

FCC TEST REPORT

(TRANSMIT SIMULTANEOUSLY)


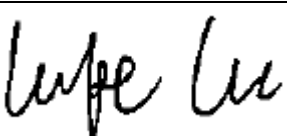
| | |
|------------|---|
| Applicant: | Particle Industries, Inc |
| Address: | 126 Post St, 4th floor, San Francisco, CA 94108 USA |

| | |
|---------------------------|---|
| Manufacturer or Supplier: | Particle Industries, Inc |
| Address: | 126 Post St, 4th floor, San Francisco, CA 94108 USA |
| Product: | B Series B402 |
| Brand Name: | Particle |
| Model Name: | B402, B402S |
| FCC ID: | 2AEMI-B402 |
| Date of tests: | Jun. 07, 2019 ~ Sep. 18, 2019 |

The tests have been carried out according to the requirements of the following standard:

- ☒ **FCC PART 27 & PART 15.247**
- ☒ **ANSI C63.10-2013**
- ☒ **ANSI C63.26-2015**

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

| | |
|--|--|
| Prepared by Alex Chen Engineer / Mobile Department | Approved by Luke Lu Manager / Mobile Department |
|  Date: Sep. 18, 2019 |  Date: Sep. 18, 2019 |

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Test Report No.: RF190606W003-1

RELEASE CONTROL RECORD

| ISSUE NO. | REASON FOR CHANGE | DATE ISSUED |
|----------------|-------------------|---------------|
| RF190606W003-1 | Original release | Sep. 18, 2019 |

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

| APPLIED STANDARD: FCC Part 27& Part 2 & Part 15.247 | | | |
|---|--|--------|--|
| STANDARD SECTION | TEST TYPE | RESULT | REMARK |
| 15.205/ 15.209/ 15.247(d) | Radiated Emissions and Band Edge Measurement | PASS | Meet the requirement of limit. Minimum passing margin is -8.18dB at 175.5MHz. |
| 2.1053 27.53 | Radiated Spurious Emissions | PASS | Meet the requirement of limit. Minimum passing margin is -35.77dB at 3418MHz. |

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:

| MEASUREMENT | UNCERTAINTY |
|------------------------|---------------------|
| Radiated emissions | $\pm 4.48\text{dB}$ |
| Band Edge Measurements | $\pm 4.48\text{dB}$ |

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

1.2 TEST SITE AND INSTRUMENTS

| Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Next Cal. |
|---|--------------|-------------------------------------|---------------------------------|-------------|-------------|
| MXE EMI Receiver | KEYSIGHT | N9038A-544 | MY54450026 | Feb. 26,19 | Feb. 25,20 |
| EXA Signal Analyzer | KEYSIGHT | N9010A-526 | MY54510322 | Feb. 26,19 | Feb. 25,20 |
| Bilog Antenna 1 | ETS-LINDGREN | 3143B | 00161964 | Feb. 26,19 | Feb. 25,20 |
| Bilog Antenna 2 | ETS-LINDGREN | 3143B | 00161965 | Feb. 26,19 | Feb. 25,20 |
| Horn Antenna 1 | ETS-LINDGREN | 3117 | 00168728 | Feb. 26,19 | Feb. 25,20 |
| Horn Antenna 2 | ETS-LINDGREN | 3117 | 00168692 | Nov. 30, 18 | Nov. 29, 19 |
| Horn Antenna (18GHz-40GHz) | N/A | QWH-SL-18-40 -K-SG/QMS-00 361 | 15433 | Nov. 21, 18 | Nov. 20, 19 |
| Radio Communication Analyzer | ANRITSU | MT8820C | 6201465426 | Feb. 26,19 | Feb. 25,20 |
| Signal Pre-Amplifier | EMSI | EMC 9135 | 980249 | Jul. 09,19 | Jul. 08,20 |
| Signal Pre-Amplifier | EMSI | EMC 012645B | 980257 | Jul. 09,19 | Jul. 08,20 |
| Signal Pre-Amplifier | EMSI | EMC 184045B | 980259 | Jul. 09,19 | Jul. 08,20 |
| 3m Semi-anechoic Chamber | ETS-LINDGREN | 9m*6m*6m | Euroshieldpn- CT0001143-1216 | Feb. 26,19 | Feb. 25,20 |
| Test Software | E3 | V 9.160323 | N/A | N/A | N/A |
| Test Software | ADT | ADT_Radiated _V7.6.15.9.2 | N/A | N/A | N/A |
| MXG Analog Microwave Signal Generator | KEYSIGHT | N5183A | MY50143024 | Feb. 26,19 | Feb. 25,20 |

- 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 Semi-anechoic Chamber and RF Oven Room.
 3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.
 4. The FCC Site Registration No. is 525120; The Designation No. is CN1171.

2 GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

| | |
|---------------------|---------------------------|
| EUT | B Series B402 |
| MODEL NAME | B402, B402S |
| POWER SUPPLY | 3.85Vdc (Li-ion, battery) |
| HW VERSION | V1.00 |
| SW VERSION | V1.2.1 |
| I/O PORTS | Refer to user's manual |
| DATA CABLE | N/A |

NOTE:

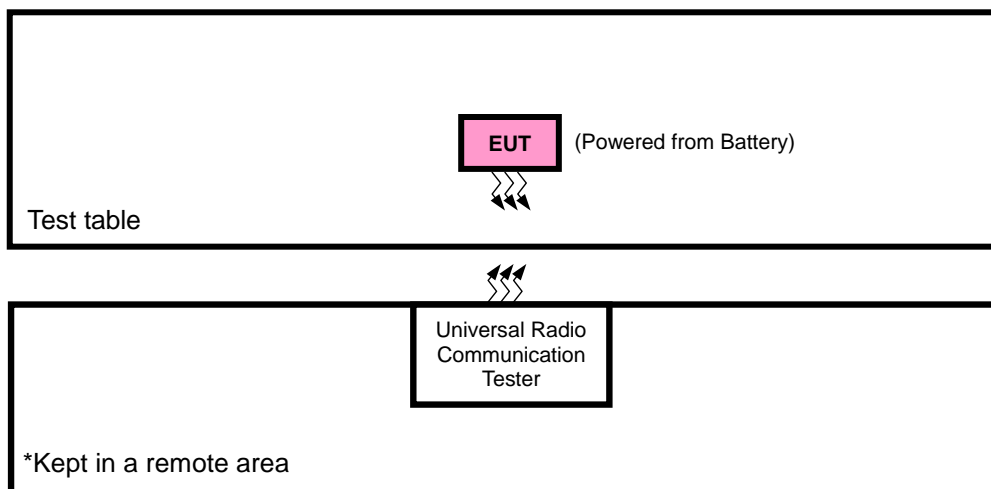
1. There are BLE and WWAN technology used for the EUT. The EUT has below radios as following table:

| | |
|---------|-----------|
| Radio 1 | Radio 2 |
| BLE | WWAN(LTE) |

2. Simultaneously transmission condition.

| | | |
|---|------------|-----------|
| Condition | Technology | |
| 1 | BLE | WWAN(LTE) |
| Note: The emission of the simultaneous operation has evaluated and no non-compliance was found. | | |

2.2 CONFIGURATION OF SYSTEM UNDER TEST FOR RADIATION EMISSION



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 | PC | HP | A6608CN | 3CR83825X3 | N/A |
| 2 | USB | N/A | N/A | N/A | N/A |
| 3 | Battery | N/A | N/A | N/A | N/A |
| 4 | N/A | 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 | N/A |
| 4 | N/A |

2.4 TEST ITEM AND TEST CONFIGURATION

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case in ERP and radiated emission was found when positioned on X-plane for LTE. Following channel(s) was (were) selected for the final test as listed below:

| EUT CONFIGURE MODE | DESCRIPTION |
|----------------------------|------------------------------------|
| BLE(1M) + LTE Band 4 | EUT + Battery with LTE link |

| TEST ITEM | ENVIRONMENTAL CONDITIONS | INPUT POWER | TESTED BY |
|-------------------|--------------------------|---------------------|-----------|
| RADIATED EMISSION | 25deg. C, 63.6%RH | 3.8Vdc from Battery | Star Le |

2.5 EUT OPERATING CONDITIONS

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency

2.6 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 standards:

FCC 47 CFR Part 2

FCC 47 CFR Part 27

FCC 47 CFR Part 15.247

ANSI C63.10-2013

ANSI C63.26-2015

NOTE: All test items have been performed and recorded as per the above standards.

3 TEST TYPES AND RESULTS

3.1 RADIATED EMISSION MEASUREMENT

3.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

| FREQUENCIES (MHz) | FIELD STRENGTH (microvolts/meter) | MEASUREMENT DISTANCE (meters) |
|----------------------|--------------------------------------|----------------------------------|
| 0.009 ~ 0.490 | 2400/F(kHz) | 300 |
| 0.490 ~ 1.705 | 24000/F(kHz) | 30 |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 100 | 3 |
| 88 ~ 216 | 150 | 3 |
| 216 ~ 960 | 200 | 3 |
| Above 960 | 500 | 3 |

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).

As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

For 47 CFR FCC Part 27:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. The emission limit equal to -13dBm .

3.1.2 TEST PROCEDURES

For 47 CFR FCC PART 15.247:

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. 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 antenna is a broadband antenna, and its height is varied from one meter to four 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 Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ($10 \log(1/\text{duty cycle})$).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

For 47 CFR FCC PART 27:

- a. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.
- b. The substitution horn antenna is substituted for EUT at the same position and signals

generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to “Read Value” of step a. Record the power level of S.G

- c. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.
- d. E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole,
 $E.R.P \text{ power} = E.I.P.R \text{ power} - 2.15\text{dBi}$.

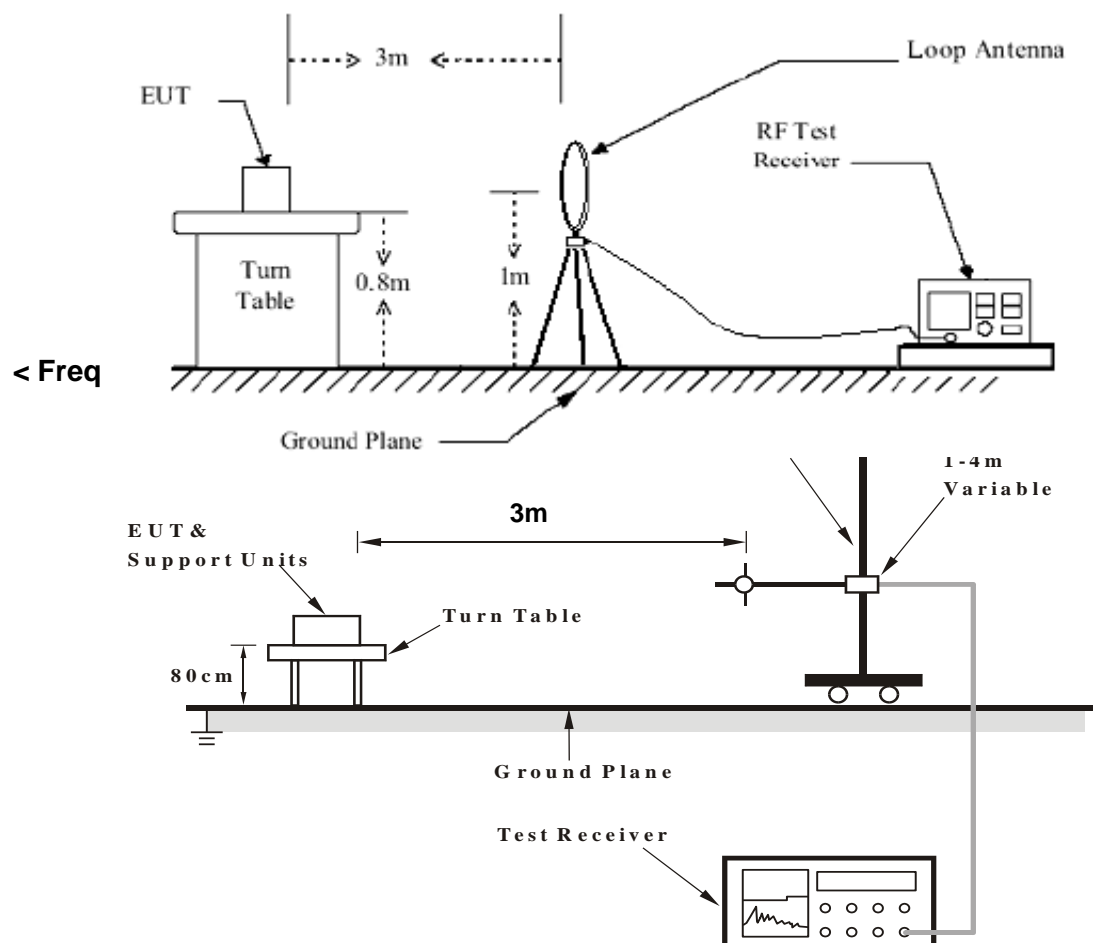
NOTE: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

3.1.3 DEVIATION FROM TEST STANDARD

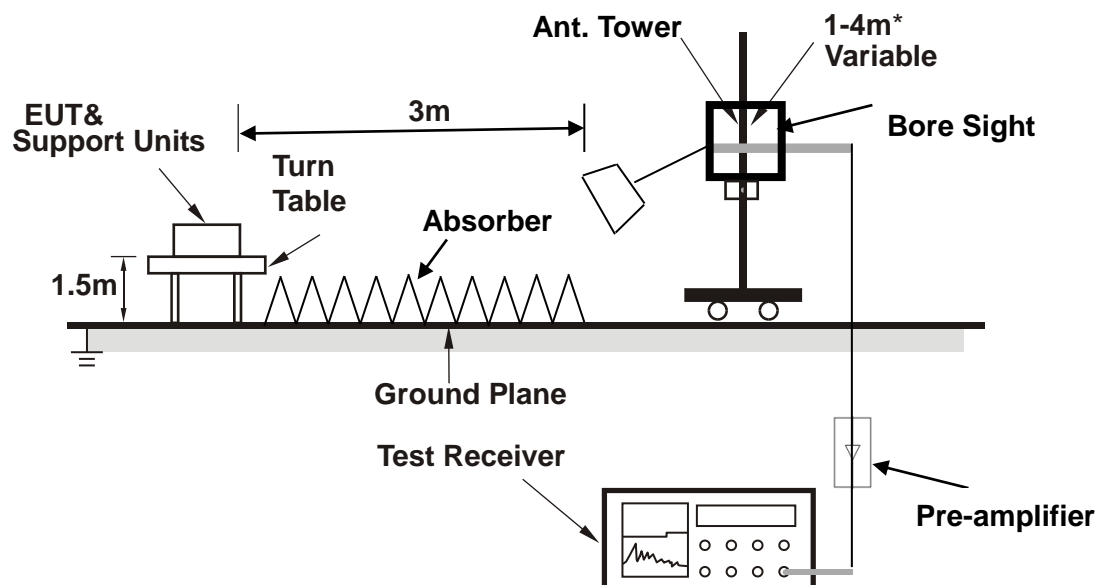
No deviation

3.1.4 TEST SETUP

< Frequency Range below 30MHz >



<Frequency Range above 1GHz>



Note: Above 1G is a directional antenna

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

For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.1.5 TEST RESULTS

BELOW 1GHz WORST-CASE DATA

9 KHz – 30 MHz data: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required in the report.

30 MHz – 1GHz data:

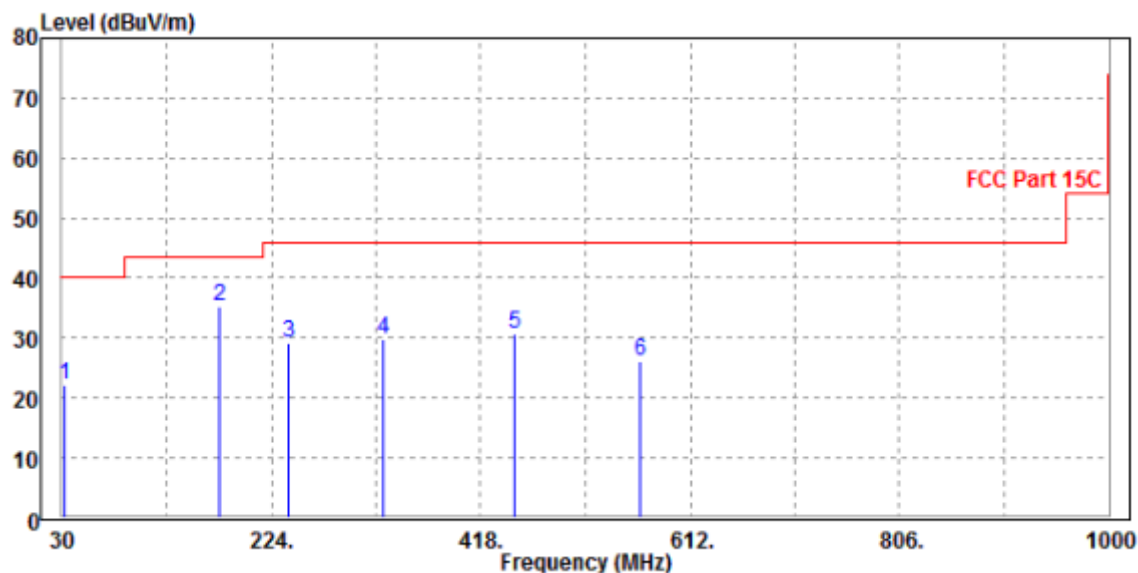
BLE (1M) + LTE Band 4 QPSK 10M

| | | | |
|------------------------|--------------|--------------------------|-----------------|
| CHANNEL | Low channel | DETECTOR FUNCTION | Quasi-Peak (QP) |
| FREQUENCY RANGE | 30MHz ~ 1GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | | | |
|---|-------------------------------|-------------------------|-------------------|----------------|------------------------------|-----------------------|--------------------------|---------------------------|----------------------------|-------------|
| FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | READ LEVEL (dBuV) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA FACTOR (dB /m) | CABLE LOSS (dB) | PREAMP FACTOR (dB) | ANTENNA HEIGHT (cm) | TABLE ANGLE (Degree) | REMARK |
| 31.94 | 22.34 | 42.76 | 40 | -17.66 | 16.2 | 0.8 | 37.42 | 200 | 360 | Peak |
| 175.5 | 35.32 | 59.94 | 43.5 | -8.18 | 10.35 | 1.69 | 36.66 | 200 | 360 | Peak |
| 240.49 | 29.28 | 51.34 | 46 | -16.72 | 12.58 | 1.99 | 36.63 | 200 | 360 | Peak |
| 327.79 | 29.92 | 49.41 | 46 | -16.08 | 14.96 | 2.32 | 36.77 | 200 | 360 | Peak |
| 449.04 | 30.68 | 46.95 | 46 | -15.32 | 17.84 | 2.8 | 36.91 | 200 | 360 | Peak |
| 566.41 | 26.3 | 40.89 | 46 | -19.7 | 19.56 | 3.1 | 37.25 | 200 | 360 | Peak |

REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
Margin value = Emission level – Limit value.

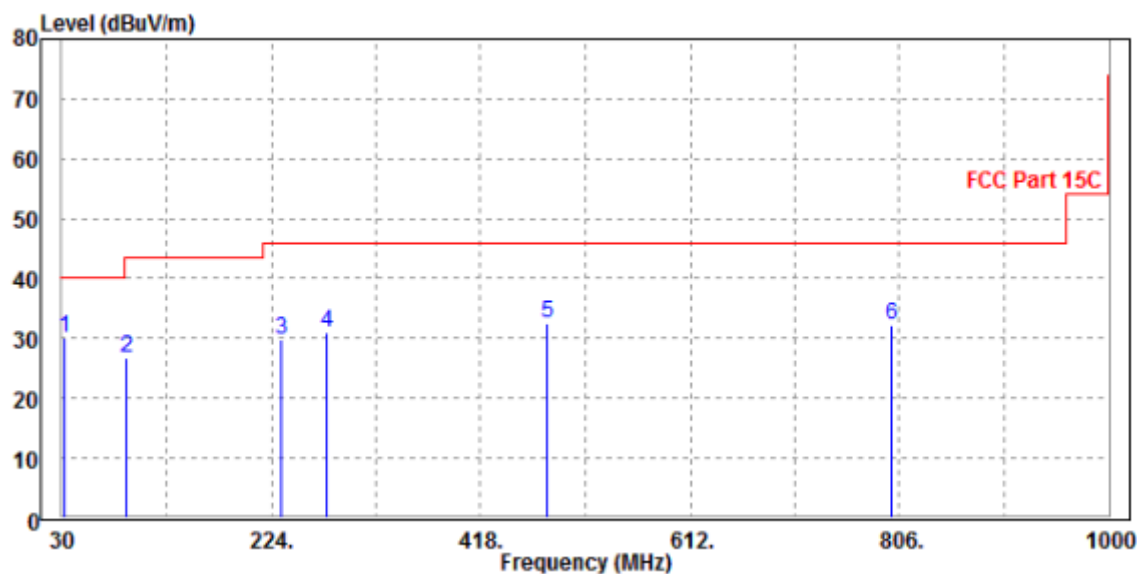


| | | | |
|------------------------|--------------|--------------------------|-----------------|
| CHANNEL | Low channel | DETECTOR FUNCTION | Quasi-Peak (QP) |
| FREQUENCY RANGE | 30MHz ~ 1GHz | | |

| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | | | |
|---|-------------------------------|-------------------------|-------------------|----------------|------------------------------|-----------------------|--------------------------|---------------------------|----------------------------|--------|
| FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | READ LEVEL (dBuV) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA FACTOR (dB /m) | CABLE LOSS (dB) | PREAMP FACTOR (dB) | ANTENNA HEIGHT (cm) | TABLE ANGLE (Degree) | REMARK |
| 31.94 | 30.05 | 50.47 | 40 | -9.95 | 16.2 | 0.8 | 37.42 | 100 | 0 | Peak |
| 89.17 | 26.66 | 54.18 | 43.5 | -16.84 | 8.47 | 1.27 | 37.26 | 100 | 0 | Peak |
| 232.73 | 29.75 | 52.18 | 46 | -16.25 | 12.24 | 1.95 | 36.62 | 100 | 0 | Peak |
| 275.41 | 31.02 | 52.03 | 46 | -14.98 | 13.56 | 2.13 | 36.7 | 100 | 0 | Peak |
| 480.08 | 32.61 | 48.42 | 46 | -13.39 | 18.24 | 2.92 | 36.97 | 100 | 0 | Peak |
| 799.21 | 32.27 | 42.69 | 46 | -13.73 | 23.4 | 3.89 | 37.71 | 100 | 0 | Peak |

REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
Margin value = Emission level – Limit value.





**BUREAU
VERITAS**

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ABOVE 1GHz WORST-CASE DATA:

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

BLE (1M) + LTE Band 4 QPSK 10M

| | | | |
|------------------------|--------------|--------------------------|--------------|
| CHANNEL | TX Channel 1 | DETECTOR FUNCTION | Peak (PK) |
| FREQUENCY RANGE | 1GHz ~ 25GHz | | Average (AV) |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | | | | | | | | |
|---|-------------------------------|-------------------------|-------------------|----------------|------------------------------|-----------------------|--------------------------|---------------------------|----------------------------|---------|
| FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | READ LEVEL (dBuV) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA FACTOR (dB /m) | CABLE LOSS (dB) | PREAMP FACTOR (dB) | ANTENNA HEIGHT (cm) | TABLE ANGLE (Degree) | REMARK |
| 2390 | 55.17 | 63.56 | 74 | -18.83 | 33.1 | 4.88 | 46.37 | 108 | 150 | Peak |
| 2390 | 27.11 | 35.5 | 54 | -26.89 | 33.1 | 4.88 | 46.37 | 108 | 150 | Average |
| 2402 | 98.71 | 107.07 | 74 | 24.71 | 33.12 | 4.89 | 46.37 | 108 | 150 | Peak |
| 2402 | 65.77 | 74.13 | 54 | 11.77 | 33.12 | 4.89 | 46.37 | 108 | 150 | Average |
| 2483.5 | 50.62 | 58.74 | 74 | -23.38 | 33.27 | 4.98 | 46.37 | 108 | 150 | Peak |
| 2483.5 | 27.22 | 35.34 | 54 | -26.78 | 33.27 | 4.98 | 46.37 | 108 | 150 | Average |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | | | | | | | | |
| FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | READ LEVEL (dBuV) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA FACTOR (dB /m) | CABLE LOSS (dB) | PREAMP FACTOR (dB) | ANTENNA HEIGHT (cm) | TABLE ANGLE (Degree) | REMARK |
| 2390 | 49.86 | 59.14 | 74 | -24.14 | 32.21 | 4.88 | 46.37 | 116 | 240 | Peak |
| 2390 | 32.21 | 41.49 | 54 | -21.79 | 32.21 | 4.88 | 46.37 | 116 | 240 | Average |
| 2402 | 92.16 | 101.39 | 74 | 18.16 | 32.25 | 4.89 | 46.37 | 116 | 240 | Peak |
| 2402 | 56.76 | 65.99 | 54 | 2.76 | 32.25 | 4.89 | 46.37 | 116 | 240 | Average |
| 2483.5 | 50.58 | 59.51 | 74 | -23.42 | 32.46 | 4.98 | 46.37 | 116 | 240 | Peak |
| 2483.5 | 32.46 | 41.39 | 54 | -21.54 | 32.46 | 4.98 | 46.37 | 116 | 240 | Average |

REMARKS:

Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor

Margin value = Emission level – Limit value.



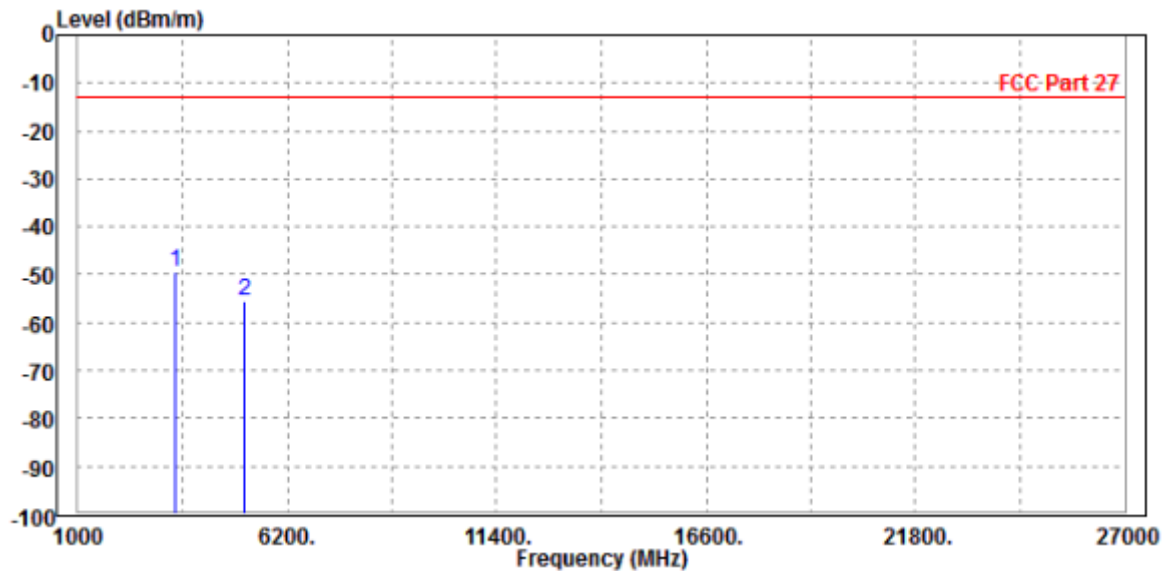
ABOVE 1GHz DATA

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

LTE Band 4

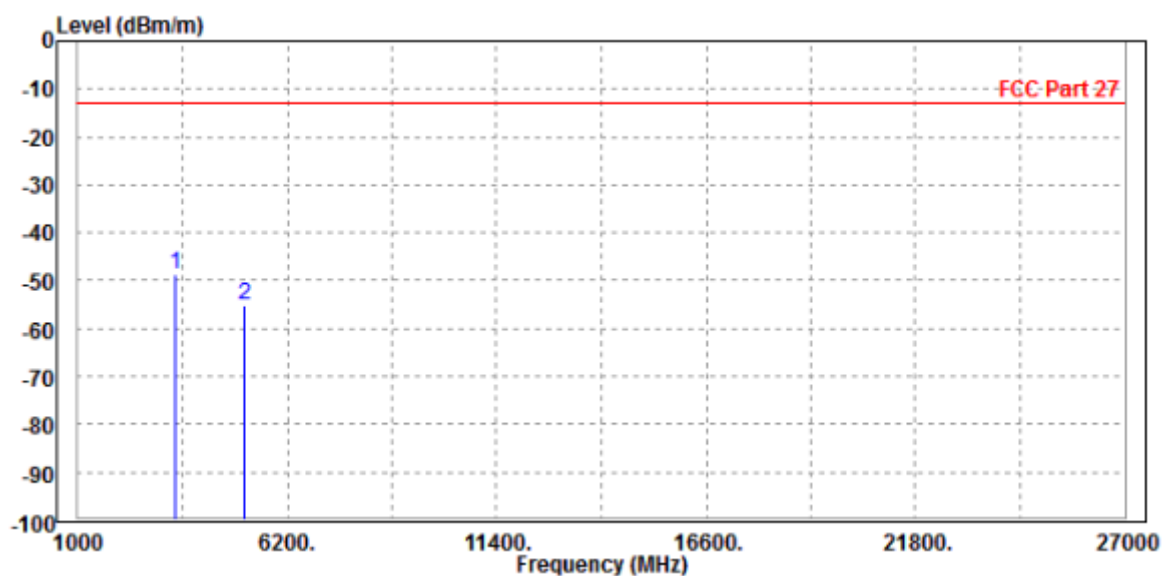
| | | | |
|---|-------------------|-----------------|---------------|
| MODE | Low channel 19965 | FREQUENCY RANGE | Above 1000MHz |
| ENVIRONMENTAL CONDITIONS | 23deg. C, 70%RH | INPUT POWER | DC 3.8V |
| TESTED BY | Star Le | | |
| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M | | | |

| | | Freq | Level | Read Level | Limit Line | Over Limit | Factor | Remark | Pol/Phase |
|---|----|----------|--------|------------|------------|------------|--------|--------|------------|
| | | MHz | dBm/m | dBm | dBm/m | dB | dB/m | | |
| 1 | PP | 3418.000 | -49.27 | -51.12 | -13.00 | -36.27 | 1.85 | Peak | Horizontal |
| 2 | | 5132.000 | -55.69 | -64.22 | -13.00 | -42.69 | 8.53 | Peak | Horizontal |



| | | | |
|---|-------------------|-----------------|---------------|
| MODE | Low channel 19965 | FREQUENCY RANGE | Above 1000MHz |
| ENVIRONMENTAL CONDITIONS | 23deg. C, 70%RH | INPUT POWER | DC 3.8V |
| TESTED BY | Star Le | | |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M | | | |

| | | | Read | Limit | Over | | | |
|---|-------------|--------|--------|--------|--------|--------|--------|-----------|
| | Freq | Level | Level | Line | Limit | Factor | Remark | Pol/Phase |
| | MHz | dBm/m | dBm | dBm/m | dB | dB/m | | |
| 1 | PP 3418.000 | -48.77 | -51.24 | -13.00 | -35.77 | 2.47 | Peak | Vertical |
| 2 | 5132.000 | -55.13 | -63.12 | -13.00 | -42.13 | 7.99 | Peak | Vertical |





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4 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).



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5 INFORMATION ON THE TESTING LABORATORIES

We, BV 7LAYERS COMMUNICATIONS TECHNOLOGY (SHENZHEN) CO. LTD., were founded in 2015 to provide our best service in EMC, Radio, Telecom and Safety consultation. 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:

Shenzhen EMC/RF Lab:

Tel: +86-755-88696566

Fax: +86-755-88696577

Email: customerservice.dg@cn.bureauveritas.com

Web Site: www.adt.com.tw

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

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

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

---END---