

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                            |                                                                                    |                                                                                                         |                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------|
| <b>Prüfbericht-Nr.:</b><br><i>Test report no.:</i>                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>60377098 001</b>                                                                                        | <b>Auftrags-Nr.:</b><br><i>Order no.:</i>                                          | <b>238486049</b>                                                                                        | Seite 1 von 46<br>Page 1 of 46          |
| <b>Kunden-Referenz-Nr.:</b><br><i>Client reference no.:</i>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>N/A</b>                                                                                                 | <b>Auftragsdatum:</b><br><i>Order date:</i>                                        | <b>2020.05.05</b>                                                                                       |                                         |
| <b>Auftraggeber:</b><br><i>Client:</i>                                                                                                                                                                                                                                                                                                                                                                                                                              | Zeroplus Technology Corporation<br>3F, No.121, Jian 8th Rd, Chung Ho District New Taipei City, 235, Taiwan |                                                                                    |                                                                                                         |                                         |
| <b>Prüfgegenstand:</b><br><i>Test item:</i>                                                                                                                                                                                                                                                                                                                                                                                                                         | BROOK WingMan-SD converter                                                                                 |                                                                                    |                                                                                                         |                                         |
| <b>Bezeichnung / Typ-Nr.:</b><br><i>Identification / Type no.:</i>                                                                                                                                                                                                                                                                                                                                                                                                  | ZPP005B                                                                                                    |                                                                                    |                                                                                                         |                                         |
| <b>Auftrags-Inhalt:</b><br><i>Order content:</i>                                                                                                                                                                                                                                                                                                                                                                                                                    | FCC Part 15C                                                                                               |                                                                                    |                                                                                                         |                                         |
| <b>Prüfgrundlage:</b><br><i>Test specification:</i>                                                                                                                                                                                                                                                                                                                                                                                                                 | FCC 47CFR Part 15: Subpart C Section 15.247                                                                |                                                                                    |                                                                                                         |                                         |
| <b>Wareneingangsdatum:</b><br><i>Date of sample receipt:</i>                                                                                                                                                                                                                                                                                                                                                                                                        | 2020.05.12                                                                                                 |                                                                                    |                                                                                                         |                                         |
| <b>Prüfmuster-Nr.:</b><br><i>Test sample no.:</i>                                                                                                                                                                                                                                                                                                                                                                                                                   | A002824737-001<br>A002824737-008                                                                           |                                                                                    |                                                                                                         |                                         |
| <b>Prüfzeitraum:</b><br><i>Testing period:</i>                                                                                                                                                                                                                                                                                                                                                                                                                      | 2020.05.18 - 2020.05.22                                                                                    |                                                                                    |                                                                                                         |                                         |
| <b>Ort der Prüfung:</b><br><i>Place of testing:</i>                                                                                                                                                                                                                                                                                                                                                                                                                 | EMC/RF Laboratory Taipei                                                                                   |                                                                                    |                                                                                                         |                                         |
| <b>Prüflaboratorium:</b><br><i>Testing laboratory:</i>                                                                                                                                                                                                                                                                                                                                                                                                              | Taipei Testing laboratories                                                                                |                                                                                    |                                                                                                         |                                         |
| <b>Prüfergebnis*:</b><br><i>Test result*:</i>                                                                                                                                                                                                                                                                                                                                                                                                                       | Pass                                                                                                       |                                                                                    |                                                                                                         |                                         |
| <b>überprüft von:</b><br><i>reviewed by:</i>                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>genehmigt von:</b><br><i>authorized by:</i>                                                             |                                                                                    |                                                                                                         |                                         |
| <b>Datum:</b> 2020.07.07<br><i>Date:</i>                                                                                                                                                                                                                                                                                                                                                                                                                            | <br>Jack H.C. Chang     |                                                                                    | <b>Datum:</b> 2020.07.07<br><i>Date:</i>                                                                |                                         |
| <b>Stellung / Position:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | Project Manager                                                                                            |                                                                                    | <br>Ryan W.T. Chen |                                         |
| <b>Stellung / Position:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | Project Manager                                                                                            |                                                                                    | Project Manager                                                                                         |                                         |
| <b>Sonstiges / Other:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                            |                                                                                    |                                                                                                         |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                            |                                                                                    |                                                                                                         |                                         |
| <b>Zustand des Prüfgegenstandes bei Anlieferung:</b><br><i>Condition of the test item at delivery:</i>                                                                                                                                                                                                                                                                                                                                                              |                                                                                                            | Prüfmuster vollständig und unbeschädigt<br><i>Test item complete and undamaged</i> |                                                                                                         |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                            |                                                                                    |                                                                                                         |                                         |
| * Legende:                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1 = sehr gut<br>P(ass) = entspricht o.g. Prüfgrundlage(n)                                                  | 2 = gut<br>F(ail) = entspricht nicht o.g. Prüfgrundlage(n)                         | 3 = befriedigend<br>N/A = nicht anwendbar                                                               | 4 = ausreichend<br>N/T = nicht getestet |
| * Legend:                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1 = very good<br>P(ass) = passed a.m. test specification(s)                                                | 2 = good<br>F(ail) = failed a.m. test specification(s)                             | 3 = satisfactory<br>N/A = not applicable                                                                | 4 = sufficient<br>N/T = not tested      |
| <p><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></p> |                                                                                                            |                                                                                    |                                                                                                         |                                         |

## TEST SUMMARY

### 5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

### 5.1.2 MAXIMUM PEAK CONDUCTED 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

### 6.1.1 MAINS CONDUCTED EMISSIONS

RESULT: Passed

### 7.1.1 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: 60377098 001, 60377100 001 Appendix P)

**Appendix D: Test Result of Radiated Emissions**

(File Name: 60377098 001 Appendix D)

#### Test Specifications

The following standards were applied.

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

| Radio                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC 47CFR Part 15: Subpart C Section 15.247<br>FCC 47CFR Part 2: Subpart J Section 2.1091<br>ANSI C63.10:2013<br>KDB558074 D01 DTS Meas Guidance v05<br>KDB447498 D01 General RF Exposure Guidance v06 |

## 2. Test Sites

### 2.1 Test Laboratory

Taipei Testing laboratories

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

### 2.2 Test Facility

Taipei Testing laboratories

No. 458-18, Sec 2, Fenliao., Linkou Dist.  
New Taipei City 244  
Taiwan (R.O.C.)  
FCC Registration No.: 226631  
IC Canada Registration No.: 25563

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**

| Equipment                       | Manufacturer                  | Model No.           | Serial No.             | Cal. Date  | Cal. Due Date |
|---------------------------------|-------------------------------|---------------------|------------------------|------------|---------------|
| EMI Test Receiver               | R&S                           | ESR7                | 102109                 | 2020/3/30  | 2021/3/29     |
| Spectrum Analyzer               | R&S                           | FSV40               | 101508                 | 2020/3/16  | 2021/3/15     |
| Pre-Amplifier                   | Agilent                       | 8447D               | 2727A05146             | 2020/2/17  | 2021/2/16     |
| Pre-Amplifier                   | EMCI                          | EMC051845SE         | 980635                 | 2020/2/11  | 2021/2/10     |
| Pre-Amplifier                   | EMCI                          | EMC184045SE         | 980656                 | 2020/2/11  | 2021/2/10     |
| Bilog Antenna                   | SCHWARZBECK                   | VULB-9168           | 00950                  | 2020/1/20  | 2021/1/19     |
| Horn Antenna                    | ETS-Lindgren                  | 3117                | 00218929               | 2019/11/27 | 2020/11/26    |
| Horn Antenna                    | SCHWARZBECK                   | BBHA 9170           | 00896                  | 2020/1/17  | 2021/1/16     |
| Loop Antenna                    | EMCI                          | LPA600              | 287                    | 2019/12/20 | 2020/12/19    |
| Test Software                   | Audix                         | e3                  | Ver. 9                 | N/A        | N/A           |
| Test Cable                      | HUBER+SUHNER                  | SUCOFLEX 104EA      | 800057/4EA             | 2020/3/25  | 2021/3/24     |
| Test Cable                      | HUBER+SUHNER                  | SUCOFLEX 104        | 802244/4               | 2020/3/25  | 2021/3/24     |
| Test Cable                      | HUBER+SUHNER                  | SUCOFLEX 104        | MY37203/4              | 2020/3/25  | 2021/3/24     |
| Test Cable                      | HUBER+SUHNER                  | SUCOFLEX 102EA      | 800897/2EA             | 2020/3/25  | 2021/3/24     |
| Test Cable                      | HUBER+SUHNER                  | SUCOFLEX 102EA      | 800902/2EA             | 2020/3/25  | 2021/3/24     |
| Test Cable                      | HUBER+SUHNER                  | SUCOFLEX 102EA      | 801026/2EA             | 2020/3/25  | 2021/3/24     |
| EMI Test Receiver               | Rohde & Schwarz               | ESCI 7              | 100797                 | 2020/03/13 | 2021/03/13    |
| Two-Line V-Network (for EUT)    | Rohde & Schwarz               | ENV216              | 101243                 | 2019/06/23 | 2020/06/23    |
| Two-Line V-Network              | Rohde & Schwarz               | ENV216              | 101262                 | 2019/07/16 | 2020/07/16    |
| Telecom ISN 4 Line              | Fischer Custom Communications | FFCC-TLISN-T4-02-09 | 101168                 | 2020/02/03 | 2021/02/03    |
| Impedance Stabilization Network | TESEQ                         | ISN T800            | 51949                  | 2020/02/25 | 2021/02/25    |
| Pulse Limiter                   | Rohde & Schwarz               | ESH3-Z2             | 0357.8810.54-102102-HN | 2019/07/25 | 2020/07/25    |
| Test Software                   | Audix                         | e3                  | Ver. 9                 | N/A        | N/A           |

## 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 by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

## 2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements are  $\pm 3\text{dB}$ .

**Table 3: Emission Measurement Uncertainty**

| Parameter                            | Uncertainty                      |
|--------------------------------------|----------------------------------|
| Radio Frequency                      | $\pm 0.1 \text{ ppm}$            |
| RF power/RF Exposure(MPE), conducted | $\pm 1.5 \text{ dB}$             |
| RF power density, conducted          | $\pm 3 \text{ dB}$               |
| spurious emissions, conducted        | $\pm 3 \text{ dB}$               |
| all emissions, radiated              | $\pm 6 \text{ dB}$               |
| Temperature                          | $\pm 1 \text{ }^{\circ}\text{C}$ |
| Humidity                             | $\pm 5 \text{ \%}$               |
| DC and low frequency voltages        | $\pm 3 \text{ \%}$               |



### 3. General Product Information

#### 3.1 Product Function and Intended Use

The EUT is a BROOK WingMan-SD converter. 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 | BROOK WingMan-SD converter |
| Type Designation  | ZPP005B                    |
| FCC ID            | 2ADKM005B                  |

**Table 5: Technical Specification of EUT**

| Technical Specification | Value                       |
|-------------------------|-----------------------------|
| Operating Frequencies   | 2402~2480 MHz               |
| Channel Spacing         | 1MHz                        |
| Number of Channels      | 79                          |
| Operation Voltage       | 5Vdc                        |
| Modulation              | GFSK, $\pi/4$ -DQPSK, 8DPSK |
| Antenna gain            | -6.72032dbi                 |

**Table 6: Frequency hopping information**

| Technical Specification  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hopping Range            | <p>Hereby we declare that the maximum frequency of this device is: 2402-2480MHz.</p> <p>This is according the Bluetooth Core Specification V5.0+EDR for devices which will be operated in the USA.</p> <p>This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Hopping Sequence         | <p>Example of a 79 hopping sequence in data mode:<br/> 33,04,21,44,23,42,53,46,55,48,40,59,72,29,76,31,08,73,<br/> 07,75,09,45,60,39,58,13,47,11,77,52,35,50,65,54,67,56,<br/> 69,62,71,64, 7,25,27,66,57,70,74,61,78,63,10,41,05,43,<br/> 15,44,64,68,02,70,06,01,51,03,55,05,03,66,53,49,36,47</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 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

### 3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

### 3.5 Submitted Documents

- |                         |                   |
|-------------------------|-------------------|
| - Photo Document        | - Circuit Diagram |
| - Technical Description | - Block Diagram   |
| - Rating Label          |                   |

## 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 |
| 1DH5 | Default           | Default  | Default  |
| 2DH5 | Default           | Default  | Default  |
| 3DH5 | Default           | Default  | Default  |

### 4.2 Test Operation and Test Software

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

This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:

Conducted: A002824737-001

Radiated: A002824737-008

|               |                                   |
|---------------|-----------------------------------|
| Test Software | RDA Host Controller Tester- HCDD1 |
|---------------|-----------------------------------|

### 4.3 Special Accessories and Auxiliary Equipment

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

Support Units:

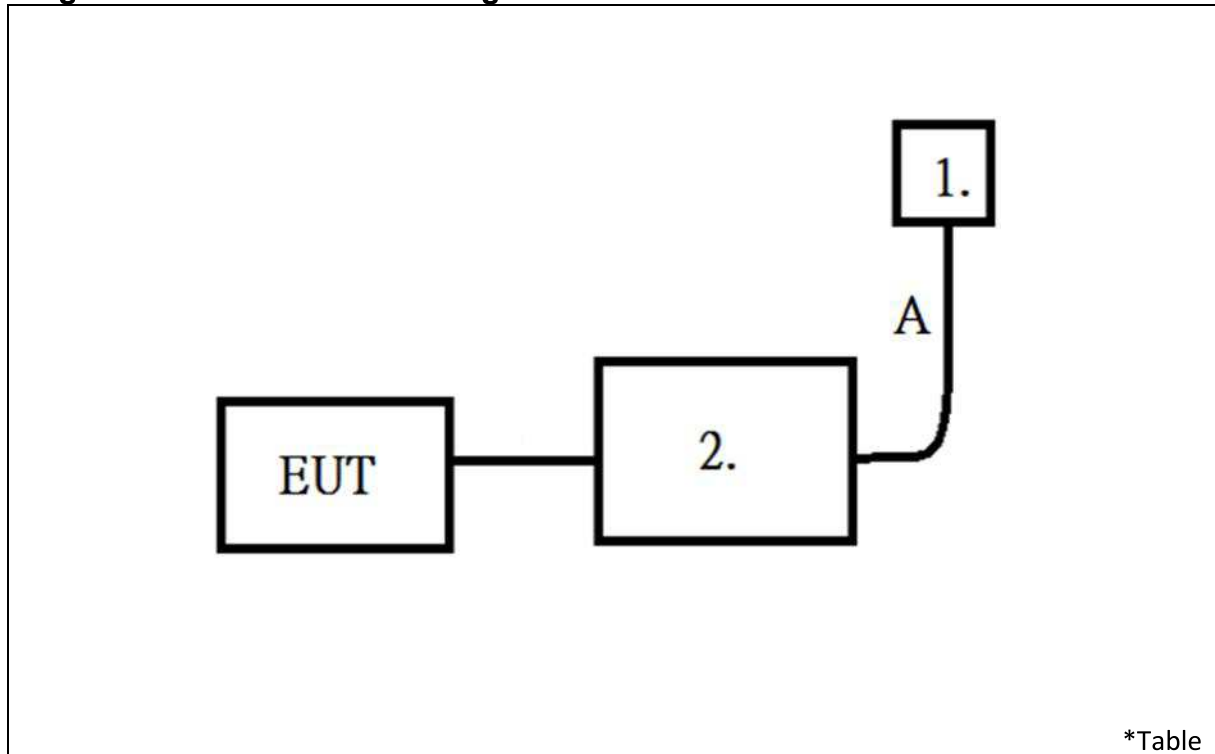
| Description         | Brand Name  | Model No. | Serial No. |
|---------------------|-------------|-----------|------------|
| Adapter (1)         | TPN-CA16    | -         | 1588-3003  |
| Notebook (2)        | 15-da1046TX | -         | CND9111RHH |
| Interface Cable (A) | -           | -         | 180 cm     |

### 4.4 Countermeasures to achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

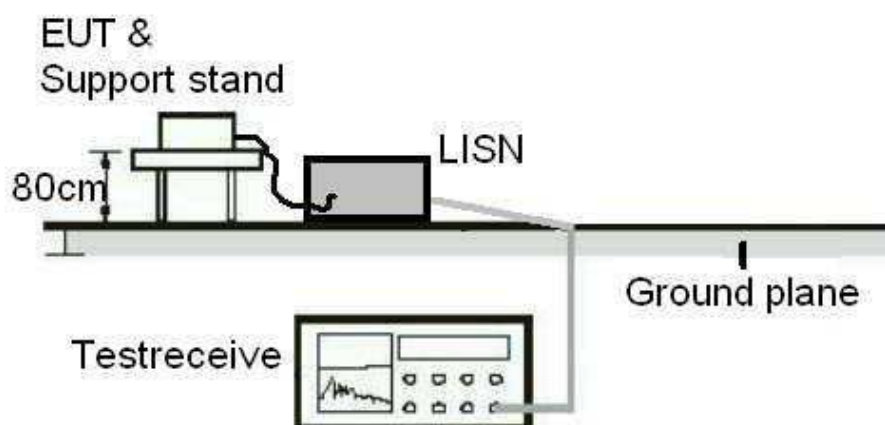
## 4.5 Test Setup Diagram

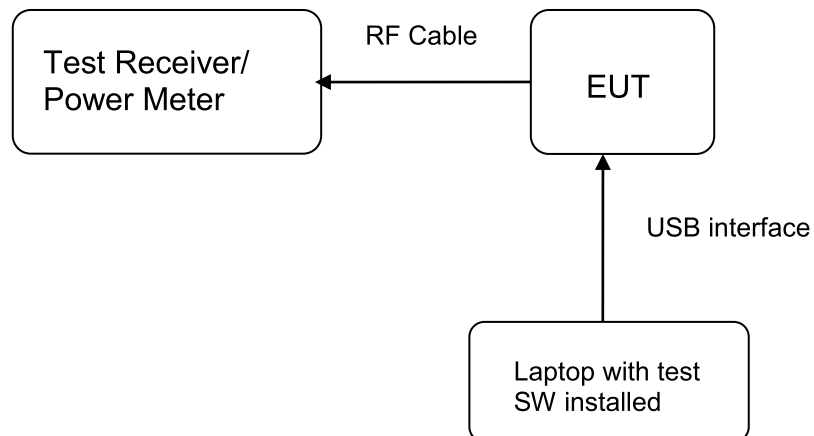
### Diagram of Measurement Configuration for Radiation Test



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

### Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)



**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                                 |
| Limit         | : | the use of antennas with directional gains that do not exceed 6dBi |

According to the manufacturer declaration, the EUT has an antenna with Max directional gain of -6.72032dBi. The antenna is a printed antenna 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 Maximum peak conducted output power

### RESULT:

**Passed**

Test standard : FCC Part 15.247(b)(3)  
 Basic standard : ANSI C63.10:2013, KDB558074  
 Limit : 125mW  
 Kind of test site : Shielded room/Conducted 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 8: Test result of Peak Output Power, 1DH5**

| Channel        | Channel Frequency (MHz) | Output Power |         | Limit |
|----------------|-------------------------|--------------|---------|-------|
|                |                         | (dBm)        | (W)     | (mW)  |
| Low Channel    | 2402                    | 5.16         | 0.00328 | 125   |
| Middle Channel | 2441                    | 4.31         | 0.00270 | 125   |
| High Channel   | 2480                    | 4.03         | 0.00253 | 125   |

**Table 9: Test result of Peak Output Power, 2DH5**

| Channel        | Channel Frequency (MHz) | Output Power |         | Limit |
|----------------|-------------------------|--------------|---------|-------|
|                |                         | (dBm)        | (W)     | (mW)  |
| Low Channel    | 2402                    | 5.10         | 0.00324 | 125   |
| Middle Channel | 2441                    | 4.23         | 0.00265 | 125   |
| High Channel   | 2480                    | 3.96         | 0.00249 | 125   |

**Prüfbericht - Nr.: 60377098 001**  
*Test Report No.***Seite 18 von 46**  
*Page 18 of 46***Table 10: Test result of Peak Output Power, 3DH5**

| Channel        | Channel Frequency (MHz) | Output Power |         | Limit |
|----------------|-------------------------|--------------|---------|-------|
|                |                         | (dBm)        | (W)     | (mW)  |
| Low Channel    | 2402                    | 5.13         | 0.00326 | 125   |
| Middle Channel | 2441                    | 4.28         | 0.00268 | 125   |
| High Channel   | 2480                    | 4.02         | 0.00252 | 125   |

### 5.1.3 20dB Bandwidth

**RESULT:**
**Passed**

Test standard : LP0002(2018): 3.10.1.6 (1)(A)  
 ANSI C63.10:2013  
 Basic standard : LP0002(2018) Appendix II  
 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 11: Test result of 20dB Bandwidth, 1DH5**

| Channel      | Channel Frequency (MHz) | 20dB Bandwidth (kHz) | Limit (MHz) | Result |
|--------------|-------------------------|----------------------|-------------|--------|
| Low Channel  | 2402                    | 944.06               | 1.5         | Pass   |
| Mid Channel  | 2441                    | 941.06               | 1.5         | Pass   |
| High Channel | 2480                    | 941.06               | 1.5         | Pass   |

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

**Table 12: Test result of 20dB Bandwidth, 3DH5**

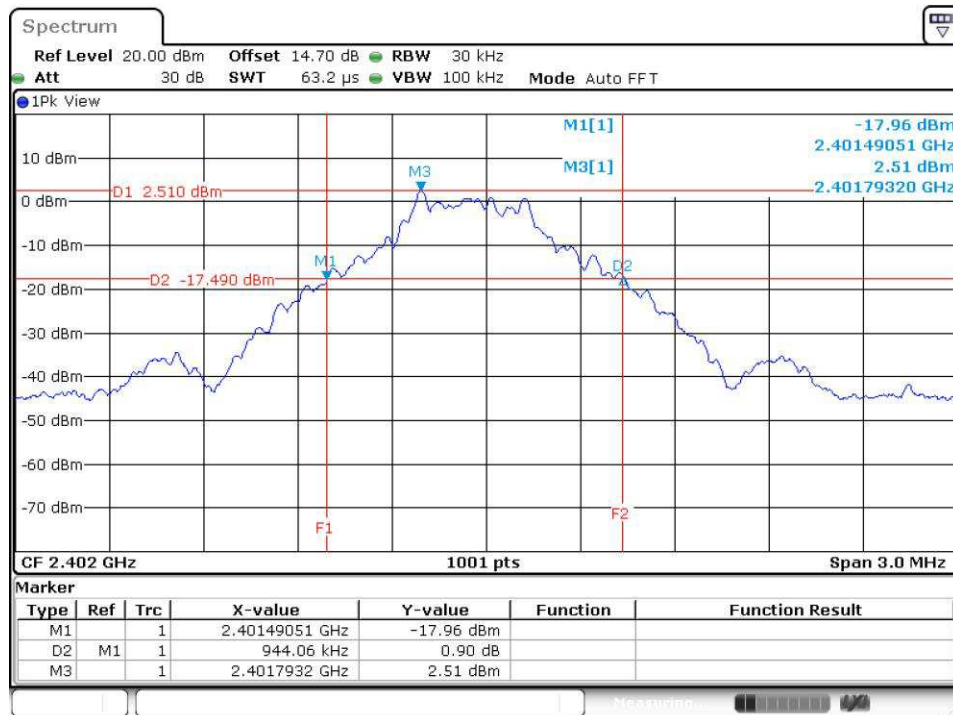
| Channel      | Channel Frequency (MHz) | 20dB Bandwidth (kHz) | Limit (MHz) | Result |
|--------------|-------------------------|----------------------|-------------|--------|
| Low Channel  | 2402                    | 1255.74              | 1.5         | Pass   |
| Mid Channel  | 2441                    | 1258.74              | 1.5         | Pass   |
| High Channel | 2480                    | 1267.70              | 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.

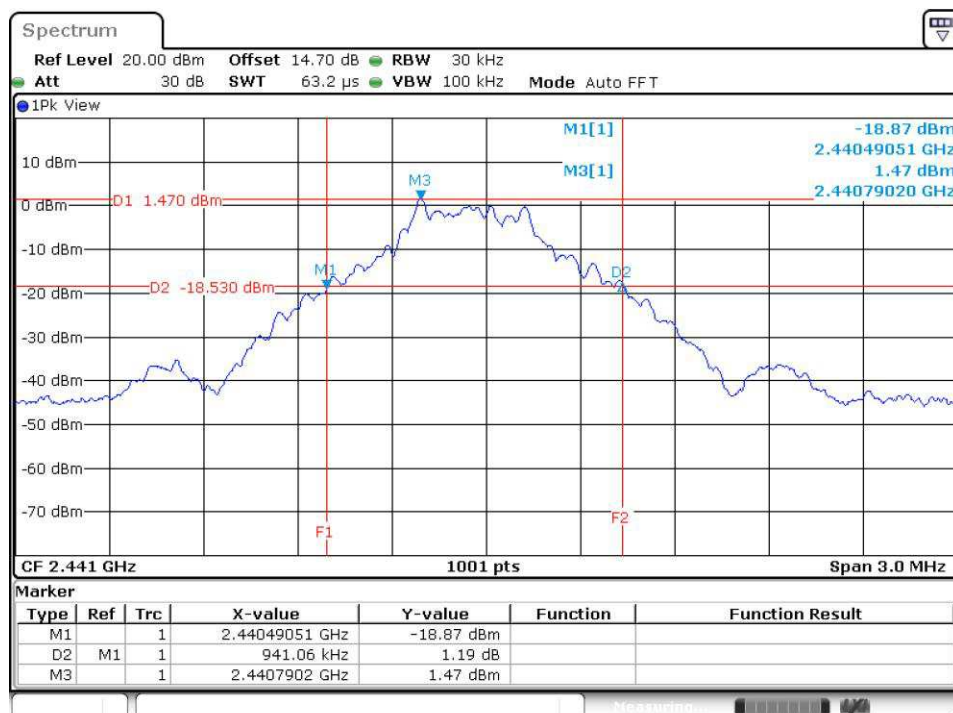
## Test Plot of 20dB Bandwidth, 1DH5

### Low Channel



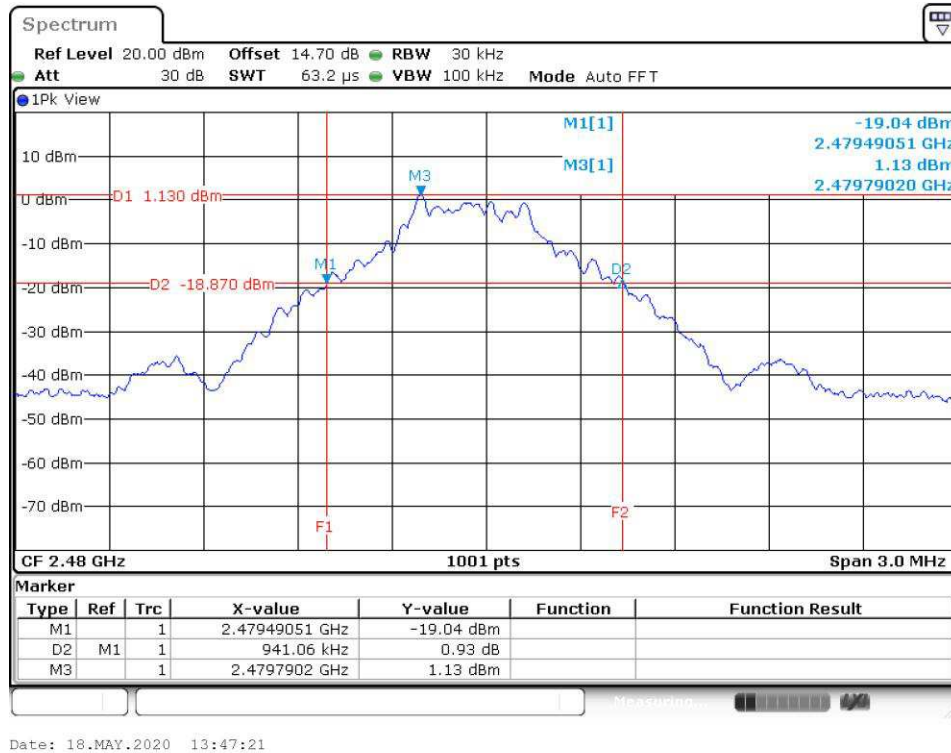
Date: 18.MAY.2020 13:38:17

### Middle Channel



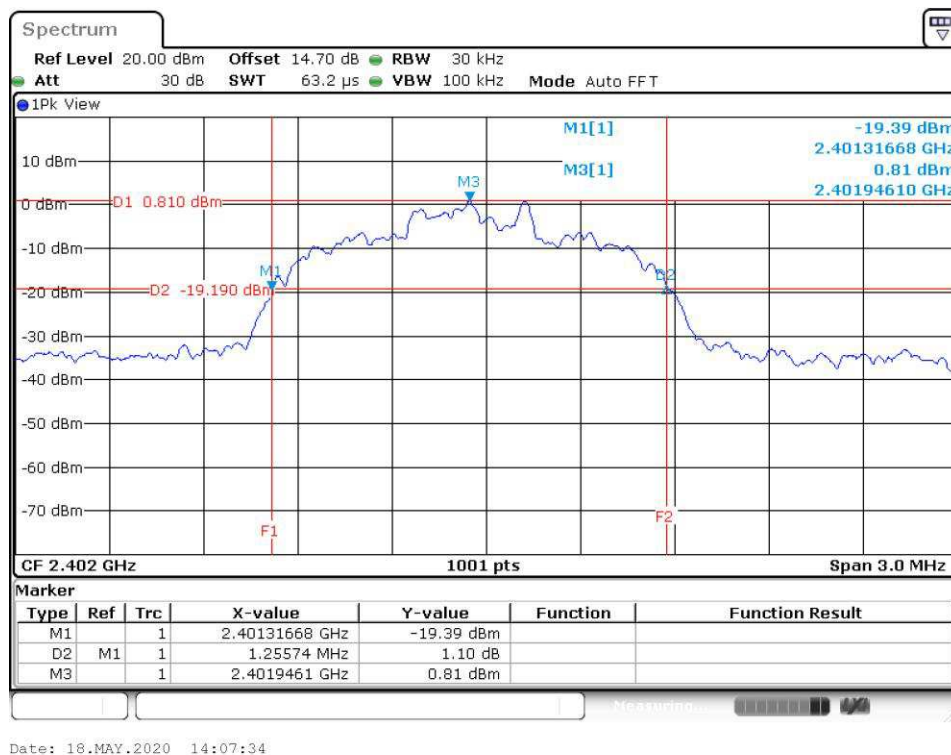
Date: 18.MAY.2020 13:43:00

### High Channel

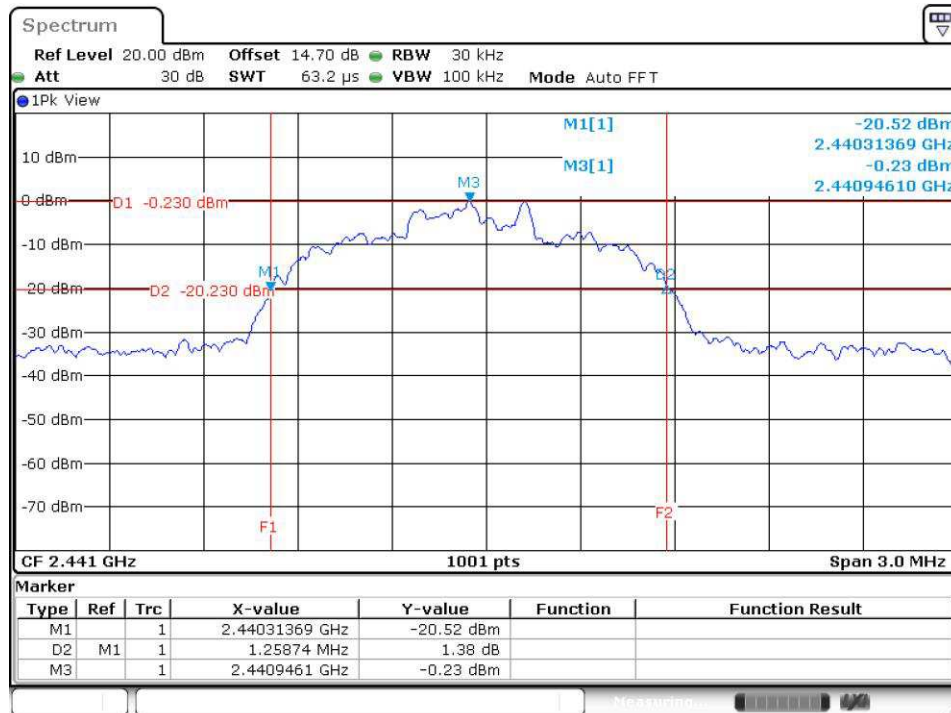


### Test Plot of 20dB Bandwidth, 3DH5

#### Low Channel

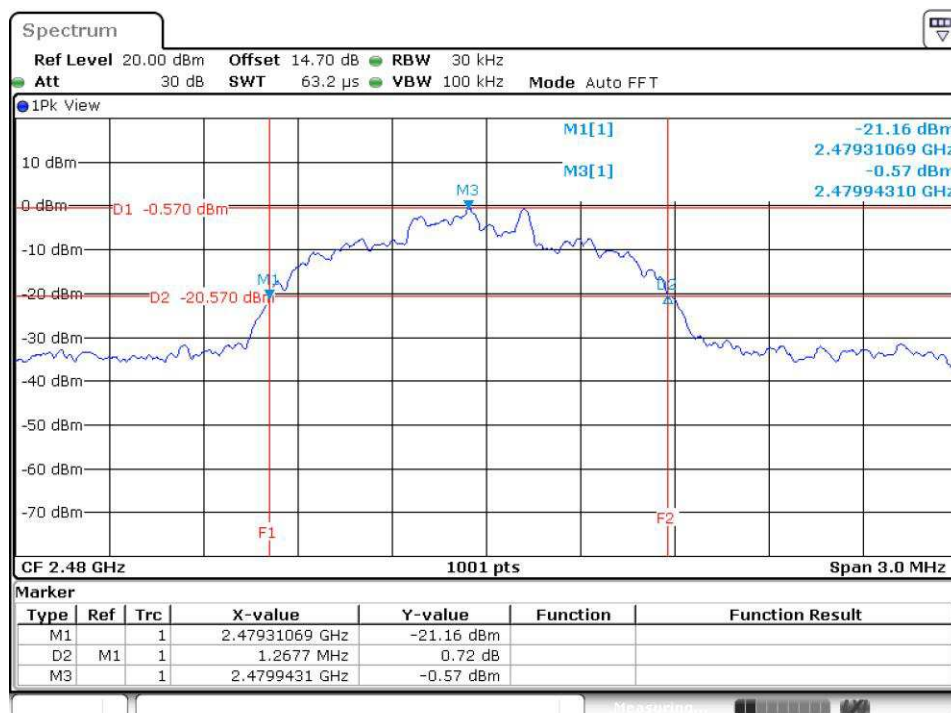


### Middle Channel



Date: 18.MAY.2020 14:13:18

### High Channel



Date: 18.MAY.2020 14:21:48

### 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, KDB558074  
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/Conducted room

**Test setup**

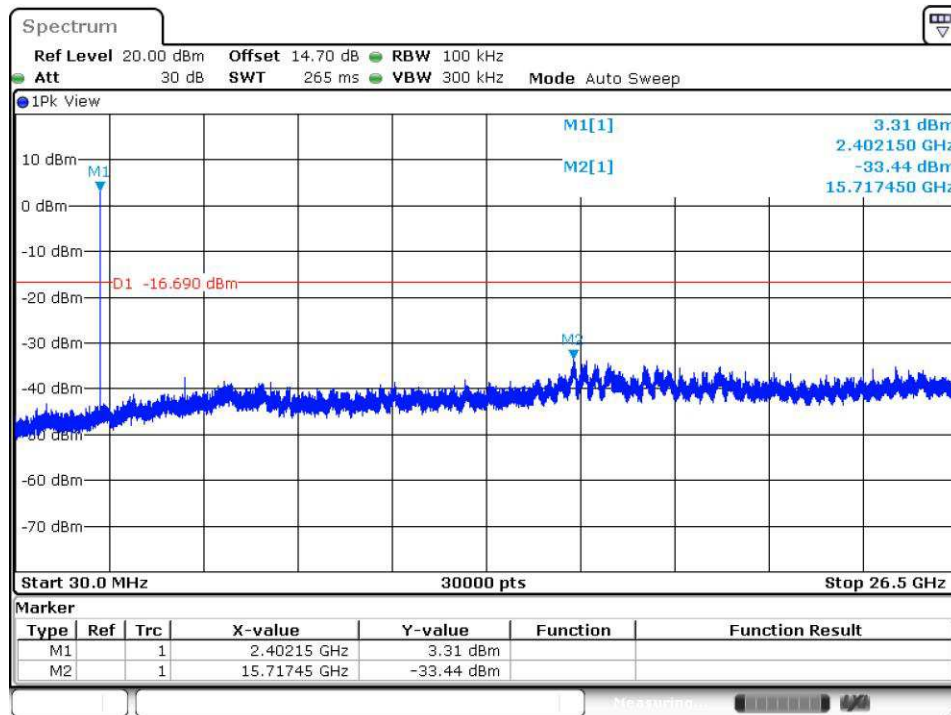
Test Channel : Low/ Mid/ High for spurious, Low/ High for Frequency Band Edge  
Operation mode : A  
Ambient temperature : 22-26 °C  
Relative humidity : 50-65%  
Atmospheric pressure : 100-103kPa

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

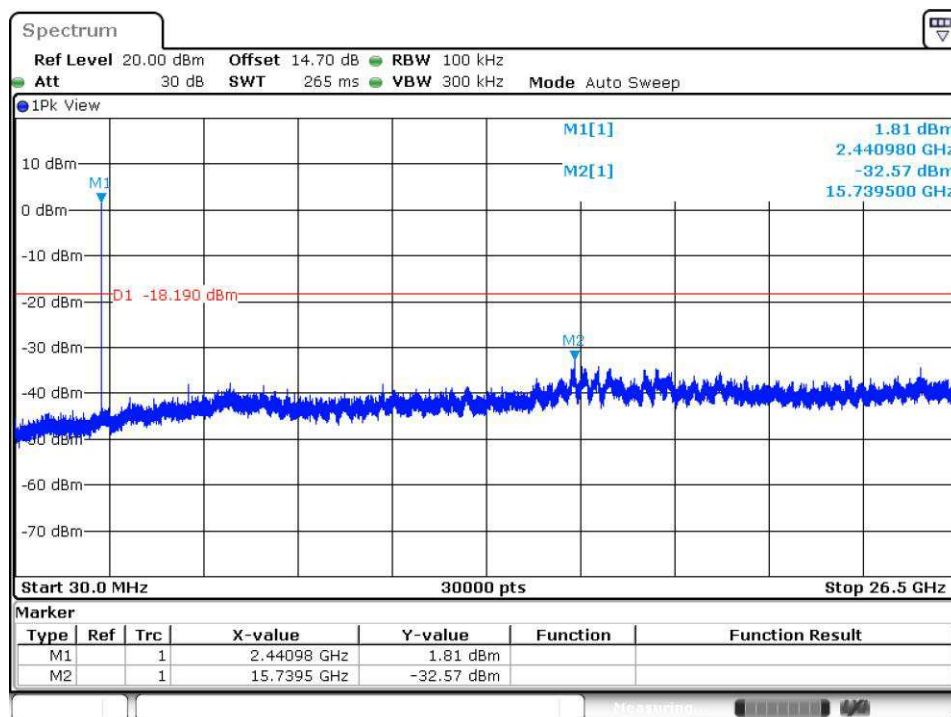
Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

## Test Plot 100kHz Conducted Emissions, 1DH5

### Low Channel

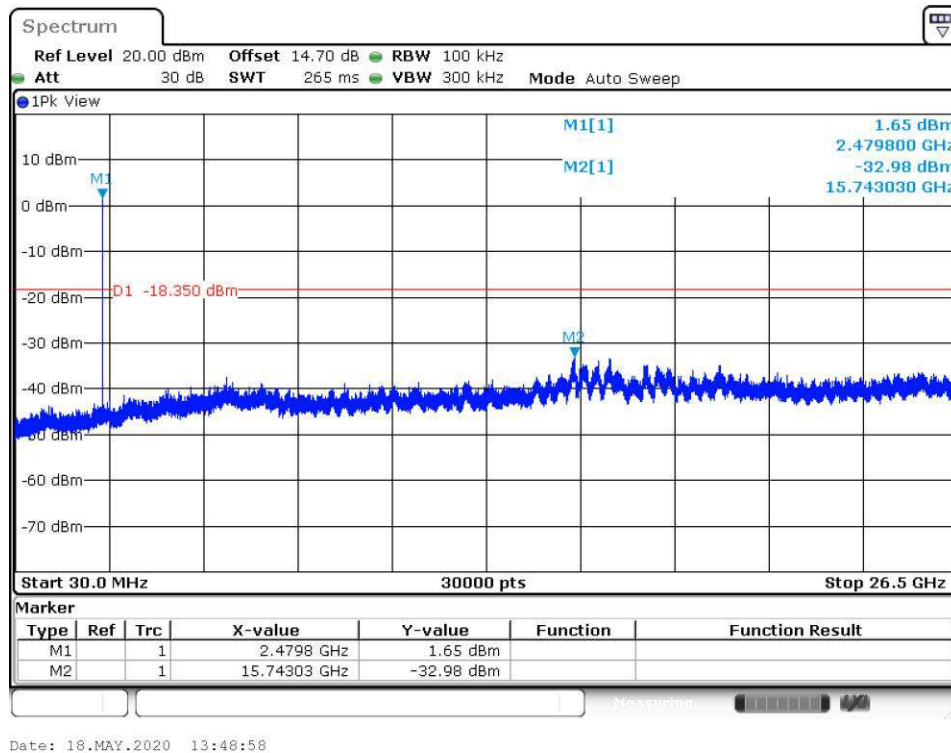


### Middle Channel



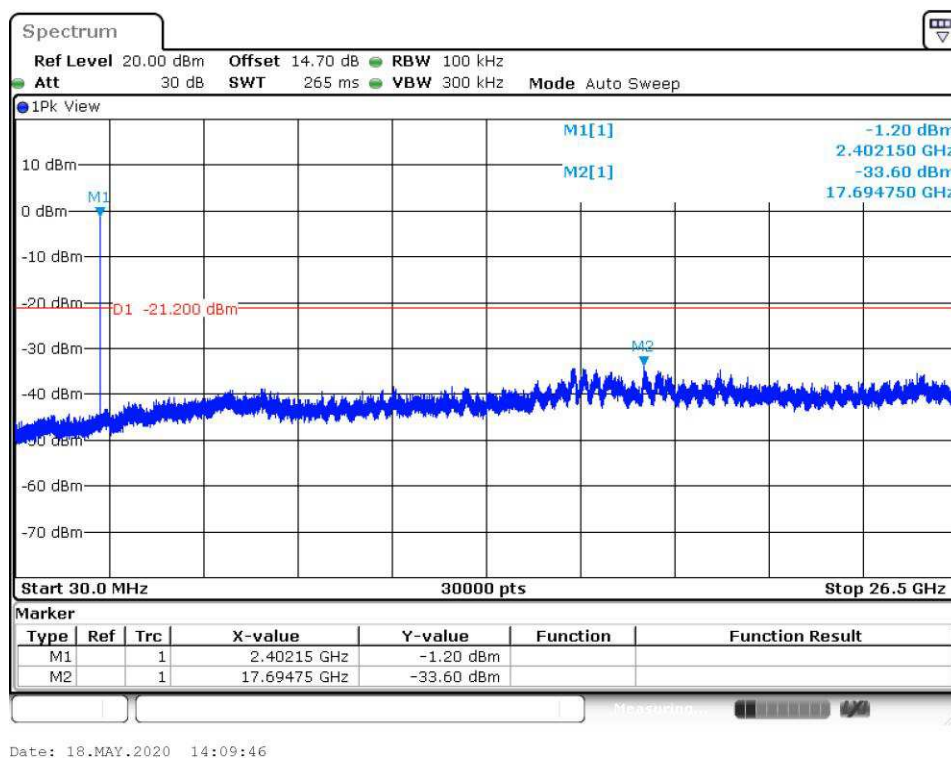


### High Channel

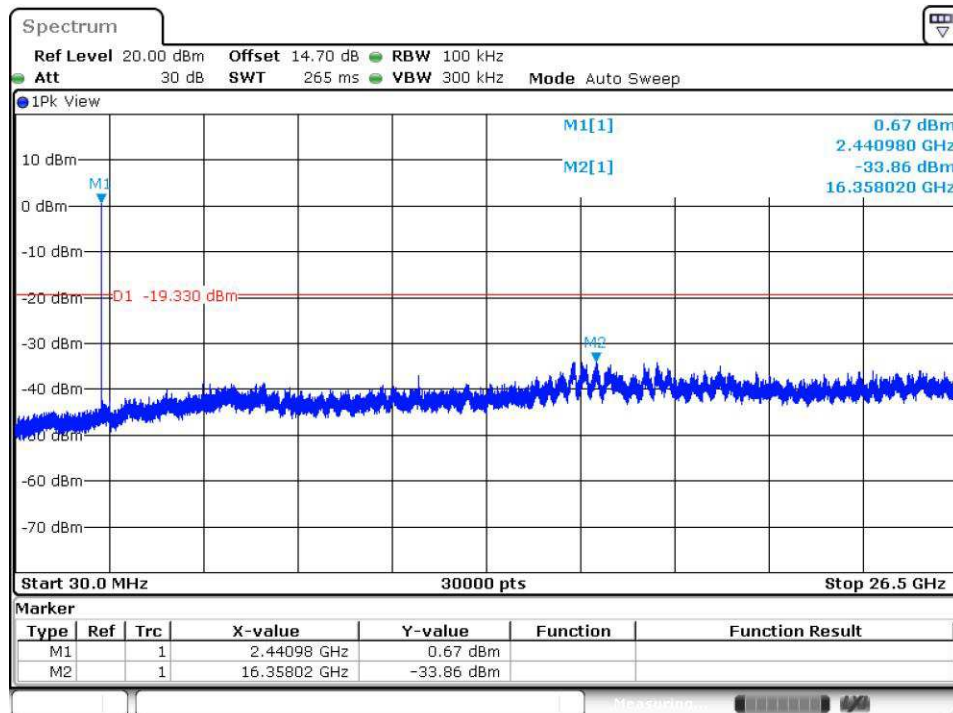


### Test Plot 100kHz Conducted Emissions, 3DH5

#### Low Channel

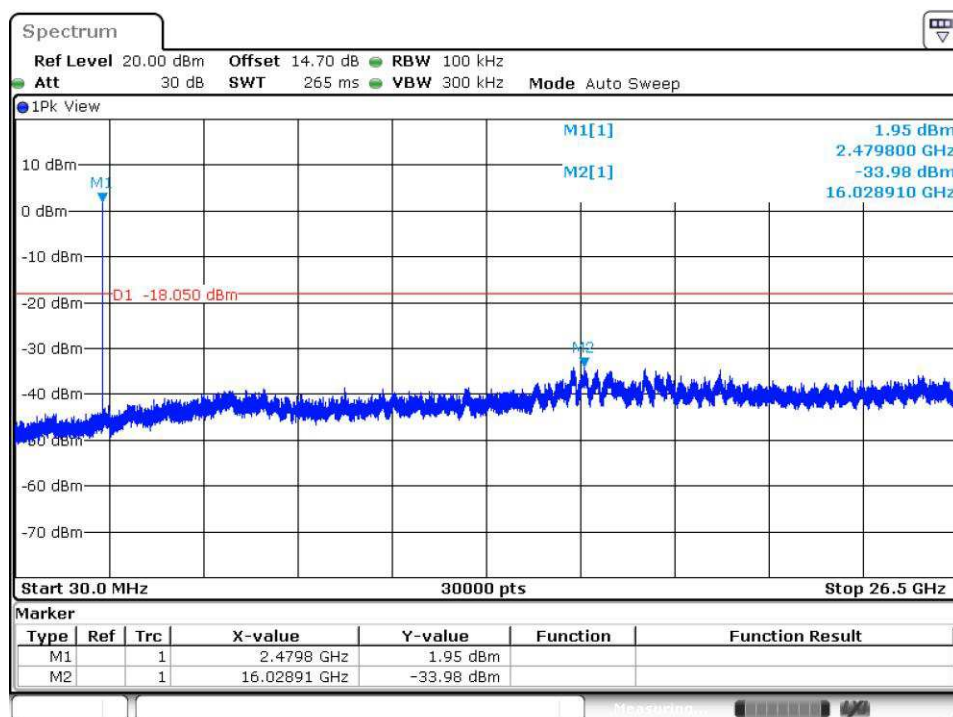


### Middle Channel



Date: 18.MAY.2020 14:15:21

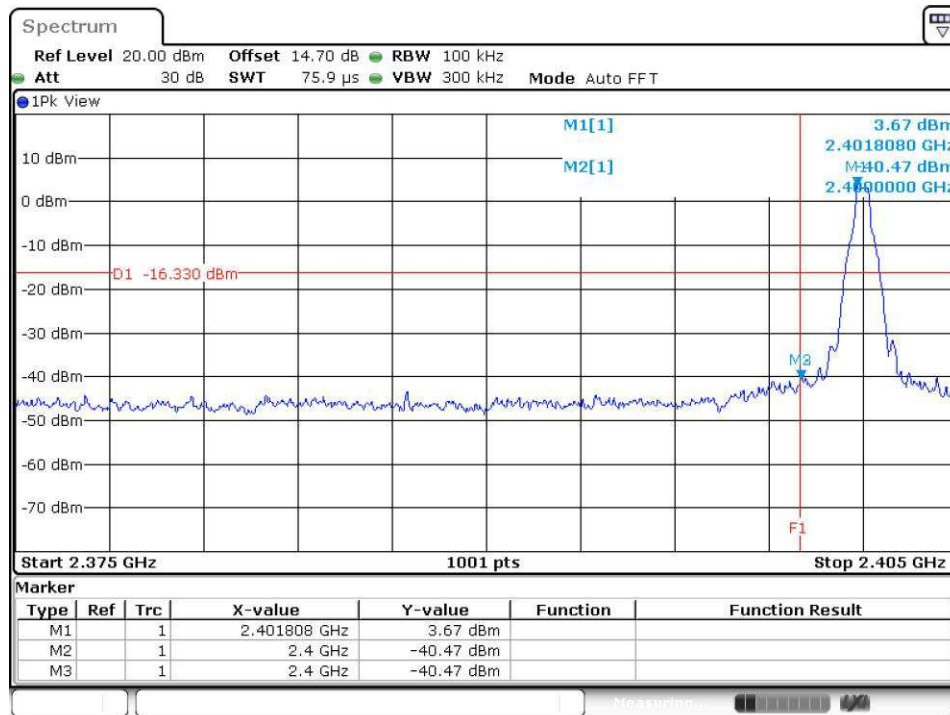
### High Channel



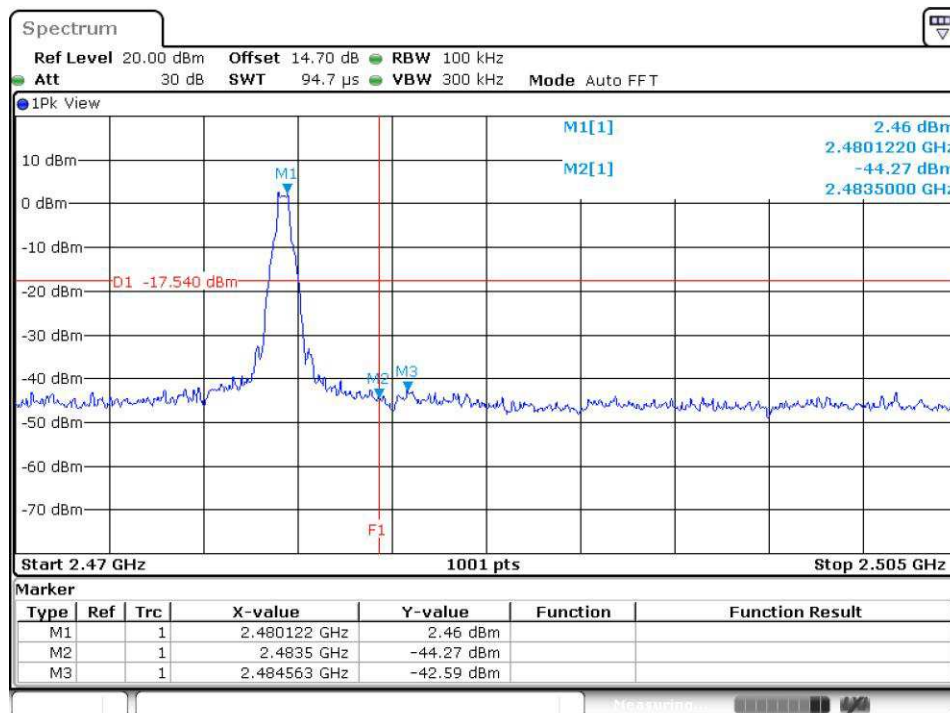
Date: 18.MAY.2020 14:23:36

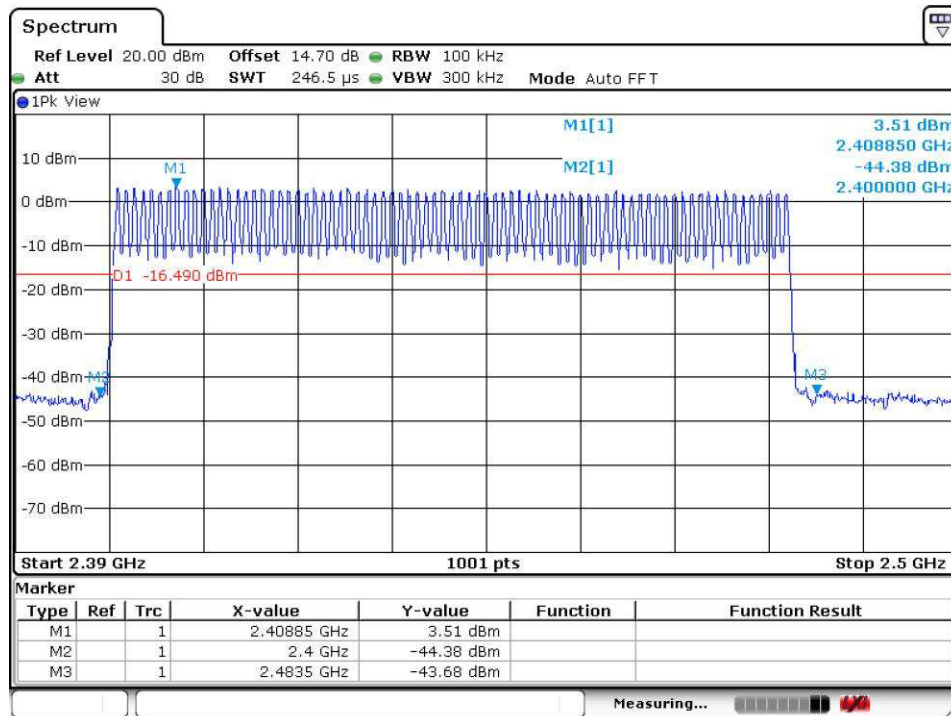
## Test Plot 100kHz RBW of Band Edge, 1DH5

### Low Channel

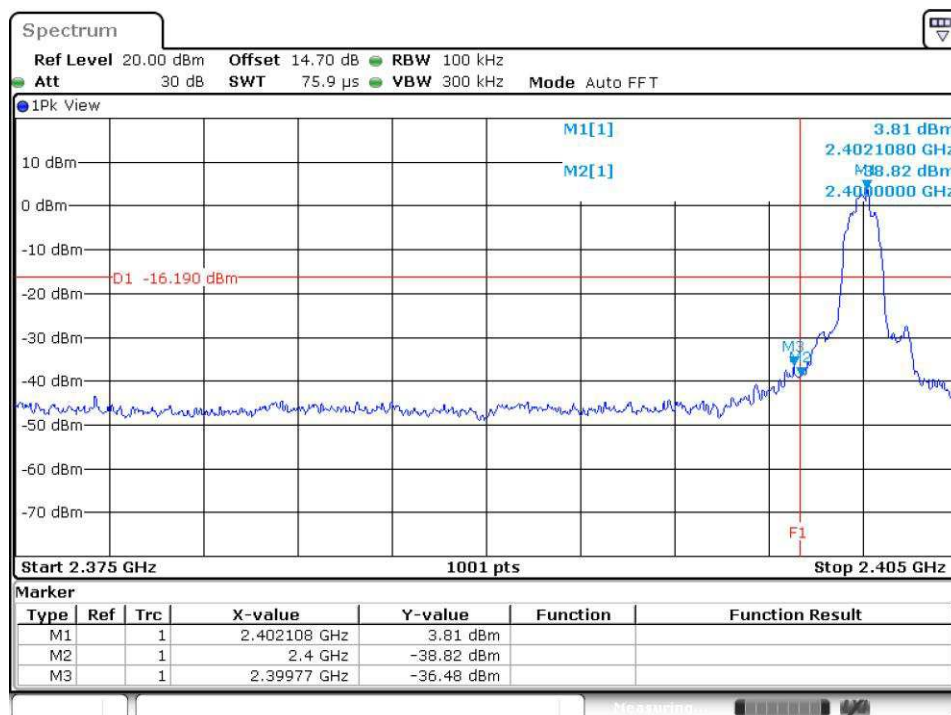


### High Channel



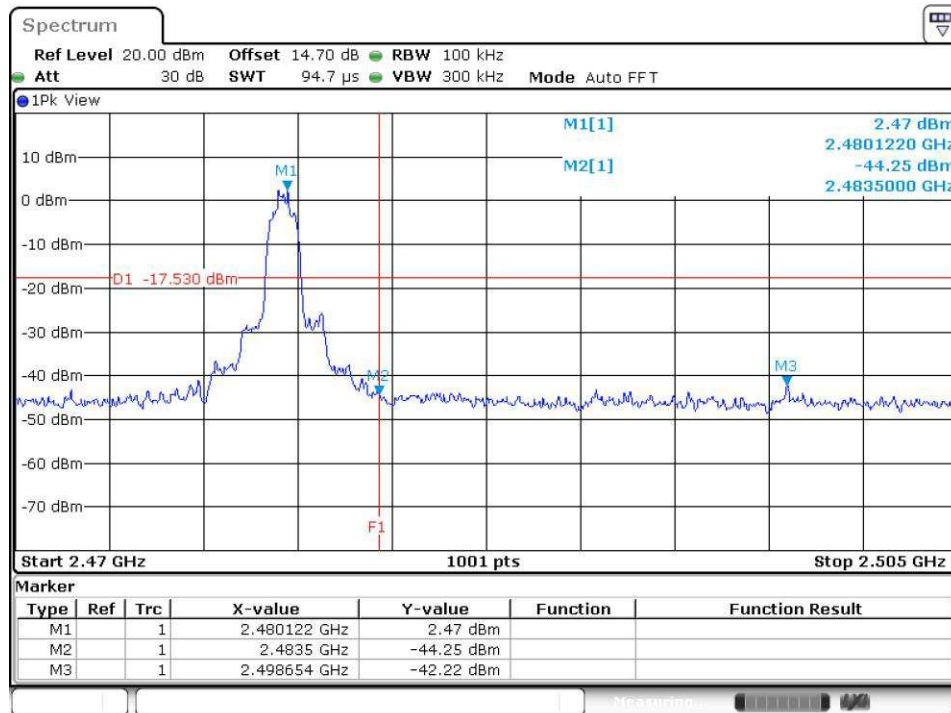
**Hopping**


Date: 18.MAY.2020 13:55:10

**Test Plot 100kHz RBW of Band Edge, 3DH5**
**Low Channel**


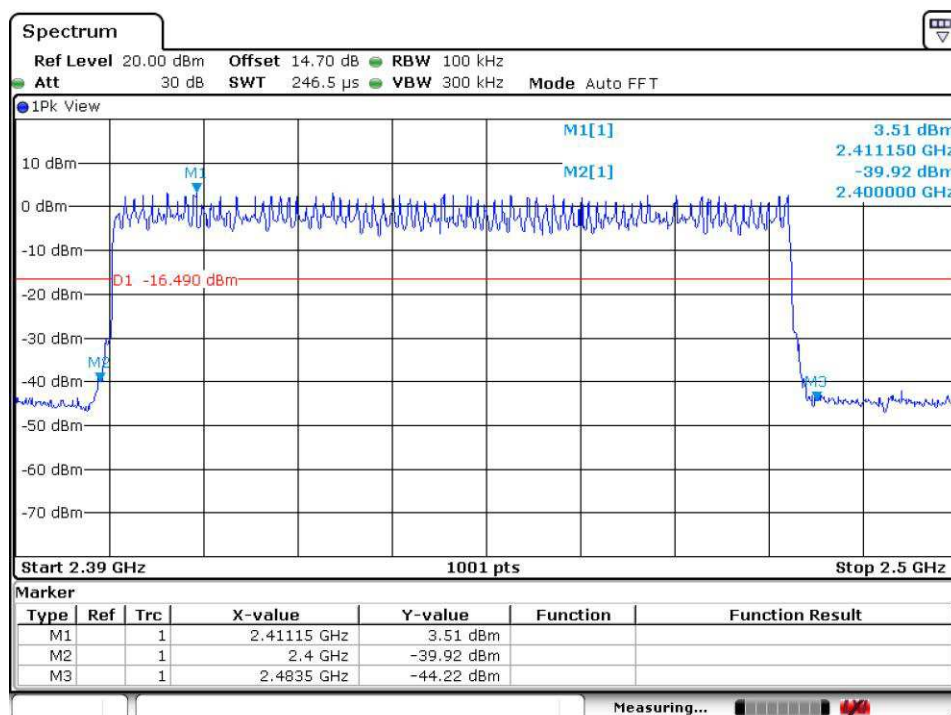
Date: 18.MAY.2020 14:10:48

### High Channel



Date: 18.MAY.2020 14:23:56

### Hopping



Date: 18.MAY.2020 14:06:05

### 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) and 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 : Low/ Middle/ High  
Operation mode : A, B

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 : 100-103kPa

**Table 13: 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                    |                                   |                                                |        |

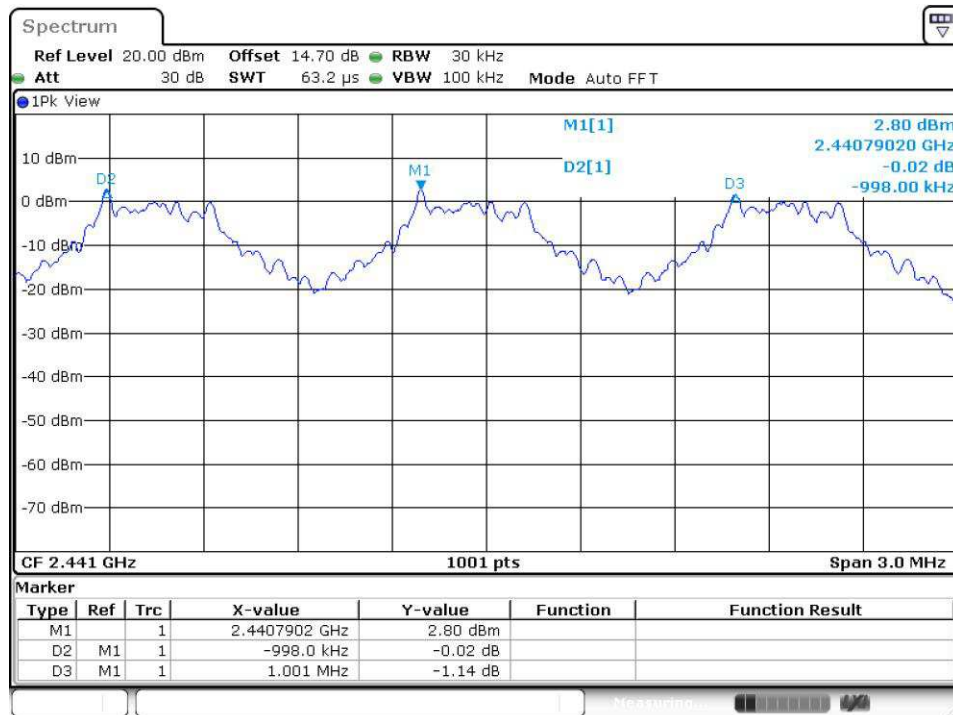
**Table 14: Test result of Frequency Separation, 3DH5**

| 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                    |                                   |                                                |        |



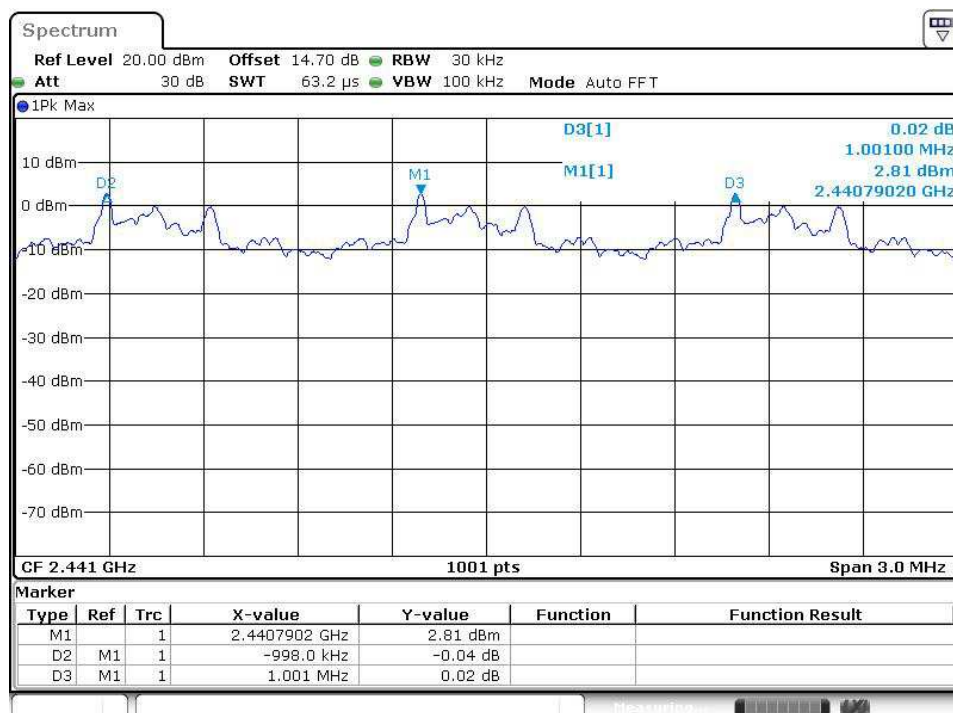
## Test Plot of Frequency Separation

### 1DH5



Date: 18.MAY.2020 13:46:18

### 3DH5



Date: 18.MAY.2020 14:20:18



### 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 : C  
Ambient temperature : 22-26 °C  
Relative humidity : 50-65%  
Atmospheric pressure : 100-103kPa

**Table 15: Test result of Number of hopping frequency, 1DH5**

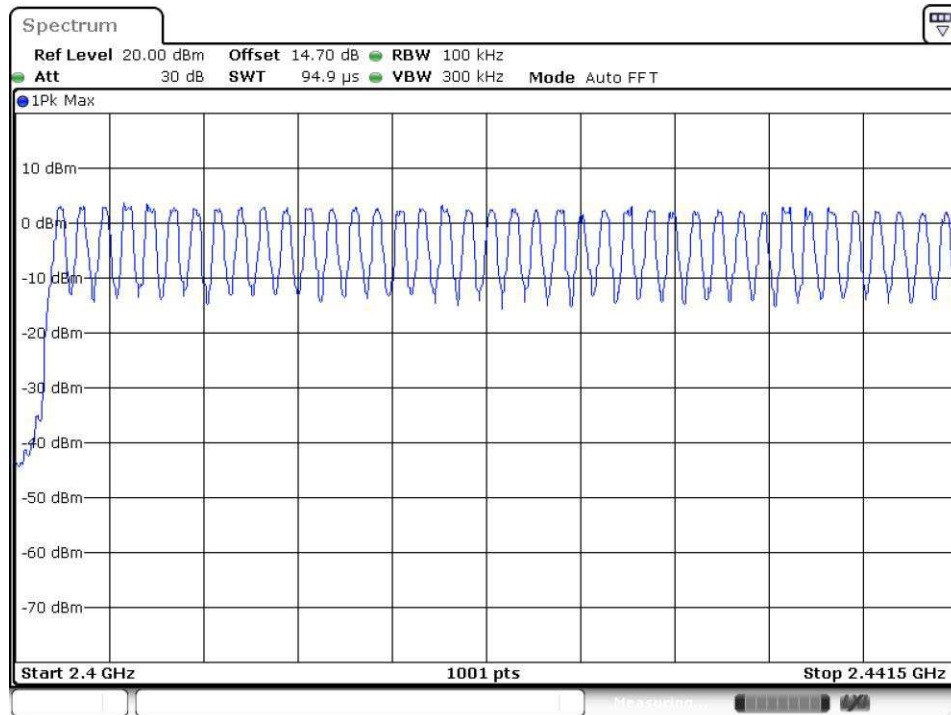
| Frequency Range                  | Measured Quantity of Hopping Channel | Limit | Result |
|----------------------------------|--------------------------------------|-------|--------|
| <u>2400</u> to <u>2483.5</u> MHz | 79                                   | ≥15   | Pass   |

**Table 16: Test result of Number of hopping frequency, 3DH5**

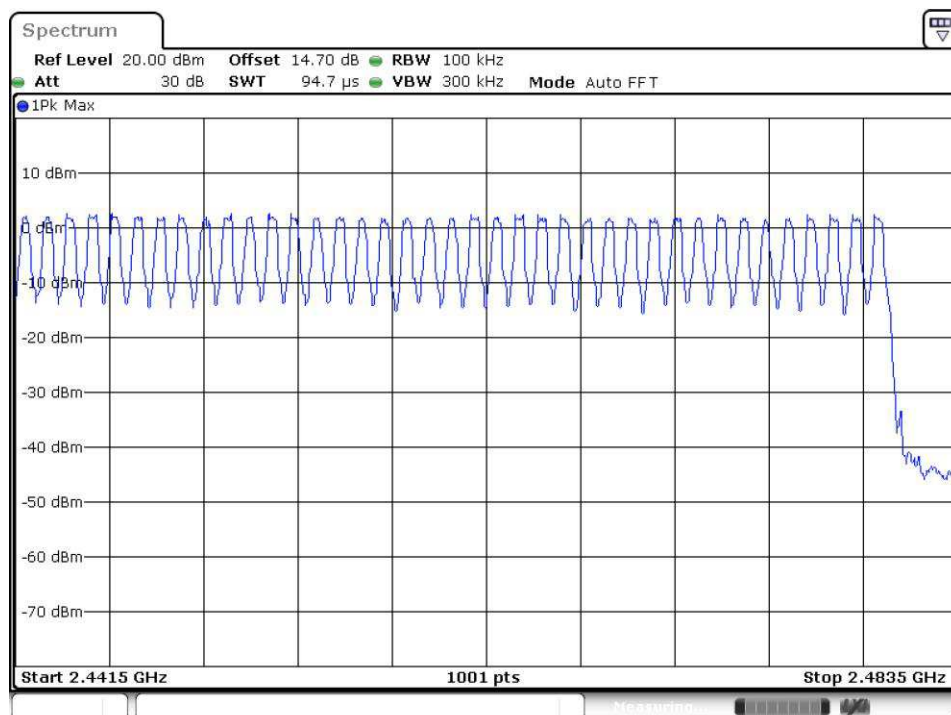
| Frequency Range                  | Measured Quantity of Hopping Channel | Limit | Result |
|----------------------------------|--------------------------------------|-------|--------|
| <u>2400</u> to <u>2483.5</u> MHz | 79                                   | ≥15   | Pass   |

## Test Plot of Number of hopping frequencies

### 1DH5

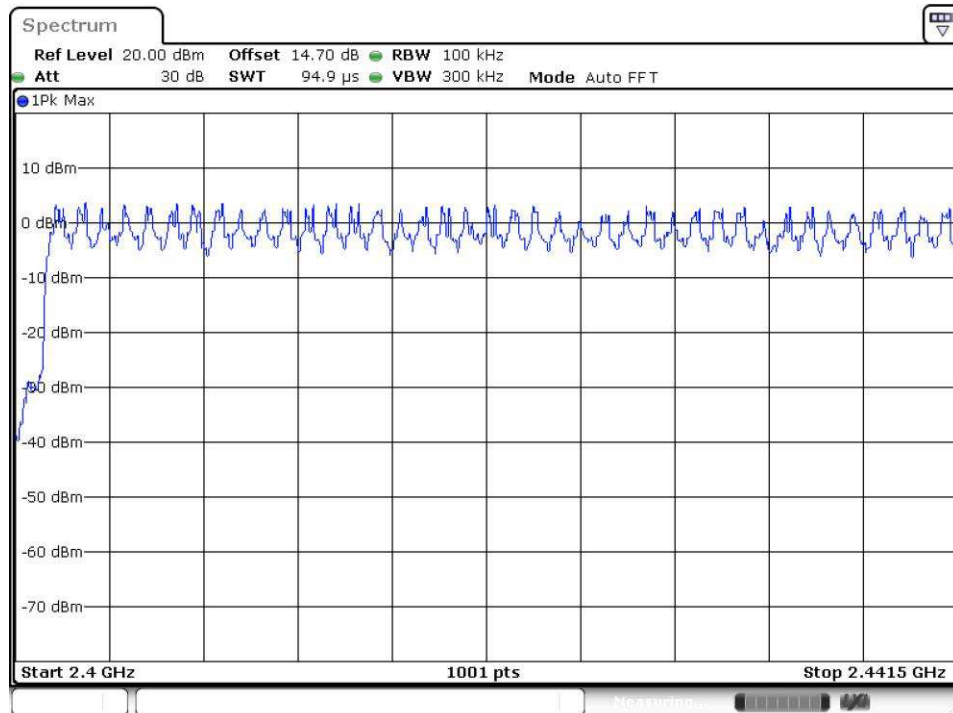


Date: 18.MAY.2020 13:53:24

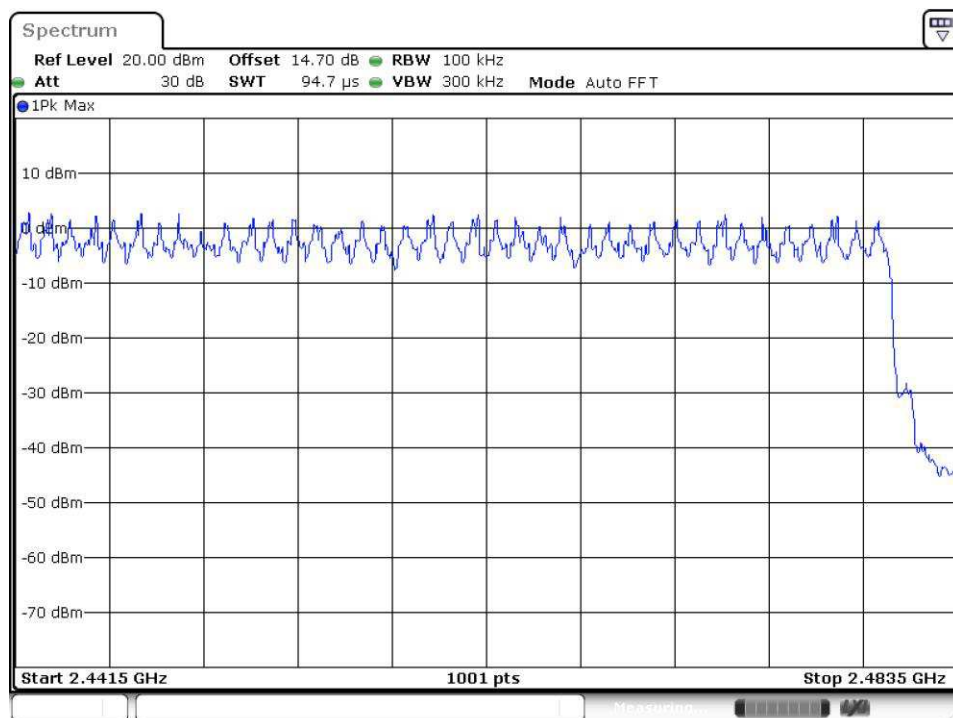


Date: 18.MAY.2020 13:53:55

### 3DH5



Date: 18.MAY.2020 14:03:49



Date: 18.MAY.2020 14:04:37

## 5.1.8 Time of Occupancy

**RESULT:****Passed**

Test standard : FCC part 15.247(a)(1)(iii)  
Basic standard : ANSI C63.10:2013  
Limits : 400 ms  
Kind of test site : Shield room

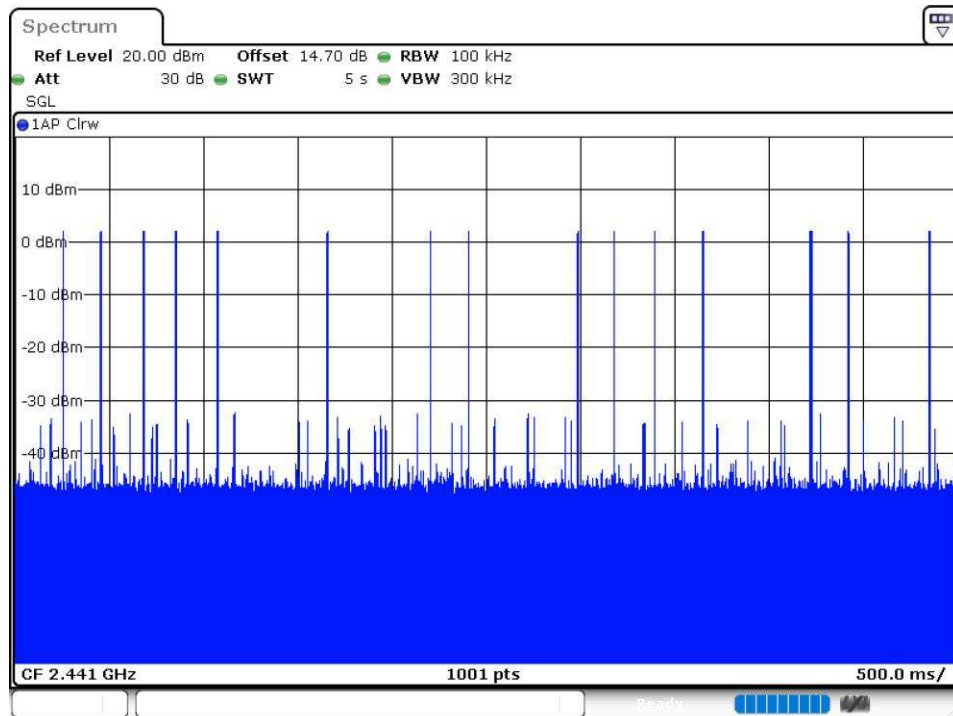
**Test setup**

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

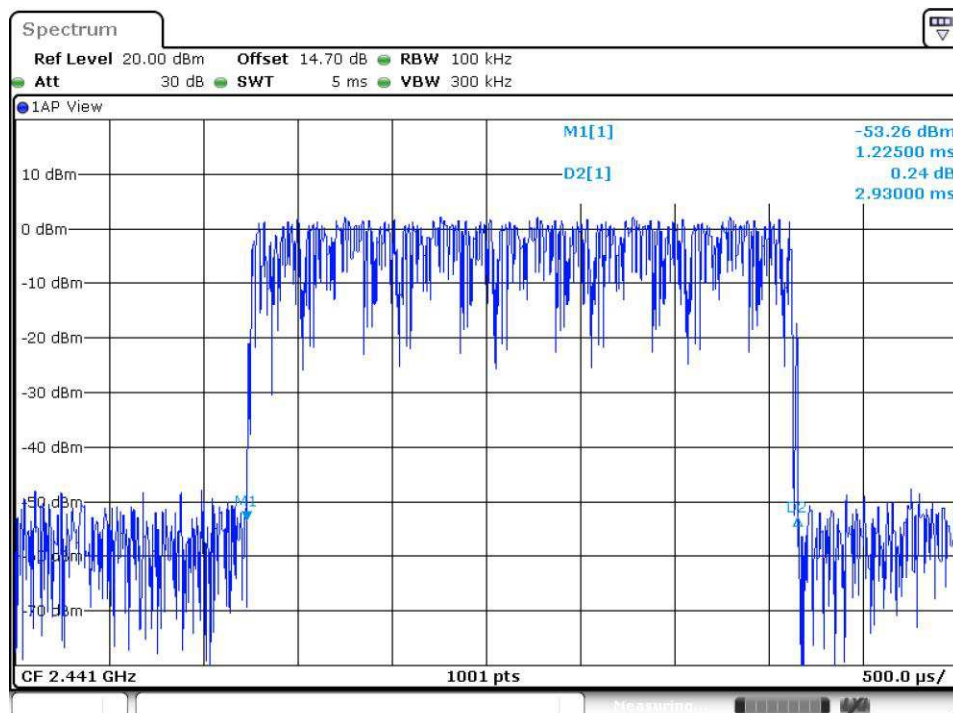
**Table 17: Test result of Time of Occupancy**

| Package Mode | Average Hopping Channel | Package Transfer Time (ms) | Sweep Time (s) | Dwell Time (ms) | Limit (ms) | Result |
|--------------|-------------------------|----------------------------|----------------|-----------------|------------|--------|
| 1DH5         | 15.00                   | 2.93                       | 5.00           | 277.76          | 400        | Pass   |
| 3DH5         | 16.00                   | 2.94                       | 5.00           | 296.79          | 400        | Pass   |

## Test Plot of Time of Occupancy, 1DH5

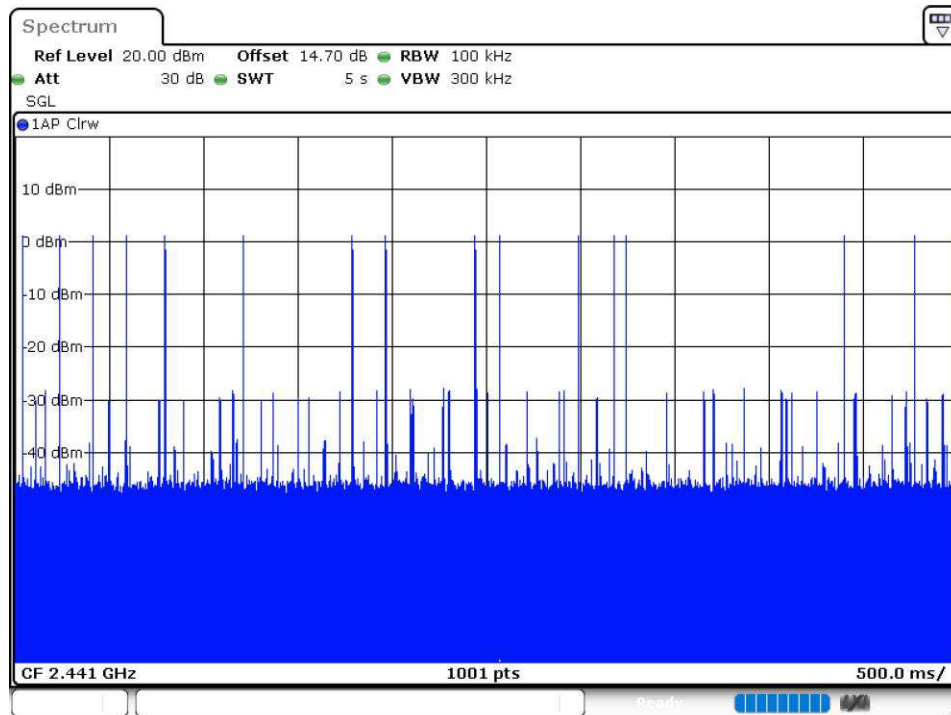


Date: 18.MAY.2020 13:57:32

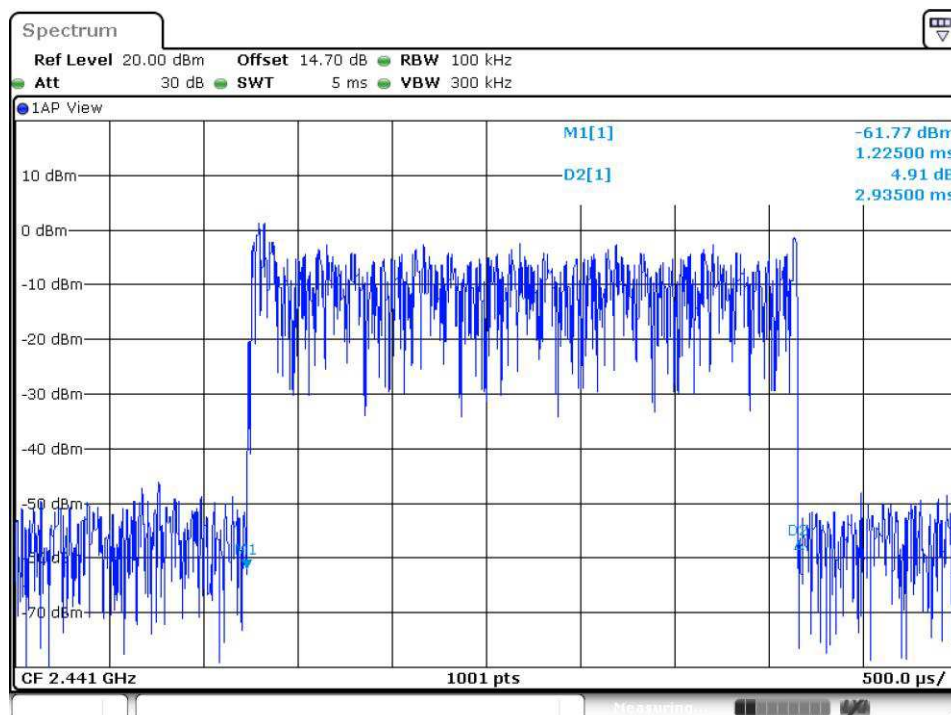


Date: 18.MAY.2020 13:57:44

## Test Plot of Time of Occupancy, 3DH5



Date: 18.MAY.2020 14:01:19



Date: 18.MAY.2020 14:01:31

## 6. Mains Emissions

### 6.1.1 Mains Conducted Emissions

**RESULT:****Passed**

Test standard : FCC Part 15.207  
FCC Part 15.107  
Limits : Mains Conducted emissions as defined in  
above standards  
Kind of test site : Shielded Room

**Test setup**

Test Channel : Middle  
Operation mode : A

Remark: For details refer to Appendix D.

## 7. Safety Human exposure

### 7.1 Radio Frequency Exposure Compliance

#### 7.1.1 Electromagnetic Fields

**RESULT:****Passed**

Test standard : FCC KDB Publication 447498 D01 v06  
47CFR 1.1310  
47CFR 2.1091

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

|                        |                            |
|------------------------|----------------------------|
| Power to Antenna (mW)  | 3.28 mW                    |
| Power to Antenna (dBm) | 5.2 dBm                    |
| Antenna Gain           | -6.72 dBi                  |
| Power+Ant Gain         | 0.7 mW                     |
| Distance               | 20 cm                      |
| S=                     | 0.00014 mW/cm <sup>2</sup> |

FCC:

|                  |                                          |
|------------------|------------------------------------------|
| 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>                   |



## 8. 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)**



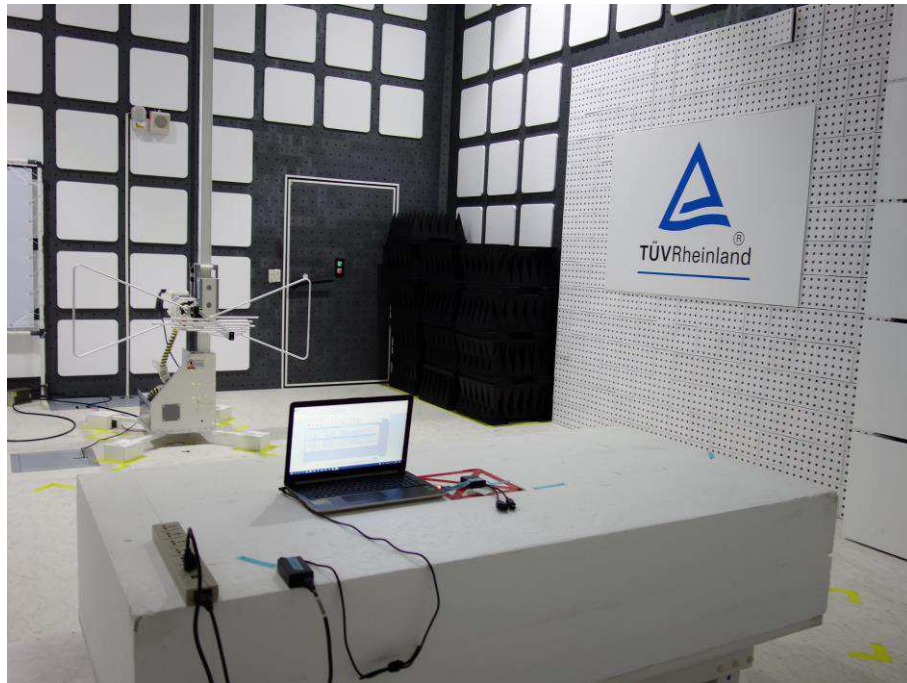
**Photograph 3: Set-up for Spurious Emissions (Back View 1)**



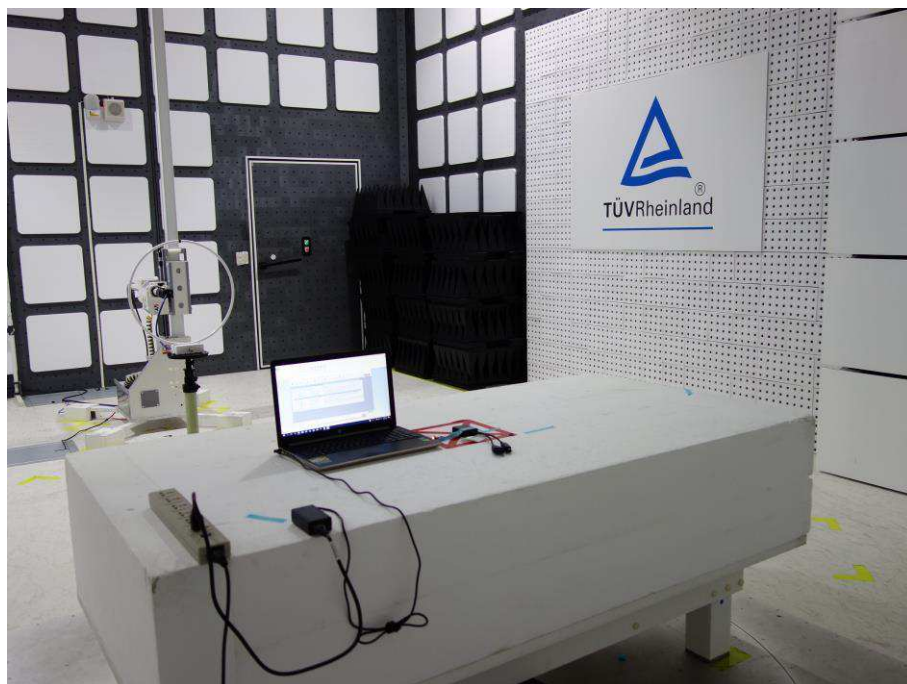
**Photograph 4: Set-up for Spurious Emissions (Back View 2)**



**Photograph 5: Set-up for Spurious Emissions (Back View 3)**

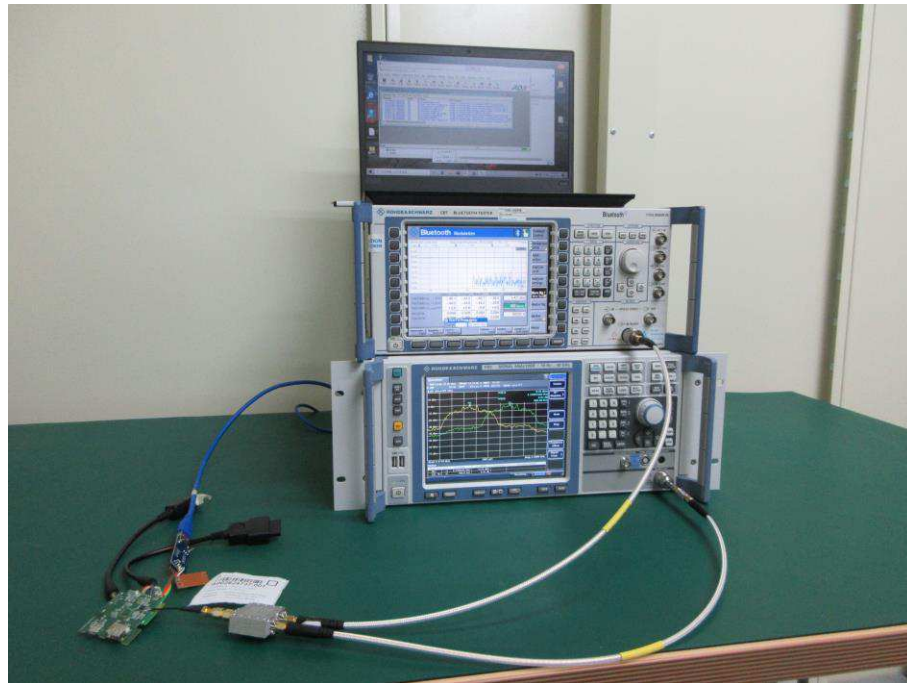


**Photograph 6: Set-up for Spurious Emissions (Back View 4)**





**Photograph 7: Set-up for Conducted testing (View 1)**



**Photograph 8: Set-up for Conducted testing (View 2)**



**Photograph 9: Set-up for AC Mains Conducted testing (Front View)**



**Photograph 10: Set-up for AC Mains Conducted testing (Back View)**



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