FCC TEST REPORT

FOR

Shenzhen SwellPro Technology CO., LTD
Remote Control
TEST Model No.: BWX01 0005
Additional Model NO.: Spry

Prepared for	:	Shenzhen SwellPro Technology CO., LTD
Address	:	5 Floor 2 Building ZhuoLin Industrial Park LiaoKeng Third Industrial park LangXin Community ShiYan Street Baoan District ShenZhen, China
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com
Date of receipt of test sample	:	November 20, 2018
Number of tested samples	:	1
Sample number	:	Prototype
Date of Test	:	December 20, 2018 ~ January 26, 2019
Date of Report	:	February 26, 2019

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FCC TEST REPORT

FCC CFR 47 PART 15 C(15.249)

Report Reference No.	**:**	**LCS181109062AEA**
Date of Issue.....	:	February 26, 2019
Testing Laboratory Name	**:**	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address.....	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name	**:**	**Shenzhen SwellPro Technology CO., LTD**
Address.....	:	5 Floor 2 Building ZhuoLin Industrial Park LiaoKeng Third Industrial park LangXin Community ShiYan Street Baoan District ShenZhen, China
Test Specification		
Standard	:	FCC CFR 47 PART 15 C(15.249)/ANSI C63.10
Test Report Form No.....	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF.....	:	Dated 2011-03

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Test Item Description.	**:**	**Remote Control**
Trade Mark	:	Swellpro
Test Model.....	:	BWX01 0005
Ratings.....	:	DC 7.4V by battery(2000mAh)
Result	**:**	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Peter Xiao	Calvin Weng	Gavin Liang
Peter Xiao / File administrators	Calvin Weng / Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : **LCS181109062AEA**	February 26, 2019 Date of issue

Test Model.....	: BWX01 0005
EUT.....	: Remote Control
Applicant.....	**: Shenzhen SwellPro Technology CO., LTD**
Address.....	: 5 Floor 2 Building ZhuoLin Industrial Park LiaoKeng Third Industrial park LangXin Community ShiYan Street Baoan District ShenZhen, China
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: Shenzhen SwellPro Technology CO., LTD**
Address.....	: 5 Floor 2 Building ZhuoLin Industrial Park LiaoKeng Third Industrial park LangXin Community ShiYan Street Baoan District ShenZhen, China
Telephone.....	: /
Fax.....	: /
Factory.....	**: Shenzhen SwellPro Technology CO., LTD**
Address.....	: 5 Floor 2 Building ZhuoLin Industrial Park LiaoKeng Third Industrial park LangXin Community ShiYan Street Baoan District ShenZhen, China
Telephone.....	: /
Fax.....	: /

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Revision	Issue Date	Revisions	Revised By
000	February 26, 2019	Initial Issue	Gavin Liang

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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	:	Remote Control
Test Model	:	BWX01 0005
List Model No.	:	Spry
Model Declaration	:	PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power Supply	:	DC 7.4V by battery (2000mAh)
Hardware Version	:	A0
Software Version	:	A0
2.4G Transmitter	:	
Frequency Range	:	2405MHz~2475MHz
Channel Number	:	3 channels
Modulation Type	:	GFSK
Antenna Description	:	External Antenna, 3dBi (max.)
5.8G Receiver		
Frequency Range	:	5725 – 5865 MHz
Channel Number	:	3 channels
Modulation Type	:	GFSK
Antenna Description	:	External Antenna, 3dBi (max.)
GPS Receiver		
Frequency Range	:	1575.42 MHz

1.2. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
SHENZHEN ZHENGFANGXING TECHNOLOGY CO.,LTD	Adapter	PGBD0500030W1UL	--	FCC VOC

Note: Auxiliary equipment is provided by the laboratory.

1.3. External I/O

I/O Port Description	Quantity	Cable
Charging interface	1	N/A

1.4. Description of Test Facility

FCC Registration Number. is 254912.

Industry Canada Registration Number. is 9642A-1.

ESMD Registration Number. is ARCB0108.

UL Registration Number. is 100571-492.

TUV SUD Registration Number. is SCN1081.

TUV RH Registration Number. is UA 50296516-001

NVLAP Registration Code is 600167-0.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.10dB	(1)
		30MHz~200MHz	±2.96dB	(1)
		200MHz~1000MHz	±3.10dB	(1)
		1GHz~26.5GHz	±3.80dB	(1)
		26.5GHz~40GHz	±3.90dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±1.63dB	(1)
Power disturbance	:	30MHz~300MHz	±1.60dB	(1)

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.7. Description of Test Modes

The EUT has been tested under operating condition.

The EUT operates in the unlicensed ISM band at 2.4GHz. The following operating modes were applied for the related test items.

All test modes were tested, only the result of the worst case was recorded in the report.

The EUT is considered a portable unit and was set to transmit at 100% duty cycle. It was pre-tested on the positioned of each 3 axis. The worst case was found positioned on X-plane.

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Mode of Operations	Transmitting Frequency (MHz)
GFSK	2405
	2445
	2475
For Conducted Emission	
Test Mode	TX Mode
For Radiated Emission	
Test Mode	TX Mode

Worst-case mode and channel used for 150 KHz-30 MHz power line conducted emissions was the mode and channel with the highest output power, that was determined to be TX-2405MHz.

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be TX-2405MHz.

Pre-test AC conducted emission at both voltage AC 120V/60Hz and AC 240V/60Hz, recorded worst case.

Pre-test AC conducted emission at power adapter mode, recorded worst case.

***Note: Using a temporary antenna connector for the EUT when the conducted measurements are performed.

1.8. Channel List and Frequency

Channel	Frequency Range (MHz)
1	2405
2	2445
3	2475

2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.249 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

According to the requirements in Section 6.2 of ANSI C63.10: 2013, AC power-line conducted emissions shall be measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table and the turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10: 2013.

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3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmit condition. Continuous transmitting. EUT will transmit continuously when powered on, Change the frequency by adjusting the lever.

3.2. EUT Exercise Software

N/A

3.3. Special Accessories

N/A

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

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4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C		
FCC Rules	Description Of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Power Line Conducted Emissions	Compliant
§15.205(a), §15.209(a), §15.249(a), §15.249(c)	Radiated Emissions Measurement	Compliant
§15.205	Band Edges Measurement	Compliant
§15.249, §15.215	99% and 20dB Bandwidth	Compliant

5. SUMMARY OF TEST equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	MXA Signal Analyzer	Agilent	N9020A	MY49100060	2018-11-15	2019-11-14
2	DC Power Supply	Agilent	E3642A	N/A	2018-11-15	2019-11-14
3	Temperature & Humidity Chamber	GUANGZHOU GOGNWEN	GDS-100	70932	2018-10-10	2019-10-09
4	EMI Test Software	AUDIX	E3	/	/	/
5	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2018-06-16	2019-06-15
6	Positioning Controller	MF	MF-7082	/	2018-06-16	2019-06-15
7	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2018-07-26	2019-07-25
8	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2018-07-26	2019-07-25
9	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2018-07-02	2019-07-01
10	EMI Test Receiver	R&S	ESR 7	101181	2018-06-16	2019-06-15
11	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2018-11-15	2019-11-14
12	AMPLIFIER	QuieTek	QTK	CHM/0809065	2018-11-15	2019-11-14
13	RF Cable-R03m	Jye Bao	RG142	CB021	2018-06-16	2019-06-15
14	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2018-06-16	2019-06-15
15	EMI Test Receiver	R&S	ESPI	101840	2018-06-16	2019-06-15
16	Artificial Mains	R&S	ENV216	101288	2018-06-16	2019-06-15
17	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2018-06-16	2019-06-15
Note: All equipment is calibrated through GUANGZHOU LISAI CALIBRATION AND TEST CO.,LTD.						

6. ANTENNA REQUIREMENT

6.1. Standard Applicable

According to § 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. 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.

6.2. Antenna Connected Construction

This sample use one external antenna maximum antenna gain are 3.00 dBi, external antenna use R-SMA antenna connector meets FCC part §15.203 antenna requirement.

This sample RF module A7105 with 2 antenna ports, while only connect one antenna port (Antenna port 0) connect antenna, the other antenna port (Antenna port 1) is reversed for internal antenna, without connect internal antenna for this device. This device only use one external antenna.

6.3. Result: Compliance.

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7. RADIATED EMISSION MEASUREMENT

7.1. Standard Applicable

According to §15.249 (d) and RSS-210 B.10 (b): 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.

Frequencies(MHz)	Field Strength(microvolts/meter)	Measurement Distance(meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

According to §15.249 (a) and RSS-210 B.10 (a): Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental		Field strength of harmonics	
	millivolts/meter	dBuV/m	microvolts/meter	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

As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

7.2. Instruments Setting

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

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Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

7.3. Test Procedure

1) **Sequence of testing 9 kHz to 30 MHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 0.8 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

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2) **Sequence of testing 30 MHz to 1 GHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

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3) **Sequence of testing 1 GHz to 18 GHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height is 1.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum found antenna polarization and turntable position of the premeasurement the software maximizes the peaks by rotating the turntable position (0° to 360°). This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps). This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

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4) **Sequence of testing above 18 GHz**

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and RMS detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

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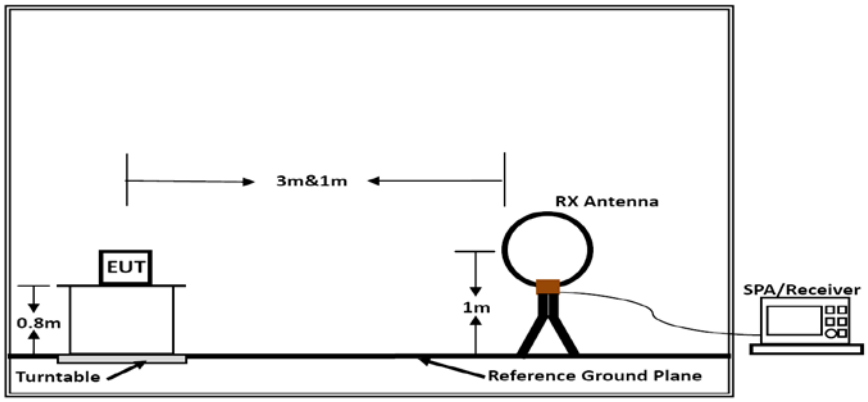
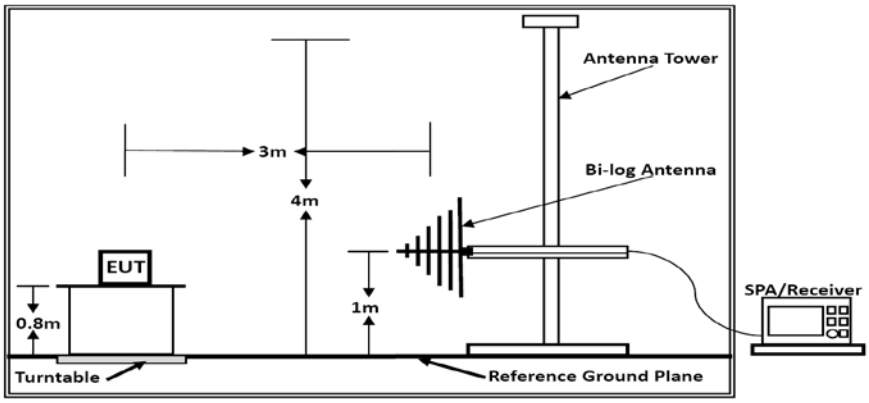
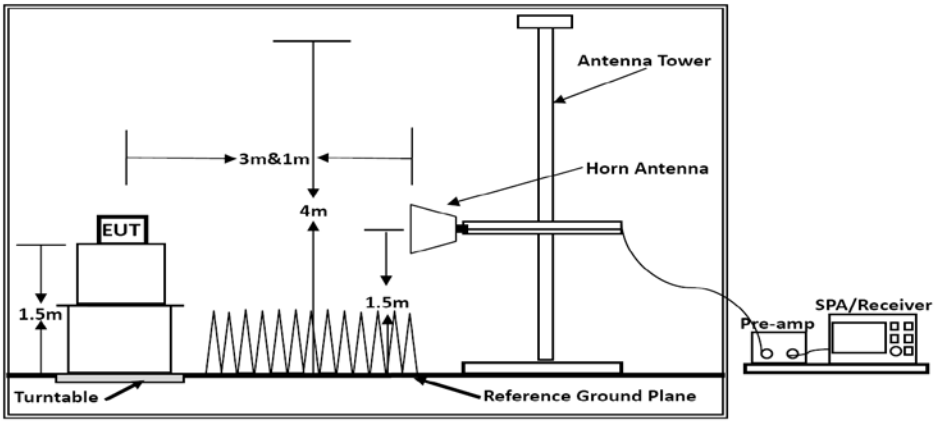
7.4. Block Diagram of Test Setup



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade form 3m to 1m.

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [1m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

7.5. Test Results of Radiated Emissions (9 KHz~30MHz)

Frequency (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

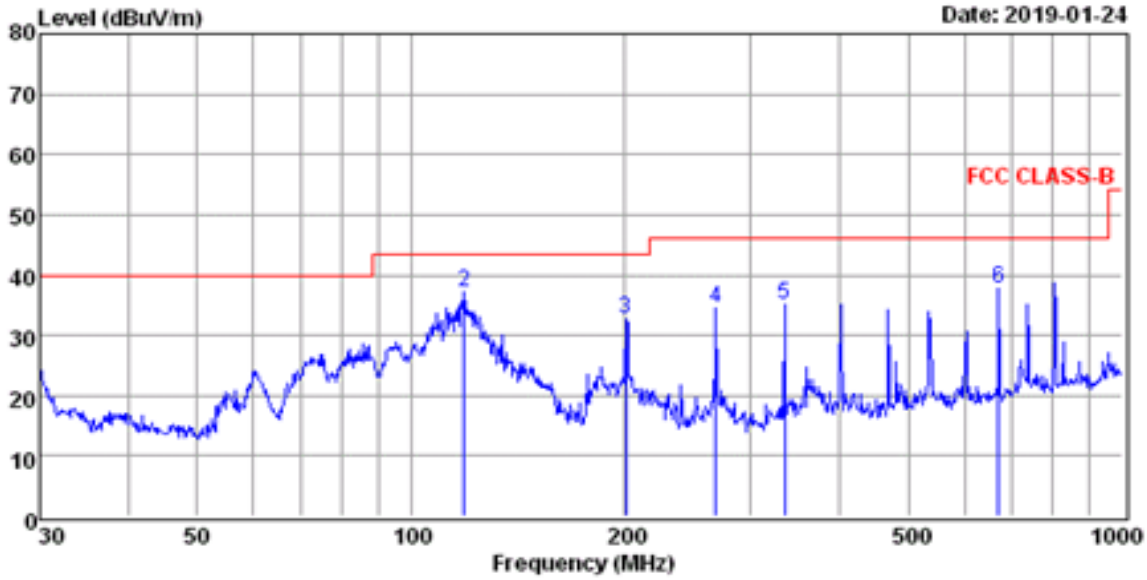
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

7.6. Test Results of Radiated Emissions (30MHz~1000MHz)

Temperature	24.3℃	Humidity	53.3%
Test Engineer	Diamond Lu	Test Mode	TX-2405MHz

Vertical

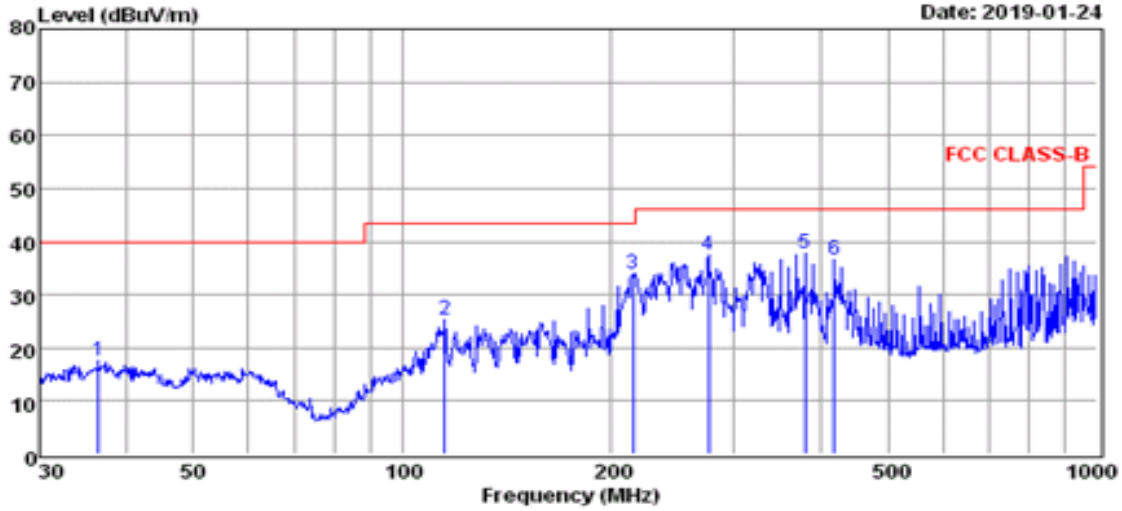


pol: VERTICAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	30.00	12.04	0.39	12.33	24.76	40.00	-15.24	QP
2	118.60	25.82	0.64	10.73	37.19	43.50	-6.31	QP
3	200.69	21.22	0.84	10.59	32.65	43.50	-10.85	QP
4	268.49	21.33	1.00	12.31	34.64	46.00	-11.36	QP
5	334.86	20.04	1.09	13.92	35.05	46.00	-10.95	QP
6	670.49	17.53	1.65	18.70	37.88	46.00	-8.12	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that are 20db below the official limit are not reported

Horizontal



pol: HORIZONTAL

	Freq MHz	Reading dBuV	CabLos dB	Antfac dB/m	Measured dBuV/m	Limit dBuV/m	Over dB	Remark
1	36.51	4.45	0.41	12.69	17.55	40.00	-22.45	QP
2	114.92	13.32	0.68	11.38	25.38	43.50	-18.12	QP
3	214.51	21.97	0.95	11.03	33.95	43.50	-9.55	QP
4	276.12	24.04	1.00	12.55	37.59	46.00	-8.41	QP
5	379.91	21.97	1.18	14.59	37.74	46.00	-8.26	QP
6	419.11	19.86	1.32	15.45	36.63	46.00	-9.37	QP

Note: 1. All readings are Quasi-peak values.
2. Measured= Reading + Antenna Factor + Cable Loss
3. The emission that are 20db below the official limit are not reported

Note:

1). Pre-scan all modes and recorded the worst case results in this report (Antenna 0 (TX-2405 MHz)).

2). Emission level (dBuV/m) = 20 log Emission level (uV/m).

3). Corrected Reading: Antenna Factor + Cable Loss + Read Level = Level.

7.7. Results for Radiated Emissions (1 – 26 GHz)

Field Strength Of Fundamental (TX-2405MHz)						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2405.00	H	80.74	74.63	114	94	Pass
2405.00	V	86.28	79.87	114	94	Pass

Freq. MHz	Reading dBuV	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuv/m	Margin dB	Remark	Pol.
4810.00	47.98	33.06	35.04	3.94	49.94	74.00	-24.06	Peak	Horizontal
4810.00	31.07	33.06	35.04	3.94	33.03	54.00	-20.97	Average	Horizontal
4810.00	49.91	33.06	35.04	3.94	51.87	74.00	-22.13	Peak	Vertical
4810.00	34.48	33.06	35.04	3.94	36.44	54.00	-17.56	Average	Vertical

Field Strength Of Fundamental (TX-2445MHz)						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2445.00	H	85.77	75.21	114	94	Pass
2445.00	V	87.93	79.47	114	94	Pass

Freq. MHz	Reading dBuV	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuv/m	Margin dB	Remark	Pol.
4890.00	47.25	33.16	35.15	3.96	49.22	74.00	-24.78	Peak	Horizontal
4890.00	32.38	33.16	35.15	3.96	34.35	54.00	-19.65	Average	Horizontal
4890.00	49.06	33.16	35.15	3.96	51.03	74.00	-22.97	Peak	Vertical
4890.00	35.93	33.16	35.15	3.96	37.90	54.00	-16.10	Average	Vertical

Field Strength Of Fundamental (TX-2475MHz)						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2475.00	H	88.25	79.38	114	94	Pass
2475.00	V	90.36	82.36	114	94	Pass

Freq. MHz	Reading dBuV	Ant. Fac dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuv/m	Margin dB	Remark	Pol.
4950.00	48.71	33.26	35.14	3.98	50.81	74.00	-23.19	Peak	Horizontal
4950.00	32.14	33.26	35.14	3.98	34.24	54.00	-19.76	Average	Horizontal
4950.00	49.53	33.26	35.14	3.98	51.63	74.00	-22.37	Peak	Vertical
4950.00	35.13	33.26	35.14	3.98	37.23	54.00	-16.77	Average	Vertical

Notes:

1). Measuring frequencies from 9 KHz - 10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30 MHz.

2). Radiated emissions measured in frequency range from 9 KHz - 10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.

3). 18~25GHz at least have 20dB margin. No recording in the test report.

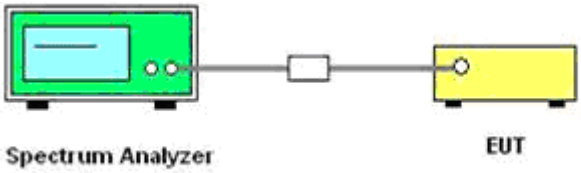
8. BAND-EDGE MEASUREMENTS FOR RADIATED EMISSIONS

8.1. Standard Applicable

According to FCC §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.

According to RSS-210 B.10 (b): Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

8.2. Test Setup Layout



8.3. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of Spectrum Analyzer.

8.4. Test Procedures

According to ANSI C63.10:2013 Field Strength Approach (linear terms):

$eirp = p_t \times g_t = (E \times d)^2/30$

Where:

p_t = transmitter output power in watts,

g_t = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m,

d = measurement distance in meters (m).

$erp = eirp/1.64 = (E \times d)^2/(30 \times 1.64)$

Where all terms are as previously defined.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to an EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=1/B for Peak detector.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)

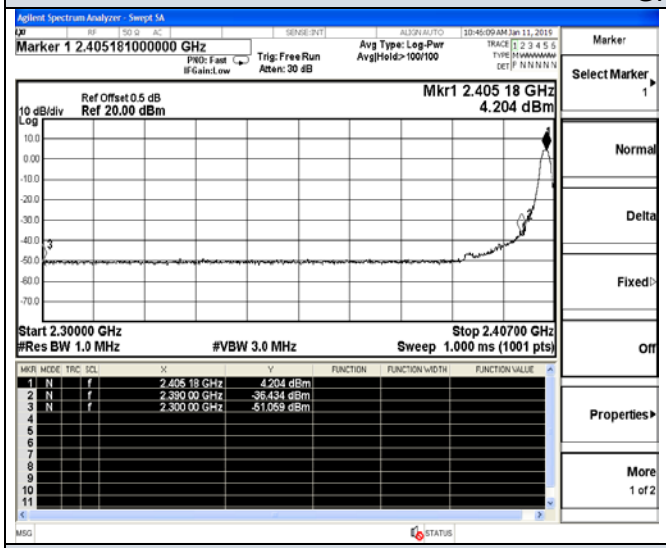
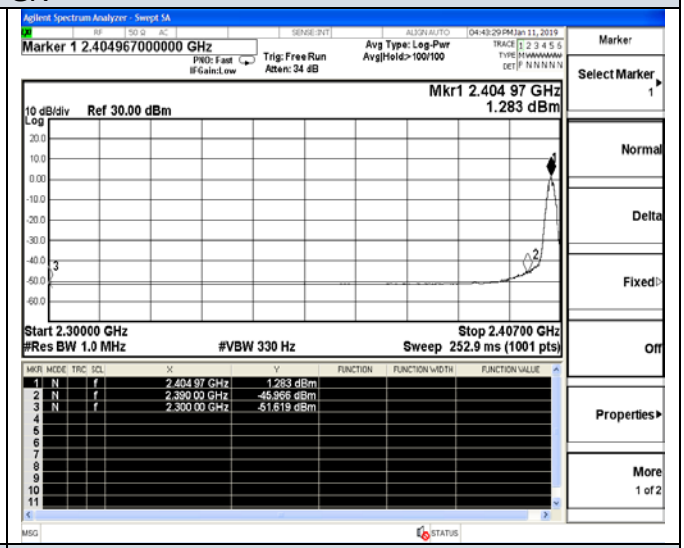
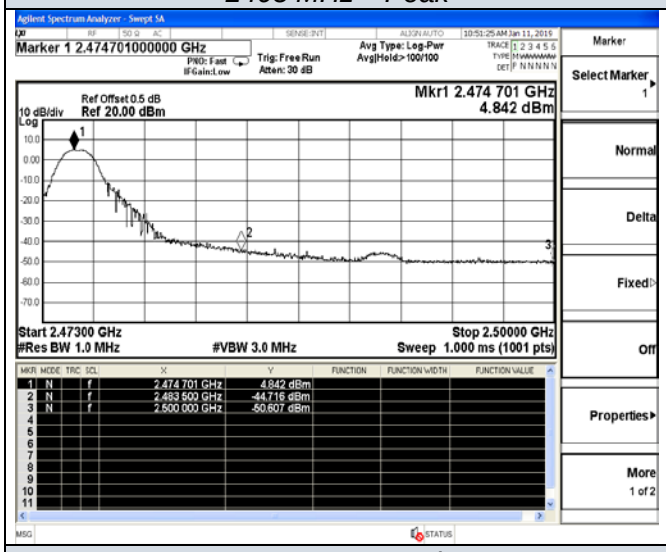
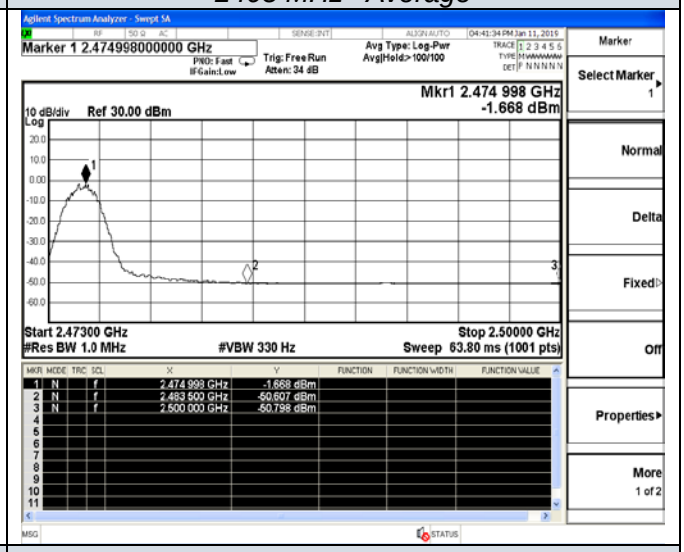
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Compare the resultant electric field strength level to the applicable regulatory limit.
11. Perform radiated spurious emission test duress until all measured frequencies were complete.

8.5. Measuring Instruments and Setting

Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	Ground Reflection Factor (dB)	Covert Radiated E Level At 3m (dBuV/m)	Detector	Limit (dBuV/m)	Verdict
2310.000	-51.059	3.00	0.0	47.169	Peak	74.00	PASS
2310.000	-51.619	3.00	0.0	46.609	AV	54.00	PASS
2390.000	-36.434	3.00	0.0	61.794	Peak	74.00	PASS
2390.000	-45.966	3.00	0.0	52.262	AV	54.00	PASS
2483.500	-44.716	3.00	0.0	53.512	Peak	74.00	PASS
2483.500	-50.607	3.00	0.0	47.621	AV	54.00	PASS
2500.000	-50.607	3.00	0.0	47.621	Peak	74.00	PASS
2500.000	-50.798	3.00	0.0	47.430	AV	54.00	PASS

Remark:

1. *The other emission levels were very low against the limit.*
2. *The average measurement was not performed when the peak measured data under the limit of average detection.*
3. *Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;*
4. *Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.*
5. *External antenna (antenna 1) and internal antenna (antenna 0) gain are same, covert radiated band edge are same. Only report one results.*
6. *Please refer to following test plots;*

Band-edge measurements for radiated emissions	
GFSK	
	
2405 MHz – Peak	2405 MHz –Average
	
2475 MHz – Peak	2475 MHz –Average

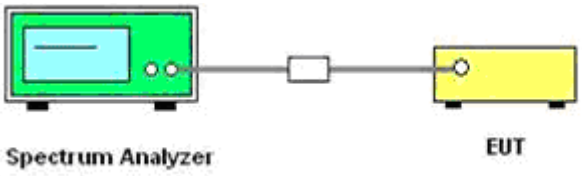
9. 99% AND 20 DB BANDWIDTH MEASUREMENT

9.1. Standard Applicable

According to § 2.1049 and RSS-Gen section 6.7 “The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.”

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

9.2. Block Diagram of Test Setup



9.3. Test Procedure

Use the following spectrum analyzer settings:

Span = 3MHz

RBW = 100KHz

VBW = 300KHz

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

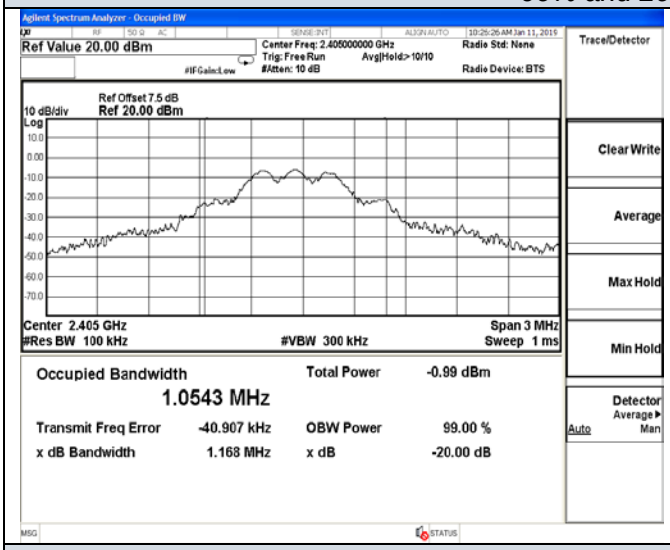
9.4. Test Results

99% and 20dB Bandwidth			
Test Frequency (MHz)	99% Bandwidth (MHz)	20dB Bandwidth (MHz)	Limit (MHz)
2405	1.0543	1.1680	Non-Specified
2445	1.0263	1.1310	Non-Specified
2475	1.0079	1.1150	Non-Specified

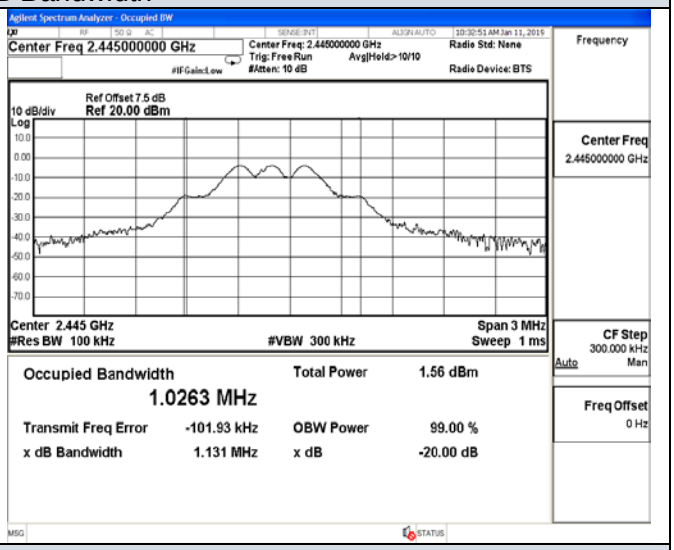
Remark:

1. *Test results including cable loss;*
2. *Please refer to following plots;*

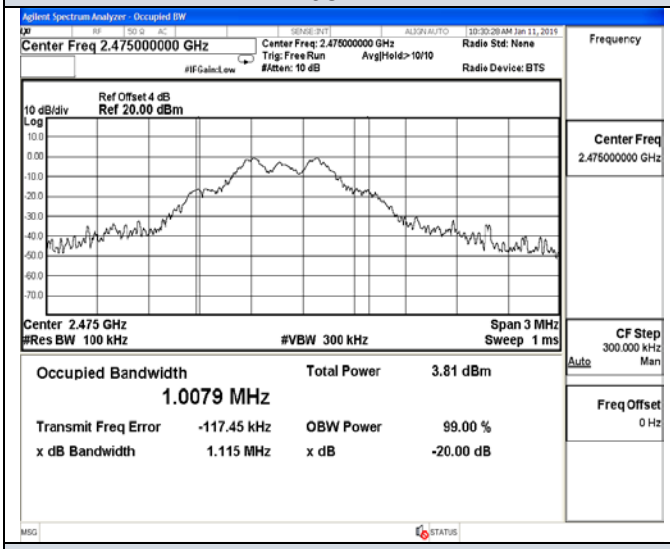
99% and 20dB Bandwidth



2405 MHz



2445 MHz



2475 MHz

10. AC POWER LINE CONDUCTED EMISSIONS

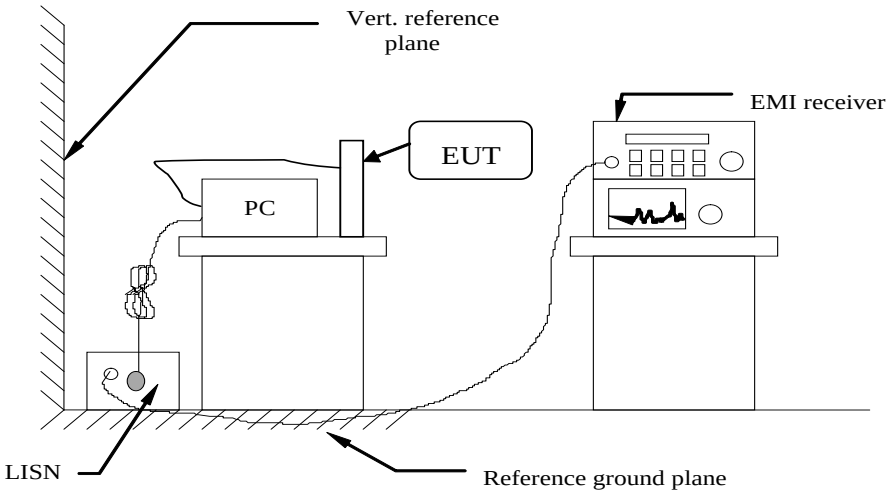
10.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

10.2 Block Diagram of Test Setup



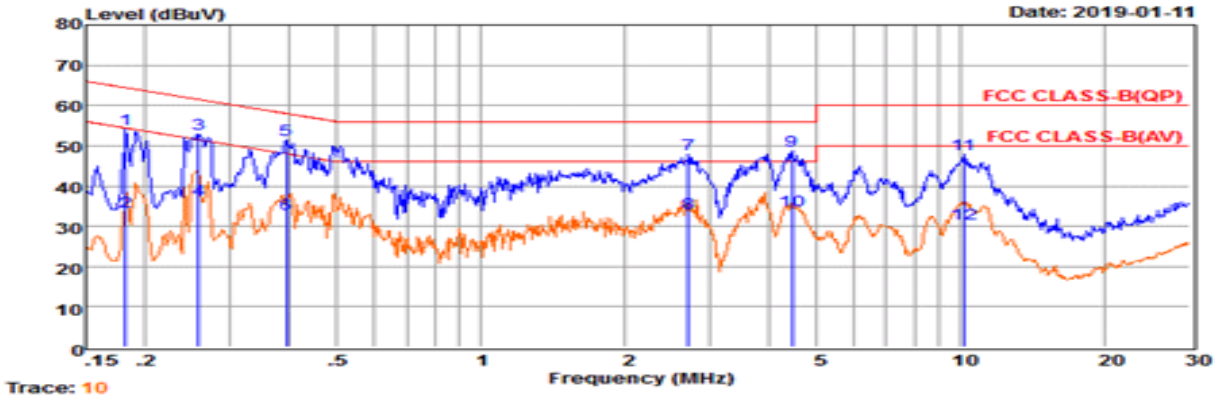
10.3 Test Results

PASS

The test data please refer to following page.

AC Conducted Emission of charge from Adapter mode @ AC 120V/60Hz (worst case)

Line

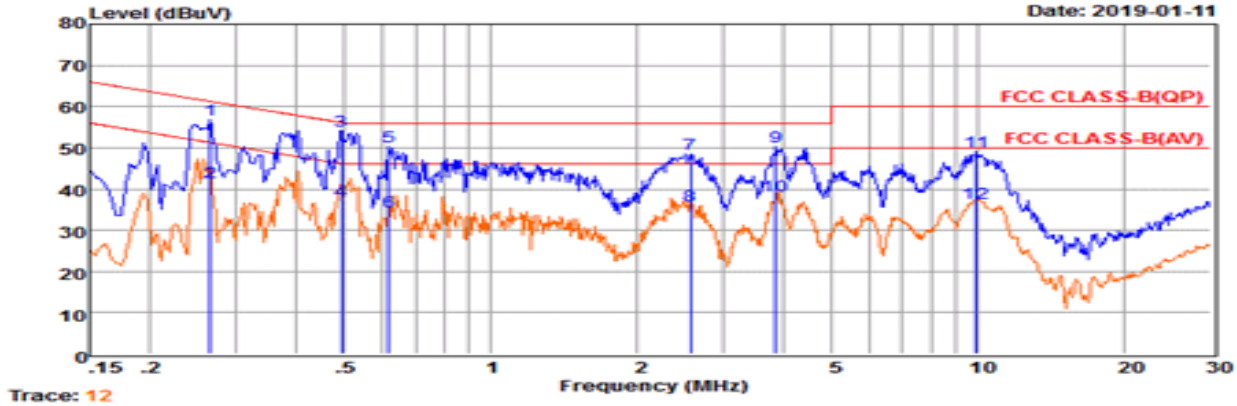


Pol: LINE

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dBuV	Limit dBuV	Over dB	Remark
1	0.18	34.44	9.61	0.02	10.00	54.07	64.42	-10.35	QP
2	0.18	14.04	9.61	0.02	10.00	33.67	54.41	-20.74	Average
3	0.26	33.34	9.63	0.03	10.00	53.00	61.51	-8.51	QP
4	0.26	16.99	9.63	0.03	10.00	36.65	51.51	-14.86	Average
5	0.39	31.76	9.62	0.04	10.00	51.42	57.99	-6.57	QP
6	0.39	13.36	9.62	0.04	10.00	33.02	47.99	-14.97	Average
7	2.71	28.07	9.64	0.05	10.00	47.76	56.00	-8.24	QP
8	2.71	13.59	9.64	0.05	10.00	33.28	46.00	-12.72	Average
9	4.45	29.07	9.65	0.06	10.00	48.78	56.00	-7.22	QP
10	4.46	14.12	9.65	0.06	10.00	33.83	46.00	-12.17	Average
11	10.18	28.04	9.69	0.08	10.00	47.81	60.00	-12.19	QP
12	10.18	10.88	9.69	0.08	10.00	30.65	50.00	-19.35	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

Neutral



Pol: NEUTRAL

	Freq MHz	Reading dBuV	LISNFac dB	CabLos dB	Aux2Fac dB	Measured dBuV	Limit dBuV	Over dB	Remark
1	0.27	37.32	9.60	0.03	10.00	56.95	61.25	-4.30	QP
2	0.27	21.86	9.60	0.03	10.00	41.49	51.24	-9.75	Average
3	0.49	34.60	9.62	0.04	10.00	54.26	56.10	-1.84	QP
4	0.49	17.65	9.62	0.04	10.00	37.31	46.10	-8.79	Average
5	0.62	30.61	9.63	0.04	10.00	50.28	56.00	-5.72	QP
6	0.62	14.83	9.63	0.04	10.00	34.50	46.00	-11.50	Average
7	2.57	28.79	9.64	0.05	10.00	48.48	56.00	-7.52	QP
8	2.57	16.17	9.64	0.05	10.00	35.86	46.00	-10.14	Average
9	3.84	30.50	9.65	0.06	10.00	50.21	56.00	-5.79	QP
10	3.84	18.59	9.65	0.06	10.00	38.30	46.00	-7.70	Average
11	9.91	29.26	9.72	0.08	10.00	49.06	60.00	-10.94	QP
12	9.91	16.90	9.72	0.08	10.00	36.70	50.00	-13.30	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
2. The emission levels that are 20dB below the official limit are not reported.

****Note: Pre-scan all modes and recorded the worst case results in this report.*

11. TEST SETUP PHOTOGRAPHS

Please refer to separated files for Test Setup Photos of the EUT.

12. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

13. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

----------THE END OF REPORT----------

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