



TEST REPORT

Applicant	Particle Industries, Inc
Address	126 Post St,4th floor, San Francisco, CA 94108 USA

Manufacturer or Supplier	Particle Industries, Inc
Address	126 Post St,4th floor, San Francisco, CA 94108 USA
Product	Boron LTE
Brand Name	Particle
Model	BRN402
Additional Model & Model Difference	BRN404; see items 2.1
Date of tests	Sep. 03, 2018 ~ Nov. 08, 2018

The submitted sample of the above equipment has been tested for according to the requirements of the following standards:

veere

CONCLUSION: The submitted sample was found to **COMPLY** with the test requirement

Tested by Breeze Jiang Senior Project Engineer / EMC Department	Approved by Glyn He Assistant Manager / EMC Department

Date: Jan. 12, 2021

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
FS180920N037	Original release	Nov. 19, 2018
IV2011WDG0364	Based on the original report FS180920N037 updated standard, changed the product name and added the additional model, but it doesn't need to be retested.	Jan. 12, 2021

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SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD					
Standard Section	Test Item	Result	Remark		
	Conducted test	PASS	Meets limits minimum passing margin is -33.47 dB at 0.75016MHz		
ICES-003 Issue 7: 2020, Class B	Radiated Emission Test (30MHz ~ 1GHz)	PASS	Meets limits minimum passing margin is -5.82 dB at 39.749 MHz		
	Radiated Emission Test (Above 1GHz)	PASS	Meets limits minimum passing margin is -15.10 dB at 6834.54 MHz		

1.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

MEASUREMENT	FREQUENCY	UNCERTAINTY	
Conducted emission test	0.15MHz ~ 30MHz	+/-2.70 dB	
De diete de enciencie no test	30MHz ~1000MHz	+/- 4.04 dB	
Radiated emissions test	1GHz ~ 6GHz	+/- 5.02 dB	

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Town, Dongguan City, Guangdong Province. 523942. People's Republic of China.



2 GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Boron LTE
MODEL NO.	BRN402
ADDITIONAL MODEL	BRN404
POWER SUPPLY	Li+ PIN: DC 3.7V from Li-ion Battery or VUSB: DC 5V From USB Host Unit
CABLE SUPPLIED	N/A
THE HIGHEST OPERATING FREQUENCY	2480MHz

NOTE:

- 1. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
- 2. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
- 3. Please refer to the EUT photo document (Reference No.: 2011WDG0364) for detailed product photo.
- 4. The EUT is wireless module, it no any accessories, the test standard were specified by applicant.
- 5. Additional model BRN404 is identical with the test model BRN402 except the model name for trading purpose.

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2.2 DESCRIPTION OF TEST MODES

The EUT was tested under the following modes the final worst mode was marked in boldface and recorded in this report.

♦ FOR CONDUCTED EMISSIONS TEST:

<u> </u>			
Test Mode	Test Voltage		
2.4G Wireless Normal Working	DC5V from Adapter		
NFC Normal Working	2001 Hom Adapto.		

♦ FOR RADIATED EMISSIONS TEST(Below 1GHz):

Test Mode	Test Voltage	
2.4G Wireless Normal Working	DC 3.7V from Battery	
NFC Normal Working		
2.4G Wireless Normal Working	DC5V from Adapter	

♦ FOR RADIATED EMISSIONS TEST(Above 1GHz):

Test Mode		Test	t Voltage
2.4G Wireless Normal Working		DC5V fro	om Adapter

2.3 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Adapter	N/A	DC 5V 1.5A	N/A	N/A
2	iPhone 6s	Apple	ML7F2CH/A	C6KQKXLAGRY8	N/A
3	Li-ion Battery	N/A	DC3.7V	N/A	N/A

NO.	DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	USB Line: Unshielded detachable 0.6m.
2, 3	N/A

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3 EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

TEST STANDARD: ICES-003 (section 3.2.1 Table 1)

EDECLIENCY (MU-)	Class A	(dBuV)	Class B (dBuV)		
FREQUENCY (MHz)	Quasi-peak	Average	Quasi-peak	Average	
0.15 - 0.5	79	66	66 - 56	56 - 46	
0.50 - 5.0	73	60	56	46	
5.0 - 30.0	73	60	60	50	

NOTE:

- (1) The lower limit shall apply at the transition frequencies.
- (2) The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
- (3) All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

3.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR7	101494	Apr. 05,18	Apr. 04,19
Artificial Mains Network	Rohde&Schwarz	ENV216	101173	Mar. 03,18	Mar. 02,19
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	100317	Apr. 05,18	Apr. 04,19
Voltage probe	SCHWARZBECK	TK 9421	TK 9421-176	Jan. 17,18	Jan. 16,19
Test software	ADT	ADT_Cond _V7.3.7	N/A	N/A	N/A

NOTE: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

2. The test was performed in shielding room 553.

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3.1.3 TEST PROCEDURE

The basic test procedure was in accordance with ANSI C63.4:2014 (section 7).

- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit 20dB) were not recorded.

NOTE:

- 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
- 2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
- 3. Margin value = Emission level Limit value
- 4. Correction factor = Insertion loss + Cable loss
- 5. Emission Level = Correction Factor + Reading Value

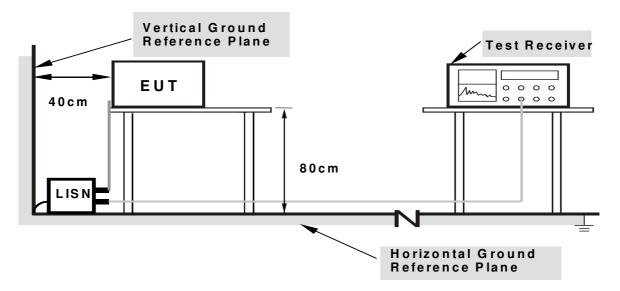
3.1.4 DEVIATION FROM TEST STANDARD

No deviation.

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3.1.5 TEST SETUP



Note: 1.Support units were connected to second LISN.

2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

3.1.6 EUT OPERATING CONDITIONS

- a. Turned on the power of all equipment.
- b. EUT was operated according to the type description in manufacturer's specifications or the User's Manual.

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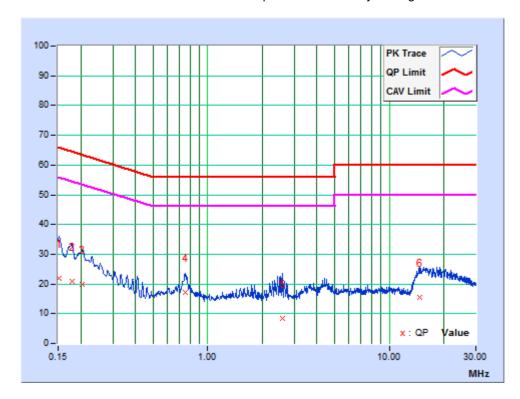


3.1.7 TEST RESULTS

TEST MODE	2.4G Wireless Normal Working	6DB BANDWIDTH	9 kHz
TEST VOLTAGE	DC 5V from Adapter	PHASE	Line (L)
ENVIRONMENTAL CONDITIONS	22deg. C, 46% RH	TESTED BY	Dragon

	Freq.	Corr.	Reading Value		Emis Le	sion vel	Limit		Margin	
No.		Factor	[dB (uV)]		[dB	(uV)]	[dB	(uV)]	(d	B)
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15225	9.90	11.95	0.69	21.85	10.59	65.88	55.88	-44.02	-45.28
2	0.17838	9.80	10.97	0.18	20.77	9.98	64.56	54.56	-43.80	-44.59
3	0.20410	10.29	9.72	-0.82	20.01	9.47	63.44	53.44	-43.43	-43.97
4	0.75016	10.16	7.17	2.37	17.33	12.53	56.00	46.00	-38.67	-33.47
5	2.58225	9.94	-1.41	-4.53	8.53	5.41	56.00	46.00	-47.47	-40.59
6	14.68275	9.77	5.82	3.13	15.59	12.90	60.00	50.00	-44.41	-37.10

REMARKS: The emission levels of other frequencies were very low against the limit.



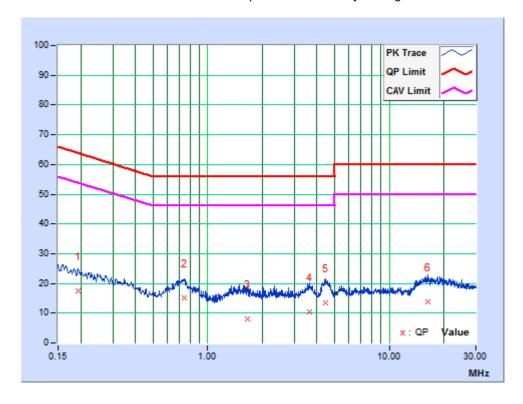
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TEST MODE	2.4G Wireless Normal Working	6DB BANDWIDTH	9 kHz
TEST VOLTAGE	DC 5V from Adapter	PHASE	Neutral (N)
ENVIRONMENTAL CONDITIONS	22deg. C, 46% RH	TESTED BY	Dragon

	Freq.	Corr.	Reading Value			ssion vel	Lir	nit	Mai	gin
No.		Factor		[dB (uV)] [dB (u\		(uV)]	[dB	(uV)]	(d	B)
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.19258	9.90	7.68	-2.66	17.58	7.24	63.92	53.92	-46.35	-46.69
2	0.74621	9.99	5.12	-2.40	15.11	7.59	56.00	46.00	-40.89	-38.41
3	1.66514	10.05	-1.92	-5.32	8.13	4.73	56.00	46.00	-47.87	-41.27
4	3.65100	9.87	0.44	-3.47	10.31	6.40	56.00	46.00	-45.69	-39.60
5	4.47900	9.73	3.69	-1.77	13.42	7.96	56.00	46.00	-42.58	-38.04
6	16.4040	9.85	4.00	0.82	13.85	10.67	60.00	50.00	-46.15	-39.33

REMARKS: The emission levels of other frequencies were very low against the limit.



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3.2 RADIATED EMISSION MEASUREMENT

3.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

TEST STANDARD: ICES-003 for below 1GHz (section 3.2.2 Table 2); for above 1GHz (section 3.2.2 Table 4)

Emissions radiated outside of the specified bands, shall be according to the general radiated limits as following:

Radiated Emissions Limits at 10 meters (dBµV/m)							
Frequencies (MHz)	Class A	Class B					
30-88	40.0	30.0					
88-216	43.5	33.1					
216-230	46.4	35.6					
230-960	47.0	37.0					
960-1000	49.5	43.5					

Radiated Emissions Limits at 3 meters (dBµV/m)						
Frequencies (MHz)	Class A	Class B				
30-88	50.0	40.0				
88-216	54.0	43.5				
216-230	56.9	46.0				
230-960	57.0	47.0				
960-1000	60.0	54.0				
Above 1000	Avg: 60 Peak: 80	Avg: 54 Peak: 74				

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FREQUENCY RANGE OF RADIATED MEASUREMENT

(For unintentional radiators)

Highest frequency generated or Upper frequency of measurement used in the device or on which the device operates or tunes (MHz)	Range (MHz)
<u><</u> 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

Note: (1) The lower limit shall apply at the transition frequencies.

- (2) Emission level (dBuV/m) = 20 log Emission level (uV/m).
- (3) All emanation from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

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3.2.2 TEST INSTRUMENTS

FOR FREQUENCY 30MHz-1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESU26	100005	Jun. 05,18	Jun. 04,19
EMI Test Receiver	Rohde&Schwarz	ESR7	101564	Jan. 18,18	Jan. 17,19
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-555	Nov. 10, 18	Nov. 09, 19
Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-554	Dec. 10, 17	Dec. 09, 18
Preamplifier	EMCI	EMC1135	980378	Mar. 20,18	Mar. 19,19
Preamplifier	EMCI	EMC1135	980423	Mar. 20,18	Mar. 19,19
10m Semi-anechoic Chamber	CHANGLING	21.4m*12.1m* 8.8m	NSEMC006	Feb. 10,18	Feb. 09,19
Test Software	ADT	ADT_Radiated _V8.7.07	N/A	N/A	N/A

FREQUENCY RANGE ABOVE 1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Horn Antenna	ETS-Lindgren	3117	00085519	Dec. 10, 17	Dec. 09, 18
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170242	May 05,18	May 04,19
Signal and Spectrum Analyzer	Rohde&Schwarz	FSV40	101003	Apr. 21,18	Apr. 20,19
Broadband Preamplifier (1~18GHz)	SCHWARZBECK	BBV9718	266	Apr. 18,18	Apr. 18,19
Pre-Amplifier (18GHz-40GHz)	EMCI	EMC 184045	980102	Nov. 09,18	Nov. 08,19
Test Software	ADT	ADT_Radiated _V8.7.07	N/A	N/A	N/A

NOTE: 1. The test was performed in 10m Chamber.

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^{2.} The calibration interval of the above test instruments is 12 months. And the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.



3.2.3 TEST PROCEDURE

The basic test procedure was in accordance with ANSI C63.4:2014 (section 12).

<Frequency Range below 1GHz>

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter semi-anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1GHz.

NOTE:

- 1. The resolution bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
- 3. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) (if the raw value not contains the amplifier)
- 4. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) Amplifier Gain(dB) (if the raw value contains the amplifier)
- 5. Margin value = Emission level Limit value



<Frequency Range above 1GHz>

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna can be varied from one meter-to four meters, the height of adjustment depends on the EUT height and the antenna 3dB beamwidth both, to detect the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. The bore sight should be used during the test above 1GHz.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test receiver/spectrum was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

NOTE:

- 1. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz for Average detection (AV) at frequency above 1GHz.
- 2. For measurement of frequency above 1000 MHz, the EUT was set 3 meters away from the receiver antenna
- 3. Emission level(dBuV/m)=Raw Value(dBuV) + Correction Factor(dB/m)
- 4. Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) (if the raw value not contains the amplifier)
- 5. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) Amplifier Gain(dB) (if the raw value contains the amplifier).
- 6. Margin value = Emission level Limit value

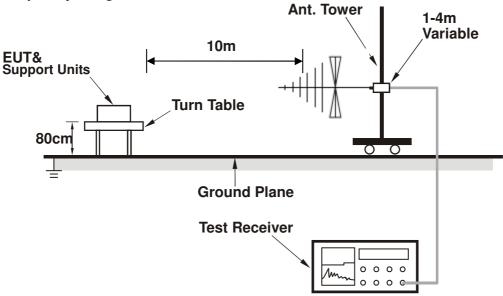
3.2.4 DEVIATION FROM TEST STANDARD

No deviation.

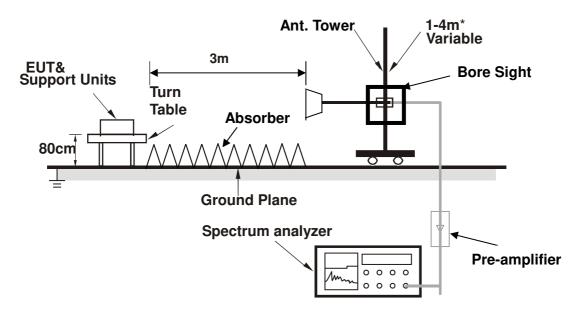


3.2.5 TEST SETUP

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



*: depends on the EUT height and the antenna 3dB beamwidth both, refer to section 7.3 of CISPR 16-2-3.

3.2.6 EUT OPERATING CONDITIONS

See items 3.1.6

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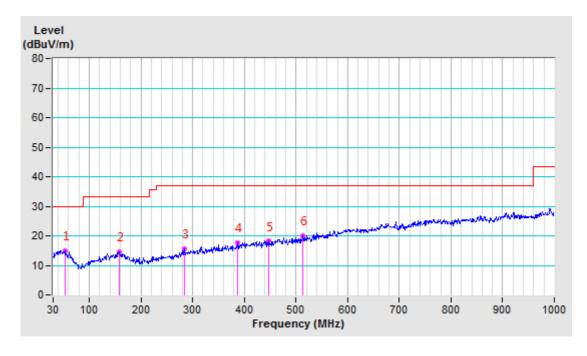


3.2.7 TEST RESULTS (BELOW 1GHZ)

TEST MODE	2.4G Wireless Normal Working	FREQUENCY RANGE	30-1000MHz	
TEST VOLTAGE	DC 5V from Adapter	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Quasi-Peak, 120kHz	
ENVIRONMENTAL CONDITIONS	24.0deg. C, 56.0% RH	TESTED BY: Daniel		

	ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 10 M								
No.	Freq. (MHz)	Correction Factor (dB/m)	Raw Value (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	
1	53.038	-17.67	32.55	14.88	30.00	-15.12	200	102	
2	157.919	-16.73	31.29	14.56	33.10	-18.54	200	201	
3	284.261	-15.93	31.51	15.58	37.00	-21.42	200	284	
4	386.596	-13.57	31.32	17.75	37.00	-19.25	200	43	
5	447.949	-12.57	30.73	18.16	37.00	-18.84	200	60	
6	513.424	-11.02	31.14	20.12	37.00	-16.88	400	310	

- REMARKS: 1. Peak detector quick scan is showed on the graph and final quasi-peak detector data is measured corresponding to relevant limit and recorded in the data table.
 - 2. Negative sign (-) in the margin column signify levels below the limit.
 - 3. Frequency range scanned: 30MHz to 1000MHz.
 - 4. Only emissions significantly above equipment noise floor are reported.



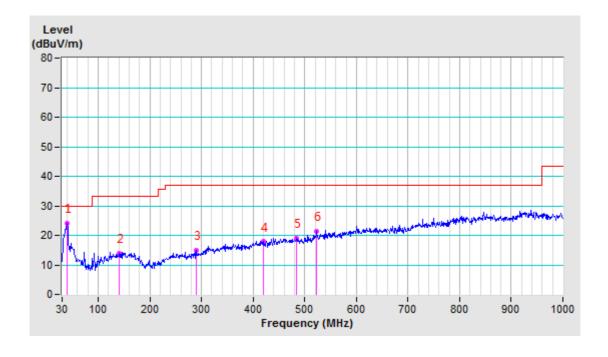
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TEST MODE	TEST MODE 2.4G Wireless Normal Working		30-1000MHz	
TEST VOLTAGE	DC 5V from Adapter	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Quasi-Peak, 120kHz	
ENVIRONMENTAL CONDITIONS	24.0deg. C, 56.0% RH	TESTED BY: Daniel		

	ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 10 M									
No.	Freq. (MHz)	Correction Factor (dB/m)	Raw Value (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)		
1	39.749	-17.76	41.94	24.18	30.00	-5.82	100	65		
2	141.071	-16.76	30.73	13.97	33.10	-19.13	100	314		
3	289.634	-15.33	30.37	15.04	37.00	-21.96	100	251		
4	419.766	-11.76	29.60	17.84	37.00	-19.16	100	94		
5	484.080	-10.41	29.46	19.05	37.00	-17.95	100	128		
6	521.863	-9.46	30.89	21.43	37.00	-15.57	100	165		

- REMARKS: 1. Peak detector quick scan is showed on the graph and final quasi-peak detector data is measured corresponding to relevant limit and recorded in the data table.
 - 2. Negative sign (-) in the margin column signify levels below the limit.
 - 3. Frequency range scanned: 30MHz to 1000MHz.
 - 4. Only emissions significantly above equipment noise floor are reported.



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3.2.8 TEST RESULTS (ABOVE 1GHZ)

TEST MODE	2.4G Wireless Normal Working	DETECTOR FUNCTION & BANDWIDTH	Peak , Average, 1MHz	
TEST VOLTAGE	DC 5V from Adapter	FREQUENCY RANGE	Above 1 GHz	
ENVIRONMENTAL CONDITIONS	21.0deg. C, 59.0% RH	TESTED BY: Dan	iiel	

	ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M							
No.	Freq. (MHz)	Correction Factor (dB/m)	Raw Value (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)
1	6834.54 PK	12.59	45.01	57.60	74.00	-16.40	100	156
2	6834.54 AV	12.59	26.31	38.90	54.00	-15.10	100	156
3	9763.45 PK	16.55	41.75	58.30	74.00	-15.70	100	58
4	9763.45 AV	16.55	22.15	38.70	54.00	-15.30	100	58
5	15167.35 PK	26.12	31.68	57.80	74.00	-16.20	100	254
6	15167.35 AV	26.12	12.28	38.40	54.00	-15.60	100	254
	ANT	ENNA POL	ARITY &	TEST DIST	ANCE: VE	RTICAL AT	3 M	
No.	Freq. (MHz)	Correction Factor (dB/m)	Raw Value (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)
1	6975.35 PK	13.07	45.53	58.60	74.00	-15.40	100	124
	0070.00111	10.07	40.00	00.00	74.00	13.40	100	
2	6975.35 AV	13.07	25.63	38.70	54.00	-15.30	100	124
3								
	6975.35 AV	13.07	25.63	38.70	54.00	-15.30	100	124
3	6975.35 AV 10056.87 PK	13.07 16.86	25.63 41.04	38.70 57.90	54.00 74.00	-15.30 -16.10	100 100	124 58

REMARKS: 1. Peak detector quick scan is showed on the graph and final quasi-peak detector data is measured corresponding to relevant limit and recorded in the data table.

- 2. Negative sign (-) in the margin column signify levels below the limit.
- 3. Frequency range scanned: 1GHz to 18GHz.
- 4. Only emissions significantly above equipment noise floor are reported.

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PHOTOGRAPHS OF THE TEST CONFIGURATION







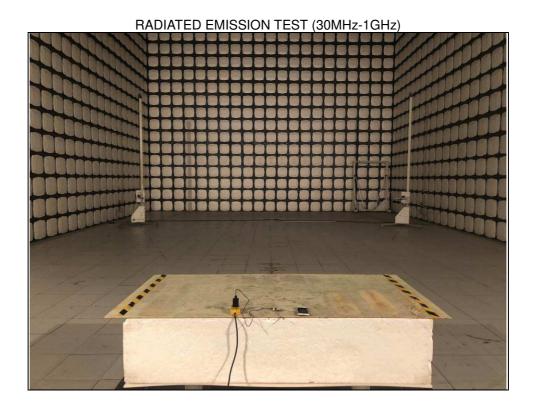
Bureau Veritas Shenzhen Co., Ltd. **Dongguan Branch**

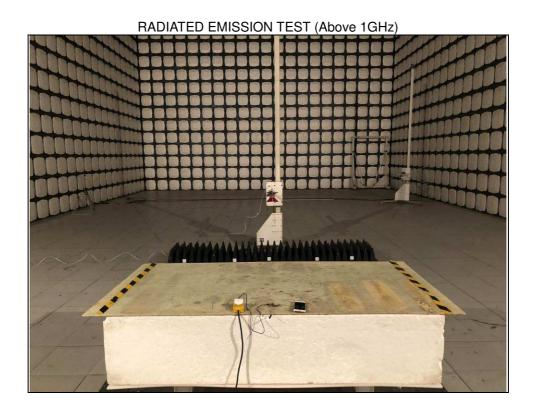
No. 96, Guantai Road (Houjie Section), Houjie Town, Dongguan City, Guangdong Province. 523942. People's Republic of China.

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5 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---

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