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TEST REPORT

Report Number: 104901690MPK-001
Project Number: G104901690
Report Issue Date: January 13, 2022
Revision Issue Date: February 18, 2022

Testing performed on the
RFID Radio Module
Model Number: 0210000745

FCC ID: 2AUAN-12XXSM
IC: 25359-12XXSM

to

FCC Part 15 Subpart C (15.225)
ISED RSS-210 Issue 10

for

Haws Corporation

Test Performed by:	**Test Authorized by:**
Intertek 1365 Adams Court Menlo Park, CA 94025 USA	Haws Corporation 1455 Kleppe Lane Sparks, NV USA

Prepared by: _____ **Date:** January 13, 2022
Gerardo Narvaez

Reviewed by: _____ **Date:** January 13, 2022
Krishna Vemuri

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Report No. 104901690MPK-001	
Equipment Under Test:	RFID Radio Module
Model Number:	0210000745
Applicant:	Haws Corporation
Contact:	Sam Hong
Address:	1455 Kleppe Lane Sparks NV, 89431
Country:	USA
Tel. Number:	775-772-9235
Email:	samh@hawsco.com
Applicable Regulation:	FCC Part 15 Subpart C (15.225) ISED RSS-210 Issue 10
Date of Test:	12/15/2021 – 02/17/2022

We attest to the accuracy of this report:

Gerardo Narvaez
Project Engineer

Krishna K Vemuri
EMC Manager

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1.0 Summary of Tests

TEST	REFERENCE FCC 15.225	REFERENCE RSS-210	RESULTS
Field Strength of Fundamental	15.225(a)	B.6	Complies
Radiated Emissions Outside the band	15.225(b), 15.225(c), 15.225(d), 15.209	B.6	Complies
Frequency Tolerance of the Carrier	15.225(e)	B.6	Complies
Line Conducted Emissions	15.207	RSS-GEN	Complies
Occupied Bandwidth	15.215	RSS-GEN	Complies
Antenna requirement	15.203	RSS-GEN	Complies[1]

[1] The EUT utilizes an internal Antenna.

EUT receive date: 12/15/2021
EUT receive condition: The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.
Test start date: 12/15/2021
Test completion date: 02/17/2022

2.0 General Description

2.1 Product Description

Haws Corporation supplied the following description of the EUT:

The RFID radio module is designed to be used in Haws Corporation water coolers as part of its water filter monitoring function.

For more information, refer to the following product specification, declared by the manufacturer.

Overview of the EUT

Applicant name & address	Haws Corporation 1455 Kleppe Lane Sparks NV, 89431
Contact info / Email	samh@hawsco.com
Model	0210000745
FCC Identifier	2AUAN-12XXSM
IC Identifier	25359-12XXSM
Operating Frequency	13.56 MHz
Number of Channels	1
Type of Modulation	ASK Modulation
Antenna Type	Internal Antenna

2.2 Related Submittal(s) Grants

None

2.3 Test Methodology

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4: 2014. Radiated tests were performed at an antenna to EUT distance of 10 meters, unless stated otherwise in this test report. All other measurements were made in accordance with the procedures in part 2 of CFR 47 7, ANSI C63.10: 2013 & RSS-GEN Issue 5.

2.4 Test Facility

The radiated emission test site and conducted measurement facility used to collect the data is 10m semi-anechoic chamber located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC and Industry Canada (Site # 2042L-1).

2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account the measurement uncertainty.

Estimated Measurement Uncertainty

Measurement	**Expanded Uncertainty (k=2)**		
	0.15 MHz – 1 GHz	**1 GHz – 2.5 GHz**	**> 2.5 GHz**
RF Power and Power Density – antenna conducted	-	0.7 dB	-
Unwanted emissions - antenna conducted	1.1 dB	1.3 dB	1.9 dB
Bandwidth – antenna conducted	-	30 Hz	-

Measurement	**Expanded Uncertainty (k=2)**		
	0.15 MHz – 30MHz	**30 MHz – 1 GHz**	**1 GHz – 18 GHz**
Radiated emissions	-	4.7	5.1 dB
AC mains conducted emissions	2.1 dB	-	-

3.0 System Test Configuration

3.1 Description of Equipment Under Test and Support Equipment

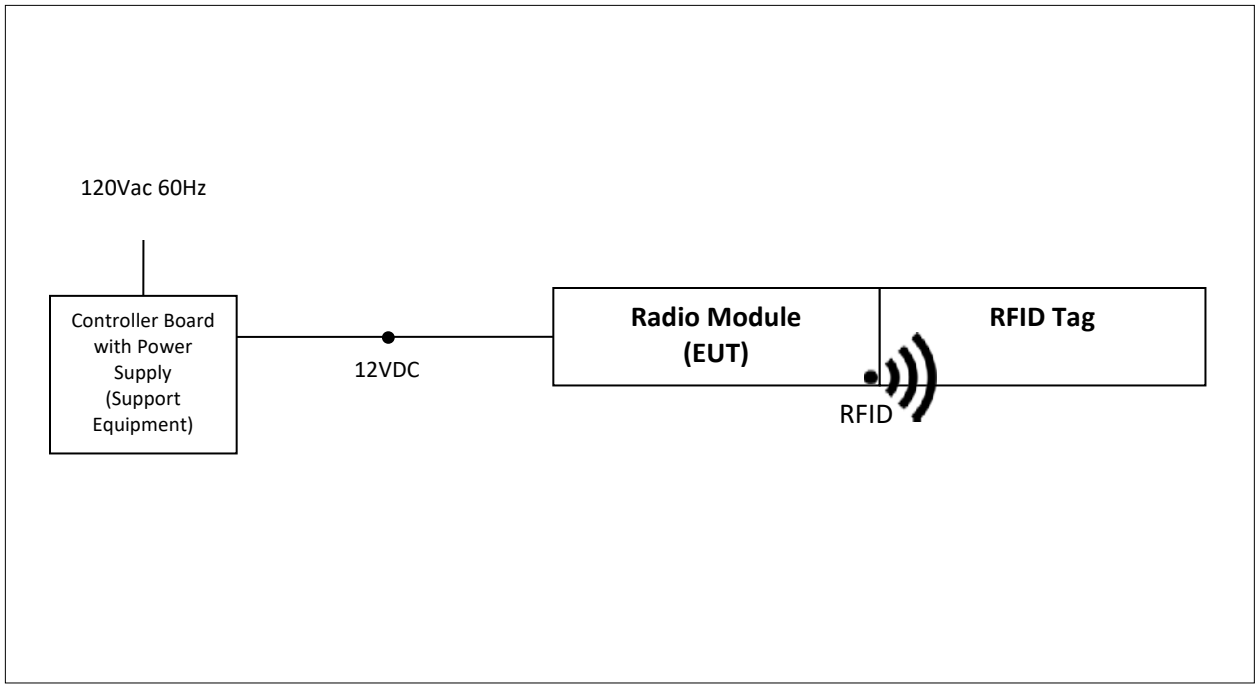
Support Equipment		
Description	**Manufacturer**	**Model**
Controller Board with Power Supply	Haws Corporation	N/A

Equipment Under Test			
Description	**Manufacturer**	**Model Number**	**Serial Number**
Radio Module	Haws Corporation	0210000745	N/A

Equipment Under Test Power Configuration			
Rated Voltage	**Rated Current**	**Rated Frequency**	**Number of Phases**
RFID Radio Module (EUT)			
$12V_{DC}$	1A	-	-
Controller Board with Power Supply (Support Equipment)			
Input			
$120V_{AC}$	0.5A	50/60Hz	Single
Output			
$12V_{DC}$	1A	-	-

3.2 Block Diagram of Test Setup

The diagram shown below details the interconnection of the EUT and support equipment. For specific layout, refer to the test configuration photograph in the relevant section of this report.



S = Shielded **U** = Unshielded	**F** = With Ferrite **m** = Length in Meters

3.3 EUT Pictures

3.3 Justification

For radiated emission measurements the EUT is placed on a non-conductive table. The EUT was configured to continuously transmit. The highest clock frequency used is 48 MHz, so radiated emissions were performed up to 1 GHz.

3.4 Software Exercise Program

None

3.5 Mode of Operation during test

The EUT was set up to continuously transmitting at 13.56MHz by placing the RFID tag on the antenna.

3.6 Modifications required for Compliance

No modifications were made by the manufacturer to bring the EUT into compliance.

3.7 Additions, deviations and exclusions from standards

No additions, deviations or exclusion have been made from standard.

4.0 Measurement Results

4.1 Field Strength of Fundamental and Radiated Emissions Outside the Band

4.1.1 Requirements

FCC Rules 15.225

a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter (84 dBuV) at 30 meters.

b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

§15.209 Radiated emission limits; general requirements.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

4.1.2 Procedure

Radiated Measurements Below 30 MHz

During the test the EUT is rotated, and the measuring antenna angles are varied during the search for maximum signal level.

Radiated emissions are taken at ten meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Measurements for below 30 MHz were made at 10 meters. Data results below are corrected for distance back to 30 meters.

Radiated Measurements Above 30 MHz

During the test the EUT is rotated, and the measuring antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at ten meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Measurements for above 30 MHz were made at 10 meters.

Radiated emission measurements were performed from 9kHz to 1 GHz.
Analyzer resolution is:

200Hz or greater for 9kHz to 150kHz
9 kHz or greater for 150kHz to 30 MHz
120 kHz or greater for 30MHz to 1000 MHz
For those frequencies quasi-peak detector applies

Data includes of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follows:

FS = RA + AF + CF – AG – DCF

Where FS = Field Strength in dB (μV/m)

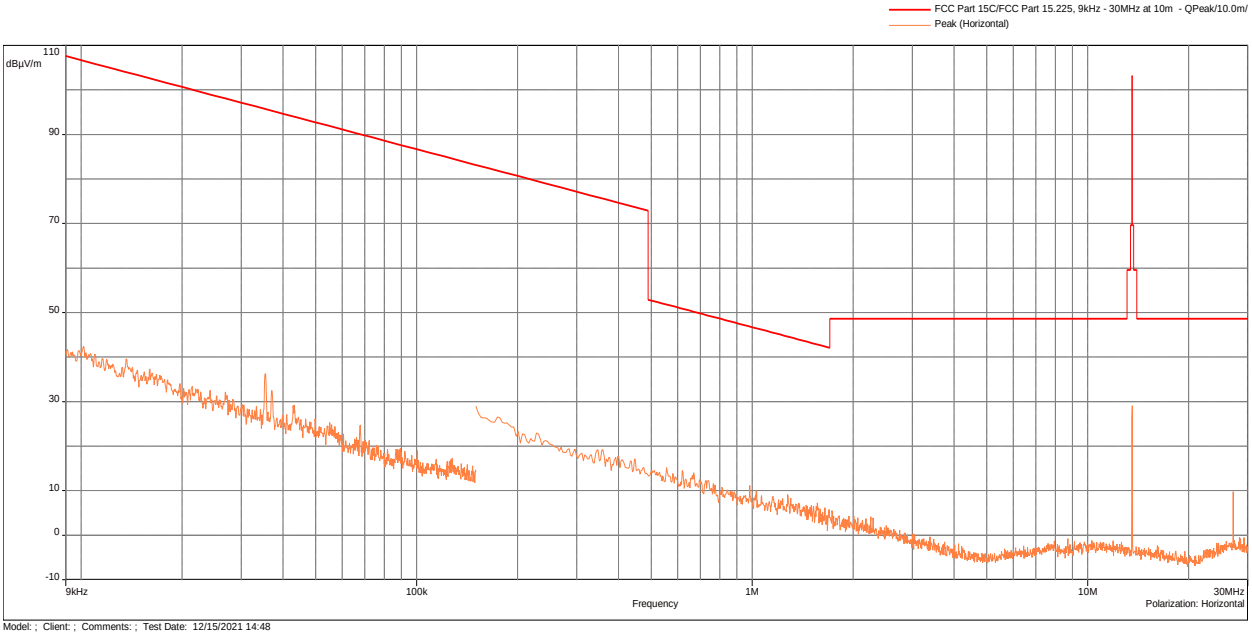
RA = Receiver Amplitude (including preamplifier) in dB (μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB (1/m)
AG = Amplifier Gain in dB
DCF = Distance Correction Factor

Note: FS was measured with loop antenna below 30MHz

4.1.3 Test Result 15.225 (a) (b) (c) (d) and 15.209

Test Result 15.225 (a)(b)(c) Radiated Spurious Emissions Mask
"EUT orientation X"

Receiving Antenna Coplanar Orientation



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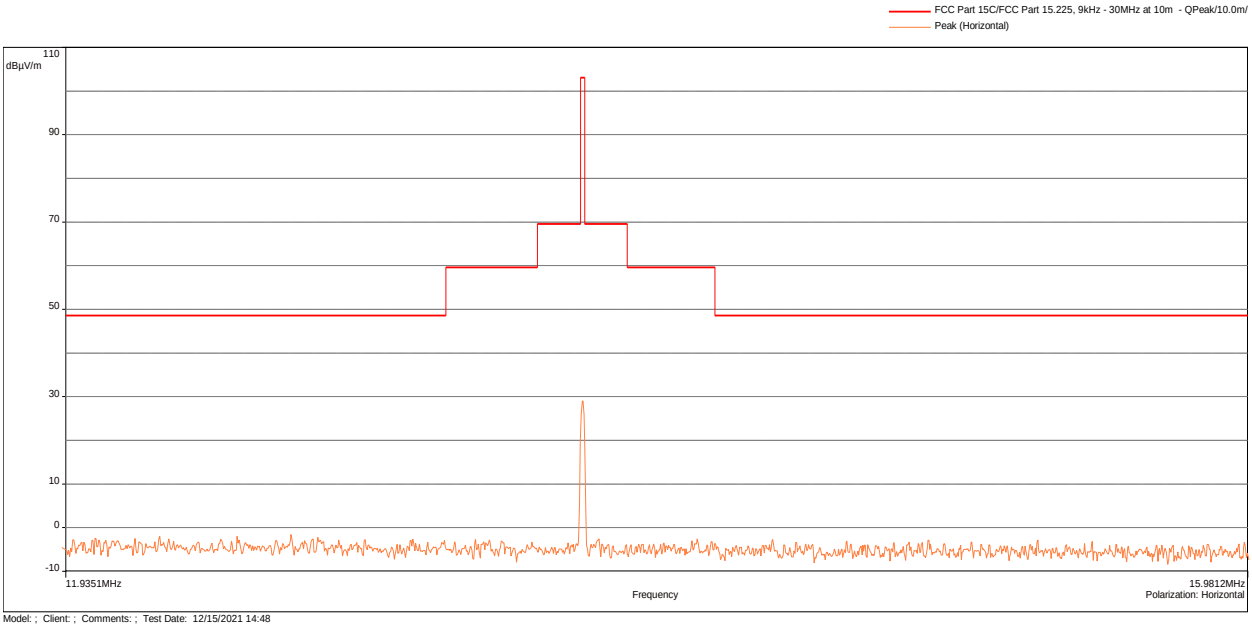

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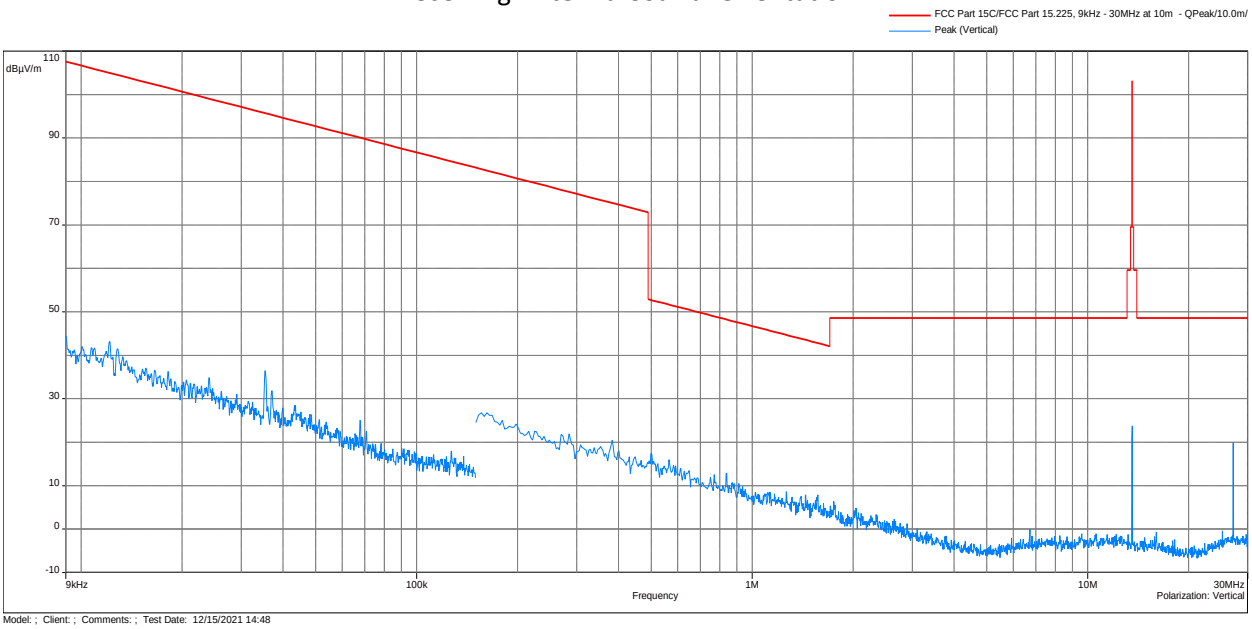
Receiving Antenna Coaxial Orientation



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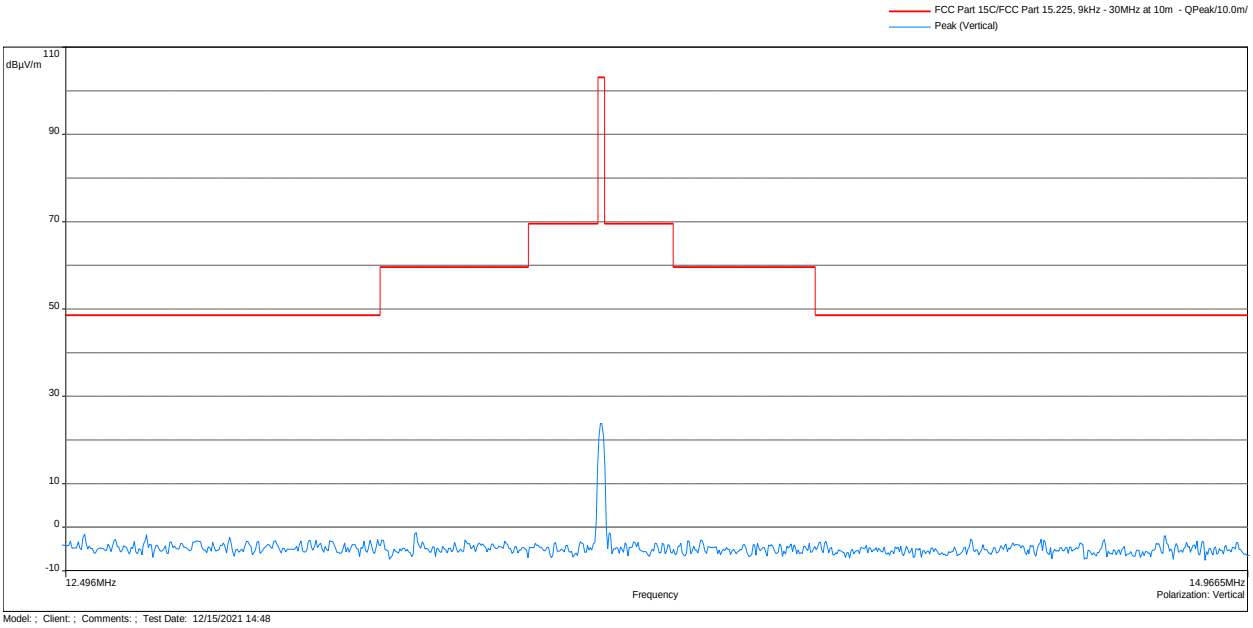

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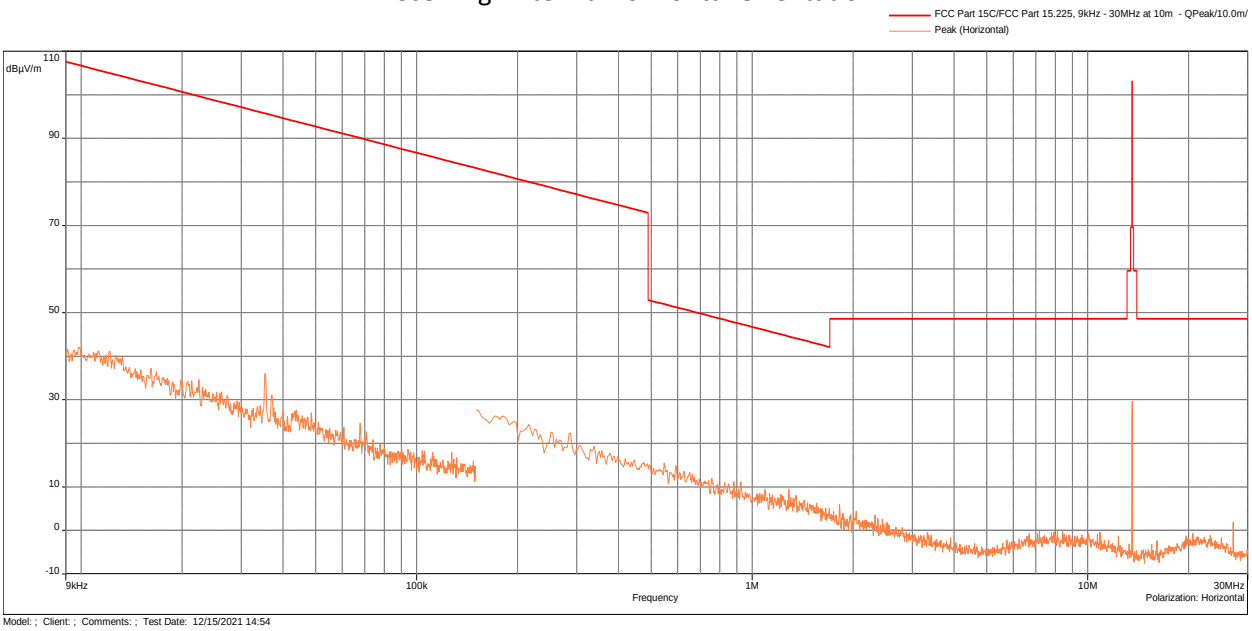
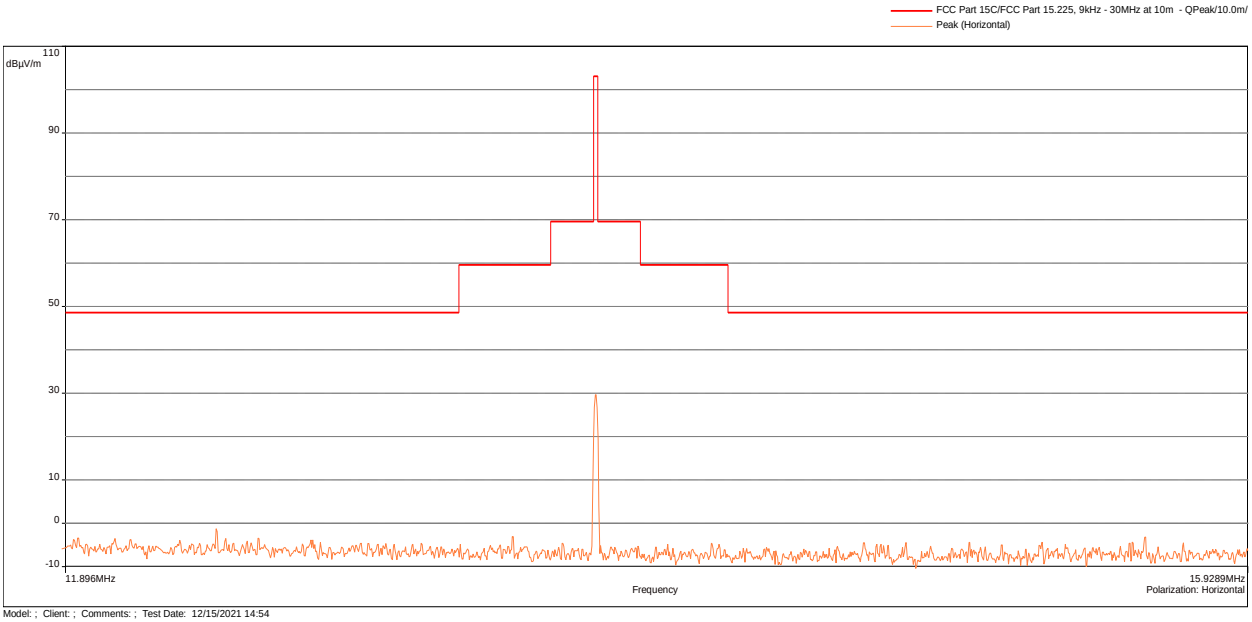
Receiving Antenna Horizontal Orientation



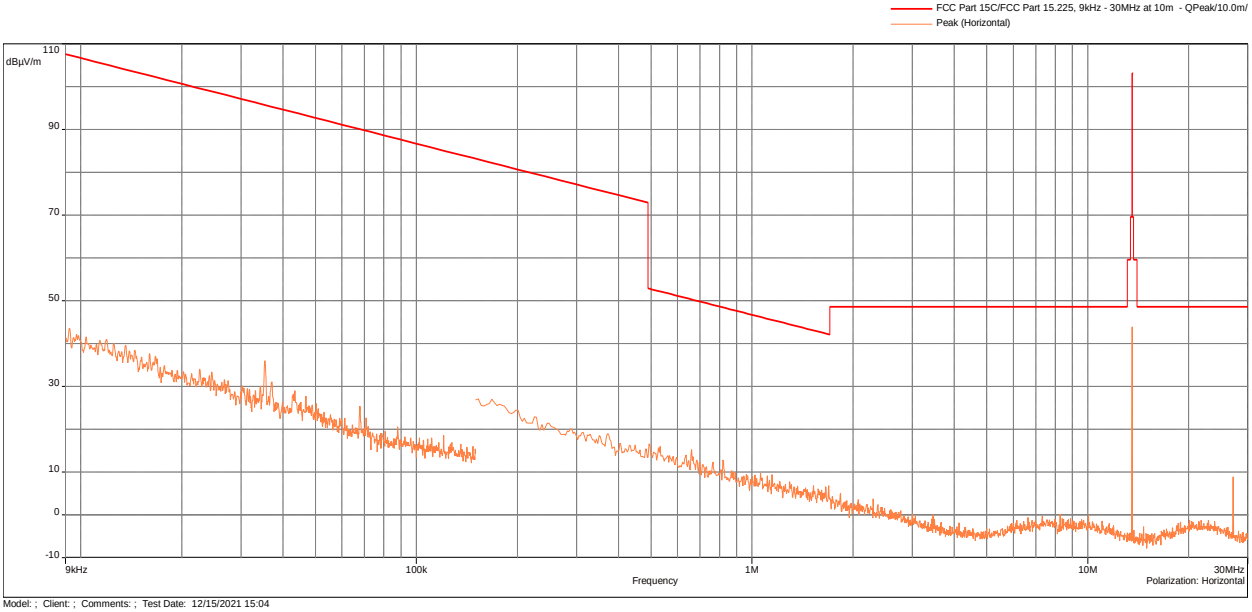


Frequency (MHz)	FS@10m dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	Comment	Correction dB
13.55862	28.96	103.1	-74.14	Coplanar	-17.82
13.56161	23.76	103.1	-79.34	Coaxial	-17.82
13.56161	29.68	103.1	-73.42	Horizontal	-17.82

Note: Correction = AF + CF - AG - Distance Correction Factor
Distance Correction Factor = $40*\log_{10}$(Limit Distance/Measured Distance)

Test Result 15.225 (a)(b)(c) Radiated Spurious Emissions Mask
"EUT orientation Y"

Receiving Antenna Coplanar Orientation



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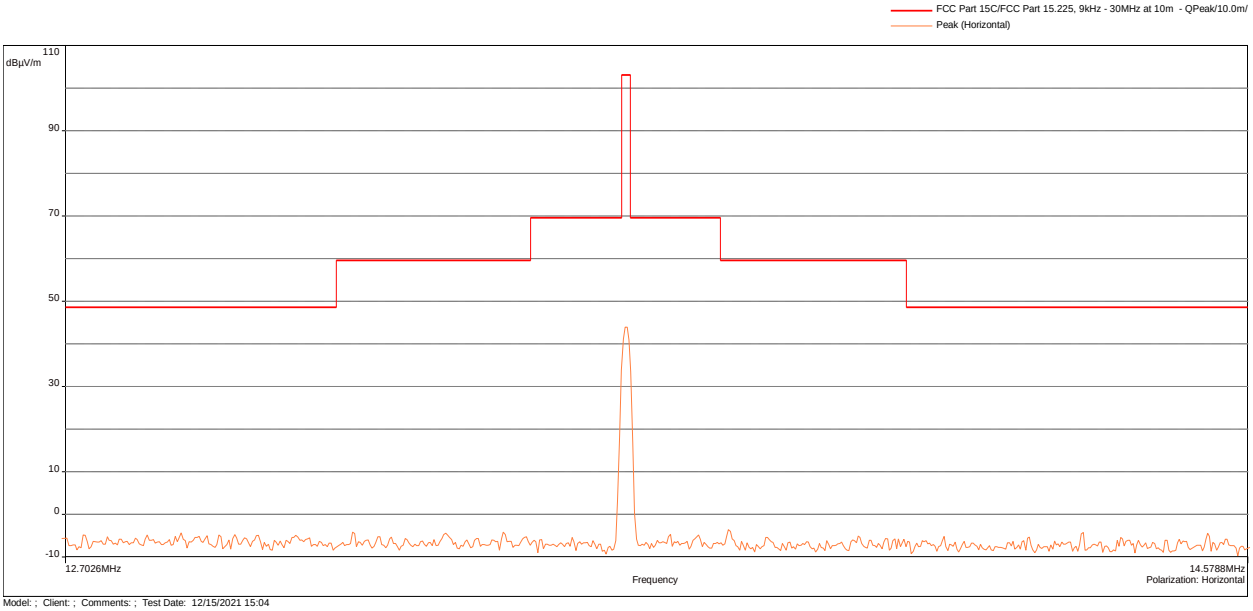

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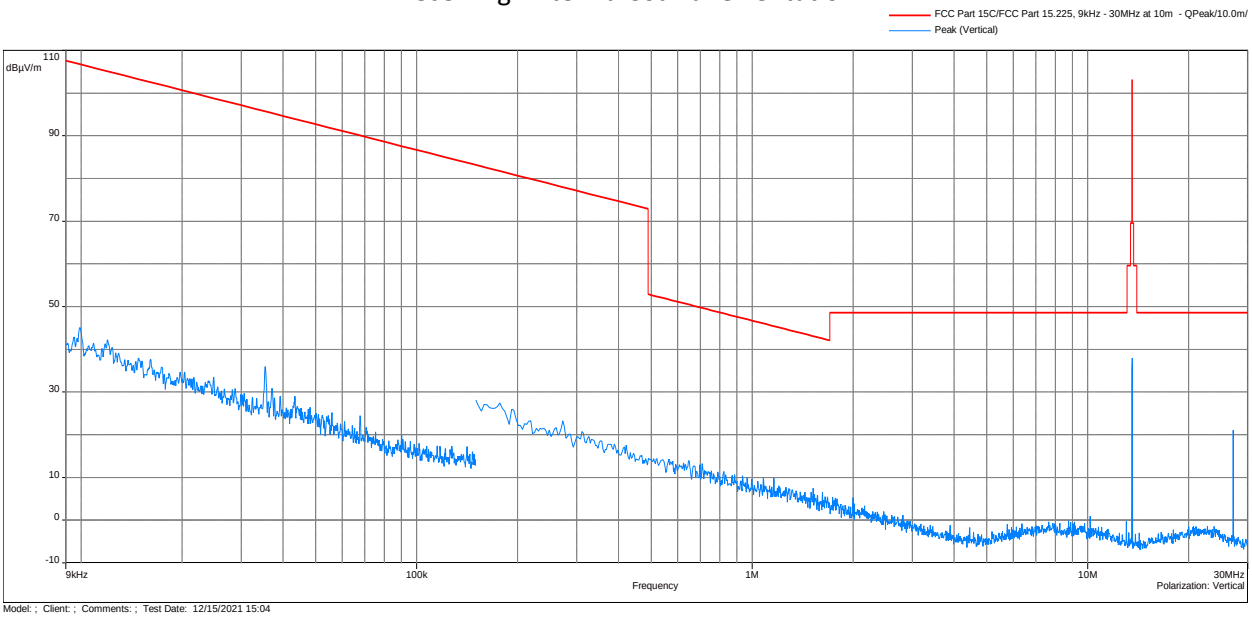
Receiving Antenna Coaxial Orientation



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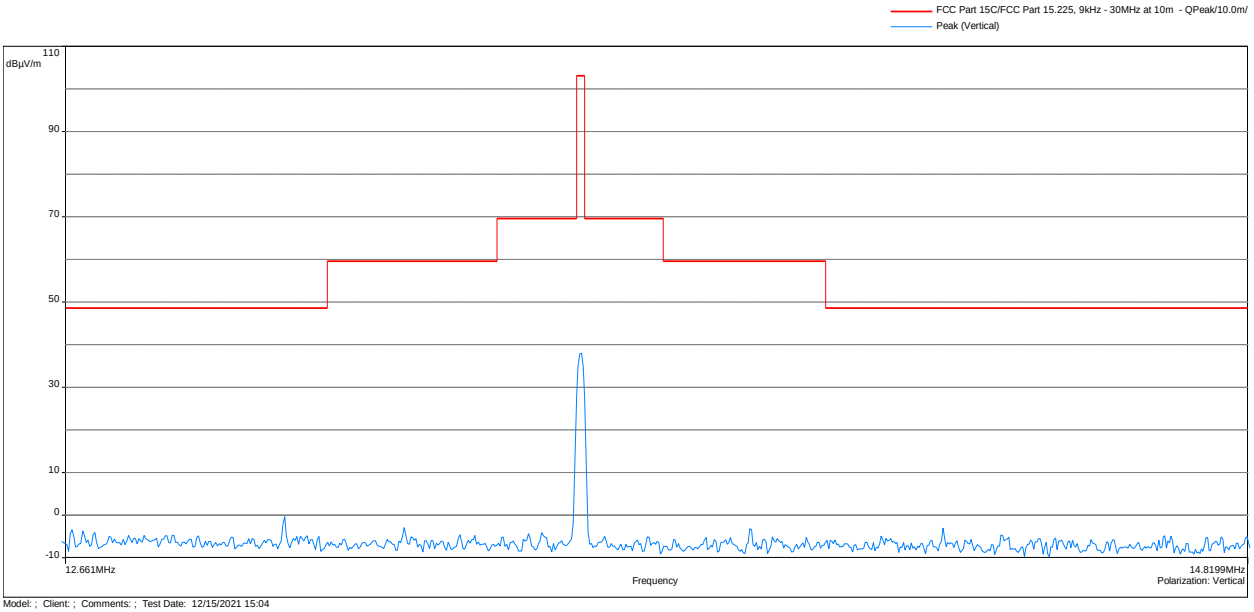

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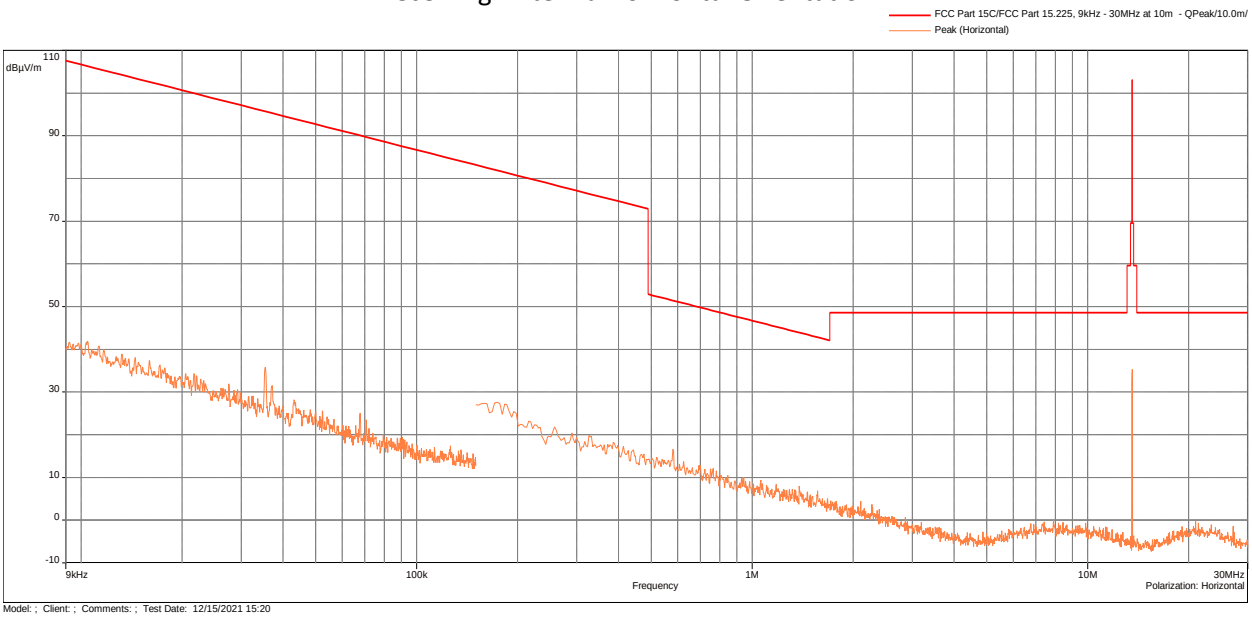
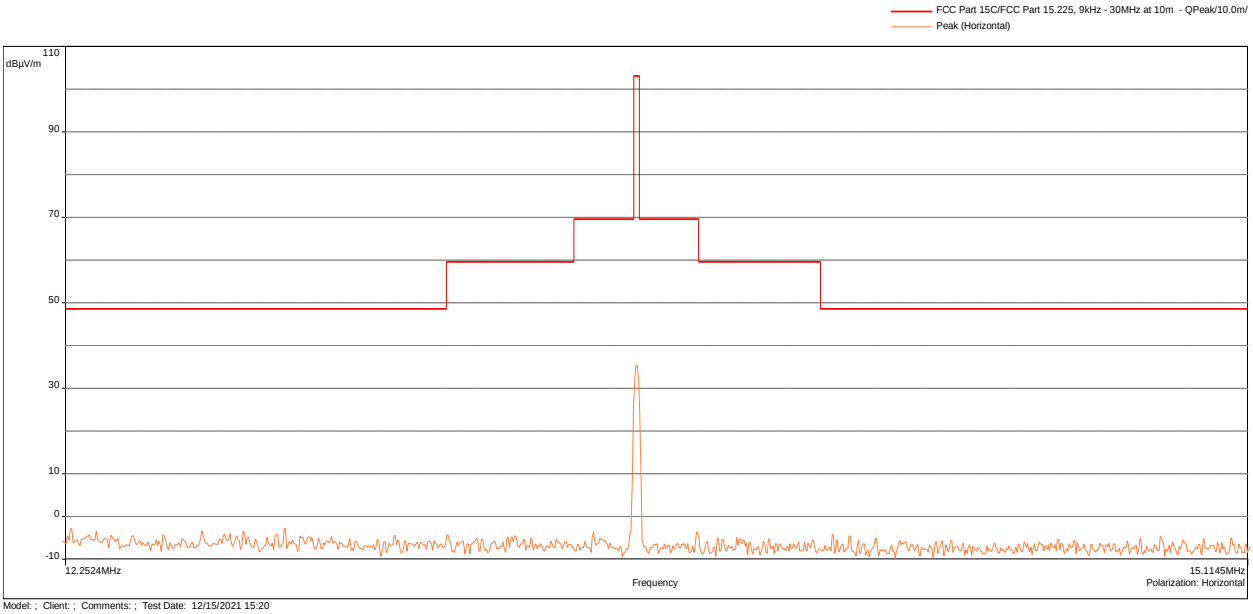
Receiving Antenna Horizontal Orientation





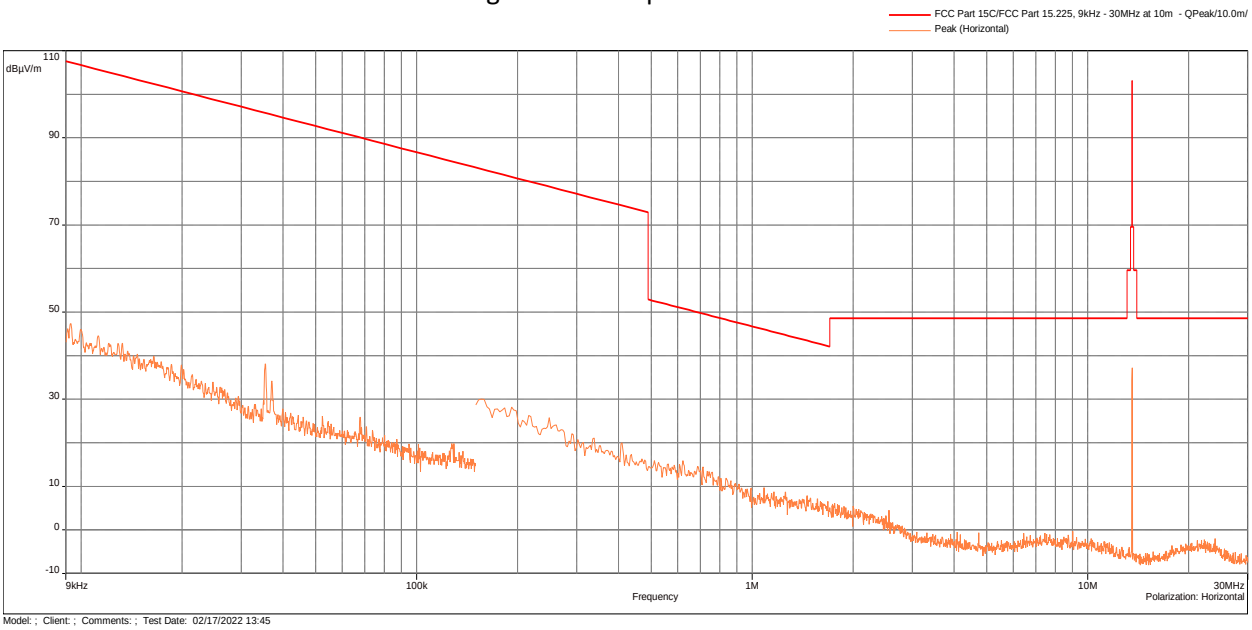
Frequency (MHz)	FS@10m dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	Comment	Correction dB
13.55862	43.95	103.1	-59.15	Coplanar	-17.82
13.56161	37.97	103.1	-65.13	Coaxial	-17.82
13.56161	35.24	103.1	-67.86	Horizontal	-17.82

Note: Correction = AF + CF - AG - Distance Correction Factor

Distance Correction Factor = $40*\log_{10}$(Limit Distance/Measured Distance)

Test Result 15.225 (a)(b)(c) Radiated Spurious Emissions Mask
"EUT orientation Z"

Receiving Antenna Coplanar Orientation



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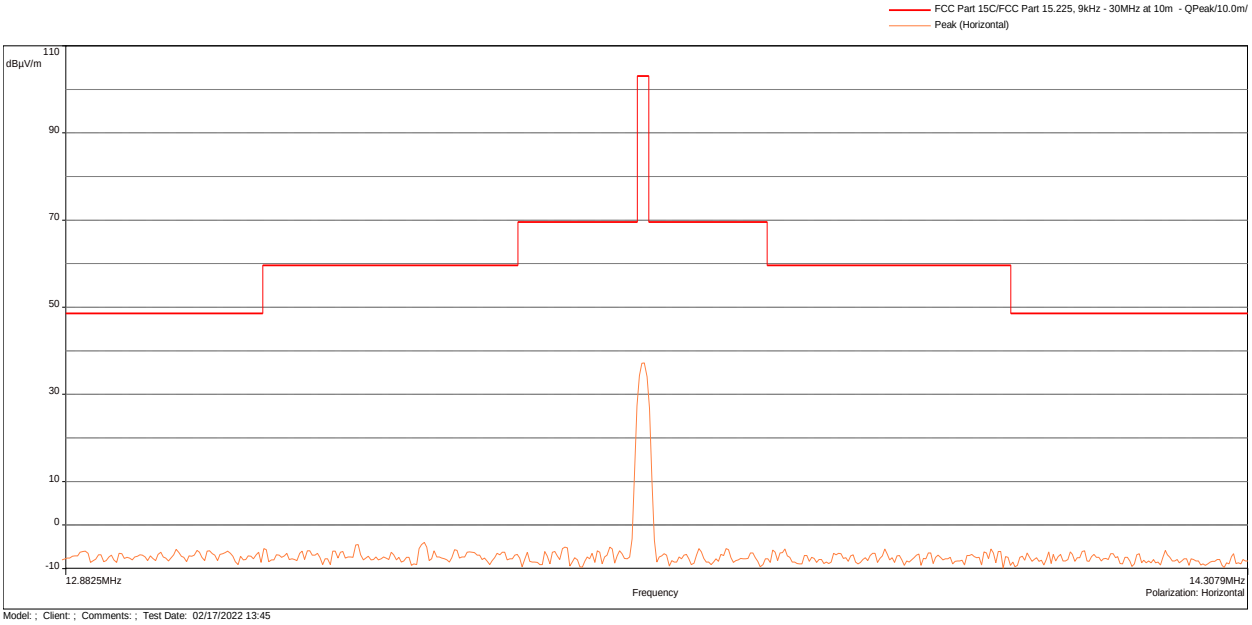

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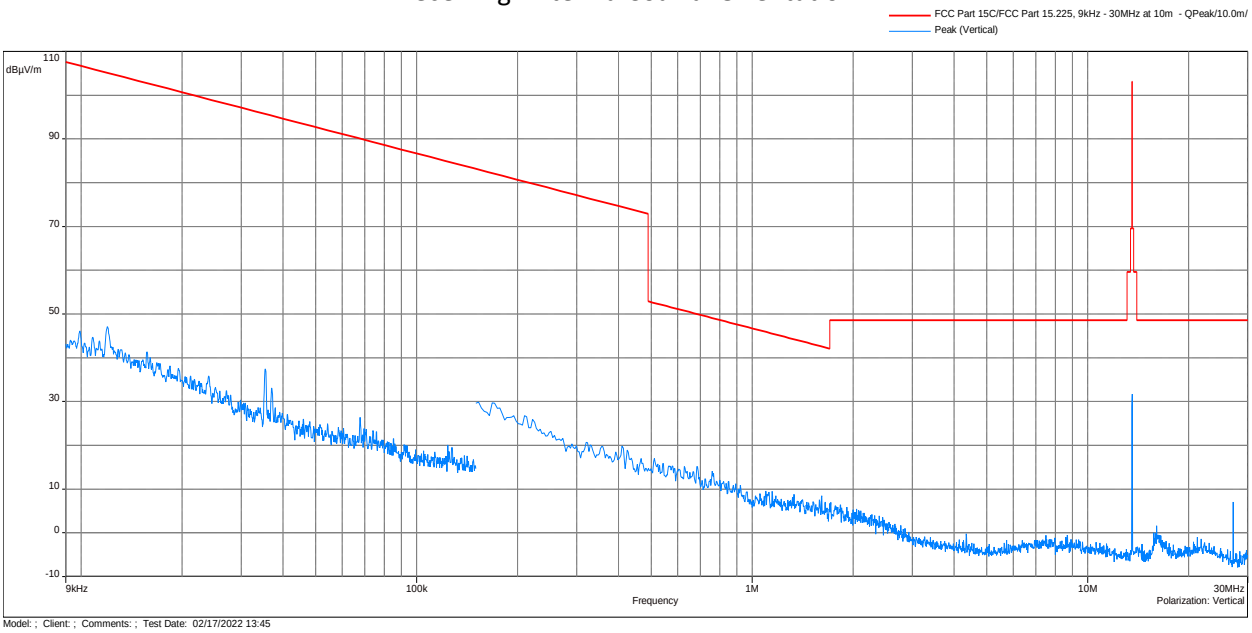
Receiving Antenna Coaxial Orientation



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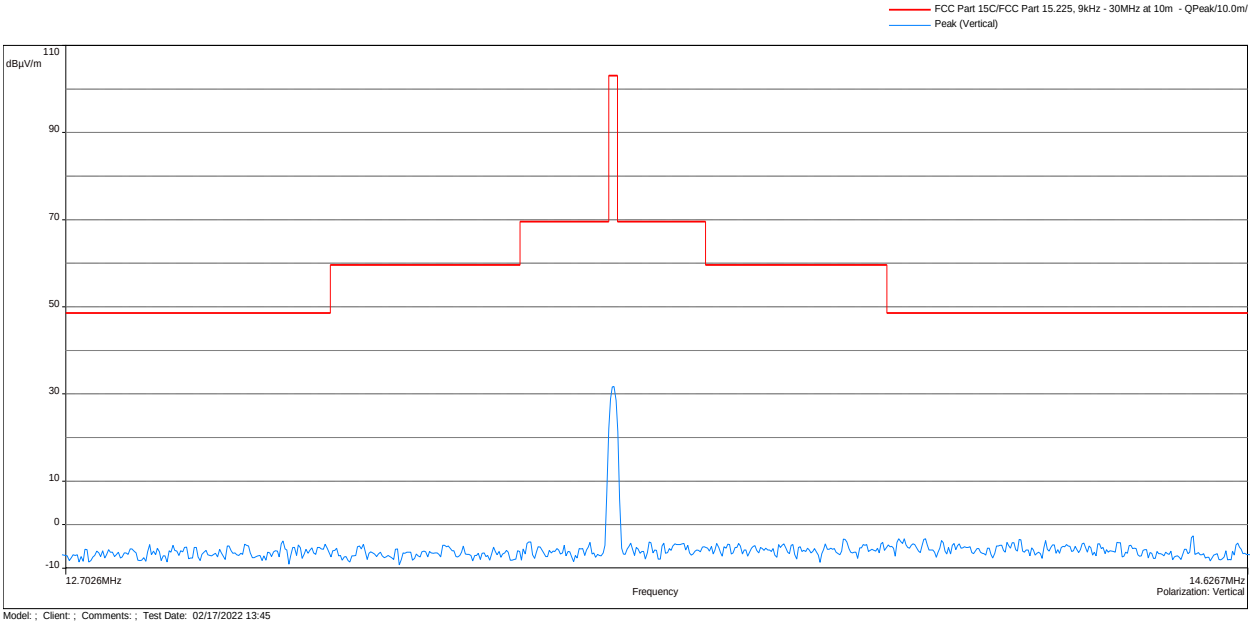

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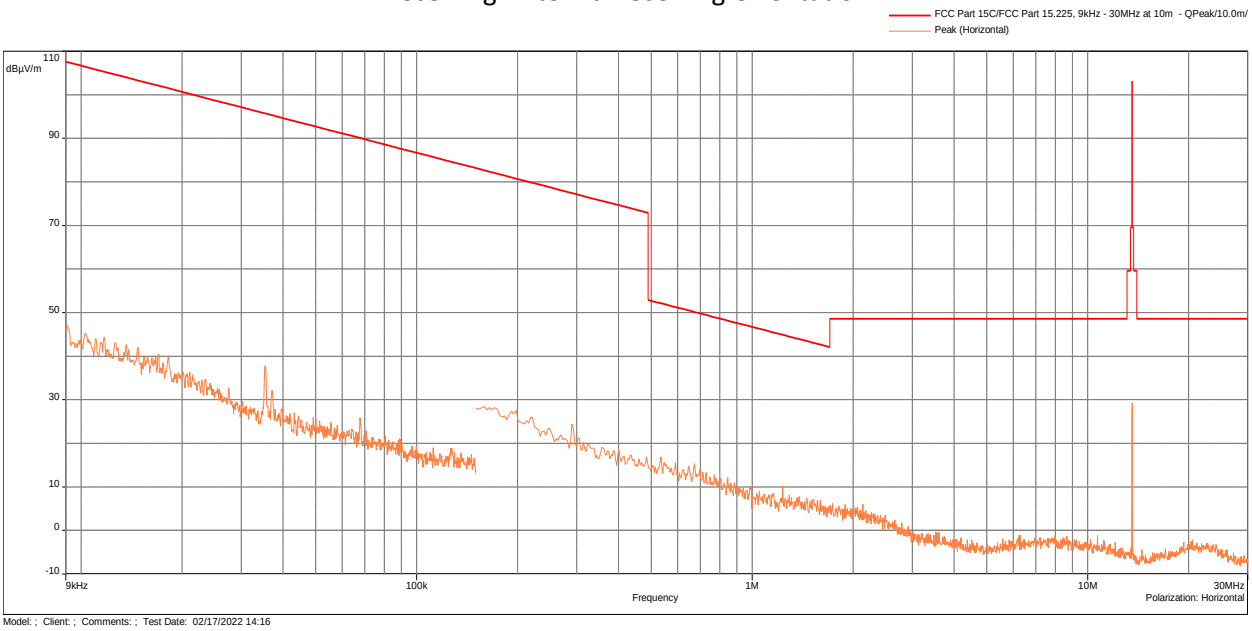
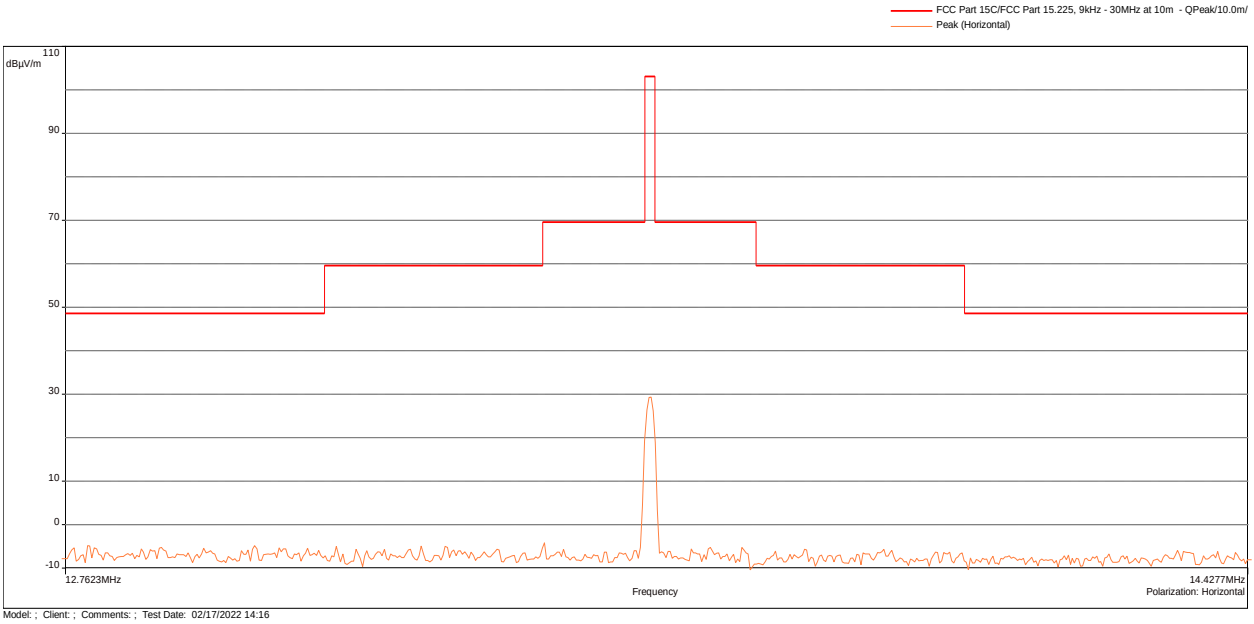
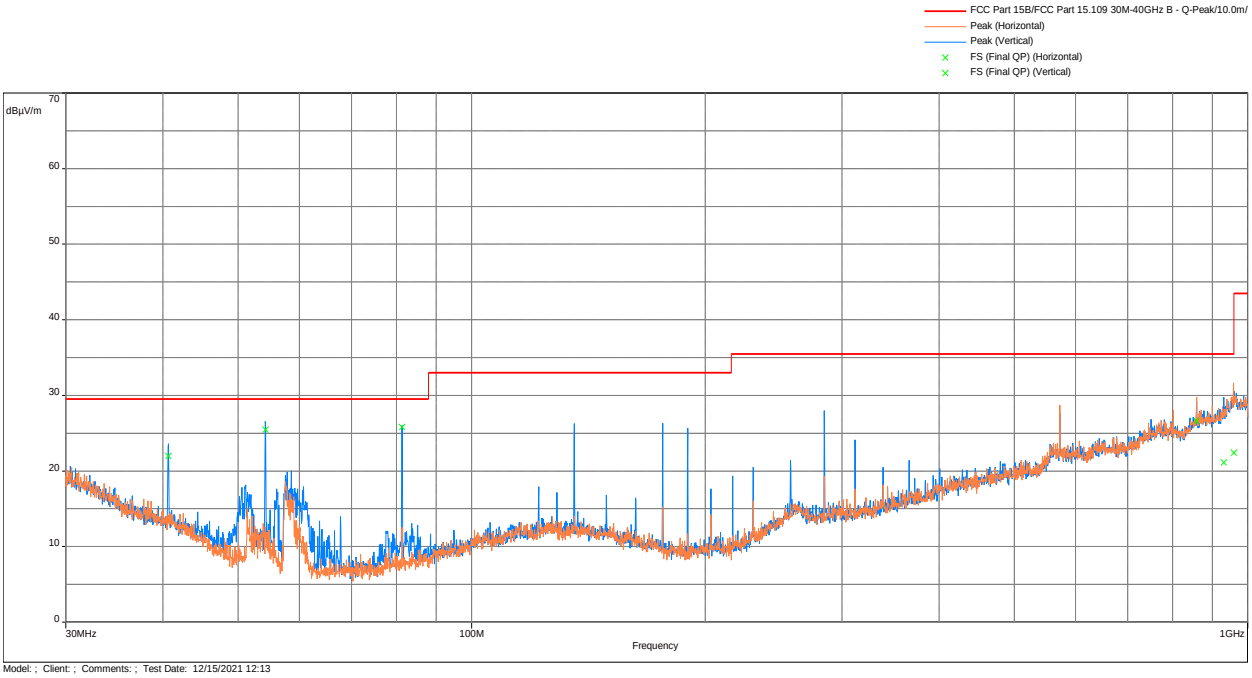
Receiving Antenna Receiving Orientation





Frequency (MHz)	FS@10m dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	Comment	Correction dB
13.56161	37.19	103.1	-65.91	Coplanar	-18.22
13.56161	31.72	103.1	-71.38	Coaxial	-18.22
13.56161	29.31	103.1	-73.79	Horizontal	-18.22

Radiated Spurious Emissions from 30 to 1000 MHz



Frequency (MHz)	FS@10m (dBµV/m)	Limit@10m (dB(uV/m))	Margin (dB)	Azimuth (deg)	Height (m)	Polarity	RA (dBuV)	Correction (dB)
859.0881	26.6	35.5	-8.9	241	1.21	Horizontal	25.63	0.97
959.3366	22.44	35.5	-13.06	315.5	3.88	Horizontal	18.64	3.8
40.67962	21.97	29.5	-7.53	104.25	3.15	Vertical	35.4	-13.43
54.2385	25.48	29.5	-4.02	55.5	3.15	Vertical	45.6	-20.13
81.35655	25.79	29.5	-3.71	48.75	1.75	Vertical	44.52	-18.72
931.1056	21.11	35.5	-14.39	27	3.02	Vertical	18.79	2.32

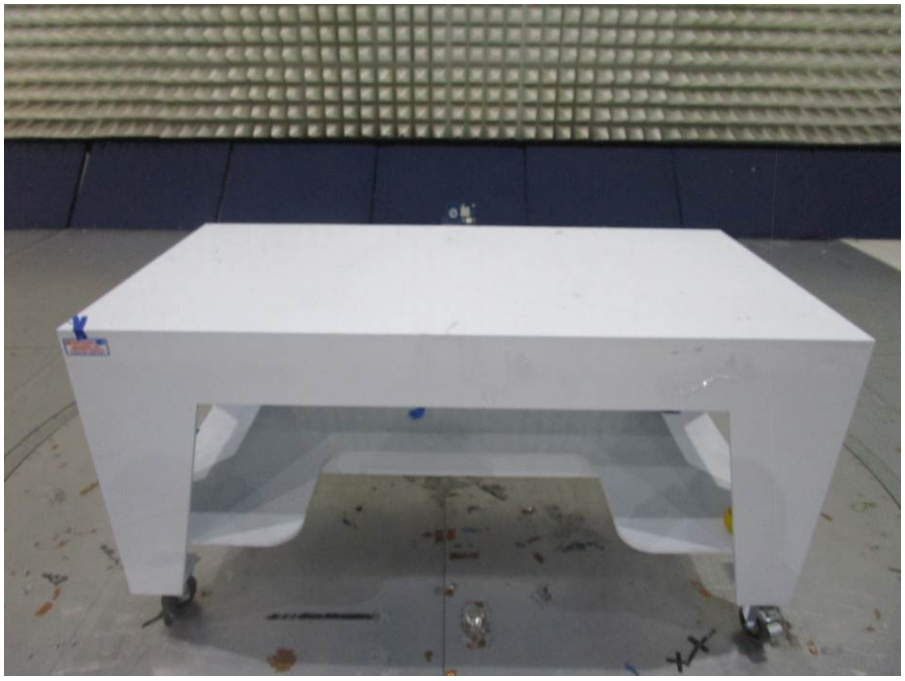
Note: Correction = AF + CF – AG

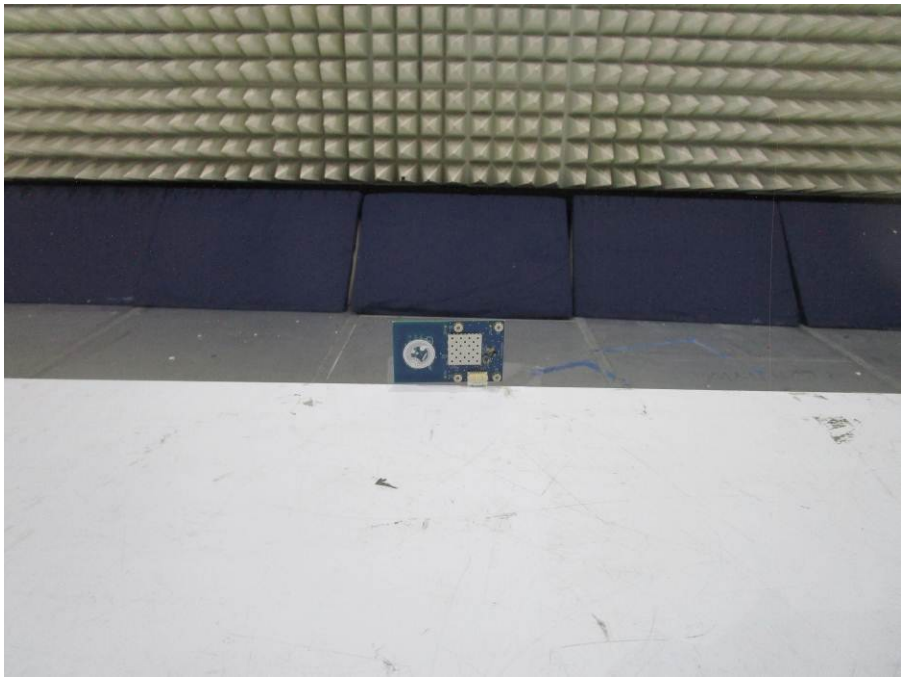
Note: Measurement done in all three orientations X, Y, Z. Worst case emissions are reported.

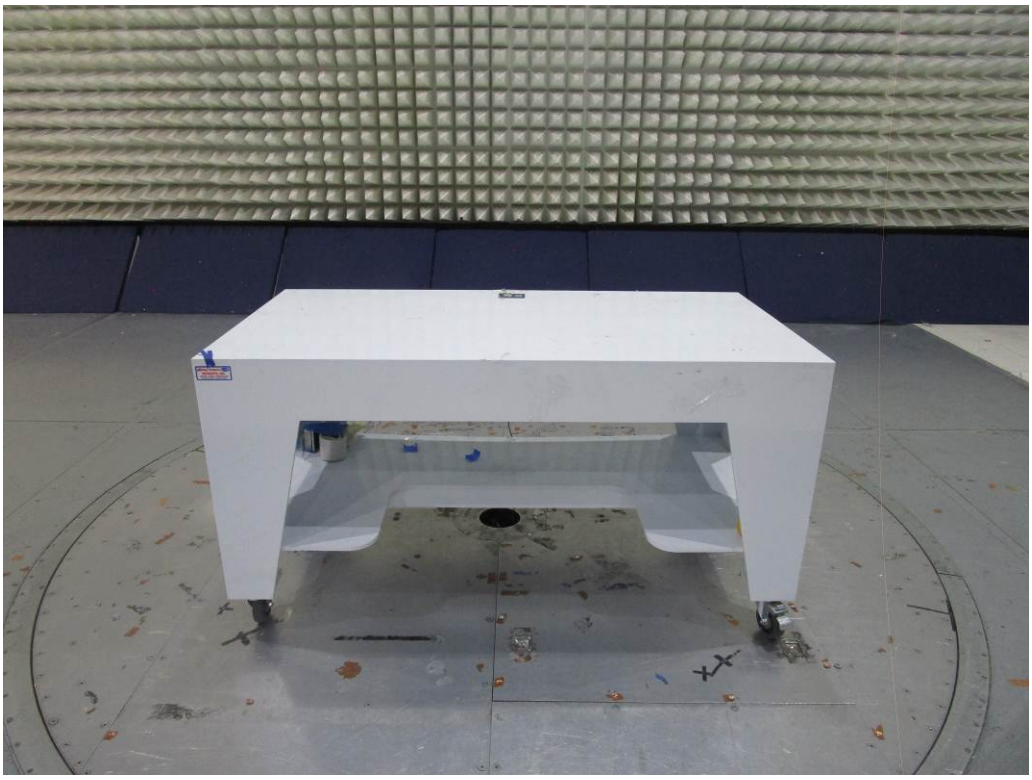
Result	**Complies** by 3.71dB

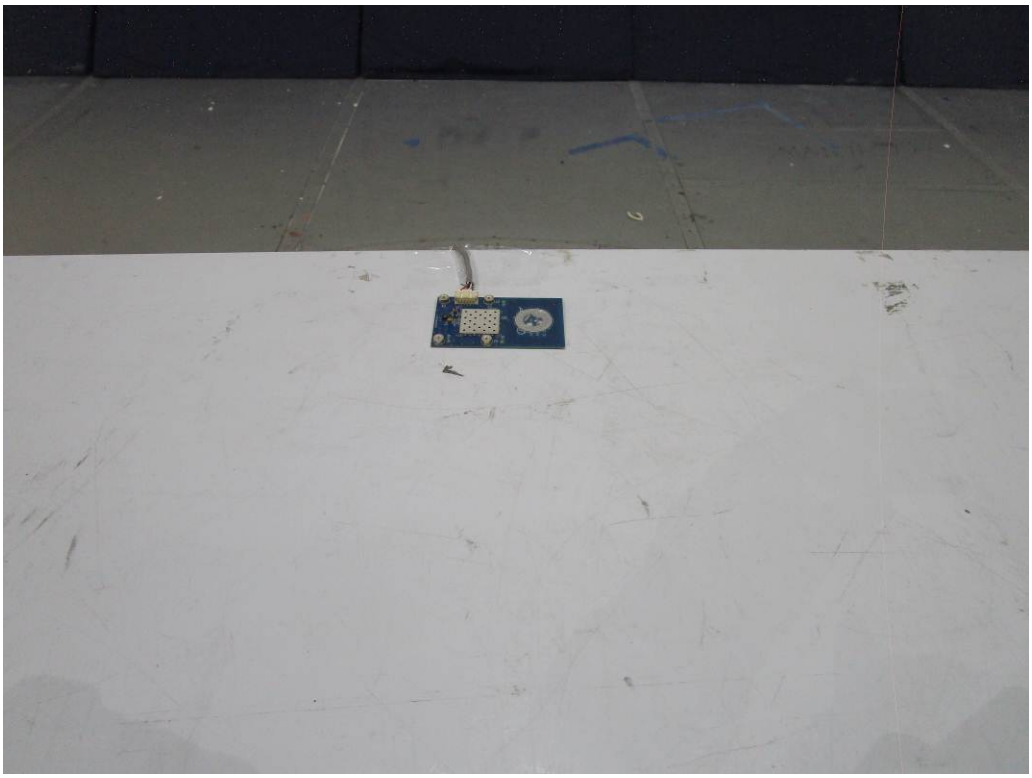
4.1.4 Test Configuration Photographs

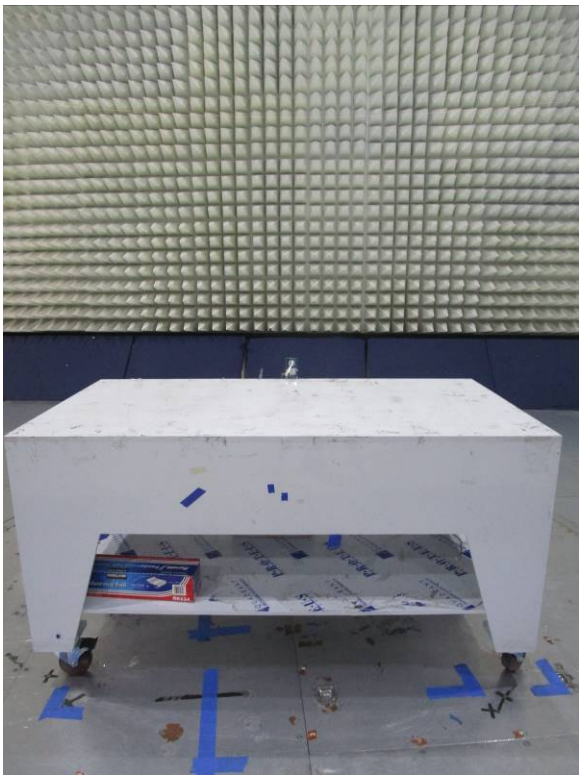
The following photographs show the testing configurations used.

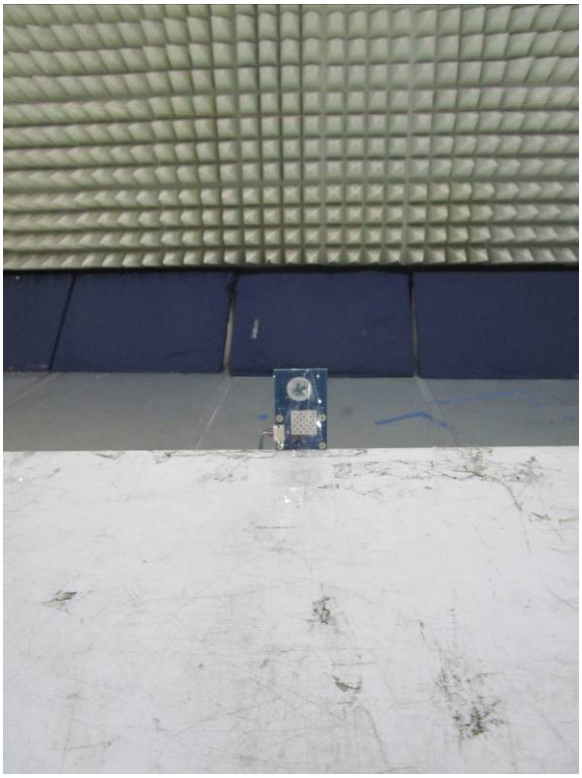


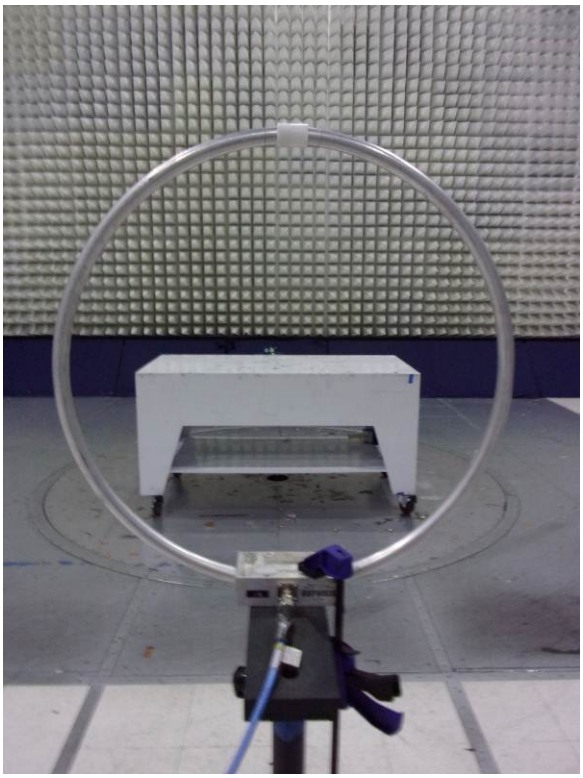


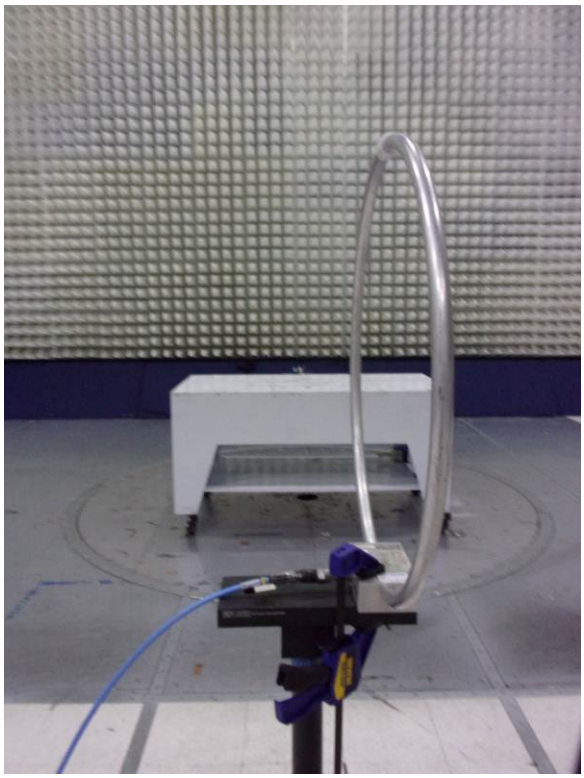


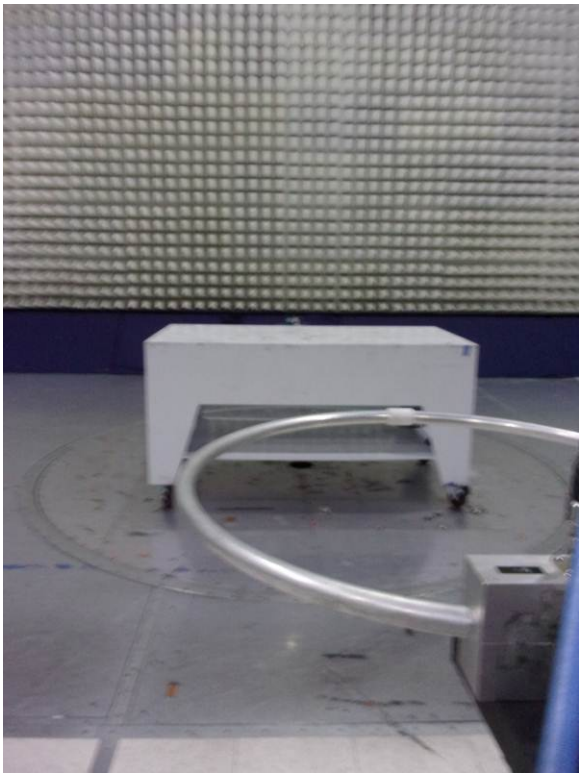












4.2 Frequency Tolerance

4.2.1 Requirement

FCC 15.225 (e)

The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

RSS-210; B.6

The carrier frequency stability shall not exceed ±100 ppm

4.2.2 Procedure

The EUT was placed in the temperature chamber. The frequency counter was connected to the transmitter output. For each temperature, the carrier frequency was recorded at 120Vac 60Hz. Also, testing was performed at 85% to 115% of the rated supply voltage.

4.2.3 Test Results 15.225 (e)

Nominal Frequency: 13559595Hz

Voltage (DC)	Temperature (^{0}C)	Measured Frequency (Hz)	Deviation from Reference (Hz)	Deviation (%)	Δ ppm
12V	-20	13559566	-29	.0002	2.0
12V	-10	13559587	-8	.0001	1.0
12V	0	13559595	0	0	0
12V	10	13559595	0	0	0
12V	20	13559595	0	0	0
12V	30	13559566	-29	.0002	2.0
12V	40	13559549	-46	.0003	3.0
12V	50	13559537	-58	.0004	4.0

Voltage (DC)	Percentage (%)	Measured Frequency (Hz)	Deviation from Reference (Hz)	Deviation (%)	Δ ppm
10.2	85	13559546	-49	.0004	4.0
13.8	115	13559676	81	.0006	6.0

4.3 Occupied Bandwidth
FCC 15.215

4.3.1 Requirements

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

4.3.2 Procedure

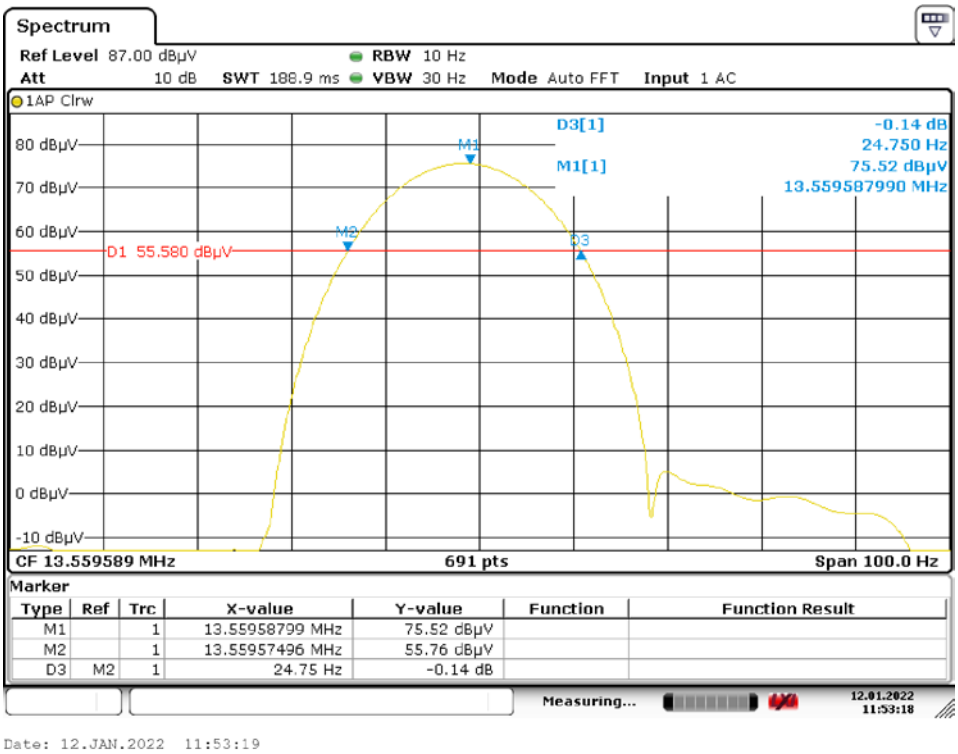
The EUT was setup to transmit in normal operating condition.

Measurements were made with the loop antenna in close proximity of the EUT. Following the procedures of ANSI 63.10: 2013, the 20dB bandwidth measurements were taken. The following plots show Occupied Bandwidth.

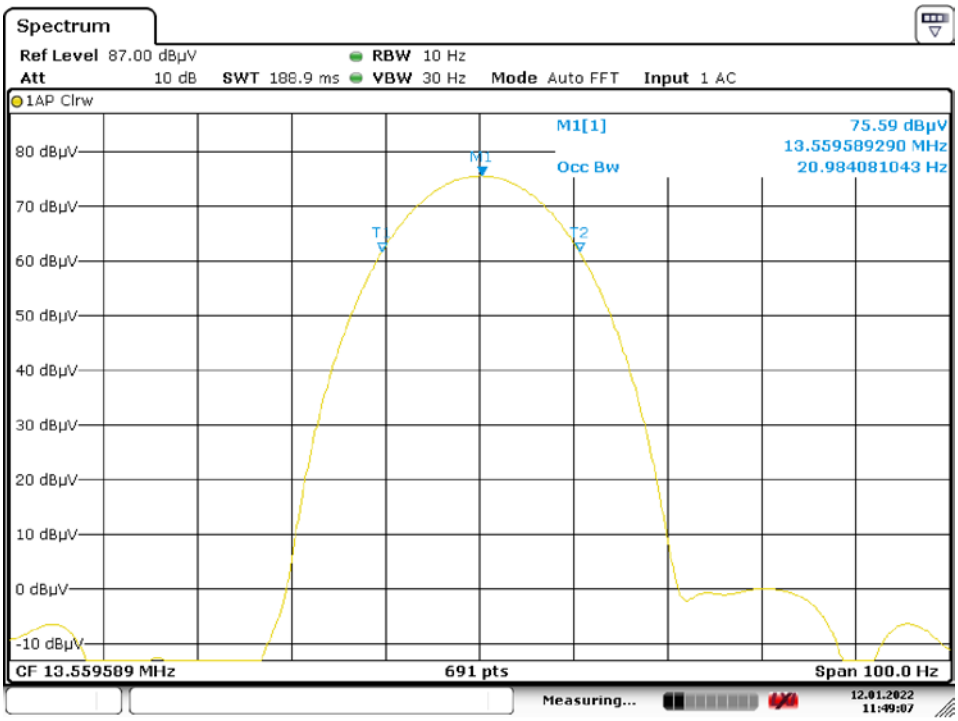
4.3.3 Test Results

Frequency (MHz)	-20 dB Channel Bandwidth (Hz)	99% Channel Bandwidth (Hz)
13.56	24.750	20.984

-20dB Channel Bandwidth Plot



99% Channel Bandwidth Plot



4.4 AC Line Conducted Emission
FCC Rule 15.207

4.4.1 Requirement

Frequency Band (MHz)	Class B Limit dB(μV)		Class A Limit dB(μV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *	79	66
0.50-5.00	56	46	73	60
5.00-30.00	60	50	73	60

*Note: *Decreases linearly with the logarithm of the frequency. At the transition frequency the lower limit applies.*

4.4.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

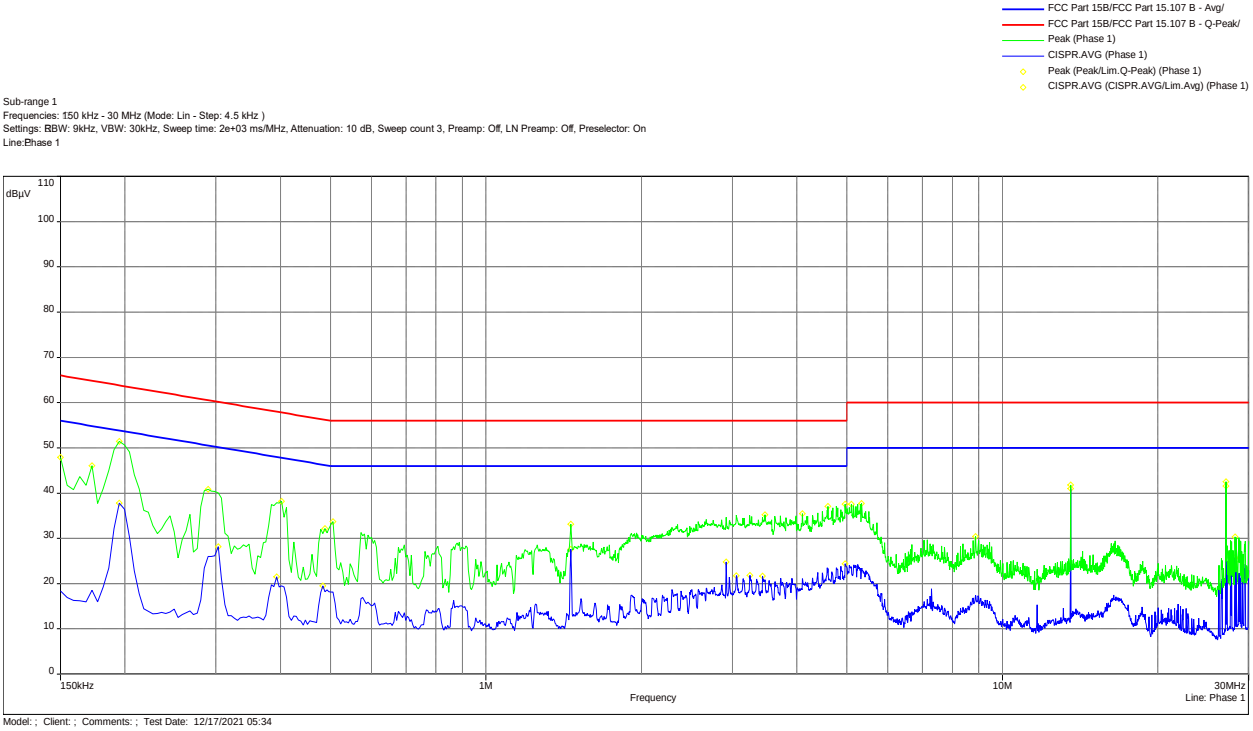
Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

EUT was placed in transmission mode then tested for conducted emissions per 15.207 to ensure the device complies with 15.207.

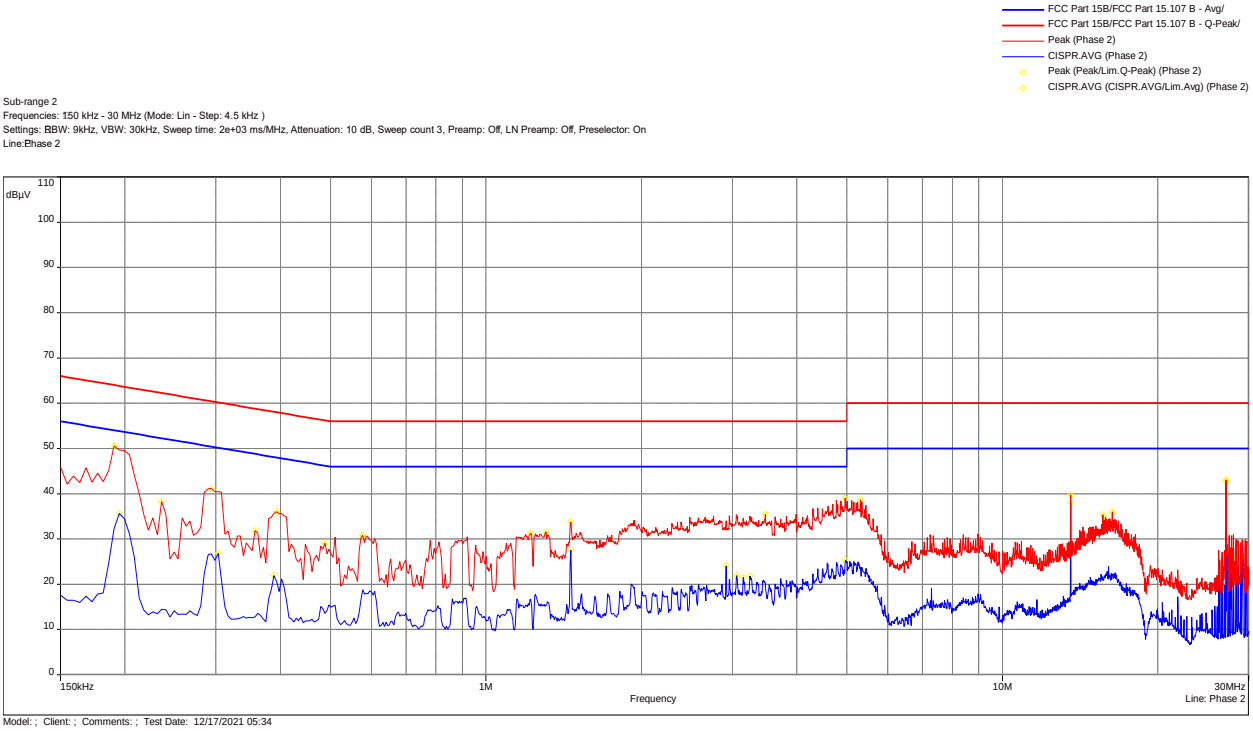
4.4.3 Test Result

15.207, 120VAC 60Hz with RFID On

AC Line Conducted Emission, 120VAC 60Hz Phase 1



AC Line Conducted Emission, 120VAC 60Hz Phase 2



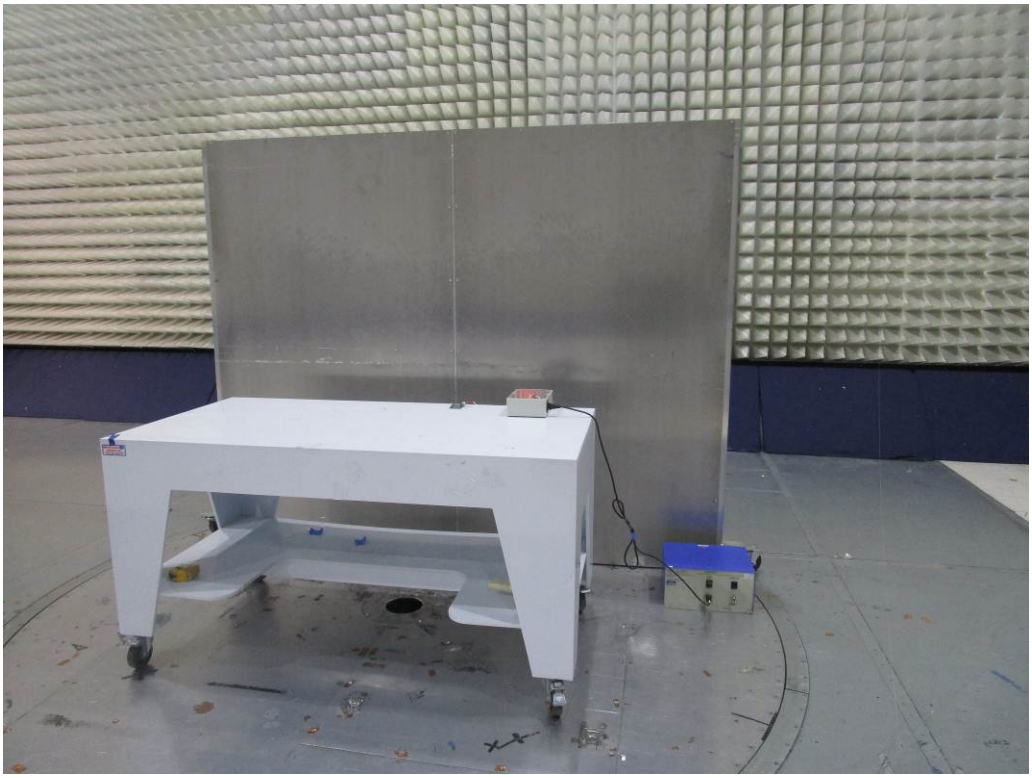
4.4.3 Test Result (Continued)

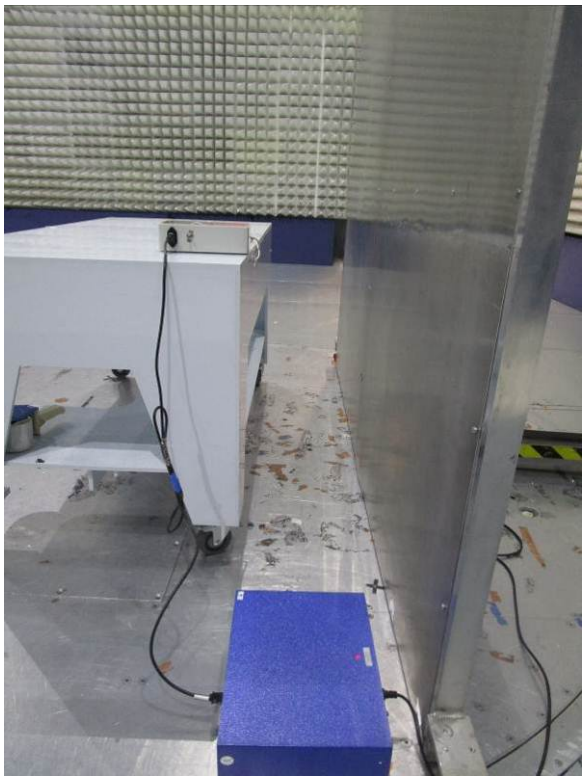
Frequency (MHz)	Peak (dBµV)	Lim.Q-Peak (dBµV)	Peak-Lim.Q-Peak (dB)	Line	Correction (dB)
0.15	47.93	66	-18.07	Phase 1	10.55
0.1725	46.07	64.84	-18.77	Phase 1	10.58
0.1905	50.53	64.01	-13.49	Phase 2	10.52
0.195	51.45	63.82	-12.37	Phase 1	10.55
0.2355	38.3	62.25	-23.95	Phase 2	10.54
0.2895	40.88	60.54	-19.66	Phase 1	10.58
0.294	41.2	60.41	-19.21	Phase 2	10.56
0.357	31.87	58.8	-26.92	Phase 2	10.56
0.393	36.03	58	-21.97	Phase 2	10.57
0.402	38.23	57.81	-19.58	Phase 1	10.58
0.4875	32.14	56.21	-24.07	Phase 1	10.58
0.4875	29.07	56.21	-27.14	Phase 2	10.58
0.5055	33.72	56	-22.28	Phase 1	10.56
0.5775	30.78	56	-25.22	Phase 2	10.57
1.221	31.28	56	-24.72	Phase 2	10.6
1.3065	31.64	56	-24.36	Phase 2	10.6
1.4595	33.78	56	-22.22	Phase 2	10.62
1.4595	33.13	56	-22.87	Phase 1	10.62
3.471	35.2	56	-20.8	Phase 1	10.68
3.4755	35.45	56	-20.55	Phase 2	10.68
4.101	35.47	56	-20.53	Phase 1	10.7
4.596	37.08	56	-18.92	Phase 1	10.72
4.9605	37.58	56	-18.42	Phase 1	10.71
4.9605	39	56	-17	Phase 2	10.71
5.1045	37.58	60	-22.42	Phase 1	10.7
5.3115	38.65	60	-21.35	Phase 2	10.72
5.3385	37.69	60	-22.31	Phase 1	10.72
8.871	30.43	60	-29.57	Phase 1	10.83
13.56	41.8	60	-18.2	Phase 1	10.92
13.56	39.72	60	-20.28	Phase 2	10.92
15.6525	35.42	60	-24.58	Phase 2	10.9
15.837	34.77	60	-25.23	Phase 2	10.93
16.3185	36.07	60	-23.93	Phase 2	10.93
27.1185	43.1	60	-16.9	Phase 2	11.04
27.1185	42.5	60	-17.5	Phase 1	11.04
28.239	30.33	60	-29.67	Phase 1	11.09

Frequency (MHz)	CISPR.AVG (dBµV)	Lim.Avg (dBµV)	CISPR.AVG-Lim.Avg (dB)	Line	Correction (dB)
0.195	37.81	53.82	-16.01	Phase 1	10.55
0.195	35.63	53.82	-18.19	Phase 2	10.55
0.303	28.15	50.16	-22.01	Phase 1	10.55
0.303	26.78	50.16	-23.38	Phase 2	10.55
0.3885	21.93	48.1	-26.17	Phase 2	10.55
0.393	21.55	48	-26.45	Phase 1	10.57
0.483	19.53	46.29	-26.76	Phase 1	10.57
1.4595	27.6	46	-18.4	Phase 1	10.62
1.4595	27.55	46	-18.45	Phase 2	10.62
2.9175	24.05	46	-21.95	Phase 2	10.67
2.9175	24.77	46	-21.23	Phase 1	10.67
3.0525	21.76	46	-24.24	Phase 1	10.68
3.057	21.94	46	-24.06	Phase 2	10.68
3.1515	21.5	46	-24.5	Phase 2	10.66
3.246	21.8	46	-24.2	Phase 1	10.67
3.246	21.85	46	-24.15	Phase 2	10.67
3.435	21.69	46	-24.31	Phase 1	10.7
4.9605	24.38	46	-21.62	Phase 1	10.71
4.965	25.36	46	-20.64	Phase 2	10.71
13.56	41	50	-9	Phase 1	10.92
13.56	38.05	50	-11.95	Phase 2	10.92
27.1185	41.56	50	-8.44	Phase 1	11.04
27.1185	42.7	50	-7.3	Phase 2	11.04
27.501	25.93	50	-24.07	Phase 2	11.06
27.681	24.82	50	-25.18	Phase 1	11.07
27.7845	26.15	50	-23.85	Phase 2	11.07
27.789	25.54	50	-24.46	Phase 1	11.07
28.005	25.72	50	-24.28	Phase 2	11.08
28.239	25.72	50	-24.28	Phase 1	11.09
28.347	25.83	50	-24.17	Phase 2	11.09
28.3515	25.17	50	-24.83	Phase 1	11.09

Result	**Complies** by 7.3 dB

4.4.4 Test Configuration Photographs FCC Rule 15.207.





5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
EMI Receiver	Rohde and Schwarz	ESU40	ITS 00961	12	03/09/22
Spectrum Analyzer	Rohde & Schwarz	ESR	ITS 0607	12	11/19/22
Pre-amp	Sonoma	310N	ITS 00415	12	04/28/22
BI-Log Antenna	Teseq	CBL611D	ITS 01774	12	04/21/22
LISN	COM-POWER	LIN-115A	ITS 01285	12	07/09/22
10kHz - 1GHz 3 meter RF Cable	TRU Corp.	TRU Core 300	ITS 01465	12	09/14/22
10kHz - 1GHz 15 meter RF Cable	TRU Corp.	TRU Core 300	ITS 01470	12	09/14/22
10kHz-1GHz 2 meter RF Cable	TRU Corp.	TRU Core 300	ITS 01339	12	09/14/22
10kHz-1GHz 11 meter RF Cable	TRU Corp.	TRU Core 300	ITS 01335	12	09/14/22
10kHz-1GHz 6 meter RF Cable	TRU Corp.	TRU Core 300	ITS 01333	12	04/28/22
Humidity Temperature Test Chamber	ESPEC	BTX-475	ITS 01436	12	11/02/22
10m Chamber	Panashield	Semi-Anechoic 10m Chamber	ITS 00984	36	07/29/23

Software used for emission compliance testing utilized the following:

Name	Manufacturer	Version	Template/Profile
BAT-EMC	Nexio	3.20.0.23	Intertek Emissions Template.bpp
RS Commander	Rohde Schwarz	1.6.4	Not Applicable (Screen grabber)

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewer Initials	Date	Change
1.0 / G104901690	GN	KV	January 13, 2022	Original document
2.0 / G104901690	GN	KV	February 18, 2022	Updated Section 4.1 with new data