



Test Report No.: W7L-P23030011EM02



VARIANT TEST REPORT (ICES-003)

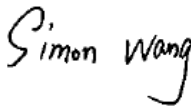
Applicant:	Particle Industries, Inc
Address:	325 9th Street, San Francisco, CA 94103, United States Of America

Manufacturer or Supplier:	Particle Industries, Inc
Address:	325 9th Street, San Francisco, CA 94103, United States Of America
Product:	E Series Module
Brand Name:	Particle
Model Name:	E404X
IC:	20127-E404X
Date of tests:	Mar. 10, 2023 ~ Mar. 24, 2023

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

- ICES-003 Issue 7: 2020
- ANSI C63.4:2014

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

Prepared by Simon Wang Engineer / Mobile Department	Approved by Luke Lu Manager / Mobile Department
	
Date: Mar. 24, 2023	Date: Mar. 24, 2023

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Table of Contents

RELEASE CONTROL RECORD	3
1 GENERAL INFORMATION	4
1.1 GENERAL DESCRIPTION OF EUT.....	4
1.2 SUMMARY OF TEST RESULTS.....	5
1.3 MEASUREMENT UNCERTAINTY.....	6
1.4 DESCRIPTION OF TEST MODES.....	7
1.5 DESCRIPTION OF SUPPORT UNITS.....	8
2 EMISSION TEST	9
2.1 RADIATED EMISSION MEASUREMENT.....	9
2.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT	9
2.1.2 TEST INSTRUMENTS.....	11
2.1.3 TEST PROCEDURE.....	12
2.1.4 DEVIATION FROM TEST STANDARD	12
2.1.5 TEST SETUP.....	13
2.1.6 EUT OPERATING CONDITIONS	13
2.1.7 TEST RESULTS	14
3 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB	18



RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
W7L-P22110028EM02	Original release	Dec. 08, 2022
W7L-P23030011EM02	Based on the original product change components and hardware version, The new sample Verify RE data.	Mar. 24, 2023



1 GENERAL INFORMATION

1.1 GENERAL DESCRIPTION OF EUT

PRODUCT	E Series Module	
BRAND NAME	Particle	
MODEL NAME	E404X	
NOMINAL VOLTAGE	5.0Vdc(adapter or host equipment) 3.8Vdc (Li-ion, battery)	
MODULATION TYPE	BLE	GFSK
	LTE	QPSK/16QAM
OPERATING FREQUENCY	BLE	2402MHz ~ 2480MHz
	LTE	1850.7MHz ~ 1909.3MHz (FOR LTE Band2) 1710.7MHz ~ 1754.3MHz (FOR LTE Band4) 824.7MHz ~ 848.3MHz (FOR LTE Band5) 699.7MHz ~ 715.3MHz (FOR LTE Band12) 779.5MHz ~ 784.5MHz (FOR LTE Band13)
HW VERSION	v1.0.0	
SW VERSION	V4.0.0	
I/O PORTS	Refer to user's manual	
CABLE SUPPLIED	N/A	
ACCESSORY DEVICES	Refer to note as below	

NOTE:

- For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
- Sample Information:

Sample Number	Description
Sample 1	Main test Sample(U11:TI - bq24195, U12:Richtek -RT5760CHGH6F)
Sample 2	Based on Sample 1 changed U11 to TI - bq24190
Sample 3	Based on Sample 1 changed U12 to TI - TLV62568
Sample 4	Based on Sample 1 changed U12 to MPS - MP1601GTF-Z



1.2 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: ICES-003 Issue 7			
Standard Section	Test Item	Result	Test lab*
ICES-003 Issue 7: 2020	Conducted Test	See Note	A
	Radiated Emission Test (30MHz ~ 1GHz)	Compliance	A
	Radiated Emission Test (Above 1GHz)	Compliance	A

NOTE: Please refer to the original report W7L-P22110028EM02, IC: 20127-E404X.

*Test Lab Information Reference

Lab A:

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

Accredited Test Lab Cert 3939.01

The IC Company Number is 21771; The CAB Identifier No. is CN0007



1.3 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
Radiated emissions	30MHz~1GHz	±4.98dB
	1GHz ~6GHz	±4.70dB
	6GHz ~18GHz	±4.60dB
	18GHz ~40GHz	±4.12dB



1.4 DESCRIPTION OF TEST MODES

Test Mode	Test Condition
Radiated emission test	
1	LTE B5 Idle + Battery + usb cable + BT Idle + Taoglas ANT + Adapter + Sample1 + SIM
2	LTE B12 Idle + Battery + usb cable + BT Idle + Taoglas ANT + Adapter + Sample1 + SIM
3	LTE B13 Idle + Battery + usb cable + BT Idle + Taoglas ANT + Adapter + Sample1 + SIM
4	Worst of 1-3 + PARTICLE ANT
5	Worst of 1-4 + Sample2(BQ24190)
6	Worst of 1-4 + Sample3
7	Worst of 1-4 + Sample4

NOTE: For radiated emission test, test mode 3 was the Worst case and only this mode was presented in this report



1.5 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.

FOR ALL TESTS

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	DC source	Kikusui/JP	PMX18-5A	0000001	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	DC Line: Unshielded, Detachable 1.0m



2 EMISSION TEST

2.1 RADIATED EMISSION MEASUREMENT

2.1.1 LIMITS OF RADIATED EMISSION MEASUREMENT

ICES-003 Table 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)	ICES-003, Class A	ICES-003, Class B	/	/
30-88	39	29.5	/	/
88-216	43.5	33.1		
216-230	46.4	35.6		
230-960	47.0	37.0	/	/
960-1000	49.5	43.5		
1000-3000	Avg: 49.5	Avg: 43.5	/	/
3000+	Peak: 69.5	Peak: 63.5	/	/

Radiated Emissions Limits at 3 meters (dBµV/m)				
Frequencies (MHz)	ICES-003, Class A	ICES-003, Class B	/	/
30-88	49.5	40	/	/
88-216	54	43.5		
216-230	56.9	46		
230-960	57.0	47.0	/	/
960-1000	60	54		
1000-3000	Avg: 60	Avg: 54	/	/
3000+	Peak: 80	Peak: 74	/	/



Frequency Range (For unintentional radiators)

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5 th harmonic of the highest frequency or 40GHz, 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. 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.
 4. QP detector shall be applied if not specified.
 5. FCC data meets IC limit requirements



2.1.2 TEST INSTRUMENTS

Frequency range below1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-CT0001143-1216	May. 19,20	May. 18,23
Bilog Antenna	ETS-LINDGREN	3143B	00161965	Mar. 05,23	Mar. 04,24
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Feb. 17,23	Feb. 16,24
Signal Pre-Amplifier	EMSI	EMC 9135	980249	May.12,22	May.11,23
E3 Test Software	E3	V 9.160323	N/A	N/A	N/A

Frequency range above 1GHz

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-CT0001143-1216	May. 19,20	May. 18,23
Horn Antenna	ETS-LINDGREN	3117	00168728	Mar. 05,23	Mar. 04,24
Horn Antenna (18GHz-40GHz)	N/A	QWH-SL-18-40-K-SG/QMS-00361	15433	Sep.04, 22	Sep.03, 23
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Feb. 17,23	Feb. 16,24
Signal Pre-Amplifier	EMSI	EMC 012645B	980257	May.12,22	May.11,23
Signal Pre-Amplifier	EMSI	EMC 184045B	980259	Feb. 17,23	Feb. 16,24
E3 Test Software	E3	V 9.160323	N/A	N/A	N/A

- NOTE:
1. The calibration interval of the above test instruments is 12 months or 36 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
 2. The test was performed in 3 Chamber.
 3. The IC Company Number is 21771; The CAB Identifier No. is CN0007.



2.1.3 TEST PROCEDURE

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

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters (below 1GHz) and 3 meters (above 1GHz) 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 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. 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 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 1 GHz.
- f. 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:

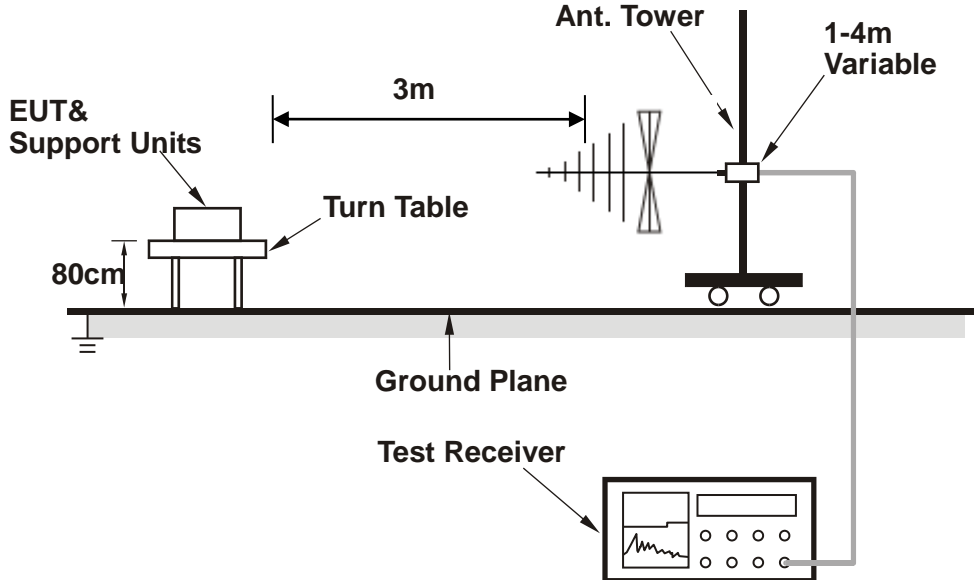
1. The resolution bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Average detection (AV) at frequency above 1GHz.
3. For measurement of frequency above 1000 MHz, the EUT was set 3 meters away from the receiver antenna.
4. $\text{Emission level(dBuV/m)} = \text{Raw Value(dBuV)} + \text{Correction Factor(dB/m)}$
5. $\text{Correction Factor(dB/m)} = \text{Antenna Factor (dB/m)} + \text{Cable Factor (dB)}$ (if the raw value not contains the amplifier);
6. $\text{Correction Factor(dB/m)} = \text{Antenna Factor (dB/m)} + \text{Cable Factor (dB)} - \text{Amplifier Gain(dB)}$ (if the raw value contains the amplifier)
7. $\text{Margin value} = \text{Emission level} - \text{Limit value}$.

2.1.4 DEVIATION FROM TEST STANDARD

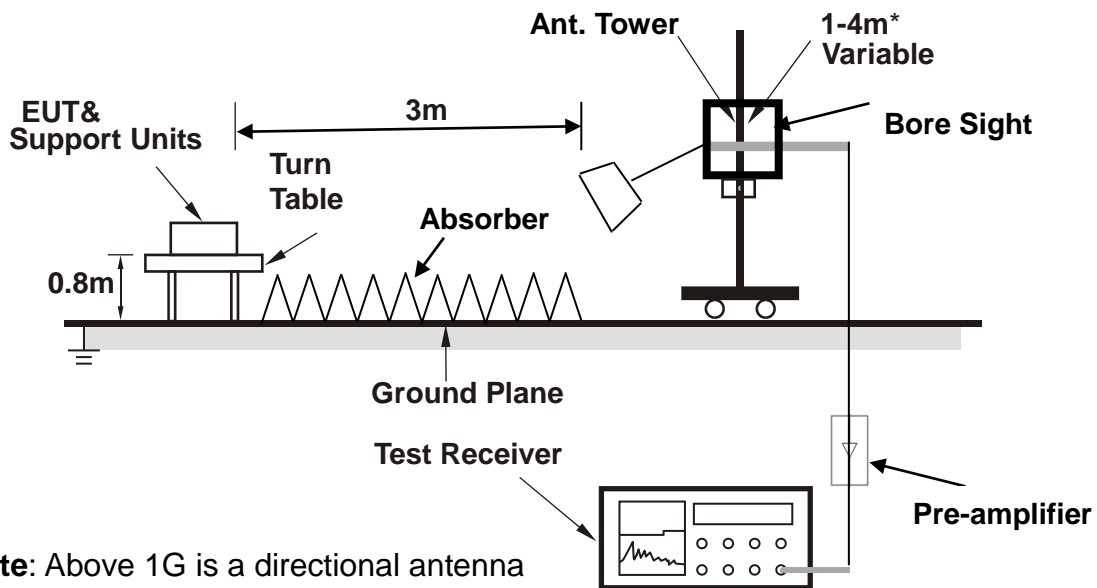
No deviation.

2.1.5 TEST SETUP

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



Note: Above 1G is a directional antenna

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

2.1.6 EUT OPERATING CONDITIONS

Same as item 2.1.6.



2.1.7 TEST RESULTS

Note: The FCC Limit meets the IC Limit requirements

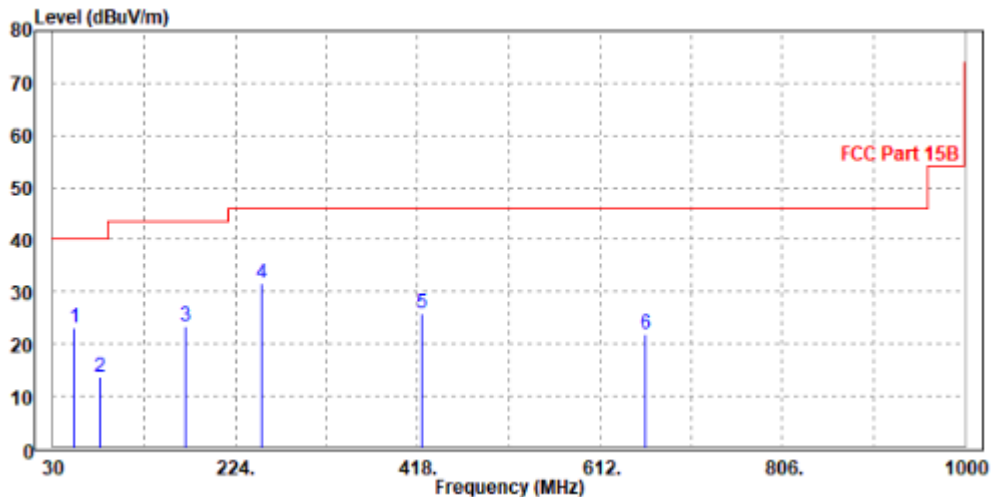
Worst case below 1G Data:

TEST VOLTAGE	Input 120 Vac, 60 Hz	FREQUENCY RANGE	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Quasi-Peak, 120 kHz
TESTED BY	Jace Hu		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dBuV/m	dB	dB/m		
1	52.310	23.20	49.81	40.00	-16.80	-26.61	Peak	Horizontal
2	79.470	13.68	42.47	40.00	-26.32	-28.79	Peak	Horizontal
3	171.620	23.35	47.91	43.50	-20.15	-24.56	Peak	Horizontal
4 PP	252.130	31.60	53.51	46.00	-14.40	-21.91	Peak	Horizontal
5	422.850	25.86	44.59	46.00	-20.14	-18.73	Peak	Horizontal
6	660.500	22.05	36.84	46.00	-23.95	-14.79	Peak	Horizontal

- 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.



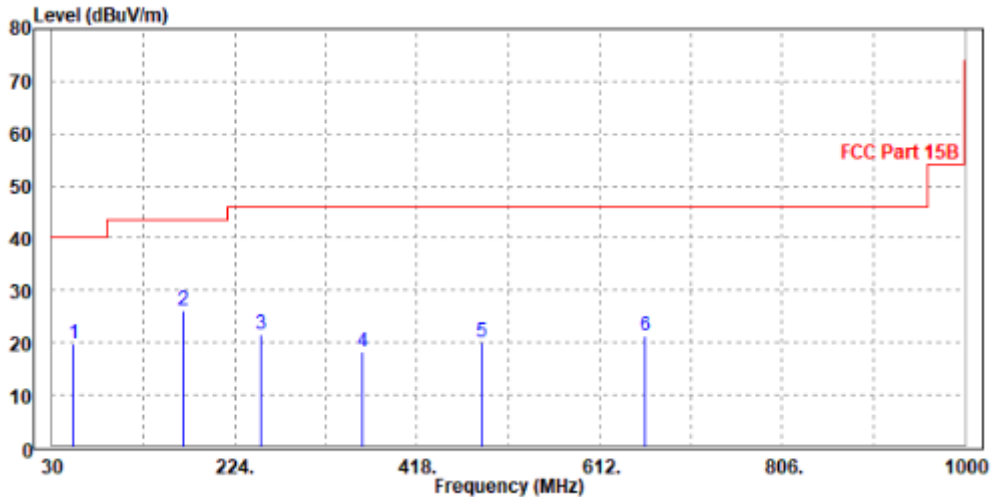


TEST VOLTAGE	Input 120 Vac, 60 Hz	FREQUENCY RANGE	30-1000 MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70 %RH	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Quasi-Peak, 120 kHz
TESTED BY	Jace Hu		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dBuV/m	dB	dB/m		
1	52.310	19.71	46.84	40.00	-20.29	-27.13	Peak	Vertical
2 PP	169.680	26.22	50.93	43.50	-17.28	-24.71	Peak	Vertical
3	252.130	21.53	44.30	46.00	-24.47	-22.77	Peak	Vertical
4	359.800	18.14	38.11	46.00	-27.86	-19.97	Peak	Vertical
5	486.870	19.93	37.89	46.00	-26.07	-17.96	Peak	Vertical
6	659.530	21.37	36.80	46.00	-24.63	-15.43	Peak	Vertical

- 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.



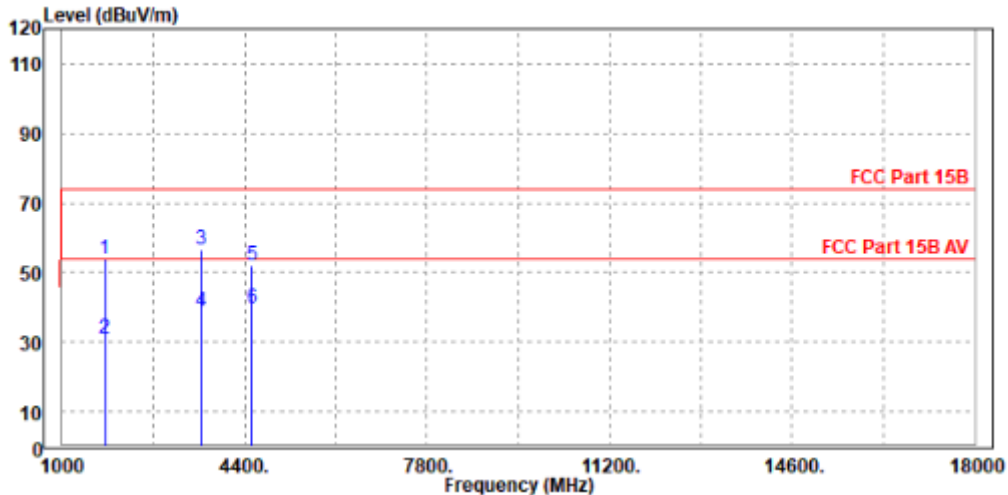


Worst case above 1G Data:

TEST VOLTAGE	Input 120 Vac, 60 Hz	FREQUENCY RANGE	1-18 GHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70 %RH	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Peak/Average, 1 MHz
TESTED BY	Jace Hu		

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
1799	53.73	62.32	74	-20.27	32.19	5.35	46.13	200	50	Peak
1799	31.06	39.65	54	-22.94	32.19	5.35	46.13	200	50	Average
3601	56.35	57.97	74	-17.65	35.96	7.93	45.51	200	35	Peak
3601	39	40.62	54	-15	35.96	7.93	45.51	200	35	Average
4536	51.8	50.79	74	-22.2	36.53	9.93	45.45	100	0	Peak
4536	39.63	38.62	54	-14.37	36.53	9.93	45.45	100	0	Average

- 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 5th harmonic of the highest frequency or 40GHz, whichever is lower. For frequency above 18GHz, the emission was tested 20db below the limit so the data not recorded in the sheet.
 4. Only emissions significantly above equipment noise floor are reported.

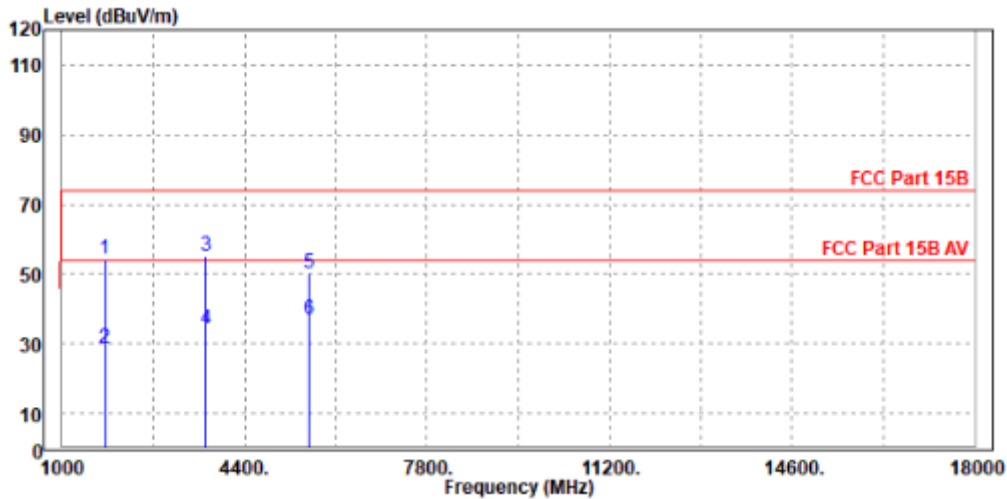




TEST VOLTAGE	Input 120 Vac, 60 Hz	FREQUENCY RANGE	1- 18GHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70 %RH	DETECTOR FUNCTION & RESOLUTION BANDWIDTH	Peak/Average, 1 MHz
TESTED BY	Jace Hu		

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
1799	54.21	63.83	74	-19.79	31.16	5.35	46.13	100	70	Peak
1799	28.63	38.25	54	-25.37	31.16	5.35	46.13	100	70	Average
3669	55.43	58.73	74	-18.57	34.27	7.91	45.48	100	360	Peak
3669	34.35	37.65	54	-19.65	34.27	7.91	45.48	100	360	Average
5607	50.06	50.04	74	-23.94	35.68	9.84	45.5	100	85	Peak
5607	36.96	36.94	54	-17.04	35.68	9.84	45.5	100	85	Average

- 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 5th harmonic of the highest frequency or 40GHz, whichever is lower. For frequency above 18GHz, the emission was tested 20db below the limit so the data not recorded in the sheet.
 4. Only emissions significantly above equipment noise floor are reported.





**BUREAU
VERITAS**

Test Report No.: W7L-P23030011EM02

3 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---