



TEST REPORT

KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr		Report No.: KR21-SRF0272-A Page (1) of (35)	KCTL
1. Client ◦ Name : CEYON TELINVENTORY CO., LTD. ◦ Address : 4F(416), 49, Gangnam-daero 37-gil, Seocho-gu, Seoul, Republic of Korea ◦ Date of Receipt : 2020-11-02			
2. Use of Report : Certification			
3. Name of Product / Model : REEL FINDER / RC2000			
4. Manufacturer / Country of Origin : CEYON TELINVENTORY CO., LTD. / Korea			
5. FCC ID : 2A3J7-RC2000			
6. Date of Test : 2021-07-26 to 2021-07-27			
7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing (Address: 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)			
8. Test method used : FCC Part 15 Subpart C, 15.225			
9. Test Result : Refer to the test result in the test report			
Affirmation	Tested by 		Technical Manager
	Name : Sumin Kim (Signature)		Name : Heesu Ahn (Signature)
2022-01-03			
KCTL Inc.			
As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc.			

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REPORT REVISION HISTORY

Date	Revision	Page No
2021-12-27	Originally issued	-
2022-01-03	Updated	6, 19, 23, 35

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Note. The report No. KR21-SRF0272 is superseded by the report No. KR21-SRF0272-A.

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ Statement not required by the standard or client used for type testing

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1. General information

Client : CEYON TELINVENTORY CO., LTD.
 Address : 4F(416), 49, Gangnam-daero 37-gil, Seocho-gu, Seoul, Republic of Korea
 Manufacturer : CEYON TELINVENTORY CO., LTD.
 Address : 4F(416), 49, Gangnam-daero 37-gil, Seocho-gu, Seoul, Republic of Korea
 Laboratory : KCTL Inc.
 Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
 Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132
 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
 CAB Identifier: KR0040, ISED Number: 8035A
 KOLAS No.: KT231

2. Device information

Equipment under test : REEL FINDER
 Model : RC2000
 Modulation technique : ASK(NFC)
 Number of channels : 1 ch
 Frequency range : 13.56 MHz
 Power source : DC 12 V
 Antenna specification : PCB antenna
 Antenna gain : N/A
 Software version : Rev 1.0
 Hardware version : Rev 1.0
 Test device serial No. : N/A
 Operation temperature : -20 °C ~ 60 °C

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source	Note.
AC Adapter	Atron	CAD120121	-	Input: 100-240 V, 50/60Hz 2.0 A Output: 12 V/10 A	-

2.2. Frequency/channel operations

This device contains the following capabilities:

Ch.	Frequency (MHz)
01	13.56

Table 2.2.1. NFC

3. Antenna requirement

Requirement of FCC part section 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.

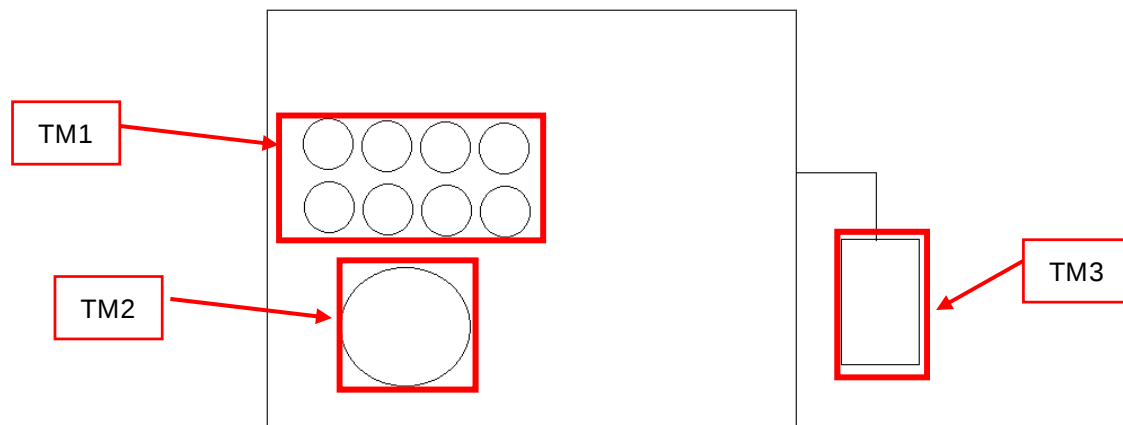
- The transmitters have permanently attached PCB antennas (Internal antenna) on board and a small loop antenna(external)*.

* The connector part is fixed with an adhesive or soldering during the assembly process so that the general user cannot take it off.

4. Declaration of Test Mode

Test modes	Description
TM1	Only operated TM1 part
TM2	Only operated TM2 part
TM3	Only operated TM3 part
TM4	Operated all of parts(TM1, TM2, TM3)

Note : This EUT has 3 transceivers. And EUT was tested in 4 cases.



-The front of device

5. Summary of tests

FCC Part section(s)	Parameter	Test Condition	Test results
15.225(a)	In-band Fundamental Emission	Radiated	Pass
15.225(b)(c)	In-band Spurious Emission		Pass
15.225(d) 15.209	Out-of-band Spurious Emission		Pass
15.225(e)	Frequency Stability Tolerance	Conducted	Pass
15.215(c)	20 dB Bandwidth		Pass
15.207(a)	AC Conducted emissions		Pass

Notes:

- All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
- These tests were performed other than open field 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.
- The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that **Y** orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in **Y** orientation
- The radiated test was performed with and without passive tag. The test results shown in the following sections represent the worst case emissions.
 - ♦ Worst Case : Without passive tag
- The test procedure(s) in this report were performed in accordance as following.
 - ♦ ANSI C63.10-2013
- The device was tested in 4 modes.
 SISO: TM1, TM2, TM3
 MIMO: TM4

6. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

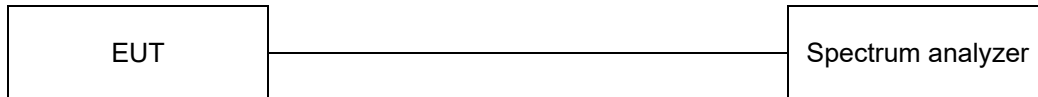
All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicated a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty ($\pm$)	
Radiated spurious emissions	9 kHz ~ 30 MHz	2.3 dB
	30 MHz ~ 1 000 MHz	2.2 dB
Conducted emissions	9 kHz ~ 150 kHz	3.7 dB
	150 kHz ~ 30 MHz	3.3 dB

7. Test results

7.1. 20 dB Bandwidth

Test setup



Limit

According to §15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test procedure

ANSI C63.10 - Section 6.9.2

Test settings

The spectrum analyzer connected receive antenna and the EUT placed on near the receive antenna. The RBW is set to 10 kHz. The VBW is set to 3 times the RBW. The sweep time is coupled.

KCTL Inc.

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Suwon-si, Gyeonggi-do, 16677, Korea
TEL: 82-31-285-0894 FAX: 82-505-299-8311
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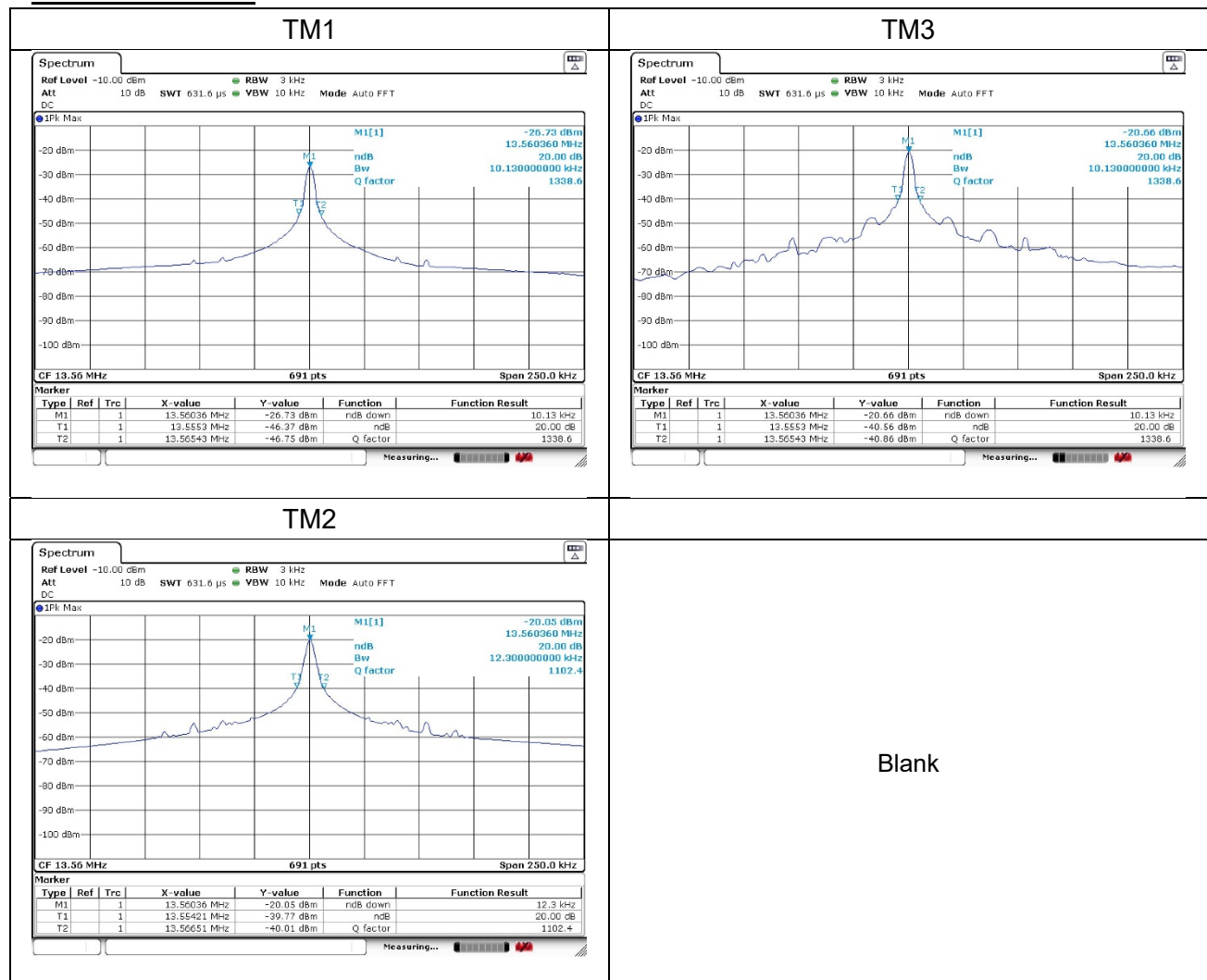
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Test results

Test mode	Frequency [MHz]	20 dB Bandwidth [MHz]		Limit [MHz]	20 dB Bandwidth [kHz]
TM1	13.56	Lowest Frequency	13.555 300	13.110 000	10.13
		Highest Frequency	13.565 430	14.010 000	
TM2		Lowest Frequency	13.554 210	13.110 000	12.30
		Highest Frequency	13.566 510	14.010 000	
TM3		Lowest Frequency	13.555 300	13.110 000	10.13
		Highest Frequency	13.565 430	14.010 000	

20 dB Bandwidth

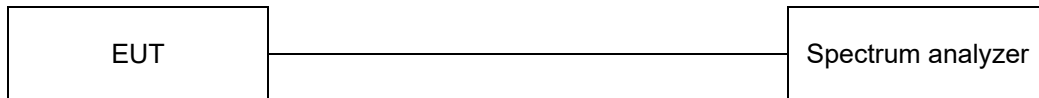


Note:

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

7.2. Frequency tolerance

Test setup



Limit

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.

Test procedure

ANSI C63.10-2013 - Section 6.8.1

Test results

[TM1]

Voltage	Voltage	TEMP	Maintaining time	Measure frequency	Frequency deviation	Deviation
[%]	[V]	[°C]		[Hz]	[Hz]	[%]
100	12.00	20(Ref.)	Startup	13 560 026	26.0	0.000 19
			2 minutes	13 560 065	65.0	0.000 48
			5 minutes	13 560 064	64.0	0.000 47
			10 minutes	13 560 099	99.0	0.000 73
		-20	Startup	13 559 961	-39.0	-0.000 29
			2 minutes	13 559 975	-25.0	-0.000 18
			5 minutes	13 559 994	-6.0	-0.000 04
			10 minutes	13 559 998	-2.0	-0.000 02
		-10	Startup	13 559 978	-22.0	-0.000 16
			2 minutes	13 559 986	-14.0	-0.000 10
			5 minutes	13 559 997	-3.0	-0.000 02
			10 minutes	13 559 994	-6.0	-0.000 04
		0	Startup	13 560 027	27.0	0.000 20
			2 minutes	13 560 039	39.0	0.000 29
			5 minutes	13 560 042	42.0	0.000 31
			10 minutes	13 560 039	39.0	0.000 29
		10	Startup	13 560 041	41.0	0.000 30
			2 minutes	13 560 062	62.0	0.000 46
			5 minutes	13 560 079	79.0	0.000 58
			10 minutes	13 560 082	82.0	0.000 61
		25	Startup	13 560 042	42.0	0.000 31
			2 minutes	13 560 070	70.0	0.000 52
			5 minutes	13 560 073	73.0	0.000 54
			10 minutes	13 560 069	69.0	0.000 51
		30	Startup	13 560 058	58.0	0.000 43
			2 minutes	13 560 058	58.0	0.000 43
			5 minutes	13 560 069	69.0	0.000 51
			10 minutes	13 560 092	92.0	0.000 68
		40	Startup	13 560 093	93.0	0.000 69
			2 minutes	13 560 101	101.0	0.000 75
			5 minutes	13 560 108	108.0	0.000 80
			10 minutes	13 560 128	128.0	0.000 94
		50	Startup	13 560 094	94.0	0.000 69
			2 minutes	13 560 109	109.0	0.000 80
			5 minutes	13 560 115	115.0	0.000 85
			10 minutes	13 560 111	111.0	0.000 82
85	10.20	20	Startup	13 560 062	62.0	0.000 46
			2 minutes	13 560 068	68.0	0.000 50
			5 minutes	13 560 081	81.0	0.000 60
			10 minutes	13 560 094	94.0	0.000 69
115	13.80	20	Startup	13 560 040	40.0	0.000 30
			2 minutes	13 560 056	56.0	0.000 41
			5 minutes	13 560 059	59.0	0.000 44
			10 minutes	13 560 079	79.0	0.000 58

[TM2]

Voltage	Voltage	TEMP	Maintaining time	Measure frequency	Frequency deviation	Deviation
[%]	[V]	[°C]		[Hz]	[Hz]	[%]
100	12.00	20(Ref.)	Startup	13 560 037	37.0	0.000 27
			2 minutes	13 560 055	55.0	0.000 41
			5 minutes	13 560 083	83.0	0.000 61
			10 minutes	13 560 086	86.0	0.000 63
		-20	Startup	13 559 963	-37.0	-0.000 27
			2 minutes	13 559 974	-26.0	-0.000 19
			5 minutes	13 560 002	2.0	0.000 02
			10 minutes	13 559 993	-7.0	-0.000 05
		-10	Startup	13 559 977	-23.0	-0.000 17
			2 minutes	13 559 979	-21.0	-0.000 16
			5 minutes	13 559 997	-3.0	-0.000 02
			10 minutes	13 559 987	-13.0	-0.000 10
		0	Startup	13 560 015	15.0	0.000 11
			2 minutes	13 560 021	21.0	0.000 16
			5 minutes	13 560 029	29.0	0.000 21
			10 minutes	13 560 051	51.0	0.000 38
		10	Startup	13 560 036	36.0	0.000 27
			2 minutes	13 560 063	63.0	0.000 47
			5 minutes	13 560 070	70.0	0.000 52
			10 minutes	13 560 088	88.0	0.000 65
		25	Startup	13 560 033	33.0	0.000 24
			2 minutes	13 560 062	62.0	0.000 46
			5 minutes	13 560 076	76.0	0.000 56
			10 minutes	13 560 077	77.0	0.000 57
		30	Startup	13 560 040	40.0	0.000 30
			2 minutes	13 560 060	60.0	0.000 44
			5 minutes	13 560 081	81.0	0.000 60
			10 minutes	13 560 087	87.0	0.000 64
		40	Startup	13 560 080	80.0	0.000 59
			2 minutes	13 560 097	97.0	0.000 72
			5 minutes	13 560 111	111.0	0.000 82
			10 minutes	13 560 127	127.0	0.000 94
		50	Startup	13 560 081	81.0	0.000 60
			2 minutes	13 560 099	99.0	0.000 73
			5 minutes	13 560 112	112.0	0.000 83
			10 minutes	13 560 109	109.0	0.000 80
85	10.20	20	Startup	13 560 051	51.0	0.000 38
			2 minutes	13 560 068	68.0	0.000 50
			5 minutes	13 560 073	73.0	0.000 54
			10 minutes	13 560 081	81.0	0.000 60
115	13.80	20	Startup	13 560 060	60.0	0.000 44
			2 minutes	13 560 064	64.0	0.000 47
			5 minutes	13 560 072	72.0	0.000 53
			10 minutes	13 560 079	79.0	0.000 58

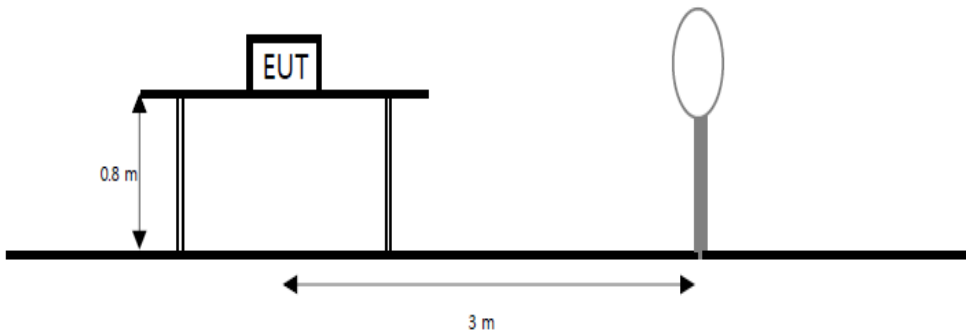
[TM3]

Voltage	Voltage	TEMP	Maintaining time	Measure frequency	Frequency deviation	Deviation
[%]	[V]	[°C]		[Hz]	[Hz]	[%]
100	12.00	20(Ref.)	Startup	13 560 025	25.0	0.000 18
			2 minutes	13 560 047	47.0	0.000 35
			5 minutes	13 560 073	73.0	0.000 54
			10 minutes	13 560 094	94.0	0.000 69
		-20	Startup	13 559 943	-57.0	-0.000 42
			2 minutes	13 559 987	-13.0	-0.000 10
			5 minutes	13 559 997	-3.0	-0.000 02
			10 minutes	13 559 985	-15.0	-0.000 11
		-10	Startup	13 559 979	-21.0	-0.000 16
			2 minutes	13 559 986	-14.0	-0.000 10
			5 minutes	13 559 990	-10.0	-0.000 07
			10 minutes	13 559 991	-9.0	-0.000 07
		0	Startup	13 560 031	31.0	0.000 23
			2 minutes	13 560 019	19.0	0.000 14
			5 minutes	13 560 039	39.0	0.000 29
			10 minutes	13 560 042	42.0	0.000 31
		10	Startup	13 560 045	45.0	0.000 33
			2 minutes	13 560 054	54.0	0.000 40
			5 minutes	13 560 064	64.0	0.000 47
			10 minutes	13 560 070	70.0	0.000 52
		25	Startup	13 560 038	38.0	0.000 28
			2 minutes	13 560 065	65.0	0.000 48
			5 minutes	13 560 080	80.0	0.000 59
			10 minutes	13 560 073	73.0	0.000 54
		30	Startup	13 560 057	57.0	0.000 42
			2 minutes	13 560 047	47.0	0.000 35
			5 minutes	13 560 079	79.0	0.000 58
			10 minutes	13 560 094	94.0	0.000 69
		40	Startup	13 560 088	88.0	0.000 65
			2 minutes	13 560 103	103.0	0.000 76
			5 minutes	13 560 102	102.0	0.000 75
			10 minutes	13 560 126	126.0	0.000 93
		50	Startup	13 560 099	99.0	0.000 73
			2 minutes	13 560 103	103.0	0.000 76
			5 minutes	13 560 103	103.0	0.000 76
			10 minutes	13 560 121	121.0	0.000 89
85	10.20	20	Startup	13 560 066	66.0	0.000 49
			2 minutes	13 560 071	71.0	0.000 52
			5 minutes	13 560 086	86.0	0.000 63
			10 minutes	13 560 083	83.0	0.000 61
115	13.80	20	Startup	13 560 057	57.0	0.000 42
			2 minutes	13 560 070	70.0	0.000 52
			5 minutes	13 560 080	80.0	0.000 59
			10 minutes	13 560 084	84.0	0.000 62

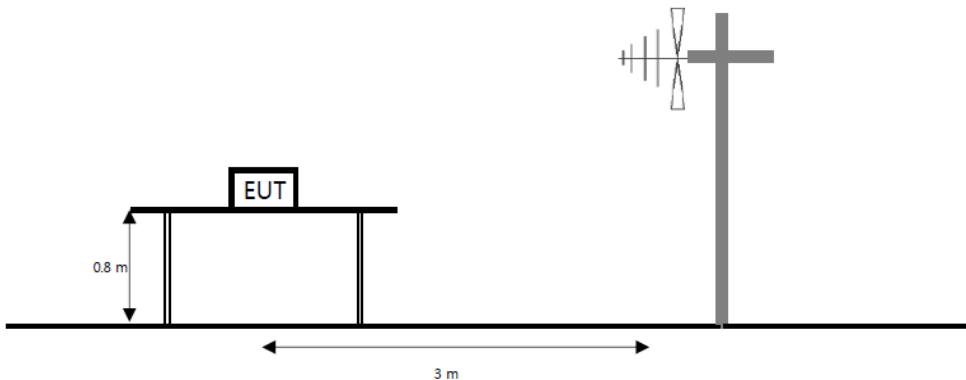
7.3. Radiated spurious emissions

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.



Limit

15.225 (a) The field strength of any emission within the band 13.553-13.567 MHz shall not exceed 15, 848 microvolts/meter at 30 meters.

15.225 (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.

15.225 (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.

15.225 (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.

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30(29.54 dB $\mu\text{V/m}$)	30
30.0-88.0	100(40 dB $\mu\text{V/m}$)	3
88-216	150(43.5 dB $\mu\text{V/m}$)	3
216-960	200 (46 dB $\mu\text{V/m}$)	3
Above 960	500 (53.98 dB $\mu\text{V/m}$)	3

Test procedure

ANSI C63.10-2013 - Section 6.4, 6.5

Test settings

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in table
3. VBW $\geq 3 \times$ RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Table. RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1 000 MHz	100 kHz to 120 kHz
> 1 000 MHz	1 MHz

Notes:

1. $f < 30$ MHz, extrapolation factor of 40 dB/decade of distance. $F_d = 40 \log(D_m/D_s)$
 $f \geq 30$ MHz, extrapolation factor of 20 dB/decade of distance. $F_d = 20 \log(D_m/D_s)$
 Where:
 F_d = Distance factor in dB
 D_m = Measurement distance in meters
 D_s = Specification distance in meters
2. 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 dB/decade) as specified in § 15.31(f)(2). Extrapolation Factor = $40 \log_{10}(30/3) = 40$ dB.
3. Factors(dB) = Antenna factor(dB/m) + Cable loss(dB) + or Amp. gain(dB) + or F_d (dB)
4. Result = Reading + Cable loss + Amp gain + Ant. factor - Distance factor
5. The worst-case emissions are reported however emissions whose levels were not within 20 dB of respective limits were not reported.
6. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
7. Below 30 MHz frequency range, all orientations about parallel, perpendicular, and ground-parallel were investigated then reported and the worse orientations of Face-on and Face-off were set for final test.
8. Face-on = Parallel, Face-off = Perpendicular
9. ¹⁾ means restricted band

[TM1]

Test results for fundamental

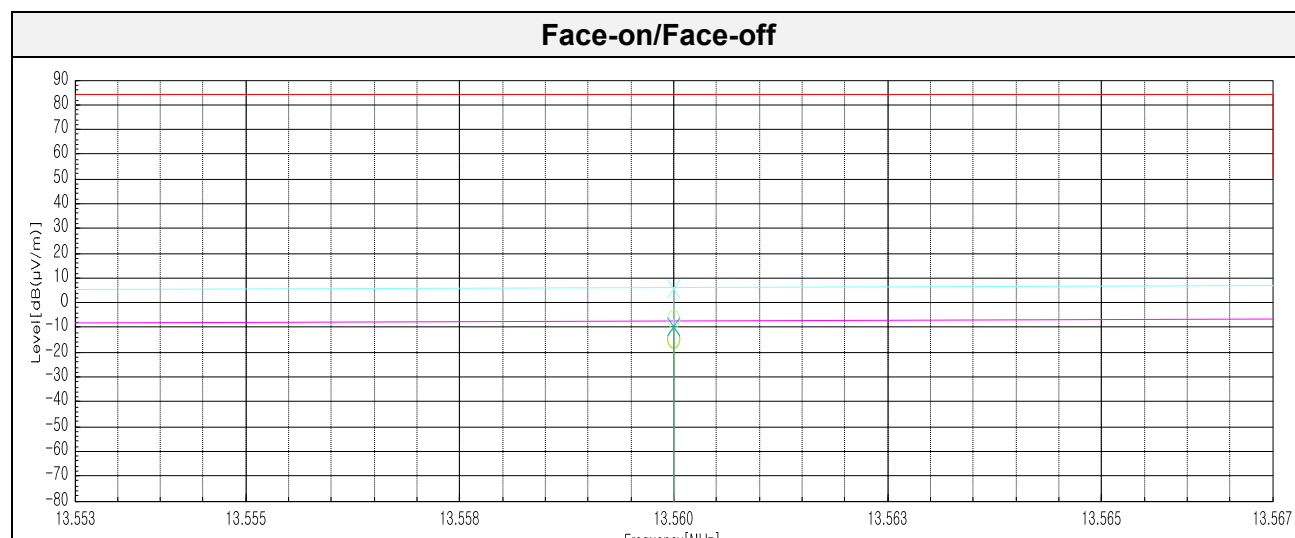
15.225 (a) 13.553-13.567 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	36.10	20.20	-31.09	40.00	-14.79	84.00	98.79

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	40.80	20.20	-31.09	40.00	-10.09	84.00	94.09



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TEL: 82-31-285-0894 FAX: 82-505-299-8311
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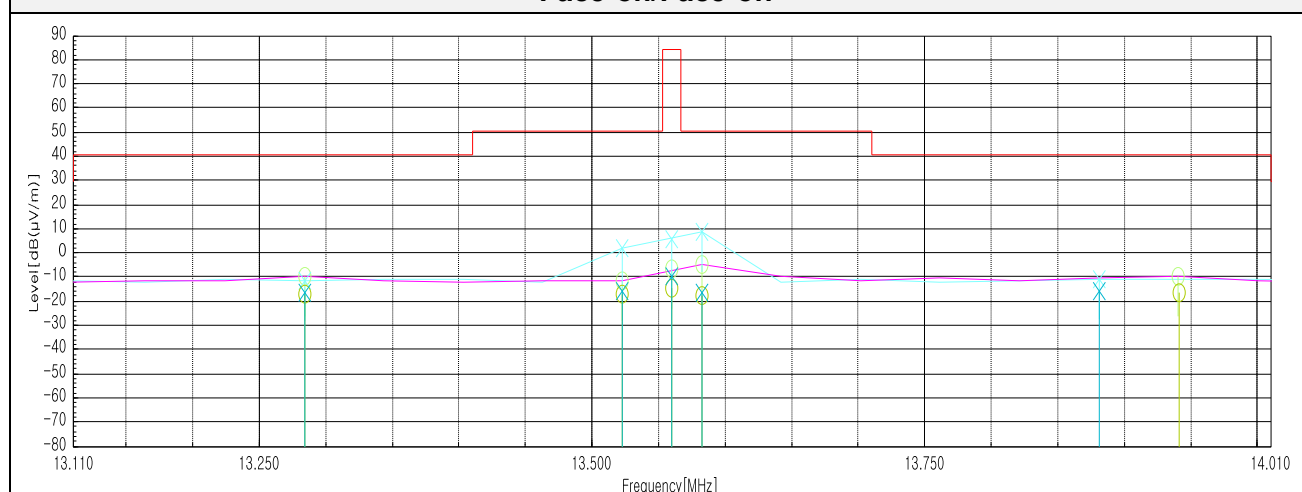
**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.28	33.60	20.20	-31.09	40.00	-17.29	40.50	57.79
13.52	33.90	20.20	-31.09	40.00	-16.99	50.50	67.49
13.58	33.10	20.20	-31.09	40.00	-17.79	50.50	68.29
13.94	34.10	20.20	-31.07	40.00	-16.77	40.50	57.27

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.28	34.50	20.20	-31.09	40.00	-16.39	40.50	56.89
13.52	34.70	20.20	-31.09	40.00	-16.19	50.50	66.69
13.58	34.60	20.20	-31.09	40.00	-16.29	50.50	66.79
13.88	34.90	20.20	-31.07	40.00	-15.97	40.50	56.47

Face-on/Face-off

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65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Korea
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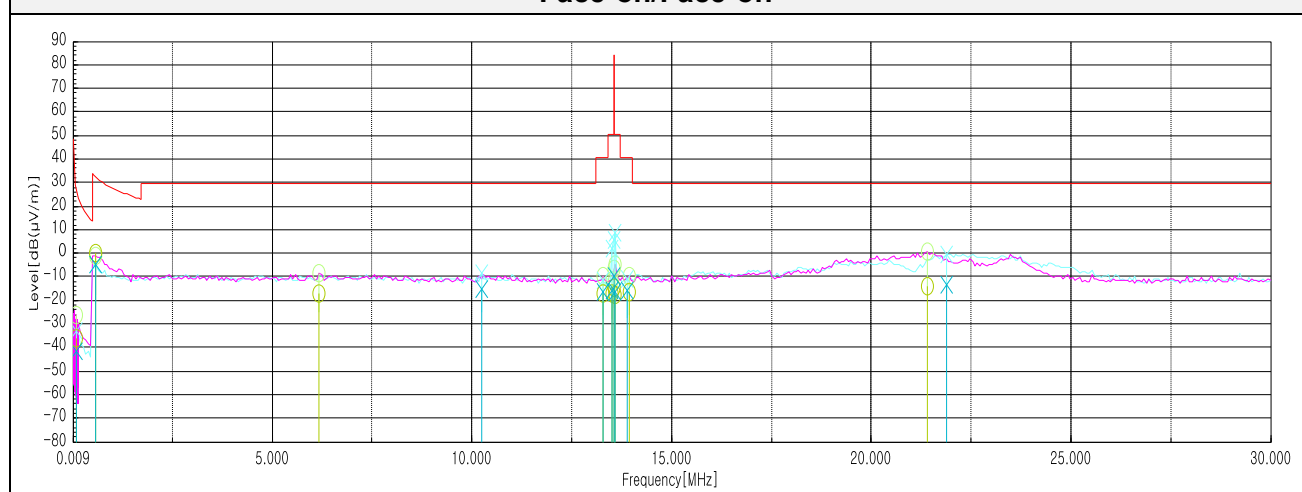
**Test results (9 kHz to 30 MHz)****15.225 (d) 0.009-30 MHz**

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.10*	56.40	19.90	-32.31	80.00	-36.01	27.70	63.71
0.57*	52.30	19.90	-32.12	40.00	0.08	32.50	32.42
6.18	34.20	20.12	-31.56	40.00	-17.24	29.50	46.74
21.40	35.60	20.66	-30.78	40.00	-14.52	29.54	44.06

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.10*	50.50	19.90	-32.31	80.00	-41.91	27.70	69.61
0.57*	47.50	19.90	-32.12	40.00	-4.72	32.50	37.22
10.24	35.60	20.20	-31.20	40.00	-15.40	29.50	44.90
21.88	36.40	20.68	-30.76	40.00	-13.68	29.54	43.22

Face-on/Face-off

* Noise floor signal.

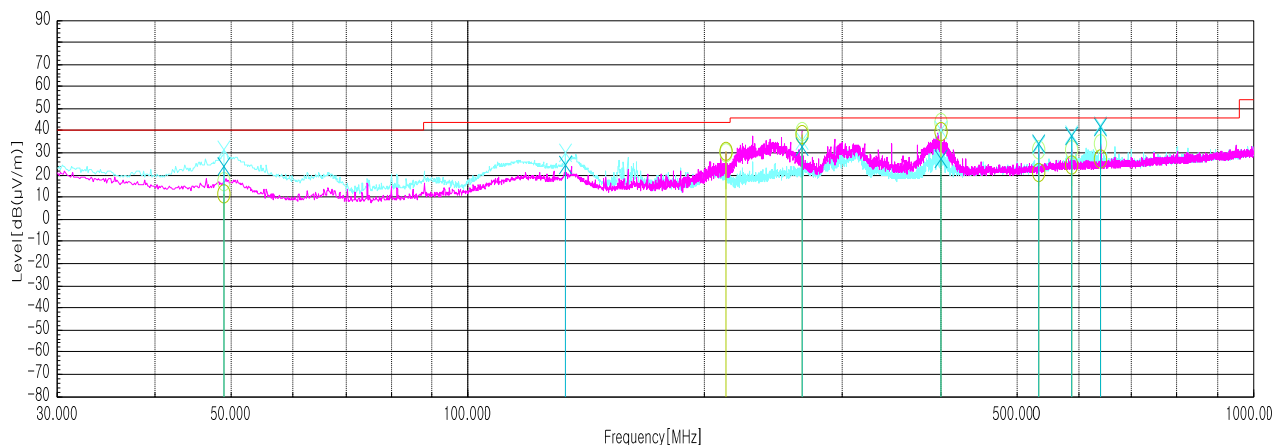
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Suwon-si, Gyeonggi-do, 16677, Korea
TEL: 82-31-285-0894 FAX: 82-505-299-8311
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**Test results (Below 1 000 MHz)****15.225 (d) 30-1 000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
49.04	H	27.30	14.34	-30.00	-	11.64	40.00	28.36
49.04	V	39.30	14.34	-30.00	-	23.64	40.00	16.36
133.31 ¹⁾	V	34.60	17.47	-28.62	-	23.45	43.50	20.05
213.33	H	43.00	16.05	-27.56	-	31.49	43.50	12.01
266.68 ¹⁾	H	45.10	18.63	-26.97	-	36.76	46.00	9.24
266.68 ¹⁾	V	39.90	18.63	-26.97	-	31.56	46.00	14.44
400.06 ¹⁾	H	42.70	21.70	-25.69	-	38.71	46.00	7.29
400.06 ¹⁾	V	30.30	21.70	-25.69	-	26.31	46.00	19.69
533.31	H	21.00	23.70	-24.59	-	20.11	46.00	25.89
533.43	V	34.00	23.70	-24.59	-	33.11	46.00	12.89
586.66	H	22.90	24.50	-24.13	-	23.27	46.00	22.73
586.66	V	35.60	24.50	-24.13	-	35.97	46.00	10.03
640.01	H	25.00	24.78	-23.71	-	26.07	46.00	19.93
640.01	V	39.20	24.78	-23.71	-	40.27	46.00	5.73

Horizontal/Vertical

[TM2]

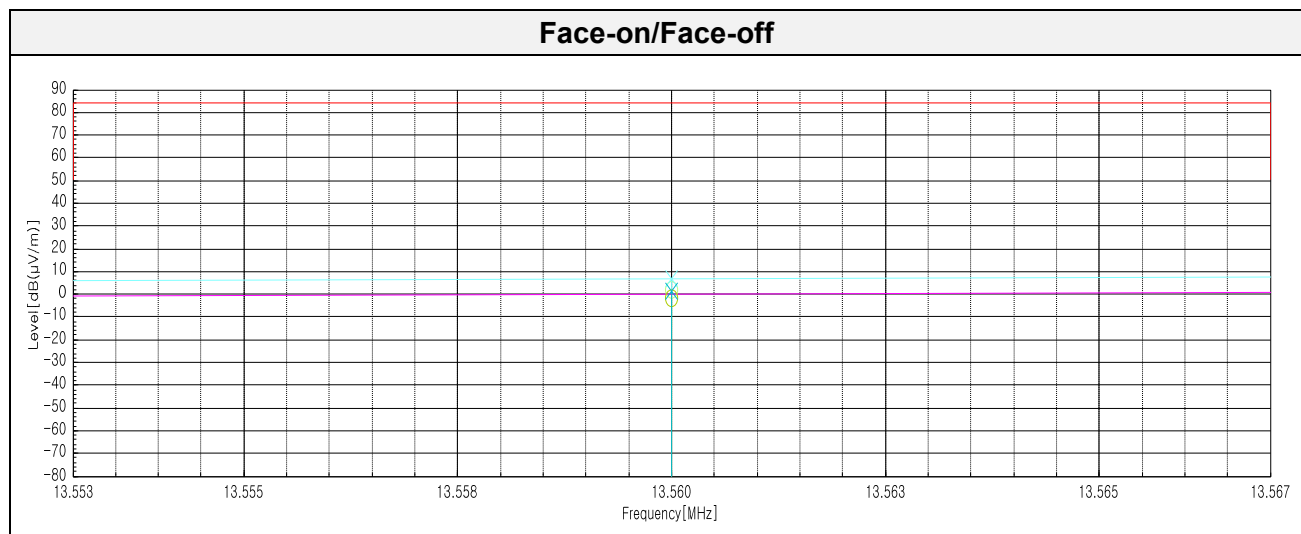
Test results for fundamental
15.225 (a) 13.553-13.567 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	49.30	20.20	-31.09	40.00	-1.59	84.00	85.59

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	52.00	20.20	-31.09	40.00	1.11	84.00	82.89



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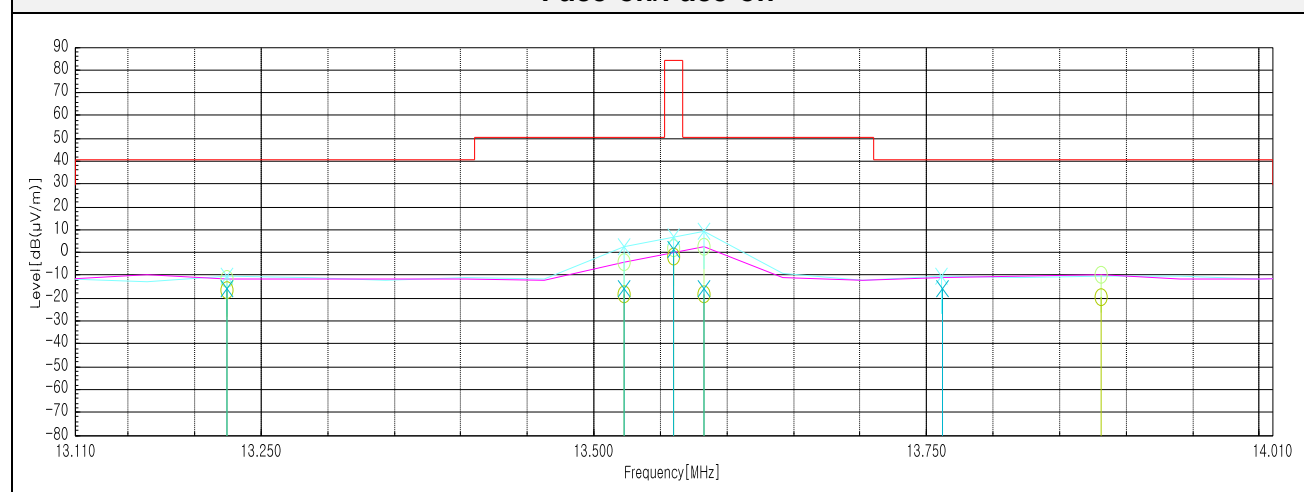
**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.22	34.50	20.20	-31.10	40.00	-16.40	40.50	56.90
13.52	32.50	20.20	-31.09	40.00	-18.39	50.50	68.89
13.58	32.40	20.20	-31.09	40.00	-18.49	50.50	68.99
13.88	31.20	20.20	-31.07	40.00	-19.67	40.50	60.17

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.22	34.90	20.20	-31.10	40.00	-16.00	40.50	56.50
13.52	35.00	20.20	-31.09	40.00	-15.89	50.50	66.39
13.58	35.10	20.20	-31.09	40.00	-15.79	50.50	66.29
13.76	35.10	20.20	-31.08	40.00	-15.78	40.50	56.28

Face-on/Face-off

Test results (9 kHz to 30 MHz)

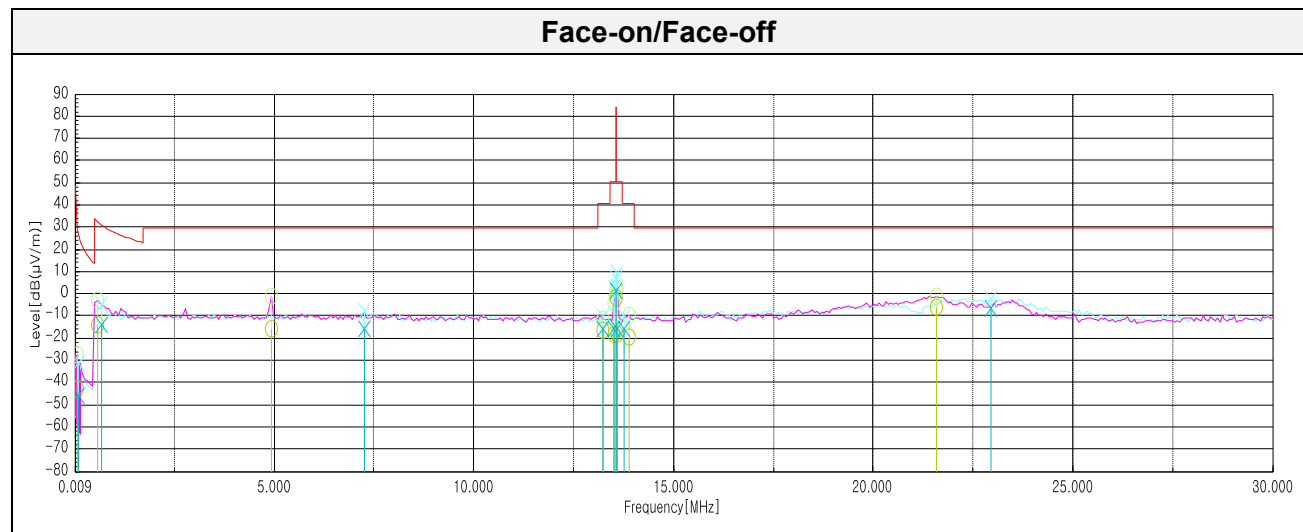
15.225 (d) 0.009-30 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.08*	49.60	20.00	-32.31	80.00	-42.71	30.10	72.81
0.57	38.20	19.90	-32.12	40.00	-14.02	32.50	46.52
4.93	35.30	20.10	-31.64	40.00	-16.24	29.50	45.74
21.58	43.60	20.66	-30.78	40.00	-6.52	29.54	36.06

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.10	46.20	19.90	-32.31	80.00	-46.21	27.70	73.91
0.69	37.80	19.90	-32.09	40.00	-14.39	30.90	45.29
7.25	35.40	20.15	-31.50	40.00	-15.95	29.50	45.45
22.96	42.90	20.72	-30.74	40.00	-7.12	29.54	36.66



* Noise floor signal.

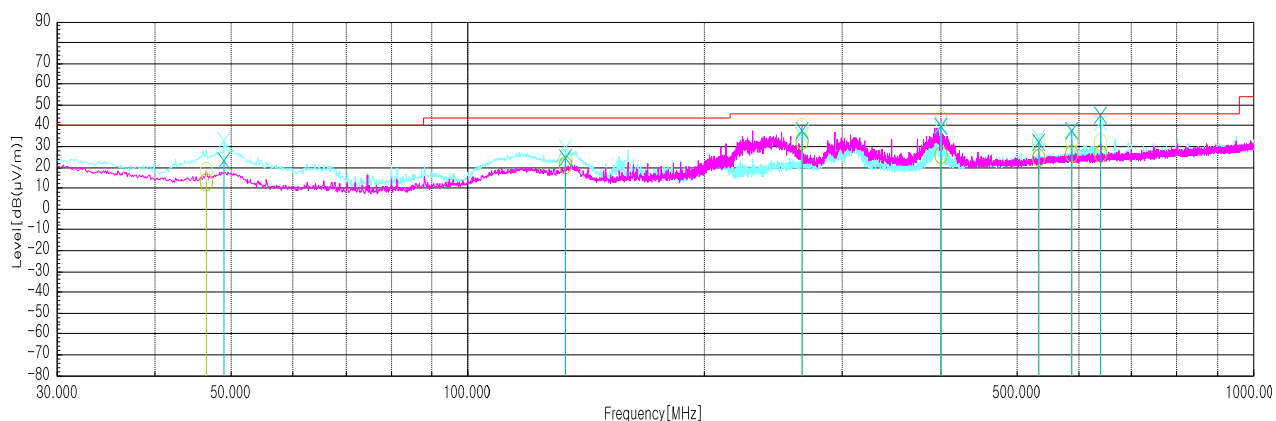
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65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Korea
TEL: 82-31-285-0894 FAX: 82-505-299-8311
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**Test results (Below 1 000 MHz)****15.225 (d) 30-1 000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
46.49	H	27.60	15.51	-30.06	-	13.05	40.00	26.95
49.04	V	38.70	14.34	-30.00	-	23.04	40.00	16.96
133.31 ¹⁾	V	34.90	17.47	-28.62	-	23.75	43.50	19.75
133.31 ¹⁾	H	31.40	17.47	-28.62	-	20.25	43.50	23.25
266.68 ¹⁾	H	44.20	18.63	-26.97	-	35.86	46.00	10.14
266.68 ¹⁾	V	39.50	18.63	-26.97	-	31.16	46.00	14.84
400.06 ¹⁾	H	42.20	21.70	-25.69	-	38.21	46.00	7.79
400.06 ¹⁾	V	29.10	21.70	-25.69	-	25.11	46.00	20.89
533.31	H	32.10	23.70	-24.59	-	31.21	46.00	14.79
533.31	V	24.50	23.70	-24.59	-	23.61	46.00	22.39
586.66	H	36.10	24.50	-24.13	-	36.47	46.00	9.53
586.66	V	24.50	24.50	-24.13	-	24.87	46.00	21.13
640.01	H	42.60	24.78	-23.71	-	43.67	46.00	2.33
640.01	V	24.10	24.78	-23.71	-	25.17	46.00	20.83

Horizontal/Vertical

[TM3]

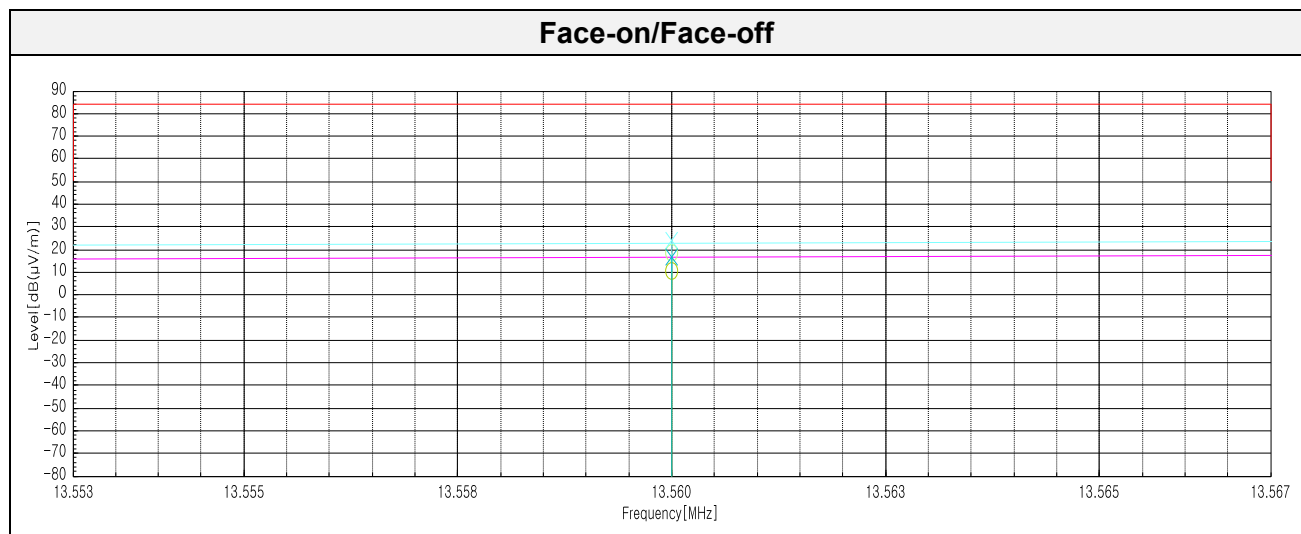
Test results for fundamental
15.225 (a) 13.553-13.567 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	61.20	20.20	-31.09	40.00	10.31	84.00	73.69

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	67.30	20.20	-31.09	40.00	16.41	84.00	67.59



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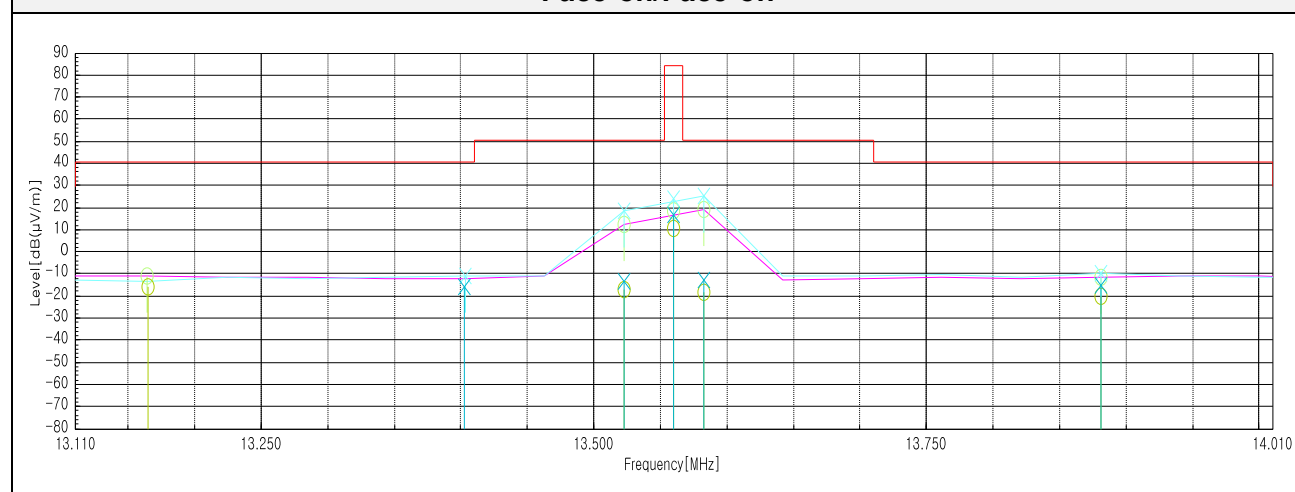
**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.17	35.00	20.20	-31.10	40.00	-15.90	40.50	56.40
13.52	33.50	20.20	-31.09	40.00	-17.39	50.50	67.89
13.58	32.40	20.20	-31.09	40.00	-18.49	50.50	68.99
13.88	30.50	20.20	-31.07	40.00	-20.37	40.50	60.87

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.40	35.10	20.20	-31.09	40.00	-15.79	40.50	56.29
13.52	37.50	20.20	-31.09	40.00	-13.39	50.50	63.89
13.58	37.90	20.20	-31.09	40.00	-12.99	50.50	63.49
13.88	35.30	20.20	-31.07	40.00	-15.57	40.50	56.07

Face-on/Face-off

KCTL Inc.

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Test results (9 kHz to 30 MHz)

15.225 (d) 0.009-30 MHz

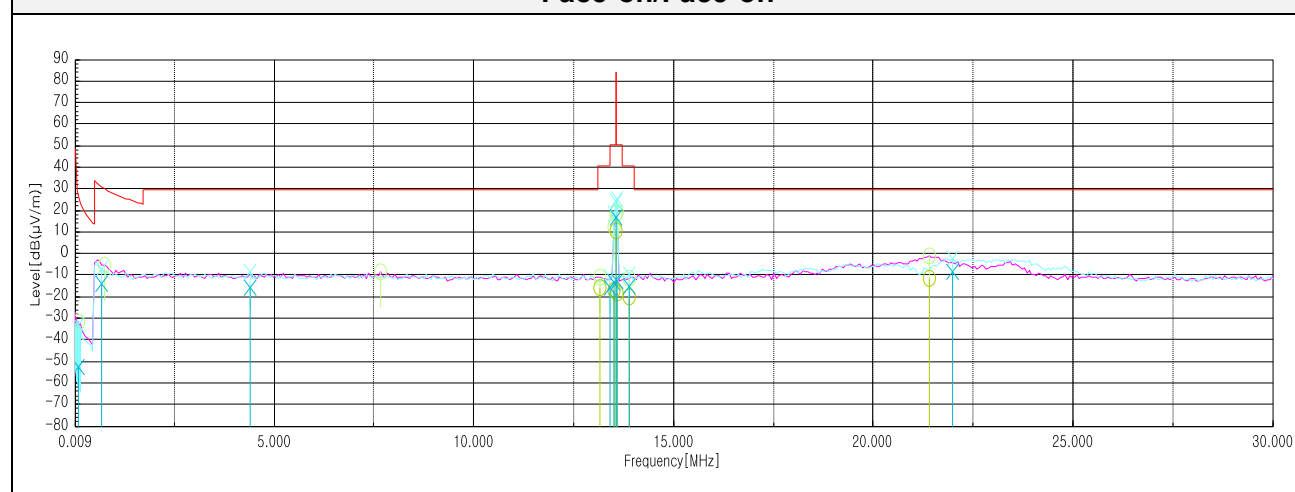
[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.10	42.00	19.90	-32.31	80.00	-50.41	27.70	78.11
0.75	36.60	19.90	-32.08	40.00	-15.58	30.10	45.68
7.67	37.50	20.15	-31.48	40.00	-13.83	29.50	43.33
21.40	38.40	20.66	-30.78	40.00	-11.72	29.54	41.26

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.10	39.80	19.90	-32.31	80.00	-52.61	27.70	80.31
0.69	38.00	19.90	-32.09	40.00	-14.19	30.90	45.09
4.39	35.50	20.10	-31.67	40.00	-16.07	29.50	45.57
22.00	41.30	20.68	-30.76	40.00	-8.78	29.54	38.32

Face-on/Face-off



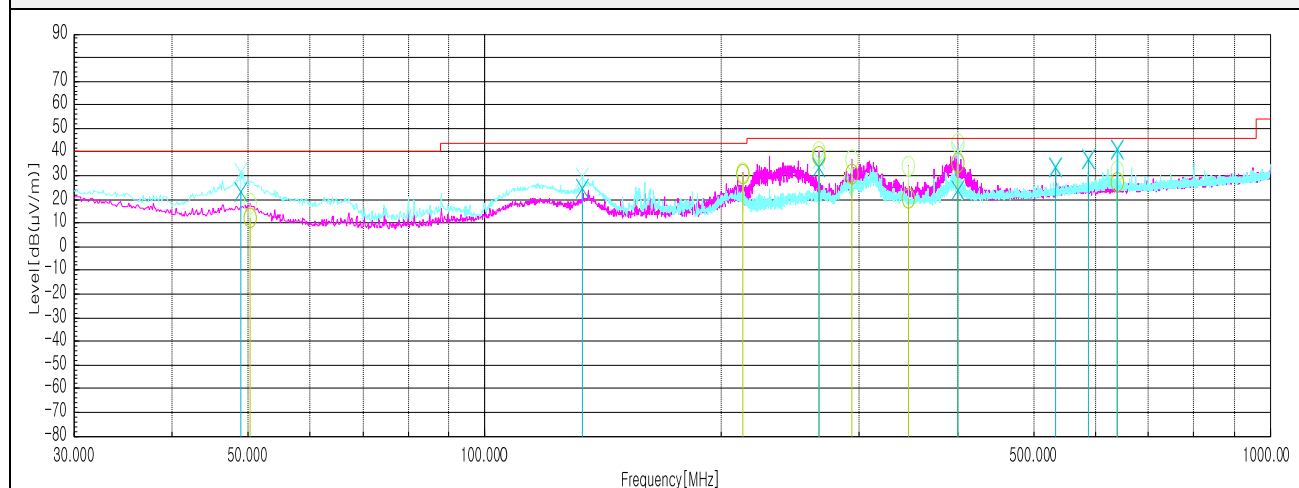
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**Test results (Below 1 000 MHz)****15.225 (d) 30-1 000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
49.04	V	39.00	14.34	-30.00	-	23.34	40.00	16.66
50.37	H	28.00	13.84	-29.96	-	11.88	40.00	28.12
133.31 ¹⁾	V	34.70	17.47	-28.62	-	23.55	43.50	19.95
213.33	H	43.00	16.05	-27.56	-	31.49	43.50	12.01
266.68 ¹⁾	H	45.30	18.63	-26.97	-	36.96	46.00	9.04
266.68 ¹⁾	V	40.40	18.63	-26.97	-	32.06	46.00	13.94
293.36	H	37.40	19.01	-26.67	-	29.74	46.00	16.26
346.71 ¹⁾	H	25.50	20.31	-26.17	-	19.64	46.00	26.36
400.06 ¹⁾	H	38.10	21.70	-25.69	-	34.11	46.00	11.89
400.06 ¹⁾	V	26.60	21.70	-25.69	-	22.61	46.00	23.39
533.31	V	33.00	23.70	-24.59	-	32.11	46.00	13.89
586.66	V	35.10	24.50	-24.13	-	35.47	46.00	10.53
640.01	H	24.90	24.78	-23.71	-	25.97	46.00	20.03
640.01	V	38.20	24.78	-23.71	-	39.27	46.00	6.73

Horizontal/Vertical

[TM4]

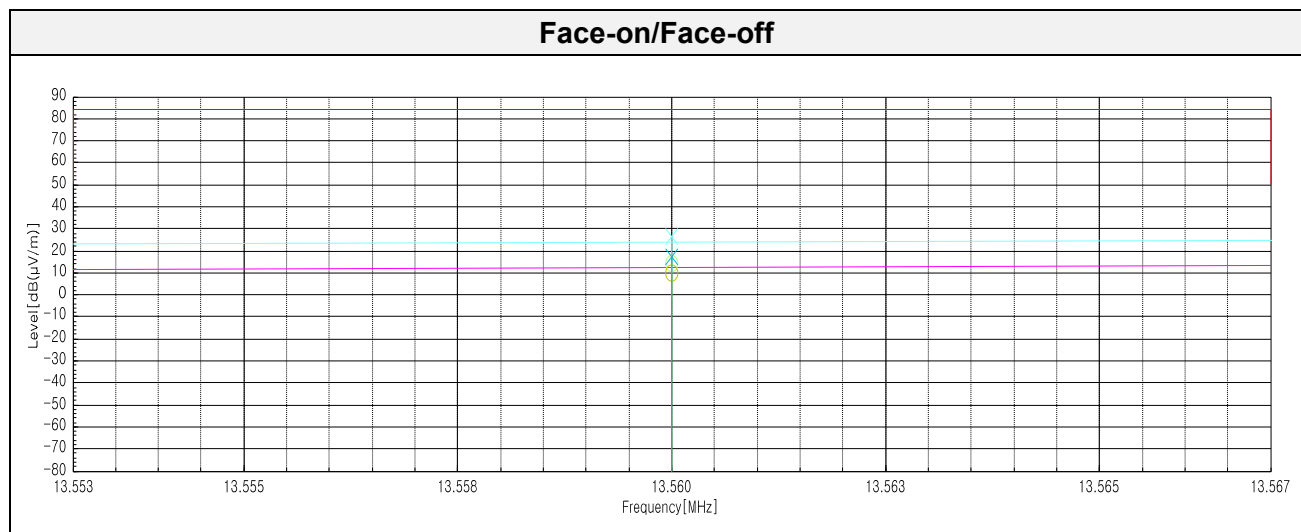
Test results for fundamental
15.225 (a) 13.553-13.567 MHz

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	60.70	20.20	-31.09	40.00	9.81	84.00	74.19

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.56	68.30	20.20	-31.09	40.00	17.41	84.00	66.59



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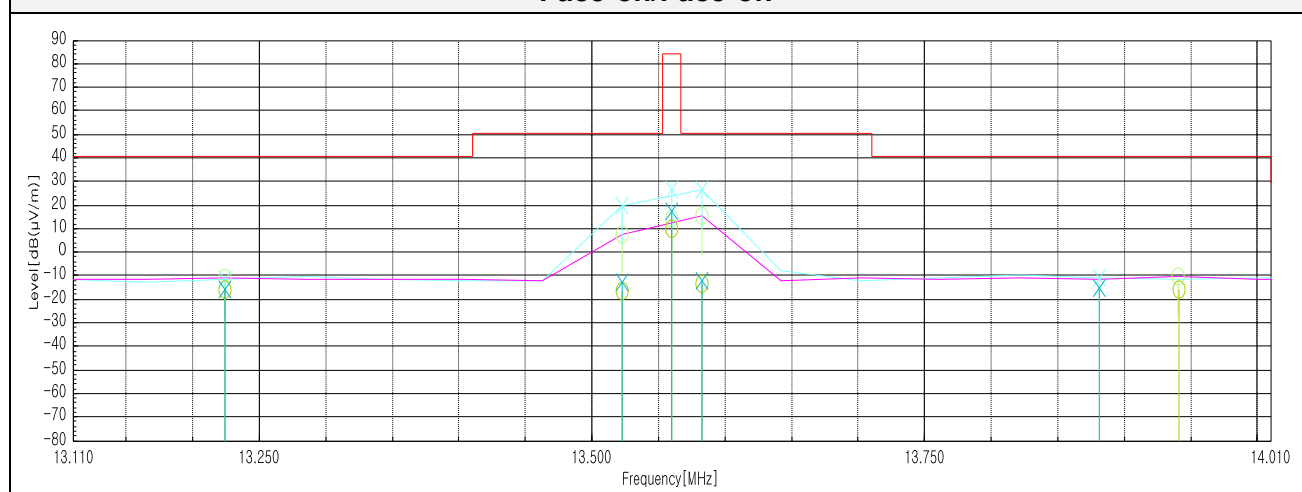
**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.22	34.80	20.20	-31.10	40.00	-16.10	40.50	56.60
13.52	34.20	20.20	-31.09	40.00	-16.69	50.50	67.19
13.58	37.20	20.20	-31.09	40.00	-13.69	50.50	64.19
13.94	34.80	20.20	-31.07	40.00	-16.07	40.50	56.57

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
13.22	35.20	20.20	-31.10	40.00	-15.70	40.50	56.20
13.52	37.70	20.20	-31.09	40.00	-13.19	50.50	63.69
13.58	38.40	20.20	-31.09	40.00	-12.49	50.50	62.99
13.88	35.30	20.20	-31.07	40.00	-15.57	40.50	56.07

Face-on/Face-off

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65, Sinwon-ro, Yeongtong-gu,
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Test results (9 kHz to 30 MHz)

15.225 (d) 0.009-30 MHz

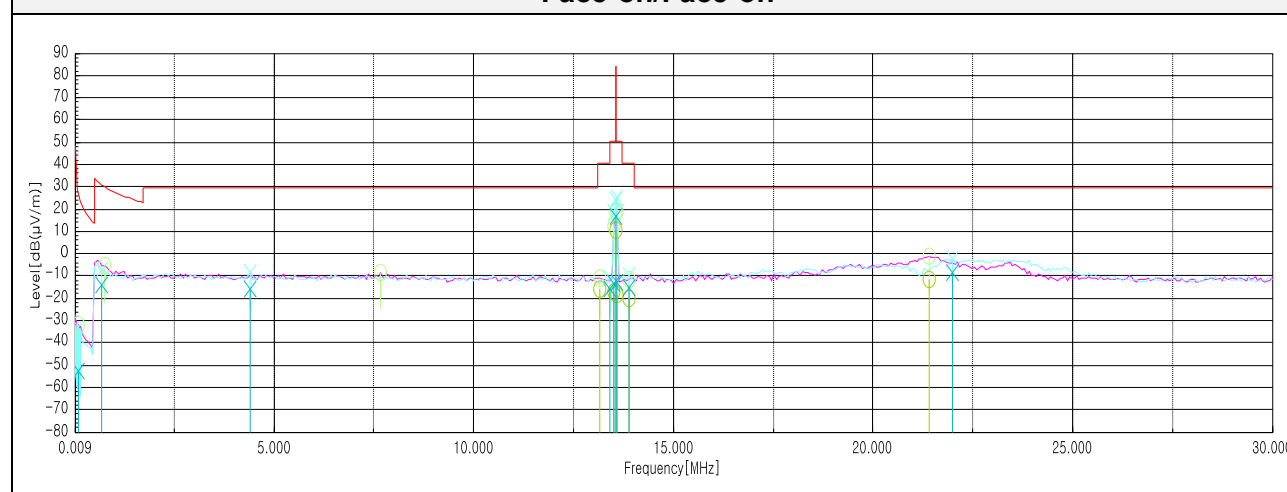
[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.07	42.30	20.00	-32.31	80.00	-50.01	30.20	80.21
0.51	41.30	19.90	-32.16	40.00	-10.96	33.50	44.46
8.75	35.20	20.17	-31.42	40.00	-16.05	29.50	45.55
21.64	37.80	20.67	-30.77	40.00	-12.30	29.54	41.84

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
0.05	45.40	20.10	-32.31	80.00	-46.81	33.60	80.41
0.51	38.40	19.90	-32.16	40.00	-13.86	33.50	47.36
8.75	35.70	20.17	-31.42	40.00	-15.55	29.50	45.05
21.64	41.80	20.67	-30.77	40.00	-8.30	29.54	37.84

Face-on/Face-off



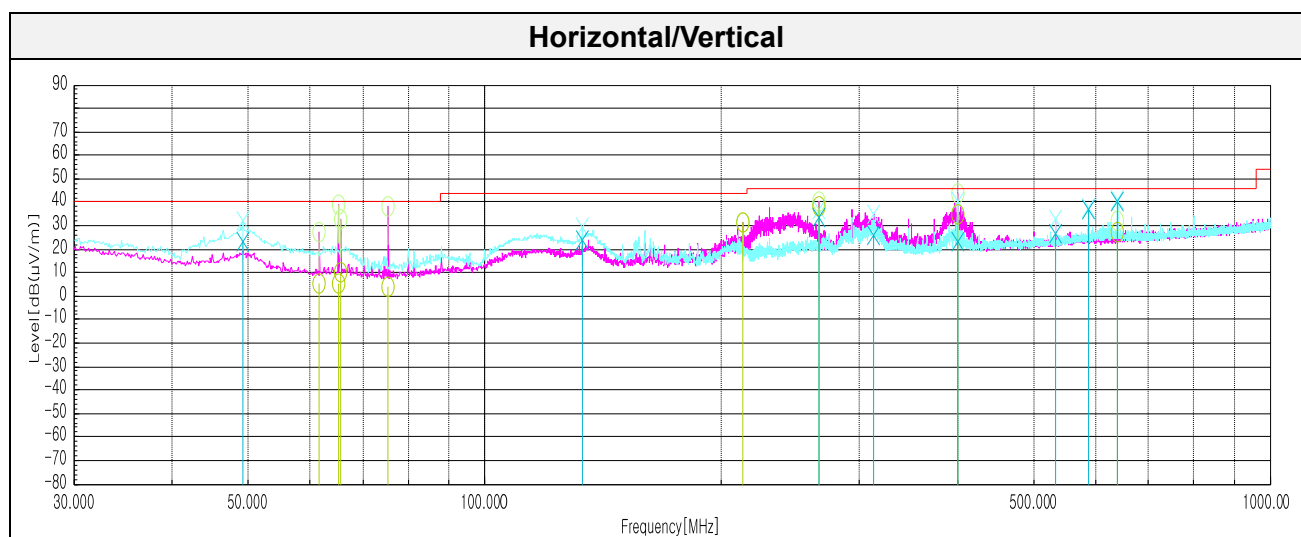
KCTL Inc.

65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Korea
TEL: 82-31-285-0894 FAX: 82-505-299-8311
www.kctl.co.kr

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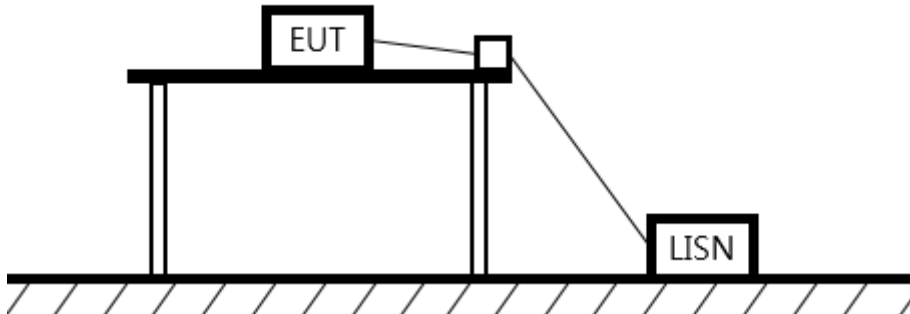
**Test results (Below 1 000 MHz)****15.225 (d) 30-1 000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
49.28	V	39.00	14.23	-29.99	-	23.24	40.00	16.76
61.65	H	22.90	12.30	-29.73	-	5.47	40.00	34.53
65.16	H	22.90	12.30	-29.65	-	5.55	40.00	34.45
65.65	H	27.60	12.30	-29.64	-	10.26	40.00	29.74
75.47	H	20.80	12.68	-29.47	-	4.01	40.00	35.99
133.31 ¹⁾	V	34.40	17.47	-28.62	-	23.25	43.50	20.25
213.33	H	43.20	16.05	-27.56	-	31.69	43.50	11.81
266.68 ¹⁾	H	45.30	18.63	-26.97	-	36.96	46.00	9.04
266.68 ¹⁾	V	40.50	18.63	-26.97	-	32.16	46.00	13.84
312.51	V	31.90	19.43	-26.48	-	24.85	46.00	21.15
400.06 ¹⁾	H	37.90	21.70	-25.69	-	33.91	46.00	12.09
400.06 ¹⁾	V	26.40	21.70	-25.69	-	22.41	46.00	23.59
533.43	V	26.40	23.70	-24.59	-	25.51	46.00	20.49
586.66	V	34.90	24.50	-24.13	-	35.27	46.00	10.73
640.01	H	24.80	24.78	-23.71	-	25.87	46.00	20.13
640.01	V	37.60	24.78	-23.71	-	38.67	46.00	7.33



7.4. AC Conducted emission

Test setup



Limit

According to 15.207(a), RSS-Gen Issue 5 (8.8) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/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 (MHz)	Conducted limit (dB μ V/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

Measurement procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω /50 μ H LISN, which is an input transducer to a spectrum analyzer or an EMI/Field Intensity — Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to peak amplitude within a bandwidth of 10 kHz or to quasi-peak and average within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

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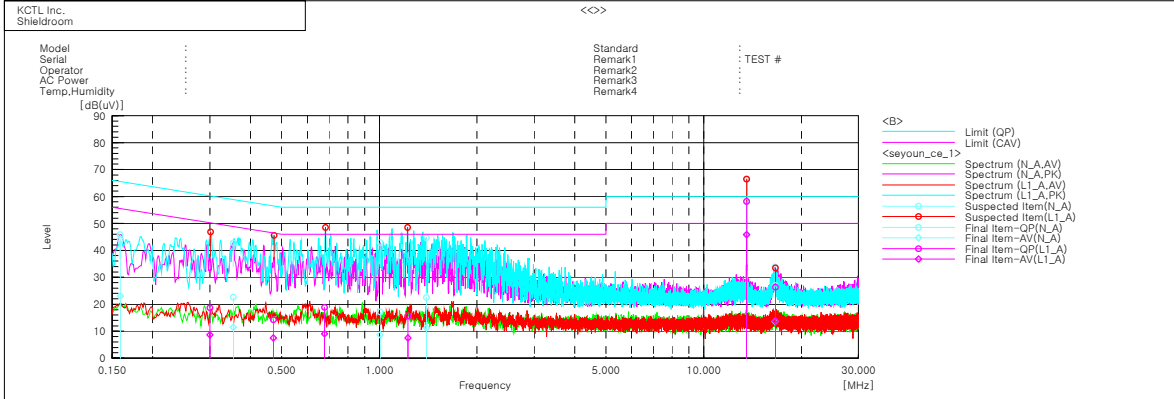
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Test results

[TM4]



Final Result

--- N_A Phase ---										
No.	Frequency	Reading	Reading	c.f	Result	Result	Limit	Limit	Margin	Margin
	[MHz]	QP	CAV		QP	CAV	QP	AV	QP	CAV
		[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.15897	33.9	13.1	10.0	43.9	23.1	65.5	55.5	21.6	32.4
2	0.35426	12.7	1.5	9.9	22.6	11.4	58.9	48.9	36.3	37.5
3	1.00451	7.4	-1.1	9.8	17.2	8.7	56.0	46.0	38.8	37.3
4	1.39557	12.7	1.4	9.8	22.5	11.2	56.0	46.0	33.5	34.8
5	13.55994	47.7	35.5	10.3	58.0	45.8	60.0	50.0	2.0	4.2
6	16.58335	16.6	3.2	10.4	27.0	13.6	60.0	50.0	33.0	36.4

--- L1_A Phase ---										
No.	Frequency	Reading	Reading	c.f	Result	Result	Limit	Limit	Margin	Margin
		QP	CAV		QP	CAV	QP	AV	QP	CAV
		[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.30054	9.0	-1.2	9.8	18.8	8.6	60.2	50.2	41.4	41.6
2	0.47081	4.3	-2.3	9.9	14.2	7.6	56.5	46.5	42.3	38.9
3	0.67754	8.9	-0.8	9.9	18.8	9.1	56.0	46.0	37.2	36.9
4	1.22337	5.9	-2.3	9.8	15.7	7.5	56.0	46.0	40.3	38.5
5	13.56071	47.8	35.5	10.4	58.2	45.9	60.0	50.0	1.8	4.1
6	16.65553	15.8	3.3	10.5	26.3	13.8	60.0	50.0	33.7	36.2

8. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
EMI TEST RECEIVER	R&S	ESC17	100732	22.03.05
Bi-Log Antenna	TESEQ	CBL 6112D	55545	23.01.14
Amplifier	SONOMA INSTRUMENT	310N	284608	21.08.20
COAXIAL FIXED ATTENUATOR	Agilent	8491B-003	2708A18758	22.04.23
LOOP Antenna	R&S	HFH2-Z2	100355	22.08.21
Antenna Mast	Innco Systems	MA4640-XP-ET	-	-
Turn Table	Innco Systems	DT2000	79	-
TWO-LINE V - NETWORK	R&S	ENV216	101584	22.04.05
EMI TEST RECEIVER	R&S	ESC13	100001	21.08.20
Spectrum Analyzer	R&S	FSV30	100807	21.07.29
Signal Generator	R&S	SMB100A	176206	22.01.20
Vector Signal Generator	R&S	SMBV100A	257566	22.07.09
Temp & Humid Chamber	Daejin Engineering	DJ-THR11000	10041	22.01.20
DC Power Supply	AGILENT	E3632A	KR73001026	22.04.01

End of test report