



CERTIFICATE #5473.01

Test Report No.:
FCC2023-0028-RF

TEST REPORT

FCC ID : 2BBMK-MMS-TPMS-0036
Applicant : Zhejiang Shenghuabo Electric Appliance Corporation
Product Name : Tire pressure sensor
Mode No. : MMS-TPMS-0036
Classification Of Test: COMMISSION TEST

CVC Testing Technology Co., Ltd.

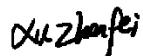
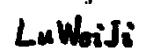
Applicant		Name: Zhejiang Shenghuabo Electric Appliance Corporation Address: Ruian International Auto&Parts industry Park, wenzhou, zhejiang, china		
Manufacturer		Name: Zhejiang Shenghuabo Electric Appliance Corporation Address: Ruian International Auto&Parts industry Park, wenzhou, zhejiang, china		
Equipment Under Test		Product Name : Tire pressure sensor Model No. : MMS-TPMS-0036 Trade mark : — Serial no. : — Sampling : 1-1		
Date of Receipt.	2023.06.01	Date of Testing	2023.06.13	
Test Specification		Test Result		
FCC CFR47 Part 15C (2020) Radio Frequency Devices ANSI C63.10 (2013)		PASS		
Evaluation of Test Result		The equipment under test was found to comply with the requirements of the standards applied.		
		Seal of CVC Issue Date: 2023.07.17		
Approved by:	Reviewed by:	Tested by:		
Chen HuaWen 	Xu Zhenfei 	Lu Weiji 		
Other Aspects: NONE.				
Abbreviations:OK,	Pass= passed	Fail = failed	N/A= not applicable	EUT= equipment, sample(s) under tested
This test report relates only to the EUT, and shall not be reproduced except in full, without written approval of CVC .				

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1. General Product Information

1.1 General information

Product Name	Tire pressure sensor
Model No.	MMS-TPMS-0036
Additional model	N/A
Power Supply	DC 3.0V
Serial Number(SN)	7EE1EE5C
firmware	V3.2
software	V1.0
specific power settings	Default
Antenna Type	Internal Antenna
Antenna Connector	A permanently attached antenna
Antenna Gain	-12.5 dBi (provided by client)
Beamforming gain	Unsupported (provided by client)
Frequency Range	433.05~434.79MHz
Channel Number	1 Channel
Type of Modulation	FSK
Max. Power	-18.92dBm
Operate Temp.Range	-40~125°C

Note:

1. The information of the EUT is declared by the manufacturer.
2. The laboratory is not responsible for the product technical specification provided by the client.

2. Test Sites

2.1 Test Facilities

The tests and measurements refer to this report were performed by RF testing Lab. of CVC Testing Technology Co., Ltd.

Add.: No.3, Tiantaiyi Road, Kaitai Avenue, Science City, Guangzhou, Guangdong, 510663, People's Republic of China

Telephone : +86-20-32293888

Fax : +86-20-32293889

FCC(Test firm designation number: CN1282)

IC(Test firm CAB identifier number: CN0103)

2.2 Description of Non-standard Method and Deviations

The testing and measurement methods used in this report are applied by all standard methods. Not any non-standard method or deviation from the used standards was used.

2.3 List of Test and Measurement Instruments

Refer to **Appendix A**.

3. Test Configuration

3.1 Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

Test Mode	Antenna Delivery	Test Channel
Transmitting	1TX	433.92MHz

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate and different channels. Preliminary tests have been done on all the configurations for confirming worst case. Data rate below means worst-case rate of each test item.

Worst-case data rates and channels are shown as following table.

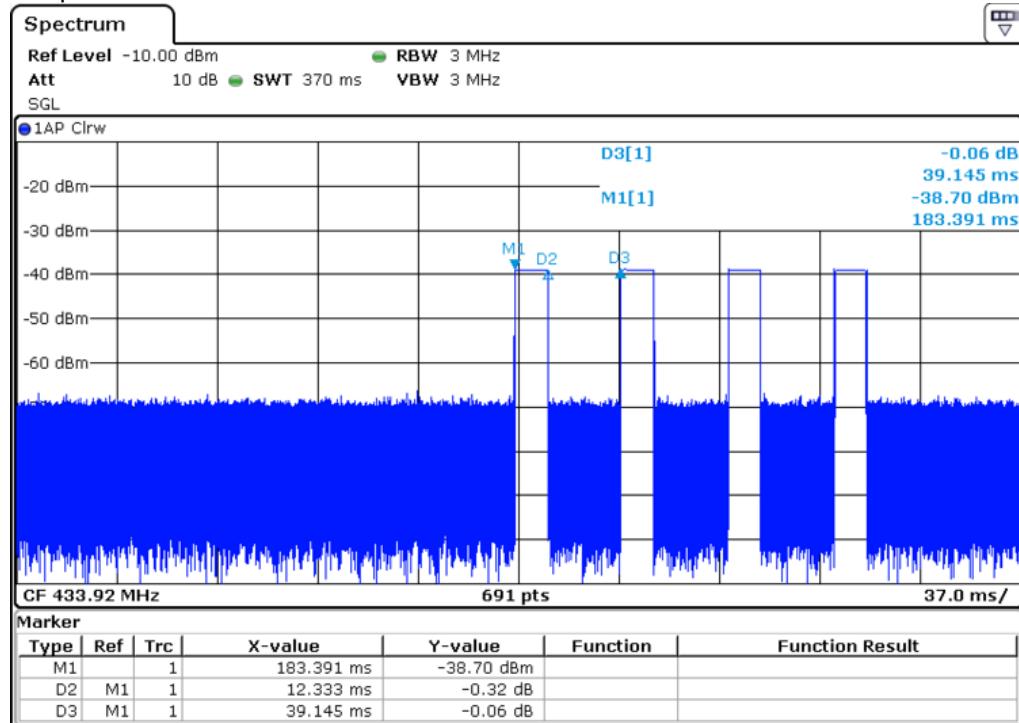
Test Mode	Data Rate		
	Antenna 1	Antenna 2	MIMO
Transmitting	9600bit/s	/	/

Test Items	Test Antenna	Test Mode	Test Channel
Radiated Emissions	Antenna 1	Transmitting	433.92MHz
Deactivation time measurement	Antenna 1	Transmitting	433.92MHz
Emission Bandwidth Measurement	Antenna 1	Transmitting	433.92MHz

3.2 Duty cycle

TestMode	Antenna	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]	Limit	Verdict
Transmitting	Ant1	12.333	39.145	31.51	---	---

The plots of test results are attached as below.



4. Summary of measurement results

Summary of measurements of results	Clause in FCC rules	Verdict	Note
Conducted Emissions	15.207	N/A	See Note1
Radiated Emissions	15.231(b), 15.209	PASS	/
Deactivation time measurement	15.231 (a)	PASS	/
Emission Bandwidth Measurement	15.231(c)	PASS	/
Antenna Requirement	15.203	PASS	No antenna connector is used

Note1: The device is not connected to the AC power line, there are no testing requirements.

5. Measurement procedure

5.1 Conducted Emission

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was setup according to ANSI C63.10, 2013 for compliance to FCC 47CFR 15.247 requirements. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

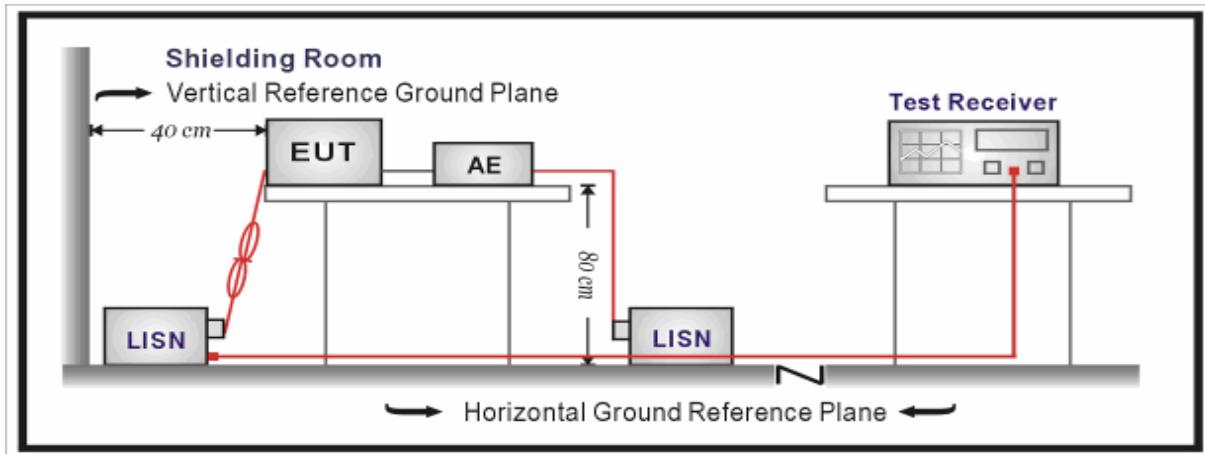
Limits:

Frequency (MHz)	Conducted Limits(dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

Test Setup:



Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Notes:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Level =Reading + Factor.

Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$. $U = 3.12$ dB.

Test Results:

Conducted Emission applies to an intentional radiator that is designed to be connected to the public utility (AC) power line. Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

5.2 Radiated Emission

Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The EUT was setup and tested according to ANSI C63.10, 2013.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from Antenna to the EUT was 3 meters.

The Antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the Antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

The frequency range from 30MHz to 10th harmonic is checked.

Note: When doing emission measurement above 1GHz, the horn Antenna will be bended down a little (as horn Antenna has the narrow beamwidth) in order to keeping the Antenna in the “cone of radiation” of EUT.

The 3dB beamwidth is 10~60 degrees for H-plane and 10~90 degrees for E-plane.

Limits:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency	Limit (μ V/m)	Limit (dB μ V/m @3m)	Remark
0.009MHz-0.490MHz	2400/F(kHz)@300m	20lg(240000/F(kHz))	Quasi-peak Level
0.490MHz~1.705MHz	24000/F(kHz)@30m	20lg(240000/F(kHz))	Quasi-peak Level
1.705MHz~30.0MHz	30@30m	49.54	Quasi-peak Level
30MHz-88MHz	100@3m	40.0	Quasi-peak Level
88MHz-216MHz	150@3m	43.5	Quasi-peak Level
216MHz-960MHz	200@3m	46.0	Quasi-peak Level
960MHz-1GHz	500@3m	54.0	Quasi-peak Level
Above 1GHz	500@3m	54.0	Average Level
	5000@3m	74.0	Peak Level

According to 15.231(b), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

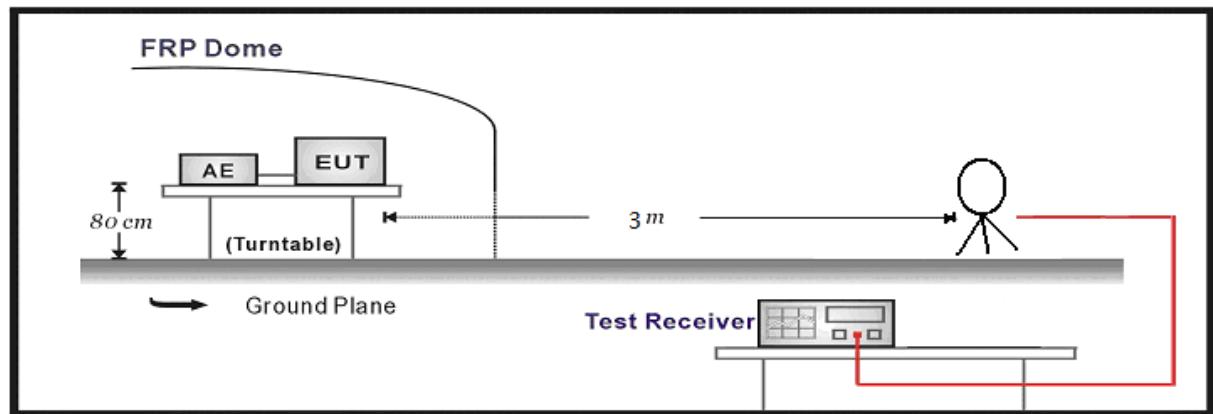
Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66–40.70	2,250	225
70–130	1,250	125
130–174	¹ 1,250 to 3,750	¹ 125 to 375
174–260	3,750	375
260–470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

NOTE:

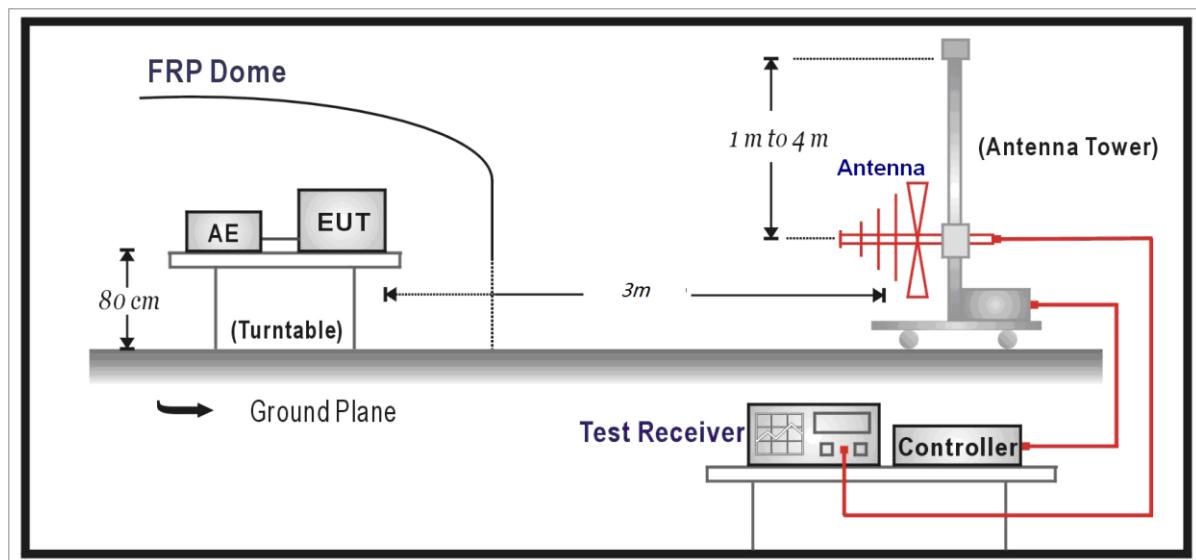
1. ¹ Linear interpolations.
2. The lower limit shall apply at the transition frequencies.
3. Emission level (dB_uV/m) = 20 log Emission level (uV/m).
4. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

Test Setup:

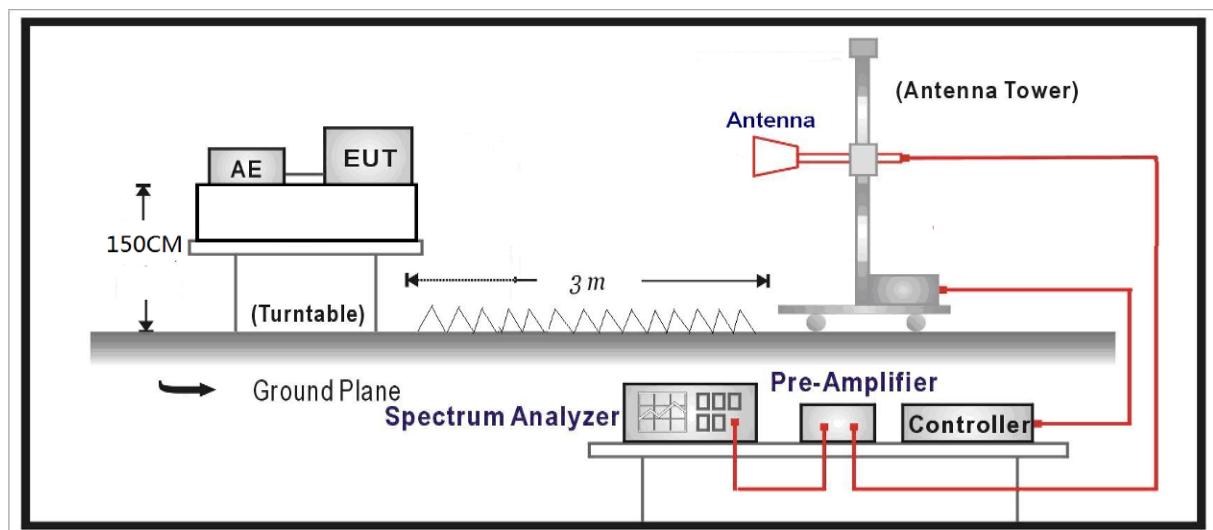
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



Measurement Data:

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Level =Reading - Factor

Factor = Preamplifier Factor – Antenna Factor–Cable Loss

Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.19 dB
200MHz-1GHz	3.63 dB
Above 1GHz	3.68 dB

Test Results:

BELOW 1GHz WORST-CASE DATA:

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3M									
No.	Freq. (MHz)	Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detect or	Antenna Height (cm)	Table Angle (Degree)	Pass/ Fail
1	49.00	20.40	8.35	40.00	31.65	QP	270	190	Pass
2	175.7729	19.78	8.28	43.50	35.22	QP	330	138	Pass
3	436.0585	24.85	22.27	46.01	23.74	QP	200	204	Pass
4	769.2458	31.65	21.47	46.00	24.53	QP	300	276	Pass
5	*433.92	24.85	76.28	105.09	28.81	PK	100	204	Pass
6	*433.92	-	66.25	85.09	18.84	AV	100	58	Pass
7	#867.84	32.75	47.46	84.39	36.93	PK	100	170	Pass
8	#867.84	-	37.43	64.39	26.96	AV	100	27	Pass

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3M									
No.	Freq. (MHz)	Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detect or	Antenna Height (cm)	Table Angle (Degree)	Pass/ Fail
1	58.2298	19.98	7.75	40.00	32.25	QP	370	57	Pass
2	143.4043	20.30	8.79	43.51	34.72	QP	130	129	Pass
3	299.881	21.42	10.65	46.02	35.37	QP	100	51	Pass
4	951.8832	33.61	23.77	46.00	22.23	QP	200	64	Pass
5	*433.92	24.85	72.33	105.09	32.76	PK	100	215	Pass
6	*433.92	-	62.3	85.09	22.79	AV	200	215	Pass
7	#867.84	32.75	32.57	84.39	51.82	PK	100	109	Pass
8	#867.84	-	22.54	64.39	41.85	AV	270	109	Pass

NOTE:

- Margin value = Limit value - Emission level.
- " * ": Fundamental frequency.
- " # ": Harmonic frequency.
- Fundamental AV value =PK Emission +20*log(duty cycle)Where the duty factor is calculated from following formula:20 log (Duty cycle) = 20Log(31.51%)=-10.03dB, Please see page 7 for plotted duty.

ABOVE 1GHz WORST-CASE DATA:

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3M									
No.	Freq. (MHz)	Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detect or	Antenna Height (cm)	Table Angle (Degree)	Pass/ Fail
1	1301.4301	28.88	44.18	74.00	29.82	PK	150	30	Pass
2	1735.4735	32.53	49.00	74.00	25.00	PK	150	90	Pass
3	2169.517	35.17	54.68	74.00	19.32	PK	150	30	Pass
4	3471.0471	-1.19	38.17	74.00	35.83	PK	150	70	Pass
5	4419.1419	-0.58	35.35	74.00	38.65	PK	150	100	Pass
6	5686.7687	3.59	38.41	74.00	35.59	PK	150	30	Pass
7	1301.4301	28.88	30.76	54.00	23.24	AV	150	90	Pass
8	1735.4735	32.53	35.45	54.00	18.55	AV	150	10	Pass
9	2169.517	35.17	39.58	54.00	14.42	AV	150	90	Pass
10	3472.5473	-1.18	26.28	54.00	27.72	AV	150	10	Pass
11	4419.1419	-0.58	25.02	54.00	28.98	AV	150	40	Pass
12	5686.7687	3.59	25.60	54.00	28.40	AV	150	100	Pass

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3M									
No.	Freq. (MHz)	Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detect or	Antenna Height (cm)	Table Angle (Degree)	Pass/ Fail
1	1301.4301	28.88	51.89	74.00	22.11	PK	150	120	Pass
2	1735.6736	32.53	61.73	74.00	12.27	PK	150	330	Pass
3	2169.517	35.17	57.23	74.00	16.77	PK	150	310	Pass
4	3471.0471	-1.19	39.21	74.00	34.79	PK	150	150	Pass
5	4431.1431	-0.59	35.85	74.00	38.15	PK	150	170	Pass
6	5533.7534	2.91	37.81	74.00	36.19	PK	150	210	Pass
7	1301.6302	28.88	33.44	54.00	20.56	AV	150	280	Pass
8	1735.6736	32.53	41.29	54.00	12.71	AV	150	10	Pass
9	2169.517	35.17	39.95	54.00	14.05	AV	150	70	Pass
10	3474.0474	-1.18	24.21	54.00	29.79	AV	150	10	Pass
11	4431.1431	-0.59	25.56	54.00	28.44	AV	150	10	Pass
12	5536.7537	2.92	25.90	54.00	28.10	AV	150	30	Pass

NOTE:

- 1 Correction Factor(dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
- 2 Margin value = Emission level – Limit value.
- 3 The emission levels of other frequencies were less than 20dB margin against the limit.

5.3 20dB BANDWIDTH MEASUREMENT

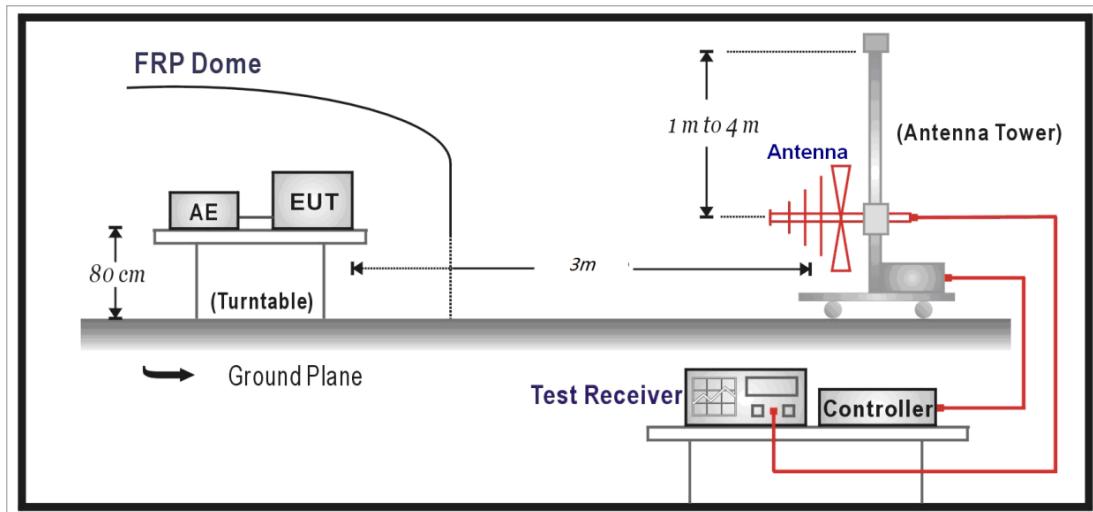
Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

The spectrum analyzer was receiving the maximum emission level. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

Test Setup:



LIMITS OF 20dB BANDWIDTH MEASUREMENT

According to FCC 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. Bandwidth is determined at the points 20 dB down from the modulated carrier.

$$\text{Limit} = \text{Fundamental Frequency} \times 0.25\% = 433.92\text{MHz} \times 0.25\% = 1084.75\text{ kHz}$$

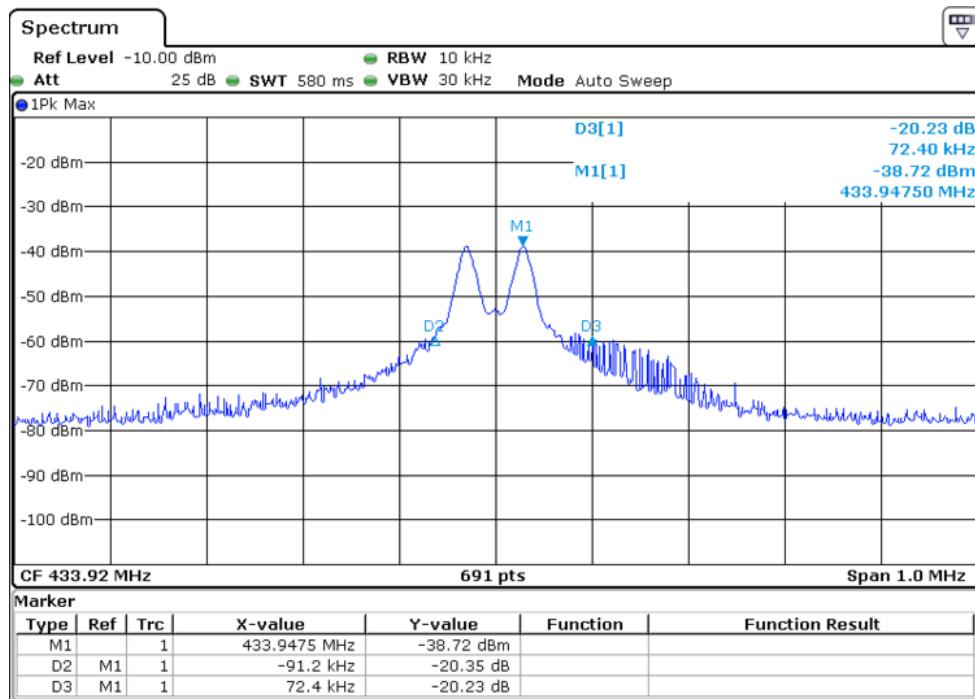
Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936\text{ Hz}$.

Test Results:

Frequency (MHz)	20dB Bandwidth (kHz)	Maximum Limit (kHz)	PASS/FAIL
433.92	163.6	1084.75	PASS

The plots of test results are attached as below.



5.4 DEACTIVATION TIME MEASUREMENT

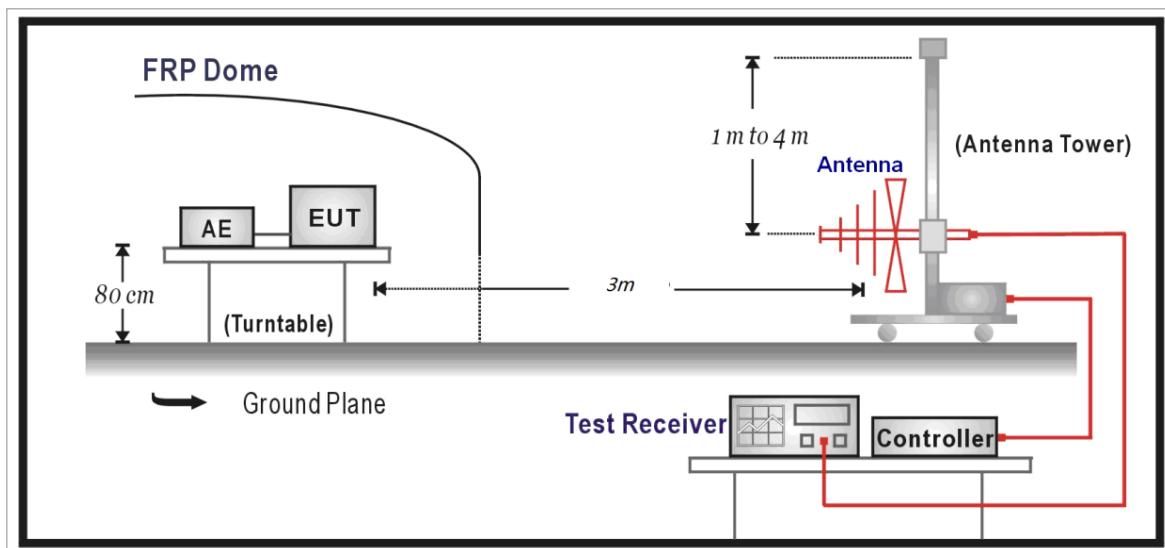
Ambient condition:

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement:

With the EUT's antenna attached, the EUT's output signal was received by the test antenna, which was connected to the spectrum analyzer set the center frequency, than set the spectrum analyzer to Zero Span for the release time reading. During the testing, the transmission duration was measured and recorded.

Test Setup:



LIMITS OF DEACTIVATION TIME MEASUREMENT

15.231 (a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

15.231 (a)(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

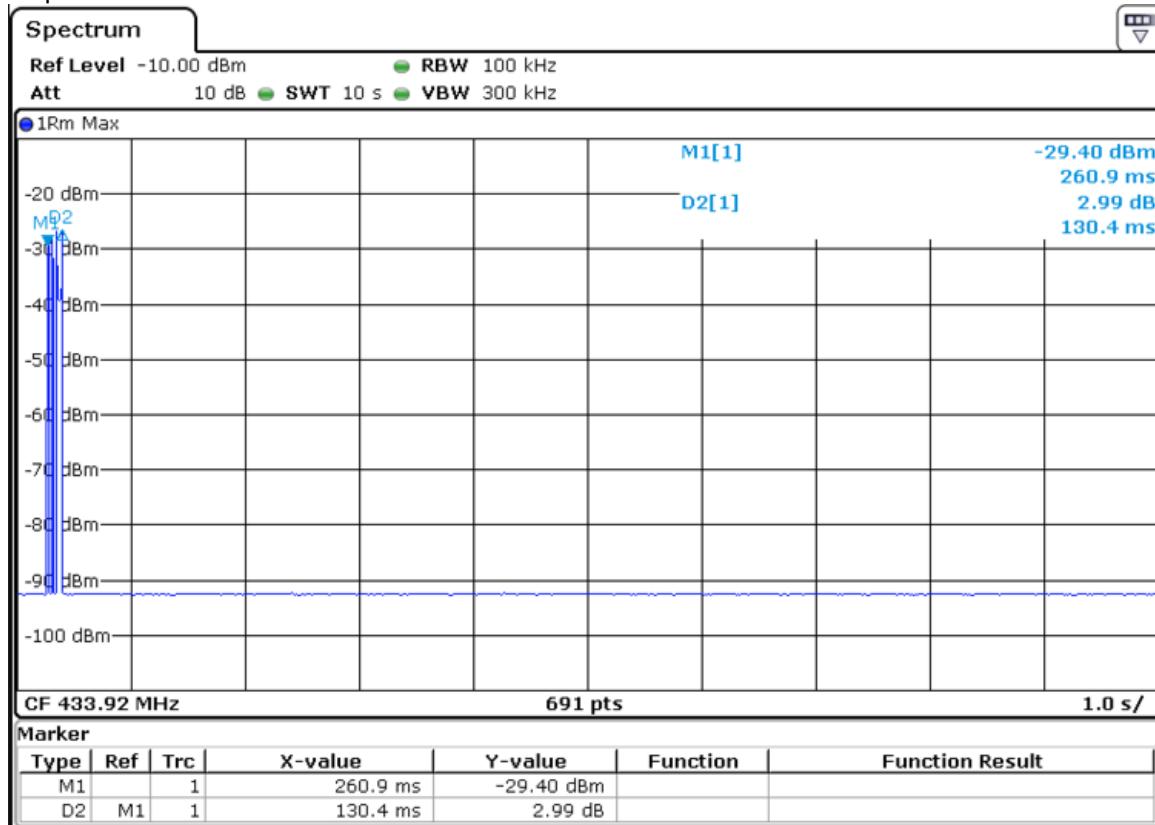
Measurement Uncertainty:

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.005s$.

Test Results:

Frequency (MHz)	Measurement Result (sec)	Maximum limit (sec)	PASS/FAIL
433.92	0.130	5	PASS

The plots of test results are attached as below.



6. Appendix A

Test Equipment	Type/Mode	SERIAL NO.	Equipment No.	Manufacturer	Cal. Due
3m Semi-Anechoic Chamber	FACT-4	ST08035	WKNA-0024	ETS	2024/12/12
5m Semi-Anechoic Chamber	SAC-5	SAC-5-2.0	EM-000557	COMTEST	2024/11/02
Spectrum Analyzer	N9010B	MY57470323	DZ-000174	KEYSIGHT	2024/02/22
EMI Test Receiver	N9038A-508	MY532290079	EM-000397	Agilent	2024/02/22
EMI Test Receiver	ESR7	102235	VGDY-0956	R&S	2024/02/22
loop antenna	HLA 6121	540046	EM-000546	TESEQ	2024/06/05
Broadband Antenna	VULB 9163	9163-676	EM-000382	SCHWARZBECK	2023/07/01
Waveguide Horn Antenna	HF906	360306/008	EM-000093	R&S	2024/02/24
Bandstop Filters	SW-BSF-2400-100-7-A1	/	EM-000495	/	2023/08/30

The End
