

TEST REPORT

of

FCC Part 15 Subpart C §15.225
RSS-210 Issue 10, RSS-Gen Issue 5

FCC ID: 2ABFG-NTT600PBACC
IC Certification: 11626A-NTT600PBACC

Equipment Under Test : Digital Door Lock
Model Name : NTT612-ACC
Variant Model Name(s) : -
Applicant : iRevo-ASSA ABLOY Korea
Manufacturer : iRevo-ASSA ABLOY Korea
Date of Receipt : 2021.04.05
Date of Test(s) : 2021.04.27 ~ 2021.05.14
Date of Issue : 2021.05.18

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

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- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
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Report Number: F690501-RF-RTL002137

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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
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- 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
 Contact Person : Jang, Soo-kyung
 Phone No. : +82 2 2107 5741

1.3. Details of manufacturer

Applicant : iRevo-ASSA ABLOY Korea
 Address : 10f of JEI PLATZ Bldg., 186, Gasan Digital 1-ro, Geumcheon-gu, Seoul, South Korea, 08502

1.4. Description of EUT

Kind of Product	Digital Door Lock
Model Name	NTT612-ACC
Serial Number	003
Power Supply	DC 6.0 V
Frequency Range	13.56 MHz (NFC)
Modulation Technique	ASK
Number of Channels	1 channel
Antenna Type	FPCB antenna
Antenna Serial Number	PC2A-L421B-F1
H/W Version	PV02
S/W Version	V3.0.4

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	255834	Jun. 03, 2020	Annual	Jun. 03, 2021
Spectrum Analyzer	R&S	FSV30	103210	Dec. 07, 2020	Annual	Dec. 07, 2021
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 04, 2020	Annual	Sep. 04, 2021
DC Power Supply	R&S	HMP2020	20089489	May 20, 2020	Annual	May 20, 2021
Temperature Chamber	ESPEC CORP.	SH-662	93000533	Jun. 03, 2020	Annual	Jun. 03, 2021
Preamplifier	H.P.	8447F	2944A03909	Aug. 06, 2020	Annual	Aug. 06, 2021
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	01126	Dec. 22, 2020	Biennial	Dec. 22, 2022
EMI Test Receiver	R&S	ESU26	100109	Feb. 19, 2021	Annual	Feb. 19, 2022
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/38 330516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/38 330516/L	N.C.R.	N/A	N.C.R.
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	RFONE	MWX221-NMSNMS (4 m)	J1023142	Dec. 01, 2020	Semi-Annual	Jun. 01, 2021
Coaxial Cable	RFONE	PL520-NMNM-10M (10 m)	20200324001	Dec. 01, 2020	Semi-Annual	Jun. 01, 2021

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 10, RSS-Gen Issue 5			
Section in FCC	Section in IC	Test item(s)	Result
15.225(a)(b)(c)(d) 15.209	RSS-210 Annex B Section B.6 RSS-Gen Section 8.9	Radiated Emission, Spurious Emission and Field Strength of Fundamental	Complied
15.225(e)	RSS-210 Annex B Section B.6 RSS-Gen Section 6.11	Frequency Stability	Complied
15.215(c)	RSS-Gen Section 6.7	20 dB Bandwidth & 99 % Bandwidth	Complied
15.207	RSS-Gen Section 8.8	AC Power Line Conducted Emissions	N/A ¹⁾

Note;

1) The AC power line test was not performed because the EUT use battery power for operation.

1.7. Sample calculation

Where relevant, the following sample calculation is provided:

1.7.1. Radiation test

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

1.8. Measurement Uncertainty

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

Parameter	Uncertainty	
Occupied Bandwidth	± 13.12 kHz	
Radiated Emission, 9 kHz to 30 MHz	H	± 3.66 dB
	V	± 3.66 dB
Radiated Emission, below 1 GHz	H	± 4.90 dB
	V	± 4.82 dB

All measurement uncertainty values are shown with a coverage factor $k = 2$ to indicate a 95 % level of confidence.

1.9. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501-RF-RTL002137	2021.05.18	Initial

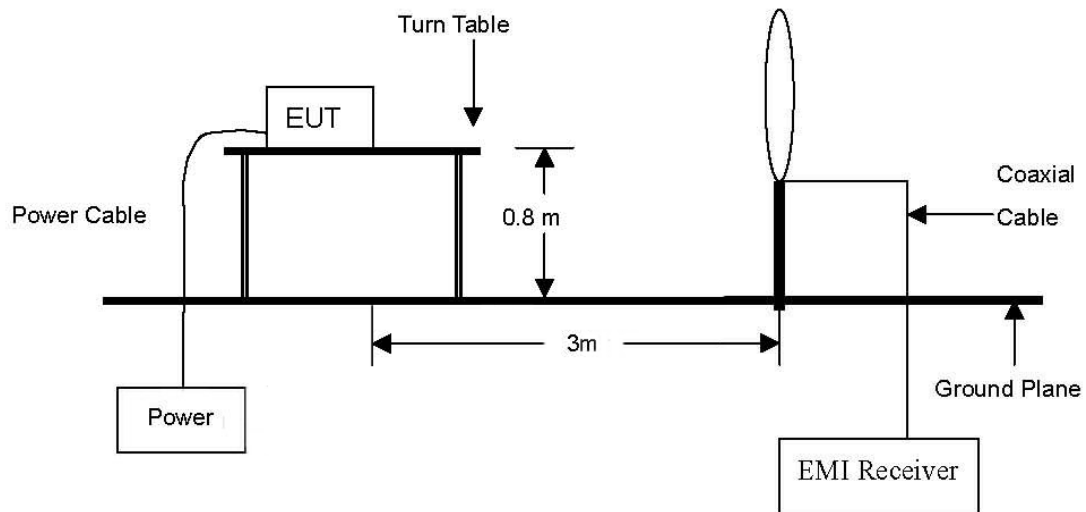
1.10. Information of software for test.

- Using the software of Internal to testing of EUT.

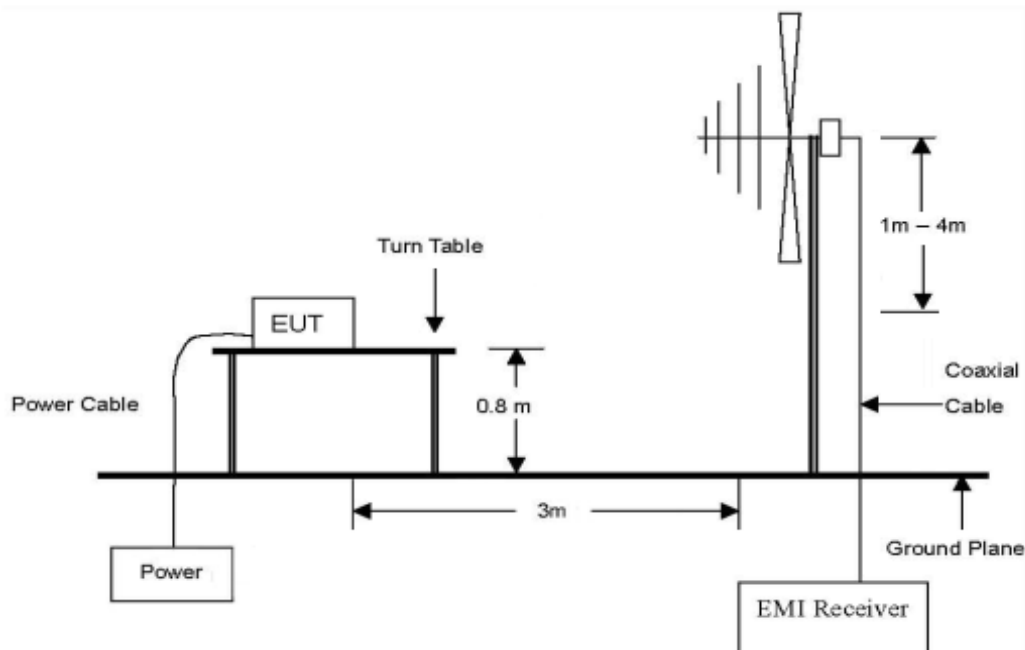
2. Radiated Emissions

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 1 000 MHz Emissions.



2.2. Limit

FCC

According to §15.225,

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15 848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

According to §15.209,

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 (microvolts/meter)	Measurement Distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** 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.

IC

According to RSS-210 Issue 10, B.6

The field strength of any emission shall not exceed the following limits:

- (a) 15.848 millivolts/m (84 dB μ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB μ V/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
- (c) 106 microvolts/m (40.5 dB μ V/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.
- (d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

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 (μ 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) (μ 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

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

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 Quasi peak Detect Function 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. 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.
3. The antenna is a bi-log 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;

Definition of the test orthogonal plan for EUT was described in the test setup photo.
The test orthogonal plan of EUT is X – axis during radiation test.

2.4. Test Result

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

The following table shows the highest levels of radiated emissions.

- Fundamental within the band 13.553 MHz - 13.567 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 30 m	Limit (dBμV/m) at 30 m	Margin (dB)
13.560	28.10	Peak	H	18.66	0.52	47.28	7.28	84.00	76.72

- Spurious emission within the bands 13.410 MHz - 13.553 MHz and 13.567 MHz - 13.710 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 30 m	Limit (dBμV/m) at 30 m	Margin (dB)
13.553	22.24	Peak	H	18.66	0.52	41.42	1.42	50.47	49.05
13.567	21.08	Peak	H	18.66	0.52	40.26	0.26	50.47	50.21

- Spurious emission within the bands 13.110 MHz - 13.410 MHz and 13.710 MHz - 14.010 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 30 m	Limit (dBμV/m) at 30 m	Margin (dB)
13.251	9.02	Peak	H	18.67	0.52	28.21	-11.79	40.51	52.30
*13.381	8.71	Peak	H	18.66	0.52	27.89	-12.11	29.54	41.65
14.007	8.74	Peak	H	18.64	0.52	27.90	-12.10	40.51	52.61

- Spurious emission within the bands 9 MHz - 13.110 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 30 or 300 m	Limit (dBμV/m) at 30 or 300 m	Margin (dB)
Below 13.110	Not detected	-	-	-	-	-	-	-	-

- Spurious emission within the bands 14.010 MHz - 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dBμV/m) at 3 m	Actual (dBμV/m) at 30 m	Limit (dBμV/m) at 30 m	Margin (dB)
14.985	9.10	Peak	H	18.60	0.52	28.22	-11.78	29.54	41.32
Above 15.000	Not detected	-	-	-	-	-	-	-	-

Remark;

1. Fundamental limit ($\mu V/m$) = $20 \log(15\ 848) = 84.00\ dB\mu V/m$.
2. 30 m distance compensation = $40 \log(3/30) = -40\ dB\mu V/m$.
3. 300 m distance compensation = $40 \log(3/300) = -80\ dB\mu V/m$.
4. “*” means the restricted band.
5. If the spurious emissions are in the restricted band, the limit complied with §15.209.
6. All data were recorded using a spectrum analyzer employing a peak detector.
If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.

- Spurious emission above 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Freq. (MHz)	Reading (dBμV)	Detect Mode	Pol.	Ant. Factor (dB/m)	AMP + CL (dB)	Actual (dBμV/m) at 3 m	Limit (dBμV/m) at 3 m	Margin (dB)
40.71	30.10	Peak	V	18.93	-27.30	21.73	40.00	18.27
612.49	31.10	Peak	V	25.15	-25.67	30.58	46.00	15.42
921.79	30.60	Peak	H	28.20	-24.18	34.62	46.00	11.38

Remark;

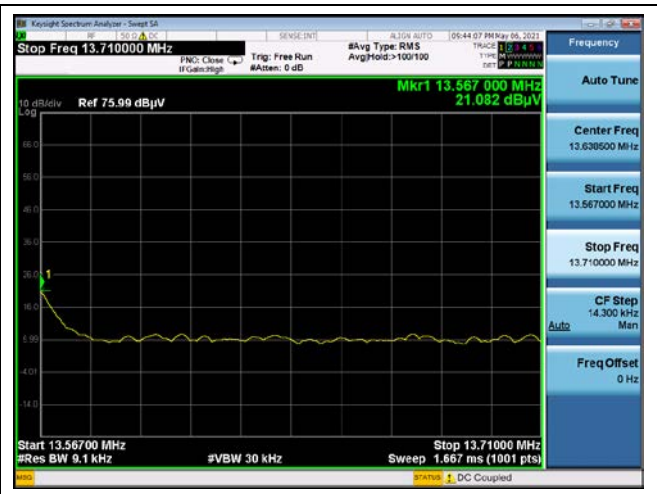
1. Radiated spurious emission measurement as below.
(Actual = Reading + Antenna Factor + Amp + CL)
2. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

Test plots

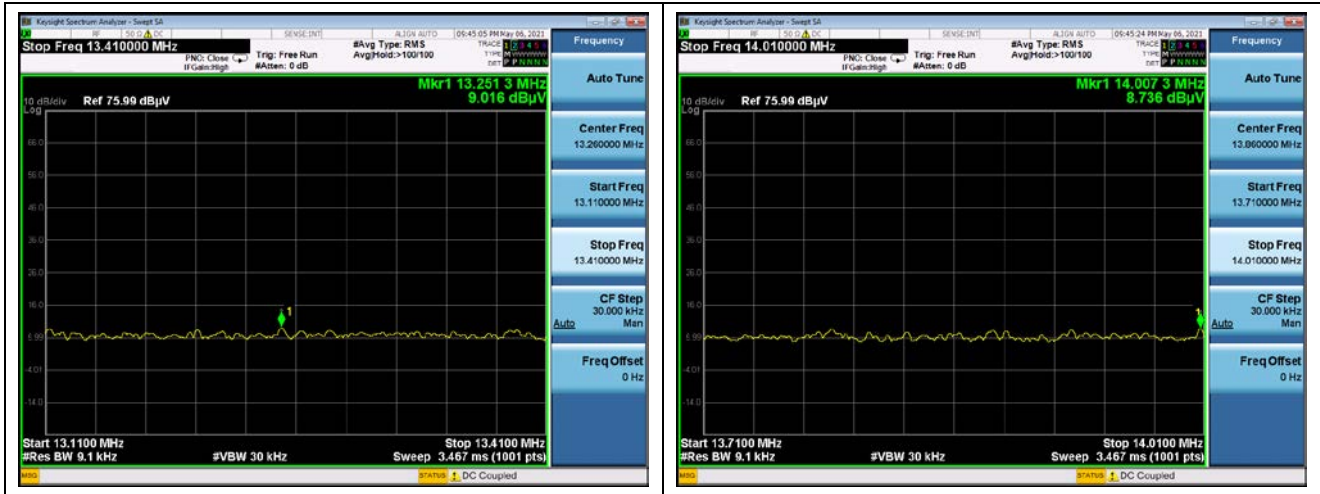
- Fundamental within the band 13.553 MHz - 13.567 MHz



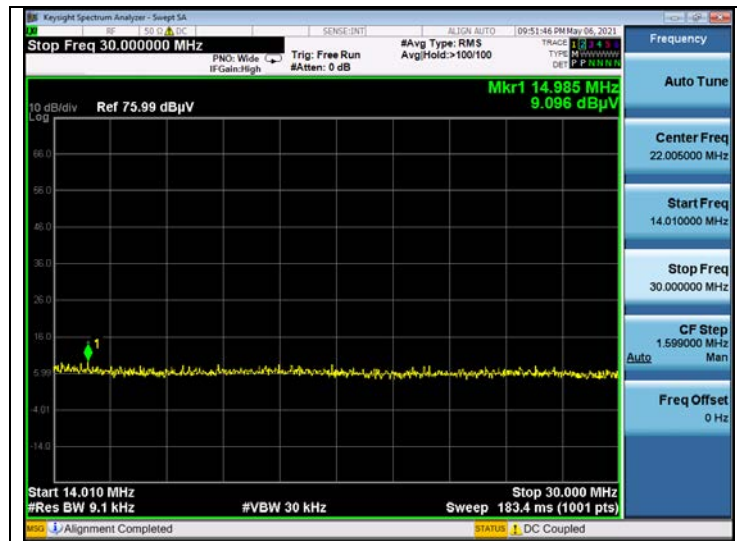
- Spurious emission within the bands 13.410 MHz - 13.553 MHz and 13.567 MHz - 13.710 MHz



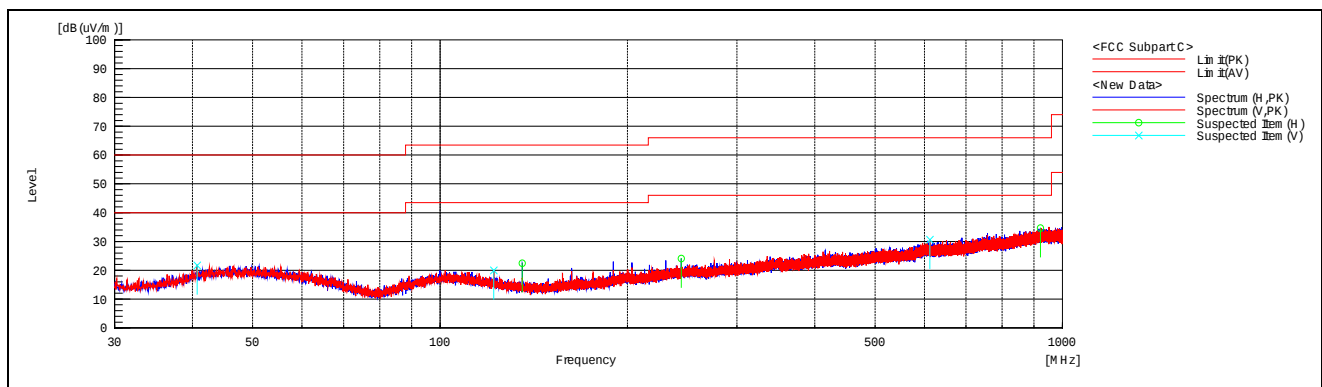
- Spurious emission within the bands 13.110 MHz - 13.410 MHz and 13.710 MHz - 14.010 MHz



- Spurious emission within the bands 14.010 MHz - 30 MHz

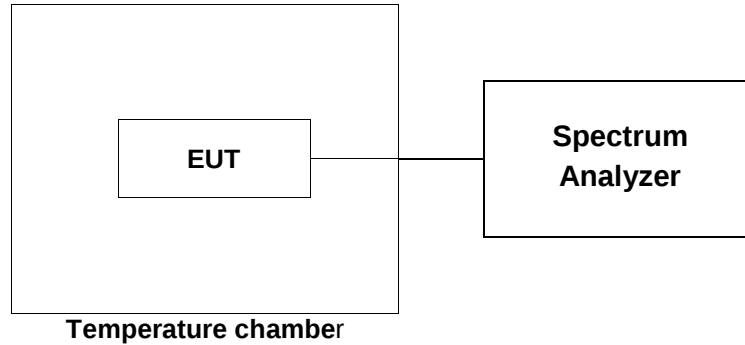


- Spurious emission above 30 MHz



3. Frequency Stability

3.1. Test Setup



3.2. Limit

FCC

According to §15.225(e), the frequency tolerance of the carrier signal shall be maintained within ± 0.01 % of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

IC

According to RSS-210, Annex B, Section B.6

Carrier frequency stability shall be maintained to ± 0.01 % (± 100 ppm).

3.3. Test Procedures

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the environment into appropriate environment.
4. Set the spectrum analyzer as RBW = 100 Hz, VBW = 100 Hz, Span = 10 kHz, Sweep time = auto.
5. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
6. Repeat until all the results are investigated.

3.4. Test Result

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

Operating Frequency : 13 560 000 Hz
 Deviation Limit : ± 0.01 % = ± 1 356 Hz

Startup

Temperature Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
6	-20	13 560 155	155	0.001 143
	-10	13 560 165	165	0.001 217
	0	13 560 170	170	0.001 254
	+10	13 560 165	165	0.001 217
	+20	13 560 075	75	0.000 553
	+30	13 560 135	135	0.000 996
	+40	13 560 115	115	0.000 848
	+50	13 560 085	85	0.000 627

Voltage Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (6.90)	+20	13 560 095	95	0.000 701
85 % (5.10)	+20	13 560 065	65	0.000 479

2 minutes

Temperature Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
6	-20	13 560 160	160	0.001 180
	-10	13 560 165	165	0.001 217
	0	13 560 165	165	0.001 217
	+10	13 560 155	155	0.001 143
	+20	13 560 075	75	0.000 553
	+30	13 560 130	130	0.000 959
	+40	13 560 105	105	0.000 774
	+50	13 560 075	75	0.000 553

Voltage Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (6.90)	+20	13 560 075	75	0.000 553
85 % (5.10)	+20	13 560 065	65	0.000 479

5 minutes

Temperature Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
6	-20	13 560 165	165	0.001 217
	-10	13 560 170	170	0.001 254
	0	13 560 165	165	0.001 217
	+10	13 560 155	155	0.001 143
	+20	13 560 070	70	0.000 516
	+30	13 560 125	125	0.000 922
	+40	13 560 095	95	0.000 701
	+50	13 560 070	70	0.000 516

Voltage Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (6.90)	+20	13 560 065	65	0.000 479
85 % (5.10)	+20	13 560 065	65	0.000 479

10 minutes

Temperature Variations

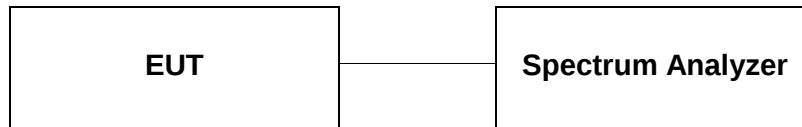
Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
6	-20	13 560 165	165	0.001 217
	-10	13 560 170	170	0.001 254
	0	13 560 155	155	0.001 143
	+10	13 560 145	145	0.001 069
	+20	13 560 065	65	0.000 479
	+30	13 560 115	115	0.000 848
	+40	13 560 085	85	0.000 627
	+50	13 560 055	55	0.000 406

Voltage Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (6.90)	+20	13 560 065	65	0.000 479
85 % (5.10)	+20	13 560 065	65	0.000 479

4. 20 dB Bandwidth & 99 % Bandwidth

4.1. Test Setup



4.2. Limit

None; for reporting purposes only.

4.3. Test Procedures

20 dB Bandwidth

1. Span = set to capture all products of the modulation process, including the emission skirts.
 RBW = 200 Hz, VBW = 200 Hz, Sweep = auto, Detector = peak, Trace = max hold.
2. 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.

99 % Bandwidth

1. Set the spectrum analyzer as Span = set to capture all products of the modulation process, including the emission skirts, RBW = 200 Hz, VBW = 200 Hz, Detector = sampling, Trace mode = max hold.
2. Measure lowest and highest frequencies are placed in a running sum until 0.5 % and 99.5 % of the total is reached.
3. The difference between the two recorded frequencies is the occupied bandwidth.

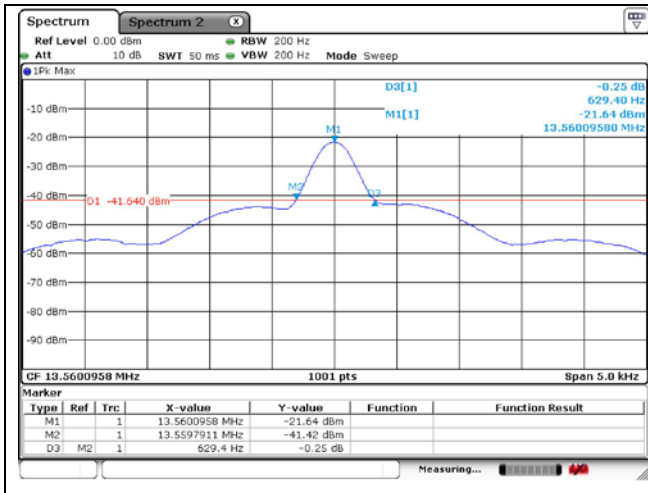
4.3. Test Result

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

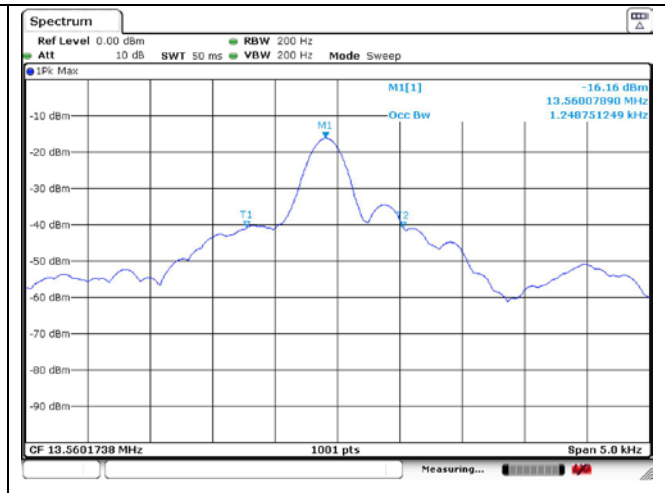
Frequency (MHz)	20 dB Bandwidth (kHz)	99 % Bandwidth (kHz)
13.560	0.629	1.249

-Test plots

20 dB Bandwidth



99 % Bandwidth



-End of the Test report-