DATech
Registration No. DAT-P-207/05

EMI -- TEST REPORT

- FCC Part 15.209 -

Test Report No. : T32848-00-02HU	19. November 2008 Date of issue

Type / Model Name : Trigger Transmitter / TSSTSc / 0533.001.014

Product Description : Tire Pressure Monitoring System

Applicant : BERU AG

Address : Mörikestrasse 155

D-71636 Ludwigsburg

Manufacturer : BERU AG

Address : Mörikestrasse 155

D-71636 Ludwigsburg

Licence holder : BERU AG

Address : Mörikestrasse 155

D-71636 Ludwigsburg

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Deutscher Akkreditierungs Rat
DAR
DAT-P-207/05-00

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.

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October, 2008)

Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements

2 SUMMARY

GENERAL REMARKS:

The Trigger Transmitter is one component of the Tire Pressure Monitoring System which controls and monitors tire pressure. The system comprises the following components:

- 4 Trigger transmitters
- 4 Sets of wheel electronics including valve
- 1 TSS control unit
- 1 Digital antenna

The Trigger Transmitter works on a center frequency of 125 kHz. All Trigger Transmitters in this system are technically identical. Therefore all tests were performed with carrier power on one Trigger Transmitter.
The EuT have been operated in the complete Tire Pressure Monitoring System.

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 : 10 November 2008

Testing concluded on : 11 November 2008

Checked by:

K. Gegenfurtner

Klaus Gegenfurtner
2008.12.11
14:25:02 +01'00'

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

Tested by:

Huber Markus

Huber Markus
I'm the author of this document
2008.11.27 10:54:59 +01'00'

Markus Huber

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT

See Attachment A1 and A2

3.2 Power supply system utilised

Power supply voltage: : 12 V / DC

3.3 Short description of the Equipment under Test (EUT)

The Trigger Transmitter will be controlled from the control unit and calls up the wheel electronics every 54 s to send data messages. For detailed information please refer to the technical documents.

Number of tested samples: 1
Serial number: see Photo documentation of the EuT under Point 3 / Equipment Under Test

EUT operation mode:

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

- Tx mode at 125 kHz

-

-

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:

- _____ Model : _____
- _____ Model : _____
- _____ Model : _____
- _____ Model : _____
- _____ Model : _____
- _____ Model : _____

- customer specific cables

- unscreened power cables

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 may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement" and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners gmbh, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component diversity and modifications in production process of devices may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for the specific test. The manufacturer has the sole responsibility of continued compliance of the EUT.

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 set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.
The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying 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 using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

5 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

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):
Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

5.1.4 Test result

Frequency range:

Min. limit margin

Remarks: The measurement is not applicable. The EuT is battery powered.

5.2 Field strength of the fundamental wave

For test instruments and accessories used see section 6 Part **CPR 1**.

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up

5.2.1 Applicable standard

According to FCC Part 15C, Section 15.209:
The emissions from intentional radiators shall not exceed the effective field strength limits.

5.2.2 Description of Measurement

The magnetic field strength from the EUT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The set up of the Equipment under test will be in accordance to ANSI C63.4. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to Section 15.31(f)(2)(2). The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209(d)(2).

The resolution bandwidth during the measurement is as follows:
9 kHz – 150 kHz: RBW: 200 Hz
150 kHz – 30 MHz: RBW: 9 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level dB(µV/m)	-	Limit dB(µV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

5.2.3 Test result

Measurement distance: 3 m

Frequency (MHz)	Level PK (dBµV)	Level AV (dBµV)	Level QP (dBµV)	Band-width (kHz)	Correct. factor (dB)	Corrected Level PK dB(µV/m)	Corrected Level AV dB(µV/m)	Corrected Level QP dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
0.125	80.8	52.5	68.9	0.2	20	100.8	72.5	88.9	**105.0**	32.5

Calculated **value at distance: 300 m**

Frequency (MHz)	Level PK (dBµV)	Level AV (dBµV)	Level QP (dBµV)	Band-width (kHz)	Correct. factor (dB)	Corrected Level PK dB(µV/m)	Corrected Level AV dB(µV/m)	Corrected Level QP dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
0.125	0.8	**-27.5**	**-11.1**	0.2	20	20.8	-7.5	8.9	25.0	32.5

Limit according to FCC Part 15C, Section 15.209(a):

Frequency	Field strength of fundamental wave		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009-0.490	**2400/F(kHz)**	**--**	**300**
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED.**

Remarks: _____

_____

_____

_____

5.3 Spurious emissions (magnetic field) 9 kHz – 30 MHz

For test instruments and accessories used see section 6 Part SER 1.

5.3.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.3.2 Photo documentation of the test set-up

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.209:
The emissions from intentional radiators shall not exceed the effective field strength limits.

5.3.4 Description of Measurement

The spurious emissions from the EUT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The antenna was positioned 3, 10 or 30 m horizontally from the EUT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to Section 15.31(f)(2). The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209(d)(2).

The resolution bandwidth during the measurement is as follows:
9 kHz – 150 kHz: RBW: 200 Hz
150 kHz – 30 MHz: RBW: 9 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level dB(µV/m)	-	Limit dB(µV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

5.3.5 Test result

Measurement distance: 3 m

Frequency (MHz)	Level PK (dBµV)	Level AV (dBµV)	Level QP (dBµV)	Band-width (kHz)	Correct. factor (dB)	Corrected Level PK dB(µV/m)	Corrected Level AV dB(µV/m)	Corrected Level QP dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
0.375	33.9	15.6	27.0	9	20	**53.9**	35.6	47.0	95.5	**59.9**

Calculated value at distance: 300m

Frequency (MHz)	Level PK (dBµV)	Level AV (dBµV)	Level QP (dBµV)	Band-width (kHz)	Correct. factor (dB)	Corrected Level PK dB(µV/m)	Corrected Level AV dB(µV/m)	Corrected Level QP dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
0.375	-46.1	-64.4	-53.0	**9**	**20**	-26.9	-44.4	-33.0	15.5	59.9

Values at distance: 30m

Frequency (MHz)	Level PK (dBµV)	Level AV (dBµV)	Level QP (dBµV)	Band-width (kHz)	Correct. factor (dB)	Corrected Level PK dB(µV/m)	Corrected Level AV dB(µV/m)	Corrected Level QP dB(µV/m)	Limit dB(µV/m)	Delta (dB)
0.49 – 30.0				**9**	**20**				29.5	**> 40**

Limit according to FCC Part 15 Subpart 15.209(a):

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009-0.490	**2400/F(kHz)**	**--**	**300**
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED.**

Remarks: _____

5.4 Emission Bandwidth

For test instruments and accessories used see section 6 Part MB.

5.4.1 Description of the test location

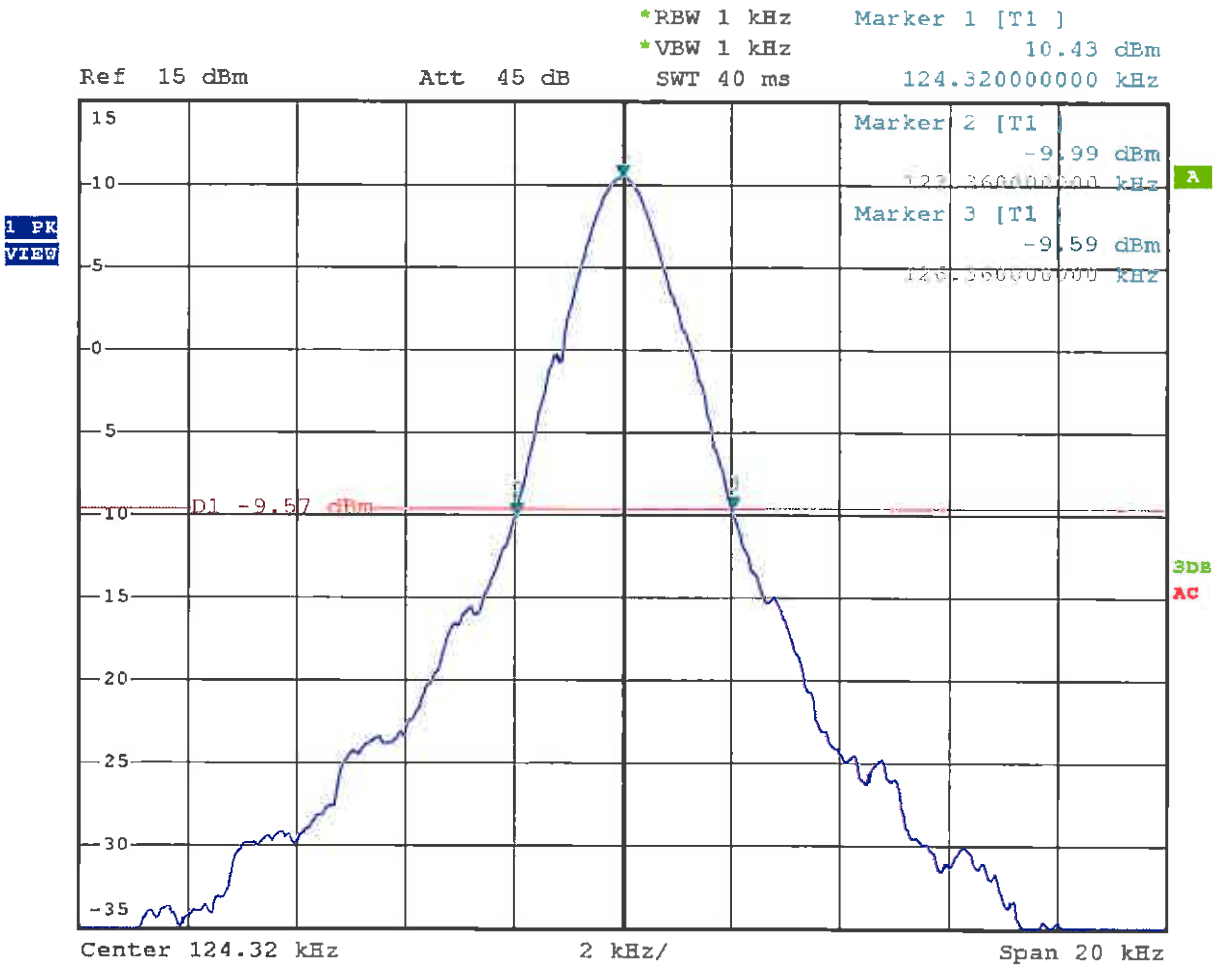
Test location: AREA4

5.4.2 Photo documentation of the test set-up

Fundamental [kHz] See Plot 1	20dB Bandwidth F1	20dB Bandwidth F2	Measured Bandwidth [kHz]
124.32	122.36	126.36	4.0

5.4.3 Test protocol

Emission Bandwidth plots



6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Kind of Equipment	Manufacturer	Equipment No.
CPR 1	FMZB 1516	Magnetic Field Antenna	Schwarzbeck Mess-Elektron	01-02/24-01-018
	ESCI	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-004
	S10162-B	RF Cable 33 m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20 m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113
MB	ESCI	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-004
	THS730A	Handheld Scope	Tektronix GmbH	02-02/13-05-001
	HZ-10	Magnetic Field Antenna	Rohde & Schwarz München	02-02/24-05-012
	PE1540	Power Supply	Phillips Fluke GmbH	02-02/50-07-033
SER 1	FMZB 1516	Magnetic Field Antenna	Schwarzbeck Mess-Elektron	01-02/24-01-018
	ESCI	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-004
	S10162-B	RF Cable 33 m	Huber + Suhner	02-02/50-05-031
	KK-EF393-21N-16	RF Cable 20 m	Huber + Suhner	02-02/50-05-033
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113

Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 1				
01-02/24-01-018	02/20/2009	02/20/2008		
02-02/03-05-004	01/08/2009	01/08/2008		
02-02/50-05-031				
02-02/50-05-033				
02-02/50-05-113				
MB				
02-02/03-05-004	01/08/2009	01/08/2008		
02-02/13-05-001	09/10/2009	09/10/2008		
02-02/24-05-012				
02-02/50-07-033				
SER 1				
01-02/24-01-018	02/20/2009	02/20/2008		
02-02/03-05-004	01/08/2009	01/08/2008		
02-02/50-05-031				
02-02/50-05-033				
02-02/50-05-113				