EMC TEST REPORT

Report No.:	20240917G17987X-W1
Product Name:	Beacon
FCC ID:	2AIDW-ZZ-H-2-001
IC ID:	21647-ZZH2001
Trade Name:	ZERO ZERO ROBOTICS
Model No. :	ZZ-H-2-001
Applicant:	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Address:	4th Floor,Qianhai E-metro Tower,Shenzhen-Hong Kong Cooperation Zone, Shenzhen,China
Received Date:	2024.09.10
Dates of Testing:	2024.09.11~2024.09.23
Issued by:	CCIC Southern Testing Co., Ltd.
Lab Location:	Electronic Testing Building, No.43, Shahe Road, Xili Street, Nanshan District, Shenzhen, Guangdong, China. **Tel:** 86-755-26627338 **E-Mail：** manager@ccic-set.com

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Test Report

Product Name.....	Beacon
Model No.	ZZ-H-2-001
Applicant.....	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Applicant Address.....	4th Floor,Qianhai E-metro Tower,Shenzhen-Hong Kong Cooperation Zone, Shenzhen,China
Manufacturer	Shenzhen Zero Zero Infinity Technology Co., Ltd.
Manufacturer Address	4th Floor,Qianhai E-metro Tower,Shenzhen-Hong Kong Cooperation Zone, Shenzhen,China
Test Standards.....	47 CFR Part 15 Subpart B ICES-003 Issue 7
Test Result.....	PASS

Tested by	Sun Jiaohui Sun Jiaohui, Test Engineer	2024.09.23
Reviewed by	Chris You Chris You, Senior Engineer	2024.09.23
Approved by	Wang Shijie Wang Shijie, Manager	2024.09.23

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Change History		
Issue	Date	Reason for change
1.0	2024.09.23	First edition

1. GENERAL INFORMATION

1.1 EUT Description

EUT Name.:	Beacon
Hardware Version:	RC100_MB_V20
Software Version:	0.0.3_20240923
Power Supply:	Battery Capacity: 940mAh, 3.62Wh Limited Charged Voltage: 3.85VDC DC 3.85V

Note1: The EUT is a Beacon;

Note2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.2 Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart B:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart B	Radio Frequency Devices
2	ICES-003 Issue 7	Information Technology Equipment (Including Digital Apparatus) — Limits and Methods of Measurement

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Result
1	15.107	Conducted Emission	PASS
2	15.109	Radiated Emission	PASS
3	ICES 003 Issue 7 Section3.2.1	Conducted Emission	PASS
4	ICES 003 Issue 7 Section3.2.2	Radiated Emission	PASS

NOTE:

（1）The EUT has been tested according to 47 CFR Part 15 Subpart B, Class B. The test procedure is according to ANSI C63.4:2014.

（2）The EUT has been tested according to ICES 003 Issue 7. The test procedure is according to ANSI C63.4:2014.

1.3 Facilities and Accreditations

1.3.1 Facilities

FCC-Registration No.: CN1283

CCIC Southern Testing Co., Ltd EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Designation Number: CN1283, valid time is until Jun 30th, 2025.

ISED Registration: 11185A-1

CCIC Southern Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on Aug. 04, 2016, valid time is until Jun 30th, 2025.

A2LA Code: 5721.01

CCIC-SET is a third party testing organization accredited by A2LA according to ISO/IEC 17025. The accreditation certificate number is 5721.01.

1.3.2 Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (℃):	15℃ - 35℃
Relative Humidity (%):	25% -75%
Atmospheric Pressure (kPa):	86kPa-106kPa

1.3.3 Measurement Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

Uncertainty of Conducted Emission:	Uc = 3.2 dB (k=2)
Uncertainty of Radiated Emission: (30MHz~1GHz)	Uc = 5.8 dB (k=2)
Uncertainty of Radiated Emission: (1~6GHz)	Uc = 5.1 dB (k=2)
Uncertainty of Radiated Emission: (6~18GHz)	Uc = 5.5 dB (k=2)

2. TEST CONDITIONS SETTING

2.1 Test Peripherals

The following is a listing of the EUT and peripherals utilized during the performance of EMC test:

Support Equipment:

Description	Brand name	Model	Serial No.	FCCID
Battery	/	ZZ-H-2-001-1	/	/
Battery	/	ZZ-H-2-001-2	/	/
Adapter	/	VC56JBCH	/	/

Support Cable：

Description	Shield Type	Ferrite Core	Length
AC Power Cable	Un- shielding	/	0.8m

2.2 Test Mode

The EUT is a Beacon; It could support the following operating mode and frequency band: 2.4G/5G WIFI; Bluetooth

The EUT have the following typical setups during the test:

Setup1: Bluetooth + Adapter + charger;

Setup2: 2.4G WIFI + Adapter + charger;

Setup3: 5G WIFI + Adapter + charger;

Setup4: Bluetooth + Battery (ZZ-H-2-001-1 + ZZ-H-2-001-2);

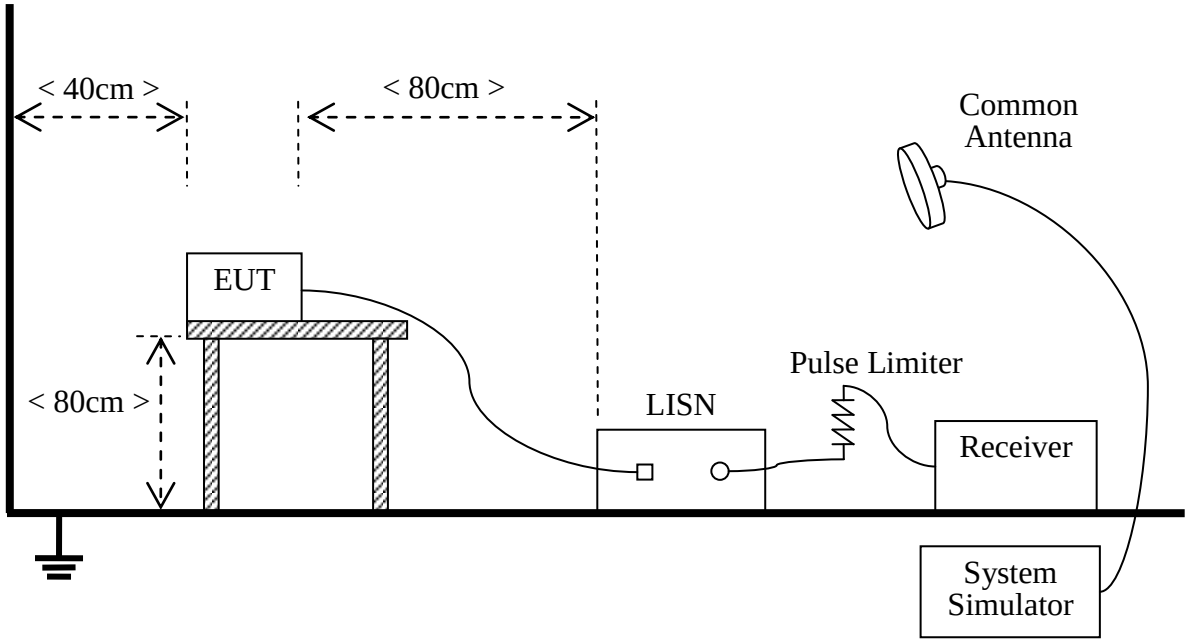
Setup5: 2.4G WIFI + Battery (ZZ-H-2-001-1 + ZZ-H-2-001-2);

Setup6: 5G WIFI + Battery (ZZ-H-2-001-1 + ZZ-H-2-001-2);

2.3 Test Setup and Equipments List

2.3.1 Conducted Emission

A. Test Setup:



The EUT is placed on a 0.8m high insulating table, which stands on the grounded conducting floor, and keeps 0.4m away from the grounded conducting wall. The EUT is connected to the power mains through a LISN which provides 50Ω/50μH of coupling impedance for the measuring instrument. The Common Antenna is used for the call between the EUT and the System Simulator (SS). A Pulse Limiter is used to protect the measuring instrument. The factors of the whole test system are calibrated to correct the reading.

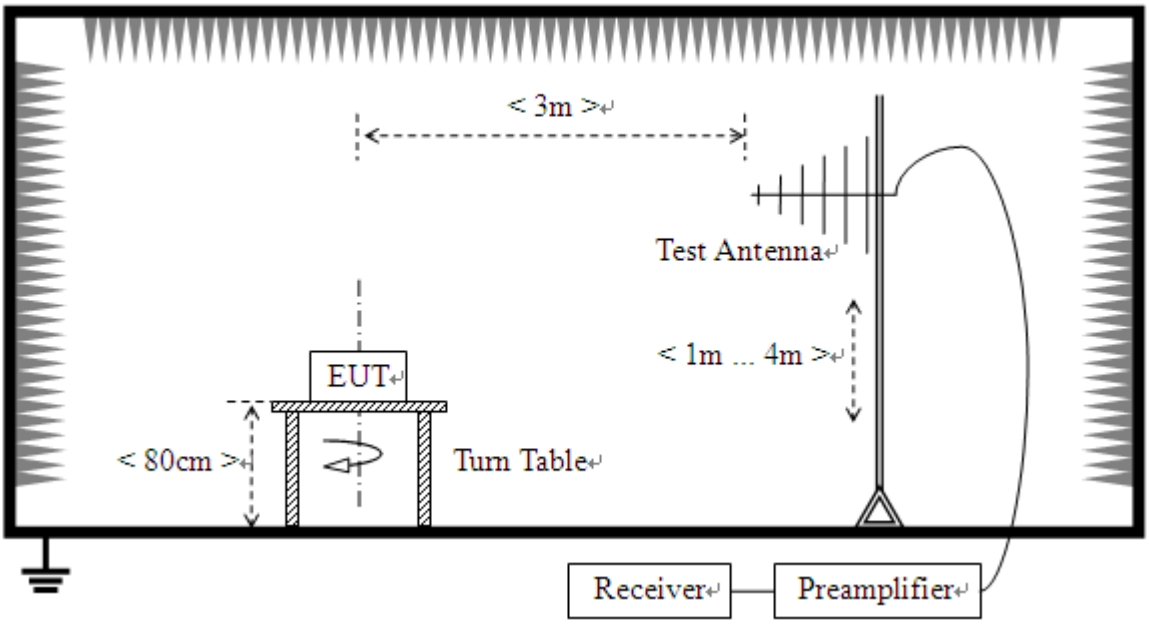
B. Equipments List:

Description	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due. Date
Test Receiver	KEYSIGHT	N9038A	A141202036	2024.06.05	2025.06.04
LISN	ROHDE&SCHWARZ	ENV216	A140701847	2024.05.23	2025.05.22
Cable	MATCHING PAD	W7	/	2024.08.02	2025.08.01

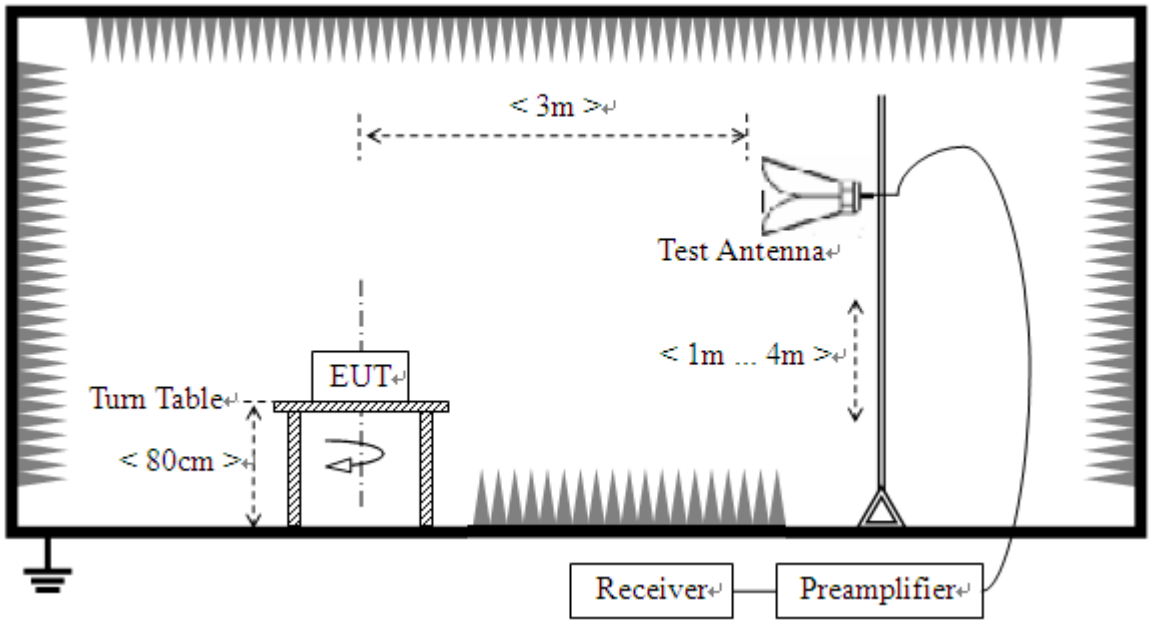
2.3.2 Radiated Emission

A. Test Setup:

1) For radiated emissions from 30MHz to1GHz



2) For radiated emissions above 1GHz



B. Test Procedure

The test is performed in a 3m Semi-Anechoic Chamber; the antenna factor, cable loss and so on of the site (factors) is calculated to correct the reading. The EUT is placed on a 0.8m high insulating Turn Table, and keeps 3m away from the Test Antenna, which is mounted on a variable-height antenna master tower.

For the test Antenna:

1) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.

C. Equipments List:

Description	Manufacturer	Model	Serial No.	Calibration Date	Calibration Due. Date
EMI Test Receiver	ROHDE&SCHWARZ	ESIB7	A0501375	2024.02.29	2025.02.28
Broadband Ant.	ETC	MCTD2786	A240204135	2024.01.19	2025.01.18
3M Anechoic Chamber	Albatross	SAC-3MAC 9*6*6m	A0412375	2024.02.28	2027.02.27
EMI Test Receiver	ROHDE&SCHWARZ	ESW26	A180502935	2024.05.24	2025.05.23
5M Anechoic Chamber	Albatross	SAC-5MAC 12.8x6.8x6.4m	A0304210	2024.08.02	2026.08.01
EMI Horn Ant.	ROHDE&SCHWARZ	HF906	A0304225	2022.04.12	2025.04.11

3. 47 CFR PART 15B REQUIREMENTS

3.1 Conducted Emission

3.1.1 Requirement

According to FCC section 15.107, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

Note:

a) The limit subjects to the Class B digital device.

b) The lower limit shall apply at the band edges.

c) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

3.1.2 Test Description

See section 2.3.1 of this report.

3.1.3 Test Result

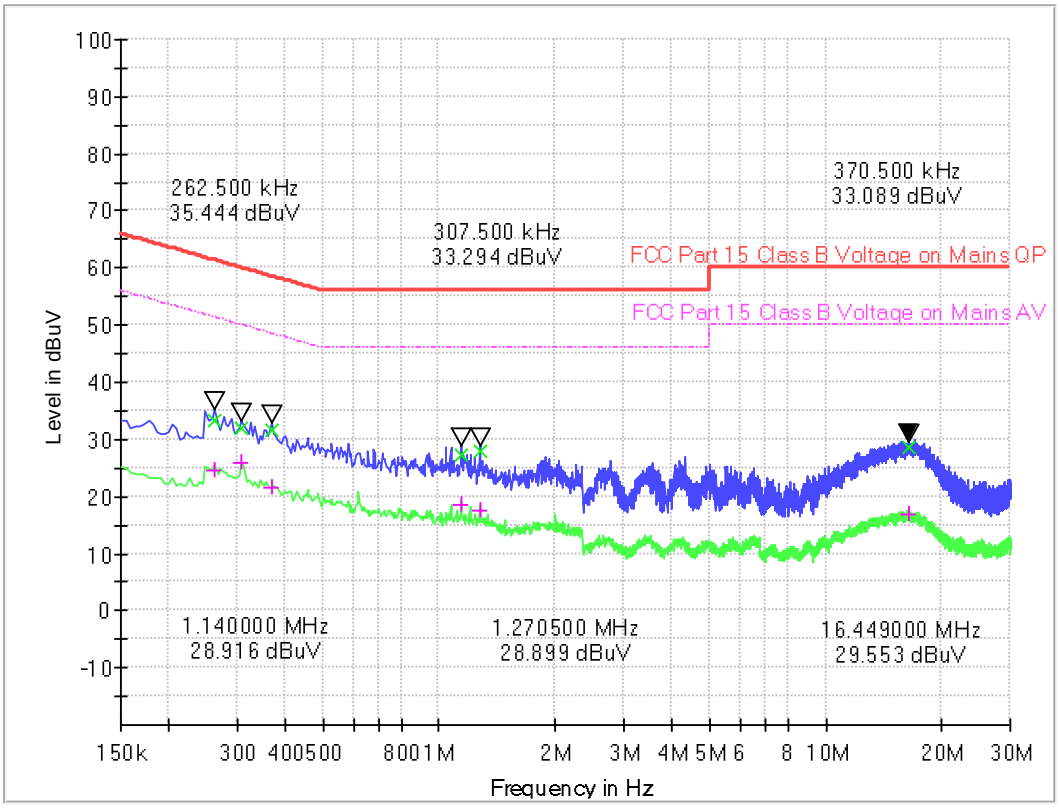
The maximum conducted interference is searched using Peak (PK), Quasi-peak (QP) and Average (AV) detectors; the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. All test modes are considered, refer to recorded points and plots below.

Note:

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a Nominal 230V AC, 50/60Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

Test voltage and frequency (230V AC, 60Hz)

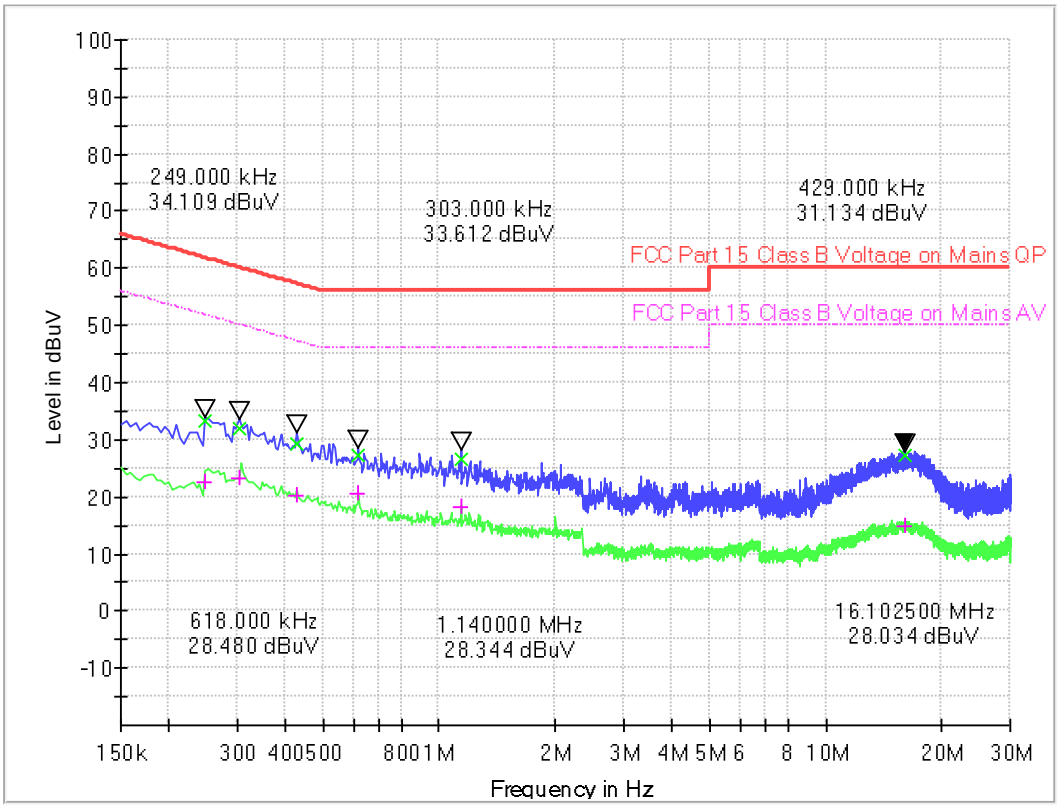
A. Mains terminal disturbance voltage, L phase, Setup 1



(Plot A: L Phase)

Frequency (MHz)	QuasiPeak (dB µ V)	CAverage (dB µ V)	Cabel Loss (dB)	Corr. (dB)	Margin - QPK	Limit - QPK	Margin - AV	Limit - AV (dB µ V)
0.262500	33.28	24.54	0.1	10.1	28.07	61.4	26.81	51.4
0.307500	31.96	25.93	0.1	10.1	28.08	60.0	24.11	50.0
0.370500	31.70	21.68	0.1	10.1	26.79	58.5	26.81	48.5
1.140000	27.11	18.69	0.2	10.2	28.89	56.0	27.31	46.0
1.270500	28.06	17.40	0.2	10.2	27.94	56.0	28.60	46.0
16.449000	28.61	16.70	0.5	10.5	31.39	60.0	33.30	50.0

B. Mains terminal disturbance voltage, N phase, Setup 1



(Plot B: N Phase)

Frequency (MHz)	QuasiPeak (dB µ V)	CAverage (dB µ V)	Cabel Loss (dB)	Corr. (dB)	Margin - QPK	Limit - QPK	Margin - AV	Limit - AV (dB µ V)
0.249000	33.31	22.58	0.1	10.1	28.48	61.8	29.21	51.8
0.303000	32.12	23.32	0.1	10.1	28.04	60.2	26.84	50.2
0.429000	29.20	20.25	0.1	10.1	28.07	57.3	27.02	47.3
0.618000	27.37	20.46	0.1	10.1	28.63	56.0	25.54	46.0
1.140000	26.75	18.36	0.2	10.2	29.25	56.0	27.64	46.0
16.102500	27.11	14.78	0.5	10.5	32.90	60.0	35.22	50.0

3.2 Radiated Emission

3.2.1 Requirement

According to FCC section 15.109, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency range (MHz)	Field Strength		Field Strength Limitation at 3m Measurement Dist	
	μV/m	Dist	(uV/m)	(dBuV/m)
30.0 - 88.0	100	3m	100	20log 100
88.0 - 216.0	150	3m	150	20log 150
216.0 - 960.0	200	3m	200	20log 200
Above 960.0	500	3m	500	20log 500

According to ICES-003 the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency range (MHz)	Field Strength Limitation at 3m Measurement Dist	
	Class A(3m) QP (dBμV/m)	Class B(3m) QP (dBμV/m)
30 - 88	49.0	40.0
88 - 216	53.5	43.5
216 - 230	56.5	46.0
230 - 960	56.5	47.0
960-1000	60.0	54.0
Frequency range (MHz)	Field Strength Limitation at 3m Measurement Dist	
	Class A(3m) (dBμV/m)	Class B(3m) (dBμV/m)
Above 1G	60(AV) /80(PK)	54(AV) /74(PK)

a) For frequencies above 1000MHz, the field strength limits are based on average detector. When average radiated emission measurements are specified in this part, including emission measurements below 1000MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

b) Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

c) For below 1G: QP detector RBW 120 kHz, VBW 300 kHz.

For Above 1G: PK detector RBW 1MHz, VBW 3MHz for PK value; AV detector RBW 1MHz, VBW 10Hz for AV value.

Note:

1) The tighter limit shall apply at the boundary between two frequency range.
2) Limitation expressed in dBuV/m is calculated by 20log Emission Level(uV/m).
3) If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula of Ld1 = Ld2 * $(d2/d1)^{2.}$
   Example:
   F.S Limit at 30m distance is 30uV/m, then F.S Limitation at 3m distance is adjusted as
   Ld1 = L1 = 30uV/m * $(10)^2$ = 100 * 30uV/m.

3.2.2 Test Description

See section 2.3.2 of this report.

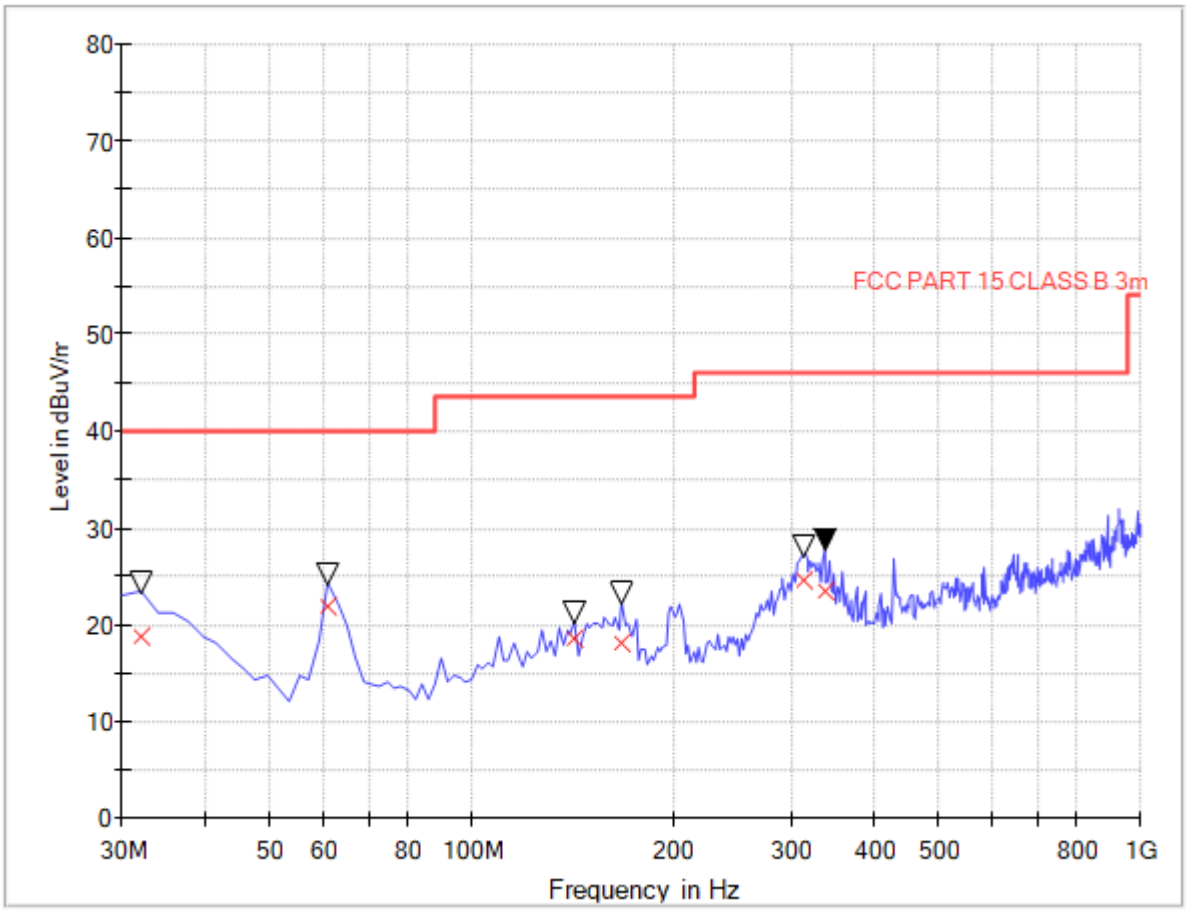
3.2.3 Test Result

The maximum radiated emission is searched using PK, QP and AV detectors; the emission levels more than the limits, and that have narrow margins from the limits will be re-measured with AV and QP detectors. Both the vertical and the horizontal polarizations of the Test Antenna are considered to perform the tests. All test modes are considered, refer to recorded points and plots below.

The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

Note: All radiated emission tests were performed in X, Y, Z axis direction, and only the worst axis test condition was recorded in this test report.

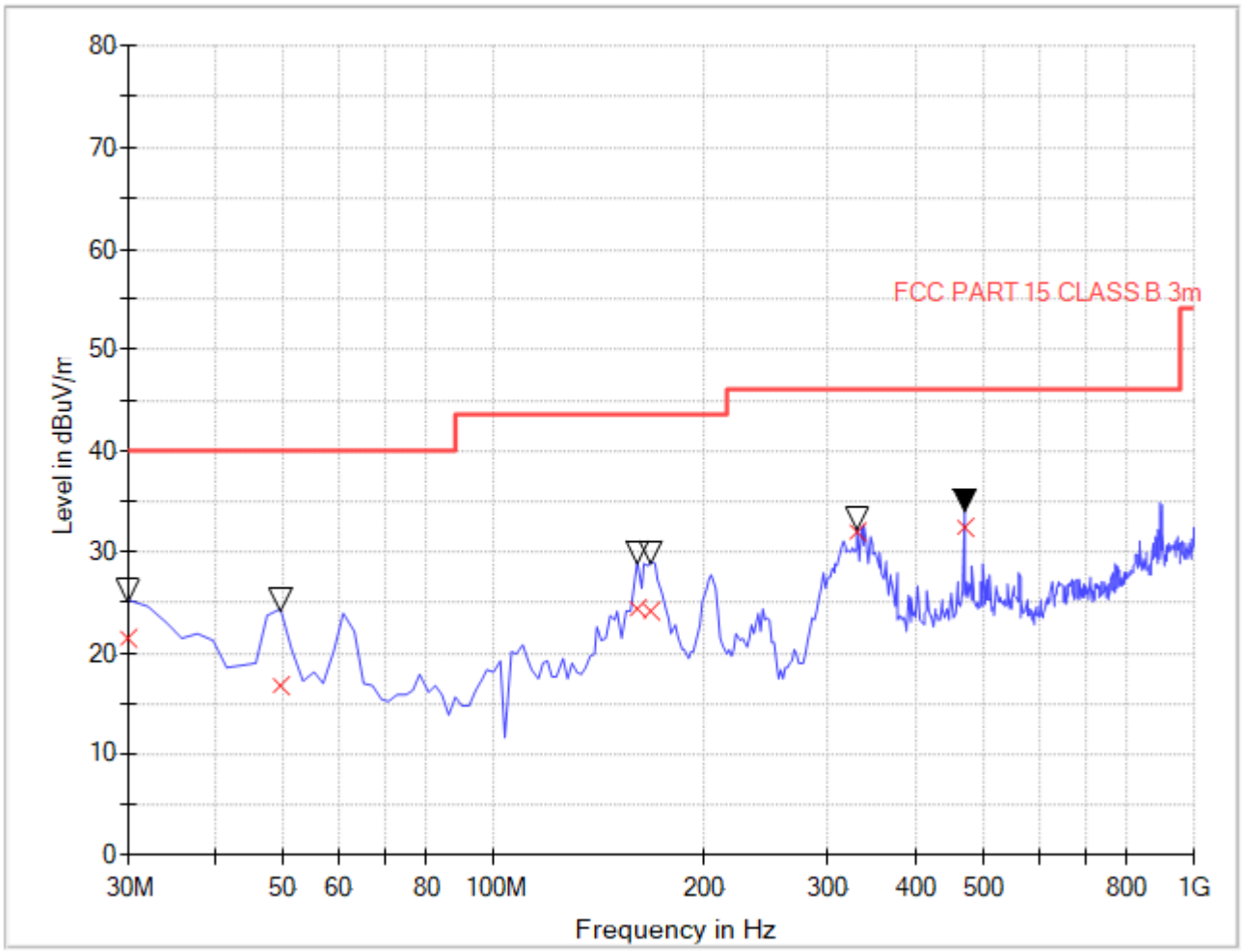
A. Radiation disturbances, antenna polarization: Horizontal, Setup1



(Plot C: Test Antenna Horizontal 30M - 1G)

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dBµV/m)	Margin (dB)	Antenna	Cable Loss(dB)	ANT. Factor(dB)	Verdict
31.94	18.71	120.000	106	40.0	21.29	Horizontal	0.5	18.2	Pass
61.10	21.95	120.000	103	40.0	18.05	Horizontal	0.8	5.4	Pass
142.74	18.51	120.000	108	43.5	24.99	Horizontal	1.0	11.5	Pass
168.01	18.07	120.000	104	43.5	25.43	Horizontal	1.2	10.8	Pass
313.80	24.61	120.000	103	46.0	21.39	Horizontal	1.4	14.5	Pass
337.13	23.53	120.000	105	46.0	22.47	Horizontal	1.4	15.1	Pass

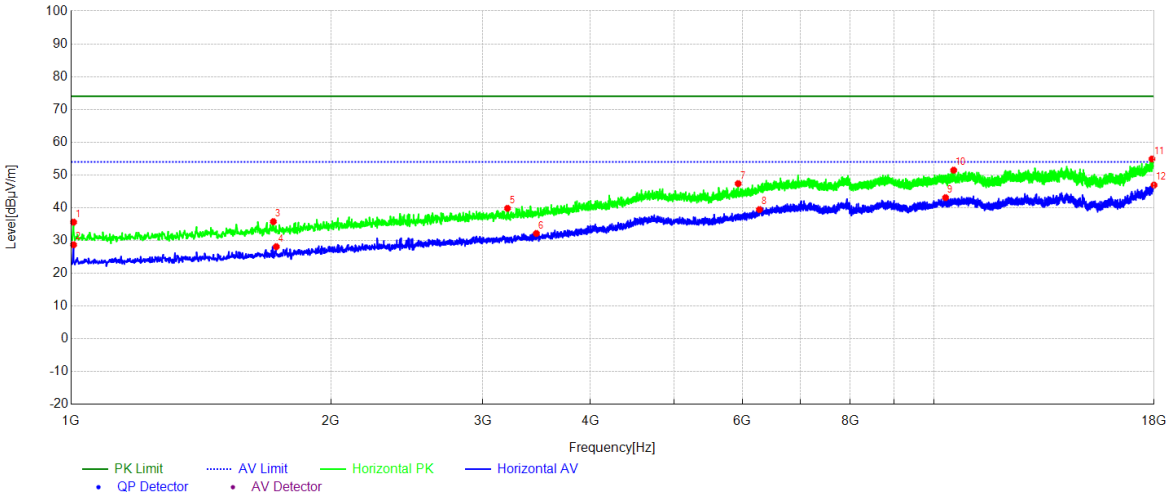
B. Radiation disturbances, antenna polarization: Vertical, Setup1



(Plot D: Test Antenna Vertical 30M - 1G)

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dBµV/m)	Margin (dB)	Antenna	Cable Loss(dB)	ANT. Factor(dB)	Verdict
30.00	21.54	120.000	105	40.0	18.46	Vertical	0.5	18.8	Pass
49.44	16.65	120.000	102	40.0	23.35	Vertical	0.5	8.2	Pass
160.24	24.32	120.000	107	43.5	19.18	Vertical	1.2	11.4	Pass
168.00	24.24	120.000	106	43.5	19.26	Vertical	1.2	10.8	Pass
331.32	31.92	120.000	109	46.0	14.08	Vertical	1.4	15.0	Pass
469.32	32.40	120.000	101	46.0	13.60	Vertical	1.5	17.6	Pass

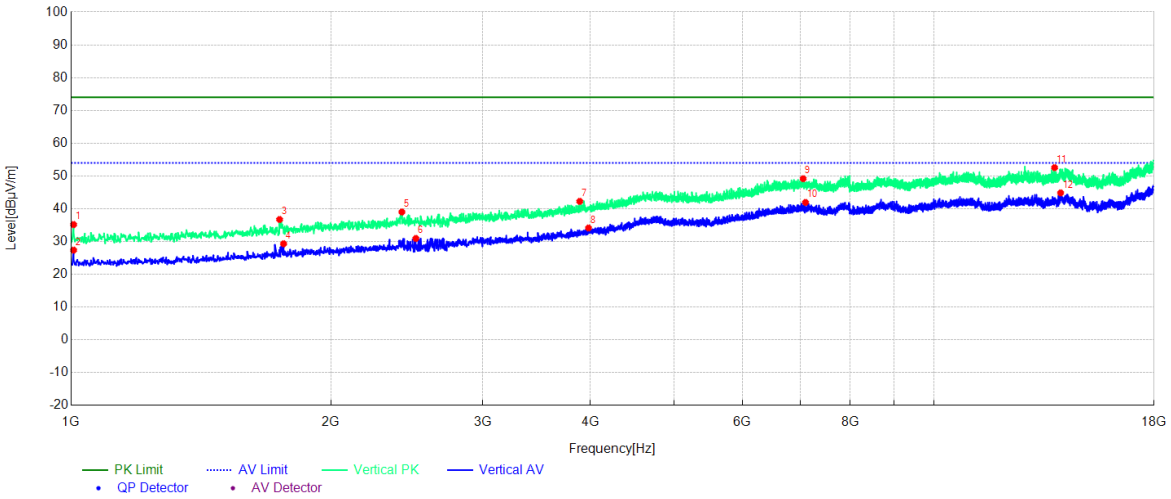
A. Radiation disturbances, antenna polarization: Horizontal, Setup1



(Plot M: Test Antenna Horizontal 1G – 18G)

NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin[dB µV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1006.80	35.61	-15.37	74.00	38.39	PK	107	275	Horizontal
2	1006.80	28.71	-15.37	54.00	25.29	AV	102	133	Horizontal
3	1715.77	35.76	-13.18	74.00	38.24	PK	103	78	Horizontal
4	1729.37	28.14	-13.10	54.00	25.86	AV	109	262	Horizontal
5	3205.12	39.82	-7.94	74.00	34.18	PK	105	294	Horizontal
6	3461.85	32.16	-7.36	54.00	21.84	AV	101	286	Horizontal
7	5932.19	47.37	0.13	74.00	26.63	PK	103	193	Horizontal
8	6279.03	39.44	1.56	54.00	14.56	AV	106	142	Horizontal
9	10316.93	43.08	5.70	54.00	10.92	AV	102	18	Horizontal
10	10544.75	51.46	6.26	74.00	22.54	PK	107	294	Horizontal
11	17897.99	54.87	14.64	74.00	19.13	PK	104	143	Horizontal
12	17996.60	46.91	14.85	54.00	7.09	AV	102	34	Horizontal

B. Radiation disturbances, antenna polarization: Vertical, Setup1



(Plot N: Test Antenna Vertical 1G – 18G)

NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin[dBµV/m]	Trace	Height [cm]	Angle [°]	Polarity
1	1006.80	35.18	-15.37	74.00	38.82	PK	102	293	Vertical
2	1006.80	27.38	-15.37	54.00	26.62	AV	108	47	Vertical
3	1744.67	36.73	-13.03	74.00	37.27	PK	106	42	Vertical
4	1763.38	29.32	-12.93	54.00	24.68	AV	103	285	Vertical
5	2417.94	39.01	-10.58	74.00	34.99	PK	105	251	Vertical
6	2509.75	30.94	-10.21	54.00	23.06	AV	101	317	Vertical
7	3886.89	42.26	-5.52	74.00	31.74	PK	107	273	Vertical
8	3978.70	34.14	-4.96	54.00	19.86	AV	103	229	Vertical
9	7056.01	49.17	3.39	74.00	24.83	PK	104	192	Vertical
10	7100.21	41.93	3.43	54.00	12.07	AV	109	68	Vertical
11	13802.28	52.55	9.42	74.00	21.45	PK	102	156	Vertical
12	14026.70	44.84	9.41	54.00	9.16	AV	106	182	Vertical

-----End of Report-----