

|                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                           |                                                                                           |                                          |                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------|----------------------------------------------|
| <b>Prüfbericht-Nr.:</b><br><i>Test Report No.:</i>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>50302722 001</b>                                                                                       | <b>Auftrags-Nr.:</b><br><i>Order No.:</i>                                                 | <b>238106853</b>                         | <b>Seite 1 von 46</b><br><i>Page 1 of 46</i> |
| <b>Kunden-Referenz-Nr.:</b><br><i>Client Reference No.:</i>                                                                                                                                                                                                                                                                                                                                                                                                | <b>N/A</b>                                                                                                | <b>Auftragsdatum:</b><br><i>Order date:</i>                                               | <b>03-Oct-2019</b>                       |                                              |
| <b>Auftraggeber:</b><br><i>Client:</i>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>REYAX TECHNOLOGY CO.,LTD.</b><br>4F.-15, No.26, Ln. 321, Yangguang St., Neihu Dist. Taipei City Taiwan |                                                                                           |                                          |                                              |
| <b>Prüfgegenstand:</b><br><i>Test item:</i>                                                                                                                                                                                                                                                                                                                                                                                                                | <b>2.4GHz Wi-Fi / Bluetooth Antenna module</b>                                                            |                                                                                           |                                          |                                              |
| <b>Bezeichnung / Typ-Nr.:</b><br><i>Identification / Type No.:</i>                                                                                                                                                                                                                                                                                                                                                                                         | <b>RYWB116</b>                                                                                            |                                                                                           |                                          |                                              |
| <b>Auftrags-Inhalt:</b><br><i>Order content:</i>                                                                                                                                                                                                                                                                                                                                                                                                           | <b>FCC Part 15C / Test report (BDR/EDR)</b>                                                               |                                                                                           |                                          |                                              |
| <b>Prüfgrundlage:</b><br><i>Test specification:</i>                                                                                                                                                                                                                                                                                                                                                                                                        | <b>FCC 47CFR Part 15: Subpart C Section 15.247 (FHSS)</b>                                                 |                                                                                           |                                          |                                              |
| <b>Wareneingangsdatum:</b><br><i>Date of receipt:</i>                                                                                                                                                                                                                                                                                                                                                                                                      | <b>05-Aug-2019</b>                                                                                        |                                                                                           |                                          |                                              |
| <b>Prüfmuster-Nr.:</b><br><i>Test sample No.:</i>                                                                                                                                                                                                                                                                                                                                                                                                          | <b>A000953041-001</b><br><b>A000953041-002</b>                                                            |                                                                                           |                                          |                                              |
| <b>Prüfzeitraum:</b><br><i>Testing period:</i>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>19-Aug-2019 - 14-Oct-2019</b>                                                                          |                                                                                           |                                          |                                              |
| <b>Ort der Prüfung:</b><br><i>Place of testing:</i>                                                                                                                                                                                                                                                                                                                                                                                                        | <b>EMC/RF Laboratory Taipei</b>                                                                           |                                                                                           |                                          |                                              |
| <b>Prüflaboratorium:</b><br><i>Testing laboratory:</i>                                                                                                                                                                                                                                                                                                                                                                                                     | <b>TUV Rheinland Taiwan Ltd.</b>                                                                          |                                                                                           |                                          |                                              |
| <b>Prüfergebnis*:</b><br><i>Test result*:</i>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Pass</b>                                                                                               |                                                                                           |                                          |                                              |
| <b>Report date / tested by:</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                           | <b>kontrolliert von / reviewed by:</b>                                                    |                                          |                                              |
|                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                           |      |                                          |                                              |
| <b>14-Jan-2020</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Mars Y.J. Lin / Project Engineer</b>                                                                   | <b>14-Jan-2020</b>                                                                        | <b>Ryan W. T. Chen / Project Manager</b> |                                              |
| <b>Datum</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Name / Stellung</b>                                                                                    | <b>Datum</b>                                                                              | <b>Name / Stellung</b>                   | <b>Unterschrift</b>                          |
| <i>Date</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>Name / Position</i>                                                                                    | <i>Date</i>                                                                               | <i>Name / Position</i>                   | <i>Signature</i>                             |
| <b>Sonstiges / Other:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                           |                                                                                           |                                          |                                              |
| <b>Zustand des Prüfgegenstandes bei Anlieferung:</b><br><i>Condition of the test item at delivery:</i>                                                                                                                                                                                                                                                                                                                                                     |                                                                                                           | <b>Prüfmuster vollständig und unbeschädigt</b><br><i>Test item complete and undamaged</i> |                                          |                                              |
| <b>* Legende:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                           | <b>1 = sehr gut</b>                                                                       |                                          |                                              |
| <b>2 = gut</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                           | <b>3 = befriedigend</b>                                                                   |                                          |                                              |
| <b>4 = ausreichend</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                           | <b>5 = mangelhaft</b>                                                                     |                                          |                                              |
| <b>P(ass) = entspricht o.g. Prüfgrundlage(n)</b>                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                           | <b>F(ail) = entspricht nicht o.g. Prüfgrundlage(n)</b>                                    |                                          |                                              |
| <b>N/A = nicht anwendbar</b>                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                           | <b>N/T = nicht getestet</b>                                                               |                                          |                                              |
| <b>Legend:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                           | <b>1 = very good</b>                                                                      |                                          |                                              |
| <b>2 = good</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                           | <b>3 = satisfactory</b>                                                                   |                                          |                                              |
| <b>4 = sufficient</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                           | <b>5 = poor</b>                                                                           |                                          |                                              |
| <b>P(ass) = passed a.m. test specification(s)</b>                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                           | <b>F(ail) = failed a.m. test specification(s)</b>                                         |                                          |                                              |
| <b>N/A = not applicable</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                           | <b>N/T = not tested</b>                                                                   |                                          |                                              |
| <b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b><br><i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i> |                                                                                                           |                                                                                           |                                          |                                              |

## TEST SUMMARY

### **5.1.1 ANTENNA REQUIREMENT**

RESULT: Passed

### **5.1.2 PEAK OUTPUT POWER**

RESULT: Passed

### **5.1.3 20dB BANDWIDTH**

RESULT: Passed

### **5.1.4 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH**

RESULT: Passed

### **5.1.5 SPURIOUS EMISSION**

RESULT: Passed

### **5.1.6 FREQUENCY SEPARATION**

RESULT: Passed

### **5.1.7 NUMBER OF HOPPING FREQUENCY**

RESULT: Passed

### **5.1.8 TIME OF OCCUPANCY**

RESULT: Passed

### **5.2.1 MAINS CONDUCTED EMISSIONS**

RESULT: Passed

### **6.1.1 ELECTROMAGNETIC FIELDS**

RESULT: Passed

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## 1. General Remarks

### 1.1 Complementary Materials

The following attachments are integral parts of this test report:

**Appendix P: Photo Documentation**  
(File Name: 50302722 001 Appendix P)

**Appendix D: Test Result of Radiated Emissions**  
(File Name: 50302722 001 Appendix D)

### Test Specifications

The following standards were applied.

**Table 1: Applied Standard and Test Levels**

| Radio                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC CFR47 Part 15: Subpart C Section 15.247<br>FCC 47CFR Part 2: Subpart J section 2 1093<br>FCC 47CFR 2.1091<br>ANSI C63.10:2013<br>KDB558074 D01 DTS Meas Guidance v05 |

### 1.2 Decision Rule of conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard

## 2. Test Sites

### 2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.  
Taipei City 105  
Taiwan (R.O.C.)

### 2.2 Test Facility

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.  
Taipei City 105  
Taiwan (R.O.C.)  
FCC Registration No.: 180491  
IC Canada Registration No.: 9465A

TAF Accredited NCC Test Lab. No.:3567

TAF ISO17025 Certification effective period: 6<sup>th</sup>-May-2019 to 05<sup>th</sup>-May-2022



Testing Laboratory  
**3567**

## 2.3 List of Test and Measurement Instruments

**Table 2: List of Test and Measurement Equipment**

| Kind of Equipment               | Manu-facturer   | Type             | S/N         | Last Calibration | Next Calibration |
|---------------------------------|-----------------|------------------|-------------|------------------|------------------|
| Test Software                   | Audix           | e3               | Ver.9       | N/A              | N/A              |
| EMI Test Receiver               | R&S             | ESR 7            | 101549      | 2018/11/12       | 2019/11/10       |
| Spectrum Analyzer               | R&S             | FSV 40           | 100921      | 2019/04/30       | 2020/04/30       |
| Preamplifier (30MHz -1GHz)      | Hewlett Packard | 8447D            | 2944A06641  | 2019/01/08       | 2020/01/08       |
| Preamplifier (18 GHz -40 GHz)   | EMC Instruments | EMC184045SE      | 980658      | 2019/02/23       | 2020/02/23       |
| Pre-Amplifier (1GHz~18GHz)      | EM Electronics  | EM01G18G         | 60649       | 2019/09/11       | 2020/09/11       |
| Bilog Antenna                   | TESEQ           | CBL 6111D        | 29804       | 2019/07/12       | 2020/07/12       |
| Horn Antenna                    | ETS-Lindgren    | 3117             | 218931      | 2018/12/27       | 2019/12/27       |
| Horn Antenna (18GHz~40GHz)      | COM-POWER       | AH-840           | 101029      | 2018/12/22       | 2019/12/22       |
| Loop Antenna                    | Schwarzbeck     | FMZB 1513        | 1513-076    | 2019/07/11       | 2020/07/11       |
| Test Software                   | Audix           | e3               | Ver. 9      | N/A              | N/A              |
| Spectrum Analyzer               | R&S             | FSP30            | 837866      | 2018/09/16       | 2019/09/15       |
| Microwave Cable (9kHz to 18GHz) | HUBER+SUHNER    | SUCOFLEX 104EA   | 800058/4EA  | 2019/05/27       | 2020/05/27       |
| Microwave Cable (9kHz to 18GHz) | HUBER+SUHNER    | SUCOFLEX 104     | 326264/4    | 2019/06/04       | 2020/06/04       |
| Microwave Cable (9kHz to 18GHz) | HUBER+SUHNER    | SUCOFLEX 104     | MY31385/4   | 2019/06/24       | 2020/06/24       |
| Microwave Cable (1GHz to 40GHz) | HUBER+SUHNER    | SUCOFLEX 102EA   | 800900/2EA  | 2019/05/27       | 2020/05/27       |
| Microwave Cable (1GHz to 40GHz) | HUBER+SUHNER    | SUCOFLEX 102     | 36486/2     | 2019/06/24       | 2020/06/24       |
| Microwave Cable (1GHz to 40GHz) | HUBER+SUHNER    | SUCOFLEX 102     | 506263/2    | 2019/07/17       | 2020/07/17       |
| Spectrum Analyzer               | R&S             | FSV40            | 101513      | 2019/2/8         | 2020/2/8         |
| Thermo Chamber                  | Giant Force     | GHT-150-40-CP-SD | MAA1902-010 | 2019/2/1         | 2020/2/1         |
| Signal Generator                | R&S             | SMB100A03        | 181335      | 2019/1/23        | 2020/1/23        |
| Power Meter                     | Anritsu         | ML2495A          | 1901008     | 2019/4/29        | 2020/4/28        |
| Power Sensor                    | Anritsu         | MA2411B          | 1725269     | 2019/4/29        | 2020/4/28        |

## 2.4 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

## 2.5 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular schedule using in house standards or comparisons.

## 2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements:

**Table 3: Emission Measurement Uncertainty**

| Parameter                                            | Uncertainty   |
|------------------------------------------------------|---------------|
| Radio Frequency                                      | $\pm 0.1$ ppm |
| RF power, conducted                                  | $\pm 1.5$ dB  |
| Adjacent channel power                               | $\pm 3$ dB    |
| Radiated emission of transmitter, valid up to 26 GHz | $\pm 6$ dB    |
| Radiated emission of receiver, valid up to 26 GHz    | $\pm 6$ dB    |
| Temperature                                          | $\pm 2$ °C    |
| Humidity                                             | $\pm 10$ %    |

### 3. General Product Information

#### 3.1 Product Function and Intended Use

The EUT is a Bluetooth Antenna module. It contains a bluetooth compatible module enabling the user to communicate data through a Wireless interface.  
For details refer to the User Guide, Data Sheet and Circuit Diagram.

#### 3.2 System Details and Ratings

**Table 4: Basic Information of EUT**

| Item                        | EUT information                         |
|-----------------------------|-----------------------------------------|
| Kind of Equipment/Test Item | 2.4GHz Wi-Fi / Bluetooth Antenna module |
| Type Identification         | RYWB116                                 |
| FCC ID                      | QLY-RYWB116                             |

**Table 5: Technical Specification of EUT**

| Technical Specification | Value                       |
|-------------------------|-----------------------------|
| Operating Frequency     | 2402 MHz ~ 2480 MHz         |
| Channel Spacing         | 1 MHz                       |
| Channel number          | 79                          |
| Operation Voltage       | 5Vdc                        |
| Modulation              | GFSK, $\pi/4$ DQPSK, 8 DPSK |
| Antenna gain            | 1.16 dBi                    |

**Table 6: Frequency hopping information**

| Technical Specification  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hopping Range            | Hereby we declare that the maximum frequency of this device is: 2402-2480MHz. This is according the Bluetooth Core Specification v5.0 for devices which will be operated in the USA. This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Hopping Sequence         | Example of a 79 hopping sequence in data mode:<br><br>33,04,21,44,23,42,53,46,55,48,40,59,72,29,76,31,08,73,07,75,09,45,60,39,58,13,47,11,77,52,35,50,65,54,67,56,69,62,71,64, 7,25,27,66,57,70,74,61,78,63,10,41,05,43,15,44,64,68,02,70,06,01,51,03,55,05,03,66,53,49,36,47,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Receiver input bandwidth | <p>The input bandwidth of the receiver is 1MHz. In every connection one Bluetooth device is the master and the other one is the 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.</p> <p>Additionally the type of connection 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.</p> <p>Repeating of a packer has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case.</p> <p>That means a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.</p> |

### 3.3 Independent Operation Modes

The basic operation modes are:

- A. Transmitting
  - 1. Low channel
  - 2. Middle channel
  - 3. High channel
- B. Receiving
  - 1. Low channel
  - 2. Middle channel
  - 3. High channel
- C. Hopping
- D. Normal

### **3.4 Noise Generating and Noise Suppressing Parts**

Refer to the Circuit Diagram.

### **3.5 Submitted Documents**

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description

## 4. Test Set-up and Operation Modes

### 4.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

**Table 7: Table for Parameters of Test Software Setting**

| Mode  | Channel Frequency |          |          |
|-------|-------------------|----------|----------|
|       | 2402 MHz          | 2441 MHz | 2480 MHz |
| 1-DH5 | 31                | 31       | 31       |
| 3-DH5 | 31                | 31       | 31       |

### 4.2 Test Operation and Test Software

Setup for testing: The Test samples are provided with a USB interface which makes it possible to control the module through the test software installed on a notebook computer.

The samples were used as follows:

Conducted: A000953041-001

Radiation: A000953041-002

Full test was applied on all test modes, but only worst case was shown

|               |           |
|---------------|-----------|
| Test Software | QCOM V1.0 |
|---------------|-----------|

### 4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

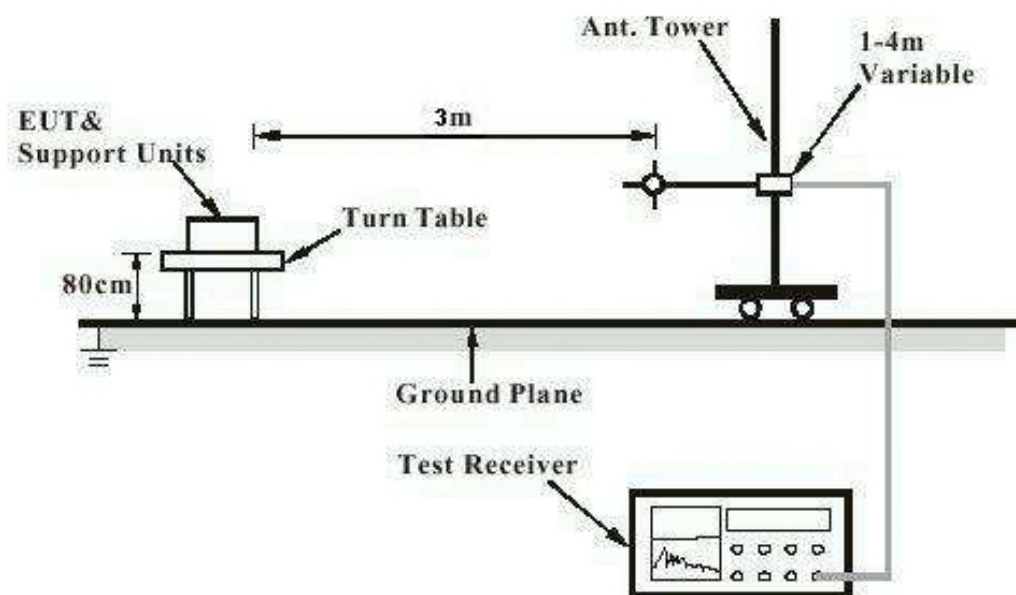
| Kind of Equipment | Manufacturer | Model Name | S/N      |
|-------------------|--------------|------------|----------|
| Notebook(EMC-06)  | Lenovo       | TP00048A   | PB-0F8B2 |

## 4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested containing the noise suppression parts as in the Photo Appendix and the Test Setup Photos. No additional measures were employed to achieve compliance.

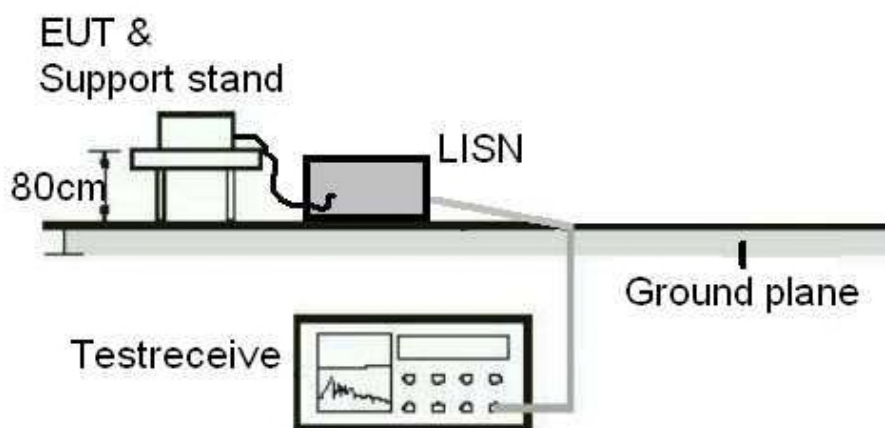
## 4.5 Test Setup Diagram

**Diagram of Measurement Configuration for Radiation Test**

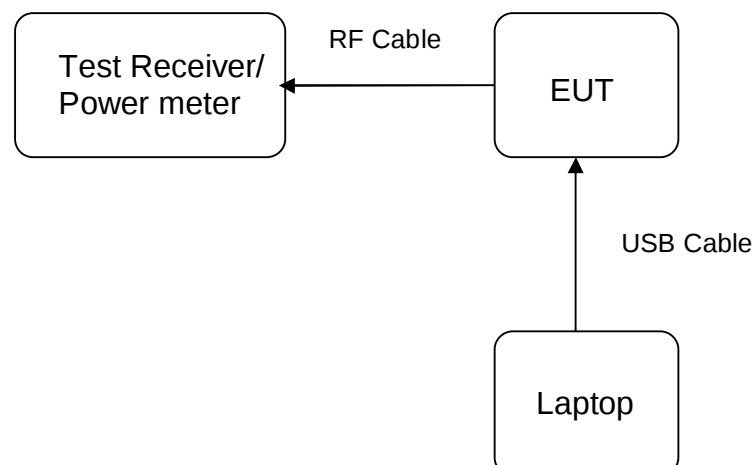


Note: Measurements above 1 GHz are done with a table height of 1.5m

### Diagram of Measurement Equipment Configuration for Mains Conduction Measurement



### Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



## 5. Test Results

### 5.1 Transmitter Requirement & Test Suites

#### 5.1.1 Antenna Requirement

**RESULT:****Passed**

Test standard : FCC Part 15.247(b)(4), Part 15.203

Requirement : use of approved antennas only with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 1.16 dBi. The antenna is a printed trace with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

## 5.1.2 Peak Output Power

**RESULT:**
**Passed**

Test standard : FCC Part 15.247(b)(1)

Basic standard : ANSI C63.10:2013

Kind of test site : Shielded room

**Test setup**

Test Channel : Low/ Middle/ High

Operation Mode : A

Ambient temperature : 22-26 °C

Relative humidity : 50-65 %

Atmospheric pressure : 100-103 kPa

**Table 8: Test result of Output Power, 1DH5**

| Channel        | Channel Frequency | Peak Output Power |         | AVG     | Limit |
|----------------|-------------------|-------------------|---------|---------|-------|
|                | (MHz)             | (dBm)             | (W)     | (W)     | (W)   |
| Low Channel    | 2402              | 16.98             | 0.04989 | 0.04487 | 0.125 |
| Middle Channel | 2441              | 17.17             | 0.05212 | 0.04667 | 0.125 |
| High Channel   | 2480              | 17.69             | 0.05875 | 0.05297 | 0.125 |

**Table 9: Test result of Output Power, 3DH5**

| Channel        | Channel Frequency | Peak Output Power |         | AVG     | Limit |
|----------------|-------------------|-------------------|---------|---------|-------|
|                | (MHz)             | (dBm)             | (W)     | (W)     | (W)   |
| Low Channel    | 2402              | 19.30             | 0.08511 | 0.04853 | 0.125 |
| Middle Channel | 2441              | 20.19             | 0.10447 | 0.05675 | 0.125 |
| High Channel   | 2480              | 21.44             | 0.13932 | 0.08017 | 0.125 |

### 5.1.3 20dB Bandwidth

**RESULT:**
**Passed**

Test standard : FCC Part 15.247(a)(1)

Basic standard : ANSI C63.10:2013

Kind of test site : Shielded room

**Test setup**

Test Channel : Low/ Middle/ High

Operation Mode : A

Ambient temperature : 22-26°C

Relative humidity : 50-65%

Atmospheric pressure : 100-103kPa

**Table 10: Test result of 20dB Bandwidth, 1DH5**

| Channel      | Channel Frequency (MHz) | 20dB Bandwidth (MHz) | Limit (MHz) | Result |
|--------------|-------------------------|----------------------|-------------|--------|
| Low Channel  | 2402                    | 1.082                | 1.5         | Pass   |
| Mid Channel  | 2441                    | 1.036                | 1.5         | Pass   |
| High Channel | 2480                    | 1.034                | 1.5         | Pass   |

Note: Limit is for Channel Separation of 1 MHz and a power limit of 125 mW.

**Table 11: Test result of 20dB Bandwidth, 3DH5**

| Channel      | Channel Frequency (MHz) | 20dB Bandwidth (MHz) | Limit (MHz) | Result |
|--------------|-------------------------|----------------------|-------------|--------|
| Low Channel  | 2402                    | 1.265                | 1.5         | Pass   |
| Mid Channel  | 2441                    | 1.263                | 1.5         | Pass   |
| High Channel | 2480                    | 1.269                | 1.5         | Pass   |

Note: Limit is for Channel Separation of 1 MHz and a power limit of 125 mW.

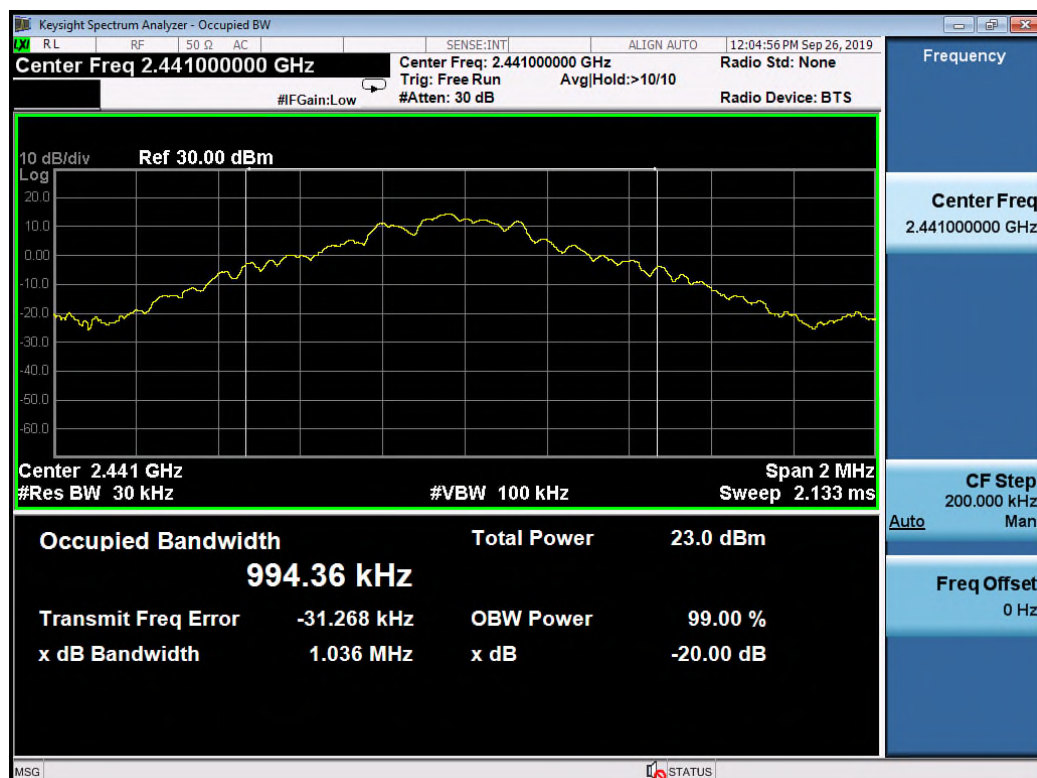
If the carrier separation frequency of a Bluetooth Device is set at 1 MHz due to the firmware setting and the Bluetooth Standard, then for power <125 mW the limit for the 20 dB Bandwidth, becomes 1 MHz / 0.66666 = 1.5 MHz.

## Test Plot of 20dB Bandwidth, 1DH5

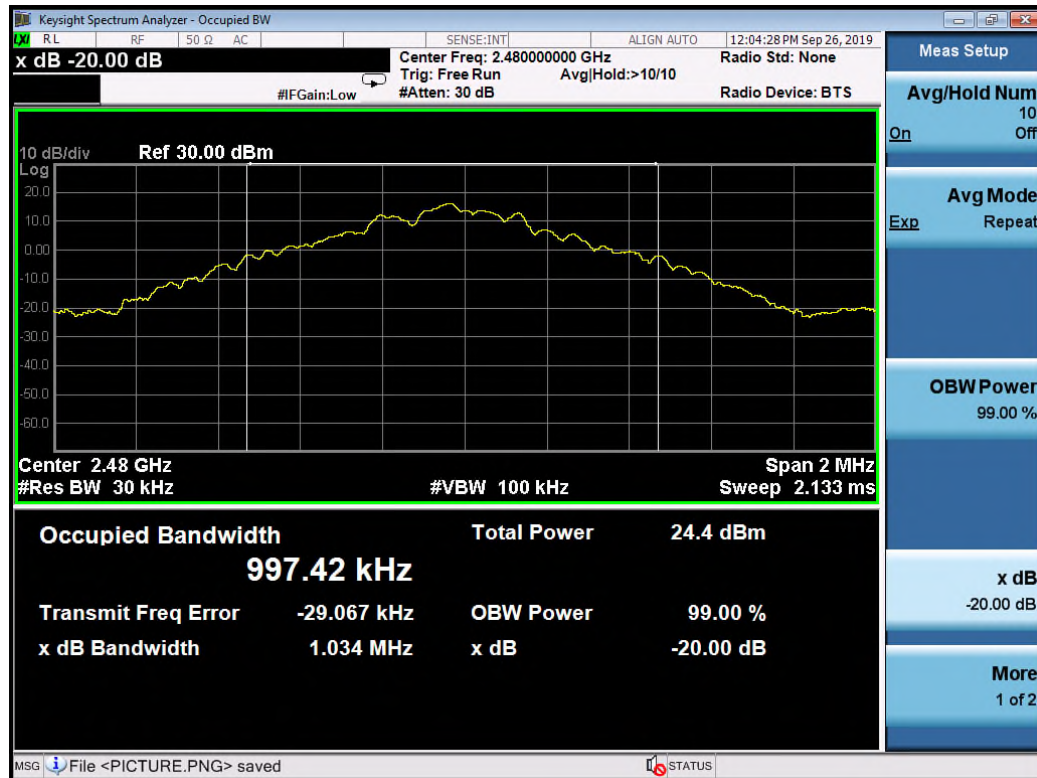
### Low Channel



### Middle Channel

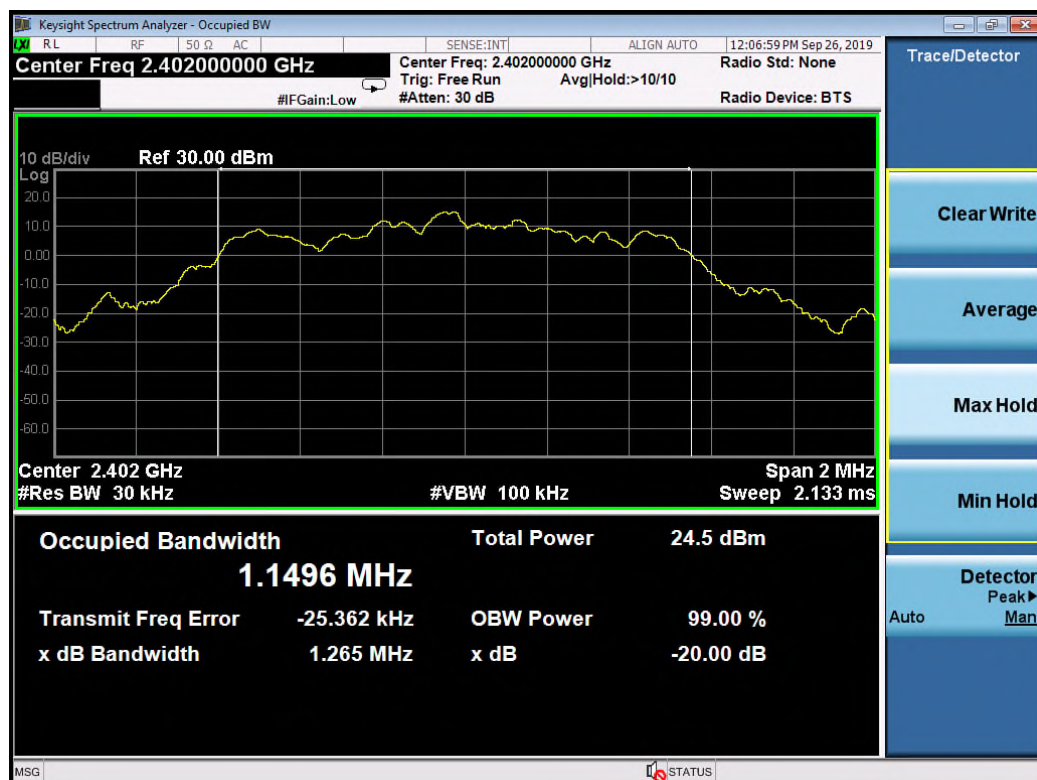


## High Channel

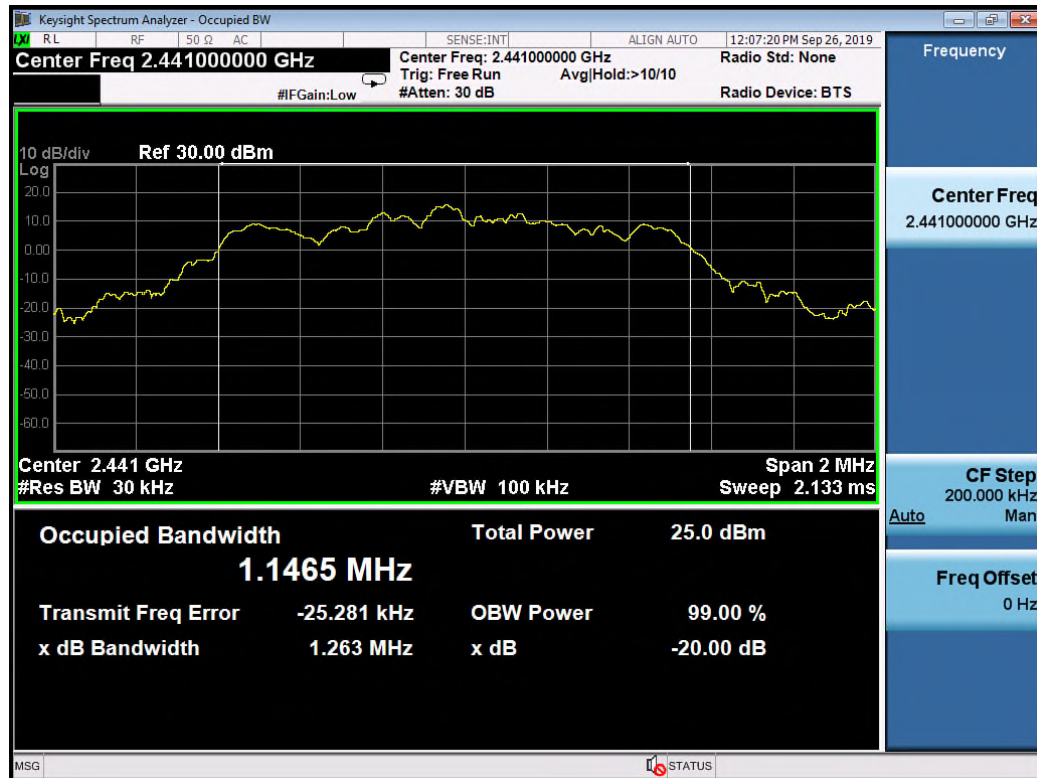


## Test Plot of 20dB Bandwidth, 3DH5

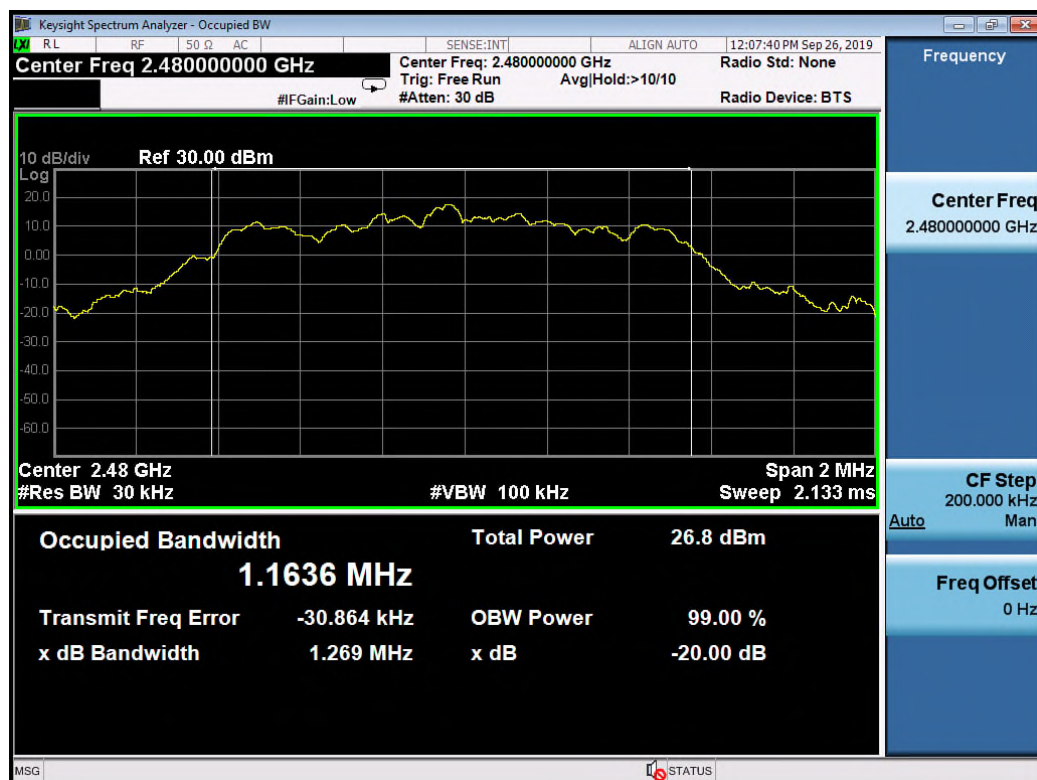
### Low Channel



### Middle Channel



### High Channel



**5.1.4 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth****RESULT:****Passed**

|                   |   |                                                                                                                |
|-------------------|---|----------------------------------------------------------------------------------------------------------------|
| Test standard     | : | FCC part 15.247(d),                                                                                            |
| Basic standard    | : | ANSI C63.10:2013                                                                                               |
| Limit             | : | 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power) |
| Kind of test site | : | Shielded room                                                                                                  |

**Test setup**

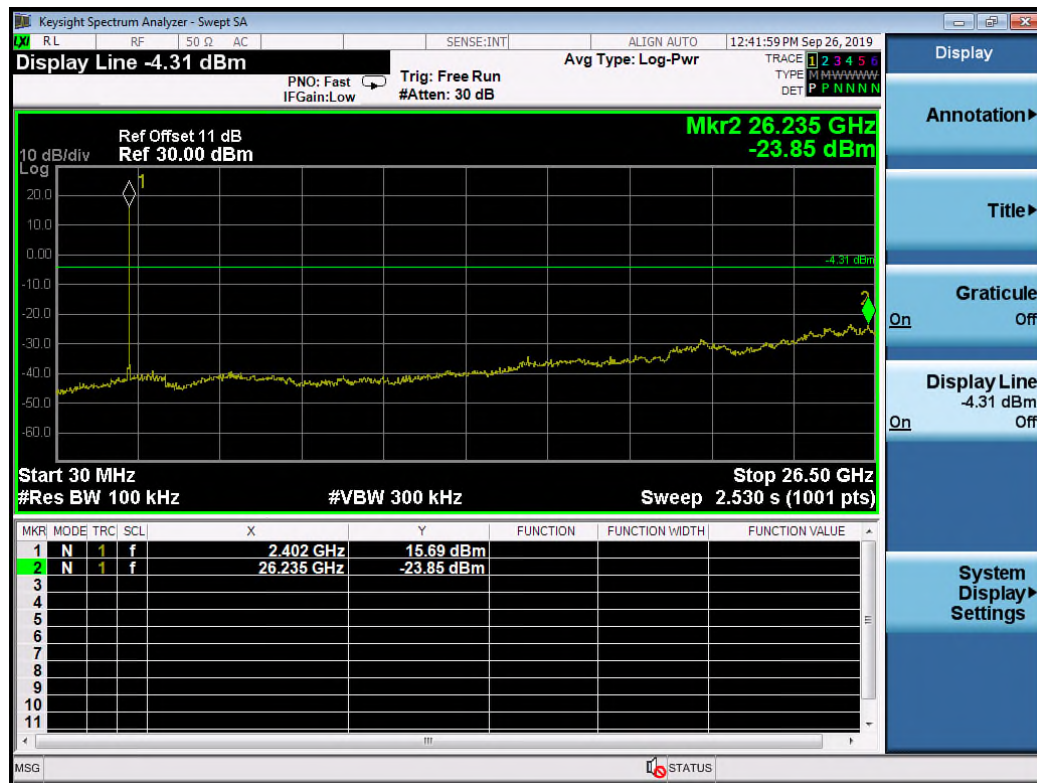
|                      |   |                                                                                                     |
|----------------------|---|-----------------------------------------------------------------------------------------------------|
| Test Channel         | : | Low/ Middle/ High for Conducted Spurious Emissions<br>Low/ High/ Hopping on for Frequency Band Edge |
| Operation Mode       | : | A, C                                                                                                |
| Ambient temperature  | : | 22-26°C                                                                                             |
| Relative humidity    | : | 50-65%                                                                                              |
| Atmospheric pressure | : | 100-103 kPa                                                                                         |

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.

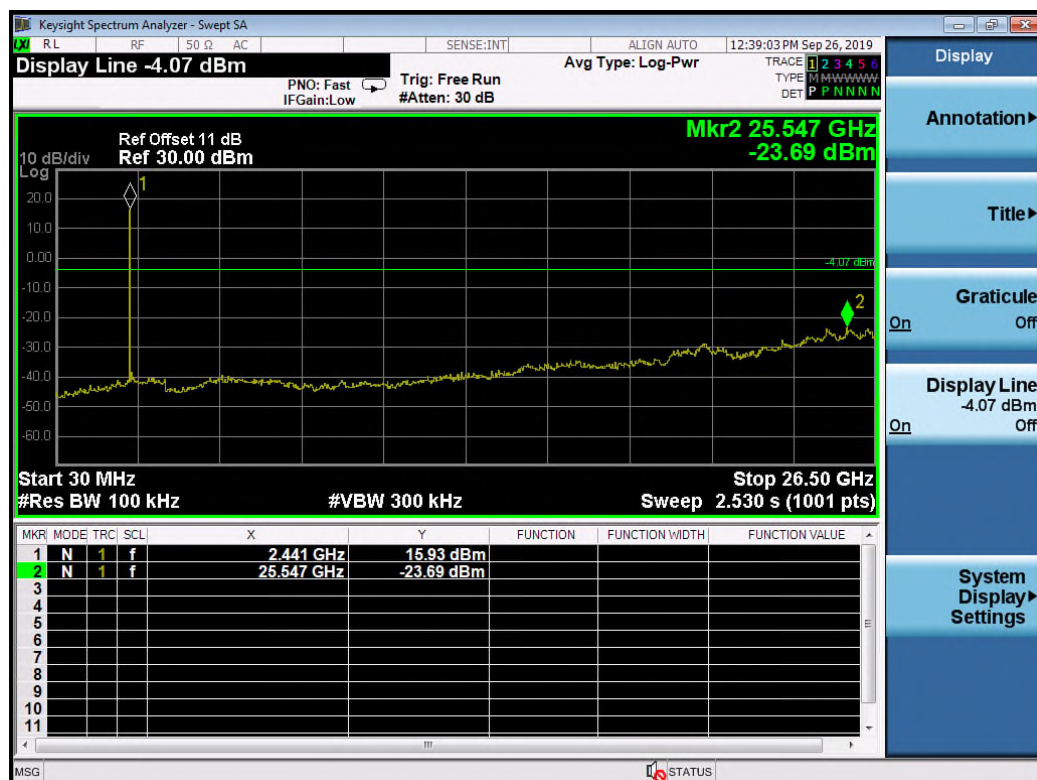
Due to the small size of the RF circuit and that there are no inductive components of significant size connected to the antenna port, 9kHz to 30MHz frequency range is not tested based on technical judgment.

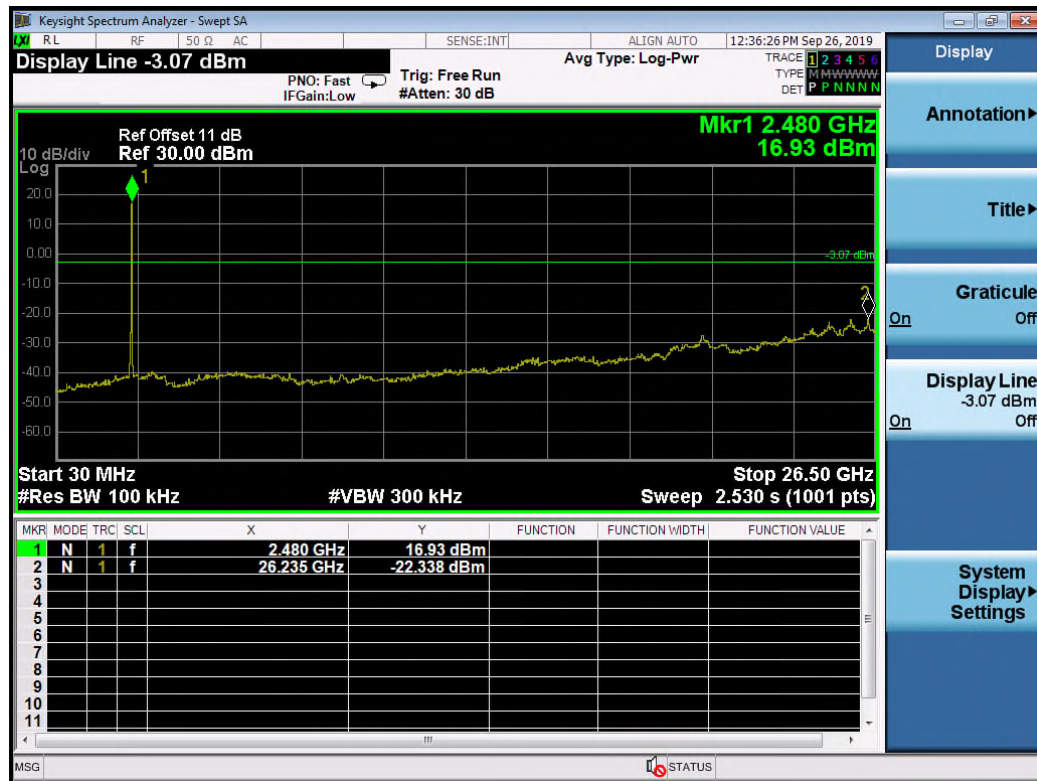
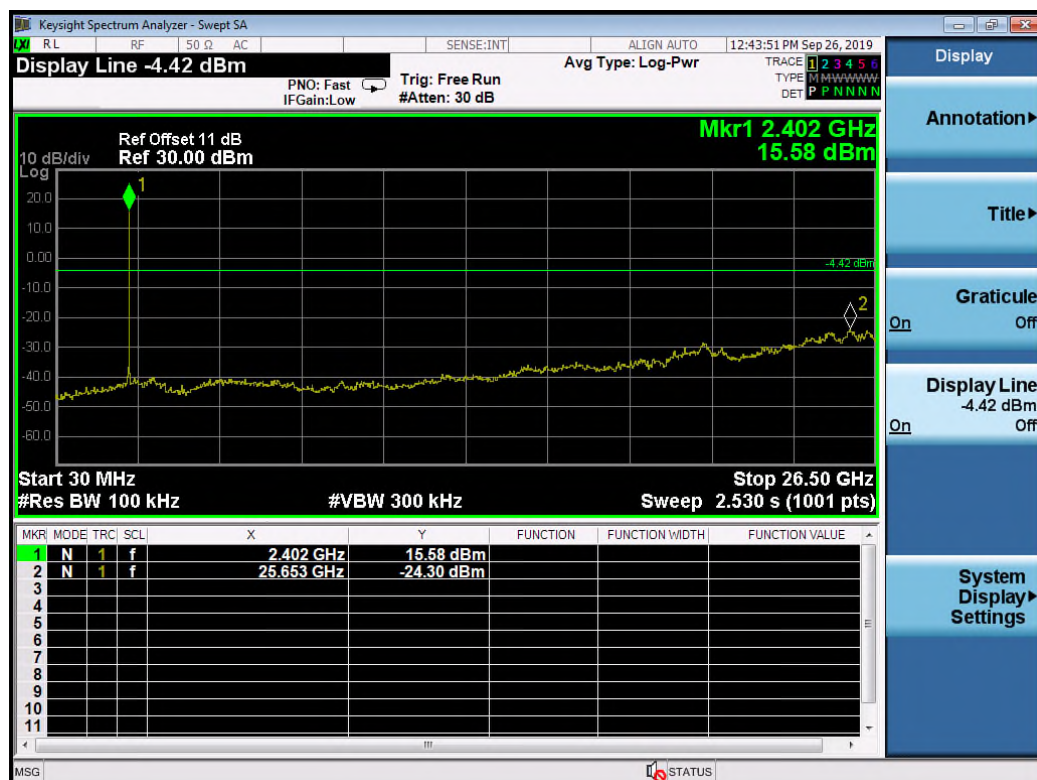
## Test Plot of 100kHz Conducted Emissions, 1DH5

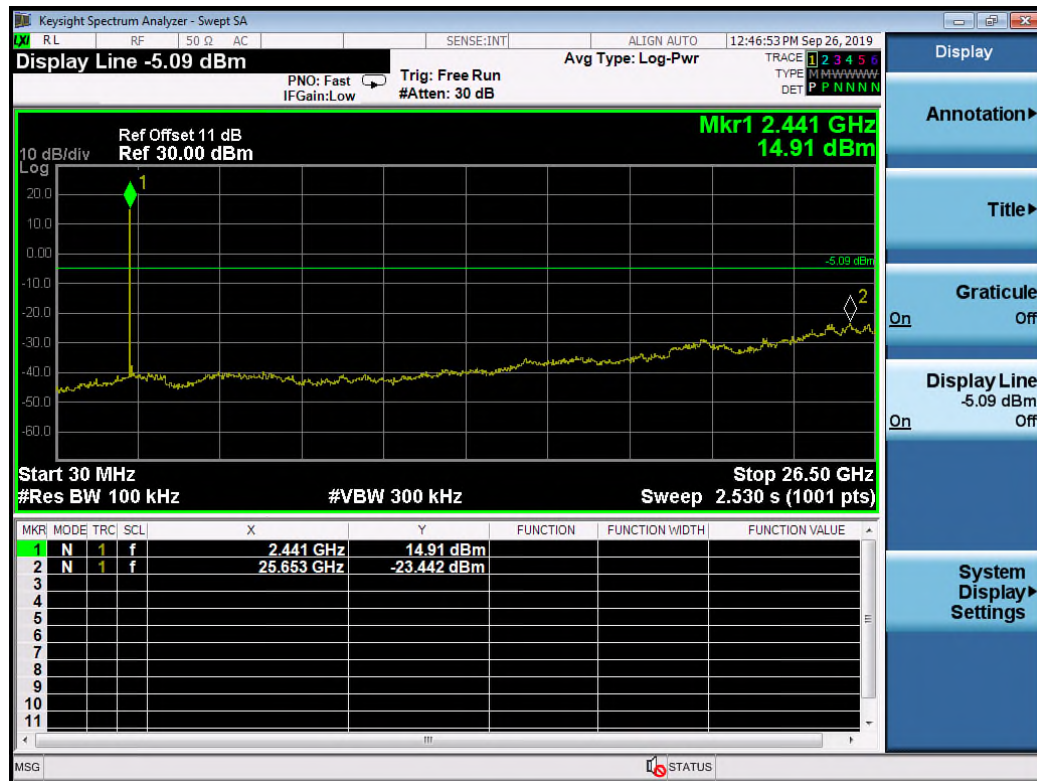
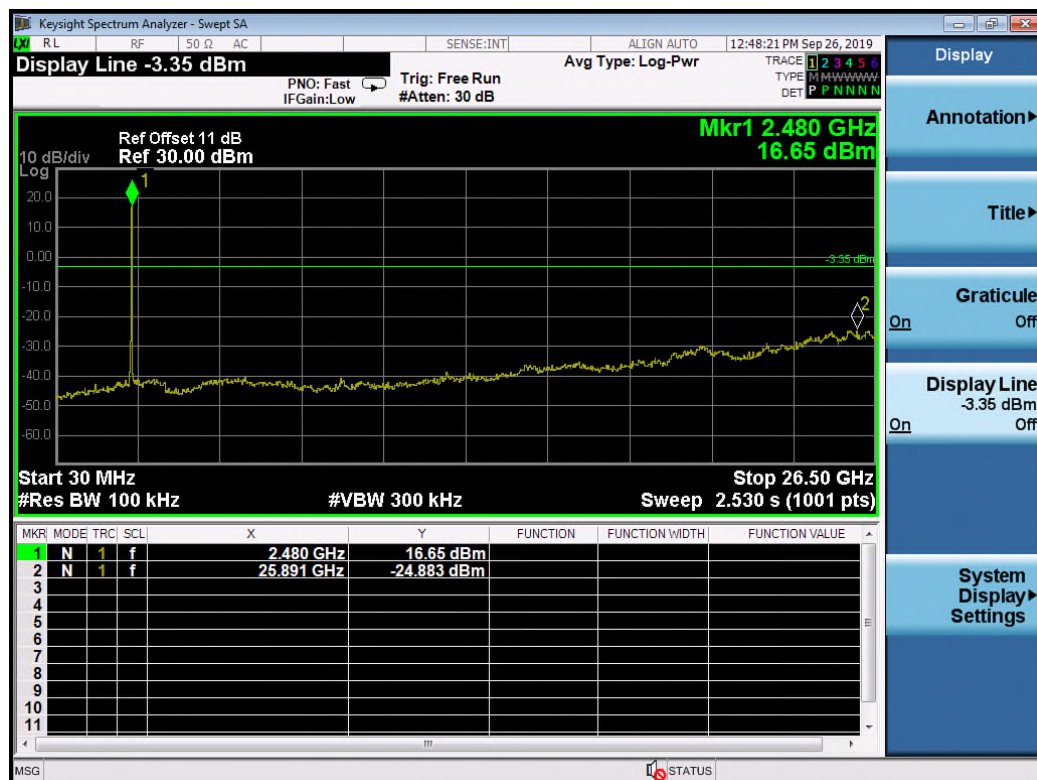
### Low Channel



### Middle Channel

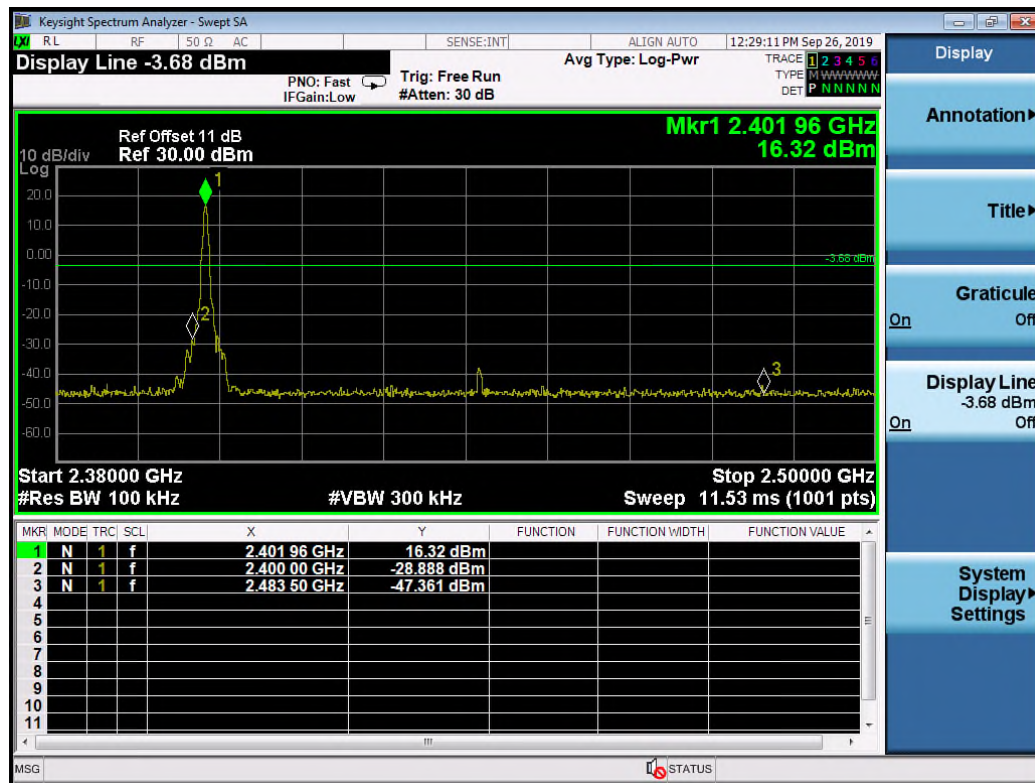


**High Channel**

**Test Plot of 100kHz Conducted Emissions, 3DH5**
**Low Channel**


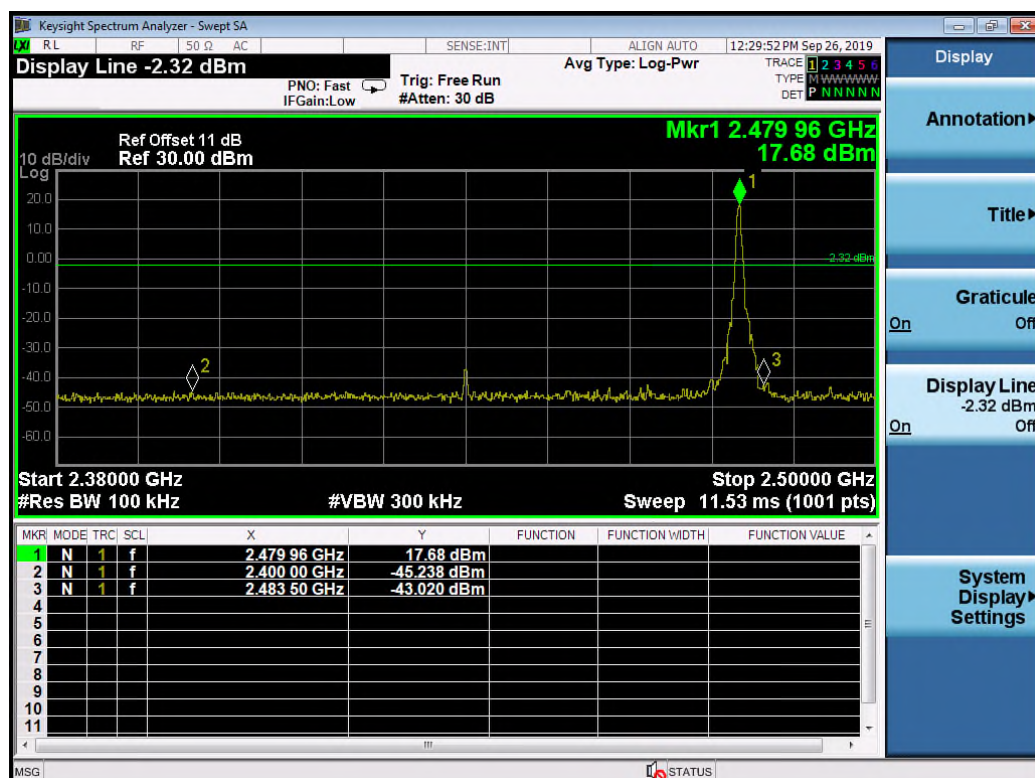
**Middle Channel**

**High Channel**


## Test Plot of 100kHz Bandwidth of Frequency Band Edge, 1DH5

### Low Channel



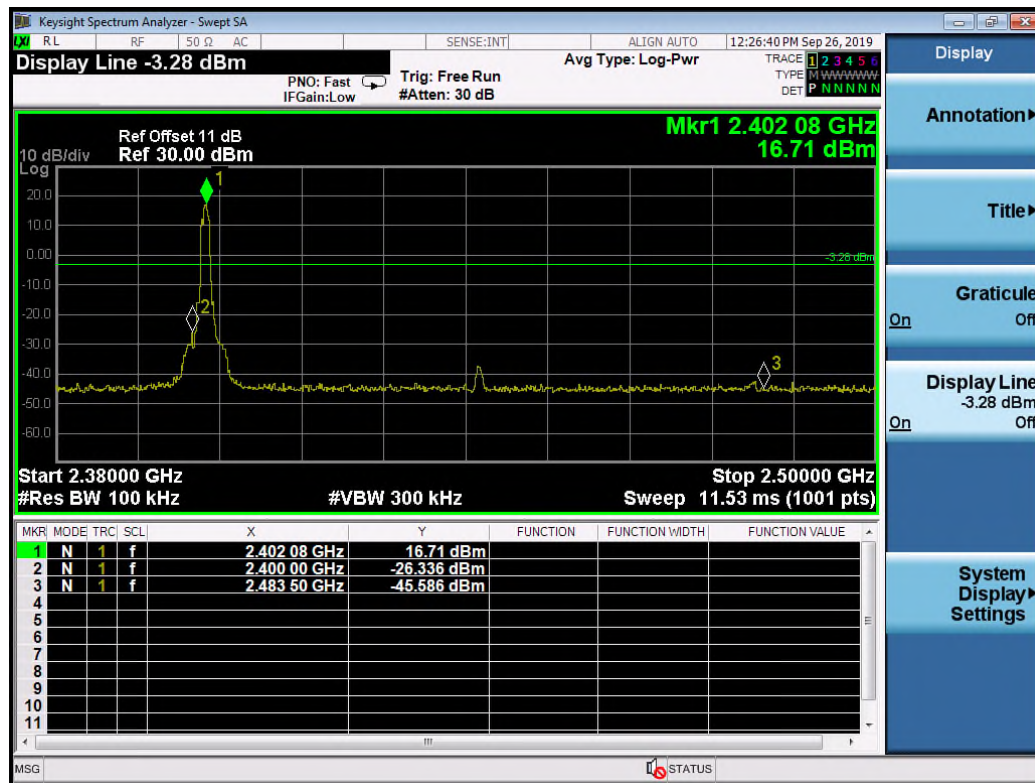
### High Channel



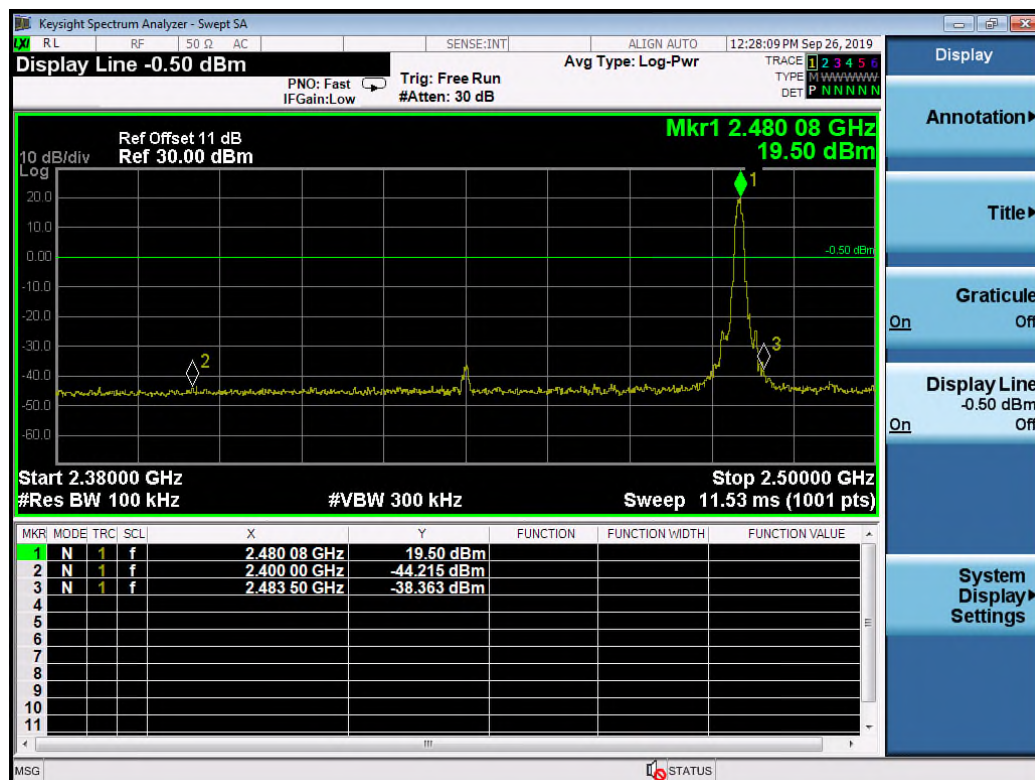


## Test Plot of 100kHz Bandwidth of Frequency Band Edge, 3DH5

### Low Channel



### High Channel





### 5.1.5 Spurious Emission

**RESULT:****Passed**

|                   |   |                                                                                                                                                                                                                                                                                                                                                 |
|-------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test standard     | : | FCC part 15.247(d), FCC 15.205, FCC 15.209                                                                                                                                                                                                                                                                                                      |
| Basic standard    | : | ANSI C63.10: 2013                                                                                                                                                                                                                                                                                                                               |
| Limits            | : | Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) must comply with the radiated emission limits specified in FCC 15.209(a) Emission radiated outside the restricted and authorized frequency bands must either comply with the radiated emission limits specified for the restricted bands or in FCC15.247(d). |
| Kind of test site | : | 3m Semi-Anechoic Chamber                                                                                                                                                                                                                                                                                                                        |

**Test setup**

|                      |   |                     |
|----------------------|---|---------------------|
| Test Channel         | : | Refer to Appendix D |
| Operation Mode       | : | A                   |
| Ambient temperature  | : | 22-26°C             |
| Relative humidity    | : | 50-65%              |
| Atmospheric pressure | : | 100-103 kPa         |

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)

Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

Remark: Testing was carried out within frequency range 9kHz to the tenth harmonic. For details refer to Appendix D. The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The worst-case Axis orientation is recorded in this test report.

## 5.1.6 Frequency Separation

**RESULT:**
**Passed**

Test standard : FCC part 15.247(a)(1)  
 Basic standard : ANSI C63.10:2013  
 Limit :  $\geq 25\text{kHz}$  or  $2/3$  of 20dB bandwidth, whichever is greater  
 Kind of test site : Shielded room

**Test setup**

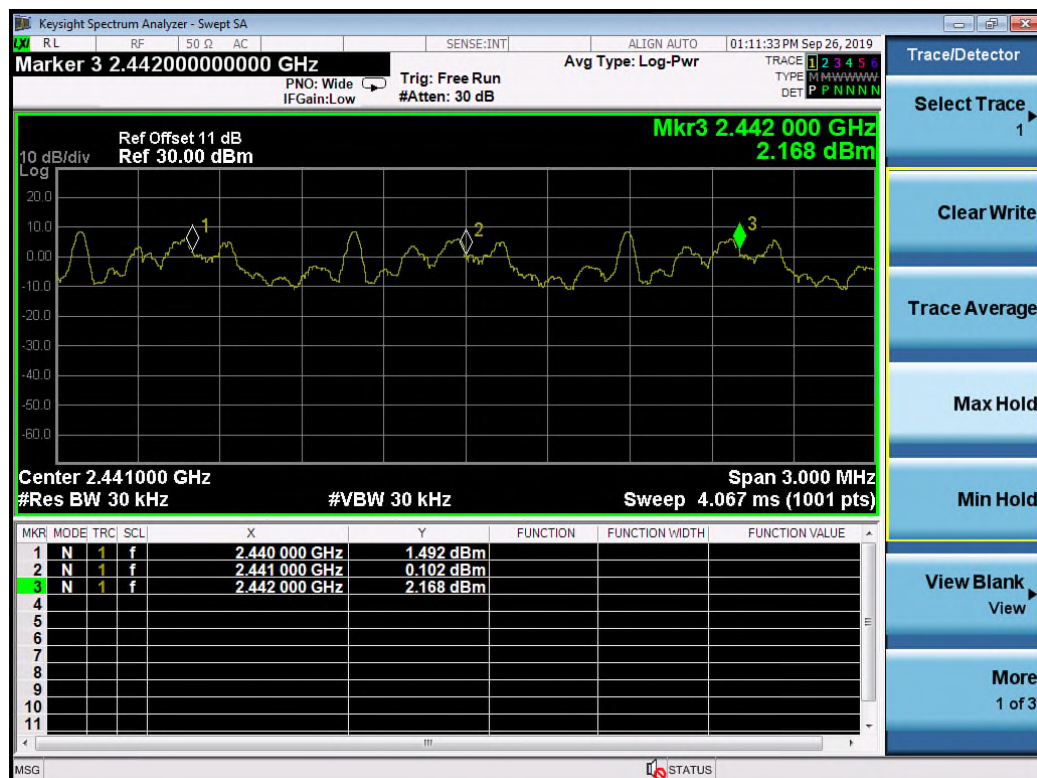
Test Channel : Hopping On  
 Operation Mode : C  
 Ambient temperature : 22-26°C  
 Relative humidity : 50-65%  
 Atmospheric pressure : 100-103 kPa

**Table 12: Test result of Frequency Separation– 1DH5**

| Channel              | Channel Frequency (MHz) | Measured Channel Separation (MHz) | Limit (kHz)                                    | Result |
|----------------------|-------------------------|-----------------------------------|------------------------------------------------|--------|
| Record Channel       | 2441                    | 1                                 | $\geq 25\text{kHz}$ or $2/3$ of 20dB bandwidth | Pass   |
| Record Channel adj 1 | 2440                    |                                   |                                                |        |
| Record Channel adj 2 | 2442                    |                                   |                                                |        |

**Table 13: Test result of Frequency Separation– 3DH5**

| Channel              | Channel Frequency (MHz) | Measured Channel Separation (MHz) | Limit (kHz)                                    | Result |
|----------------------|-------------------------|-----------------------------------|------------------------------------------------|--------|
| Record Channel       | 2441                    | 1                                 | $\geq 25\text{kHz}$ or $2/3$ of 20dB bandwidth | Pass   |
| Record Channel adj 1 | 2440                    |                                   |                                                |        |
| Record Channel adj 2 | 2442                    |                                   |                                                |        |



**5.1.7 Number of hopping frequency****RESULT:****Passed**

Test standard : FCC part 15.247(a)(1)(iii)

Basic standard : ANSI C63.10:2013

Kind of test site : Shielded room

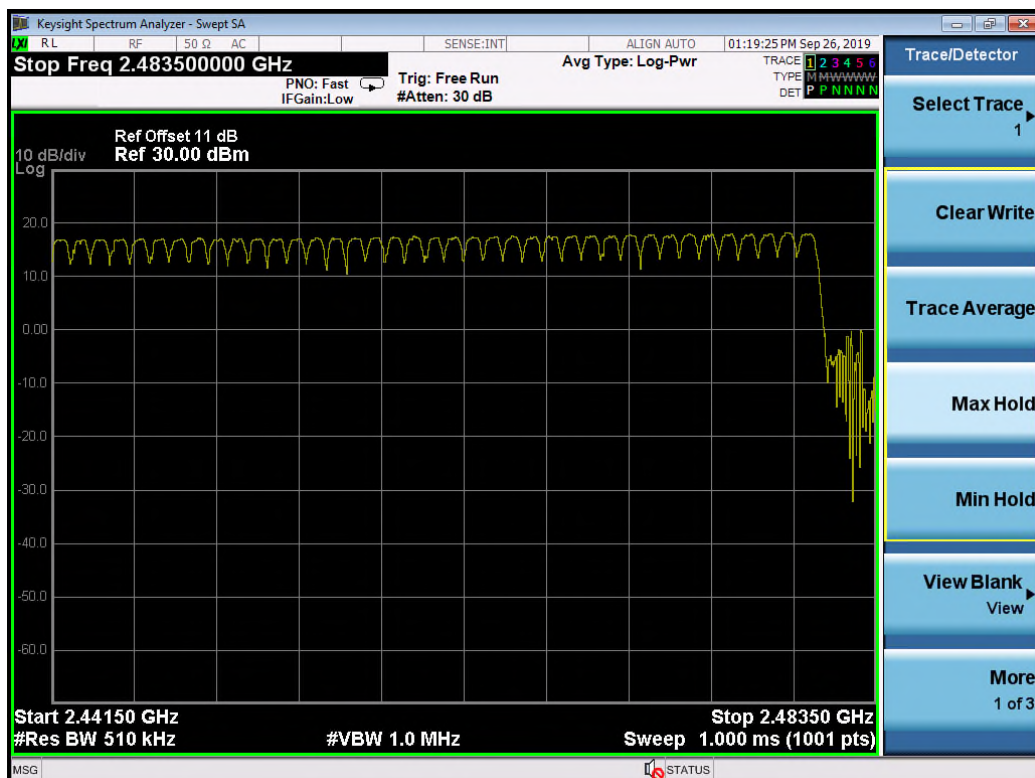
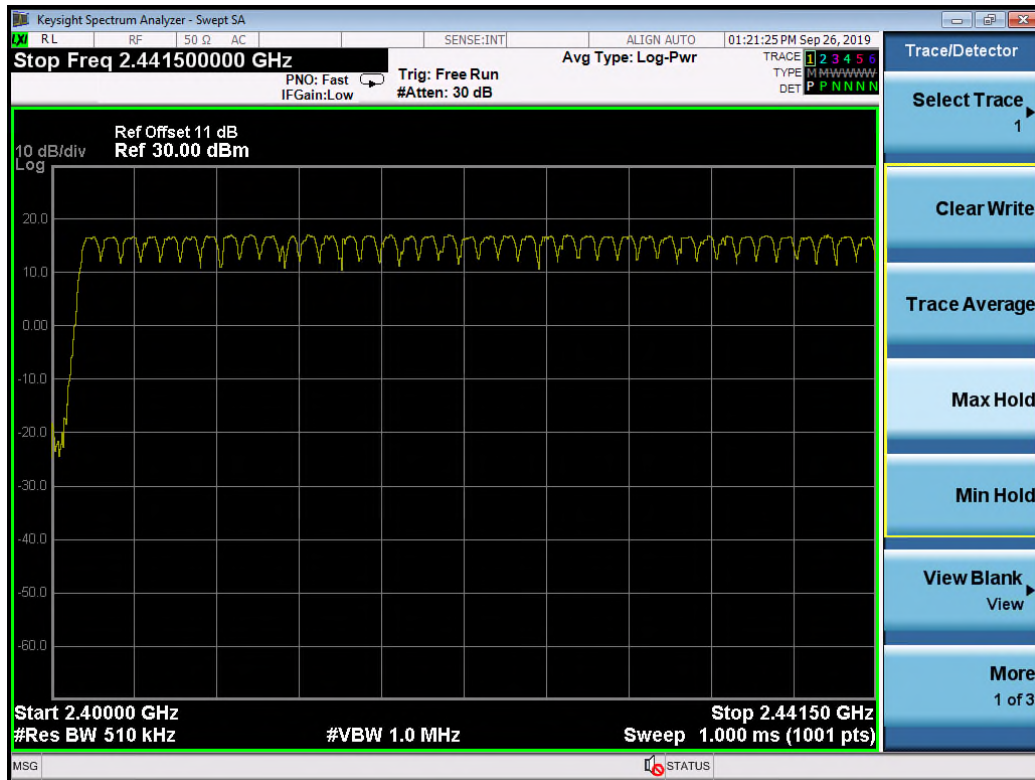
**Test setup**Test Channel : Hopping On  
Operation Mode : CAmbient temperature : 22-26°C  
Relative humidity : 50-65%  
Atmospheric pressure : 100-103 kPa**Table 14: Test result of Number of hopping frequency – 1DH5**

| Frequency Range                  | Measured Quantity of Hopping Channel | Limit | Result |
|----------------------------------|--------------------------------------|-------|--------|
| <u>2400</u> to <u>2483.5</u> MHz | 79                                   | ≥15   | Pass   |

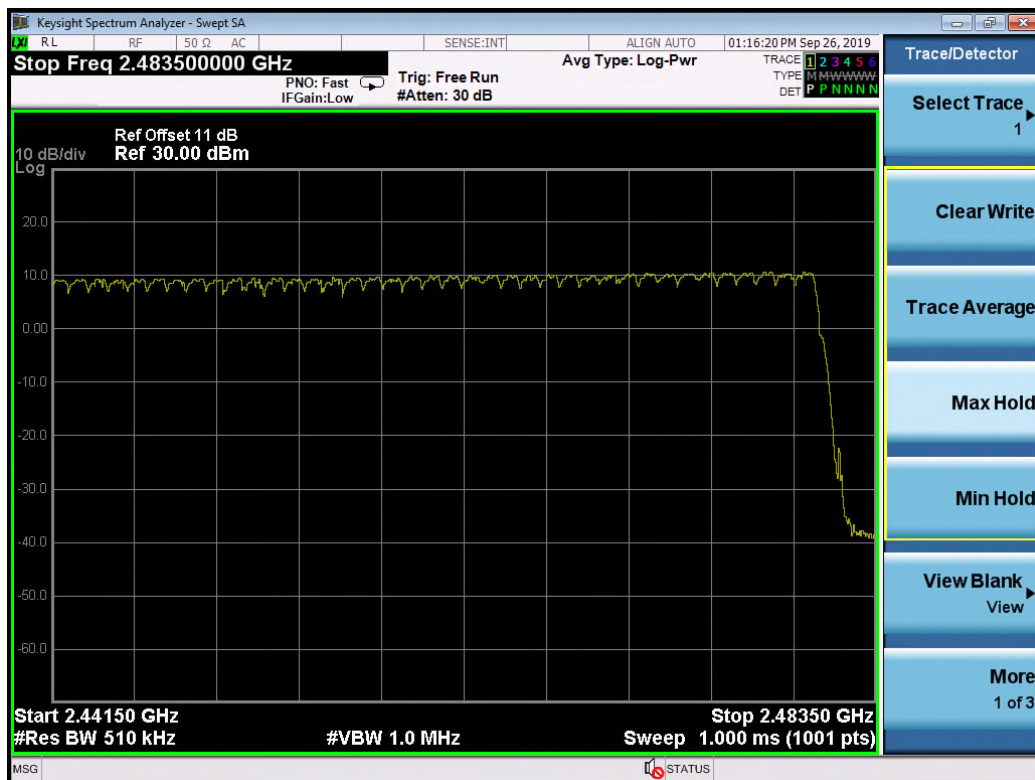
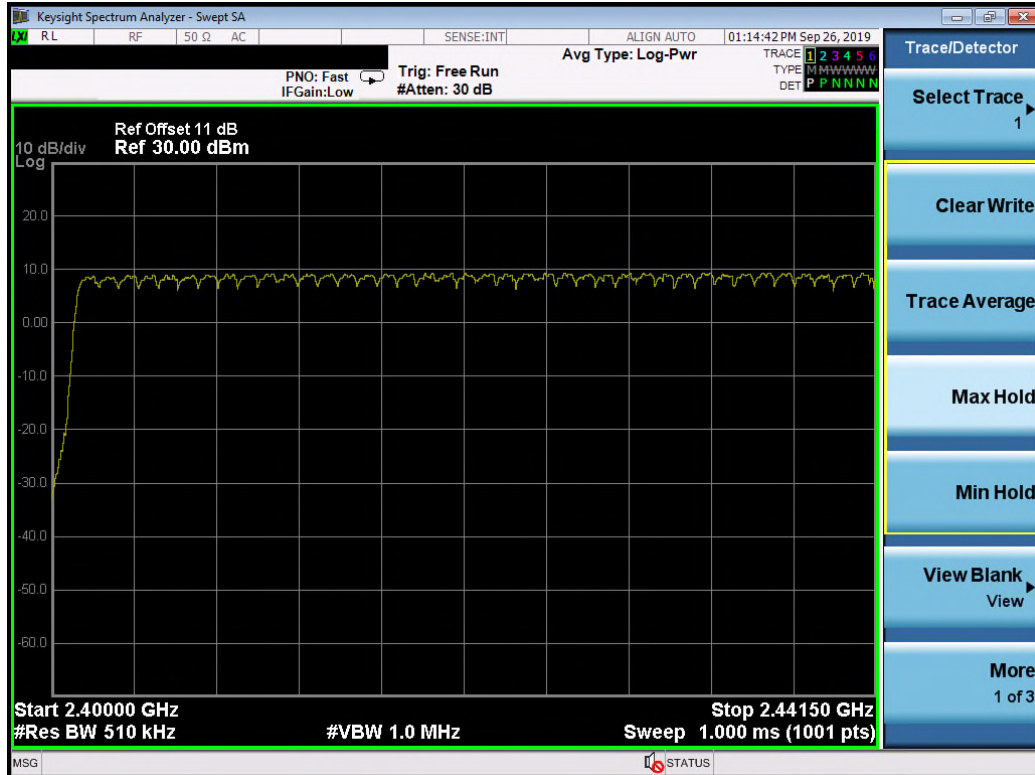
**Table 15: Test result of Number of hopping frequency – 3DH5**

| Frequency Range                  | Measured Quantity of Hopping Channel | Limit | Result |
|----------------------------------|--------------------------------------|-------|--------|
| <u>2400</u> to <u>2483.5</u> MHz | 79                                   | ≥15   | Pass   |

## Test Plot of Number of hopping frequencies 1DH5



### 3DH5



### 5.1.8 Time of Occupancy

**RESULT:**
**Passed**

Test standard : FCC part 15.247(a)(1)(iii)

Basic standard : ANSI C63.10:2013

Limits : 0.4s

Kind of test site : Shield room

**Test setup**

Test Channel : Low

Operation Mode : A

Ambient temperature : 22-26°C

Relative humidity : 50-65%

Atmospheric pressure : 100-103 kPa

**Table 16: Test result of Time of Occupancy**

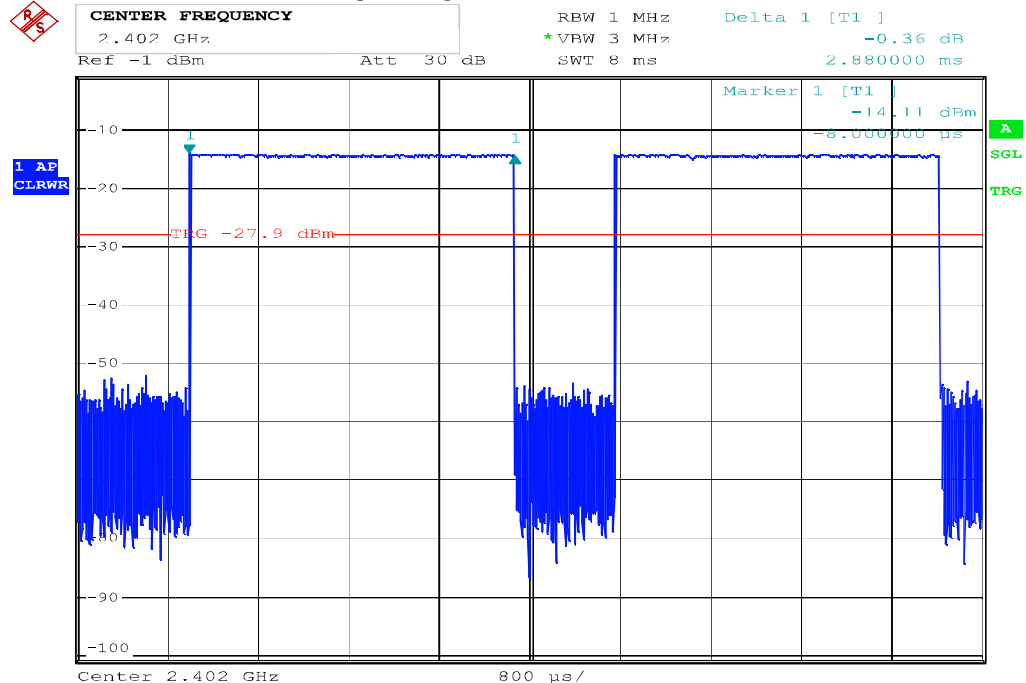
| Data Mode | Captured Burst (s) | Dwell time (s) | On+Off time (s) | Limit (s) | Result |
|-----------|--------------------|----------------|-----------------|-----------|--------|
| 1DH5      | 0.00288            | 0.3080         | 0.00374         | 0.4       | Pass   |
| 3DH5      | 0.00288            | 0.3080         | 0.00374         | 0.4       | Pass   |

Note:

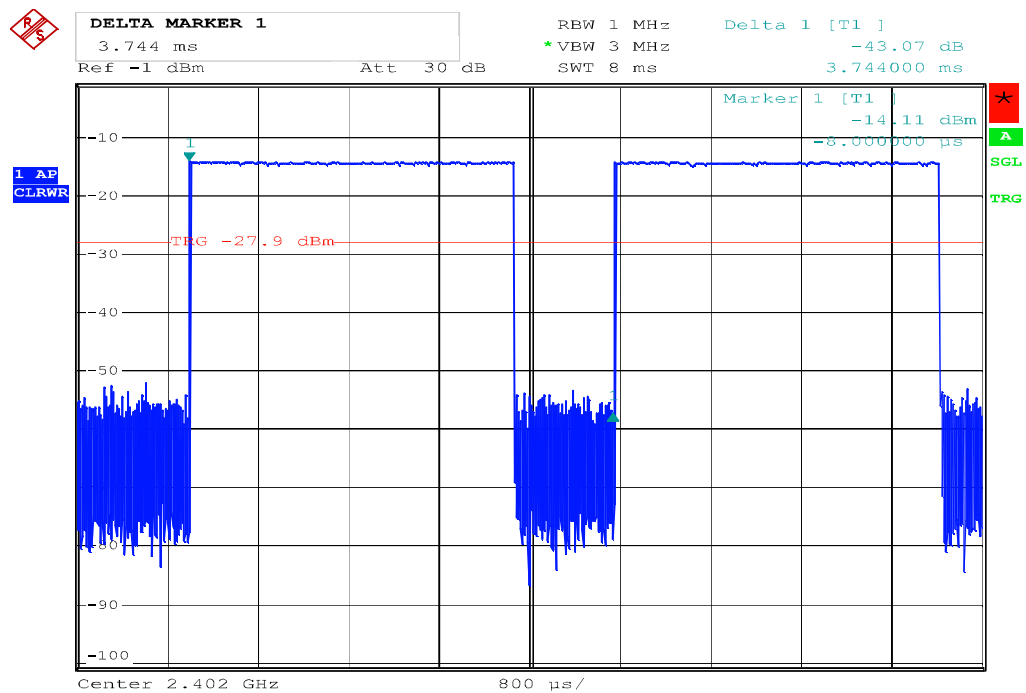
Dwell time = Pulse width x (Hopping rate / Number of channels) x Period

Period = 0.4 (seconds/ channel) x 79 (channel) = 31.6 seconds.

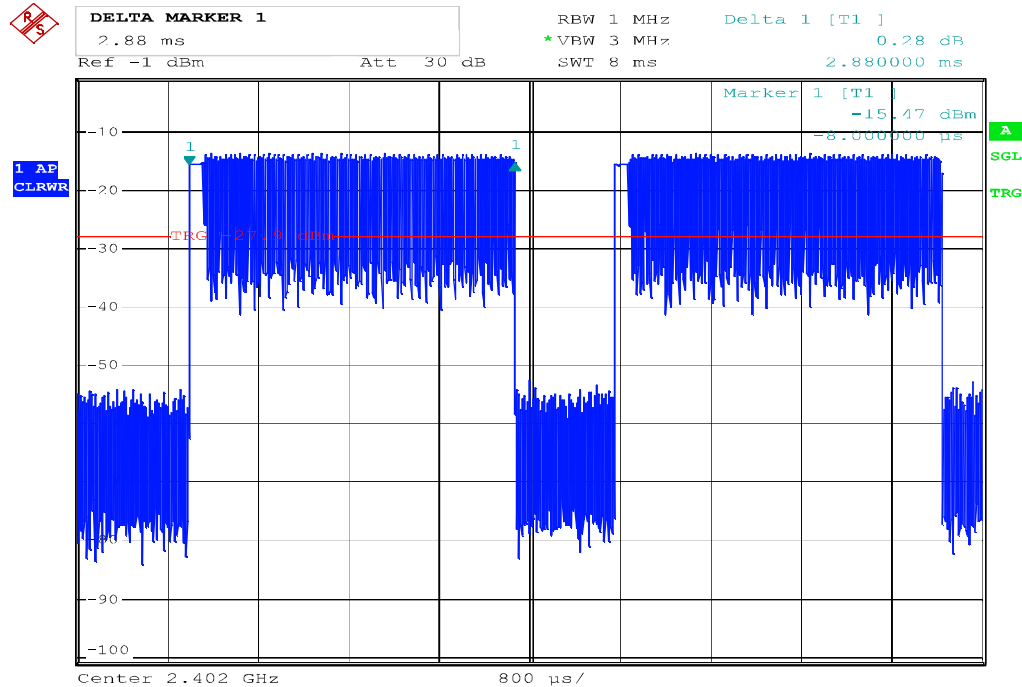
Hopping rate = 1 / (On+Off time) = 267 Hz

**Test Plot of Time of Occupancy, 1DH5**


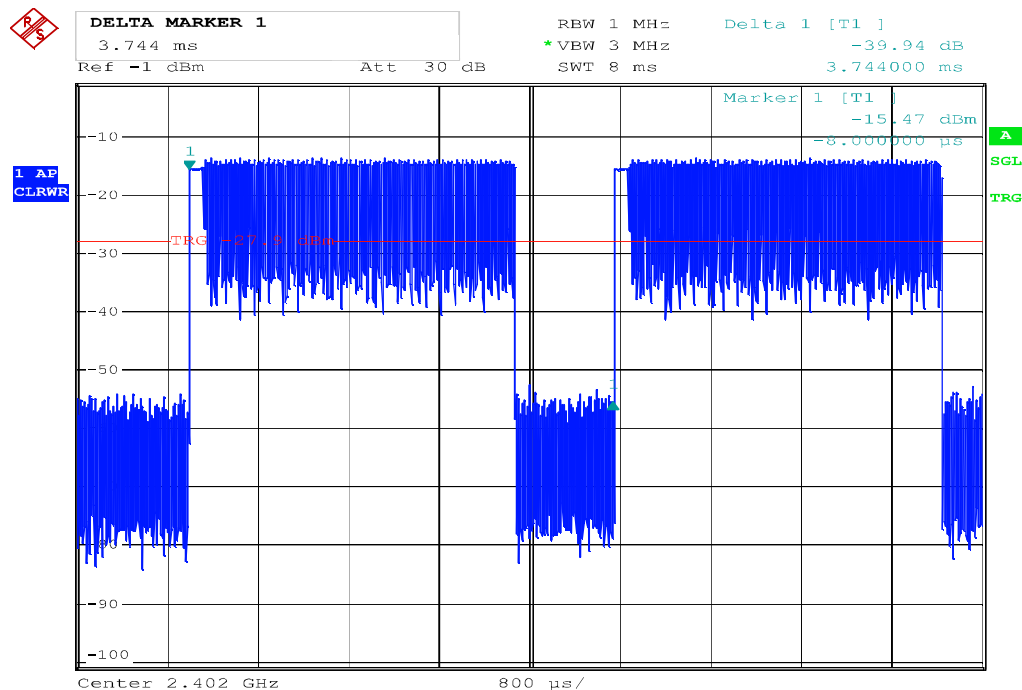
Date: 14.OCT.2019 16:17:45



Date: 14.OCT.2019 16:18:44

**Test Plot of Time of Occupancy, 3DH5**


Date: 14.OCT.2019 16:19:21



Date: 14.OCT.2019 16:19:37

## 5.2 Mains Emissions

### 5.2.1 Mains Conducted Emissions

**RESULT:****Passed**

Test standard : FCC Part 15.207  
FCC Part 15.107

Limits : Mains Conducted emissions as defined in  
above test standards must comply with the  
mains conducted emission limits specified

Kind of test site : Shielded Room

**Test setup**

Operation mode : D

Ambient temperature : 22-26°C

Relative humidity : 50-65%

Atmospheric pressure : 100-103 kPa

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)

Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

Remark: For details refer to Appendix D.

## 6. Safety Human exposure

### 6.1 Radio Frequency Exposure Compliance

#### 6.1.1 Electromagnetic Fields

**RESULT:****Passed**Test standard : 47CFR1.1310  
47CFR 2.1091

Separation distance is more than 20 cm, thus mobile device exposure limits can be applied

**Maximum Exposure:**

|                        |                          |
|------------------------|--------------------------|
| Power to Antenna (mW)  | 139 mW                   |
| Power to Antenna (dBm) | 21.4 dBm                 |
| Antenna Gain           | 1.16 dBi                 |
| Power+Ant Gain         | 181.6 mW                 |
| Distance               | 20 cm                    |
| S=                     | 0.036 mW/cm <sup>2</sup> |

Limit FCC: 1 mW/cm<sup>2</sup>FCC/NCC:

|                  |                                          |
|------------------|------------------------------------------|
| 0.3-1.34 MHz     | (100) mW/cm <sup>2</sup>                 |
| 1.34-30 MHz      | (180/f <sup>2</sup> ) mW/cm <sup>2</sup> |
| 30-300 MHz       | 0.2 mW/cm <sup>2</sup>                   |
| 300-1500 MHz     | f/1500 mW/cm <sup>2</sup>                |
| 1500-100,000 MHz | 1.0 mW/cm <sup>2</sup>                   |

---End---

## 7. Photographs of the Test Set-Up

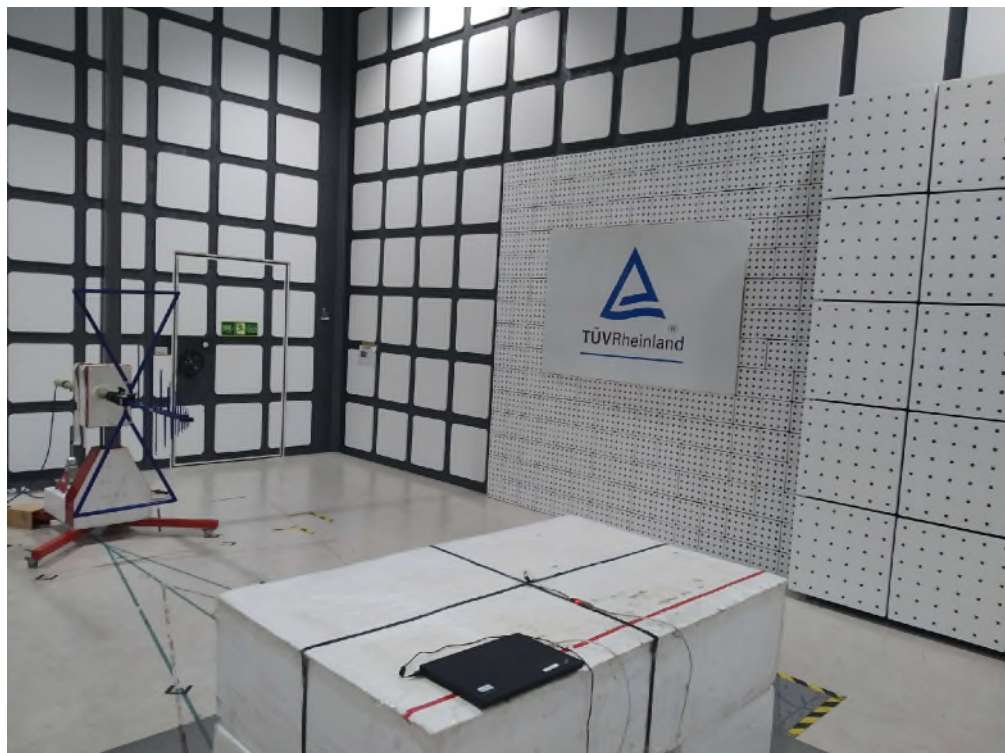
**Photograph 1: Set-up for Spurious Emissions (Front View 1)**



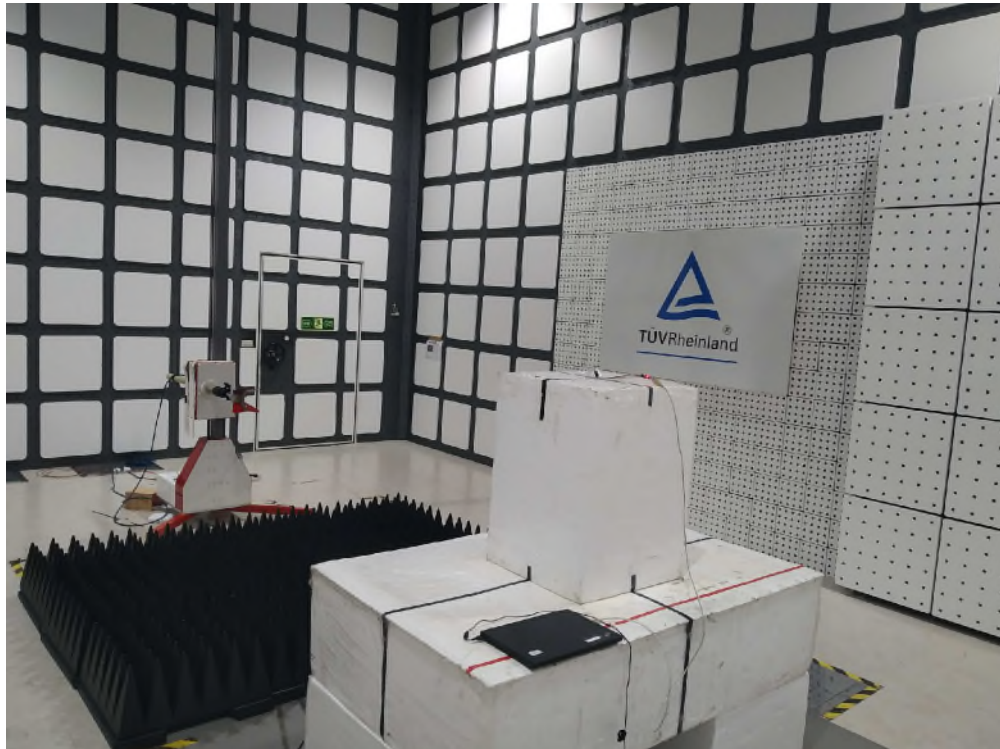
**Photograph 2: Set-up for Spurious Emissions (Front View 2)**



**Photograph 3: Set-up for Spurious Emissions (Back View 1)**



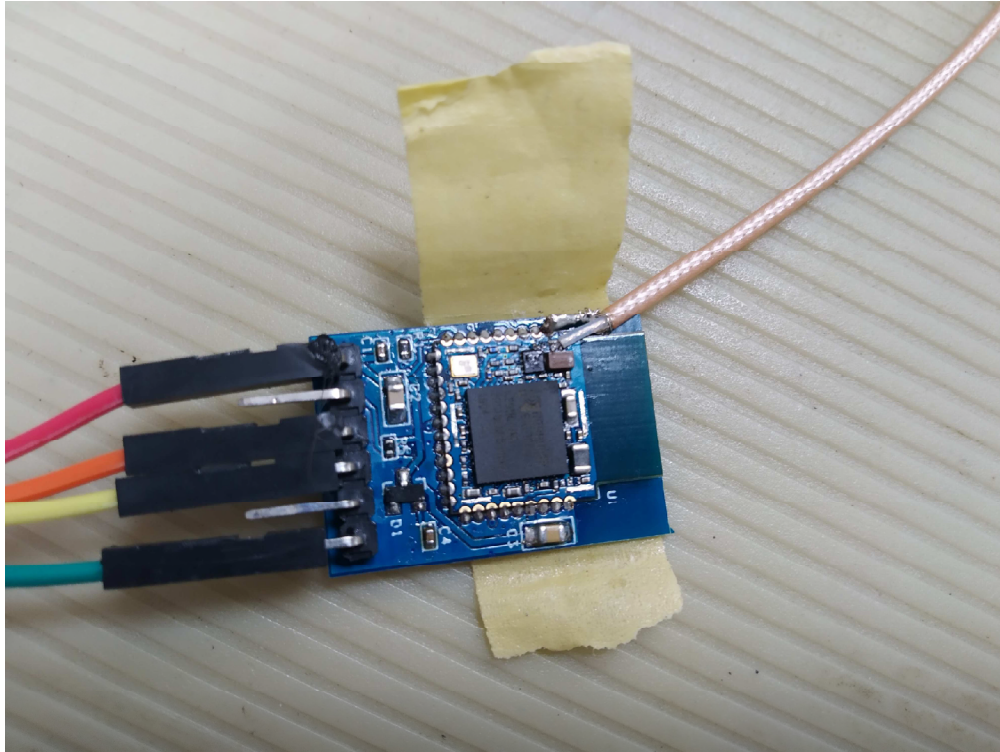
**Photograph 4: Set-up for Spurious Emissions (Back View 2)**



**Photograph 5: Set-up for Conducted testing (View 1)**



**Photograph 6: Set-up for Conducted testing (View 2)**



**Photograph 7: Set-up for Mains Conducted testing (Front View)**



**Photograph 8: Set-up for Mains Conducted testing (Front View)**



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