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Phone: +1 (949) 393-1123
Web: www.vista-compliance.com
Email: info@vista-compliance.com

FCC ISED RF Test Report

Test Report Number	PFE-22030421-LC-FCC-IC-RF
FCC ID	N4TWMC915R1
IC	3196A-WMC915R1
Applicant	Phase IV Engineering Inc.
Applicant Address	2820 Wilderness Place Suite C, Boulder, CO 80301
Product Name	WIKA Module
Model (s)	44-100358-00
Date of Receipt	04/08/2022
Date of Test	04/08/2022- 05/24/2022
Report Issue Date	06/24/2022
Test Standards	47 CFR Part 15.247
Test Result	**PASS**

Issued by:

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

Devin Tai (Test Engineer)

David Zhang (Technical Manager)

REVISION HISTORY

Report Number	Version	Description	Issued Date
PFE-22030421-LC-FCC-IC-RF	01	Initial report	06/24/2022

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1 Test Summary

Test Item	Test Requirement	Test Method	Result
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AC Power Line Conducted Emissions	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Occupied Bandwidth	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
DTS (6 dB) Channel Bandwidth	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Conducted Maximum Output Power	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Power Spectral Density	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Conducted Band-Edge	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass
Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands	47 CFR Part 15.247	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02	Pass

2 General Information

2.1 Applicant

Applicant	Phase IV Engineering Inc.
Applicant address	2820 Wilderness Place Suite C, Boulder, CO 80301
Manufacturer	Phase IV Engineering Inc.
Manufacturer Address	2820 Wilderness Place Suite C, Boulder, CO 80301

2.2 Product information

Product Name	WIKA Module
Product Description	WIKA Module
Model Number	44-100358-00
Family Models	N/A
Serial Number	FCC1
Frequency Band	906 – 924 MHz
Type of modulation	OQPSK (DSSS)
Equipment Class	DTS
Antenna Information	Antenna#1 - Mag mount vertical whip antenna with a gain of 2.82 dBi (Model: NMO5T900B) Antenna#2 - Short monopole with a gain of 2.7 dBi (Model: FW.95.B.SMA.M) Antenna#3 - Short monopole with a gain of 2 dBi (Model: S1551AH-915S)
Clock Frequencies	N/A
Input Power	DC 3.3V
Power Adapter Manufacturer/Model	N/A
Power Adapter SN	N/A
Hardware version	N/A
Software version	N/A
Simultaneous Transmission	N/A
Additional Info	Both antenna #2 and #3 are short monopole antenna type. Only the worst case one with higher gain, the antenna #2 together with #1, were tested as representative.

2.3 Test standard and method

Test standard	47 CFR Part 15.247
Test method	ANSI C63.10-2013 558074 D01 15.247 Meas Guidance v05r02

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	23.2°C	58.2%	996 mbar
Radiated Emission Testing	23.2°C	58.2%	996 mbar

4 Modification of EUT / Deviations from Standards

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

5 Test Configuration and Operation

5.1 EUT Test Configuration

EUT is set to different transmission mode in terms of radio mode bandwidth, power level, test channel, etc.

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
LEAP Radio Test	Setting EUT into different RF test mode

5.2 Supporting Equipment

Description	Manufacturer	Model #	Serial #
DC Power Supply	RIGOL	DP712	DP7B194900487

6 Uncertainty of Measurement

Test item	Measurement Uncertainty (dB)
RF Output Power (Conducted)	±1.2 dB
Power Spectral Density	±0.9 dB
Unwanted Emission (conducted)	±2.6 dB
Occupied Channel Bandwidth	±5 %
Radiated Emission (9KHz-30MHz)	±3.5 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 has an unique U.FL RF connectors on the PCB board.
- Both main board and antenna are equipped with U.FL connector. No standard RF connector is used.

Conclusion:

- EUT complies with antenna requirement in § 15.203.

7.2 Conducted Emissions

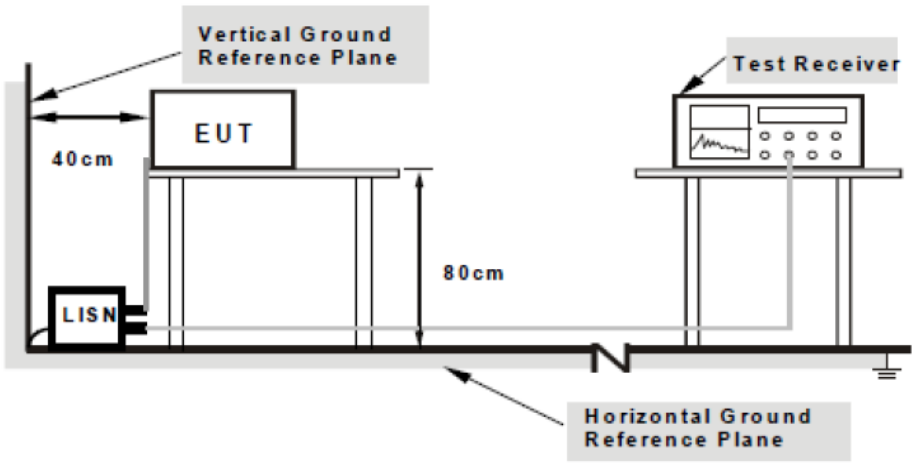
7.2.1 Requirement

Per § 15.207 (a), 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.

Limits for Conducted Emissions at the Mains Ports

Section	Frequency ranges (MHz)	Limit (dBuV)	
		QP	Average
Class B devices	0.15 – 0.5	66 – 56	56 – 46
	0.5 – 5	56	46
	5 - 30	60	50
NOTE 1 The lower limit shall apply at the transition frequencies.			

7.2.2 Test setup



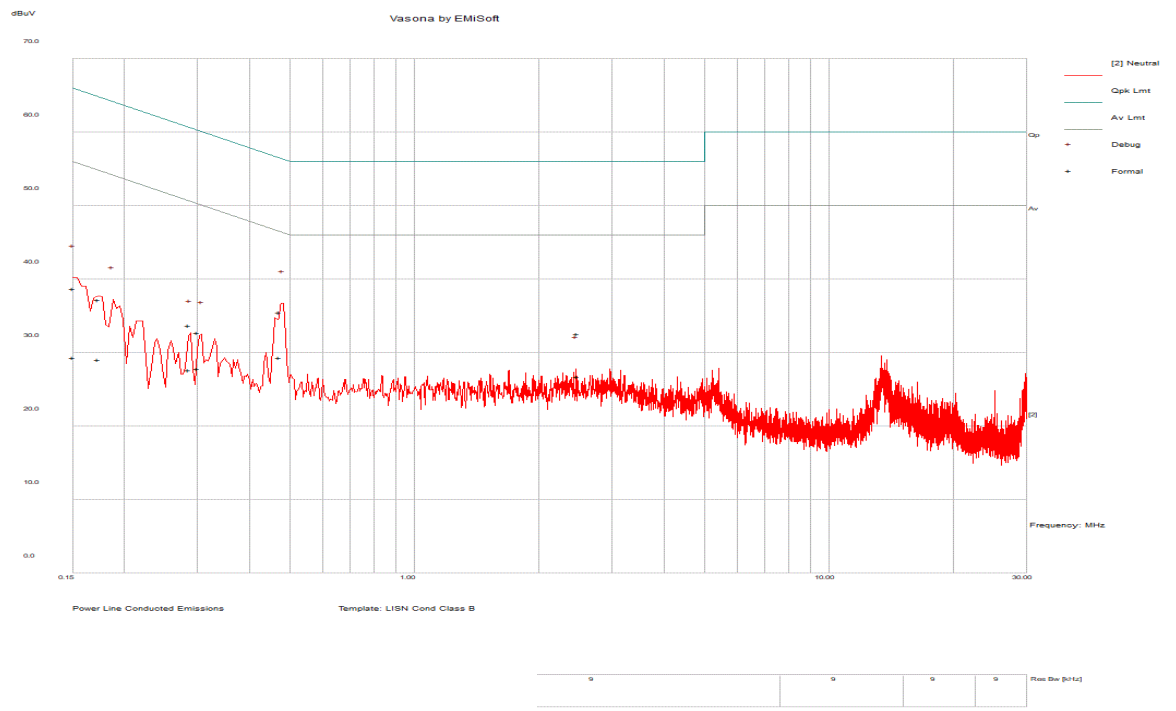
Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

7.2.3 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/50µH 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. 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.

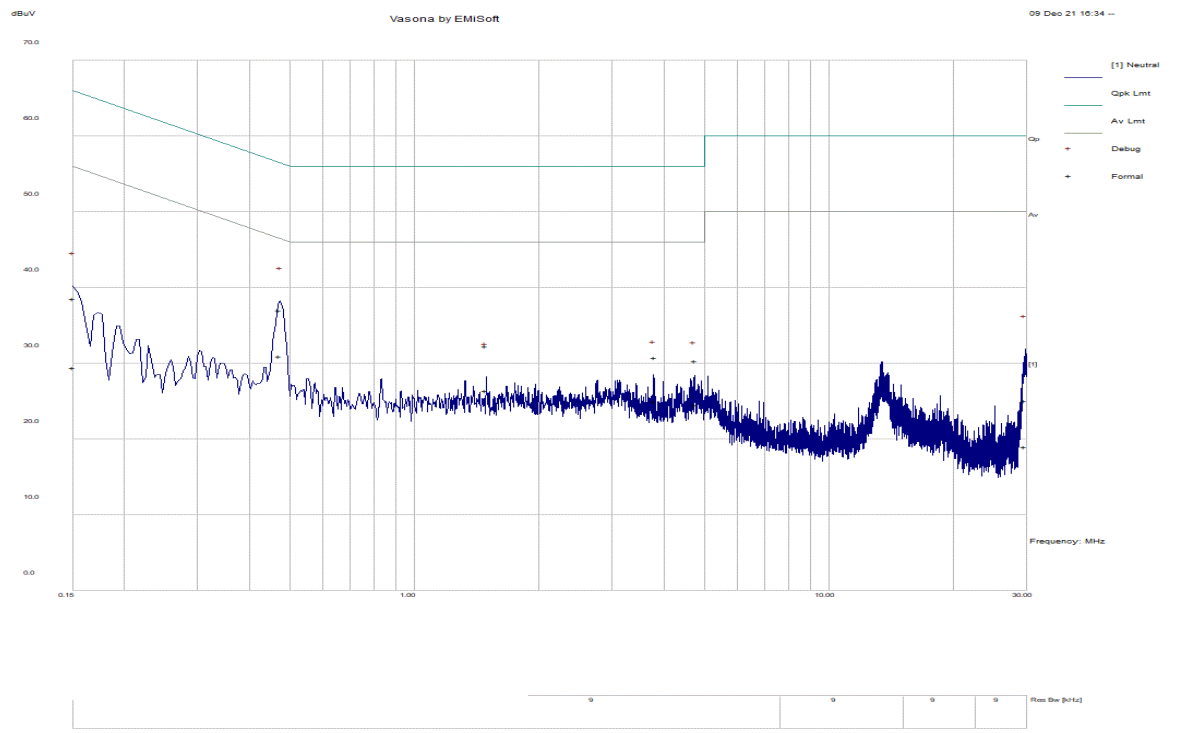
7.2.4 Test Result

Test Standard:	Part 15.207	Mode:	900MHz TX mode
Frequency Range:	0.15-30MHz	Test Date:	05/24/2022
Antenna Type/Polarity:	N/A	Test Personnel:	Devin Tai
Remark:	Class B, 120VAC, 60Hz (tested with AC/DC adapter)	Test Result:	Pass



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Meas. Ty pe	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
0.473	25.30	10.10	0.10	35.50	QP	Neutral	56.50	-20.90	Pass
0.150	28.50	10.10	0.20	38.80	QP	Neutral	66.00	-27.20	Pass
0.173	27.00	10.10	0.20	37.20	QP	Neutral	64.80	-27.60	Pass
0.299	22.60	10.10	0.10	32.80	QP	Neutral	60.30	-27.40	Pass
0.286	23.50	10.10	0.10	33.80	QP	Neutral	60.70	-26.90	Pass
2.464	22.30	10.30	0.10	32.60	QP	Neutral	56.00	-23.40	Pass
0.473	19.20	10.10	0.10	29.40	AV	Neutral	46.50	-17.00	Pass
0.150	19.10	10.10	0.20	29.50	AV	Neutral	56.00	-26.50	Pass
0.173	18.90	10.10	0.20	29.20	AV	Neutral	54.80	-25.60	Pass
0.299	17.60	10.10	0.10	27.90	AV	Neutral	50.30	-22.40	Pass
0.286	17.50	10.10	0.10	27.80	AV	Neutral	50.70	-22.90	Pass
2.464	16.40	10.30	0.10	26.80	AV	Neutral	46.00	-19.20	Pass

Test Standard:	Part 15.207	Mode:	900MHz TX mode
Frequency Range:	0.15-30MHz	Test Date:	05/24/2022
Antenna Type/Polarity:	N/A	Test Personnel:	Devin Tai
Remark:	Class B, 120VAC, 60Hz (tested with AC/DC adapter)	Test Result:	Pass



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Meas. Type	Line	Limit (dBuV)	Margin (dB)	Pass /Fail
0.471	26.90	10.10	0.10	37.10	QP	Live	56.50	-19.40	Pass
0.150	28.30	10.10	0.20	38.60	QP	Live	66.00	-27.40	Pass
3.789	20.40	10.30	0.10	30.80	QP	Live	56.00	-25.20	Pass
4.747	19.80	10.40	0.10	30.40	QP	Live	56.00	-25.60	Pass
1.486	22.00	10.20	0.10	32.30	QP	Live	56.00	-23.70	Pass
29.660	13.30	10.90	0.90	25.10	QP	Live	60.00	-34.90	Pass
0.471	20.80	10.10	0.10	31.00	AV	Live	46.50	-15.50	Pass
0.150	19.20	10.10	0.20	29.50	AV	Live	56.00	-26.50	Pass
3.789	14.60	10.30	0.10	25.00	AV	Live	46.00	-21.00	Pass
4.747	14.00	10.40	0.10	24.60	AV	Live	46.00	-21.40	Pass
1.486	16.20	10.20	0.10	26.50	AV	Live	46.00	-19.50	Pass
29.660	7.10	10.90	0.90	19.00	AV	Live	50.00	-31.00	Pass

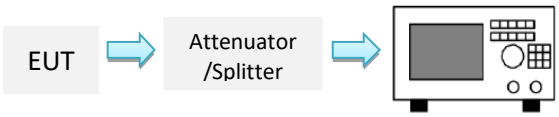
7.3 DTS (6 dB) Bandwidth

7.3.1 Requirement

§ 15.247 (a)(2)

Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

7.3.2 Test Setup



7.3.3 Test Procedure

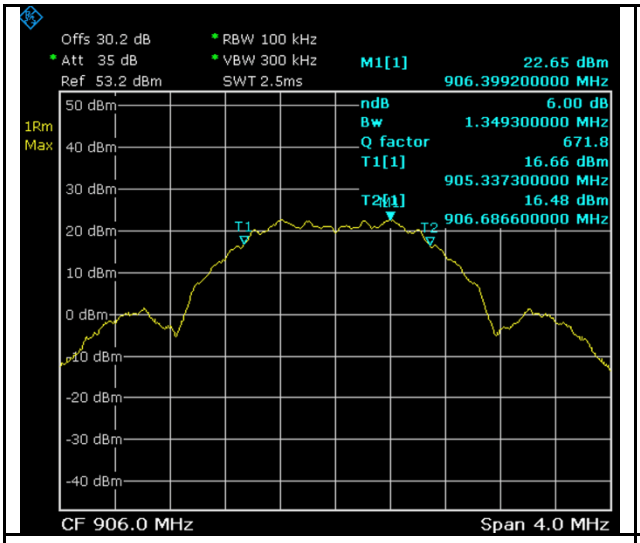
According to section 8.2, option 2, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.8 of ANSI C63.10-2013:

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.

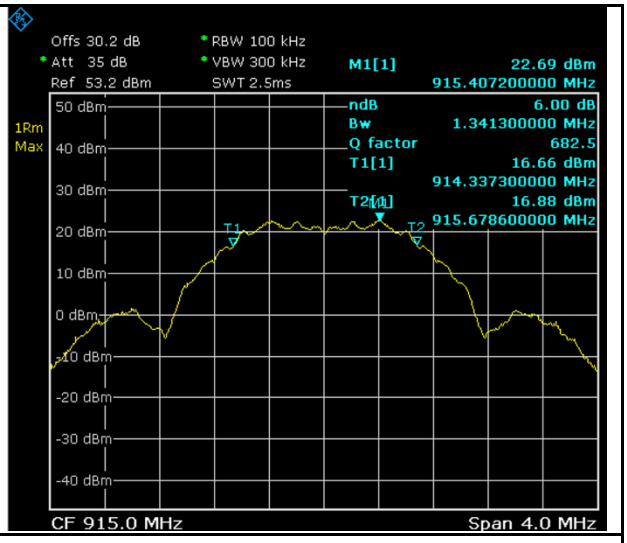
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

7.3.4 Test Result

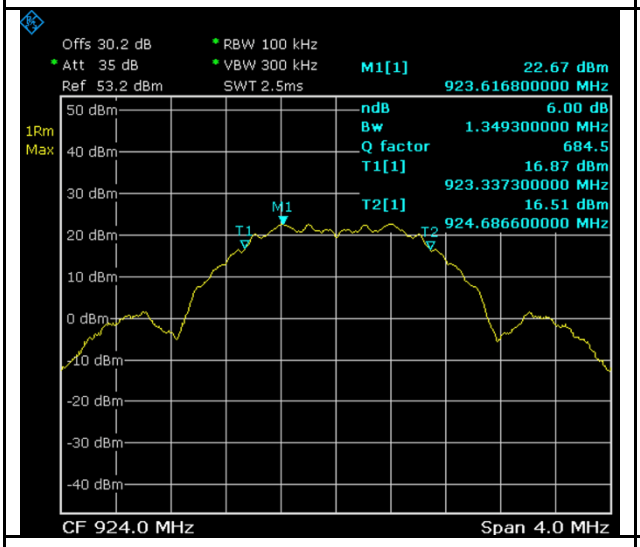
Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
900MHz	906	200Kbps	1349.3	500	Pass
900MHz	915	200Kbps	1341.3	500	Pass
900MHz	924	200Kbps	1349.3	500	Pass



DTS BW-Low CH



DTS BW-Mid CH



DTS BW-High CH

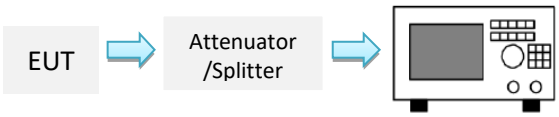
7.4 Occupied Bandwidth (99%)

7.4.1 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.

7.4.2 Test Setup



7.4.3 Test Procedure

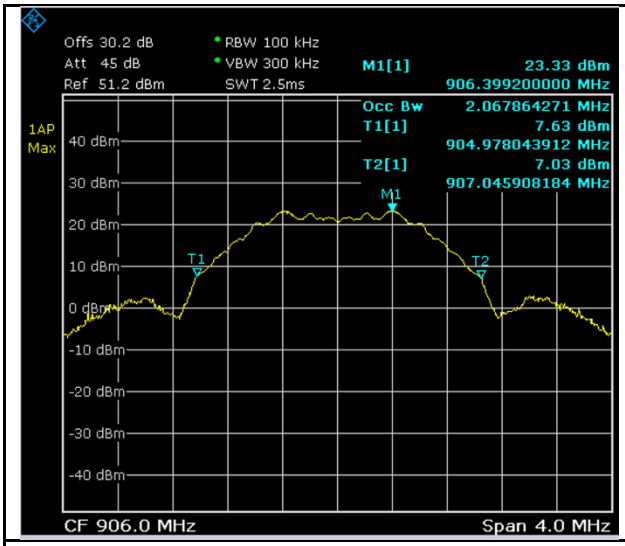
According to section RSS-Gen §6.7

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.

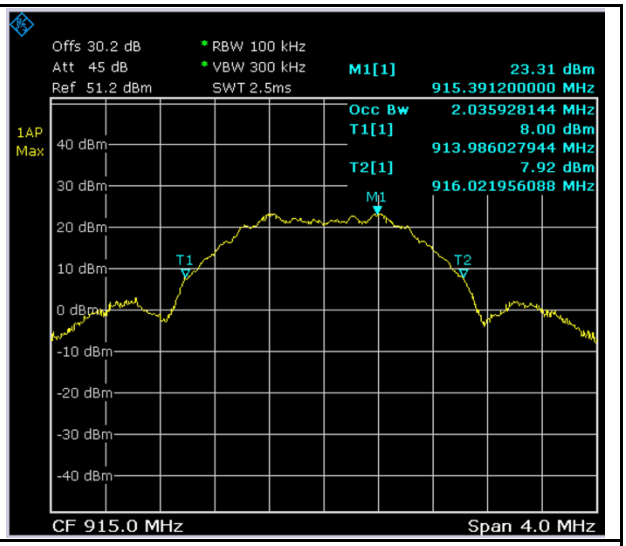
1. Set RBW = 1% to 5% of the actual occupied BW.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Span = large enough to capture all products of the modulation process
7. Allow the trace to stabilize.
8. Use automatic bandwidth measurement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

7.4.4 Test Result

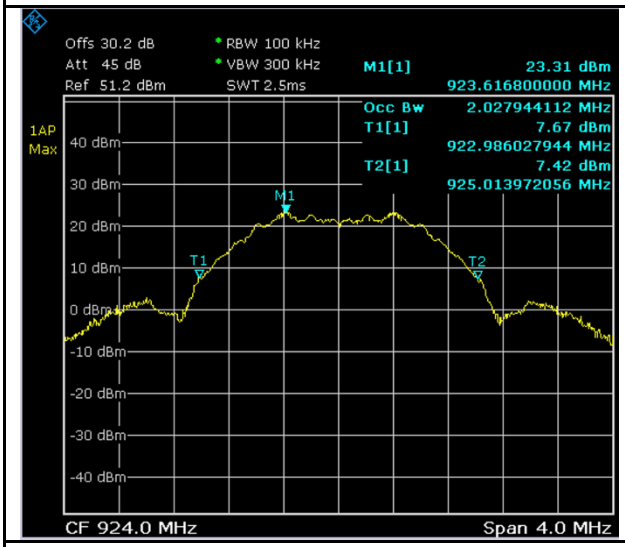
Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured 99% Bandwidth (KHz)	Minimum Bandwidth (KHz)	Result
900MHz	906	200Kbps	2067.9	N/A	N/A
900MHz	915	200Kbps	2035.9	N/A	N/A
900MHz	924	200Kbps	2027.9	N/A	N/A



99% BW-Low CH



99% BW-Mid CH



99% BW-High CH

7.5 Maximum Output Power

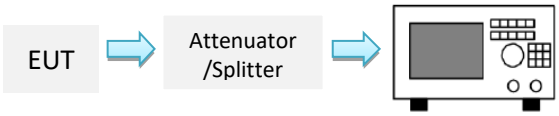
7.5.1 Requirement

§ 15.247 (b)(3), RSS-247 §5.4

or systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: the maximum output power is 1 Watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.5.2 Test Setup



7.5.3 Test Procedure

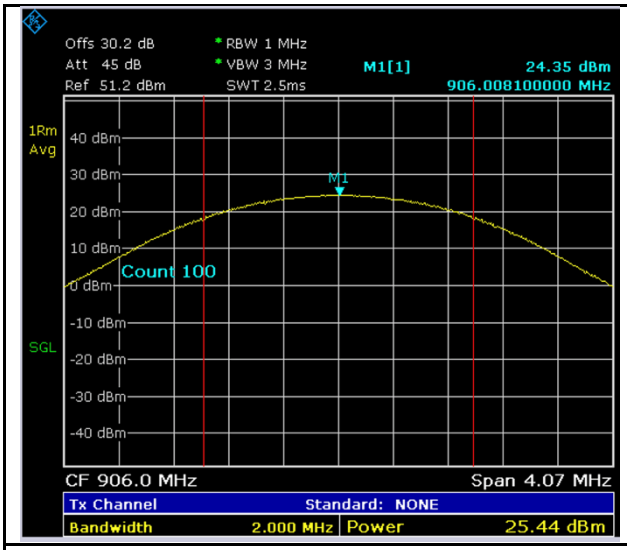
Power measurement is according to subclause 11.9.1.2 of ANSI C63.10-2013:

1. Set the RBW = 1MHz
2. Set VBW ≥ 3 X RBW.
2. Set SPAN ≥ 1.5 X DTS RBW.
3. Sweep time = auto couple.
4. Detector = peak.
5. Trace mode = max hold
6. Allow trace to fully stabilize.
7. Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select the peak detector). If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.

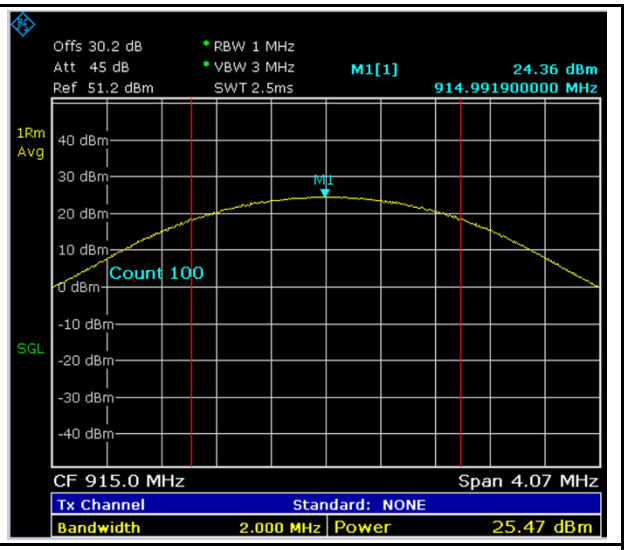
7.5.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured Output Power (dBm)	Max Output Power Limit (dBm)	Result
900MHz	906	200Kbps	25.44	30	Pass
900MHz	915	200Kbps	25.47	30	Pass
900MHz	924	200Kbps	25.50	30	Pass

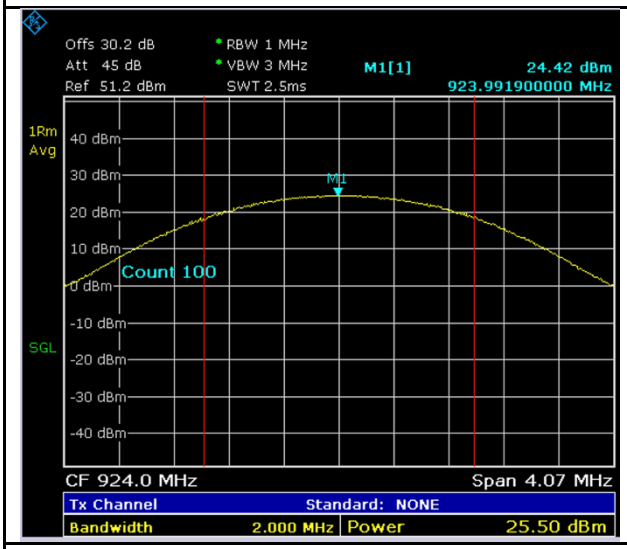
7.5.5 Test Plots



Output Power-Low CH



Output Power-Mid CH



Output Power-High CH

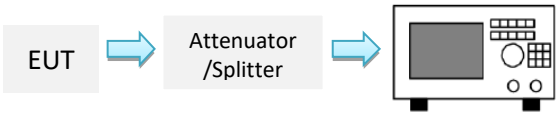
7.6 Power Spectral Density

7.6.1 Requirement

§ 15.247 (e), RSS-247 §5.2

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power is used to determine the power spectral density.

7.6.2 Test Setup



7.6.3 Test Procedure

According to section 8.4 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.10.2 PKPSD of ANSI C63.10-2013:

1. Set analyser centre frequency to DTS channel centre frequency.
2. Set the span to 1.5 X DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x 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 the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

7.6.4 Test Result

Mode/ Bandwidth	Frequency (MHz)	Data rate	Measured PSD (dBm/3KHz)	Max PSD (dBm/3KHz)	Result
900MHz	906	200Kbps	2.28	8	Pass
900MHz	915	200Kbps	2.33	8	Pass
900MHz	924	200Kbps	2.38	8	Pass

7.6.5 Test Plots

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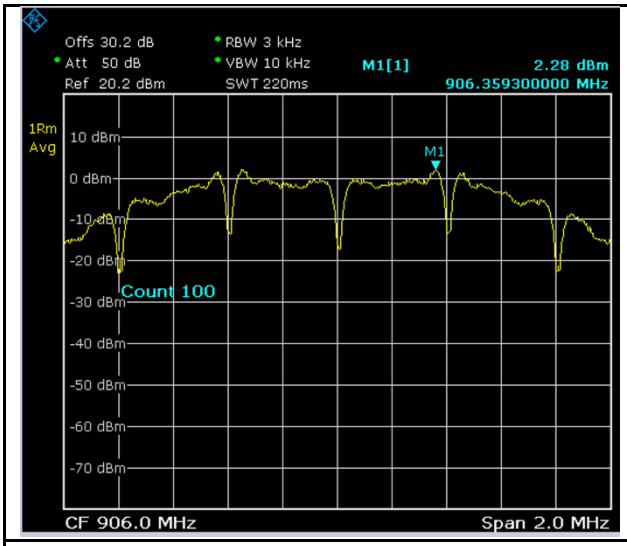
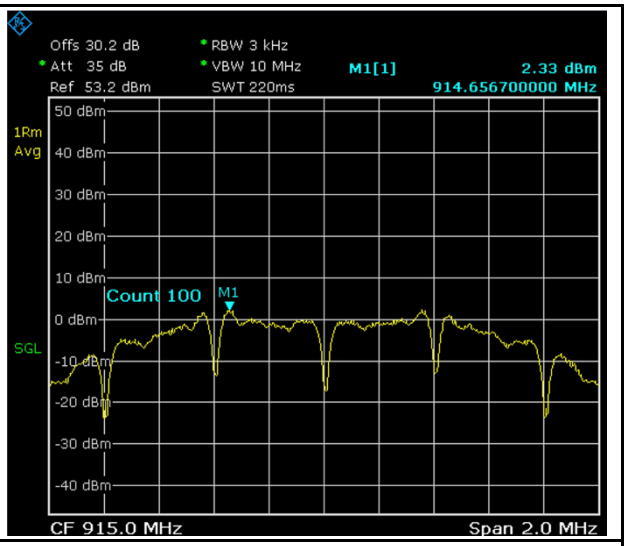
<tr><td> 
</td><td> 
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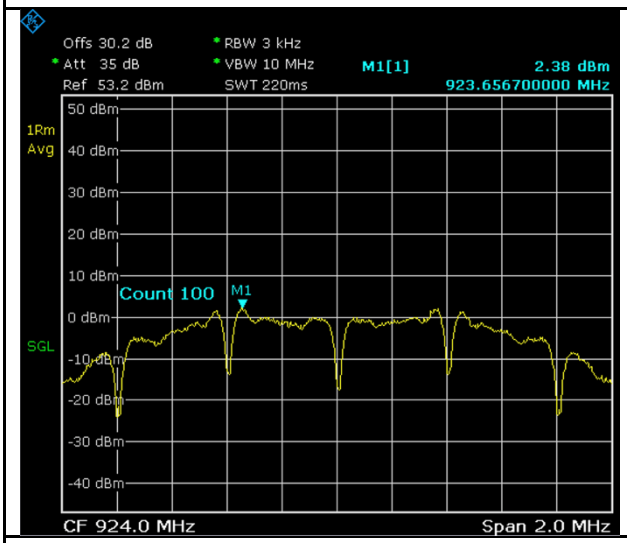
<tr><td>PSD-Low CH</td><td>PSD-Mid CH</td></tr>
<tr><td> 
</td><td></td></tr>
<tr><td>PSD-High CH</td><td></td></tr>
</table>

7.7 Radiated Spurious Emissions into Restricted Frequency Bands

7.7.1 Requirement

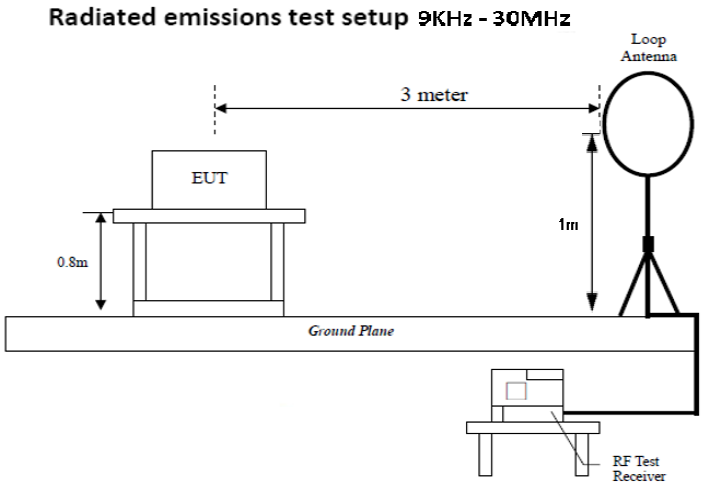
§ 15.247 (d), RSS-247 §5.5

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.

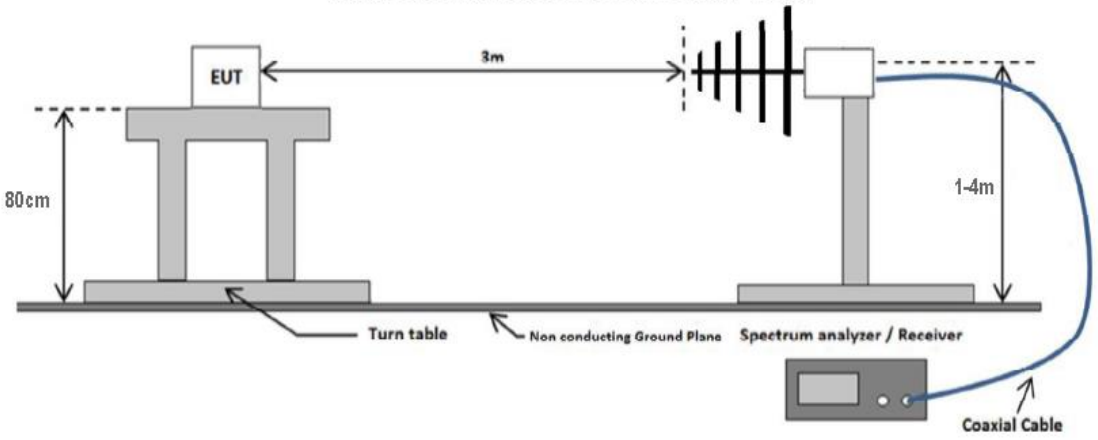
Attenuation below the general limits specified in §15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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

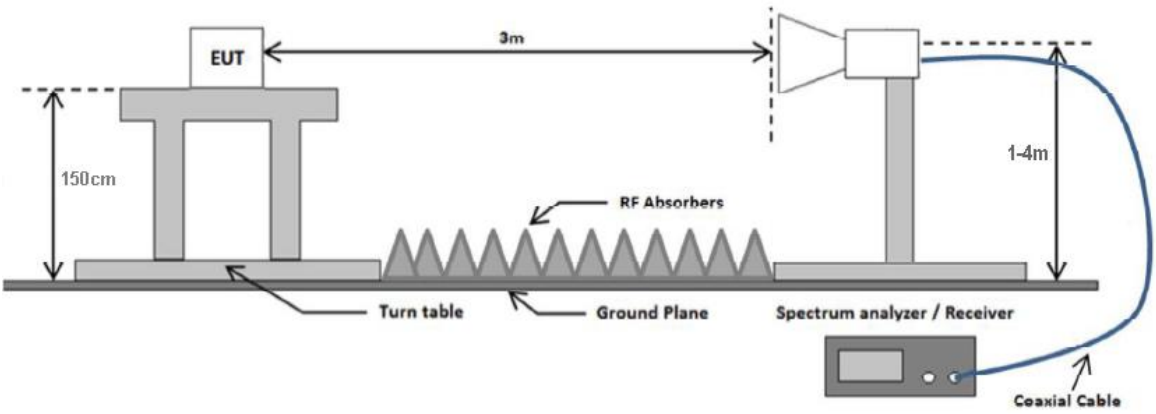
7.7.2 Test Setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



7.7.3 Test Procedure

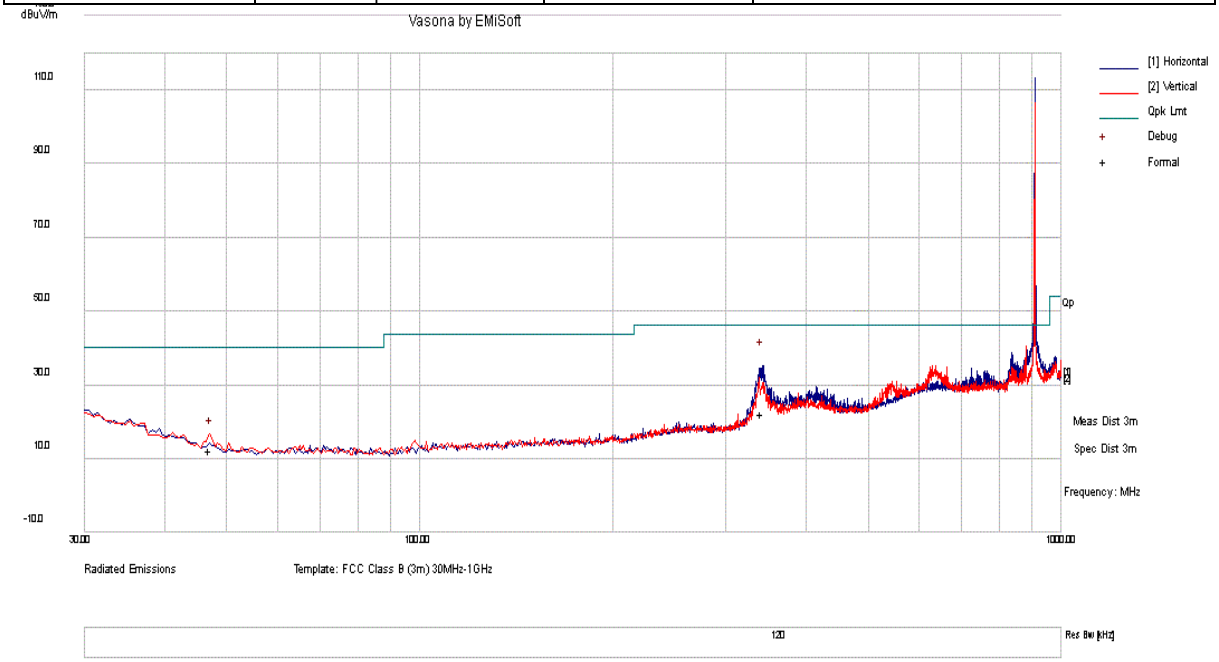
According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C63.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was 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.

7.7.4 Test Result

RADIATED EMISSIONS BELOW 1 GHZ

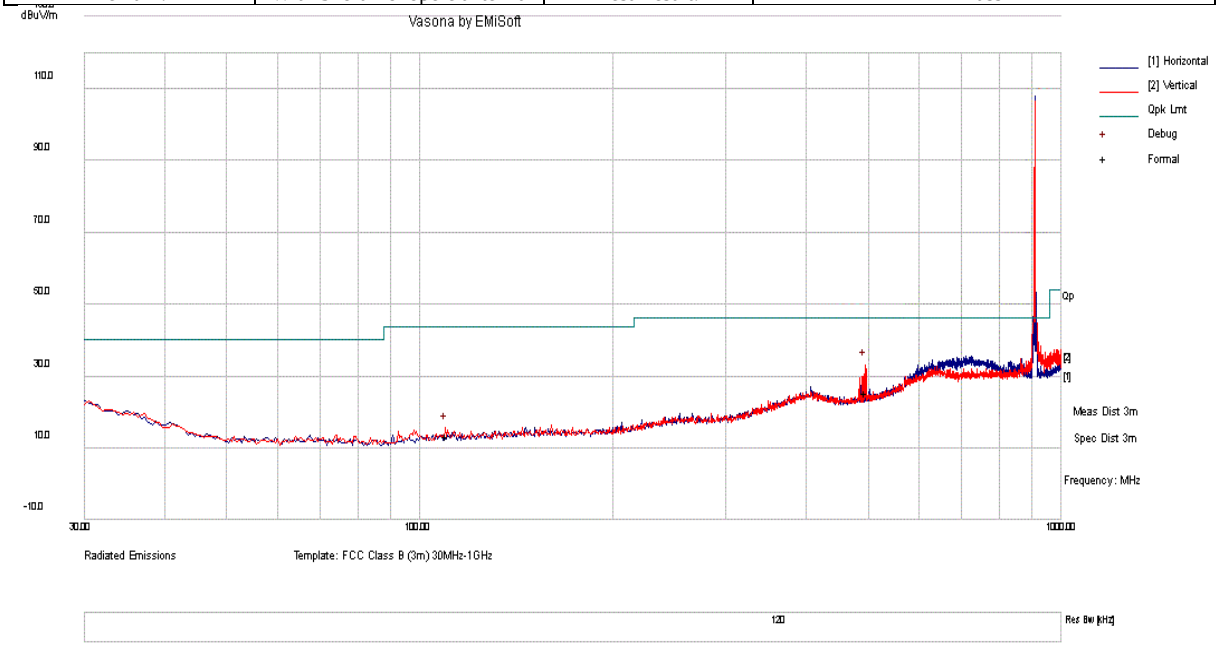
Test Standard:	15.247, 15.209, RSS-247	Mode:	900MHz TX Low CH
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With Mag mount vertical whip antenna	Test Result:	Pass



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
492.638	27.7	6.1	-8.5	25.3	Quasi Max	H	100	231	46	-20.7	Pass
341.885	27.8	6	-11.5	22.2	Quasi Max	H	117	282	46	-23.8	Pass
47.065	29.6	2.7	-20	12.3	Quasi Max	V	270	262	40	-27.7	Pass

Note: Emission at around 900MHz is fundamental emission.

Test Standard:	15.247, 15.209, RSS-247	Mode:	900MHz TX Low CH
Frequency Range:	30 MHz - 1 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Bi-Log/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With Short monopole antenna	Test Result:	Pass



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
734.495	27.1	7.3	-5	29.4	Quasi Max	H	109	316	46	-16.6	Pass
495.289	27.7	6.1	-8.5	25.4	Quasi Max	V	278	62	46	-20.6	Pass
846.897	28.9	7.4	-4	32.4	Quasi Max	H	179	56	46	-13.6	Pass
109.96	28.5	3.7	-18.8	13.4	Quasi Max	V	259	326	43.5	-30.1	Pass

Note: Emission at around 900MHz is fundamental emission.

RADIATED EMISSIONS ABOVE 1GHZ

Test Standard:	15.247, 15.209, RSS-247	Mode:	906MHz TX mode
Frequency Range:	1 GHz – 18 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With #1 Mag mount vertical whip antenna	Test Result:	Pass

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7206.90	36.3	20.5	1.2	58	Peak Max	H	244	0	74	-16	Pass
8120.70	28.1	21.2	0.4	49.7	Peak Max	V	206	350	74	-24.3	Pass
3623.99	26.3	16.1	-4.9	37.5	Peak Max	V	257	33	74	-36.5	Pass
7206.90	9	20.5	1.2	30.7	Average Max	H	244	0	54	-23.3	Pass
8120.70	24.7	21.2	0.4	46.3	Average Max	V	206	350	54	-7.7	Pass
3623.99	14.3	16.1	-4.9	25.5	Average Max	V	257	33	54	-28.5	Pass

Test Standard:	15.247, 15.209, RSS-247	Mode:	915MHz TX mode
Frequency Range:	1 GHz – 18 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With #1 Mag mount vertical whip antenna	Test Result:	Pass

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7203.22	20.4	20.4	1.2	42	Peak Max	V	347	0	74	-32	Pass
9998.55	19.6	22.4	0.9	42.9	Peak Max	V	269	277	74	-31.1	Pass
4574.29	23.9	17.3	-3.3	37.9	Peak Max	V	337	56	74	-36.1	Pass
7203.22	8.9	20.4	1.2	30.6	Average Max	V	347	0	54	-23.4	Pass
9998.55	7.2	22.4	0.9	30.5	Average Max	V	269	277	54	-23.5	Pass
4574.29	12.4	17.3	-3.3	26.4	Average Max	V	337	56	54	-27.6	Pass

Test Standard:	15.247, 15.209, RSS-247	Mode:	924MHz TX mode
Frequency Range:	1 GHz – 18 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With #1 Mag mount vertical whip antenna	Test Result:	Pass

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
7343.01	21.1	20.7	1.2	43	Peak Max	V	290	314	74	-31	Pass
9149.06	27.7	21.3	0.1	49.1	Peak Max	V	186	173	74	-24.9	Pass
3695.94	26.3	16.2	-4.8	37.6	Peak Max	V	158	257	74	-36.4	Pass
7343.01	9.2	20.7	1.2	31.1	Average Max	V	290	314	54	-22.9	Pass
9149.06	24.4	21.3	0.1	45.8	Average Max	V	186	173	54	-8.2	Pass
3695.94	14.4	16.2	-4.8	25.7	Average Max	V	158	257	54	-28.3	Pass

Test Standard:	15.247, 15.209, RSS-247	Mode:	906MHz TX mode
Frequency Range:	1 GHz – 18 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With #2 Short monopole antenna	Test Result:	Pass

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
3623.07	26.6	16.2	-4.8	37.9	Peak Max	V	360	346	74	-36.1	Pass
8237.00	21.5	21.2	0.5	43.2	Peak Max	H	339	304	74	-30.8	Pass
4833.95	23.5	17.4	-2.2	38.7	Peak Max	V	147	304	74	-35.3	Pass
3623.07	14.6	16.2	-4.8	25.9	Average Max	V	360	346	54	-28.1	Pass
8237.00	8.6	21.2	0.5	30.4	Average Max	H	339	304	54	-23.6	Pass
4833.95	11.5	17.4	-2.2	26.7	Average Max	V	147	304	54	-27.3	Pass

Test Standard:	15.247, 15.209, RSS-247	Mode:	915MHz TX mode
Frequency Range:	1 GHz – 18 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With #2 Short monopole antenna	Test Result:	Pass

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
8204.71	20.8	21.2	0.5	42.5	Peak Max	V	248	0	74	-31.5	Pass
3659.33	33.1	16.1	-4.9	44.4	Peak Max	V	386	144	74	-29.6	Pass
9021.86	18.7	21.1	0.3	40.1	Peak Max	V	100	184	74	-33.9	Pass
8204.71	8.6	21.2	0.5	30.3	Average Max	V	248	0	54	-23.7	Pass
3659.33	14.4	16.1	-4.9	25.6	Average Max	V	386	144	54	-28.4	Pass
9021.86	7.1	21.1	0.3	28.4	Average Max	V	100	184	54	-25.6	Pass

Test Standard:	15.247, 15.209, RSS-247	Mode:	924MHz TX mode
Frequency Range:	1 GHz – 18 GHz	Test Date:	05/24/2022
Antenna Type/Polarity:	Horn/Hor & Ver	Test Personnel:	Devin Tai
Remark:	With #2 Short monopole antenna	Test Result:	Pass

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass/Fail
8226.25	20.5	21.2	0.5	42.2	Peak Max	V	280	237	74	-31.8	Pass
3694.30	26	16.1	-4.9	37.2	Peak Max	V	227	158	74	-36.8	Pass
7226.08	21.1	20.5	1.2	42.8	Peak Max	V	252	355	74	-31.2	Pass
8226.25	8.3	21.2	0.5	30.1	Average Max	V	280	237	54	-23.9	Pass
3694.30	14.4	16.1	-4.9	25.6	Average Max	V	227	158	54	-28.4	Pass
7226.08	8.7	20.5	1.2	30.4	Average Max	V	252	355	54	-23.6	Pass

Radiated Emission between 9KHz – 30MHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

7.8 Conducted Band-Edge

7.8.1 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

7.8.2 Test Setup

7.8.3 Test Procedure

According to ANSI C63.10-2013 clause 11.13

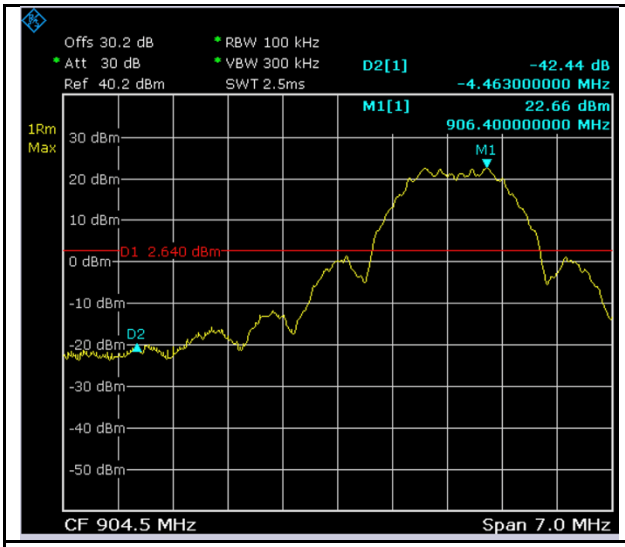
1. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW=100 KHZ, VBW=300 KHZ, Peak Detector. Unwanted Emissions measured in any 100 khz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 db relative to the maximum in-band peak PSD level in 100 KHZ when maximum peak conducted output power procedure is used. 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 per 15.247(d).
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete and record the results in the test report.

7.8.4 Test Result

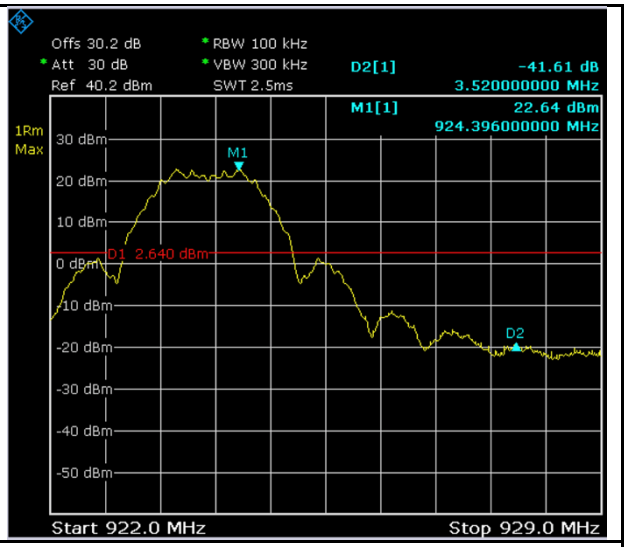
Conducted Band edge

Test Data

Mode	Data rate	Frequency (MHz)	Ref level (dBm)	Measured result (dBm)	Limit (dBm) Δ-20dBc	Result
900MHz	200Kbps	906	22.66	-19.78	2.66	Pass
		924	22.64	-18.97	2.64	Pass



Band Edge-Low CH



Band Edge-High CH

8 EUT and Test Setup Photos

See FCC exhibits

9 Test Instrument List

Equipment	Manufacturer	Model	Instrument Number	Cal. Date	Cal. Due
Semi-Anechoic Chamber	ETS-Lindgren	10M	VL001	10/18/2021	10/18/2022
Shielding Control Room	ETS-Lindgren	Series 81	VL006	N/A	N/A
Spectrum Analyzer	Keysight	N9020A	MY50110074	06/17/2021	06/17/2022
EMC Test Receiver	R&S	ESL6	100230	06/14/2021	06/14/2022
Bi-Log Antenna	ETS-Lindgren	3142E	217921	11/15/2021	11/15/2022
Horn Antenna (1-18GHz)	Electro-Metrics	EM-6961	6292	05/14/2022	05/14/2023
Horn Antenna (18-40GHz)	Com-Power	AH-840	101109	06/24/2021	06/24/2022
Preamplifier	RF Bay, Inc.	LPA-10-20	11180621	07/16/2021	07/16/2022
True RMS Multi-meter	UNI-T	UT181A	C173014829	05/05/2022	05/05/2023
Temp / Humidity / Pressure Meter	PCE Instruments	PCE-THB 40	R062028	05/05/2022	05/05/2023
RF Attenuator	Pasternack	PE7005-3	VL061	07/16/2021	07/16/2022
Preamplifier 100KHz - 40GHz	Aeroflex	33711-392-77150-11	064	07/16/2021	07/16/2022
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	05/16/2022	05/16/2023
RE test cable (below 6GHz)	Vista	RE-6GHz-01	RE-6GHz-01	07/16/2021	07/16/2022
RE test cable (1-18GHz)	PhaseTrack	II-240	RE-18GHz-01	07/16/2021	07/16/2022
RE test cable (>18GHz)	Sucoflex	104	344903/4	07/16/2021	07/16/2022
Pulse limiter	Com-Power	LIT-930A	531727	07/16/2021	07/16/2022
CE test cable #1	FIRST RF	FRF-C-1002-001	CE-6GHz-01	07/16/2021	07/16/2022
CE test cable#2	FIRST RF	FRF-C-1002-001	CE-6GHz-02	07/16/2021	07/16/2022
Vector Signal Generator	Keysight	N5182A	US47080548	06/17/2021	06/17/2022
USB RF Power Sensor	ETS-Lindgren	7002-006	SN 00151268	05/15/2022	05/15/2023
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
Wideband Communication	R&S	CMW500	147508	05/10/2022	05/10/2023
Radio Communication Tester	Anritsu	MT8000a	6262261939	02/23/2022	02/23/2023
Temperature/Humidity Chamber	Thermotron	SM-8-8200	40991	09/08/2021	09/08/2022