

<b>Prüfbericht-Nr.:</b> <i>Test Report No.:</i>	<b>50287839 001</b>	<b>Auftrags-Nr.:</b> <i>Order No.:</i>	238107999	Seite 1 von 47 Page 1 of 47
<b>Kunden-Referenz-Nr.:</b> <i>Client Reference No.:</i>	N/A	<b>Auftragsdatum:</b> <i>Order date:</i>	22-Jul-2019	
<b>Auftraggeber:</b> <i>Client:</i>	Zeroplus Technology Corporation 3rd Floor, No. 121, Jianba Road, Zhonghe District, New Taipei City, Taiwan (R.O.C)			
<b>Prüfgegenstand:</b> <i>Test item:</i>	C17068-P4 Battery Pack			
<b>Bezeichnung / Typ-Nr.:</b> <i>Identification / Type No.:</i>	ZPMN02C			
<b>Auftrags-Inhalt:</b> <i>Order content:</i>	FCC Part15C Test report (BT)			
<b>Prüfgrundlage:</b> <i>Test specification:</i>	FCC 47 CFR Part 15: Subpart C Section 15.247(FHSS) FCC 47CFR Part 2: Subpart J section 2 .1091			
<b>Wareneingangsdatum:</b> <i>Date of receipt:</i>	16-Aug-2019			
<b>Prüfmuster-Nr.:</b> <i>Test sample No.:</i>	A000976081-004 to 005			
<b>Prüfzeitraum:</b> <i>Testing period:</i>	23-Sep-2019 – 27-Sep-2019			
<b>Ort der Prüfung:</b> <i>Place of testing:</i>	EMC/RF Laboratory Taipei			
<b>Prüflaboratorium:</b> <i>Testing laboratory:</i>	TUV Rheinland Taiwan Ltd.			
<b>Prüfergebnis*:</b> <i>Test result*:</i>	Pass			
<b>geprüft von / tested by:</b> <i>Jack Chang</i>		<b>kontrolliert von / reviewed by:</b> <i>Arvin Ho</i>		
04-Oct-2019	Jack Chang/Project Manager	04-Oct-2019	Arvin Ho/Vice General Manager	
<b>Datum</b>	<b>Name / Stellung</b>	<b>Unterschrift</b>	<b>Datum</b>	<b>Name / Stellung</b>
<i>Date(Report Date)</i>	<i>Name / Position</i>	<i>Signature</i>	<i>Date</i>	<i>Name / Position</i>
<b>Sonstiges / Other:</b>				
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend
	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	5 = mangelhaft
Legend:	1 = very good	2 = good	3 = satisfactory	4 = sufficient
	P(ass) = passed a.m. test specification(s)	F(ail) = failed a.m. test specification(s)	N/A = not applicable	5 = poor
				N/T = nicht getestet
				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>  <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 CONDUCTED OUTPUT POWER***RESULT: Passed***5.1.3 20dB BANDWIDTH***RESULT: N/A***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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Produkte  
Products

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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: 50287839 001 APPENDIX P)

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

(File Name: 50287839 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
FCC 47CFR Part 2: Subpart J Section 2.1091
ANSI C63.10:2013
KDB558074 D01 DTS Meas Guidance v05r02
KDB447498 D01 General RF Exposure Guidance v06

### 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.  
Taipei Testing Laboratories

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**

<b>Kind of Equipment</b>	<b>Manu-facturer</b>	<b>Type</b>	<b>S/N</b>	<b>Last Calibration</b>	<b>Next Calibration</b>
Spectrum Analyzer	Agilent	N9010A	MY53470241	2019/06/17	2020/06/17
Power Meter	Anritu	ML2495A	1901008	2019/04/29	2020/04/29
Spectrum Analyzer	Rohde & Schwarz	FSV-40	101112	2018/10/01	2019/10/01
Pre-Amplifier	EMC Instruments	EMC9135	980628	2019/02/23	2020/02/23
Pre-Amplifier	EM Electronics	EM01G18G	060649	2019/09/11	2020/09/11
Pre-Amplifier	EMC Instruments	EMC184045SE	980408	2019/06/12	2020/06/14
Bilog Antenna	TESEQ	CBL 6111D	40101	2018/10/03	2019/10/03
Horn Antenna	ETS-Lindgren	3117	00218931	2018/12/27	2019/12/27
Horn Antenna	Com-Power	AH-840	101029	2018/12/22	2019/12/22
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2019/07/11	2020/07/11
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100797	2019/01/16	2020/01/16
Two-Line V-Network	Rohde & Schwarz	ENV216	101243	2019/06/23	2020/06/23
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  $\pm 3$ dB.

**Table 3: Emission Measurement Uncertainty**

Parameter	Uncertainty
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 Battery Pack with Bluetooth function. 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	C17068-P4 Battery Pack
Type Identification	ZPMN02C
FCC ID	2ADKMN009

**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	-6.72032dBi

**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:  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. Hopping

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

Refer to the Circuit Diagram.

### **3.5 Submitted Documents**

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

## 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. The test modes were adapted accordingly in reference to the instructions for use.

### 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.

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 sample: A000976081-004  
Radiation sample: A000976081-005

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

Power Setting for 1-DH5	10
Power Setting for 3-DH5	7

### 4.3 Special Accessories and Auxiliary Equipment

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

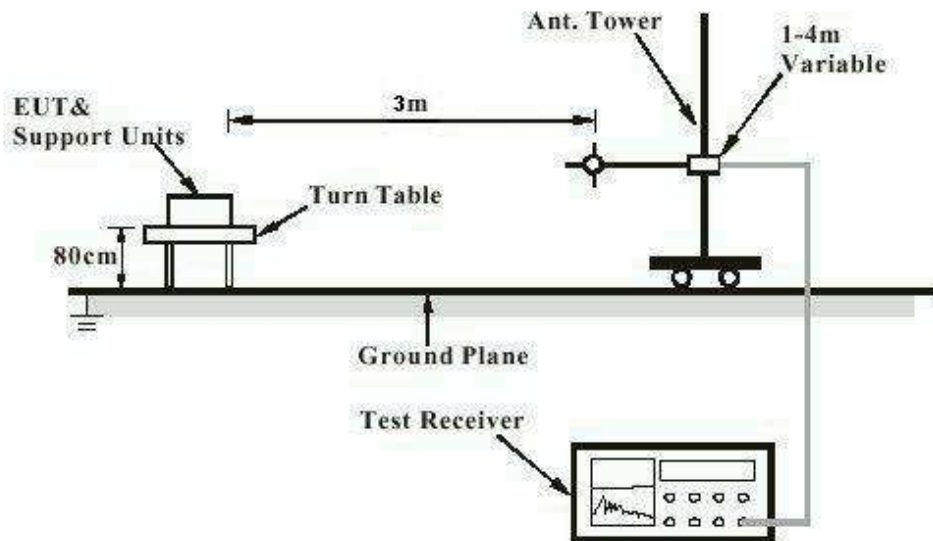
Description	Manufacturer	Model No.	Serial No.
Notebook(EMC-09)	Lenovo	G580	-
Test tool	銳迪科微電子 (上海)有限公司	HC_Data_Test.exe	3.2.0
Adapter for AC mains	Lenovo	E480	-

### 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.

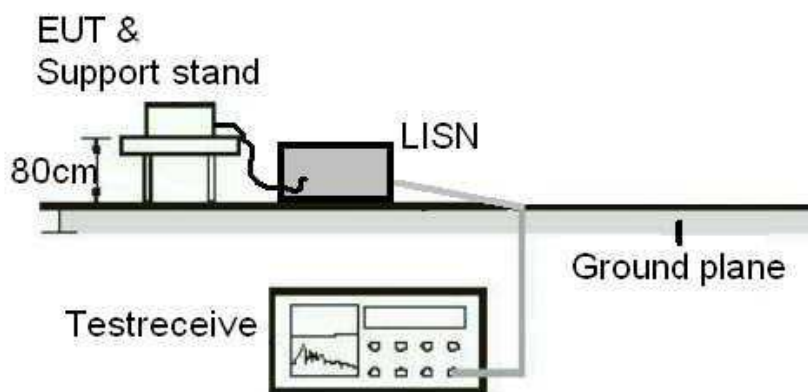
## 4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test

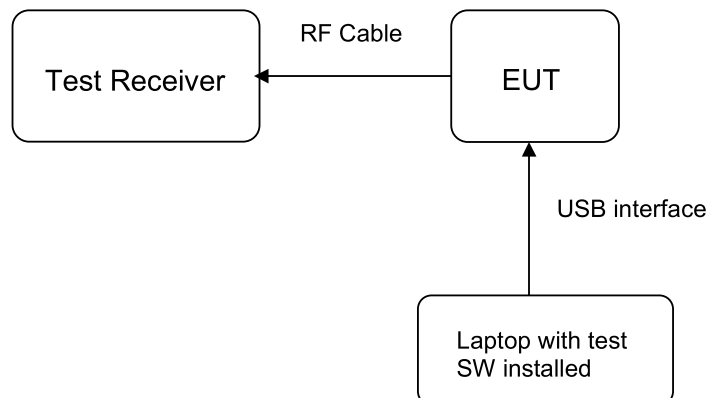


Note: Measurements above 1 GHz are done with a table height of 1.5m

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



**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 Max directional gain of -6.72032dBi. The antenna is a printed PCB 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 Maximum conducted output power

**RESULT:**
**Passed**

Test standard : FCC Part 15.247(b)(1)  
 Basic standard : ANSI C63.10:2013  
 Kind of test site : Conducted room

**Test setup**

Test Channel : Low/ Middle/ High  
 Operation Mode : A

Ambient temperature : 18-25 °C  
 Relative humidity : 50-65 %  
 Atmospheric pressure : 100-103kPa

**Table 7: Test result of Maximum conducted output power, 1DH5**

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2402	-15.72	0.00003	0.125
Middle Channel	2441	-15.83	0.00003	0.125
High Channel	2480	-16.32	0.00002	0.125

**Table 8: Test result of Maximum conducted output power, 3DH5**

Channel	Channel Frequency	Peak Output Power		Limit
	(MHz)	(dBm)	(W)	(W)
Low Channel	2402	-7.39	0.00018	0.125
Middle Channel	2441	-7.57	0.00017	0.125
High Channel	2480	-7.66	0.00017	0.125

### 5.1.3 20dB Bandwidth

**RESULT:**
**N/A**

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 : 18-25°C  
 Relative humidity : 50-65%  
 Atmospheric pressure : 100-103kPa

**Table 9: Test result of 20dB Bandwidth, 1DH5**

Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
Low Channel	2402	1.029
Mid Channel	2441	1.026
High Channel	2480	1.029

Note: For reporting purposes only.

**Table 10: Test result of 20dB Bandwidth, 3DH5**

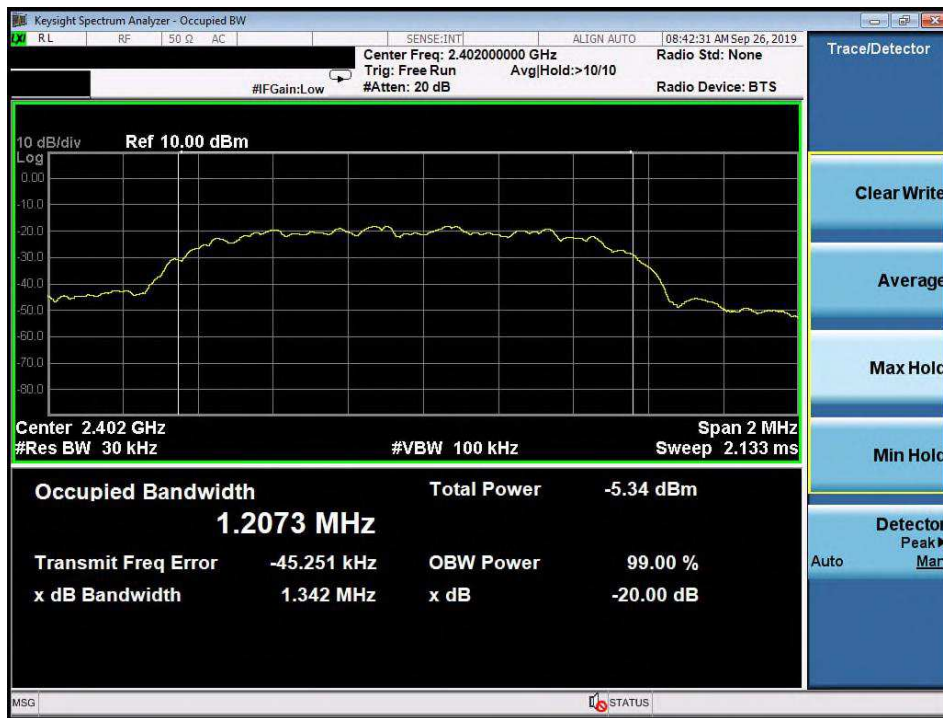
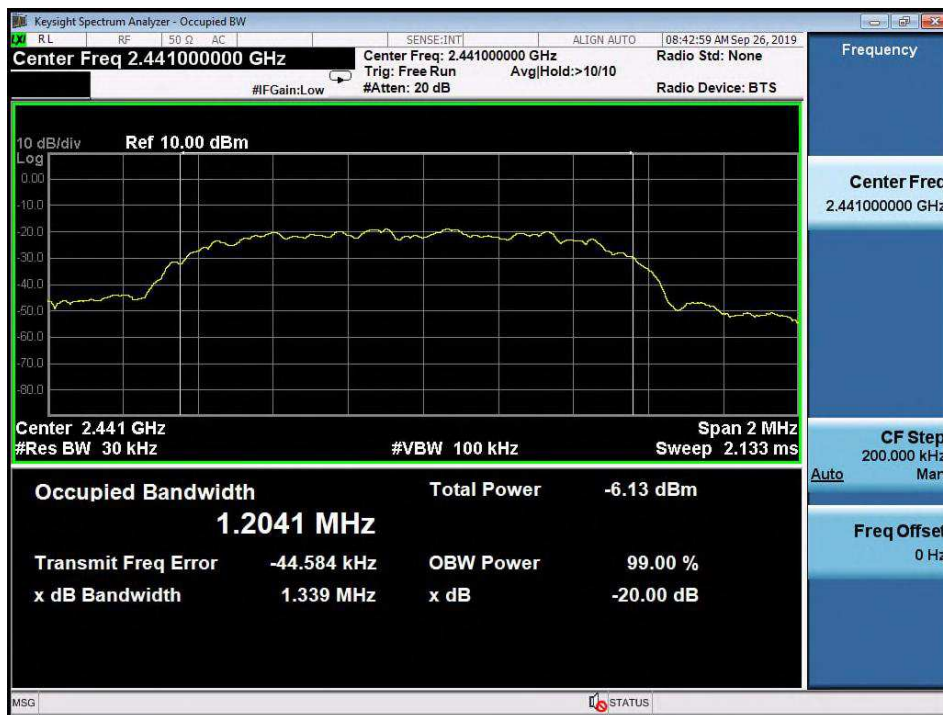
Channel	Channel Frequency (MHz)	20dB Bandwidth (MHz)
Low Channel	2402	1.342
Mid Channel	2441	1.339
High Channel	2480	1.339

Note: For reporting purposes only.

**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, 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 : Conducted room

##### Test setup

Test Channel : Low/ Mid/ High for spurious, Low/ High for Band Edge  
Operation Mode : A  
Ambient temperature : 18-25°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.



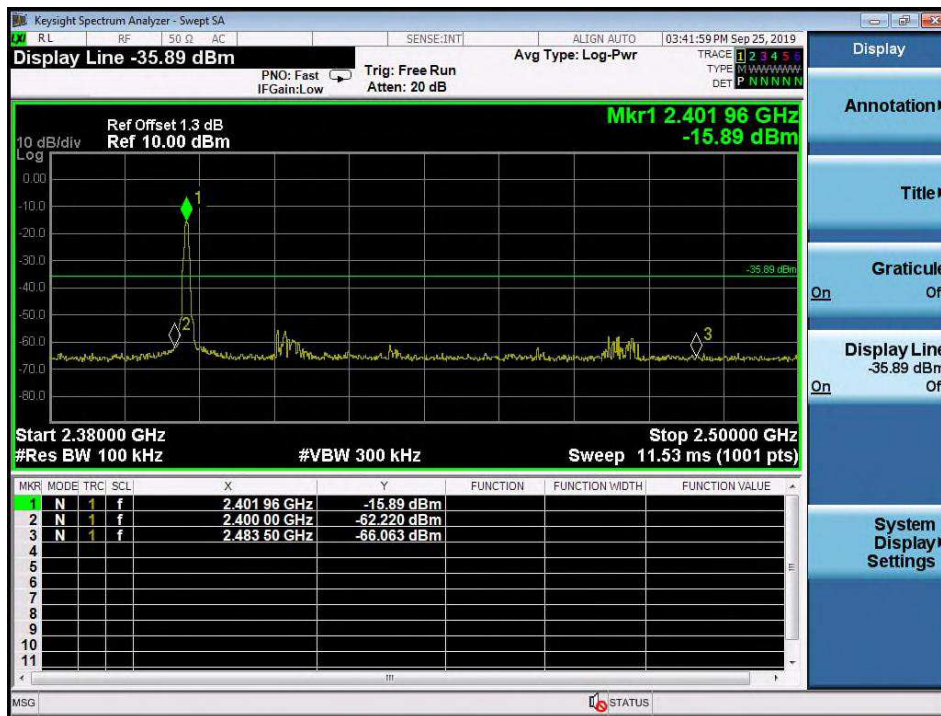




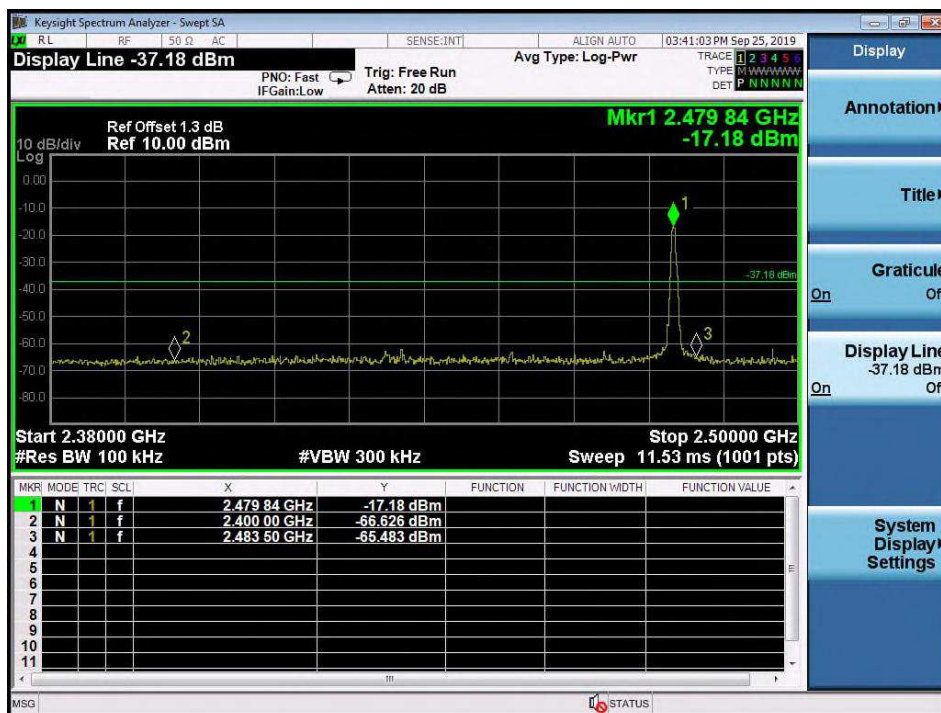


## Test Plot of 100kHz Bandwidth of Frequency Band Edge, 1DH5

### Low Channel



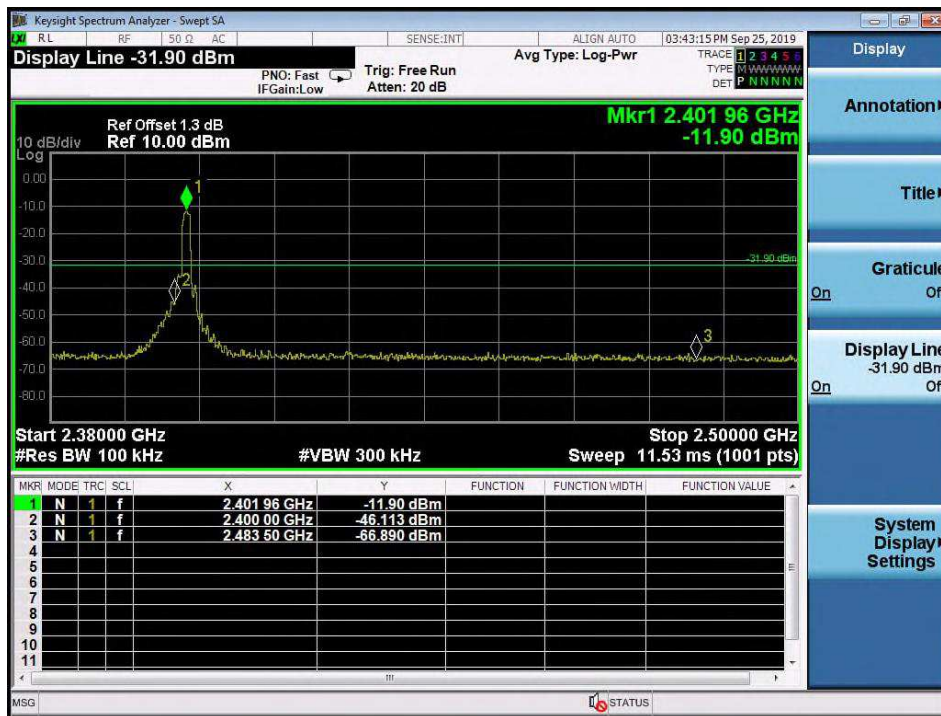
### High Channel



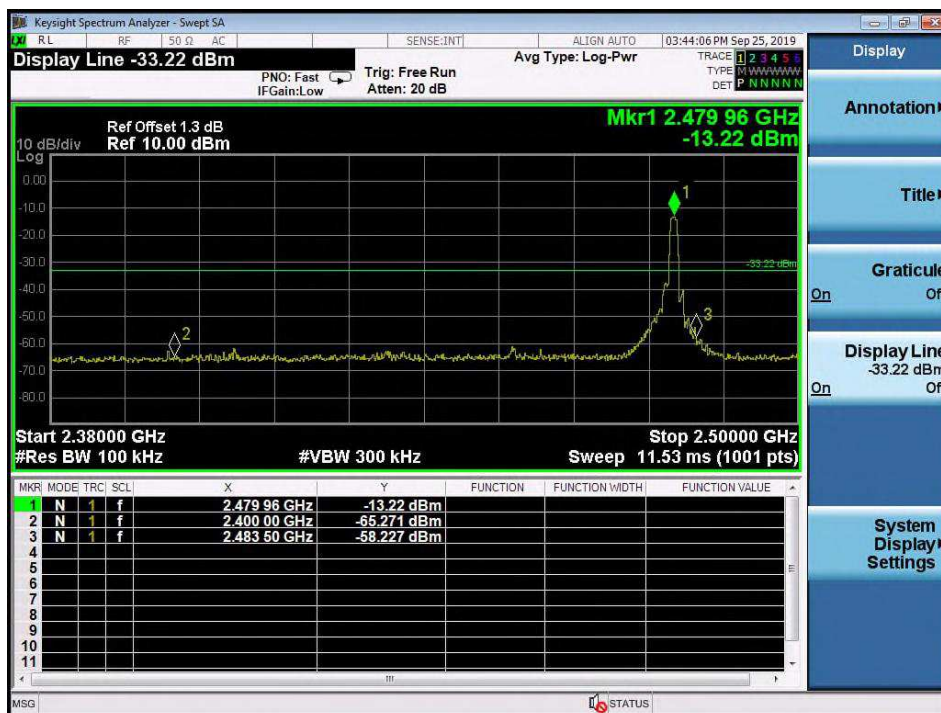


## Test Plot of 100kHz Bandwidth of Frequency Band Edge, 3DH5

### 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
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 specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a).
Kind of test site	:	3m Semi-Anechoic Chamber

**Test setup**

Test Channel	:	Low/ Middle/ High
Operation Mode	:	A

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.

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

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

### 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

**Test setup**

Operation Mode : B  
 Ambient temperature : 18-25°C  
 Relative humidity : 50-65%

**Table 11: 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 12: 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  
 Limits :  $\geq 15$  non-overlapping channels  
 Kind of test site : Shield room

**Test setup**

Test Channel : Hopping On

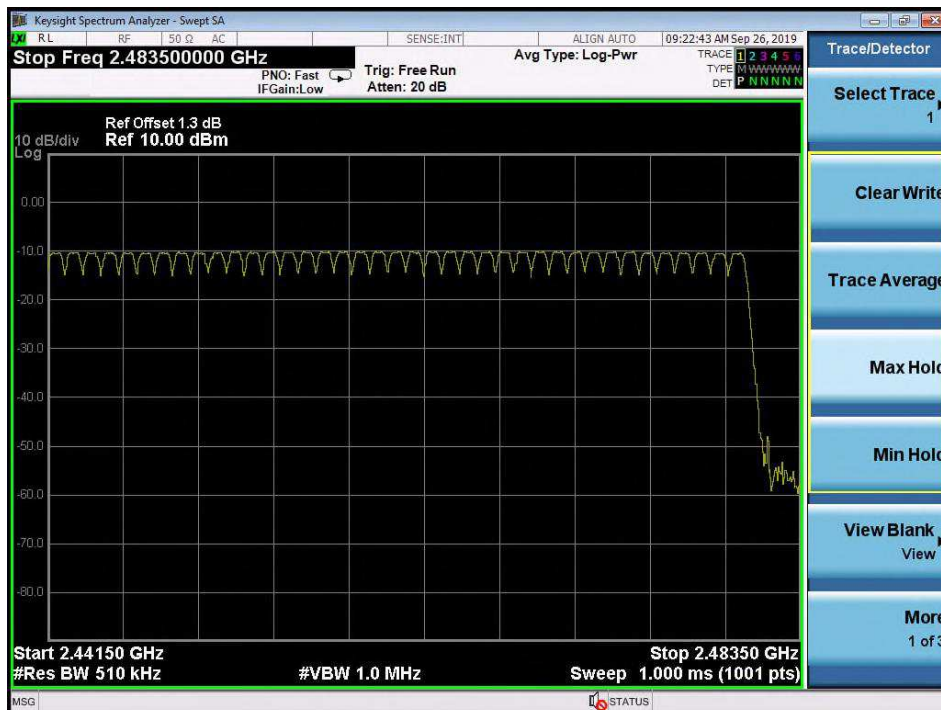
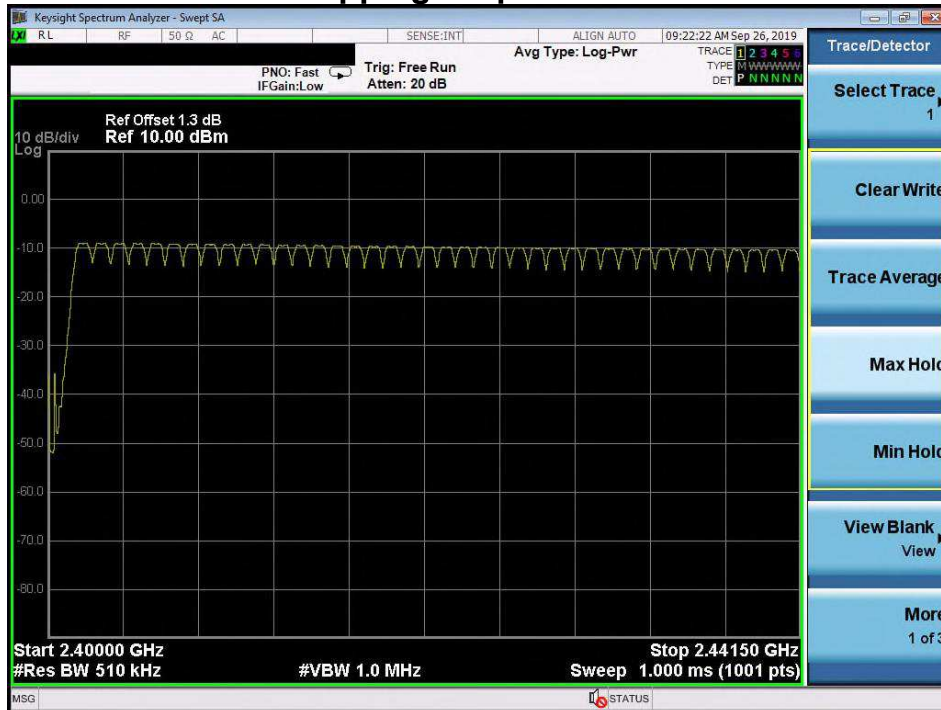
Ambient temperature : 18-25°C  
 Relative humidity : 50-65%  
 Atmospheric pressure : 100-103kPa

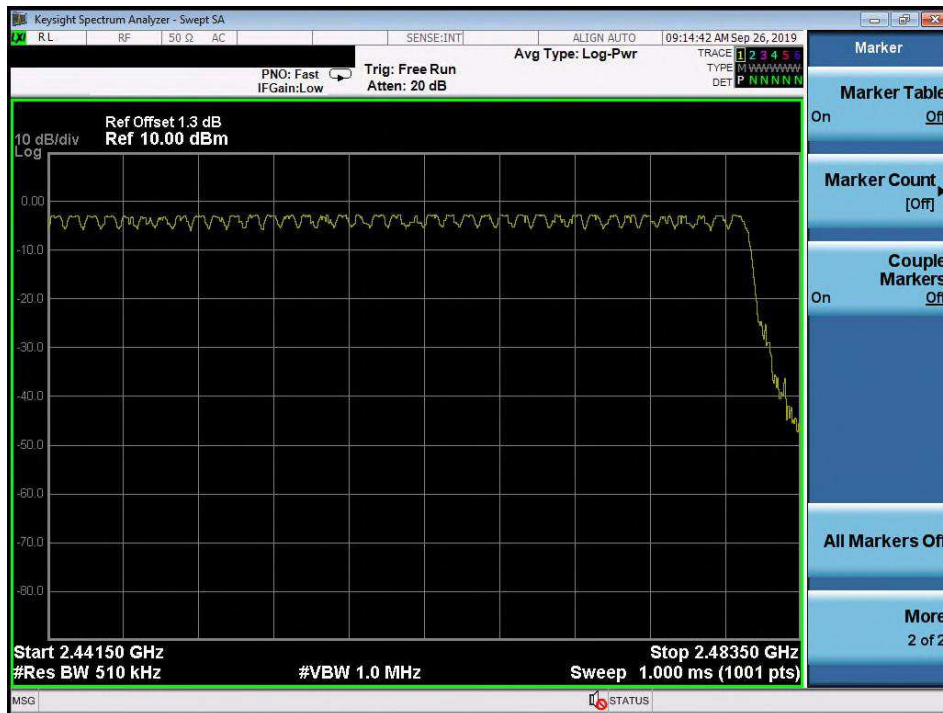
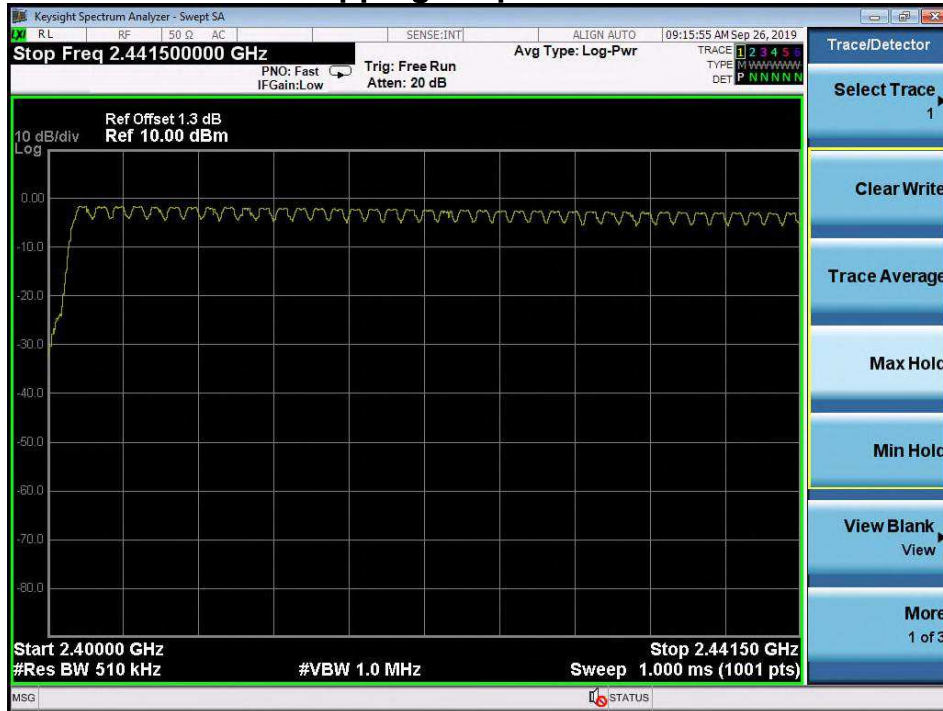
**Table 13: Test result of Number of hopping frequency – 1DH5**

Frequency Range	Measured Quantity of Hopping Channel	Limit	Result
<u>2400</u> to <u>2441</u> MHz	79	$\geq 15$	Pass

**Table 14: Test result of Number of hopping frequency – 3DH5**

Frequency Range	Measured Quantity of Hopping Channel	Limit	Result
<u>2400</u> to <u>2441</u> MHz	79	$\geq 15$	Pass

**Test Plot of Number of hopping frequencies – 1DH5**


**Test Plot of Number of hopping frequencies – 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 : Conducted room

**Test setup**

Test Channel : Low  
 Operation Mode : A  
  
 Ambient temperature : 18-25°C  
 Relative humidity : 50-65%  
 Atmospheric pressure : 100-103kP

**Table 15: Test result of Time of Occupancy**

Data Mode	Captured Burst (s)	Dwell time (s)	On+Off time (s)	Limit (s)	Result
1DH5	0.00295	0.3147	0.00375	0.4	Pass
3DH5	0.00288	0.3072	0.00375	0.4	Pass

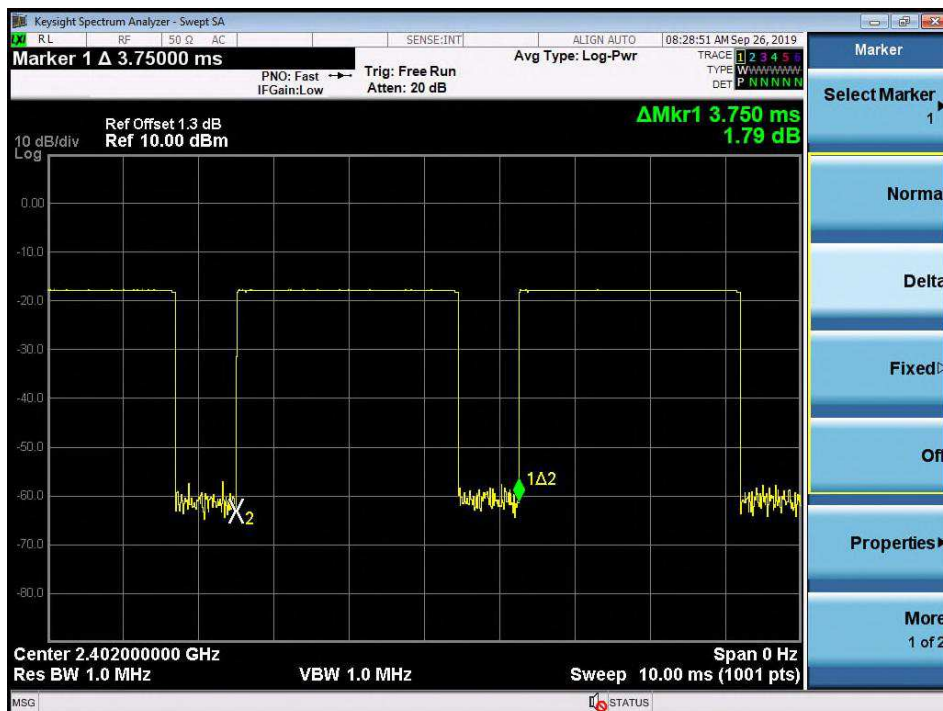
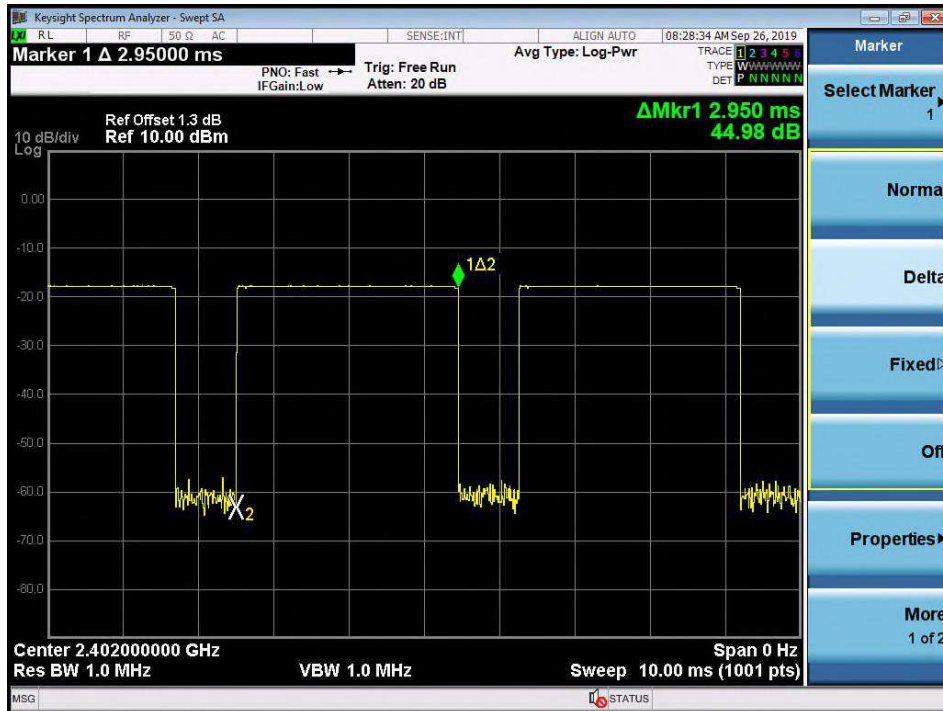
Note:

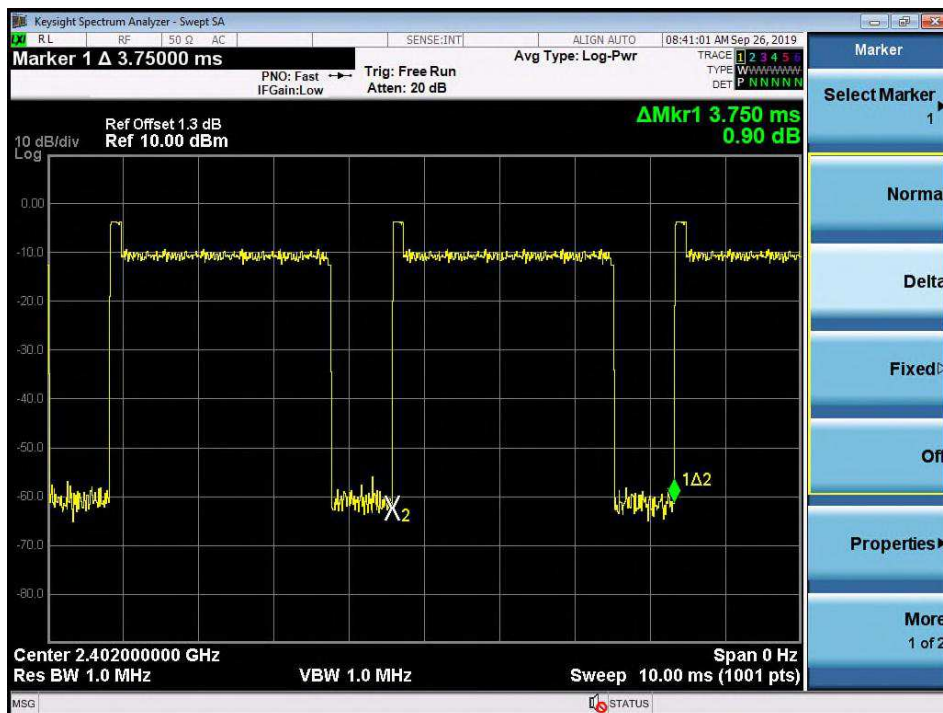
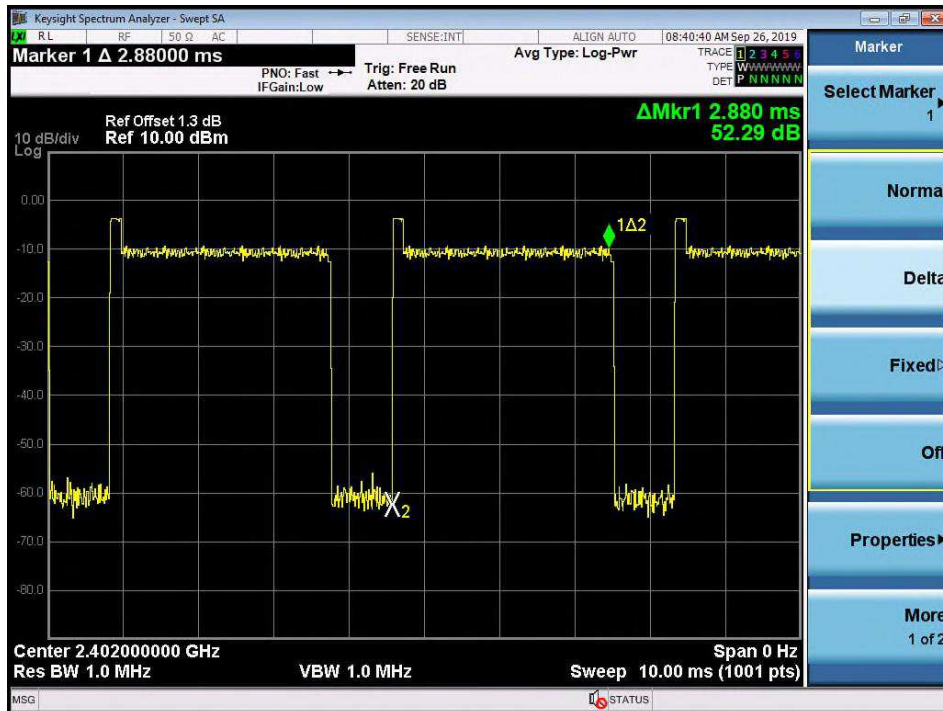
$$\text{Dwell time} = \text{Pulse width} \times (\text{Hopping rate} / \text{Number of channels}) \times \text{Period}$$

$$\text{Period} = 0.4 \text{ (seconds/ channel)} \times 79 \text{ (channel)} = 31.6 \text{ seconds.}$$

$$\text{Hopping rate} = 1 / (\text{On+Off time})$$

Hopping Rate for DH5 = 267 Hz  
 Hopping Rate for 3DH5 = 267 Hz

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


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


## 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**

Test Channel : Middle  
Operation mode : A

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

Since maximum peak output power of the transmitter is  $0.18\text{mW} < 10\text{mW}$ , hence the EUT is excluded from SAR evaluation according FCC KDB publication 447498: Mobile Portable RF Exposure. Portable RF Exposure.

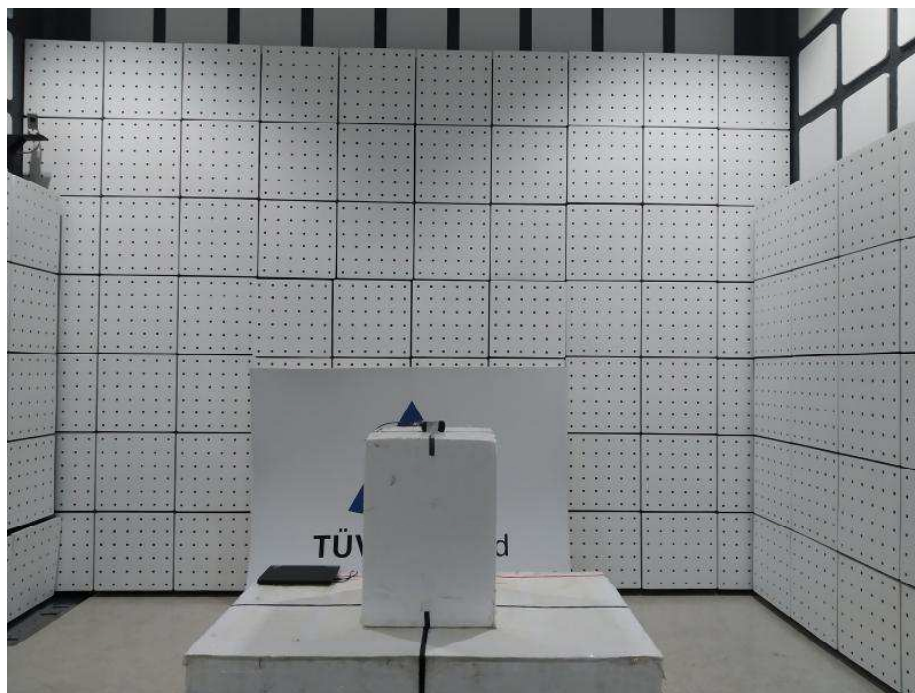
**---End---**

## 7. Photographs of the Test Set-Up

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



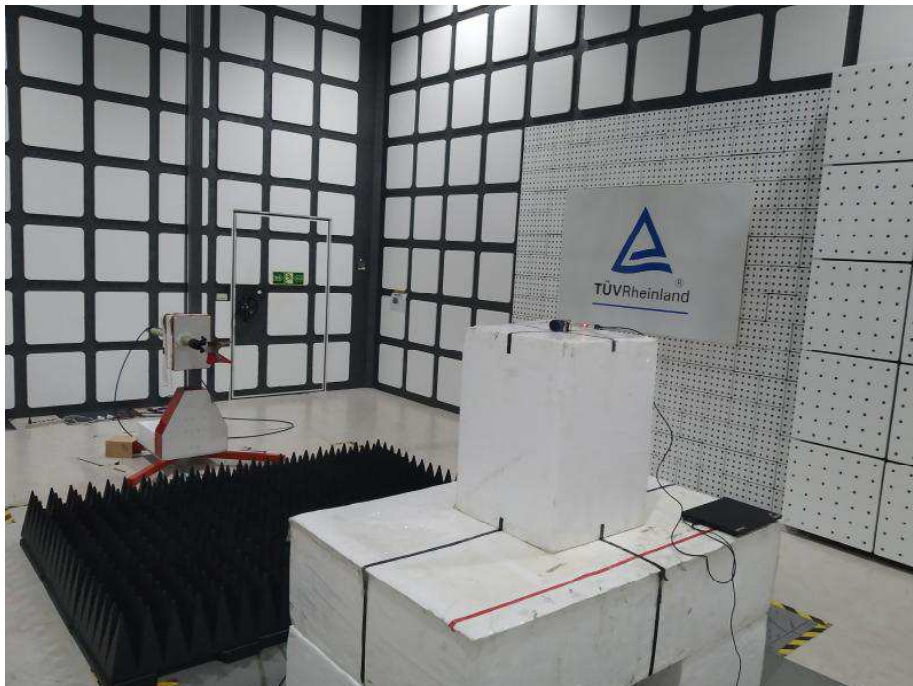
**Photograph 2: Set-up for Spurious Emissions (Front View 2)**



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



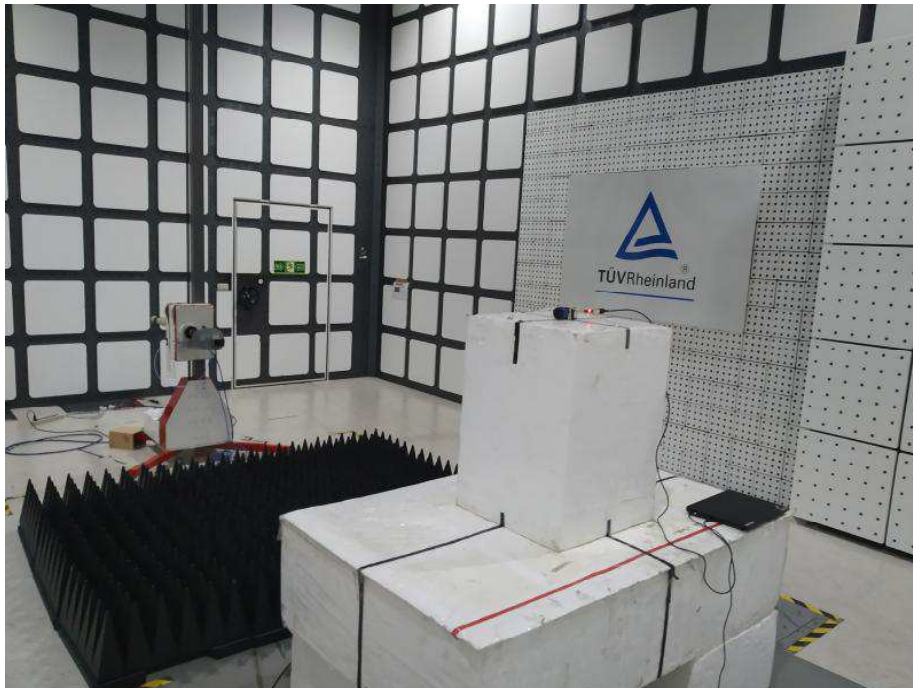
**Photograph 4: Set-up for Spurious Emissions (Back View 2)**



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



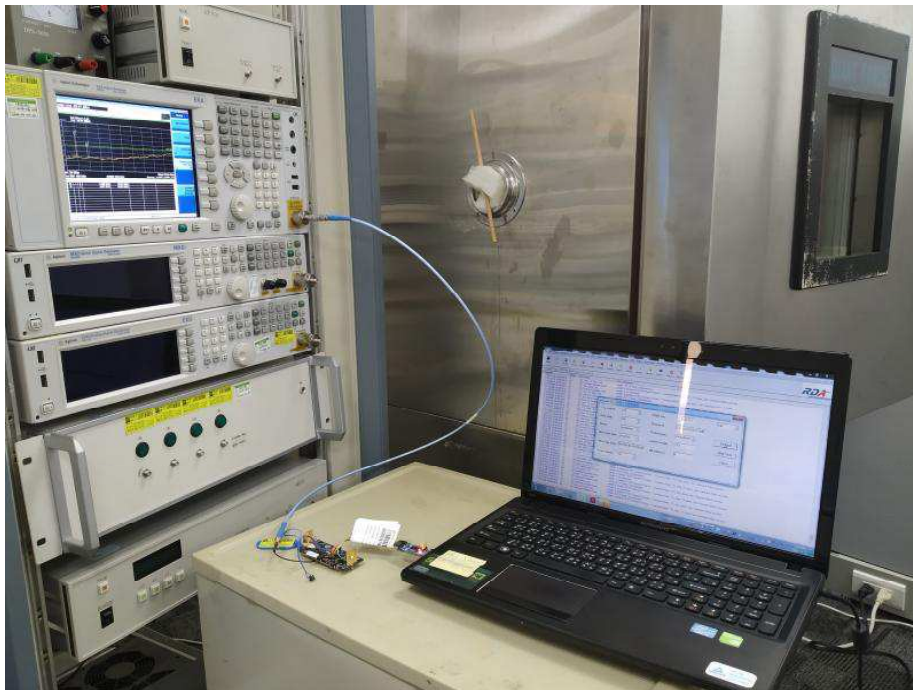
**Photograph 6: Set-up for Spurious Emissions (Back View 4)**



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



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



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



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



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