

Produkte  
Products

**Prüfbericht - Nr.:** 14042049 001

Test Report No.:

Seite 1 von 15  
Page 1 of 15

**Auftraggeber:** Raden Inc  
**Client:**  
 15 Maiden Lane Suite 1000  
 New York, NY, 10038  
 New York  
 United States

**Gegenstand der Prüfung:** Bluetooth Low Energy RF module  
**Test Item:**

**Bezeichnung:** RF-BM-N16B2CIC **Serien-Nr.:** **Engineering sample**  
**Identification:** Serial No.:

**Wareneingangs-Nr.:** A000310050-001 **Eingangsdatum:** 18.01.2016  
**Receipt No.:** Date of Receipt:

**Prüfort:** TÜV Rheinland Hong Kong Ltd.  
**Testing Location:**  
 8/F, First Group Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong  
**Hong Kong Productivity Council**  
 HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong

**Zustand des Prüfgegenstandes bei Anlieferung:** Test samples are not damaged and suitable  
**Condition of test item at delivery:** for testing.

**Prüfgrundlage:** FCC Part 15 Subpart C  
**Test Specification:**  
 RSS-247 Issue 1  
 ANSI C63.10-2013

**Prüfergebnis:** Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben  
**Test Results:** genannter Prüfgrundlage.  
 The above mentioned product was tested and **passed**.

**Prüflaboratorium:** TÜV Rheinland Hong Kong Ltd.  
**Testing Laboratory:**  
 8 - 10/F., Goldin Financial Global Square, 7 Wang Tai Road, Kowloon Bay,  
 Kowloon, Hong Kong

geprüft/ tested by:

01.03.2016 Benny Lau  
 Senior Project Manager



01.03.2016 Sharon Li  
 Department Manager



Datum Name/Stellung Unterschrift  
 Date Name/Position Signature

Datum Name/Stellung Unterschrift  
 Date Name/Position Signature

**Sonstiges:** FCC ID: 2AGD6-RAMDBT001  
**Other Aspects:** IC: 20802-RAMDBT001

Abkürzungen: P(ass) = entspricht Prüfgrundlage  
 F(all) = entspricht nicht Prüfgrundlage  
 N/A = nicht anwendbar  
 N/T = nicht getestet

Abbreviations: P(ass) = passed  
 F(all) = failed  
 N/A = not applicable  
 N/T = not tested

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.  
 This test report 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 safety mark on this or similar products.

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## Product information

### Manufacturers declarations

	Transceiver
Operating frequency range	2402 - 2480 MHz
Type of modulation	GFSK
Number of channels	40
Channel separation	2 MHz
Type of antenna	PCB Antenna
Antenna gain (dBi)	2.41 dBi
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	No
Nominal voltage	V <sub>nor</sub> : 3.3 VDC
Independent Operation Modes	Transmitting

### Product function and intended use

The equipment under test (EUT) is a Bluetooth low energy RF module. It can be used for Bluetooth low energy and 2.4GHz ultra low-power wireless applications. It operates at the frequency range 2402 – 2480MHz. It has an integral PCB antenna and it is powered by 3.3VDC.

FCC ID: 2AGD6-RAMDBT001 / IC: 20802-RAMDBT001

Models	Product description
RF-BM-N16B2CIC	Bluetooth low energy RF module

### Submitted documents

Circuit Diagram  
 Block Diagram  
 User manual  
 Label

### Independent Operation Modes

The basic operation modes are:

- Transmitting mode.

For further information refer to User Manual

### Related Submittal(s) Grants

This is a single application for certification of the transmitter.

### Remark

The test results in this test report are only relevant to the tested sample and does not involve any assessment in the production.

## Test Set-up and Operation Mode

### Principle of Configuration Selection

**Emission:** The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

### Test Operation and Test Software

Test operation should refer to test methodology.

- Special software is provided by the applicant to set the device to operate in a fixed frequency channel and maximum RF output power level. The setting of the maximum RF output power shall be fixed on the final product.
- Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate.

### Special Accessories and Auxiliary Equipment

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

- none

Supporting equipment:

- DC power supply model: Manson NP-9615 (provide by TUV)

### Countermeasures to achieve EMC Compliance

- none

## Test Methodology

### Radiated Emission

The radiated emission measurements were performed according to the procedures in ANSI C63.10-2013.

The equipment under test (EUT) was placed at the middle of the 80 cm and 1.5m height turntable, and the turntable is 3 meters far from the measuring antenna. During the testing, the EUT was operated standalone and arranged for maximum emissions. The EUT was tested in three orthogonal planes.

The investigation is performed with the EUT rotated 360 °, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained.

All radiated tests were performed at an antenna to EUT with 3 meters distance, unless stated otherwise in particular parts of this test report.

### Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

$$FS = R + AF + CF + FA - PA$$

Where FS = Field Strength in dBuV/m at 3 meters.

R = Reading of Spectrum Analyzer in dBuV.

AF = Antenna Factor in dB.

CF = Cable Attenuation Factor in dB.

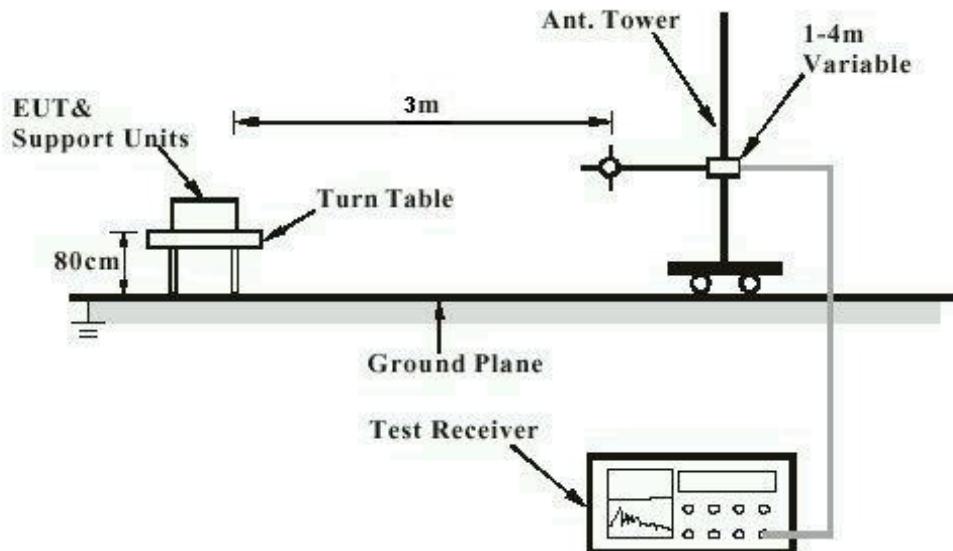
FA = Filter Attenuation Factor in dB.

PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

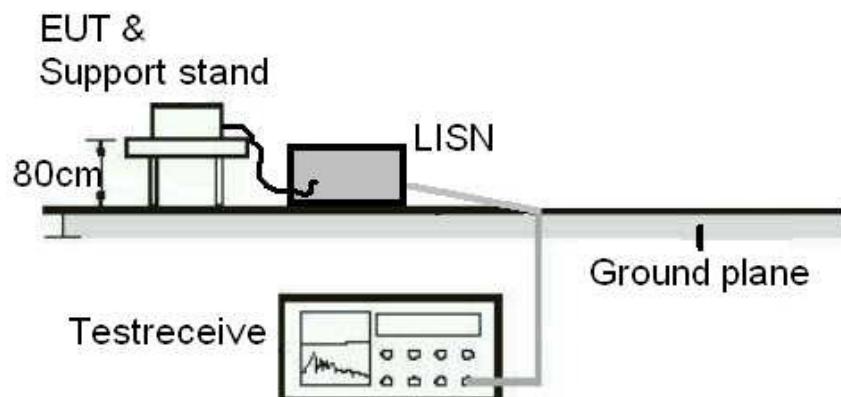
## Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test

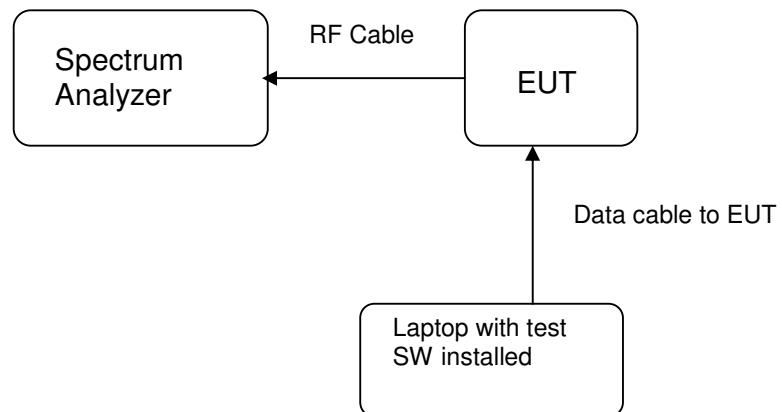


Note: Measurements above 1 GHz are done with a table height of 1.5m

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



**Diagram of Equipment Configuration for Antenna-port Conducted Measurement (if applicable)**



## List of Test and Measurement Instruments

Hong Kong Productivity Council (Registration number: 90656)

### Radiated Emission

Equipment	Manufacturer	Type	Cal. Date	Due Date
Semi-anechoic Chamber	Frankonia	Nil	14-Apr-15	14-Apr-16
New Fully Ancheonic Chamber	TDK	N/A	15-Apr-15	15-Apr-16
Cable	Hubersuhner	SUCOFLEX 104	31-Mar-14	31-Mar-16
Test Receiver	R & S	ESU26	12-Feb-15	07-Dec-16
Bi-conical Antenna	R & S	HK116	1-Sep-15	1-Sep-17
Log Periodic Antenna	R & S	HL223	1-Sep-15	1-Sep-17
Coaxial cable	Harbour	LL335	10-Jun-14	10-Jun-16
Microwave amplifier 0.5-26.5GHz, 25dB gain	HP	83017A	17-Jul-14	17-Jul-16
High Pass Filter (cutoff freq. =1000MHz)	Trilithic	23042	28-Oct-15	28-Oct-17
Horn Antenna	EMCO	3115	26-Aug-15	26-Aug-17
Active Loop Antenna	EMCO	6502	17-May-15	17-May-16

## TÜV Rheinland Hong Kong Ltd

### Radio Test

Equipment	Manufacturer	Type	Cal. Date	Due Date
Spectrum Analyzer	R & S	FSP30	12-Jan-15	12-Jan-2017

### AC Mains Conducted Emission

Equipment	Manufacturer	Type	Cal. Date	Due Date
Test Receiver	R & S	ESR3	22-Oct-15	22-Oct-16
LISN	R & S	ENV216	05 Feb 15	19-Jan-17
EMC32	R & S	v9.12	N/A	N/A

## Results FCC Part 15 – Subpart C / RSS-247 Issue 1

FCC 15.203 – Antenna Requirement 1		Pass
<b>FCC Requirement:</b>	No antenna other than that furnished by the responsible party shall be used with the device	
<b>Results:</b>	a) Antenna type: b) Manufacturer and model no: c) Peak Gain:	Integral PCB antenna N/A 2.41 dBi
<b>Verdict:</b>	Pass	
FCC 15.204 – Antenna Requirement 2		N/A
<b>FCC Requirement:</b>	An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator.	
<b>Results:</b>	Only one integral antenna can be used.	
<b>Verdict:</b>	N/A	
RSS-Gen 6.3 – External Control		Pass
<b>IC Requirement:</b>	The device shall not have any external controls accessible to the user that enable it to be adjusted, selected or programmed to operate in violation of the limits prescribed in the applicable RSS.	
<b>Results:</b>	The device does not have any transmitter external controls accessible to the user that can be adjusted and operated in violation of the limits of this standard.	
<b>Verdict:</b>	Pass	
RSS-Gen 8.3 – Antenna Requirement		Pass
<b>IC Requirement:</b>	When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer.	
<b>Results:</b>	a) Antenna type: b) Manufacturer c) model no d) Gain with reference to an isotropic radiator:	Fixed Integral wire antenna N/A N/A 0 dBi
<b>Verdict:</b>	Pass	

FCC 15.207/ RSS-Gen 8.8 – Conducted Emission on AC Mains						Pass
Test Specification : ANSI C63.10 – 2013						
Mode of operation : TX mode						
Port of testing : AC Mains input port of power supply						
Detector : Quasi-peak and Average						
RBW : 9 kHz						
Supply voltage : 120Vac 60Hz						
Temperature : 23°C						
Humidity : 50%						
Requirement: 15.207(a)						
<b>Results:</b> Pass						
<b>Live measurement</b>						
Frequency range (MHz)	Frequency (MHz)	Quasi-peak dB $\mu$ V	Average dB $\mu$ V	Limit QP (dB $\mu$ V)	Limit AV (dB $\mu$ V)	Verdict
0,15 – 0,5	No peak found	---	---	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass
<b>Neutral measurement</b>						
Frequency range (MHz)	Frequency (MHz)	Quasi-peak dB $\mu$ V	Average dB $\mu$ V	Limit QP (dB $\mu$ V)	Limit AV (dB $\mu$ V)	Verdict
0,15 – 0,5	No peak found	---	---	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass
<b>Results:</b> Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate.						
The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz does not exceed the limits. For test Results plots refer to Appendix 1.						

FCC 15.247 (a)(2) / RSS-247 5.2(1) – 6dB Bandwidth Measurement						Pass
<b>FCC Requirement:</b> Systems using digital modulation techniques may operate in the 902 – 928 MHz, 2400 – 2483.5 MHz, and 5725 – 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500kHz.						
Test Specification : KDB 558074 D01 DTS Measurement Guidance v03r02 section 8.1 Option 1						
Mode of operation : TX mode						
Port of testing : Temporary antenna port						
Detector : Peak						
RBW/VBW : 100KHz/ 300KHz						
Supply voltage : 3.3 Vdc						
Temperature : 23°C						
Humidity : 50%						
<b>Results:</b> For test protocols please refer to Appendix 1.						

Channel frequency (MHz)	6 dB left (MHz)	6 dB right (MHz)	6dB bandwidth (kHz)
2402	2401.672	2402.352	680
2440	2439.680	2440.352	672
2480	2479.680	2480.360	680

<b>RSS-Gen 6.6 – Occupied Bandwidth</b>		<b>Pass</b>																
<b>FCC/ IC Requirement</b> : N/A																		
Test Specification : RSS-Gen Mode of operation : Tx mode Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 120VAC Temperature : 23°C Humidity : 50%																		
<b>Results:</b> Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. For test protocols refer to Appendix 1.																		
<table border="1"> <thead> <tr> <th>Frequency (MHz)</th> <th>Left (MHz)</th> <th>Right (MHz)</th> <th>99% bandwidth (MHz)</th> </tr> </thead> <tbody> <tr> <td>2402</td> <td>2401.500</td> <td>2402.560</td> <td>1.06</td> </tr> <tr> <td>2440</td> <td>2439.500</td> <td>2440.550</td> <td>1.05</td> </tr> <tr> <td>2479</td> <td>2479.500</td> <td>2480.560</td> <td>1.06</td> </tr> </tbody> </table>		Frequency (MHz)	Left (MHz)	Right (MHz)	99% bandwidth (MHz)	2402	2401.500	2402.560	1.06	2440	2439.500	2440.550	1.05	2479	2479.500	2480.560	1.06	
Frequency (MHz)	Left (MHz)	Right (MHz)	99% bandwidth (MHz)															
2402	2401.500	2402.560	1.06															
2440	2439.500	2440.550	1.05															
2479	2479.500	2480.560	1.06															

<b>FCC 15.247(b)(3) / RSS-247 5.4(4) – Maximum Peak Coudected Output Power</b>		<b>Pass</b>																
<b>FCC Requirement:</b> For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850MHz bands: 1 Watt (30dBm)																		
Test Specification : KDB 558074 D01 DTS Measurement Guidance v03r02 section 9.1.1 Mode of operation : TX mode Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1MHz/ 3MHz Supply voltage : 3.3 Vdc Temperature : 23°C Humidity : 50%																		
<b>Results:</b> For test protocols please refer to Appendix 1.																		
<table border="1"> <thead> <tr> <th>Frequency (MHz)</th> <th>Measured Output Power (dBm)</th> <th>Limit (W/dBm)</th> <th>Verdict</th> </tr> </thead> <tbody> <tr> <td>2402</td> <td>-1.22</td> <td>1 / 30.0</td> <td>Pass</td> </tr> <tr> <td>2440</td> <td>-1.12</td> <td>1 / 30.0</td> <td>Pass</td> </tr> <tr> <td>2480</td> <td>-1.65</td> <td>1 / 30.0</td> <td>Pass</td> </tr> </tbody> </table>		Frequency (MHz)	Measured Output Power (dBm)	Limit (W/dBm)	Verdict	2402	-1.22	1 / 30.0	Pass	2440	-1.12	1 / 30.0	Pass	2480	-1.65	1 / 30.0	Pass	
Frequency (MHz)	Measured Output Power (dBm)	Limit (W/dBm)	Verdict															
2402	-1.22	1 / 30.0	Pass															
2440	-1.12	1 / 30.0	Pass															
2480	-1.65	1 / 30.0	Pass															

FCC 15.247(e) / RSS-247 5.2(2) – Power Spectral Density		Pass	
<b>FCC Requirement:</b> For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.			
Test Specification : KDB 558074 D01 DTS Measurement Guidance v03r02 section 10.2 Mode of operation : TX mode Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 KHz / 300KHz Supply voltage : 3.3 Vdc Temperature : 23°C Humidity : 50%			
<b>Results:</b> For test protocols please refer to Appendix 1.			
Operating frequency (MHz)	Power density (dBm)	Limit (dBm)	Verdict
2402	-1.74	8.0	Pass
2440	-1.59	8.0	Pass
2480	-2.11	8.0	Pass

FCC 15.247(d) / RSS-247 5.5 – Spurious Conducted Emissions		Pass			
Test Specification : KDB 558074 D01 DTS Measurement Guidance v03r02 section 11.1 Mode of operation : TX mode Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 3.3 Vdc Temperature : 23 °C Humidity : 50 %					
<b>FCC Requirement:</b> In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.					
<b>Results:</b> Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate.  Only the worst cases is shown below. For test protocols refer to Appendix 1.					
Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	2400.00	-44.57	-1.74	42.83	Pass
2440	22960.00	-31.61	-1.59	30.02	Pass
2480	22720.00	-32.02	-2.11	29.91	Pass

FCC 15.205 / RSS-Gen 8.9 – Radiated Emissions in Restricted Frequency Bands			Pass
Test Specification : ANSI C63.10 – 2013 Mode of operation : TX mode Port of testing : Enclosure Detector : Peak RBW/VBW : 100 kHz / 300 kHz for f < 1 GHz 1 MHz / 3 MHz for f > 1 GHz Supply voltage : 3.3 Vdc Temperature : 23°C Humidity : 50%			
<b>FCC Requirement:</b> In any 100kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.205(c).			
<b>Results:</b> Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate.  All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.			
Mode: 2402MHz TX		Vertical Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	
72.006	31.4	40.0 / QP	
2390.000	51.00	74.0 / PK	
2390.000	34.05	54.0 / AV	
4804.000	57.92	74.0 / PK	
4804.000	46.73	54.0 / AV	
Mode: 2402 MHz TX		Horizontal Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	
2390.000	56.40	74.0 / PK	
2390.000	33.38	54.0 / AV	
4804.000	58.94	74.0 / PK	
4804.000	48.20	54.0 / AV	
Mode: 2440 MHz TX		Vertical Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	
72.006	31.5	40.0 / QP	
4880.000	59.98	74.0 / PK	
4880.000	49.64	54.0 / AV	
Mode: 2440 MHz TX		Horizontal Polarization	
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	
4880.000	59.87	74.0 / PK	
4880.000	48.51	54.0 / AV	

Mode: 2480MHz TX		
Vertical Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
72.006	31.6	40.0 / QP
2483.500	47.99	74.0 / PK
2483.500	36.75	54.0 / AV
4960.000	60.28	74.0 / PK
4960.000	49.97	54.0 / AV

Mode: 2480 MHz TX		
Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
2483.500	60.12	74.0 / PK
2483.500	44.33	54.0 / AV
4960.000	60.14	74.0 / PK
4960.000	49.76	54.0 / AV