Head office & Test Lab: 28(175-20,Annyeong-dong)
406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

▪ **DSS BT(BDR/EDR)**

# TEST REPORT

Report No: KST-FCR-140005

| | | |
|---|---|---|
| **Applicant** | Name | Bluebird Inc. |
| | Address | (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul, South Korea |
| **Manufacturer** | Name | Bluebird Inc. |
| | Address | (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul, South Korea |
| | | |
| **Equipment** | Name | Handheld Mobile Computer |
| | Model No | BM180 |
| | Brand | None |
| | FCC ID | SS4BM180M |
| | | |
| **Test Standard** | FCC CFR 47, Part 15. Subpart C-15.247 | |
| **Test Date(s)** | 2014. 07. 28 ~ 2014. 08. 12 | |
| **Issue Date** | 2014. 08. 13 | |
| **Test Result** | Compliance | |
| **Note** | This equipment contained the certified module for GSM850/1900, WCDMA Band II/V and not certified modules for WLAN 802.11abgn, Bluetooth 4.0, NFC. | |

## Supplementary Information

The device bearing the brand name and FCC ID specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with measurement procedures specified in ANSI C 63.10-2009.

We attest to the accuracy of data and all measurements reported herein were performed by KOSTEC Co., Ltd. and were made under Chief Engineer's supervision. We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by Mi Young, Lee  Approved by Gyeong Hyeon, Park

Signature  Signature

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406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
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# 1. GENERAL INFORMATION

## 1.1 Test Facility

### Test laboratory and address

KOSTEC Co., Ltd.

128(175-20,Annyeong-dong)406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea

The open area field test site and conducted measurement facility are used for these testing. This site at was fully described in a reports submitted to the Federal Communications Commission (FCC).

The details of these reports have been found to be in complies with the requirements of Section 2.948 of the FCC Rules on November 14, 2002. The facility also complies with the radiated and conducted test site criteria set forth in ANSI C 63.10-2009.

The Federal Communications Commission (FCC) has the reports on file and KOSTEC Co., Ltd. is listed under FCC Registration No.525762. The test site has been approved by the FCC for public use and is List in the FCC Public Access Link CORES (Commission Registration System)

### Registration information

KCC (Korea Communications Commission) Number : KR0041

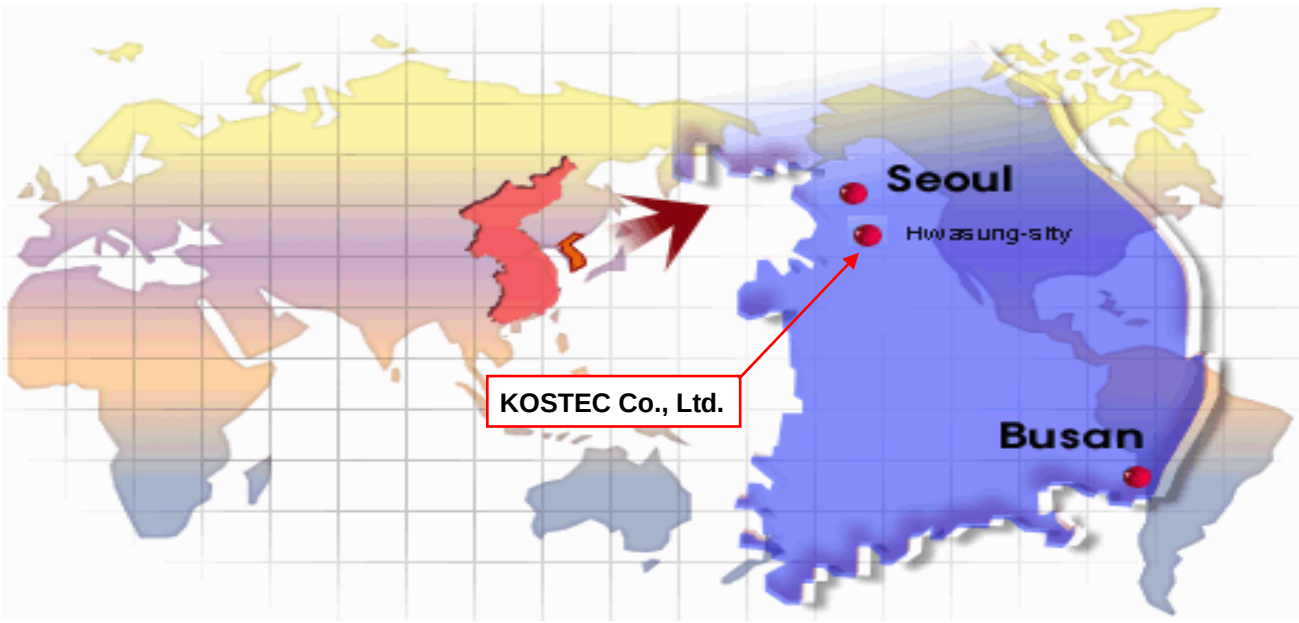
KOLAS(Korea Laboratory Accreditation Scheme) Number : 232

FCC Registration Number(FRN) : 525762

VCCI Registration Number : R-1657 / C –1763

IC Registration Site Number : 8305A-1

## 1.2 Location



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## 2. EQUIPMENT DESCRIPTION

The product specification described herein was declared by manufacturer. And refer to user's manual for the details.

| | |
|---|---|
| Equipment Name | Handheld Mobile Computer |
| Model No | BM180 |
| Usage | Handheld Mobile Computer |
| Serial Number | Proto type |
| Data connection Type | FHSS(frequency hopping spread spectrum system) |
| Modulation type | GSM: GMSK, 8PSK<br>WCDMA: QPSK<br>802.11b: DSSS (DBPSK / DQPSK / CCK)<br>802.11a/g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM)<br>Bluetooth 2.1 BDR (1Mbps) : GFSK<br>Bluetooth 2.1 EDR (2Mbps) : π/4-DQPSK<br>Bluetooth 2.1 EDR (3Mbps) : 8-DPSK<br>Bluetooth 4.0 LE: GFSK<br>NFC: ASK |
| Max peak output | 3.15 dBm |
| Operated Frequency | GSM 850: 824.2 MHz - 848.8 MHz<br>GSM1900: 1850.2 MHz – 1909.8 MHz<br>WCDMA Band II: 1 852.4 MHz – 1 907.6 MHz<br>WCDMA Band V: 826.4 MHz - 846.6 MHz<br>802.11b/g: 2 412 MHz – 2 462 MHz<br>802.11a: 5 180 MHz – 5 240 MHz (UNII Band I)<br>5 745 MHz – 5 825 MHz (UNII Band IV)<br>802.11n(HT20): 2 412 MHz – 2 462 MHz<br>5 180 MHz – 5 240 MHz (UNII Band I)<br>5 745 MHz – 5 825 MHz (UNII Band IV)<br>802.11n(HT40): 2 422 MHz – 2 452 MHz<br>5 190 MHz – 5 230 MHz (UNII Band I)<br>5 755 MHz – 5 795 MHz (UNII Band IV)<br>Bluetooth: 2 402 MHz – 2 480 MHz<br>NFC: 13.561 MHz |
| Channel Number | 79 CH |
| Operation temperature | - 20℃~ + 55 ℃ |
| Power Source | AC/DC adapter<br>Input : AC 100-240 V, 0.3 A, 50 - 60 Hz<br>Output : DC 5 V, 1.0 A<br>Battery : Li-ion DC 3.7 V |
| Antenna Description | Type : Internal PCB Antenna |
| FCC ID | SS4BM180M |

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| | |
|---|---|
| Remark | 1. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.<br>2. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.<br>3. Bluetooth operation was evaluated at both 1Mb/s and 3Mb/s data rates. For π/4 QPSK its same modulation type with 8-DPSK, and based exploratory test, there is no significant difference of that two types test result, after the preliminary scan, 8-DPSK will have higher emission, so except output power, all other items final test were only performed with the worse case 8-DPSK and GFSK.<br>4. This report only for Bluetooth BDR(1Mbps) and EDR(2Mbps, 3Mbps) mode of EUT,for Bluetooth 4.0-LE mode and etc modes were reported in another test report<br>5. The above DUT's information was declared by manufacturer. Please refer to the specifications or user manual for more detailed description. |
| Test Mode | Mode 1: Transmit - 1Mbps (GFSK)<br>Mode 2: Transmit - 3Mbps (8DPSK) |

** it is maximum peak conducted power in only BT(BDR,EDR).

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# 3. SYSTEM CONFIGURATION FOR TEST

## 3.1 Characteristics of equipment

The Equipment Under Test (EUT) contains the following capabilities:
GSM850/1900, WCDMA Band II/V, WLAN 802.11abgn, Bluetooth 4.0, NFC.

The test data contained in this report pertains only to the emissions due to the BT(BDR,EDR) transmitter of the EUT. Bluetooth chip Communication type is frequency hopping spread spectrum system(FHSS), and it support the EDR mode (Enhanced data rate), used frequency band is 2 402 ㎒ - 2 480 ㎒.

## 3.2 Used peripherals list

| Description | Model No. | Serial No. | Manufacture | Remark |
|---|---|---|---|---|
| Battery | EG-520 | - | Egen | Li-ion 3.7 V |
| AC/DC adapter | PSAI05R-050Q CH | - | Phihong (Dongguan) Electronics Co.,Ltd | Output: 5.0 V |
| Bluetooth tester | TC-3000B | 3000B6A0166 | TESCOM CO., LTD. | Due cal date: 2015.07.14 |

## 3.3 Product Modification

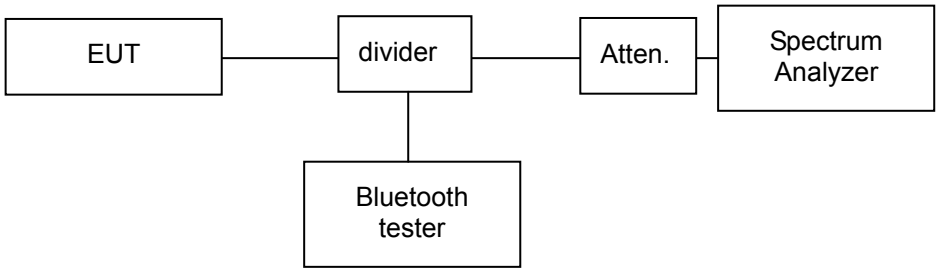
N/A

## 3.4 Operating Mode

* All measurements were intended to emit maximum RF signal from EUT continuously.

## 3.5 Test Setup of EUT

The measurements were taken in continuous transmit / receive mode using the Bluetooth tester.
Communication between the device and the emulator was established by air link and conducted link.



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## 3.6 Parameters of Test Software Setting

During testing, for channel & mode and un-mod, hopping setting is controlled using the Bluetooth tester. Communication between the device and the emulator was established by air link and conducted link.

## 3.7 Table for Test condition

| Test Items | Channel No | Frequency (㎒) | Operated Condition |
|---|---|---|---|
| Carrier frequency separation | 39, 40, 41 | 2 440, 2 441, 2 442 | Hopping on and continuous modulation setting mode |
| Number of hopping frequencies | 1 ~ 79 | 2 402 ~ 2 480 | Hopping on mode |
| Time of occupancy (Dwell Time) | 40 | 2 441 | Hopping on mode |
| Conducted peak output power | 1 | 2 402 | Hopping off and continuous modulation setting mode |
| | 40 | 2 441 | |
| | 79 | 2 480 | |
| Band-edge Compliance | 1 | 2 402 | Hopping off and continuous modulation setting mode |
| | 79 | 2 480 | |
| Spurious RF conducted emissions | - | - | Frequency band setting by required standard (FCC Rules)* |
| Spurious radiated emissions | - | - | |

*Note Channel number is selected lowest, middle, highest channel and also hopping on/off mode operation

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## 3.8 Used Test Equipment List

| No. | Instrument | Model | S/N | Manufacturer | Due to cal date | Cal interval | used |
|---|---|---|---|---|---|---|---|
| 1 | T & H Chamber | EY-101 | 90E14260 | TABAI ESPEC | 2014.10.05 | 1 year | ☒ |
| 2 | Constant switch Tester | DS-COT | None | Dong sung Ele. | N/A | N/A | ☐ |
| 3 | Vibration Tester | 70UA | L90016 | IDEX Co.,Ltd | N/A | N/A | ☐ |
| 4 | Vibration Meter | VM-6360 | N225098 | LANDTEK | 2015.04.04 | 18 month | ☐ |
| 5 | Falling Tester | SWD-8000 | None | Sinwoo | N/A | N/A | ☐ |
| 6 | Spectrum Analyzer | 8563E | 3846A10662 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 7 | Spectrum Analyzer | 8593E | 3710A02859 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 8 | Spectrum Analyzer | FSV30 | 20-353063 | Rohde& Schwarz | 2015.02.07 | 1 year | ☒ |
| 9 | EMI Test Receiver | ESCI7 | 100823 | Rohde& Schwarz | 2015.02.05 | 1 year | ☒ |
| 10 | EMI Test Receiver | ESI | 834000/002 | Rohde& Schwarz | 2015.02.05 | 1 year | ☒ |
| 11 | Vector Signal Analyzer | 89441A | 3416A02620 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 12 | Network Analyzer | 8753ES | US39172348 | AGILENT | 2014.10.05 | 1 year | ☐ |
| 13 | EPM Series Power meter | E4418B | GB39512547 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 14 | RF Power Sensor | E9300A | MY41496631 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 15 | Microwave Frequency Counter | 5352B | 2908A00480 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 16 | Modulation Analyzer | 8901A | 3538A07071 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 17 | Audio Analyzer | 8903B | 3514A16919 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 18 | Audio Telephone Analyzer | DD-5601CID | 520010281 | CREDIX | 2015.02.07 | 1 year | ☐ |
| 19 | Digital storage Oscilloscope | TDS3052 | B015962 | Tektronix | 2014.10.05 | 1 year | ☐ |
| 20 | ESG-D Series Signal Generator | E4436B | US39260458 | Agilent Technology | 2015.02.07 | 1 year | ☒ |
| 21 | ESG Vector Signal Generator | E4438C | MY42083133 | Agilent Technology | 2014.10.05 | 1 year | ☐ |
| 22 | Vector Signal Generator | SMBV100A | 257557 | Rohde & Schwarz | 2015.01.21 | 1 year | ☐ |
| 23 | Tracking Source | 85645A | 070521-A1 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 24 | Signal Generator | SML03 | 100692 | Rohde& Schwarz | 2015.02.07 | 1 year | ☐ |
| 25 | SLIDAC | None | 0207-4 | Myoung sung Ele. | 2015.02.07 | 1 year | ☐ |
| 26 | DC Power supply | DRP-5030 | 9028029 | Digital Electronic Co.,Ltd | 2015.02.07 | 1 year | ☐ |
| 27 | DC Power supply | 6038A | 3440A12674 | Agilent Technology | 2015.02.07 | 1 year | ☐ |
| 28 | DC Power supply | E3610A | KR24104505 | Agilent Technology | 2015.02.07 | 1 year | ☒ |
| 29 | DC Power supply | UP-3005T | 68 | Unicon Co.,Ltd | 2015.02.07 | 1 year | ☐ |
| 30 | DC Power Supply | SM 3004-D | 114701000117 | DELTA ELEKTRONIKA | 2015.02.07 | 1 year | ☐ |
| 31 | Dummy Load | 8173 | 3780 | Bird Electronic Co., Corp | 2015.02.07 | 1 year | ☐ |
| 32 | Attenuator | 50FH-030-500 | 140410 9433 | JEW Idustries Inc. | 2015.02.07 | 1 year | ☐ |
| 33 | Attenuator | 765-20 | 9703 | Narda | 2014.10.05 | 1 year | ☐ |
| 34 | Attenuator | 8498A | 3318A09485 | HP | 2015.02.07 | 1 year | ☐ |
| 35 | Step Attenuator | 8494B | 3308A32809 | HP | 2015.02.07 | 1 year | ☐ |
| 36 | Step Attenuator | 8495D | 3308A01464 | HP | 2015.02.07 | 1 year | ☐ |
| 37 | Power divider | 11636B | 51212 | HP | 2014.10.05 | 1 year | ☒ |
| 38 | 3Way Power divider | KPDSU3W | 00070365 | KMW | 2015.02.07 | 1 year | ☐ |
| 39 | Band rejection filter | WTR-BRF2442-84NN | 09020001 | WAVE TECH Co.,LTD | 2015.02.07 | 1 year | ☐ |
| 40 | White noise audio filter | ST31EQ | 101902 | SoundTech | 2014.10.05 | 1 year | ☐ |
| 41 | Dual directional coupler | 778D | 17693 | HEWLETT PACKARD | 2015.02.07 | 1 year | ☐ |
| 42 | Dual directional coupler | 772D | 2839A00924 | HEWLETT PACKARD | 2015.02.07 | 1 year | ☐ |
| 43 | Band rejection filter | 3TNF-0006 | 26 | DOVER Tech | 2015.02.07 | 1 year | ☐ |
| 44 | Band rejection filter | 3TNF-0008 | 317 | DOVER Tech | 2015.02.07 | 1 year | ☐ |
| 45 | Band rejection filter | 3TNF-0007 | 311 | DOVER Tech | 2015.02.07 | 1 year | ☐ |
| 46 | Highpass Filter | WHJS1100-10EF | 1 | WAINWRIGHT | 2015.02.07 | 1 year | ☐ |
| 47 | Highpass Filter | WHJS3000-10EF | 1 | WAINWRIGHT | 2015.02.07 | 1 year | ☐ |
| 48 | Radio Communication Alalyzer | MT8815A | 6200429622 | ANRITSU | 2015.02.07 | 1 year | ☐ |
| 49 | CDMA Mobile Station Test Set | E8285A | US40081298 | AGILENT | 2015.02.07 | 1 year | ☐ |
| 50 | WideBand Radio Communication Tester | CMW500 | 102276 | Rohde & Schwarz | 2015.04.10 | 1 year | ☐ |

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| No. | Instrument | Model | S/N | Manufacturer | Due to cal date | Cal interval | used |
|---|---|---|---|---|---|---|---|
| 51 | RF Up/Down Converter | DCP-1780 | 980901003 | CREDIX | 2015.02.07 | 1 year | ☐ |
| 52 | DECT Test set | 8923B | 3829U00364 | HP | 2015.02.07 | 1 year | ☐ |
| 53 | DECT Test set | CMD60 | 840677/005 | Rohde& Schwarz | 2014.12.04 | 1 year | ☐ |
| 54 | Loop Antenna | 6502 | 9203-0493 | EMCO | 2015.05.31 | 2 year | ☒ |
| 55 | Dipole Antenna | HZ-12 | 100005 | Rohde & Schwarz | 2016.07.01 | 2 year | ☐ |
| 56 | Dipole Antenna | HZ-13 | 100007 | Rohde & Schwarz | 2016.07.01 | 2 year | ☐ |
| 57 | BiconiLog Antenna | HL562 | 100076 | Rohde & Schwarz | 2014.12.10 | 2 year | ☒ |
| 58 | Horn Antenna | 3115 | 9605-4834 | EMCO | 2016.06.16 | 2 year | ☒ |
| 59 | Horn Antenna | 3115 | 2996 | EMCO | 2016.02.26 | 2 year | ☐ |
| 60 | Horn Antenna | BBHA9170 | BBHA9170152 | SCHWARZBECK | 2015.05.27 | 2 year | ☒ |
| 61 | Signal Generator | SMT-06 | 100552 | Rohde & Schwarz | 2015.02.07 | 1 year | ☐ |
| 62 | HYGRO-Thermograph | NSII-Q | 1611545 | SATO | 2014.10.05 | 1 year | ☐ |
| 63 | Barometer | 7612 | 81134 | SATO | 2016.01.20 | 2 year | ☐ |
| 64 | Multi meter | DM-313 | S60901832 | LG Precision Co.,Ltd | 2015.02.07 | 1 year | ☐ |
| 65 | Antenna Mast(OSA) | AT14 | None | Daeil EMC | N/A | N/A | ☐ |
| 66 | Turn table(OSA) | None | None | Daeil EMC | N/A | N/A | ☐ |
| 67 | RF Amplifier(OSA) | 8447D | 2944A07881 | AGILENT | 2015.02.04 | 1 year | ☐ |
| 68 | Antenna Master(3) | AT13 | None | AUDIX | N/A | N/A | ☒ |
| 69 | Turn Table(3) | None | None | AUDIX | N/A | N/A | ☒ |
| 70 | PREAMPLIFIER(3) | 8449B | 3008A02577 | Agilent | 2015.02.05 | 1 year | ☒ |
| 71 | Antenna Master(10) | MA4000-EP | None | inno systems GmbH | N/A | N/A | ☒ |
| 72 | Turn Table(10) | None | None | inno systems GmbH | N/A | N/A | ☒ |
| 73 | AMPLIFIER(10) | TK-PA6S | 120009 | TESTEK | 2015.02.05 | 1 year | ☐ |
| 74 | Vernier Calipers | None | 8280373 | Mitutoyo | 2014.10.05 | 1 year | ☐ |

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## 4. SUMMARY TEST RESULTS

| Description of Test | FCC Rule | Reference Clause | Used | Test Result |
|---|---|---|---|---|
| Carrier frequency separation (20 dB bandwidth) | 15.247(a)(1) | Clause 5.1 | ☒ | Compliance |
| Number of hopping frequencies | 15.247(a)(1)(iii) | Clause 5.2 | ☒ | Compliance |
| Time of occupancy (Dwell Time) | 15.247(a)(1)(iii) | Clause 5.3 | ☒ | Compliance |
| Max. Conducted peak output power | 15.247(b)(1) | Clause 5.4 | ☒ | Compliance |
| Band edge compliance of RF conducted emissions | 15.247(d) | Clause 5.5 | ☒ | Compliance |
| Spurious RF conducted emissions | 15.247(d) | Clause 5.6 | ☒ | Compliance |
| Spurious RF radiated emissions | 15.247(d), 15.209 | Clause 5.7 | ☒ | Compliance |
| Antenna requirement | 15.203, 15.247 | Clause 5.8 | ☒ | Compliance |
| AC Conducted emission | 15.207 | Clause 5.9 | ☒ | Compliance |

Compliance/pass : The EUT complies with the essential requirements in the standard.
Not Compliance : The EUT does not comply with the essential requirements in the standard.
N/A : The test was not applicable in the standard.

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# 5. MEASUREMENT RESULTS

## 5.1 Carrier Frequency Separation

### 5.1.1 Standard Applicable [FCC §15.247(a),(1)]

Frequency hopping systems operating in the ( 2 400 ~ 2 483.5 ) ㎒ band may have hopping channel carrier frequencies that are separated by 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater.

### 5.1.2 Test Environment conditions

• Ambient temperature : (22 - 23) ℃,
• Relative Humidity : (58 - 67) % R.H.

### 5.1.3 Measurement Procedure

After place the EUT on the table and set it in transmitting mode, remove the antenna from EUT and then connect a RF cable from the antenna port to the spectrum analyzer.
The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal while EUT had its hopping function enabled. After the trace being stable, the reading value between the peak of the adjacent channels using the marker- Delta function was recorded as the measurement results.

The spectrum analyzer is set to the as follows :

- Span : 10 ㎒
- RBW : 100 ㎑
- VBW : 300 ㎑
- Sweep : auto
- Detector function : peak
- Trace : max hold

### 5.1.4 Measurement Result

| Mode | Channel separation (㎒) | 20㏈ Bandwidth (㎒) | Result | Limit (㎒) 2/3 of 20㏈ bandwidth |
|---|---|---|---|---|
| GFSK hopping off Tx Mode (DH5) | 0.99 | 0.94 | Compliance | 0.62 |
| 8-DPSK hopping off Tx Mode(3-DH5) | 1.00 | 1.25 | Compliance | 0.83 |

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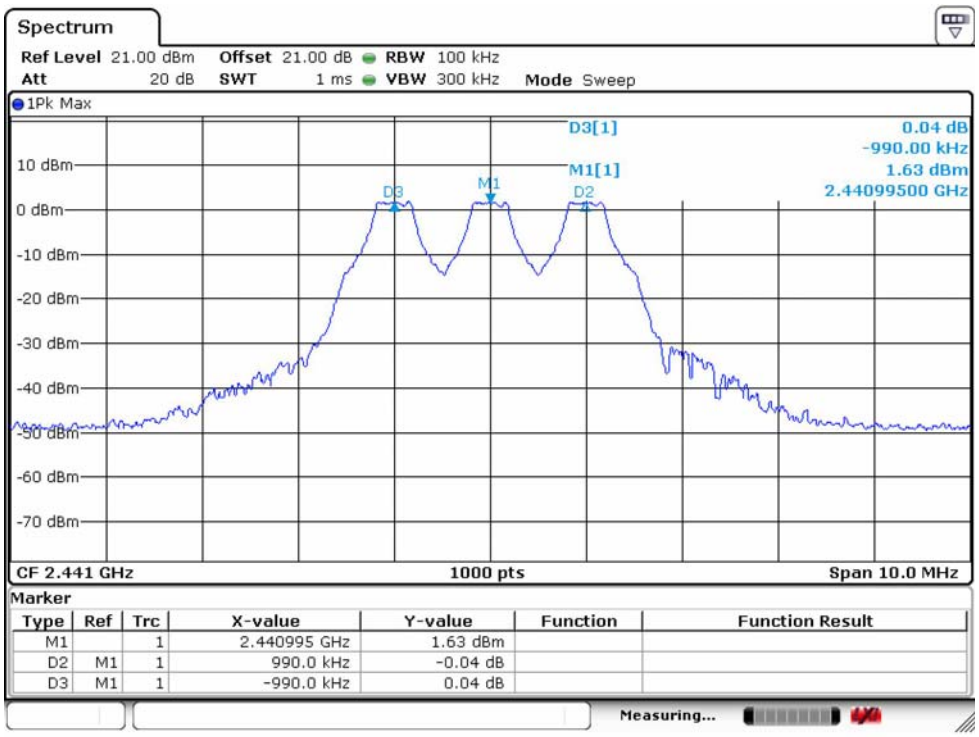
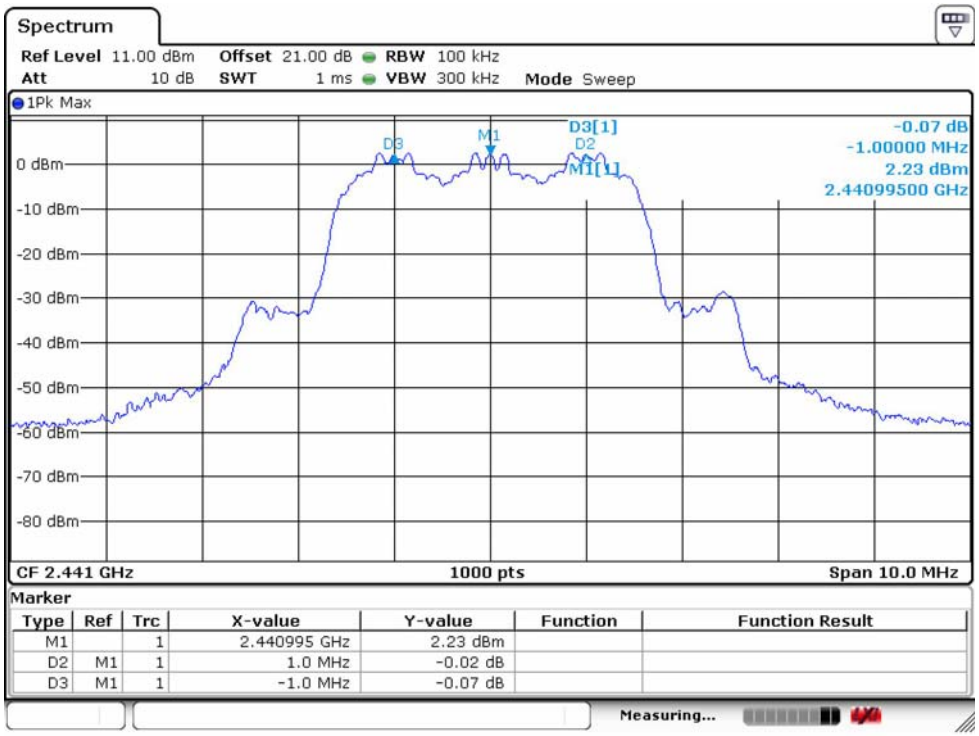
## 5.1.5 Test Plot (Carrier Frequency Separation)

GFSK




8-DPSK



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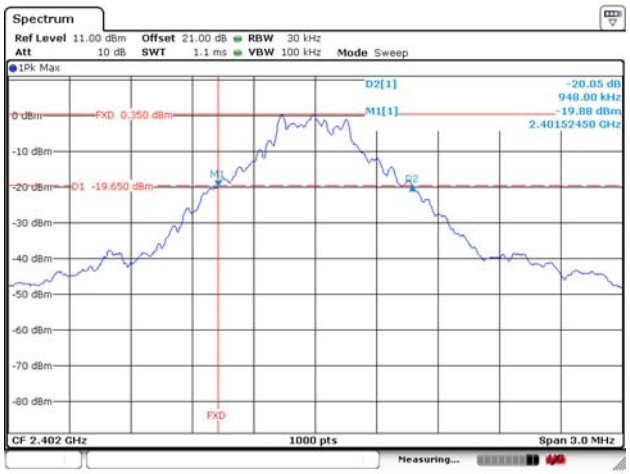
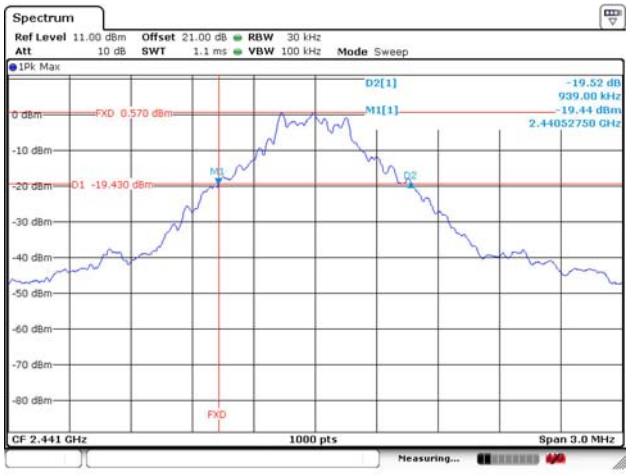
## Test Plot (20 dB bandwidth) GFSK

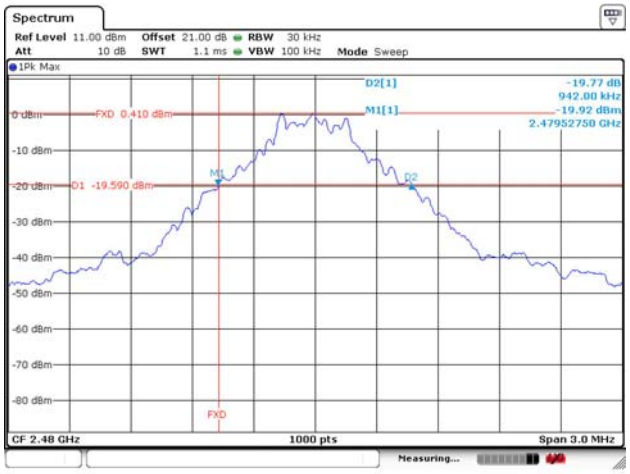
### CH Low ( 2 402 MHz)




### CH Middle (2 441 MHz)




### CH High (2 480 MHz)



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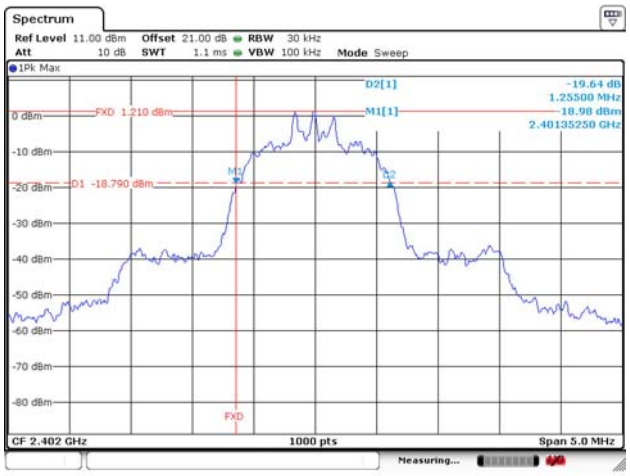
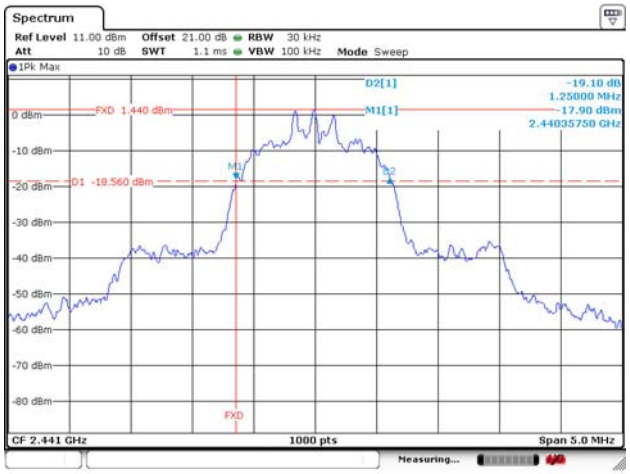
## Test Plot (20 dB bandwidth) 8-DPSK

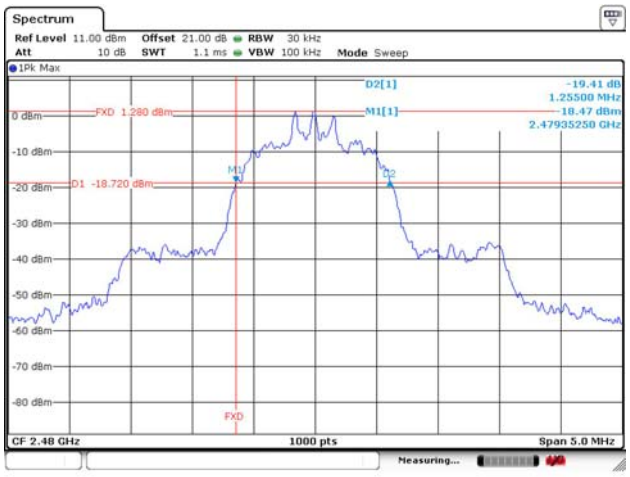
### CH Low ( 2 402 MHz)




### CH Middle (2 441 MHz)




### CH High (2 480 MHz)



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* Note : 20 dB bandwidth

▪ Limit : Intentional radiators operating under the alternative provisions to the general emission limits, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

▪ Test setup : The spectrum analyzer is set to the as follows :

- Span : 5-30 % greater than the EBW
- RBW : 30 ㎑
- VBW : 100 ㎑
- Sweep : auto
- Detector function : peak
- Trace : max hold

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## 5.2 Number of hopping frequencies

### 5.2.1 Standard Applicable [FCC §15.247(a),(1)(iii)]

Frequency hopping systems in the ( 2 400 ~ 2 483.5 ) ㎒ band shall use at least 15 channels

### 5.2.2 Test Environment conditions

- Ambient temperature : (22 - 23) ℃,
- Relative Humidity : (58 - 67) % R.H.

### 5.2.3 Measurement Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna Terminal to get higher resolution, two frequency ranges within the ( 2 400 ~ 2 483.5 ) ㎒ Frequency hopping band were examined. The EUT must have its hoping function enabled. After the trace being stable, it may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

The spectrum analyzer is set to the as follows :

- Span : Start 2 400 ㎒, Stop 2 483.5 ㎒
- RBW : 100 ㎑
- VBW : 300 ㎑
- Sweep : auto
- Detector function : peak
- Trace : max hold

### 5.2.4 Measurement Result

| Channel Number | Mode | Hopping frequency band (㎒) | Test Results | | |
|---|---|---|---|---|---|
| | | | Measured total number of Hopping Channels | Limit | Result |
| 1 ~ 79 | GFSK hopping on Tx Mode | ( 2 402 ~ 2 480 ) ㎒ | 79 | ≥ 15 | Compliance |
| 1 ~ 79 | 8-DPSK hopping on Tx Mode | ( 2 402 ~ 2 480 ) ㎒ | 79 | ≥ 15 | Compliance |

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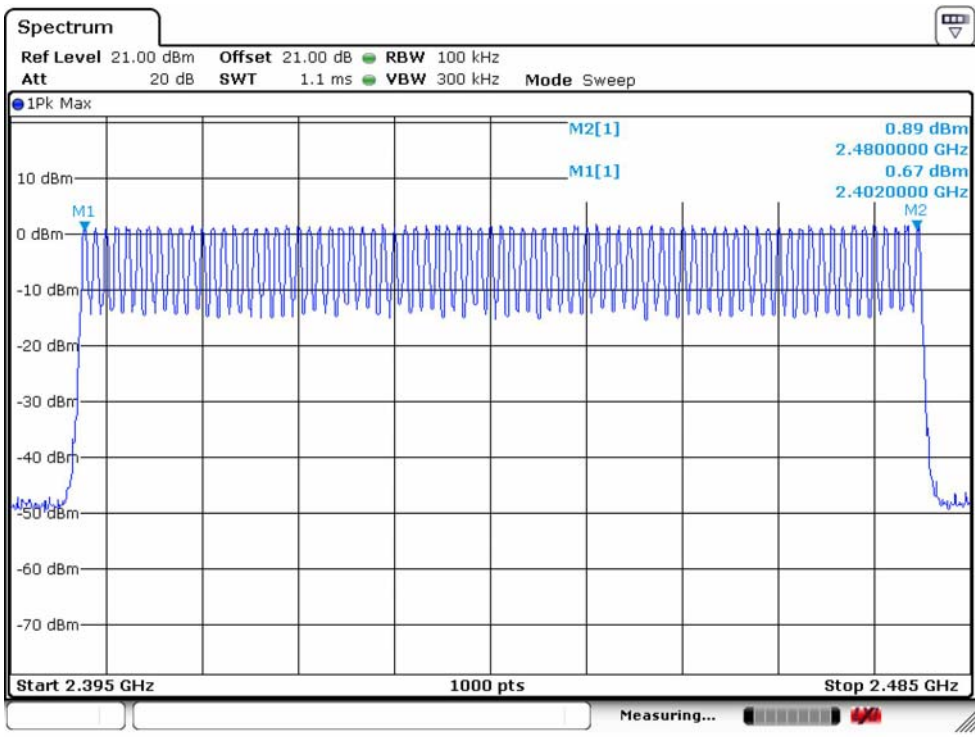
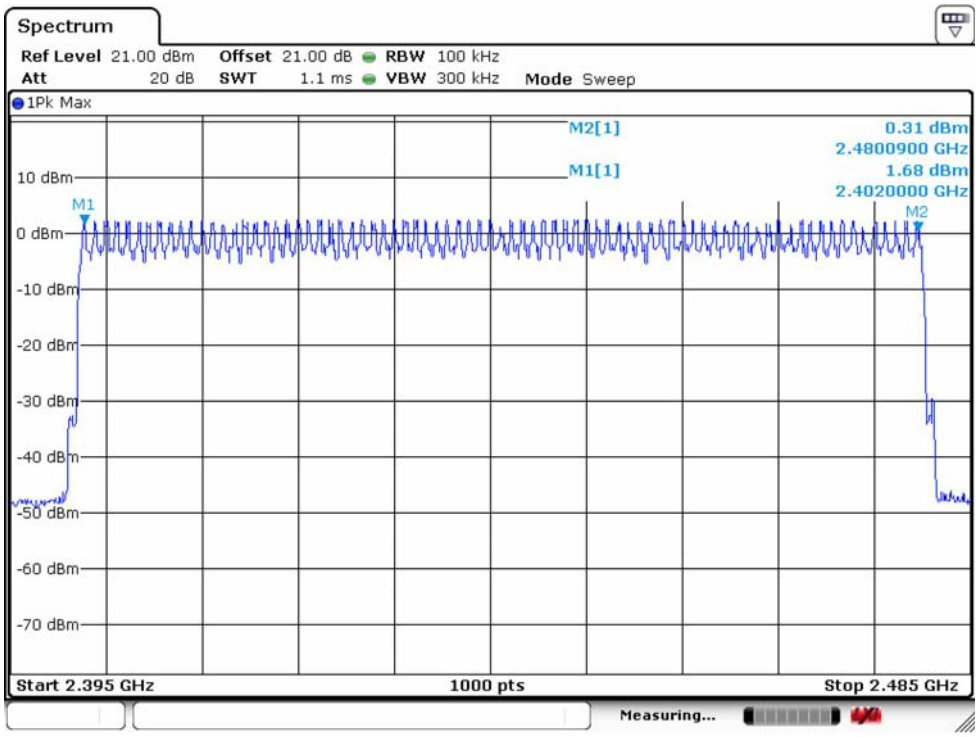
### 5.2.5 Test Plot

GFSK hopping off Tx Mode




8-DPSK hopping off Tx Mode



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## 5.3 Time of occupancy (Dwell Time)

### 5.3.1 Standard Applicable [FCC §15.247(a),(1)(iii)]

According to §15.247(a),(1)(iii), Frequency hopping systems operating in the 2 400 ㎒ – 2 483.5 ㎒. 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.

### 5.3.2 Test Environment conditions

- Ambient temperature : (22 - 23) ℃,
- Relative Humidity : (58 - 67) % R.H.

### 5.3.3 Measurement Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled. After used the marker-delta function to determine the dwell time.

The spectrum analyzer is set to the as follows :

- Span : Zero , Centered on a hopping channel
- Resolution (or IF) Bandwidth(RBW) : 1 ㎒
- Video (or Average) Bandwidth(VBW) : ≥ RBW
- Detector function : peak
- Trace : max hold

### 5.3.4 Measurement Result

| Mode | Pulse Width [ms] | Max. number of transmissions in 31.6 sec | Dwell time<br>Pulse Width * Max. number of transmissions[ms] | Limit [s] | Result |
|---|---|---|---|---|---|
| GFSK DH1 | 0.396 | 640 | 253.44 | ≤ 0.4 | Compliance |
| DH3 | 1.648 | 214 | 352.67 | ≤ 0.4 | Compliance |
| DH5 | 2.900 | 128 | 371.20 | ≤ 0.4 | Compliance |
| 8-DPSK 3-DH1 | 0.402 | 640 | 257.28 | ≤ 0.4 | Compliance |
| 3-DH3 | 1.626 | 214 | 347.96 | ≤ 0.4 | Compliance |
| 3-DH5 | 2.915 | 128 | 373.12 | ≤ 0.4 | Compliance |

Dwell time = total hops *pulse's on time.

Note:
The channel staying time of 0.4 s within a 31.6 second period in data mode is constant for Bluetooth® devices and independent from the packet type (packet length). The calculation for a 31.6 second period is a follows:
Channel staying time = time slot length * hop rate / number of hopping channels * 31.6 s
Example for a DH1 packet (with a maximum length of one time slot) Channel staying time = 625 µs * 1600*1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)
For multi-slot packets the hopping is reduced according to the length of the packet.
Example for a DH3 packet (with a maximum length of three time slots) Channel staying time = 3 * 625 µs * 1600/3 *1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)
Example for a DH5 packet (with a maximum length of five time slots) Channel staying time = 5 * 625 µs * 1600/5 *1/s / 79 * 31.6 s = 0.4 s (in a 31.6 s period)

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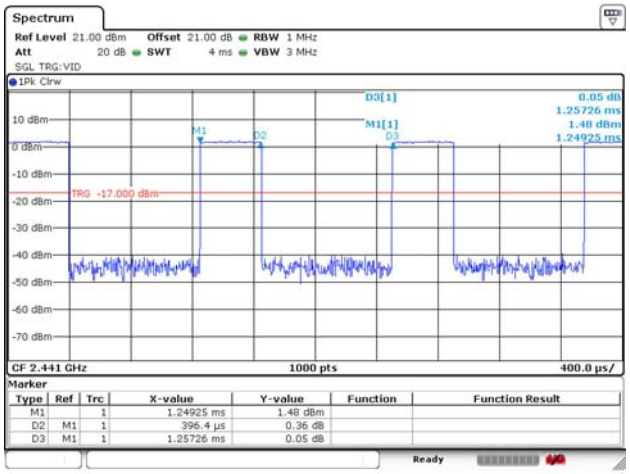
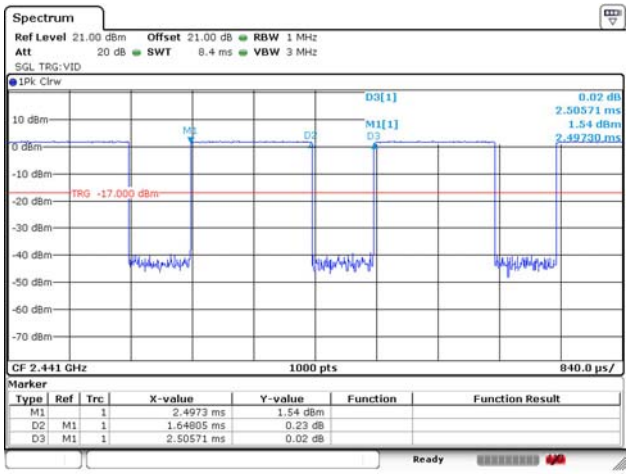
## 5.3.5 Test Plot (Time slot) GFSK

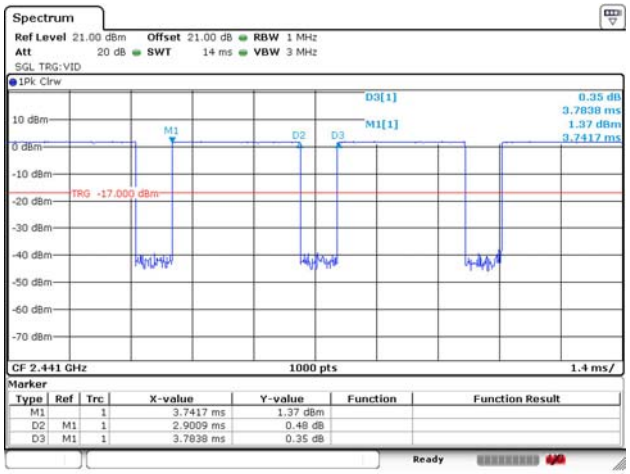
### DH1




### DH3




### DH5



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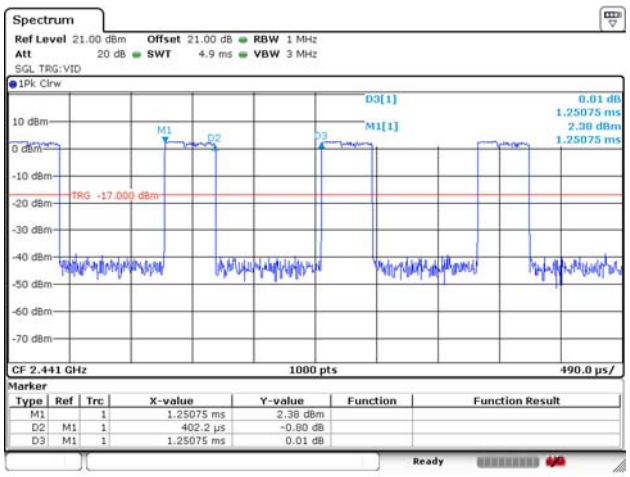
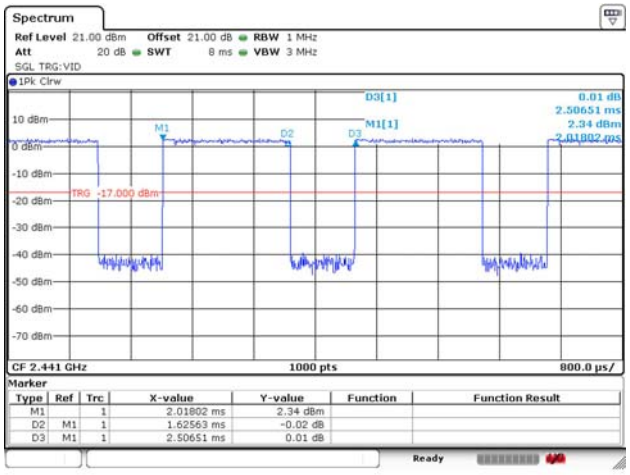
## Test Plot (Time slot) 8-DPSK

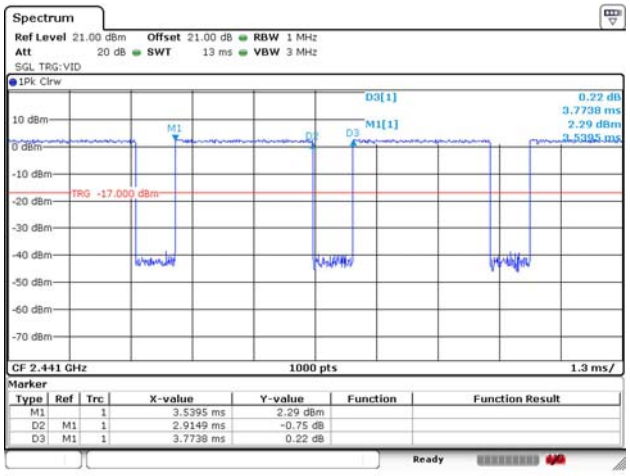
### 3DH1




### 3DH3




### 3DH5



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## 5.4 Max. Conducted peak output power

### 5.4.1 Standard Applicable [FCC §15.247(b)(1)]

For frequency hopping systems operating in the 2 400 - 2 483.5 ㎒ band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 850 ㎒ band : 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

### 5.4.2 Test Environment conditions

- Ambient temperature : (22 - 23) ℃,
- Relative Humidity : (58 - 67) % R.H.

### 5.4.3 Measurement Procedure

he transmitter output was connected to the spectrum analyzer with an attenuator. The maximum peak output power was measured and recorded with the spectrum analyzer. EUT was programmed to be in continuously transmitting mode. All conducted power tests were performed using a test receiver in accordance with ANSI C63.10, 2009; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

*The spectrum analyzer is set to the as follows ;

- Span : approximately 5 times the 20 ㏈ bandwidth
- RBW : > 20 ㏈ bandwidth of the emission being measured
- VBW : ≥ RBW
- Sweep : auto
- Detector function : peak
- Trace : max hold

* Above measurement frequency is selected to the lowest, Middle and Highest channel

### 5.4.4 Measurement Result

| Mode | Freq(㎒) | Test Results | | |
|---|---|---|---|---|
| | | Measured power [㏈m] | Limit [㏈m] | Result |
| GFSK hopping off Tx Mode | 2402 | 3.03 | ≤ 30 | Compliance |
| | 2441 | 3.15 | ≤ 30 | Compliance |
| | 2480 | 2.99 | ≤ 30 | Compliance |
| π/4 DQPSK hopping off Tx Mode | 2402 | 2.62 | ≤ 30 | Compliance |
| | 2441 | 2.79 | ≤ 30 | Compliance |
| | 2480 | 2.66 | ≤ 30 | Compliance |
| 8-DPSK hopping off Tx Mode | 2402 | 2.97 | ≤ 30 | Compliance |
| | 2441 | 3.11 | ≤ 30 | Compliance |
| | 2480 | 2.95 | ≤ 30 | Compliance |

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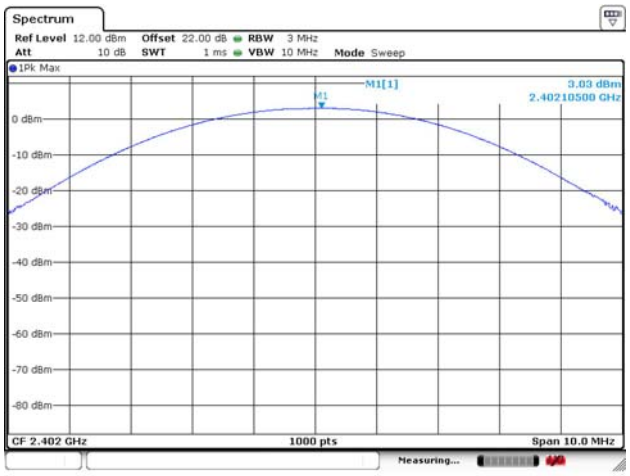
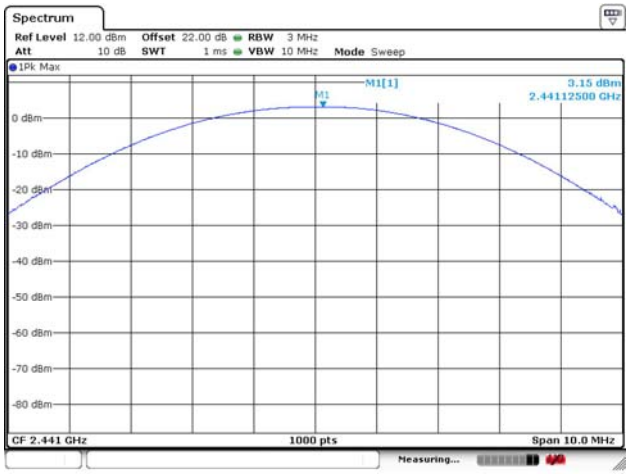
## 5.4.6 Test Plot (GFSK)

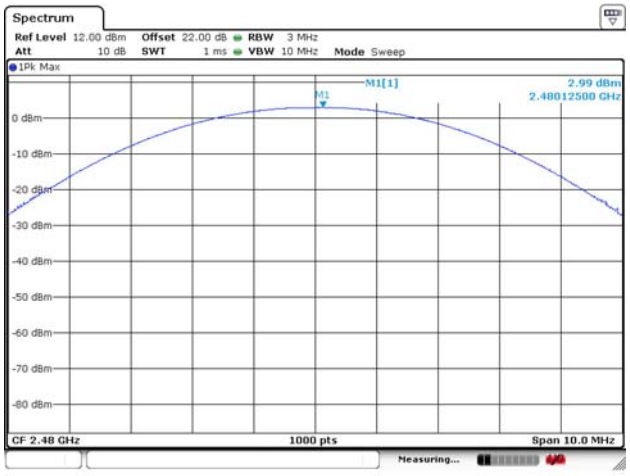
### CH Low ( 2 402 ㎒)




### CH Middle (2 441 ㎒)




### CH High (2 480 ㎒)



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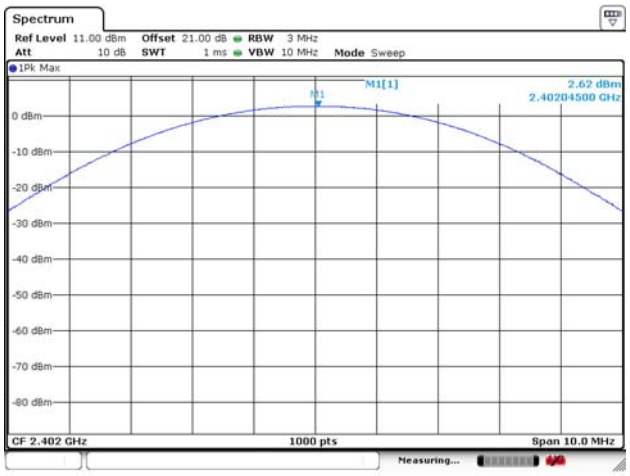
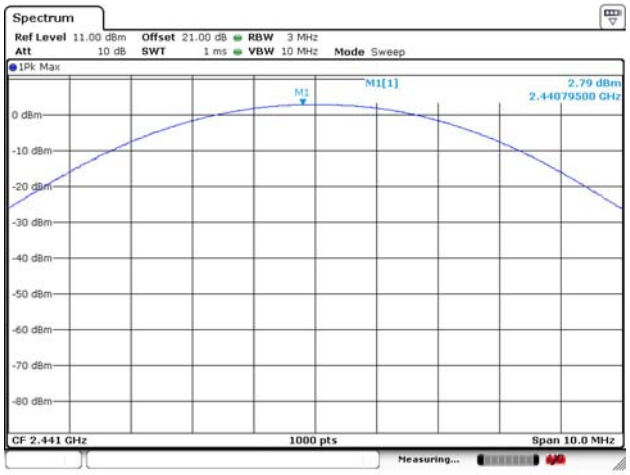
## Test Plot (π/4 QPSK )

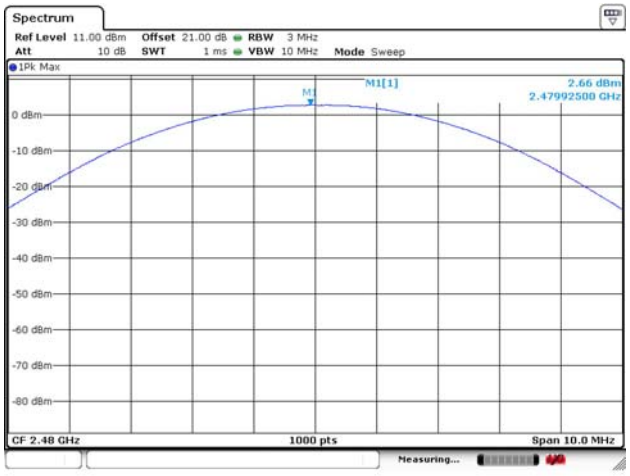
### CH Low ( 2 402 ㎒)




### CH Middle (2 441 ㎒)




### CH High (2 480 ㎒)



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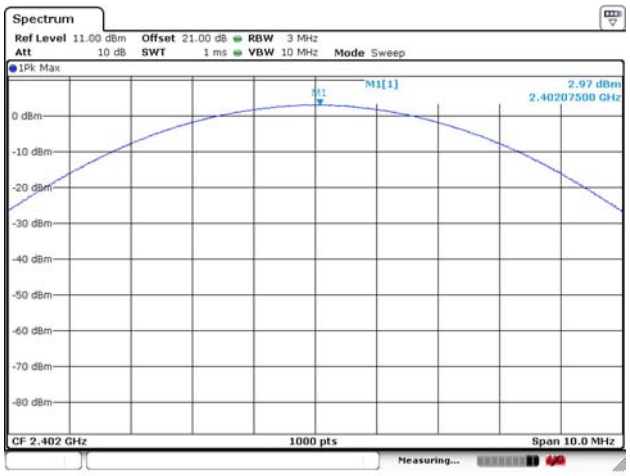
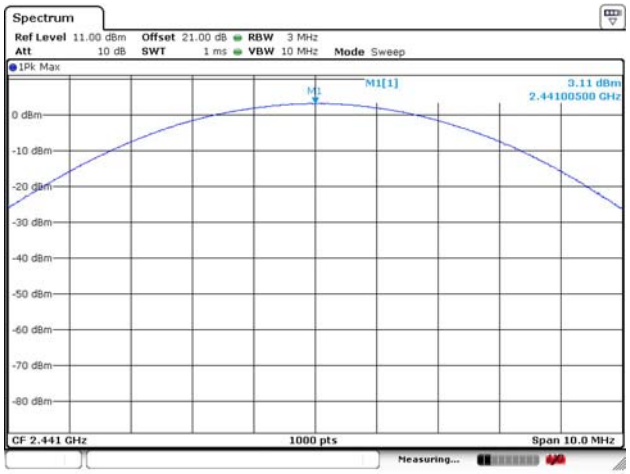
## Test Plot (8-DPSK )

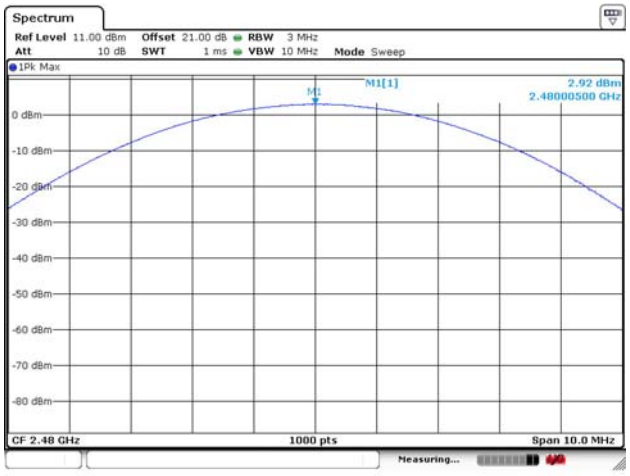
### CH Low ( 2 402 ㎒)




### CH Middle (2 441 ㎒)




### CH High (2 480 ㎒)



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## 5.5 Band-edge Compliance of RF Conducted emissions

### 5.5.1 Standard Applicable [FCC §15.247(d)]

In any 100 ㎑ 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 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on RF conducted.

### 5.5.2 Test Environment conditions

- Ambient temperature : (22 - 23) ℃,
- Relative Humidity : (58 - 67) % R.H.

### 5.5.3 Measurement Procedure

① Pre-calibration for the spectrum analyzer has to be done first through a reference CW signal from CAL OUT(-10 ㏈m)
② Reference frequency generated from the signal generator is supply to spectrum analyzer input port via RF cable and attenuator, and then, it's apply to offset value on spectrum analyzer as follows ; on spectrum analyzer [Amplitude→1 More of 3→REF LVL OFFSET(measured loss ㏈)]
③ Remove the antenna from the EUT and then, connected to spectrum analyzer via a dc Block, suitable low loss RF cable and attenuator.
④ set on the emission at the band-edge
⑤ After the trace being stable, Use the marker-to-peak function to move the marker to the peak of the in-band emission.
⑥ The marker-delta value now displayed must comply with the limit specified in above standard.
⑦ please refer to the detailed procedure method FCC Public Notice(DA 00-705)

The spectrum analyzer is set to the as follows :

- Span : 5 ㎒ - 10 ㎒
- RBW : 100 ㎑ (≥ 1 % of the span)
- VBW : 300 ㎑
- Sweep : auto
- Detector function : peak
- Trace : Max hold

### 5.5.5 Measurement Result

| Setting Channel | | Mode | Test Results | | |
|---|---|---|---|---|---|
| | | | Measured value [㏈] | Limit [㏈] | Result |
| CH Low (2 402 ㎒) | ~ 2 400 ㎒ | GFSK DH5 | 44.31 | ≤ 20 | Compliance |
| CH High (2 480 ㎒) | 2 483.5 ㎒ ~ | | 58.01 | | Compliance |
| CH Low (2 402 ㎒) | ~ 2 400 ㎒ | 8-DPSK 3-DH5 | 48.99 | | Compliance |
| CH High (2 480 ㎒) | 2 483.5 ㎒ ~ | | 58.94 | | Compliance |
| All restriction band have been tested, and only the worst case is shown in report.<br>Hopping on and hopping off mode all have been test, hopping off mode is worst case and reported only. | | | | | |

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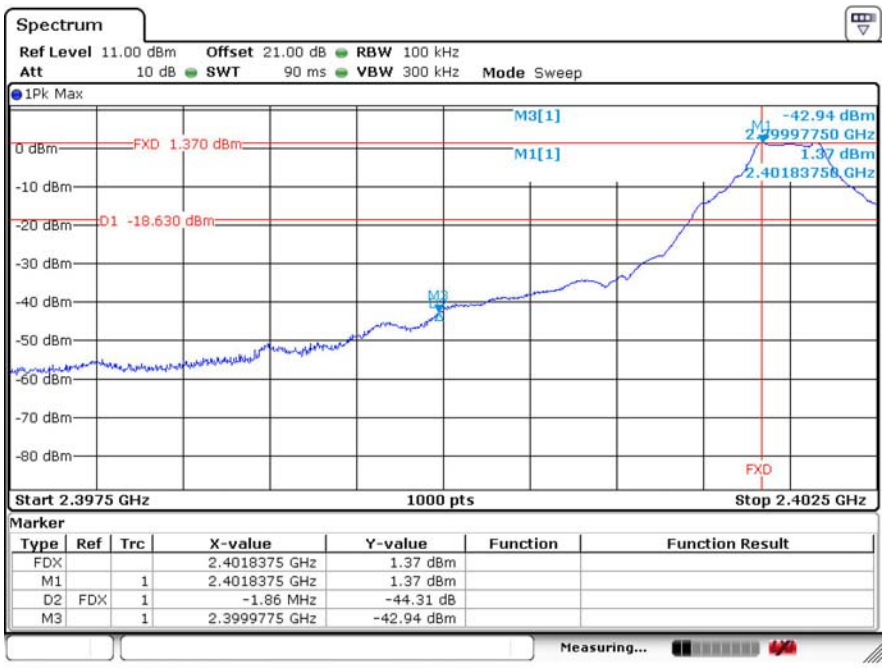
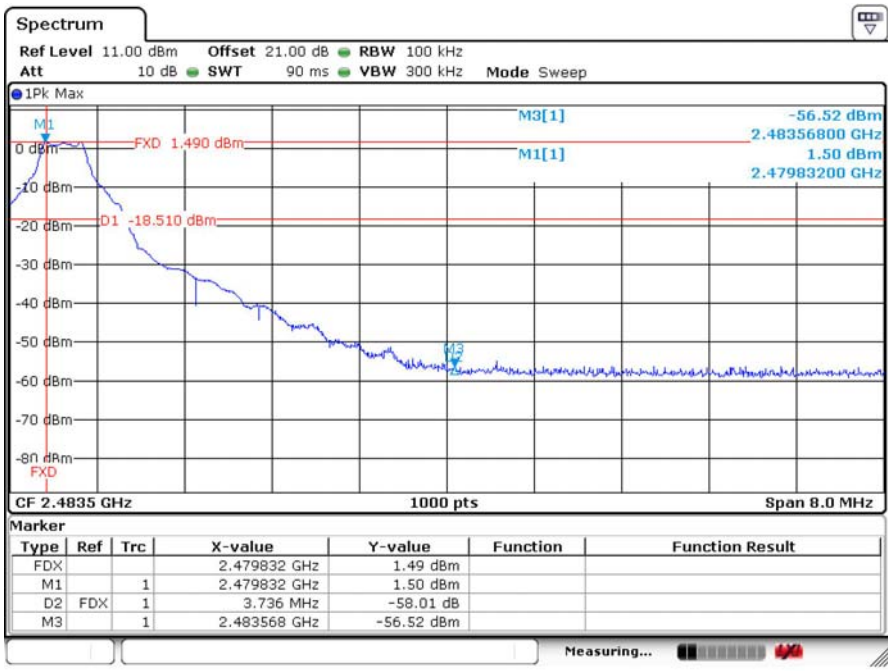
## 5.5.6 Test Plot (GFSK)

CH Low ( 2 402 ㎒)




CH High (2 480 ㎒)



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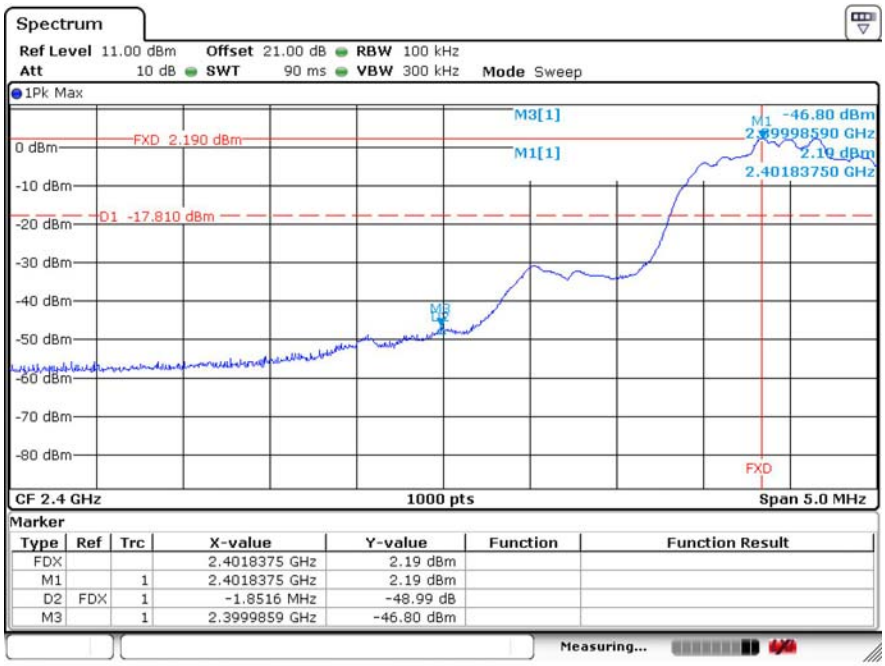
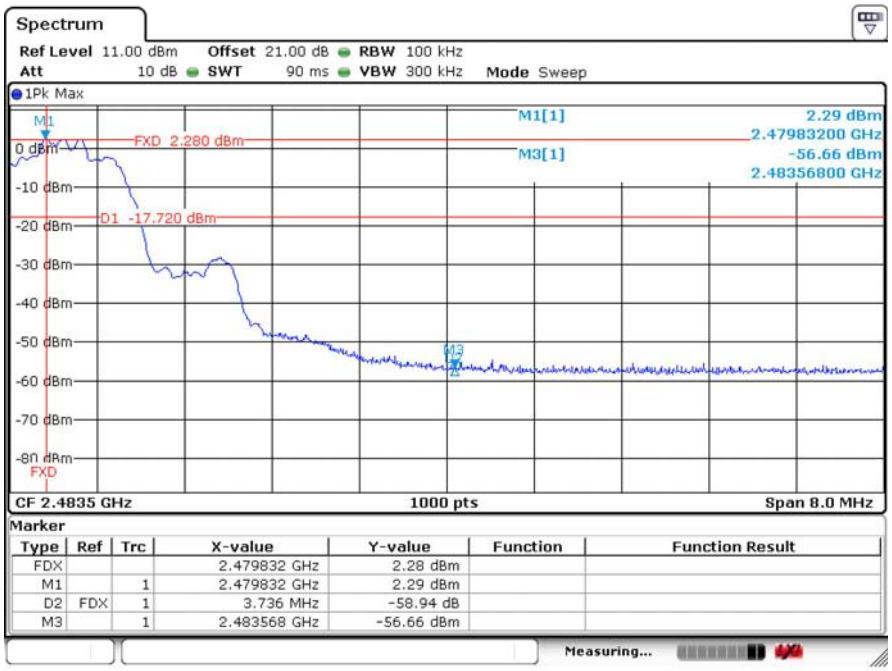
## Test Plot (8-DPSK)

### CH Low ( 2 402 ㎒)




### CH High (2 480 ㎒)



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## 5.6 Spurious RF Conducted emissions

### 5.6.1 Standard Applicable [FCC §15.247(d)]

In any 100 ㎑ 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 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power.

### 5.6.2 Test Environment conditions

- Ambient temperature : (22 - 23) ℃
- Relative Humidity : (58 - 67) % R.H.

### 5.6.3 Measurement Procedure

① Pre-calibration for the spectrum analyzer has to be done first through a reference CW signal from CAL OUT(-10 ㏈m)

② Reference frequency generated from the signal generator is supply to spectrum analyzer input port via RF cable and attenuator, and then, it's apply to offset value on spectrum analyzer as follows ; on spectrum analyzer [Amplitude→1 More of 3→REF LVL OFFSET(measured loss ㏈)]

③ Remove the antenna from the EUT and then, connected to spectrum analyzer via a dc Block, suitable low loss RF cable and attenuator.

④ set on the emission at the band-edge

⑤ After the trace being stable, Use the marker-to-peak function to move the marker to the peak of the in-band emission.

⑥ The marker-delta value now displayed must comply with the limit specified in above standard.

⑦ please refer to the detailed procedure method FCC Public Notice(DA 00-705)

The spectrum analyzer is set to the as follows :

- Span : wide enough to capture the peak level of the in-band emission and all spurious emissions from the Lowest frequency generated in the EUT up through the 10$^{th}$ harmonic. Typically, several plots are required to cover this entire span.
- RBW : 100 ㎑ (≥ 1 % of the span)
- VBW : 300 ㎑
- Sweep : auto
- Detector function : peak
- Trace : Max hold

### 5.6.4 Measurement Result

No non-compliance noted.
Please refer as following plots

*Note: All restriction band have been tested, and only the worst case is shown in report.
Hopping on and hopping off mode all have been test, hopping off mode is worst case and reported only.

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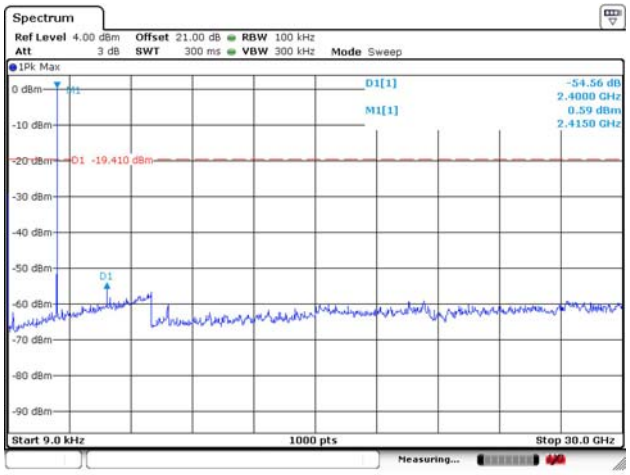
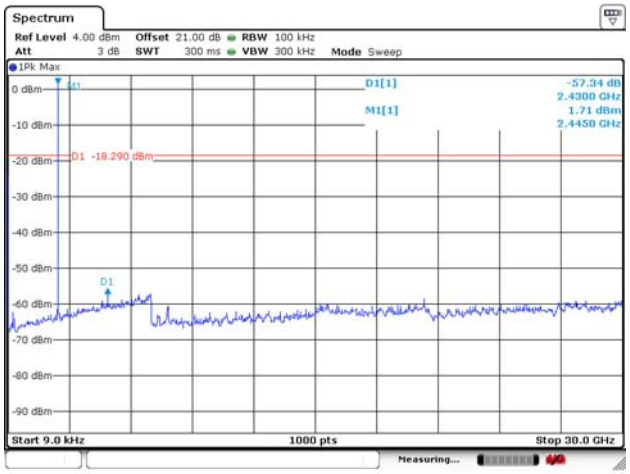
## 5.6.5 Test Plot (GFSK DH5)

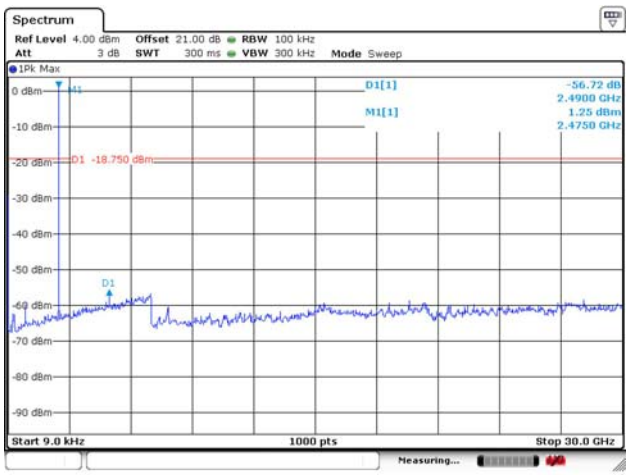
### CH Low ( 2 402 ㎒)




### CH Middle (2 441 ㎒)




### CH High (2 480 ㎒)



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406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
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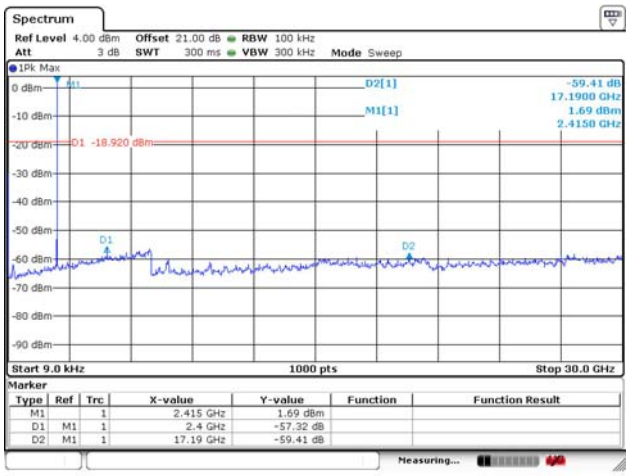
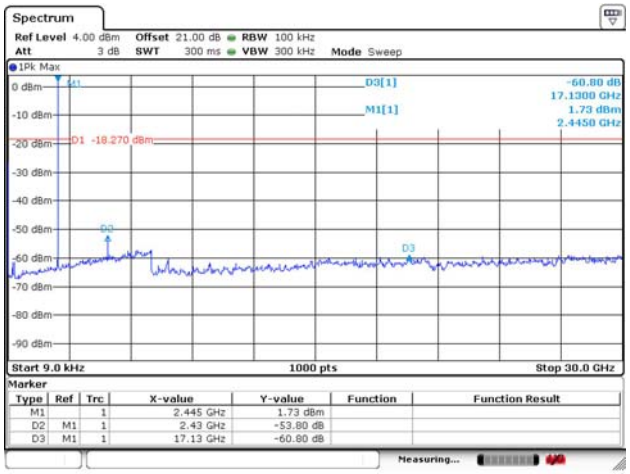
## Test Plot (8-DPSK 3-DH5)

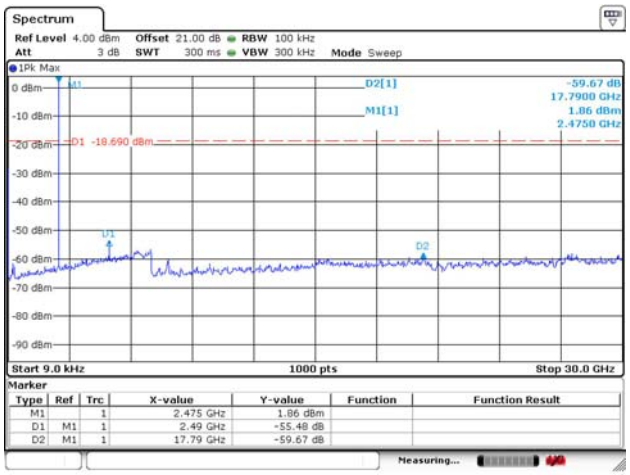
### CH Low ( 2 402 ㎒)




### CH Middle (2 441 ㎒)




### CH High (2 480 ㎒)



Head office & Test Lab: 28(175-20,Annyeong-dong)
406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

## 5.7 Spurious RF Radiated emissions

### 5.7.1 Standard Applicable [ FCC §15.247(d) ]

All other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10 ㎓, the frequency Range of measurements : to the tenth harmonic of the highest fundamental frequency or to 40 ㎓, Whichever is lower. In addition, radiated emissions which fall in the restricted bands, as defined in Sec.15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a)

§15.209. [Table 1] limits for radiated emissions measurements (distance at 3m)

| Frequency Band [㎒] | DISTANCE[Meters] | Limit [㎶/m] | Limit [dB㎶/m] | Detector |
|---|---|---|---|---|
| 0.009 ~ 0.490 | 300 | 2400/F(㎑) | 67.6-20log(F) | Peak |
| 0.490 ~ 1.705 | 30 | 24000/F(㎑) | 87.6-20log(F) | Peak |
| 1.705 ~ 30.0 | 30 | 30 | 29.54 | Peak |
| 30 - 88 | 3 | 100 ** | 40.00 | Quasi peak |
| 88 - 216 | 3 | 150 ** | 43.52 | Quasi peak |
| 216 - 960 | 3 | 200 ** | 46.02 | Quasi peak |
| Above 960 | 3 | 500 | 54.00 | Average |
| Above 1000 | 3 | 74.0 dB(μV)/m (Peak), 54.0 dB(μV)/m (Average) | | |

** fundamental emissions from intentional radiators operation under this Section shall not be located in the frequency bands 54-72 ㎒, 76-88 ㎒, 174-216 ㎒, or 470-806 ㎒. However, operation within these Frequency bands is permitted under other sections of this Part Section 15.231 and 15.241

§15.205. [Table 2] Restrict Band of Operation

| Only spurious emissions are permitted in any of the frequency bands listed below ; | | | |
|---|---|---|---|
| [㎒] | [㎒] | [㎒] | [㎓] |
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| 0.495 - 0.505** | 16.694 75 - 16.695 25 | 608 - 614 | 5.35 - 5.46 |
| 2.173 5 - 2.190 5 | 16.804 25 - 16.804 75 | 960 – 1 240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1 300 – 1 427 | 8.025 - 8. |
| 4.177 25 - 4.177 75 | 37.5 -38.25 | 1 435 – 1 626.5 | 9.0 - 9.2 |
| 4.207 25 - 4.207 75 | 73 - 74.6 | 1 645.5 – 1 646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1 660 – 1 710 | 10.6 - 12.7 |
| 6.267 75 - 6.268 25 | 108 - 121.94 | 1 718.8 -1 722.2 | 13.25 - 13. |
| 6.311 75 - 6.312 25 | 123 - 138 | 2 200 – 2 300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2 310 – 2 390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.524 75 - 156.525 25 | 2 483.5 – 2 500 | 17.7 - 21.4 |
| 8.376 25 - 8.38 6 75 | 156.7 - 156.9 | 2 690 – 2 900 | 22.01 - 23.12 |
| 8.414 25 - 8.414 75 | 162.012 5 - 167.17 | 3 260 – 3 267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3 332 – 3 339 | 31.2 - 31.8 |
| 12.519 75 - 12.520 25 | 240 - 285 | 3 345.8 – 3 358 | 36.43 - 36.5 |
| 12.576 75 - 12.577 25 | 322 - 335.4 | 3 600 – 4 400 | Above 38.6 |

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

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406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

### 5.7.2 Test Environment conditions

- Ambient temperature : (22 - 23) ℃
- Relative Humidity : (58 - 67) % R.H.

### 5.7.3 Measurement Procedure

The measurements procedure of the transmitter radiated E-field is as following describe method.

The test is performed in a Shield chamber to determine the accurate frequencies, after maximum emissions level will be checked on a test chamber and measuring distance is 3 m from EUT to test antenna.
(The chamber is ensured that comply with at least 6 dB above the ambient noise level)

① The EUT was powered ON with continuously operating mode and placed on a 0.8 meter high non-conductive table on the reference ground plane.

② The test antenna was used on Horn antenna for above 1 GHz, and if the below 1 GHz, broad-band antenna and Loop antenna were used for below 30 MHz and it's antenna positioned in both the horizontal and vertical plane was location at EUT during the test for maximized the emission measurement.

③ The output of the test antenna will be connected to a measuring receiver, and it is set to tuned over the frequency range according to required standard

④ The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure; RBW is set at 1MHz, VBW is set at 10Hz for Average measure(according ANSI C63.10:2009 clause 4.2.3.2.3 procedure for average measure). Both PK and AV level test, PK detector is used.

⑤ The fundamental frequency at which a relevant radiated signal component is detected, the test antenna will be raised and lowered through the specified range of heights in horizontal and vertical polarized orientation, until an maximum signal level is detected on the measuring receiver.

⑥ The transmitter is position x, y, z axis on rotating through 360 degrees, until the maximum signal level is detected by the measuring receiver.

⑦ The receiver is scanned from requested measuring frequency band and then the maximum meter reading is recorded. The radiated emissions were measured with required standard.

- The measurement results are obtained as described below:
  Result(dBμV/m) = Reading(dBμV) + Antenna factor(dB/m)+ CL(dB) + other applicable factor (dB)
- According to §15.33 (a)(1), Frequency range of radiated measurement is performed the tenth harmonic.

### 5.7.4 Measurement Uncertainty

All measurements involve certain levels of uncertainties. The factors contributing to uncertainties are test receiver, Cable loss, Antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, Antenna frequency interpolation, measurement distance variation, Site imperfection, mismatch, and system repeatability based on NIS 80,81, The measurement uncertainty level with a 95 % confidence level were apply to Uncertainty of a radiation emissions measurement at Chamber of KOSTEC is ± 6.0 dB

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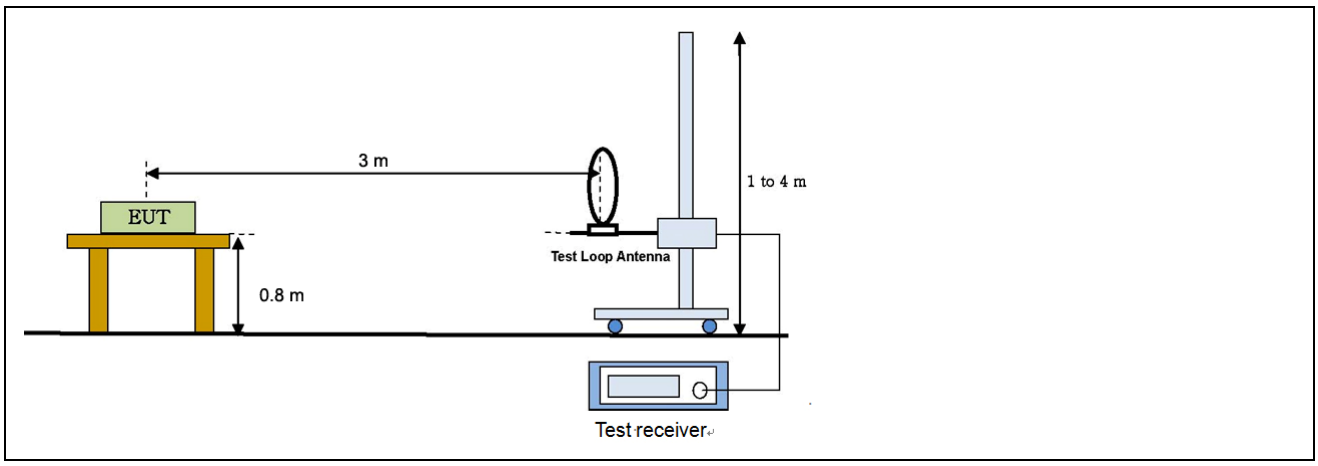
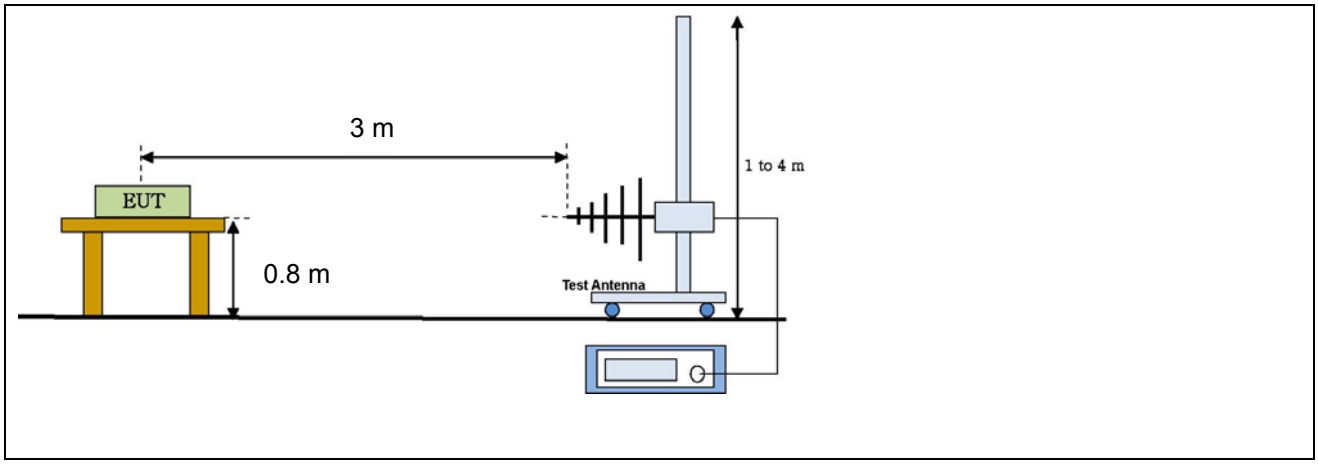
406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

## 5.7.5 Test Configuration

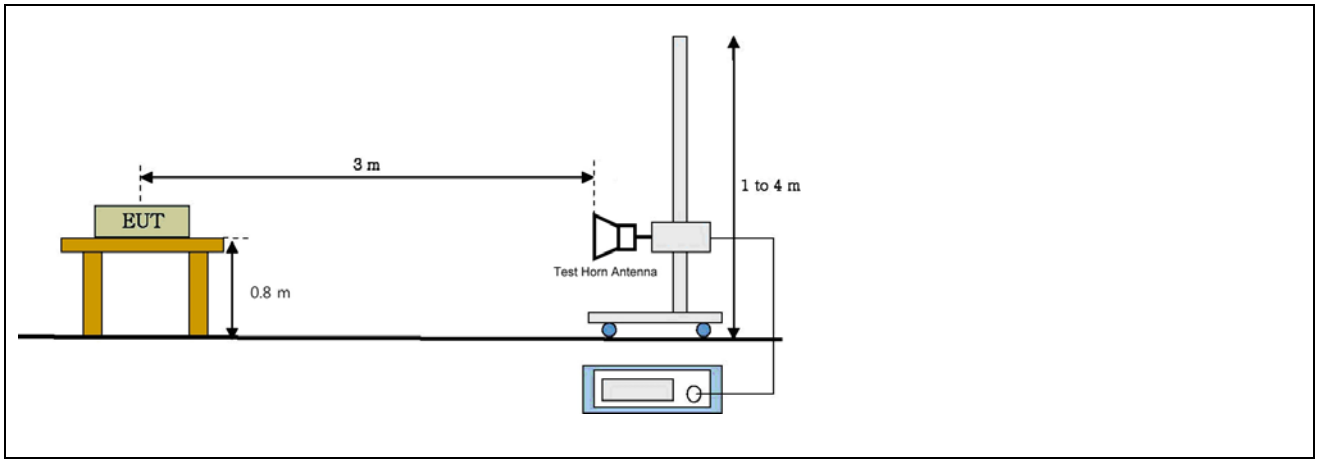
Radiated emission setup, Below 30 MHz




Radiated emission setup, Below 1 000 MHz




Radiated emission setup, Above 1 GHz



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406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

## 5.7.6 Measurement Result

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

Following channel(s) was (were) selected for the final test as listed below.

| Freq band | Mode | Measured CH |
|---|---|---|
| Below 1 ㎓ | GFSK(1Mbps) DH5 | 2441 |
| Above 1 ㎓ | GFSK(1Mbps) DH5 | 2402, 2441, 2480 |
| | 8-DPSK(1Mbps) 3-DH5 | 2402, 2441, 2480 |

▣ Below 1 ㎓

CH MID ( 2 441 ㎒)

| Freq. (㎒) | Reading (dB㎶/m) | Table (Deg) | Antenna | | | CL (dB) | Pre AMP (dB) | Meas Result (dB㎶/m) | Limit (dB㎶/m ) | Mgn (dB) | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | | | | | |
| 38.52 | 26.03 | 110 | 1.0 | V | 15.33 | 1.20 | - | 42.56 | 46 | 3.44 | Compliance |
| 50.70 | 26.92 | 120 | 1.0 | V | 8.53 | 1.41 | - | 36.86 | 46 | 9.14 | Compliance |
| 160.02 | 26.66 | 120 | 4.0 | H | 8.46 | 2.63 | | 37.75 | 46 | 8.25 | Compliance |
| 310.02 | 16.65 | 120 | 1.0 | V | 12.01 | 3.80 | | 32.46 | 46 | 13.54 | Compliance |
| Below 30㎒, Above 310.02 ㎒ Nil emission | | | | | | | | | | | |

▣Above 1 ㎓

GFSK :CH LOW (2 402 ㎒)

| Freq. (㎓) | Reading (dB㎶/m) | | Table (Deg) | Antenna | | | CL+Pre AMP (dB) | Meas Result (dB㎶/m) | | Limit (dB㎶/m ) | | Mgn. (dB) | | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PK | AV | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | PK | AV | PK | AV | PK | AV | |
| 2.138 | 35.03 | 17.80 | 120 | 1.0 | H | 27.85 | 2.38 | 65.26 | 48.03 | 74 | 54 | 8.74 | 5.97 | Compliance |
| Above 2.138 ㎓ Nil emission | | | | | | | | | | | | | | |

GFSK :CH Middle (2 441 ㎒)

| Freq. (㎓) | Reading (dB㎶/m) | | Table (Deg) | Antenna | | | CL+Pre AMP (dB) | Meas Result (dB㎶/m) | | Limit (dB㎶/m ) | | Mgn. (dB) | | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PK | AV | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | PK | AV | PK | AV | PK | AV | |
| 2.138 | 35.85 | 18.02 | 120 | 1.0 | H | 27.85 | 2.38 | 66.08 | 48.25 | 74 | 54 | 7.92 | 5.75 | Compliance |
| Above 2.138 ㎓ Nil emission | | | | | | | | | | | | | | |

GFSK :CH High (2 480 ㎒)

| Freq. (㎓) | Reading (dB㎶/m) | | Table (Deg) | Antenna | | | CL+PreAMP (dB) | Meas Result (dB㎶/m) | | Limit (dB㎶/m ) | | Mgn. (dB) | | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PK | AV | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | PK | AV | PK | AV | PK | AV | |
| 2.138 | 34.48 | 17.26 | 120 | 1 | H | 27.85 | 2.38 | 64.71 | 47.49 | 74 | 54 | 9.29 | 6.51 | Compliance |
| Above 2.138 ㎓ Nil emission | | | | | | | | | | | | | | |

Head office & Test Lab: 28(175-20,Annyeong-dong)
406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

8-DPSK :CH LOW (2 402 ㎒)

| Freq. (㎓) | Reading (dB㎶/m) | | Table (Deg) | Antenna | | | CL+Pre AMP (dB) | Meas Result (dB㎶/m) | | Limit (dB㎶/m ) | | Mgn. (dB) | | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PK | AV | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | PK | AV | PK | AV | PK | AV | |
| 2.138 | 35.63 | 18.21 | 120 | 1 | H | 27.85 | 2.38 | 65.86 | 48.44 | 74 | 54 | 8.14 | 5.56 | Compliance |
| Above 2.138 ㎓ Nil emission | | | | | | | | | | | | | | |

8-DPSK :CH Middle (2 441 ㎒)

| Freq. (㎓) | Reading (dB㎶/m) | | Table (Deg) | Antenna | | | CL+Pre AMP (dB) | Meas Result (dB㎶/m) | | Limit (dB㎶/m ) | | Mgn. (dB) | | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PK | AV | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | PK | AV | PK | AV | PK | AV | |
| 2.138 | 35.14 | 17.96 | 120 | 1 | H | 27.85 | 2.38 | 65.37 | 48.19 | 74 | 54 | 8.63 | 5.81 | Compliance |
| Above 2.138 ㎓ Nil emission | | | | | | | | | | | | | | |

8-DPSK :CH High (2 480 ㎒)

| Freq. (㎓) | Reading (dB㎶/m) | | Table (Deg) | Antenna | | | CL+PreAMP (dB) | Meas Result (dB㎶/m) | | Limit (dB㎶/m ) | | Mgn. (dB) | | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PK | AV | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | PK | AV | PK | AV | PK | AV | |
| 2.138 | 34.12 | 17.05 | 120 | 1 | H | 27.85 | 2.38 | 64.35 | 47.28 | 74 | 54 | 9.65 | 6.72 | Compliance |
| Above 2.138 ㎓ Nil emission | | | | | | | | | | | | | | |

※Note

• Above 1 ㎓ is measured average and peak detector mode on Spectrum analyzer in accordance with FCC Rule15.35
• Limit: 54 dB㎶/m(Average), 74 dB㎶/m(Peak), Attenuated more than 20 dB below the permissible value.
• For the below 30 ㎒, measured any other signal is not detected on test receiver
• It is not recorded on the report that the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to measured.
• For emissions below 1 ㎓, according exploratory explorer test, when change Tx mode and channel, have no distinct influence on emissions level, so for emissions below 1 ㎓, the final test was only performed with EUT working in GFSK, Tx 2441 ㎒ mode.
• The transmitter radiated spectrum was investigated from 9 ㎑ to 25 ㎓

Freq.(㎒) : Measurement frequency, Reading(dB㎶/m) : Indicated value for test receiver,
Table (Deg) : Directional degree of Turn table,
Antenna (Height, Pol, Fctr) : Antenna Height, Polarization and Factor
Cbl(dB) : Cable loss, Pre AMP(dB) : Preamplifier gain(dB)
Meas Result (dB㎶/m ) :Reading(dB㎶/m)+ Antenna factor.(dB/m )+ CL(dB) - Pre AMP(dB)
Limit(dB㎶/m): Limit value specified with FCC Rule, Mgn(dB) : FCC Limit (dB㎶/m) – Meas Result(dB㎶/m)

Head office & Test Lab: 28(175-20,Annyeong-dong)
406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

## 5.8 Antenna requirement

### 5.8.1 Standard applicable [FCC §15.203, §15.247(4)(1)]

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that user a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The manufacturer may design the unit So that broken antenna can be replaced by the user, but the Use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(4)(1), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

According to above requirement standard's This product's antenna type is an PCB type and it's gain is -1.0 dBi, So radiated emission field strength from EUT is below requirement standard limit

### 5.8.2 Antenna gain

| Frequency Band | Gain [dBi] | Limit [dBi] | Results |
|---|---|---|---|
| ( 2 400 ~ 2 485) MHz | 1.56 | ≤ 6 | Compliance |

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406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

## 5.9 AC Power Conducted emissions

### 5.9.1 Standard Applicable [FCC §15.207(a)]

For 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 frequencies hopping mode within the band 150 ㎑ to 30 ㎒ shall not exceed the limits in the following table, as measured using a 50 uH/50 ohms line Impedance stabilization network(LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

§15.207 limits for AC line conducted emissions;

| Frequency of Emission(㎒) | Conducted Limit (㏈㎶) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 ~ 0.5 | 66 to 56 * | 56 to 46 * |
| 0.5 ~ 5 | 56 | 46 |
| 5 ~ 30 | 60 | 50 |

* Decreases with the logarithm of the frequency

### 5.9.2 Test Environment conditions

- Ambient temperature : (22 - 23) ℃
- Relative Humidity : (58 - 67) % R.H.

### 5.9.3 Measurement Procedure

The measurements were performed in a shielded room. EUT was placed on a non-metallic table Height of 0.4 m above the reference ground plane. They were folded back and forth forming a bundle 30 ㎝ to 40 ㎝ long and were hanged at a 40 ㎝ height to the ground plane.Each EUT power lead, except ground (safety) lead, was individually connected through a LISN to Input power source.Both lines of power cord, live and neutral, were measured.

### 5.9.4 Used equipment

| Equipment | Model No. | Serial No. | Manufacturer | Next cal date | Cal interval | Used |
|---|---|---|---|---|---|---|
| Test receiver | ESCS30 | 100111 | Rohde & Schwarz | 2015.02.05 | 1 year | ● |
| LISN | ESH3-Z5 | 100147 | R&S | 2015.02.05 | 1 year | ● |

*Test Program: " ESXS-K1 V2.2"

Measurement uncertainty

Conducted Emission measurement: 3.5 ㏈ (CL: Approx 95%, *k*=2)

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
Following channel(s) was (were) selected for the final test as listed below.

| Freq band | Mode | Measured CH |
|---|---|---|
| Below 1 ㎓ | GFSK(1Mbps) DH5 | 2441 |

## 5.9.5 Measurement Result

Line. Live

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Conducted Emission

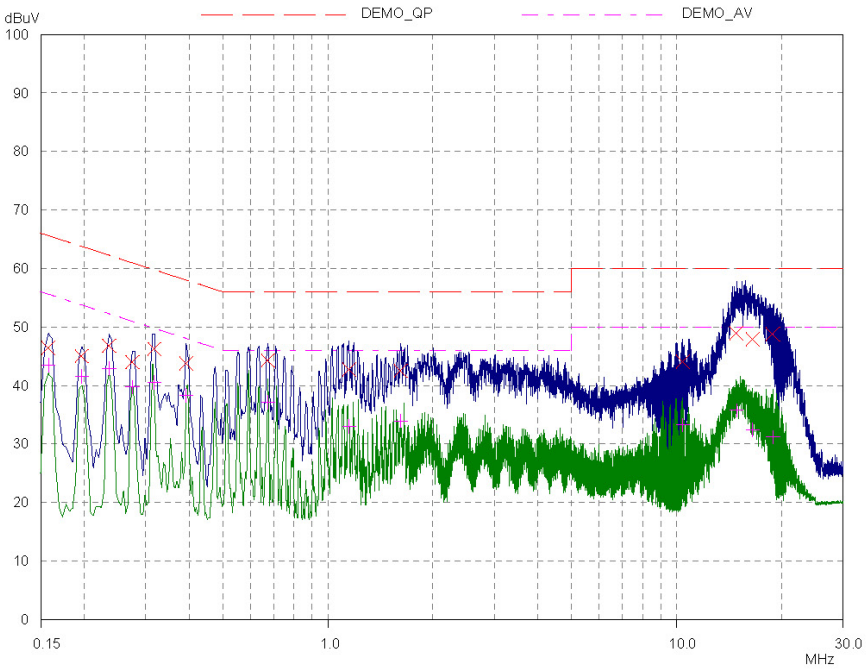
| | |
|---|---|
| EUT: | BM180 |
| Manuf: | Bluebird Inc. |
| Op Cond: | a.c. 120 V, 60 Hz |
| Operator: | |
| Test Spec: | |
| Comment: | Live |
| | RF EMC_BT |
| Result File: | 0920_l.dat : New Measurement |

Scan Settings (1 Range)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 30MHz | 3.9063kHz | 9kHz | PK+AV | 10msec | 15 dB | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 12 | 9kHz | 30MHz | CNEFactor |

| Final Measurement: | | |
|---|---|---|
| | Detectors: | X QP / + AV |
| | Meas Time: | 1sec |
| | Subranges: | 25 |
| | Acc Margin: | 50 dB |




PAGE 1

# Line. Live

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## Conducted Emission

EUT: BM180
Manuf: Bluebird Inc.
Op Cond: a.c. 120 V, 60 Hz
Operator:
Test Spec:
Comment: Live
RF EMC_BT
Result File: 0920_l.dat : New Measurement

Scan Settings (1 Range)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 30MHz | 3.9063kHz | 9kHz | PK+AV | 10msec | 15 dB | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 12 | 9kHz | 30MHz | CNEFactor |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Subranges: 25
Acc Margin: 50 dB

Final Measurement Results

| Frequency MHz | QP Level dBuV | QP Limit dBuV | QP Delta dB |
|---|---|---|---|
| 0.15781 | 46.37 | 65.58 | 19.21 |
| 0.19687 | 45.02 | 63.74 | 18.72 |
| 0.23593 | 46.74 | 62.24 | 15.50 |
| 0.275 | 43.99 | 60.97 | 16.98 |
| 0.31796 | 46.20 | 59.76 | 13.56 |
| 0.39218 | 43.80 | 58.02 | 14.22 |
| 0.67343 | 44.26 | 56.00 | 11.74 |
| 1.15 | 42.71 | 56.00 | 13.29 |
| 1.61875 | 42.52 | 56.00 | 13.48 |
| 10.41953 | 44.10 | 60.00 | 15.90 |
| 14.86093 | 48.86 | 60.00 | 11.14 |
| 16.5289 | 47.83 | 60.00 | 12.17 |
| 18.87265 | 48.80 | 60.00 | 11.20 |

| Frequency MHz | AV Level dBuV | AV Limit dBuV | AV Delta dB |
|---|---|---|---|
| 0.15781 | 43.47 | 55.58 | 12.11 |
| 0.19687 | 41.55 | 53.74 | 12.19 |
| 0.23593 | 42.86 | 52.24 | 9.38 |
| 0.275 | 39.72 | 50.97 | 11.25 |
| 0.31796 | 40.52 | 49.76 | 9.24 |
| 0.39218 | 38.30 | 48.02 | 9.72 |
| 0.67343 | 37.14 | 46.00 | 8.86 |
| 1.15 | 32.99 | 46.00 | 13.01 |
| 1.61875 | 33.93 | 46.00 | 12.07 |
| 10.41953 | 33.21 | 50.00 | 16.79 |
| 14.86093 | 35.74 | 50.00 | 14.26 |
| 16.5289 | 32.35 | 50.00 | 17.65 |
| 18.87265 | 31.16 | 50.00 | 18.84 |

* limit exceeded

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# Line. Neutral

Kostec Co., Ltd. 01 Aug 2014 18:28

## Conducted Emission

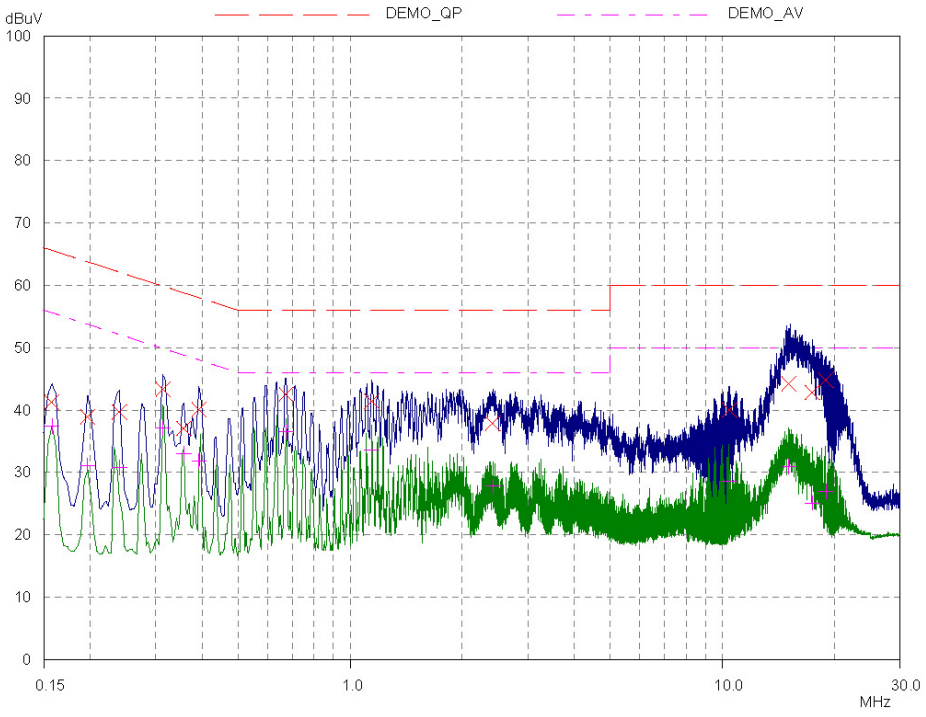
| | |
|---|---|
| EUT: | BM180 |
| Manuf: | Bluebird Inc. |
| Op Cond: | a.c. 120 V, 60 Hz |
| Operator: | |
| Test Spec: | |
| Comment: | Neutral |
| | RF EMC_BT |
| Result File: | 0920_n.dat : New Measurement |

Scan Settings (1 Range)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 30MHz | 3.9063kHz | 9kHz | PK+AV | 10msec | 15 dB | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 12 | 9kHz | 30MHz | CNEFactor |

| Final Measurement: | | |
|---|---|---|
| | Detectors: | X QP / + AV |
| | Meas Time: | 1sec |
| | Subranges: | 25 |
| | Acc Margin: | 50 dB |




PAGE 1

# Line. Neutral

Kostec Co., Ltd. 01 Aug 2014 18:28

## Conducted Emission

EUT: BM180
Manuf: Bluebird Inc.
Op Cond: a.c. 120 V, 60 Hz
Operator:
Test Spec:
Comment: Neutral
RF EMC_BT
Result File: 0920_n.dat : New Measurement

Scan Settings (1 Range)

| Frequencies | | | Receiver Settings | | | | | |
|---|---|---|---|---|---|---|---|---|
| Start | Stop | Step | IF BW | Detector | M-Time | Atten | Preamp | OpRge |
| 150kHz | 30MHz | 3.9063kHz | 9kHz | PK+AV | 10msec | 15 dB | OFF | 60dB |

| Transducer | No. | Start | Stop | Name |
|---|---|---|---|---|
| | 12 | 9kHz | 30MHz | CNEFactor |

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Subranges: 25
Acc Margin: 50 dB

Final Measurement Results

| Frequency MHz | QP Level dBuV | QP Limit dBuV | QP Delta dB |
|---|---|---|---|
| 0.15781 | 41.25 | 65.58 | 24.33 |
| 0.19687 | 38.88 | 63.74 | 24.86 |
| 0.23984 | 39.67 | 62.10 | 22.43 |
| 0.31406 | 43.34 | 59.86 | 16.52 |
| 0.35703 | 37.07 | 58.80 | 21.73 |
| 0.39218 | 40.05 | 58.02 | 17.97 |
| 0.67343 | 42.50 | 56.00 | 13.50 |
| 1.14218 | 41.40 | 56.00 | 14.60 |
| 2.41953 | 37.86 | 56.00 | 18.14 |
| 10.45859 | 40.02 | 60.00 | 19.98 |
| 15.09921 | 44.15 | 60.00 | 15.85 |
| 17.47812 | 42.82 | 60.00 | 17.18 |
| 18.98593 | 44.79 | 60.00 | 15.21 |

| Frequency MHz | AV Level dBuV | AV Limit dBuV | AV Delta dB |
|---|---|---|---|
| 0.15781 | 37.44 | 55.58 | 18.14 |
| 0.19687 | 31.09 | 53.74 | 22.65 |
| 0.23984 | 30.76 | 52.10 | 21.34 |
| 0.31406 | 37.08 | 49.86 | 12.78 |
| 0.35703 | 32.95 | 48.80 | 15.85 |
| 0.39218 | 31.79 | 48.02 | 16.23 |
| 0.67343 | 36.47 | 46.00 | 9.53 |
| 1.14218 | 33.53 | 46.00 | 12.47 |
| 2.41953 | 27.77 | 46.00 | 18.23 |
| 10.45859 | 28.56 | 50.00 | 21.44 |
| 15.09921 | 30.91 | 50.00 | 19.09 |
| 17.47812 | 25.09 | 50.00 | 24.91 |
| 18.98593 | 26.97 | 50.00 | 23.03 |

* limit exceeded

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