

TEST REPORT



CTK Co., Ltd.
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Report No.:
CTK-2022-03391
Page (1) / (21) Pages

1. Applicant

- Name : Aptiv Connection Systems Korea LLC
- Address : 3, Hyundaikia-ro, Paltan-myeon, Hwaseong-si, Gyeonggi-do, Republic of Korea
- Date of Receipt : 2022-08-24

2. Manufacturer

- Name : Aptiv Connection Systems Korea LLC
- Address : 3, Hyundaikia-ro, Paltan-myeon, Hwaseong-si, Gyeonggi-do, Republic of Korea

3. Use of Report : For FCC Certification, For ISED Certification

4. Test Sample / Model : Wireless Power Charger / SX2 WPC with NFC

5. Date of Test : 2022-09-29 to 2022-12-14

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.225
RSS-Gen Issue 5, RSS-210 Issue 10

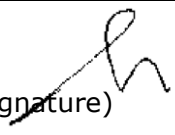
7. Testing Environment: refer to 11 pages to 18 pages

8. Test Results : Compliance

9. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
(Address : 5, Dongbu-ro 221beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea)

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

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Approval	Tested by	Technical Manager
	Bong-seok Kim: (Signature) 	Young-taek Lee: (Signature) 

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2022-12-29

CTK Co., Ltd.



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REPORT REVISION HISTORY

Date	Revision	Page No
2022-12-29	Issued (CTK-2022-03391)	all

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 CTK Co., Ltd. The Power Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2022-03391 Page (4) / (21) Pages	
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1. General Product Description

1.1 Client Information

Company	Aptiv Connection Systems Korea LLC
Contact Point	3, Hyundaiakia-ro, Paltan-myeon, Hwaseong-si, Gyeonggi-do, Republic of Korea
Contact Person	Name : Maeng, MinKyung E-mail : min-kyung.maeng@aptiv.com Tel : +82-31-350-1799

1.2 Product Information

FCC ID	2A29I-SX2WPCNFC
IC	29623-SX2WPCNFC
Product Description	Wireless Power Charger
Model name	SX2 WPC with NFC
Variant Model name	-
FVIN	N/A
Operating Frequency Range	13.56 MHz
RF Output Power	78.6 dBuV/m @ 3m
Antenna Type	PCB antenna(Loop antenna)
Power Source	DC 12 V

1.3 Antenna Information

☒	Integral antenna (antenna permanently attached)
☐	Temporary RF connector provided
☒	No temporary RF connector provided Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path.
☐	External antenna (dedicated antennas)

2. Accreditations

2.1 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A
KOREA	NRRA	KR0025

2.2 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

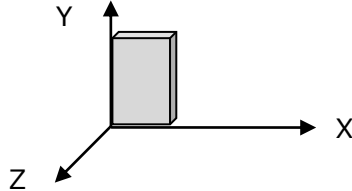
3. Test Specifications

3.1 Standards

FCC Part Section(s)	RSS Section(s)	Requirement(s)	Status (Note 1)	Report Clause
15.203	RSS-Gen 6.8	Antenna Requirement	C	1.3
15.215(c)	RSS-Gen 6.7	Emission Bandwidth	C	4.1
15.225 (a)(b)(c)(d)	RSS-210 Annex B.6 (a)(b)(c)(d)	Field strength emissions	C	4.2
15.225(e)	RSS-210 Annex B.6	Frequency tolerance	C	4.3
15.207	RSS-Gen 8.8	AC Power line Conducted Emissions	NA(Note 4)	-
<u>Note 1:</u> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
<u>Note 2:</u> The data in this test report are traceable to the national or international standards.				
<u>Note 3:</u> The sample was tested according to the following specification: ANSI C63.10-2013.				
<u>Note 4:</u> The equipment is operated on battery power only				

3.2 Mode of operation during the test

The Worst Case Measurement Configuration

Tests Item	Transmitter Radiated Emissions, Emission Bandwidth
Condition	Radiated measurement
User Position	☒ EUT will be placed in fixed position.
	☐ EUT will be placed in mobile position and operating multiple positions.
	☐ EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions.
Operating Mode	Continuous TX
EUT faces identified relative to view from receiving antenna	

3.3 Peripheral Devices

No.	Device	Manufacturer	Model No.	Serial No.
1	DC Power Supply	Topward Electric Instruments	6303D	711196

3.4 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
 Coverage factor $k = 2$, Confidence levels of 95 %

Test Item	Uncertainty
Radiated emissions	3.88 dB(C.L. : Approx. 95%, $k = 2$)
Frequency tolerance	10 Hz(C.L. : Approx. 95%, $k = 2$)

4. Technical Characteristic Test

4.1 Emission Bandwidth

Requirement

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.

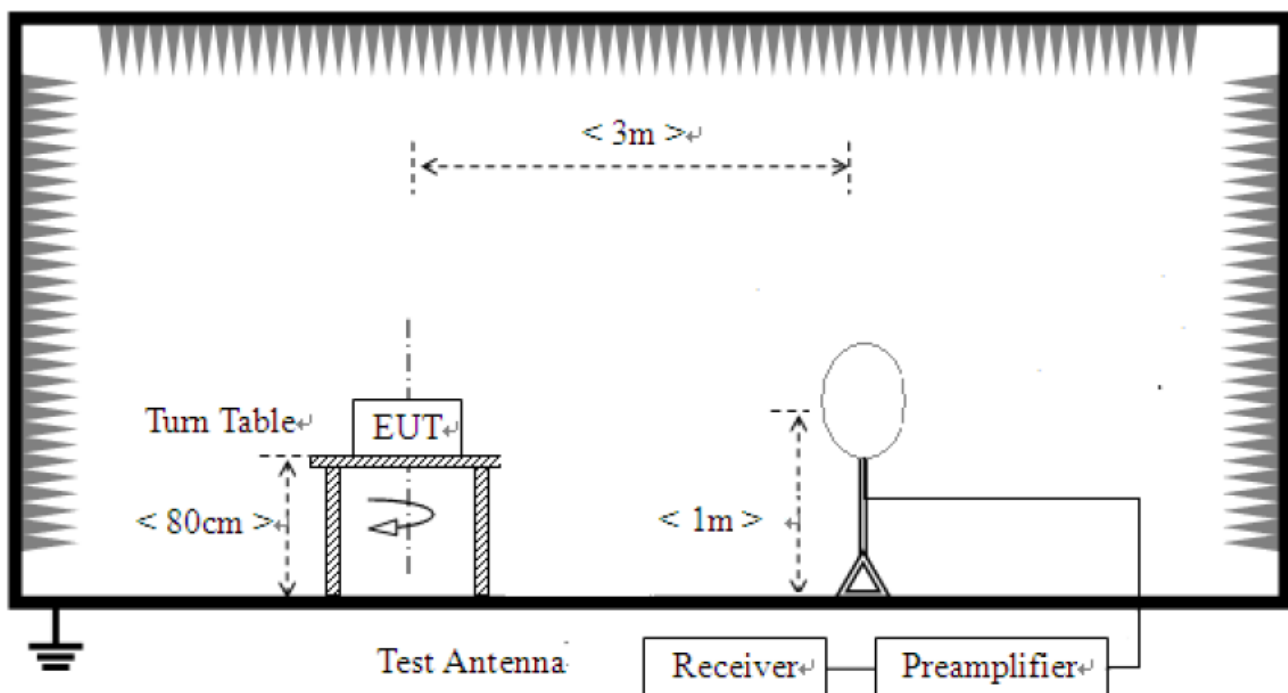
The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

Test Procedures

For the emission bandwidth refer ANSI C63.10-2013, clause 6.9(Occupied bandwidth).

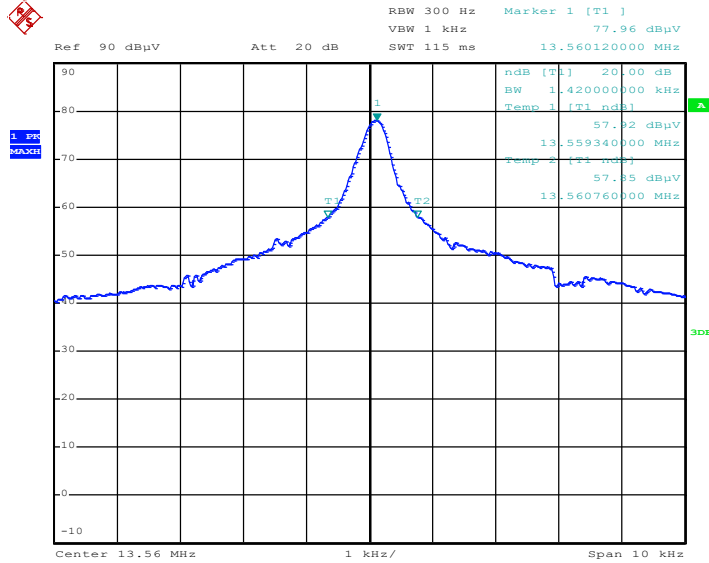
Test Setup



Test results

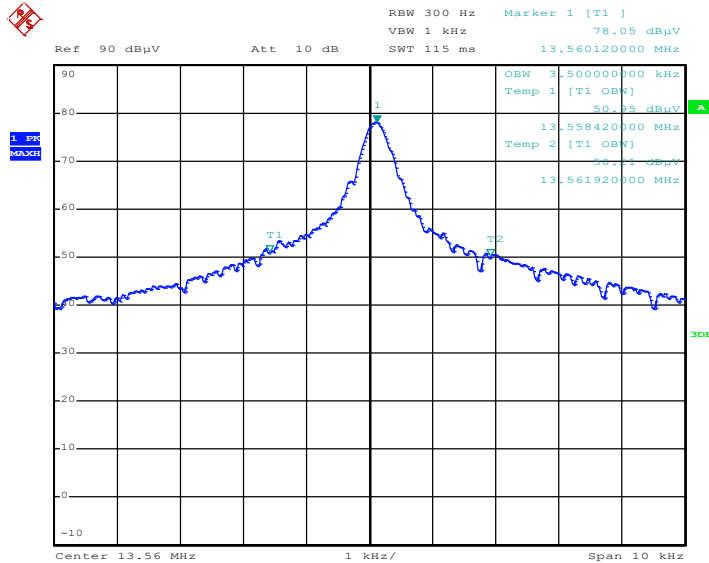
Emission Bandwidth	Result	Limit
20dB Bandwidth	1.42 kHz	N/A
99% Bandwidth	3.50 kHz	N/A

Emission Bandwidth Plot 20dB Bandwidth



Date: 9.DEC.2022 09:29:58

Emission Bandwidth Plot 99% Bandwidth



Date: 9.DEC.2022 09:36:56

4.2 Field strength emissions

Requirement

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

Frequency(MHz)	Field Strength uV/m@30m	Field Strength dBuV/m@30m	Field Strength dBuV/m@3m
13.553-13.567	15,848	84.0	124.0

- (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.

Frequency(MHz)	Field Strength uV/m@30m	Field Strength dBuV/m@30m	Field Strength dBuV/m@3m
13.410-13.553	334	50.5	90.5
13.567-13.710	334	50.5	90.5

- © 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.

Frequency(MHz)	Field Strength uV/m@30m	Field Strength dBuV/m@30m	Field Strength dBuV/m@3m
13.110-13.410	106	40.5	80.5
13.710-14.010	106	40.5	80.5

- (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(RSS-GEN).

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency(MHz)	Field Strength uV/m	Field Strength dBuV/m	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	48.5 – 13.8	300
0.490-1.705	24000/F(kHz)	33.8 – 23	30
1.705-30	30	29.5	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note : The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

Test Location

☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)

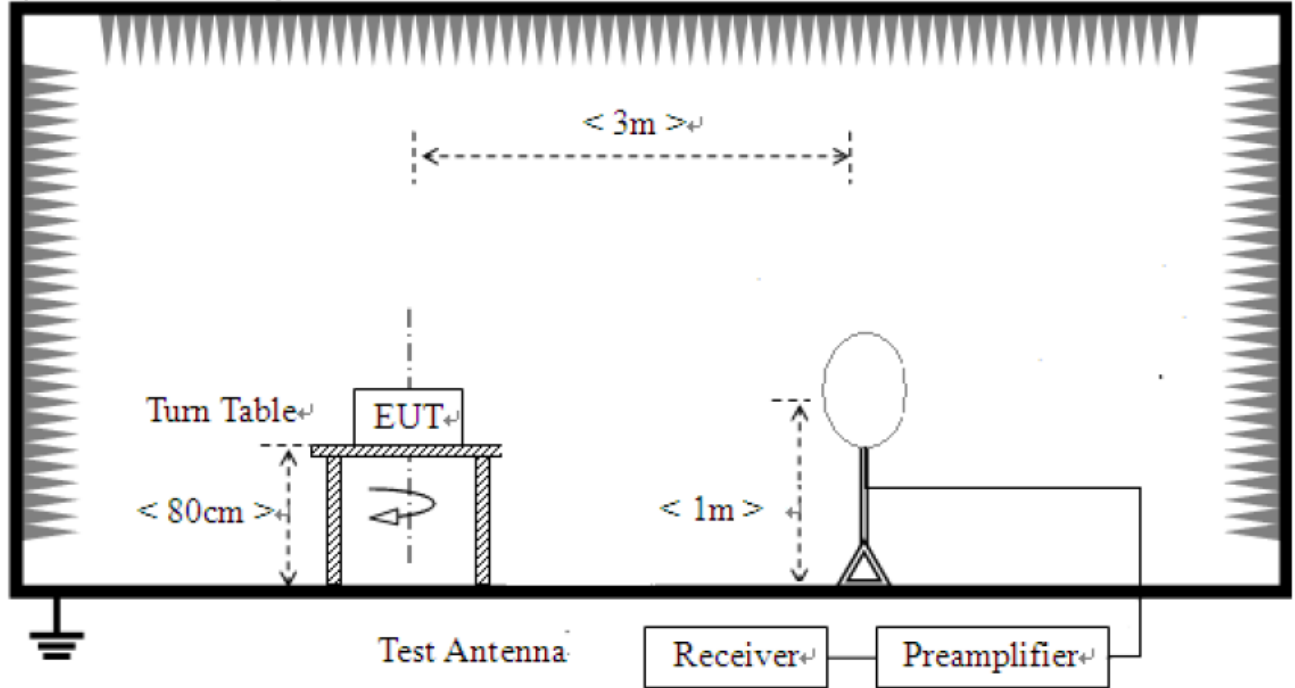
Test Procedures

Test Method	
☒	Refer as ANSI C63.10-2013, clause 6.4(Radiated emissions from unlicensed wireless devices below 30 MHz).
☒	Radiated emission tests shall be performed in the frequency range of 9 kHz to 30 MHz, using a calibrated loop antenna. When perpendicular to the ground plane, the lowest height of the magnetic antenna shall be 1 m above the ground and shall be positioned at the specified distance from the EUT. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
☒	The results shall be by using the square of an inverse linear distance extrapolation factor(40 dB/decade).
☒	Refer as ANSI C63.10-2013, clause 6.5(Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz).
☒	In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) is used. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.
☒	Emissions more than 20 dB below the limit do not need to be reported.

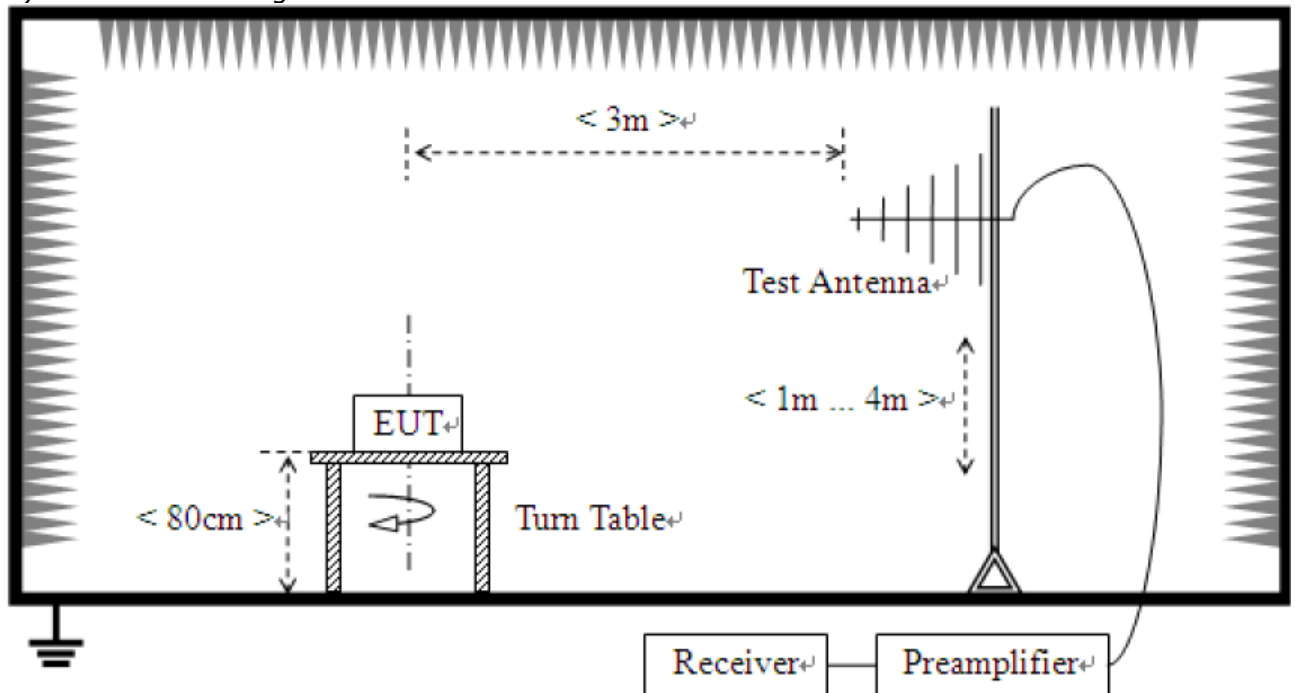
Measuring instrument Settings	
Frequency Range	9 kHz – 1 000 MHz
RBW	200 Hz (9 kHz – 150 kHz) 9 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1 000 MHz)
VBW	≥ RBW
Sweep time	auto couple
Detector function	CISPR quasi-peak(below 1 000 MHz)

Test Setup

- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



Test results

1) Radiated emissions within the band 13.110-14.010 MHz

Test Date

2022-09-29

Testing Environment

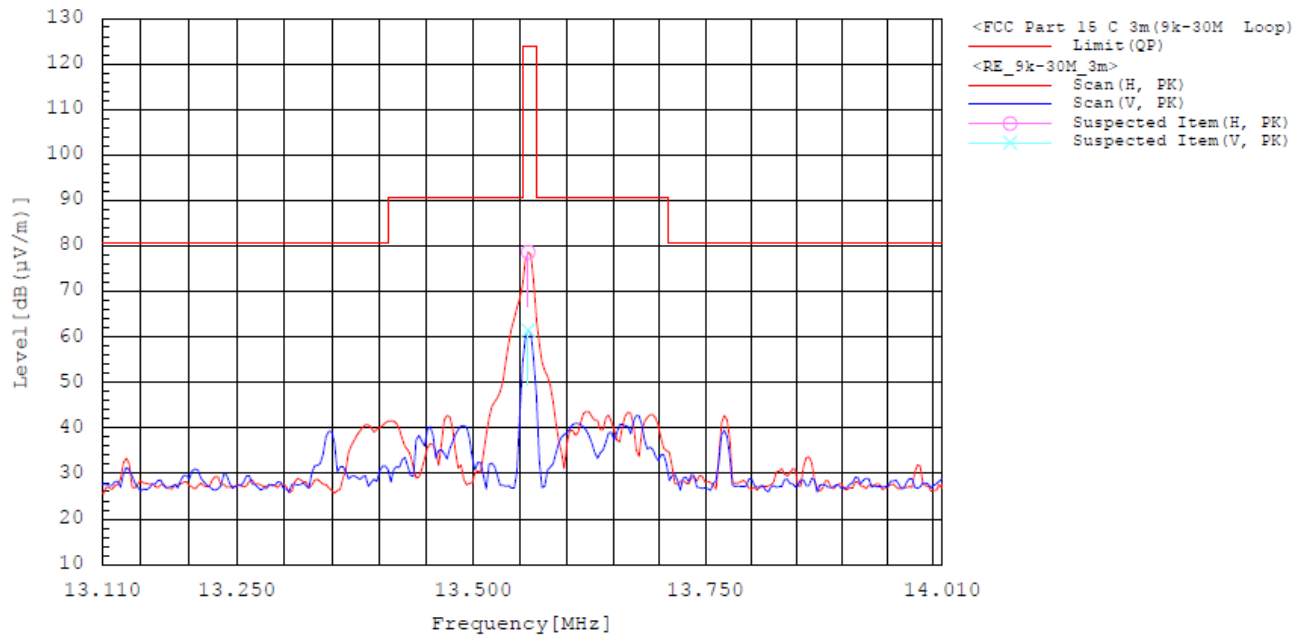
Temperature: (23 ± 1) °C

Relative Humidity: (54 ± 3) % R.H.

The requirements are:

☒ Complies

Test Model : SX2 :
Test Mode : RFID :
Tester : BS KIM :
Date : 29 September, 2022 13:43 :
:



No.	Frequency [MHz]	Reading [dBuV]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin[dB]	Remark
1	13.56	52.1	26.5	78.6	124.0	45.4	

Remark :

1. Result = Reading + c.f(correction factor)
2. Correction factor : Antenna factor, Cable loss, 6 dB attenuator
3. The test result in peak detector is less than quasi-peak limit.

2) Field strength of any emissions appearing outside of the 13.110-14.010 MHz

Frequency range : 9 kHz – 13.110 MHz

Test Date

2022-09-29

Testing Environment

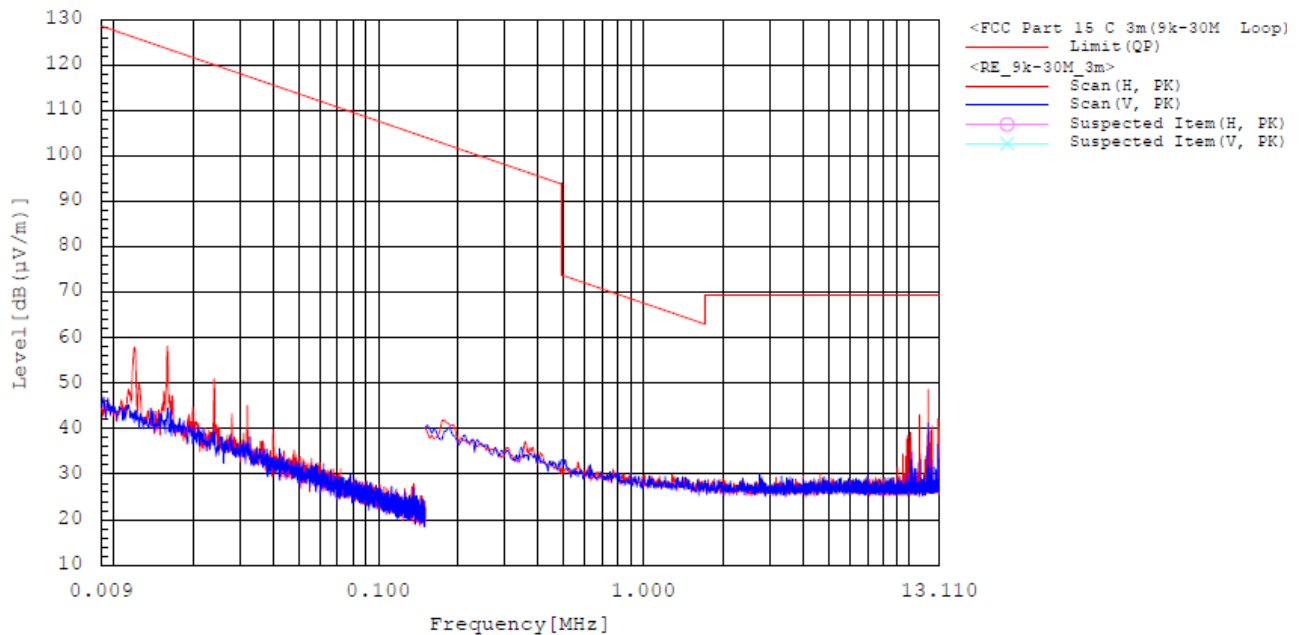
Temperature: (23 ± 1) °C

Relative Humidity: (54 ± 3) % R.H.

The requirements are:

☒ Complies

Test Model : SX2 :
Test Mode : RFID :
Tester : BS KIM :
Date : 29 September, 2022 13:43 :
: :



Remark :

1. Result = Reading + c.f(correction factor)
2. Correction factor : Antenna factor, Cable loss, 6 dB attenuator
3. Emissions more than 20 dB below the limit do not need to be reported.

Frequency range : 14.010 MHz – 30 MHz

Test Date

2022-09-29

Testing Environment

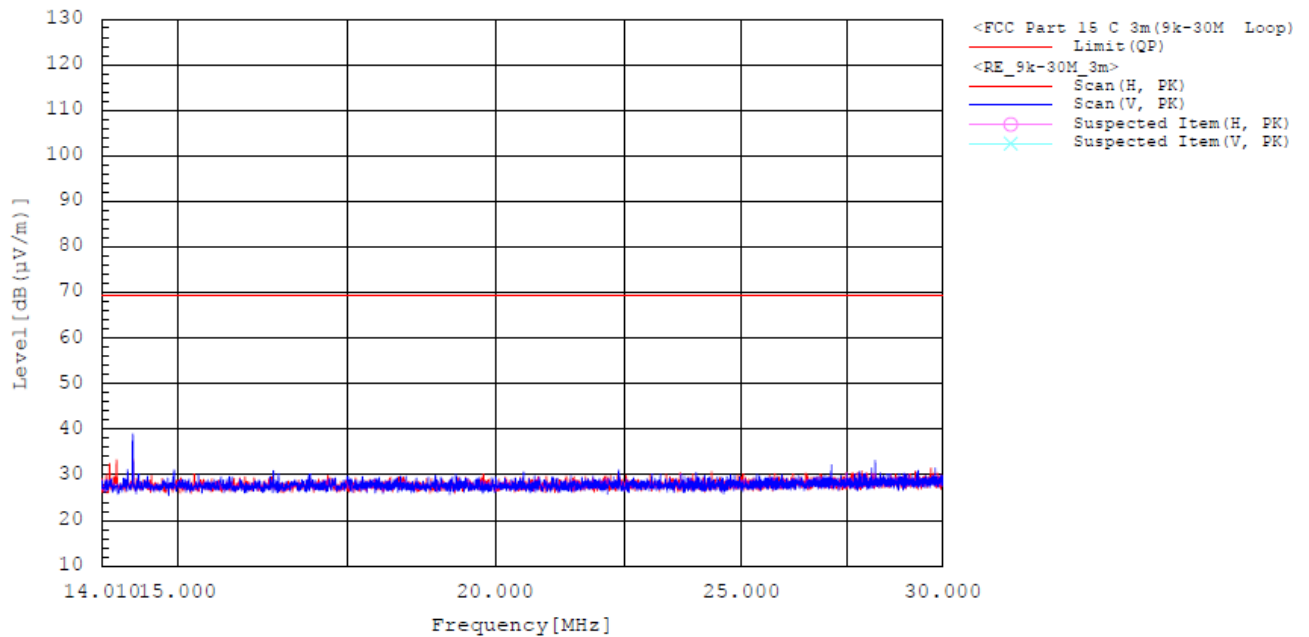
Temperature: (23 ± 1) °C

Relative Humidity: (54 ± 3) % R.H.

The requirements are:

☒ Complies

Test Model : SX2 :
Test Mode : RFID :
Tester : BS KIM :
Date : 29 September, 2022 13:43 :
: :



Remark :

1. Result = Reading + c.f(correction factor)
2. Correction factor : Antenna factor, Cable loss, 6 dB attenuator
3. Emissions more than 20 dB below the limit do not need to be reported.

3) Radiated emissions in the range of 30 MHz to 1 000 MHz band

Test Date

2022-12-14

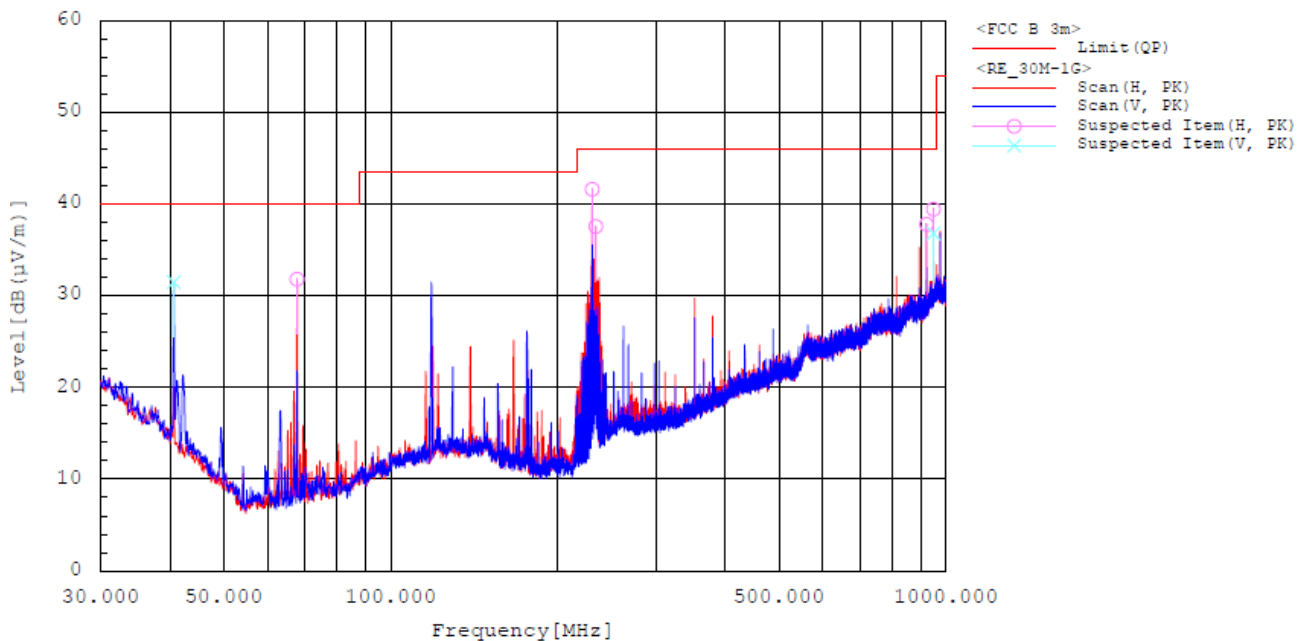
Testing Environment

Temperature: (21± 1) °C

Relative Humidity: (40 ± 3) % R.H.

The requirements are:

☒ Complies



No.	Frequency [MHz]	Pol.	Reading [dBuV]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin[dB]	Remark
1	40.670	V	43.7	-12.2	31.5	40.0	8.5	
2	67.733	H	50.7	-18.9	31.8	40.0	8.2	
3	230.499	H	55.3	-13.7	41.6	46.0	4.4	
4	233.894	H	50.7	-13.2	37.5	46.0	8.5	
5	922.109	H	33.3	4.5	37.8	46.0	8.2	
6	949.269	H	33.7	5.7	39.4	46.0	6.6	
7	949.269	V	31.1	5.7	36.8	46.0	9.2	

Remark :

1. Result = Reading + c.f(Correction factor)
2. Correction factor : Antenna factor, Cable loss, 6 dB attenuator, Amp Gain
3. The test result in peak detector is less than quasi-peak limit.

4.3 Frequency Stability

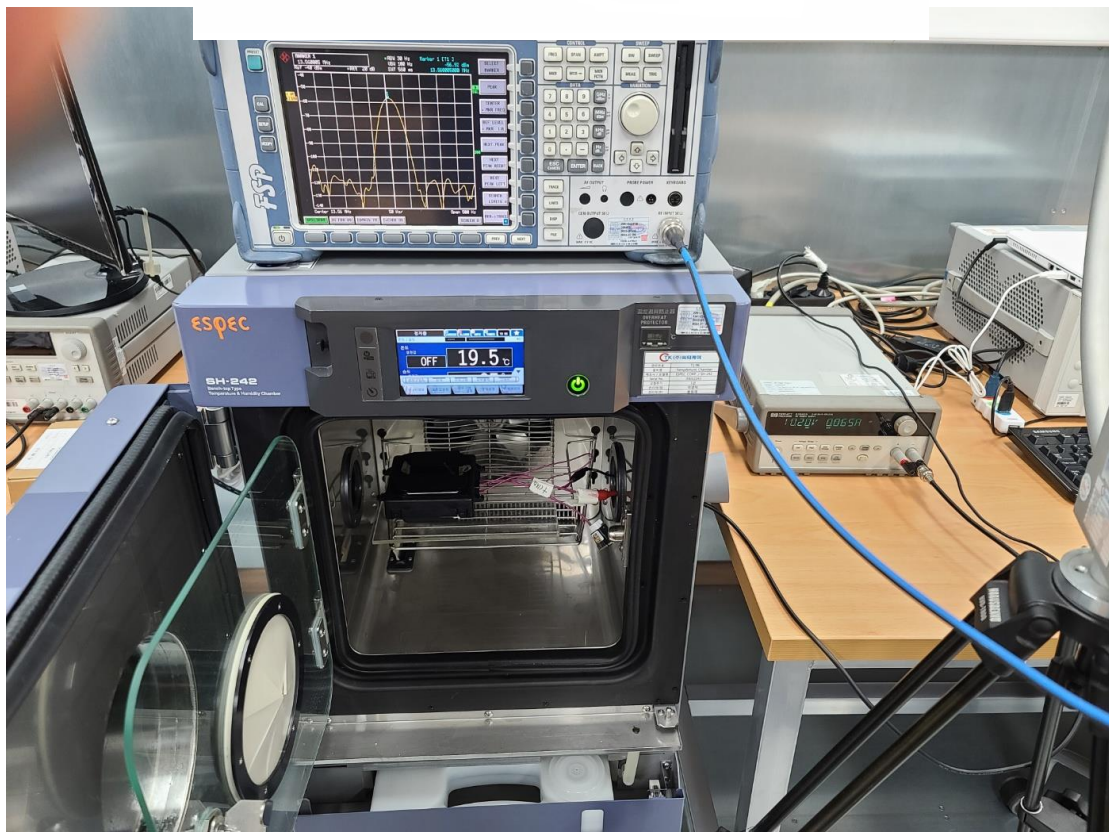
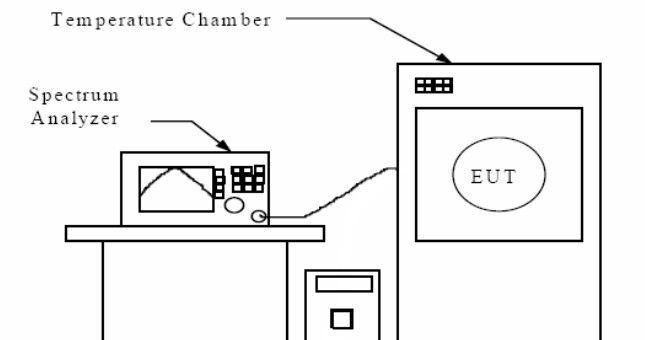
Requirement

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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.

Test Procedures

For the emission bandwidth refer ANSI C63.10-2013, clause 6.8(Frequency stability tests).

Test Setup



Test Results

The requirements are:

☒ Complies

Condition	Measurement Frequency (MHz)				Frequency Stability (ppm)			
	Startup	2 min	5 min	10 min	Start-up	2 min	5 min	10 min
Temp. 50℃	13.559940	13.559926	13.559926	13.559926	-5.16	-6.19	-6.19	-6.19
Temp. 40℃	13.559964	13.559940	13.559940	13.559940	-3.39	-5.16	-5.16	-5.16
Temp. 30℃	13.560001	13.559981	13.559972	13.559969	-0.66	-2.14	-2.80	-3.02
Temp. 20℃	13.560010	13.560010	13.560010	13.560010	0	0	0	0
Temp. 10℃	13.560066	13.560057	13.560054	13.560052	4.13	3.47	3.24	3.10
Temp. 0℃	13.560090	13.560086	13.560083	13.560081	5.90	5.60	5.38	5.24
Temp. -10℃	13.560089	13.560092	13.560092	13.560092	5.83	6.05	6.05	6.05
Temp. -20℃	13.560072	13.560074	13.560074	13.560075	4.57	4.72	4.72	4.79
Voltage 85%	13.560004	13.560004	13.560004	13.560005	-0.44	-0.44	-0.44	-0.37
Voltage 115%	13.560002	13.560002	13.560002	13.560002	-0.59	-0.59	-0.59	-0.59
Limit(ppm)	-				100			

APPENDIX A – Test Equipment Used For Tests

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	EMI Test Receiver	R&S	ESW44	102039	2022-05-04	2023-05-04
2	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2022-04-15	2024-04-15
3	BILOG ANTENNA	TESEQ	CBL6111D	60654	2021-09-03	2023-09-03
4	AMPLIFIER	SONOMA INSTRUMENT	310N	411011	2022-08-10	2023-08-10
5	6dB Attenuator	PASTERNAK	PE7AP006-06	L20210504000023	2022-08-10	2023-08-10
6	Spectrum Analyzer	R&S	FSP	100401	2022-01-05	2023-01-05
7	Temp&Humi Chamber	ESPEC CORP	SH-242	93008423	2022-05-02	2023-05-02

No.	Cable	Manufacturer	Model No.	Serial No.	Check Date
1	RF Cable (1 GHz below Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2022-09-21
2	RF Cable (1 GHz below Radiated)	CANARE	L-5D2W	N/A	2022-09-21

-END-