FCC ID: CHO-VCRFSU

EMI – TEST REPORT

- FCC Part 15.249 -

Deutsche Akkreditierungsstelle D-PL-12030-01-01

Test Report No. : **T35772-00-02HU**	16. May 2012 Date of issue

Type / Model Name : VIBCONNECT RF Sensor Unit

Product Description : Industrial Data Acquisition System

Applicant : PRÜFTECHNIK Condition Monitoring GmbH

Address : Oskar-Messter-Str. 19-21

D-85737 Ismaning

Manufacturer : PRÜFTECHNIK Condition Monitoring GmbH

Address : Oskar-Messter-Str. 19-21

D-85737 Ismaning

Licence holder : PRÜFTECHNIK Condition Monitoring GmbH

Address : Oskar-Messter-Str. 19-21

D-85737 Ismaning

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

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2011)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2011)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.249	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz
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.
ANSI C95.1:2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment

2 SUMMARY

GENERAL REMARKS:

The manufacturer declared that the transmitter / receiver circuit is identical in Bridge and Sensor Unit and is based on the IC Atmel AT86RF212.

Tests were performed with Bridge Unit as a system.

It is not possible to set the EuT only in receiving mode.

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 : 18. January 2012

Testing concluded on : 21. February 2012

Checked by:

Thomas Weise
I confirm the correctness and integrity of this document
2012.05.16 10:33:32 +02'00'

Weise Thomas
Dipl. Ing.(FH)
Laboratory Manager

Tested by:

Markus Huber
I'm the author of this document
2012.05.16 10:32:59 +02'00'

Markus Huber

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Please see attachment A

3.2 Power supply system utilised

Power supply voltage, Sensor Unit : 7.2 V / DC

3.3 Short description of the equipment under test (EUT)

The Industrial Data Acquisition System consists of a sensor unit and a bridge.
The "Sensor Unit" collects with two accelerometers data's and transmit them via wireless to the "Bridge" which will transfer them via Ethernet to a host computer. The radio link is bidirectional, half duplex.

Number of tested samples: 1 System (Bridge & Sensor Unit)
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 916 MHz

-

-

EUT configuration:

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

- _____ 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 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 processes may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the EUT.

4.4 Measurement protocol for FCC

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.

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.

4.4.2 DETAILS OF TEST PROCEDURES

General Standard information

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.

4.4.3 Conducted emission

Description of measurement

The final level, expressed in dBμV, 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.

To convert between dBμV and μV, the following conversions apply:

dBμV = 20*log(μV);
μV = 10^(dBμV/20);

Conducted emissions on the 50 Hz and/or 60 Hz 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 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin of a peak mode measurement appears to be less than 20 dB, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.4.4 Radiated emission (electrical field 30 MHz - 1 GHz)

Description of measurement

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised 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 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4.The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that 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 screened room located outside the test area. The antenna is positioned 3, 10 or 30 meters horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters and the EUT is rotated 360 degrees.
The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency	Level	+	Factor	=	Level	-	CISPR Limit	=	Delta
(MHz)	(dBµV)		(dB)		(dBµV/m)		(dBµV/m)		(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.4.5 Radiated emission (electrical field 1 GHz - 40 GHz)

Description of measurement

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. 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 screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

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

Test location: Shielded Room S2

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 given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 described under item 4.4.3. If the minimum limit 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.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin

Limit according to FCC Part 15, Section 15.207(a):

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

Remarks: The measurement is not applicable

The device is battery powered.

5.2 Radiated emission of the fundamental wave

For test instruments and accessories used see section 6 Part **CPR 2**.

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

Sensor Unit:

5.2.1 Applicable standard

According to FCC Part 15C, Section 15.249(a):
The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

5.2.2 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a tuned receiver and appropriate linear polarized antennas.
Receiver settings:
RBW: 120 kHz Detector: Quasi peak

5.2.3 Test result

Sensor Unit:

Frequency (MHz)	Level QP (dBµV)	Correct. factor (dB)	Corrected level dB(µV/m)	Limit dB(µV/m)	Delta (dB)
916.0	64.8	28.8	93.6	94.0	-0.4

Limit according to FCC Section 15.249(a) for fundamental

Frequency	Field strength of fundamental	
(MHz)	(mV/m)	dB(µV/m)
902 - 928	50	94

The requirements are **FULFILLED.**

Remarks: _____

5.3 Spurious emissions radiated

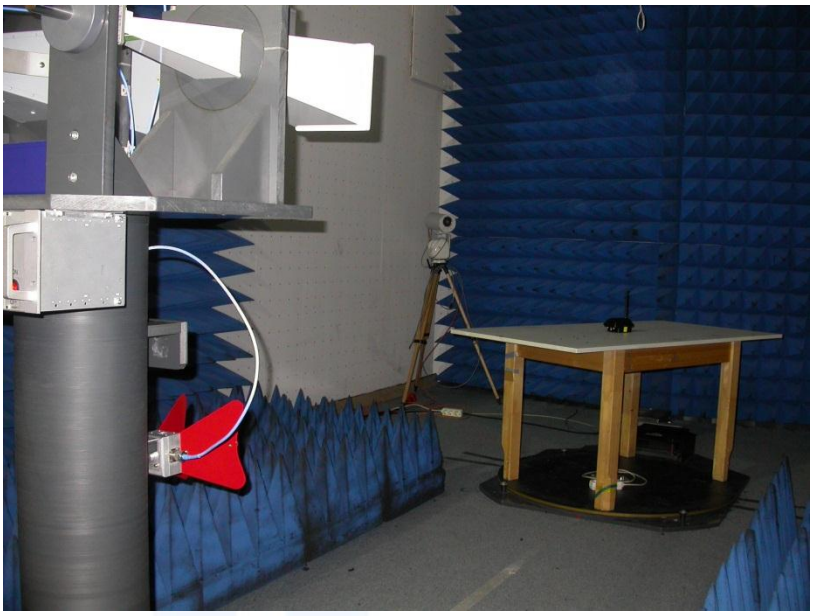
For test instruments and accessories used see section 6 Part **SER 1, SER 2, SER 3**.

5.3.1 Description of the test location

Test location: OATS1
Test location: Anechoic Chamber A2

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 15.249(d):
Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in §15.209, whichever is the lesser attenuation.

5.3.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT will be in accordance to ANSI C63.4. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. During the test, the EUT was set into continuous transmitting mode modulated.
Instrument settings:

9 kHz – 150 kHz	RBW:	200 Hz
150 kHz - 30 MHz	RBW:	9 kHz
30 MHz – 1000 MHz:	RBW:	120 kHz
1000 MHz – 40 GHz	RBW = VBW:	1 MHz

5.3.5 Test result f < 1 GHz

Frequency (MHz)	L: QP (dBµV)	L: AV (dBµV)	Bandwidth (kHz)	Correct. (dB)	L: QP dB(µV/m)	L: AV dB(µV/m)	Limit dB(µV/m)	Delta (dB)
0.009 – 0.490	---	---	0.2				108.5 - 13.8	>20
0.490 – 1.705	---	---	9				33.8 - 22.9	>20
1.705 - 30	---	---	9				29.5	>20
30 – 88	---	---	120				40	>20
88 – 216	---	---	120				43.5	>20
216 - 960	---	---	120				46	>20
Above 960	---	---	120				54	>20

Note: No unwanted emissions could be measured!

5.3.6 Test result f > 1 GHz

Frequency (MHz)	L: PK (dBµV)	L: AV (dBµV)	Bandwidth (kHz)	Correct. (dB)	Corrected AV level dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
1832.0	75.4	47.0	1000	-12.5	34.5	54.0	-19.5
2748.0	77.4	33.0	1000	-10.0	23.0	54.0	-31.0
3664.0	73.2	40.5	1000	-9.1	31.4	54.0	-22.6
4580.0	56.2	30.8	1000	4.1	34.9	54.0	-19.1
5496.0	41.2	31.7	1000	4.7	36.4	54.0	-17.6

*) Average values were measured with spectrum analyzer by taking the following settings

RBW: 1 MHz
VBW: 10 Hz
Sweep: Auto

Limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits dB(µV/m)	Measurement distance (m)
0.009 - -0.49	2400/f(kHz)	300
0.49 – 1.705	24000/f(kHz)	30
1.705 – 30.0	30	30
30-88	40	3
88-216	43,5	3
216-960	46	3
Above 960	54	3

The requirements are **FULFILLED.**

Remarks: The measurement was performed up to the 10th harmonic (10000 MHz).

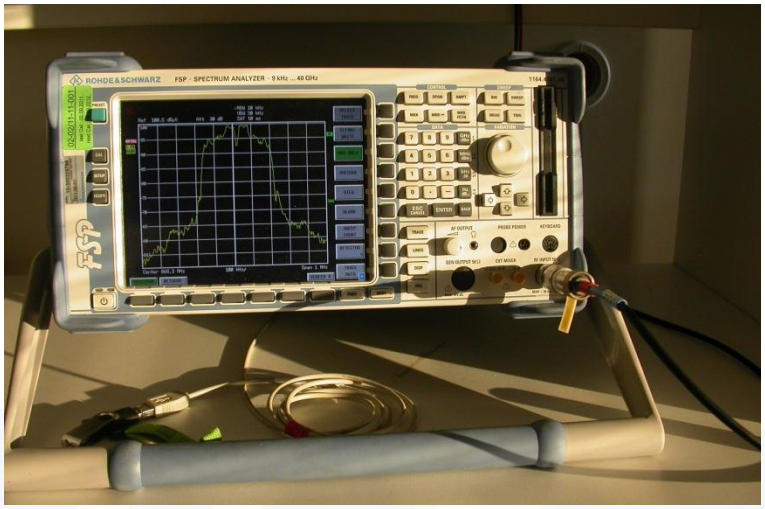
5.4 Emission Bandwidth

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



5.4.3 Applicable standard

According to FCC Part 15, Section 15.215(c):
Intentional radiators operating under the provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band is designated in the rule section under which the equipment is operated.

5.4.4 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB. The reference level is the level of the highest signal amplitude observed from the transmitter at the fundamental frequency. Alternative is the x-dB-down function of the analyser used. The EBW is than directly shown in the marker display. The measurement is performed with normal modulation and a transfer rate means the worst case.
Spectrum analyser settings see protocol:

5.4.5 Test result

Fundamental [MHz]	20dB Bandwidth F1 [MHz]	20dB Bandwidth F2 [MHz]	Measured Bandwidth [MHz]
916.0	915.38	916.66	1.28

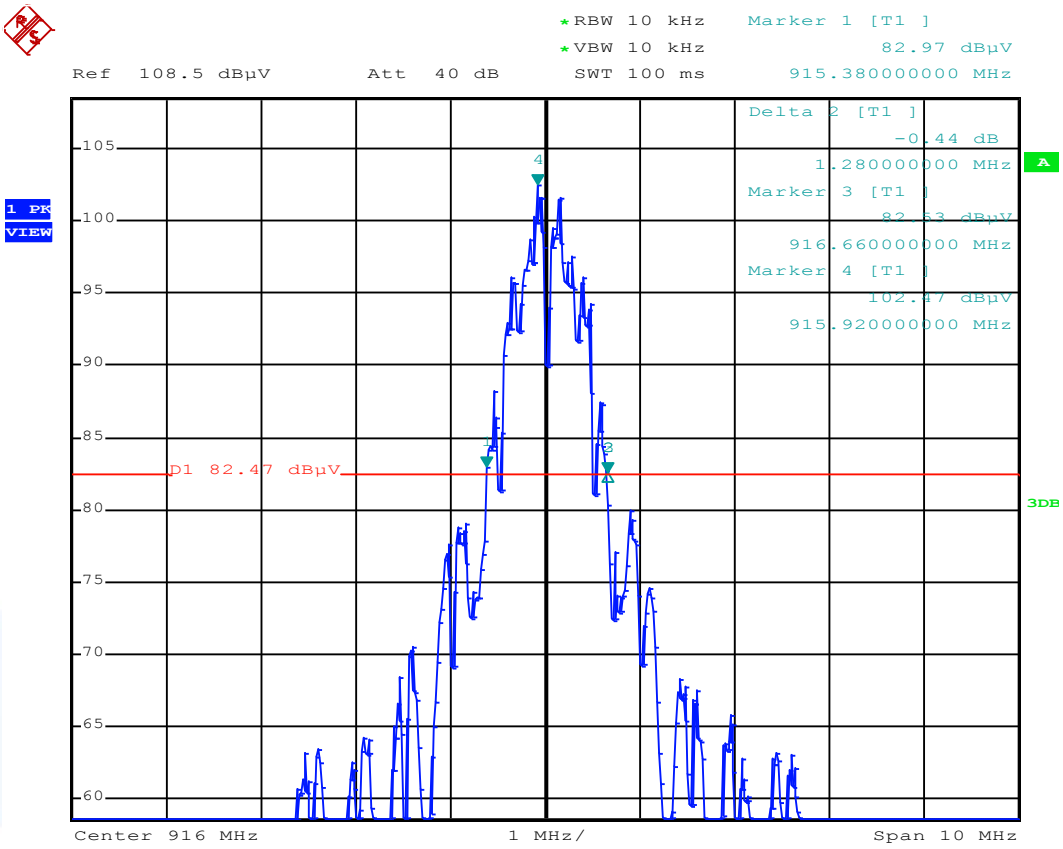
80% bandwidth of the permitted band (902 – 928 MHz): **20.8 MHz**

Limit according to FCC Part 15C, Section 15.215(c):
The EUT must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band is designated in the rule section under which the equipment is operated. The requirement includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well the frequency stability. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.
The requirements are **FULFILLED.**

Remarks: For detailed results, please see the test protocol below.

5.4.6 Test protocol

Emission bandwidth



5.5 Antenna application

5.5.1 Applicable standard

According to FCC Part 15C, Section 15.203(a):
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

Remarks: The EUT's antenna meets the requirement of FCC Part 15 C, Section 15.203 and 15.204.

5.6 Receiver radiated emissions

For test instruments and accessories used see section 6 Part **SER1, SER2** and **SER3**.

5.6.1 Description of the test location

Test location: NONE
Test distance:

Test location: NONE
Test distance:

5.6.2 Photo documentation of the test set-up

5.6.3 Applicable standard

According to FCC Part 15C, Section 15.209(a):
Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 m shall not exceed the given limit.

5.6.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. The setup of the EUT will be in accordance to ANSI C63.4. If the emission level in peak mode complies with the average limit then testing will be stopped and peak values of the EUT will be reported, otherwise, the emission will be measured in average mode again and reported. During the test, the EUT was set into continuous transmitting mode modulated.
Instrument settings:

9 kHz – 150 kHz	RBW:	200 Hz
150 kHz - 30 MHz	RBW:	9 kHz
30 MHz – 1000 MHz:	RBW:	120 kHz
1000 MHz – 40 GHz	RBW = VBW:	1 MHz

5.6.5 Test result f < 1 GHz

Frequency (MHz)	Level QP (dBµV)	Bandwidth (kHz)	Corr. factor (dB)	Corr. level QP dB(µV/m)	Limit dB(µV/m)	Delta (dB)

Test result f >1 GHz

Frequency (MHz)	Level PK (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected level PK dB(µV/m)	Limit dB(µV/m)	Delta (dB)

Limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits dB(µV/m)	Measurement distance (m)
0.009 – 0.49	2400/f(kHz)	300
0.49 – 1.705	24000/f(kHz)	30
1.705 – 30.0	30	30
30 – 88	40	3
88 – 216	43,5	3
216 – 960	46	3
Above 960	54	3

Remarks: The measurement is not applicable, because it is not possible to set the EuT only in receive mode.

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	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESHS 30	02-02/03-05-002	30/06/2012	30/06/2011		
	NNLK 8129	02-02/20-05-001			09/07/2012	09/01/2012
	ESH 2 - Z 5	02-02/20-05-004	12/05/2013	12/05/2011	09/07/2012	09/01/2012
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155			05/04/2012	05/10/2011
	SP 103 /3.5-60	02-02/50-05-182				
CPR 2	ESVS 30	02-02/03-05-006	20/06/2012	20/06/2011		
	VULB 9168	02-02/24-05-005	07/03/2012	07/03/2011	06/04/2012	06/10/2011
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
MB	ESCI	02-02/03-05-005	21/11/2012	21/11/2011		
	THS730A	02-02/13-05-001	17/10/2012	17/10/2011		
	RF Antenna	02-02/24-05-032				
	WK-340/40	02-02/45-05-001	31/05/2013	31/05/2011	22/06/2012	22/12/2011
	6543A	02-02/50-05-157				
SER 1	FMZB 1516	01-02/24-01-018			16/02/2013	16/02/2012
	ESCI	02-02/03-05-005	21/11/2012	21/11/2011		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	20/06/2012	20/06/2011		
	VULB 9168	02-02/24-05-005	07/03/2012	07/03/2011	06/04/2012	06/10/2011
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 3	FSP 40	02-02/11-11-001	02/09/2012	02/09/2011		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	16/02/2013	16/02/2012		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				