

# TEST REPORT

**Application No.:** SHEM2002001015CR  
**FCC ID:** N82-KOHLER046  
**IC:** 4554A-KOHLER046  
**Applicant:** Kohler Co.  
**Address of Applicant:** 444 Highland Drive Kohler, WI 53044 United States  
**Manufacturer:** Shanghai Kohler Electronics., Ltd.  
**Address of Manufacturer:** No. 1955, Fengxiang Road, Baoshan Area, Shanghai, PRC Post code: 200444  
**Factory:** Shanghai Kohler Electronics., Ltd.  
**Address of Factory:** No. 1955, Fengxiang Road, Baoshan Area, Shanghai, PRC Post code: 200444

**Equipment Under Test (EUT):**

**EUT Name:** NUMI 2.0 INTELLIGENT TOILET  
**Model No.:** K-30754  
**Trade mark:** KOHLER  
**Standard(s):** 47 CFR Part 15, Subpart C 15.247  
 RSS-247 Issue 2, February 2017  
 RSS-Gen Issue 5, March 2019 Amendment 1

**Date of Receipt:** 2020-02-21  
**Date of Test:** 2020-11-27 to 2020-12-22  
**Date of Issue:** 2020-12-24

|                     |              |
|---------------------|--------------|
| <b>Test Result:</b> | <b>Pass*</b> |
|---------------------|--------------|

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

*Parlam Zhan*

Parlam Zhan  
 E&E Section Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.



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| Revision Record |             |            |        |
|-----------------|-------------|------------|--------|
| Version         | Description | Date       | Remark |
| 00              | Original    | 2020-12-24 | /      |
|                 |             |            |        |
|                 |             |            |        |

|                          |  |  |  |
|--------------------------|--|--|--|
| Authorized for issue by: |  |  |  |
|                          |  |   |  |
|                          |  | <hr/>  |  |
|                          |  | Vincent Zhu / Project Engineer   |  |
|                          |  |  |  |
|                          |  | <hr/>  |  |
|                          |  | Parlam Zhan / Reviewer   |  |

## 2 Test Summary

| Radio Spectrum Technical Requirement   |  |                        |        |                      |
|--|--|------------------------|--------|----------------------|
| Item   | FCC Requirement                                | IC Requirement         | Method | Result               |
| Antenna Requirement  | 47 CFR Part 15, Subpart C 15.203 & 15.247(c)   | RSS-Gen Clause 6.8     | N/A    | Customer Declaration |
| Other requirements<br>Frequency Hopping<br>Spread Spectrum<br>System Hopping<br>Sequence | 47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h) | RSS-247 Section 5.1(a) | N/A    | Pass                 |

N/A: Not applicable

| Radio Spectrum Matter Part                            |   |   |  |        |
|---|---|---|--|--------|
| Item  | FCC Requirement                           | IC Requirement                            | Method                                 | Result |
| Conducted Emissions at AC Power Line (150kHz-30MHz)   | 47 CFR Part 15, Subpart C 15.207          | RSS-Gen Section 8.8                       | ANSI C63.10 (2013) Section 6.2         | Pass   |
| Conducted Peak Output Power                           | 47 CFR Part 15, Subpart C 15.247(b)(1)    | RSS-247 Section 5.4(b)                    | ANSI C63.10 (2013) Section 7.8.5       | Pass   |
| 20dB Bandwidth  | 47 CFR Part 15, Subpart C 15.247(a)(1)    | RSS-247 Section 5.1(a)                    | ANSI C63.10 (2013) Section 7.8.7       | Pass   |
| Carrier Frequencies Separation                        | 47 CFR Part 15, Subpart C 15.247a(1)      | RSS-247 Section 5.1(b)                    | ANSI C63.10 (2013) Section 7.8.2       | Pass   |
| Hopping Channel Number                                | 47 CFR Part 15, Subpart C 15.247a(1)(iii) | RSS-247 Section 5.1(d)                    | ANSI C63.10 (2013) Section 7.8.3       | Pass   |
| Dwell Time  | 47 CFR Part 15, Subpart C 15.247a(1)(iii) | RSS-247 Section 5.1(d)                    | ANSI C63.10 (2013) Section 7.8.4       | Pass   |
| Conducted Band Edges Measurement                      | 47 CFR Part 15, Subpart C 15.247(d)       | RSS-247 Section 5.5                       | ANSI C63.10 (2013) Section 7.8.6       | Pass   |
| Conducted Spurious Emissions                          | 47 CFR Part 15, Subpart C 15.247(d)       | RSS-247 Section 5.5                       | ANSI C63.10 (2013) Section 7.8.8       | Pass   |
| Radiated Emissions which fall in the restricted bands | 47 CFR Part 15, Subpart C 15.205 & 15.209 | RSS-247 Section 3.3 & RSS-Gen Section 8.9 | ANSI C63.10 (2013) Section 6.10.5      | Pass   |
| Radiated Spurious Emissions                           | 47 CFR Part 15, Subpart C 15.205 & 15.209 | RSS-247 Section 3.3 & RSS-Gen Section 8.9 | ANSI C63.10 (2013) Section 6.4,6.5,6.6 | Pass   |
| 99% Bandwidth   | -   | RSS-Gen Section 6.7                       | ANSI C63.10 Section 6.9.3              | Pass   |

### 3 Contents

|  | Page      |
|--|-----------|
| <b>1 COVER PAGE .....</b>  | <b>1</b>  |
| <b>2 TEST SUMMARY .....</b>  | <b>3</b>  |
| <b>3 CONTENTS .....</b>  | <b>4</b>  |
| <b>4 GENERAL INFORMATION .....</b>   | <b>5</b>  |
| 4.1 DETAILS OF E.U.T. ....   | 5         |
| 4.2 DESCRIPTION OF SUPPORT UNITS.....  | 5         |
| 4.3 POWER LEVEL SETTING USING IN TEST: .....   | 5         |
| 4.4 MEASUREMENT UNCERTAINTY .....  | 6         |
| 4.5 TEST LOCATION .....  | 7         |
| 4.6 TEST FACILITY .....  | 7         |
| 4.7 DEVIATION FROM STANDARDS .....   | 7         |
| 4.8 ABNORMALITIES FROM STANDARD CONDITIONS .....                                       | 7         |
| <b>5 EQUIPMENT LIST .....</b>  | <b>8</b>  |
| <b>6 RADIO SPECTRUM TECHNICAL REQUIREMENT .....</b>                                    | <b>10</b> |
| 6.1 ANTENNA REQUIREMENT .....  | 10        |
| 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE ..... | 11        |
| <b>7 RADIO SPECTRUM MATTER TEST RESULTS .....</b>                                      | <b>12</b> |
| 7.1 CONDUCTED EMISSIONS AT AC POWER LINE (150kHz-30MHz) .....                          | 12        |
| 7.2 CONDUCTED PEAK OUTPUT POWER .....  | 18        |
| 7.3 20DB BANDWIDTH.....  | 19        |
| 7.4 CARRIER FREQUENCIES SEPARATION .....   | 20        |
| 7.5 HOPPING CHANNEL NUMBER .....   | 21        |
| 7.6 DWELL TIME .....   | 22        |
| 7.7 CONDUCTED BAND EDGES MEASUREMENT .....   | 23        |
| 7.8 CONDUCTED SPURIOUS EMISSIONS .....   | 24        |
| 7.9 RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS.....                         | 25        |
| 7.10 RADIATED SPURIOUS EMISSIONS .....   | 42        |
| 7.11 99% BANDWIDTH.....  | 64        |
| <b>8 TEST SETUP PHOTOGRAPHS .....</b>  | <b>65</b> |
| <b>9 EUT CONSTRUCTIONAL DETAILS .....</b>  | <b>65</b> |

## 4 General Information

### 4.1 Details of E.U.T.

|                             |   |
|-----------------------------|---|
| Power supply:               | AC120V 60Hz                             |
| Test voltage:               | AC120V 60Hz                             |
| Serial Number:              | ZM00001                                 |
| Firmware Version:           | V1.003                                  |
| Cable:                      | AC cable 1m                             |
| Antenna Gain:               | 2.45dBi(Provided by the manufacturer)   |
| Antenna Type:               | PCB Antenna                             |
| Bluetooth Version:          | V5.0 Classic                            |
| Channel Spacing:            | 1MHz                                    |
| Modulation Type:            | GFSK, $\pi/4$ DQPSK, 8DPSK              |
| Data Rate:                  | 1/2/3Mbps                               |
| Number of Channels:         | 79                                      |
| Operation Frequency:        | 2402MHz to 2480MHz                      |
| Spectrum Spread Technology: | Frequency Hopping Spread Spectrum(FHSS) |

### 4.2 Description of Support Units

| Description               | Manufacturer | Model No.      | Serial No. |
|---------------------------|--------------|----------------|------------|
| BT test board             | /            | Test Plate 2   | /          |
| Laptop                    | Lenovo       | ThinkPad X100e | /          |
| Serial port adapter plate | /            | Test Plate 3   | /          |

### 4.3 Power level setting using in test:

| Channel | BT      |
|---------|---------|
| 0       | Default |
| 39      | Default |
| 78      | Default |

#### 4.4 Measurement Uncertainty

| No. | Item                            | Measurement Uncertainty |
|-----|---------------------------------|-------------------------|
| 1   | Radio Frequency                 | 8.4 x 10 <sup>-8</sup>  |
| 2   | Timeout                         | 2s                      |
| 3   | Duty Cycle                      | 0.37%                   |
| 4   | Occupied Bandwidth              | 3%                      |
| 5   | RF Conducted Power              | 0.6dB                   |
| 6   | RF Power Density                | 2.9dB                   |
| 7   | Conducted Spurious Emissions    | 0.75dB                  |
| 8   | RF Radiated Power               | 5.1dB (Below 1GHz)      |
|     |                                 | 4.9dB (Above 1GHz)      |
| 9   | Radiated Spurious Emission Test | 4.2dB (Below 30MHz)     |
|     |                                 | 4.5dB (30MHz-1GHz)      |
|     |                                 | 5.1dB (1GHz-18GHz)      |
|     |                                 | 5.4dB (Above 18GHz)     |
| 10  | Temperature Test                | 1°C                     |
| 11  | Humidity Test                   | 3%                      |
| 12  | Supply Voltages                 | 1.5%                    |
| 13  | Time                            | 3%                      |

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

#### 4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shanghai Branch

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666

Fax: +86 21 6191 5678

No tests were sub-contracted.

#### 4.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **NVLAP (LAB CODE: 201034-0)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

- **FCC (Designation Number: CN5033)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

- **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.

- **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

#### 4.7 Deviation from Standards

None

#### 4.8 Abnormalities from Standard Conditions

None

## 5 Equipment List

| Equipment   | Manufacturer | Model No         | Inventory No | Cal Date   | Cal Due Date |
|---|--------------|------------------|--------------|------------|--------------|
| <b>Conducted Emission at Mains Terminals (150kHz-30MHz)</b> |              |                  |              |            |              |
| EMI test receiver   | R&S          | ESR7             | SHEM162-1    | 2019-12-20 | 2020-12-19   |
| LISN  | Schwarzbeck  | NSLK8127         | SHEM061-1    | 2019-12-20 | 2020-12-19   |
| LISN  | EMCO         | 3816/2           | SHEM019-1    | 2019-12-20 | 2020-12-19   |
| Pulse limiter   | R&S          | ESH3-Z2          | SHEM029-1    | 2019-12-20 | 2020-12-19   |
| Shielding Room  | ZHONGYU      | 8*4*3M           | SHEM079-2    | 2019-12-20 | 2020-12-19   |
| CE test Cable   | /            | CE01             | /            | 2019-12-20 | 2020-12-19   |
| <b>RF Conducted Test</b>                                    |              |                  |              |            |              |
| Spectrum Analyzer   | R&S          | FSP-30           | SHEM002-1    | 2019-12-20 | 2020-12-19   |
| Spectrum Analyzer   | Agilent      | N9020A           | SHEM181-1    | 2019-08-13 | 2020-08-12   |
| Signal Generator  | R&S          | SMR20            | SHEM006-1    | 2019-08-13 | 2020-08-12   |
| Signal Generator  | Agilent      | N5182A           | SHEM182-1    | 2019-08-13 | 2020-08-12   |
| Communication Tester  | R&S          | CMW270           | SHEM183-1    | 2019-08-13 | 2020-08-12   |
| Switcher  | Tonscend     | JS0806           | SHEM184-1    | 2019-08-13 | 2020-08-12   |
| Power Sensor  | Keysight     | U2021XA * 4      | SHEM184-1    | 2019-08-13 | 2020-08-12   |
| Splitter  | Anritsu      | MA1612A          | SHEM185-1    | /          | /            |
| Coupler   | e-meca       | 803-S-1          | SHEM186-1    | /          | /            |
| High-low Temp Cabinet                                       | Suzhou Zhihe | TL-40            | SHEM087-1    | 2017-09-25 | 2020-09-24   |
| AC Power Stabilizer   | APC          | KDF-31020T-V0-F0 | SHEM216-1    | 2019-12-20 | 2020-12-19   |
| DC Power Supply   | MCH          | MCH-303A         | SHEM210-1    | 2019-12-20 | 2020-12-19   |
| Conducted test Cable  | /            | RF01-RF04        | /            | 2019-12-20 | 2020-12-19   |
| <b>RF Radiated Test</b>                                     |              |                  |              |            |              |
| EMI test Receiver   | R&S          | ESU40            | SHEM051-1    | 2019-12-20 | 2020-12-19   |
| Spectrum Analyzer   | R&S          | FSP-30           | SHEM002-1    | 2019-12-20 | 2020-12-19   |
| Loop Antenna (9kHz-30MHz)                                   | Schwarzbeck  | FMZB1519         | SHEM135-1    | 2019-12-20 | 2020-12-19   |
| Antenna (25MHz-2GHz)  | Schwarzbeck  | VULB9168         | SHEM048-1    | 2019-10-14 | 2021-10-13   |
| Antenna (25MHz-2GHz)  | Schwarzbeck  | VULB9168         | SHEM202-1    | 2019-04-30 | 2021-04-29   |
| Horn Antenna (1-18GHz)                                      | Schwarzbeck  | HF906            | SHEM009-1    | 2017-10-24 | 2020-10-23   |
| Horn Antenna (1-18GHz)                                      | Schwarzbeck  | BBHA9120D        | SHEM050-1    | 2019-10-14 | 2021-10-13   |
| Horn Antenna (14-40GHz)                                     | Schwarzbeck  | BBHA 9170        | SHEM049-1    | 2017-10-31 | 2020-10-30   |
| Pre-amplifier (9kHz-2GHz)                                   | CLAVIIO      | BDLNA-0001       | SHEM164-1    | 2019-08-13 | 2020-08-12   |
| Pre-amplifier (1-18GHz)                                     | CLAVIIO      | BDLNA-0118       | SHEM050-2    | 2019-08-13 | 2020-08-12   |
| High-amplifier (14-40GHz)                                   | Schwarzbeck  | 10001            | SHEM049-2    | 2019-12-20 | 2020-12-19   |
| Signal Generator  | R&S          | SMR40            | SHEM058-1    | 2019-08-13 | 2020-08-12   |
| Band Filter   | LORCH        | 9BRX-875/X150    | SHEM156-1    | /          | /            |
| Band Filter   | LORCH        | 13BRX-1950/X500  | SHEM083-2    | /          | /            |
| Band Filter   | LORCH        | 5BRX-2400/X200   | SHEM155-1    | /          | /            |
| Band Filter   | LORCH        | 5BRX-5500/X1000  | SHEM157-2    | /          | /            |
| High pass Filter  | Wainwright   | WHK3.0/18G       | SHEM157-1    | /          | /            |
| High pass Filter  | Wainwright   | WHKS1700         | SHEM157-3    | /          | /            |
| Semi/Fully Anechoic   | ST           | 11*6*6M          | SHEM078-2    | 2020-05-25 | 2023-05-24   |
| RE test Cable   | /            | RE01, RE02, RE06 | /            | 2019-12-20 | 2020-12-19   |





| Equipment   | Manufacturer | Model No                      | Inventory No          | Cal Date   | Cal Due Date |
|---|--------------|-------------------------------|-----------------------|------------|--------------|
| <b>Conducted Emission at Mains Terminals (150kHz-30MHz)</b> |              |                               |                       |            |              |
| EMI test receiver   | R&S          | ESR7                          | SHEM162-1             | 2020-12-20 | 2021-12-19   |
| LISN  | Schwarzbeck  | NSLK8127                      | SHEM061-1             | 2020-12-20 | 2021-12-19   |
| LISN  | EMCO         | 3816/2                        | SHEM019-1             | 2020-12-20 | 2021-12-19   |
| Pulse limiter   | R&S          | ESH3-Z2                       | SHEM029-1             | 2020-12-20 | 2021-12-19   |
| Shielding Room  | ZHONGYU      | 8*4*3M                        | SHEM079-2             | 2020-12-20 | 2021-12-19   |
| CE test Cable   | /            | CE01                          | /                     | 2020-12-20 | 2021-12-19   |
| Test software   | ESE          | E3                            | Version:<br>6.111221a | /          | /            |
| <b>RF Conducted Test</b>                                    |              |                               |                       |            |              |
| Spectrum Analyzer   | R&S          | FSP-30                        | SHEM002-1             | 2020-12-20 | 2021-12-19   |
| Spectrum Analyzer   | Agilent      | N9020A                        | SHEM181-1             | 2020-08-13 | 2021-08-12   |
| Signal Generator  | R&S          | SMR20                         | SHEM006-1             | 2020-08-13 | 2021-08-12   |
| Signal Generator  | Agilent      | N5182A                        | SHEM182-1             | 2020-08-13 | 2021-08-12   |
| Communication Tester  | R&S          | CMW270                        | SHEM183-1             | 2020-08-13 | 2021-08-12   |
| Switcher  | Tonscend     | JS0806                        | SHEM184-1             | 2020-08-13 | 2021-08-12   |
| Power Sensor  | Keysight     | U2021XA * 4                   | SHEM184-1             | 2020-08-13 | 2021-08-12   |
| Splitter  | Anritsu      | MA1612A                       | SHEM185-1             | /          | /            |
| Coupler   | e-meca       | 803-S-1                       | SHEM186-1             | /          | /            |
| High-low Temp Cabinet                                       | Suzhou Zhihe | TL-40                         | SHEM087-1             | 2018-09-25 | 2021-09-24   |
| AC Power Stabilizer   | APC          | KDF-31020T-V0-F0              | SHEM216-1             | 2020-12-20 | 2021-12-19   |
| DC Power Supply   | MCH          | MCH-303A                      | SHEM210-1             | 2020-12-20 | 2021-12-19   |
| Conducted test Cable  | /            | RF01-RF04                     | /                     | 2020-12-20 | 2021-12-19   |
| Test software   | Tonscend     | JS Tonscend<br>BT/WIFI System | Version: 2.6          | /          | /            |
| <b>RF Radiated Test</b>                                     |              |                               |                       |            |              |
| EMI test Receiver   | R&S          | ESU40                         | SHEM051-1             | 2020-12-20 | 2021-12-19   |
| Spectrum Analyzer   | R&S          | FSP-30                        | SHEM002-1             | 2020-12-20 | 2021-12-19   |
| Loop Antenna (9kHz-30MHz)                                   | Schwarzbeck  | FMZB1519                      | SHEM135-1             | 2020-12-20 | 2021-12-19   |
| Antenna (25MHz-2GHz)  | Schwarzbeck  | VULB9168                      | SHEM048-1             | 2019-10-14 | 2021-10-13   |
| Antenna (25MHz-2GHz)  | Schwarzbeck  | VULB9168                      | SHEM202-1             | 2019-04-30 | 2021-04-29   |
| Horn Antenna (1-18GHz)                                      | Schwarzbeck  | HF906                         | SHEM009-1             | 2018-10-24 | 2021-10-23   |
| Horn Antenna (1-18GHz)                                      | Schwarzbeck  | BBHA9120D                     | SHEM050-1             | 2019-10-14 | 2021-10-13   |
| Horn Antenna (14-40GHz)                                     | Schwarzbeck  | BBHA 9170                     | SHEM049-1             | 2018-10-31 | 2021-10-30   |
| Pre-amplifier (9kHz-2GHz)                                   | CLAVIIO      | BDLNA-0001                    | SHEM164-1             | 2020-08-13 | 2021-08-12   |
| Pre-amplifier (1-18GHz)                                     | CLAVIIO      | BDLNA-0118                    | SHEM050-2             | 2020-08-13 | 2021-08-12   |
| High-amplifier (14-40GHz)                                   | Schwarzbeck  | 10001                         | SHEM049-2             | 2020-12-20 | 2021-12-19   |
| Signal Generator  | R&S          | SMR40                         | SHEM058-1             | 2020-08-13 | 2021-08-12   |
| Band Filter   | LORCH        | 9BRX-875/X150                 | SHEM156-1             | /          | /            |
| Band Filter   | LORCH        | 13BRX-1950/X500               | SHEM083-2             | /          | /            |
| Band Filter   | LORCH        | 5BRX-2400/X200                | SHEM155-1             | /          | /            |
| Band Filter   | LORCH        | 5BRX-5500/X1000               | SHEM157-2             | /          | /            |
| High pass Filter  | Wainwright   | WHK3.0/18G                    | SHEM157-1             | /          | /            |
| High pass Filter  | Wainwright   | WHKS1700                      | SHEM157-3             | /          | /            |
| Semi/Fully Anechoic   | ST           | 11*6*6M                       | SHEM078-2             | 2020-05-25 | 2023-05-24   |
| RE test Cable   | /            | RE01, RE02, RE06              | /                     | 2020-12-20 | 2021-12-19   |
| Test software   | ESE          | E3                            | Version:<br>6.111221a | /          | /            |

## **6 Radio Spectrum Technical Requirement**

### **6.1 Antenna Requirement**

#### **6.1.1 Test Requirement:**

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

#### **6.1.2 Conclusion**

Standard Requirement:

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

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is PCB antenna and no consideration of replacement. The best case gain of the antenna is 2.45dBi.

Antenna location: Refer to Appendix (Internal Photos)

## **6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence**

### **6.2.1 Test Requirement:**

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

### **6.2.2 Conclusion**

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

> Number of shift register stages: 9

> Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits

> Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:

Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band s

## 7 Radio Spectrum Matter Test Results

### 7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207  
Test Method: ANSI C63.10 (2013) Section 6.2  
Limit:

| Frequency of emission(MHz) | Conducted limit(dB $\mu$ V) |           |
|----------------------------|-----------------------------|-----------|
|                            | 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.

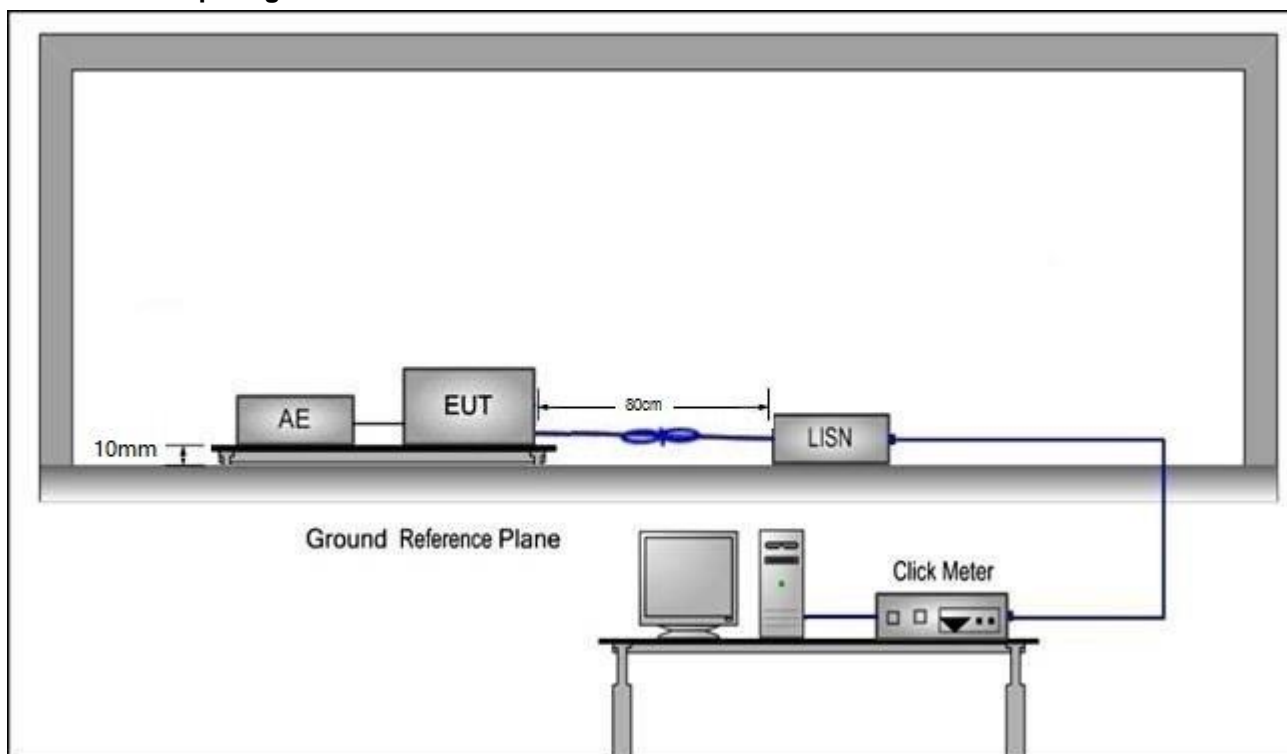
#### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.1.2 Test Setup Diagram

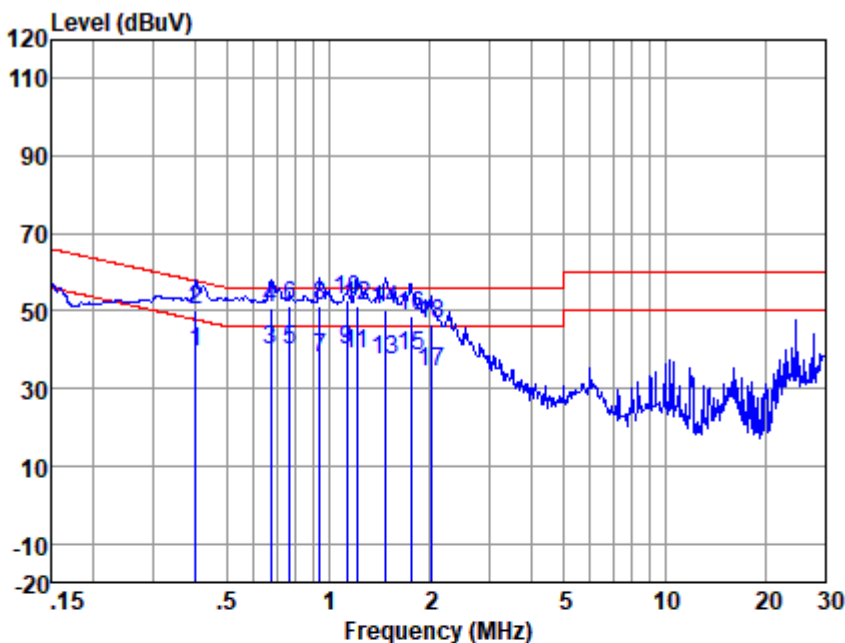


### 7.1.3 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) For floor-standing arrangement, the EUT was placed on 10 mm of insulating material horizontal ground reference plane.
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: LISN=Read Level+ Cable Loss+ LISN Factor

Mode:b; Line:Live Line



**LISN : LINE**

|    | Freq (MHz) | Read level (dBuV) | LISN Factor (dB) | Cable Loss (dB) | Emission Level (dBuV) | Limit (dBuV) | Over Limit (dB) | Remark  |
|----|------------|-------------------|------------------|-----------------|-----------------------|--------------|-----------------|---------|
| 1  | 0.40       | 29.05             | 0.08             | 10.04           | 39.17                 | 47.81        | -8.64           | Average |
| 2  | 0.40       | 40.29             | 0.08             | 10.04           | 50.41                 | 57.81        | -7.40           | QP      |
| 3  | 0.67       | 29.78             | 0.08             | 10.07           | 39.93                 | 46.00        | -6.07           | Average |
| 4  | 0.67       | 40.85             | 0.08             | 10.07           | 51.00                 | 56.00        | -5.00           | QP      |
| 5  | 0.77       | 29.53             | 0.09             | 10.08           | 39.70                 | 46.00        | -6.30           | Average |
| 6  | 0.77       | 41.06             | 0.09             | 10.08           | 51.23                 | 56.00        | -4.77           | QP      |
| 7  | 0.94       | 27.93             | 0.09             | 10.10           | 38.12                 | 46.00        | -7.88           | Average |
| 8  | 0.94       | 40.91             | 0.09             | 10.10           | 51.10                 | 56.00        | -4.90           | QP      |
| 9  | 1.14       | 29.95             | 0.10             | 10.11           | 40.16                 | 46.00        | -5.84           | Average |
| 10 | 1.14       | 42.82             | 0.10             | 10.11           | 53.03                 | 56.00        | -2.97           | QP      |
| 11 | 1.21       | 28.94             | 0.10             | 10.11           | 39.15                 | 46.00        | -6.85           | Average |
| 12 | 1.21       | 40.94             | 0.10             | 10.11           | 51.15                 | 56.00        | -4.85           | QP      |
| 13 | 1.48       | 27.23             | 0.12             | 10.13           | 37.48                 | 46.00        | -8.52           | Average |
| 14 | 1.48       | 39.92             | 0.12             | 10.13           | 50.17                 | 56.00        | -5.83           | QP      |
| 15 | 1.75       | 28.32             | 0.13             | 10.14           | 38.59                 | 46.00        | -7.41           | Average |
| 16 | 1.75       | 38.59             | 0.13             | 10.14           | 48.86                 | 56.00        | -7.14           | QP      |

Notes: Emission Level = Read Level + LISN Factor + Cable loss



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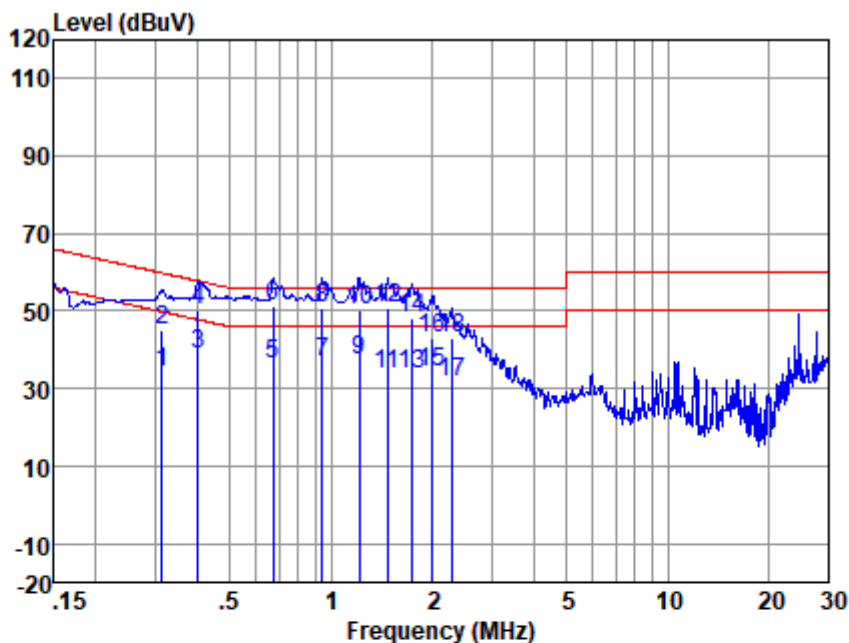
Report No.: SHEM200200101501

Page: 15 of 65

|    | Freq<br>(MHz) | Read<br>level<br>(dBuV) | LISN<br>Factor<br>(dB) | Cable<br>Loss<br>(dB) | Emission<br>Level<br>(dBuV) | Limit<br>(dBuV) | Over<br>Limit<br>(dB) | Remark  |
|----|---------------|-------------------------|------------------------|-----------------------|-----------------------------|-----------------|-----------------------|---------|
| 17 | 2.01          | 23.94                   | 0.14                   | 10.15                 | 34.23                       | 46.00           | -11.77                | Average |
| 18 | 2.01          | 36.13                   | 0.14                   | 10.15                 | 46.42                       | 56.00           | -9.58                 | QP      |

Notes: Emission Level = Read Level + LISN Factor + Cable loss

Mode:b; Line:Neutral Line



**LISN : NEUTRAL**

| Freq (MHz) | Read level (dBuV) | LISN Factor (dB) | Cable Loss (dB) | Emission Level (dBuV) | Limit (dBuV) | Over Limit (dB) | Remark |         |
|------------|-------------------|------------------|-----------------|-----------------------|--------------|-----------------|--------|---------|
| 1          | 0.31              | 24.21            | 0.06            | 10.02                 | 34.29        | 49.84           | -15.55 | Average |
| 2          | 0.31              | 34.93            | 0.06            | 10.02                 | 45.01        | 59.84           | -14.83 | QP      |
| 3          | 0.40              | 28.56            | 0.06            | 10.04                 | 38.66        | 47.81           | -9.15  | Average |
| 4          | 0.40              | 40.07            | 0.06            | 10.04                 | 50.17        | 57.81           | -7.64  | QP      |
| 5          | 0.67              | 26.38            | 0.07            | 10.07                 | 36.52        | 46.00           | -9.48  | Average |
| 6          | 0.67              | 40.90            | 0.07            | 10.07                 | 51.04        | 56.00           | -4.96  | QP      |
| 7          | 0.94              | 26.59            | 0.08            | 10.10                 | 36.77        | 46.00           | -9.23  | Average |
| 8          | 0.94              | 40.40            | 0.08            | 10.10                 | 50.58        | 56.00           | -5.42  | QP      |
| 9          | 1.21              | 27.39            | 0.09            | 10.11                 | 37.59        | 46.00           | -8.41  | Average |
| 10         | 1.21              | 40.13            | 0.09            | 10.11                 | 50.33        | 56.00           | -5.67  | QP      |
| 11         | 1.47              | 23.30            | 0.09            | 10.13                 | 33.52        | 46.00           | -12.48 | Average |
| 12         | 1.47              | 40.53            | 0.09            | 10.13                 | 50.75        | 56.00           | -5.25  | QP      |
| 13         | 1.73              | 23.74            | 0.10            | 10.14                 | 33.98        | 46.00           | -12.02 | Average |
| 14         | 1.73              | 38.08            | 0.10            | 10.14                 | 48.32        | 56.00           | -7.68  | QP      |
| 15         | 2.00              | 23.81            | 0.10            | 10.15                 | 34.06        | 46.00           | -11.94 | Average |
| 16         | 2.00              | 32.69            | 0.10            | 10.15                 | 42.94        | 56.00           | -13.06 | QP      |

Notes: Emission Level = Read Level + LISN Factor + Cable loss





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Report No.: SHEM200200101501

Page: 17 of 65

|    | Freq<br>(MHz) | Read<br>level<br>(dBuV) | LISN<br>Factor<br>(dB) | Cable<br>Loss<br>(dB) | Emission<br>Level<br>(dBuV) | Limit<br>(dBuV) | Over<br>Limit<br>(dB) | Remark  |
|----|---------------|-------------------------|------------------------|-----------------------|-----------------------------|-----------------|-----------------------|---------|
| 17 | 2.27          | 21.30                   | 0.11                   | 10.17                 | 31.58                       | 46.00           | -14.42                | Average |
| 18 | 2.27          | 32.64                   | 0.11                   | 10.17                 | 42.92                       | 56.00           | -13.08                | QP      |

Notes: Emission Level = Read Level + LISN Factor + Cable loss

## 7.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)  
Test Method: ANSI C63.10 (2013) Section 7.8.5  
Limit:

| Frequency range(MHz) | Output power of the intentional radiator(watt)         |
|----------------------|--|
| 902-928              | 1 for $\geq 50$ hopping channels                       |
|                      | 0.25 for $25 \leq$ hopping channels $< 50$             |
|                      | 1 for digital modulation                               |
| 2400-2483.5          | 1 for $\geq 75$ non-overlapping hopping channels       |
|                      | 0.125 for all other frequency hopping systems          |
|                      | 1 for digital modulation                               |
| 5725-5850            | 1 for frequency hopping systems and digital modulation |

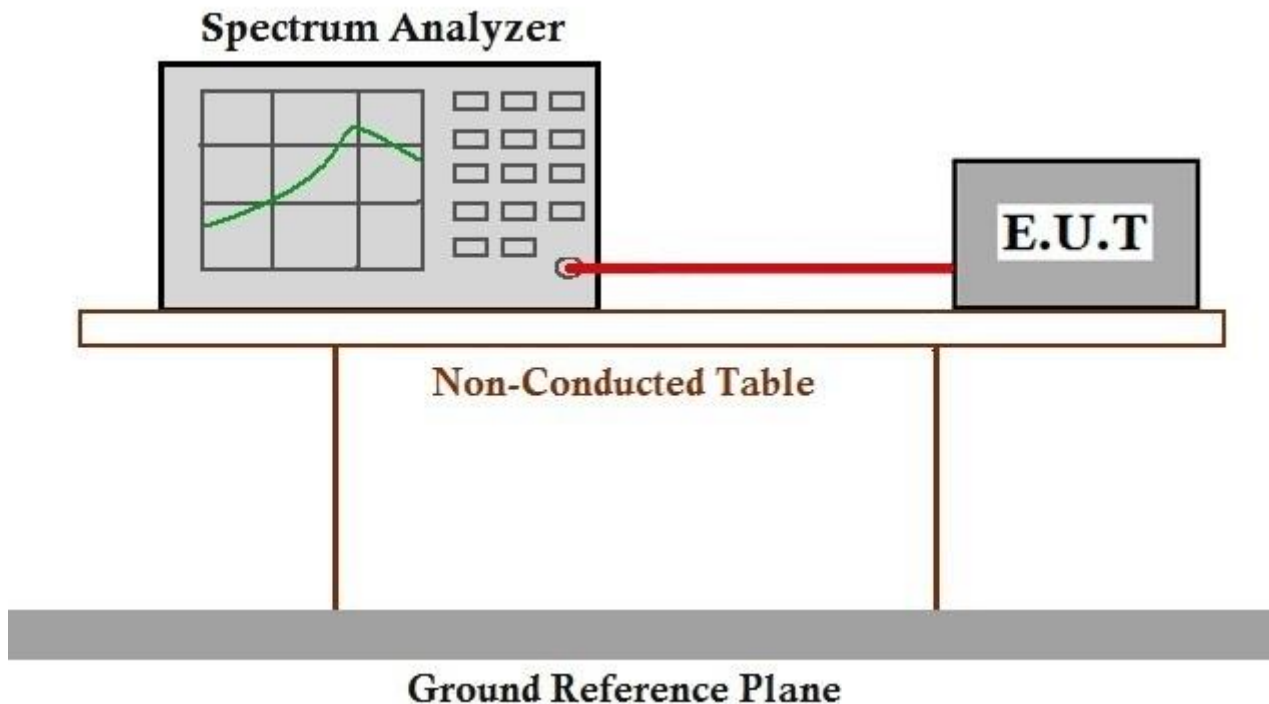
### 7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

### 7.2.2 Test Setup Diagram



### 7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM200200101501

### 7.3 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)  
Test Method: ANSI C63.10 (2013) Section 7.8.7

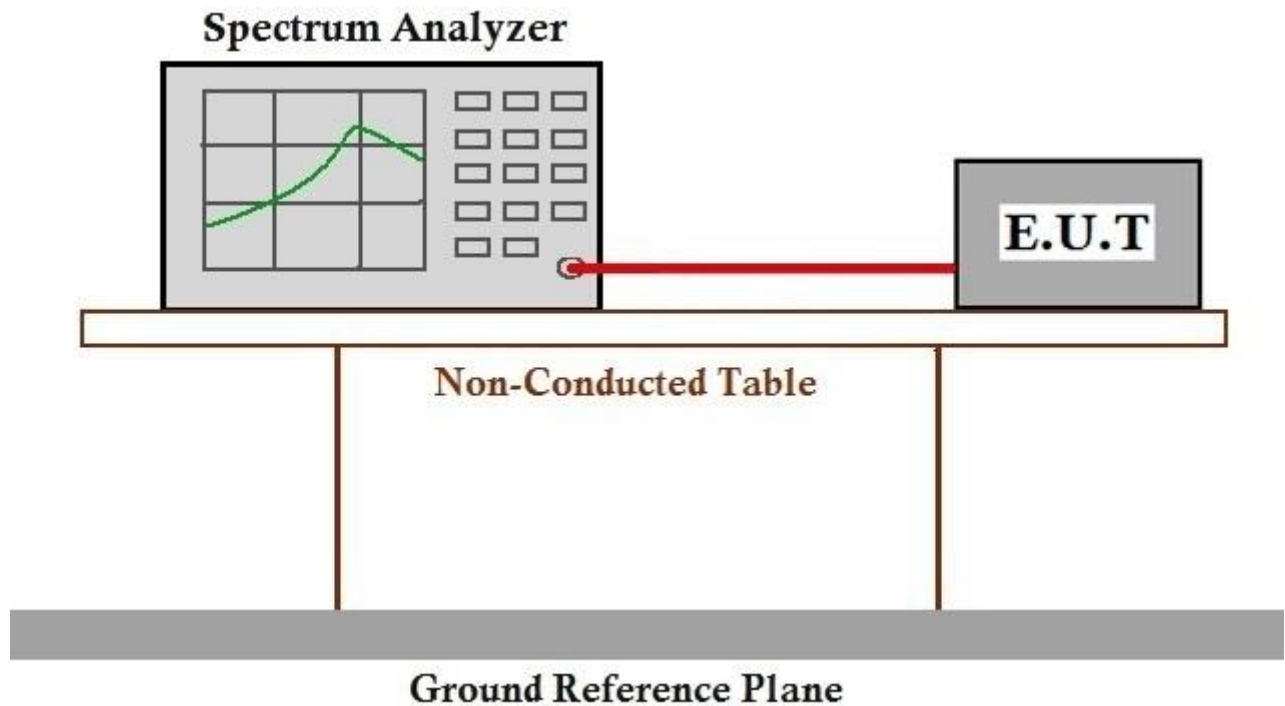
#### 7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.3.2 Test Setup Diagram



#### 7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM200200101501

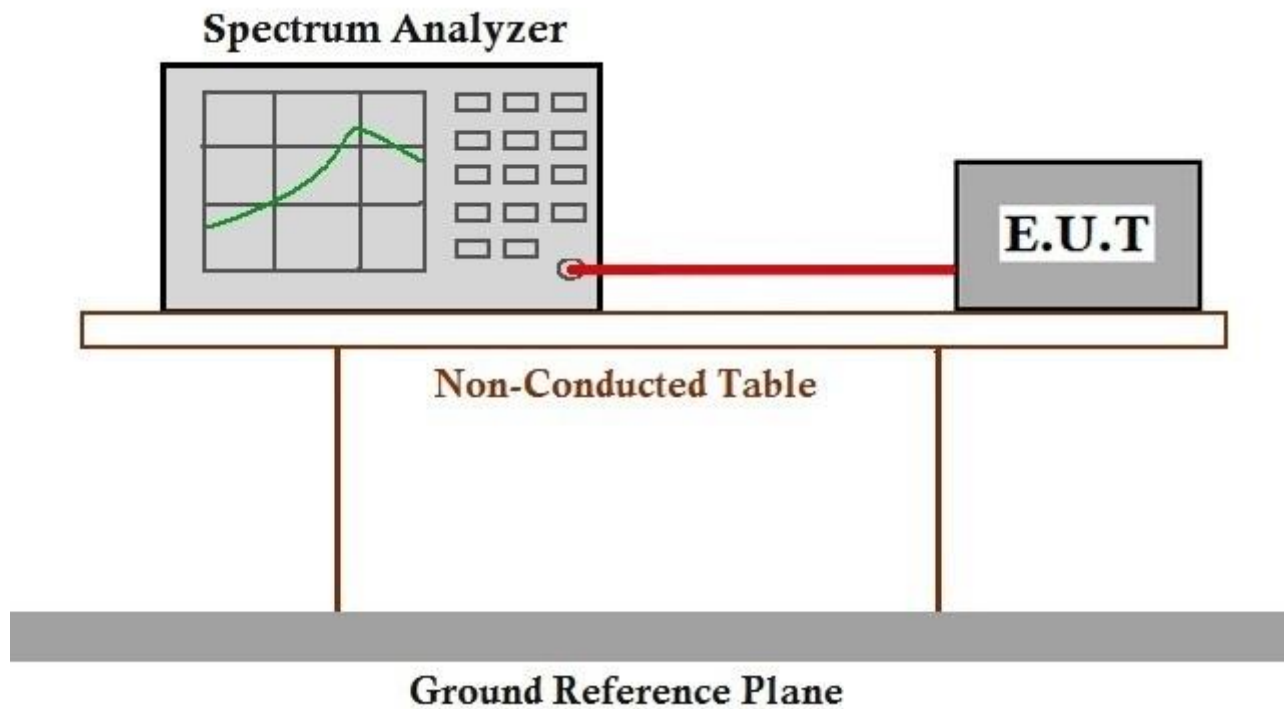
### 7.4 Carrier Frequencies Separation

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)  
 Test Method: ANSI C63.10 (2013) Section 7.8.2  
 Limit: 2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W

#### 7.4.1 E.U.T. Operation

Operating Environment:  
 Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar  
 Test mode a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.4.2 Test Setup Diagram



#### 7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM200200101501

### 7.5 Hopping Channel Number

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)  
Test Method: ANSI C63.10 (2013) Section 7.8.3  
Limit:

| Frequency range(MHz) | Number of hopping channels (minimum) |
|----------------------|--------------------------------------|
| 902-928              | 50 for 20dB bandwidth <250kHz        |
|                      | 25 for 20dB bandwidth ≥250kHz        |
| 2400-2483.5          | 15                                   |
| 5725-5850            | 75                                   |

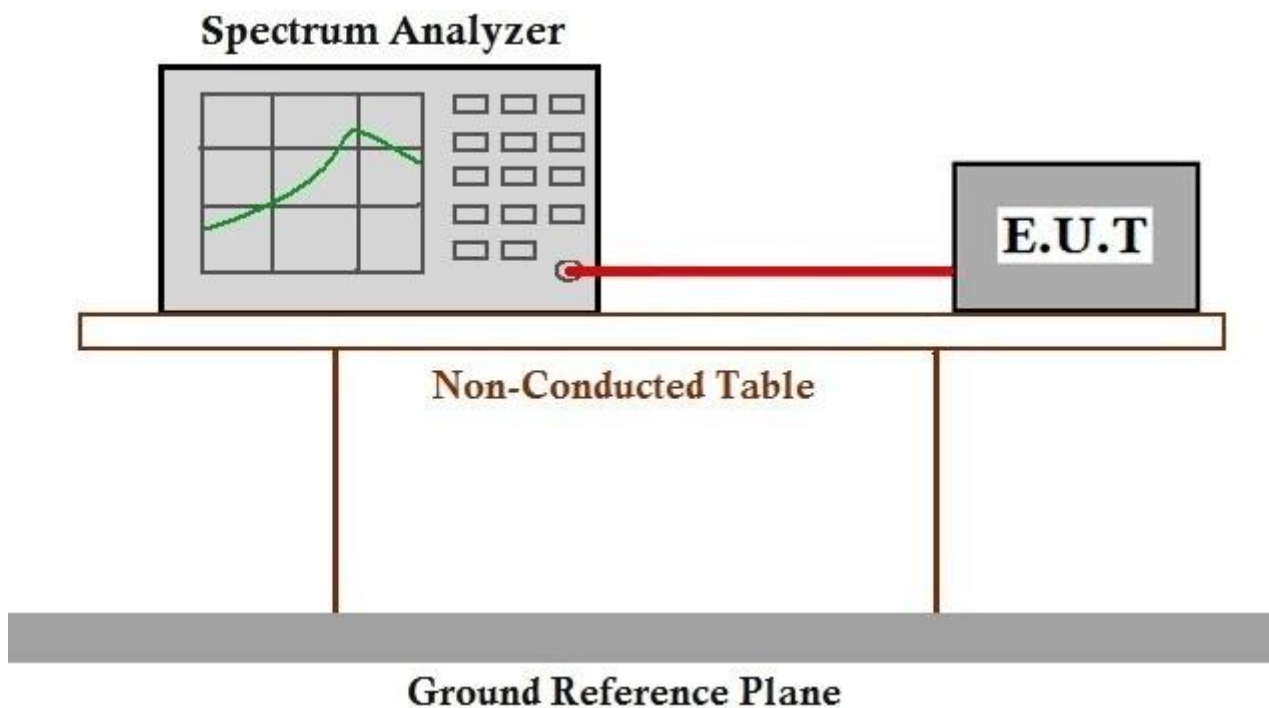
#### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.5.2 Test Setup Diagram



#### 7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM200200101501

**7.6 Dwell Time**

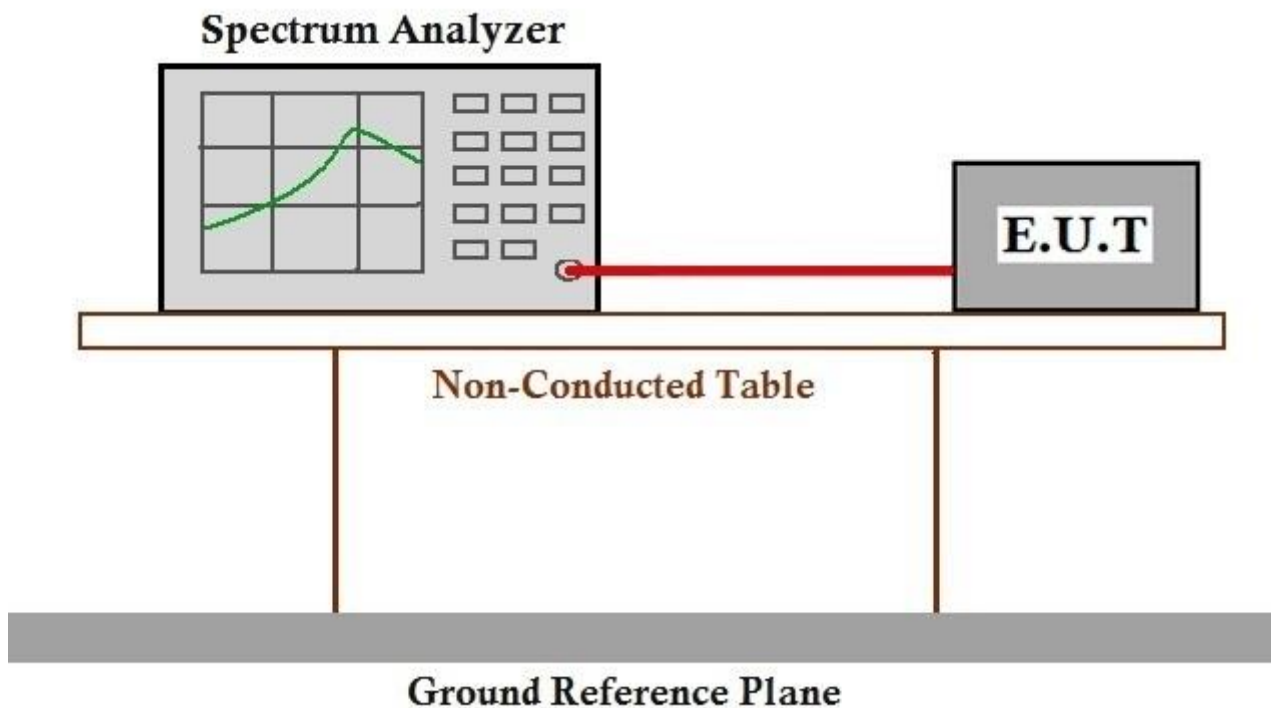
Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)  
Test Method: ANSI C63.10 (2013) Section 7.8.4  
Limit:

| Frequency(MHz) | Limit   |
|----------------|---|
| 902-928        | 0.4S within a 20S period(20dB bandwidth<250kHz)                           |
|                | 0.4S within a 10S period(20dB bandwidth≥250kHz)                           |
| 2400-2483.5    | 0.4S within a period of 0.4S multiplied by the number of hopping channels |
| 5725-5850      | 0.4S within a 30S period  |

**7.6.1 E.U.T. Operation**

Operating Environment:  
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar  
Test mode a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

**7.6.2 Test Setup Diagram**



**7.6.3 Measurement Procedure and Data**

The detailed test data see: Appendix A for SHEM200200101501

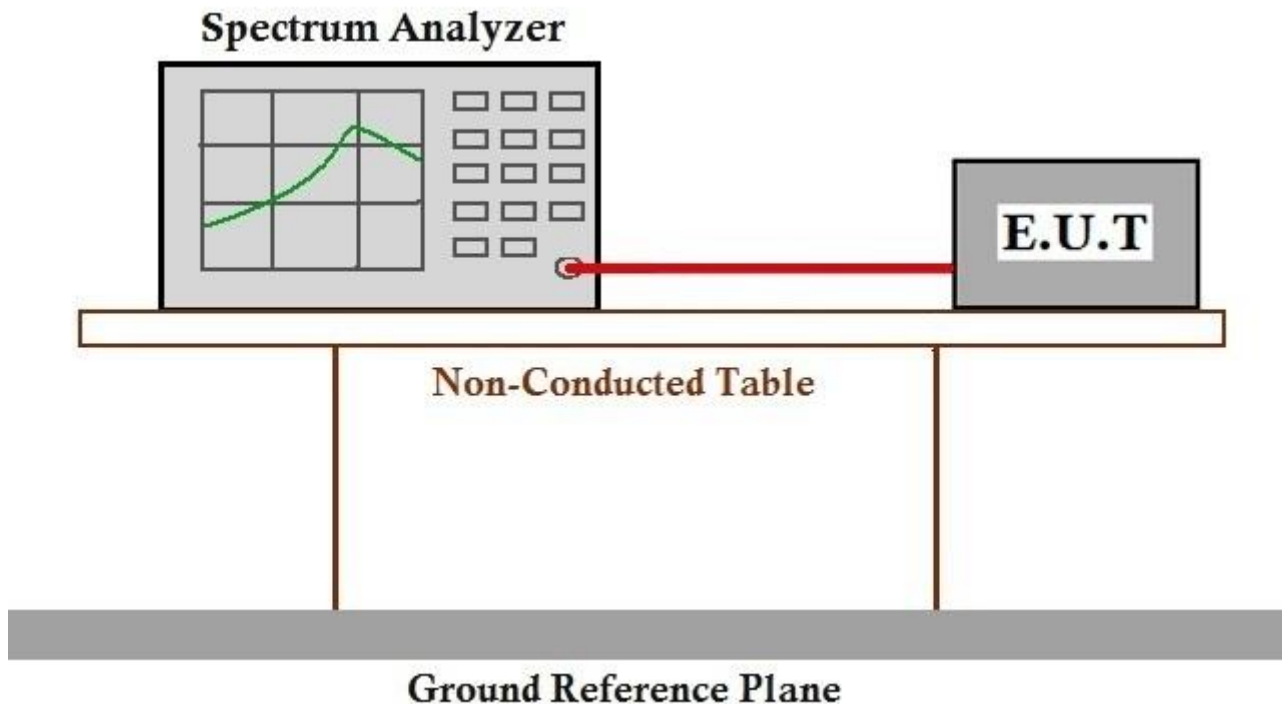
### 7.7 Conducted Band Edges Measurement

**Test Requirement** 47 CFR Part 15, Subpart C 15.247(d)  
**Test Method:** ANSI C63.10 (2013) Section 7.8.6  
**Limit:** 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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

#### 7.7.1 E.U.T. Operation

**Operating Environment:**  
**Temperature:** 22 °C      **Humidity:** 50 % RH      **Atmospheric Pressure:** 1002 mbar  
**Test mode:** a:TX\_Hop mode\_Keep the EUT in frequency hopping mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.  
 b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.7.2 Test Setup Diagram



#### 7.7.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM200200101501

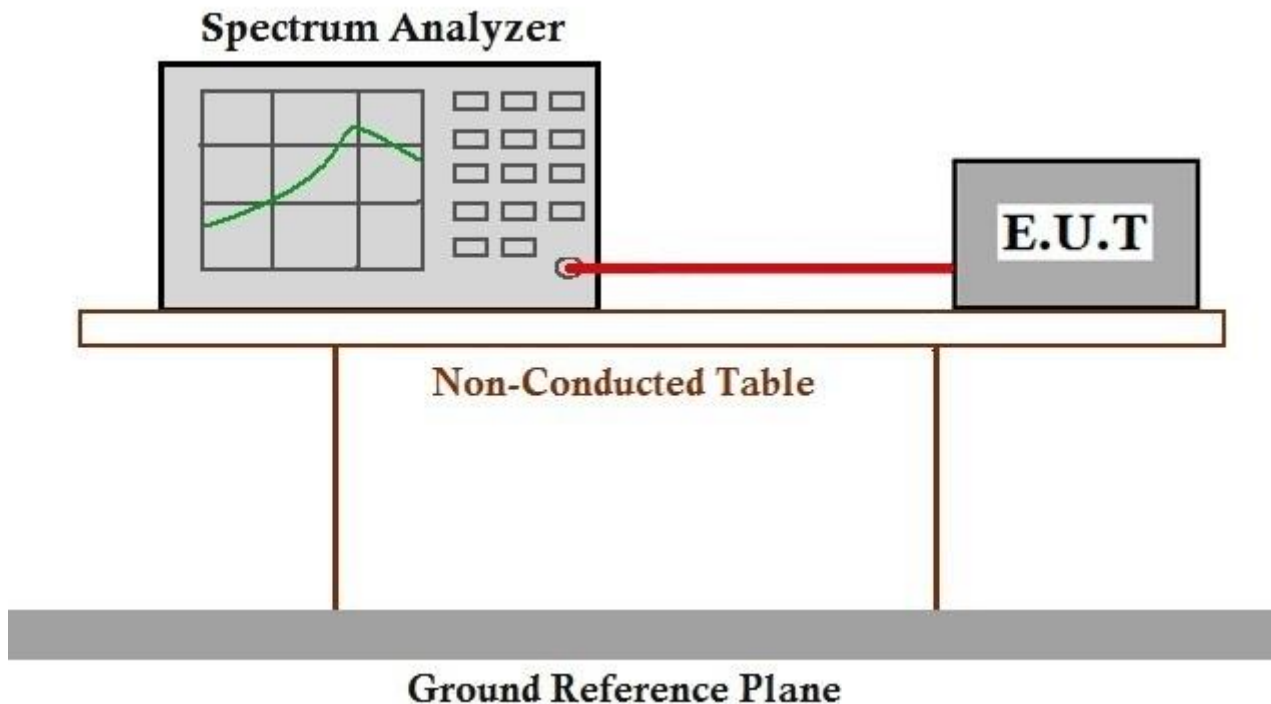
## 7.8 Conducted Spurious Emissions

|                  |   |
|------------------|---|
| Test Requirement | 47 CFR Part 15, Subpart C 15.247(d)   |
| Test Method:     | ANSI C63.10 (2013) Section 7.8.8  |
| Limit:           | 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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)) |

### 7.8.1 E.U.T. Operation

|                        |  |           |   |
|------------------------|--|-----------|---|
| Operating Environment: |  |           |   |
| Temperature:           | 22 °C  | Humidity: | 50 % RH Atmospheric Pressure: 1002 mbar |
| Test mode              | b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report. |           |   |

### 7.8.2 Test Setup Diagram



### 7.8.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM200200101501



### 7.9 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209  
Test Method: ANSI C63.10 (2013) Section 6.10.5  
Limit:

| Frequency(MHz) | Field strength(microvolts/meter) | Measurement distance(meters) |
|----------------|----------------------------------|------------------------------|
| 0.009-0.490    | 2400/F(kHz)                      | 300                          |
| 0.490-1.705    | 24000/F(kHz)                     | 30                           |
| 1.705-30.0     | 30                               | 30                           |
| 30-88          | 100                              | 3                            |
| 88-216         | 150                              | 3                            |
| 216-960        | 200                              | 3                            |
| Above 960      | 500                              | 3                            |

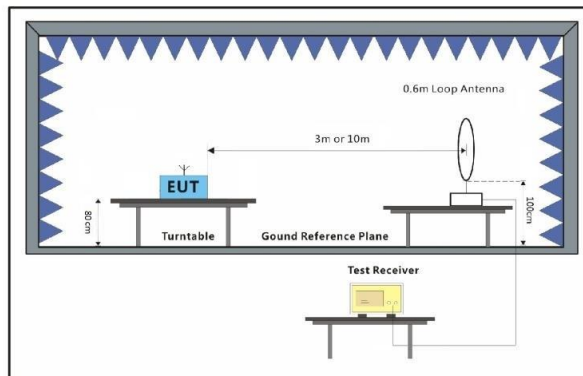
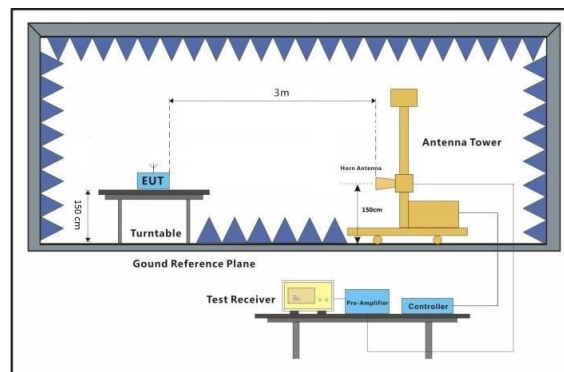
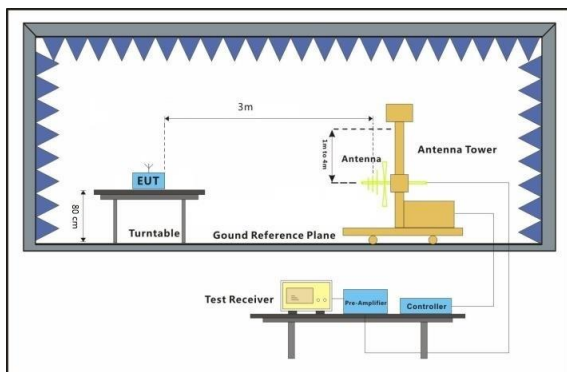
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

#### 7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar  
Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.9.2 Test Setup Diagram



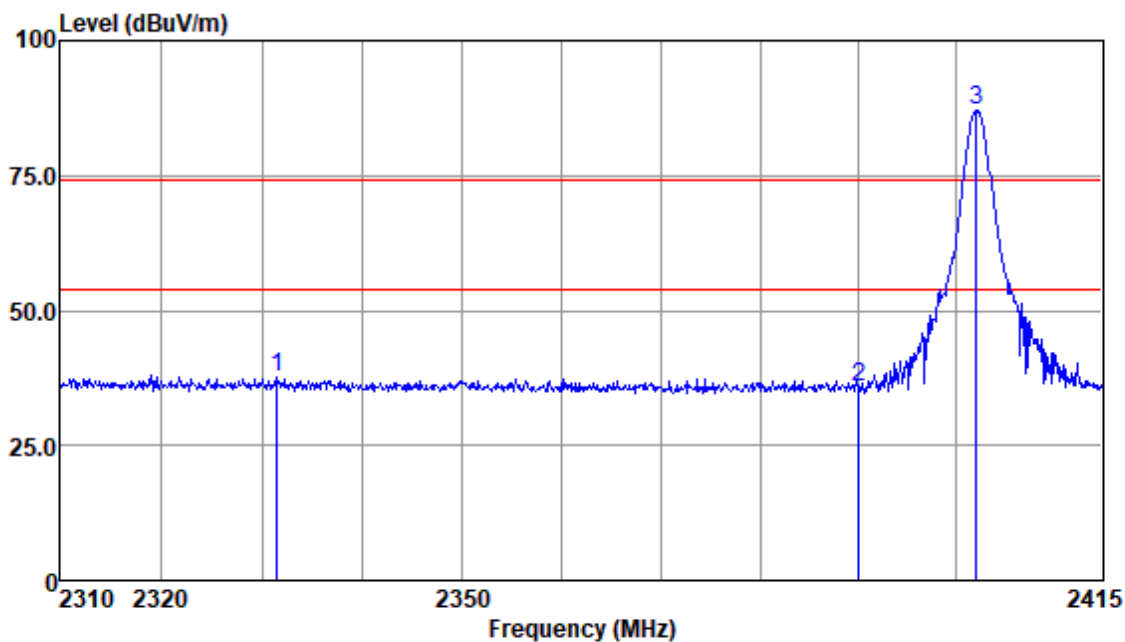
### 7.9.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1:  $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

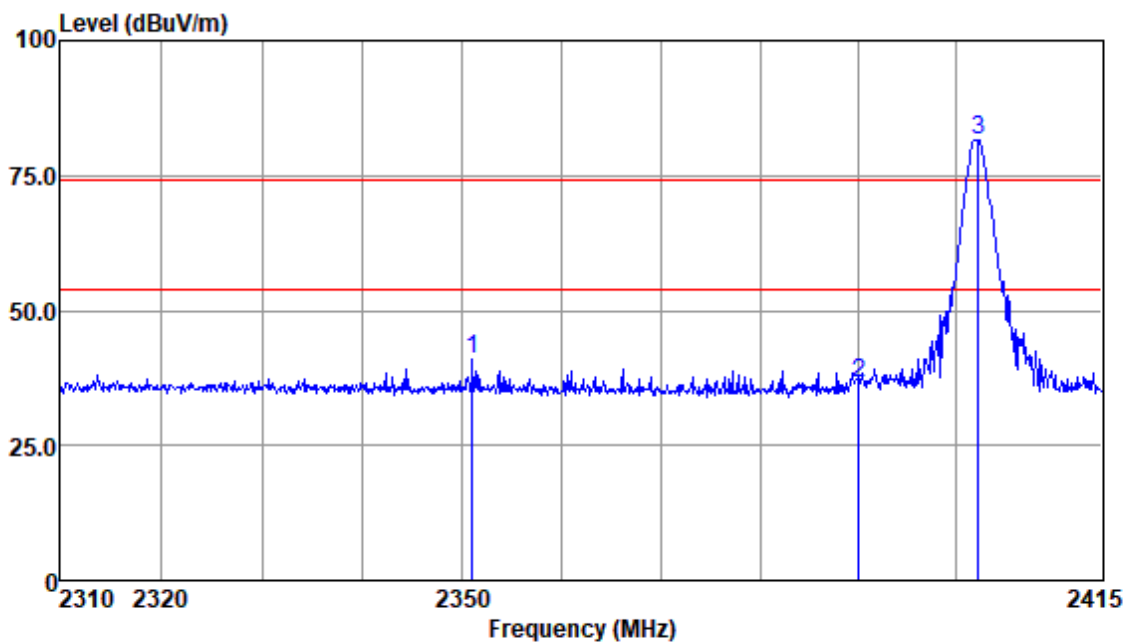


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2331.46   | 46.19 | 25.95          | 3.05       | 37.37         | 37.82          | 74.00      | -36.18     | Peak   |
| 2390.00   | 43.93 | 26.03          | 3.15       | 37.40         | 35.71          | 74.00      | -38.29     | Peak   |
| 2402.05   | 95.23 | 26.05          | 3.14       | 37.40         | 87.02          | 74.00      | 13.02      | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

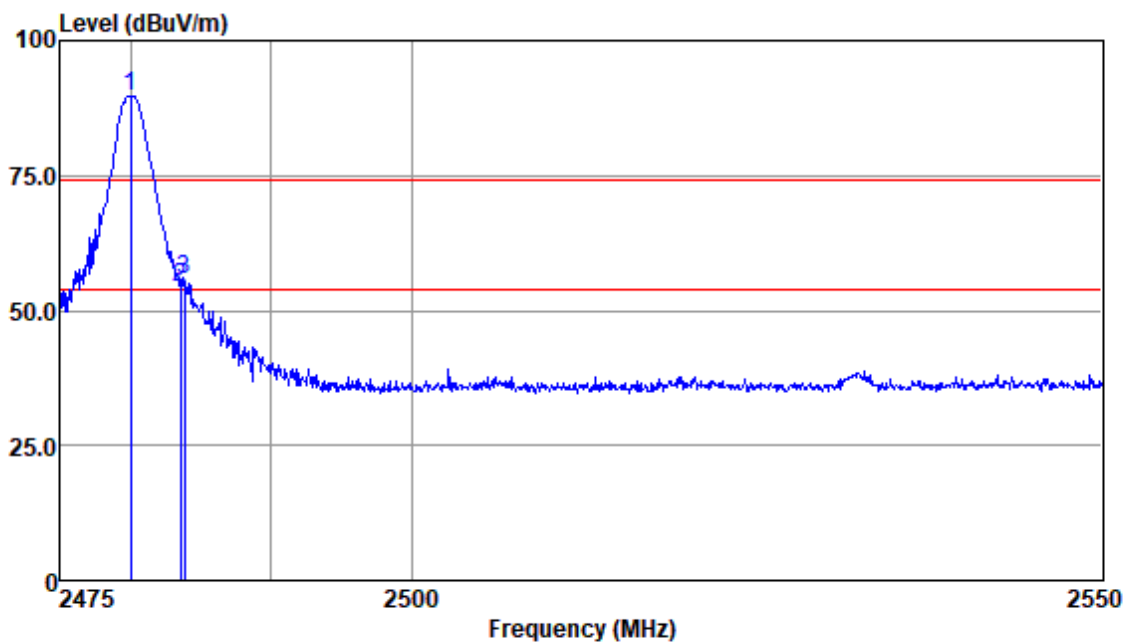


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2350.92   | 49.09 | 25.98          | 3.10       | 37.37         | 40.80          | 74.00      | -33.20     | Peak   |
| 2390.00   | 44.81 | 26.03          | 3.15       | 37.40         | 36.59          | 74.00      | -37.41     | Peak   |
| 2402.26   | 89.86 | 26.05          | 3.14       | 37.40         | 81.65          | 74.00      | 7.65       | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

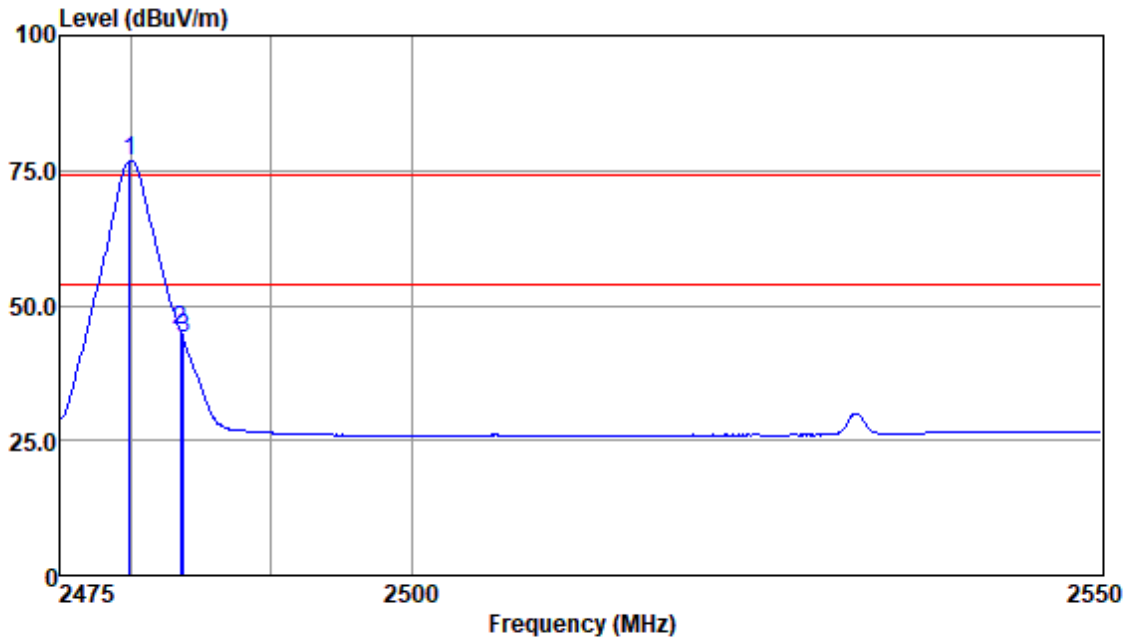


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2479.96   | 97.94 | 26.17          | 3.14       | 37.57         | 89.68          | 74.00      | 15.68      | Peak   |
| 2483.50   | 62.56 | 26.18          | 3.14       | 37.57         | 54.31          | 74.00      | -19.69     | Peak   |
| 2483.81   | 63.83 | 26.18          | 3.14       | 37.57         | 55.58          | 74.00      | -18.42     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

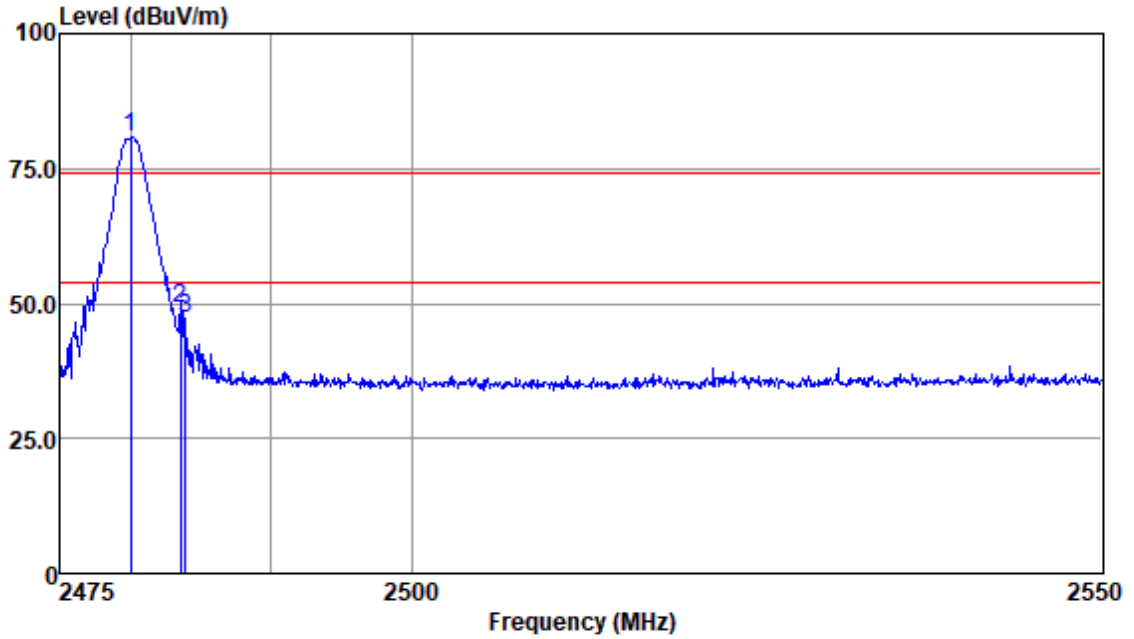


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 2479.88   | 85.14 | 26.17          | 3.14       | 37.57         | 76.88          | 54.00      | 22.88      | Average |
| 2483.50   | 53.81 | 26.18          | 3.14       | 37.57         | 45.56          | 54.00      | -8.44      | Average |
| 2483.73   | 52.21 | 26.18          | 3.14       | 37.57         | 43.96          | 54.00      | -10.04     | Average |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High

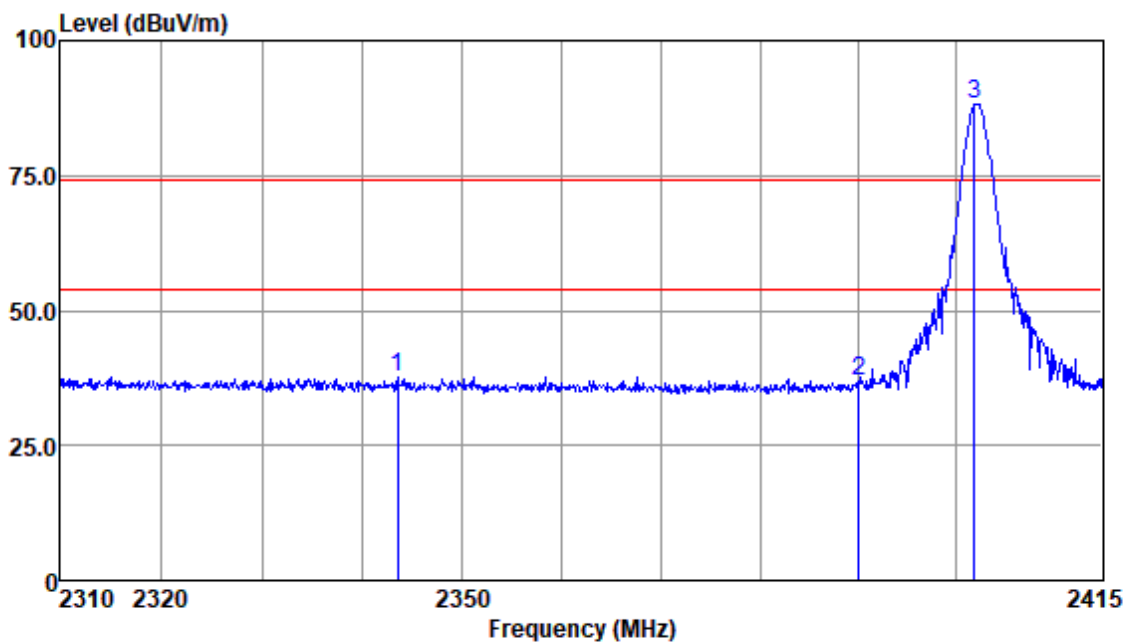


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2479.96   | 88.95 | 26.17          | 3.14       | 37.57         | 80.69          | 74.00      | 6.69       | Peak   |
| 2483.50   | 57.27 | 26.18          | 3.14       | 37.57         | 49.02          | 74.00      | -24.98     | Peak   |
| 2483.88   | 55.33 | 26.18          | 3.14       | 37.57         | 47.08          | 74.00      | -26.92     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation: $\pi/4$  DQPSK; ; Channel:Low



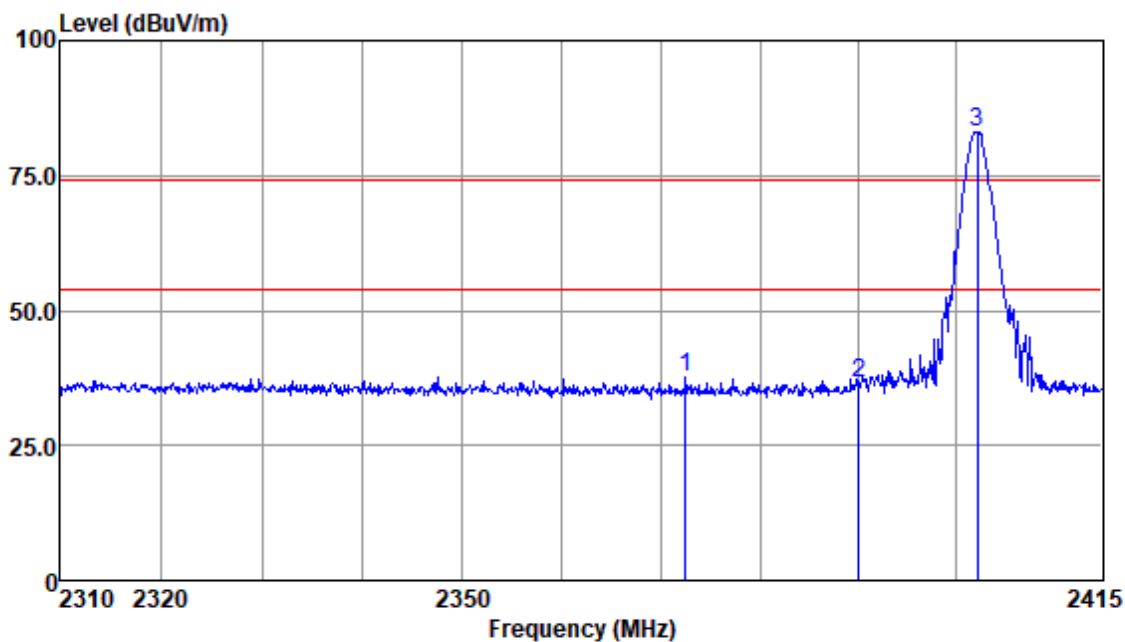
Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2343.51   | 45.84 | 25.97          | 3.08       | 37.37         | 37.52          | 74.00      | -36.48     | Peak   |
| 2390.00   | 45.25 | 26.03          | 3.15       | 37.40         | 37.03          | 74.00      | -36.97     | Peak   |
| 2401.83   | 96.53 | 26.05          | 3.15       | 37.40         | 88.33          | 74.00      | 14.33      | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



Mode:b; Polarization:Vertical; Modulation: $\pi/4$  DQPSK; ; Channel:Low

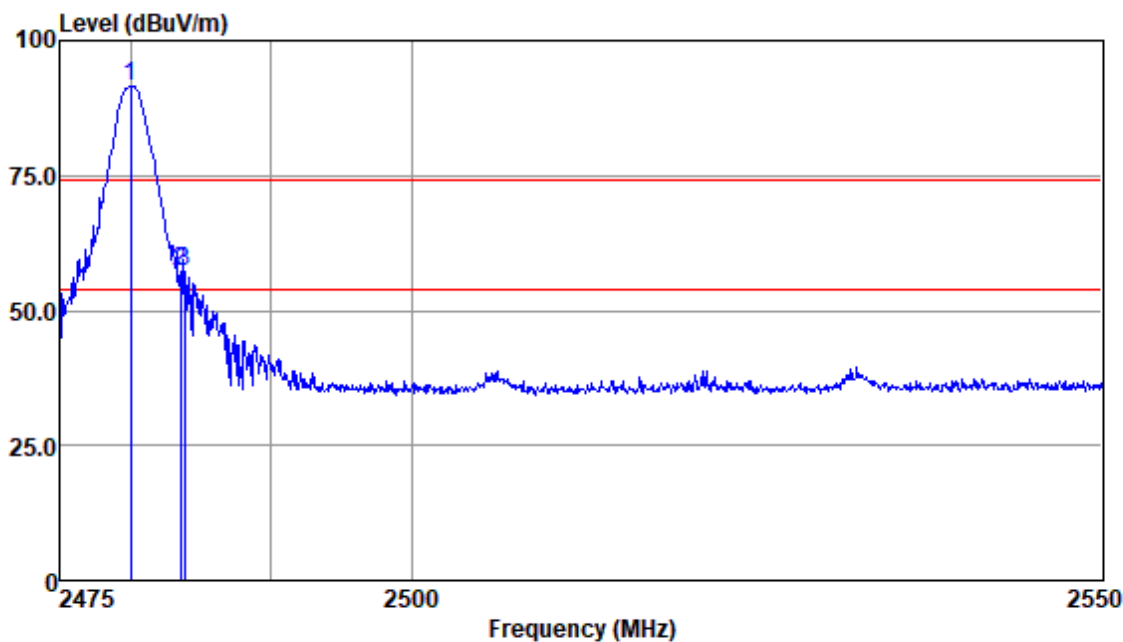


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2372.44   | 45.91 | 26.01          | 3.17       | 37.39         | 37.70          | 74.00      | -36.30     | Peak   |
| 2390.00   | 44.79 | 26.03          | 3.15       | 37.40         | 36.57          | 74.00      | -37.43     | Peak   |
| 2402.15   | 91.32 | 26.05          | 3.14       | 37.40         | 83.11          | 74.00      | 9.11       | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation: $\pi/4$  DQPSK; ; Channel:High

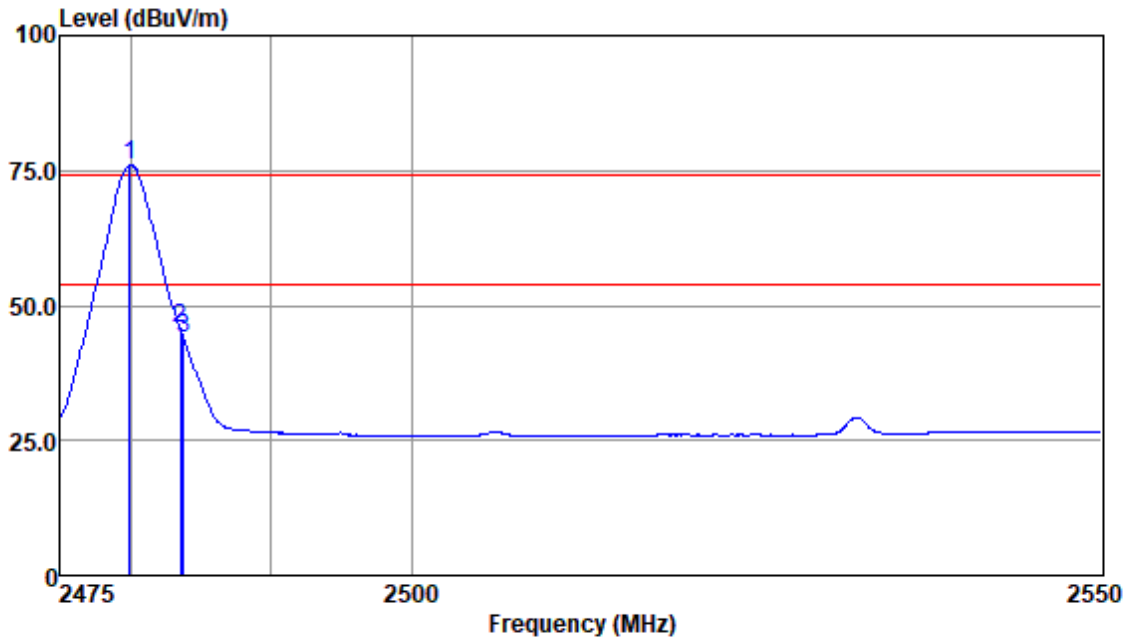


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2479.96   | 99.82 | 26.17          | 3.14       | 37.57         | 91.56          | 74.00      | 17.56      | Peak   |
| 2483.50   | 65.49 | 26.18          | 3.14       | 37.57         | 57.24          | 74.00      | -16.76     | Peak   |
| 2483.81   | 65.50 | 26.18          | 3.14       | 37.57         | 57.25          | 74.00      | -16.75     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation: $\pi/4$  DQPSK; ; Channel:High

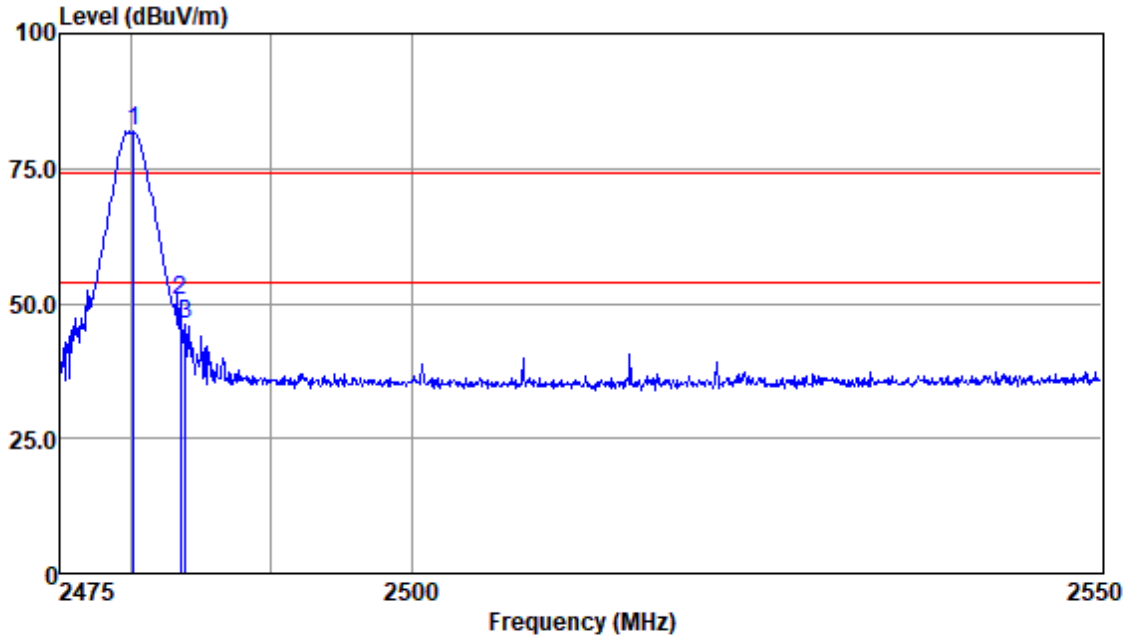


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 2479.88   | 84.40 | 26.17          | 3.14       | 37.57         | 76.14          | 54.00      | 22.14      | Average |
| 2483.50   | 54.10 | 26.18          | 3.14       | 37.57         | 45.85          | 54.00      | -8.15      | Average |
| 2483.73   | 52.24 | 26.18          | 3.14       | 37.57         | 43.99          | 54.00      | -10.01     | Average |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation: $\pi/4$  DQPSK; ; Channel:High

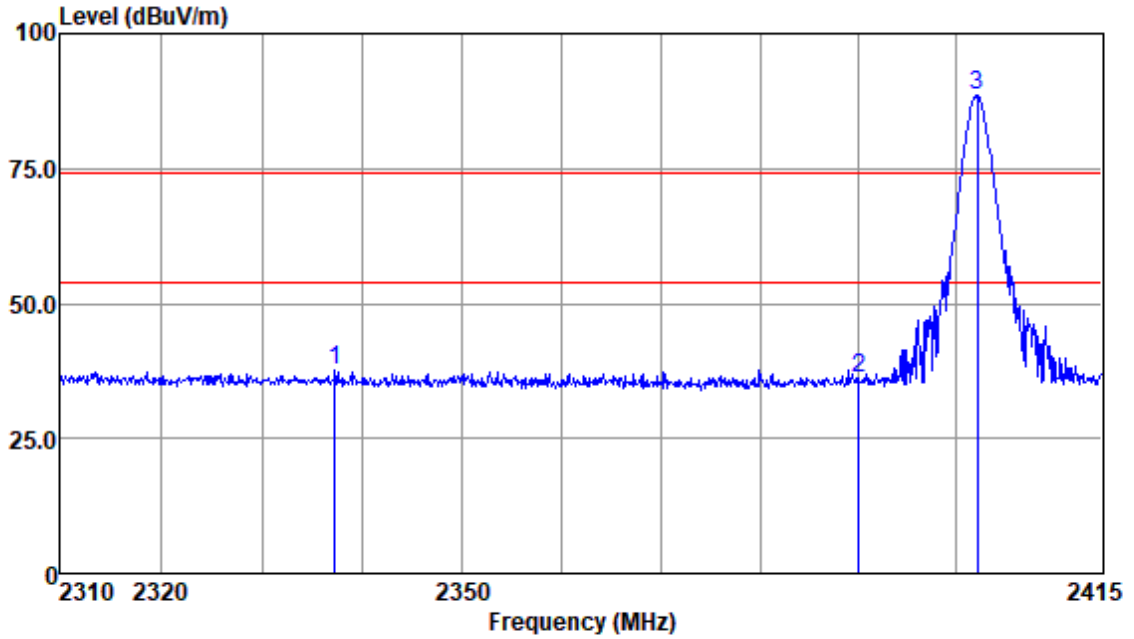


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2480.18   | 90.11 | 26.17          | 3.14       | 37.57         | 81.85          | 74.00      | 7.85       | Peak   |
| 2483.50   | 58.84 | 26.18          | 3.14       | 37.57         | 50.59          | 74.00      | -23.41     | Peak   |
| 2483.88   | 54.47 | 26.18          | 3.14       | 37.57         | 46.22          | 74.00      | -27.78     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:Low

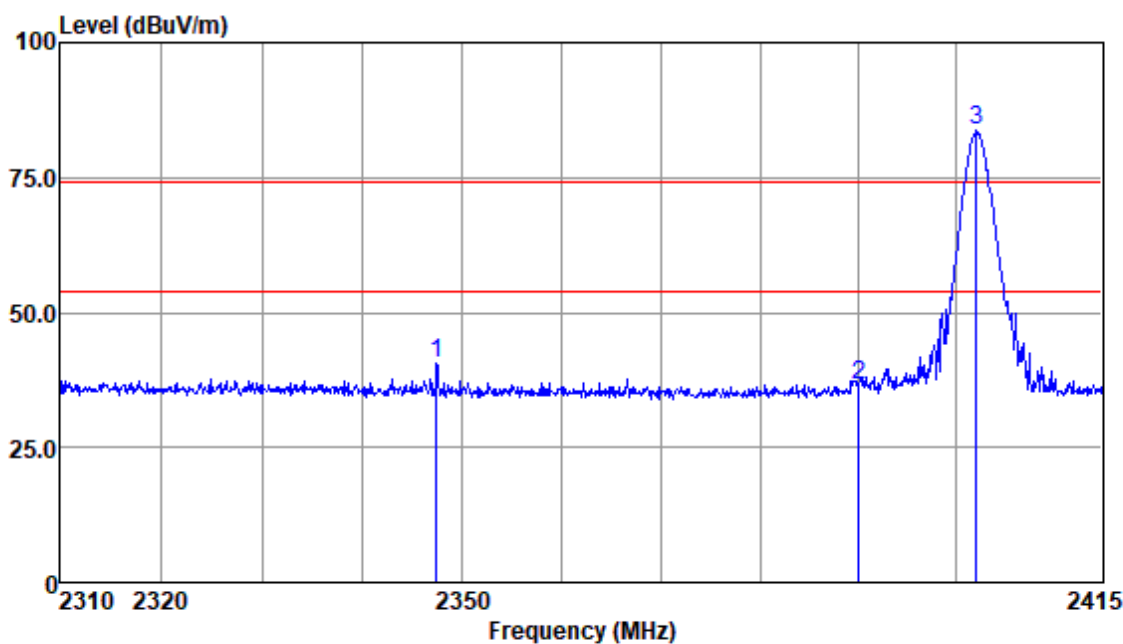


Antenna Polarity :HORIZONTAL

| Read Freq | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2337.16   | 45.98      | 25.96          | 3.05       | 37.37         | 37.62          | 74.00      | -36.38     | Peak   |
| 2390.00   | 44.25      | 26.03          | 3.15       | 37.40         | 36.03          | 74.00      | -37.97     | Peak   |
| 2402.15   | 96.76      | 26.05          | 3.14       | 37.40         | 88.55          | 74.00      | 14.55      | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:Low

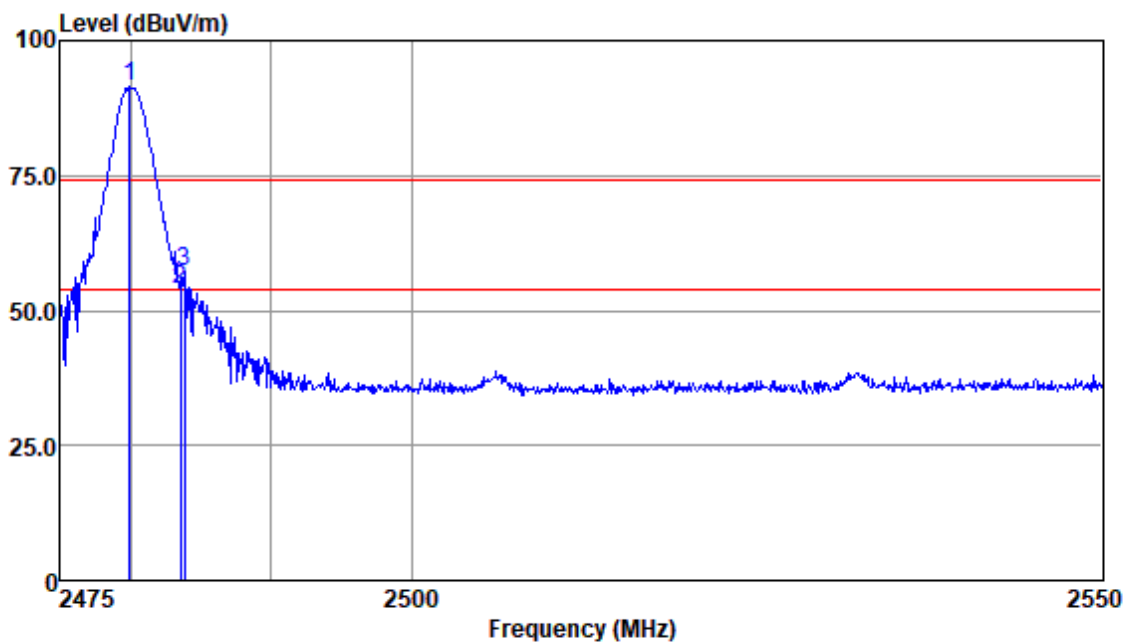


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2347.37   | 48.91 | 25.97          | 3.10       | 37.37         | 40.61          | 74.00      | -33.39     | Peak   |
| 2390.00   | 44.65 | 26.03          | 3.15       | 37.40         | 36.43          | 74.00      | -37.57     | Peak   |
| 2402.05   | 91.89 | 26.05          | 3.14       | 37.40         | 83.68          | 74.00      | 9.68       | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:High

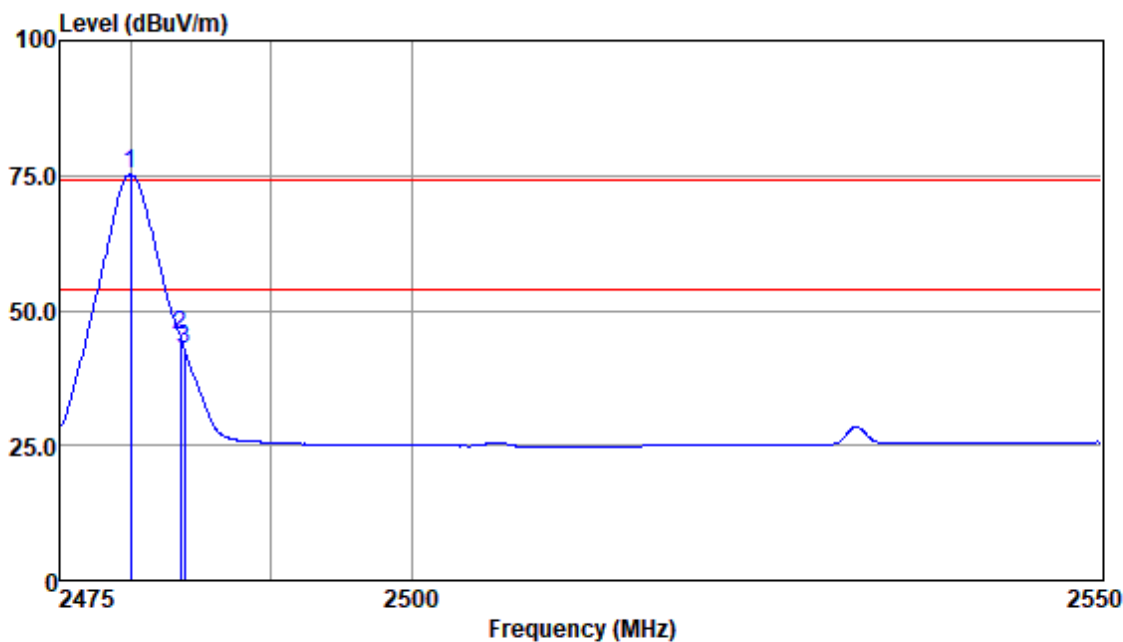


Antenna Polarity :HORIZONTAL

| Read Freq | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2479.88   | 99.66      | 26.17          | 3.14       | 37.57         | 91.40          | 74.00      | 17.40      | Peak   |
| 2483.50   | 62.00      | 26.18          | 3.14       | 37.57         | 53.75          | 74.00      | -20.25     | Peak   |
| 2483.81   | 65.49      | 26.18          | 3.14       | 37.57         | 57.24          | 74.00      | -16.76     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:High



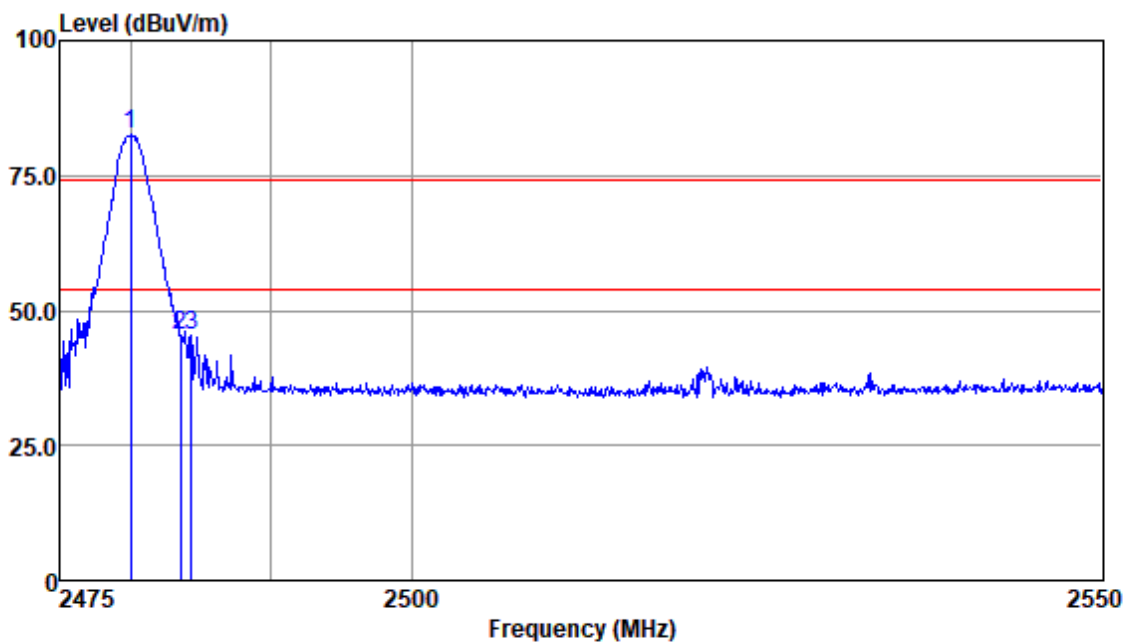
Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 2479.96   | 83.64 | 26.17          | 3.14       | 37.57         | 75.38          | 54.00      | 21.38      | Average |
| 2483.50   | 53.55 | 26.18          | 3.14       | 37.57         | 45.30          | 54.00      | -8.70      | Average |
| 2483.81   | 51.07 | 26.18          | 3.14       | 37.57         | 42.82          | 54.00      | -11.18     | Average |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:High



Antenna Polarity :VERTICAL

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz     | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 2479.96 | 90.75      | 26.17          | 3.14       | 37.57         | 82.49          | 74.00      | 8.49       | Peak   |
| 2483.50 | 53.64      | 26.18          | 3.14       | 37.57         | 45.39          | 74.00      | -28.61     | Peak   |
| 2484.33 | 53.76      | 26.18          | 3.14       | 37.57         | 45.51          | 74.00      | -28.49     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

### 7.10 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209  
Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6  
Limit:

| Frequency(MHz) | Field strength(microvolts/meter) | Measurement distance(meters) |
|----------------|----------------------------------|------------------------------|
| 0.009-0.490    | 2400/F(kHz)                      | 300                          |
| 0.490-1.705    | 24000/F(kHz)                     | 30                           |
| 1.705-30.0     | 30                               | 30                           |
| 30-88          | 100                              | 3                            |
| 88-216         | 150                              | 3                            |
| 216-960        | 200                              | 3                            |
| Above 960      | 500                              | 3                            |

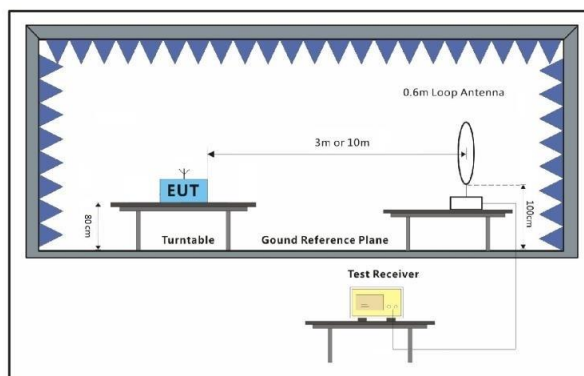
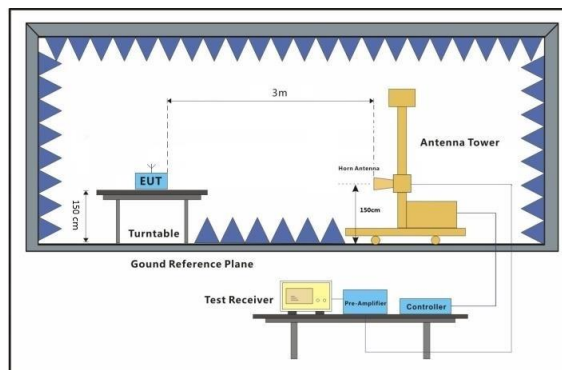
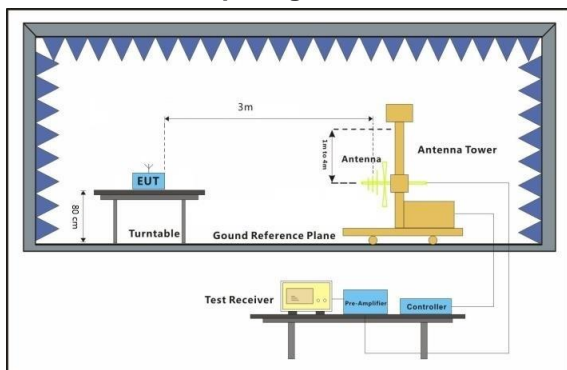
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

#### 7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar  
Test mode b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

#### 7.10.2 Test Setup Diagram



### 7.10.3 Measurement Procedure and Data

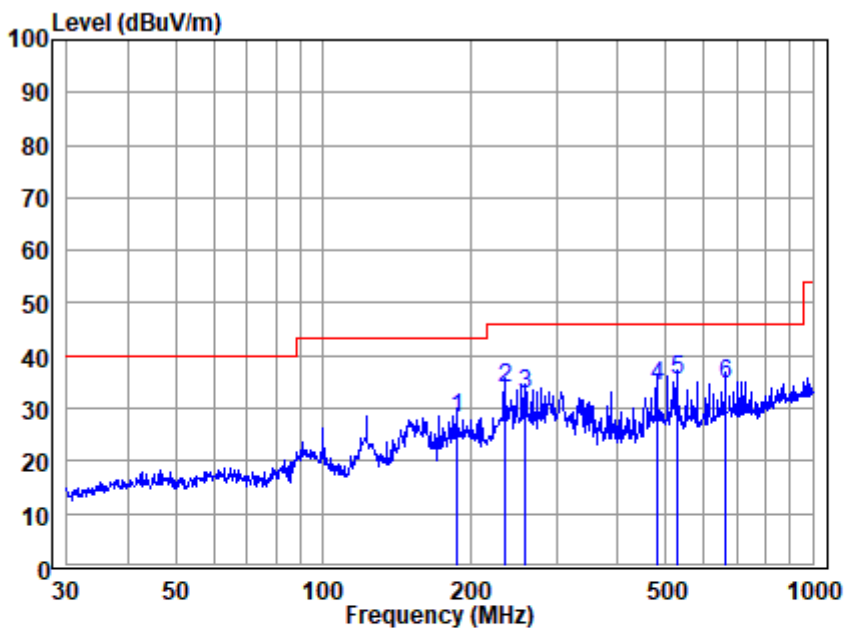
- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

**Remark:**

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Pre-amplifier. The basic equation with a sample calculation is as follows:  
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Pre-amplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown

Below 1GHz

Mode:b; Polarization:Horizontal

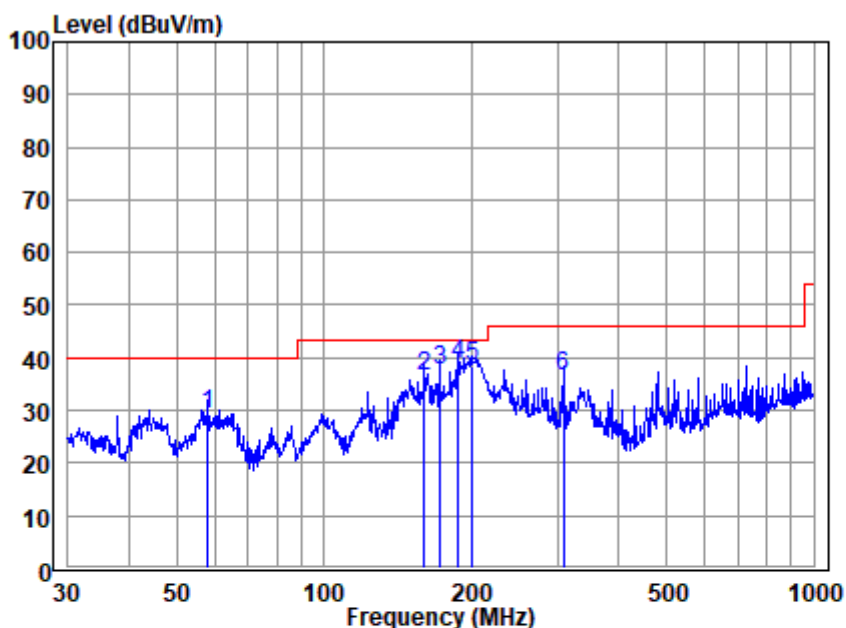


Antenna Polarity :Horizontal

| Freq     | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|----------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz      | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 1 187.10 | 41.09      | 11.35          | 2.45       | 26.70         | 28.19          | 43.50      | -15.31     | QP     |
| 2 234.99 | 46.49      | 11.00          | 2.91       | 26.49         | 33.91          | 46.00      | -12.09     | QP     |
| 3 258.33 | 44.23      | 12.00          | 2.99       | 26.47         | 32.75          | 46.00      | -13.25     | QP     |
| 4 480.53 | 39.84      | 17.94          | 4.36       | 27.75         | 34.39          | 46.00      | -11.61     | QP     |
| 5 528.25 | 39.25      | 19.22          | 4.76       | 27.89         | 35.34          | 46.00      | -10.66     | QP     |
| 6 663.47 | 36.45      | 20.81          | 5.47       | 28.02         | 34.71          | 46.00      | -11.29     | QP     |

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical



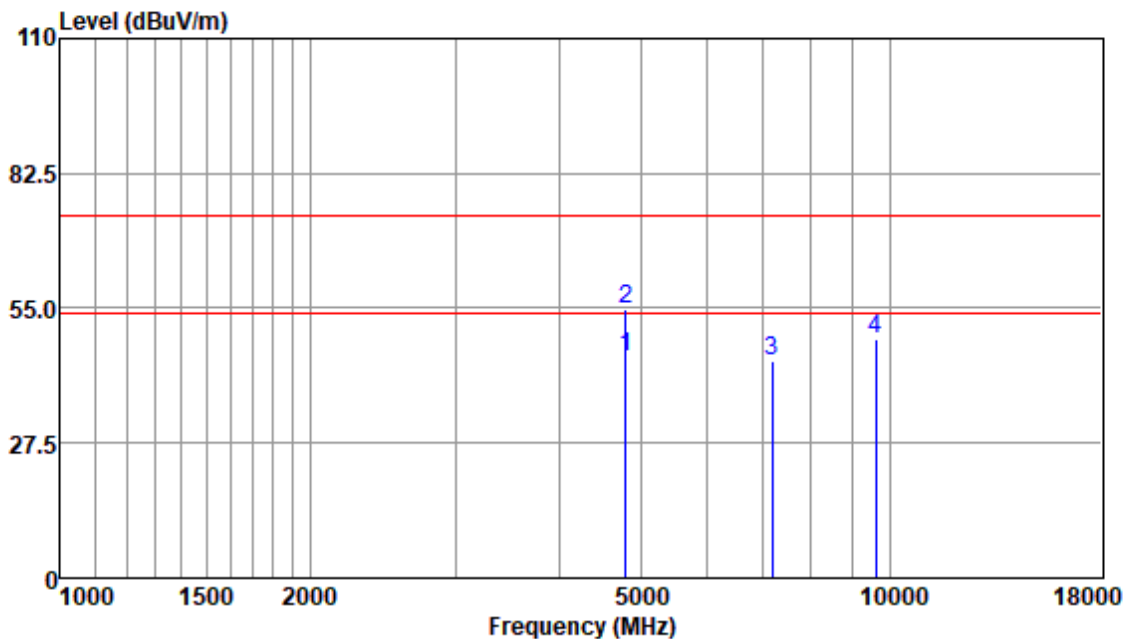
Antenna Polarity :Vertical

|   | Read Freq | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---|-----------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
|   | MHz       | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 1 | 58.00     | 42.05      | 12.80          | 1.35       | 27.11         | 29.09          | 40.00      | -10.91     | QP     |
| 2 | 159.78    | 47.82      | 13.40          | 2.22       | 26.84         | 36.60          | 43.50      | -6.90      | QP     |
| 3 | 171.99    | 49.71      | 12.52          | 2.29       | 26.80         | 37.72          | 43.50      | -5.78      | QP     |
| 4 | 187.10    | 51.61      | 11.35          | 2.45       | 26.70         | 38.71          | 43.50      | -4.79      | QP     |
| 5 | 199.99    | 52.45      | 10.00          | 2.62       | 26.67         | 38.40          | 43.50      | -5.10      | QP     |
| 6 | 307.83    | 46.11      | 13.64          | 3.12       | 26.53         | 36.34          | 46.00      | -9.66      | QP     |

Note: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Above 1GHz

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

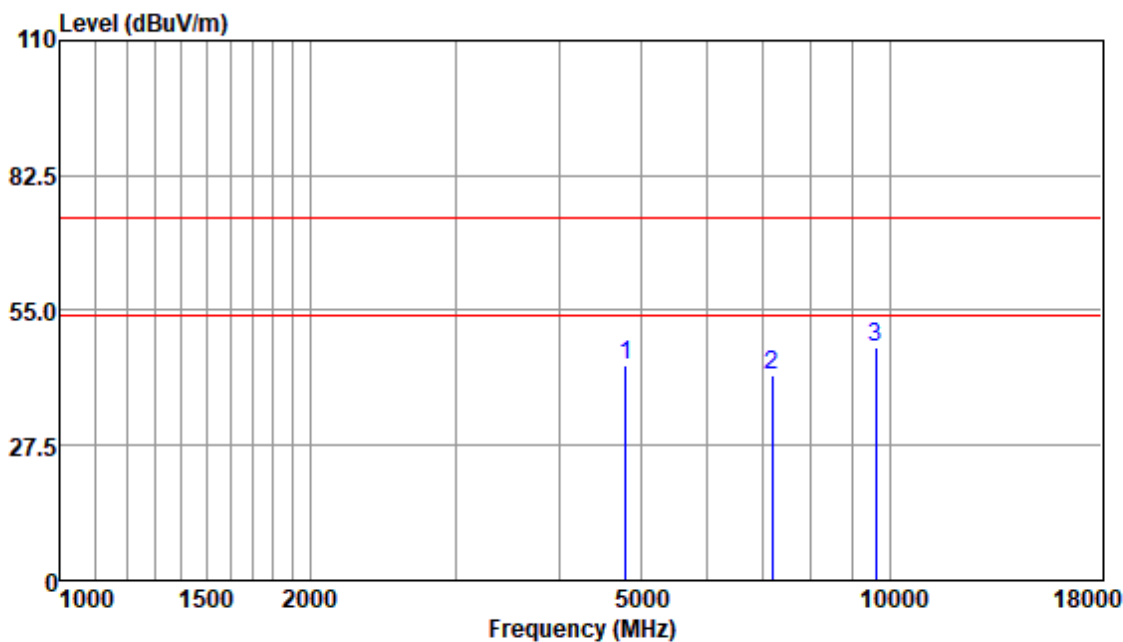


Antenna Polarity :HORIZONTAL

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|---------|------------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz     | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4804.00 | 45.15      | 33.72          | 5.09       | 38.71         | 45.25          | 54.00      | -8.75      | Average |
| 4804.00 | 54.87      | 33.72          | 5.09       | 38.71         | 54.97          | 74.00      | -19.03     | Peak    |
| 7206.00 | 39.39      | 36.28          | 5.75       | 37.18         | 44.24          | 74.00      | -29.76     | Peak    |
| 9608.00 | 38.53      | 37.70          | 6.78       | 34.18         | 48.83          | 74.00      | -25.17     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

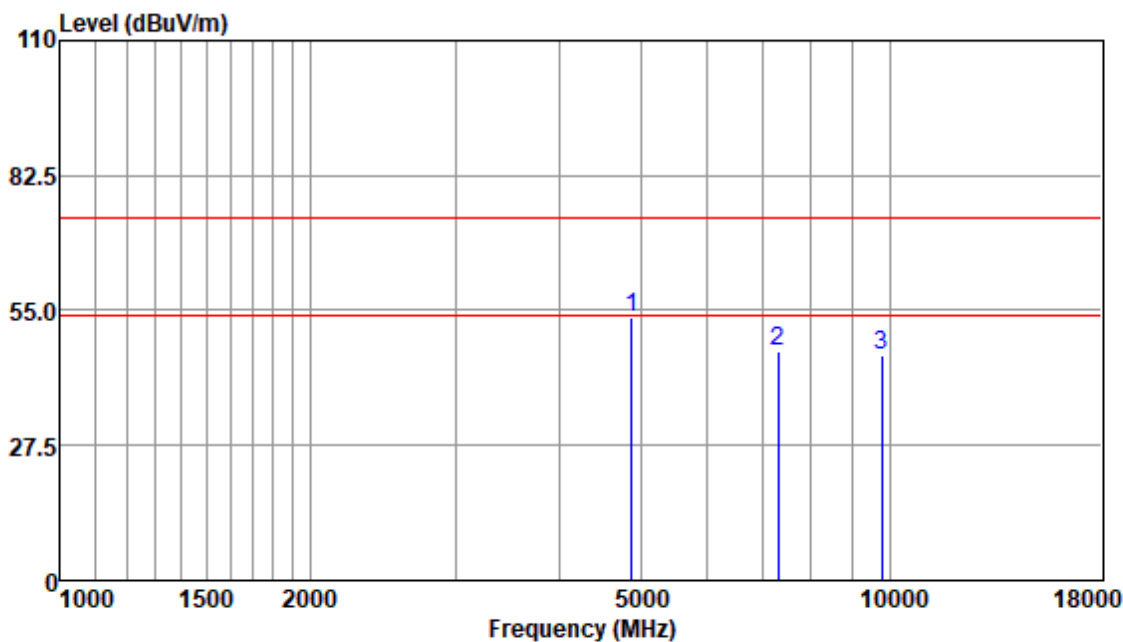


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4804.00   | 43.80 | 33.72          | 5.09       | 38.71         | 43.90          | 74.00      | -30.10     | Peak   |
| 7206.00   | 37.05 | 36.28          | 5.75       | 37.18         | 41.90          | 74.00      | -32.10     | Peak   |
| 9608.00   | 37.16 | 37.70          | 6.78       | 34.18         | 47.46          | 74.00      | -26.54     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle



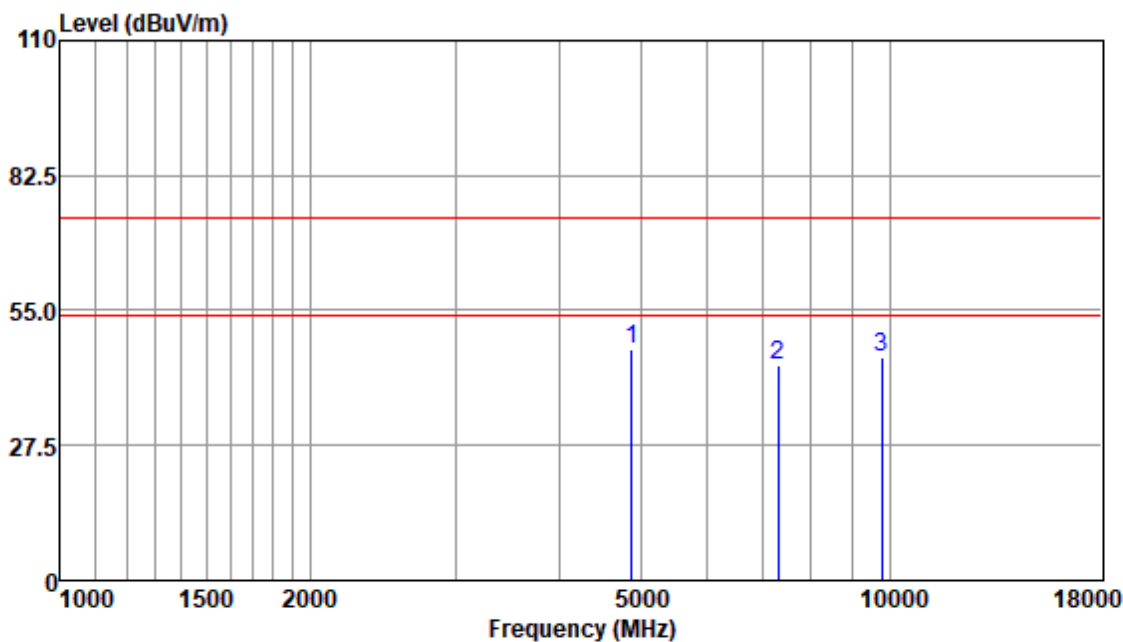
Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4882.00   | 54.10 | 33.95          | 4.48       | 38.78         | 53.75          | 74.00      | -20.25     | Peak   |
| 7323.00   | 41.52 | 36.47          | 5.98       | 37.10         | 46.87          | 74.00      | -27.13     | Peak   |
| 9764.00   | 35.95 | 37.68          | 6.48       | 34.14         | 45.97          | 74.00      | -28.03     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:middle

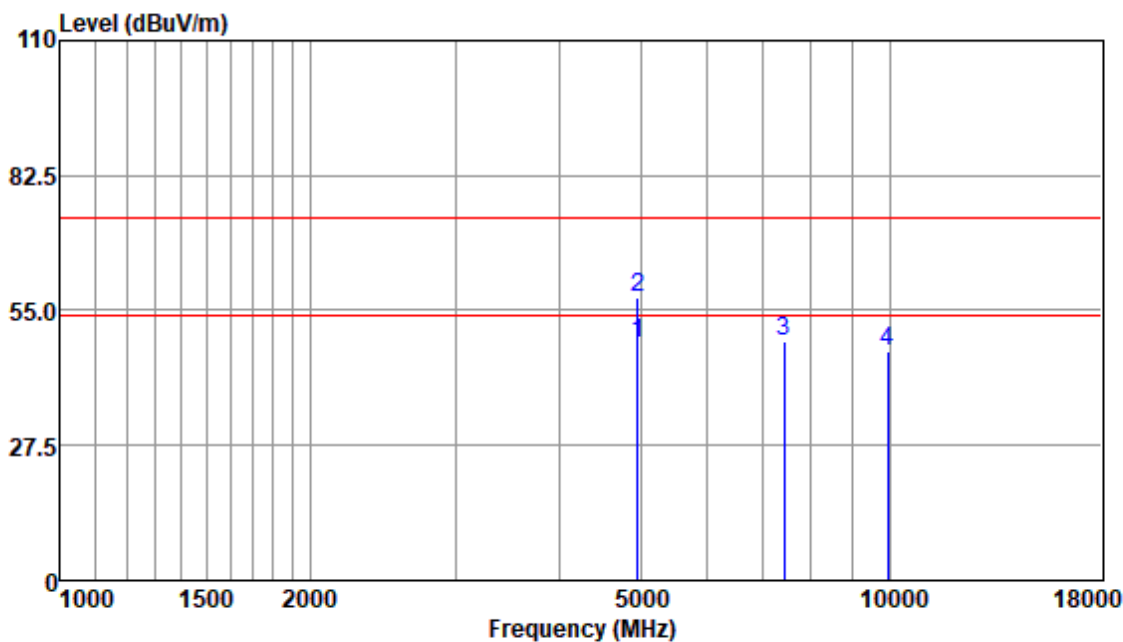


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4882.00   | 47.48 | 33.95          | 4.48       | 38.78         | 47.13          | 74.00      | -26.87     | Peak   |
| 7323.00   | 38.34 | 36.47          | 5.98       | 37.10         | 43.69          | 74.00      | -30.31     | Peak   |
| 9764.00   | 35.29 | 37.68          | 6.48       | 34.14         | 45.31          | 74.00      | -28.69     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

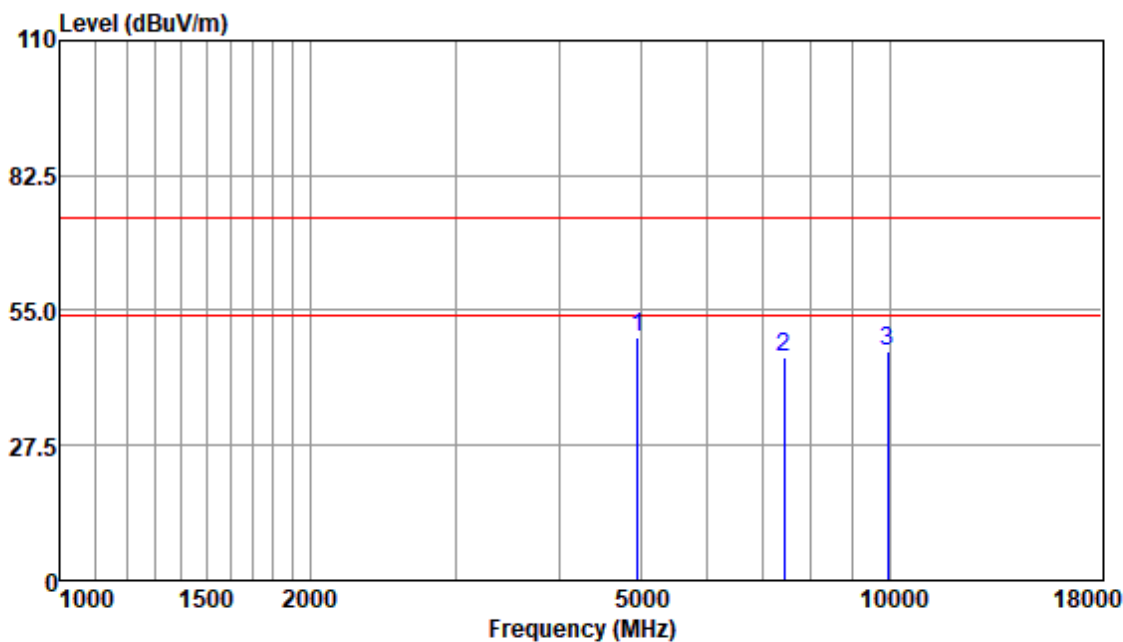


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4960.00   | 48.16 | 33.98          | 5.04       | 38.87         | 48.31          | 54.00      | -5.69      | Average |
| 4960.00   | 57.54 | 33.98          | 5.04       | 38.87         | 57.69          | 74.00      | -16.31     | Peak    |
| 7440.00   | 43.35 | 36.40          | 6.09       | 37.03         | 48.81          | 74.00      | -25.19     | Peak    |
| 9920.00   | 36.59 | 37.81          | 6.53       | 34.11         | 46.82          | 74.00      | -27.18     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High



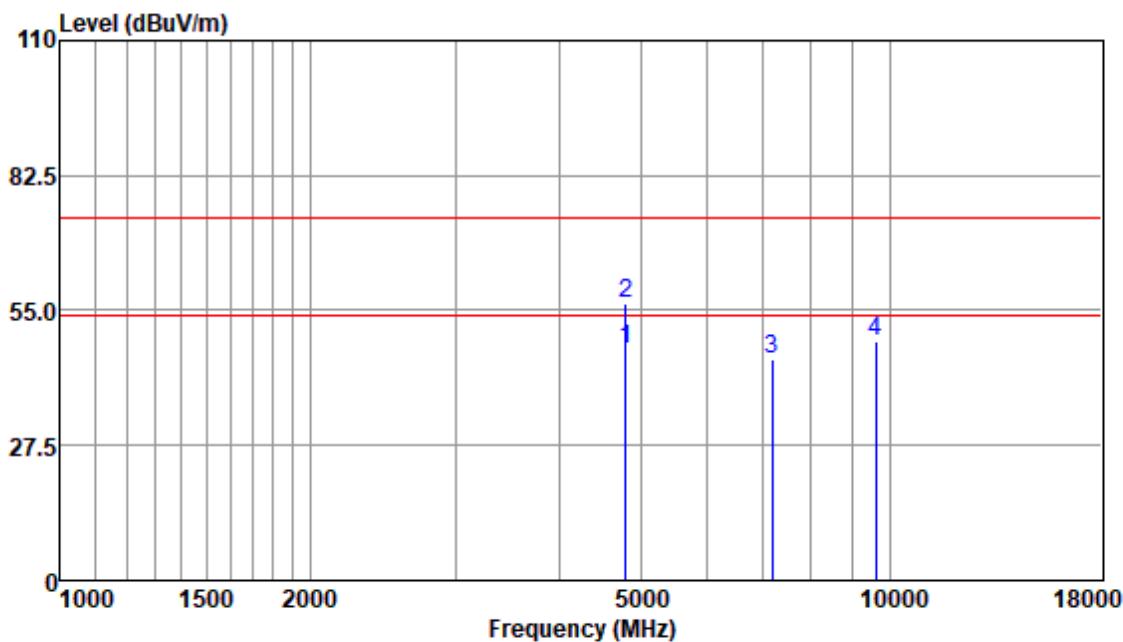
Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4960.00   | 49.35 | 33.98          | 5.04       | 38.87         | 49.50          | 74.00      | -24.50     | Peak   |
| 7440.00   | 39.98 | 36.40          | 6.09       | 37.03         | 45.44          | 74.00      | -28.56     | Peak   |
| 9920.00   | 36.43 | 37.81          | 6.53       | 34.11         | 46.66          | 74.00      | -27.34     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



Mode:b; Polarization:Horizontal; Modulation:π/4 DQPSK; ; Channel:Low

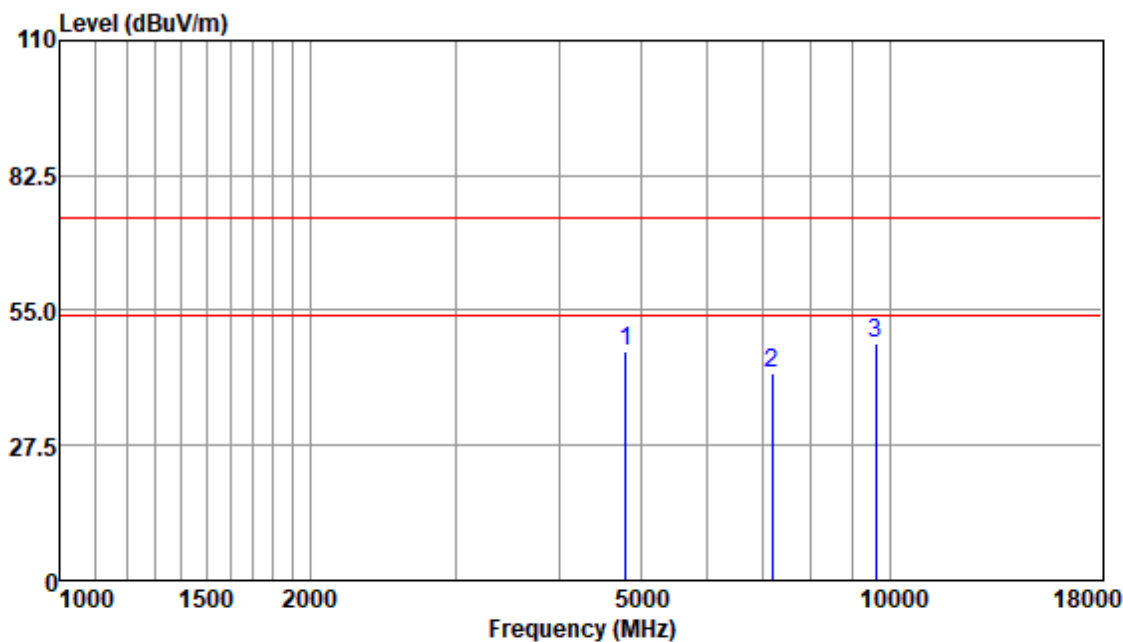


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4804.00   | 46.95 | 33.72          | 5.09       | 38.71         | 47.05          | 54.00      | -6.95      | Average |
| 4804.00   | 56.51 | 33.72          | 5.09       | 38.71         | 56.61          | 74.00      | -17.39     | Peak    |
| 7206.00   | 40.15 | 36.28          | 5.75       | 37.18         | 45.00          | 74.00      | -29.00     | Peak    |
| 9608.00   | 38.25 | 37.70          | 6.78       | 34.18         | 48.55          | 74.00      | -25.45     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation: $\pi/4$  DQPSK; ; Channel:Low

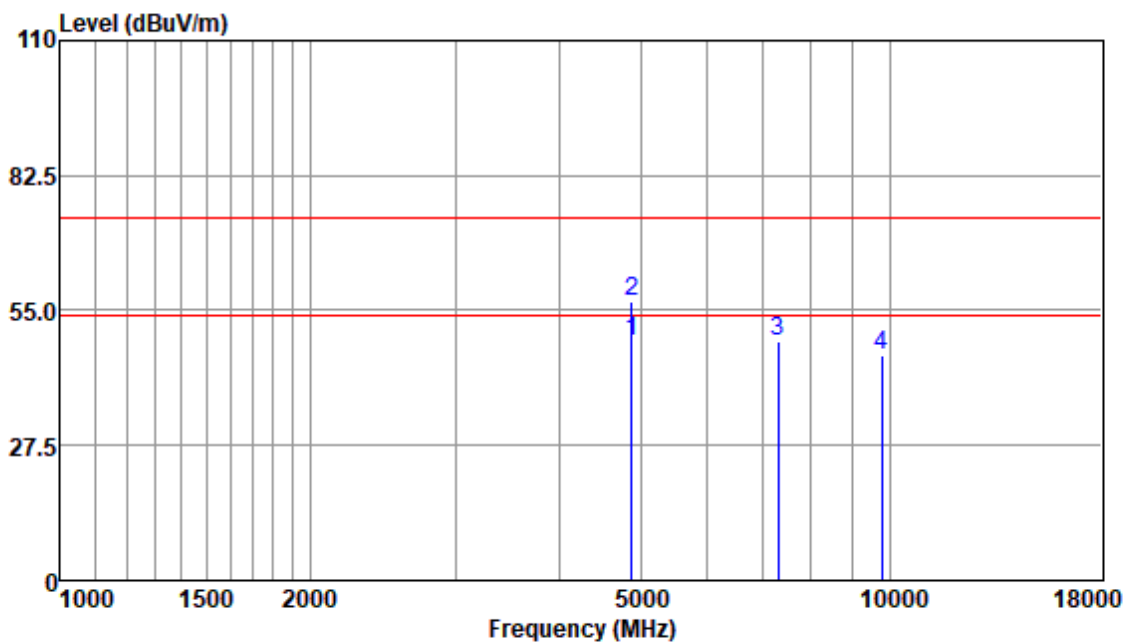


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4804.00   | 46.59 | 33.72          | 5.09       | 38.71         | 46.69          | 74.00      | -27.31     | Peak   |
| 7206.00   | 37.30 | 36.28          | 5.75       | 37.18         | 42.15          | 74.00      | -31.85     | Peak   |
| 9608.00   | 37.82 | 37.70          | 6.78       | 34.18         | 48.12          | 74.00      | -25.88     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation: $\pi/4$  DQPSK; ; Channel:middle

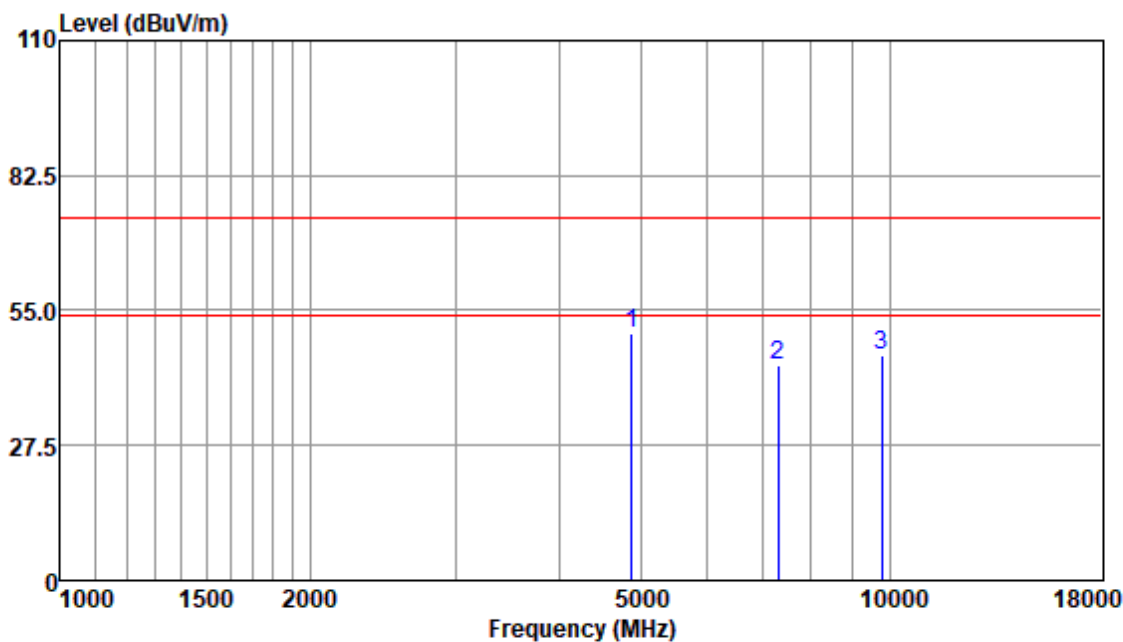


Antenna Polarity :HORIZONTAL

| Read Freq | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|------------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4882.00   | 48.95      | 33.95          | 4.48       | 38.78         | 48.60          | 54.00      | -5.40      | Average |
| 4882.00   | 57.38      | 33.95          | 4.48       | 38.78         | 57.03          | 74.00      | -16.97     | Peak    |
| 7323.00   | 43.50      | 36.47          | 5.98       | 37.10         | 48.85          | 74.00      | -25.15     | Peak    |
| 9764.00   | 35.68      | 37.68          | 6.48       | 34.14         | 45.70          | 74.00      | -28.30     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation: $\pi/4$  DQPSK; ; Channel:middle

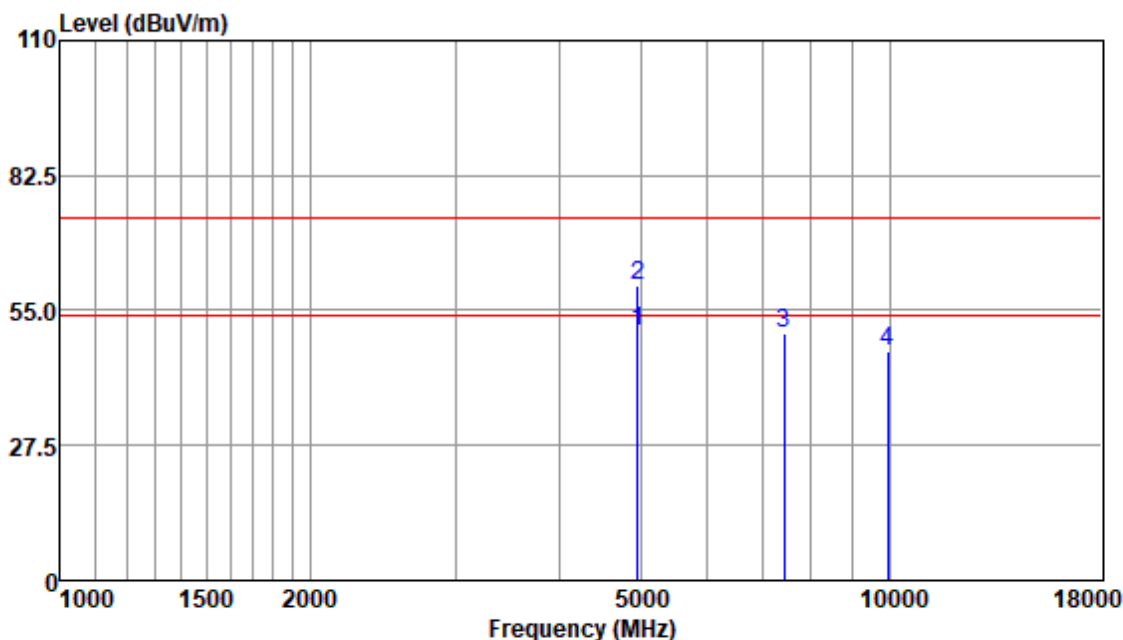


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4882.00   | 50.59 | 33.95          | 4.48       | 38.78         | 50.24          | 74.00      | -23.76     | Peak   |
| 7323.00   | 38.43 | 36.47          | 5.98       | 37.10         | 43.78          | 74.00      | -30.22     | Peak   |
| 9764.00   | 35.98 | 37.68          | 6.48       | 34.14         | 46.00          | 74.00      | -28.00     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation: $\pi/4$  DQPSK; ; Channel:High



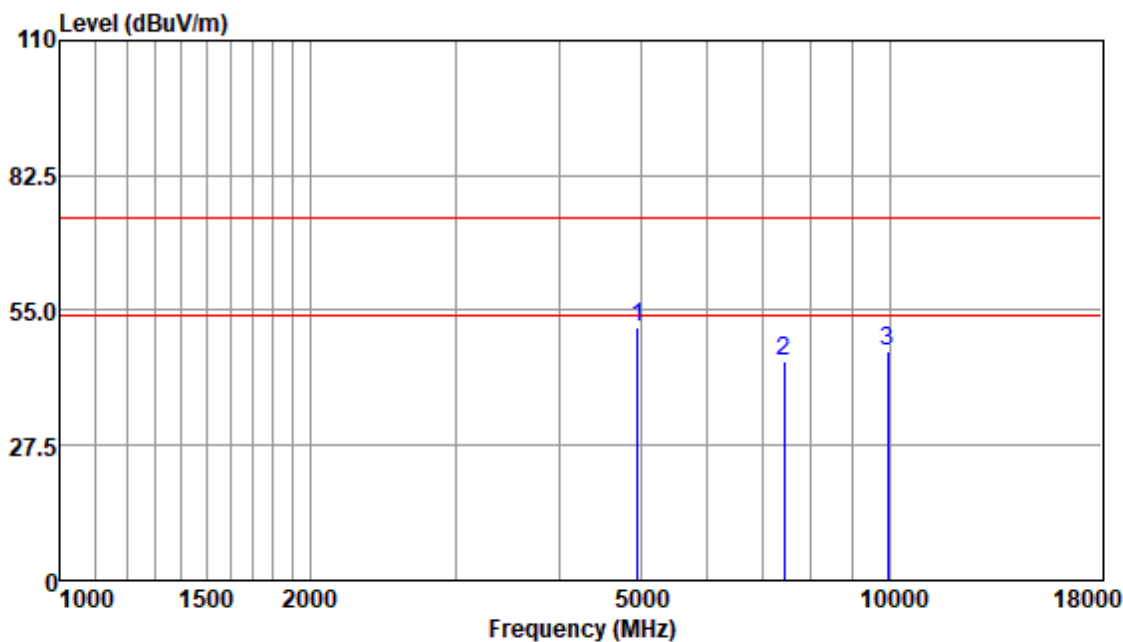
Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4960.00   | 50.51 | 33.98          | 5.04       | 38.87         | 50.66          | 54.00      | -3.34      | Average |
| 4960.00   | 59.83 | 33.98          | 5.04       | 38.87         | 59.98          | 74.00      | -14.02     | Peak    |
| 7440.00   | 44.86 | 36.40          | 6.09       | 37.03         | 50.32          | 74.00      | -23.68     | Peak    |
| 9920.00   | 36.44 | 37.81          | 6.53       | 34.11         | 46.67          | 74.00      | -27.33     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



Mode:b; Polarization:Vertical; Modulation: $\pi/4$  DQPSK; ; Channel:High

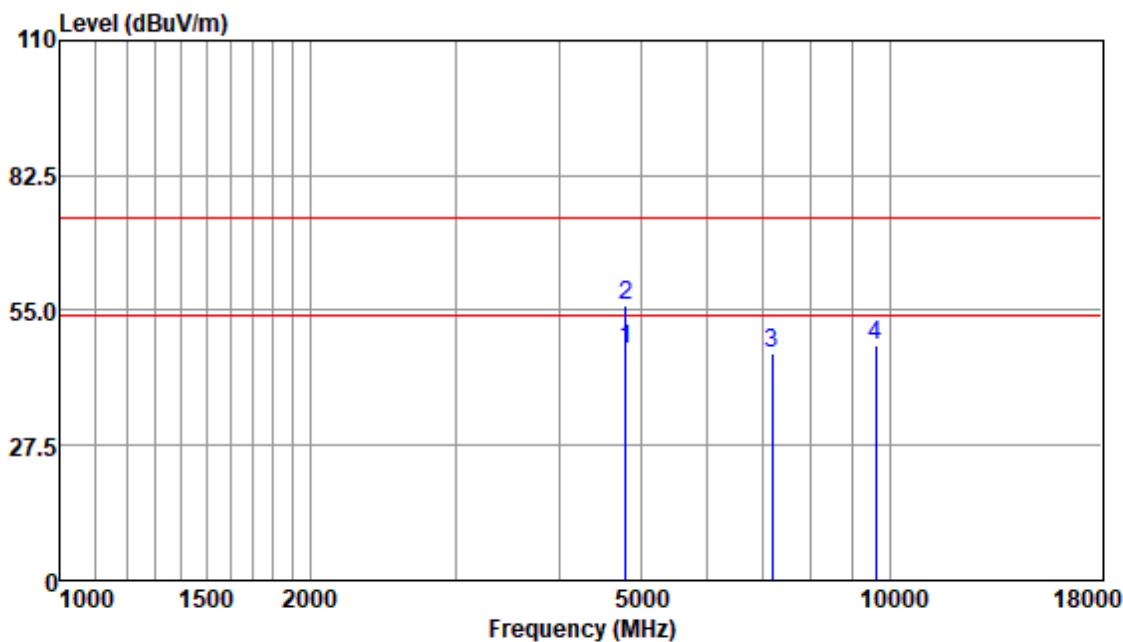


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4960.00   | 51.30 | 33.98          | 5.04       | 38.87         | 51.45          | 74.00      | -22.55     | Peak   |
| 7440.00   | 39.39 | 36.40          | 6.09       | 37.03         | 44.85          | 74.00      | -29.15     | Peak   |
| 9920.00   | 36.41 | 37.81          | 6.53       | 34.11         | 46.64          | 74.00      | -27.36     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:Low

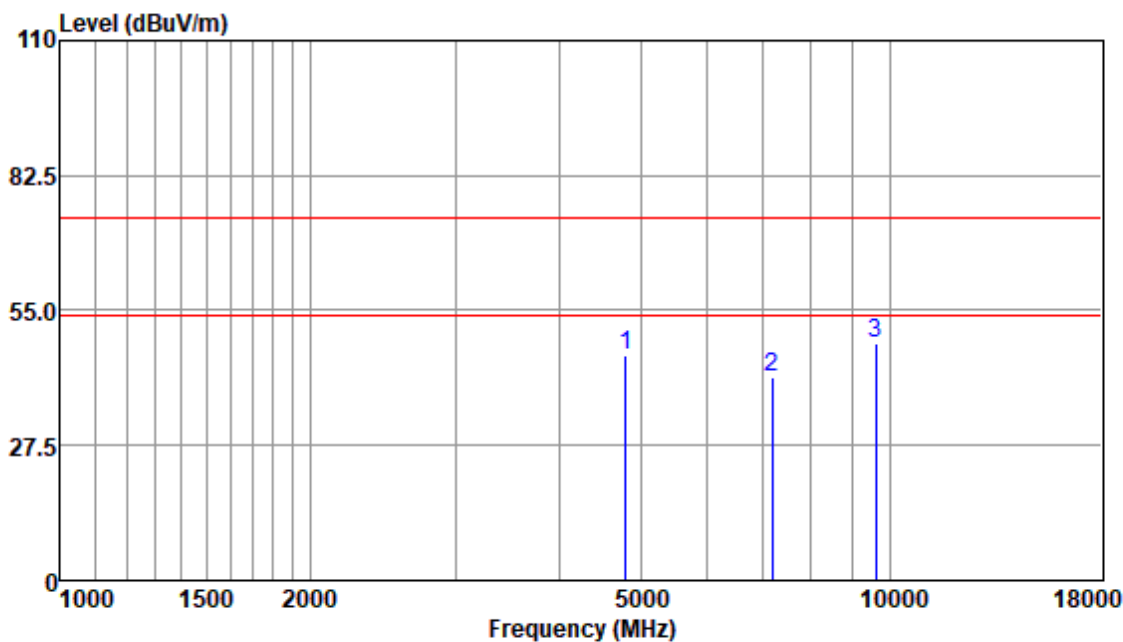


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4804.00   | 46.99 | 33.72          | 5.09       | 38.71         | 47.09          | 54.00      | -6.91      | Average |
| 4804.00   | 55.99 | 33.72          | 5.09       | 38.71         | 56.09          | 74.00      | -17.91     | Peak    |
| 7206.00   | 41.26 | 36.28          | 5.75       | 37.18         | 46.11          | 74.00      | -27.89     | Peak    |
| 9608.00   | 37.64 | 37.70          | 6.78       | 34.18         | 47.94          | 74.00      | -26.06     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:Low

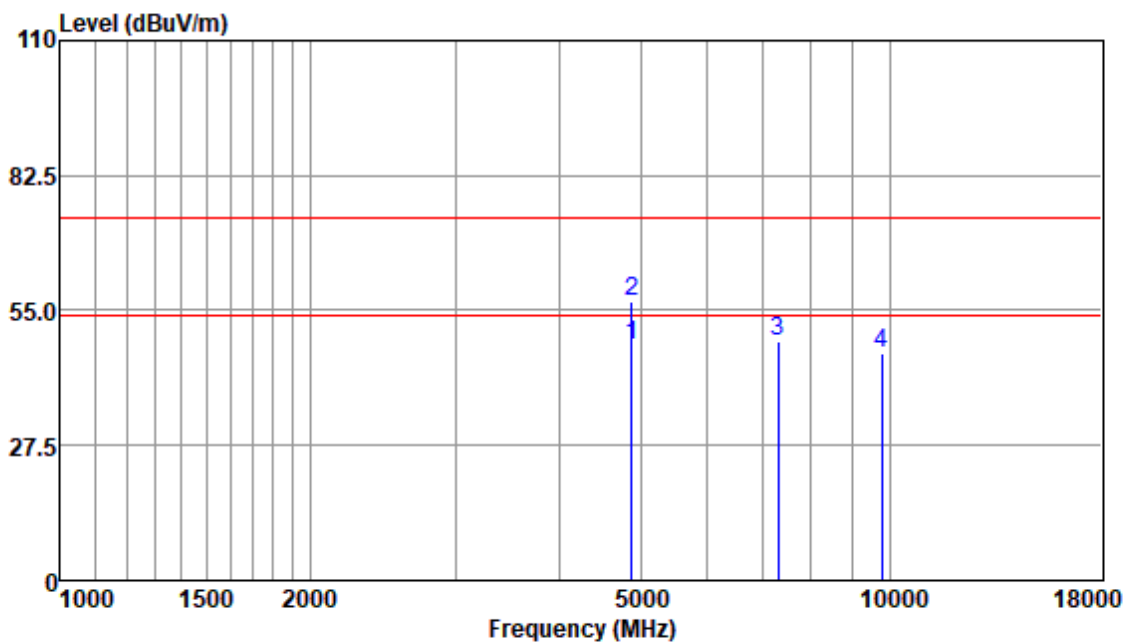


Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4804.00   | 45.84 | 33.72          | 5.09       | 38.71         | 45.94          | 74.00      | -28.06     | Peak   |
| 7206.00   | 36.74 | 36.28          | 5.75       | 37.18         | 41.59          | 74.00      | -32.41     | Peak   |
| 9608.00   | 38.14 | 37.70          | 6.78       | 34.18         | 48.44          | 74.00      | -25.56     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:middle

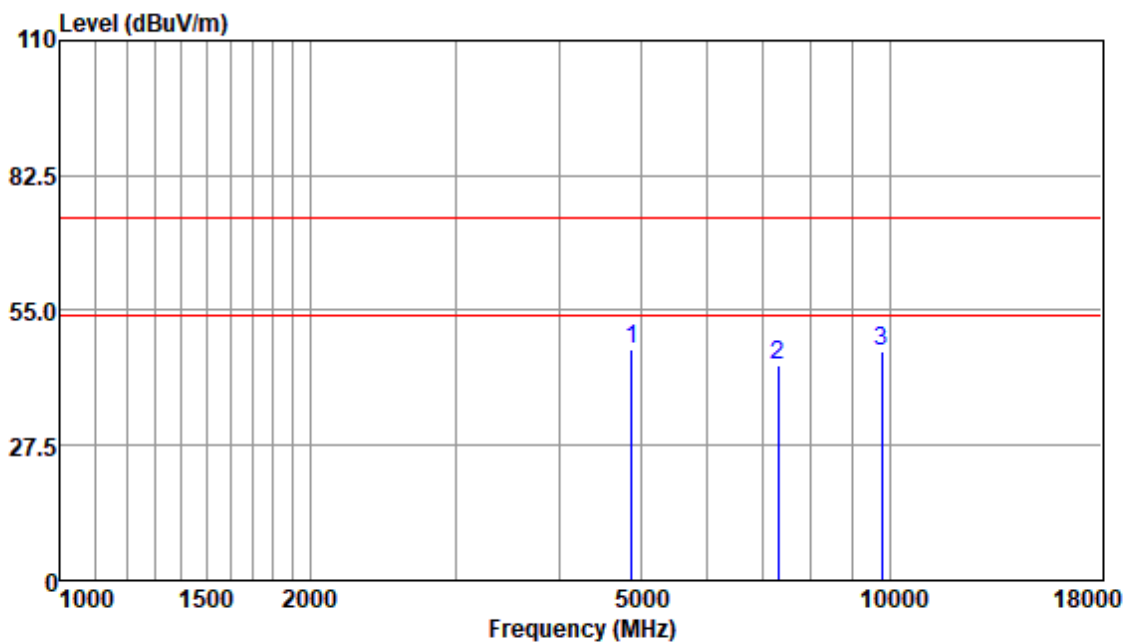


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4882.00   | 48.45 | 33.95          | 4.48       | 38.78         | 48.10          | 54.00      | -5.90      | Average |
| 4882.00   | 57.29 | 33.95          | 4.48       | 38.78         | 56.94          | 74.00      | -17.06     | Peak    |
| 7323.00   | 43.25 | 36.47          | 5.98       | 37.10         | 48.60          | 74.00      | -25.40     | Peak    |
| 9764.00   | 36.27 | 37.68          | 6.48       | 34.14         | 46.29          | 74.00      | -27.71     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:middle



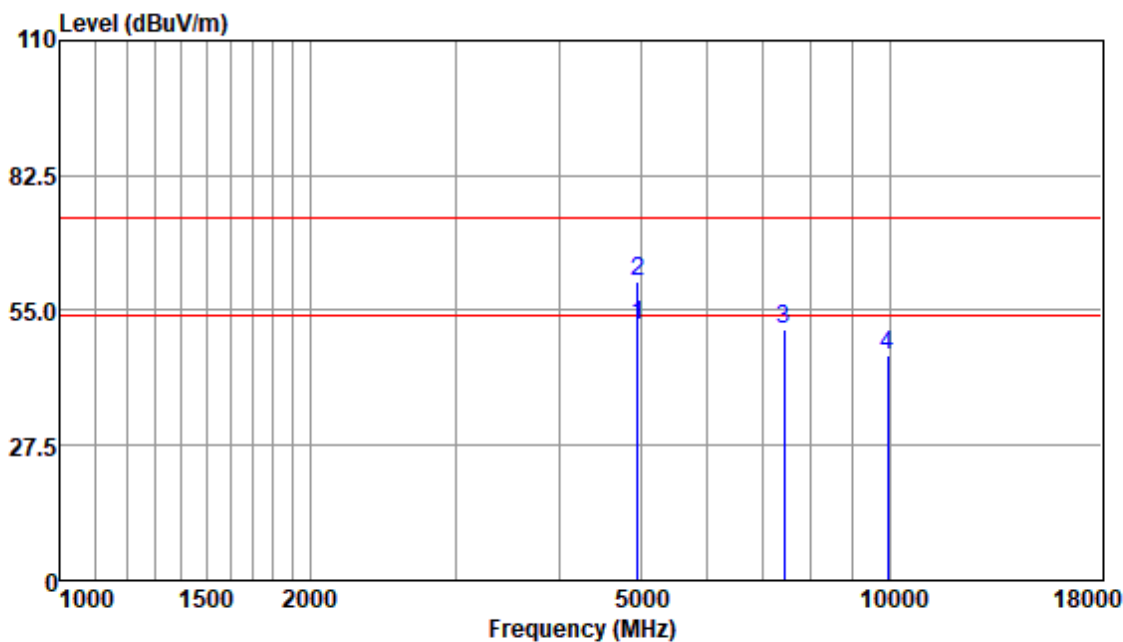
Antenna Polarity :VERTICAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4882.00   | 47.36 | 33.95          | 4.48       | 38.78         | 47.01          | 74.00      | -26.99     | Peak   |
| 7323.00   | 38.45 | 36.47          | 5.98       | 37.10         | 43.80          | 74.00      | -30.20     | Peak   |
| 9764.00   | 36.54 | 37.68          | 6.48       | 34.14         | 46.56          | 74.00      | -27.44     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor



Mode:b; Polarization:Horizontal; Modulation:8DPSK; ; Channel:High

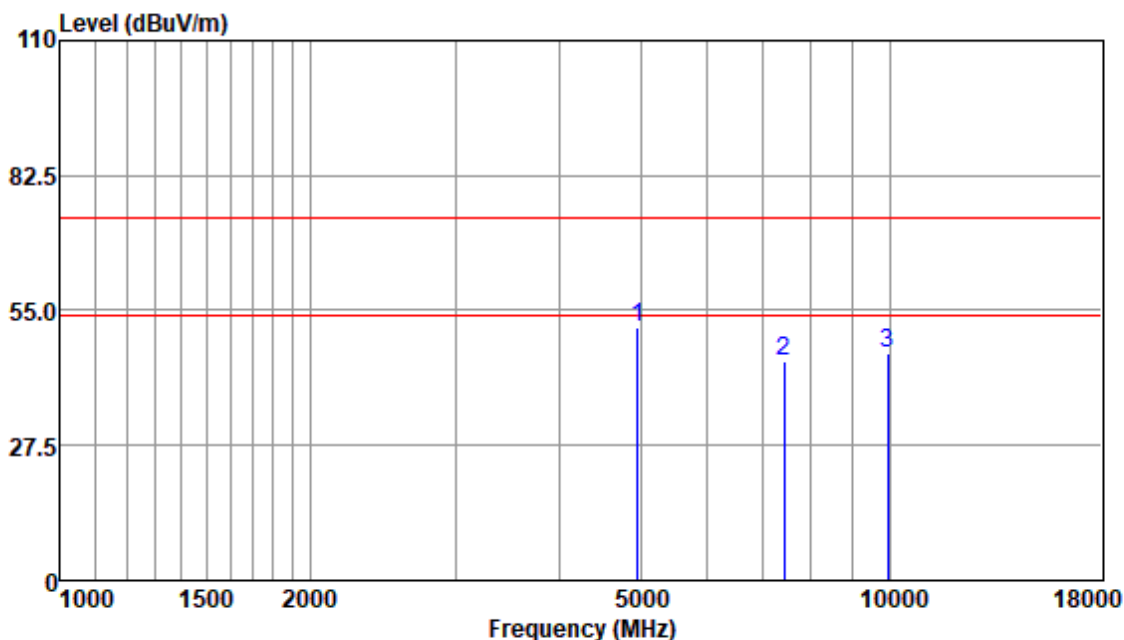


Antenna Polarity :HORIZONTAL

| Read Freq | Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark  |
|-----------|-------|----------------|------------|---------------|----------------|------------|------------|---------|
| MHz       | dBuv  | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |         |
| 4960.00   | 51.81 | 33.98          | 5.04       | 38.87         | 51.96          | 54.00      | -2.04      | Average |
| 4960.00   | 60.62 | 33.98          | 5.04       | 38.87         | 60.77          | 74.00      | -13.23     | Peak    |
| 7440.00   | 45.64 | 36.40          | 6.09       | 37.03         | 51.10          | 74.00      | -22.90     | Peak    |
| 9920.00   | 35.72 | 37.81          | 6.53       | 34.11         | 45.95          | 74.00      | -28.05     | Peak    |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Modulation:8DPSK; ; Channel:High



Antenna Polarity :VERTICAL

| Freq    | Read Level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---------|------------|----------------|------------|---------------|----------------|------------|------------|--------|
| MHz     | dBuv       | dB/m           | dB         | dB            | dBuv/m         | dBuv/m     | dB         |        |
| 4960.00 | 51.59      | 33.98          | 5.04       | 38.87         | 51.74          | 74.00      | -22.26     | Peak   |
| 7440.00 | 39.37      | 36.40          | 6.09       | 37.03         | 44.83          | 74.00      | -29.17     | Peak   |
| 9920.00 | 35.90      | 37.81          | 6.53       | 34.11         | 46.13          | 74.00      | -27.87     | Peak   |

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

**7.11 99% Bandwidth**

Test Requirement      RSS-Gen Section 6.7  
Test Method:            ANSI C63.10 Section 6.9.3

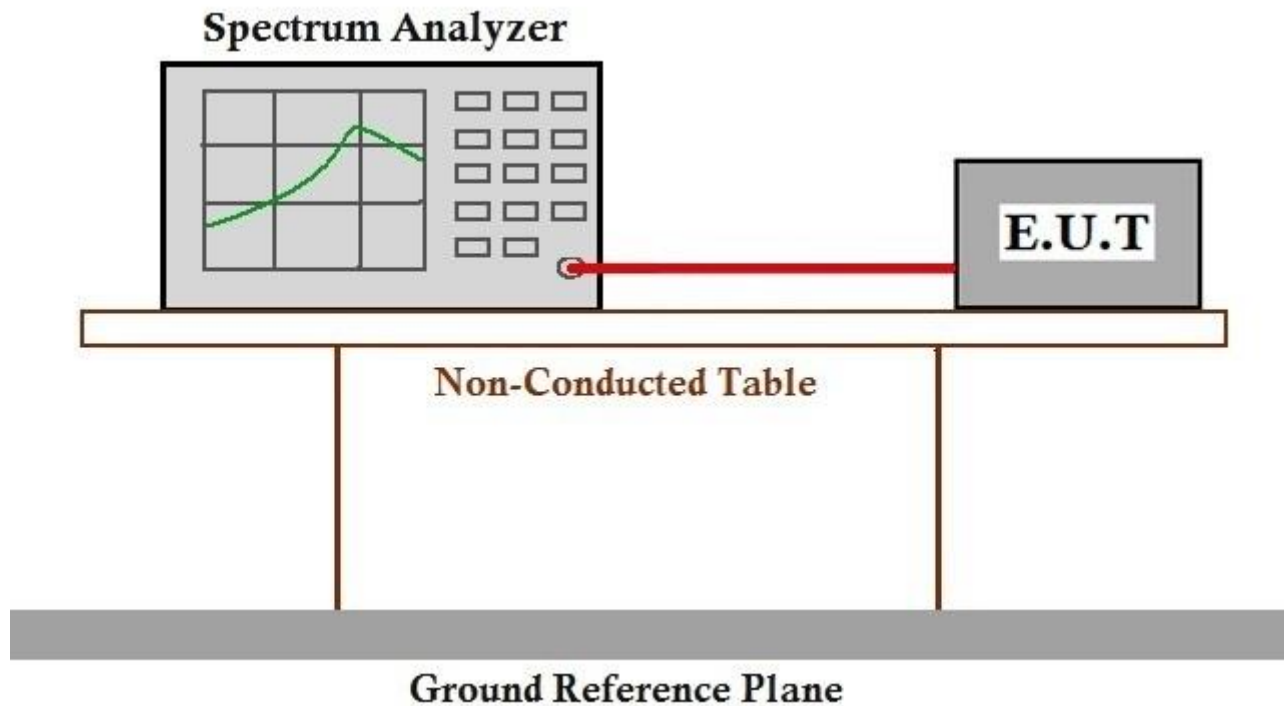
**7.11.1 E.U.T. Operation**

Operating Environment:

Temperature:    22 °C                    Humidity:    50 % RH                    Atmospheric Pressure: 1020 mbar

Test mode        b:TX\_non-Hop mode\_Keep the EUT in continuously transmitting mode with GFSK modulation,  $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

**7.11.2 Test Setup Diagram**



**7.11.3 Measurement Procedure and Data**

The detailed test data see: Appendix A for SHEM200200101501





## **8 Test Setup Photographs**

Refer to the < Test Setup photos-FCC>.

## **9 EUT Constructional Details**

Refer to the < External Photos > & < Internal Photos >.

**- End of the Report -**