# RF Test Report

## For

| | |
|---|---|
| **Applicant Name:** | Shenzhen Xinlongwei intelligent Technology Co., LTD |
| Address: | 4 / F, Building E, Xingguang Industrial Park, Shilong Community, Shiyan Street, Baoan District, Shenzhen |
| EUT Name: | wristband |
| Brand Name: | N/A |
| Model Number: | LH10 |
| Series Model Number: | LH8, LH9, LH17, LH18, LH19, LH20, LH21, LH22, LH23, LH25, LH26, LH28, LH29 |

## Issued By

| | |
|---|---|
| **Company Name:** | **BTF Testing Lab (Shenzhen) Co., Ltd.** |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Report Number: | BTF230703R00501 |
| Test Standards: | 47 CFR Part 15 Subpart C Section 15.247 |
| FCC ID: | 2BBTT-LH10 |
| Test Conclusion: | Pass |
| Test Date: | 2023-06-26 to 2023-07-05 |
| Date of Issue: | 2023-07-05 |
| Prepared By: | Elma.yang / Project Engineer |
| Date: | 2023-07-05 |
| Approved By: | Ryan.CJ / Manager |
| Date: | 2023-07-05 |

*Note: All the test results in this report only related to th[illegible] g sa[illegible]s. Which can [illegible]icate [illegible]ompletely for the legal use with approval of applicant; it shall not be reproduced except in full without the written approval of BTF Testing Lab (Shenzhen) Co., Ltd., All the objections should be raised within thirty days from the date of issue. To validate the report, you can contact us.*

| Revision History | | |
|---|---|---|
| Version | Issue Date | Revisions Content |
| R_V0 | July 05th 2023 | Original |
| | | |
| *Note:* | *Once the revision has been made, then previous versions reports are invalid.* | |

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BTF Testing Lab (Shenzhen) Co., Ltd.
F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China

# 1. Introduction

## 1.1 Identification of Testing Laboratory

| | |
|---|---|
| Company Name: | BTF Testing Lab (Shenzhen) Co., Ltd. |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Phone Number: | +86-0755-23146130 |
| Fax Number: | +86-0755-23146130 |

## 1.2 Identification of the Responsible Testing Location

| | |
|---|---|
| Test Location: | BTF Testing Lab (Shenzhen) Co., Ltd. |
| Address: | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Description: | All measurement facilities used to collect the measurement data are located at F101,201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| FCC Registration Number: | 518915 |
| Designation Number: | CN1330 |

## 1.3 Laboratory Condition

| | |
|---|---|
| Ambient Temperature: | 20℃ to 25℃ |
| Ambient Relative Humidity: | 45% to 55% |
| Ambient Pressure: | 100 kPa to 102 kPa |

## 1.4 Announcement

(1) The test report reference to the report template version v0.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.

(5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

(6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

# 2. Product Information

## 2.1 Application Information

| | |
|---|---|
| Company Name: | Shenzhen Xinlongwei intelligent Technology Co., LTD |
| Address: | 4 / F, Building E, Xingguang Industrial Park, Shilong Community, Shiyan Street, Baoan District, Shenzhen |

## 2.2 Manufacturer Information

| | |
|---|---|
| Company Name: | Shenzhen Xinlongwei intelligent Technology Co., LTD |
| Address: | 4 / F, Building E, Xingguang Industrial Park, Shilong Community, Shiyan Street, Baoan District, Shenzhen |

## 2.3 Factory Information

| | |
|---|---|
| Company Name: | Shenzhen Xinlongwei intelligent Technology Co., LTD |
| Address: | 4 / F, Building E, Xingguang Industrial Park, Shilong Community, Shiyan Street, Baoan District, Shenzhen |

## 2.4 General Description of Equipment under Test (EUT)

| | |
|---|---|
| EUT Name | wristband |
| Under Test Model Name | LH10 |
| Series Model Name | LH8, LH9, LH17, LH18, LH19, LH20, LH21, LH22, LH23, LH25, LH26, LH28, LH29 |
| Description of Model name differentiation | All the same except model number |
| Hardware Version | V1.0 |
| Software and Firmware Version | V1.0 |



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## 2.5 Technical Information

| | |
|---|---|
| Modulation Technology | FHSS |
| Modulation Type | GFSK, π/4-DQPSK, 8-DPSK |
| Product Type | ☐ Mobile<br>☒ Portable<br>☐ Fixed Location |
| Transfer Rate | DH5: 1 Mbps<br>2DH5: 2 Mbps<br>3DH5: 3 Mbps |
| Frequency Range | The frequency range used is 2402 MHz – 2480 MHz;<br>The frequency block is 2400 MHz to 2483.5 MHz. |
| Number of Channel | 79 (at intervals of 1 MHz) |
| Tested Channel | 0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz) |
| Antenna Type | Internal Antenna |
| Antenna Gain# | 0.5 dBi |
| Antenna Impedance | 50Ω |
| Antenna System<br>(MIMO Smart Antenna) | N/A |

Note:

#: The antenna gain provided by the applicant, and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant.



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All channel was listed on the following table:

| Channel number | Freq. (MHz) | Channel number | Freq. (MHz) | Channel number | Freq. (MHz) | Channel number | Freq. (MHz) |
|---|---|---|---|---|---|---|---|
| **0** | **2402** | 21 | 2423 | 42 | 2444 | 63 | 2465 |
| 1 | 2403 | 22 | 2424 | 43 | 2445 | 64 | 2466 |
| 2 | 2404 | 23 | 2425 | 44 | 2446 | 65 | 2467 |
| 3 | 2405 | 24 | 2426 | 45 | 2447 | 66 | 2468 |
| 4 | 2406 | 25 | 2427 | 46 | 2448 | 67 | 2469 |
| 5 | 2407 | 26 | 2428 | 47 | 2449 | 68 | 2470 |
| 6 | 2408 | 27 | 2429 | 48 | 2450 | 69 | 2471 |
| 7 | 2409 | 28 | 2430 | 49 | 2451 | 70 | 2472 |
| 8 | 2410 | 29 | 2431 | 50 | 2452 | 71 | 2473 |
| 9 | 2411 | 30 | 2432 | 51 | 2453 | 72 | 2474 |
| 10 | 2412 | 31 | 2433 | 52 | 2454 | 73 | 2475 |
| 11 | 2413 | 32 | 2434 | 53 | 2455 | 74 | 2476 |
| 12 | 2414 | 33 | 2435 | 54 | 2456 | 75 | 2477 |
| 13 | 2415 | 34 | 2436 | 55 | 2457 | 76 | 2478 |
| 14 | 2416 | 35 | 2437 | 56 | 2458 | 77 | 2479 |
| 15 | 2417 | 36 | 2438 | 57 | 2459 | **78** | **2480** |
| 16 | 2418 | 37 | 2439 | 58 | 2460 | - | - |
| 17 | 2419 | 38 | 2440 | 59 | 2461 | - | - |
| 18 | 2420 | **39** | **2441** | 60 | 2462 | - | - |
| 19 | 2421 | 40 | 2442 | 61 | 2463 | - | - |
| 20 | 2422 | 41 | 2443 | 62 | 2464 | - | - |



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# 3. Summary of Test Results

## 3.1 Test Standards

| No. | Identity | Document Title |
|---|---|---|
| 1 | 47 CFR Part 15 Subpart C Section 15.247 | Intentional Radiators |
| 2 | ANSI C63.10-2013 | American National Standard for Testing Unlicensed Wireless Devices |
| 3 | KDB 558074 D01 15.247 Meas Guidance v05r02 | Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules |



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## 3.2 Summary of Test Result

| No. | Description | FCC Part No. | Channel | Test Result | Verdict | Remark |
|---|---|---|---|---|---|---|
| 1 | Antenna Requirement | 15.203 | N/A | -- | Pass | -- |
| 2 | Number of Hopping Frequencies | 15.247(a) | Hopping Mode | ANNEX A.1 | Pass | -- |
| 3 | Peak Output Power | 15.247(b) | Low/Middle/High | ANNEX A.2 | Pass | -- |
| 4 | Occupied Bandwidth | 15.247(a) | Low/Middle/High | ANNEX A.3 | Pass | -- |
| 5 | Carrier Frequency Separation | 15.247(a) | Hopping Mode | ANNEX A.4 | Pass | -- |
| 6 | Time of Occupancy (Dwell time) | 15.247(a) | Hopping Mode | ANNEX A.5 | Pass | -- |
| 7 | Conducted Spurious Emission & Authorized-band band-edge | 15.247(d) | Low/High | ANNEX A.6 | Pass | -- |
| 8 | Conducted Emission | 15.207 | Low/Middle/High | ANNEX A.7 | Pass | -- |
| 9 | Radiated Spurious Emission | 15.209<br>15.247(d) | Low/Middle/High | ANNEX A.8 | Pass | -- |
| 10 | Band Edge (Restricted-band band-edge) | 15.209<br>15.247(d) | Low/High | ANNEX A.9 | Pass | -- |



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## 3.3 Uncertainty of Test

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2 and TR100 028-1/-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| Measurement | Value |
|---|---|
| Occupied Channel Bandwidth | 69 KHz |
| RF output power, conducted | 0.87 dB |
| Unwanted Emissions, conducted | 0.94 dB |
| All emissions, radiated(<1GHz) | 4.12 dB |
| All emissions, radiated(>1GHz) | 4.16 dB |
| Temperature | 0.82 °C |
| Humidity | 4.1 % |



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# 4. Test Configuration

## 4.1 Environment Condition

| Environment Parameter | Selected Values During Tests | | | |
|---|---|---|---|---|
| | Temperature | Voltage | Relative Humidity | Ambient Pressure |
| Normal Temperature, Normal Voltage (NTNV) | 20°C to 25°C | DC 3.7V from battery | 30% to 60% | 100 kPa to 102 kPa |

## 4.2 Test Equipment List

| Conducted Method Test | | | | | | |
|---|---|---|---|---|---|---|
| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due | Use |
| MXA Signal Analyzer | KEYSIGHT | N9020A | MY50410020 | 2022.11.24 | 2023.11.23 | ☒ |
| WIDEBAND RADIO COMMNUNICATION TESTER | Rohde & Schwarz | CMW500 | 161997 | 2022.11.24 | 2023.11.23 | ☒ |
| ESG VECTOR SIGNAL GENERATOR | Agilent | E4438C | MY45094854 | 2022.11.24 | 2023.11.23 | ☒ |
| MXG Vector Signal Generator | Agilent | N5182A | MY46240163 | 2022.11.24 | 2023.11.23 | ☒ |
| Adjustable Direct Current Regulated Power Supply | Dongguan Tongmen Electronic Technology Co., LTD | etm-6050c | 20211026123 | 2022.11.25 | 2023.11.24 | ☒ |
| Programmable constant temperature and humidity box | ZZCKONG | ZZ-K02A | 20210928007 | 2022.11.24 | 2023.11.23 | ☒ |
| RF Control Unit | TST | TST-Full | S01 | / | / | ☒ |
| RF Test software | TST | V2.0 | / | / | / | ☒ |

| Radiated Method Test | | | | | | |
|---|---|---|---|---|---|---|
| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due | Use |
| SIGNAL ANALYZER | ROHDE&SCHWARZ | FSQ40 | 100010 | 2022.11.24 | 2023.11.23 | ☒ |
| EMI TEST RECEIVER | ROHDE&SCHWARZ | ESCI7 | 101032 | 2022.11.24 | 2023.11.23 | ☒ |
| Log periodic antenna | SCHWARZBECK | VULB 9168 | 01328 | 2021.11.28 | 2023.11.27 | ☒ |
| Horn Antenna | SCHWARZBECK | BBHA9170 | 01157 | 2021.11.28 | 2023.11.27 | ☒ |
| POSITIONAL CONTROLLER | SKET | PCI-GPIB | / | / | / | ☒ |
| RE Cable | REBES Talent | UF2-NMNM-10m | 21101570 | 2022.11.24 | 2023.11.23 | ☒ |
| RE Cable | REBES Talent | UF2-NMNM-2.5m | 21101573 | 2022.11.24 | 2023.11.23 | ☒ |



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| | | | | | | |
|---|---|---|---|---|---|---|
| RE Cable | REBES Talent | UF2-NMNM-1m | 21101576 | 2022.11.24 | 2023.11.23 | ☒ |
| Coaxial cable Multiflex 141 | Schwarzbeck | N/SMA 0.5m | 517386 | 2023.3.24 | 2024.3.23 | ☒ |
| RE Cable | Talent Microwave | A40-2.92M2.92 M-14M | 22080539 | 2022.11.24 | 2023.11.23 | ☒ |
| RE Cable | Talent Microwave | A81-SMAMNM-14M | 22080538 | 2022.11.24 | 2023.11.23 | ☒ |
| Preamplifier | SCHWARZBECK | BBV9744 | 00246 | 2022.11.24 | 2023.11.23 | ☒ |
| Horn Antenna | Schwarzbeck | BBHA9120D | 2597 | 2022.5.22 | 2024.5.21 | ☒ |
| Broadband Preamplilifier | Schwarzbeck | BBV9718D | 00008 | 2023.3.24 | 2024.3.23 | ☒ |

| Conducted disturbance Test | | | | | | |
|---|---|---|---|---|---|---|
| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due | Use |
| EMI Receiver | ROHDE&SCHWARZ | ESCI3 | 101422 | 2022.11.24 | 2023.11.23 | ☒ |
| V-LISN | SCHWARZBECK | NSLK 8127 | 01073 | 2022.11.24 | 2023.11.23 | ☒ |
| LISN | AFJ | LS16/110VAC | 16010020076 | 2022.11.24 | 2023.11.23 | ☒ |
| Coaxial Switcher | SCHWARZBECK | CX210 | CX210 | 2022.11.24 | 2023.11.23 | ☒ |
| Pulse Limiter | SCHWARZBECK | VTSD 9561-F | 00953 | 2022.11.24 | 2023.11.23 | ☒ |
| EZ_EMC | Frad | EMC-CON 3A1.1+ | / | / | / | ☒ |

## 4.3 Test Auxiliary Equipment

| Description | Manufacturer | Model | Serial No. | Length | Description | Use |
|---|---|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A | N/A | ☒ |



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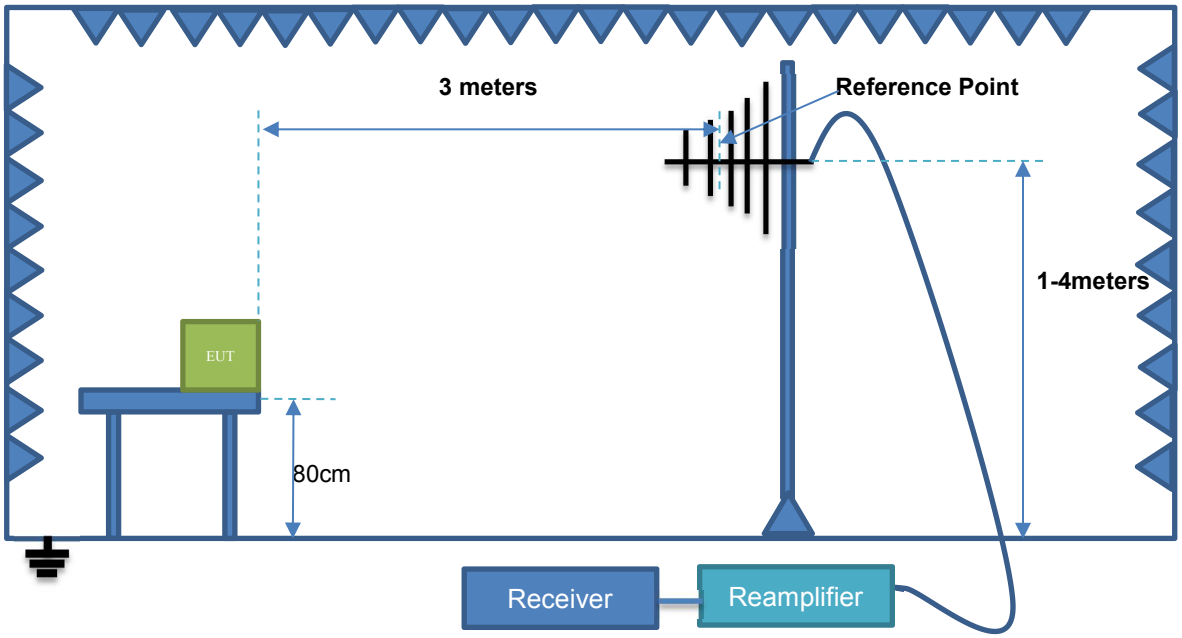
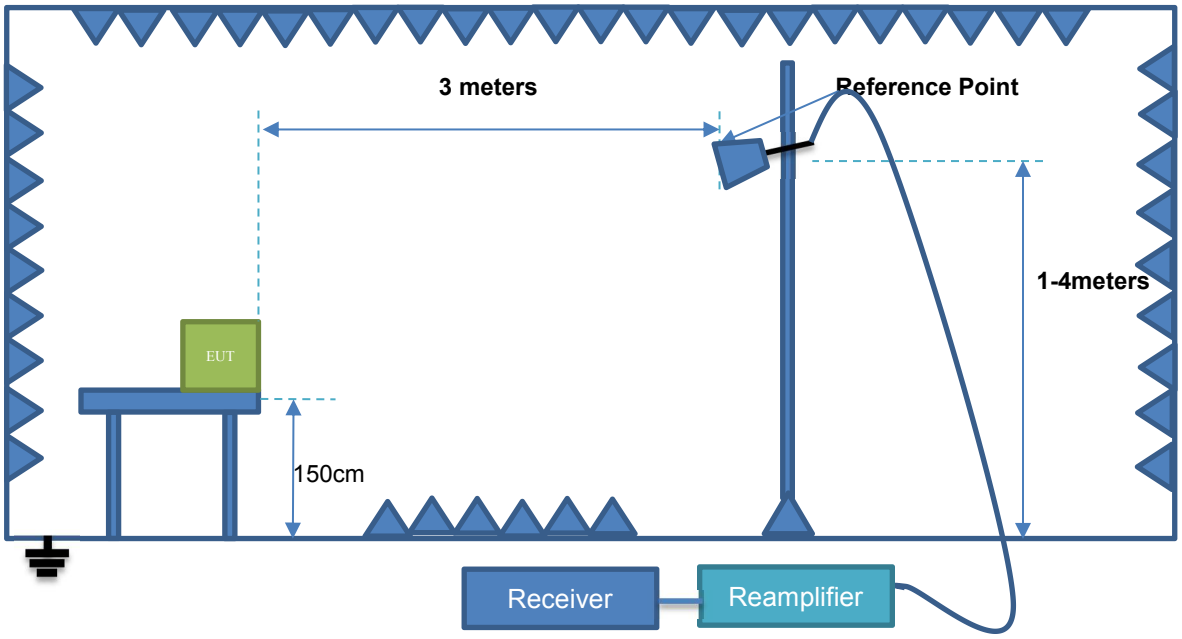
## 4.4 Test Setup

### Test Setup 1

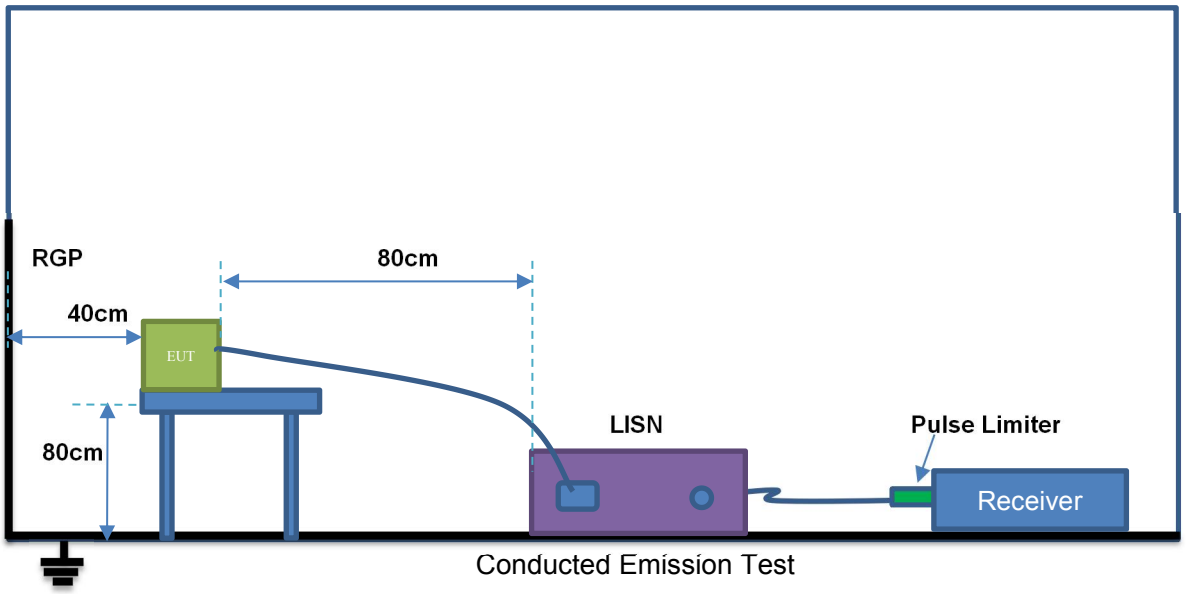



Radiation Test (30MHz – 1GHz)



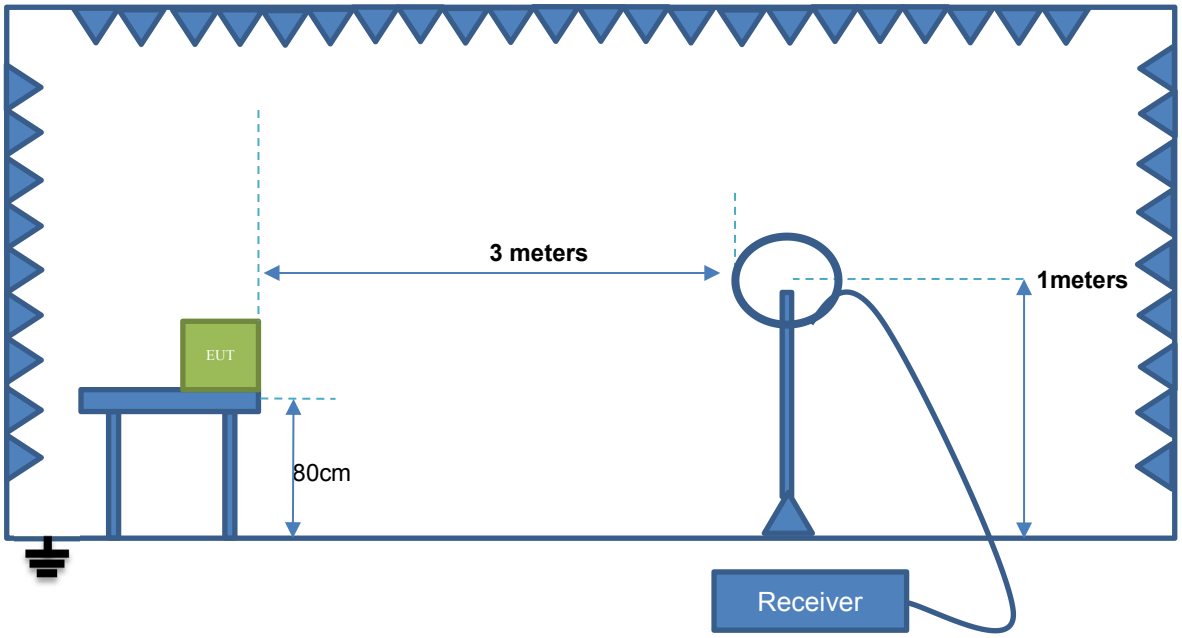

Radiation Test (Above 1GHz)

**Test Setup 2**



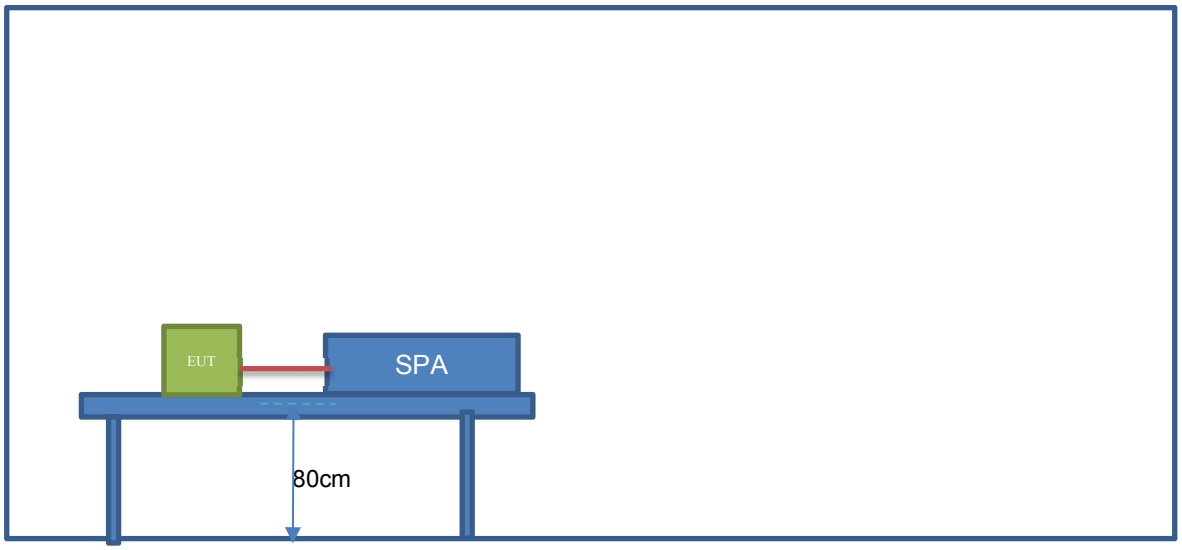

Conducted Emission Test

**Test Setup 3**




Radiation Test (9k - 30MHz)

**Test Setup 4**



# 5. Test Items

## 5.1 Antenna Requirements

### 5.1.1 Relevant Standards

FCC §15.203 & §15.247, RSS-247, 5.4(f)
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. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

### 5.1.2 Antenna Anti-Replacement Construction

| Protected Method | Description |
|---|---|
| The antenna is embedded in the product. | An embedded in antenna design is used. |

| Reference Documents | Item |
|---|---|
| Photo | Please refer to the EUT Photo documents. |

### 5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

## 5.2 Frequency Hopping System

### 5.2.1 Relevant Standards

FCC §15.247(a) (1) (i) (ii) (iii) (iv); FCC §15.247(g); FCC §15.247(h)

Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, to demonstrate that the sequence meets the requirement specified in the definition of an FHSS system. Per the definition in Section 2.1(c), the hop set shall appear as random in the near term, shall appear as evenly distributed in the long term, and sequential hops shall be randomly distributed in both direction and magnitude of change.
Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g., that each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event).
Describe how the associated receiver(s) complies with the requirement that the input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.
Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals.
For short burst systems, describe how the EUT complies with the requirement that it be designed to be capable of operating as a true frequency hopping system. Specifically, the device shall comply with the equal frequency use and pseudorandom hopping sequence requirement when transmitting in short bursts, and shall be designed to comply when presented with continuous data (or information) stream.
Describe how the EUT complies with the requirement that it not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

### 5.2.2 Description of the systems

1. According to the preset procedure of the whole network, all the stations in the automatic control network synchronously change the frequency multiple times within one second, and temporarily stay on each frequency hopping channel. Periodic synchronization signaling is sent from the primary station, instructing all slaves to simultaneously change the operating frequency, then the hopping sequence is generated.
2. The hop set shall appear as random in the near term, shall appear as evenly distributed in the long term, and sequential hops shall be randomly distributed in both direction and magnitude of change.
3. Channels are classified into two categories, used and unused, where used channels are part of the hopping sequence and unused channels are replaced in the hopping sequence by used channels in a pseudo- random way. Make each individual EUT meets the requirement that each of its hopping channels is used equally on average.
4. The input bandwidth and transmitted bandwith are both 1MHz, the associated receiver(s) complies with the requirement that the input bandwidth matches the bandwidth of the transmitted signal.
5. Connected devices communicate on the same physical channel by synchronizing with a common clock and hopping sequence.
6. EUT isn’t short burst systems.
7. EUT can’t have the ability to be coordinated with other FHSS systems in an effort.



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## 5.3 Number of Hopping Frequencies

### 5.3.1 Limit

FCC §15.247(a) (1) (iii); RSS-247, 5.1(d)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

### 5.3.2 Test Setup

See section 4.5 for test setup description for antenna port The photo of test setup please refer to ANNEX B

### 5.3.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = The frequency band of operation
RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
VBW ≥ RBW
Sweep = auto
Detector function = peak Trace = max hold
Allow the trace to stabilize

### 5.3.4 Test Result

Please refer to ANNEX A.1

## 5.4 Peak Output Power

### 5.4.1 Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247, 5.4(b)
For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

### 5.4.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

### 5.4.3 Test Procedure

The Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.
Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW

Sweep = auto

Detector function = peak Trace = max hold
Allow the trace to stabilize.

### 5.4.4 Test Result

Please refer to ANNEX A.2



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## 5.5 Occupied Bandwidth

### 5.5.1 Limit

FCC §15.247(a)l; RSS-247, 5.1(a)

Measurement of the 20dB bandwidth of the modulated signal.

### 5.5.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

### 5.5.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel RBW = in the range of 1% to 5% of the OBW
VBW ≥ RBW

Sweep = auto

Detector function = peak Trace = max hold
The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

### 5.5.4 Test Result

Please refer to ANNEX A.3

## 5.6 Carrier Frequency Separation

### 5.6.1 Limit

FCC §15.247(a); RSS-247, 5.1(b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 2/3 of the 20 dB bandwidth of the hopping channel, whichever is greater.

### 5.6.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

### 5.6.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span Video (or Average) Bandwidth (VBW) ≥ RBW
Sweep = auto

Detector function = peak Trace = max hold

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

### 5.6.4 Test Result

Please refer to ANNEX A.4

## 5.7 Time of Occupied (Dwell time)

### 5.7.1 Limit

FCC §15.247(a); RSS-247, 5.1(d)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 5.7.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

### 5.7.3 Test Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings: Span: Zero span, centered on a hopping channel

RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel

Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel

Detector function: Peak Trace: Max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

The average time of occupancy on any channel within the Period can be calculated with formulas: For GFSK and 8-DPSK:

For DH1 package type

{Total of Dwell} = {Pulse Time} * (1600 / 2) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4 s * {Number of Hopping Frequency}

For DH3 package type

{Total of Dwell} = {Pulse Time} * (1600 / 4) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4 s * {Number of Hopping Frequency}

For DH5 package type

{Total of Dwell} = {Pulse Time} * (1600 / 6) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4 s * {Number of Hopping Frequency}



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For AFH Mode:

For DH1 package type

{Total of Dwell} = {Pulse Time} * (800 / 2) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4 s * {Number of Hopping Frequency}

For DH3 package type

{Total of Dwell} = {Pulse Time} * (800 / 4) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4 s * {Number of Hopping Frequency}

For DH5 package type

{Total of Dwell} = {Pulse Time} * (800 / 6) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4 s * {Number of Hopping Frequency}

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

### 5.7.4 Test Result

Please refer to ANNEX A.5

## 5.8 Conducted Spurious Emission & Authorized-band band-edge

### 5.8.1 Limit

FCC §15.247(d); RSS-247, 5.5

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.

### 5.8.2 Test Setup

See section 4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B

### 5.8.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz VBW = 300 kHz
Sweep = auto
Detector function = peak Trace = max hold
Allow the trace to stabilize

### 5.8.4 Test Result

Please refer to ANNEX A.6



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## 5.9 Conducted Emission

### 5.9.1 Limit

FCC §15.207; RSS-Gen, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

| Frequency range (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quai-peak | Average |
| 0.15 - 0.50 | 66 to 56 | 56 to 46 |
| 0.50 - 5 | 56 | 46 |
| 0.50 - 30 | 60 | 50 |

### 5.9.2 Test Setup

See section 4.5 for test setup description for setup 2. The photo of test setup please refer to ANNEX B

### 5.9.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

### 5.9.4 Test Result

Please refer to ANNEX A.7

NOTE:

1. Results (dBuV) = Reading (dBuV) + Factor (dB)

The reading level is calculated by software which is not shown in the sheet

2. Factor = Insertion loss + Cable loss
3. Over limit = Results – Limit.

## 5.10 Radiated Spurious Emission

### 5.10.1 Limit

FCC §15.209&15.247(d); RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a). According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|---|---|---|
| 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 |

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

### 5.10.2 Test Setup

See section 4.5 for test setup description for setup 1 and 3. The photo of test setup please refer to ANNEX B

### 5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak Trace = max hold
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

### 5.10.4 Test Result

Please refer to ANNEX A.8

NOTE:

1. Results (dBuV) = Reading (dBuV) + Factor (dB)

The reading level is calculated by software which is not shown in the sheet

2. Factor = Insertion loss + Cable loss
3. Over limit = Results – Limit.

## 5.11 Band Edge (Restricted-band-edge)

### 5.11.1 Limit

FCC §15.209&15.247(d); RSS-Gen 8.10; RSS-247, 5.5

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

### 5.11.2 Test Setup

See section 4.5 for test setup description for antenna port. The photo of test setup please refer to ANNEX B

### 5.11.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.
Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

### 5.11.4 Test Result

Please refer to ANNEX A.9



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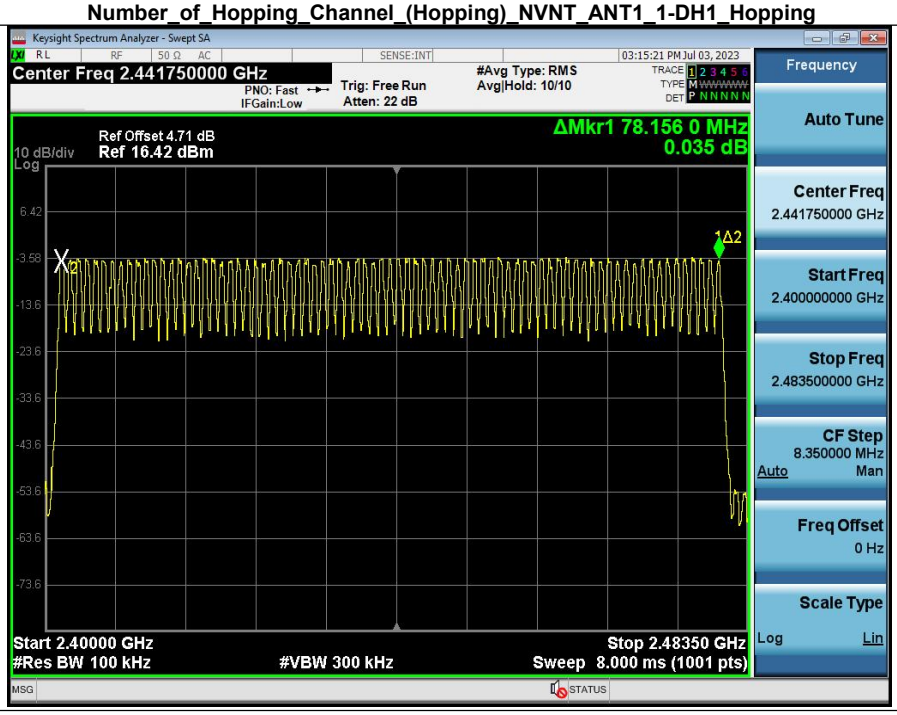
# ANNEX A Test Results

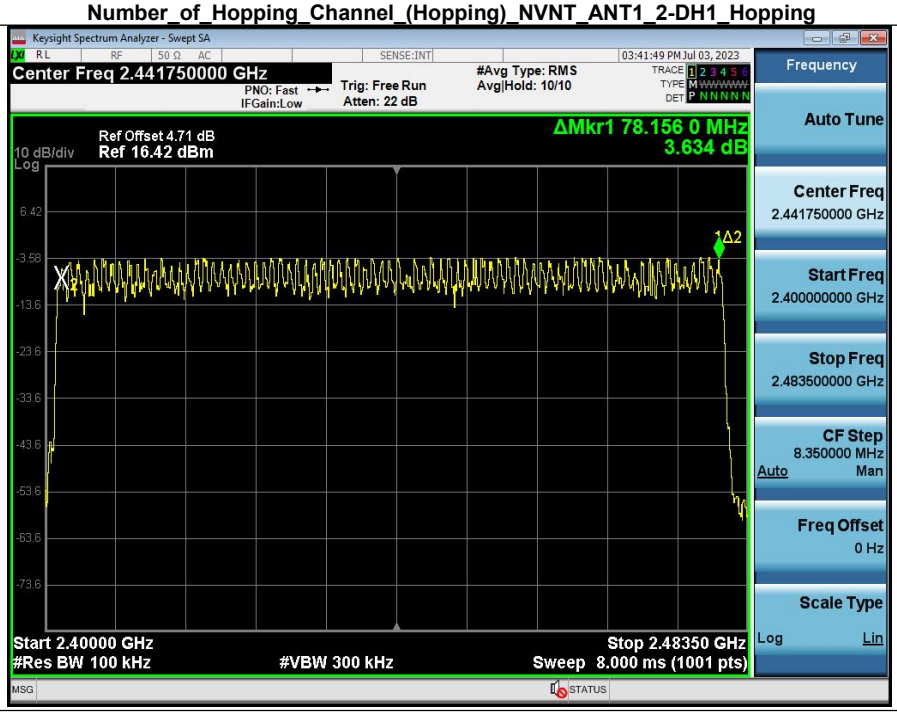
## A.1 Number of Hopping Frequency

| Antenna | Modulation | Hopping Num | Limit | Result |
|---|---|---|---|---|
| ANT1 | 1-DH1 | 79 | 15 | Pass |
| ANT1 | 2-DH1 | 79 | 15 | Pass |
| ANT1 | 3-DH1 | 79 | 15 | Pass |

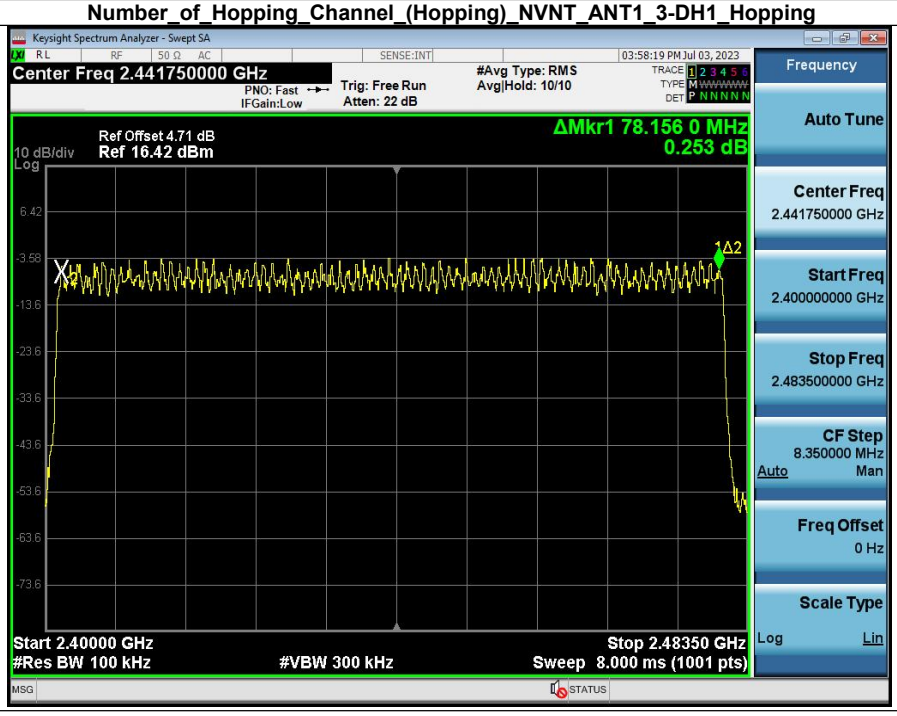
Number_of_Hopping_Channel_(Hopping)_NVNT_ANT1_1-DH1_Hopping



Number_of_Hopping_Channel_(Hopping)_NVNT_ANT1_2-DH1_Hopping




Number_of_Hopping_Channel_(Hopping)_NVNT_ANT1_3-DH1_Hopping



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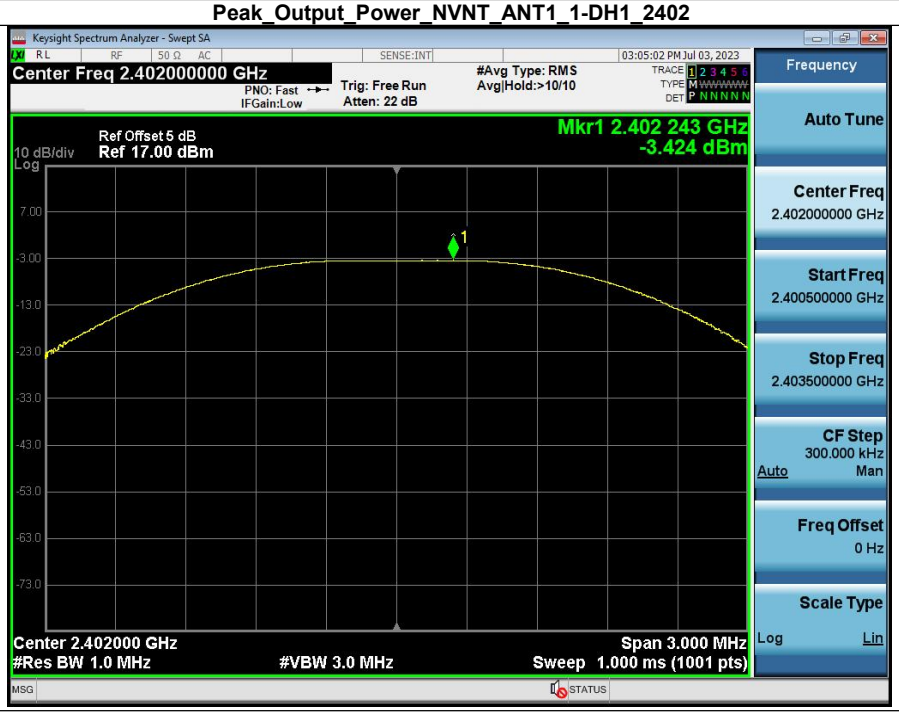
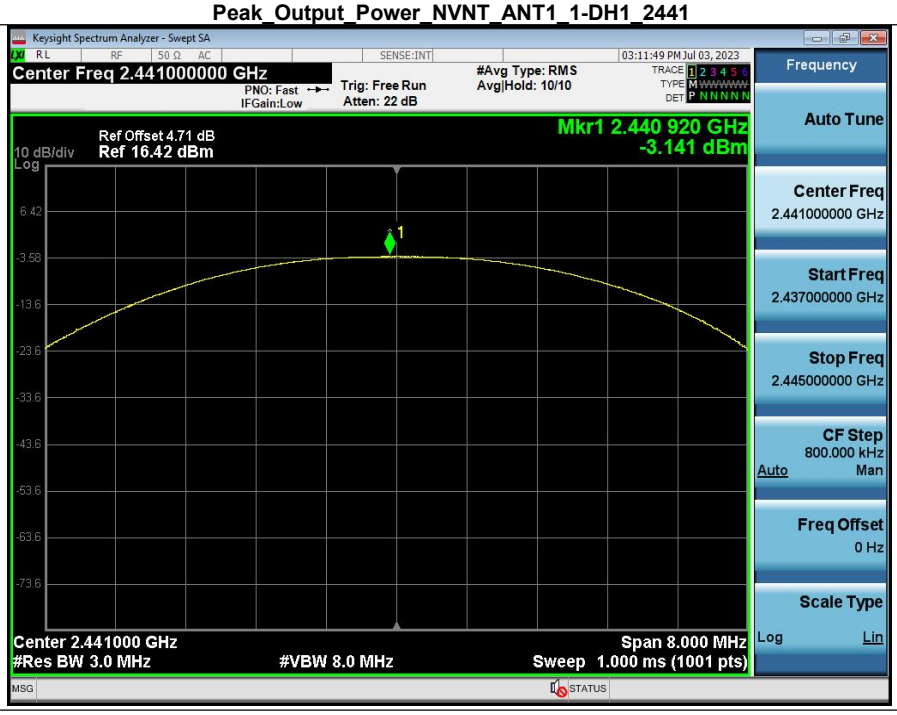
## A.2 Peak Output Power

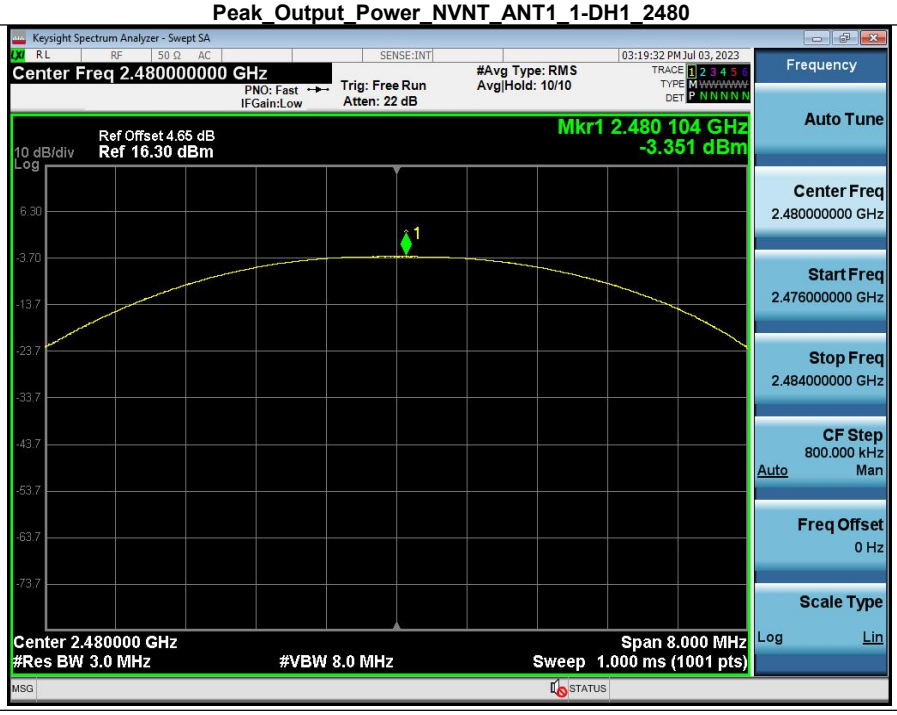
| Modulation | Frequency (MHz) | Max. Conducted Power(dBm) | Max. Conducted Power(mW) | Limit(mW) | Result |
|---|---|---|---|---|---|
| 1-DH1 | 2402.00 | -3.42 | 0.45 | 1000 | Pass |
| 1-DH1 | 2441.00 | -3.14 | 0.49 | 125 | Pass |
| 1-DH1 | 2480.00 | -3.35 | 0.46 | 125 | Pass |
| 2-DH1 | 2402.00 | -2.58 | 0.55 | 125 | Pass |
| 2-DH1 | 2441.00 | -2.43 | 0.57 | 125 | Pass |
| 2-DH1 | 2480.00 | -2.51 | 0.56 | 125 | Pass |
| 3-DH1 | 2402.00 | -2.14 | 0.61 | 125 | Pass |
| 3-DH1 | 2441.00 | -2.07 | 0.62 | 125 | Pass |
| 3-DH1 | 2480.00 | -2.17 | 0.61 | 125 | Pass |

Peak_Output_Power_NVNT_ANT1_1-DH1_2402



| Peak_Output_Power_NVNT_ANT1_1-DH1_2441 |
| --- |
|  |



| Peak_Output_Power_NVNT_ANT1_1-DH1_2480 |
| --- |
|  |





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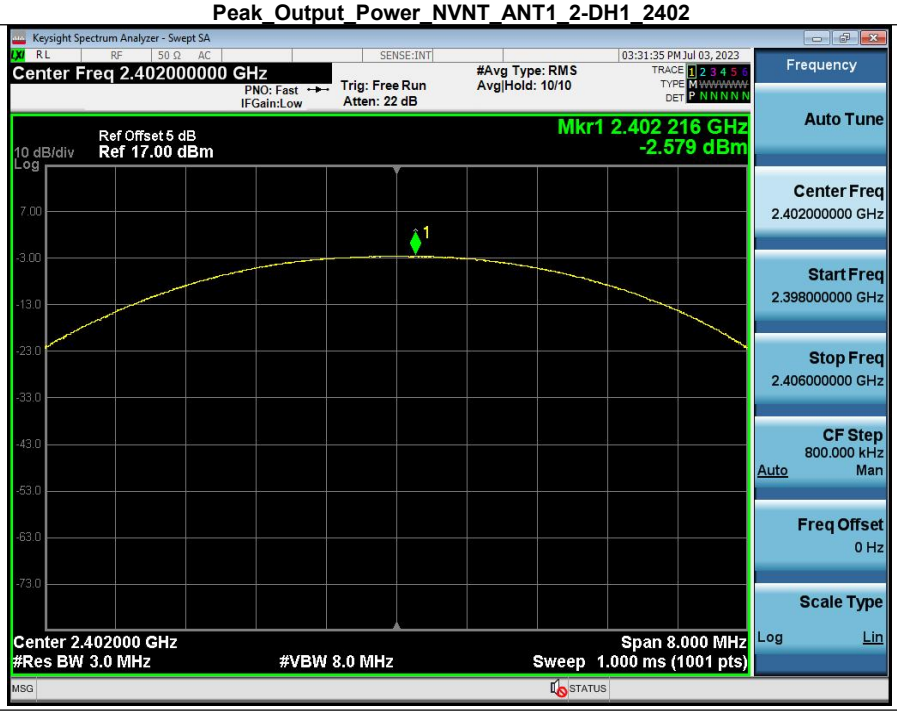
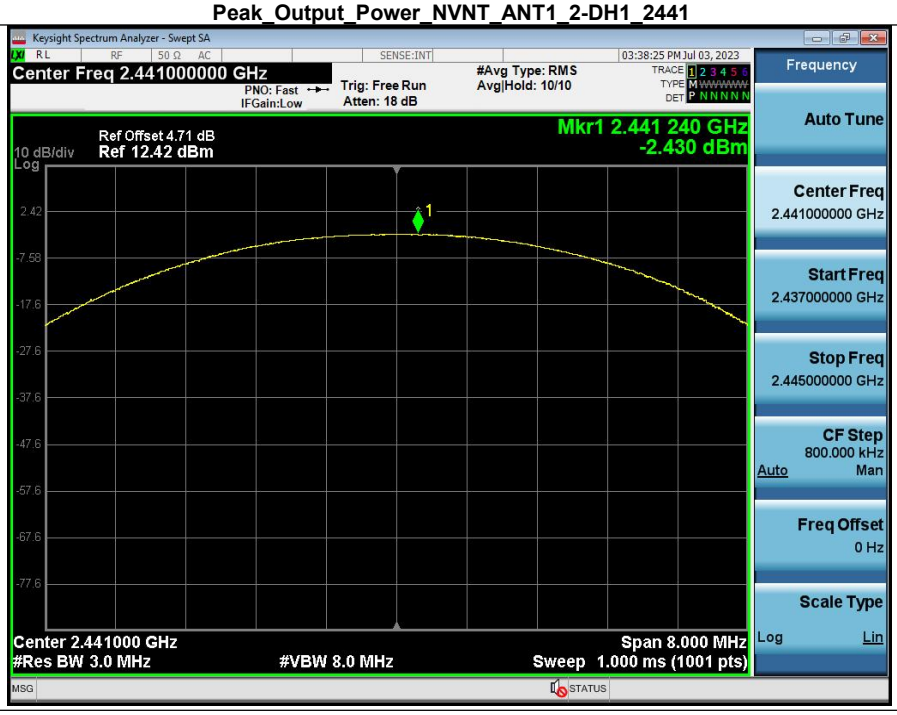
| Peak_Output_Power_NVNT_ANT1_2-DH1_2402 |
| --- |
|  |



| Peak_Output_Power_NVNT_ANT1_2-DH1_2441 |
| --- |
|  |





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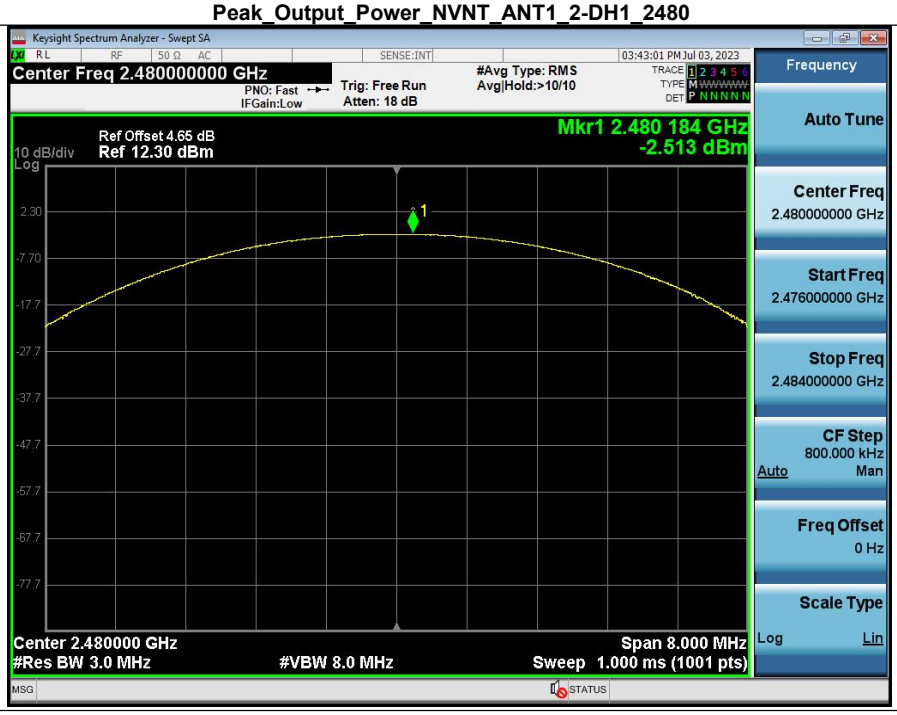
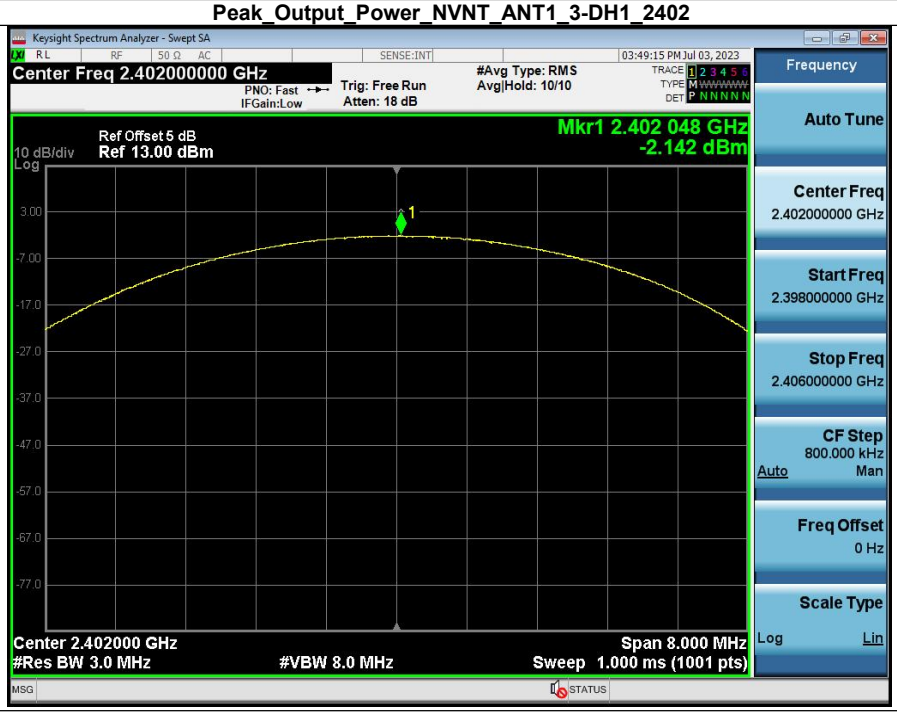
Peak_Output_Power_NVNT_ANT1_2-DH1_2480




Peak_Output_Power_NVNT_ANT1_3-DH1_2402



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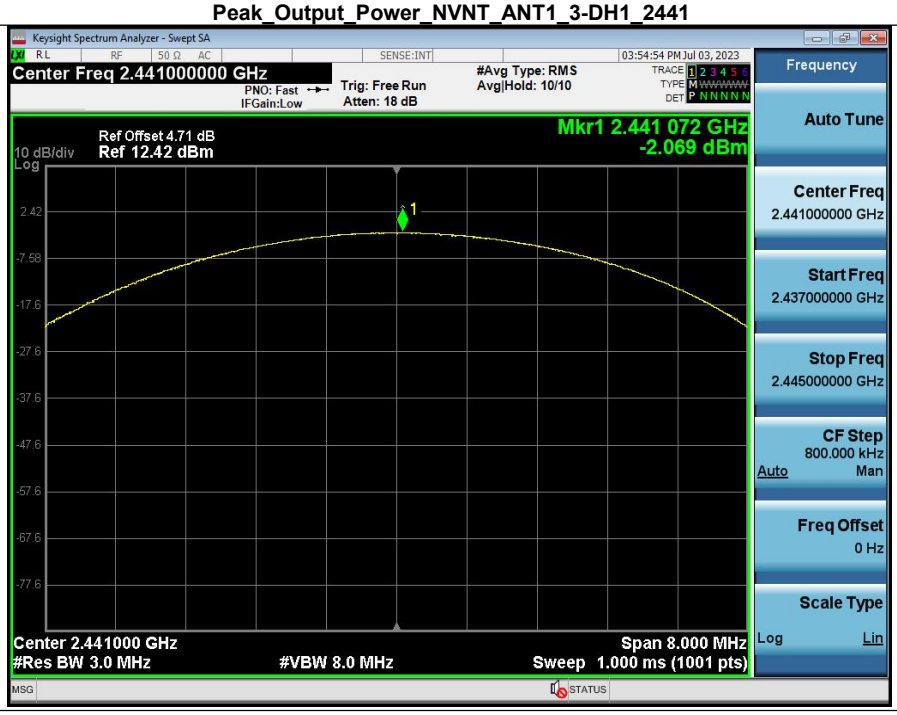
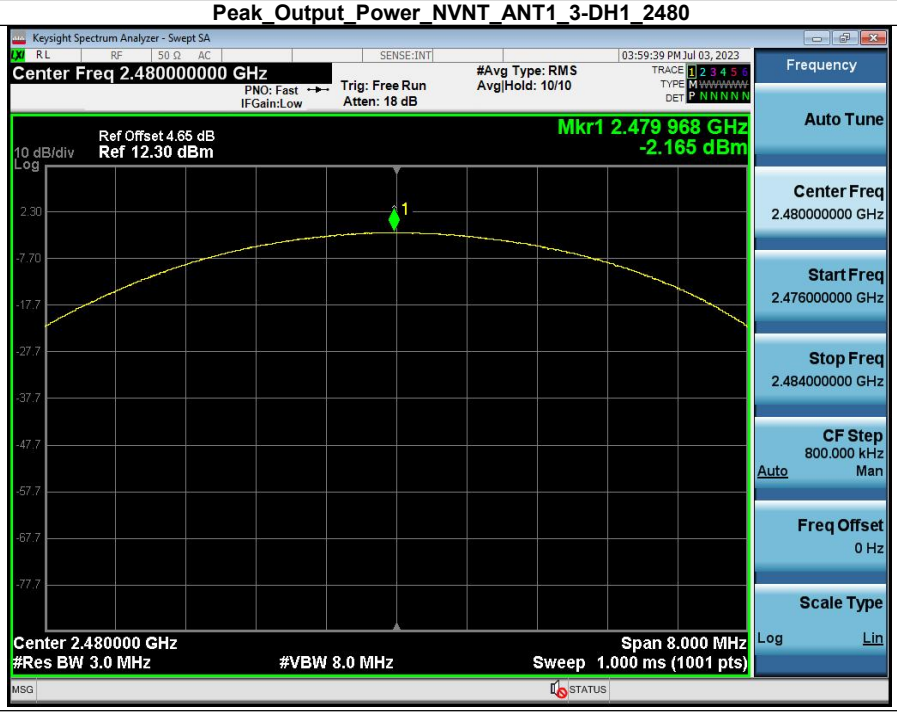
| Peak_Output_Power_NVNT_ANT1_3-DH1_2441 |
| --- |
|  |



| Peak_Output_Power_NVNT_ANT1_3-DH1_2480 |
| --- |
|  |





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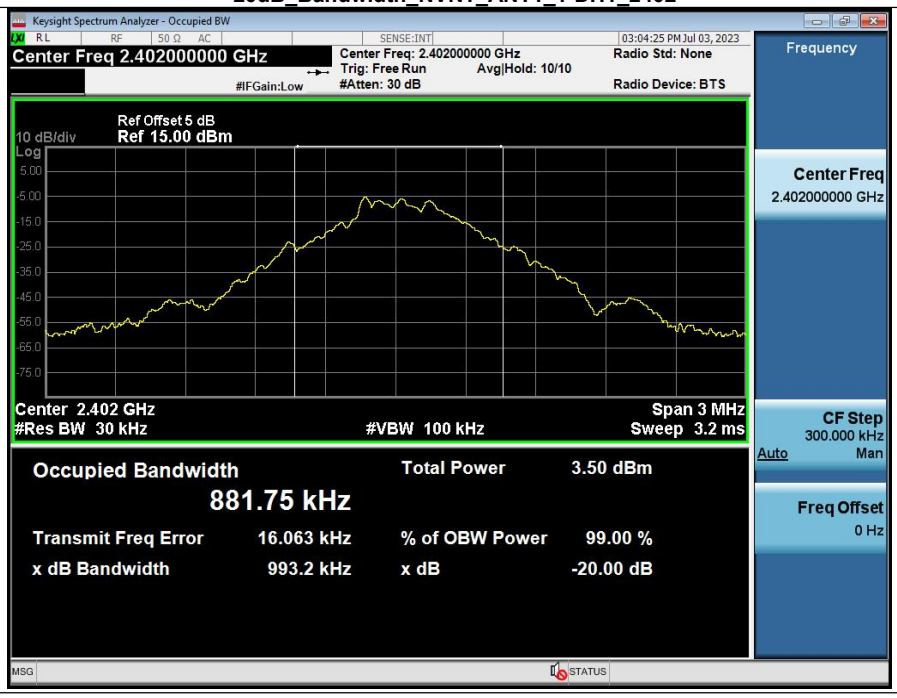
# A.3 20 dB and 99% Bandwidth

| Modulation | Frequency (MHz) | -20dB BW(MHz) | Result |
|---|---|---|---|
| 1-DH1 | 2402.00 | 0.993 | Pass |
| 1-DH1 | 2441.00 | 1.014 | Pass |
| 1-DH1 | 2480.00 | 1.026 | Pass |
| 2-DH1 | 2402.00 | 1.292 | Pass |
| 2-DH1 | 2441.00 | 1.291 | Pass |
| 2-DH1 | 2480.00 | 1.288 | Pass |
| 3-DH1 | 2402.00 | 1.306 | Pass |
| 3-DH1 | 2441.00 | 1.321 | Pass |
| 3-DH1 | 2480.00 | 1.320 | Pass |

-20dB_Bandwidth_NVNT_ANT1_1-DH1_2402



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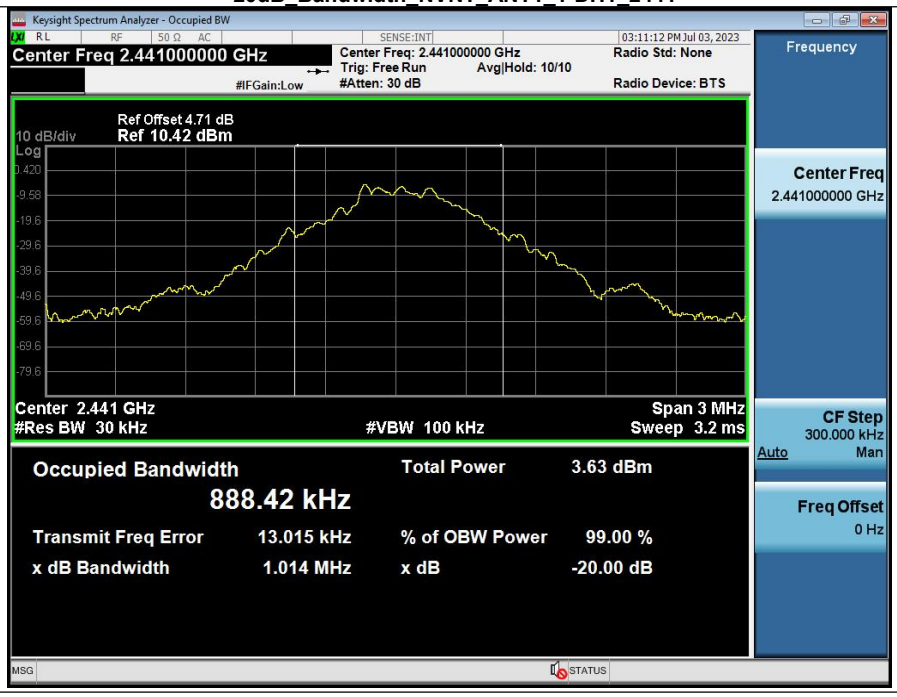
-20dB_Bandwidth_NVNT_ANT1_1-DH1_2441




-20dB_Bandwidth_NVNT_ANT1_1-DH1_2480

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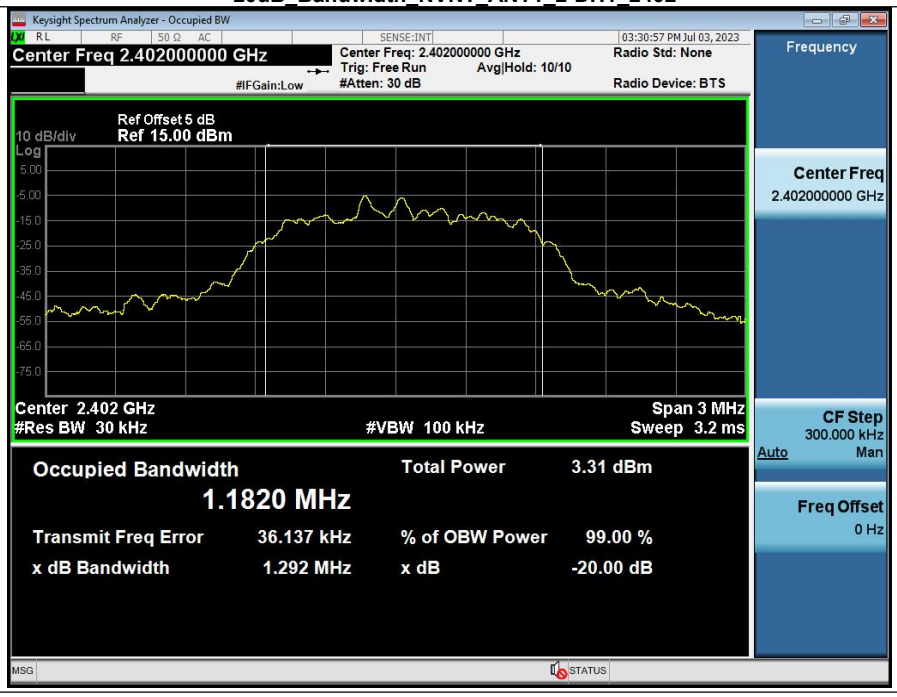
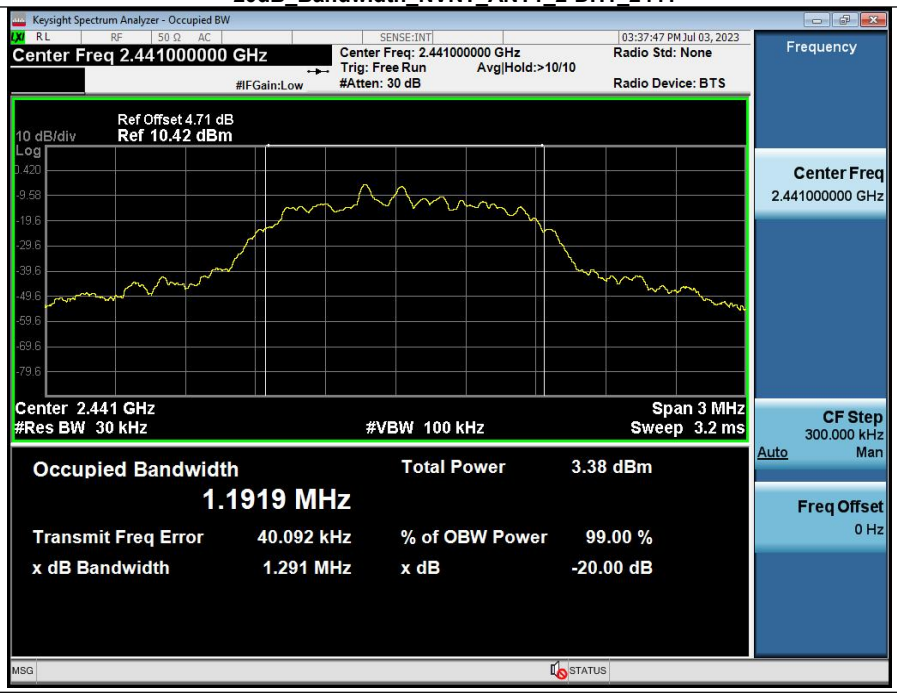
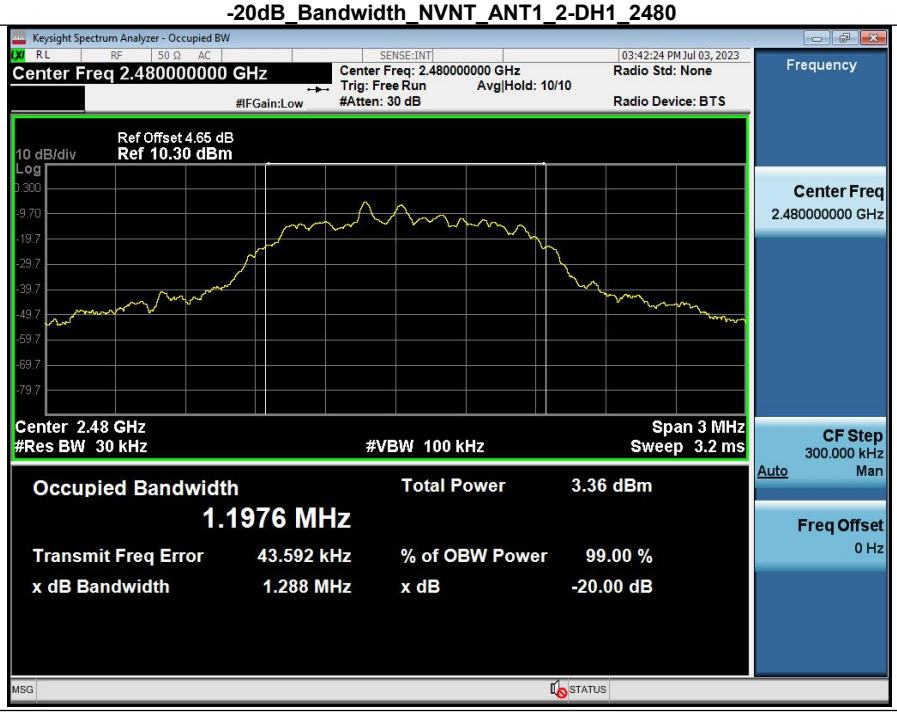
-20dB_Bandwidth_NVNT_ANT1_2-DH1_2402




-20dB_Bandwidth_NVNT_ANT1_2-DH1_2441



-20dB_Bandwidth_NVNT_ANT1_2-DH1_2480




-20dB_Bandwidth_NVNT_ANT1_3-DH1_2402

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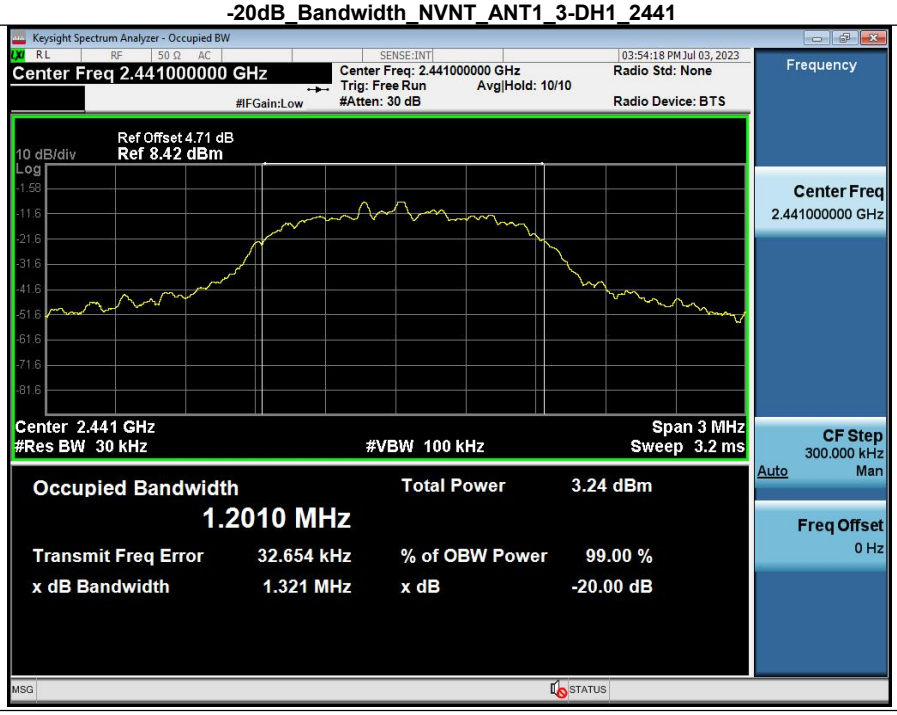
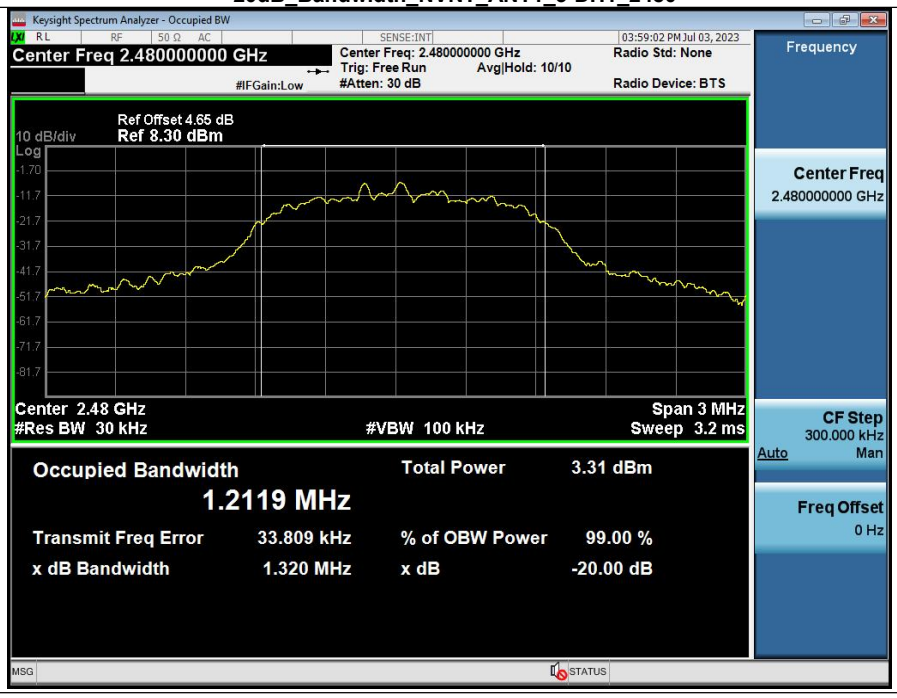
-20dB_Bandwidth_NVNT_ANT1_3-DH1_2441




-20dB_Bandwidth_NVNT_ANT1_3-DH1_2480



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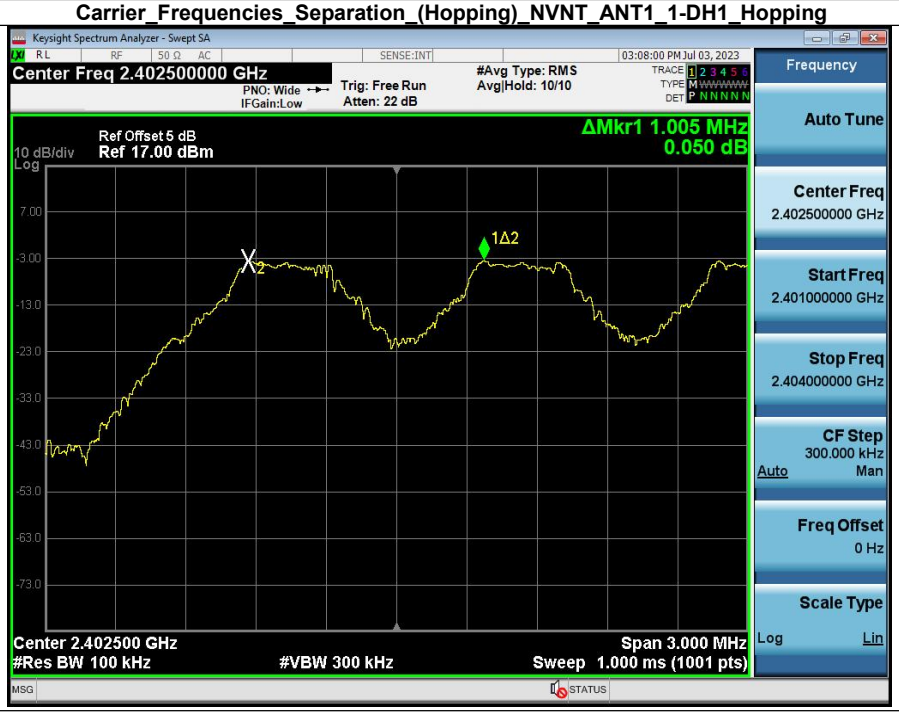
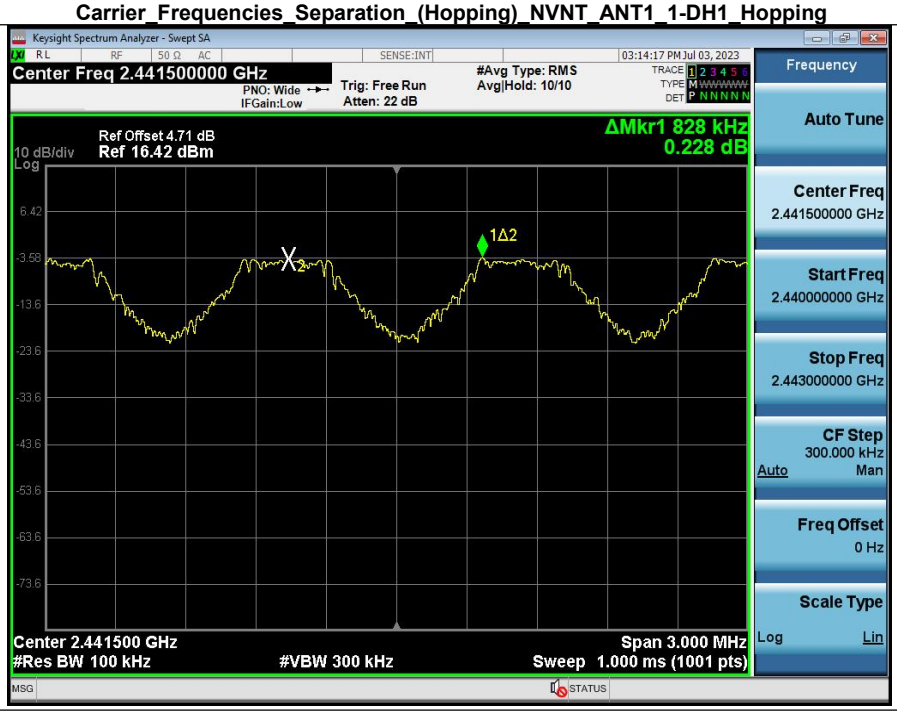
# A.4 Hopping Frequency Separation

| Modulation | Frequency(MHz) | Hopping NO.0 (MHz) | Hopping NO.1 (MHz) | Carrier Frequencies Separation(MHz) | Limit(MHz) | Result |
|---|---|---|---|---|---|---|
| 1-DH1 | 2402.00 | 2401.867 | 2402.872 | 1.00 | 0.662 | Pass |
| 1-DH1 | 2441.00 | 2441.038 | 2441.866 | 0.83 | 0.676 | Pass |
| 1-DH1 | 2480.00 | 2478.879 | 2479.863 | 0.98 | 0.684 | Pass |
| 2-DH1 | 2402.00 | 2401.873 | 2402.875 | 1.00 | 0.861 | Pass |
| 2-DH1 | 2441.00 | 2440.876 | 2441.887 | 1.01 | 0.861 | Pass |
| 2-DH1 | 2480.00 | 2478.879 | 2479.878 | 1.00 | 0.859 | Pass |
| 3-DH1 | 2402.00 | 2402.008 | 2403.028 | 1.02 | 0.871 | Pass |
| 3-DH1 | 2441.00 | 2440.864 | 2442.139 | 1.27 | 0.881 | Pass |
| 3-DH1 | 2480.00 | 2478.876 | 2479.878 | 1.00 | 0.880 | Pass |

Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_1-DH1_Hopping



| Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_1-DH1_Hopping |
|---|
|  |



| Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_1-DH1_Hopping |
|---|
|  |

Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_2-DH1_Hopping


Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_2-DH1_Hopping

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Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_2-DH1_Hopping


Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_3-DH1_Hopping




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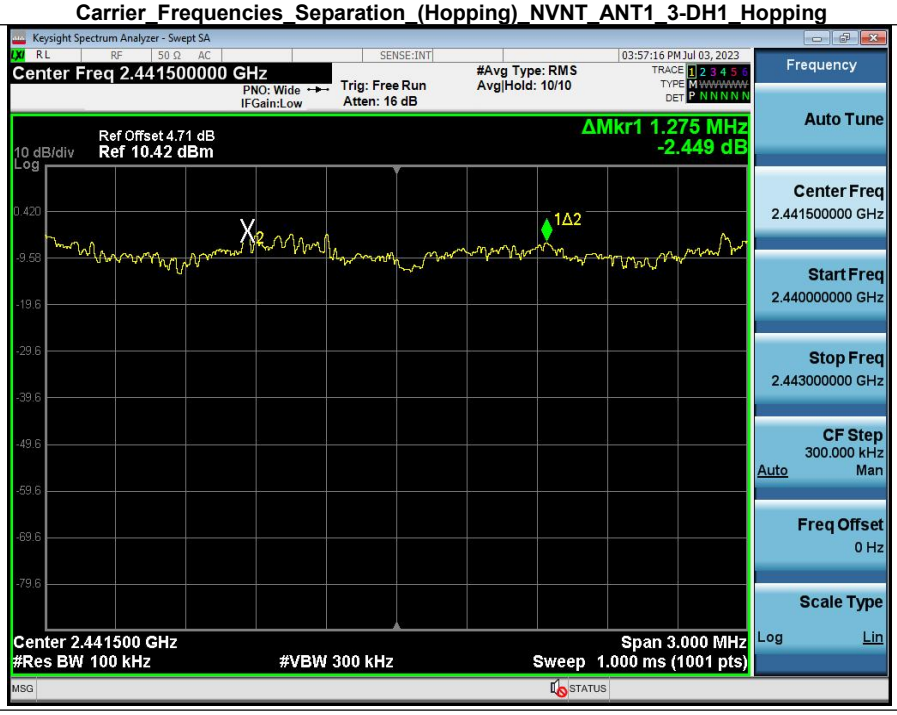
Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_3-DH1_Hopping




Carrier_Frequencies_Separation_(Hopping)_NVNT_ANT1_3-DH1_Hopping