FCC TEST REPORT

For

Shenzhen Xtooltech Intelligent Co., Ltd

TPMS Diagnostic Tool

Test Model: TP150

Additional Model No.: TP200, TPMS200, F400

Prepared for	:	Shenzhen Xtooltech Intelligent Co., Ltd
Address	:	17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Shajing Street, Baoan District, Shenzhen, 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	:	July 26, 2023
Number of tested samples	:	2
Sample No.	:	A07153005-1, A07153005-2
Serial number	:	Prototype
Date of Test	:	July 26, 2023 ~ August 21, 2023
Date of Report	:	August 21, 2023

FCC TEST REPORT
FCC CFR 47 PART 15C(15.231)

Report Reference No.	:	**LCSA07153005EC**
Date of Issue	:	August 21, 2023
Testing Laboratory Name	:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Shajing Street, Baoan District, Shenzhen, China
Testing Location/ Procedure	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name	:	**Shenzhen Xtooltech Intelligent Co., Ltd**
Address	:	17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China
Test Specification		
Standard	:	FCC CFR 47 PART 15 C(15.231)
Test Report Form No	:	LCSEMC-1.0
TRF Originator	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF	:	Dated 2011-03

Test Item Description	:	**TPMS Diagnostic Tool**
Trade Mark	:	XTOOL
Test Model	:	TP150
Ratings	:	Input: DC 5V, 1A DC 3.7V by Rechargeable Li-ion Battery, 3000mAh For AC Adapter Model: MX15Z-0502000VU Input: 100-240V~, 50/60Hz, 0.4A Output: 5.0V⎓2.0A, 10.0W
Result	:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Li Huan/Administrator	Cary Luo/ Technique principal	Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : **LCSA07153005EC**	August 21, 2023 Date of issue

Test Mode.....	: TP150
EUT.....	: TPMS Diagnostic Tool
Applicant.....	: **Shenzhen Xtooltech Intelligent Co., Ltd**
Address.....	: 17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Manufacturer.....	: **Shenzhen Xtooltech Intelligent Co., Ltd**
Address.....	: 17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China
Telephone.....	: /
Fax.....	: /
Factory.....	: **Bao'an Branch of Shenzhen Xtooltech Intelligent Co., Ltd**
Address.....	: 2,3,4/F, Building 12, Tangtou Third Industrial Zone, Shiyan street, Bao'an 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

Report Version	Issue Date	Revision Content	Revised By
000	August 21, 2023	Initial Issue	---

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	: TPMS Diagnostic Tool
Test Model	: TP150
Additional Model No.	: TP200, TPMS200, F400
Model Declaration	: PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Power Supply	: Input: DC 5V, 1A DC 3.7V by Rechargeable Li-ion Battery, 3000mAh For AC Adapter Model: MX15Z-0502000VU Input: 100-240V~, 50/60Hz, 0.4A Output: 5.0V⎓2.0A, 10.0W
Hardware Version	: /
Software Version	: /
2.4G WLAN	
Frequency Range	: 2412 – 2462 MHz
Channel Number	: 11 Channels for 20MHz bandwidth (2412~2462MHz)
Channel Spacing	: 5MHz
Modulation Type	: IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: PCB Antenna, 2.22dBi(Max.)
433MHz Operation frequency	: 433.92MHz
Modulation Type	: ASK
Channel Number	: 1
Antenna Type	: Spring Antenna
Antenna Gain	: -4.58dBi (Max)
315MHz Operation frequency	: 315MHz
Number of Channels	: 1
Modulation Type	: ASK
Antenna Description	: Spring Antenna, -5.56dBi (Max.)

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
--	Power Adapter	MX15Z-0502000VU	--	FCC

1.3. External I/O Cable

I/O Port Description	Quantity	Cable
Power Port	1	N/A
VGA Port	1	N/A

1.4. Description of Test Facility

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

CNAS Registration Number is L4595.

Test Firm Registration Number: 254912.

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)
Occupied Channel Bandwidth	:	0.01MHz~26.5GHz	5%	(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 engineering mode. The field strength of radiation emission was measured in the following position: EUT stand-up position (Y axis), lie-down position (X, Z axis). The worst case of X axis was reported.
A new battery supplied DC 3.7V power to the EUT for testing.

The EUT transmits signal as soon as it is powered on, and recorded the result in this report.

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

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 15.231 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT 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, which is 0.8 m above ground plane. 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.

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmit condition.

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.

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C		
FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.205	Restricted Band	Compliant
§15.209	General Requirement	Compliant
§15.231 (b)	Radiated Emissions	Compliant
§15.231 (c)	20dB Bandwidth Testing	Compliant
§15.231 (a)(1)	Deactivation Testing	Compliant
§15.231	Duty cycle Factor	Compliant
§15.207	Conducted Emissions	Compliant

Note: All test modes were taken into consideration, but we only recorded the worst case in this report.

5. TEST ITEMS AND RESULTS

5.1. Duration of each Transmission and the silent period

FCC 15.231 (a)

5.1.1. Limit

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

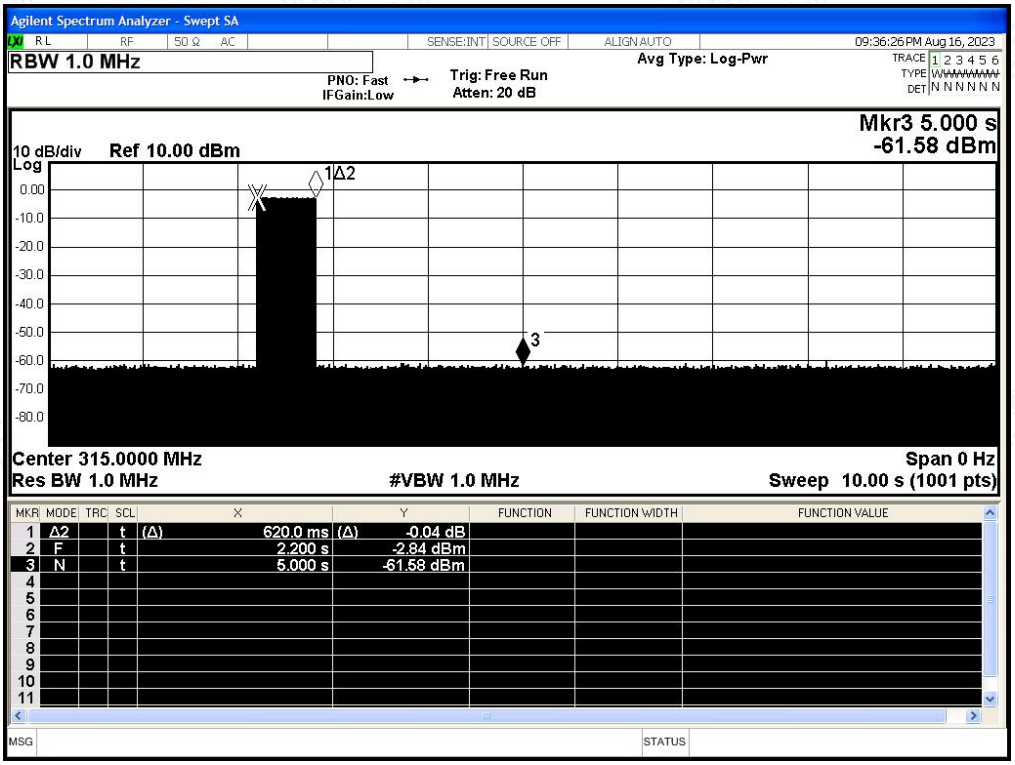
5.1.2. Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

5.1.3. Test Results

Temperature	24.6℃	Humidity	54.1%
Test Engineer	Nick Peng	Configurations	TX Mode

Frequency (MHz)	Activation Time (s)	Limit: not more than 5 seconds of being released (s)	Conclusion
315	0.620	5s	PASS



5.2. Transmitter Field Strength of Emissions

5.2.1. Limit

FCC §15.231 (b)

In addition to the provisions of § 15.205, the field strength of emissions from Intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field Strength of Fundamental (microvolt/meter)	Field Strength of spurious emissions (microvolt/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,370	125 to375
174-260	3,750	375
260-470	3,750 to12, 500	375 to 1,250
Above 470	12,500	1,250

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, μV/m at 3 meters = 56.81818(F) - 6136.3636; for the band 260-470 MHz, μV/m at 3 meters = 41.6667(F) - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	608-614	4.5-5.15
[1]0.495-0.505	16.69475-16.68525	960-1240	5.35-5.46
2.1735-2.1905	16.80425-16.80475	1300-1427	7.25-7.75
4.125-4.128	25.525.67	1435-1626.5	8.025-8.5
4.17725-4.17775	37.5-38.25	1645.5-1646.5	9.0-9.2
4.20725-4.20775	73-74.6	1660-1710	9.3-9.5
6.215-6.218	74.8-75.2	1718.8-1722.2	10.6-12.7
6.26775-6.26825	108-121.94	2200-2300	13.25-13.4
6.31175-6.31225	123-138	2310-2390	14.47-14.5
8.291-8.294	149.9-150.05	2483.5-2500	15.35-16.2
8.362-8.366	156.52475-156.52525	2655-2900	17.7-21.4
8.37625-8.38675	156.7-156.9	3260-3267	22.01-23.12
8.41425-8.41475	162.0125167.17	3332-3339	23.6-24.0
12.29-12.293	167.72-173.2	3345.8-3358	31.2-31.8
12.51975-12.52025	240-285	3600-4400	36.43-36.5
12.57675-12.57725	322-335.4		.([2])
13.36-13.41	399.9-410		

1. Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

2. Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 72 MHz, 76 88 MHz, 174 216 MHz or 470 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

5.2.2 Measuring Instruments and Setting

Please refer to equipment's 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 / 3MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	1MHz / 3MHz for Peak, 1 MHz / 10Hz for Average

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

5.2.3. Test Procedures

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 1.0 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.

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.

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.

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:

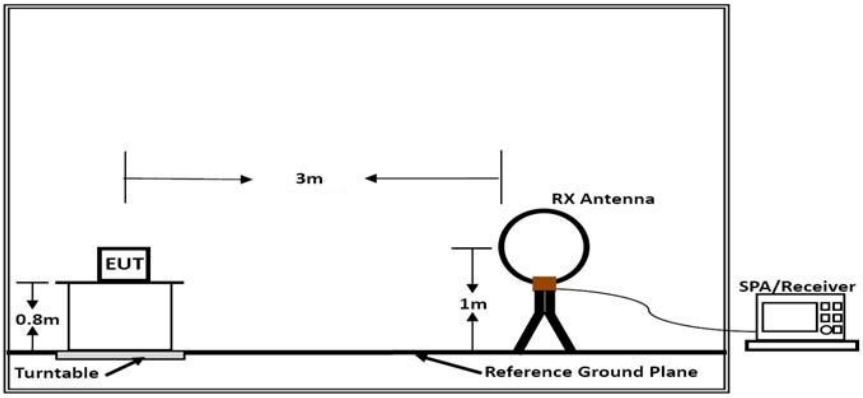
--- The antenna is moved spherical over the EUT in different polarizations of the antenna.

Final measurement:

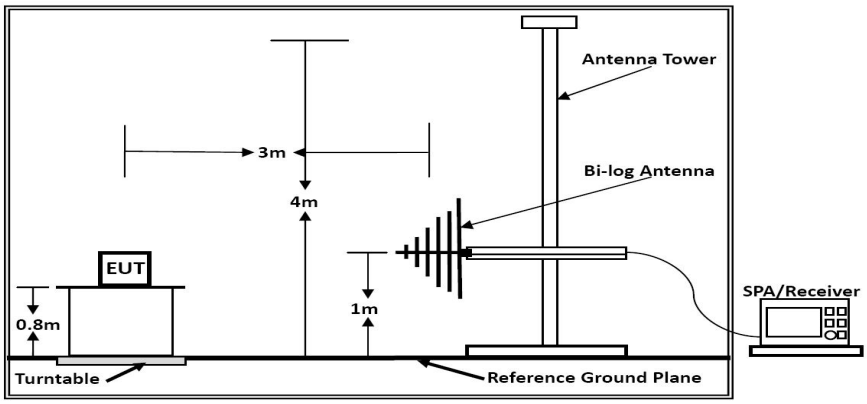
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and RMS detector.

--- 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.

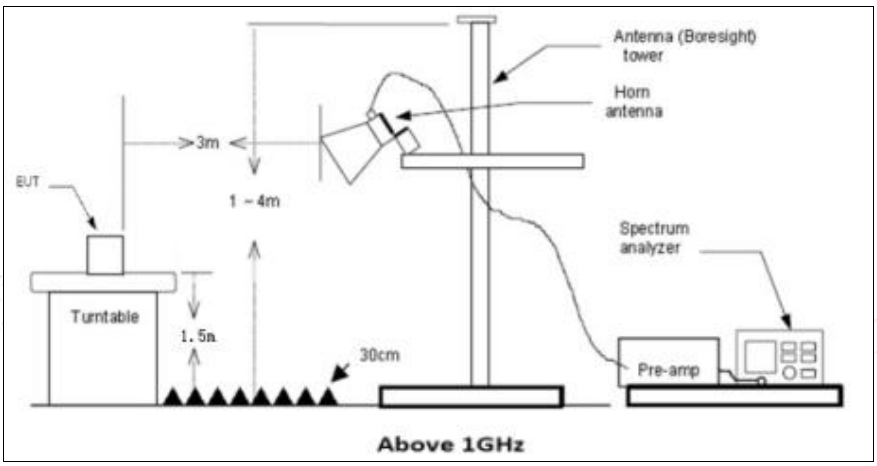
5.2.4. Test Setup Layout



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.

5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

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

Temperature	23.8℃	Humidity	52.1%
Test Engineer	Nick Peng	Configurations	TX

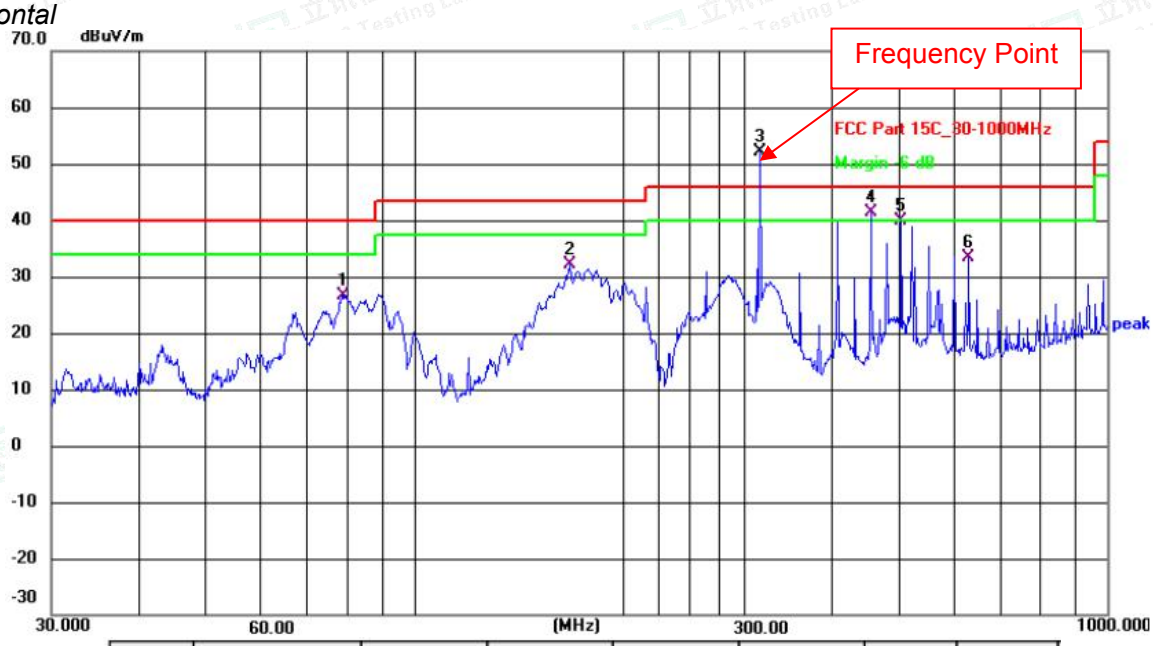
Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dB)	Remark
-	-	-	-	See Note

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.

5.2.7. Results of Radiated Emissions (30MHz~1GHz)

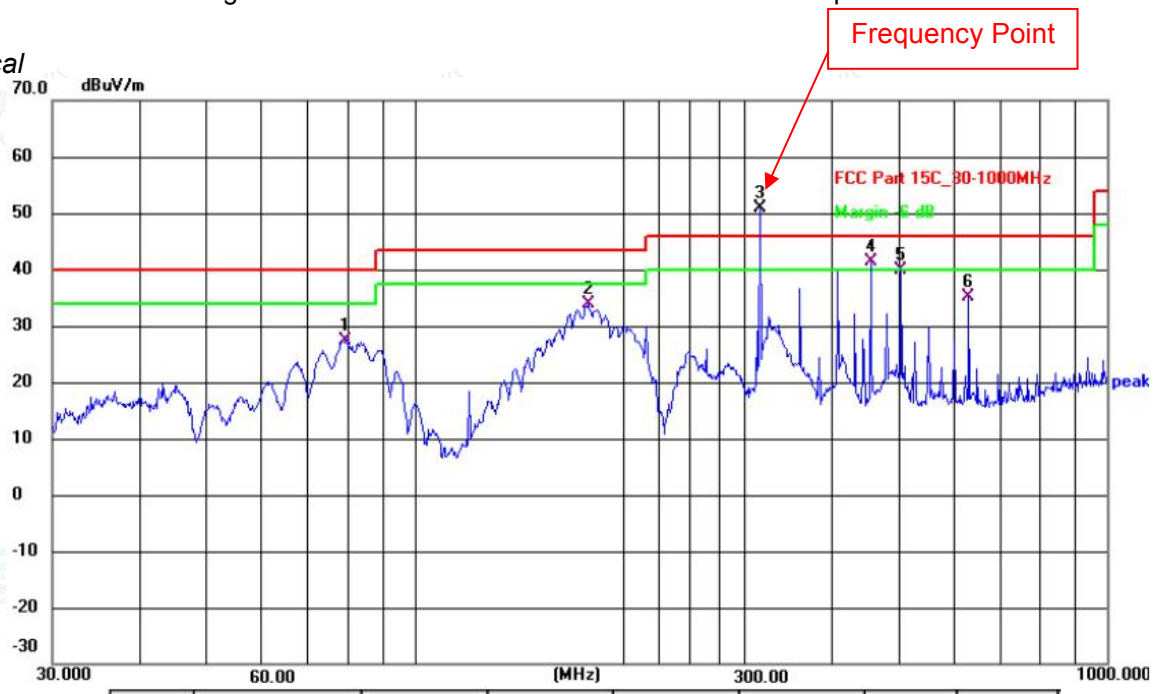
Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	79.2425	46.49	-19.85	26.64	40.00	-13.36	QP
2	167.8240	51.78	-19.56	32.22	43.50	-11.28	QP
3	315.4806	66.88	-14.74	52.14	46.00	6.14	peak
4	455.9057	55.59	-14.25	41.34	46.00	-4.66	QP
5	504.7062	53.02	-13.07	39.95	46.00	-6.05	QP
6	631.6883	44.50	-11.06	33.44	46.00	-12.56	QP

Fundamental and Harmonics Average Result						
Frequency (MHz)	Peak Level (dBμV/m)	AV Factor(dBμV/m) (see Section 5.4)	Average Level (dBμV/m)	Limit(dBμV/m) (average)	Limit(dBμV/m) (Peak)	Conclusion
315.08	52.14	-16.39	35.75	75.62	95.62	PASS
630.16	33.44	-16.39	17.05	55.62	75.62	PASS

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	79.5207	47.36	-19.86	27.50	40.00	-12.50	QP
2	178.1322	52.65	-18.85	33.80	43.50	-9.70	QP
3	315.4806	65.60	-14.74	50.86	46.00	4.86	peak
4	455.9057	55.79	-14.45	41.34	46.00	-4.66	QP
5	504.7062	53.07	-13.07	40.00	46.00	-6.00	QP
6	631.6883	46.12	-11.06	35.06	46.00	-10.94	QP

Fundamental and Harmonics Average Result						
Frequency (MHz)	Peak Level (dBμV/m)	AV Factor(dBμV/m) (see Section 5.4)	Average Level (dBμV/m)	Limit(dBμV/m) (average)	Limit(dBμV/m) (Peak)	Conclusion
315.08	50.86	-16.39	34.47	75.62	95.62	PASS
630.16	35.06	-16.39	18.67	55.62	75.62	PASS

Note:

1. All reading are Quasi-peak values.
2. Measured = Reading + Antenna Factor + Cable Loss
3. The emission that are 20dB below the official limit are not reported
*4. * - means fundamental frequency*
*5. ** - means harmonic frequency*
6. AV values = Peak values + Duty cycle factor

5.2.8. Results of Radiated Emissions (Above1GHz)

Temperature	24.6℃	Humidity	54.1%
Test Engineer	Nick Peng	Configurations	Harmonics Emissions/ Spurious Emission

Peak Value				
Frequency (MHz)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1383.52	47.25	74.00	-26.75	Horizontal
2162.88	46.32	74.00	-27.68	Horizontal
1356.42	46.35	74.00	-27.65	Vertical
2166.01	48.16	74.00	-25.84	Vertical

Average Value:						
Frequency (MHz)	Peak Level (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Margin (dB)	Polarization
1383.52	47.25	-16.39	30.86	54.00	-23.14	Horizontal
2162.88	46.32	-16.39	29.93	54.00	-24.07	Horizontal
1356.42	46.35	-16.39	29.96	54.00	-24.04	Vertical
2166.01	48.16	-16.39	31.77	54.00	-22.23	Vertical

Remark:

1. *Measuring frequencies from 9k~10th harmonic (ex. 5GHz), No emission found between lowest internal used/generated frequency to 30MHz.*
2. *Radiated emissions measured in frequency range from 9k~10th harmonic (ex. 5GHz) were made with an instrument using Peak detector mode.*
3. *Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
4. *Average value=peak reading level + average factor.*

5.3. 99% and 20dB Bandwidth Emissions

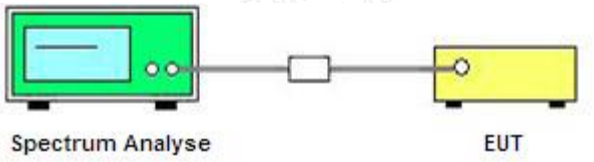
5.3.1. Limit

According to § 15.231 (c), the bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

☒0.25% of the center operating frequency

☐0.5% of the center operating frequency

5.4.2. Block Diagram of Test Setup



5.3.2. Test Procedure

Use the following spectrum analyzer settings:

Span = 3MHz

RBW = 30 KHz

VBW = 100 KHz

Sweep = auto

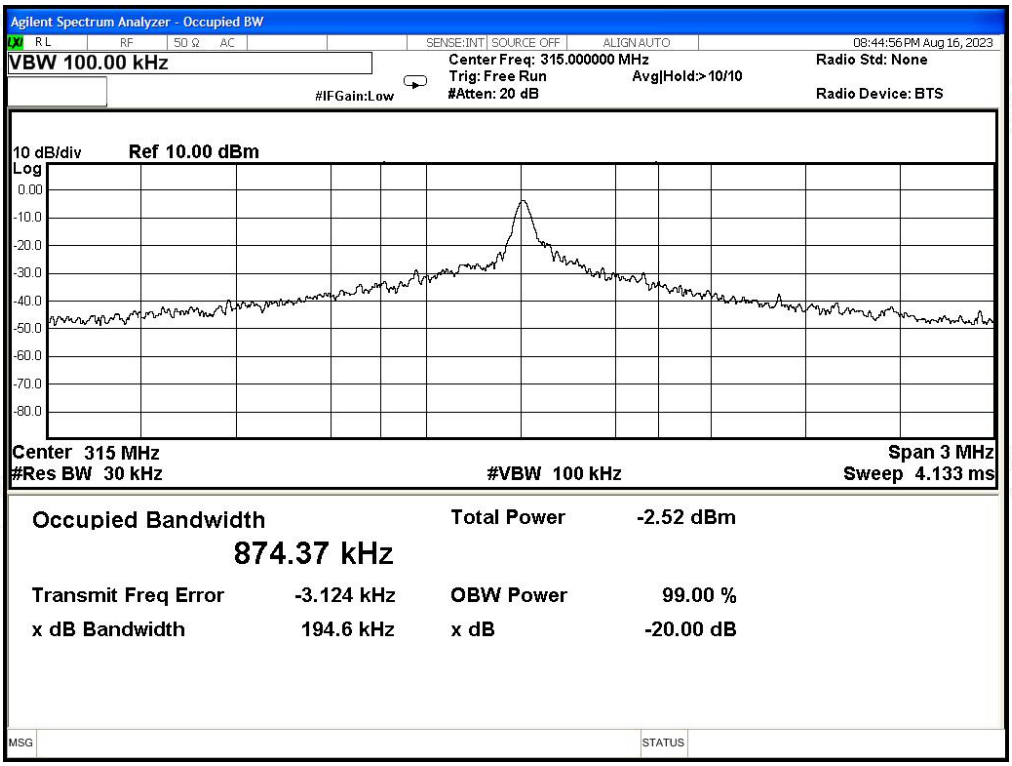
Detector function = peak

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).

5.3.3. Test Data

Transmit Frequency (MHz)	Limit (kHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	Result
315.00	787.50	194.6	874.37	PASS

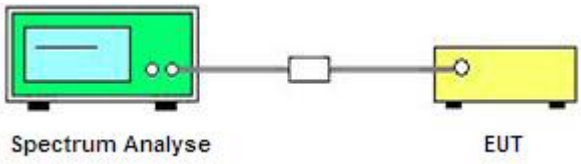

Agilent Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
SOURCE OFF
ALIGN AUTO
08:44:56 PM Aug 16, 2023
VBW 100.00 kHz
Center Freq: 315.000000 MHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 20 dB
Radio Std: None
Radio Device: BTS
10 dB/div
Ref 10.00 dBm
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
Center 315 MHz
#Res BW 30 kHz
#VBW 100 kHz
Span 3 MHz
Sweep 4.133 ms
Occupied Bandwidth
874.37 kHz
Total Power -2.52 dBm
Transmit Freq Error -3.124 kHz
OBW Power 99.00 %
x dB Bandwidth 194.6 kHz
x dB -20.00 dB
MSG
STATUS

5.4. Duty cycle

5.4.1. Limit

No dedicated limit specified in the Rules.

5.4.2. Block Diagram of Test Setup



5.4.3. Test Procedure

a. Place the EUT on the table and set it in transmitting mode.

b. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

c. Set centre frequency of spectrum analyzer=operating frequency.

d. Set the spectrum analyzer as RBW=1.0 MHz, VBW=1.0 MHz, Span=0Hz, Adjust Sweep=auto.

e. Repeat above procedures until all frequency measured was complete.

5.4.3. Test Results

Ton = 0.701*9+0.200*15=9.31 ms

Tp = 61.44 (ms)

The duty cycle = 9.31/61.44 = 15.15%

Average Correction Factory = 20log (Ton/Tp) =20log (0.1515) = -16.39dB

Test plot of Duty cycle

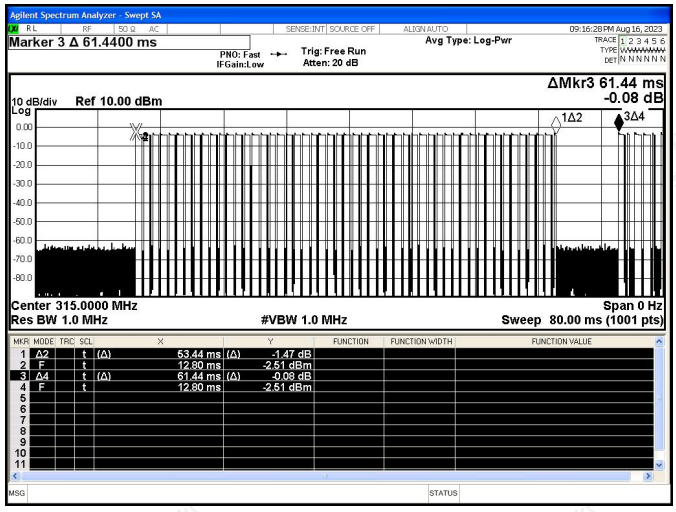


Fig.1

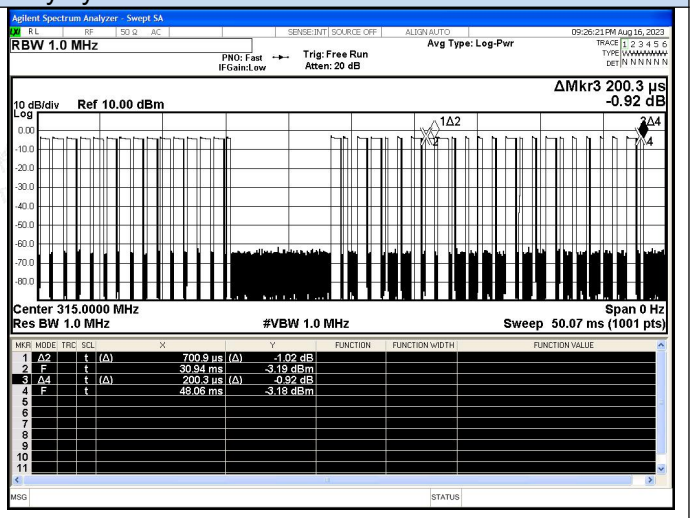


Fig.2

5.5. AC Power Line Conducted Emissions

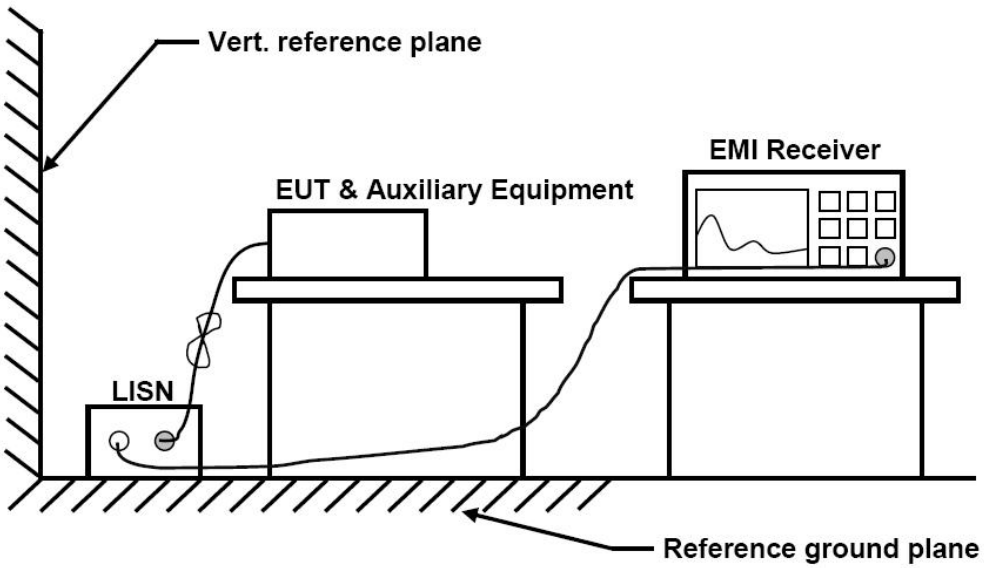
5.5.1 Standard Applicable

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 is 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

5.5.2 Block Diagram of Test Setup



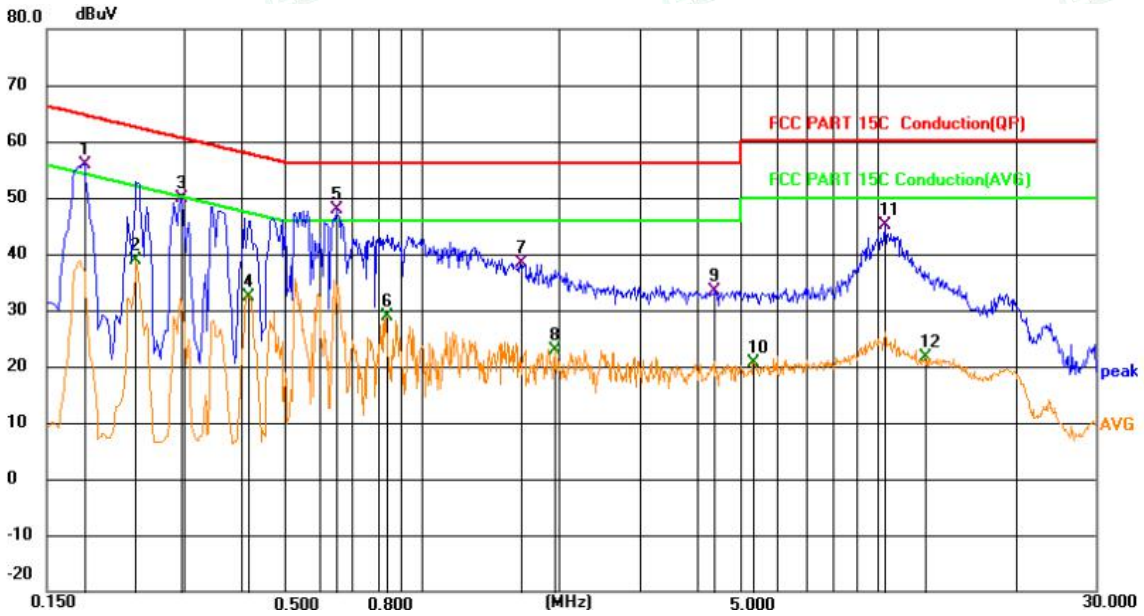
5.5.3 Test Results

Temperature	23.5℃	Humidity	53.6%
Test Engineer	Nick Peng		

PASS.

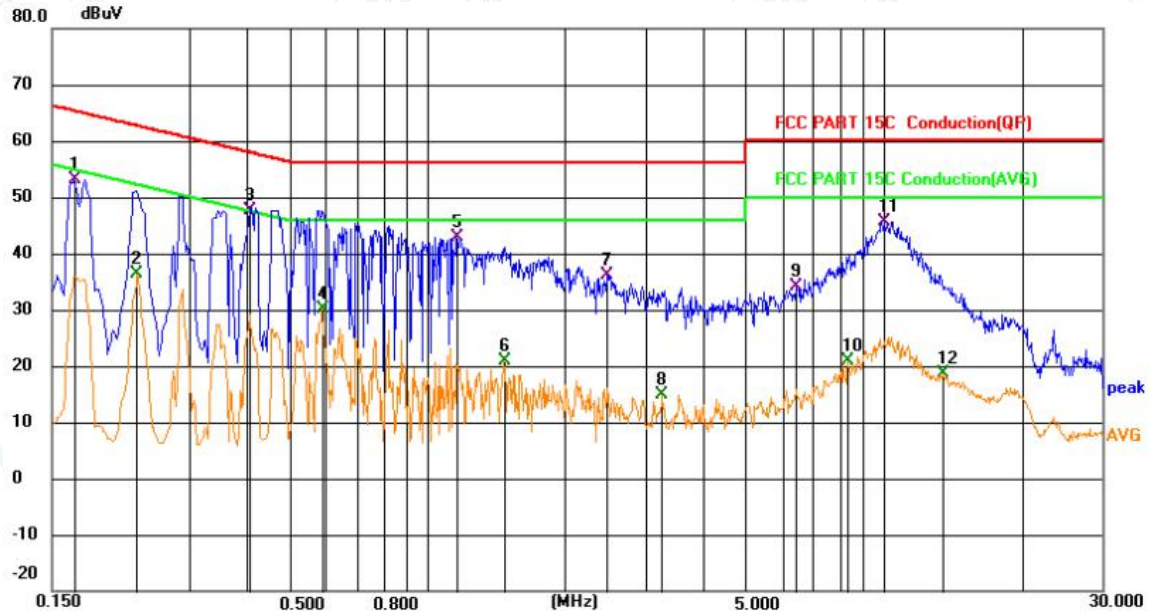
The test data please refer to following page.

Line



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1816	36.17	19.63	55.80	64.41	-8.61	QP	
2		0.2356	19.20	19.63	38.83	52.25	-13.42	AVG	
3		0.2941	30.16	19.63	49.79	60.41	-10.62	QP	
4		0.4156	12.79	19.63	32.42	47.54	-15.12	AVG	
5	*	0.6495	28.26	19.65	47.91	56.00	-8.09	QP	
6		0.8340	9.26	19.64	28.90	46.00	-17.10	AVG	
7		1.6440	18.71	19.67	38.38	56.00	-17.62	QP	
8		1.9590	3.21	19.68	22.89	46.00	-23.11	AVG	
9		4.3981	13.80	19.70	33.50	56.00	-22.50	QP	
10		5.3341	0.95	19.70	20.65	50.00	-29.35	AVG	
11		10.3696	25.20	19.85	45.05	60.00	-14.95	QP	
12		12.6871	1.75	19.85	21.60	50.00	-28.40	AVG	

Neutral



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1681	33.49	19.63	53.12	65.05	-11.93	QP	
2		0.2311	16.82	19.63	36.45	52.41	-15.96	AVG	
3	*	0.4066	28.09	19.63	47.72	57.72	-10.00	QP	
4		0.5866	10.58	19.66	30.24	46.00	-15.76	AVG	
5		1.1536	23.16	19.65	42.81	56.00	-13.19	QP	
6		1.4686	1.25	19.66	20.91	46.00	-25.09	AVG	
7		2.4676	16.41	19.70	36.11	56.00	-19.89	QP	
8		3.2640	-4.86	19.76	14.90	46.00	-31.10	AVG	
9		6.4096	14.35	19.82	34.17	60.00	-25.83	QP	
10		8.3401	1.00	19.84	20.84	50.00	-29.16	AVG	
11		10.0456	25.84	19.85	45.69	60.00	-14.31	QP	
12		13.4656	-1.25	19.84	18.59	50.00	-31.41	AVG	

****Note: 1). Pre-scan all modes and recorded the worst case results in this report.*

2). Measurement = Reading + Correct, Margin = Measurement – Limit.
Correct Factor= Lisn Factor+Cable Factor

5.6. Antenna Requirement

5.6.1. Standard Applicable

According to § 15.203 and RSS-Gen, 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.

5.6.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is -5.56dBi, and the antenna is an Spring Antenna connect to board and no consideration of replacement. Please see EUT photo for details.

5.6.3 Result

Compliance.

6. LIST OF MEASURING EQUIPMENTS

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	MXA Signal Analyzer	Agilent	N9020A	MY49100060	2022-10-29	2023-10-28
2	DC Power Supply	Agilent	E3642A	N/A	2022-10-29	2023-10-28
3	Temperature & Humidity Chamber	GUANGZHOU GOGNWEN	GDS-100	70932	2022-10-06	2023-10-05
4	EMI Test Software	AUDIX	E3	/	N/A	N/A
5	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2023-06-09	2024-06-08
6	Positioning Controller	Max-Full	MF7802BS	MF780208586	N/A	N/A
7	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2021-08-29	2024-08-28
8	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2021-09-12	2024-09-11
9	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2021-09-05	2024-09-04
10	EMI Test Receiver	R&S	ESR 7	101181	2023-06-09	2024-06-08
11	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2022-10-29	2023-10-28
12	Broadband Preamplifier	/	BP-01M18G	P190501	2023-06-09	2024-06-08
13	EMI Test Receiver	R&S	ESPI	101940	2022-08-16	2023-08-15
					2023-08-15	2024-08-14
14	Artificial Mains	R&S	ENV216	101288	2023-06-09	2024-06-08
15	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2023-06-09	2024-06-08
16	EMI Test Software	Farad	EZ	/	N/A	N/A

7. PHOTOGRAPHS OF TEST SETUP

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

8. EXTERIOR PHOTOGRAPHS OF THE EUT

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

9. INTERIOR PHOTOGRAPHS OF THE EUT

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

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