

TEST REPORT

of

FCC Part 15 Subpart C §15.249
RSS-210 Issue 9, RSS-Gen Issue 5

FCC ID: 2ABFG-YRIZW2USPB1
IC Certification: 11626A-YRIZW2USPB1

Equipment Under Test : Digital Door Lock
Model Name : YRD136-ZW2-619
Variant Model Names : YRD136-ZW2-605, YRD136-ZW2-0BP,
YRD136-ZW2-BSP
Applicant : iRevo-ASSA ABLOY Korea
Manufacturer : iRevo-ASSA ABLOY Korea
Date of Receipt : 2019.08.07
Date of Test(s) : 2019.09.08 ~ 2019.09.18
Date of Issue : 2019.09.18

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Murphy Kim

Date:

2019.09.18

Technical
Manager:



Jungmin Yang

Date:

2019.09.18

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1. General information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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1.2. Details of Applicant

Applicant : iRevo-ASSA ABLOY Korea

Address : 205-29, Gasan Digital 1-ro, Geumcheon-gu, Seoul, South Korea, 08503

Contact Person : Jang, Soo-kyung

Phone No. : +82 2 2107 5741

1.3. Details of Manufacturer

Applicant : Same as applicant

Address : Same as applicant

1.4. Description of EUT

Kind of Product	Digital Door Lock
Model Name	YRD136-ZW2-619
Variant Model Names	YRD136-ZW2-605, YRD136-ZW2-0BP, YRD136-ZW2-BSP
Power Supply	DC 6.0 V
Frequency Range	908.4 MHz ~ 916 MHz
Modulation Technique	FSK
Number of Channels	3 channels
Antenna Type	Helical antenna
Antenna Gain	-4.55 dBi

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1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMR40	100272	Jun. 07, 2019	Annual	Jun. 07, 2020
Signal Generator	R&S	SMBV100A	255834	Jun. 10, 2019	Annual	Jun. 10, 2020
Spectrum Analyzer	R&S	FSV30	103210	Dec. 05, 2018	Annual	Dec. 05, 2019
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 21, 2018	Annual	Sep. 21, 2019
High Pass Filter	Wainwright Instrument GmbH	WHKX1.5/15G-6SS	4	Jun. 12, 2019	Annual	Jun. 12, 2020
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-2	Feb. 19, 2019	Annual	Feb. 19, 2020
Preamplifier	H.P.	8447F	2944A03909	Aug. 07, 2019	Annual	Aug. 07, 2020
Signal Conditioning Unit	R&S	SCU-18	10117	Jun. 12, 2019	Annual	Jun. 12, 2020
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	396	Mar. 21, 2019	Biennial	Mar. 21, 2021
Horn Antenna	R&S	HF906	100326	Feb. 14, 2018	Biennial	Feb. 14, 2020
Turn Table	Innco systems GmbH	CONTROLLER CO3000	N/A	N. C. R	N/A	N. C. R
Antenna Master	Innco systems GmbH	MA4640-XP-ET	N/A	N. C. R	N/A	N. C. R
Test Receiver	R&S	ESU26	100109	Jan. 31, 2019	Annual	Jan. 31, 2020
Anechoic Chamber	SY Corporation	L × W × H (9.6 m×6.4 m×6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SUCOFLEX	104 (3 m)	MY3258414	Jul. 20, 2019	Semi-annual	Jan. 20, 2020
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jul. 20, 2019	Semi-annual	Jan. 20, 2020

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1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

Applied Standard: FCC Part15 Subpart C, IC RSS-210 Issue 9, RSS-Gen Issue 5			
Section		Test Item	Result
15.205 15.209(a) 15.249(a) 15.249(c) 15.249(d)	RSS-210 Issue 9 B.10 RSS-Gen Issue 5 8.9 RSS-Gen Issue 5 8.10	Fundamental and Radiated Spurious Emission	Complied
15.215(c)	RSS-Gen Issue 5 6.7	20 dB Bandwidth & 99 % Bandwidth	Complied

Note;

- Due to the frequency range of the device operate (908.4 MHz ~ 916 MHz) is 1 to 10 MHz, so we perform test Lowest and Highest frequency according to 15.31 requirement.

1.7. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the DUT.

1.8. Sample Calculation

Where relevant, the following sample calculation is provided

1.8.1. Radiation Test

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB) + Cable loss (dB) - Amplifier gain (dB)

1.9. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty (dB)
Radiated Disturbance, 9 kHz to 30 MHz	± 3.59
Radiated Disturbance, below 1 GHz	± 5.88
Radiated Disturbance, above 1 GHz	± 5.94

Uncertainty figures are valid to a confidence level of 95 %.

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1.10. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501/RF-RTL014359	2019.09.18	Initial

1.11. Information of Variant Models

Model Name		Description
Basic Model	YRD136-ZW2-619	- Basic model
Variant Models	YRD136-ZW2-605	- Same as basic model but with different color of case
	YRD136-ZW2-0BP	
	YRD136-ZW2-BSP	

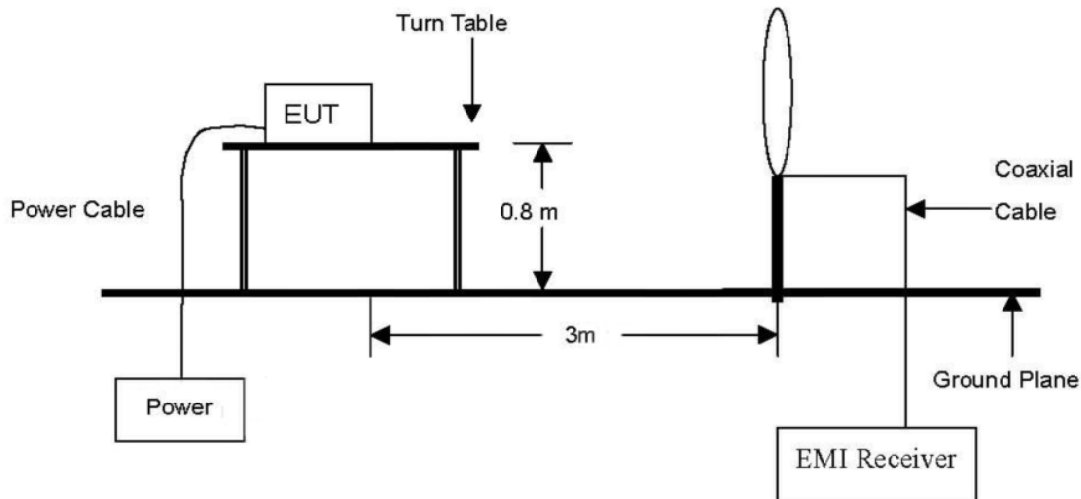
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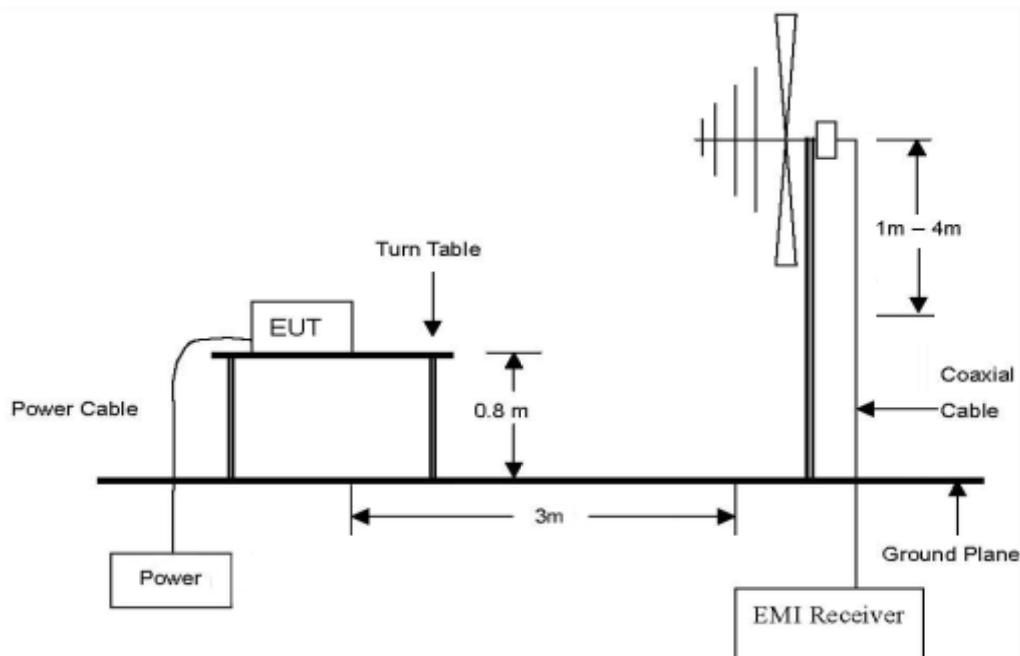
2. Fundamental and Radiated Spurious Emission

2.1. Test Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



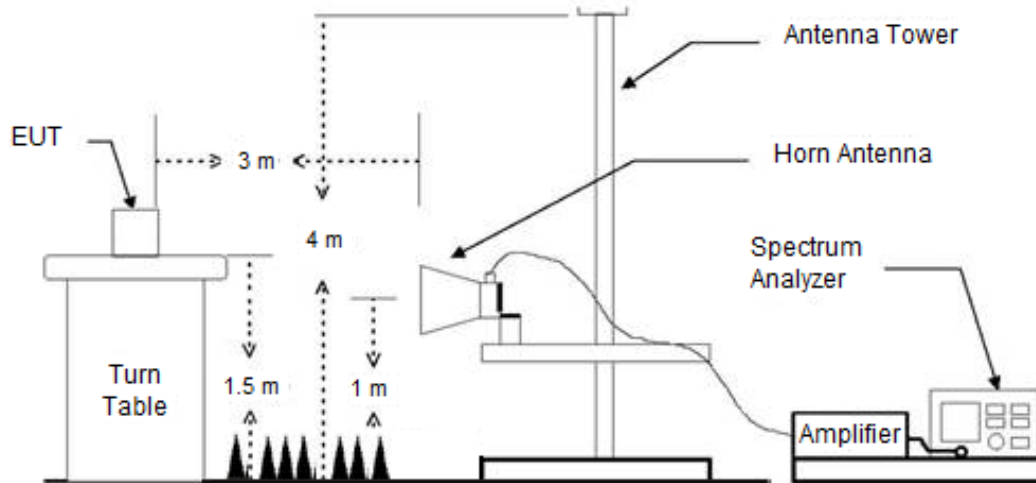
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



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The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



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2.2. Limit

2.2.1. FCC

According to §15.249(a), Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (mV/m)	Field strength of harmonics (μV/m)
902-928 MHz	50	500
2 400-2 483.5 MHz	50	500
5 725-5 875 MHz	50	500
24.0-24.25 GHz	250	2 500

According to §15.249(d), Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever the lesser attenuation.

According to §15.209(a), Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (μV/m)	Measurement distance (Meters)
0.009-0.490	2 400/F(kHz)	300
0.490-1.705	24 000/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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

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A4(210 mm x 297 mm)

2.2.2. IC

According to RSS-Gen Issue 5, 8.9, Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 - General field strength limits at frequencies above 30 MHz

Frequency (MHz)	Field strength ($\mu\text{V/m}$ at 3 m)
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

Table 6 - General field strength limits at frequencies below 30 MHz

Frequency	Magnetic Field Strength (H-Field) ($\mu\text{A/m}$)	Measurement distance (m)
9 - 490 kHz ¹	6.37/F (F in kHz)	300
490 - 1 705 kHz	63.7/F (F in kHz)	30
1.705 - 30 MHz	0.08	30

Note¹; The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

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According to B.10 of RSS-210 Issue 9, Devices shall comply with the following requirements:

- (a) The field strength of fundamental and harmonic emissions, measured at 3 m, shall not exceed 50 $\mu\text{V}/\text{m}$ and 0.5 $\mu\text{V}/\text{m}$ respectively.

The field strength limits shall be measured using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

- (b) Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to general field strength limits specified in RSS-Gen, whichever is less stringent.

The provisions of RSS-Gen regarding pulsed operation do not apply to CISPR measurement for the band 902-928 MHz.

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2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

2.3.1. Test procedures for emission below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test procedures for emission above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 GHz and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note;

1. For frequency below 1 GHz, set spectrum analyzer detector to peak, and resolution bandwidth is 100 kHz and video bandwidth is 300 kHz.
2. For frequency above 1 GHz, set spectrum analyzer detector to peak, and resolution bandwidth is 1 MHz and video bandwidth is 3 MHz.
3. Definition of DUT Axis.
Definition of the test orthogonal plan for EUT was described in the test setup photo.
The test orthogonal plan of EUT is **Z – axis** during radiation test.

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2.4. Test result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

2.4.1. Field Strength of Fundamental

The following table shows the highest levels of radiated emissions between polarizations of horizontal and vertical.

Frequency (MHz)	Detect Mode	Ant. Pol.	Reading (dB μ V)	AF (dB/m)	CL (dB)	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
<Low channel 908.4 MHz>								
908.40	Peak	H	57.06	28.27	4.95	90.28	94.00	3.72
<High channel 916 MHz>								
916.00	Peak	H	58.53	28.30	5.11	91.94	94.00	2.06

Remark;

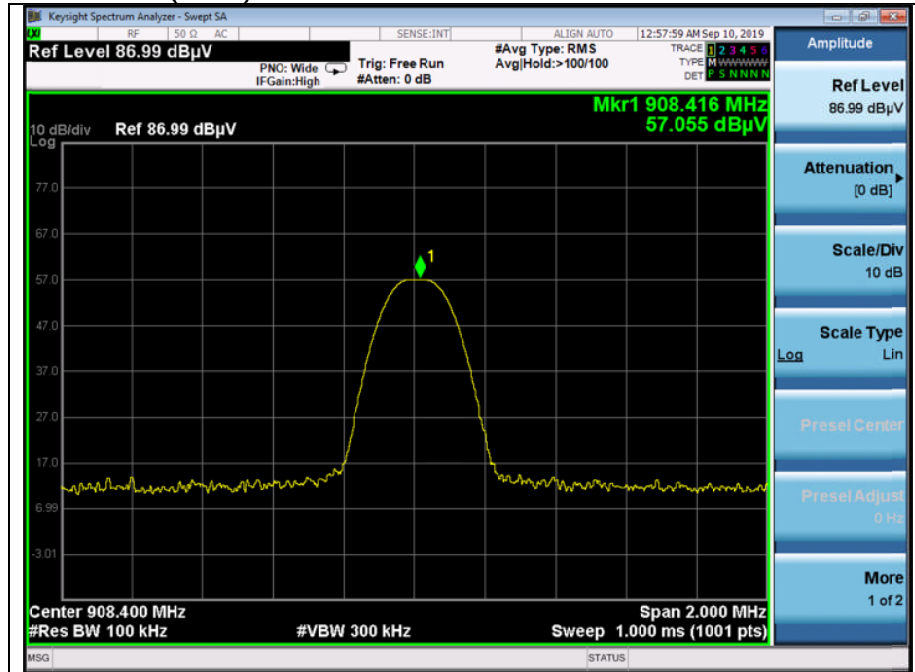
1. Result = Reading + AF + CL

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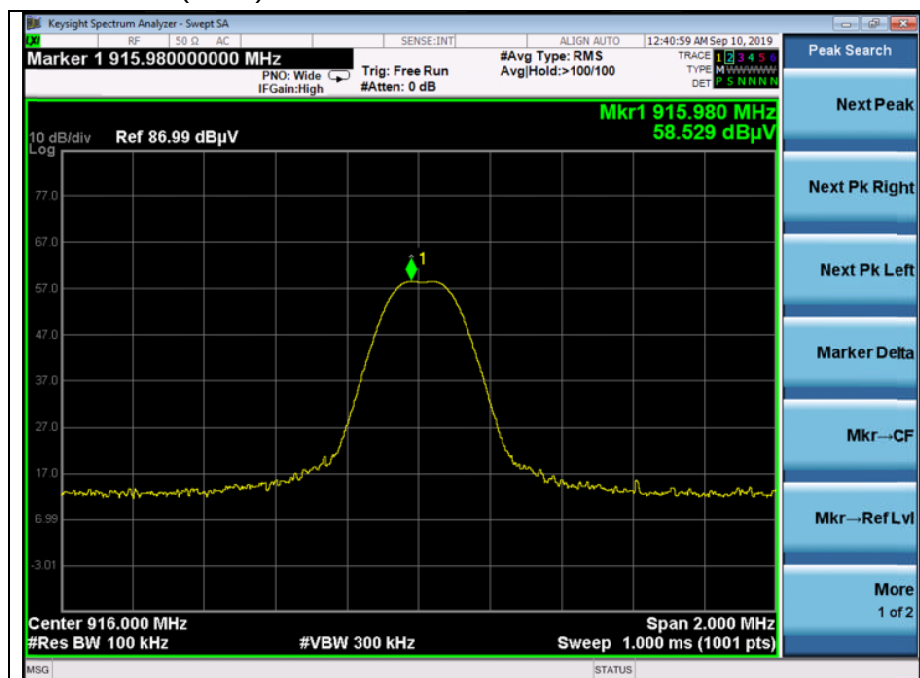
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- Test plots

Low channel fundamental (Peak)



High channel fundamental (Peak)



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2.4.2. Radiated Spurious Emission below 1 000 MHz

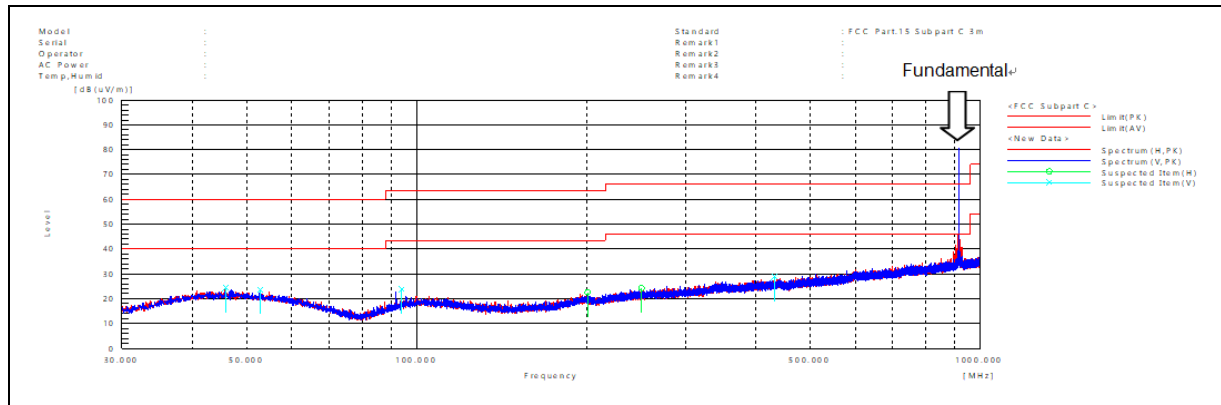
The frequency spectrum from 9 kHz to 1 000 MHz was investigated. All reading values are peak values.

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
45.84	30.50	Peak	V	20.60	-26.77	24.33	40.00	15.67
52.80	30.50	Peak	V	19.82	-26.63	23.69	40.00	16.31
93.90	33.70	Peak	V	16.17	-25.53	24.34	43.50	19.16
431.10	31.30	Peak	V	22.12	-25.03	28.39	46.00	17.61
Above 500.00	Not detected	-	-	-	-	-	-	-

Remark;

- Spurious emissions for all channels were investigated and almost the same below 1 GHz.
- Reported spurious emissions are in **High channel** as worst case among other channels.
- Radiated spurious emission measurement as below.
(Actual = Reading + AF + Amp + CL)
- According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

- Test plot



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2.4.3. Radiated Band edge Emission and Spurious Emission above 1 000 MHz

A. Low Channel (908.40 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
901.65	3.97	Peak	V	28.13	4.90	37.00	46.00	9.00
902.00	0.28	Peak	V	28.14	4.90	33.32	46.00	12.68

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-			-	-

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B. High Channel (916.00 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
928.00	3.13	Peak	V	28.24	5.16	36.53	46.00	9.47
929.94	3.14	Peak	V	28.20	5.15	36.49	46.00	9.51

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-			-	-

Remarks;

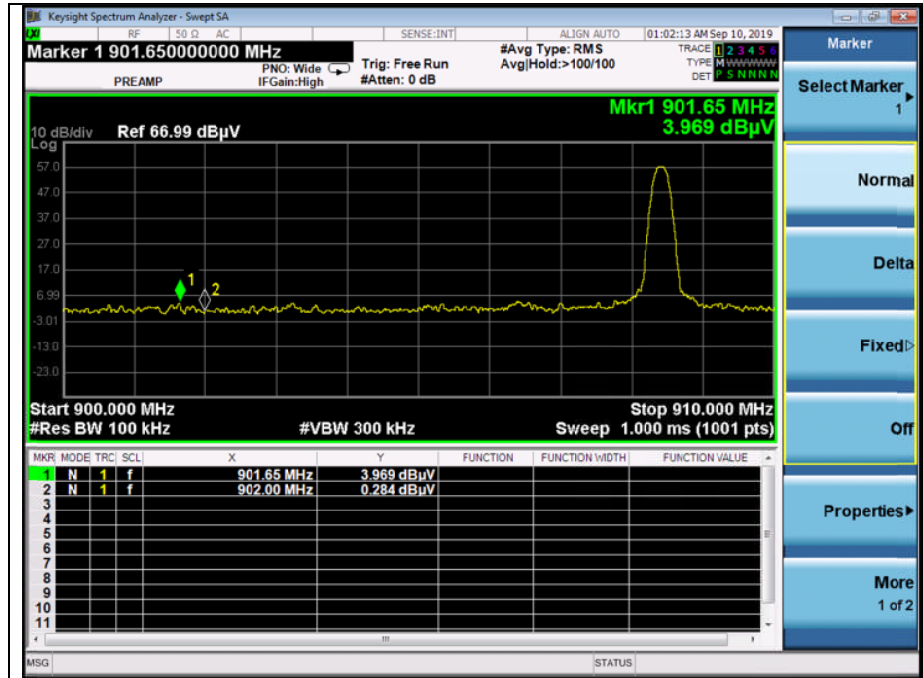
1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Actual = Reading + AF + CL or Reading + AF + AMP + CL.
3. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.

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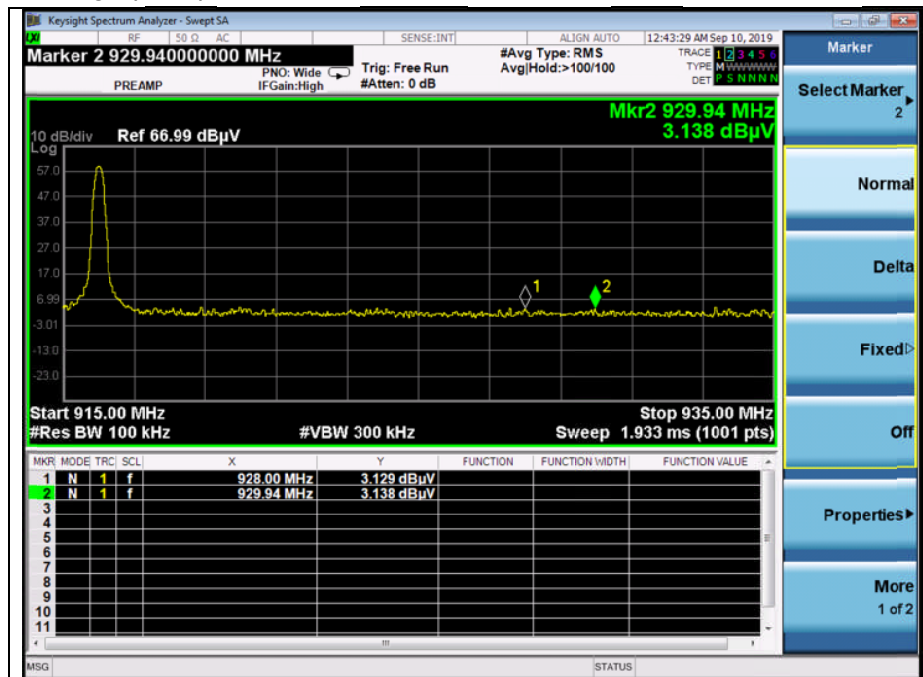
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- Test plots

Low channel Band edge (Peak)



High channel Band edge (Peak)

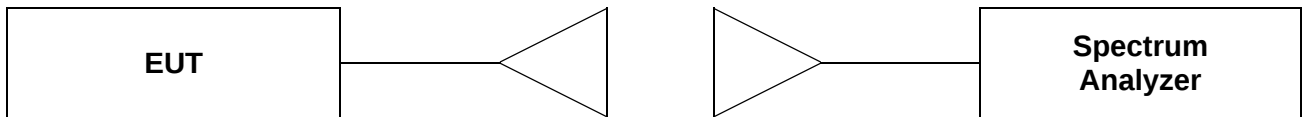


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3. 20 dB Bandwidth & 99% Bandwidth

3.1. Test Setup



3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

3.3.1. 20 dB Bandwidth

The test follows ANSI C63.10-2013.

The 20 dB bandwidth was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency.

Use the following spectrum analyzer setting:

Span = approximately 2 to 5 times the 20 dB bandwidth.

RBW $\geq$ 1 % to 5 % of the 20 dB bandwidth.

VBW $\geq$ 3 x RBW

Sweep = auto

Detector = peak

Trace = max hold

The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

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A4(210 mm x 297 mm)

3.3.2. 99 % Bandwidth

- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

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3.4. Test Results

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

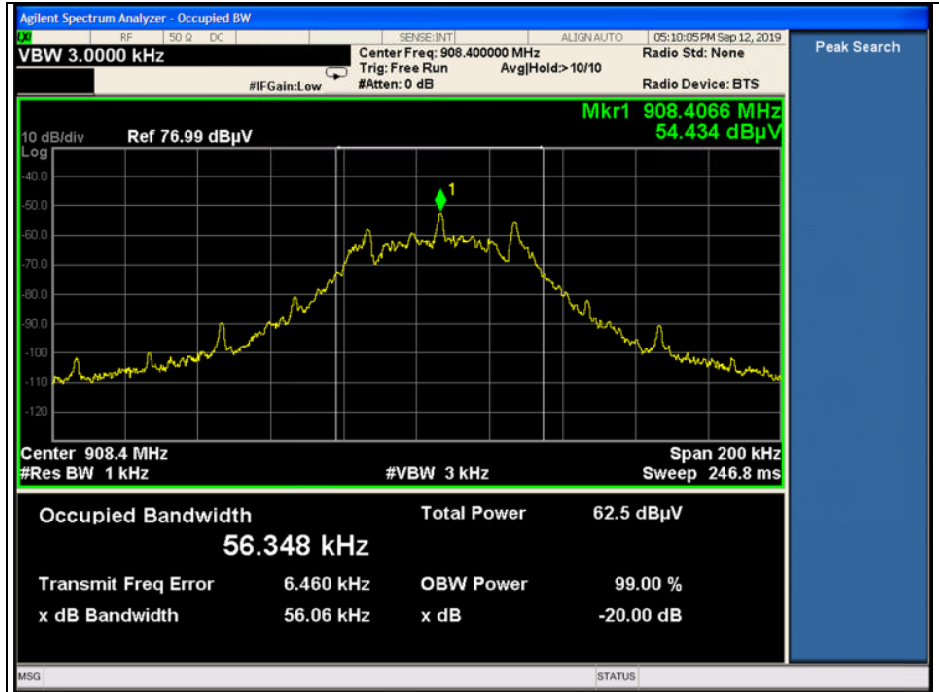
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	908.40	56.060	56.348
High	916.00	72.440	75.852

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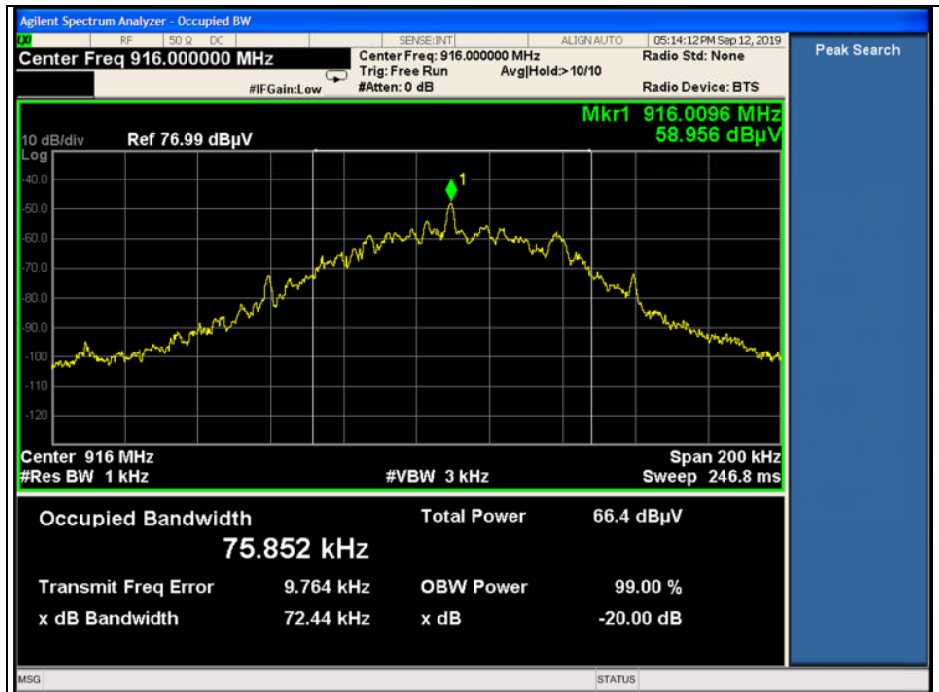
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- Test plots

Low Channel



High Channel



- End of the Test Report -

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