



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.: KR22-SRF0011 Page (1) of (18)	KCTL
1. Client ◦ Name : ISTCONTROL Co., Ltd ◦ Address : 1203, 37, Maebongsan-ro Mapo-gu, Seoul, Republic of Korea ◦ Date of Receipt : 2021-08-13			
2. Use of Report : Certification			
3. Name of Product / Model : Smart RFID Card Reader / IRD2M			
4. Manufacturer / Country of Origin : ISTCONTROL Co., Ltd / Korea			
5. FCC ID : 2AZS5IRD2M			
6. Date of Test : 2021-10-05 to 2021-10-19			
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)
2022-02-09			
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
2022-02-09	Originally issued	-

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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 : ISTCONTROL Co., Ltd
 Address : 1203, 37, Maebongsan-ro Mapo-gu, Seoul, Republic of Korea
 Manufacturer : ISTCONTROL Co., Ltd
 Address : 1203, 37, Maebongsan-ro Mapo-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 : Smart RFID Card Reader
 Model : IRD2M
 Modulation technique : GFSK(Bluetooth Low Energy)
 ASK (RFID)
 Number of channels : 40 ch (Bluetooth Low Energy), 1 ch (RFID)
 Frequency range : 2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy)
 13.56 MHz (RFID)
 Power source : DC 12 V
 Antenna specification : Multilayer Chip Antenna (Bluetooth Low Energy)
 PCB Loop antenna (RFID)
 Antenna gain : 3.50 dBi (Bluetooth Low Energy)
 Software version : V2.00
 Hardware version : V1.01
 Test device serial No. : N/A
 Operation temperature : -20 °C ~ 50 °C

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source	Note.
N/A	-	-	-	-	-

2.2. Frequency/channel operations

This device contains the following capabilities:

Bluetooth Low Energy, 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 PCB Loop antenna (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)	Conducted emissions		N/A ¹⁾

Notes:

1. This test is not applicable because the EUT only connects DC power line.
2. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
3. 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.
4. 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
5. 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
6. The test procedure(s) in this report were performed in accordance as following.
 - ♦ ANSI C63.10-2013

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.

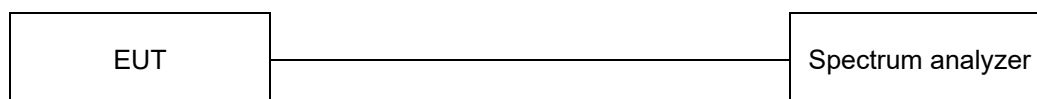
Parameter	Expanded uncertainty ($\pm$)	
Radiated spurious emissions	9 kHz ~ 30 MHz	2.3 dB
	30 MHz ~ 1 000 MHz	2.2 dB
Conducted emissions	9 kHz ~ 150 kHz	3.7 dB
	150 kHz ~ 30 MHz	3.3 dB



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

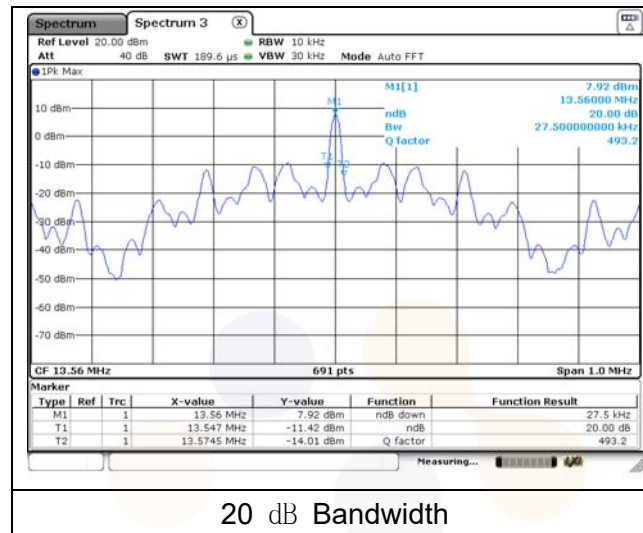
ANSI C63.10 - Section 6.9.2

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.

Test results

Frequency [MHz]	20 dB Bandwidth [MHz]		Limit [MHz]	20 dB Bandwidth [kHz]
13.56	Lowest Frequency	13.547 0	13.110 000	27.5
	Highest Frequency	13.574 5	14.010 000	

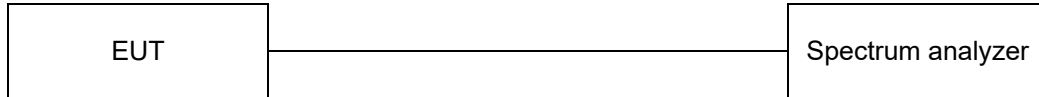


Note:

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



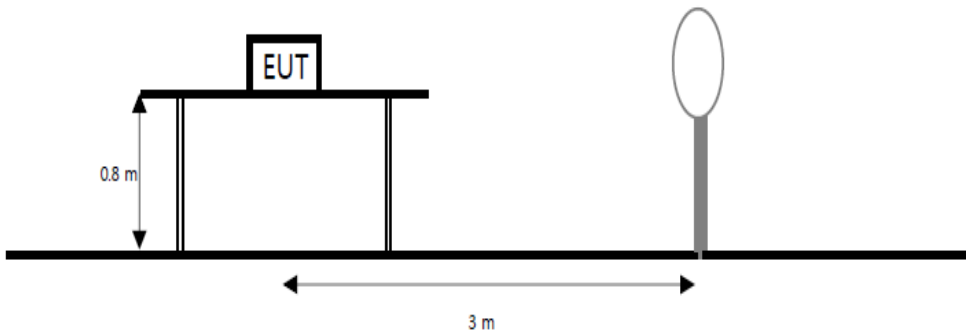
Test results

Voltage	Voltage	TEMP	Maintaining	Measure	Frequency	Deviation
[%]	[V]	[°C]	time	frequency	deviation	[%]
100	12.00	20(Ref.)	Startup	13 560 263	-263.0	0.001 94
			2 minutes	13 560 230	-230.0	0.001 70
			5 minutes	13 560 242	-242.0	0.001 79
			10 minutes	13 560 274	-274.0	0.002 02
		-20	Startup	13 560 305	-305.0	0.002 25
			2 minutes	13 560 567	-567.0	0.004 18
			5 minutes	13 560 688	-688.0	0.005 07
			10 minutes	13 560 801	-801.0	0.005 91
		-10	Startup	13 560 231	-231.0	0.001 70
			2 minutes	13 560 316	-316.0	0.002 33
			5 minutes	13 560 390	-390.0	0.002 88
			10 minutes	13 560 385	-385.0	0.002 84
		0	Startup	13 560 125	-125.0	0.000 92
			2 minutes	13 560 216	-216.0	0.001 59
			5 minutes	13 560 224	-224.0	0.001 65
			10 minutes	13 560 239	-239.0	0.001 76
		10	Startup	13 560 214	-214.0	0.001 58
			2 minutes	13 560 253	-253.0	0.001 87
			5 minutes	13 560 228	-228.0	0.001 68
			10 minutes	13 560 227	-227.0	0.001 67
		25	Startup	13 560 189	-189.0	0.001 39
			2 minutes	13 560 232	-232.0	0.001 71
			5 minutes	13 560 148	-148.0	0.001 09
			10 minutes	13 560 224	-224.0	0.001 65
		30	Startup	13 560 196	-196.0	0.001 45
			2 minutes	13 559 892	108.0	-0.000 80
			5 minutes	13 559 936	64.0	-0.000 47
			10 minutes	13 559 898	102.0	-0.000 75
		40	Startup	13 559 886	114.0	-0.000 84
			2 minutes	13 559 823	177.0	-0.001 31
			5 minutes	13 559 784	216.0	-0.001 59
			10 minutes	13 559 796	204.0	-0.001 50
		50	Startup	13 559 112	888.0	-0.006 55
			2 minutes	13 559 087	913.0	-0.006 73
			5 minutes	13 559 335	665.0	-0.004 90
			10 minutes	13 560 138	-138.0	0.001 02
85	10.20	20	Startup	13 560 222	-222.0	0.001 64
			2 minutes	13 560 247	-247.0	0.001 82
			5 minutes	13 560 235	-235.0	0.001 73
			10 minutes	13 560 255	-255.0	0.001 88
115	13.80	20	Startup	13 560 236	-236.0	0.001 74
			2 minutes	13 560 239	-239.0	0.001 76
			5 minutes	13 560 259	-259.0	0.001 91
			10 minutes	13 560 263	-263.0	0.001 94

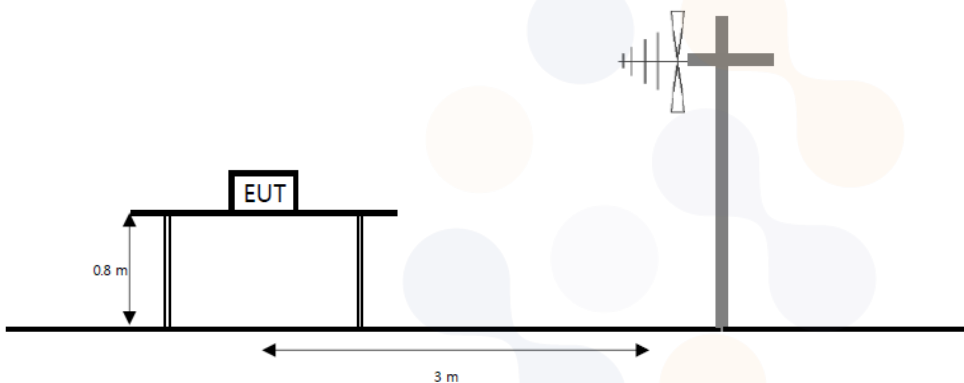
6.3. Radiated spurious emissions

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 ($\mu V/m$)	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 $\mu V/m$)	30
30.0-88.0	100(40 dB $\mu V/m$)	3
88-216	150(43.5 dB $\mu V/m$)	3
216-960	200 (46 dB $\mu V/m$)	3
Above 960	500 (53.98 dB $\mu V/m$)	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

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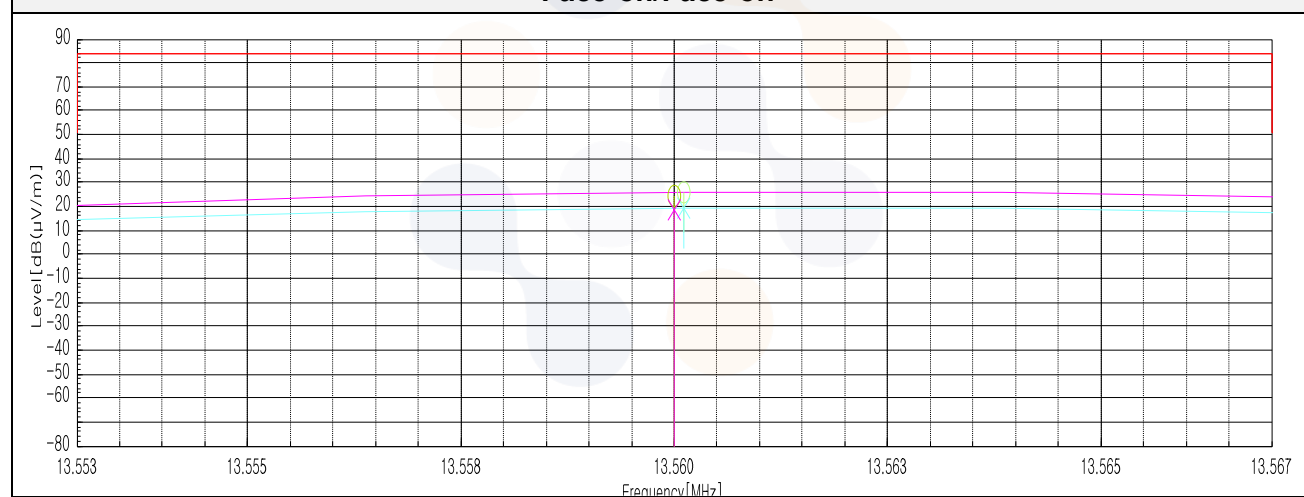
**Test results for fundamental****15.225 (a) 13.553-13.567 MHz**

[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	75.10	20.2	-31.04	40.00	24.26	84.00	59.74

[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							
13.56	68.90	20.2	-31.04	40.00	18.06	84.00	65.94

Face-on/Face-off

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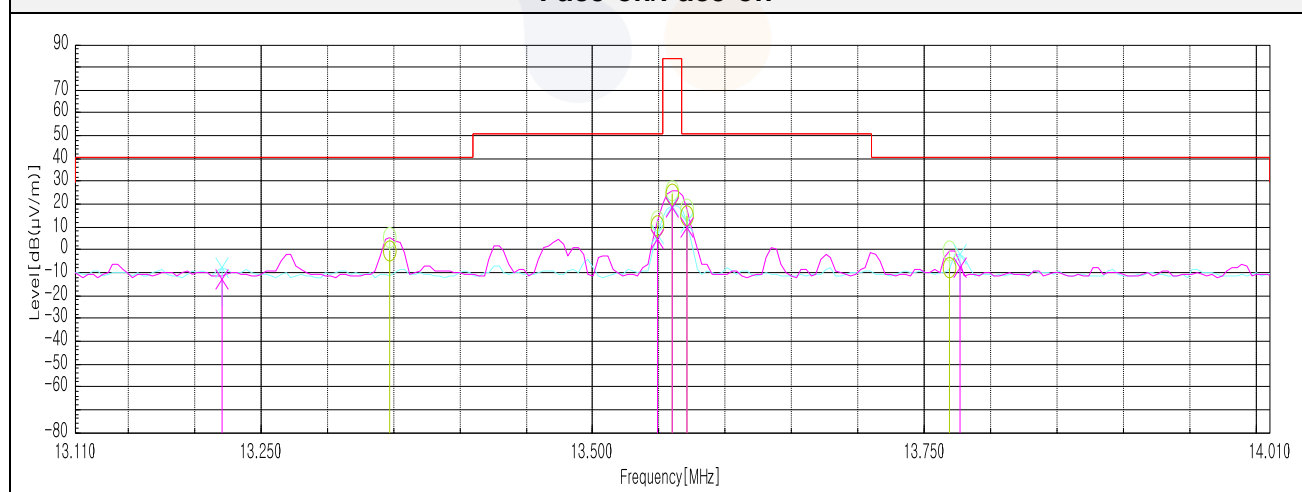
**Test results for in-band & out-band (9 kHz to 30 MHz)****15.225 (b,c) 13.110-14.010 MHz**

[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							
13.35	50.20	20.20	-31.05	40.00	-0.65	40.50	41.15
13.55	61.50	20.20	-31.04	40.00	10.66	50.50	39.84
13.57	65.80	20.20	-31.04	40.00	14.96	50.50	35.54
13.77	43.20	20.20	-31.02	40.00	-7.62	40.50	48.12

[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	37.50	20.20	-31.06	40.00	-13.36	40.50	53.86
13.55	55.20	20.20	-31.04	40.00	4.36	50.50	46.14
13.57	60.10	20.20	-31.04	40.00	9.26	50.50	41.24
13.78	42.80	20.20	-31.02	40.00	-8.02	40.50	48.52

Face-on/Face-off

Test results (9 kHz to 30 MHz)

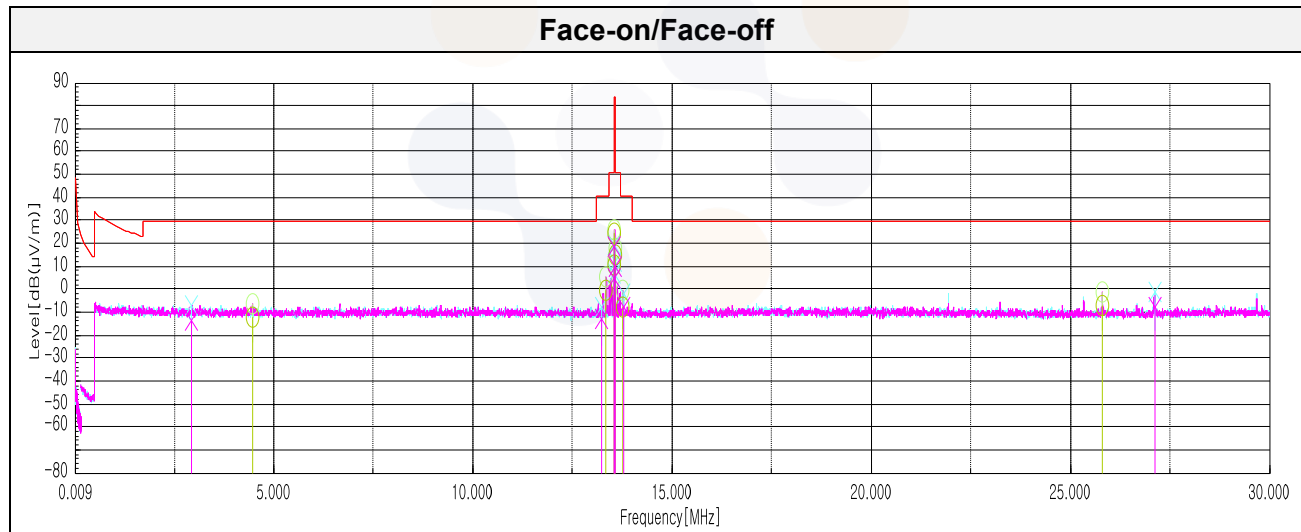
15.225 (d) 0.009-30 MHz

[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							
4.46	39.20	20.10	-31.66	40.00	-12.36	29.54	41.90
27.12	42.10	20.50	-30.56	40.00	-7.96	29.54	37.50

[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							
2.94	38.10	20.09	-31.73	40.00	-13.54	29.54	43.08
25.81	39.60	20.69	-30.54	40.00	-10.25	29.54	39.79



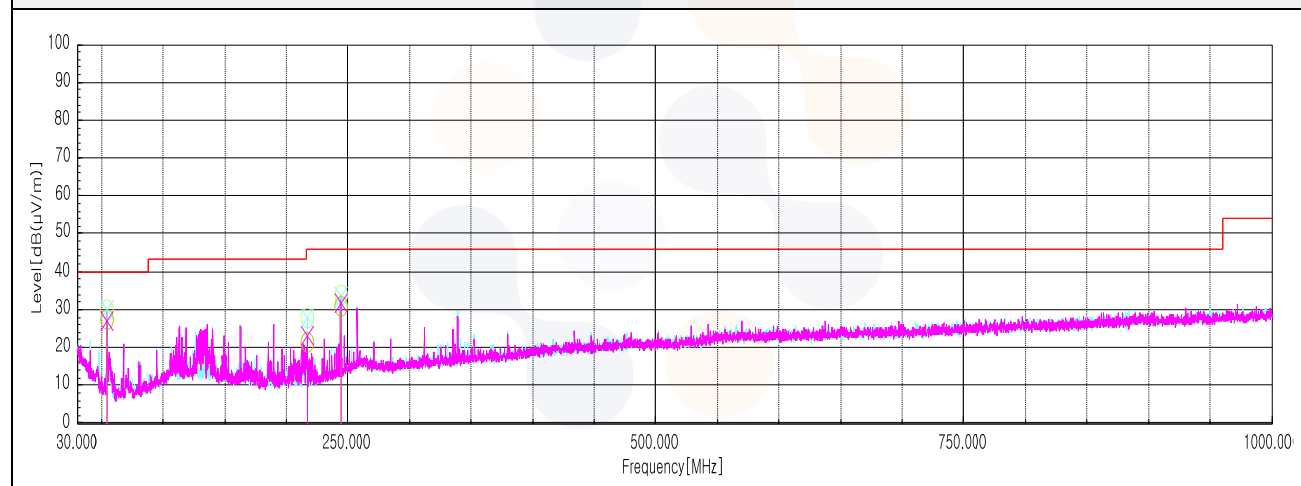
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**Test results (Below 1 000 MHz)****15.225 (d) 30-1000 MHz**

Frequency	Pol.	Reading	Antenna Factor	Amp. + Cable	Distance Factor	Result	Limit	Margin
(MHz)	(V/H)	(dB(μV))	(dB)	(dB)	(dB)	(dB(μV/m))	(dB(μV/m))	(dB)
Quasi peak data								
54.25	V	44.10	12.78	-29.82	-	27.06	40.00	12.94
54.25	H	44.50	12.78	-29.82	-	27.46	40.00	12.54
216.97	V	35.20	14.92	-26.92	-	23.20	46.00	22.80
216.97	H	33.40	14.92	-26.92	-	21.40	46.00	24.60
244.13 ¹⁾	V	40.50	17.68	-26.49	-	31.69	46.00	14.31
244.13 ¹⁾	H	39.60	17.68	-26.49	-	30.79	46.00	15.21

Horizontal/Vertical

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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	21.12.24
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
EMI TEST RECEIVER	R&S	ESCI7	100732	22.03.05

End of test report