Bluetooth RF/RF-PHY Test Report

REPORT NO.: AKZS-WDG-P21123161-1

MODEL NO.: P2

RECEIVED: 2021/12/17

TESTED: 2022/02/26

ISSUED: 2022/05/13

APPLICANT: Particle Industries,Inc

ADDRESS: 325 9th Street, San Francisco, CA 94103 United States

ISSUED BY: Bureau Veritas Shenzhen Co., Ltd., Dongguan Branch

LAB ADDRESS: No. 96, Guantai Road (Houjie Section) Houjie Town, Dongguan City Guangdong Province, 523942, People's Republic of China

This report should not be used by the client to claim product certification, approval, or endorsement by A2LA or any government agencies.

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
AKZS-WDG-P21123161-1	Original release	2022/05/13

1 CERTIFICATION INFO

Applicant:	Particle Industries,Inc
Product Name:	Wi-Fi Module
Brand:	particle
Product Model:	P2
Series Models:	N/A
Product Specification	5.3
HW version:	1.0
SW version:	1.0
TCRL Version:	TCRL 2021-2
Product Type:	Unique Products
Product Description:	Wi-Fi and Bluetooth LE IoT module
Specification(s):	RF-PHY.TS.p17

The above equipment has been tested by **Bureau Veritas Shenzhen Co., Ltd., Dongguan Branch** and found compliance with the requirement of the above test standards.

PREPARED BY : _Cheng Zhong_   **DATE:**   2022/04/12
Cheng Zhong/Engineer

APPROVED BY : _Joany Peng_   **DATE:**   2022/05/13
Joany Peng/Manager

2   SUMMARY OF TEST RESULTS

The DUT has been tested according to the following specifications:

TEST SECTIONS	SUMMARY OF RESULT			
Specifications	PASS	FAIL	NA	NT
RF	0	0	26	0
RF-PHY	19	0	28	0

Tested by: Cheng Zhong

Note: External and internal antennas have been tested

2.1   ABBREVIATIONS IN THIS REPORT:

Pass: for test cases whose requirements where fulfilled.

Fail: for test case whose requirements where NOT fulfilled.

NA: for test cases not applicable for testing.

NT: for test cases not tested

LE: Low Energy

BR: Basic Rate

DUT: Design under test

PICS: Protocol Implementation Conformance Statement

PIXIT: Protocol Implementation Extra Information for Testing

2.2 TESTING EQUIPMENTS

InterLab BT RF Test Suite is a radio conformance test platform developed by 7Layers and qualified by the Bluetooth SIG for certification. This platform covers the official test cases for Core Test Requirement including Bluetooth (BR/EDR) and (LE 1M/2M/CODED PHY/SMI) .The relative instrumentations used to perform the RF and RF-PHY Test Cases are listed below:

RF Test Platform Version	InterLab RF Test Suite v5.4.1

Equipment	Model. No.	Serial No.	Calibration Until
Wireless Connection Tester	CMW270	100616	2023/01/16
Spectrum Analyzer	FSL3	104733	2022/08/18
Power Sensor	NRP-Z21	104968	2022/08/18
Power Supply	HMP2020	101295	2022/08/17
Vector Signal Generator	SMBV100A	261673	2022/08/18
Signal Generator	SMF100A	104984	2022/08/18

2.3 MEASUREMENT UNCERTAINTY

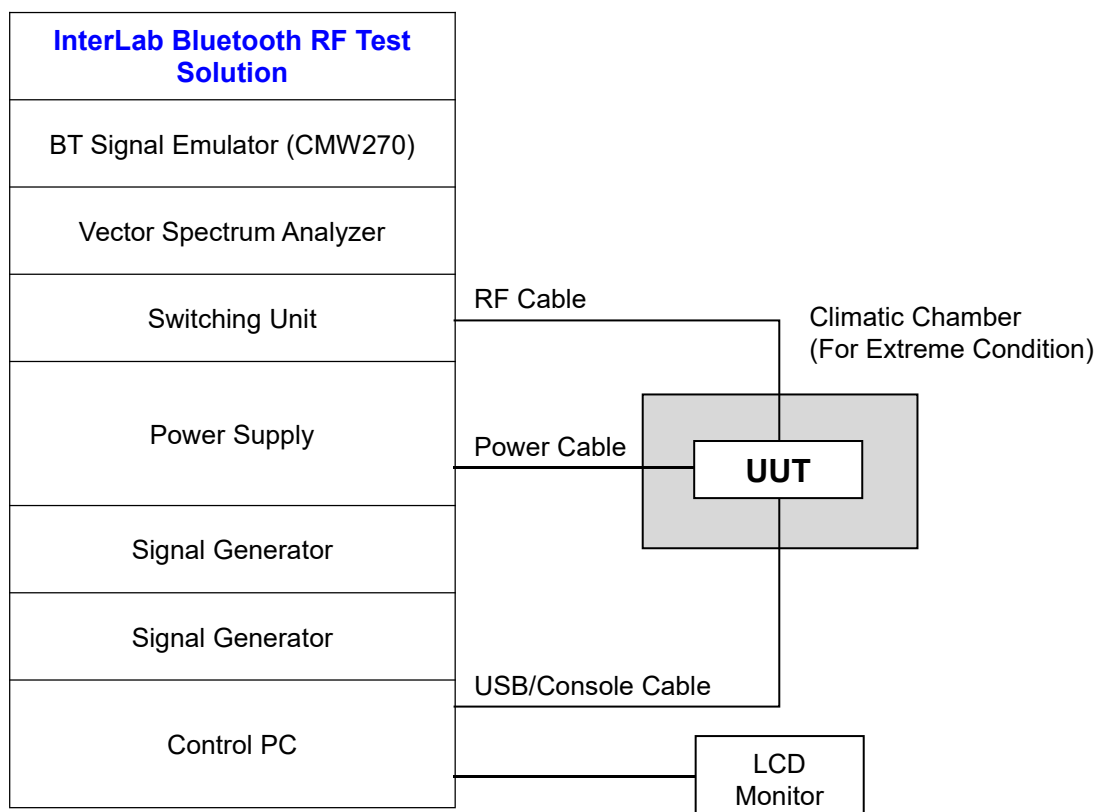Uncertainty (factor k=2) was calculated according to the 7Layers InterLab BT RF Test Suite uncertainty document.

Testcase	Measurement	Specification	InterLab Bluetooth RF Test Solution
TRM/CA/01/C: Output Power	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/02/C: Power Density	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/03/C: Power Control	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/04/C: TX Output Spectrum - Frequency range	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/05/C: TX Output Spectrum - 20 dB Bandwidth	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/06/C: TX Output Spectrum - Adjacent channel power	Absolute RF power (for unwanted emissions in the BT band):	± 3 dB	± 0.87 dB
	Absolute RF power (wanted channel):	± 1.2 dB	± 0.87 dB
TRM/CA/07/C: Modulation Characteristics	Freq dev uncertainty in payload (GFSK)	± 4 kHz	±4kHz
	Freq drift uncertainty (GFSK)	± 1 kHz	±1kHz
	Absolute radio frequency	± 5 kHz	±5kHz
TRM/CA/08/C: Initial Carrier Frequency Tolerance	Freq dev uncertainty in payload (GFSK)	± 4 kHz	±4kHz
	Freq drift uncertainty (GFSK)	± 1 kHz	±1kHz
	Absolute radio frequency	± 5 kHz	±5kHz
TRM/CA/09/C: Carrier Frequency Drift	Freq dev uncertainty in payload (GFSK)	± 4 kHz	±4kHz
	Freq drift uncertainty (GFSK)	± 1 kHz	±1kHz
	Absolute radio frequency	± 5 kHz	±5kHz
TRM/CA/10/C: EDR Relative Transmit Power	Relative RF power:	± 1 dB	± 0.50 dB
TRM/CA/11/C: EDR Carrier Frequency Stability and Modulation Accuracy	Absolute radio frequency:	± 5 kHz	±5kHz
	RMS DEVM	<5%	3%
	Relative drift radio frequency:	± 1 kHz	±1kHz
TRM/CA/12/C: EDR Differential Phase Encoding	Symbol Error	± 1ppm	±1ppm
	Frequency Accuracy	± 1ppm	<0.5us or +-1ppm
TRM/CA/13/C:EDR In-band Spurious Emissions	Absolute RF power (for unwanted emissions in the BT band):	± 3 dB	± 0.87 dB
	Absolute RF power (wanted channel):	± 1.2 dB	± 0.87 dB
TRM/CA/14/C: EDR Enhanced Power Control	Absolute RF power:	± 1.2 dB	± 0.87 dB
RCV/CA/01/C: Sensitivity - single slot packets	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV/CA/02/C: Sensitivity - multi slot packets	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV/CA/03/C: C/I Performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.88 dB
	Absolute RF power (for interfering signal):	± 3 dB	± 1.13 dB
RCV/CA/04/C: Blocking Performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.88 dB
	Absolute RF power (for 1st interfering signal):	± 3 dB	± 1.13 dB
	Absolute RF power (2nd interfering signal):	± 3 dB	± 1.56 dB
RCV/CA/05/C: Intermodulation Performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.88 dB

Testcase	Measurement	Specification	InterLab Bluetooth RF Test Solution
	Absolute RF power (for 1st interfering signal):	± 3 dB	± 1.13 dB
	Absolute RF power (for 2nd interfering signal):	± 3 dB	± 1.22 dB
RCV/CA/06/C: Maximum Input Level	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV/CA/07/C: EDR Sensitivity	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV/CA/08/C: EDR BER Floor Performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV/CA/09/C: EDR C/I Performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.88 dB
	Absolute RF power (for interfering signal):	± 3 dB	± 1.13 dB
RCV/CA/10/C: EDR Maximum Input Level	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
TP/PHYS/TRX/BV-06-E (EDR Guard Time)	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
	Symbol timing Error	±1.5µs	±0.125µs.
	Symbol Rate	1ppm	±1ppm
TP/PHYS/TRX/BV-07-E (EDR Synchronization Sequence and Trailer)	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
	Symbol timing Error	±1.5µs	±0.125µs.
	Symbol Rate	1ppm	±1ppm
TRM-LE/CA/01/C: Output Power at NOC	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM-LE/CA/02/C: Output Power at EOC	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM-LE/CA/03/C:In-band Spurious Emissions at NOC	Absolute RF power (for unwanted emissions in the BT band):	± 3 dB	± 0.87 dB
	Absolute RF power (wanted channel):	± 1.2 dB	± 0.87 dB
TRM-LE/CA/04/C:In-band Spurious Emissions at EOC	Absolute RF power (for unwanted emissions in the BT band):	± 3 dB	± 0.87 dB
	Absolute RF power (wanted channel):	± 1.2 dB	± 0.87 dB
TRM-LE/CA/05/C: Modulation Characteristics	Freq dev uncertainty in payload (GFSK)	± 4 kHz	±4kHz
	Freq drift uncertainty (GFSK)	± 1 kHz	±1kHz
	Absolute radio frequency	± 5 kHz	±5kHz
TRM-LE/CA/06/C: Carrier Frequency offset and drift at NOC	Freq dev uncertainty in payload (GFSK)	± 4 kHz	±4kHz
	Freq drift uncertainty (GFSK)	± 1 kHz	±1kHz
	Absolute radio frequency	± 5 kHz	±5kHz
TRM-LE/CA/07/C: Carrier Frequency offset and drift at EOC	Freq dev uncertainty in payload (GFSK)	± 4 kHz	±4kHz
	Freq drift uncertainty (GFSK)	± 1 kHz	±1kHz
	Absolute radio frequency	± 5 kHz	±5kHz
RCV-LE/CA/01/C: Receiver sensitivity at NOC	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV-LE/CA/02/C: Receiver sensitivity at EOC	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV-LE/CA/03/C: C/I and receiver selectivity performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB

Testcase	Measurement	Specification	InterLab Bluetooth RF Test Solution
	Absolute RF power (for interfering signal):	± 3 dB	± 1.13 dB
RCV-LE/CA/04/C: Blocking performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
	Absolute RF power (for 1st interfering signal):	± 3 dB	± 1.13 dB
	Absolute RF power (2nd interfering signal):	± 3 dB	± 1.56 dB
RCV-LE/CA/05/C: Intermodulation performance	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
	Absolute RF power (for 1st interfering signal):	± 3 dB	± 1.13 dB
	Absolute RF power (for 2nd interfering signal):	± 3 dB	± 1.22 dB
RCV-LE/CA/06/C: Maximum input signal level	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB
RCV-LE/CA/07/C: PER report integrity	Absolute RF power (wanted channel):	± 1.2 dB	± 0.69 dB

2.4 CONFIGURATION OF DEVICE UNDER TEST

RF/RF-PHY Testing Configuration:

InterLab Bluetooth RF Test Solution
BT Signal Emulator (CMW270)
Vector Spectrum Analyzer
Switching Unit
Power Supply
Signal Generator
Signal Generator
Control PC

RF Cable

Climatic Chamber (For Extreme Condition)

Power Cable

UUT

USB/Console Cable

LCD Monitor

2.5 COMPETENCE AND GUARANTEES

Bureau Veritas is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, Bureau Veritas has a calibration and maintenance program for its measurement equipment.

Bureau Veritas guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at Bureau Veritas at the time of performance of the test.

Bureau Veritas is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

3   GENERAL CONDITIONS

1. This report is only referred to the item/s that has/have undergone the test/s.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of Bureau Veritas.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of Bureau Veritas and the Accreditation Bodies

4 USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS

4.1 USAGE OF SAMPLES

Sample(s) below is composed of the following elements:

Item	Control No.	Description	Model	Date of reception
WDG211202/022Q02N01	AKZS-WDG-P21123161-1	RF-PHY Sample	P2	2021/12/17

Sample(s) has undergone the following test(s): As specified in section 6.2.

4.2 TESTING PERIOD

The performed test started on 2021/12/17 and finished on 2022/02/26.

The tests have been performed at Bureau Veritas.

4.3 TEST ENVIRONMENT

General environmental conditions during tests:

Temperature	Min. = 20ºC Max. = 30ºC
Humidity	Min. = 50% Max. = 60%

Extreme environmental conditions not exceeded during tests:

Temperature	Min. = 0ºC Max. = 50ºC
Humidity	Min. = 0% Max. = 75%

5 DUT CONFORMANCE STATUS

5.1 DYNAMIC CONFORMANCE SUMMARY

The test campaign did NOT reveal any errors on the DUT.

6 TEST RESULTS

6.1 DEFINITION

Abbreviations used in the header row of the test campaign report tables are:

Test Case: This Field contains Test Case ID, Test Case Name, and Test Case Category. Test Conditions are defined in NOC (Normal Operation Condition) and EOC (Extreme Operation Condition) for High, Normal and Low Temperature and Voltage conditions defined by manufacture in IXIT.

Test Case Verdict: Records the verdict of each test case run to completion.

Test Execution Date: The execution Date for the test case

6.2   TEST RESULTS

6.2.1   EXTERNAL ANTENNA

RF Test Program Version	InterLab RF Test Suite v5.4.1				
Test Specification	RF.TS.p32				
Tested By	Cheng Zhong				
Test Case ID	Condition	Date	Results	Sample ID
RF/TRM/CA/BV-01-C	Output Power	NA	NA	NA
RF/TRM/CA/BV-02-C	Power Density	NA	NA	NA
RF/TRM/CA/BV-03-C	Power Control	NA	NA	NA
RF/TRM/CA/BV-04-C	TX Output Spectrum - Frequency range	NA	NA	NA
RF/TRM/CA/BV-05-C	TX Output Spectrum - 20 dB Bandwidth	NA	NA	NA
RF/TRM/CA/BV-06-C	TX Output Spectrum - Adjacent channel power	NA	NA	NA
RF/TRM/CA/BV-07-C	Modulation Characteristics	NA	NA	NA
RF/TRM/CA/BV-08-C	Initial Carrier Frequency Tolerance	NA	NA	NA
RF/TRM/CA/BV-09-C	Carrier Frequency Drift	NA	NA	NA
RF/TRM/CA/BV-10-C	EDR Relative Transmit Power	NA	NA	NA
RF/TRM/CA/BV-11-C	EDR Carrier Frequency Stability and Modulation Accuracy	NA	NA	NA

RF/TRM/CA/BV-12-C	EDR Differential Phase Encoding	NA	NA	NA
RF/TRM/CA/BV-13-C	EDR In-band Spurious Emissions	NA	NA	NA
RF/TRM/CA/BV-14-C	Enhanced Power Control	NA	NA	NA
RF/TRM/CA/BV-15-C	EDR Guard Time	NA	NA	NA
RF/TRM/CA/BV-16-C	EDR Synchronization Sequence and Trailer	NA	NA	NA
RF/RCV/CA/BV-01-C	Sensitivity - single slot packets	NA	NA	NA
RF/RCV/CA/BV-02-C	Sensitivity - multi-slot packets	NA	NA	NA
RF/RCV/CA/BV-03-C	C/I performance	NA	NA	NA
RF/RCV/CA/BV-04-C	Blocking performance	NA	NA	NA
RF/RCV/CA/BV-05-C	Intermodulation Performance	NA	NA	NA
RF/RCV/CA/BV-06-C	Maximum Input Level	NA	NA	NA
RF/RCV/CA/BV-07-C	EDR Sensitivity	NA	NA	NA
RF/RCV/CA/BV-08-C	EDR BER Floor Performance	NA	NA	NA
RF/RCV/CA/BV-09-C	EDR C/I Performance	NA	NA	NA
RF/RCV/CA/BV-10-C	EDR Maximum Input Level	NA	NA	NA

RF Test Program Version	InterLab RF Test Suite v5.4.1
Test Specification	RF-PHY.TS.p17
Tested By	Cheng Zhong

Test Case ID	Condition	Date	Results	Sample ID
RFPHY/TRM/BV-01-C	Output power, -20 dBm ≤ PAVG ≤ +10 dBm	2022.2.25	Pass	WDG211202/022Q02N01
RFPHY/TRM/BV-03-C	In-band emissions	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/TRM/BV-05-C	Modulation characteristics	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/TRM/BV-06-C	Carrier frequency offset and drift	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/TRM/BV-08-C	In-band emissions at 2 Ms/s	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/TRM/BV-09-C	Stable Modulation Characteristics at 1 Ms/s	NA	NA	NA
RFPHY/TRM/BV-10-C	Modulation Characteristics at 2 Ms/s	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/TRM/BV-11-C	Stable Modulation Characteristics at 2 Ms/s	NA	NA	NA
RFPHY/TRM/BV-12-C	Carrier frequency offset and drift at 2 Ms/s	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/TRM/BV-13-C	Modulation Characteristics, LE Coded (S=8)	NA	NA	NA
RFPHY/TRM/BV-14-C	Carrier frequency offset and drift, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-01-C	Receiver sensitivity	2022.2.22	Pass	WDG211202/022Q02N01

RFPHY/RCV/BV-03-C	C/I and receiver selectivity performance	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-04-C	Blocking performance	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-05-C	Intermodulation performance	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-06-C	Maximum input signal level	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-07-C	PER Report Integrity	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-08-C	Receiver sensitivity at 2 Ms/s	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-09-C	C/I and Receiver Selectivity Performance at 2 Ms/s	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-10-C	Blocking performance at 2 Ms/s	2022.2.23	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-11-C	Intermodulation performance at 2 Ms/s	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-12-C	Maximum input signal level at 2 Ms/s	2022.2.22	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-13-C	PER Report Integrity at 2 Ms/s	2022.2.26	Pass	WDG211202/022Q02N01
RFPHY/RCV/BV-14-C	Receiver Sensitivity at NOC, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-15-C	C/I and Receiver Selectivity Performance, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-16-C	Blocking Performance, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-17-C	Intermodulation Performance, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-18-C	Maximum input signal level, Stable Modulation Index	NA	NA	NA

RFPHY/RCV/BV-19-C	PER Report Integrity, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-20-C	Receiver sensitivity at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-21-C	C/I and Receiver Selectivity Performance at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-22-C	Blocking performance at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-23-C	Intermodulation performance at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-24-C	Maximum input signal level at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-25-C	PER Report Integrity at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-26-C	Receiver sensitivity, LE Coded (S=2)	NA	NA	NA
RFPHY/RCV/BV-27-C	Receiver sensitivity, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-28-C	C/I and Receiver Selectivity Performance, LE Coded (S=2)	NA	NA	NA
RFPHY/RCV/BV-29-C	C/I and Receiver Selectivity Performance, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-30-C	PER Report Integrity, LE Coded (S=2)	NA	NA	NA
RFPHY/RCV/BV-31-C	PER Report Integrity, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-32-C	Receiver sensitivity, LE Coded (S=2), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-33-C	Receiver sensitivity, LE Coded (S=8), Stable Modulation Index	NA	NA	NA

Test Case ID	Condition	Date	Results	Sample ID
RFPHY/RCV/BV-34-C	C/I and Receiver Selectivity Performance, LE Coded (S=2), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-35-C	C/I and Receiver Selectivity Performance, LE Coded (S=8), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-36-C	PER Report Integrity, LE Coded (S=2), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-37-C	PER Report Integrity, LE Coded (S=8), Stable Modulation Index	NA	NA	NA

6.2.2   INTERNAL ANTENNA

RF Test Program Version	InterLab RF Test Suite v5.4.1			
Test Specification	RF.TS.p32			
Tested By	Cheng Zhong			
Test Case ID	**Condition**	**Date**	**Results**	**Sample ID**
RF/TRM/CA/BV-01-C	Output Power	NA	NA	NA
RF/TRM/CA/BV-02-C	Power Density	NA	NA	NA
RF/TRM/CA/BV-03-C	Power Control	NA	NA	NA
RF/TRM/CA/BV-04-C	TX Output Spectrum - Frequency range	NA	NA	NA
RF/TRM/CA/BV-05-C	TX Output Spectrum - 20 dB Bandwidth	NA	NA	NA
RF/TRM/CA/BV-06-C	TX Output Spectrum - Adjacent channel power	NA	NA	NA
RF/TRM/CA/BV-07-C	Modulation Characteristics	NA	NA	NA

RF/TRM/CA/BV-08-C	Initial Carrier Frequency Tolerance	NA	NA	NA
RF/TRM/CA/BV-09-C	Carrier Frequency Drift	NA	NA	NA
RF/TRM/CA/BV-10-C	EDR Relative Transmit Power	NA	NA	NA
RF/TRM/CA/BV-11-C	EDR Carrier Frequency Stability and Modulation Accuracy	NA	NA	NA
RF/TRM/CA/BV-12-C	EDR Differential Phase Encoding	NA	NA	NA
RF/TRM/CA/BV-13-C	EDR In-band Spurious Emissions	NA	NA	NA
RF/TRM/CA/BV-14-C	Enhanced Power Control	NA	NA	NA
RF/TRM/CA/BV-15-C	EDR Guard Time	NA	NA	NA
RF/TRM/CA/BV-16-C	EDR Synchronization Sequence and Trailer	NA	NA	NA
RF/RCV/CA/BV-01-C	Sensitivity - single slot packets	NA	NA	NA
RF/RCV/CA/BV-02-C	Sensitivity - multi-slot packets	NA	NA	NA
RF/RCV/CA/BV-03-C	C/I performance	NA	NA	NA
RF/RCV/CA/BV-04-C	Blocking performance	NA	NA	NA
RF/RCV/CA/BV-05-C	Intermodulation Performance	NA	NA	NA
RF/RCV/CA/BV-06-C	Maximum Input Level	NA	NA	NA

Test Case ID	Condition	Date	Results	Sample ID
RF/RCV/CA/BV-07-C	EDR Sensitivity	NA	NA	NA
RF/RCV/CA/BV-08-C	EDR BER Floor Performance	NA	NA	NA
RF/RCV/CA/BV-09-C	EDR C/I Performance	NA	NA	NA
RF/RCV/CA/BV-10-C	EDR Maximum Input Level	NA	NA	NA

RF Test Program Version	InterLab RF Test Suite v5.4.1			
Test Specification	RF-PHY.TS.p17			
Tested By	Cheng Zhong			
Test Case ID	**Condition**	**Date**	**Results**	**Sample ID**
RFPHY/TRM/BV-01-C	Output power, -20 dBm $\leqslant$ PAVG $\leqslant$ +10 dBm	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/TRM/BV-03-C	In-band emissions	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/TRM/BV-05-C	Modulation characteristics	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/TRM/BV-06-C	Carrier frequency offset and drift	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/TRM/BV-08-C	In-band emissions at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/TRM/BV-09-C	Stable Modulation Characteristics at 1 Ms/s	NA	NA	NA
RFPHY/TRM/BV-10-C	Modulation Characteristics at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01

RFPHY/TRM/BV-11-C	Stable Modulation Characteristics at 2 Ms/s	NA	NA	NA
RFPHY/TRM/BV-12-C	Carrier frequency offset and drift at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/TRM/BV-13-C	Modulation Characteristics, LE Coded (S=8)	NA	NA	NA
RFPHY/TRM/BV-14-C	Carrier frequency offset and drift, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-01-C	Receiver sensitivity	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-03-C	C/I and receiver selectivity performance	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-04-C	Blocking performance	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-05-C	Intermodulation performance	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-06-C	Maximum input signal level	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-07-C	PER Report Integrity	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-08-C	Receiver sensitivity at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-09-C	C/I and Receiver Selectivity Performance at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-10-C	Blocking performance at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-11-C	Intermodulation performance at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-12-C	Maximum input signal level at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01
RFPHY/RCV/BV-13-C	PER Report Integrity at 2 Ms/s	2022.2.26	Pass	WDG211202/ 022Q02N01

RFPHY/RCV/BV-14-C	Receiver Sensitivity at NOC, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-15-C	C/I and Receiver Selectivity Performance, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-16-C	Blocking Performance, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-17-C	Intermodulation Performance, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-18-C	Maximum input signal level, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-19-C	PER Report Integrity, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-20-C	Receiver sensitivity at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-21-C	C/I and Receiver Selectivity Performance at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-22-C	Blocking performance at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-23-C	Intermodulation performance at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-24-C	Maximum input signal level at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-25-C	PER Report Integrity at 2 Ms/s, Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-26-C	Receiver sensitivity, LE Coded (S=2)	NA	NA	NA
RFPHY/RCV/BV-27-C	Receiver sensitivity, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-28-C	C/I and Receiver Selectivity Performance, LE Coded (S=2)	NA	NA	NA

RFPHY/RCV/BV-29-C	C/I and Receiver Selectivity Performance, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-30-C	PER Report Integrity, LE Coded (S=2)	NA	NA	NA
RFPHY/RCV/BV-31-C	PER Report Integrity, LE Coded (S=8)	NA	NA	NA
RFPHY/RCV/BV-32-C	Receiver sensitivity, LE Coded (S=2), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-33-C	Receiver sensitivity, LE Coded (S=8), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-34-C	C/I and Receiver Selectivity Performance, LE Coded (S=2), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-35-C	C/I and Receiver Selectivity Performance, LE Coded (S=8), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-36-C	PER Report Integrity, LE Coded (S=2), Stable Modulation Index	NA	NA	NA
RFPHY/RCV/BV-37-C	PER Report Integrity, LE Coded (S=8), Stable Modulation Index	NA	NA	NA

6.3 REMARKS AND COMMENTS

There are no remarks or comments.

7 SUMMARY

Considering the results of the performed test, stated in section 6.2, the item/s under test is/are IN COMPLIANCE with the specifications listed in section 1 "CERTIFICATION INFO".

NOTE: The results presented in this Test Report apply only to the particular item under test established in section 4, "USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS"

8   INFORMATION ON THE TESTING LABORATORIES

We, **Bureau Veritas Shenzhen Co., Ltd., Dongguan Branch** were founded in 2010 to provide our best service in EMC, RF, Safety, GCF/PTCRB, OTA, Wi-Fi, WiMAX and Energy Efficiency. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

ANNEX A – PICS/PIXIT
IMPLEMENTATION CONFORMANCE
STATEMENT (ICS) for RF

Item	Bluetooth RF Capability	Status	Supported
1	Power Class 1	C.5	☐
2	Power Class 2	C.5	☐
3	Power Class 3	C.5	☐
4	Power Control	C.1	☐
5	1-slot packets supported	M	☐
6	3-slot packets supported	O	☐
7	5-slot packets supported	O	☐
8	79 Channels	M	☐
9	Support for GFSK modulation	M	☐
10	Support for p/4-DQPSK modulation	C.2	☐
11	Support for 8DPSK modulation	C.3	☐
12	Enhanced Power Control	C.4	☐

C.1: Mandatory to support IF 1/1 (Power Class 1) is supported, ELSE Optional to support IF 1/2 (Power Class 2) OR 1/3 (Power Class 3) is supported.

C.2: Mandatory IF SUM_ICS 21/4 (Core Specification 2.0+EDR) OR SUM_ICS 21/6 (Core Specification 2.1+EDR) OR (SUM_ICS 21/8 (Core Specification 3.0) or later AND (SUM_ICS 22/1 (EDR for asynchronous transports (single slot)) OR SUM_ICS 22/2 (EDR for asynchronous transports (multi-slot)) OR SUM_ICS 22/3 (EDR for synchronous transports) OR SUM_ICS 22/4 (EDR for synchronous transports (CSA 1 and 3.0 or later)))) is claimed; ELSE Excluded.

C.3: Mandatory IF SUM_ICS 21/4 (Core Specification 2.0+EDR) OR SUM_ICS 21/6 (Core Specification 2.1+EDR) OR (SUM_ICS 21/8 (Core Specification 3.0) or later AND (SUM_ICS 22/1 (EDR for asynchronous transports (single slot)) OR SUM_ICS 22/2 (EDR for asynchronous transports (multi-slot)) OR SUM_ICS 22/3 (EDR for synchronous transports))) is claimed; ELSE Excluded.

C.4: Optional IF SUM_ICS, 21/8 (Core Specification 3.0) or later AND 1/4 (Power Control) supported, ELSE Excluded.

C.5: Must choose one and only one power class

IMPLEMENTATION CONFORMANCE STATEMENT (ICS) for RF-PHY

Item	Bluetooth LE RF Capability	Status	Supported
1	LE Transmitter (Non-connectable, Broadcaster)	C.1	☒
2	LE Receiver (Non-connectable, Observer)	C.1	☒
3	LE Transceiver (Connectable, Peripheral/Central)	C.1	☒
4	LE 2M PHY	C.2	☒
5	Stable Modulation Index - Transmitter	C.3	☐
6	Stable Modulation Index - Receiver	C.4	☐
7	LE Coded PHY	C.2	☐
8	Transmitting Constant Tone Extensions	C.3	☐
9	2 µs Antenna Switching During Constant Tone Extension Transmission (AoD)	C.5	☐
10	1 µs Antenna Switching During Constant Tone Extension Transmission (AoD)	C.6	☐
11	2 µs Antenna Sampling During Constant Tone Extension Reception (AoD)	C.4	☐
12	2 µs Antenna Switching and Sampling During Constant Tone Extension Reception (AoA)	C.7	☐
13	1 µs Antenna Sampling During Constant Tone Extension Reception (AoD)	C.7	☐
14	1µs Antenna Switching and Sampling During Constant Tone Extension Reception (AoA)	C.8	☐
15	Power Class 1	C.9	☐

C.1: Mandatory to support at least one of these capabilities.

C.2: Optional IF SUM ICS 21/16 "Core 5.0" AND RF PHY 1/3 "LE Transceiver" are supported, otherwise Excluded.

C.3: Optional IF SUM ICS 21/16 "Core 5.0" AND (RF PHY 1/1 "LE Transmitter" OR RF PHY 1/3 "LE Transceiver") are supported, otherwise Excluded.

C.4: Optional IF SUM ICS 21/16 "Core 5.0" AND (RF PHY 1/2 "LE Receiver" OR RF PHY 1/3 "LE Transceiver") are supported, otherwise Excluded.

C.5: Optional IF RF PHY 1/8 "Transmitting Constant Tone Extensions" is supported, otherwise Excluded.

C.6: Optional IF 1/9 "2 µs Antenna Switching During Constant Tone Extension Transmission (AoD)" is supported, otherwise Excluded.

C.7: Optional IF RF PHY 1/11 "2 µs Antenna Sampling During Constant Tone Extension Reception (AoD)" is supported, otherwise Excluded.

C.8: Mandatory IF RF PHY 1/12 "2 µs Antenna Switching and Sampling During Constant Tone Extension Reception (AoA)" and RF/PHY 1/13 "1 µs Antenna Sampling During Constant Tone Extension Reception (AoD)" are supported, otherwise Excluded.

C.9: Excluded IF SUM ICS 21/14 "Core v4.2" is supported AND SUM ICS 21/15 "CSA 5" is not supported, otherwise Optional.

Item	Bluetooth LE RF Capability	Status	Supported
1	HCI Test Interface	C.1	☒
2	UART Test Interface	C.1	☐

C.1: Mandatory to support at least one of these capabilities.

IMPLEMENTATION EXTRA INFORMATION (IXIT) FOR RF

IXIT Reference	Description	Comment	Units (if applicable)	Value
RF:P1	Timer for TX power control	TRM/CA/03 Power Control	ms	/
RF:P2	Inband Image frequency	RCV/CA/03 C/I Performance RCV/CA/09 EDR C/I Performance	MHz	/
RF:P3	Value n for Intermodulation test	RCV/CA/05 Intermodulation Performance	Integer	/
RF:P6	Type of power source	Chapter 6.4, RF Test Specification		/
RF:P7	Nominal power source voltage	Chapter 6.4, RF Test Specification	V	/
RF:P8	Operating temperature range	Chapter 6.5, RF Test Specification	°C	/
RF:P9	Extreme power source voltage	Chapter 6.5, RF Test Specification	V	/
RF:P10	Antenna gain	Chapter 6.9, RF Test Specification	dB	/

IMPLEMENTATION EXTRA INFORMATION (IXIT) FOR RF-PHY

IXIT Reference	Identifier	Sub-Identifier (Optional)	Units (if applicable)	Value
RF-PHY:P1:1	Inband Image frequency	Low frequency	MHz	-3
RF-PHY:P1:2		Middle frequency	MHz	-3
RF-PHY:P1:3		High frequency	MHz	-3
RF-PHY:P2:1	Value n for Intermodulation test	Low frequency	Integer	5
RF-PHY:P2:2		Middle frequency	Integer	5
RF-PHY:P2:3		High frequency	Integer	5
RF-PHY:P3	Type of power source			DC
RF-PHY:P4:1	Power source voltage	Nominal (NOC)	V	3.3
RF-PHY:P5:1	Operating temperature	Nominal (NOC)	°C	25
RF-PHY:P6:1	Air humidity range (relative)	Maximum (EOC)	%	75
RF-PHY:P6:2		Minimum (EOC)	%	25
RF-PHY:P6:3		Air humidity level for NOC/EOC tests	%	50
RF-PHY:P7:1	Test interface implementation	HCI or 2-wire UART		HCI
RF-PHY:P7:2		Datarate	bps	115200
RF-PHY-PHY:P8	Antenna gain		dBi	2
RF-PHY:P9:1	Maximum TX packet length		37~255(Bytes)	255
RF-PHY:P9:2	Maximum RX packet length		37~255(Bytes)	255
RF-PHY:P9:3	Maximum TX packet length 2M		37~255(Bytes)	255
RF-PHY:P9:4	Maximum TX packet length S=2		37~255(Bytes)	/
RF-PHY:P9:5	Maximum TX packet length S=8		37~255(Bytes)	/
RF-PHY:P9:6	Maximum RX packet length 2M		37~255(Bytes)	255
RF-PHY:P9:7	Maximum RX packet length S=2		37~255(Bytes)	/
RF-PHY:P9:8	Maximum RX packet length S=8		37~255(Bytes)	/
RF-PHY:P10:1	Maximum TX mode output power		-20(dBm) to 10 (dBm) (CSA5 unsupported) -20(dBm) to 20(dBm) (CSA5 supported)	10
RF-PHY:P11:1	Inband Image Frequency (2Ms/s)	Low frequency	MHz	-3
RF-PHY:P11:2		Middle frequency	MHz	-3
RF-PHY:P11:3		High frequency	MHz	-3
RF-PHY:P12:1	Value n for	Low frequency	Integer	5

RF-PHY:P12:2	Intermodulation test (2Ms/s)length	Middle frequency	Integer	5
RF-PHY:P12:3		High frequency	Integer	5
RF-PHY:P13:1	Inband Image Frequency (Stable Modulation Receiver)	Low frequency	MHz	/
RF-PHY:P13:2		Middle frequency	MHz	/
RF-PHY:P13:3		High frequency	MHz	/
RF-PHY:P14:1	Value n for Intermodulation test (Stable Modulation Receiver)	Low frequency	Integer	/
RF-PHY:P12:2		Middle frequency	Integer	/
RF-PHY:P14:3		High frequency	Integer	/
RF-PHY:P15:1	Inband Image Frequency (Stable Modulation Receiver, 2Ms/s)	Low frequency	MHz	/
RF-PHY:P15:2		Middle frequency	MHz	/
RF-PHY:P15:3		High frequency	MHz	/
RF-PHY:P16:1	Value n for Intermodulation test (Stable Modulation Receiver, 2Ms/s)	Low frequency	Integer	/
RF-PHY:P16:2		Middle frequency	Integer	/
RF-PHY:P16:3		High frequency	Integer	/
RF-PHY:17	IQ Report Rate	0x0006 to 0xFFFF		/
RF-PHY:18	The length of the Constant Tone Extension(1Ms/s)	16 to 160	bits	/
RF-PHY:19	The length of the Constant Tone Extension(2Ms/s)	32 to 320	bits	/
RF-PHY:20	The number of antennae	$\geqslant 1$		/

ANNEX B – PHOTOGRAPHS

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