



TEST REPORT

1. Applicant

| | |
|------------|---|
| Name | : GB solutions Inc. |
| Brand Name | : N/A |
| Address | : A-203#, 29, Gonghang-daero 61-gil, Gangseo-gu, Seoul, Korea |
| FCC ID | : 2ACZ4BLTC-200 |

2. Products

| | |
|-------------------|---|
| Name | : SMART LED CONTROLLER BLE |
| Model No. | : SBLTC-200 |
| Variant Model No. | : N/A |
| Manufacturer | : GB solutions Inc. |
| Address | : A-203#, 29, Gonghang-daero 61-gil, Gangseo-gu, Seoul, Korea |

| | |
|--------------------|--|
| 3. Test Standard | : 47 CFR Part 15, Subpart C |
| 4. Test Method | : ANSI C63.10-2009 |
| 5. Test Result | : PASS |
| 6. Dates of Test | : November 02, 2015 to November 06, 2015 |
| 7. Date of Issue | : November 09, 2015 |
| 8. Test Laboratory | : Standard Engineering Co. Ltd. FCC Designation Number : 624439 |

Tested by

SoonHo, Kim / Test Engineer

Approved by

SeongSeok, Seo / Compliance Engineer

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Standard Engineering Co. Ltd.

377-11, Sinjang-ri, Eumam-myeon, Seosan-si,
ChoongNam 356-844, South Korea

Tel.: +82-41-663-9436, Fax :+82-41-663-9434

www.stdeng.com



1. Test Summary

| Test | Test Requirement | Test method | Result |
|---|--|-------------------------|--------|
| Antenna Requirement | 47 CFR Part 15, Subpart C Section 15.203/15.247 (c) | ANSI C63.10 2009 | PASS |
| AC Power Line Conducted Emission | 47 CFR Part 15, Subpart C Section 15.207 | ANSI C63.10 2009 | PASS |
| Conducted Peak Output Power | 47 CFR Part 15, Subpart C Section 15.247 (b)(3) | KDB558074 D01 v03r01 | PASS |
| 6dB Occupied Bandwidth | 47 CFR Part 15, Subpart C Section 15.247 (a)(2) | KDB558074 D01 v03r01 | PASS |
| Power Spectral Density | 47 CFR Part 15, Subpart C Section 15.247 (e) | KDB558074 D01 v03r01 | PASS |
| Band-edge for RF Conducted Emissions | 47 CFR Part 15, Subpart C Section 15.247(d) | KDB558074 D01 v03r01 | PASS |
| RF Conducted Spurious Emissions | 47 CFR Part 15, Subpart C Section 15.247(d) | KDB558074 D01 v03r01 | PASS |
| Radiated Spurious Emissions | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 2009 | PASS |
| Band Edge (Radiated Emission) | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 2009 | PASS |



2. TABLE OF CONTENTS

| | |
|---|-----------|
| 1. Test Summary..... | 2 |
| 2. Table of Contents..... | 3 |
| 3. General Information..... | 4 |
| 3.1 Client Information..... | 4 |
| 3.2 General Description of E.U.T..... | 4 |
| 3.3 Details of E.U.T..... | 4 |
| 3.4 Operation Frequency each of channel..... | 5 |
| 3.5 Description of Support Units | 5 |
| 3.6 Abnormalities from Standard Conditions..... | 6 |
| 3.7 Other Information Requested by the Customer..... | 6 |
| 3.8 Test Location..... | 6 |
| 4. Equipment Used during Test..... | 7 |
| 5. Test Results and Measurement Data..... | 8 |
| 5.1 Antenna Requirement..... | 8 |
| 5.2 Conducted Peak Output Power..... | 9 |
| 5.3 6dB Occupy Bandwidth..... | 12 |
| 5.4 Power Spectral Density..... | 15 |
| 5.5 Band-edge for RF Conducted Emissions..... | 18 |
| 5.6 RF Conducted Spurious Emissions..... | 20 |
| 5.7 Radiated Spurious Emissions..... | 24 |
| 5.7.1Harmonic and other spurious emissions..... | 28 |
| 5.7.1.1 Test at Lowest Channel in transmitting status..... | 28 |
| 5.7.1.2 Test at middle Channel in transmitting status..... | 31 |
| 5.7.1.3 Test at Highest Channel in transmitting status..... | 34 |
| 5.8 Band Edge (Radiated Emission)..... | 37 |
| 5.9 Conducted Emissions at Mains Terminals 150 kHz to 30 MHz..... | 42 |
| 5.9.1 Measurement Data..... | 44 |
| 5.10 Radio Frequency Exposure Procedures..... | 46 |
| ** APPENDIX..... | 48 |



3. General Information

3.1. Client Information

Applicant : GB solutions Inc.

Address of Applicant : A-203#, 29, Gonghang-daero 61-gil, Gangseo-gu, Seoul, Korea

3.2. General Description of E.U.T.

Product Name : SMART LED CONTROLLER BLE

Model No. : SBLTC-200

3.3. Details of E.U.T.

| | |
|---------------------|------------------------|
| Operation Frequency | : 2402 MHz to 2480 MHz |
| Wireless Type | : Bluetooth |
| Channel Numbers | : 40 Channels |
| Channel Spacing | : 2MHz |
| Type of Modulation | : GFSK |
| Antenna Type | : Chip Antenna |
| Antenna Gain | : 1.53 dBi |
| Test Software | : SmartRF Studio 7 |
| Power Supply | : DC 5.0 V |
| Test Voltage | : DC 5.0 V |

**3.4. Operation Frequency each of channel**

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| 1 | 2402MHz | 11 | 2422MHz | 21 | 2442MHz | 31 | 2462MHz |
| 2 | 2404MHz | 12 | 2424MHz | 22 | 2444MHz | 32 | 2464MHz |
| 3 | 2406MHz | 13 | 2426MHz | 23 | 2446MHz | 33 | 2466MHz |
| 4 | 2408MHz | 14 | 2428MHz | 24 | 2448MHz | 34 | 2468MHz |
| 5 | 2410MHz | 15 | 2430MHz | 25 | 2450MHz | 35 | 2470MHz |
| 6 | 2412MHz | 16 | 2432MHz | 26 | 2452MHz | 36 | 2472MHz |
| 7 | 2414MHz | 17 | 2434MHz | 27 | 2454MHz | 37 | 2474MHz |
| 8 | 2416MHz | 18 | 2436MHz | 28 | 2456MHz | 38 | 2476MHz |
| 9 | 2418MHz | 19 | 2438MHz | 29 | 2458MHz | 39 | 2478MHz |
| 10 | 2420MHz | 20 | 2440MHz | 30 | 2460MHz | 40 | 2480MHz |

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel | Frequency |
|-----------------|-----------|
| Lowest channel | 2402MHz |
| Middle channel | 2440MHz |
| Highest channel | 2480MHz |

3.5. Description of Support Units

The EUT has been tested with corresponding accessories as below:

Supplied by Standard Engineering Laboratory.:

| Description | Manufacturer | Model No. | Serial No. |
|--------------|----------------|-------------|---------------|
| NoteBook | LG Electronics | SD550-GDA6K | 308QCZP556717 |
| USB Cable | - | - | - |
| Jig | TI | USB-SPI | - |
| Power Supply | Provice | PWS-5005D | 205050 |



3.6. Abnormalities from Standard Conditions

None.

3.7. Other Information Requested by the Customer

None.

3.8. Test Location

377-11, Sinjang-ri, Eumam-myeon, Seosan-si, ChoongNam 356-844, South Korea
(FCC Designation Number : 624439)

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.



4. Equipment Used during Test

| No. | Test Equipment | Manufacturer | Model No. | Serial No. | Cal. Date | Next Cal. Data | Used equipment |
|-----|-------------------|--------------------|----------------------------------|--------------|------------|----------------|----------------|
| 1 | EMI Test Receiver | LIG | LSA-265 | L07098033 | 20/12/2014 | 12/20/2015 | ■ |
| 2 | EMI Test Receiver | Rhode & Schwarz | ESIB7 | 3311 | 02/11/2015 | 02/11/2016 | ■ |
| 2 | Bi-log Antenna | Schwarzbeck | VULB9163 | 164 | 09/15/2014 | 09/15/2016 | ■ |
| 5 | Loop Antenna | EMCO | 6502 | 9206-2769 | 02/13/2014 | 02/13/2016 | ■ |
| 6 | Spectrum Analyzer | Agilent | E4440A | US45303130 | 02/04/2015 | 01/26/2016 | ■ |
| 8 | Frequency Counter | HP | 5347A | 3009A02742 | 02/04/2015 | 01/26/2016 | ■ |
| 13 | Attenuator | Agilent | 8495B | 3308A22485 | 02/04/2015 | 01/26/2016 | □ |
| 15 | Power Meter | Agilent | E4418B | MY405111655 | 02/04/2015 | 01/26/2016 | □ |
| 16 | Power Sensor | HP | 8485A | 2347A02746 | 02/04/2015 | 01/26/2016 | □ |
| 18 | RF Cable | Gigalane | SMS102-MF1 41-SMS102-1.0 M | PB1252301285 | N/A | N/A | ■ |
| 20 | Signal Generator | HP | 83630A | 3420A00728 | 02/04/2015 | 01/26/2016 | ■ |
| 21 | Oscilloscope | HP | 54815A | US38380122 | 02/04/2015 | 01/26/2016 | □ |
| 23 | Pre Amplifier | Agilent | 8449B | 3008A02105 | 02/04/2015 | 01/26/2016 | ■ |
| 25 | Signal Generator | Rhode & Schwarz | SML03 | 102330 | 01/23/2015 | 01/26/2016 | ■ |
| 26 | POWER DIVIDER | Agilent | 11636B | 50309 | 02/04/2015 | 01/26/2016 | □ |
| 27 | Power Sensor | Agilent | 8482B | 3318A05111 | 02/04/2015 | 01/26/2016 | □ |
| 29 | DC Power Supply | HP | 6032A | US35420383 | 02/04/2015 | 01/26/2016 | □ |
| 30 | Slidacs | Sunchang Electrics | 5KV | N/A | 02/04/2015 | 01/26/2016 | □ |
| 32 | Bandreject Filter | K&L Microwave | 50140 | 555 | 02/04/2015 | 01/26/2016 | □ |
| 33 | Horn Antenna | SCHWARZBECK | BBHA9120A | 346 | 01/27/2014 | 01/27/2016 | ■ |
| 34 | Horn Antenna | A.H. SYSTEMS | SAS-572 | 269 | 08/07/2015 | 08/07/2017 | ■ |
| 35 | DC Power Supply | Provice | PWS-5005D | 205050 | 02/04/2015 | 01/26/2016 | ■ |
| 36 | LISN | Rhode & Schwarz | ESH2-Z5 | 100164 | 01/27/2015 | 12/01/2015 | ■ |
| 38 | Pulse Limiter | Rhode & Schwarz | ESH3-Z2 | 100137 | 11/12/2014 | 11/12/2015 | ■ |



5. Test Results and Measurement Data

5.1. Antenna Requirement

Standard requirement: 47 CFR Part 15C Section 15.203 /247(c)

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

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.

EUT Antenna

PASS

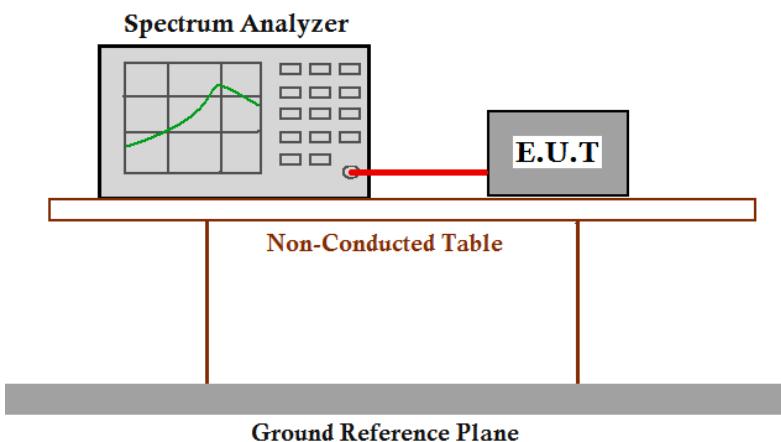
The transmitter has an Internal Chip antenna. The directional gain of the antenna is 1.53 dBi. please refer to the EUT Internal photos and Antenna gain.



5.2. Conducted Peak Output Power

| | |
|-------------------|---------------------------------------|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (b)(1) |
| Test Method: | KDB558074 D01 v03r01 |

Test Configuration:



| | |
|------------------------|---|
| Test Instruments: | Refer to section 4.10 for details |
| Exploratory Test Mode: | Transmitting mode |
| Final Test Mode: | Non-hopping transmitting with GFSK modulation |
| Limit: | 30dBm |
| Test Results: | Pass |

Measurement Data

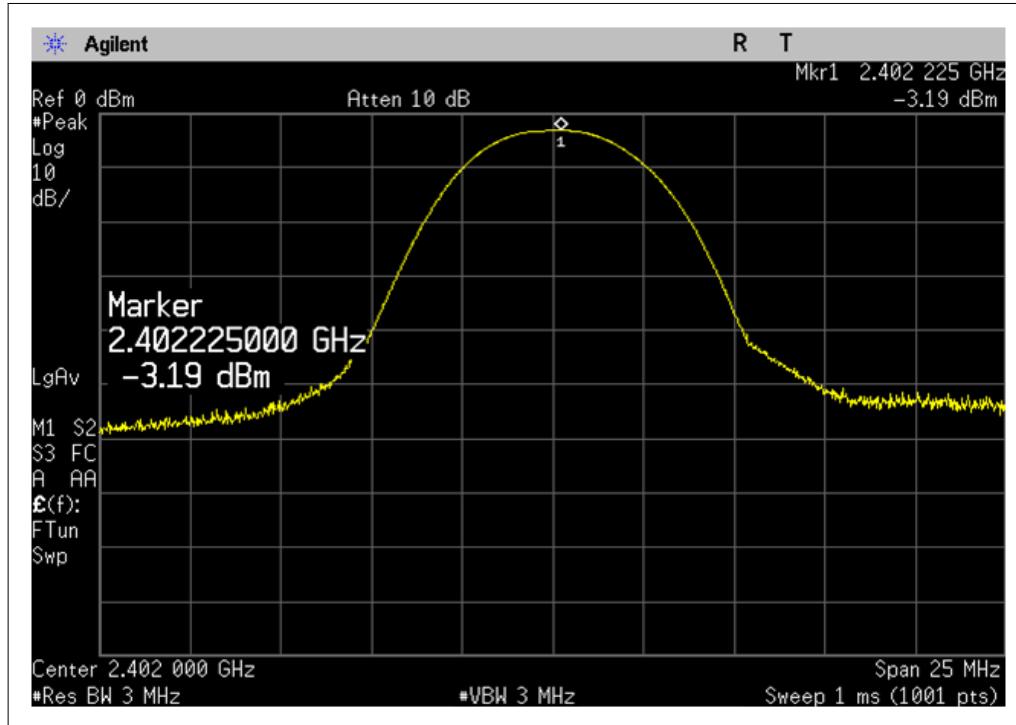
| GFSK mode | | | |
|--------------|-------------------------|-------------|--------|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | -3.19 | 30.00 | Pass |
| Middle | -2.94 | 30.00 | Pass |
| Highest | -3.06 | 30.00 | Pass |



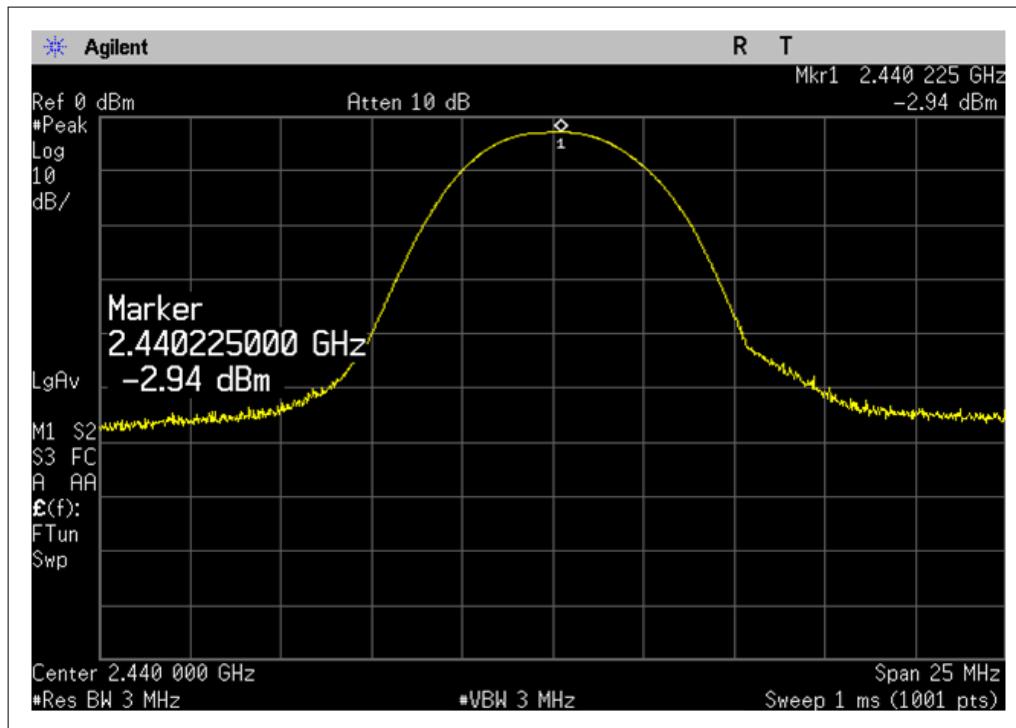
Result plot as follows:

Test mode: GFSK

Lowest Channel:

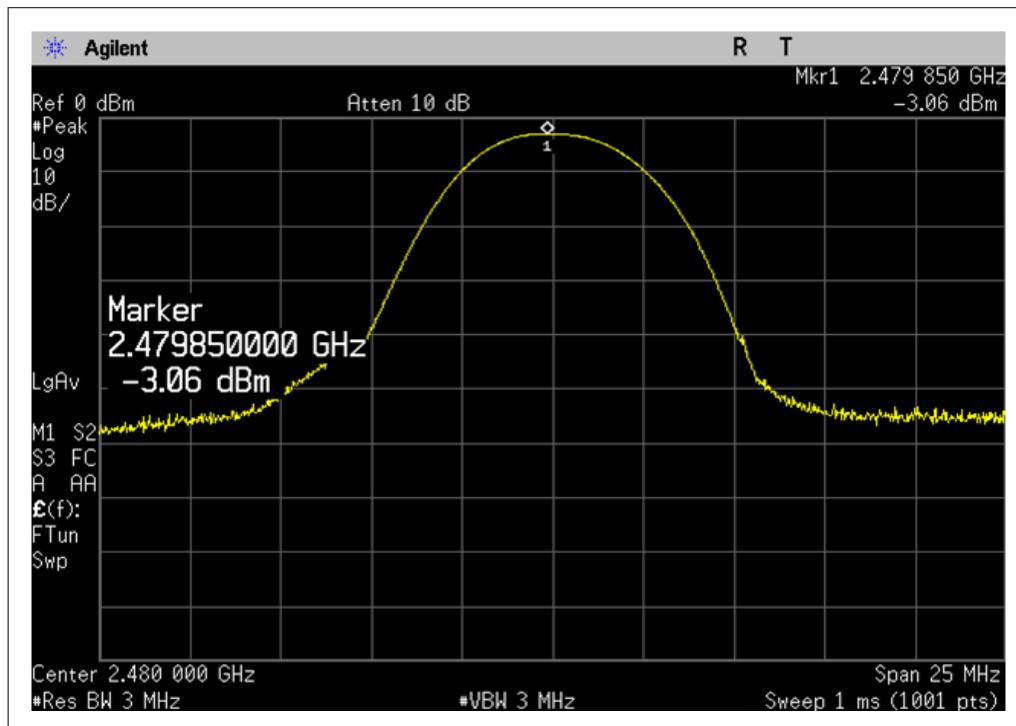


Middle Channel:





Highest Channel:

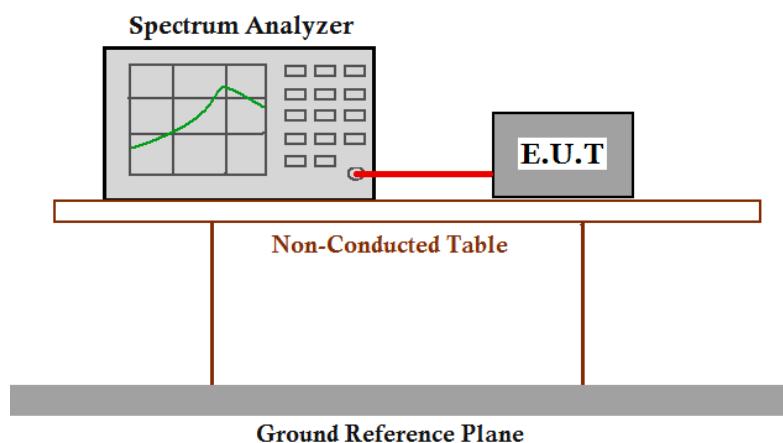




5.3. 6dB Occupy Bandwidth

| | |
|-------------------|---------------------------------------|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(2) |
| Test Method: | KDB558074 D01 v03r01 |

Test Configuration:



| | |
|------------------------|---|
| Instruments Used: | Refer to section 4.10 for details |
| Exploratory Test Mode: | Transmitting mode |
| Final Test Mode: | Non-hopping transmitting with GFSK modulation |
| Limit: | ≥ 500 kHz |
| Test Results: | Pass |

Measurement Data

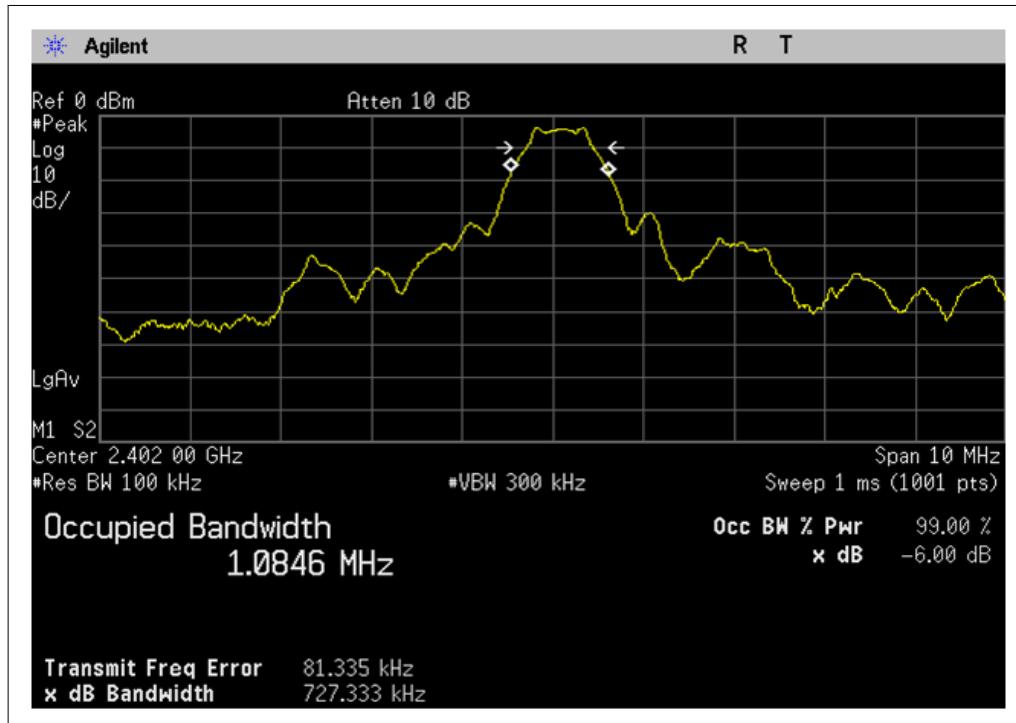
| Test channel | 6dB Occupy Bandwidth (kHz) | Limit (kHz) | Result |
|--------------|----------------------------|-------------|--------|
| Lowest | 727 | ≥ 500 | Pass |
| Middle | 720 | ≥ 500 | Pass |
| Highest | 714 | ≥ 500 | Pass |



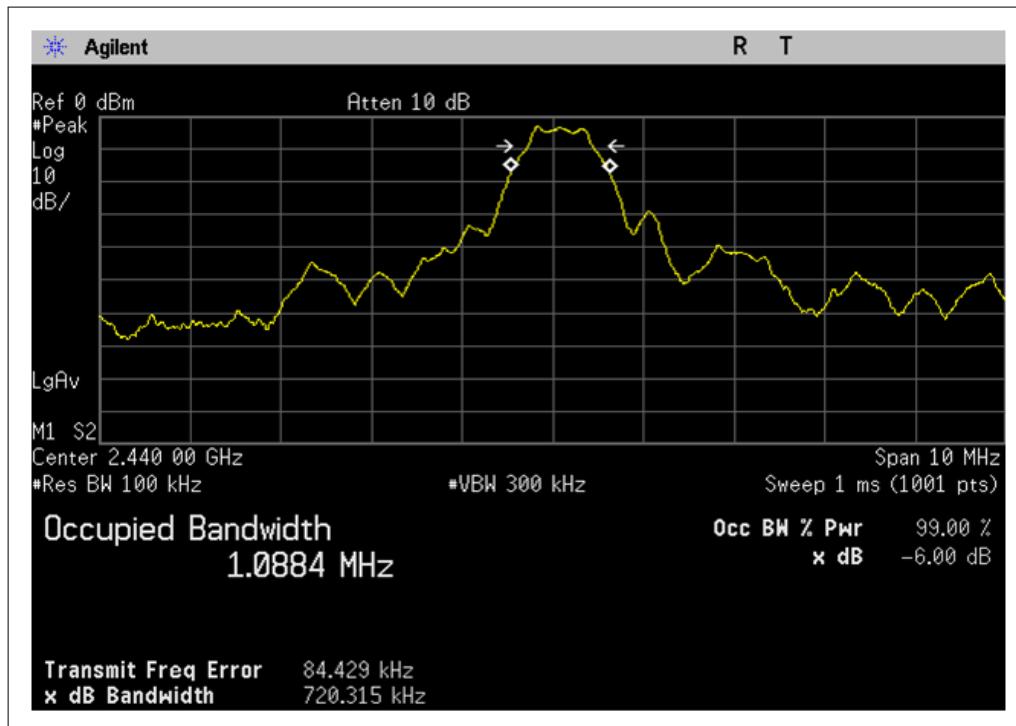
Result plot as follows:

Test mode: GFSK

Lowest Channel:

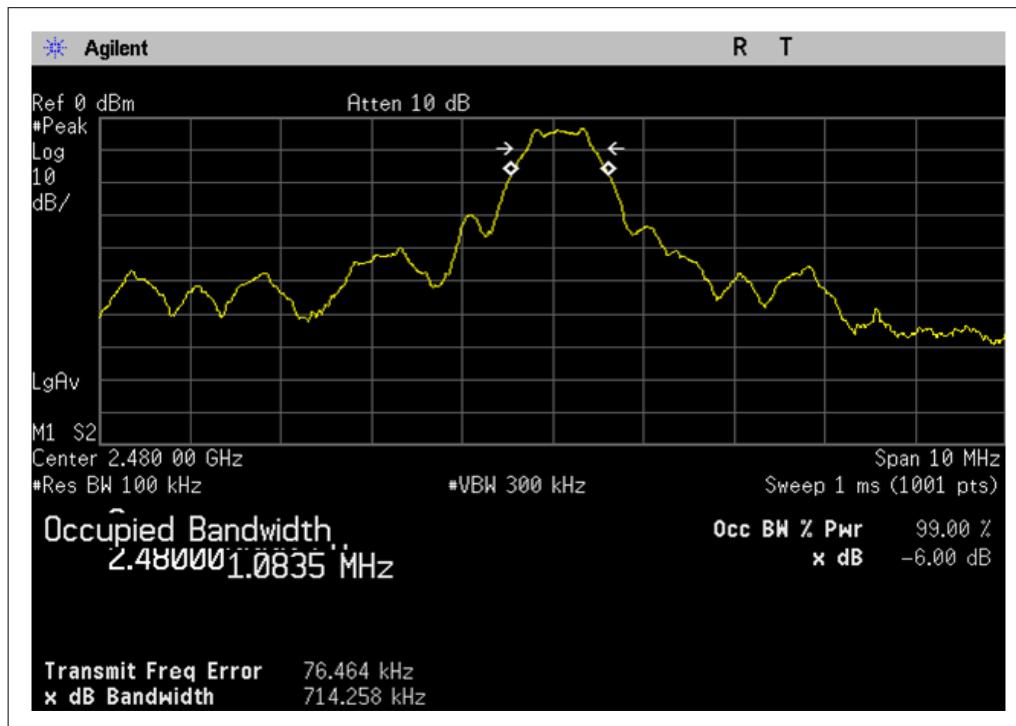


Middle Channel:





Highest Channel:

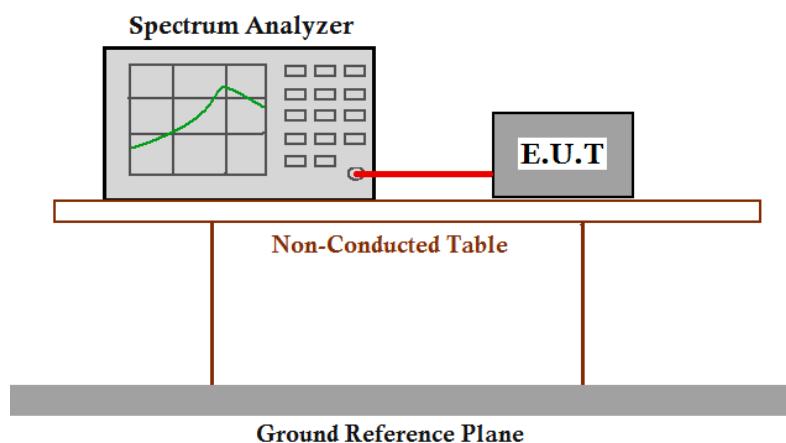




5.4. Power Spectral Density

| | |
|-------------------|------------------------------------|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (e) |
| Test Method: | KDB558074 D01 v03r01 |

Test Configuration:



| | |
|------------------------|---|
| Test Instruments: | Refer to section 4.10 for details |
| Exploratory Test Mode: | Transmitting mode |
| Final Test Mode: | Non-hopping transmitting with GFSK modulation |
| Limit: | $\leq 8\text{dBm}/3\text{kHz}$ |
| Test Results: | Pass |

Measurement Data

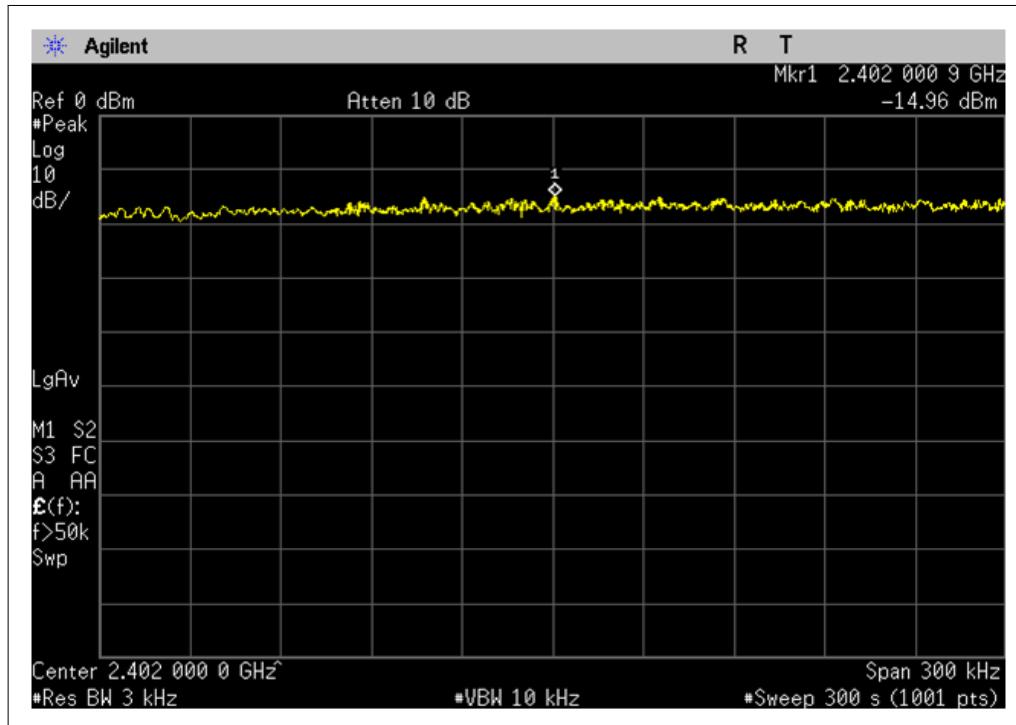
| GFSK mode | | | |
|--------------|------------------------------|--------------------------------|--------|
| Test channel | Power Spectral Density (dBm) | Limit (dBm) | Result |
| Lowest | -14.96 | $\leq 8\text{dBm}/3\text{kHz}$ | Pass |
| Middle | -14.82 | $\leq 8\text{dBm}/3\text{kHz}$ | Pass |
| Highest | -14.85 | $\leq 8\text{dBm}/3\text{kHz}$ | Pass |



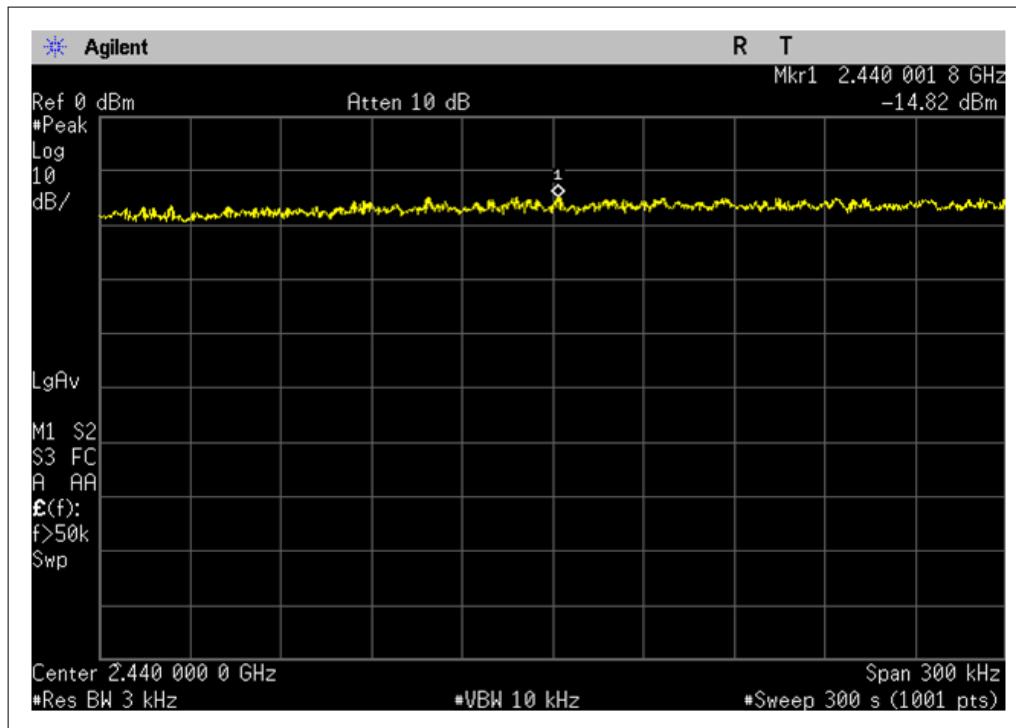
Result plot as follows:

Test mode: GFSK

Lowest Channel:

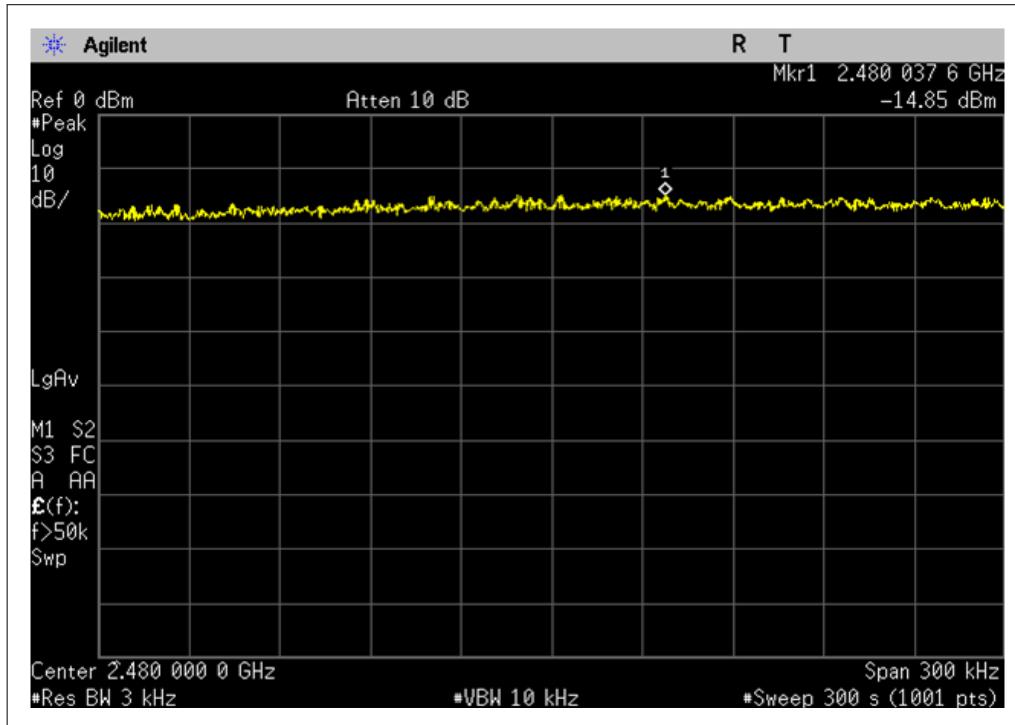


Middle Channel:





Highest Channel:

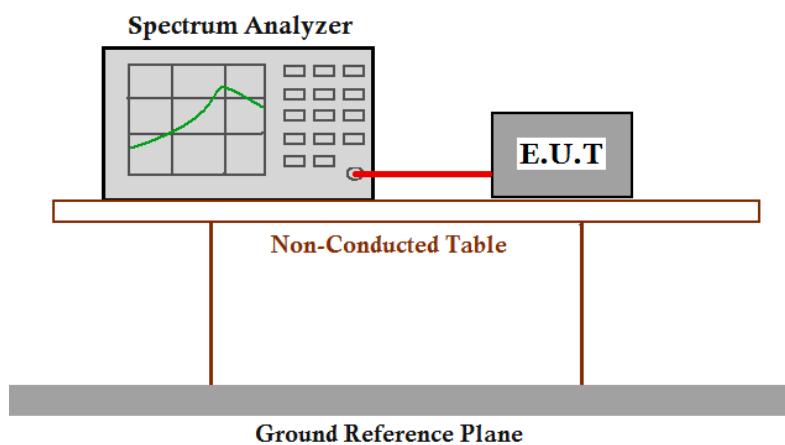




5.5. Band-edge for RF Conducted Emissions

| | |
|-------------------|---------------------------------|
| Test Requirement: | FCC Part15 C section 15.247 (d) |
| Test Method: | KDB558074 D01 v03r01 |

Test Configuration:



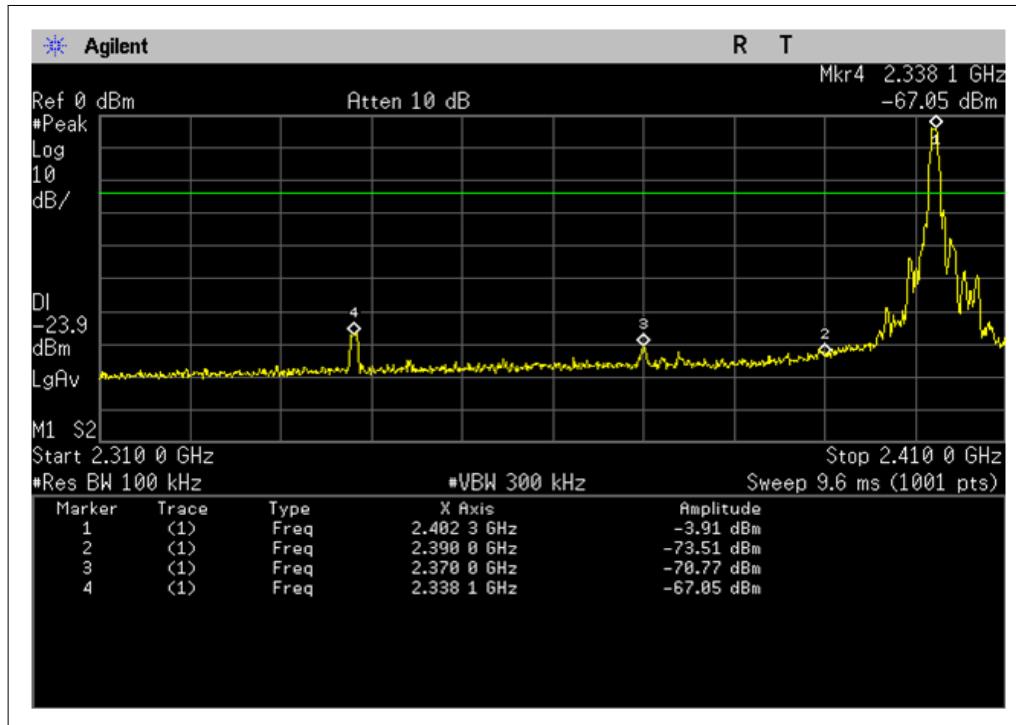
| | |
|------------------------|---|
| Exploratory Test Mode: | Transmitting mode |
| Final Test Mode: | Non-hopping transmitting with GFSK modulation |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power 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. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |



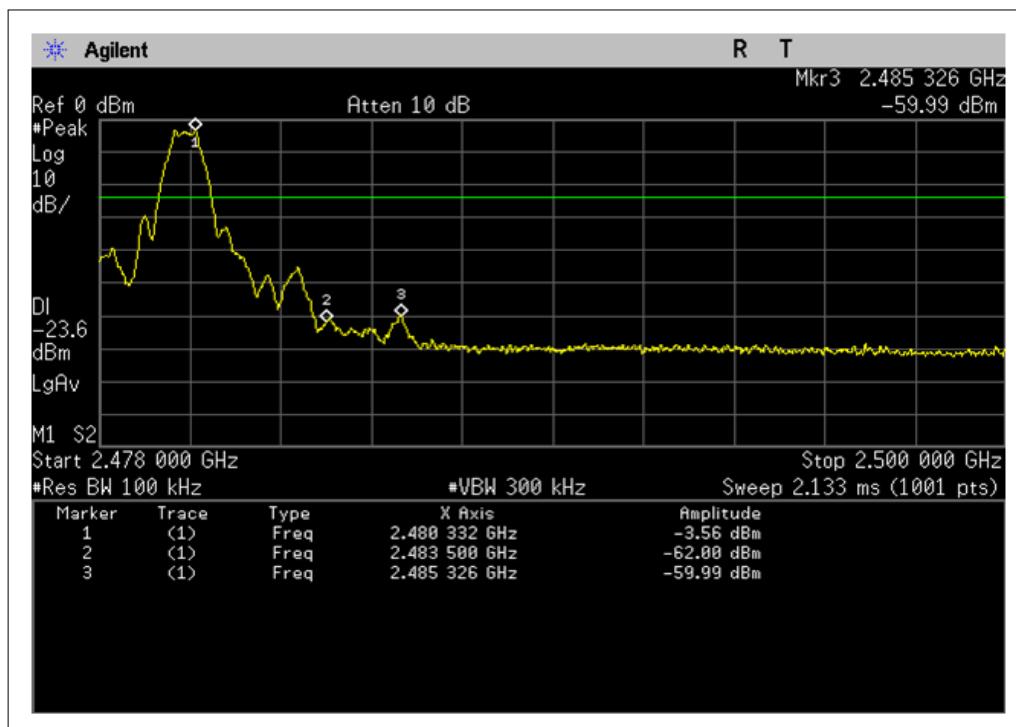
Result plot as follows:

Test mode: GFSK

Lowest Channel:



Highest Channel:

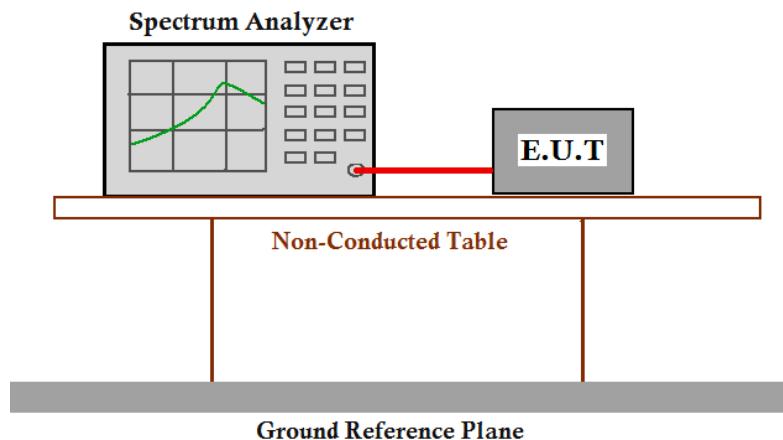




5.6. RF Conducted Spurious Emissions

| | |
|-------------------|------------------------------------|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | KDB558074 D01 v03r01 |

Test Configuration:



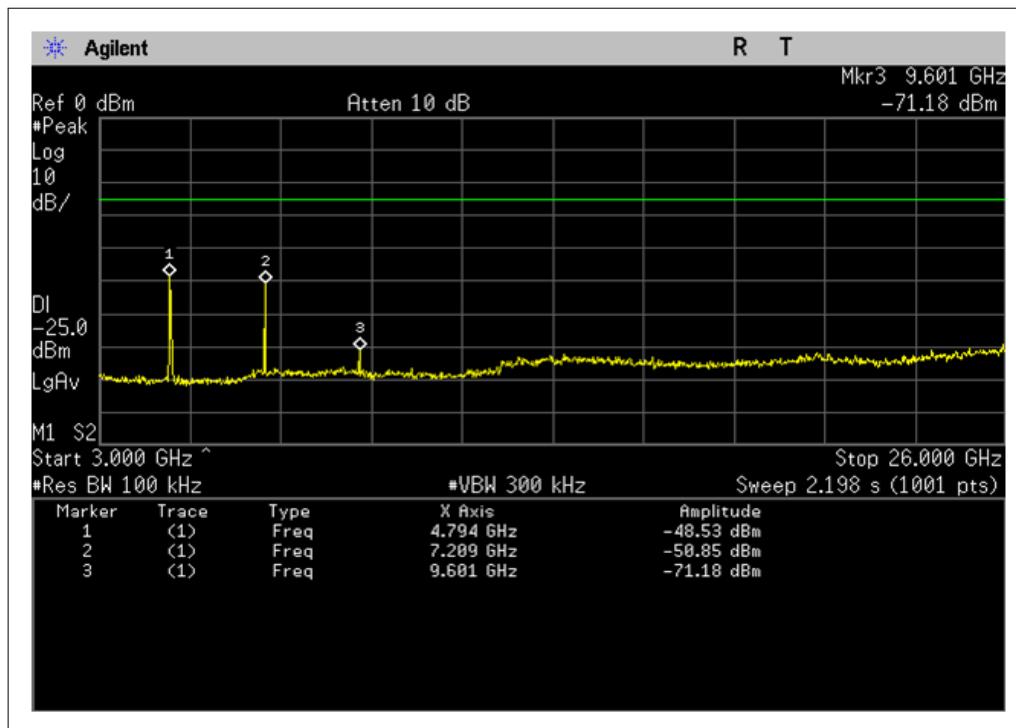
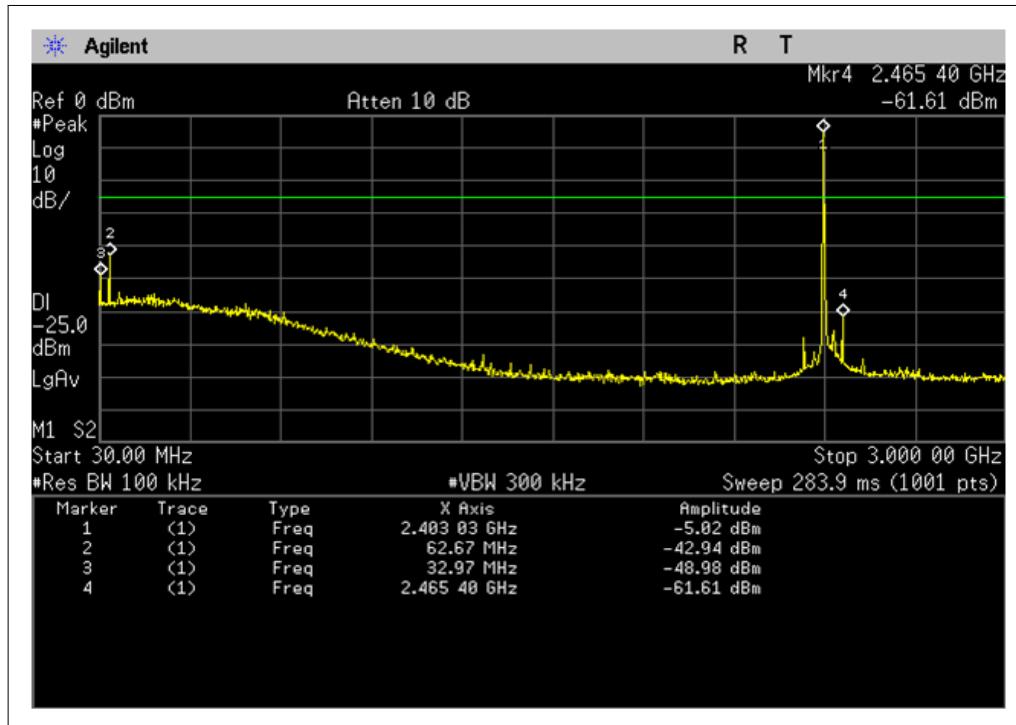
| | |
|------------------------|---|
| Exploratory Test Mode: | Transmitting mode |
| Final Test Mode: | Non-hopping transmitting with GFSK modulation |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power 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. |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |



Result plot as follows:

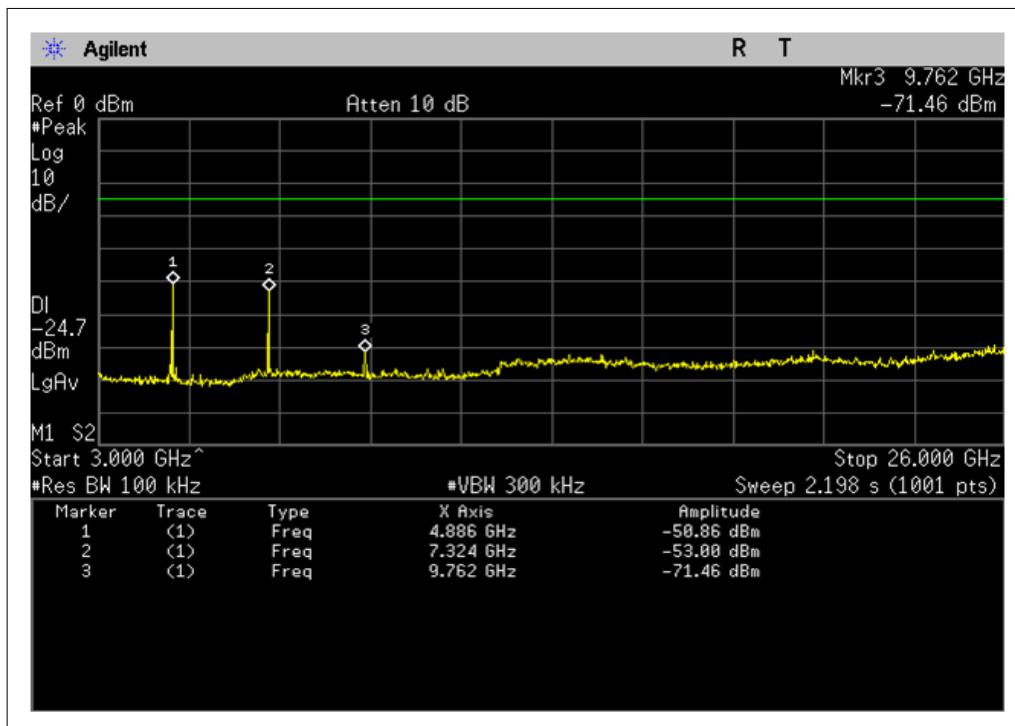
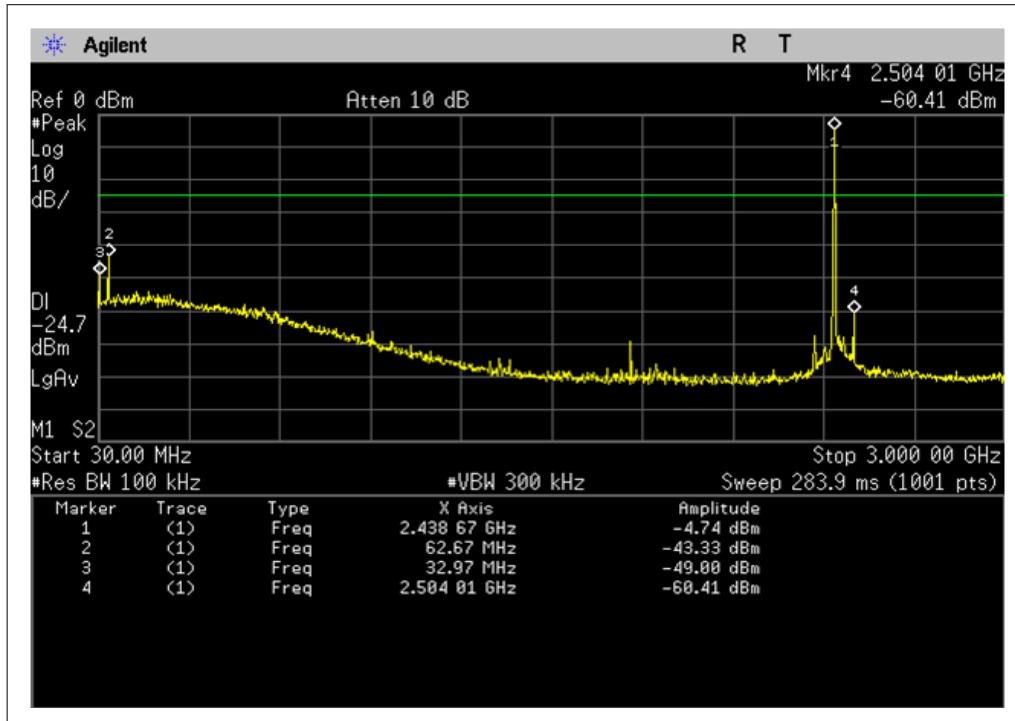
Test mode: GFSK

Lowest Channel:



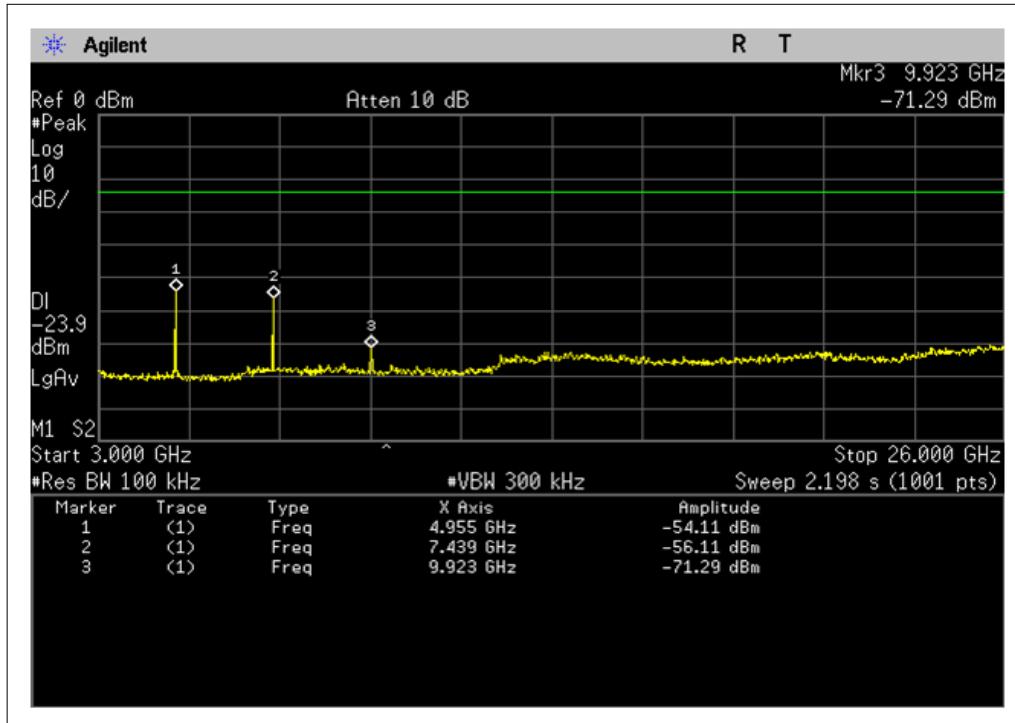
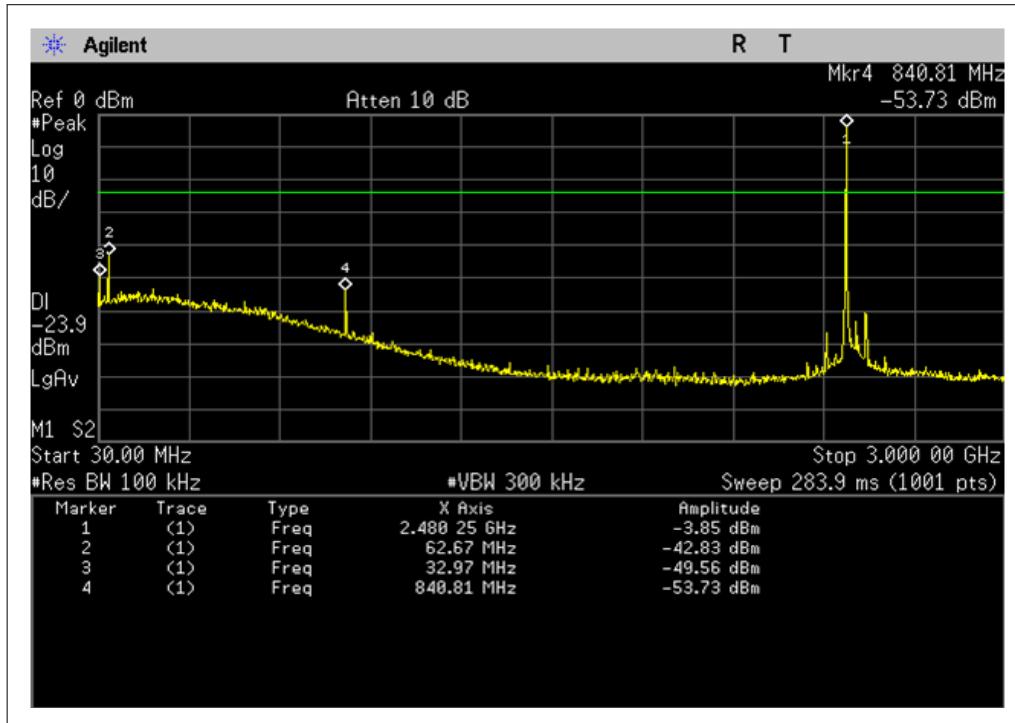


Middle Channel:





Highest Channel:





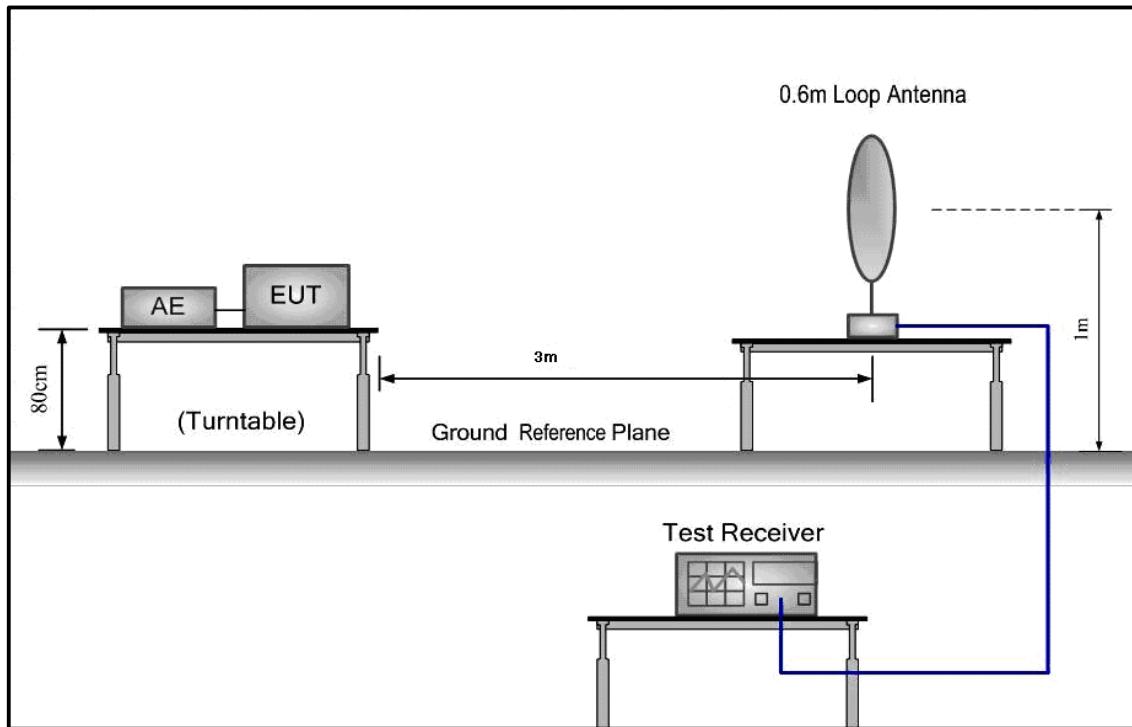
5.7. Radiated Spurious Emissions

| | | | | | |
|------------------|--|-------------------------------------|-------------------|------------|-----------------------------|
| Test equirement: | 47 CFR Part 15C Section 15.209 and 15.205 | | | | |
| Test Method: | ANSI C63.10 2009 | | | | |
| Test Site: | Measurement Distance: 3m | | | | |
| Receiver Setup: | Frequency | Detector | RBW | VBW | Remark |
| | 0.009MHz-0.090MHz | Peak | 10kHz | 30kHz | Peak |
| | 0.009MHz-0.090MHz | Average | 10kHz | 30kHz | Average |
| | 0.090MHz-0.110MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| | 0.110MHz-0.490MHz | Peak | 10kHz | 30kHz | Peak |
| | 0.110MHz-0.490MHz | Average | 10kHz | 30kHz | Average |
| | 0.490MHz -30MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| | 30MHz-1GHz | Quasi-peak | 100kHz | 300kHz | Quasi-peak |
| | Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | | Peak | 1MHz | 10Hz | Average |
| Limit: | Frequency | Field strength (microvolt/meter) | Limit (dBuV/m) | Remark | Measurement distance (m) |
| | 0.009MHz-0.490MHz | 2400/F(kHz) | - | - | 300 |
| | 0.490MHz-1.705MHz | 24000/F(kHz) | - | - | 30 |
| | 1.705MHz-30MHz | 30 | - | - | 30 |
| | 30MHz-88MHz | 100 | 40.0 | Quasi-peak | 3 |
| | 88MHz-216MHz | 150 | 43.5 | Quasi-peak | 3 |
| | 216MHz-960MHz | 200 | 46.0 | Quasi-peak | 3 |
| | 960MHz-1GHz | 500 | 54.0 | Quasi-peak | 3 |
| | Above 1GHz | 500 | 54.0 | Average | 3 |
| | Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device. | | | | |

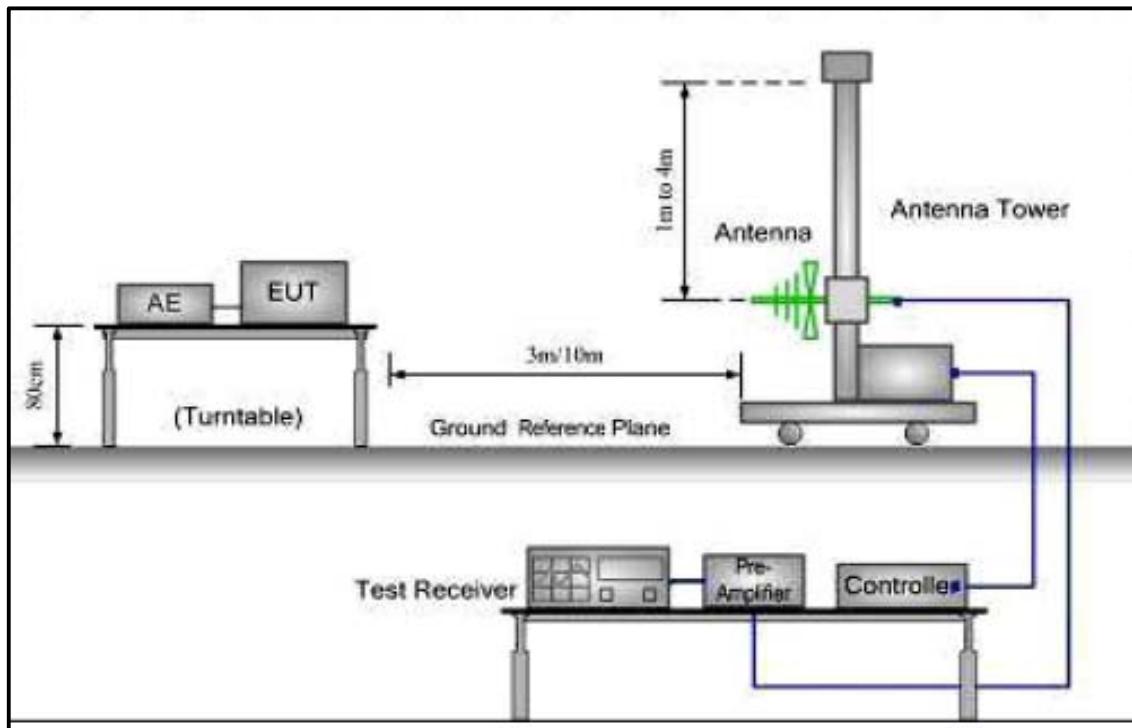


Test Configuration:

1) 9 kHz to 30 MHz emissions:

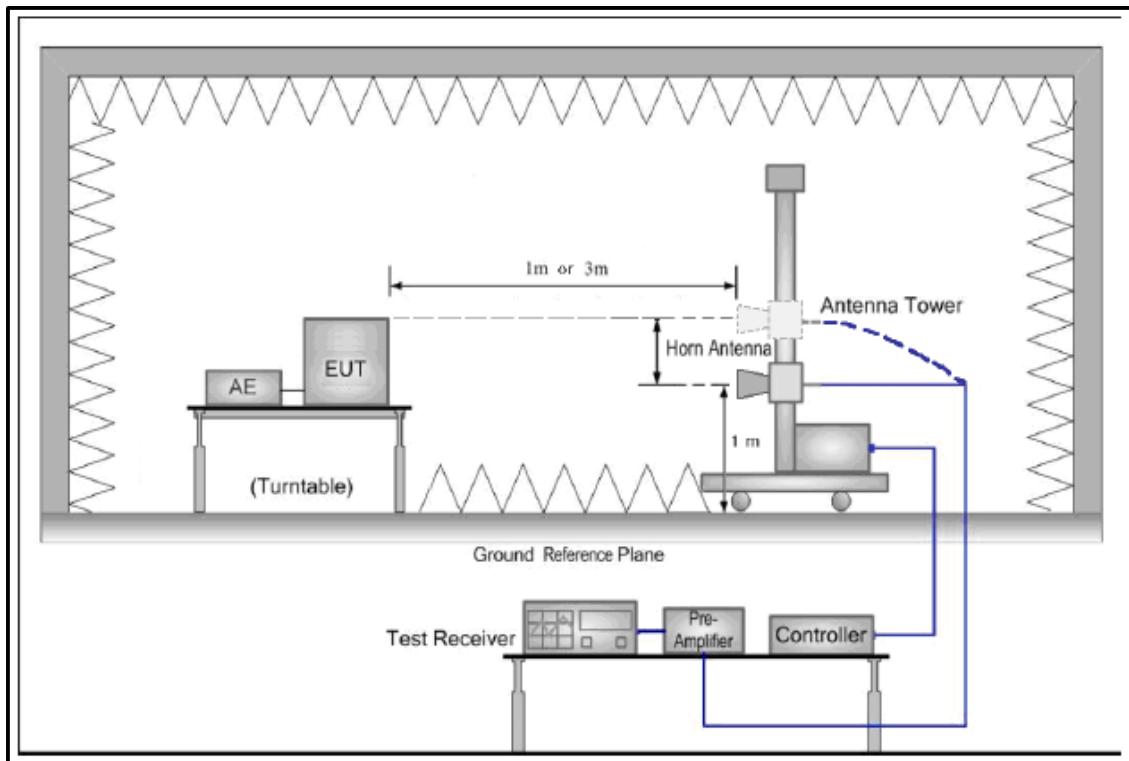


2) 30 MHz to 1 GHz emissions:





3) 1 GHz to 25 GHz emissions:



| | |
|-----------------|---|
| Test Procedure: | <p>a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter OATS. The table was rotated 360 degrees to determine the position of the highest radiation.</p> <p>b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.</p> <p>c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.</p> <p>d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters(for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.</p> |
|-----------------|---|



| | |
|------------------------|---|
| Test Procedure: | <p>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.</p> <p>g. Test the EUT in the lowest channel ,the middle channel ,the Highest channel</p> <p>h. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, Only the test worst case mode is recorded in the report.</p> <p>i. Repeat above procedures until all frequencies measured was complete.</p> |
| Exploratory Test Mode: | Transmitting mode. |
| Final Test Mode: | Non-hopping transmitting with GFSK modulation |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |



5.7.1. Harmonic and other spurious emissions

5.7.1.1. Test at Lowest Channel in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

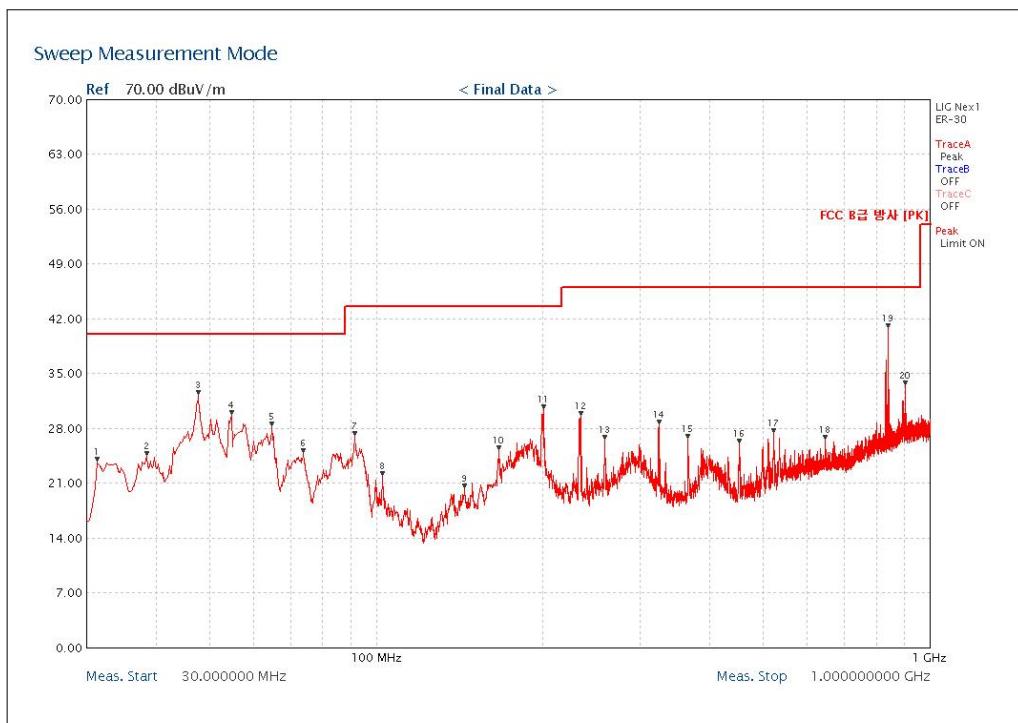
30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement

Test Mode: GFSK

Test channel: Lowest

Vertical:

Level (dB μ V/m)



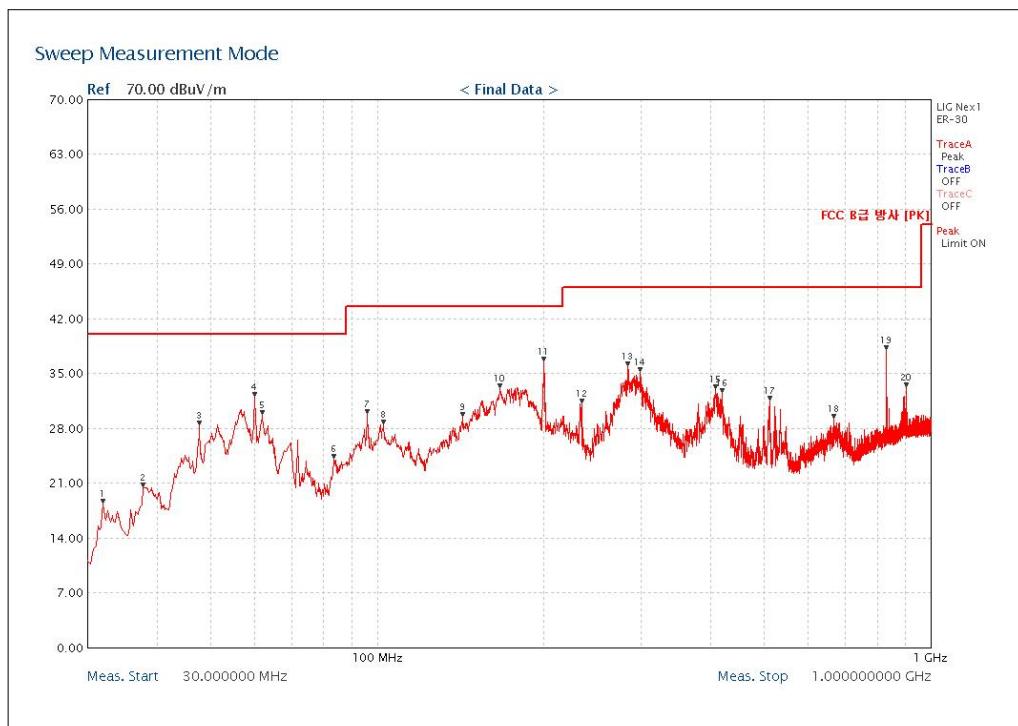
Quasi-peak measurement

| Frequency (MHz) | Detect Mode | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|-----------------|-------------|--------------------|-----------------------------|------------------------------------|-------------------------------|----------------------|
| 47.64 | QP | V | 32.17 | 15.61 | 16.56 | 40.0 |
| 54.86 | QP | V | 29.69 | 14.69 | 15.00 | 40.0 |
| 200.52 | QP | V | 30.36 | 12.06 | 18.30 | 43.5 |
| 838.70 | QP | V | 40.74 | 24.77 | 15.97 | 46.0 |



Horizontal:

Level (dB μ V/m)



Quasi-peak measurement

| Frequency (MHz) | Detect Mode | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|-----------------|-------------|--------------------|-----------------------------|------------------------------------|-------------------------------|----------------------|
| 60.07 | QP | H | 31.92 | 14.04 | 17.88 | 40.0 |
| 199.93 | QP | H | 36.43 | 12.04 | 24.39 | 43.5 |
| 283.77 | QP | H | 35.83 | 15.02 | 20.81 | 46.0 |
| 830.89 | QP | H | 37.92 | 24.66 | 13.26 | 46.0 |
| 900.52 | QP | H | 33.12 | 25.68 | 7.44 | 46.0 |



1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak / Average Measurement:

| Frequency (MHz) | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Amplifier Gain (dB) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|--|-----------------------|-----------------------------------|---|---------------------------|-------------------------------------|-------------------------|
| | | | | | | |
| The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported. | | | | | | |
| | | | | | | |



5.7.1.2. Test at middle Channel in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

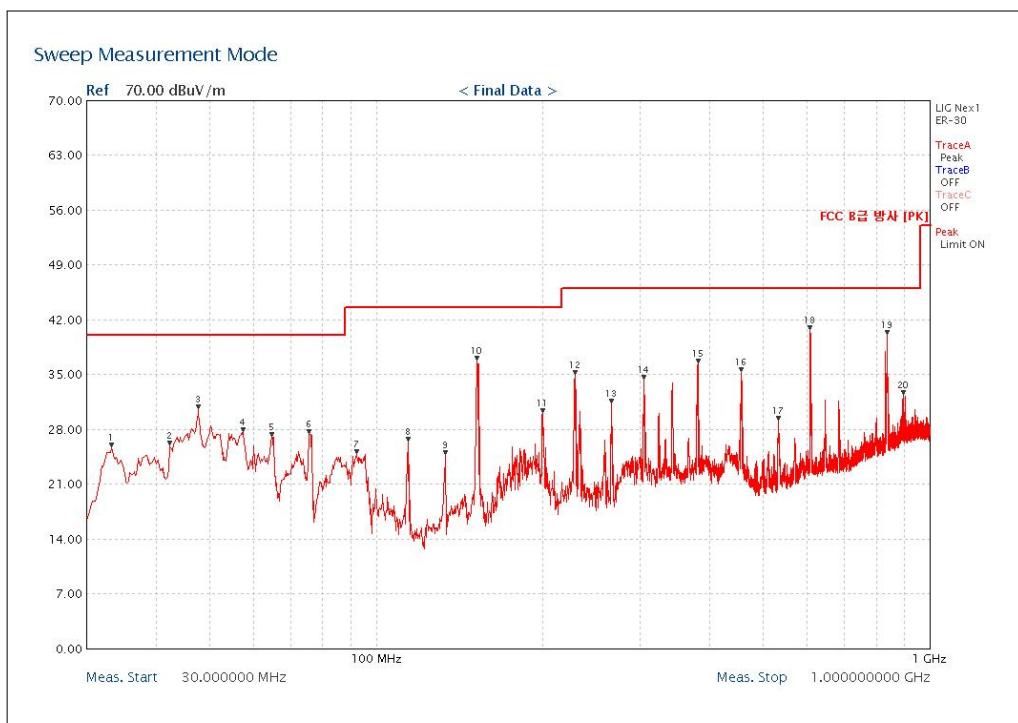
30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement

Test Mode: GFSK

Test channel: Middle

Vertical:

Level (dB μ V/m)



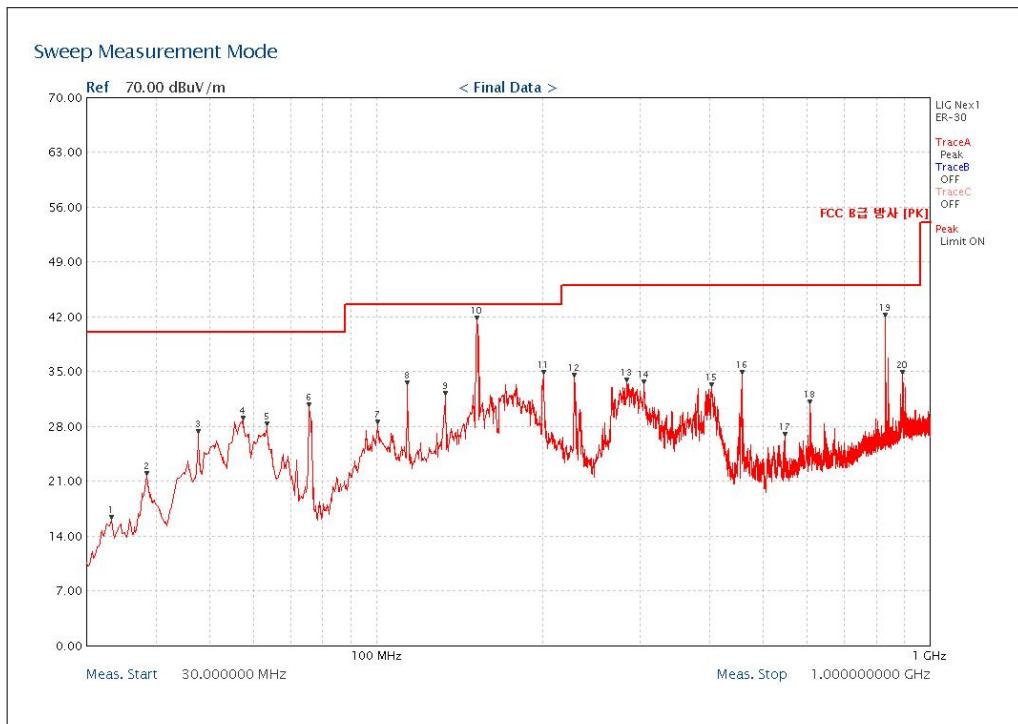
Quasi-peak measurement

| Frequency (MHz) | Detect Mode | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|-----------------|-------------|--------------------|-----------------------------|------------------------------------|-------------------------------|----------------------|
| 47.64 | QP | V | 30.54 | 15.61 | 14.93 | 40.0 |
| 152.21 | QP | V | 36.73 | 9.97 | 26.76 | 43.5 |
| 228.47 | QP | V | 34.93 | 13.34 | 21.59 | 46.0 |
| 455.72 | QP | V | 35.29 | 18.86 | 16.43 | 46.0 |
| 607.42 | QP | V | 40.62 | 21.89 | 18.73 | 46.0 |
| 837.99 | QP | V | 39.94 | 24.76 | 15.18 | 46.0 |



Horizontal:

Level (dB μ V/m)



Quasi-peak measurement

| Frequency (MHz) | Detect Mode | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|-----------------|-------------|--------------------|-----------------------------|------------------------------------|-------------------------------|----------------------|
| 75.71 | QP | H | 30.38 | 9.74 | 20.64 | 40.0 |
| 152.21 | QP | H | 41.45 | 9.97 | 31.48 | 43.5 |
| 200.52 | QP | H | 34.45 | 12.06 | 22.39 | 43.5 |
| 457.03 | QP | H | 34.54 | 18.88 | 15.66 | 46.0 |
| 830.18 | QP | H | 41.78 | 24.65 | 17.13 | 46.0 |



1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak / Average Measurement:

| Frequency (MHz) | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Amplifier Gain (dB) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|--|-----------------------|-----------------------------------|---|---------------------------|-------------------------------------|-------------------------|
| | | | | | | |
| The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported. | | | | | | |
| | | | | | | |



5.7.1.3. Test at Highest Channel in transmitting status

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

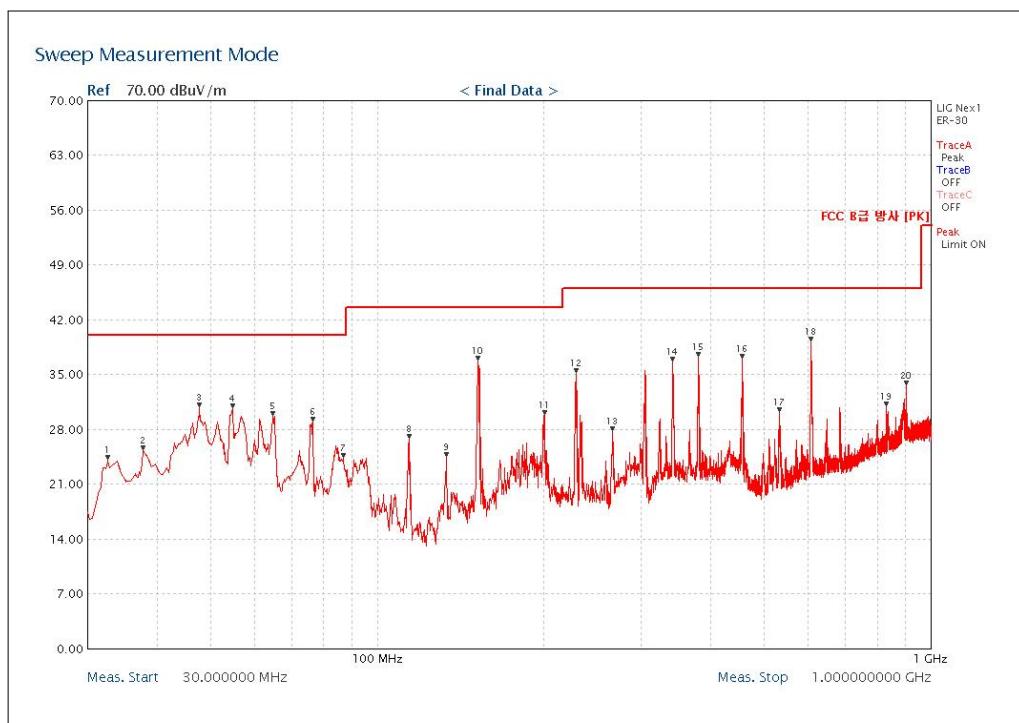
30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement

Test Mode: GFSK

Test channel: Highest

Vertical:

Level (dB μ V/m)



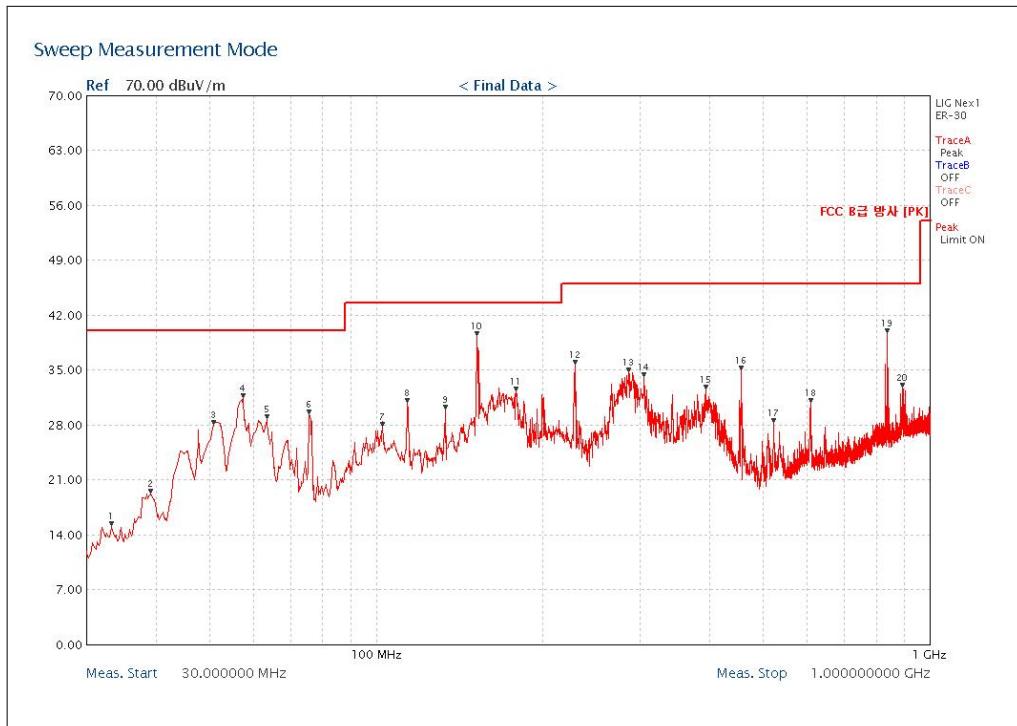
Quasi-peak measurement

| Frequency (MHz) | Detect Mode | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|-----------------|-------------|--------------------|-----------------------------|------------------------------------|-------------------------------|----------------------|
| 47.64 | QP | V | 30.69 | 15.61 | 15.08 | 40.0 |
| 152.21 | QP | V | 36.72 | 9.97 | 26.75 | 43.5 |
| 228.47 | QP | V | 35.11 | 13.34 | 21.77 | 46.0 |
| 379.46 | QP | V | 37.18 | 17.43 | 19.75 | 46.0 |
| 455.72 | QP | V | 36.91 | 18.86 | 18.05 | 46.0 |
| 607.42 | QP | V | 39.17 | 21.89 | 17.28 | 46.0 |



Horizontal:

Level (dB μ V/m)



Quasi-peak measurement

| Frequency (MHz) | Detect Mode | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|-----------------|-------------|--------------------|-----------------------------|------------------------------------|-------------------------------|----------------------|
| 57.47 | QP | H | 31.31 | 14.37 | 16.94 | 40.0 |
| 152.21 | QP | H | 39.24 | 9.97 | 29.27 | 43.5 |
| 228.47 | QP | H | 35.58 | 13.34 | 22.24 | 46.0 |
| 455.72 | QP | H | 34.84 | 18.86 | 15.98 | 46.0 |
| 837.99 | QP | H | 39.66 | 24.76 | 14.90 | 46.0 |



1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak / Average Measurement:

| Frequency (MHz) | Polarization (V/H) | Measured Value (dB μ V) | Antenna Factor + Cable Loss (dB/m) | Amplifier Gain (dB) | Emission Level (dB μ V/m) | Limit (dB μ V/m) |
|--|-----------------------|-----------------------------------|---|---------------------------|-------------------------------------|-------------------------|
| | | | | | | |
| The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported. | | | | | | |
| | | | | | | |

Remark:

- 1). The field strength is calculated by adding the Antenna Factor. Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Emission = Measured Value + Antenna Factor + Cable Loss - Amplifier Gain.
- 2). As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.
- 3). The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.



5.8. Band Edge (Radiated Emission)

| | |
|-------------------|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) In addition, radiated emissions 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 Method: | ANSI C63.10: 2009 |
| Measurement | 3m |
| Limit: | Section 15.209(a) 40.0 dB μ V/m between 30MHz & 88MHz; Quasi-peak Value 43.5 dB μ V/m between 88MHz & 216MHz; Quasi-peak Value 46.0 dB μ V/m between 216MHz & 960MHz; Quasi-peak Value 54.0 dB μ V/m between 960MHz.& 1GHz; Quasi-peak Value 54.0 dB μ V/m Above 1GHz; Average Value 74.0 dB μ V/m Above 1GHz; Peak Value |
| Test Procedure: | <ol style="list-style-type: none">a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.f. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channelg. Test the EUT in the lowest channel , the Highest channelh. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.i. Repeat above procedures until all frequencies measured was complete. |

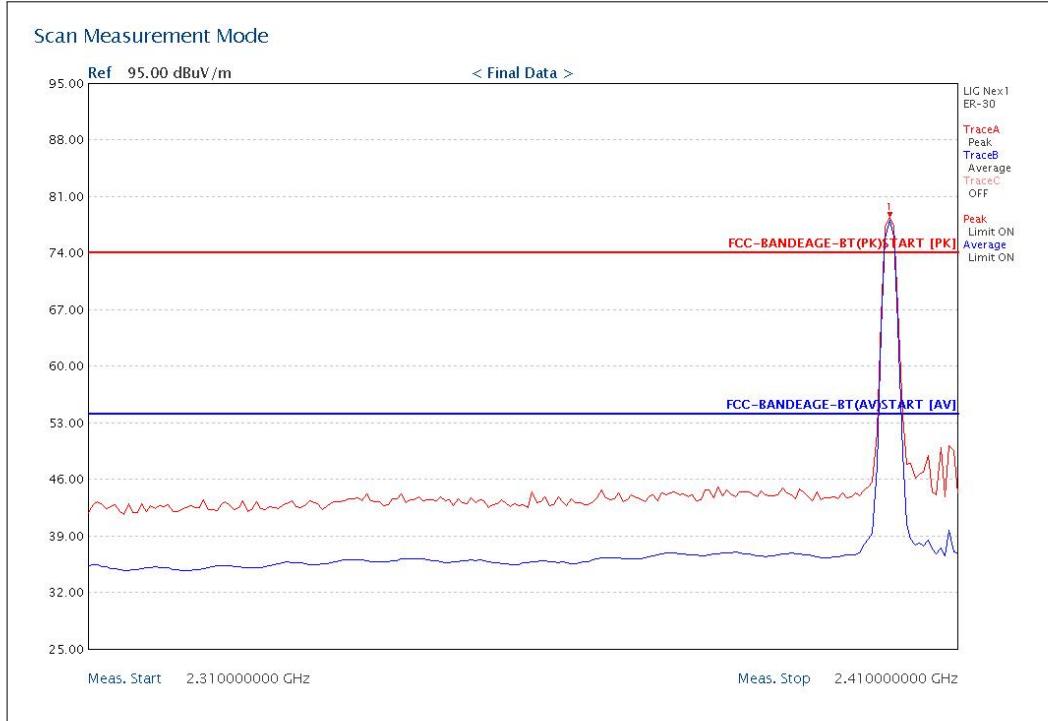


| | |
|------------------------|---|
| Exploratory Test Mode: | Transmitting mode |
| Final Test Mode: | Non-hopping transmitting with GFSK modulation |
| Instruments Used: | Refer to section 4.10 for details |
| Test Results: | Pass |

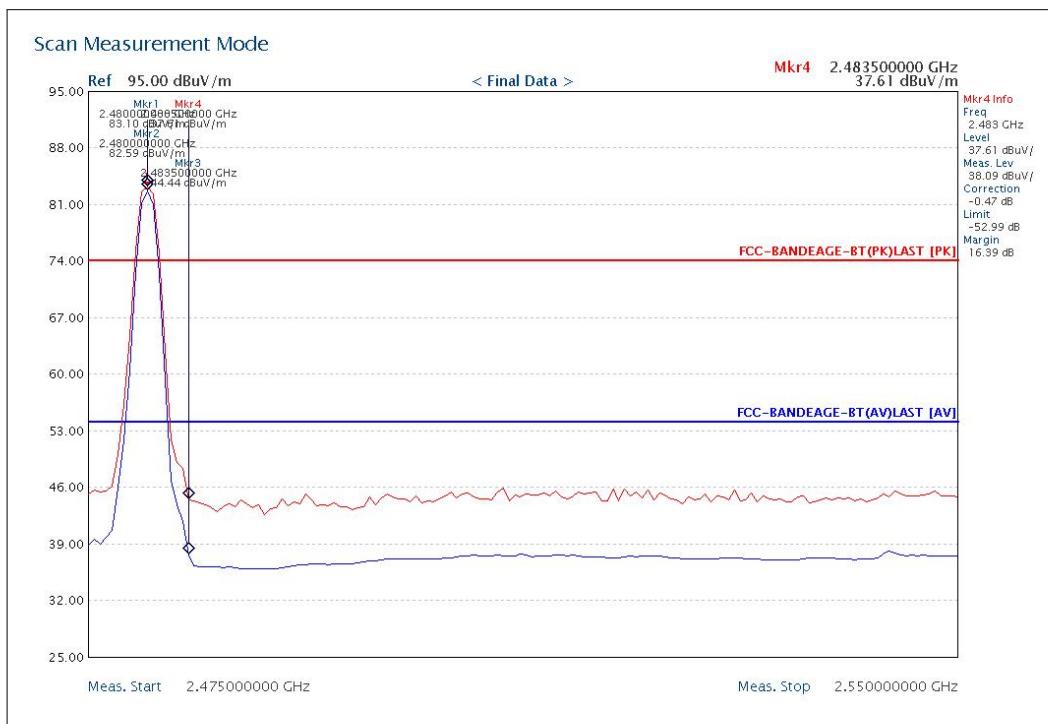


Measurement Result

Lowest Channel , Horizontal , Peak/Average Detector

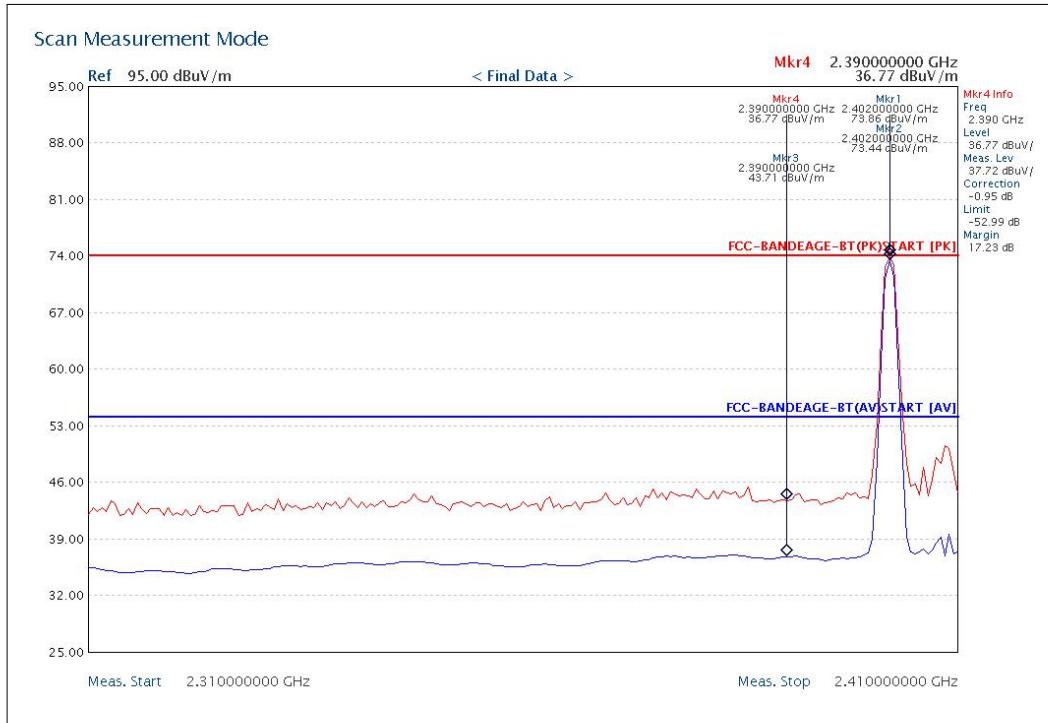


High Channel , Horizontal , Peak/Average Detector

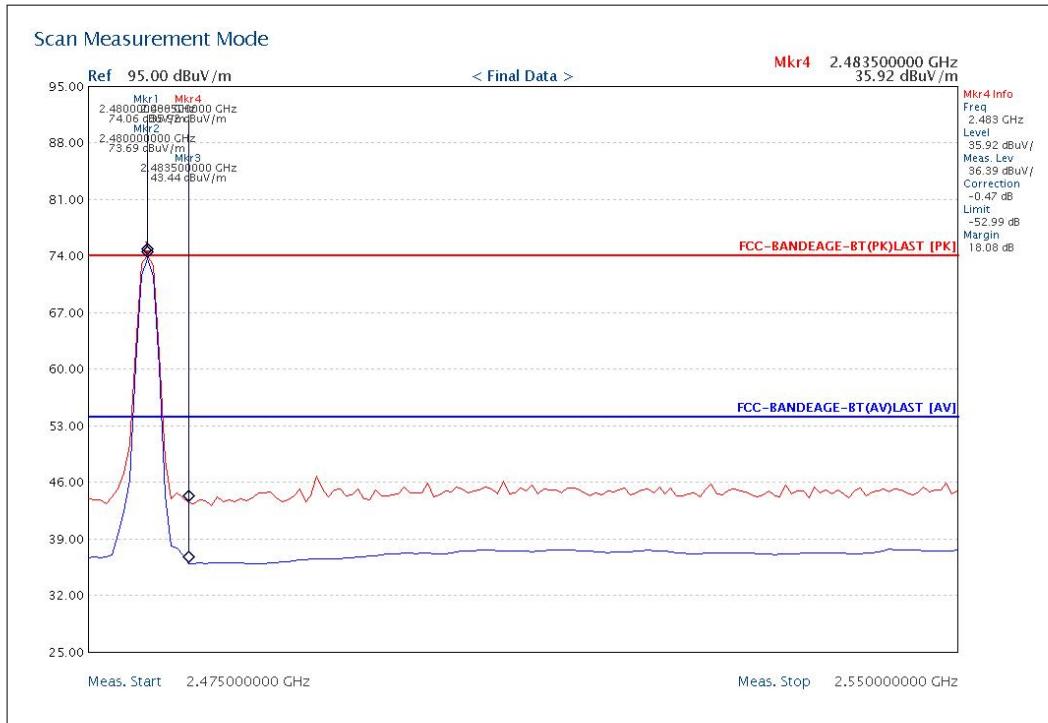




Low Channel , Vertical , Peak/Average Detector



High Channel , Vertical , Peak/Average Detector





Section 15.205 Restricted bands of operation.

(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 | GHz |
|----------------------------|-----------------------|-----------------|---------------|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| ¹ 0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2655 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | |
| 13.36 - 13.41 | | | |



5.9. Conducted Emissions at Mains Terminals 150 kHz to 30 MHz

Test Requirement: FCC Part 15 C section 15.207

Test Method: ANSI C63.10: ANSI C63.10: 2009

Frequency Range: 150 kHz to 30 MHz

Detector: Peak for pre-scan (9 kHz Resolution Bandwidth)

Test Limit

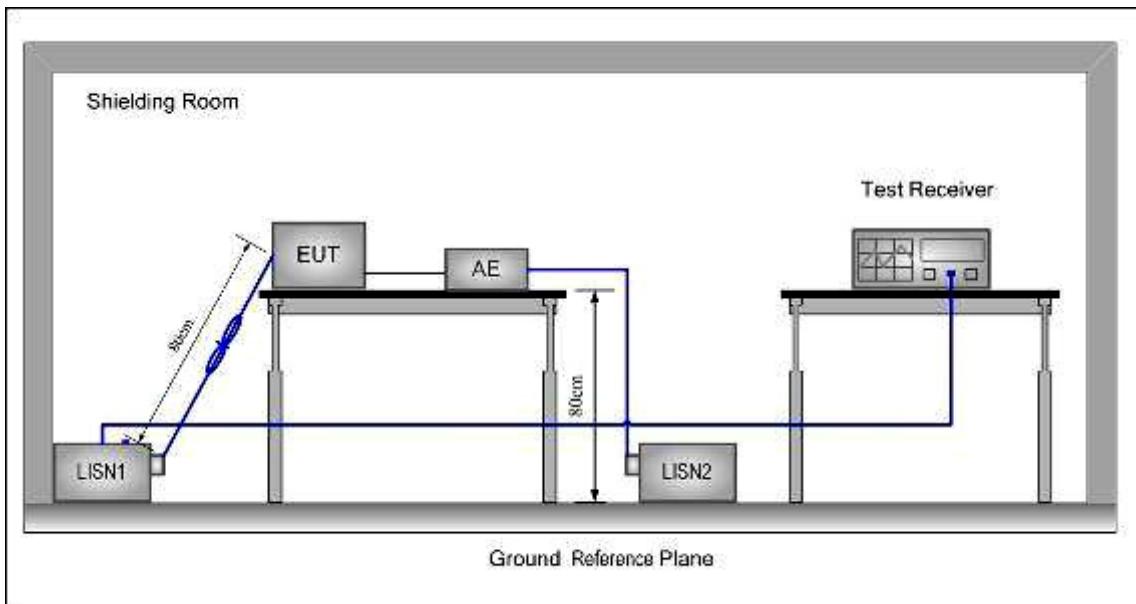
Limits for conducted disturbance at the mains ports of class B

| Frequency Range (MHz) | Class B Limit dB(µV) | |
|--------------------------|----------------------|----------|
| | 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 |

NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.

EUT Operation: Test in normal operating mode. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Test Configuration:



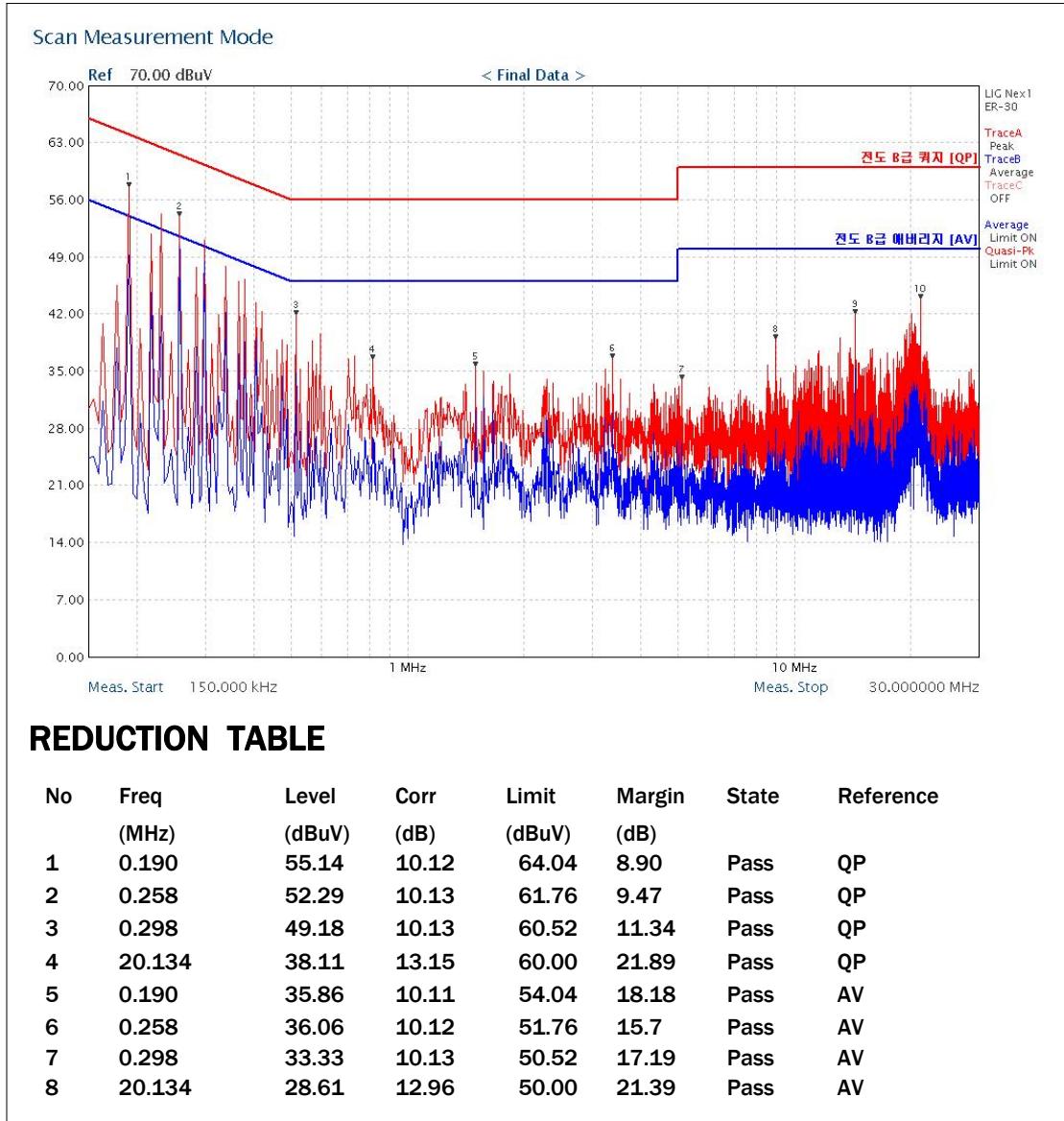
Test procedure:

1. The mains terminal disturbance voltage test was conducted in a shielded room.
2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50/50\mu\text{H} + 5\text{linear}$ impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.
4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2009 on conducted measurement.

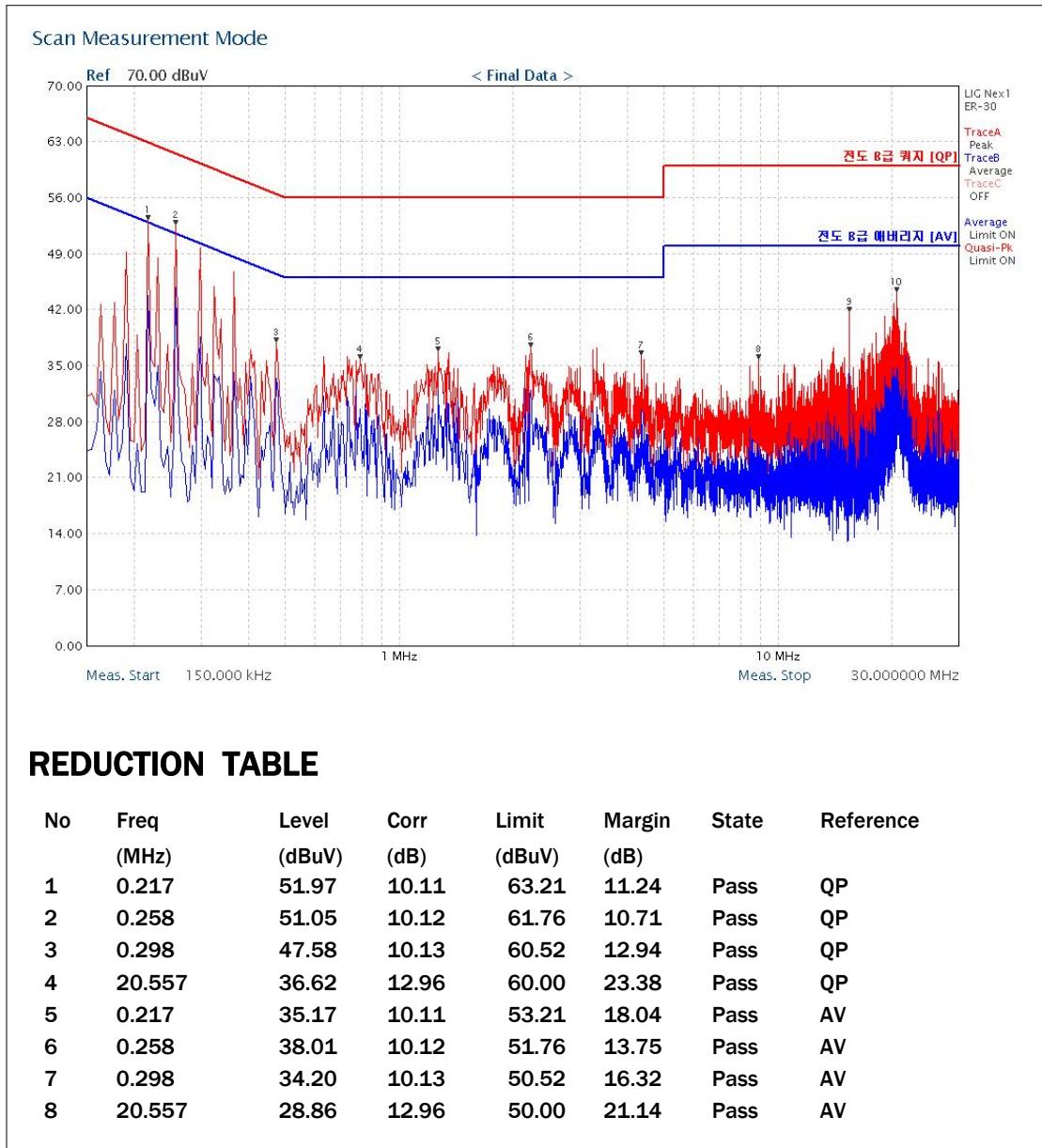
5.9.1. Measurement Data

Pre-scan was performed with peak detected on all ports, Quasi-peak & average measurements were performed at the frequencies at which maximum peak emission level were detected. Please see the attached Quasi-peak and Average test results.

Line - PE(QusIPeak and Average detector used)



Neutral – PE(QusipEak and Average detector used)



Measurement data:

* Detector function was set into Quasi-peak & Average mode.

* Corr = LISN Factor + Cable loss + Pulse Limiter



5.10. Radio Frequency Exposure Procedures

Regulation

According to §15.247(i) and § 1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

KDB 447498 D01: Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table:

| MHz | 5 | 10 | 15 | 20 | 25 | mm |
|------|----|----|-----|-----|-----|-----------------------------------|
| 150 | 39 | 77 | 116 | 155 | 194 | SAR Test Exclusion Threshold (mW) |
| 300 | 27 | 55 | 82 | 110 | 137 | |
| 450 | 22 | 45 | 67 | 89 | 112 | |
| 835 | 16 | 33 | 49 | 66 | 82 | |
| 900 | 16 | 32 | 47 | 63 | 79 | |
| 1500 | 12 | 24 | 37 | 49 | 61 | |
| 1900 | 11 | 22 | 33 | 44 | 54 | |
| 2450 | 10 | 19 | 29 | 38 | 48 | |
| 3600 | 8 | 16 | 24 | 32 | 40 | |
| 5200 | 7 | 13 | 20 | 26 | 33 | |
| 5400 | 6 | 13 | 19 | 26 | 32 | |
| 5800 | 6 | 12 | 19 | 25 | 31 | |

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances \leq 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is \leq 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is $<$ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.



Maximum Measured Transmitter Power:

| Channel Frequency (MHz) | Maximum Peak Conducted Output Power | | Max Antenna Gain (dBi) | Numeric antenna gain (mW) |
|-------------------------|-------------------------------------|-------|------------------------|---------------------------|
| | (dBm) | (mW) | | |
| 2440 | -2.94 | 0.508 | 1.53 | 1.422 |

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]

$$\cdot [\sqrt{f(\text{GHz})}] = 0.508/5 * \sqrt{2.440} = 0.1587 \leq 3.0$$

Threshold at which no SAR required is 10mW and ≤ 3.0 for 1-g SAR, Separation distance is 5mm.

Conclusion : The SAR measurement is exempt.



APPENDIX

1. EUT photo

