

EMI - TEST REPORT

- FCC Part 15B -

Test Report No. :	T28855-00-06KJ	17. December 2014 Date of issue
--------------------------	-----------------------	------------------------------------

Type / Model Name : US-3046

Product Description : Base Station

Applicant : smaXtec animal care sales GmbH

Address : Wastiangasse 4
8010 GRAZ, AUSTRIA

Manufacturer : smaXtec animal care sales GmbH

Address : Wastiangasse 4
8010 GRAZ, AUSTRIA

Licence holder : smaXtec animal care sales GmbH

Address : Wastiangasse 4
8010 GRAZ, AUSTRIA

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



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	3
3 Final assessment	7
4 TEST ENVIRONMENT	8
4.1 Address of the test laboratory	8
4.2 Environmental conditions	8
4.3 Statement of the measurement uncertainty	8
4.4 Measurement protocol for FCC	9
5 TEST CONDITIONS AND RESULTS	11
5.1 Conducted emission	11
5.2 Radiated emission	17
6 USED TEST EQUIPMENT AND ACCESSORIES	20

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart A - General (September, 2014)

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 B - Unintentional Radiators (September, 2014)

Part 15, Subpart B, Section 15.107	AC Line conducted emission <input type="checkbox"/> Class A device <input checked="" type="checkbox"/> Class B device
Part 15, Subpart B, Section 15.109	Radiated emission, general requirements
Part 15, Subpart B, Section 15.111	Antenna power conduction

ANSI C63.4: 2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
------------------	---

CISPR 16-4-2: 2011 EN 55016-4-2: 2011	Uncertainty in EMC measurement
--	--------------------------------

CISPR 22: 2008 EN 55022: 2010	Information technology equipment
----------------------------------	----------------------------------

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see attachment A



2.2 Short description of the equipment under test (EUT)

The base station is an electronic device that is intended to read measurement data from smaxtec Temp Sensor, Climate Sensor, and pH & Temp Sensor. The data is forwarded from the PCBA to the Beagle Bone where it is stored permanently into a flash memory. The BeagleBone then sends the data samples via Ethernet or GSM (if available and activated) to a smaxtec Server.

The coverage of readout devices is with 5 to 10 m relatively small. To cover larger areas, one or more smaxtec Repeater can be used to increase the readout coverage. Repeater and Basestation set up a multihop network on the 2.4 GHz network, over which the Repeater can forward the read data to the Basestation and further to the smaxtec Server.

Number of tested samples: 1
Serial number: Prototype

2.3 Variants of the EUT

There are no variants.

2.4 Antenna

Number	Characteristic	Frequency range (MHz)	Gain (dBi)
1	PCB-antenna	905.5	-3.5

Number	Characteristic	Certification name	Plug	f-range (GHz)	Gain (dBi)	Cable loss (dB)	Effective gain (dBi)
1	OMNI	Print antenna	-	2.4	3.3	0	3.3

2.5 Transmit operating modes

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

- RX-Mode

-

2.6 Power supply system utilised

Power supply voltage, V_{nom} : 100-240 V AC - 50-60 Hz / tested with 115 V AC - 60 Hz

2.7 Peripheral devices and interface cables

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

- _____ Model : _____
 - _____ Model : _____

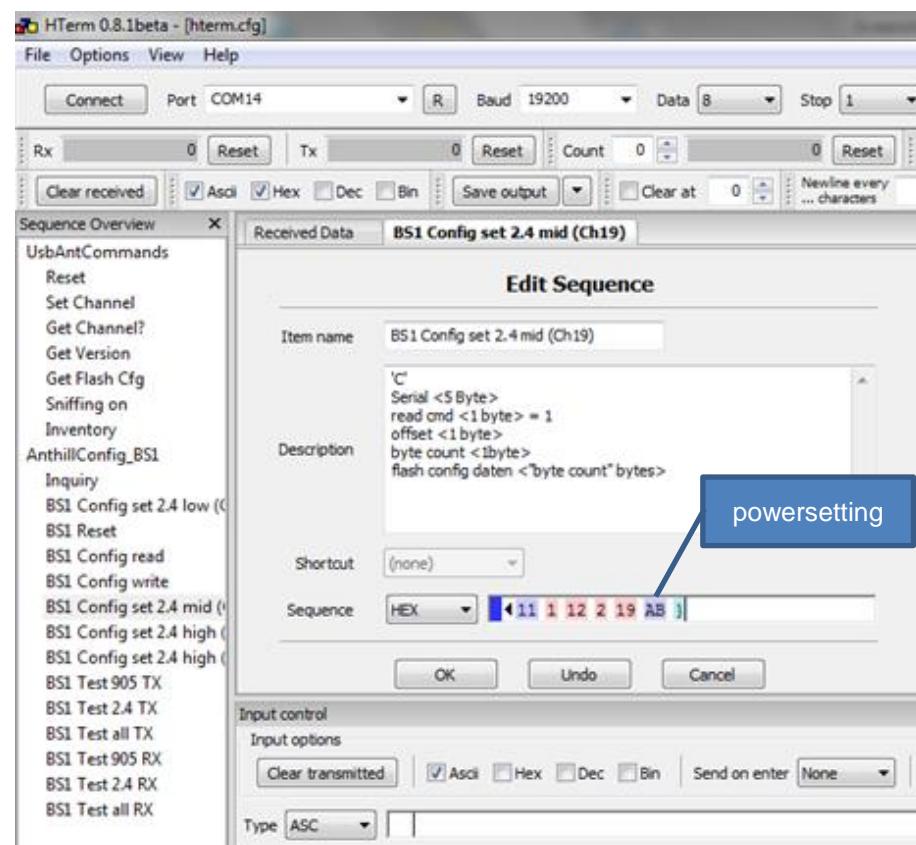
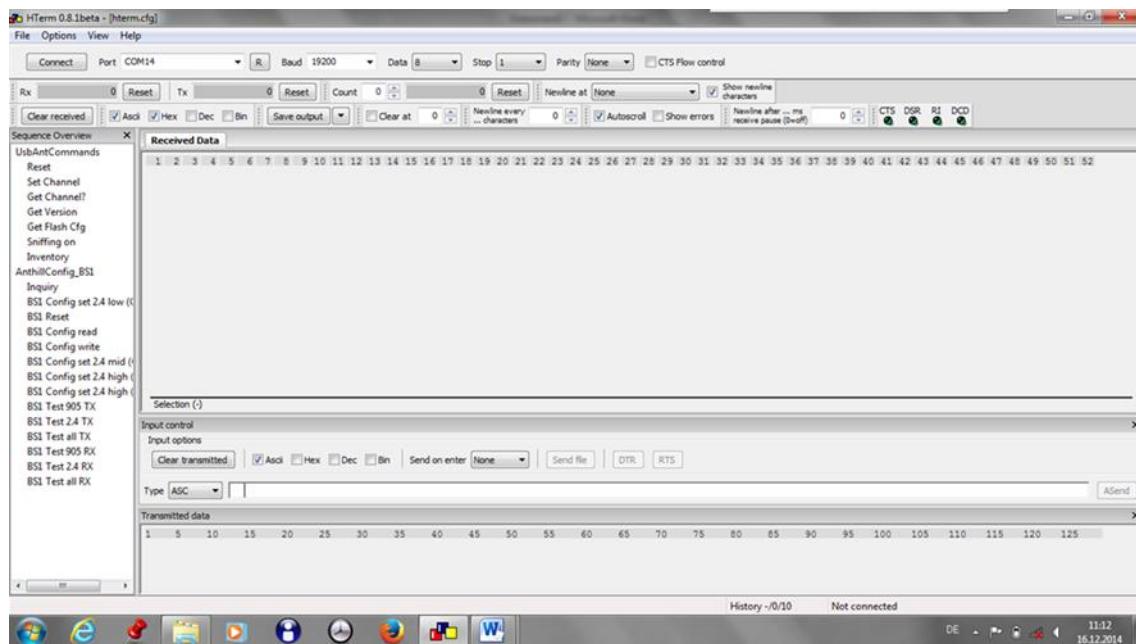
2.8 Determination of worst case conditions for final measurement

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting of the EUT produce the maximum of the emissions.

2.8.1 Test Jig

No test jig is used.

2.8.2 Test software



3 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 : 20 October 2014

Testing concluded on : 08 December 2014

Checked by:

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Josef Knab
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
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. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. 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. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern 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 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

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

4.4.2.1 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 Emission 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

4.4.3.1 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.

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

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \cdot \log(\mu\text{V}) \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)} \end{aligned}$$

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 $50 \Omega / 50 \mu\text{H}$ (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 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.

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

4.4.4.1 Description of measurement

Spurious emission from the EUT is 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 centre 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 centre of the table and to a screened room located outside the test area. The antenna is positioned in horizontal polarisation and is repeated vertically. To locate maximum emission from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.

The final level in dB μ V/m is calculated by add the antenna correction factor and cable loss factor (dB) on the reading from the EMI receiver (dB μ V). The FCC or CISPR limit is subtracted from this result in order to provide the delta to limit listed in the measurement protocol.

Example:

Frequency (MHz)	Reading level (dB μ V)	+	Correction Factor (dB/m)	=	Level (dB μ V/m)	-	CISPR Limit (dB μ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

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

4.4.5.1 Description of measurement

Radiated emission 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 centre 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 centre 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 emission under better uncertainty and is calculated to the specified test distance.

5 TEST CONDITIONS AND RESULTS

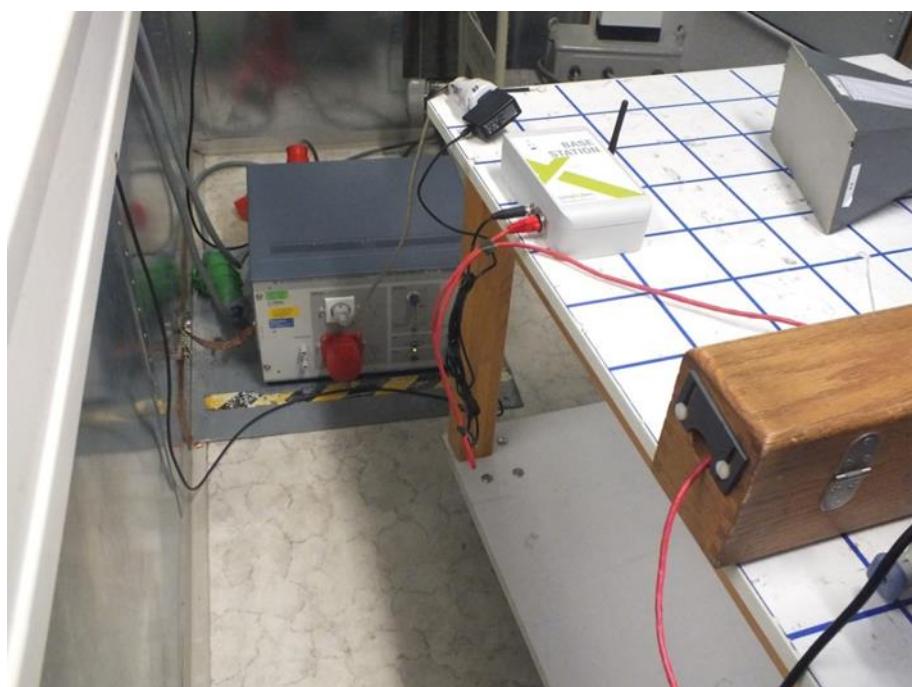
5.1 Conducted emission

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 15.107(a):

Except for Class A devices, for equipment 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. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission are re-measured 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 9.9 dB at 0.155 MHz

Limit according to FCC Part 15, Section 15.107(a):

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	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

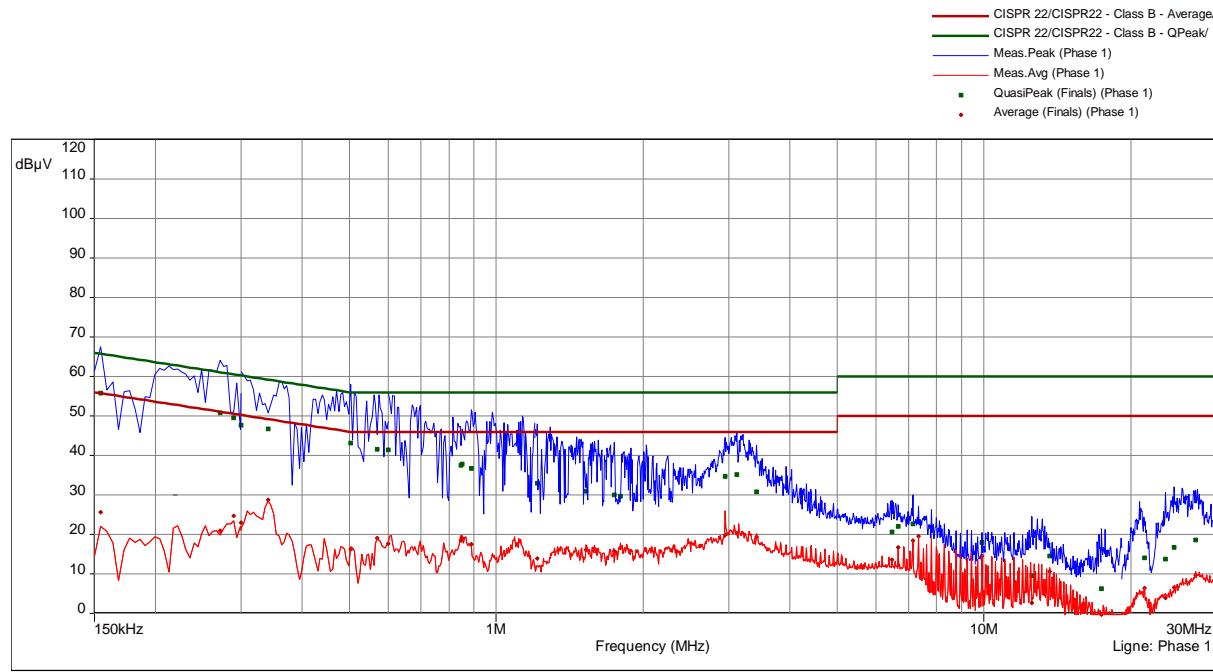
The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocols.

5.1.6 Test protocol

Test point L1
 Operation mode: RX-Mode
 Remarks: -

Result: passed

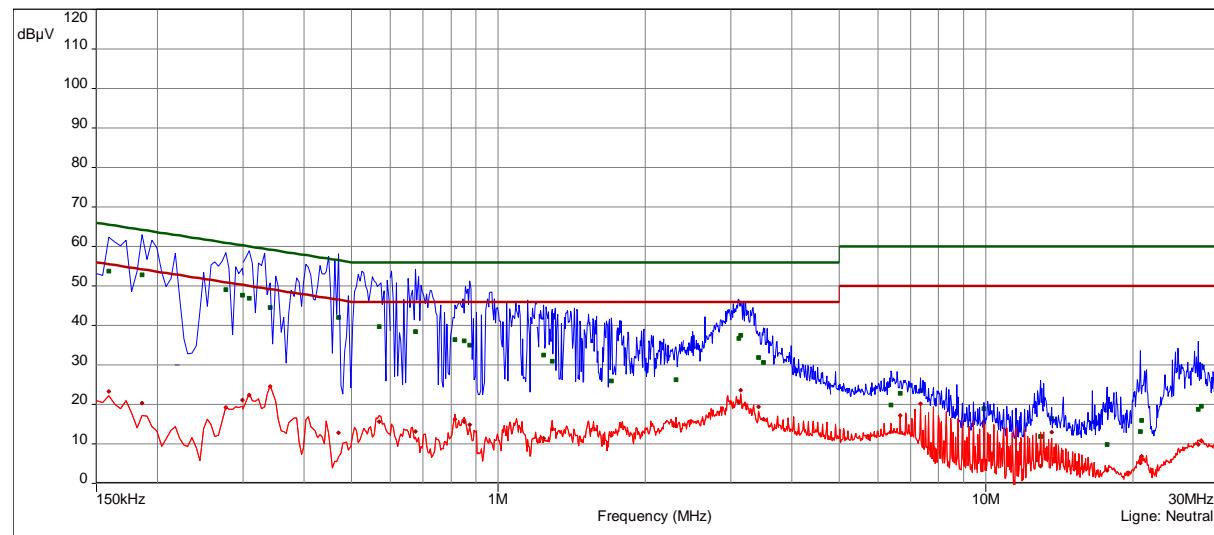


freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB	
0.155	1	55.8	9.9	65.8	25.6	30.1	55.8	Phase 1
0.272	1	50.9	10.2	61.1	20.9	30.1	51.1	Phase 1
0.290	1	49.6	11.0	60.5	24.7	25.9	50.5	Phase 1
0.300	2	47.7	12.5	60.2	23.0	27.2	50.2	Phase 1
0.341	2	46.7	12.5	59.2	28.8	20.4	49.2	Phase 1
0.503	2	43.1	12.9	56.0	16.3	29.7	46.0	Phase 1
0.570	2	41.6	14.4	56.0	19.0	27.0	46.0	Phase 1
0.600	3	41.5	14.5	56.0	17.7	28.3	46.0	Phase 1
0.848	3	37.5	18.5	56.0	18.4	27.6	46.0	Phase 1
0.852	3	37.8	18.2	56.0	19.1	26.9	46.0	Phase 1
0.888	3	36.8	19.2	56.0	17.6	28.4	46.0	Phase 1
1.214	4	32.9	23.1	56.0	13.9	32.2	46.0	Phase 1
1.529	4	31.0	25.0	56.0	16.1	29.9	46.0	Phase 1
1.745	4	30.0	26.0	56.0	15.8	30.2	46.0	Phase 1
1.799	4	29.7	26.3	56.0	16.6	29.4	46.0	Phase 1
2.945	5	34.8	21.2	56.0	19.9	26.1	46.0	Phase 1
3.116	5	35.2	20.8	56.0	20.3	25.8	46.0	Phase 1
3.422	5	30.9	25.1	56.0	19.3	26.7	46.0	Phase 1
6.479	6	20.7	39.3	60.0	13.6	36.4	50.0	Phase 1
6.668	6	22.0	38.0	60.0	16.7	33.3	50.0	Phase 1
7.145	6	22.7	37.3	60.0	18.5	31.5	50.0	Phase 1
7.334	6	23.3	36.7	60.0	19.6	30.4	50.0	Phase 1
9.906	7	17.9	42.1	60.0	14.6	35.4	50.0	Phase 1
12.539	7	9.5	50.5	60.0	2.7	47.4	50.0	Phase 1
13.623	7	14.5	45.5	60.0	10.7	39.3	50.0	Phase 1
17.439	7	6.2	53.8	60.0	- 1.4	51.4	50.0	Phase 1
21.338	8	14.0	46.0	60.0	6.4	43.6	50.0	Phase 1
23.565	8	13.8	46.2	60.0	3.9	46.1	50.0	Phase 1
24.578	8	16.7	43.3	60.0	6.5	43.5	50.0	Phase 1
27.183	8	18.6	41.4	60.0	9.7	40.3	50.0	Phase 1

Test point: **N**
 Operation mode: **RX-Mode**
 Remarks: **-**

Result: passed

 CISPR 22/CISPR22 - Class B - Average/
 CISPR 22/CISPR22 - Class B - QPeak/
 Meas. Peak (Neutral)
 Meas. Avg (Neutral)
 QuasiPeak (Finals) (Neutral)
 Average (Finals) (Neutral)



CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB	
0.159	9	53.8	11.8	65.5	23.3	32.2	55.5	Neutral
0.186	9	52.8	11.4	64.2	20.4	33.8	54.2	Neutral
0.276	9	49.1	11.9	60.9	19.2	31.7	50.9	Neutral
0.299	9	47.6	12.7	60.3	21.1	29.2	50.3	Neutral
0.309	10	46.9	13.1	60.0	22.4	27.6	50.0	Neutral
0.341	10	44.6	14.6	59.2	24.6	24.6	49.2	Neutral
0.471	10	42.0	14.5	56.5	12.8	33.7	46.5	Neutral
0.570	10	39.7	16.3	56.0	15.7	30.3	46.0	Neutral
0.677	11	38.5	17.5	56.0	13.1	32.9	46.0	Neutral
0.816	11	36.4	19.6	56.0	16.2	29.8	46.0	Neutral
0.852	11	36.2	19.8	56.0	15.7	30.3	46.0	Neutral
0.875	11	35.1	21.0	56.0	14.8	31.2	46.0	Neutral
1.241	12	32.5	23.5	56.0	11.4	34.6	46.0	Neutral
1.290	12	30.9	25.1	56.0	13.8	32.2	46.0	Neutral
1.704	12	26.0	30.0	56.0	12.2	33.8	46.0	Neutral
2.316	12	26.3	29.7	56.0	14.5	31.5	46.0	Neutral
3.116	13	36.7	19.3	56.0	20.4	25.6	46.0	Neutral
3.143	13	37.6	18.4	56.0	23.6	22.4	46.0	Neutral
3.422	13	31.9	24.1	56.0	19.3	26.7	46.0	Neutral
3.503	13	30.7	25.3	56.0	16.3	29.7	46.0	Neutral
6.393	14	19.9	40.1	60.0	13.1	36.9	50.0	Neutral
6.668	14	22.8	37.2	60.0	17.3	32.7	50.0	Neutral
7.334	14	23.5	36.5	60.0	20.1	29.9	50.0	Neutral
9.906	15	18.9	41.1	60.0	15.7	34.4	50.0	Neutral
12.930	15	11.9	48.1	60.0	4.5	45.5	50.0	Neutral
13.623	15	16.4	43.6	60.0	12.9	37.1	50.0	Neutral
17.709	15	9.8	50.2	60.0	3.3	46.7	50.0	Neutral
20.735	16	13.2	46.8	60.0	5.1	44.9	50.0	Neutral
20.861	16	16.0	44.0	60.0	6.8	43.2	50.0	Neutral
27.296	16	18.8	41.2	60.0	9.8	40.2	50.0	Neutral
27.624	16	19.6	40.4	60.0	10.8	39.2	50.0	Neutral

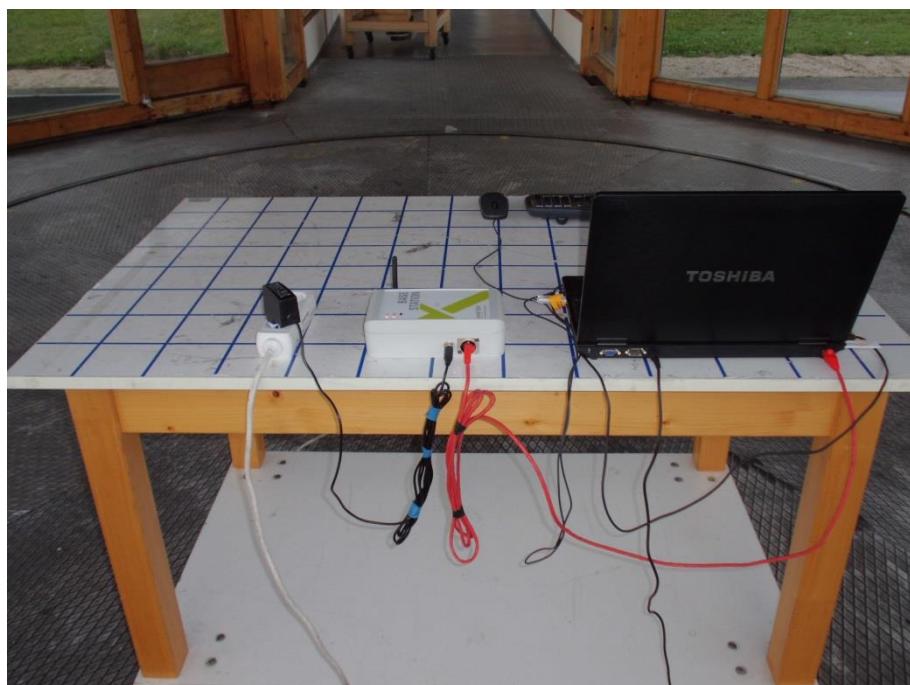
5.2 Radiated emission

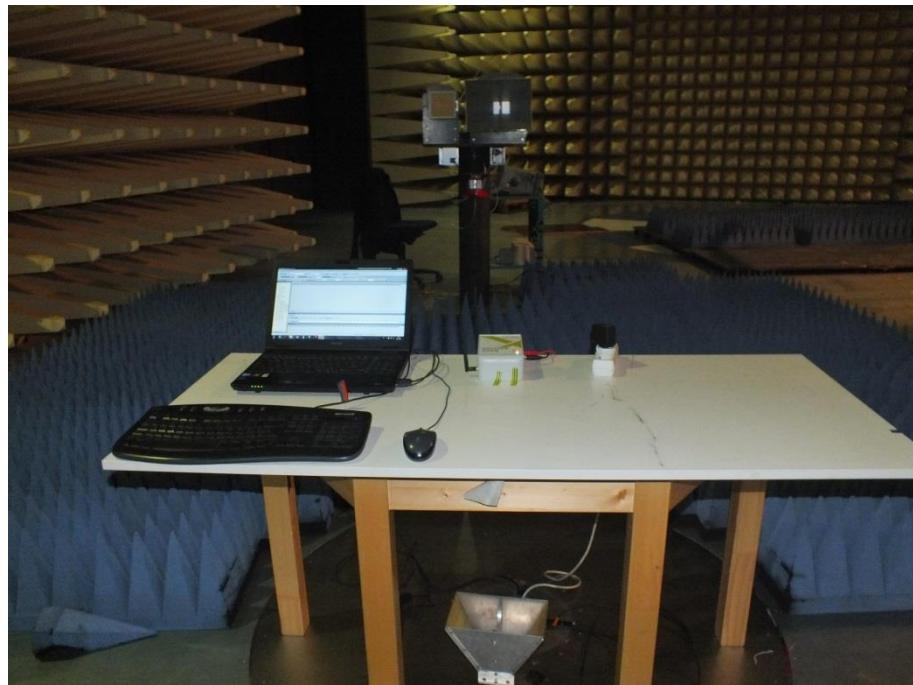
For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

5.2.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 2
Test distance: 3 m

5.2.2 Photo documentation of the test setup





5.2.3 Applicable standard

According to FCC Part 15B, Section 15.109 (a):

Except for Class A digital devices, the field strength of radiated emission from unintentional radiators at a distance of 3 m shall not exceed the given limit.

5.2.4 Description of Measurement

The 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. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.4, Item 8 and 12. In the frequency range above 1 GHz a spectrum analyser is used. If the emission level in peak mode complies with the average limit, testing is stopped and peak values will be reported, otherwise, the emission is measured in average mode again and both are reported. The EUT is measured in RX continuous mode under normal conditions.

Instrument settings:

30 MHz – 1000 MHz:	RBW: 120 kHz	VBW: 3MHz	Detector: Peak
1000 MHz – 12.5 GHz	RBW: 1 MHz		

5.2.5 Test result

f < 1 GHz

Frequency (MHz)	Reading level QP (dB μ V)	Reading level AV (dB μ V)	Bandwidth (kHz)	Correction factor (dB/m)	Corrected level QP dB(μ V/m)	Corrected level AV dB(μ V/m)	Limit dB(μ V/m)	Delta (dB)
75.0	11.0	-	120	11.6	22.6	-	40.0	-17.4
230.0	7.5	-	120	12.7	20.2	-	46.0	-25.8
470.0	8.1	-	120	20.9	29.0	-	46.0	-17.0
560.0	7.8	-	120	23.2	31.0	-	46.0	-15.0
750.0	8.6	-	120	26.8	35.4	-	46.0	-10.6
900.0	9.4	-	120	28.9	38.3	-	46.0	-7.7

Note: The correction factor includes cable loss and antenna factor.

f > 1 GHz

Frequency (MHz)	Level PK dB(μ V/m)	Limit PK dB(μ V/m)	Margin PK (dB)	Limit AV dB(μ V/m)	Margin AV (dB)
1554	41.2	74.0	-32.8	54.0	-12.8
3622	43.9	74.0	-30.1	54.0	-10.1
8924	47.2	74.0	-26.8	54.0	-6.8
11913	47.6	74.0	-26.4	54.0	-6.4

Limit according to FCC Part 15B, Section 15.109(a):

Frequency (MHz)	Limit (μ V/m)	Limit (dB μ V/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

The requirements are **FULFILLED**.

Remarks: The measurement is performed according to FCC Part 15A, Section 15.33(b), up to the 5th harmonic.

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	17/07/2015	17/07/2014		
	ESH 2 - Z 5	02-02/20-05-004	18/10/2015	18/10/2013	02/03/2015	02/09/2014
	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	19/11/2015	19/11/2014	19/05/2015	19/11/2014
SER 2	ESVS 30	02-02/03-05-006	03/07/2015	03/07/2014		
	VULB 9168	02-02/24-05-005	08/04/2015	08/04/2014	04/03/2015	04/09/2014
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
SER 3	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	07/05/2015	07/05/2014		
	WHJS 1000-10EE	02-02/50-05-070				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	WHK 3.0/18G-10EF	02-02/50-05-180				
	SF104/11N/11N/1500MM	02-02/50-13-015				