

Prüfbericht - Nr.: 14026758 004

Test Report No.:

Seite 1 von 15

Page 1 of 15

Auftraggeber: AvantWave Limited
Client: 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: BTR602 **Serien-Nr.:** Engineering sample
Identification: *Serial No.:*

Wareneingangs-Nr.: A000112943-006, **Eingangsdatum:** 26.09.2014
Receipt No.: A000112943-007 *Date of Receipt:*

Zustand des Prüfgegenstandes bei Anlieferung: Test sample(s) is/are not damaged and
Condition of test item at delivery: suitable for testing.

Prüfort: Hong Kong Productivity Council
Testing Location: HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong

Prüfgrundlage: FCC Part 15 Subpart C
Test Specification: ANSI C63.4-2003

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:

kontrolliert/ reviewed by:

20.11.2014 Hugo Wan
Senior Project Manager

20.11.2014 Sharon Li
Section Manager

Datum **Name/Stellung** **Unterschrift**
Date Name/Position Signature

Datum **Name/Stellung** **Unterschrift**
Date Name/Position 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 "Modification of product" on page 5.

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

Abbreviations: P(ass) = passed
F(ail) = 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.

Table of Content

	Page
Cover Page	1
Table of Content	2
Product information	4
Manufacturers declarations.....	4
Product function and intended use	4
Submitted documents.....	5
Modification of product.....	5
Remark.....	5
Independent Operation Modes.....	6
Related Submittal(s) Grants	6
Test Set-up and Operation Mode.....	7
Principle of Configuration Selection	7
Test Operation and Test Software	7
Special Accessories and Auxiliary Equipment	7
Countermeasures to achieve EMC Compliance.....	7
Test Methodology	8
Radiated Emission.....	8
Field Strength Calculation	8
List of Test and Measurement Instruments.....	9
Results FCC Part 15 – Subpart C	10
Subclause 15.203 – Antenna Information.....	Pass 10
Subclause 15.204 – Antenna Information.....	Pass 10
Subclause 15.207 – Disturbance Voltage on AC Mains	Pass 10
Subclause 15.247 (a)(1) – Carrier Frequency Separation	Pass 10
Subclause 15.247 (a)(1)(iii) – Number of hopping channels.....	Pass 10
Subclause 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time).....	Pass 10
Subclause 15.247 (a) – 20 dB Bandwidth	Pass 11
Subclause 15.247 (a) – Hopping Sequence.....	Pass 11
Subclause 15.247 (a) – Equal Hopping Frequency Use	Pass 11
Subclause 15.247 (a) – Receiver Input Bandwidth.....	Pass 11
Subclause 15.247 (a) – Receiver Hopping Capability	Pass 11
Subclause 15.247 (b)(1) – Peak Output Power.....	Pass 12
Subclause 15.247 (d) – Band edge compliance of conducted emissions	Pass 12
Subclause 15.205 (a) – Restricted Bands next to Band-edge	Pass 13
Subclause 15.247 (d) – Spurious Conducted Emissions.....	Pass 13
Subclause 15.247 (c) – Spurious Radiated Emissions	Pass 14

Appendix 1 – Test protocols	13 pages
Appendix 2 – Test setup	2 pages
Appendix 3 – Photo documentation	3 pages
Appendix 4 – Product documentation	59 pages
Appendix 5 – Radio Frequency Exposure.....	2 pages

Product information

Manufacturers declarations

	Transceiver
Operating frequency range	2402 - 2480 MHz
Type of modulation	GFSK; Pi/4 DQPSK; 8 DPSK / FHSS
Number of channels	79
Channel separation	1 MHz
Type of antenna	Integral antenna
Antenna gain (dBi)	0
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	No
Nominal voltage	V _{nom} : 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
Declaration of Equivalence letter

Modification of product

Change as follow:

- Antenna is changed, with same type but different in antenna gain. Antenna gain is changed from -2 to 0.
- matching circuit to antenna is changed with 3 components.

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.

Remark

--

Independent Operation Modes

The basic operation modes are:

- Radio communication link maintained with data transfer.

For further information refer to User Manual

Related Submittal(s) Grants

This is a single application for class II permissive change certification of the transmitter.

Test Set-up and Operation Mode

Principle of Configuration Selection

Emission: The 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.

- 1) The EUT was powered by the external power supply via the connecting adapter
- 2) A control software CSR BlueTest 3 was used to control the transmitting frequency, modulation and output power of the EUT.

Special Accessories and Auxiliary Equipment

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

Countermeasures to achieve EMC Compliance

- none

Test Methodology

Radiated Emission

The radiated emission measurements were performed according to the procedures in ANSI C63.4-2003.

The equipment under test (EUT) was placed at the middle of the 80 cm 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.

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
Spectrum Analyzer	Rohde & Schwarz	FSP30	100007	03 Dec 2014

Results FCC Part 15 – Subpart C

Subclause 15.203 – Antenna Information		Pass
FCC Requirement: No antenna other than that furnished by the responsible party shall be used with the device		
Results:	Permanent attached antenna	
Verdict:	Pass	

Subclause 15.204 – Antenna Information		Pass
FCC Requirement: Provide information for every antenna proposed for the use with the EUT		
Results:		
	<u>New antenna</u>	<u>Original antenna</u>
a) Antenna type:	Chip Antenna	Chip Antenna
b) Manufacturer and model no:	N.A.	N.A.
c) Gain with reference to an isotropic radiator:	0 dBi	-2 dBi
Verdict:	Pass	

Subclause 15.207 – Disturbance Voltage on AC Mains		Pass
Remark:	Please refer to test report 14026758 002 for test result.	

Subclause 15.247 (a)(1) – Carrier Frequency Separation		Pass
Remark:	Please refer to test report 14026758 002 for test result.	

Subclause 15.247 (a)(1)(iii) – Number of hopping channels		Pass
Remark:	Please refer to test report 14026758 002 for test result.	

Subclause 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time)		Pass
Remark:	Please refer to test report 14026758 002 for test result.	

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

Subclause 15.247 (b)(1) – Peak Output Power					Pass
Test Specification : FCC Public Notice DA 00-705 Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), GFSP, $\pi/4$ -DQPSK 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.					
Results: For test protocols please refer to Appendix 1, page 2-7.					
GFSK Modulation					
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-1.74	0.00	-1.74	1 / 30.0	Pass
2441	-2.41	0.00	-2.41	1 / 30.0	Pass
2480	-2.38	0.00	-2.38	1 / 30.0	Pass
$\pi/4$-DQPSK Modulation					
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-2.14	0.00	-2.14	0.125 / 21.0	Pass
2441	-2.87	0.00	-2.87	0.125 / 21.0	Pass
2480	-2.87	0.00	-2.87	0.125 / 21.0	Pass
8DPSK Modulation					
Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	-1.98	0.00	-1.98	0.125 / 21.0	Pass
2441	-2.69	0.00	-2.69	0.125 / 21.0	Pass
2480	-2.66	0.00	-2.66	0.125 / 21.0	Pass
Subclause 15.247 (d) – Band edge compliance of conducted emissions					Pass
Remark: Please refer to test report 14026758 002 for test result.					

Subclause 15.205 (a) – Restricted Bands next to Band-edge		Pass
Test Specification : FCC Public Notice DA 00-705 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 bans, as defined in 15.205 (a), must also comply with the radiated emission limits specified in 15.209(a).	
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. There is no peak found in the restricted bands. For test protocols refer to Appendix 1, page 8-11.	
Subclause 15.247 (d) – Spurious Conducted Emissions		Pass
Remark:	Please refer to test report 14026758 002 for test result.	

Subclause 15.247 (c) – Spurious Radiated Emissions		Pass
<p>Test Specification : ANSI C63.4 – 2003</p> <p>Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz), 8DPSK</p> <p>Port of testing : Enclosure</p> <p>Detector : Peak / Average*</p> <p>RBW/VBW : 100 kHz / 300 kHz for f < 1 GHz 1 MHz / 3 MHz for f > 1 GHz</p> <p>Supply voltage : 3.3 VDC</p> <p>Temperature : 23°C</p> <p>Humidity : 50%</p> <p>*Average reading using duty cycle correction factor on peak measurement:</p> <p>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> <p>Duty cycle correction factor 1 calculation for 2nd harmonics emission:</p> <p>Total on time in one pulse = 2.912 ms Number of pulse found in 100ms = 1 Duty cycle factor = 20 x log ((on time x no. of pulse) / 100ms) = -30.7 dB</p> <p>Duty cycle correction factor 2 calculation for 1.6GHz spurious:</p> <p>Total on time in 100ms = 0.3 ms Number of pulse found in 100ms = 6 x 5 = 30 Duty cycle factor = 20 x log ((on time x no. of pulse) / 100ms) = -20.9 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 section15.205(a), must also comply with the radiated emission limits specified in section 15.205(c).	
Results:	<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
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
48.000	32.0	40 / QP
1602.051	53.2	74.0 / PK
1602.051	*32.3	54.0 / AV
4803.984	67.4	74.0 / PK
4803.984	*36.7	54.0 / AV

Tx frequency 2402MHz			Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
1602.019	55.7	74.0 / PK	1602.019	*34.8	54.0 / AV
4804.048	66.0	74.0 / PK	4804.048	*35.7	54.0 / AV
Tx frequency 2441MHz			Vertical Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
48.000	32.0	40.0 / QP	1626.615	53.7	74.0 / PK
1626.615	53.7	74.0 / PK	1626.615	*32.8	54.0 / AV
4882.000	68.7	74.0 / PK	4882.000	*38.0	54.0 / AV
Tx frequency 2441MHz			Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
1626.636	56.1	74.0 / PK	1626.636	*35.2	54.0 / AV
4882.112	64.8	74.0 / PK	4882.112	*34.0	54.0 / AV
Tx frequency 2480MHz			Vertical Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
48.000	31.8	40.0 / QP	1652.660	50.7	74.0 / PK
1652.660	50.7	74.0 / PK	1652.660	*29.8	54.0 / AV
4960.048	69.5	74.0 / PK	4960.048	*38.7	54.0 / AV
Tx frequency 2480MHz			Horizontal Polarization		
Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m	Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
1652.596	54.6	74.0 / PK	1652.628	*33.7	54.0 / AV
4959.904	66.1	74.0 / PK	4959.904	*35.4	54.0 / AV

* Duty cycle correction factor applied