Radio Test Report

Report No: STS2410043W03

Issued for

Shenzhen Xtooltech Intelligent Co., Ltd.

17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China

Product Name:	Tire-Pressure Sensor
Brand Name:	XTOOL, AutoProPAD
Model Name:	TS101
Series Model(s):	TS100 Pro, TS101 Pro
FCC ID:	2AW3ITPMS3
Test Standards:	FCC Part 15.231

TEST REPORT

Applicant's Name	Shenzhen Xtooltech Intelligent Co., Ltd.
Address.....	17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China
Manufacturer's Name.....	Shenzhen Xtooltech Intelligent Co., Ltd.
Address.....	17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China

Product Description

Product Name	Tire-Pressure Sensor
Brand Name.....	XTOOL, AutoProPAD
Model Name.....	TS101
Series Model(s)	TS100 Pro, TS101 Pro
Test Standards.....	FCC Part 15.231
Test Procedure	ANSI C63.10-2020

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Shenzhen STS Test Services Co., Ltd.

Date of Test.....	
Date of Receipt of Test Item ...:	11 Oct. 2024
Date of performance of tests ..:	11 Oct. 2024 ~ 27 Nov. 2024
Date of Issue.....	27 Nov. 2024
Test Result	**Pass**

Testing Engineer : Aaron Bu

(Aaron Bu)

Technical Manager : Tony Liu

(Tony Liu)

Authorized Signatory : Bovey Yang

(Bovey Yang)

SHENZHEN STS TEST SERVICES CO.,LTD. TESTING APPROVAL

TABLE OF CONTENTS **Page**

TABLE OF CONTENTS **Page**

Revision History

Rev.	Issue Date	Report No.	Effect Page	Contents
00	27 Nov. 2024	STS2410043W03	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part 15.231,Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	N/A	--
15.205(a)/15.209/ 15.231(e)	Radiated Spurious Emission	PASS	--
15.231(e)	Transmission requirement	PASS	--
15.231(C)	20 dB Bandwidth	PASS	--
15.203	Antenna Requirement	PASS	--

NOTE: (1) "N/A" denotes test is not applicable in this Test Report.

(2) All tests are according to ANSI C63.10-2020.

1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD

Add. : 101, Building B, Zhuoke Science Park, No.190 Chongqing Road, ZhanChengShequ, Fuhai Sub-District, Bao'an District, Shenzhen, Guang Dong, China

FCC test Firm Registration Number: 625569

IC test Firm Registration Number: 12108A

A2LA Certificate No.: 4338.01

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ±**U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.755dB
2	Unwanted Emissions, conducted	±2.874dB
3	All emissions, radiated 9K-30MHz	±3.80dB
4	All emissions, radiated 30M-1GHz	±4.18dB
5	All emissions, radiated 1G-6GHz	±4.90dB
6	All emissions, radiated>6G	±5.24dB
7	Conducted Emission (9KHz-150KHz)	±2.19dB
8	Conducted Emission (150KHz-30MHz)	±2.53dB
9	Occupied Channel Bandwidth	±3.5%
10	Power Spectral Density, conducted	±1.245dB
11	Duty Cycle	±3.2%

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

<table>
<tr><td>Product Name</td><td>Tire-Pressure Sensor</td></tr>
<tr><td>Trade Name</td><td>XTOOL, AutoProPAD</td></tr>
<tr><td>Model Name</td><td>TS101</td></tr>
<tr><td>Series Model</td><td>TS100 Pro, TS101 Pro</td></tr>
<tr><td>Model Difference</td><td>Only the model name and Brand name are different</td></tr>
<tr><td>PMN</td><td>Tire-Pressure Sensor</td></tr>
<tr><td>HVIN</td><td>TPMS3</td></tr>
<tr><td>FVIN</td><td>N/A</td></tr>
<tr><td>Product Description</td><td>The EUT is a Tire-Pressure Sensor
<table><tr><td>Operation Frequency:</td><td>315MHz, 433.92MHz</td></tr><tr><td>Modulation Type:</td><td>ASK, FSK</td></tr><tr><td>Antenna Designation:</td><td>Spring Antenna</td></tr><tr><td>Antenna Gain(Peak)</td><td>315MHz: -20.75dBi
433.92MHz: -20.55 dBi</td></tr></table>
More details of EUT technical specification, please refer to the User Manual.</td></tr>
<tr><td>Rating</td><td>Input: DC 3.0V CR2032 (Manganese dioxide Lithium Battery)</td></tr>
<tr><td>Battery</td><td>Model: CR2032A
Brand: Panasonic
Rated Voltage:3V
Charge Limit Voltage: N/A
Capacity: 210mAh

Model: CR2032HT
Brand: EVE
Rated Voltage:3V
Charge Limit Voltage: N/A
Capacity: 200mAh

Model: CR2032HR
Brand: Maxell
Rated Voltage:3V
Charge Limit Voltage: N/A
Capacity: 200mAh

Model: CR2032W
Brand: murata
Rated Voltage:3V
Charge Limit Voltage: N/A
Capacity: 210mAh</td></tr>
<tr><td>Hardware version number</td><td>TS100_MB_V3.0</td></tr>
<tr><td>Software version number</td><td>N/A</td></tr>
</table>

Serial Numbers	241010016-2
Connecting I/O Port(s)	Please refer to Note 1.

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications orthe User Manual.
2. Table for filed Antenna

Fre.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
315MHz	XTOOL	TS101	Spring	N/A	-20.75	Antenna
433MHz	XTOOL	TS101	Spring	N/A	-20.55	Antenna

2.2 DESCRIPTION OF THE TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	TX Mode(315MHz, ASK)
Mode 2	TX Mode(433.92MHz, ASK)
Mode 3	TX Mode(315MHz, FSK)
Mode 4	TX Mode(433.92MHz, FSK)

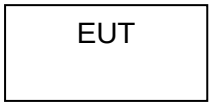
	For Radiated Emission
Final Test Mode	Description
Mode 1	TX Mode(315MHz, ASK)
Mode 2	TX Mode(433.92MHz,ASK)
Mode 3	TX Mode(315MHz, FSK)
Mode 4	TX Mode(433.92MHz, FSK)

Note:

(1)The measurements are performed at all Bit Rate of Transmitter, the worst data was reported

2.3 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters



2.4 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
N/A	N/A	N/A	N/A	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
N/A	N/A	N/A	N/A	N/A	N/A

Note:

(1)For detachable type I/O cable should be specified the length in cm in『Length』column.

2.5 EQUIPMENTS LIST

RF Radiation Test Equipment					
Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
Temperature & Humidity	SW-108	SuWei	N/A	2024.03.15	2025.03.14
Pre-Amplifier(0.1M-3GHz)	EM	EM330	060665	2024.02.23	2025.02.22
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2024.09.23	2025.09.22
Positioning Controller	MF	MF-7802	MF-780208587	N/A	N/A
Signal Analyzer	R&S	FSV 40-N	101823	2024.09.23	2025.09.22
Filter Box	BALUN Technology	SU319E	BL-SZ1530051	N/A	N/A
Bilog Antenna	TESEQ	CBL6111D	34678	2024.09.30	2025.09.29
Active loop Antenna	ZHINAN	ZN30900C	16035	2023.02.28	2025.02.27
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2023.09.24	2025.09.23
Antenna Mast	MF	MFA-440H	N/A	N/A	N/A
Turn Table	EM	SC100_1	60531	N/A	N/A
AC Power Source	APC	KDF-11010G	F214050035	N/A	N/A
DC power supply	HONGSHENGFENG	DPS-305AF	17064939	2024.09.23	2025.09.22
Test SW	EZ-EMC	Ver.STSLAB-03A1 RE			
RF Connected Test					
Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Signal Analyzer	Agilent	N9020A	MY51510623	2024.02.23	2025.02.22
Temperature & Humidity	SW-108	SuWei	N/A	2024.03.15	2025.03.14

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

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 the limits in the following table.

FREQUENCY (MHz)	Class B (dBuV)		Standard
	Quasi-peak	Average	
0.15 -0.5	66 - 56 *	56 - 46 *	CISPR
0.50 -5.0	56.00	46.00	CISPR
5.0 -30.0	60.00	50.00	CISPR

0.15 -0.5	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	56.00	46.00	FCC
5.0 -30.0	60.00	50.00	FCC

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.2 TEST PROCEDURE

a. The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

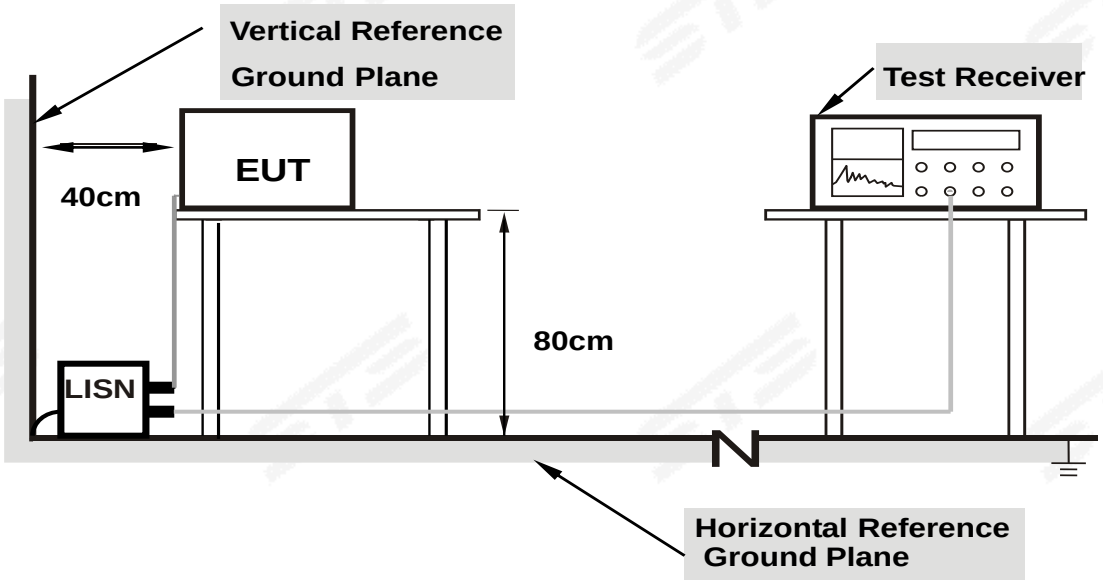
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

d. LISN at least 80 cm from nearest part of EUT chassis.

e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3 TEST SETUP



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

3.4 TEST RESULTS

Temperature:	N/A	Relative Humidity:	N/A
Phase:	L/N	Test Mode:	N/A

Note: EUT is only power by Button cell battery, So it is not applicable for this test.

4. RADIATED EMISSION MEASUREMENT

4.1 RADIATED EMISSION LIMITS

In case the emission fall within the restricted band specified on Part 15.205(a), then the Part 15.209(a), Part 15.231(e) limit in the table below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/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

Fundamental Frequency (MHz)	Field Strength of fundamental (microvolts/meter)	Field Strength of Unwanted Emissions (microvolts/meter)
40.66 - 40.70	1,000	100
70 - 130	500	50
130 - 174	500 to 1,500 **	50 to 1,50 **
174 - 260	1,500	1,50
260 - 470	1,500 to 5,000 **	1,50 to 5,00 **
Above 470	5,000	5,00

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Class B (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

NOTE:** linear interpolations

[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, uV/m at 3 meters = 22.72727(F) - 2454.545; for the band 260-470 MHz, uV/m at 3 meters = 16.6667(F) - 2833.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

The limits on the field strength of the spurious emissions in the above table are based on thefundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to theaverage (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in93 Section 15.209, whichever limit permits a higher field strength.

LIMITS OF RESTRICTED FREQUENCY BANDS

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1MHz / 3MHz

Receiver Parameter	**Setting**
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

4.2 TEST PROCEDURE

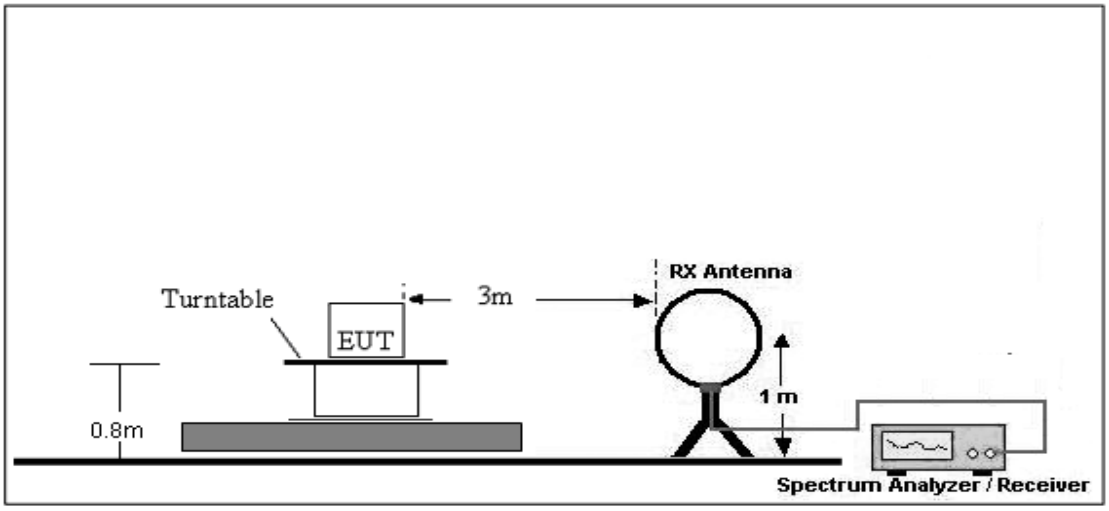
a. The test is performed in a 3m Semi-Anechoic Chamber; the antenna factor, cable loss and so on of the site (factors) is calculated to correct the reading.The EUT is placed on a 0.8m high insulating Turn Table, and keeps 3m away from theTest Antenna, which is mounted on avariable-height antenna master tower.
During test, the table was rotated 360 degrees to determine the position of the highest radiation.
b. In the frequency range of 9KHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 3m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
c. In the frequency range 30MHz-1GHz, Bi-Log Test Antenna used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.
d. In the frequency above1GHz, place the measurement antenna 3m away from the EUT for 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 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.
f. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
g. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
h. For the actual test configuration, please refer to the related Item –EUT Test Photos.
Note: Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

4.3 DEVIATION FROM TEST STANDARD

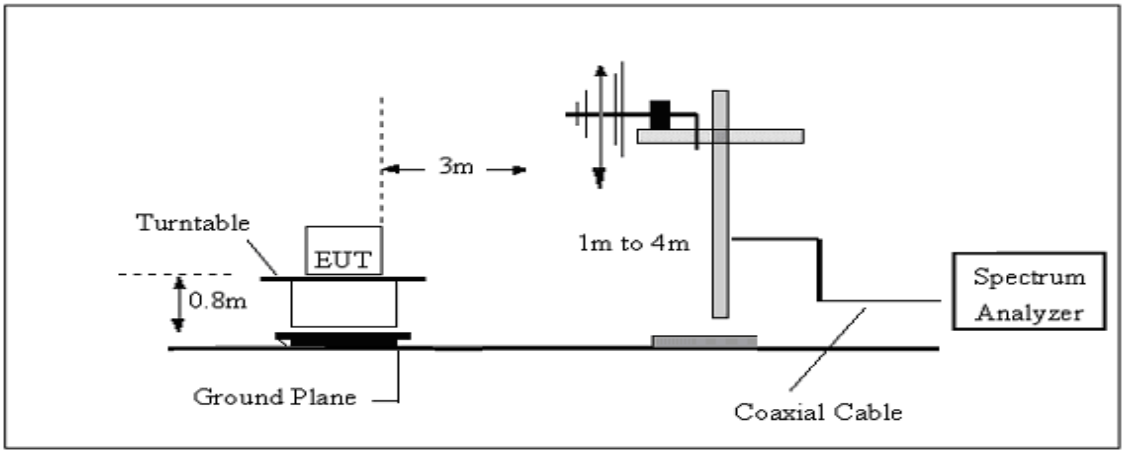
No deviation

4.4 TEST SETUP

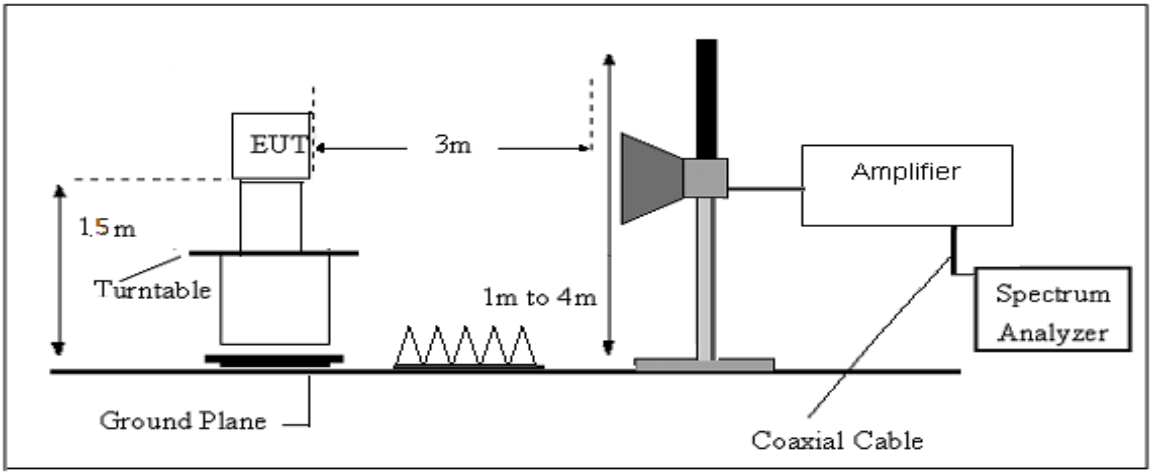
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



4.5 EUT OPERATING CONDITIONS

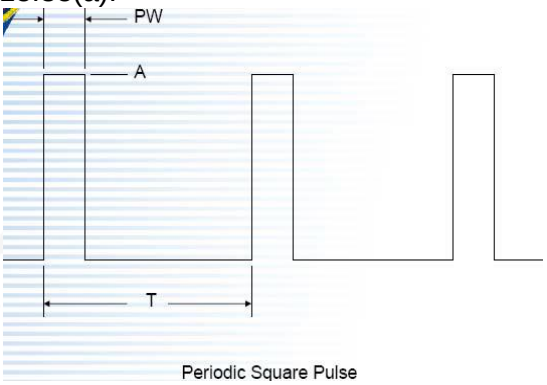
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

4.6 TEST RESULTS

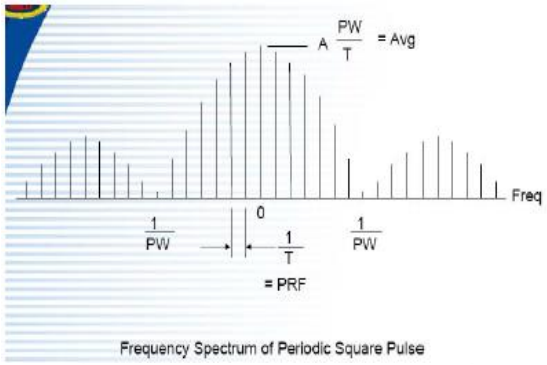
INTRODUCTION TO PDCF

Reference: (§15.35 Measurement detector functions and bandwidths.)

a. Part 15 of the FCC Rules provides for the operation of low power communication devices without an individual license (e.g., intrusion detectors, pulsed water tank level gauges, etc.), subject to certain requirements. Some of these devices use extremely narrow pulses to generate wideband emissions, which are measured to determine compliance with the rules. These measurements are typically performed with a receiver or spectrum analyzer. Depending on a number of factors (e.g., resolution bandwidth, pulsewidth, etc.), the spectrum analyzer may not always display the true peak value of the measured emission. This effect, called “pulse desensitization,” relates to the capabilities of the measuring instrument. For the measurement and reporting of the true peak of pulsed emissions, it may be necessary to apply a “pulse desensitization correction factor” (PDCF) to the measured value, pursuant to 47 CFR 15.35(a).



Periodic Square Pulse



Frequency Spectrum of Periodic Square Pulse

If using spectrum analyzer to measure pulse signal, it have to make sure the RBW use is at least 2/PW.

•When RBW is less than 2/PW, you are able to measure the true peak level of the pulse signal. If this is the case, PDCF is required to compensate to determine true peak value.

Pulse desensitization:

315MHz, FSK

PW =29600usec,Period=100000usec, Level=A

RBW>2/PW=0.068K , PRF=1/T=0.01K ,

433.92MHz,ASK

PW =17600usec,Period=100000usec, Level=A

RBW>2/PW=0.1K , PRF=1/T=0.01K

NOTE: 2 / PW < RBW, first don't need

b. For the actual test, please refer to the ANSI C63.10,Annex C refer to section 7 for more detail

4.7 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting theAmplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:
FS = RA + AF + CL - AG
Where
FS = Field Strength
CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude
AG = Amplifier Gain
AF = Antenna Factor
For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

4.8 TEST RESULTS (EMISSION)

(Radiated Emission<30MHz (9KHz-30MHz, H-field))

Temperature:	20 ℃	Relative Humidtity:	48%
Test Mode:	Mode 1	Polarization:	--

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	PASS
--	--	--	--	PASS

Note: The amplitude of spurious emissions which are attenuated by more than 20dB 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.

Between 30MHz – 5000 MHz

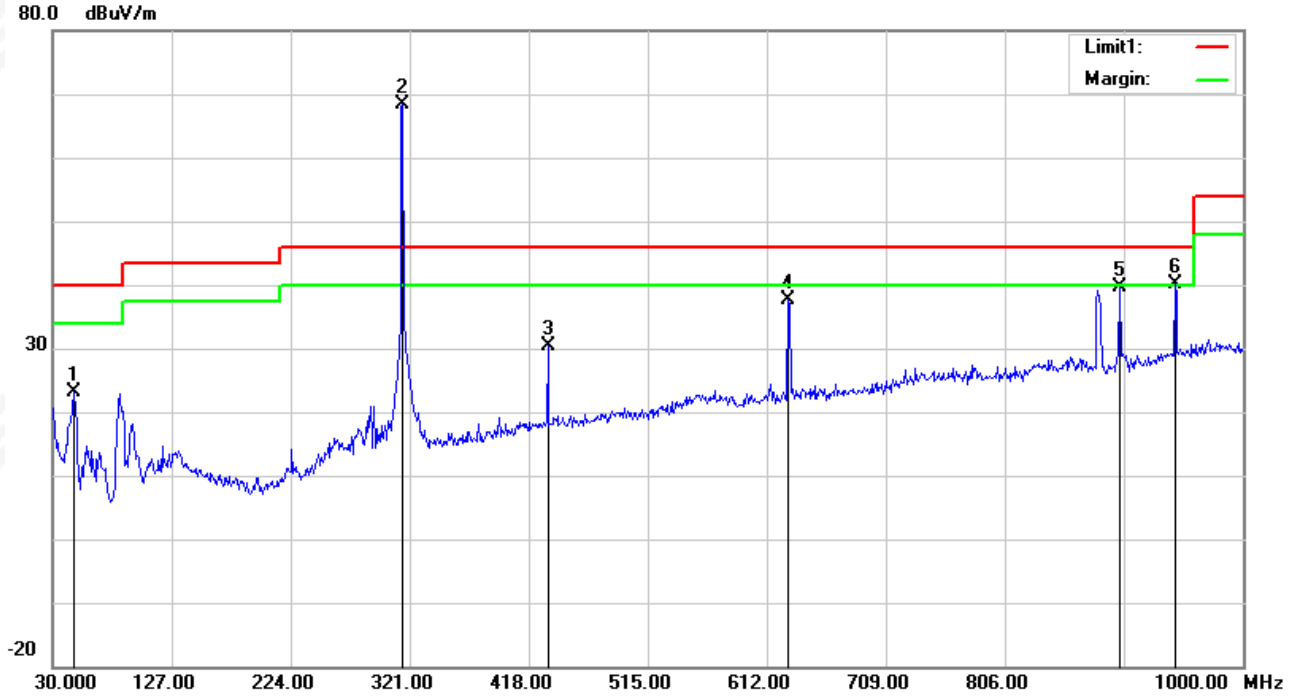
Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Horizontal	Test Mode:	Mode 1

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	47.4600	45.03	-21.92	23.11	40.00	-16.89	peak
3	433.5200	40.55	-10.13	30.42	46.00	-15.58	peak
4	629.4600	42.67	-5.07	37.60	46.00	-8.40	peak
5	900.0900	40.20	-0.45	39.75	46.00	-6.25	peak
6	944.7100	38.62	1.48	40.10	46.00	-5.90	peak

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	
2	315.0000	82.58	-14.22	-	68.36	87.67	-19.31	Peak
2	315.0000	82.58	-14.22	-15.76	52.6	67.67	-15.07	AVG

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



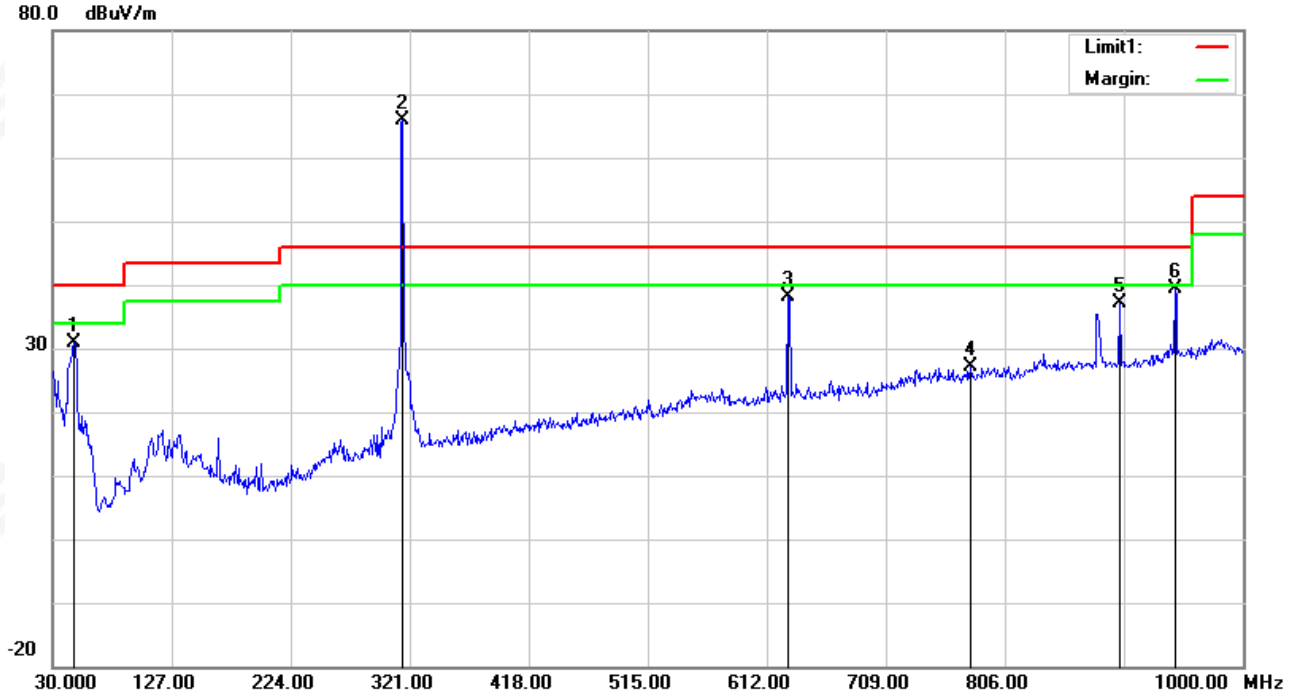
Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Vertical	Test Mode:	Mode 1

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	47.4600	52.90	-21.92	30.98	40.00	-9.02	peak
3	629.4600	43.08	-5.07	38.01	46.00	-7.99	peak
4	777.8700	29.49	-2.24	27.25	46.00	-18.75	peak
5	900.0900	37.54	-0.45	37.09	46.00	-8.91	peak
6	944.7100	37.84	1.48	39.32	46.00	-6.68	peak

Fundamental Frequency

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Duty cycle Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2	315.0000	80.08	-14.22	-	65.86	87.67	-21.81	Peak
2	315.0000	80.08	-14.22	-15.76	50.1	67.67	-17.57	AVG

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



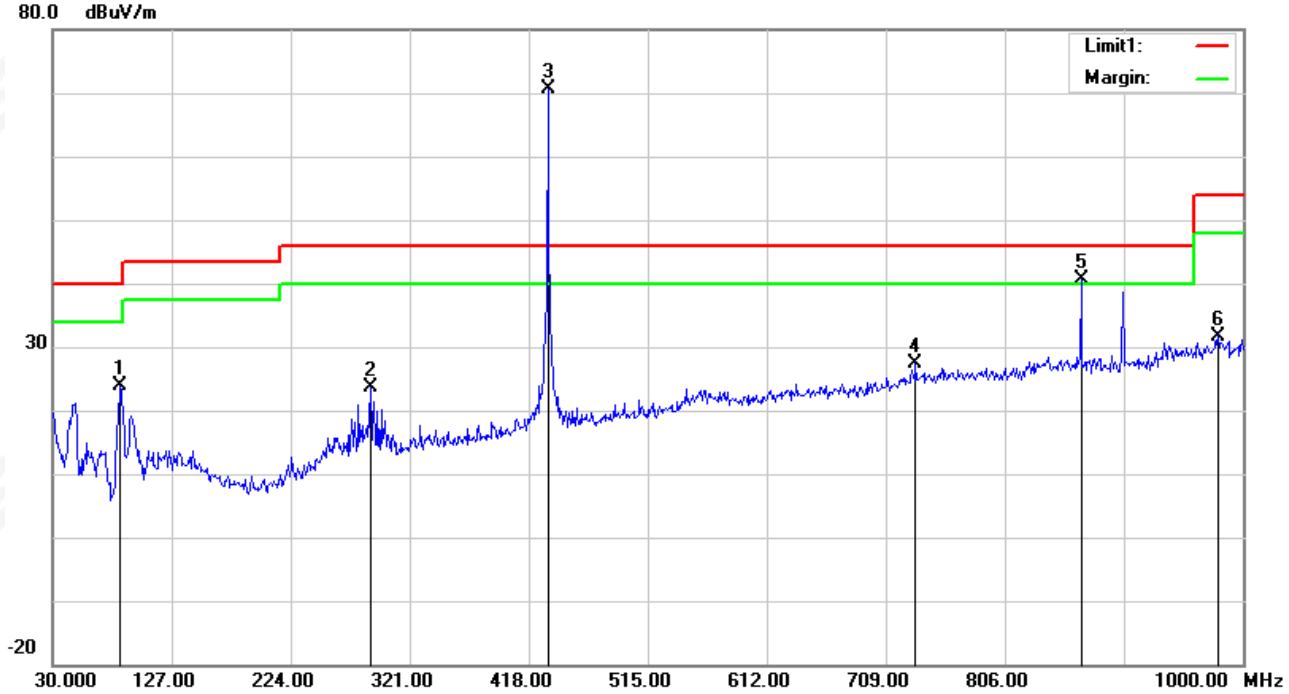
Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Horizontal	Test Mode:	Mode 2

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	85.2900	45.97	-22.13	23.84	40.00	-16.16	peak
2	288.9900	38.80	-15.21	23.59	46.00	-22.41	peak
4	733.2500	29.71	-2.35	27.36	46.00	-18.64	peak
5	868.0800	41.11	-0.51	40.60	46.00	-5.40	peak
6	979.6300	29.10	2.65	31.75	54.00	-22.25	peak

Fundamental Frequency

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Duty cycle Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
3	433.9200	80.75	-10.13	-	70.62	92.87	-22.25	Peak
3	433.9200	80.75	-10.13	-15.37	55.25	72.87	-17.62	AVG

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



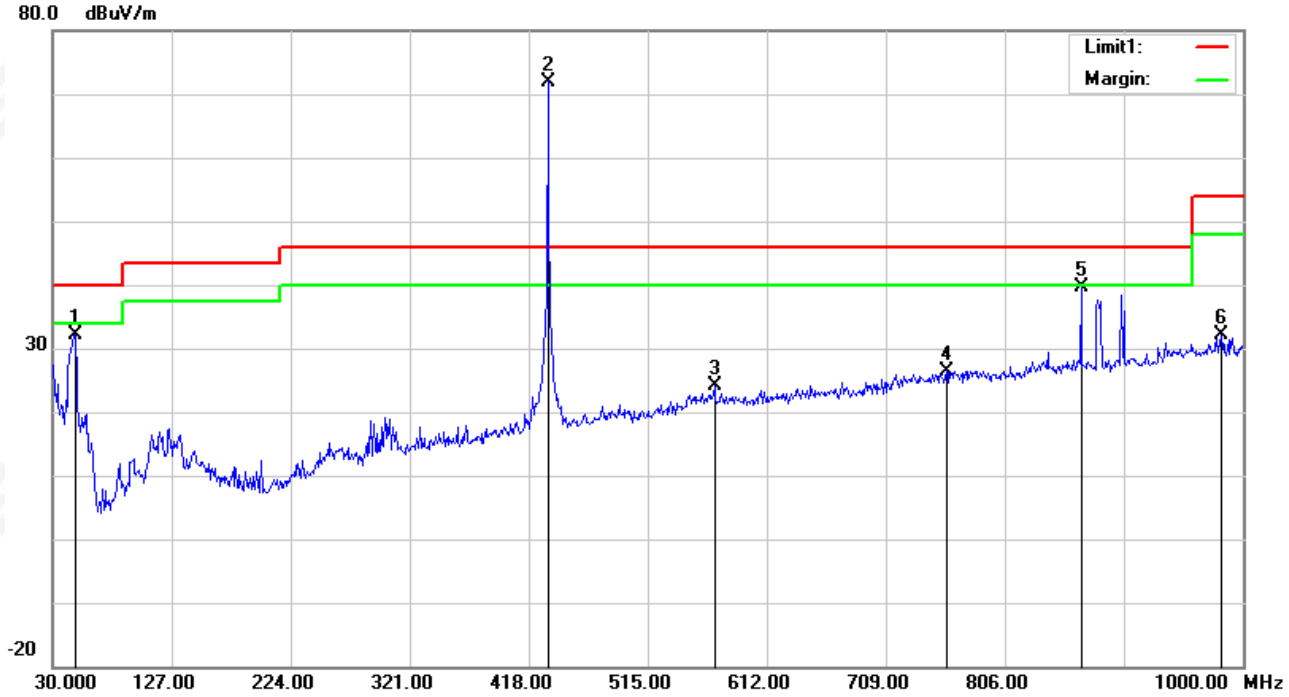
Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Vertical	Test Mode:	Mode 2

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	48.4300	54.60	-22.44	32.16	40.00	-7.84	peak
3	569.3200	29.63	-5.59	24.04	46.00	-21.96	peak
4	758.4700	28.67	-2.17	26.50	46.00	-19.50	peak
5	868.0800	40.24	-0.51	39.73	46.00	-6.27	peak
6	982.5400	29.49	2.52	32.01	54.00	-21.99	peak

Fundamental Frequency

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Duty cycle Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2	433.9200	82.13	-10.13	-	72.00	92.87	-20.87	Peak
2	433.9200	82.13	-10.13	-15.37	56.63	72.87	-16.24	AVG

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



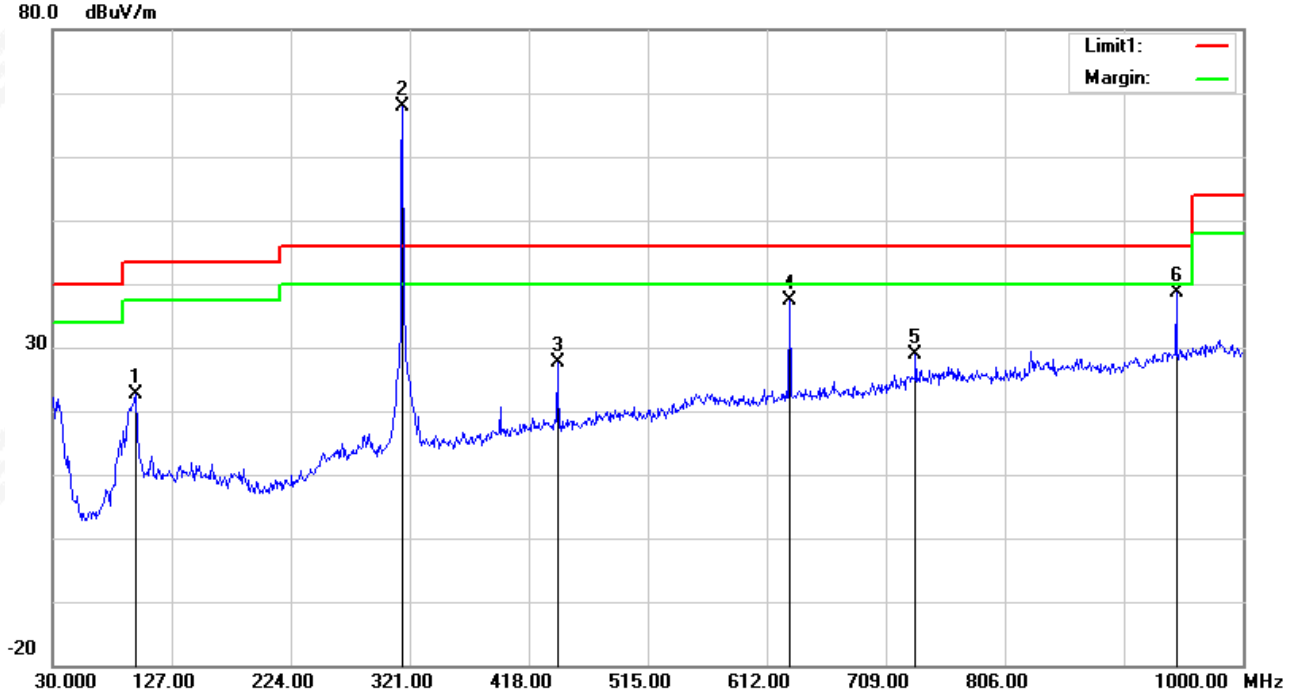
Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Horizontal	Test Mode:	Mode 3

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	97.9000	43.07	-20.46	22.61	43.50	-20.89	peak
2	441.2800	37.67	-10.04	27.63	46.00	-18.37	peak
4	630.4300	42.39	-5.03	37.36	46.00	-8.64	peak
5	733.2500	31.35	-2.35	29.00	46.00	-17.00	peak
6	945.6800	37.08	1.50	38.58	46.00	-7.42	peak

Fundamental Frequency

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Duty cycle Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2	315.0000	82.10	-14.22	-	67.88	87.67	-19.79	Peak
2	315.0000	82.10	-14.22	-10.89	56.99	67.67	-10.68	AVG

Remark:
3. Margin = Result (Result =Reading + Factor)–Limit
4. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



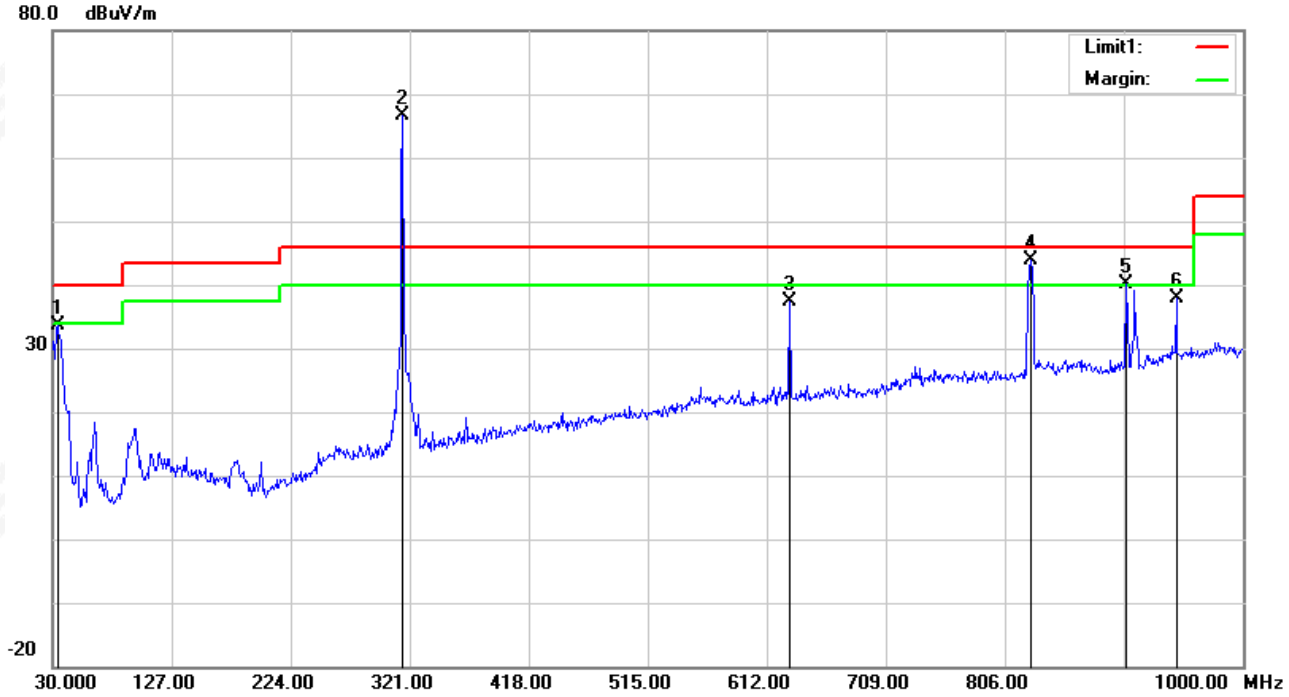
Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Vertical	Test Mode:	Mode 3

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	33.8800	48.37	-14.80	33.57	40.00	-6.43	peak
3	630.4300	42.38	-5.03	37.35	46.00	-8.65	peak
4	827.3400	44.95	-1.08	43.87	46.00	-2.13	peak
5	904.9400	40.49	-0.32	40.17	46.00	-5.83	peak
6	945.6800	36.37	1.50	37.87	46.00	-8.13	peak

Fundamental Frequency

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Duty cycle Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
2	315.0000	80.73	-14.22	-	66.51	87.67	-21.16	Peak
2	315.0000	80.73	-14.22	-10.89	55.62	67.67	-12.05	AVG

Remark:
3. Margin = Result (Result =Reading + Factor)–Limit
4. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Horizontal	Test Mode:	Mode 4

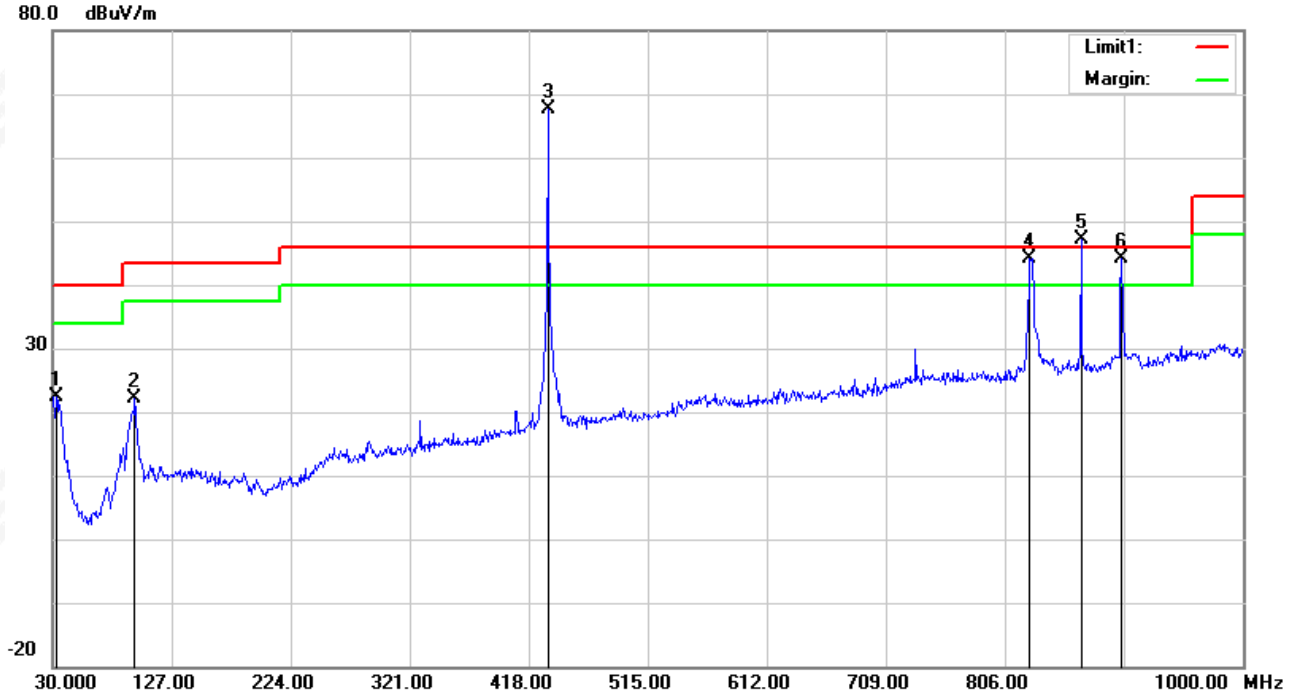
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	32.9100	36.76	-14.33	22.43	40.00	-17.57	peak
2	96.9300	42.75	-20.57	22.18	43.50	-21.32	peak
4	826.3700	45.25	-1.19	44.06	46.00	-1.94	peak
6	901.0600	44.50	-0.43	44.07	46.00	-1.93	peak

Fundamental Frequency

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Duty cycle Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
3	433.9200	77.70	-10.13	-	67.57	92.87	-25.30	peak
3	433.9200	77.70	-10.13	-10.60	56.97	72.87	-15.90	AV
5	867.8400	47.59	-0.51	-	47.08	72.87	-25.79	peak

Remark:

5. Margin = Result (Result =Reading + Factor)–Limit
6. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



Temperature:	23.4℃	Relative Humidity:	60%
Phase:	Vertical	Test Mode:	Mode 4

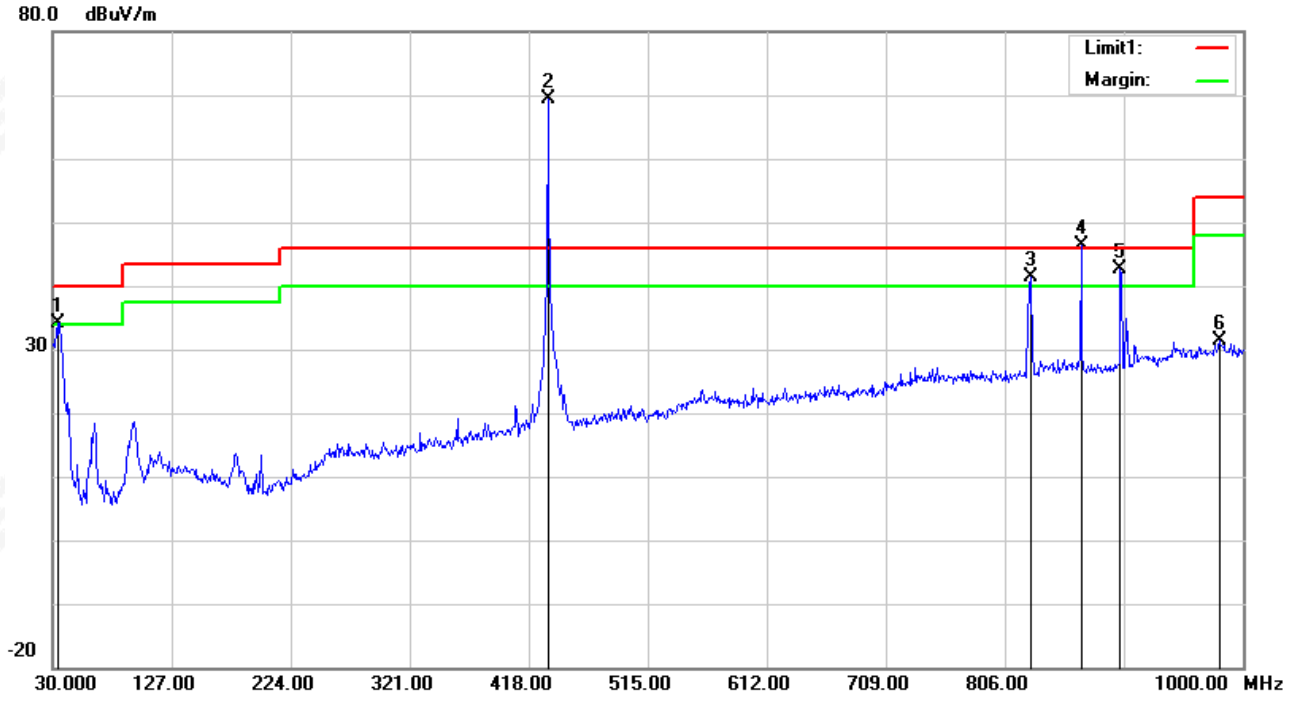
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Results (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	33.8800	49.00	-14.80	34.20	40.00	-5.80	peak
3	827.3400	42.44	-1.08	41.36	46.00	-4.64	peak
5	900.0900	43.07	-0.45	42.62	46.00	-3.38	peak
6	980.6000	28.64	2.63	31.27	54.00	-22.73	peak

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	Factor(dB)	(dBuV/m)	(dBuV/m)	(dB)	
2	433.9200	79.53	-10.13	-	69.40	92.87	-23.47	peak
2	433.9200	79.53	-10.13	-10.60	58.8	72.87	-14.07	AV
4	867.8400	47.59	-0.51	-	46.41	72.87	-26.46	peak

Remark:

5. Margin = Result (Result =Reading + Factor)–Limit
6. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



PEAK TEST RESULTS:

Mode 1

Frequency	Meter Reading	Detector	Amplifier	Loss	Antenna Factor	Orrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
								Limit	Margin	Polar
(MHz)	(dBμV/m)	(PK/QP/AV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
944.96	64.07	PK	45.1	4.0	25.1	-16.00	48.07	67.67	-19.60	H
944.96	64.35	PK	45.1	4.0	25.1	-16.00	48.35	67.67	-19.32	V
1260.28	61.50	PK	44.1	5.3	25	-13.80	47.70	67.67	-19.97	H
1260.28	63.22	PK	44.1	5.3	25	-13.80	49.42	67.67	-18.25	V
1574.84	60.04	PK	43.8	5.4	25.9	-12.47	47.57	74	-26.43	H
1574.84	60.45	PK	43.8	5.4	25.9	-12.47	47.98	74	-26.02	V
1889.9	55.54	PK	44.4	6.0	27.6	-10.77	44.77	67.67	-22.90	H
1889.9	56.07	PK	44.4	6.0	27.6	-10.77	45.30	67.67	-22.37	V

Mode 2

Frequency	Meter Reading	Detector	Amplifier	Loss	Antenna Factor	Orrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
								Limit	Margin	Polar
(MHz)	(dBμV/m)	(PK/QP/AV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1302.06	63.98	PK	45.1	4.0	25.1	-16.00	47.98	74	-26.02	H
1302.06	64.45	PK	45.1	4.0	25.1	-16.00	48.45	74	-25.55	V
1735.68	61.51	PK	44.1	5.3	25	-13.80	47.71	72.87	-25.16	H
1735.68	63.27	PK	44.1	5.3	25	-13.80	49.47	72.87	-23.40	V
2169.82	60.24	PK	43.8	5.4	25.9	-12.47	47.77	72.87	-25.10	H
2169.82	60.82	PK	43.8	5.4	25.9	-12.47	48.35	72.87	-24.52	V
2603.41	55.92	PK	44.4	6.0	27.6	-10.77	45.15	72.87	-27.72	H
2603.41	56.14	PK	44.4	6.0	27.6	-10.77	45.37	72.87	-27.50	V

Mode 3

Frequency	Meter Reading	Detector	Amplifier	Loss	Antenna Factor	Orrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
								Limit	Margin	Polar
(MHz)	(dBμV/m)	(PK/QP/AV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
944.99078	63.96	PK	45.1	4.0	25.1	-16.00	47.96	67.67	-19.71	H
944.99078	64.42	PK	45.1	4.0	25.1	-16.00	48.42	67.67	-19.25	V
1260.1206	61.39	PK	44.1	5.3	25	-13.80	47.59	67.67	-20.08	H
1260.1206	63.19	PK	44.1	5.3	25	-13.80	49.39	67.67	-18.28	V
1575.1918	60.12	PK	43.8	5.4	25.9	-12.47	47.65	74	-26.35	H
1575.1918	60.60	PK	43.8	5.4	25.9	-12.47	48.13	74	-25.87	V
1890.0755	55.56	PK	44.4	6.0	27.6	-10.77	44.79	67.67	-22.88	H
1890.0755	56.06	PK	44.4	6.0	27.6	-10.77	45.29	67.67	-22.38	V

Mode 4

Frequency	Meter Reading	Detector	Amplifier	Loss	Antenna Factor	Orrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
								Limit	Margin	Polar
(MHz)	(dBμV/m)	(PK/QP/AV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1301.8357	63.65	PK	45.1	4.0	25.1	-16.00	47.65	74	-26.35	H
1301.8357	64.58	PK	45.1	4.0	25.1	-16.00	48.58	74	-25.42	V
1735.6883	61.60	PK	44.1	5.3	25	-13.80	47.80	72.87	-25.07	H
1735.6883	63.34	PK	44.1	5.3	25	-13.80	49.54	72.87	-23.33	V
2169.8077	60.43	PK	43.8	5.4	25.9	-12.47	47.97	72.87	-24.90	H
2169.8077	60.70	PK	43.8	5.4	25.9	-12.47	48.24	72.87	-24.63	V
2603.6696	55.67	PK	44.4	6.0	27.6	-10.77	44.90	72.87	-27.97	H
2603.6696	56.21	PK	44.4	6.0	27.6	-10.77	45.44	72.87	-27.43	V

Note:
1. Above 2.6 GHz The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. The peak value is less than the AV limit, so AV data does not need to be tested.

5. BANDWIDTH TEST

5.1 LIMIT

FCC Part15.231,Subpart C			
Section	Test Item	Limit	Result
15.231(C)	20 Bandwidth&	The20dB bandwidth of the emissions shall not exceed 0.25% of the center frequency	PASS

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth
RB	1% to 5% of the OBW
VB	≥3RB
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.2 TEST REQUIREMENTS

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.

5.3 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: 1% to 5% of the OBW, VBW≥3RBW, Sweep time = Auto.

5.4 TEST SETUP

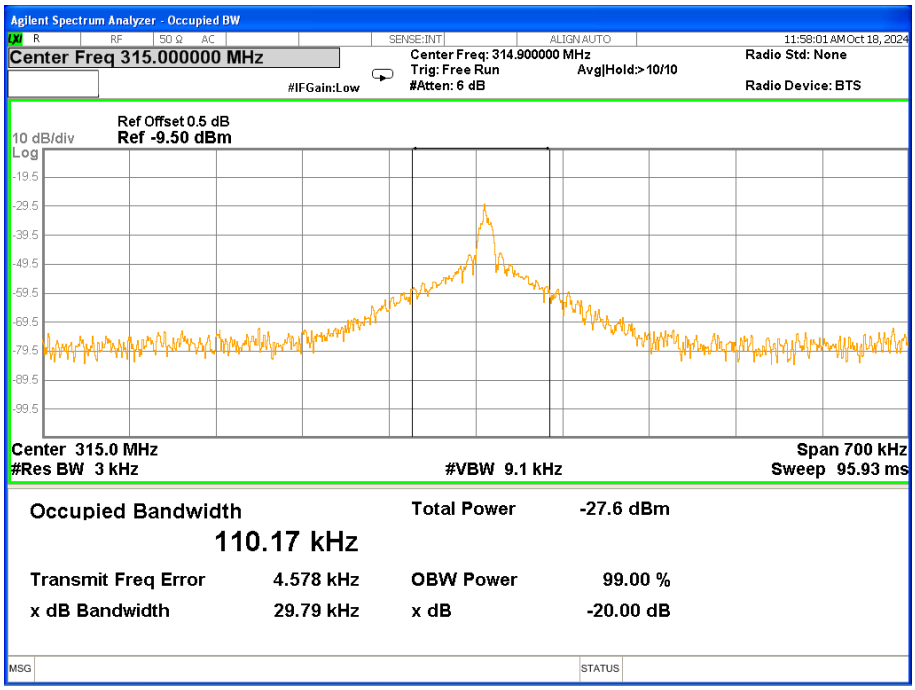
5.5 EUT OPERATION CONDITIONS

TX mode.

5.6 TEST RESULTS

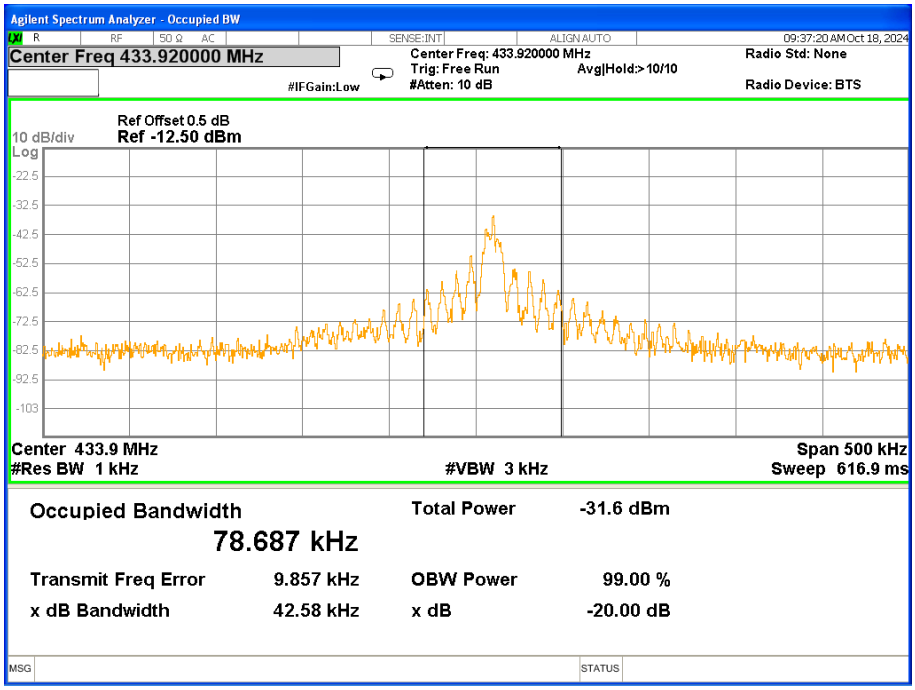
Temperature:	25 ℃	Relative Humidity:	60%
Test Mode:	Mode 1		

Centre Frequency	Measurement		
	20dB Bandwidth (KHz)	Limit(kHz)	Frequency Range (MHz)
315 MHz	29.79	787.5	PASS



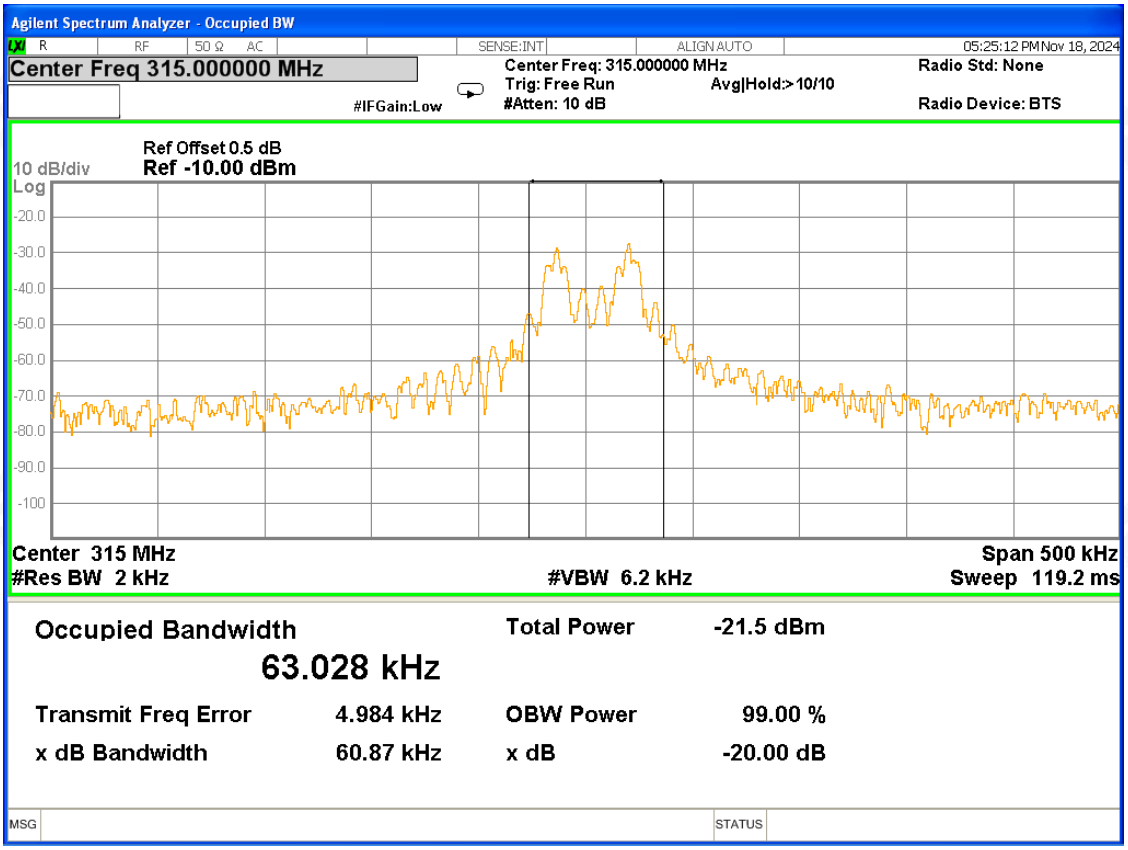
Temperature:	25 ℃	Relative Humidity:	60%
Test Mode:	Mode 2		

Centre Frequency	Measurement		
	20dB Bandwidth (KHz)	Limit(kHz)	Frequency Range (MHz)
433.92 MHz	42.58	1085	PASS



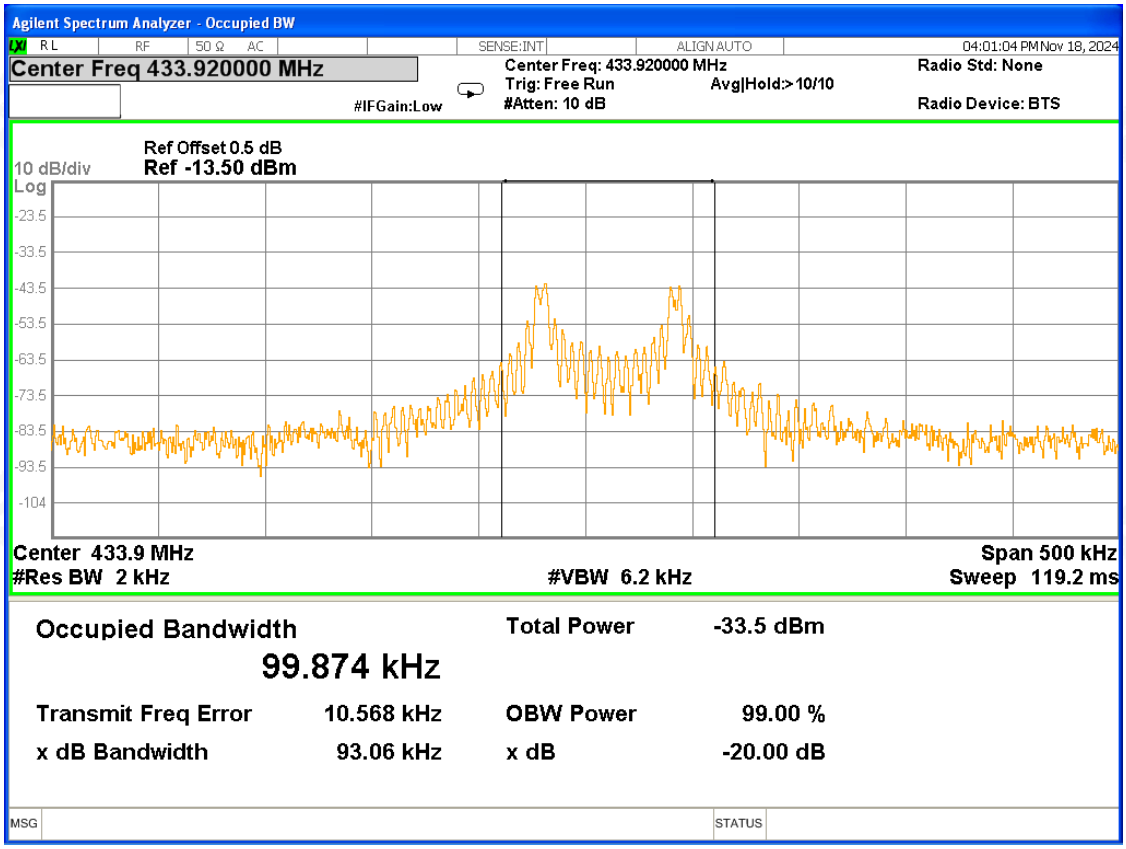
Temperature:	25 ℃	Relative Humidity:	60%
Test Mode:	Mode 3		

Centre Frequency	Measurement		
	20dB Bandwidth (KHz)	Limit(kHz)	Frequency Range (MHz)
315 MHz	60.87	1085	PASS



Temperature:	25 ℃	Relative Humidity:	60%
Test Mode:	Mode 4		

Centre Frequency (MHz)	Measurement		
	20dB Bandwidth (KHz)	Limit(kHz)	Frequency Range (MHz)
433.92 MHz	93.06	1085	PASS



6. TRANSMITTER TIMEOUT

6.1 LIMIT

In addition, devices operated under the provisions of this paragraph shall be provided with a meansFor automatically limiting operation so that the duration of each transmission shall not be greater thanone second and the silent period between transmissions shall be at least 30 times the duration of thebut in no case less than 10 seconds.

6.2 TEST PROCEDURE

(1) Put the EUT on the support in its standard position with associated equipment and switched on.
(2) Set center frequency of spectrum analyzer = operating frequency.
(3) Set the spectrum analyzer as RBW=1000kHz, VBW=1000kHz, Span=0Hz, Adjust Sweep=Auto.
(4) record the duration time

6.3 TEST SETUP

6.4 TEST RESULTS

Temperature:	26 ℃	Relative Humidity:	53%
Test Mode:	Mode 1		

Frequency(MHz)	Total cycle transmission time(s)	Each transmission time(s)	silent period between transmissions(s)
315	60	0.88	59.12
Limit	>10s	<1s	>10s and > 30*(duration of transmission)
Result	Pass		

Temperature:	26 ℃	Relative Humidity:	53%
Test Mode:	Mode 2		

Frequency(MHz)	Total cycle transmission time(s)	Each transmission time(s)	silent period between transmissions(s)
433.92	60	0.88	59.12
Limit	>10s	<1s	>10s and > 30*(duration of transmission)
Result	Pass		

Temperature:	26 ℃	Relative Humidity:	53%
Test Mode:	Mode 3		

Frequency(MHz)	Total cycle transmission time(s)	Each transmission time(s)	silent period between transmissions(s)
315	60.24	0.96	59.28
Limit	>10s	<1s	>10s and > 30*(duration of transmission)
Result	Pass		

Temperature:	26 ℃	Relative Humidity:	53%
Test Mode:	Mode 4		

Frequency(MHz)	Total cycle transmission time(s)	Each transmission time(s)	silent period between transmissions(s)
433.92	59.76	0.88	58.88
Limit	>10s	<1s	>10s and > 30*(duration of transmission)
Result	Pass		

7. PERIODIC OPERATION

7.1 TEST PROCEDURE

The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
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 * Log10(Duty Cycle(%)

7.2 TEST SETUP

7.3 EUT OPERATION CONDITIONS

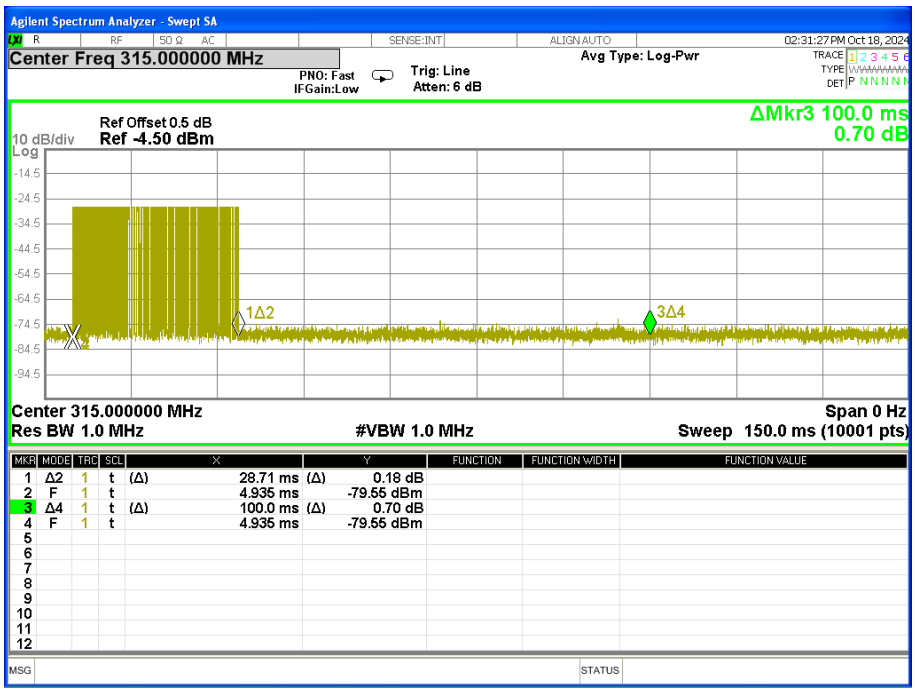
TX mode.

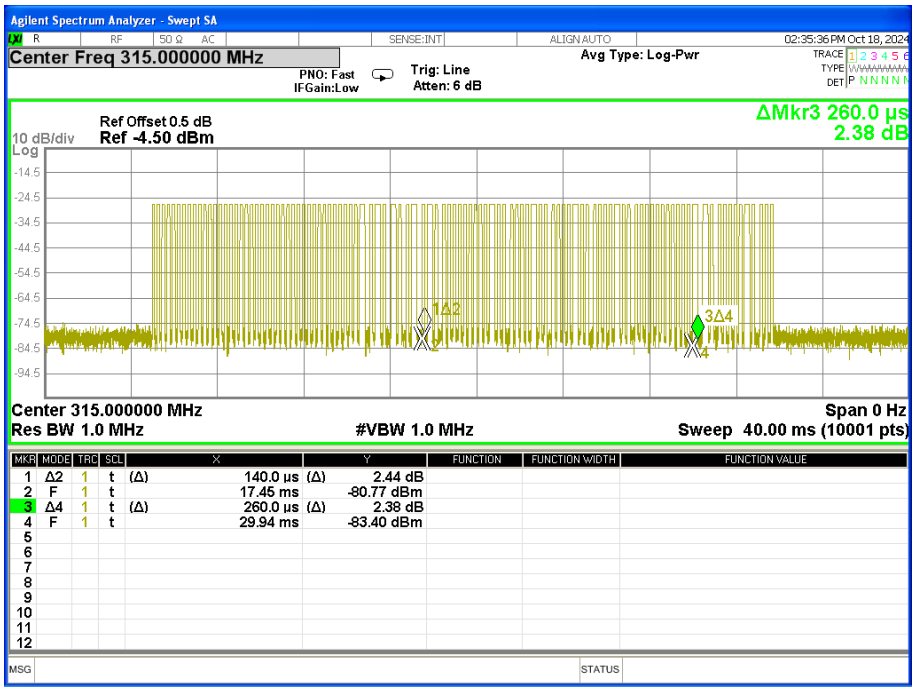
7.4 TEST RESULTS

Mode 1

FCC Part15.231(e)	
Total On interval in a complete pulse train(ms)	16.3
Length of a complete pulse train(ms)	100
Duty Cycle(%)	16.30%
Duty Cycle Correction Factor(dB)	-15.76

Refer to the duty cycle plot (as below), This device meets the FCC requirement. Length of a complete pulse train
Remark:FCC part15.35(c) and required that a complete pulse train is more 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.
Note: Number of pulse train 1 = 96, Time of single pulse train 1 = 0.14ms;
Number of pulse train 2 = 11, Time of single pulse train 2 = 0.26ms;
Total on interval in a complete pulse train= Number of pulse train 1x Time of single pulse train 1+ Number of pluse train 2x Time of single pulse train 2+ Number of pluse train =96x0.14+11 x0.26=16.3ms

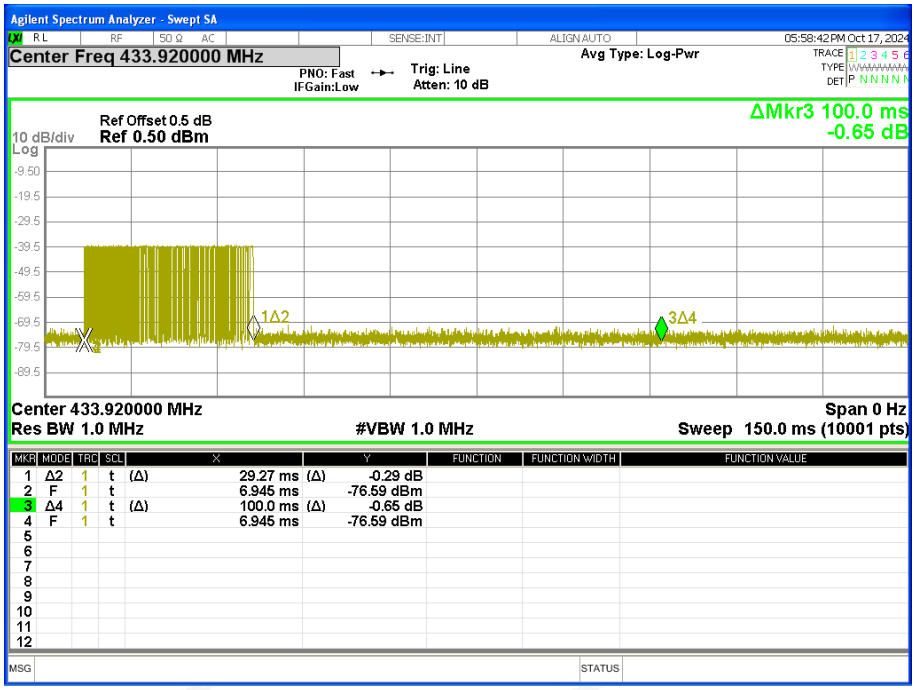



Agilent Spectrum Analyzer - Swept SA
Center Freq 315.000000 MHz
PNO: Fast
IFGain:Low
Trig: Line
Atten: 6 dB
Avg Type: Log-Pwr
02:35:36 PM Oct 18, 2024
Ref Offset 0.5 dB
10 dB/div
Log
Ref -4.50 dBm
ΔMkr3 260.0 µs
2.38 dB
1Δ2
3Δ4
Center 315.000000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 40.00 ms (10001 pts)
1 Δ2 1 t (Δ) 140.0 µs (Δ) 2.44 dB
2 F 1 t 17.45 ms -80.77 dBm
3 Δ4 1 t (Δ) 260.0 µs (Δ) 2.38 dB
4 F 1 t 29.94 ms -83.40 dBm

Mode 2

FCC Part15.231(e)	
Total On interval in a complete pulse train(ms)	17.05
Length of a complete pulse train(ms)	100
Duty Cycle(%)	17.05%
Duty Cycle Correction Factor(dB)	-15.37

Refer to the duty cycle plot (as below), This device meets the FCC requirement. Length of a complete pulse train
Remark:FCC part15.35(c) required that a complete pulse train is more 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.
Note: Number of pulse train 1 = 82, Time of single pulse train 1 = 0.14ms;
Number of pulse train 2 = 19, Time of single pulse train 2 = 0.26ms;
Number of pulse train 3 = 1, Time of single pulse train 3 = 0.63ms;
Total on interval in a complete pulse train= Number of pulse train 1x Time of single pulse train 1+ Number of pluse train 2x Time of single pulse train 2+ Number of pluse train 3x Time of single pulse train 3=82x0.14+19x0.26+1 x0.63=17.05ms




Agilent Spectrum Analyzer - Swept SA
Center Freq 433.920000 MHz
PNO: Fast
IFGain:Low
Trig: Line
Atten: 10 dB
Avg Type: Log-Pwr
05:55:20 PM Oct 17, 2024
Ref Offset 0.5 dB
10 dB/div
Log
Ref 0.50 dBm
ΔMkr5 630.0 µs
-0.33 dB
Center 433.920000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 50.00 ms (10001 pts)
1 Δ2 1 t (Δ) 140.0 µs (Δ) -3.27 dB
2 F 1 t 18.65 ms -78.34 dBm
3 Δ4 1 t (Δ) 260.0 µs (Δ) 0.41 dB
4 F 1 t 21.98 ms -78.36 dBm
5 Δ6 1 t (Δ) 630.0 µs (Δ) -0.33 dB
6 F 1 t 35.60 ms -77.46 dBm
MSG
STATUS

Mode 3

FCC Part15.231(e)	
Total On interval in a complete pulse train(ms)	28.53
Length of a complete pulse train(ms)	100
Duty Cycle(%)	28.53%
Duty Cycle Correction Factor(dB)	10.89

Refer to the duty cycle plot (as below), This device meets the FCC requirement. Length of a complete pulse train

Remark:FCC part15.35(c) required that a complete pulse train is more 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.

Note: Number of pulse train 1 = 1, Time of single pulse train 1 = 28.53ms;

Total on interval in a complete pulse train= Number of pulse train 1x Time of single pulse train 1=1x28.53=28.53ms

Mode 4

FCC Part15.231(e)	
Total On interval in a complete pulse train(ms)	29.52
Length of a complete pulse train(ms)	100
Duty Cycle(%)	29.52%
Duty Cycle Correction Factor(dB)	10.60

Refer to the duty cycle plot (as below), This device meets the FCC requirement. Length of a complete pulse train

Remark:FCC part15.35(c) required that a complete pulse train is more 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.

Note: Number of pulse train 1 = 1, Time of single pulse train 1 = 29.52ms;

Total on interval in a complete pulse train= Number of pulse train 1x Time of single pulse train 1=1x29.52=29.52ms

8. ANTENNA REQUIREMENT

8.1 STANDARD REQUIREMENT

According to the FCC Part 15 Paragraph 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 to the intentional radiator shall be considered sufficient to comply with the provisions of this section. This product use a permanent ceramic printed antenna, fulfill the requirement of this section

8.2 EUT ANTENNA

The EUT antenna is Spring antenna.It conforms to the standard requirements.

APPENDIX 1-PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※