RADIO TEST REPORT

(EN 301 908-1)

Product:	Boron 2G/3G
Model Name:	BRN310, BRN314
Applicant:	Particle Industries,Inc
Address:	126 Post St, 4th floor, San Francisco, CA 94108 USA
Manufacturer:	Particle Industries,Inc
Address:	126 Post St, 4th floor, San Francisco, CA 94108 USA
Prepared by:	BV 7Layers Communications Technology (Shenzhen) Co. Ltd
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Report No.:	REP20120008-2
Received Date:	Sep. 21, 2018
Test Date:	Sep. 24, 2018 ~ Oct. 22, 2018
Issued Date:	Dec. 25, 2020

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
RE180921W002-2	Original release	Nov. 14, 2018
REP20120008-1	Based on the original report RE180921W002-1 change the product name and models, which not affect RF function. So all the test data re-use from RE180921W002-1.	Dec. 25, 2020

1 CERTIFICATION

PRODUCT:	Boron 2G/3G
BRAND NAME:	Particle Industries,Inc
MODEL NAME:	BRN310, BRN314
APPLICANT:	Particle Industries,Inc
TESTED:	Sep. 24, 2018 ~ Oct. 22, 2018
TEST SAMPLE:	Production Unit
STANDARD:	**EN 301 908-1 V11.1.1 (2016-07)**
TEST ITEM:	**RADIATED SPURIOUS EMISSIONS (Clause 4.2.2)** **CONTROL AND MONITORING FUNCTIONS (Clause 4.2.4)**

The above equipment has been tested by **BV 7Layers Communications Technology (Shenzhen) Co. Ltd** and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

PREPARED BY : Alex (Alex Chen / Engineer) **DATE :** Dec. 25, 2020

APPROVED BY : Luke Lu (Luke Lu / Manager) **DATE :** Dec. 25, 2020

2 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: EN 301 908-1 V11.1.1			
STANDARD SUBCLAUSE	**TEST TYPE AND LIMIT**	**REMARKS**	**PASS/FAIL**
CROSS REFERENCES FOR USER EQUIPMENT (UE)			
4.2.2	Radiated emissions	Applicable	Pass
4.2.4	Control and monitoring functions	N/A(see note)	Pass
CROSS REFERENCES FOR BASE STATIONS (BS) AND REPEATERS			
4.2.3	Radiated emissions	N/A(see note)	NA

Note: more detail please refer to the original report RE180921W002-2

2.1 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Signal Pre-Amplifier	EMSI	EMC 9135	980249	Jul. 09,18	Jul. 08,19
Signal Pre-Amplifier	EMSI	EMC 012645B	980257	Jul. 09,18	Jul. 08,19
3m Fully-anechoic Chamber	ETS-LINDGREN	10m*5m*5m	Euroshieldpn-CT0001143-1217	Mar. 16,18	Mar. 15,19
RS Antenna_LF	Rohde&Schwarz	R&S® HL046E	HL064E	NA	NA
Horn Antenna	ETS-LINDGREN	3117	00168692	Nov. 26,16	Nov. 25,18
EXA Signal Analyzer	KEYSIGHT	N9010A-544	MY54510523	Mar. 16,18	Mar. 15,19
Radio Communication Analyzer	ANRITSU	MT8820C	6201465426	Mar. 02,18	Mar. 01,19

NOTE:

1. The calibration interval of the above test instruments is 12 months or 24 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
2. The test was performed in 3m Fully-anechoic Chamber.
3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.

2.2 MEASUREMENT UNCERTAINTY

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated and shall correspond to an expansion factor (coverage factor) k = 1,96 (which provides a confidence level of 95 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)). Principles for the calculation of measurement uncertainty are contained in ETSI TR 100 028 [i.3], in particular in annex D of the ETSI TR 100 028-2 [i.3].

Tables 5.2-1 and 5.2-2 are based on such expansion factors.

Table 5.2-1: Maximum measurement uncertainty (UE)

Parameter	Uncertainty
Effective radiated RF power between 30 MHz and 180 MHz	±6 dB
Effective radiated RF power between 180 MHz and 12,75 GHz	±3 dB
Conducted RF power	±1 dB

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Boron 2G/3G
MODEL NAME	BRN310, BRN314
MODULATION TYPE	BPSK,QPSK
RADIO TECHNOLOGY	WCDMA / HSDPA / HSUPA
OPERATING FREQUENCY	WCDMA Band I Tx: 1922.6 ~ 1977.4MHz Rx: 2112.6 ~ 2167.4MHz WCDMA Band VIII Tx: 882.4 ~ 912.6MHz Rx: 927.4MHz ~ 957.6MHz
ANTENNA TYPE	Fixed External Antenna with 0dBi gain
HW VERSION	V1.00
SW VERSION	V1.00
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	N/A

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. The differences of BRN310 and BRN314 are as follow: BRN310 uses eSIM of Kore. BRN314 uses eSIM of Twilio.

3.2 CONDUCTED POWER

WCDMA Band I & Band VIII

Band	WCDMA I			WCDMA VIII		
Channel	9613	9750	9887	2712	2788	2863
Rx Channel	10563	10700	10837	2937	3013	3088
Frequency	1922.6	1950	1977.4	882.4	897.6	912.6
AMR	-	-	-	-	-	-
RMC 12.2K	22.44	22.32	**22.97**	22.91	22.84	**22.94**
HSDPA Subtest-1	21.54	21.42	22.07	22.01	21.94	22.04
HSDPA Subtest-2	21.38	21.26	21.91	21.85	21.78	21.88
HSDPA Subtest-3	21.08	20.96	21.61	21.55	21.48	21.58
HSDPA Subtest-4	21.02	20.90	21.55	21.49	21.42	21.52
HSUPA Subtest-1	21.49	21.37	22.02	21.96	21.89	21.99
HSUPA Subtest-2	19.42	19.30	19.95	19.89	19.82	19.92
HSUPA Subtest-3	20.39	20.27	20.92	20.86	20.79	20.89
HSUPA Subtest-4	19.53	19.41	20.06	20.00	19.93	20.03
HSUPA Subtest-5	21.59	21.47	22.12	22.06	21.99	22.09

3.3 DESCRIPTION OF TEST MODES

✧ The EUT was tested under following conditions:

BAND	OPERATING CONDITIONS	AXIS
WCDMA Band I	Linking / Idle mode at middle channel (CH 9750)	Y-Plane
WCDMA Band VIII	Linking / Idle mode at middle channel (CH 2788)	Y-Plane

NOTE:

1. Since the EUT is considered a portable unit, it was pre-tested on the positioned of each 3 axis. Only the worst case was present in this report positioned.

3.4 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

EN 301 908-1 V11.1.1 (2016-07)

All tests have been performed and recorded as per the above standard.

3.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together without any other necessary accessories or support units.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Desktop	Lenovo	M73 SFF	PC04GRQV	N/A
2	Cable	N/A	N/A	N/A	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	AC Line: Unshielded, Detachable 1.5m
2	N/A

3.6 CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photograph of the test configuration for reference.

4 TEST TYPES AND RESULTS

4.1 RADIATED SPURIOUS EMISSIONS – IN LINK MODE

4.1.1 LIMIT OF RADIATED SPURIOUS EMISSIONS – IN LINK MODE

FREQUENCY RANGE	FREQUENCIES BELOW 1GHz	FREQUENCIES ABOVE 1GHz
Limit value	250nW (–36dBm/100KHz)	1μW (–30dBm/1MHz)

4.1.2 TEST PROCEDURES

Whenever possible the test site should be a fully anechoic chamber simulating the free-space conditions. EUT shall be placed on a non-conducting support. Mean power of any spurious components shall be detected by the test antenna and measuring receiver (e.g. a spectrum analyser).

Measurements are made with a tuned dipole antenna or a reference antenna with a known gain referenced to an isotropic antenna. Unless otherwise stated, all measurements are done as mean power (RMS).

4.1.3 TEST SETUP

For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).

4.1.4 DEVIATION FROM TEST STANDARD

No deviation

4.1.5 TEST RESULTS

Note: For higher frequency, the emission is too low to be detected.

LINKING MODE AT MIDDLE CHANNEL WCDMA B1

FREQUENCY RANGE	30 ~ 12750 MHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	25deg.C,55%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Linking mode at middle channel (CH 9750)		

SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
33.88	H	-67.66	-36.00	-31.66
51.34	H	-75.28	-36.00	-39.28
173.56	H	-84.51	-36.00	-48.51
290.93	H	-80.48	-36.00	-44.48
405.39	H	-77.94	-36.00	-41.94
551.86	H	-77.05	-36.00	-41.05
3901.46	H	-54.63	-30.00	-24.63
5854.36	H	-49.95	-30.00	-19.95
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
38.73	V	-63.69	-36.00	-27.69
56.19	V	-74.49	-36.00	-38.49
107.60	V	-88.62	-36.00	-52.62
250.19	V	-77.01	-36.00	-41.01
400.54	V	-79.89	-36.00	-43.89
568.35	V	-76.55	-36.00	-40.55
3897.35	V	-52.62	-30.00	-22.62
5852.59	V	-48.41	-30.00	-18.41

LINKING MODE AT MIDDLE CHANNEL WCDMA B8

FREQUENCY RANGE	30 ~ 12750 MHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	25deg.C,55%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Linking mode at middle channel (CH 2788)		

SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
45.52	H	-72.67	-36.00	-36.67
147.37	H	-87.08	-36.00	-51.08
250.19	H	-78.63	-36.00	-42.63
454.86	H	-78.73	-36.00	-42.73
589.69	H	-76.05	-36.00	-40.05
811.82	H	-73.51	-36.00	-37.51
1796.71	H	-38.80	-30.00	-8.80
2690.59	H	-53.07	-30.00	-23.07
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
34.85	V	-65.40	-36.00	-29.40
58.13	V	-76.19	-36.00	-40.19
221.09	V	-82.26	-36.00	-46.26
410.24	V	-78.58	-36.00	-42.58
633.34	V	-76.80	-36.00	-40.80
791.45	V	-75.43	-36.00	-39.43
1792.68	V	-45.24	-30.00	-15.24
2692.89	V	-48.20	-30.00	-18.20

4.2 CONTROL AND MONITORING FUNCTIONS (UE)

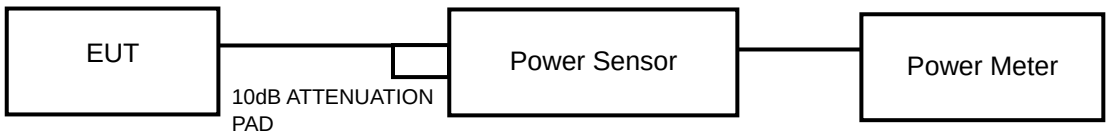
4.2.1 LIMIT OF CONTROL AND MONITORING FUNCTIONS (UE)

The maximum measured power during the duration of the test shall not exceed -30 dBm.

4.2.2 TEST PROCEDURES

At the start of the test, the UE shall be switched off. The UE antenna connector shall be connected to a power. The UE shall be switched on for a period of approximately fifteen minutes, and then switched off. The EUT shall remain switched off for a period of at least thirty seconds, and shall then be switched on for a period of approximately one minute. The maximum power emitted from the UE throughout the duration of the test shall be recorded.

4.2.3 TEST SETUP



4.2.4 DEVIATION FROM TEST STANDARD

No deviation

4.2.5 TEST RESULTS

WCDMA B1

TEST VOLTAGE	230Vac, 50Hz	ENVIRONMENTAL CONDITIONS	25deg.C, 54%RH
OPERATING CONDITIONS	Mid channel (CH 9750)	TESTED BY	Yuqiang Yin

THE MAXIMUM MEASURED POWER DURING THE DURATION OF THE TEST LEVEL			
TEST TIMES	MEASUREMENT POWER LEVEL (dBm)	LIMIT (dBm)	RESULT
1	-62.67	-30.0	PASS
2	-62.80	-30.0	PASS
3	-62.67	-30.0	PASS
4	-62.38	-30.0	PASS
5	-62.43	-30.0	PASS

WCDMA B8

TEST VOLTAGE	230Vac, 50Hz	ENVIRONMENTAL CONDITIONS	25deg.C, 54%RH
OPERATING CONDITIONS	Mid channel (CH 2788)	TESTED BY	Yuqiang Yin

THE MAXIMUM MEASURED POWER DURING THE DURATION OF THE TEST LEVEL			
TEST TIMES	MEASUREMENT POWER LEVEL (dBm)	LIMIT (dBm)	RESULT
1	-62.54	-30.0	PASS
2	-62.63	-30.0	PASS
3	-62.39	-30.0	PASS
4	-62.72	-30.0	PASS
5	-62.46	-30.0	PASS

4.3 RADIATED SPURIOUS EMISSIONS – IN IDLE MODE

4.3.1 LIMIT OF RADIATED SPURIOUS EMISSIONS – IN IDLE MODE

FREQUENCY RANGE	FREQUENCIES BELOW 1GHz	OTHER FREQUENCIES ABOVE 1GHz
Limit value	-57dBm/100KHz	-47dBm/1MHz

4.3.2 TEST PROCEDURES

Whenever possible the test site should be a fully anechoic chamber simulating the free-space conditions. EUT shall be placed on a non-conducting support. Mean power of any spurious components shall be detected by the test antenna and measuring receiver (e.g. a spectrum analyser).

Measurements are made with a tuned dipole antenna or a reference antenna with a known gain referenced to an isotropic antenna. Unless otherwise stated, all measurements are done as mean power (RMS).

4.3.3 TEST SETUP

For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration).

4.3.4 DEVIATION FROM TEST STANDARD

No deviation

4.3.5 TEST RESULTS

Note: For higher frequency, the emission is too low to be detected.

IDLE MODE AT MIDDLE CHANNEL WCDMA B1

FREQUENCY RANGE	30 ~ 12750 MHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	25deg.C,55%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Idle mode at middle channel (CH 9750)		

SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
36.79	H	-66.05	-57.00	-9.05
58.13	H	-79.65	-57.00	-22.65
200.72	H	-84.85	-57.00	-27.85
333.61	H	-80.12	-57.00	-23.12
498.51	H	-76.82	-57.00	-19.82
722.58	H	-77.41	-57.00	-20.41
2723.07	H	-56.22	-47.00	-9.22
4278.97	H	-52.96	-47.00	-5.96
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
32.91	V	-66.11	-57.00	-9.11
56.19	V	-74.28	-57.00	-17.28
221.09	V	-81.96	-57.00	-24.96
314.21	V	-80.22	-57.00	-23.22
478.14	V	-77.59	-57.00	-20.59
630.43	V	-77.18	-57.00	-20.18
2093.30	V	-58.33	-47.00	-11.33
4464.20	V	-52.59	-47.00	-5.59

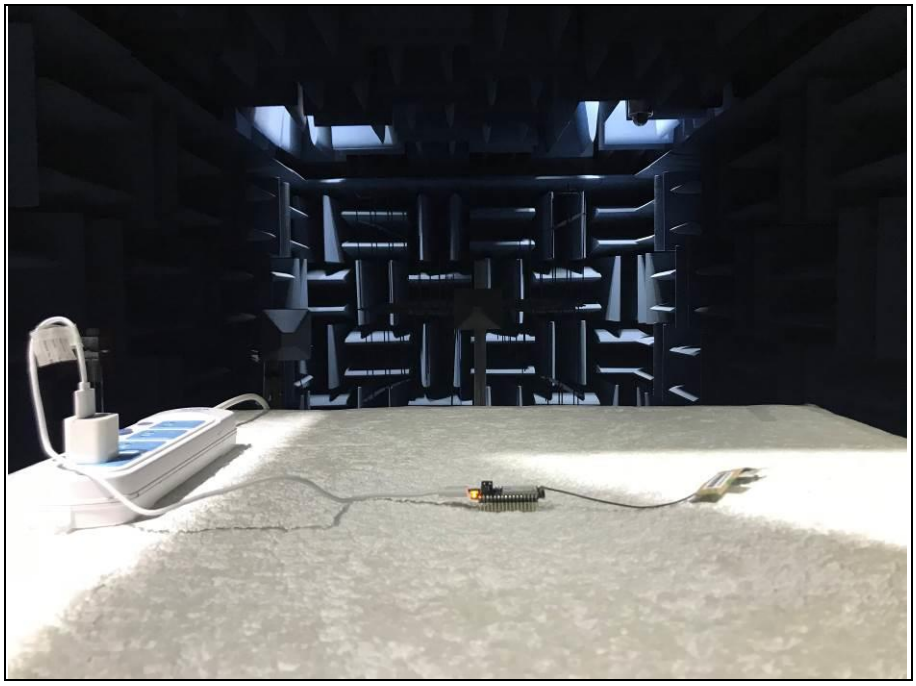
IDLE MODE AT MIDDLE CHANNEL WCDMA B8

FREQUENCY RANGE	30 ~ 12750 MHz	**TEST VOLTAGE**	230Vac, 50Hz
ENVIRONMENTAL CONDITIONS	25deg.C,55%RH	**TESTED BY**	Star Le
OPERATING CONDITIONS	Idle mode at middle channel (CH 2788)		

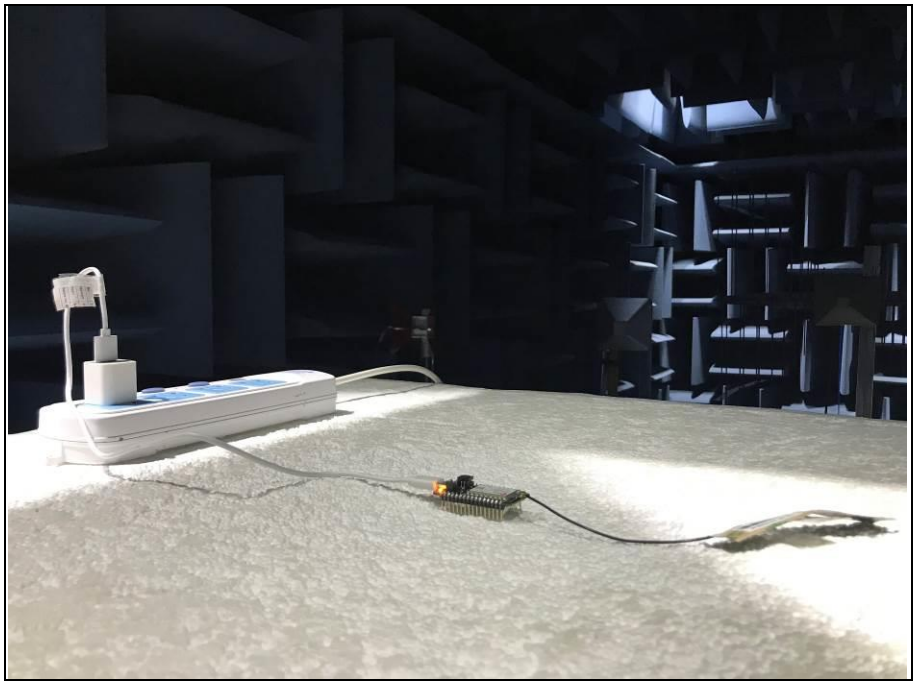
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
32.91	H	-66.06	-57.00	-9.06
58.13	H	-78.85	-57.00	-21.85
152.22	H	-84.39	-57.00	-27.39
250.19	H	-79.58	-57.00	-22.58
364.65	H	-76.98	-57.00	-19.98
543.13	H	-76.00	-57.00	-19.00
1945.12	H	-59.53	-47.00	-12.53
4316.02	H	-52.27	-47.00	-5.27
SPURIOUS EMISSION LEVEL				
Frequency (MHz)	**Antenna Polarization**	**Level (dBm)**	**Limit (dBm)**	**Margin (dB)**
36.79	V	-65.31	-57.00	-8.31
62.98	V	-81.27	-57.00	-24.27
151.25	V	-87.06	-57.00	-30.06
250.19	V	-78.00	-57.00	-21.00
364.65	V	-78.17	-57.00	-21.17
475.23	V	-76.37	-57.00	-19.37
2352.61	V	-57.19	-47.00	-10.19
4032.00	V	-53.45	-47.00	-6.45

5 PHOTOGRAPHS OF THE TEST CONFIGURATION

LINK AND IDLE SPURIOUS EMISSION (BELOW 1GHz)



LINK AND IDLE SPURIOUS EMISSION (ABOVE 1GHZ)



6 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications were made to the EUT by the lab during the test.

--- END ---