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# FCC Test Report

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Report No.: AGC12810240702FR01

**FCC ID** : 2BERM-GX87

**APPLICATION PURPOSE** : Original Equipment

**PRODUCT DESIGNATION** : MECHANICAL KEYBOARD

**BRAND NAME** : MCHOSE

**MODEL NAME** : GX87

**APPLICANT** : Shenzhen Zhishi intelligent Technology Co., LTD

**DATE OF ISSUE** : Aug. 05, 2024

**STANDARD(S)** : FCC Part 15 Subpart C §15.247

**REPORT VERSION** : V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd



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**Report Revise Record**

| Report Version | Revise Time | Issued Date   | Valid Version | Notes           |
|----------------|-------------|---------------|---------------|-----------------|
| V1.0           | /           | Aug. 05, 2024 | Valid         | Initial Release |

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## 1. General Information

|                              |   |
|------------------------------|---|
| Applicant                    | Shenzhen Zhishi intelligent Technology Co., LTD   |
| Address                      | A3401 Rongde Times Square, Huaqiao Xincun Community, Henggang Street, Longgang District, Shenzhen, China            |
| Manufacturer                 | Zhishi intelligent Technology (Dongguan) Co., LTD   |
| Address                      | Room 102, Building 1, No.21, Xiewu Industrial Road, Hengshan, Shipai Town, Dongguan City, Guangdong Province, China |
| Factory                      | Zhishi intelligent Technology (Dongguan) Co., LTD   |
| Address                      | Room 102, Building 1, No.21, Xiewu Industrial Road, Hengshan, Shipai Town, Dongguan City, Guangdong Province, China |
| Product Designation          | MECHANICAL KEYBOARD   |
| Brand Name                   | MCHOSE  |
| Test Model                   | GX87  |
| Series Model(s)              | N/A   |
| Difference Description       | N/A   |
| Date of receipt of test item | Jul. 18, 2024   |
| Date of Test                 | Jul. 18, 2024 to Aug. 05, 2024  |
| Deviation from Standard      | No any deviation from the test method   |
| Condition of Test Sample     | Normal  |
| Test Result                  | Pass  |
| Test Report Form No          | AGCER-FCC-BR_EDR-V1   |

Note: The test results of this report relate only to the tested sample identified in this report.

|             |  |               |
|-------------|--|---------------|
| Prepared By |  |               |
|             | Jack Gui<br>(Project Engineer)   | Aug. 05, 2024 |
| Reviewed By |   |               |
|             | Calvin Liu<br>(Reviewer)   | Aug. 05, 2024 |
| Approved By |  |               |
|             | Max Zhang<br>(Authorized Officer)  | Aug. 05, 2024 |

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## 2. Product Information

### 2.1 Product Technical Description

|                           |   |
|---------------------------|---|
| Frequency Band            | 2400MHz-2483.5MHz   |
| Operation Frequency Range | 2402MHz-2480MHz   |
| Bluetooth Version         | V5.0  |
| Modulation Type           | BR <input checked="" type="checkbox"/> GFSK, EDR <input type="checkbox"/> π/4-DQPSK, <input type="checkbox"/> 8DPSK |
| Number of channels        | 79 Channels   |
| Channel Separation        | 1 MHz   |
| Maximum Transmitter Power | -3.894dBm   |
| Hardware Version          | X79 916 DN LED US UK  |
| Software Version          | V1.0  |
| Antenna Designation       | PCB Antenna   |
| Antenna Gain              | 2.34dBi   |
| Power Supply              | DC 3.7V by battery or DC 5V by adapter or DC 5V by PC   |

### 2.2 Test Frequency List

| Frequency Band | Channel Number | Frequency |
|----------------|----------------|-----------|
| 2400~2483.5MHz | 0              | 2402 MHz  |
|                | 1              | 2403 MHz  |
|                | :              | :         |
|                | 39             | 2441MHz   |
|                | :              | :         |
|                | 77             | 2479 MHz  |
|                | 78             | 2480 MHz  |

Note:  $f = 2402 + 1k \text{ MHz}$ ,  $k = 0, \dots, 78$ ; “f” is the operating frequency (MHz); “k” is the operating channel.

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## 2.3 Related Submittal(S) / Grant (S)

This submittal(s) (test report) is intended for FCC ID: **2BERM-GX87**, filing to comply with Part 2, Part 15 of the Federal Communication Commission rules.

## 2.4 Test Methodology

The tests were performed according to following standards:

| No. | Identity   | Document Title  |
|-----|--|---|
| 1   | FCC 47 CFR Part 2                                | Frequency allocations and radio treaty matters; general rules and regulations   |
| 2   | FCC 47 CFR Part 15                               | Radio Frequency Devices   |
| 3   | ANSI C63.10-2013                                 | American National Standard for Testing Unlicensed Wireless Devices  |
| 4   | KDB 558074<br>D01 15.247 Meas<br>Guidance v05r02 | Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under Section 15.247 of the FCC rules |

## 2.5 Receiver Input Bandwidth

The input bandwidth of the receiver is 1.3MHz, in every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally, the type of connection (e.g. single of multi slot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also, the slave of the connection will use these settings. Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

## 2.6 Equally Average Use of Frequencies and Behaviour.

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection.
2. Internal master clock.

The LAP (lower address part) are the 24 LSB's of the 48 BD\_ADDRESS. The BD\_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24MSB's of the 48BD\_ADDRESS

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For behavior action with other units only offset is used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us. The clock has a cycle of about one day(23h30).

In most case it is implemented as 28 bits counter. For the deriving of the hopping sequence the entire. LAP (24 bits),4LSB's(4bits) (Input 1) and the 27MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the Sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behavior:

The first connection between the two devices is established, a hopping sequence was generated. For Transmitting the wanted data the complete hopping sequence was not used. The connection ended.

The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmission is longer (and it Cannot be shorter) than the minimum resolution of the clock(312.5us). The hopping sequence will always differ from the first one.

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## 2.7 Pseudorandom Frequency Hopping Sequence

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

- Number of shift register stages: 9
- Length of pseudo-random sequence:  $2^9 - 1 = 511$  bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of The PRBS Sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.



## 2.8 Special Accessories

Not available for this EUT intended for grant.

## 2.9 Equipment Modifications

Not available for this EUT intended for grant.

## 2.10 Antenna Requirement

| Standard Requirement  |
|---|
| <p><b>15.203 requirement:</b><br/>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.</p> <p><b>15.247(b) (4) requirement:</b><br/>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</p> |
| <p><b>EUT Antenna:</b><br/>The non-detachable antenna inside the device cannot be replaced by the user at will. The gain of the antenna is 2.34dBi.</p>   |

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### 3. Test Environment

#### 3.1 Address of The Test Laboratory

Laboratory: Attestation of Global Compliance (Shenzhen) Co., Ltd.

Address: 1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

#### 3.2 Test Facility

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

##### **CNAS-Lab Code: L5488**

Attestation of Global Compliance (Shenzhen) Co., Ltd. has been assessed and proved to follow CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories.)

##### **A2LA-Lab Cert. No.: 5054.02**

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to follow ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

##### **FCC-Registration No.: 975832**

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files with Registration 975832.

##### **IC-Registration No.: 24842(CAB identifier: CN0063)**

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the Certification and Engineering Bureau of Industry Canada. The acceptance letter from the IC is maintained in our files with Registration 24842.

### 3.3 Environmental Conditions

|                         | Normal Conditions |
|-------------------------|-------------------|
| Temperature range (°C)  | 15 - 35           |
| Relative humidity range | 20 % - 75 %       |
| Pressure range (kPa)    | 86 - 106          |
| Power supply            | DC 3.7V           |

### 3.4 Measurement Uncertainty

The reported uncertainty of measurement  $y \pm U$ , where expanded uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95%.

| Item  | Measurement Uncertainty    |
|---|----------------------------|
| Uncertainty of Conducted Emission for AC Port | $U_c = \pm 2.9 \text{ dB}$ |
| Uncertainty of Radiated Emission below 1GHz   | $U_c = \pm 3.9 \text{ dB}$ |
| Uncertainty of Radiated Emission above 1GHz   | $U_c = \pm 4.9 \text{ dB}$ |
| Uncertainty of total RF power, conducted      | $U_c = \pm 0.8 \text{ dB}$ |
| Uncertainty of RF power density, conducted    | $U_c = \pm 2.6 \text{ dB}$ |
| Uncertainty of spurious emissions, conducted  | $U_c = \pm 2 \%$           |
| Uncertainty of Occupied Channel Bandwidth     | $U_c = \pm 2 \%$           |

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### 3.5 List of Equipment Used

| ● RF Conducted Test System          |               |                     |              |            |            |                           |                           |
|-------------------------------------|---------------|---------------------|--------------|------------|------------|---------------------------|---------------------------|
| Used                                | Equipment No. | Test Equipment      | Manufacturer | Model No.  | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| <input checked="" type="checkbox"/> | AGC-ER-E036   | Spectrum Analyzer   | Agilent      | N9020A     | MY49100060 | 2024-05-24                | 2025-05-23                |
| <input checked="" type="checkbox"/> | AGC-ER-E062   | Power Sensor        | Agilent      | U2021XA    | MY54110007 | 2024-02-01                | 2025-01-31                |
| <input checked="" type="checkbox"/> | AGC-ER-E063   | Power Sensor        | Agilent      | U2021XA    | MY54110009 | 2024-02-01                | 2025-01-31                |
| <input checked="" type="checkbox"/> | AGC-EM-A001   | 6dB Attenuator      | Eeatsheep    | LM-XX-6-5W | N/A        | 2023-09-21                | 2025-09-20                |
| <input type="checkbox"/>            | AGC-ER-E083   | Signal Generator    | Agilent      | E4421B     | US39340815 | 2024-05-23                | 2025-05-22                |
| <input checked="" type="checkbox"/> | N/A           | RF Connection Cable | N/A          | 1#         | N/A        | Each time                 | N/A                       |
| <input checked="" type="checkbox"/> | N/A           | RF Connection Cable | N/A          | 2#         | N/A        | Each time                 | N/A                       |

| ● Radiated Spurious Emission        |               |                               |              |            |            |                           |                           |
|-------------------------------------|---------------|-------------------------------|--------------|------------|------------|---------------------------|---------------------------|
| Used                                | Equipment No. | Test Equipment                | Manufacturer | Model No.  | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| <input checked="" type="checkbox"/> | AGC-EM-E046   | EMI Test Receiver             | R&S          | ESCI       | 10096      | 2024-02-01                | 2025-01-31                |
| <input type="checkbox"/>            | AGC-EM-E116   | EMI Test Receiver             | R&S          | ESCI       | 100034     | 2024-05-24                | 2025-05-23                |
| <input checked="" type="checkbox"/> | AGC-EM-E061   | Spectrum Analyzer             | Agilent      | N9010A     | MY53470504 | 2024-05-28                | 2025-05-27                |
| <input checked="" type="checkbox"/> | AGC-EM-E086   | Loop Antenna                  | ZHINAN       | ZN30900C   | 18051      | 2024-03-05                | 2026-03-04                |
| <input checked="" type="checkbox"/> | AGC-EM-E001   | Wideband Antenna              | SCHWARZBECK  | VULB9168   | D69250     | 2023-05-11                | 2025-05-10                |
| <input checked="" type="checkbox"/> | AGC-EM-E029   | Broadband Ridged Horn Antenna | ETS          | 3117       | 00034609   | 2024-03-31                | 2025-03-30                |
| <input checked="" type="checkbox"/> | AGC-EM-E082   | Horn Antenna                  | SCHWARZBECK  | BBHA 9170  | #768       | 2023-09-24                | 2025-09-23                |
| <input checked="" type="checkbox"/> | AGC-EM-E146   | Pre-amplifier                 | ETS          | 3117-PA    | 00246148   | 2022-08-04                | 2024-08-03                |
| <input checked="" type="checkbox"/> | AGC-EM-E146   | Pre-amplifier                 | ETS          | 3117-PA    | 00246148   | 2024-07-24                | 2026-07-23                |
| <input checked="" type="checkbox"/> | AGC-EM-A119   | 2.4GHz Filter                 | SongYi       | N/A        | N/A        | 2024-05-23                | 2025-05-22                |
| <input checked="" type="checkbox"/> | AGC-EM-A138   | 6dB Attenuator                | Eeatsheep    | LM-XX-6-5W | N/A        | 2023-06-09                | 2025-06-08                |
| <input type="checkbox"/>            | AGC-EM-A139   | 6dB Attenuator                | Eeatsheep    | LM-XX-6-5W | N/A        | 2023-06-09                | 2025-06-08                |

| ● AC Power Line Conducted Emission  |               |                   |              |            |            |                           |                           |
|-------------------------------------|---------------|-------------------|--------------|------------|------------|---------------------------|---------------------------|
| Used                                | Equipment No. | Test Equipment    | Manufacturer | Model No.  | Serial No. | Last Cal. Date (YY-MM-DD) | Next Cal. Date (YY-MM-DD) |
| <input checked="" type="checkbox"/> | AGC-EM-E045   | EMI Test Receiver | R&S          | ESPI       | 101206     | 2024-05-28                | 2025-05-27                |
| <input checked="" type="checkbox"/> | AGC-EM-A130   | 6dB Attenuator    | Eeatsheep    | LM-XX-6-5W | DC-6GZ     | 2023-06-09                | 2025-06-08                |
| <input checked="" type="checkbox"/> | AGC-EM-E023   | AMN               | R&S          | 100086     | ESH2-Z5    | 2024-05-28                | 2025-05-27                |

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| ● Test Software                     |               |                     |              |                                 |                     |
|-------------------------------------|---------------|---------------------|--------------|---------------------------------|---------------------|
| Used                                | Equipment No. | Test Equipment      | Manufacturer | Model No.                       | Version Information |
| <input checked="" type="checkbox"/> | AGC-EM-S001   | CE Test System      | R&S          | ES-K1                           | V1.71               |
| <input type="checkbox"/>            | AGC-EM-S003   | RE Test System      | FARA         | EZ-EMC                          | V.RA-03A            |
| <input checked="" type="checkbox"/> | AGC-EM-S004   | RE Test System      | Tonscend     | TS <sup>+</sup> Ver2.1(JS32-RE) | 4.0.0.0             |
| <input checked="" type="checkbox"/> | AGC-ER-S012   | BT/WIFI Test System | Tonscend     | JS1120-2                        | 2.6                 |
| <input checked="" type="checkbox"/> | AGC-EM-S011   | RSE Test System     | Tonscend     | TS+-Ver2.1(JS36-RSE)            | 4.0.0.0             |

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## 4. System Test Configuration

### 4.1 EUT Configuration

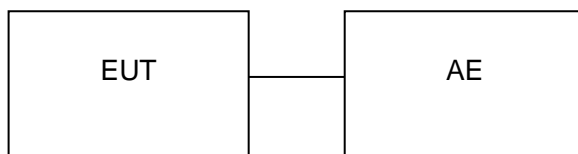
The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 4.2 EUT Exercise

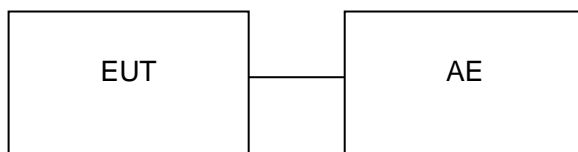
The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

### 4.3 Configuration of Tested System

Radiated Emission Configure:



Conducted Emission Configure:



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#### 4.4 Equipment Used in Tested System

The following peripheral devices and interface cables were connected during the measurement:

☒ Test Accessories Come From The Laboratory

| No. | Equipment   | Manufacturer | Model No.    | Specification Information | Cable |
|-----|-------------|--------------|--------------|---------------------------|-------|
| 1   | Control Box | --           | USB-TTL      | --                        | --    |
| 2   | Adapter     | HUAWEI       | HW-200440C00 | --                        | --    |

☒ Test Accessories Come From The Manufacturer

| No. | Equipment | Manufacturer | Model No. | Specification Information | Cable          |
|-----|-----------|--------------|-----------|---------------------------|----------------|
| 1   | USB Cable | /            | /         | /                         | 1.75m shielded |

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#### 4.5 Summary of Test Results

| Item | FCC Rules            | Description of Test                           | Result |
|------|----------------------|---|--------|
| 1    | §15.203&15.247(b)(4) | Antenna Equipment                             | Pass   |
| 2    | §15.247 (b)(1)       | RF Output Power                               | Pass   |
| 3    | §15.247 (a)(1)       | 20 dB Bandwidth                               | Pass   |
| 4    | §15.247 (d)          | Conducted Band Edge and Out-of-Band Emissions | Pass   |
| 5    | §15.209              | Radiated Spurious Emission                    | Pass   |
| 6    | §15.247 (a)(1)(iii)  | Number of Hopping Frequency                   | Pass   |
| 7    | §15.247 (a)(1)(iii)  | Time of Occupancy                             | Pass   |
| 8    | §15.247 (a)(1)       | Frequency Separation                          | Pass   |
| 9    | §15.207              | AC Power Line Conducted Emission              | Pass   |

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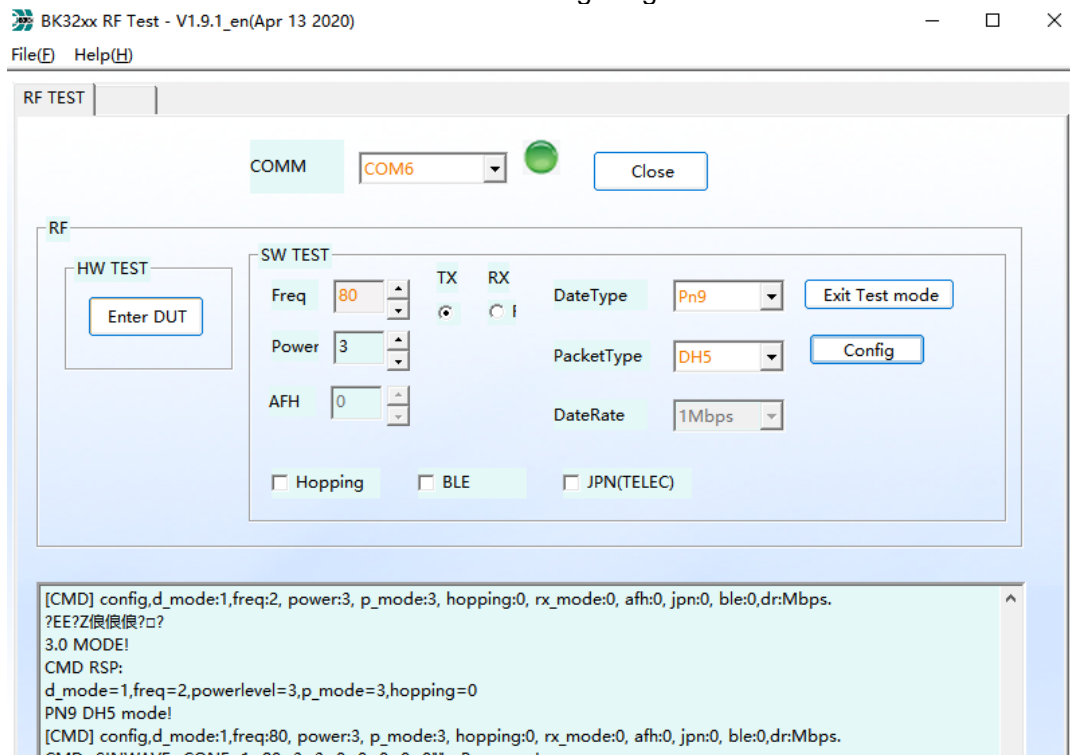
## 5. Description of Test Modes

| Summary table of Test Cases     |   |
|---------------------------------|---|
| Test Item                       | Data Rate / Modulation  |
|                                 | Bluetooth – BR_EDR (GFSK)   |
| Radiated & Conducted Test Cases | Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps (Battery powered or AC/DC adapter or Connected PC) |
|                                 | Mode 2: Bluetooth Tx CH39_2441 MHz_1Mbps (Battery powered or AC/DC adapter or Connected PC) |
|                                 | Mode 3: Bluetooth Tx CH78_2480 MHz_1Mbps (Battery powered or AC/DC adapter or Connected PC) |
|                                 | Mode4: Bluetooth Tx Hopping-1Mbps (Battery powered or AC/DC adapter or Connected PC)        |
| AC Conducted Emission           | Mode 1: Bluetooth Link + Battery + USB Cable (Charging from AC Adapter or Connected PC)     |

Note:

1. Only the result of the worst case was recorded in the report, if no other cases.
2. The battery is full-charged during the test.
3. For Radiated Emission, 3axis were chosen for testing for each applicable mode.
4. For Conducted Test method, a temporary antenna connector is provided by the manufacture.

Software Setting Diagram



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## 6. RF Output Power Measurement

### 6.1 Provisions Applicable

The maximum out power permissible output power is 1 Watt for all frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels.

The maximum out power permissible output power is 0.125 watts for all other frequency hopping systems in the 2400-2483.5 MHz band.

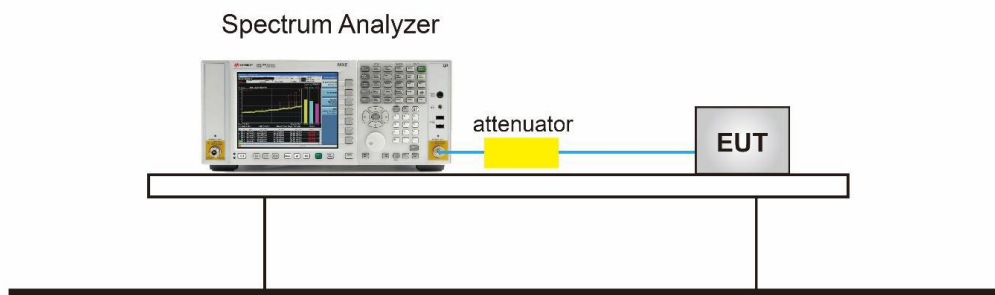
### 6.2 Measurement Procedure

☒ For Peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
3. RBW > 20 dB bandwidth of the emission being measured.
4. VBW  $\geq$  RBW.
5. Sweep: Auto.
6. Detector function: Peak.
7. Trace: Max hold.
8. Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power, after any corrections for external attenuators and cables.

### 6.3 Measurement Setup (Block Diagram of Configuration)

☒ For peak power test setup



### 6.4 Measurement Result

| Test Data of Conducted Output Power |                      |                  |              |              |
|-------------------------------------|----------------------|------------------|--------------|--------------|
| Test Mode                           | Test Frequency (MHz) | Peak Power (dBm) | Limits (dBm) | Pass or Fail |
| GFSK                                | 2402                 | -4.387           | $\leq 21$    | Pass         |
|                                     | 2441                 | -4.297           | $\leq 21$    | Pass         |
|                                     | 2480                 | -3.894           | $\leq 21$    | Pass         |

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### Test Graphs of Conducted Output Power

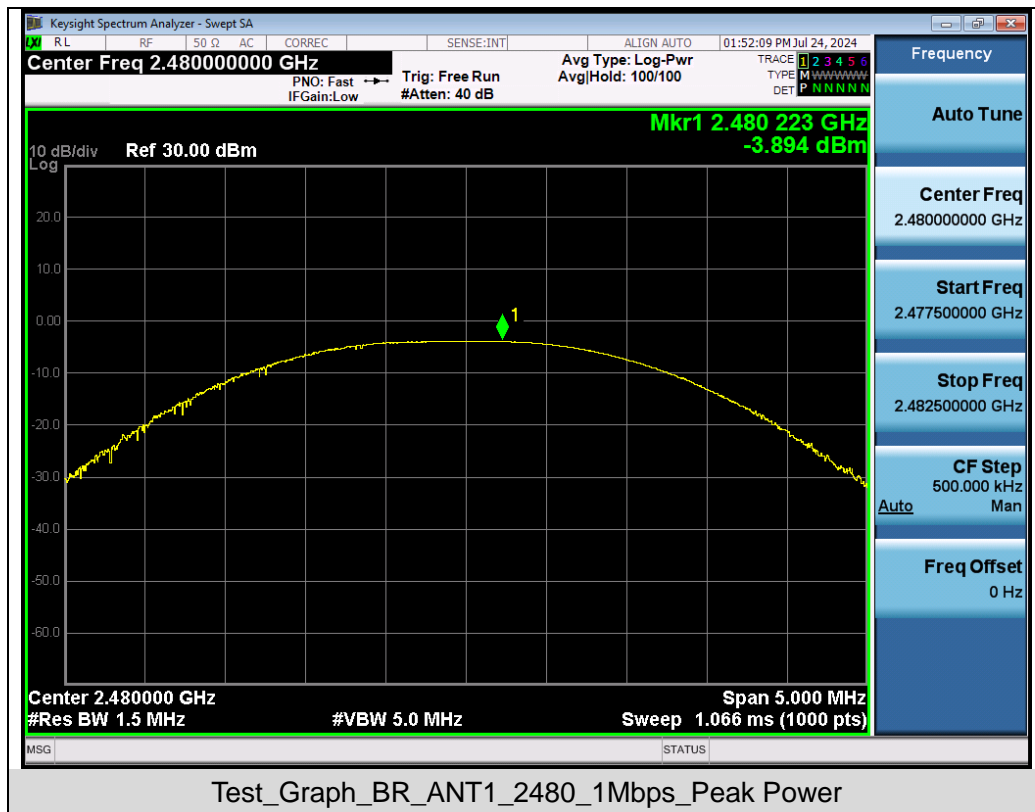


Test\_Graph\_BR\_ANT1\_2402\_1Mbps\_Peak Power



Test\_Graph\_BR\_ANT1\_2441\_1Mbps\_Peak Power

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## 7. 20dB Bandwidth and 99% Occupied Bandwidth Measurement

### 7.1 Provisions Applicable

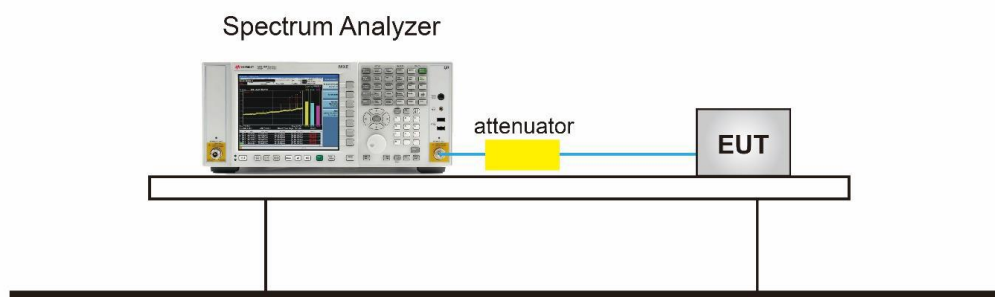
There is no corresponding limit requirement for this test item.

### 7.2 Measurement Procedure

The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 6.9.2 (20dB BW).

- The 20dB bandwidth spectrum analyzer setting reference is as follows:
  1. Set RBW  $\geq 1\%$  to 5% of the 20dB bandwidth
  2. VBW = Approximately three times RBW
  3. Span = Approximately 2 to 5 times the 20dB bandwidth, centered on a hopping channel
  4. Detector = Peak
  5. Trace mode = Max hold
  6. Sweep = Auto couple
  7. Allow the trace to stabilize
  8. Measure the maximum width of the emission that is constrained by the frequencies associated
  9. with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20
  10. dB relative to the maximum level in the fundamental emission.
- The 99% bandwidth spectrum analyzer setting reference is as follows:
  1. Span = 1.5 times to 5 times the OBW
  2. Set RBW = 1% to 5% the OBW
  3. VBW  $\geq 3 \times$  RBW
  4. Detector = Peak
  5. Trace mode = Max hold
  6. Sweep = Auto couple
  7. Allow the trace was allowed to stabilize

### 7.3 Measurement Setup (Block Diagram of Configuration)

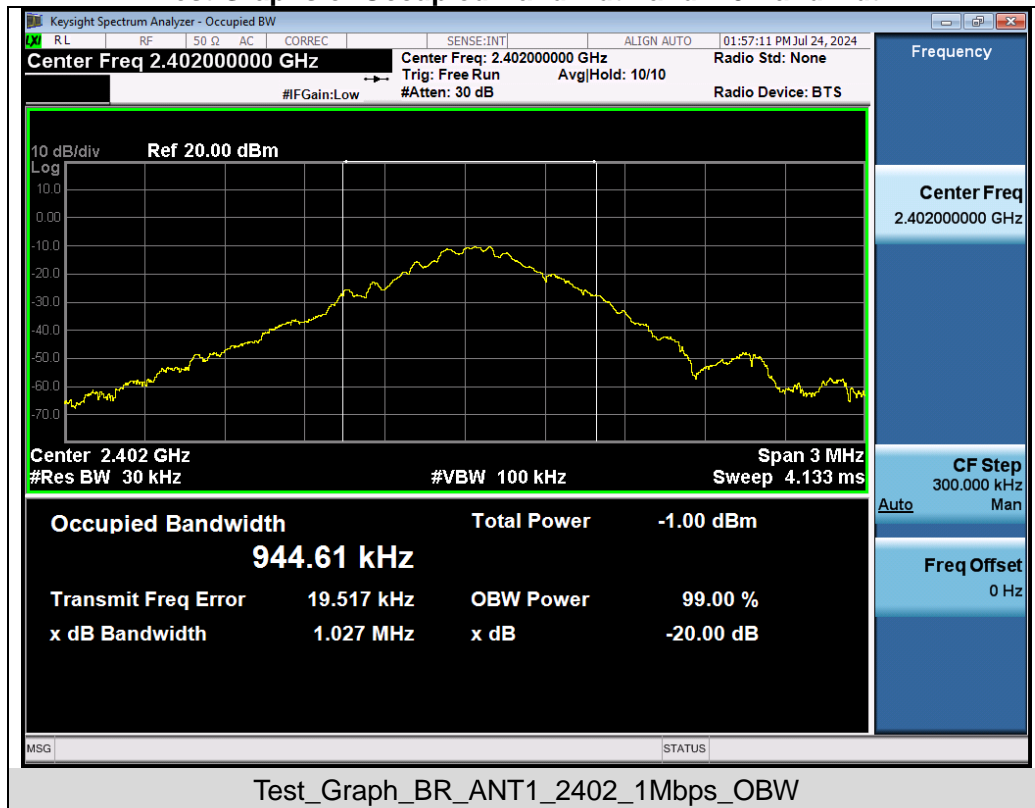


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## 7.4 Measurement Results

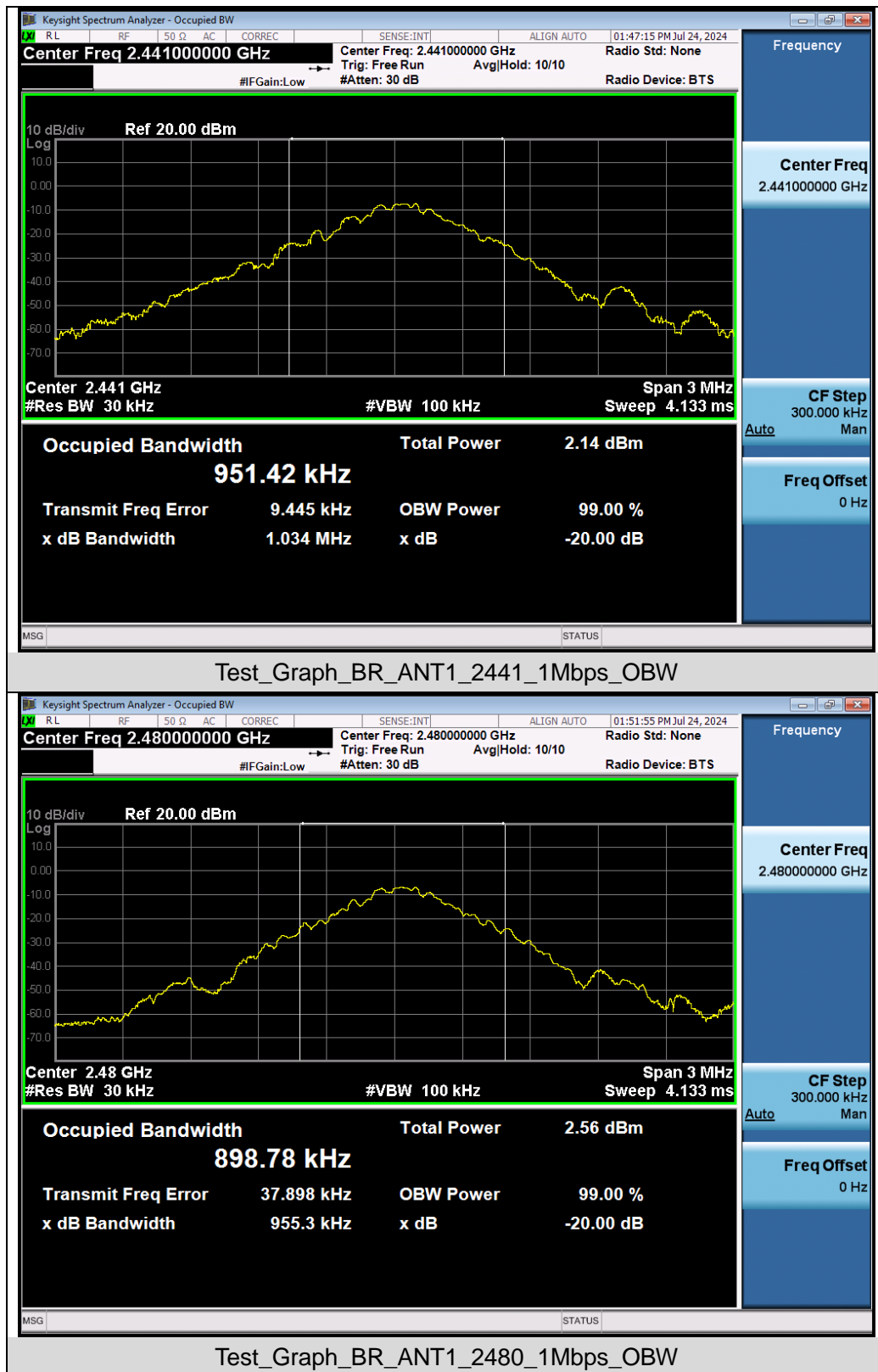
| Test Data of Occupied Bandwidth and -20dB Bandwidth |                      |                              |                       |        |              |
|---|----------------------|------------------------------|-----------------------|--------|--------------|
| Test Mode   | Test Frequency (MHz) | 99% Occupied Bandwidth (MHz) | -20dB Bandwidth (MHz) | Limits | Pass or Fail |
| GFSK  | 2402                 | 0.945                        | 1.027                 | N/A    | Pass         |
|   | 2441                 | 0.951                        | 1.034                 | N/A    | Pass         |
|   | 2480                 | 0.899                        | 0.955                 | N/A    | Pass         |

Test Graphs of Occupied Bandwidth and -20 Bandwidth



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## 8. Conducted Band Edge and Out-of-Band Emissions

### 8.1 Provisions Applicable

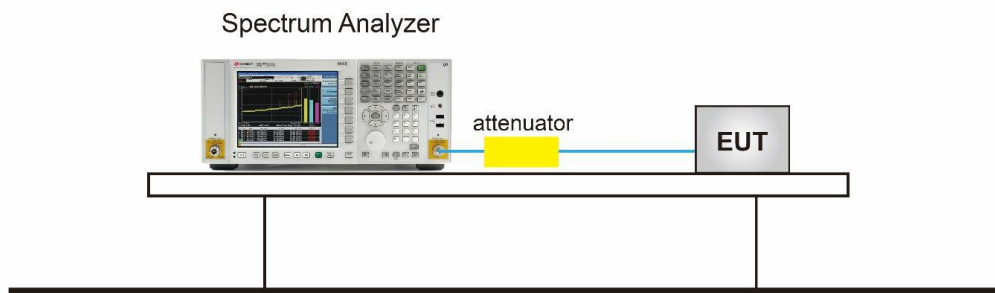
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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 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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

### 8.2 Measurement Procedure

The testing follows the ANSI C63.10 Section 6.10.4 and 7.8.8:

- Reference level measurement
  1. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
  2. RBW = 100kHz
  3. VBW = 300kHz
  4. Detector = Peak
  5. Sweep time = Auto couple
  6. Trace mode = Max hold
  7. Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- Emission level measurement
  1. 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.
  2. RBW = 100kHz
  3. VBW = 300kHz
  4. Detector = Peak
  5. Sweep time = Auto couple
  6. Trace mode = Max hold
  7. Trace was allowed to stabilize
  8. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

### 8.3 Measurement Setup (Block Diagram of Configuration)



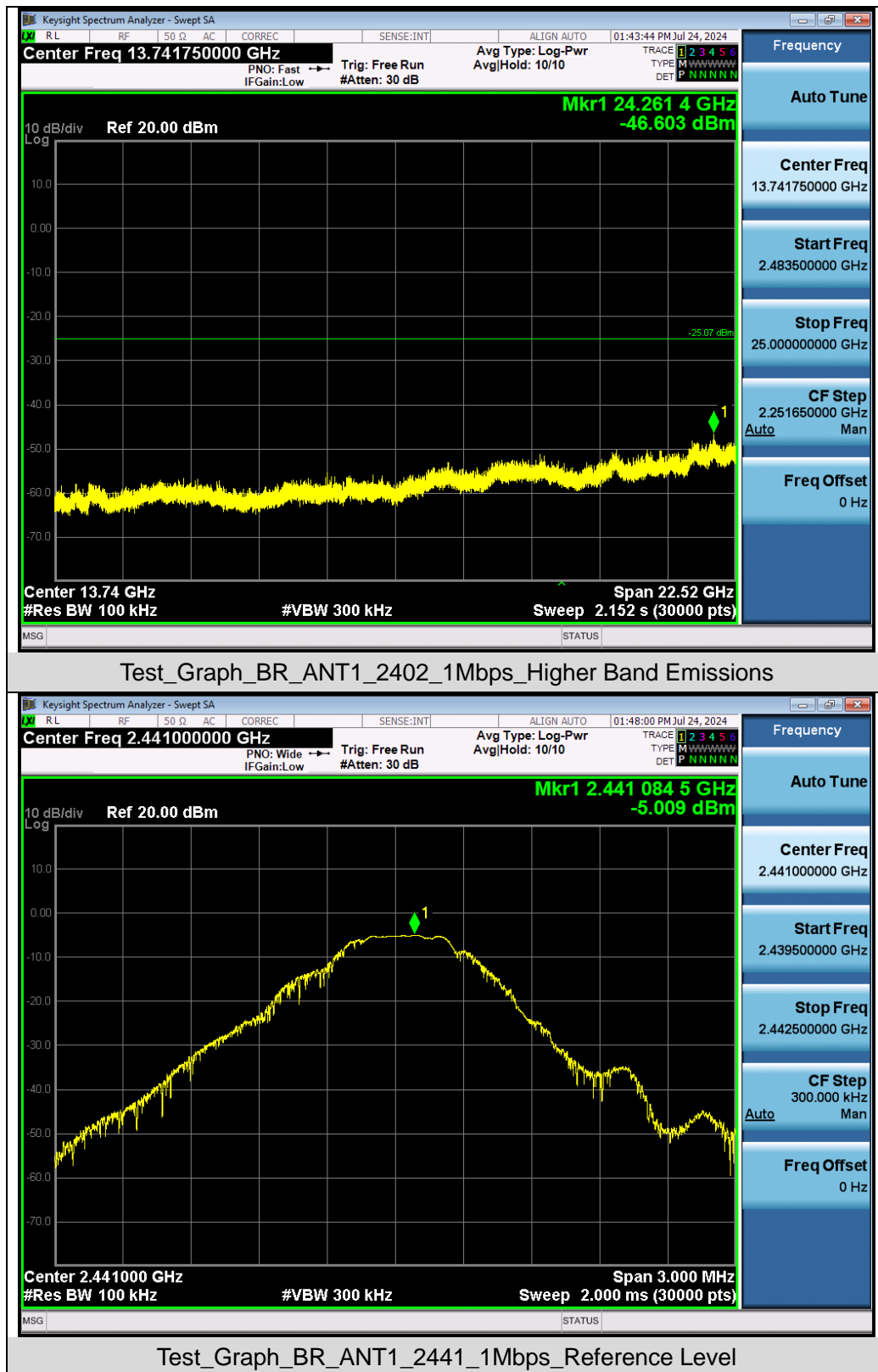
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## 8.4 Measurement Results

### Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands

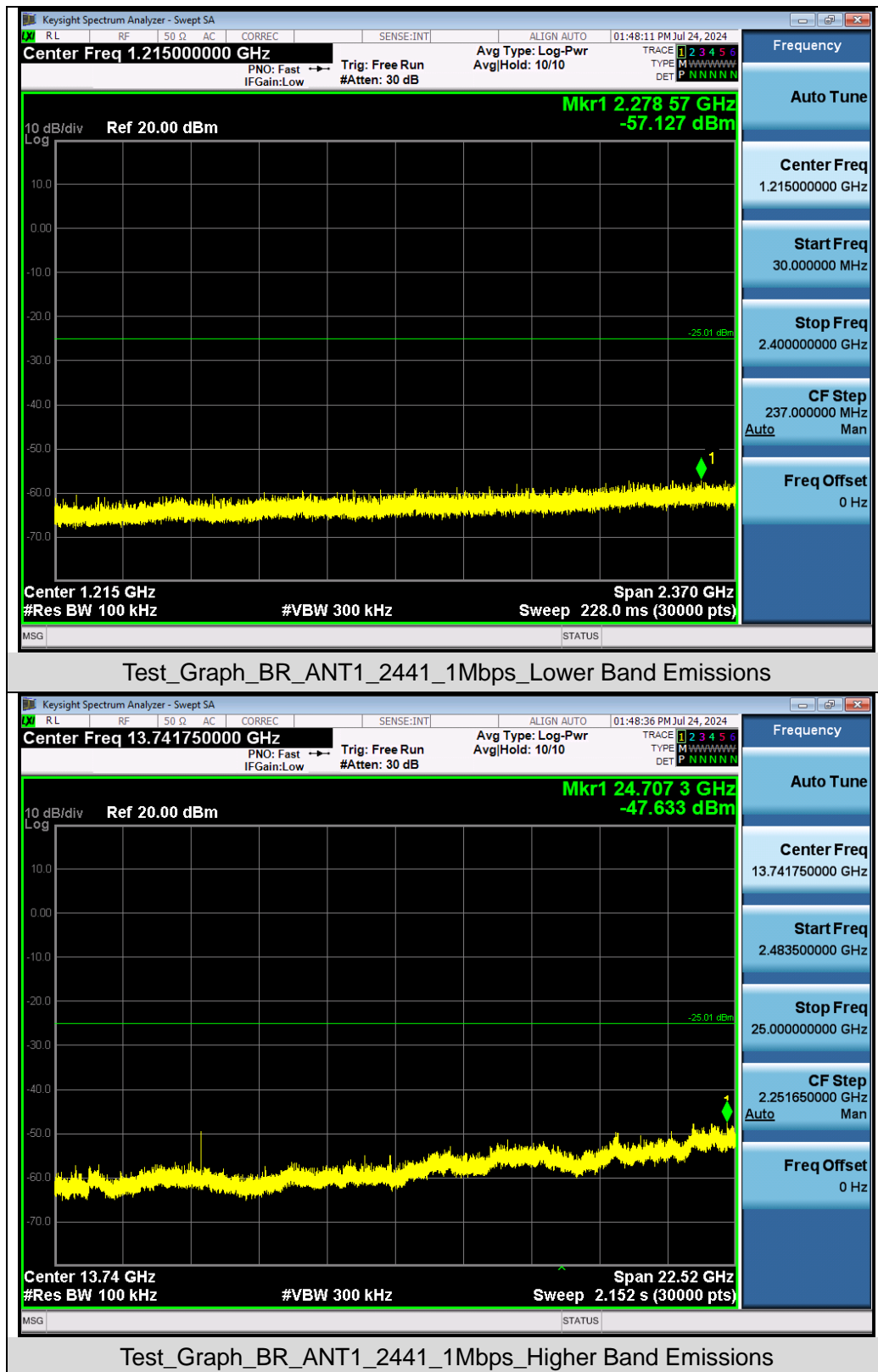


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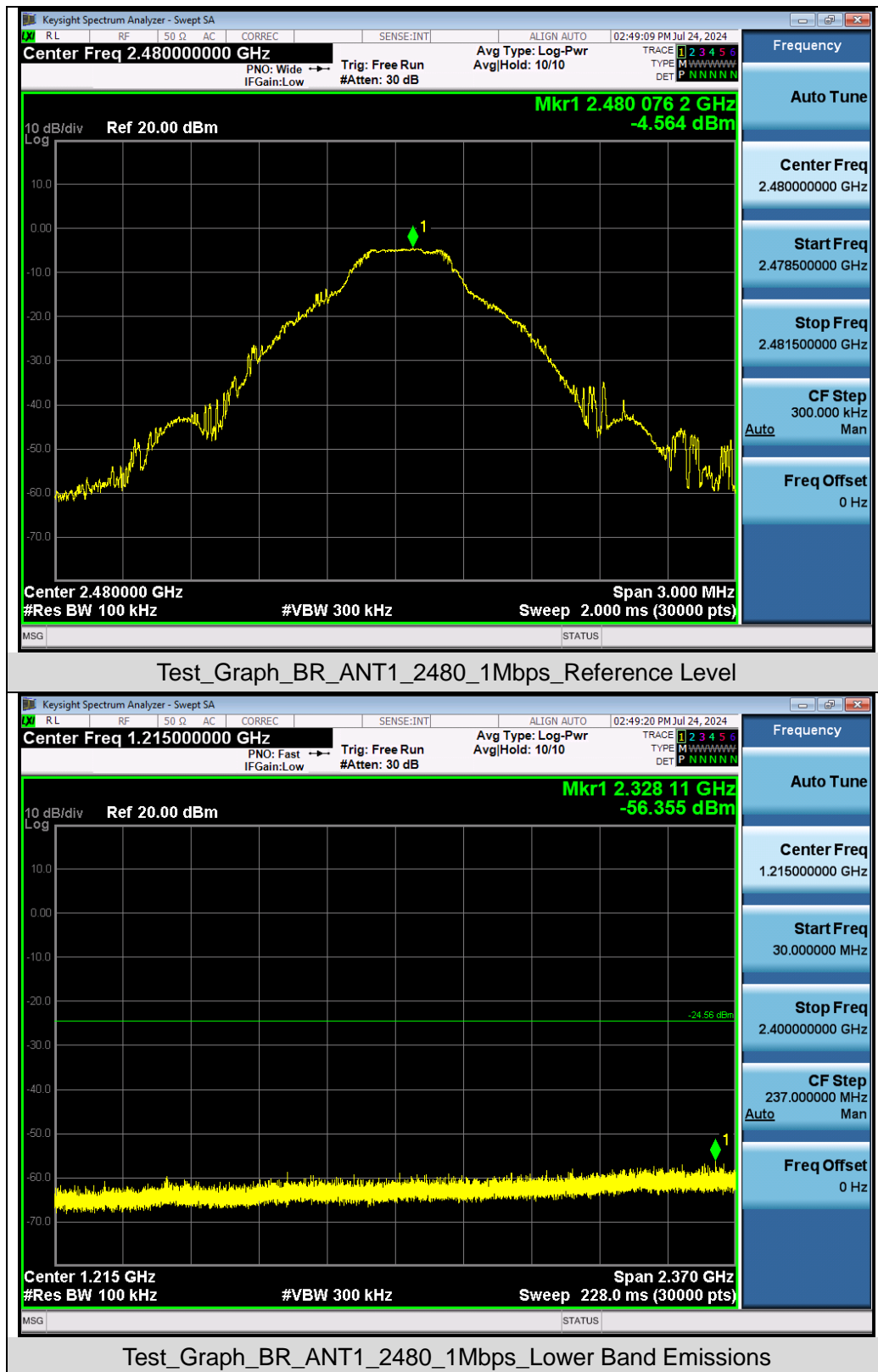
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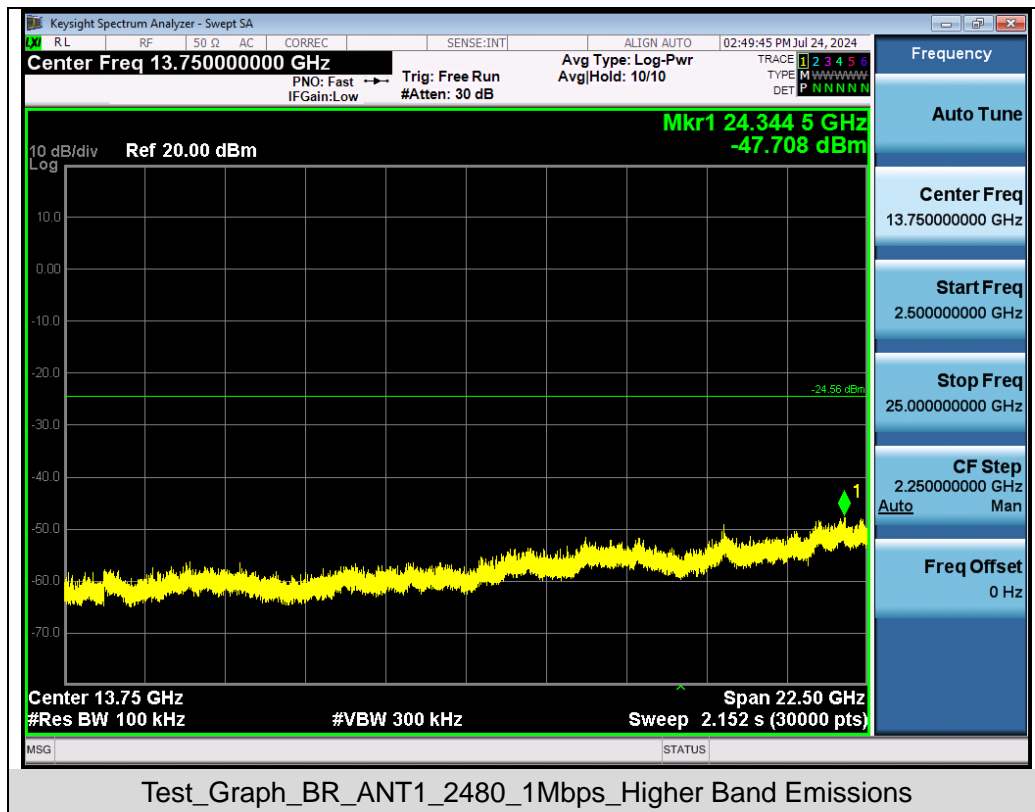
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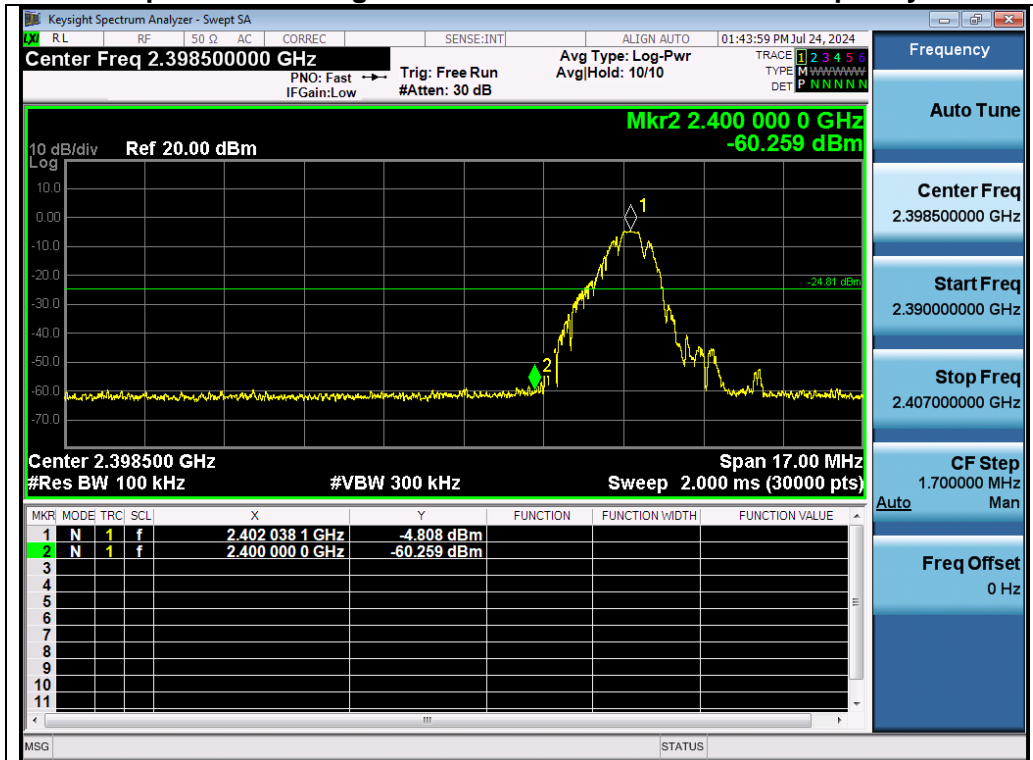


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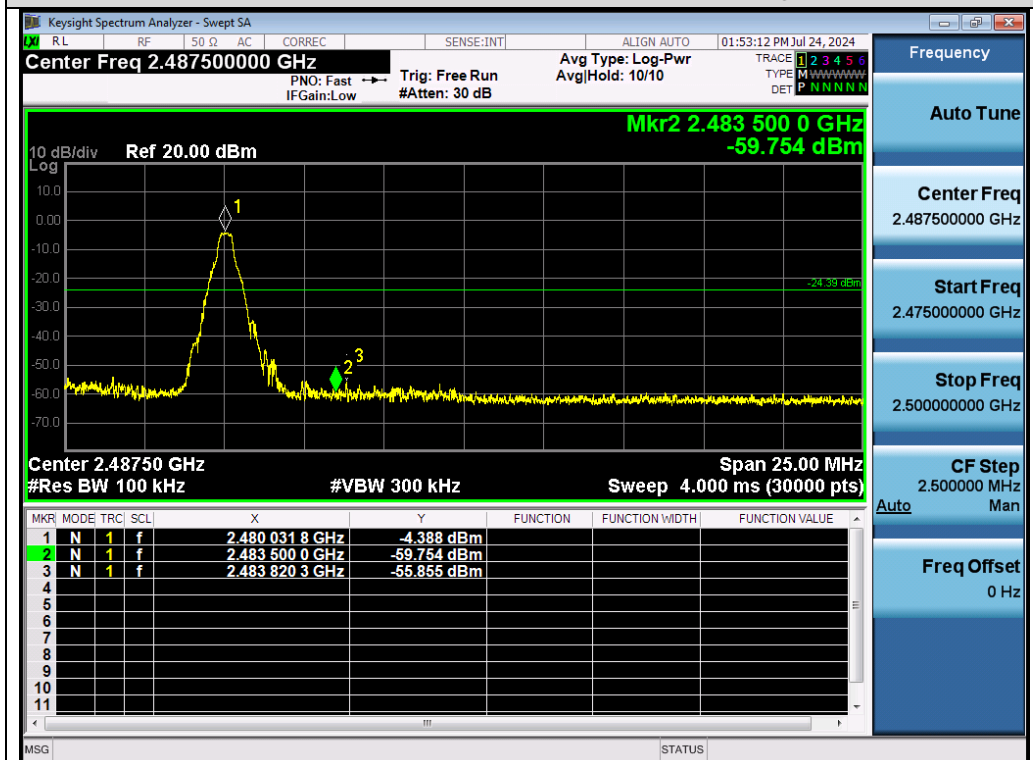
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### Test Graphs of Band Edge Emissions in Non-Restricted Frequency Bands

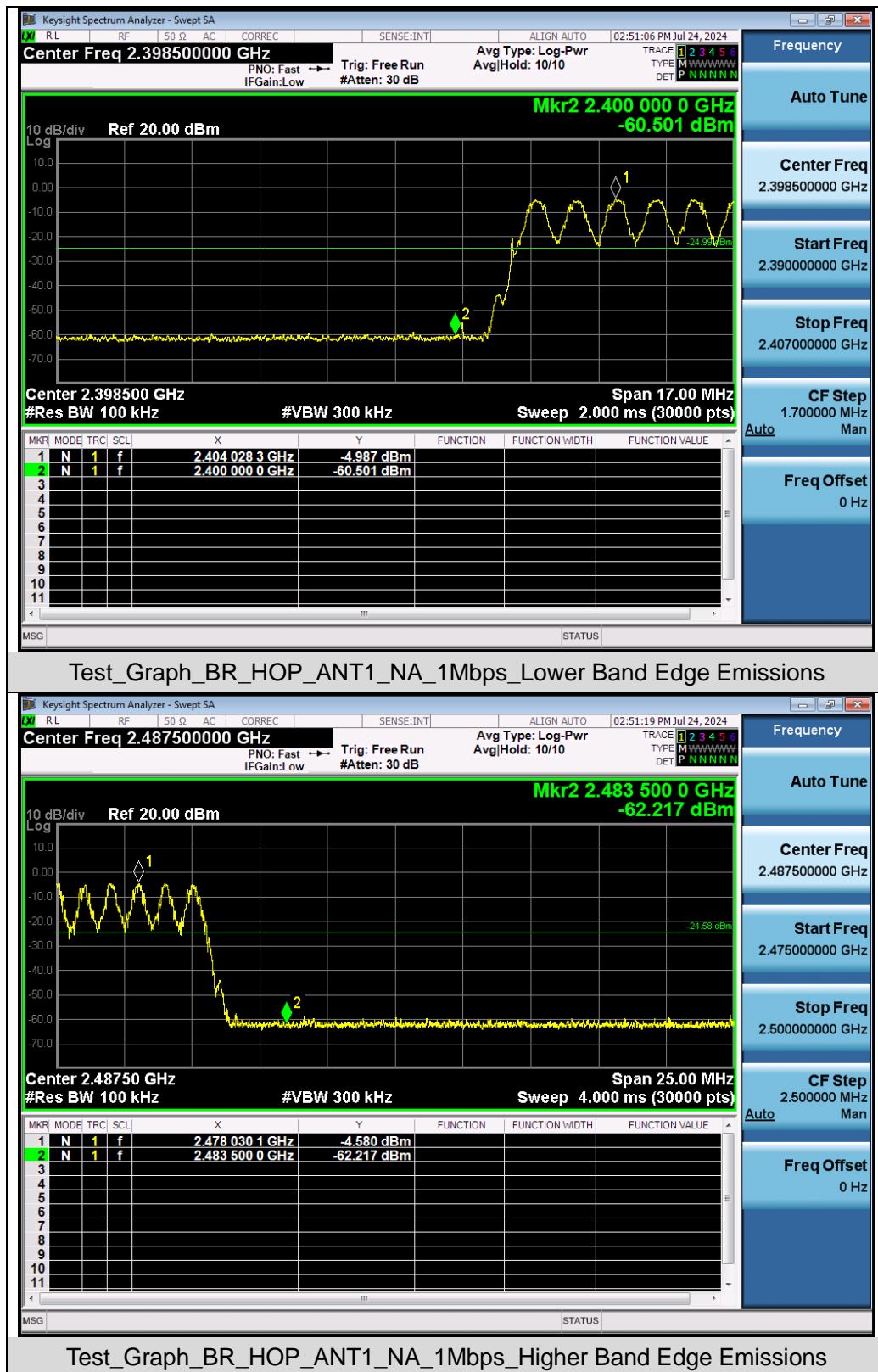


Test\_Graph\_BR\_ANT1\_2402\_1Mbps\_Lower Band Edge Emissions



Test\_Graph\_BR\_ANT1\_2480\_1Mbps\_Higher Band Edge Emissions

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## 9. Radiated Spurious Emission

### 9.1 Measurement Limit

15.209 Limit in the below table has to be followed

| Frequencies<br>(MHz) | Field Strength<br>(microvolts/meter) | Measurement Distance<br>(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                                |

Note: All modes were tested for restricted band radiated emission, the test records reported below are the worst result compared to other modes.

### 9.2 Measurement Procedure

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average

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absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.

8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

The following table is the setting of spectrum analyzer and receiver.

| Spectrum Parameter    | Setting   |
|-----------------------|---|
| Start ~Stop Frequency | 9KHz~150KHz/RB 200Hz for QP                               |
| Start ~Stop Frequency | 150KHz~30MHz/RB 9KHz for QP                               |
| Start ~Stop Frequency | 30MHz~1000MHz/RB 120KHz for QP                            |
| Start ~Stop Frequency | 1GHz~26.5GHz<br>1MHz/3MHz for Peak, 1MHz/3MHz for Average |

| Receiver Parameter    | Setting                        |
|-----------------------|--------------------------------|
| Start ~Stop Frequency | 9KHz~150KHz/RB 200Hz for QP    |
| Start ~Stop Frequency | 150KHz~30MHz/RB 9KHz for QP    |
| Start ~Stop Frequency | 30MHz~1000MHz/RB 120KHz for QP |

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● **Quasi-Peak Measurements below 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = as shown in the table above
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

● **Peak Measurements above 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

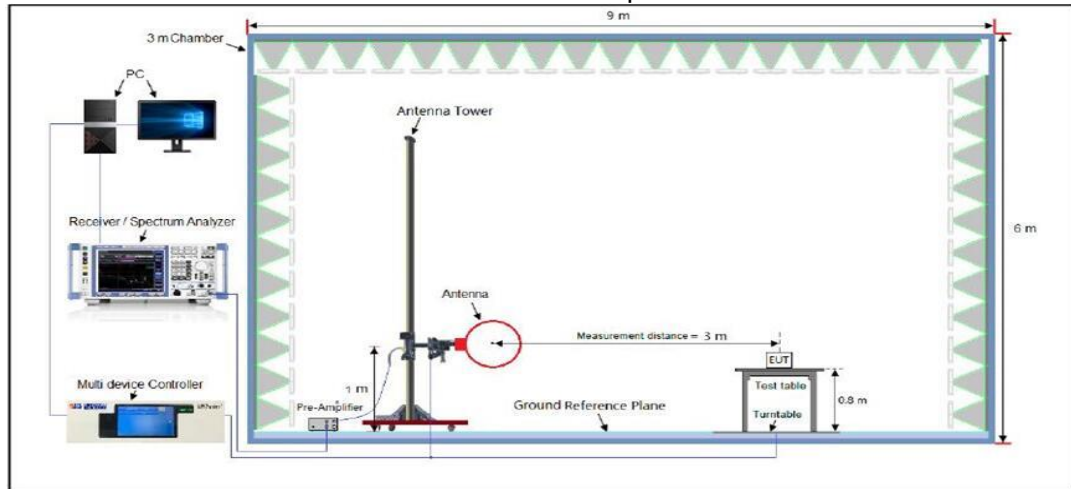
● **Average Measurements above 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW  $\geq [3 \times \text{RBW}]$
4. Detector = Power averaging (rms)
5. Averaging type = power (i.e., rms)
6. Sweep time = auto
7. Perform a trace average of at least 100 traces.
8. The applicable correction factor is  $[10 \cdot \log(1 / D)]$ , where D is the duty cycle. The factor had been edited in the "Input Correction" of the Spectrum Analyzer.

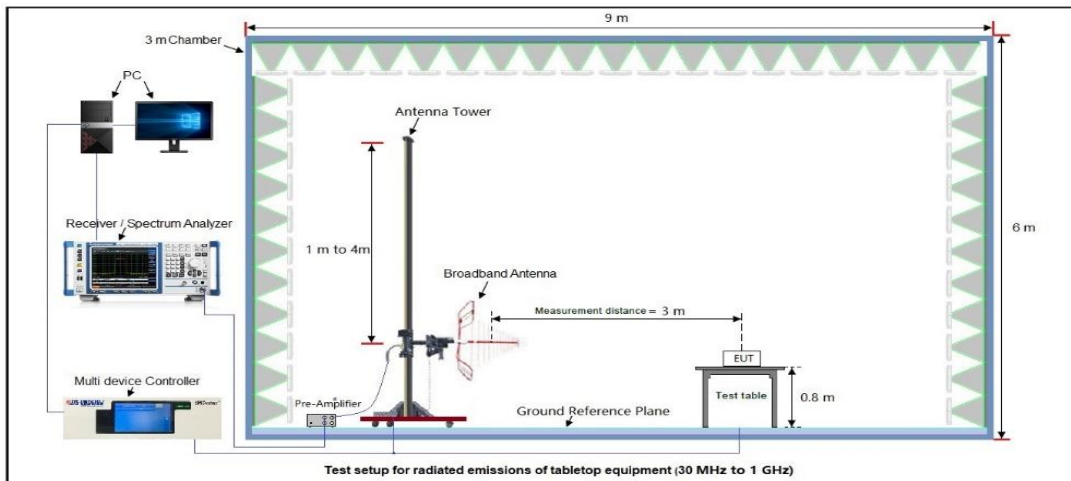


### 9.3 Measurement Setup (Block Diagram of Configuration)

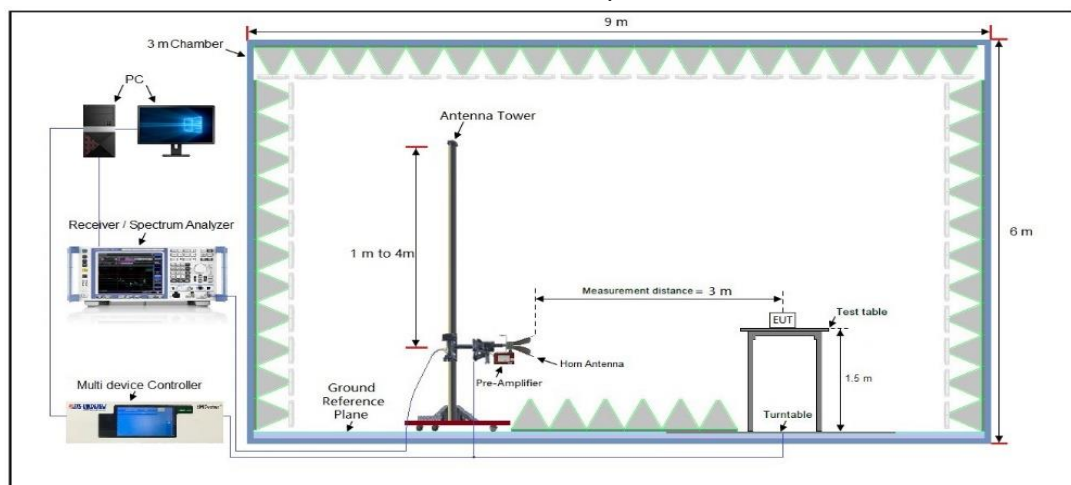
Radiated Emission Test Setup 9KHz-30MHz



Radiated Emission Test Setup 30MHz-1000MHz



Radiated Emission Test Setup Above 1000MHz

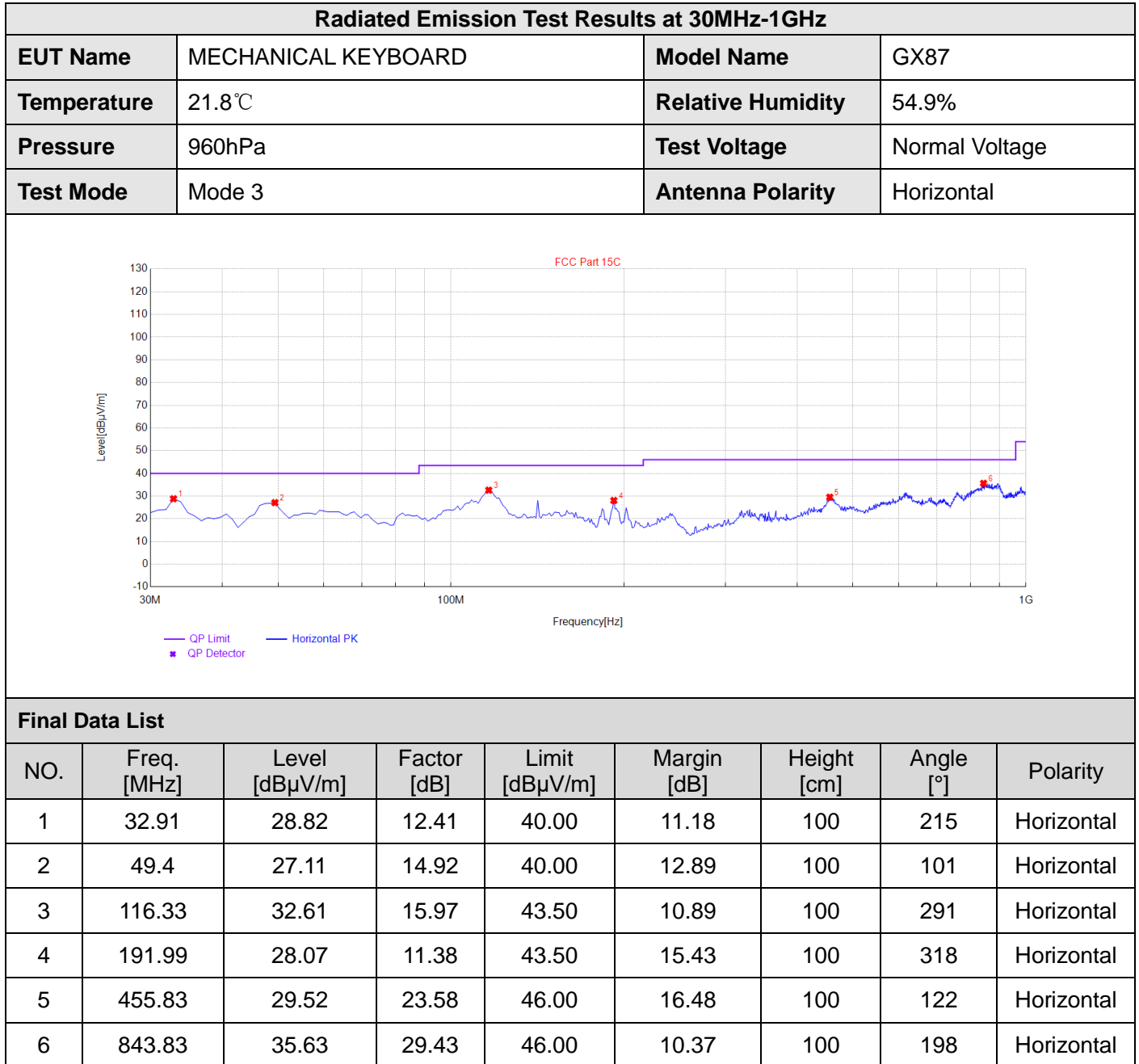


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## 9.4 Measurement Result

### Radiated Emission Below 30MHz

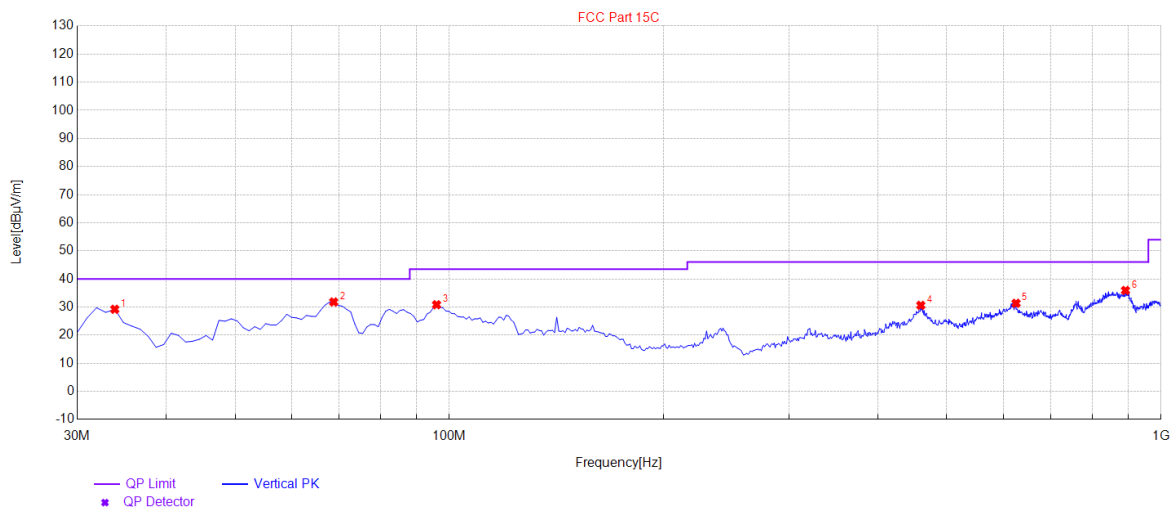
The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.



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| Radiated Emission Test Results at 30MHz-1GHz |                     |                   |                |
|--|---------------------|-------------------|----------------|
| EUT Name                                     | MECHANICAL KEYBOARD | Model Name        | GX87           |
| Temperature                                  | 21.8℃               | Relative Humidity | 54.9%          |
| Pressure                                     | 960hPa              | Test Voltage      | Normal Voltage |
| Test Mode                                    | Mode 3              | Antenna Polarity  | Vertical       |



#### Final Data List

| NO. | Freq. [MHz] | Level [dBμV/m] | Factor [dB] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
|-----|-------------|----------------|-------------|----------------|-------------|-------------|-----------|----------|
| 1   | 33.88       | 29.22          | 12.12       | 40.00          | 10.78       | 100         | 91        | Vertical |
| 2   | 68.8        | 31.81          | 15.04       | 40.00          | 8.19        | 100         | 113       | Vertical |
| 3   | 95.96       | 30.83          | 15.85       | 43.50          | 12.67       | 100         | 309       | Vertical |
| 4   | 459.71      | 30.62          | 24.69       | 46.00          | 15.38       | 100         | 96        | Vertical |
| 5   | 625.58      | 31.35          | 25.12       | 46.00          | 14.65       | 100         | 276       | Vertical |
| 6   | 891.36      | 35.91          | 29.88       | 46.00          | 10.09       | 100         | 360       | Vertical |

#### RESULT: Pass

**Note:** 1. Factor=Antenna Factor + Cable loss, Margin= Limit-Level.

2. All test modes had been pre-tested. The mode 3 is the worst case and recorded in the report.

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### Radiated Emissions Test Results Above 1GHz

|                    |                     |                          |                |
|--------------------|---------------------|--------------------------|----------------|
| <b>EUT Name</b>    | MECHANICAL KEYBOARD | <b>Model Name</b>        | GX87           |
| <b>Temperature</b> | 21.8℃               | <b>Relative Humidity</b> | 54.9%          |
| <b>Pressure</b>    | 960hPa              | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 1              | <b>Antenna Polarity</b>  | Horizontal     |

| Frequency<br>(MHz) | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|--------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4804.000           | 46.82                   | 0.08           | 46.9                       | 74                 | -27.1          | peak       |
| 4804.000           | 36.92                   | 0.08           | 37                         | 54                 | -17            | AVG        |
| 7206.000           | 42.45                   | 2.21           | 44.66                      | 74                 | -29.34         | peak       |
| 7206.000           | 33.51                   | 2.21           | 35.72                      | 54                 | -18.28         | AVG        |
|                    |                         |                |                            |                    |                |            |
|                    |                         |                |                            |                    |                |            |

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

|                    |                     |                          |                |
|--------------------|---------------------|--------------------------|----------------|
| <b>EUT Name</b>    | MECHANICAL KEYBOARD | <b>Model Name</b>        | GX87           |
| <b>Temperature</b> | 21.8℃               | <b>Relative Humidity</b> | 54.9%          |
| <b>Pressure</b>    | 960hPa              | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 1              | <b>Antenna Polarity</b>  | Vertical       |

| Frequency<br>(MHz) | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|--------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4804.000           | 46.27                   | 0.08           | 46.35                      | 74                 | -27.65         | peak       |
| 4804.000           | 37.48                   | 0.08           | 37.56                      | 54                 | -16.44         | AVG        |
| 7206.000           | 42.63                   | 2.21           | 44.84                      | 74                 | -29.16         | peak       |
| 7206.000           | 33.19                   | 2.21           | 35.4                       | 54                 | -18.6          | AVG        |
|                    |                         |                |                            |                    |                |            |
|                    |                         |                |                            |                    |                |            |

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

**RESULT: Pass**

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### Radiated Emissions Test Results for Above 1GHz

|                    |                     |                          |                |
|--------------------|---------------------|--------------------------|----------------|
| <b>EUT Name</b>    | MECHANICAL KEYBOARD | <b>Model Name</b>        | GX87           |
| <b>Temperature</b> | 21.8℃               | <b>Relative Humidity</b> | 54.9%          |
| <b>Pressure</b>    | 960hPa              | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 2              | <b>Antenna Polarity</b>  | Horizontal     |

| Frequency<br>(MHz) | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|--------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4882.000           | 46.18                   | 0.14           | 46.32                      | 74                 | -27.68         | peak       |
| 4882.000           | 37.42                   | 0.14           | 37.56                      | 54                 | -16.44         | AVG        |
| 7323.000           | 42.19                   | 2.36           | 44.55                      | 74                 | -29.45         | peak       |
| 7323.000           | 33.85                   | 2.36           | 36.21                      | 54                 | -17.79         | AVG        |
|                    |                         |                |                            |                    |                |            |
|                    |                         |                |                            |                    |                |            |

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

|                    |                     |                          |                |
|--------------------|---------------------|--------------------------|----------------|
| <b>EUT Name</b>    | MECHANICAL KEYBOARD | <b>Model Name</b>        | GX87           |
| <b>Temperature</b> | 21.8℃               | <b>Relative Humidity</b> | 54.9%          |
| <b>Pressure</b>    | 960hPa              | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 2              | <b>Antenna Polarity</b>  | Vertical       |

| Frequency<br>(MHz) | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|--------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4882.000           | 45.47                   | 0.14           | 45.61                      | 74                 | -28.39         | peak       |
| 4882.000           | 37.63                   | 0.14           | 37.77                      | 54                 | -16.23         | AVG        |
| 7323.000           | 41.23                   | 2.36           | 43.59                      | 74                 | -30.41         | peak       |
| 7323.000           | 34.04                   | 2.36           | 36.4                       | 54                 | -17.6          | AVG        |
|                    |                         |                |                            |                    |                |            |
|                    |                         |                |                            |                    |                |            |

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

**RESULT: Pass**

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### Radiated Emissions Test Results for Above 1GHz

|                    |                     |                          |                |
|--------------------|---------------------|--------------------------|----------------|
| <b>EUT Name</b>    | MECHANICAL KEYBOARD | <b>Model Name</b>        | GX87           |
| <b>Temperature</b> | 21.8℃               | <b>Relative Humidity</b> | 54.9%          |
| <b>Pressure</b>    | 960hPa              | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 3              | <b>Antenna Polarity</b>  | Horizontal     |

| Frequency<br>(MHz) | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|--------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4960.000           | 46.58                   | 0.22           | 46.8                       | 74                 | -27.2          | peak       |
| 4960.000           | 39.17                   | 0.22           | 39.39                      | 54                 | -14.61         | AVG        |
| 7440.000           | 42.46                   | 2.64           | 45.1                       | 74                 | -28.9          | peak       |
| 7440.000           | 32.38                   | 2.64           | 35.02                      | 54                 | -18.98         | AVG        |
|                    |                         |                |                            |                    |                |            |
|                    |                         |                |                            |                    |                |            |

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

|                    |                     |                          |                |
|--------------------|---------------------|--------------------------|----------------|
| <b>EUT Name</b>    | MECHANICAL KEYBOARD | <b>Model Name</b>        | GX87           |
| <b>Temperature</b> | 21.8℃               | <b>Relative Humidity</b> | 54.9%          |
| <b>Pressure</b>    | 960hPa              | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 3              | <b>Antenna Polarity</b>  | Vertical       |

| Frequency<br>(MHz) | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|--------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4960.000           | 46.25                   | 0.22           | 46.47                      | 74                 | -27.53         | peak       |
| 4960.000           | 37.41                   | 0.22           | 37.63                      | 54                 | -16.37         | AVG        |
| 7440.000           | 41.49                   | 2.64           | 44.13                      | 74                 | -29.87         | peak       |
| 7440.000           | 32.68                   | 2.64           | 35.32                      | 54                 | -18.68         | AVG        |
|                    |                         |                |                            |                    |                |            |
|                    |                         |                |                            |                    |                |            |

Remark:

Factor = Antenna Factor + Cable Loss – Pre-amplifier.

### RESULT: Pass

#### Note:

- The amplitude of other spurious emissions from 1G to 25 GHz which are attenuated more than 20 dB below the permissible value need not be reported.
- Factor = Antenna Factor + Cable loss – Pre-amplifier gain, Margin =Emission Level-Limit.
- The “Factor” value can be calculated automatically by software of measurement system.

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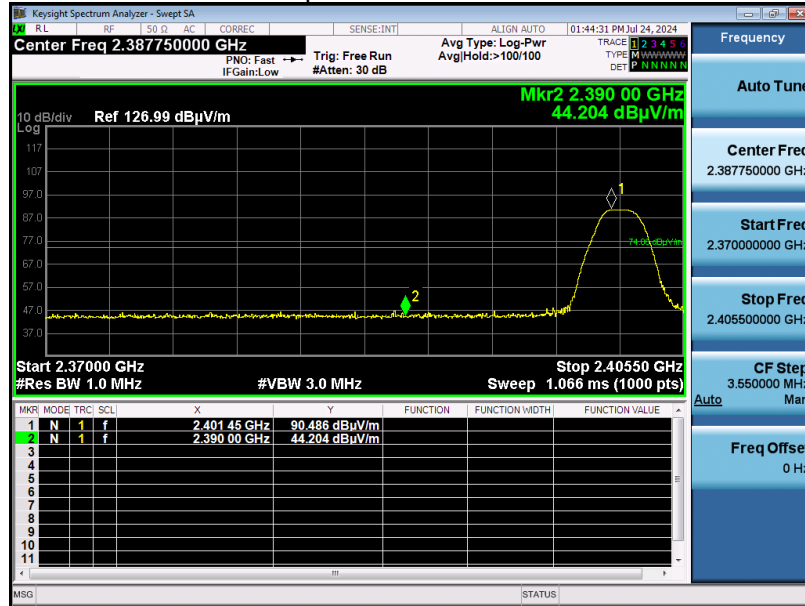
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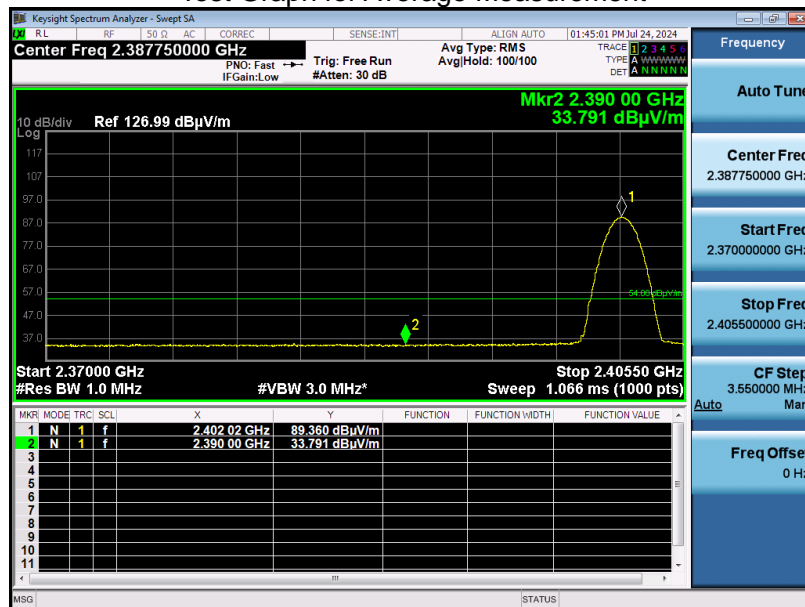
### Band Edge Emission Test Results for Restricted Bands

|             |                     |                   |                |
|-------------|---------------------|-------------------|----------------|
| EUT Name    | MECHANICAL KEYBOARD | Model Name        | GX87           |
| Temperature | 21.8°C              | Relative Humidity | 54.9%          |
| Pressure    | 960hPa              | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 1              | Antenna Polarity  | Horizontal     |

Test Graph for Peak Measurement



Test Graph for Average Measurement



**RESULT: Pass**

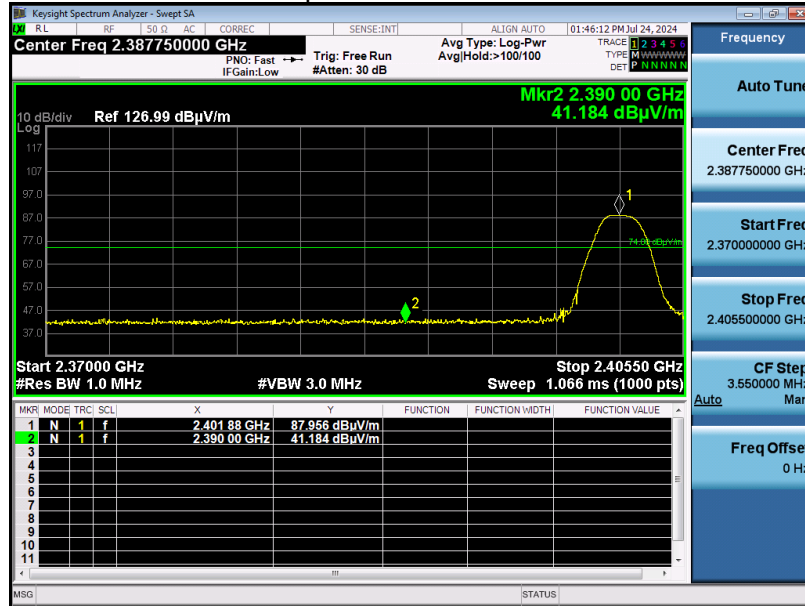
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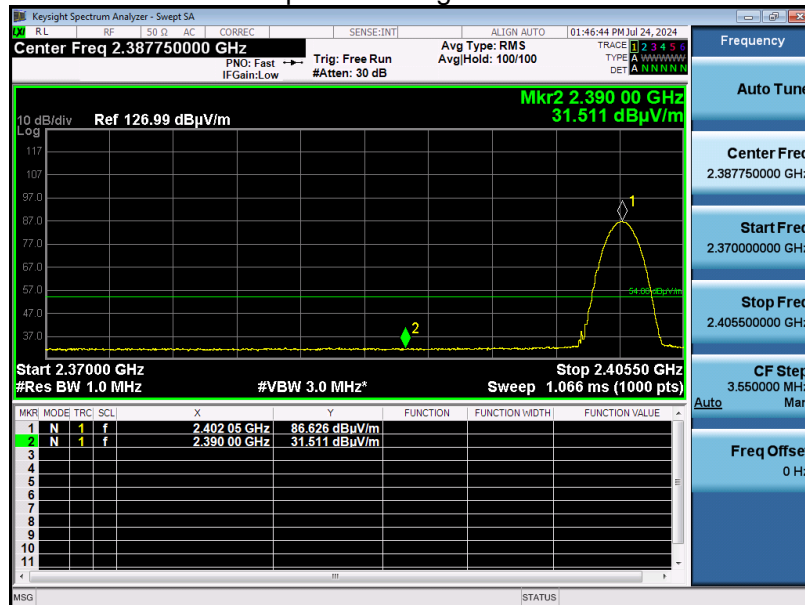
### Band Edge Emission Test Results for Restricted Bands

|             |                     |                   |                |
|-------------|---------------------|-------------------|----------------|
| EUT Name    | MECHANICAL KEYBOARD | Model Name        | GX87           |
| Temperature | 21.8°C              | Relative Humidity | 54.9%          |
| Pressure    | 960hPa              | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 1              | Antenna Polarity  | Vertical       |

Test Graph for Peak Measurement



Test Graph for Average Measurement



**RESULT: Pass**

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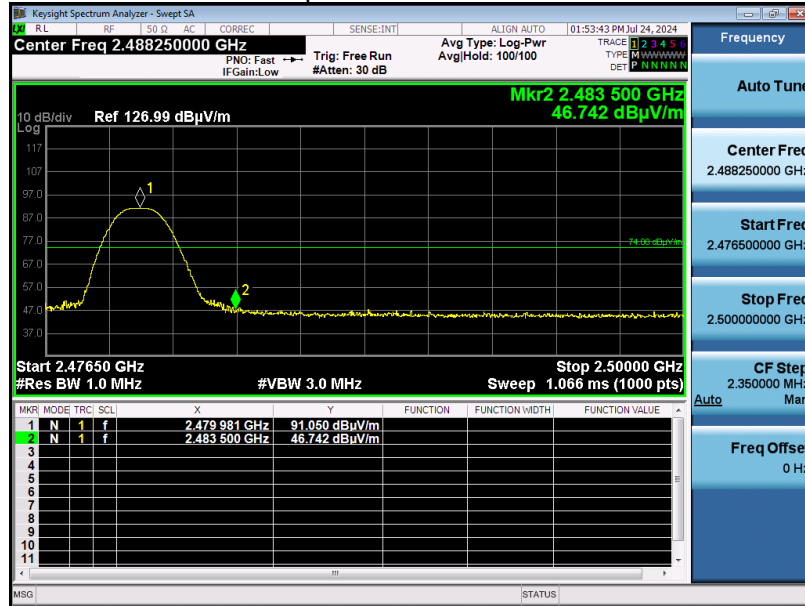
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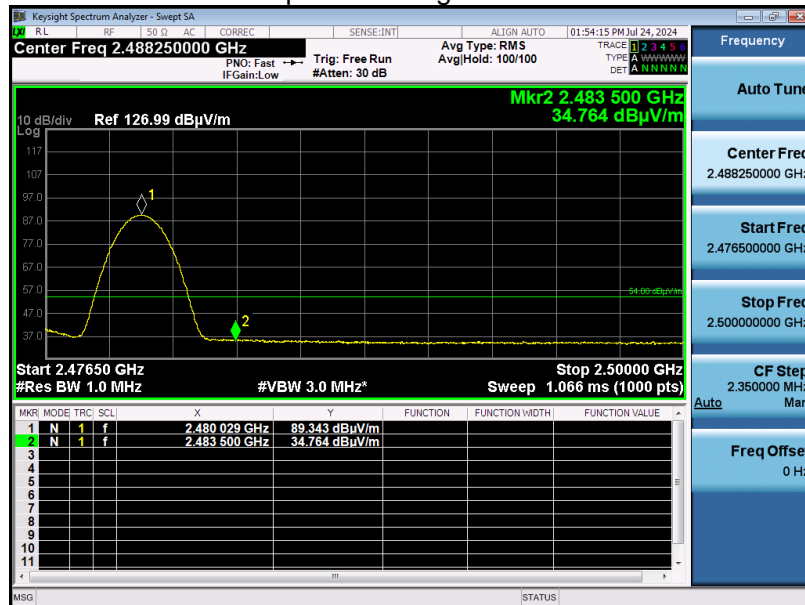
### Band Edge Emission Test Results for Restricted Bands

|             |                     |                   |                |
|-------------|---------------------|-------------------|----------------|
| EUT Name    | MECHANICAL KEYBOARD | Model Name        | GX87           |
| Temperature | 21.8°C              | Relative Humidity | 54.9%          |
| Pressure    | 960hPa              | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 3              | Antenna Polarity  | Horizontal     |

Test Graph for Peak Measurement



Test Graph for Average Measurement



**RESULT: Pass**

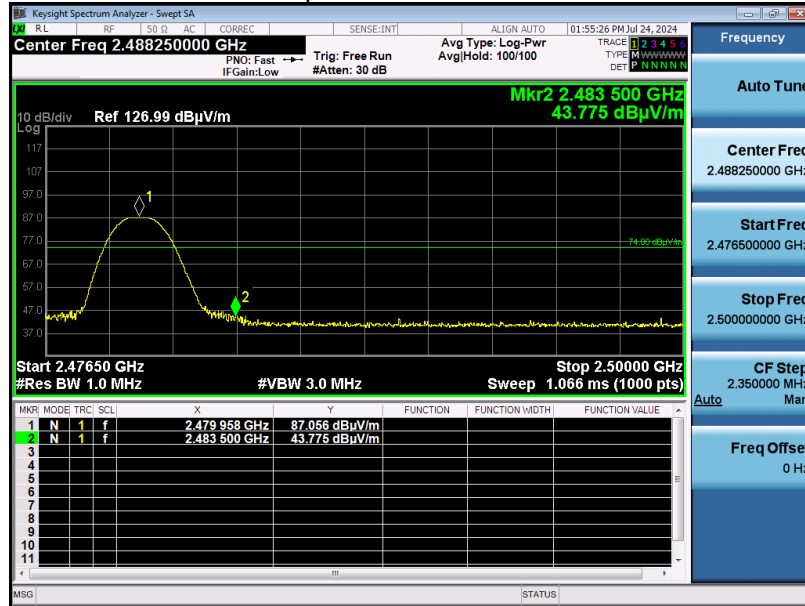
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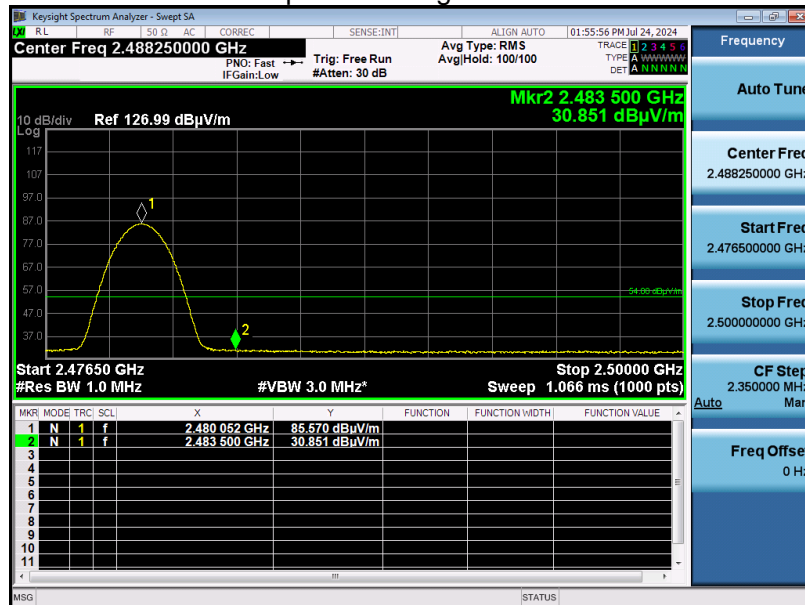
### Band Edge Emission Test Results for Restricted Bands

|             |                     |                   |                |
|-------------|---------------------|-------------------|----------------|
| EUT Name    | MECHANICAL KEYBOARD | Model Name        | GX87           |
| Temperature | 21.8°C              | Relative Humidity | 54.9%          |
| Pressure    | 960hPa              | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 3              | Antenna Polarity  | Vertical       |

Test Graph for Peak Measurement



Test Graph for Average Measurement



### RESULT: Pass

Note: The factor had been edited in the “Input Correction” of the Spectrum Analyzer.

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## 10. Number of Hopping Frequency Measurement

### 10.1 Provisions Applicable

This frequency hopping system must employ a minimum of 15 hopping channels.

### 10.2 Measurement Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span = The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. 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.
3. VBW  $\geq$  RBW
4. Sweep time = Auto couple
5. Detector = Peak
6. Trace mode = Max hold
7. Allow the trace to stabilize

### 10.3 Measurement Setup (Block Diagram of Configuration)

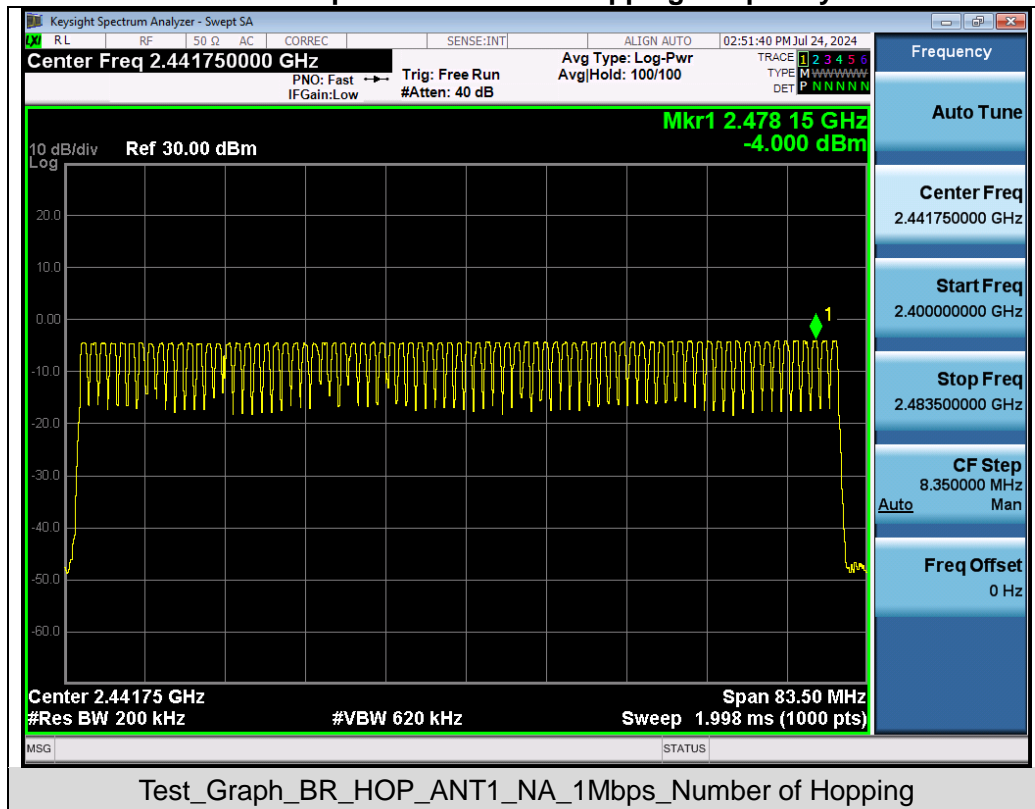


### 10.4 Measurement Result

| Test Data of Number of Hopping Frequency |                             |           |              |
|--|-----------------------------|-----------|--------------|
| Test Mode                                | Number of Hopping Frequency | Limits    | Pass or Fail |
| GFSK Hopping                             | 79                          | $\geq 15$ | Pass         |

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### Test Graphs of Number of Hopping Frequency



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## 11. Time of Occupancy (Dwell Time) Measurement

### 11.1 Provisions Applicable

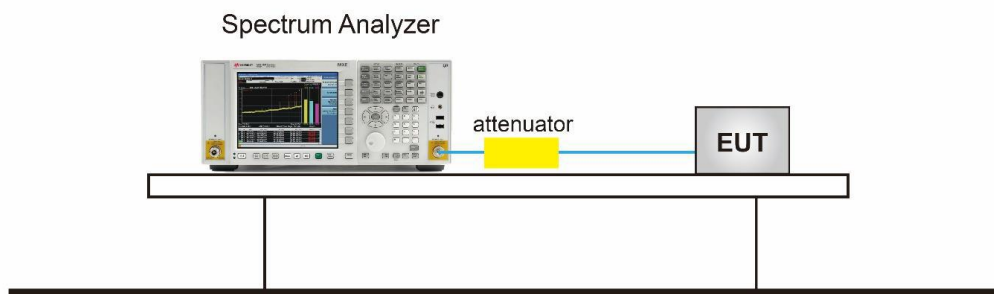
The maximum permissible time of occupancy is 400ms within a period of 400ms multiplied by the number of hopping channels employed.

### 11.2 Measurement Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span = Zero span, centered on a hopping channel.
2. RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where T is the expected dwell time per channel.
3. VBW  $\geq$  RBW
4. Sweep time = As necessary to capture the entire dwell time per hopping channel
5. Detector = Peak
6. Trace mode = Free Run
7. 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. An oscilloscope may be used instead of a spectrum analyzer. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

### 11.3 Measurement Setup (Block Diagram of Configuration)

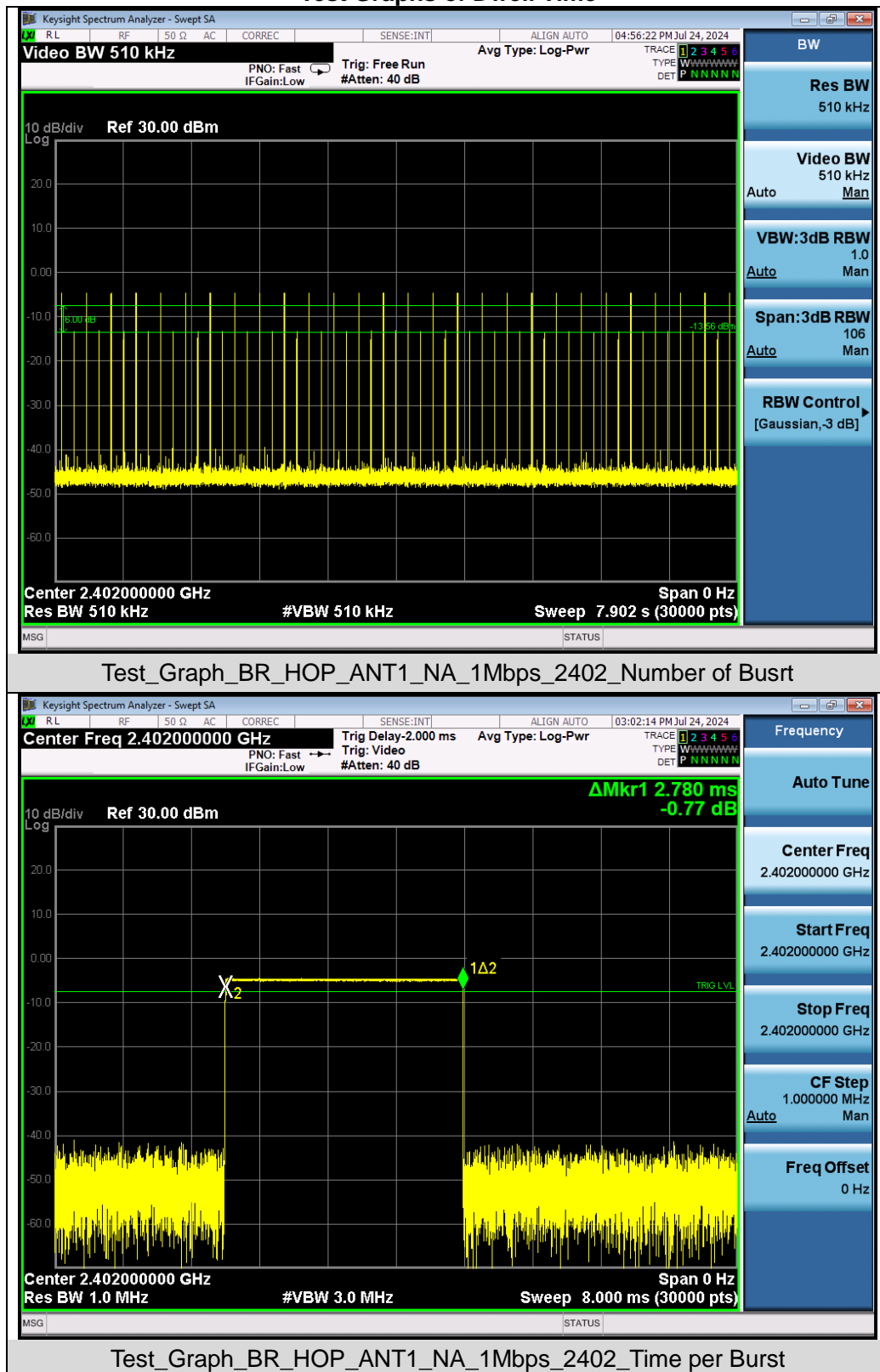


### 11.4 Measurement Result

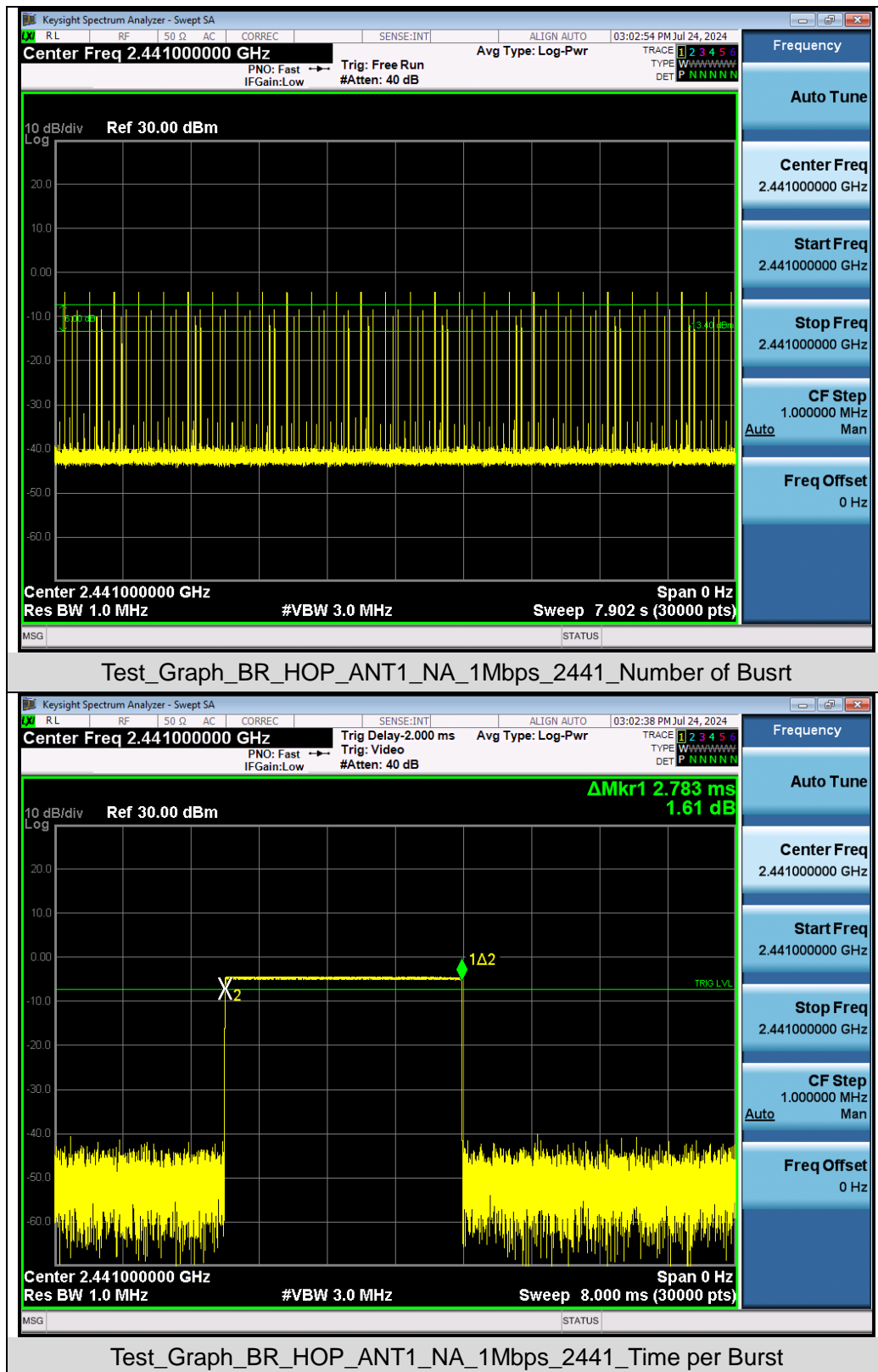
| Test Data of Dwell Time |                            |  |                 |            |              |
|-------------------------|----------------------------|--|-----------------|------------|--------------|
| Channel                 | Time of Pulse for DH5 (ms) | Number of hops in the period specified in the requirements | Dwell Time (ms) | Limit (ms) | Pass or Fail |
| 2402                    | 2.780                      | 28.0*4   | 311.360         | 400        | Pass         |
| 2441                    | 2.783                      | 28.0*4   | 311.696         | 400        | Pass         |
| 2480                    | 2.783                      | 27.0*4   | 300.564         | 400        | Pass         |

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### Test Graphs of Dwell Time

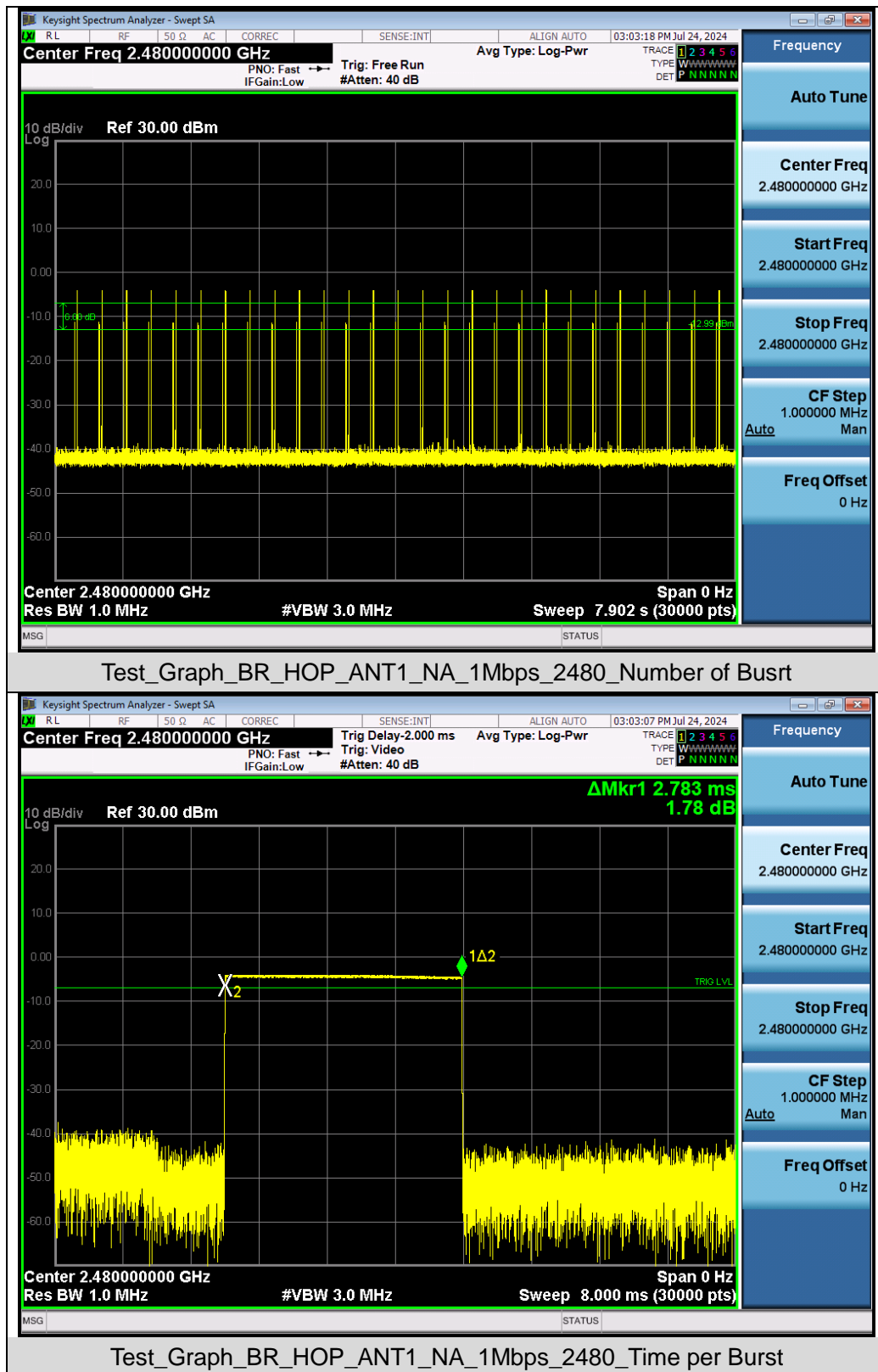


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## 12. Frequency Separation Measurement

### 12.1 Provisions Applicable

When the power is less than 0.125W: The minimum permissible channel separation for this system is 2/3 the value of the 20dB BW.

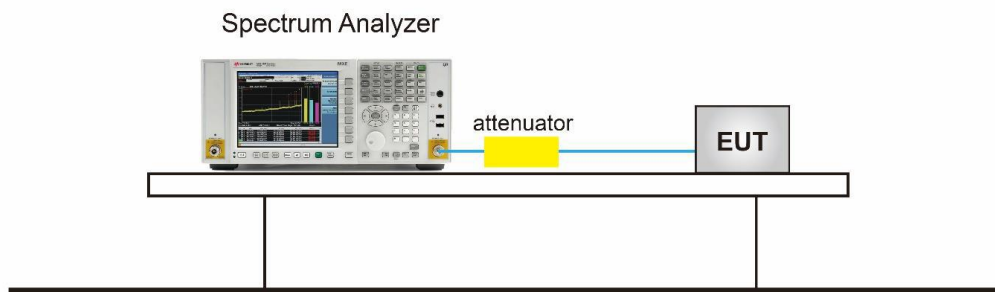
When the power is less than 1W: The minimum permissible channel separation for this system is 20dB BW.

### 12.2 Measurement Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Wide enough to capture the peaks of two adjacent channels.
2. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3. Video (or average) bandwidth (VBW)  $\geq$  RBW.
4. Sweep: Auto.
5. Detector function: Peak.
6. Trace: Max hold. g) Allow the trace to stabilize.
7. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

### 12.3 Measurement Setup (Block Diagram of Configuration)



### 12.4 Measurement Result

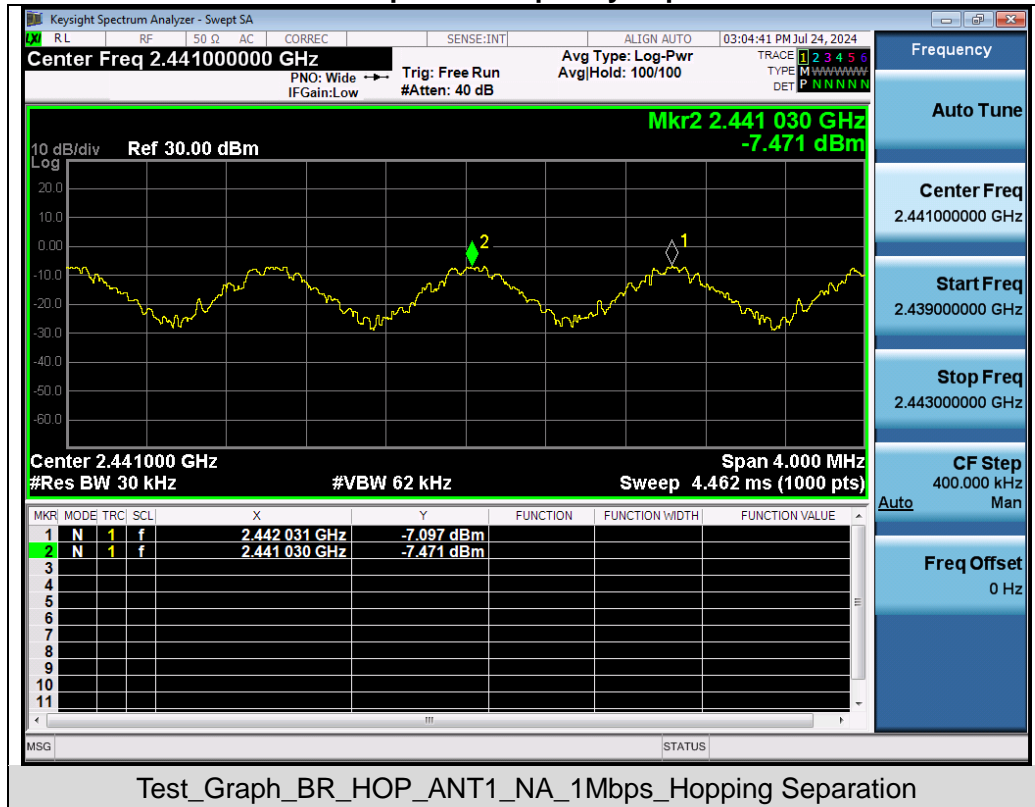
| Test Data of Frequency Separation |                          |              |              |
|-----------------------------------|--------------------------|--------------|--------------|
| Test Mode                         | Channel Separation (MHz) | Limits (MHz) | Pass or Fail |
| GFSK Hopping                      | 1.001                    | $\geq 0.689$ | Pass         |

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### Test Graphs of Frequency Separation



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### 13. AC Power Line Conducted Emission Test

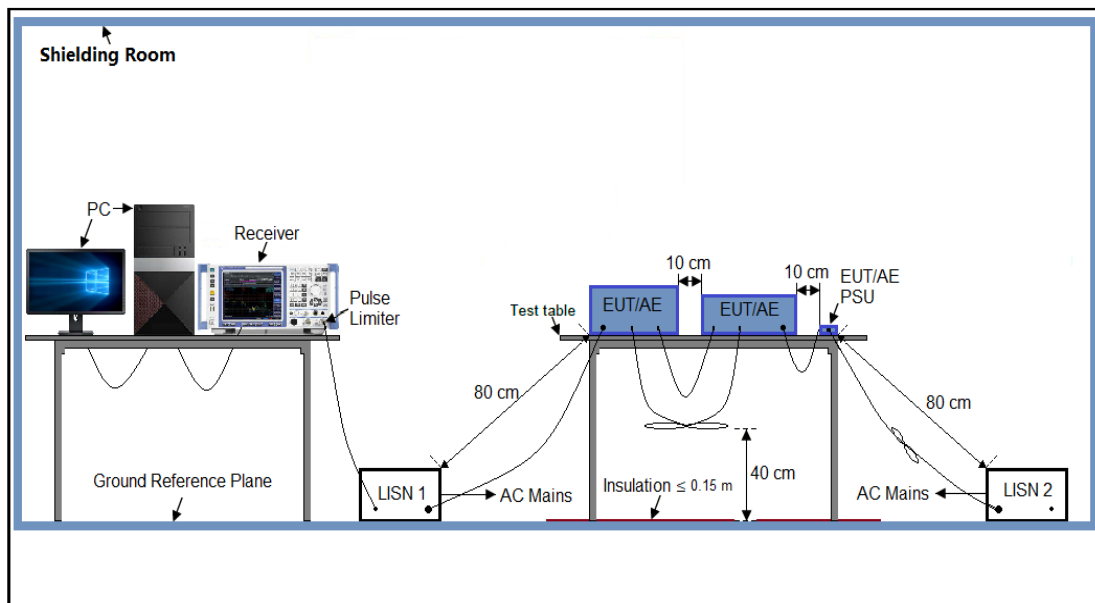
### 13.1 Measurement Limit

| Frequency     | Maximum RF Line Voltage |                |
|---------------|-------------------------|----------------|
|               | Q.P. (dBμV)             | Average (dBμV) |
| 150kHz~500kHz | 66-56                   | 56-46          |
| 500kHz~5MHz   | 56                      | 46             |
| 5MHz~30MHz    | 60                      | 50             |

Note:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

### 13.2 Measurement Setup (Block Diagram of Configuration)



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### 13.3 Preliminary Procedure of Line Conducted Emission Test

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.10.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4. All support equipment received AC120V/60Hz power from a LISN, if any.
5. The EUT received DC 5V power from adapter which received AC120V/60Hz power from a LISN.
6. The test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

### 13.4 Final Procedure of Line Conducted Emission Test

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less – 2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

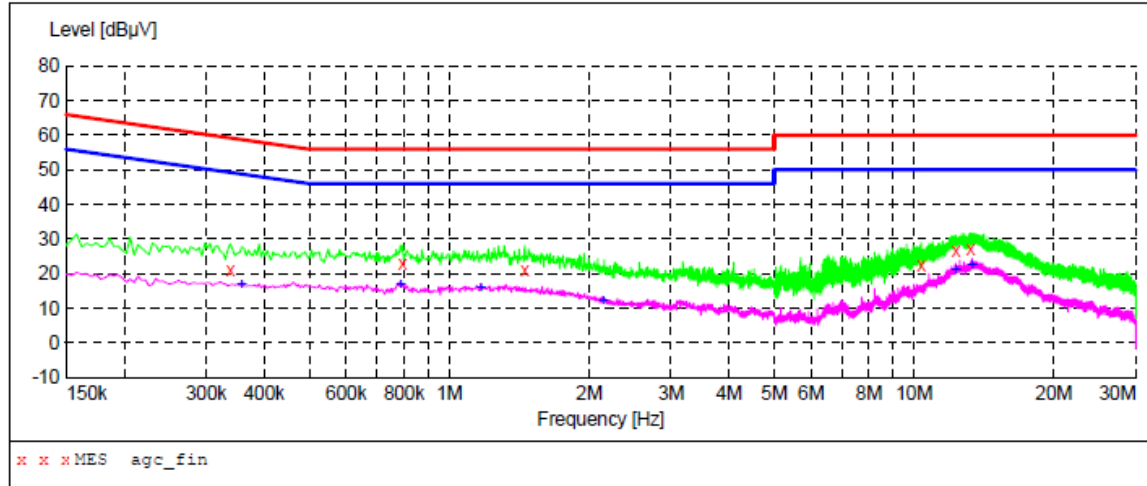
### 13.5 Measurement Results

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### AC Power Line Conducted Emission Test

|           |        |           |          |
|-----------|--------|-----------|----------|
| Test Mode | Mode 1 | LISN Line | Hot Side |
|-----------|--------|-----------|----------|



#### MEASUREMENT RESULT: "agc\_fin"

2024/7/22 12:08

| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line |
|------------------|---------------|--------------|---------------|--------------|----------|------|
| 0.338000         | 21.10         | 6.1          | 59            | 38.2         | QP       | L1   |
| 0.794000         | 22.90         | 6.2          | 56            | 33.1         | QP       | L1   |
| 1.454000         | 21.10         | 6.2          | 56            | 34.9         | QP       | L1   |
| 10.362000        | 22.40         | 6.7          | 60            | 37.6         | QP       | L1   |
| 12.302000        | 26.50         | 6.8          | 60            | 33.5         | QP       | L1   |
| 13.226000        | 27.10         | 6.8          | 60            | 32.9         | QP       | L1   |

#### MEASUREMENT RESULT: "agc\_fin2"

2024/7/22 12:08

| Frequency<br>MHz | Level<br>dBμV | Transd<br>dB | Limit<br>dBμV | Margin<br>dB | Detector | Line |
|------------------|---------------|--------------|---------------|--------------|----------|------|
| 0.358000         | 16.70         | 6.1          | 49            | 32.1         | AV       | L1   |
| 0.786000         | 16.90         | 6.2          | 46            | 29.1         | AV       | L1   |
| 1.170000         | 15.80         | 6.2          | 46            | 30.2         | AV       | L1   |
| 2.142000         | 12.00         | 6.2          | 46            | 34.0         | AV       | L1   |
| 12.302000        | 21.10         | 6.8          | 50            | 28.9         | AV       | L1   |
| 13.322000        | 22.40         | 6.8          | 50            | 27.6         | AV       | L1   |

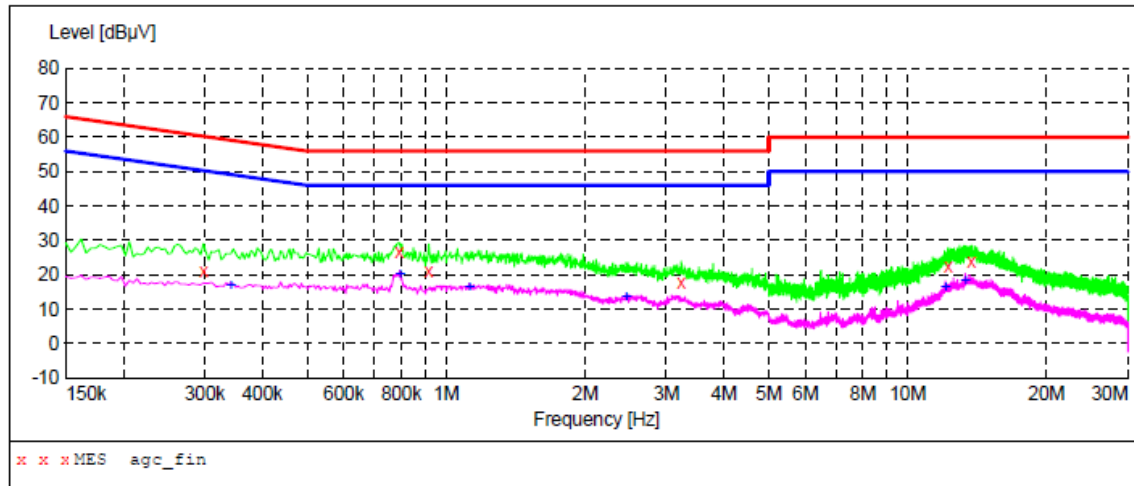
**RESULT: Pass**

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### AC Power Line Conducted Emission Test

|           |        |           |              |
|-----------|--------|-----------|--------------|
| Test Mode | Mode 1 | LISN Line | Neutral Side |
|-----------|--------|-----------|--------------|



#### MEASUREMENT RESULT: "agc\_fin"

2024/7/22 12:04

| Frequency<br>MHz | Level<br>dBuV | Transd<br>dB | Limit<br>dBuV | Margin<br>dB | Detector | Line |
|------------------|---------------|--------------|---------------|--------------|----------|------|
| 0.298000         | 21.20         | 6.1          | 60            | 39.1         | QP       | N    |
| 0.790000         | 26.70         | 6.2          | 56            | 29.3         | QP       | N    |
| 0.918000         | 20.80         | 6.2          | 56            | 35.2         | QP       | N    |
| 3.234000         | 17.50         | 6.3          | 56            | 38.5         | QP       | N    |
| 12.266000        | 22.20         | 6.8          | 60            | 37.8         | QP       | N    |
| 13.750000        | 23.80         | 6.8          | 60            | 36.2         | QP       | N    |

#### MEASUREMENT RESULT: "agc\_fin2"

2024/7/22 12:04

| Frequency<br>MHz | Level<br>dBuV | Transd<br>dB | Limit<br>dBuV | Margin<br>dB | Detector | Line |
|------------------|---------------|--------------|---------------|--------------|----------|------|
| 0.342000         | 17.00         | 6.1          | 49            | 32.2         | AV       | N    |
| 0.794000         | 20.10         | 6.2          | 46            | 25.9         | AV       | N    |
| 1.122000         | 16.30         | 6.2          | 46            | 29.7         | AV       | N    |
| 2.458000         | 13.30         | 6.3          | 46            | 32.7         | AV       | N    |
| 12.070000        | 16.20         | 6.8          | 50            | 33.8         | AV       | N    |
| 13.342000        | 18.30         | 6.8          | 50            | 31.7         | AV       | N    |

**RESULT: Pass**

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### **Appendix I: Photographs of Test Setup**

Refer to the Report No.: AGC12810240702AP02

### **Appendix II: Photographs of Test EUT**

Refer to the Report No.: AGC12810240702AP03

**-----End of Report-----**

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3. The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.
4. In the event of the improper use of the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.
5. Samples submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.
6. The Company will not be liable for or accept responsibility for any loss or damage however arising from the use of information contained in any of its Reports or in any communication whatsoever about its said tests or investigations.
7. Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.
8. The Company is not responsible for recalling the electronic version of the original report when any revision is made to them. The Client assumes the responsibility to providing the revised version to any interested party who uses them.
9. Subject to the variable length of retention time for test data and report stored hereinto as otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of the test report for a period of six years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after retention period. Under no circumstances shall we be liable for damage of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

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