TEST REPORT

KES Co., Ltd.
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■ **FCC&IC TEST REPORT**

1. Client

○ Name : RFENGINE CO., LTD.
○ Address : 1-618, Cheongju Techono S-Tower, 530 Jikji-daero, Heungdeok-gu, Cheongju-si Chungcheongbuk-do, South Korea

2. Sample Description

○ Product item : 13.56MHz RFID READER
○ Model name : HFR-2AM
○ Manufacturer etc. : RFENGINE CO., LTD.

3. Date of test : 2024.06.26 ~2024.06.27

4. Location of Test : ☑ Permanent Testing Lab ☐ On Site Testing

○ Adress : 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea

5. Test method used : Part 15.225 & RSS-210 (Issue 11)

6. Test result : PASS

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This laboratory is not accredited for the test results marked*.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : Gu-Bong, Kang (Signature) [강구봉]2024/06/28	Technical Manager Name : Yeong-Jun Cho (Signature) [조영준]2024/06/28

2024. 06. 28.

KES Co., Ltd.

Accredited by KOLAS, Republic of KOREA

REPORT REVISION HISTORY

Date	Test Report No.	Revision History
2024.06.28	KES-RF240357	Initial

Use of uncertainty of measurement for decisions on conformity (decision rule):

■ No decision rule is specified by the standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty(“simple acceptance” decision rule, previously known as “accuracy method”).

☐ Other (to be specified, for example when required by the standard or client)

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1. General information

Applicant	RFENGINE CO., LTD.
Applicant address	1-618, Cheongju Techono S-Tower, 530 Jikji-daero, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do, South Korea
Test site	KES Co., Ltd.
Test site address	☐ #3002, #3503, #3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do,14057,Republic of Korea ☒ 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Test Facility	FCC Accreditation Designation No.: KR0100, Registration No.: 444148
FCC rule part(s):	15.225
IC rule part(s):	RSS-210 (Issue 11) & RSS-Gen (Issue 5)
FCC ID:	2BDL2HFR2AM
IC Number:	31937-HFR2AM
Test device serial No.	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	13.56MHz RFID READER
Frequency range	13.561 4 ㎒ (NFC)
Model	HFR-2AM
Variant Model:	-
Modulation technique	ASK
Number of channels	13.561 4 ㎒ (NFC) : 1 ch
Antenna specification	NFC : Loop Antenna
Power source	AC 120 V (Adapter Output DC 5 V)
H/W Version	HFR-2AM (V03-KC)
S/W Version	“4D 26 F2”
Serial number	2024.04.08001

1.2. Test configuration

The **RFENGINE CO., LTD. // 13.56MHz RFID READER // HFR-2AM //FCC ID: 2BDL2HFR2AM // IC :31937-HFR2AM** was tested according to the specification of EUT, the EUT must comply with following standards

FCC Part 15
FCC Part 2
ANSI C63.10-2013
ISED RSS-210 Issue 11 and RSS-Gen Issue 5

1.3. Information about derivative model

N/A

1.4. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
AC/DC Adapter	Shenzhen Perfect Gallant Tec Co.,Ltd.	PG122-0502000UD	-	AC 100~240 V

1.5. Sample calculation

Where relevant, the following sample calculation is provided
For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Offset(㏈) = RF cable loss(㏈) + attenuator factor(㏈).
= 0.69 + 10 = 10.69 (㏈)

For Radiation test :
Field strength level (㏈㎶/m) = Measured level (㏈㎶) + Antenna factor (㏈) + Cable loss (㏈) – Amplifier gain (㏈)

1.6. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.22 ㏈ (SHIELD ROOM #6)
Uncertainty for Radiation emission test (include Fundamental emission)	Below 1㎓	4.04 ㏈ (SAC #6)
	Above 1㎓	5.32 ㏈ (SAC #5)
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		

1.7. Frequency/channel operations

Ch.	Frequency (㎒)	Rate(Mbps)
01	13.561 4	NFC

2. Summary of tests

Section in FCC Part 15 & 2	Section in RSS-210 & Gen	Parameter	Test results
-	RSS-Gen 6.7	99% Occupied Bandwidth	Pass
15.225(a)	RSS-210 B.6	The field strength of fundamental	Pass
15.225(b)(c)	RSS-210 B.6	The field strength of spurious emission(In-band)	Pass
15.225(d) 15.209	RSS-Gen 8.9	The field strength of spurious emission(Out-band)	Pass
2.1049	RSS-Gen 6.7	20 dB bandwidth	Pass
15.225(e)	RSS-210 B.6	Frequency stability	Pass
15.207	RSS-Gen 8.8	AC conducted emissions	Pass
15.203	-	Antenna Requirement	Pass

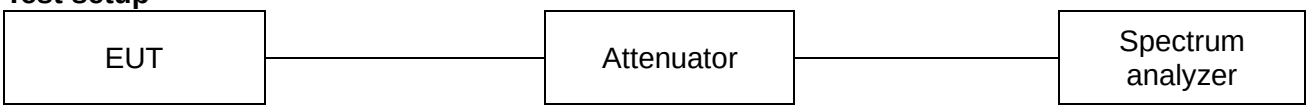
3 Test results

3.1. 99% Occupied Bandwidth

Test procedure

ANSI C63.10-2013 clause 6.9.2 and 6.9.3

Test setup



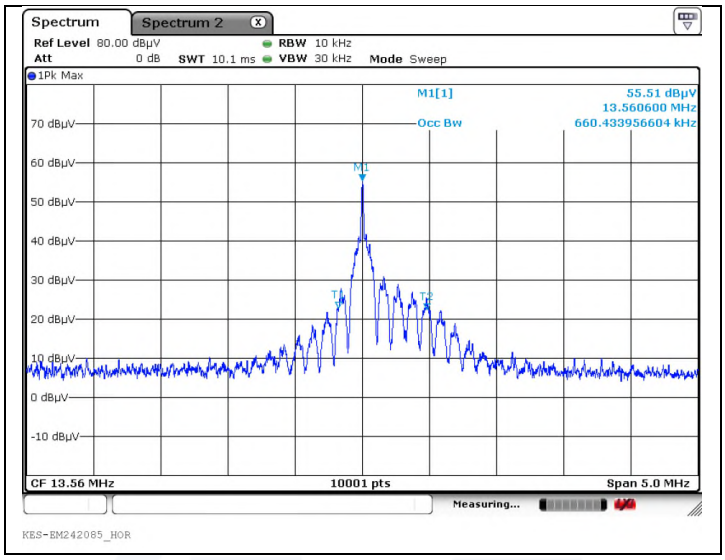
Test setting

1. Span = The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
2. RBW = The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW 3. VBW = shall be approximately three times the RBW
4. Sweep = auto
5. Detector function = Peak
6. Trace = Max hold

Limit

None; for reporting purpose only.

Test results

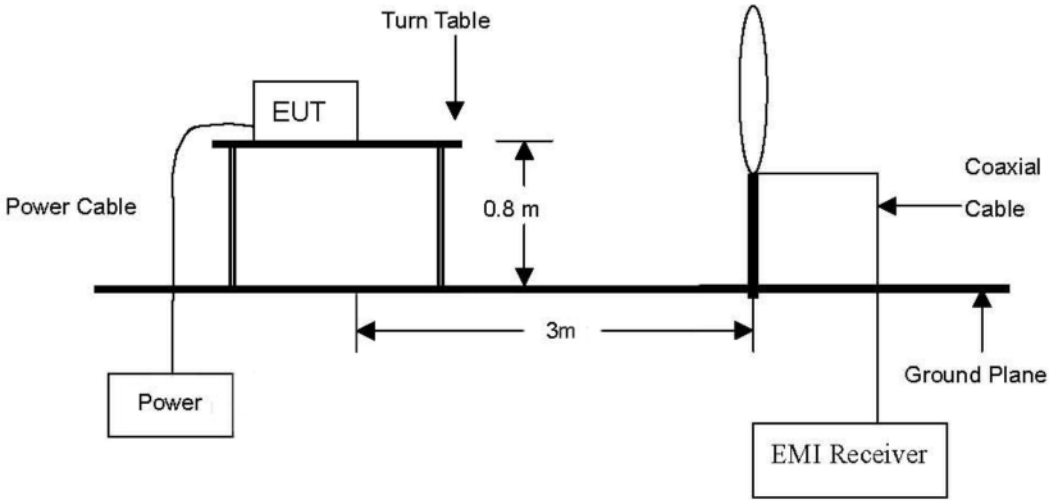


Note.
Because the measured signal is CW/CW-like, adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

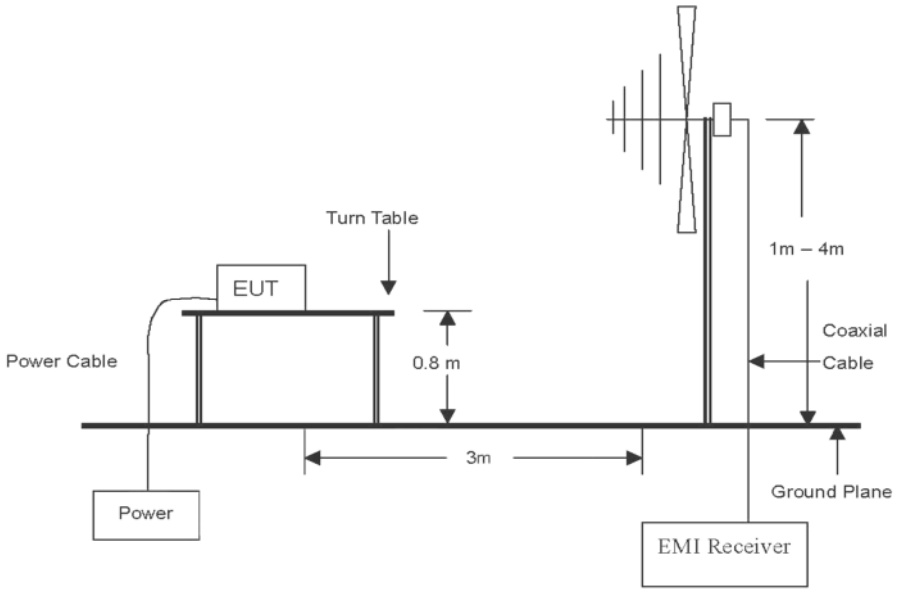
3.2. Radiated spurious emissions

Test setup

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



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



Test procedure

[9 ㎑ to 30 ㎒]

The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. 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. 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. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

[30 ㎒ to 1 ㎓]

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.
The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.

Note.

According to exploratory test no any obvious emission except for fundamental 13.56 ㎒ were detected from 9 ㎑ to 30 ㎒. Although these test were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

FCC Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400/F(㎑)
0.490 ~ 1.705	30	24000/F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**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 ㎒, 76 ~ 88 ㎒, 174 ~ 216 ㎒ or 470 ~ 806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

In the section 15.225:

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

(b) Within the bands 13.410 ~ 13.553 ㎒ and 13.567 ~ 13.710 ㎒, the field strength of any emissions shall not exceed 334 microvolts/meter (=50.5 ㏈㎶/m) at 30 meters.

(c) Within the bands 13.110 ~ 13.410 ㎒ and 13.710 ~ 14.010 ㎒ the field strength of any emissions shall not exceed 106 microvolts/meter (=40.5 ㏈㎶/m) at 30 meters.

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

IC Limit

According to RSS-Gen, 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 ㎒	
Frequency (㎒)	**Field strength (㎶/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 ㎒		
Frequency	**Magnetic field strength (H-Field) (㎂/m)**	**Measurement distance (m)**
9 - 490 ㎑Note 1	6.37/F (F in ㎑)	300
490 - 1705 ㎑	63.7/F (F in ㎑)	30
1.705 - 30 ㎒	0.08	30

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

In the section RSS-210 B.6 :

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

i. 15.848 mV/m (84 ㏈㎶/m) at 30 m, within the band 13.553-13.567 ㎒

ii. 334 µV/m (50.5 ㏈㎶/m) at 30 m, within the bands 13.410-13.553 ㎒ and 13.567-13.710 ㎒

iii. 106 µV/m (40.5 ㏈㎶/m) at 30 m, within the bands 13.110-13.410 ㎒ and 13.710-14.010 ㎒

iv. RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 ㎒

Test results for fundamental

Operating frequency: 13.561 4 ㎒

Distance of measurement: 3 meter

Radiated emissions		Ant.	Total factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Correction factor (dB/m)	Distance factor (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
13.561 4	32.20	H	19.70	40.00	11.90	84.00	72.10
13.561 4	37.50	V	19.70	40.00	17.20	84.00	66.80

Test results for in-band & out-band(9 ㎑ to 30 ㎒)

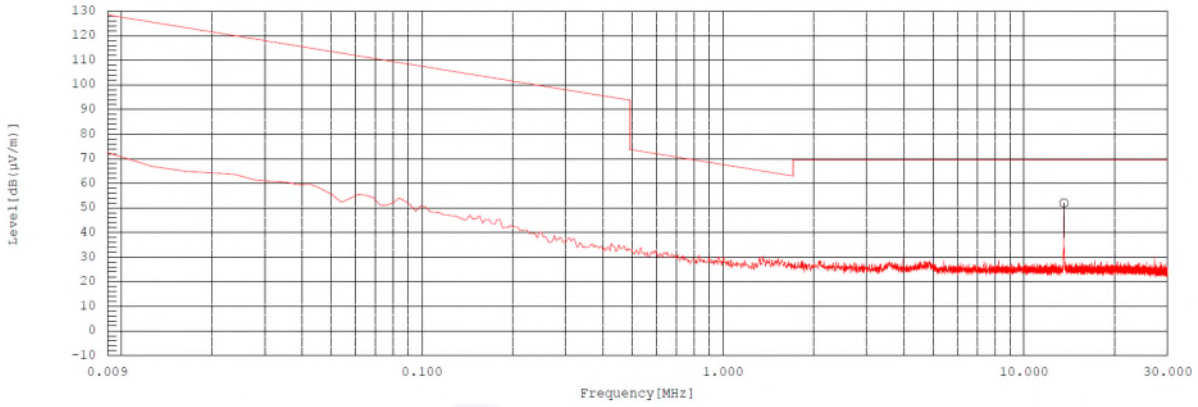
Radiated emissions		Ant.	Total factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Correction factor (dB/m)	Distance factor (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
12.438	9.90	V	19.63	40.00	-10.47	29.54	40.01
12.622	9.93	H	19.63	40.00	-10.44	40.50	50.94
13.307	11.19	H	19.65	40.00	-9.16	50.50	59.66
13.402	12.59	V	19.66	40.00	-7.75	84.00	91.75
13.553	26.79	H	19.66	40.00	6.45	50.50	44.05
13.553	31.41	V	19.66	40.00	11.07	40.50	29.43
13.561	33.74	H	19.66	40.00	13.40	29.54	16.14
13.561	38.81	V	19.66	40.00	18.47	29.54	11.07
13.567	29.27	H	19.66	40.00	8.93	40.50	31.57
13.567	34.37	V	19.66	40.00	14.03	50.50	36.47
13.719	16.39	V	19.67	40.00	-3.94	84.00	87.94
13.853	12.60	H	19.68	40.00	-7.72	50.50	58.22
14.035	14.94	V	19.68	40.00	-5.38	40.50	45.88
14.281	10.85	H	19.69	40.00	-9.46	29.54	39.00

Note.

1. All measurements were performed using a loop antenna. The antenna was investigated with three polarizations, and horizontal and vertical polarizations were reported as the worst case.
2. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
3. Measurements were performed at 3m and the data was extrapolated to the specified measurement distance of 30m using the square of an inverse linear distance extrapolation factor (40 ㏈/decade) as specified in §15.31(f)(2). Extrapolation Factor = 20 log10(30/3)^2 = 40 ㏈.
4. The spectrum was investigated from 9 ㎑ up to 30 ㎒ using the loop antenna. Only the emissions shown in the table above were found to be significant.
5. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
6. Actual = Reading + Correction factors(Ant. factor + Cable loss) - Distance factor
7. Margin [dB] = Limit [㏈㎶//m] - Field Strength Level [㏈㎶//m]
8. All modes (e.g. with and without a tag) were investigated. Only the radiated emissions of the configuration (with a tag) that produced the worst case emissions are reported in this section.

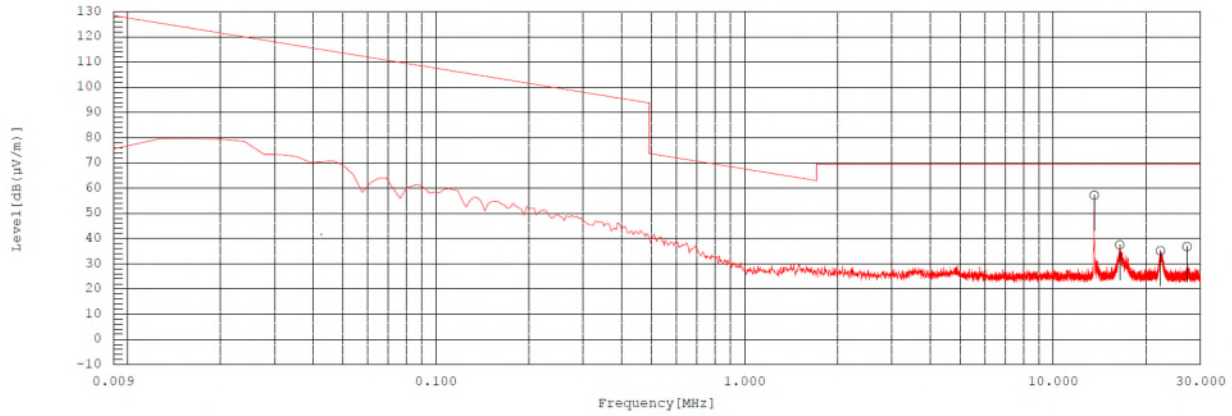
Test results (9 ㎑ to 30 ㎒)

Horizontal // Fundamental

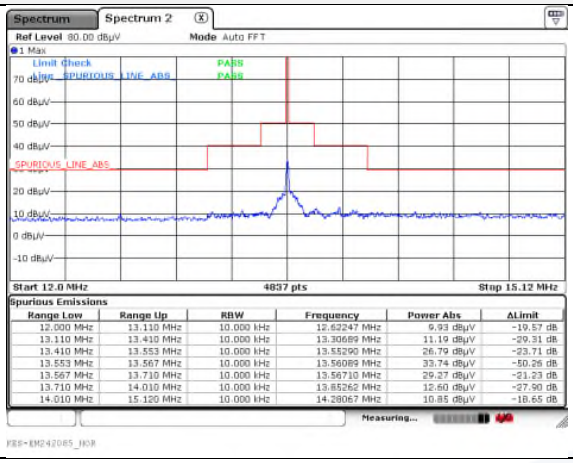
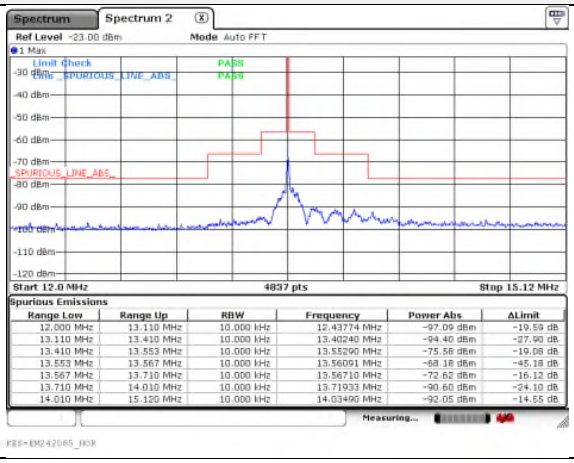


No.	Range	Frequency [MHz]	Reading PK [dB(μV)]	c.f [dB(1/m)]	Result PK [dB(μV/m)]	Limit PK [dB(μV/m)]	Angle [deg]	Remark
1	Range1	13.561	32.2	19.7	51.9	----------	69.0	

Vertical // Fundamental

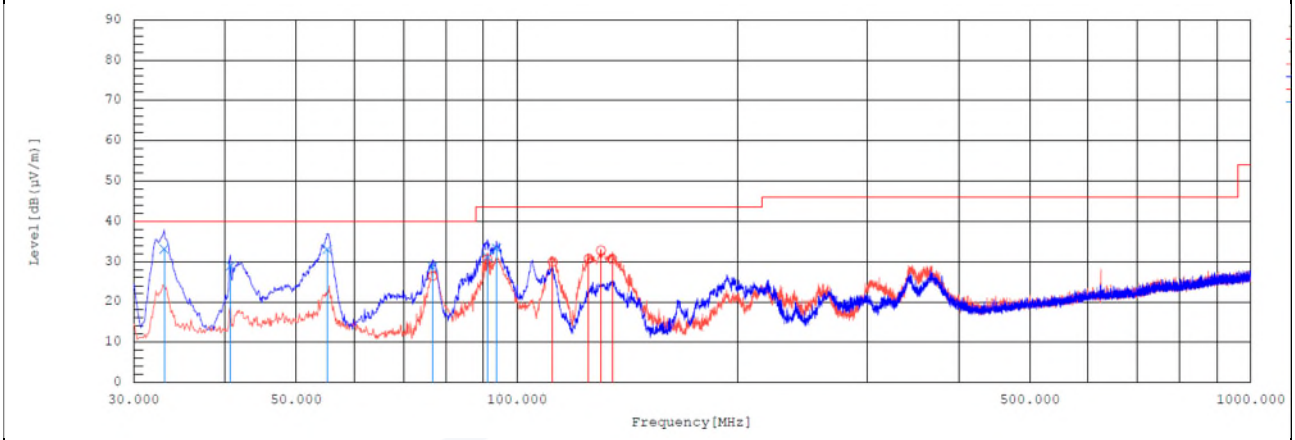


No.	Range	Frequency [MHz]	Reading PK [dB(μV)]	c.f [dB(1/m)]	Result PK [dB(μV/m)]	Limit PK [dB(μV/m)]	Angle [deg]	Remark
1	Range1	13.561	37.5	19.7	57.2	----------	0.0	
2	Range1	16.403	17.8	19.7	37.5	----------	23.4	
3	Range1	22.255	15.5	19.7	35.2	----------	110.1	
4	Range1	27.125	17.3	19.5	36.8	----------	177.1	

Horizontal // in-band & out-band	Vertical // in-band & out-band
	

Test results (Below 1 000 ㎒)

Horizontal // Vertical



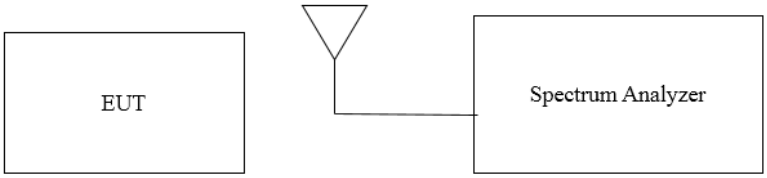
No.	Frequency [MHz]	Pol	Reading QP [dB(μV)]	c.f [dB(1/m)]	Result QP [dB(μV/m)]	Limit QP [dB(μV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	33.031	V	48.2	-15.1	33.1	40.0	6.9	100.0	243.9	
2	40.670	V	42.4	-13.5	28.9	40.0	11.1	104.0	199.1	
3	55.099	V	45.6	-12.6	33.0	40.0	7.0	109.0	131.9	
4	76.681	V	46.3	-17.6	28.7	40.0	11.3	142.0	52.7	
5	76.681	H	44.0	-17.6	26.4	40.0	13.6	375.0	206.6	
6	91.110	V	46.5	-15.3	31.2	43.5	12.3	157.0	52.7	
7	91.110	H	45.9	-15.3	30.6	43.5	12.9	252.0	359.8	
8	93.778	V	48.1	-14.8	33.3	43.5	10.2	109.0	243.9	
9	111.844	H	44.5	-14.6	29.9	43.5	13.6	168.0	68.3	
10	125.181	H	46.2	-15.5	30.7	43.5	12.8	218.0	27.4	
11	130.153	H	48.7	-15.9	32.8	43.5	10.7	192.0	44.8	
12	134.881	H	46.8	-16.2	30.6	43.5	12.9	188.0	264.6	

Note.

1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 960 ㎒.
2. Both Vertical and Horizontal polarities of the receive antenna were evaluated with the worst case emissions being reported. Below 30 ㎒ the loop antenna was positioned in 3 orthogonal planes (X Front, Y side, Z top) to determine the orientation resulting in the worst case emissions.
3. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
4. No spurious emissions levels were found to be greater than the level of the fundamental.

3.3 20 dB bandwidth

Test setup



Test procedure

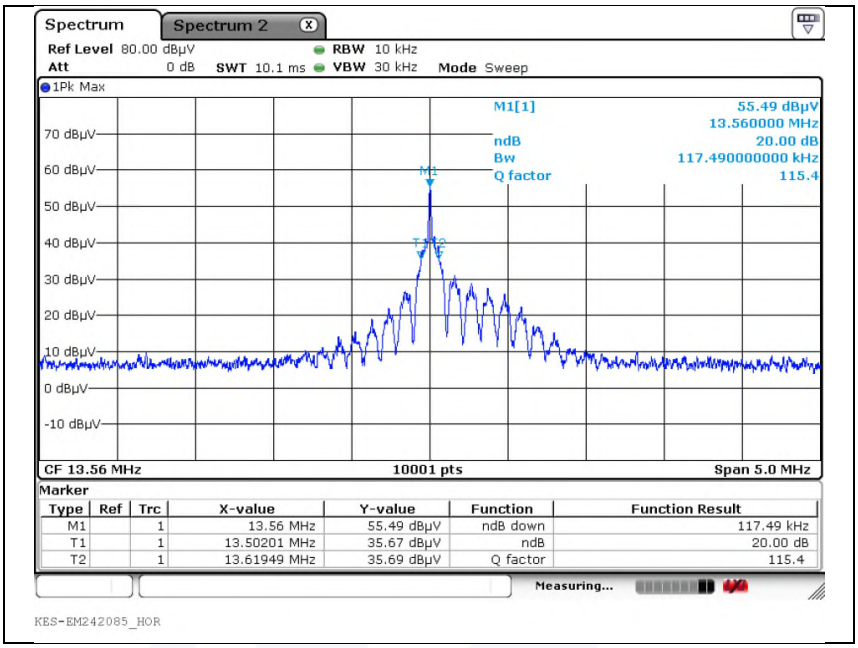
ANSI C63.10-2013 – Section 6.9.2

1. Spectrum analyzer frequency is set to the nominal EUT channel center frequency.
2. RBW = 1~5% OBW
3. VBW ≥ 3 x RBW
4. Reference level set to keep signal from exceeding maximum input mixer for linear operation.
5. Detector = Peak
6. Trace mode = Max hold
7. Sweep = Auto couple
8. The trace was allowed to stabilize
9. Using the marker-delta function, determine the “-20 dB down amplitude” using [(highest in band spectral density) – 20 dB]
10. Set a marker at the lowest frequency of the envelope of the spectral density, such that the marker is at or slightly below the “-20 dB down amplitude” determined in Step 9.
11. Reset Marker-delta function and move the marker to other side of the emission until the delta marker amplitude is the same level as reference amplitude. The marker delta frequency reading at this point is the specified emission bandwidth.

Limit

None; for reporting purpose only.

Test results



Note.

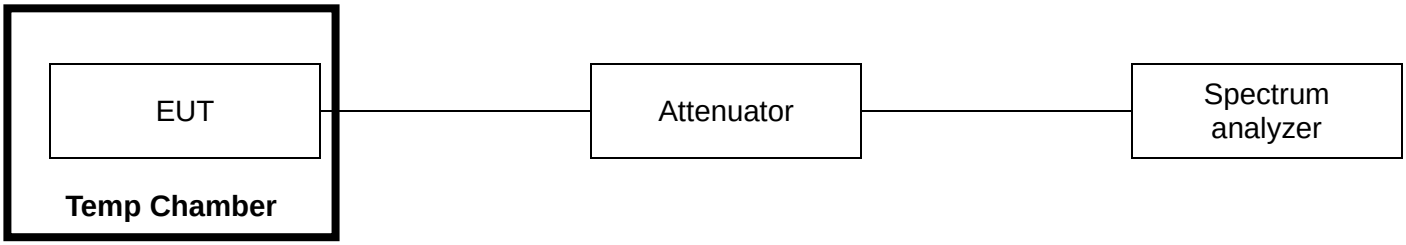
Because the measured signal is CW/CW-like, adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

3.4. Frequency Stability

Test procedure

ANSI C63.10-2013, clause 6.8.1

Test setup



1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2. Turn the EUT on and couple its output to a spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.
7. While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

FCC Limit

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 Limit

According to §RSS-210 B.6 the carrier frequency stability shall not exceed ± 0.01% (±100 ppm)

Test results

Test voltage (%)	Test voltage (V)	Temperature (℃)	Maintaining time	Measure frequency (㎒)	Frequency deviation (㎐)	Deviation (%)
100 %	AC 120 V	-20	Startup	13.560 800	-600	-0.004 4
			2 minutes	13.560 813	-587	-0.004 3
			5 minutes	13.560 807	-593	-0.004 4
			10 minutes	13.560 839	-561	-0.004 1
		-10	Startup	13.560 867	-533	-0.003 9
			2 minutes	13.560 882	-518	-0.003 8
			5 minutes	13.560 875	-525	-0.003 9
			10 minutes	13.560 859	-541	-0.004 0
		0	Startup	13.560 867	-533	-0.003 9
			2 minutes	13.560 885	-515	-0.003 8
			5 minutes	13.560 878	-522	-0.003 8
			10 minutes	13.560 860	-540	-0.004 0
		10	Startup	13.560 905	-495	-0.003 7
			2 minutes	13.560 915	-485	-0.003 6
			5 minutes	13.560 890	-510	-0.003 8
			10 minutes	13.560 900	-500	-0.003 7
		20	Startup	13.560 900	-500	-0.003 7
			2 minutes	13.560 902	-498	-0.003 7
			5 minutes	13.560 922	-478	-0.003 5
			10 minutes	13.560 889	-511	-0.003 8
		30	Startup	13.560 869	-531	-0.003 9
			2 minutes	13.560 900	-500	-0.003 7
			5 minutes	13.560 884	-516	-0.003 8
			10 minutes	13.560 877	-523	-0.003 9
		40	Startup	13.560 879	-521	-0.003 8
			2 minutes	13.560 855	-545	-0.004 0
			5 minutes	13.560 890	-510	-0.003 8
			10 minutes	13.560 905	-495	-0.003 7
		50	Startup	13.561 400	0	0.000 0
			2 minutes	13.561 423	23	0.000 2
			5 minutes	13.561 415	15	0.000 1
			10 minutes	13.561 385	-15	-0.000 1
85 %	AC 102 V	20	Startup	13.560 918	-482	-0.003 6
			2 minutes	13.560 908	-492	-0.003 6
			5 minutes	13.560 887	-513	-0.003 8
			10 minutes	13.560 901	-499	-0.003 7
115 %	AC 138 V	20	Startup	13.560 904	-496	-0.003 7
			2 minutes	13.560 879	-521	-0.003 8
			5 minutes	13.560 885	-515	-0.003 8
			10 minutes	13.560 903	-497	-0.003 7

3.5. AC conducted emissions

FCC Limit

According to 15.207(a), 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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (㎒)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

*Decreases with the logarithm of the frequency

IC Limit

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 ㎑ to 30 ㎒ shall not exceed the limits in table 4, as measured using a 50 H / 50 line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Frequency of Emission (㎒)	**Conducted limit (dB㎶)**	
	Quasi-peak	**Average**
0.15 – 0.5	66 to 56[note1]	56 to 46 [note1]
0.5 – 5.	56	46
5 – 30	60	50

Note 1: The level decreases linearly with the logarithm of the frequency.

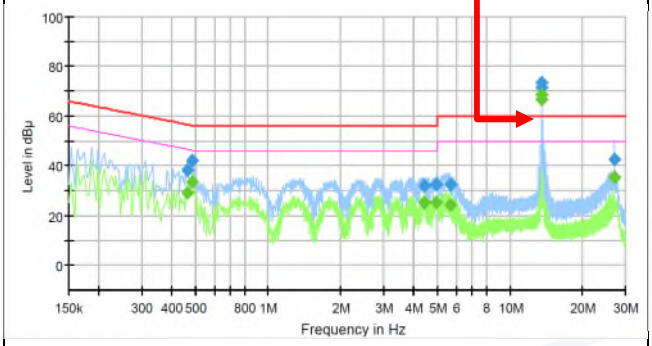
For an EUT with a permanent or detachable antenna operating between 150 ㎑ and 30 ㎒, the AC power-line conducted emissions must be measured using the following configurations:

a. Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.

b. Retest with a dummy load instead of the antenna to determine compliance with the limits b. of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

Test results

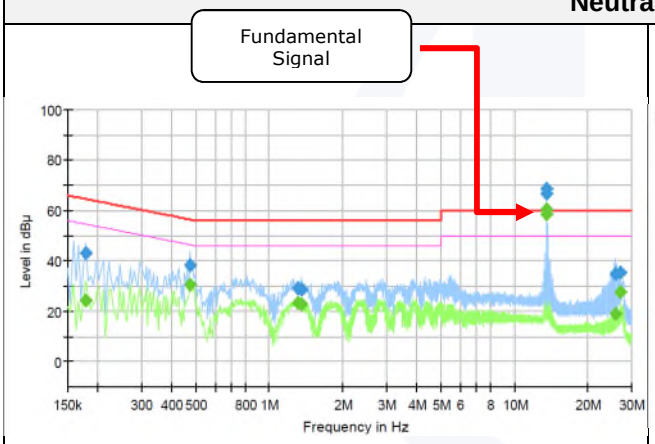
Hot Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.462000	---	29.08	46.66	17.58	1000.0	9.000	L1	19.5
0.462000	38.15	---	56.66	18.51	1000.0	9.000	L1	19.5
0.486000	---	33.60	46.24	12.64	1000.0	9.000	L1	19.5
0.486000	42.10	---	56.24	14.14	1000.0	9.000	L1	19.5
4.418000	---	25.03	46.00	20.97	1000.0	9.000	L1	19.9
4.418000	31.86	---	56.00	24.14	1000.0	9.000	L1	19.9
4.978000	32.35	---	56.00	23.65	1000.0	9.000	L1	20.0
4.978000	---	25.19	46.00	20.81	1000.0	9.000	L1	20.0
5.662000	---	24.33	50.00	25.67	1000.0	9.000	L1	20.0
5.662000	32.45	---	60.00	27.55	1000.0	9.000	L1	20.0
13.558000	71.47	---	60.00	-11.47	1000.0	9.000	L1	20.6
13.558000	---	66.47	50.00	-16.47	1000.0	9.000	L1	20.6
13.562000	73.60	---	60.00	-13.60	1000.0	9.000	L1	20.6
13.562000	---	68.64	50.00	-18.64	1000.0	9.000	L1	20.6
27.118000	---	35.58	50.00	14.42	1000.0	9.000	L1	21.2
27.118000	42.70	---	60.00	17.30	1000.0	9.000	L1	21.2

Neutral Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.178000	43.00	---	64.58	21.58	1000.0	9.000	N	19.5
0.178000	---	24.40	54.58	30.18	1000.0	9.000	N	19.5
0.474000	---	30.30	46.44	16.14	1000.0	9.000	N	19.5
0.474000	38.04	---	56.44	18.40	1000.0	9.000	N	19.5
1.302000	28.92	---	56.00	27.08	1000.0	9.000	N	19.6
1.302000	---	23.38	46.00	22.62	1000.0	9.000	N	19.6
1.358000	---	23.01	46.00	22.99	1000.0	9.000	N	19.6
1.358000	28.79	---	56.00	27.21	1000.0	9.000	N	19.6
13.558000	66.77	---	60.00	-6.77	1000.0	9.000	N	20.6
13.558000	---	58.28	50.00	-9.28	1000.0	9.000	N	20.6
13.562000	---	60.42	50.00	-10.42	1000.0	9.000	N	20.6
13.562000	68.71	---	60.00	-8.71	1000.0	9.000	N	20.6
25.858000	---	18.79	50.00	31.21	1000.0	9.000	N	21.2
25.858000	34.82	---	60.00	25.18	1000.0	9.000	N	21.2
27.126000	---	27.78	50.00	22.22	1000.0	9.000	N	21.3
27.126000	35.33	---	60.00	24.67	1000.0	9.000	N	21.3

3.6. Antenna Requirement

According to 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d),
must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV40	101725	1 year	2025.06.12
Spectrum analyzer	R&S	FSV3044	101272	1 year	2025.03.12
SIGNAL GENERATOR	KEYSIGHT	N5182B	MY59100115	1 year	2025.04.15
Loop Antenna	Schwarzbeck	FMZB1513	1513-257	2 years	2025.11.16
BILOG ANTENNA	Schwarzbeck	VULB 9163	714	2 years	2026.04.19
Attenuator	HUBER+SHHNER	6806.17.A	NONE	1 year	2025.02.13
Amplifier	SONOMA INSTRUMENT	310N	401123	1 year	2025.02.13
EMI TEST RECEIVER	ESU26	R & S	100517	1 year	2024.07.31
AC POWER SOURCE/ ANALYZER	HP	6813A	3729A00754	1 year	2025.01.12
EMI Test Receiver	R&S	ESR3	101783	1 year	2024.11.08
PULSE LIMITER	R&S	ESH3-Z2	101915	1 year	2024.11.08
LISN	R&S	ENV216	101787	1 year	2024.11.08
LISN	R&S	ESH2-Z5	100450	1 year	2024.11.08
Temperature & Humidity Chamber	ESPEC	SH-642	93012671	1 year	2026.06.12

* Statement of Traceability: KES Co., Ltd. attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Peripheral device

Device	Manufacturer	Model No.	Serial No.
Monitor	Samsung Electronics Co., Ltd.	LT23C350	009MHYCH106388P
Monitor Adapter	Samsung Electronics Co., Ltd.	A4514_DDY	CN07BN44-00593BD07G690189
KeyBoard	CAN TECHNOLOGY CO., LTD	ST-600	-
Mouse	Intech Electronics Corp.	XM-1600	-
Desktop PC	SuZhou MEAN WELL Technology Co., Ltd.	DB400T2A	-

The end of test report.