TEST REPORT

Reference No.	:	WTS18S01100927-1E
FCC ID	:	2ANYY-SW1001LN
Applicant	:	Switcheroo LLC
Address	:	100 S. Commons Suite 102, Pittsburgh, Pennsylvania 15212, United States
Manufacturer	:	Switcheroo LLC
Address	:	100 S. Commons Suite 102, Pittsburgh, Pennsylvania 15212, United States
Product	:	Switcheroo
Model(s)	:	SW-1001LN
Standards	:	FCC CFR47 Part 15 Section 15.249:2017
Date of Receipt sample	:	2018-01-17
Date of Test	:	2018-01-18 to 2018-03-13
Date of Issue	:	2018-03-27
Test Result	:	Pass

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:
Waltek Services (Shenzhen) Co., Ltd.
Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen, Guangdong, China
Tel :+86-755-83551033
Fax:+86-755-83552400

Compiled by:

Robin Zhou / Test Engineer

Approved by:

Philo Zhong / Manager

1 Laboratories Introduction

Waltek Services (Shenzhen) Co., Ltd is a professional third-party testing and certification laboratory with multi-year product testing and certification experience, established strictly in accordance with ISO/IEC 17025 requirements, and accredited by ILAC (International Laboratory Accreditation Cooperation) member. A2LA (American Association for Laboratory Accreditation) of USA, Meanwhile, Waltek has got recognition as registration and accreditation laboratory from EMSD (Electrical and Mechanical Services Department), and American Energy star, FCC(The Federal Communications Commission), CEC(California energy efficiency), IC(Industry Canada). It's the strategic partner and data recognition laboratory of international authoritative organizations, such as Intertek(ETL-SEMKO), TÜV Rheinland, TÜV SÜD, etc.

Waltek Services (Shenzhen) Co., Ltd is one of the largest and the most comprehensive third party testing laboratory in China. Our test capability covered four large fields: safety test. ElectroMagnetic Compatibility(EMC), and energy performance, wireless radio. As a professional, comprehensive, justice international test organization, we still keep the scientific and rigorous work attitude to help each client satisfy the international standards and assist their product enter into globe market smoothly.

1.1 Test Facility

A. Accreditations for Conformity Assessment (International)

Country/Region	Accreditation Body	Scope	Note
USA	**A2LA (Certificate No.: 4243.01)**	FCC ID \ DOC \ VOC	1
Canada		IC ID \ VOC	2
Japan		MIC-T \ MIC-R	-
Europe		EMCD \ RED	-
Taiwan		NCC	-
Hong Kong		OFCA	-
Australia		RCM	-
India	**International Services**	WPC	-
Thailand		NTC	-
Singapore		IDA	-

Note:

1. FCC Designation No.: CN1201. Test Firm Registration No.: 523476.
2. IC Canada Registration No.: 7760A

B.TCBs and Notify Bodies Recognized Testing Laboratory.

Recognized Testing Laboratory of …	Notify body number
TUV Rheinland	Optional.
Intertek	
TUV SUD	
SGS	
Phoenix Testlab GmbH	0700
Element Materials Technology Warwick Ltd	0891
Timco Engineering, Inc.	1177
Eurofins Product Service GmbH	0681

2 Contents

3 Revision History

Test report No.	Date of Receipt sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTS18S01100927-1E	2018-01-17	2018-01-18 to 2018-03-13	2018-03-15	Original	-	Replaced
WTS18S01100927-1E	2018-01-17	2018-01-18 to 2018-03-13	2018-03-27	revision1	Added RF Conducted Measurement Test Setup	Valid

4 General Information

4.1 General Description of E.U.T.

Product:	Switcheroo
Model(s):	SW-1001LN
Model Differences Description:	N/A
Type of Modulation:	FSK
Frequency Range:	905.21MHz
Antenna installation:	wire antenna
Antenna Gain:	0dBi

4.2 Details of E.U.T.

Ratings:	Input: AC 120V/60Hz, 5A Output: AC 120V/60Hz, 5A

4.3 Channel List

Channel No.	Frequency (MHz)
1	905.21

4.4 Standards Applicable for Testing

The tests were performed according to following standards:	
FCC CFR47 Part 15 Section 15.249:2016	Telecommunication-RADIO FREQUENCY DEVICES-Intentional Radiators-Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHZ, and 24.0-24.25 GHz.

4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests.

Test mode	Test channel
Transmitting	905.21MHz

Note: The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting.

5 Equipment Used during Test

5.1 Equipments List

Conducted Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	EMI Test Receiver	R&S	ESCI	100947	2017-09-12	2018-09-11
2	LISN	R&S	ENV216	100115	2017-09-12	2018-09-11
3	Cable	Top	TYPE16(3.5M)	-	2017-09-12	2018-09-11
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Spectrum Analyzer	R&S	FSP30	100091	2017-04-29	2018-04-28
2	Broad-band Horn Antenna(1-18GHz)	SCHWARZBECK	BBHA 9120 D	667	2017-04-09	2018-04-08
3	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	2017-04-13	2018-04-12
4	Coaxial Cable (above 1GHz)	Top	1GHz-18GHz	EW02014-7	2017-04-13	2018-04-12
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No**	**Last Calibration Date**	**Calibration Due Date**
1	Test Receiver	R&S	ESCI	101296	2017-04-13	2018-04-12
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2017-04-13	2018-04-12
3	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	2017-04-09	2018-04-08
4	Amplifier	ANRITSU	MH648A	M43381	2017-04-13	2018-04-12
5	Cable	HUBER+SUHNER	CBL2	525178	2017-04-13	2018-04-12
6	Coaxial Cable (below 1GHz)	Top	TYPE16 (13M)	-	2017-09-12	2018-09-11
RF Conducted Testing						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	Spectrum Analyzer	R&S	FSP30	100091	2017-04-29	2018-04-28
2	Coaxial Cable	Top	10Hz-30GHz	-	2017-09-12	2018-09-11
3	Antenna Connector*	Realacc	45RSm	-	2017-09-12	2018-09-11

"*": The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	± 1 x 10^{-6}
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Emissions test	± 5.03 dB (30M~1000MHz)
	± 5.47 dB (1000M~25000MHz)
Conducted Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

5.3 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: N/A

Lab address: N/A

FCC Designation No.: N/A Test Firm Registration No.: N/A.

Test items: N/A

6 Test Summary

Test Items	Test Requirement	Result
Conducted Emissions	15.207	Pass
Radiated Emission	15.249(a) 15.209 15.205(a)	Pass
Periodic Operation	15.35(c)	Pass
Band Edge	15.249 15.205 15.209	Pass
Bandwidth	15:215(c)	Pass
Antenna Requirement	15.203	Pass
Note: Pass=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable.		

7 Conducted Emission

Test Requirement: FCC CFR 47 Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Class/Severity: Class B

Limit:

Frequency (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	50	60
5 to 30	60	50

7.1 E.U.T. Operation

Operating Environment **:**

Temperature: 22.8 °C

Humidity: 52.6 % RH

Atmospheric Pressure: 101.2kPa

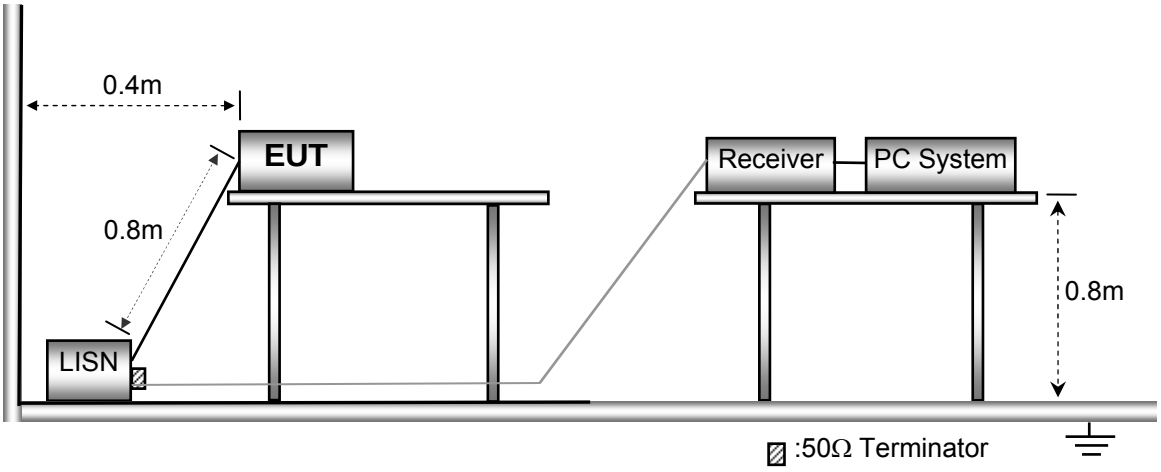
Test Voltage: AC 120V, 60Hz

EUT Operation **:**

The test was performed in transmitting mode, the test data were shown in the report.

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.

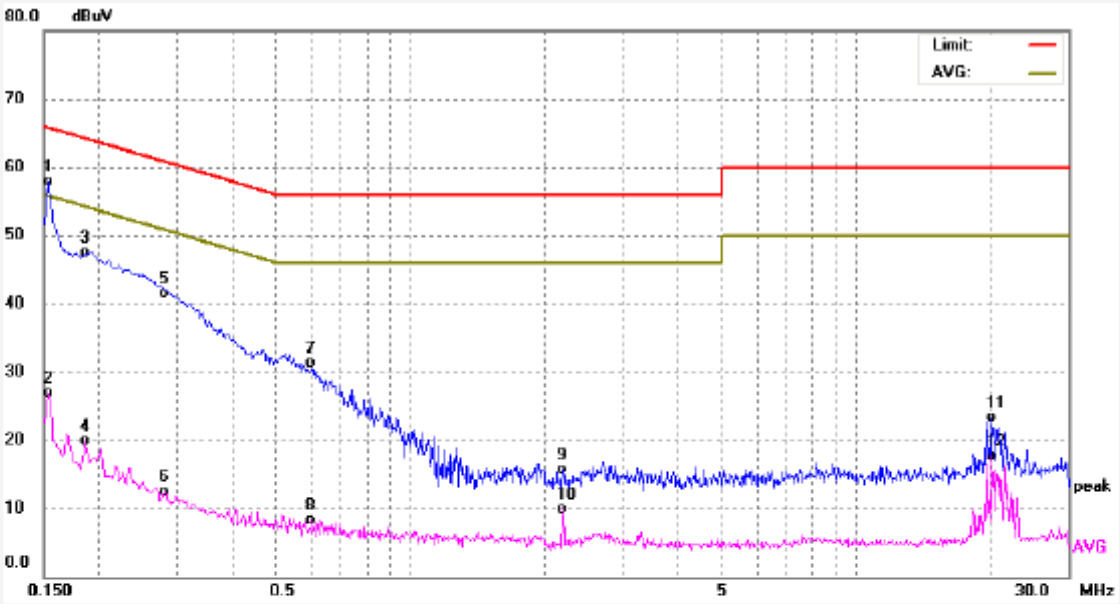


7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

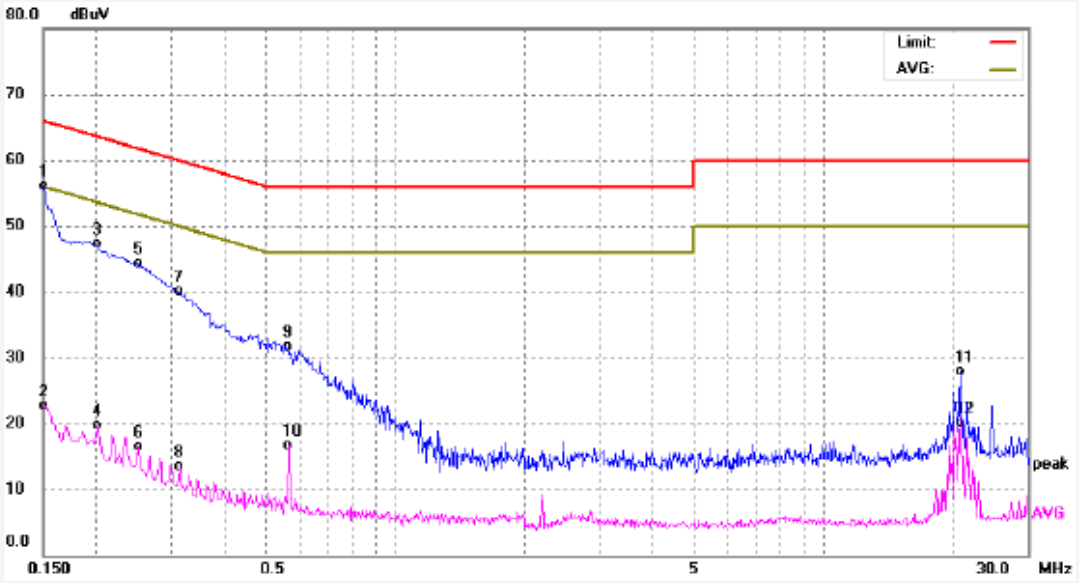
7.4 Conducted Emission Test Result

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1539	48.26	9.64	57.90	65.78	-7.88	QP	
2	0.1539	17.35	9.64	26.99	55.78	-28.79	AVG	
3	0.1859	37.88	9.63	47.51	64.21	-16.70	QP	
4	0.1859	10.28	9.63	19.91	54.21	-34.30	AVG	
5	0.2819	31.93	9.64	41.57	60.76	-19.19	QP	
6	0.2819	2.92	9.64	12.56	50.76	-38.20	AVG	
7	0.5980	21.55	9.72	31.27	56.00	-24.73	QP	
8	0.5980	-1.46	9.72	8.26	46.00	-37.74	AVG	
9	2.2020	5.71	9.95	15.66	56.00	-40.34	QP	
10	2.2020	-0.06	9.95	9.89	46.00	-36.11	AVG	
11	20.2580	12.89	10.34	23.23	60.00	-36.77	QP	
12	20.2580	7.27	10.34	17.61	50.00	-32.39	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	46.44	9.64	56.08	65.99	-9.91	QP	
2	0.1500	13.05	9.64	22.69	55.99	-33.30	AVG	
3	0.2020	37.70	9.62	47.32	63.52	-16.20	QP	
4	0.2020	10.11	9.62	19.73	53.52	-33.79	AVG	
5	0.2500	34.63	9.64	44.27	61.75	-17.48	QP	
6	0.2500	6.83	9.64	16.47	51.75	-35.28	AVG	
7	0.3140	30.42	9.64	40.06	59.86	-19.80	QP	
8	0.3140	3.80	9.64	13.44	49.86	-36.42	AVG	
9	0.5658	22.07	9.70	31.77	56.00	-24.23	QP	
10	0.5658	7.01	9.70	16.71	46.00	-29.29	AVG	
11	20.9020	17.47	10.35	27.82	60.00	-32.18	QP	
12	20.9020	9.72	10.35	20.07	50.00	-29.93	AVG	

8 Radiation Emission Test

Test Requirement: FCC Part15 Paragraph 15.249&15.209&15.205

Test Method: ANSI 63.10: 2013

Measurement Distance: 3m

Test Result: PASS

15.249(a)Limit:

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

15.209 Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))}$ + 80
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))}$ + 40
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)}$ + 40=(29.54+40)
30 ~ 88	100	3	100	$20\log^{(100)}$ =(40)
88 ~ 216	150	3	150	$20\log^{(150)}$ =(43.5)
216 ~ 960	200	3	200	$20\log^{(200)}$ =(46)
Above 960	500	3	500	$20\log^{(500)}$ =(54)

Note: RF Voltage(dBuV)=20 $\log_{10}$ RF Voltage(uV)

8.1 EUT Operation

Operating Environment **:**

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

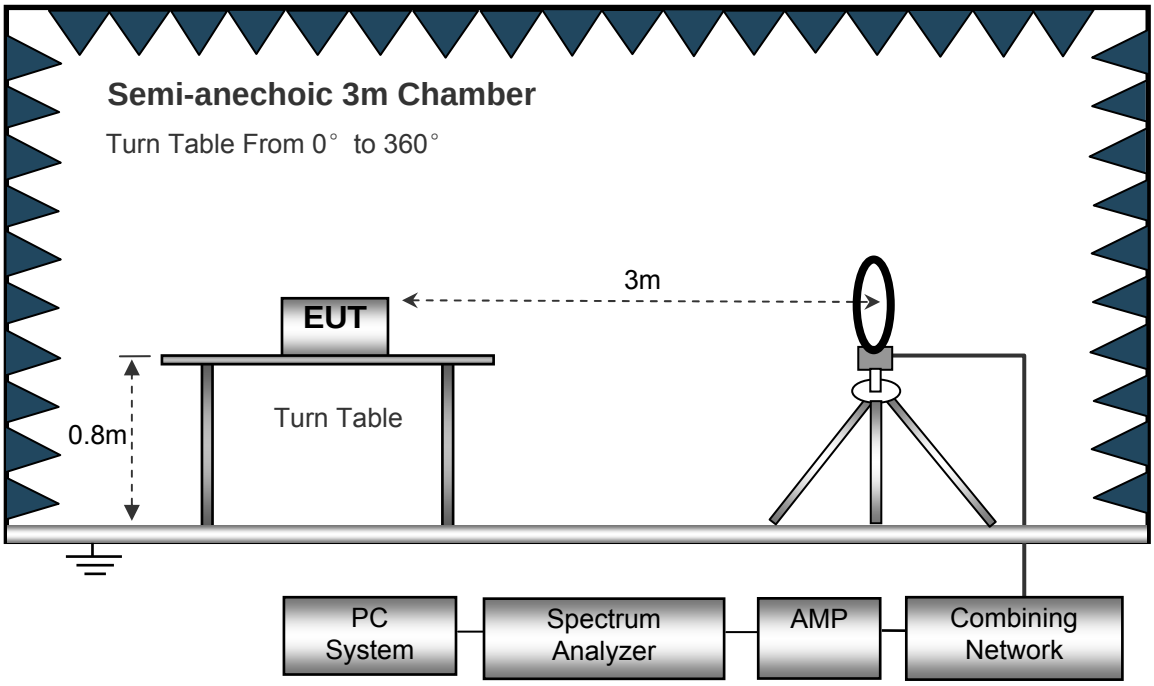
Test Voltage: AC 120V, 60Hz

EUT Operation **:**

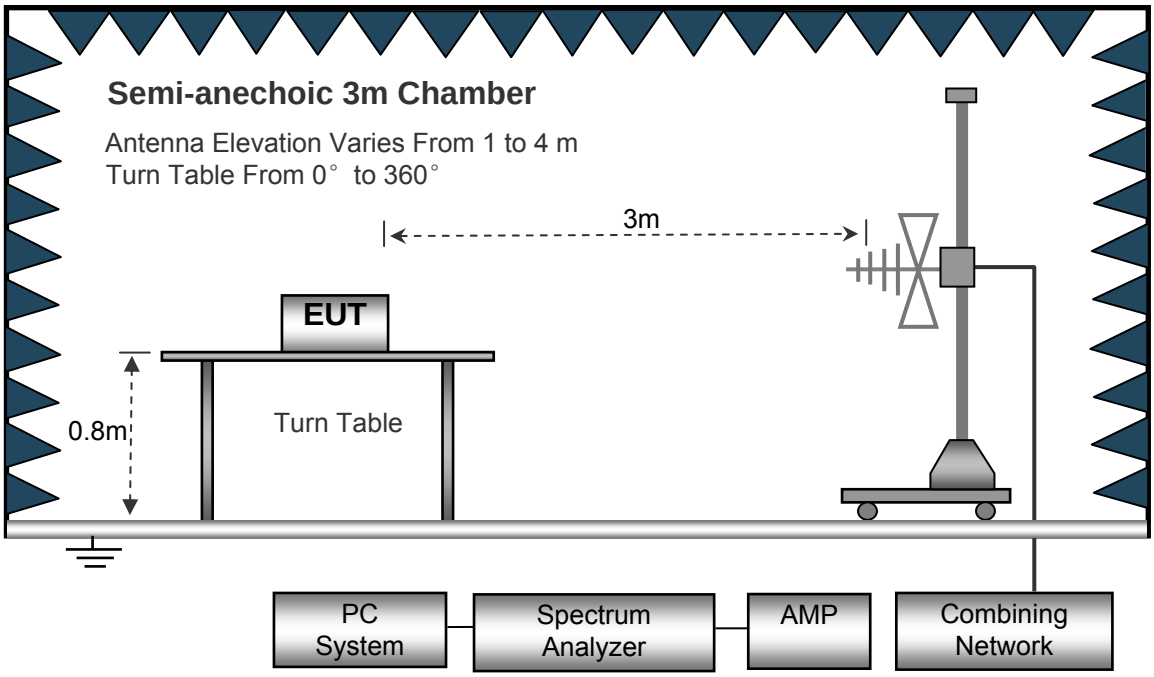
The test was performed in transmitting mode, the test data were shown in the report.

8.2 Test Setup

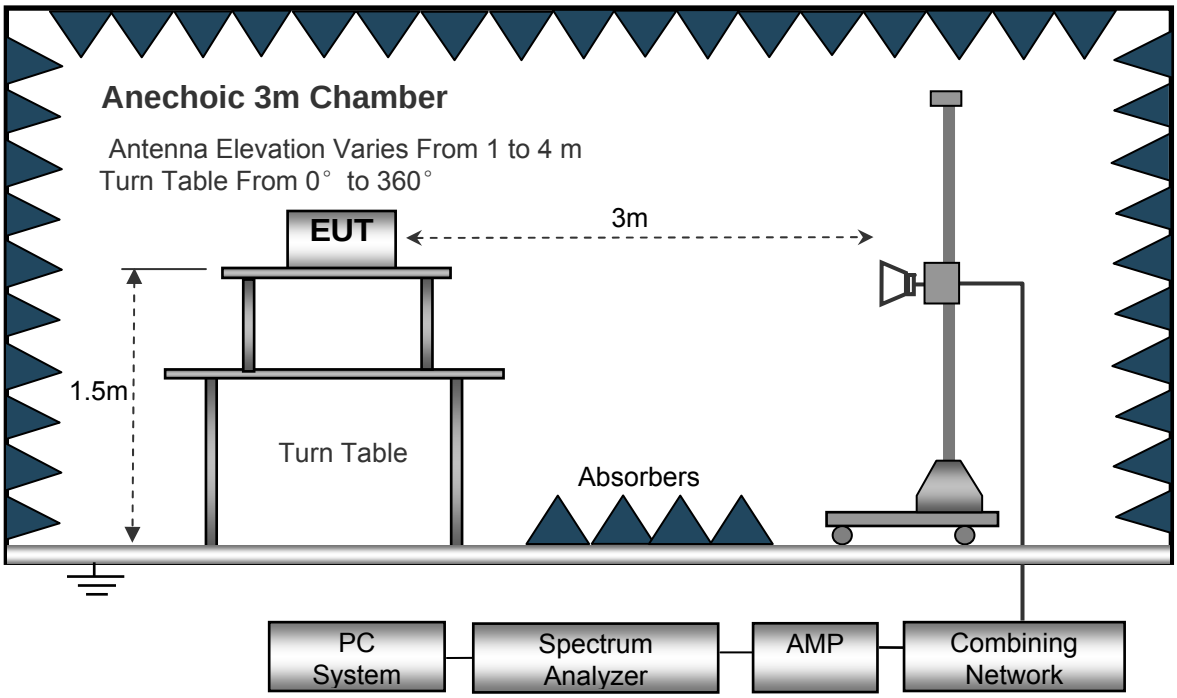
The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed	Auto
IF Bandwidth	10kHz
Video Bandwidth	10kHz
Resolution Bandwidth	10kHz

30MHz ~ 1GHz

Sweep Speed	Auto
Detector	PK
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz

Above 1GHz

Sweep Speed	Auto
Detector	PK
Resolution Bandwidth	1MHz
Video Bandwidth	3MHz
Detector	Ave.
Resolution Bandwidth	1MHz
Video Bandwidth	10Hz
Video Bandwidth	10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. For the radiated emission test above 1GHz:

   Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
8. The radiation measurements are tested under 3-axes(X, Y, Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), after pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

8.5 Frequency range of radiated measurements.

According to FCC 47 CFR Section 15.33:

(a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

(3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

(4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1) through (a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this section, whichever is the higher frequency range of investigation.

Result: So the Frequency range of radiated form: 9 kHz to 10GHz.

8.6 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

8.7 Test Result

Test Frequency: 9 kHz~30 MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30 MHz ~ 10 GHz

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	FCC Part 15.249/209/205	
				Height	Polar			Limit	Margin
(MHz)	(dBμV)	(PK/QP)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
32.98	37.74	QP	308	1.5	V	-17.31	20.43	40.00	-19.57
905.21	82.43	PK	68	1.5	H	2.34	84.77	114.00	-29.23
905.21	76.03	PK	213	1.8	V	2.34	78.37	114.00	-35.63
1810.42	62.95	PK	53	1.2	H	-14.33	48.62	74.00	-25.38
1810.42	64.88	PK	55	1.0	V	-14.33	50.55	74.00	-23.45
2715.63	57.58	PK	234	1.5	H	-9.68	47.90	74.00	-26.10
2715.63	64.03	PK	31	1.0	V	-9.68	54.35	74.00	-19.65
3620.84	57.16	PK	103	1.8	H	-4.59	52.57	74.00	-21.43
3620.84	68.78	PK	320	1.5	V	-4.59	64.19	74.00	-9.81

AV = Peak +20Log10(duty cycle) =PK+(-28.11) [refer to section 9 for more detail]

Frequency	PK	RX Antenna Polar	Duty cycle Factor	AV	FCC Part 15.249/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
905.21	84.77	H	-28.11	56.66	94.00	-37.34
905.21	78.37	V	-28.11	50.26	94.00	-43.74
1810.42	48.62	H	-28.11	20.51	54.00	-33.49
1810.42	50.55	V	-28.11	22.44	54.00	-31.56
2715.63	47.90	H	-28.11	19.79	54.00	-34.21
2715.63	54.35	V	-28.11	26.24	54.00	-27.76
3620.84	52.57	H	-28.11	24.46	54.00	-29.54
3620.84	64.19	V	-28.11	36.08	54.00	-17.92

9 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity,the duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

Duty Cycle Correction Factor(dB)=20 * Log_{10}(Duty Cycle Correction Factor)

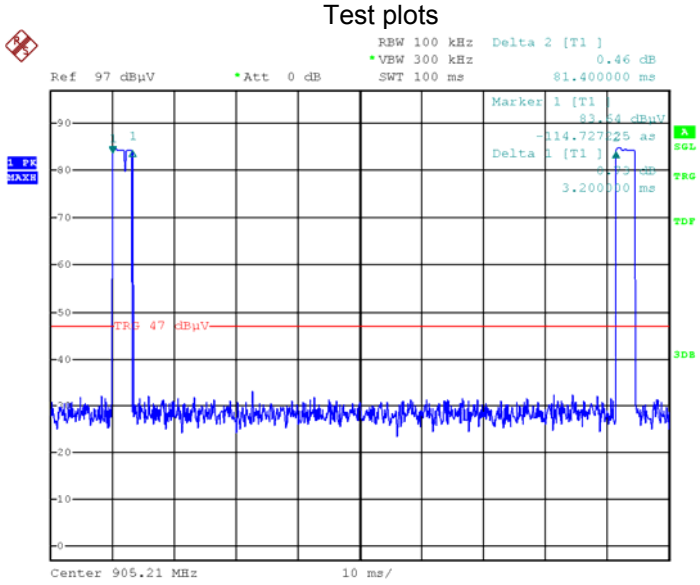
Pulse-repetition frequency (Hz) =1/ Pulse duration(s)

Total transmission time(ms)	3.20
Pulse duration(s)	78.20
Pulse-repetition frequency(Hz)	12.79
Length of a complete transmission period(ms)	81.40
Duty Cycle(%)	3.93
Duty Cycle Correction Factor(dB)	-28.11

(* Note: the transmitter operates for longer than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. So the Length of a complete transmission period=100ms)

Refer to the duty cycle plot (as below)

Test plots



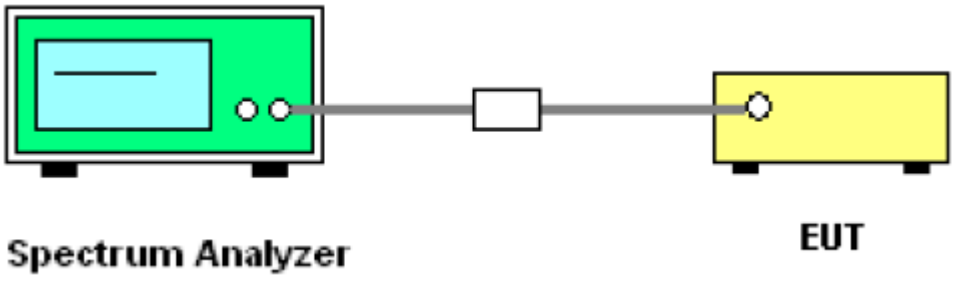
10 Band Edge

Test Requirement:	15.249(d):Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
Test Method:	ANSI C63.10:2013
Test Mode:	Transmitting

10.1 Test Procedure

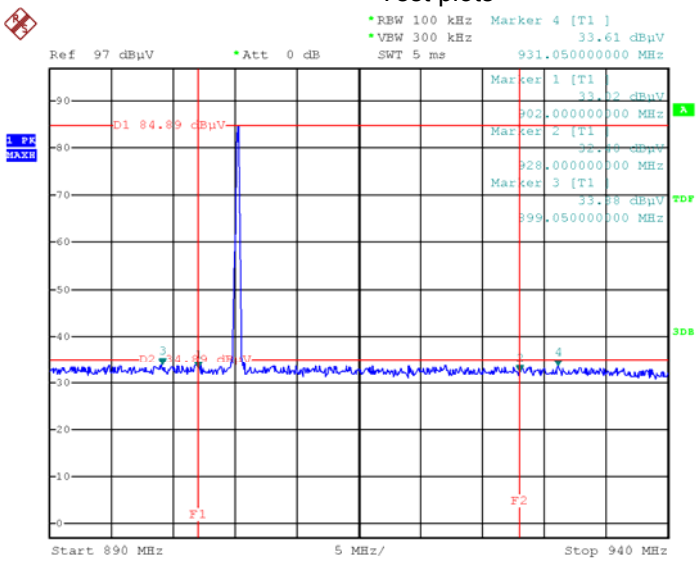
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100 kHz, VBW = 300 kHz, Sweep = auto
   Detector function = peak, Trace = max hold

10.2 Test Setup



10.3 Test Result

Test plots



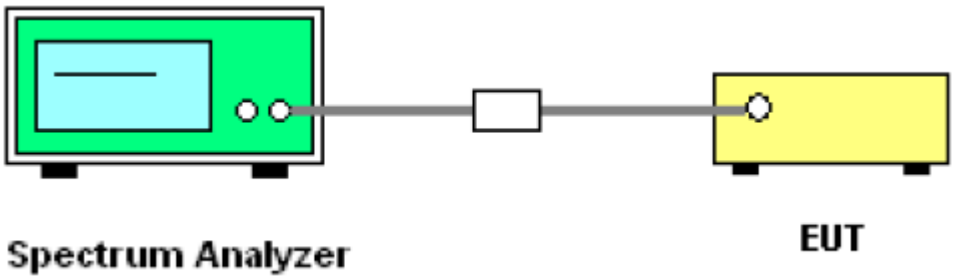
11 Bandwidth Measurement

Test Requirement:	FCC CFR47 Part 15 Section 15.215(c)
Test Method:	ANSI C63.10:2013
Test Mode:	Transmitting

11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyser: RBW = 10 kHz, VBW = 30 kHz

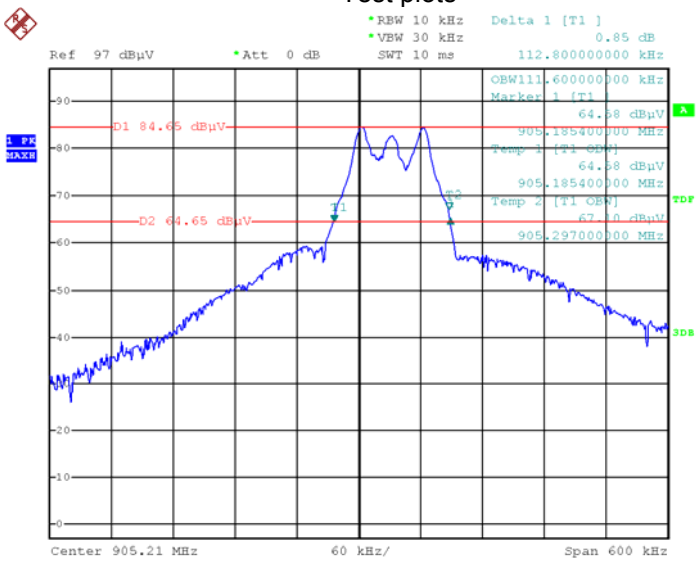
11.2 Test Setup



11.3 Test Result

Frequency (MHz)	20dB Bandwidth Emission (kHz)	99% Bandwidth Emission (kHz)
905.21	112.80	111.60

Test plots



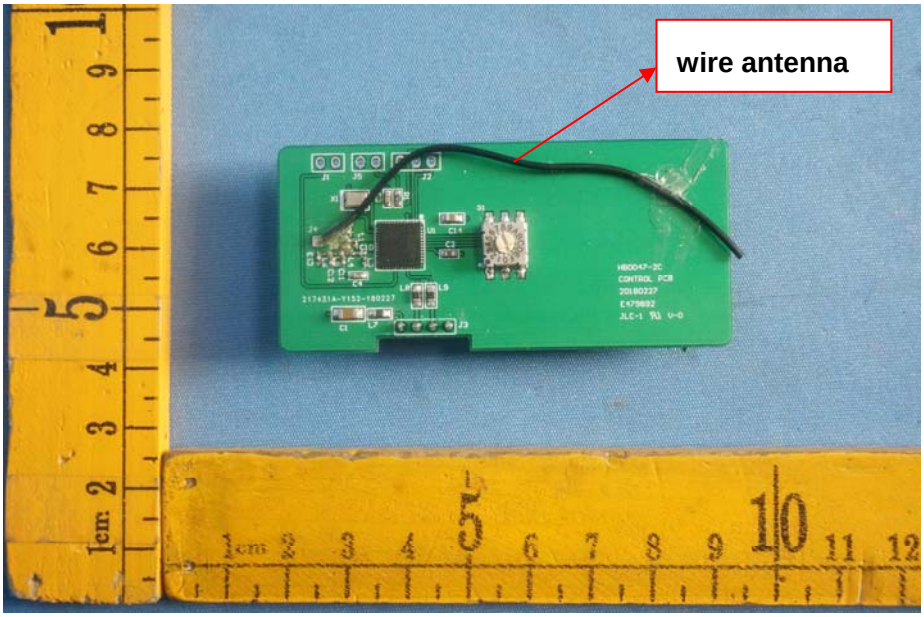
12 Antenna Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Result:

The EUT has one wire antenna, the gain is 0dBi. meets the requirements of FCC 15.203.



13 Photographs- Model SW-1001LN Test Setup Photos

Note: Please refer to Photos: WTS18S01100927-2E.

14 Photographs - Constructional Details

14.1 Model SW-1001LN – External Photos

Note: Please refer to Photos: WTS18S01100927-2E.

14.2 Model SW-1001LN – Internal Photos

Note: Please refer to Photos: WTS18S01100927-2E.

======End of Report======