

FCC Test Report

Product Name	Tyre Pressure Monitoring Sensor
Model No.	SHS4
FCC ID.	MRXSHS4

Applicant	Schrader Electronics
Address	11 Technology Park, Belfast Road, Antrim, BT41 1QS, Northern Ireland

Date of Receipt	June 01, 2015
Issued Date	June 26, 2015
Report No.	1560101R-RFUSP14V00
Report Version	V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by TAF or any agency of the government.

The test report shall not be reproduced without the written approval of QuieTek Corporation.

Test Report

Issued Date : June 26, 2015

Report No. : 1560101R-RFUSP14V00



Product Name	Tyre Pressure Monitoring Sensor
Applicant	Schrader Electronics
Address	11 Technology Park, Belfast Road, Antrim, BT41 1QS, Northern Ireland
Manufacturer	Schrader Electronics
Model No.	SHS4
FCC ID.	MRXSHS4
EUT Rated Voltage	DC 3V(Power by Battery)
EUT Test Voltage	DC 3V(Power by Battery)
Trade Name	SCHRADER ELECTRONICS
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2014 ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

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Tested By : Ivan Chuang
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Approved By : Vincent Lin
(Director / Vincent Lin)

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Attachment 1: EUT Test Photographs

Attachment 2: EUT Detailed Photographs

1. General Information

1.1. EUT Description

Product Name	Tyre Pressure Monitoring Sensor
Trade Name	SCHRADER ELECTRONICS
Model No.	SHS4
FCC ID	MRXSHS4
Frequency Range	433.92MHz
Number of Channels	1
Type of Modulation	FSK
Antenna Information	MFR: SCHRADER ELECTRONICS, M/N: N/A

Frequency of Each Channel:

Channel	Frequency
Channel 1:	433.92 MHz

Note:

1. The EUT is a Tyre Pressure Monitoring Sensor with a built-in 433.92 MHz transmitter.
2. The antenna of EUT is conform to FCC 15.203
3. These tests are conducted on a sample for the purpose of demonstrating compliance with Part 15 Subpart C Paragraph 15.231(e).
4. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.

Test Mode	Mode 1: Transmit
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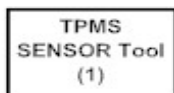
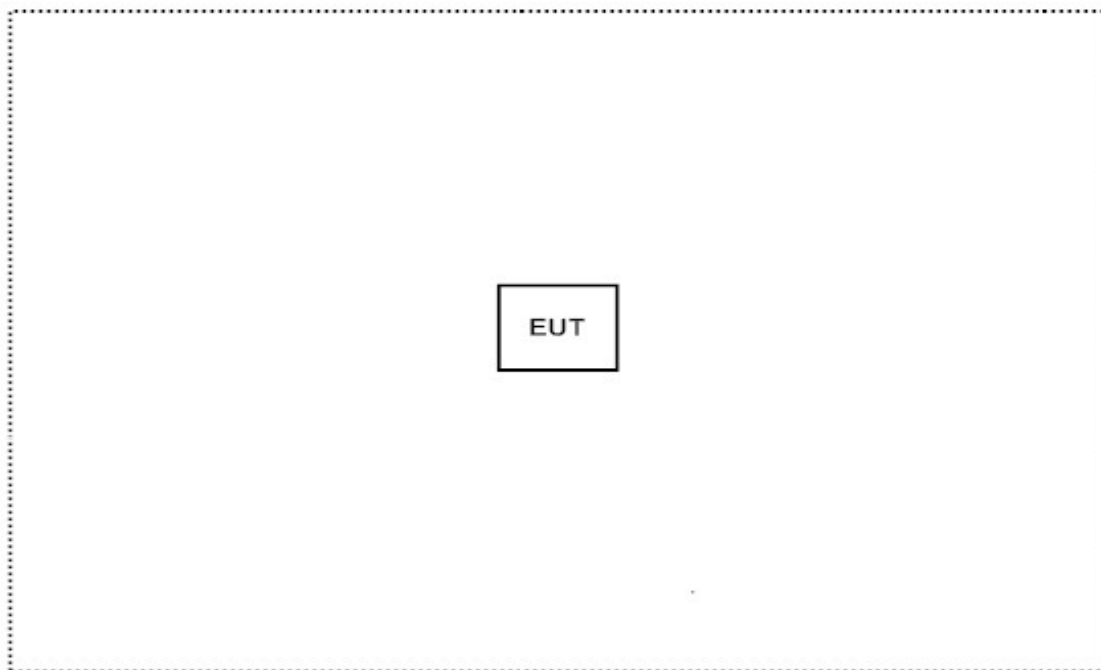
1.3. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	FCC ID	Power Cord	
1	TPMS SENSOR Tool	Ford Motor Company	8C2T-1A203-AB	N/A	N/A	N/A

Signal Cable Type	Signal cable Description
	N/A

1.4. Configuration of tested System



1.5. EUT Exercise Software

1	Setup the EUT as shown in section 1.4.
2	Press and hold the button of TPMS SENSOR Tool.
3	Start transmits continually.
4	Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	30-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from

Quietek Corporation's Web Site: <http://www.quietek.com/chinese/about/certificates.aspx?bval=5>

The address and introduction of Quietek Corporation's laboratories can be founded in our Web site:

<http://www.quietek.com/>

Site Description: File on
Federal Communications Commission
FCC Engineering Laboratory
7435 Oakland Mills Road
Columbia, MD 21046s
Registration Number: 92195

Site Name: Quietek Corporation
Site Address: No.5-22, Ruishukeng,
Linkou Dist. New Taipei City 24451,
Taiwan, R.O.C.
TEL: 886-2-8601-3788 / FAX : 886-2-8601-3789
E-Mail : service@quietek.com

FCC Accreditation Number: TW1014

2. Conducted Emission

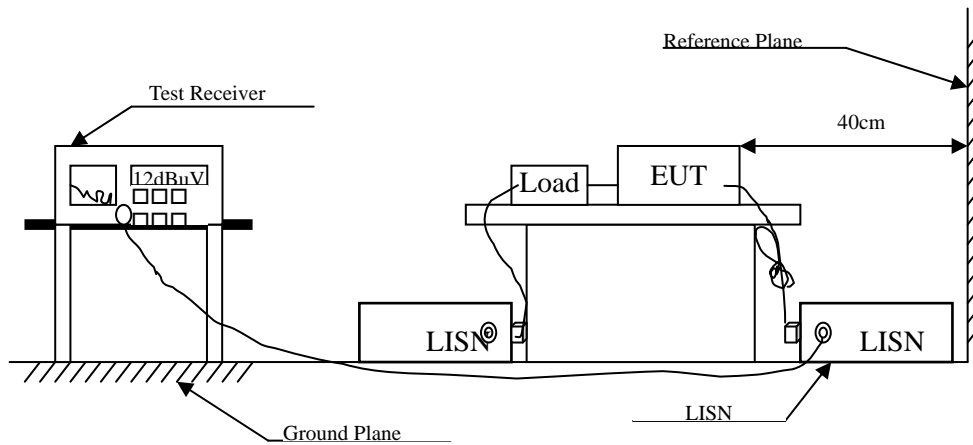
2.1. Test Equipment

	Equipment	Manufacturer	Model No. / Serial No.	Last Cal.	Remark
X	Test Receiver	R & S	ESCS 30 / 825442/018	Sep., 2014	
X	Artificial Mains Network	R & S	ENV4200 / 848411/10	Feb., 2015	Peripherals
X	LISN	R & S	ESH3-Z5 / 825562/002	Feb., 2015	EUT
	DC LISN	Schwarzbeck	8226 / 176	Mar, 2015	EUT
X	Pulse Limiter	R & S	ESH3-Z2 / 357.8810.52	Feb., 2015	
	No.1 Shielded Room				

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked by “X” are used to measure the final test results.

2.2. Test Setup



2.3. Limits

FCC Part 15 Subpart C Paragraph 15.207 Limits (dBuV)		
Frequency MHz	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks : In the above table, the tighter limit applies at the band edges.

2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /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 refers 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 C63.10: 2013 on conducted measurement.

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

2.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.231(e)

2.6. Uncertainty

± 2.26 dB

2.7. Test Result

Owing to the DC operation of EUT, this test item is not performed.

3. Radiated Emission

3.1. Test Equipment

The following test equipments are used during the radiated emission test:

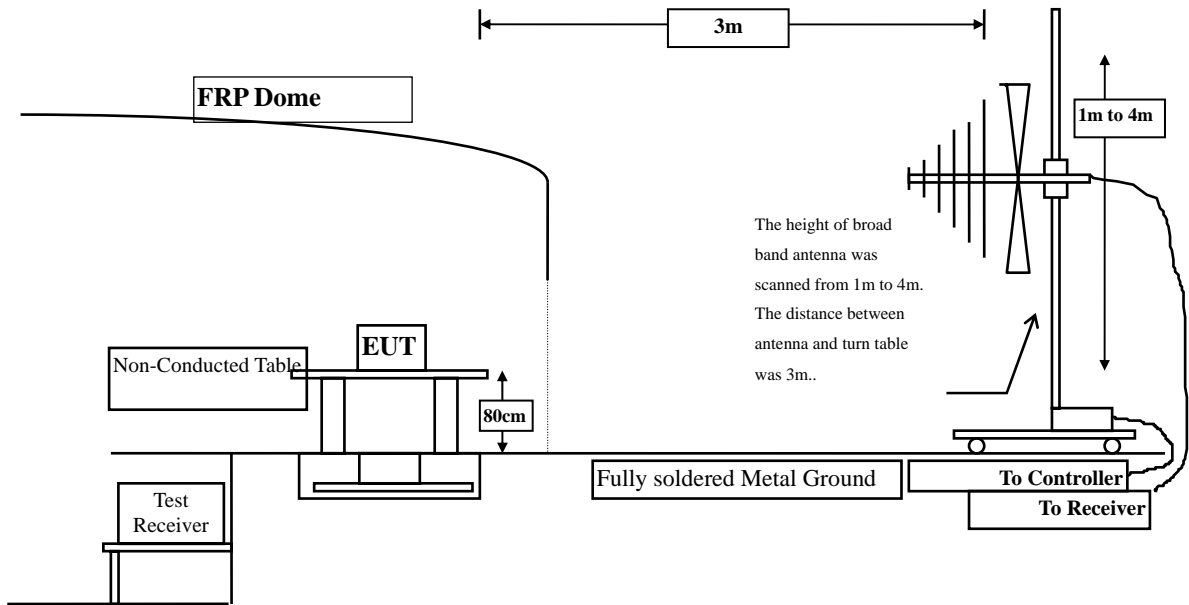
Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
☒ Site # 3	X	Magnetic Loop Antenna	Teseq	HLA6121/ 37133	Sep, 2014
	X	Bilog Antenna	Schaffner Chase	CBL6112B/ 2707	Jun, 2015
	X	EMI Test Receiver	R&S	ESCS 30/838251/ 001	Jun, 2015
	X	Coaxial Cable	QTK(Arnist)	RG 214/ LC003-RG	Jun, 2015
	X	Coaxial signal switch	Arnist	MP59B/ 6200798682	Jun, 2015

Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
☒ CB # 8	X	Spectrum Analyzer	R&S	FSP40/ 100339	Oct, 2014
	X	Horn Antenna	ETS-Lindgren	3117/ 35205	Mar, 2015
	X	Horn Antenna	Schwarzbeck	BBHA9170/209	Jan, 2015
	X	Horn Antenna	TRC	AH-0801/95051	Aug, 2014
	X	Pre-Amplifier	EMCI	EMC012630SE/980210	Jan, 2015
	X	Pre-Amplifier	MITEQ	JS41-001040000-58-5P/153945	Jul, 2014
	X	Pre-Amplifier	NARDA	DBL-1840N506/013	Jul, 2014

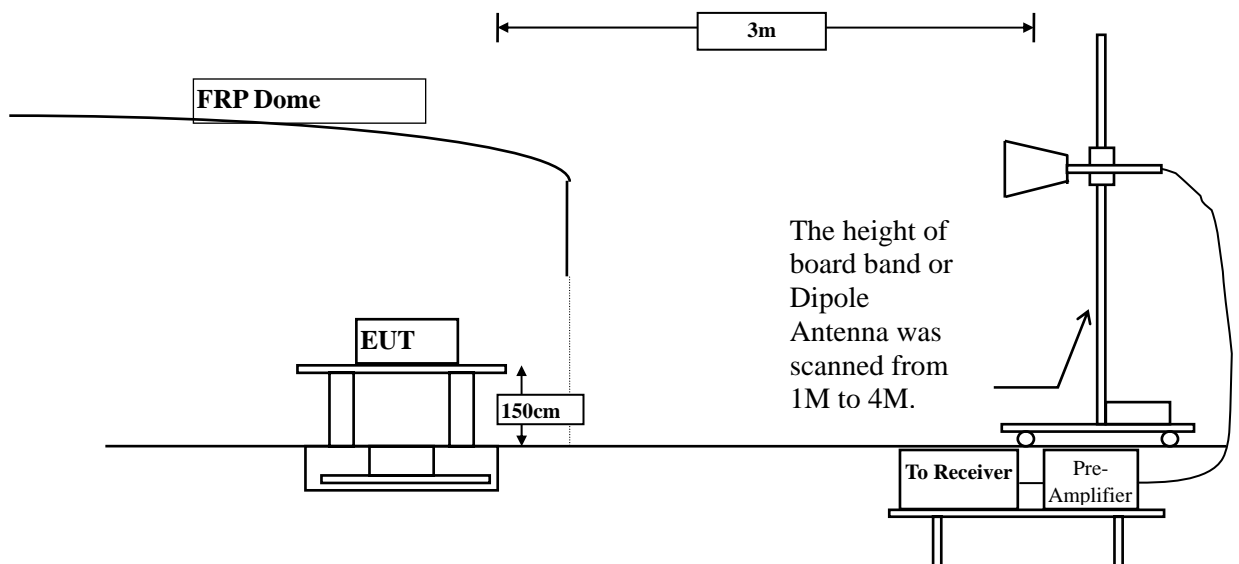
- Note:
1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
 2. The test instruments marked with "X" are used to measure the final test results.

3.2. Test Setup

Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



3.3. Limits

➤ Fundamental and Harmonics Emission Limits (Section 15.231(e))

Fundamental Frequency MHz	Field Strength of Fundamental	Field Strength of Spurious Emission
40.66-40.70	1000	100
70-130	500	50
130-174	500 to 1500	50 to 150
174-260	1500	150
260-470	1500 to 5000	150 to 500
above 470	5000	500

- Remarks :
1. RF Voltage (dBuV) = 20 log RF Voltage (uV)
 2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
 3. The emission limit in this paragraph is based on measurement instrumentation employing an average detector.

➤ Spurious electric field strength limits

FCC Part 15 Subpart C Paragraph 15.209 Limits			
Frequency MHz	uV/m	dBuV/m	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	See Remark ¹	300
0.490-1.705	24000/F(kHz)	See Remark ¹	30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

- Remarks :
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 closed point of any part of the device or system.

3.4. Test Procedure

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10, 2013 on radiated measurement.

On the field strength of fundamental and harmonics, the limits shown are based on measuring equipment employing a average detector function. As an alternative, compliance with the limits may be based on the use of measurement instrumentation with a CISPR quasi-peak detector.

On the field strength of spurious electric, on any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a quasi-peak detector function and on any frequency or frequencies above 1000 MHz the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function.

When average radiated emission measurement are included emission measurement below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

The bandwidth The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

3.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.231(e)

3.6. Uncertainty

± 3.8 dB below 1GHz

± 3.9 dB above 1GHz

3.7. Test Result

Product	Tyre Pressure Monitoring Sensor		
Test Item	Fundamental Radiated Emission		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/10	Test Site	No.3 OATS

Fundamental Power (X-Line)

Peak Detector:

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-----------------

Horizontal

433.920	-11.140	77.900	66.760	-26.100	92.860
---------	---------	--------	--------	---------	--------

Vertical

433.920	-12.070	88.400	76.330	-16.530	92.860
---------	---------	--------	--------	---------	--------

Average Detector:

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-----------------

Horizontal

433.920	-11.140	51.500	40.360	-32.500	72.860
---------	---------	--------	--------	---------	--------

Vertical

433.920	-12.070	57.300	45.230	-27.630	72.860
---------	---------	--------	--------	---------	--------

Note:

1. Correct factor = Antenna Factor + Cable Loss – Pre-amplifier Gain
2. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.
3. Limit = $20\log(4398\mu\text{V}) = 72.86\text{dBuV}$.

Product	Tyre Pressure Monitoring Sensor		
Test Item	Fundamental Radiated Emission		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/10	Test Site	No.3 OATS

Fundamental Power (Y-Line)

Peak Detector:

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-----------------

Horizontal

433.920	-11.140	87.600	76.460	-16.400	92.860
---------	---------	--------	--------	---------	--------

Vertical

433.920	-12.070	85.900	73.830	-19.030	92.860
---------	---------	--------	--------	---------	--------

Average Detector:

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-----------------

Horizontal

433.920	-11.140	59.900	48.760	-24.100	72.860
---------	---------	--------	--------	---------	--------

Vertical

433.920	-12.070	60.300	48.230	-24.630	72.860
---------	---------	--------	--------	---------	--------

Note:

1. Correct factor = Antenna Factor + Cable Loss – Pre-amplifier Gain
2. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.
3. Limit = $20\log(4398\mu V) = 72.86\text{dBuV}$.

Product	Tyre Pressure Monitoring Sensor		
Test Item	Fundamental Radiated Emission		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/10	Test Site	No.3 OATS

Fundamental Power (Z-Line)

Peak Detector:

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-----------------

Horizontal

433.920	-11.140	78.150	67.010	-25.850	92.860
---------	---------	--------	--------	---------	--------

Vertical

433.920	-12.070	89.900	77.830	-15.030	92.860
---------	---------	--------	--------	---------	--------

Average Detector:

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-----------------

Horizontal

433.920	-11.140	52.600	41.460	-31.400	72.860
---------	---------	--------	--------	---------	--------

Vertical

433.920	-12.070	61.600	49.530	-23.330	72.860
---------	---------	--------	--------	---------	--------

Note:

1. Correct factor = Antenna Factor + Cable Loss – Pre-amplifier Gain
2. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.
3. Limit = $20\log(4398\mu V) = 72.86\text{dBuV}$.

Product	Tyre Pressure Monitoring Sensor		
Test Item	Harmonic Radiated Emission		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/01	Test Site	No.3 OATS

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Peak Limit dBuV/m	Average Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-------------------------	----------------------------

Harmonic Radiated Emission

Horizontal

Peak

1301.760	-6.411	51.930	45.519	-28.481	74.000	54.000
1735.680	-2.831	51.890	49.059	-24.941	74.000	54.000
2169.600	-3.702	50.820	47.118	-26.882	74.000	54.000
2603.520	-3.079	41.250	38.171	-35.829	74.000	54.000
3037.440	-3.164	48.980	45.816	-28.184	74.000	54.000
3471.350	-2.054	48.620	46.566	-27.434	74.000	54.000
3905.280	-0.432	43.250	42.818	-31.182	74.000	54.000
4339.200	0.360	45.170	45.530	-28.470	74.000	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	Tyre Pressure Monitoring Sensor		
Test Item	Harmonic Radiated Emission		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/01	Test Site	No.3 OATS

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Peak Limit dBuV/m	Average Limit dBuV/m
------------------	-------------------------	--------------------------	--------------------------------	--------------	-------------------------	----------------------------

Harmonic Radiated Emission

Vertical

Peak

1301.760	-5.568	47.280	41.712	-32.288	74.000	54.000
1735.680	-2.056	45.940	43.884	-30.116	74.000	54.000
2169.600	-3.817	44.570	40.753	-33.247	74.000	54.000
2603.520	-3.246	40.920	37.673	-36.327	74.000	54.000
3037.440	-3.146	47.050	43.904	-30.096	74.000	54.000
3471.360	-1.966	45.810	43.844	-30.156	74.000	54.000
3905.280	0.079	40.110	40.189	-33.811	74.000	54.000
4339.200	1.116	42.510	43.626	-30.374	74.000	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product	Tyre Pressure Monitoring Sensor		
Test Item	General Radiated Emission		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/10	Test Site	No.3 OATS

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
Horizontal					
Quasi-Peak					
145.032	-23.799	48.168	24.369	-19.131	43.500
207.212	-21.302	44.523	23.221	-20.279	43.500
284.936	-17.968	40.823	22.855	-23.145	46.000
420.176	-11.238	41.057	29.819	-16.181	46.000
622.260	-6.666	37.676	31.010	-14.990	46.000
934.712	-6.053	32.301	26.248	-19.752	46.000
Vertical					
Quasi-Peak					
135.705	-17.893	41.484	23.591	-19.909	43.500
177.676	-15.702	36.462	20.761	-22.739	43.500
247.628	-12.947	31.722	18.775	-27.225	46.000
412.404	-12.120	39.584	27.464	-18.536	46.000
574.071	-10.262	32.054	21.792	-24.208	46.000
897.404	-5.285	31.128	25.843	-20.157	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.
8. No emission found between lowest internal used/generated frequency to 30MHz.

4. Transmit time

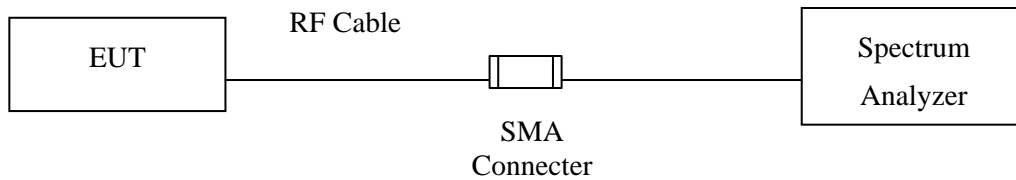
4.1. Test Equipment

The following test equipment are used during the test:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

Note: 1. All equipments are calibrated every one year.
2. The test instruments marked by “X” are used to measure the final test results.

4.2. Test Setup



4.3. Limits

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

4.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.231(e)

4.5. Uncertainty

± 25ms

4.6. Test Result

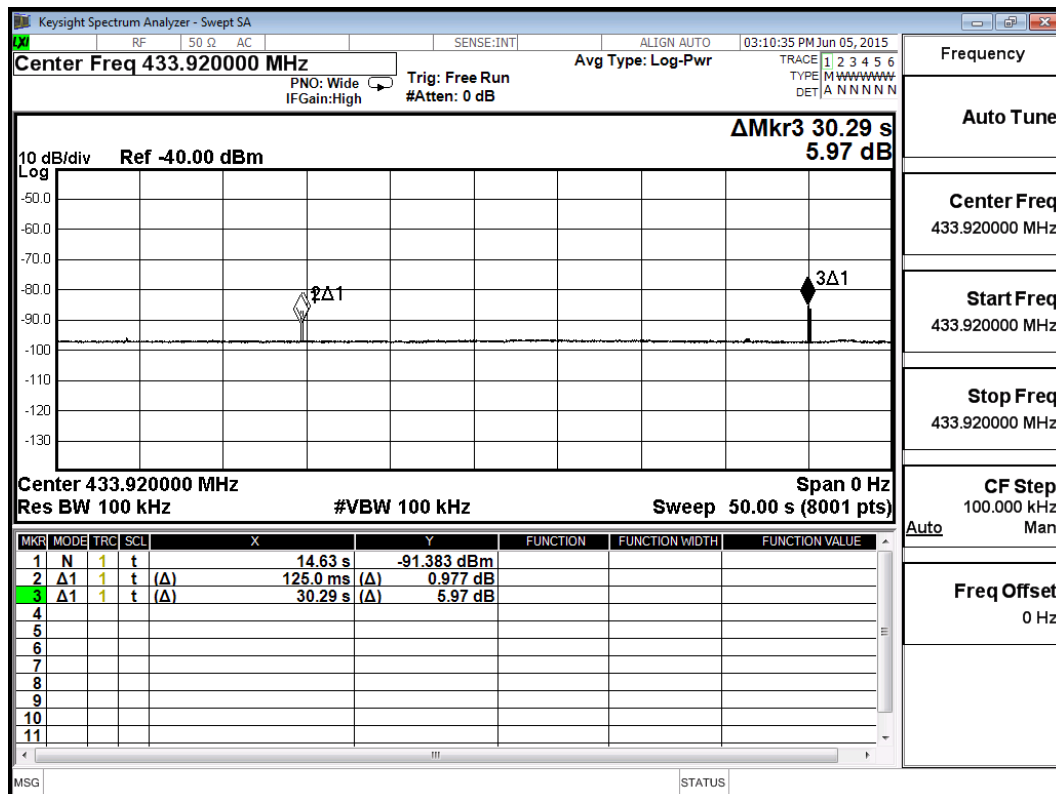
Product	Tyre Pressure Monitoring Sensor		
Test Item	Transmit time		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/05	Test Site	No.3 OATS

Channel No.	Frequency (MHz)	Measurement Value (Sec)	Limit (Sec)	Result
1 (Transmit time)	433.92	0.125	< 1	Pass
1 (Silent period time)	433.92	30.29	> 10	Pass
1 (Silent period time)	433.92	30.29	< 3.75(motel)	Pass

Note:

- The silent period between transmissions shall be at least 30 times.

(Transmit time: 0.125 Sec*30 times= 3.75 Sec)



5. Occupied Bandwidth

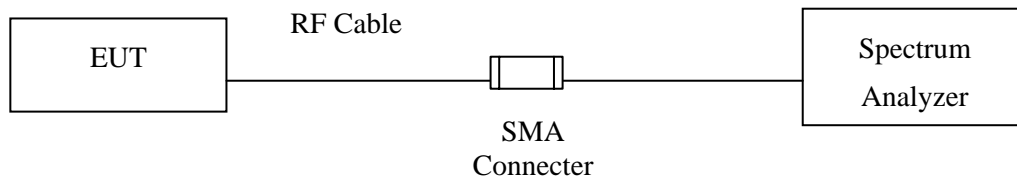
5.1. Test Equipment

The following test equipment are used during the test:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

Note: 1. All equipments are calibrated every one year.
2. The test instruments marked by "X" are used to measure the final test results.

5.2. Test Setup



5.3. Limits

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. For devices operating above 900MHz, 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

5.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.231(c)

5.5. Uncertainty

± 150Hz

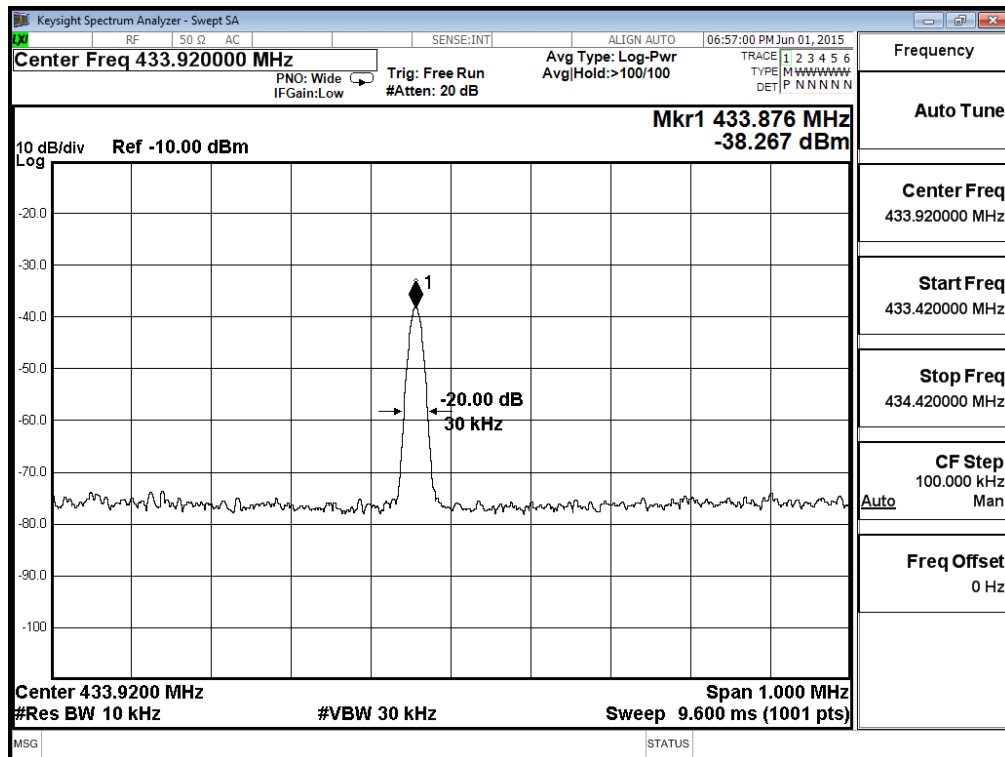
5.6. Test Result

Product	Tyre Pressure Monitoring Sensor		
Test Item	Occupied Bandwidth		
Test Mode	Mode 1: Transmit		
Date of Test	2015/06/05	Test Site	No.3 OATS

Channel No.	Frequency (MHz)	Measurement Value (MHz)	Limit (MHz)	Result
1	433.92	0.03	1.0848	Pass

Note: Limit = 433.92MHz * 0.25% = 1.0848MHz

Figure Channel 1:



Attachment 1: EUT Test Photographs

Attachment 2: EUT Detailed Photographs