# TEST REPORT

| | |
|---|---|
| **Application No.:** | SZEM1901010500CR |
| **Applicant:** | Skullcandy Inc. |
| **Address of Applicant:** | 6301 N Landmark Dr, Park City, Utah 84098, United States |
| **Manufacturer:** | Skullcandy Inc. |
| **Address of Manufacturer:** | 6301 N Landmark Dr, Park City, Utah 84098, United States |
| **Equipment Under Test (EUT):** | |
| **EUT Name:** | Jib+ / JibXT |
| **Model No.:** | S2JPW |
| **Trade mark:** | Skullcandy |
| **FCC ID:** | Y22-S2JPW |
| **Standard(s) :** | 47 CFR Part 15, Subpart C 15.247 |
| **Date of Receipt:** | 2019-01-22 |
| **Date of Test:** | 2019-01-23 to 2019-01-29 |
| **Date of Issue:** | 2019-02-27 |
| **Test Result:** | **Pass*** |

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

Keny Xu
EMC Laboratory Manager

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| Revision Record | | | | |
|---|---|---|---|---|
| **Version** | **Chapter** | **Date** | **Modifier** | **Remark** |
| 01 | | 2019-02-27 | | Original |
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|---|---|---|---|---|
| **Authorized for issue by:** | | | | |
| | | Benson Wang<br>**Benson Wang /Project Engineer** | | |
| | | Eric Fu<br>**Eric Fu /Reviewer** | | |

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# 2 Test Summary

| Radio Spectrum Technical Requirement | | | | |
|---|---|---|---|---|
| **Item** | **Standard** | **Method** | **Requirement** | **Result** |
| Antenna Requirement | 47 CFR Part 15, Subpart C 15.247 | N/A | 47 CFR Part 15, Subpart C 15.203 & 15.247(c) | Pass |
| Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence | 47 CFR Part 15, Subpart C 15.247 | N/A | 47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h) | Pass |

| Radio Spectrum Matter Part | | | | |
|---|---|---|---|---|
| **Item** | **Standard** | **Method** | **Requirement** | **Result** |
| Conducted Peak Output Power | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.5 | 47 CFR Part 15, Subpart C 15.247(b)(1) | Pass |
| 20dB Bandwidth | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.7 | 47 CFR Part 15, Subpart C 15.247(a)(1) | Pass |
| Carrier Frequencies Separation | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.2 | 47 CFR Part 15, Subpart C 15.247a(1) | Pass |
| Hopping Channel Number | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.3 | 47 CFR Part 15, Subpart C 15.247a(1)(iii) | Pass |
| Dwell Time | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.4 | 47 CFR Part 15, Subpart C 15.247a(1)(iii) | Pass |
| Conducted Band Edges Measurement | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.6 | 47 CFR Part 15, Subpart C 15.247(d) | Pass |
| Conducted Spurious Emissions | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.8 | 47 CFR Part 15, Subpart C 15.247(d) | Pass |
| Radiated Emissions which fall in the restricted bands | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.10.5 | 47 CFR Part 15, Subpart C 15.205 & 15.209 | Pass |
| Radiated Spurious Emissions | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.4,6.5,6.6 | 47 CFR Part 15, Subpart C 15.205 & 15.209 | Pass |

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# 4 General Information

## 4.1 Details of E.U.T.

| | |
|---|---|
| Power supply: | Rechargeable battery: 3.7V 87mAh (Charged by adapter) |
| Cable: | USB cable: 25cm unshielded |
| Bluetooth Version: | V5.0 Classic |
| Operation Frequency: | 2402MHz to 2480MHz |
| Spectrum Spread Technology: | Frequency Hopping Spread Spectrum(FHSS) |
| Modulation Type: | GFSK, π/4DQPSK, 8DPSK |
| Channel Spacing: | 1MHz |
| Number of Channels: | 79 |
| Antenna Type: | Integral Antenna |
| Antenna Gain: | -0.75dBi |

## 4.2 Description of Support Units

The EUT has been tested as an independent unit.

## 4.3 Measurement Uncertainty

| No. | Item | Measurement Uncertainty |
|---|---|---|
| 1 | Radio Frequency | ± 7.25 x $10^{-8}$ |
| 2 | Duty cycle | ± 0.37% |
| 3 | Occupied Bandwidth | ± 3% |
| 4 | RF conducted power | ± 0.75dB |
| 5 | RF power density | ± 2.84dB |
| 6 | Conducted Spurious emissions | ± 0.75dB |
| 7 | RF Radiated power | ± 4.5dB (below 1GHz) |
| | | ± 4.8dB (above 1GHz) |
| 8 | Radiated Spurious emission test | ± 4.5dB (Below 1GHz) |
| | | ± 4.8dB (Above 1GHz) |
| 9 | Temperature test | ± 1℃ |
| 10 | Humidity test | ± 3% |
| 11 | Supply voltages | ± 1.5% |
| 12 | Time | ± 3% |

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## 4.4 Test Location

All tests were performed at:

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Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

## 4.5 Test Facility

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

• **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 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.

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

## 4.6 Deviation from Standards

None

## 4.7 Abnormalities from Standard Conditions

None

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# 5 Equipment List

| Conducted Peak Output Power | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

| 20dB Bandwidth | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

| Carrier Frequencies Separation | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

| Hopping Channel Number | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |

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| | | | | | |
|---|---|---|---|---|---|
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

**Dwell Time**

| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

**Conducted Band Edges Measurement**

| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

**Conducted Spurious Emissions**

| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

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| Radiated Emissions which fall in the restricted bands | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| 3m Semi-Anechoic Chamber | AUDIX | N/A | SEM001-02 | 2018-03-13 | 2021-03-12 |
| Measurement Software | AUDIX | e3 V8.2014-6-27 | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM026-01 | 2018-07-12 | 2019-07-11 |
| EXA Spectrum Analyzer | AgilentTechnologies Inc | N9010A | SEM004-12 | 2018-04-13 | 2019-04-12 |
| BiConiLog Antenna (26-3000MHz) | ETS-Lindgren | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| Horn Antenna (1-18GHz) | Rohde & Schwarz | HF907 | SEM003-07 | 2018-04-13 | 2021-04-12 |
| Horn Antenna (15GHz-40GHz) | Schwarzbeck | BBHA 9170 | SEM003-15 | 2017-10-17 | 2020-10-16 |
| Pre-amplifier (0.1-1300MHz) | HP | 8447D | SEM005-02 | 2018-09-25 | 2019-09-24 |
| Pre-Amplifier (0.1-26.5GHz) | Compliance Directions Systems Inc. | PAP-0126 | SEM004-11 | 2018-11-12 | 2019-11-11 |
| Pre-amplifier(18-26GHz) | Rohde & Schwarz | CH14-H052 | SEM005-17 | 2018-04-02 | 2019-04-01 |
| Pre-amplifier (26GHz-40GHz) | Compliance Directions Systems Inc. | PAP-2640-50 | SEM005-08 | 2018-04-02 | 2019-04-01 |
| DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Active Loop Antenna | ETS-Lindgren | 6502 | SEM003-08 | 2017-08-22 | 2020-08-21 |

| Radiated Spurious Emissions | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| 3m Semi-Anechoic Chamber | AUDIX | N/A | SEM001-02 | 2018-03-13 | 2021-03-12 |
| Measurement Software | AUDIX | e3 V8.2014-6-27 | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM026-01 | 2018-07-12 | 2019-07-11 |
| EXA Spectrum Analyzer | AgilentTechnologies Inc | N9010A | SEM004-12 | 2018-04-13 | 2019-04-12 |
| BiConiLog Antenna (26-3000MHz) | ETS-Lindgren | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| Horn Antenna (1-18GHz) | Rohde & Schwarz | HF907 | SEM003-07 | 2018-04-13 | 2021-04-12 |

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| | | | | | |
|---|---|---|---|---|---|
| Horn Antenna (15GHz-40GHz) | Schwarzbeck | BBHA 9170 | SEM003-15 | 2017-10-17 | 2020-10-16 |
| Pre-amplifier (0.1-1300MHz) | HP | 8447D | SEM005-02 | 2018-09-25 | 2019-09-24 |
| Pre-Amplifier (0.1-26.5GHz) | Compliance Directions Systems Inc. | PAP-0126 | SEM004-11 | 2018-11-12 | 2019-11-11 |
| Pre-amplifier(18-26GHz) | Rohde & Schwarz | CH14-H052 | SEM005-17 | 2018-04-02 | 2019-04-01 |
| Pre-amplifier (26GHz-40GHz) | Compliance Directions Systems Inc. | PAP-2640-50 | SEM005-08 | 2018-04-02 | 2019-04-01 |
| DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Active Loop Antenna | ETS-Lindgren | 6502 | SEM003-08 | 2017-08-22 | 2020-08-21 |

| **RE in Chamber** | | | | | |
|---|---|---|---|---|---|
| **Test Equipment** | **Manufacturer** | **Model No.** | **Inventory No.** | **Cal. Date** | **Cal. Due date** |
| 3m Semi-Anechoic Chamber | ETS-LINDGREN | N/A | SEM001-01 | 2017-08-05 | 2020-08-04 |
| MXE EMI Receiver (20Hz-8.4GHz) | Agilent Technologies | N9038A | SEM004-05 | 2018-09-25 | 2019-09-24 |
| BiConiLog Antenna (26-3000MHz) | ETS-LINDGREN | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| Pre-amplifier (0.1-1300MHz) | Agilent Technologies | 8447D | SEM005-01 | 2018-04-02 | 2019-04-01 |
| Measurement Software | AUDIX | e3 V8.2014-6-27 | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM025-01 | 2018-07-12 | 2019-07-11 |

| **General used equipment** | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Model No** | **Inventory No** | **Cal Date** | **Cal Due Date** |
| Humidity/ Temperature Indicator | Shanghai Meteorological Industry Factory | ZJ1-2B | SEM002-03 | 2018-09-27 | 2019-09-26 |
| Humidity/ Temperature Indicator | Shanghai Meteorological Industry Factory | ZJ1-2B | SEM002-04 | 2018-09-27 | 2019-09-26 |
| Humidity/ Temperature Indicator | Mingle | N/A | SEM002-08 | 2018-09-27 | 2019-09-26 |
| Barometer | Changchun Meteorological Industry Factory | DYM3 | SEM002-01 | 2018-04-08 | 2019-04-07 |

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# 6 Radio Spectrum Technical Requirement

## 6.1 Antenna Requirement

### 6.1.1 Test Requirement:

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

### 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 integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -0.75dBi.

Antenna location: Refer to Appendix(Internal photos)

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## 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: 29 -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:

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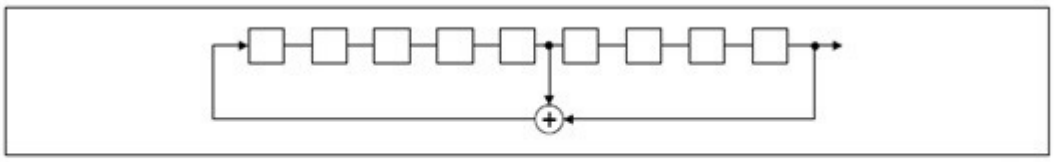
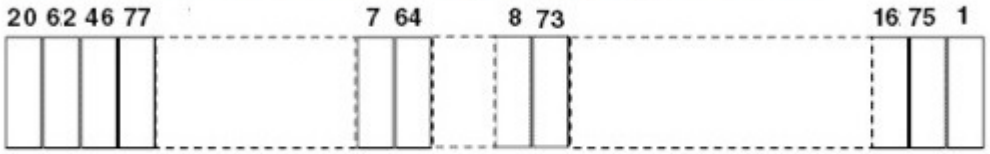


*Linear Feedback Shift Register for Generation of the PRBS sequence*

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 so that it individually and independently to avoid hopping on the occupied channels.

The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

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# 7 Radio Spectrum Matter Test Results

## 7.1 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 ≥50 hopping channels |
| | 0.25 for 25≤ hopping channels <50 |
| | 1 for digital modulation |
| 2400-2483.5 | 1 for ≥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 |

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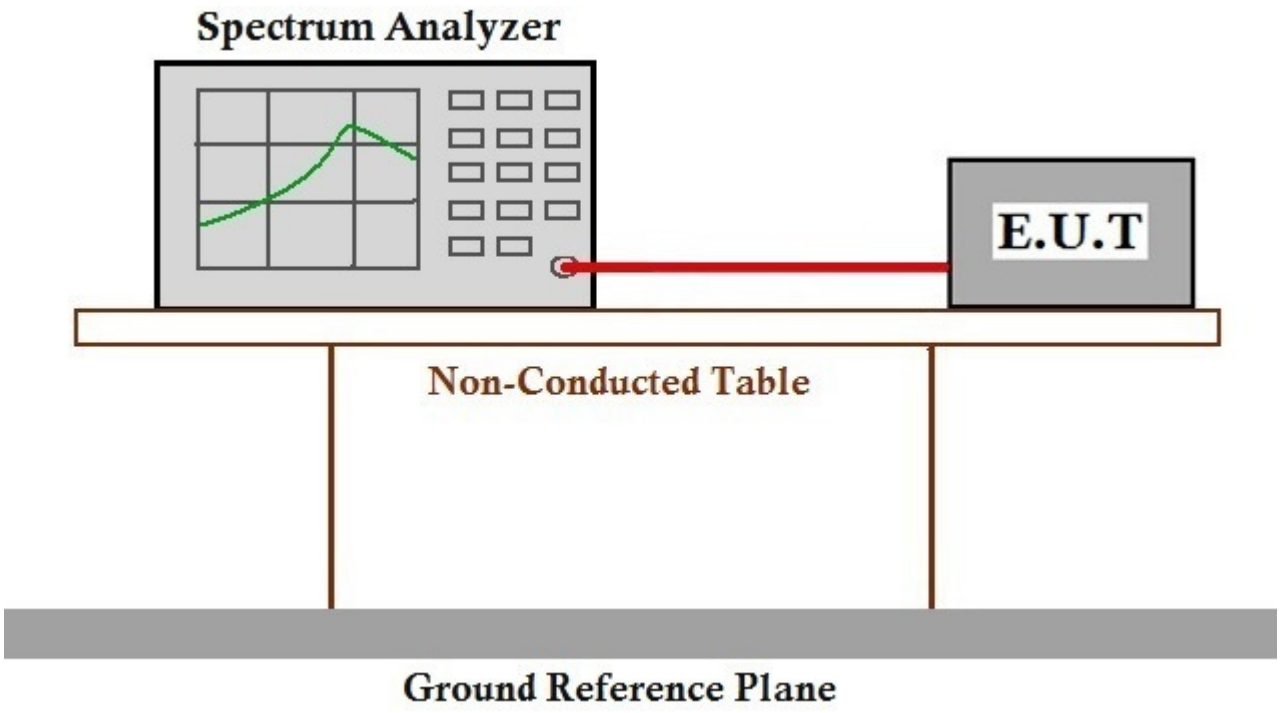
### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22.4 °C Humidity: 51.2 % RH Atmospheric Pressure: 1020 mbar

Test mode c:TX_non-Hop mode_Keep the EUT in continuously transmitting 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.

### 7.1.2 Test Setup Diagram




### 7.1.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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## 7.2 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.7

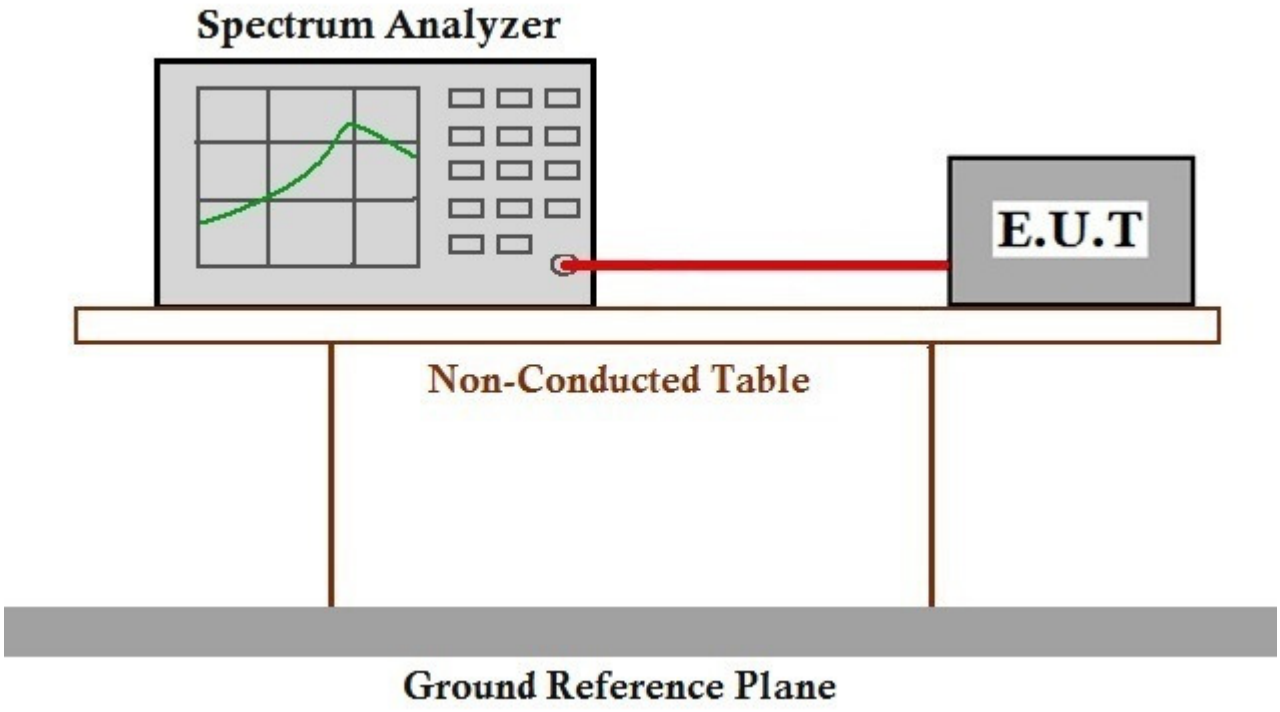
### 7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 22.4 °C Humidity: 51.2 % RH Atmospheric Pressure: 1020 mbar

Test mode c:TX_non-Hop mode_Keep the EUT in continuously transmitting 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.

### 7.2.2 Test Setup Diagram




### 7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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## 7.3 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

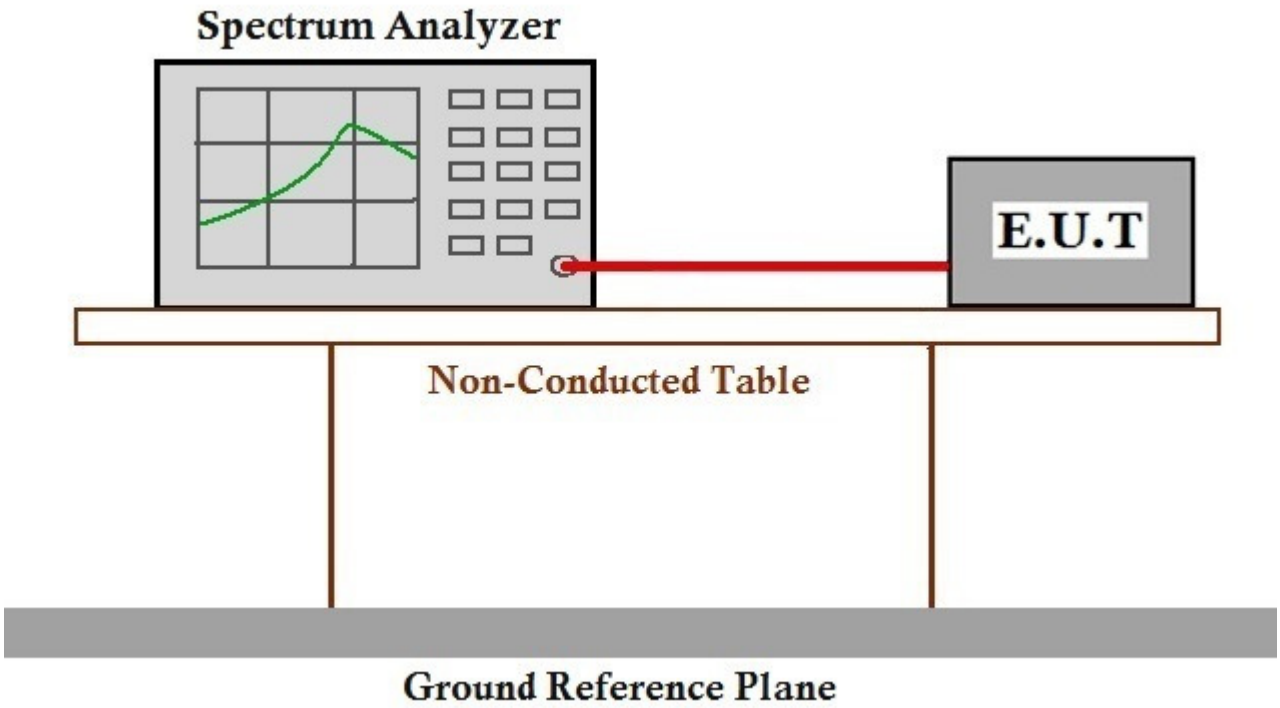
### 7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 22.4 °C Humidity: 51.2 % RH Atmospheric Pressure: 1020 mbar

Test mode b: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.

### 7.3.2 Test Setup Diagram




### 7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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## 7.4 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 |

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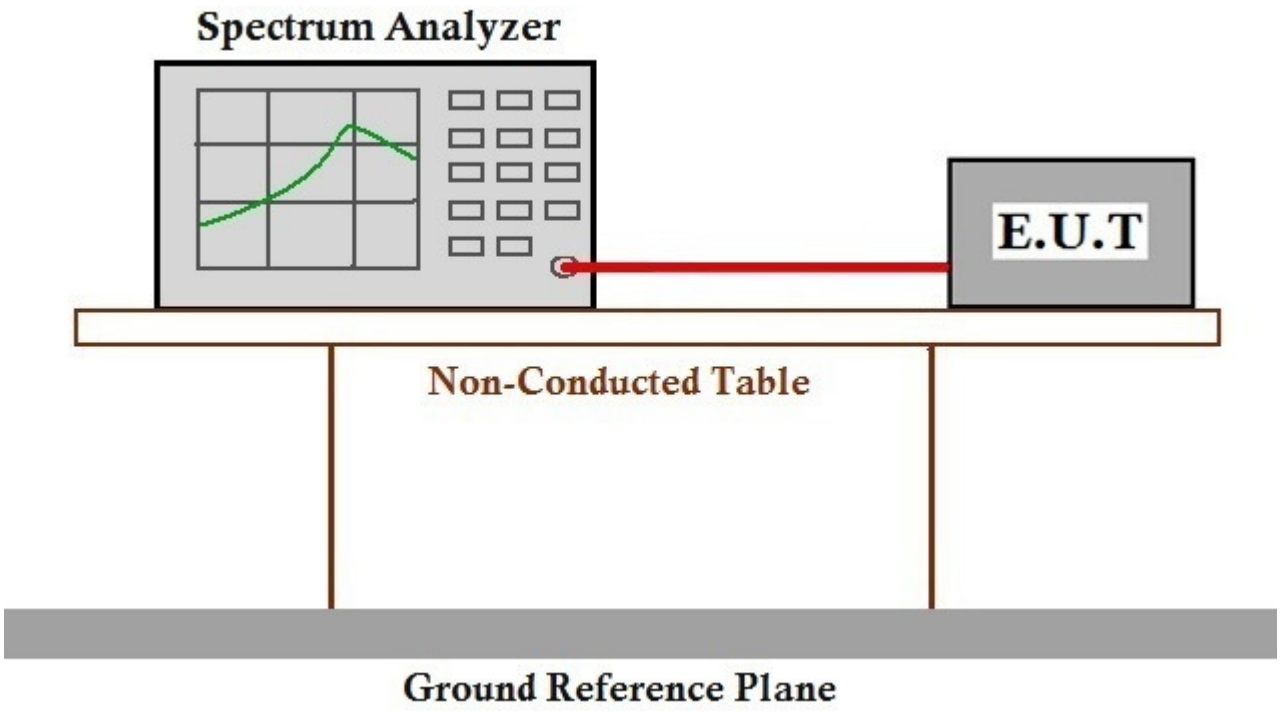
### 7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 22.4 °C Humidity: 51.1 % RH Atmospheric Pressure: 1020 mbar

Test mode b: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.

### 7.4.2 Test Setup Diagram




### 7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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## 7.5 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 |

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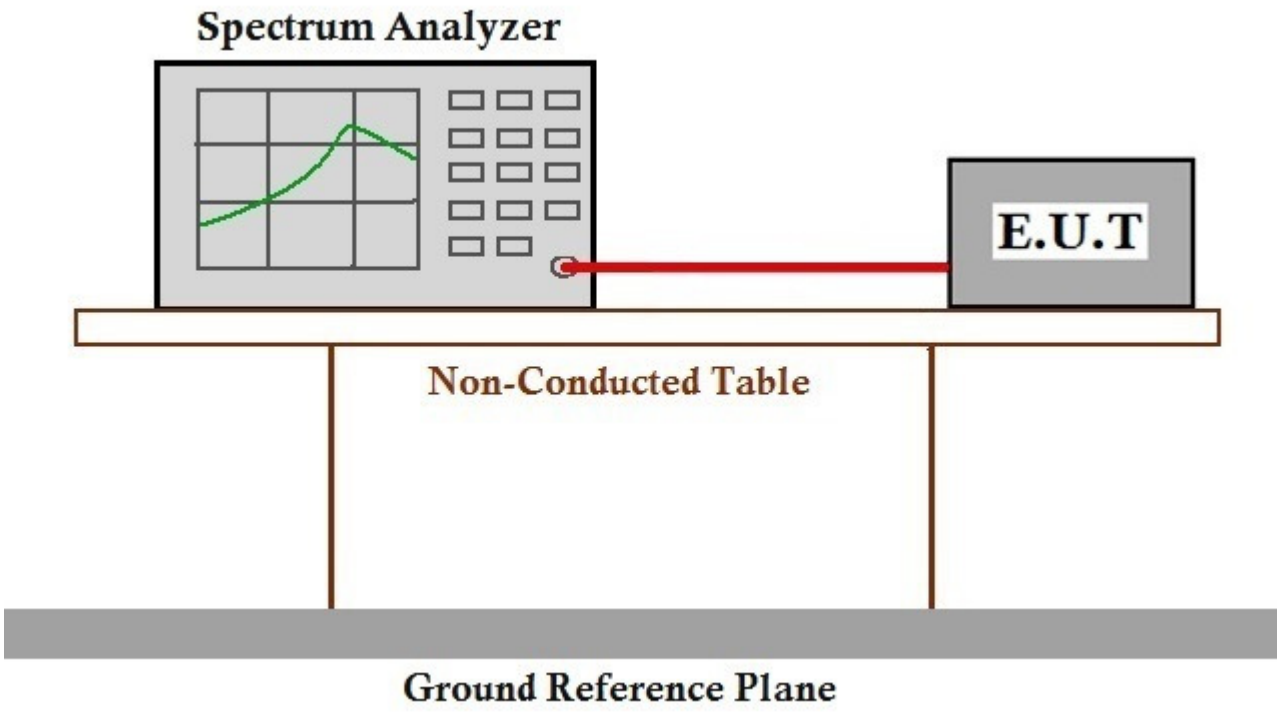
### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 22.4 °C Humidity: 51.1 % RH Atmospheric Pressure: 1020 mbar

Test mode b: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.

### 7.5.2 Test Setup Diagram




### 7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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## 7.6 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) |

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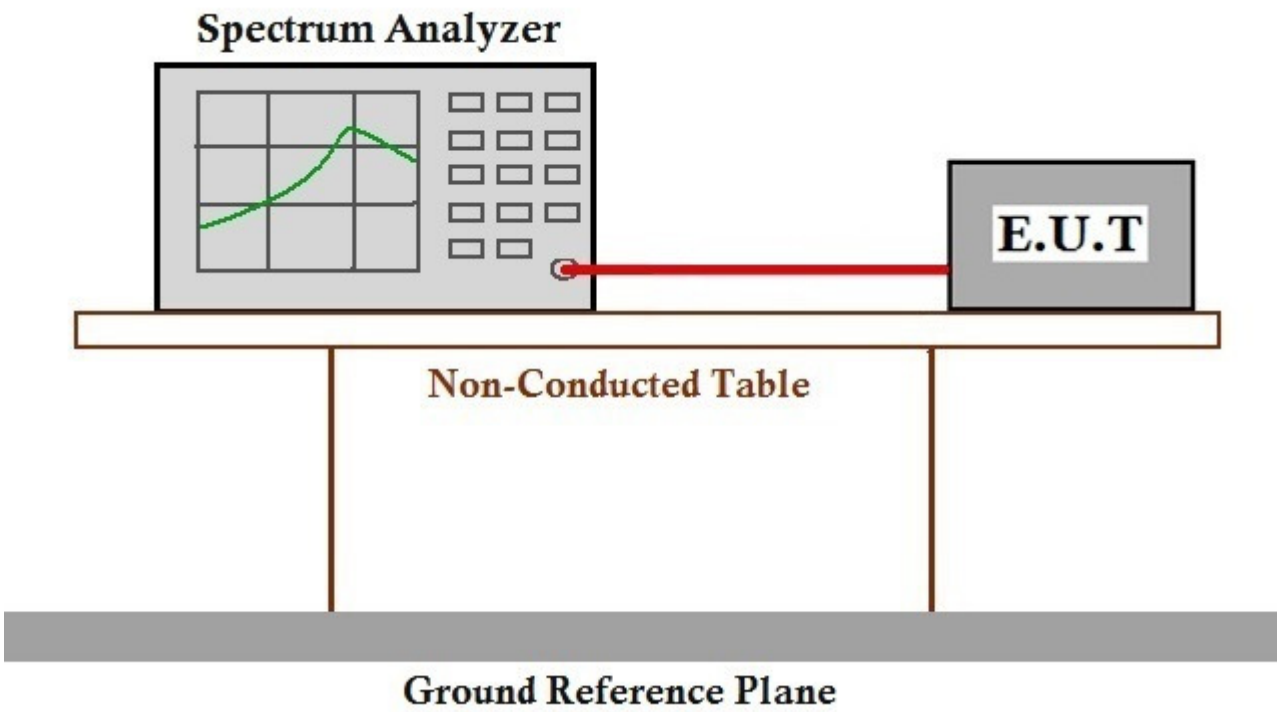
### 7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 22.4 °C Humidity: 51 % RH Atmospheric Pressure: 1020 mbar

| | |
|---|---|
| Pretest these modes to find the worst case: | b: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.<br>c:TX_non-Hop mode_Keep the EUT in continuously transmitting 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. |
| The worst case for final test: | b: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.<br>c:TX_non-Hop mode_Keep the EUT in continuously transmitting 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 15.247

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## 7.7 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) |

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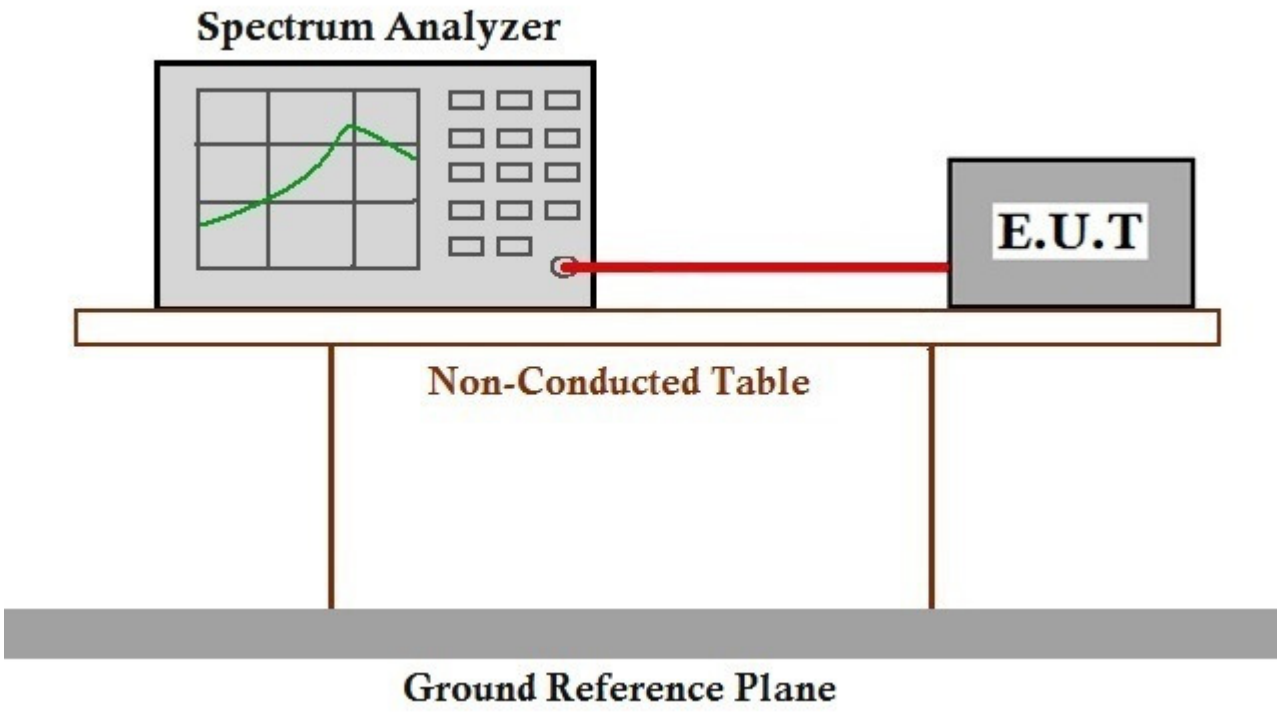
### 7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 22.4 °C Humidity: 51.1 % RH Atmospheric Pressure: 1020 mbar

Test mode c:TX_non-Hop mode_Keep the EUT in continuously transmitting 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.

### 7.7.2 Test Setup Diagram




### 7.7.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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## 7.8 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
Measurement Distance: 3m
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. | | |

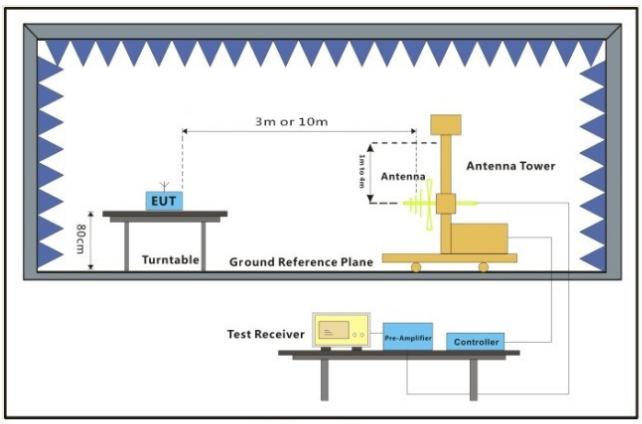
### 7.8.1 E.U.T. Operation

Operating Environment:

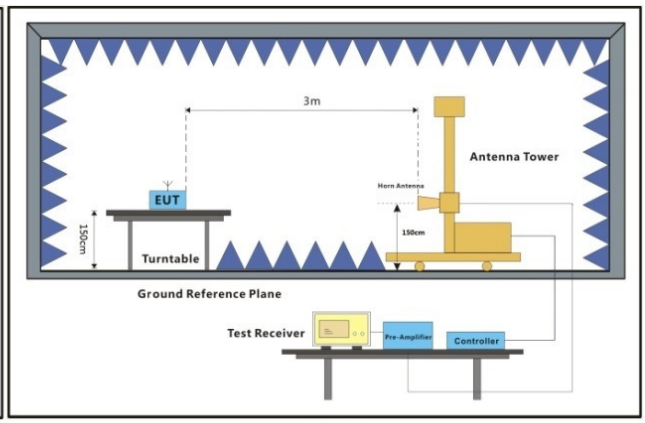
Temperature: 22.3 °C Humidity: 46 % RH Atmospheric Pressure: 1020 mbar

Test mode c:TX_non-Hop mode_Keep the EUT in continuously transmitting 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.

### 7.8.2 Test Setup Diagram




30MHz-1GHz




Above 1GHz

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### 7.8.3 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: Level= Read Level+ Cable Loss+ Antenna Factor- 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.

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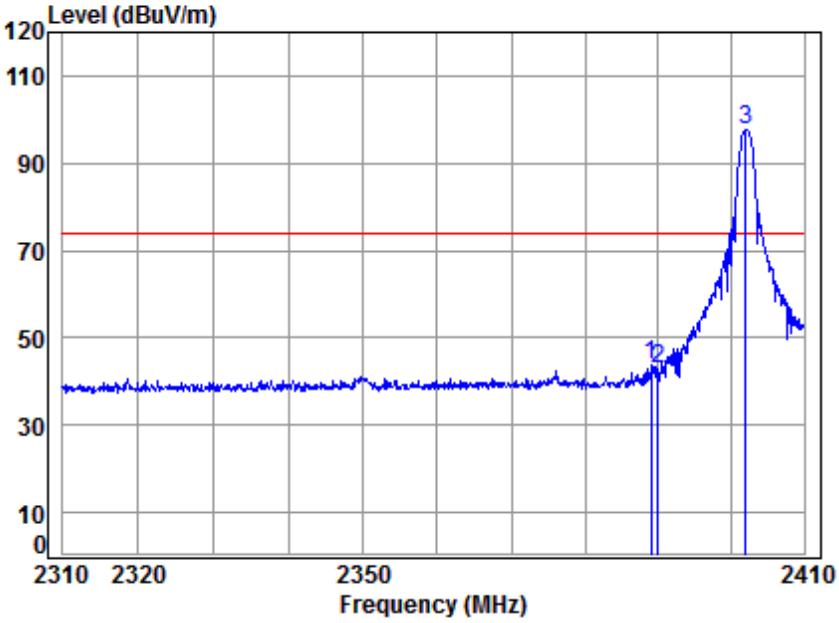
Mode:c; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low




Site : chamber
Condition: 3m HORIZONTAL
Job No : 10500CR/10501CR
Mode : 2402 Band edge
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 2389.052 | 5.47 | 28.52 | 41.17 | 51.08 | 43.90 | 74.00 | -30.10 | peak |
| 2 | 2390.000 | 5.47 | 28.52 | 41.17 | 49.96 | 42.78 | 74.00 | -31.22 | peak |
| 3 * | 2402.000 | 5.49 | 28.54 | 41.18 | 104.65 | 97.50 | 74.00 | 23.50 | peak |

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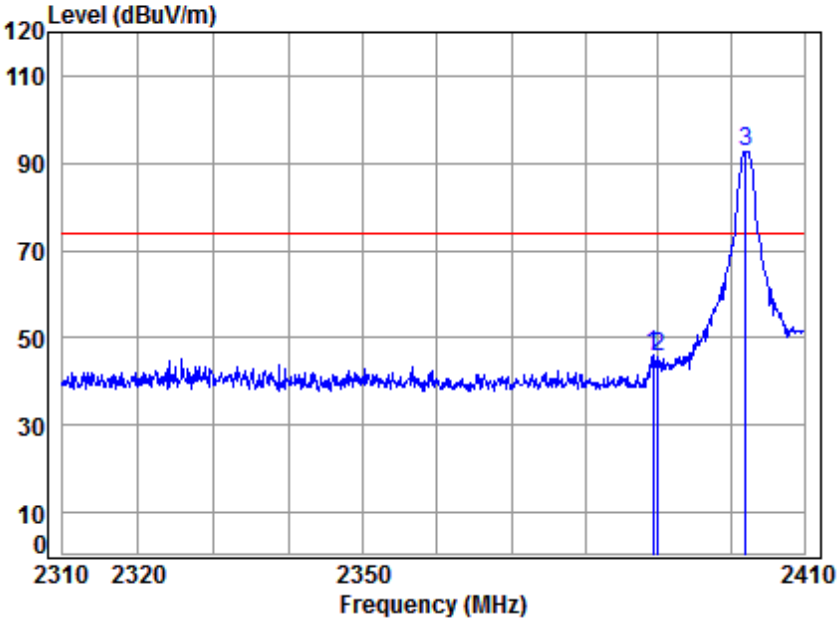
Mode:c; Polarization:Vertical; Modulation:GFSK; ; Channel:Low




Site : chamber
Condition: 3m VERTICAL
Job No : 10500CR/10501CR
Mode : 2402 Band edge
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 2389.254 | 5.47 | 28.52 | 41.17 | 53.21 | 46.03 | 74.00 | -27.97 | peak |
| 2 | 2390.000 | 5.47 | 28.52 | 41.17 | 52.90 | 45.72 | 74.00 | -28.28 | peak |
| 3 * | 2402.000 | 5.49 | 28.54 | 41.18 | 99.81 | 92.66 | 74.00 | 18.66 | peak |

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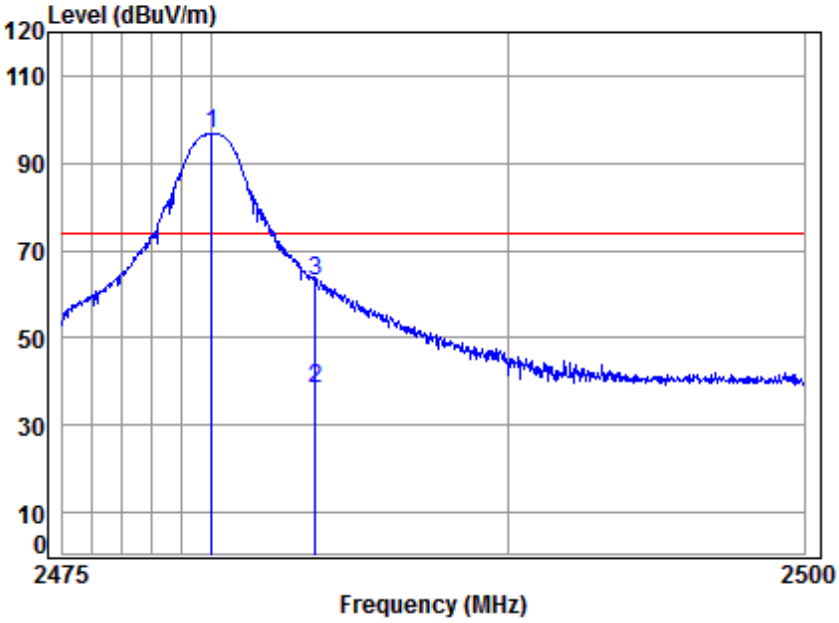
Mode:c; Polarization:Horizontal; Modulation:GFSK; ; Channel:High




Site : chamber
Condition: 3m HORIZONTAL
Job No : 10500CR/10501CR
Mode : 2480 Band edge
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 * | 2480.000 | 5.59 | 28.67 | 41.21 | 103.61 | 96.66 | 74.00 | 22.66 | peak |
| 2 | 2483.500 | 5.60 | 28.67 | 41.21 | 45.25 | 38.31 | 54.00 | -15.69 | Average |
| 3 | 2483.500 | 5.60 | 28.67 | 41.21 | 69.92 | 62.98 | 74.00 | -11.02 | peak |

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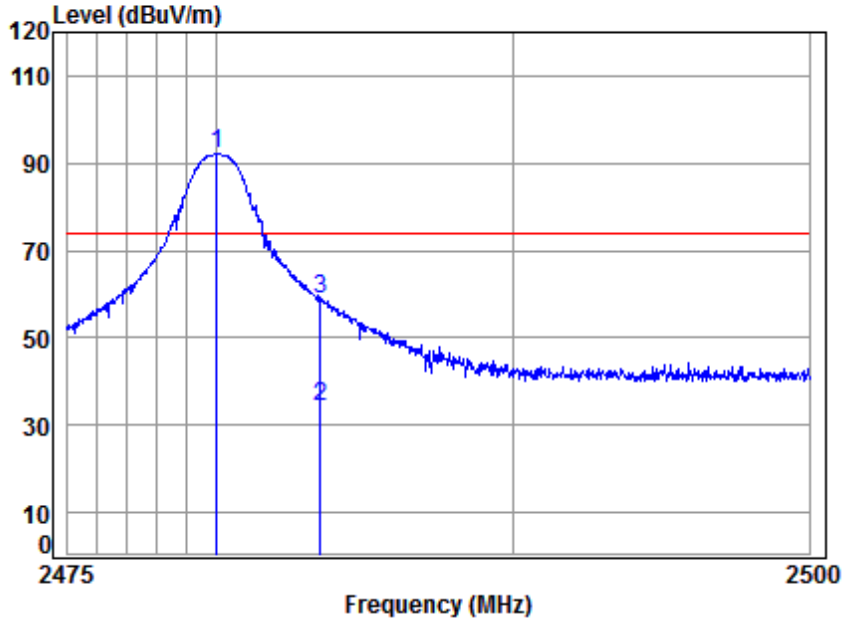
Mode:c; Polarization:Vertical; Modulation:GFSK; ; Channel:High




Site : chamber
Condition: 3m VERTICAL
Job No : 10500CR/10501CR
Mode : 2480 Band edge
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 * | 2480.000 | 5.59 | 28.67 | 41.21 | 98.92 | 91.97 | 74.00 | 17.97 | peak |
| 2 | 2483.500 | 5.60 | 28.67 | 41.21 | 41.22 | 34.28 | 54.00 | -19.72 | Average |
| 3 | 2483.500 | 5.60 | 28.67 | 41.21 | 65.89 | 58.95 | 74.00 | -15.05 | peak |

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## 7.9 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
Measurement Distance: 3m
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. | | |

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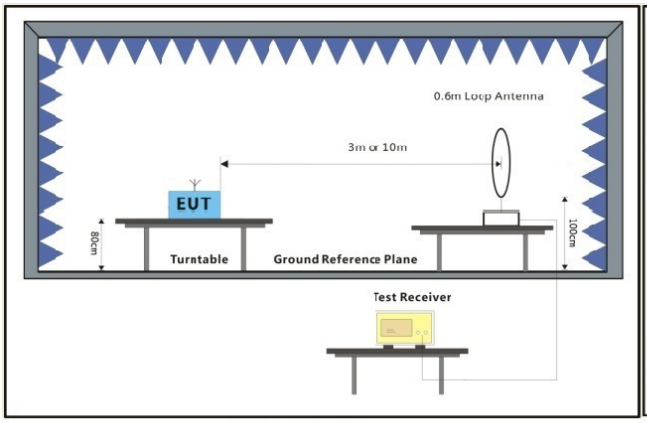
### 7.9.1 E.U.T. Operation

Operating Environment:

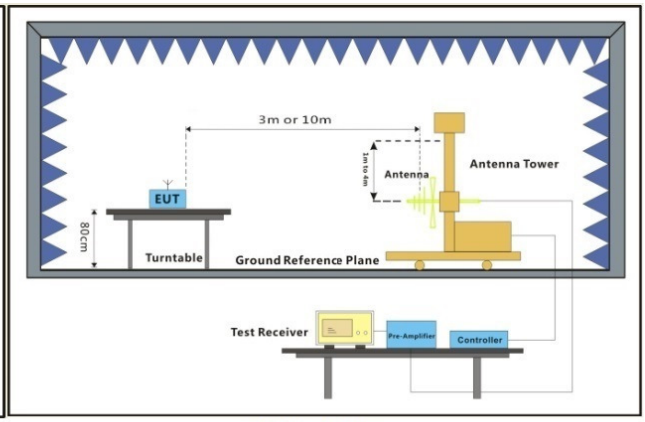
Temperature: 22.3 °C Humidity: 46.1 % RH Atmospheric Pressure: 1020 mbar

Test mode c:TX_non-Hop mode_Keep the EUT in continuously transmitting 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.

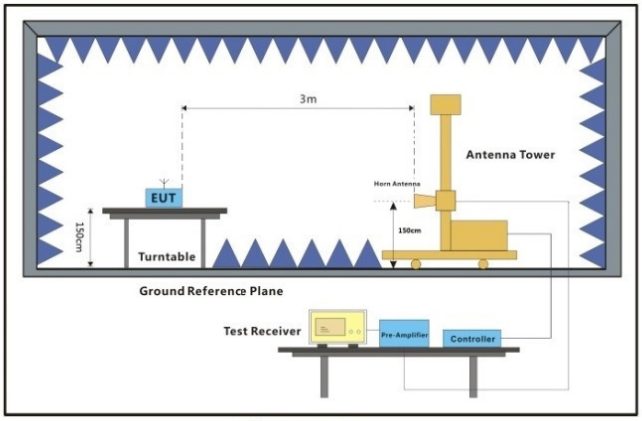
### 7.9.2 Test Setup Diagram




Below 30MHz




30MHz-1GHz




Above 1GHz

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### 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) 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 & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier 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 in the report.

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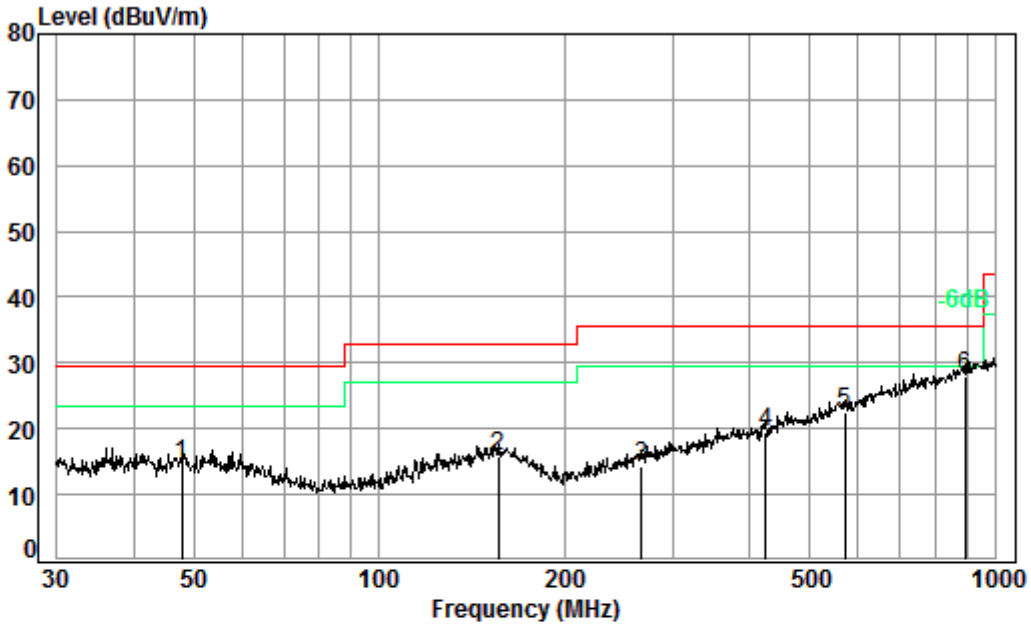
**30MHz~1GHz**

QP value:

Mode: c; Polarization: Horizontal;




Condition: 10m HORIZONTAL
Job No. : 10500CR
Test Mode: c

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 47.83 | 6.86 | 12.83 | 32.52 | 27.35 | 14.52 | 29.50 | -14.98 |
| 2 | 156.46 | 7.48 | 13.40 | 32.51 | 27.34 | 15.71 | 33.00 | -17.29 |
| 3 | 266.61 | 7.94 | 11.73 | 32.47 | 27.21 | 14.41 | 35.60 | -21.19 |
| 4 | 425.03 | 8.36 | 15.55 | 32.43 | 27.92 | 19.40 | 35.60 | -16.20 |
| 5 | 570.61 | 8.83 | 18.10 | 32.41 | 27.90 | 22.42 | 35.60 | -13.18 |
| 6 pp | 893.86 | 9.50 | 22.14 | 31.59 | 27.78 | 27.83 | 35.60 | -7.77 |

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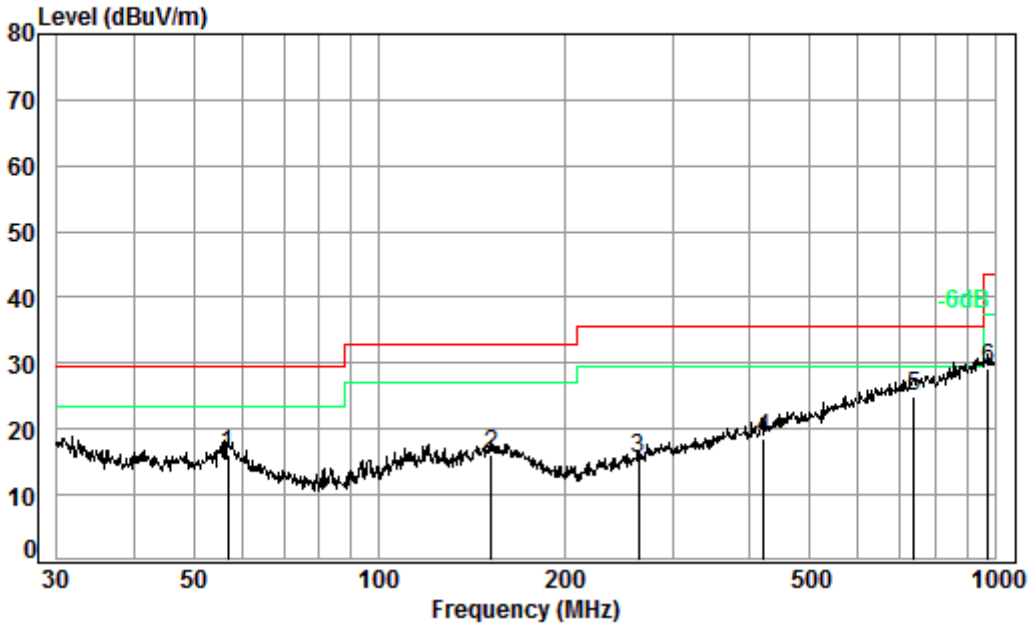
Mode :c; Polarization: Vertical




Condition: 10m VERTICAL
Job No. : 10500CR
Test Mode: c

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit |
|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 56.79 | 7.00 | 12.24 | 32.53 | 29.45 | 16.16 | 29.50 | -13.34 |
| 2 | 152.13 | 7.46 | 13.41 | 32.51 | 27.80 | 16.16 | 33.00 | -16.84 |
| 3 | 263.82 | 7.92 | 11.62 | 32.47 | 28.42 | 15.49 | 35.60 | -20.11 |
| 4 | 422.06 | 8.36 | 15.47 | 32.43 | 27.17 | 18.57 | 35.60 | -17.03 |
| 5 pp | 739.66 | 9.20 | 20.64 | 32.39 | 27.36 | 24.81 | 35.60 | -10.79 |
| 6 | 975.75 | 9.60 | 22.81 | 30.96 | 27.76 | 29.21 | 43.50 | -14.29 |

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The test was performed at a 10m test site. According to below formulate and the test data at 10m test distance,

$L_3 / L_{10} = D_{10} / D_3$

Note:

$L_3$: Level @ 3m distance. Unit: uV/m;

$L_{10}$: Level @ 10m distance. Unit: uV/m;

$D_3$: 3m distance. Unit: m

$D_{10}$: 10m distance. Unit: m

The level at 3m test distance is below:

| Frequency (MHz) | Level @ 10m (dBuV/m) | Level @ 10m (uV/m) | Level @ 3m (uV/m) | Level @ 3m (dBuV/m) | Limit @ 3m (dBuV/m) | Margin (dB) | Ant. Polarization |
|---|---|---|---|---|---|---|---|
| 56.79 | 16.16 | 6.43 | 21.42 | 26.62 | 40.00 | -13.38 | V |
| 152.13 | 16.16 | 6.43 | 21.42 | 26.62 | 43.50 | -16.88 | V |
| 263.82 | 15.49 | 5.95 | 19.83 | 25.95 | 46.00 | -20.05 | V |
| 422.06 | 18.57 | 8.48 | 28.27 | 29.03 | 46.00 | -16.97 | V |
| 739.66 | 24.81 | 17.40 | 57.99 | 35.27 | 46.00 | -10.73 | V |
| 975.75 | 29.21 | 28.87 | 96.25 | 39.67 | 54.00 | -14.33 | V |
| 47.83 | 14.52 | 5.32 | 17.74 | 24.98 | 40.00 | -15.02 | H |
| 156.46 | 15.71 | 6.10 | 20.34 | 26.17 | 43.50 | -17.33 | H |
| 266.61 | 14.41 | 5.25 | 17.51 | 24.87 | 46.00 | -21.13 | H |
| 425.03 | 19.40 | 9.33 | 31.11 | 29.86 | 46.00 | -16.14 | H |
| 570.61 | 22.42 | 13.21 | 44.04 | 32.88 | 46.00 | -13.12 | H |
| 893.86 | 27.83 | 24.63 | 82.11 | 38.29 | 46.00 | -7.71 | H |

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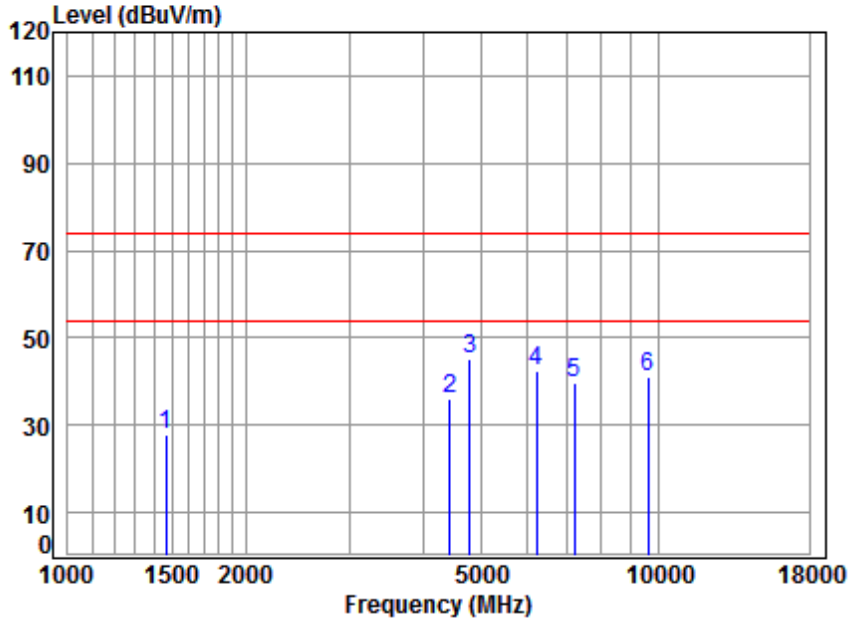
**Above 1GHz**

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




Site : chamber
Condition: 3m HORIZONTAL
Job No : 10500CR/10501CR
Mode : 2402 TX RSE
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 1468.761 | 5.38 | 25.69 | 40.68 | 37.56 | 27.95 | 74.00 | -46.05 | peak |
| 2 | 4430.628 | 7.48 | 33.48 | 43.23 | 38.36 | 36.09 | 74.00 | -37.91 | peak |
| 3 | 4804.000 | 7.89 | 33.97 | 43.61 | 46.84 | 45.09 | 74.00 | -28.91 | peak |
| 4 | 6231.427 | 11.03 | 35.34 | 42.63 | 38.67 | 42.41 | 74.00 | -31.59 | peak |
| 5 | 7206.000 | 10.08 | 36.07 | 41.86 | 35.24 | 39.53 | 74.00 | -34.47 | peak |
| 6 | 9608.000 | 10.75 | 37.67 | 38.43 | 30.86 | 40.85 | 74.00 | -33.15 | peak |

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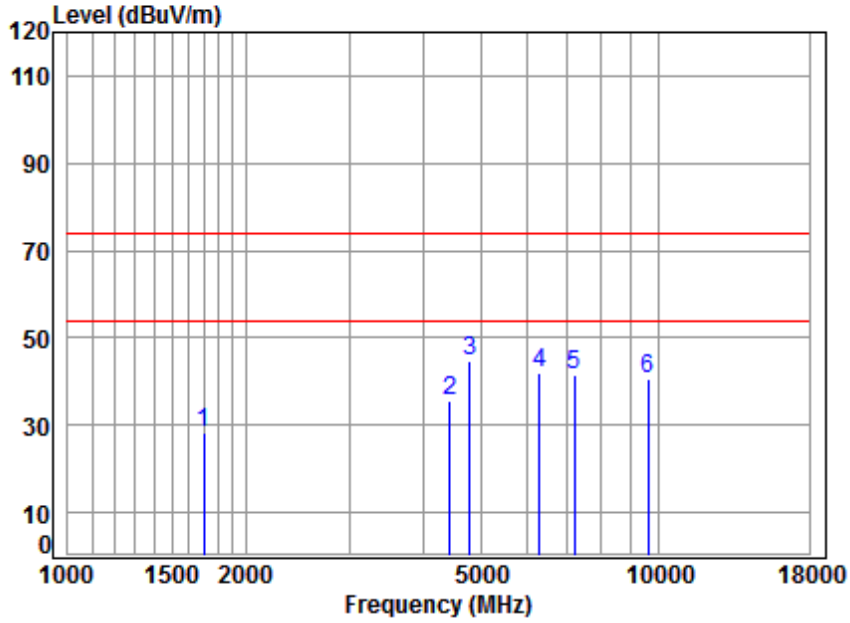
Mode:c; Polarization:Vertical; Modulation:GFSK; ; Channel:Low




Site : chamber
Condition: 3m VERTICAL
Job No : 10500CR/10501CR
Mode : 2402 TX RSE
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 1702.042 | 5.23 | 26.68 | 40.83 | 37.00 | 28.08 | 74.00 | -45.92 | peak |
| 2 | 4443.453 | 7.50 | 33.50 | 43.25 | 37.80 | 35.55 | 74.00 | -38.45 | peak |
| 3 | 4804.000 | 7.89 | 33.97 | 43.61 | 46.47 | 44.72 | 74.00 | -29.28 | peak |
| 4 | 6303.890 | 11.17 | 35.41 | 42.57 | 37.98 | 41.99 | 74.00 | -32.01 | peak |
| 5 | 7206.000 | 10.08 | 36.07 | 41.86 | 37.23 | 41.52 | 74.00 | -32.48 | peak |
| 6 | 9608.000 | 10.75 | 37.67 | 38.43 | 30.48 | 40.47 | 74.00 | -33.53 | peak |

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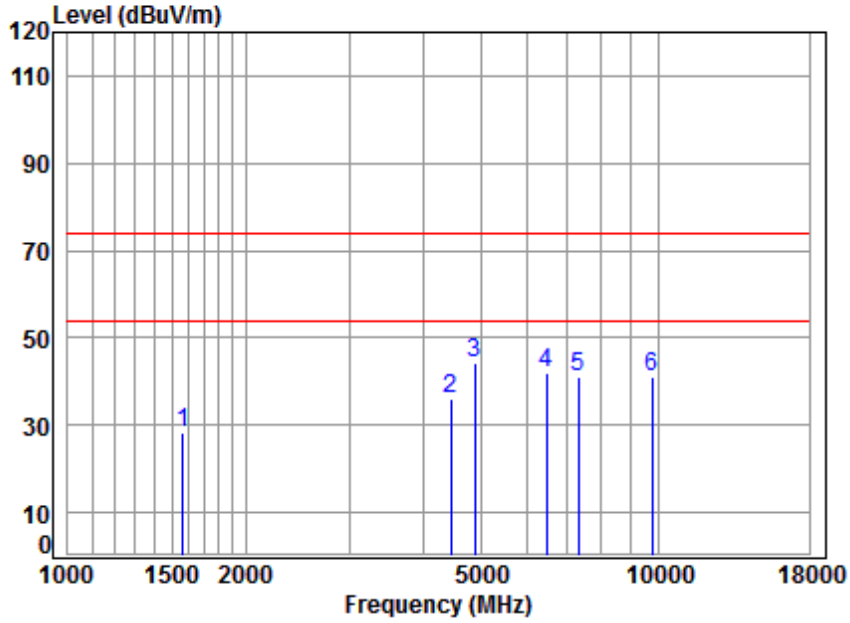
Mode:c; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle




Site : chamber
Condition: 3m HORIZONTAL
Job No : 10500CR/10501CR
Mode : 2441 TX RSE
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 1569.721 | 5.39 | 26.12 | 40.75 | 37.39 | 28.15 | 74.00 | -45.85 | peak |
| 2 | 4456.315 | 7.51 | 33.53 | 43.26 | 38.36 | 36.14 | 74.00 | -37.86 | peak |
| 3 | 4882.000 | 7.97 | 34.06 | 43.69 | 45.69 | 44.03 | 74.00 | -29.97 | peak |
| 4 | 6470.026 | 11.48 | 35.57 | 42.43 | 37.36 | 41.98 | 74.00 | -32.02 | peak |
| 5 | 7323.000 | 10.05 | 36.16 | 41.77 | 36.76 | 41.20 | 74.00 | -32.80 | peak |
| 6 | 9764.000 | 10.82 | 37.76 | 38.17 | 30.67 | 41.08 | 74.00 | -32.92 | peak |

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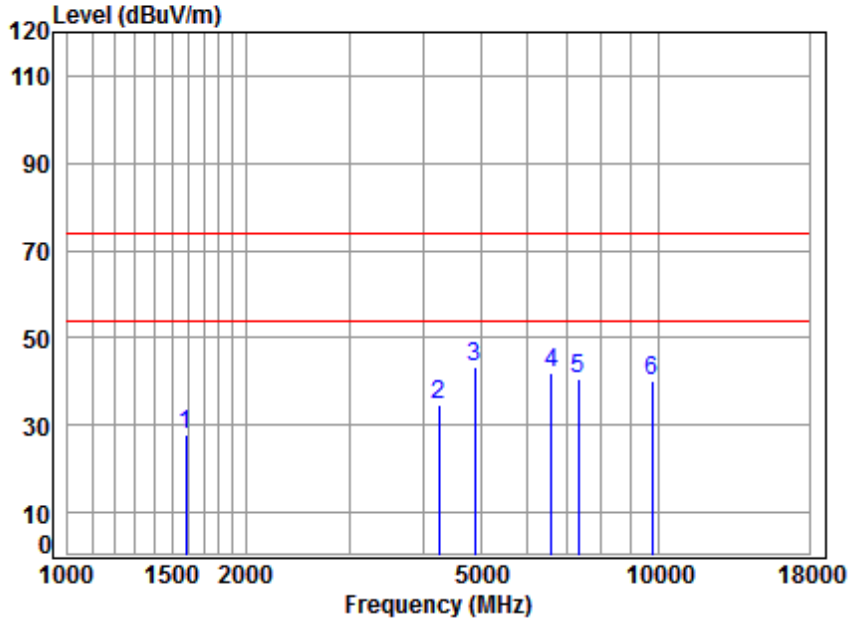
Mode:c; Polarization:Vertical; Modulation:GFSK; ; Channel:middle




Site : chamber
Condition: 3m VERTICAL
Job No : 10500CR/10501CR
Mode : 2441 TX RSE
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 1587.975 | 5.37 | 26.20 | 40.76 | 36.95 | 27.76 | 74.00 | -46.24 | peak |
| 2 | 4254.921 | 7.28 | 33.17 | 43.04 | 37.21 | 34.62 | 74.00 | -39.38 | peak |
| 3 | 4882.000 | 7.97 | 34.06 | 43.69 | 44.89 | 43.23 | 74.00 | -30.77 | peak |
| 4 | 6583.209 | 11.30 | 35.65 | 42.34 | 37.56 | 42.17 | 74.00 | -31.83 | peak |
| 5 | 7323.000 | 10.05 | 36.16 | 41.77 | 36.14 | 40.58 | 74.00 | -33.42 | peak |
| 6 | 9764.000 | 10.82 | 37.76 | 38.17 | 29.67 | 40.08 | 74.00 | -33.92 | peak |

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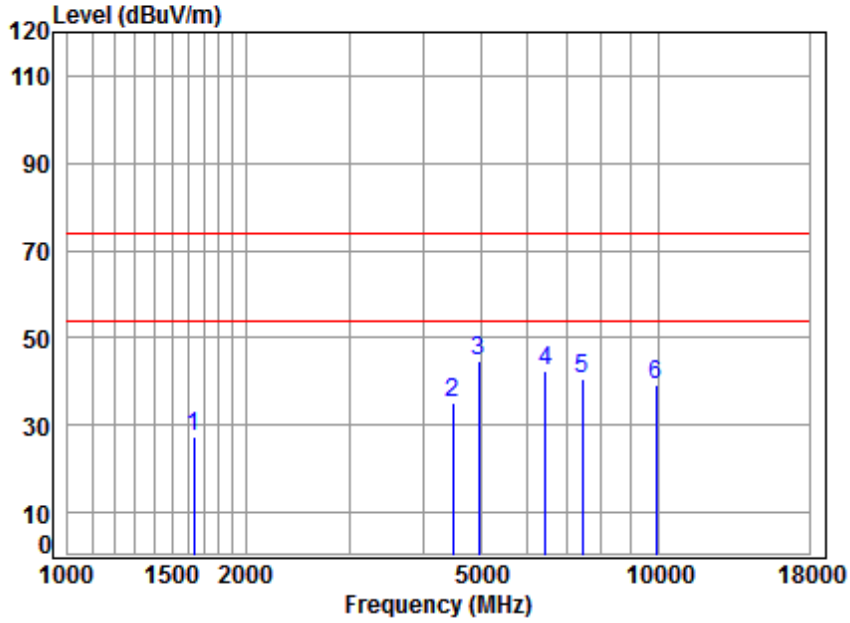
Mode:c; Polarization:Horizontal; Modulation:GFSK; ; Channel:High




Site : chamber
Condition: 3m HORIZONTAL
Job No : 10500CR/10501CR
Mode : 2480 TX RSE
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 1634.543 | 5.31 | 26.40 | 40.79 | 36.43 | 27.35 | 74.00 | -46.65 | peak |
| 2 | 4495.125 | 7.55 | 33.59 | 43.30 | 37.14 | 34.98 | 74.00 | -39.02 | peak |
| 3 | 4960.000 | 8.05 | 34.15 | 43.76 | 46.26 | 44.70 | 74.00 | -29.30 | peak |
| 4 | 6451.353 | 11.45 | 35.55 | 42.44 | 37.83 | 42.39 | 74.00 | -31.61 | peak |
| 5 | 7440.000 | 10.02 | 36.25 | 41.69 | 36.12 | 40.70 | 74.00 | -33.30 | peak |
| 6 | 9920.000 | 10.90 | 37.85 | 37.93 | 28.61 | 39.43 | 74.00 | -34.57 | peak |

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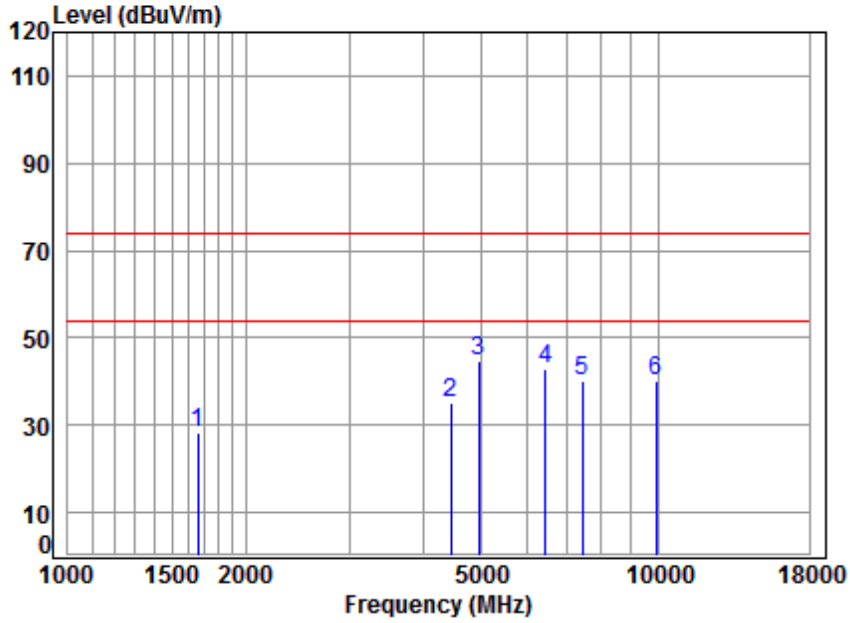
Mode:c; Polarization:Vertical; Modulation:GFSK; ; Channel:High




Site : chamber
Condition: 3m VERTICAL
Job No : 10500CR/10501CR
Mode : 2480 TX RSE
Note : BT

| | Freq | Cable Loss | Ant Factor | Preamp Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 1663.137 | 5.27 | 26.52 | 40.81 | 37.16 | 28.14 | 74.00 | -45.86 | peak |
| 2 | 4456.315 | 7.51 | 33.53 | 43.26 | 37.46 | 35.24 | 74.00 | -38.76 | peak |
| 3 | 4960.000 | 8.05 | 34.15 | 43.76 | 46.24 | 44.68 | 74.00 | -29.32 | peak |
| 4 | 6451.353 | 11.45 | 35.55 | 42.44 | 38.22 | 42.78 | 74.00 | -31.22 | peak |
| 5 | 7440.000 | 10.02 | 36.25 | 41.69 | 35.75 | 40.33 | 74.00 | -33.67 | peak |
| 6 | 9920.000 | 10.90 | 37.85 | 37.93 | 29.22 | 40.04 | 74.00 | -33.96 | peak |

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# 8 Photographs

## 8.1 Test Setup

Please refer to setup photos.

## 8.2 EUT Constructional Details (EUT Photos)

Please refer to external and internal photos for details.

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# 9 Appendix

## 9.1 Appendix 15.247

**1.20 dB Bandwidth**

| Test Mode | Test Channel | EBW[MHz] | Limit[MHz] | Verdict |
|---|---|---|---|---|
| DH5 | 2402 | 1.028 | --- | PASS |
| DH5 | 2441 | 1.028 | --- | PASS |
| DH5 | 2480 | 1.026 | --- | PASS |
| 2DH5 | 2402 | 1.400 | --- | PASS |
| 2DH5 | 2441 | 1.396 | --- | PASS |
| 2DH5 | 2480 | 1.392 | --- | PASS |
| 3DH5 | 2402 | 1.386 | --- | PASS |
| 3DH5 | 2441 | 1.384 | --- | PASS |
| 3DH5 | 2480 | 1.374 | --- | PASS |

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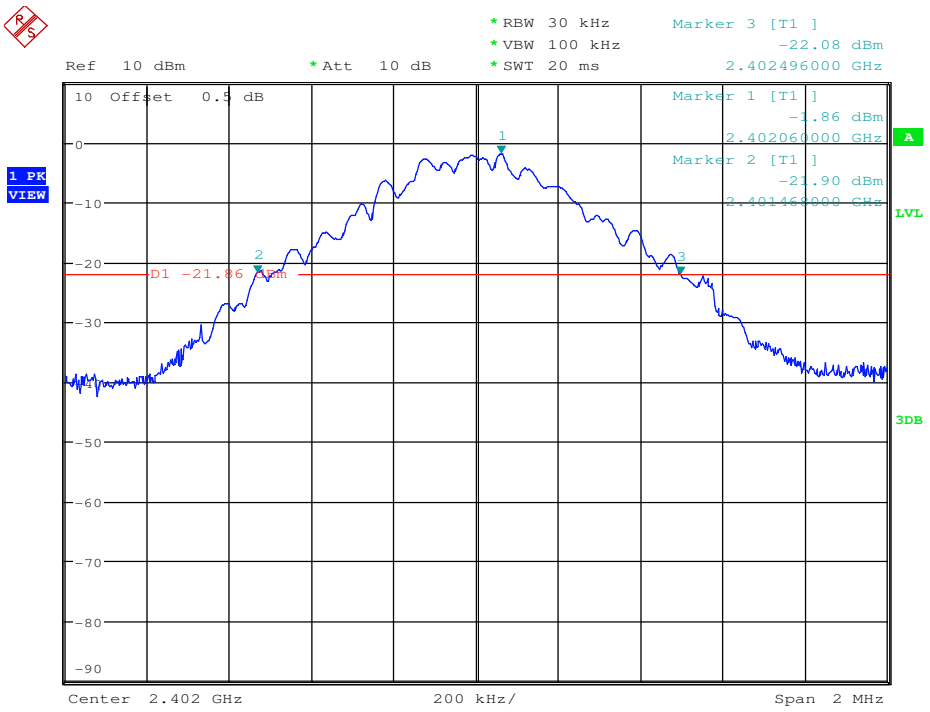
## 20 dB Bandwidth_DH5_2402

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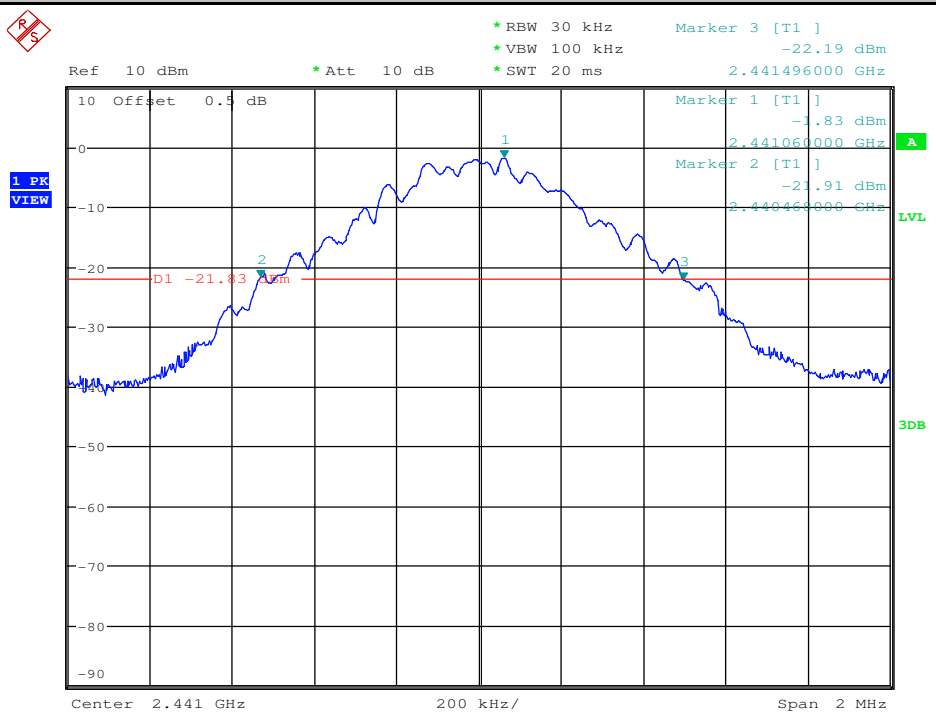


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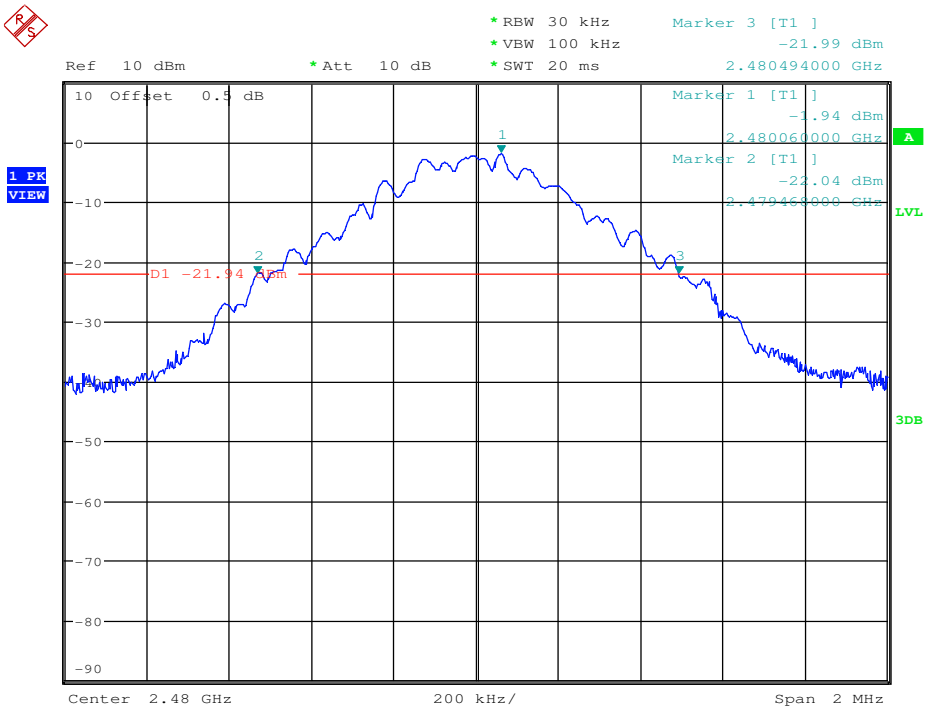
## 20 dB Bandwidth_DH5_2480

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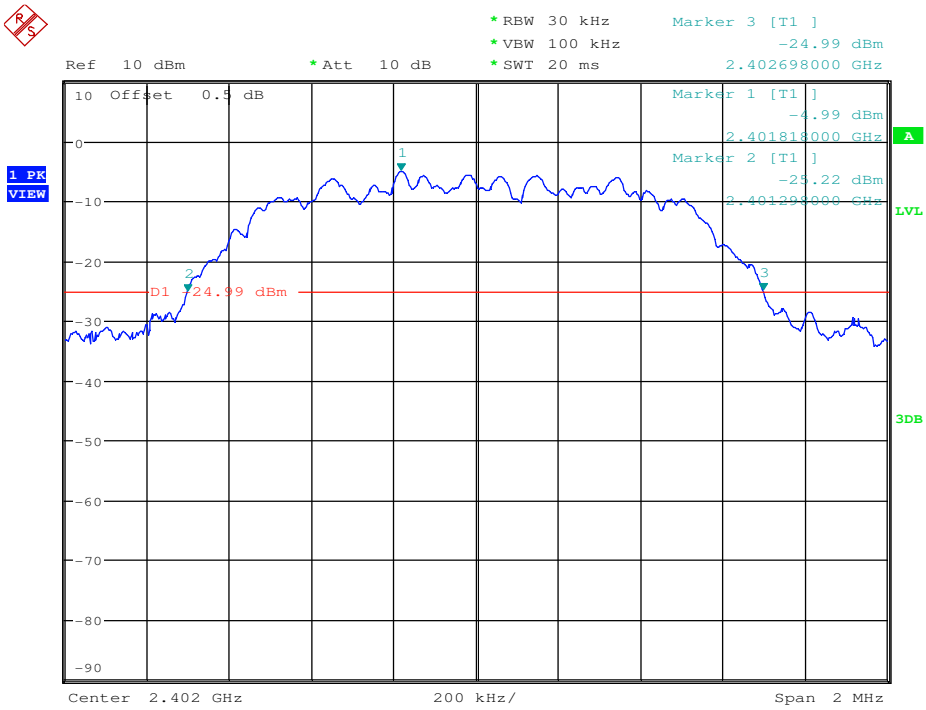


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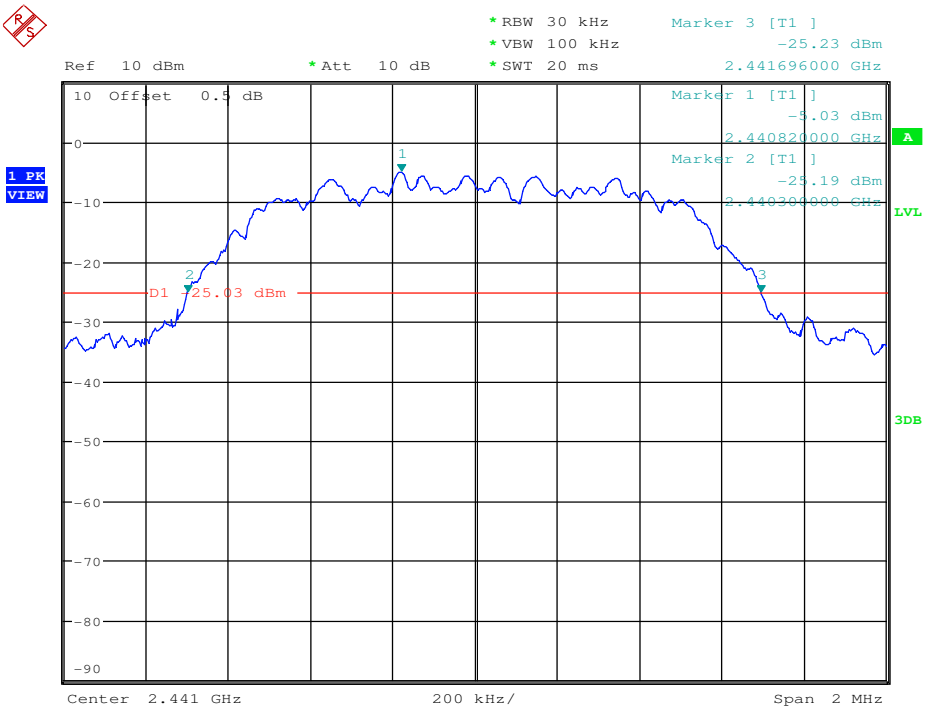
## 20 dB Bandwidth_2DH5_2441

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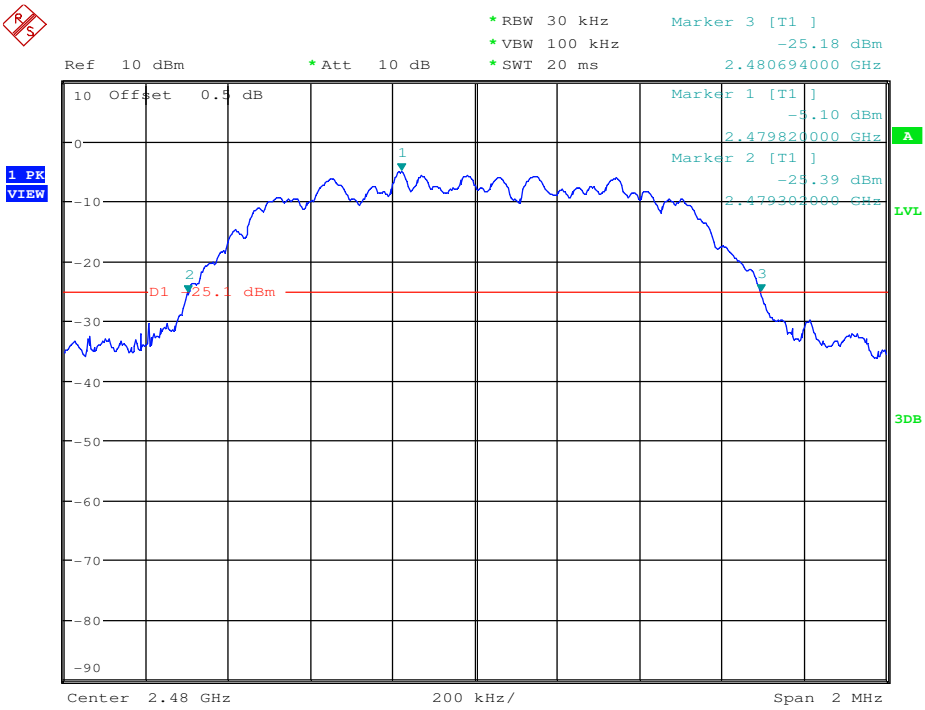


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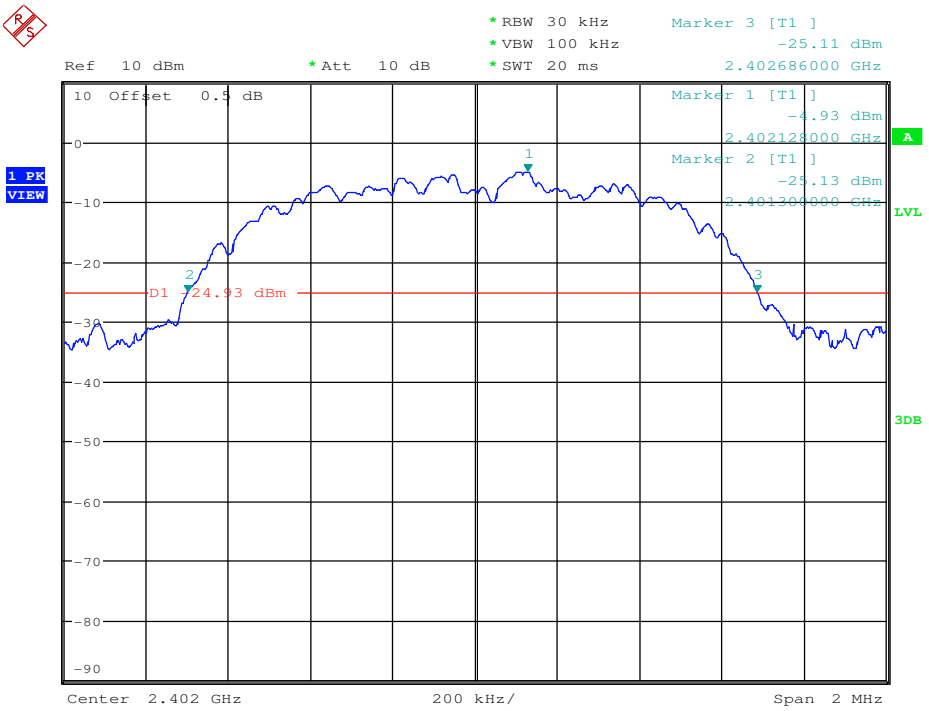
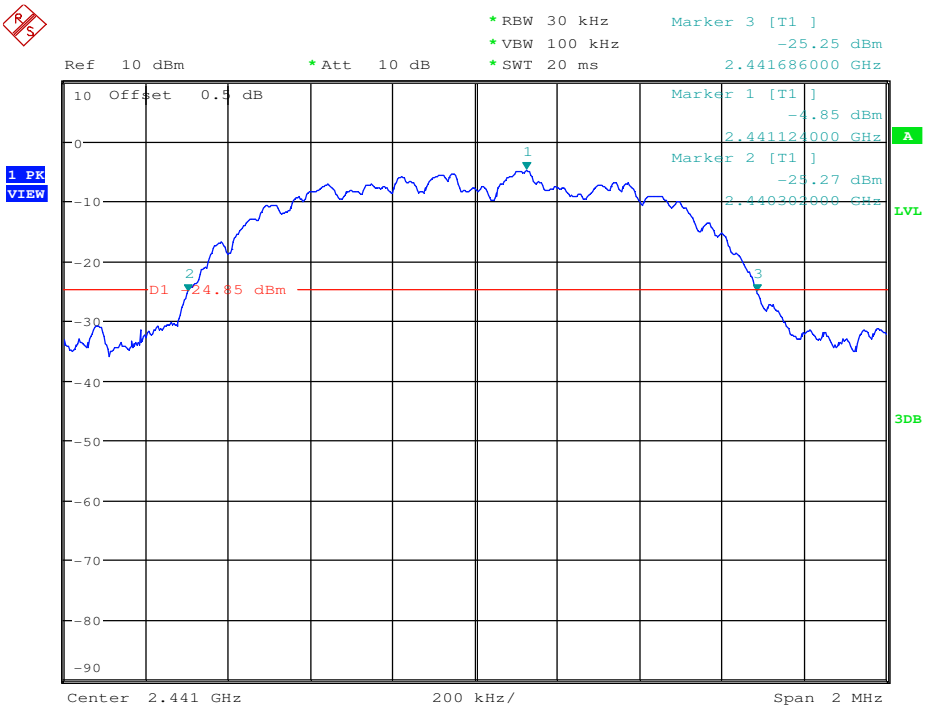
## 20 dB Bandwidth_3DH5_2402




## 20 dB Bandwidth_3DH5_2441

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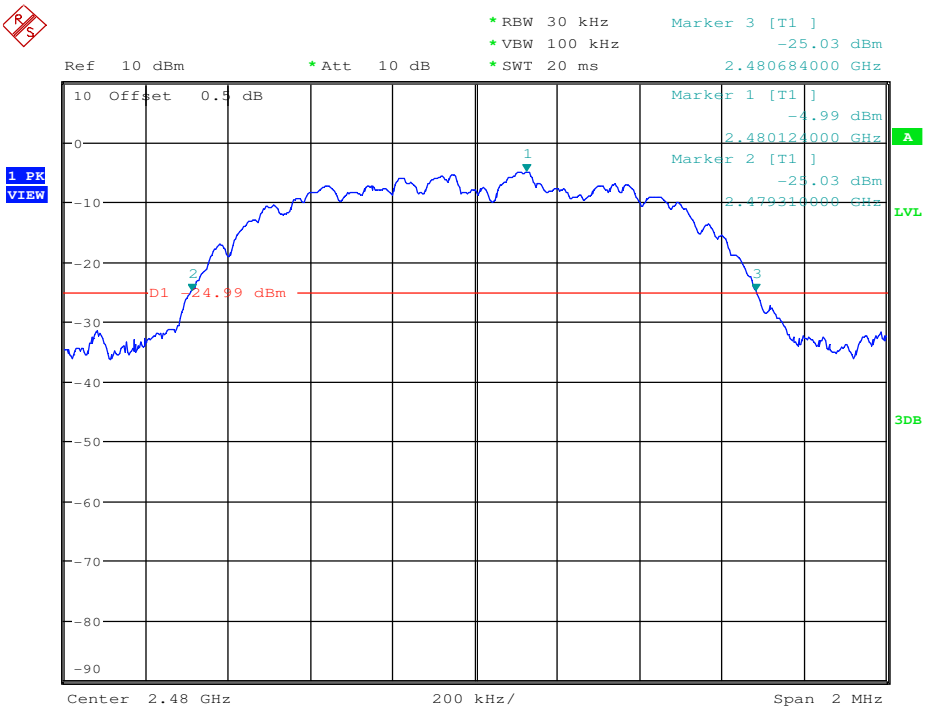
20 dB Bandwidth_3DH5_2480

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**2.Conducted Peak Output Power**

| Test Mode | Test Channel | Power[dBm] | Limit[dBm] | Verdict |
|---|---|---|---|---|
| DH5 | 2402 | 1.71 | <=20.97 | PASS |
| DH5 | 2441 | 1.70 | <=20.97 | PASS |
| DH5 | 2480 | 1.61 | <=20.97 | PASS |
| 2DH5 | 2402 | 2.56 | <=20.97 | PASS |
| 2DH5 | 2441 | 2.66 | <=20.97 | PASS |
| 2DH5 | 2480 | 2.68 | <=20.97 | PASS |
| 3DH5 | 2402 | 2.71 | <=20.97 | PASS |
| 3DH5 | 2441 | 2.85 | <=20.97 | PASS |
| 3DH5 | 2480 | 2.93 | <=20.97 | PASS |

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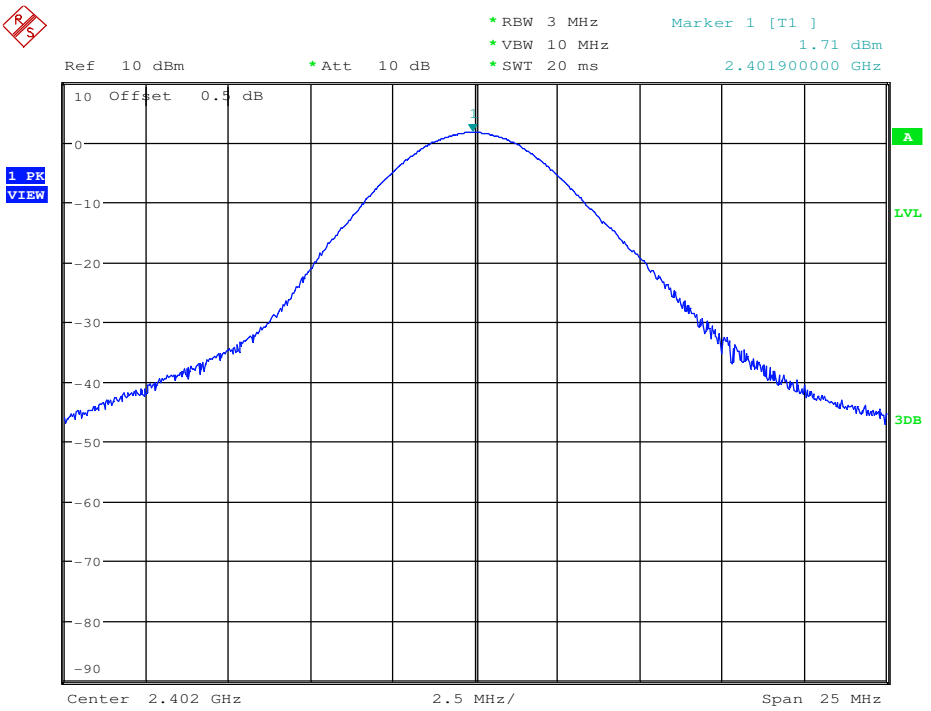
## Conducted Peak Output Power_DH5_2402

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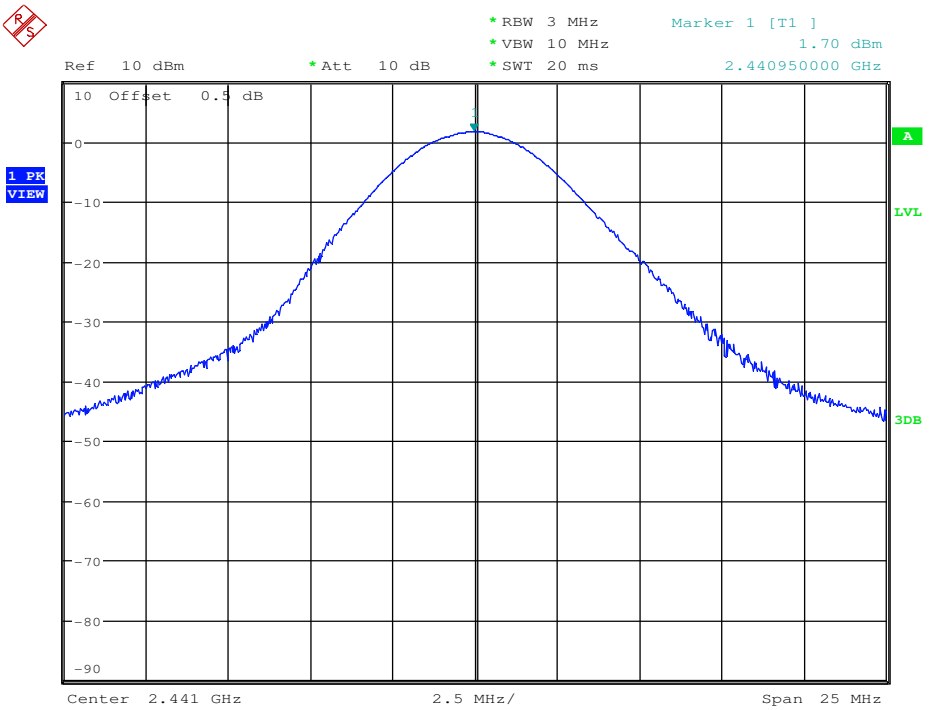


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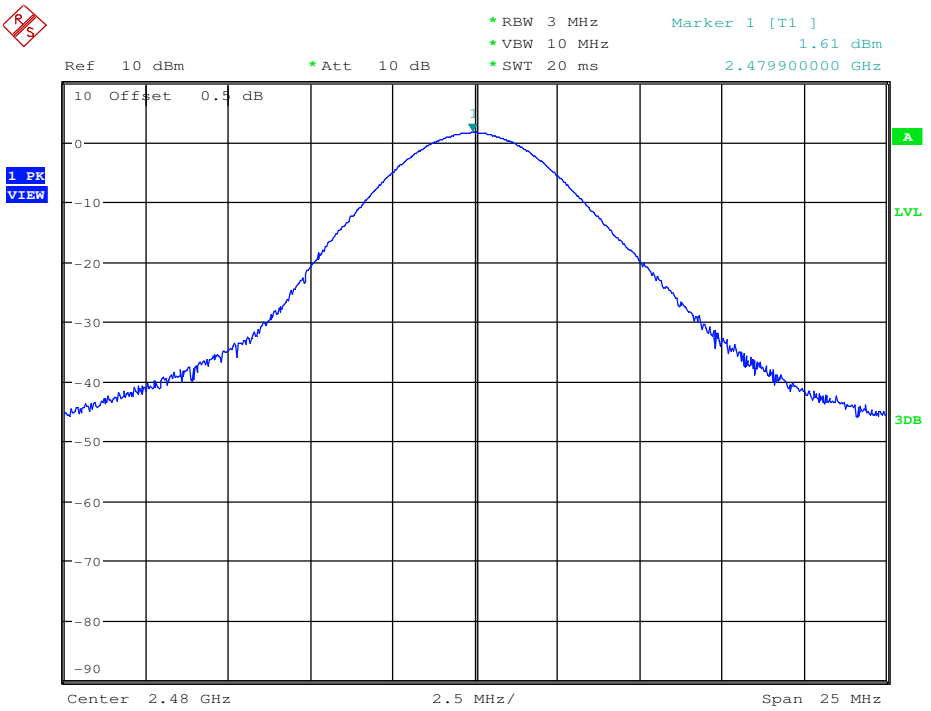
## Conducted Peak Output Power_DH5_2480

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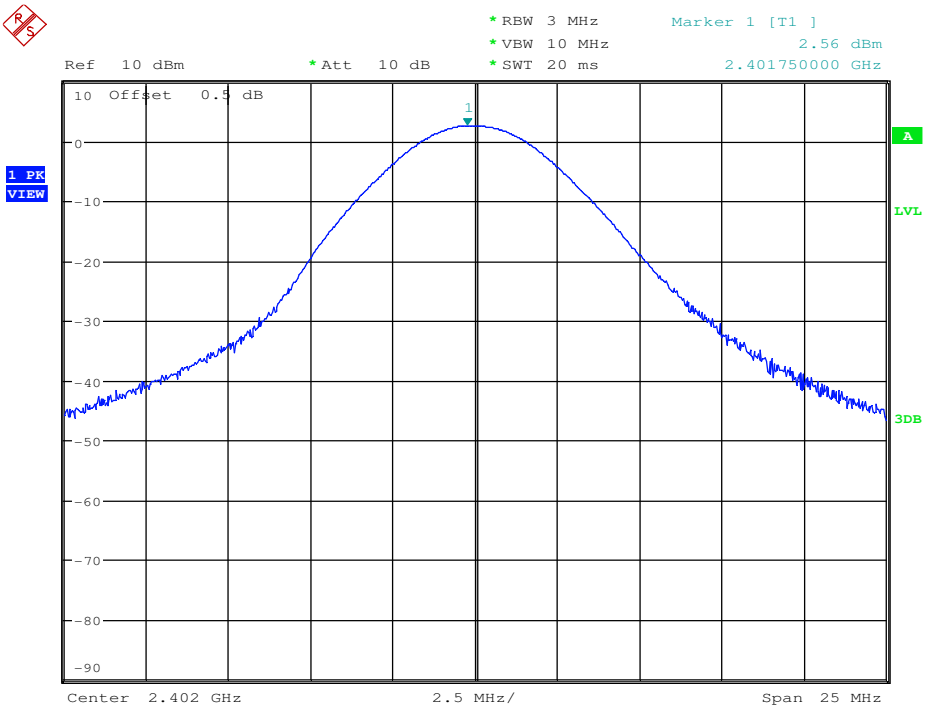


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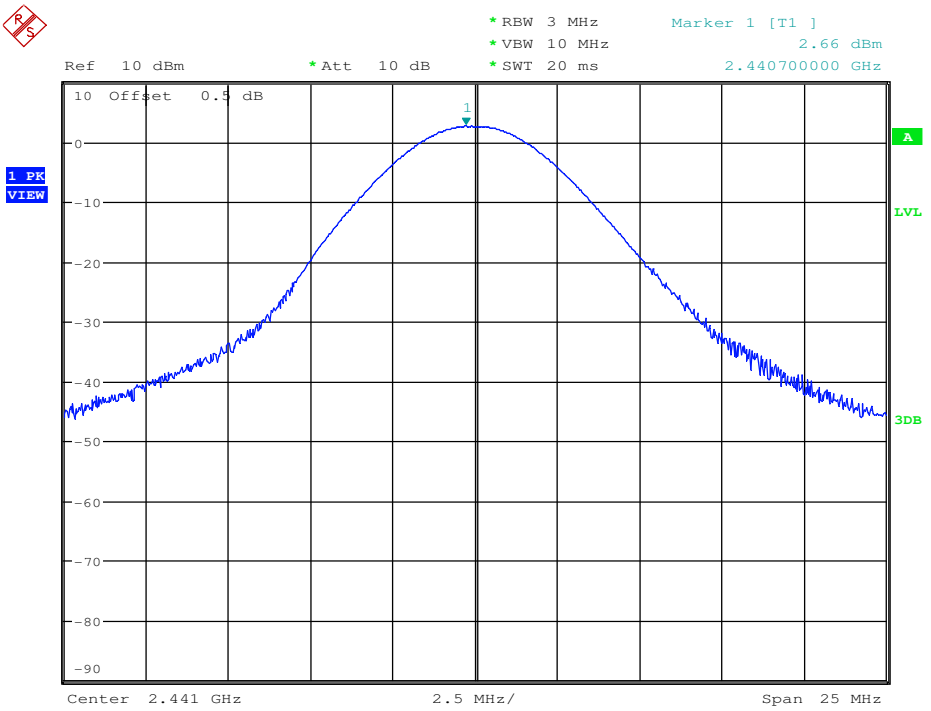
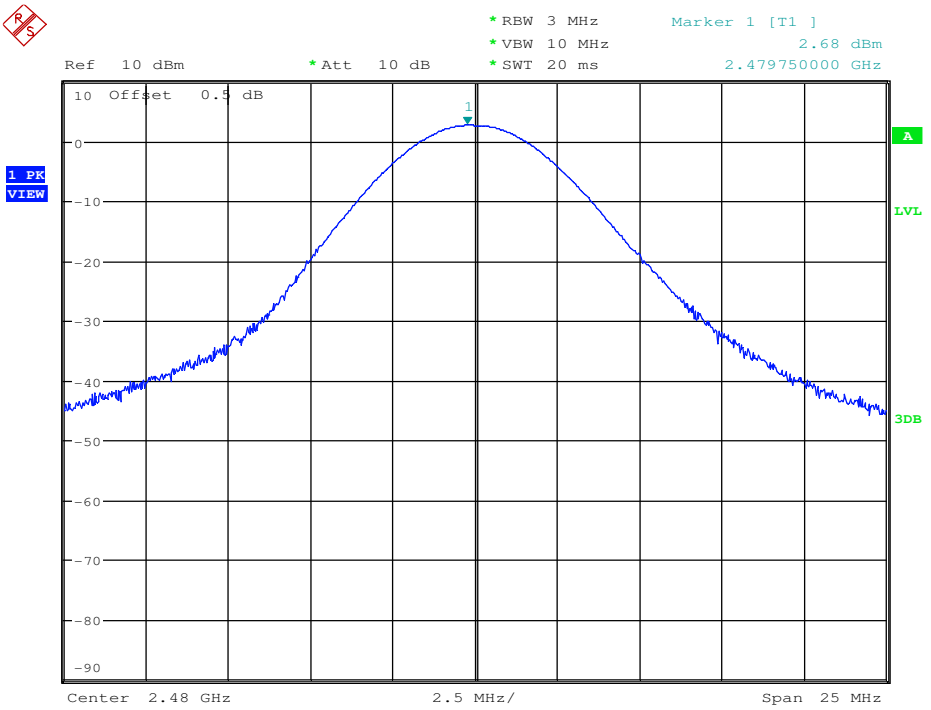
## Conducted Peak Output Power_2DH5_2441




## Conducted Peak Output Power_2DH5_2480

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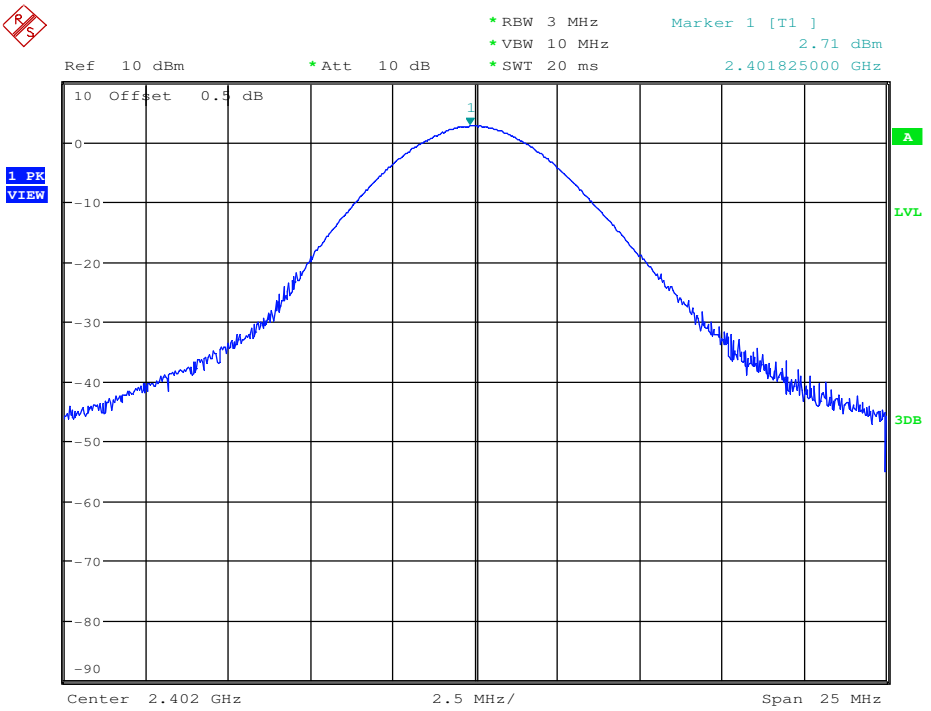
## Conducted Peak Output Power_3DH5_2402

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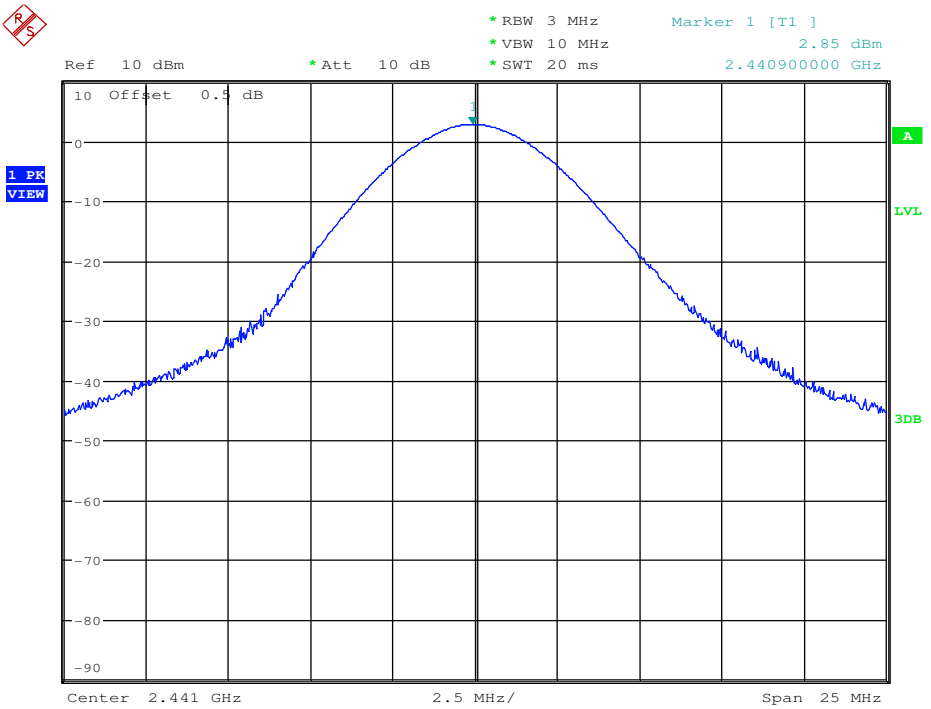


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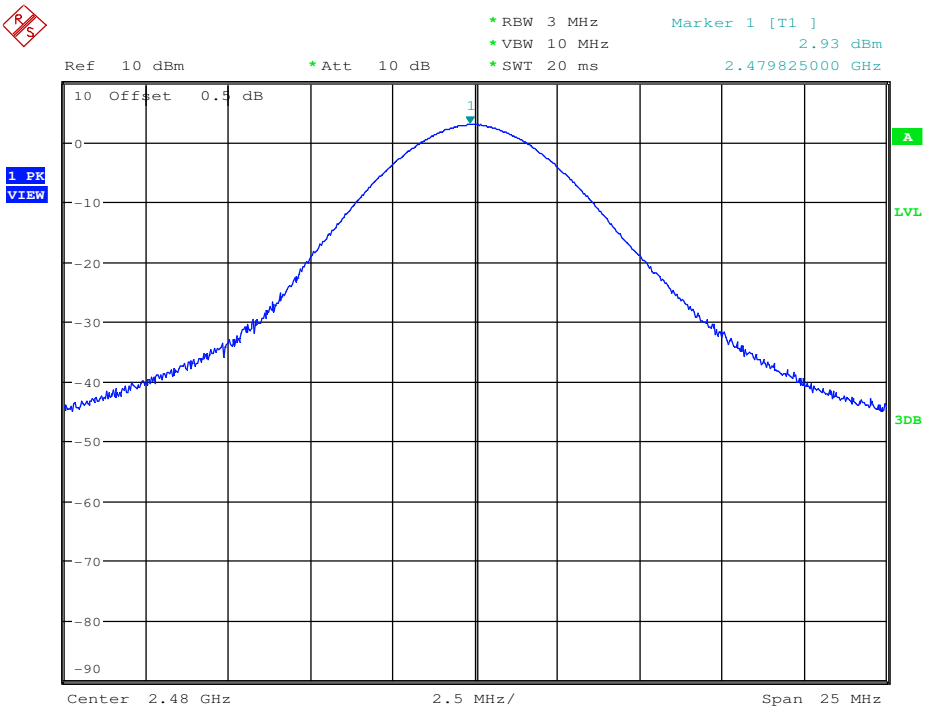
Conducted Peak Output Power_3DH5_2480




## 3.Carrier Frequency Separation

| Test Mode | Test Channel | Result[MHz] | Limit[MHz] | Verdict |
|---|---|---|---|---|
| DH5 | 2441 | 1.002 | >=0.69 | PASS |
| 2DH5 | 2441 | 0.993 | >=0.93 | PASS |
| 3DH5 | 2441 | 1.008 | >=0.92 | PASS |

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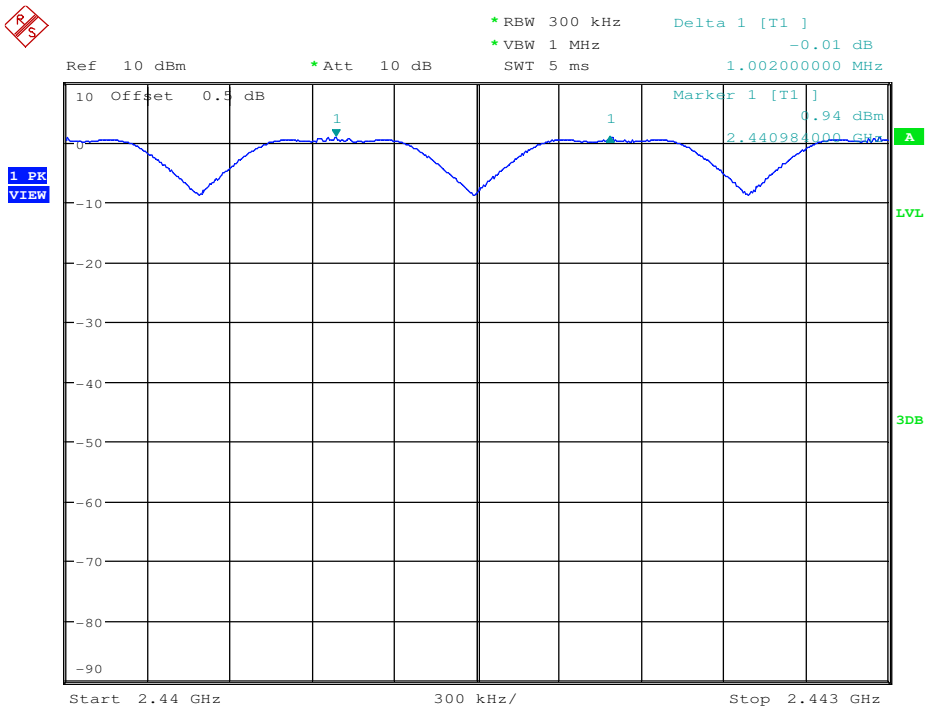
## Carrier Frequency Separation_DH5_2441

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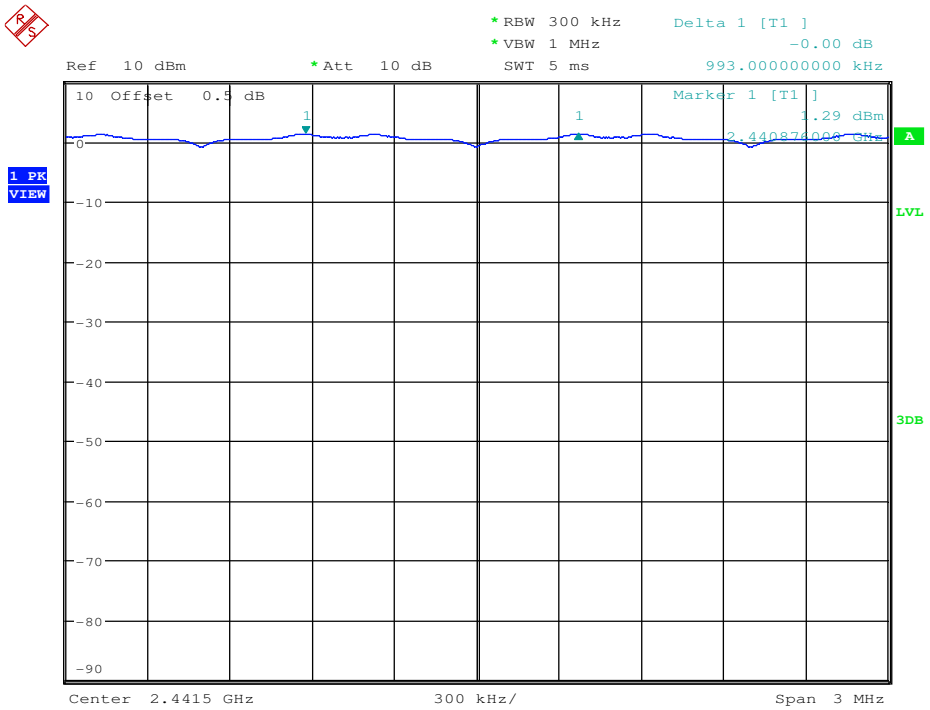


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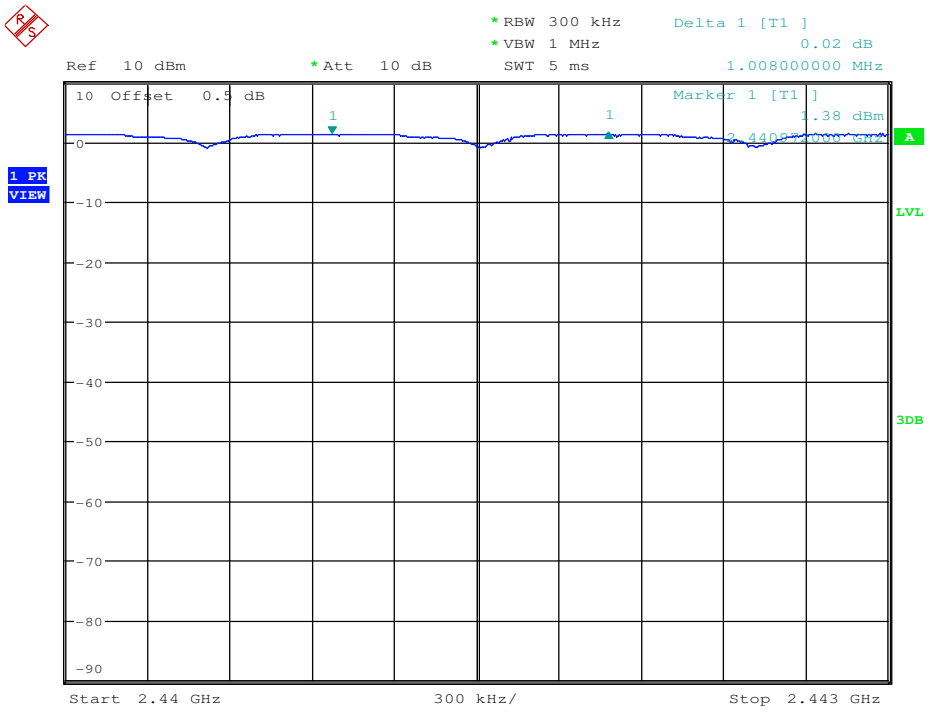
Carrier Frequency Separation_3DH5_2441




## 4.Dwell Time

| Test Mode | Test Channel | Burst Width[ms/hop/ch] | Total Hops[hop*ch] | Dwell Time[s] | Limit[s] | Verdict |
|---|---|---|---|---|---|---|
| DH1 | 2402 | 0.37 | 370 | 0.137 | <0.4 | PASS |
| DH3 | 2402 | 1.66 | 170 | 0.282 | <0.4 | PASS |
| DH5 | 2402 | 2.91 | 110 | 0.32 | <0.4 | PASS |
| 2DH1 | 2402 | 0.37 | 380 | 0.141 | <0.4 | PASS |
| 2DH3 | 2402 | 1.64 | 170 | 0.279 | <0.4 | PASS |
| 2DH5 | 2402 | 2.91 | 110 | 0.32 | <0.4 | PASS |
| 3DH1 | 2402 | 0.37 | 380 | 0.141 | <0.4 | PASS |
| 3DH3 | 2402 | 1.67 | 170 | 0.284 | <0.4 | PASS |
| 3DH5 | 2402 | 2.93 | 110 | 0.322 | <0.4 | PASS |

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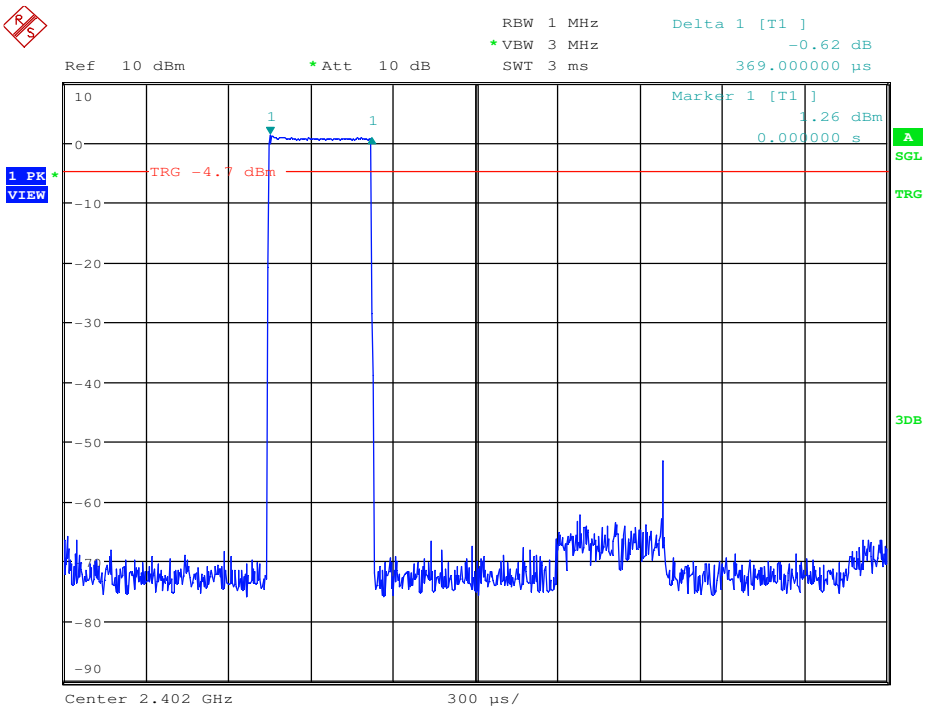
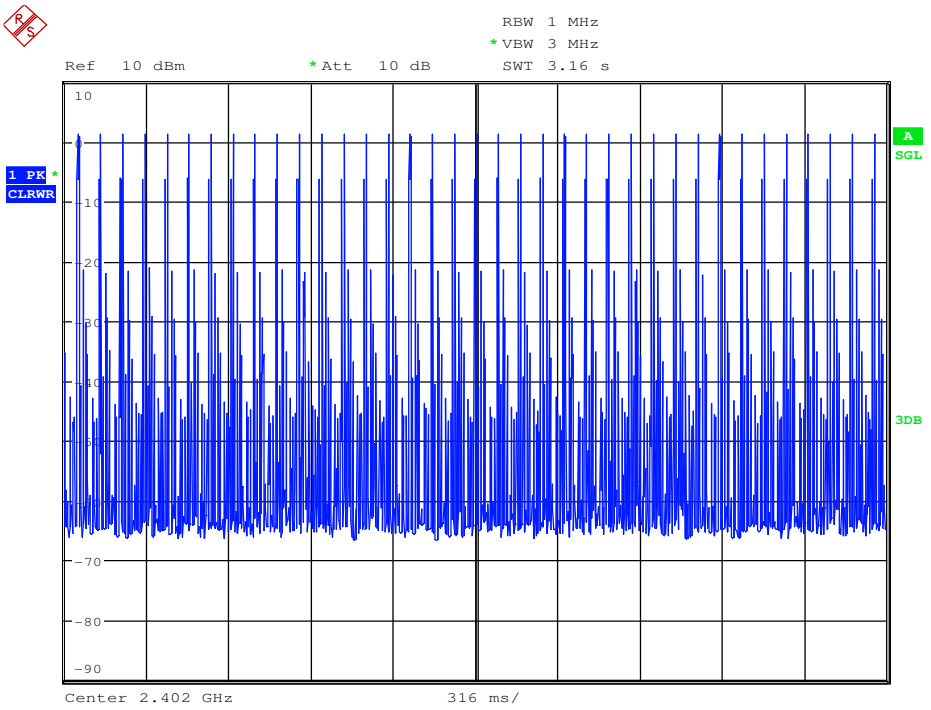
Dwell Time_DH1_2402

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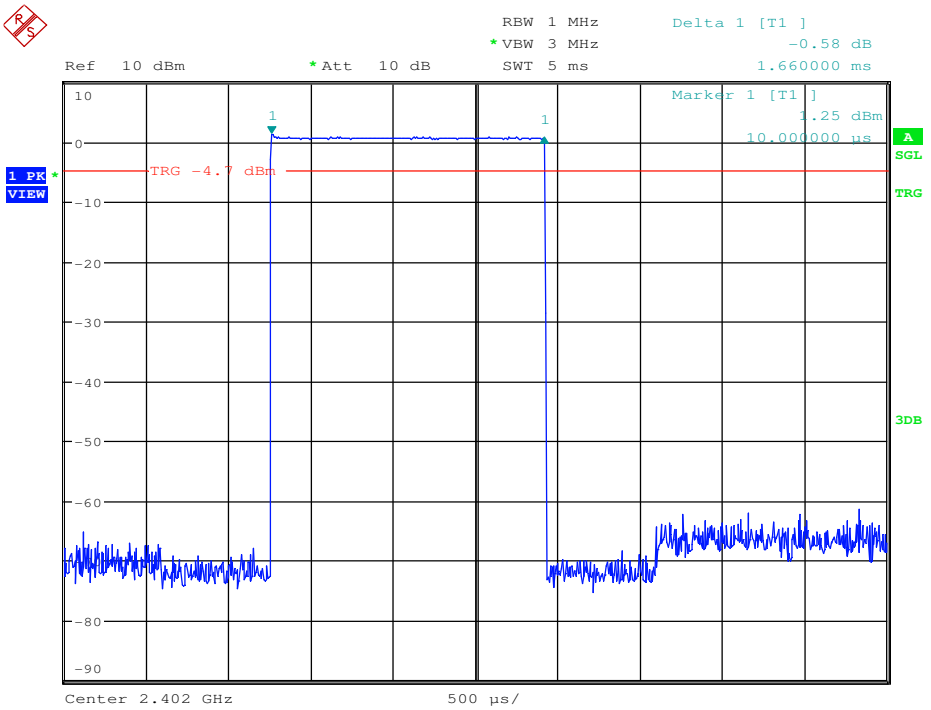
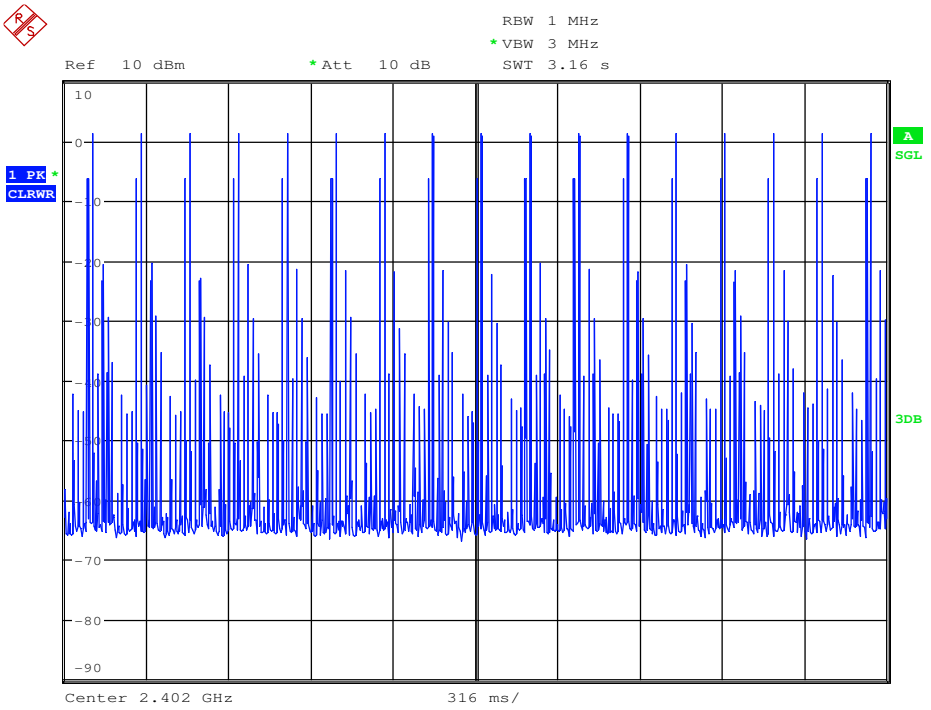
Dwell Time_DH3_2402

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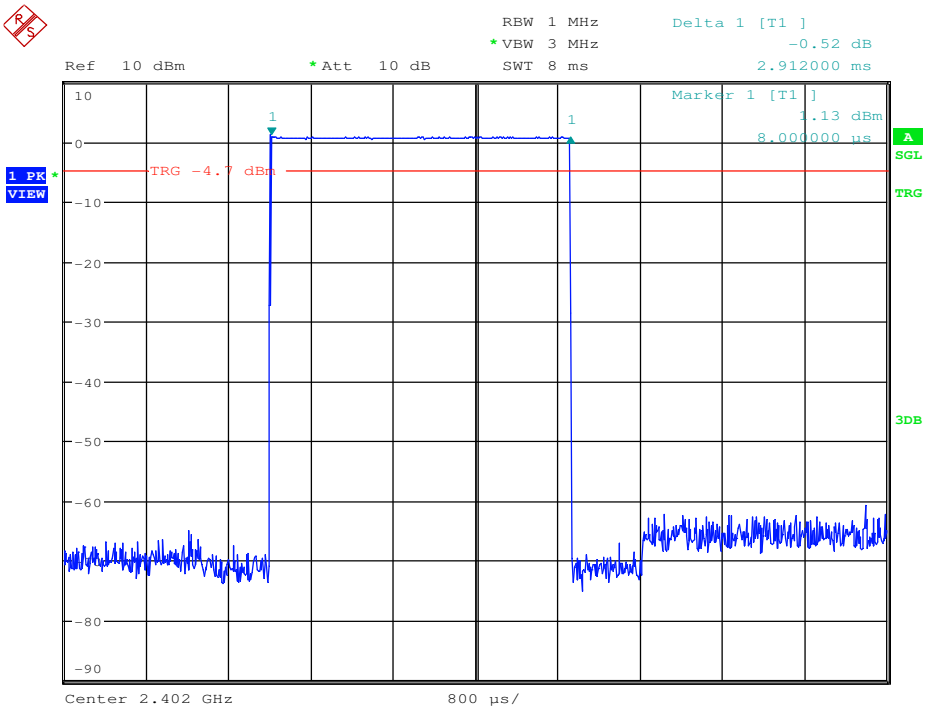
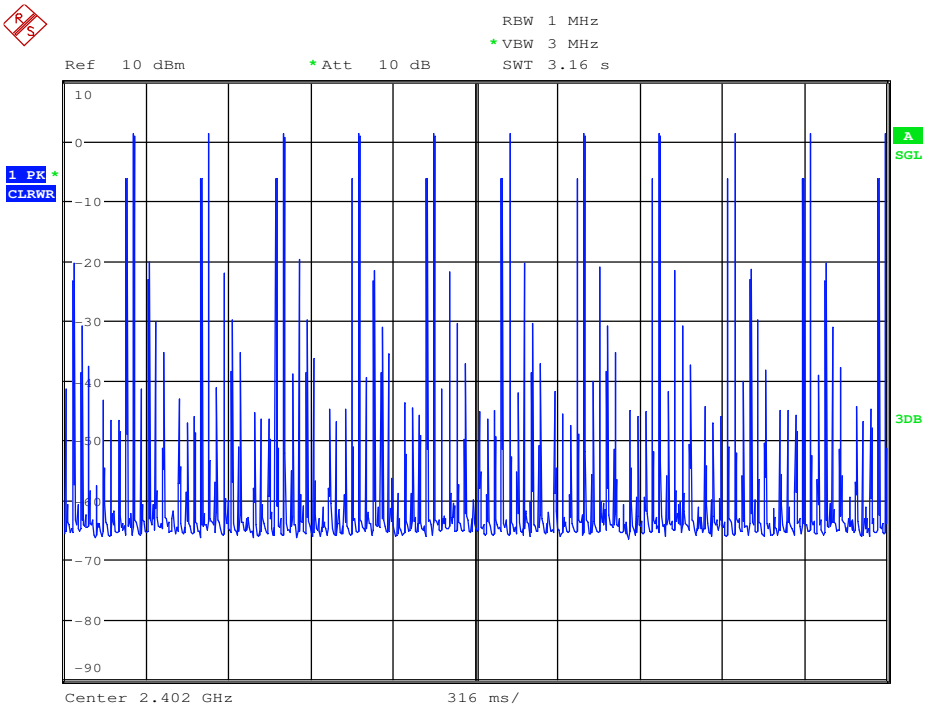
## Dwell Time_DH5_2402

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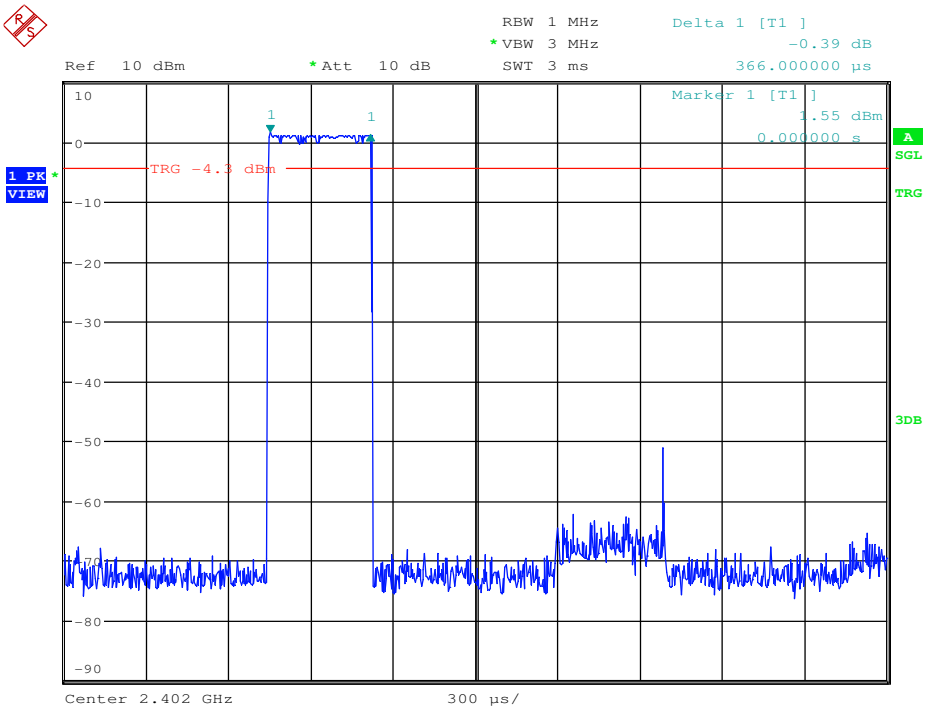
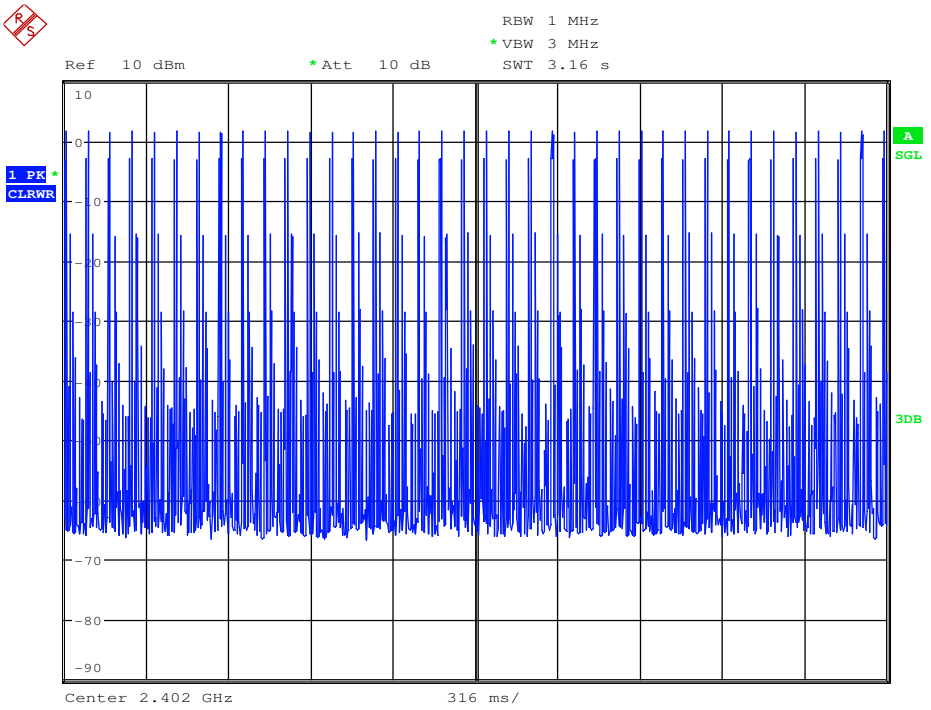
## Dwell Time_2DH1_2402

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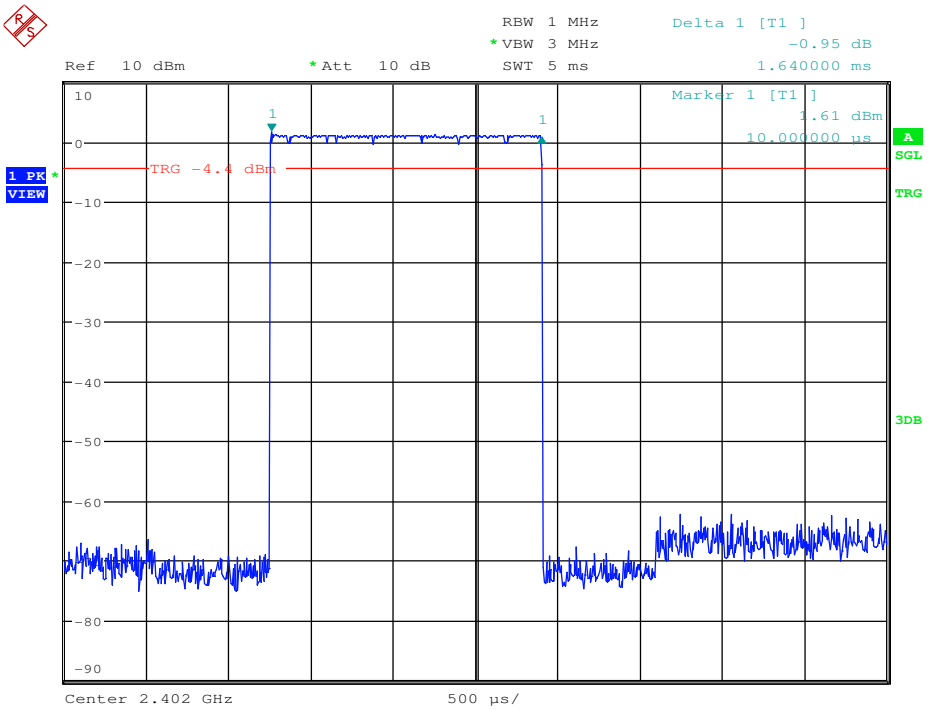
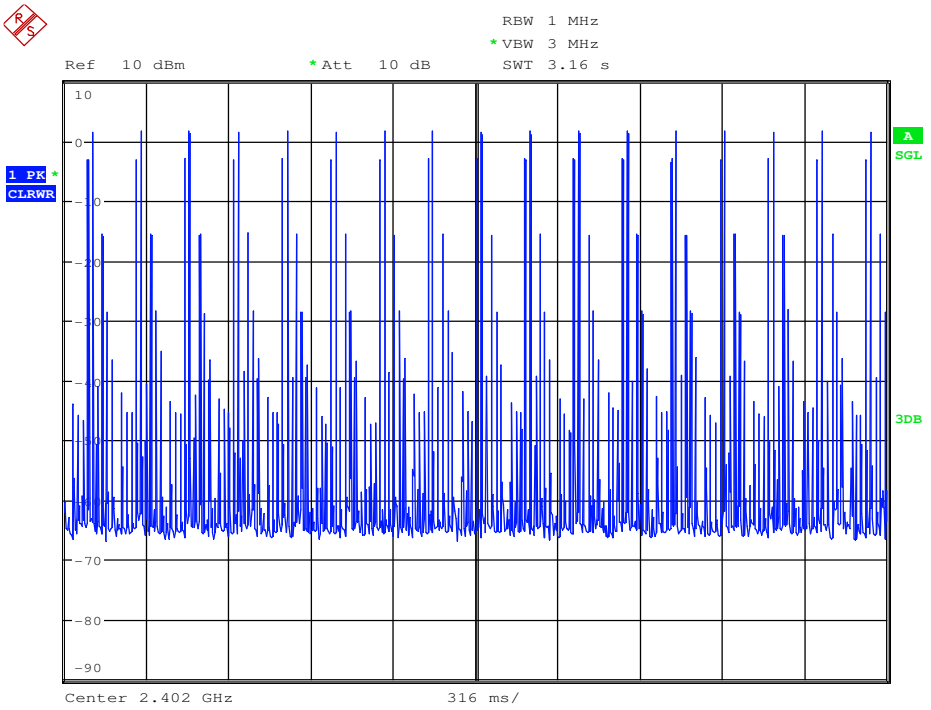
## Dwell Time_2DH3_2402

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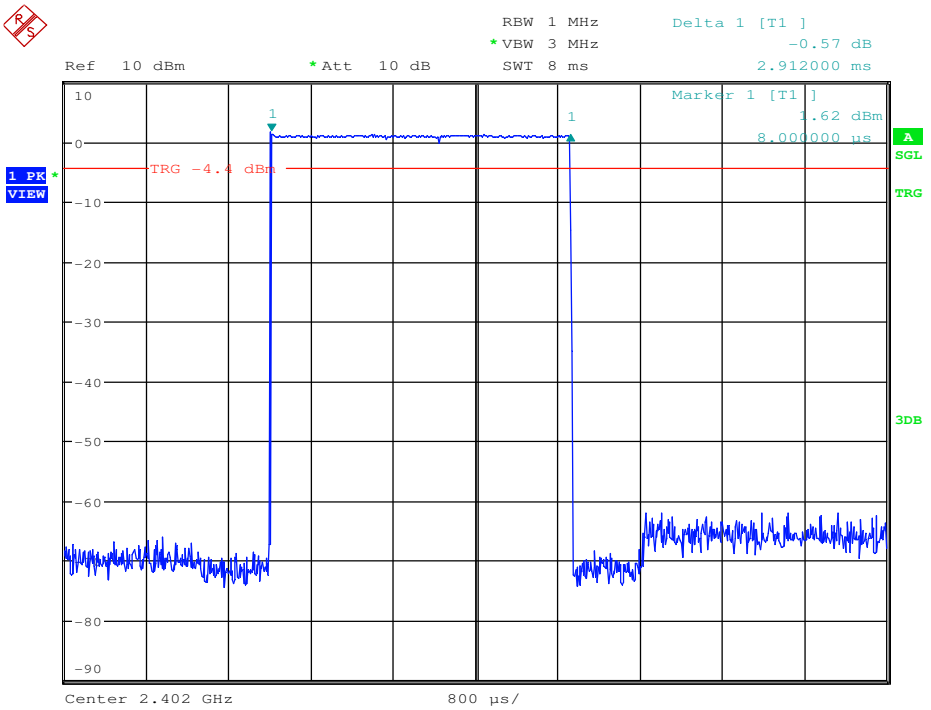


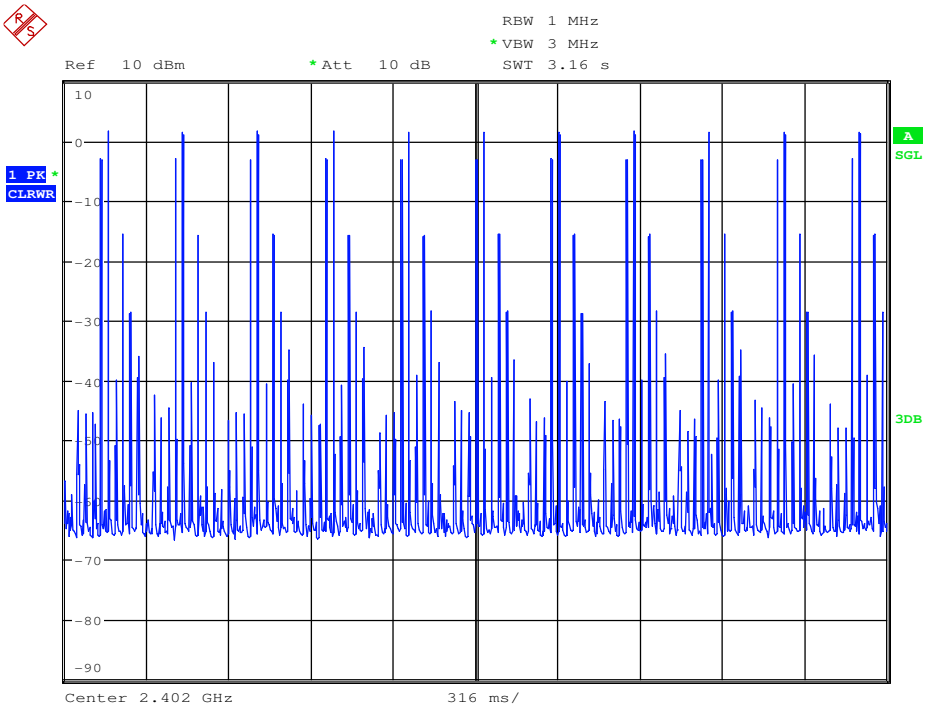


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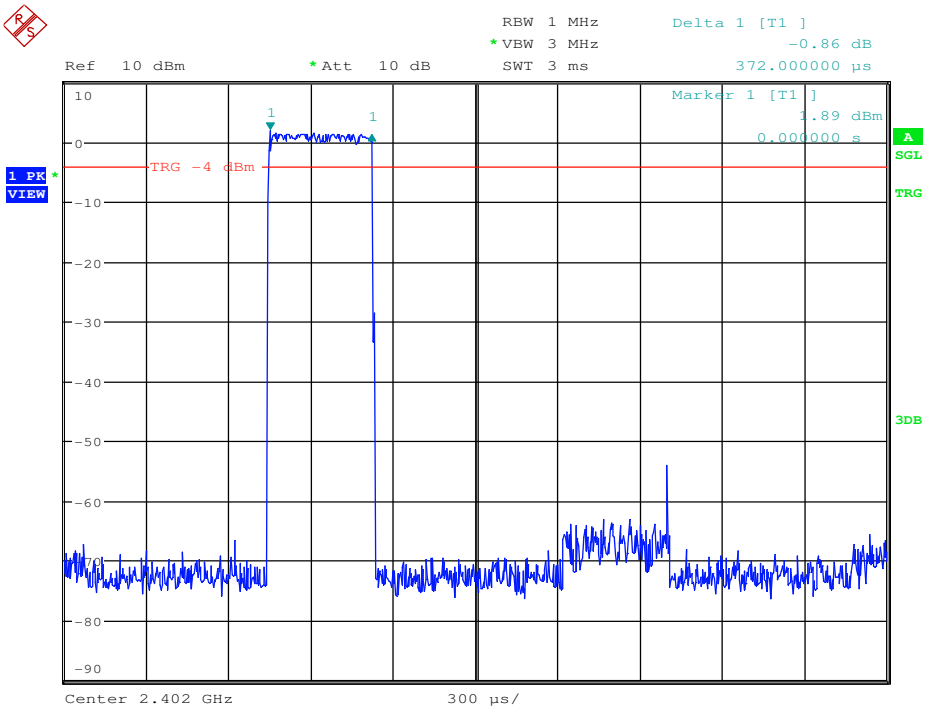
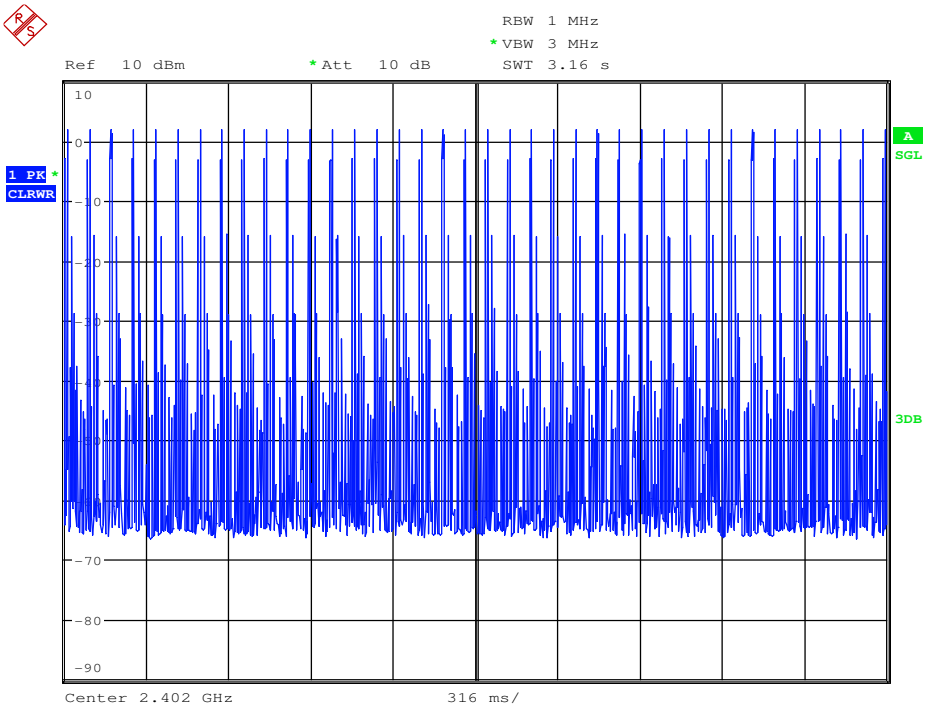
Dwell Time_3DH1_2402

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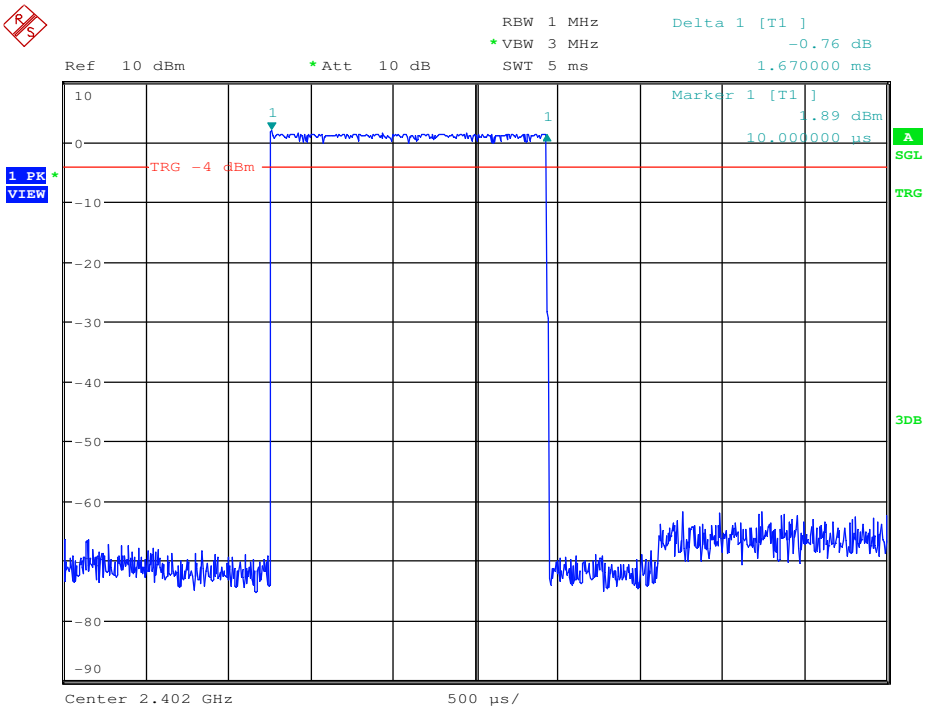
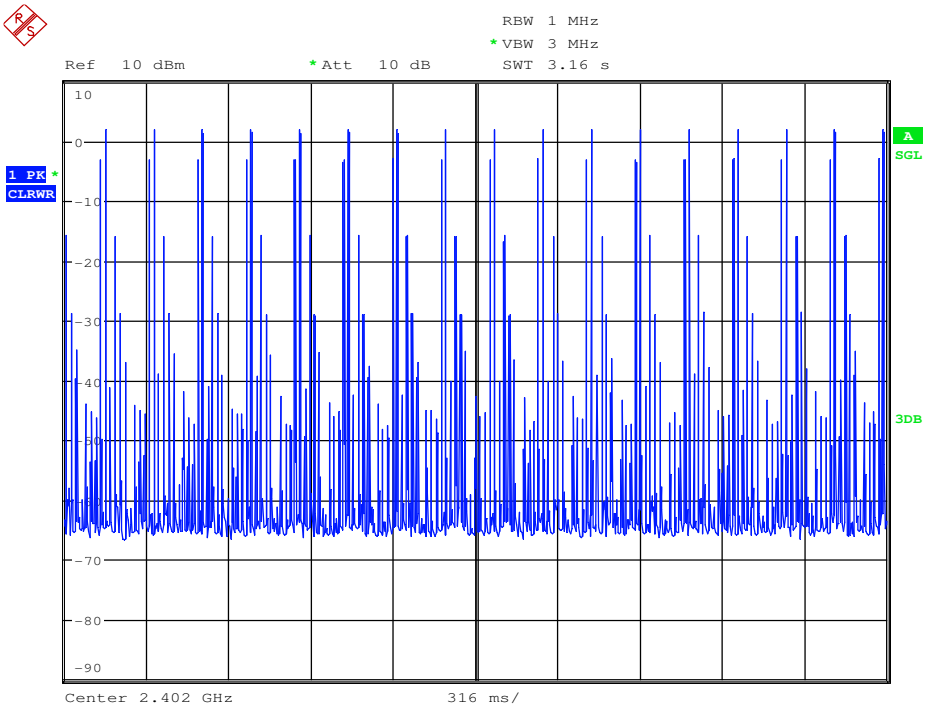
Dwell Time_3DH3_2402

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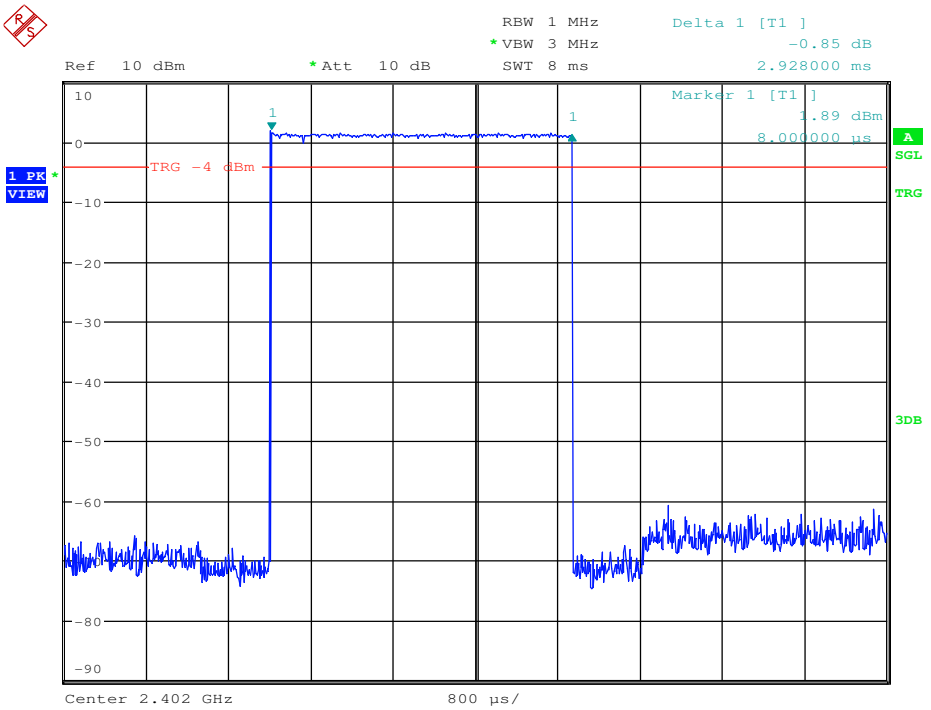
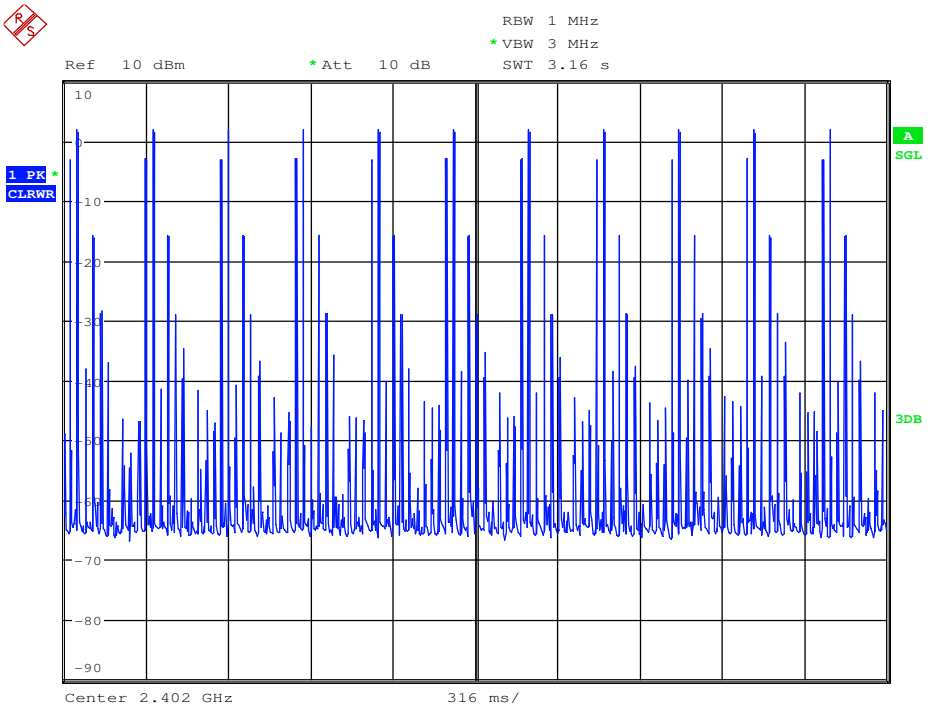
## Dwell Time_3DH5_2402

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**5.Hopping Channel Number**

| Test Mode | Test Channel | Number of Hopping Channel[N] | Limit[N] | Verdict |
|---|---|---|---|---|
| DH5 | 2402 | 79 | >=15 | PASS |
| 2DH5 | 2402 | 79 | >=15 | PASS |
| 3DH5 | 2402 | 79 | >=15 | PASS |

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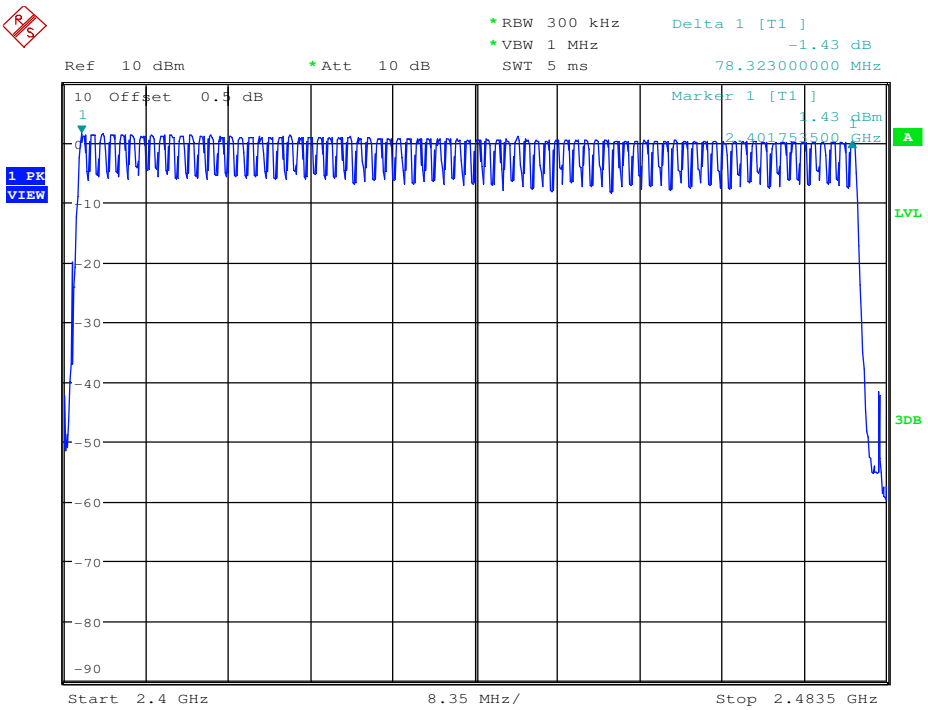
## Hopping Channel Number_DH5_2402

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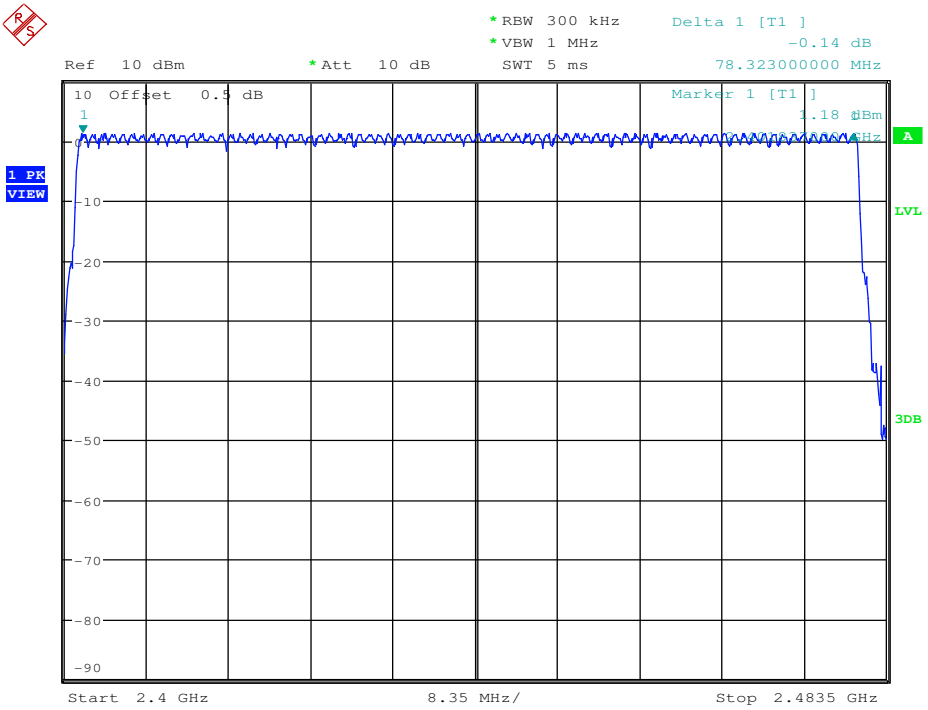


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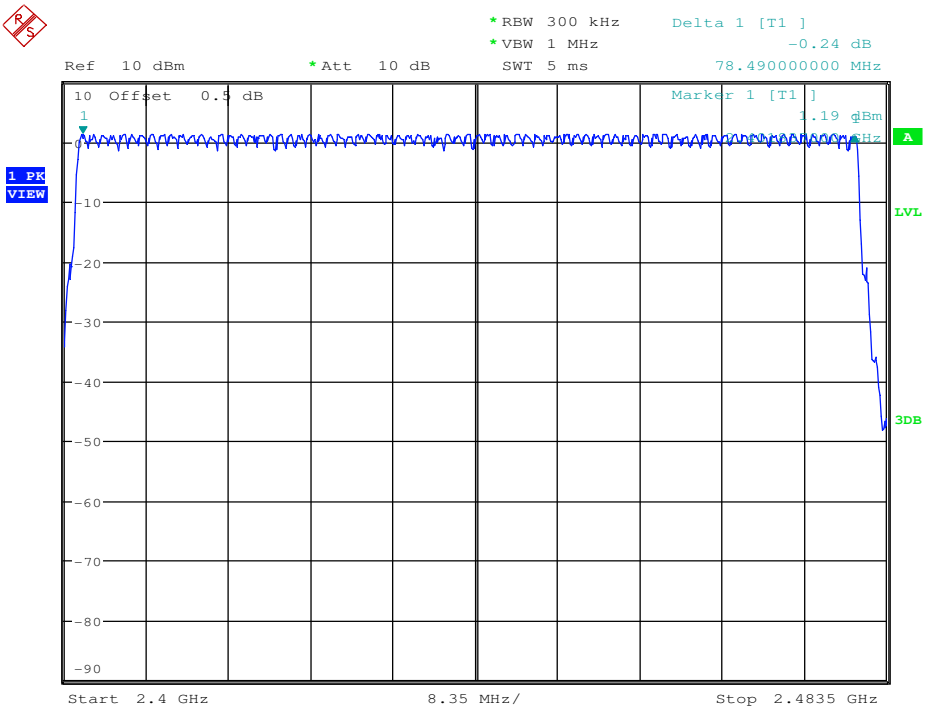
Hopping Channel Number_3DH5_2402




## 6.Band-edge for RF Conducted Emissions

| Test Mode | Test Channel | Hopping | Carrier Power[dBm] | Max. Spurious Level [dBm] | Limit[dBm] | Verdict |
|---|---|---|---|---|---|---|
| DH5 | 2402 | On | 0.910 | -63.376 | <-19.09 | PASS |
| DH5 | 2402 | Off | 0.640 | -63.290 | <-19.36 | PASS |
| DH5 | 2480 | On | 0.450 | -53.319 | <-19.55 | PASS |
| DH5 | 2480 | Off | 0.600 | -50.455 | <-19.4 | PASS |
| 2DH5 | 2402 | On | -1.460 | -63.164 | <-21.46 | PASS |
| 2DH5 | 2402 | Off | -0.820 | -63.097 | <-20.82 | PASS |
| 2DH5 | 2480 | On | -0.910 | -55.874 | <-20.91 | PASS |
| 2DH5 | 2480 | Off | -0.790 | -49.129 | <-20.79 | PASS |
| 3DH5 | 2402 | On | -0.890 | -62.227 | <-20.89 | PASS |
| 3DH5 | 2402 | Off | -0.770 | -61.938 | <-20.77 | PASS |
| 3DH5 | 2480 | On | -0.800 | -53.132 | <-20.8 | PASS |
| 3DH5 | 2480 | Off | -0.760 | -49.521 | <-20.76 | PASS |

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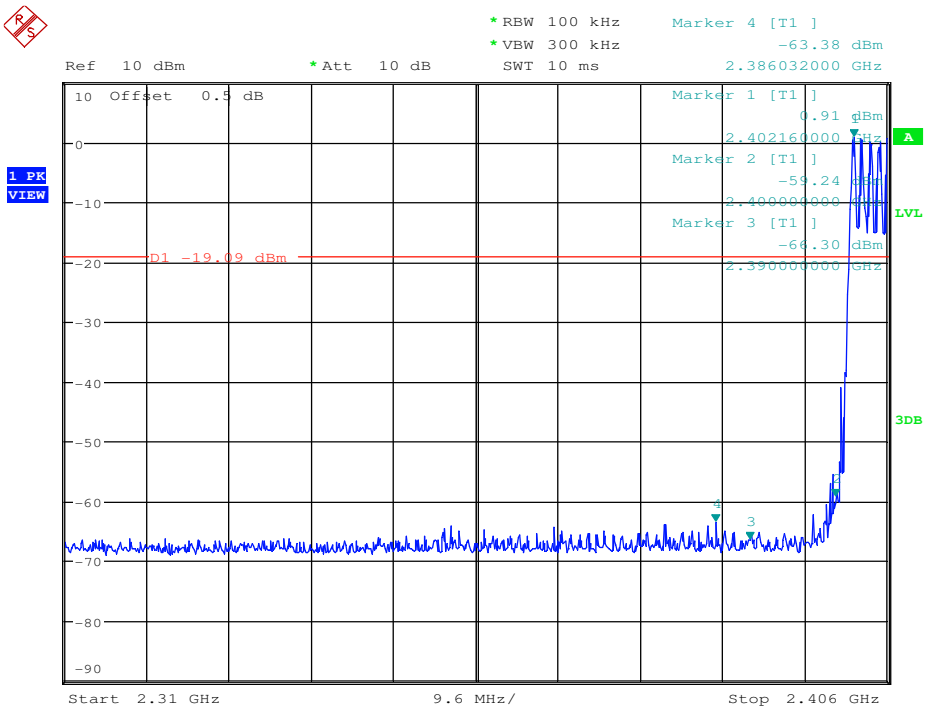
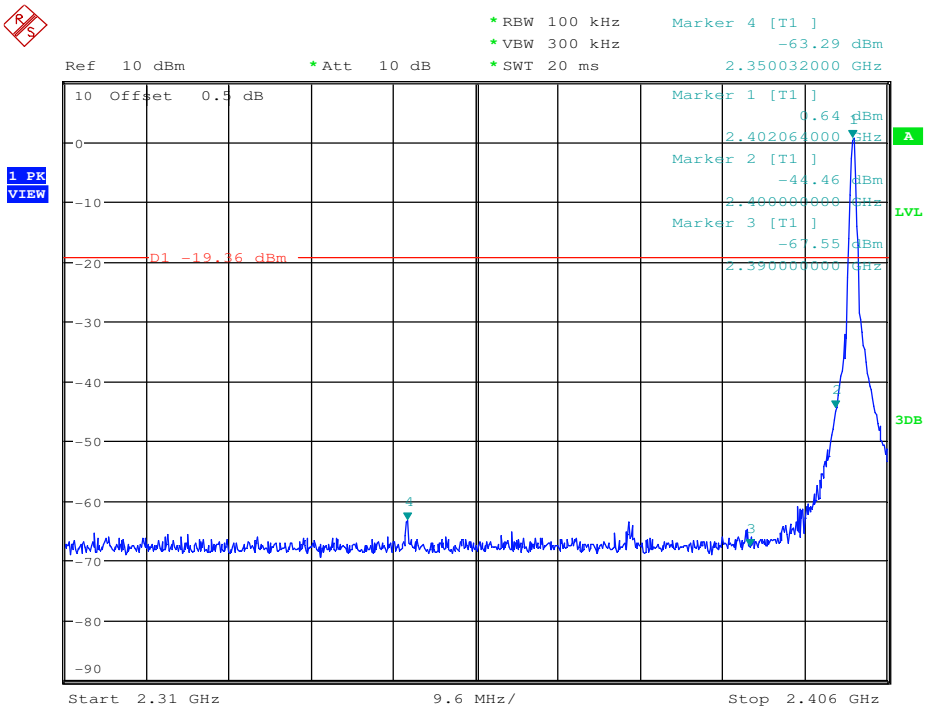
Band-edge for RF Conducted Emissions_DH5_2402_Hopping On




Band-edge for RF Conducted Emissions_DH5_2402_Hopping Off

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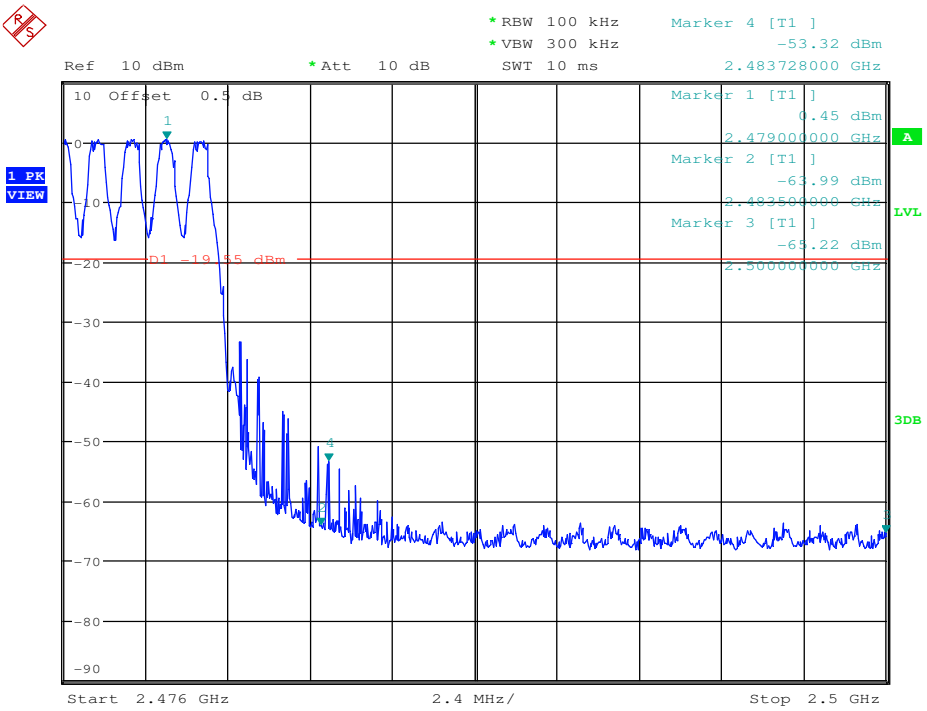
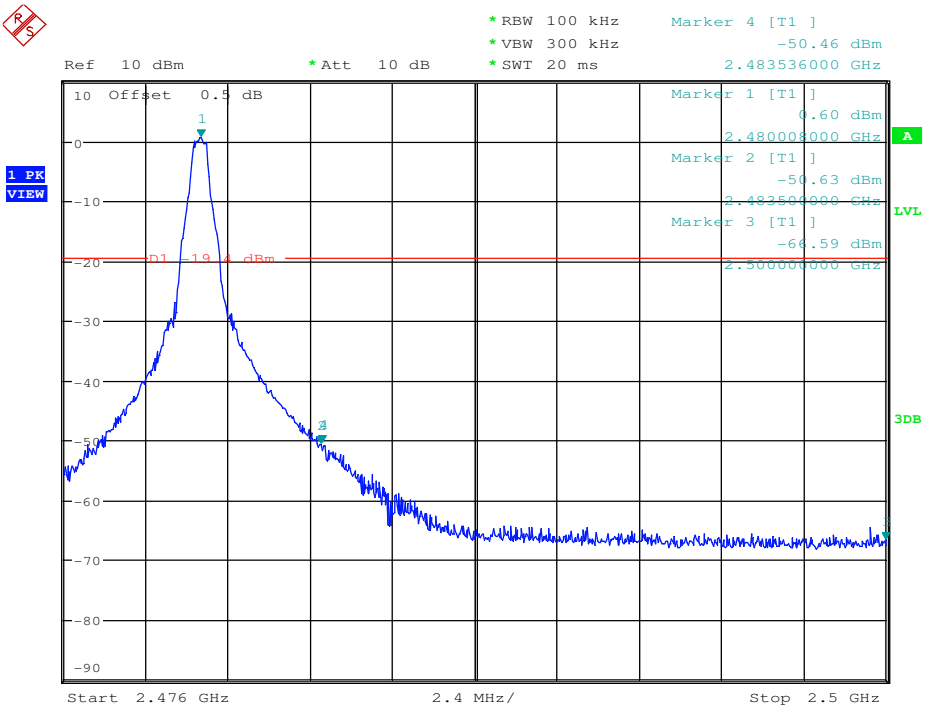
## Band-edge for RF Conducted Emissions_DH5_2480_Hopping On




## Band-edge for RF Conducted Emissions_DH5_2480_Hopping Off

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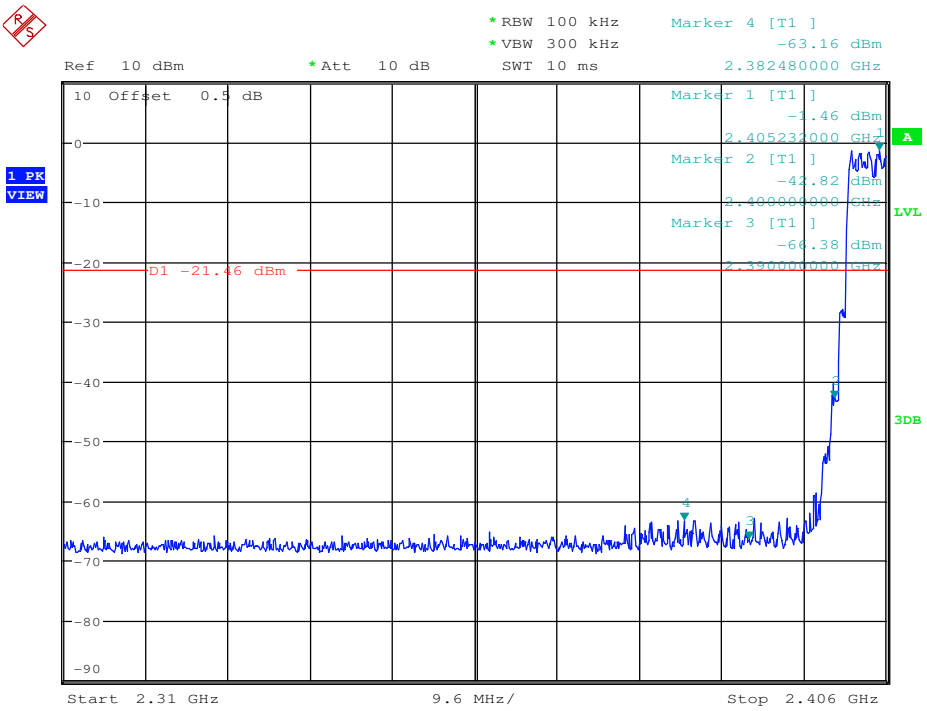
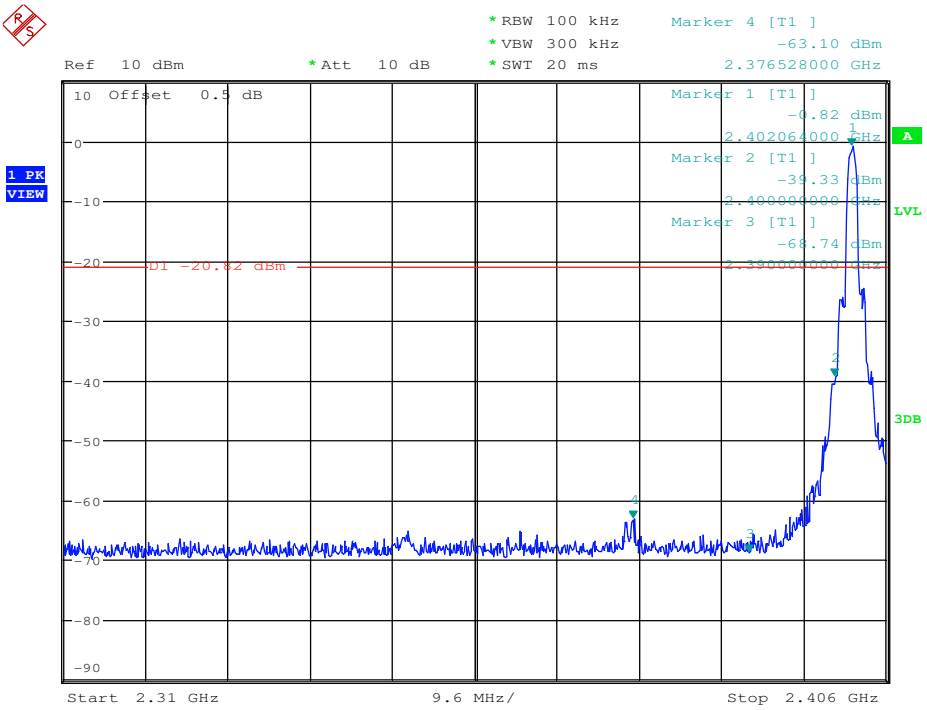



## Band-edge for RF Conducted Emissions_2DH5_2402_Hopping Off

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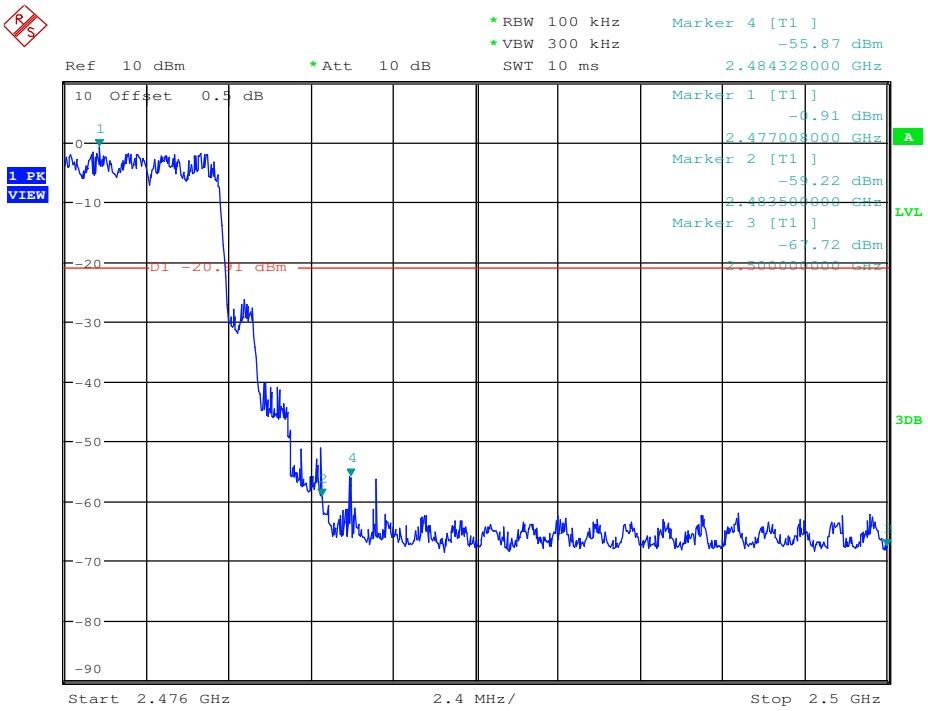


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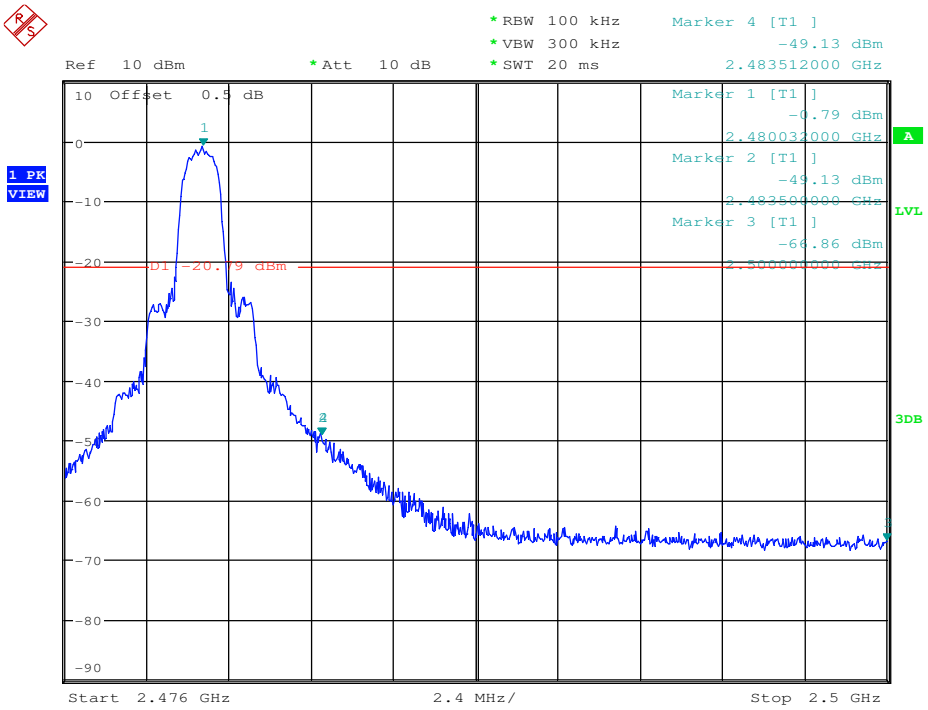


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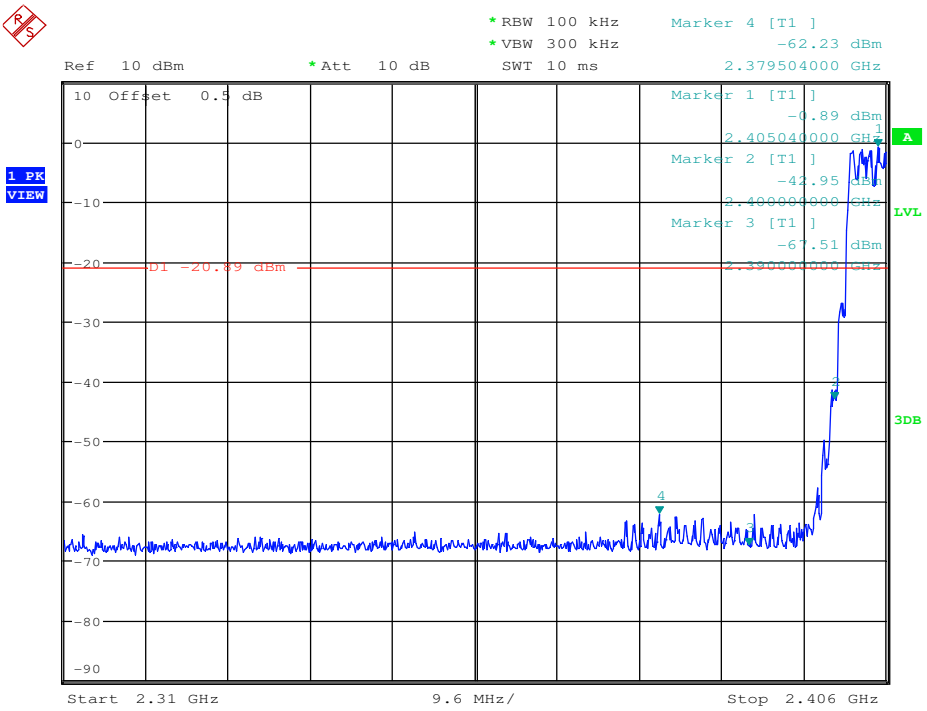
## Band-edge for RF Conducted Emissions_3DH5_2402_Hopping On

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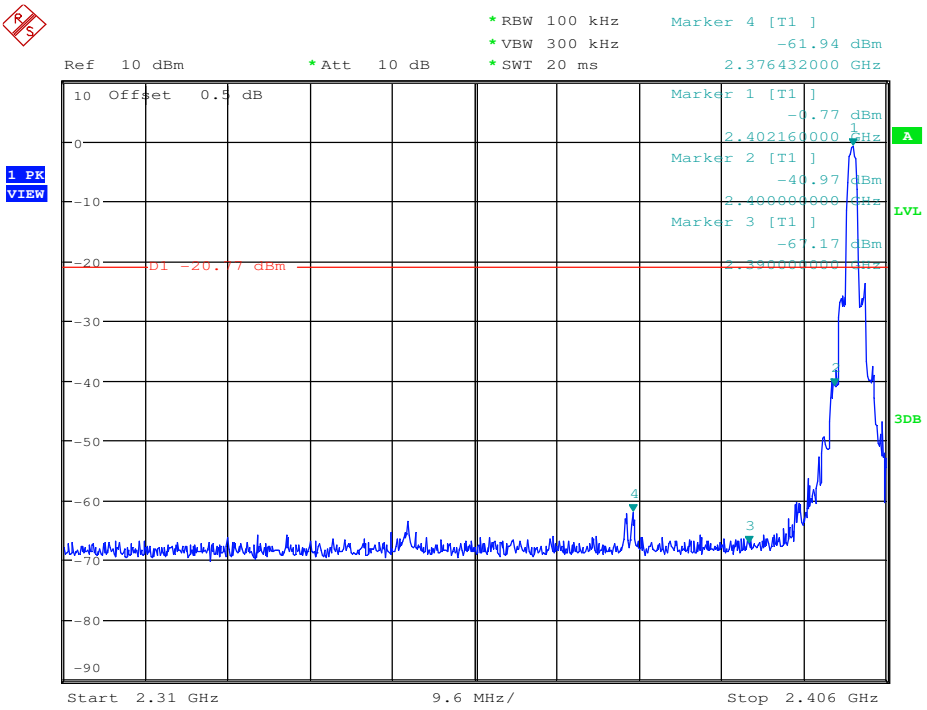


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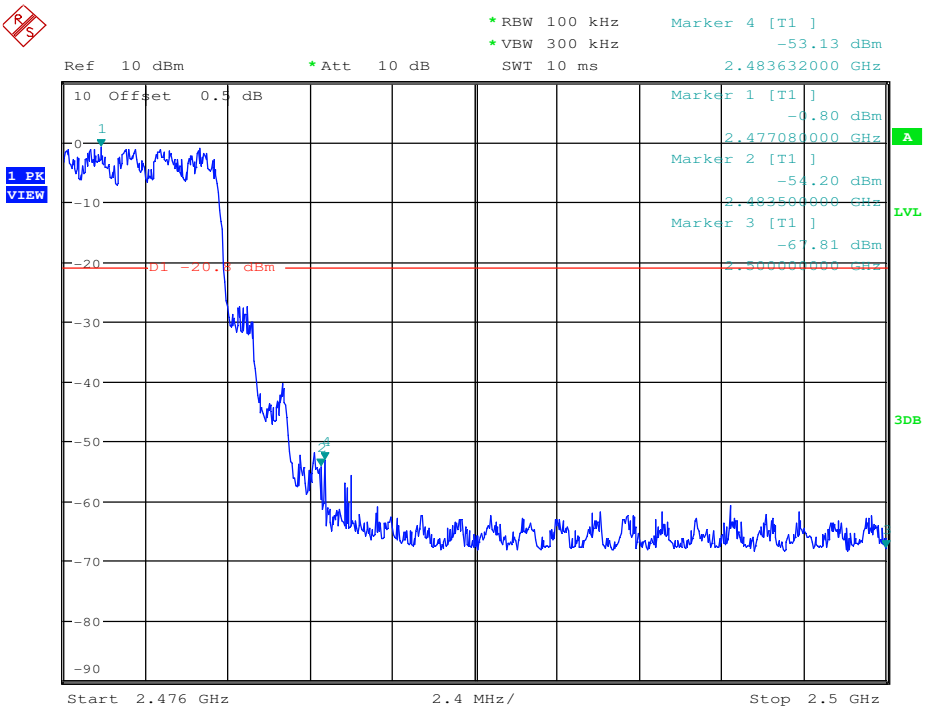
## Band-edge for RF Conducted Emissions_3DH5_2480_Hopping On

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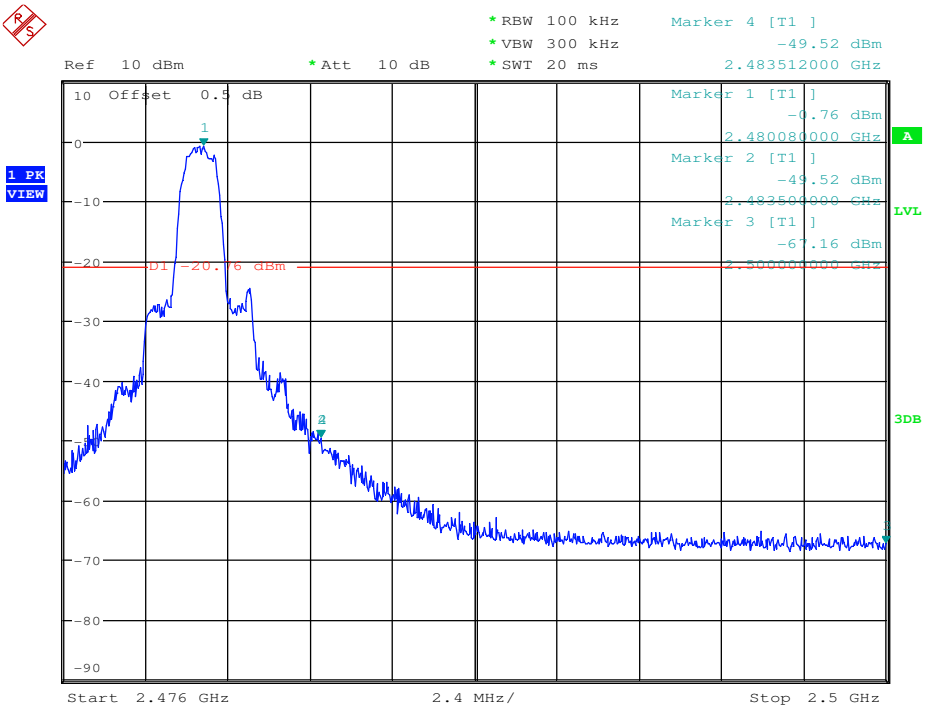


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**7.RF Conducted Spurious Emissions**

| Test Mode | Test Channel | StartFre [MHz] | StopFre [MHz] | RBW [kHz] | VBW [kHz] | Pref[dBm] | Max. Level [dBm] | Limit [dBm] | Verdict |
|---|---|---|---|---|---|---|---|---|---|
| DH5 | 2402 | 30 | 10000 | 1000 | 3000 | 0.61 | -43.230 | <-19.39 | PASS |
| DH5 | 2402 | 10000 | 25000 | 1000 | 3000 | 0.61 | -59.630 | <-19.39 | PASS |
| DH5 | 2441 | 30 | 10000 | 1000 | 3000 | 0.53 | -44.560 | <-19.47 | PASS |
| DH5 | 2441 | 10000 | 25000 | 1000 | 3000 | 0.53 | -57.090 | <-19.47 | PASS |
| DH5 | 2480 | 30 | 10000 | 1000 | 3000 | 0.64 | -45.570 | <-19.36 | PASS |
| DH5 | 2480 | 10000 | 25000 | 1000 | 3000 | 0.64 | -62.610 | <-19.36 | PASS |
| 2DH5 | 2402 | 30 | 10000 | 1000 | 3000 | -1.24 | -41.820 | <-21.24 | PASS |
| 2DH5 | 2402 | 10000 | 25000 | 1000 | 3000 | -1.24 | -57.460 | <-21.24 | PASS |
| 2DH5 | 2441 | 30 | 10000 | 1000 | 3000 | -0.89 | -43.630 | <-20.89 | PASS |
| 2DH5 | 2441 | 10000 | 25000 | 1000 | 3000 | -0.89 | -55.320 | <-20.89 | PASS |
| 2DH5 | 2480 | 30 | 10000 | 1000 | 3000 | -0.88 | -44.830 | <-20.88 | PASS |
| 2DH5 | 2480 | 10000 | 25000 | 1000 | 3000 | -0.88 | -61.230 | <-20.88 | PASS |
| 3DH5 | 2402 | 30 | 10000 | 1000 | 3000 | -0.83 | -41.110 | <-20.83 | PASS |
| 3DH5 | 2402 | 10000 | 25000 | 1000 | 3000 | -0.83 | -56.760 | <-20.83 | PASS |
| 3DH5 | 2441 | 30 | 10000 | 1000 | 3000 | -0.71 | -43.470 | <-20.71 | PASS |
| 3DH5 | 2441 | 10000 | 25000 | 1000 | 3000 | -0.71 | -55.040 | <-20.71 | PASS |
| 3DH5 | 2480 | 30 | 10000 | 1000 | 3000 | -0.85 | -44.230 | <-20.85 | PASS |
| 3DH5 | 2480 | 10000 | 25000 | 1000 | 3000 | -0.85 | -61.260 | <-20.85 | PASS |

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| RF Conducted Spurious Emissions_DH5_2402 | |
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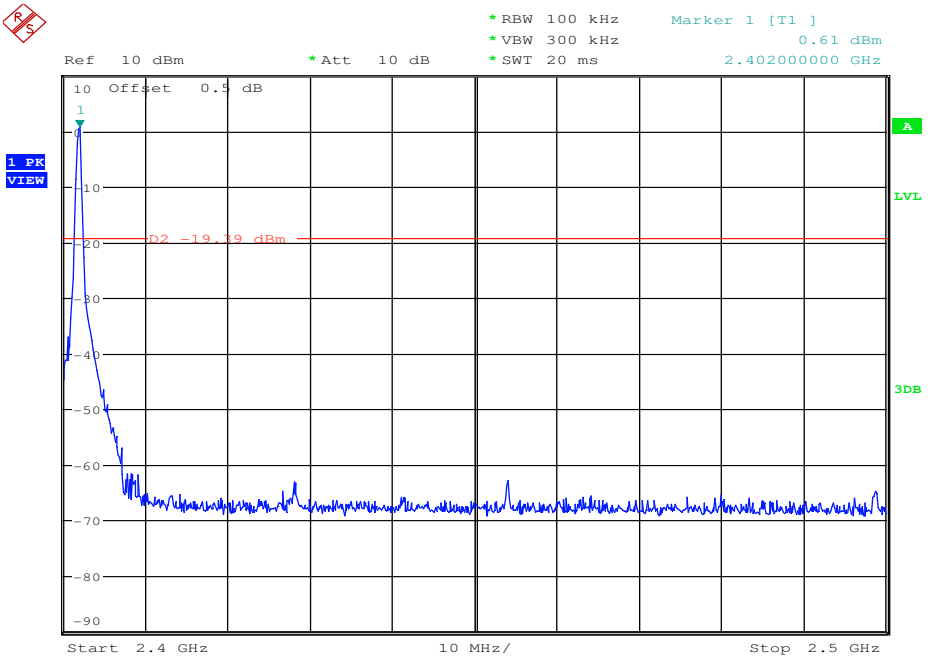
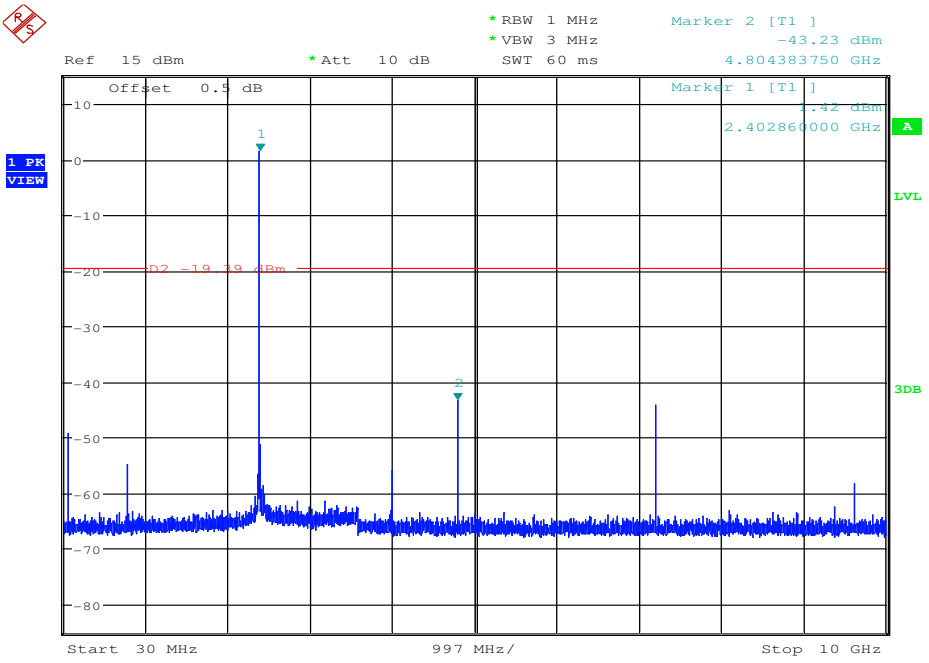
| Pref |  |
| CSE_1 |  |





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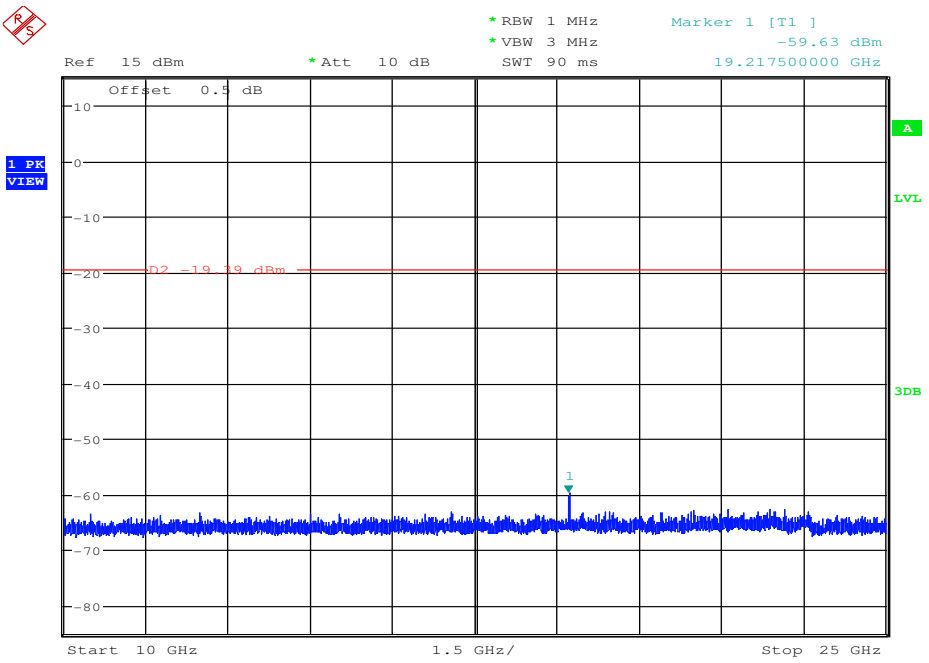
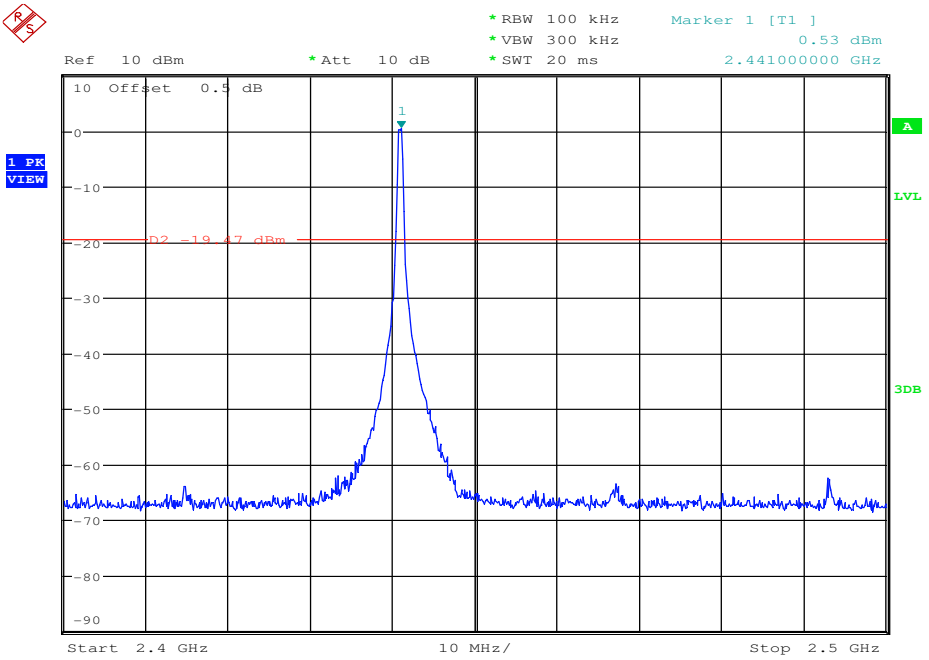
CSE_2




RF Conducted Spurious Emissions_DH5_2441

Pref

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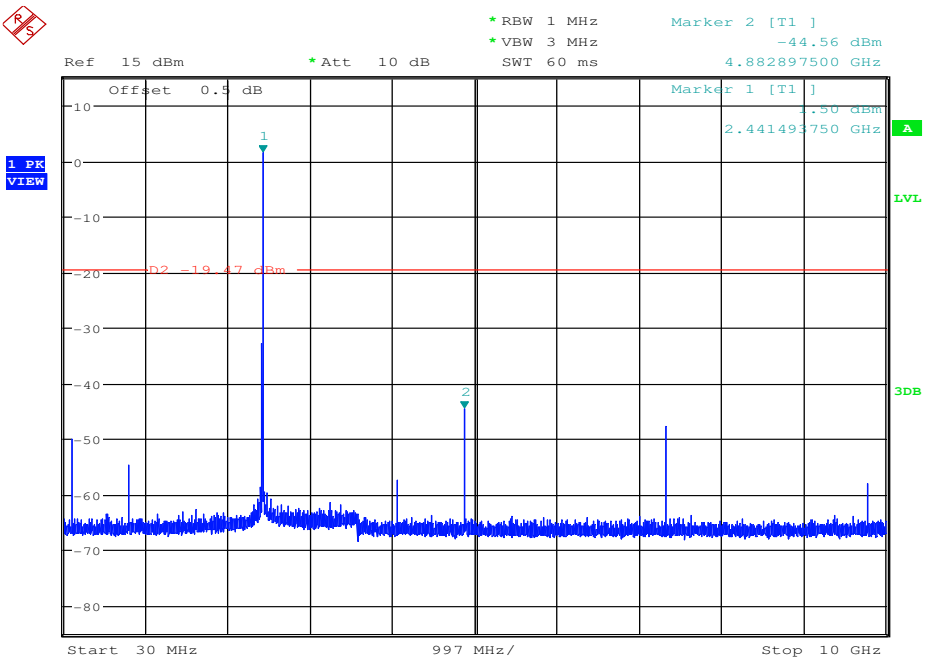
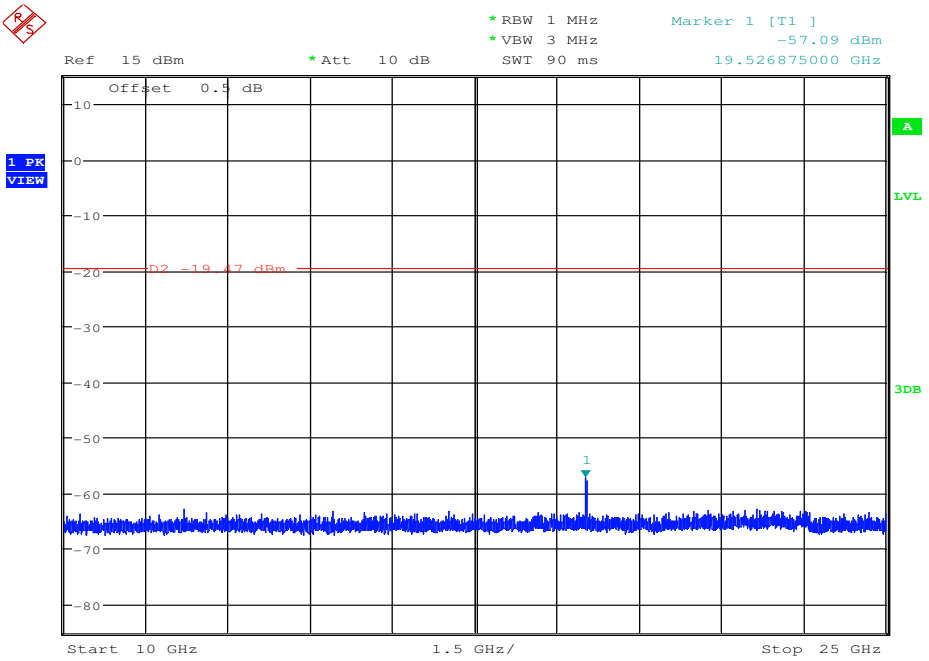
CSE_1




CSE_2

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| RF Conducted Spurious Emissions_DH5_2480 | |
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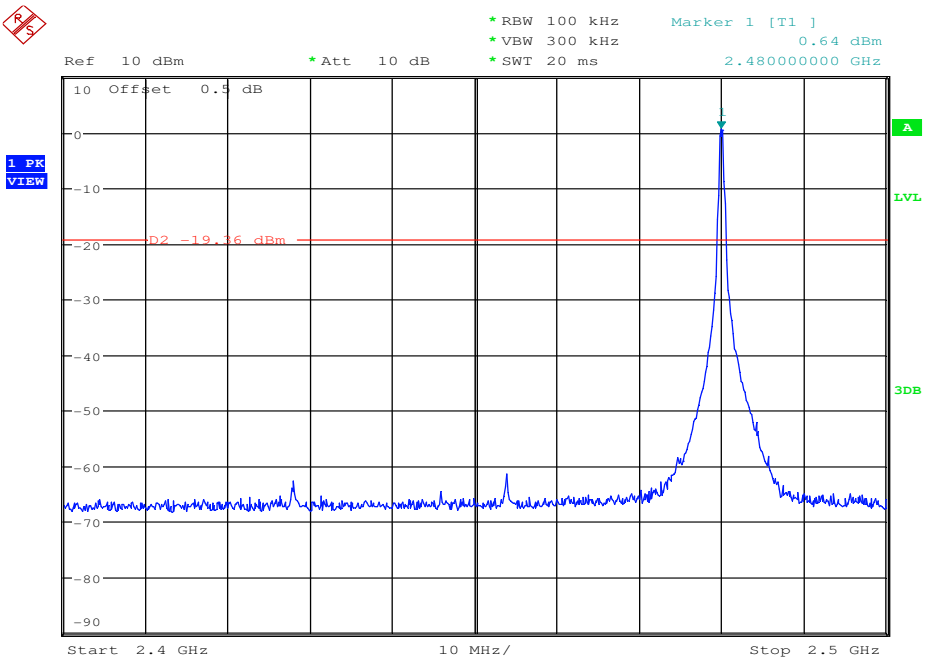
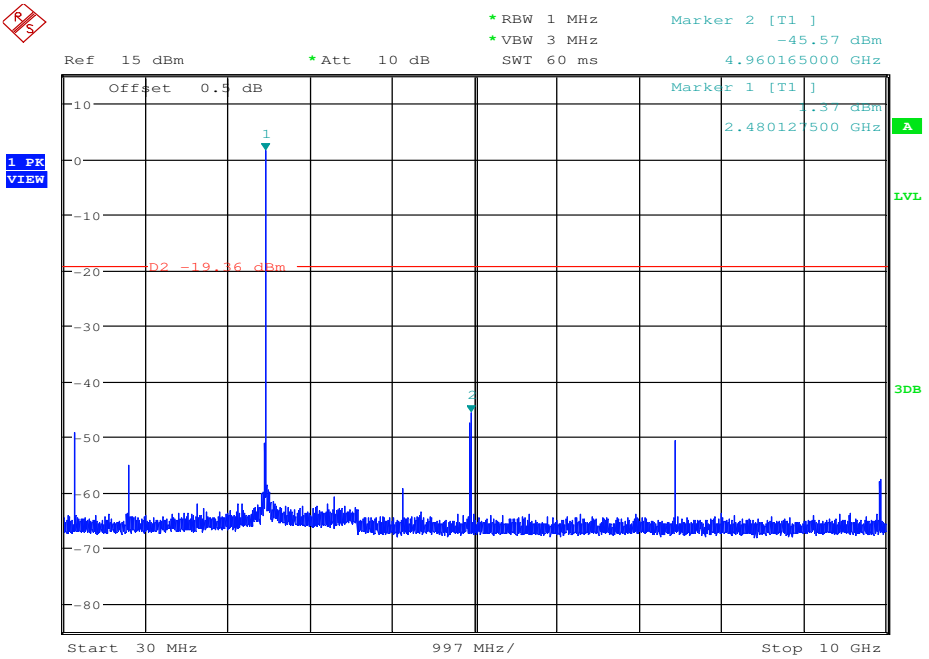
| Pref |  |
| CSE_1 |  |





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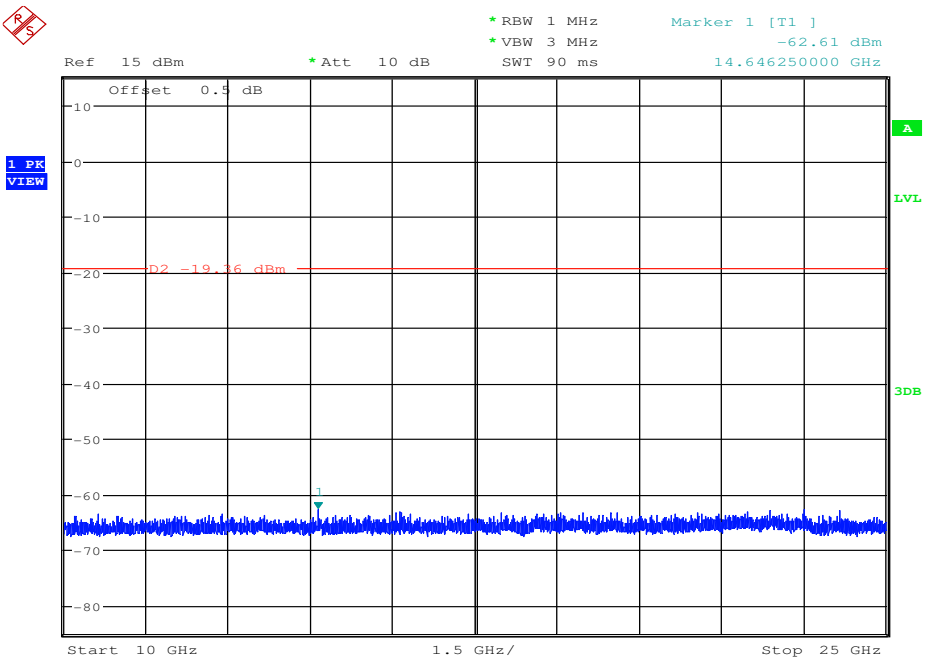
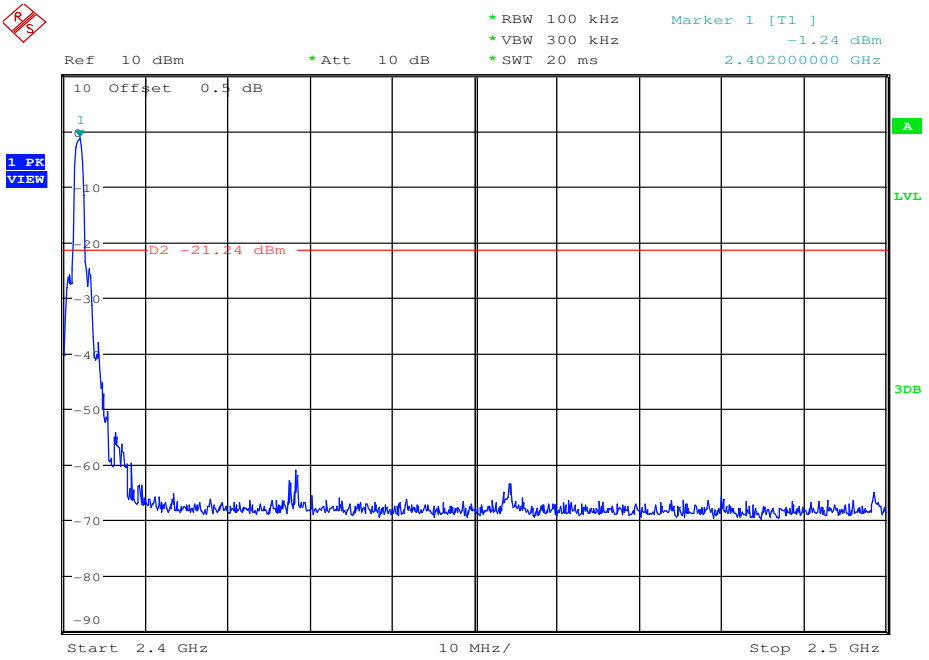
CSE_2




RF Conducted Spurious Emissions_2DH5_2402

Pref

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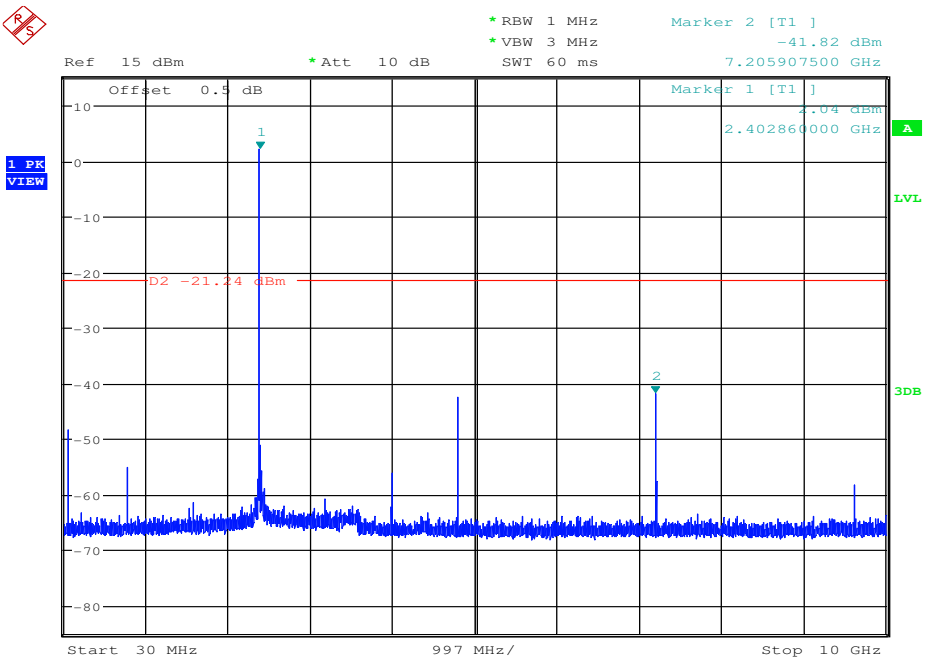
CSE_1

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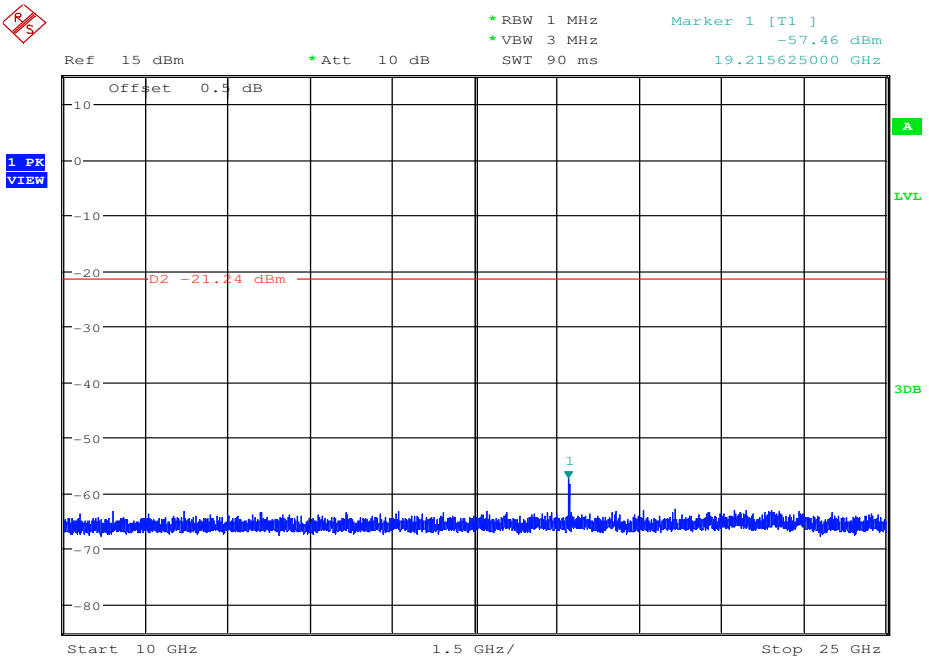


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| RF Conducted Spurious Emissions_2DH5_2441 | |
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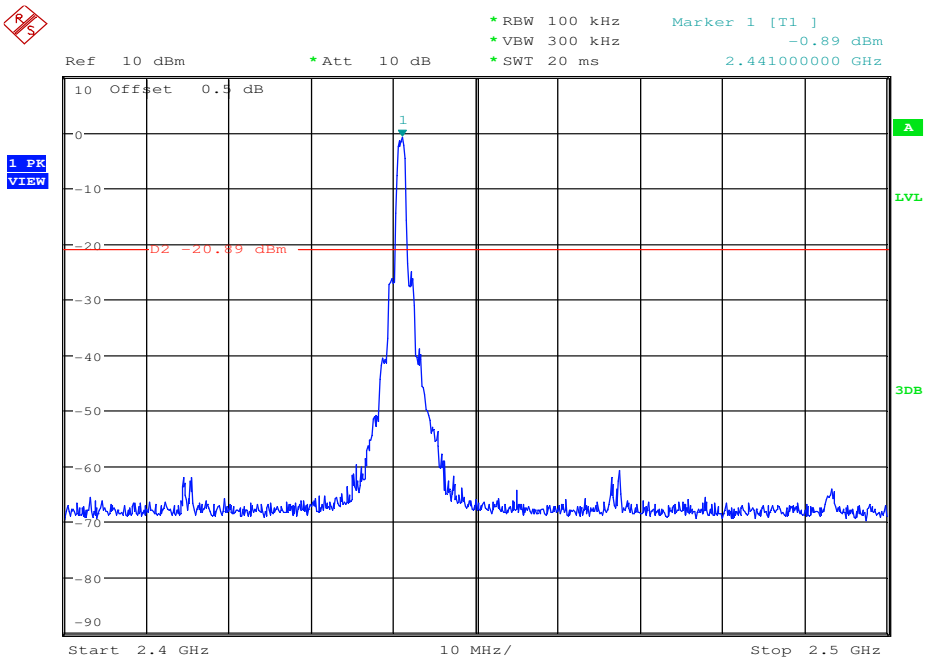
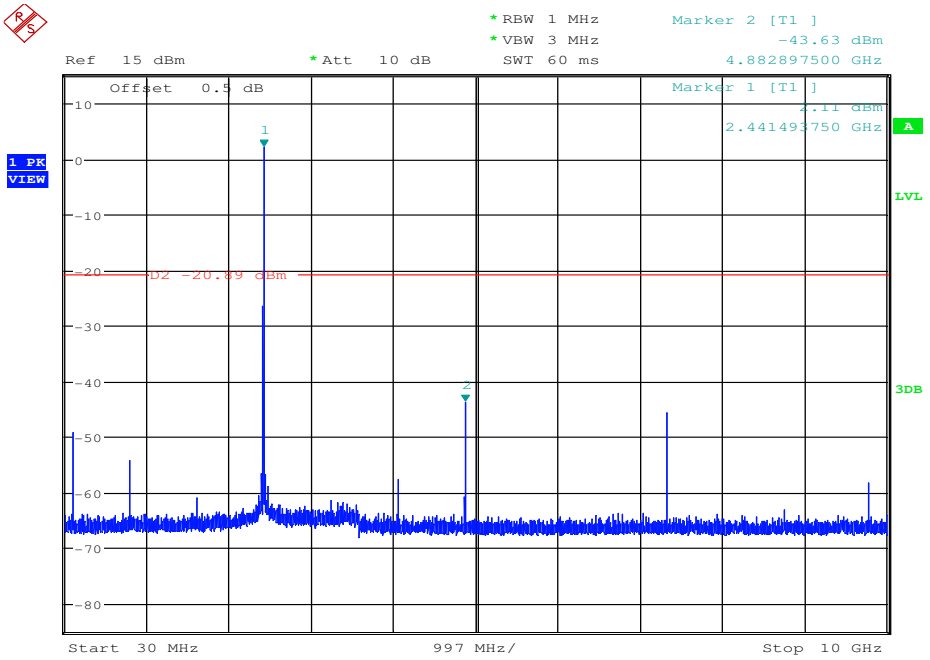
| Pref |  |
| CSE_1 |  |





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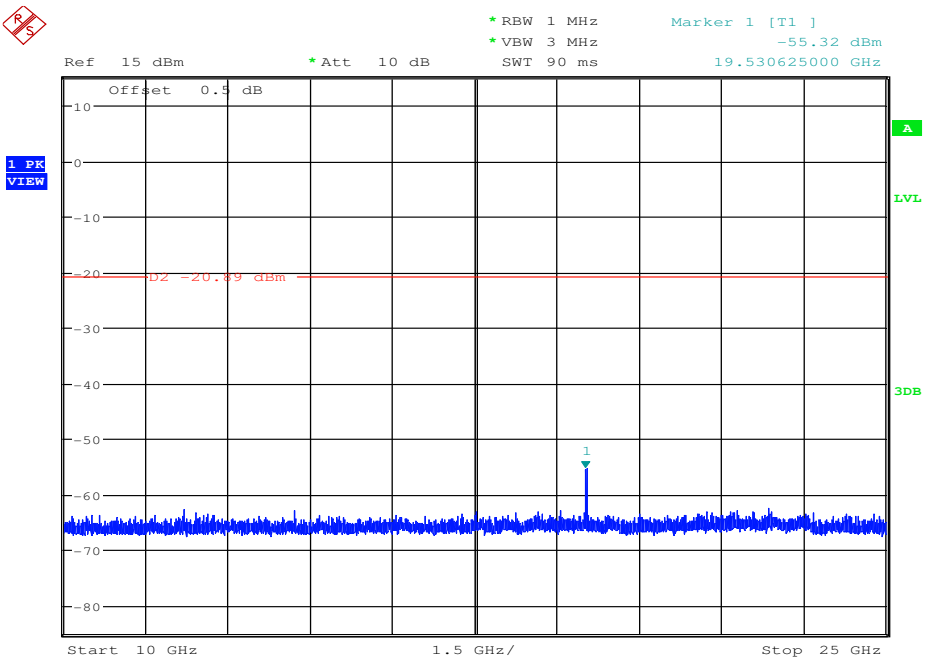


RF Conducted Spurious Emissions_2DH5_2480

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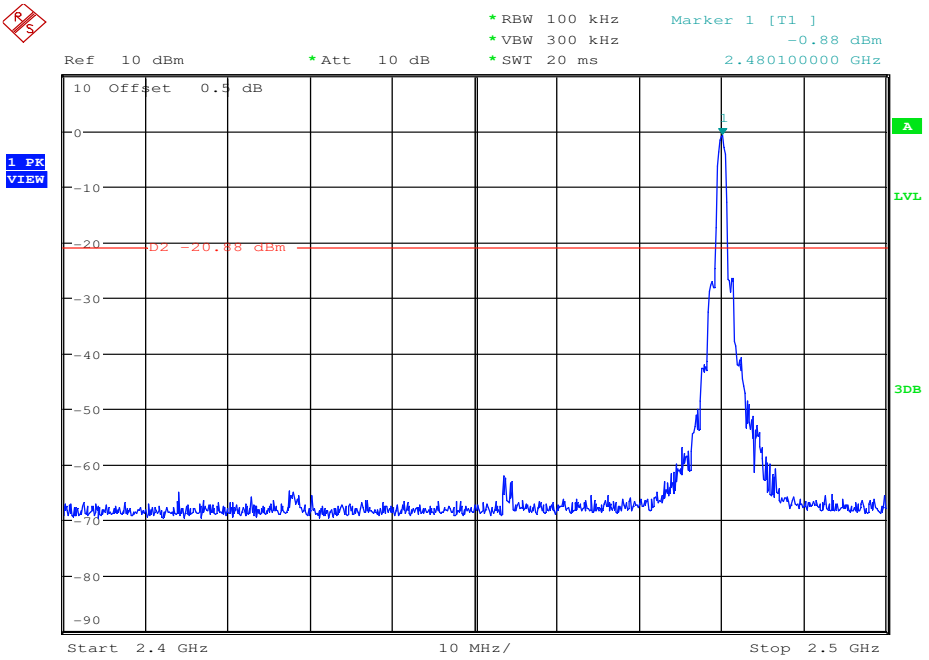


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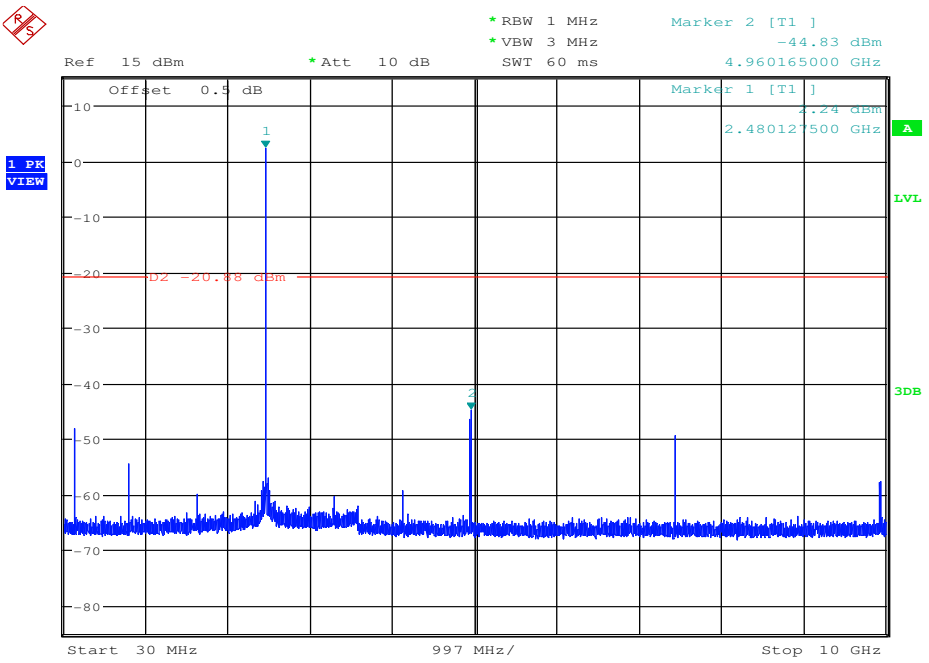


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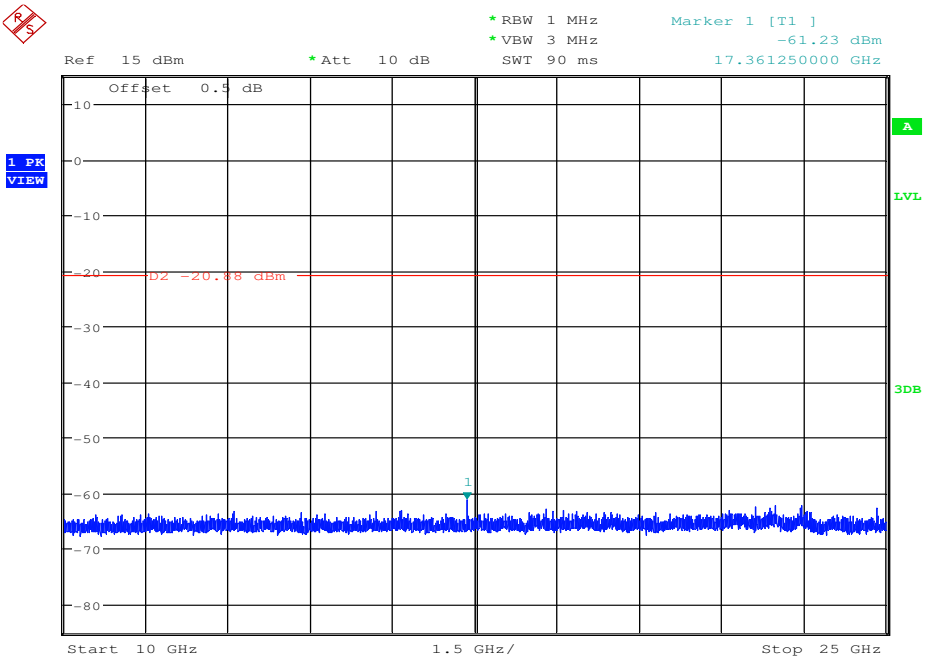


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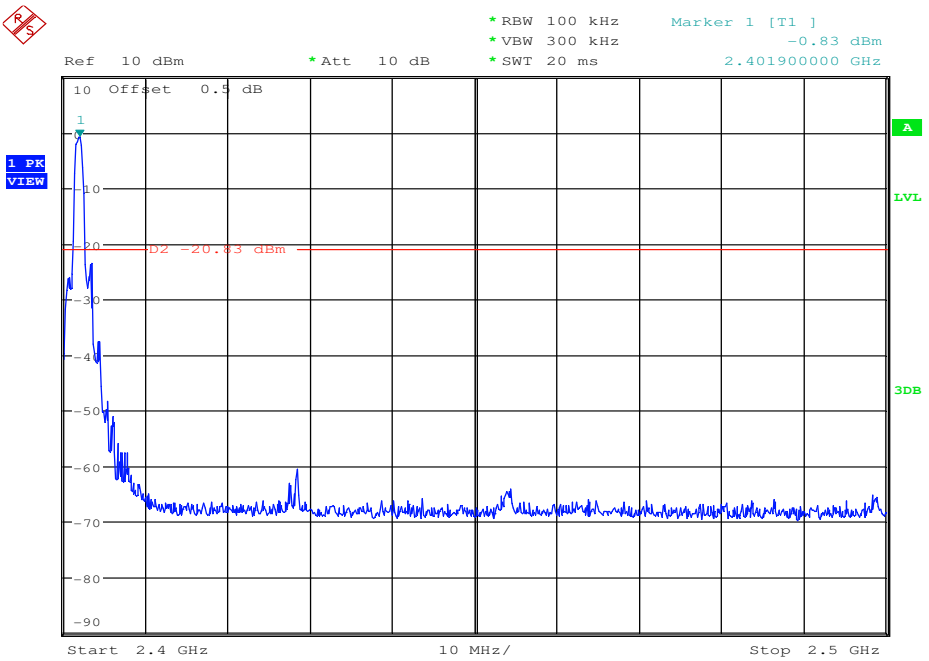
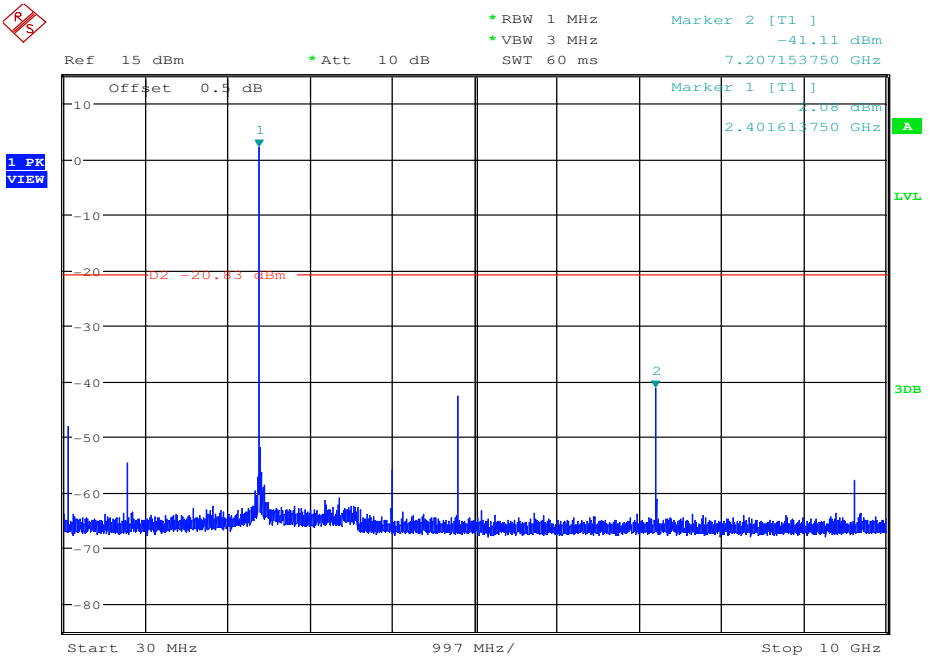
| Pref |  |
| CSE_1 |  |





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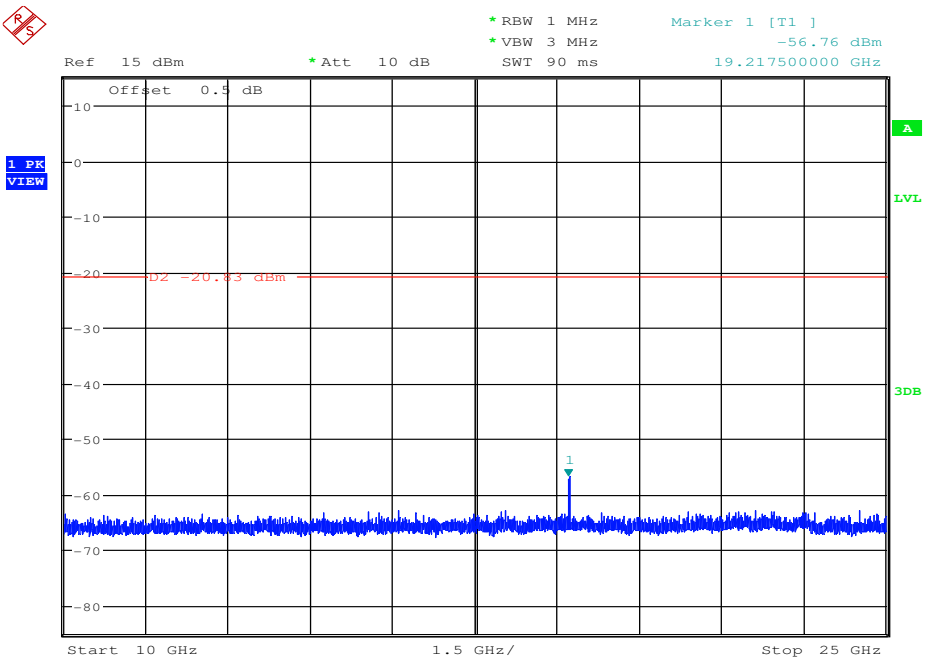
CSE_2

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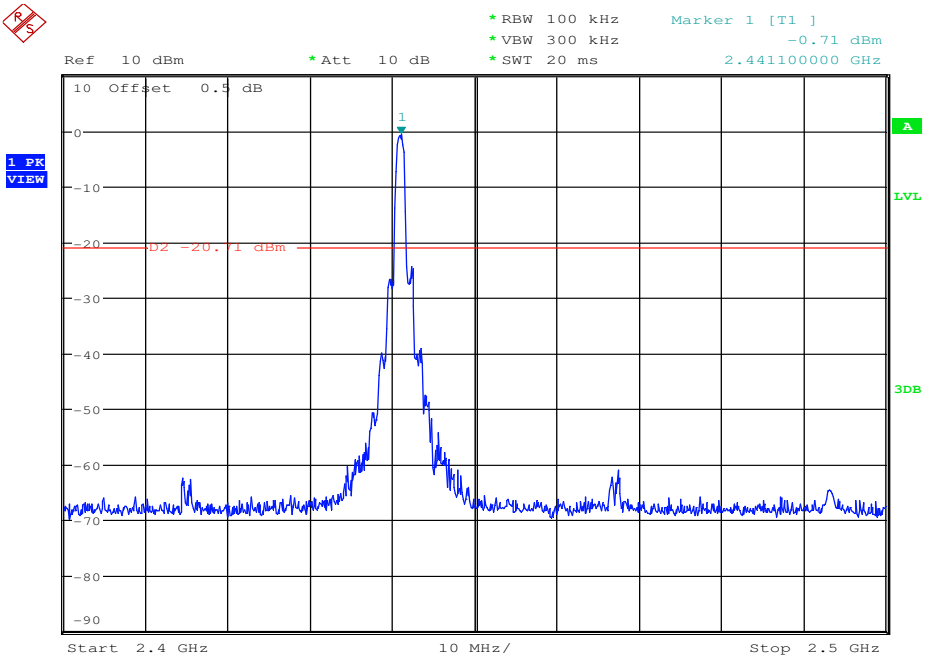


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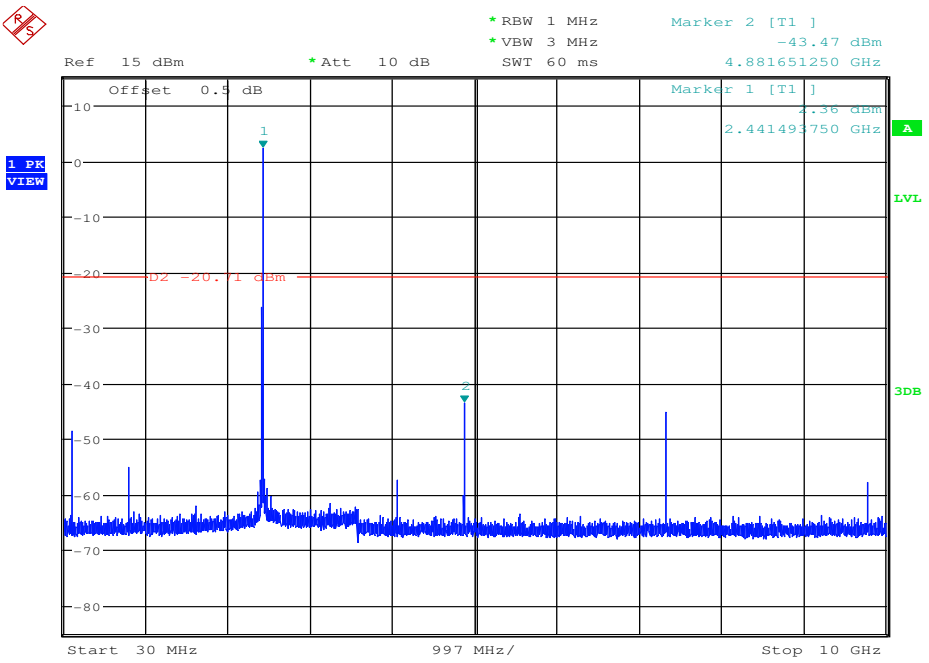


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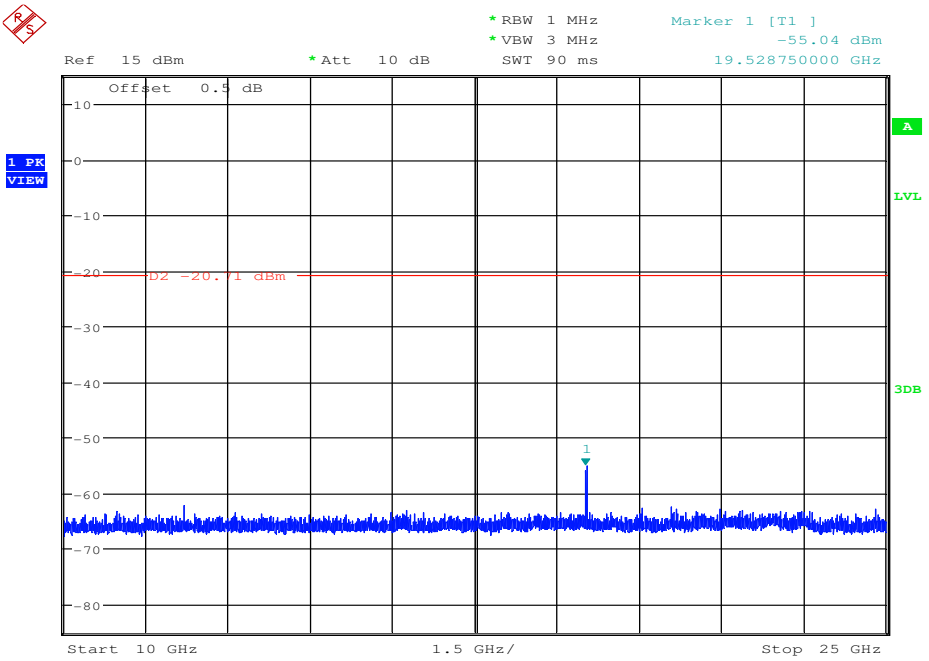


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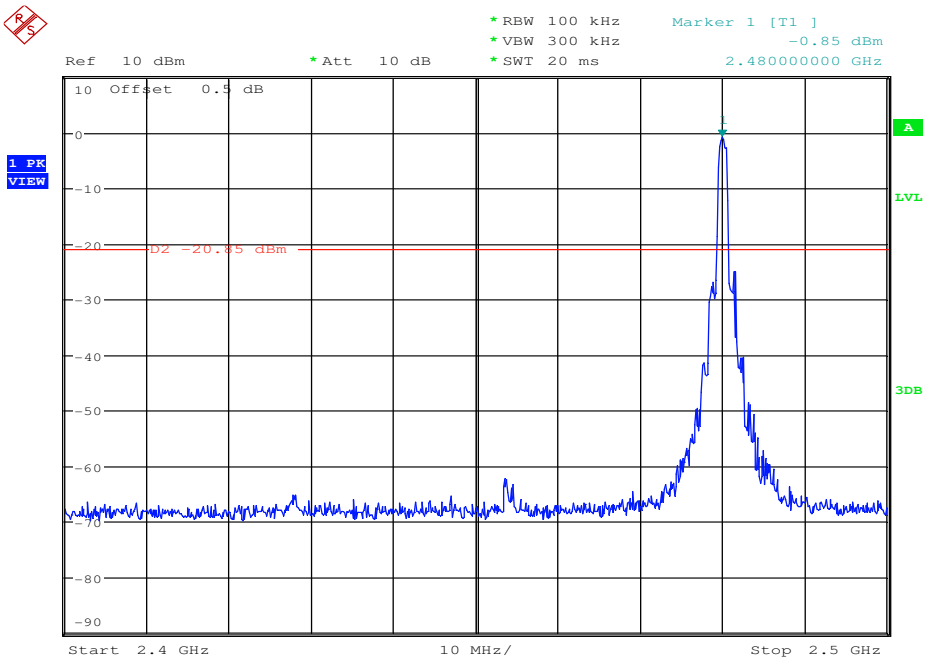
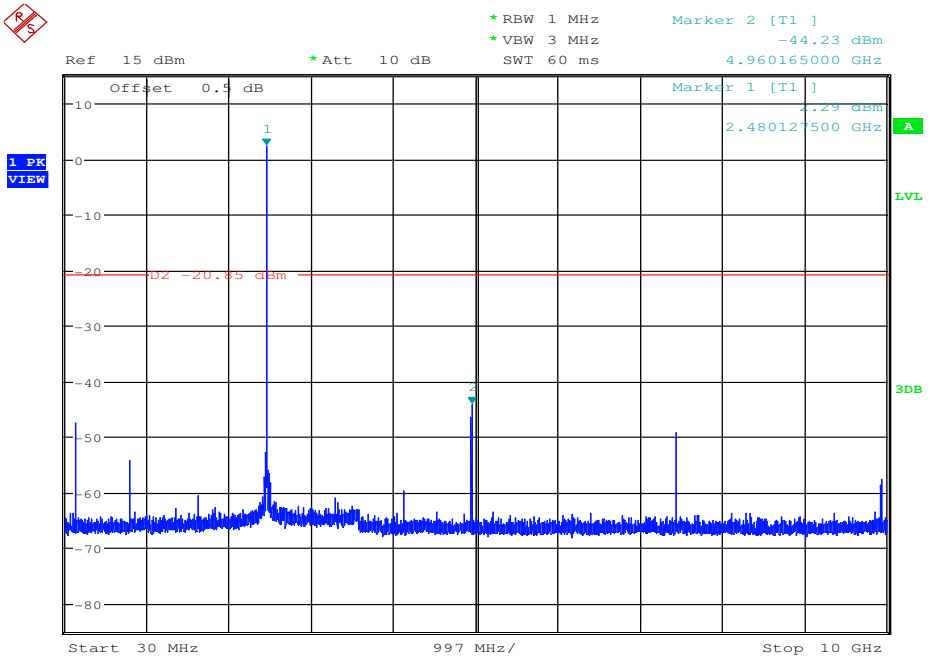
| Pref |  |
| CSE_1 |  |



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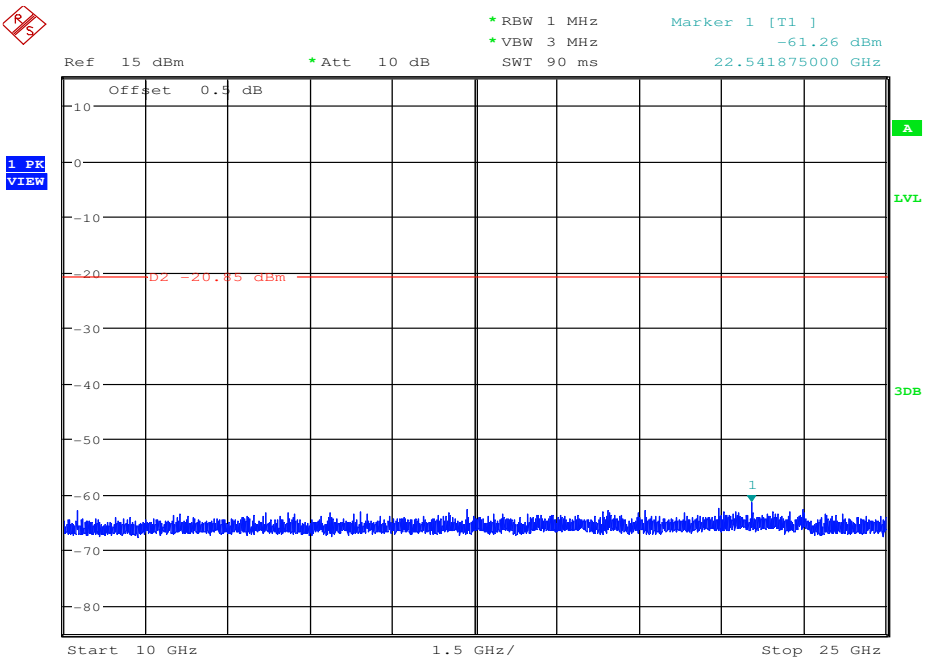
| CSE_2 |  |



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