

Date: ESPOO 25.04.2003

Page: 1 (10)

Appendices -

Number:
No. 1 / 1

1031681

Date of handing in: 07.04.2003

Tested by:



T017 (EN ISO/IEC 17025)

Timo Leismala, Product Manager

Reviewed by:

Janne Nyman, Product Manager, EMC

SORT OF EQUIPMENT:

Tyre Pressure Monitoring Device

MARKETING NAME:

RoadSnoop Pressure Watch

TYPE:

RSPW-01

MANUFACTURER:

Flextronics International Finland.

SERIAL NUMBER:

- - -

CLIENT:

Nokian Tyres Plc.

ADDRESS:

P.O.BOX 20, FIN-37101 NOKIA, Finland

TELEPHONE:

+ 358 3 340 7268

TEST SPECIFICATION:

**CISPR 22 (1997) and ANSI C63.4-1992
FCC 47 CFR Part 15, Subpart C, Class B (1994)**

SUMMARY:

The radiated interference field strength in the frequency range 30 - 1000 MHz fulfils the class B requirements defined in the test specification CISPR 22 (1997). The margin with respect to the limits is 16.0 dB or more (Margin with respect to FCC 47 CFR Part 15, Subpart C, Class B (1994) limit is 15.5 dB or more). The radiated interference field strength in the frequency range 1000 - 5000 MHz fulfils the requirements defined in the test specification FCC 47 CFR Part 15, Subpart C, Class B (1994). The margin with respect to the limits is 4.0 dB or more.

According to the standards the emission measurement results have been compared directly with the limit lines without considering measurement uncertainties.

The test results are valid for the tested unit only. Without a written permission of Nemko Oy it is allowed to copy this report as a whole, but not partially.

Summary of performed tests and test results

Emission tests according to the test specification FCC 47 CFR Part 15, Subpart C, Class B (1994)

Emission test	Test method	Conclusion
Radiated disturbance 30-1000 MHz	ANSI C63.4-1992 CISPR 22(1997)	Pass

Emission tests according to the test specification FCC 47 CFR Part 15, Subpart C, Class B (1994)

Emission test	Test method	Conclusion
Radiated disturbance 1000-5000 MHz	ANSI C63.4-1992 CISPR 22(1997)	Pass

Contents

1. General	4
2. System Configuration	4
2.1 Test set-up.....	4
2.2 Operating conditions and monitoring of the EUT	4
3. Test procedures.....	5
3.1 Emission tests	5
3.1.1 Radiated disturbance emission test	5
4. Test results	6
4.1 Emission tests	6
4.1.1 Radiated disturbance emission test	6
5. List of test equipment.....	9
6. Photographs.....	10

1. General

The equipment under test (EUT) was a Tyre Pressure Monitoring Device. The purpose of the performed tests was to see if in regard to these tests the EUT fulfils the EMC requirements defined in the FCC 47 CFR Part 15, Subpart C, Class B (1994). The tests were performed according to the test specifications CISPR 22 (1997) and ANSI C63.4-1992 by using accredited test methods.

2. System Configuration

2.1 Test set-up

Equipment under test (EUT):

- RoadSnoop Tyre Pressure Monitoring Device, type: RSPW-01, S/N: - - -

The RSPW-01 consists of four tyre pressure / temperature sensors, RSPW-01T and one receiver unit, RSPW-01R.

Operating voltage of the EUT:

- RSPW-01T: 3V DC battery
- RSPW-01R: 3.6V DC battery

2.2 Operating conditions and monitoring of the EUT

One transmitter was installed inside a test tyre. The air pressure of the test tyre was within the normal pressure range. The remaining three transmitters were installed on the surface of the test tyre. Hence, three sensors indicated low air pressure.

The test tyre was installed to a motor axle and the motor was turned on. The speed of rotation of the tyre was approximately 600rpm.

RSPW-01T transmits temperature and pressure information using radio frequency of 433.92MHz. RSPW-01R decodes the transmitted radio frequency signal and indicates the pressure level of each tyre in its user interface.

3. Test procedures

3.1 Emission tests

3.1.1 Radiated disturbance emission test

The test was performed as a compliance test. The test parameters concerned were as follows:

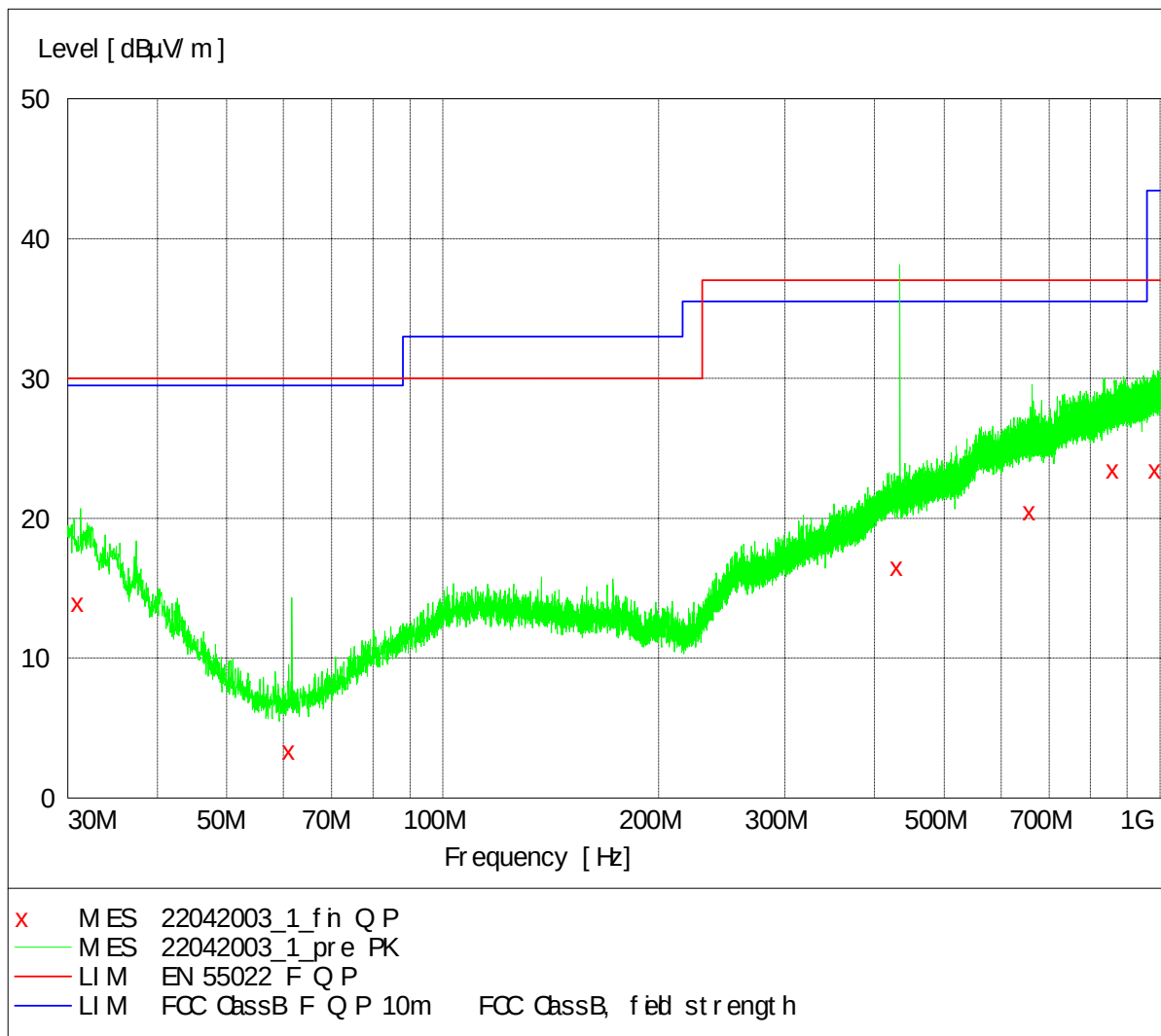
Parameter	Specification
Test method	CISPR 22 (1997) and ANSI C63.4-1992
Frequency range	30 - 5000 MHz
Site name	Nemko Oy / Perkkaa
Date of testing	18.-23.04.2003
Test equipment	45, 65, 82, 83, 84, 89, 184, 199, 319, 338, 350, 397, 525
Test uncertainty U95	+3.1 dB / -4.0 dB
Test conditions	21-23 °C, 30-37 % RH

The test was performed in a semi-anechoic shielded room. For the duration of the test the EUT was placed on a non-conductive table 0.8 m high standing on the turntable (photographs 1 and 2). During the test in the frequency range 30-1000 MHz the distance from the EUT to the measuring antenna was 10 meters. During the test in the frequency range 1000-5000 MHz the distance from the EUT to the measuring antenna was 3 meters. In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna and the lay-out of the EUT cables were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations.

4. Test results

4.1 Emission tests

4.1.1 Radiated disturbance emission test

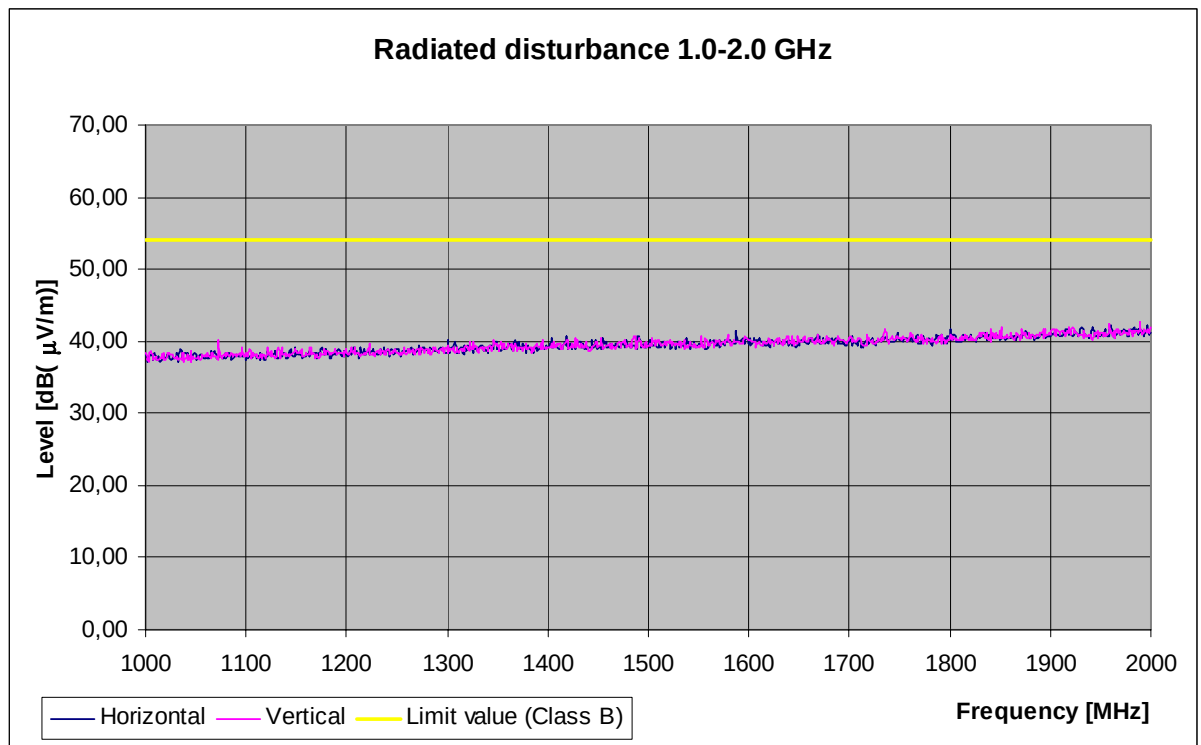


Vertical and horizontal polarizations in the frequency range 30 – 1000 MHz measured by using the peak detector. During the peak detector scan, the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 3.0 m. The highest levels of the radiated interference field strength measured by using the quasi-peak detector were recorded.

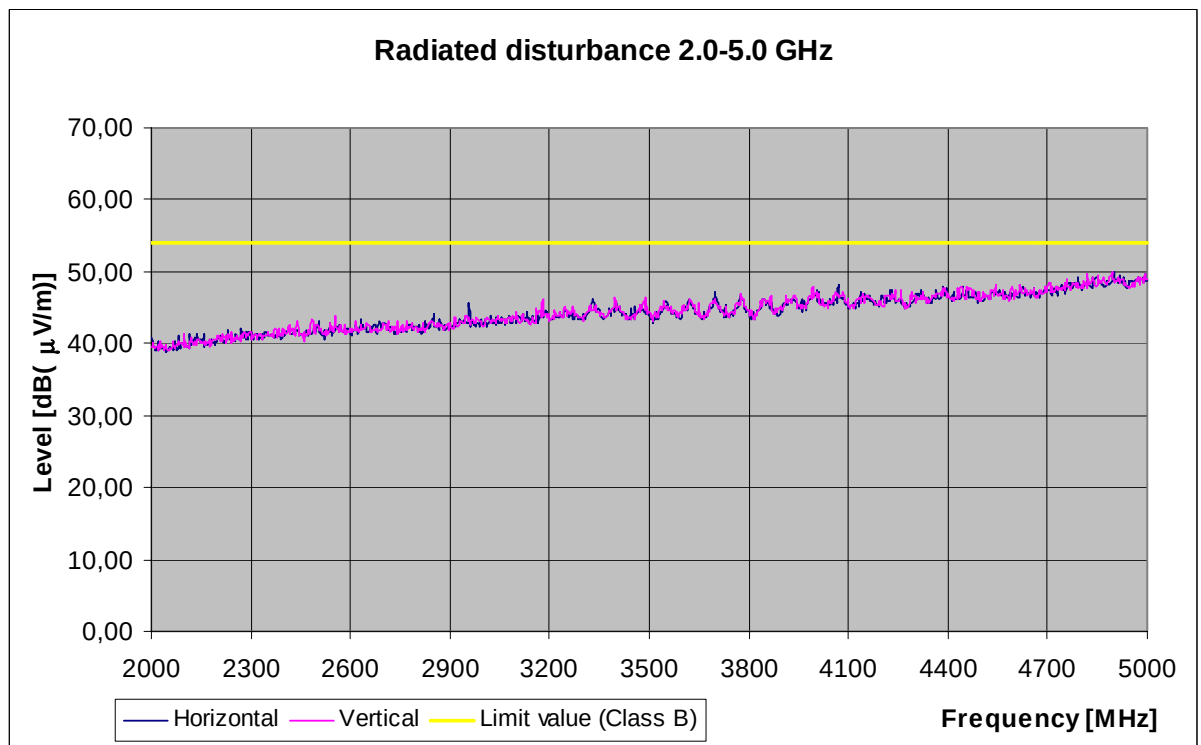
Measurement results (QP)

Frequency MHz	Level dBμV/m	Limit dBμV/m	Margin dB	Exceed	Height cm	Azimuth degrees	Polarization Hor/Ver
31.28	14.0	29.5	15.5	-	261	359	Horizontal
61.56	3.4	29.5	26.1	-	100	96	Vertical
433.28	16.6	35.5	18.9	-	303	80	Horizontal
663.56	20.5	35.5	25.0	-	146	134	Horizontal
866.56	23.5	35.5	22.0	-	100	1	Vertical
992.28	23.5	43.5	20.0	-	377	4	Vertical

3 meter limit values are transformed to 10 meter limit values by using the inverse linear-distance extrapolation factor (20 dB/decade). Measured test results are compared to transformed FCC 47 CFR Part 15, Subpart C, Class B limit. 100, 150, 200 and 500 μV/m have been calculated to correspond 40, 43.5, 46, 54 dB(μV/m) as follows: $[dB(\mu V/m)] = 20 \log[\mu V/m]$.



Horizontal and vertical polarizations in the frequency range 1000 - 2000 MHz measured by using the peak detector. The highest levels of the radiated interference field strength measured by using the peak detector were recorded.



Horizontal and vertical polarizations in the frequency range 2000 - 5000 MHz measured by using the peak detector. The highest levels of the radiated interference field strength measured by using the peak detector were recorded.

MEASUREMENT RESULTS (PK)

Frequency MHz	Level dB μ V/m	Limit dB μ V/m	Margir dB	Exceed	Height cm	Azimuth degrees	Polarization Hor/Ver
2956.67	45.7	54.0	8.3	-	-	-	Horizontal

Example of the calculation of the measurement result (frequency 2956.67 MHz):

53.3 dB μ V (meter reading) + 30.4dB/m (antenna factor) + 3.1dB (attenuation of the measuring cable) - 41.1 (amplification of the measuring amplifier) = 45.7 dB(μ V/m)

The FCC 47 CFR Part 15, Subpart C, Class B limit of 500 μ V/m has been calculated to correspond 54 dB(μ V/m) as follows: $[\text{dB}(\mu\text{V/m})]=20\log[\mu\text{V/m}]$.

When measurements are performed in the frequency range 30 - 1000 MHz the antenna factor and the effects of the attenuation of the measuring cable and the amplification of the amplifier are automatically added to the meter reading by the measuring receiver. CISPR 22 (1997) Class B limit value defined for 10m measuring distance has been applied.

When measurements are performed in the frequency range 1000 - 5000 MHz the antenna factor, the amplification of the amplifier and the effect of the attenuation of the measuring cable are manually added to the meter reading. FCC 47 CFR Part 15, Subpart C, Class B limit value defined for 3m measuring distance has been applied.

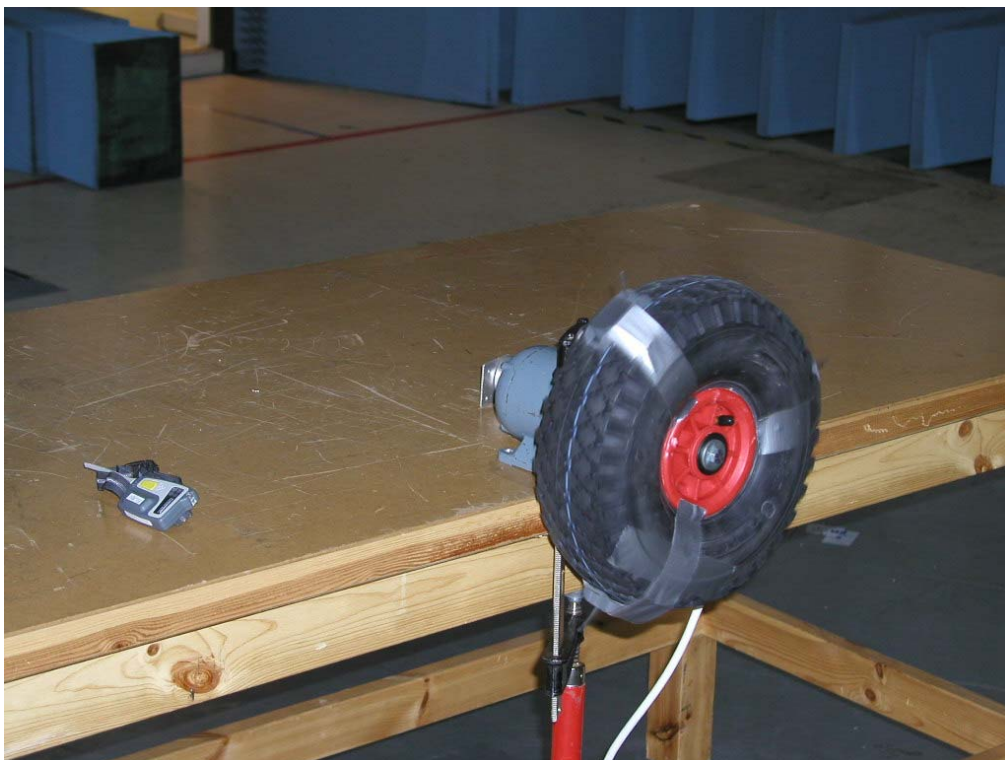
5. List of test equipment

No.	Equipment	Type	Manufacturer	Serial Number
5	Test receiver	ESH-3	Rohde & Schwarz	894718/015
338	Test receiver	ESS	Rohde & Schwarz	847151/009
42	Spectrum analyzer	8566B	Hewlett Packard	2637A04102
45	Spectrum analyzer	FSBS	Rohde & Schwarz	862563/010
38	RF generator	SMG	Rohde & Schwarz	883590/035
351	RF generator	SMT 06	Rohde & Schwarz	845715/001
199	RF amplifier	ZHL-1042J	Mini-Circuits	012288-10
205	RF amplifier	ZHL-1042J	Mini-Circuits	012288-11
340	RF-power amplifier	7100LC-CE	Kalmus	7583B1
354	RF power amplifier	AR 500W1000M7	Amplifier Research	20487
355	RF power amplifier	LA100V - CE	Kalmus	7809-1
366	RF-amplifier	AR15A25	Amplifier Research	10783
397	RF-amplifier	ZFL-2000	Mini-Circuits	-
89	Antenna, logperiodic	3147	EMCO	9202-1078
90	Antenna, biconical	3109	EMCO	9109-2582
188	Antenna, bilog	CBL 6111	Chase	1028
319	Antenna	CBL6112	Chase	2018
352	Antenna	3142	EMCO	9701-1122
417	Antenna, bilog	CBL 6141	Chase	4028
56	Power meter	NAUS 3	Rohde & Schwarz	87076/087
167	Artificial mains network	NSLK 8126	Schwartzbeck	8126101
168	Artificial mains network	NSLK 8127	Schwartzbeck	8127162
343	Artificial mains network	NSLK 8128	Schwartzbeck	8128177
367	LISN	NNB-4/200	Rolf Heine	4/200X-96009
57	Power meter	NAUS 3	Rohde & Schwarz	87076/088
58	Power meter	NAUS 4	Rohde & Schwarz	87089/103
184	Temp. & humidity meter	HMI 32	Vaisala	63837
359	E-field probe	HI-4422	Holaday	95835
411	E-field probe	HI-4433-GRE	Holaday	96730
193	ESD generator	NSG435	Schaffner	316
405	Horizontal coupling plane	HCP1	Self made	-
406	Vertical coupling plate	VCP1	Self made	-
409	ESD generator	NSG435	Schaffner	2288
322	Coupling network	HV-SURGE 63.3	EMCEC OY	011996
224	EFT/Burst generator	PEFT JUNIOR	Haefely	083180-46
225	HF coupling clamp	IP4A	Haefely	083078-008
320	Voltage dip tester	PLINE 1610	Haefely Trench AG	083690-22
347	Automotive test system	NSG5000	Shaffner	EK3396-021
370	AC Power source	15003i-400/3	California Instr.	-
294	DCN-network	801-M2/M3	Lüthi GmbH	-
299	RF injection clamp	EM 100	Lüthi GmbH	-
416	RF High-Power Attenuator	765-6	Narda	9708
222	Impulse tester	PSURGE4	Haefely	083070-10
364	Coupling/decoupling dev.	CDN 801-M4/63A	MEB	12998
365	Coupling/decoupling dev.	CDN 801-M5/25A	MEB	11514
416	RF High-Power Attenuator	765-6	Narda	9708
429	Directional coupler	DC6280	Amplifier Research	24067
431	Power meter	NRVD	Rohde & Schwarz	826224/047
432	Voltage probe	URV5-Z2	Rohde & Schwarz	826853/030
433	Voltage probe	URV5-Z2	Rohde & Schwarz	826853/029
485	Horizontal coupling plane	HCP2	Self made	992
348	Shielded room	RFSD-100	Euroshield Oy	1320
349	Shielded room	RFSD-100	Euroshield Oy	1319
350	Semi-anechoic shielded room	RFD-F-100	Euroshield Oy	1327

6. Photographs



Photograph 1. Radiated disturbance emission test



Photograph 2. Radiated disturbance emission test