

**Prüfbericht - Nr.: 14026758 003**

Test Report No.:

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**Auftraggeber:**

Client:

 AvantWave Limited  
 3 Rd. Floor, Photonics Centre  
 No. 2 Science Park Avenue East  
 Hong Kong Science Park  
 Shatin Hong Kong

**Gegenstand der Prüfung:**

Bluetooth Module

Test Item:

**Bezeichnung:**

Identification:

BTR602

**Serien-Nr.:**

Serial No.:

Engineering sample

**Wareneingangs-Nr.:**

Receipt No.:

A000039504-001,

A000041708-001

**Eingangsdatum:**

03.03.2014,

Date of Receipt:

19.03.2014

**Zustand des Prüfgegenstandes bei Anlieferung:**

Condition of test item at delivery:

 Test sample(s) is/are not damaged and  
 suitable for testing.

**Prüfort:**

Testing Location:

Hong Kong Productivity Council

HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong

TÜV Rheinland Hong Kong Ltd.

8/F., First Group Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong

**Prüfgrundlage:**

Test Specification:

FCC Part 15 Subpart C

ANSI C63.4-2003

CISPR 22:1997

**Prüfergebnis:**

Test Results:

 Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben  
 genannter Prüfgrundlage.

 The above mentioned product was tested and **passed**.

**Prüflaboratorium:**

Testing Laboratory:

TÜV Rheinland Hong Kong Ltd.

8 - 10/F., Goldin Financial Global Square, 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong

**geprüft/ tested by:**
**kontrolliert/ reviewed by:**

 09.04.2014      Hugo Wan  
 Senior Project Manager



09.04.2014

 Sharon Li  
 Section Manager



 Datum  
 Date

 Name/Stellung  
 Name/Position

 Unterschrift  
 Signature

 Datum  
 Date

 Name/Stellung  
 Name/Position

 Unterschrift  
 Signature

**Sonstiges / Other Aspects:**

FCCID: XQN-BTR60X

This test report is issued for "Class II permissive change" of the previously tested EUT of AvantWave model BTR60X in test report number 14026758 002. For details, please refer to "Remark" on page 4.

**Abkürzungen:**

P(pass)	= entspricht Prüfgrundlage
F(fail)	= entspricht nicht Prüfgrundlage
N/A	= nicht anwendbar
N/T	= nicht getestet

**Abbreviations:**

P(pass)	= passed
F(fail)	= 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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Subclause 15.204 – Antenna Information.....	Pass .....
Subclause 15.207 – Disturbance Voltage on AC Mains .....	Pass .....
Subclause 15.247 (a)(1) – Carrier Frequency Separation .....	Pass .....
Subclause 15.247 (a)(1)(iii) – Number of hopping channels.....	Pass .....
Subclause 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time).....	Pass .....
Subclause 15.247 (a) – 20 dB Bandwidth .....	Pass .....
Subclause 15.247 (a) – Hopping Sequence.....	Pass .....
Subclause 15.247 (a) – Equal Hopping Frequency Use .....	Pass .....
Subclause 15.247 (a) – Receiver Input Bandwidth.....	Pass .....
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## Product information

### Manufacturers declarations

	<b>Transceiver</b>
Operating frequency range	2402 - 2480 MHz
Type of modulation	GFSK; Pi/4 DQPSK; 8 DPSK
Number of channels	79
Channel separation	1 MHz
Type of antenna	Integral antenna
Antenna gain (dBi)	-2
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	No
Nominal voltage	V <sub>nor</sub> : 3.3V
Independent Operation Modes	Page scan Inquiry scan Connection state - ACL Link Connection state - SCO Link

## Product function and intended use

The test item is a Bluetooth Module based on the Bluetooth technology. Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices. Bluetooth operates in the unlicensed ISM Band at 2.4GHz. With the introduction of the enhanced data rate (EDR) feature, the data rates can be up to 3 Mb/s. An increase in the peak data rate beyond the basic rate of 1 Mb/s is achieved by modulating the RF carrier using phase shift keying (PSK) techniques, resulting in an increase of two to three times the number of bits per symbol. The 2 Mb/s EDR packets use a Pi/4-DQPSK modulation and the 3 Mb/s EDR packets use 8DPSK modulation.

## Submitted documents

Circuit Diagram  
Block Diagram  
Bill of material  
User Manual  
Label Artwork

## Remark

Change as follow:  
- PCB manufacturer changed

To show compliance, the following tests were repeated on the modified sample:

Radiated spurious Emission  
Peak Output Power  
Radiated Emission in Restricted Bands next to Band-edge

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases.

## Special accessories and auxiliary equipment

### Additional accessory used for testing

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

1. AC/DC Power adaptor  
Model number: PSM02R-055  
Input: 100-240VAC, 50-60Hz, 0.1A  
Output: 5.5VDC 0.35A
2. LPT cable provided by client

## List of Test and Measurement Instruments

**Hong Kong Productivity Council (FCC Registration number: 90656)**

### Radiated Emission

Equipment	Manufacturer	Type	S/N	Cal Due Date
Semi-anechoic Chamber	Frankonia	Nil	Nil	12 Apr 2014
EMI Test Receiver	Rohde & Schwarz	ESU40	100190	18 Sep 2014
Biconical Antenna	Rohde & Schwarz	HK116	100241	11 Jun 2015
Log-Periodic Antenna	Rohde & Schwarz	HL223	841516/017	10 Jun 2015
Horn Antenna	EMCO	3115	9002-3347	11 Jun 2015
Coaxial Cable 50ohm	Rosenberger	RTK081-05S-05S-10m	LA2-001-10M / 001	15 Nov 2015
Active Loop Antenna	EMCO	6502	9107-2651	21 Apr 2014

**TÜV Rheinland Hong Kong Ltd.**

### Radio Frequency

Equipment	Manufacturer	Type	S/N	Cal Due Date
Spectrum Analyzer	Rohde & Schwarz	FSP30	100007	03 Dec 2014

## Results FCC Part 15 – Subpart C

<b>Subclause 15.203 – Antenna Information</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.204 – Antenna Information</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.207 – Disturbance Voltage on AC Mains</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.247 (a)(1) – Carrier Frequency Separation</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.247 (a)(1)(iii) – Number of hopping channels</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time)</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.

<b>Subclause 15.247 (a) – 20 dB Bandwidth</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.247 (a) – Hopping Sequence</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.247 (a) – Equal Hopping Frequency Use</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.247 (a) – Receiver Input Bandwidth</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.
<b>Subclause 15.247 (a) – Receiver Hopping Capability</b>	<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.

<b>Subclause 15.247 (b)(1) – Peak Output Power</b>						<b>Pass</b>
Test Specification : FCC Part 15 Subpart A – Subclause 15.31						
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), GFSP, π/4-DPSK and 8DPSK						
Port of testing : Temporary antenna port						
Detector : Peak						
RBW/VBW : 3 MHz / 10 MHz						
Supply voltage : 3.3 VDC						
Temperature : 23°C						
Humidity : 50%						
Requirement: For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 Watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts.						
<b>Results:</b>	For test protocols please refer to Appendix 1, page 2-7.					
<b>GFSK Modulation</b>						
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	<b>Verdict</b>	
2402	-4.40	0.00	-4.40	1 / 30.0	<b>Pass</b>	
2441	-3.24	0.00	-3.24	1 / 30.0	<b>Pass</b>	
2480	-3.39	0.00	-3.39	1 / 30.0	<b>Pass</b>	
<b>π/4-DPSK Modulation</b>						
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	<b>Verdict</b>	
2402	-4.31	0.00	-4.31	0.125 / 21.0	<b>Pass</b>	
2441	-3.03	0.00	-3.03	0.125 / 21.0	<b>Pass</b>	
2480	-3.27	0.00	-3.27	0.125 / 21.0	<b>Pass</b>	
<b>8DPSK Modulation</b>						
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	<b>Verdict</b>	
2402	-4.25	0.00	-4.25	0.125 / 21.0	<b>Pass</b>	
2441	-3.09	0.00	-3.09	0.125 / 21.0	<b>Pass</b>	
2480	-3.24	0.00	-3.24	0.125 / 21.0	<b>Pass</b>	
<b>Subclause 15.247 (d) – Band edge compliance of conducted emissions</b>						<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.					

<b>Subclause 15.205 (a) – Restricted Bands next to Band-edge</b>		<b>Pass</b>
Test Specification	:	FCC Part 15 Subpart A – Subclause 15.31
Mode of operation	:	Tx mode (2402MHz, 2480MHz), GFSK
Port of testing	:	Enclosure
Detector	:	a) Peak, b) Average
RBW/VBW	:	a) 1 MHz / ≤ RBW (Peak), b) 1MHz / 10Hz (Average)
Supply voltage	:	3.3 VDC
Temperature	:	23°C
Humidity	:	50%
Requirement:	Radiated emissions which fall in the restricted bands, as defined in 15.205 (a), must also comply with the radiated emission limits specified in 15.209(a).	
<b>Results:</b>	<p>Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.</p> <p>There is no peak found in the restricted bands. For test protocols refer to Appendix 1, page 8-11.</p>	
<b>Subclause 15.247 (d) – Spurious Conducted Emissions</b>		<b>Pass</b>
<b>Remark:</b>	Please refer to test report 14026758 002 for test result.	

<b>Subclause 15.247 (c) – Spurious Radiated Emissions</b>		<b>Pass</b>
Test Specification	: ANSI C63.4 – 2003	
Mode of operation	: Tx mode (2402MHz, 2441MHz, 2480MHz), 8DPSK	
Port of testing	: Enclosure	
Detector	: Peak / Average*	
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%	
*Average reading using duty cycle correction factor on peak measurement:		
<p style="margin-left: 20px;">Devices transmitting pulsed emissions and subject to a limit requiring an average detector function for radiated emissions shall initially be measured with an instrument that uses a peak detector. A radiated emission measured with a peak detector may then be corrected to a true average using the appropriate factor for emission duty cycle. This correction factor relates the measured peak level to the average limit and is derived by averaging absolute field strength over one complete pulse train that is 0.1 s, or less, in length.</p>		
Duty cycle correction factor calculation:		
<p style="margin-left: 20px;">Total on time in 100ms = 2.92 ms      Number of pulse found in 100ms = 1      Duty cycle factor           = <math>20 \times \log((\text{on time in } 100\text{ms} \times \text{no. of pulse}) / 100\text{ms})</math>                                           = -30.7 dB</p>		
Requirement:	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>	<p>Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.</p> <p>All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.</p>	
Tx frequency 2402MHz		Vertical Polarization
<b>Freq MHz</b>	<b>Level dBuV/m</b>	<b>Limit/ Detector dBuV/m</b>
4804.022	68.6	74.0 / PK
4804.022	*37.9	54.0 / AV
Tx frequency 2402MHz		Horizontal Polarization
<b>Freq MHz</b>	<b>Level dBuV/m</b>	<b>Limit/ Detector dBuV/m</b>
1601.817	48.5	74.0 / PK
1602.010	45.8	54.0 / AV
3203.952	47.5	74.0 / PK
3203.968	39.8	54.0 / AV
4804.070	66.4	74.0 / PK
4804.070	*35.7	54.0 / AV

Tx frequency 2441MHz		
Vertical Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
4881.907	69.4	74.0 / PK
4881.907	*38.7	54.0 / AV
Tx frequency 2441MHz		
Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
1626.699	46.9	74.0 / PK
1626.651	41.0	54.0 / AV
4881.987	64.1	74.0 / PK
4881.987	*33.4	54.0 / AV
Tx frequency 2480MHz		
Vertical Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
4960.016	67.8	74.0 / PK
4960.016	*37.1	54.0 / AV
Tx frequency 2480MHz		
Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
4959.968	64.6	74.0 / PK
4959.968	*33.9	54.0 / AV

\* Duty cycle correction factor applied