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FCC ISED RF Test Report

Test Report Number	NSC-20080541-LC-FCC-IC
FCC ID	EF400209
ISED ID	1078A-00209
Applicant	Nortek Security & Control LLC/GTO Access
Applicant Address	5919 Sea Otter Pl #100, Carlsbad, CA 92010
Product Name	900MHz Transceiver
Model (s)	2GIG-XCVR2E-345, 2GIG-XCVR2-345
Date of Receipt	10/13/2020
Date of Test	10/20/2020 – 10/27/2020
Report Issue Date	10/28/2020
Test Standards	47CFR Part 15.247, Subpart C RSS-247 Issue 2, Feb. 2017
Test Result	**PASS**

Issued by:

Vista Compliance Laboratories
1261 Puerta Del Sol, San Clemente, CA 92673 USA
www.vista-compliance.com

Daniel Bruno (Test Technician)

David Zhang (Technical Manager)

REVISION HISTORY

Report Number	Version	Description	Issued Date
NSC-20080541-LC-FCC-IC	01	Initial report	10/28/2020

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1 Test Summary

Test Item	Test Requirement	Test Method	Result
20 dB Bandwidth	§15.247 (a)(1) RSS-247 §5.1b	ANSI C63.10 (2013)	Pass
Occupied Bandwidth	RSS-Gen §6.7	RSS-Gen Issue#5, March 2019	Pass
Number of Hopping Channels	§15.247 (a)(1) RSS-247 §5.1d	ANSI C63.10 (2013)	Pass
Maximum Output Power	§15.247 (b)(2) RSS-247 §5.4b	ANSI C63.10 (2013)	Pass
Channel Separation	§15.247 (a)(1)	ANSI C63.10 (2013)	Pass
Time of Occupancy	§15.247 (a)(1)	ANSI C63.10 (2013)	Pass
Band-edge & Unwanted Emissions	§15.247 (d) RSS-247 §5.5	ANSI C63.10 (2013)	Pass
Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	§15.205, §15.209 (b)(2), §15.247 (d) RSS-247 §5.5	ANSI C63.10 (2013)	Pass
AC Power Line Conducted Emissions	§15.207 (a) RSS-Gen §8.8	ANSI C63.10 (2013)	Pass

2 General Information

2.1 Applicant

Applicant	Nortek Security & Control LLC/GTO Access
Applicant address	5919 Sea Otter Pl #100, Carlsbad, CA, 92010
Manufacturer	Nortek Security & Control LLC/GTO Access
Manufacturer Address	5919 Sea Otter Pl #100, Carlsbad, CA, 92010

2.2 Product information

Product Name	900MHz Transceiver
Model Number	2GIG-XCVR2E-345
Family Models	2GIG-XCVR2-345
Serial Number	N/A
Frequency Band	910.200-919.872MHz
Type of modulation	BPSK
Equipment Class	DSS
Antenna Information	Internal Antenna, 2dBi
Clock Frequencies	N/A
Input Power	N/A
Power Adapter Manufacturer/Model	Brand: ZBPower Model: ZB-H140017
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	N/A
Additional Info	Modular approval The only difference between the model of 2GIG-XCVR2-345 and 2GIG-XCVR2E-345 is the firmware has no encryption which has no impact on the RF output. Only the 2GIG-XCVR2E-345 was tested as representative.

* EUT is not sold with a standard power adapter. This adapter was used for testing purposes only.

2.3 Test standard and method

Test standard	47CFR Part 15.247, Subpart C RSS-247 Issue 2, Feb. 2017
Test method	ANSI C63.10-2013

3 Test Site Information

Lab performing tests	Vista Laboratories, Inc.
Lab Address	1261 Puerta Del Sol, San Clemente, CA 92673 USA
Phone Number	+1 (949) 393-1123
Website	www.vista-compliance.com

Test Condition	Temperature	Humidity	Atmospheric Pressure
RF Testing	23.5°C	58.2%	996 mbar

4 Modification of EUT / Deviations from Standards

N/A

5 Test Configuration and Operation

5.1 EUT Test Configuration

EUT was set to continuous transmission mode during TX testing.

The following software was used for testing and to monitor EUT performance

Software	Description
EMISoft Vasona	EMC/RF Spurious emission test software used during testing
TeraTerm	To set EUT into continuous TX mode

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #
Laptop	Dell	G1H5102	P29G003

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Conducted Measurement (30MHz – 18GHz)	±1.5 dB
Radiated Emission (30MHz-1GHz)	±4.6 dB
Radiated Emission (1-18GHz)	±4.9 dB
Radiated Emission (18-40GHz)	±3.5 dB

7 Test Results

7.1 Antenna Requirement

7.1.1 Requirement

Per § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

7.1.2 Result

Analysis:

- EUT uses internal chip antenna. No standard RF connector is used.

Conclusion:

- EUT complies with antenna requirement in § 15.203.

7.2 20 dB Bandwidth

7.2.1 Requirement

Per § 15.247 (a) (1) (i), RSS-247 §5.1 (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

7.2.2 Test Setup

7.2.3 Test Procedure

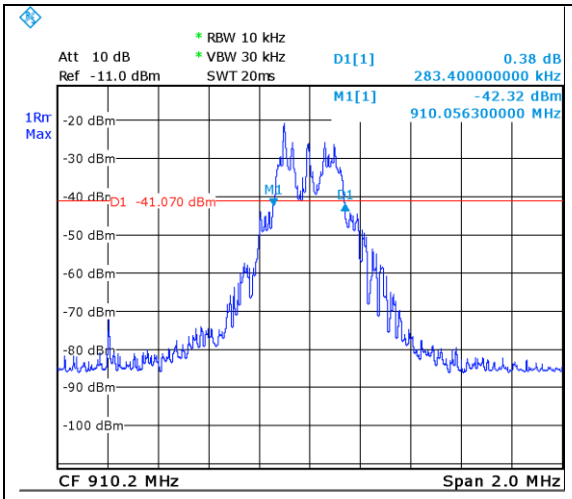
According to section 6.9.2, in ANSI C63.10-2013:

Measurement is made with the occupied bandwidth measurement function incorporated in spectrum analyzer. The following setting are used per ANSI C63.10-2013.

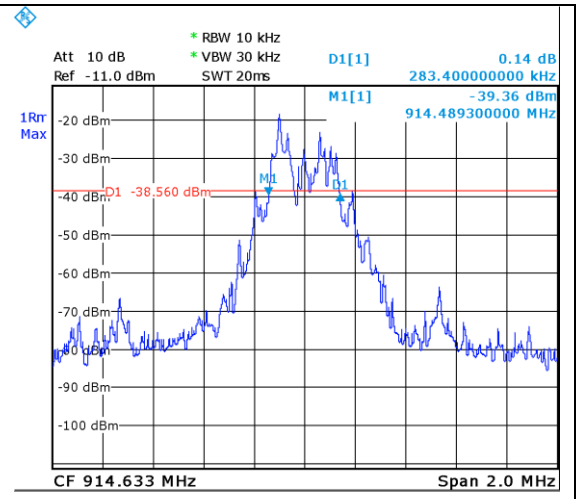
1. Set Center Frequency = Nominal EUT channel center frequency.
2. Set Span to be between two times and five times of the OBW.
3. RBW shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times RBW.
4. Set detection mode to peak and trace mode to max hold.
5. Use the occupied bandwidth measurement function to place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "-xx dB down amplitude" determined.
6. The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labelled. Tabular data may be reported in addition to the plot(s).

7.2.4 Test Result

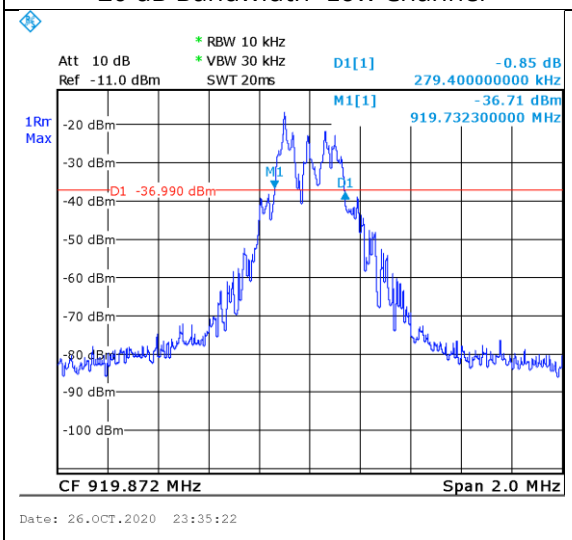
Channel	Frequency (MHz)	Measured Bandwidth (kHz)	Limit (KHz)	Result
Low	910.200	283.4	≥250	N/A
Mid	914.633	283.4	≥250	N/A
High	919.872	279.4	≥250	N/A



20 dB Bandwidth -Low Channel



20 dB Bandwidth -Mid Channel



20 dB Bandwidth -High Channel

7.3 Occupied Bandwidth (99%)

7.3.1 Requirement

RSS-Gen §6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

7.3.2 Test Procedure

According to section RSS-Gen §6.7

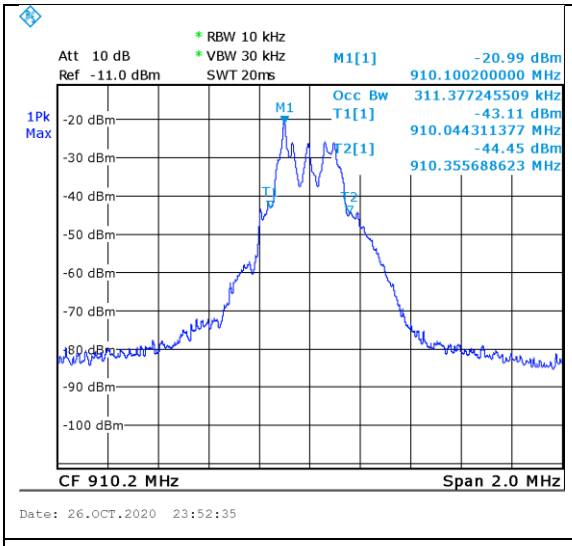
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement capability on instrument to obtain BW result.

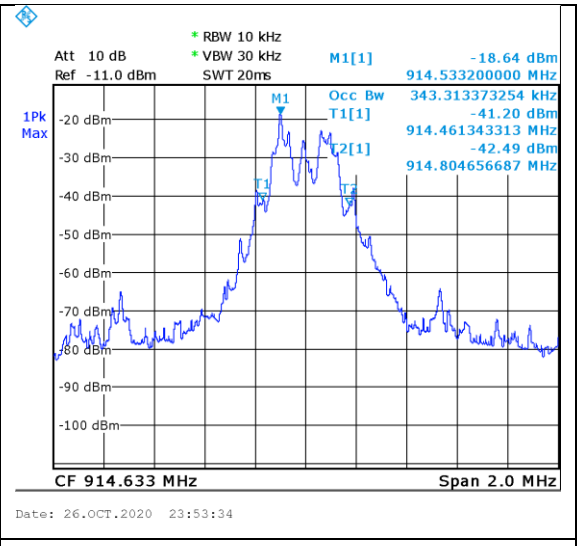
7.3.3 Test Setup

7.3.4 Test Result

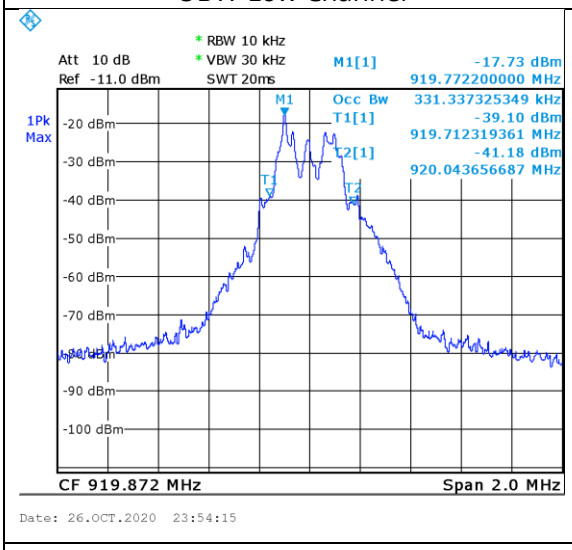
Channel	Frequency (MHz)	Measured Bandwidth (kHz)	Limit (KHz)	Result
Low	910.200	311.377	N/A	N/A
Mid	914.633	343.313	N/A	N/A
High	919.872	331.337	N/A	N/A



OBW-Low Channel



OBW-Mid Channel



OBW-High Channel

7.4 Number of Hopping Channel

7.4.1 Requirement

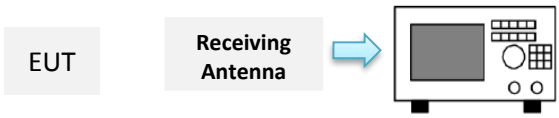
Per § 15.247 (a) (1) (i), RSS-247 §5.1 (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Per § 15.247 (g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

Per § 15.247 (h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

7.4.2 Test Procedure



7.4.3 Test Setup

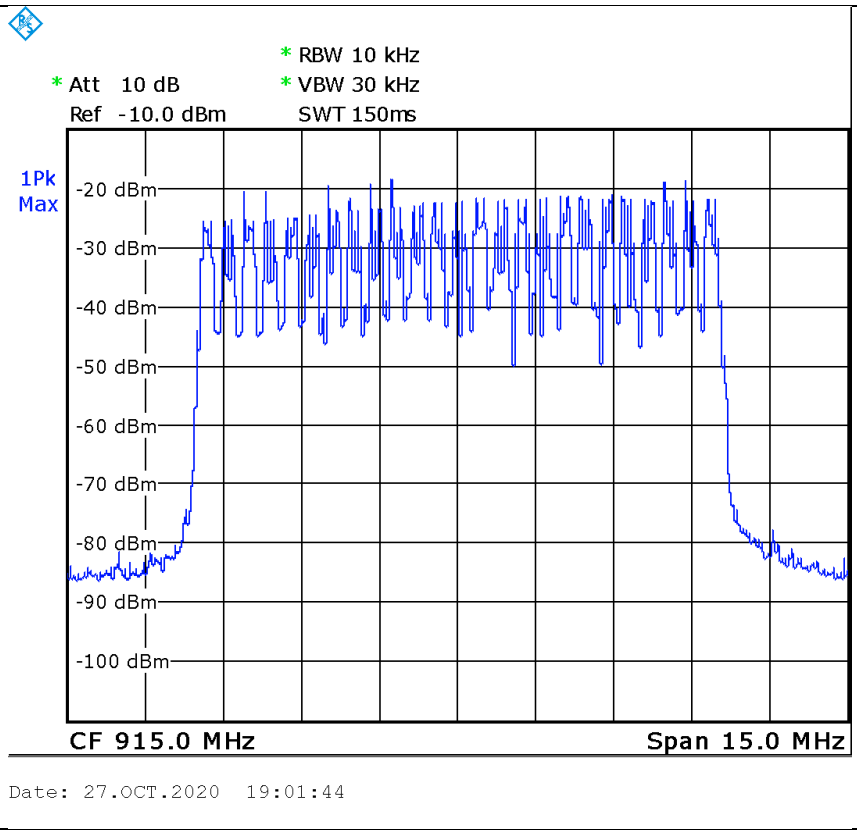
According to section 7.8.3, in ANSI C63.10-2013:

Measurement is made with spectrum analyzer. The following setting is used.

1. Set Span to be the frequency band of operation.
2. Set RBW to less 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. VBW ≥ RBW.
4. Sweep: Auto.
5. Detector function: Peak.
6. Trace: Max hold.
7. Allow the trace to stabilize.

7.4.4 Test Result

Mode	Frequency (MHz)	Channel Number	Minimum Limit	Result
Hopping	910.200 - 919.872	25	≥25	Pass



Hopping Channel Number

- 25 channels: channel 1 at 910.200 MHz to channel 25 at 919.872 MHz
- Psuedo-Random Hopping Sequence (example): 21, 16 ,3, 14, 11, 7, 12, 4, 9, 8, 1, 20, 17, 22, 6, 5, 15, 23, 2, 25, 24, 18, 13, 10, 19

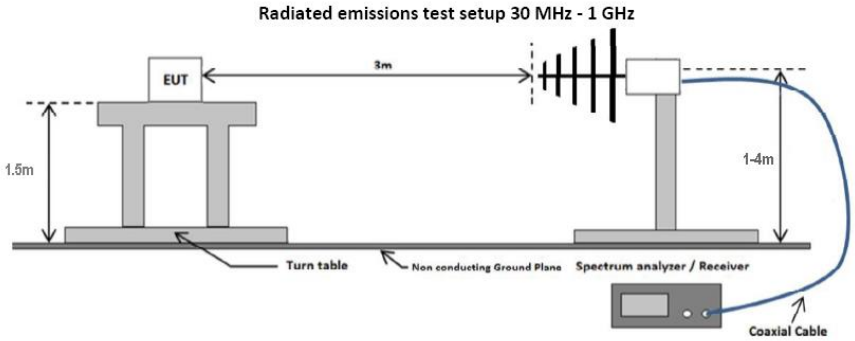
7.5 Maximum Output Power

7.5.1 Requirement

Per § 15.247 (b) (2), RSS-247 §5.4 (a)

For frequency hopping systems operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels, but at least 25 hopping channels.

7.5.2 Test Procedure



7.5.3 Test Setup

According to subclause 6.6, Radiated spurious emission measurements, in ANSI C63.10-2013:

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
    a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT was chosen.
    b. The EUT was then rotated to the direction that gave the maximum emission.
    c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for at frequency between 30MHz - 1GHz.
4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

Once the emission is maximized and the worst case EUT position is recorded, then use following method to measure the peak output power using radiated method.

According to section 7.8.5 of ANSI C63.10-2013. The measurement was made with the following setting,

1. Set the RBW > 20 dB BW
2. Set VBW ≥ RBW.
3. Set span to approximately five times the 20 dB bandwidth, centered on a hopping channel.
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.

7.5.4 Test Result

Channel	Frequency (MHz)	Measured Field Strength (dBuV/m)	Antenna Gain (dBi)	Calculated Output Power (dBm)	Max Output Power (dBm)	Result
Low	910.200	109.65	2	12.420	24	Pass
Mid	914.633	110.45	2	13.220	24	Pass
High	919.872	110.25	2	13.020	24	Pass

*Measured Output Power is calculated by following
Output Power = Field Strength - 95.23 - declared antenna gain.
Declared antenna gain is 2dBi.

7.6 Channel Separation

7.6.1 Requirement

Per § 15.247 (a) (1) (i), RSS-247 §5.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.6.2 Test Procedure

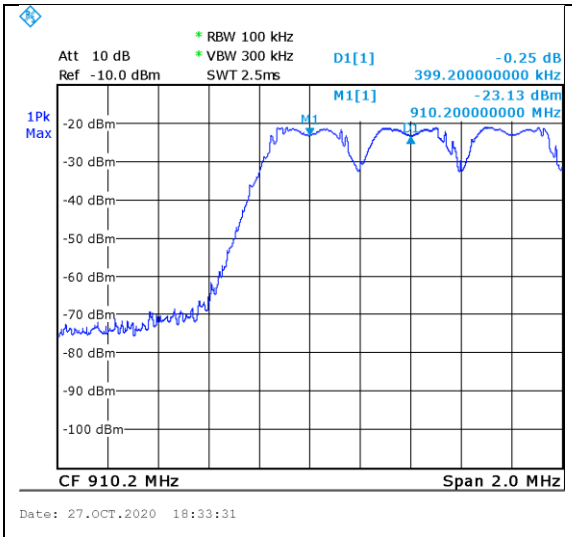
7.6.3 Test Setup

According to section 7.8.2 of ANSI C63.10-2013. The measurement was made with spectrum analyzer. The following setting is used.

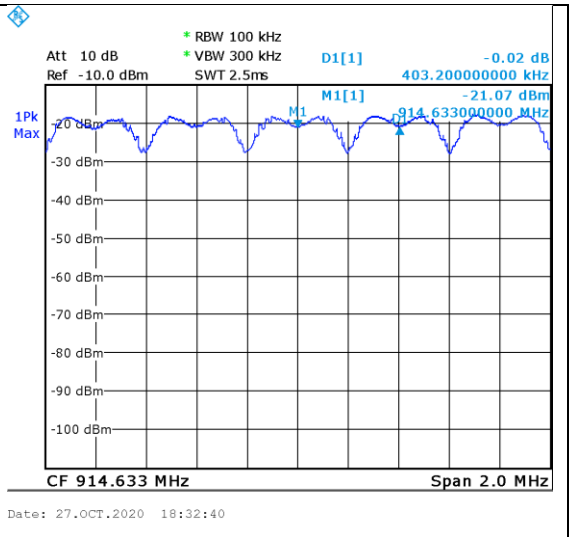
1. Set Span to wide enough to capture the peaks of two adjacent channels.
2. RBW: Start with the RBW set to approximately 30% of the channel spacing
3. VBW ≥ RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine separation between the peaks of adjacent channels.

7.6.4 Test Result

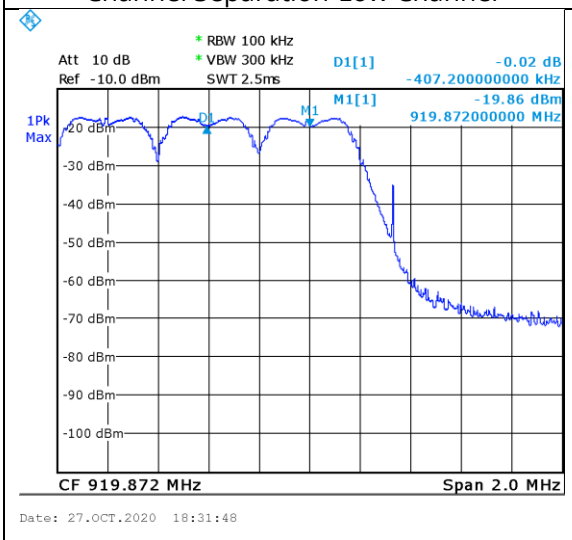
Channel	Frequency (MHz)	Channel Separation (kHz)	20dB Bandwidth (kHz)	Result
Low	910.200	399.2	283.4	Pass
Mid	914.633	403.2	283.4	Pass
High	919.872	407.2	279.4	Pass



Channel Separation-Low Channel



Channel Separation-Mid Channel



Channel Separation-High Channel

7.7 Time of Occupancy

7.7.1 Requirement

Per § 15.247 (a) (1) (i), RSS-247 §5.1 (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

7.7.2 Test Procedure

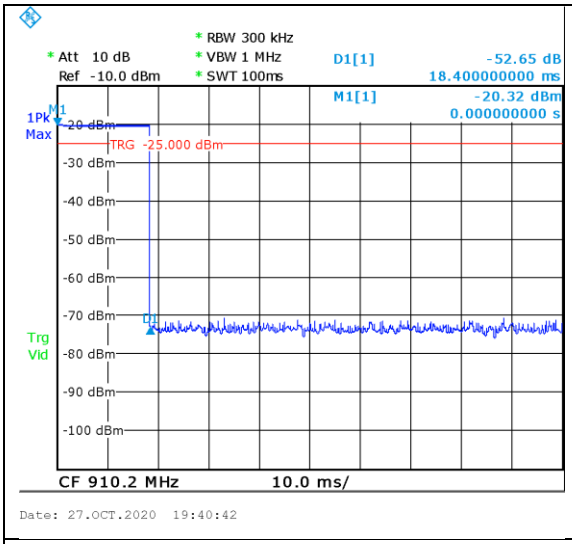
7.7.3 Test Setup

According to section 7.8.4 of ANSI C63.10-2013. The measurement was made with spectrum analyzer. The following setting is used.

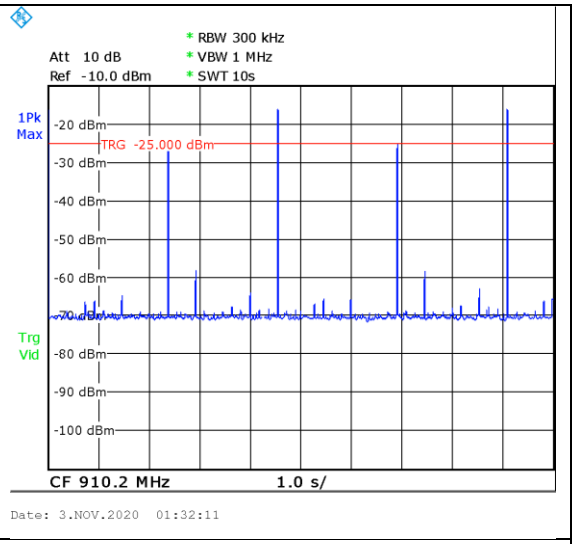
1. Set Span to zero, centered on a hopping channel.
2. RBW shall be ≤ channel spacing.
3. VBW ≥ RBW.
5. Detector = peak.
6. Sweep time = auto couple. As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the marker-delta function to determine the transmit time per hop.

7.7.4 Test Result

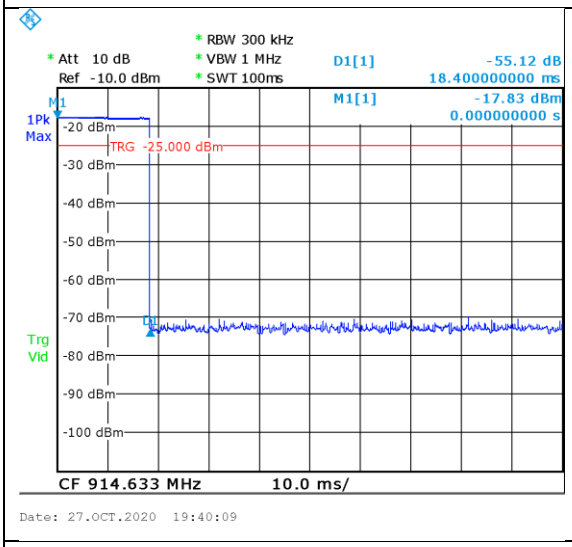
Mode/Bandwidth	Frequency (MHz)	Burst Width (ms/hop/ch)	Dwell Time (s)	Limit (s)	Result
Low	910.200	18.4	0.0368	≤0.4	Pass
Mid	914.633	18.4	0.0368	≤0.4	Pass
High	919.872	18.4	0.0368	≤0.4	Pass



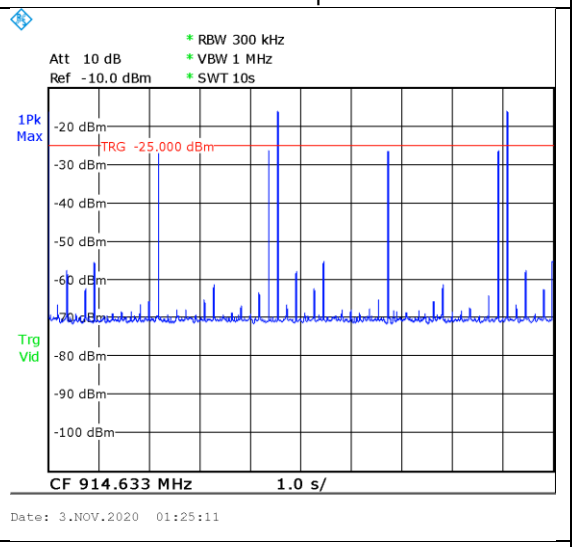
Dwell Time-Low Channel



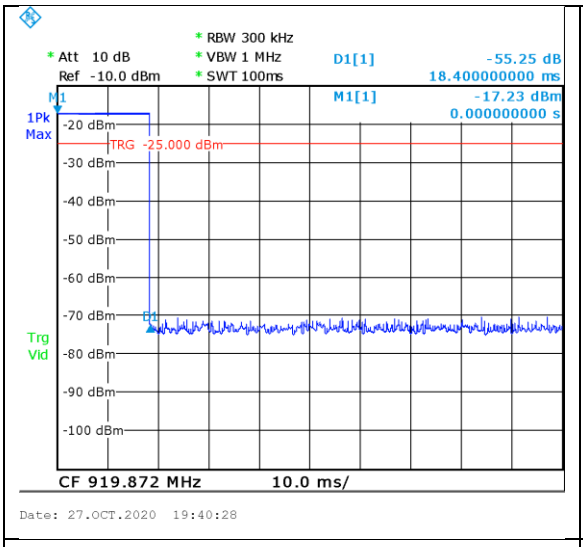
900MHz Radio-10sec Span-Low Channel



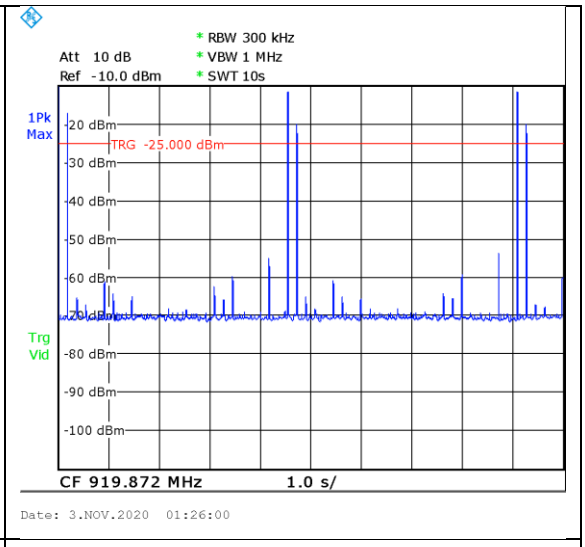
900MHz Radio-Dwell Time-Mid Channel



900MHz Radio-10sec Span -Mid Channel



900MHz Radio-Dwell Time-High Channel



900MHz Radio-10sec Span -High Channel

Each channel transmission repeats twice in 10 seconds.
Total transmission duration is 2 x 18.4 ms in 10 seconds which is less than 0.4 seconds

7.8 Band-edge Measurement

7.8.1 Requirement

Per § 15.247 (d), RSS-247 §5.5

in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

7.8.2 Test Procedure

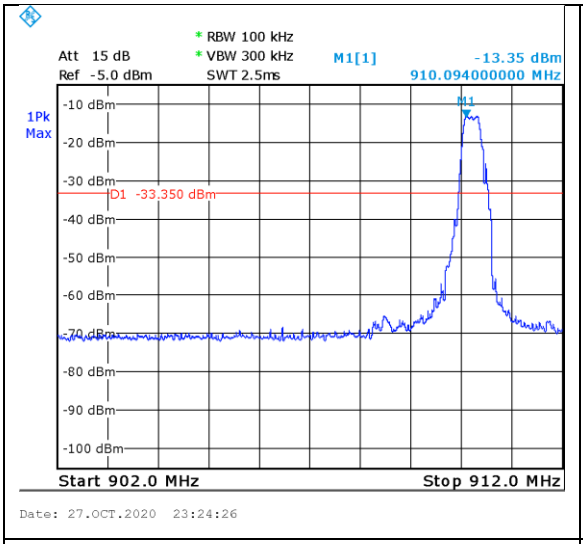
7.8.3 Test Setup

According to section 7.8.6 and 6.10 of ANSI C63.10-2013.

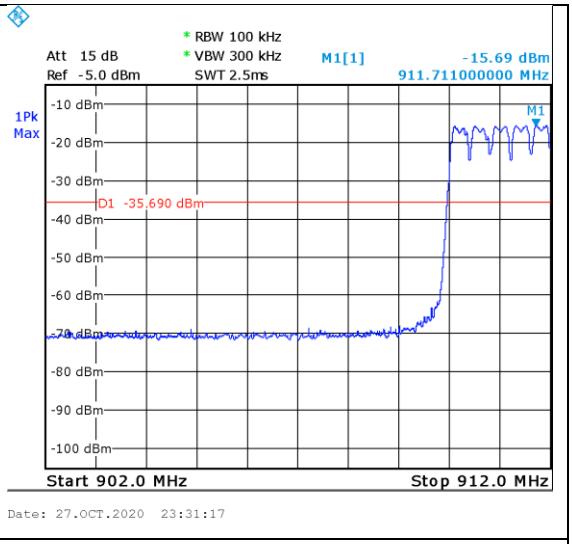
1. The EUT was switched on and allowed to warm up to its normal operating condition. Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation”
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
    a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT was chosen.
    b. The EUT was then rotated to the direction that gave the maximum emission.
    c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. Configure the spectrum analyzer settings as described in following steps
    a. Set the RBW =100KHz
    b. Set VBW = 300KHz
    c. Set span to Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation
    d. Sweep time = auto couple.
    e. Detector = peak.
    f. Trace mode = max hold.

4. Allow trace to fully stabilize.
5. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
6. Steps 1 and 5 were repeated for the next frequency point, until all selected frequency points were measured.

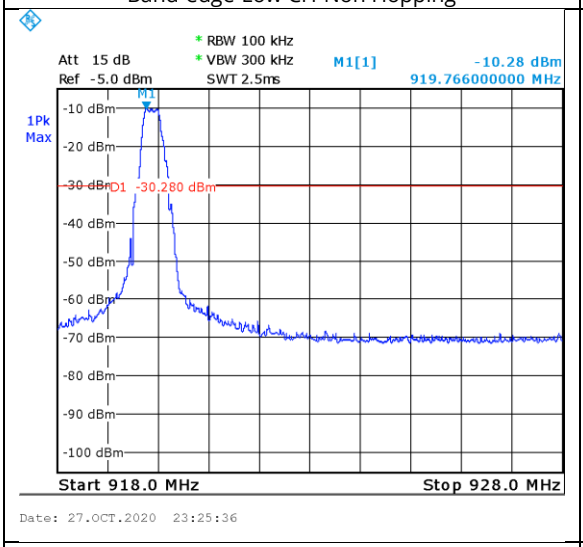
7.8.4 Test Result



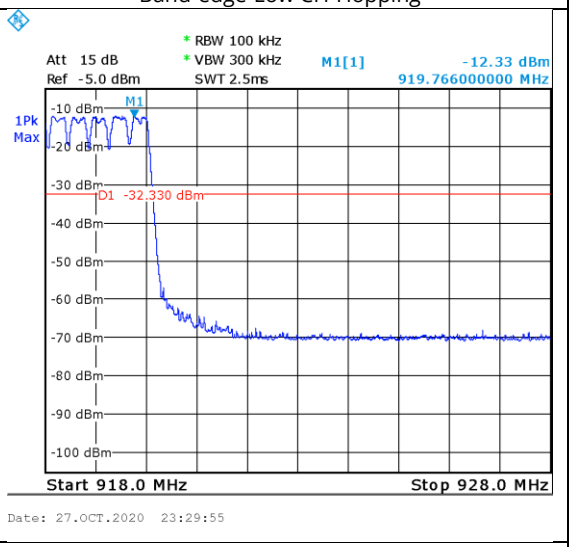
Band-edge-Low CH-Non Hopping



Band-edge-Low CH-Hopping



Band-edge-High CH-Non Hopping



Band-edge-High CH-Hopping

7.9 Radiated Spurious Emissions into the Restricted Frequency Bands

7.9.1 Requirement

§ 15.247 (d), RSS-247 §5.5

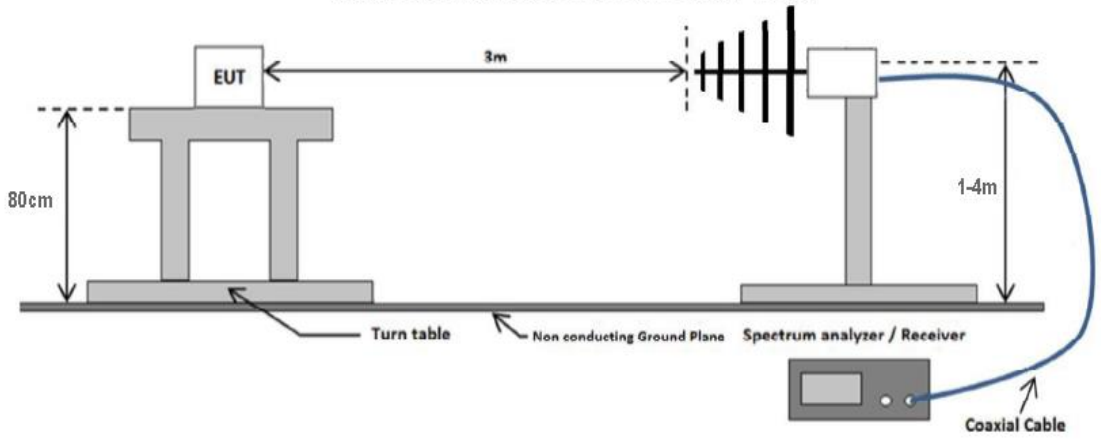
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

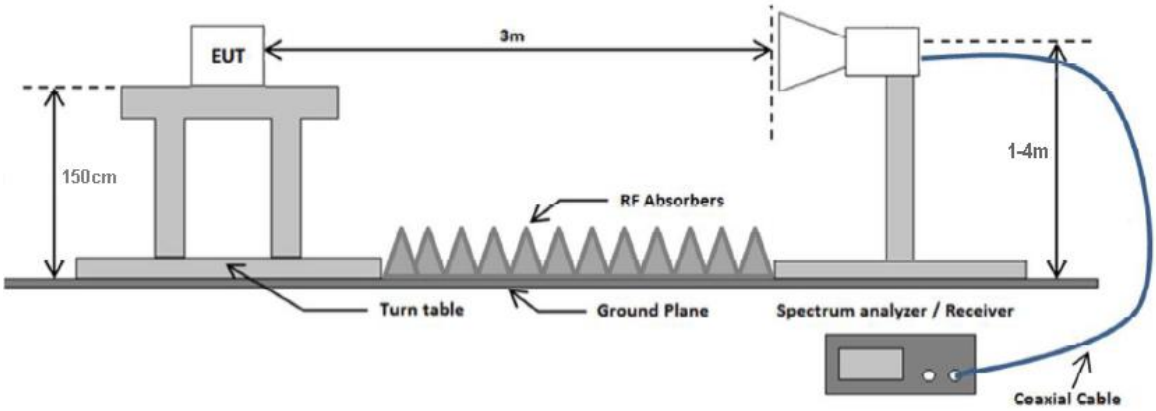
Frequency range (MHz)	Field Strength (μV/m)
0.009~0.490	2400/F(KHz)
0.490~1.705	24000/F(KHz)
1.705~30.0	30
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

7.9.2 Test Setup

Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.9.3 Test Procedure

According to subclause 6.5 and 6.6, Radiated spurious emission measurements in ANSI C63.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

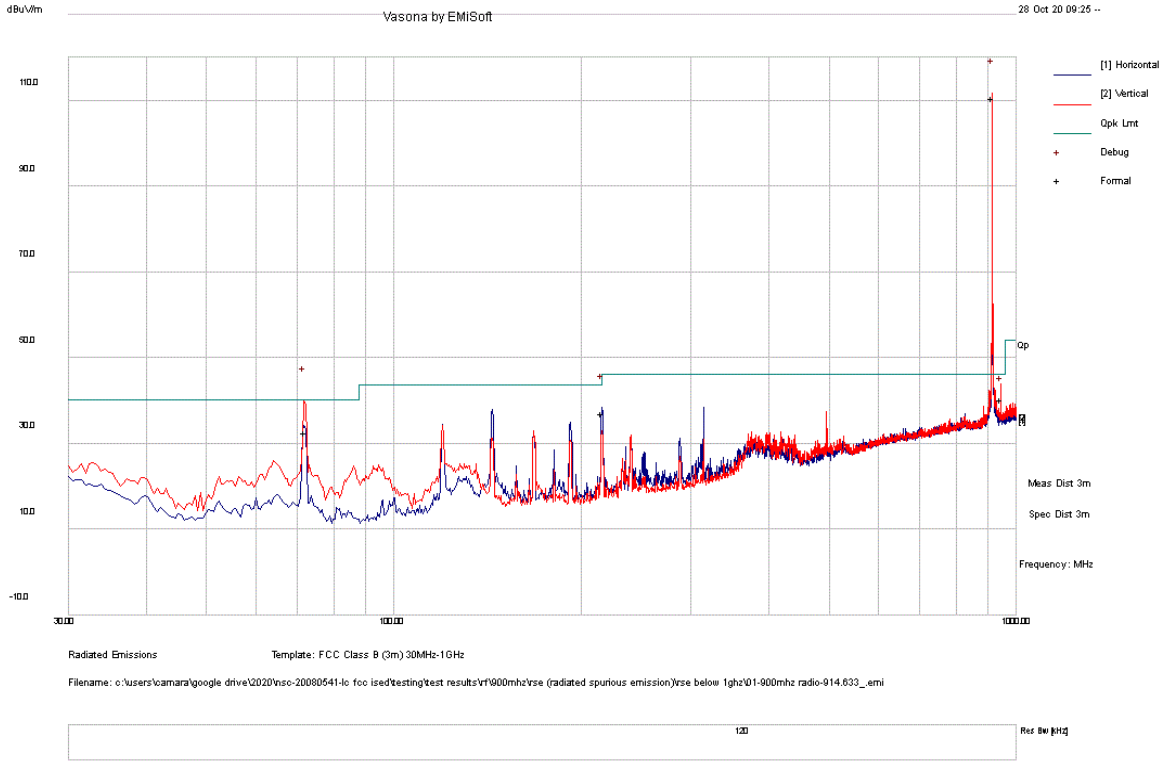
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
   a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
   b. The EUT was then rotated to the direction that gave the maximum emission.
   c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

7.9.4 Test Result

RADIATED SPURIOUS EMISSIONS BELOW 1 GHZ

Test Standard:	15.209, 15.247	Mode:	Mid channel
Frequency Range:	30 MHz - 1 GHz	Test Date:	10/20/2020 - 10/27/2020
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

900MHz Radio-Mid Channel



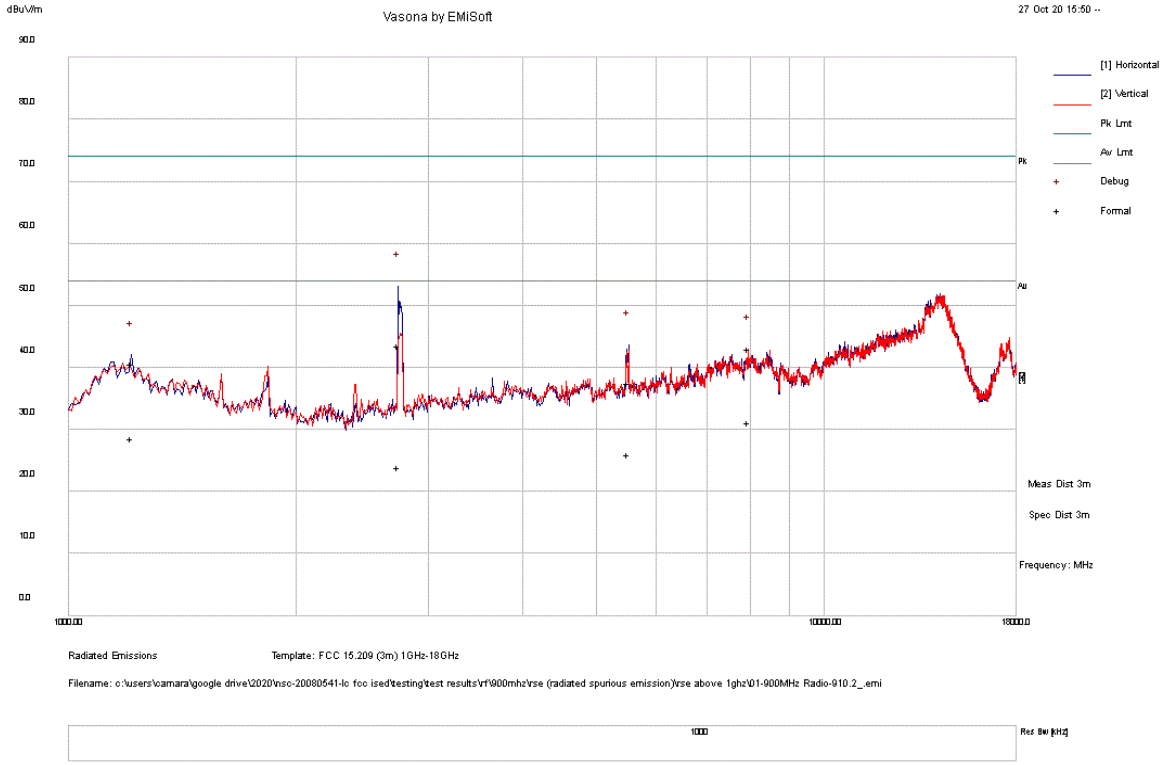
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
71.9	53.86	3.20	-24.43	32.62	Quasi Max	V	357	236	40.00	-7.38	Pass
215.99	52.88	4.91	-20.64	37.15	Quasi Max	H	144	219	43.50	-6.35	Pass
944.13	38.43	7.78	-5.93	40.28	Quasi Max	V	101	17	46.00	-5.72	Pass

Note: The highest emission is fundamental emission.

RADIATED SPURIOUS EMISSION ABOVE 1GHZ

Test Standard:	15.209, 15.247	Mode:	Low Channel
Frequency Range:	1 GHz - 18 GHz	Test Date:	10/20/2020 - 10/27/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

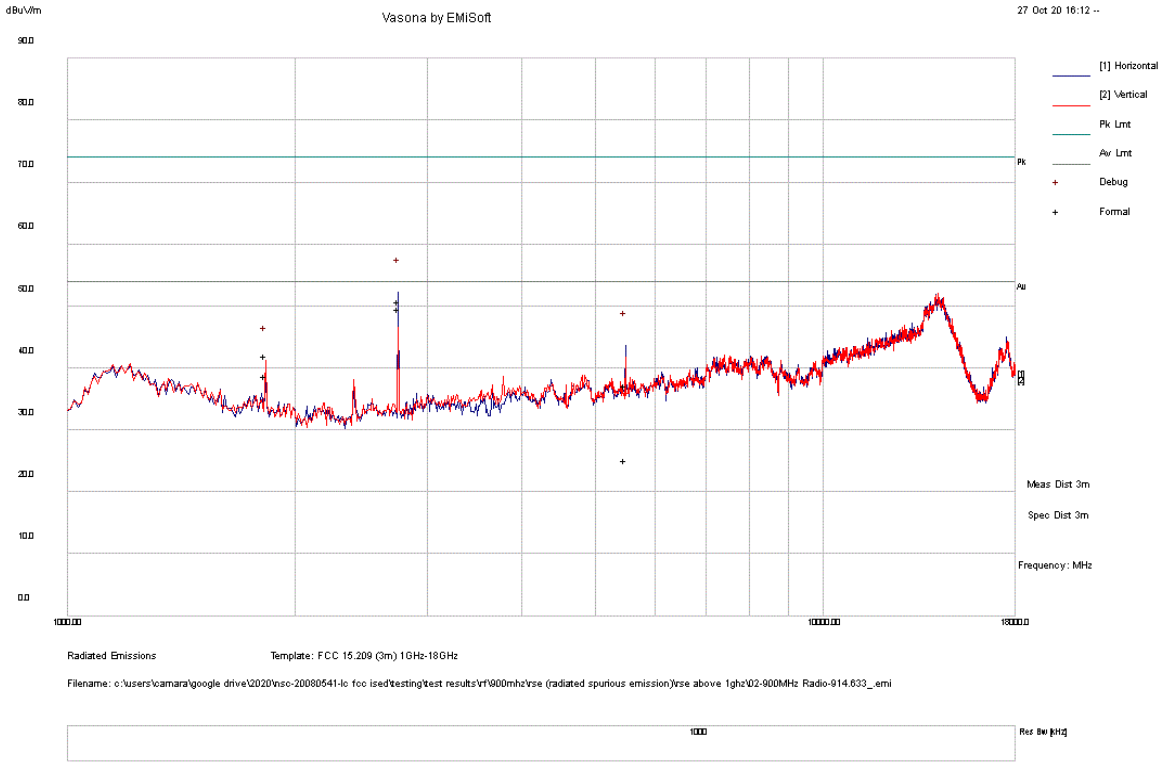
900MHz Radio-Low Channel



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
2732.17	36.95	15.06	-8.47	43.54	Peak Max	H	382	164	74.00	-30.46	Pass
5514.21	20.44	17.57	-0.41	37.60	Peak Max	H	388	244	74.00	-36.40	Pass
7947.44	21.52	21.23	0.27	43.03	Peak Max	V	208	172	74.00	-30.97	Pass
1211.67	31.70	14.33	-5.35	40.68	Peak Max	H	173	49	74.00	-33.32	Pass
2732.17	17.43	15.06	-8.47	24.02	Average Max	H	382	164	54.00	-29.98	Pass
5514.21	8.85	17.57	-0.41	26.02	Average Max	H	388	244	54.00	-27.99	Pass
7947.44	9.62	21.23	0.27	31.13	Average Max	V	208	172	54.00	-22.88	Pass
1211.67	19.71	14.33	-5.35	28.70	Average Max	H	173	49	54.00	-25.30	Pass

Test Standard:	15.209, 15.247	Mode:	Mid Channel
Frequency Range:	1 GHz - 18 GHz	Test Date:	10/20/2020 - 10/27/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

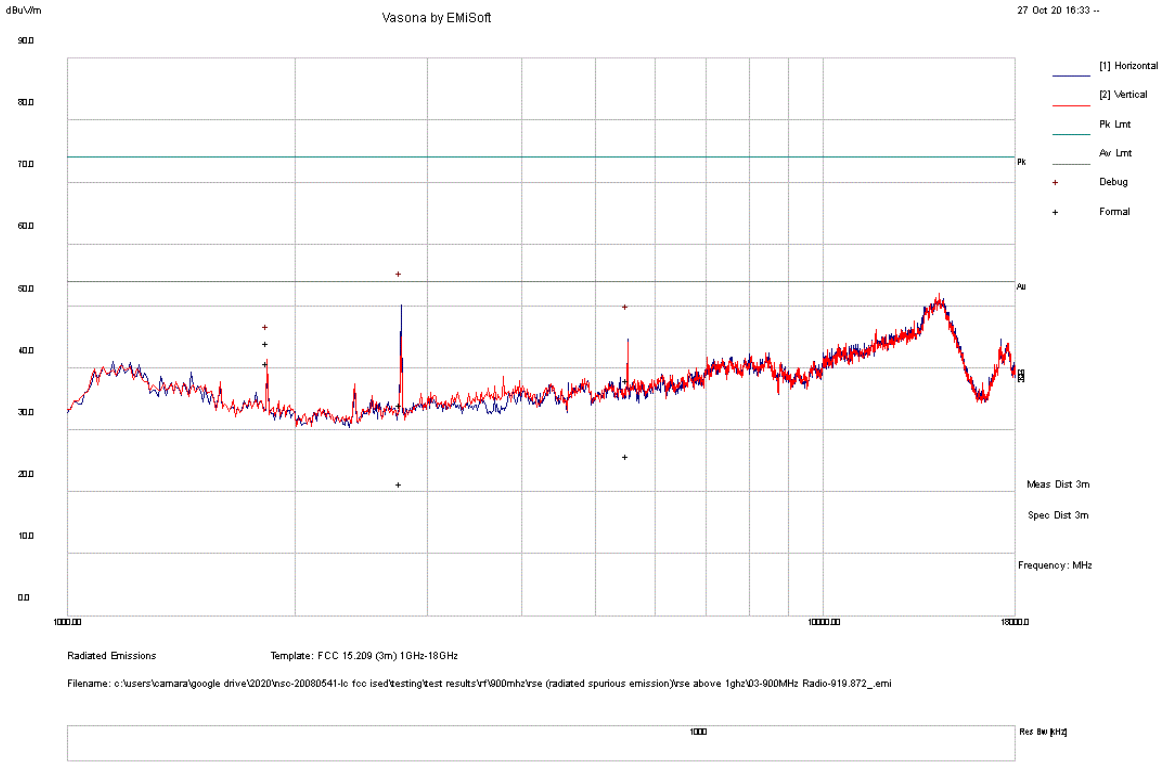
900MHz Radio-Mid Channel



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
2743.78	44.15	15.07	-8.44	50.78	Peak Max	H	148	0	74.00	-23.22	Pass
5481.78	20.05	17.53	-0.42	37.15	Peak Max	H	107	360	74.00	-36.85	Pass
1829.28	36.41	14.44	-8.79	42.06	Peak Max	V	185	180	74.00	-31.94	Pass
2743.78	43.01	15.07	-8.44	49.64	Average Max	H	148	0	54.00	-4.36	Pass
5481.78	8.15	17.53	-0.42	25.25	Average Max	H	107	360	54.00	-28.75	Pass
1829.28	33.04	14.44	-8.79	38.70	Average Max	V	185	180	54.00	-15.30	Pass

Test Standard:	15.209, 15.247	Mode:	High Channel
Frequency Range:	1 GHz - 18 GHz	Test Date:	10/20/2020 - 10/27/2020
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass

900MHz Radio-High Channel



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
2764.12	27.32	15.09	-8.36	34.05	Peak Max	H	280	133	74.00	-39.95	Pass
5516.24	20.99	17.58	-0.41	38.16	Peak Max	H	256	287	74.00	-35.84	Pass
1839.63	38.32	14.43	-8.70	44.05	Peak Max	V	108	18	74.00	-29.95	Pass
2764.12	14.64	15.09	-8.36	21.37	Average Max	H	280	133	54.00	-32.63	Pass
5516.24	8.67	17.58	-0.41	25.84	Average Max	H	256	287	54.00	-28.16	Pass
1839.63	35.11	14.43	-8.70	40.84	Average Max	V	108	18	54.00	-13.16	Pass

7.10 AC Line Conducted Emissions

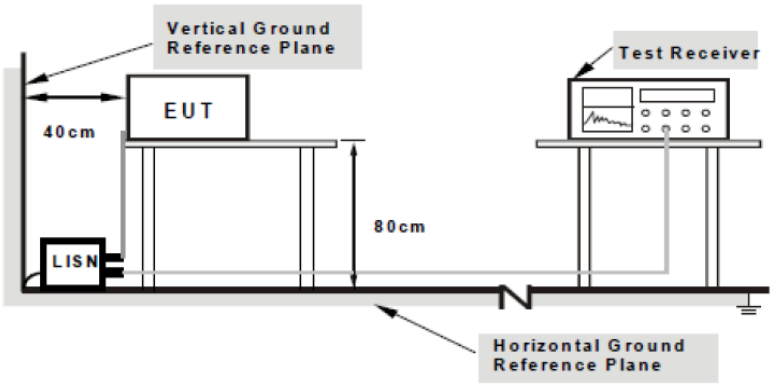
7.10.1 Requirement

15.207(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66-56*	56-46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency

7.10.2 Test Setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

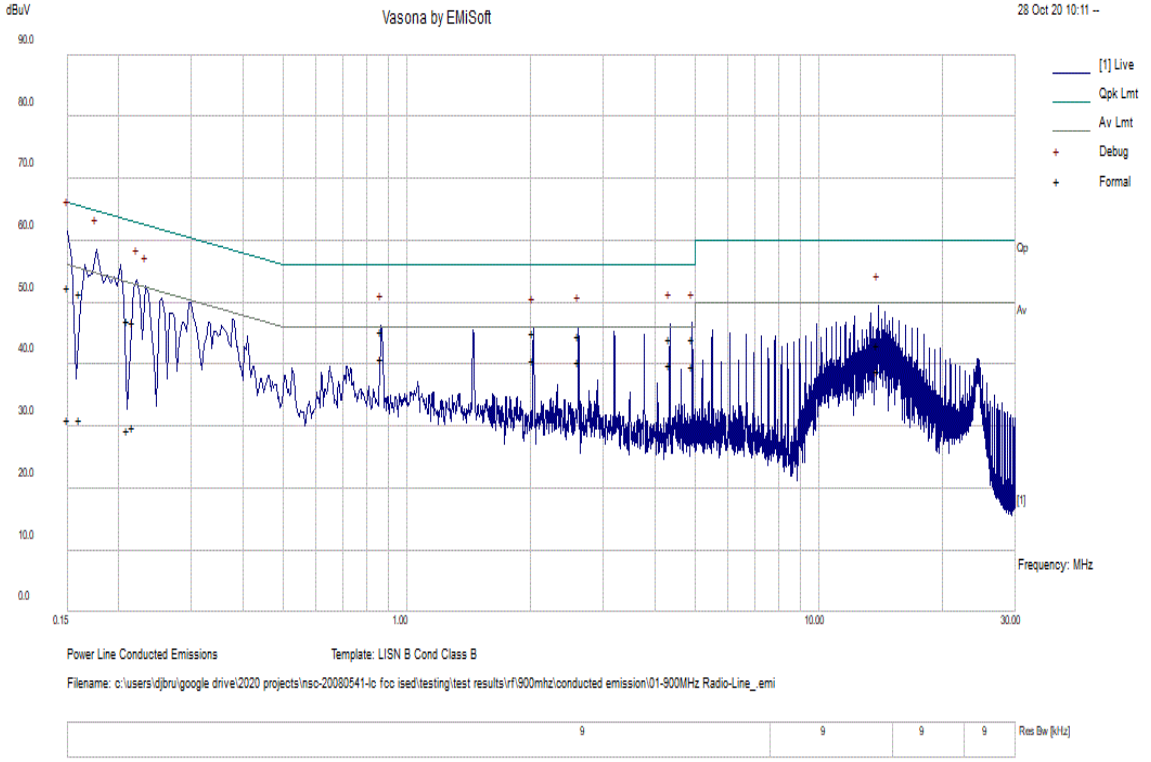
7.10.3 Test Procedure

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/5μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment was powered separately from another main supply.
5. The EUT was switched on and allowed to warm up to its normal operating condition.
6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
7. High peaks, relative to the limit line, were then selected.
8. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. For FCC tests, only Quasi-peak measurements were made; while for CISPR/EN tests, both Quasi-peak and Average measurements were made.
9. All possible modes of operation were investigated. Only the worst-case emissions were measured and reported. All other emissions were relatively insignificant.

7.10.4 Test Result

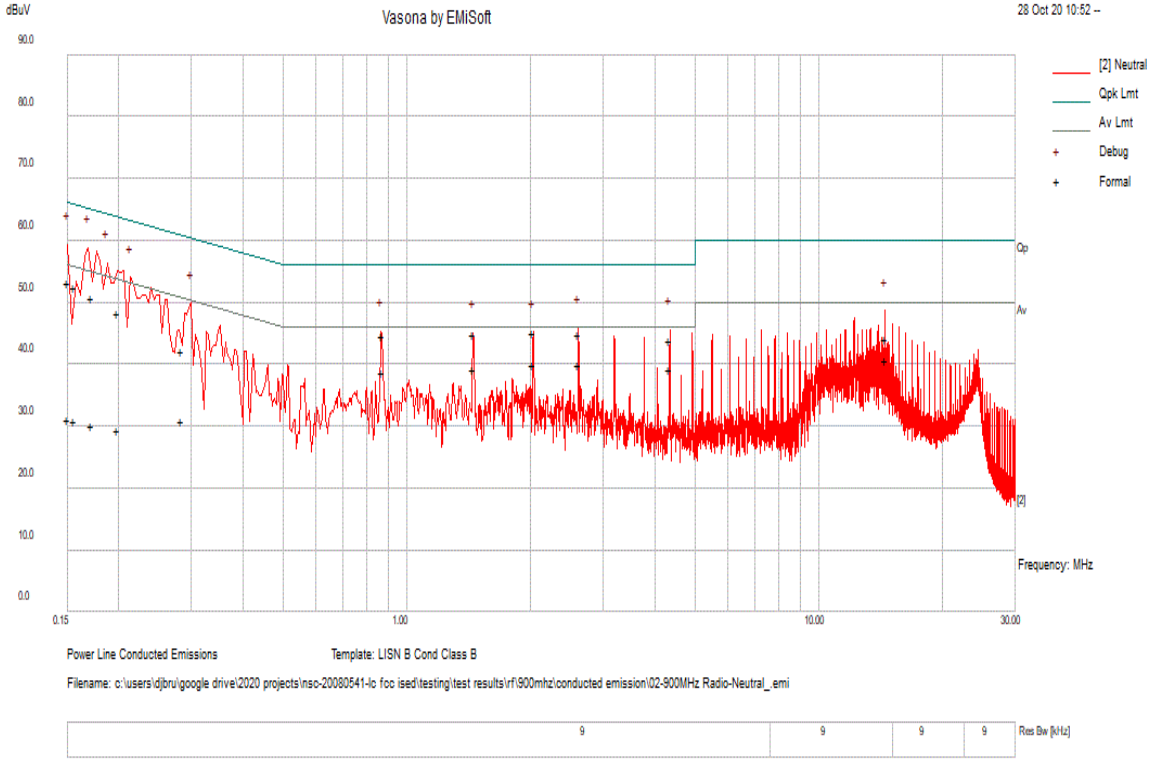
CONDUCTED EMISSIONS

Test Standard:	LISN B Cond Class B	Mode:	Con-TX
Frequency Range:	0.15 - 30MHz	Test Date:	10/20/2020 - 10/27/2020
Line:	Live	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



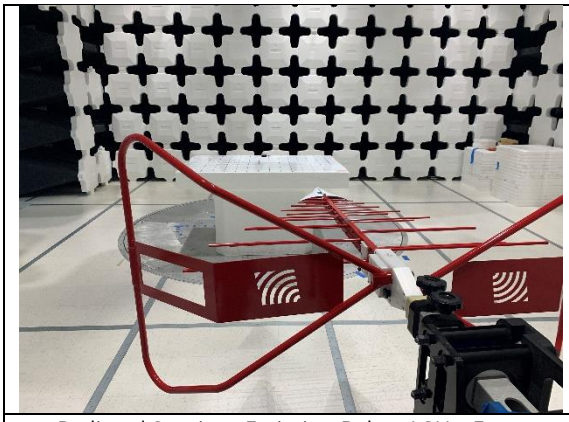
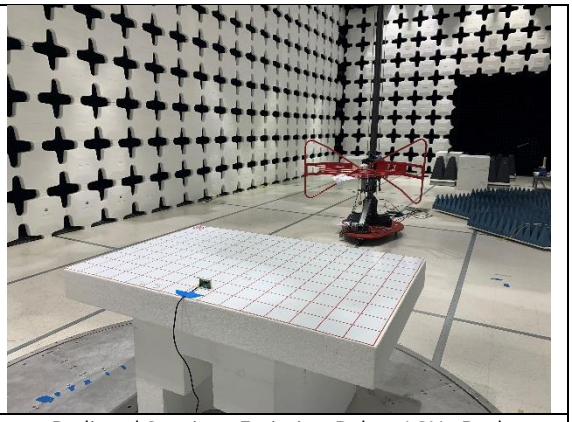
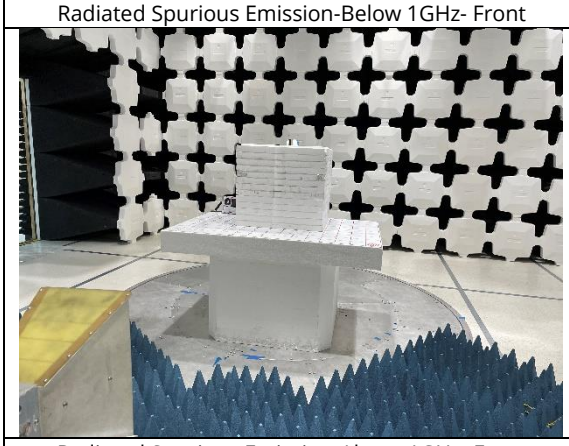
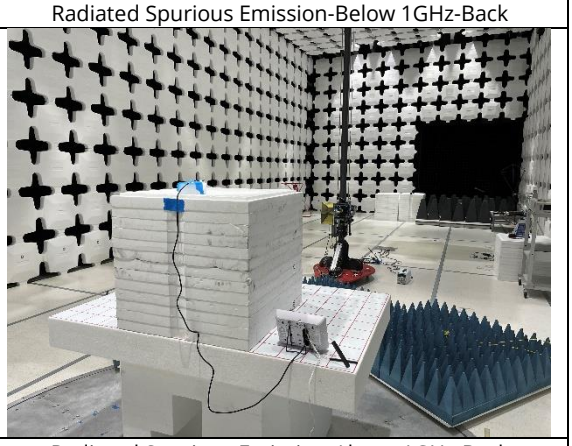
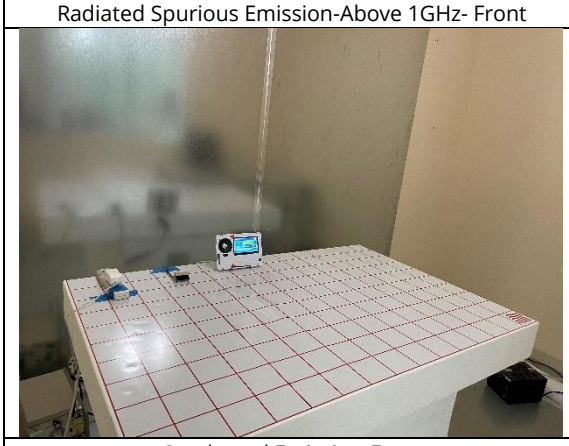
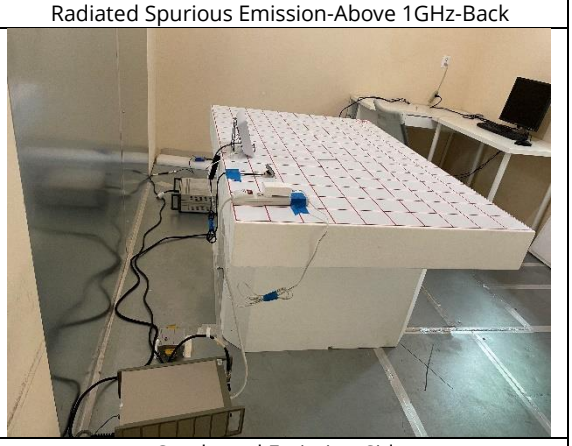
Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV/m	Margin dB	Pass/Fail
0.15	42.29	10.07	0.24	52.61	Quasi Peak	Live	66.00	-13.39	Pass
0.16	41.35	10.07	0.23	51.66	Quasi Peak	Live	65.44	-13.78	Pass
0.21	36.80	10.08	0.18	47.06	Quasi Peak	Live	63.24	-16.18	Pass
4.93	33.64	10.39	0.15	44.17	Quasi Peak	Live	56.00	-11.83	Pass
4.35	33.81	10.35	0.13	44.30	Quasi Peak	Live	56.00	-11.70	Pass
0.87	35.30	10.14	0.10	45.54	Quasi Peak	Live	56.00	-10.46	Pass
0.22	36.59	10.08	0.17	46.84	Quasi Peak	Live	62.95	-16.12	Pass
2.61	34.37	10.26	0.11	44.74	Quasi Peak	Live	56.00	-11.26	Pass
2.03	34.75	10.22	0.11	45.08	Quasi Peak	Live	56.00	-10.92	Pass
13.9	32.29	10.63	0.29	43.20	Quasi Peak	Live	60.00	-16.80	Pass
0.15	20.97	10.07	0.24	31.28	Average	Live	56.00	-24.71	Pass
0.16	20.98	10.07	0.23	31.28	Average	Live	55.44	-24.15	Pass
0.21	19.14	10.08	0.18	29.39	Average	Live	53.24	-23.84	Pass
4.93	29.24	10.39	0.15	39.77	Average	Live	46.00	-6.23	Pass
4.35	29.53	10.35	0.13	40.02	Average	Live	46.00	-5.98	Pass
0.87	30.76	10.14	0.10	41.00	Average	Live	46.00	-5.00	Pass
0.22	19.61	10.08	0.17	29.86	Average	Live	52.95	-23.09	Pass
2.61	30.26	10.26	0.11	40.63	Average	Live	46.00	-5.37	Pass
2.03	30.54	10.22	0.11	40.87	Average	Live	46.00	-5.13	Pass
13.9	28.01	10.63	0.29	38.92	Average	Live	50.00	-11.08	Pass

Test Standard:	LISN B Cond Class B	Mode:	900MHz Radio-Neutral
Frequency Range:	0.15 - 30MHz	Test Date:	10/20/2020 - 10/27/2020
Line:	Neutral	Test Personnel:	Daniel Bruno
Remark:	N/A	Test Result:	Pass



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV/m	Margin dB	Pass/Fail
0.16	42.30	10.07	0.24	52.61	Quasi Peak	Neutral	65.67	-13.06	Pass
0.15	42.86	10.07	0.24	53.17	Quasi Peak	Neutral	66.00	-12.83	Pass
0.17	40.46	10.07	0.21	50.75	Quasi Peak	Neutral	64.87	-14.12	Pass
0.2	38.19	10.07	0.18	48.44	Quasi Peak	Neutral	63.66	-15.21	Pass
2.61	34.62	10.26	0.11	44.99	Quasi Peak	Neutral	56.00	-11.01	Pass
0.28	31.99	10.08	0.14	42.21	Quasi Peak	Neutral	60.68	-18.47	Pass
4.35	33.43	10.36	0.13	43.92	Quasi Peak	Neutral	56.00	-12.08	Pass
0.87	34.56	10.14	0.10	44.80	Quasi Peak	Neutral	56.00	-11.20	Pass
2.03	34.82	10.22	0.11	45.15	Quasi Peak	Neutral	56.00	-10.85	Pass
1.45	34.59	10.19	0.11	44.88	Quasi Peak	Neutral	56.00	-11.12	Pass
0.16	20.70	10.07	0.24	31.01	Average	Neutral	55.67	-24.66	Pass
0.15	20.86	10.07	0.24	31.18	Average	Neutral	56.00	-24.82	Pass
0.17	19.86	10.07	0.21	30.15	Average	Neutral	54.87	-24.72	Pass
0.2	19.28	10.07	0.18	29.53	Average	Neutral	53.66	-24.12	Pass
2.61	29.63	10.26	0.11	40.00	Average	Neutral	46.00	-6.00	Pass
0.28	20.74	10.08	0.14	30.97	Average	Neutral	50.68	-19.71	Pass
4.35	28.78	10.36	0.13	39.27	Average	Neutral	46.00	-6.73	Pass
0.87	28.55	10.14	0.10	38.78	Average	Neutral	46.00	-7.22	Pass
2.03	29.58	10.22	0.11	39.91	Average	Neutral	46.00	-6.09	Pass
1.45	29.00	10.19	0.11	39.29	Average	Neutral	46.00	-6.71	Pass

8 EUT Setup and Photos

	
Radiated Spurious Emission-Below 1GHz- Front	Radiated Spurious Emission-Below 1GHz-Back
	
Radiated Spurious Emission-Above 1GHz- Front	Radiated Spurious Emission-Above 1GHz-Back
	
Conducted Emission-Front	Conducted Emission-Side

9 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/19	10/18/21
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	6/17/20	6/17/21
EMC Test Receiver	R&S	ESL6	100230	6/14/20	6/14/21
LISN (9KHz – 30MHz)	EMCO	3816/2	9705-1066	5/4/20	5/4/21
LISN (9KHz – 30MHz)	Com-Power	LI-550C	20140050	01/29/2020	01/29/2021
LISN (9KHz – 30MHz)	Com-Power	LI-550C	20140051	01/29/2020	01/29/2021
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2019	11/15/2020
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	5/14/2020	5/14/2021
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	6/24/20	6/24/21
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	7/16/2020	7/16/2021
True RMS Multi-meter	UNI-T	UT181A	C173014829	5/5/2020	5/5/2021
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	5/15/2020	5/15/2021
RF Attenuator	Pasternack	PE7005-3	VL061	7/16/2020	7/16/2021
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	7/16/2020	7/16/2021
EM Center Control	ETS-Lindgren	7006-001	160136	N/A	N/A
Turn Table	ETS-Lindgren	2181-3.03	VL002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	VL003	N/A	N/A
Loop Antenna (9k-30MHz)	Com-Power	AL-130	121012	5/16/20	5/16/21
RE test cable(below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	7/16/2020	7/16/2021
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	7/16/2020	7/16/2021
RE test cable (>18GHz)	Sucoflex	104	344903/4	7/16/2020	7/16/2021
Pulse limiter	Com-Power	LIT-930A	531727	7/16/2020	7/16/2021
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	7/16/2020	7/16/2021
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	7/16/2020	7/16/2021
Vector Signal Generator	Keysight	N5182A	US47080548	6/17/20	6/17/21
RF Power Amplifier (80-1000MHz)	Ophir	5226FE	1013/1815	N/A	N/A
RF Power Amplifier (700-6000MHz)	Ophir	5293FE	1063/1815	N/A	N/A
Horn Antenna (1-18GHz)	FT-RF	HA-07M18G-NF	180010HA	N/A	N/A