

TEST REPORT

FCC ID: 2AXCX-T10

Product: TPMS SENSOR

Model No.: T10

Additional Model No.: N/A

Trade Mark: FOXWELL

Report No.: TCT201125E003

Issued Date: Dec. 07, 2020

Issued for:

Shenzhen Foxwell Technology Co., Ltd 5/F, Plant C, Baocheng 71st Zone, Xin'an Street, Baoan District, Shenzhen, 518106 China

Issued By:

Shenzhen Tongce Testing Lab.

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TABLE OF CONTENTS

1.	Test Certification	 3
2.	Test Result Summary	 4
3.	EUT Description	5
4.	General Information	6
	4.1. Test Environment and Mode	
	4.2. Description of Support Units	
5.	Facilities and Accreditations	7
	5.1. Facilities	
	5.2. Location	
	5.3. Measurement Uncertainty	7
6.	Test Results and Measurement Data	
	6.1. Antenna Requirement	8
	6.2. Conducted Emission	9
	6.3. Radiated Emission Measurement	
	6.4. Manually Activated Transmitter	19
	6.5. Occupied Bandwidth	21
Αp	pendix A: Photographs of Test Setup	
Ap	pendix B: Photographs of EUT	



1. Test Certification

Report No.: TCT201125E003

Product:	TPMS SENSOR		
Model No.:	T10		
Additional Model No.:	N/A		
Trade Mark:	FOXWELL		
Applicant:	Shenzhen Foxwell Technology Co., Ltd		
Address:	5/F, Plant C, Baocheng 71st Zone, Xin'an Street, Baoan District, Shenzhen, 518106 China		
Manufacturer:	Shenzhen Foxwell Technology Co., Ltd		
Address:	5/F, Plant C, Baocheng 71st Zone, Xin'an Street, Baoan District, Shenzhen, 518106 China		
Date of Test:	Nov. 26, 2020 – Dec. 04, 2020		
Applicable Standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.231		

The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By:	Kein Huang	Date:	Dec. 04, 2020
Reviewed By:	Kevin Huang	Date:	Dec. 07, 2020
	Beryl Zhao		
Approved By:	Tomsm	Date:	Dec. 07, 2020

Tomsin



2. Test Result Summary

Requirement	CFR 47 Section	Result
Conduction Emission, 0.15MHz to 30MHz	§15.207	N/A
Manually Activated Transmitter	§15.231(a)	PASS
Radiation Emission	§15.231(b), §15.205, §15.209, §15.35	PASS
Occupied Bandwidth	§15.231(c)	PASS

Note:

- 1. PASS: Test item meets the requirement.
- 2. Fail: Test item does not meet the requirement.
- 3. N/A: Test case does not apply to the test object.
- 4. The test result judgment is decided by the limit of test standard.



3. EUT Description

·	
Product:	TPMS SENSOR
Model No.:	T10
Additional Model No.:	N/A
Trade Mark:	FOXWELL
Operation Frequency:	315MHz, 433.93MHz
Modulation Technology:	FSK
Antenna Type:	Internal Antenna
Antenna Gain:	0dBi
Power Supply:	DC 3V

Note: The antenna gain listed in this report is provided by applicant, and the test laboratory is not responsible for this parameter.





4. General Information

4.1. Test Environment and Mode

Operating Environment:				
Temperature:	25.0 °C			
Humidity:	55 % RH			
Atmospheric Pressure:	1010 mbar			
Toot Model				

T 1			
IACT	w		Δ.
Test	IIV	UU	┖.

Operation mode:	Keep the EUT in continuous transmitting
	with modulation

The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case (Y axis) are shown in Test Results of the following pages.

Per-test mode.

We have verified the construction and function in typical operation, The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. which was shown in this test report and defined as follows:

Axis	Х	Υ	Z
Field Strength(dBuV/m)	52.47	55.31	52.59

Final Test Mode:

According to ANSI C63.10 standards, the test results are both the "worst case" and "worst setup": Y axis (see the test setup photo)

4.2. Description of 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.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
TPMS Service tool	T1000	/	(6)1	Foxwell

Note: TPMS Service tool T1000 has passed FCC DoC test certification and meets the requirements of auxiliary device.

- 1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
- 2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

Page 6 of 29



5. Facilities and Accreditations

5.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

• FCC - Registration No.: 645098

Shenzhen Tongce Testing Lab.

The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

IC - Registration No.: 10668A-1

The 3m Semi-anechoic chamber of SHENZHEN TONGCE TESTING LAB has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

5.2. Location

Shenzhen Tongce Testing Lab.

Address: 1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District,

Shenzhen, Guangdong, China

Tel: 86-755-27673339

5.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, 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	MU
1	Conducted Emission	±2.56dB
2	RF power, conducted	±0.12dB
3	Spurious emissions, conducted	±0.11dB
4	All emissions, radiated(<1G)	±3.92dB
5	All emissions, radiated(>1G)	±4.28dB
6	Temperature	±0.1°C
7	Humidity	±1.0%



Test Results and Measurement Data

6.1. Antenna Requirement

Standard requirement:

FCC Part15 C Section 15.203 /247(c)

15.203 requirement:

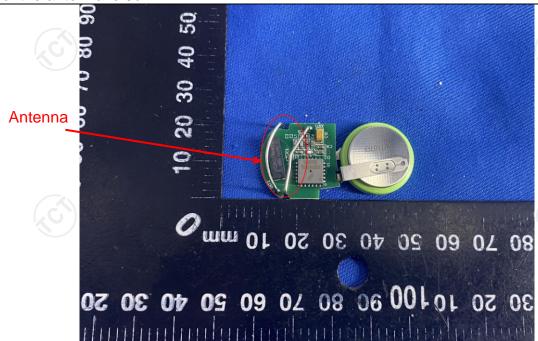
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

E.U.T Antenna:

The antenna is internal antenna which permanently attached, and the best case gain of the antenna is 0dBi.



Page 8 of 29





6.2. Conducted Emission

6.2.1. Test Specification

Test Requirement:	FCC Part15 C Section	15.207		
Test Method:	ANSI C63.4:2014			
Frequency Range:	150 kHz to 30 MHz			
Receiver setup:	RBW=9 kHz, VBW=30	kHz, Sweep time:	=auto	
	Frequency range	Limit (c	Limit (dBuV)	
	(MHz)	Quasi-peak	Áverage	
Limits:	0.15-0.5	66 to 56*	56 to 46*	
	0.5-5	56	46	
	5-30	60	50	
	Refere	nce Plane		
Test Setup:	AUX Equipment Test table/Insulation pla Remark: E.U.T. Equipment Under Test LISN: Line Impedence Stabilization Test table height=0.8m	EMI Receiver	er — AC power	
Test Mode:	Transmitting Mode	(6)		
Test Procedure:	 The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement. 			
Test Result:	N/A			
/ 6 \				

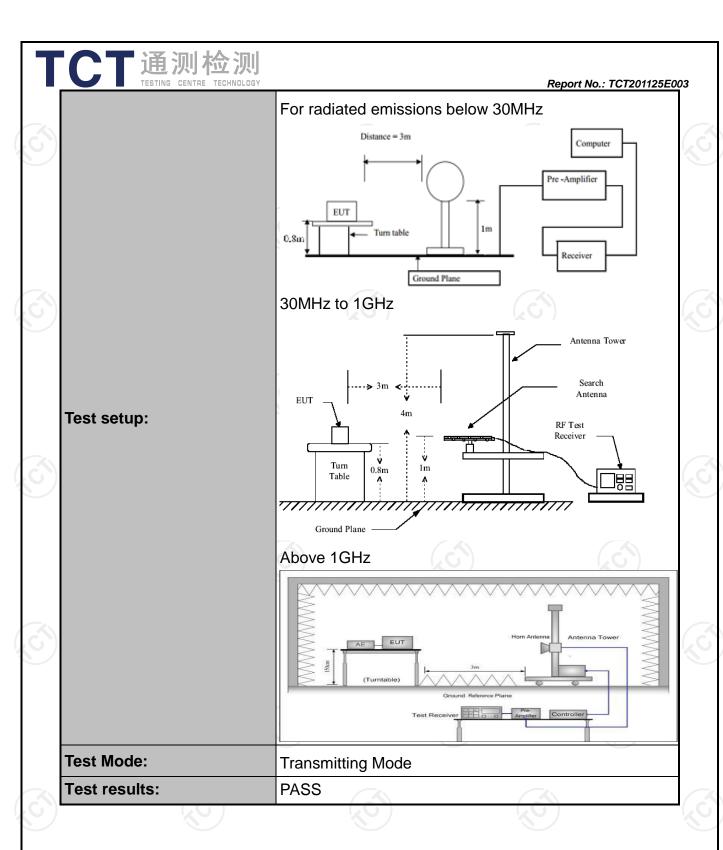




6.3. Radiated Emission Measurement

6.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.231(a) and 15.209							
Test Method:	ANSI C63.4:	2014 and	ANSI C6	3.10:201	13			
Frequency Range:	9 kHz to 5 G	Hz						
Measurement Distance:	3 m							
Antenna Polarization:	Horizontal &	Vertical						
Receiver Setup:	Frequency 9kHz- 150kHz 150kHz- 30MHz 30MHz-1GHz Above 1GHz	Peak Peak	1MHz 1MHz	VBW 1kHz 30kHz 300KHz 3MHz 10Hz	Remark Quasi-peak Value Quasi-peak Value Quasi-peak Value Peak Value Average Value Otating table 0.8			
	30MHz-1GHz Quasi-peak 120KHz 300KHz Quasi-peak Above 1GHz Peak 1MHz 3MHz Peak Val							





6.3.2. Limit

Report No.: TCT201125E003

Fundamental Frequency (MHz)	Filed Strength of Fundamental (microvolts/meter)	Filed Strength of Spurious Emission (microvolts/meter)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750*	125 to 375*
174-260	3750	375
260-470	3750 to 12500*	375 to 1250*
Above 470	12500	1250
Horn Antenna	Schwarzbeck	BBHA 9120D

^{*}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, μ V/m at 3 meters = 56.81818(F) - 6136.3636; for the band 260-470 MHz, μ V/m at 3 meters = 41.6667(F) - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

For EUT

Fundamental Frequency (MHz)	Filed Strength of Fundamental (dBµV/m)	Filed Strength of Spurious Emission(dBµV/m)		
315	75.62	55.62		
433.93	80.83	60.83		

Note:

- Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions.
- 2.According to 15.35, on any frequency or frequencies below or equal to 1000 MHz, the limits Shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test.
- 3. According to 15.231(b), The limits on the field strength of the spurious emissions in the above table is based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits one higher field strength.



Frequencies in restricted band are complied to limit on Paragraph 15.209

Frequency Range (MHz)	Distance (m)	Field strength (dB μ V/m)		
0.009-0.490	3	20log 2400/F (kHz) + 80		
0.490-1.705	3	20log 24000/F (kHz) + 40		
1.705-30	3	20log 30 + 40		
30-88	3	40.0		
88-216	3	43.5		
216-960	3	46.0		
Above 960	3	54.0		

Note:

- 1. RF Voltage (dBuV) = 20 log RF Voltage (uV)
- 2. In the Above Table, the tighter limit applies at the band edges.
- 3. Distance refers to the distance in meters between the measuring instrument antenna and the EUT
- 4. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand), After pre-test. It was found that the worse radiated emission was get at the lying position.
- 5. If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula Ld1 = Ld2 * (d2/d1)







6.3.3. Test Instruments

	Radiated Emiss	ion Test Site (96	66)		
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due	
ESPI Test Receiver	ROHDE&SCHWARZ	ESIB7	100197	Jul. 27, 2021	
Spectrum Analyzer	ROHDE&SCHWARZ	FSQ40	200061	Sep. 11, 2021	
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Sep. 02, 2021	
Pre-amplifier	HP	8447D	2727A05017	Sep. 02, 2021	
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 05, 2022	
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 04, 2022	
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 04, 2022	
Horn Antenna	A-INFO	LB-180400-KF	J211020657	Sep. 04, 2022	
Line-4	тст	RE-high-04	N/A	Sep. 02, 2021	
Line-8	TCT	RE-01	N/A	Jul. 27, 2021	
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A	

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).



6.3.4. Test Data

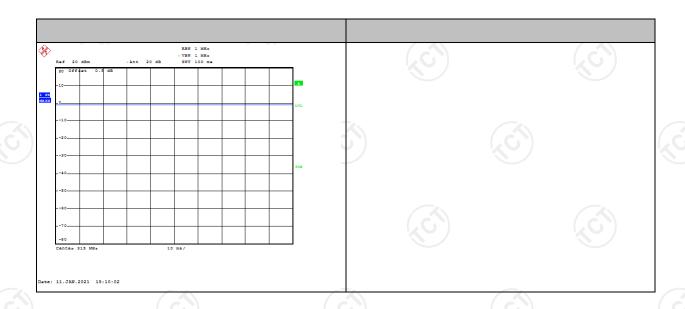
Duty Cycle Test Data:

315MHz:

Total time one cycle(ms)	Effective time one cycle(ms)	Duty Cycle	AV Factor(dB)
100	100	1	0

Note:

Effective time one cycle= 100
Duty Cycle= Effective time one cycle/ Total time one cycle= 1
AV Factor = 20 log(Duty Cycle)= 0





433.93MHz:

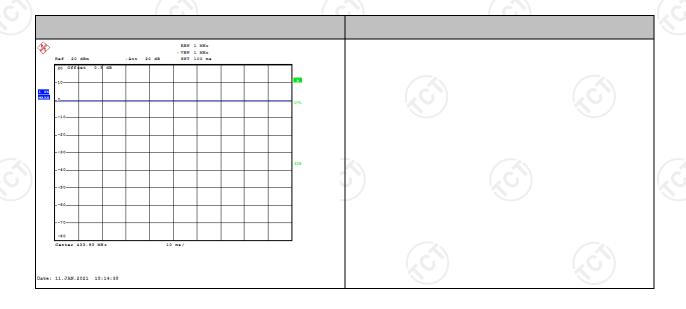
Total time one cycle(s) Effective time one cycle(s)		Duty Cycle	AV Factor(dB)	
100	100	1	0	

Note:

Effective time one cycle= 100

Duty Cycle= Effective time one cycle/ Total time one cycle= 1

AV Factor = 20 log(Duty Cycle)= 0





Field Strength of Fundamental

\					
)	Frequency (MHz)	Emission PK (dBuV/m)	Horizontal /Vertical	Limits PK (dBuV/m)	Margin (dB)
	315	73.25	Н	95.62	-22.37
	315	72.43	V	95.62	-23.19
	433.93	75.17	Н	100.83	-25.66
	433.93	74.06	V	100.83	-26.77

Frequency (MHz)	Emission PK (dBuV/m)	AV Factor(dB)	Horizontal /Vertical	Emission AVG (dBuV/m)	Limits AV (dBuV/m)	Margin (dB)
315	73.25	(0)	Н	73.25	75.62	-2.37
315	72.43	0	V	72.43	75.62	-3.19
433.93	75.17	0	Н	75.17	80.83	-5.66
433.93	74.06	0	(C) V	74.06	80.83	-6.77

Harmonics and Spurious Emissions

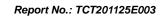
Frequency Range (9 kHz-30MHz)

Frequency (MHz)	Level@3m (dBµV/m)	Limit@3m (dBµV/m)
	1	1
(.6)		(6)
'		

Note: 1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement

Page 17 of 29





Below 1GHz

Quasi-peak Value Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
36.52	32.47	11.25	0.60	30.08	14.24	40.00	-25.76	Vertical
52.63	30.44	11.93	0.81	29.97	13.21	40.00	-26.79	Vertical
81.37	29.84	10.60	1.09	29.76	11.77	43.50	-31.73	Vertical
117.27	29.31	7.37	1.52	29.44	8.76	43.50	-34.74	Vertical
213.10	28.81	14.03	2.51	29.84	15.51	46.00	-30.49	Vertical
461.63	43.95	18.19	3.47	29.30	36.31	46.00	-9.69	Vertical
47.70	29.09	11.25	0.58	30.09	10.83	40.00	-29.17	Horizontal
79.68	29.72	7.35	0.99	29.82	8.24	40.00	-31.76	Horizontal
112.43	28.79	10.98	1.12	29.74	11.15	43.50	-32.35	Horizontal
151.03	31.25	8.02	1.62	29.37	11.52	43.50	-31.98	Horizontal
358.45	35.85	13.01	2.29	29.90	21.25	46.00	-24.75	Horizontal
461.63	47.75	14.74	2.68	29.67	35.50	46.00	-10.50	Horizontal

Above 1GHz (PK value)

Frequency PK Value (MHz)	Read Level PK (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level PK (dBuV/m)	Limit Line PK (dBuV/m)	Over Limit (dB)	Polarization
1370.00	36.74	25.66	4.59	33.39	33.60	74.00	-40.40	Vertical
2355.00	36.06	27.69	5.34	34.05	35.04	74.00	-38.96	Vertical
3415.00	36.23	28.67	6.80	32.85	38.85	74.00	-35.15	Vertical
4150.00	32.06	30.06	8.01	32.01	38.12	74.00	-35.88	Vertical
4695.00	32.84	31.65	8.51	32.03	40.97	74.00	-33.03	Vertical
5645.00	30.32	32.36	9.72	32.35	40.05	74.00	-33.95	Vertical
1430.00	35.68	25.42	4.64	33.47	32.27	74.00	-41.73	Horizontal
2410.00	34.86	27.57	5.40	33.99	33.84	74.00	-40.16	Horizontal
3395.00	36.71	28.60	6.76	32.87	39.20	74.00	-34.80	Horizontal
4115.00	29.39	29.95	7.97	32.05	35.26	74.00	-38.74	Horizontal
4635.00	30.23	31.57	8.46	32.01	38.25	74.00	-35.75	Horizontal
5590.00	28.00	32.22	9.63	32.38	37.47	74.00	-36.53	Horizontal

Note:

- 1. Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss Pre-amplifier
- 2. Margin (dB) = Emission Level (dB μ V/m)- limit (dB μ V/m)
- 3. The emission levels of other frequencies are very lower than the limit and not show in test report.
- 4. Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency.
- 5. Data of measurement shown " * "in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.

Page 18 of 29



6.4. Manually Activated Transmitter

6.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.231(a)(1)		
Test Method:	ANSI C63.10: 2013		
Limit:	According to 15.231(a), A manually operated transmitted shall employ a switch that will automatically deactivathe transmitter within not more than 5 seconds of being released.		
	 According to the follow Test-setup, keep the relative position between the artificial antenna and the EUT. Set to the maximum power setting and enable the EUT transmit continuously. Use the following spectrum analyzer settings. VBW = 1MHz, VBW > RBW; Span = 0; Sweep Time = 5s; Detector function = peak; Measure and record the results in the test report. 		
Test setup:	Spectrum Analyzer EUT		
Test Mode:	Transmitting Mode		
Test results:	PASS		
	1201		

6.4.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2021

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

Page 19 of 29



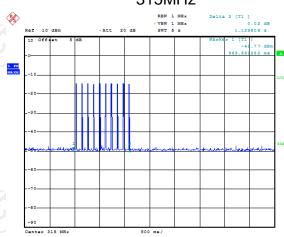
6.4.3. Test data

Report No.: TCT201125E003

	Test Channel (MHz)	Manually Activated Transmitter (s)	Limit (s)	Conclusion
ĺ	315	1.13	5	PASS
ĺ	433.93	1.11	5	PASS

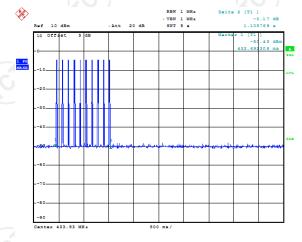
Test plots as follows:

315MHz



Date: 2.DEC.2020 14:09:12

434.93MHz



Date: 2.DEC.2020 13:42:24



6.5. Occupied Bandwidth

6.5.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.231C		
Test Method:	ANSI C63.10: 2013		
Limit:	According to 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the centre 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 centre frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.		
	 According to the follow Test-setup, keep the relative position between the artificial antenna and the EUT. Set to the maximum power setting and enable the EUT transmit continuously. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel; RBW ≥ 1% of the 20 dB bandwidth; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold. Measure and record the results in the test report. 		
Test setup:	Spectrum Analyzer EUT		
Test Mode:	Transmitting Mode		
Test results:	PASS		

6.5.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2021

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

Page 21 of 29



6.5.3. Test data

Report No.: TCT201125E003

Test Channel (MHz)	20dB Occupy Bandwidth (kHz)	Limit (kHz)	Conclusion
315	98.72	787.50	PASS
433.93	136.54	1084.83	PASS

Note: Limit = 315MHz *0.25% = 787.50 kHz, Limit = 433.93MHz *0.25% = 1084.83 kHz

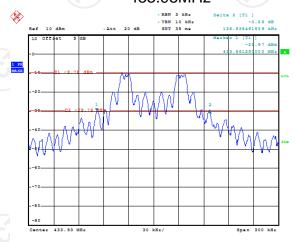
Test plots as follows:

315MHz



Date: 2.DEC.2020 14:05:56

433.93MHz

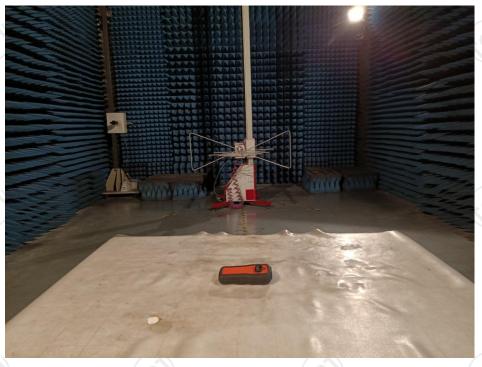


Date: 2.DEC.2020 13:13:28



Appendix A: Photographs of Test Setup Product: TPMS SENSOR

Product: TPMS SENSOF Model: T10 Radiated Emission







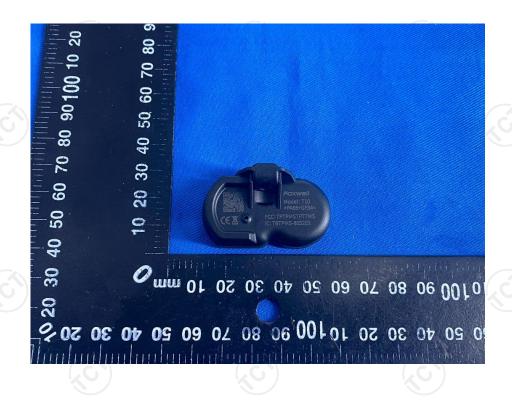
Appendix B: Photographs of EUT
Product: TPMS SENSOR
Model: T10

External Photos



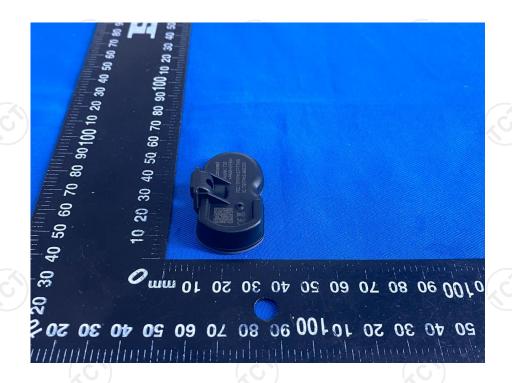








追沙小位沙



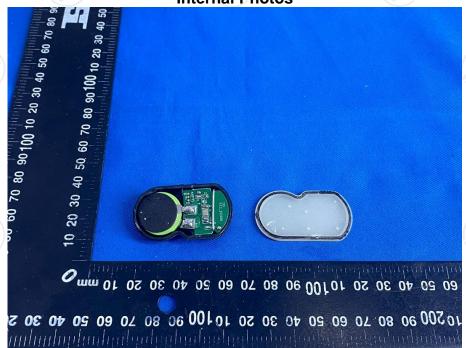


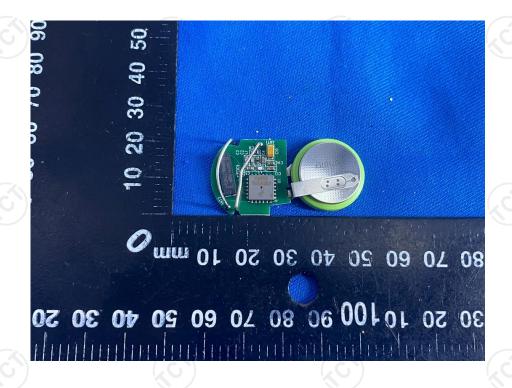




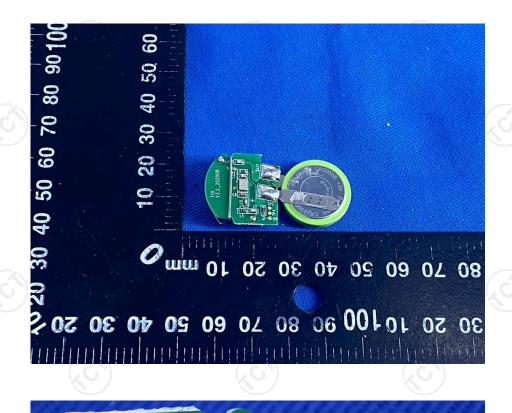


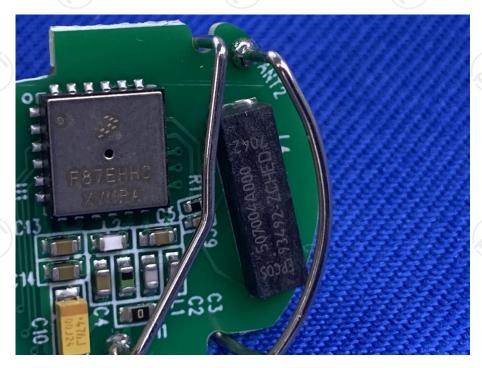
Product: TPMS SENSOR Model: T10 Internal Photos











*****END OF REPORT*****

Page 29 of 29