

<b>Prüfbericht-Nr.:</b> Test Report No.:	10051342 001	<b>Auftrags-Nr.:</b> Order No.:	114035147 Seite 1 von 37 Page 1 of 37
<b>Kunden-Referenz-Nr.:</b> Client Reference No.:	N/A	<b>Auftragsdatum:</b> Order date:	27-Apr-2015
<b>Auftraggeber:</b> Client:	RIFO TECHNOLOGY CO.,LTD, 13F.-1, No.5, Sec. 3, New Taipei Blvd., Xinzhuang Dist., New Taipei City 242, Taiwan (R.O.C.)		
<b>Prüfgegenstand:</b> Test item:	BLE module		
<b>Bezeichnung / Typ-Nr.:</b> Identification / Type No.:	TM41B1412-SF256		
<b>Auftrags-Inhalt:</b> Order content:	FCC Part 15C Test report		
<b>Prüfgrundlage:</b> Test specification:	FCC 47CFR Part 15: Subpart C Section 15.247		
<b>Wareneingangsdatum:</b> Date of receipt:	5-May-2015		
<b>Prüfmuster-Nr.:</b> Test sample No.:	A000194175-002 A000194175-003		
<b>Prüfzeitraum:</b> Testing period:	25-May-2015 - 26-May-2015		
<b>Ort der Prüfung:</b> Place of testing:	EMC/RF Laboratory Taipei		
<b>Prüflaboratorium:</b> Testing laboratory:	TUV Rheinland Taiwan Ltd.		
<b>Prüfergebnis*:</b> Test result*:	Pass		
<b>geprüft von / tested by:</b> 2015-06-18 Ryan Chen/Project Engineer Datum Name / Stellung Unterschrift Date Name / Position Signature		<b>kontrolliert von / reviewed by:</b> 2015-06-18 Rene Charton/Senior Project Manager Datum Name / Stellung Unterschrift Date Name / Position Signature	
<b>Sonstiges / Other:</b>			
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged	
<p>* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet</p> <p>Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested</p>			
<p>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.</p> <p>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.</p>			

## TEST SUMMARY

### **5.1.1 ANTENNA REQUIREMENT**

RESULT: *Passed*

### **5.1.2 PEAK OUTPUT POWER**

RESULT: *Passed*

### **5.1.3 6dB BANDWIDTH AND 99% BANDWIDTH**

RESULT: *Passed*

### **5.1.4 POWER DENSITY**

RESULT: *Passed*

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

RESULT: *Passed*

### **5.1.6 SPURIOUS EMISSION**

RESULT: *Passed*

### **5.2.1 MAINS CONDUCTED EMISSIONS**

RESULT: *Passed*

### **6.1.1 ELECTROMAGNETIC FIELDS**

RESULT: *Passed*

## Contents

<b>1.</b>	<b>GENERAL REMARKS .....</b>	<b>5</b>
<b>1.1</b>	<b>COMPLEMENTARY MATERIALS.....</b>	<b>5</b>
<b>2.</b>	<b>TEST SITES .....</b>	<b>6</b>
<b>2.1</b>	<b>TEST LABORATORY .....</b>	<b>6</b>
<b>2.2</b>	<b>TEST FACILITY.....</b>	<b>6</b>
<b>2.3</b>	<b>LIST OF TEST AND MEASUREMENT INSTRUMENTS.....</b>	<b>7</b>
<b>2.4</b>	<b>TRACEABILITY .....</b>	<b>8</b>
<b>2.5</b>	<b>CALIBRATION .....</b>	<b>8</b>
<b>2.6</b>	<b>MEASUREMENT UNCERTAINTY .....</b>	<b>8</b>
<b>3.</b>	<b>GENERAL PRODUCT INFORMATION.....</b>	<b>9</b>
<b>3.1</b>	<b>PRODUCT FUNCTION AND INTENDED USE .....</b>	<b>9</b>
<b>3.2</b>	<b>SYSTEM DETAILS AND RATINGS.....</b>	<b>9</b>
<b>3.3</b>	<b>INDEPENDENT OPERATION MODES.....</b>	<b>10</b>
<b>3.4</b>	<b>NOISE GENERATING AND NOISE SUPPRESSING PARTS .....</b>	<b>10</b>
<b>3.5</b>	<b>SUBMITTED DOCUMENTS.....</b>	<b>10</b>
<b>4.</b>	<b>TEST SET-UP AND OPERATION MODES.....</b>	<b>11</b>
<b>4.1</b>	<b>PRINCIPLE OF CONFIGURATION SELECTION .....</b>	<b>11</b>
<b>4.2</b>	<b>TEST OPERATION AND TEST SOFTWARE.....</b>	<b>11</b>
<b>4.3</b>	<b>SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT .....</b>	<b>11</b>
<b>4.4</b>	<b>COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE.....</b>	<b>12</b>
<b>4.5</b>	<b>TEST SETUP DIAGRAM .....</b>	<b>12</b>
<b>5.</b>	<b>TEST RESULTS .....</b>	<b>14</b>
<b>5.1</b>	<b>TRANSMITTER REQUIREMENT &amp; TEST SUITES .....</b>	<b>14</b>
5.1.1	<i>Antenna Requirement .....</i>	<i>14</i>
5.1.2	<i>Peak Output Power.....</i>	<i>15</i>
5.1.3	<i>6dB Bandwidth and 99% Bandwidth.....</i>	<i>18</i>
5.1.4	<i>Power Density.....</i>	<i>23</i>
5.1.5	<i>Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth.....</i>	<i>26</i>
5.1.6	<i>Spurious Emission .....</i>	<i>30</i>
<b>5.2</b>	<b>MAINS EMISSIONS.....</b>	<b>31</b>
5.2.1	<i>Mains Conducted Emissions.....</i>	<i>31</i>
<b>6.</b>	<b>SAFETY HUMAN EXPOSURE .....</b>	<b>32</b>

<b>6.1</b>	<b>RADIO FREQUENCY EXPOSURE COMPLIANCE .....</b>	<b>32</b>
6.1.1	<i>Electromagnetic Fields.....</i>	<i>32</i>
<b>7.</b>	<b>PHOTOGRAPHS OF THE TEST SET-UP.....</b>	<b>33</b>
<b>8.</b>	<b>LIST OF TABLES .....</b>	<b>37</b>
<b>9.</b>	<b>LIST OF PHOTOGRAPHS.....</b>	<b>37</b>

## 1. General Remarks

### 1.1 Complementary Materials

The following attachments are integral parts of this test report:

**Appendix P: Photo Documentation internal view**  
(File Name: 10051342APPENDIX P)

**Appendix D: Test Result of Radiated Emissions**  
(File Name: 10051342APPENDIX D)

Test Specifications

The following standards were applied.

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

Radio
NCC Low-power Radio-frequency Devices Technical Regulations LP0002(2011)(100年6月28日)
FCC CFR47 Part 15: Subpart C Section 15.247
ANSI C63.4:2009, ANSI C63.10:2009 (FCC Part 15)
ANSI C63.10:2013 (RSS-Gen)
KDB558074 D01 DTS Meas Guidance v02

## 2. Test Sites

### 2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.  
Taichung Branch Office

No.9, Lane 36, Minsheng Rd., Sec. 3, Daya District,  
Taichung City 428  
Taiwan (R.O.C.)

### 2.2 Test Facility

TUV Rheinland Taiwan Ltd.  
Taipei Office

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

FCC RegistrationNo.: 365730  
IC Canada Registration No.: 9465A-1  
TAF Accredited NCC Test Lab. No.:0759  
TAF ISO17025 Certification effective periods: 2013-Jul-1st to 2016-Jun-30th



**Testing Laboratory**  
**0759**

## 2.3 List of Test and Measurement Instruments

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

Kind of Equipment	Manufacturer	Type	S/N	Last Calibration	Next Calibration
EMI Test Receiver	R&S	ESR7	101062	31-Aug-14	30-Aug-15
Bilog Antenna	TESEQ	CBL6111D	29802	4-Jul-14	3-Jul-16
Spectrum Analyzer	R&S	FSV 40	100921	17-Dec-14	16-Dec-15
Spectrum Analyzer	Agilent	N9010A	MY53470241	1-Apr-15	30-Mar-16
Horn Antenna	ETS-Lindgren	3117	138160	12-Jan-15	11-Jan-17
Horn Antenna (18GHz~40GHz)	COM-POWER	AH840	101031	30-Oct-13	29-Oct-15
Preamplifier (30MHz -1GHz)	HP	8447F	2805A03335	23-Aug-14	22-Aug-15
Preamplifier (18 GHz -40 GHz)	COM-POWER	PAM-840	461257	26-Aug-14	25-Aug-15
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM30180	60558	4-Nov-14	3-Nov-15
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	22-Oct-14	21-Oct-15
EMI Test Receiver	R&S	ESCI7	100797	28-Dec-14	27-Dec-15
LISN (1 phase)	R&S	ENV216	101243	31-May-14	30-May-15
LISN	Rolf Heine	NNB-2/16Z	99080	26-Aug-14	25-Aug-15

## 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	$\pm 1 \times 10^{-7}$
RF power, conducted	$\pm 1.5$ dB
RF power density, conducted	$\pm 3$ dB
spurious emissions, conducted	$\pm 3$ dB
all emissions, radiated	$\pm 6$ dB
Temperature	$\pm 1$ °C
Humidity	$\pm 5$ %
DC and low frequency voltages	$\pm 3$ %



## 3. General Product Information

### 3.1 Product Function and Intended Use

The EUT is a Bluetooth Module. It contains a Bluetooth 4.0 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	BLE module
Type Designation	TM41B1412-SF256
FCC ID	2AEQ4RIFO

**Table 5: Technical Specification of EUT**

Technical Specification	Value
Operating Frequencies	2402~2480 MHz
Channel Spacing	2 MHz
Channel number	40
Operation Voltage	3V
Modulation	GFSK
Antenna gain	2.41dBi

### **3.3 Independent Operation Modes**

Basic operation modes are:

- A. Transmitting
  - 1. Low channel
  - 2. Middle channel
  - 3. High channel
- B. Receiving
- C. Standby
- D. Off

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

### 4.2 Test Operation and Test Software

Setup for testing: Test samples are provided with a USB SPI 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: A000194175-003

Radiation: A000194175-002

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

### 4.3 Special Accessories and Auxiliary Equipment

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

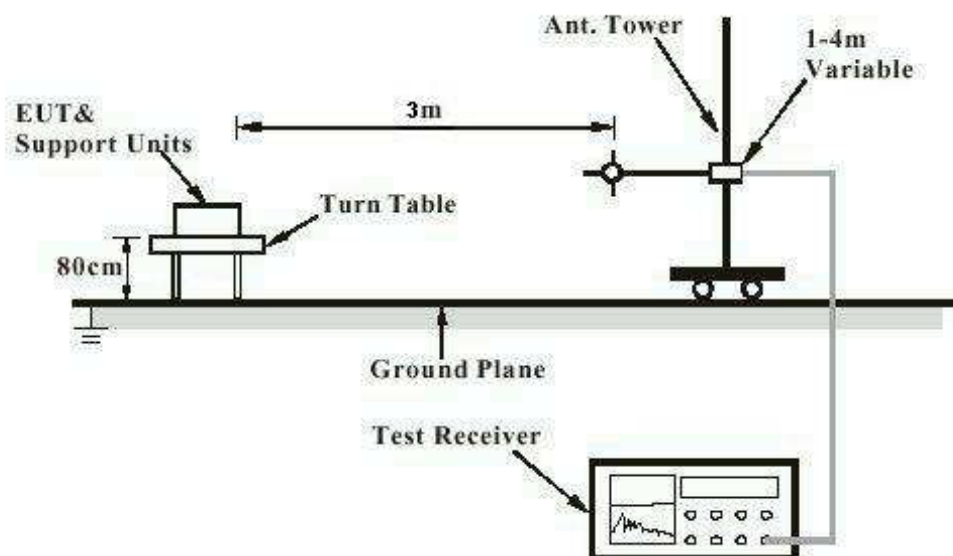
Kind of Equipment	Manufacturer	S/N
Laptop	HP	CNF0339QBM

## 4.4 Countermeasures to achieve EMC Compliance

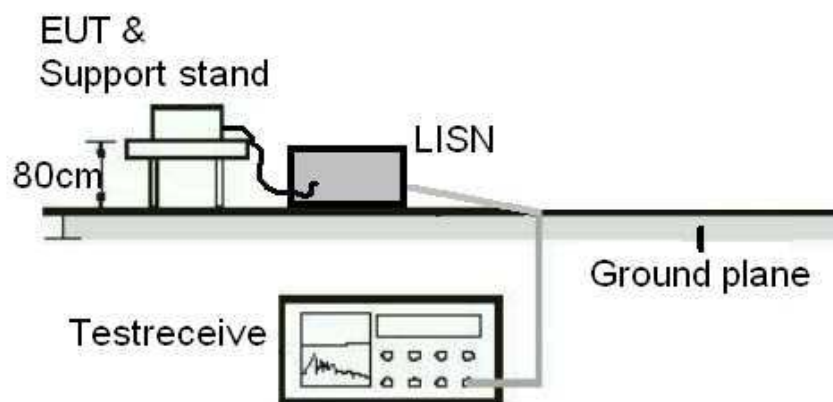
The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

## 4.5 Test Setup Diagram

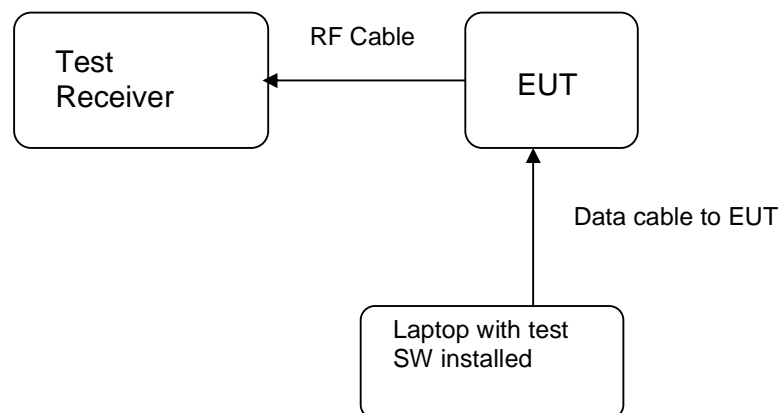
Diagram of Measurement Configuration for Radiation Test



### 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	:	LP0002(2011): 2.2, 3.10.1, (3) FCC Part 15.247(b)(4), Part 15.203 and RSS- Gen 8.3
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 2.41dBi. 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 Peak Output Power

### RESULT:

**Passed**

Test standard : LP0002(2011): 3.10.1, (2)  
FCC Part 15.247(b)(3), RSS-210 A8.4(4)  
Basic standard : ANSI C63.10:2009, KDB558074  
Limit : 1 Watt  
Kind of test site : Shielded room

### Test setup

Test Channel : Low/ Middle/ High  
Operation Mode : A  
  
Ambient temperature : 20-24 °C  
Relative humidity : 50-65 %  
Atmospheric pressure : 100-103 kPa

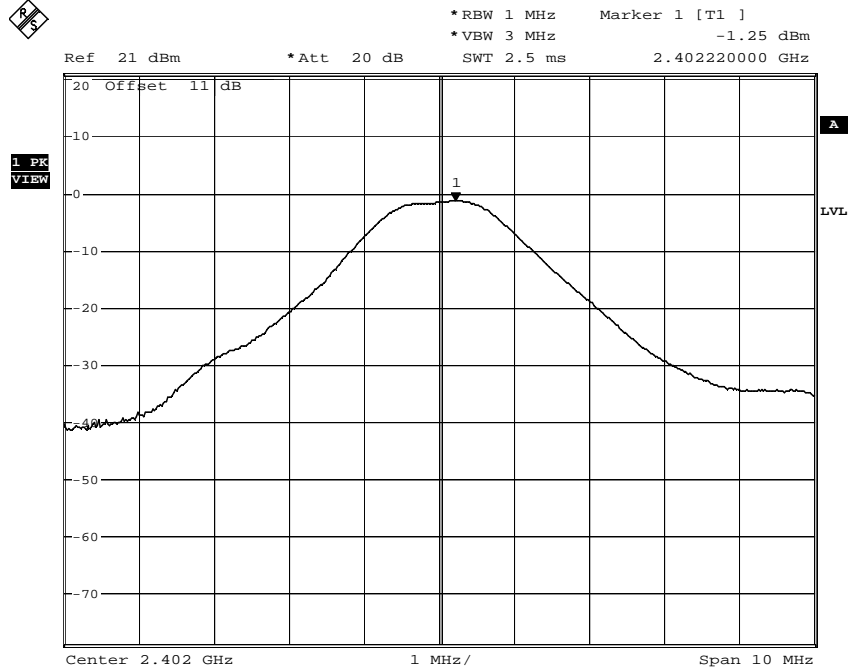
**Table 6: Test result of Peak Output Power**

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	-1.25	0.0007	1
Middle Channel	2442	-1.73	0.0007	1
High Channel	2480	-2.27	0.0006	1

Pmax: 0.7499 mW

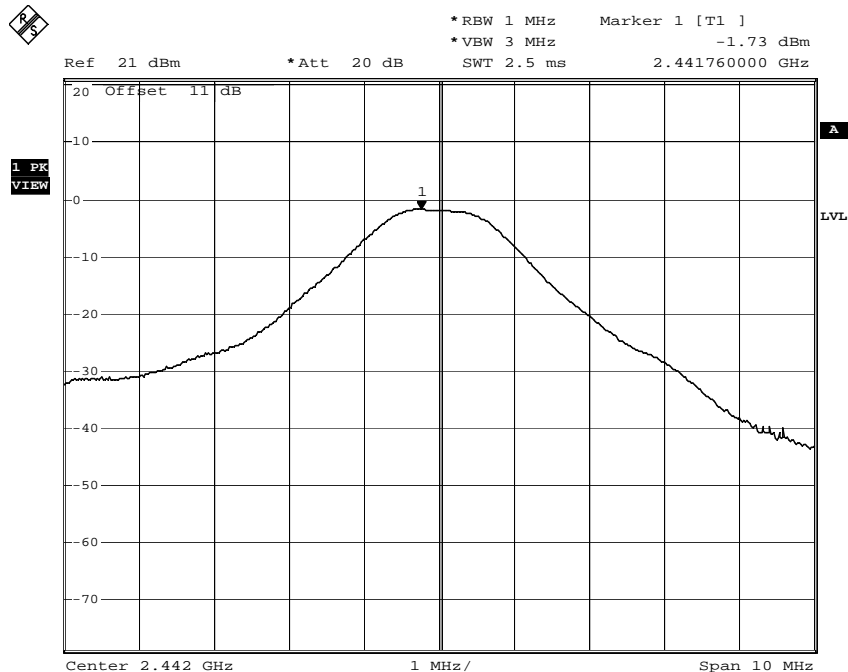
## Test Plot of Output Power

### Low Channel



Date: 2.JUN.2015 18:23:41

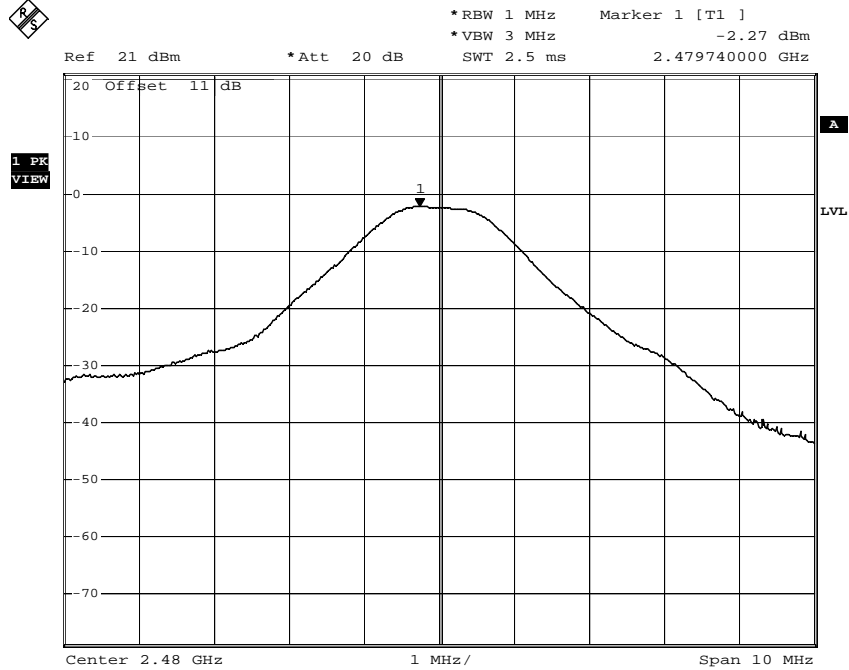
### Middle Channel



Date: 2.JUN.2015 18:24:39



### High Channel



Date: 2.JUN.2015 18:25:12

### 5.1.3 6dB Bandwidth and 99% Bandwidth

**RESULT:**
**Passed**

Test standard : LP0002(2011): 3.10.1, (5)  
 FCC Part 15.247(a)(2), RSS-210 A8.2(1)  
 Basic standard : ANSI C63.10:2009, KDB558074  
 Kind of test site : Shielded room

**Test setup**

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

Ambient temperature : 20-24°C  
 Relative humidity : 50-65%  
 Atmospheric pressure : 100-103 kPa

**Table 7: Test result of 6dB Bandwidth**

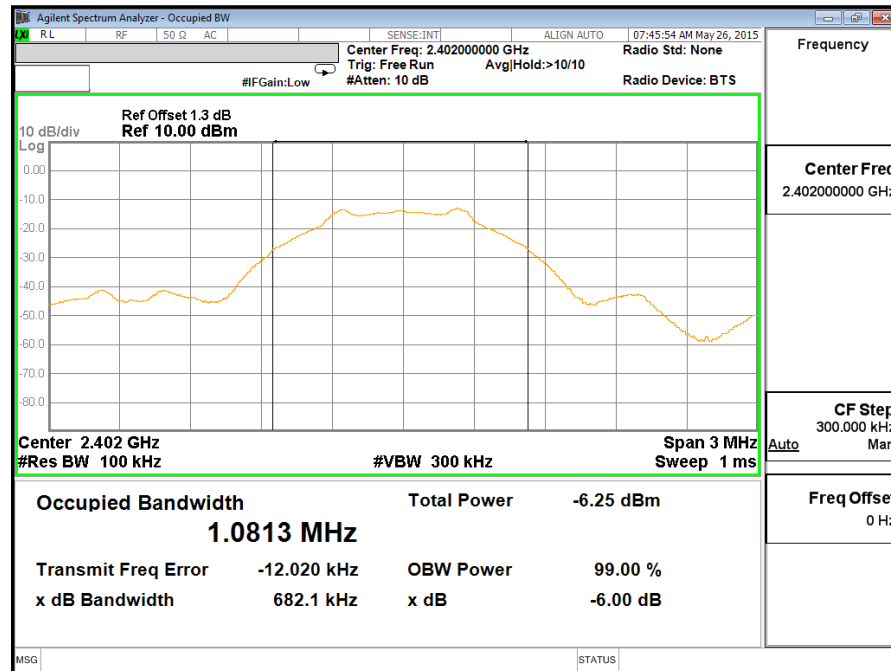
Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	682.1	>500	Pass
Mid Channel	2442	673.4	>500	Pass
High Channel	2480	686.5	>500	Pass

**Table 8: Test result of 99% Bandwidth, GFSK modulation**

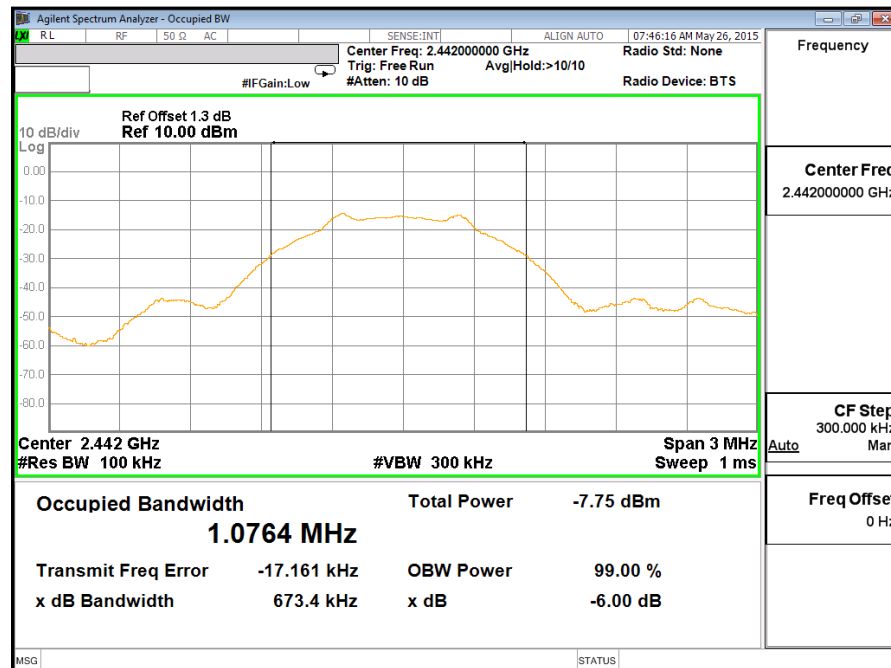
Channel	Channel Frequency (MHz)	99% Bandwidth (kHz)
Low Channel	2402	1062.4
Mid Channel	2442	1060
High Channel	2480	1055.2

## Test Plot of 6dB Bandwidth

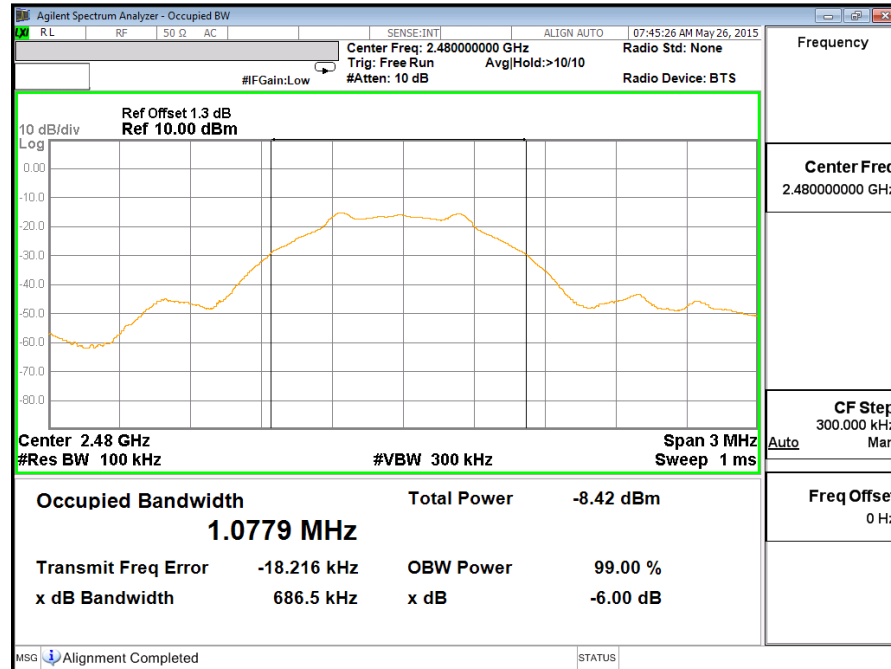
### Low Channel



### Middle Channel

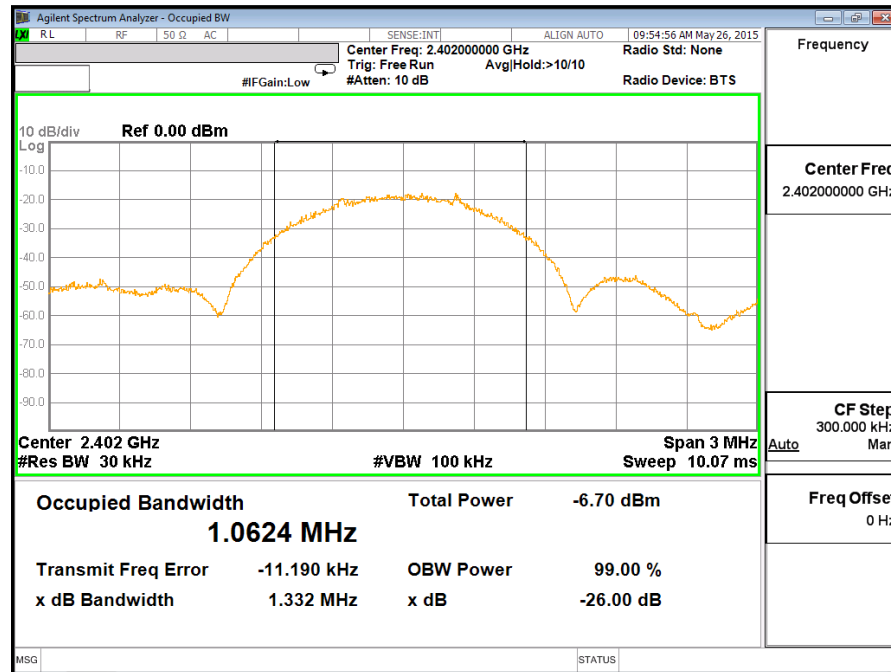


### High Channel

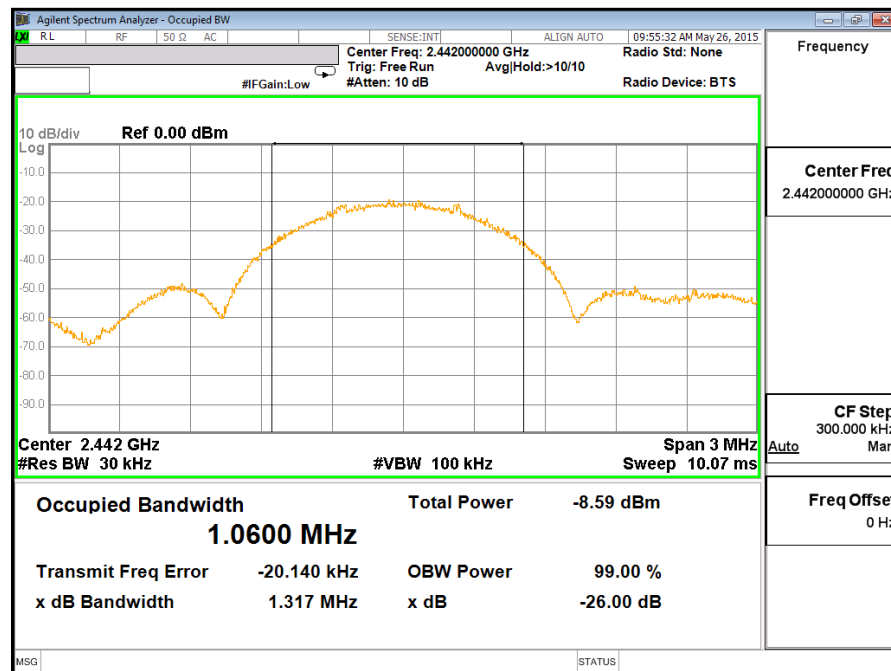


## Test Plot of 99% Bandwidth

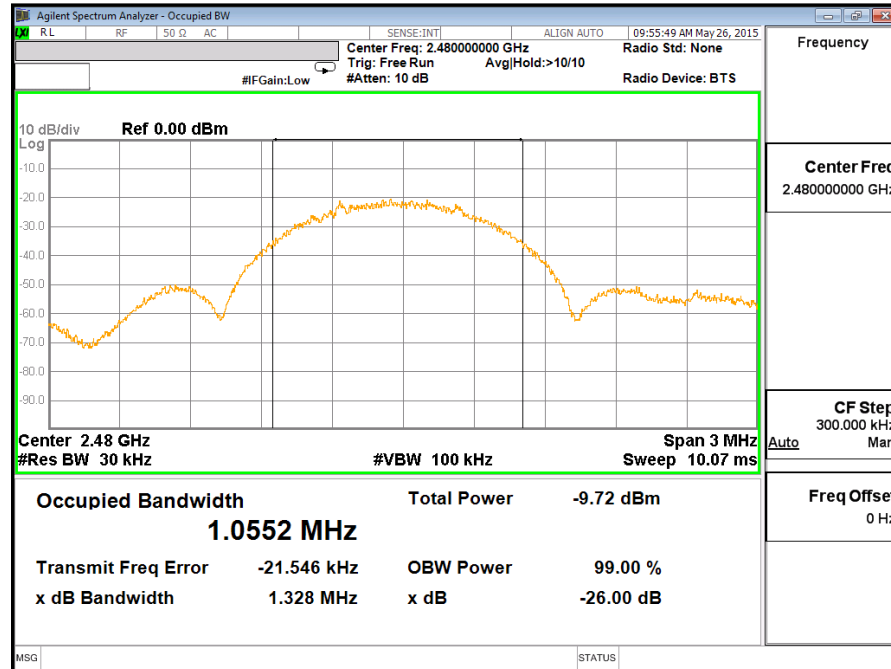
### Low Channel



### Middle Channel



### High Channel



### 5.1.4 Power Density

**RESULT:****Passed**

Test standard : LP0002(2011): 3.10.1, (6.2.2)  
FCC Part 15.247(e) , RSS-210 A8.2(2)  
Basic standard : ANSI C63.10:2009, KDB558074  
Kind of test site : Shielded room

**Test setup**

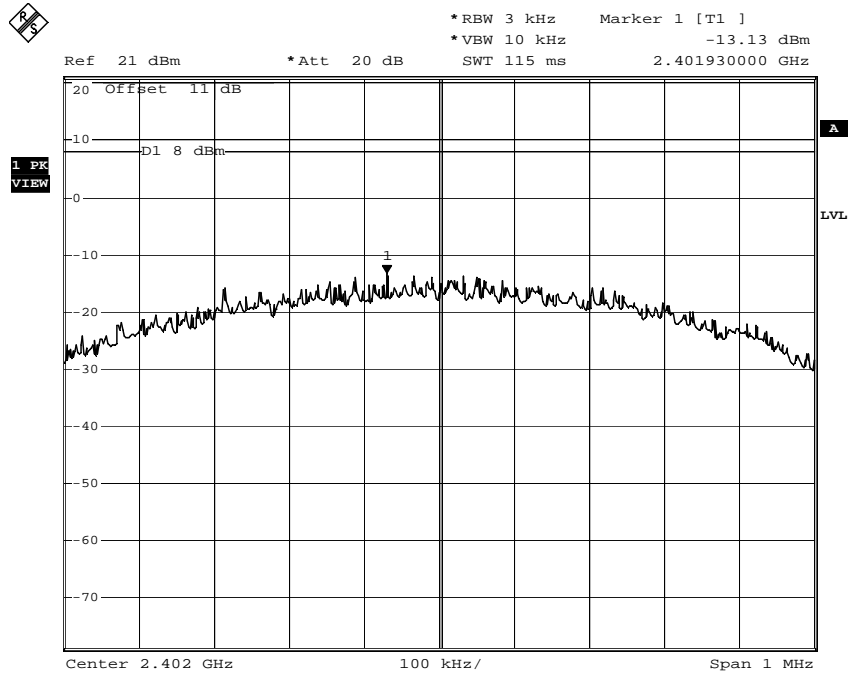
Test Channel : Low/ Middle/ High  
Operation Mode : A  
Ambient temperature : 20-24°C  
Relative humidity : 50-65%  
Atmospheric pressure : 100-103 kPa

**Table 9: Test result of Power Density**

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2402	-13.13	8
Middle Channel	2442	-14.83	8
High Channel	2480	-14.18	8

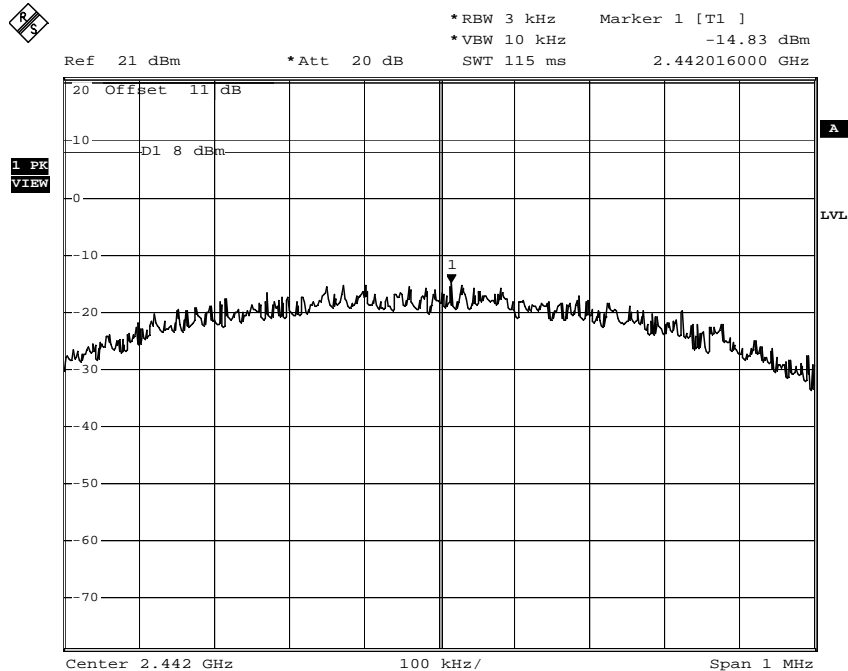
## Test Plot of Power Density

### Low Channel



Date: 2.JUN.2015 18:28:29

### Middle Channel



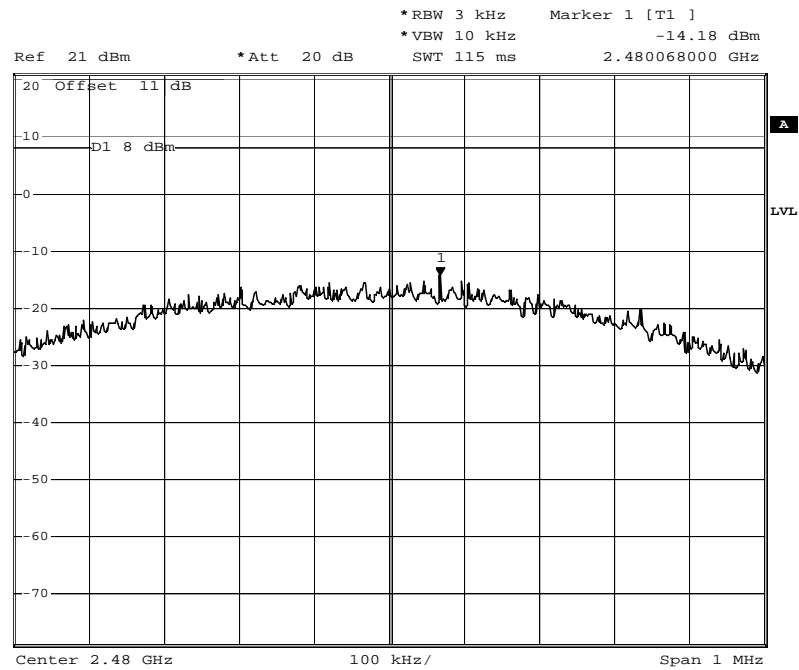
Date: 2.JUN.2015 18:27:49



**High Channel**



1. PK  
VIEW



Date: 2.JUN.2015 18:27:16

### 5.1.5 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

**RESULT:****Passed**

Test standard	:	LP0002(2011): 3.10.1, (5)
Basic standard	:	FCC part 15.247(d), RSS-210 A8.5
Limit	:	ANSI C63.10:2009, KDB558074
	:	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**

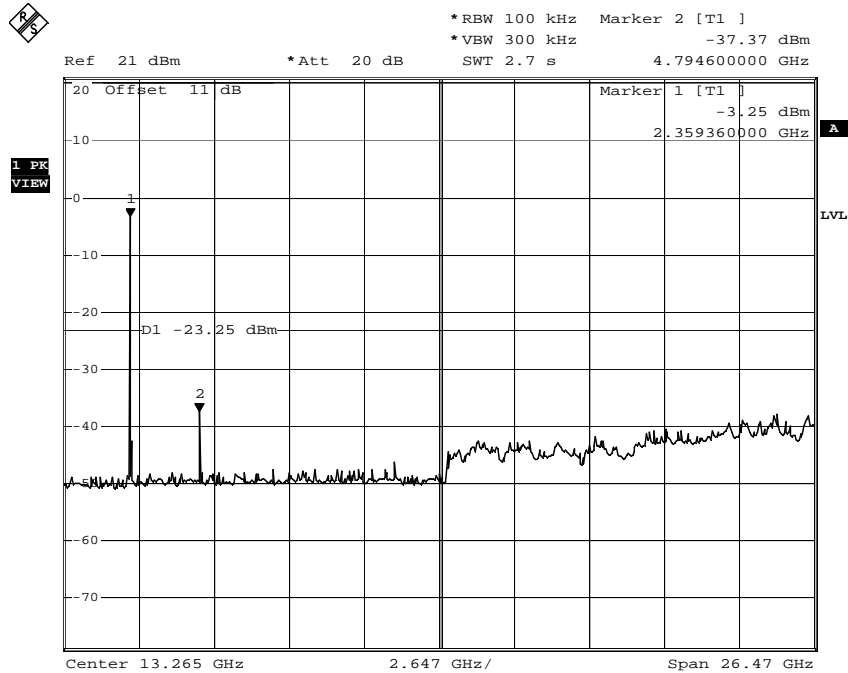
Test Channel	:	Low/ High
Operation mode	:	A
Ambient temperature	:	20-24°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103 kPa

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

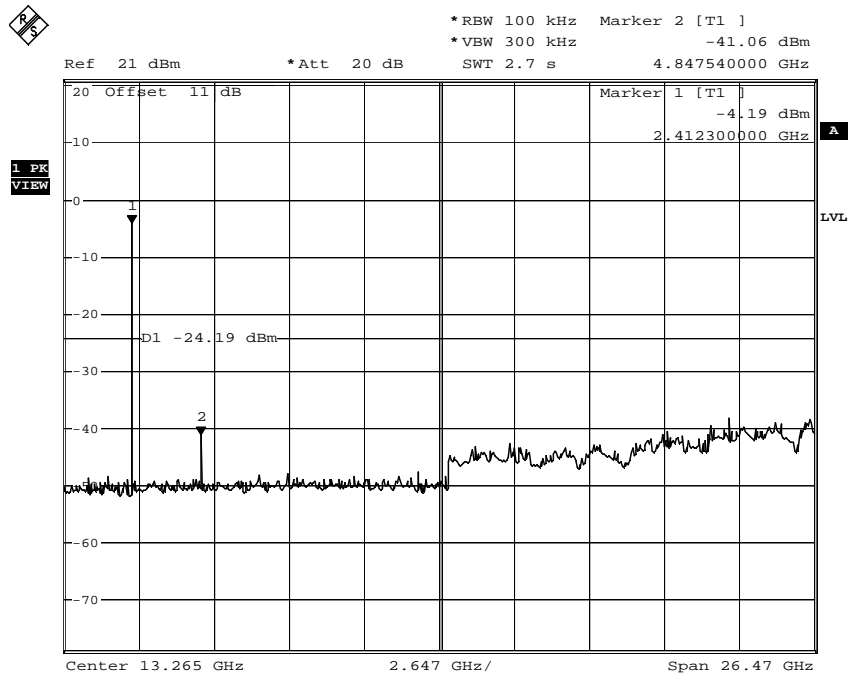
## Test Plot 100kHz Conducted Emissions

### Low Channel



Date: 2.JUN.2015 18:37:21

### Middle Channel

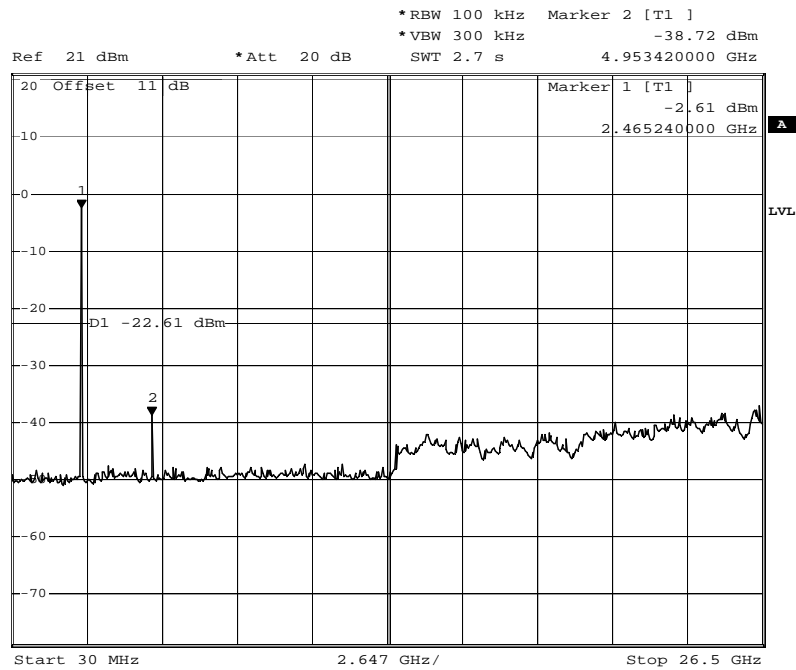


Date: 2.JUN.2015 18:36:29

### High Channel



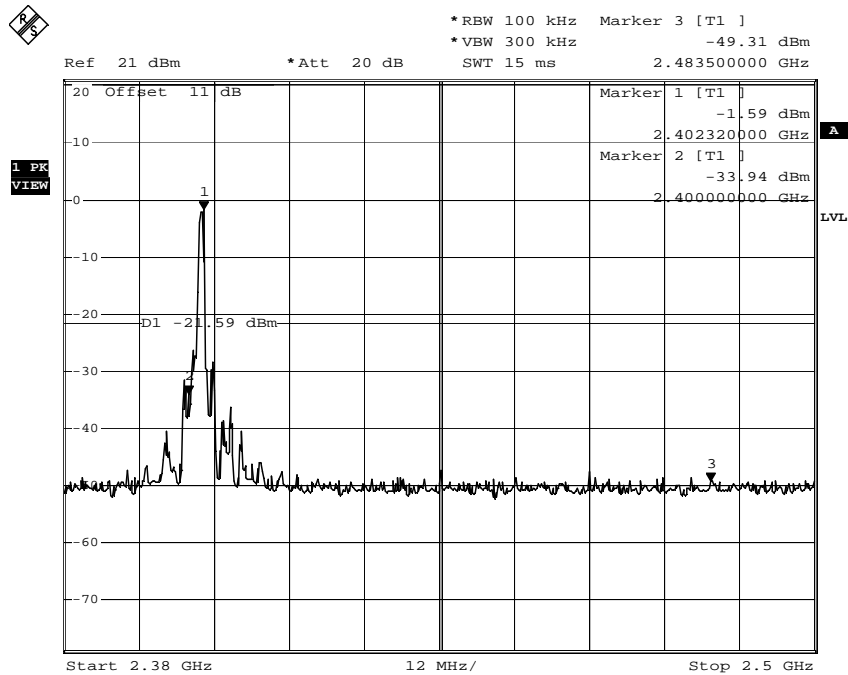
1. PK  
VIEW



Date: 2.JUN.2015 18:35:32

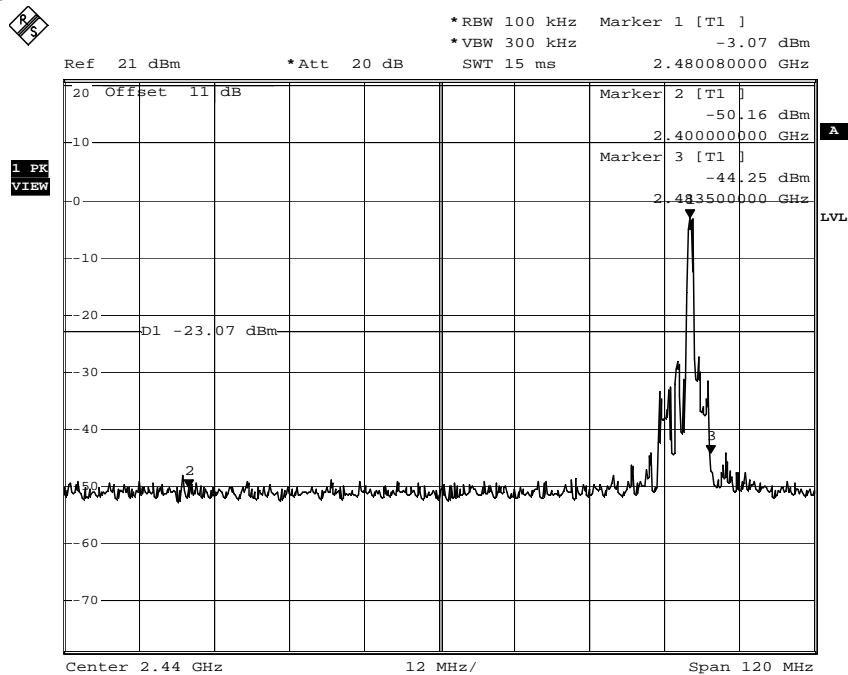
## Test Plot 100kHz RBW of Band Edge

### Low Channel



Date: 2.JUN.2015 18:32:16

### High Channel



Date: 2.JUN.2015 18:33:26

## 5.1.6 Spurious Emission

**RESULT:****Passed**

Test standard	:	FCC part 15.247(d), FCC 15.205, FCC 15.209, RSS-210 2.2, RSS-210 A8.5 and RSS-Gen 8.9 LP0002(2011): 3.10.1, (5)
Basic standard	:	ANSI C63.10: 2009
Limits	:	Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-210 2.7 (Table 1), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-210 2.7 (Table 2 and 3). Radiated emissions which fall in the restricted bands, as defined in LP0002(2011): 2.7, must comply with the radiated emission limits specified in LP0002(2011): 2.8 Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a) and FCC 15.249(a), RSS-210 2.7 (Table 2 and 3) and RSS-210 A2.9(a). Emission radiated outside the specified frequency bands must comply with the radiated emission limits specified in LP0002(2011): 2.8
Kind of test site	:	3m Semi-Anechoic Chamber

**Test setup**

Test Channel	:	Low/ Middle/ High
Operation mode	:	A, B

Remark: Testing was carried out within frequency range 30MHz to the tenth harmonic.

For details refer to Appendix D.

Testing was carried out within frequency range 30MHz 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. 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.

## 5.2 Mains Emissions

### 5.2.1 Mains Conducted Emissions

**RESULT:****Passed**

Test standard	:	FCC Part 15.207 FCC Part 15.107 RSS-Gen 8.8 LP0002: 2.3
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**

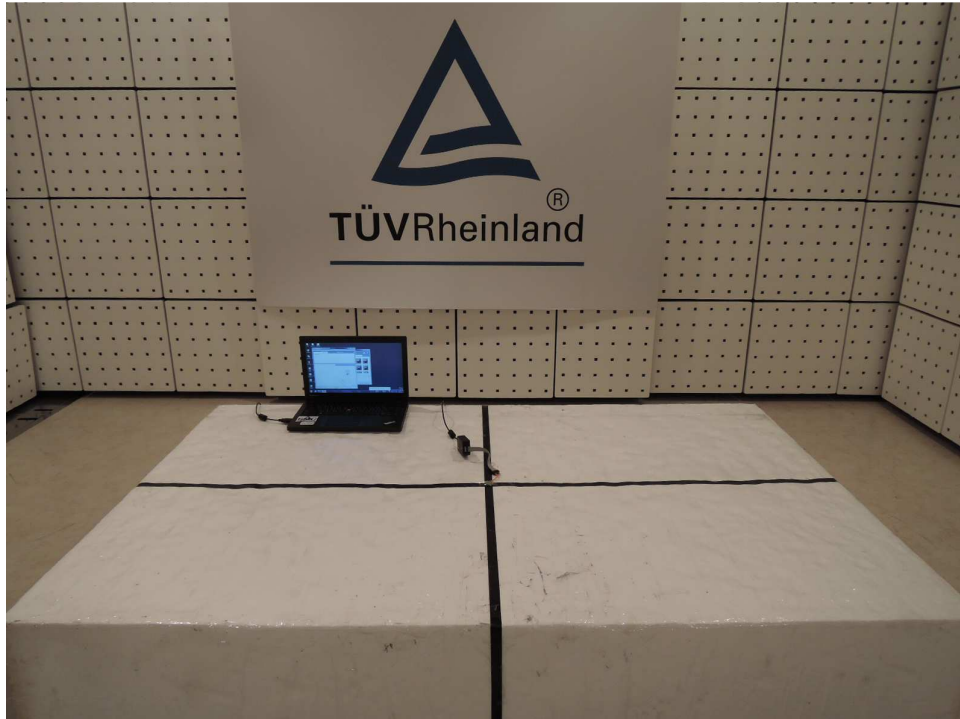
Test standard : FCC KDB Publication 447498 D01 v05

Since maximum peak output power of the transmitter is 0.7499 mW < 1mW, hence the EUT is excluded from SAR evaluation according to FCC KDB publication 447498 D01 v05: Mobile Portable RF Exposure.

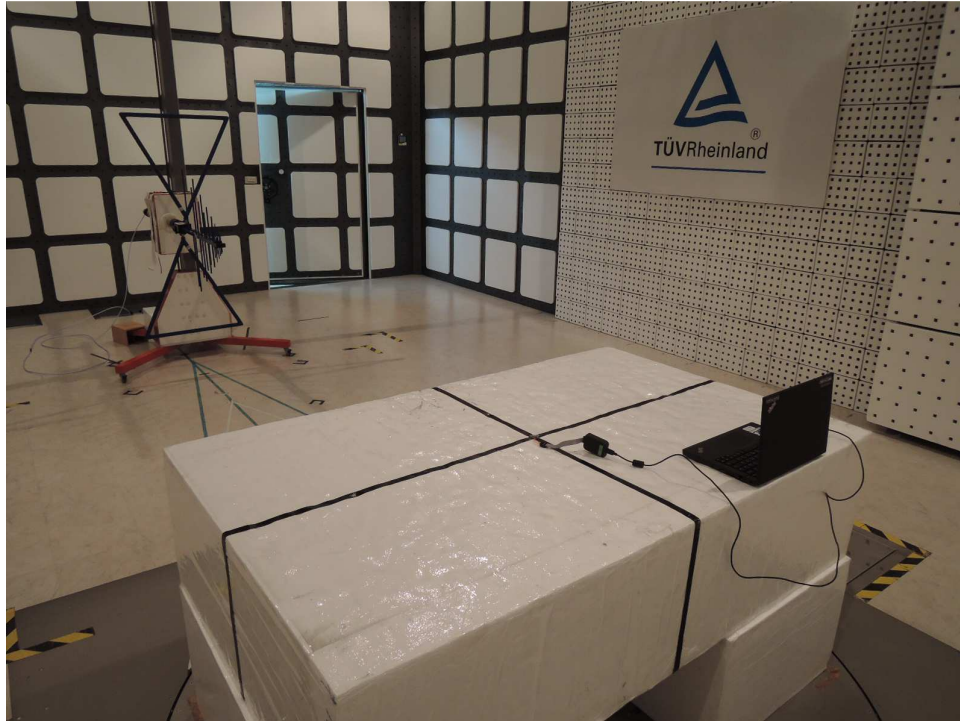


## 7. Photographs of the Test Set-Up

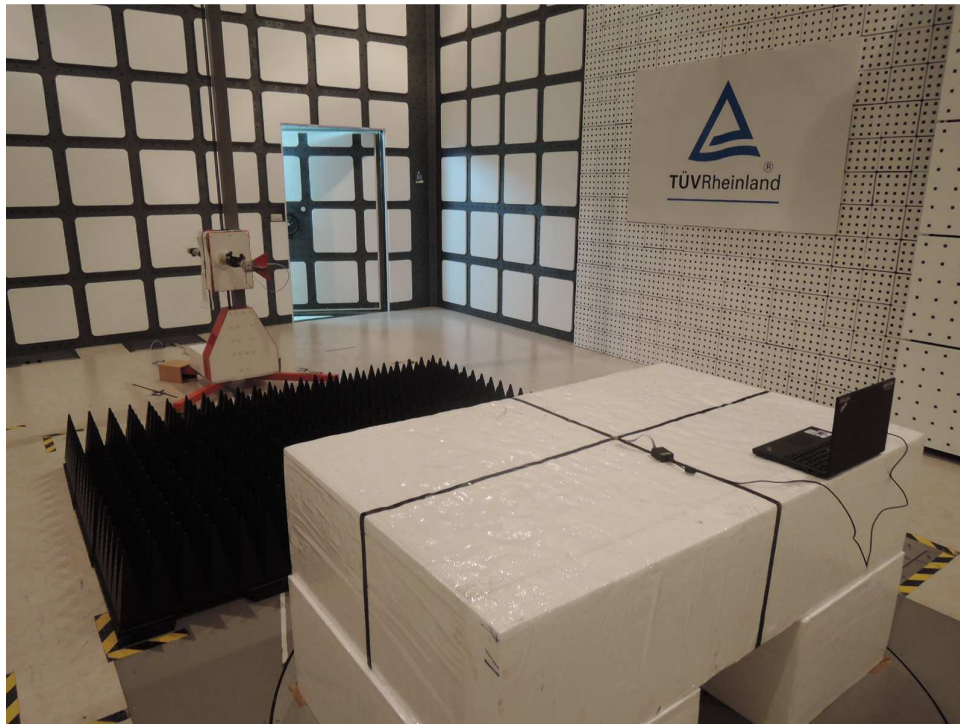
**Photograph 1: Set-up for Spurious Emissions (Front View)**



**Photograph 2: Set-up for Spurious Emissions (Back View 1)**



**Photograph 3: Set-up for Spurious Emissions (Back View 2)**



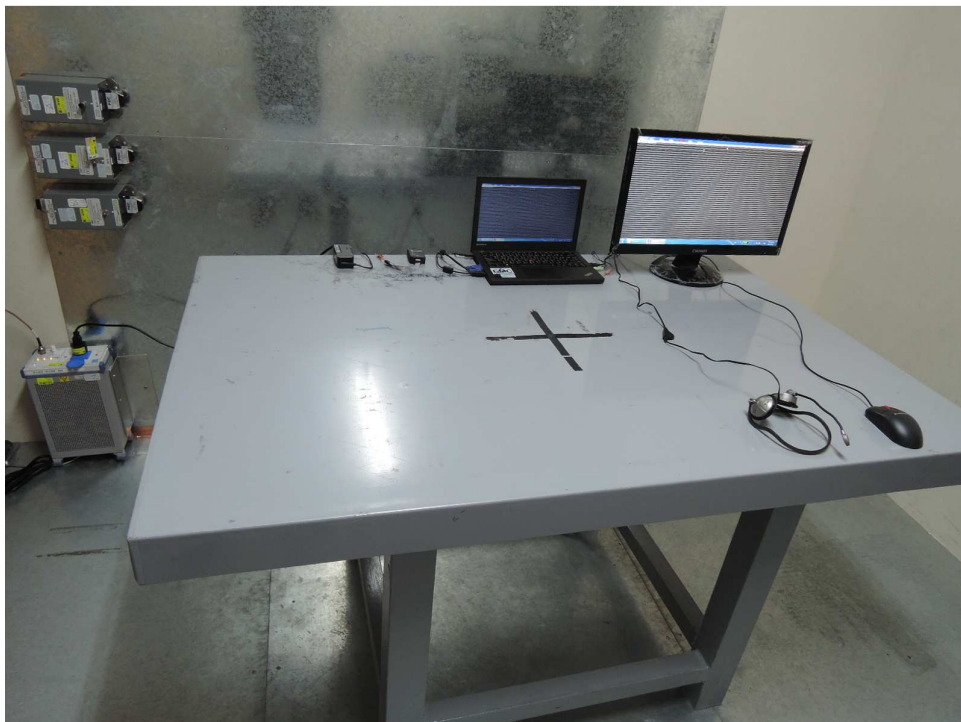
**Photograph 4: Set-up for Conducted testing**



**Photograph 5: Set-up for for Mains Conducted testing Back**



**Photograph 6: Set-up for for Mains Conducted testing Front**





## 8. List of Tables

Table 1: Applied Standard and Test Levels .....	5
Table 2: List of Test and Measurement Equipment .....	7
Table 3: Emission Measurement Uncertainty.....	8
Table 4: Basic Information of EUT .....	9
Table 5: Technical Specification of EUT .....	9
Table 6: Test result of Peak Output Power .....	15
Table 7: Test result of 6dB Bandwidth .....	18
Table 8: Test result of 99% Bandwidth, GFSK modulation .....	18
Table 9: Test result of Power Density .....	23

## 9. List of Photographs

Photograph 1: Set-up for Spurious Emissions (Front View).....	33
Photograph 2: Set-up for Spurious Emissions (Back View 1) .....	34
Photograph 3: Set-up for Spurious Emissions (Back View 2) .....	35
Photograph 4: Set-up for Conducted testing .....	35
Photograph 5: Set-up for for Mains Conducted testing Back .....	36
Photograph 6: Set-up for for Mains Conducted testing Front.....	36