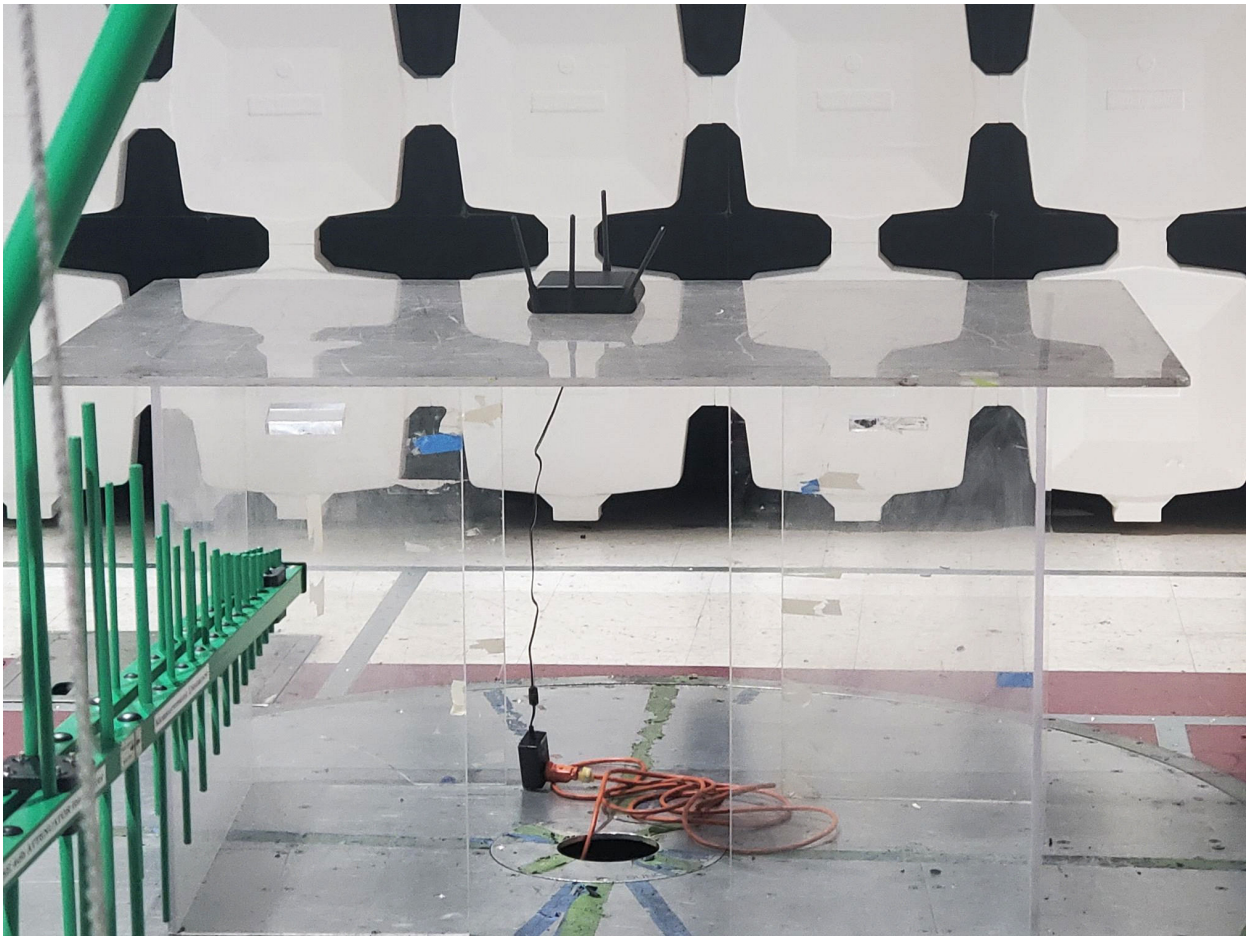

Figure 6. Radiated Emissions (30 MHz – 1 GHz), Test Setup

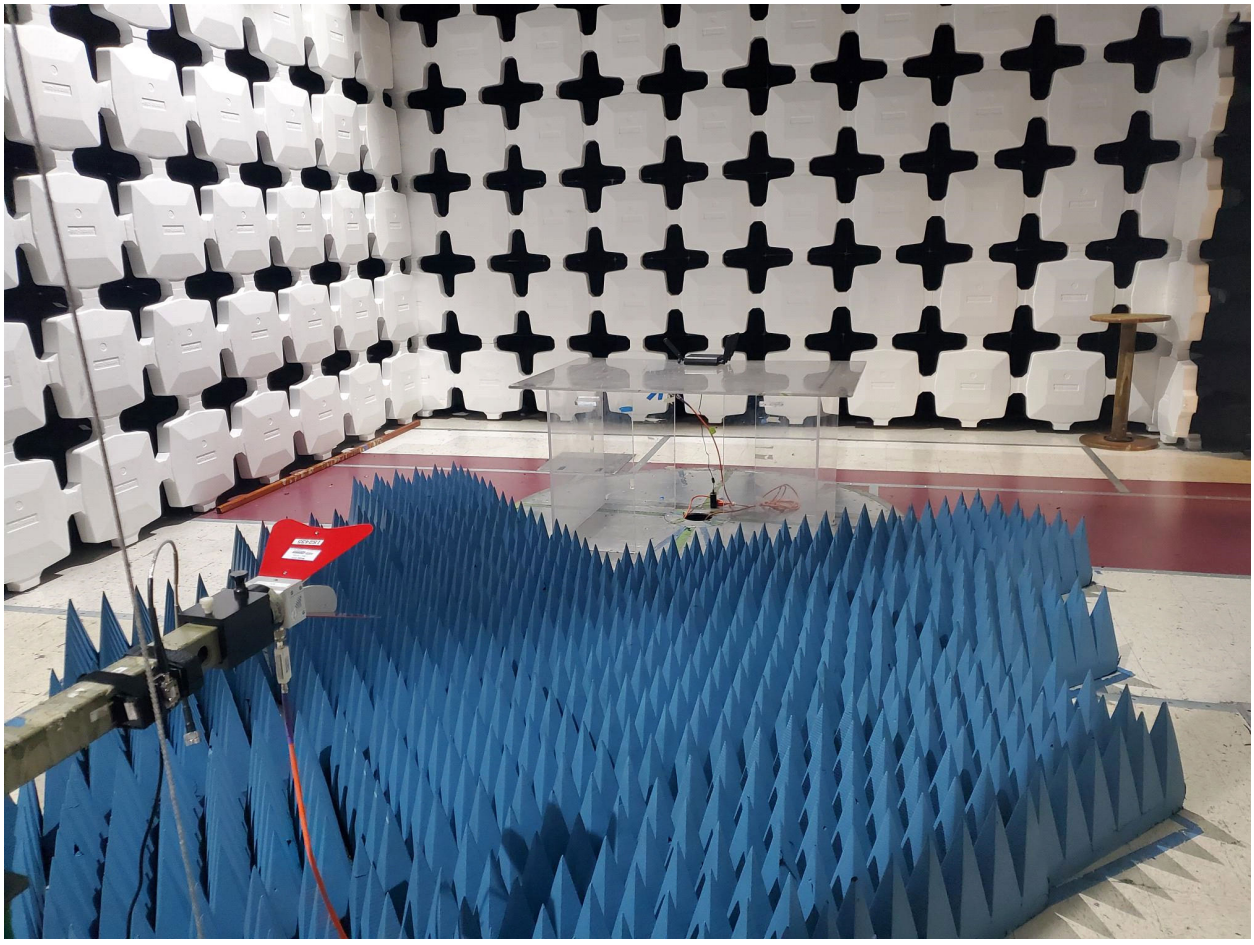

Figure 7. Radiated Emissions (1 - 6 GHz), Test Setup

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

Test Name: RE			**Test Date(s):** 07/01/2021		
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2435	Horn Antenna (Medium)	ETS-Lindgren	3117	03/09/2021	03/09/2023
1U3962	Spectrum Analyzer (PSA)	Keysight/Agilent	E4448A	07/31/2020	07/31/2021
1S2600	Bilog Antenna	Teseq	CBL6112D	05/11/2021	05/11/2023
1S3928	EMI Tester Receiver	Rohde & Schwarz	ESR26	03/04/2020	03/04/2021
1S2399	Turntable Controller	SUNOL SCIENCE	SC99V	Not Required	
1S4064	Digital Barometer	Control Co	6530	09/15/2020	09/15/2022
1S2805	Radio Communication Tester	Rohde & Schwarz	CMW500	01/14/2021	01/14/2022
Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.					

Table 6. Radiated Emissions, Test Equipment

END OF REPORT

