MEASUREMENT REPORT
FCC Part 15B & ICES-003 Test Report

FCC ID:	VPYLB1PR
IC:	772C-LB1PR
APPLICANT:	Murata Manufacturing Co., Ltd.

Application Type:	Certification
Product:	Bluetooth mesh node
Model No.:	LBCC2ZZ1PR
FCC Rule Part(s):	FCC Part 15 Subpart B
IC Rule(s):	ICES-003, Issue 6: April 2017
Test Date:	April 13 ~ May 30, 2018

Reviewed By : Kevin Guo
(Kevin Guo)

Approved By : Marlin Chen
(Marlin Chen)

Revision History

Report No.	Version	Description	Issue Date	Note
1803WSU012-U3	Rev. 01	Initial Report	04-17-2018	Invalid
1803WSU012-U3	Rev. 02	Add Conducted Emission Test	05-30-2018	Valid

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Description Page

§2.1033 General Information

Applicant:	Murata Manufacturing Co., Ltd.
Applicant Address:	10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555, Japan
Manufacturer:	Murata Manufacturing Co., Ltd.
Manufacturer Address:	10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555, Japan
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
FCC Registration No.:	893164
IC Registration No.:	11384A-1
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering

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. 893164) 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.**


Accredited Laboratory

A2LA has accredited

MRT TECHNOLOGY (SUZHOU) CO., LTD.

Suzhou, Jiangsu, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 6th day of September 2016.

Senior Director of Quality and Communications
For the Accreditation Council
Certificate Number 3628.01
Valid to August 31, 2018

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

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

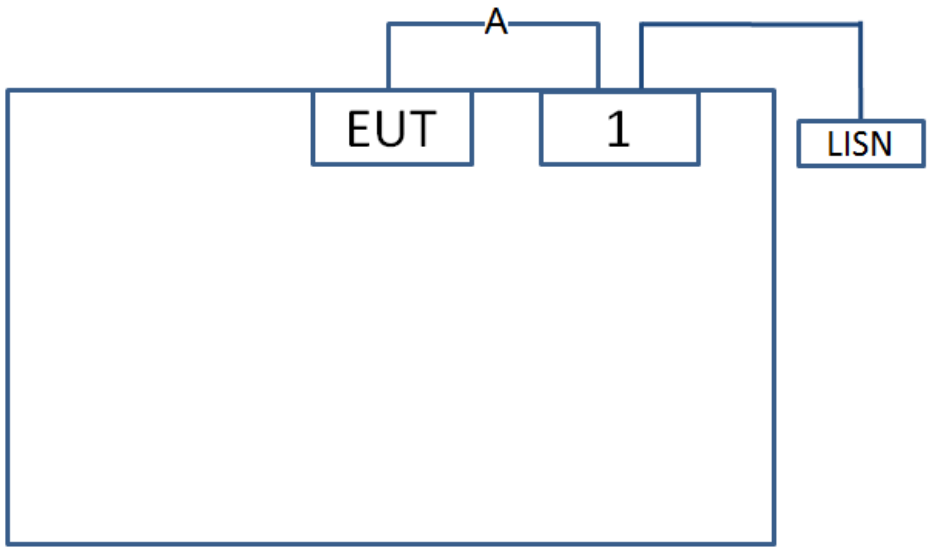
Product Name:	Bluetooth mesh node
Model No.:	LBCC2ZZ1PR
Bluetooth Specification:	V4.2 single mode
Power Type:	DC 12V

2.2. Test Mode

Test Mode	
EMI Mode	Mode 1: Normal operation

2.3. Test Configuration

The EUT was tested per the guidance FCC Part 15 Subpart B: 2016, ICES-003 Issue 6: April 2017 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


Cable Type		Cable Description
A	Power Cable	1.5m, Non-Shielding

2.4. Test 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	DC Source	APECC	DPS-336030D	N/A	N/A

2.5. Test Software

Not Applicable.

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 Equipment under test.

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.

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 Emission - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2018/08/18
Two-Line V-Network	R&S	ENV 216	MRTSUE06002	1 year	2018/06/21
Two-Line V-Network	R&S	ENV 216	MRTSUE06003	1 year	2018/06/21
DC Power Supply	APECC	DPS-336030D	MRTSUE06014	1 year	2018/12/15
Thermohygrometer	Testo	608-H1	MRTSUE06404	1 year	2018/08/14
Shielding Anechoic Chamber	Mikebang	Chamber-SR2	MRTSUE06215	1 year	2019/04/30

Radiated Emission - AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
MXE EMI Receiver	Agilent	N9038A	MRTSUE06125	1 year	2018/08/18
EXA Signal Analyzer	Agilent	N9010A	MRTSUE06195	1 year	2019/04/22
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2018/11/20
Bilog Period Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2018/10/21
Broad Band Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06171	1 year	2018/11/18
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2018/11/17
DC Power Supply	APECC	DPS-336030D	MRTSUE06014	1 year	2018/12/15
Digitial Thermometer & Hygrometer	MingGao	ETH529	MRTSUE06170	1 year	2018/12/12
Anechoic Chamber	RIKEN	Chamber-AC2	MRTSUE06213	1 year	2019/04/30

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 (AC2)
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): Horizontal: 30MHz~1GHz: 4.07dB Vertical: 30MHz~1GHz: 4.18dB

6. TEST RESULT

6.1. Summary

Company Name: **Murata Manufacturing Co., Ltd.**

FCC ID: **VPYLB1PR**

IC: **772C-LB1PR**

FCC Section(s)	IC Section(s)	Test Description	Test Result
15.107	ICES-003, Issue 6: April 2017	Conducted Emission	Pass
15.109	ICES-003, Issue 6: April 2017	Radiated Emission	Pass

6.2. Conducted Emission Measurement

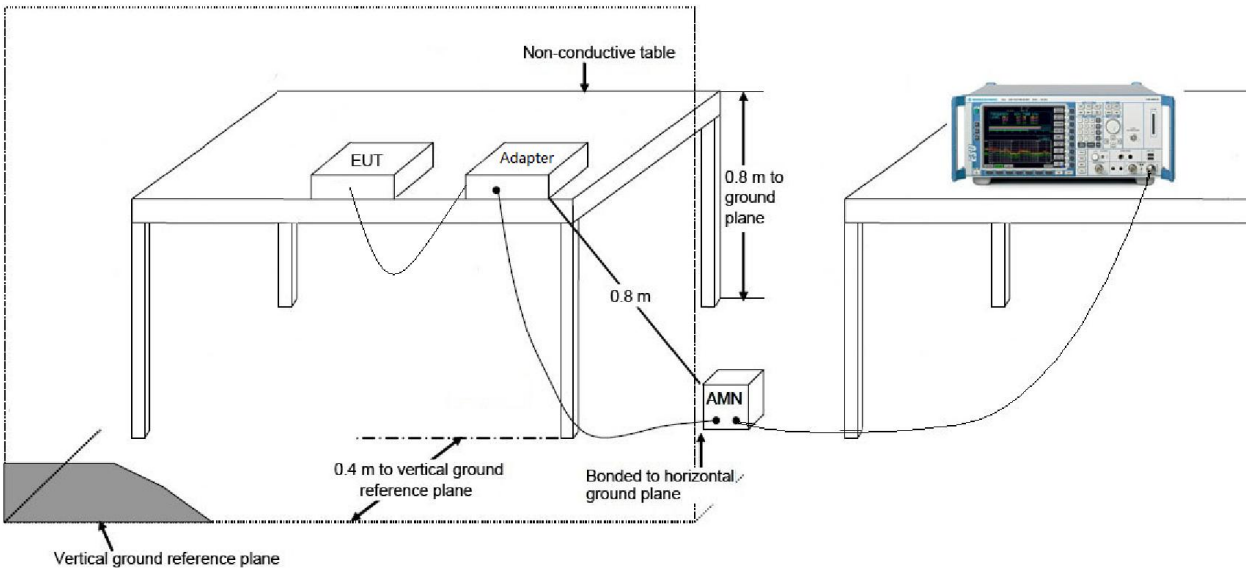
6.2.1.Test Limit

ICES-003, Issue 6: April 2017 Table 2		
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.

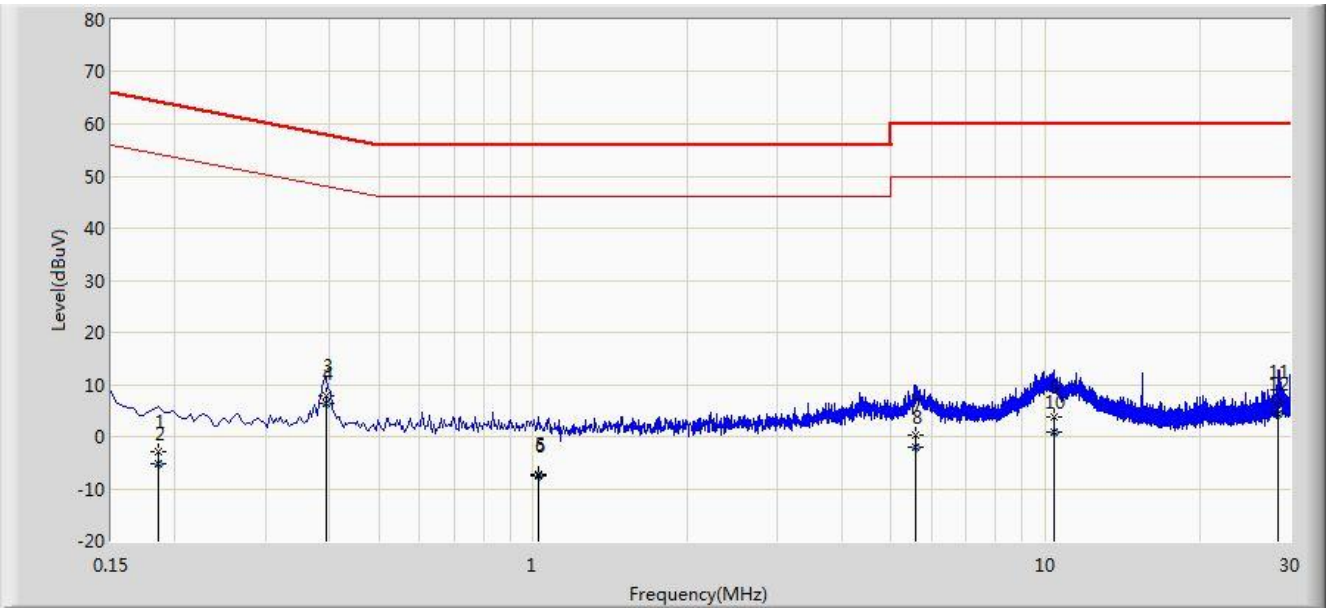
Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

6.2.2.Test Setup



6.2.3.Test Result

Site: SR2	Time: 2018/05/25 - 14:38
Limit: FCC_Part15.107_CE_AC Power_ClassB	Engineer: Polly Zong
Probe: ENV216_101683_Filter On	Polarity: Line
EUT: Bluetooth mesh node	Power: DC 12V
Test Mode 1	

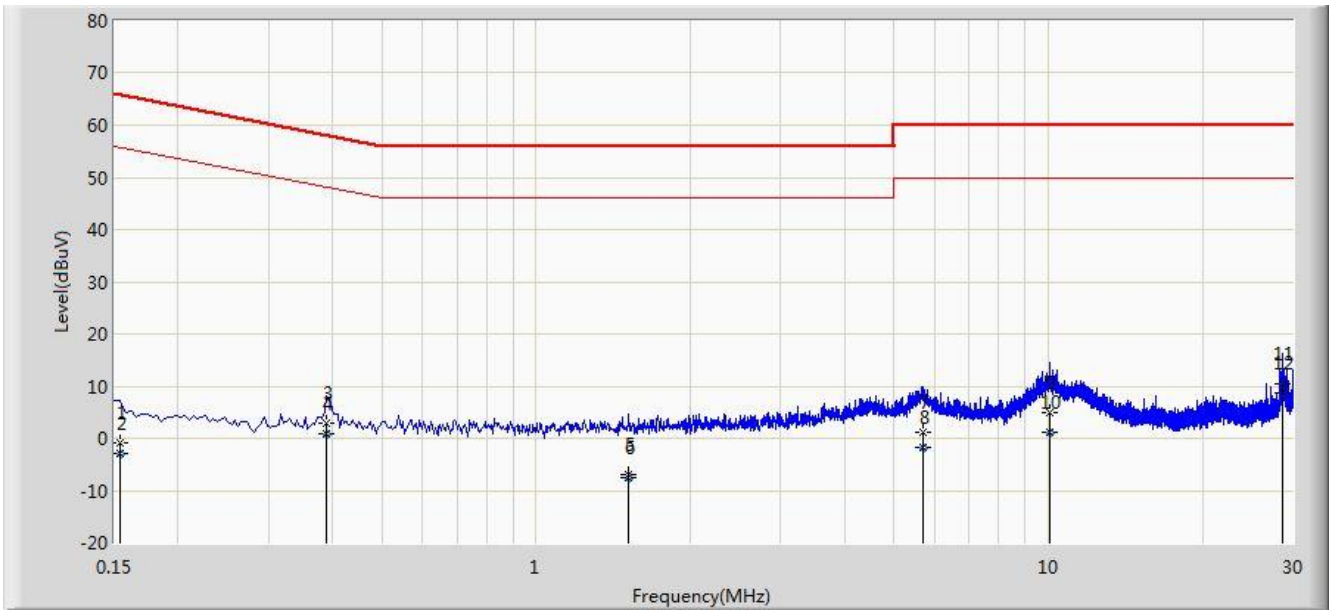


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.186	-3.014	-13.052	-67.227	64.213	10.039	QP
2			0.186	-5.275	-15.314	-59.488	54.213	10.039	AV
3			0.394	7.776	-2.304	-50.203	57.979	10.080	QP
4		*	0.394	6.429	-3.651	-41.550	47.979	10.080	AV
5			1.022	-7.262	-17.170	-63.262	56.000	9.908	QP
6			1.022	-7.640	-17.548	-53.640	46.000	9.908	AV
7			5.570	0.242	-9.833	-59.758	60.000	10.075	QP
8			5.570	-2.138	-12.213	-52.138	50.000	10.075	AV
9			10.406	3.875	-6.257	-56.125	60.000	10.132	QP
10			10.406	0.998	-9.134	-49.002	50.000	10.132	AV
11			28.502	6.794	-3.471	-53.206	60.000	10.265	QP
12			28.502	4.254	-6.011	-45.746	50.000	10.265	AV

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

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

Site: SR2	Time: 2018/05/25 - 14:43
Limit: FCC_Part15.107_CE_AC Power_ClassB	Engineer: Polly Zong
Probe: ENV216_101683_Filter On	Polarity: Neutral
EUT: Bluetooth mesh node	Power: DC 12V
Test Mode 1	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.154	-0.903	-11.619	-66.685	65.781	10.716	QP
2			0.154	-3.032	-13.748	-58.814	55.781	10.716	AV
3			0.390	2.816	-7.288	-55.247	58.064	10.105	QP
4			0.390	0.898	-9.207	-47.166	48.064	10.105	AV
5			1.518	-6.968	-16.858	-62.968	56.000	9.889	QP
6			1.518	-7.416	-17.305	-53.416	46.000	9.889	AV
7			5.698	1.160	-8.951	-58.840	60.000	10.111	QP
8			5.698	-1.758	-11.868	-51.758	50.000	10.111	AV
9			10.054	4.844	-5.322	-55.156	60.000	10.167	QP
10			10.054	1.089	-9.077	-48.911	50.000	10.167	AV
11			28.562	10.318	-0.094	-49.682	60.000	10.412	QP
12		*	28.562	8.673	-1.739	-41.327	50.000	10.412	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)\

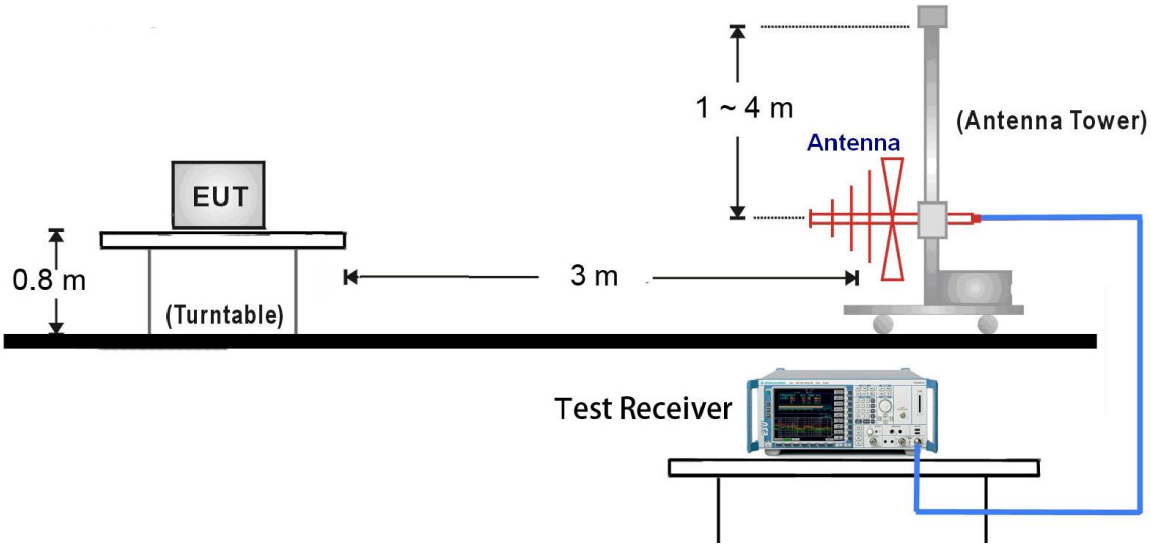
6.3.2. Test Frequency selected

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:

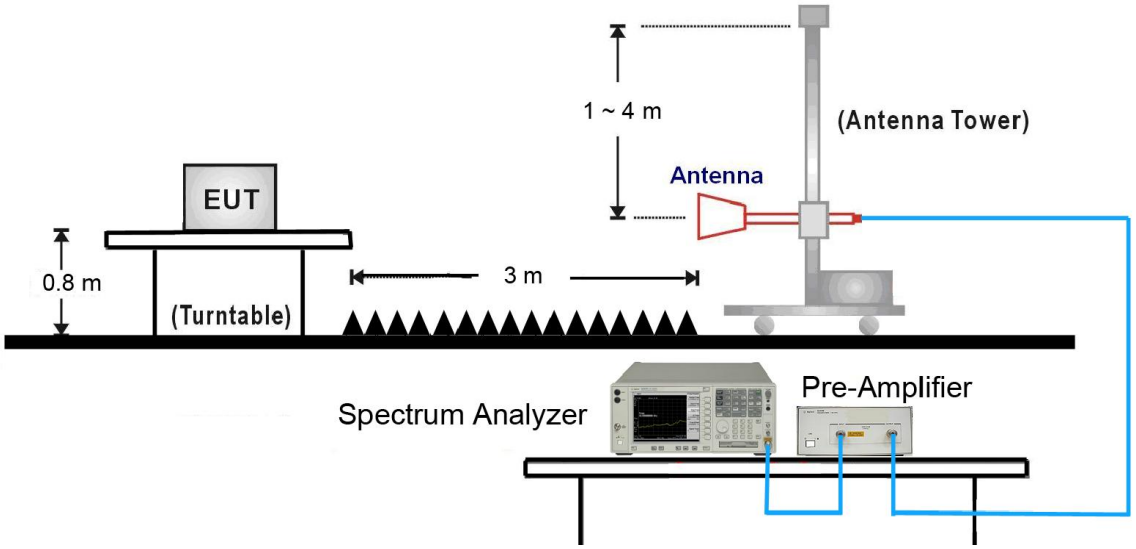
Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705 - 108	1000
108 - 500	2000
500 - 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

6.3.3. Test Setup

30MHz ~ 1GHz Test Setup:

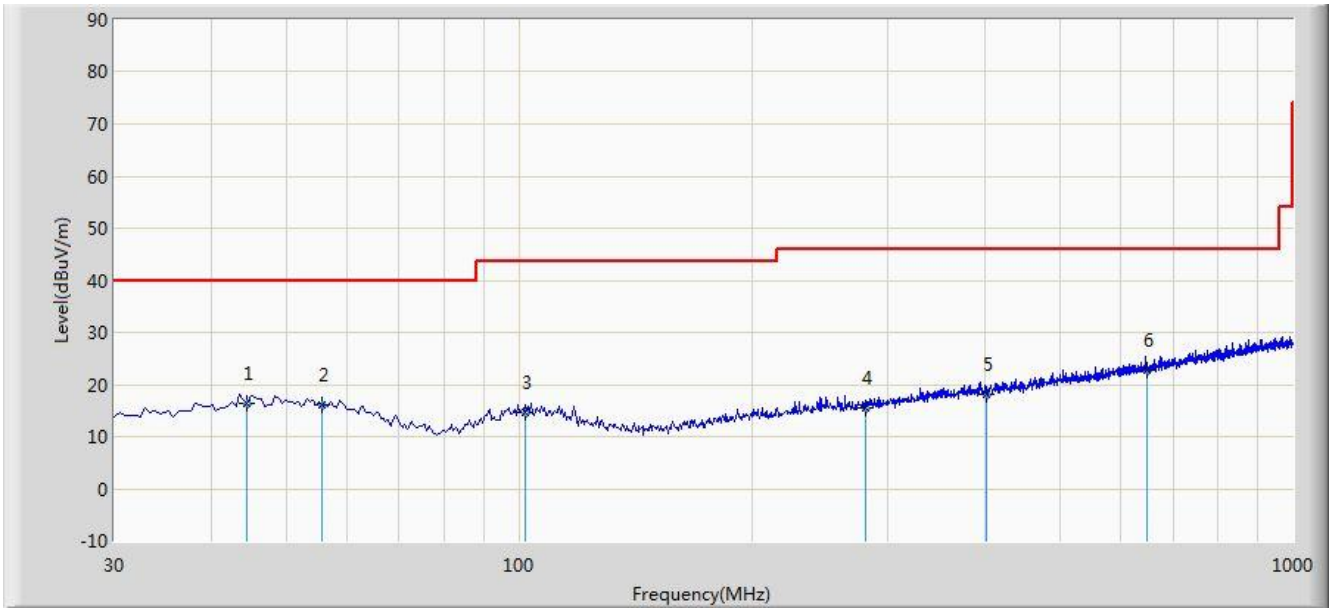


1GHz ~18GHz Test Setup:



6.3.4. Test Result

Site: AC2	Time: 2018/04/15 - 21:32
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Will Yan
Probe: VULB9162_0.03-8GHz	Polarity: Horizontal
EUT: Bluetooth mesh node	Power: DC 12V
Test Mode 1	

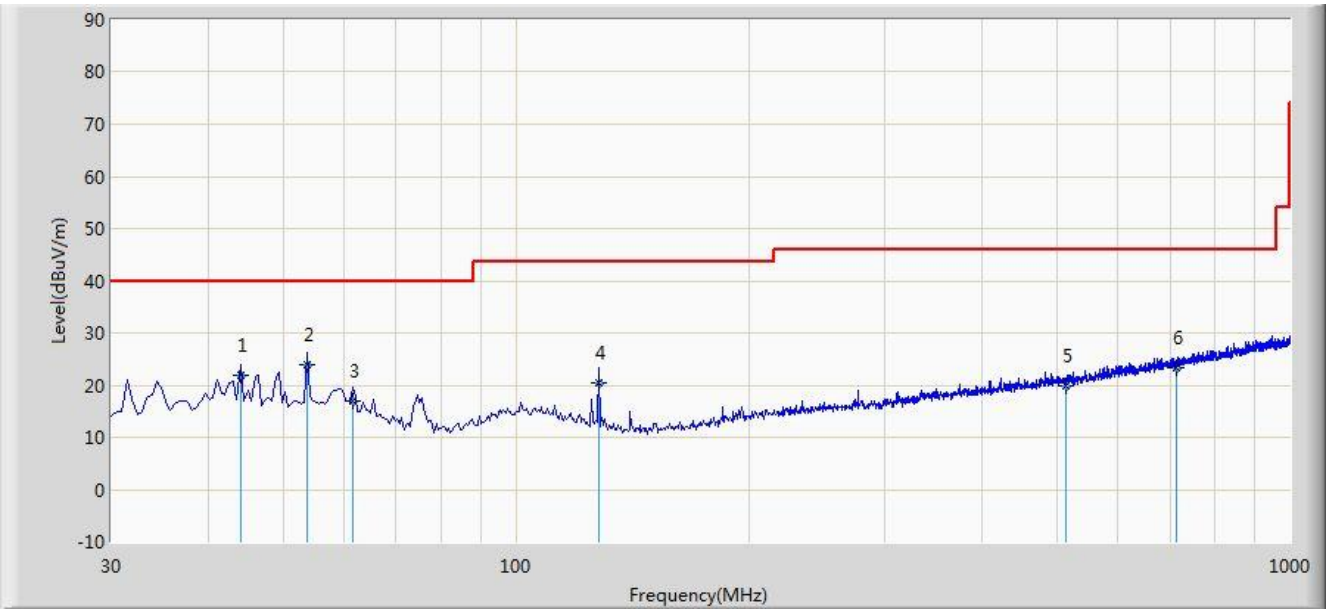


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			44.550	16.310	1.466	-23.690	40.000	14.844	QP
2			55.705	16.062	1.365	-23.938	40.000	14.697	QP
3			101.780	14.721	1.348	-28.779	43.500	13.372	QP
4			280.260	15.554	1.074	-30.446	46.000	14.480	QP
5			401.510	18.073	1.004	-27.927	46.000	17.069	QP
6		*	649.345	22.728	1.656	-23.272	46.000	21.072	QP

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

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

Site: AC2	Time: 2018/04/15 - 21:36
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Will Yan
Probe: VULB9162_0.03-8GHz	Polarity: Vertical
EUT: Bluetooth mesh node	Power: DC 12V
Test Mode 1	

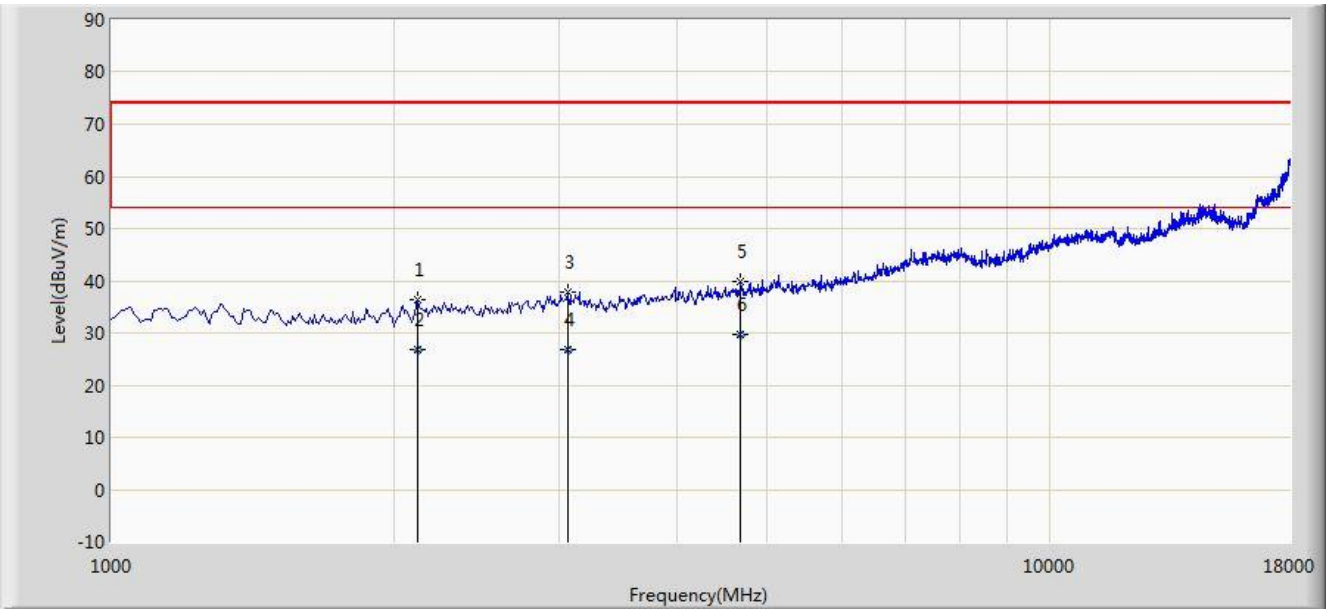


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			44.065	21.761	7.010	-18.239	40.000	14.751	QP
2		*	53.765	24.041	9.050	-15.959	40.000	14.991	QP
3			61.525	16.910	3.150	-23.090	40.000	13.761	QP
4			127.900	20.518	10.070	-22.982	43.500	10.448	QP
5			513.060	19.870	1.010	-26.130	46.000	18.860	QP
6			714.820	23.246	1.046	-22.754	46.000	22.200	QP

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

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

Site: AC2	Time: 2018/04/15 - 23:07
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Will Yan
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Bluetooth mesh node	Power: DC 12V
Test Mode 1	

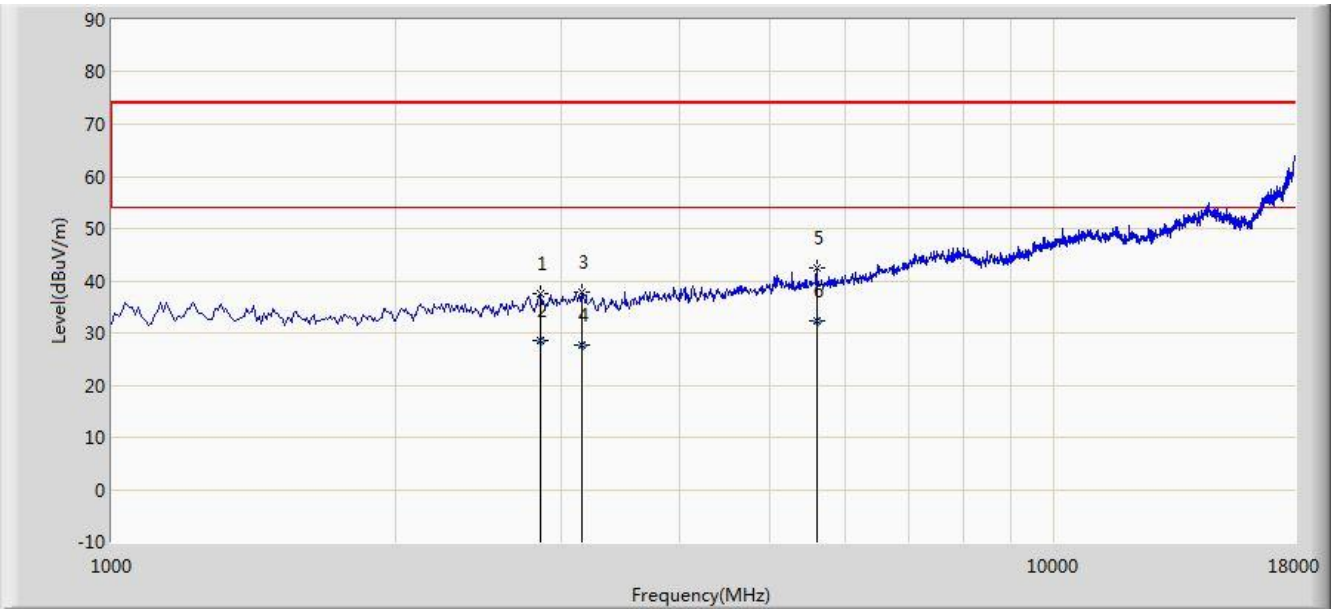


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2122.000	36.242	36.976	-37.758	74.000	-0.734	PK
2			2122.050	26.915	27.648	-27.085	54.000	-0.733	AV
3			3065.500	37.698	37.467	-36.302	74.000	0.231	PK
4			3065.510	26.811	26.580	-27.189	54.000	0.231	AV
5			4680.500	39.855	34.503	-34.145	74.000	5.351	PK
6		*	4680.500	29.712	24.360	-24.288	54.000	5.351	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: AC2	Time: 2018/04/15 - 23:11
Limit: FCC_Part15.109_RE(3m)_ClassB	Engineer: Will Yan
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Bluetooth mesh node	Power: DC 12V
Test Mode 1	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2853.000	37.675	37.532	-36.325	74.000	0.143	PK
2			2853.015	28.453	28.310	-25.547	54.000	0.143	AV
3			3150.500	37.747	37.176	-36.253	74.000	0.572	PK
4			3150.500	27.721	27.150	-26.279	54.000	0.572	AV
5			5598.500	42.536	35.858	-31.464	74.000	6.677	PK
6		*	5598.510	32.318	25.640	-21.682	54.000	6.678	AV

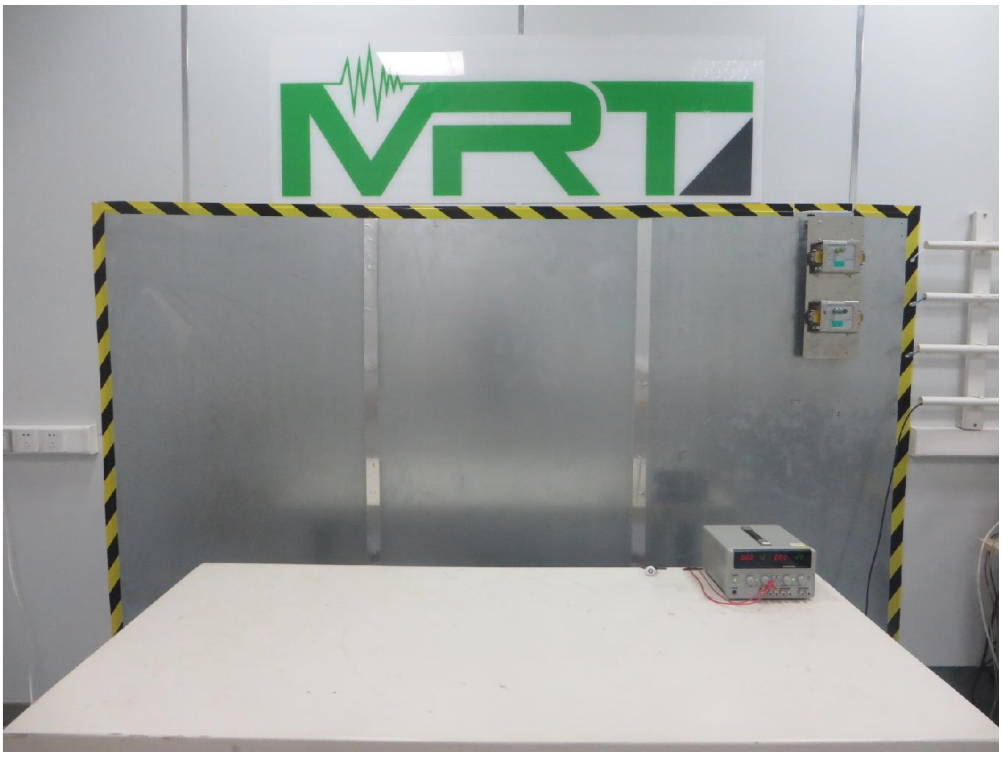
Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

6.4. Test Photograph

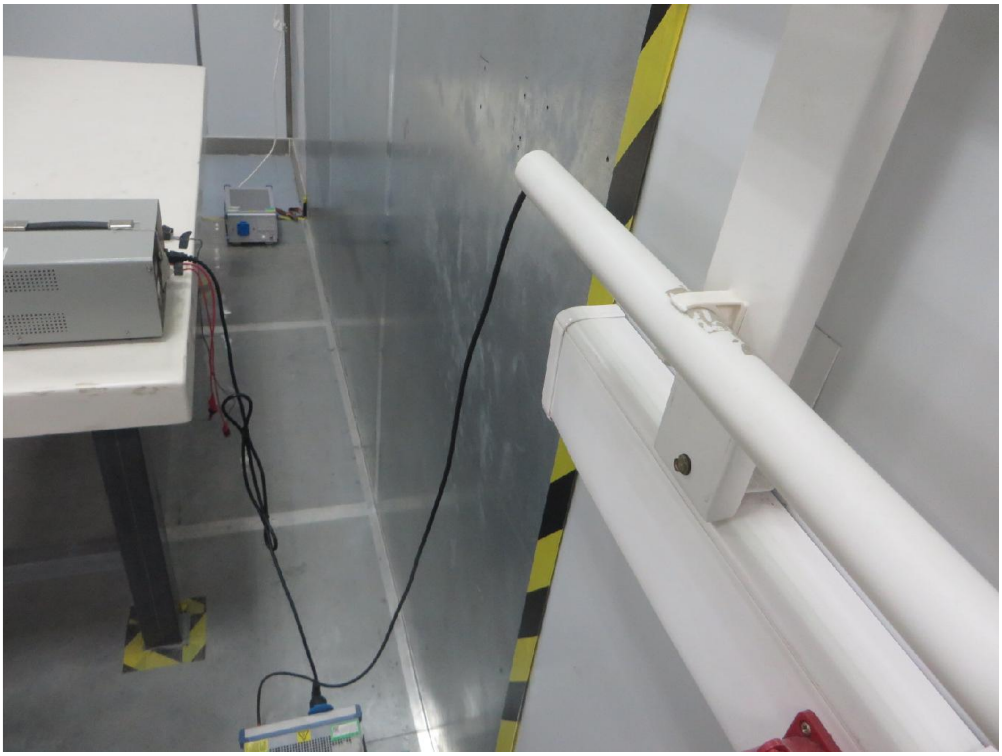
Test Mode 1

Description: Front View of Conducted Emission Test Setup Power Port

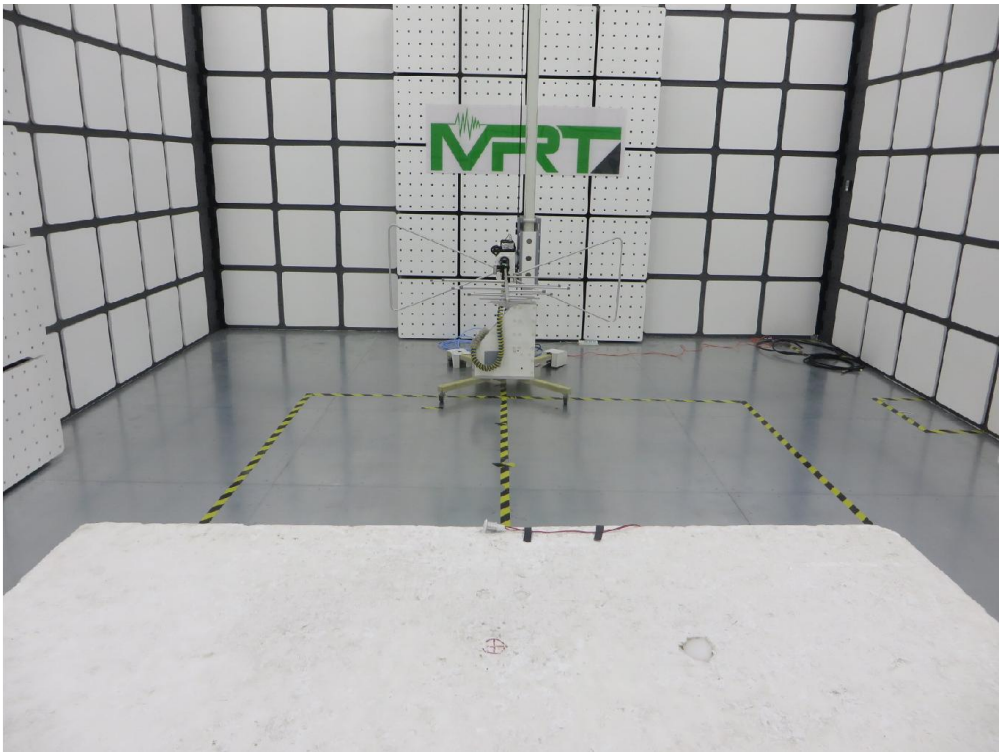


Test Mode 1

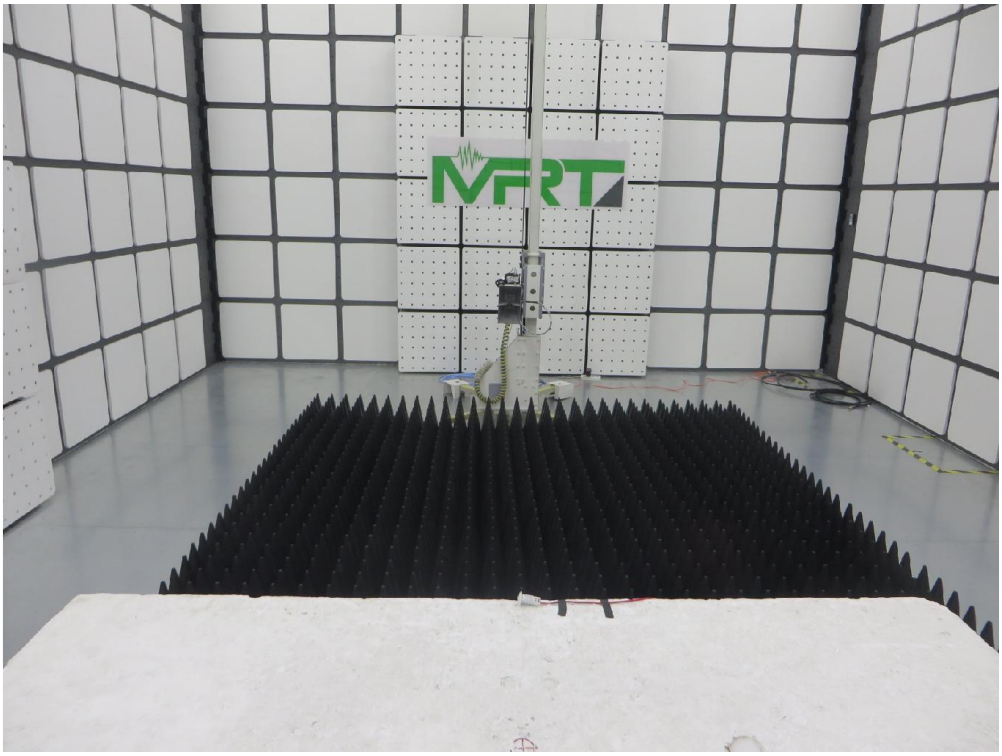
Description: Back view of Conducted Emission Test Setup for Power Port



Radiated disturbance Test Setup (30MHz ~ 1000MHz)



Radiated disturbance Test Setup (1GHz ~ 18GHz)



The End