



# EMI -- TEST REPORT

- FCC Part 15.249 -

<b>Test Report No. :</b> <b>T34021-00-04KJ</b>	30. April 2010 Date of issue
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Type / Model Name : Combio-915 RevoLine

Product Description : Transceiver unit for controlling roller shutters,  
venation blinds and sun protection systems

**Applicant** : elero GmbH Antriebstechnik

Address : Linsenhofer Str. 59-63  
72660 BEUREN, GERMANY

**Manufacturer** : elero GmbH Antriebstechnik

Address : Linsenhofer Str. 59-63  
72660 BEUREN, GERMANY

**Licence holder** : elero GmbH Antriebstechnik

Address : Linsenhofer Str. 59-63  
72660 BEUREN, GERMANY

<b>Test Result</b> according to the standards listed in clause 1 test standards:	<b>POSITIVE</b>
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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 A - General (October, 2009)**

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 (October, 2009)**

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.
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## 2 SUMMARY

### GENERAL REMARKS:

The EuT is working in transmit mode and receive mode at 918.3 MHz.  
The frequency range was scanned from 9 kHz to 10000 MHz.  
All emissions not reported in this test report were more than 10 dB below the specified limit.

### 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 : 02. March 2010

Testing concluded on : 12. April 2010

Checked by:

Tested by:

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

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Josef Knab

### 3 EQUIPMENT UNDER TEST

#### 3.1 Photo documentation of the EUT – External Photos

Combio-915 RevoLine  
System overview  
(incl. VarioTel2 at lower left side)



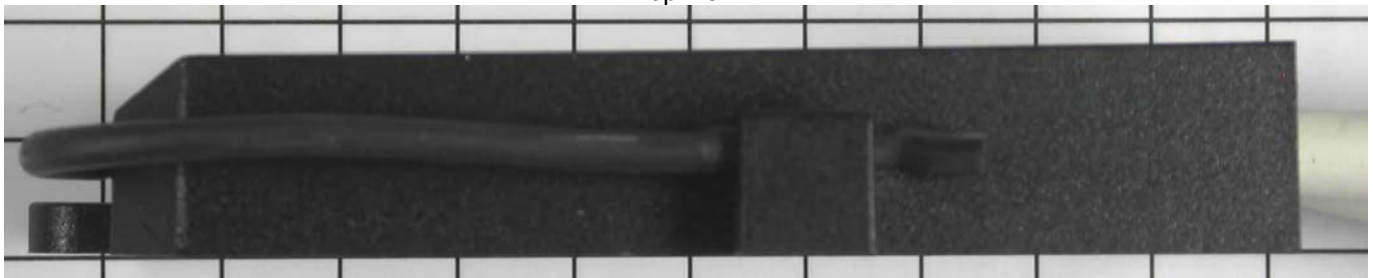
Combio-915 RevoLine  
Front view



Combio-915 RevoLine  
Rear view



Combio-915 RevoLine  
Top view






Combio-915 RevoLine  
Cable entry



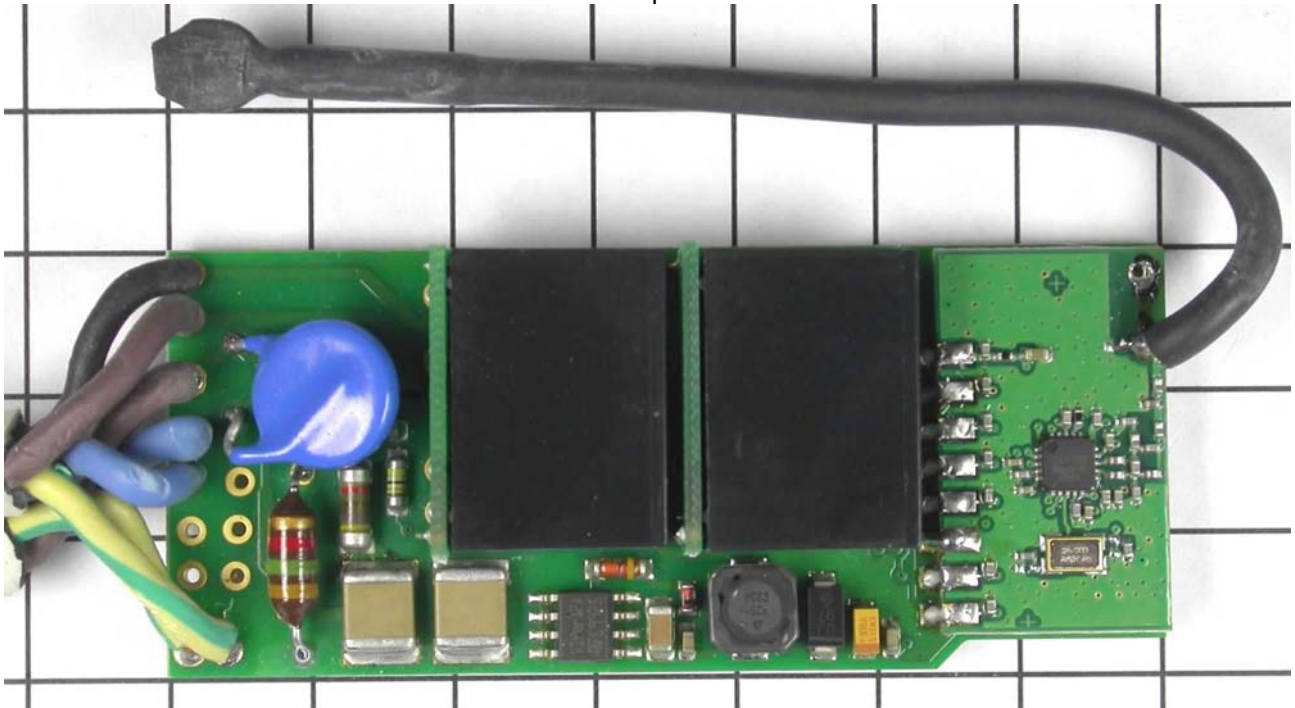
FCC ID: YBU285XX0901

Combio-915 RevoLine  
Label view

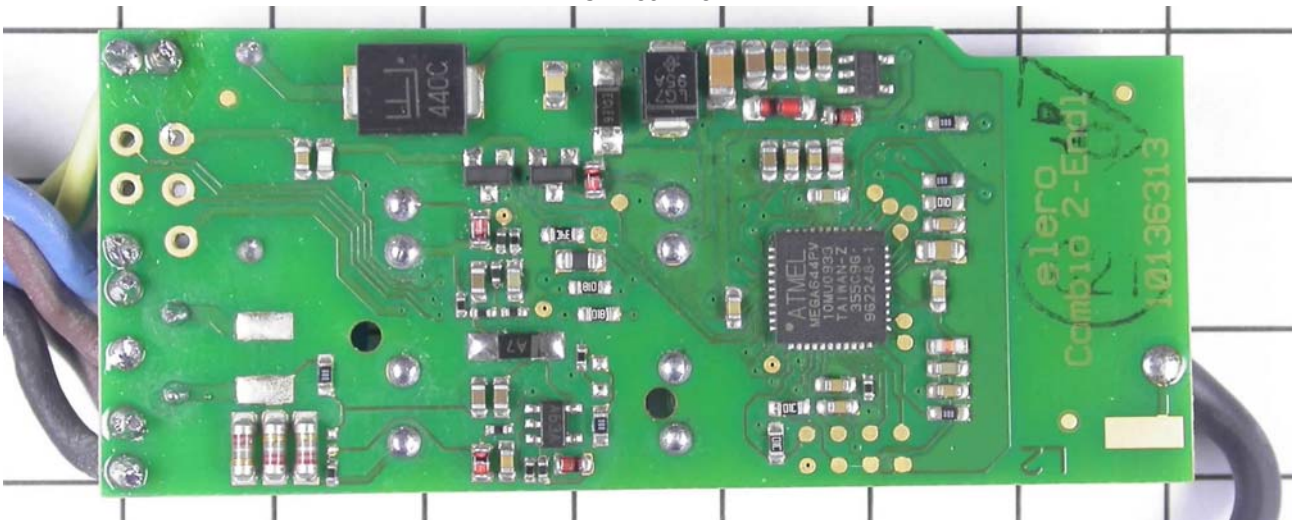
www.elerero.com		<b>elerero</b>	
Combio-915 RevoLine		IP 56	04.10
28 525.0906	230V/50Hz	915 MHz Band	450 W
No. 9 0001 00429 . 57	Manufactured in Germany		
FCC ID: YBU285XX0901 / IC: 8929A-285XX0901			
 4016684020940			

### 3.2 Photo documentation of the EUT – Internal Photos

Combio-915 RevoLine  
PCB top view

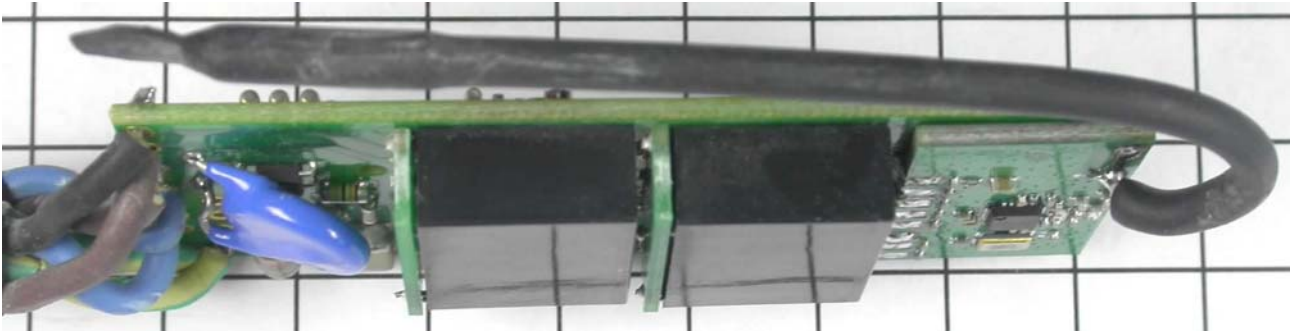


Combio-915 RevoLine  
PCB rear view

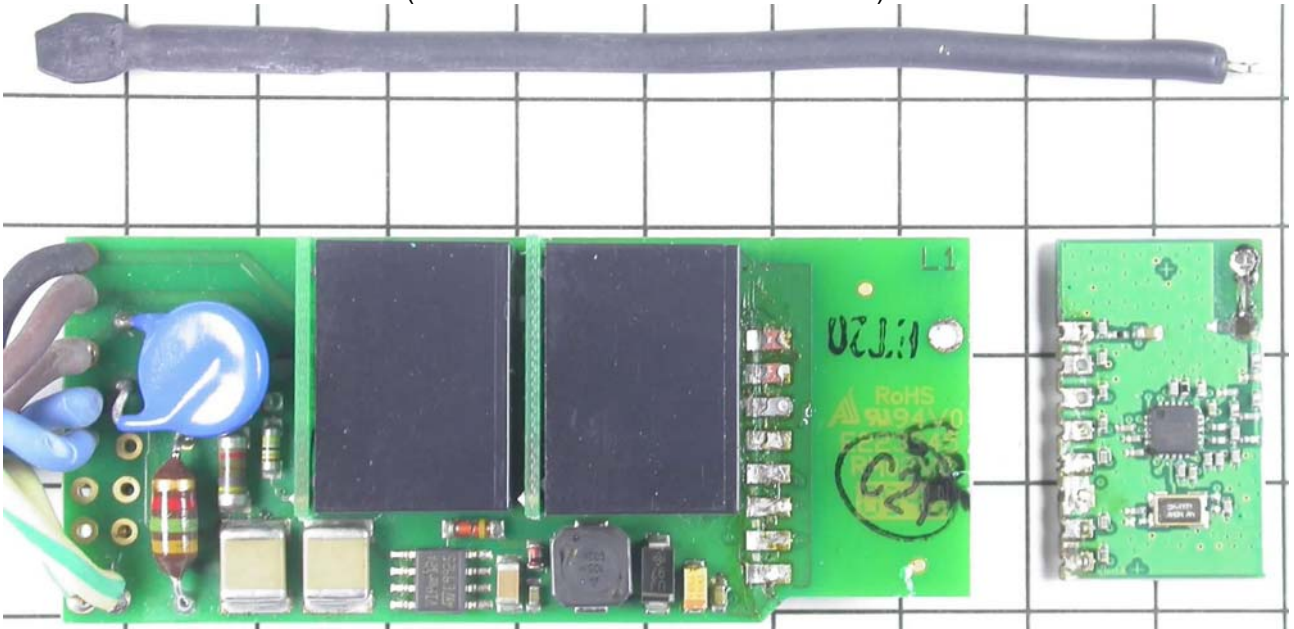




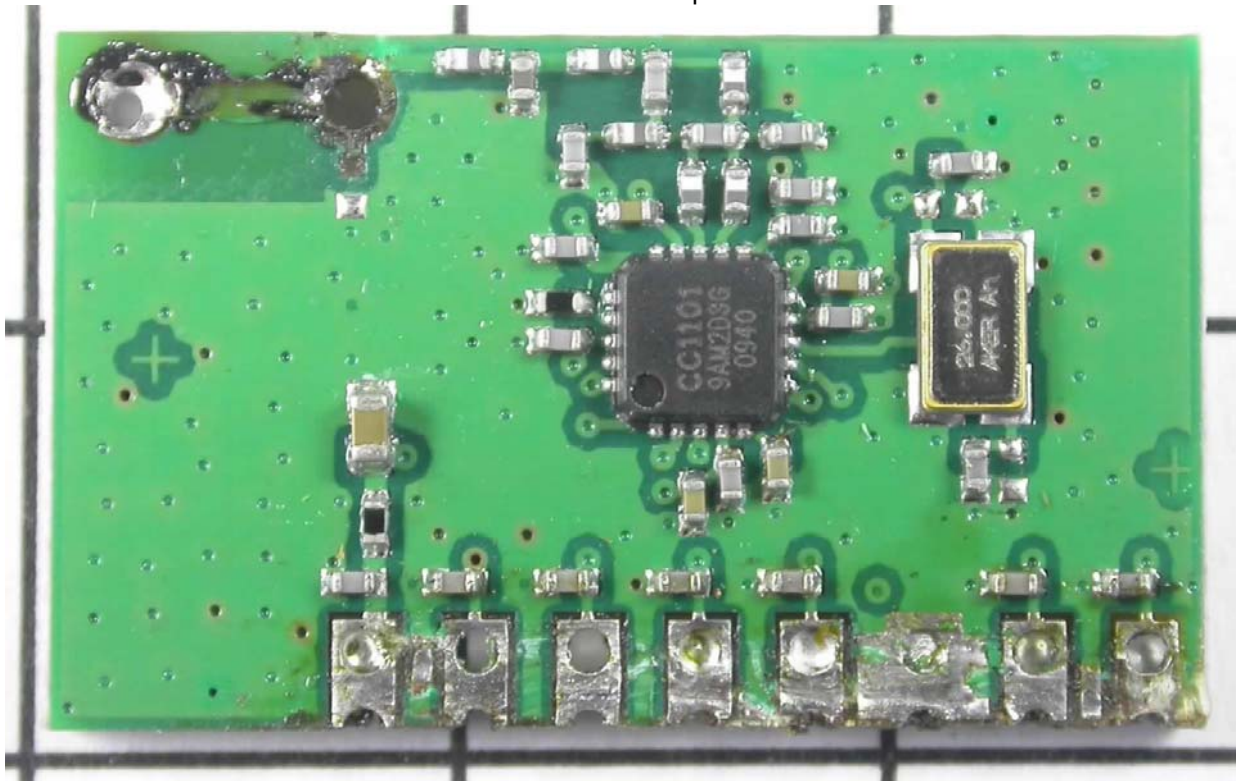
Combio-915 RevoLine  
PCB side view



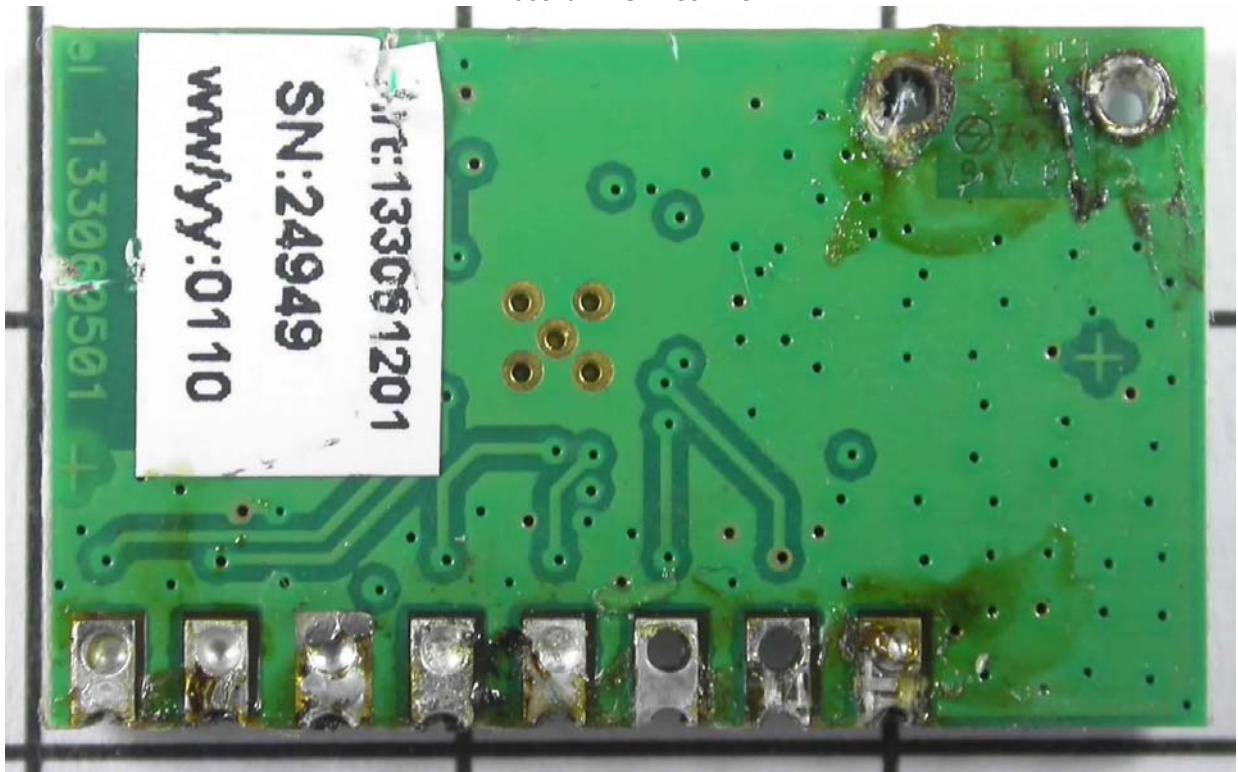
Combio-915 RevoLine  
PCB top view  
(with unsoldered RF board and antenna)



Combio-915 RevoLine  
RF board - PCB top view



Combio-915 RevoLine  
RF board - PCB rear view



### 3.3 Power supply system utilised

Power supply voltage : 115 V / 60 Hz / 1φ

### 3.4 Short description of the equipment under test (EUT)

The EuT is a transceiver unit that allows the extension of alternating current drives to a radio drive and can only be used for controlling roller shutters and sun protection systems such as venetian blinds.

Number of tested samples: 1  
Serial number: 0000122.41

#### EUT operation mode:

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

- continuous TX at 918.300 MHz

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- receive mode

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#### 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 : _____

## 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, 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.

##### 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 dB $\mu$ 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 $\mu$ V and  $\mu$ 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  $\mu$ 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 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 dB $\mu$ V/m is calculated by taking the reading from the EMI receiver (Level dB $\mu$ V) 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.

#### 4.5 Discovery of worst case measurement conditions

The tested model is a transceiver unit and consists of 2 different versions.

Combio-915 RevoLine	art.-no. 28.520.0906
Combio-915 JA	art.-no. 28.500.0906

All the versions are technically identical except the following items:

- different cable connections in accordance to the part lists
- firmware versions of the microcontrollers

The complete measurement was performed with Combio-915 RevoLine.

## 5 TEST CONDITIONS AND RESULTS

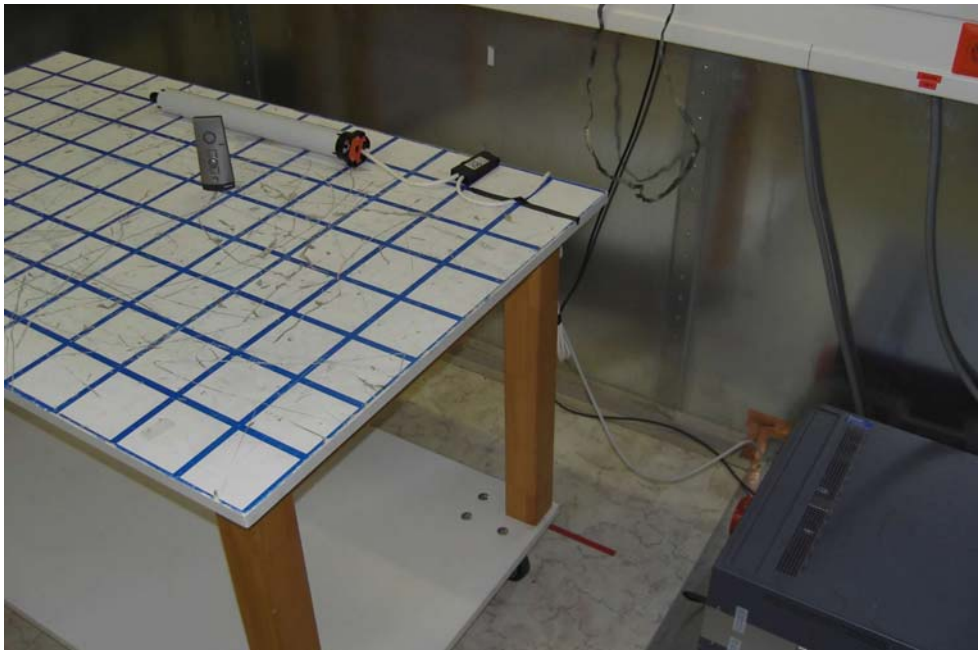
### 5.1 Conducted emissions

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 8.1 dB at 0.755 MHz

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

The requirements are **FULFILLED**.

**Remarks:** For detailed test result please refer to following test protocols  
 \_\_\_\_\_  
 \_\_\_\_\_



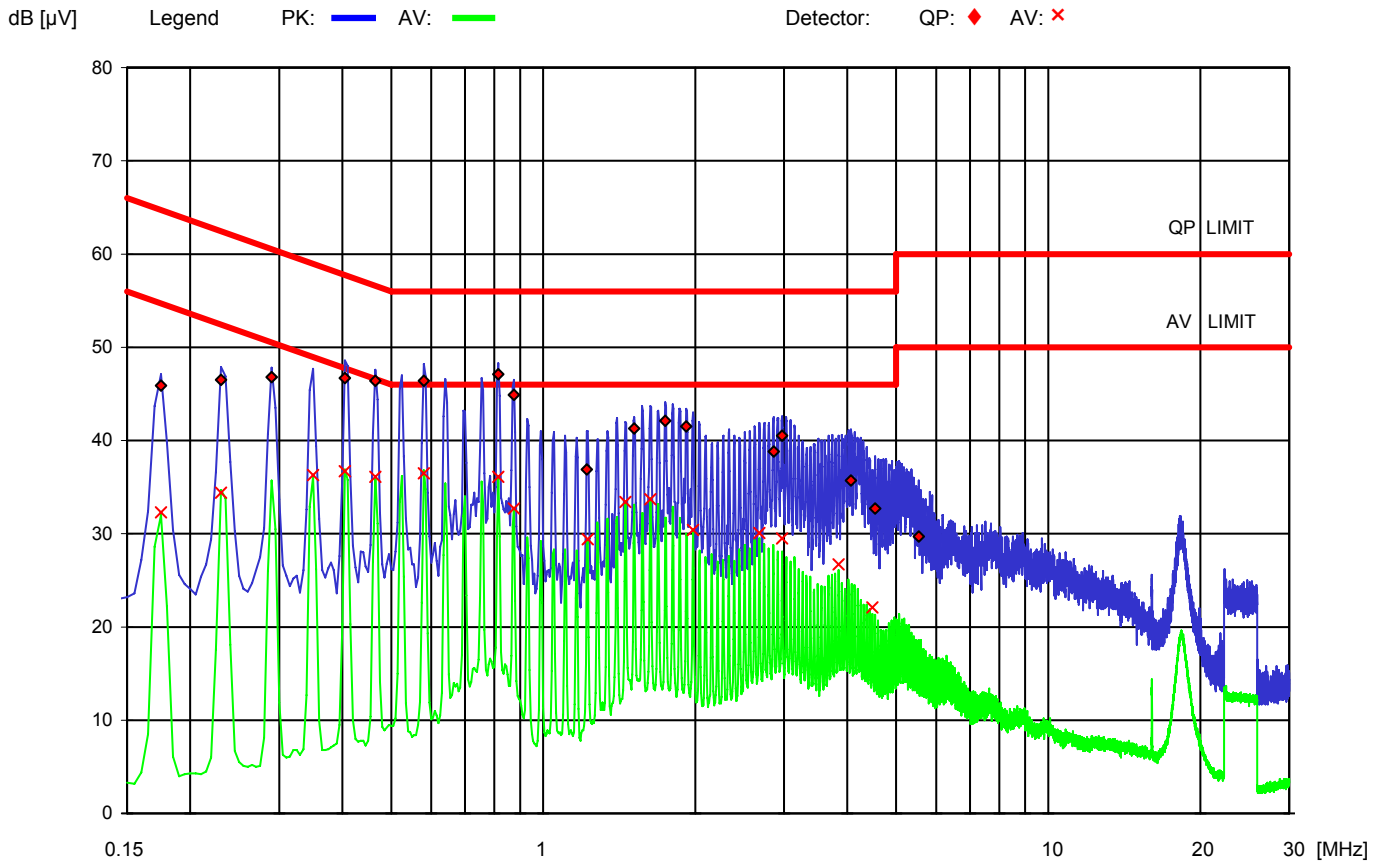
5.1.6 Test protocol

Test point L1  
 Operation mode: TX mode (continuous drive mode)  
 Remarks: -

Result: passed

Freq kHz	QP- L dB[μV]	D -Limit QP [dB]	Freq kHz	AV-L dB[μV]	D -Limit AV [dB]
175	45,9	18,8	175	32,3	22,4
230	46,5	15,9	230	34,4	18,0
290	46,8	13,7	350	36,3	12,7
405	46,7	11,1	405	36,7	11,1
465	46,4	10,2	465	36,1	10,5
580	46,4	9,6	580	36,5	9,5
815	47,1	8,9	815	36,1	9,9
875	44,9	11,1	875	32,7	13,3
1220	36,9	19,1	1225	29,4	16,6
1515	41,3	14,7	1455	33,4	12,6
1745	42,1	13,9	1630	33,7	12,3
1920	41,5	14,5	1980	30,4	15,6
2860	38,8	17,2	2680	30,1	15,9
2970	40,5	15,5	2970	29,5	16,5
4070	35,7	20,3	3845	26,7	19,3

Freq kHz	QP- L dB[μV]	D -Limit QP [dB]	Freq kHz	AV-L dB[μV]	D -Limit AV [dB]
4545	32,7	23,3	4485	22,1	23,9
5540	29,7	30,3			

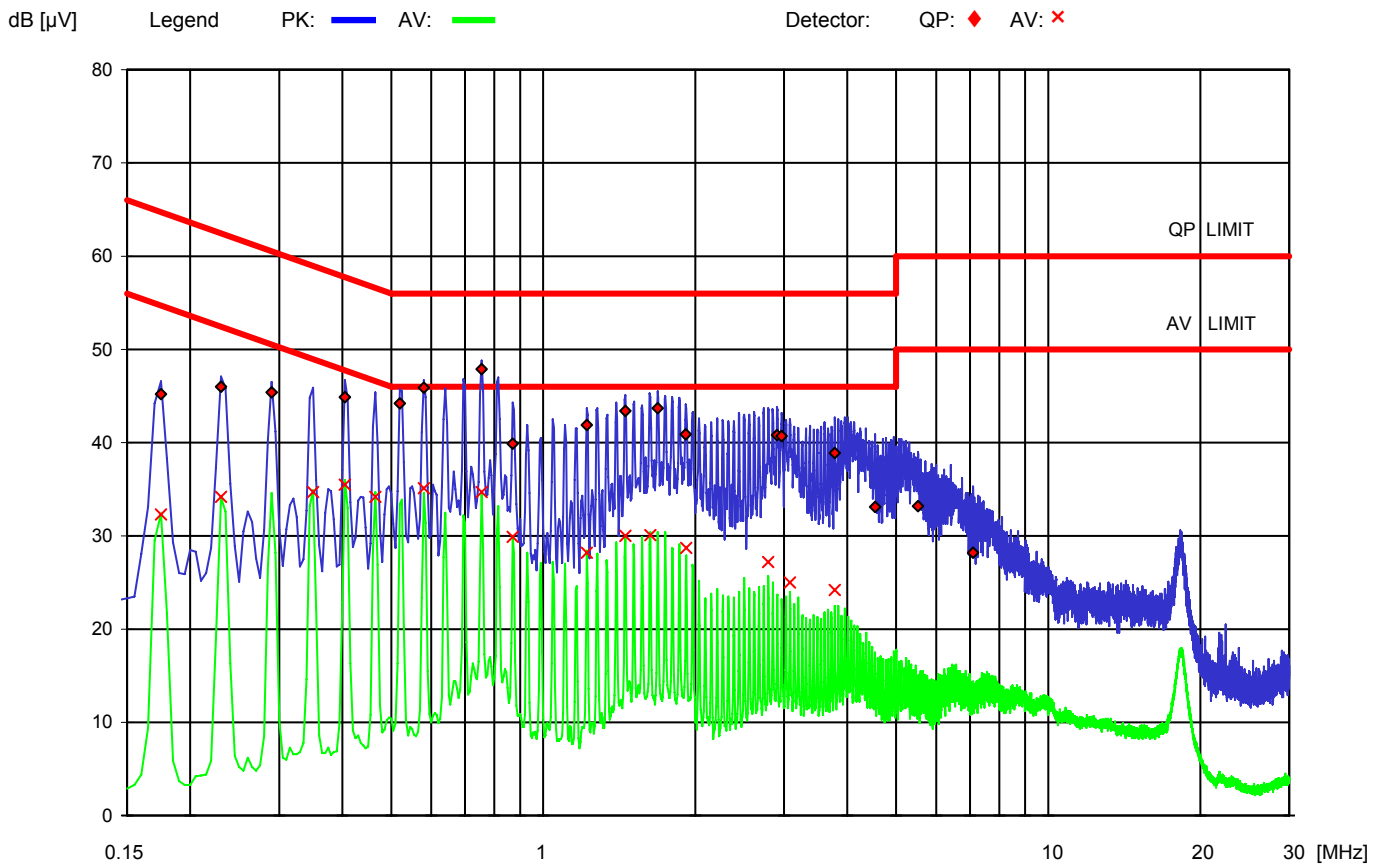


Test point: N  
 Operation mode: TX mode (continuous drive mode)  
 Remarks: -

Result: passed

Freq kHz	QP- L dB[µV]	D -Limit QP [dB]	Freq kHz	AV-L dB[µV]	D -Limit AV [dB]
175	45,2	19,5	175	32,3	22,4
230	46	16,4	230	34,2	18,2
290	45,4	15,1	350	34,7	14,3
405	44,9	12,9	405	35,5	12,3
520	44,2	11,8	465	34,2	12,4
580	45,9	10,1	580	35,1	10,9
755	47,9	8,1	755	34,7	11,3
870	39,9	16,1	870	29,9	16,1
1220	41,9	14,1	1220	28,2	17,8
1455	43,4	12,6	1455	30	16,0
1685	43,7	12,3	1630	30,1	15,9
1915	40,9	15,1	1920	28,7	17,3
2905	40,8	15,2	2790	27,2	18,8
2965	40,7	15,3	3080	25	21,0
3780	38,9	17,1	3780	24,2	21,8

Freq kHz	QP- L dB[µV]	D -Limit QP [dB]	Freq kHz	AV-L dB[µV]	D -Limit AV [dB]
4545	33,1	22,9			
5525	33,2	26,8			
7100	28,2	31,8			

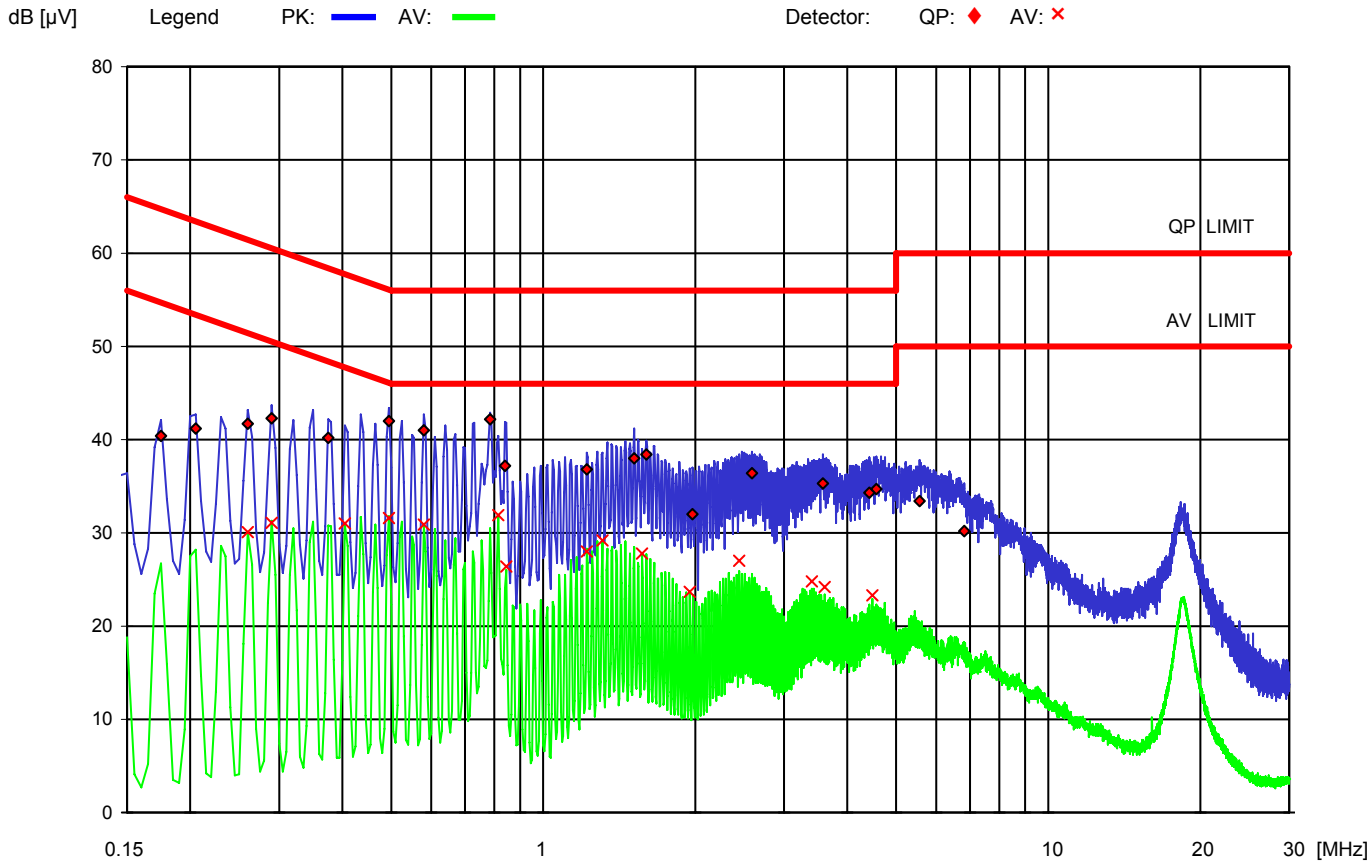


Test point: L1  
 Operation mode: receive mode  
 Remarks: -

Result: passed

Freq	QP- L	D -Limit	Freq	AV-L	D -Limit
kHz	dB[μV]	QP [dB]	kHz	dB[μV]	AV [dB]
175	40,4	24,3	260	30,1	21,3
205	41,2	22,2	290	31,1	19,4
260	41,7	19,7	405	31	16,8
290	42,3	18,2	495	31,6	14,5
375	40,2	18,2	580	30,9	15,1
495	42	14,1	815	31,9	14,1
580	41	15,0	845	26,4	19,6
785	42,2	13,8	1220	28	18,0
840	37,2	18,8	1310	29,2	16,8
1220	36,8	19,2	1570	27,8	18,2
1515	38	18,0	1950	23,7	22,3
1600	38,4	17,6	2445	27	19,0
1975	32	24,0	3405	24,8	21,2
2590	36,4	19,6	3610	24,2	21,8
3580	35,3	20,7	4485	23,3	22,7

Freq	QP- L	D -Limit	Freq	AV-L	D -Limit
kHz	dB[μV]	QP [dB]	kHz	dB[μV]	AV [dB]
4425	34,3	21,7			
4570	34,7	21,3			
5565	33,4	26,6			
6820	30,2	29,8			

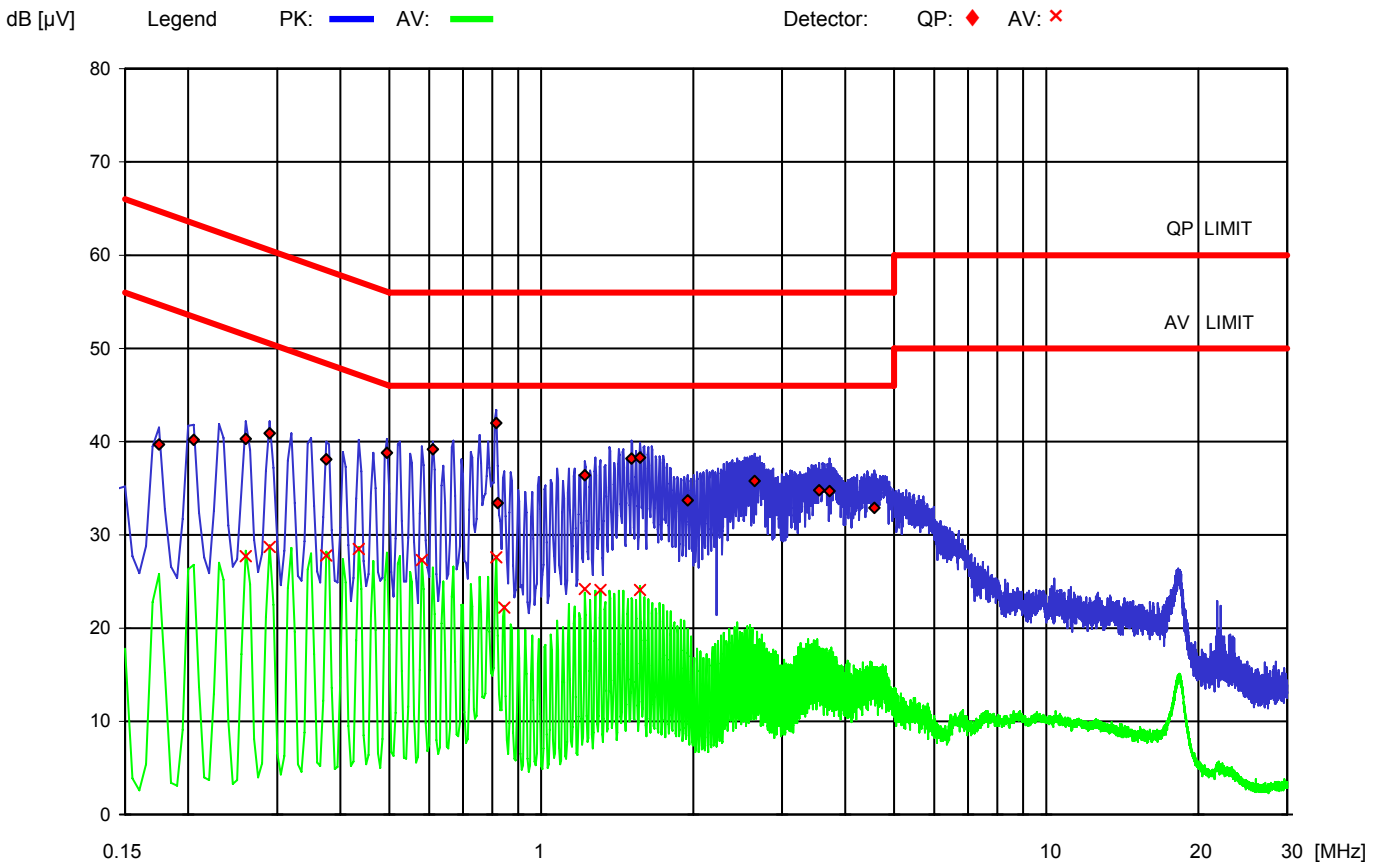


Test point: N  
 Operation mode: receive mode  
 Remarks: -

Result: passed

Freq	QP- L	D -Limit	Freq	AV-L	D -Limit
kHz	dB[μV]	QP [dB]	kHz	dB[μV]	AV [dB]
175	39,7	25,0	260	27,7	23,7
205	40,2	23,2	290	28,7	21,8
260	40,3	21,1	375	27,8	20,6
290	40,9	19,6	435	28,5	18,7
375	38,1	20,3	580	27,3	18,7
495	38,8	17,3	815	27,6	18,4
610	39,2	16,8	845	22,2	23,8
815	42	14,0	1220	24,2	21,8
820	33,4	22,6	1310	24,1	21,9
1220	36,4	19,6	1570	24,1	21,9
1510	38,2	17,8			
1570	38,3	17,7			
1950	33,7	22,3			
2645	35,8	20,2			
3550	34,8	21,2			

Freq	QP- L	D -Limit	Freq	AV-L	D -Limit
kHz	dB[μV]	QP [dB]	kHz	dB[μV]	AV [dB]
3725	34,7	21,3			
4570	32,9	23,1			



## 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



**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**

Frequency (MHz)	Level QP (dBµV)	Correct. factor (dB)	Corrected level dB(µV/m)	Limit dB(µV/m)	Delta (dB)
918.30	59.6	28.5	88.1	94.0	5.9

Limit according to FCC Section 15.249(a) for fundamental

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

The requirements are **FULFILLED**.

Remarks:

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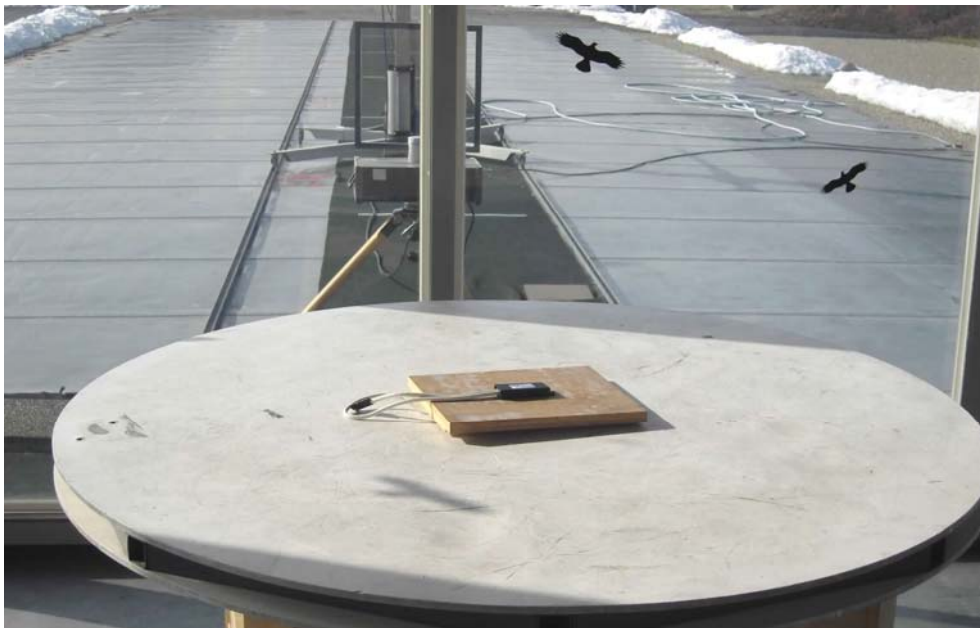
### 5.3 Spurious emissions radiated

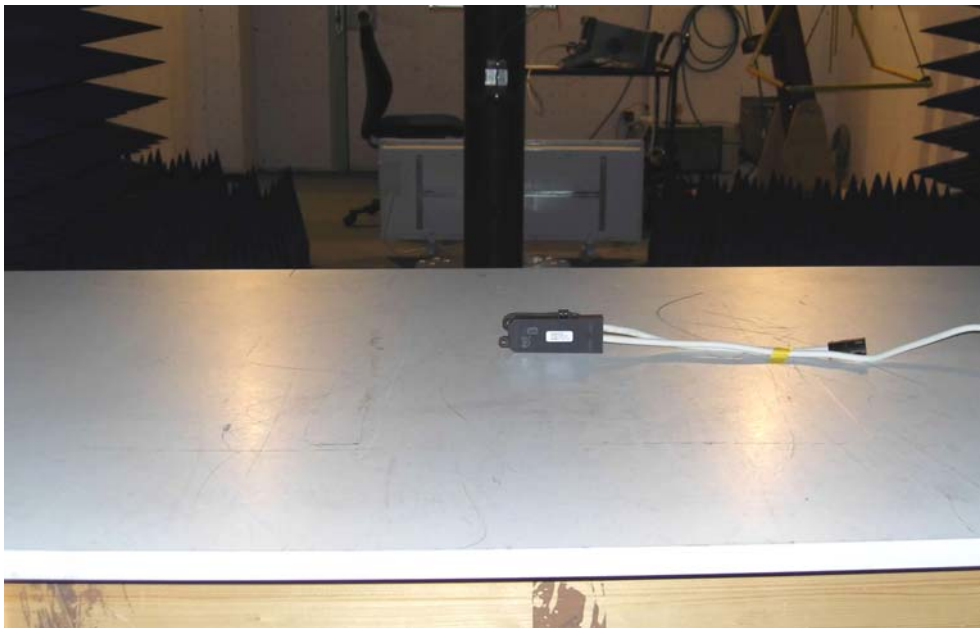
For test instruments and accessories used see section 6 Part SER 1, SER 2, SER 3.

#### 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 set up 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)	Reading level QP (dBµV)	Reading level AV (dBµV)	Bandwidth (kHz)	Correction factor (dB)	Corrected level QP dB(µV/m)	Corrected level AV dB(µV/m)	Limit dB(µV/m)	Delta (dB)
0.009 – 0.15					< 30			
0.15 – 30					< 30			
30 – 1000					< 30			

**5.3.6 Test result f > 1 GHz**

Frequency (MHz)	Level PK (dBµV)	Duty Cycle Correction (dB)	Level AV (dBµV)*	Correct. Factor (dB)	Corrected Level PK dB(µV/m)	Corrected Level AV dB(µV/m)	Limit PK dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
1834	60.9	-20	40.9	-11.2	49.7	29.7	74	54	24.3
5512	45.8	-20	25.8	4.9	50.7	30.7	74	54	23.3

\*) Average values were calculated from the subtraction of peak values minus correction duty cycle factor.

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 10<sup>th</sup> harmonic (10000 MHz).

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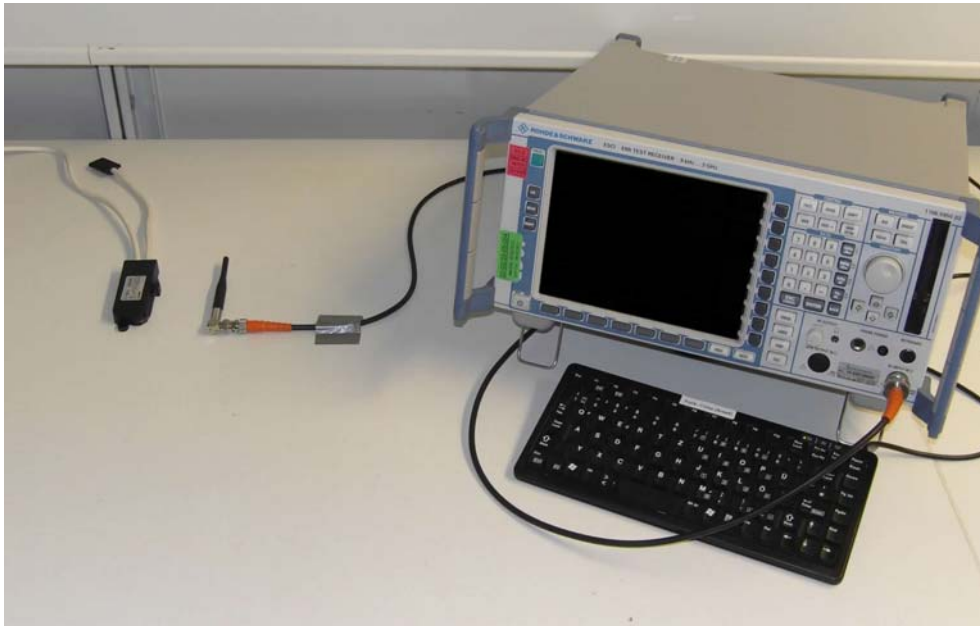
## 5.4 Emission Bandwidth

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

### 5.4.1 Description of the test location

Test location:                   Shielded Room S4

### 5.4.2 Photo documentation of the test set-up



### 5.4.3 Applicable standard

According to FCC Part 15, Section 15.215©:

Intentional radiators operating under the provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band 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. Alternatively is the x-dB-down function of the analyser used. The EBW is then directly shown in the marker display. The measurement is performed with normal modulation and a transfer rate means the worst case.

Spectrum analyser settings:

RBW:	10 kHz	VBW:	30 kHz	Span:	500 kHz
Sweep time:	100 ms	Detector:	Peak		

## 5.4.5 Test result

Operating frequency band (MHz)	Channel no.	20 dB Bandwidth (MHz)
$f_{\text{low}} > 902$	1	$f_{\text{low}} = 918.222$
$f_{\text{high}} < 928$	1	$f_{\text{high}} = 918.358$

80% bandwidth of the permitted band:

912.4 MHz to 917.6 MHz

Limit according to FCC Part 15C, Section 15.215©:

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.

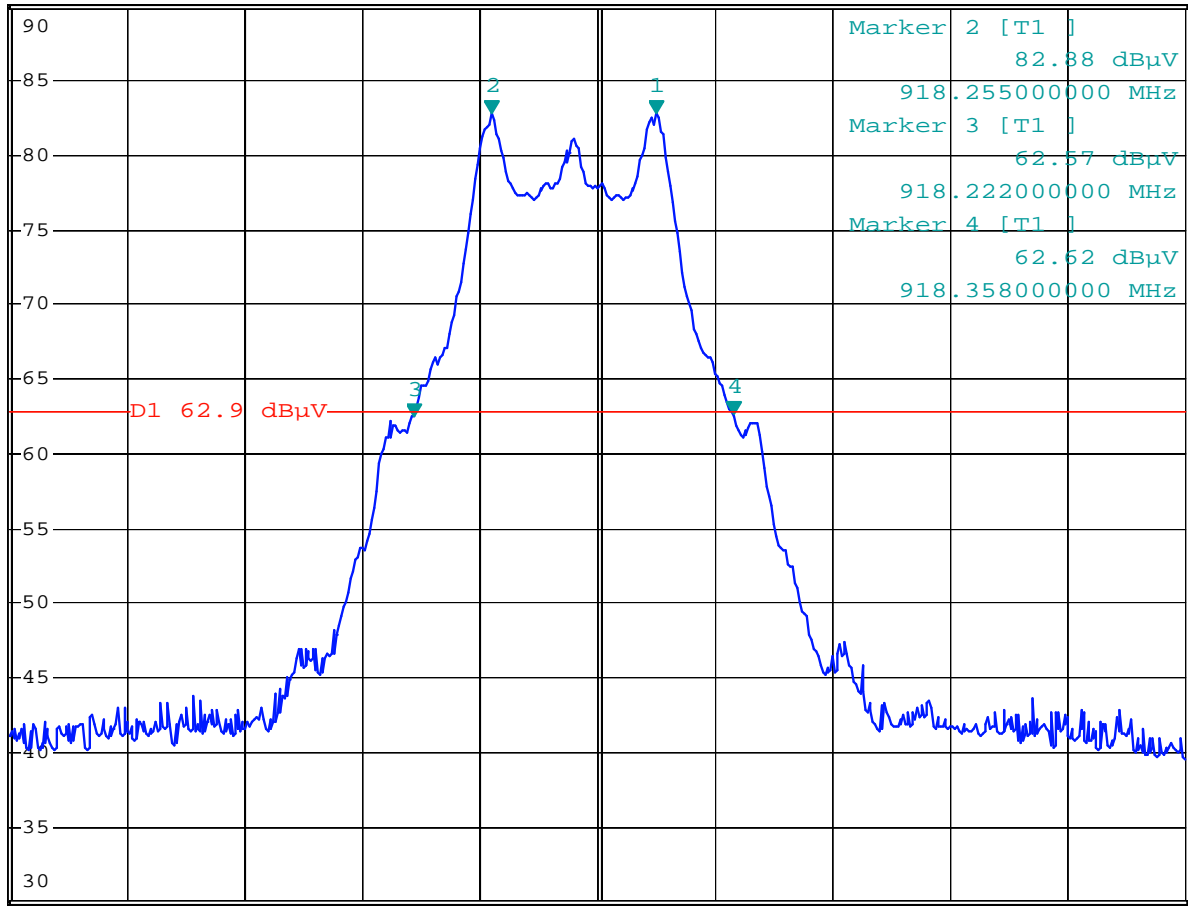
For the bandwidth there is no limit defined in Part 15.249. This measurement is informative only.

5.4.6 Test protocol

Center frequency: 918.300 MHz

Ref 90 dBμV      \* Att 10 dB      \* RBW 10 kHz      Marker 1 [T1]      82.90 dBμV  
 \* VBW 30 kHz      918.325000000 MHz  
 \* SWT 100 ms

1 PK  
VIEW



A

3DB  
AC

Center 918.3 MHz      50 kHz/      Span 500 kHz

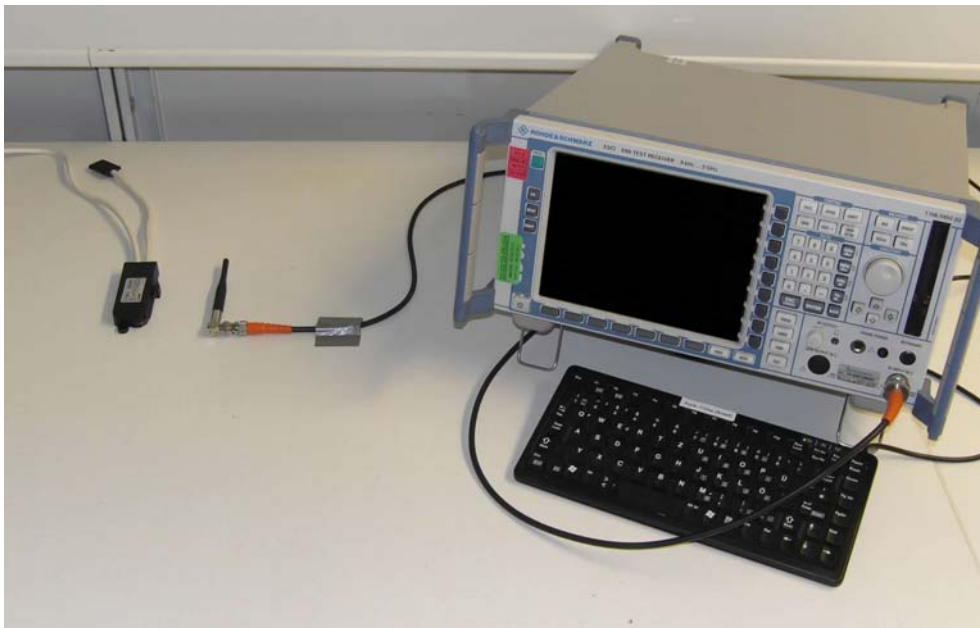
## 5.5 Band edge test

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

### 5.5.1 Description of the test location

Test location:                 Shielded Room S4

### 5.5.2 Photo documentation of the test set-up



### 5.5.3 Description of Measurement

The EuT was connected to the spectrum analyzer with a suitable attenuator. The span of the spectrum analyzer was set wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation. The highest amplitude appearing on spectral display was measured and it was set as the reference level for the emission mask. It was allowed the trace to stabilize and after then it was set the emission mask on the reference level to show the compliance with the bandedge requirements.

Further settings on the spectrum analyzer:

RBW:	≥ 1% of the span
VBW:	≥ RBW
Sweep:	Auto
Detector function:	Peak

5.5.4 Test result

Frequency [MHz]	Peak Power Output [dBμV]	Spurious emission read value [dBμV]	Result of Band edge [dBc]	Band edge LIMIT [dBc]
< 902,0	110.0	47.8	62.2	>50
> 928,0	109.8	46.4	63.4	>50

Peak-Limit according to FCC Subpart 15.249(d)

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

The requirements are **FULFILLED**.

**Remarks:** For detailed test result please refer to following test protocol.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

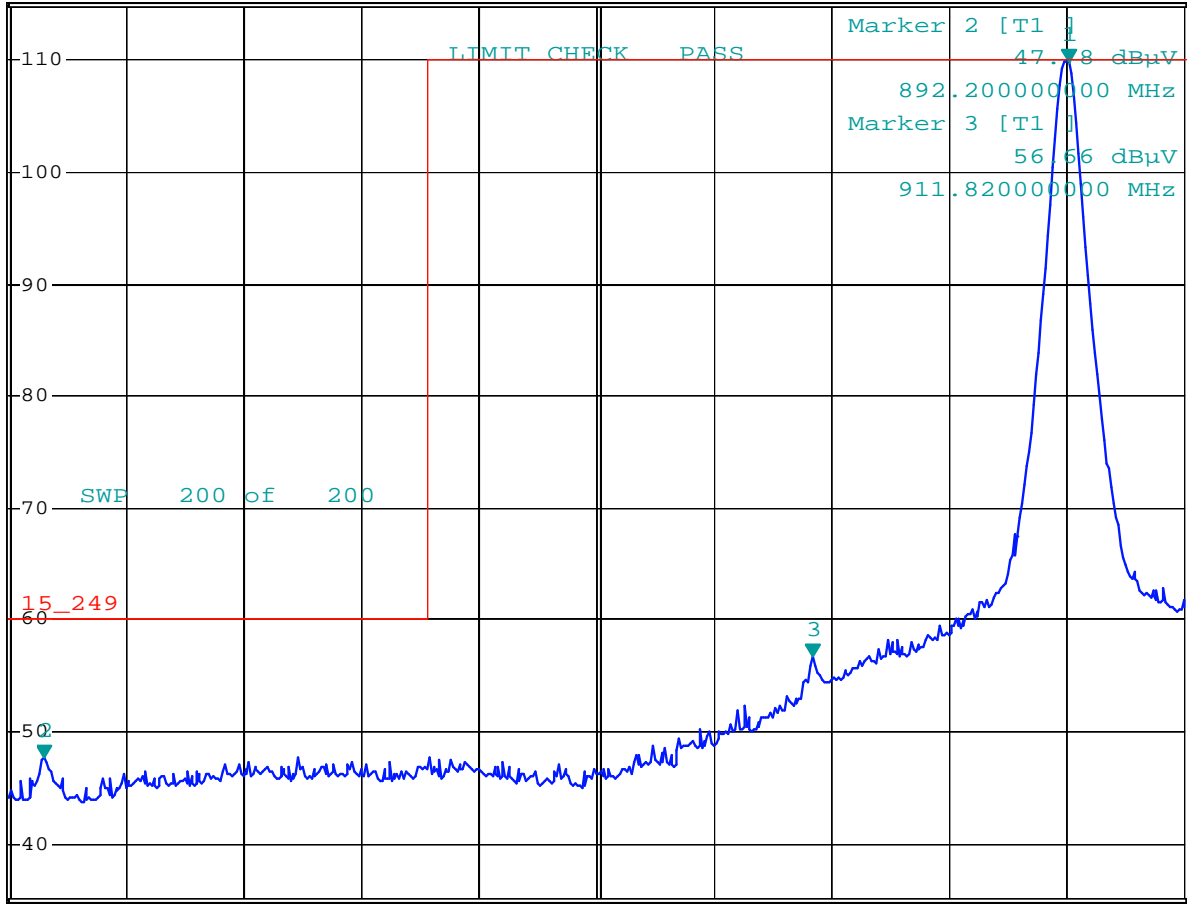
5.5.5 Test protocol

Lower band edge – 902 MHz

\*RBW 300 kHz Marker 1 [T1 ]  
VBW 1 MHz 109.95 dBuV  
\*Att 20 dB \*SWT 100 ms 918.360000000 MHz

Ref 115 dBuV

1 PK  
VIEW



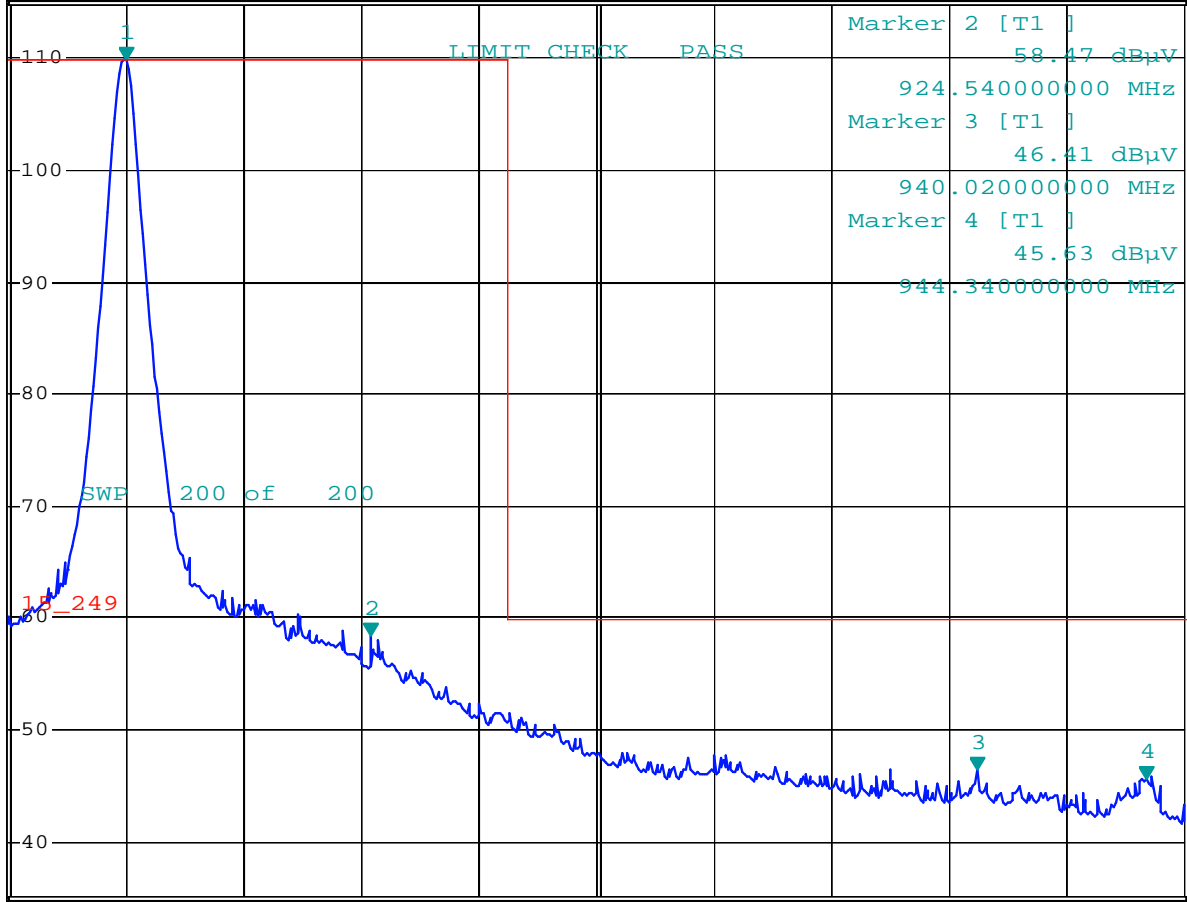
Center 906.3 MHz 3 MHz/ Span 30 MHz

Higher band edge – 928 MHz

\*RBW 300 kHz Marker 1 [T1 ]  
 VBW 1 MHz 109.80 dBµV  
 \*Att 20 dB \*SWT 100 ms 918.300000000 MHz

Ref 115 dBµV

1 PK  
 VIEW



Center 930.3 MHz

3 MHz/

Span 30 MHz



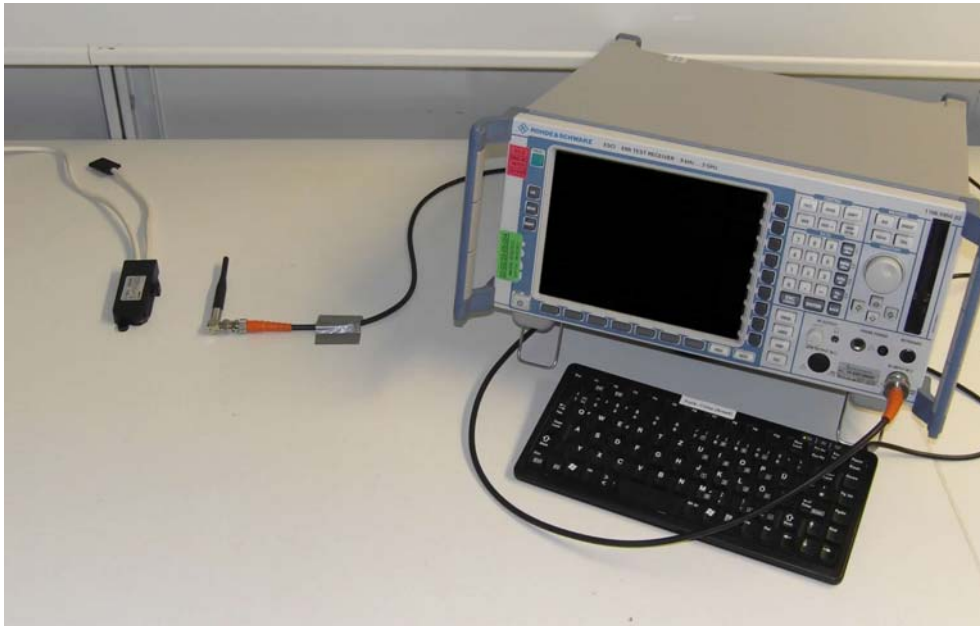
## 5.6 Correction for pulse operation (duty cycle)

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

### 5.6.1 Description of the test location

Test location:                   Shielded Room S4

### 5.6.2 Photo documentation of the test set-up



### 5.6.3 Applicable standard

According to FCC Part 15A, Section 15.35©:

When the radiated emission limits are expressed in terms of average value and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete puls train, including blanking intervals, as long as the pulse train does not exceed 0.1s. in cases where the puls train exceeds 0.1s, the measured field strength shall be determined from the average absolute voltage during a 0.1s interval during which the field strength is at its maximum. The exact method of calculating the average field strength shall be submitted.

### 5.6.4 Description of Measurement

The duty cycle factor (dB) is calculated applying the following formula:

$$KE = 20 \log (t_B/T_B)$$

<i>KE</i> :	pulse operation correction factor	(dB)
<i>t<sub>B</sub></i>	pulse duration for one pulse	( $\mu$ s)
<i>T<sub>B</sub></i>	a period of one pulse	(ms)

## 5.6.5 Test result

$t_B$ (ms)	$T_B$ (ms)	$KE$ (dB/%)
100	4.4	27.1

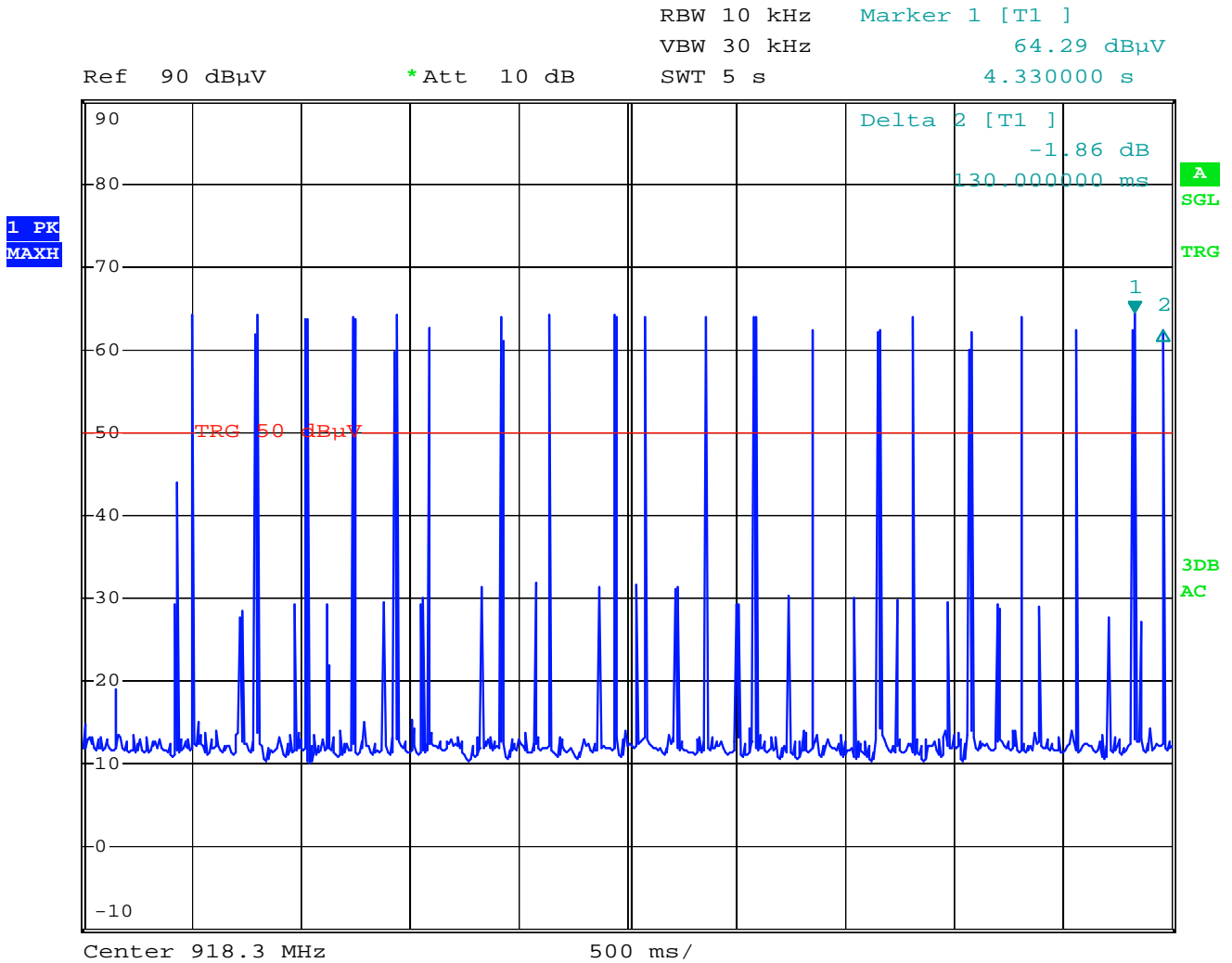
**Remarks:** The pulse train ( $T_w$ ) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms width with the highest average value.

For detailed results, please see the test protocol below.

The maximal duty cycle correction is 20 dB.

5.6.6 Test protocol

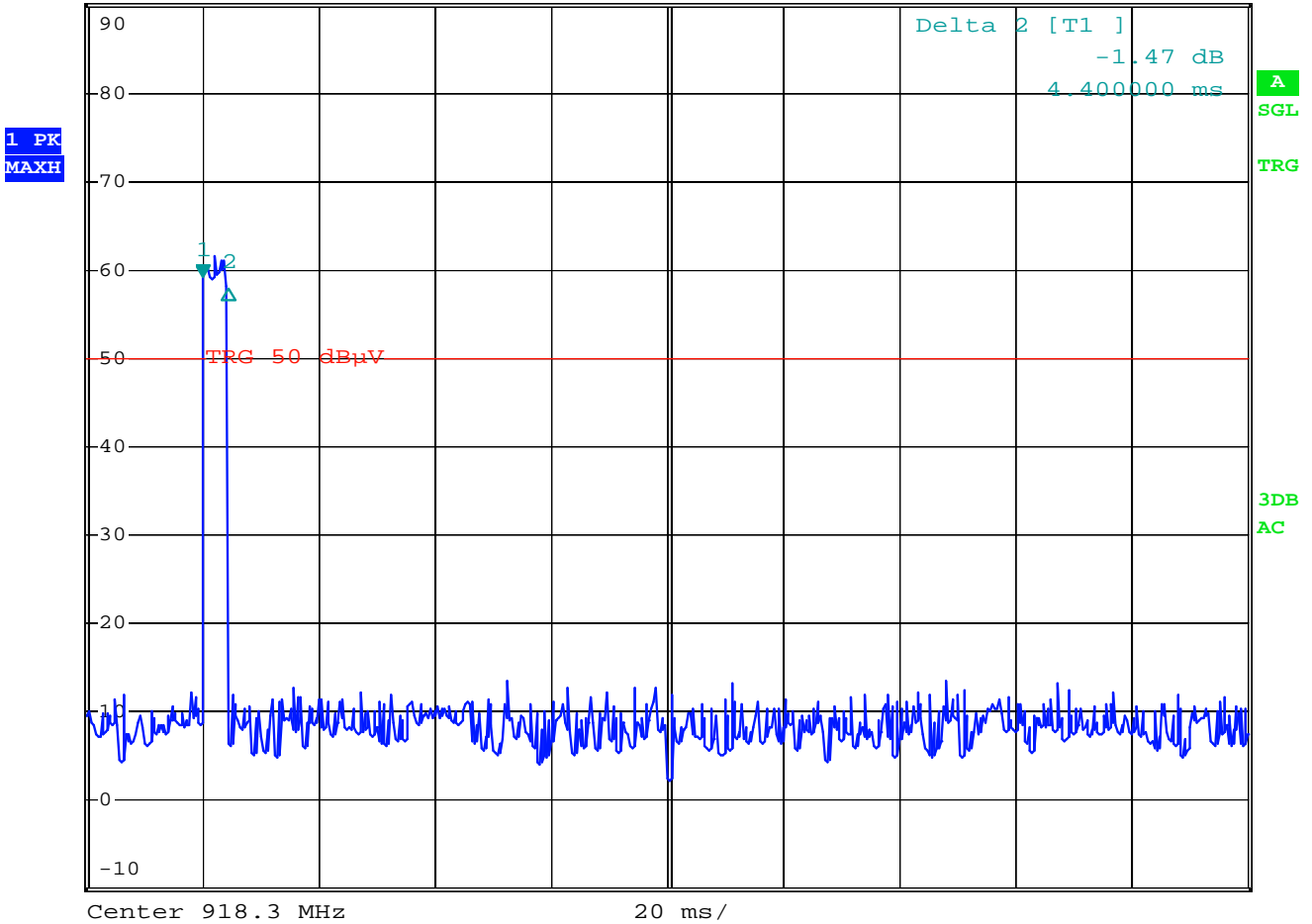
**Correction for pulse operation**  
 FCC Part 15C, Section 15.35©  
 (minimum repetition rate between two peaks)



\*) the lower peaks by 30 dBµV are from the transmitter

Correction for pulse operation  
 FCC Part 15C, Section 15.35©  
 (peak zoom)

Ref 90 dBµV      \*Att 10 dB      RBW 10 kHz      Marker 1 [T1 ]  
 VBW 30 kHz      59.27 dBµV  
 SWT 200 ms      3.603278 as



## 5.7 Antenna application

### 5.7.1 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.

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

### 5.7.2 Result

The EUT used a dipole antenna and is printed on the PCB and no other antenna than that furnished by the responsible party are be used with the device.

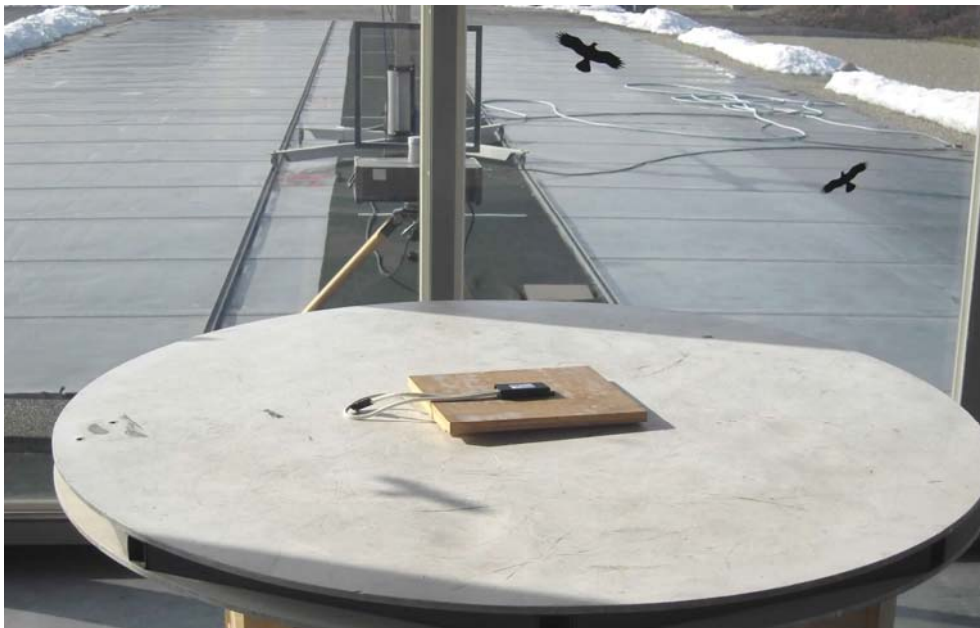
## 5.8 Receiver radiated emissions

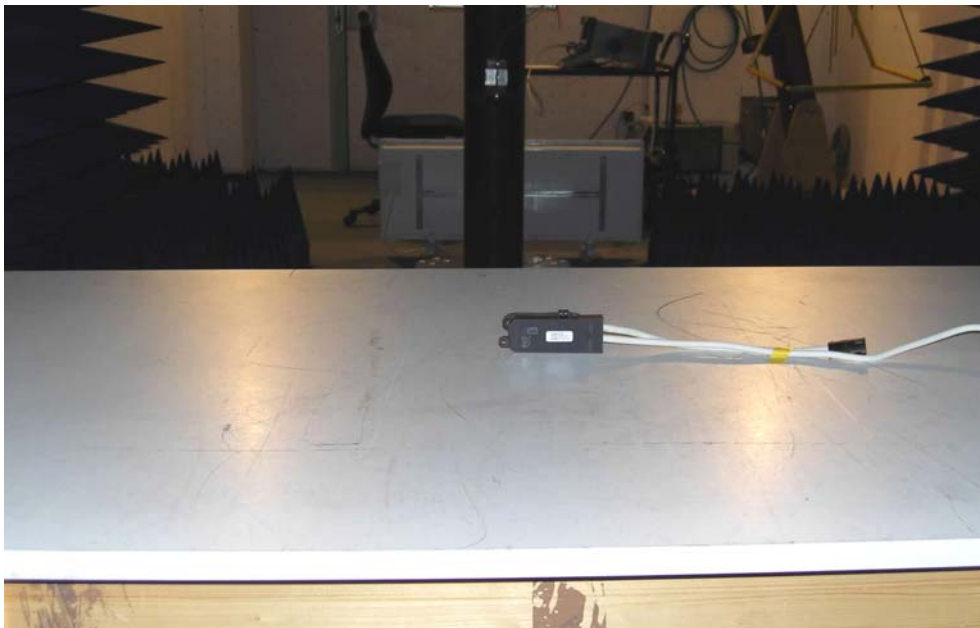
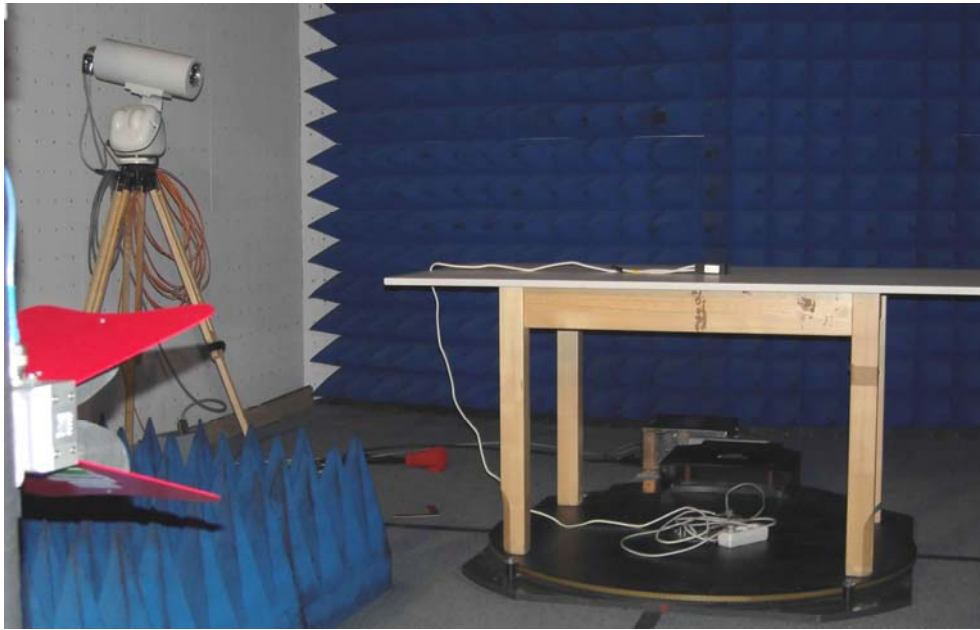
For test instruments and accessories used see section 6 Part **SER1**, **SER2** and **SER3**.

### 5.8.1 Description of the test location

Test location: OATS1  
Test location: Anechoic Chamber A2  
Test distance: 3 metres

### 5.8.2 Photo documentation of the test set-up





### 5.8.3 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.

**5.8.4 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 set up 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

**5.8.5 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)
0.009 – 0.15				< 30		
0.15 – 30				< 30		
30 – 1000				< 30		

**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)
1000 – 5000				< 40		

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:** During the test, the EUT was set into continuous receiving mode.  
The measurement was performed up to the 5<sup>th</sup> harmonic (5000 MHz).



**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	05/06/2010	05/06/2009		
	NNLK 8129	02-02/20-05-001			06/22/2010	12/22/2009
	ESH 2 - Z 5	02-02/20-05-004	03/13/2011	03/13/2008	05/17/2010	11/17/2009
	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			04/06/2010	10/06/2009
CPR 2	ESVS 30	02-02/03-05-006	08/05/2010	08/05/2009		
	VULB 9168	02-02/24-05-005	05/06/2011	05/06/2008	10/01/2010	04/01/2010
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
DC	ESCI	02-02/03-05-005	11/10/2010	11/10/2009		
	RF Antenna	02-02/24-05-032				
MB	ESCI	02-02/03-05-005	11/10/2010	11/10/2009		
	RF Antenna	02-02/24-05-032				
SER 1	FMZB 1516	01-02/24-01-018			02/15/2011	02/15/2010
	ESCI	02-02/03-05-005	11/10/2010	11/10/2009		
	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	08/05/2010	08/05/2009		
	VULB 9168	02-02/24-05-005	05/06/2011	05/06/2008	10/01/2010	04/01/2010
	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 30	02-02/11-05-001	04/20/2010	04/20/2009		
	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	02/10/2011	02/10/2010		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				