

CERTIFICATION TEST REPORT

FCC CFR47 Part 15 Subpart C

| | | | |
|----------------------|---|---|------------------------------------|
| Test Report File No. | 14-IST-0299 | <input checked="" type="checkbox"/> Basic | <input type="checkbox"/> Alternate |
| Date of Receipt | April 09, 2014 | Begin of test date | May 08, 2014 |
| Date of Issue | May 21, 2014 | End of test date | May 16, 2014 |
| Kind of Product | Bluetooth Stereo Headset | | |
| Model(s) | Groove | | |
| FCC ID | 2ACABGROOVE | | |
| Applicant | Byzero Inc. | | |
| Address | Jeonpa-ro 44beon-gil 36 2F, Manan-gu, Anyang-si, Gyeonggi-do, Korea | | |
| Manufacturer | Byzero Inc. | | |
| Address | Jeonpa-ro 44beon-gil 36 2F, Manan-gu, Anyang-si, Gyeonggi-do, Korea | | |

Test Result

Positive

Negative

Tested By



B.O. KO.

Reviewed By



S.J. CHO

Comment(s)

- Investigations requested : Measurement to the relevant clauses of FCC rules and regulations Part 15 Subpart C.
- The test report is consists of 40 pages.
- The test result only responds to the tested sample.
- It is not allowed to copy this report even partly without the allowance of IST Co., Ltd.
- This equipment as for has been shown to be capable of continued compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4

I assume full responsibility for accuracy and completeness of these data.



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Note:

INFORMATIONS OF TEST LABORATORY

EMC LABORATORY of IST Co., Ltd.
 52-20, Sinjeong-ro 41beon-gil, Giheung-gu,
 Yongin-si, Gyeonggi-do, Korea
 TEL: +82 31 326 6700 FAX: +82 31 326 6797

VCCI Registration No. : 1739
 FCC Registration No. : 400603
 KCC Registration No. : KR0018
 KOLAS Registration No. : KT118



Measurement Uncertainty

| | |
|--|--|
| Conducted Emissions | $U = 2.98$ [dB] (Confidence level approximately 95 %, $k = 2$) |
| Radiated Emissions (Antenna - Horizontal) | $U = 3.83$ [dB] (Confidence level approximately 95 %, $k = 2$) |
| Radiated Emissions (Antenna - Vertical) | $U = 4.50$ [dB] (Confidence level approximately 95 %, $k = 2$) |

PRODUCT INFORMATION

| Bluetooth Stereo Headset(Groove) | Specification |
|----------------------------------|--------------------------------------|
| Bluetooth | V3.0, Headset /A2DP/AVRCP Profile |
| Battery | 3.7 V/ 250 mAh (Lithium Ion Polymer) |
| Standby | Max 625 hours |
| Distance | Within 10 m |
| Operating Temperature Range | -10 °C ~ 50 °C |
| Frequency Range | 2.402 GHz ~ 2.480 GHz ISN Band |
| Remark | - |

Test Mode :

Mode 1: Transmit (DH5)

Mode 2: Transmit (3DH5)

1. DH5 is for GFSK modulation, and 3DH5 is for Pi/4 DQPSK
2. Regards to the frequency band operation; the highest that was included the lowest, middle and highest frequency of channel were selected to perform the test, and then shown on this report.

- Please refer to user's manual.

SUMMARY

Bluetooth Mode(2402MHz ~2480MHz)

Applied Standard : FCC CRF Part 15 Subpart C

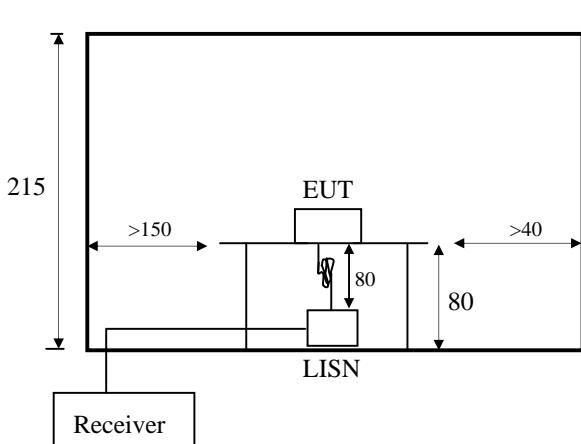
| Description of Test | FCC Rule Parts | Results |
|-------------------------------------|---------------------------|-----------|
| AC Conducted Emission | 15.207 | Compliant |
| Carrier Frequency Separation | 15.247(a)(1) | Compliant |
| 20 dB Bandwidth | 15.247(a)(1)(ii) or (iii) | Compliant |
| Time of Occupancy | 15.247(a)(1)(ii) or (iii) | Compliant |
| Number of Hopping Frequencies | 15.247(a)(1)(ii) or (iii) | Compliant |
| Conducted Maximum Peak Output Power | 15.247(b)(1) | Compliant |
| Spurious RF Conducted Emission | 15.247(d) | Compliant |
| Spurious Radiated Emission | 15.247(d), 15.209 | Compliant |
| Receiver Spurious Emission | | Compliant |
| Out-of- Band Emission | 15.247(d) | Compliant |
| Occupied Bandwidth | | Compliant |

Conducted Emissions:

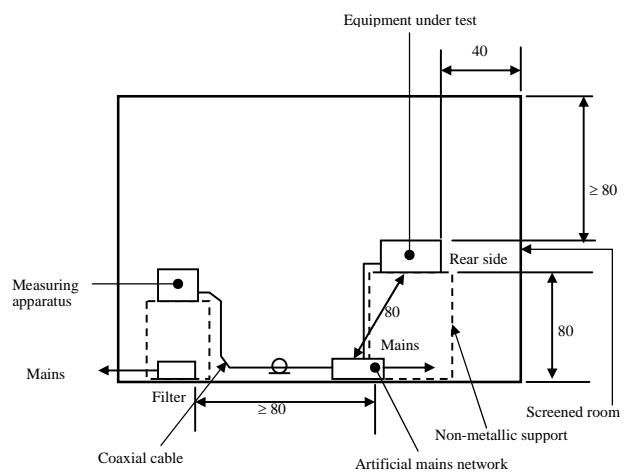
The measurement were performed over the frequency range of 0.15 MHz to 30 MHz using a $50 \Omega/50 \mu\text{H}$ LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 10 kHz or for "quasi-peak" & "Average" within a bandwidth of 9 KHz.

- Procedure of Test

The line-conducted facility is located inside a shielded room No.1. A 1 m X 1.5 m wooden table 80 cm height is placed 40 cm away from the vertical wall and 1.5 m away from the other wall of the shielded room. The R/S ESCI and Hyup-Rip KNW-407 LISN are bonded to bottom of the shielded room. The EUT is located on the wooden table with distance more than 80 cm from the LISN and powered from the EMC LISN. The peripheral equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner $\phi 1.2$ cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the EMC LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating conditions. The RF output of the LISN was connected to the R/S receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using Quasi-Peak mode by manual measurement, after scanned by automatic Peak mode for frequency range from 0.15 to 30 MHz. The bandwidth of the receiver was set to 10 kHz. The EUT, peripheral equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.



< Side View >



< Concept Drawing >

Limits

According to §15.207(a) except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency Range (MHz) | Limits | |
|--------------------------|------------|-----------|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56* | 56 to 46* |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

Test specification.

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207

Conducted Emissions

[Applicable]

◆ Test Equipment Used

| Model Name | Description | Manufacturer | Due for Cal | Serial No. |
|------------|---------------|-----------------|---------------|------------|
| ESCI | Test Receiver | Rohde & Schwarz | Jul. 16, 2014 | 100373 |
| ENV216 | LISN | Rohde & Schwarz | Dec. 09, 2014 | 101718 |

Note : The equipment used is calibrated in regular for every year.

◆ Test Accessories Used

| Equipment | Type | Brand | Serial No. |
|--|------------------|---|-------------------|
| Bluetooth Stereo Headset | Groove | Byzero Inc. | N/A |
| Laptop Adapter (Laptop) | LGR40 PA-1900-08 | LG Electronics Dongguang Lite Power 2nd Plant | 705KSLP024816 N/A |
| radio equipment for mobile communication | SHV-E210K | Samsung Electronics. | R33C710VHEV |

Connecting Interface Cables :

AC Power Cable : 1.8 m (Unshielded)

USB Cable (Micro 5pin to USB) : 1.0 m (shielded)

◆ Test Conditions

| | |
|-------------|-----------------------|
| Temperature | (21.2 ± 0.2) °C |
| Humidity | (45.8 ± 0.2) % R.H. |
| Atmosphere | (1000) mbar |

◆ Test Area

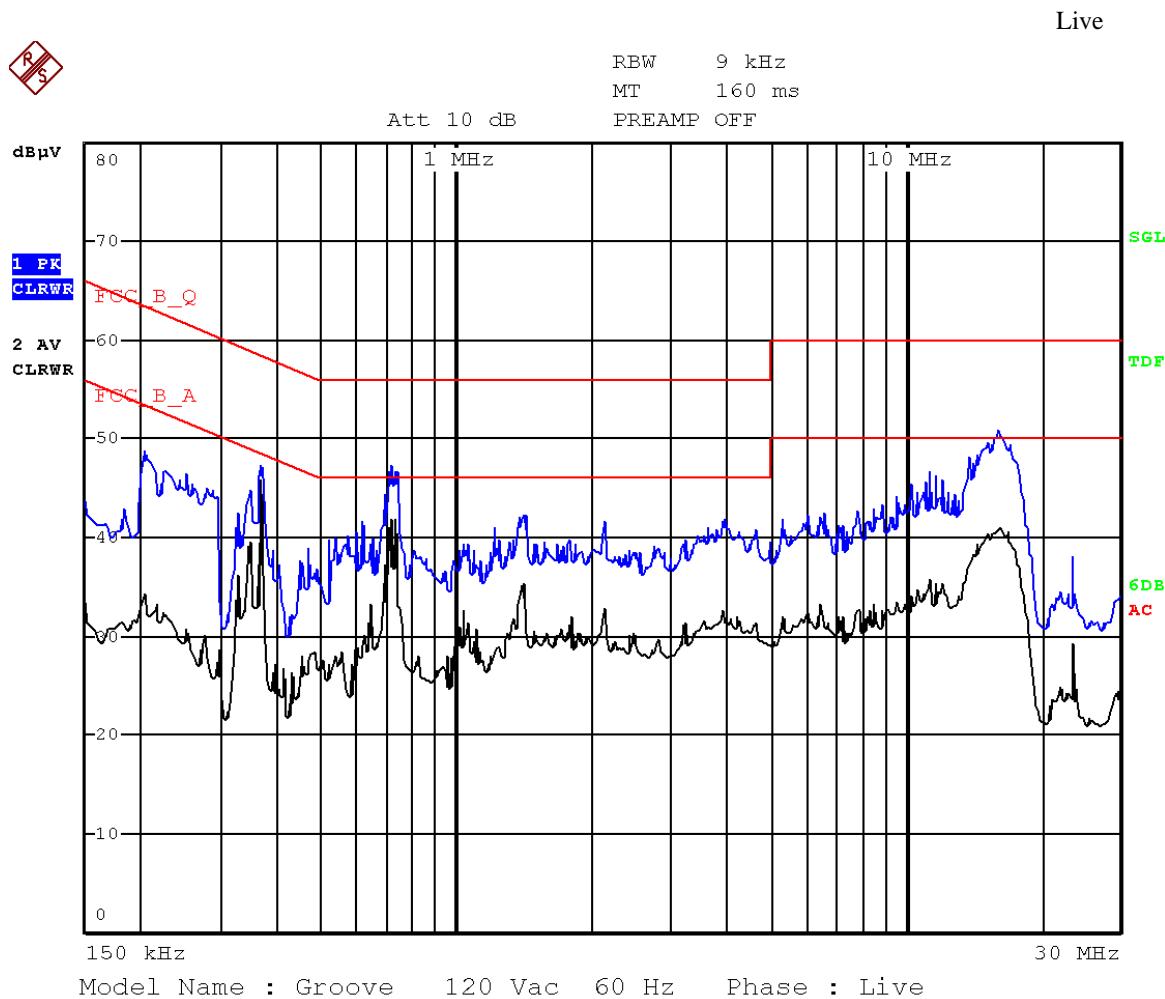
Conducted Room #1

◆ Test Date

May 08, 2014

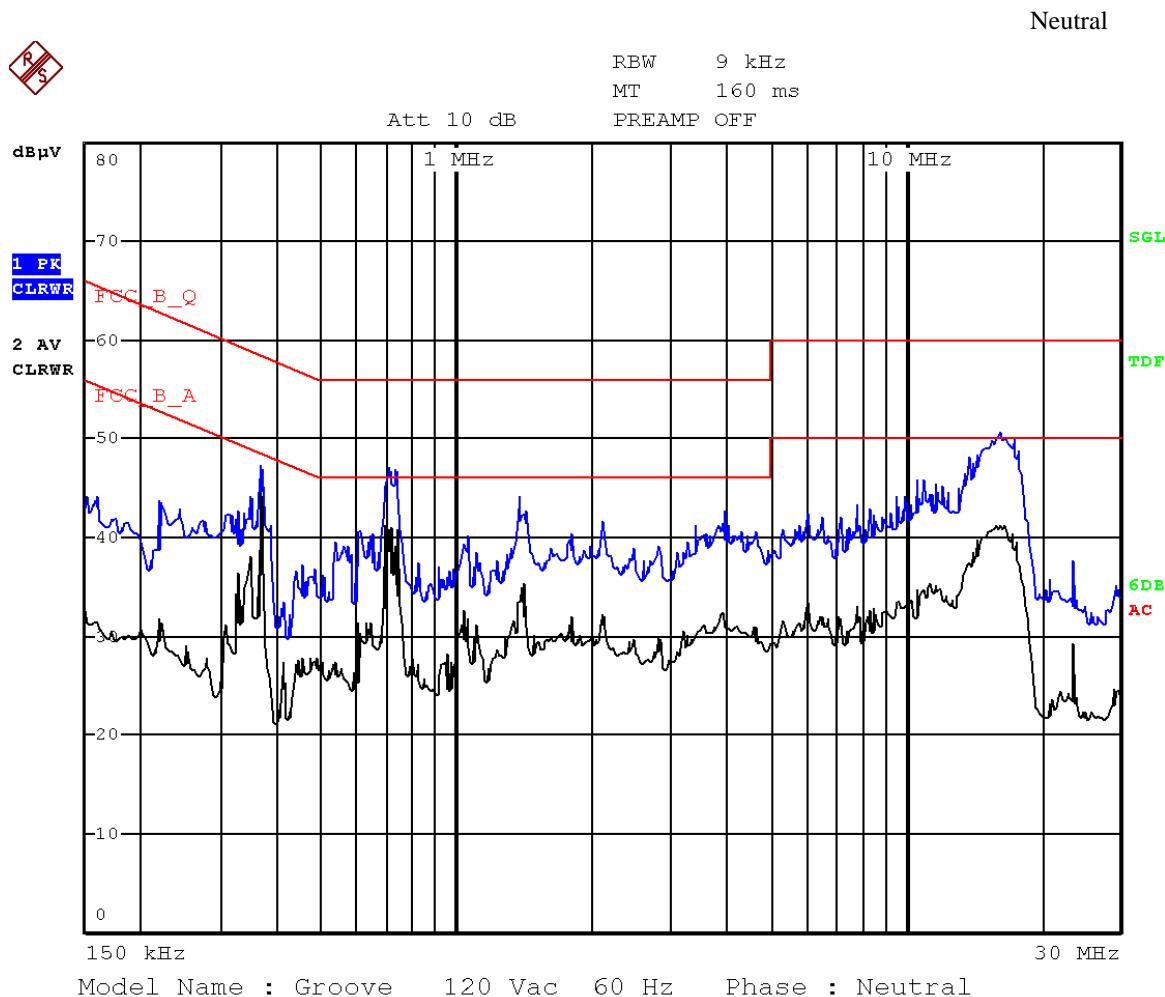
Note :

Conducted Emissions result



| Freq. [MHz] | Measurement [dB μ V] | | Limit [dB μ V] | | Insertion Loss [dB] | Cable Loss [dB] | Result [dB μ V] | | Margin [dB] | |
|----------------|-----------------------------|---------|-----------------------|---------|---------------------------|-----------------------|------------------------|---------|----------------|---------|
| | Q-peak | Average | Q-peak | Average | | | Q-peak | Average | Q-peak | Average |
| 0.366 | 36.76 | 35.09 | 58.59 | 48.59 | 9.55 | 0.13 | 46.44 | 44.77 | 12.15 | 3.82 |
| 0.714 | 35.55 | 32.20 | 56.00 | 46.00 | 9.56 | 0.09 | 45.20 | 41.85 | 10.80 | 4.15 |
| 1.412 | 29.73 | 25.47 | 56.00 | 46.00 | 9.56 | 0.10 | 39.39 | 35.13 | 16.61 | 10.87 |
| 2.134 | 27.03 | 22.61 | 56.00 | 46.00 | 9.57 | 0.11 | 36.71 | 32.29 | 19.29 | 13.71 |
| 11.334 | 30.46 | 25.15 | 60.00 | 50.00 | 9.61 | 0.16 | 40.24 | 34.93 | 19.77 | 15.08 |
| 16.058 | 34.99 | 30.37 | 60.00 | 50.00 | 9.65 | 0.25 | 44.88 | 40.26 | 15.12 | 9.74 |

Conducted Emissions result



| Freq. [MHz] | Measurement [dB μ V] | | Limit [dB μ V] | | Insertion Loss [dB] | Cable Loss [dB] | Result [dB μ V] | | Margin [dB] | |
|----------------|-----------------------------|---------|-----------------------|---------|---------------------------|-----------------------|------------------------|---------|----------------|---------|
| | Q-peak | Average | Q-peak | Average | | | Q-peak | Average | Q-peak | Average |
| 0.366 | 36.61 | 34.92 | 58.59 | 48.59 | 9.55 | 0.13 | 46.29 | 44.60 | 12.30 | 3.99 |
| 0.712 | 35.44 | 32.23 | 56.00 | 46.00 | 9.56 | 0.09 | 45.09 | 41.88 | 10.91 | 4.12 |
| 1.379 | 28.31 | 23.42 | 56.00 | 46.00 | 9.56 | 0.10 | 37.97 | 33.08 | 18.03 | 12.92 |
| 2.133 | 27.10 | 22.53 | 56.00 | 46.00 | 9.57 | 0.11 | 36.78 | 32.21 | 19.22 | 13.79 |
| 3.846 | 26.94 | 21.79 | 56.00 | 46.00 | 9.57 | 0.14 | 36.65 | 31.50 | 19.35 | 14.50 |
| 16.710 | 36.25 | 31.32 | 60.00 | 50.00 | 9.64 | 0.22 | 46.11 | 41.18 | 13.89 | 8.82 |

Peak Power Output

◆ Test Equipment

The following test equipment are used during the test:

| Item | Equipment | Manufacturer | Model no/Serial No. | Due for Cal. |
|------|-------------------|--------------|----------------------|---------------|
| 1 | Spectrum Analyzer | ADVANTEST | R3273 / 110600587 | May. 08, 2015 |
| 2 | Bluetooth Tester | TESCOM | TC-3000B/3000B640056 | May. 09, 2015 |
| 3 | Power Divider | Agilent | 11636B/54458 | May. 09, 2015 |
| 4 | RF ROOM | | | |

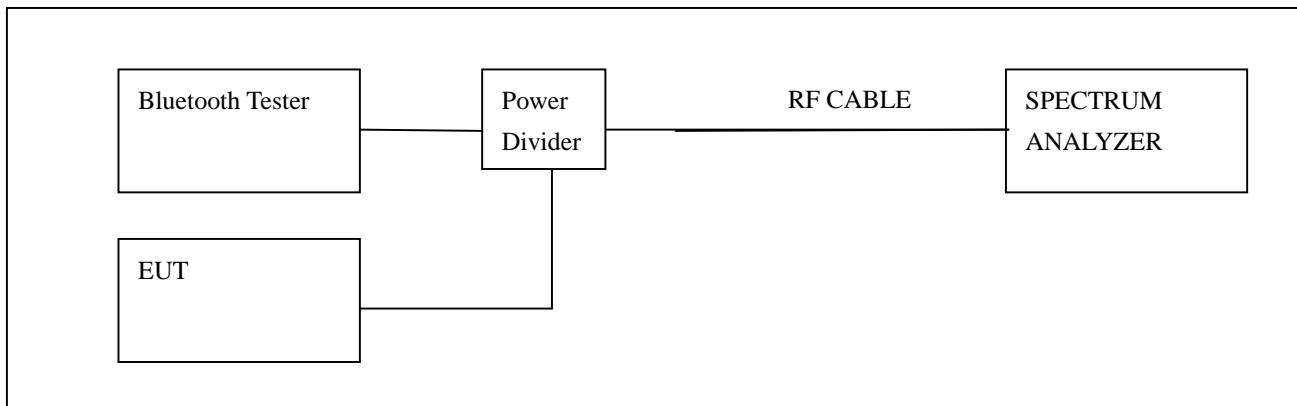
Note : All equipment upon which need to calibrated are with calibration period of 1 year.

◆ Limits

The maximum peak output power of the intentional radiator shall not exceed the following :

1. According to § 15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz : 1Watt.
2. According to § 15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs(b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi

◆ Test Setup



◆ Test Procedure

The transmitter output is connected to the Spectrum analyzer using Bluetooth tester and Power divider.

The Spectrum analyzer is set to the peak power detection.

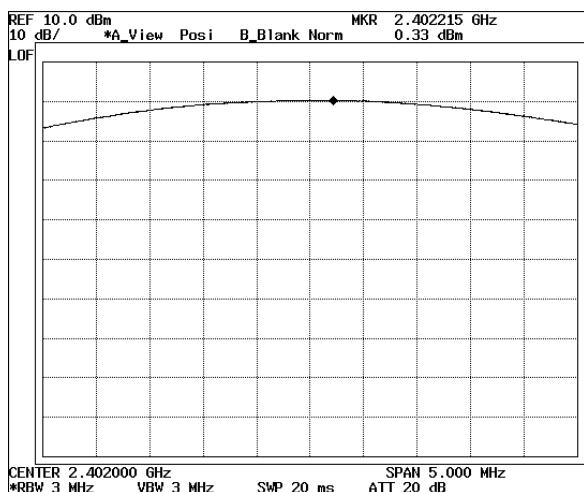
Peak Power Test result

| | | | | |
|--------------------|------------------------|--|--|--|
| Product | Groove | | | |
| Test Item | Peak Power Output | | | |
| Test Mode | Tx / Channel 0, 39, 78 | | | |
| Test Site | RF Room | | | |
| Measurement Method | Conducted | | | |

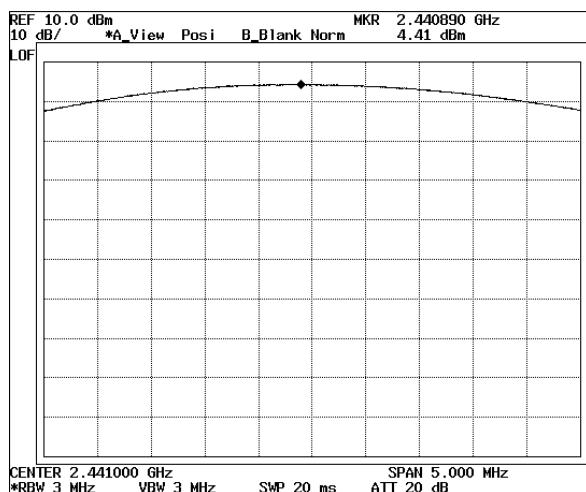
DH5

| Channel No. | Frequency (MHz) | Measure Level (dBm) | Limit (dBm) | Result |
|-------------|-----------------|---------------------|-------------|--------|
| 0 | 2402 | 0.33 | 1Watt=30dBm | Pass |
| 39 | 2441 | 4.41 | 1Watt=30dBm | Pass |
| 78 | 2480 | 5.66 | 1Watt=30dBm | Pass |

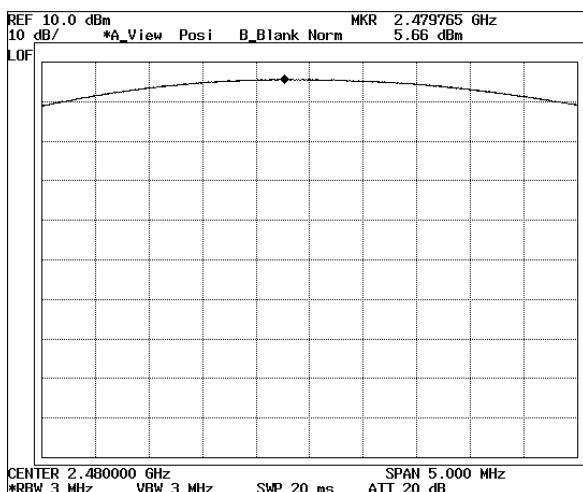
Channel 0



Channel 39



Channel 78



Note : Measurement level = reading level + correct factor

Peak Power Test result

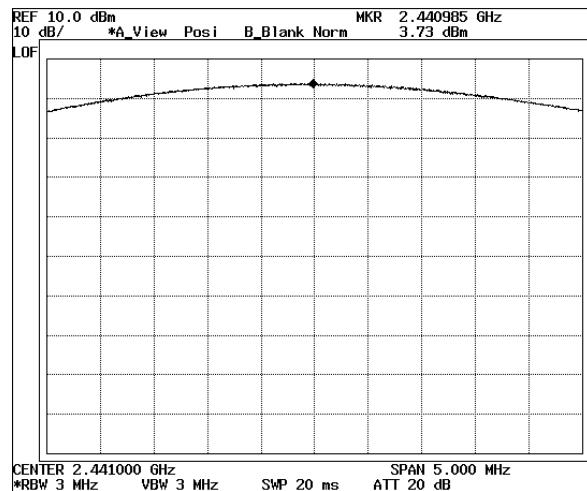
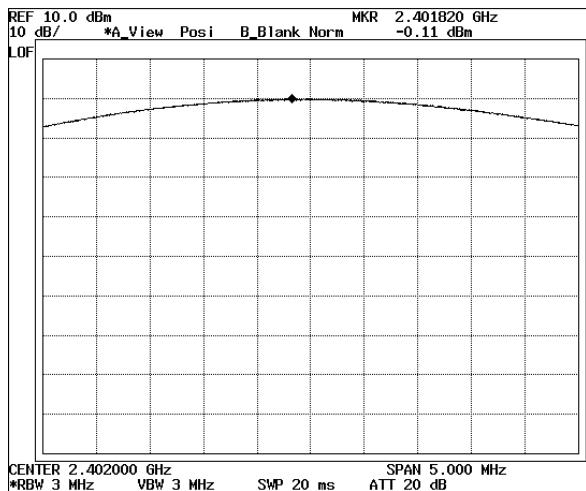
| | | | | |
|--------------------|------------------------|--|--|--|
| Product | Groove | | | |
| Test Item | Peak Power Output | | | |
| Test Mode | Tx / Channel 0, 39, 78 | | | |
| Test Site | RF Room | | | |
| Measurement Method | Conducted | | | |

3DH5

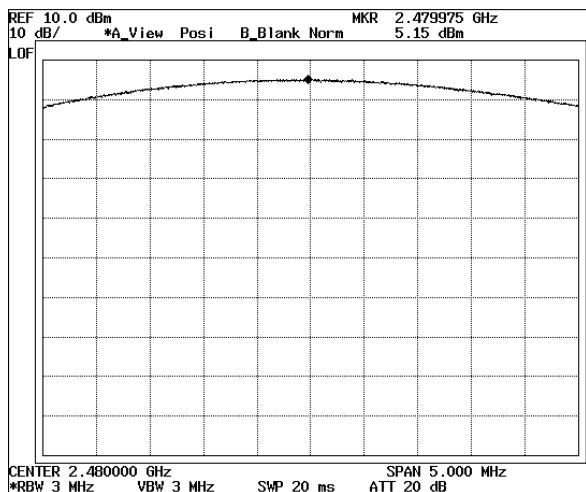
| Channel No. | Frequency (MHz) | Measure Level (dBm) | Limit (dBm) | Result |
|-------------|-----------------|---------------------|-------------|--------|
| 0 | 2402 | -0.11 | 1Watt=30dBm | Pass |
| 39 | 2441 | 3.73 | 1Watt=30dBm | Pass |
| 78 | 2480 | 5.15 | 1Watt=30dBm | Pass |

Channel 0

Channel 39



Channel 78



Note : Measurement level = reading level + correct factor

Conducted Spurious Emissions

& Band Edge

◆ TEST Equipment

The following test equipment are used during the test:

| Item | Equipment | Manufacturer | Model no/Serial No. | Due for Cal. |
|------|-------------------|--------------|----------------------|---------------|
| 1 | Spectrum Analyzer | ADVANTEST | R3273 / 110600587 | May. 08, 2015 |
| 2 | Bluetooth Tester | TESCOM | TC-3000B/3000B640056 | May. 09, 2015 |
| 3 | Power Divider | Agilent | 11636B/54458 | May. 09, 2015 |
| 4 | RF ROOM | | | |

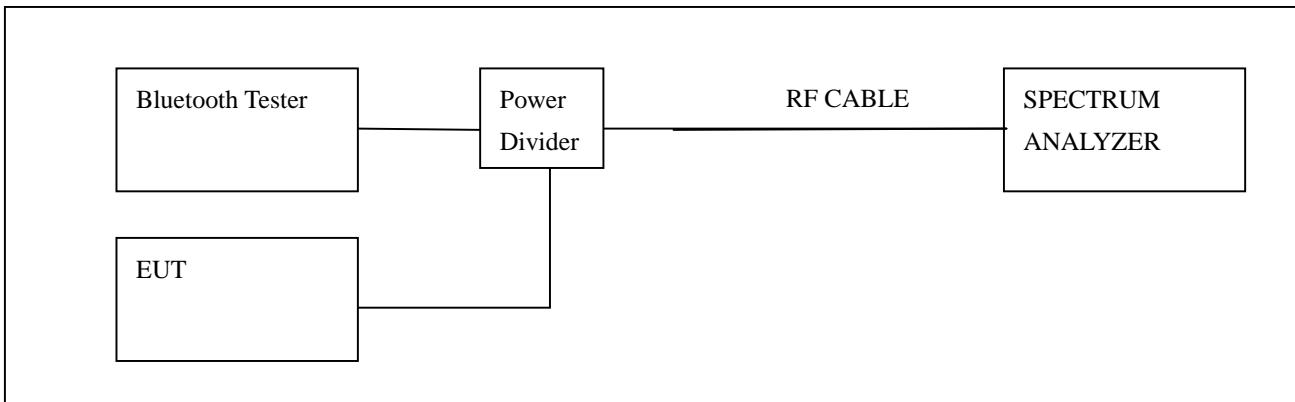
*Note : 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to RRL, KRISS, KTL and HCT.
 2. The calibration interval of horn ant. and loop ant. is 24 months*

◆ Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio Frequency power that is produced by the intentional radiator 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.

Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a)(see Section 15.205(c)).

◆ Test Setup



◆ Test Procedure

The transmitter output is connected to the Spectrum analyzer using Bluetooth tester and Power divider.

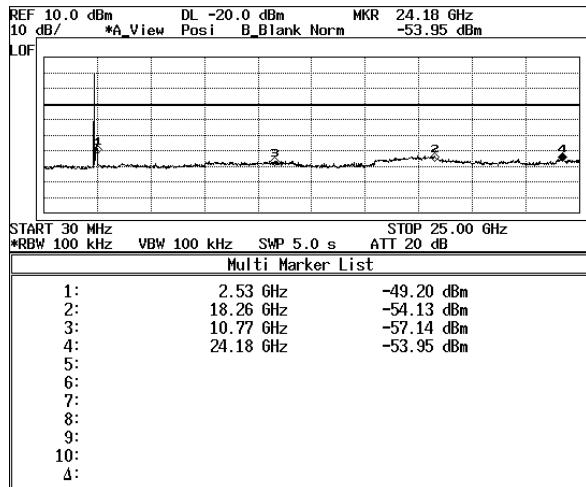
According to FCC CFR Title 47 Part 15 Subpart C Section 15.247

Conducted Spurious Emissions Test result

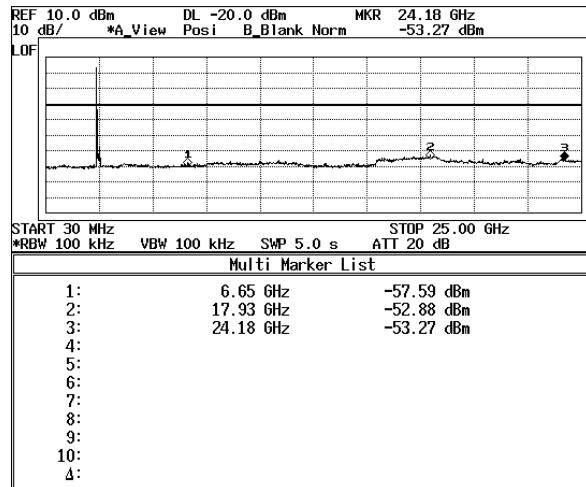
| | |
|--------------------|---------------------------------|
| Product | Groove |
| Test Item | Spurious Emissions |
| Test Mode | Tx / Channel 0, 39, 78, Hopping |
| Test Site | RF Room |
| Measurement Method | Conducted |

DH5

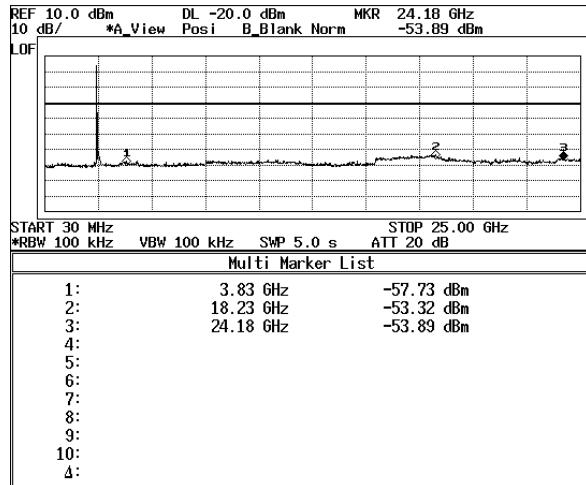
Channel 0 (2402 MHz)



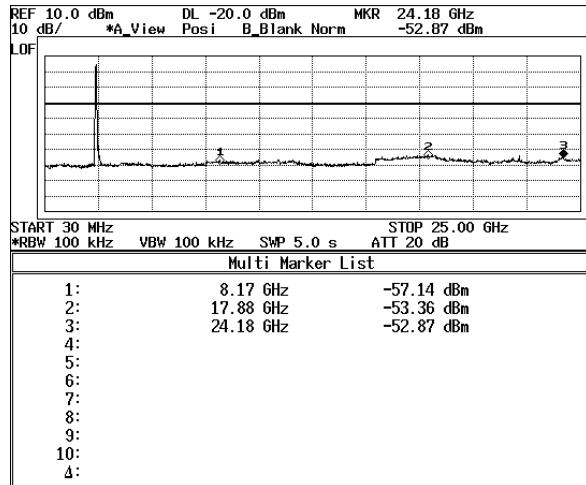
Channel 39 (2441 MHz)



Channel 78 (2480 MHz)



Hopping mode



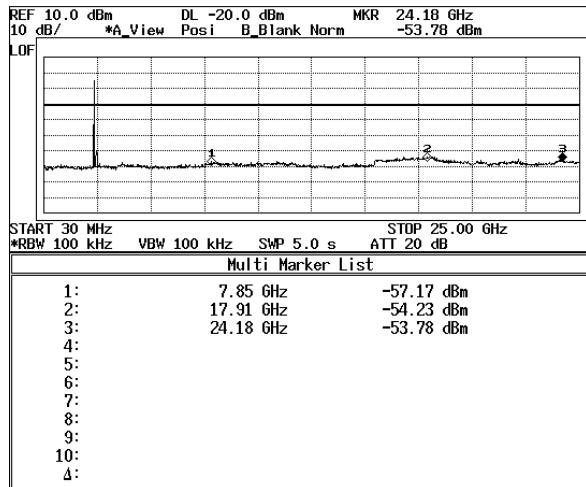
Note : Measurement level = reading level + correct factor

Conducted Spurious Emissions Test result

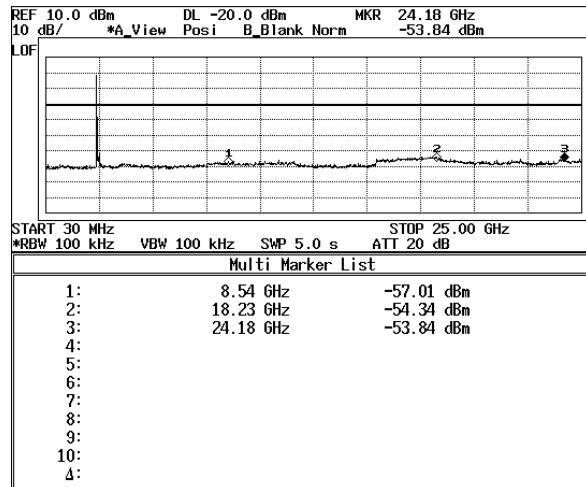
| | |
|--------------------|---------------------------------|
| Product | Groove |
| Test Item | Spurious Emissions |
| Test Mode | Tx / Channel 0, 39, 78, Hopping |
| Test Site | RF Room |
| Measurement Method | Conducted |

3DH5

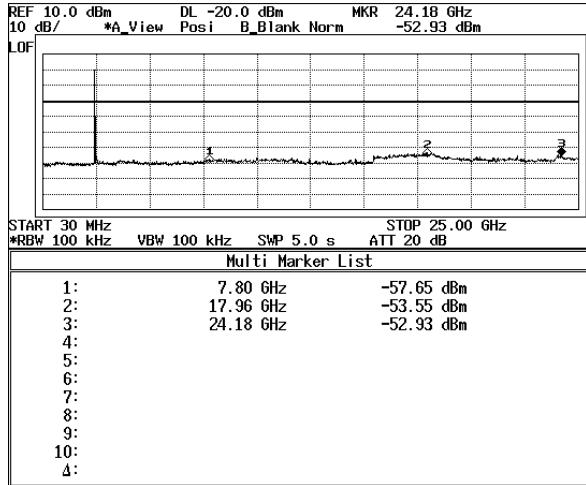
Channel 0 (2402 MHz)



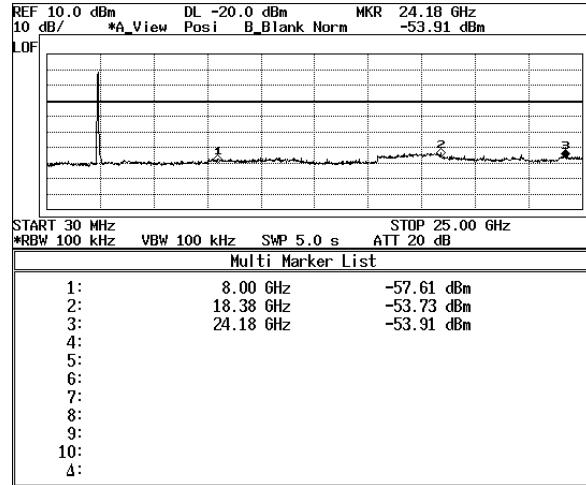
Channel 39 (2441 MHz)



Channel 78 (2480 MHz)



Hopping mode



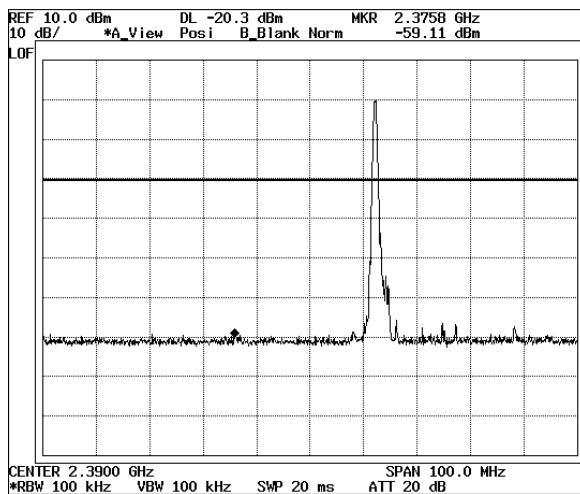
Note : Measurement level = reading level + correct factor

Band Edge Test result

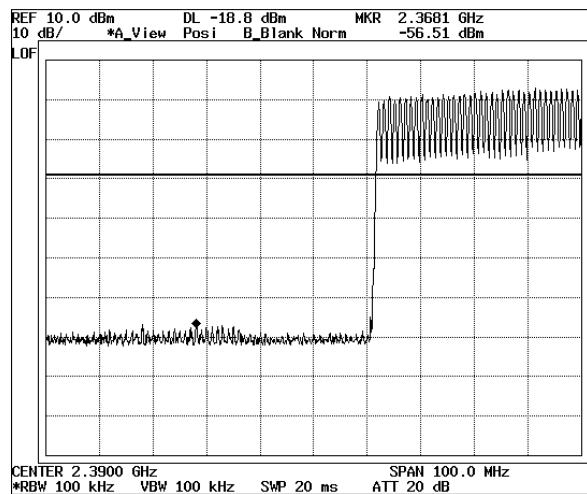
| | |
|--------------------|-----------------------------|
| Product | Groove |
| Test Item | Band Edge |
| Test Mode | Tx / Channel 0, 78, Hopping |
| Test Site | RF Room |
| Measurement Method | Conducted |

DH5

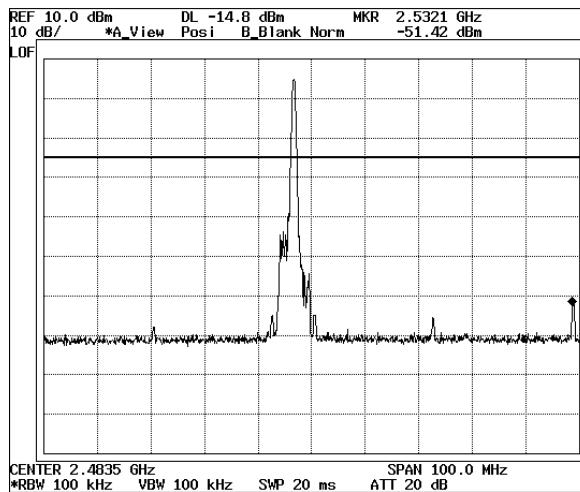
Channel : 0 CH(2402 MHz)



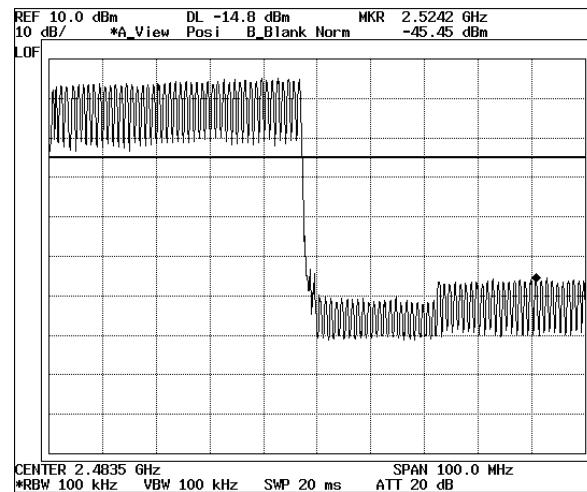
Hopping mode



Channel : 78 CH(2480 MHz)



Hopping mode



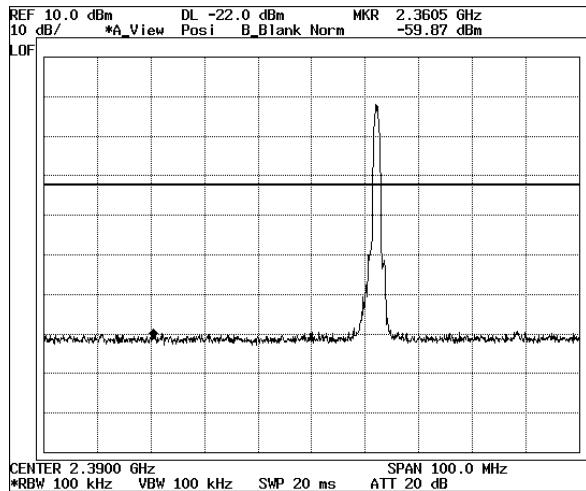
Note : Measurement level = reading level + correct factor

Band Edge Test result

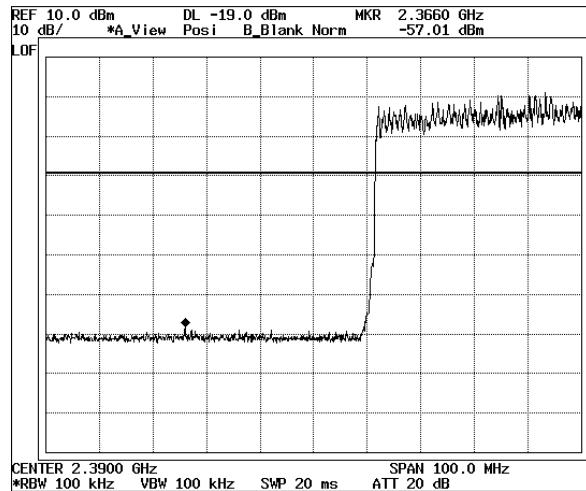
| | |
|--------------------|-----------------------------|
| Product | Groove |
| Test Item | Band Edge |
| Test Mode | Tx / Channel 0, 78, Hopping |
| Test Site | RF Room |
| Measurement Method | Conducted |

3DH5

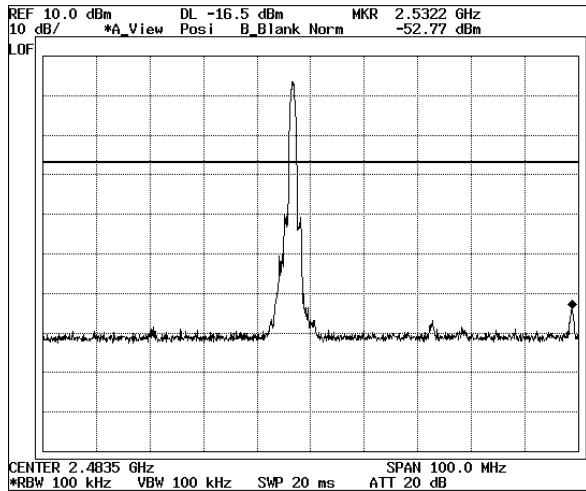
Channel : 0 CH(2402 MHz)



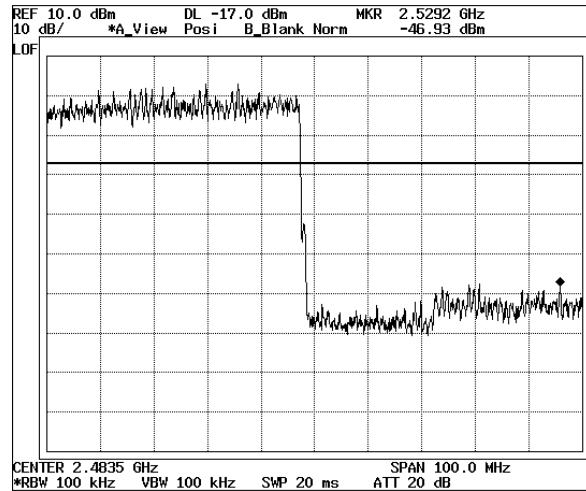
Hopping mode



Channel : 78 CH(2480 MHz)



Hopping mode



Note : Measurement level = reading level + correct factor

20dB BandWidth &

Channel Separation & Occupied Bandwidth

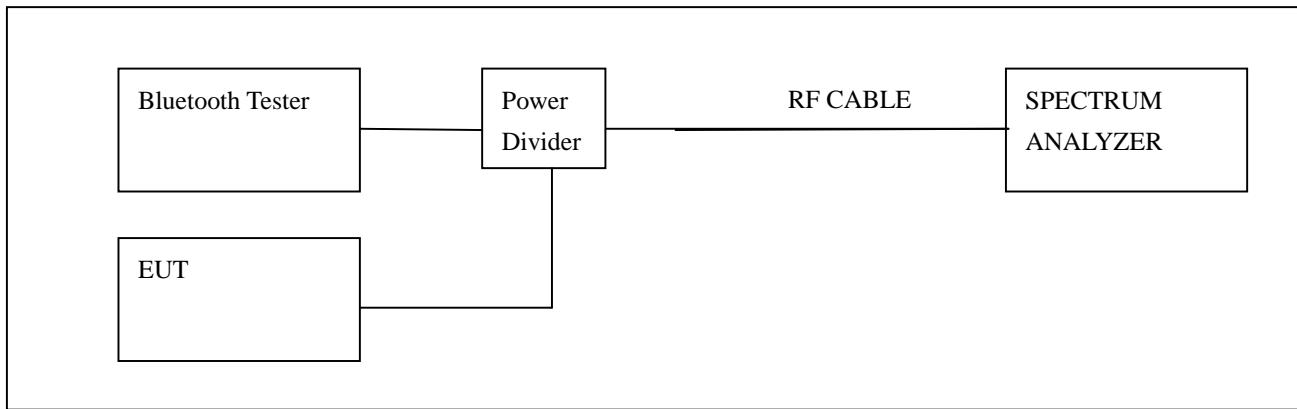
◆ Test Equipment

The following test equipment are used during the test:

| Item | Equipment | Manufacturer | Model no/Serial No. | Due for Cal. |
|------|-------------------|--------------|----------------------|---------------|
| 1 | Spectrum Analyzer | ADVANTEST | R3273 / 110600587 | May. 08, 2015 |
| 2 | Bluetooth Tester | TESCOM | TC-3000B/3000B640056 | May. 09, 2015 |
| 3 | Power Divider | Agilent | 11636B/54458 | May. 09, 2015 |
| 4 | RF ROOM | | | |

Note : All equipment upon which need to calibrated are with calibration period of 1 year.

◆ Test Setup



◆ Limits

According to 15.247(a)(1), Frequency hopping systems operation in the 2400-2483.5 MHz band may have hopping carrier frequencies that are separated by 25 KHz or two-third of 20 dB band width of hopping channel, is greater.

◆ Test Procedure

The transmitter output is connected to the Spectrum analyzer using Bluetooth tester and Power divider.

According to FCC CFR Title 47 Part 15 Subpart C Section 15.247

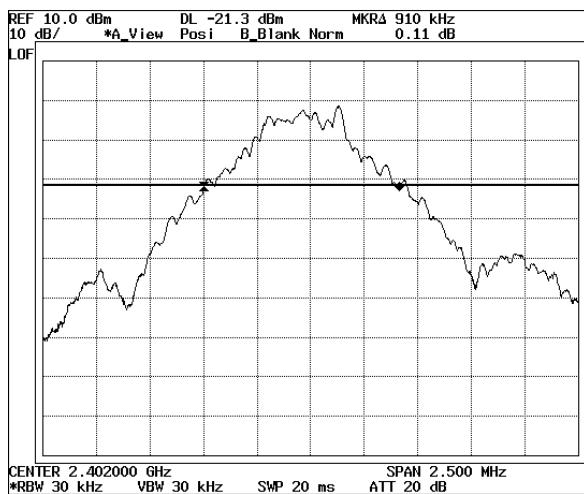
20dB BandWidth Test result

| | |
|--------------------|----------------|
| Product | Groove |
| Test Item | 20dB Bandwidth |
| Test Mode | Transmit |
| Test Site | RF Room |
| Measurement Method | Conducted |

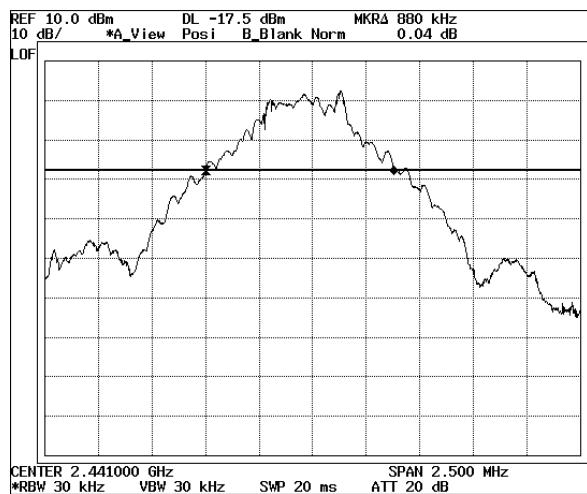
DH5

| Channel | 20dB Band width (KHz) | Result |
|-----------|-----------------------|--------|
| Low CH | 910 | |
| Middle CH | 880 | |
| High CH | 830 | Pass |

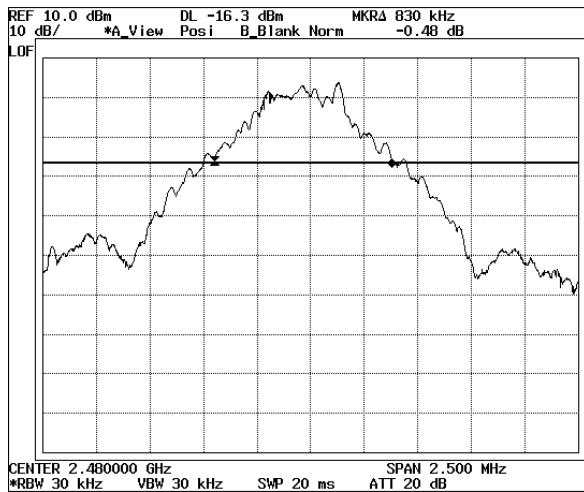
Low Channel



Mid Channel



High Channel



Note : Measurement level = reading level + correct factor

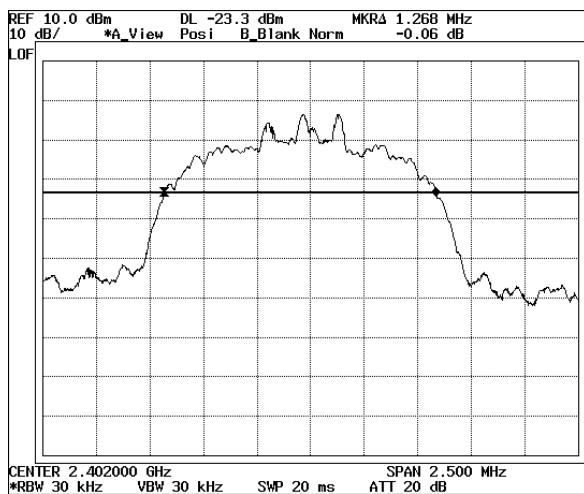
20dB BandWidth Test result

| | |
|--------------------|----------------|
| Product | Groove |
| Test Item | 20dB Bandwidth |
| Test Mode | Transmit |
| Test Site | RF Room |
| Measurement Method | Conducted |

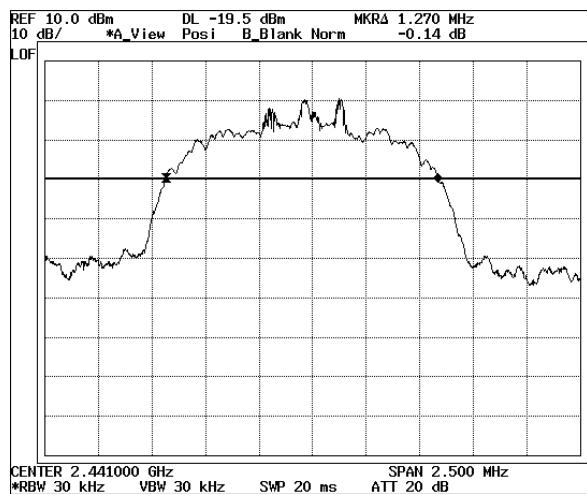
3DH5

| Channel | 20dB Band width (KHz) | Result |
|-----------|-----------------------|--------|
| Low CH | 1268 | |
| Middle CH | 1270 | |
| High CH | 1270 | Pass |

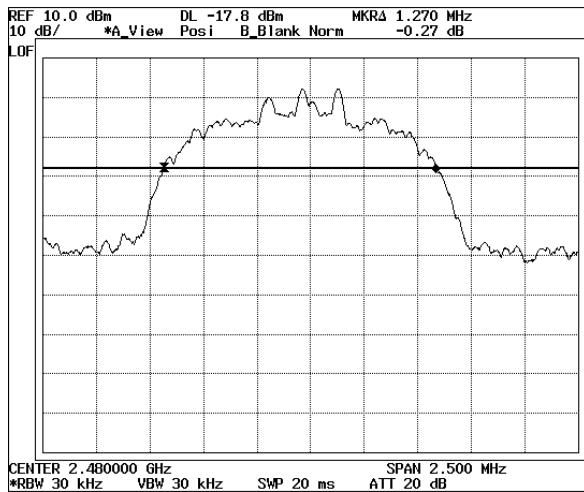
Low Channel



Mid Channel



High Channel



Note : Measurement level = reading level + correct factor

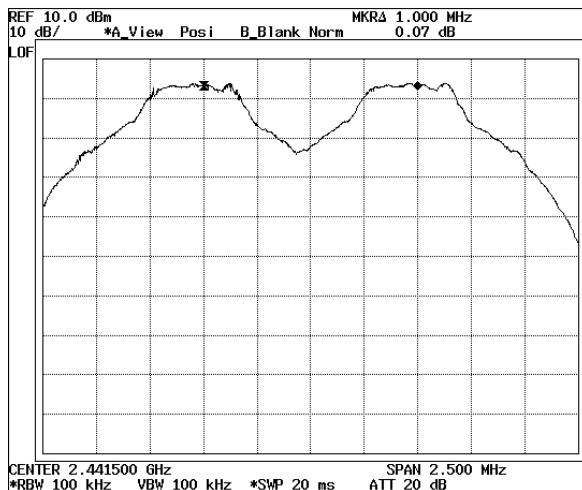
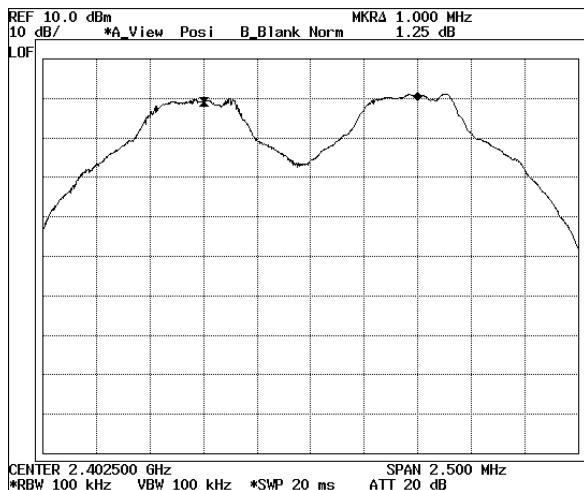
Channel Separation Test result

| | | | | |
|--------------------|--------------------|--|--|--|
| Product | Groove | | | |
| Test Item | Channel Separation | | | |
| Test Mode | Transmit | | | |
| Test Site | RF Room | | | |
| Measurement Method | Conducted | | | |

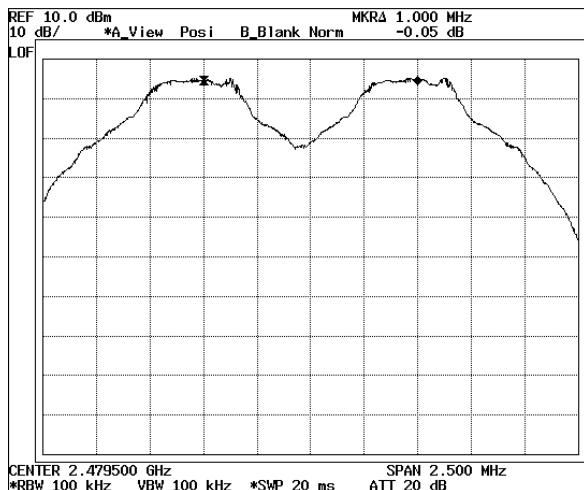
DH5

| Channel | Channel Separation (KHz) | 20dB bandwidth (KHz) | Limit (KHz) | Result |
|-----------|--------------------------|----------------------|----------------------------------|--------|
| Low CH | 1000 | 910 | >25 or >2/3 of the 20dB BW | Pass |
| Middle CH | 1000 | 880 | | |
| High CH | 1000 | 830 | | |

Low Channel



High Channel



Note : Measurement level = reading level + correct factor

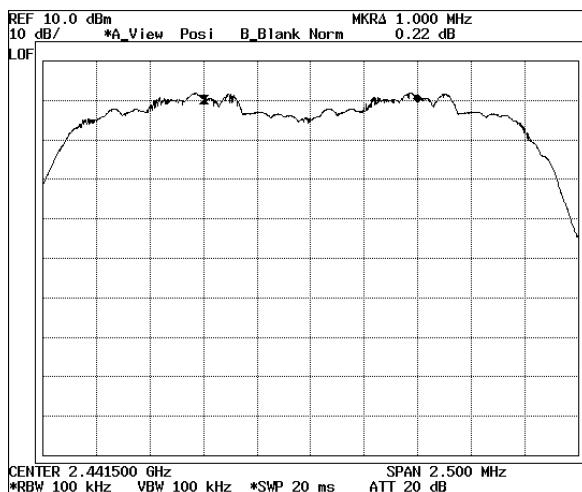
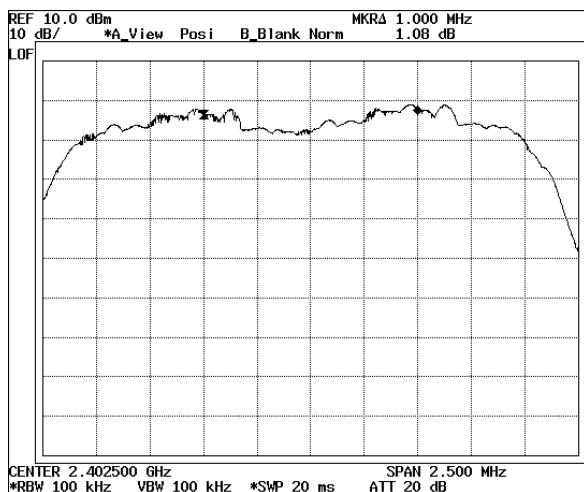
Channel Separation Test result

| | | | | |
|--------------------|--------------------|--|--|--|
| Product | Groove | | | |
| Test Item | Channel Separation | | | |
| Test Mode | Transmit | | | |
| Test Site | RF Room | | | |
| Measurement Method | Conducted | | | |

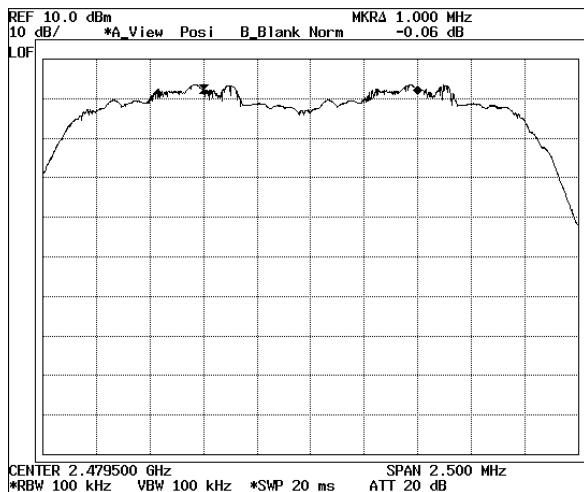
3DH5

| Channel | Channel Separation (KHz) | 20dB bandwidth (KHz) | Limit (KHz) | Result |
|-----------|--------------------------|----------------------|----------------------------------|--------|
| Low CH | 1000 | 1268 | >25 or >2/3 of the 20dB BW | Pass |
| Middle CH | 1000 | 1270 | | |
| High CH | 1000 | 1270 | | |

Low Channel



High Channel



Note : Measurement level = reading level + correct factor

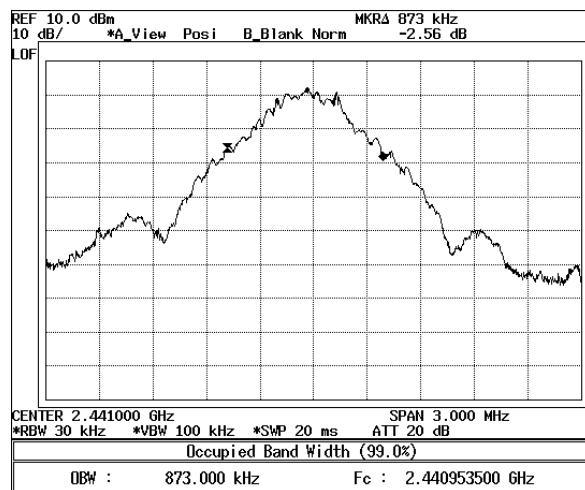
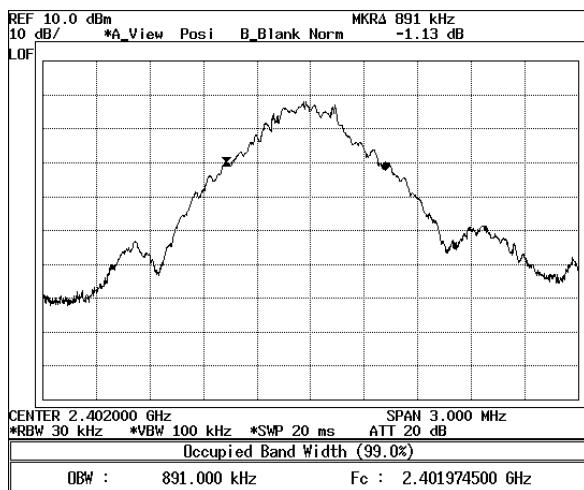
Occupied BandWidth Test result

| | |
|--------------------|--------------------|
| Product | Groove |
| Test Item | Occupied Bandwidth |
| Test Mode | Transmit |
| Test Site | RF Room |
| Measurement Method | Conducted |

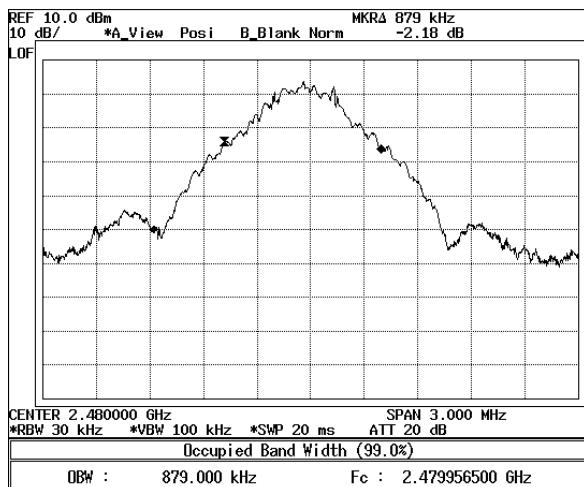
DH5

| Channel | 99% BW(KHz) | Result |
|-----------|-------------|--------|
| Low CH | 891 | Pass |
| Middle CH | 873 | |
| High CH | 879 | |

Low Channel



High Channel



Note : Measurement level = reading level + correct factor

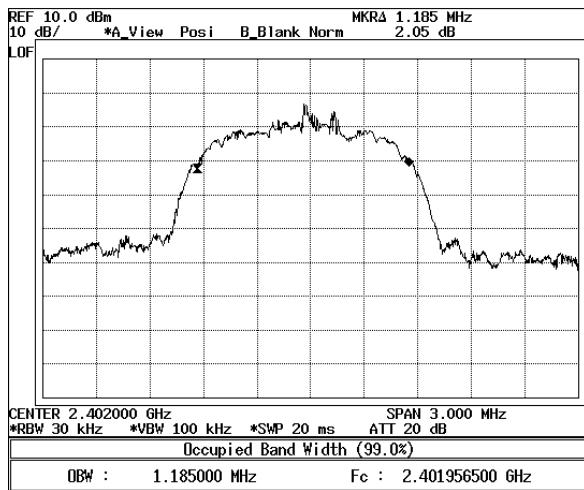
Occupied BandWidth Test result

| | |
|--------------------|--------------------|
| Product | Groove |
| Test Item | Occupied Bandwidth |
| Test Mode | Transmit |
| Test Site | RF Room |
| Measurement Method | Conducted |

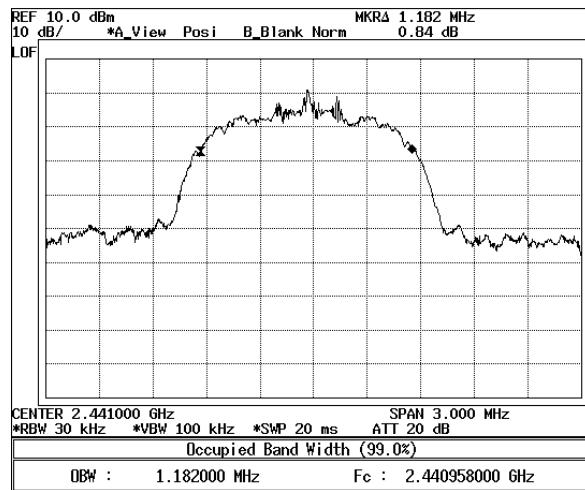
3DH5

| Channel | 99% BW(KHz) | Result |
|-----------|-------------|--------|
| Low CH | 1185 | |
| Middle CH | 1182 | |
| High CH | 1182 | Pass |

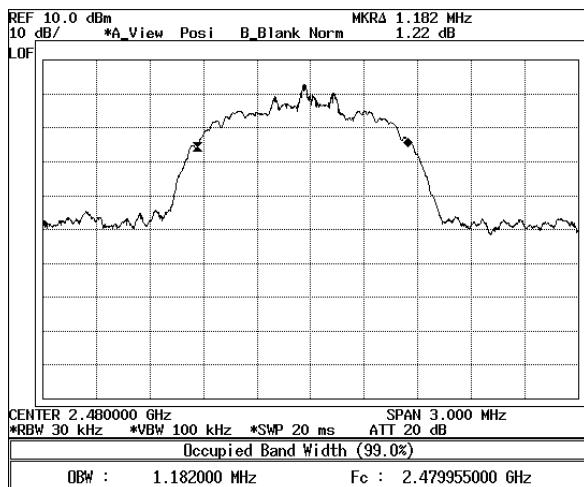
Low Channel



Mid Channel



High Channel



Note : Measurement level = reading level + correct factor

Number of Hopping Frequency

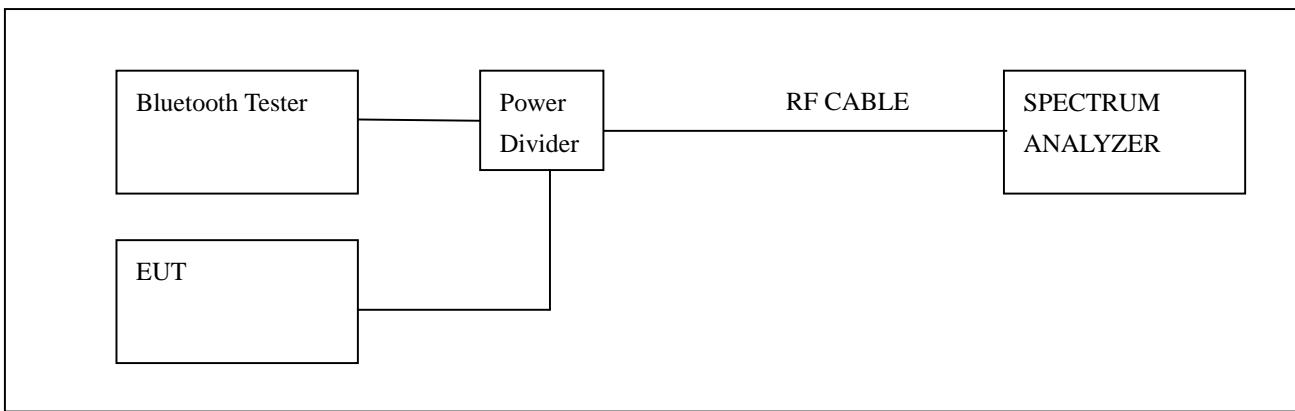
◆ Test Equipment

The following test equipment are used during the test:

| Item | Equipment | Manufacturer | Model no/Serial No. | Due for Cal. |
|------|-------------------|--------------|----------------------|---------------|
| 1 | Spectrum Analyzer | ADVANTEST | R3273 / 110600587 | May. 08, 2015 |
| 2 | Bluetooth Tester | TESCOM | TC-3000B/3000B640056 | May. 09, 2015 |
| 3 | Power Divider | Agilent | 11636B/54458 | May. 09, 2015 |
| 4 | RF ROOM | | | |

Note : All equipment upon which need to calibrated are with calibration period of 1 year.

◆ Test Setup



◆ Limits

According to 15.247(a)(1)(ii), Frequency hopping systems operation in the 2400-2483.5 MHz bands shall use at least 15 hopping frequencies.

◆ Test Procedure

The transmitter output is connected to the Spectrum analyzer using Bluetooth tester and Power divider.

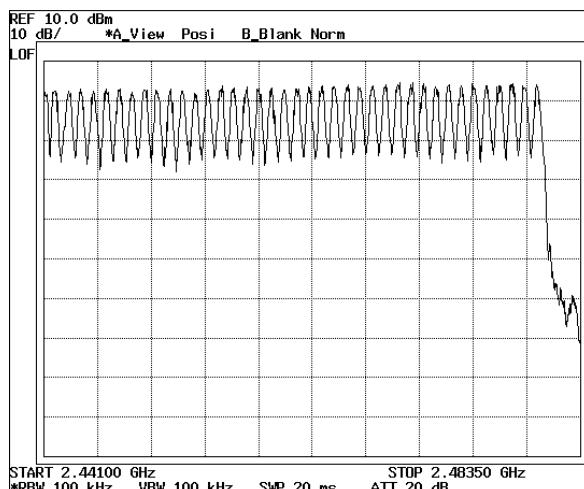
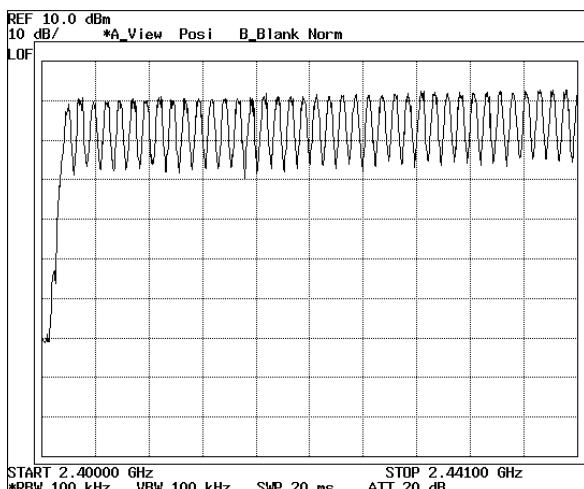
According to FCC CFR Title 47 Part 15 Subpart C Section 15.247

Test result

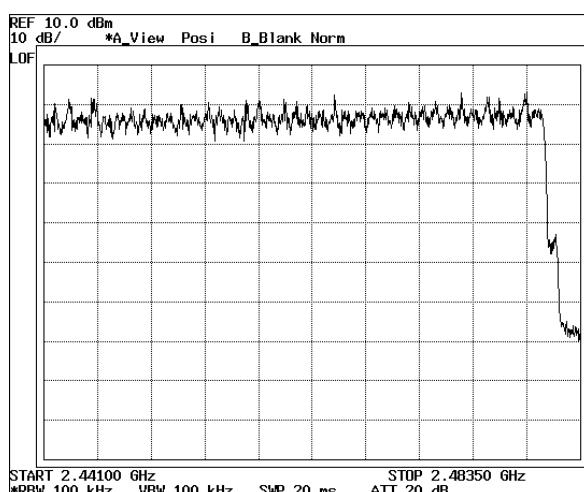
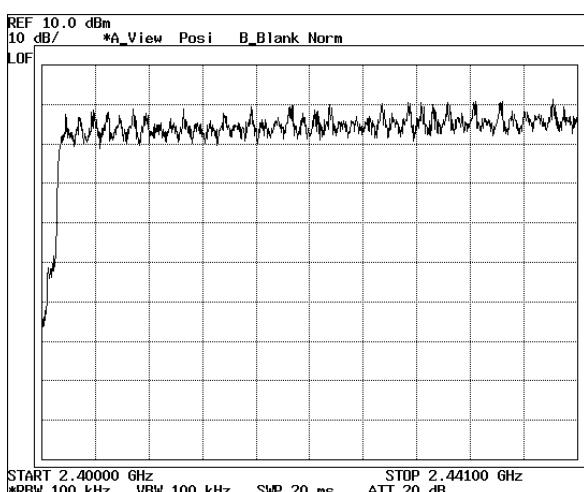
| | |
|--------------------|-----------------------------|
| Product | Groove |
| Test Item | Number of hopping frequency |
| Test Mode | Transmit |
| Test Site | RF Room |
| Measurement Method | Conducted |

| Channel (No. of channel) | Limit (No. of channel) | Result |
|--------------------------|------------------------|--------|
| 79 | >15 | Pass |

DH5



3DH5



Note : Measurement level = reading level + correct factor

Time of Occupancy (Dwell Time)

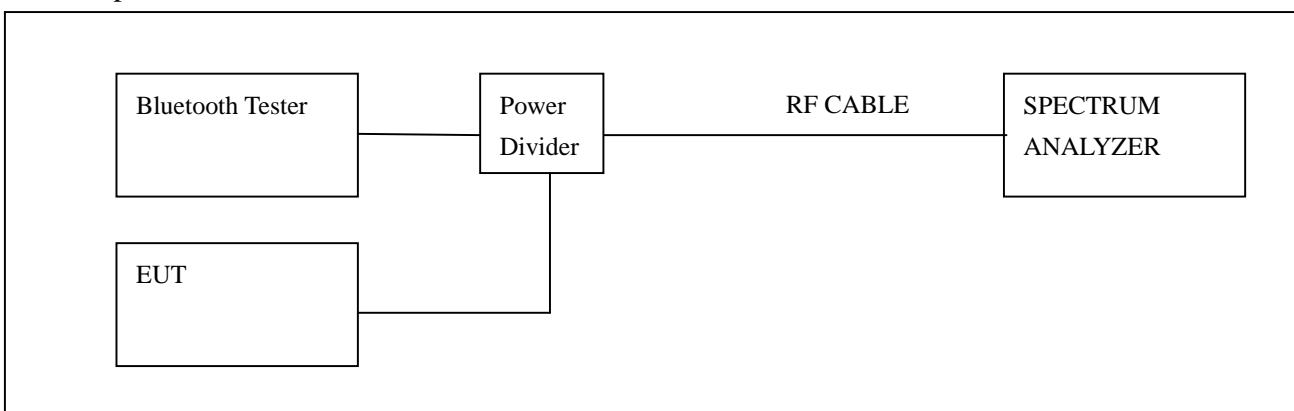
◆ Test Equipment

The following test equipment are used during the test:

| Item | Equipment | Manufacturer | Model no/Serial No. | Due for Cal. |
|------|-------------------|--------------|----------------------|---------------|
| 1 | Spectrum Analyzer | ADVANTEST | R3273 / 110600587 | May. 08, 2015 |
| 2 | Bluetooth Tester | TESCOM | TC-3000B/3000B640056 | May. 09, 2015 |
| 3 | Power Divider | Agilent | 11636B/54458 | May. 09, 2015 |
| 4 | RF ROOM | | | |

Note : All equipment upon which need to calibrated are with calibration period of 1 year.

◆ Test Setup



◆ Limits

According to 15.247(a)(1)(iii), Frequency hopping systems operating in the 2400-2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4s within a period 0.4s multiplied by the number of hopping channels employed.

◆ Test Procedure

The transmitter output is connected to the Spectrum analyzer using Bluetooth tester and Power divider.

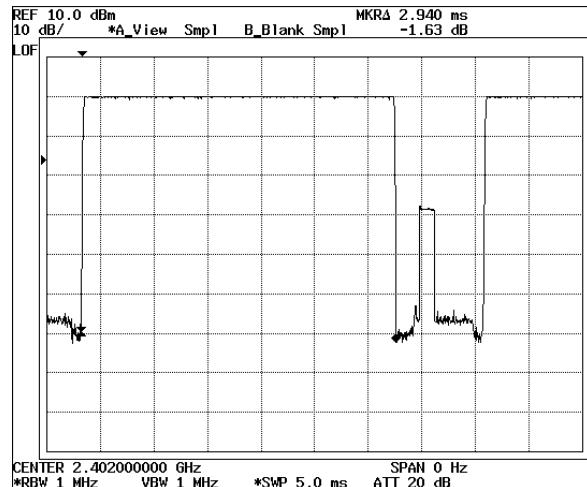
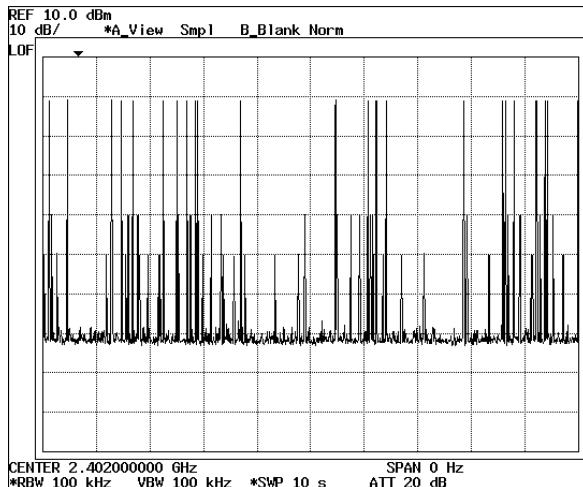
According to FCC CFR Title 47 Part 15 Subpart C Section 15.247

Dwell time Test result

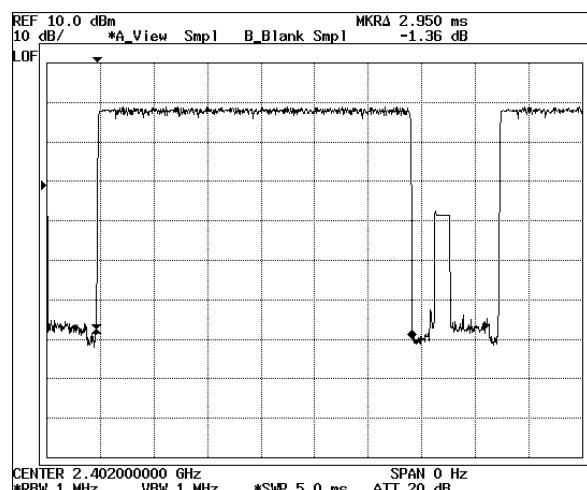
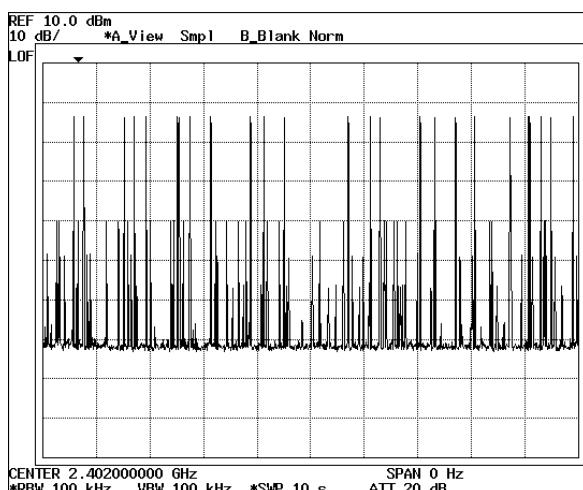
| | | | | | |
|--------------------|------------|--|--|--|--|
| Test Item | Dwell Time | | | | |
| Test Mode | Transmit | | | | |
| Test Site | RF Room | | | | |
| Measurement Method | Conducted | | | | |

| Mode | Number of transmission in a 31.6 | Length of transmission time(ms) | Result (ms) | Limit (ms) | Result |
|------|----------------------------------|---------------------------------|-------------|------------|--------|
| DH5 | 23(times/10s) *3.16 = 72.68times | 2.940 | 213.679 | 400 | Pass |
| 3DH5 | 23(times/10s) *3.16 = 72.68times | 2.950 | 214.406 | | Pass |

DH5



3DH5



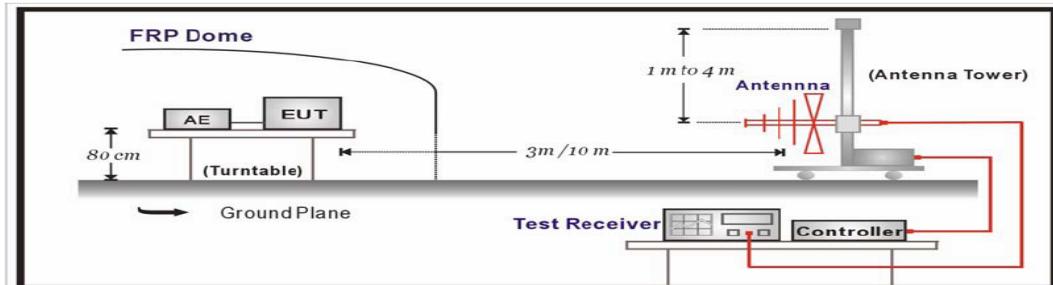
Note : Measurement level = reading level + correct factor

Radiated Emissions:

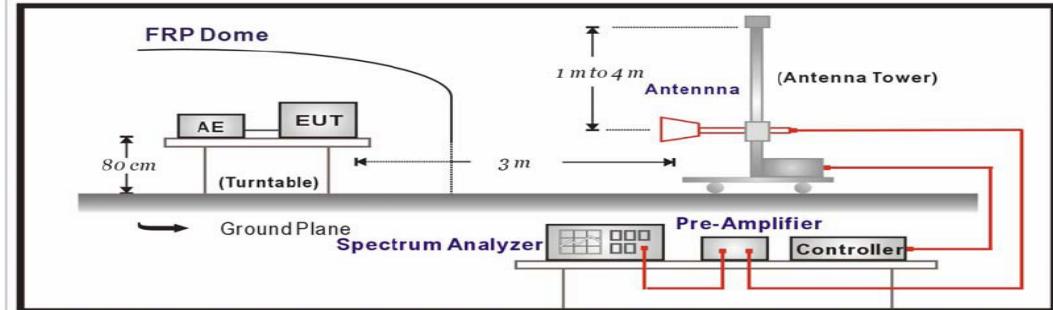
The measurement was performed over the frequency range of 30MHz to 1GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurement was made with the detector set for "quasi-peak" within a bandwidth of 120kHz. Procedure of Test

Preliminary measurements were made at 3 meter using bi-log antennas, and spectrum analyzer to determine the frequency producing the max. emission in anechoic chamber. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turn-table azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30MHz to 1000MHz using bi-log antenna. Above 1GHz, linearly polarized double ridge horn antennas were used. Final measurements were made at open site with 3-meters test distance using bi-log antenna or horn antenna. The OATS have been verified in regular for its normalized site attenuation. The test equipment was placed on a wooden table. Sufficient time for the EUT, peripheral equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 120kHz or 1MHz depending on the frequency of type of signal. The EUT, peripheral equipment and interconnecting cables were re-configured to the set-up producing the max. emission for the frequency and were placed on top of a 0.8-meter high nonmetallic 1 x 1.5 meter table. The EUT, peripheral equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by: varying the mode of operation to the EUT and/or peripheral equipment and changing the polarity of the antenna, whichever determined the worst-case emission. (The bandwidth below 1GHz setting on the field strength meter is 120KHz and above 1GHz is 1MHz.)

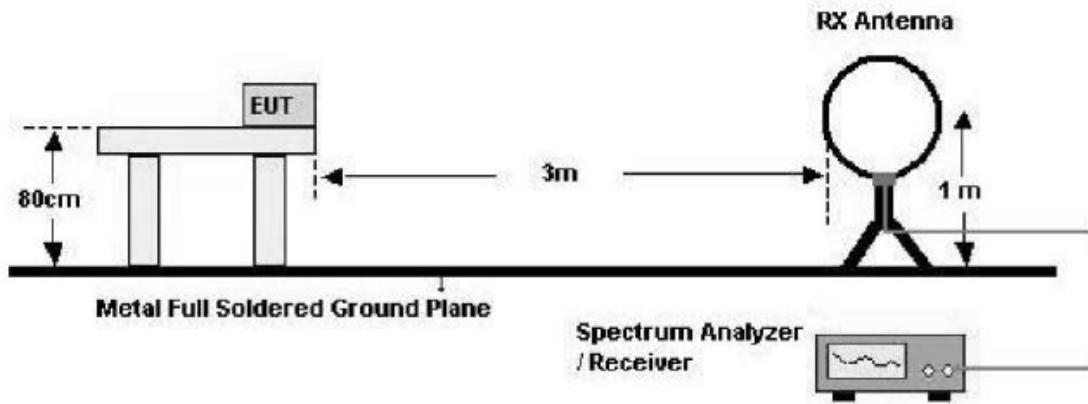
Under 1GHz Test Setup:



Above 1GHz Test Setup:



Below 30 MHz



Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, Shall be attenuated by at least 20dB below the level of the fundamental or to the General radiated emission limits in paragraph 15.209, whichever is the lesser attenuation:

| FCC Part 15 Subpart C Section 15.209 Limits | | |
|---|-------------------------------|--|
| Frequency (MHz) | $\mu\text{V}/\text{meter}$ | $\text{dB}\mu\text{V}/\text{meter}$ (3m) |
| 0.009-0.490 | $2400/\text{F(KHz)}$ at 300 m | $20\log 2400/\text{F(KHz)} + 80$ |
| 0.490-1.705 | $24000/\text{F(KHz)}$ at 30m | $20\log 24000/\text{F(KHz)} + 40$ |
| 1.705-30 | 30 at 30 m | 49.5 |
| 30-88 | 100 | 40 |
| 88-216 | 150 | 43.5 |
| 216-960 | 200 | 46 |
| Above 960 | 500 | 54 |

Remarks :

1. RF Voltage ($\text{dB}\mu\text{V}$) = $20\log$ RF Voltage (μV)
2. $\text{dB}\mu\text{V}/\text{m} = \text{ERP(dBm)} + 106.92 \text{ dB} + 20\log(10\text{m}/3\text{m}) + 2.15\text{dB}$ (conversion Factor for E.I.R.P)
3. In the Above Table, the tighter limit applies at the band edges.
4. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

Test specification.

According to FCC CFR Title 47 Part 15 Subpart C Section 15.209.

Radiated Spurious Emission

[Applicable]

◆ Test Equipment Used

| Name | Type | Manufacturer | Due for Cal | Serial Number |
|-------------------|---------------|-----------------|---------------|---------------|
| EMI Receiver | ESCS30 | Rohde & Schwarz | May. 08, 2015 | 100171 |
| EMI Receiver | ESCI7 | Rohde & Schwarz | Jul. 16, 2014 | 100872 |
| SPECTRUM ANALYZER | R3273 | ADVANTEST | May. 08, 2015 | 110600587 |
| Bluetooth Tester | TC-3000B | TESCOM | May. 09, 2015 | 3000B640056 |
| Loop Antenna | HFH2-Z2 | Rohde & Schwarz | Oct. 26, 2014 | 8620771017 |
| Bi-Log Antenna | VULB9160 | Schwarz beck | Jun. 03, 2015 | 3071 |
| HORN-Antenna | 3115 | EMCO | Dec. 04, 2015 | 9012-3602 |
| HORN-Antenna | HF906 | Rohde & Schwarz | Oct. 25, 2015 | 100530 |
| PRE AMPLIFIER | 8449B OPT H02 | HP | Oct. 08, 2014 | 3008A0530 |

Note : 1. The calibration interval of the above test instruments is 12 months
 and the calibrations are traceable to RRA, KRISS, KTL and HCT.
 2. The calibration interval of horn ant. and loop ant. is 24 months

◆ Test Conditions

Temperature (21.6 ± 0.2) °C
 Humidity (48.3 ± 0.2) % R.H.
 Atmosphere (1008) mbar

◆ Test Area Full-Anechoic Room (3m)

◆ Test Date May 12, 2014

Note :

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

$$\text{Peak} = \text{Reading} + \text{Corrected Factor}$$

Where Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

Radiated Emissions Test, 9 kHz to 30 MHz (Magnetic Field Test)

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 3 meters according to Section 15.31(f)(2).
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector with specified bandwidth.
5. The result was 20dB lower than the limit line 15.31(o) was not reported.

Radiated Emission Result

| Frequency | Reading | P | Ant. Factor | Cable Loss | Limit | Total | Margin |
|-----------|---------|--------|-------------|------------|-------|-------|--------|
| MHz | dBuV | (H, V) | dB | dB | dBuV | dBuV | dB |
| | | | | | | | |
| | | | | | | | |

Note : The result was 20dB lower than the limit line 15.31(o) was not reported.

Radiated Emission Result

[Applicable]

Spurious Emissions Test (Below 1GHz) :

Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, packet types and antenna ports(if EUT with antenna diversity architecture), and X, Y, Z Axis.

| | | | |
|-------|---------|-------|----------------|
| EUT | Groove | PROBE | Below 1 GHz |
| POWER | 3.7 Vdc | NOTE | Bluetooth mode |

DH5

| Frequency | Reading | P | Ant. Factor | Cable Loss | Limit | Total | Margin |
|-----------|---------|--------|-------------|------------|-------|-------|--------|
| MHz | dBuV | (H, V) | dB | dB | dBuV | dBuV | dB |
| 284.082 | 22.10 | H | 12.37 | 2.85 | 46.00 | 37.32 | -8.68 |
| 304.377 | 20.20 | H | 13.04 | 2.94 | 46.00 | 36.18 | -9.82 |
| 316.269 | 21.40 | H | 13.34 | 2.99 | 46.00 | 37.73 | -8.27 |
| 321.111 | 21.00 | H | 13.46 | 3.01 | 46.00 | 37.47 | -8.53 |
| 879.730 | 13.50 | V | 22.79 | 5.01 | 46.00 | 41.30 | -4.70 |

3DH5

| Frequency | Reading | P | Ant. Factor | Cable Loss | Limit | Total | Margin |
|-----------|---------|--------|-------------|------------|-------|-------|--------|
| MHz | dBuV | (H, V) | dB | dB | dBuV | dBuV | dB |
| 112.388 | 23.50 | V | 9.89 | 1.73 | 43.50 | 35.12 | -8.38 |
| 126.029 | 21.20 | V | 11.19 | 1.83 | 43.50 | 34.22 | -9.28 |
| 161.785 | 18.90 | H | 12.68 | 2.09 | 43.50 | 33.67 | -9.83 |
| 721.631 | 16.40 | V | 20.92 | 4.56 | 46.00 | 41.88 | -4.12 |
| 893.324 | 13.20 | V | 22.91 | 5.09 | 46.00 | 41.20 | -4.80 |

Note : 1. Remark "*" means that the data is the worst emission level.

2. All reading levels are Quasi-peak value.

3. Measurement level = reading level + correct factor

Spurious Emissions Test (Above 1GHz) :

Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, packet types and antenna ports(if EUT with antenna diversity architecture), and X, Y, Z Axis.

• **BDR**

| | | | |
|-------|---------|---------|----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | CHANNEL | 0 Channel (2402 MHz) |
| MODE | DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit dBuV | | Margin dB | |
|------------------|-----------------|-------|-------|---------------|-------|--------------|-------|
| | Peak | AV | | Peak | AV | Peak | AV |
| | 1.013 | 36.87 | 24.96 | V | 74.00 | 54.00 | 37.13 |
| 1.995 | 41.81 | 28.90 | V | 74.00 | 54.00 | 32.19 | 25.10 |
| 3.891 | 45.48 | 34.54 | V | 74.00 | 54.00 | 28.52 | 19.46 |
| 1.012 | 36.87 | 24.82 | H | 74.00 | 54.00 | 37.13 | 29.18 |
| 1.969 | 40.69 | 28.70 | H | 74.00 | 54.00 | 33.31 | 25.30 |
| 3.403 | 45.70 | 33.80 | H | 74.00 | 54.00 | 28.30 | 20.20 |

| | | | |
|-------|---------|---------|-----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | CHANNEL | 39 Channel (2441 MHz) |
| MODE | DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit dBuV | | Margin dB | |
|------------------|-----------------|-------|-------|---------------|-------|--------------|-------|
| | Peak | AV | | Peak | AV | Peak | AV |
| | 1.062 | 38.26 | 21.71 | V | 74.00 | 54.00 | 35.74 |
| 1.536 | 38.83 | 24.92 | V | 74.00 | 54.00 | 35.17 | 29.08 |
| 5.121 | 46.71 | 35.04 | V | 74.00 | 54.00 | 27.29 | 18.96 |
| 5.63 | 46.4 | 35.86 | V | 74.00 | 54.00 | 27.60 | 18.14 |
| 1.84 | 38.27 | 24.58 | H | 74.00 | 54.00 | 35.73 | 29.42 |
| 3.784 | 43.35 | 33.35 | H | 74.00 | 54.00 | 30.65 | 20.65 |
| 5.142 | 45.66 | 35.76 | H | 74.00 | 54.00 | 28.34 | 18.24 |

| | | | |
|-------|---------|---------|-----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | CHANNEL | 78 Channel (2480 MHz) |
| MODE | DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit | | Margin | | |
|------------------|-----------------|-------|---|-------|-------|--------|-------|--|
| | dBuV | | | Peak | AV | dB | | |
| | Peak | AV | | | | Peak | AV | |
| 1.781 | 39.64 | 27.02 | V | 74.00 | 54.00 | 34.36 | 26.98 | |
| 3.318 | 45.41 | 33.66 | V | 74.00 | 54.00 | 28.59 | 20.34 | |
| 5.320 | 49.01 | 36.39 | V | 74.00 | 54.00 | 24.99 | 17.61 | |
| 1.754 | 39.52 | 27.09 | H | 74.00 | 54.00 | 34.48 | 26.91 | |
| 3.061 | 45.03 | 33.40 | H | 74.00 | 54.00 | 28.97 | 20.60 | |
| 4.862 | 46.10 | 34.30 | H | 74.00 | 54.00 | 27.90 | 19.70 | |
| 5.220 | 48.09 | 36.76 | H | 74.00 | 54.00 | 25.91 | 17.24 | |

Note : Reading(dBuV) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

• **EDR**

| | | | |
|-------|---------|---------|----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | CHANNEL | 0 Channel (2402 MHz) |
| MODE | 3DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit | | Margin | | |
|------------------|-----------------|-------|---|-------|-------|--------|-------|--|
| | dBuV | | | Peak | AV | dB | | |
| | Peak | AV | | | | Peak | AV | |
| 1.498 | 41.15 | 26.60 | V | 74.00 | 54.00 | 32.85 | 27.40 | |
| 1.660 | 38.62 | 25.69 | V | 74.00 | 54.00 | 35.38 | 28.31 | |
| 2.782 | 44.36 | 29.60 | V | 74.00 | 54.00 | 29.64 | 24.40 | |
| 5.234 | 44.54 | 33.43 | V | 74.00 | 54.00 | 29.46 | 20.57 | |
| 1.072 | 38.71 | 24.58 | H | 74.00 | 54.00 | 35.29 | 29.42 | |
| 1.536 | 42.35 | 28.16 | H | 74.00 | 54.00 | 31.65 | 25.84 | |
| 3.000 | 48.05 | 35.37 | H | 74.00 | 54.00 | 25.95 | 18.63 | |

| | | | |
|-------|---------|---------|-----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | CHANNEL | 39 Channel (2441 MHz) |
| MODE | 3DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit dBuV | | Margin dB | |
|------------------|-----------------|-------|-------|---------------|-------|--------------|-------|
| | Peak | AV | | Peak | AV | Peak | AV |
| | 1.274 | 36.71 | 26.76 | V | 74.00 | 54.00 | 37.29 |
| 1.788 | 38.23 | 26.92 | V | 74.00 | 54.00 | 35.77 | 27.08 |
| 4.893 | 41.41 | 33.15 | V | 74.00 | 54.00 | 32.59 | 20.85 |
| 1.537 | 36.24 | 27.06 | H | 74.00 | 54.00 | 37.76 | 26.94 |
| 3.361 | 42.33 | 32.52 | H | 74.00 | 54.00 | 31.67 | 21.48 |
| 5.035 | 46.14 | 35.83 | H | 74.00 | 54.00 | 27.86 | 18.17 |
| 5.662 | 46.20 | 35.58 | H | 74.00 | 54.00 | 27.84 | 18.02 |

| | | | |
|-------|---------|---------|-----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | CHANNEL | 78 Channel (2480 MHz) |
| MODE | 3DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit dBuV | | Margin dB | |
|------------------|-----------------|-------|-------|---------------|-------|--------------|-------|
| | Peak | AV | | Peak | AV | Peak | AV |
| | 1.598 | 39.12 | 25.73 | V | 74.00 | 54.00 | 34.88 |
| 1.993 | 42.18 | 27.85 | V | 74.00 | 54.00 | 31.82 | 26.15 |
| 3.000 | 47.05 | 33.92 | V | 74.00 | 54.00 | 26.95 | 20.08 |
| 5.846 | 45.83 | 35.32 | V | 74.00 | 54.00 | 28.17 | 18.68 |
| 1.460 | 41.78 | 26.42 | H | 74.00 | 54.00 | 32.22 | 27.58 |
| 1.599 | 42.74 | 29.36 | H | 74.00 | 54.00 | 31.26 | 24.64 |
| 4.345 | 46.85 | 34.63 | H | 74.00 | 54.00 | 27.15 | 19.37 |
| 5.542 | 46.15 | 34.68 | H | 74.00 | 54.00 | 27.85 | 19.32 |

Note : Reading(dBuv) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

Radiated Restricted Band Edge Result

● **BDR**

| | | | |
|-------|---------|-------|----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | NOTE | 0 Channel (2402 MHz) |
| MODE | DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit dBuV | | Margin dB | |
|------------------|-----------------|-------|---|---------------|-------|--------------|-------|
| | Peak | AV | | Peak | AV | Peak | AV |
| | 2.379 | 38.46 | V | 74.00 | 54.00 | 35.54 | 27.42 |
| 2.336 | 38.71 | 26.39 | H | 74.00 | 54.00 | 35.29 | 27.61 |

| | | | |
|-------|---------|-------|-----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | NOTE | 78 Channel (2480 MHz) |
| MODE | DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit dBuV | | Margin dB | |
|------------------|-----------------|-------|---|---------------|-------|--------------|-------|
| | Peak | AV | | Peak | AV | Peak | AV |
| | 2.490 | 38.62 | V | 74.00 | 54.00 | 35.38 | 27.78 |
| 2.488 | 37.95 | 26.39 | H | 74.00 | 54.00 | 36.05 | 27.61 |

Note : Reading(dBuV) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

● EDR

| | | | |
|-------|---------|-------|----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | NOTE | 0 Channel (2402 MHz) |
| MODE | 3DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit | | Margin | | |
|------------------|-----------------|-------|---|-------|-------|--------|-------|--|
| | dBuV | | | Peak | AV | Peak | AV | |
| | Peak | AV | | | | | | |
| 2.352 | 38.42 | 25.57 | V | 74.00 | 54.00 | 35.58 | 28.43 | |
| 2.361 | 37.58 | 26.85 | H | 74.00 | 54.00 | 36.42 | 27.15 | |

| | | | |
|-------|---------|-------|-----------------------|
| EUT | Groove | PROBE | Above 1 GHz |
| POWER | 3.7 Vdc | NOTE | 78 Channel (2480 MHz) |
| MODE | 3DH5 | | |

Test Data

| Frequency GHz | Reading dBuV | | P | Limit | | Margin | | |
|------------------|-----------------|-------|---|-------|-------|--------|-------|--|
| | dBuV | | | Peak | AV | Peak | AV | |
| | Peak | AV | | | | | | |
| 2.487 | 38.60 | 26.65 | V | 74.00 | 54.00 | 35.40 | 27.35 | |
| 2.488 | 36.43 | 26.24 | H | 74.00 | 54.00 | 37.47 | 27.76 | |

Note : Reading(dBuV) : Measurement Level + Ant Factor + Cable Loss - Amp Gain

Antenna requirements

According to FCC 47 CFR 15.203

“an intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached or an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section”

* the antenna of this EUT are permanently attached.

* the EUT complies with the requirement of 15.203

