

FCC

EMC

TEST REPORT

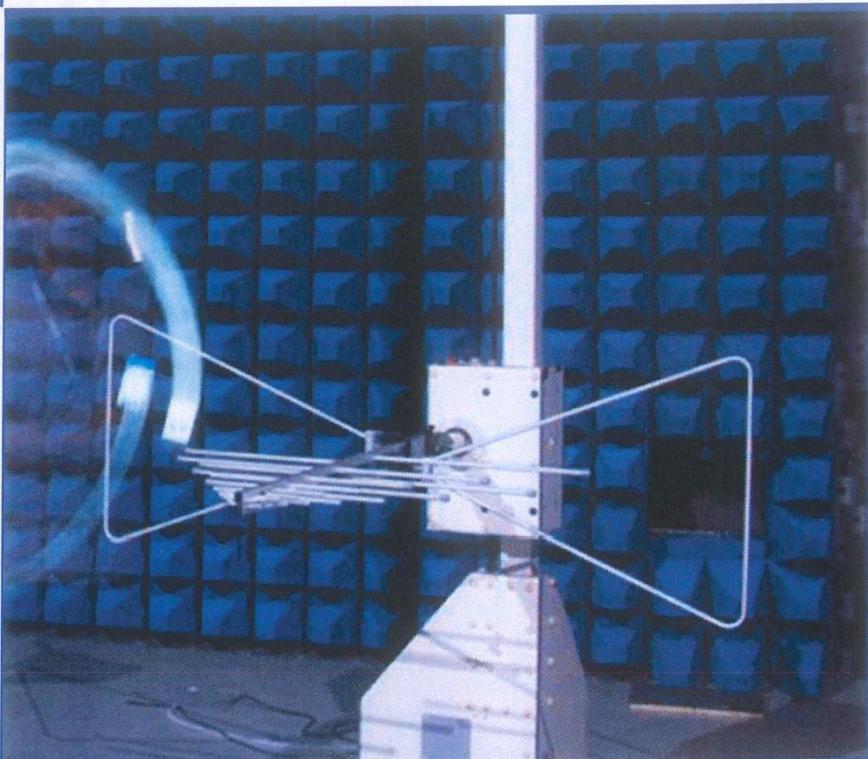
ISSUED BY
Shenzhen BALUN Technology Co., Ltd.



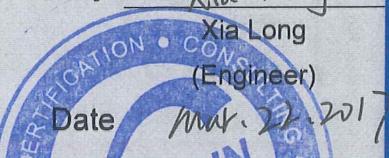
FOR
Tethys

ISSUED TO
Shanghai Bwave Technology Co., Ltd.

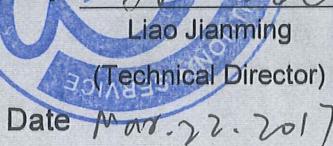
6F, Building 12, 399 Keyuan Road, Zhangjiang Hi-Tech Park,
Shanghai, China



Tested by: Xia Long



Approved by: Liao Jianming



Report No.: BL-SZ16C0097-401

EUT Name: Tethys

Model Name: RTK00V2XRC7746SFS

Brand Name: N/A

Test Standard: 47 CFR Part 15 Subpart B

FCC ID: 2AHMN-TETHYS

Test Conclusion: Pass

Test Date: Jan. 09, 2017 ~ Mar. 01, 2017

Date of Issue: Mar. 22, 2017

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Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Jan. 18, 2017</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Feb. 08, 2017</u>	<u>Added a ancillary equipment and Retest all the item</u>
<u>Rev. 03</u>	<u>Mar. 21, 2017</u>	<u>Retest all the item and Update the data, Change the Software Version, Increased the FCC ID number</u>

TABLE OF CONTENTS

1	GENERAL INFORMATION	4
1.1	Identification of the Testing Laboratory	4
1.2	Identification of the Responsible Testing Location	4
1.3	Laboratory Condition.....	4
1.4	Announce.....	4
2	PRODUCT INFORMATION.....	5
2.1	Applicant Information	5
2.2	Manufacturer Information	5
2.3	Factory Information	5
2.4	General Description for Equipment under Test (EUT)	5
2.5	Ancillary Equipment	6
2.6	Technical Information.....	6
3	SUMMARY OF TEST RESULTS.....	7
3.1	Test Standards.....	7
3.2	Verdict.....	7
3.3	Test Uncertainty	7
4	GENERAL TEST CONFIGURATIONS.....	8
4.1	Test Environments	8
4.2	Test Equipment List	8
4.3	Test Enclosure list.....	9
4.4	Test Configurations	10
4.5	Test Setups	11
4.6	Test Conditions	13

5 TEST ITEMS.....	14
5.1 Emission Tests.....	14
ANNEX A TEST RESULTS.....	16
A.1 Radiated Emission	16
A.2 Conducted Emission	20
ANNEX B TEST SETUP PHOTOS	22
ANNEX C EUT EXTERNAL PHOTOS	22
ANNEX D EUT INTERNAL PHOTOS	22

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 v6.3.
- (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	Shanghai Bwave Technology Co., Ltd.
Address	6F, Building 12, 399 Keyuan Road, Zhangjiang Hi-Tech Park, Shanghai, China

2.2 Manufacturer Information

Manufacturer	Shanghai Bwave Technology Co., Ltd.
Address	6F, Building 12, 399 Keyuan Road, Zhangjiang Hi-Tech Park, Shanghai, China

2.3 Factory Information

Factory	N/A
Address	N/A

2.4 General Description for Equipment under Test (EUT)

EUT Name	Tethys
Model Name Under Test	RTK00V2XRC7746SFS
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	V3.0
Software Version	beta2(main board)+C2X_FW_U_01.01.02(RF board)
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A
The Highest Speed of Processor	N/A
Network and Wireless connectivity	Dedicated Short-Range Communications Service Roadside Units (DSRCS-RSUs), GPS

2.5 Ancillary Equipment

Ancillary Equipment 1	3dB Antenna	
	Length	2.0 m
Ancillary Equipment 2	5dB Antenna	
	Length	0.2 m
Ancillary Equipment 3	GPS Antenna	
	Length	5.0 m
Ancillary Equipment 4	USB Cable	
	Length	1.5 m
Ancillary Equipment 5	CAN Cable	
	Length	0.8 m

2.6 Technical Information

N/A

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	FCC 47 CFR Part 15 Subpart B (10-1-15 Edition)	Unintentional Radiators
2	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	Test Verdict	Result
1	Radiated Emission	15.109	Pass	Annex A.1
2	Conducted Emission, AC Ports	15.107	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	DC 12 V	50%-55%	100 to 102 kPa

4.2 Test Equipment List

Radiated Emission Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2016.09.09	2017.09.08	<input checked="" type="checkbox"/>
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-624	2015.07.22	2017.07.21	<input checked="" type="checkbox"/>
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	9120D-1148	2015.07.22	2017.07.21	<input checked="" type="checkbox"/>
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2015.02.28	2017.02.27	<input checked="" type="checkbox"/>

Conducted disturbance Test						
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due	Use
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2016.07.05	2017.07.04	<input checked="" type="checkbox"/>
LISN	SCHWARZBECK	NSLK 8127	8127-687	2016.07.05	2017.07.04	<input checked="" type="checkbox"/>
Shielded Enclosure	ChangNing	CN-130701	130703	N/A	N/A	<input checked="" type="checkbox"/>

4.3 Test Enclosure list

Description	Manufacturer	Model	Serial No.	Length	Description	Use
PC	Dell	015K3N	N/A	N/A	Special Handled	<input type="checkbox"/>
Laptop	Lenovo	E31	R3026PU9	N/A	N/A	<input checked="" type="checkbox"/>
Printer	HP	DESKJET 1000	N/A	N/A	N/A	<input type="checkbox"/>
Keyboard	Logitech	Y-BP62a	N/A	N/A	N/A	<input type="checkbox"/>
Mouse	Logitech	M100	N/A	N/A	N/A	<input type="checkbox"/>
USB Disk	Kingston	N/A	N/A	N/A	N/A	<input checked="" type="checkbox"/>
TF Card	Kingston	N/A	N/A	N/A	N/A	<input checked="" type="checkbox"/>
VGA Cable	N/A	N/A	N/A	1.5 m	Shielded with core	<input type="checkbox"/>
HDMI Cable	N/A	N/A	N/A	1.5 m	Shielded with core	<input type="checkbox"/>
DVI Cable	N/A	N/A	N/A	1.5 m	Shielded with core	<input type="checkbox"/>
Coaxial video cable	N/A	N/A	N/A	2.0 m	Shielded with core	<input type="checkbox"/>
iPhone	Apple	A1586	N/A	N/A	N/A	<input type="checkbox"/>
Phone	MI	M4	N/A	N/A	N/A	<input type="checkbox"/>
Bluetooth Earphone	SAMSUNG	Gear Circle	N/A	N/A	N/A	<input type="checkbox"/>
GPS/GLONAS S Vector signal generator	R&S	N5172B EXG	N/A	N/A	N/A	<input checked="" type="checkbox"/>
WIFI Router	TP-LINK	TL-WDR7500	N/A	N/A	N/A	<input checked="" type="checkbox"/>
Earphone	N/A	OPPO	N/A	1.1 m	N/A	<input checked="" type="checkbox"/>
Car Battery	Camel	55530	N/A	N/A	12 V/55 Ah	<input type="checkbox"/>
Artificial load	N/A	N/A	N/A	N/A	2.5 Ω/100 W	<input type="checkbox"/>
Artificial load	N/A	N/A	N/A	N/A	5 Ω/100 W	<input type="checkbox"/>
Electronic Load	ITECH	IT8511	N/A	N/A	N/A	<input type="checkbox"/>
USB Cable	N/A	N/A	N/A	1.5 m	Shielded with core	<input type="checkbox"/>
DC Power Supply	ITECH	IT6863A	60001401068 7210006	N/A	N/A	<input checked="" type="checkbox"/>
LCD Monitor	SAMSUNG	UA32C4000P	N/A	N/A	N/A	<input type="checkbox"/>
LCD Monitor	Dell	U241HB	N/A	N/A	N/A	<input type="checkbox"/>
RJ45 Cable	N/A	N/A	N/A	1.5 m	Shielded with core	<input checked="" type="checkbox"/>
Adapter	GOLEDN PROFIT	GPE048A-120300-W	N/A	N/A	12 V/3 A	<input checked="" type="checkbox"/>

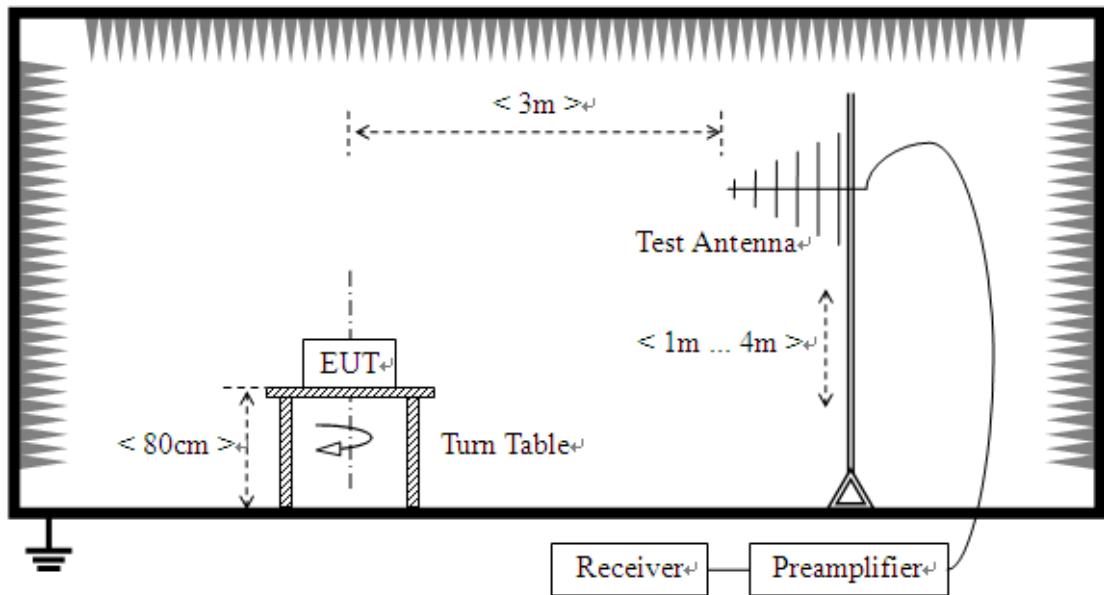
4.4 Test Configurations

Test Configurations (TC) No.	Description
TC01	<u>The TX Test Mode (3dB)</u> EUT + Adapter (DC Power Supply) + USB Cable + TF Card + Earphone + Laptop + RJ45 Cable + WIFI Router + USB Disk + 3dB Antenna + GPS Antenna + CAN Cable
TC02	<u>The TX Test Mode (5dB)</u> EUT + Adapter (DC Power Supply) + USB Cable + TF Card + Earphone + Laptop + RJ45 Cable + WIFI Router + USB Disk + 5dB Antenna + GPS Antenna + CAN Cable
TC03	<u>The RX Test Mode (3dB)</u> EUT + Adapter (DC Power Supply) + USB Cable + TF Card + Earphone + Laptop + RJ45 Cable + WIFI Router + USB Disk + 3dB Antenna + GPS Antenna + CAN Cable
TC04	<u>The RX Test Mode (5dB)</u> EUT + Adapter (DC Power Supply) + USB Cable + TF Card + Earphone + Laptop + RJ45 Cable + WIFI Router + USB Disk + 5dB Antenna + GPS Antenna + CAN Cable

Note: Radiated Emission test use the adapter power supply, Conducted Emission test use the DC power supply.

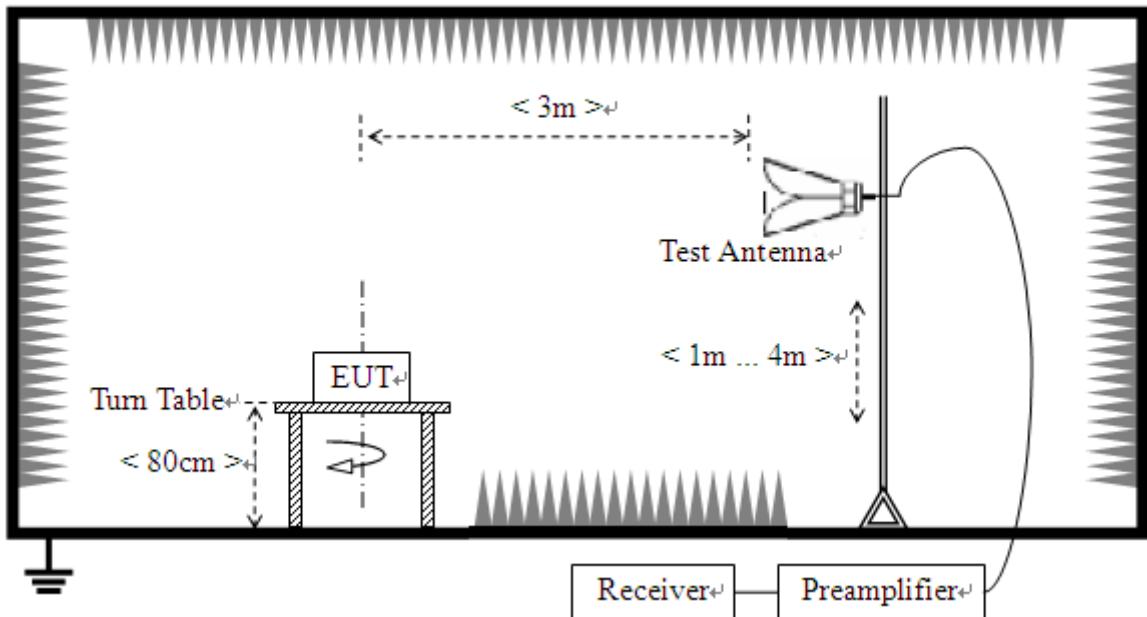
4.5 Test Setups

Test Setup 1

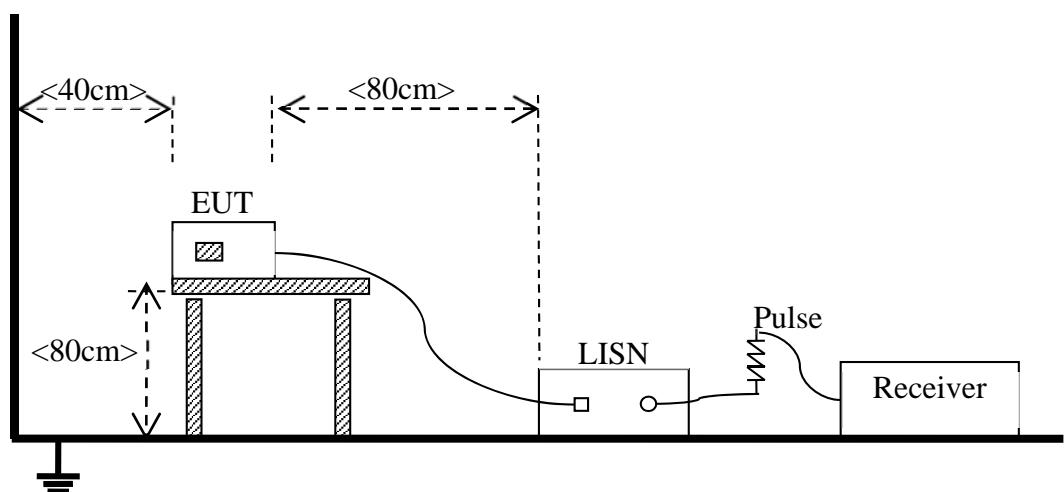


(For Radiated Emission Test (30 MHz-1 GHz))

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~TC04 <small>Note</small>
Conducted Emission, AC Ports	Test Env.	NTNV
	Test Setup	Test Setup 3
	Test Configuration	TC01~TC04 <small>Note</small>

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 TX Test Mode (5dB) 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 A (at 10 m)	
	Field Strength ($\mu\text{V}/\text{m}$)	Field Strength ($\text{dB}\mu\text{V}/\text{m}$)	Field Strength ($\mu\text{V}/\text{m}$)	Field Strength ($\text{dB}\mu\text{V}/\text{m}$)
30 - 88	100	40	90	39
88 - 216	150	43.5	150	43.5
216 - 960	200	46	210	46.4
Above 960	500	54	300	49.5

NOTE:

- 1) Field Strength ($\text{dB}\mu\text{V}/\text{m}$) = $20 \times \log [\text{Field Strength} (\mu\text{V}/\text{m})]$.
- 2) In the emission tables above, the tighter limit applies at the band edges.

5.1.1.2 Test Setup

Refer to 4.5 section (test setups1 to test setups2) for radiated emission test, the photo of test setup please refer to ANNEX B.

5.1.1.3 Test Procedure

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 (dB μ V)	Average (dB μ V)
0.15 - 0.50	79	66
0.50 - 30	73	60

Frequency range (MHz)	Class B	
	Quasi-peak (dB μ V)	Average (dB μ V)
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.

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 EUT is connected to the power mains through a LISN which provides 50 Ω/50 μ H 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.

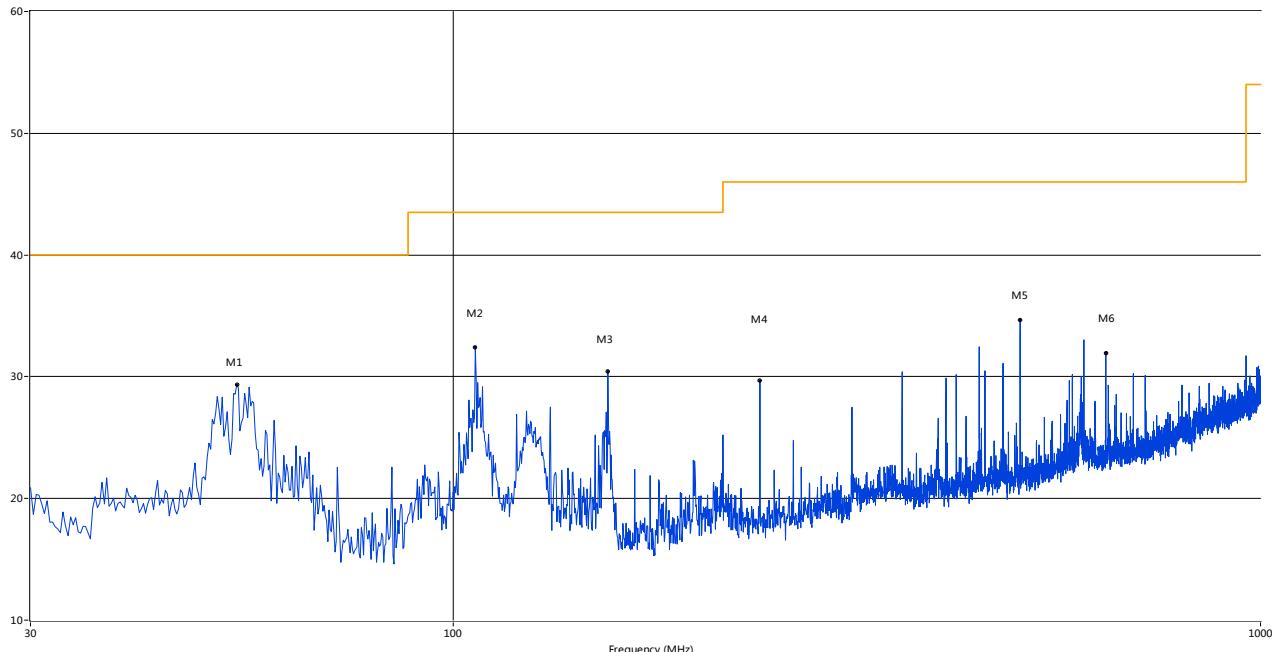
Note 2: For the test data above 1 GHz, according the ANSI C63.4-2014, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note 3: This frequency which near 5.9 GHz with circle should be ignored because they are working carrier frequency.

The TX Test Mode (5dB)

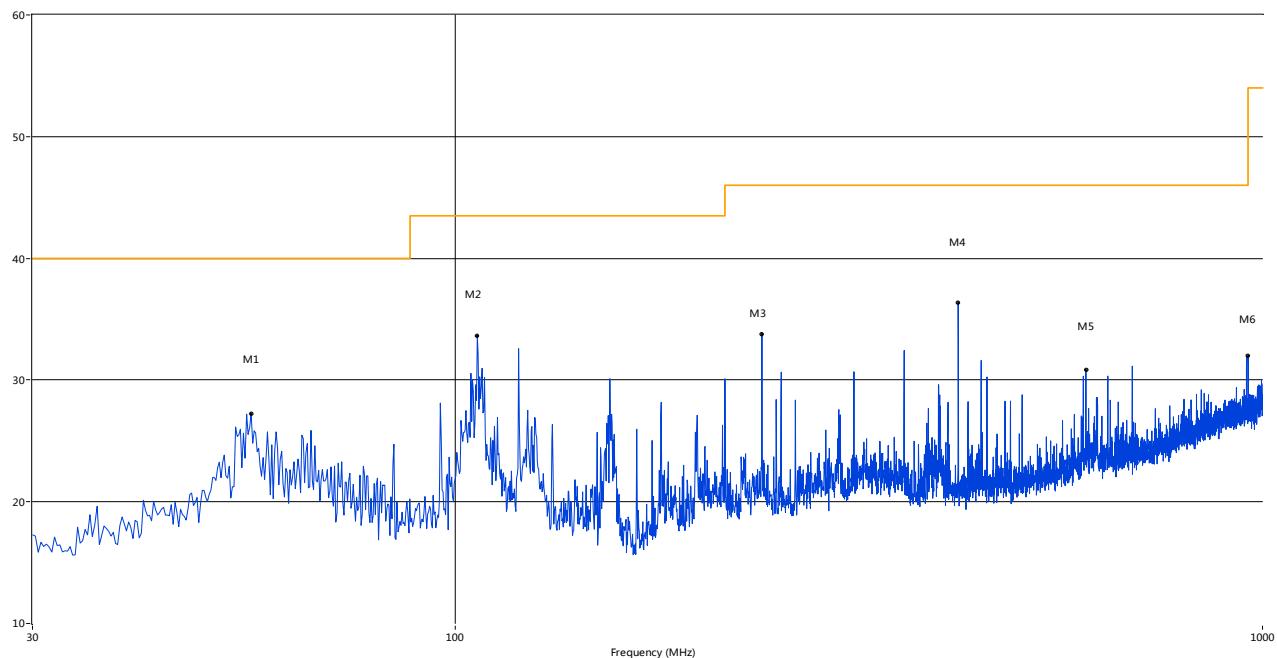
Test Data and Plots

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	54.008	29.37	-19.80	40.0	10.63	Peak	40.00	100	Vertical	Pass
2	106.630	32.41	-21.32	43.5	11.09	Peak	354.20	100	Vertical	Pass
3	155.615	30.45	-24.45	43.5	13.05	Peak	308.00	100	Vertical	Pass
4	240.005	29.70	-20.47	46.0	16.30	Peak	11.90	100	Vertical	Pass
5	504.087	34.67	-14.35	46.0	11.33	Peak	30.60	100	Vertical	Pass
6	643.525	31.93	-11.72	46.0	14.07	Peak	169.30	100	Vertical	Pass

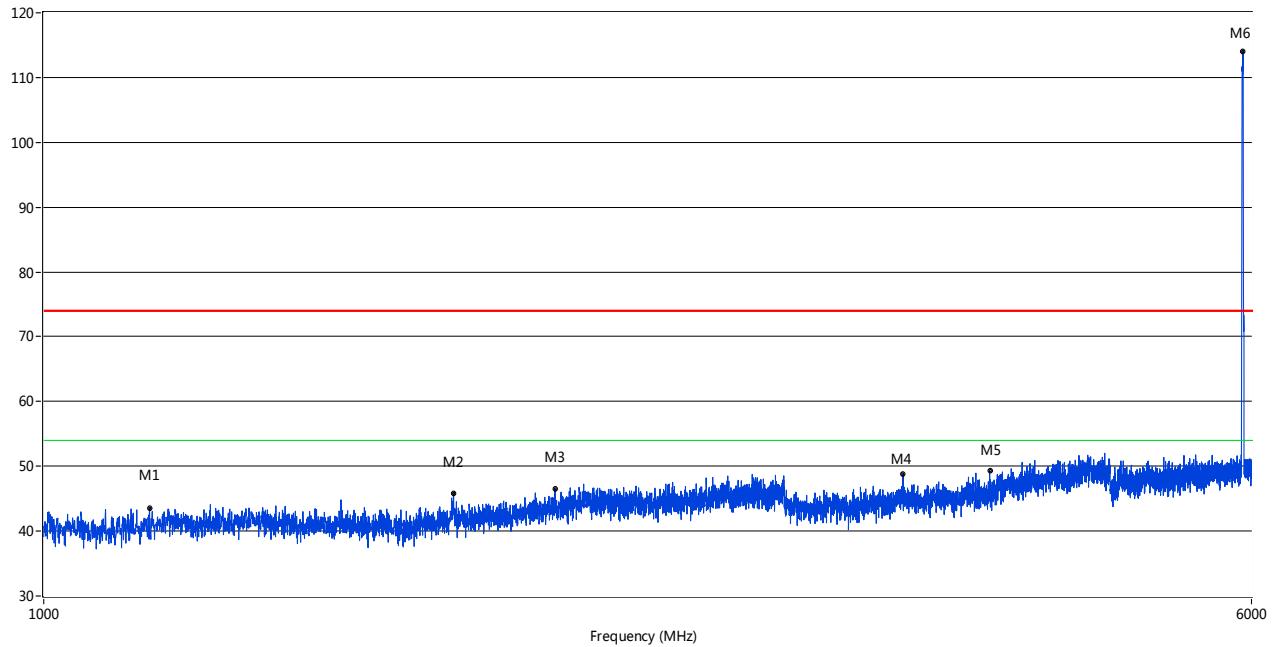
A.1.2 Test Antenna Horizontal, 30 MHz – 1 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	55.947	27.24	-20.23	40.0	12.76	Peak	4.30	100	Horizontal	Pass
2	106.630	33.66	-21.32	43.5	9.84	Peak	49.20	100	Horizontal	Pass
3	240.005	33.77	-20.47	46.0	12.23	Peak	349.40	100	Horizontal	Pass
4	419.940	36.33	-16.10	46.0	9.67	Peak	189.20	100	Horizontal	Pass
5	604.482	30.82	-12.03	46.0	15.18	Peak	189.20	100	Horizontal	Pass
6	959.987	31.99	-6.53	46.0	14.01	Peak	67.70	100	Horizontal	Pass

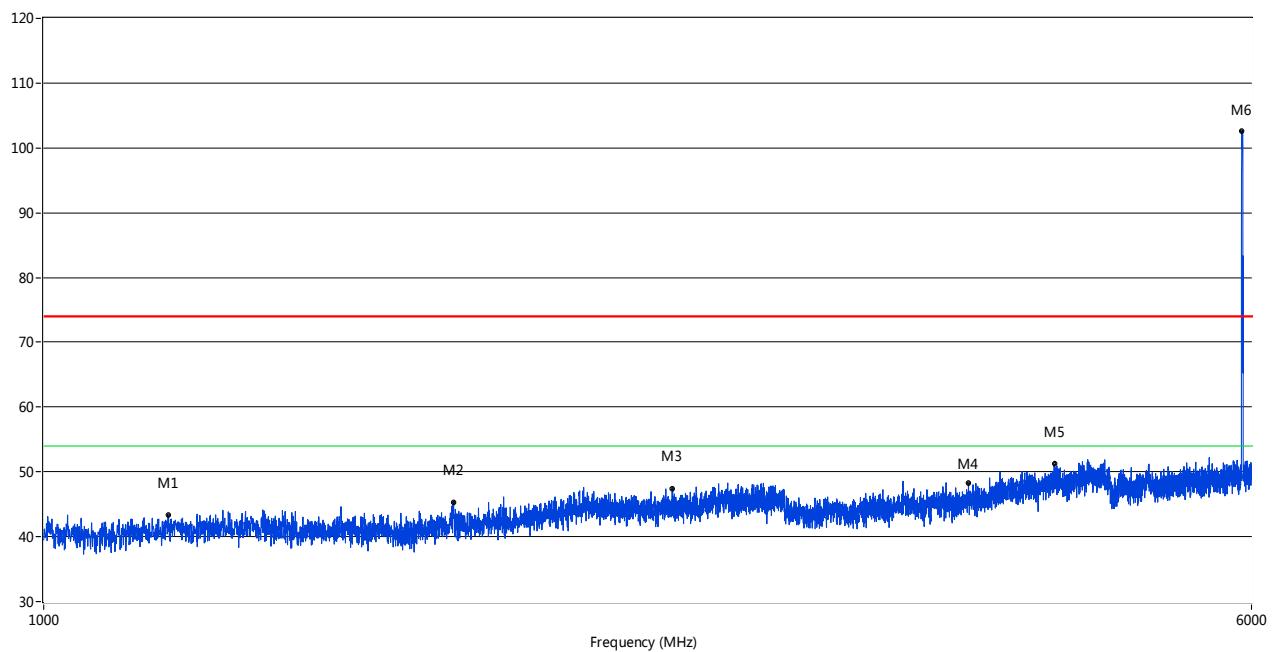
Test Data and Plots (Above 1 GHz)

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	1169.96	43.56	31.23	74.0	30.44	Peak	207.60	100	Vertical	Pass
2	1836.29	45.82	40.17	74.0	28.18	Peak	5.20	100	Vertical	Pass
3	2135.22	46.53	39.42	74.0	27.47	Peak	335.40	100	Vertical	Pass
4	3578.11	48.74	42.30	74.0	25.26	Peak	103.00	100	Vertical	Pass
5	4069.23	49.26	40.11	74.0	24.74	Peak	273.90	100	Vertical	Pass
6	5925.77	114.06	40.11	74.0	-40.06	Peak	270.10	100	Vertical	N/A

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



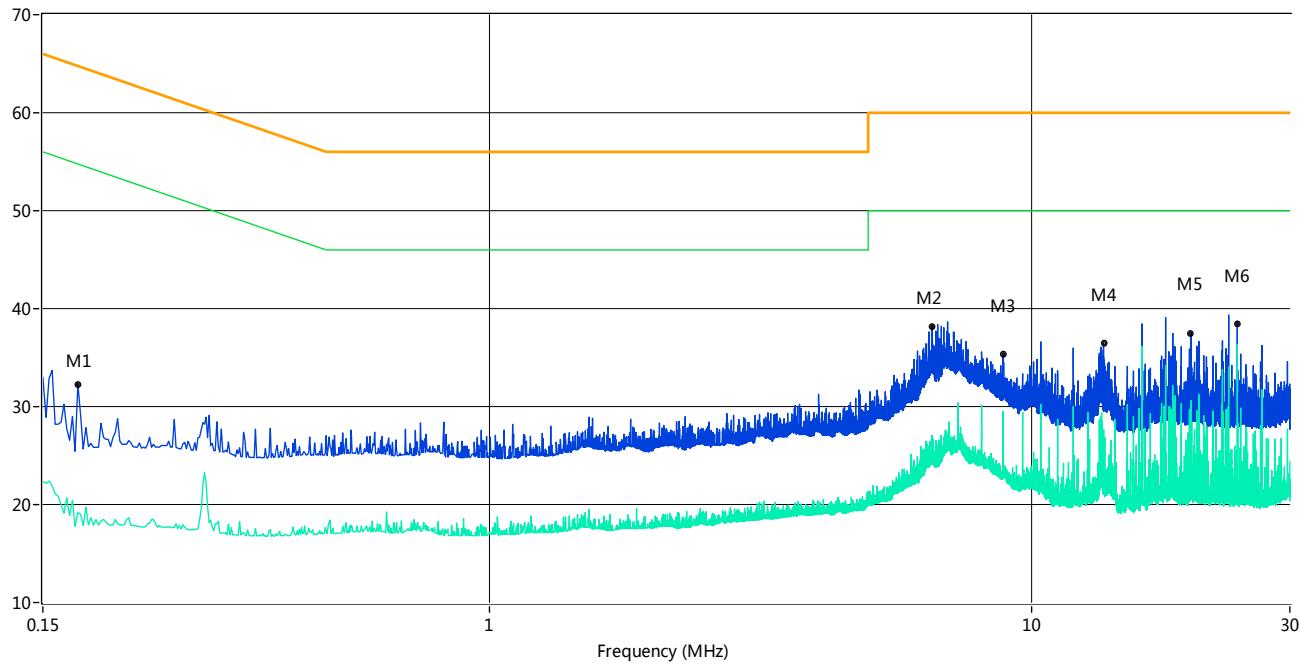
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1202.45	43.32	30.89	74.0	30.68	Peak	0.40	100	Horizontal	Pass
2	1836.29	45.32	40.17	74.0	28.68	Peak	6.40	100	Horizontal	Pass
3	2542.11	47.43	39.12	74.0	26.57	Peak	341.60	100	Horizontal	Pass
4	3943.26	48.28	40.05	74.0	25.72	Peak	353.90	100	Horizontal	Pass
5	4477.88	51.18	37.88	74.0	22.82	Peak	55.60	100	Horizontal	Pass
6	5916.02	102.59	40.12	74.0	-28.59	Peak	64.20	100	Horizontal	N/A

A.2 Conducted Emission

The TX Test Mode (5dB)

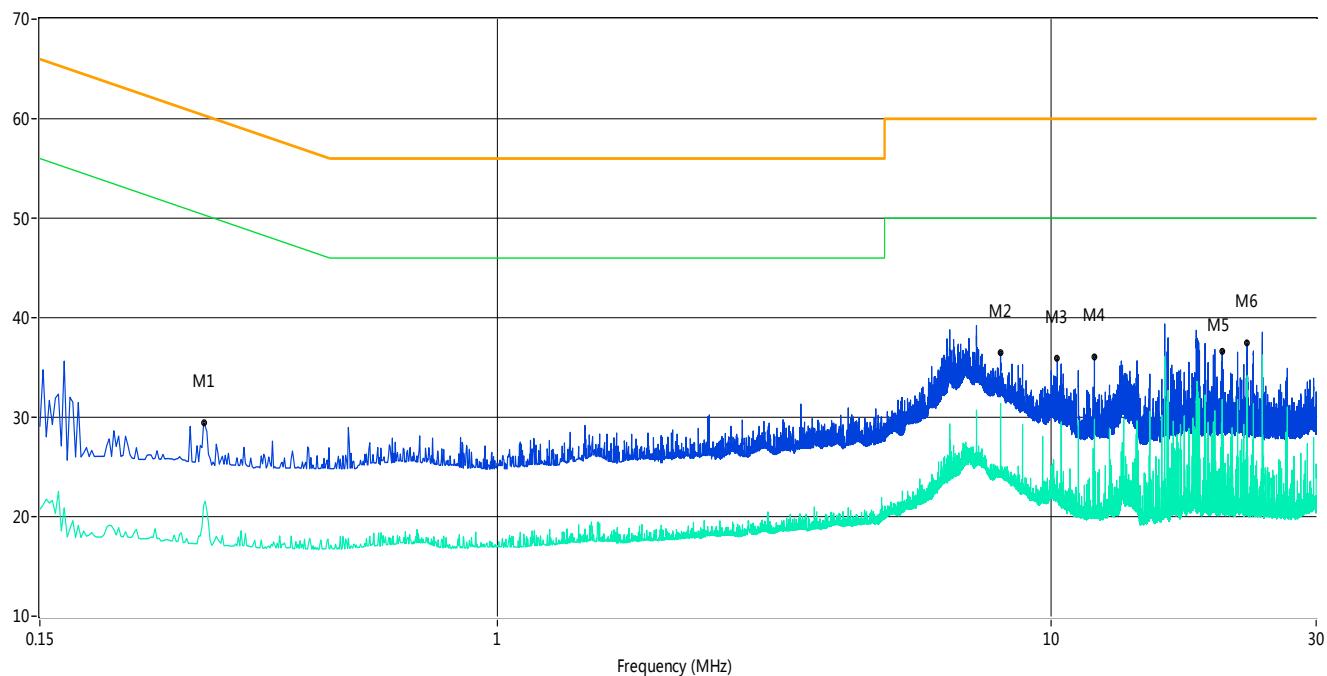
Test Data and Plots

A.2.1 L Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.17	32.3	11.00	65.3	33.00	Peak	L Line	Pass
1**	0.17	19.2	11.00	55.3	36.10	AV	L Line	Pass
2	6.55	38.2	11.00	60.0	21.80	Peak	L Line	Pass
2**	6.55	27.1	11.00	50.0	22.90	AV	L Line	Pass
3	8.87	35.3	11.00	60.0	24.70	Peak	L Line	Pass
3**	8.87	29.5	11.00	50.0	20.50	AV	L Line	Pass
4	13.59	36.4	11.00	60.0	23.60	Peak	L Line	Pass
4**	13.59	25.4	11.00	50.0	24.60	AV	L Line	Pass
5	19.71	37.5	11.00	60.0	22.50	Peak	L Line	Pass
5**	19.71	30.6	11.00	50.0	19.40	AV	L Line	Pass
6	24.00	38.5	11.00	60.0	21.50	Peak	L Line	Pass
6**	24.00	36.3	11.00	50.0	13.70	AV	L Line	Pass

A.2.2 N Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.30	29.4	11.00	61.8	32.40	Peak	N Line	Pass
1**	0.30	21.2	11.00	51.8	30.60	AV	N Line	Pass
2	8.10	36.5	11.00	60.0	23.50	Peak	N Line	Pass
2**	8.10	30.8	11.00	50.0	19.20	AV	N Line	Pass
3	10.25	35.9	11.00	60.0	24.10	Peak	N Line	Pass
3**	10.25	24.0	11.00	50.0	26.00	AV	N Line	Pass
4	11.95	36.0	11.00	60.0	24.00	Peak	N Line	Pass
4**	11.95	28.4	11.00	50.0	21.60	AV	N Line	Pass
5	20.32	36.6	11.00	60.0	23.40	Peak	N Line	Pass
5**	20.32	31.4	11.00	50.0	18.60	AV	N Line	Pass
6	22.53	37.4	11.00	60.0	22.60	Peak	N Line	Pass
6**	22.53	34.2	11.00	50.0	15.80	AV	N Line	Pass

ANNEX B TEST SETUP PHOTOS

Please refer the document "BL-SZ16C0097-AE.PDF".

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document "BL-SZ16C0097-AW.PDF".

ANNEX D EUT INTERNAL PHOTOS

Please refer the document "BL-SZ16C0097-AI.PDF".

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