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TEST REPORT

Part 15 Subpart C 15.231

Equipment under test Tire Pressure Monitoring System

Model name NWK-LIS

FCC ID F2ONWK-LIS

Applicant Nae Woi Korea.,ltd

Manufacturer Nae Woi Korea.,ltd

Date of test(s) 2013.04.22 ~ 2013.04.24

Date of issue 2013.04.26

Issued to

Nae Woi Korea.,ltd
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Issued by

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Test and report completed by :	**Report approval by :**
	
Byeong-Geol Chu Test engineer	Jeff Do Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2013.04.26	KES-RF-13T0007	Initial

TABLE OF CONTENTS

1. General information

1.1. EUT description

Equipment under test	Tire Pressure Monitoring System
Model name	NWK-LIS
Serial number	N/A
Frequency Range	433.92 ㎒
Modulation technique	ASK
Number of channels	1
Antenna type	Fixed type(Helix antenna)
Power source	DC 4.5 V(Battery)

1.2. Test frequency

	Low channel	**Middle channel**	**High channel**
Frequency (㎒)	433.92	N/A	N/A

1.3. Information about variant model

N/A

1.4. Device modifications

N/A

1.5. Test facility

C3701 Dongil Techno Town, 889-1, Gwanyang 2-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea 477-6, Hageo-ri, Yeoju-eup, Yeoju-gun, Gyeonggi-do, 469-803, Korea

The open area test site is constructed in conformance with the requirements ANSI C63.4-2003.

1.6. Laboratory accreditations and listings

Country	Agency	Scope of accreditation	Certificate No.
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	KC	EMI (10 meter Open Area Test Site and two conducted sites) Radio (3 & 10 meter Open Area Test Sites and one conducted site)	KR0100
CANADA	IC	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1

2. Summary of tests

Reference	Parameter	Status
15.231(e) 15.209(a)	The field strength of fundamental and the field strength of spurious emission	C
15.231(c)	20 dB bandwidth	C
15.231(e)	Transmission plot	C
Note: C=Complies NC=Not complies NT=Not tested NA=Not applicable		

3. Test results

3.1. The field strength of fundamental and the field strength of spurious emission

Test location
Testing was performed at a test distance of 3 meter Open Area Test Site

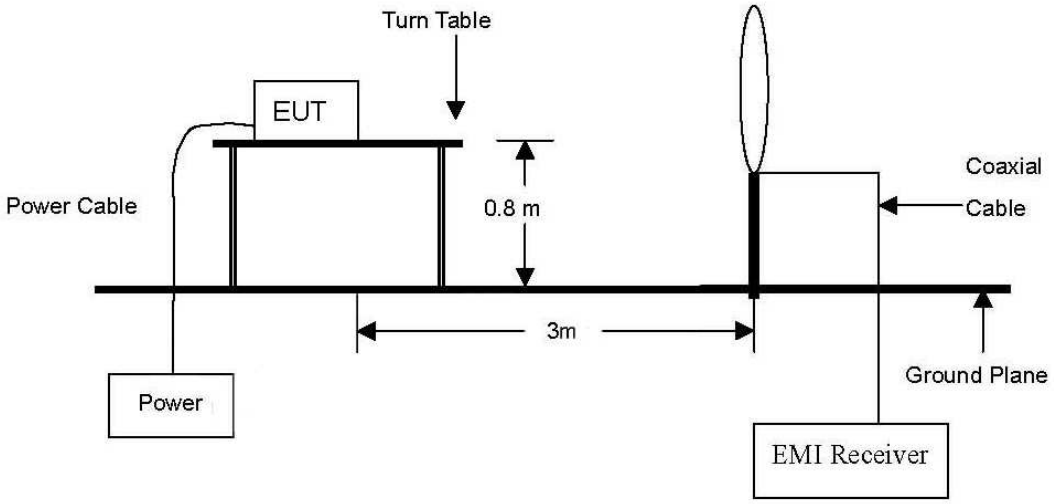
Test procedures
[9 ㎑ to 30 ㎒]
The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Quasi-peak function and specified bandwidth with maximum hold mode.

The spectrum analyzer is set to:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.

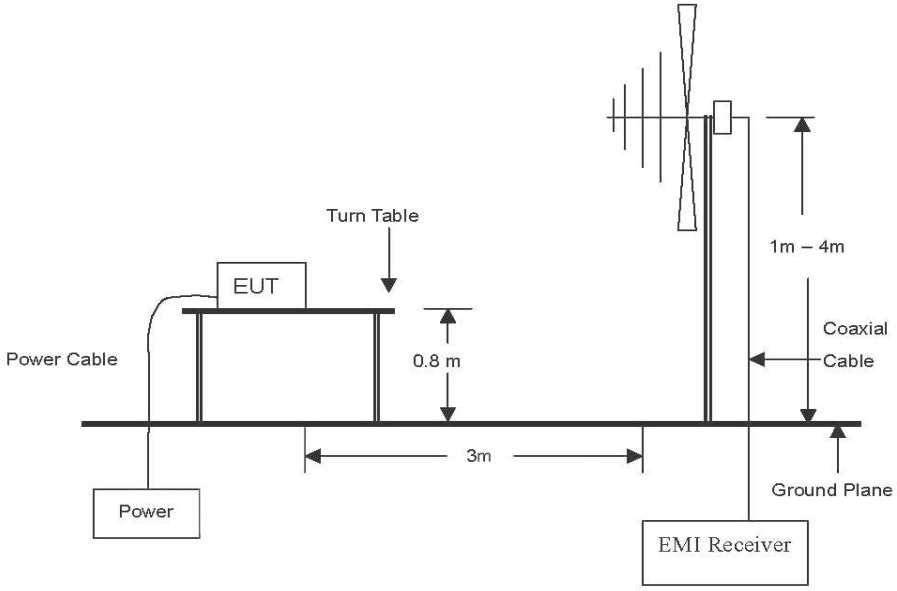
[30 ㎒ to 1 ㎓ and above 1 ㎓]
The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity.
The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

The spectrum analyzer is set to:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection at frequency above 1 ㎓.

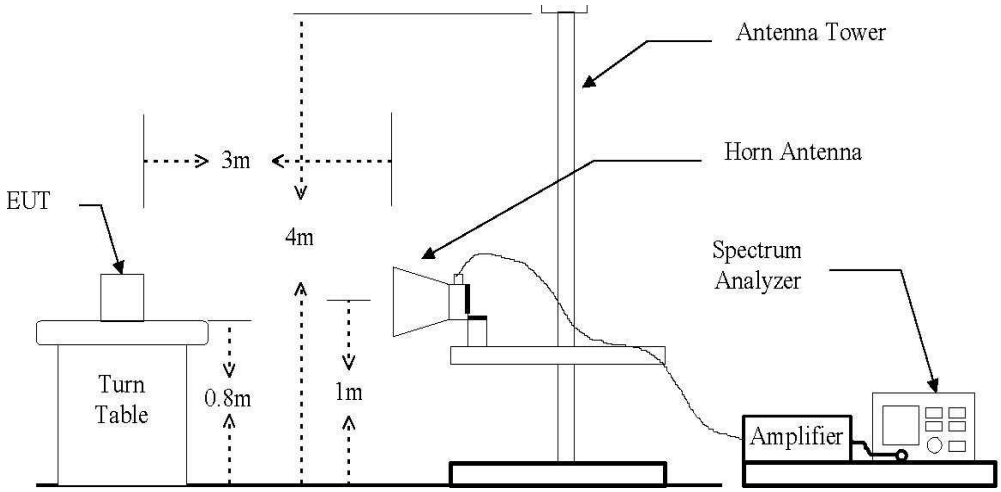
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 5 ㎓ emissions.



Limit

In the section 15.209:

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

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400 / F(㎑)
0.490 ~ 1.705	30	24000 / F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

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

In the section 15.231(e):
Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) and may be employed for any type of operation, including operation prohibited in paragraph (a), provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this Section, except the field strength table in paragraph (b) is replaced by the following:

Fundamental frequency (㎒)	Field strength of fundamental (microvolts / meter)	Field strength of spurious emission (microvolts / meter)
40.66 ~ 40.70	1,000	100
70 ~ 130	500	50
130 ~ 174	500 to 1,500**	50 to 150**
174 ~ 260	1,500	150
260 ~ 470	1,500 to 5,000**	150 to 500**
Above 470	5,000	500

Where F is the frequency in ㎒, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130 ~ 174 ㎒, ㎶/m at 3 meters = 22.72727(F) – 2454.545; for the band 260 ~ 470 ㎒, ㎶/m at 3 meters = 16.6667(F) – 2833.3333. The maximum permitted unwanted emission level is 20 ㏈ below the maximum permitted fundamental level.

Test results

Below 30 ㎒

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Fd (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Not detected								

※ Remark

1. Actual = Reading + Ant. factor + Cable loss + Fd
2. Fd = 40log(Dm / Ds)

   Where:

   Fd = Distance factor in dB

   Dm = Measurement distance in meters

   Ds = Specification distance in meters

Fundamental

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
433.92	17.87	H	15.76	4.43	38.06	100.82	62.76
433.92	13.74	V	15.76	4.43	33.93	100.82	66.89

Spurious emission

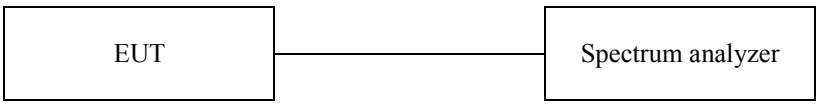
Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Pol.	Ant. factor (dB/m)	Cable loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Not detected							

※ Remark

1. Actual = Reading + Ant. factor + Cable loss
2. Detector mode: Quasi peak
3. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes

3.2. 20 dB bandwidth

Test setup



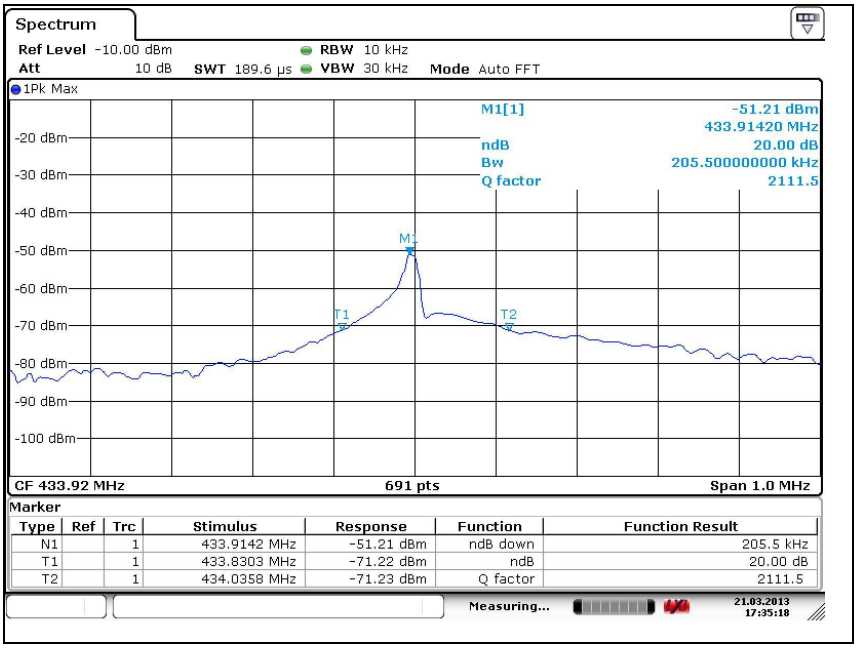
Test procedure

1. Use the following spectrum analyzer setting
2. RBW = 10 ㎑
3. VBW = 30 ㎑ (≥ RBW)
4. Span = 1 ㎒
5. Detector function = peak
6. Trace = max hold

Limit

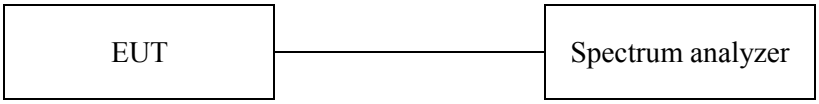
The bandwidth of the emissions shall be no wider than 0.25 % of the center frequency for devices operating above 70 ㎒ and below 900 ㎒. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test results



3.3. Transmission plot

Test setup



Test procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW=100 ㎑, VBW=100 ㎑.

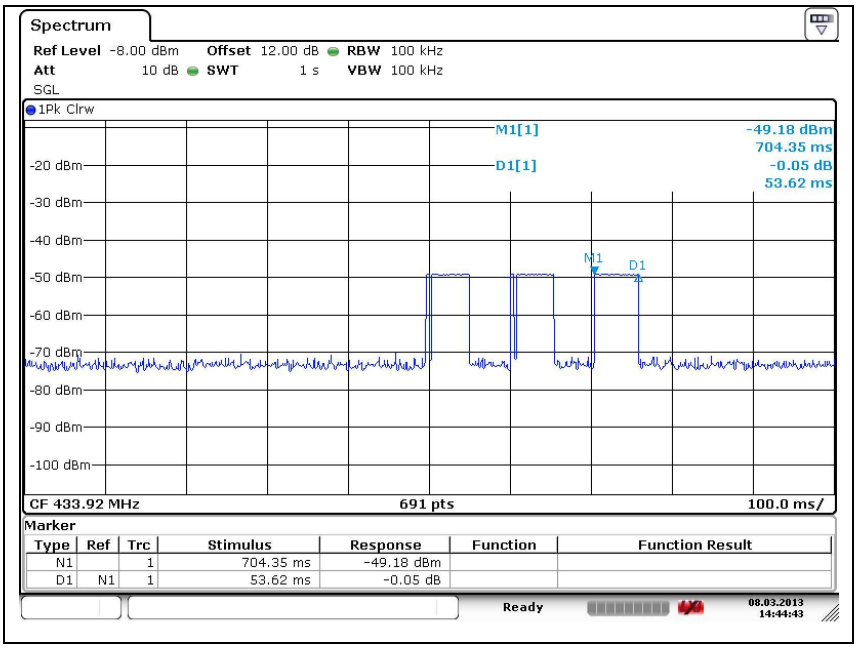
Limit

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 on 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.

Test results

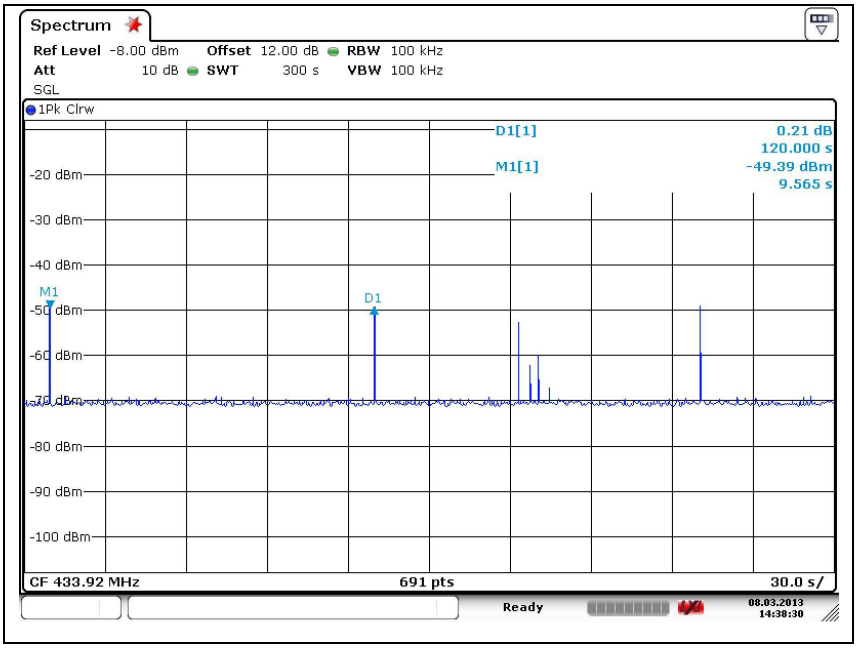
Transmission time

Transmission time (ms)	Frame no.	Result(s)	Limit (s)
53.62	3	0.16086	<1



Silent time

Silent time(s)	Limit (s)
120	≥4.825 8



Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Calibration due.
Spectrum Analyzer	R&S	FSV30	2014.01.09
Vector Signal Generator	R&S	SMBV2100A	2014.01.10
Loop Antenna	R&S	HFH2-Z2.335.4711.52	2015.03.10
Trilog-Broadband Antenna	Schwarzbeck	VULB 9168	2013.10.25
Horn Antenna	A.H.	SAS-571	2015.02.28
Preamplifier	HP	8447F	2013.05.04
Preamplifier	HP	8449B	2013.08.02
EMI Test Receiver	R&S	ESHS10	2013.05.04

Peripheral device

Device	Manufacturer	Model No.	Serial No.
N/A			

Appendix B. Test setup photos