FCC/ISED EMC TEST REPORT

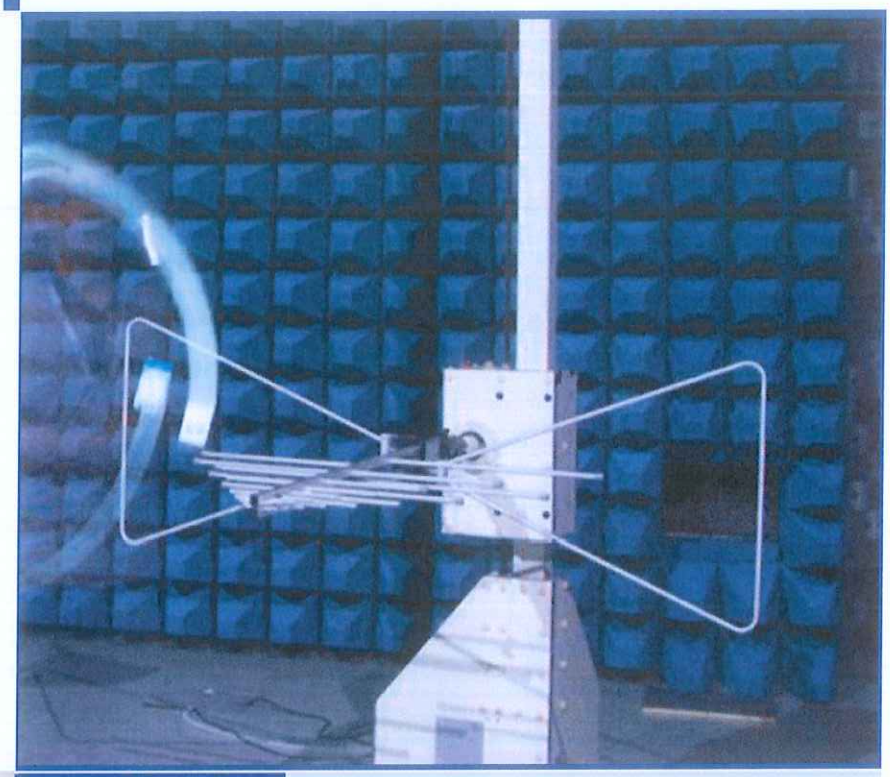
ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Box

ISSUED TO
MatchX GmbH

Adalbert Str.8 10999 Berlin, Germany



Report No.:	BL-SZ1770051-401
EUT Name:	Box
Model Name:	MX1702
Brand Name:	MatchX
Test Standard:	47 CFR Part 15 Subpart B
	ICES-003 (Issue 6, January 2016)
FCC ID:	2AMPF-MX1702
Test Conclusion:	Pass
Test Date:	Jul. 07, 2017 ~ Jul. 09, 2017
Date of Issue:	Jul. 10, 2017

Tested by: Xia Long
Xia Long
(Engineer)
Date Jul. 10. 2017

Approved by:
Wei Yanquan
(Chief Engineer)
Date Jul. 10. 2017

NOTE: This test report of test results only related to testing samples, which can be duplicated completely for the legal use with the approval of the applicant; it shall not be reproduced except in full, without the written approval of Shenzhen BALUN Technology Co., Ltd. BALUN Laboratory. Any objections should be raised within thirty days from the date of issue. To validate the report, please contact us.

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Revision History

Version	Issue Date	Revisions Content
Rev. 01	Jul. 10, 2017	Initial Issue

TABLE OF CONTENTS

1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 832625. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20°C~25°C
Ambient Relative Humidity	45% - 55%
Ambient Pressure	100 kPa - 102 kPa

1.4 Announce

(1) The test report reference to the report template version v1.1.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	MatchX GmbH
Address	Adalbert Str.8 10999 Berlin, Germany

2.2 Manufacturer Information

Manufacturer	MatchX GmbH
Address	Adalbert Str.8 10999 Berlin, Germany

2.3 Factory Information

Factory	Moko Technology Ltd.
Address	4F, Buliding 2, GuangHui Technology Park, MinQing Rd, LongHua, Shenzhen, China

2.4 General Description for Equipment under Test (EUT)

EUT Name	Box
Model Name Under Test	MX1702
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	V3.2
Software Version	V1.0
Dimensions (Approx.)	207.5*80*32.1mm
Weight (Approx.)	400g
The Highest Speed of Processor	580MHz
Network and Wireless connectivity	WIFI, GPS, GLONASS, Lora

2.5 Ancillary Equipment

Ancillary Equipment 1	Adapter	
	Brand Name	N/A
	Model Name	G0549A-240-050
	Rated Input	100-240 V~, 50/60 Hz
	Rated Output	24 V⎓, 0.5 A
Ancillary Equipment 2	Power Line	
	Length (Approx.)	0.7 m

2.6 Technical Information

Note: Not applicable.

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	FCC 47 CFR Part 15 Subpart B (10-1-16 Edition)	Unintentional Radiators
2	ICES-003 (Issue 6, January 2016)	Information Technology Equipment (Including Digital Apparatus) — Limits and Methods of Measurement
3	ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

3.2 Verdict

No.	Description	FCC Rule	ISED Rule	Test Verdict	Result
1	Radiated Emission	15.109	ICES-003 6.1	Pass	Annex A .1
2	Conducted Emission, AC Ports	15.107	ICES-003 6.2	Pass	Annex A .2

3.3 Test Uncertainty

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	Value
Conducted emissions (9 kHz-30 MHz)	3.23 dB
Radiated emissions (30 MHz-1 GHz)	4.30 dB
Radiated emissions (1 GHz-18 GHz)	4.81 dB
Radiated emissions (18 GHz-40 GHz)	5.71 dB

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

Environment Parameter	Selected Values During Tests			
	Temperature	Voltage	Relative Humidity	Ambient Pressure
Normal Temperature, Normal Voltage (NTNV)	23°C~26°C	AC 120 V/60 Hz	50%-55%	100 to 102 kPa

4.2 Test Equipment List

Radiated Emission Test For Frequency Below 1 GHz						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2017.06.22	2018.06.21	☒
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-977	2016.07.19	2018.07.18	☒
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	9120D-1600	2016.07.12	2018.07.11	☐
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60 *7.35m	N/A	2016.08.09	2018.08.08	☒

Radiated Emission Test For Frequency Above 1 GHz						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2016.09.09	2017.09.08	☒
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-624	2015.07.22	2017.07.21	☐
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	9120D-1148	2015.07.22	2017.07.21	☒
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2017.02.21	2019.02.20	☒

Conducted Emission Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2017.06.22	2018.06.21	☒
LISN	SCHWARZBECK	NSLK 8127	8127-687	2017.06.22	2018.06.21	☒
LISN	SCHWARZBECK	NNLK 8129	8129-462	2016.09.14	2017.09.13	☐
AMN	SCHWARZBECK	NNBM8124	8124-509	2017.06.22	2018.06.21	☐
AMN	SCHWARZBECK	NNBM8124	8124-510	2017.06.22	2018.06.21	☐
ISN	TESEQ	ISN T800	34449	2017.06.22	2018.06.21	☐
Shielded Enclosure	ChangNing	CN-130701	130703	N/A	N/A	☒

4.3 Test Enclosure list

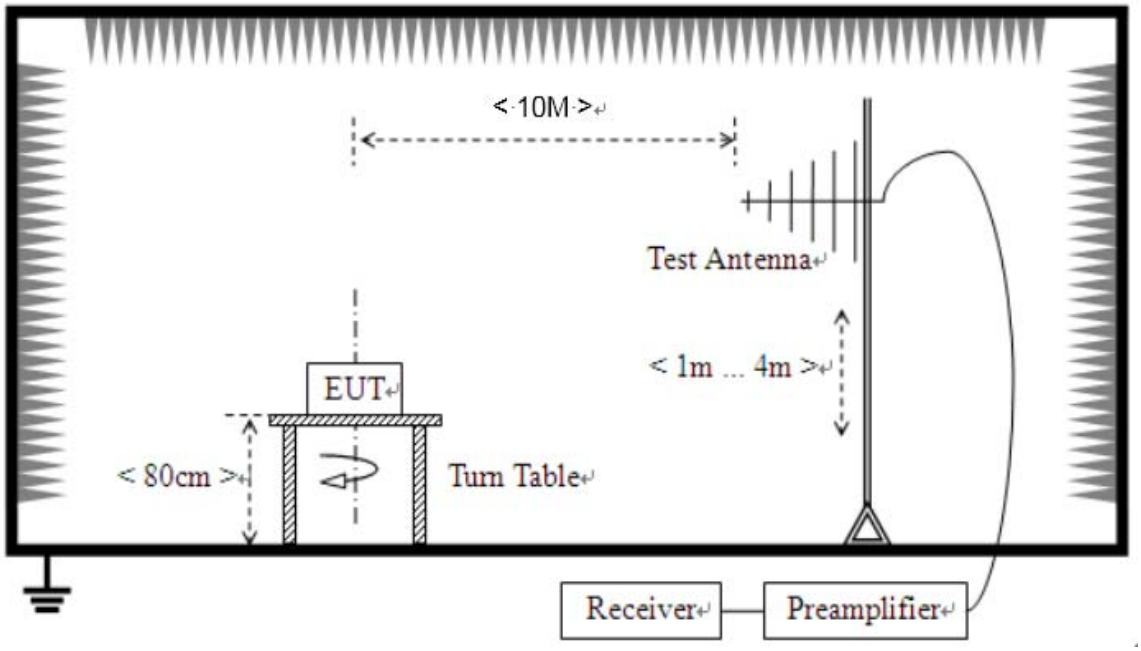
Description	Manufacturer	Model	Serial No.	Length	Description	Use
PC	N/A	N/A	N/A	N/A	Special Handled	☐
Laptop	Lenovo	E31-80	R3026PU9	N/A	N/A	☒
Printer	HP	DESKJET 1000	N/A	N/A	N/A	☐
Keyboard	Logitech	Y-BP62a	N/A	N/A	N/A	☐
Mouse	Logitech	M100	N/A	N/A	N/A	☐
USB Disk	Kingston	N/A	N/A	N/A	N/A	☒
TF Card	Kingston	N/A	N/A	N/A	N/A	☐
VGA Cable	N/A	N/A	N/A	1.5 m	Shielded with core	☐
HDMI Cable	N/A	N/A	N/A	1.5 m	Shielded with core	☐
DVI Cable	N/A	N/A	N/A	1.5 m	Shielded with core	☐
Coaxial video cable	N/A	N/A	N/A	2.0 m	Shielded with core	☐
Audio Cable	N/A	N/A	N/A	0.5 m	Shielded with core	☐
iPhone	Apple	A1586	N/A	N/A	N/A	☒
Bluetooth Earphone	SAMSUNG	Gear Circle	N/A	N/A	N/A	☐
GPS/GLONASS Vector signal generator	R&S	N5172B EXG	N/A	N/A	N/A	☒
WIFI Router	TP-LINK	TL-WDR7500	N/A	N/A	N/A	☐
Earphone	N/A	OPPO	N/A	1.1 m	N/A	☐
Car Battery	Camel	55530	N/A	N/A	12 V/55 Ah	☐
Artificial load	N/A	N/A	N/A	N/A	2.5 Ω/100 W	☐
Artificial load	N/A	N/A	N/A	N/A	5 Ω/100 W	☐
Electronic Load	ITECH	IT8511	N/A	N/A	N/A	☐
USB Cable	N/A	N/A	N/A	1.5 m	Shielded with core	☐
DC Power Supply	ITECH	IT6863A	600014010687210006	N/A	N/A	☐
LCD Monitor	SAMSUNG	UA32C4000P	N/A	N/A	N/A	☐
RJ45 Cable	N/A	N/A	N/A	1.5 m	Shielded with core	☒

4.4 Test Configurations

Test Configurations (TC) No.	Description
TC01	The Working Test Mode EUT + Adapter + Power Line + RJ45 Cable + Laptop + USB Disk + WIFI Link + Lora RX + GPS RX + GLONASS RX

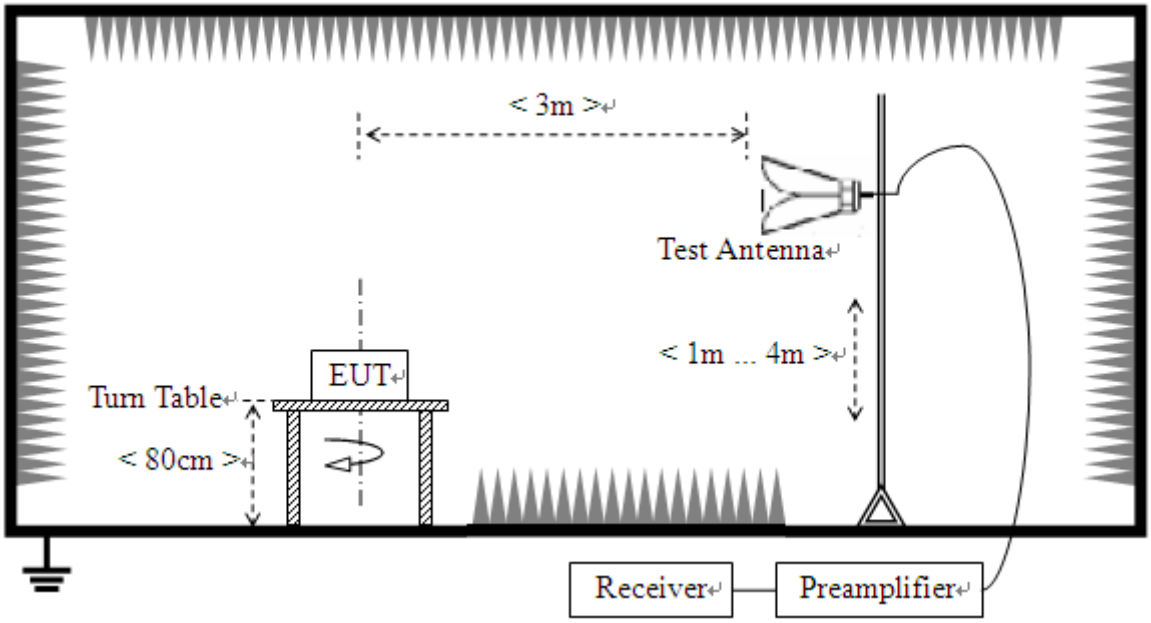
4.5 Test Setups

Test Setup 1



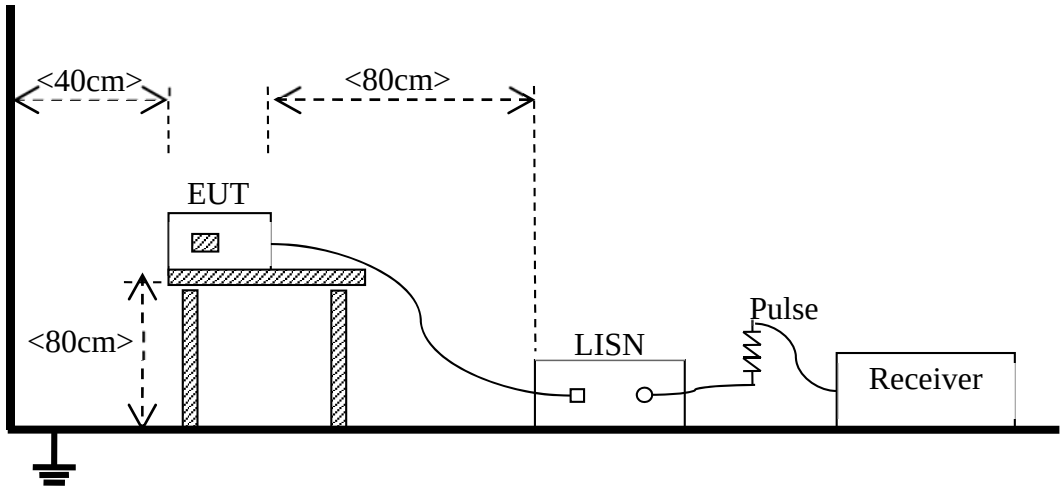
(For Radiated Emission Test (30 MHz-1 GHz))

Test Setup 2



(For Radiated Emission Test (above 1 GHz))

Test Setup 3



(For Conducted Emission, AC Ports Test)

4.6 Test Conditions

Test Case	Test Conditions	
Radiated Emission	Test Env.	NTNV
	Test Setup	Test Setup 1&2
	Test Configuration	TC01 Note
Conducted Emission, AC Ports	Test Env.	NTNV
	Test Setup	Test Setup 3
	Test Configuration	TC01 Note
Note: Based on client request, all normal using modes of the normal function were tested but only the worst test data of the worst mode is reported by this report. The Working Test Mode is the worst mode in this report.		

5 TEST ITEMS

5.1 Emission Tests

5.1.1 Radiated Emission

5.1.1.1 Limit

Frequency range (MHz)	Class B (at 3 m)		Class B (at 10 m)	Class A (at 10 m)	
	Field Strength (μV/m)	Field Strength (dBμV/m)	Field Strength (dBμV/m)	Field Strength (μV/m)	Field Strength (dBμV/m)
30 - 88	100	40	30	90	39
88 - 216	150	43.5	33.5	150	43.5
216 - 960	200	46	36	210	46.4
Above 960	500	54	44	300	49.5

NOTE:

1) Field Strength (dBμV/m) = 20*log [Field Strength (μV/m)].
2) In the emission tables above, the tighter limit applies at the band edges.
3) The limits using ANSI C63.4.

5.1.1.2 Test Setup

Refer to 4.5 section (test setup 1 to test setup 2) for radiated emission test, the photo of test setup please refer to ANNEX B.

5.1.1.3 Test Procedure

The test employing the methods of measurement described in the publication referenced in Section 3(b) (ANSI C63.4);

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

An initial pre-scan was performed in the chamber using the EMI Receiver in peak detection mode. Quasi-peak measurements were conducted based on the peak sweep graph. The EUT was measured by Bi-Log antenna with 2 orthogonal polarities.

5.1.1.4 Test Result

Please refer to ANNEX A.1.

5.1.2 Conducted Emission

5.1.2.1 Test Limit

Frequency range (MHz)	Class A	
	Quasi-peak (dBμV)	Average (dBμV)
0.15 - 0.50	79	66
0.50 - 30	73	60

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

NOTE:

1) The lower limit shall apply at the band edges.
2) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50 MHz.
3) The limit using ANSI C63.4.

5.1.2.2 Test Setup

Refer to 4.5 section test (test setup 3) for conducted emission, the photo of test setup please refer to ANNEX B.

5.1.2.3 Test Procedure

The test employing the methods of measurement described in the publication referenced in Section 3(b) (ANSI C63.4);

The EUT is connected to the power mains through a LISN which provides 50 Ω/50 μH of coupling impedance for the measuring instrument. The test frequency range is from 150 kHz to 30 MHz. The maximum conducted interference is searched using Peak (PK), Quasi-peak (QP) and Average (AV) detectors; the emission levels that are 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.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) 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.

5.1.2.4 Test Result

Please refer to ANNEX A.2.

ANNEX A TEST RESULTS

A.1 Radiated Emission

Note 1: The symbol of "--" in the table which means not application.

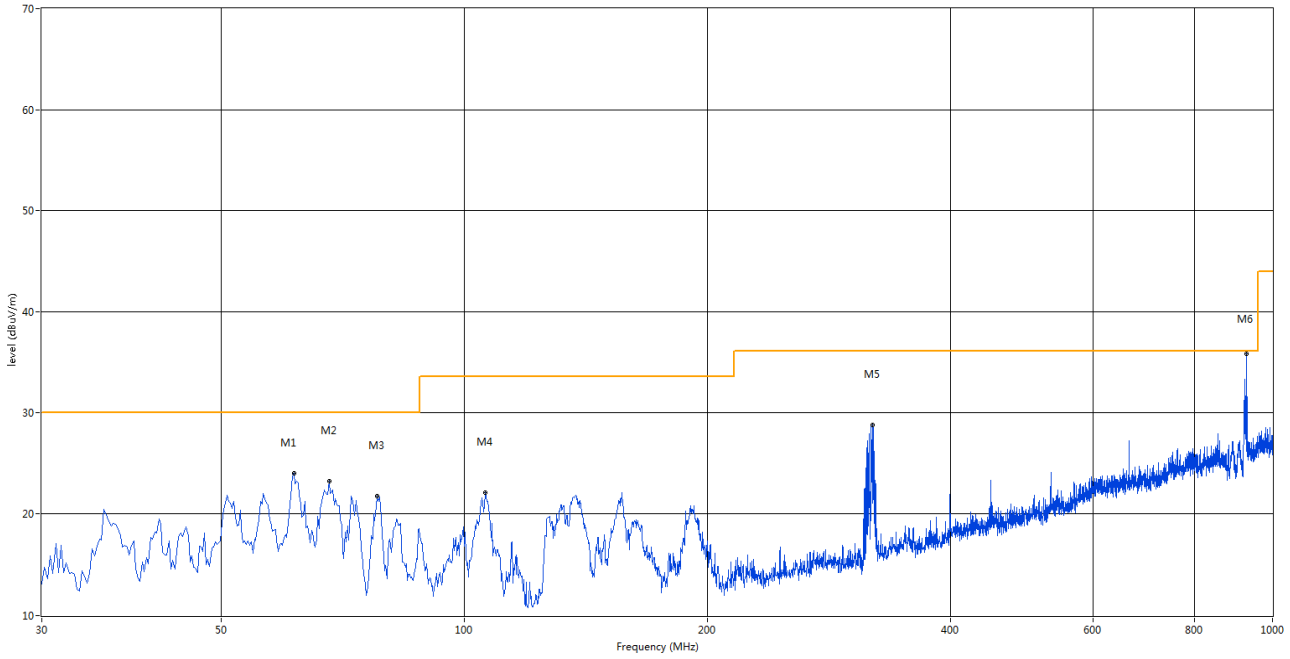
Note 2: For the test data above 1 GHz, according the ANSI C63.4-2014, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note 3: This frequency which near 900 MHz with circle should be ignored because they are Lora carrier frequency, the marked spikes near 2400 MHz with circle should be ignored because they are WIFI carrier frequency.

Test Data and Plots

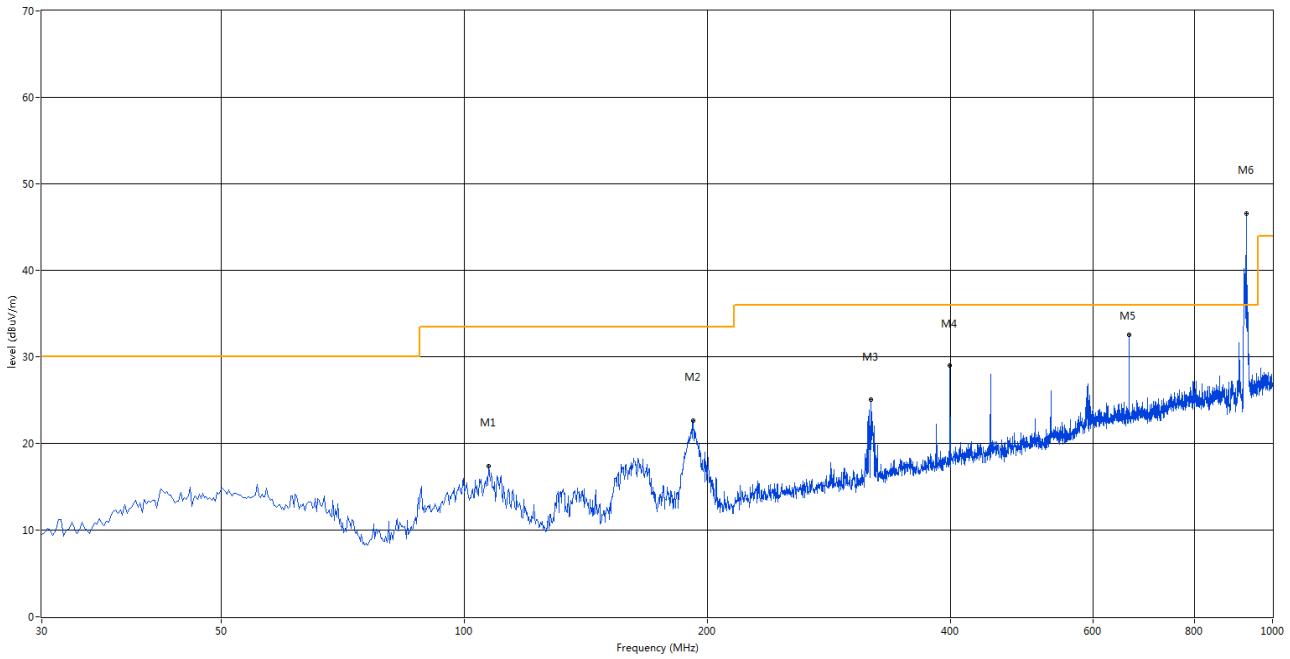
The Working Test Mode

A.1.1 Test Antenna Vertical, 30 MHz – 1 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	61.517	24.04	-11.87	30.0	5.96	Peak	27.00	300	Vertical	Pass
2	68.063	23.25	-13.42	30.0	6.75	Peak	46.00	200	Vertical	Pass
3	78.003	21.77	-16.07	30.0	8.23	Peak	109.00	100	Vertical	Pass
4	106.126	22.10	-11.66	33.5	11.40	Peak	109.00	100	Vertical	Pass
5	319.715	28.80	-8.35	36.0	7.20	Peak	0.00	200	Vertical	Pass
6	927.753	35.80	2.65	36.0	0.20	Peak	314.00	300	Vertical	N/A

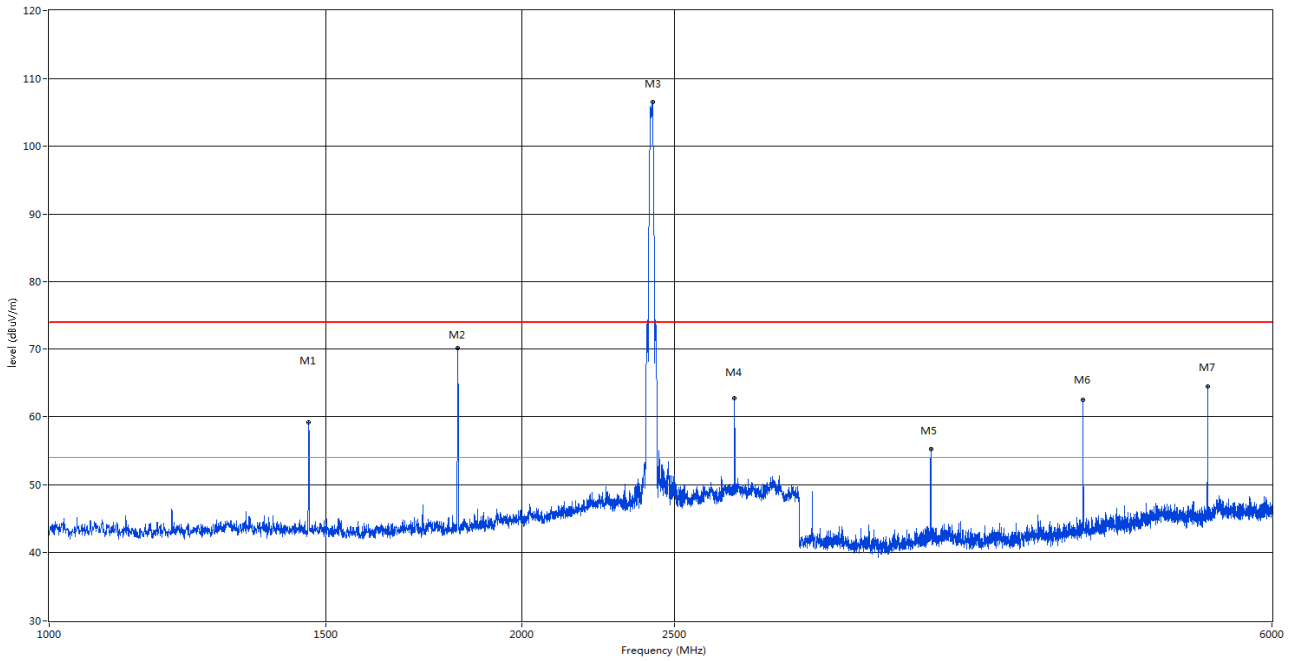
A.1.2 Test Antenna Horizontal, 30 MHz – 1 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	107.096	17.37	-11.72	33.5	16.13	Peak	360.00	300	Horizontal	Pass
2	191.950	22.64	-12.12	33.5	10.86	Peak	66.00	400	Horizontal	Pass
3	318.503	24.97	-8.36	36.0	11.03	Peak	106.00	300	Horizontal	Pass
4	398.750	28.94	-6.20	36.0	7.06	Peak	41.00	300	Horizontal	Pass
5	664.949	32.51	-0.91	36.0	3.49	Peak	246.00	100	Horizontal	Pass
6	927.753	46.63	2.65	36.0	-10.63	Peak	246.00	100	Horizontal	N/A

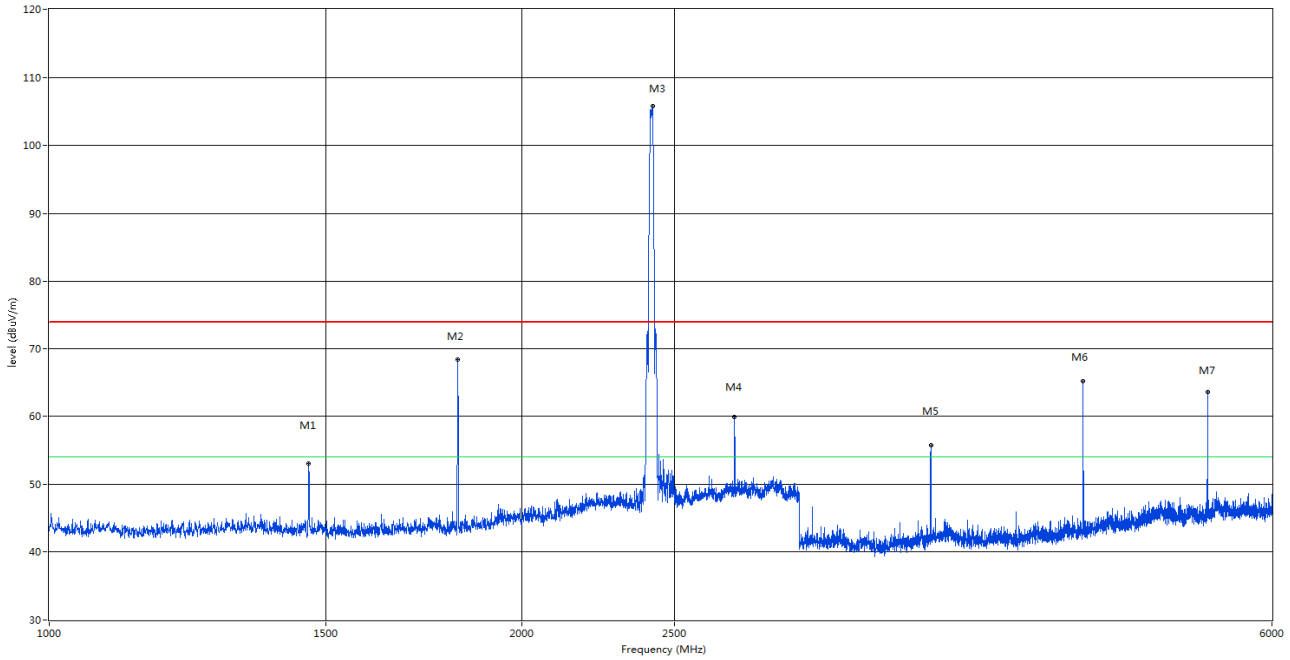
Test Data and Plots (Above 1 GHz)

A.1.3 Test Antenna Vertical, 1 GHz – 6 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1462.500	54.35	-3.12	74.0	19.65	Peak	359.10	100	Vertical	Pass
1**	1462.500	29.45	-3.12	54.0	24.55	AV	359.10	100	Vertical	Pass
2	1819.500	70.14	-2.24	74.0	3.86	Peak	336.70	100	Vertical	N/A
3	2420.500	106.57	1.25	74.0	-32.57	Peak	326.60	100	Vertical	N/A
4	2730.000	62.75	4.66	74.0	11.25	Peak	227.70	100	Vertical	N/A
5	3639.750	55.26	7.61	74.0	18.74	Peak	145.90	100	Vertical	N/A
6	4549.500	62.53	9.26	74.0	11.47	Peak	309.00	100	Vertical	N/A
7	5460.000	64.41	10.97	74.0	9.59	Peak	145.90	100	Vertical	N/A

A.1.4 Test Antenna Horizontal, 1 GHz – 6 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1462.500	53.06	-3.12	74.0	20.94	Peak	275.90	100	Horizontal	Pass
2	1820.000	68.41	-2.25	74.0	5.59	Peak	30.40	100	Horizontal	N/A
3	2420.500	105.79	1.25	74.0	-31.79	Peak	345.90	100	Horizontal	N/A
4	2729.500	59.90	4.63	74.0	14.10	Peak	141.60	100	Horizontal	N/A
5	3639.750	55.79	7.61	74.0	18.21	Peak	84.80	100	Horizontal	N/A
6	4549.500	60.21	9.26	74.0	13.79	Peak	0.60	100	Horizontal	N/A
7	5460.000	63.63	10.97	74.0	10.37	Peak	79.60	100	Horizontal	N/A

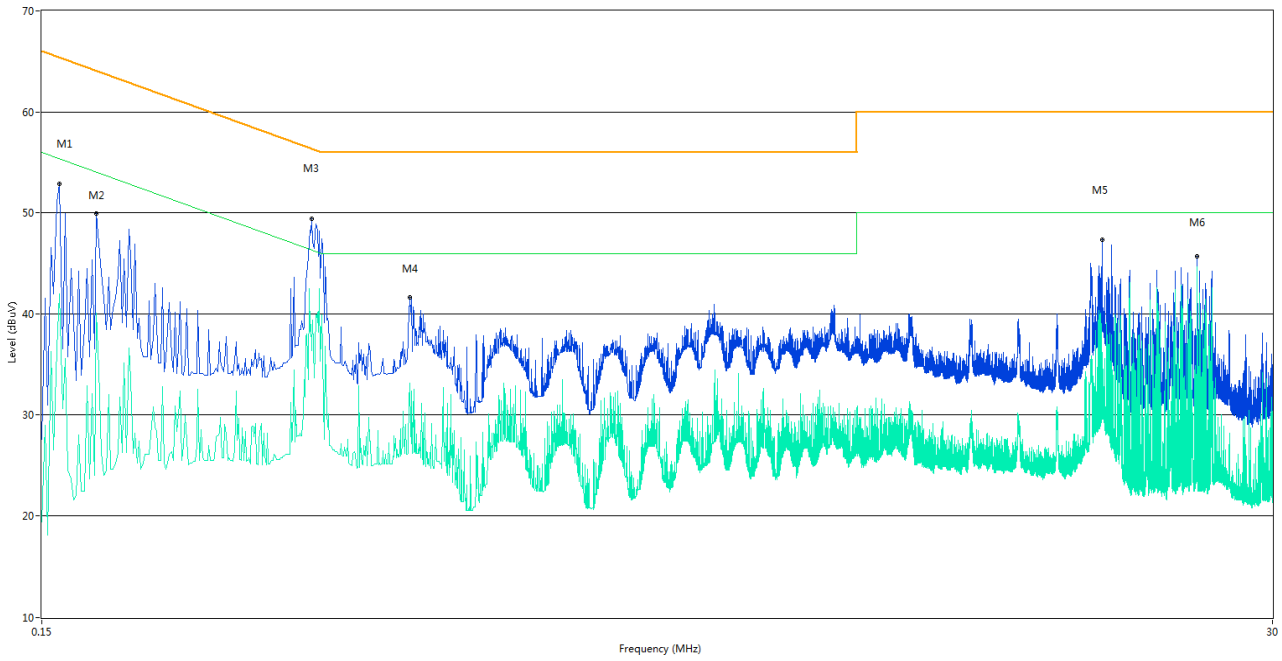
A.2 Conducted Emission

Note: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.

Test Data and Plots

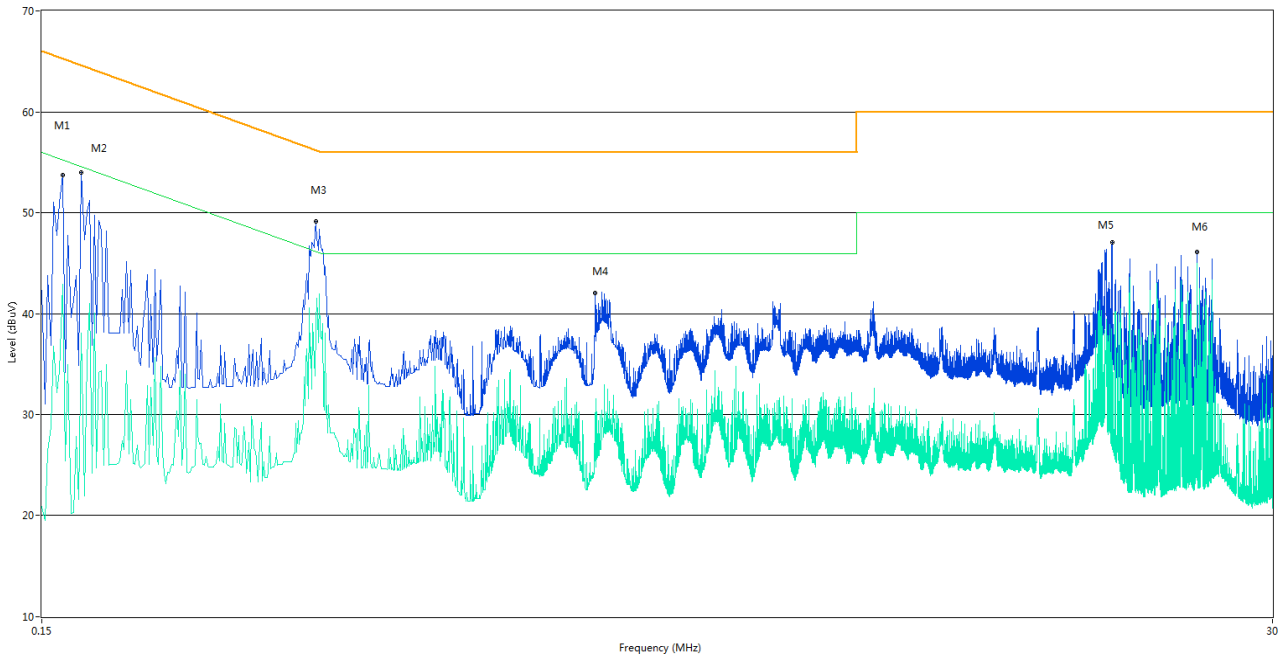
The Working Test Mode

A.2.1 L Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.162	52.9	9.85	65.4	12.50	Peak	L Line	Pass
1**	0.162	42.0	9.85	55.4	13.40	AV	L Line	Pass
2	0.190	49.9	9.35	64.0	14.10	Peak	L Line	Pass
2**	0.190	40.1	9.35	54.0	13.90	AV	L Line	Pass
3	0.480	49.5	11.23	56.3	6.80	Peak	L Line	Pass
3**	0.480	36.3	11.23	46.3	10.00	AV	L Line	Pass
4	0.732	41.7	9.38	56.0	14.30	Peak	L Line	Pass
4**	0.732	33.1	9.38	46.0	12.90	AV	L Line	Pass
5	14.408	47.4	11.35	60.0	12.60	Peak	L Line	Pass
5**	14.408	30.6	11.35	50.0	19.40	AV	L Line	Pass
6	21.660	45.7	11.00	60.0	14.30	Peak	L Line	Pass
6**	21.660	44.6	11.00	50.0	5.40	AV	L Line	Pass

A.2.2 N Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.164	53.8	9.41	65.3	11.50	Peak	N Line	Pass
1**	0.164	42.9	9.41	55.3	12.40	AV	N Line	Pass
2	0.178	54.0	10.16	64.6	10.60	Peak	N Line	Pass
2**	0.178	38.0	10.16	54.6	16.60	AV	N Line	Pass
3	0.488	49.2	10.28	56.2	7.00	Peak	N Line	Pass
3**	0.488	38.9	10.28	46.2	7.30	AV	N Line	Pass
4	1.624	42.1	9.85	56.0	13.90	Peak	N Line	Pass
4**	1.624	26.2	9.85	46.0	19.80	AV	N Line	Pass
5	15.080	47.1	11.45	60.0	12.90	Peak	N Line	Pass
5**	15.080	28.8	11.45	50.0	21.20	AV	N Line	Pass
6	21.660	46.1	11.00	60.0	13.90	Peak	N Line	Pass
6**	21.660	45.0	11.00	50.0	5.00	AV	N Line	Pass

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ1770051-AE.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ1770051-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ1770051-AI.PDF”.

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