.

# Test Report of FCC CFR 47 Part 15 Subpart C

## On Behalf of

**TIC AUDIO INC**

15224 STAFFORD STREET CITY OF INDUSTRY, CA 91744, USA

| | |
|---|---|
| Product Name: | **Bluetooth Speaker** |
| Model/Type No.: | **BA1, Parasol** |
| FCC ID: | **2AJNG-BA1** |
| Prepared By: | **Shenzhen Hongcai Testing Technology Co., Ltd.**<br>1st-3rd Floor, Building C, Shuanghuan Xin Yi Dai Hi-Tech Industrial Park, No.8 Baoqing Road, Baolong Industrial Zone, Longgang District, Shenzhen, Guangdong, China<br>Tel: +86-755-86337020<br>Fax:+86-755-86337028 |
| Report Number: | HCT16IR236E |
| Tested Date: | October 10~31, 2016 |
| Issued Date: | October 31, 2016 |
| Tested By: | Jerry Zhao/ Jerry Zhao |

Reviewed By: Owen Yang

Owen.Yang
EMC Technical Supervisor

Approved By: Tony Wu

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## TABLE OF CONTENTS





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# 1. GENERAL INFORMATION

## 1.1 Product Description for Equipment Under Test (EUT)

Client Information

| | |
|---|---|
| Applicant: | **TIC AUDIO INC** |
| Address of applicant: | 15224 STAFFORD STREET CITY OF INDUSTRY, CA 91744, USA |
| Manufacturer : | **Shenzhen Accolade Sound Technology Co., Ltd.** |
| Address of manufacturer: | Room 3010, 3rd, C1, Yintian Industrial Zone, Yantian Area, Xixiang, Baoan, Shenzhen, China |

General Description of E.U.T

| **Items** | **Description** |
|---|---|
| EUT Description: | Bluetooth Speaker |
| Model No.: | BA1 |
| Supplementary model: | Parasol |
| Trade Mark: | TIC |
| BT Module | V2.1 + EDR |
| Frequency Band: | 2402~2480MHz |
| Number of Channels: | 79 |
| Type of Modulation: | GFSK, Pi/4 DQPSK, 8-DPSK |
| Antenna Gain | 0 dBi |
| Antenna Type: | PCB Antenna |
| Power Supply: | DC 18V, 2A |
| Adapter information: | Adapter 1:CB65-180200W<br>Input: AC 100~240V, 50/60Hz, 1A<br>Output: DC18V, 2A<br>Adapter 2:LY036SPS-180200W2<br>Input: AC 100~240V, 50/60Hz, 1A<br>Output: DC18V, 2A |

Remark: ** The test data gathered are from the production sample provided by the manufacturer.*
** Supplementary model has the same base board circuit, the name is different.*
** We test all adapters, the adapter LY036SPS-180200W2 show the worst data. So we chose it for data in the report.*



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## 1.2 Related Submittal(s) / Grant (s) and Test Methodology

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

## 1.3 Test Facility

All measurement required was performed at laboratory of Shenzhen CTL Testing Technology Co., Ltd.

Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

FCC – Registration No.: 970318

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 970318, December, 2013.

IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.





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# 2. SYSTEM TEST CONFIGURATION

## 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

## 2.2 EUT Exercise

The calibrated antennas used to sample the radiated field strength are mounted on a non-conductive, motorized antenna mast 3 or 10 meters from the leading edge of the turntable.

## 2.3 General Test Procedures

Conducted Emissions: The EUT is placed on the table, which is 0.8 m above ground plane According to the requirements in ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak detector mode.

Radiated Emissions: The EUT is a placed on as turntable, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in ANSI C63.10-2013.

## 2.4 Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| Parameter | Uncertainty |
|---|---|
| Transmitter power conducted | +/- 0.57 dB |
| Transmitter power Radiated | +/- 2.20 dB |
| Conducted spurious emission 9KHz-40 GHz | +/- 2.20 dB |
| Power Line Conducted Emission | +/- 3.20 dB |
| Radiated Emission | +/- 4.32 dB |

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



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## 2.5 Measure Results Explanation Example

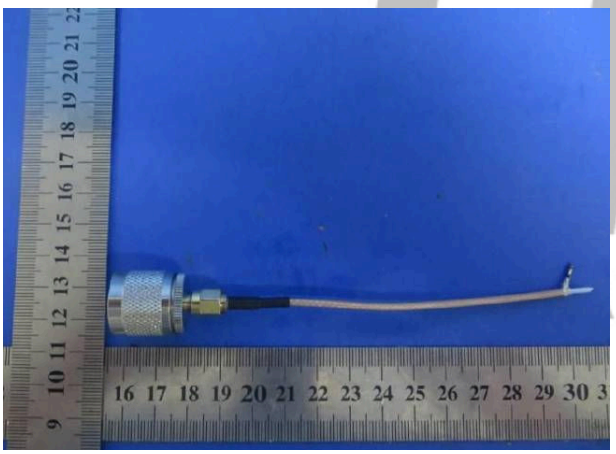
For all conducted test items:

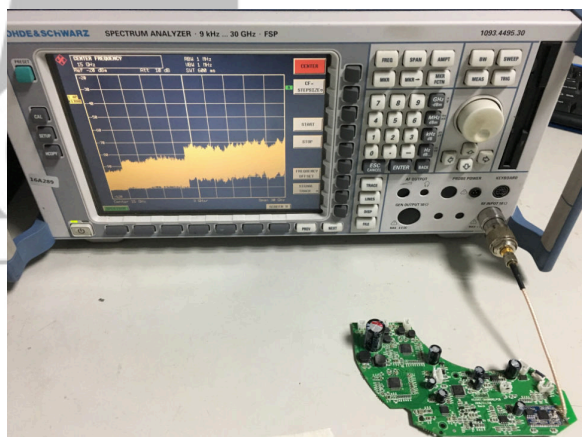
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable less and attenuator factor.
Offset= RF cable less+ attenuator factor.

Note: Using a temporary antenna connector for the EUT when the conducted measurements are performed.

| Equipment | Manufacturer | Model No. | Frequency range(GHz) | Attenuation values(dBm) |
|---|---|---|---|---|
| Line | Zhenjiang south electronic | RG316 | 1-12 | 0.08 |
| | | | <1G | 0.03 |
| | | | >12G | 1.00 |
| Connector | Zhenjiang south electronic | SMA-K/N-J | 1-12 | 0.01 |
| | | | <1G | 0.005 |
| | | | >12G | 0.03 |





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## 2.6Test Equipment List and Details

Test equipments list of Shenzhen CTL Testing Technology Co., Ltd.

| No. | Instrument no. | Equipment | Manufacturer | Model No. | S/N | Last Calculator | Due Calculator |
|---|---|---|---|---|---|---|---|
| 1 | BCT-EMC001 | EMI Test Receiver | R&S | ESCI | 100687 | 2016-7-25 | 2017-7-24 |
| 2 | BCT-EMC002 | EMI Test Receiver | R&S | ESPI | 100097 | 2016-10-1 | 2017-10-31 |
| 3 | BCT-EMC003 | Amplifier | HP | 8447D | 1937A02492 | 2016-7-25 | 2017-7-24 |
| 4 | BCT-EMC018 | TRILOG Broadband Test-Antenna | SCHWARZBECK | VULB9163 | 9163-324 | 2016-7-25 | 2017-7-24 |
| 5 | BCT-EMC021 | Triple-Loop Antenna | EVERFINE | LLA-2 | 711002 | 2016-10-1 | 2017-10-31 |
| 6 | BCT-EMC026 | RF POWER AMPLIFIER | FRANKONIA | FLL-75 | 1020A1109 | 2016-7-25 | 2017-7-24 |
| 7 | BCT-EMC029 | 6DB Attenuator | FRANKONIA | N/A | 1001698 | 2016-7-25 | 2017-7-24 |
| 8 | BCT-EMC032 | 10dB attenuator | ELECTRO-METRICS | EM-7600 | 836 | 2016-7-25 | 2017-7-24 |
| 9 | BCT-EMC036 | Spectrum Analyzer | R&S | FSP | 100397 | 2016-10-1 | 2017-10-31 |
| 10 | BCT-EMC037 | Broadband preamplifier | SCH WARZBECK | BBV9718 | 9718-182 | 2016-7-25 | 2017-7-24 |
| 11 | BCT-EMC039 | Horn Antenna | SCHWARZBECK | BBHA 9120D | 0437 | 2016-7-25 | 2017-7-24 |
| 12 | BCT-EMC038 | Horn Antenna | SCHWARZBECK | BBHA9170 | 0483 | 2016-7-25 | 2017-7-24 |



# 3. SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|---|---|---|
| FCC §15.207 | AC Power Line Conducted Emission | Pass |
| FCC §15.247(a)(1) | Hopping Channel Bandwidth | Pass |
| FCC §15.247(a)(1) | Hopping Channel Separation | Pass |
| FCC §15.247(a)(1) | Number of Hopping Frequency Used | Pass |
| FCC §15.247(a)(1)(iii) | Dwell Time of Each Frequency | Pass |
| FCC §15.247(b)(1) | Maximum Peak Output Power | Pass |
| FCC §15.247(d) | Band Edges Emission | Pass |
| FCC §15.247(d) | Spurious Radiated Emission | Pass |
| FCC §15.203/15.247(b)/(c) | Antenna Requirement | Pass |



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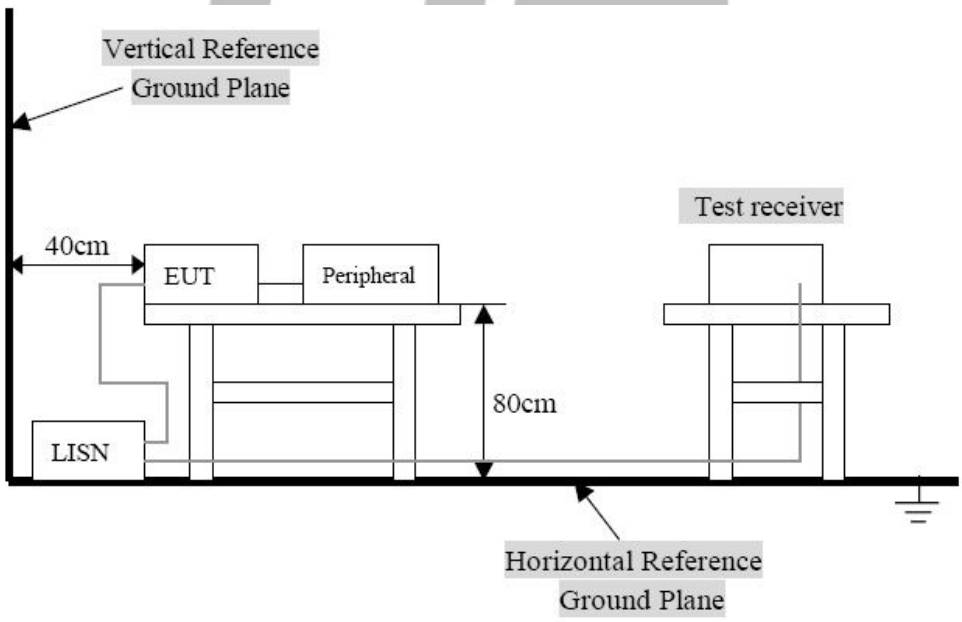
# 4. TEST OF AC POWER LINE CONDUCTED EMISSION

## 4.1 Applicable Standard

Refer to FCC §15.207.
For a Low-power Radio-frequency Device is designed to be connected to the AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed below limits table.

| Frequency Range (MHz) | Limits ( dBuV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.150～0.500 | 66～56 | 56～46 |
| 0.500～5.000 | 56 | 46 |
| 5.000～30.00 | 60 | 50 |

## 4.2 Test Setup Diagram




Remark: The EUT was connected to a 120 VAC/ 60Hz power source.

## 4.3 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 23~25 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 45~58 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: Tx Mode |

Note: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports. The BR1M Low Channel was chosen for this result.



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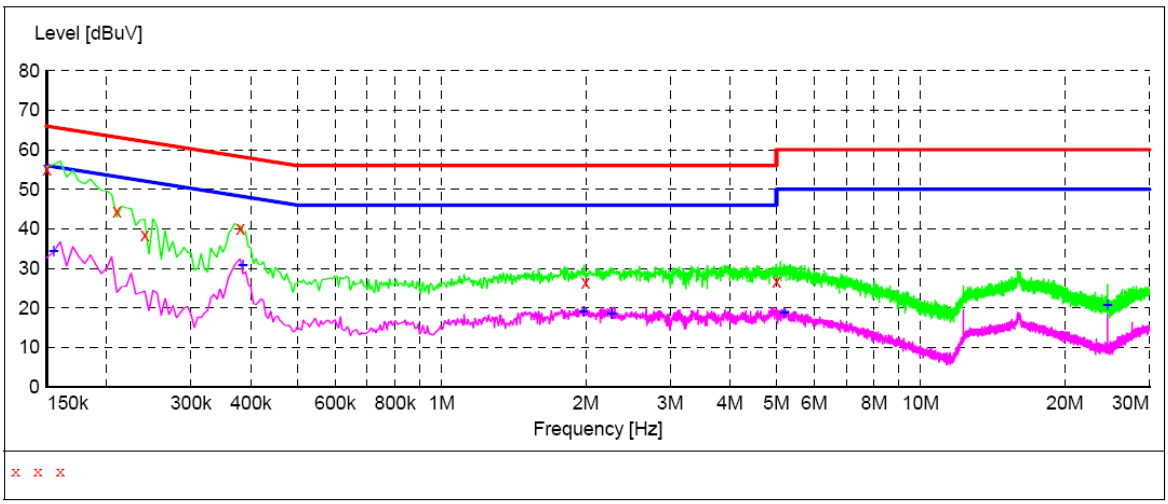
**The worst data Conducted Emission of BR1M Low Channel:**

| | |
|---|---|
| EUT: | Bluetooth Speaker |
| M/N: | BA1 |
| Operating Condition: | Tx Mode |
| Test Site: | Shielded Room |
| Operator: | Yang |
| Test Specification: | AC 120V/60Hz for adapter |
| Comment: | L Line |

***SCAN TABLE: "Voltage(150K-30M)FIN"***
Short Description: 150K-30M Voltage




***MEASUREMENT RESULT:***

| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.150000 | 55.10 | 15.4 | 66 | 10.9 | QP | L1 | GND |
| 0.210000 | 44.50 | 14.7 | 63 | 18.7 | QP | L1 | GND |
| 0.240000 | 38.50 | 14.1 | 62 | 23.6 | QP | L1 | GND |
| 0.380000 | 40.10 | 11.0 | 58 | 18.2 | QP | L1 | GND |
| 1.995000 | 26.50 | 13.3 | 56 | 29.5 | QP | L1 | GND |
| 5.000000 | 26.70 | 13.5 | 56 | 29.3 | QP | L1 | GND |

***MEASUREMENT RESULT:***

| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.155000 | 34.30 | 15.4 | 56 | 21.4 | AV | L1 | GND |
| 0.385000 | 30.90 | 11.0 | 48 | 17.3 | AV | L1 | GND |
| 1.980000 | 19.10 | 13.2 | 46 | 26.9 | AV | L1 | GND |
| 2.265000 | 18.60 | 13.0 | 46 | 27.4 | AV | L1 | GND |
| 5.200000 | 18.80 | 13.3 | 50 | 31.2 | AV | L1 | GND |
| 24.575000 | 20.80 | 11.9 | 50 | 29.2 | AV | L1 | GND |



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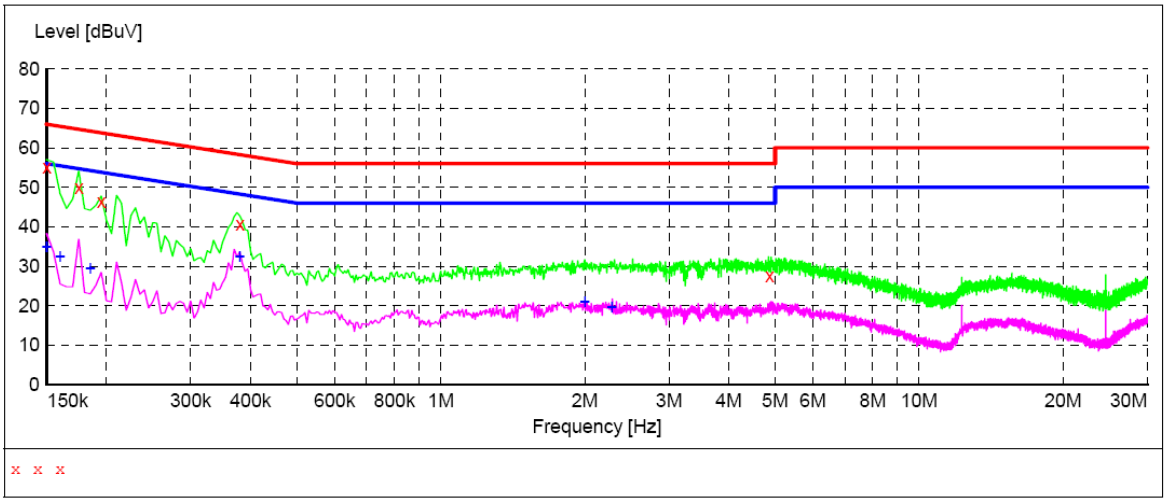
**The worst data Conducted Emission of BR1M Low Channel:**

| | |
|---|---|
| EUT: | Bluetooth Speaker |
| M/N: | BA1 |
| Operating Condition: | Tx Mode |
| Test Site: | Shielded Room |
| Operator: | Yang |
| Test Specification: | AC 120V/60Hz for adapter |
| Comment: | N Line |

***SCAN TABLE: "Voltage(150K-30M)FIN"***
Short Description: 150K-30M Voltage




***MEASUREMENT RESULT:***

| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.150000 | 55.00 | 15.4 | 66 | 11.0 | QP | N | GND |
| 0.175000 | 50.00 | 15.2 | 65 | 14.7 | QP | N | GND |
| 0.195000 | 46.50 | 15.0 | 64 | 17.3 | QP | N | GND |
| 0.380000 | 40.70 | 11.0 | 58 | 17.6 | QP | N | GND |
| 4.865000 | 27.40 | 13.5 | 56 | 28.6 | QP | N | GND |

***MEASUREMENT RESULT:***

| Frequency MHz | Level dBuV | Transd dB | Limit dBuV | Margin dB | Detector | Line | PE |
|---|---|---|---|---|---|---|---|
| 0.150000 | 34.80 | 15.4 | 56 | 21.2 | AV | N | GND |
| 0.160000 | 32.50 | 15.3 | 56 | 23.0 | AV | N | GND |
| 0.185000 | 29.60 | 15.1 | 54 | 24.7 | AV | N | GND |
| 0.380000 | 32.50 | 11.0 | 48 | 15.8 | AV | N | GND |
| 2.000000 | 20.90 | 13.3 | 46 | 25.1 | AV | N | GND |
| 2.280000 | 19.60 | 13.0 | 46 | 26.4 | AV | N | GND |



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# 5. Test of Hopping Channel Bandwidth

## 5.1 Applicable Standard

Section 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

## 5.2 EUT Setup


**Spectrum Analyzer**

## 5.3 Test Equipment List and Details

See section 2.5.

## 5.4 Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.

2. Use the following spectrum analyzer settings:
   Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
   RBW ⩾ 1% of the 20 dB bandwidth, VBW ⩾ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

3. The spectrum width with level higher than 20dB below the peak level.

4. Repeat above 1~3 points for the middle and highest channel of the EUT.

## 5.5 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 22~23 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 50~54 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: Tx Mode |



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**BR 1M**

| Modulation Type | Channel No. | Frequency (MHz) | 20dB Bandwidth (kHz) |
|---|---|---|---|
| GFSK | Low | 2402.00 | 920 |
| GFSK | Middle | 2441.00 | 924 |
| GFSK | High | 2480.00 | 944 |

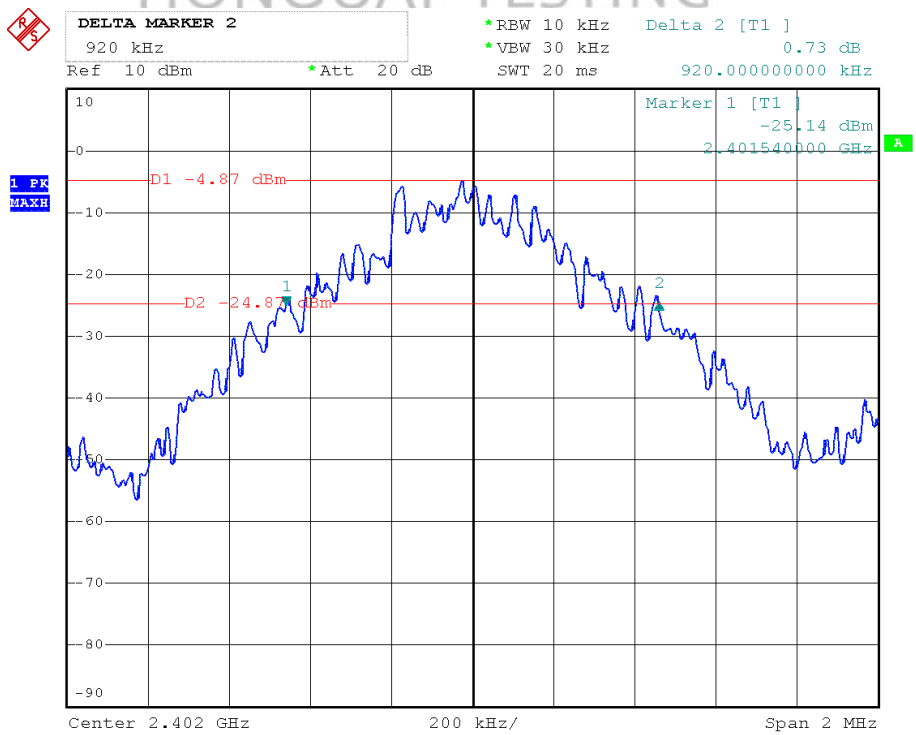
**EDR 2M**

| Modulation Type | Channel No. | Frequency (MHz) | 20dB Bandwidth (kHz) |
|---|---|---|---|
| Pi/4 DQPSK | Low | 2402.00 | 1212 |
| Pi/4 DQPSK | Middle | 2441.00 | 1228 |
| Pi/4 DQPSK | High | 2480.00 | 1228 |

**EDR 3M**

| Modulation Type | Channel No. | Frequency (MHz) | 20dB Bandwidth (kHz) |
|---|---|---|---|
| 8-DPSK | Low | 2402.00 | 1212 |
| 8-DPSK | Middle | 2441.00 | 1216 |
| 8-DPSK | High | 2480.00 | 1216 |

**BR 1M**
**Channel Low**



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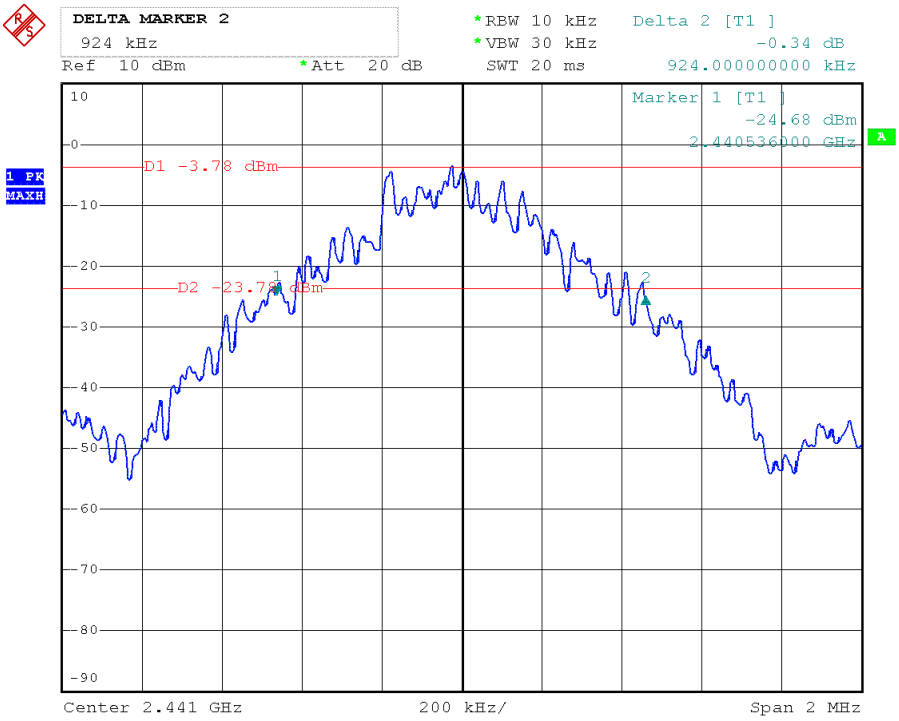
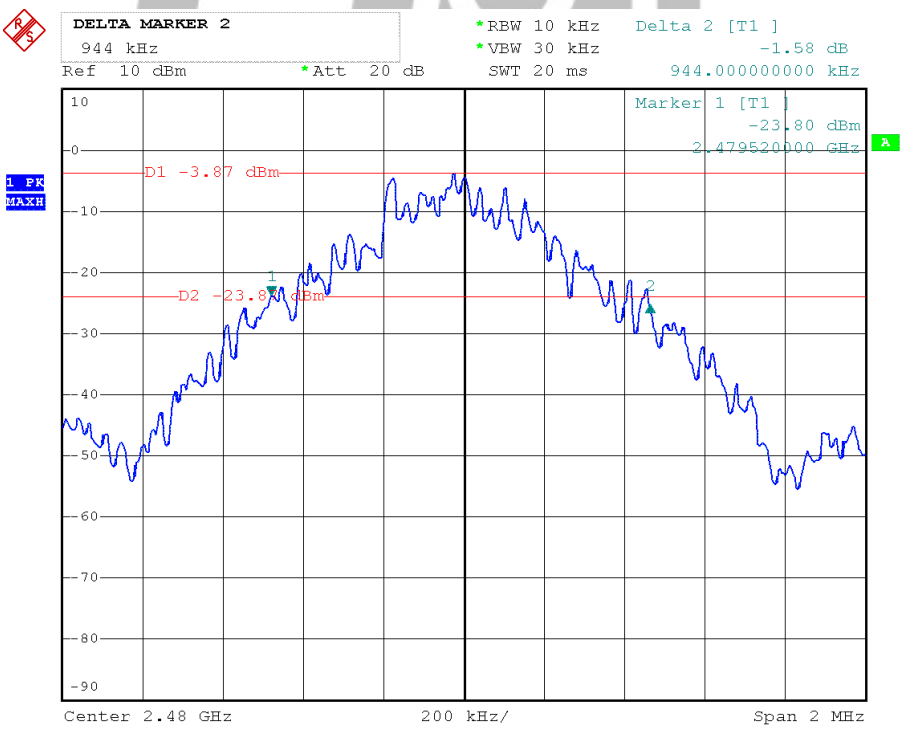
## Channel Middle




## Channel High



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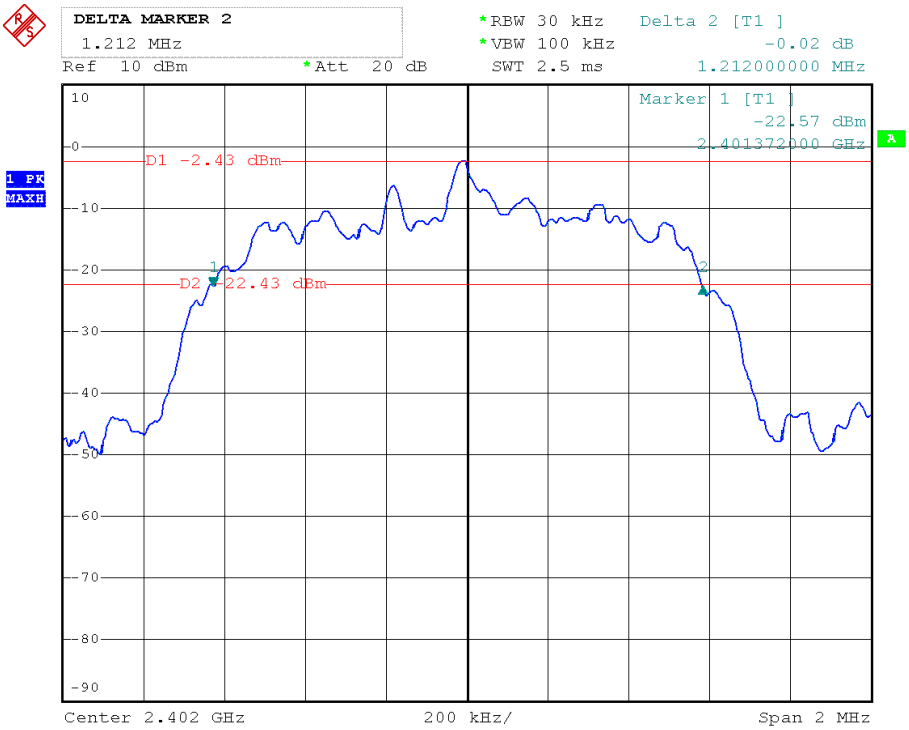
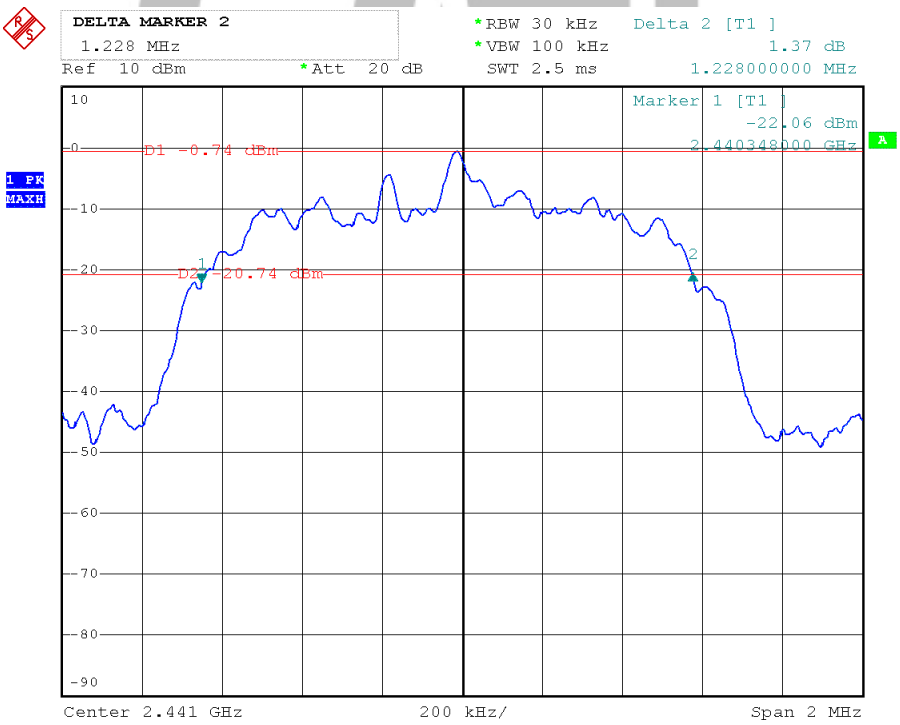
**EDR 2M**
**Channel Low**




**Channel Middle**



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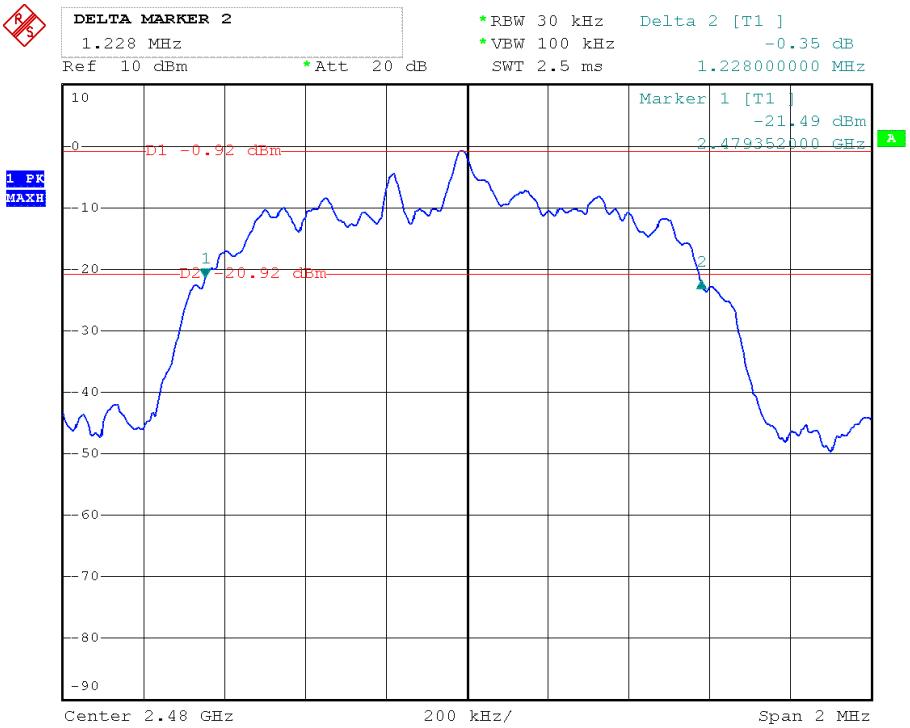
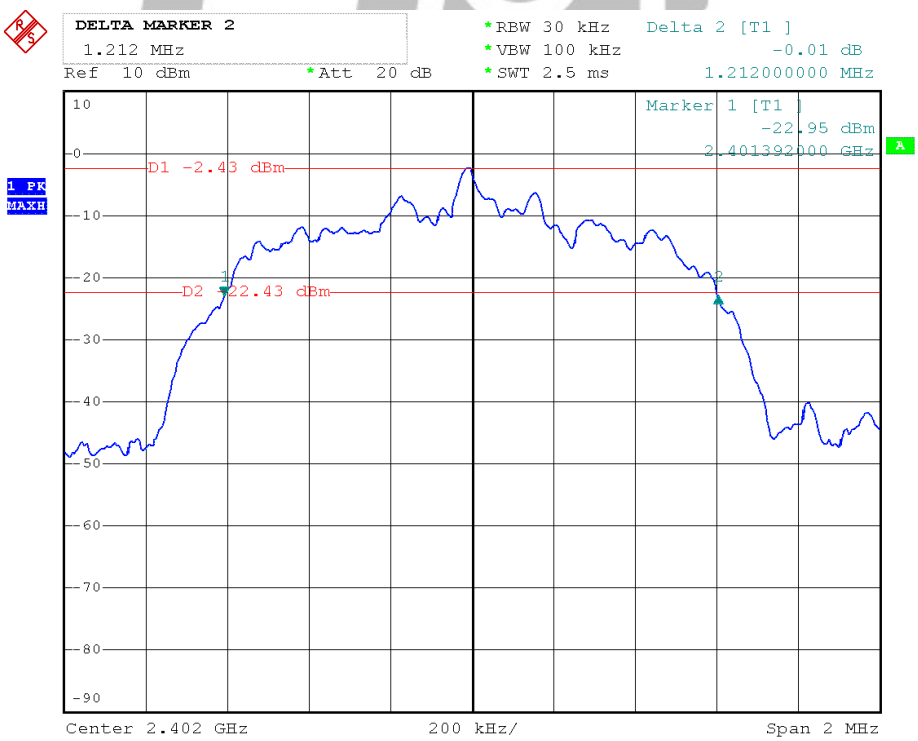
**Channel High**




**EDR 3M**
**Channel Low**



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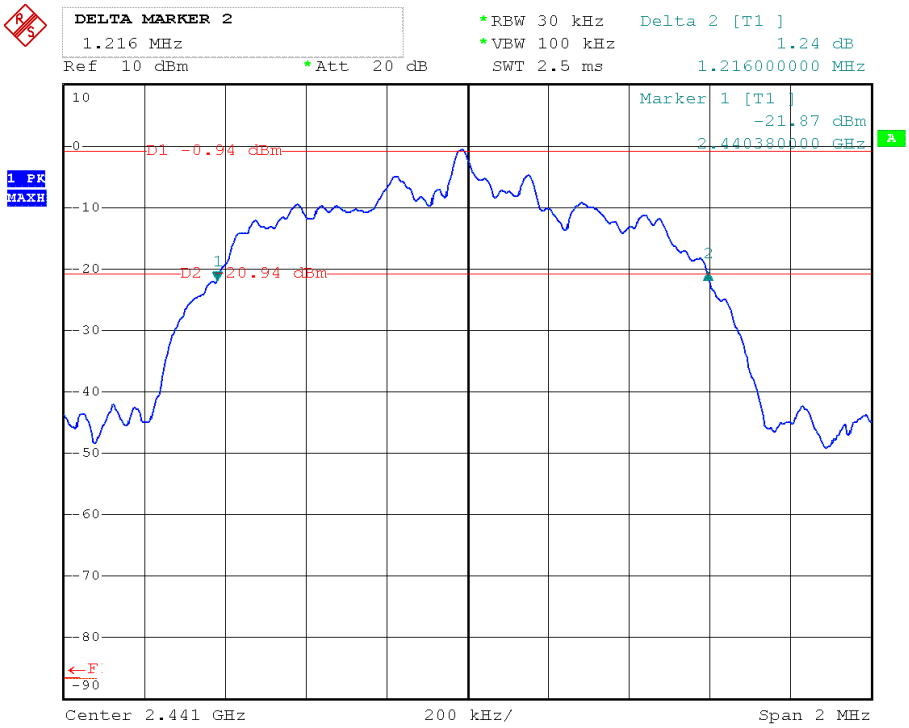
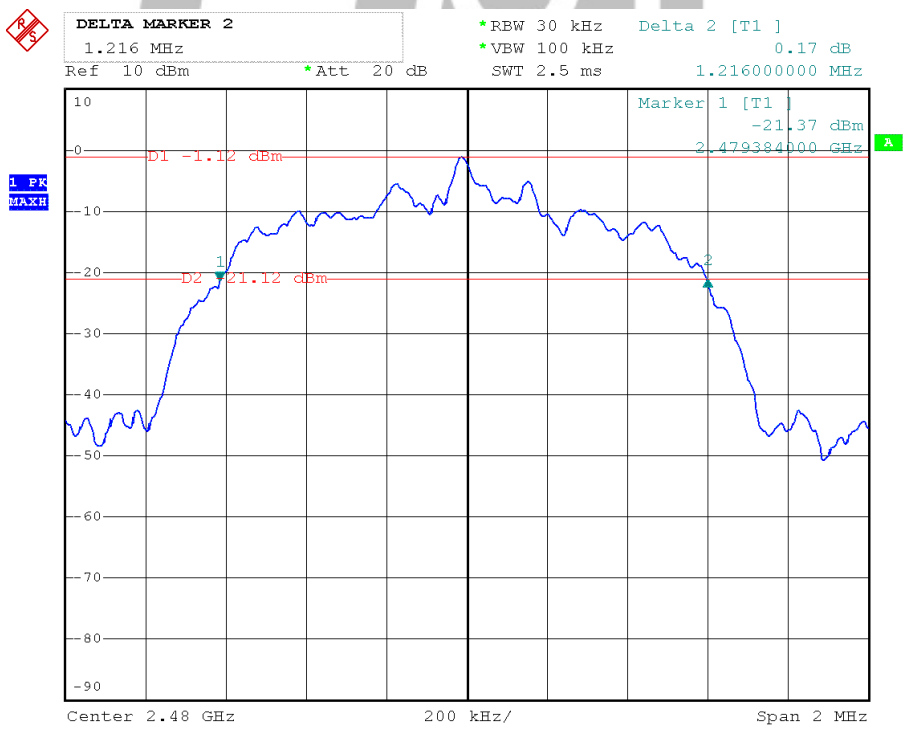
## Channel Middle




## Channel High



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# 6. Test of Hopping Channel Separation

## 6.1 Applicable Standard

Section 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

## 6.2 EUT Setup


**Spectrum Analyzer**

## 6.3 Test Equipment List and Details

See section 2.5.

## 6.4 Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.

2. Set RBW of spectrum analyzer to 30KHz and VBW to 100KHz.

3. Set Detector to Peak, Trace to Max Hold and Sweep Time is Auto.

4. The Hopping Channel Separation is defined as the separation between 2 neighboring hopping frequencies.

5. Repeat above 1~3 points for the middle and highest channel of the EUT.

## 6.5 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 22~23 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 50~54 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: Tx Mode |



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**BR 1M**

| Modulation Type | Frequency (MHz) | Channel Separation (MHz) | Min. Limit (kHz) |
|---|---|---|---|
| GFSK | 2402~2403 | 1.008 | 613 |
| GFSK | 2441~2442 | 1.000 | 616 |
| GFSK | 2479~2480 | 1.004 | 629 |

**EDR 2M**

| Modulation Type | Frequency (MHz) | Channel Separation (MHz) | Min. Limit (kHz) |
|---|---|---|---|
| Pi/4 DQPSK | 2402~2403 | 1.004 | 808 |
| Pi/4 DQPSK | 2441~2442 | 1.008 | 853 |
| Pi/4 DQPSK | 2479~2480 | 1.000 | 867 |

**EDR 3M**

| Modulation Type | Frequency (MHz) | Channel Separation (MHz) | Min. Limit (kHz) |
|---|---|---|---|
| 8-DPSK | 2402~2403 | 1.000 | 808 |
| 8-DPSK | 2441~2442 | 1.000 | 808 |
| 8-DPSK | 2479~2480 | 1.000 | 811 |





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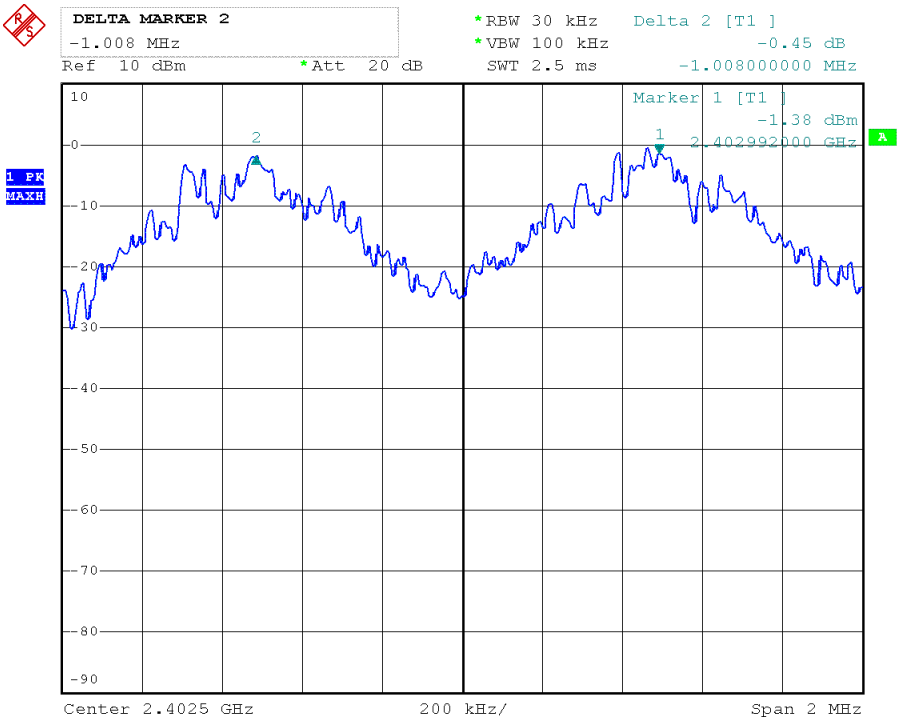
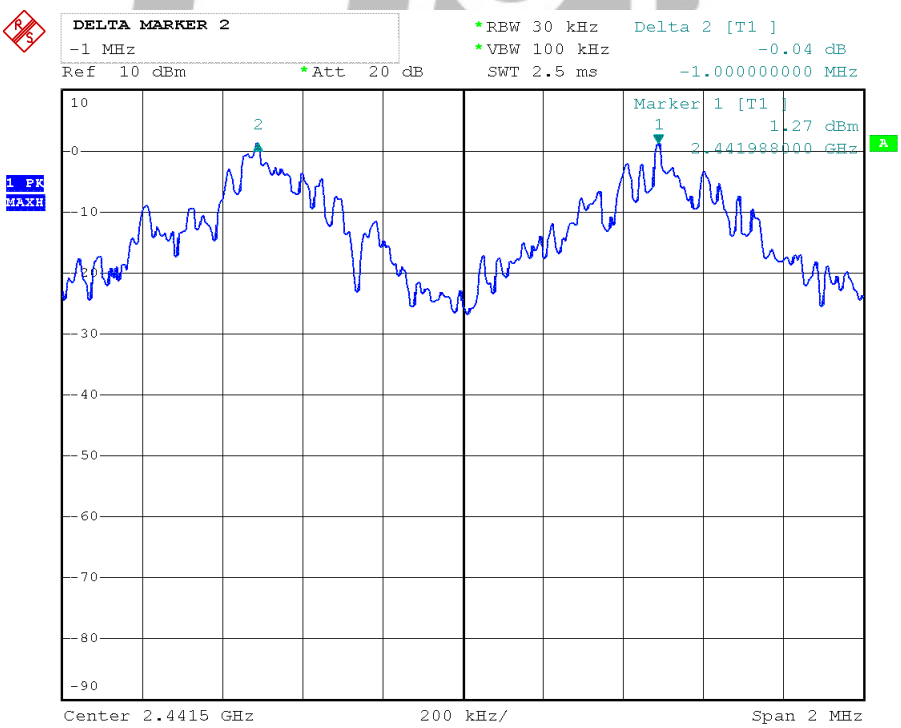
## BR 1M
## Channel Low




## Channel Middle



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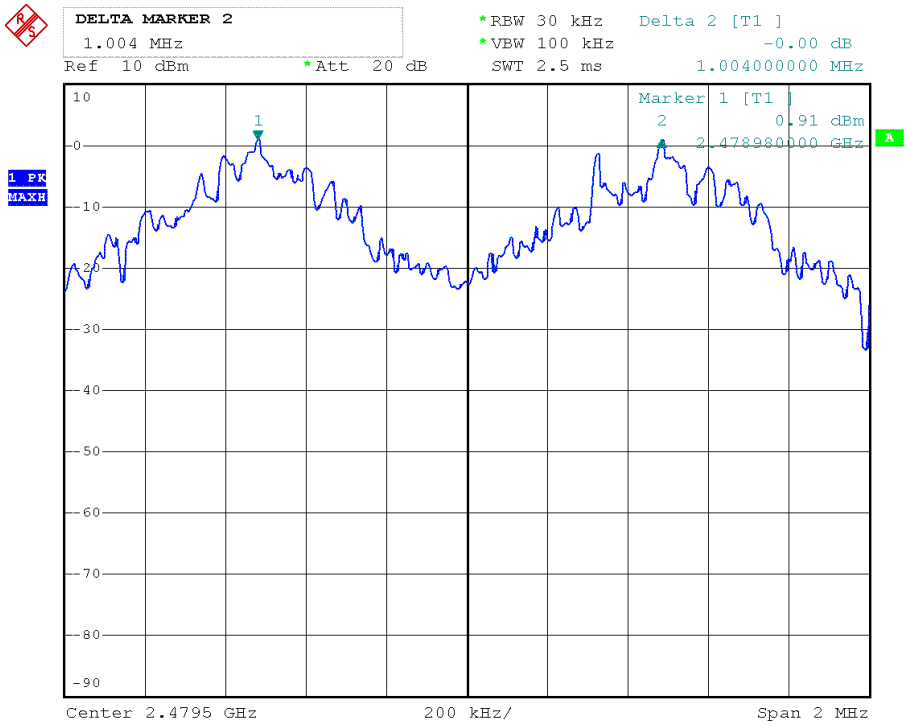
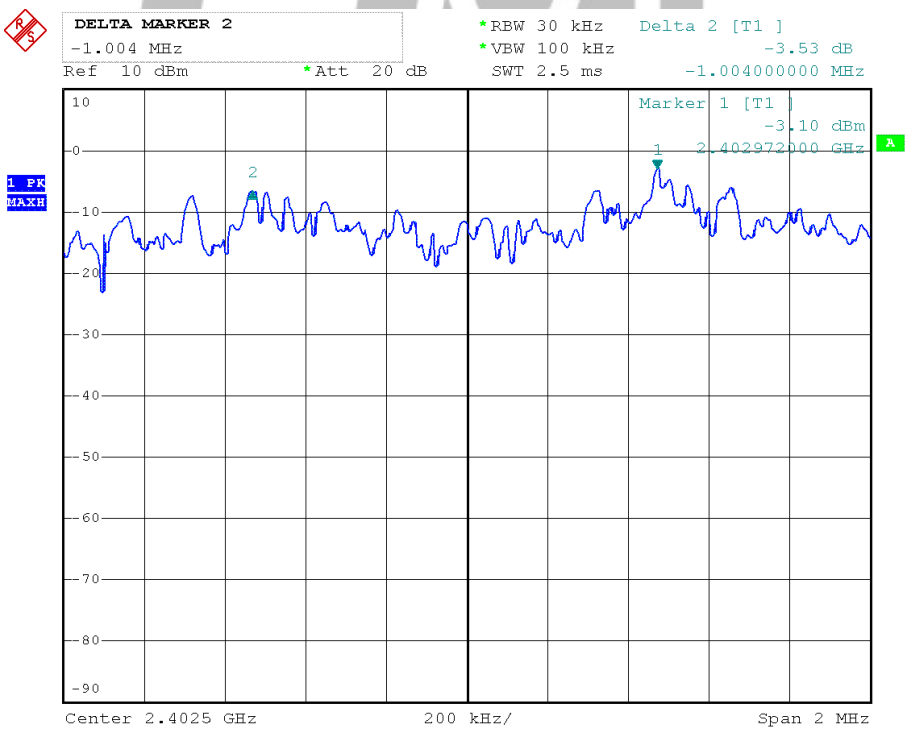
## Channel High




## EDR 2M
## Channel Low



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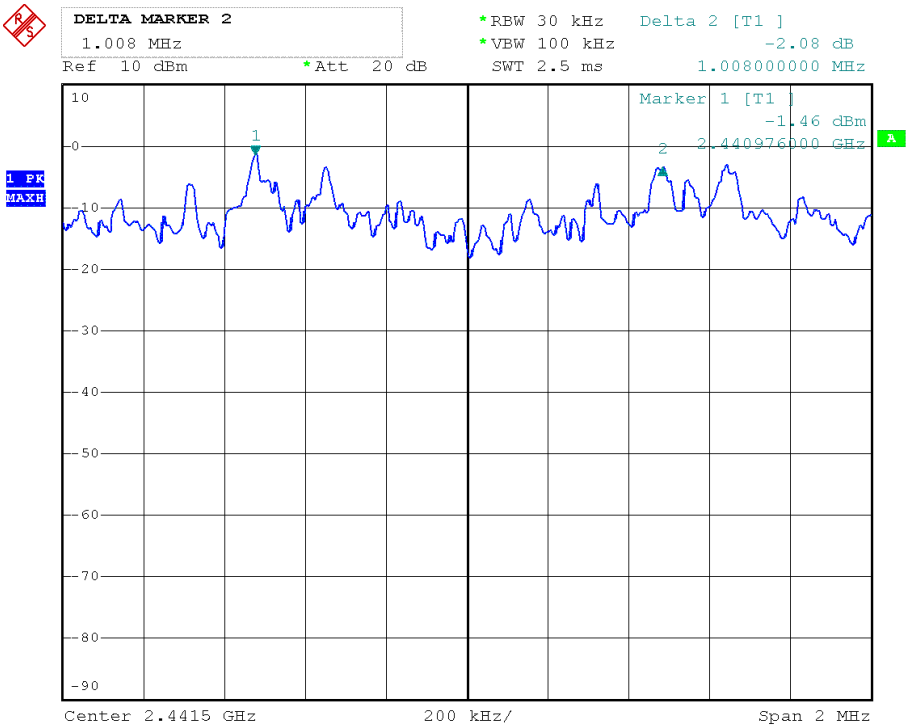
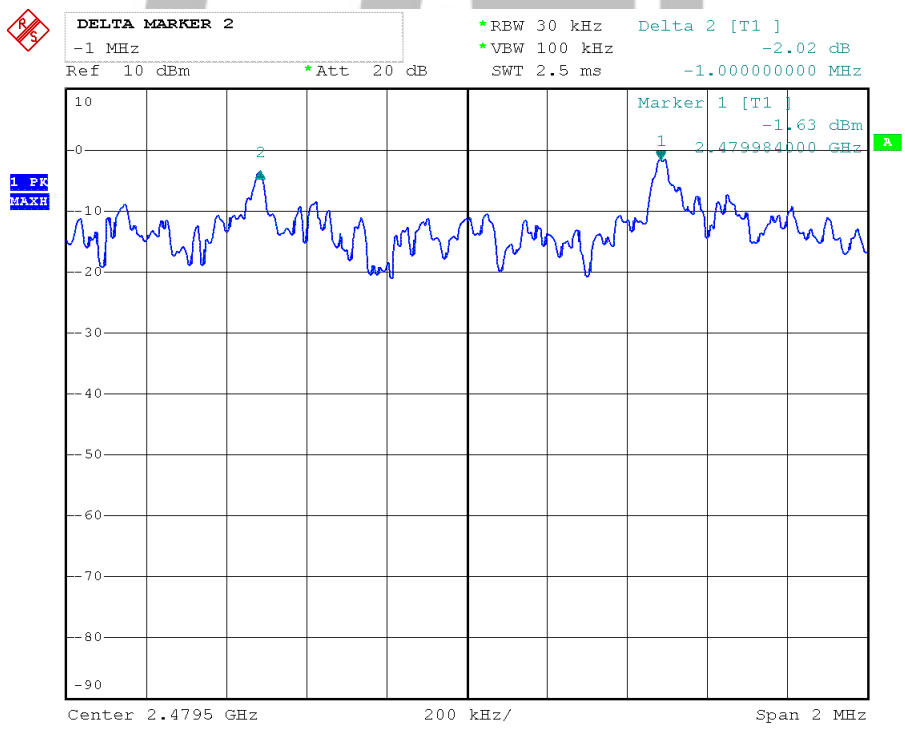
## Channel Middle




## Channel High



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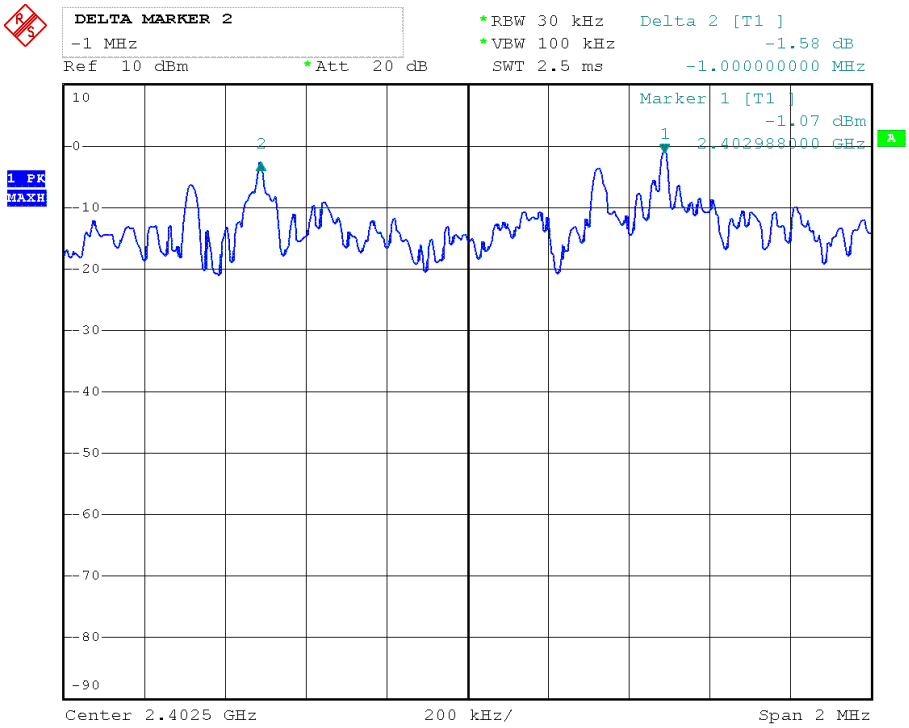
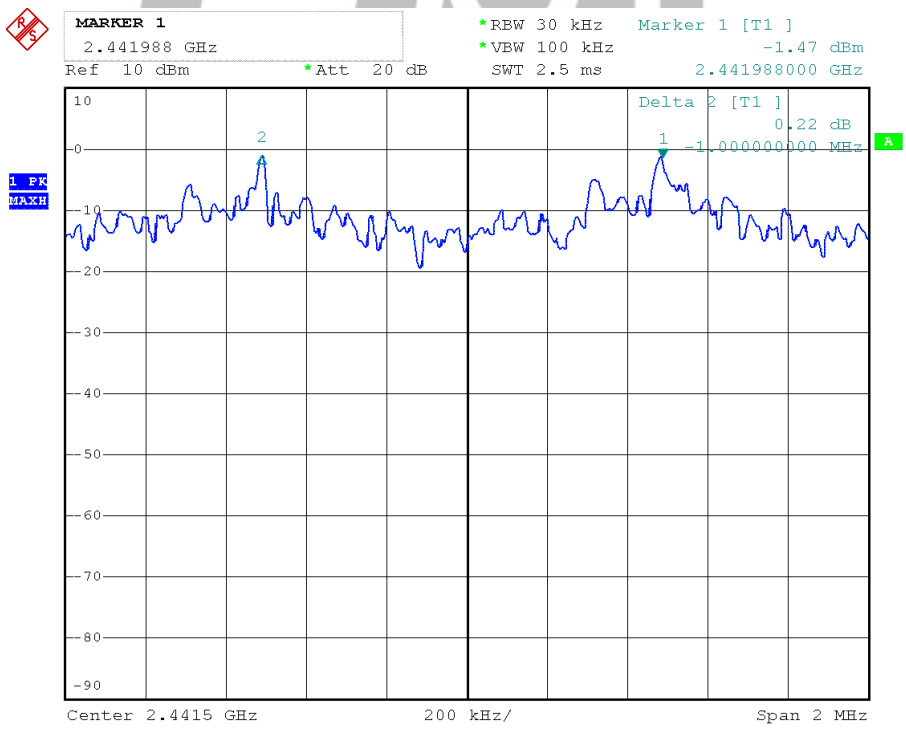
## EDR 3M
## Channel Low




## Channel Middle



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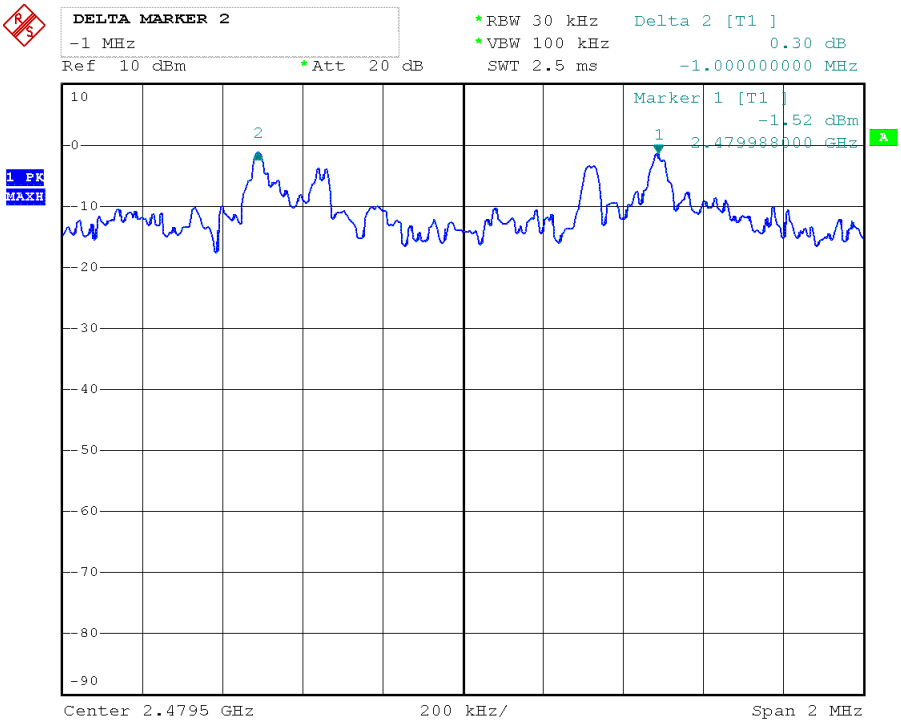
## Channel High





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# 7. Test of Number of Hopping Frequency

## 7.1 Applicable Standard

Section 15.247(a)(1)(iii): For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 15 non-overlapping hopping channels. Frequency hopping system which use fewer than 75 hopping frequencies may employ intelligent hopping techniques to avoid interference to other transmissions. Frequency hopping system may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels are used.

## 7.2 EUT Setup


**Spectrum Analyzer**

## 7.3 Test Equipment List and Details

See section 2.5.

## 7.4 Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.

2. Set RBW of spectrum analyzer to 100KHz and VBW to 100KHz.

3. Set Detector to Peak, Trace to Max Hold and Sweep Time is Auto.

4. Observe frequency hopping in 2400MHz~2483.5MHz, there are at least 32 non-overlapping channels.

5. Repeat above 1~3 points for the middle and highest channel of the EUT.

## 7.5 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 22~23 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 50~54 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: Tx Mode |

| Modulation Type | Frequency (MHz) | Number of Hopping Channels | Min. Limit |
|---|---|---|---|
| GFSK | 2402~2480 | 79 | ≥15 |
| Pi/4 DQPSK | 2402~2480 | 79 | ≥15 |
| 8-DPSK | 2402~2480 | 79 | ≥15 |



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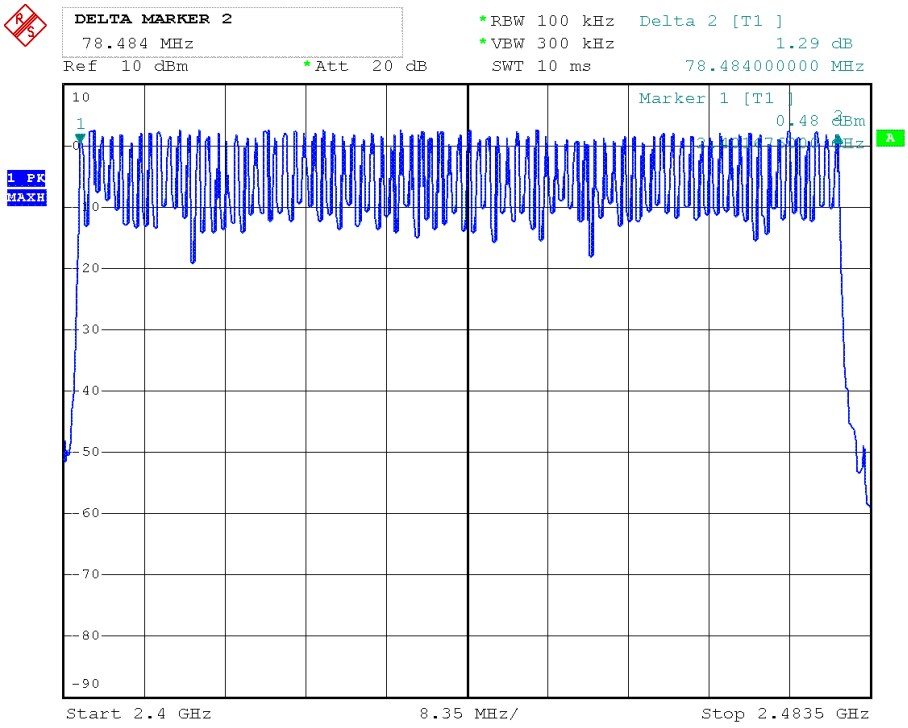
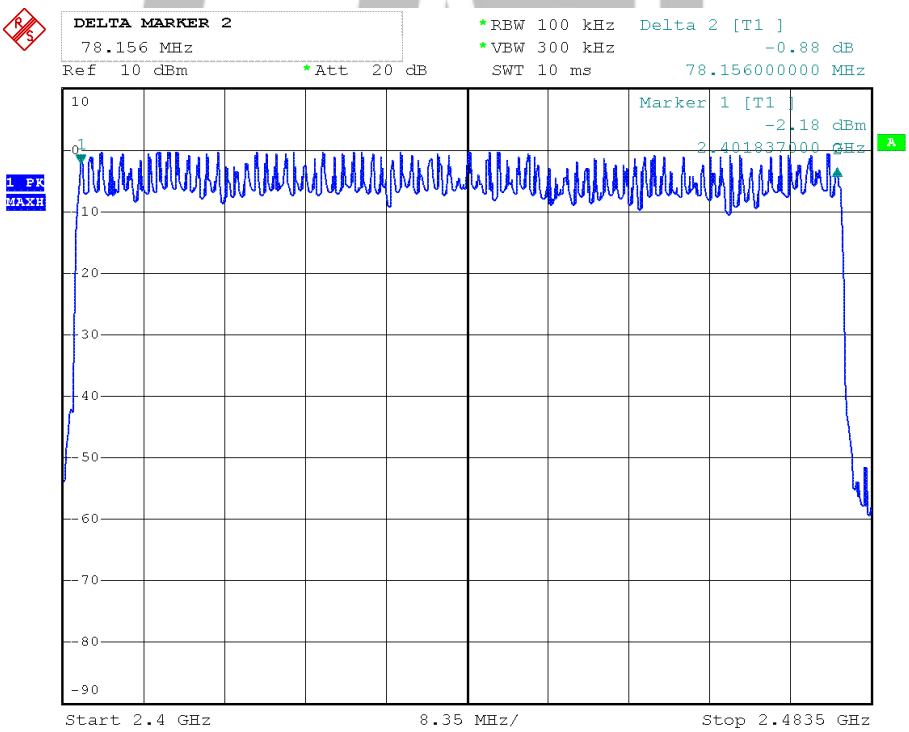
**BR-1M**




**EDR-2M**



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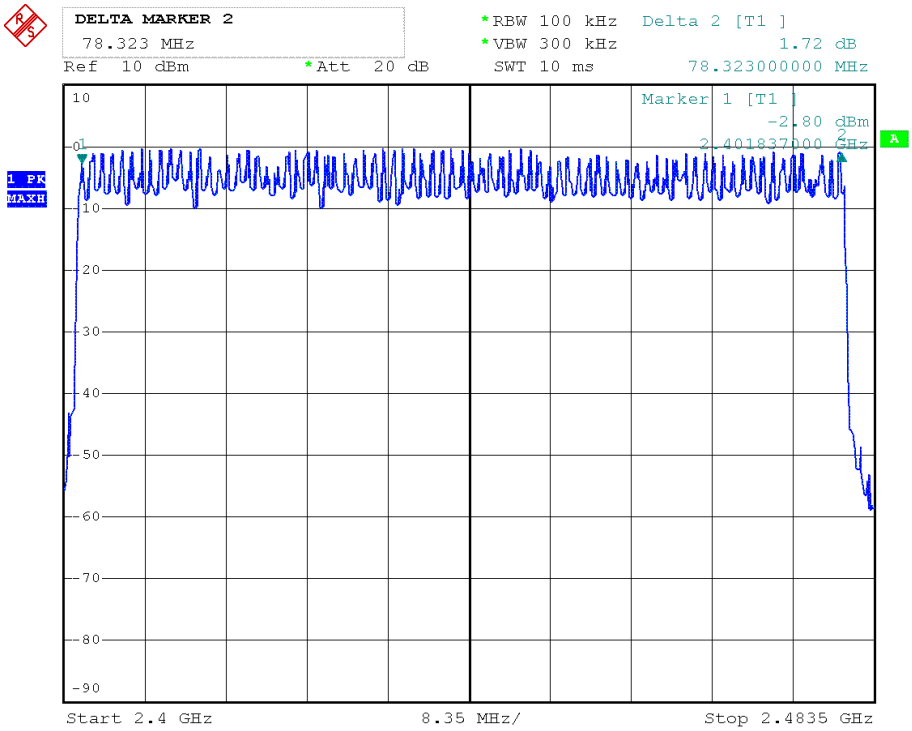
**EDR-3M**





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# 8. Test of Dwell Time of Each Frequency

## 8.1 Applicable Standard

Section 15.247(a)(1)(iii): For frequency hopping systems operating in the 2400-2483.5 MHz band The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4seconds multiplied by the number of hopping channels employed.

## 8.2 EUT Setup


**Spectrum Analyzer**

## 8.3 Test Equipment List and Details

See section 2.5.

## 8.4 Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator.

2. Set RBW of spectrum analyzer to 1000kHz and VBW to 1000kHz.

3. Set Detector to Peak, Trace to Max Hold and Sweep Time is more than once pulse time.

4. Set the center frequency on any frequency would be measure and set the frequency span to zero span.

5. Measure the maximum time duration of one single pulse.

## 8.5 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 22~23 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 50~54 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: Tx Mode |

DH1

Dwell time= t*(1.6/2/79)*31.6

DH3

Dwell time= t*(1.6/4/79)*31.6

DH5

Dwell time= t*(1.6/6/79)*31.6



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**BR 1M**
**Low Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| GFSK | DH1 | 0.384 | 122.88 | 400 |
| GFSK | DH3 | 1.640 | 262.40 | 400 |
| GFSK | DH5 | 2.888 | 309.02 | 400 |

**Middle Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| GFSK | DH1 | 0.385 | 123.20 | 400 |
| GFSK | DH3 | 1.620 | 259.20 | 400 |
| GFSK | DH5 | 2.888 | 309.02 | 400 |

**High Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| GFSK | DH1 | 0.385 | 123.20 | 400 |
| GFSK | DH3 | 1.620 | 259.20 | 400 |
| GFSK | DH5 | 2.888 | 309.02 | 400 |

**EDR 2M**
**Low Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| Pi/4 DQPSK | 2DH1 | 0.395 | 126.40 | 400 |
| Pi/4 DQPSK | 2DH3 | 1.645 | 263.20 | 400 |
| Pi/4 DQPSK | 2DH5 | 2.909 | 311.26 | 400 |

**Middle Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| Pi/4 DQPSK | 2DH1 | 0.395 | 126.40 | 400 |
| Pi/4 DQPSK | 2DH3 | 1.645 | 263.20 | 400 |
| Pi/4 DQPSK | 2DH5 | 2.877 | 307.84 | 400 |

**High Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| Pi/4 DQPSK | 2DH1 | 0.395 | 126.40 | 400 |
| Pi/4 DQPSK | 2DH3 | 1.645 | 263.20 | 400 |
| Pi/4 DQPSK | 2DH5 | 2.877 | 307.84 | 400 |



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**EDR 3M**

**Low Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| 8-DPSK | 3DH1 | 0.400 | 128.00 | 400 |
| 8-DPSK | 3DH3 | 1.640 | 262.40 | 400 |
| 8-DPSK | 3DH5 | 2.896 | 308.97 | 400 |

**Middle Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| 8-DPSK | 3DH1 | 0.400 | 128.00 | 400 |
| 8-DPSK | 3DH3 | 1.640 | 262.40 | 400 |
| 8-DPSK | 3DH5 | 2.896 | 308.97 | 400 |

**High Channel**

| Modulation Type | | Reading (ms) | Dwell Time (ms) | Limit (ms) |
|---|---|---|---|---|
| 8-DPSK | 3DH1 | 0.405 | 129.60 | 400 |
| 8-DPSK | 3DH3 | 1.640 | 262.40 | 400 |
| 8-DPSK | 3DH5 | 2.896 | 308.97 | 400 |





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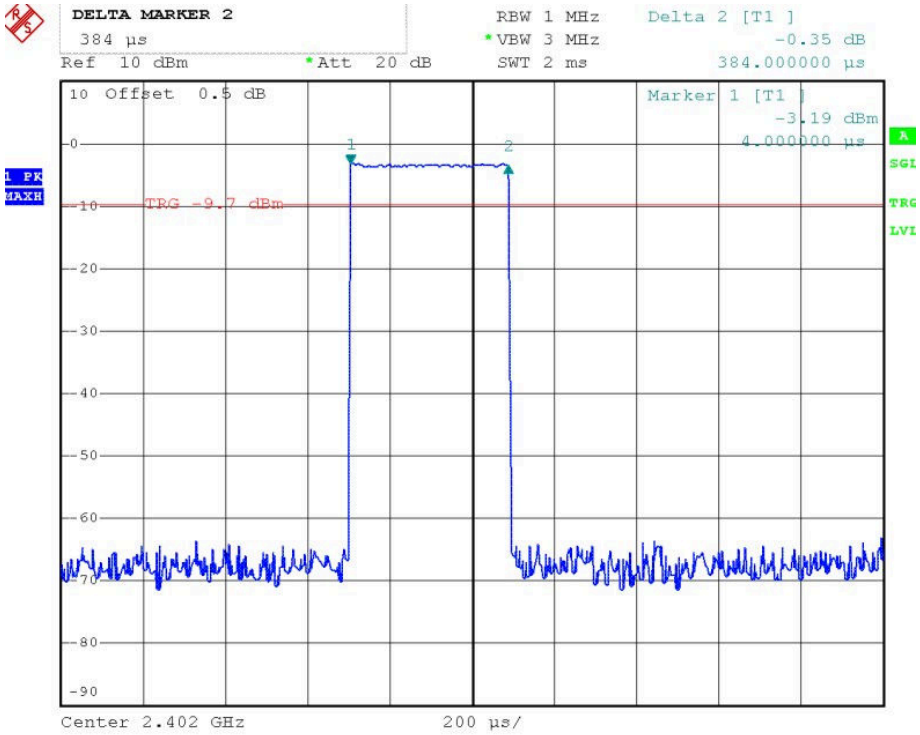
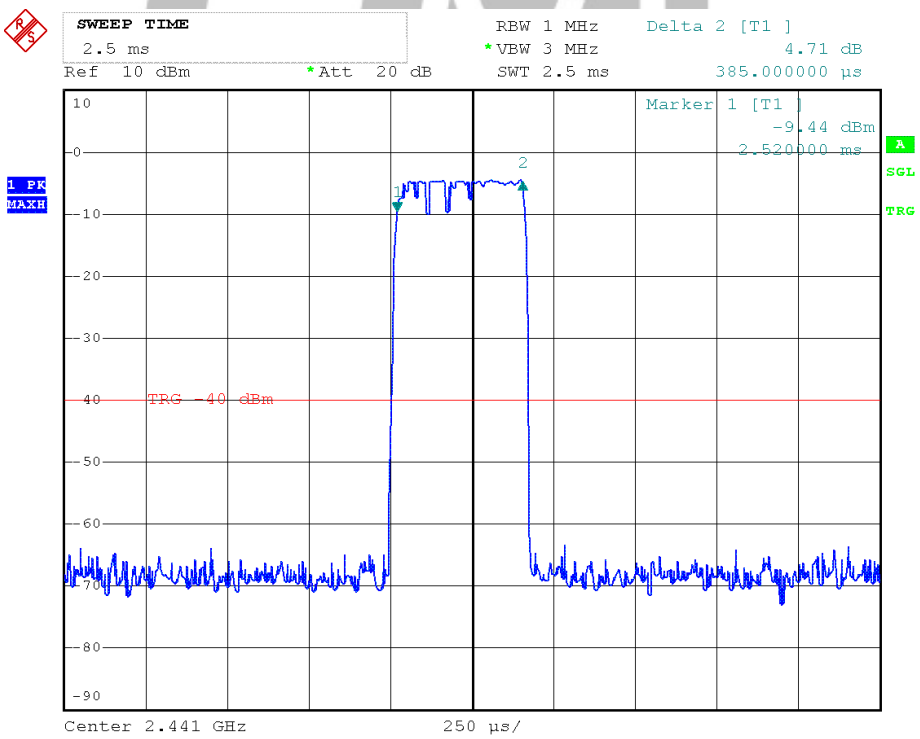
**BR-DH1**
**Channel Low**




**Channel Middle**



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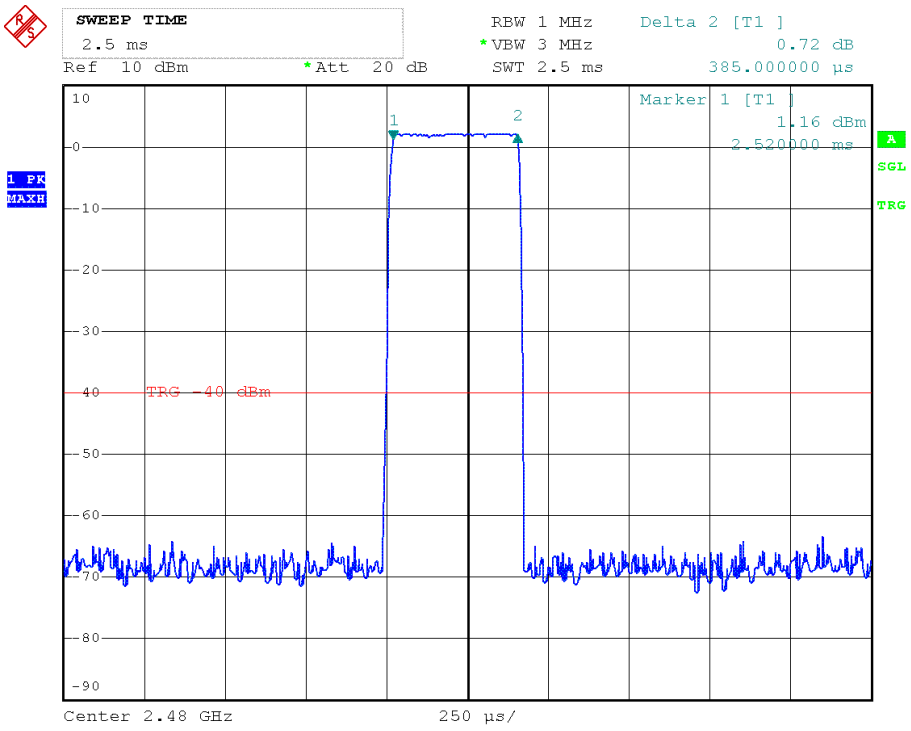
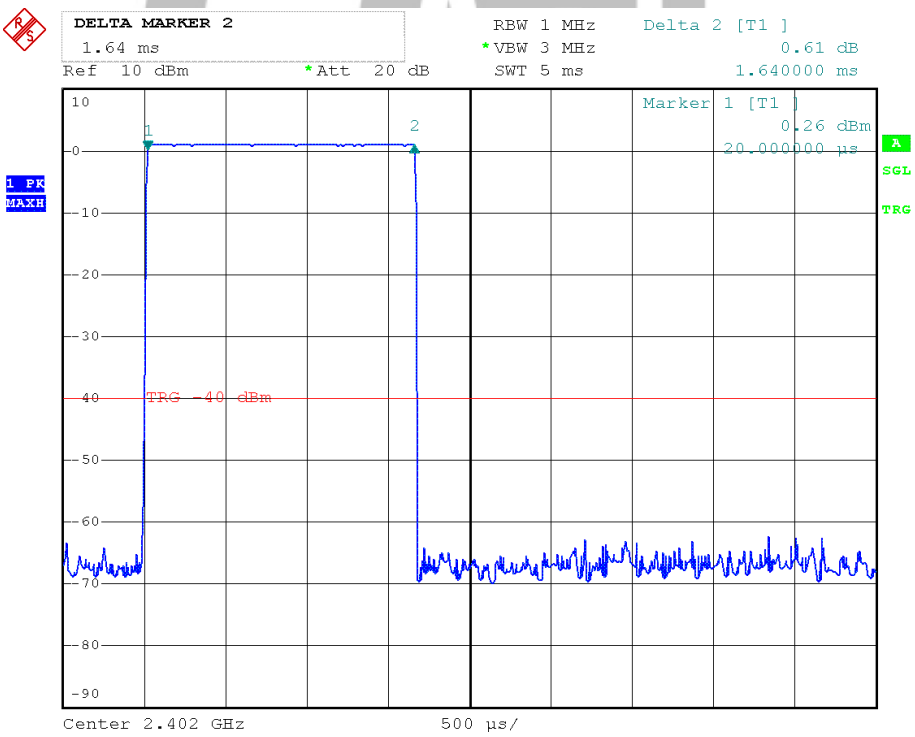
## Channel High




## DH3
## Channel Low



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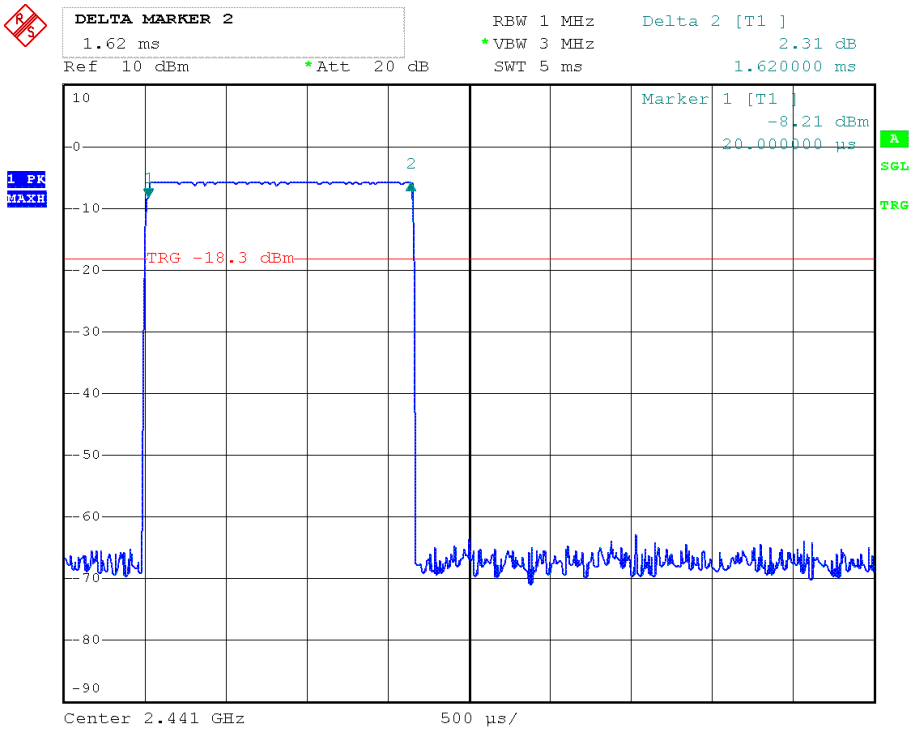
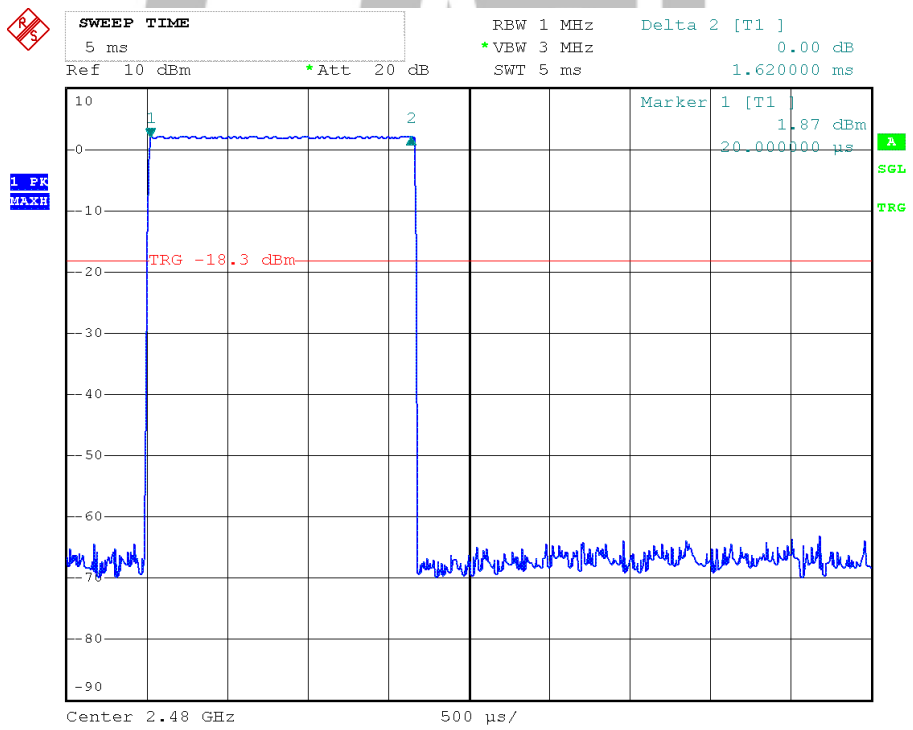
## Channel Middle




## Channel High



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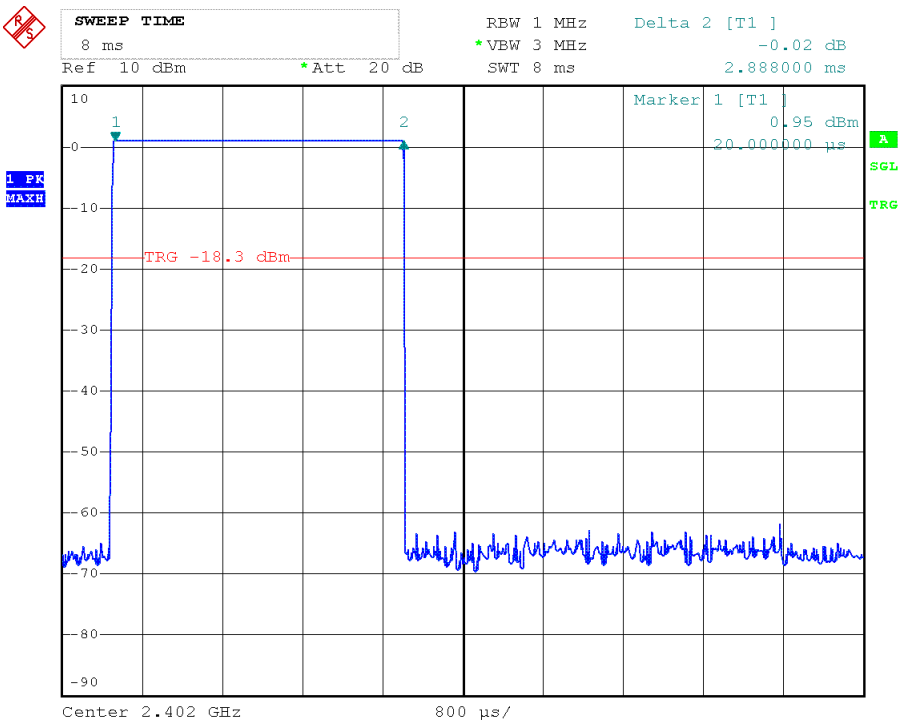
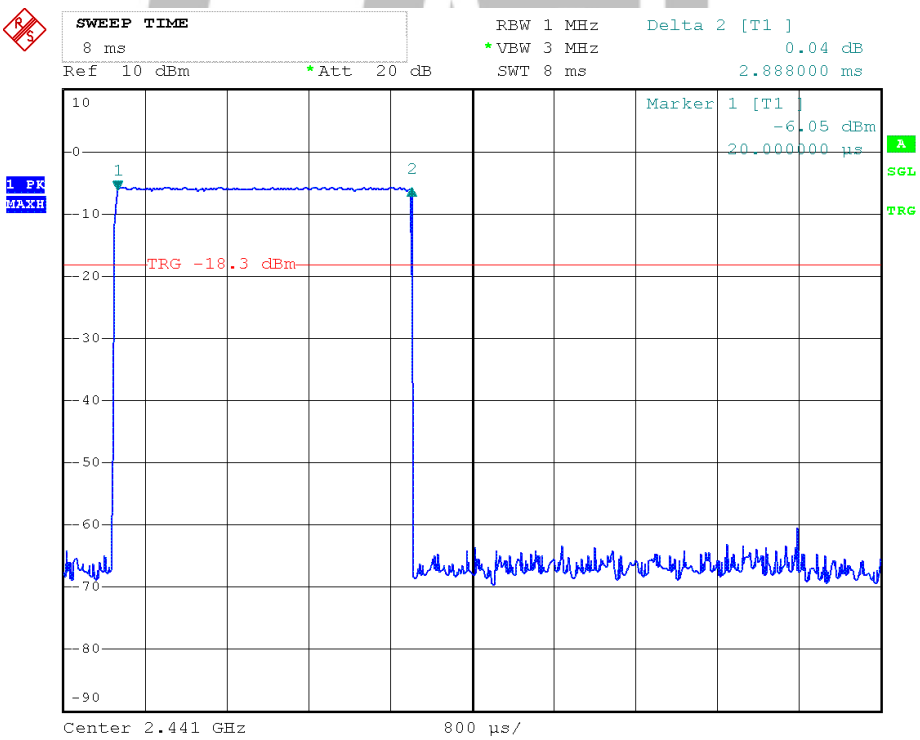
## DH5
## Channel Low




## Channel Middle



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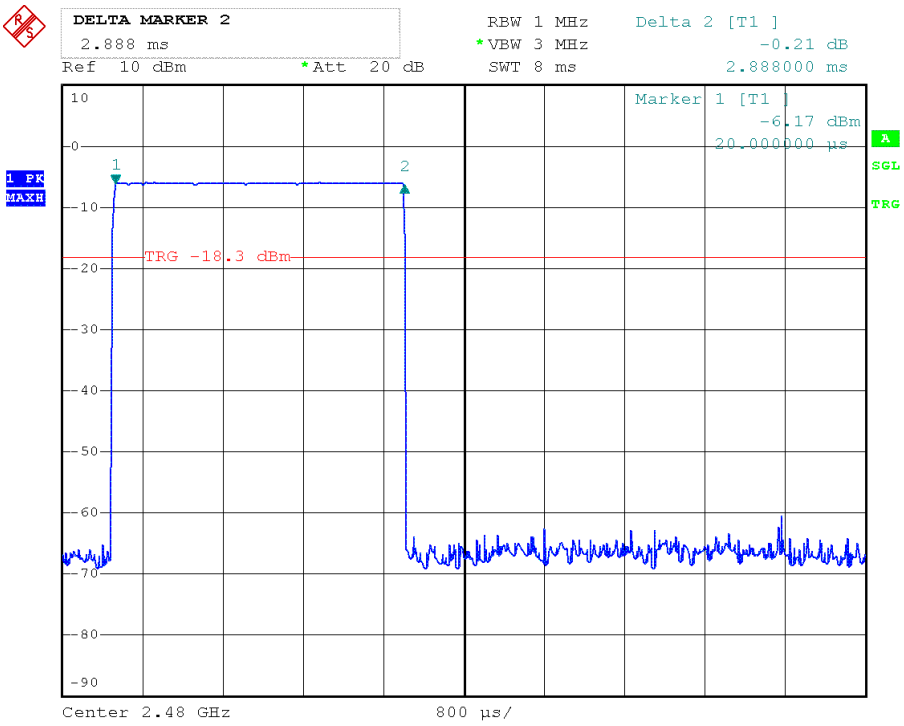
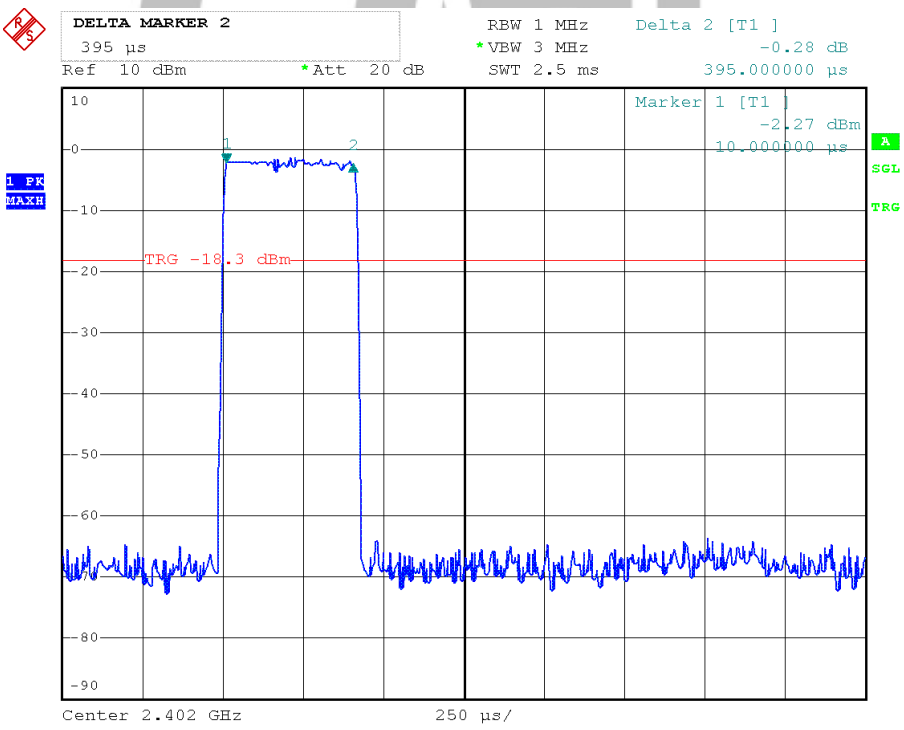
## Channel High




## EDR 2M 2DH1
## Channel Low



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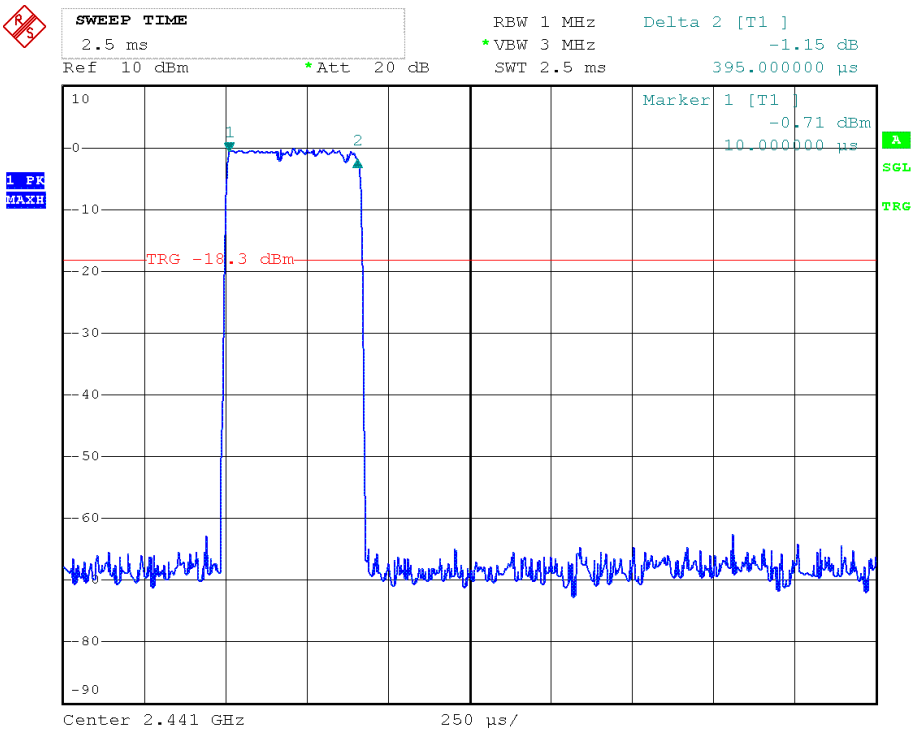
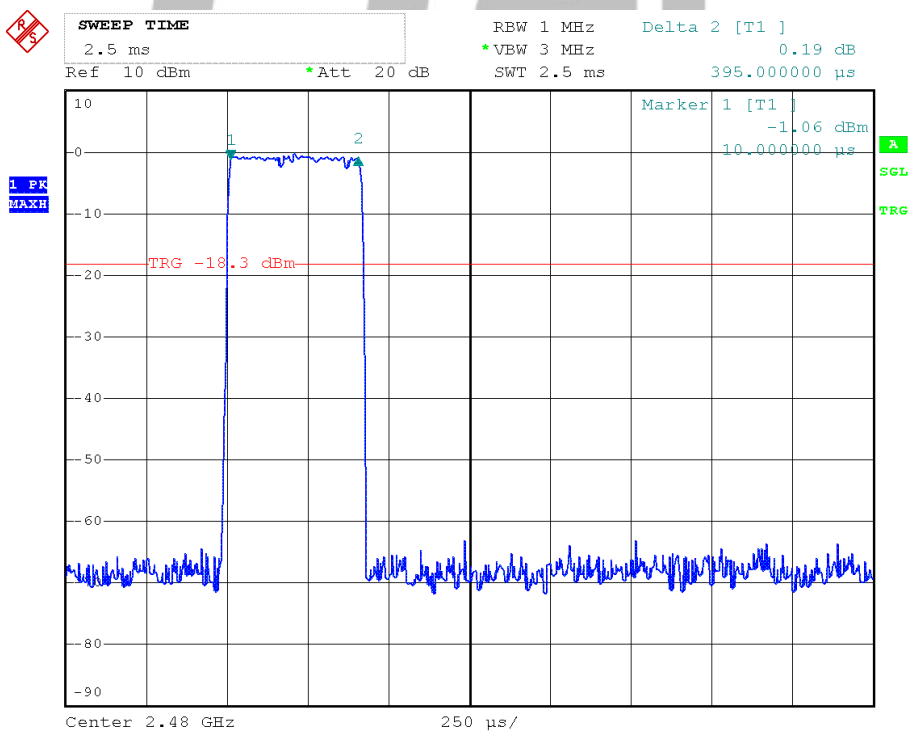
## Channel Middle




## Channel High



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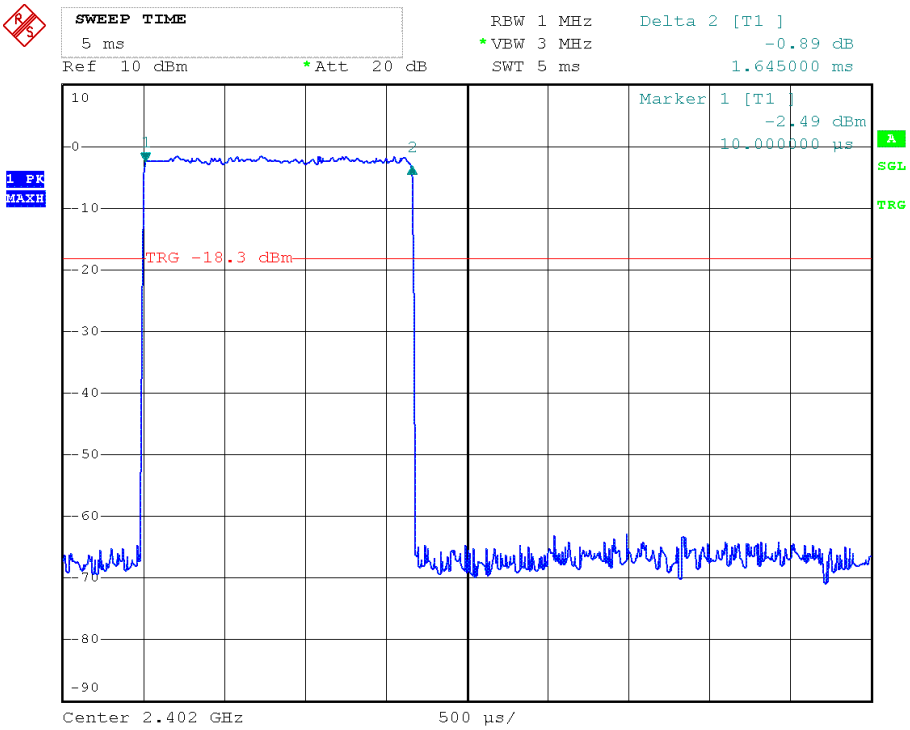
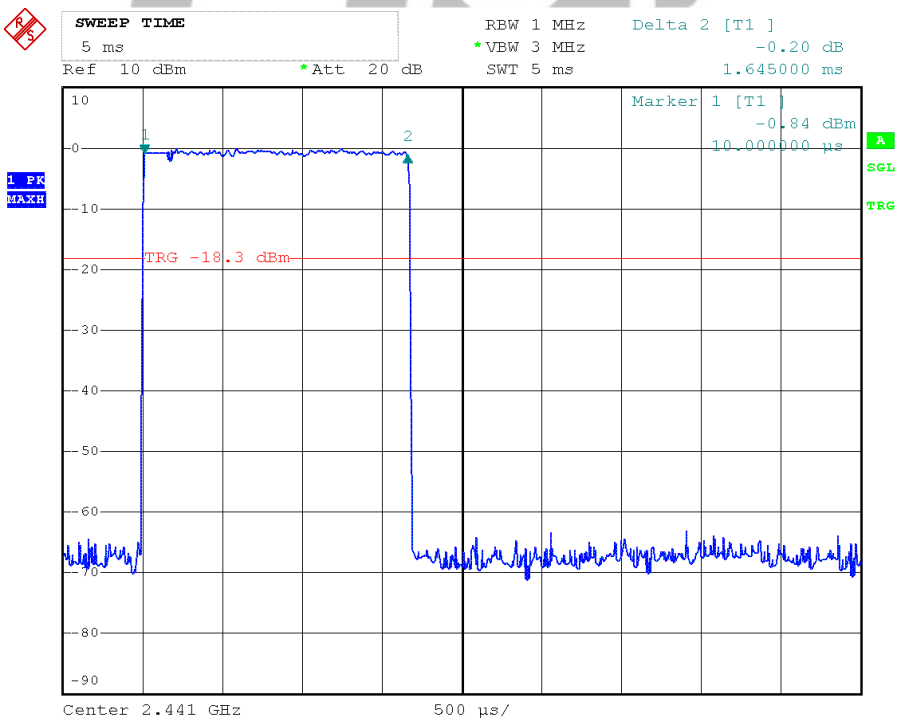
## EDR 2M 2DH3
## Channel Low




## Channel Middle



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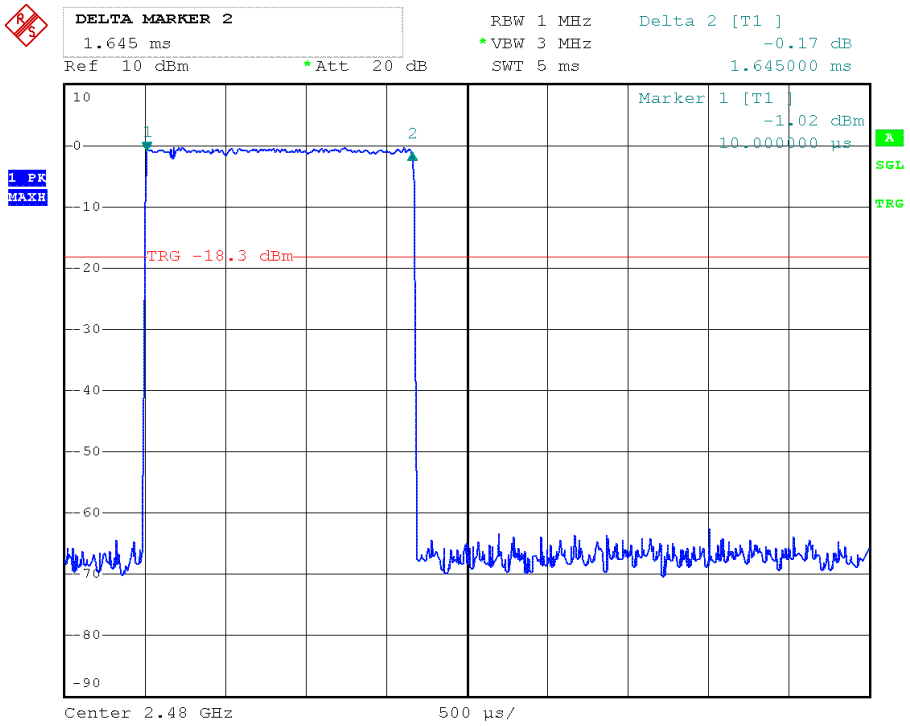
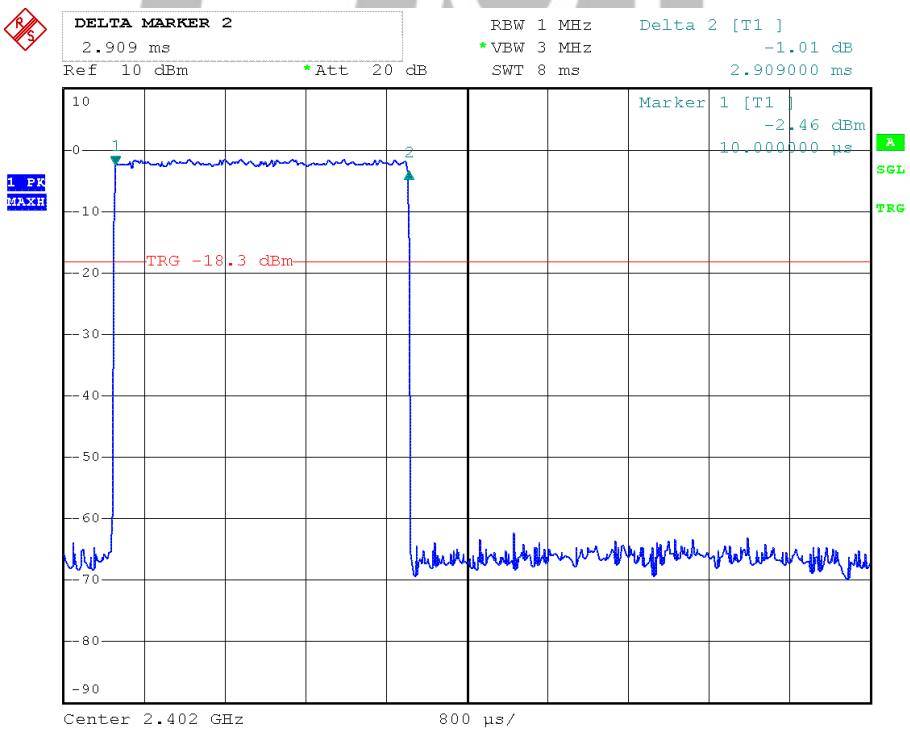
## Channel High




## EDR 2M 2DH5
## Channel Low



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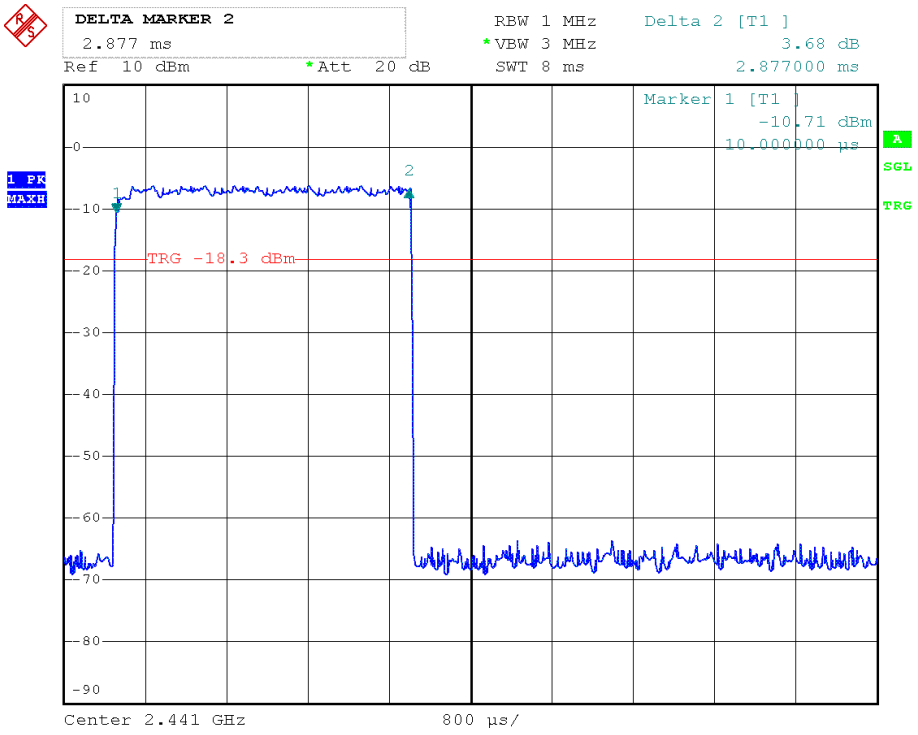
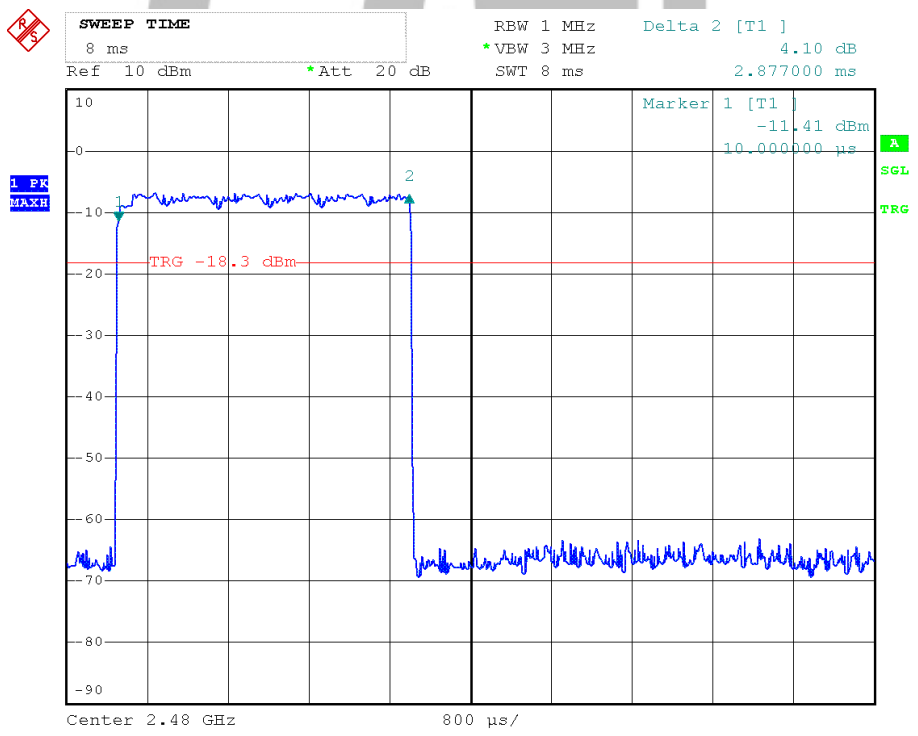
## Channel Middle




## Channel High



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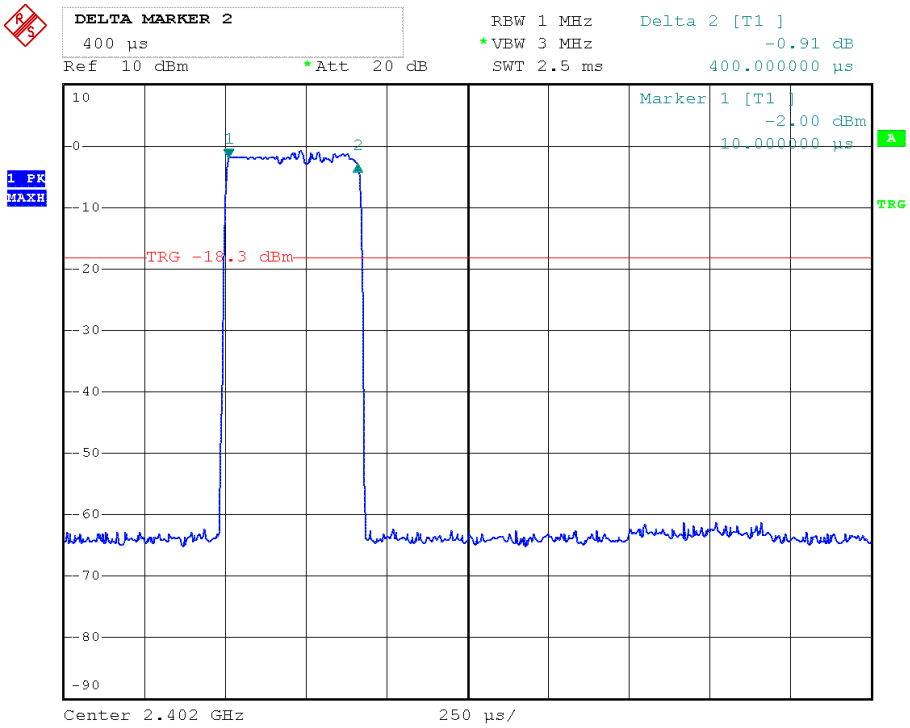
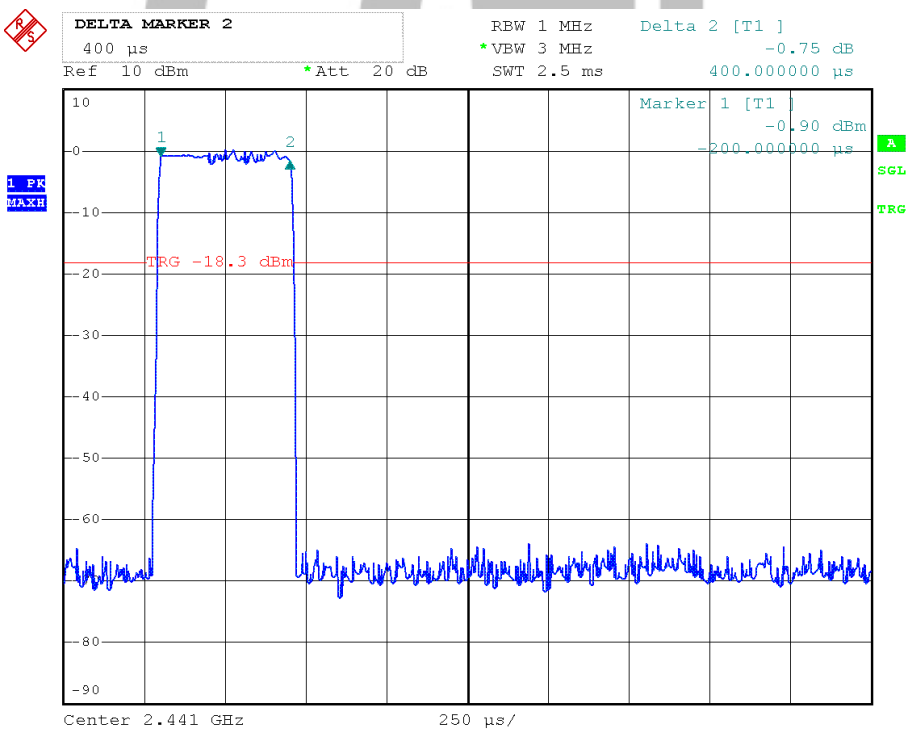
## EDR 3M 3DH1
## Channel Low




## Channel Middle



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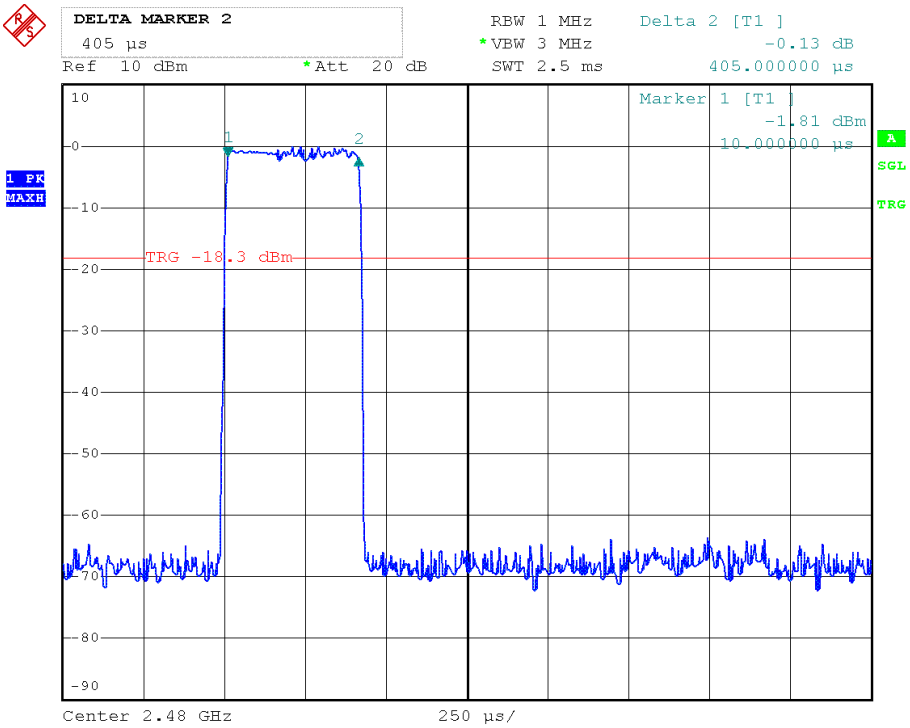
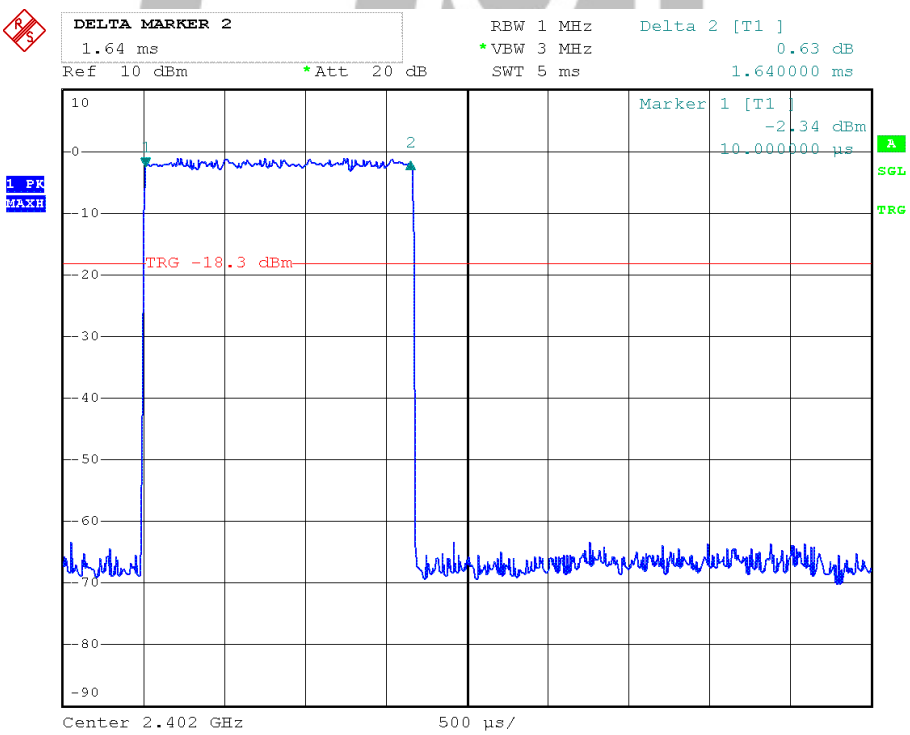
## Channel High




## EDR 3M 3DH3
## Channel Low



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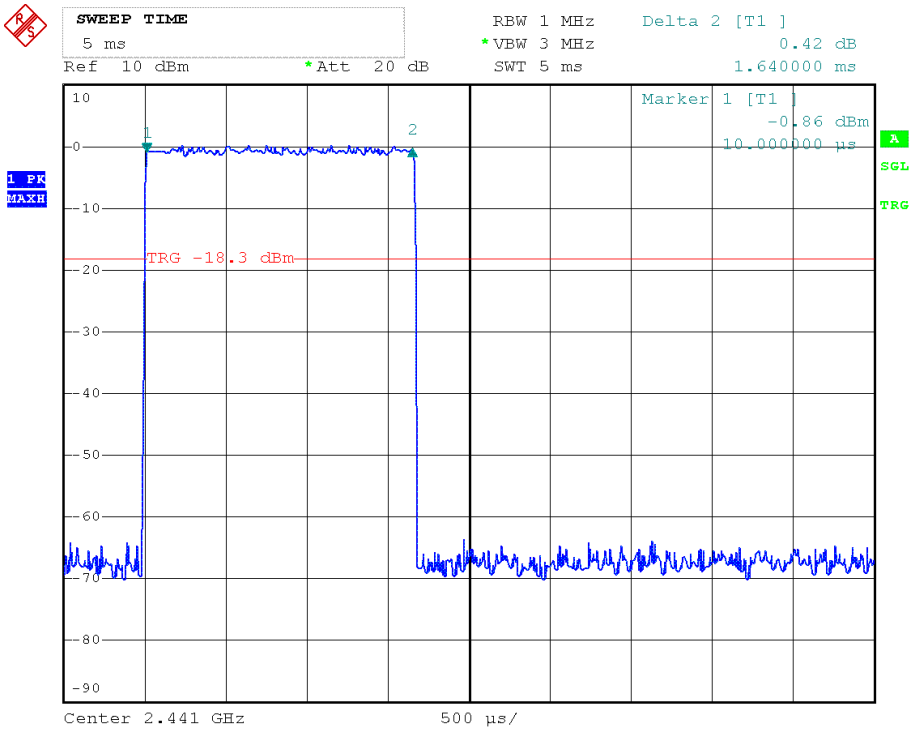
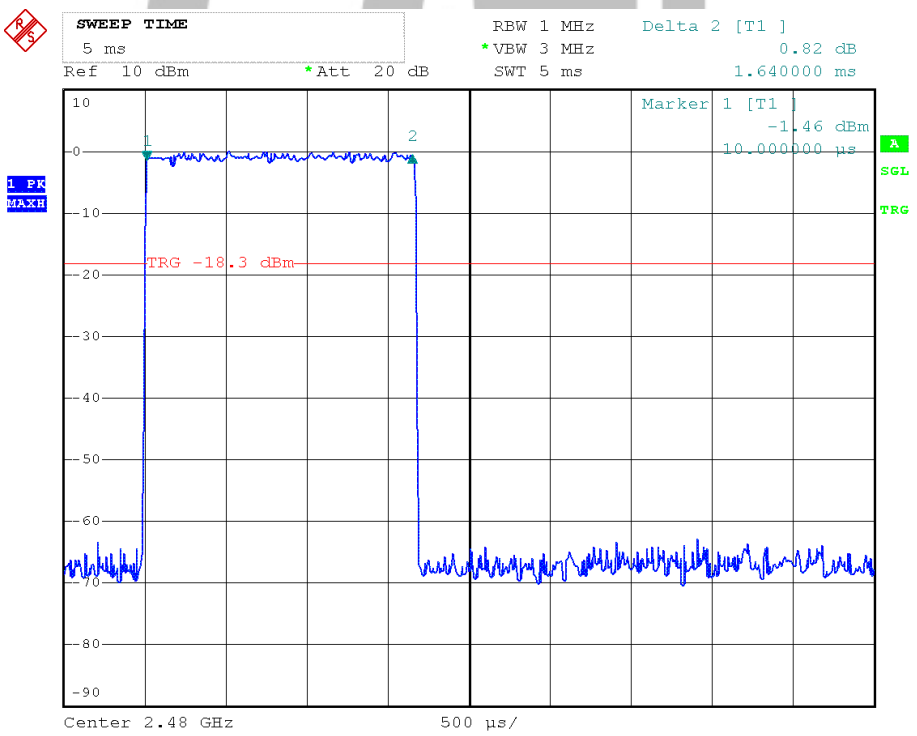
## Channel Middle




## Channel High



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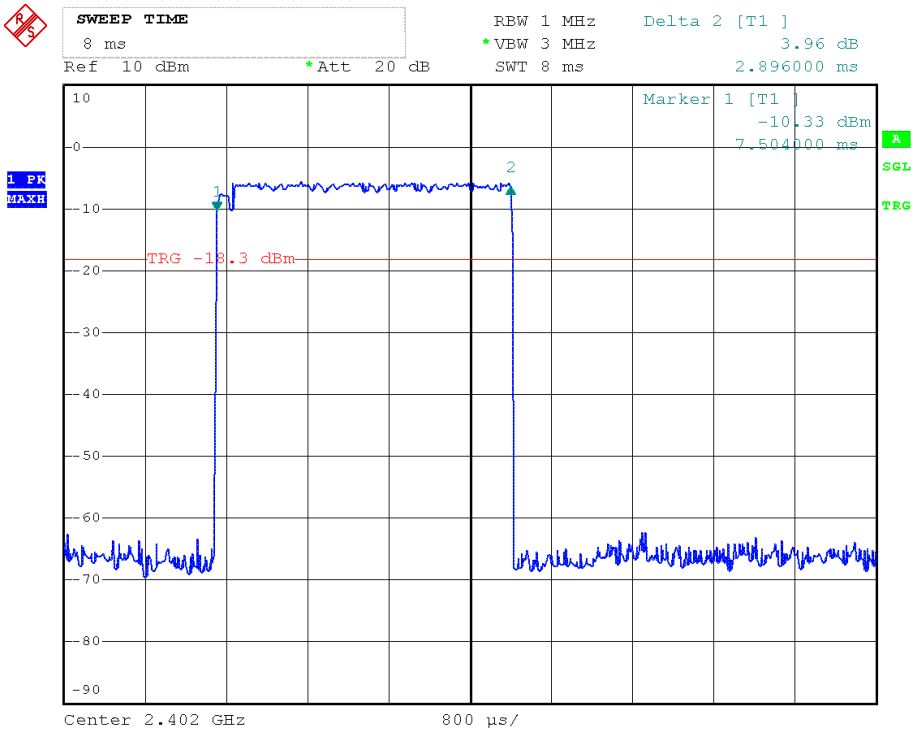
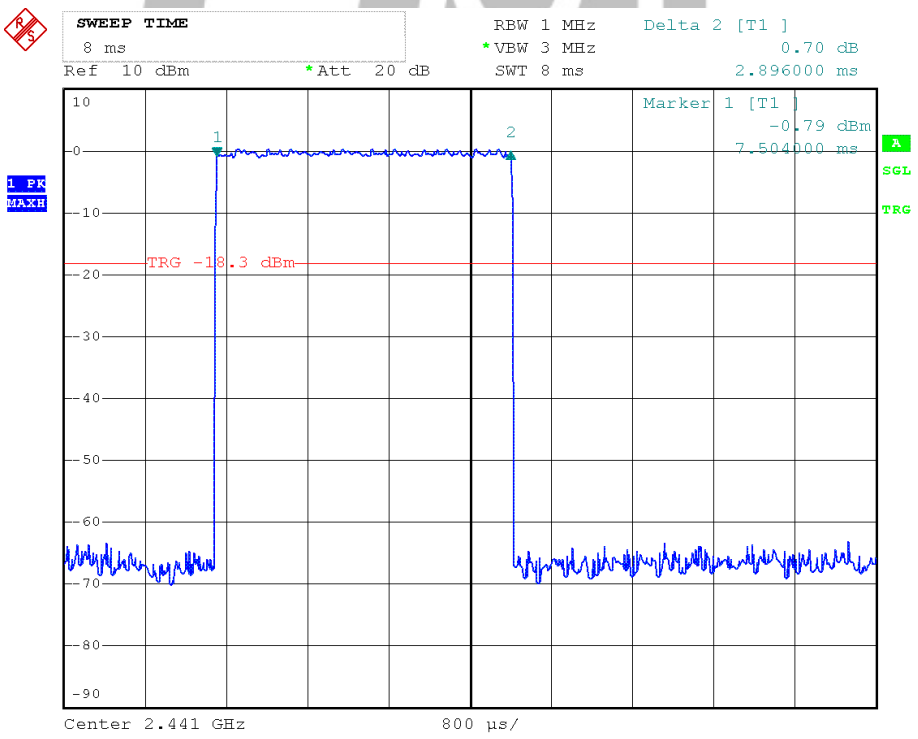
## EDR 3M 3DH5
## Channel Low




## Channel Middle



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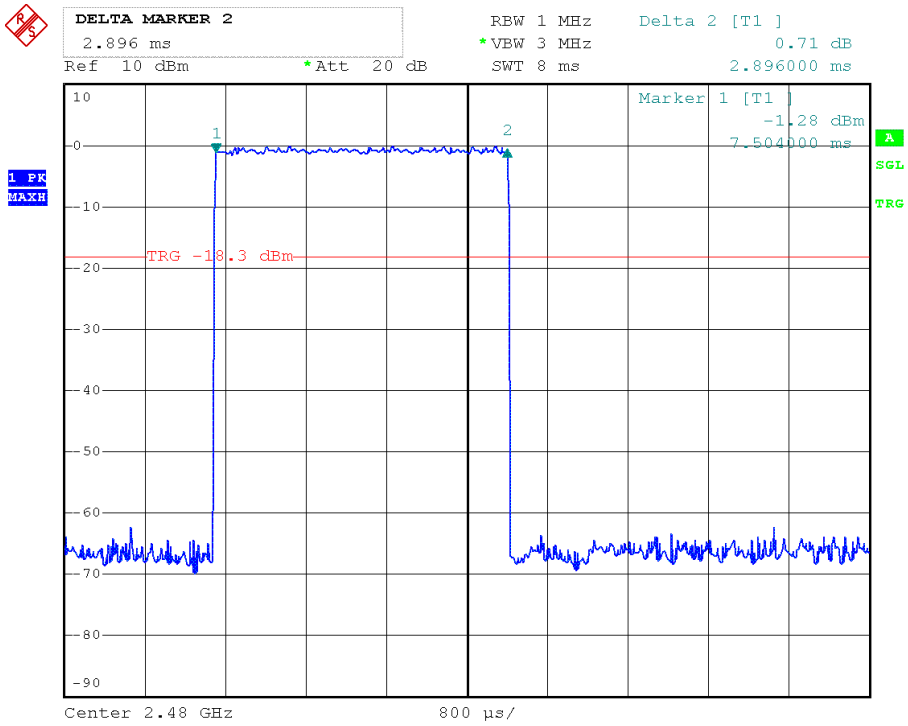
## Channel High





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# 9. Test of Maximum Peak Output Power

## 9.1 Applicable Standard

Section 15.247(b)(1): For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels and The maximum peak output power shall not exceed 1 watt. For all other frequency hopping systems in this frequency band, The maximum peak output power shall not exceed 0.125 watt.

## 9.2 EUT Setup


**Spectrum Analyzer**

## 9.3 Test Equipment List and Details

See section 2.5.

## 9.4 Test Procedure

1. The transmitter output was connected to the peak power meter and recorded the peak value.

2. Peak power meter parameter set to auto attenuator and filter is the same as.

3. Repeated the 1 for the middle and highest channel of the EUT.

## 9.5 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 22~23 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 50~54 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: Tx Mode |



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**BR 1M**

| Modulation Type | Channel No. | Frequency (MHz) | Output Power (dBm) | Limits (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| GFSK | Low | 2402.00 | 1.13 | 21 | -24.65 |
| GFSK | Middle | 2441.00 | 2.15 | 21 | -25.43 |
| GFSK | High | 2480.00 | 2.09 | 21 | -26.72 |

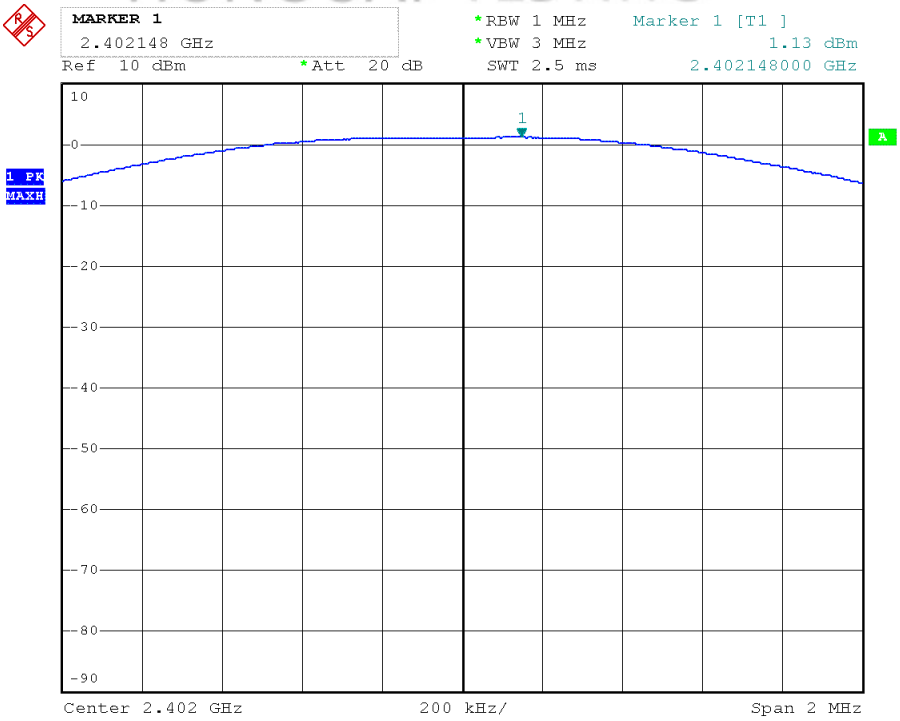
**EDR 2M**

| Modulation Type | Channel No. | Frequency (MHz) | Output Power (dBm) | Limits (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Pi/4 DQPSK | Low | 2402.00 | -1.25 | 21 | -24.87 |
| Pi/4 DQPSK | Middle | 2441.00 | 0.24 | 21 | -25.32 |
| Pi/4 DQPSK | High | 2480.00 | 0.04 | 21 | -26.75 |

**EDR 3M**

| Modulation Type | Channel No. | Frequency (MHz) | Output Power (dBm) | Limits (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| 8-DPSK | Low | 2402.00 | -0.98 | 21 | -24.82 |
| 8-DPSK | Middle | 2441.00 | 0.24 | 21 | -25.25 |
| 8-DPSK | High | 2480.00 | 0.27 | 21 | -26.74 |

**BR 1M**
**Channel Low**



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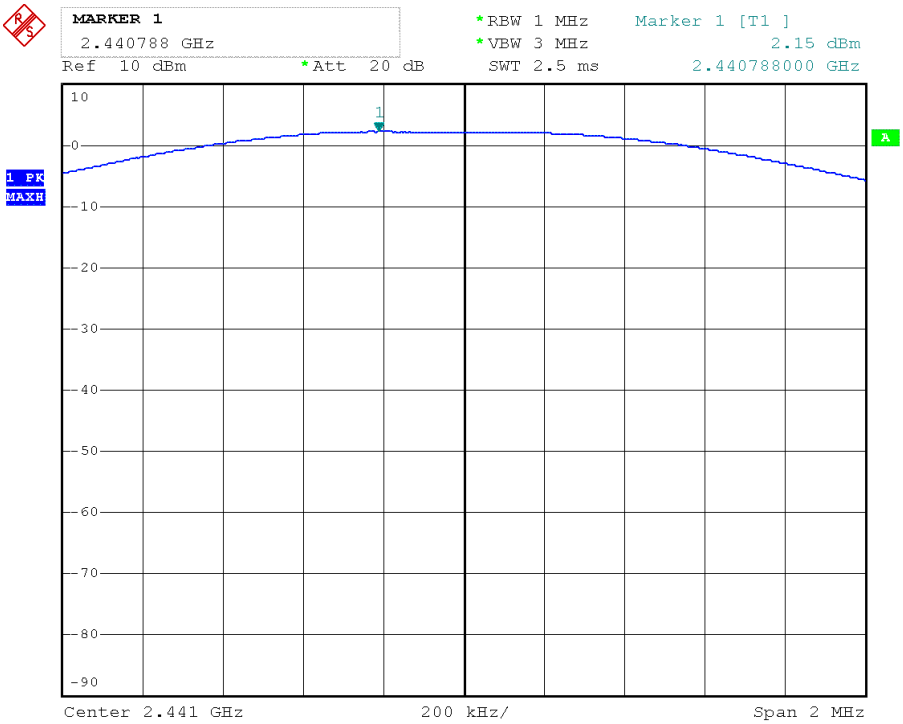
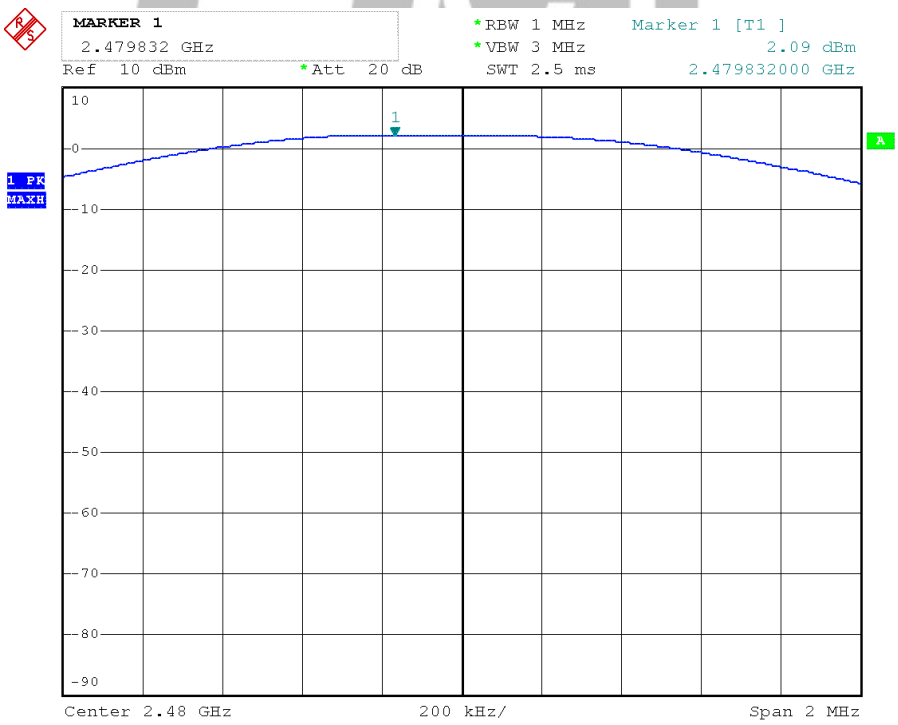
**Channel** **Middle**




**Channel High**



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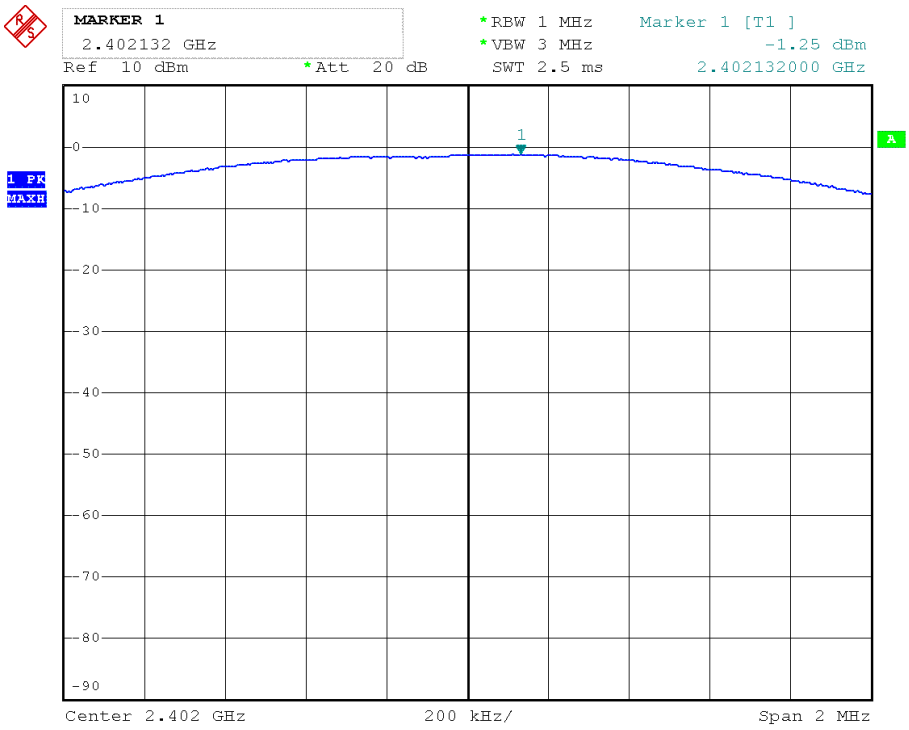
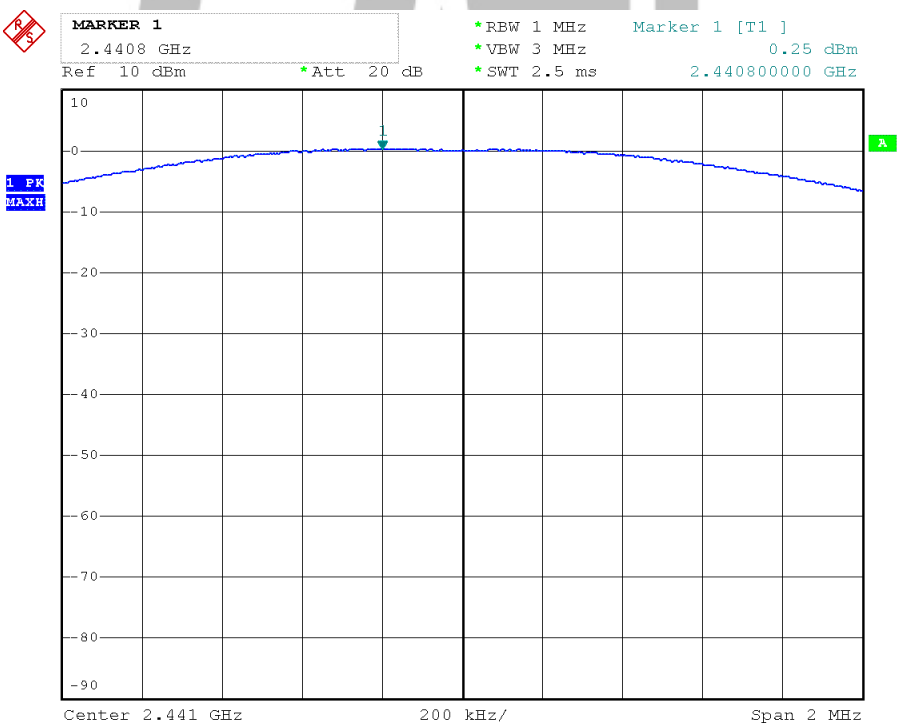
**EDR 2M**
**Channel Low**




**Channel Middle**



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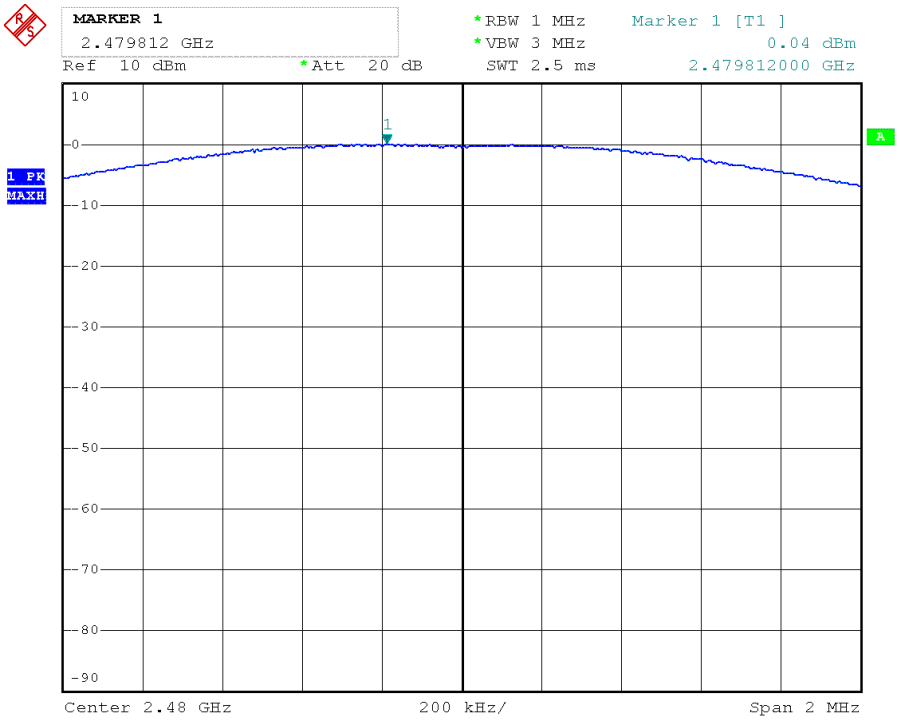
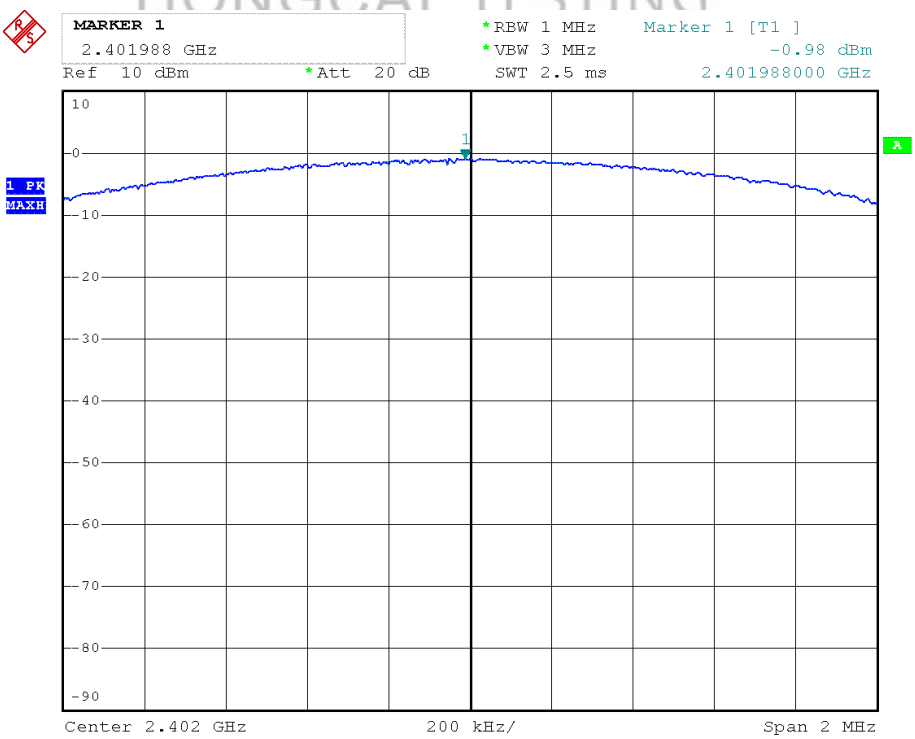
**Channel High**




**EDR 3M**
**Channel Low**





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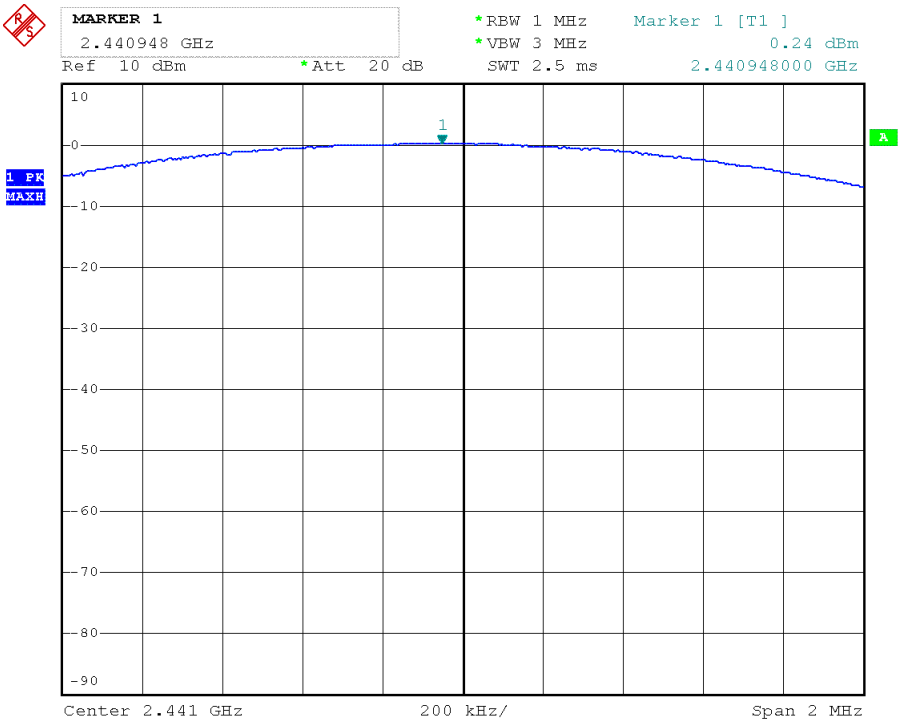
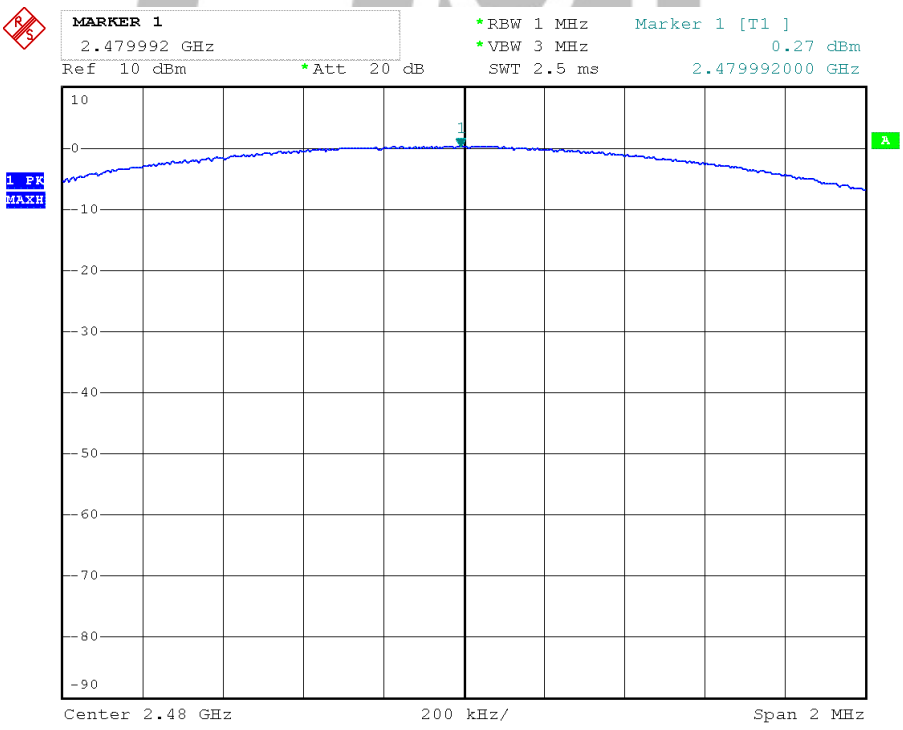
## Channel Middle




## Channel High



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# 10. Test of Band Edges Emission

## 10.1 Applicable Standard

Section 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions that fall in the restricted bands, as defined in Section 15.205, must also comply with the radiated emission limits specified in Section 15.209.

## 10.2 EUT Setup

Radiated Measurement Setup

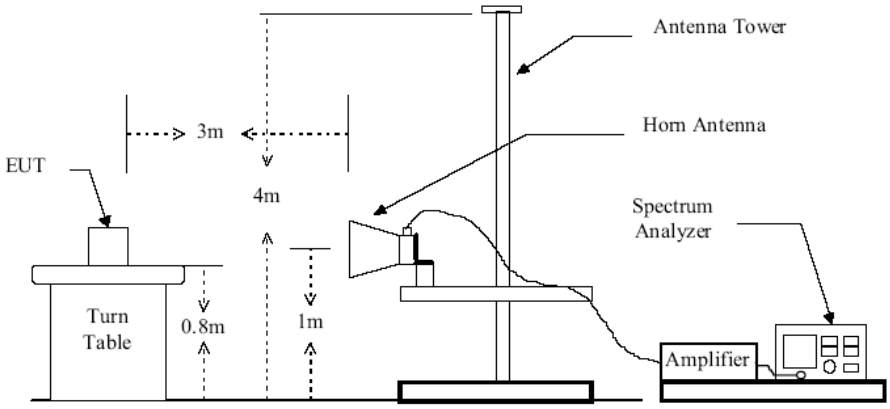


Figure 2 : Frequencies measured above 1 GHz configuration



Conducted Measurement Setup


**Spectrum Analyzer**

## 10.3 Test Equipment List and Details

See section 2.5.

## 10.4 Test Procedure

Conducted Measurement

1. The transmitter is set to the lowest channel.

2. The transmitter output was connected to the spectrum analyzer via a cable .



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3. Set both RBW and VBW of spectrum analyzer to 100KHz with convenient frequency span including 100MHz bandwidth from lower band edge. Then detector set to peak and max hold this trace.

4. The lowest band edges emission was measured and recorded.

5. The transmitter set to the highest channel and repeated 2~4.

Radiated Measurement

1. Configure the EUT according to ANSI C63.4-2013

2. The turntable was rotated by 360 degrees to determine the position of the highest radiation.

3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization.

4. For band edge emission, the antenna tower was scan (from 1 M to 4 M) and then the turn table was rotated (from 0 degree to 360 degrees) to find the maximum reading.

5. For band edge emission, use 1MHz VBW and 1MHz RBW for reading under AV and use 1MHz VBW and 1MHz RBW for reading under PK.

## 10.5 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 22~23 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 50~54 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: Tx Mode |

**Radiated Test Result**

**Worst Case BR 1M**



| Frequency (MHz) | Antenna Polarization | Emission Read Value (dBμV/m) | Emission Level (dBμV/m) | Margin (dB) | Limits (dBμV/m) | Det. |
|---|---|---|---|---|---|---|
| 2389.5 | H | 32.23 | 60.13 | -13.87 | 74 | PK |
| 2389.5 | H | 17.21 | 47.11 | -6.89 | 54 | AV |
| 2389.5 | V | 32.49 | 62.29 | -11.71 | 74 | PK |
| 2389.5 | V | 17.32 | 47.22 | -6.78 | 54 | AV |
| 2483.7 | H | 31.66 | 61.54 | -12.46 | 74 | PK |
| 2483.7 | H | 17.90 | 47.80 | -6.20 | 54 | AV |
| 2483.7 | V | 32.58 | 62.46 | -11.54 | 74 | PK |
| 2483.7 | V | 18.20 | 48.10 | -5.9 | 54 | AV |



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**Worst Case EDR 2M**

| Frequency (MHz) | Antenna Polarization | Emission Read Value (dBμV/m) | Emission Level (dBμV/m) | Margin (dB) | Limits (dBμV/m) | Det. |
|---|---|---|---|---|---|---|
| 2389.4 | H | 31.27 | 61.78 | -12.22 | 74 | PK |
| 2389.4 | H | 16.36 | 46.58 | -7.42 | 54 | AV |
| 2389.4 | V | 32.54 | 63.04 | -10.96 | 74 | PK |
| 2389.4 | V | 17.24 | 47.58 | -6.42 | 54 | AV |
| 2483.7 | H | 31.64 | 61.98 | -12.02 | 74 | PK |
| 2483.7 | H | 18.17 | 48.68 | -5.32 | 54 | AV |
| 2483.7 | V | 33.57 | 64.29 | -9.71 | 74 | PK |
| 2483.7 | V | 18.35 | 48.9 | -5.1 | 54 | AV |

**Worst Case EDR 3M**

| Frequency (MHz) | Antenna Polarization | Emission Read Value (dBμV/m) | Emission Level (dBμV/m) | Margin (dB) | Limits (dBμV/m) | Det. |
|---|---|---|---|---|---|---|
| 2389.5 | H | 31.27 | 60.68 | -13.32 | 74 | PK |
| 2389.5 | H | 19.46 | 48.54 | -5.46 | 54 | AV |
| 2389.5 | V | 33.57 | 63 | -11 | 74 | PK |
| 2389.5 | V | 18.14 | 47.91 | -6.09 | 54 | AV |
| 2483.6 | H | 31.27 | 61.13 | -12.87 | 74 | PK |
| 2483.6 | H | 18.36 | 47.91 | -6.09 | 54 | AV |
| 2483.6 | V | 33.54 | 62.83 | -11.17 | 74 | PK |
| 2483.6 | V | 18.97 | 47.58 | -6.42 | 54 | AV |

Note: 1. Emission Level = Emission Read Value + Correction Factor

2. Correction Factor) = Antenna Factor + Cable Loss- amplifier gain

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level – Limit value



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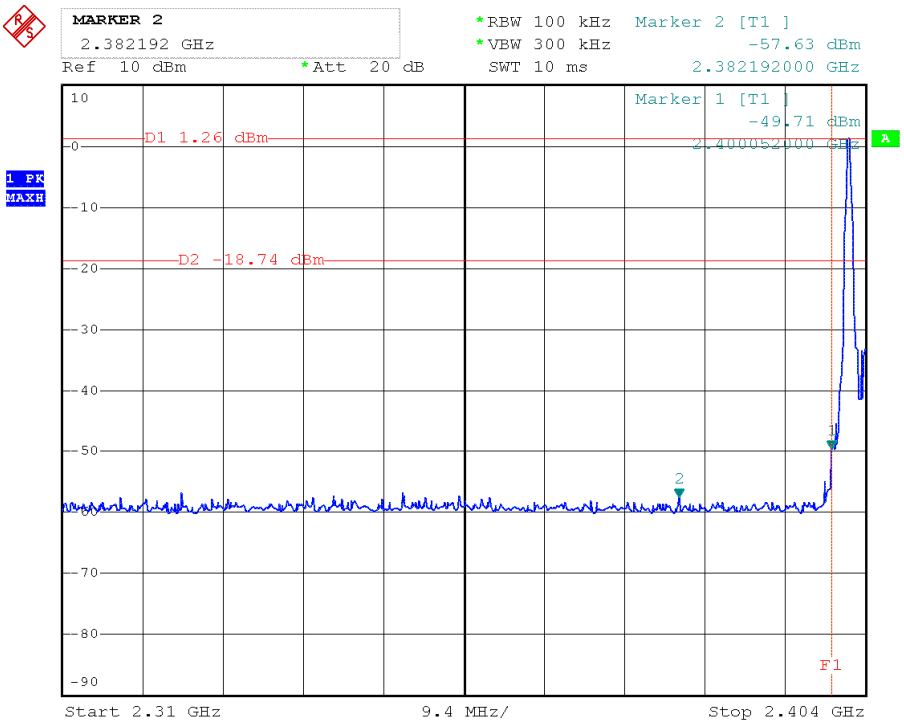
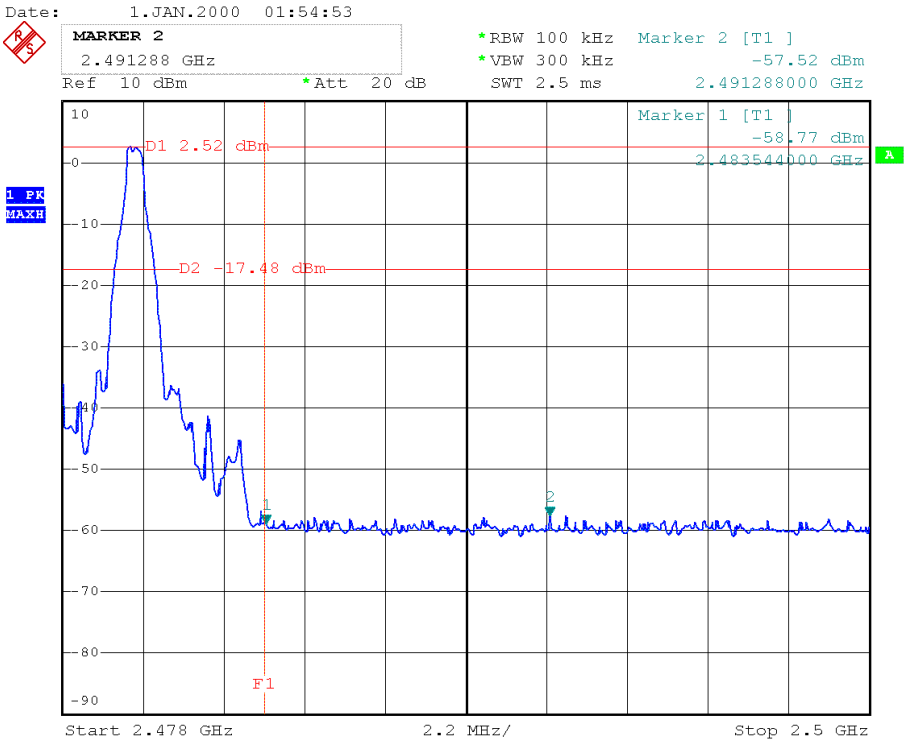
**Conducted Test Result**
**BR 1M**
**Low Channel**




**High Channel**



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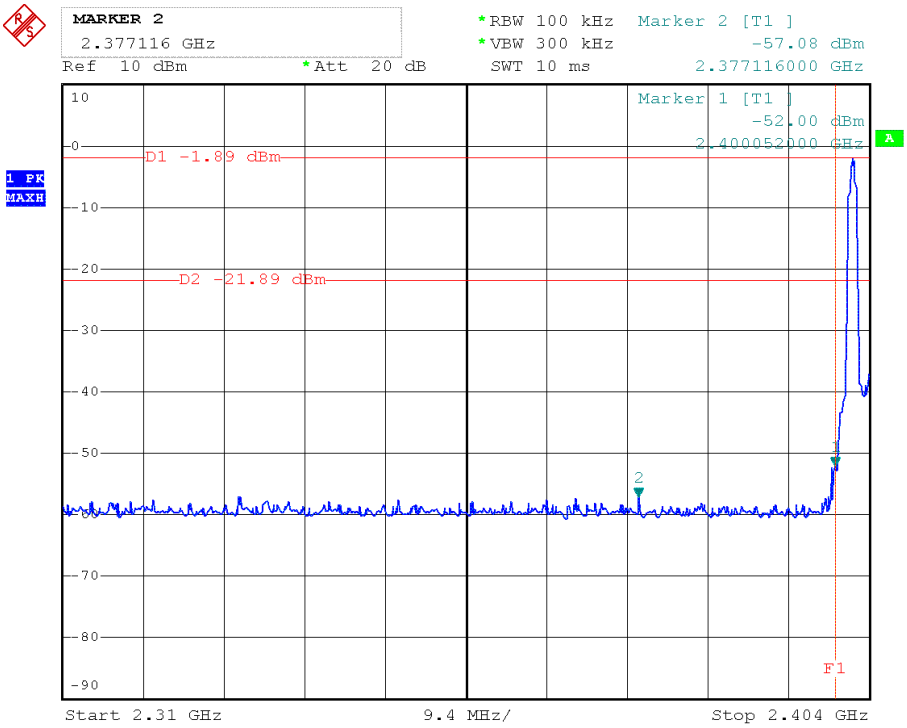
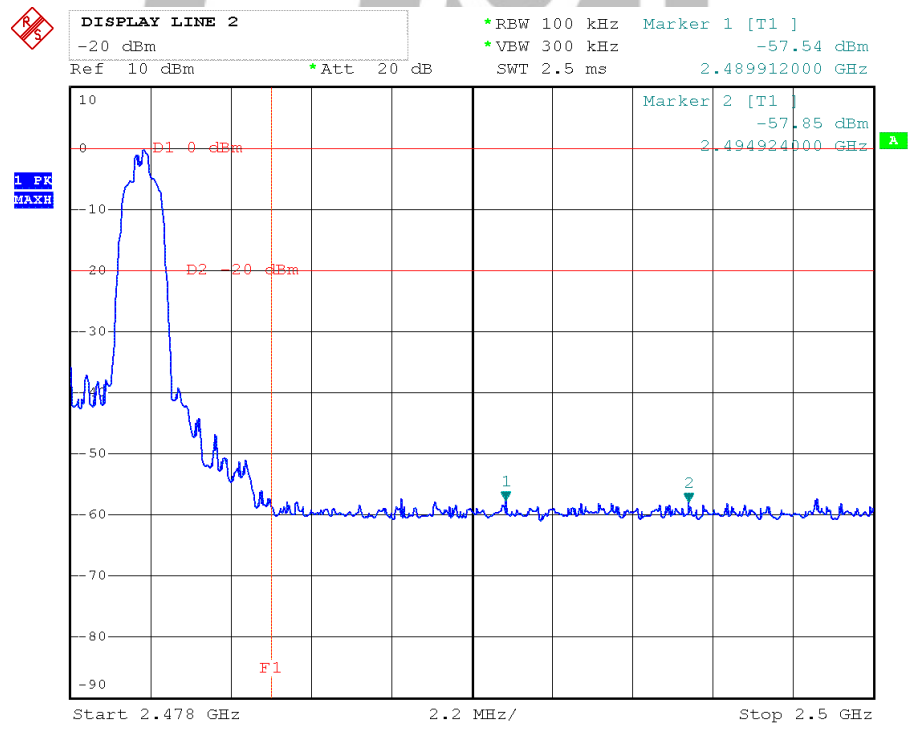
**EDR 2M**
**Low Channel**




**High Channel**



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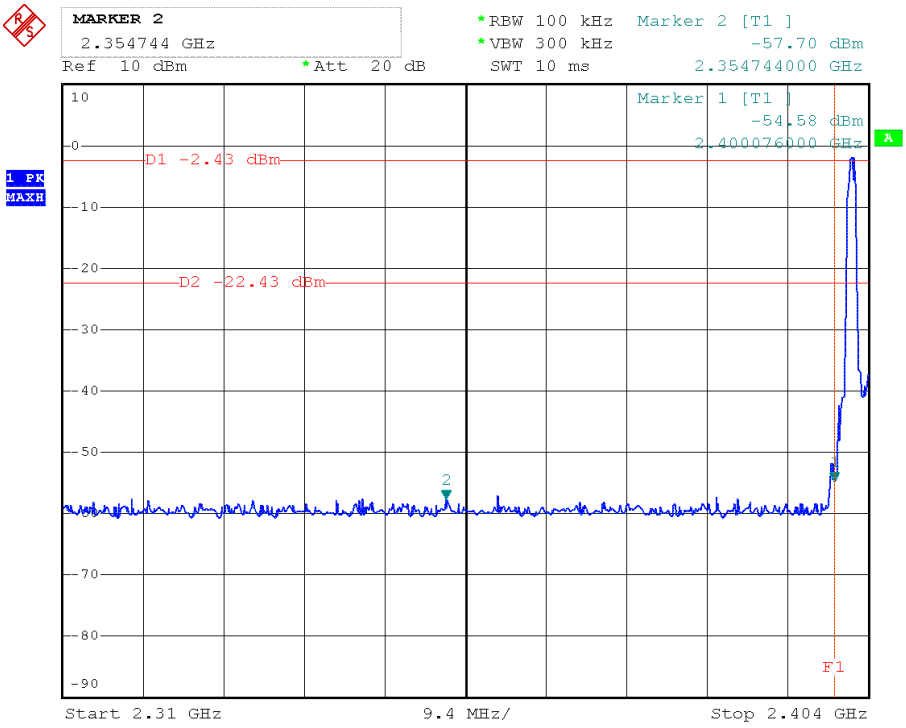
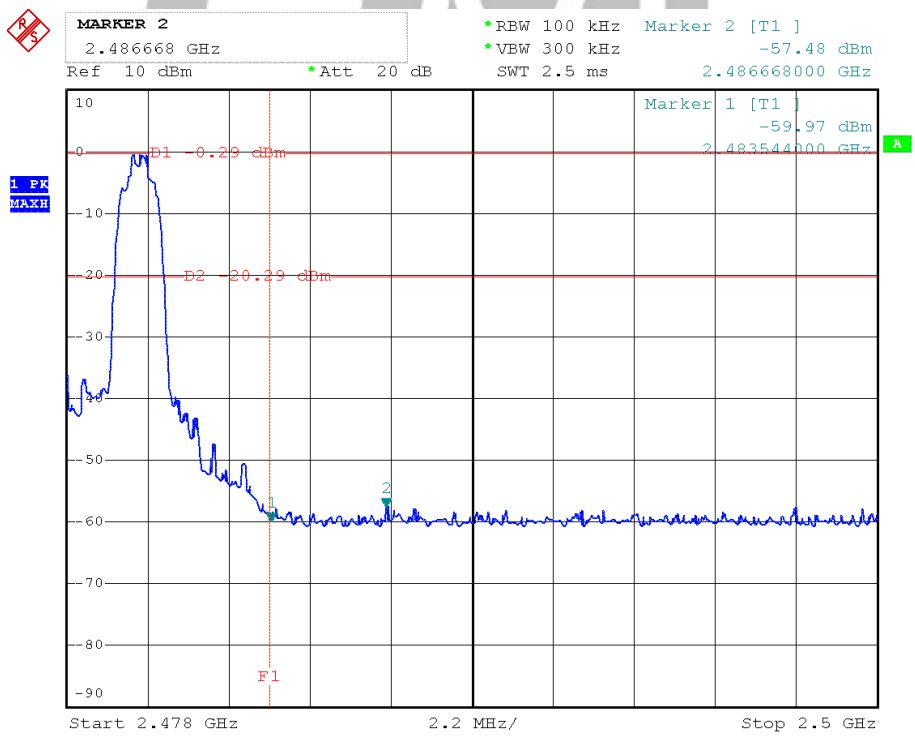
**EDR 3M**
**Low Channel**




**High Channel**



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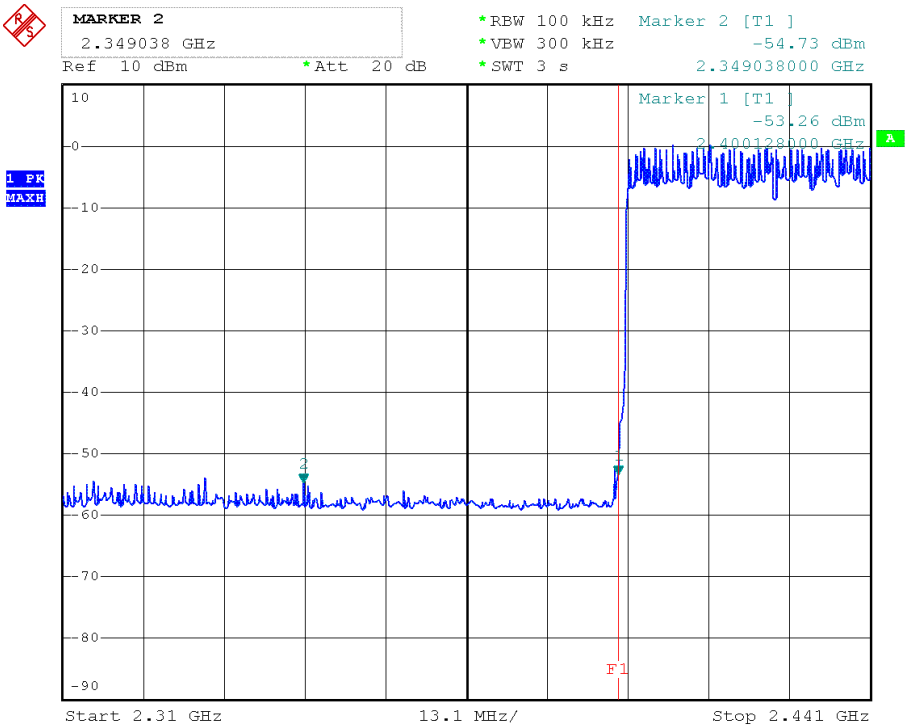
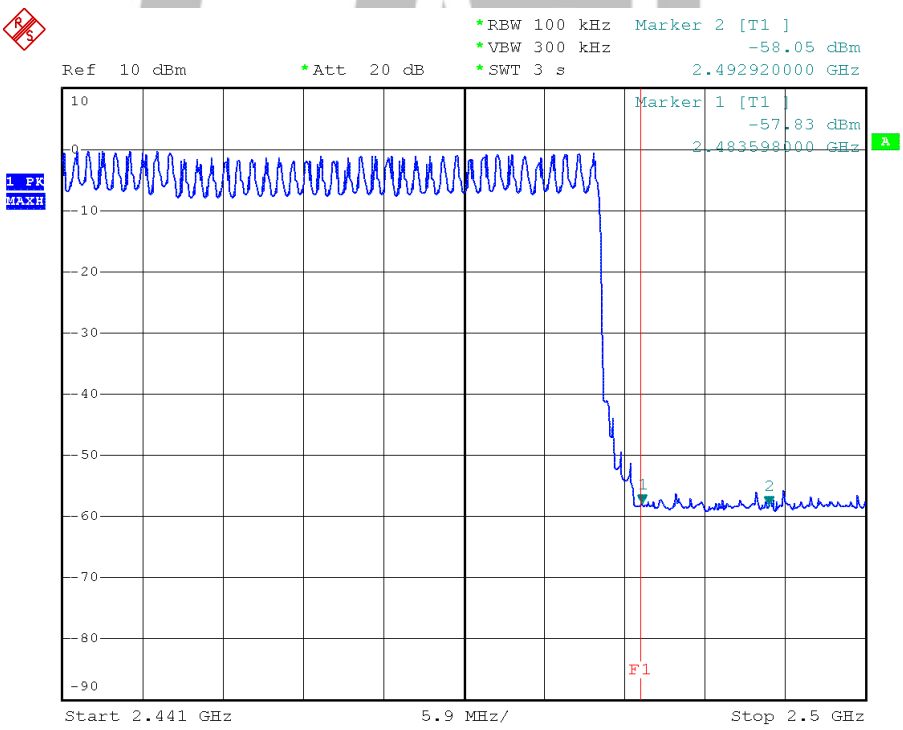
## Hopping Mode Worst case EDR 2M

### Low




### High



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# 11. Test of Spurious Radiated Emission

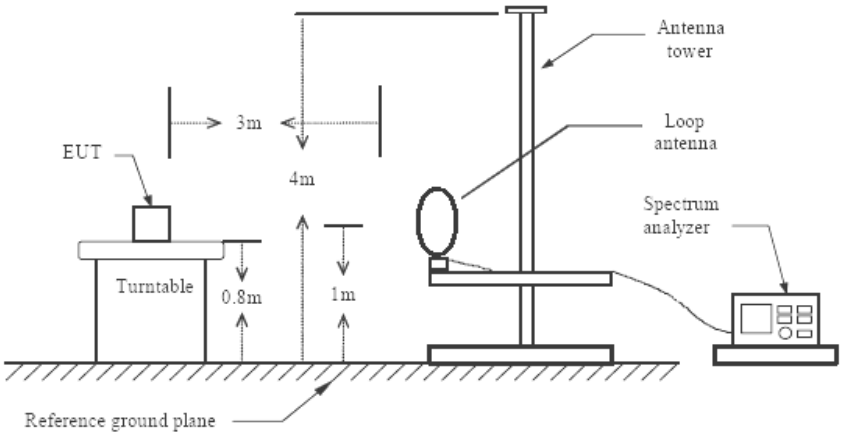
## 11.1 Applicable Standard

Section 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains
the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions that fall in the restricted bands, as defined in Section 15.205, must also comply with the radiated emission limits specified in Section 15.209.

## 11.2 EUT Setup

### Conducted Measurement Setup


### Radiated Measurement Setup



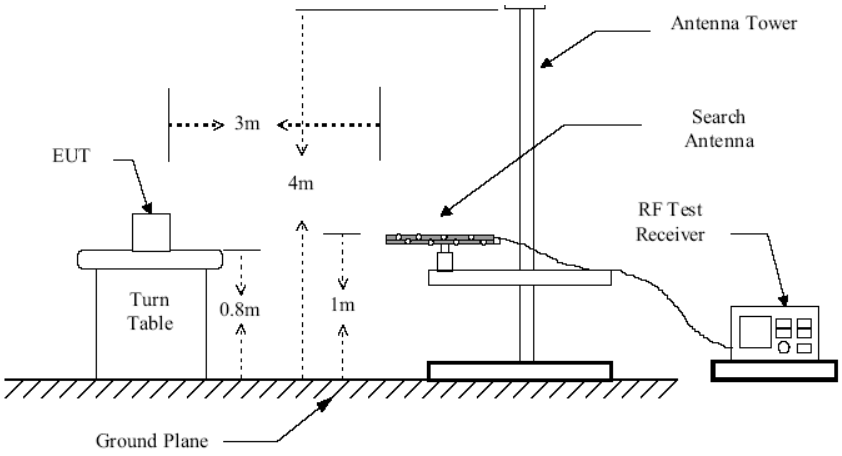




Figure 1 : Frequencies measured below 1 GHz configuration



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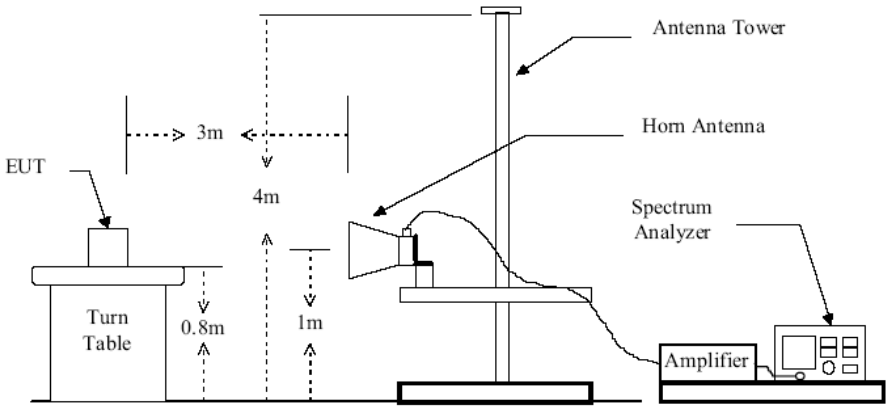


Figure 2 : Frequencies measured above 1 GHz configuration

## 11.3 Test Equipment List and Details

See section 2.5.

## 11.4 Test Procedure

**Conducted Measurement**

1. For emission above 1GHz to 26G,conducted measurement method is used.

2. The transmitter is set to the lowest channel.

3. The transmitter output was connected to the spectrum analyzer via a cable and cable loss is used as the offset of the spectrum analyzer.

4. Set RBW to 1 MHz and VBW to 3 MHz, Then detector set to peak and max hold this trace.

5. The lowest band edges emission was measured and recorded.

6. The transmitter set to the highest channel and repeated 2~4.

**Radiated Measurement**

1. Configure the EUT according to ANSI C63.4-2013

2. The EUT was placed on the top of the turntable 0.8 meter above ground.

3. Receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable. When the frequency spectrum measured started from 9 kHz to 30 MHz, a loop antenna is used. When the frequency spectrum measured started from 30 MHz to 1000 MHz and above 1000 MHz, a broadband receiving antenna and the horn antenna are used.

4. Power on the EUT and all the supporting units.

5. The turntable was rotated by 360 degrees to determine the position of the highest radiation.

6. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization.

7. For each suspected emission, the antenna tower was scanned (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.



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8. According to the characteristic of the EUT crystals, the range of frequencies was investigated from 9KHz to 30MHz, 30MHz to 1GHz and 1GHz to 26GHz.

9. For emission below 1GHz, Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.

10. For emission above 1GHz, Set the RBW=1MHz,VBW=3MHz for Peak Detector while the RBW=1MHz, VBW=10Hz for Average Detector, Readings are both peak and average values.

11. The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos. The worst case data is recorded in the report. All emission not reported are much lower than the prescribed limits.

### 11.5 Test Result

| | |
|---|---|
| Temperature ( ℃ ) : 22~23 | EUT: Bluetooth Speaker |
| Humidity (%RH ): 50~54 | M/N: BA1 |
| Barometric Pressure ( mbar ): 950~1000 | Operation Condition: TX Mode |





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## WORST-CASE RADIATED EMISSION BELOW 1 GHz

**CH Low:**

Horizontal

| Frequency | Meter Reading | Tansd | Limits | Margin | Detector Mode |
|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dB μ V/M) | (dB) | PK/QP |
| 36.76 | 27.80 | 13.6 | 40 | -12.2 | QP |
| 86.26 | 25.60 | 13.8 | 40 | -14.4 | QP |
| 101.78 | 27.80 | 16.1 | 43.5 | -15.7 | QP |
| 187.14 | 25.60 | 13.7 | 43.5 | -17.9 | QP |
| 549.92 | 32.70 | 20.9 | 46 | -13.3 | QP |
| 873.90 | 39.00 | 25.4 | 46 | -7.0 | QP |
| N/A | ---- | ---- | ---- | ---- | ---- |

Vertical

| Frequency | Meter Reading | Tansd | Limits | Margin | Detector Mode |
|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dB μ V/M) | (dB) | PK/QP |
| 33.88 | 35.40 | 13.8 | 40 | -4.6 | QP |
| 107.6 | 33.70 | 15.5 | 43.5 | -9.8 | QP |
| 121.18 | 36.00 | 13.4 | 43.5 | -7.5 | QP |
| 134.76 | 37.60 | 11.8 | 43.5 | -5.9 | QP |
| 148.34 | 36.10 | 11.6 | 43.5 | -7.4 | QP |
| 922.40 | 38.50 | 25.9 | 46 | -7.5 | QP |
| N/A | ---- | ---- | ---- | ---- | ---- |

**CH Middle:**

Horizontal

| Frequency | Meter Reading | Tansd | Limits | Margin | Detector Mode |
|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dB μ V/M) | (dB) | PK/QP |
| 36.78 | 27.82 | 13.62 | 40 | -12.18 | QP |
| 86.28 | 25.62 | 13.82 | 40 | -14.38 | QP |
| 101.8 | 27.82 | 16.12 | 43.5 | -15.68 | QP |
| 187.16 | 25.62 | 13.72 | 43.5 | -17.88 | QP |
| 549.94 | 32.72 | 20.92 | 46 | -13.28 | QP |
| 873.92 | 39 | 25.4 | 46 | -7 | QP |
| N/A | ---- | ---- | ---- | ---- | ---- |



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Vertical

| Frequency | Meter Reading | Tansd | Limits | Margin | Detector Mode |
|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dB μ V/M) | (dB) | PK/QP |
| 33.84 | 35.36 | 13.76 | 40 | -4.64 | QP |
| 107.56 | 33.66 | 15.46 | 43.5 | -9.84 | QP |
| 121.14 | 35.96 | 13.36 | 43.5 | -7.54 | QP |
| 134.72 | 37.56 | 11.76 | 43.5 | -5.94 | QP |
| 148.3 | 36.06 | 11.56 | 43.5 | -7.44 | QP |
| 922.36 | 38.46 | 25.86 | 46 | -7.54 | QP |
| N/A | ---- | ---- | ---- | ---- | ---- |

**CH High:**

Horizontal

| Frequency | Meter Reading | Tansd | Limits | Margin | Detector Mode |
|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dB μ V/M) | (dB) | PK/QP |
| 36.83 | 27.87 | 13.67 | 40 | 24.63 | 36.83 |
| 86.33 | 25.67 | 13.87 | 40 | 71.93 | 86.33 |
| 101.85 | 27.87 | 16.17 | 43.5 | 86.15 | 101.85 |
| 187.21 | 25.67 | 13.77 | 43.5 | 169.31 | 187.21 |
| 549.99 | 32.77 | 20.97 | 46 | 536.69 | 549.99 |
| 873.97 | 39.07 | 25.47 | 46 | 866.97 | 873.97 |
| N/A | ---- | ---- | ---- | ---- | ---- |

Vertical

| Frequency | Meter Reading | Tansd | Limits | Margin | Detector Mode |
|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dB μ V/M) | (dB) | PK/QP |
| 33.95 | 35.47 | 13.87 | 40 | -4.53 | QP |
| 107.67 | 33.77 | 15.57 | 43.5 | -9.73 | QP |
| 121.25 | 36.07 | 13.47 | 43.5 | -7.43 | QP |
| 134.83 | 37.67 | 11.87 | 43.5 | -5.83 | QP |
| 148.41 | 36.17 | 11.67 | 43.5 | -7.33 | QP |
| 922.47 | 38.57 | 25.97 | 46 | -7.43 | QP |
| N/A | ---- | ---- | ---- | ---- | ---- |

Note:

1. The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos. The worst case data is recorded in the report.

2. Emission level (dBuV/m) =Raw Value (dBuV) + Correction Factor (dB/m)

3. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)

4. The other emission levels were very low against the limit.

5. Margin value = Emission level.- Limit value



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**The worst Spurious Emission Data BR Mode Above 1GHz**
**Channel Low**

| Channel Low（2402MHz） | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Maximum Frequency (MHz) | Polarity and Level | | | | | Limit (dBμV/m) | Margin (dBμV/m) | Mark (P/Q/A) |
| | Polarity | Height (m) | Reading dBμV | Transd | Result dBμV/m | | | |
| 2402 | H | 1 | 86.24 | -6.47 | 79.77 | ---- | ---- | P |
| | | | 79.54 | -6.47 | 73.07 | ---- | ---- | A |
| 2402 | V | 1 | 84.24 | -6.47 | 77.77 | ---- | ---- | P |
| | | | 78.25 | -6.47 | 71.78 | ---- | ---- | A |
| 4804 | H | 1 | 41.30 | 0.52 | 41.82 | 74 | -32.18 | P |
| | | | 30.27 | 0.52 | 30.79 | 54 | -23.21 | A |
| 4804 | V | 1 | 42.71 | 0.52 | 43.23 | 74 | -30.77 | P |
| | | | 30.22 | 0.52 | 30.74 | 54 | -23.26 | A |
| 7206 | H | 1 | 40.15 | 7.41 | 47.56 | 74 | -26.44 | P |
| | | | 30.63 | 7.41 | 38.04 | 54 | -15.96 | A |
| 7206 | V | 1 | 40.15 | 7.41 | 47.56 | 74 | -26.44 | P |
| | | | 30.46 | 7.41 | 37.87 | 54 | -16.13 | A |
| 9608 | H | 1 | 40.89 | 10.29 | 51.18 | 74 | -22.82 | P |
| | | | 30.67 | 10.29 | 40.96 | 54 | -13.04 | A |
| 9608 | V | 1 | 42.59 | 7.38 | 49.97 | 74 | -24.03 | P |
| | | | 32.85 | 7.38 | 40.23 | 54 | -13.77 | A |
| 12023.31 | H | 1 | 41.58 | 14.01 | 55.59 | 74 | -18.41 | P |
| | | | 31.33 | 14.01 | 45.34 | 54 | -8.66 | A |
| 12023.33 | V | 1 | 42.85 | 14.01 | 56.86 | 74 | -17.14 | P |
| | | | 32.58 | 14.01 | 46.59 | 54 | -7.41 | A |
| 25220.37 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

Remark: 1. Transd.=Antenna Factor+Cable Loss-Pre-amplifier
Margin = Level-Limit
Mark: P means Peak Value, Q means Quasi Peak Value, A means Average Value
2. Data of measurement within this frequency range shown " -" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
3. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz.
4. The test limit distance is 3m limit



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## Channel Mid

| Channel Middle（2441MHz） | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Maximum Frequency (MHz) | Polarity and Level | | | | | Limit (dBμV/m) | Margin (dBμV/m) | Mark (P/Q/A) |
| | Polarity | Height (m) | Reading dBμV | Transd | Result dBμV/m | | | |
| 2441 | H | 1 | 86.21 | -6.37 | 79.84 | ---- | ---- | P |
| | | | 78.12 | -6.37 | 71.75 | ---- | ---- | A |
| 2441 | V | 1 | 85.23 | -6.37 | 78.86 | ---- | ---- | P |
| | | | 77.27 | -6.37 | 70.9 | ---- | ---- | A |
| 4882 | H | 1 | 40.77 | 0.75 | 41.52 | 74 | -32.48 | P |
| | | | 30.64 | 0.75 | 31.39 | 54 | -22.61 | A |
| 4882 | V | 1 | 42.25 | 0.75 | 43.00 | 74 | -31.00 | P |
| | | | 31.64 | 0.75 | 32.39 | 54 | -21.61 | A |
| 7323 | H | 1 | 39.41 | 7.48 | 46.89 | 74 | -27.11 | P |
| | | | 30.84 | 7.48 | 38.32 | 54 | -15.68 | A |
| 7323 | V | 1 | 40.08 | 7.48 | 47.56 | 74 | -26.44 | P |
| | | | 30.73 | 7.48 | 38.21 | 54 | -15.79 | A |
| 9764 | H | 1 | 41.24 | 10.47 | 51.71 | 74 | -22.29 | P |
| | | | 30.36 | 10.47 | 40.83 | 54 | -13.17 | A |
| 9764 | V | 1 | 42.78 | 10.47 | 53.25 | 74 | -20.75 | P |
| | | | 32.84 | 10.47 | 43.31 | 54 | -10.69 | A |
| 12168.22 | H | 1 | 41.15 | 14.1 | 55.25 | 74 | -18.75 | P |
| | | | 30.75 | 14.1 | 44.85 | 54 | -9.15 | A |
| 12168.22 | V | 1 | 43.64 | 14.1 | 57.74 | 74 | -16.26 | P |
| | | | 31.38 | 14.1 | 45.48 | 54 | -8.52 | A |
| 25380.37 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

Remark: 1. Transd.=Antenna Factor+Cable Loss-Pre-amplifier
Margin = Level-Limit
Mark: P means Peak Value, Q means Quasi Peak Value, A means Average Value
2. Data of measurement within this frequency range shown " -" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
3. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz.
4. The test limit distance is 3m limit



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## Channel High

| Channel High（2480MHz） | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Maximum Frequency (MHz) | Polarity and Level | | | | | Limit (dBμV/m) | Margin (dBμV/m) | Mark (P/Q/A) |
| | Polarity | Height (m) | Reading dBμV | Transd | Result dBμV/m | | | |
| 2480 | H | 1 | 85.74 | -6.28 | 79.46 | ---- | ---- | P |
| | | | 76.74 | -6.28 | 70.46 | ---- | ---- | A |
| 2480 | V | 1 | 84.27 | -6.28 | 77.99 | ---- | ---- | P |
| | | | 72.48 | -6.28 | 66.20 | ---- | ---- | A |
| 4960 | H | 1 | 41.07 | 0.97 | 42.04 | 74 | -31.96 | P |
| | | | 30.74 | 0.97 | 31.71 | 54 | -22.29 | A |
| 4960 | V | 1 | 44.59 | 0.97 | 45.56 | 74 | -28.44 | P |
| | | | 31.73 | 0.97 | 32.70 | 54 | -21.30 | A |
| 7440 | H | 1 | 40.48 | 7.56 | 48.04 | 74 | -25.96 | P |
| | | | 30.24 | 7.56 | 37.80 | 54 | -16.20 | A |
| 7440 | V | 1 | 39.84 | 7.56 | 47.40 | 74 | -26.60 | P |
| | | | 29.75 | 7.56 | 37.31 | 54 | -16.69 | A |
| 9920 | H | 1 | 45.77 | -8.23 | 37.54 | 74 | -36.46 | P |
| | | | 33.67 | -8.23 | 25.44 | 54 | -28.56 | A |
| 9920 | V | 1 | 46.27 | -8.23 | 38.04 | 74 | -35.96 | P |
| | | | 33.78 | -8.23 | 25.55 | 54 | -28.45 | A |
| 12361.67 | H | 1 | 41.58 | 14.19 | 55.77 | 74 | -18.23 | P |
| | | | 31.78 | 14.19 | 45.97 | 54 | -8.03 | A |
| 12361.67 | V | 1 | 42.89 | 14.19 | 57.08 | 74 | -16.92 | P |
| | | | 32.74 | 14.19 | 46.93 | 54 | -7.07 | A |
| 25380.37 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

Remark: 1. Transd.=Antenna Factor+Cable Loss-Pre-amplifier
Margin = Level-Limit
Mark: P means Peak Value, Q means Quasi Peak Value, A means Average Value
2. Data of measurement within this frequency range shown " -" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
3. Spectrum analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz.
4. The test limit distance is 3m limit



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**The worst Spurious Emission Data BR Mode Below 30 MHz**

| Frequency (MHz) | Read Level (dBuV) | Antenna Factor (dB/m) | Cable Loss (dB) | Emission Levels (dBuV/m) | Limit (dBμV/m) | Margin (dB) | Detector Mode |
|---|---|---|---|---|---|---|---|
| 0.558 | 22.56 | 8.23 | 1.03 | 29.76 | 72.6 | -42.84 | QP |
| 14.78 | 21.38 | 9.07 | 1.19 | 29.26 | 69.5 | -40.24 | QP |
| 21.56 | 21.59 | 9.25 | 1.08 | 29.76 | 69.5 | -39.74 | QP |
| 24.69 | 21.45 | 8.43 | 1.66 | 28.22 | 69.5 | -41.28 | QP |

Note:

1. The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos. The worst case data is recorded in the report.

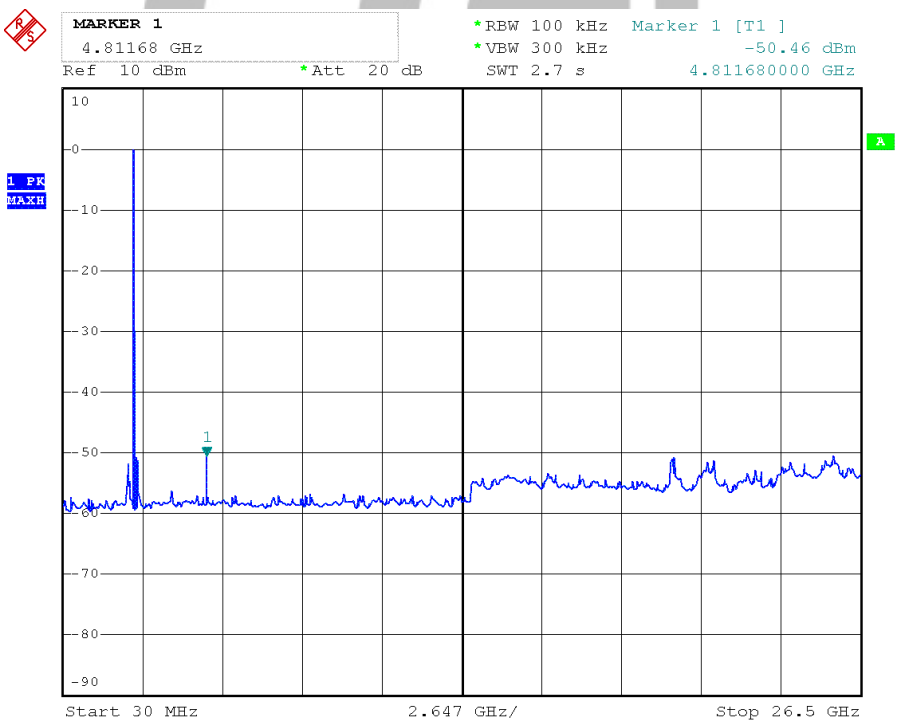
2. Emission level (dBuV/m) =Raw Value (dBuV) + Correction Factor (dB/m)

3. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)

4. The other emission levels were very low against the limit.

5. Margin value = Emission level.- Limit value

**Conducted Spurious Emission**
**BR 1M**
**Channel Low**



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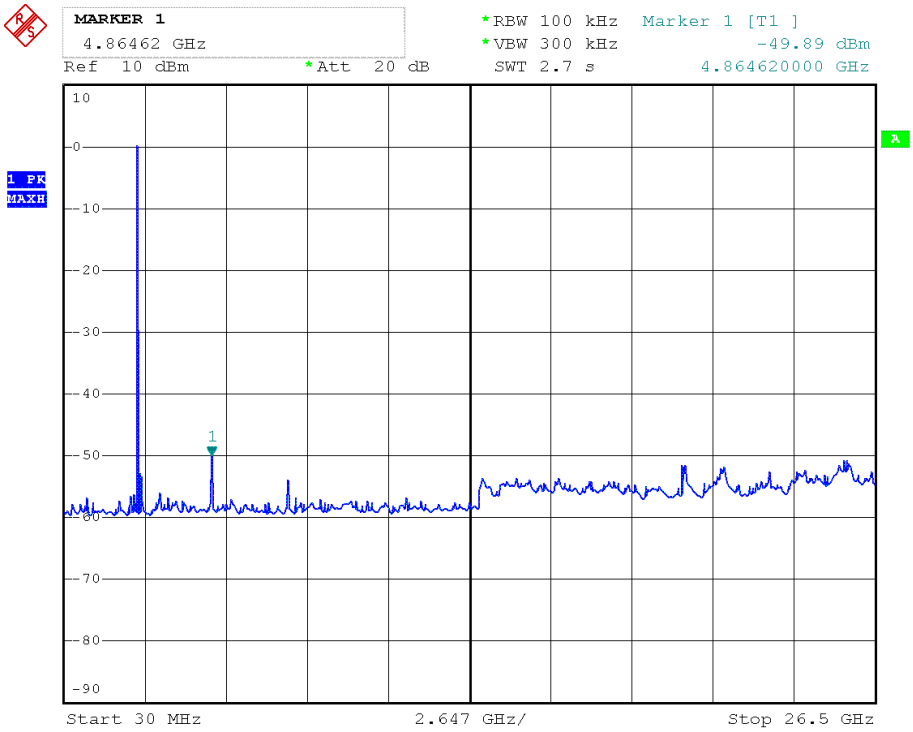
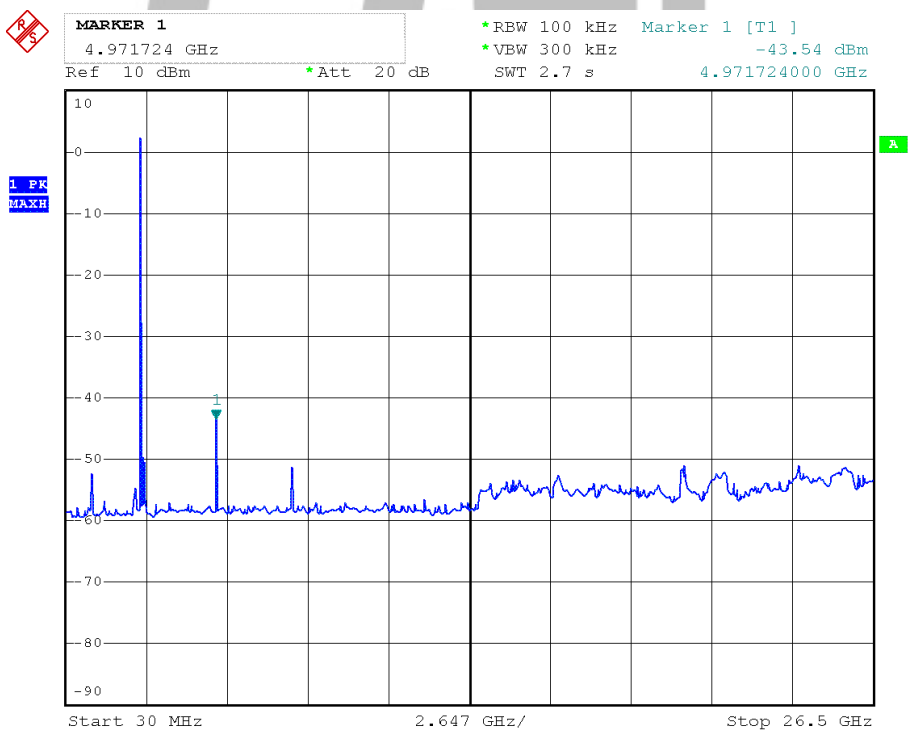
## Channel Mid




## Channel High



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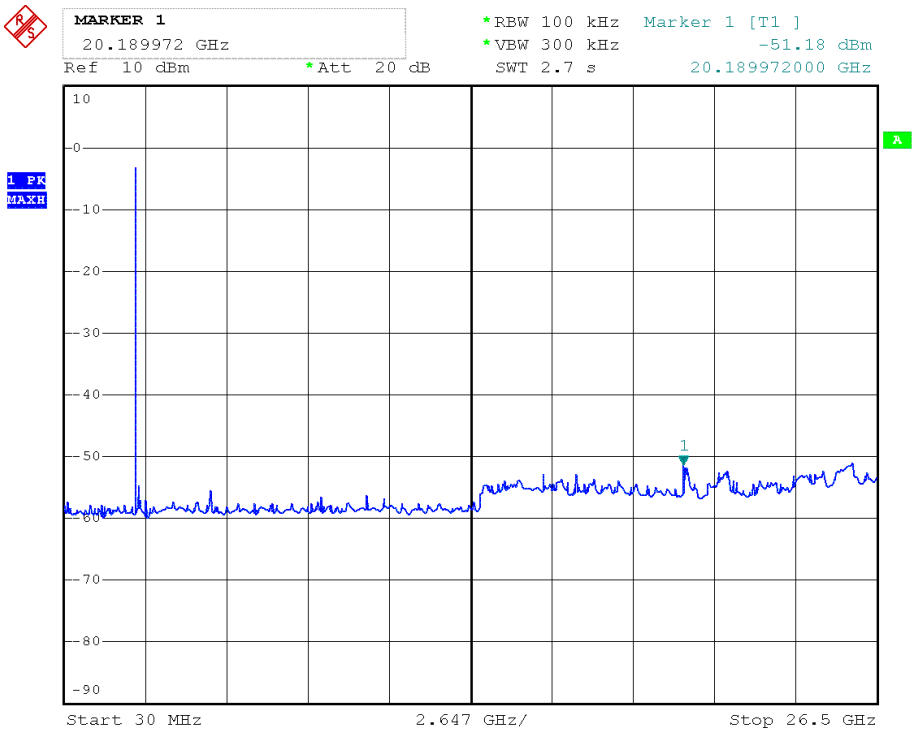
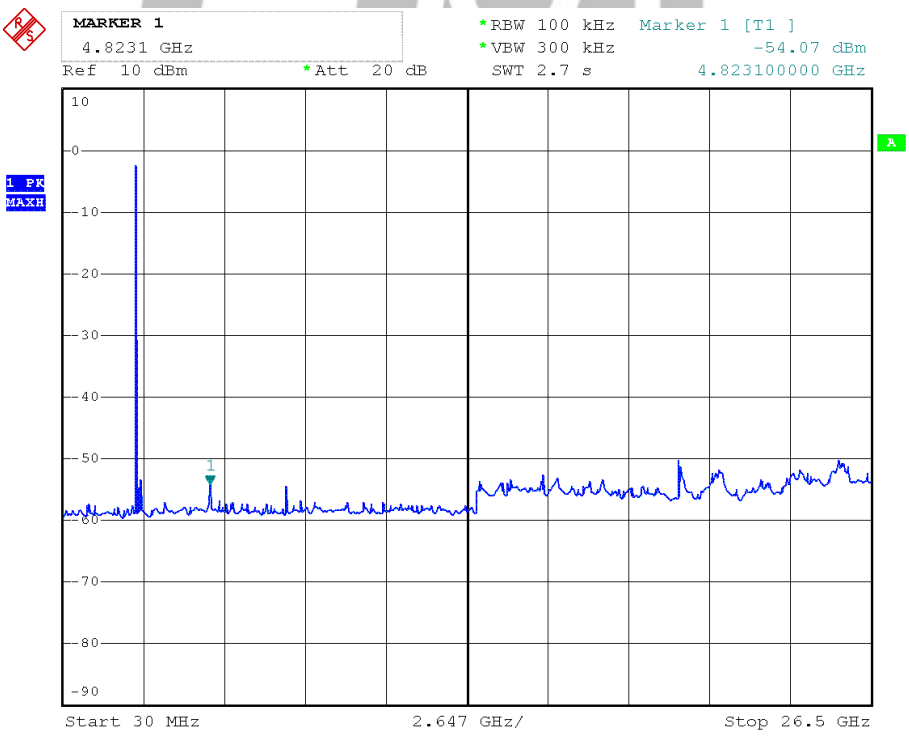
**EDR 2M**
**Channel Low**




**Channel Middle**



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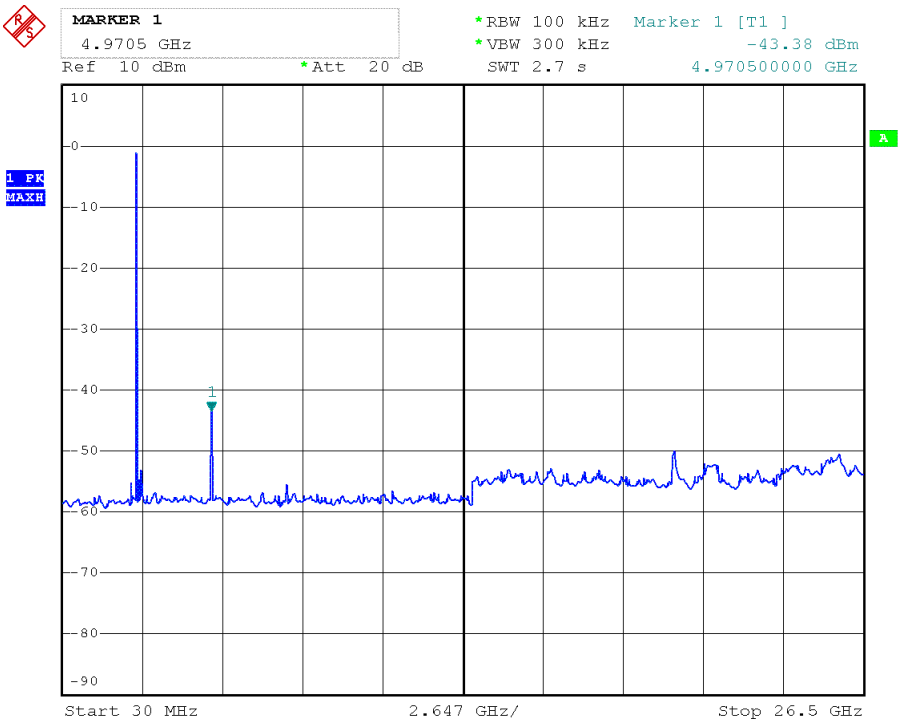
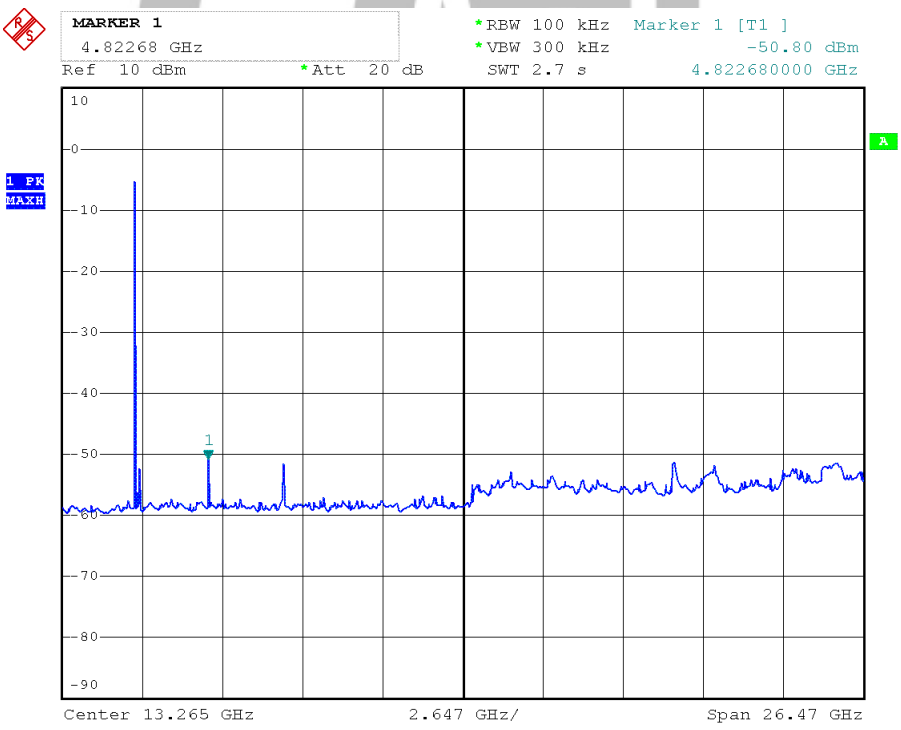
**Channel High**




**EDR 3M**
**Channel Low**



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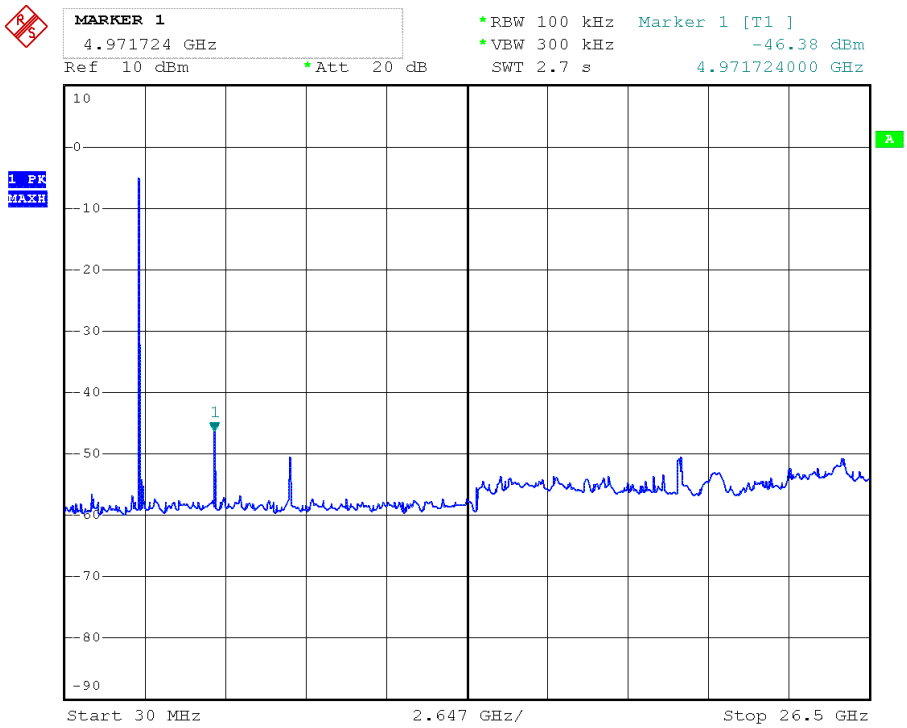
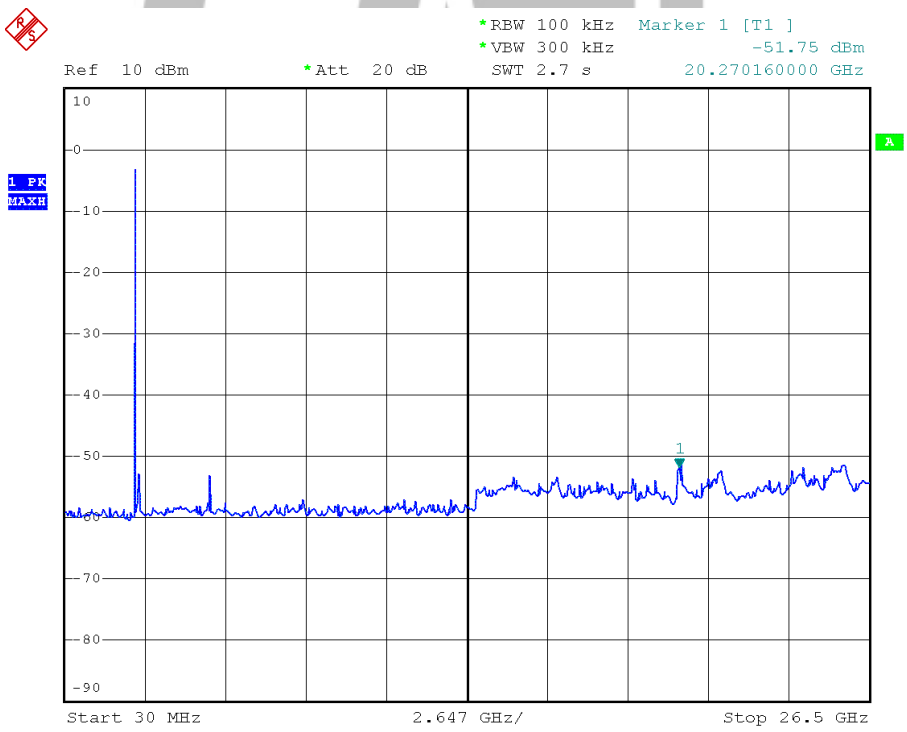
## Channel Middle




## Channel High



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# 12. ANTENNA REQUIREMENT

## 12.1 Standard Applicable

Section 15.203:

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

Section 15.247(b)/(c):

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

If the intentional radiator is used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

## 12.2 Antenna Connected Construction

The antenna is designed with permanent attachment and no consideration of replacement. The antenna used in this product is complied with Standard. The maximum Gain of the antenna lower than 6.0dBi and have the definite antenna Specification.





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# 13. Radio Frequency Exposure Report

## 13.1 Objective

The objective of the following report is used to demonstrate that EUT operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the relative provisions of FCC 47CFR Part 1.1307

## 13.2 General Description of Test

| Items | Description |
|---|---|
| EUT Frequency band | ☒ FHSS: 2.400GHz ~ 2.483GHz<br>☐ WLAN: 2.400GHz ~ 2.483GHz<br>☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz<br>☐ WLAN: 5.745GHz ~ 5825GHz<br>☐Others: _____ |
| Device category | ☐Portable (<20cm separation)<br>☒Mobile (>20cm separation)<br>☐Others _____ |
| Exposure classification | ☐Occupational/Controlled exposure (S = 5mW/cm2)<br>☒General Population/Uncontrolled exposure (S=1mW/cm$^2$)<br>☐Others: _____ |
| Antenna diversity | ☒Single antenna<br>☐Multiple antennas:<br>☐Tx diversity<br>☐Rx diversity<br>☐Tx/Rx diversity |
| Max. output power | 2.15dBm (0.0016W) |
| Antenna gain (Max) | 0dBi (Numeric gain:1) |
| Evaluation applied | ☒MPE Evaluation<br>☐SAR Evaluation |
| ***Note:***<br>*1. The maximum output power is 2.15dBm (0.0016W) at 2441MHz (with 1 numeric antenna gain.)*<br>*2. For mobile or fixed location transmitters, no SAR consideration applied. The minimum separation generally be used is at least 20 cm, even if the calculations indicate that the MPE distance would be lesser.* | |



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## 13.3 Human Exposure Assessment Results

**Calculation**

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$

*Where* $E$ = *Field Strength in Volts / meter*
$P$ = *Power in Watts*
$G$=*Numeric antenna gain*
$d$=*Distance in meters*
$S$=*Power Density in milliwatts / square centimeter*

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

$P\ (mW) = P\ (W) / 1000$ *and*
$d\ (cm) = 100 * d\ (m)$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$ ***Equation 1***

*Where* $d$ = *distance in cm*
$P$ = *Power in mW*
$G$ = *Numeric antenna gain*
$S$ = *Power Density in* $mW / cm^2$

| ***EUT parameter (data from the separate report)*** | |
|---|---|
| Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$ | Where<br>G: numerical gain of transmitting antenna;<br>TP: Transmitted power in watt;<br>d: distance from the transmitting antenna in meter |
| Max average output power in Watt (TP) | 2.15dBm (0.0016W) |
| Antenna gain (G) | 0 dBi (Numeric gain: 1) |
| Exposure classification | S=1mW/cm$^2$ |
| Minimum distance in meter (d)<br>(from transmitting structure to the human body) | 20cm (0.2m) |



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Yields

$$S = \frac{30xPxG}{3770d^2}, \quad P=0.0016W, G=1, d=0.2$$

$S=0.0003mW/cm^2$

Or

$$d=\sqrt{\frac{30xPxG}{3770S}}, \quad S=1, P=0.0016W, G=1$$

d=0.0035m

Conclusion:

$S=0.0003mW/cm^2$ is significant lower than the General Population Exposure Power Density Limit $1mW/cm^2$ or except the distance when human body proximity to the antenna is less than 0.35cm then will reach the General Population Exposure Power Density Limit

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW / $cm^2$ even if the calculation indicates that the power density would be larger.)





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