



EMI -- TEST REPORT

- FCC Part 15.249 -

Test Report No. : T33922-00-03HS	13 April 2010 Date of issue
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Type / Model Name : USB Receiver, 2503-525

Product Description : Receiver for radio keyboard

Applicant : ruwido austria gmbh

Address : Koestendorfer Str. 8
5202 NEUMARKT, AUSTRIA

Manufacturer : ruwido austria gmbh

Address : Koestendorfer Str. 8
5202 NEUMARKT, AUSTRIA

Licence holder : ruwido austria gmbh

Address : Koestendorfer Str. 8
5202 NEUMARKT, AUSTRIA

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

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart 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 B - Unintentional Radiators (October, 2009)

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

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 and 5725 - 5850 MHz

ANSI C63.4: 2009	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C95.1:1992	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 EUT is a wireless transceiver based on wireless USB-Protocol. The transceiver provides 1 - 79 channels in the 2.4 GHz frequency range. In the case a transmitting channel will be disturbed by another application, a dynamic channel selection helps to be less sensible against interference. The EUT is limited by firmware to 250 kbps (8DR mode) and the DSSS modulation method of the base band. The operation mode RX is the default mode. TX mode is used only at the first pairing with a wireless keyboard. The EUT works with the TDMA method and acknowledge every succeeded packet. In RX mode the USB is active and transmits the received data to the PC.

The EUT has the following variants:

Receiver	Model number
USB dome receiver	2503-525
USB stick receiver	2509-5

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 : 07 December 2009

Testing concluded on : 11 January 2010

Checked by:

Tested by:

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

Hermann Smetana
Dipl.-Ing.(FH)
Radio Expert

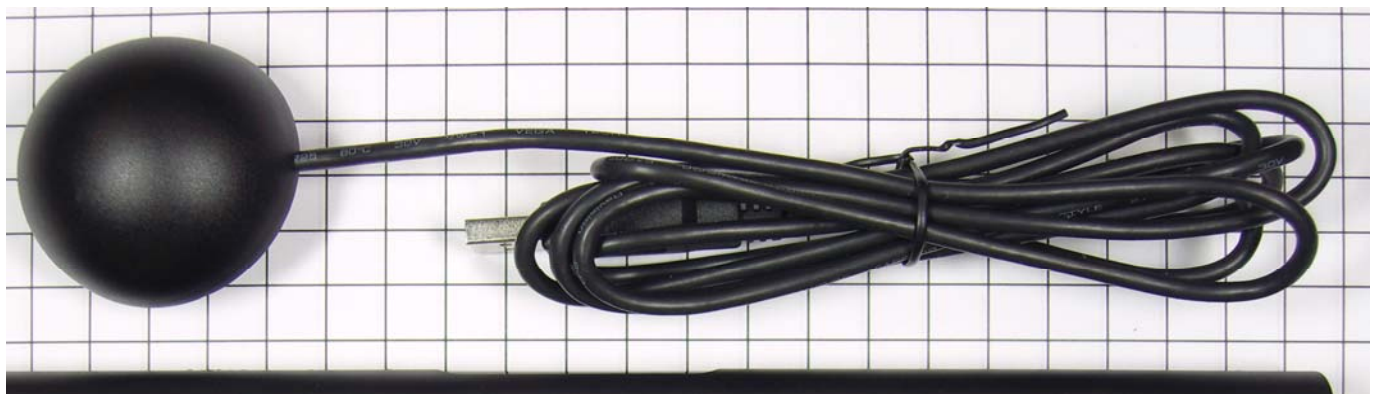
3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT

External views: USB stick receiver

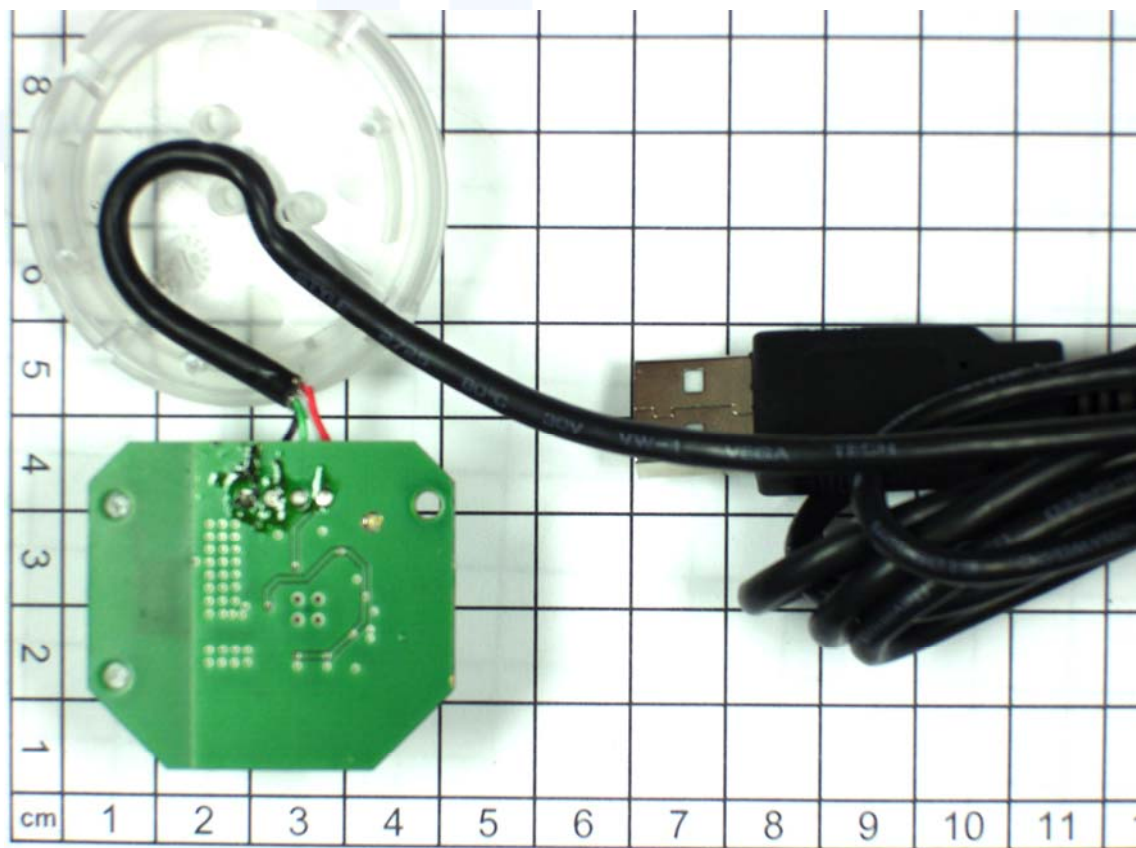


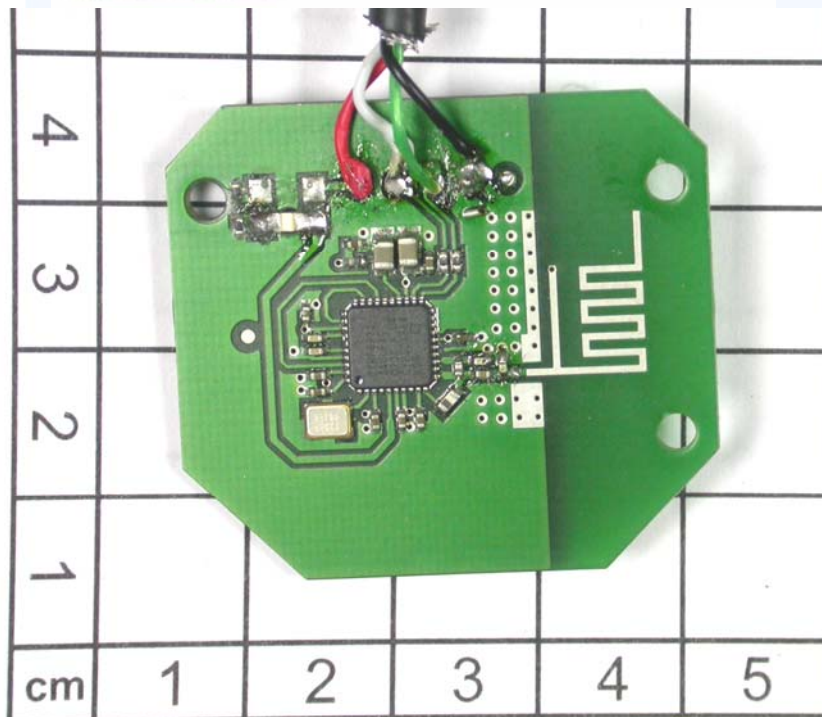
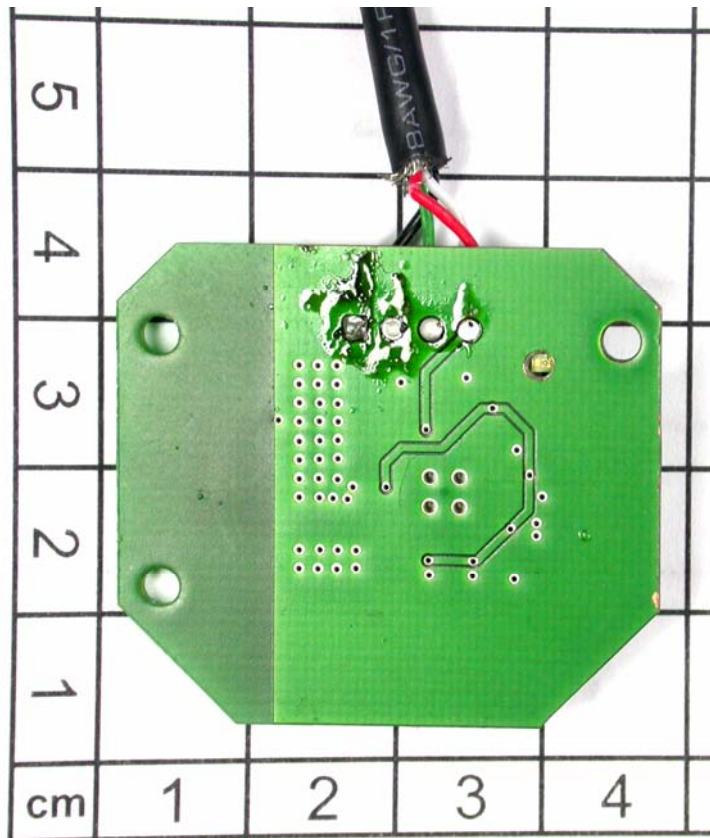
USB dome receiver

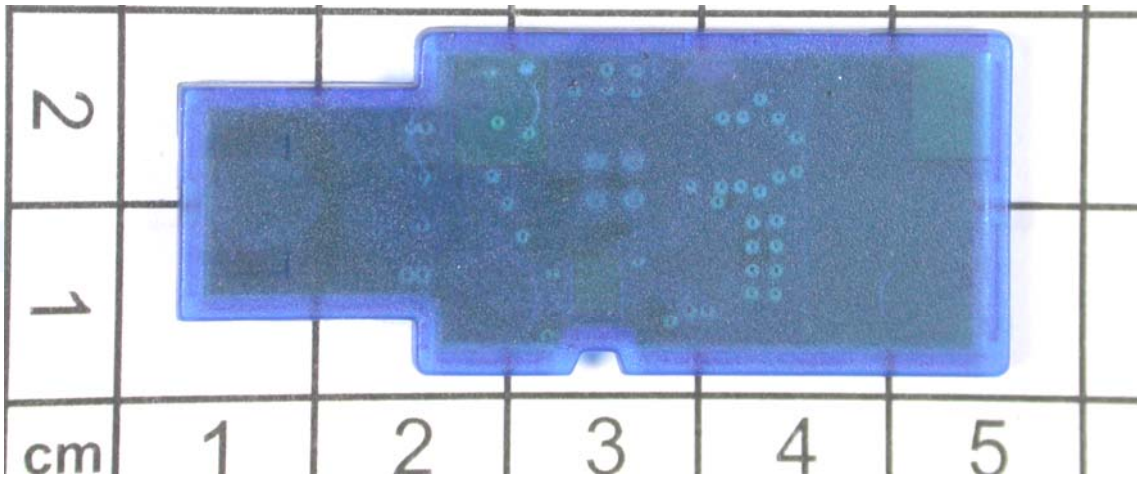
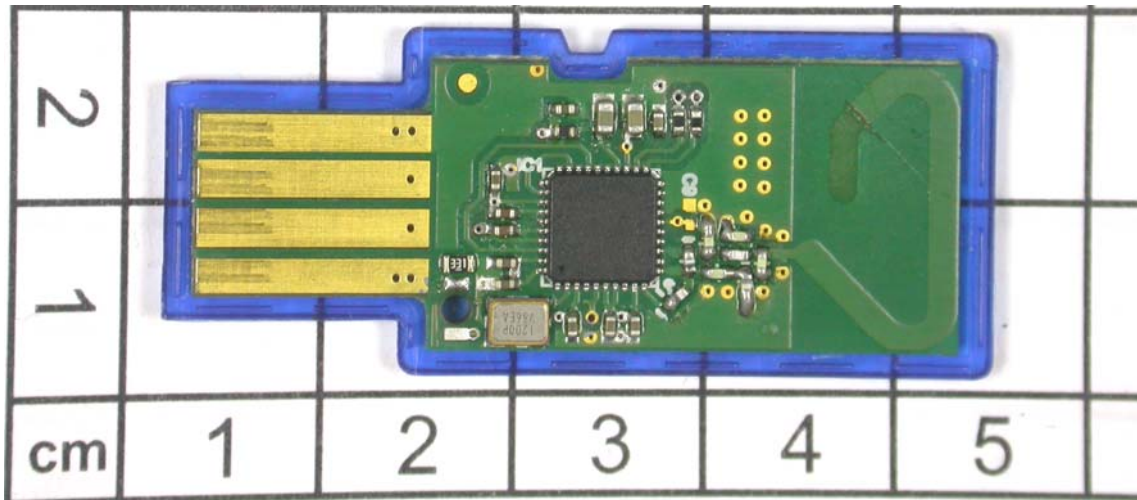




Internal views:







3.2 Power supply system utilised

Power supply voltage : 5 VDC (USB-powered)

3.3 Short description of the equipment under test (EUT)

The EUT is a receiver for wireless keyboards operating in the 2.4 GHz range. The receiver is connected via USB to a PC and is powered by USB. The EUT is designed for easy use without limiting cables.

Number of tested samples: 1 USB stick and 1 USB dome receiver

Serial number: Prototype

EUT operation mode:

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

- TX continuous mode

- RX mode

EUT configuration:

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

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

- A PC for power supply were connected 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 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.

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 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 Ω /50 μ 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 cm 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 m 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 m and the EUT is rotated 360 degrees.

The final level in dB μ V/m is calculated by add on the reading value from the EMI receiver (level dB μ V) the correction factor (1/m). 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)		(1/m)		(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 cm 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 cm to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 cm 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 bandwidth 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will than 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 Determination of worst case measurement conditions

The both receiver has an identical layout the kind of connection of the USB differs only. Pre measurement has been done to determine the worst case. The dome receiver has the highest antenna gain of the devices. Therefore the final transmission tests are made on this device awaiting the highest emissions. The EUT has a temporary antenna connector for testing only.

Operation modes:

TX: The EUT is limited to 250 kbps (8DR mode). TX continuous mode is implemented for testing only.

RX: RX mode is set by the firmware. After power on the RX mode is set.

The most important mode is the 8DR mode at a data rate of 250 kbps for the worst case.

Modulation types:

For the 8DR packet the modulation method DSSS is used. GFSK for the 1 Mbps is disabled by firmware. The receiver acknowledges every successful transmission of a data packet.

Following channels were selected for the final test:

Available channel	Tested channel	Modulation	Modulation type	Data rate (kbps)
1 to 79	1, 39, 79	DSSS	32 chip 8DR	250

5 TEST CONDITIONS AND RESULTS

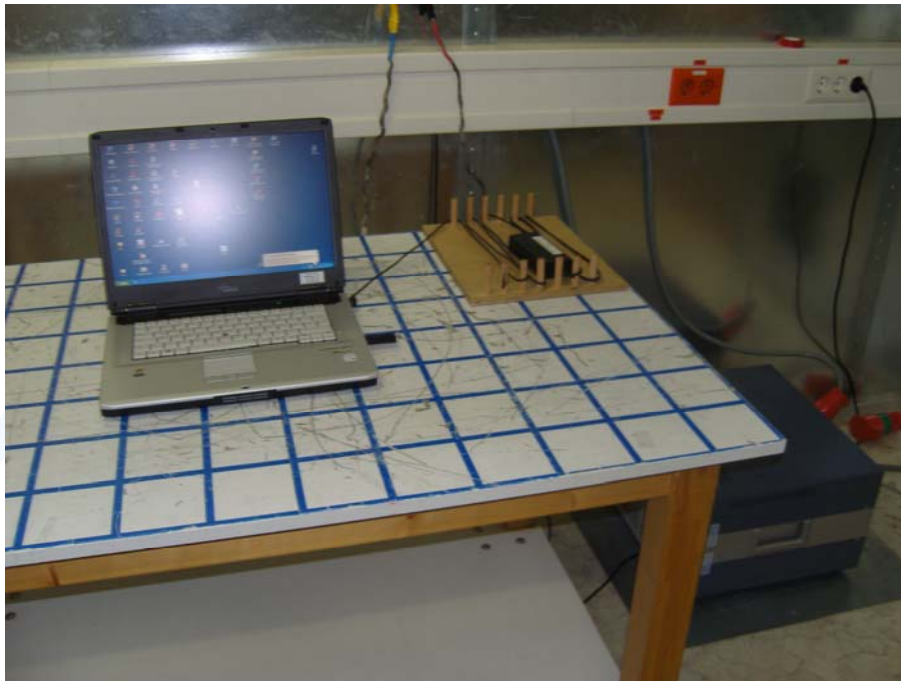
5.1 Conducted emissions

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 7.9 dB at 0.585 MHz

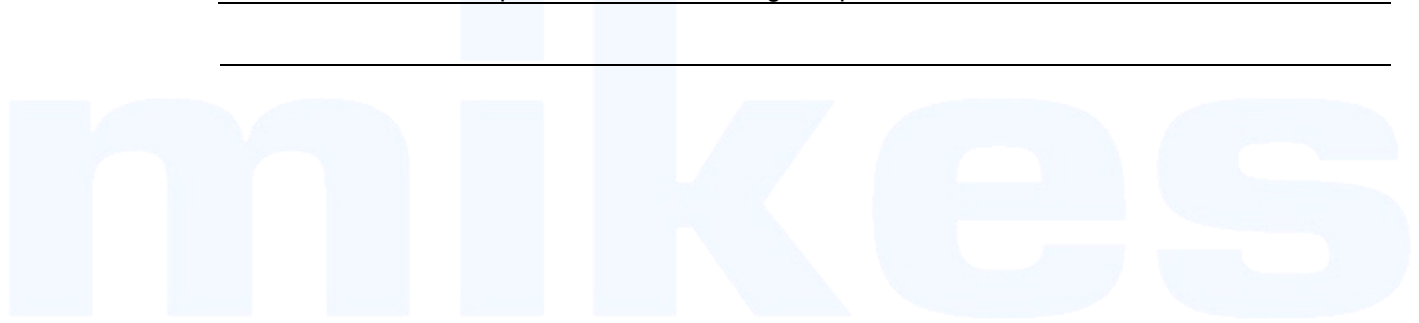
Limit according to FCC Part 15, Section 15.207(a):

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**.

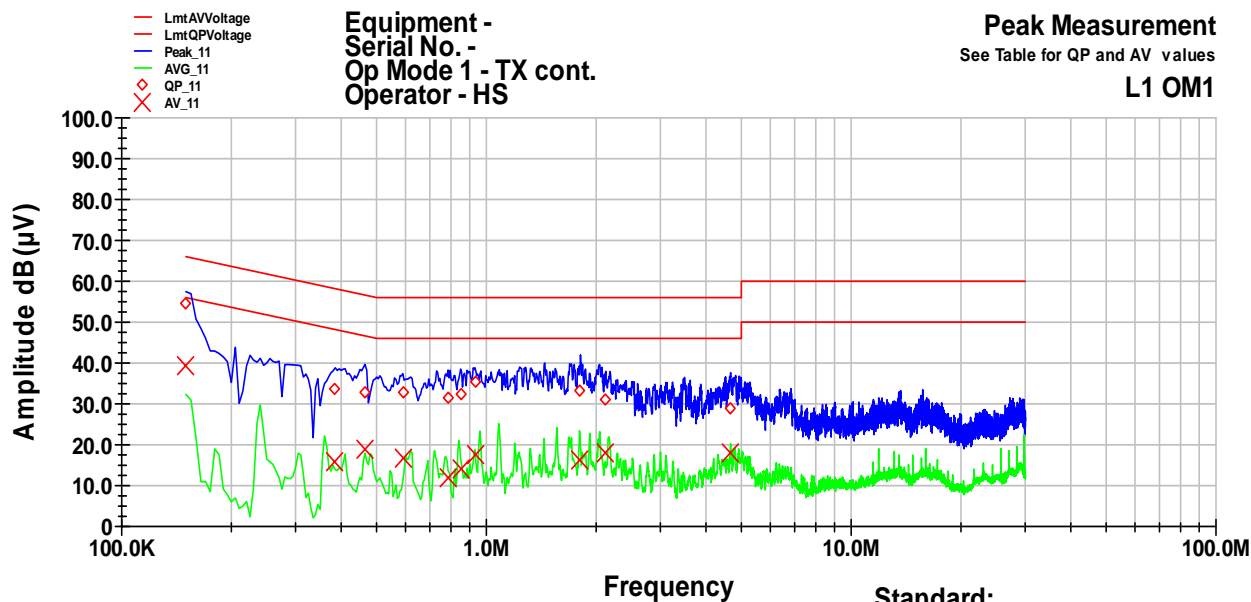
Remarks: For detailed test result please refer to following test protocols _____



5.1.6 Test protocol

Test point: L1
 Operation mode: TX continuous mode
 Remarks:

Result: passed



Equipment -
 Serial No. -
 Op Mode 1 - TX cont.
 Operator - HS

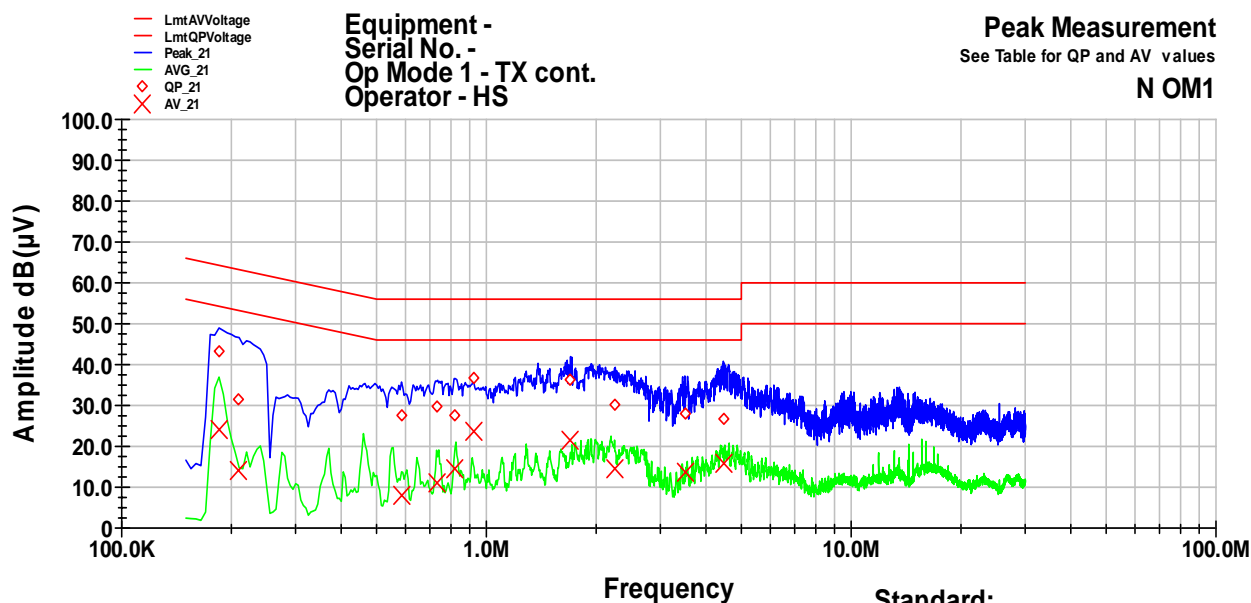
Peak Measurement
 See Table for QP and AV values
L1 OM1

Standard:
 File Number: T33922

Frequency MHz	QP Level dB(µV)	QP Delta dB	QP Limit dB	AV Level dB(µV)	AV Delta dB	AV Limit dB
0.15	54.7	-11.3	66.0	39.2	-16.8	56.0
0.385	33.9	-24.3	58.2	15.9	-32.2	48.2
0.465	32.9	-23.7	56.6	18.8	-27.8	46.6
0.59	32.7	-23.3	56.0	16.7	-29.3	46.0
0.785	31.5	-24.5	56.0	11.8	-34.3	46.0
0.85	32.4	-23.6	56.0	14.2	-31.8	46.0
0.93	35.4	-20.6	56.0	17.4	-28.6	46.0
1.81	33.3	-22.7	56.0	16.4	-29.6	46.0
2.125	31.0	-25.0	56.0	17.9	-28.1	46.0
4.67	28.8	-27.2	56.0	18.2	-27.8	46.0

Test point: N
 Operation mode: TX continuous mode
 Remarks:

Result: passed

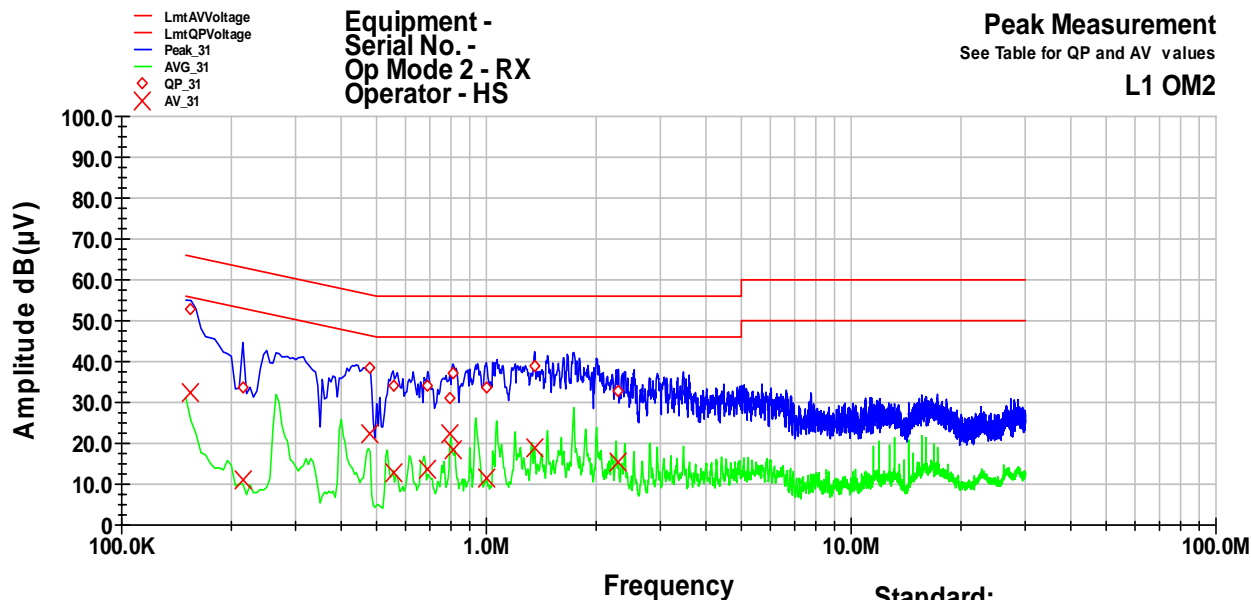


Standard:
 File Number: T33922

Frequency MHz	QP Level dB(µV)	QP Delta dB	QP Limit dB	AV Level dB(µV)	AV Delta dB	AV Limit dB
0.185	43.5	-20.8	64.3	24.1	-30.1	54.3
0.21	31.6	-31.6	63.2	13.9	-39.3	53.2
0.585	27.6	-28.4	56.0	7.9	-38.1	46.0
0.735	29.6	-26.4	56.0	10.9	-35.1	46.0
0.82	27.4	-28.6	56.0	14.5	-31.5	46.0
0.92	36.9	-19.1	56.0	23.6	-22.4	46.0
1.7	36.1	-19.9	56.0	21.7	-24.3	46.0
2.255	30.1	-25.9	56.0	14.7	-31.3	46.0
3.5	27.9	-28.1	56.0	13.6	-32.4	46.0
4.46	26.8	-29.2	56.0	15.7	-30.3	46.0

Test point: L1
 Operation mode: RX mode
 Remarks:

Result: passed

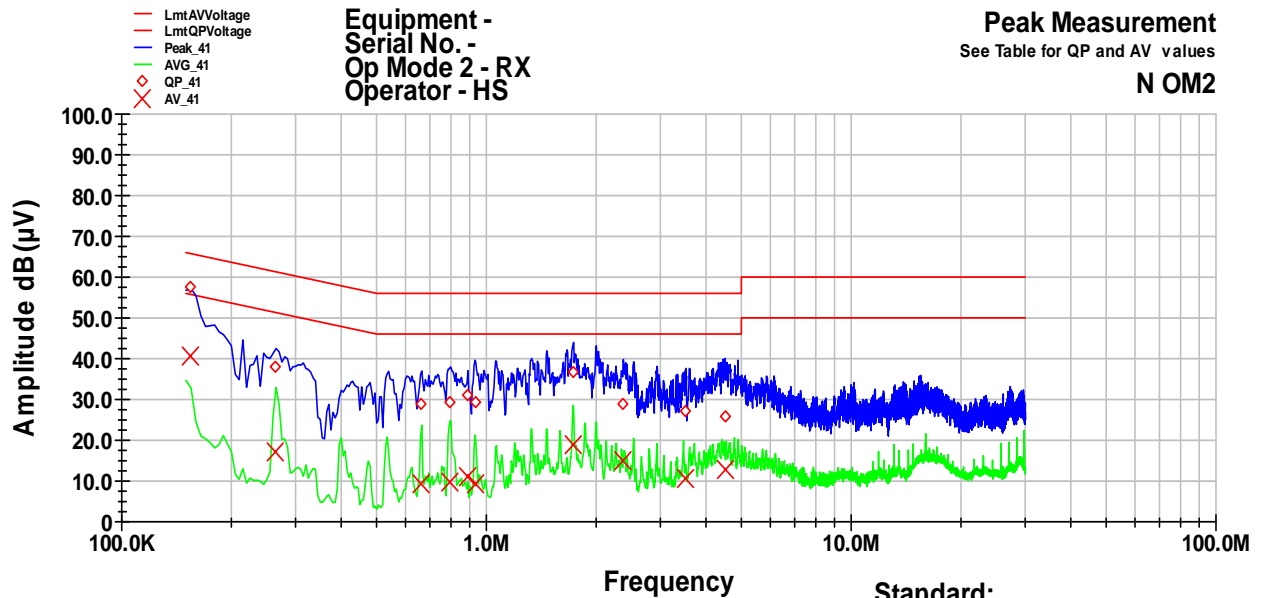


Standard:
 File Number: T33922

Frequency MHz	QP Level dB(µV)	QP Delta dB	QP Limit dB	AV Level dB(µV)	AV Delta dB	AV Limit dB
0.155	52.7	-13.1	65.7	32.2	-23.5	55.7
0.215	33.7	-29.3	63.0	11.0	-42.0	53.0
0.48	38.3	-18.1	56.3	22.3	-24.0	46.3
0.555	34.2	-21.8	56.0	13.0	-33.0	46.0
0.69	34.0	-22.0	56.0	13.6	-32.4	46.0
0.795	31.1	-24.9	56.0	22.1	-23.9	46.0
0.81	36.9	-19.1	56.0	18.3	-27.7	46.0
1	33.7	-22.3	56.0	11.6	-34.4	46.0
1.355	38.8	-17.2	56.0	19.1	-26.9	46.0
2.3	32.6	-23.4	56.0	15.4	-30.5	46.0

Test point: N
 Operation mode: RX mode
 Remarks:

Result: passed



Standard:
File Number: T33922

Frequency MHz	QP Level dB(µV)	QP Delta dB	QP Limit dB	AV Level dB(µV)	AV Delta dB	AV Limit dB
0.155	57.4	-8.3	65.7	40.7	-15.1	55.7
0.265	38.2	-23.1	61.3	17.2	-34.1	51.3
0.665	28.7	-27.3	56.0	9.3	-36.7	46.0
0.795	29.2	-26.8	56.0	9.5	-36.5	46.0
0.89	31.1	-24.9	56.0	11.2	-34.8	46.0
0.93	29.3	-26.7	56.0	9.5	-36.5	46.0
1.735	36.8	-19.2	56.0	19.0	-27.0	46.0
2.375	28.7	-27.3	56.0	15.0	-31.0	46.0
3.52	27.1	-28.9	56.0	10.5	-35.5	46.0
4.51	25.6	-30.4	56.0	12.6	-33.4	46.0

5.2 Radiated emission of the fundamental wave

For test instruments and accessories used see section 6 Part CPR 3.

5.2.1 Description of the test location

Test location: Anechoic Chamber A2
Test distance: 3 metres

5.2.2 Photo documentation of the test set-up



5.2.3 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.

5.3 Spurious emissions radiated

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

5.3.1 Description of the test location

Test location: OATS 1
Test location: Anechoic Chamber A2
Test distance: 3 metres

5.3.2 Photo documentation of the test set-up

Open area test site



Anechoic chamber



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 FCC Part 15C, Section 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:

10 MHz – 30 MHz:	RBW:	9kHz
30 MHz – 1000 MHz:	RBW:	120 kHz
1000 MHz – 40 GHz	RBW = VBW:	1 MHz

5.3.5 Test result 10 MHz < f < 1 GHz

Channel 1

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)
-	-							

Channel 39

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)
-	-							

Channel 79

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)
-	-							

Note: The correction factor takes into account cable loss and antenna factor.

Remark: No emission could be detected within 20 dB to the limit in the range 10 MHz to 1 GHz.

5.3.6 Test result f > 1 GHz

Channel 1 (2403 MHz)

Antenna		Power Setting	Frequency (MHz)	Peak		Average	
Type	Gain (dBi)			Value dB(µV/m)	Limit dB(µV/m)	Value dB(µV/m)	Limit dB(µV/m)
PCB	1.5	7	1600	47.7	74		54
PCB	1.5	7	4805	52.6	74		54

Channel 39 (2441 MHz)

Antenna		Power Setting (Δ dB)	Frequency (MHz)	Peak		Average	
Type	Gain (dBi)			Value dB(μ V/m)	Limit dB(μ V/m)	Value dB(μ V/m)	Limit dB(μ V/m)
PCB	1.5	7	1624	50.9	74		54
PCB	1.5	7	4875	46.0	74		54

Channel 79 (2481 MHz)

Antenna		Power Setting (Δ dB)	Frequency (MHz)	Peak		Average	
Type	Gain (dBi)			Value dB(μ V/m)	Limit dB(μ V/m)	Value dB(μ V/m)	Limit dB(μ V/m)
PCB	1.5	7	1654	53.5	74		54
PCB	1.5	7	4962	43.5	74		54

5.3.6.1 Radiated emissions in restricted bands

Channel 1 (2403 MHz); Nearest restricted band: 2310 - 2390 MHz

Antenna		Power Setting (Δ dB)	Frequency (MHz)	Peak		Average	
Type	Gain (dBi)			Value dB(μ V/m)	Limit dB(μ V/m)	Value dB(μ V/m)	Limit dB(μ V/m)
PCB	1.5	7	2390	36.3	74		54

Channel 79 (2481 MHz); Nearest restricted band: 2483.5-2500 MHz

Antenna		Power Setting (Δ dB)	Frequency (MHz)	Peak		Average	
Type	Gain (dBi)			Value dB(μ V/m)	Limit dB(μ V/m)	Value dB(μ V/m)	Limit dB(μ V/m)
PCB	1.5	7	2483.5	44.6	74		54
PCB	1.5	7	2484.1	48.9	74		54

Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	(μ V/m)	dB(μ V/m)	
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

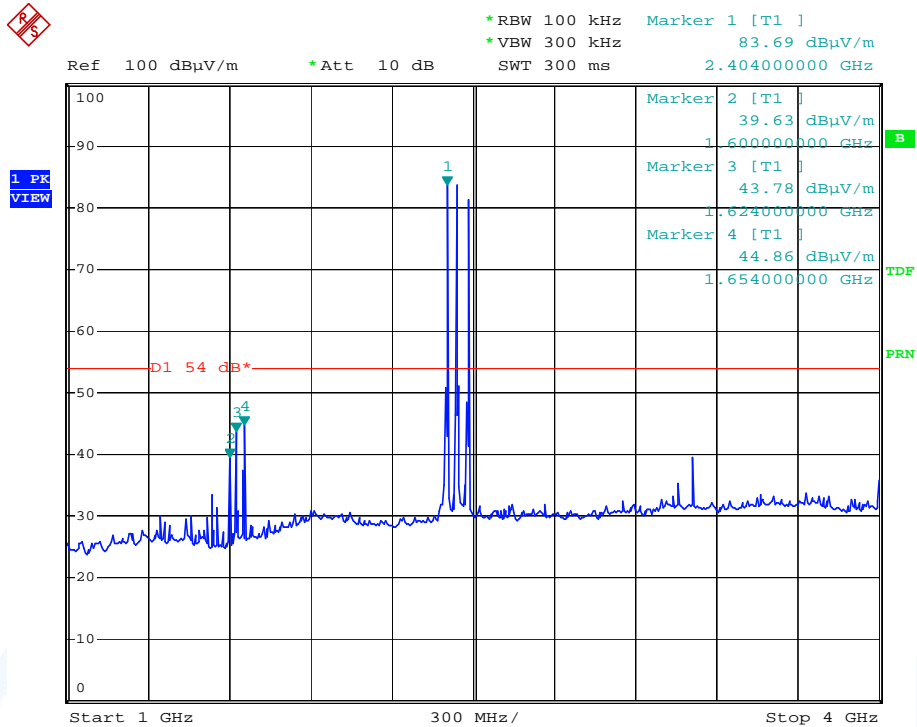
The requirements are **FULFILLED**.

Remarks: The measurement was performed up to the 10th harmonic. For detailed test results please see following test protocols.

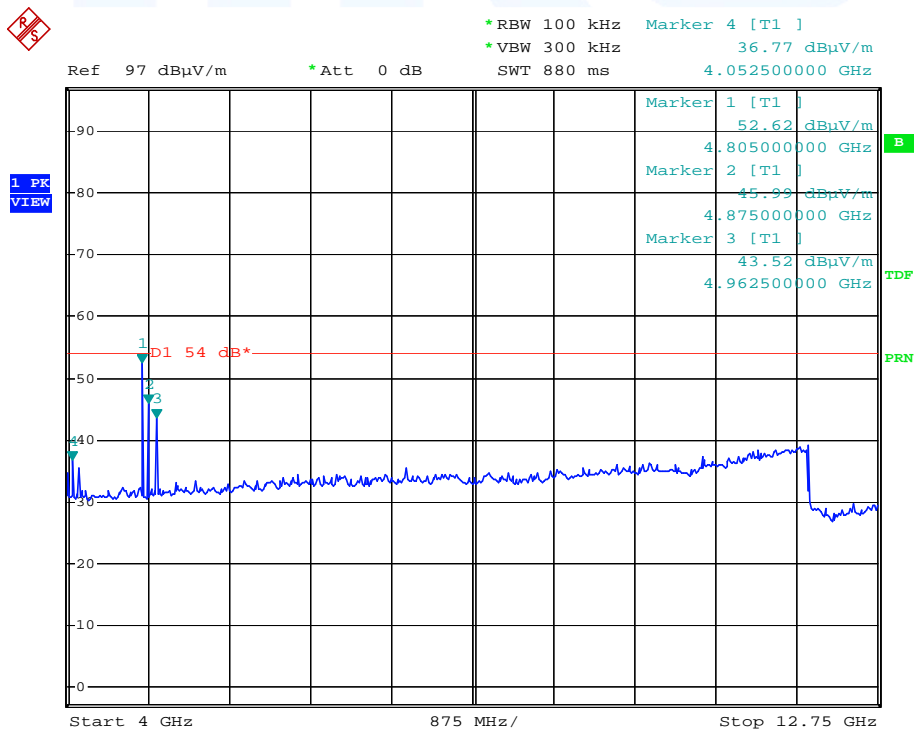
5.3.7 Test protocols

Plots of spurious emissions radiated out of operating frequency bands (-20 dBc)

Spurious emissions radiated from 1 GHz to 4 GHz (worst case)

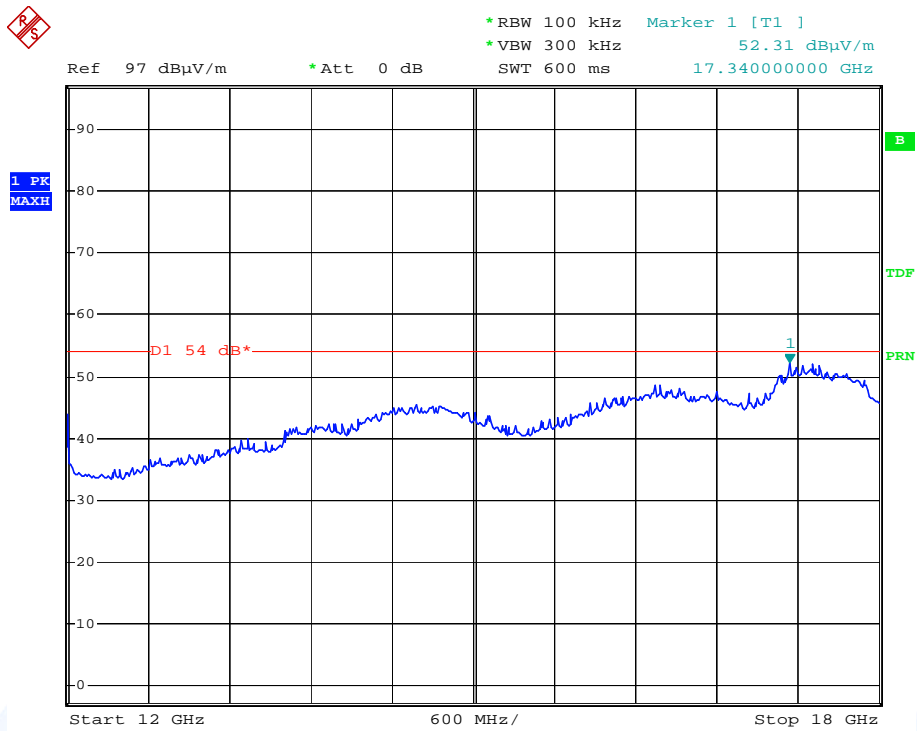


Spurious emissions radiated from 4 GHz to 12 GHz (worst case)



Date: 11.DEC.2009 13:33:26

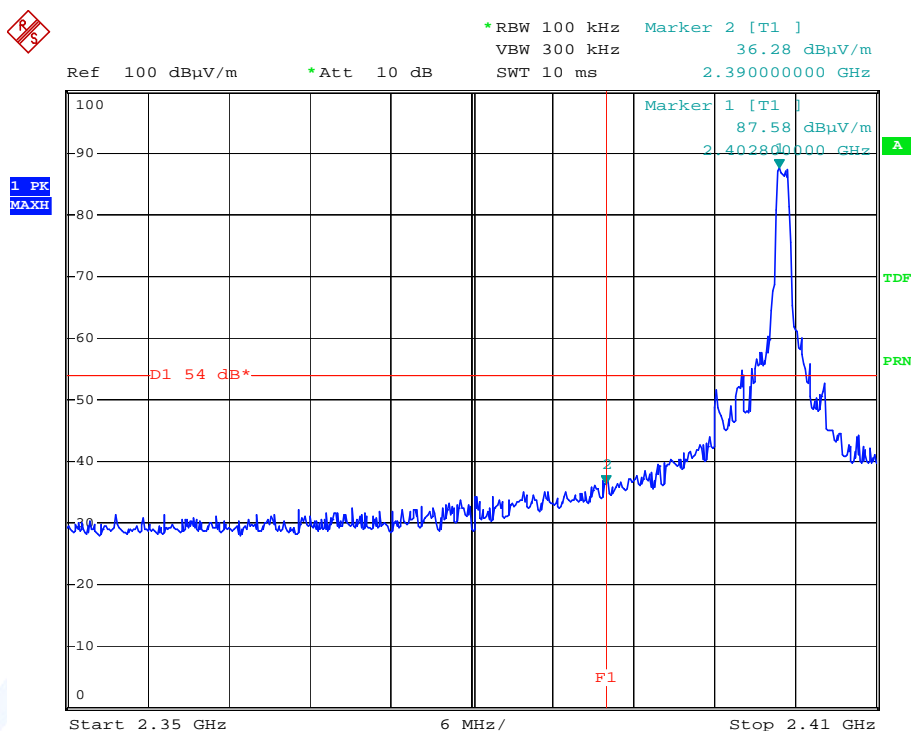
Spurious emissions radiated from 12 GHz to 18 GHz (worst case)



Remark: All peak emissions were below the limits of part 15.209. Up from 12 GHz to 25 GHz no emission could be detected.

Plots of spurious emissions in the nearest restricted bands:

Lower Channel (2403 MHz)



Higher Channel (2481 MHz)



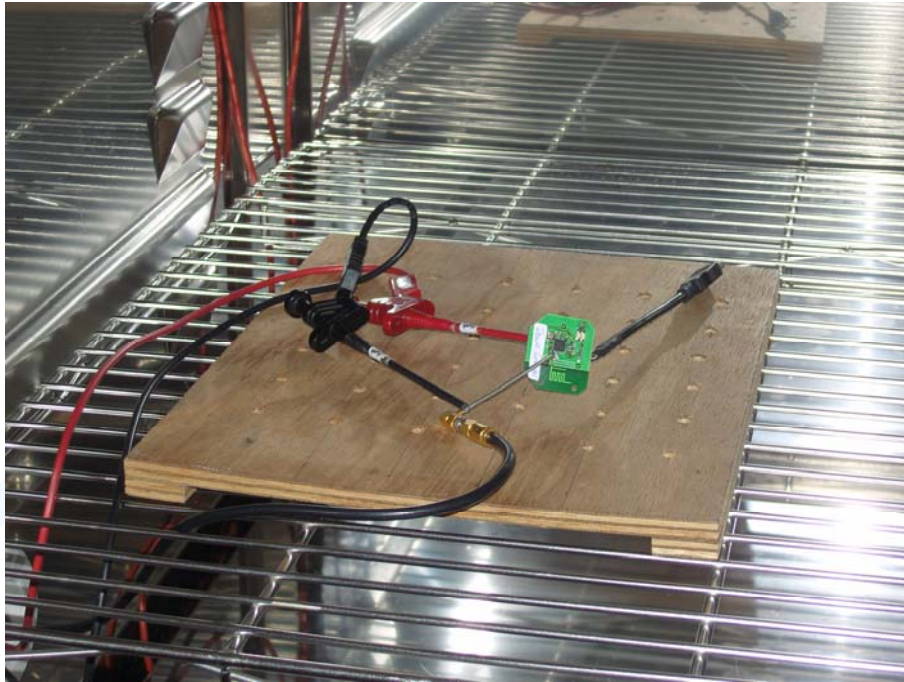
5.4 20 dB bandwidth

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 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. Alternative 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:	100 kHz	VBW:	300 kHz	Span:	5 MHz
Sweep time:	2.5 ms	Detector:	Peak		

5.4.5 Test result

Operating frequency band (MHz)		20 dB Bandwidth (kHz)
$f_{\text{low}} > 2400$		$f_{\text{low}} = 2403.000$
$f_{\text{high}} < 2483.5$		$f_{\text{high}} = 2481.870$

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: The EUT stay in the limits of the operating band.

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.

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

5.5.2 Result

The EUT use a dipole antenna is printed on PCB. The antenna's gain is 1.5 dBi and meets the requirement.

Remarks: _____

5.6 Receiver conducted disturbance

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

5.6.1 Description of the test location

Test location: NONE

Remarks: The measurement is not applicable. The EUT is USB powered.

5.7 Receiver radiated emissions

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

5.7.1 Description of the test location

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

5.7.2 Photo documentation of the test set-up



5.7.3 Applicable standard

According to FCC Part 15B, Section 15.109 (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.

5.7.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.4. If the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, 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.

Instrument settings:

30 MHz – 1000 MHz: RBW: 120 kHz

1000 MHz – 12500 MHz: RBW: 1 MHz

5.7.5 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)
175	22.4		120	14.2	36.6		43.5	-6.9
256	23.8		120	14.7	38.5		46.0	-7.5
288	25.6		120	16.0	41.6		46.0	-4.4
432	25.2		120	20.1	45.3		46.0	-0.7
496	22.0		120	21.8	43.8		46.0	-2.2

f > 1 GHz

Frequency (MHz)	L: PK (dBµV)	L: AV (dBµV)	Correct. (dB)	L: PK dB(µV/m)	L: AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
1888				45.4		54.0	-8.6

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

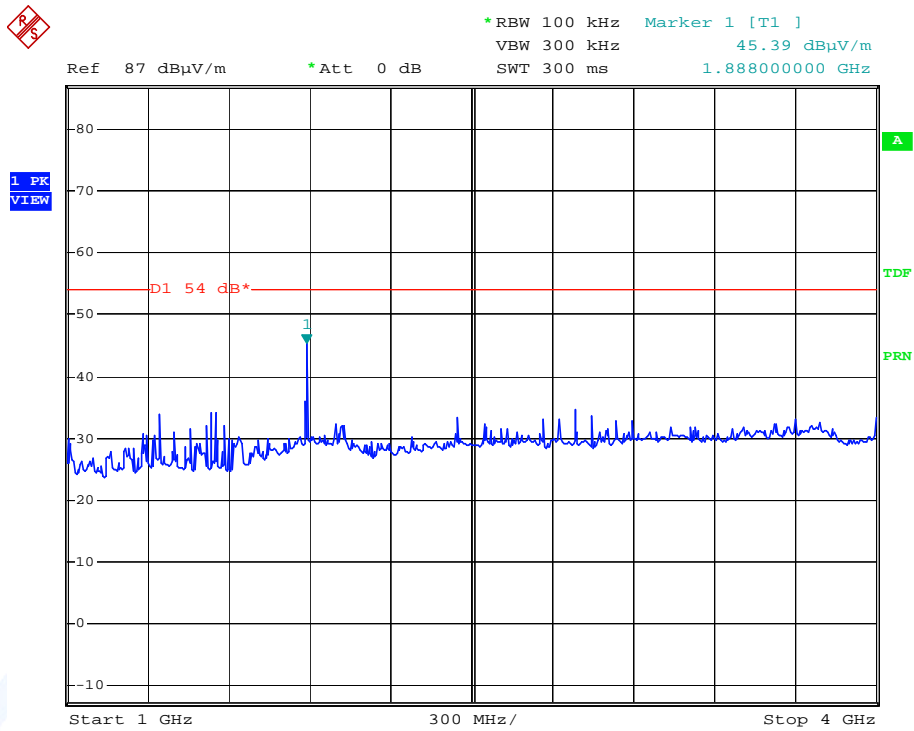
Frequency (MHz)	Limit (µV/m)	Limit dB(µV/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

The requirements are **FULFILLED**.

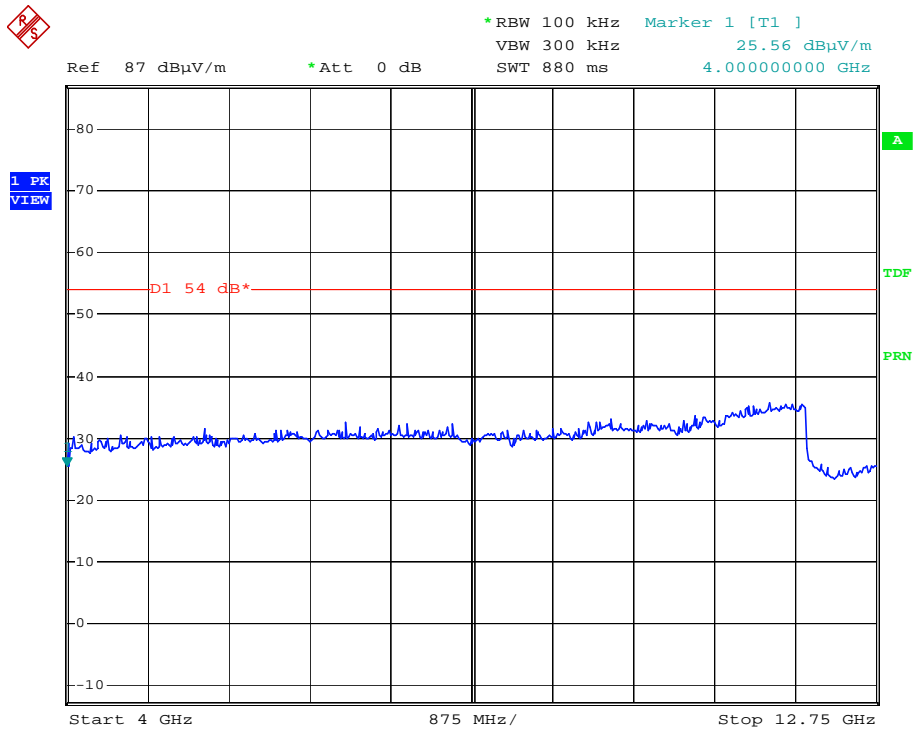
Remarks: The measurement was performed according to FCC Part 15A, Section 15.33(b), up to the effective frequency.

5.7.6 Test protocols

Radiated spurious emissions from 1 GHz to 4 GHz (worst case)



Radiated spurious emissions from 4 GHz to 12 GHz (worst case)



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
MB	FSP 30	02-02/11-05-001	04/20/2010	04/20/2009		
	WK-340/40	02-02/45-05-001	06/17/2014	06/17/2009	06/10/2010	12/10/2009
	6543A	02-02/50-05-157				
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				