



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-SRF0271-A Page (1) of (33)	
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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 / RF4500

4. Manufacturer / Country of Origin : CEYON TELINVENTORY CO., LTD. / Korea

5. FCC ID : 2A3J7-RF4500

6. Date of Test : 2021-11-11 to 2021-11-16

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 : Eunseong Lim (Signature)	Name : Heesu Ahn (Signature)

2021-12-29

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
2021-12-22	Originally issued	-
2021-12-29	Updated	6,9,24

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Note. The report No. KR21-SRF0271 is superseded by the report No. KR21-SRF0271-A.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 : RF4500
 Modulation technique : ASK(RFID)
 Number of channels : 1 ch
 Frequency range : 13.56 MHz (RFID)
 Power source : AC 120 V
 Antenna specification : TAG antenna (RFID)
 Antenna gain : N/A
 Software version : Rev 1.0
 Hardware version : Rev 1.0
 Test device serial No. : N/A
 Operation temperature : -20 °C ~ 50 °C

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2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
AC/DC Adapter	SHENZHEN YINGHUIYUAN ELECRTINICS CO., LTD	YHY- 12010000	DS120120C14-W	INPUT: AC100-240V~50-60Hz, 2.5A OUTPUT:DC12V

2.2. Frequency/channel operations

This device contains the following capabilities:

RFID(13.56 MHz)

Ch.	Frequency (MHz)
01	13.56

Table 2.2.1. RFID

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 transmitter has permanently attached TAG antenna (External antenna).

4. 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)	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 : With passive tag
- The test procedure(s) in this report were performed in accordance as following.
 - ♦ ANSI C63.10-2013
- The device was tested in 3 mode. (Full, Half, One)

Test Mode	Information
Full	All sockets were used for this test. (57 socket)
Half	Half of the sockets were used for this test. (29 socket)
One	Only one of the sockets was used for this test. (1 socket)

- This device is approved with 57 antennas attached as documented. Additional co-location evaluation test will be needed when transmitting with multiple of these devices.

5. Measurement uncertainty

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

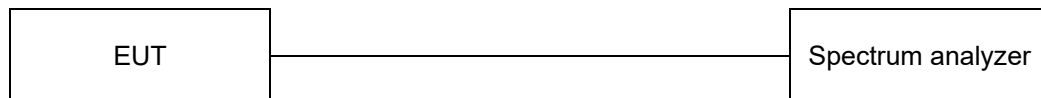
All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicated a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine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

6. Test results

6.1. 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.

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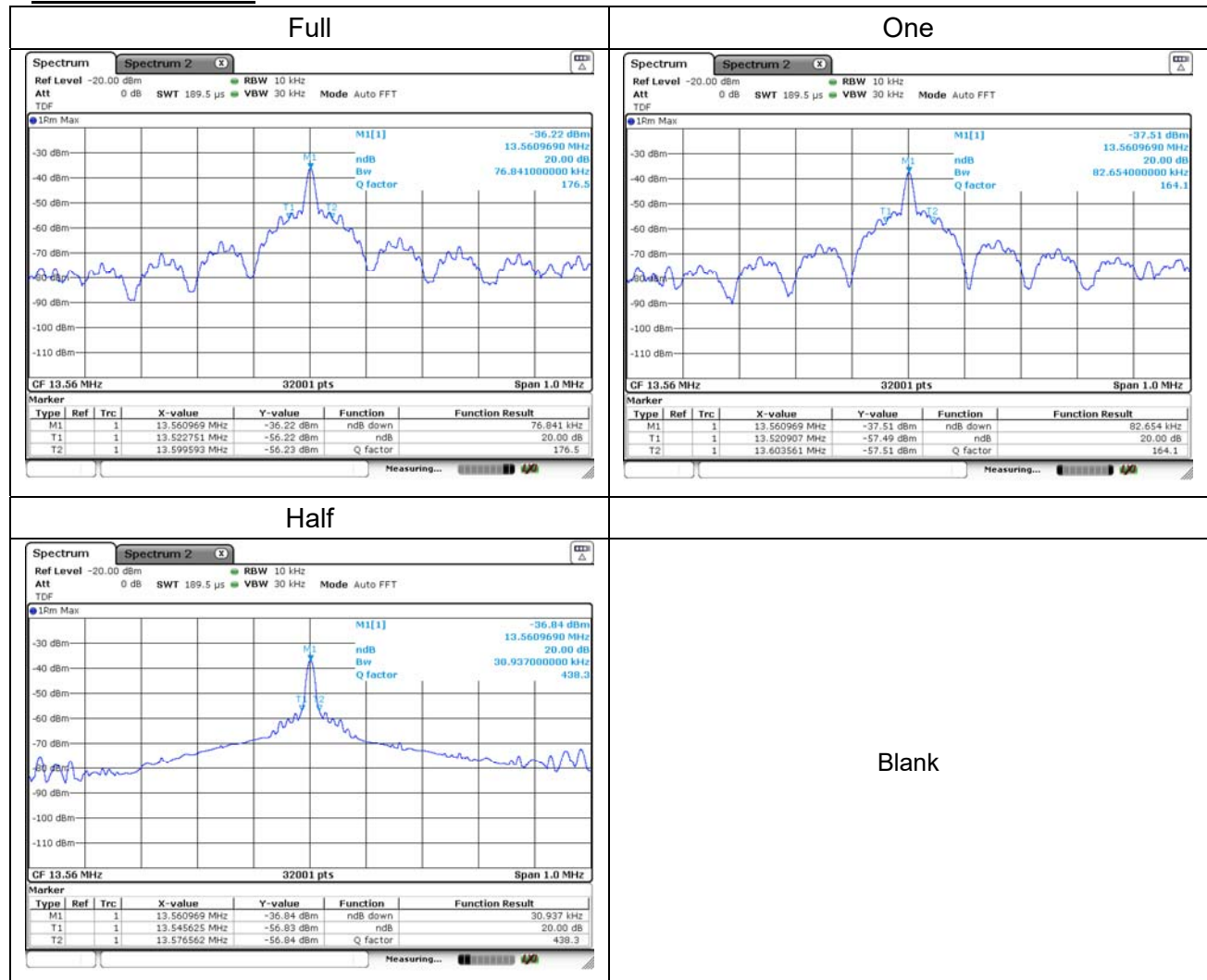
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Test results

Mode	Frequency [MHz]	20 dB Bandwidth [MHz]		Limit [MHz]	20 dB Bandwidth [kHz]
Full	13.56	Lowest Frequency	13.522 8	13.110 000	76.84
		Highest Frequency	13.599 6	14.010 000	
Half	13.56	Lowest Frequency	13.545 6	13.110 000	30.94
		Highest Frequency	13.576 6	14.010 000	
One	13.56	Lowest Frequency	13.520 9	13.110 000	82.65
		Highest Frequency	13.603 6	14.010 000	

20 dB Bandwidth

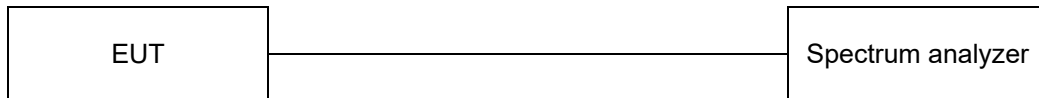


Note:

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

6.2. 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

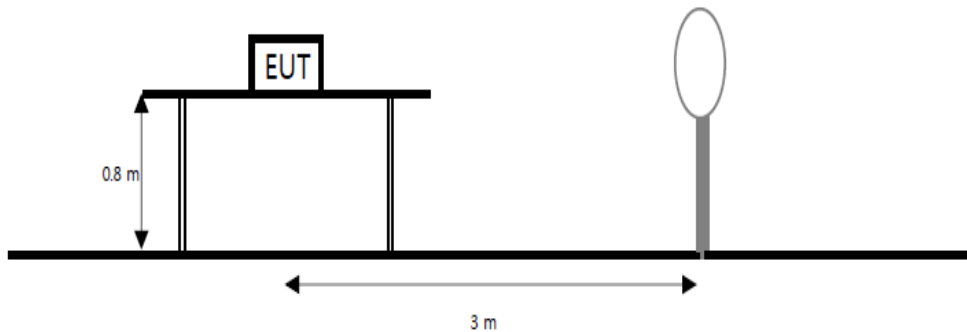
[Full]

Voltage	Voltage	TEMP	Maintaining time	Measure frequency	Frequency deviation	Deviation
[%]	[V]	[°C]		[Hz]	[Hz]	[%]
100	120.00	20(Ref.)	Startup	13 560 969	-969.0	0.007 15
			2 minutes	13 560 875	-875.0	0.006 45
			5 minutes	13 560 935	-935.0	0.006 90
			10 minutes	13 560 915	-915.0	0.006 75
		-20	Startup	13 560 451	-451.0	0.003 33
			2 minutes	13 560 381	-381.0	0.002 81
			5 minutes	13 560 121	-121.0	0.000 89
			10 minutes	13 560 151	-151.0	0.001 11
		-10	Startup	13 560 567	-567.0	0.004 18
			2 minutes	13 560 489	-489.0	0.003 61
			5 minutes	13 560 591	-591.0	0.004 36
			10 minutes	13 560 415	-415.0	0.003 06
		0	Startup	13 560 680	-680.0	0.005 01
			2 minutes	13 560 645	-645.0	0.004 76
			5 minutes	13 560 655	-655.0	0.004 83
			10 minutes	13 560 614	-614.0	0.004 53
		10	Startup	13 560 745	-745.0	0.005 49
			2 minutes	13 560 785	-785.0	0.005 79
			5 minutes	13 560 751	-751.0	0.005 54
			10 minutes	13 560 748	-748.0	0.005 52
		25	Startup	13 560 914	-914.0	0.006 74
			2 minutes	13 560 825	-825.0	0.006 08
			5 minutes	13 560 886	-886.0	0.006 53
			10 minutes	13 560 841	-841.0	0.006 20
		30	Startup	13 560 970	-970.0	0.007 15
			2 minutes	13 560 956	-956.0	0.007 05
			5 minutes	13 560 964	-964.0	0.007 11
			10 minutes	13 561 005	-1005.0	0.007 41
		40	Startup	13 561 113	-1113.0	0.008 21
			2 minutes	13 560 985	-985.0	0.007 26
			5 minutes	13 560 941	-941.0	0.006 94
			10 minutes	13 560 956	-956.0	0.007 05
		50	Startup	13 561 058	-1058.0	0.007 80
			2 minutes	13 561 125	-1125.0	0.008 30
			5 minutes	13 561 025	-1025.0	0.007 56
			10 minutes	13 560 856	-856.0	0.006 31
85	102.00	20	Startup	13 560 884	-884.0	0.006 52
			2 minutes	13 560 865	-865.0	0.006 38
			5 minutes	13 560 795	-795.0	0.005 86
			10 minutes	13 560 815	-815.0	0.006 01
115	138.00	20	Startup	13 560 896	-896.0	0.006 61
			2 minutes	13 560 965	-965.0	0.007 12
			5 minutes	13 560 914	-914.0	0.006 74
			10 minutes	13 560 945	-945.0	0.006 97

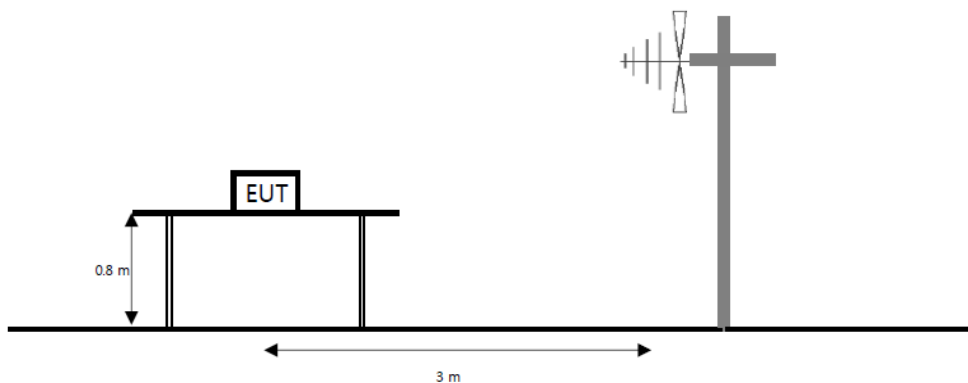
6.3. Radiated spurious emissions

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

[Full]

Test results for fundamental

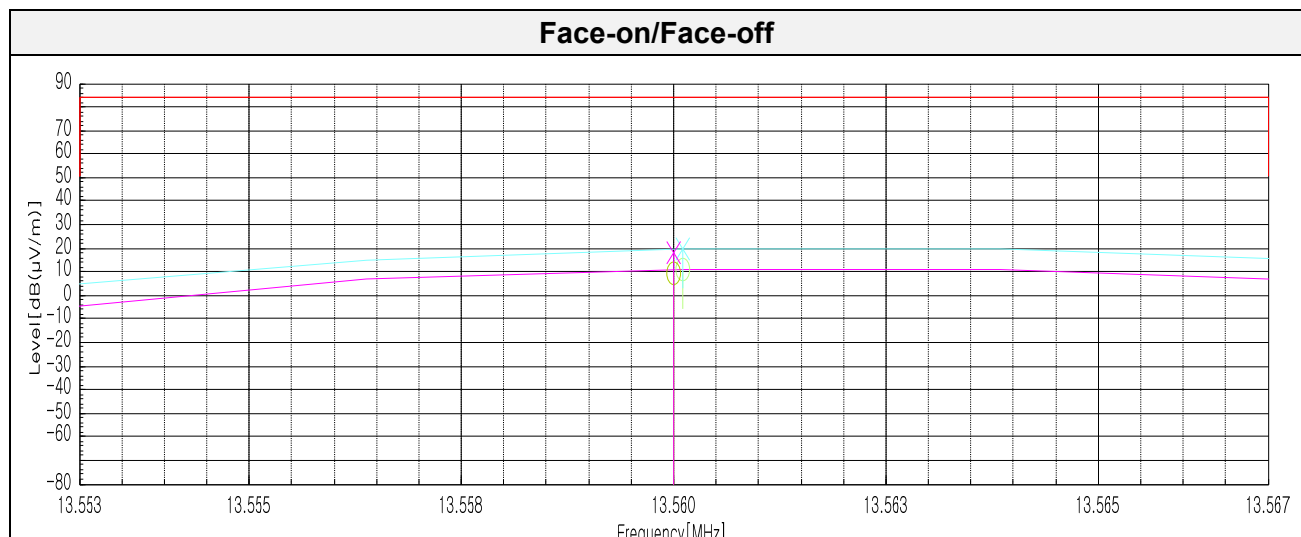
15.225 (a) 13.553-13.567 MHz

[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	60.10	20.2	-31.02	40.00	9.28	84.00	74.72

[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	68.70	20.2	-31.02	40.00	17.88	84.00	66.12



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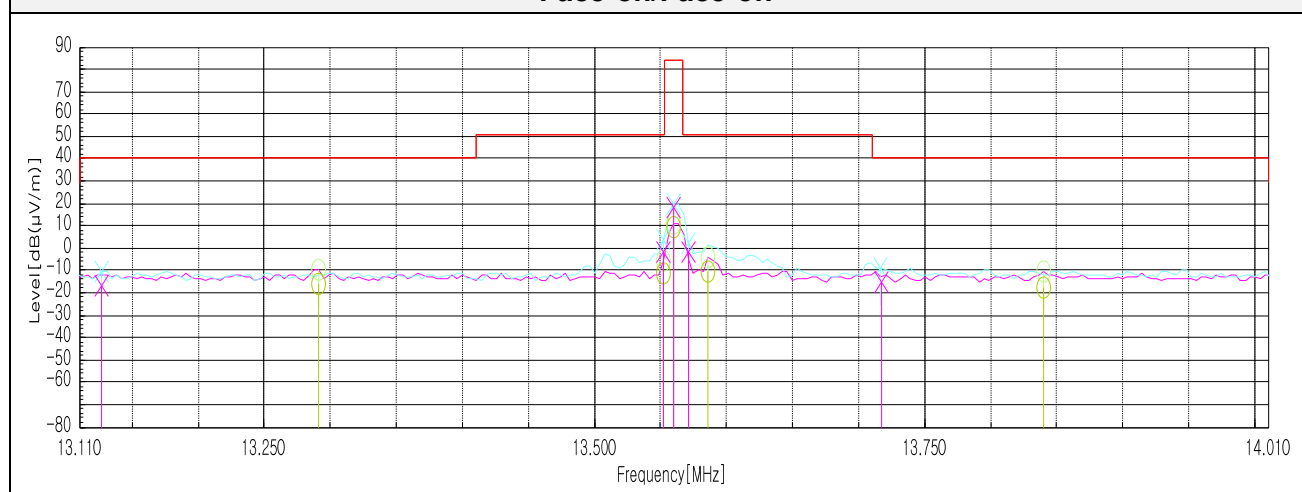
KCTL**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[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							
13.29	35.10	20.20	-31.04	40.00	-15.74	40.50	56.24
13.55	39.50	20.20	-31.02	40.00	-11.32	50.50	61.82
13.59	40.20	20.20	-31.02	40.00	-10.62	50.50	61.12
13.84	33.20	20.20	-30.98	40.00	-17.58	40.50	58.08

[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							
13.13	33.90	20.20	-31.05	40.00	-16.95	40.50	57.45
13.55	48.90	20.20	-31.02	40.00	-1.92	50.50	52.42
13.57	48.70	20.20	-31.02	40.00	-2.12	50.50	52.62
13.72	35.70	20.20	-31.00	40.00	-15.10	40.50	55.60

Face-on/Face-off

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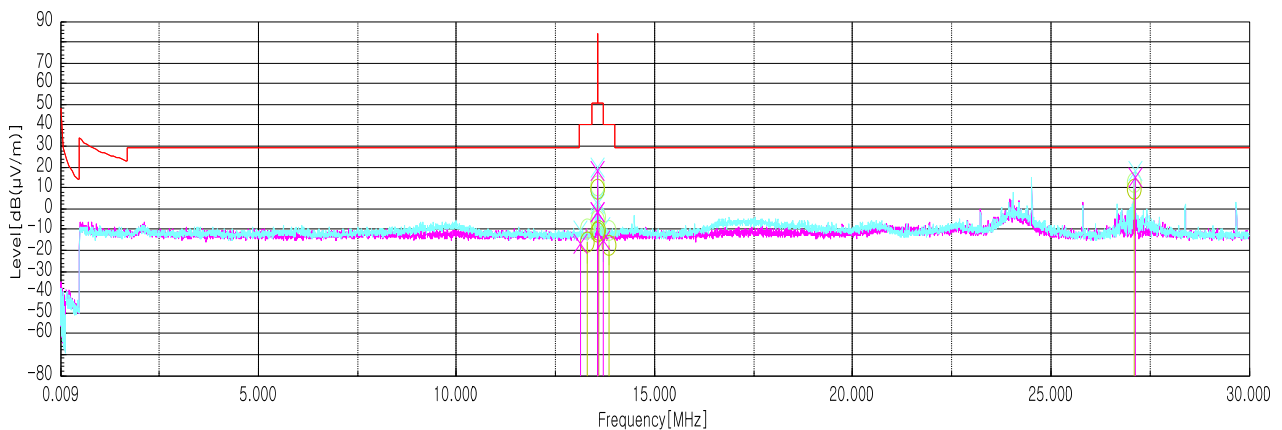
KCTL**Test results (9 kHz to 30 MHz)****15.225 (d) 0.009-30 MHz**

[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							
27.10	58.80	20.51	-30.51	40.00	8.80	29.54	20.74

[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							
27.12	64.70	20.50	-30.51	40.00	14.69	29.54	14.85

Face-on/Face-off

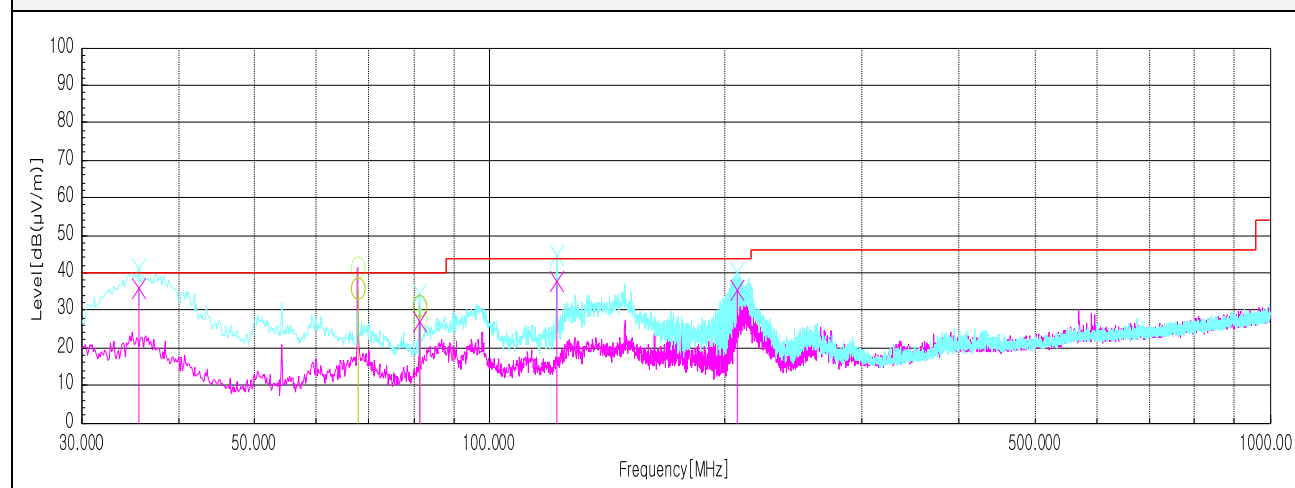
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KCTL**Test results (Below 1 000 MHz)****15.225 (d) 30-1000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Quasi peak data								
35.58	V	44.80	21.41	-30.27	-	35.94	40.00	4.06
67.83	H	53.10	12.20	-29.46	-	35.84	40.00	4.16
81.41	H	46.90	13.18	-29.14	-	30.94	40.00	9.06
81.41	V	43.10	13.18	-29.14	-	27.14	40.00	12.86
122.03	V	47.90	18.10	-28.31	-	37.69	43.50	5.81
207.63	V	47.10	15.19	-27.09	-	35.20	43.50	8.30

Horizontal/Vertical

[Half]

Test results for fundamental

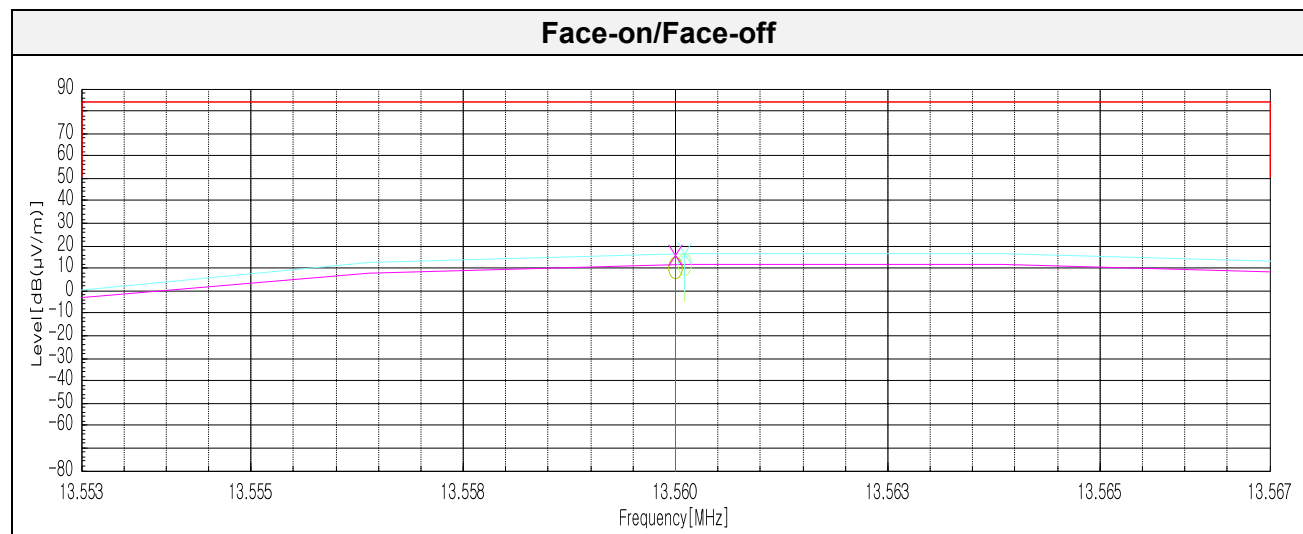
15.225 (a) 13.553-13.567 MHz

[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	61.10	20.2	-31.02	40.00	10.28	84.00	73.72

[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	66.40	20.2	-31.02	40.00	15.58	84.00	68.42



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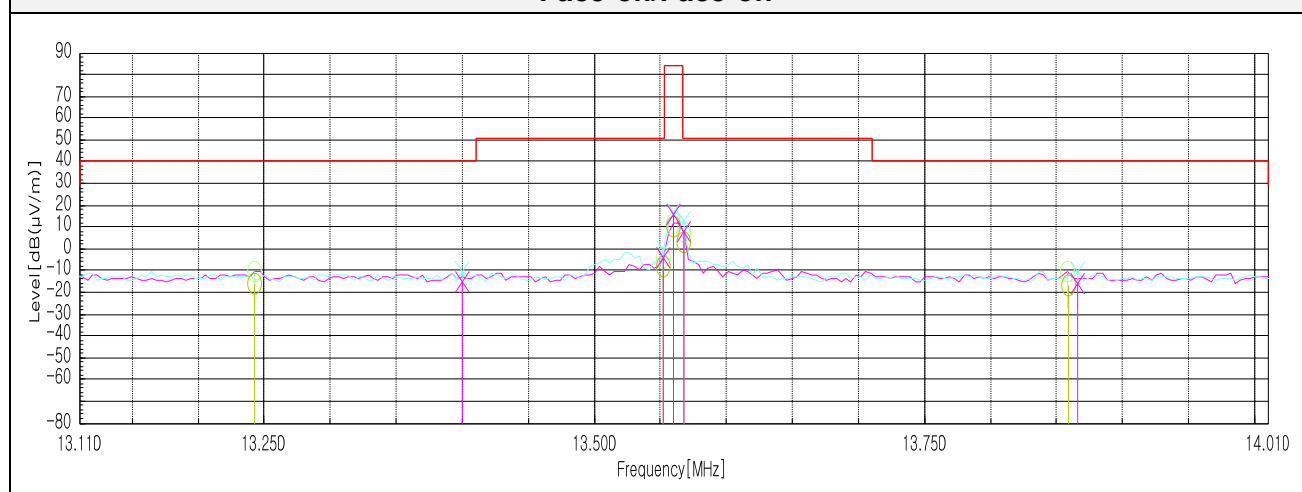
KCTL**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[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							
13.24	34.90	20.20	-31.05	40.00	-15.95	40.50	56.45
13.55	42.30	20.20	-31.02	40.00	-8.52	50.50	59.02
13.57	53.80	20.20	-31.02	40.00	2.98	50.50	47.52
13.86	34.20	20.20	-30.97	40.00	-16.57	40.50	57.07

[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	35.90	20.20	-31.04	40.00	-14.94	40.50	55.44
13.55	46.20	20.20	-31.02	40.00	-4.62	50.50	55.12
13.57	58.10	20.20	-31.02	40.00	7.28	50.50	43.22
13.87	34.50	20.20	-30.97	40.00	-16.27	40.50	56.77

Face-on/Face-off

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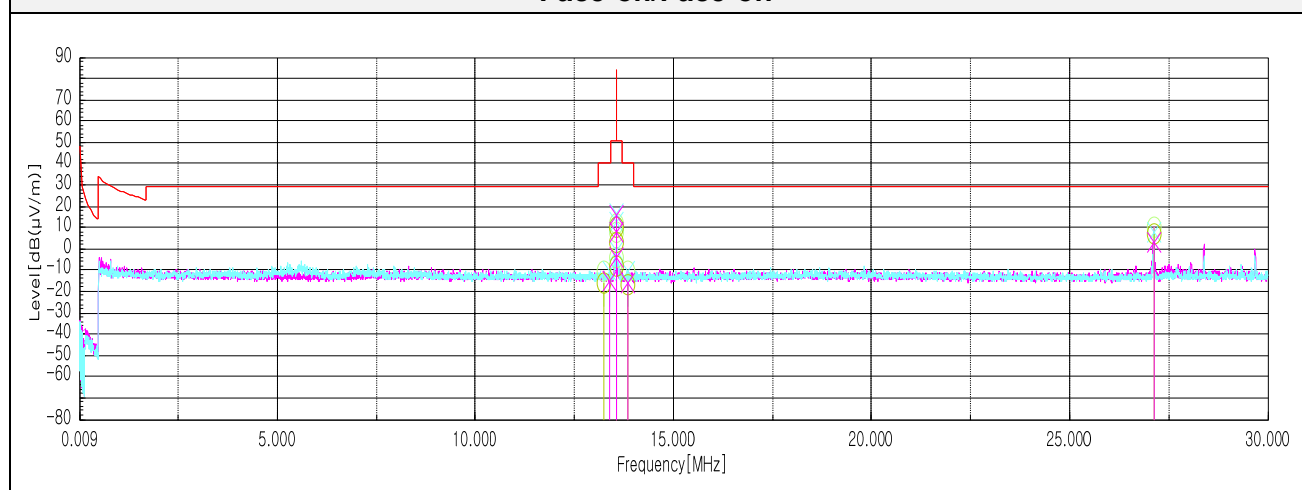
KCTL**Test results (9 kHz to 30 MHz)****15.225 (d) 0.009-30 MHz**

[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							
27.12	57.10	20.50	-30.51	40.00	7.09	29.54	22.45

[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							
27.12	46.20	19.90	-32.31	40.00	3.19	29.54	26.35

Face-on/Face-off

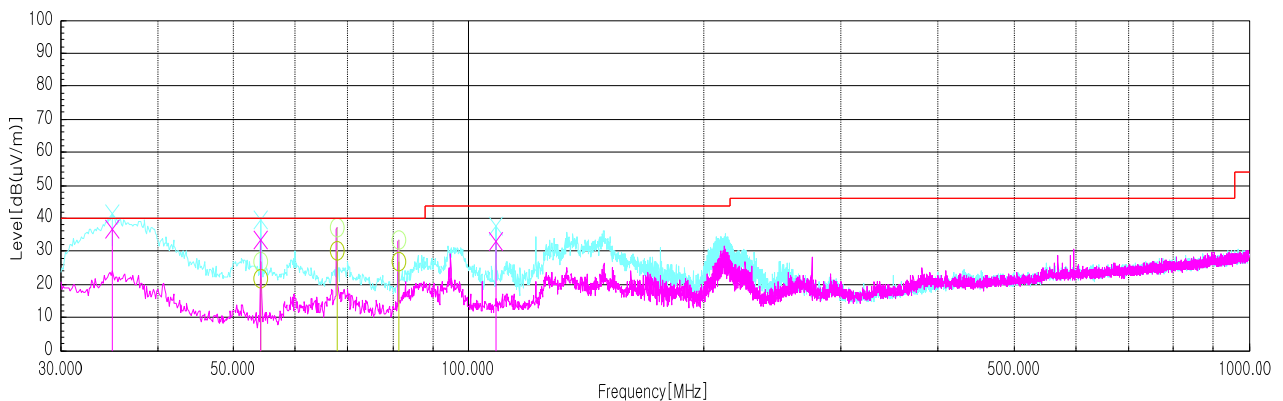
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KCTL**Test results (Below 1 000 MHz)****15.225 (d) 30-1000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Quasi peak data								
34.97	V	45.20	21.72	-30.31	-	36.61	40.00	3.39
54.25	V	50.30	12.78	-29.82	-	33.26	40.00	6.74
54.25	V	38.60	12.78	-29.82	-	21.56	40.00	18.44
67.83	H	47.50	12.20	-29.46	-	30.24	40.00	9.76
81.41	V	43.10	13.18	-29.14	-	27.14	40.00	12.86
108.45 ¹⁾	V	43.60	17.70	-28.53	-	32.77	43.50	10.73

Horizontal/Vertical

[One]

Test results for fundamental

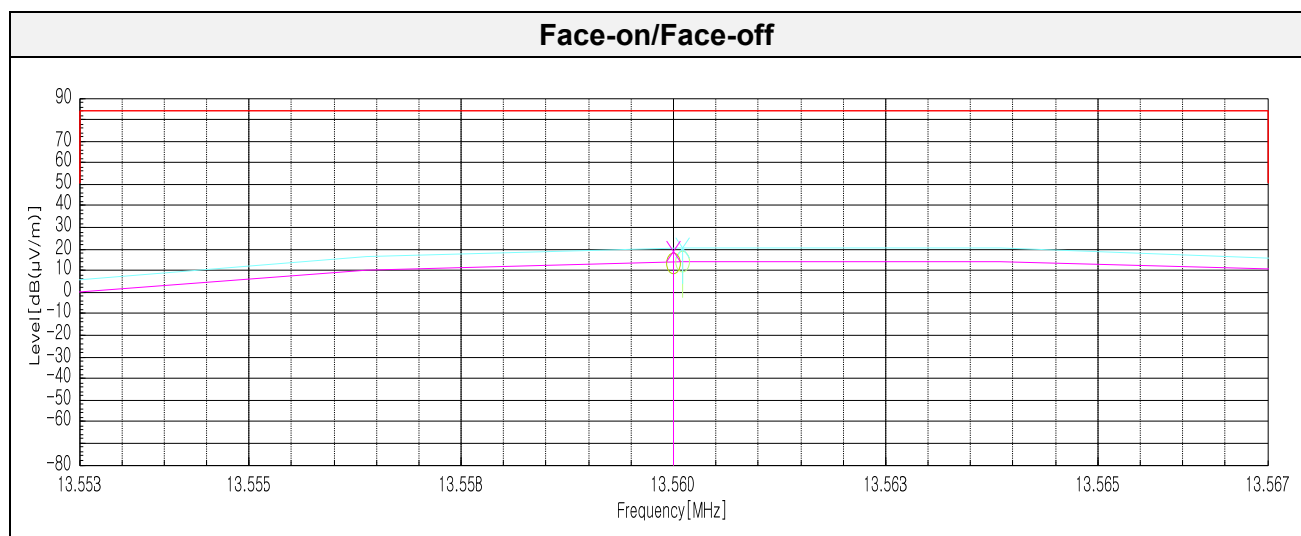
15.225 (a) 13.553-13.567 MHz

[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	63.90	20.20	-31.02	40.00	13.08	84.00	70.92

[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	69.70	20.20	-31.02	40.00	18.88	84.00	65.12



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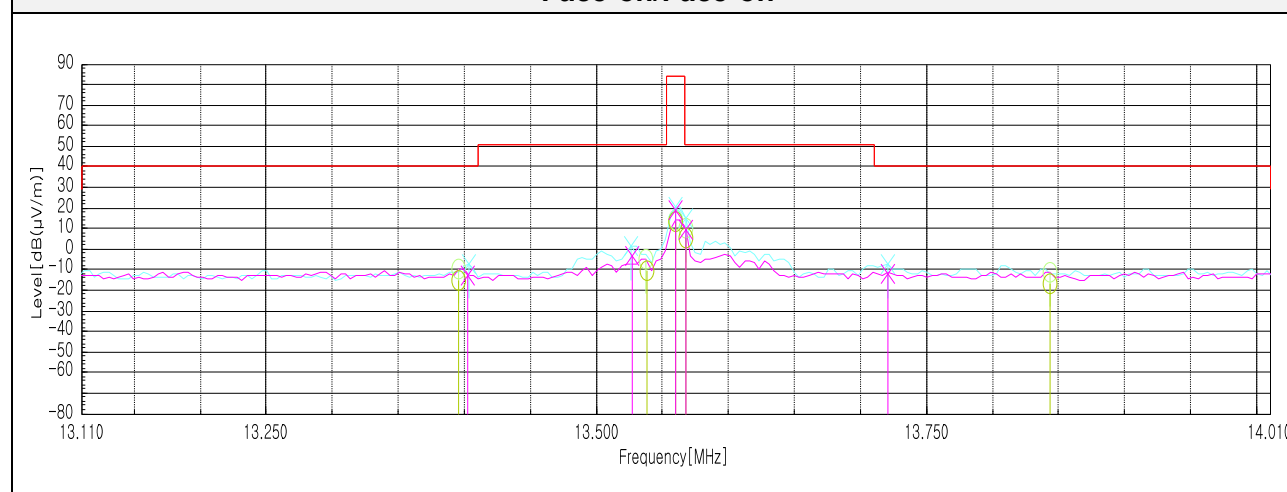
KCTL**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[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							
13.40	35.60	20.20	-31.04	40.00	-15.24	40.50	55.74
13.54	40.30	20.20	-31.02	40.00	-10.52	50.50	61.02
13.57	55.80	20.20	-31.02	40.00	4.98	50.50	45.52
13.84	34.10	20.20	-30.97	40.00	-16.67	40.50	57.17

[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							
13.53	47.20	20.20	-31.03	40.00	-3.63	50.50	54.13
13.40	38.10	20.20	-31.04	40.00	-12.74	40.50	53.24
13.57	60.40	20.20	-31.02	40.00	9.58	50.50	40.92
13.72	38.60	20.20	-30.99	40.00	-12.19	40.50	52.69

Face-on/Face-off

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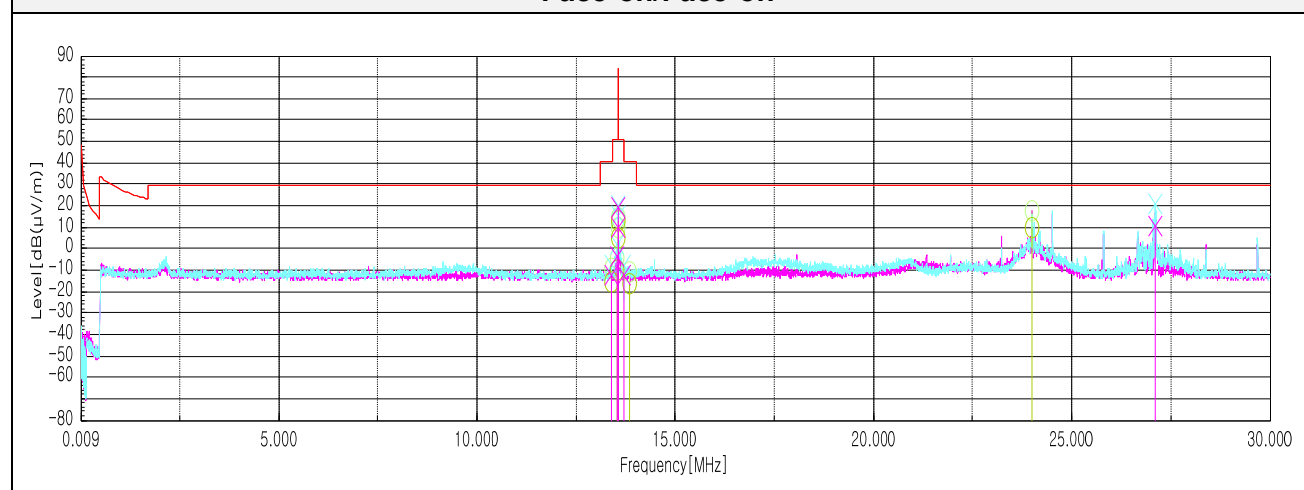
KCTL**Test results (9 kHz to 30 MHz)****15.225 (d) 0.009-30 MHz**

[Face-on]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Quasi peak data							
24.00	59.10	20.76	-30.64	40.00	9.22	29.54	20.32

[Face-off]

Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Quasi peak data							
27.10	60.20	20.51	-30.51	40.00	10.20	29.54	19.34

Face-on/Face-off

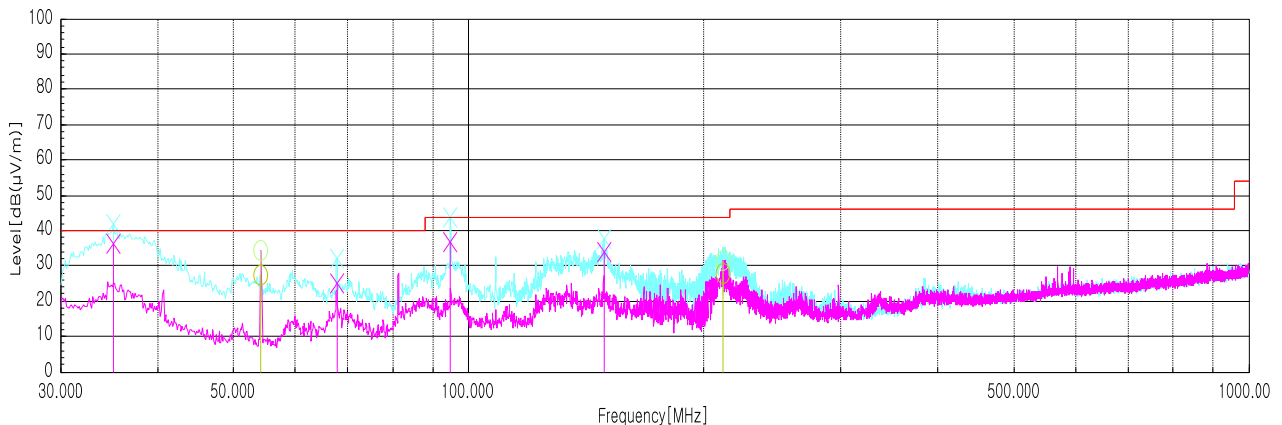
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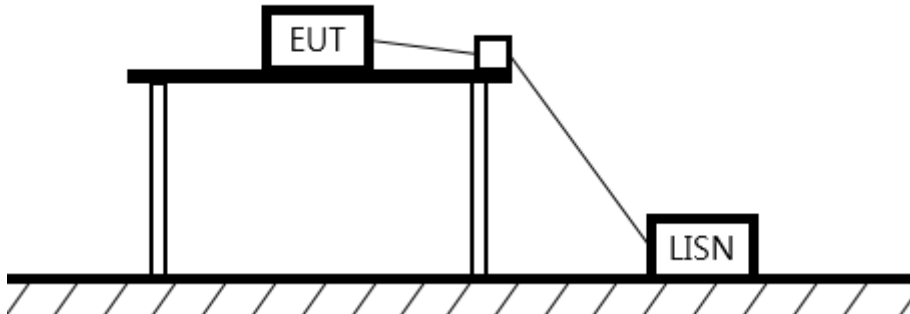
KCTL**Test results (Below 1 000 MHz)****15.225 (d) 30-1000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μ V))	(dB)	(dB)	(dB)	(dB(μ V/m))	(dB(μ V/m))	(dB)
Quasi peak data								
35.09	V	45.10	21.65	-30.30	-	36.45	40.00	3.55
54.25	H	44.30	12.78	-29.82	-	27.26	40.00	12.74
67.83	V	42.50	12.20	-29.46	-	25.24	40.00	14.76
94.87	V	50.30	15.37	-28.84	-	36.83	43.50	6.67
149.19	V	45.10	16.50	-27.85	-	33.75	43.50	9.75
212.00	H	39.90	14.98	-27.01	-	27.87	43.50	15.63

Horizontal/Vertical

6.4. 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 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 (MHz)	Conducted limit (dBμV/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 50Ω/50μH 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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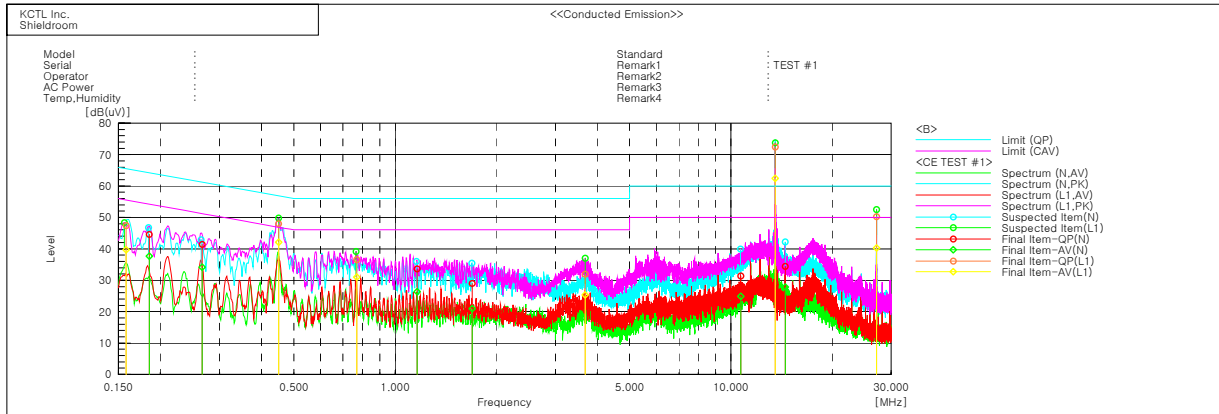
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Test results

[Tests with the antenna connected_Full]



Final Result

--- N Phase ---

No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading CAV [dB(μV)]	c.f [dB]	Result QP [dB(μV)]	Result CAV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin CAV [dB]
1	0.18537	34.7	27.7	9.9	44.6	37.6	64.2	54.2	19.6	16.6
2	0.26623	31.8	24.6	9.6	41.4	34.2	61.2	51.2	19.8	17.0
3	1.16285	23.9	16.6	9.7	33.6	26.3	56.0	46.0	22.4	19.7
4	1.69597	19.4	11.3	9.6	29.0	20.9	56.0	46.0	27.0	25.1
5	10.69404	21.6	15.1	9.8	31.4	24.9	60.0	50.0	28.6	25.1
6	14.51216	24.6	17.9	9.9	34.5	27.8	60.0	50.0	25.5	22.2

--- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading CAV [dB(μV)]	c.f [dB]	Result QP [dB(μV)]	Result CAV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin CAV [dB]
1	0.15834	37.7	29.9	9.8	47.5	39.7	65.6	55.6	18.1	15.9
2	0.45036	38.2	32.3	9.8	48.0	42.1	56.9	46.9	8.9	4.8
3	0.7682	26.7	21.2	9.8	36.5	31.0	56.0	46.0	19.5	15.0
4	3.6799	22.2	15.6	9.7	31.9	25.3	56.0	46.0	24.1	20.7
5	13.56034	62.5	52.5	9.9	72.4	62.4	60.0	50.0	-12.4	-12.4
6	27.12123	40.2	30.3	10.0	50.2	40.3	60.0	50.0	9.8	9.7

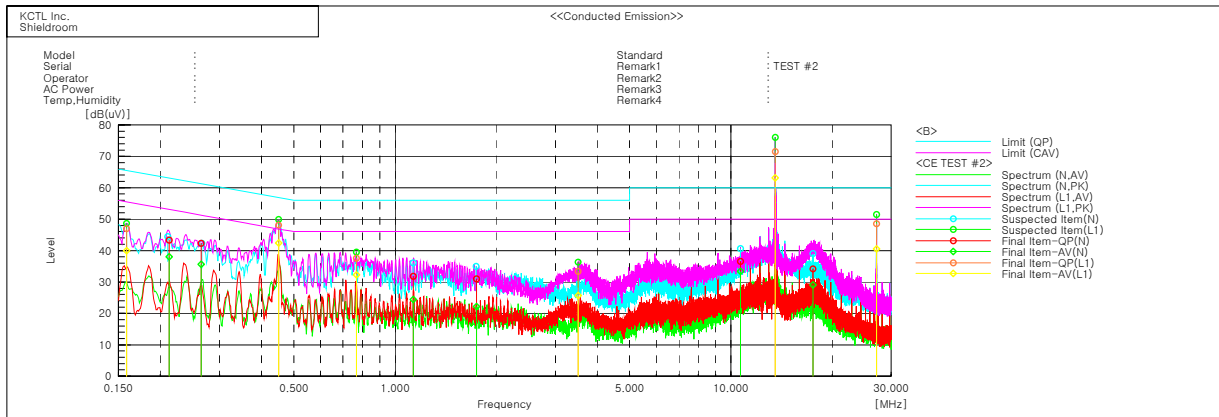
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[Tests with the antenna connected _Half]



Final Result

--- N Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.21276	33.7	28.3	9.7	43.4	38.0	63.1	53.1	19.7	15.1
2	0.26481	32.8	26.0	9.6	42.4	35.6	61.3	51.3	18.9	15.7
3	1.13324	22.1	14.8	9.7	31.8	24.5	56.0	46.0	24.2	21.5
4	1.74732	21.4	12.5	9.6	31.0	22.1	56.0	46.0	25.0	23.9
5	10.67294	26.7	23.5	9.8	36.5	33.3	60.0	50.0	23.5	16.7
6	17.53465	24.3	19.2	9.9	34.2	29.1	60.0	50.0	25.8	20.9

--- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.15868	37.2	30.2	9.8	47.0	40.0	65.5	55.5	18.5	15.5
2	0.44977	38.3	32.6	9.8	48.1	42.4	56.9	46.9	8.8	4.5
3	0.7675	27.8	22.5	9.8	37.6	32.3	56.0	46.0	18.4	13.7
4	3.50605	23.7	16.0	9.7	33.4	25.7	56.0	46.0	22.6	20.3
5	13.55989	61.6	53.2	9.9	71.5	63.1	60.0	50.0	-11.5	-13.1
6	27.12177	38.6	30.5	10.0	48.6	40.5	60.0	50.0	11.4	9.5

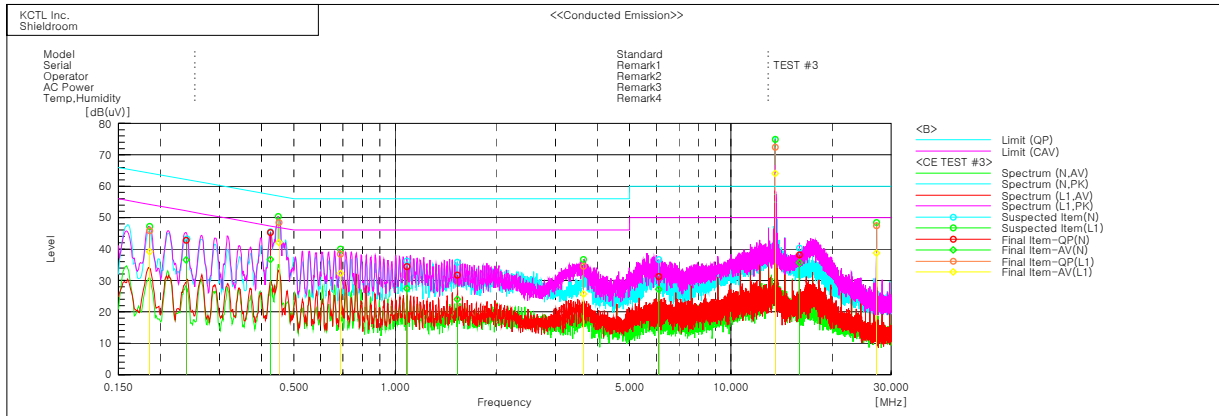
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[Tests with the antenna connected _One]



Final Result

--- N Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.23903	33.2	26.9	9.6	42.8	36.5	62.1	52.1	19.3	15.6
2	0.42597	35.5	26.9	9.8	45.3	36.7	57.3	47.3	12.0	10.6
3	1.08447	24.7	17.6	9.7	34.4	27.3	56.0	46.0	21.6	18.7
4	1.5313	22.1	14.4	9.6	31.7	24.0	56.0	46.0	24.3	22.0
5	6.09662	21.6	17.5	9.7	31.3	27.2	60.0	50.0	28.7	22.8
6	16.00209	28.2	25.8	9.9	38.1	35.7	60.0	50.0	21.9	14.3

--- L1 Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.18601	35.9	29.2	9.9	45.8	39.1	64.2	54.2	18.4	15.1
2	0.45086	38.6	32.3	9.8	48.4	42.1	56.9	46.9	8.5	4.8
3	0.68756	28.5	22.4	9.8	38.3	32.2	56.0	46.0	17.7	13.8
4	3.6424	24.9	16.0	9.7	34.6	25.7	56.0	46.0	21.4	20.3
5	13.56189	62.5	54.1	9.9	72.4	64.0	60.0	50.0	-12.4	-14.0
6	27.12178	37.4	28.7	10.0	47.4	38.7	60.0	50.0	12.6	11.3

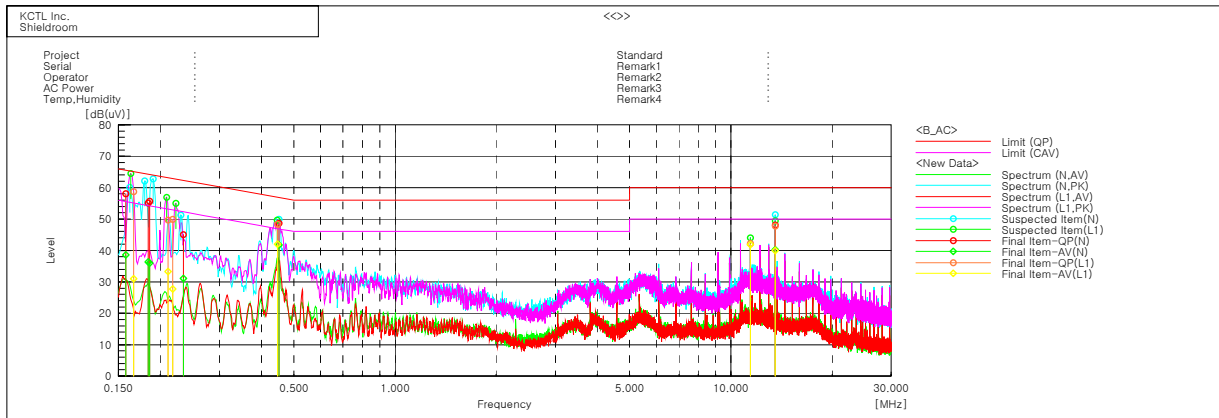
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[Retest with a dummy load_Full]



Final Result

--- N Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.15768	48.2	28.8	9.8	58.0	38.6	65.6	55.6	7.6	17.0
2	0.18417	45.2	26.3	10.0	55.2	36.3	64.3	54.3	9.1	18.0
3	0.18602	45.6	26.0	10.0	55.6	36.0	64.2	54.2	8.6	18.2
4	0.234	35.5	21.6	9.6	45.1	31.2	62.3	52.3	17.2	21.1
5	0.45145	38.9	32.0	9.8	48.7	41.8	56.8	46.8	8.1	5.0
6	13.56106	38.3	30.5	9.8	48.1	40.3	60.0	50.0	11.9	9.7

--- L1 Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.16645	48.7	21.0	10.0	58.7	31.0	65.1	55.1	6.4	24.1
2	0.21085	39.9	23.4	9.8	49.7	33.2	63.2	53.2	13.5	20.0
3	0.21785	40.1	18.0	9.7	49.8	27.7	62.9	52.9	13.1	25.2
4	0.44692	38.5	32.2	9.8	48.3	42.0	56.9	46.9	8.6	4.9
5	11.43766	32.6	32.1	9.7	42.3	41.8	60.0	50.0	17.7	8.2
6	13.56159	38.0	30.1	9.8	47.8	39.9	60.0	50.0	12.2	10.1

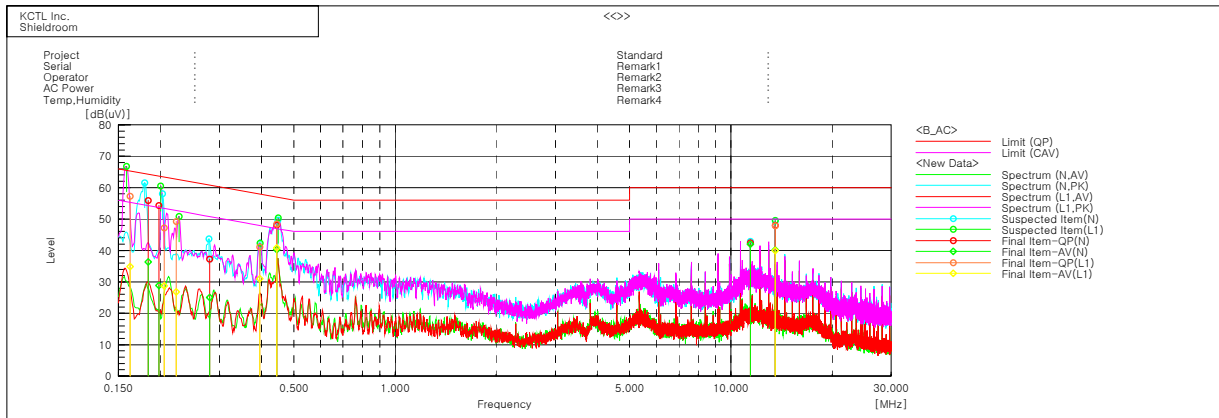
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[Retest with a dummy load _Half]



Final Result

--- N Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.18402	45.9	26.4	10.0	55.9	38.4	64.3	54.3	8.4	17.9
2	0.19803	44.4	18.9	9.9	54.3	28.8	63.7	53.7	9.4	24.9
3	0.28057	27.7	15.4	9.6	37.3	25.0	60.8	50.8	23.5	25.8
4	0.44462	38.3	30.5	9.8	48.1	40.3	57.0	47.0	8.9	6.7
5	11.43704	32.6	32.2	9.8	42.4	42.0	60.0	50.0	17.6	8.0
6	13.56152	38.2	30.3	9.8	48.0	40.1	60.0	50.0	12.0	9.9

--- L1 Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.16237	47.3	25.0	9.9	57.2	34.9	65.3	55.3	8.1	20.4
2	0.20535	37.4	18.9	9.8	47.2	28.7	63.4	53.4	16.2	24.7
3	0.22333	39.5	17.2	9.7	49.2	26.9	62.7	52.7	13.5	25.8
4	0.39559	31.3	21.3	9.8	41.1	31.1	57.9	47.9	16.8	16.8
5	0.44492	38.7	31.1	9.8	48.5	40.9	57.0	47.0	8.5	6.1
6	13.56149	38.0	30.2	9.8	47.8	40.0	60.0	50.0	12.2	10.0

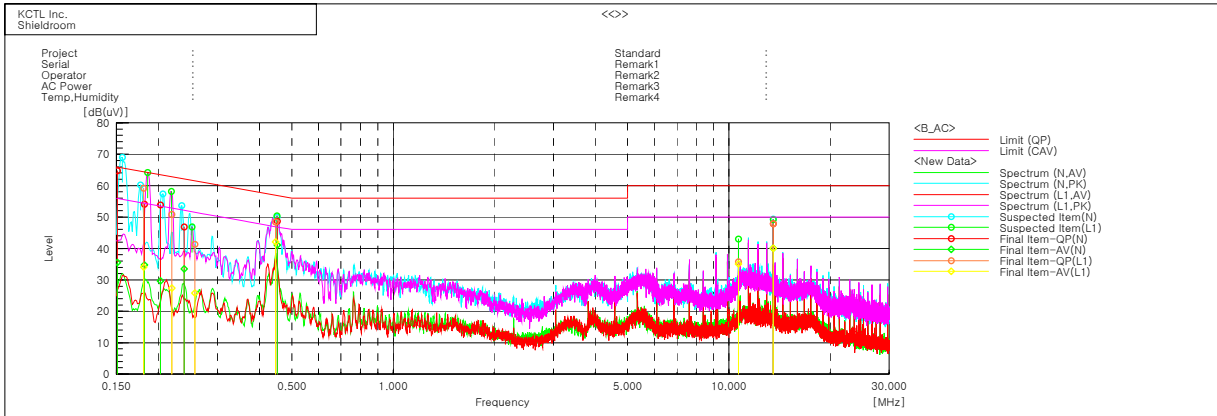
KCTL Inc.

65, Sinwon-ro, Yeongtong-gu,
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[Retest with a dummy load _One]



Final Result

--- N Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.1512	55.1	25.9	9.7	64.8	35.6	65.9	55.9	1.1	20.3
2	0.1818	44.1	24.8	10.0	54.1	34.8	64.4	54.4	10.3	19.6
3	0.20307	44.0	19.7	9.9	53.9	29.6	63.5	53.5	9.6	23.9
4	0.23861	37.3	23.9	9.6	46.9	33.5	62.1	52.1	15.2	18.6
5	0.45269	38.8	31.3	9.8	48.6	41.1	56.8	46.8	8.2	5.7
6	13.56008	38.0	30.2	9.8	47.8	40.0	60.0	50.0	12.2	10.0

--- L1 Phase ---

No.	Frequency	Reading QP	Reading CAV	c.f	Result QP	Result CAV	Limit QP	Limit AV	Margin QP	Margin CAV
	[MHz]	[dB(uV)]	[dB(uV)]	[dB]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.18081	49.2	24.1	10.0	59.2	34.1	64.4	54.4	5.2	20.3
2	0.2195	41.1	17.7	9.7	50.8	27.4	62.8	52.8	12.0	25.4
3	0.25715	31.7	16.2	9.6	41.3	25.8	61.5	51.5	20.2	25.7
4	0.44718	38.7	32.3	9.8	48.5	42.1	56.9	46.9	8.4	4.8
5	10.66967	26.0	25.3	9.7	35.7	35.0	60.0	50.0	24.3	15.0
6	13.56084	38.1	30.3	9.8	47.9	40.1	60.0	50.0	12.1	9.9

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7. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Signal Generator	R&S	SMB100A	176206	22.01.20
Spectrum Analyzer	R&S	FSV30	100732	22.01.20
DC Power Supply	AGILENT	E3632A	KR94907664	22.05.10
Temp & Humid Chamber	Myeongseong R&P	CTHC-50P-DT	20150824-2	22.07.27
Bi-Log Antenna	TESEQ	CBL 6112D	55545	22.04.24
ATTENUATOR	KEYSIGHT	8491B-6dB	MY39271060	22.04.24
LOOP Antenna	R&S	HFH2-Z2	100355	22.08.21
AMPLIFIER	SONOMA	310N	186280	22.04.03
Antenna Mast	Innco Systems	MA4000-EP	303	N/A
Turn Table	Innco Systems	DT2000	79	N/A
ISOLATION TRANSFORMER	ONETECH CO., LTD	OT-IT500VA	OTR1-16026	22.04.02
TWO-LINE V - NETWORK	R&S	ENV216	101358	22.09.29
EMI TEST RECEIVER	R&S	ESCI3	100001	22.08.19

End of test report