MEASUREMENT REPORT
FCC Part 15B

FCC ID: 2AD6M-X20

APPLICANT: P2 Mobile Technologies Limited

Application Type:	Certification
Product:	MeshRanger X20 Dual 5GHz 802.11ac
Model No.:	X20
FCC Classification:	FCC Class B Digital Device (JBP)
FCC Rule Part(s):	FCC Part 15 Subpart B
Test Procedure(s):	ANSI C63.4: 2014
Test Date:	January 15 ~ 19, 2016

Reviewed By : Robin Wu
(Robin Wu)

Approved By : Marlinchen
(Marlin Chen)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2014. Test results reported herein relate only to the item(s) tested.
The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date
1511RSU00204	Rev. 01	Initial report	01-20-2016

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§2.1033 General Information

Applicant:	P2 Mobile Technologies Limited
Applicant Address:	Unit 708, 7/F, Bio-Informatics Centre, No. 2 Science Park West Avenue, Hong Kong Science Park, Shatin, New Territories, Hong Kong
Manufacturer:	P2 Mobile Technologies Limited
Manufacturer Address:	Unit 708, 7/F, Bio-Informatics Centre, No. 2 Science Park West Avenue, Hong Kong Science Park, Shatin, New Territories, Hong Kong
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
MRT FCC Registration No.:	809388
Model No.:	X20
FCC ID:	2AD6M-X20
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering
FCC Classification:	FCC Class B Digital Device (JBP)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- **MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.**

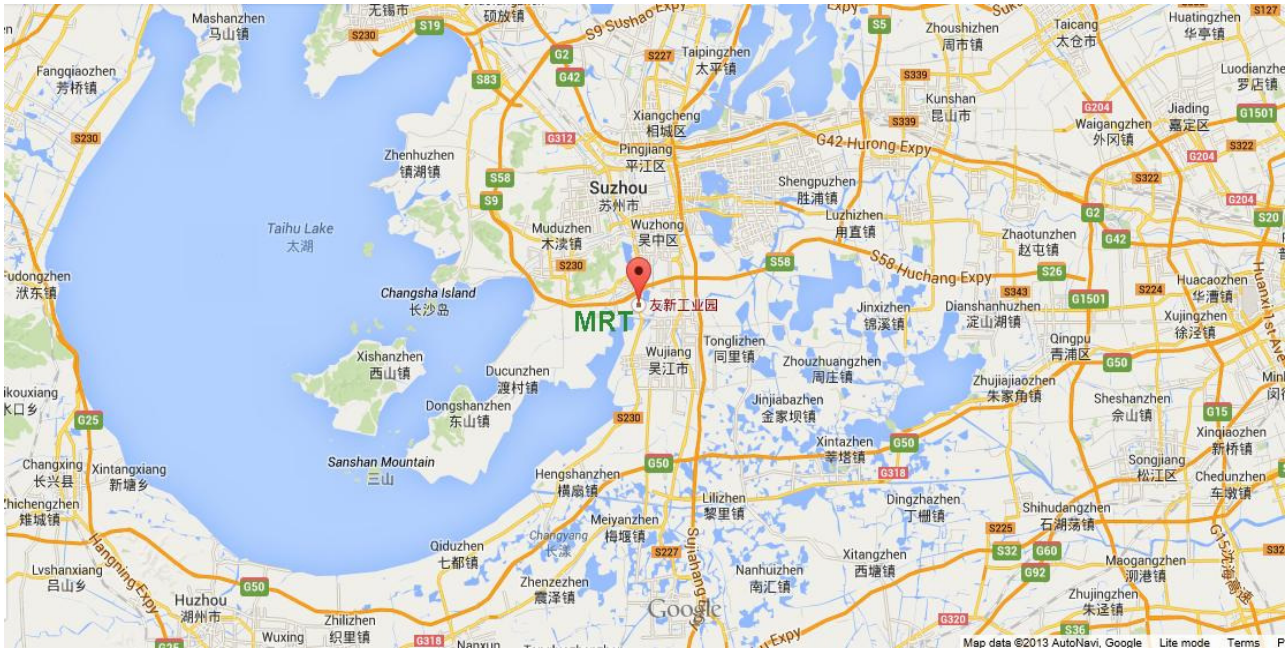
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	MeshRanger X20 Dual 5GHz 802.11ac
Model No.	X20
Frequency Range	For 802.11a/n-HT20/ac-VHT20: 5180~5240MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40: 5190~5230MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5775MHz
Type of Modulation	802.11a/n/ac: OFDM

2.2. Description of Available Antennas

Antenna Type	Frequency Band (GHz)	Tx Paths	Max Peak Gain (dBi)	Beam Forming Directional Gain (dBi)	CDD Directional Gain (dBi)	
					For Power	For PSD
Internal Antenna						
	5	2	18	21	18	21
External Antenna						
	5	2	20	23	20	23

Note:

1. Transmit at two 5GHz cards support two antennas.
2. The EUT supports Beam Forming technology & CDD technology.

2.3. Device Capabilities

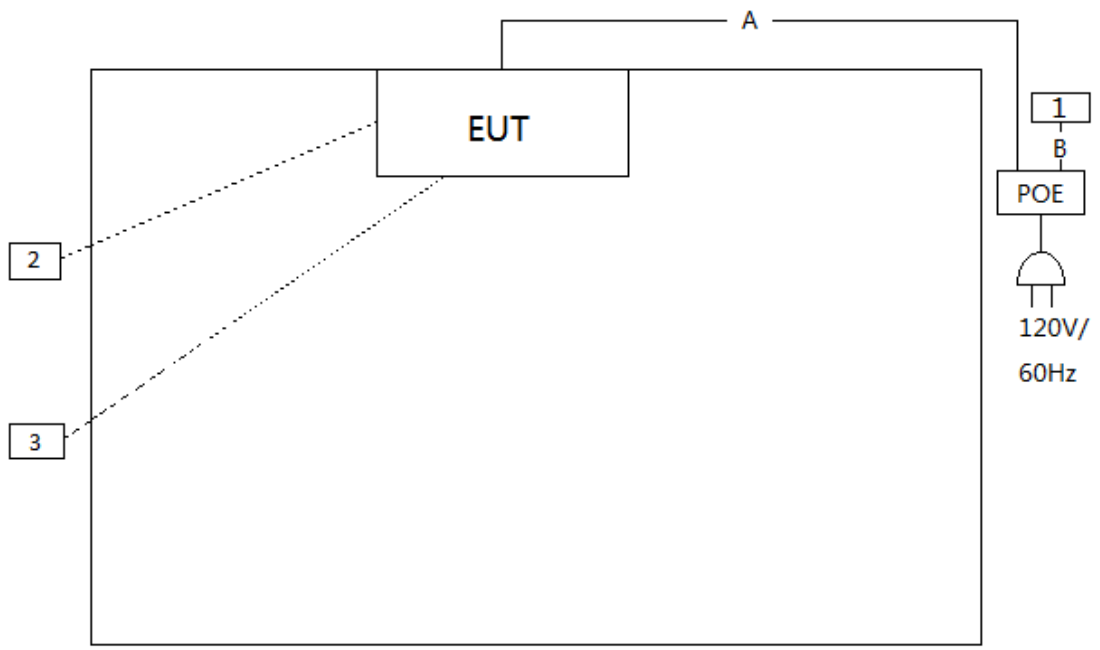
This device contains the following capabilities:

5GHz Wi-Fi Device (UNII)

2.4. Test Configuration

The **MeshRanger X20 Dual 5GHz 802.11ac, FCC ID: 2AD6M-X20** was tested per the guidance FCC Part 15 Subpart B: 2013 and ANSI C63.4: 2014 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

Connection Diagram



Signal Cable Type		Signal cable Description
A	LAN Cable	Non-shielding, >10m
B	LAN Cable	Non-shielding, 1m

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	Notebook	Lenovo	E430c	MP-4CFX213/10	Non-Shielded, 1.8m
2	Notebook	Lenovo	X201	3626AM3	Non-Shielded, 1.8m
3	Notebook	Lenovo	E431	OC17836	Non-Shielded, 1.8m

2.5. Test Software

Not applicable.

2.6. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.7. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2014) was used in the measurement of the **MeshRanger X20 Dual 5GHz 802.11ac FCC ID: 2AD6M-X20.**

Deviation from measurement procedure…….....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150 kHz to 30 MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or resolution, clock or data exchange speed, scrolling H pattern to the EUT and/or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site.

Line conducted emissions test results are shown in Section 6.2.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. An MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30 MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30 MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 0.8 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB beam-width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2016/11/03
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06182	1 year	2016/12/20

Radiated Emissions - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	E4447A	MRTSUE06028	1 year	2016/06/23
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Preamplifier	Agilent	83017A	MRTSUE06076	1 year	2016/03/29
Preamplifier	Schwarzbeck	BBV9721	MRTSUE06121	1 year	2016/04/16
TRILOG Antenna	Schwarzbeck	VULB9162	MRTSUE06022	1 year	2016/11/07
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2016/11/07
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06183	1 year	2016/12/20

Software	Version	Function
e3	V8.3.5	EMI Test Software

5. MEASUREMENT UNCERTAINTY

Where relevant, the following test 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.

AC Conducted Emission Measurement - SR2
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: 3.5dB
Radiated Emission Measurement - AC1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): Horizontal: 30MHz~1GHz: 4.07dB 1GHz~18GHz: 4.16 dB Vertical: 30MHz~1GHz: 4.18 dB 1GHz~18GHz: 4.76 dB

6. TEST RESULT

6.1. Summary

Product Name: **MeshRanger X20 Dual 5GHz 802.11ac**
FCC ID: **2AD6M-X20**
FCC Classification: **FCC Class B Digital Device (JBP)**
Test Mode: **Communication with Notebook**

FCC Part Section(s)	Test Description	Test Result
15.107	Conducted Emissions	Pass
15.109	Radiated Emissions	Pass

6.2. Conducted Emission Measurement

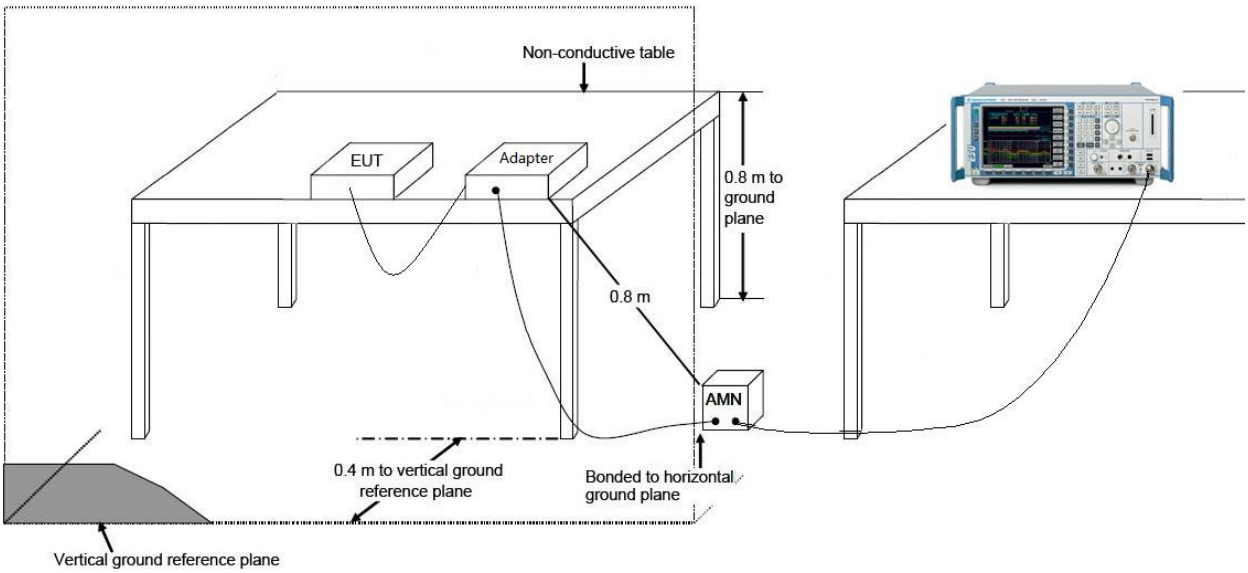
6.2.1. Test Limit

FCC Part 15.107 Limits		
Frequency (MHz)	QP (dBμV)	AV (dBμV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

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

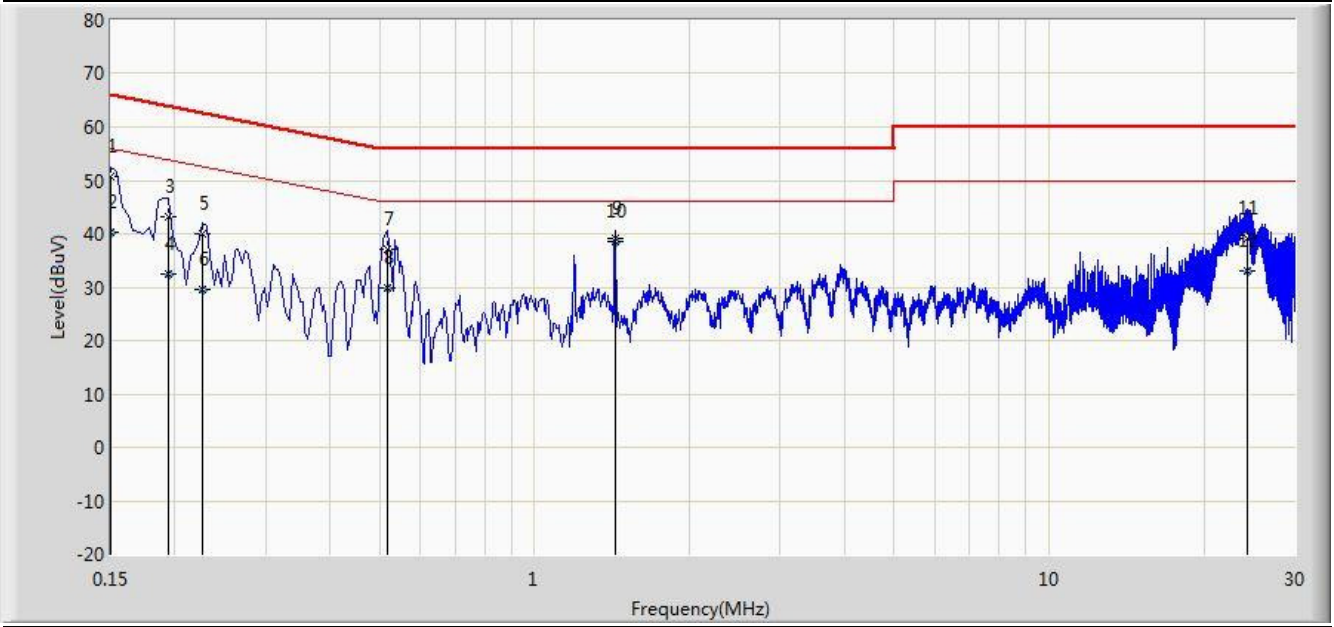
Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

6.2.2. Test Setup



6.2.3. Test Result of Conducted Emissions

Site: SR2	Time: 2016/01/17 - 15:35
Limit: FCC_Part15.107_CE_Class B	Engineer: Roy Cheng
Probe: ENV216_101683_Filter On	Polarity: Line
EUT: MeshRanger X20 Dual 5GHz 802.11ac	Power: AC 120V/60Hz
Test Mode: Communication with Notebook	

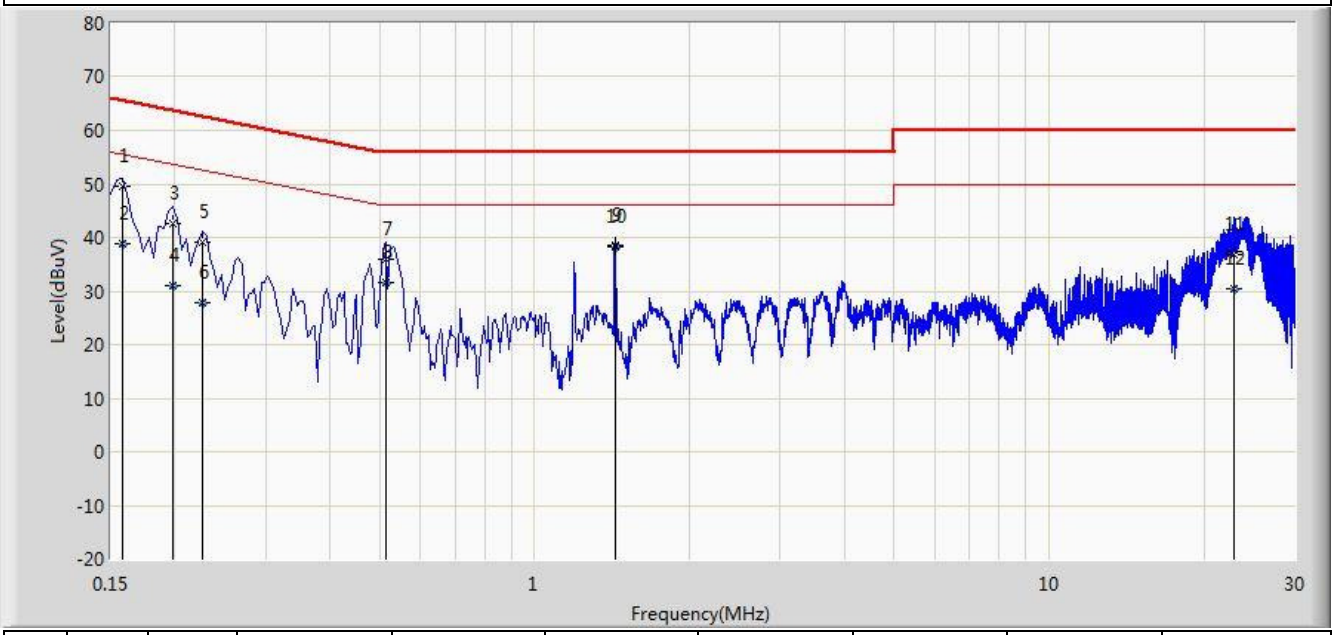


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.150	50.761	39.593	-15.239	66.000	11.168	QP
2			0.150	40.393	29.225	-15.607	56.000	11.168	AV
3			0.194	43.313	33.296	-20.551	63.864	10.017	QP
4			0.194	32.320	22.303	-21.544	53.864	10.017	AV
5			0.226	40.053	30.109	-22.542	62.595	9.944	QP
6			0.226	29.585	19.640	-23.011	52.595	9.944	AV
7			0.518	37.113	26.957	-18.887	56.000	10.156	QP
8			0.518	29.888	19.732	-16.112	46.000	10.156	AV
9			1.434	39.152	29.261	-16.848	56.000	9.892	QP
10		*	1.434	38.693	28.802	-7.307	46.000	9.892	AV
11			24.326	39.103	28.896	-20.897	60.000	10.207	QP
12			24.326	32.960	22.753	-17.040	50.000	10.207	AV

Note: Measure Level (dBμV) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

Site: SR2	Time: 2016/01/17 - 15:41
Limit: FCC_Part15.107_CE_Class B	Engineer: Roy Cheng
Probe: ENV216_101683_Filter On	Polarity: Neutral
EUT: MeshRanger X20 Dual 5GHz 802.11ac	Power: AC 120V/60Hz
Test Mode: Communication with Notebook	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.158	49.512	39.222	-16.056	65.568	10.290	QP
2			0.158	38.872	28.582	-16.697	55.568	10.290	AV
3			0.198	42.622	32.608	-21.072	63.694	10.015	QP
4			0.198	31.052	21.037	-22.642	53.694	10.015	AV
5			0.226	39.187	29.204	-23.409	62.595	9.982	QP
6			0.226	27.727	17.744	-24.869	52.595	9.982	AV
7			0.514	35.841	25.665	-20.159	56.000	10.176	QP
8			0.514	31.649	21.473	-14.351	46.000	10.176	AV
9			1.434	38.494	28.602	-17.506	56.000	9.893	QP
10		*	1.434	38.198	28.306	-7.802	46.000	9.893	AV
11			22.886	36.756	26.510	-23.244	60.000	10.246	QP
12			22.886	30.522	20.277	-19.478	50.000	10.246	AV

Note: Measure Level (dBμV) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

6.3. Radiated Emission Measurement

6.3.1. Test Limit

FCC Part 15.109 Limits		
Frequency (MHz)	Distance (m)	Level (dBμV/m)
30 - 88	3	40
88 - 216	3	43.5
216 - 960	3	46
Above 960	3	54

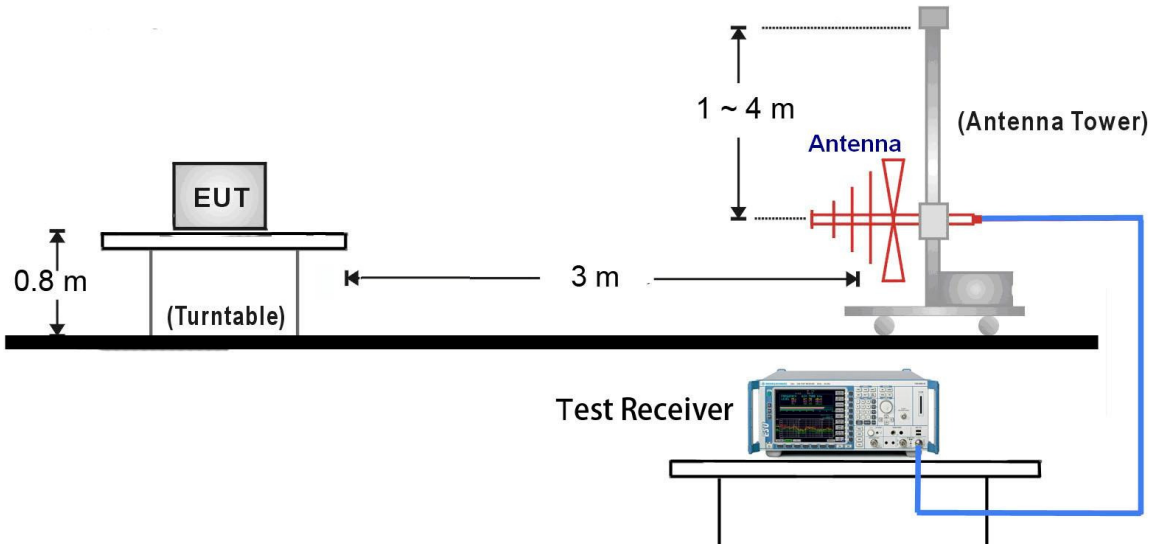
Note 1: The lower limit shall apply at the transition frequency.

Note 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.

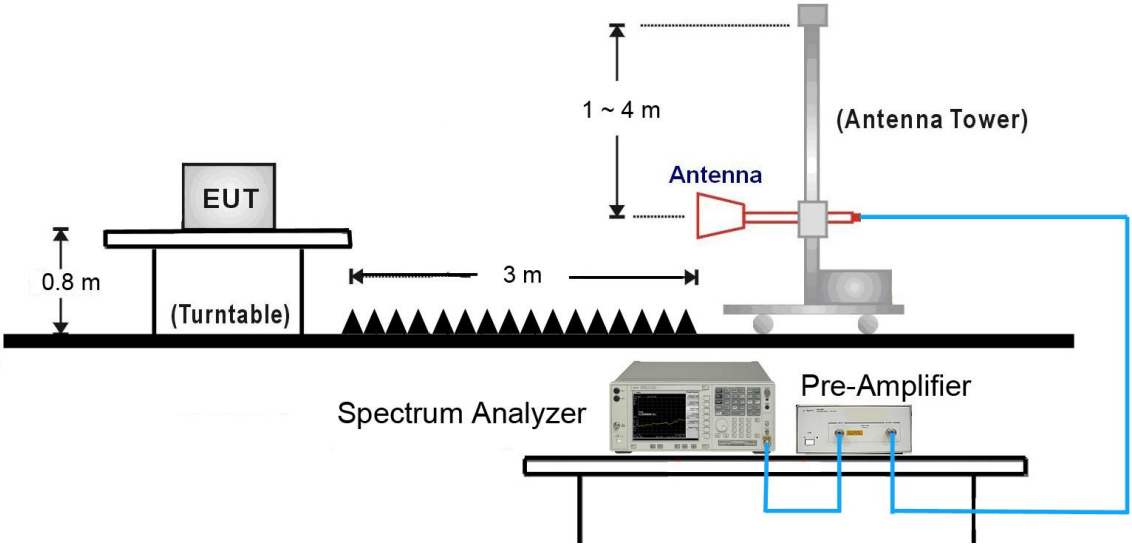
Note 3: E field strength (dBμV/m) = 20 log E field strength (uV/m)

6.3.2. Test Setup

30MHz ~ 1GHz Test Setup:

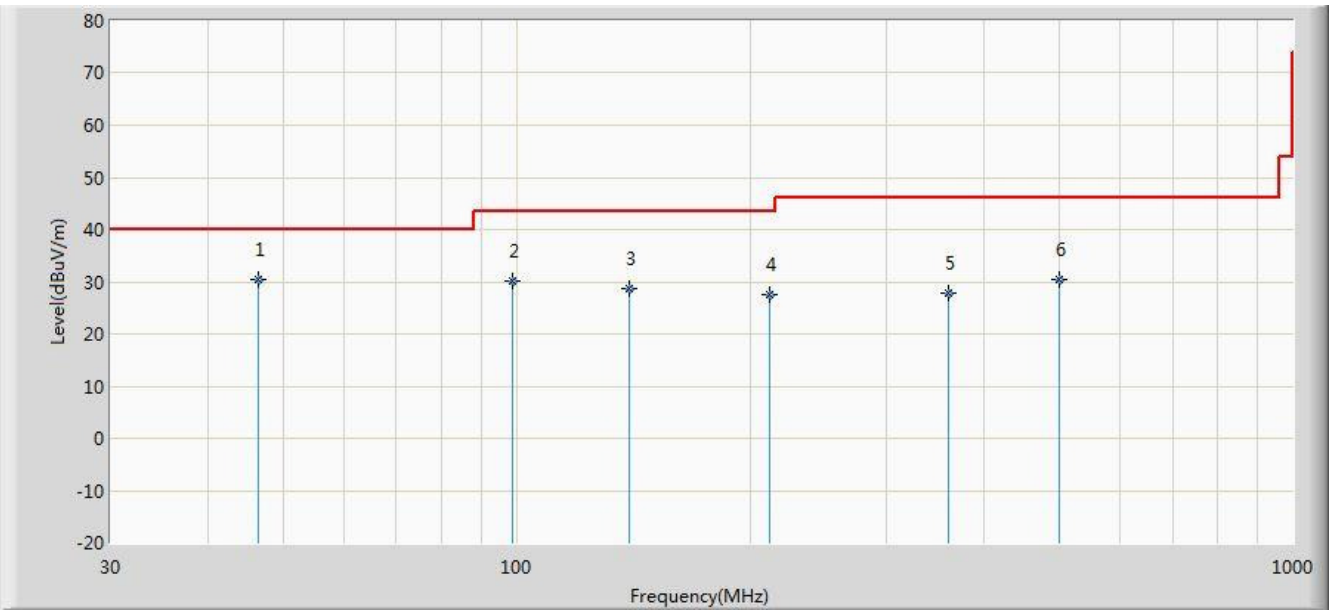


1GHz ~18GHz Test Setup:



6.3.3. Test Result of Radiated Emissions

Site: AC 1	Time: 2016/01/19 - 09:16
Limit: FCC_Part15.109_RE(3m)_Class B	Engineer: Milo Li
Probe: VULB9162_0.03-8GHz	Polarity: Horizontal
EUT: MeshRanger X20 Dual 5GHz 802.11ac	Power: AC 120V/60Hz
Test Mode: Communication with Notebook	

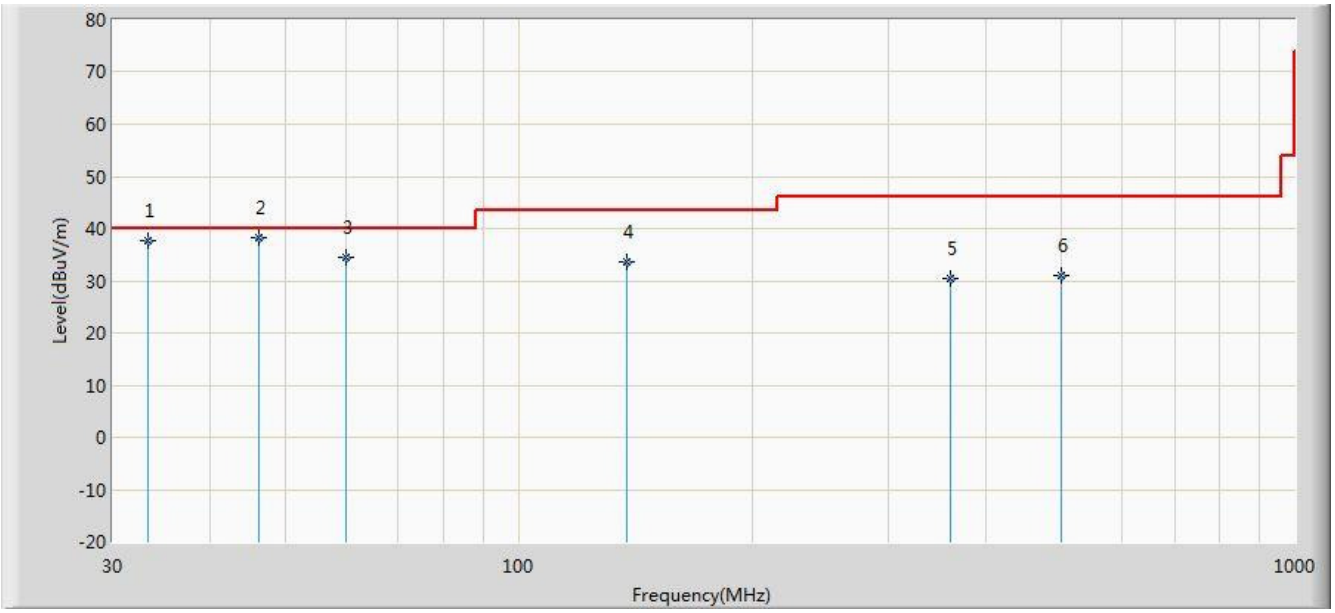


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	46.492	30.392	16.254	-9.608	40.000	14.138	QP
2			98.872	30.231	19.354	-13.269	43.500	10.877	QP
3			139.610	28.713	14.254	-14.787	43.500	14.459	QP
4			211.875	27.663	16.250	-15.837	43.500	11.414	QP
5			360.285	27.931	12.252	-18.069	46.000	15.679	QP
6			500.010	30.433	11.950	-15.567	46.000	18.483	QP

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC 1	Time: 2016/01/19 - 09:16
Limit: FCC_Part15.109_RE(3m)_Class B	Engineer: Milo Li
Probe: VULB9162_0.03-8GHz	Polarity: Vertical
EUT: MeshRanger X20 Dual 5GHz 802.11ac	Power: AC 120V/60Hz
Test Mode: Communication with Notebook	

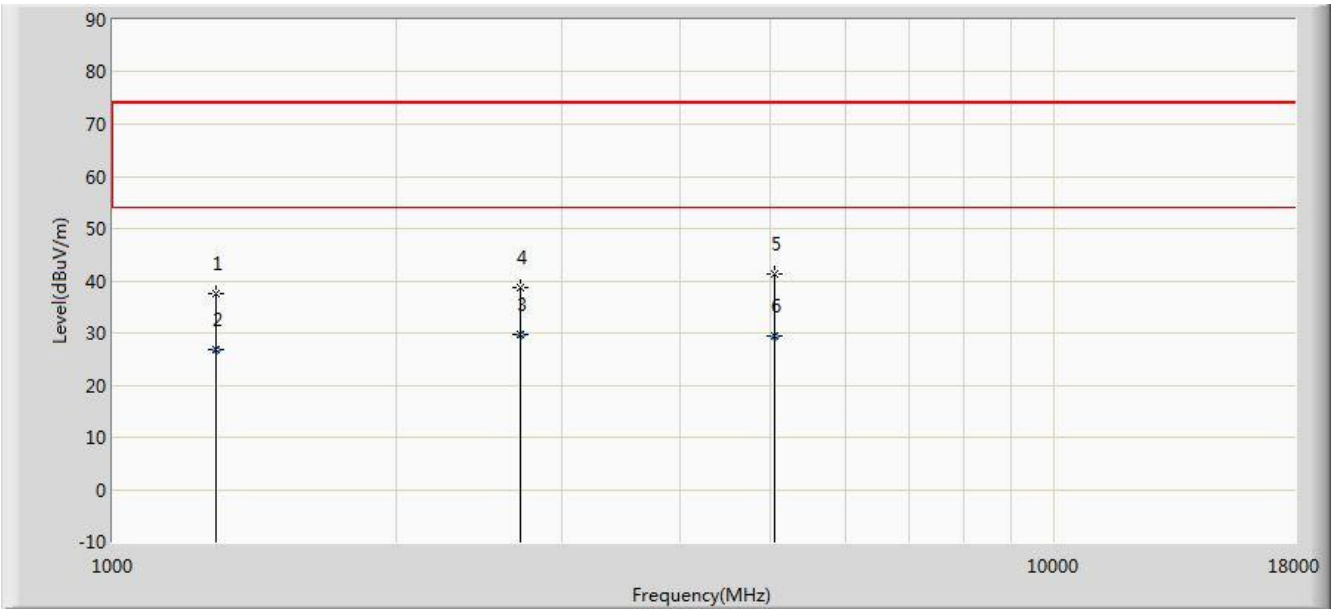


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			33.395	37.781	24.035	-2.219	40.000	13.746	QP
2		*	46.300	38.299	24.157	-1.701	40.000	14.143	QP
3			60.070	34.566	21.254	-5.434	40.000	13.312	QP
4			138.155	33.583	19.240	-9.917	43.500	14.343	QP
5			360.285	30.369	14.690	-15.631	46.000	15.679	QP
6			500.001	31.023	12.540	-14.977	46.000	18.483	QP

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC 1	Time: 2016/01/19 - 09:23
Limit: FCC_Part15.109_RE(3m)_Class B	Engineer: Milo Li
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: MeshRanger X20 Dual 5GHz 802.11ac	Power: AC 120V/60Hz
Test Mode: Communication with Notebook	

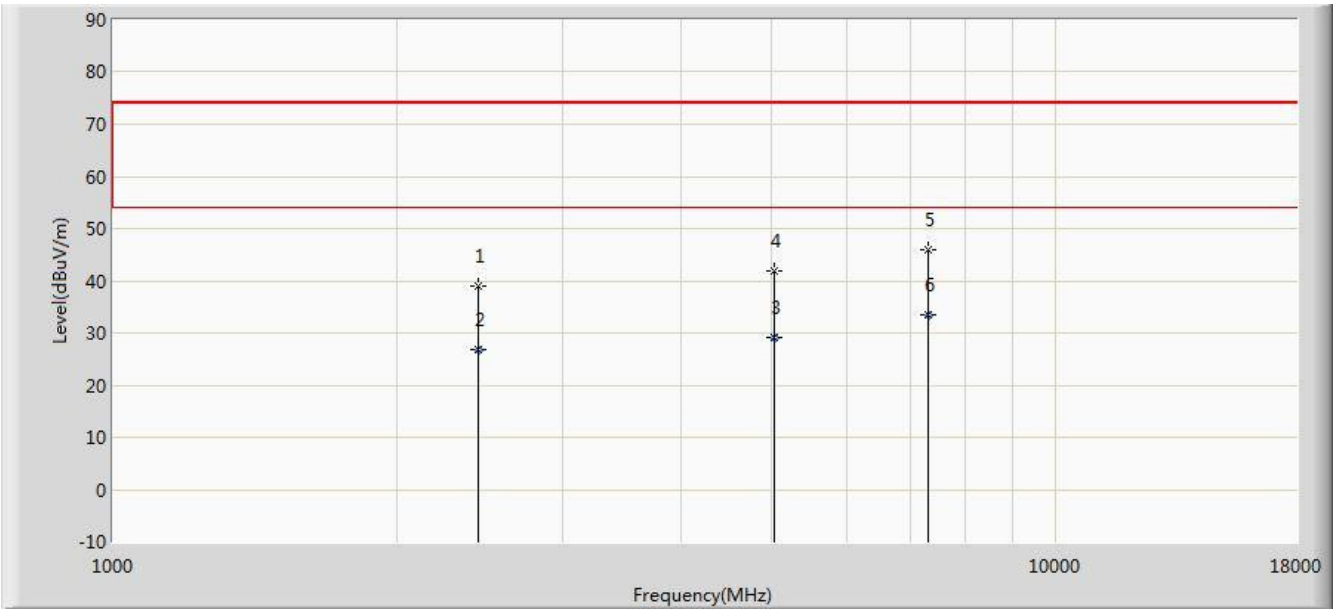


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			1289.000	37.469	45.773	-36.531	74.000	-8.304	PK
2			1289.025	26.950	35.254	-27.050	54.000	-8.304	AV
3		*	2708.245	29.625	32.325	-24.375	54.000	-2.700	AV
4			2708.500	38.826	41.525	-35.174	74.000	-2.699	PK
5			5046.000	41.447	38.337	-32.553	74.000	3.110	PK
6			5046.240	29.465	26.354	-24.535	54.000	3.110	AV

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB).

Site: AC 1	Time: 2016/01/19 - 09:23
Limit: FCC_Part15.109_RE(3m)_Class B	Engineer: Milo Li
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: MeshRanger X20 Dual 5GHz 802.11ac	Power: AC 120V/60Hz
Test Mode: Communication with Notebook	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2445.000	39.089	42.884	-34.911	74.000	-3.795	PK
2			2445.241	26.896	30.692	-27.104	54.000	-3.796	AV
3			5020.254	29.187	26.124	-24.813	54.000	3.063	AV
4			5020.500	41.818	38.755	-32.182	74.000	3.063	PK
5			7324.000	45.875	37.832	-28.125	74.000	8.043	PK
6		*	7324.024	33.518	25.475	-20.482	54.000	8.043	AV

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB).

7. CONCLUSION

The data collected relate only the item(s) tested and show that the **MeshRanger X20 Dual 5GHz 802.11ac FCC ID: 2AD6M-X20** has been tested to comply with the requirements specified in §15.107 and §15.109 of the FCC Rules.

The End