

FCC Test Report

Product Name : peplink PEPWAVE Wireless Product
Model No. : Balance 20X Pro, BPL-021X-PRO-LTEA-Q-T-PRM
FCC ID : U8G-P1AX19

Applicant : PISMO LABS TECHNOLOGY LIMITED
Address : A8, 5/F, HK Spinners Industrial Building, Phase 6, 481
Castle Peak Road, Cheung Sha Wan, Hong Kong

Date of Receipt : 2022/07/06
Issued Date : 2022/10/17
Report No. : 2270136R-E3012110001-A
Report Version : V2.0



The test results relate only to the samples tested.
The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.
This report must not be used to claim product endorsement by TAF or any agency of the government.
The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

Issued Date : 2022/10/17
Report No. : 2270136R-E3012110001-A



Product Name : peplink PEPWAVE Wireless Product
Applicant : PISMO LABS TECHNOLOGY LIMITED
Address : A8, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Hong Kong
Manufacturer : PISMO LABS TECHNOLOGY LIMITED
Model No. : Balance 20X Pro, BPL-021X-PRO-LTEA-Q-T-PRM
FCC ID : U8G-P1AX19
EUT Rated Voltage : DC 10-30V, 25W
EUT Test Voltage : AC 120 V / 60 Hz
Trade Name : PEPWAVE / peplink
Applicable Standard : FCC CFR Title 47 Part 15 Subpart B: 2020, Class A
Test Result : Complied
Performed Location : DEKRA Testing and Certification Co., Ltd.
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Approved By : 
(Director / Vincent Lin)

Laboratory Information

We, **DEKRA Testing and Certification Co., Ltd.**, are an independent EMC and safety consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted (audited or listed) by the following related bodies in compliance with ISO 17025, EN 45001 and specified testing scopes:

Taiwan	:	BSMI, NCC, TAF
Norway	:	DNVGL
USA	:	FCC
Japan	:	VCCI

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site : <http://www.dekra.com.tw>

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Product Photos: Please refer to the file: 2270136R-Product Photos

Revision History

Report No.	Version	Description	Issued Date
2270136R-E3012110001-A	V1.0	Initial issue of report	2022-08-02
2270136R-E3012110001-A	V2.0	Report plus FCC ID	2022-10-17

1. General Information

1.1. EUT Description

Product Name	peplink PEPWAVE Wireless Product
Trade Name	PEPWAVE / peplink
Model No.	Balance 20X Pro, BPL-021X-PRO-LTEA-Q-T-PRM
EUT Max Frequency	5.8GHz

Component	
GPS Cable	Shielded, 5.0m
Power Adapter	MFR: DEE VAN ENTERPRISE CO.,LTD. M/N: DSA-36PFN-12 FUS 120300 INPUT: 100-240V~, 50/60Hz, 1.0A OUTPUT: 12.0V=3.0A Cable Out: Shielded, 1.5m.

Note: The EUT is including two models for different marketing requirement.

1.2. Mode of Operation

DEKRA has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

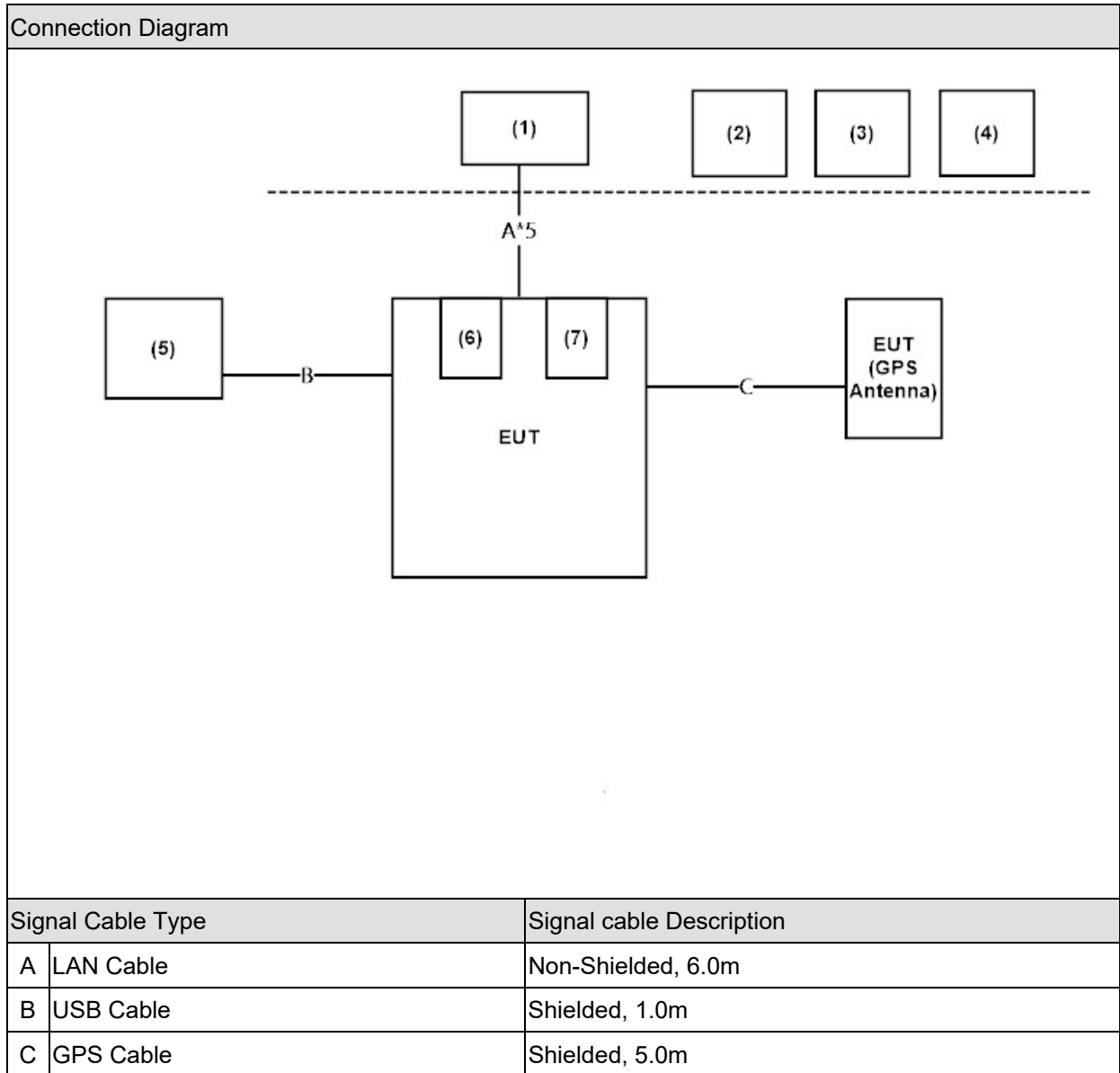
Pre-Test Mode	
Mode 1: Normal Operation(WWAN Worst Band LTE B1+ GPS + WiFi 5G + Ethernet LAN & WAN port link + USB)	
Mode 2: Normal Operation(WWAN Worst Band LTE B1 + GPS + WiFi 2.4G + Ethernet LAN & WAN port link + USB)	
Final Test Mode	
Emission	Mode 1: Normal Operation(WWAN Worst Band LTE B1+ GPS + WiFi 5G + Ethernet LAN & WAN port link + USB)

1.3. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord	
1	SERVER	Lenovo	5464	5464AC1-J30TX1T	Non-Shielded, 1.8m
2	Notebook PC	DELL	Latitude 5580	GDZN7H2	Non-Shielded, 1.8m
3	Base Station	R&S	CMW500	152861	Non-Shielded, 1.8m
4	GPS Simulator	Oroila	GSG-5	202350	Non-Shielded, 1.8m
5	LOAD	N/A	N/A	N/A	N/A
6	SIM	SIM	SIM-01	SIM-01	N/A
7	SIM	R&S	GP CMW-Z06	113706	N/A

1.4. Configuration of Tested System



Note:

- Use Full system setup configuration determines Worst-Case Mode.
- Use 2dB law program determines Max. Cable Configuration and Worst-Case Mode.
- Radiated emission item test: Performed using the Horn Antenna 3dB Beamwidth to 3m from the EUT size sufficient to cover the procedure.
- Radiated emission item test: Performed using the Horn Antenna 3dB Beamwidth non 3m distance sufficient to cover the size of the EUT program.

1.5. EUT Exercise Software

1	Setup the EUT and simulators as shown on 1.4.
2	Turn on the power of all equipment.
3	All the features of the EUT operation normally.

2. Technical Test

2.1. Summary of Test Result

- No deviations from the test standards
- Deviations from the test standards as below description:

Emission			
Performed Item	Normative References	Test Performed	Deviation
Conducted Emission	FCC CFR Title 47 Part 15 Subpart B: 2020, Class A CISPR 22: 2008 ANSI C63.4-2014, ANSI C63.4a-2017	Yes	No
Radiated Emission	FCC CFR Title 47 Part 15 Subpart B: 2020, Class A CISPR 22: 2008 ANSI C63.4-2014, ANSI C63.4a-2017	Yes	No

2.2. List of Test Equipment

Conducted Emission / LK-SR08 (SR8)

Instrument	Manufacturer	Type No.	Serial No	Cal. Date	Due. Date
EMI Test Receiver	R&S	ESR3	101973	2021/11/12	2022/11/11
Two-Line V-Network	R&S	ENV216	101479	2021/08/13	2022/08/12
Two-Line V-Network	R&S	ENV216	100097	2022/05/05	2023/05/04
Coaxial Cable	SUHNER	RG 400	LC018-RG	2022/06/17	2023/06/16
Test Software version : DEKRA Test System V2.0					

Note:Test Receiver Detector:Quasipeak and Average Bandwidth:9kHz

Radiated Emission / LK-Site03 (Site3)

Instrument	Manufacturer	Type No.	Serial No	Cal. Date	Due. Date
Trilog-Broadband Antenna	Schwarzbeck	VULB 9168	1123	2022/05/19	2023/05/18
EMI Test Receiver	R&S	ESCS 30	100368	2021/11/08	2022/11/07
Coaxial Cable	SUHNER	RG 214	LC003A-RG LC003B-RG	2022/06/10	2023/06/09
Coaxial Switch	Anritsu	MP59B	6201415889	2022/06/10	2023/06/09
Preamplifier	Jet-Power	JPA-10M1G33	170101000330010	2022/06/10	2023/06/09
NSA	DEKRA	N/A	N/A	2022/06/10	2023/06/09
Test Software version : DEKRA Test System V2.0					

Note:Test Receiver Detector:Quasipeak Bandwidth:120kHz

Radiated Emission (Above 1GHz) / LK-CB05 (CB7) (Up to 40GHz)

Instrument	Manufacturer	Type No.	Serial No	Cal. Date	Due. Date
Double Ridged Guide Horn Antenna	ETS-Lindgren	3117	00202723	2021/10/12	2022/10/11
Horn Antenna	COM-POWER	AH-840	101043	2022/05/14	2023/05/13
EMI Test Receiver	R&S	ESU26	100433	2022/01/12	2023/01/11
Signal Analyzer	R&S	FSV40	101176	2022/05/25	2023/05/24
Coaxial Cable	SUHNER	SUCOFLEX 104	LC034-SF	2022/06/20	2023/06/19
Coaxial Cable	ROSNOL	R-Test EW0630	LC046-SF	2022/06/20	2023/06/19
Coaxial Cable	ROSNOL	MP533A	AC031-MP	2022/06/20	2023/06/19
Microwave Preamplifier	EMCI	EMC051845SE	980359	2021/12/14	2022/12/13
Microwave Preamplifier with cable	EMCI	EMC184045SE	980370	2022/04/07	2023/04/06
VSWR	DEKRA	N/A	N/A	2022/06/21	2023/06/20
Test Software version : DEKRA Test System V2.0					

2.3. Measurement Uncertainty

Conducted Emission

The measurement uncertainty is evaluated as ± 3.49 dB.

Radiated Emission(Under 1GHz)

The measurement uncertainty is evaluated as ± 5.16 dB.

Radiated Emission(Above 1GHz)

The measurement uncertainty is evaluated as ± 4.88 dB.

2.4. Test Environment

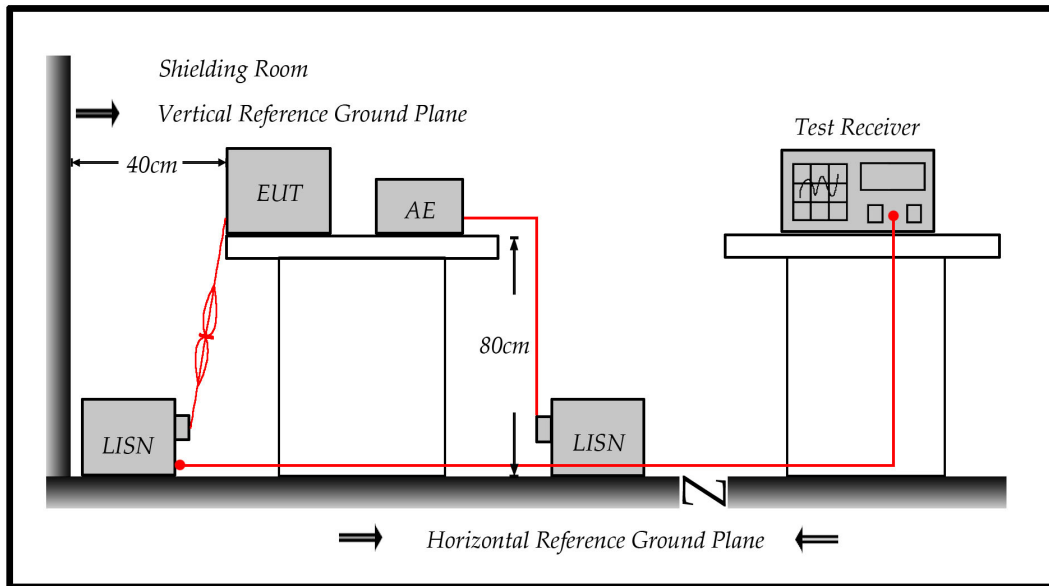
Performed Item	Items	Required
Conducted Emission	Temperature (°C)	10-40
	Humidity (%RH)	10-90
Radiated Emission	Temperature (°C)	10-40
	Humidity (%RH)	10-90

3. Conducted Emission

3.1. Test Specification

According to Standard : FCC Part 15 Subpart B

3.2. Test Setup



3.3. Limit

Conducted emissions limits (AC mains power terminals)				
Frequency range (MHz)	Class A Quasi-peak (dBuV)	Class A Average (dBuV)	Class B Quasi-peak (dBuV)	Class B Average (dBuV)
0.15 - 0.5	79	66	66 to 56	56 to 46
0.5 - 5	73	60	56	46
5 - 30	73	60	60	50

Note:

1. The more stringent limit applies at transition frequencies.
2. The limit level in dBuV decreases linearly with the logarithm of frequency

3.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination.

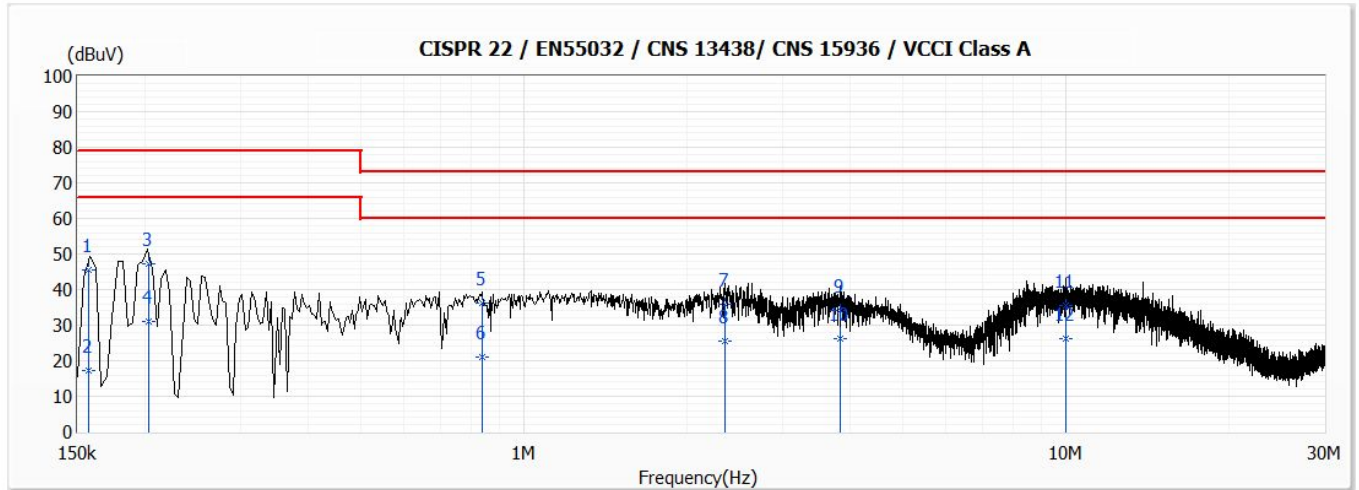
(Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

3.5. Test Result

Model No	Balance 20X Pro	Site	SR8
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Gary Luo
Phase	L1	Temperature (°C)	25.9
Test Condition	--	Humidity (%RH)	52

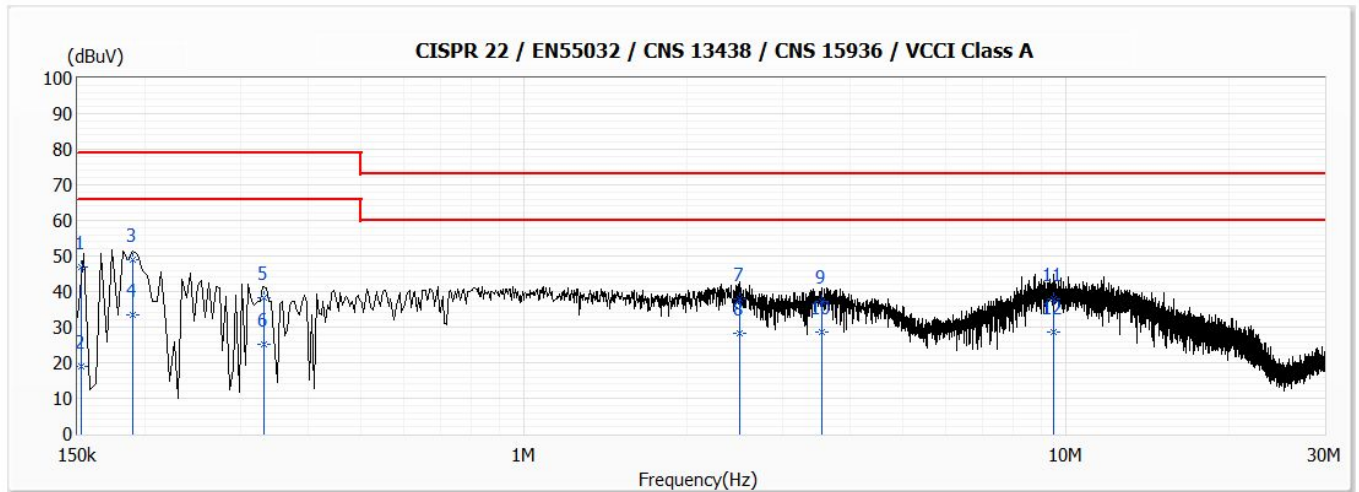


No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.157	45.45	79.00	-33.55	35.83	9.62	QP
2	0.157	17.25	66.00	-48.75	7.63	9.62	AV
*3	0.203	47.25	79.00	-31.75	37.63	9.62	QP
4	0.203	30.92	66.00	-35.08	21.30	9.62	AV
5	0.837	36.18	73.00	-36.82	26.50	9.68	QP
6	0.837	20.98	60.00	-39.02	11.30	9.68	AV
7	2.343	35.88	73.00	-37.12	26.15	9.73	QP
8	2.343	25.47	60.00	-34.53	15.74	9.73	AV
9	3.839	34.16	73.00	-38.84	24.37	9.79	QP
10	3.839	26.33	60.00	-33.67	16.54	9.79	AV
11	10.008	35.62	73.00	-37.38	25.67	9.95	QP
12	10.008	26.27	60.00	-33.73	16.32	9.95	AV

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=LISN Factor+Cable Loss).
3. Margin=Emission Level-Limit

Model No	Balance 20X Pro	Site	SR8
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Gary Luo
Phase	N	Temperature (°C)	25.9
Test Condition	--	Humidity (%RH)	52



No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.153	46.81	79.00	-32.19	37.19	9.62	QP
2	0.153	18.87	66.00	-47.13	9.25	9.62	AV
*3	0.190	48.81	79.00	-30.19	39.19	9.62	QP
4	0.190	33.57	66.00	-32.43	23.95	9.62	AV
5	0.330	38.33	79.00	-40.67	28.70	9.63	QP
6	0.330	25.17	66.00	-40.83	15.54	9.63	AV
7	2.499	37.97	73.00	-35.03	28.24	9.73	QP
8	2.499	28.38	60.00	-31.62	18.65	9.73	AV
9	3.537	37.21	73.00	-35.79	27.43	9.78	QP
10	3.537	28.46	60.00	-31.54	18.68	9.78	AV
11	9.468	37.87	73.00	-35.13	27.92	9.95	QP
12	9.468	28.52	60.00	-31.48	18.57	9.95	AV

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=LISN Factor+Cable Loss).
3. Margin=Emission Level-Limit

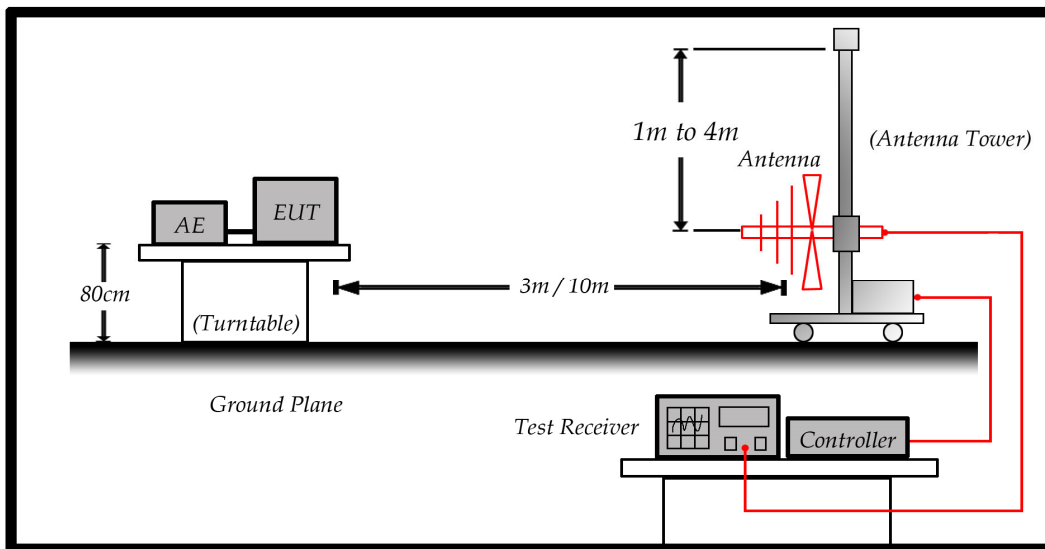
4. Radiated Emission

4.1. Test Specification

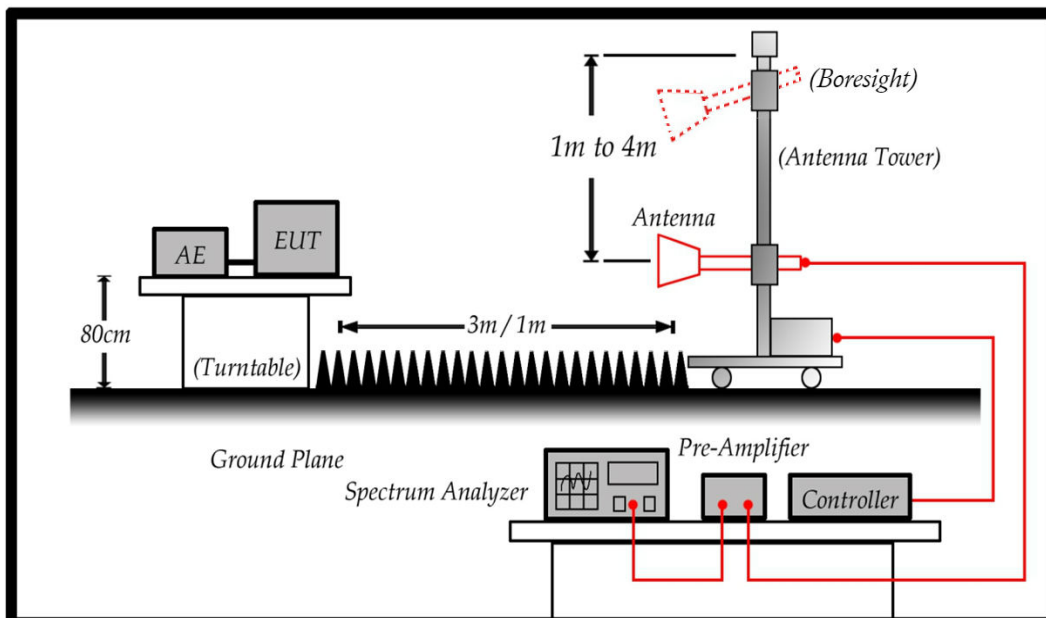
According to EMC Standard : FCC Part 15 Subpart B

4.2. Test Setup

Under 1GHz Test Setup:



Above 1GHz Test Setup:



4.3. Limit

Test shall not exceed the following value:

FCC Part 15 Subpart B Paragraph 15.109 Limits (dBuV/m)		
Frequency (MHz)	Distance(m)	dBuV/m
30-88	10	39
88-216	10	43.5
216-960	10	46.4
960-1000	10	49.5
1000-40000	3	60
18000-40000	1	69.5

Remark:

1. The tighter limit shall apply at the edge between two frequency bands.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
3. $RF\ Voltage\ (dBuV/m) = 20\ \log\ RF\ Voltage\ (\mu V/m)$

4.4. Test Procedure

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground.

The turn table can rotate 360 degrees to determine the position of the maximum emission level and the antenna (boresight antenna tower) can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated on radiated measurement.

For an unintentional radiator, including a digital device, the spectrum shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

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 40 GHz, whichever is lower

On any frequency or frequencies below or equal to 1000MHz, the radiated limits shown are based on measuring equipment employing a quasi-peak detector function and above 1000MHz, the radiated limits shown are based measuring equipment employing an average detector function.

When average radiated emission measurement are included emission measurement Above 1000MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

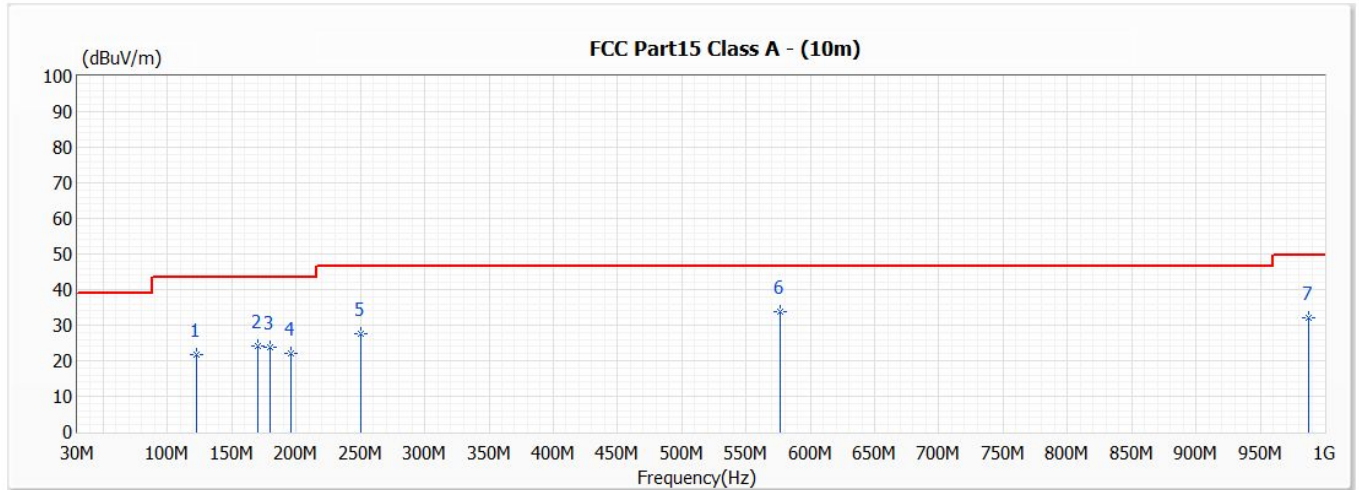
For class A, the measurement distance between the EUT and antenna is 10 meters for under 1GHz and above 1GHz.

For class B, the measurement distance between the EUT and antenna is 10 meters for under 1GHz and 3 meters for above 1GHz.

The bandwidth below 1GHz setting on the field strength meter (Test Receiver) is 120kHz

4.5. Test Result

Model No	Balance 20X Pro	Site	SITE3
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Cloud Hsieh
Polarity	Horizontal	Temperature (°C)	33
Test Condition	--	Humidity (%RH)	41

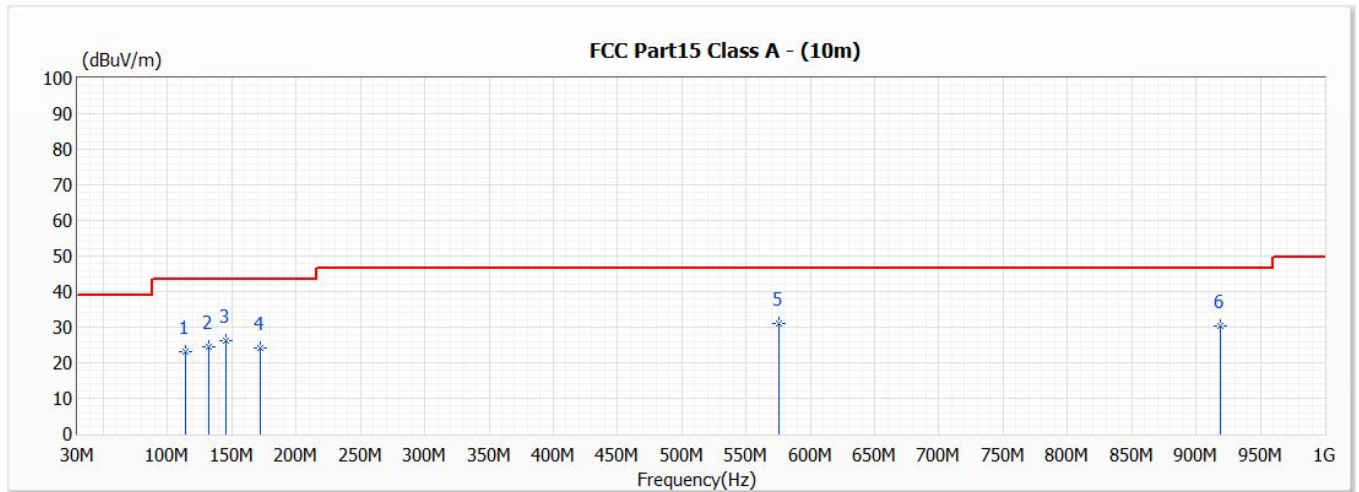


No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Ant Pos (cm)	TT Pos (deg)	Detector Type
1	122.700	21.56	43.50	-21.94	34.90	-13.34	370	-85	QP
2	169.900	24.18	43.50	-19.32	35.40	-11.22	370	-193	QP
3	179.600	23.69	43.50	-19.81	35.80	-12.11	370	33	QP
4	196.300	21.97	43.50	-21.53	35.40	-13.43	370	158	QP
5	250.000	27.69	46.40	-18.71	38.90	-11.21	370	-103	QP
* 6	576.200	33.73	46.40	-12.67	35.10	-1.37	200	-103	QP
7	987.700	32.01	49.50	-17.49	23.90	8.11	100	32	QP

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=Ant Factor+Cable Loss-Pre Amp).
3. Margin=Emission Level-Limit.

Model No	Balance 20X Pro	Site	SITE3
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Cloud Hsieh
Polarity	Vertical	Temperature (°C)	33
Test Condition	--	Humidity (%RH)	41

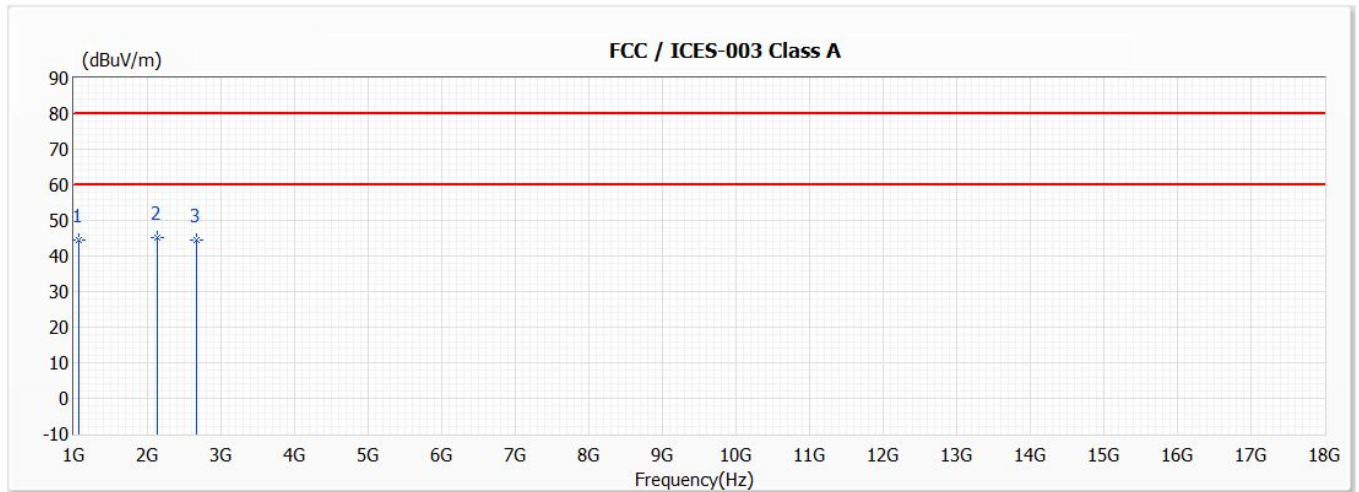


No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Ant Pos (cm)	TT Pos (deg)	Detector Type
1	113.900	23.23	43.50	-20.27	37.30	-14.07	100	-144	QP
2	131.600	24.55	43.50	-18.95	36.90	-12.35	100	32	QP
3	145.800	26.36	43.50	-17.14	37.40	-11.04	100	119	QP
4	172.400	24.29	43.50	-19.21	35.60	-11.31	100	85	QP
* 5	576.000	31.13	46.40	-15.27	32.50	-1.37	300	-21	QP
6	918.600	30.21	46.40	-16.19	23.40	6.81	150	102	QP

Remark:

1. "*" means this data is the worst emission level; "!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor(Correct Factor=Ant Factor+Cable Loss-Pre Amp).
3. Margin=Emission Level-Limit.

Model No	Balance 20X Pro	Site	CB7
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Nilk Chen
Polarity	Horizontal	Temperature (°C)	25.3
Test Condition	--	Humidity (%RH)	64

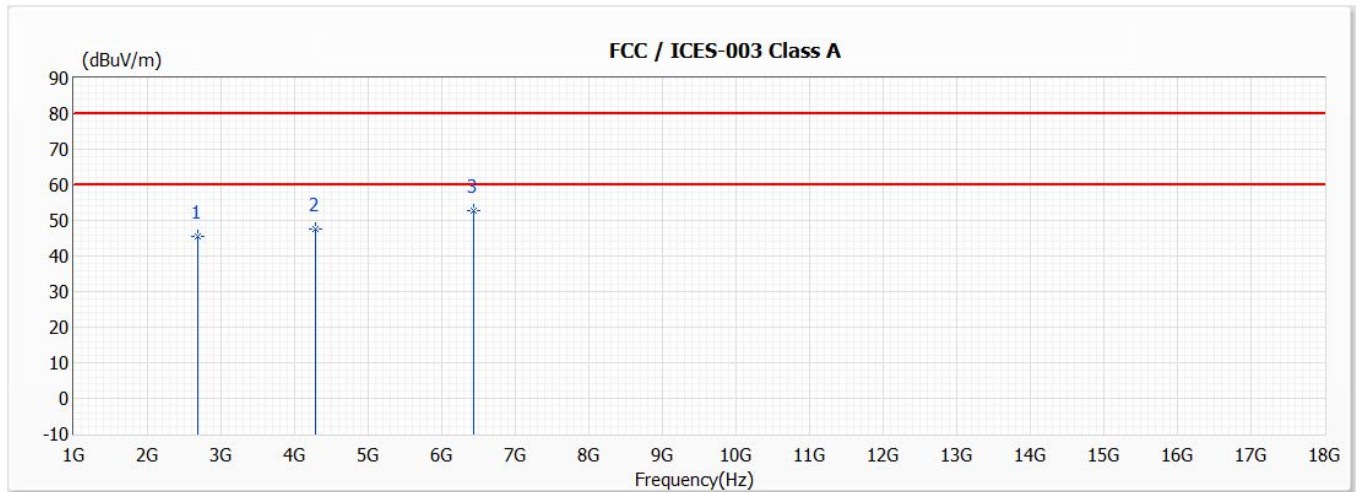


No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Ant Pos (cm)	TT Pos (deg)	Detector Type
1	1068.000	44.59	80.00	-35.41	58.48	-13.89	110	5	PK
* 2	2139.000	45.26	80.00	-34.74	53.67	-8.41	160	-136	PK
3	2666.000	44.43	80.00	-35.57	50.55	-6.12	100	94	PK

Remark:

1. "*" means this data is the worst emission level; "!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor (Correct Factor=Ant Factor+Cable Loss-Pre Amp).
3. Margin= Emission Level-Limit.
4. The above 1 GHz test. When PEAK measures level less than AV limit by 20 dBuV, its average is not measured separately.

Model No	Balance 20X Pro	Site	CB7
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Nilk Chen
Polarity	Vertical	Temperature (°C)	25.3
Test Condition	--	Humidity (%RH)	64

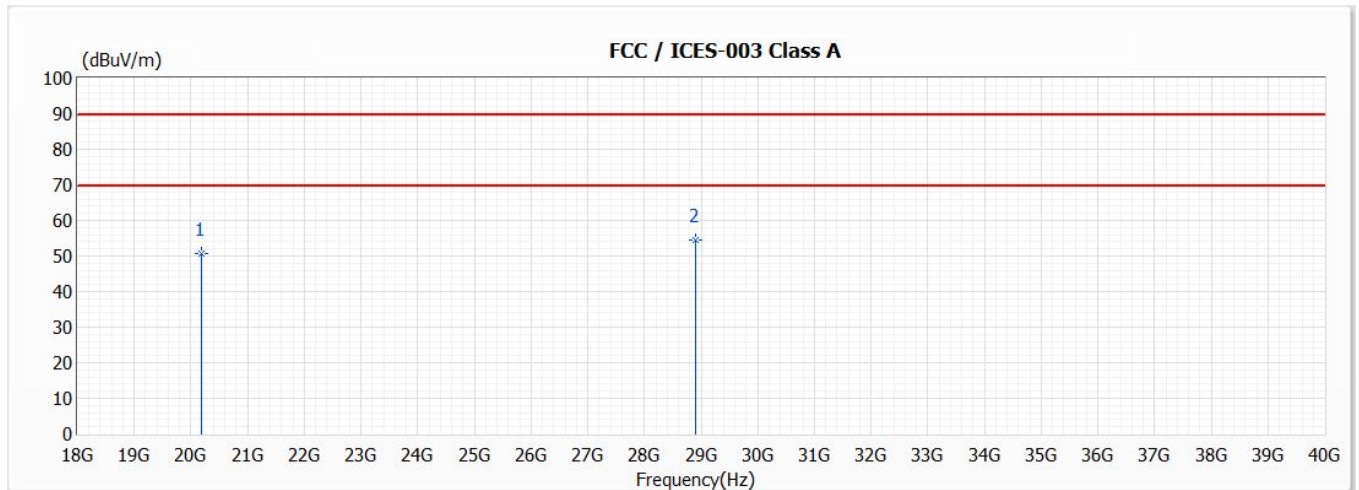


No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Ant Pos (cm)	TT Pos (deg)	Detector Type
1	2683.000	45.55	80.00	-34.45	51.71	-6.16	170	196	PK
2	4281.000	47.58	80.00	-32.42	50.21	-2.63	130	-28	PK
* 3	6440.000	52.73	80.00	-27.27	51.17	1.56	100	47	PK

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor (Correct Factor=Ant Factor+Cable Loss-Pre Amp).
3. Margin= Emission Level-Limit.
4. The above 1 GHz test. When PEAK measures level less than AV limit by 20 dBuV, its average is not measured separately.

Model No	Balance 20X Pro	Site	CB7
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Nilk Chen
Polarity	Horizontal	Temperature (°C)	25.3
Test Condition	--	Humidity (%RH)	64

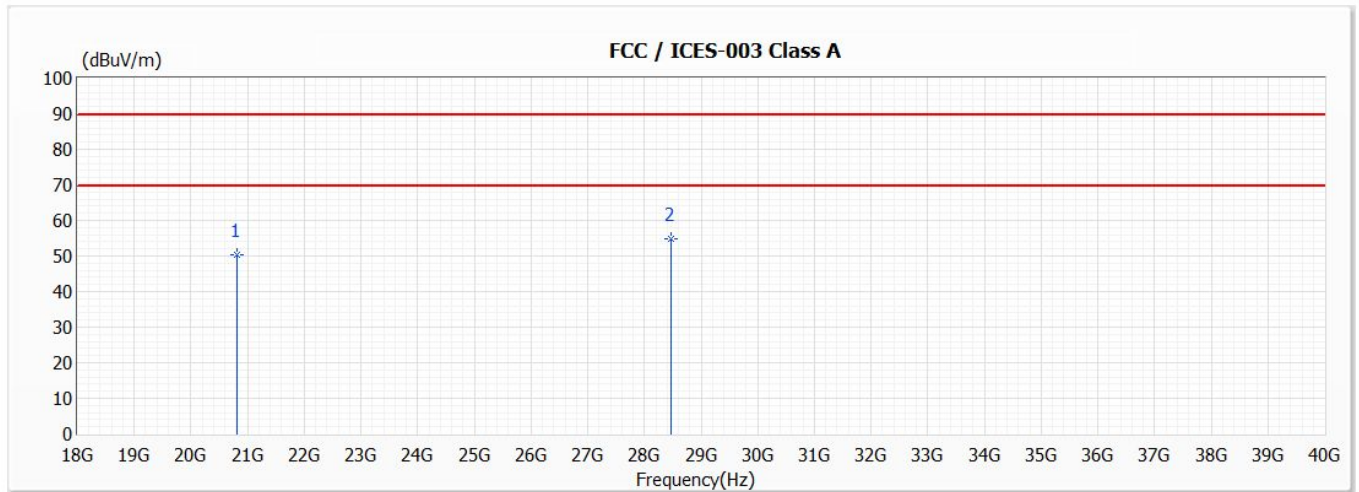


No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Ant Pos (cm)	TT Pos (deg)	Detector Type
1	20184.000	50.70	89.50	-38.80	50.78	-0.08	100	46	PK
* 2	28907.000	54.40	89.50	-35.10	49.74	4.66	100	-131	PK

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor (Correct Factor=Ant Factor+Cable Loss-Pre Amp).
3. Margin= Emission Level-Limit.
4. The above 1 GHz test. When PEAK measures level less than AV limit by 20 dBuV, its average is not measured separately.

Model No	Balance 20X Pro	Site	CB7
Test Voltage	AC 120V/60Hz	Test Date	2022/7/19
Test Mode	Mode 1	Engineer	Nilk Chen
Polarity	Vertical	Temperature (°C)	25.3
Test Condition	--	Humidity (%RH)	64



No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB/m)	Ant Pos (cm)	TT Pos (deg)	Detector Type
1	20812.000	50.30	89.50	-39.20	49.52	0.78	100	194	PK
* 2	28466.000	54.70	89.50	-34.80	50.10	4.60	100	-79	PK

Remark:

1. "*" means this data is the worst emission level;"!" means this data is over limit.
2. Emission Level=Reading Level + Correct Factor (Correct Factor=Ant Factor+Cable Loss-Pre Amp).
3. Margin= Emission Level-Limit.
4. The above 1 GHz test. When PEAK measures level less than AV limit by 20 dBuV, its average is not measured separately.