

FCC ID: OYGTSSDA4PB

EMI -- TEST REPORT

Test Report No. : T30529-00-04XF	February 15, 2006 Date of issue
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Type / Model Name : Digital antenna + / TSSDA4Pb

Product Description : Tire Safety System

Applicant : BERU AG

Address : Mörikestrasse 155

71636 Ludwigsburg

Manufacturer : BERU AG

Address : Mörikestrasse 155

71636 Ludwigsburg

Licence holder : BERU AG

Address : Mörikestrasse 155

71636 Ludwigsburg

Test Result according to the standards listed in clause 1 test standards:	Positive
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The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (October 01, 2004)

Part 15, Subpart B, Section 15.107(a)	AC Line conducted emissions
Part 15, Subpart B, Section 15.109(a)	Radiated emissions, general requirements
Part 15, Subpart B, Section 15.111(a)	Antenna power conduction

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2 SUMMARY

GENERAL REMARKS:

The Digital Antenna is one component of the Tire Safety System (TSS) which controls and monitors tire pressures. The system comprises the following components:

1 TSS control unit
4 sets of wheel electronics including valve
1 digital antenna +
4 trigger transmitters

The "Digital Antenna +" is a 433 MHz Receiver and during all tests, the Eut have been operated in the complete Tire Safety System (TSS), where it was possible to set the different modes via suitable software.

FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : January 25, 2006

Testing concluded on : January 30, 2006

Checked by:

Tested by:

Klaus Gegenfurtner
Dipl.-Ing.(FH)
Manager: Radio Group

Fischer Xavier

Power supply system utilised

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Power supply voltage : 12 V / DC

3.4 Short description of the Equipment under Test (EuT)

The digital antenna has integrated signal conditioning (decoding processor) to receive and decode the HF signal sent by the wheel electronics. The conditioned information is transferred to the TSS control unit via a LIN communication. For exactly description please refer to the technical documents.

Number of tested samples: 1
Serial number: Prototype

EuT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- Receive mode

EuT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

- Notebook	Model : IBM
-	Model :
-	Model :
-	Model :
-	Model :
-	Model :
-	Model :

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
94342 Strasskirchen
Germany

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 /11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement Protocol for FCC, VCCI and AUSTEL

4.4.1 GENERAL INFORMATION

4.4.1.1 Test Methodology

Conducted and radiated disturbance testing is performed according to the procedures in International Special Committee on Radio Interference (CISPR) Publication 22 (1997), European Standard EN 55022 and Australian Standard AS 3548 (which are based on CISPR 22).

The Japanese standard, "Voluntary Control Council for Interference (VCCI) by Data Processing Equipment and Electronic Office Machines, Technical Requirements" is technically equivalent to CISPR 22 (1997). For official compliance, a conformance report must be sent to and accepted by the VCCI.

In compliance with FCC Docket 92-152, "Harmonization of Rules for Digital Devices Incorporate International Standards", testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using the CISPR 22 Limits.

4.4.1.2 Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into it's characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

4.4.2.1 General Standard Information

The test methods used comply with CISPR Publication 22 (1997), EN 55022 (2001) and AS 3548 (1992) - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" and with ANSI C63.4-2003 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

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TEST CONDITIONS AND RESULTS

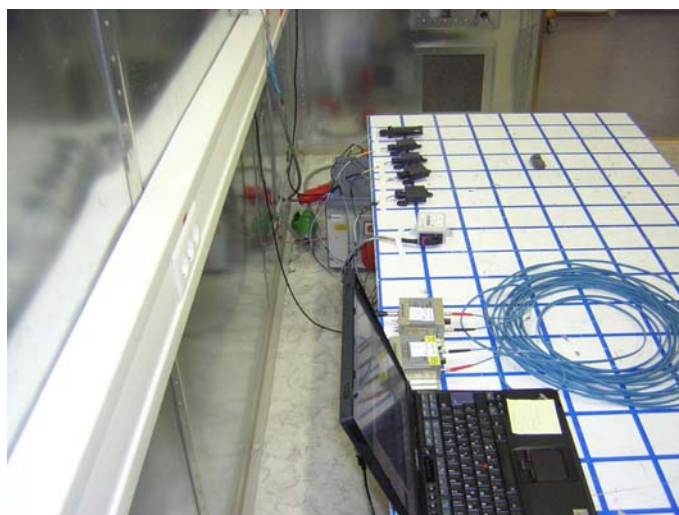
5.1 Conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up



5.1.3 Description of Measurement

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit, which is equivalent to the Australian AS 3548 limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the the DC power interface of the EuT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeter's above the floor and is positioned 40 centimeter's from the vertical ground plane (wall) of the screen room. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.4 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 23 dB at 16,00 MHz

The requirements are **FULFILLED**.

Remarks: This test was performed on the complete tire safety system because the power supply for the
"Digital Antenna +" is provided by the control unit.

5.2 Radiated emissions (electric field)

For test instruments and accessories used see section 6 Part **SER 2**, **SER 3**.

5.2.1 Description of the test location

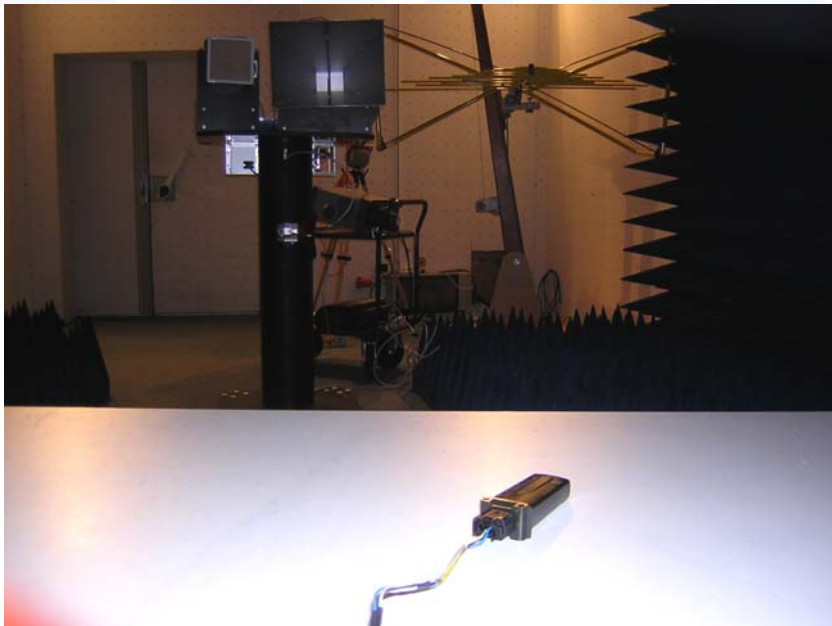
Test location: OATS1
Anechoic Chamber A2

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up



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5.2.3 Description of Measurement

Radiated emissions from the EuT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003. The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization's and the EuT are rotated 360 degrees.

The final level, expressed in dB μ V/m, is arrived by taking the reading from the EMI receiver (Level dB μ V) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

The radiated emissions from the EuT are measured in the frequency range of 1 GHz to maximum frequency as specified in section 15.33, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003.

The Interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3 horizontally from the EuT.

Measurement are made in both the horizontal and vertical planes of polarization in a fully anechoic room using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 1 MHz. All tests are performed at a test-distance of 3 meters. Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration procedure the highest emission relative the limit and therefore shall be used for final testing. During the tests the EUT is rotated all around to find the maximum levels of emissions. The cables and equipment were placed and moved within the range of position likely to find their maximum emissions. When the EuT is larger than the beamwidth of the measuring antenna, the measurement antenna will be moved over the surfaces for the four sides or the test distance will be reduced to demonstrate that emissions were at maximum at the limit distance.

The resolution bandwidth during the measurement is as follows:

30 MHz – 1000 MHz:	ResBW: 120 kHz
Above 1000 MHz	ResBW: 1 MHz

5.2.4 Test result

Testresult in detail:(<1GHz)

Frequency [MHz]	L: QP [dB μ V]	L: AV [dB μ V]	Bandwidth [kHz]	Correct. [dB]	L: QP [dB μ V/m]	L: AV [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
30-1000			120		< 30			

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Testresult in detail:(>1GHz)

Frequency [MHz]	L: PK [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	Limit AV [dBµV/m]	Delta [dB]
1000-5000			1000		< 50			

Limit according to FCC Subpart 15.109(a)

Frequency [MHz]	15.109 Limits [µV/m]	15.109 Limits [dBµV/m]
30-88	100	40
88-216	150	43,5
216-960	200	46
Above 960	500	54

The requirements are

Remarks: According to FCC Part 15.33(b), the measurement was performed up to 5000 MHz.

5.3 Spurious emissions (Antenna Conducted)

For test instruments and accessories used see section 6 Part SEC 2, SEC 3.

5.3.1 Description of the test location

Test location:

5.3.2 Photo documentation of the test set-up

5.3.3 Test result

Testresult in detail:

SPURIOUS EMISSIONS LEVEL [dBm]								
CH1			CH2			CH3		
f[MHz]	Bandwidth [kHz]	Level [dBm]	f[MHz]	Bandwidth [kHz]	Level [dBm]	f[MHz]	Bandwidth [kHz]	Level [dBm]
Measurement uncertainty			± 3 dB					

Bandwidth [kHz]; refers to the bandwidth of the measuring receiver

Limit according to FCC Subpart 15.111(a)

Frequencies 30 - 2000 MHz
2.0nW (-57dBm)

Remarks: This test is not applicable because the receiver has only a printed antenna on PCB and
no external antenna connectors.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

The calibration intervals and the calibration history will be given out on request.

Test ID	Model / Type	Kind of Equipment	Manufacturer	Equipment No.
A 4	ESHS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-002
	NNLK 8129	LISN	Schwarzbeck Mess-Elektronik	02-02/20-05-001
	ESH 2 - Z 5	LISN	Rohde & Schwarz München	02-02/20-05-004
	ESH 3 - Z 2	Pulse Limiter	Rohde & Schwarz München	02-02/50-05-001
	N-4000-BNC	RF Cable	mikes-testingpartners gmbh	02-02/50-05-138
	N-1500-N	RF Cable	mikes-testingpartners gmbh	02-02/50-05-140
SER 2	ESVS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-006
	VULB 9168	Trilog-Broadband Antenna	Schwarzbeck Mess-Elektronik	02-02/24-05-005
	S10162-B / +11N-50-10-5 / +	RF Cable 33m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113
SER 3	AFS4-01000400-10-10P-4	RF Amplifier 1-4 GHz	PARZICH GMBH	02-02/17-05-003
	AMF-4F-04001200-15-10P	RF Amplifier 4-12 GHz	PARZICH GMBH	02-02/17-05-004
	AFS5-12001800-18-10P-6	RF Amplifier 12-18 GHz	PARZICH GMBH	02-02/17-05-005
	3117	Horn Antenna 1-18 GHz	EMCO Elektronik GmbH	02-02/24-05-009
	Sucoflex N-1600-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-073
	Sucoflex N-2000-SMA	RF Cable	novotronik Signalverarbeitung	02-02/50-05-075