

TEST REPORT



CTK Co., Ltd.
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Report No.:
CTK-2018-00831
Page (1) / (47) Pages

1. Client

- Name : Samsung Electronics Co Ltd
- Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey
- Date of Receipt : 2018-03-19

2. Manufacturer

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea, 16677

3. Use of Report : For FCC & IC Certification

4. Test Sample / Model: Audio Transceiver / WSN720S

5. Date of Test : 2018-03-20 to 2018-04-03

6. Test Standard(method) used : FCC 47 CFR part 15 subpart E 15.407 RSS-247 Issue 2

7. Testing Environment: Temp.: (23 ± 1) °C, Humidity: (48 ± 5) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by	Technical Manager
	Bongseok Kim: (Signature)	Young-taek Lee: (Signature)

2018-04-03

Republic of KOREA **CTK Co., Ltd.**



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REPORT REVISION HISTORY

Date	Revision	Page No
2018-04-03	Issued (CTK-2018-00831)	all

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1.0 General Product Description

1.1 Client Information

Company	Samsung Electronics Co., Ltd.
Contact Point	19 Chapin Rd., Building D, Pine Brook, New Jersey
Contact Person	Name : Minhyung Cho E-mail : mh719.cho@samsung.com Tel : +82-31-277-2688

1.2 Product Information

FCC ID	A3LWSN720S
IC	649E-WSN720S
Product Description	Audio Transceiver
Model name	WSN720S
Operating Frequency	5 180 MHz - 5 240 MHz(3 channels) 5 736 MHz - 5 814 MHz(3 channels)
RF Output Power	5 180 MHz - 5 240 MHz : 14.66 dBm (29.24 mW) 5 736 MHz - 5 814 MHz : 8.74 dBm (7.48 mW)
Antenna type	PCB Antenna
Antenna gain	5.2 GHz band : 3.7 dBi (Antenna A), 4.3 dBi (Antenna B) 5.8 GHz band : 4.4 dBi (Antenna A), 4.2 dBi (Antenna B)
Type of Modulation	QPSK
Power Source	DC 5.0 V
Firmware Version Id Number(FVIN)	TX(CU) : ver 2** RX(MU) : ver 1**
Test Software(Version)	MP Tool(1.0.0.1)

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND7253QRM
AC/DC Adapter	HP	HSTNN-LA40	854054-001

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2.0 Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
CANADA	ISED	ISED EMI (3/10m test site)	8737A-2	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	NRRA	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.3 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.

3.0 Test Specifications

3.1 Standards

FCC Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
15.407(e)	6 dB Bandwidth	C	Conducted
15.407	26 dB Bandwidth and 99% Bandwidth	C	
15.407(a)(1)	Conducted Output Power	C	
15.407(a)(1)	Power Spectral Density	C	
15.407(g)	Frequency Stability	C	
15.407 (b)	Undesirable emission	C	Radiated
15.209, 15.407 (b)(5),(6)	Radiated Spurious Emission	C	
15.207	AC Conducted Emissions	C	Line Conducted
<i>Note 1:</i> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable			
<i>Note 2:</i> The data in this test report are traceable to the national or international standards.			

ISED Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
RSS-247 6.2.4.1	6 dB Bandwidth	C	Conducted
-	26 dB Bandwidth and 99% Bandwidth	C	
RSS-247 6.2.1.1, 6.2.4.1	Conducted Output Power	C	
RSS-247 6.2.1.1, 6.2.4.1	Power Spectral Density	C	
RSS-247 6.2.1.2, 6.2.4.2	Undesirable emission	C	Radiated
RSS-Gen 6.13	Radiated Spurious Emission	C	
RSS-Gen 5	Receiver Spurious Emissions	C	
RSS-Gen 8.8	AC Conducted Emissions	C	Line Conducted
<i>Note 1:</i> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable			
<i>Note 2:</i> The data in this test report are traceable to the national or international standards.			

The sample was tested according to the following specification:
FCC Part 15.407, ANSI C63.10-2013, RSS-247 Issue 2

The tests were performed according to the method of measurements prescribed in
KDB No.789033.

3.2 Mode of operation during the test

The UUT is operated in a manner representative of the typical of the equipments.
During at testing, system components were manipulated within the confines of typical usage to maximize each emission.
The results are only attached worst cases.

Test Frequency

Frequency Band	Lowest channel	Middle channel	Highest channel
5.2 GHz	5 180 MHz	5 210 MHz	5 240 MHz
5.8 GHz	5 736 MHz	5 762 MHz	5 814 MHz

Test antenna

Antenna 1	Antenna 2
ANT-A	ANT-B

Duty cycle

Test item	Duty cycle
Radiated emission	19 %(On time : 0.48 ms, 2.04 ms)
Conducted emission	100 %

3.3 Maximum Measurement Uncertainty

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

Description	Uncertainty
Conducted RF Output Power	± 1.5 dB
Power Spectral Density	± 1.5 dB
Occupied Bandwidth	± 0.1 MHz
Unwanted Emission(conducted)	± 3.0 dB
Radiated Emissions ($f \leq 1$ GHz)	± 4.0 dB
Radiated Emissions ($f > 1$ GHz)	± 5.0 dB

4.0 Technical Characteristic Test

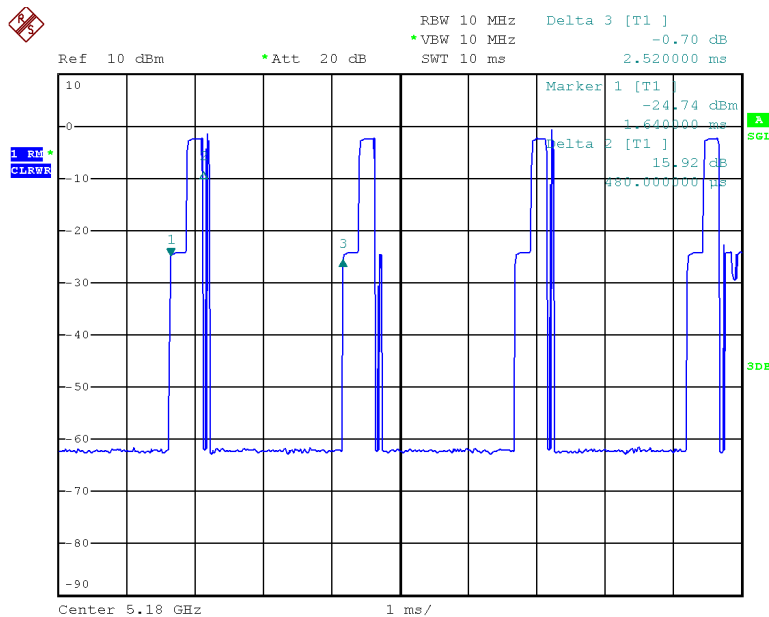
4.1 ON Time, Duty Cycle

Test Procedures

KDB 789033 Zero-Span Spectrum Analyzer Method.

Test Data:

ON Time (ms)	Period (ms)	TX OFF (ms)	Duty Cycle (linear)	Duty Cycle (%)
0.48	2.52	2.04	0.19	19.0



Date: 29.MAR.2018 23:11:12

4.2 26dB Bandwidth and 99 % Bandwidth

Test Procedures(ANSI C63.10-2013 6.9.2)

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 26 dB relative to the maximum level measured in the fundamental emission.

Test Procedures(ANSI C63.10-2013 6.9.3)

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :

Center frequency = the highest, middle and the lowest channels

- a) RBW = approximately 1 % of the emission bandwidth
- b) VBW $\geq$ RBW
- c) Detector = peak
- d) Trace mode = Max hold
- e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Limit :

NA

Test Data:

ANT-A

Frequency Band	Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	99% Bandwidth [MHz]	Result
5.2 GHz	Low	5 180	22.09	15.48	Complies
	Middle	5 210	21.64	15.47	Complies
	High	5 240	19.12	15.44	Complies
5.8 GHz	Low	5 736	17.08	14.01	Complies
	Middle	5 762	17.10	14.08	Complies
	High	5 814	17.06	14.00	Complies

ANT-B

Frequency Band	Channel	Frequency [MHz]	26 dB Bandwidth [MHz]	99% Bandwidth [MHz]	Result
5.2 GHz	Low	5 180	21.64	15.47	Complies
	Middle	5 210	17.41	15.43	Complies
	High	5 240	21.69	15.46	Complies
5.8 GHz	Low	5 736	17.09	14.03	Complies
	Middle	5 762	17.04	14.00	Complies
	High	5 814	17.12	14.04	Complies

See next pages for actual measured spectrum plots.

ANT-A 5.2 GHz Band



ANT-B 5.2 GHz Band



ANT-A 5.8 GHz Band



ANT-B 5.8 GHz Band



4.3 6dB Bandwidth

Test Procedures(ANSI C63.10-2013 6.9.2)

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Settings :

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW $\geq 3 \times$ RBW
- c) Detector = peak
- d) Trace mode = Max hold
- e) Sweep = auto couple
- f) Allow trace to fully stabilize
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Limit :

6 dB Bandwidth > 500 kHz

Test Data:

ANT-A

Frequency Band	Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Result
5.2 GHz	Low	5 180	14.66	Complies
	Middle	5 210	14.79	Complies
	High	5 240	14.67	Complies
5.8 GHz	Low	5 736	9.83	Complies
	Middle	5 762	9.83	Complies
	High	5 814	9.83	Complies

ANT-B

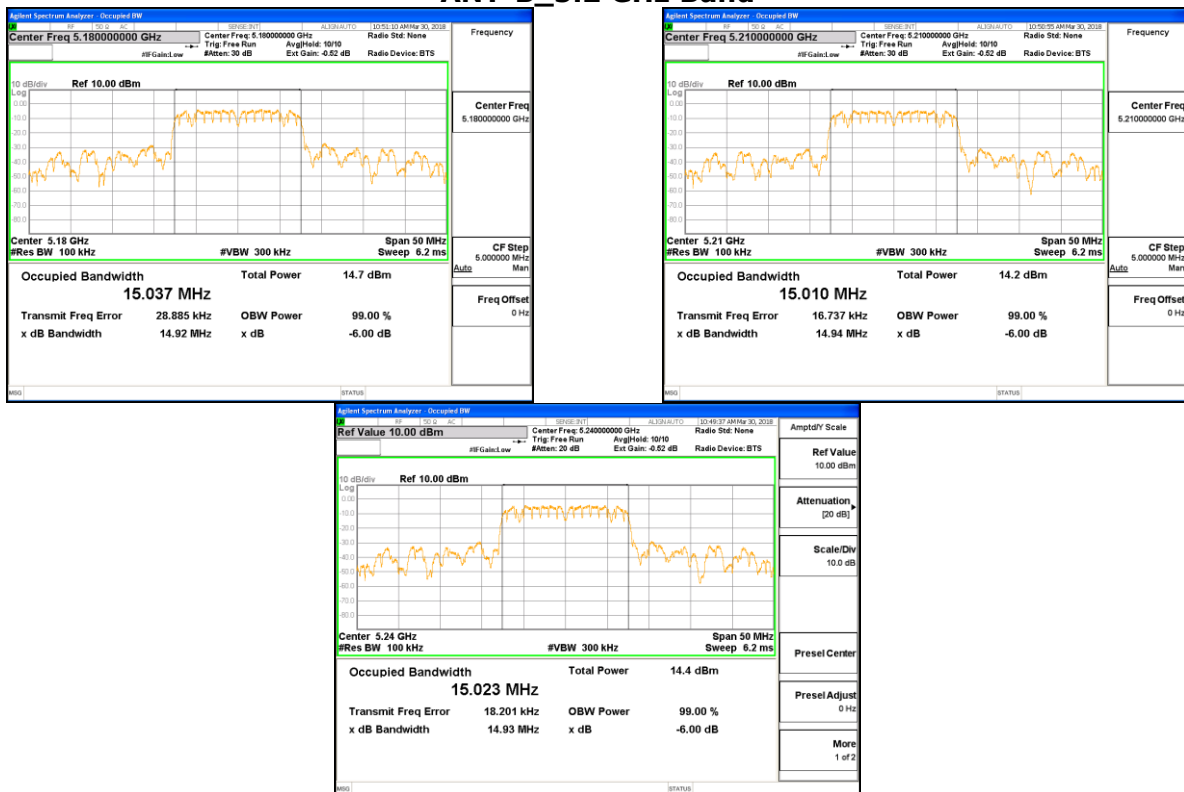
Frequency Band	Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Result
5.2 GHz	Low	5 180	14.92	Complies
	Middle	5 210	14.94	Complies
	High	5 240	14.93	Complies
5.8 GHz	Low	5 736	9.83	Complies
	Middle	5 762	9.83	Complies
	High	5 814	9.83	Complies

See next pages for actual measured spectrum plots.

ANT-A 5.2 GHz Band



ANT-B 5.2 GHz Band



ANT-A_5.8 GHz Band



ANT-B_5.8 GHz Band

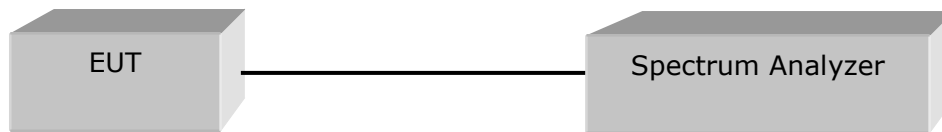


4.4 Maximum Conducted Output Power

Test Procedures

Maximum Conducted Output Power(KDB 789033, Method SA-1)

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.



Test Settings :

Center frequency = the highest, middle and the lowest channels

- a) RBW = 1 MHz
- b) VBW $\geq 3 \times$ RBW
- c) Sweep time = auto
- d) Detector = power averaging (rms)
- e) Trace mode = Average at least 100

Limit

5.2 GHz band : Not exceed $10+10\log(B) = 10+10\log(15.4) = 21.9$ dBm (155 mW)

5.8 GHz band : Not exceed 1 W (30 dBm)

Test Data

ANT-A

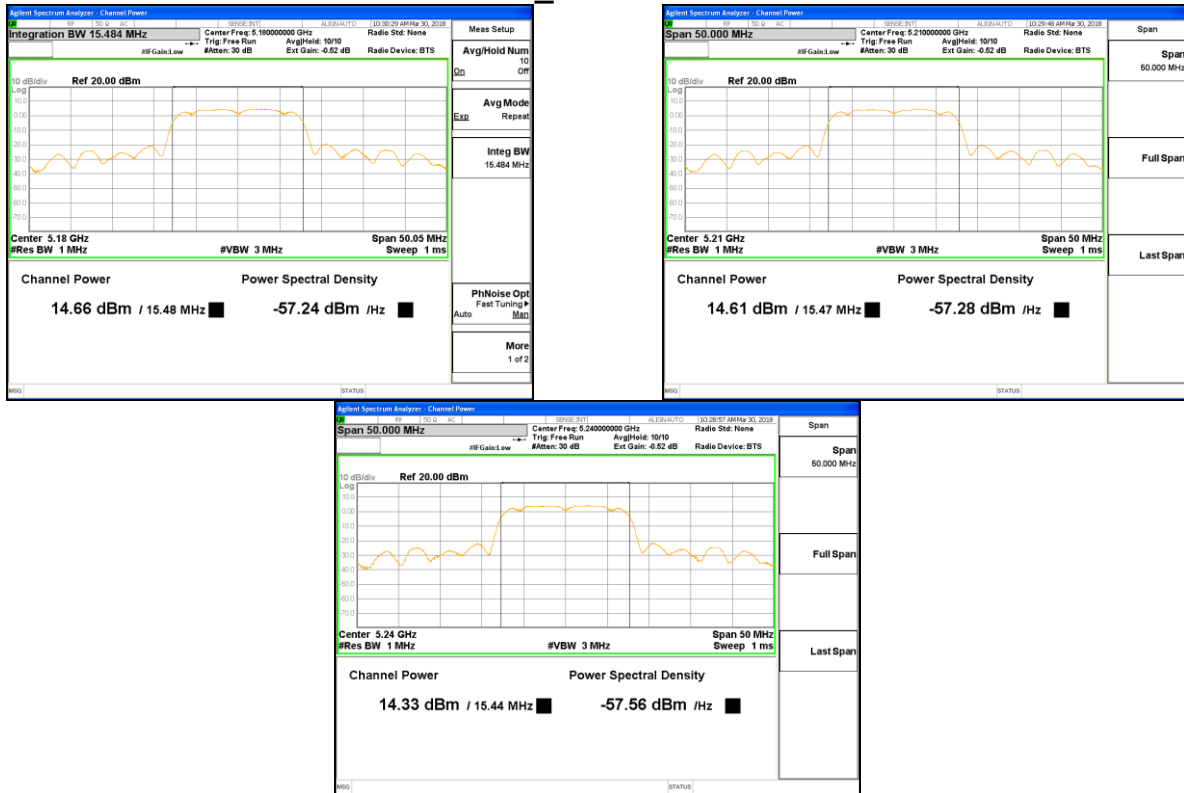
Frequency Band	Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
5.2 GHz	Low	5 180	14.66	21.9	Complies
	Middle	5 210	14.61	21.9	Complies
	High	5 240	14.33	21.9	Complies
5.8 GHz	Low	5 736	8.49	30	Complies
	Middle	5 762	7.24	30	Complies
	High	5 814	7.93	30	Complies

ANT-B

Frequency Band	Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
5.2 GHz	Low	5 180	14.55	21.9	Complies
	Middle	5 210	13.99	21.9	Complies
	High	5 240	14.50	21.9	Complies
5.8 GHz	Low	5 736	8.74	30	Complies
	Middle	5 762	8.16	30	Complies
	High	5 814	8.73	30	Complies

See next pages for actual measured spectrum plots.

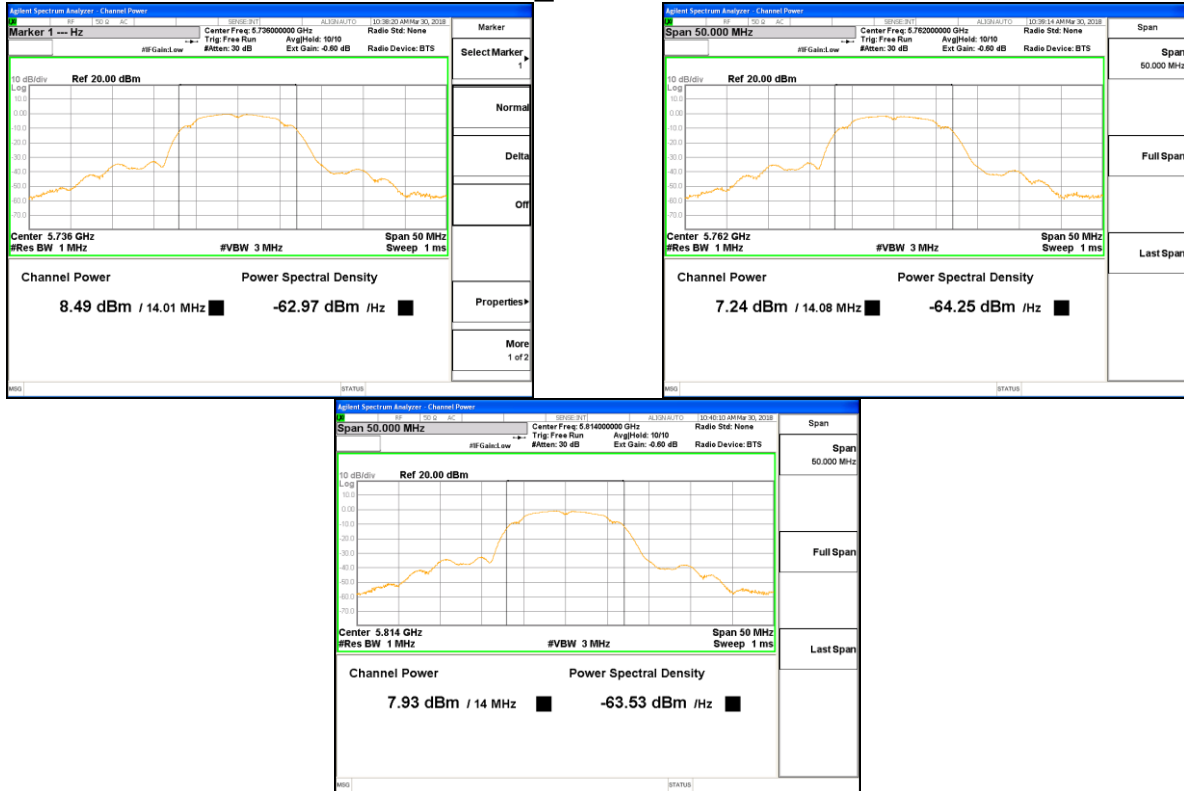
ANT-A 5.2 GHz Band



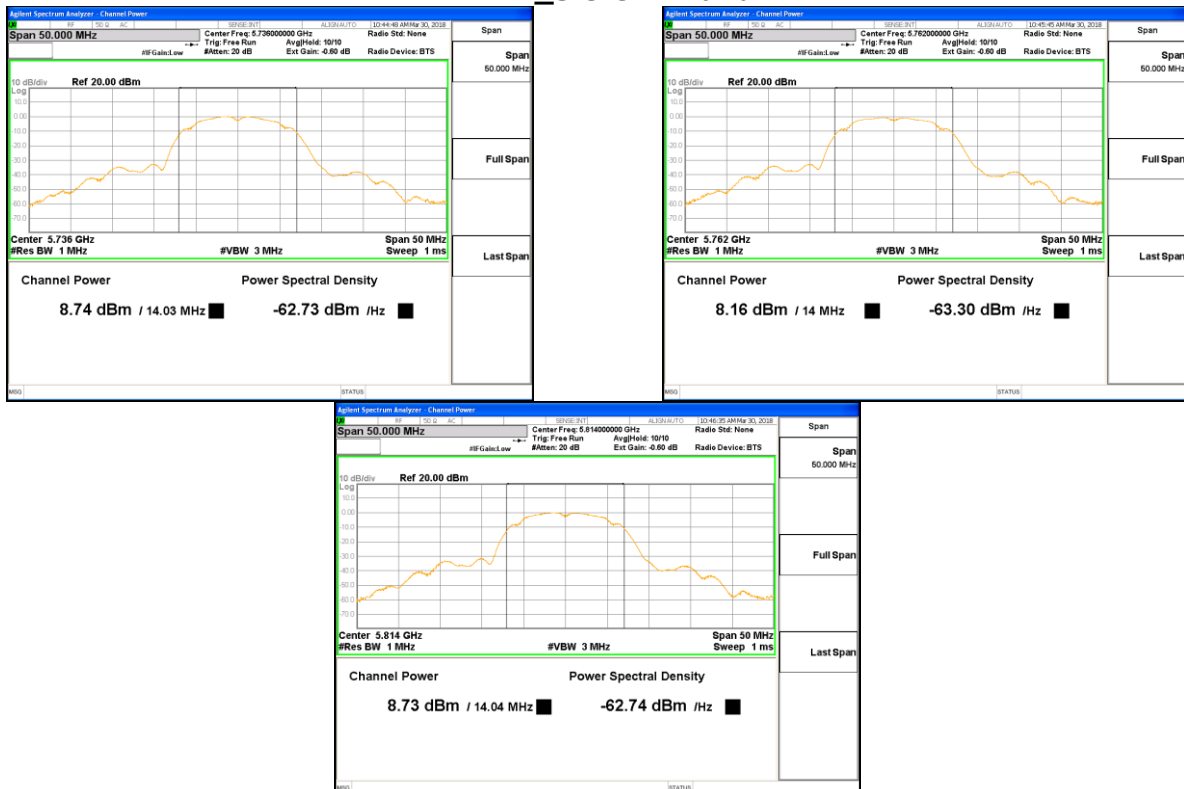
ANT-B 5.2 GHz Band



ANT-A 5.8 GHz Band



ANT-B 5.8 GHz Band



4.5 Power Spectral Density

Test Procedures

Maximum Power Spectral Density (KDB 789033, Method SA-1)

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Test Settings :

Center frequency = the highest, middle and the lowest channels

- a) RBW = 1 MHz, 500 KHz (UNII 3)
- b) VBW = 3 MHz, 1.5 MHz (UNII 3)
- c) Sweep time = auto
- d) Detector = power averaging (rms)
- e) Trace mode = Average at least 100

Limit

5.2 GHz band FCC : Not exceed 17 dBm in any 1 MHz band

5.2 GHz band IC : Not exceed 10 dBm in any 1 MHz band(e.i.r.p.)

5.8 GHz band : Not exceed 30 dBm in any 500 kHz band

Test Data

ANT-A

Frequency Band	Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
5.2 GHz	Low	5 180	4.73	10	Complies
	Middle	5 210	4.13	10	Complies
	High	5 240	4.26	10	Complies
5.8 GHz	Low	5 736	-2.76	30	Complies
	Middle	5 762	-4.16	30	Complies
	High	5 814	-3.45	30	Complies

Remark

5.2 GHz band Antenna A gain : 3.7 dBi

ANT-B

Frequency Band	Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
5.2 GHz	Low	5 180	4.39	10	Complies
	Middle	5 210	4.06	10	Complies
	High	5 240	4.29	10	Complies
5.8 GHz	Low	5 736	-2.57	30	Complies
	Middle	5 762	-3.65	30	Complies
	High	5 814	-2.94	30	Complies

Remark

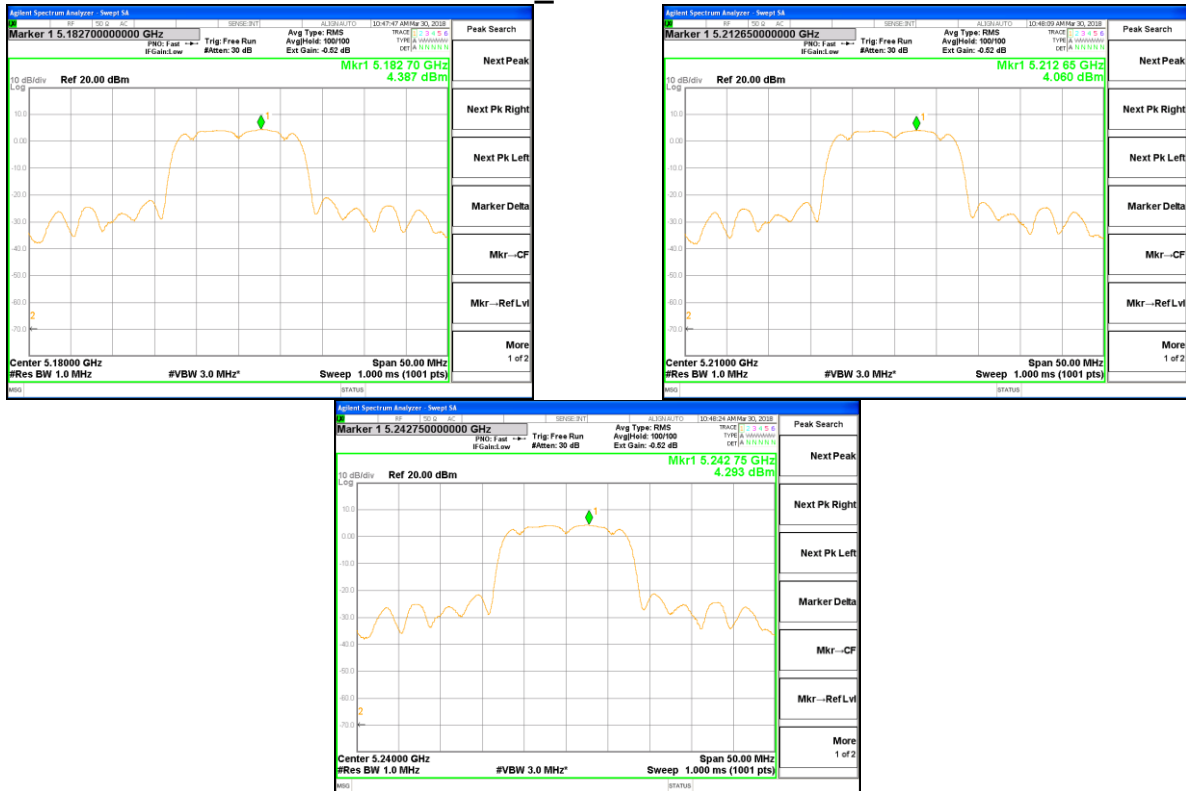
5.2 GHz band Antenna B gain : 4.3 dBi

See next pages for actual measured spectrum plots.

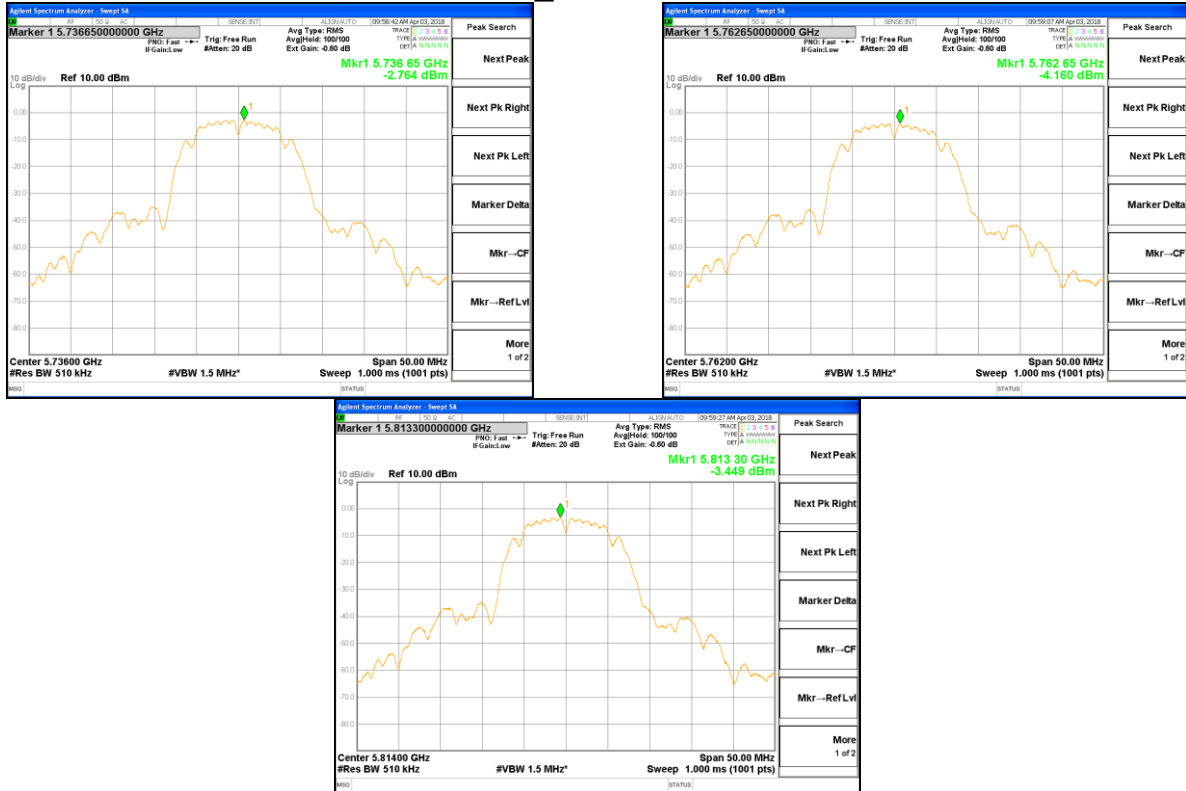
ANT-A 5.2 GHz Band



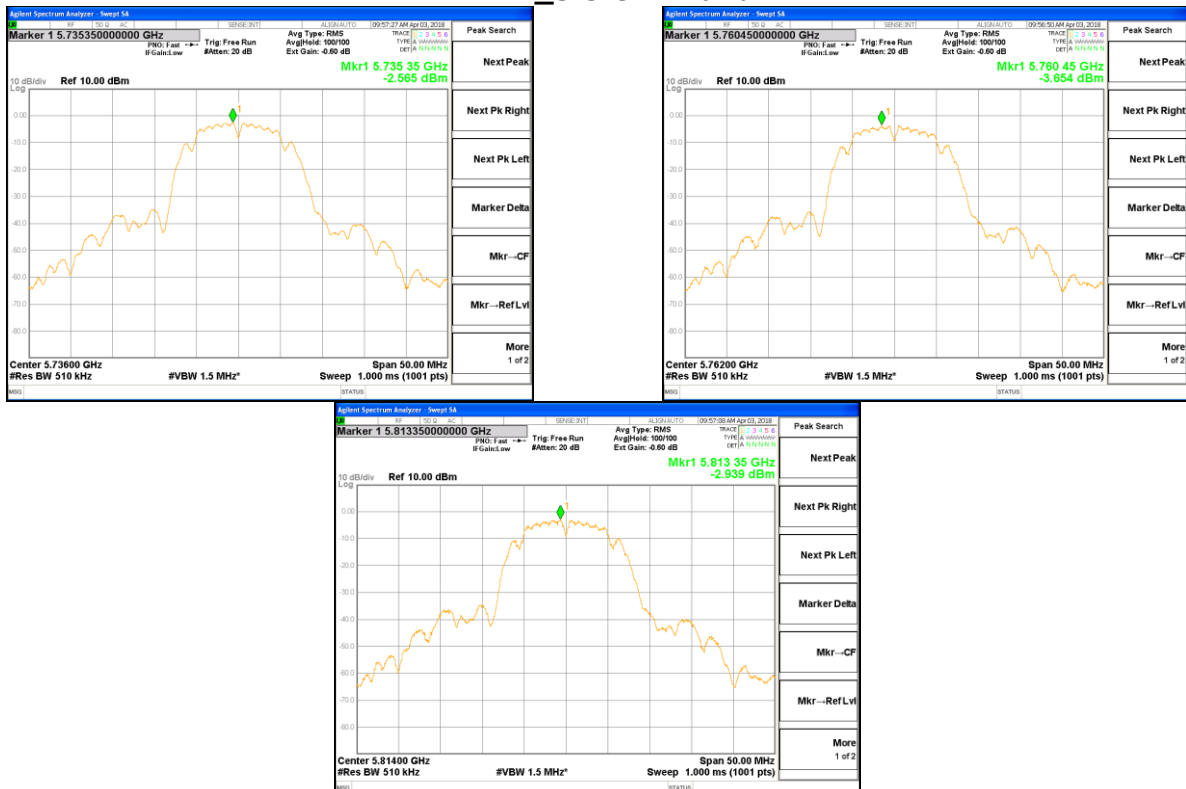
ANT-B 5.2 GHz Band



ANT-A_5.8 GHz Band



ANT-B_5.8 GHz Band



4.6 Frequency Stability

Test Procedures

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -20 °C and +50 °C (Declaration by the Manufacturer). The temperature was incremented by 10 °C intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.

Limit

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user manual.

Frequency Error (kHz)								
Frequency [MHz]	Temperature							
	-20 °C	-10 °C	0 °C	10 °C	20 °C	30 °C	40 °C	50 °C
5 180	40.79	41.88	36.24	17.65	20.35	8.54	8.24	19.43
5 210	42.45	43.48	36.69	20.06	20.94	10.33	9.62	19.24
5 240	42.09	43.18	36.96	20.19	20.46	8.46	9.88	18.78
5 736	43.56	43.82	36.79	21.42	19.22	8.76	7.59	17.64
5 762	42.47	44.17	37.94	22.79	19.38	7.79	8.34	16.24
5 814	42.90	43.78	37.19	22.11	20.90	8.66	6.81	15.05

Note :

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature range as tested.

This modular transmitter have its own power supply regulation.

4.7 Unwanted Emissions

Test Location

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

Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. 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.

Test Settings:

Frequency Range = 9 kHz ~ 40 GHz

- a) RBW = 1 MHz for $f \geq 1$ GHz, 120 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz
- b) VBW $\geq$ RBW
- c) Sweep time = auto

Limit

- 15.209(a)

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Deasurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	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.

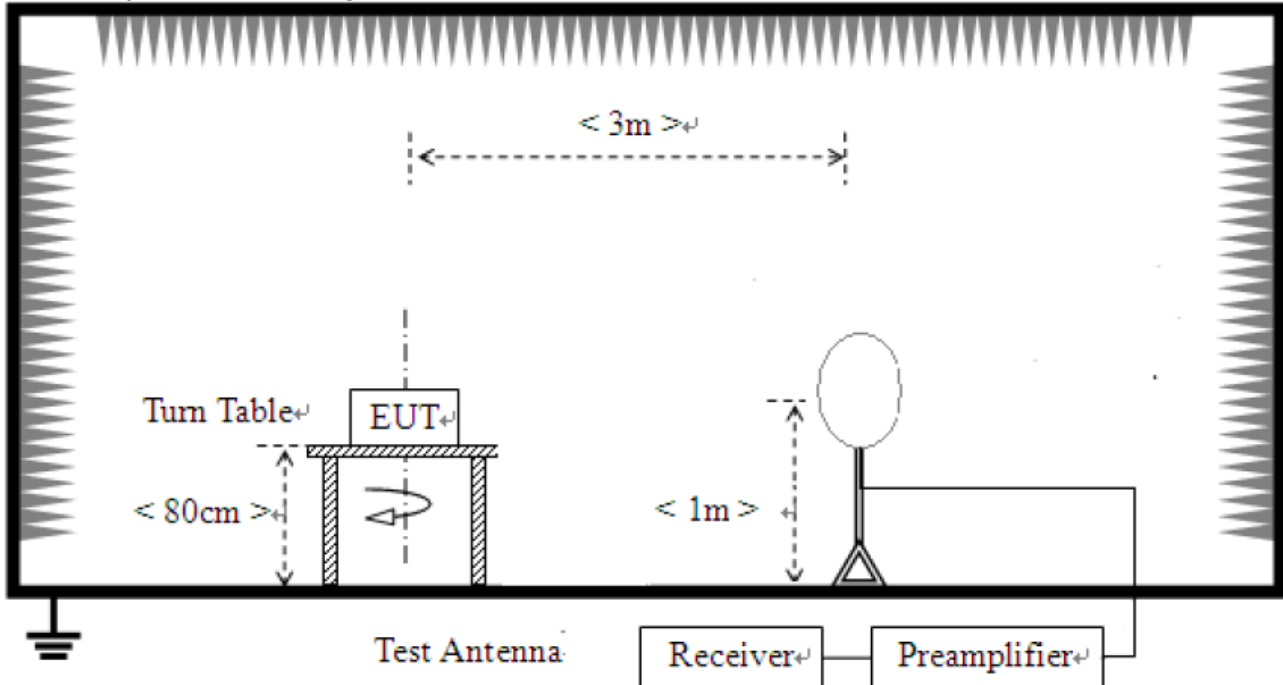
- 15.407, KDB 789033

E.I.R.P -27 dBm/MHz

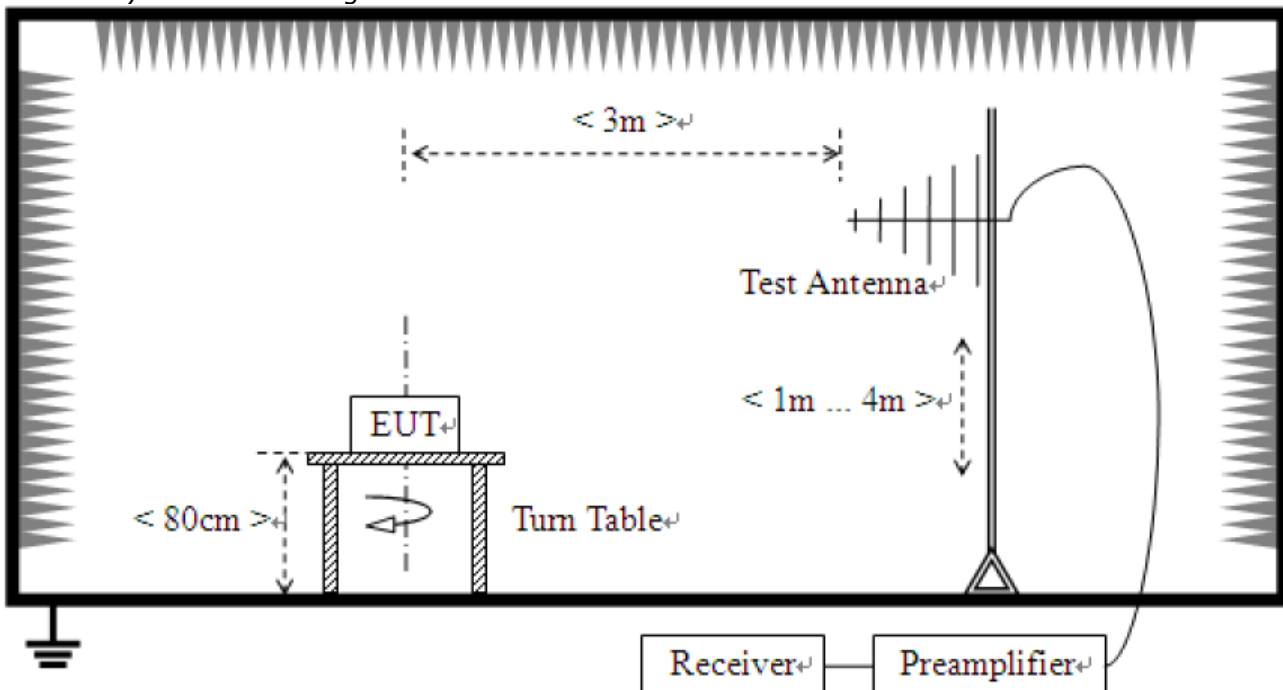
$E[\text{dBuV/m}] = \text{EIRP}[\text{dBm}] + 95.2$, for $d = 3\text{m}$

Test Setup:

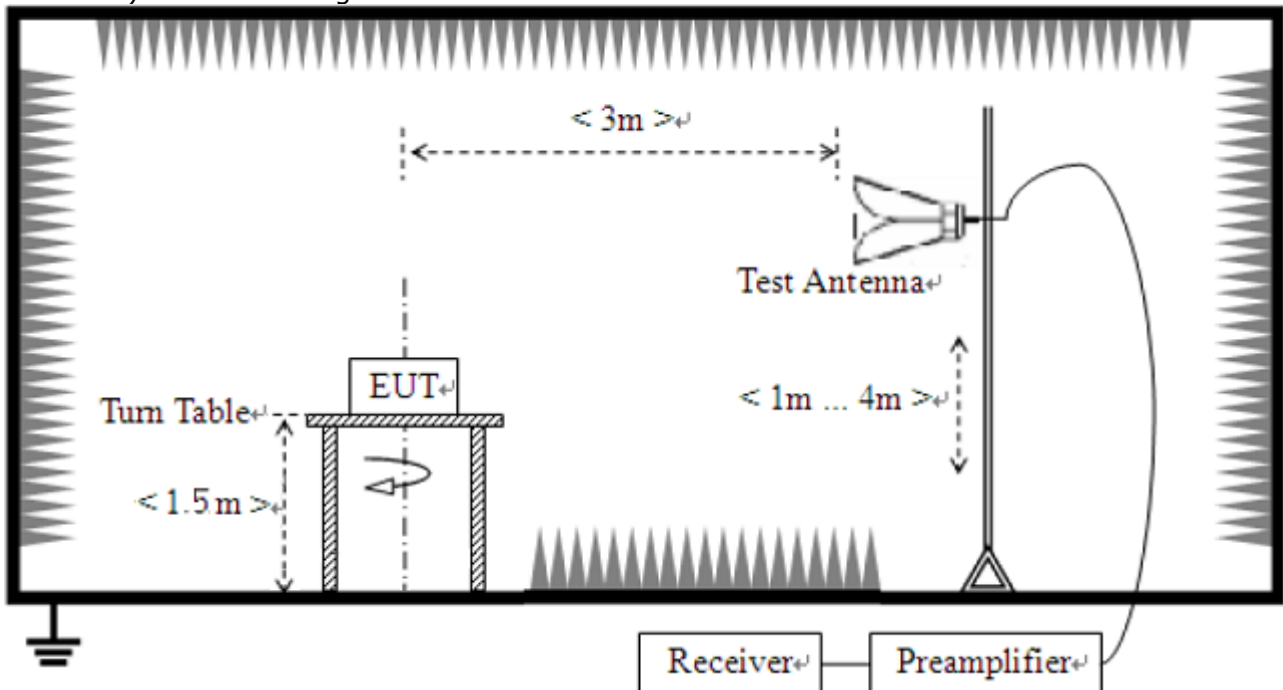
- 1) For field strength of emissions from 9 kHz to 30 MHz



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



3) For field strength of emissions above 1 GHz



Test Results

1) 9 kHz to 30 MHz

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)

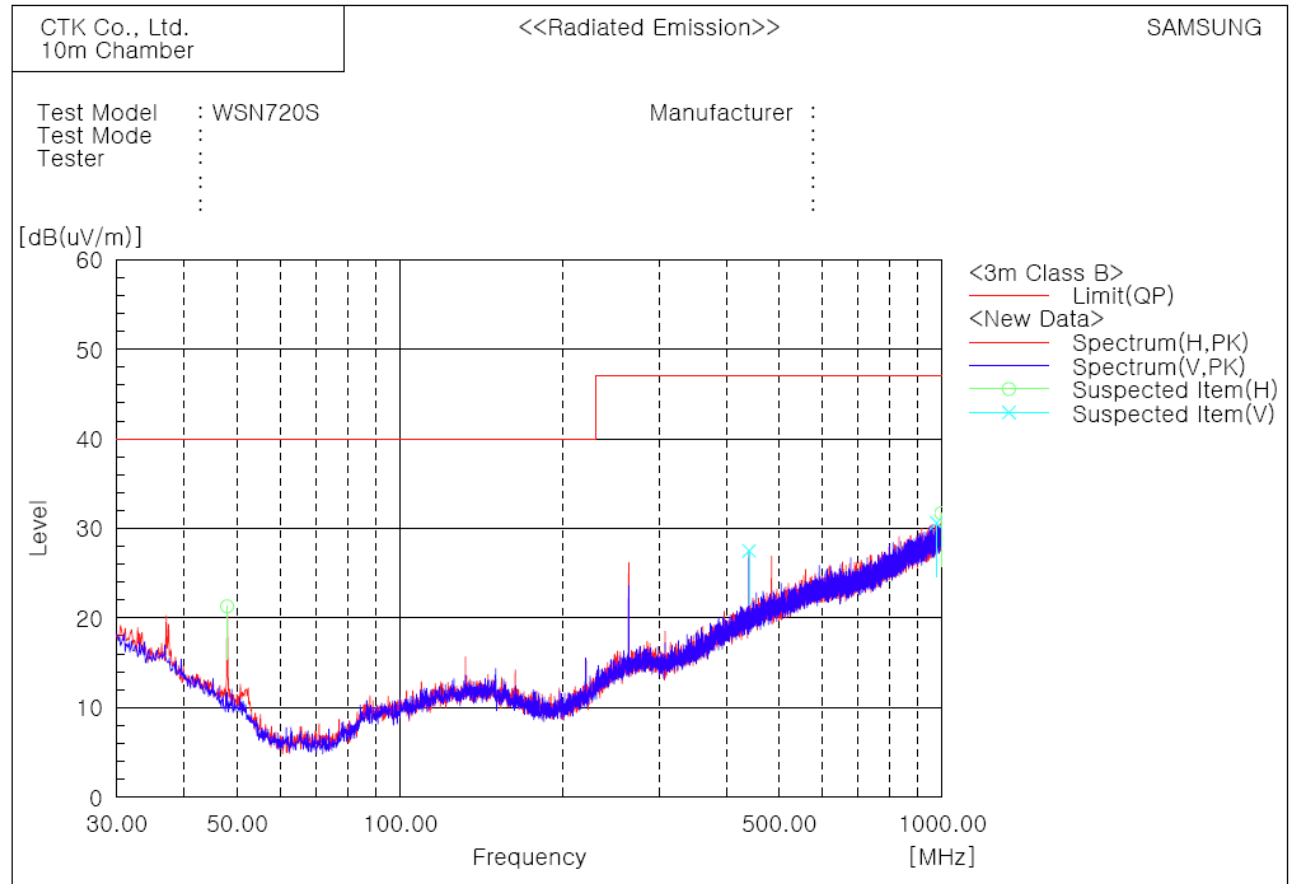
2) 30 MHz to 1 GHz

Test mode : 5.2 GHz band, Transmit, ANT-A, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency (P)	Reading	c.f	Result PK	Limit QP	Margin QP	Height	Angle
	[MHz]	[dB(uV)]	[dB(1/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB]	[cm]	[deg]
1	47.945	H 35.9	-14.6	21.3	40.0	18.7	300.0	322.0
2	440.068	V 30.6	-3.1	27.5	47.0	19.5	101.0	223.0
3	976.599	V 23.1	7.5	30.6	47.0	16.4	400.0	58.0
4	995.392	H 23.6	8.1	31.7	47.0	15.3	400.0	144.0

Remark :

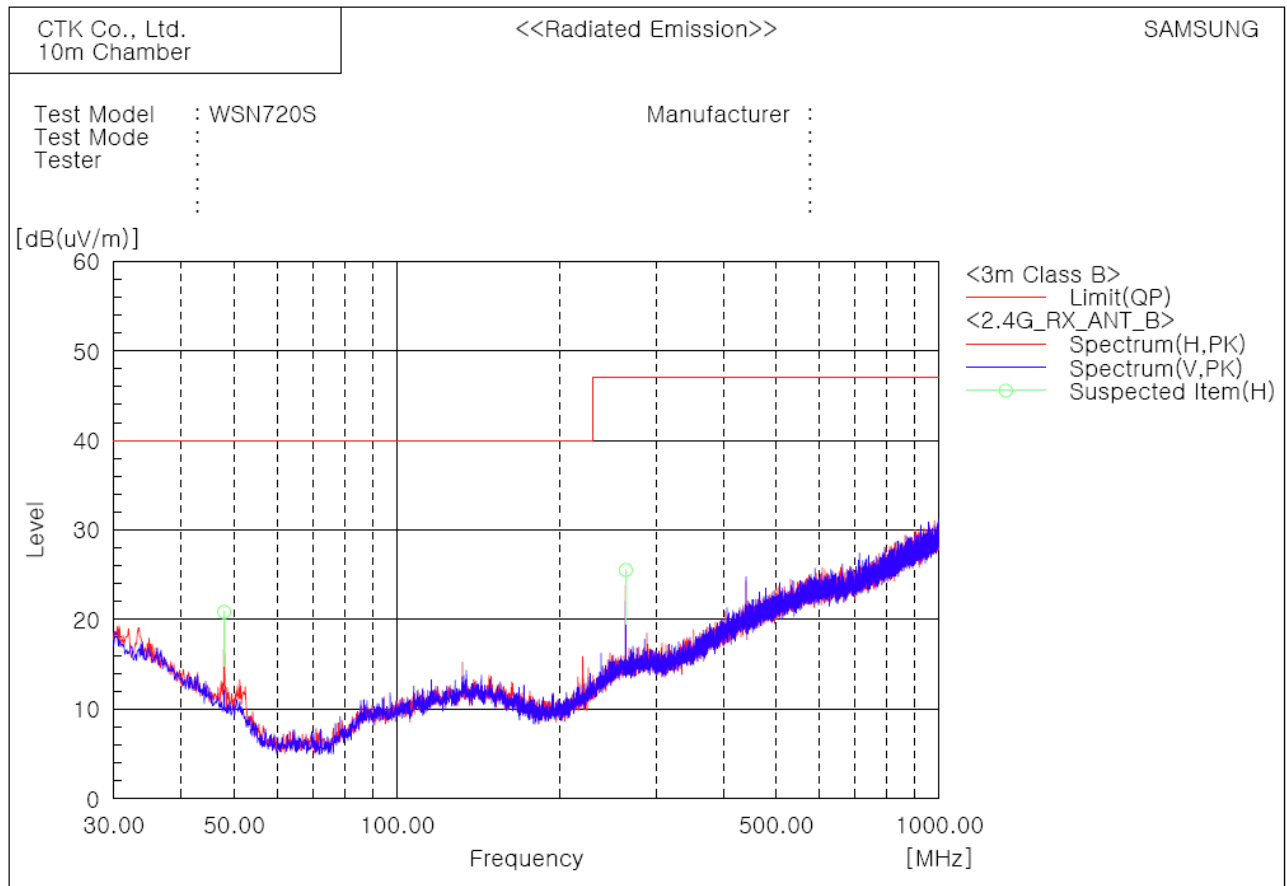
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

Test mode : 5.2 GHz band, Receiver, ANT-A, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	47.945	H	35.4	-14.6	20.8	40.0	19.2	300.0	197.0
2	264.013	H	34.3	-8.8	25.5	47.0	21.5	101.0	145.0

Remark :

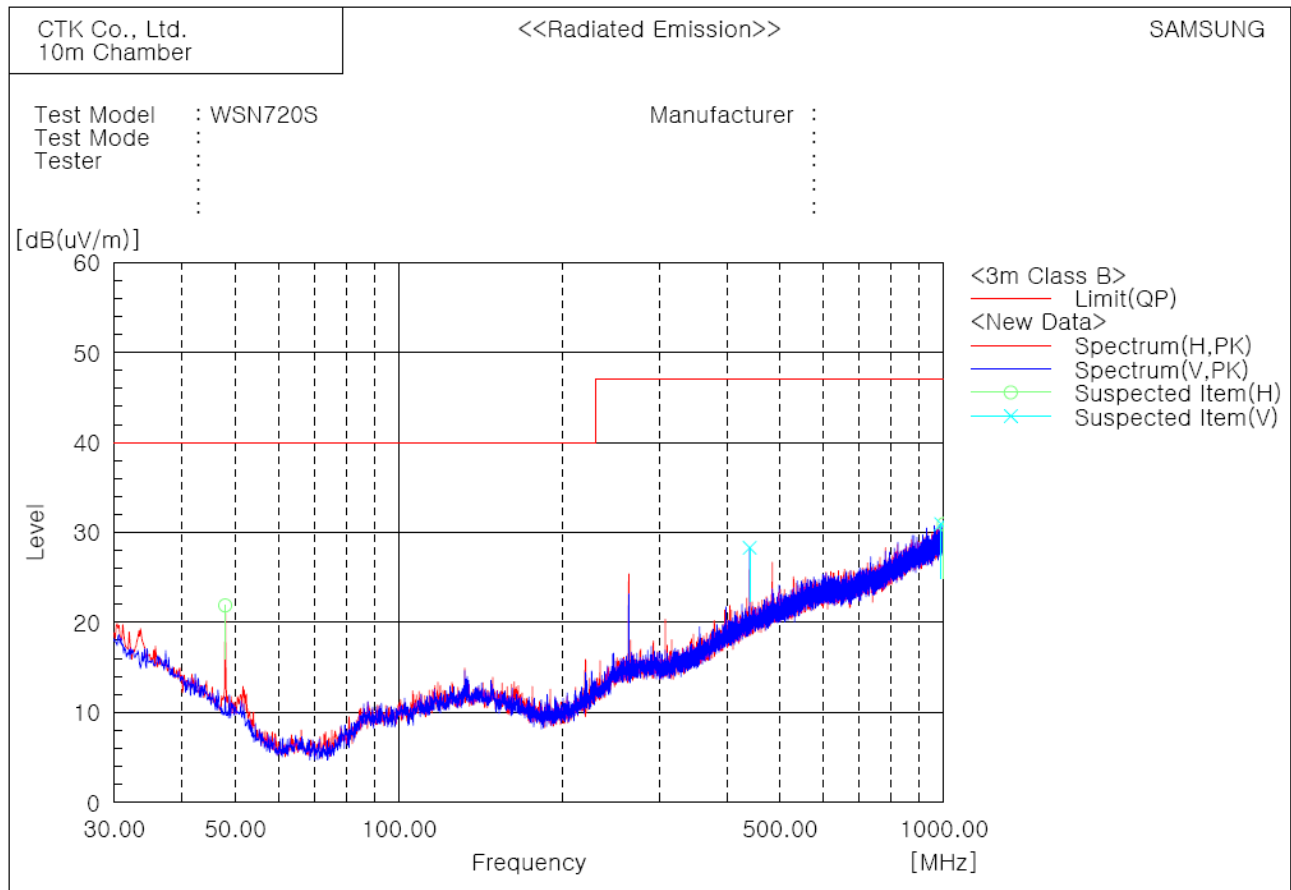
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

Test mode : 5.2 GHz band, Transmit, ANT-B, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	47.945	H	36.5	-14.6	21.9	40.0	18.1	300.0	91.0
2	440.068	V	31.4	-3.1	28.3	47.0	18.7	100.0	190.0
3	987.754	V	23.0	7.9	30.9	47.0	16.1	200.0	358.0
4	999.757	H	22.7	8.2	30.9	47.0	16.1	300.0	0.0

Remark :

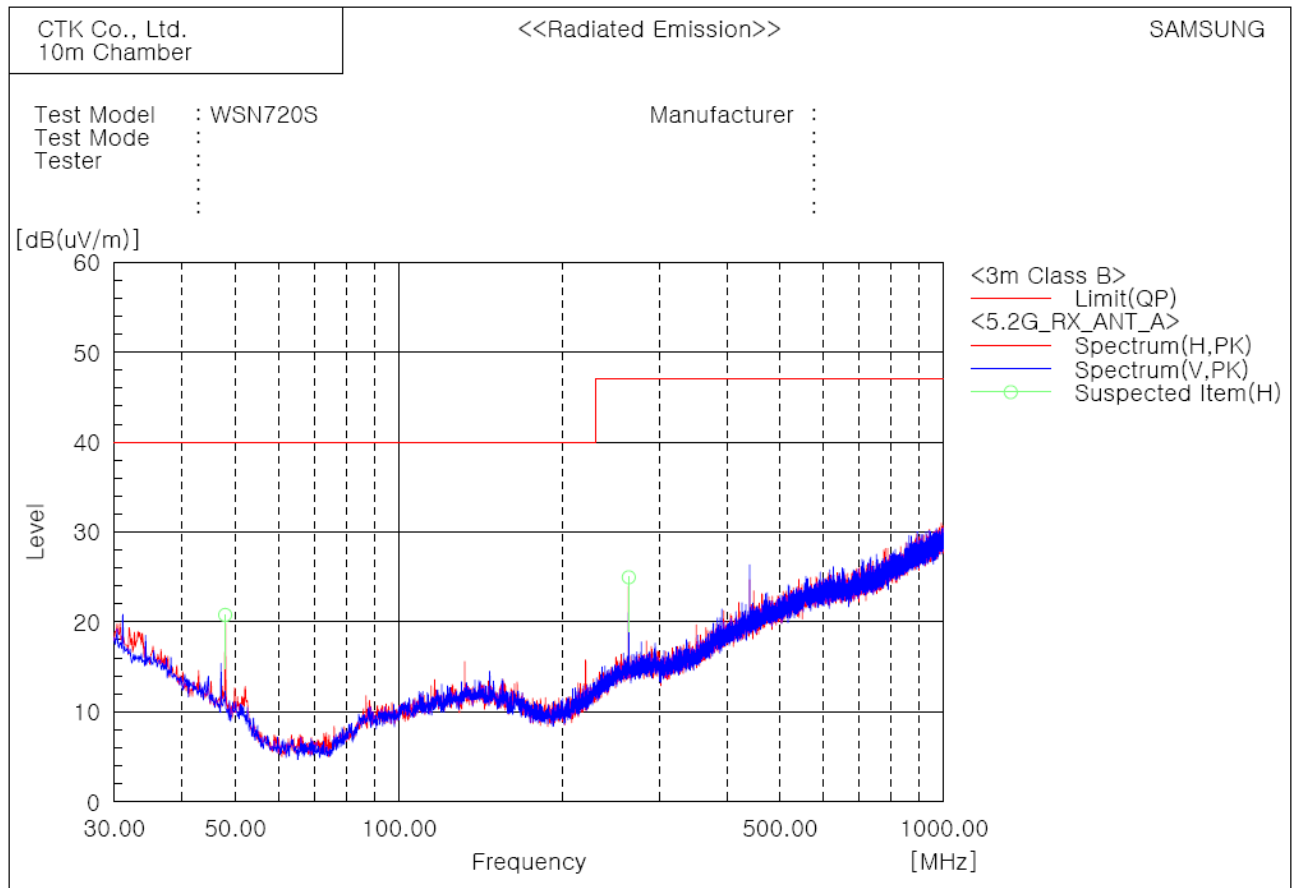
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

Test mode : 5.2 GHz band, Receiver, ANT-B, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	47.945	H	35.4	-14.6	20.8	40.0	19.2	399.0	322.0
2	264.013	H	33.8	-8.8	25.0	47.0	22.0	101.0	223.0

Remark :

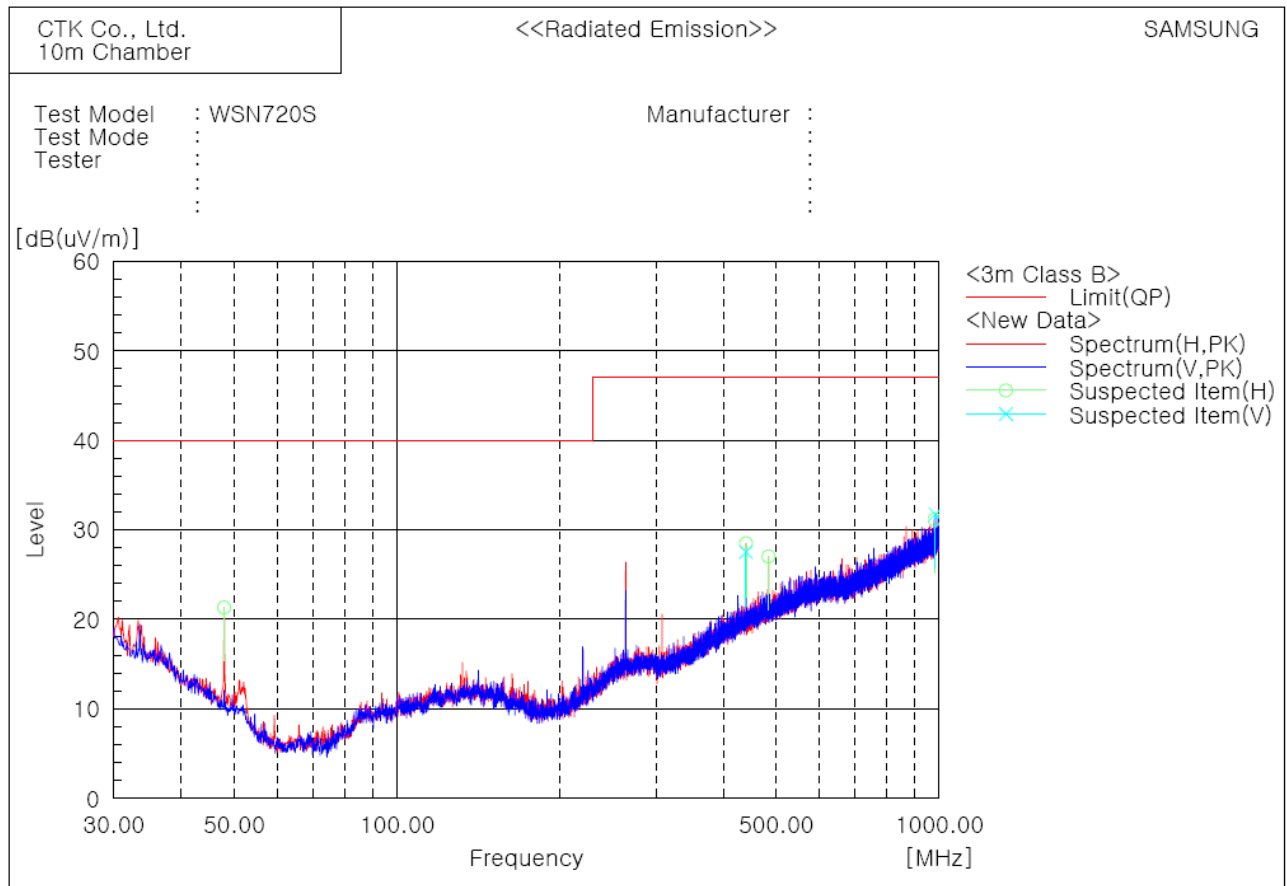
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

Test mode : 5.8 GHz band, Transmit, ANT-A, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	47.945	H	35.9	-14.6	21.3	40.0	18.7	399.0	321.0
2	439.946	V	30.6	-3.1	27.5	47.0	19.5	101.0	164.0
3	440.068	H	31.6	-3.1	28.5	47.0	18.5	200.0	242.0
4	484.081	H	28.7	-1.7	27.0	47.0	20.0	200.0	242.0
5	979.145	H	23.5	7.6	31.1	47.0	15.9	399.0	190.0
6	983.752	V	23.9	7.8	31.7	47.0	15.3	300.0	321.0

Remark :

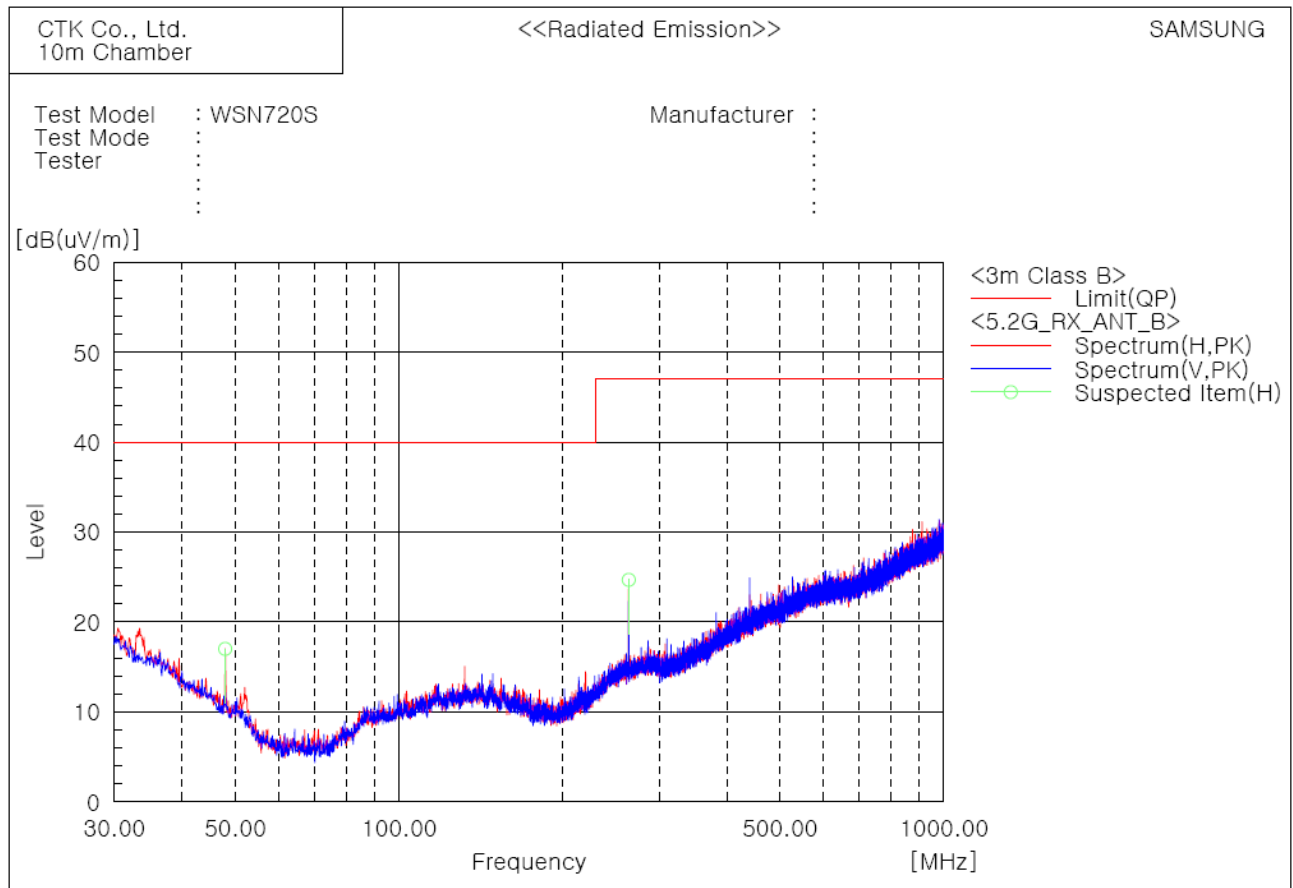
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

Test mode : 5.8 GHz band, Receiver, ANT-A, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	47.945	H	31.6	-14.6	17.0	40.0	23.0	399.0	321.0
2	264.013	H	33.5	-8.8	24.7	47.0	22.3	100.0	145.0

Remark :

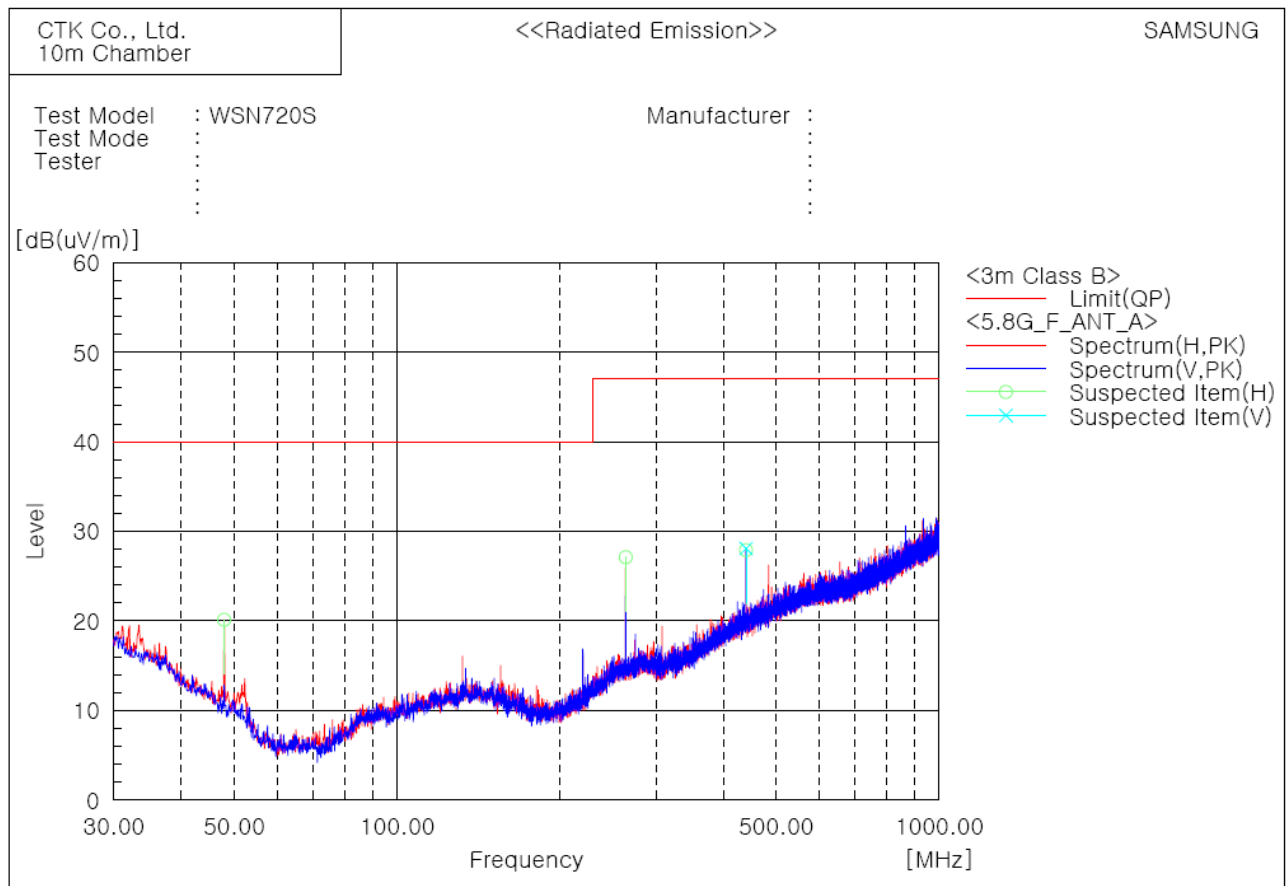
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

Test mode : 5.8 GHz band, Transmit, ANT-B, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	47.945	H	34.7	-14.6	20.1	40.0	19.9	299.0	223.0
2	264.013	H	35.9	-8.8	27.1	47.0	19.9	101.0	66.0
3	440.068	V	31.2	-3.1	28.1	47.0	18.9	100.0	111.0
4	440.068	H	31.0	-3.1	27.9	47.0	19.1	101.0	66.0

Remark :

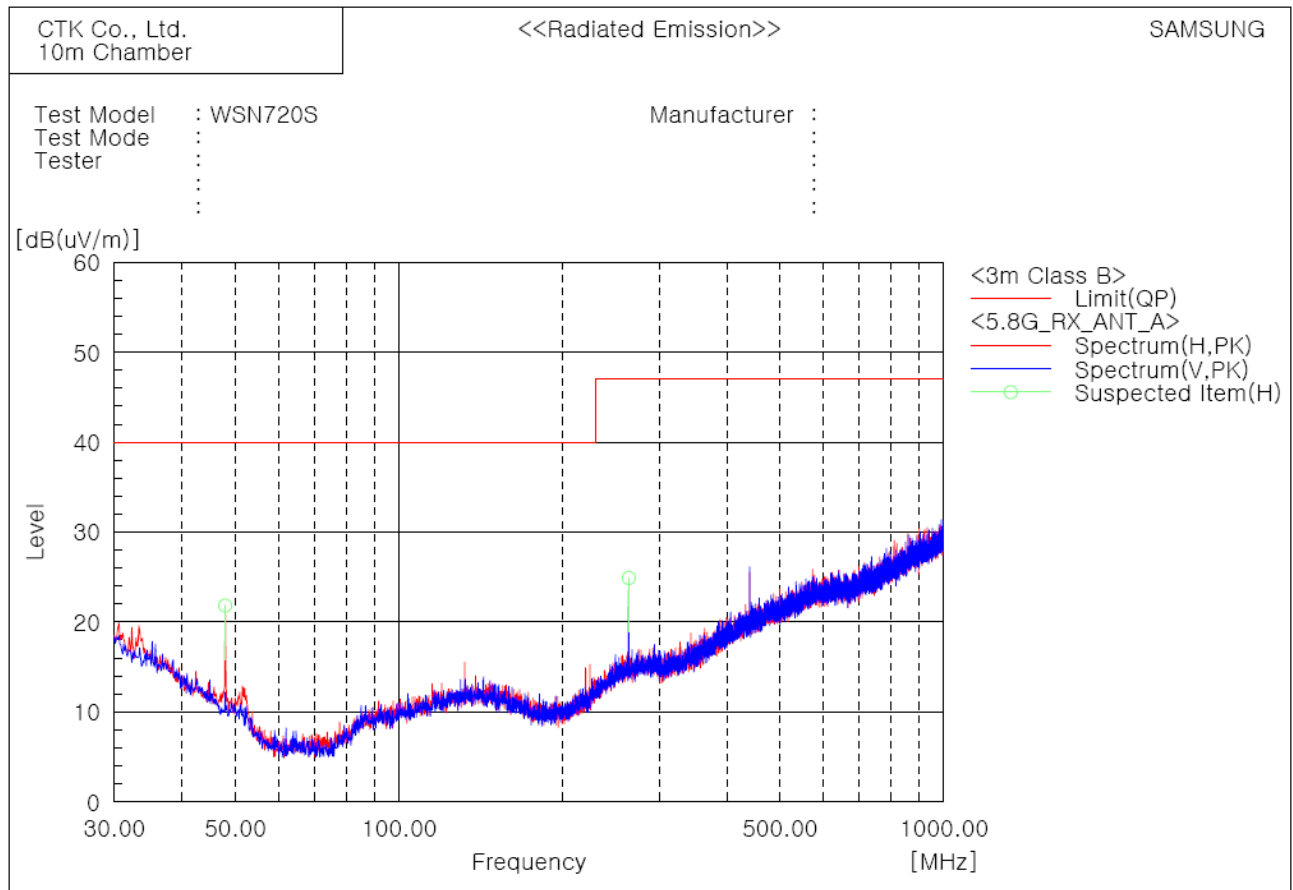
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

Test mode : 5.8 GHz band, Receiver, ANT-B, low channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	47.945	H	36.4	-14.6	21.8	40.0	18.2	300.0	197.0
2	264.013	H	33.7	-8.8	24.9	47.0	22.1	101.0	197.0

Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

3) above 1 GHz

ANT-A

Channel : 5 180 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
5 148.70	V	29.84 / 52.74	2.0	31.83 / 54.73	54.00 / 74.00	22.17 / 19.27

Channel : 5 210 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
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The emission is more than 20dB lower than the limit.

Channel : 5 240 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
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The emission is more than 20dB lower than the limit.

Channel : 5 736 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
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The emission is more than 20dB lower than the limit.

Channel : 5 762 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
--------------------	-----	------------------------------	----------------------	-----------------------------	----------------------------	-------------------------

The emission is more than 20dB lower than the limit.

Channel : 5 814 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
5 594.52	V	41.34 / 55.04	3.37	44.71 / 58.41	54.00 / 74.00	9.29 / 15.59

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain

ANT-B

Channel : 5 180 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
5 148.70	V	34.76 / 57.66	2.0	36.76 / 59.66	54.00 / 74.00	17.24 / 14.34

Channel : 5 210 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
--------------------	-----	------------------------------	----------------------	-----------------------------	----------------------------	-------------------------

The emission is more than 20dB lower than the limit.

Channel : 5 240 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
--------------------	-----	------------------------------	----------------------	-----------------------------	----------------------------	-------------------------

The emission is more than 20dB lower than the limit.

Channel : 5 736 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
--------------------	-----	------------------------------	----------------------	-----------------------------	----------------------------	-------------------------

The emission is more than 20dB lower than the limit.

Channel : 5 762 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
--------------------	-----	------------------------------	----------------------	-----------------------------	----------------------------	-------------------------

The emission is more than 20dB lower than the limit.

Channel : 5 814 MHz

Frequency [MHz]	(P)	Reading AV/PK [dBuV/m]	Correction Factor	Result AV/PK [dBuV/m]	Limit AV/PK [dBuV/m]	Margin AV/PK [dB]
5 632.71	V	41.57 / 55.27	3.85	45.42 / 59.12	54.00 / 74.00	8.58 / 14.88

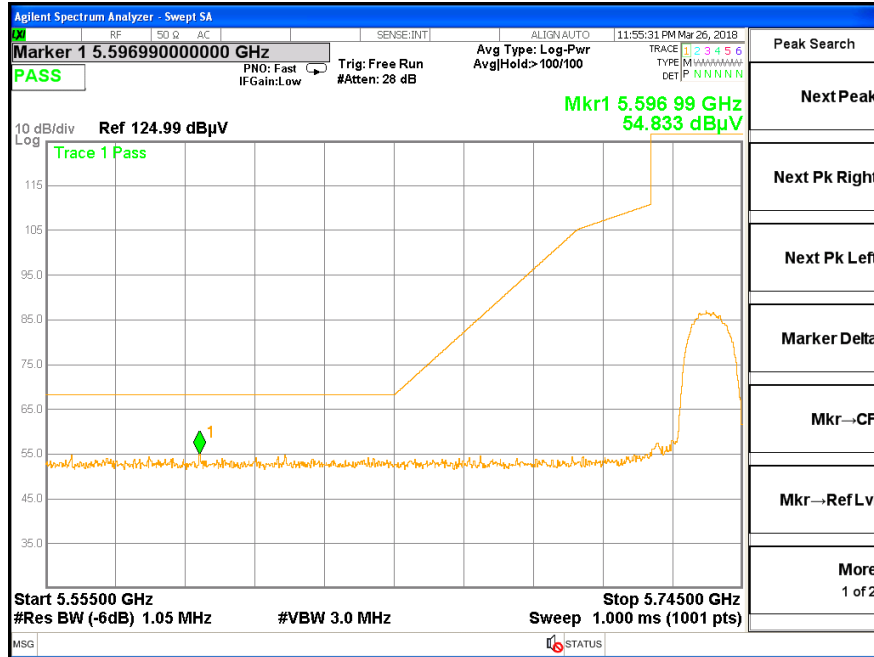
Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain

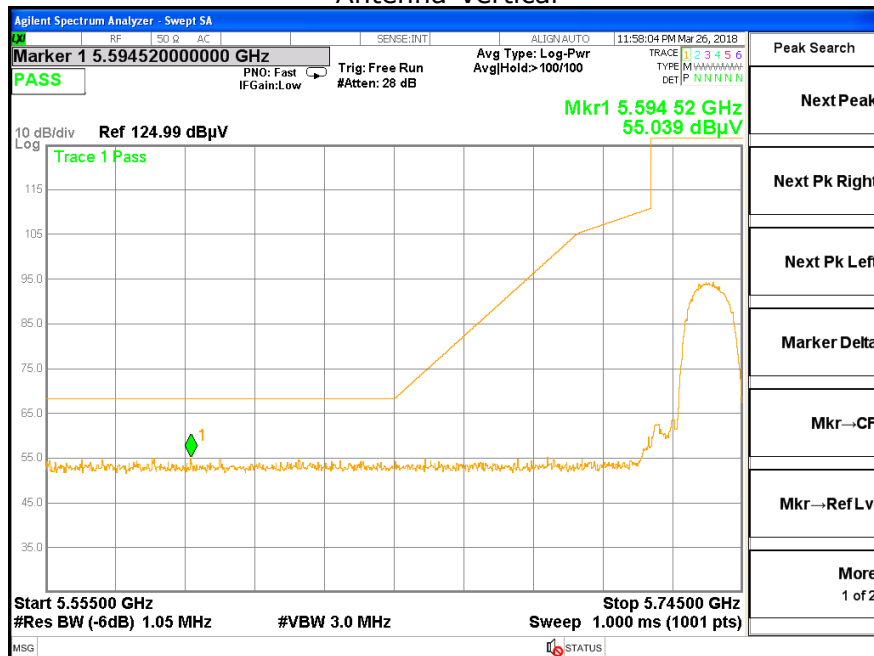
Band emissions mask

Test mode : 5.8 GHz band, ANT-A, low channel

Antenna-Horizontal

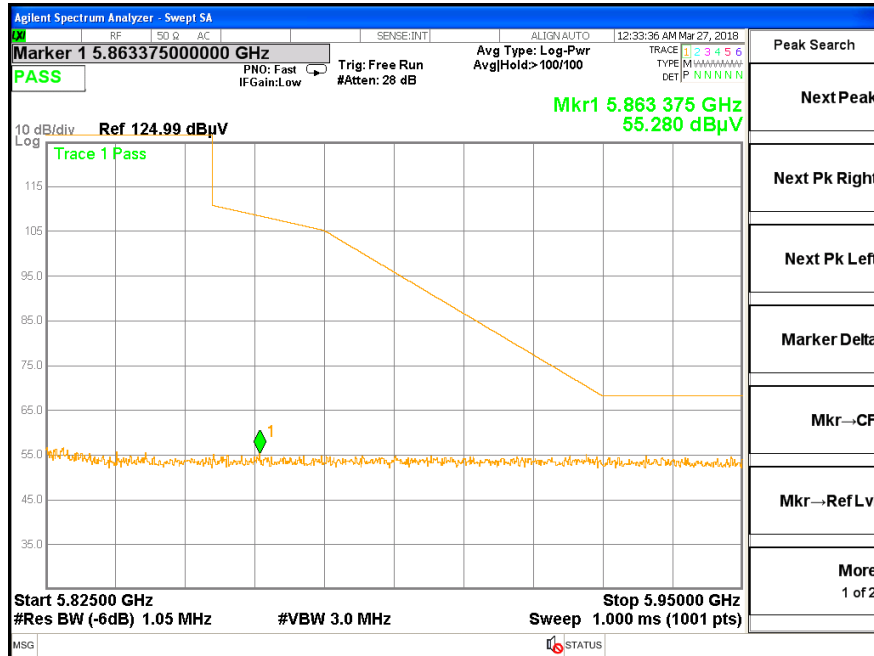


Antenna-Vertical

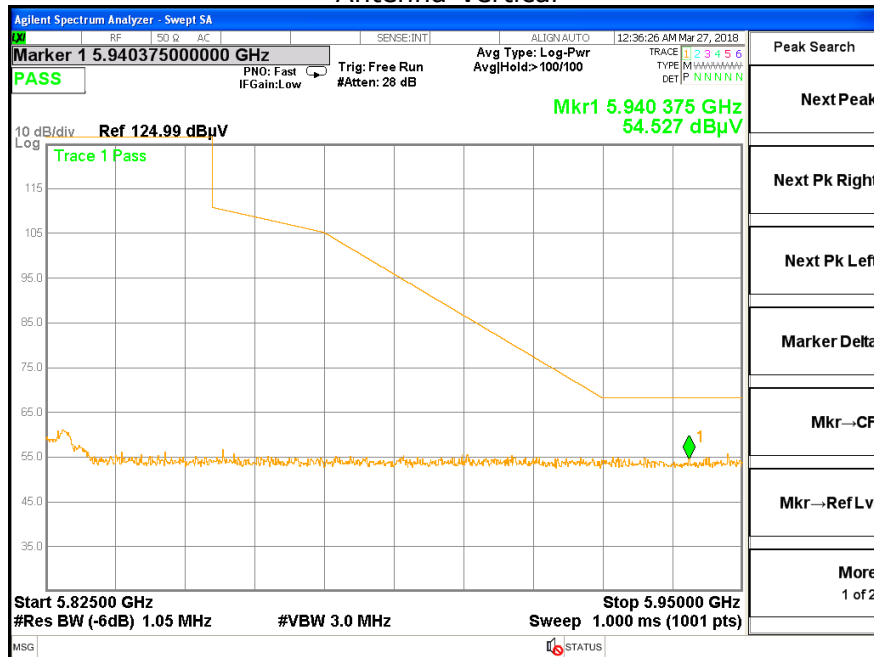


Test mode : 5.8 GHz band, ANT-A, high channel

Antenna-Horizontal

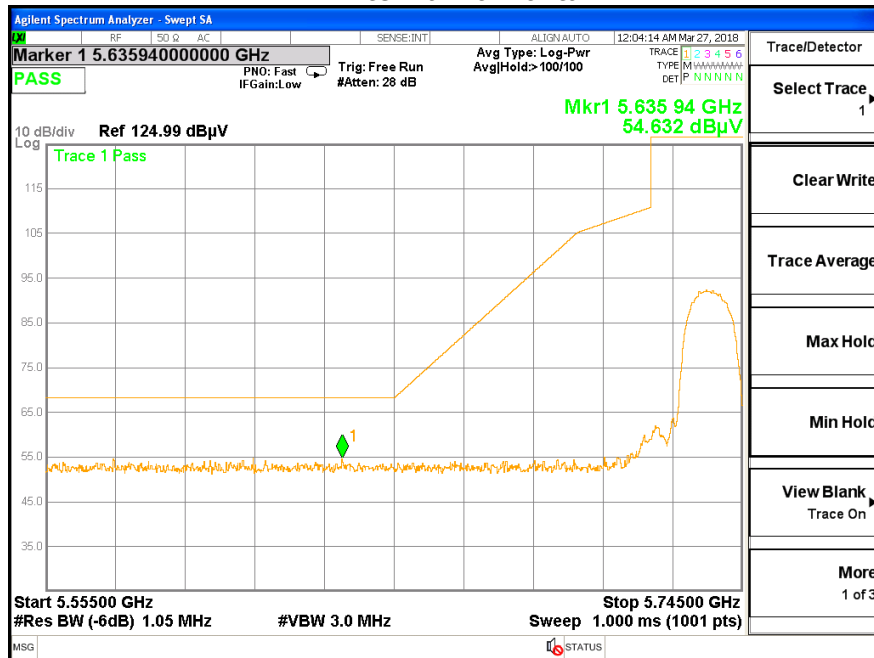


Antenna-Vertical

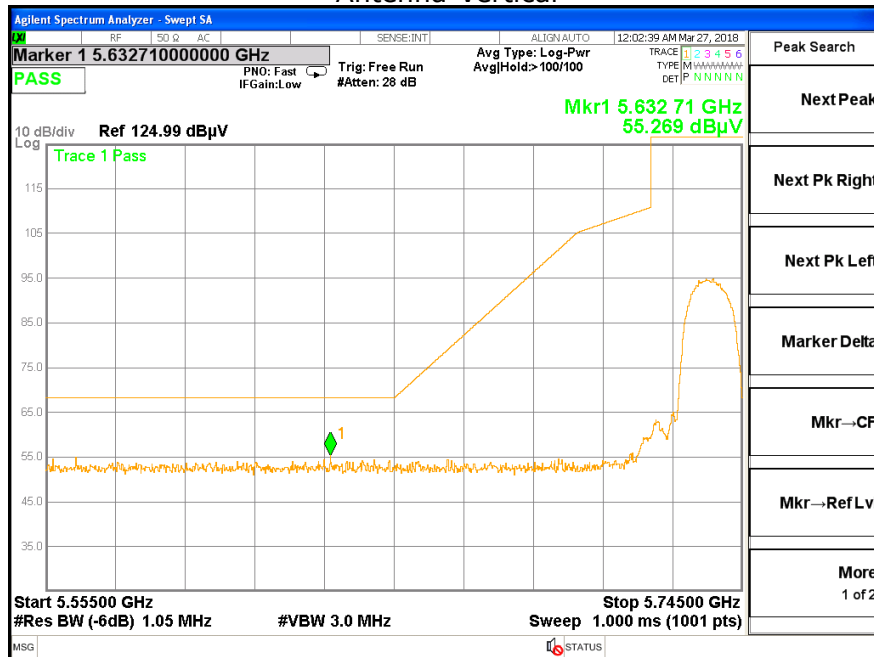


Test mode : 5.8 GHz band, ANT-B, low channel

Antenna-Horizontal

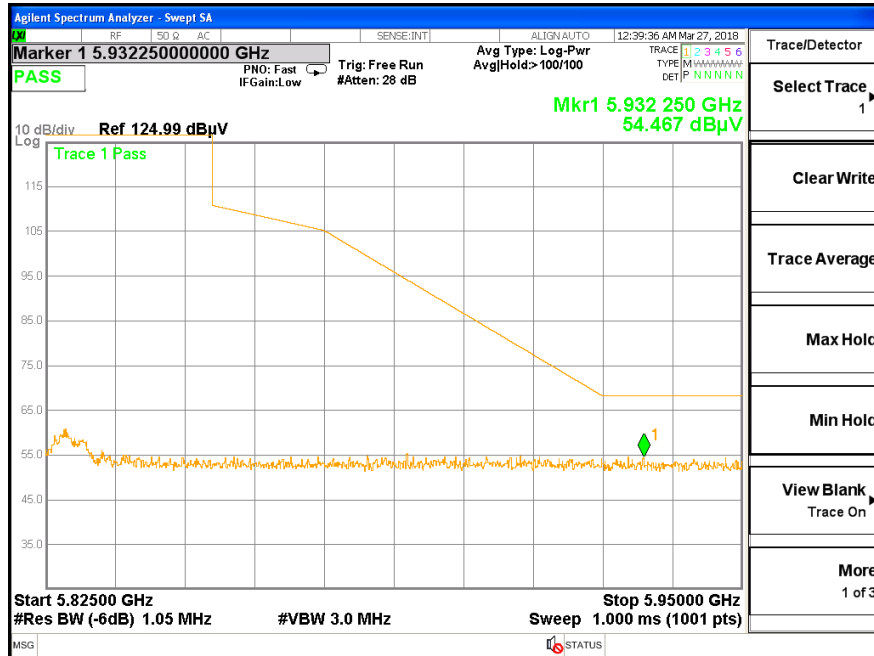


Antenna-Vertical

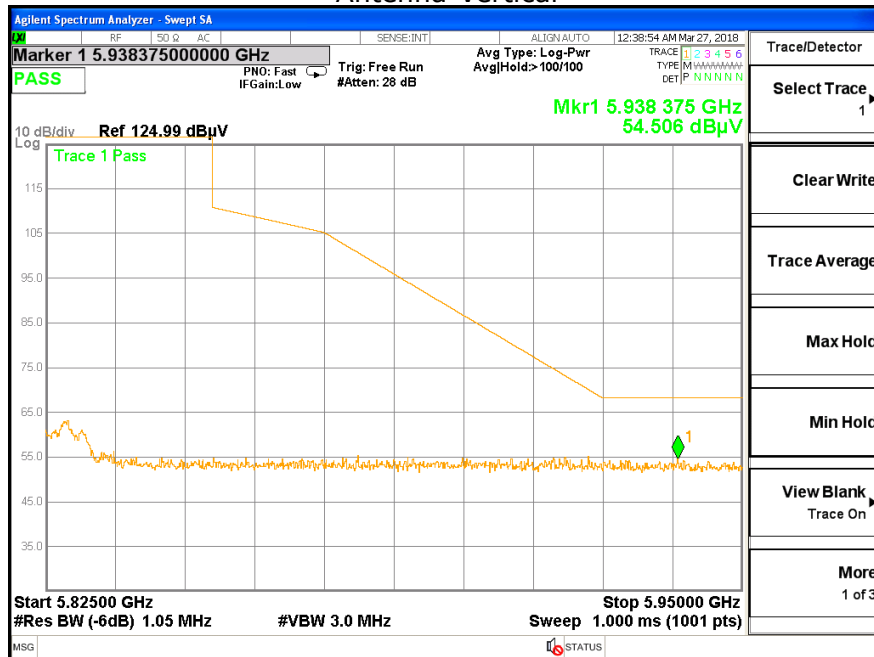


Test mode : 5.8 GHz band, ANT-B, high channel

Antenna-Horizontal



Antenna-Vertical



4.8 AC Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average**
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* The level decreases linearly with the logarithm of the frequency.

** A linear average detector is required.

Test Results

The requirements are:

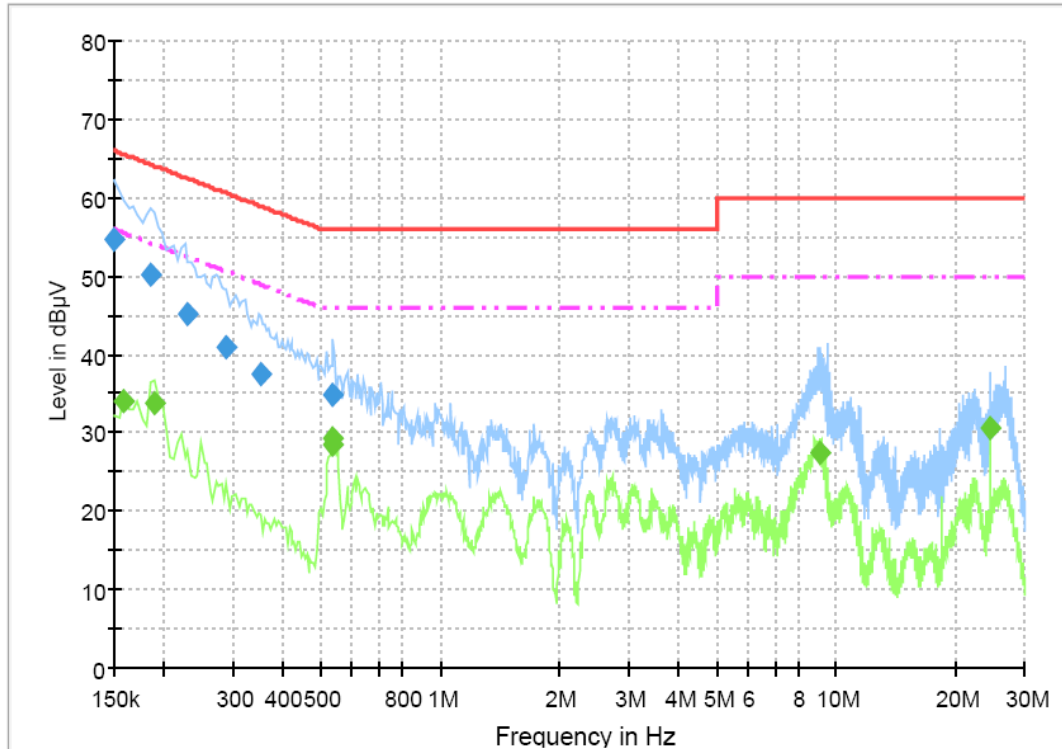
☒ Complies

Test mode : 5.2 GHz band, Transmit, ANT-A, low channel(Worst case)

Frequency [MHz]	Measured Data [dBuV]	Margin [dB]	Remark
0.150	54.6	11.4	Quasi-peak

Test Data

[LINE]



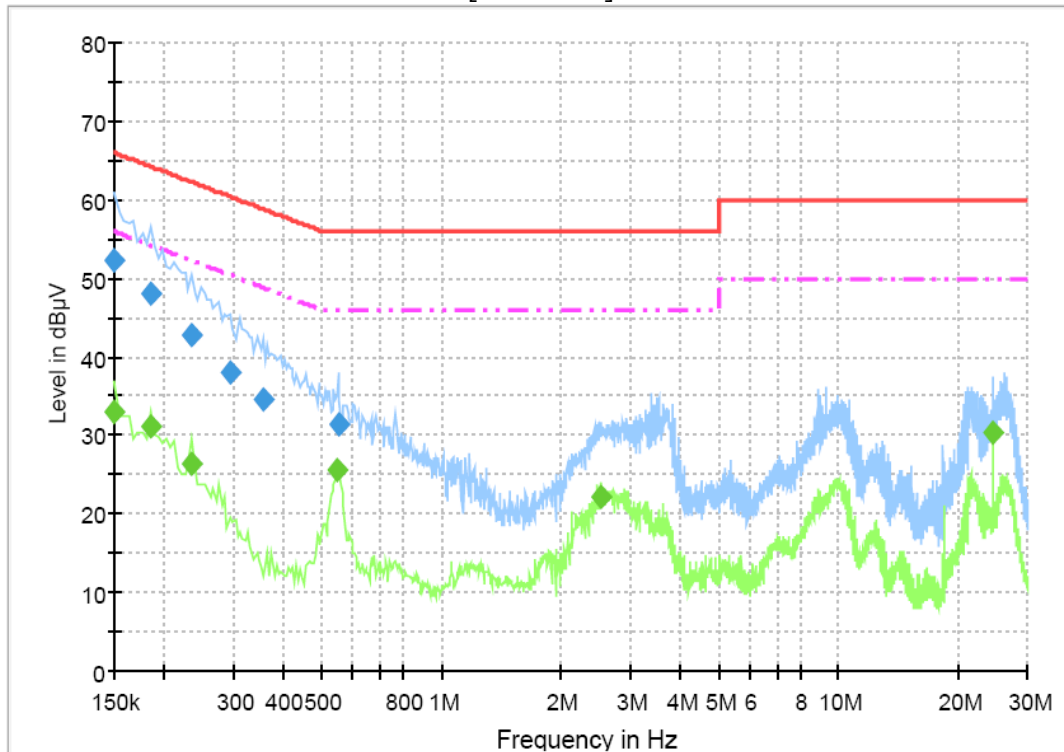
Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	54.6	1000.0	9.000	On	L1	9.8	11.4	66.0
0.186000	50.1	1000.0	9.000	On	L1	9.8	14.1	64.2
0.231000	45.2	1000.0	9.000	On	L1	9.7	17.2	62.4
0.289500	40.8	1000.0	9.000	On	L1	9.8	19.7	60.5
0.352500	37.4	1000.0	9.000	On	L1	9.9	21.5	58.9
0.537000	34.9	1000.0	9.000	On	L1	10.0	21.1	56.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.159000	34.1	1000.0	9.000	On	L1	9.8	21.5	55.5
0.190500	33.8	1000.0	9.000	On	L1	9.8	20.3	54.0
0.532500	28.6	1000.0	9.000	On	L1	10.0	17.4	46.0
0.537000	29.3	1000.0	9.000	On	L1	10.0	16.7	46.0
9.069000	27.6	1000.0	9.000	On	L1	9.9	22.4	50.0
24.576000	30.7	1000.0	9.000	On	L1	10.2	19.3	50.0

[NEUTRAL]



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	52.3	1000.0	9.000	On	N	9.8	13.7	66.0
0.186000	48.0	1000.0	9.000	On	N	9.9	16.2	64.2
0.235500	42.7	1000.0	9.000	On	N	9.8	19.6	62.3
0.294000	38.1	1000.0	9.000	On	N	9.8	22.3	60.4
0.357000	34.5	1000.0	9.000	On	N	9.9	24.3	58.8
0.550500	31.5	1000.0	9.000	On	N	9.9	24.5	56.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	33.1	1000.0	9.000	On	N	9.8	22.9	56.0
0.186000	31.3	1000.0	9.000	On	N	9.9	23.0	54.2
0.235500	26.5	1000.0	9.000	On	N	9.8	25.8	52.3
0.546000	25.6	1000.0	9.000	On	N	9.9	20.4	46.0
2.512500	22.2	1000.0	9.000	On	N	9.8	23.8	46.0
24.576000	30.4	1000.0	9.000	On	N	10.2	19.6	50.0

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Signal Analyzer	Agilent	N9020A	MY50510324	2018-01-26	2019-01-26
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2017-11-01	2018-11-01
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2017-10-25	2018-10-25
4	Bilog Antenna	Schaffner	CBL6111C	2551	2016-05-13	2018-05-13
5	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2016-05-16	2018-05-16
6	6dB Attenuator	R&S	DNF	272.4110.50-2	2017-10-25	2018-10-25
7	AMPLIFIER	SONOMA	310	291721	2018-02-02	2019-02-02
8	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2018-02-01	2019-02-01
9	LISN	Rohde & Schwarz	ENV216	101235	2018-01-31	2019-01-31
10	Preamplifier	Agilent	8449B	3008A02011	2017-11-30	2018-11-30
11	Horn Antenna	ETS-Lindgren	3116	00062504	2017-12-04	2019-12-04
12	Horn Antenna	ETS-Lindgren	3117	00154525	2017-09-14	2019-09-14
13	Band Reject Filter	Micro Tronics	BRM50716	G184	2018-01-26	2019-01-26
14	Dual-Tracking DC Power Supply	Topward Electric Instruments Co.,Ltd.	6303D	711196	2018-01-30	2019-01-30