



TEST REPORT

Eurofins KCTL Co.,Ltd.
 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.:
 KR22-SRF0148-C
 Page (1) of (33)



1. Client

- Name : CEYON TELINVENTORY CO., LTD.
- Address : 4F(416), 49, Gangnam-daero 37-gil, Seocho-gu, Seoul, Republic of Korea
- Date of Receipt : 2022-08-25

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 : 2A3J7RF4500

6. Date of Test : 2022-09-14 to 2022-09-22

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 : Taekyong Nam (Signature)	Name : Heesu Ahn (Signature)

2022-12-20

Eurofins KCTL Co.,Ltd.

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 Eurofins KCTL Co.,Ltd.

Eurofins KCTL Co.,Ltd. 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.: KR22-SRF0148-C Page (2) of (33)	
--	--	---

REPORT REVISION HISTORY

Date	Revision	Page No
2022-10-17	Originally issued	-
2022-10-20	Updated	9
2022-10-27	Updated	27~32
2022-12-20	Updated	9, 27~29

This report shall not be reproduced except in full, without the written approval of Eurofins KCTL Co.,Ltd. This document may be altered or revised by Eurofins KCTL Co.,Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by Eurofins KCTL Co.,Ltd. will constitute fraud and shall nullify the document. This test report is a general report that does not use the KOLAS accreditation mark and is not related to KS Q ISO/IEC 17025 and KOLAS accreditation.

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

CONTENTS

1.	General information	4
2.	Device information	4
2.1.	Frequency/channel operations.....	5
3.	Antenna requirement	5
4.	Summary of tests	6
5.	Measurement uncertainty	7
6.	Test results	8
6.1.	20 dB Bandwidth.....	8
6.2.	Frequency tolerance	10
6.3.	Radiated spurious emissions	12
6.4.	AC Conducted emission	26
7.	Measurement equipment	30



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 : Eurofins KCTL Co.,Ltd.
 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(NFC)
 Number of channels : 1 ch
 Frequency range : 13.56 MHz
 Power source : AC 110 ~ 220 V
 Antenna specification : TAG 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 ~ 50 °C

2.1. Frequency/channel operations

This device contains the following capabilities:

NFC

Ch.	Frequency (MHz)
01	13.56

Table 2.1.1. 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 TAG antennas (Internal antenna) on board.



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)	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 : 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.

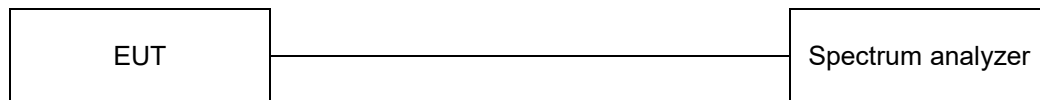
Parameter	Expanded uncertainty ($\pm$)	
Radiated spurious emissions	9 kHz ~ 30 MHz	2.4 dB
	30 MHz ~ 1 000 MHz	2.3 dB
Conducted emissions	9 kHz ~ 150 kHz	1.6 dB
	150 kHz ~ 30 MHz	1.7 dB



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

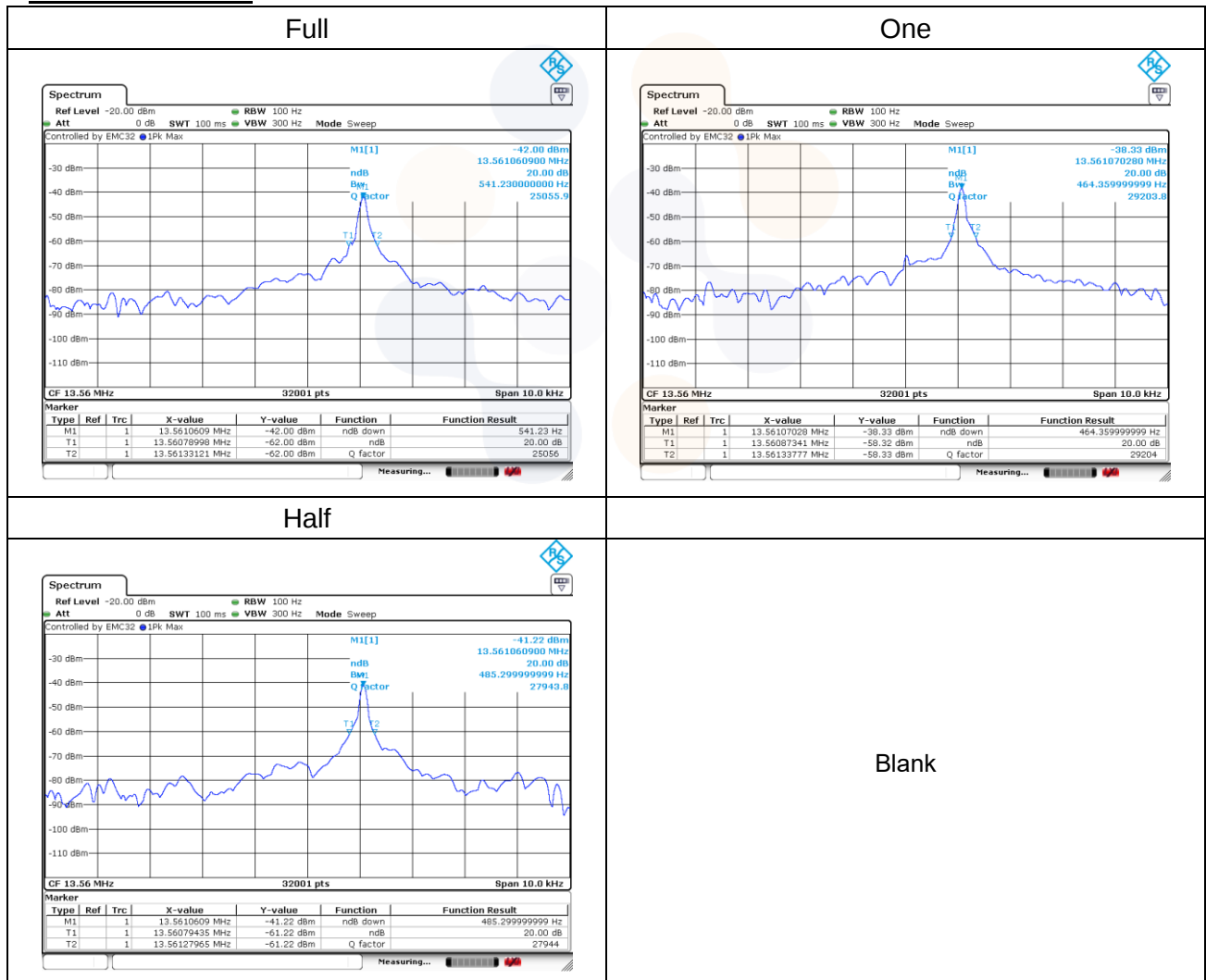
Test settings

The spectrum analyzer connected receive antenna and the EUT placed on near the receive antenna. The RBW is set to 100 Hz. The VBW is set to 3 times the RBW. The sweep time is coupled.

Test results

Mode	Frequency [MHz]	20 dB Bandwidth [MHz]		Limit [MHz]	20 dB Bandwidth [kHz]
Full	13.56	Lowest Frequency	13.560 8	13.110 000	0.54
		Highest Frequency	13.561 3	14.010 000	
Half	13.56	Lowest Frequency	13.560 8	13.110 000	0.49
		Highest Frequency	13.561 3	14.010 000	
One	13.56	Lowest Frequency	13.560 9	13.110 000	0.46
		Highest Frequency	13.561 3	14.010 000	

20 dB Bandwidth

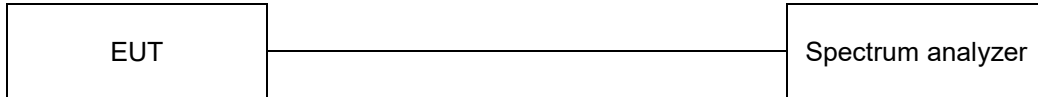


Note:

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



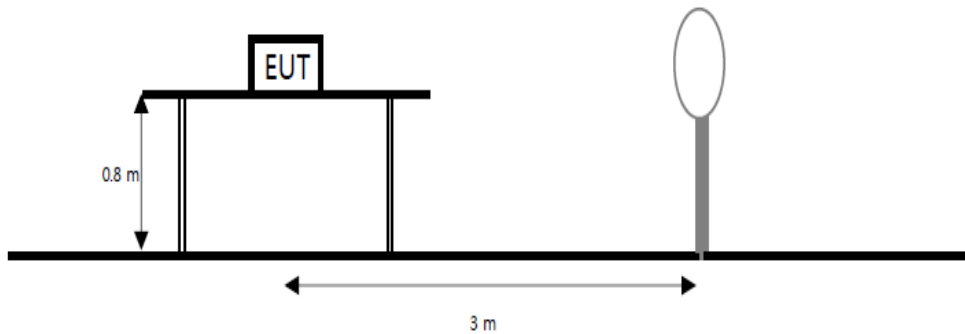
Test results

Voltage [%]	Voltage [V]	TEMP [°C]	Maintaining time	Measure frequency [Hz]	Frequency deviation [Hz]	Deviation [%]
100	12.00	20(Ref.)	Startup	13 561 051	-1051.0	0.007 75
			2 minutes	13 561 049	-1049.0	0.007 74
			5 minutes	13 561 048	-1048.0	0.007 73
			10 minutes	13 561 045	-1045.0	0.007 71
		-20	Startup	13 561 100	-1100.0	0.008 11
			2 minutes	13 561 098	-1098.0	0.008 10
			5 minutes	13 561 097	-1097.0	0.008 09
			10 minutes	13 561 095	-1095.0	0.008 08
		-10	Startup	13 561 068	-1068.0	0.007 88
			2 minutes	13 561 066	-1066.0	0.007 86
			5 minutes	13 561 065	-1065.0	0.007 85
			10 minutes	13 561 064	-1064.0	0.007 85
		0	Startup	13 561 055	-1055.0	0.007 78
			2 minutes	13 561 055	-1055.0	0.007 78
			5 minutes	13 561 054	-1054.0	0.007 77
			10 minutes	13 561 053	-1053.0	0.007 77
		10	Startup	13 561 044	-1044.0	0.007 70
			2 minutes	13 561 047	-1047.0	0.007 72
			5 minutes	13 561 047	-1047.0	0.007 72
			10 minutes	13 561 049	-1049.0	0.007 74
		25	Startup	13 561 042	-1042.0	0.007 68
			2 minutes	13 561 040	-1040.0	0.007 67
			5 minutes	13 561 041	-1041.0	0.007 68
			10 minutes	13 561 042	-1042.0	0.007 68
		30	Startup	13 561 034	-1034.0	0.007 63
			2 minutes	13 561 033	-1033.0	0.007 62
			5 minutes	13 561 033	-1033.0	0.007 62
			10 minutes	13 561 031	-1031.0	0.007 60
		40	Startup	13 561 027	-1027.0	0.007 57
			2 minutes	13 561 025	-1025.0	0.007 56
			5 minutes	13 561 024	-1024.0	0.007 55
			10 minutes	13 561 022	-1022.0	0.007 54
		50	Startup	13 561 018	-1018.0	0.007 51
			2 minutes	13 561 022	-1022.0	0.007 54
			5 minutes	13 561 023	-1023.0	0.007 54
			10 minutes	13 561 023	-1023.0	0.007 54
85	10.20	20	Startup	13 561 042	-1042.0	0.007 68
			2 minutes	13 561 043	-1043.0	0.007 69
			5 minutes	13 561 044	-1044.0	0.007 70
			10 minutes	13 561 044	-1044.0	0.007 70
115	13.80	20	Startup	13 561 045	-1045.0	0.007 71
			2 minutes	13 561 047	-1047.0	0.007 72
			5 minutes	13 561 048	-1048.0	0.007 73
			10 minutes	13 561 048	-1048.0	0.007 73

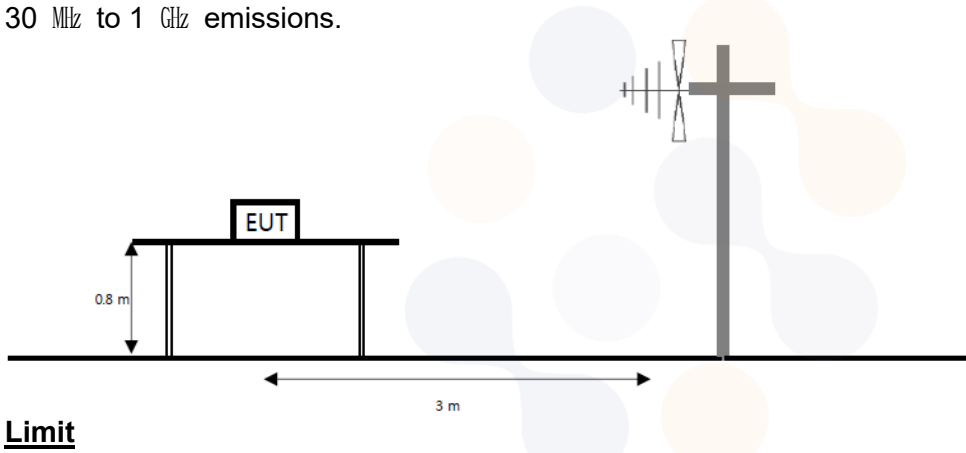
6.3. Radiated spurious emissions

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

Test results for fundamental

- Full

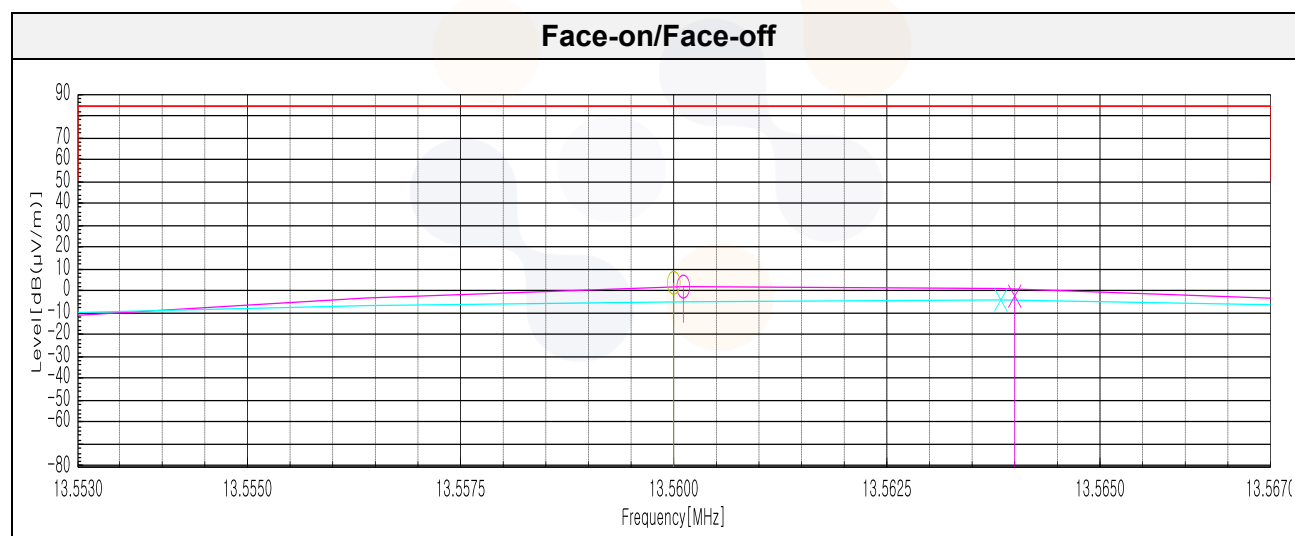
15.225 (a) 13.553-13.567 MHz

[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	54.00	20.31	-31.13	40.00	3.18	84.00	80.82

[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	48.10	20.31	-31.13	40.00	-2.72	84.00	86.72



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

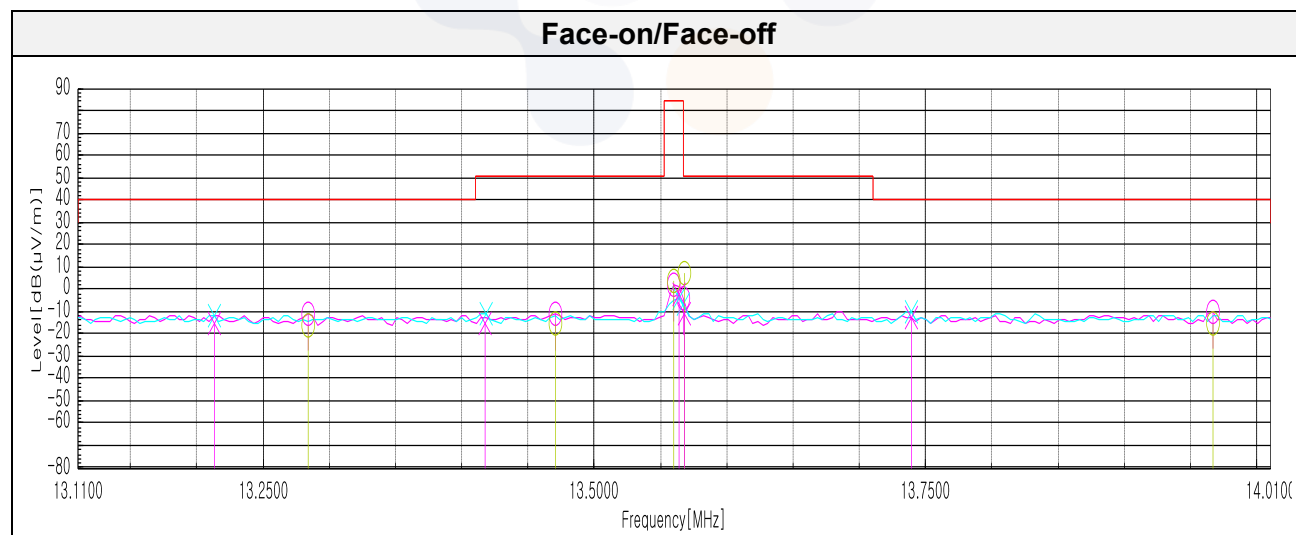
15.225 (b,c) 13.110-14.010 MHz

[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	34.70	20.30	-31.15	40.00	-16.15	40.50	56.65
13.47	35.20	20.31	-31.13	40.00	-15.62	50.50	66.12
13.57	57.90	20.31	-31.13	40.00	7.08	50.50	43.42
13.97	35.60	20.34	-31.14	40.00	-15.20	40.50	55.70

[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							
13.21	34.90	20.29	-31.15	40.00	-15.96	40.50	56.46
13.42	35.00	20.31	-31.14	40.00	-15.83	50.50	66.33
13.57	39.80	20.31	-31.13	40.00	-11.02	50.50	61.52
13.74	38.20	20.32	-31.13	40.00	-12.61	40.50	53.11



Test results (9 kHz to 30 MHz)

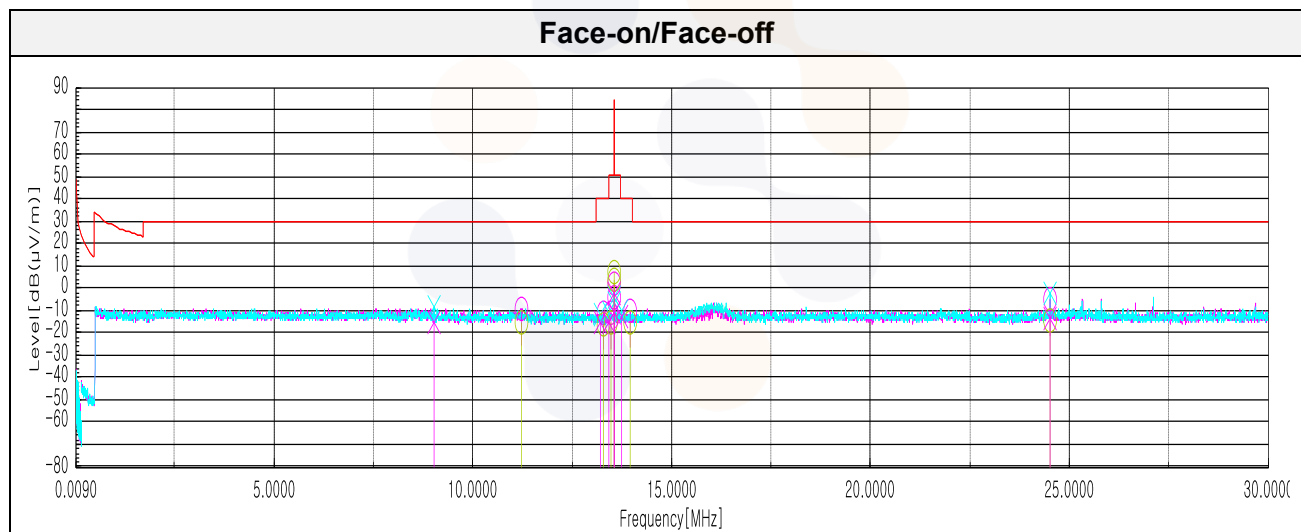
15.225 (d) 0.009-30 MHz

[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							
24.52	34.80	20.97	-30.60	40.00	-14.83	29.54	44.37

[Face-off]

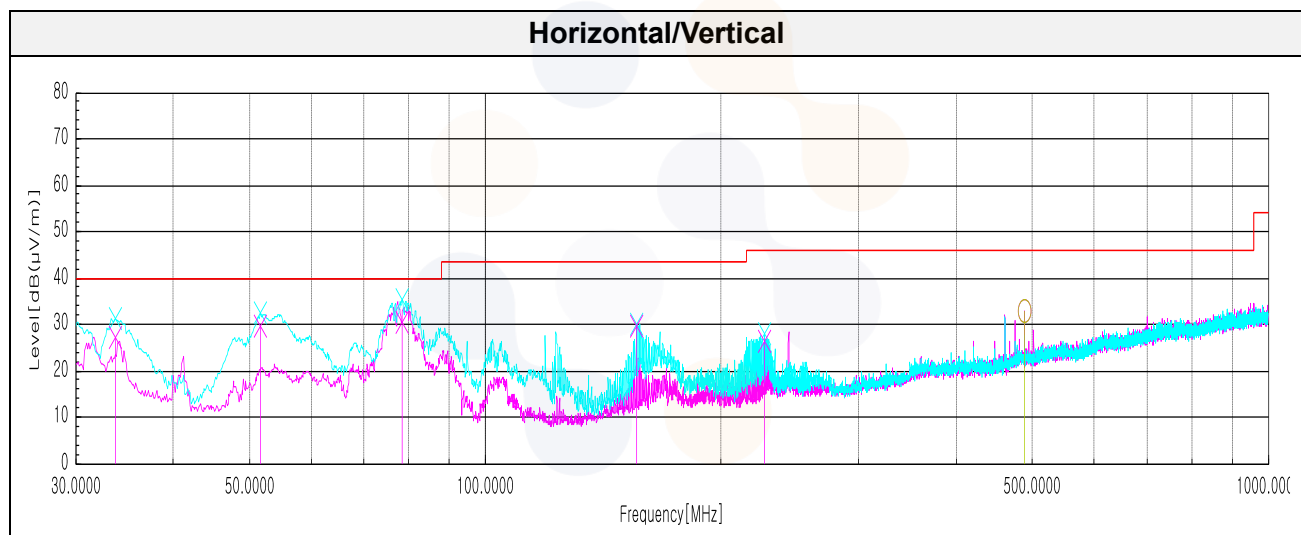
Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
24.52	35.40	20.97	-30.60	40.00	-14.23	29.54	43.77



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								
33.76	V	35.60	21.04	-29.56	-	27.08	40.00	12.92
51.70	V	44.70	14.03	-29.07	-	29.66	40.00	10.34
78.50	V	46.80	12.10	-28.41	-	30.49	40.00	9.51
156.10	V	40.70	15.90	-26.90	-	29.70	43.50	13.80
227.40	V	34.70	17.64	-25.97	-	26.37	46.00	19.63
488.20	H	31.30	24.74	-22.99	-	33.05	46.00	12.95



- Half

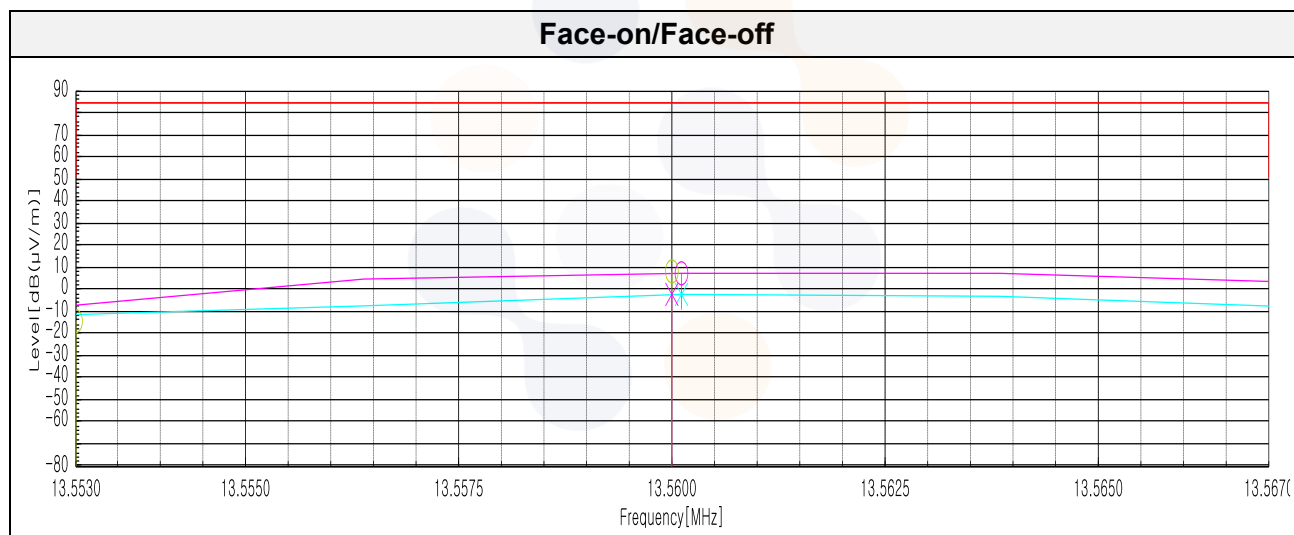
15.225 (a) 13.553-13.567 MHz

[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	58.90	20.31	-31.13	40.00	8.08	84.00	75.92

[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	48.50	20.31	-31.13	40.00	-2.32	84.00	86.32



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

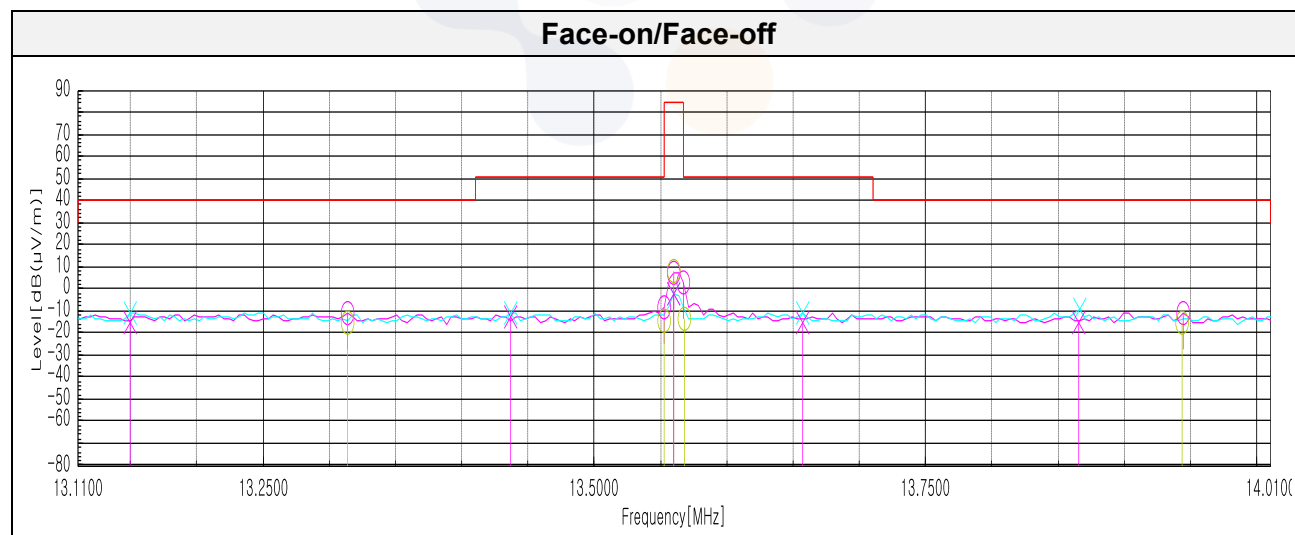
15.225 (b,c) 13.110-14.010 MHz

[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							
13.31	34.80	20.30	-31.14	40.00	-16.04	40.50	56.54
13.55	35.90	20.31	-31.13	40.00	-14.92	50.50	65.42
13.57	37.10	20.31	-31.13	40.00	-13.72	50.50	64.22
13.94	34.80	20.34	-31.14	40.00	-16.00	40.50	56.50

[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							
13.15	35.00	20.29	-31.16	40.00	-15.87	40.50	56.37
13.44	37.90	20.31	-31.14	40.00	-12.93	50.50	63.43
13.66	35.50	20.32	-31.13	40.00	-15.31	50.50	65.81
13.87	35.10	20.33	-31.14	40.00	-15.71	40.50	56.21



Test results (9 kHz to 30 MHz)

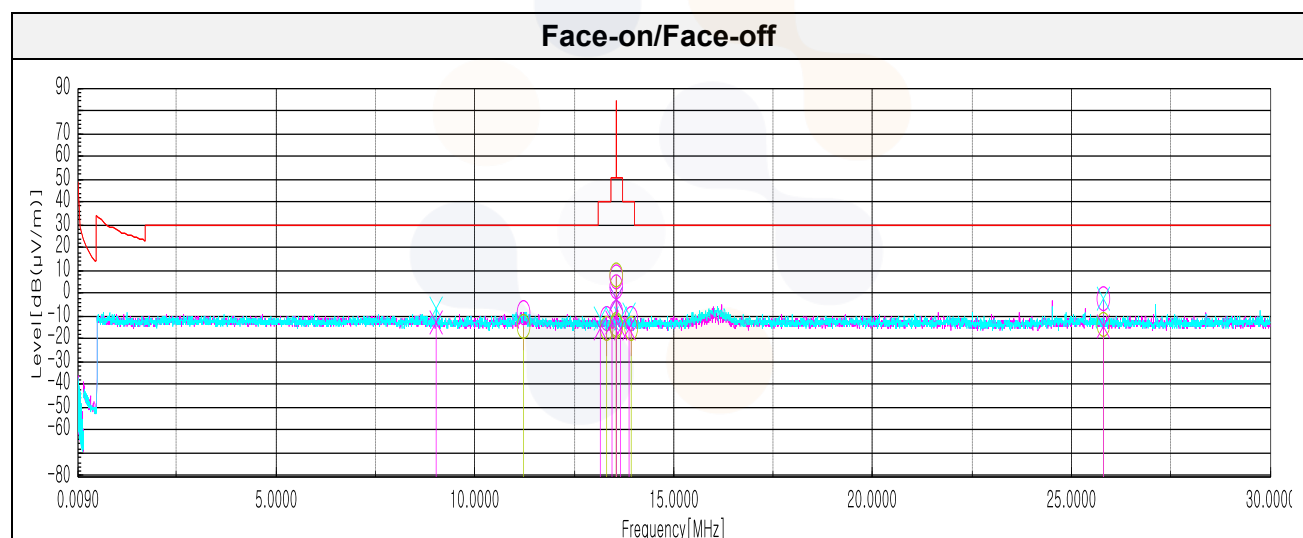
15.225 (d) 0.009-30 MHz

[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							
25.81	35.90	20.87	-30.54	40.00	-13.77	29.54	43.31

[Face-off]

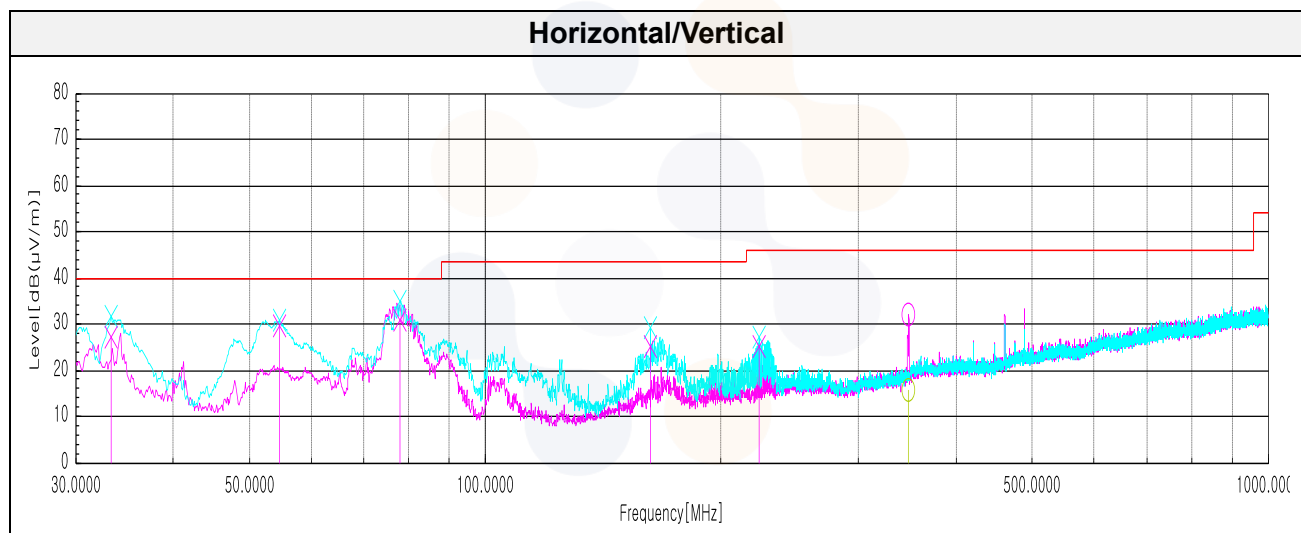
Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
25.81	34.70	20.87	-30.54	40.00	-14.97	29.54	44.51



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								
33.27	V	35.40	21.34	-29.52	-	27.11	40.00	12.89
54.61	V	44.90	13.58	-28.41	-	29.44	40.00	10.56
78.02	V	47.00	12.10	-27.88	-	30.68	40.00	9.32
162.77 ¹⁾	V	36.20	15.60	-26.72	-	24.98	43.50	18.52
224.24	V	33.40	17.44	-25.95	-	24.85	46.00	21.15
347.80	H	19.00	21.32	-22.99	-	15.86	46.00	30.14



- One

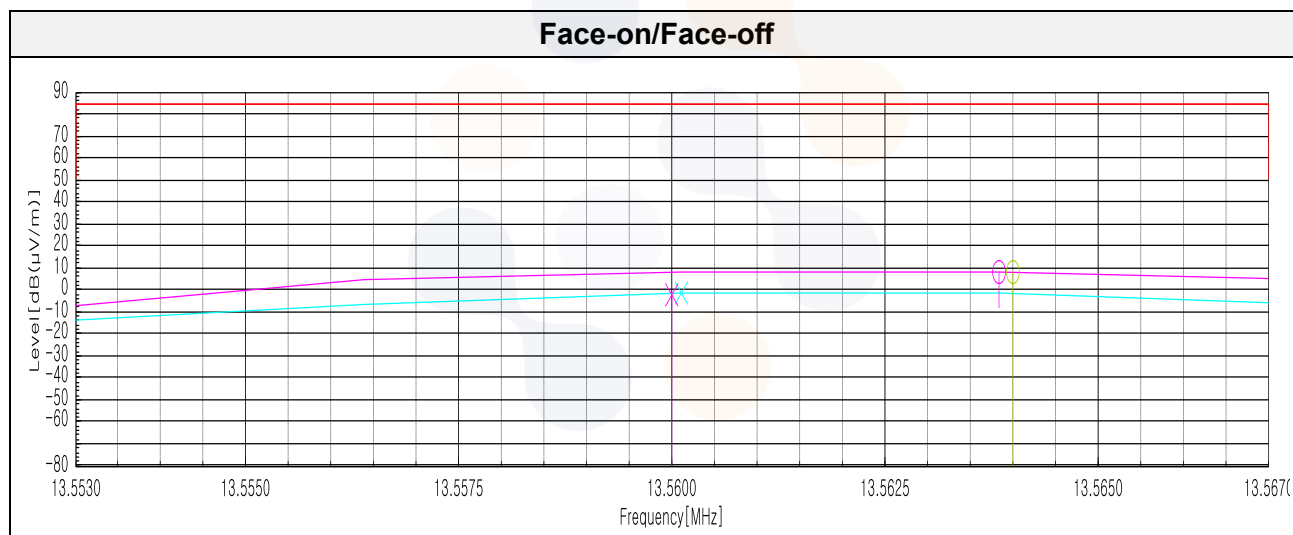
15.225 (a) 13.553-13.567 MHz

[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	58.60	20.31	-31.13	40.00	7.78	84.00	76.22

[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	48.30	20.31	-31.13	40.00	-2.52	84.00	86.52



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

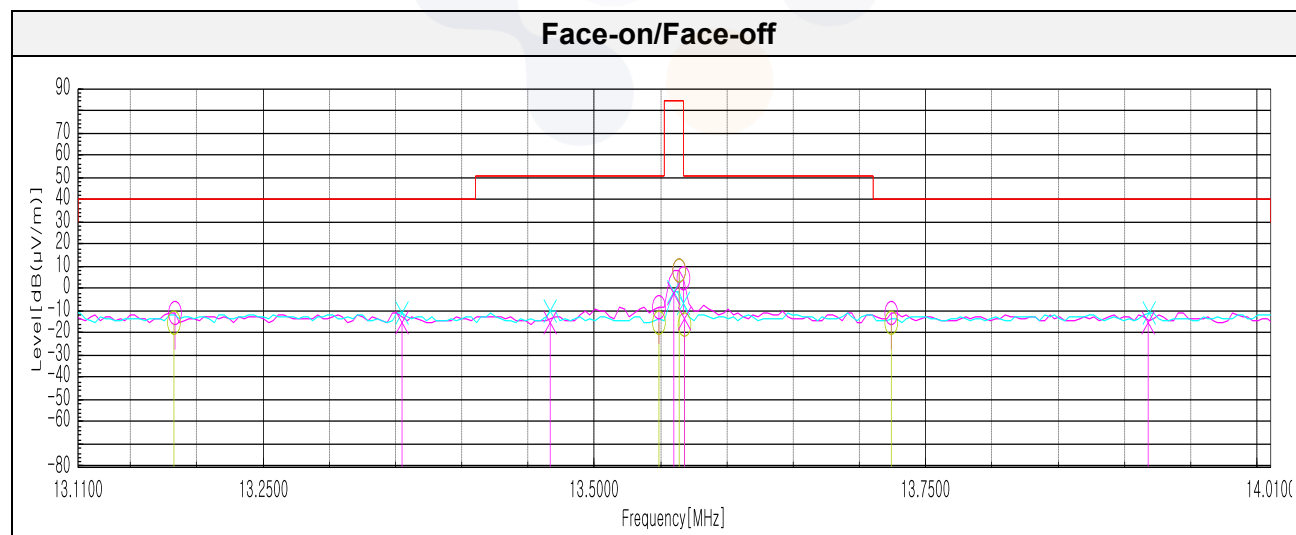
15.225 (b,c) 13.110-14.010 MHz

[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							
13.18	34.90	20.29	-31.16	40.00	-15.97	40.50	56.47
13.55	35.60	20.31	-31.13	40.00	-15.22	50.50	65.72
13.57	34.60	20.31	-31.13	40.00	-16.22	50.50	66.72
13.72	35.30	20.32	-31.13	40.00	-15.51	40.50	56.01

[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							
13.36	35.10	20.30	-31.14	40.00	-15.74	50.50	66.24
13.47	35.00	20.31	-31.13	40.00	-15.82	50.50	66.32
13.57	37.30	20.31	-31.13	40.00	-13.52	50.50	64.02
13.92	35.20	20.34	-31.14	40.00	-15.60	40.50	56.10



Test results (9 kHz to 30 MHz)

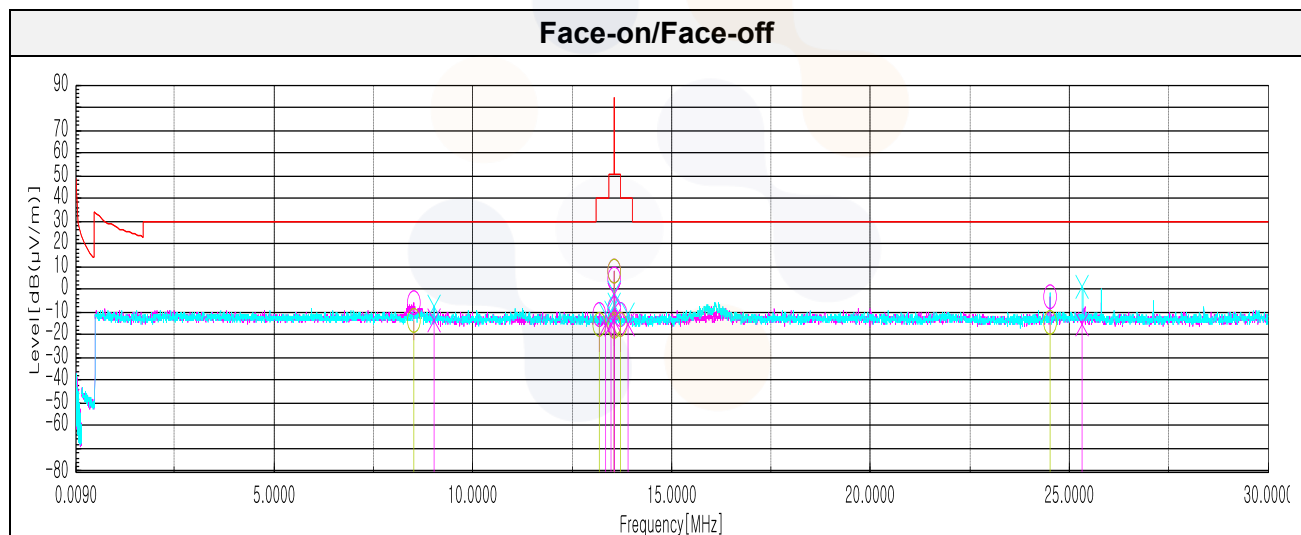
15.225 (d) 0.009-30 MHz

[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							
24.52	34.70	20.97	-30.60	40.00	-14.93	29.54	44.47

[Face-off]

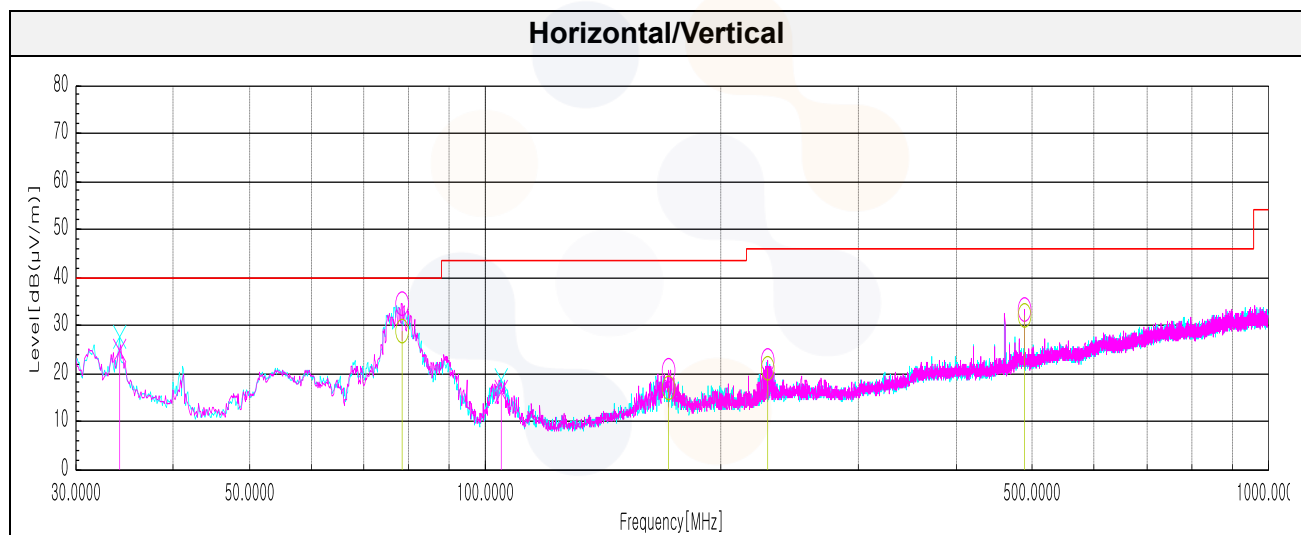
Frequency	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data							
25.34	34.30	20.95	-30.55	40.00	-15.30	29.54	44.84



Test results (Below 1 000 MHz)

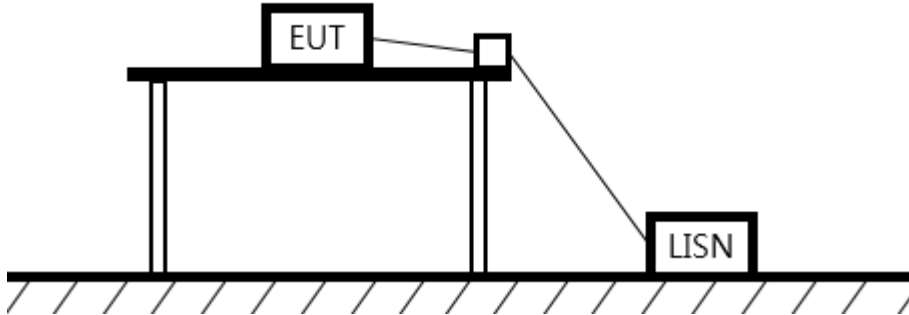
15.225 (d) 30-1 000 MHz

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								
34.12	V	33.40	20.85	-29.52	-	24.73	40.00	15.27
78.38	H	45.00	12.10	-28.41	-	28.69	40.00	11.31
105.05	V	29.80	14.39	-27.88	-	16.31	43.50	27.19
171.74 ¹⁾	H	28.10	15.67	-26.72	-	17.05	43.50	26.45
229.70	H	29.30	17.78	-25.95	-	21.13	46.00	24.87
488.20	H	30.40	24.74	-22.99	-	32.15	46.00	13.85



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

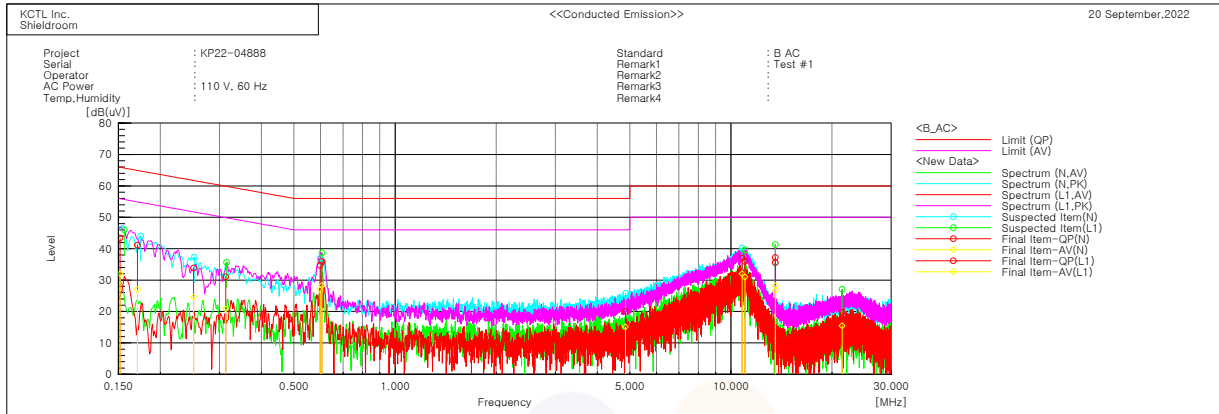
Measurement procedure

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.

Test results

[Tests with the antenna connected]

[Full]



Final Result

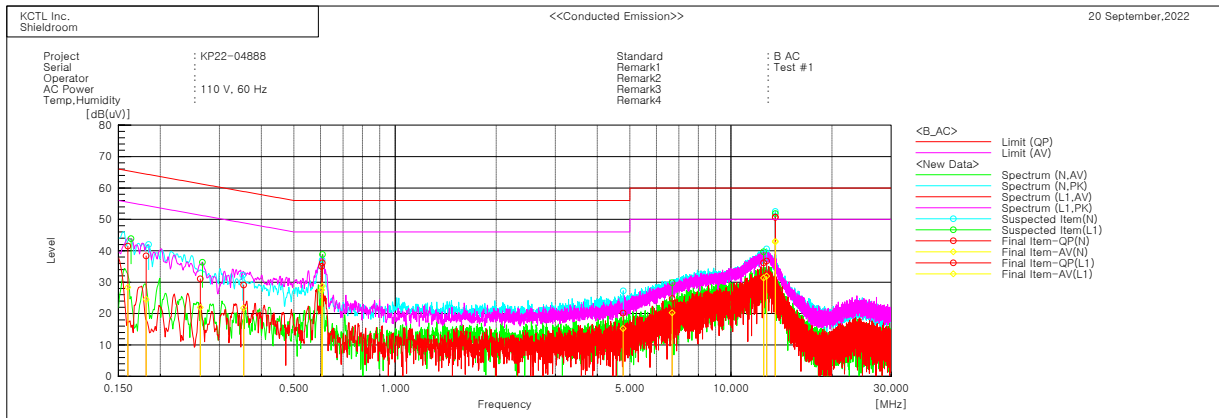
--- N Phase ---

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	0.17086	31.1	17.0	10.0	41.1	27.0	64.9	54.9	23.8	27.9
2	0.25121	24.2	15.0	9.6	33.8	24.6	61.7	51.7	27.9	27.1
3	0.59825	24.9	17.1	9.8	34.7	26.9	56.0	46.0	21.3	19.1
4	4.85266	10.3	5.4	9.7	20.0	15.1	56.0	46.0	36.0	30.9
5	10.79285	27.1	22.2	9.8	36.9	32.0	60.0	50.0	23.1	18.0
6	13.56026	25.8	17.0	9.8	35.6	26.8	60.0	50.0	24.4	23.2

--- 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	0.1516	33.7	22.3	9.7	43.4	32.0	65.9	55.9	22.5	23.9
2	0.31297	21.4	11.1	9.7	31.1	20.8	59.9	49.9	26.8	29.1
3	0.6048	26.1	18.5	9.8	35.9	28.3	56.0	46.0	20.1	17.7
4	11.01176	26.1	21.1	9.8	35.9	30.9	60.0	50.0	24.1	19.1
5	13.56053	27.3	18.4	9.8	37.1	28.2	60.0	50.0	22.9	21.8
6	21.4443	9.7	5.4	10.0	19.7	15.4	60.0	50.0	40.3	34.6

[Half]



Final Result

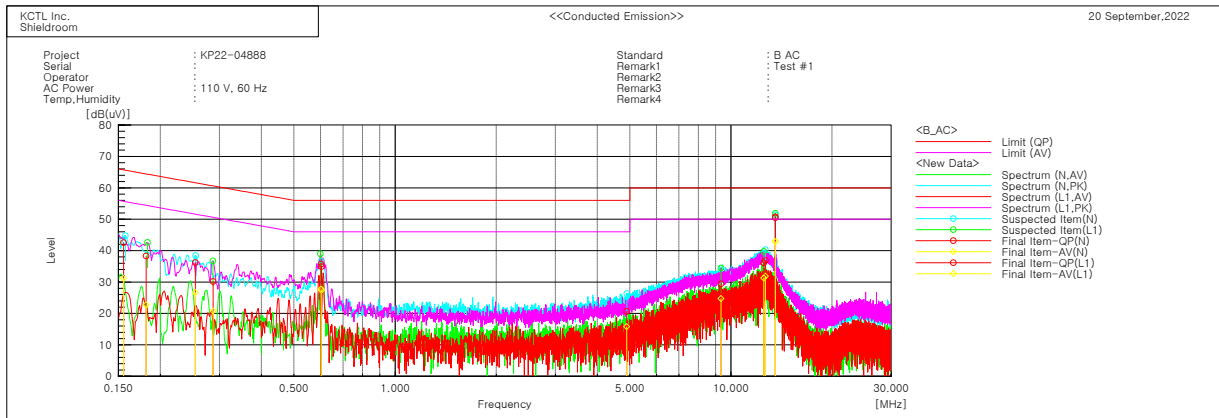
--- N Phase ---

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	0.18147	28.4	14.5	10.0	38.4	24.5	64.4	54.4	26.0	29.9
2	0.35383	19.4	12.0	9.7	29.1	21.7	58.9	48.9	29.8	27.2
3	0.60425	25.2	17.7	9.8	35.0	27.5	56.0	46.0	21.0	18.5
4	4.77575	10.5	5.5	9.7	20.2	15.2	56.0	46.0	35.8	30.8
5	12.77197	26.9	22.1	9.8	36.7	31.9	60.0	50.0	23.3	18.1
6	13.56086	40.8	33.2	9.8	50.6	43.0	60.0	50.0	9.4	7.0

--- 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	0.16006	31.6	18.5	9.9	41.5	28.4	65.5	55.5	24.0	27.1
2	0.26292	21.5	12.4	9.6	31.1	22.0	61.3	51.3	30.2	29.3
3	0.60732	26.4	18.9	9.8	36.2	28.7	56.0	46.0	19.8	17.3
4	6.67982	15.1	10.6	9.7	24.8	20.3	60.0	50.0	35.2	29.7
5	12.51937	26.4	21.6	9.8	36.2	31.4	60.0	50.0	23.8	18.6
6	13.56084	40.9	33.0	9.8	50.7	42.8	60.0	50.0	9.3	7.2

[One]



Final Result

--- N Phase ---

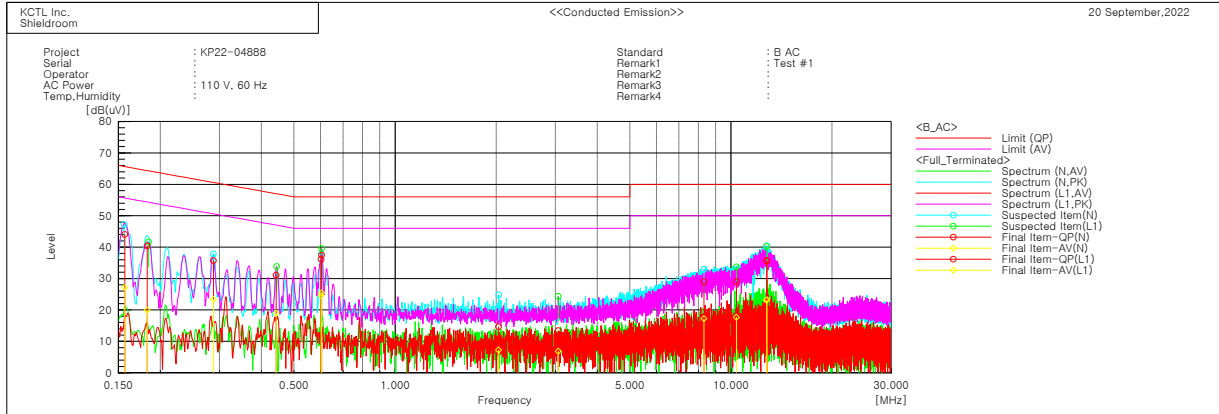
No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.15536	32.8	21.4	9.8	42.6	31.2	65.7	55.7	23.1	24.5
2	0.25418	26.6	17.0	9.6	36.2	26.6	61.6	51.6	25.4	25.0
3	0.60327	25.1	17.6	9.8	34.9	27.4	56.0	46.0	21.1	18.6
4	4.89244	10.9	6.1	9.7	20.6	15.8	56.0	46.0	35.4	30.2
5	12.66106	27.0	22.1	9.8	36.8	31.9	60.0	50.0	23.2	18.1
6	13.56107	40.9	33.2	9.8	50.7	43.0	60.0	50.0	9.3	7.0

--- 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	0.18134	28.3	12.7	10.0	38.3	22.7	64.4	54.4	26.1	31.7
2	0.28722	20.6	11.2	9.6	30.2	20.8	60.6	50.6	30.4	29.8
3	0.60203	25.9	18.0	9.8	35.7	27.8	56.0	46.0	20.3	18.2
4	9.34086	19.6	14.9	9.8	29.4	24.7	60.0	50.0	30.6	25.3
5	12.52815	26.3	21.5	9.8	36.1	31.3	60.0	50.0	23.9	18.7
6	13.56222	40.7	33.0	9.8	50.5	42.8	60.0	50.0	9.5	7.2

[Retest with a dummy load]

[Full]

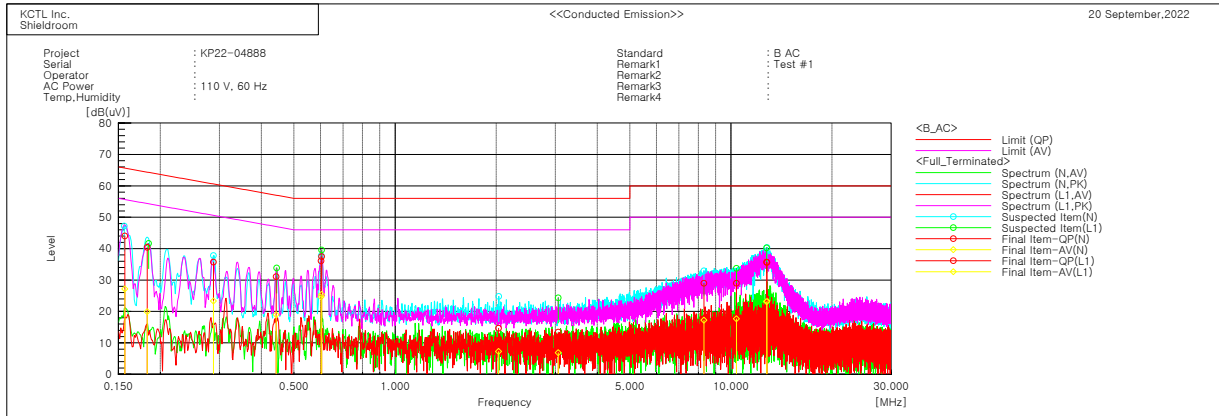


Final Result

--- 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(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.15676	34.2	17.4	9.8	44.0	27.2	65.6	55.6	21.6	28.4
2	0.28786	26.1	13.7	9.6	35.7	23.3	60.6	50.6	24.9	27.3
3	0.60196	26.3	14.8	9.8	36.1	24.6	56.0	46.0	19.9	21.4
4	2.03211	5.0	-2.3	9.6	14.6	7.3	56.0	46.0	41.4	38.7
5	8.31261	19.2	7.5	9.7	28.9	17.2	60.0	50.0	31.1	32.8
6	12.80805	25.8	13.5	9.8	35.6	23.3	60.0	50.0	24.4	26.7

--- 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(uV)]	[dB(uV)]	[dB(uV)]	[dB(uV)]	[dB]	[dB]
1	0.18266	30.4	9.9	10.0	40.4	19.9	64.4	54.4	24.0	34.5
2	0.44244	21.3	9.1	9.8	31.1	18.9	57.0	47.0	25.9	28.1
3	0.60444	27.7	15.6	9.8	37.5	25.4	56.0	46.0	18.5	20.6
4	3.0589	3.8	-2.7	9.6	13.4	6.9	56.0	46.0	42.6	39.1
5	10.3803	19.2	7.8	9.8	29.0	17.6	60.0	50.0	31.0	32.4
6	12.77791	25.9	13.3	9.8	35.7	23.1	60.0	50.0	24.3	26.9

[Half]



Final Result

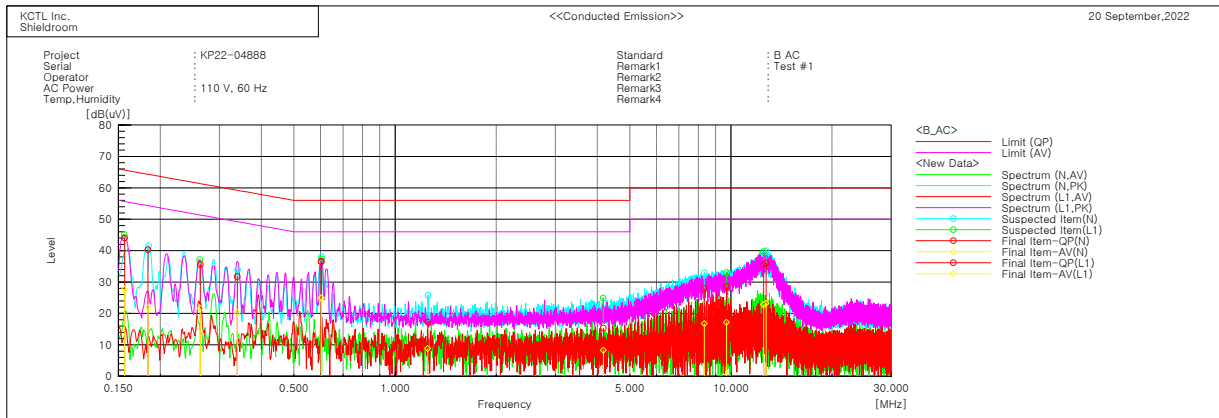
--- N Phase ---

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	0.15676	34.2	17.4	9.8	44.0	27.2	65.6	55.6	21.6	28.4
2	0.26786	26.1	13.7	9.6	35.7	23.3	60.6	50.6	24.9	27.3
3	0.60196	26.3	14.8	9.8	36.1	24.6	56.0	46.0	19.9	21.4
4	2.03211	5.0	-2.3	9.6	14.6	7.3	56.0	46.0	41.4	38.7
5	8.31261	19.2	7.5	9.7	28.9	17.2	60.0	50.0	31.1	32.8
6	12.80805	25.8	13.5	9.8	35.6	23.3	60.0	50.0	24.4	26.7

--- 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	0.18266	30.4	9.9	10.0	40.4	19.9	64.4	54.4	24.0	34.5
2	0.44244	21.3	9.1	9.8	31.1	18.9	57.0	47.0	25.9	28.1
3	0.6044	27.7	15.6	9.8	37.5	25.4	56.0	46.0	18.5	20.6
4	3.0589	3.8	-2.7	9.6	13.4	6.9	56.0	46.0	42.6	39.1
5	10.3803	19.2	7.8	9.8	29.0	17.6	60.0	50.0	31.0	32.4
6	12.77791	25.9	13.3	9.8	35.7	23.1	60.0	50.0	24.3	26.9

[One]



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	0.18368	30.3	11.7	10.0	40.3	21.7	64.3	54.3	24.0	32.6
2	0.33886	22.0	10.5	9.7	31.7	20.2	59.2	49.2	27.5	29.0
3	0.60297	26.6	15.0	9.8	36.4	24.8	56.0	46.0	19.6	21.2
4	1.25085	7.6	-0.9	9.7	17.3	8.8	56.0	46.0	38.7	37.2
5	8.33155	18.2	7.0	9.7	27.9	16.7	60.0	50.0	32.1	33.3
6	12.72387	26.2	13.4	9.8	36.0	23.2	60.0	50.0	24.0	26.8

--- 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	0.15657	34.2	17.9	9.8	44.0	27.7	65.6	55.6	21.6	27.9
2	0.26298	26.0	12.0	9.6	35.6	21.6	61.3	51.3	25.7	29.7
3	0.60262	26.8	15.2	9.8	36.6	25.0	56.0	46.0	19.4	21.0
4	4.17237	5.6	-1.5	9.7	15.3	8.2	56.0	46.0	40.7	37.8
5	9.7055	18.7	7.4	9.8	28.5	17.2	60.0	50.0	31.5	32.8
6	12.51438	25.7	13.0	9.8	35.5	22.8	60.0	50.0	24.5	27.2

7. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Vector Signal Generator	R&S	SMBV100A	257566	23.01.19
Spectrum Analyzer	R&S	FSV40-N	101462	23.01.06
AC/DC Power Supply	KIKUSUI	PCR2000W	GB001619	23.07.11
Temp & Humid Chamber	Myeongseong R&P	CTHC-50P-DT	20150824-1	22.12.21
LOOP Antenna	R&S	HFH2-Z2	100355	24.08.10
Bi-Log Antenna	TESEQ	CBL 6112D	62438	24.08.24
ATTENUATOR	KEYSIGHT	8491B-6dB	MY39271060	24.04.27
Amplifier	SONOMA INSTRUMENT	310N	284608	23.08.18
EMI TEST RECEIVER	R&S	ESCI7	101408	23.03.04
TWO-LINE V - NETWORK	R&S	ENV216	101358	23.09.29

End of test report