

TEST REPORT



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-2018-04034
Page (1) / (34) Pages

1. Client

- Name : Haier US Appliance Solutions, Inc.
- Address : Appliance Park AP2-226, Louisville, KY 40225, United States
- Date of Receipt : 2018-12-18

2. Manufacturer

- Name : Haier US Appliance Solutions, Inc.
- Address : Appliance Park AP2-226, Louisville, KY 40225, United States

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

4. Test Sample / Model: Bluetooth Module / BCEA002



5. Date of Test : 2018-12-20 to 2018-12-24

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247
RSS-247 & RSS-Gen

7. Testing Environment: Temp.: (24 ± 5) °C, Humidity: (48 ± 3) % 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  Ji-Hye Kim: (Signature) | Technical Manager  Won-Jae, Hwang: (Signature) |
|-------------|---|---|

2018-12-24

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



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-2018-04034
Page (2) / (34) Pages

REPORT REVISION HISTORY

| Date | Revision | Page No |
|------------|-------------------------|---------|
| 2018-12-24 | Issued (CTK-2018-04034) | all |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

This report shall not be reproduced except in full, without the written approval of CTK Co., Ltd. This document may be altered or revised by CTK Co., Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by CTK Co., Ltd. will constitute fraud and shall nullify the document.



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-2018-04034
Page (3) / (34) Pages

CONTENTS

| | |
|---|----|
| 1. General Product Description | 4 |
| 1.1 Client Information | 4 |
| 1.2 Product Information..... | 4 |
| 1.3 Peripheral Devices | 4 |
| 2. Facility and Accreditations..... | 5 |
| 2.1 Test Facility..... | 5 |
| 2.2 Laboratory Accreditations and Listings | 5 |
| 2.3 Calibration Details of Equipment Used for Measurement | 5 |
| 3. Test Specifications | 6 |
| 3.1 Standards..... | 6 |
| 3.2 Mode of operation during the test | 7 |
| 3.3 Device Modifications | 7 |
| 3.4 Maximum Measurement Uncertainty | 7 |
| 3.5 Test Software..... | 7 |
| 4. Technical Characteristic Test..... | 8 |
| 4.1 6dB Bandwidth..... | 8 |
| 4.2 Maximum peak Conducted Output Power..... | 14 |
| 4.3 Transmitter Power Spectral Density..... | 17 |
| 4.4 Conducted Spurious emission | 20 |
| 4.5 Radiated Emission | 22 |
| 4.6 AC Conducted Emissions | 31 |
| APPENDIX A – Test Equipment Used For Tests | 34 |



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-2018-04034
Page (4) / (34) Pages

1. General Product Description

1.1 Client Information

| | |
|-----------------------|---|
| Company | Haier US Appliance Solutions, Inc. |
| Contact Point | Appliance Park AP2-226, Louisville, KY 40225, United States |
| Contact Person | Name : Park, Hansung E-mail : hansung.park@geappliances.com Tel : +82-31-724-8668 Tel : +82-31-8094-6732 |

1.2 Product Information

| | |
|----------------------------------|---|
| FCC ID | ZKJ-BCEA002 |
| Certification Number ISED | 10229A-BCEA002 |
| Product Description | Bluetooth Module |
| Model name | BCEA002 |
| Variant Model name | - |
| Operating Frequency | 2 402 MHz – 2 480 MHz |
| RF Output Power | 8.74 dBm (7.48 mW) |
| Antenna Specification | Antenna type : Chip Antenna Peak Gain : 1.47 dBi |
| Type of Modulation | GFSK (Bluetooth 4.2 - LE) |
| Power Source | DC 12 V |
| Hardware Rev | V3.4 |
| Software Rev | V0.0.4.0 |

1.3 Peripheral Devices





| Device | Manufacturer | Model No. | Serial No. |
|---------------|--------------|------------|------------|
| Note Computer | HP | 15-bs563TU | CND7253R6N |
| AC/DC Adapter | HP | HSTNN-CA40 | - |

2. 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 | MSIP | 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.



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-2018-04034
 Page (6) / (34) Pages

3. Test Specifications

3.1 Standards

| FCC Part Section(s) | Requirement(s) | Status (Note 1) | Test Condition |
|---|------------------------------------|-----------------|----------------|
| 15.247(a) | 6 dB Bandwidth | C | Conducted |
| 15.247(b) | Maximum Output Power | C | |
| 15.247(d) | Conducted Spurious emission | C | |
| 15.247(d) | Unwanted Emission(Conducted) | C | |
| 15.247(e) | Transmitter Power Spectral Density | C | |
| 15.209 | Radiated Emissions | C | Radiated |
| 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. | | | |
| <i>Note 3:</i> The sample was tested according to the following specification: FCC Part 15.247 | | | |
| <i>Note 4:</i> The tests were performed according to the method of measurements prescribed in KDB No.558074, ANSI C63.10-2013 | | | |

| ISED Part Section(s) | Requirement(s) | Status (Note 1) | Test Condition |
|--|------------------------------------|-----------------|----------------|
| RSS-247 5.2(a) | 6 dB Bandwidth | C | Conducted |
| RSS-247 5.4(d) | Maximum Output Power | C | |
| RSS-247 5.5 | Conducted Spurious emission | C | |
| RSS-247 5.5 | Unwanted Emission(Conducted) | C | |
| RSS-247 5.2(b) | Transmitter Power Spectral Density | C | |
| RSS-Gen 6.13 | Radiated Emissions | C | Radiated |
| 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. | | | |
| <i>Note 3:</i> The sample was tested according to the following specification: RSS-247, RSS-GEN | | | |
| <i>Note 4:</i> The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013 | | | |



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-2018-04034
 Page (7) / (34) Pages

3.2 Mode of operation during the test

The EUT 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. All modulation modes were tests.
 The results are only attached worst cases.

Test Frequency

| Lowest channel | Middle channel | Highest channel |
|----------------|----------------|-----------------|
| 2 402 MHz | 2 440 MHz | 2 480 MHz |

Test mode

| Modulation | Duty Cycle | Duty Cycle Factor |
|------------|------------|-------------------|
| GFSK | 64.9% | 1.88 dB |

3.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable

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 %

| 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 ≤ 1 GHz) | ± 4.0 dB |
| Radiated Emissions (f > 1 GHz) | ± 5.0 dB |

3.5 Test Software

| | |
|---------------------|--|
| Conducted Test | Ics Pro Ver. 6.0.3 |
| Radiated Test | TOYO EMI software EP5RE Ver. 5.1.0 |
| Line Conducted Test | ESCI7, ESCI3 : EMC32 Ver. 8.50.0 ESR7 : EMC32 Ver. 8.53.0 |



4. Technical Characteristic Test

4.1 6dB Bandwidth

Test Procedures

KDB 558074 - Section 8.2
ANSI C63.10-2013 - Section 11.8.2
RSS-Gen – Section 6.7

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 Procedures

ANSI C63.10-2013 - Section 6.9
RSS-Gen – Section 6.7

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 = 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.

Minimum Standard :

6 dB Bandwidth > 500kHz



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

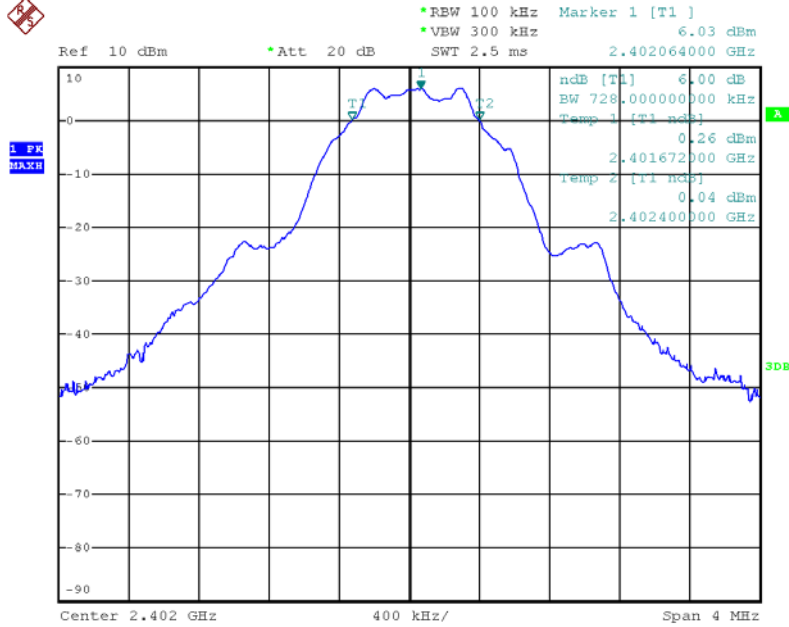
Report No.:
CTK-2018-04034
Page (9) / (34) Pages

Test Data :

| Frequency (MHz) | 6dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Result |
|-----------------|---------------------|---------------------|----------|
| 2 402 | 0.728 | 1.096 | Complies |
| 2 440 | 0.728 | 1.096 | Complies |
| 2 480 | 0.720 | 1.096 | Complies |

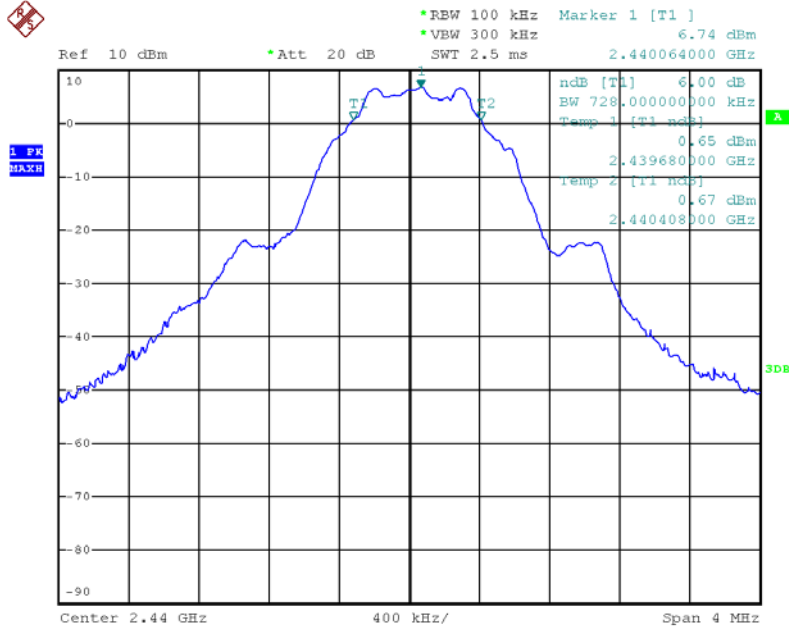
See next pages for actual measured spectrum plots.

**6 dB bandwidth
Low channel (2 402 MHz)**



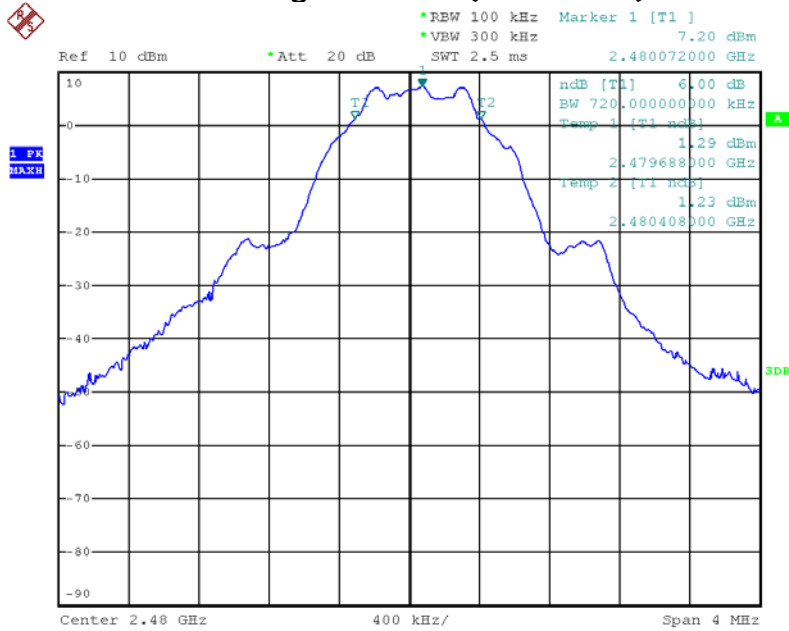
Date: 21.DEC.2018 20:13:04

Middle channel (2 440MHz)



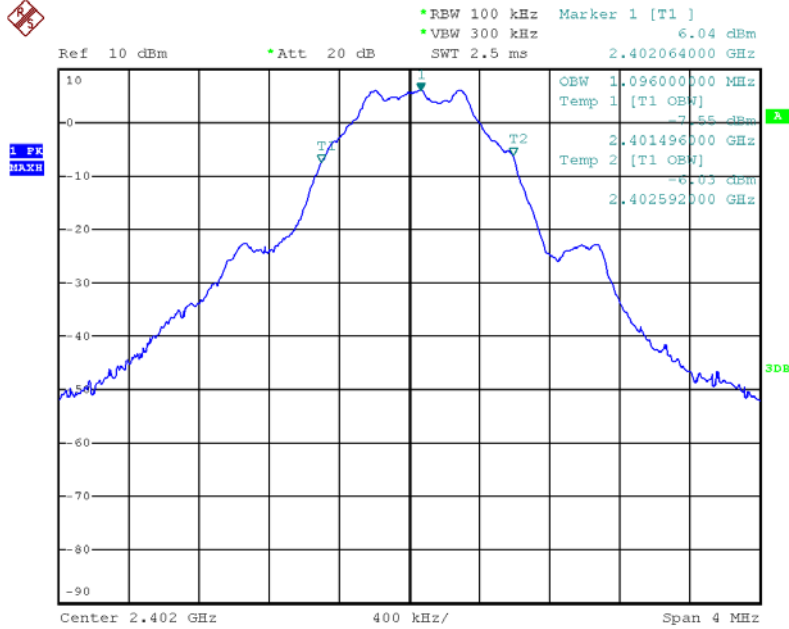
Date: 21.DEC.2018 20:18:12

High channel (2 480 MHz)



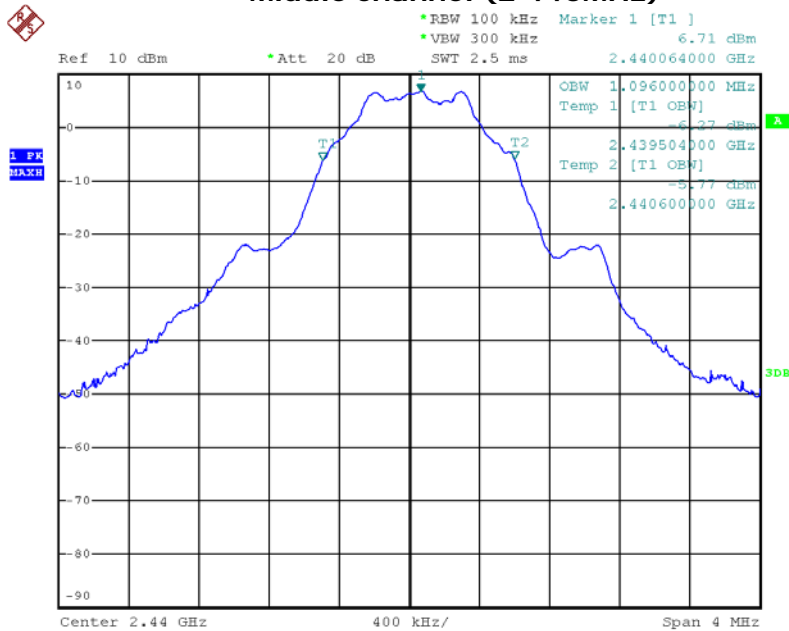
Date: 21.DEC.2018 20:26:35

99% Bandwidth Low channel (2 402 MHz)



Date: 21.DEC.2018 20:13:17

Middle channel (2 440MHz)



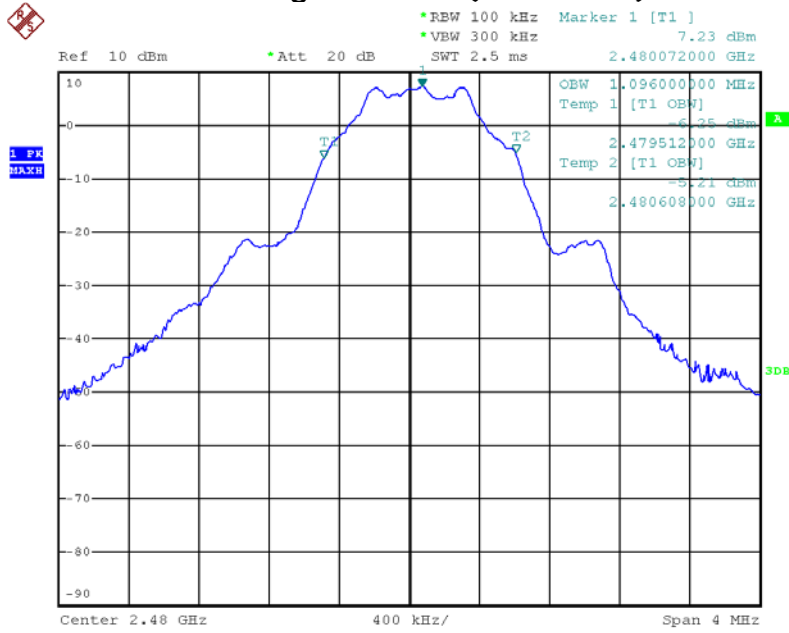
Date: 21.DEC.2018 20:18:39



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-2018-04034
Page (13) / (34) Pages

High channel (2 480 MHz)



Date: 21.DEC.2018 20:26:47



4.2 Maximum peak Conducted Output Power

Test Procedures

KDB 558074 - Section 8.3.1.1
ANSI C63.10-2013 - Section 11.9.1.1
RSS-Gen – Section 6.12

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW \geq DTS bandwidth
- b) VBW \geq 3 x RBW
- c) span \geq 3 x RBW
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode = max hold
- g) Allow trace to fully stabilize
- h) Use peak marker function to determine the peak amplitude level.

Limit :

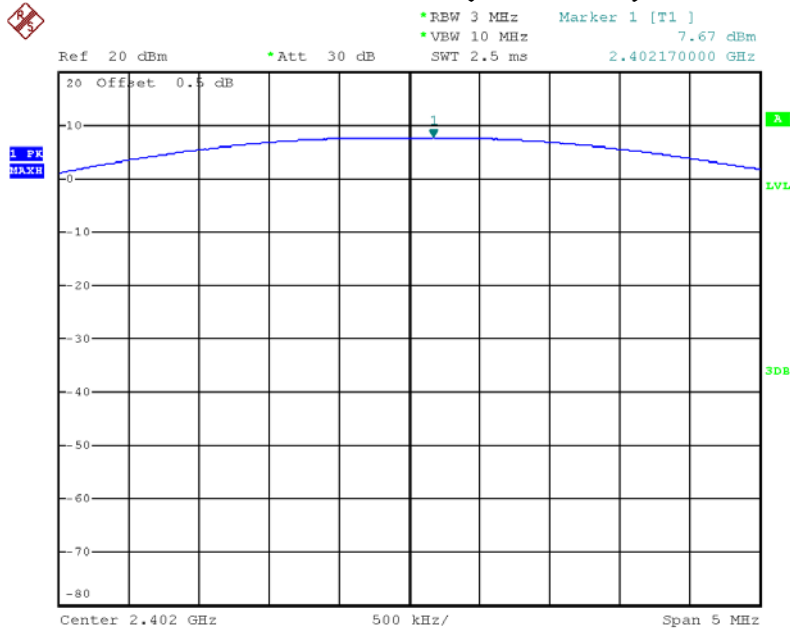
Maximum Output Power < 1 W (30 dBm)

Test Data :

| Frequency (MHz) | Maximum peak Conducted Output Power | | |
|-----------------|-------------------------------------|-------------------|----------|
| | Output power (dBm) | Output power (mW) | Result |
| 2 402 | 7.67 | 5.85 | Complies |
| 2 440 | 8.25 | 6.68 | Complies |
| 2 480 | 8.74 | 7.48 | Complies |

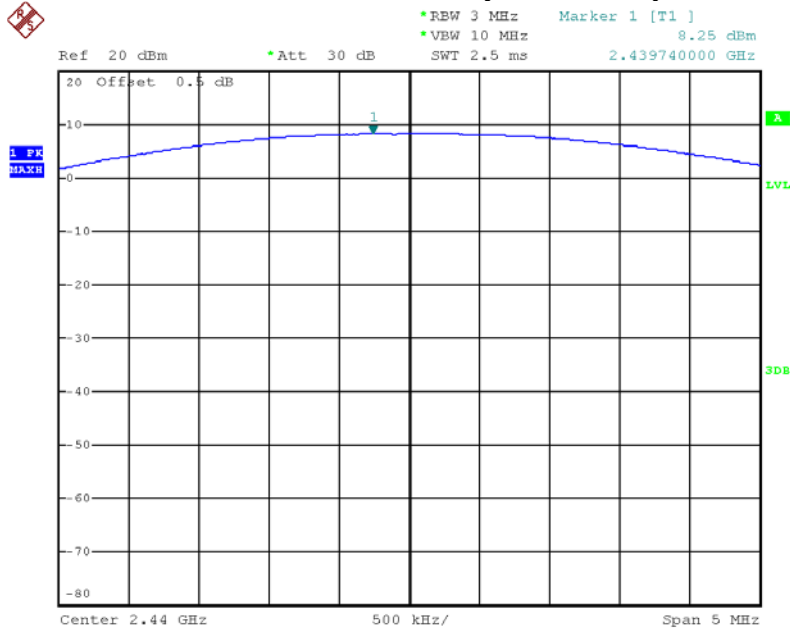
See next pages for actual measured spectrum plots.

Low channel (2 402 MHz)



Date: 21.DEC.2018 20:13:33

Middle channel (2 440 MHz)



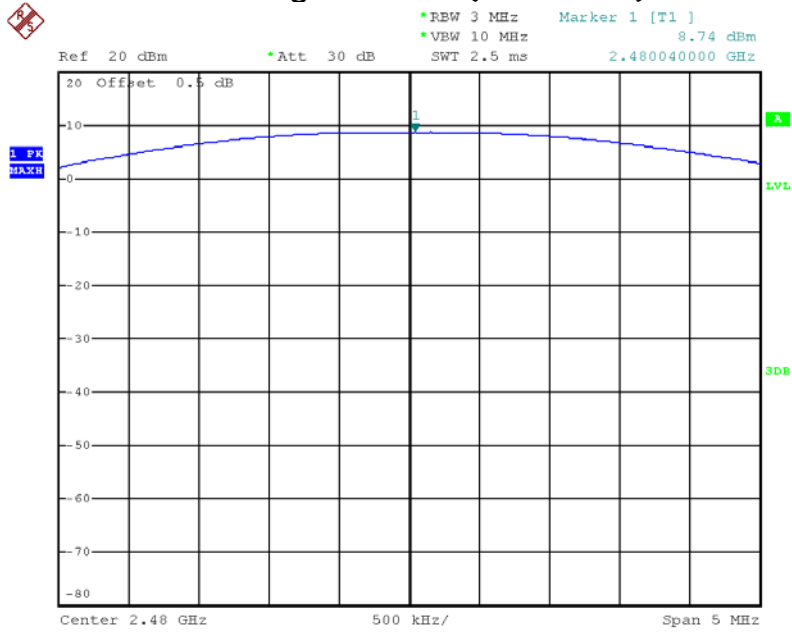
Date: 21.DEC.2018 20:18:55



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-2018-04034
Page (16) / (34) Pages

High channel (2 480 MHz)



Date: 21.DEC.2018 20:27:04



4.3 Transmitter Power Spectral Density

Test Procedures

KDB 558074 - Section 8.4
ANSI C63.10-2013 - Section 11.10.2

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance.

Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW : $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- b) VBW $\geq 3 \times \text{RBW}$
- c) span $\geq 1.5 \times \text{DTS bandwidth}$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode = max hold
- g) Allow trace to fully stabilize
- h) Use the peak marker function to determine the maximum amplitude level within the RBW.

Limit :

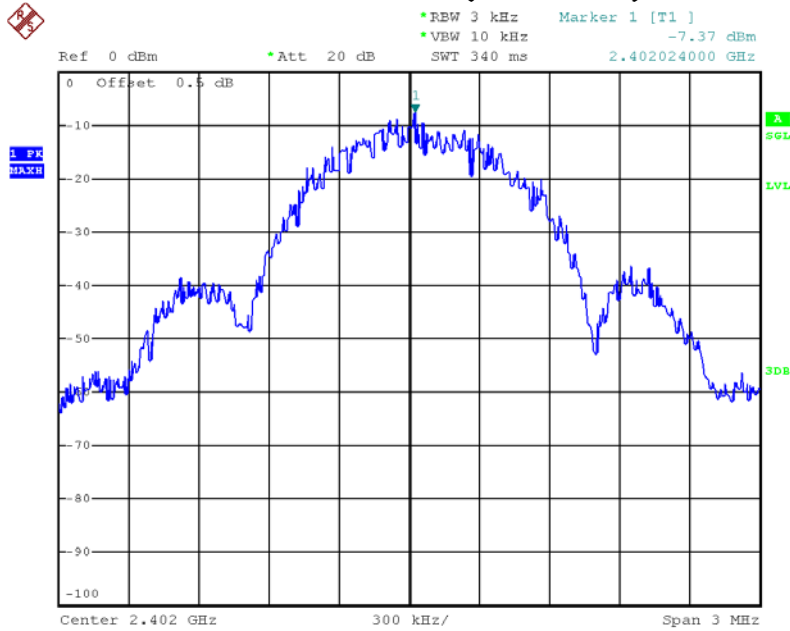
Power Spectral Density < 8dBm @ 3 kHz BW

Test Data :

| Frequency (MHz) | Power Spectral Density | |
|-----------------|------------------------|----------|
| | dBm | Result |
| 2 402 | -7.37 | Complies |
| 2 440 | -6.67 | Complies |
| 2 480 | -6.36 | Complies |

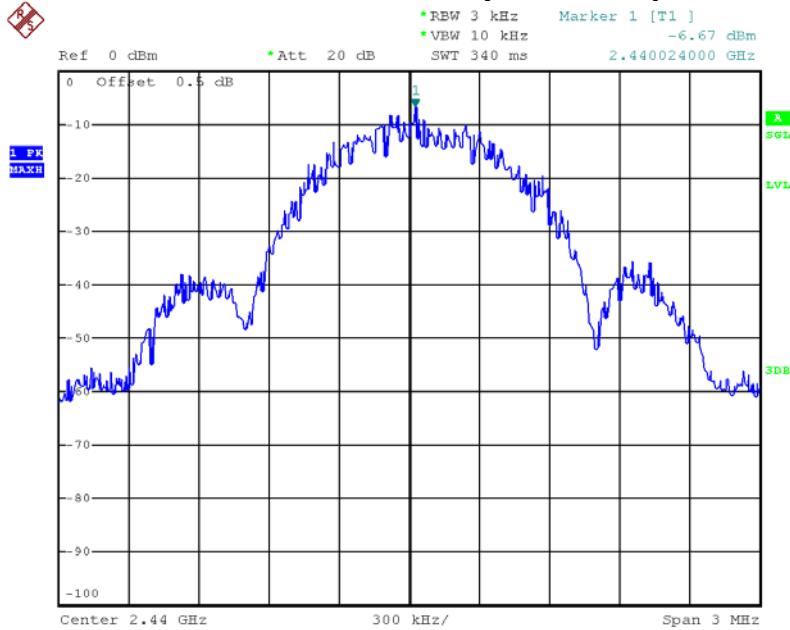
See next pages for actual measured spectrum plots.

Low channel (2 402 MHz)



Date: 21.DEC.2018 20:25:28

Middle channel (2 440 MHz)



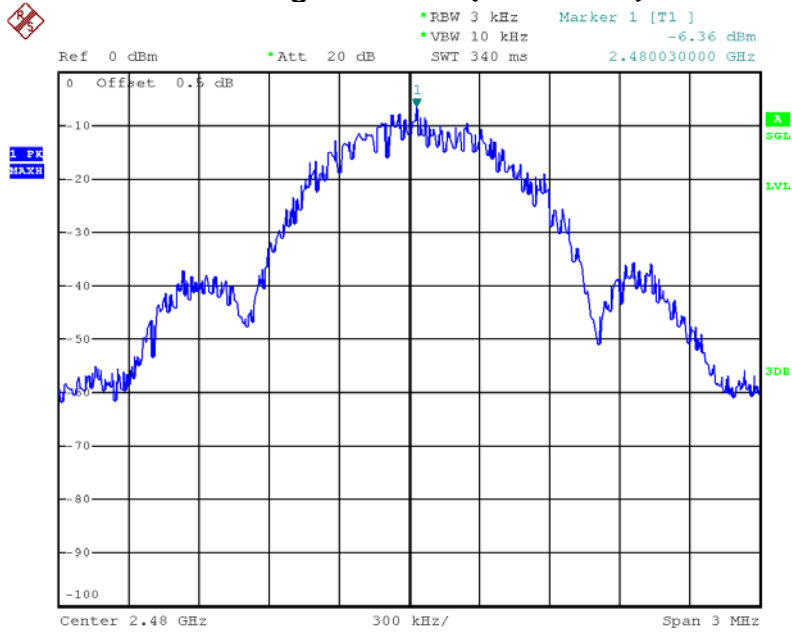
Date: 21.DEC.2018 20:26:08



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-2018-04034
Page (19) / (34) Pages

High channel (2 480 MHz)



Date: 21.DEC.2018 20:27:20



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-2018-04034
Page (20) / (34) Pages

4.4 Conducted Spurious emission

Test Procedures

KDB 558074 - Section 8.5
ANSI C63.10-2013 - Section 11.11.3
RSS-Gen - Section 6.13

The Unwanted emission from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.11 of ANSI C63.10-2013.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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) Sweep time = auto couple
- e) Trace mode = max hold
- f) Allow trace to fully stabilize
- g) Use the peak marker function to determine the maximum amplitude level.

Limit :

Emission level < 20 dBc

Test results: Complies

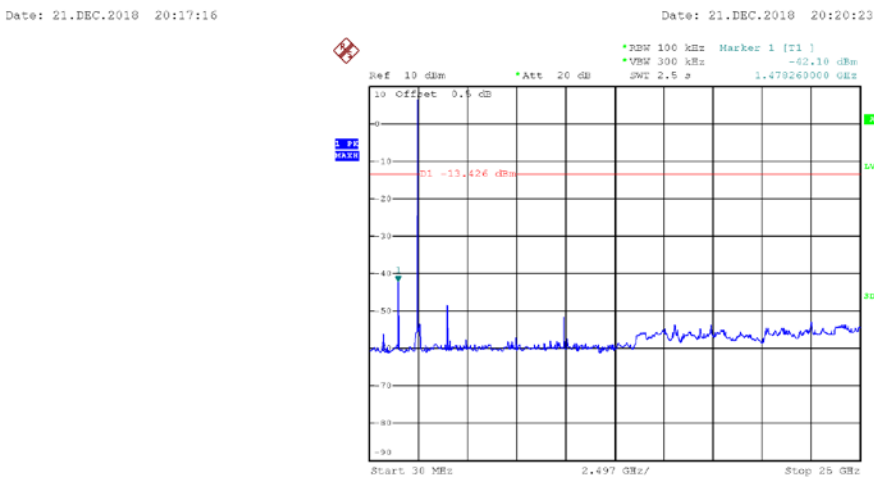
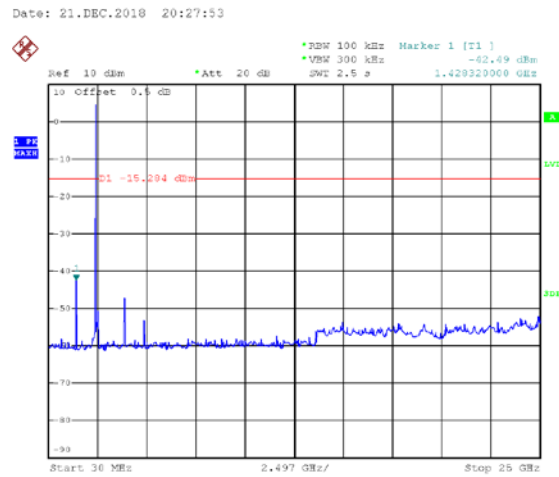
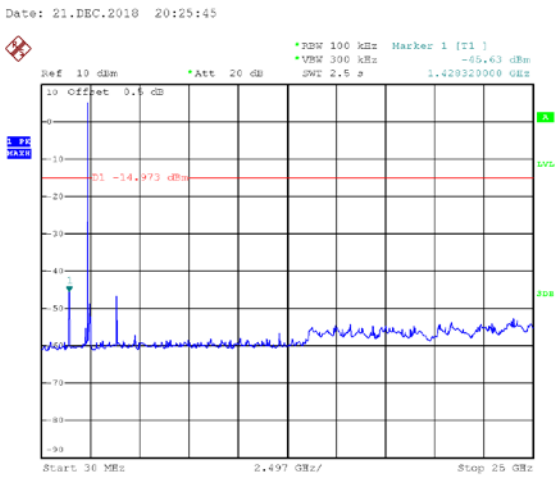
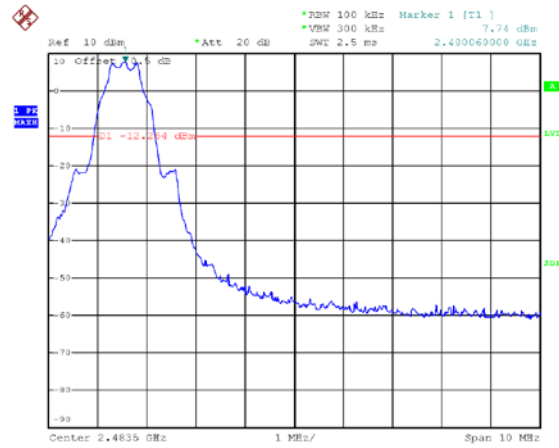
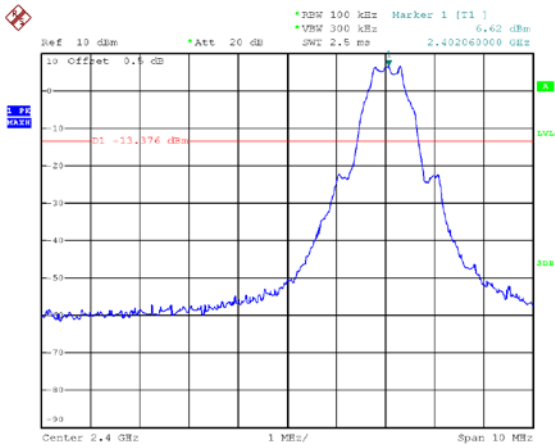
- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest in-band spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.



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-2018-04034
Page (21) / (34) Pages



Date: 21.DEC.2018 20:27:36



4.5 Radiated Emission

Test Location

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

Test Procedures

KDB 558074 - Section 8.5, 8.6
ANSI C63.10-2013 - Section 11.11, 11.12
RSS-Gen - Section 6.13

- 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 ~ 1 GHz

- a) RBW = 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz
- b) VBW \geq RBW
- c) Detector = CISPR Quasi-peak
- d) Sweep time = auto couple

- Peak

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10th harmonic)

- a) RBW = 1 MHz
- b) VBW \geq 3 x RBW
- c) Detector = Peak
- d) Sweep time = auto
- e) Trace mode = max hold

- Average (duty cycle \geq 98%)

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10th harmonic)

- a) RBW = 1 MHz
- b) VBW \geq 3 x RBW
- c) Detector = RMS
- d) Sweep time = auto
- e) Averaging type = power (i.e., RMS)
- f) Trace mode = average (at least 100 traces)



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-2018-04034
 Page (23) / (34) Pages

- Average (duty cycle < 98%, duty cycle variations are less than ±2%)

Frequency Range = 1 GHz ~ 25 GHz (2.4 GHz 10th harmonic)

a) RBW = 1 MHz

b) VBW ≥ 3 x RBW

d) Sweep time = auto

f) Trace mode = average (at least 100 traces)

c) Detector = RMS

e) Averaging type = power (i.e., RMS)

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle.

If power averaging (RMS) mode, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

Duty cycle factor : 1.88 dB

Limit :

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | MHz | MHz | GHz |
|--------------------------|-------------------|---------------------|---------------|-------------|-------------------------|
| 0.09-0.11 | 8.37626-8.38675 | 73-74.6 | 399.9-410 | 2690-2900 | 10.6-12.7 |
| ¹ 0.495-0.505 | 8.41425-8.41475 | 74.8-75.2 | 608-614 | 3260-3267 | 13.25-13.4 |
| 2.1735-2.1905 | 12.29-12.293 | 108-121.94 | 960-1240 | 3332-3339 | 14.47-14.5 |
| 4.125-4.128 | 12.51975-12.52025 | 123-138 | 1300-1427 | 3345.8-3358 | 15.35-16.2 |
| 4.17725-4.17775 | 12.57675-12.57725 | 149.9-150.05 | 1435-1626.5 | 3600-4400 | 17.7-21.4 |
| 4.20725-4.20775 | 13.36-13.41 | 156.52475-156.52525 | 1645.5-1646.5 | 4500-5150 | 22.01-23.12 |
| 6.215-6.218 | 16.42-16.423 | 156.7-156.9 | 1660-1710 | 5350-5460 | 23.6-24 |
| 6.26775-6.26825 | 16.69475-16.69525 | 162.0125-167.17 | 1718.8-1722.2 | 7250-7750 | 31.2-31.8 |
| 6.31175-6.31225 | 16.80425-16.80475 | 167.72-173.2 | 2200-2300 | 8025-8500 | 36.43-36.5 |
| 8.291-8.294 | 25.5-25.67 | 240-285 | 2310-2390 | 9000-9200 | ² Above 38.6 |
| 8.362-8.366 | 37.5-38.25 | 322-335.4 | 2483.5-2500 | 9300-9500 | |

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.



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-2018-04034
Page (24) / (34) Pages

FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

| 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 |

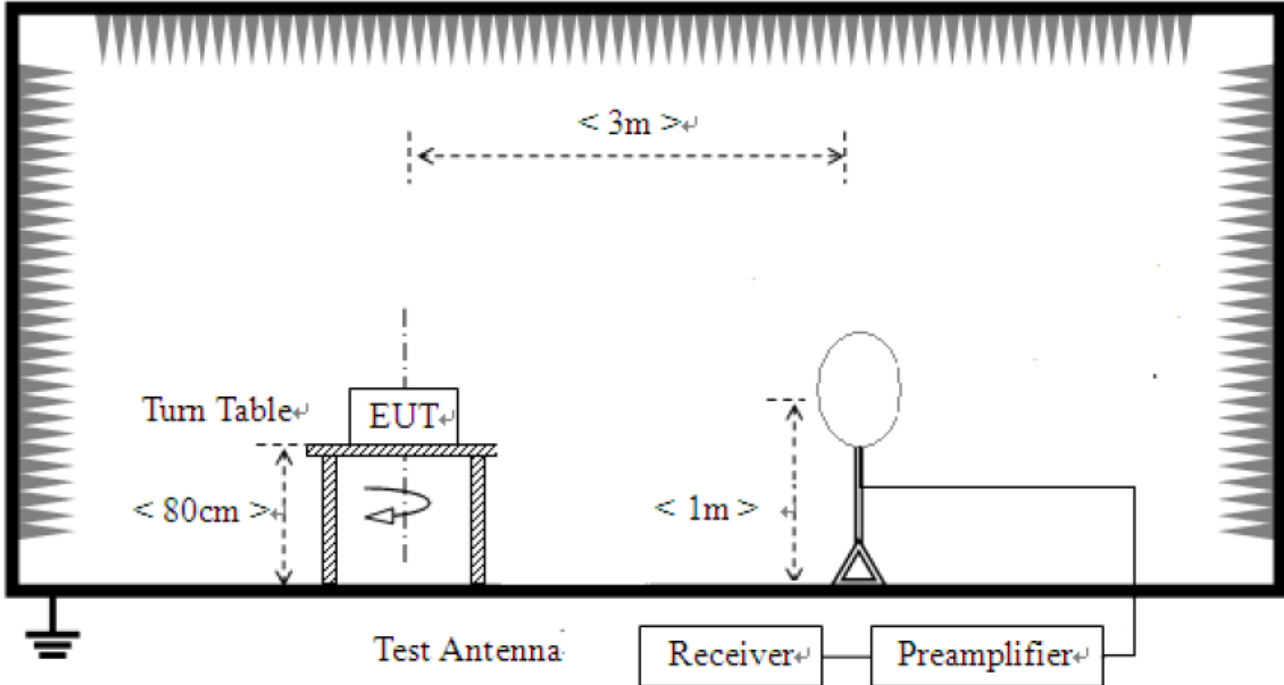
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231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

Note :

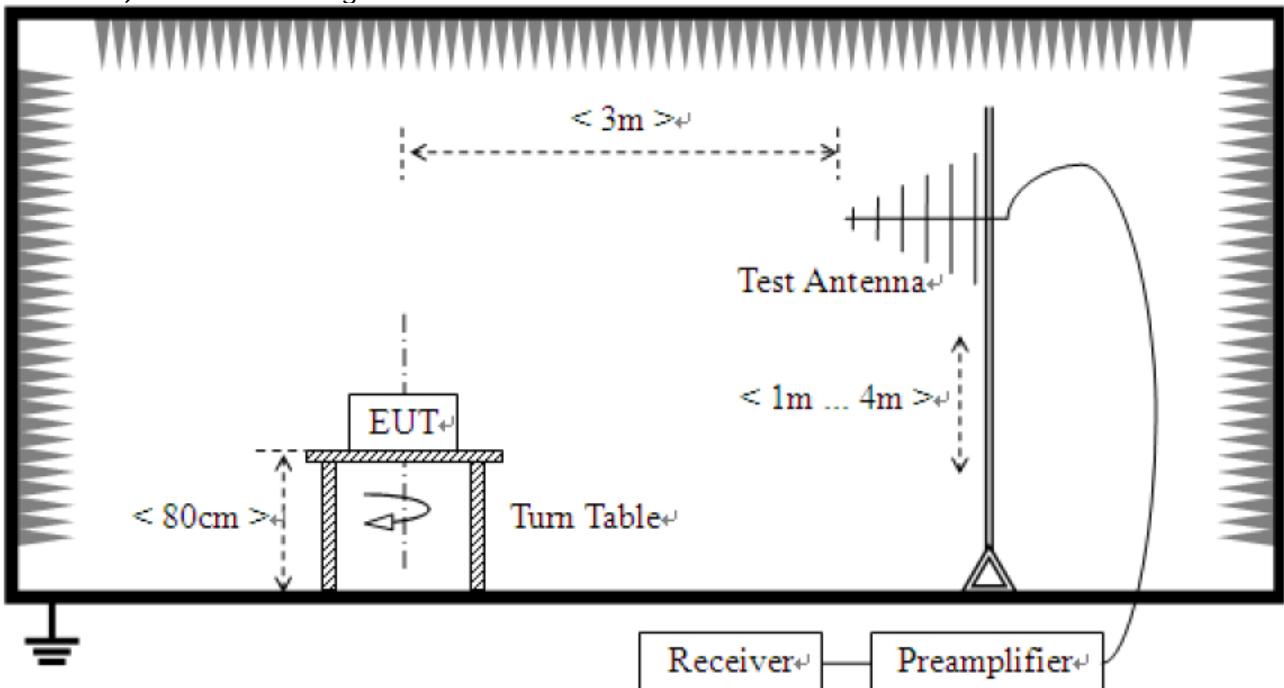
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Setup:

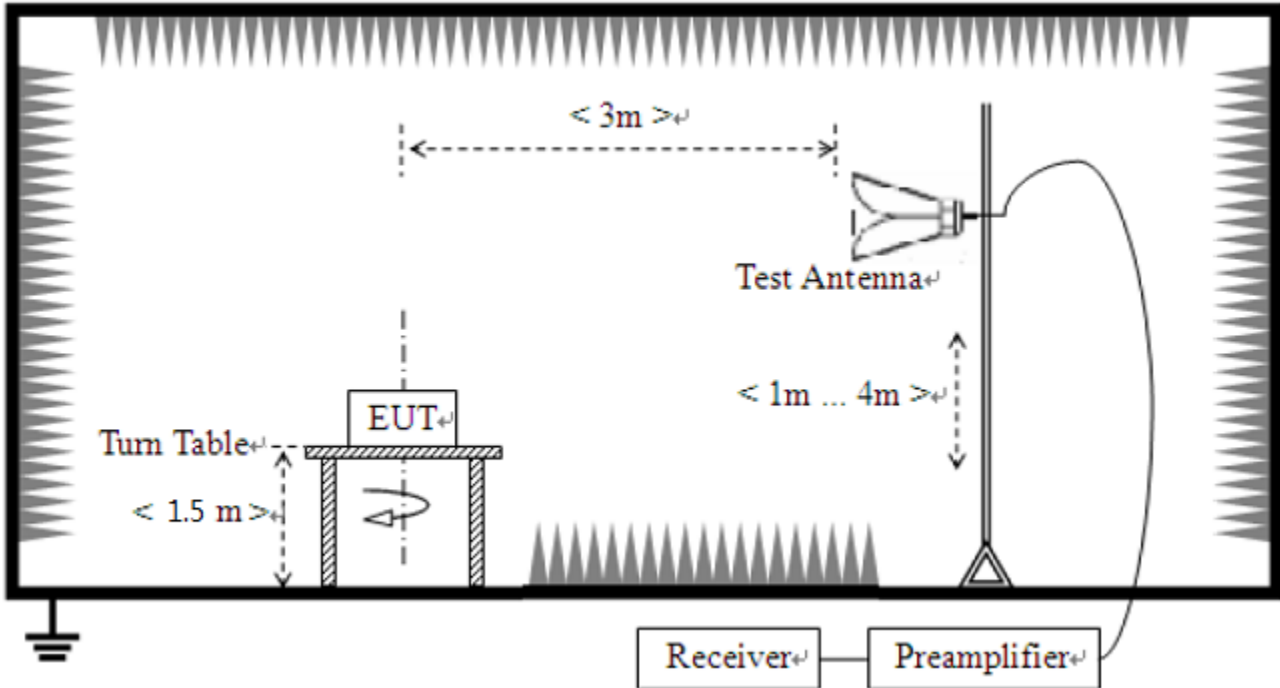
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 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

Test mode : Transmitter

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)

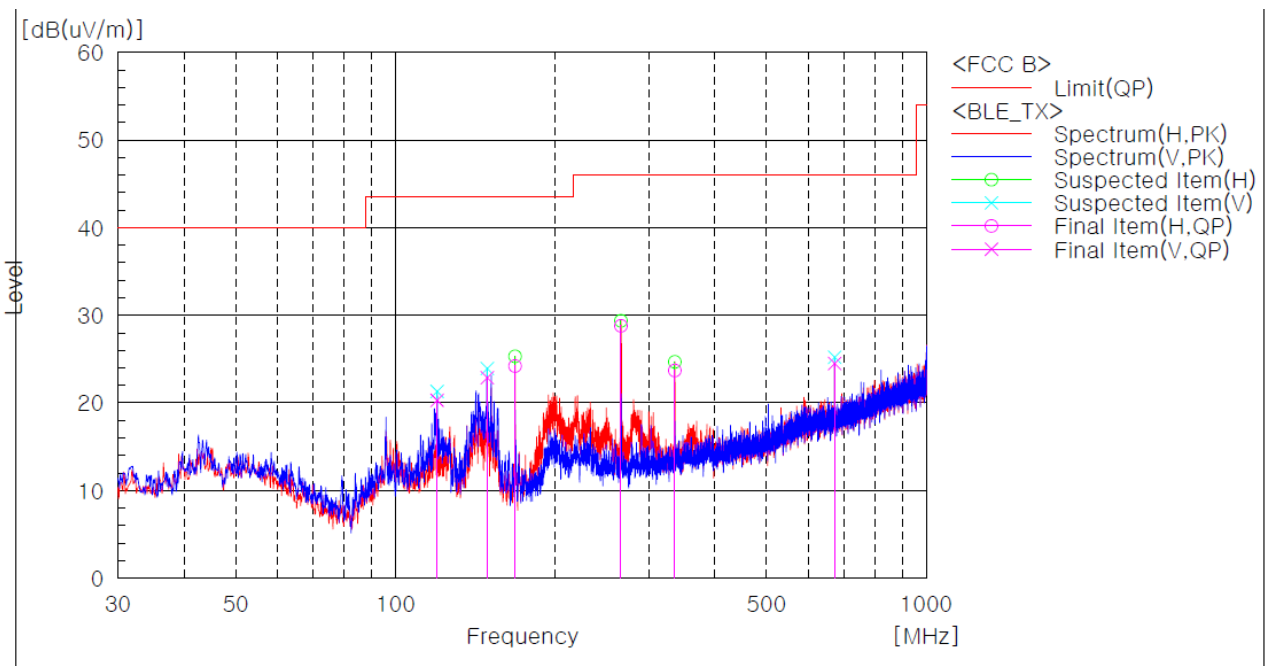
2) 30 MHz to 1 GHz

Test mode : Transmitter (Worst Case)

The requirements are:

Complies

Test Data



Final Result

| No. | Frequency [MHz] | (P) | Reading QP [dB(uV)] | c.f [dB(1/m)] | Result QP [dB(uV/m)] | Limit QP [dB(uV/m)] | Margin QP [dB] | Height [cm] | Angle [deg] | Remark |
|-----|-----------------|-----|---------------------|---------------|----------------------|---------------------|----------------|-------------|-------------|--------|
| 1 | 119.707 | V | 36.1 | -15.8 | 20.3 | 43.5 | 23.2 | 99.8 | 258.5 | |
| 2 | 148.775 | V | 40.4 | -17.5 | 22.9 | 43.5 | 20.6 | 99.8 | 234.2 | |
| 3 | 167.935 | H | 41.0 | -16.8 | 24.2 | 43.5 | 19.3 | 99.8 | 317.3 | |
| 4 | 265.916 | H | 41.3 | -12.5 | 28.8 | 46.0 | 17.2 | 99.8 | 169.5 | |
| 5 | 336.027 | H | 35.1 | -11.4 | 23.7 | 46.0 | 22.3 | 99.8 | 0.0 | |
| 6 | 671.993 | V | 31.5 | -7.0 | 24.5 | 46.0 | 21.5 | 99.8 | 258.5 | |

Remark :

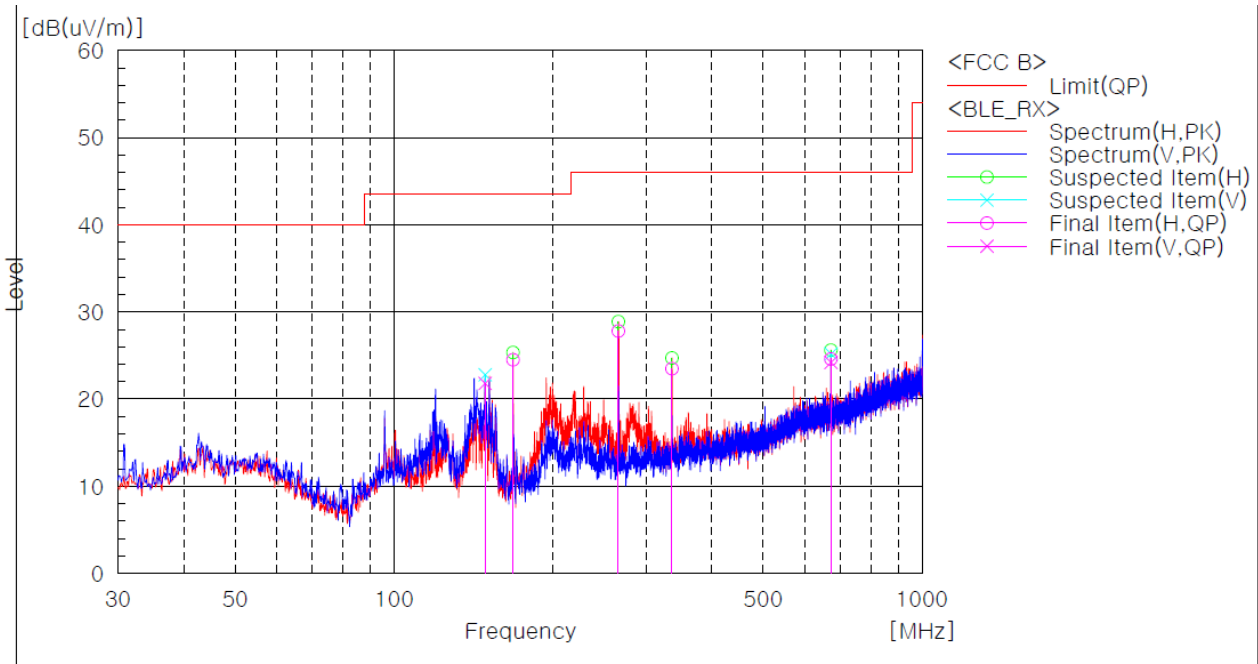
1. The EUT was tested in three orientations in order to determine that "Y axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

Test mode : Receiver (Worst Case)

The requirements are:

Complies

Test Data



Final Result

| No. | Frequency [MHz] | (P) | Reading QP [dB(uV)] | c.f [dB(1/m)] | Result QP [dB(uV/m)] | Limit QP [dB(uV/m)] | Margin QP [dB] | Height [cm] | Angle [deg] | Remark |
|-----|-----------------|-----|---------------------|---------------|----------------------|---------------------|----------------|-------------|-------------|--------|
| 1 | 148.666 | V | 39.3 | -17.5 | 21.8 | 43.5 | 21.7 | 99.8 | 202.3 | |
| 2 | 167.935 | H | 41.3 | -16.8 | 24.5 | 43.5 | 19.0 | 99.8 | 317.3 | |
| 3 | 266.025 | H | 40.3 | -12.5 | 27.8 | 46.0 | 18.2 | 99.8 | 164.8 | |
| 4 | 336.027 | H | 34.9 | -11.4 | 23.5 | 46.0 | 22.5 | 99.8 | 3.3 | |
| 5 | 671.884 | V | 31.2 | -7.0 | 24.2 | 46.0 | 21.8 | 99.8 | 268.2 | |
| 6 | 671.993 | H | 31.6 | -7.0 | 24.6 | 46.0 | 21.4 | 99.8 | 329.5 | |

Remark :

1. The EUT was tested in three orientations in order to determine that "Y axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain



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-2018-04034
Page (29) / (34) Pages

3) above 1 GHz

Test mode : Transmitter

The requirements are:

Complies

Test Data

Low (2 402 MHz)

| Frequency [MHz] | (P) | Limit AV [dBuV/m] | Limit PK [dBuV/m] | Result AV [dBuV/m] | Result PK [dBuV/m] | Margin AV [dB] | Margin PK [dB] |
|-----------------|-----|-------------------|-------------------|--------------------|--------------------|----------------|----------------|
| 1 440.75 | V | 54.00 | 74.00 | 44.11 | 54.30 | 9.89 | 19.70 |
| 2 378.07 | V | 54.00 | 74.00 | 36.48 | 43.60 | 17.52 | 30.40 |
| 4 804.05 | H | 54.00 | 74.00 | 36.98 | 44.90 | 17.02 | 29.10 |
| 4 804.06 | V | 54.00 | 74.00 | 38.28 | 46.50 | 15.72 | 27.50 |

Mid (2 440 MHz)

| Frequency [MHz] | (P) | Limit AV [dBuV/m] | Limit PK [dBuV/m] | Result AV [dBuV/m] | Result PK [dBuV/m] | Margin AV [dB] | Margin PK [dB] |
|-----------------|-----|-------------------|-------------------|--------------------|--------------------|----------------|----------------|
| 4 879.56 | H | 54.00 | 74.00 | 38.48 | 47.10 | 15.52 | 26.90 |
| 4 880.03 | V | 54.00 | 74.00 | 41.38 | 50.80 | 12.62 | 23.20 |

High (2 480 MHz)

| Frequency [MHz] | (P) | Limit AV [dBuV/m] | Limit PK [dBuV/m] | Result AV [dBuV/m] | Result PK [dBuV/m] | Margin AV [dB] | Margin PK [dB] |
|-----------------|-----|-------------------|-------------------|--------------------|--------------------|----------------|----------------|
| 4 959.99 | H | 54.00 | 74.00 | 40.28 | 48.90 | 13.72 | 25.10 |
| 4 960.02 | V | 54.00 | 74.00 | 41.28 | 52.30 | 12.72 | 21.70 |

Remarks

1. The EUT was tested in three orientations in order to determine that "Y axis" was the worst case.



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-2018-04034
Page (30) / (34) Pages

Test mode : Receiver

The requirements are:

Complies

Test Data

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

The emissions above 1 GHz were 20 dB lower than the limit.

Remarks

1. The EUT was tested in three orientations in order to determine that "Y axis" was the worst case.



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-2018-04034
Page (31) / (34) Pages

4.6 AC Conducted Emissions

Frequency Range of Measurement

150 kHz to 30 MHz

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

RSS-Gen - Section 8.8

Module has been tested by mounting the End product(Printer).

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

- 15.207(a)

| 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.

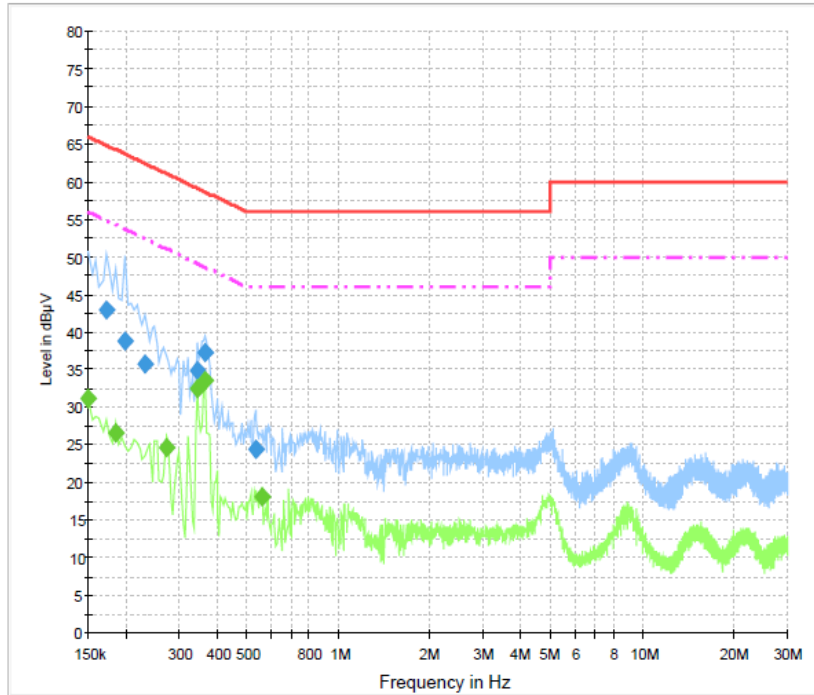
Test Results

The requirements are:

Complies

Test Data

[LINE]
Class B_L1



Final Result 1

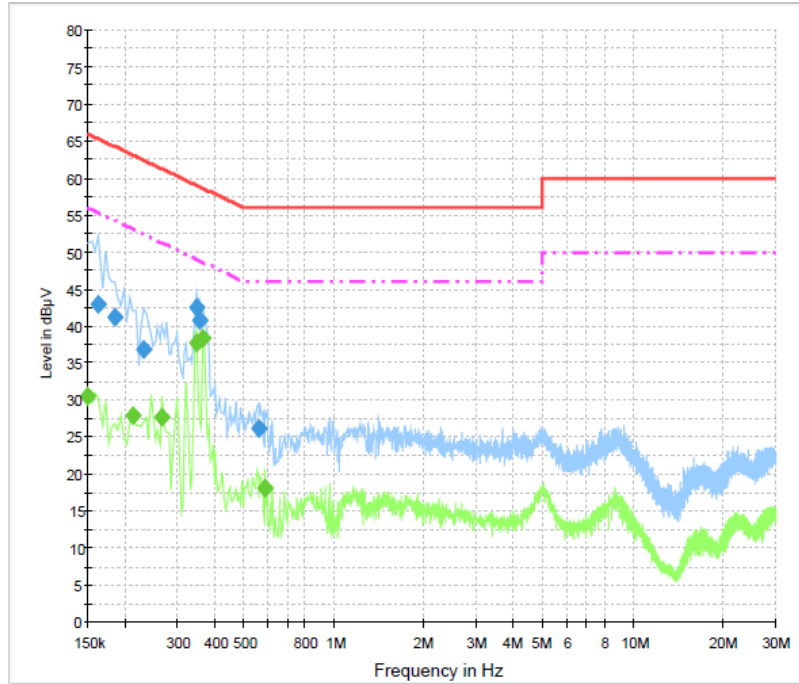
| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.172500 | 43.0 | 1000.0 | 9.000 | On | L1 | 9.8 | 21.8 | 64.8 |
| 0.199500 | 38.8 | 1000.0 | 9.000 | On | L1 | 9.9 | 24.8 | 63.6 |
| 0.231000 | 35.7 | 1000.0 | 9.000 | On | L1 | 9.8 | 26.7 | 62.4 |
| 0.343500 | 35.0 | 1000.0 | 9.000 | On | L1 | 9.9 | 24.1 | 59.1 |
| 0.366000 | 37.3 | 1000.0 | 9.000 | On | L1 | 9.9 | 21.3 | 58.6 |
| 0.532500 | 24.4 | 1000.0 | 9.000 | On | L1 | 9.9 | 31.6 | 56.0 |

Final Result 2

| Frequency (MHz) | CAverage (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.150000 | 31.1 | 1000.0 | 9.000 | On | L1 | 9.8 | 24.9 | 56.0 |
| 0.186000 | 26.6 | 1000.0 | 9.000 | On | L1 | 9.9 | 27.7 | 54.2 |
| 0.271500 | 24.7 | 1000.0 | 9.000 | On | L1 | 9.8 | 26.3 | 51.1 |
| 0.343500 | 32.5 | 1000.0 | 9.000 | On | L1 | 9.9 | 16.6 | 49.1 |
| 0.366000 | 33.6 | 1000.0 | 9.000 | On | L1 | 9.9 | 15.0 | 48.6 |
| 0.564000 | 18.1 | 1000.0 | 9.000 | On | L1 | 9.9 | 27.9 | 46.0 |

[NEUTRAL]

Class B_N



Final Result 1

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.163500 | 43.0 | 1000.0 | 9.000 | On | N | 9.8 | 22.2 | 65.3 |
| 0.186000 | 41.1 | 1000.0 | 9.000 | On | N | 9.9 | 23.1 | 64.2 |
| 0.231000 | 36.8 | 1000.0 | 9.000 | On | N | 9.7 | 25.7 | 62.4 |
| 0.348000 | 42.5 | 1000.0 | 9.000 | On | N | 9.9 | 16.5 | 59.0 |
| 0.357000 | 40.9 | 1000.0 | 9.000 | On | N | 9.9 | 17.9 | 58.8 |
| 0.559500 | 26.1 | 1000.0 | 9.000 | On | N | 9.9 | 29.9 | 56.0 |

Final Result 2

| Frequency (MHz) | CAverage (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.150000 | 30.5 | 1000.0 | 9.000 | On | N | 9.8 | 25.5 | 56.0 |
| 0.213000 | 28.0 | 1000.0 | 9.000 | On | N | 9.8 | 25.1 | 53.1 |
| 0.267000 | 27.7 | 1000.0 | 9.000 | On | N | 9.7 | 23.6 | 51.2 |
| 0.348000 | 37.8 | 1000.0 | 9.000 | On | N | 9.9 | 11.2 | 49.0 |
| 0.366000 | 38.5 | 1000.0 | 9.000 | On | N | 9.9 | 10.1 | 48.6 |
| 0.591000 | 18.1 | 1000.0 | 9.000 | On | N | 9.9 | 27.9 | 46.0 |



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-2018-04034
 Page (34) / (34) Pages

APPENDIX A – Test Equipment Used For Tests

| | Name of Equipment | Manufacturer | Model No. | Serial No. | Cal Date | Due Date |
|----|---------------------------|--------------------|--------------|---------------|------------|------------|
| 1 | Signal Analyzer | R&S | FSP-30 | 100994 | 2018-10-25 | 2019-10-25 |
| 2 | Signal Generator | Rohde & Schwarz | SMB100A | 175528 | 2018-10-24 | 2019-10-24 |
| 3 | EMI Test Receiver | Rohde & Schwarz | ESCI3 | 100032 | 2018-01-31 | 2019-01-31 |
| 4 | Bilog Antenna | Schaffner | CBL6111C | 2551 | 2018-05-10 | 2020-05-10 |
| 5 | Active Loop Antenna | SCHWARZBECK | FMZB 1513 | 1513-125 | 2018-05-02 | 2020-05-02 |
| 6 | 6dB Attenuator | R&S | DNF | 272.4110.50-2 | 2018-10-25 | 2019-10-25 |
| 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 | Preamplifier | Agilent | 8449B | 3008A02011 | 2018-12-03 | 2019-12-03 |
| 10 | Horn Antenna | ETS-Lindgren | 3116 | 00062504 | 2017-12-04 | 2019-12-04 |
| 11 | Horn Antenna | ETS-Lindgren | 3117 | 00154525 | 2017-09-14 | 2019-09-14 |
| 12 | Band Reject Filter | Micro Tronics | BRM50702 | G233 | 2018-01-26 | 2019-01-26 |
| 13 | LISN | Rohde & Schwarz | ENV216 | 101760 | 2018-01-31 | 2019-01-31 |
| 14 | Singnal Canditioning Unit | R&S | SCU-40 | 10023 | 2018-10-24 | 2019-10-24 |
| 15 | RF Cable | Canare Corporation | L-5D2W | N/A | - | - |
| 16 | RF Cable | Junkosha Inc. | MWX221 | 1510S085 | - | - |
| 17 | RF Cable | HUBER+SUHNER | SUCOFLEX 102 | MY073/2 | - | - |
| 18 | RF Cable | HUBER+SUHNER | SUCOFLEX 102 | MY4728/2 | - | - |
| 19 | RF Cable | HUBER+SUHNER | SUCOFLEX 104 | MY27558/4 | - | - |
| 20 | RF Cable | HUBER+SUHNER | SUCOFLEX 104 | N/A | - | - |
| 21 | RF Cable | HUBER+SUHNER | SUCOFLEX 104 | MY27573/4 | - | - |
| 22 | RF Cable | HUBER+SUHNER | SUCOFLEX 106 | N/A | - | - |