

# TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID : ZNFD855

Equipment Under Test : Cellular/PCS GSM/GPRS/EDGE/WCDMA and LTE phone with Bluetooth, WLAN and RFID  
Model Name : LG-D855  
Alternative models : LGD855, D855, LG-D855k, LG-D855K, LGD855k, LGD855K, D855k, D855K  
Applicant : LG Electronics MobileComm U.S.A., Inc.  
Manufacturer : LG Electronics MobileComm U.S.A., Inc.  
Date of Test(s) : 2014.04.16 ~ 2014.04.30  
Date of Issue : 2014.05.27

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Logan Lee

Date:

2014.05.27

Approved By:



Feel Jeong

Date:

2014.05.27

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# INDEX

| <u>Table of Contents</u>                                             | Page |
|----------------------------------------------------------------------|------|
| 1. General Information -----                                         | 3    |
| 2. Radiated Spurious Emissions and Conducted Spurious Emission ----- | 8    |
| 3. 20 dB Bandwidth -----                                             | 39   |
| 4. Output Power Measurement -----                                    | 46   |
| 5. Carrier Frequency Separation -----                                | 48   |
| 6. Number of Hopping Frequency -----                                 | 52   |
| 7. Time of Occupancy(Dwell Time) -----                               | 56   |
| 8. AC Power Line Conducted Emission -----                            | 70   |
| 9. Antenna Requirement -----                                         | 74   |

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RTT5041-20(2014.01.20)(2)

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A4(210 mm x 297 mm)

## 1. General Information

### 1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 3FL, 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-040

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : +82 31 428 5700

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### 1.2. Details of Applicant

Applicant : LG Electronics MobileComm U.S.A., Inc.

Address : 10101 Old Grove Road, San Diego, CA 92131

Contact Person : Lee, Sang-Myung

Phone No. : +82 2 2033 4606

### 1.3. Description of EUT

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kind of Product      | Cellular/PCS GSM/GPRS/EDGE/WCDMA and LTE phone with Bluetooth, WLAN and RFID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Model Name           | LG-D855 (Alternative models: LGD855, D855, LG-D855k, LG-D855K, LGD855k, LGD855K, D855k, D855K)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Power Supply         | DC 3.8 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Frequency Range      | 13.56 MHz (NFC)<br>2 402 MHz ~ 2 480 MHz (BT, BT LE),<br>2 412 MHz ~ 2 462 MHz (11b/g/n_HT20),<br>5 745 MHz ~ 5 825 MHz (Band 3: 11a/n_HT20, 11ac_VHT20),<br>5 755 MHz ~ 5 795 MHz (Band 3: 11n_HT40, 11ac_VHT40),<br>5 775 MHz (Band 3: 11ac_VHT80),<br>5 180 MHz ~ 5 240 MHz (Band 1: 11a/n_HT20, 11ac_VHT20),<br>5 190 MHz ~ 5 230 MHz (Band 1: 11n_HT40, 11ac_VHT40),<br>5 210 MHz (Band 1: 11ac_VHT80),<br>5 260 MHz ~ 5 320 MHz (Band 2A: 11a/n_HT20, 11ac_VHT20),<br>5 270 MHz ~ 5 310 MHz (Band 2A: 11n_HT40, 11ac_VHT40),<br>5 290 MHz (Band 2A: 11ac_VHT80),<br>5 500 MHz ~ 5 700 MHz (Band 2C: 11a/n_HT20, 11ac_VHT20),<br>5 510 MHz ~ 5 670 MHz (Band 2C: 11n_HT40, 11ac_VHT40),<br>5 530 MHz (Band 2C: 11ac_VHT80) |
| Modulation Technique | DSSS, OFDM, GFSK, $\pi/4$ DQPSK, 8DPSK, ASK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Number of Channels   | 11 channel (11b/g/n_HT20),<br>5 channel (Band 3: 11a/n_HT20, 11ac_VHT20),<br>2 channel (Band 3: 11n_HT40, 11ac_VHT40), 1 channel (Band 3: 11ac_VHT80),<br>4 channel (Band 1: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 1: 11n_HT40, 11ac_VHT40),<br>1 channel (Band 1: 11ac_VHT80),<br>4 channel (Band 2A: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 2A: 11n_HT40, 11ac_VHT40),<br>1 channel (Band 2A: 11ac_VHT80),<br>8 channel (Band 2C: 11a/n_HT20, 11ac_VHT20), 3 channel (Band 2C: 11n_HT40, 11ac_VHT40),<br>1 channel (Band 2C: 11ac_VHT80),<br>79 channel (BT), 40 channel (BT LE), 1 channel (NFC)                                                                                                                        |
| Antenna Type         | Internal type (SISO)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Antenna Gain         | 2 402 MHz ~ 2 480 MHz, 2 412 MHz ~ 2 462 MHz: -3.09 dB i,<br>5 180 MHz ~ 5 320 MHz: -1.58 dB i,<br>5 500 MHz ~ 5 700 MHz: -0.13 dB i,<br>5 745 MHz ~ 5 825 MHz: -0.13 dB i                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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#### 1.4. Declaration by the manufacturer

- Adaptive Frequency Hopping is supported and use at least 20 channels

#### 1.5. Information about the FHSS characteristics:

##### 1.5.1. Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

##### 1.5.2. Equal Hopping Frequency Use

All Bluetooth units participating in the piconet are time and hop-synchronized to the channel.

##### 1.5.3. System Receiver Input Bandwidth

Each channel bandwidth is 1 MHz

##### 1.5.4. Equipment Description

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

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## 1.6. Test Equipment List

| Equipment           | Manufacturer                  | Model                                  | S/N           | Cal Date      | Cal Interval | Cal Due.      |
|---------------------|-------------------------------|----------------------------------------|---------------|---------------|--------------|---------------|
| Signal Generator    | R&S                           | SMR40                                  | 100540        | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator    | R&S                           | SMJ 100A                               | 100882        | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Spectrum Analyzer   | Agilent                       | N9030A                                 | MY53120526    | Jul. 30, 2013 | Annual       | Jul. 30, 2014 |
| High Pass Filter    | Wainwright                    | WHK3.0/18G-6SS                         | 4             | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| High Pass Filter    | Wainwright                    | WHK7.5/26.5G-6SS                       | 15            | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Low Pass Filter     | Mini circuits                 | NLP-1200+                              | V9500401023-1 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Power Sensor        | R&S                           | NRP-Z81                                | 101341        | Jul. 04, 2013 | Annual       | Jul. 04, 2014 |
| Bluetooth Tester    | TESCOM                        | TC-3000C                               | 3000C000296   | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Directional Coupler | KRYTAR                        | 152613                                 | 127445        | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| DC Power Supply     | Agilent                       | U8002A                                 | MY48490027    | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |
| Preamplifier        | H.P.                          | 8447D                                  | 1726A01265    | Sep. 23, 2013 | Annual       | Sep. 23, 2014 |
| Preamplifier        | R&S                           | SCU 18                                 | 10070         | Jun. 21, 2013 | Annual       | Jun. 21, 2014 |
| Preamplifier        | MITEQ Inc.                    | JS44-18004000-35-8P                    | 1546891       | Jun. 13, 2013 | Annual       | Jun. 13, 2014 |
| Bilog Antenna       | SCHWARZBECK<br>MESSELEKTRONIK | VULB9163                               | 9163-437      | Oct. 04, 2013 | Biennial     | Oct. 04, 2015 |
| Loop Antenna        | SCHWARZBECK<br>MESSELEKTRONIK | FMZB 1519                              | 1519-039      | Jul. 09, 2013 | Biennial     | Jul. 09, 2015 |
| Horn Antenna        | R&S                           | HF906                                  | 100608        | Aug. 03, 2012 | Biennial     | Aug. 03, 2014 |
| Horn Antenna        | SCHWARZBECK<br>MESSELEKTRONIK | BBHA9170                               | BBHA9170431   | Aug. 24, 2012 | Biennial     | Aug. 24, 2014 |
| Antenna Master      | INN-CO                        | MA4000-EP                              | N/A           | N.C.R.        | N/A          | N.C.R.        |
| Turn Table          | INN-CO                        | DT-3000S-3T                            | N/A           | N.C.R.        | N/A          | N.C.R.        |
| Shield Room         | SY Corporation                | L × W × H<br>(6.5 m × 3.5 m × 3.5 m)   | N/A           | N.C.R.        | N/A          | N.C.R.        |
| EMI Test Receiver   | R&S                           | ESU26                                  | 100194        | Sep. 13, 2013 | Annual       | Sep. 13, 2014 |
| Two-Line V-Network  | R&S                           | ENV216                                 | 101120        | Jan. 02, 2014 | Annual       | Jan. 02, 2015 |
| Anechoic Chamber    | SY Corporation                | L × W × H<br>(21.5 m × 13.0 m × 9.0 m) | N/A           | N.C.R.        | N/A          | N.C.R.        |

### ► Support equipment

| Description      | Manufacturer   | Model   | Serial Number | FCC ID    |
|------------------|----------------|---------|---------------|-----------|
| Wireless Charger | LG Electronics | WCP-300 | 306HYN008023  | BEJWCP300 |

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## 1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

| APPLIED STANDARD:FCC Part15 subpart C |                                                             |          |
|---------------------------------------|-------------------------------------------------------------|----------|
| Section in FCC 15                     | Test Item                                                   | Result   |
| 15.205(a)<br>15.209<br>15.247(d)      | Radiated Spurious Emissions and Conducted Spurious Emission | Complied |
| 15.247(a)(1)                          | 20 dB Bandwidth                                             | Complied |
| 15.247(b)(1)                          | Output Power Measurement                                    | Complied |
| 15.247(a)(1)                          | Carrier Frequency Separation                                | Complied |
| 15.247(a)(1)(iii)                     | Number of Hopping Frequency                                 | Complied |
| 15.247(a)(1)(iii)                     | Time of Occupancy (Dwell Time)                              | Complied |
| 15.207                                | AC Power Line Conducted Emission                            | Complied |

## 1.8. Test Procedure(s)

The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) and the guidance provided in DA 00-705 were used in the measurement of the DUT.

## 1.9. Sample calculation

Where relevant, the following sample calculation is provided:

### 1.9.1. Conducted test

Offset value (dB) = Directional Coupler(dB) + Cable loss (dB)

### 1.9.2. Radiation test

Field strength level (dB $\mu$ V/m) = Measured level (dB $\mu$ V) + Antenna factor (dB) + Cable loss (dB) – amplifier gain (dB)

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### 1.10. Test report revision

| Revision | Report number          | Date of Issue | Description                                                                              |
|----------|------------------------|---------------|------------------------------------------------------------------------------------------|
| 0        | F690501/RF-RTL007644   | 2014.05.12    | Initial                                                                                  |
| 1        | F690501/RF-RTL007644-1 | 2014.05.27    | - Added actual test equipment list in each test result & DUT axis description on page 9. |

### 1.11. Information of Alternative model

| Model    | Information                                                                                   |
|----------|-----------------------------------------------------------------------------------------------|
| LG-D855  | Basic model name.                                                                             |
| LG-D855k | H/W and S/W are same to basic model.<br>It is only different model name for marketing purpose |
| LG-D855K | H/W and S/W are same to basic model.<br>It is only different model name for marketing purpose |
| LGD855k  | H/W and S/W are same to basic model.<br>It is only different model name for marketing purpose |
| LGD855K  | H/W and S/W are same to basic model.<br>It is only different model name for marketing purpose |
| D855k    | H/W and S/W are same to basic model.<br>It is only different model name for marketing purpose |
| D855K    | H/W and S/W are same to basic model.<br>It is only different model name for marketing purpose |

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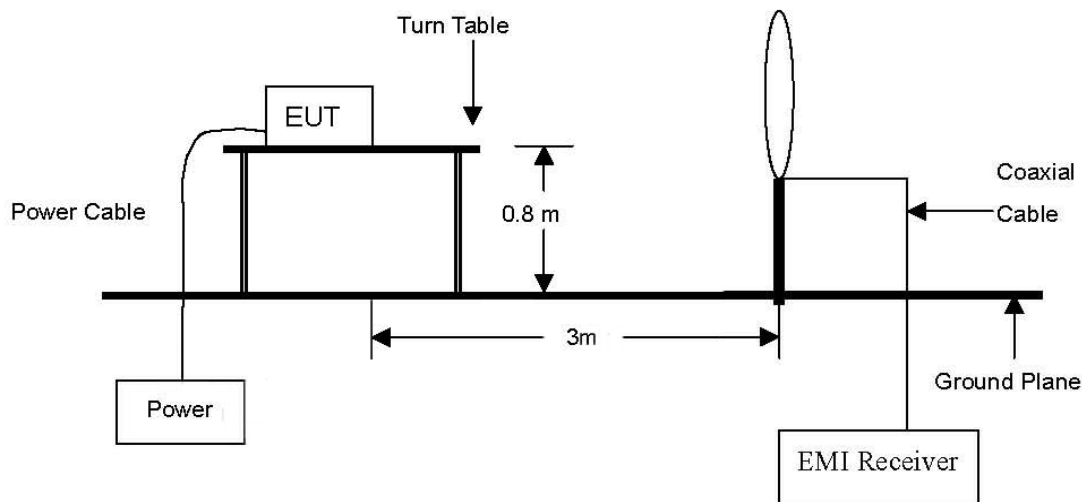
A4(210 mm x 297 mm)

## 2. Radiated Spurious Emissions and Conducted Spurious Emission

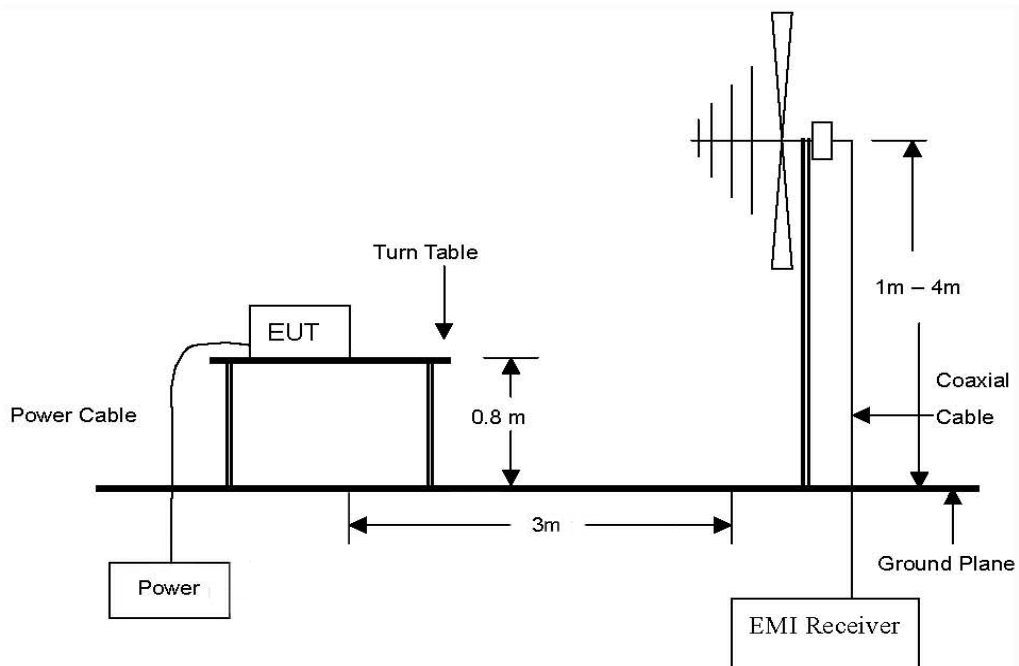
### 2.1. Test Setup

#### 2.1.1. Radiated Spurious Emissions

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



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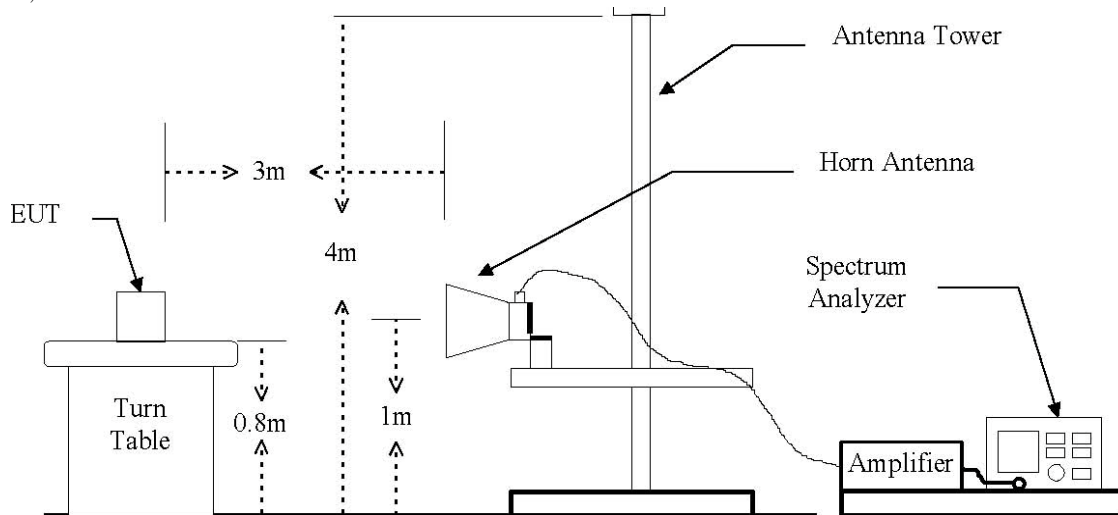
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The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



#### 2.1.1.1. Actual equipment used for Radiated spurious Emissions

| Equipment         | Manufacturer                  | Model                                  | S/N           | Cal Date      | Cal Interval | Cal Due.      |
|-------------------|-------------------------------|----------------------------------------|---------------|---------------|--------------|---------------|
| Spectrum Analyzer | Agilent                       | N9030A                                 | MY53120526    | Jul. 30, 2013 | Annual       | Jul. 30, 2014 |
| Signal Generator  | R&S                           | SMR40                                  | 100540        | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator  | R&S                           | SMJ 100A                               | 100882        | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| EMI Test Receiver | R&S                           | ESU26                                  | 100194        | Sep. 13, 2013 | Annual       | Sep. 13, 2014 |
| High Pass Filter  | Wainwright                    | WHK3.0/18G-6SS                         | 4             | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| High Pass Filter  | Wainwright                    | WHK7.5/26.5G-6SS                       | 15            | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Low Pass Filter   | Mini circuits                 | NLP-1200+                              | V9500401023-1 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Bluetooth Tester  | TESCOM                        | TC-3000C                               | 3000C000296   | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Preamplifier      | H.P.                          | 8447D                                  | 1726A01265    | Sep. 23, 2013 | Annual       | Sep. 23, 2014 |
| Preamplifier      | R&S                           | SCU 18                                 | 10070         | Jun. 21, 2013 | Annual       | Jun. 21, 2014 |
| Preamplifier      | MITEQ Inc.                    | JS44-18004000-35-8P                    | 1546891       | Jun. 13, 2013 | Annual       | Jun. 13, 2014 |
| Bilog Antenna     | SCHWARZBECK<br>MESSELEKTRONIK | VULB9163                               | 9163-437      | Oct. 04, 2013 | Biennial     | Oct. 04, 2015 |
| Loop Antenna      | SCHWARZBECK<br>MESSELEKTRONIK | FMZB 1519                              | 1519-039      | Jul. 09, 2013 | Biennial     | Jul. 09, 2015 |
| Horn Antenna      | R&S                           | HF906                                  | 100608        | Aug. 03, 2012 | Biennial     | Aug. 03, 2014 |
| Horn Antenna      | SCHWARZBECK<br>MESSELEKTRONIK | BBHA9170                               | BBHA9170431   | Aug. 24, 2012 | Biennial     | Aug. 24, 2014 |
| Antenna Master    | INN-CO                        | MA4000-EP                              | N/A           | N.C.R.        | N/A          | N.C.R.        |
| Turn Table        | INN-CO                        | DT-3000S-3T                            | N/A           | N.C.R.        | N/A          | N.C.R.        |
| Anechoic Chamber  | SY Corporation                | L x W x H<br>(21.5 m x 13.0 m x 9.0 m) | N/A           | N.C.R.        | N/A          | N.C.R.        |

#### 2.1.1.2. Definition of DUT Axis.

- Definition of DUT three orthogonal planes were described in the test setup photo.

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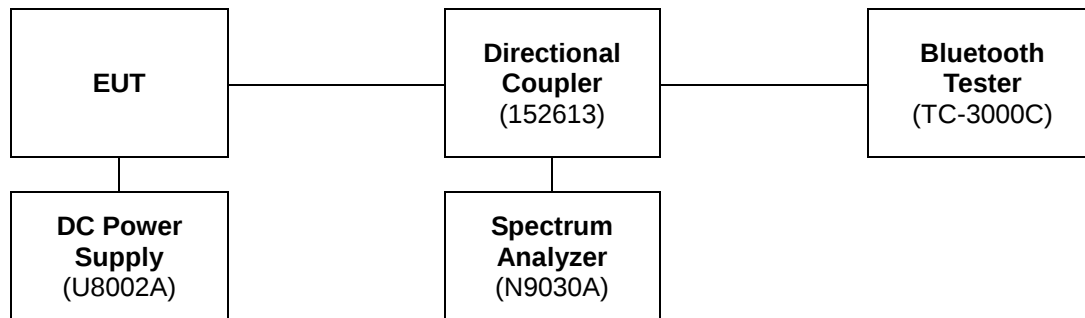
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## 2.1.2. Conducted Spurious Emissions



### 2.1.2.1. Actual equipment used for Conducted spurious Emissions

| Equipment           | Manufacturer | Model    | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|---------------------|--------------|----------|-------------|---------------|--------------|---------------|
| Signal Generator    | R&S          | SMR40    | 100540      | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator    | R&S          | SMJ 100A | 100882      | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Spectrum Analyzer   | Agilent      | N9030A   | MY53120526  | Jul. 30, 2013 | Annual       | Jul. 30, 2014 |
| Bluetooth Tester    | TESCOM       | TC-3000C | 3000C000296 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Directional Coupler | KRYTAR       | 152613   | 127445      | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| DC Power Supply     | Agilent      | U8002A   | MY48490027  | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |

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## 2.2. Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

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

| Frequency<br>(MHz) | Distance<br>(Meters) | Field Strength<br>(dBμV/m) | Field Strength<br>(μV/m) |
|--------------------|----------------------|----------------------------|--------------------------|
| 0.009 – 0.490      | 300                  | 20 log (2400/F(kHz))       | 2400/F(kHz)              |
| 0.490 – 1.705      | 30                   | 20 log (24000/F(kHz))      | 24000/F(kHz)             |
| 1.705 – 30.0       | 30                   | 29.54                      | 30                       |
| 30 - 88            | 3                    | 40.0                       | 100                      |
| 88 – 216           | 3                    | 43.5                       | 150                      |
| 216 – 960          | 3                    | 46.0                       | 200                      |
| Above 960          | 3                    | 54.0                       | 500                      |

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## 2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of DA 00-705 and ANSI C63.4 2003.

Battery cover of EUT is supported to battery charging condition with wireless charger.

According to KDB648474 D03 Wireless Chargers Battery Cover v01r02, transmitter spurious emissions measurement had to be adjusted as two kinds of test which are without battery charger and with battery charger during normal charging condition in radiation spurious emission.

### 2.3.1. Test Procedures for emission below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

### 2.3.2. Test Procedures for emission from above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its 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.
4. 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 table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 dB 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 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

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A4(210 mm x 297 mm)

## NOTE;

All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz. Both average and peak measurements were made using a peak detector.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz > 1/T Hz, where T = pulse width in seconds for Average detection (AV) at frequency above 1 GHz.
4. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes. The antenna is manipulated through typical positions, polarity and length during the tests.
5. When Average result is different from peak result over 20 dB (over-averaging), According to 15.35 (c), as a "duty cycle correction factor", pulse averaging with 20 log(duty cycle) has to be used.

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### 2.3.3. Test Procedures for Conducted Spurious Emissions

#### 2.3.3.1. Band-edge Compliance of RF Conducted Emissions

The transmitter output was connected to the spectrum analyzer.

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.

RBW  $\geq$  100 kHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

#### 2.3.3.2. Spurious RF Conducted Emissions

The transmitter output was connected to the spectrum analyzer.

RBW = 1 MHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

- RBW was set to 1 MHz rather than 100 kHz in order to increase the measurement speed.
- The display line shown in section 2.4.3 plots denotes the limit at 20 dB below the fundamental emission level measured in a 100 kHz bandwidth. However, since the traces in the plots are measured with a 1 MHz RBW, the display line may not necessarily appear to be 20 dB below the level of the fundamental in a 1 MHz bandwidth.
- For plots showing conducted spurious emissions near the limits, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

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## 2.4. Test Results

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.

### 2.4.1. Spurious Radiated Emission below 1 000 MHz

The frequency spectrum from 9 MHz to 1 000 MHz was investigated. The spurious emissions were investigated for all data rates and the worst case emissions were found with EUT transmitting at 3 Mbps.

#### 2.4.1.1. Battery Cover without charger

| Radiated Emissions |                      |             | Ant  | Correction Factors |               | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP + CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| Below 30.00        | Not detected         | -           | -    | -                  | -             | -                     | -                    | -           |
| 40.96              | 26.94                | Peak        | H    | 13.57              | -24.43        | 16.08                 | 40.00                | 23.92       |
| 90.33              | 29.62                | Peak        | V    | 11.94              | -23.92        | 17.64                 | 43.50                | 25.86       |
| 100.71             | 25.84                | Peak        | H    | 13.06              | -23.79        | 15.11                 | 43.50                | 28.39       |
| 133.40             | 28.70                | Peak        | H    | 8.95               | -23.43        | 14.22                 | 43.50                | 29.28       |
| 134.08             | 39.43                | Peak        | V    | 8.87               | -23.43        | 24.87                 | 43.50                | 18.63       |
| 139.42             | 40.32                | Peak        | V    | 8.26               | -23.38        | 25.20                 | 43.50                | 18.30       |
| 148.92             | 39.88                | Peak        | V    | 8.40               | -23.26        | 25.02                 | 43.50                | 18.48       |
| 157.94             | 39.02                | Peak        | V    | 8.62               | -23.15        | 24.49                 | 43.50                | 19.01       |
| 179.09             | 35.82                | Peak        | V    | 9.63               | -22.96        | 22.49                 | 43.50                | 21.01       |
| 725.68             | 30.54                | Peak        | H    | 19.40              | -21.79        | 28.15                 | 46.00                | 17.85       |
| 786.12             | 29.62                | Peak        | H    | 20.77              | -21.55        | 28.84                 | 46.00                | 17.16       |
| Above 790.00       | Not detected         | -           | -    | -                  | -             | -                     | -                    | -           |

Remark:

1. All spurious emissions at channels are almost the same below 1 GHz, so that the middle channel was chosen as representative in final test.
2. Radiated spurious emission measurement as below  
(Actual = Reading + AF + Cable Loss – Amplifier factor)
3. All reading values are peak values.

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### 2.4.1.2. Battery Cover with charger

#### - Emission below 30 MHz

| Radiated Emissions |                      |             | Ant  | Correction Factors |            | Total                        |                                        | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|------------|------------------------------|----------------------------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | Cable (dB) | Actual (dB $\mu$ V/m) at 3 m | Actual (dB $\mu$ V/m) at 30 m or 300 m | Limit (dB $\mu$ V/m) | Margin (dB) |
| 0.15               | 41.30                | Average     | V    | 19.99              | 0.04       | 61.33                        | -18.67                                 | 24.08                | 42.75       |
| 0.44               | 24.20                | Average     | H    | 20.08              | 0.09       | 44.37                        | -35.63                                 | 14.74                | 50.37       |
| 0.74               | 16.40                | Quasi Peak  | H    | 20.25              | 0.14       | 36.79                        | -3.21                                  | 30.22                | 33.43       |
| 9.00               | 10.70                | Quasi Peak  | V    | 20.14              | 0.59       | 31.43                        | -8.57                                  | 29.54                | 38.11       |
| 18.76              | 9.70                 | Quasi Peak  | V    | 20.27              | 0.69       | 30.66                        | -9.34                                  | 29.54                | 38.88       |
| Above 19.00        | Not detected         | -           | -    | -                  | -          | -                            | -                                      | -                    | -           |

#### - Emission above 30 MHz

| Radiated Emissions |                      |             | Ant  | Correction Factors |               | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP + CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| 431.19             | 27.78                | Peak        | H    | 15.53              | -22.56        | 20.75                 | 46.00                | 25.25       |
| 489.30             | 28.01                | Peak        | H    | 16.42              | -22.68        | 21.75                 | 46.00                | 24.25       |
| 698.72             | 27.82                | Peak        | V    | 20.04              | -21.91        | 25.95                 | 46.00                | 20.05       |
| 875.55             | 29.92                | Peak        | H    | 20.84              | -21.05        | 29.71                 | 46.00                | 16.29       |
| 876.62             | 32.00                | Peak        | V    | 20.85              | -21.04        | 31.81                 | 46.00                | 14.19       |
| Above 880.00       | Not detected         | -           | -    | -                  | -             | -                     | -                    | -           |

#### Remark:

1. All spurious emission at channels are almost the same below 1 MHz, so that the middle channel was chosen at representative in final test.
2. Radiated spurious emission measurement as below  
(Actual = Reading + AF + Cable Loss – Amplifier factor)
3. Measurement with wireless charger was performed during actual charging condition.
4. Emissions of the frequency between 0.009 MHz and 0.490 MHz should be adjusted as 300 m distance.  
Distance compensation:  $40 \log (300/3) = 80 \text{ dB}$
5. Emissions of the frequency between 0.490 MHz and 1.705 MHz should be adjusted as 30 m distance.  
Distance compensation:  $40 \log (30/3) = 40 \text{ dB}$

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## 2.4.2. Spurious Radiated Emission

The frequency spectrum above 1 000 MHz was investigated.

### 2.4.2.1. Battery Cover without charger

Operating Mode: GFSK(1 Mbps)

A. Low Channel (2 402 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 390.00          | 24.22                | Peak        | H    | 28.30              | 8.87    | 61.39                 | 74.00                | 12.61       |
| *2 390.00          | 13.10                | Average     | H    | 28.30              | 8.87    | 50.27                 | 54.00                | 3.73        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 804.90          | 34.92                | Peak        | H    | 33.20              | -31.74      | 36.38                 | 74.00                | 37.62       |
| *4 804.90          | 25.26                | Average     | H    | 33.20              | -31.74      | 26.72                 | 54.00                | 27.28       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

B. Middle Channel (2 441 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 883.65          | 34.58                | Peak        | H    | 33.29              | -31.72      | 36.15                 | 74.00                | 37.85       |
| *4 883.65          | 24.51                | Average     | H    | 33.29              | -31.72      | 26.08                 | 54.00                | 27.92       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

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## C. High Channel (2 480 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 483.50          | 25.77                | Peak        | H    | 28.52              | 9.15    | 63.44                 | 74.00                | 10.56       |
| *2 483.50          | 13.28                | Average     | H    | 28.52              | 9.15    | 50.95                 | 54.00                | 3.05        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 960.75          | 34.31                | Peak        | H    | 33.38              | -31.71      | 35.98                 | 74.00                | 38.02       |
| *4 960.75          | 25.63                | Average     | H    | 33.38              | -31.71      | 27.30                 | 54.00                | 26.70       |
| Above 5 000.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

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**Operating Mode: 8DPSK(3 Mbps)**
**A. Low Channel (2 402 MHz)**

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 390.00          | 22.64                | Peak        | H    | 28.30              | 8.87    | 59.81                 | 74.00                | 14.19       |
| *2 390.00          | 12.88                | Average     | H    | 28.30              | 8.87    | 50.05                 | 54.00                | 3.95        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 804.85          | 32.63                | Peak        | H    | 33.20              | -31.74      | 34.09                 | 74.00                | 39.91       |
| *4 804.85          | 24.77                | Average     | H    | 33.20              | -31.74      | 26.23                 | 54.00                | 27.77       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

**B. Middle Channel (2 441 MHz)**

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 882.33          | 35.06                | Peak        | H    | 33.29              | -31.72      | 36.63                 | 74.00                | 37.37       |
| *4 882.33          | 25.41                | Average     | H    | 33.29              | -31.72      | 26.98                 | 54.00                | 27.02       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

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## C. High Channel (2 480 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 483.50          | 23.15                | Peak        | H    | 28.52              | 9.15    | 60.82                 | 74.00                | 13.18       |
| *2 483.50          | 13.31                | Average     | H    | 28.52              | 9.15    | 50.98                 | 54.00                | 3.02        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 960.25          | 33.97                | Peak        | H    | 33.38              | -31.71      | 35.64                 | 74.00                | 38.36       |
| *4 960.25          | 24.69                | Average     | H    | 33.38              | -31.71      | 26.36                 | 54.00                | 27.64       |
| Above 5 000.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

## Remarks;

1. "\*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10<sup>th</sup> harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + AMP + CL

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### 2.4.2.2. Battery Cover with charger

#### Operating Mode: GFSK(1 Mbps)

##### A. Low Channel (2 402 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 390.00          | 24.22                | Peak        | H    | 28.30              | 8.87    | 61.39                 | 74.00                | 12.61       |
| *2 390.00          | 13.11                | Average     | H    | 28.30              | 8.87    | 50.28                 | 54.00                | 3.72        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 804.75          | 33.78                | Peak        | H    | 33.20              | -31.74      | 35.24                 | 74.00                | 38.76       |
| *4 804.75          | 26.12                | Average     | H    | 33.20              | -31.74      | 27.58                 | 54.00                | 26.42       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

##### B. Middle Channel (2 441 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 881.54          | 33.15                | Peak        | H    | 33.29              | -31.72      | 34.72                 | 74.00                | 39.28       |
| *4 881.54          | 24.51                | Average     | H    | 33.29              | -31.72      | 26.08                 | 54.00                | 27.92       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

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## C. High Channel (2 480 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 483.50          | 25.75                | Peak        | H    | 28.30              | 9.15    | 63.42                 | 74.00                | 10.58       |
| *2 483.50          | 13.33                | Average     | H    | 28.30              | 9.15    | 51.00                 | 54.00                | 3.00        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 960.65          | 34.78                | Peak        | H    | 33.38              | -31.71      | 36.45                 | 74.00                | 37.55       |
| *4 960.65          | 26.03                | Average     | H    | 33.38              | -31.71      | 27.70                 | 54.00                | 26.30       |
| Above 5 000.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

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**Operating Mode: 8DPSK(3 Mbps)**
**A. Low Channel (2 402 MHz)**

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 390.00          | 22.62                | Peak        | H    | 28.30              | 8.87    | 59.79                 | 74.00                | 14.21       |
| *2 390.00          | 12.90                | Average     | H    | 28.30              | 8.87    | 50.07                 | 54.00                | 3.93        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 804.15          | 33.75                | Peak        | H    | 33.20              | -31.74      | 35.21                 | 74.00                | 38.79       |
| *4 804.15          | 24.89                | Average     | H    | 33.20              | -31.74      | 26.35                 | 54.00                | 27.65       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

**B. Middle Channel (2 441 MHz)**

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 882.02          | 35.11                | Peak        | H    | 33.29              | -31.72      | 36.68                 | 74.00                | 37.32       |
| *4 882.02          | 25.42                | Average     | H    | 33.29              | -31.72      | 26.99                 | 54.00                | 27.01       |
| Above 4 900.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

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A4(210 mm x 297 mm)

## C. High Channel (2 480 MHz)

| Radiated Emissions |                      |             | Ant  | Correction Factors |         | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|---------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *2 483.50          | 23.16                | Peak        | H    | 28.52              | 9.15    | 60.83                 | 74.00                | 13.17       |
| *2 483.50          | 13.32                | Average     | H    | 28.52              | 9.15    | 50.99                 | 54.00                | 3.01        |

| Radiated Emissions |                      |             | Ant  | Correction Factors |             | Total                 | FCC Limit            |             |
|--------------------|----------------------|-------------|------|--------------------|-------------|-----------------------|----------------------|-------------|
| Frequency (MHz)    | Reading (dB $\mu$ V) | Detect Mode | Pol. | AF (dB/m)          | AMP+CL (dB) | Actual (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
| *4 960.26          | 33.84                | Peak        | H    | 33.38              | -31.71      | 35.51                 | 74.00                | 38.49       |
| *4 960.26          | 24.50                | Average     | H    | 33.38              | -31.71      | 26.17                 | 54.00                | 27.83       |
| Above 5 000.00     | Not detected         | -           | -    | -                  | -           | -                     | -                    | -           |

## Remarks;

1. "\*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10<sup>th</sup> harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + AMP + CL

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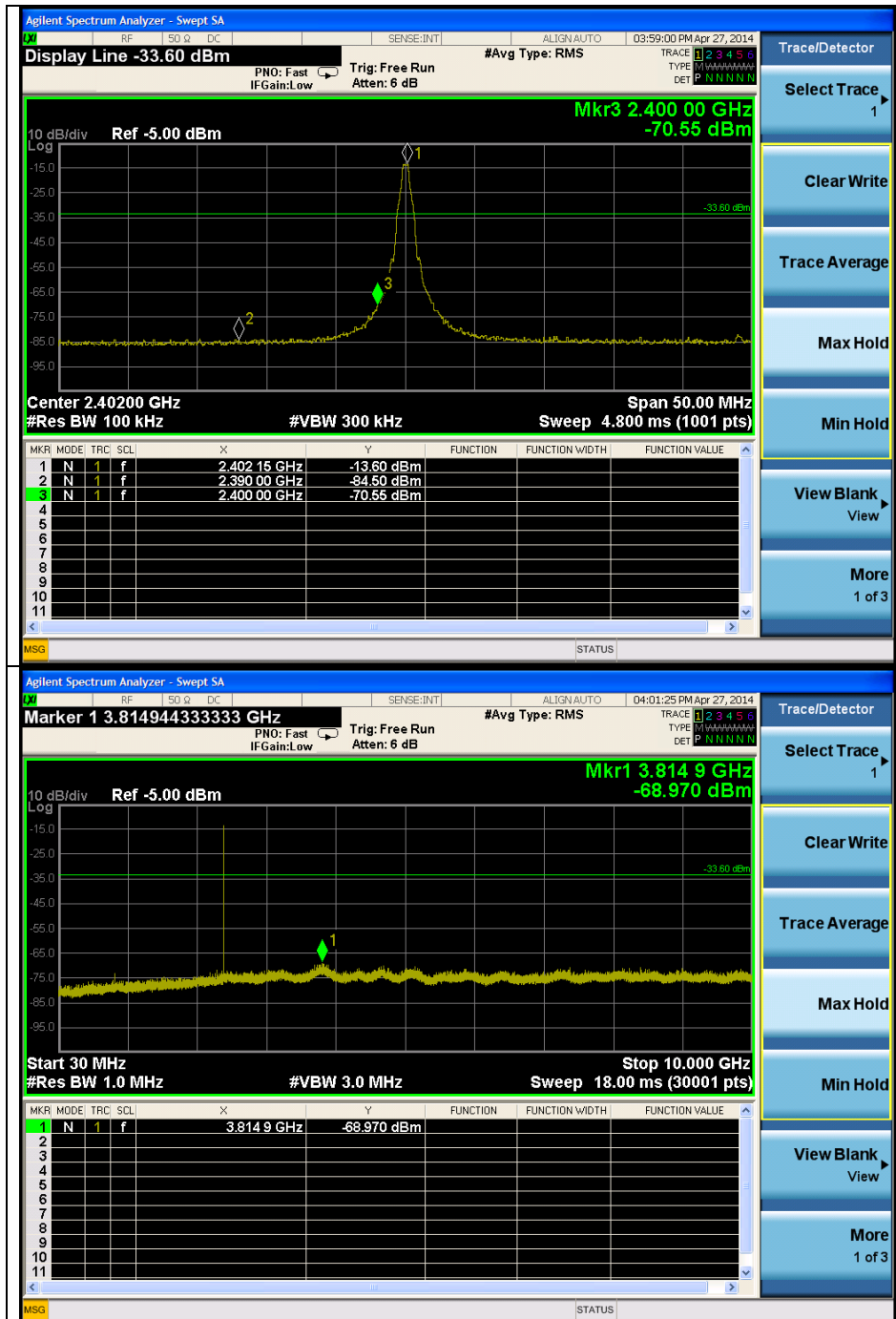
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## 2.4.3. Spurious RF Conducted Emissions: Plot of Spurious RF Conducted Emission

Operating Mode: GFSK(1 Mbps)

Low Channel



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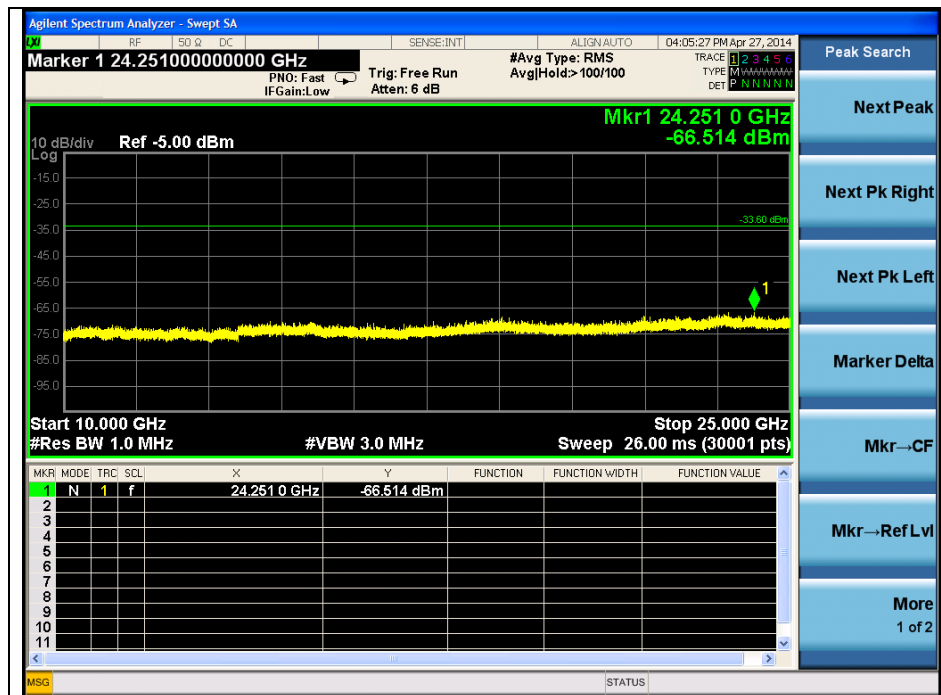
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-040

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Note:

Offset (dB) = Directional Coupler(dB) + Cable loss (dB)

Result (dB m) = Offset (dB) + Reading values (dB m)

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 402.15 (fundamental) | -13.60                | 16.28       | 2.68          |
| 2 390.00               | -84.50                | 16.15       | -68.35        |
| 2 400.00               | -70.55                | 16.26       | -54.29        |
| 3 814.90               | -68.97                | 16.74       | -52.23        |
| 24 251.00              | Noise floor           | -           | -             |

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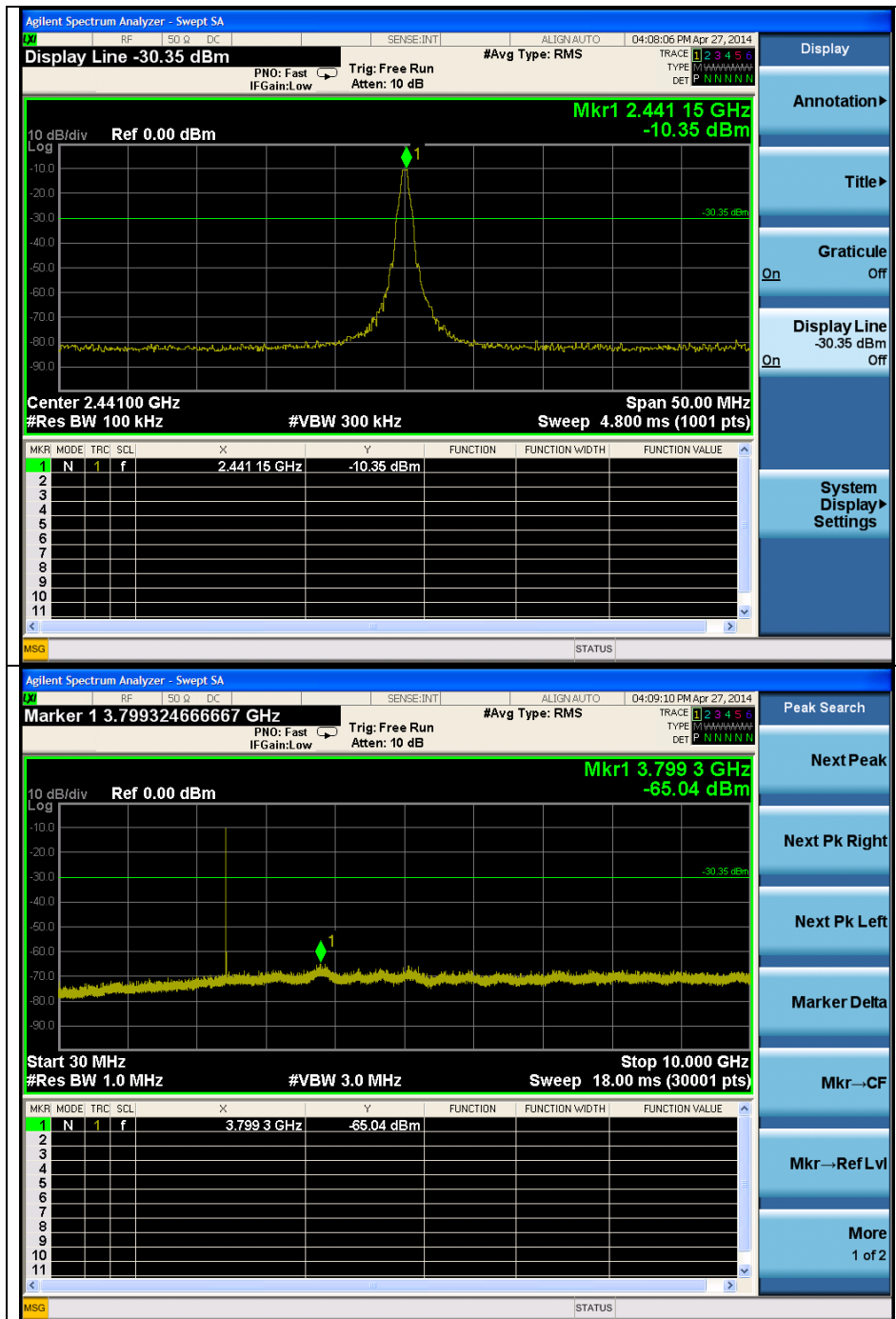
<http://www.sgsgroup.kr>

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## Middle Channel



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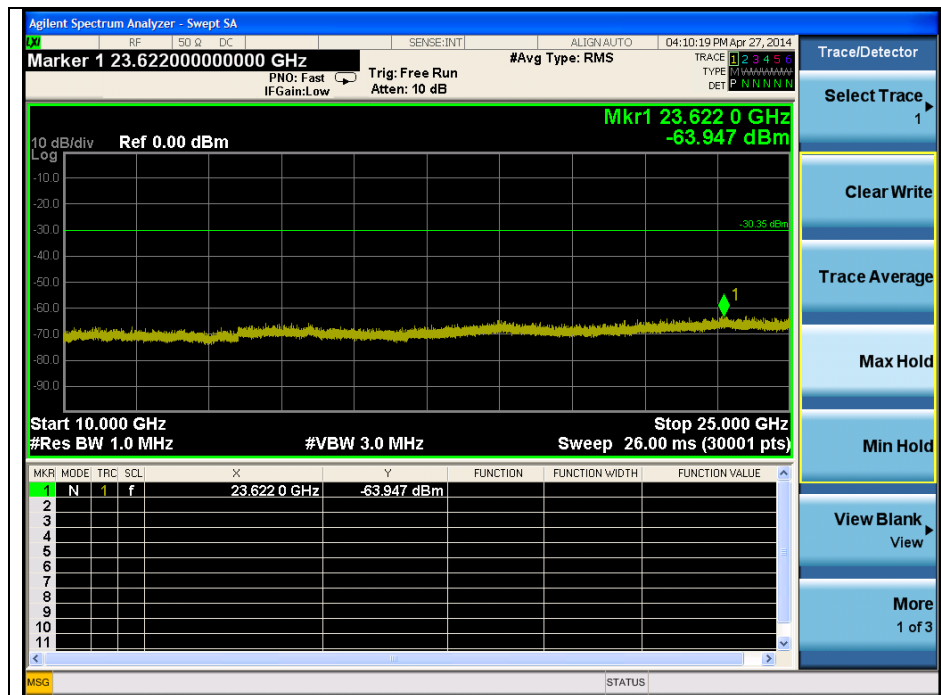
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-040

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Note:

Offset (dB) = Directional Coupler(dB) + Cable loss (dB)

Result (dB m) = Offset (dB) + Reading values (dB m)

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 441.15 (fundamental) | -10.35                | 16.36       | 6.01          |
| 3 799.30               | -65.04                | 16.68       | -48.36        |
| 23 622.00              | Noise floor           | -           | -             |

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## High Channel



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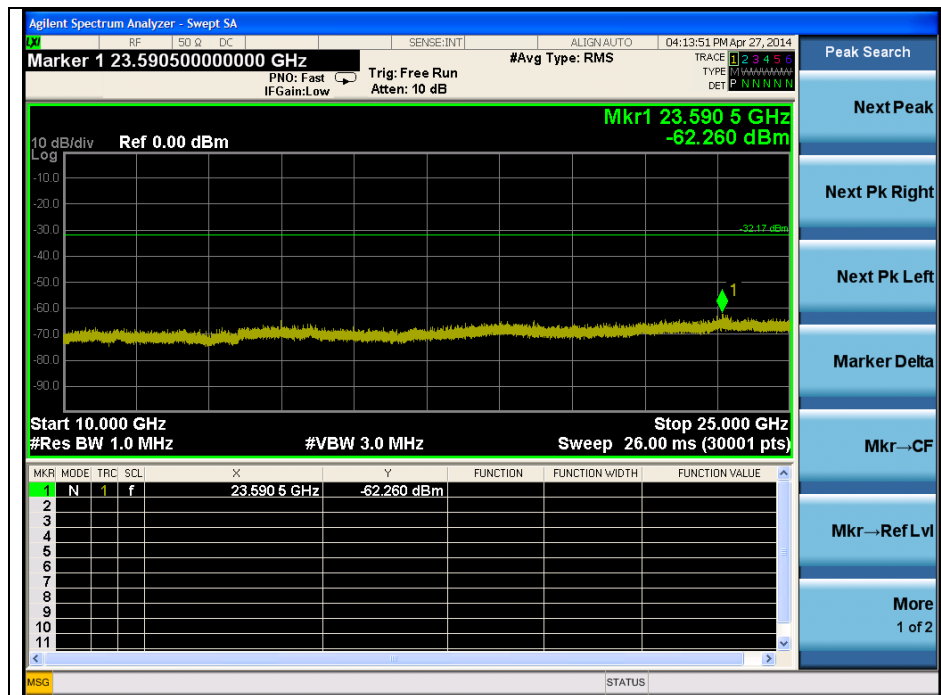
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A4(210 mm x 297 mm)



Note:

Offset (dB) = Directional Coupler(dB) + Cable loss (dB)

Result (dB m) = Offset (dB) + Reading values (dB m)

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 480.00 (fundamental) | -12.17                | 16.31       | 4.14          |
| 2 483.50               | -77.61                | 16.33       | -61.28        |
| 3 264.60               | -65.91                | 16.44       | -49.47        |
| 23 590.50              | Noise floor           | -           | -             |

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A4(210 mm x 297 mm)

## Band edge Compliance with Hopping Enabled

### Low channel



### High channel



Note:

Offset (dB) = Directional Coupler(dB) + Cable loss (dB)

Result (dB m) = Offset (dB) + Reading values (dB m)

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 402.88 (fundamental) | -14.11                | 16.28       | 2.17          |
| 2 399.88               | -73.43                | 16.25       | -57.18        |
| 2 480.03 (fundamental) | -12.38                | 16.31       | 3.93          |
| 2 483.93               | -77.72                | 16.34       | -61.38        |

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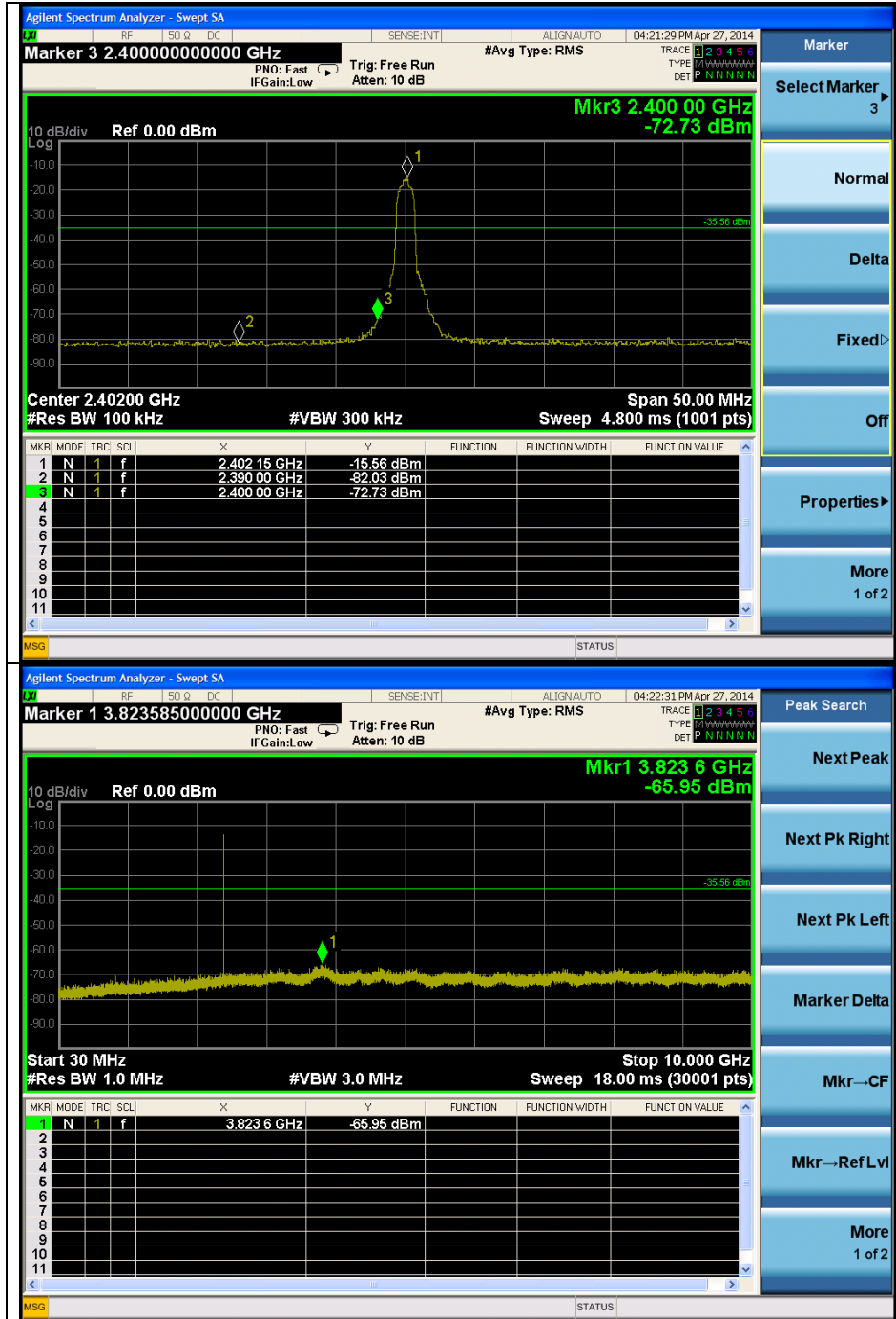
RTT5041-20(2014.01.20)(2)

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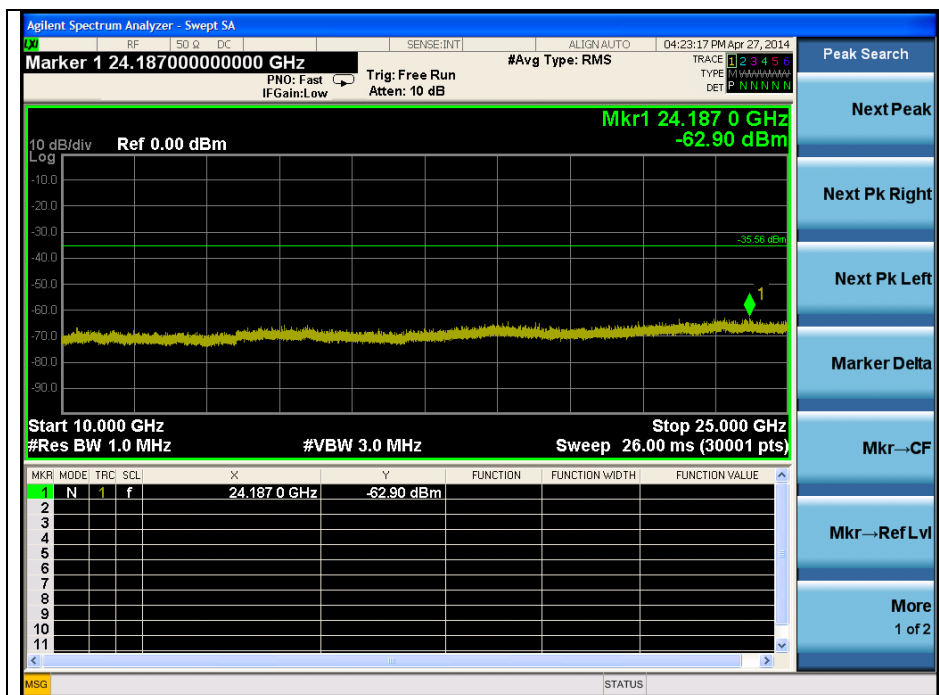
A4(210 mm x 297 mm)

## Operating Mode : 8DPSK(3 Mbps)

### Low Channel



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Note:

Offset (dB) = Directional Coupler(dB) + Cable loss (dB)

Result (dB m) = Offset (dB) + Reading values (dB m)

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 402.15 (fundamental) | -15.56                | 16.28       | 0.72          |
| 2 390.00               | -82.03                | 16.15       | -65.88        |
| 2 400.00               | -72.73                | 16.26       | -56.47        |
| 3 823.60               | -65.95                | 16.77       | -49.18        |
| 24 187.00              | Noise floor           | -           | -             |

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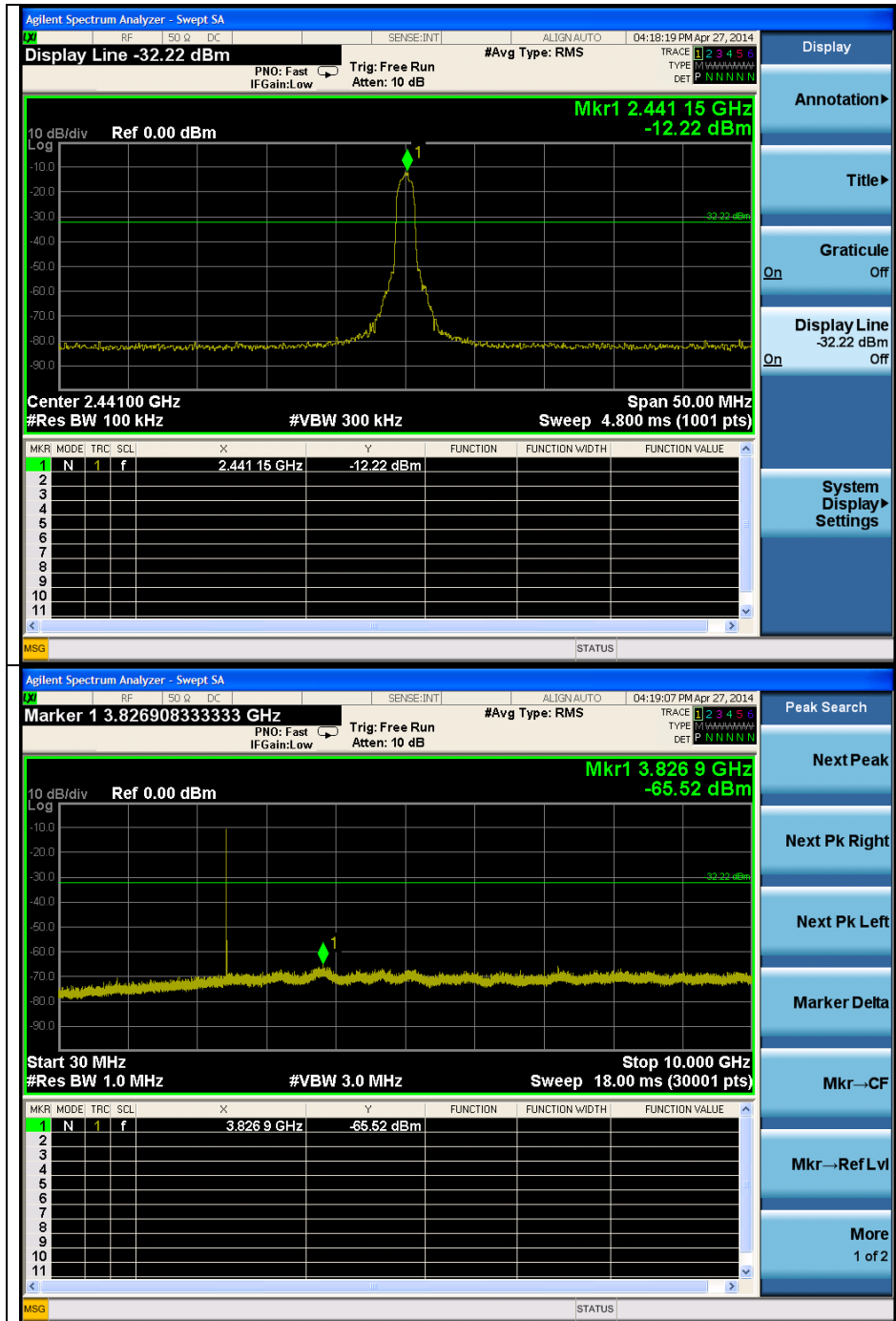
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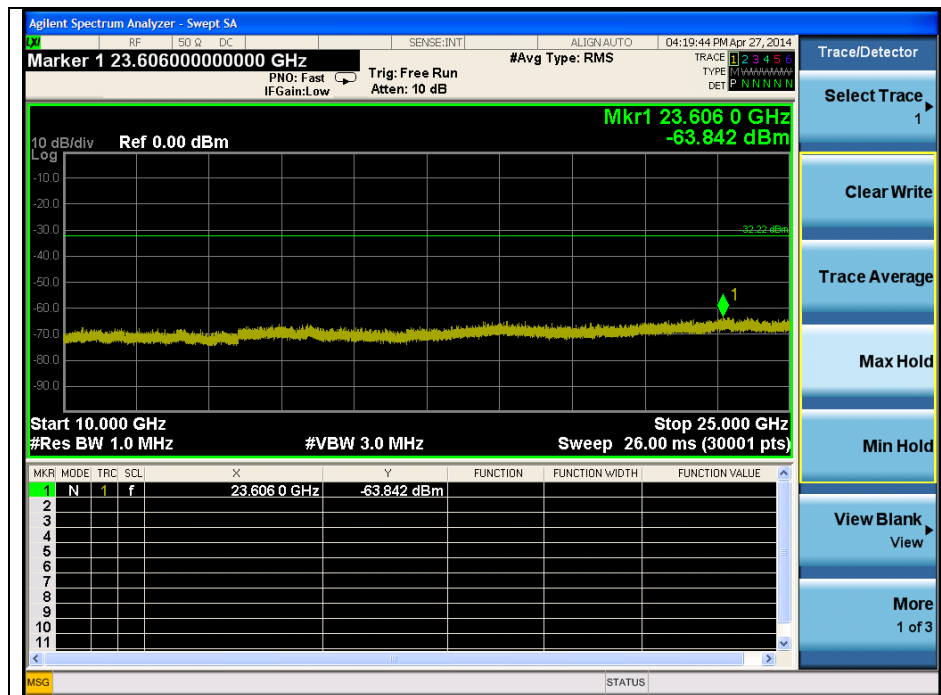
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A4(210 mm x 297 mm)

## Middle Channel



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Note:

$$\text{Offset (dB)} = \text{Directional Coupler(dB)} + \text{Cable loss (dB)}$$
$$\text{Result (dB m)} = \text{Offset (dB)} + \text{Reading values (dB m)}$$

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 441.15 (fundamental) | -12.22                | 16.36       | 4.14          |
| 3 826.90               | -65.52                | 16.76       | -48.76        |
| 23 606.00              | Noise floor           | -           | -             |

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## High Channel



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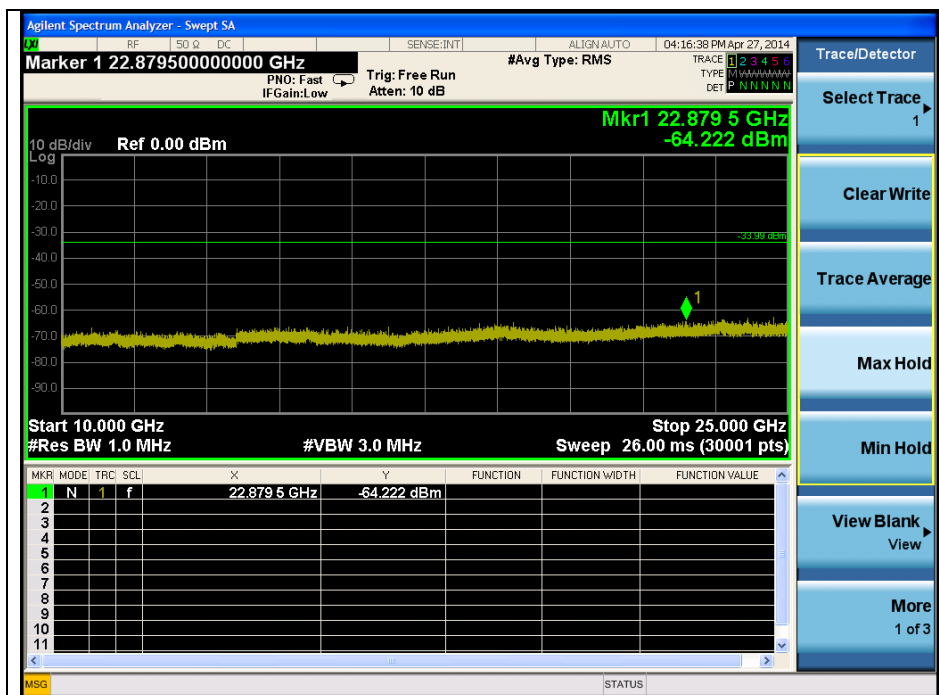
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A4(210 mm x 297 mm)



Note:

Offset (dB) = Directional Coupler(dB) + Cable loss (dB)

Result (dB m) = Offset (dB) + Reading values (dB m)

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 480.15 (fundamental) | -13.99                | 16.31       | 2.32          |
| 2 483.50               | -79.68                | 16.33       | -63.35        |
| 3 198.10               | -65.91                | 16.40       | -49.51        |
| 22 879.50              | Noise floor           | -           | -             |

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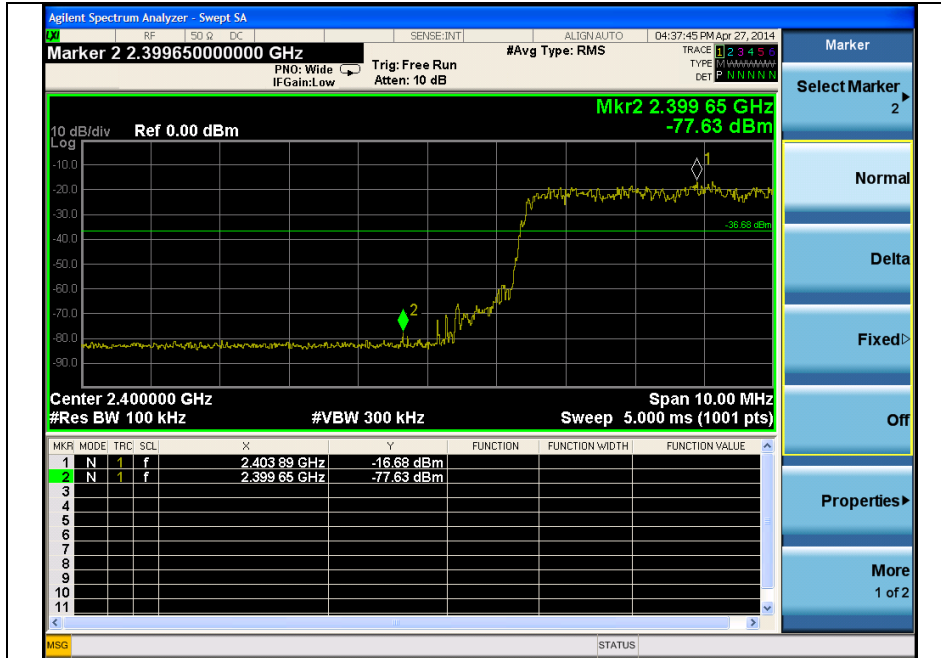
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A4(210 mm x 297 mm)

## Band edge Compliance with Hopping Enabled

### Low channel



### High channel



Note:

Offset (dB) = Directional Coupler(dB) + Cable loss (dB)

Result (dB m) = Offset (dB) + Reading values (dB m)

| Frequency (MHz)        | Reading values (dB m) | Offset (dB) | Result (dB m) |
|------------------------|-----------------------|-------------|---------------|
| 2 403.89 (fundamental) | -16.68                | 16.27       | -0.41         |
| 2 399.65               | -77.63                | 16.25       | -61.38        |
| 2 480.17 (fundamental) | -14.79                | 16.31       | 1.52          |
| 2 483.50               | -81.71                | 16.33       | -65.38        |

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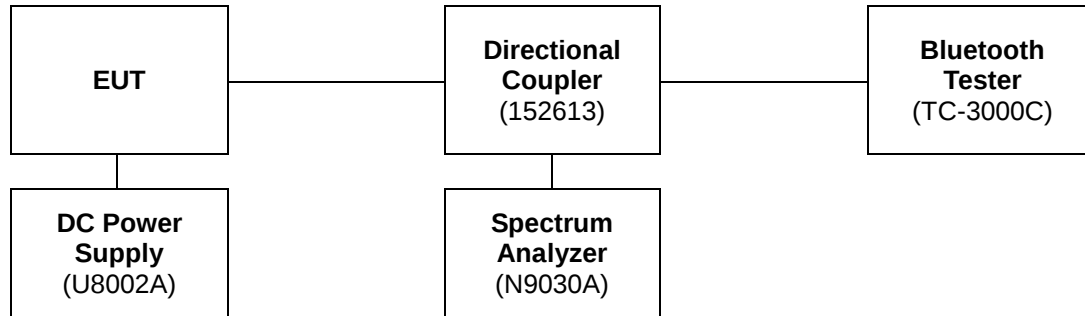
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### 3. 20 dB Bandwidth Measurement

#### 3.1. Test Setup



##### 3.1.1. Actual equipment used for 20 dB Bandwidth Measurement

| Equipment           | Manufacturer | Model    | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|---------------------|--------------|----------|-------------|---------------|--------------|---------------|
| Signal Generator    | R&S          | SMR40    | 100540      | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator    | R&S          | SMJ 100A | 100882      | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Spectrum Analyzer   | Agilent      | N9030A   | MY53120526  | Jul. 30, 2013 | Annual       | Jul. 30, 2014 |
| Bluetooth Tester    | TESCOM       | TC-3000C | 3000C000296 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Directional Coupler | KRYTAR       | 152613   | 127445      | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| DC Power Supply     | Agilent      | U8002A   | MY48490027  | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |

#### 3.2. Limit

Limit: Not Applicable

#### 3.3. Test Procedure

##### 3.3.1. 20 dB Bandwidth

All data rates and modes were investigated for this test.

The test follows DA 00-705

The 20 dB band width was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency.

Use the following spectrum analyzer setting :

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel.

RBW = greater than 1 % of the 20 dB bandwidth

VBW ≥ RBW

Sweep = auto

Detector = peak

Trace = max hold

The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

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### 3.4. Test Results

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.

| Operation Mode | Data Rate | Channel | Channel Frequency (MHz) | 20 dB Bandwidth (MHz) |
|----------------|-----------|---------|-------------------------|-----------------------|
| GFSK           | 1 Mbps    | Low     | 2 402                   | 0.948                 |
|                |           | Middle  | 2 441                   | 0.957                 |
|                |           | High    | 2 480                   | 1.029                 |
| π/4DQPSK       | 2 Mbps    | Low     | 2 402                   | 1.326                 |
|                |           | Middle  | 2 441                   | 1.323                 |
|                |           | High    | 2 480                   | 1.287                 |
| 8DPSK          | 3 Mbps    | Low     | 2 402                   | 1.281                 |
|                |           | Middle  | 2 441                   | 1.308                 |
|                |           | High    | 2 480                   | 1.275                 |

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20 dB Bandwidth

Operating Mode: GFSK

Low Channel



Middle Channel



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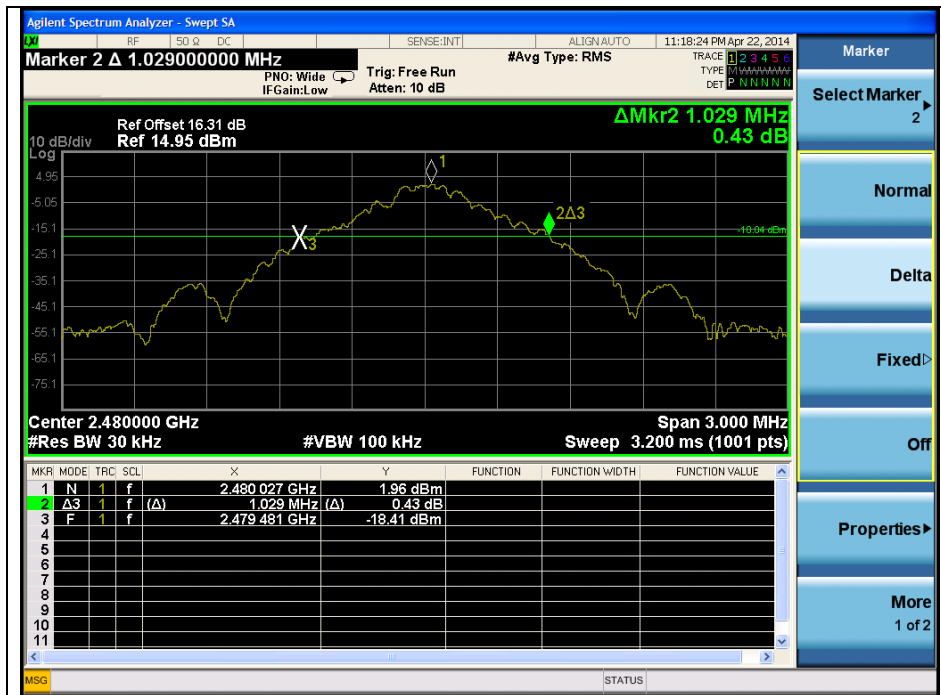
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## High Channel



**Operating Mode:  $\pi/4$ DQPSK**

## Low Channel



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## Middle Channel



## High Channel



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## High Channel



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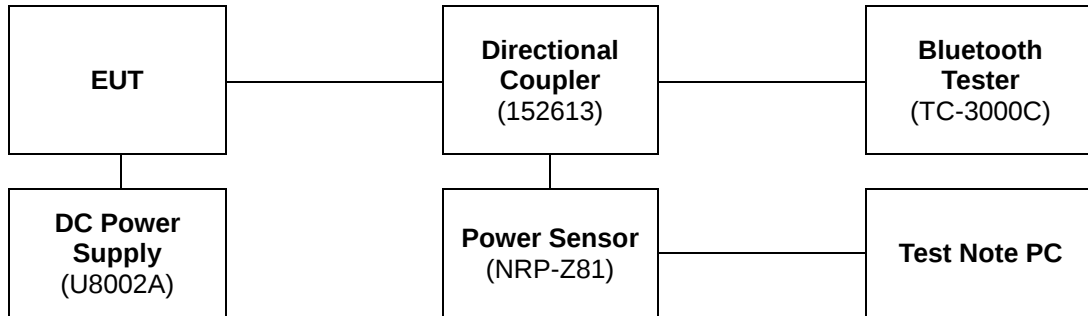
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A4(210 mm x 297 mm)

## 4. Output Power Measurement

### 4.1. Test Setup



#### 4.1.1. Actual equipment used for Output Power Measurement

| Equipment           | Manufacturer | Model    | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|---------------------|--------------|----------|-------------|---------------|--------------|---------------|
| Signal Generator    | R&S          | SMR40    | 100540      | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator    | R&S          | SMJ 100A | 100882      | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Power Sensor        | R&S          | NRP-Z81  | 101341      | Jul. 04, 2013 | Annual       | Jul. 04, 2014 |
| Bluetooth Tester    | TESCOM       | TC-3000C | 3000C000296 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Directional Coupler | KRYTAR       | 152613   | 127445      | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| DC Power Supply     | Agilent      | U8002A   | MY48490027  | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |

### 4.2. Limit

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

- §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
- §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 MHz band: 1 Watt.

### 4.3. Test Procedure

All data rates and modes were investigated for this test. The test follows DA 00-705. Using the power sensor instead of a spectrum analyzer.

- Place the EUT on the table and set it in the transmitting mode.
- Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
- Test program : (S/W name : R&S Power Viewer, Version : 3.2.0)
- Measure peak & average power each channel.

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#### 4.4. Test Results

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.

| Operation Mode | Data Rate | Channel | Channel Frequency (MHz) | Attenuator + Cable offset (dB) | Average Power Result (dB m) | Peak Power Result (dB m) | Peak Power Limit (dB m) |
|----------------|-----------|---------|-------------------------|--------------------------------|-----------------------------|--------------------------|-------------------------|
| GFSK           | 1 Mbps    | Low     | 2 402                   | 16.25                          | 3.06                        | 3.55                     | 30.00                   |
|                |           | Middle  | 2 441                   | 16.33                          | 6.13                        | <u>6.42</u>              | 30.00                   |
|                |           | High    | 2 480                   | 16.35                          | 4.60                        | 4.98                     | 30.00                   |
| π/4DQPSK       | 2 Mbps    | Low     | 2 402                   | 16.25                          | 0.65                        | 3.58                     | 20.97                   |
|                |           | Middle  | 2 441                   | 16.33                          | 3.69                        | <u>6.54</u>              | 20.97                   |
|                |           | High    | 2 480                   | 16.35                          | 2.08                        | 5.04                     | 20.97                   |
| 8DPSK          | 3 Mbps    | Low     | 2 402                   | 16.25                          | 0.66                        | 3.95                     | 20.97                   |
|                |           | Middle  | 2 441                   | 16.33                          | 3.72                        | <u>6.96</u>              | 20.97                   |
|                |           | High    | 2 480                   | 16.35                          | 2.10                        | 5.39                     | 20.97                   |

Remark:  
In the case of AFH, the limit for peak power is 0.125 W

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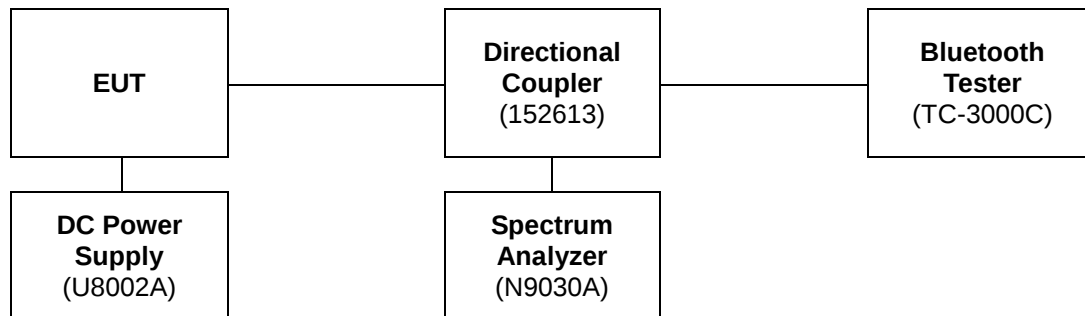
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A4(210 mm × 297 mm)

## 5. Carrier Frequency Separation

### 5.1. Test Setup



#### 5.1.1. Actual equipment used for Carrier Frequency Separation

| Equipment           | Manufacturer | Model    | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|---------------------|--------------|----------|-------------|---------------|--------------|---------------|
| Signal Generator    | R&S          | SMR40    | 100540      | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator    | R&S          | SMJ 100A | 100882      | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Spectrum Analyzer   | Agilent      | N9030A   | MY53120526  | Jul. 30, 2013 | Annual       | Jul. 30, 2014 |
| Bluetooth Tester    | TESCOM       | TC-3000C | 3000C000296 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Directional Coupler | KRYTAR       | 152613   | 127445      | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| DC Power Supply     | Agilent      | U8002A   | MY48490027  | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |

### 5.2. Limit

§15.247(a)(1) Frequency hopping system operating in 2 400 – 2 483.5 MHz. Band may have hopping channel carrier frequencies that are separated by 25 kHz or two-third of 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

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### 5.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section. The test follows DA 00-705.

The device is operating in hopping mode between 79 channels and also supporting Adaptive Frequency Hopping with hopping between 20 channels. As compared with each operating mode, 79 channels are chosen as a representative for test.

Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels.

RBW  $\geq$  1 % of the span.

VBW  $\geq$  RBW

Sweep = auto

Detector = peak

Trace = max hold.

Allow the trace to stabilize. Use the marker-delta function to determine the between the peaks of the adjacent channels.

---

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## 5.4. Test Results

Ambient temperature :  $(23 \pm 1)$  °C  
Relative humidity : 47 % R.H.

| Operation Mode | Channel (Middle) | Adjacent Hopping Channel Separation (kHz) | Two-third of 20 dB Bandwidth (kHz) | Minimum Bandwidth (kHz) |
|----------------|------------------|-------------------------------------------|------------------------------------|-------------------------|
| GFSK           | 2 441 MHz        | 1 000                                     | 638                                | 25                      |
| 8DPSK          | 2 441 MHz        | 1 000                                     | 872                                | 25                      |

Note;

Measurement is made with EUT operating in hopping mode between 79 channels providing a worse case scenario as compared to AFH mode hopping between 20 channels.

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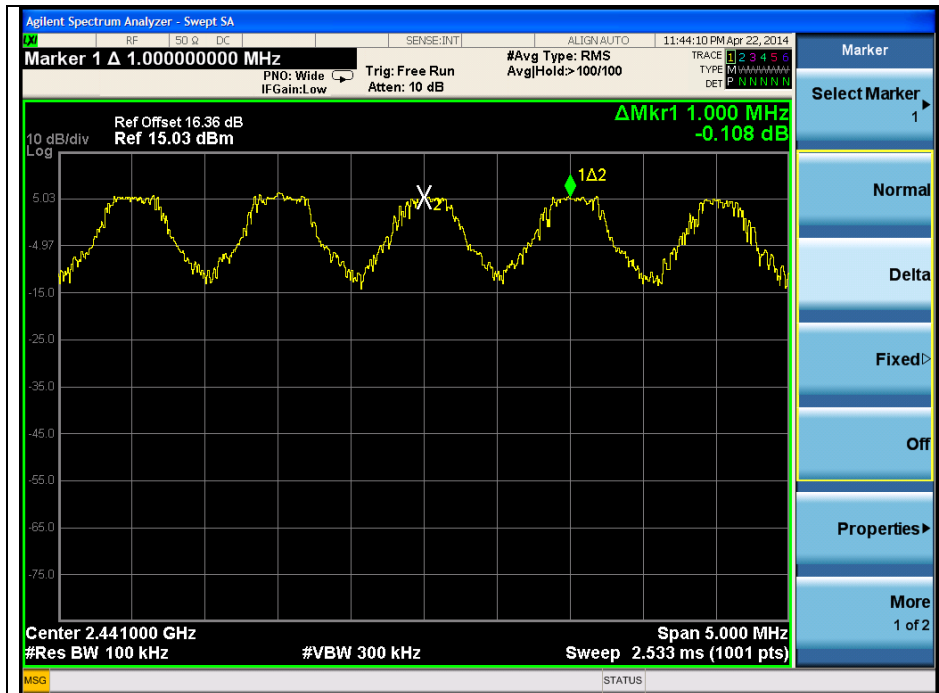
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## Operating Mode: GFSK



## Operating Mode: 8DPSK



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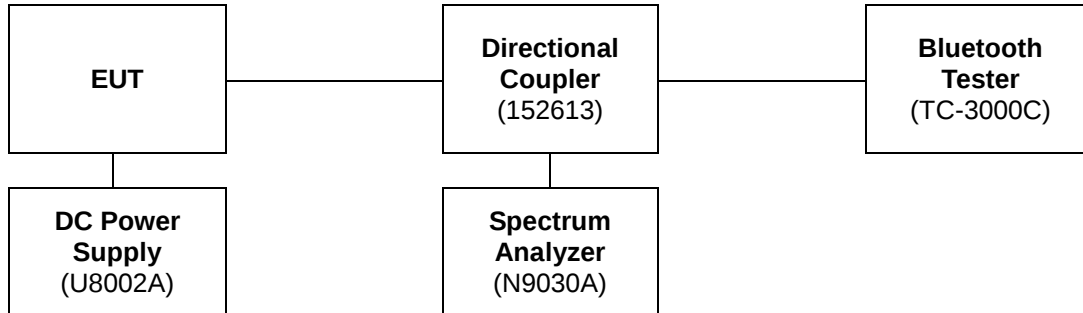
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## 6. Number of Hopping Frequency

### 6.1. Test Setup



#### 6.1.1. Actual equipment used for Number of Hopping Frequency

| Equipment           | Manufacturer | Model    | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|---------------------|--------------|----------|-------------|---------------|--------------|---------------|
| Signal Generator    | R&S          | SMR40    | 100540      | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator    | R&S          | SMJ 100A | 100882      | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Spectrum Analyzer   | Agilent      | N9030A   | MY53120526  | Jul. 30, 2013 | Annual       | Jul. 30, 2014 |
| Bluetooth Tester    | TESCOM       | TC-3000C | 3000C000296 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Directional Coupler | KRYTAR       | 152613   | 127445      | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| DC Power Supply     | Agilent      | U8002A   | MY48490027  | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |

### 6.2. Limit

§15.247(a)(1)(iii), Frequency hopping systems in the 2 400–2 483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 6.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section. The test follows DA 00-705.

The device supports Adaptive Frequency Hopping and will use a minimum of 20 channels of the 79 available channels.

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna the port to the Spectrum analyzer
3. Set spectrum analyzer Start = 2 400 MHz, Stop = 2 441.5 MHz, Sweep=sweep and Start = 2 441.5 MHz, Stop = 2 483.5 MHz, Sweep = sweep. Detector = peak.
4. Set the spectrum analyzer as RBW, VBW = 510 kHz.
5. Max hold, allow the trace to stabilize and count how many channel in the band.

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## 6.4. Test Results

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.

| Operation Mode | Number of Hopping Frequency | Limit |
|----------------|-----------------------------|-------|
| GFSK           | 79                          | ≥15   |
| 8DPSK          | 79                          | ≥15   |

**Remark:**

Measurement is made with EUT operating in hopping mode between 79 channels providing a worse case scenario as compared to AFH mode hopping between 20 channels.

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## Operating Mode: GFSK



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## Operating Mode : 8DPSK



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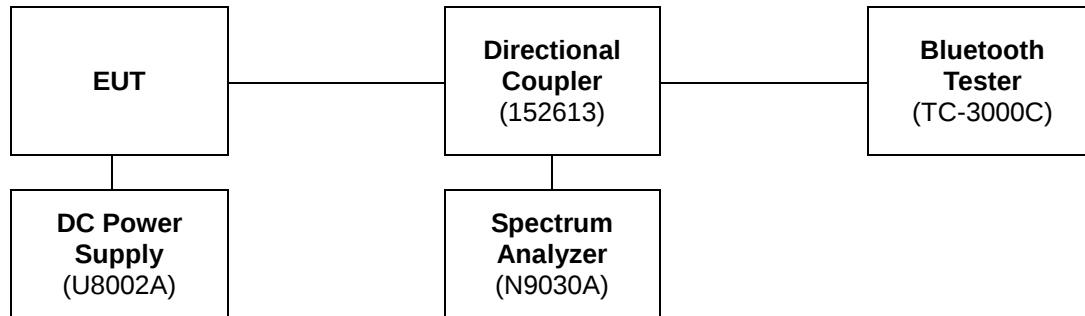
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## 7. Time of Occupancy (Dwell Time)

### 7.1. Test Set up



#### 7.1.1. Actual equipment used for 20 dB Bandwidth Measurement

| Equipment           | Manufacturer | Model    | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|---------------------|--------------|----------|-------------|---------------|--------------|---------------|
| Signal Generator    | R&S          | SMR40    | 100540      | Jan. 08, 2014 | Annual       | Jan. 08, 2015 |
| Signal Generator    | R&S          | SMJ 100A | 100882      | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Spectrum Analyzer   | Agilent      | N9030A   | MY53120526  | Jul. 30, 2013 | Annual       | Jul. 30, 2014 |
| Bluetooth Tester    | TESCOM       | TC-3000C | 3000C000296 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Directional Coupler | KRYTAR       | 152613   | 127445      | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| DC Power Supply     | Agilent      | U8002A   | MY48490027  | Jan. 03, 2014 | Annual       | Jan. 03, 2015 |

### 7.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2 400 – 2 483.5 MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

A period time = 0.4(s) \* 79 = 31.6(s)

#### \*Adaptive Frequency Hopping

A period time = 0.4(s) \* 20 = 8 (s)

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### 7.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section. The test follows DA 00-705.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable.
3. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
4. The Bluetooth has 3 type of payload, DH1, DH3, DH5 and 3-DH1, 3-DH3, 3-DH5. The hopping rate is insisted of 1 600 per second.

The EUT must have its hopping function enabled. Use the following spectrum analyzer setting:

Span = zero span, centered on a hopping channel

RBW = 1 MHz

VBW ≥ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector = peak

Trace = max hold

Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation repeat this test for each variation.

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## 7.4. Test Results

Ambient temperature : (23 ± 1) °C  
Relative humidity : 47 % R.H.

### 7.4.1. Packet Type: DH1, 3-DH1

| Operation Mode | Frequency | Dwell Time (ms) | Time of occupancy on the Tx Channel in 31.6 sec (ms) | Limit for time of occupancy on the Tx Channel in 31.6 sec (ms) |
|----------------|-----------|-----------------|------------------------------------------------------|----------------------------------------------------------------|
| GFSK           | 2 441 MHz | 0.38            | 121.60                                               | 400                                                            |
| 8DPSK          | 2 441 MHz | 0.38            | 121.60                                               | 400                                                            |

Note:

Time of occupancy on the TX channel in 31.6 sec

In case of GFSK & 8DPSK,  $0.38 \times \{(1600 \div 2) / 79\} \times 31.6 = 121.60 \text{ ms}$

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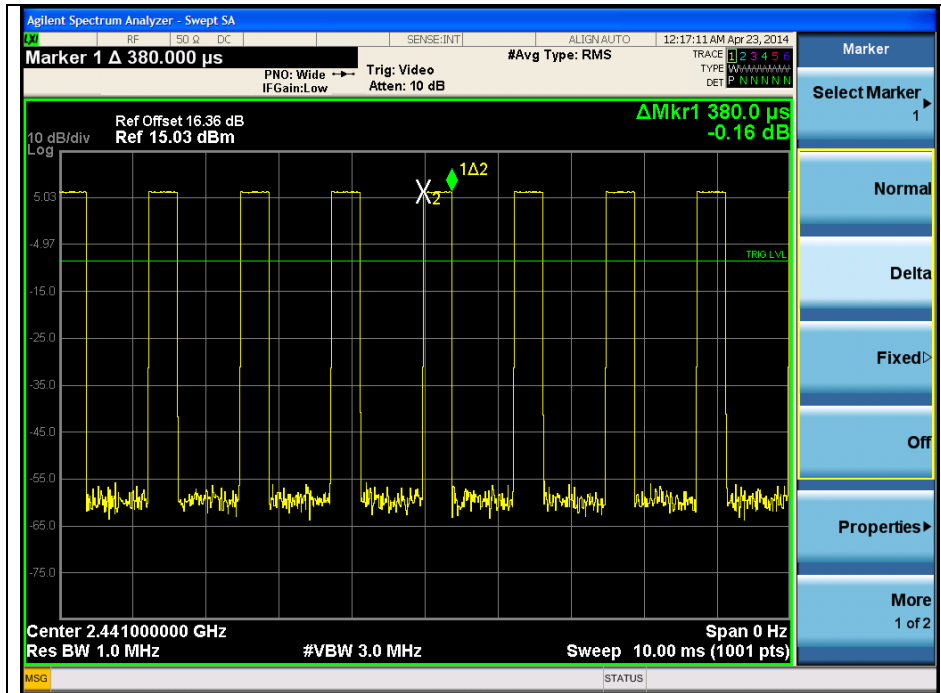
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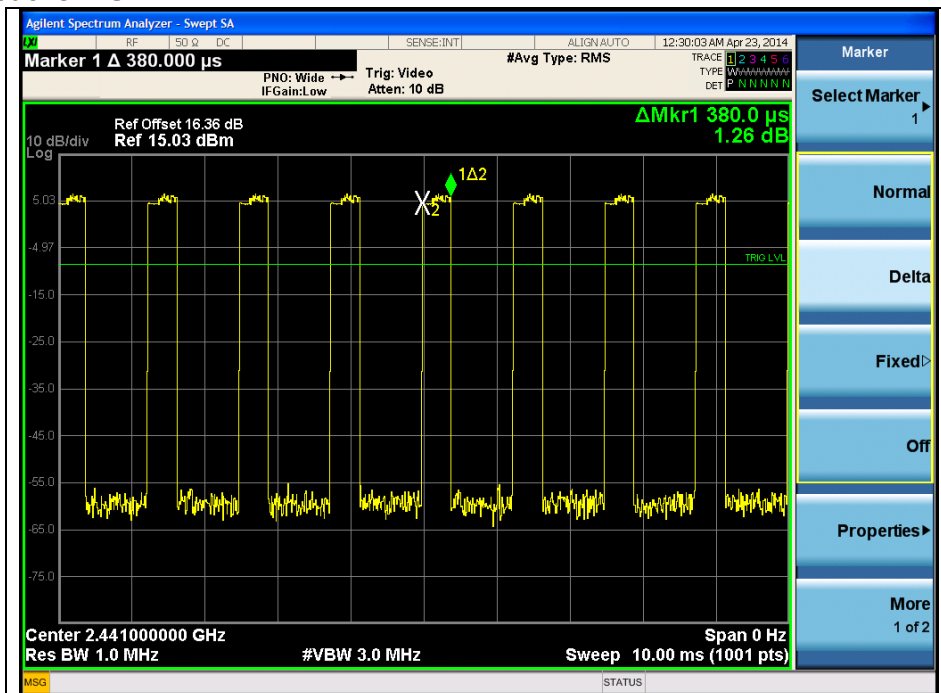
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A4(210 mm × 297 mm)

## Operating Mode: GFSK



## Operating Mode: 8DPSK



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#### 7.4.2. Packet Type: DH3, 3-DH3

| Operation Mode | Frequency | Dwell Time (ms) | Time of occupancy on the Tx Channel in 31.6 sec (ms) | Limit for time of occupancy on the Tx Channel in 31.6 sec (ms) |
|----------------|-----------|-----------------|------------------------------------------------------|----------------------------------------------------------------|
| GFSK           | 2 441 MHz | 1.62            | 259.20                                               | 400                                                            |
| 8DPSK          | 2 441 MHz | 1.62            | 259.20                                               | 400                                                            |

Note:

Time of occupancy on the TX channel in 31.6 sec

In case of GFSK & 8DPSK,  $1.62 \times \{(1600 \div 4) / 79\} \times 31.6 = 259.20$  ms

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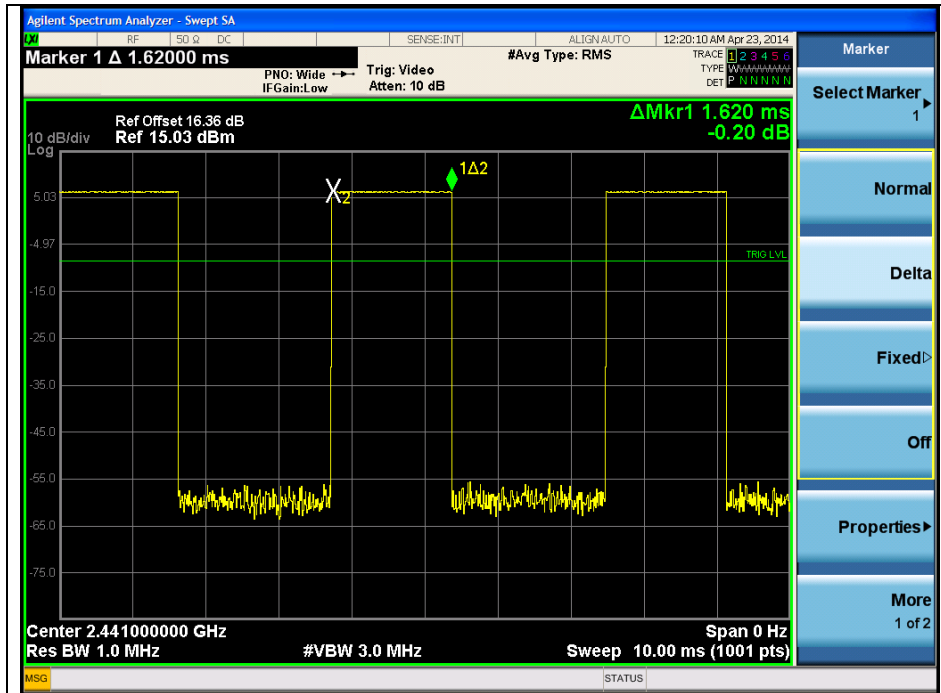
<http://www.sgsgroup.kr>

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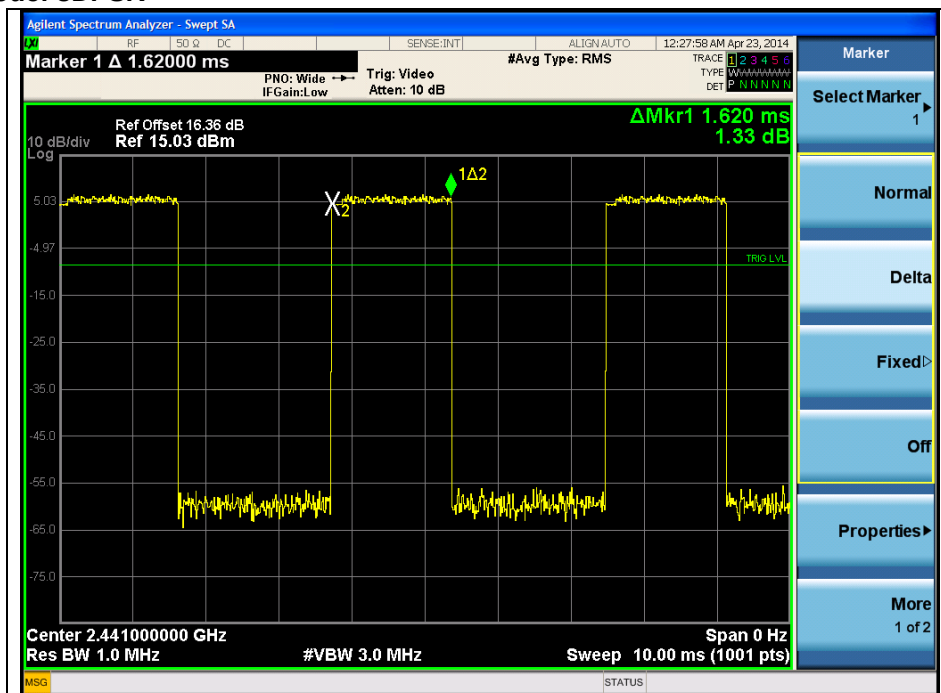
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A4(210 mm x 297 mm)

## Operating Mode: GFSK



## Operating Mode: 8DPSK



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### 7.4.3. Packet Type: DH5, 3-DH5

| Operation Mode | Frequency | Dwell Time (ms) | Time of occupancy on the Tx Channel in 31.6 sec (ms) | Limit for time of occupancy on the Tx Channel in 31.6 sec (ms) |
|----------------|-----------|-----------------|------------------------------------------------------|----------------------------------------------------------------|
| GFSK           | 2 441 MHz | 2.88            | 307.20                                               | 400                                                            |
| 8DPSK          | 2 441 MHz | 2.88            | 307.20                                               | 400                                                            |

Note:

Time of occupancy on the TX channel in 31.6 sec

In case of GFSK & 8DPSK,  $2.88 \times \{(1600 \div 6) / 79\} \times 31.6 = 307.20 \text{ ms}$

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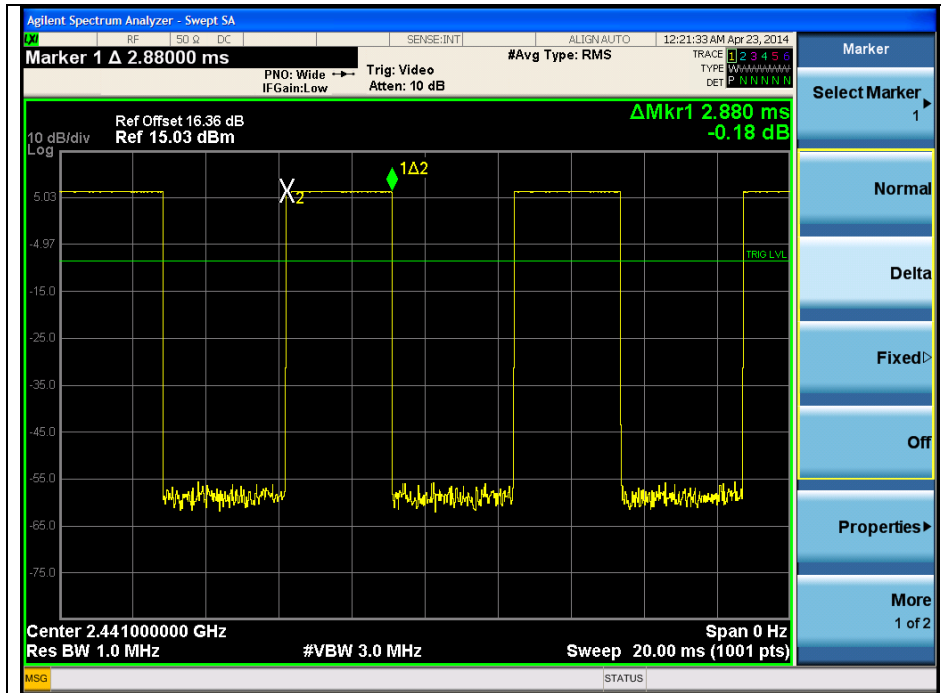
<http://www.sgsgroup.kr>

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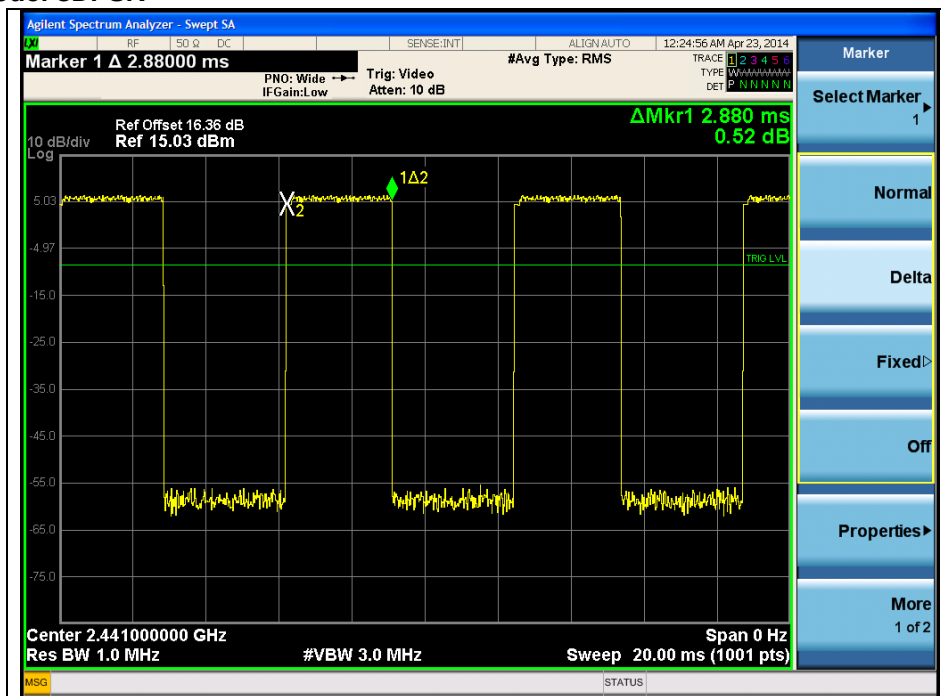
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A4(210 mm x 297 mm)

## Operating Mode: GFSK



## Operating Mode: 8DPSK



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#### 7.4.4. Packet Type: DH1, 3-DH1 (Adaptive Frequency Hopping)

| Operation Mode | Frequency | Dwell Time (ms) | Time of occupancy on the Tx Channel in 8 sec (ms) | Limit for time of occupancy on the Tx Channel in 8 sec (ms) |
|----------------|-----------|-----------------|---------------------------------------------------|-------------------------------------------------------------|
| GFSK           | 2 441 MHz | 0.38            | 60.80                                             | 400                                                         |
| 8DPSK          | 2 441 MHz | 0.38            | 60.80                                             | 400                                                         |

Note:

Time of occupancy on the TX channel in 8 sec

In case of GFSK & 8DPSK,  $0.38 \times \{(800 \div 2) / 20\} \times 8 = 60.80 \text{ ms}$

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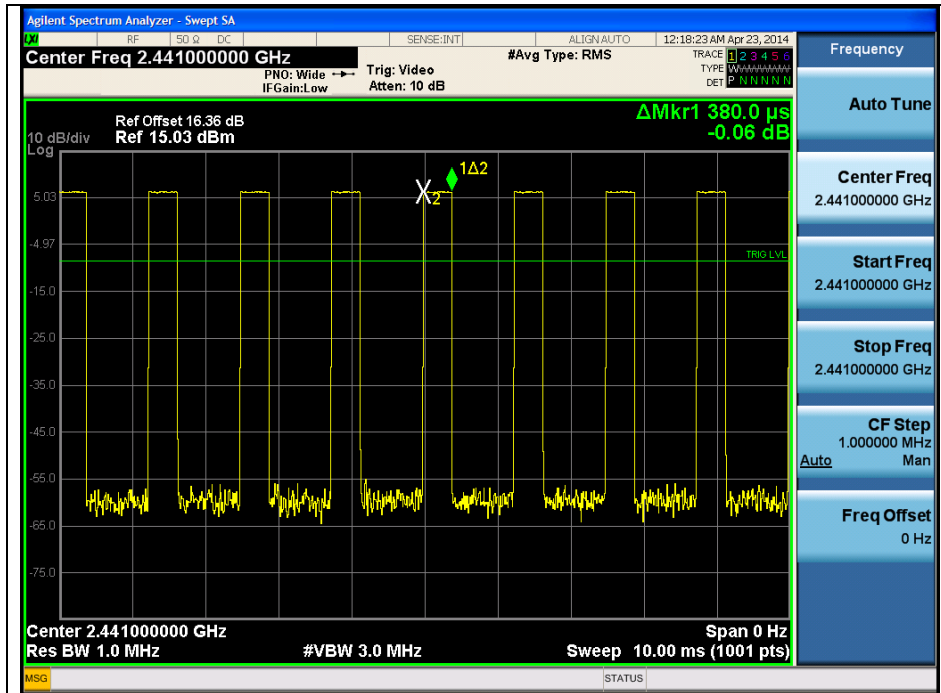
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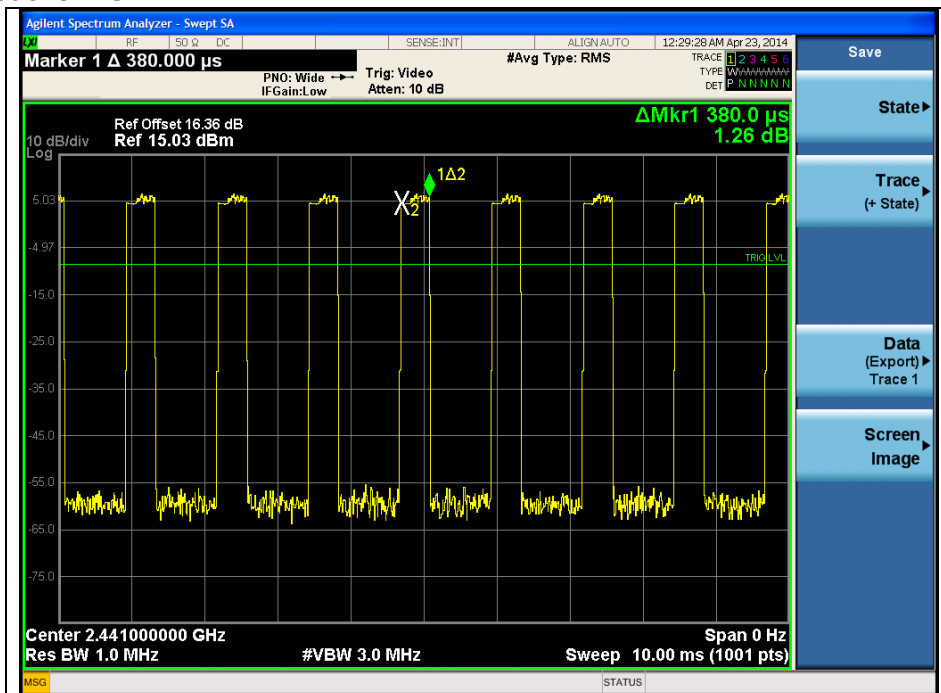
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A4(210 mm x 297 mm)

## Operating Mode: GFSK



## Operating Mode: 8DPSK



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#### 7.4.5. Packet Type: DH3, 3-DH3 (Adaptive Frequency Hopping)

| Operation Mode | Frequency | Dwell Time (ms) | Time of occupancy on the Tx Channel in 8 sec (ms) | Limit for time of occupancy on the Tx Channel in 8 sec (ms) |
|----------------|-----------|-----------------|---------------------------------------------------|-------------------------------------------------------------|
| GFSK           | 2 441 MHz | 1.62            | 129.60                                            | 400                                                         |
| 8DPSK          | 2 441 MHz | 1.62            | 129.60                                            | 400                                                         |

Note:

Time of occupancy on the TX channel in 8 sec

In case of GFSK and 8DPSK,  $1.62 \times \{(800 \div 4) / 20\} \times 8 = 129.60 \text{ ms}$

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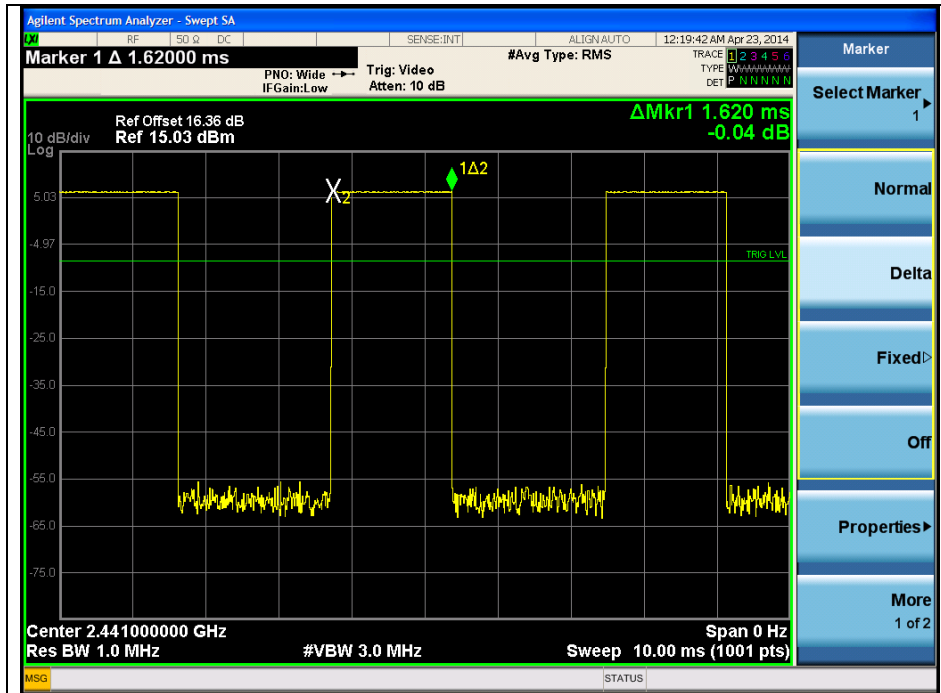
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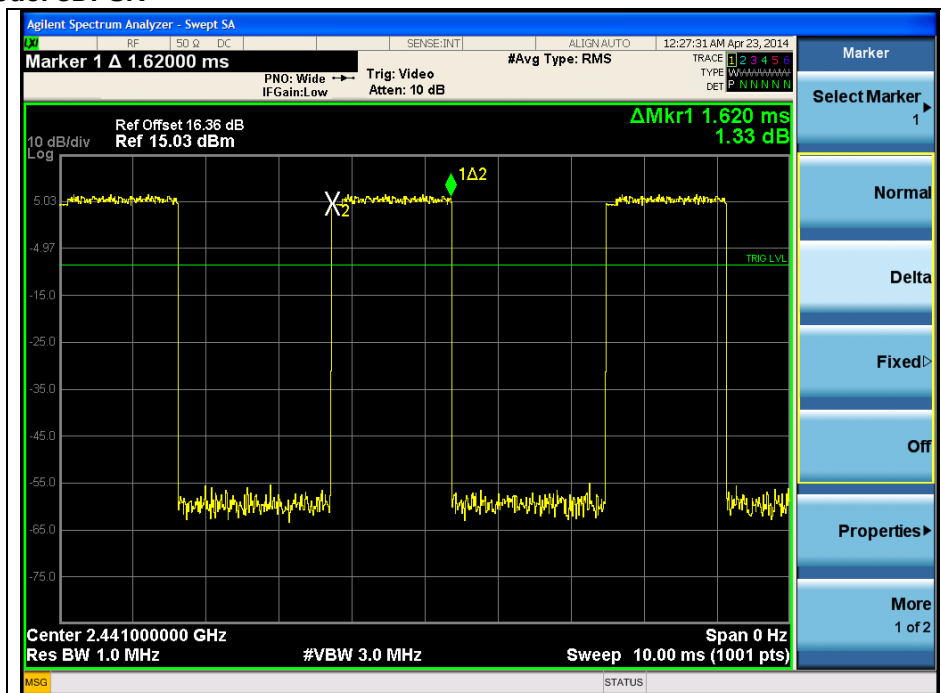
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A4(210 mm x 297 mm)

## Operating Mode: GFSK



## Operating Mode: 8DPSK



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#### 7.4.6. Packet Type: DH5, 3-DH5 (Adaptive Frequency Hopping)

| Operation Mode | Frequency | Dwell Time (ms) | Time of occupancy on the Tx Channel in 8 sec (ms) | Limit for time of occupancy on the Tx Channel in 8 sec (ms) |
|----------------|-----------|-----------------|---------------------------------------------------|-------------------------------------------------------------|
| GFSK           | 2 441 MHz | 2.88            | 153.60                                            | 400                                                         |
| 8DPSK          | 2 441 MHz | 2.88            | 153.60                                            | 400                                                         |

Note:

Time of occupancy on the TX channel in 8 sec

In case of GFSK & 8DPSK,  $2.88 \times \{(800 \div 6) / 20\} \times 8 = 153.60 \text{ ms}$

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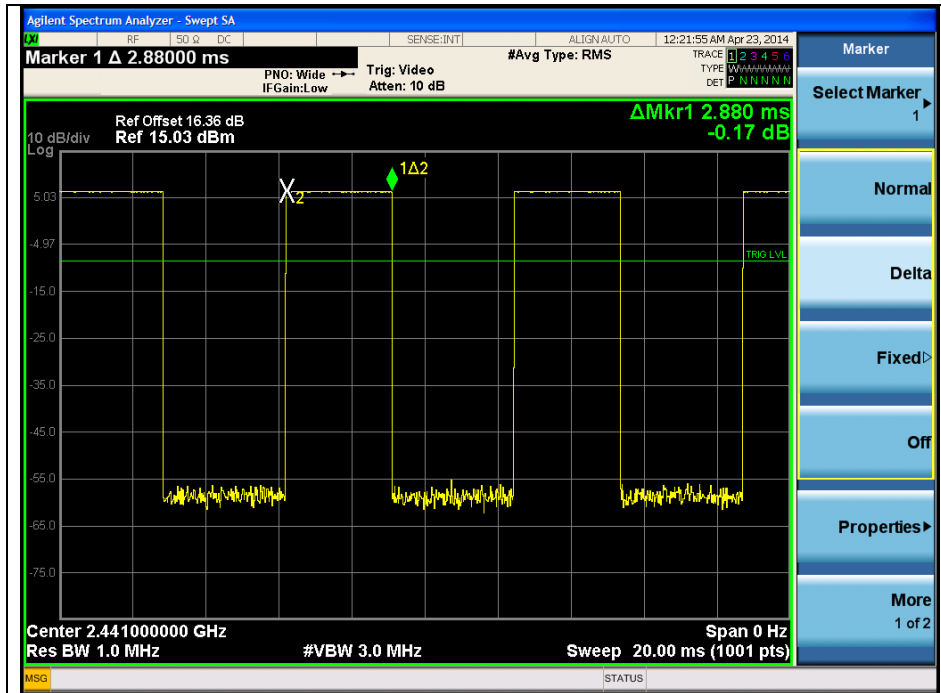
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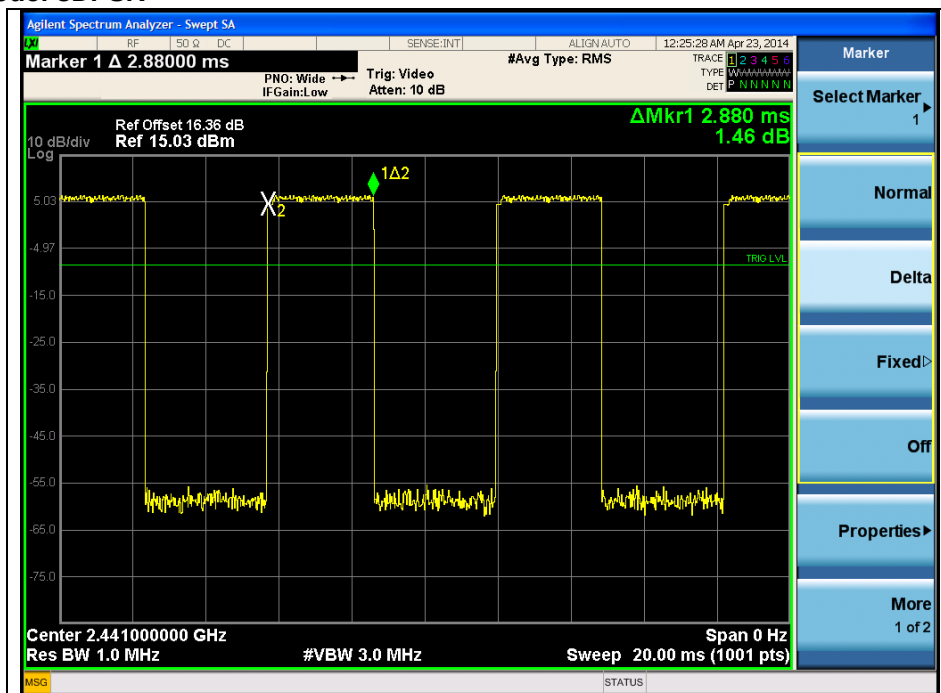
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A4(210 mm x 297 mm)

## Operating Mode: GFSK



## Operating Mode: 8DPSK



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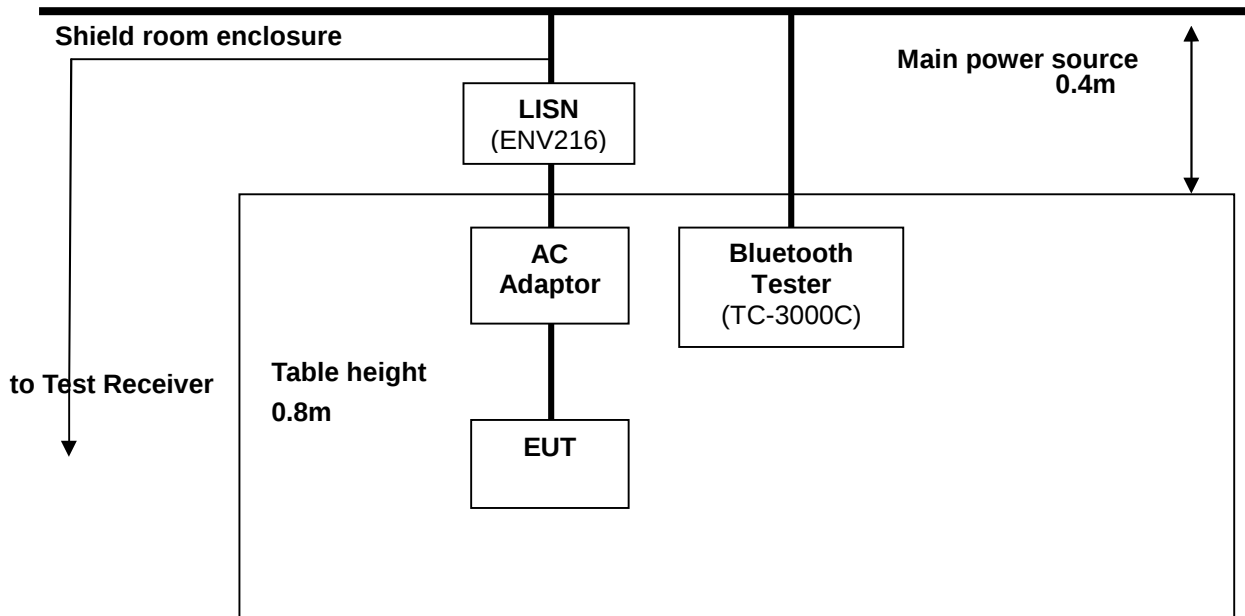
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## 8. Transmitter AC Power Line Conducted Emission

### 8.1. Test Setup



#### 8.1.1. Actual equipment used for Transmitter AC Power Line Conducted Emission

| Equipment          | Manufacturer   | Model                                | S/N         | Cal Date      | Cal Interval | Cal Due.      |
|--------------------|----------------|--------------------------------------|-------------|---------------|--------------|---------------|
| EMI Test Receiver  | R&S            | ESU26                                | 100194      | Sep. 13, 2013 | Annual       | Sep. 13, 2014 |
| Signal Generator   | R&S            | SMJ 100A                             | 100882      | Jul. 03, 2013 | Annual       | Jul. 03, 2014 |
| Bluetooth Tester   | TESCOM         | TC-3000C                             | 3000C000296 | Jul. 02, 2013 | Annual       | Jul. 02, 2014 |
| Two-Line V-Network | R&S            | ENV216                               | 101120      | Jan. 02, 2014 | Annual       | Jan. 02, 2015 |
| Shield Room        | SY Corporation | L × W × H<br>(6.5 m × 3.5 m × 3.5 m) | N/A         | N.C.R.        | N/A          | N.C.R.        |

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## 8.2. Limit

According to §15.207(a) 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 uH/50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

| Frequency of Emission (MHz) | Conducted limit (dB µV) |          |
|-----------------------------|-------------------------|----------|
|                             | Quasi-peak              | Average  |
| 0.15 – 0.50                 | 66 - 56*                | 56 - 46* |
| 0.50 – 5.00                 | 56                      | 46       |
| 5.00 – 30.0                 | 60                      | 50       |

\* Decreases with the logarithm of the frequency.

## 8.3. Test Procedures

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

AC power line conducted emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m(W)× 1.5 m(L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. The excess power cable between the EUT and the LISN was bundled. All connecting cables of EUT were moved to find the maximum emission.

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#### 8.4. Test Results (Worst case configuration\_8DPSK mode, 3 Mbps, Middle channel)

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

##### 8.4.1. Battery Cover without charger

Frequency range : 0.15 MHz – 30 MHz

Measured Bandwidth : 9 kHz

| FREQ.<br>(MHz) | LEVEL(dB $\mu$ V) |         | LINE | LIMIT(dB $\mu$ V) |         | MARGIN(dB) |         |
|----------------|-------------------|---------|------|-------------------|---------|------------|---------|
|                | Quasi Peak        | Average |      | Quasi Peak        | Average | Quasi Peak | Average |
| 0.15           | 28.08             | 12.42   | H    | 65.78             | 55.78   | 37.70      | 43.36   |
| 0.19           | 21.72             | 12.76   | H    | 63.86             | 53.86   | 42.14      | 41.10   |
| 0.57           | 20.46             | 10.62   | H    | 56.00             | 46.00   | 35.54      | 35.38   |
| 1.85           | 26.18             | 16.55   | H    | 56.00             | 46.00   | 29.82      | 29.45   |
| 6.92           | 31.55             | 22.27   | H    | 60.00             | 50.00   | 28.45      | 27.73   |
| 10.95          | 32.75             | 24.85   | H    | 60.00             | 50.00   | 27.25      | 25.15   |
| 0.18           | 34.25             | 18.86   | N    | 64.58             | 54.58   | 30.33      | 35.72   |
| 0.21           | 24.06             | 7.29    | N    | 63.05             | 53.05   | 38.99      | 45.76   |
| 0.50           | 25.69             | 12.34   | N    | 56.03             | 46.03   | 30.34      | 33.69   |
| 0.86           | 35.11             | 27.36   | N    | 56.00             | 46.00   | 20.89      | 18.64   |
| 2.15           | 35.31             | 27.90   | N    | 56.00             | 46.00   | 20.69      | 18.10   |
| 17.25          | 40.37             | 31.08   | N    | 60.00             | 50.00   | 19.63      | 18.92   |

Note ;

- Line ( H ): Hot, Line ( N ): Neutral
- All modes of operation were investigated and the worst-case emissions are reported. The above data was taken while the EUT was transmitting on middle channel.
- The limit for Class B device(s) from 150 kHz to 30 MHz are specified in Section of the Title 47 CFR.
- Traces shown in plot are made using a peak detector and average detector
- Deviations to the Specifications: None.

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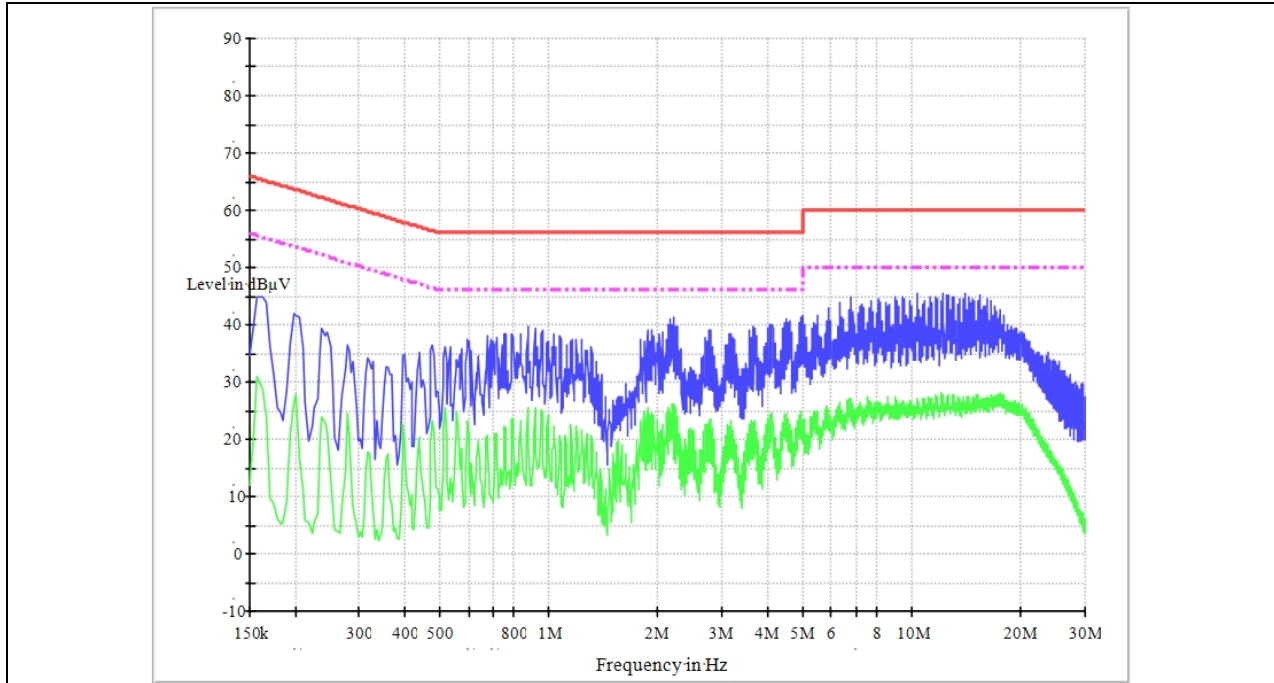
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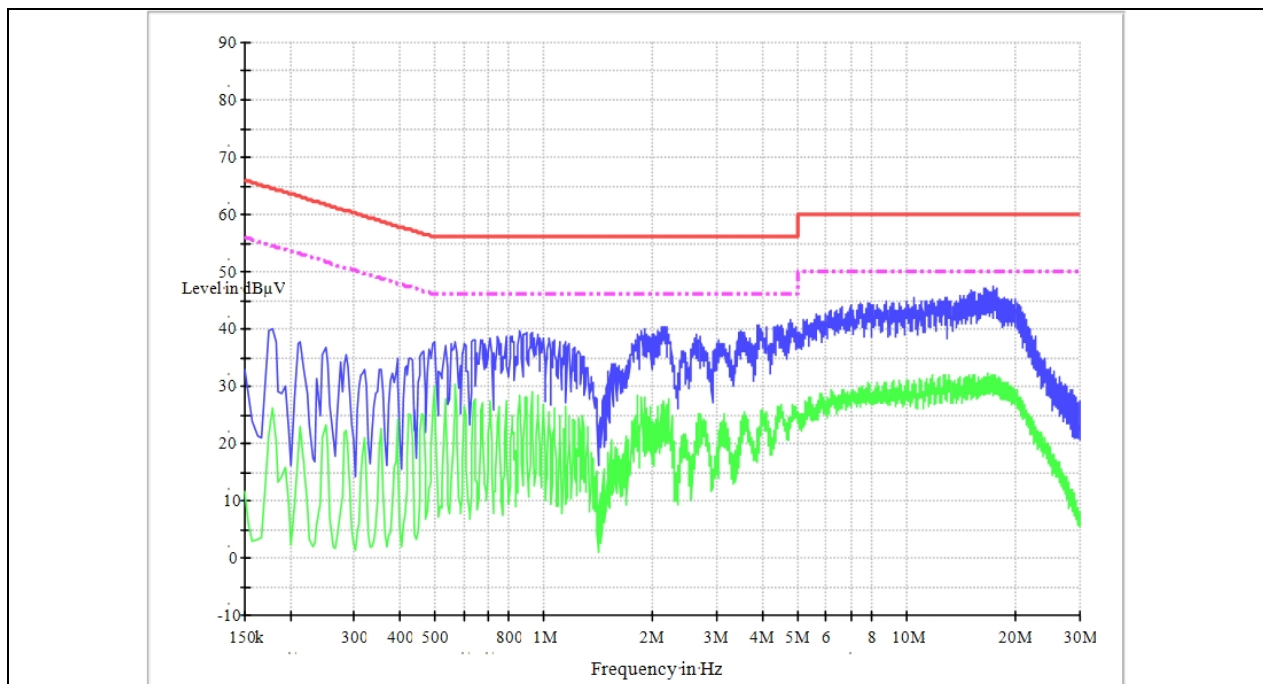
A4(210 mm x 297 mm)

## Plots of Conducted Power line (Battery Cover without charger)

Test mode : (Hot)



Test mode : (Neutral)



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## 9. Antenna Requirement

### 9.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, 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. And according to FCC 47 CFR Section §15.247 (b) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

### 9.2. Antenna Connected Construction

Antenna used in this product is Integral antenna and peak max gain of antenna as below.

|      |                                |
|------|--------------------------------|
| Band | 2 402 MHz – 2 480 MHz<br>(ISM) |
| Mode | (GFSK, π/4DQPSK , 8DPSK)       |
| Gain | -3.09 dBi                      |

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