Bluetooth RF/RF-PHY Test Report

REPORT NO.: BT 200103W001
MODEL NO.: B520,B523, B524
RECEIVED: 2020/01/03
TESTED: 2020/01/07
ISSUED: 2021/07/05

APPLICANT: Particle Industries,Inc

ADDRESS: 126 Post St,4th floor, San Francisco,CA 94108 USA

ISSUED BY: BV 7Layers Communications Technology (Shenzhen) Co., Ltd.

LAB ADDRESS: No.B102, Dazu Chuangxin Mansion, North of Beihuan Avenue, North Area, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 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
BT 200103W001	Original release	2020/03/23
BT 200103W001	Add the model number for B524	2021/07/05

1 CERTIFICATION INFO

Product Name:	B SOM
Applicant:	Particle Industries,Inc
Model:	B520,B523, B524
Product Specification	5.0
HW version:	V1.00
SW version:	V1.5.0
TCRL Version:	TCRL 2019-2
Specification(s):	RF-PHY.TS.5.1.1

The above equipment has been tested by **BV 7Layers Communications Technology (Shenzhen) Co., Ltd.**, and found compliance with the requirement of the above test standards.

PREPARED BY : Alisa Zhao **DATE:** 2020/03/23

Alisa Zhao / Engineer

APPROVED BY : Andy Liu **DATE:** 2021/07/05

Andy Liu / 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-PHY	27	0	0	0

Tested by: Alisa Zhao

2.1 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 v2.0(BR/EDR) /v3.0(HS) and v4.0 (LE) .The relative instrumentations used to perform the RF and RF-PHY Test Cases are listed below:

RF Test Platform Version	InterLab RF Test Suite v5.2.2

Equipment	Model. No.	Serial No.	Calibration Until
Wireless Connection Tester	CMW270	100616	2021/02/26
Spectrum Analyzer	FSL3	104733	2020/09/08
Power Sensor	NRP-Z21	104968	2020/08/25
Power Supply	HMP2020	101295	2020/08/25
Vector Signal Generator	SMBV100A	261673	2020/08/25
Signal Generator	SMF100A	104984	2020/10/15

2.2 MEASUREMENT UNCERTAINTY

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

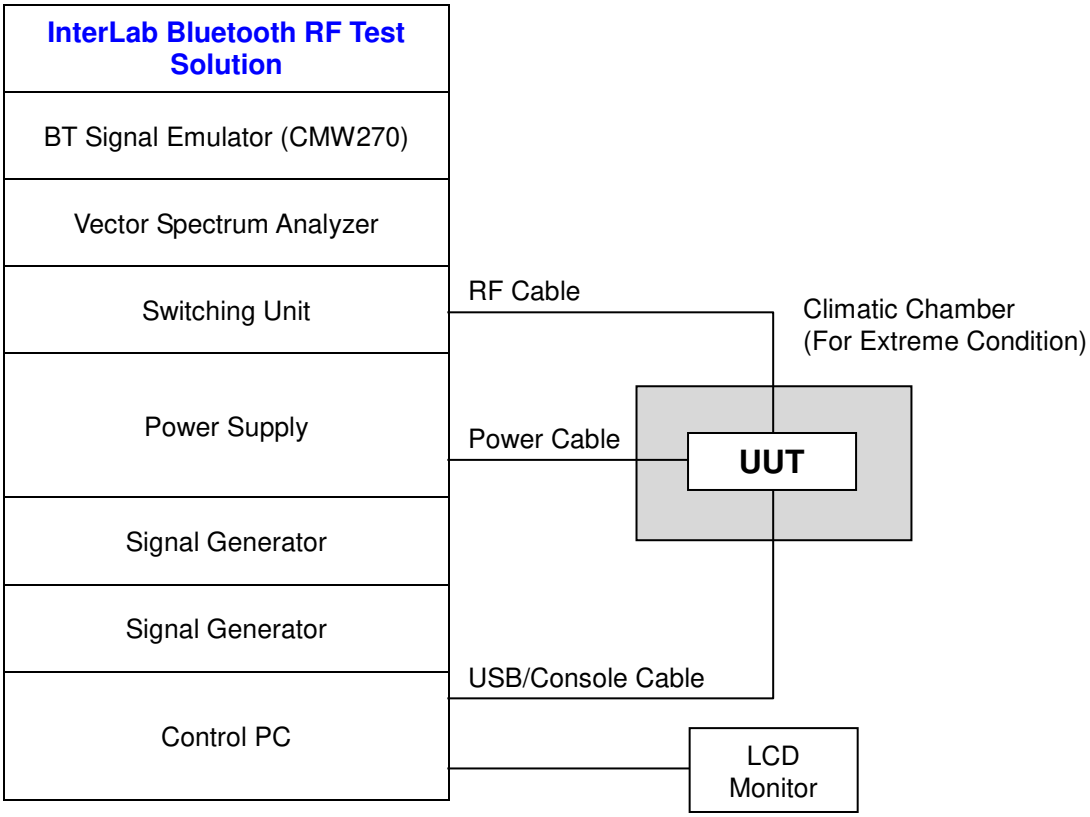
Testcase	Measurement	Specification	InterLab Bluetooth RF Test Solution
TRM/CA/01/C: Output Power	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/02/C: Power Density	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/03/C: Power Control	Absolute RF power:	± 1.2 dB	± 0.87 dB
TRM/CA/04/C: TX Output Spectrum - Frequency 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

2.3 CONFIGURATION OF DEVICE UNDER TEST

RF/RF-PHY Testing Configuration:



2.4 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 tests.
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
M01	W200103-003-001-002	RF/RF-PHY Sample	B520 , B523, B524	2020/01/03

Samples have undergone the following test(s): As specified in section 6.2.

4.2 TESTING PERIOD

The performed test started on 2020/01/06 and finished on 2020/01/07

The tests have been performed at Bureau Veritas.

4.3 ENVIRONMENT CONDITIONS

General environmental conditions during tests:

Temperature	Min. = 23ºC Max. = 28ºC
Relative humidity	Min. = 30% Max. = 50%

Extreme environmental conditions not exceeded during tests:

Temperature	Min. = -40ºC Max. = 100ºC
Relative humidity	Min. = 20% Max. = 95%

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.

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 (e.g. not required by BQC)

Test Execution Date: The execution Date for the test case

6.2 TEST RESULTS

RF Test Program Version	InterLab RF Test Suite v5.2.2
Test Specification	RF-PHY.TS.5.1.1
Tested By	Alisa Zhao

Test Case ID	Condition	Date	Results	Sample ID
TP/RCV-LE/CA/BV-01-C	Receiver sensitivity	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-03-C	C/I and receiver selectivity performance	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-04-C	Blocking performance	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-05-C	Intermodulation performance	2020/01/07	Pass	M01
TP/RCV-LE/CA/BV-06-C	Maximum input signal level	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-07-C	PER Report Integrity	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-08-C	Receiver sensitivity at 2 Ms/s	2020/01/07	Pass	M01
TP/RCV-LE/CA/BV-09-C	C/I and Receiver Selectivity Performance at 2 Ms/s	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-10-C	Blocking performance at 2 Ms/s	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-11-C	Intermodulation performance at 2 Ms/s	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-12-C	Maximum input signal level at 2 Ms/s	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-13-C	PER Report Integrity at 2 Ms/s	2020/01/06	Pass	M01

TP/RCV-LE/CA/BV-26-C	Receiver sensitivity, LE Coded (S=2)	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-27-C	Receiver sensitivity, LE Coded (S=8)	2020/01/06	Pass	M01
TP/RCV-LE/CA/BV-28-C	C/I and Receiver Selectivity Performance, LE Coded (S=2)	2020/01/07	Pass	M01
TP/RCV-LE/CA/BV-29-C	C/I and Receiver Selectivity Performance, LE Coded (S=8)	2020/01/07	Pass	M01
TP/RCV-LE/CA/BV-30-C	PER Report Integrity, LE Coded (S=2)	2020/01/07	Pass	M01
TP/RCV-LE/CA/BV-31-C	PER Report Integrity, LE Coded (S=8)	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-01-C	Output power	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-03-C	In-band emissions	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-05-C	Modulation characteristics	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-06-C	Carrier frequency offset and drift	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-08-C	In-band emissions at 2 Ms/s	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-10-C	Modulation Characteristics at 2 Ms/s	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-12-C	Carrier frequency offset and drift at 2 Ms/s	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-13-C	Modulation Characteristics, LE Coded (S=8)	2020/01/07	Pass	M01
TP/TRM-LE/CA/BV-14-C	Carrier frequency offset and drift, LE Coded (S=8)	2020/01/07	Pass	M01

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, BV 7Layers Communications Technology (Shenzhen) Co., Ltd., were founded in 1988 to provide our best service in EMC, GCF/PTCRB, OTA, and BQB. 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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Web Site: www.bureauveritas.com

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-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	☑

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.

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

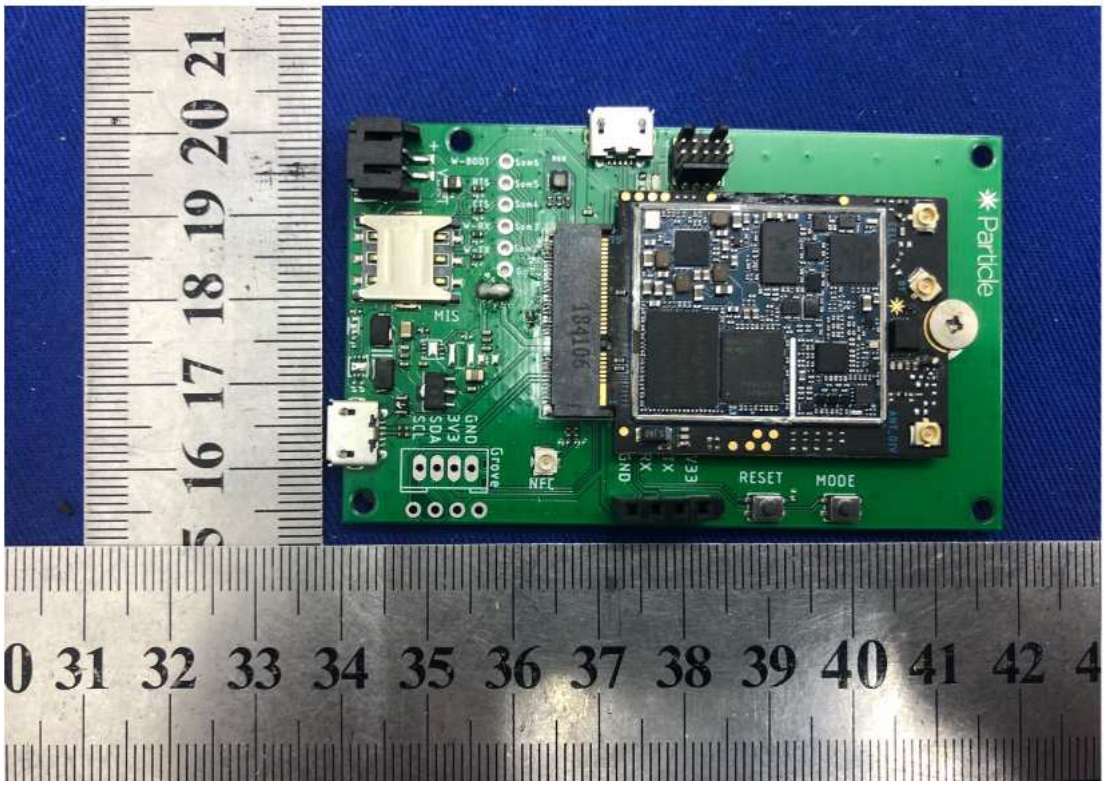
C.1: Mandatory to support at least one of these capabilities.

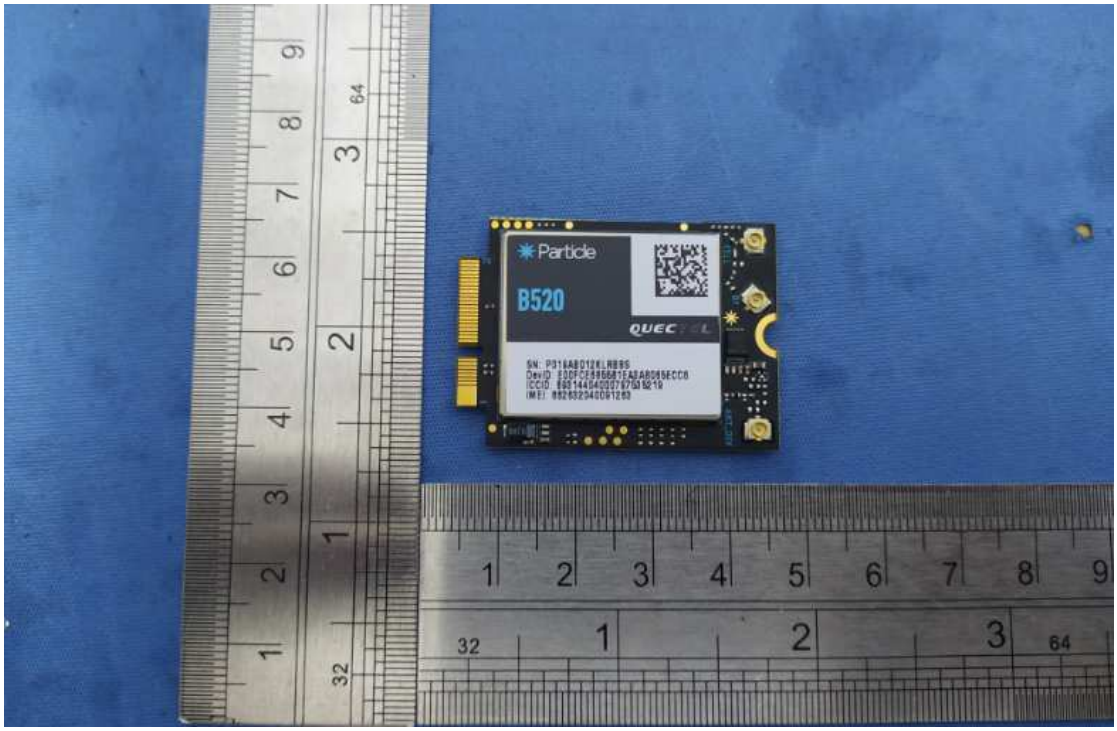
IMPLEMENTATION EXTRA INFORMATION (IXIT) FOR RF-PHY

IXIT Reference	Identifier	Sub-Identifier (Optional)	Units (if applicable)	Value
RF-PHY:P1:1	Inband Image frequency	Low frequency	MHz	4
RF-PHY:P1:2		Middle frequency	MHz	4
RF-PHY:P1:3		High frequency	MHz	4
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			/
RF-PHY:P4:1	Power source voltage	Nominal (NOC)	V	4
RF-PHY:P4:2		Maximum (EOC)	V	4.2
RF-PHY:P4:3		Minimum (EOC)	V	3.6
RF-PHY:P5:1	Operating temperature	Nominal (NOC)	°C	25
RF-PHY:P5:2		Maximum (EOC)	°C	85
RF-PHY:P5:3		Minimum (EOC)	°C	-40
RF-PHY:P6:1	Air humidity range (relative)	Maximum (EOC)	%	/
RF-PHY:P6:2		Minimum (EOC)	%	/
RF-PHY:P6:3		Air humidity level for NOC/EOC tests	%	65
RF-PHY:P7:1	Test interface implementation	HCI or 2-wire UART		2-wire UART
RF-PHY:P7:2		Datarate	bps	19200
RF-PHY-PHY:P8	Antenna gain		dBi	0
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)	255
RF-PHY:P9:5	Maximum TX packet length S=8		37~255(Bytes)	255
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)	255
RF-PHY:P9:8	Maximum RX packet length S=8		37~255(Bytes)	255
RF-PHY:P10:1	Maximum TX mode output power		-20(dBm) to 10 (dbm) (CSA5 unsupported)	/
RF-PHY:11:1	Inband Image Frequency (2Ms/s)	Low frequency	MHz	8
RF-PHY:11:2		Middle frequency	MHz	8
RF-PHY:11:3		High frequency	MHz	8
RF-PHY:12:1	Value n for	Low frequency	Integer	5

RF-PHY:12:2	Intermodulation test (2Ms/s)length	Middle frequency	Integer	5
RF-PHY:12:3		High frequency	Integer	5
RF-PHY:13:1	Inband Image Frequency (Stable Modulation Receiver)	Low frequency	MHz	/
RF-PHY:13:2		Middle frequency	MHz	/
RF-PHY:13:3		High frequency	MHz	/
RF-PHY:14:1	Value n for Intermodulation test (Stable Modulation Receiver)	Low frequency	Integer	/
RF-PHY:14:2		Middle frequency	Integer	/
RF-PHY:14:3		High frequency	Integer	/
RF-PHY:15:1	Inband Image Frequency (Stable Modulation Receiver, 2Ms/s)	Low frequency	MHz	8
RF-PHY:15:2		Middle frequency	MHz	8
RF-PHY:15:3		High frequency	MHz	8
RF-PHY:16:1	Value n for Intermodulation test (Stable Modulation Receiver, 2Ms/s)	Low frequency	Integer	5
RF-PHY:16:2		Middle frequency	Integer	5
RF-PHY:16:3		High frequency	Integer	5

ANNEX B – PHOTOGRAPHS





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