FCC ID:SDL-PRA92R01

EMI – TEST REPORT

- FCC Part 15.249 and RSS 210 -

DAkkS Deutsche Akkreditierungsstelle D-PL-12030-01-01

Test Report No. :	**T35012-00-02HS**	07. December 2011 Date of issue

Type / Model Name : PRA92

Product Description : Radio remote control

Applicant : Hilti AG

Address : Feldkirchnerstrasse 100

9494 SCHAAN, LIECHTENSTEIN

Manufacturer : Solar Wide Industrial Ltd.

Address : Units A-C, CDW BUILDING, HONG KONG

388 Castle Peak Road Tsuen Wan, N.T.

Licence holder : Hilti AG

Address : Feldkirchnerstrasse 100

9494 SCHAAN, LIECHTENSTEIN

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

ilac-MRA

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (October, 2010)

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, 2010)

Part 15, Subpart C, Section 15.203	Antenna requirement
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.
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment

2 SUMMARY

GENERAL REMARKS:

The EUT provides a test mode for TX continuous with a duty cycle x = 1. The real duty cycle of this manual operated device is much smaller.

2.1 Test result summery

Operating in the 2400 MHz – 2483.5 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
Intentional radiator			
15.207(a)	RSS Gen, 7.2.4.	AC power line conducted emissions	not applicable
15.249(a)(2)	RSS210, A2.9(a)	Field strength	passed
15.249(d)	RSS210, A2.9(b)	Out-of-band emission, radiated	passed
15.249(e)		Peak field strength limit	passed
15.35(c)	RSS-Gen, 4.5	Pulsed operation	passed
15.203	RSS-Gen, 7.1.2	Antenna requirement	passed
	RSS-Gen, 4.6.1	OBW99	passed
	RSS-Gen, 7.2.6	Transmitter frequency stability	not required
Unintentional radiator			
	RSS Gen, 7.2.4.	AC power line conducted emissions	not applicable
	RSS-Gen, 6.1	Receiver spurious emissions, radiated	not required

The mentioned RSS Rule Parts in the above table are related to:
RSS Gen, Issue 3, December 2010
RSS 210, Issue 8, December 2010
RSS 102, Issue 4, March 2010

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 2011

Testing concluded on : 08 March 2011

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this documents
2011.12.07 10:15:24 +01'00'

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

Tested by:

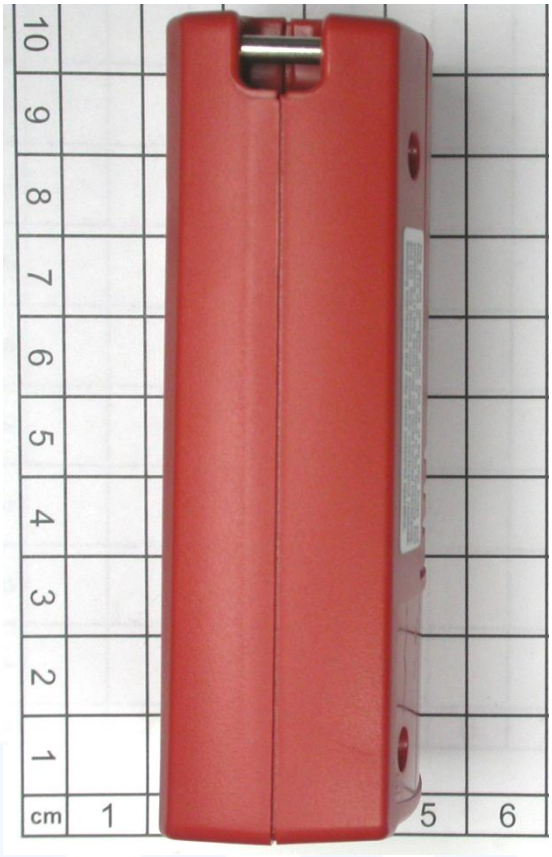
Hermann Smetana
I am the author of this document
2011.12.07 10:11:32 +01'00'

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

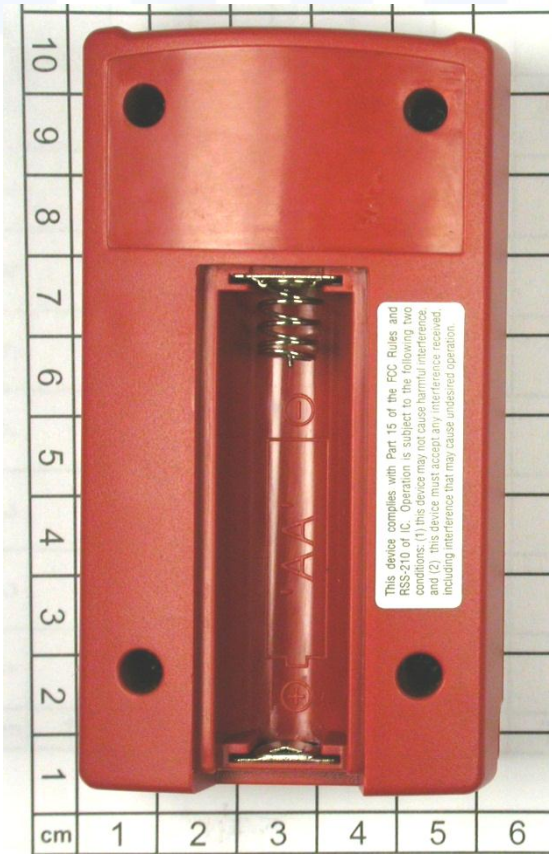
3 EQUIPMENT UNDER TEST

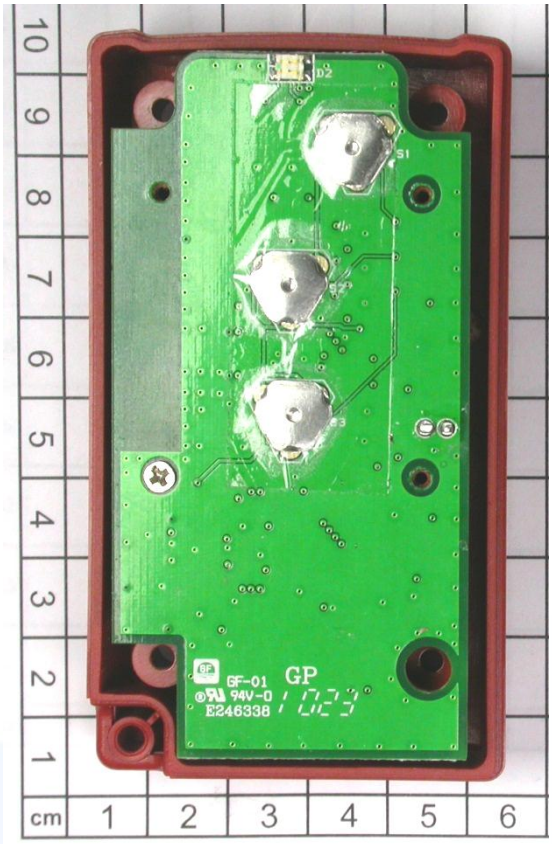
3.1 Photo documentation of the EUT

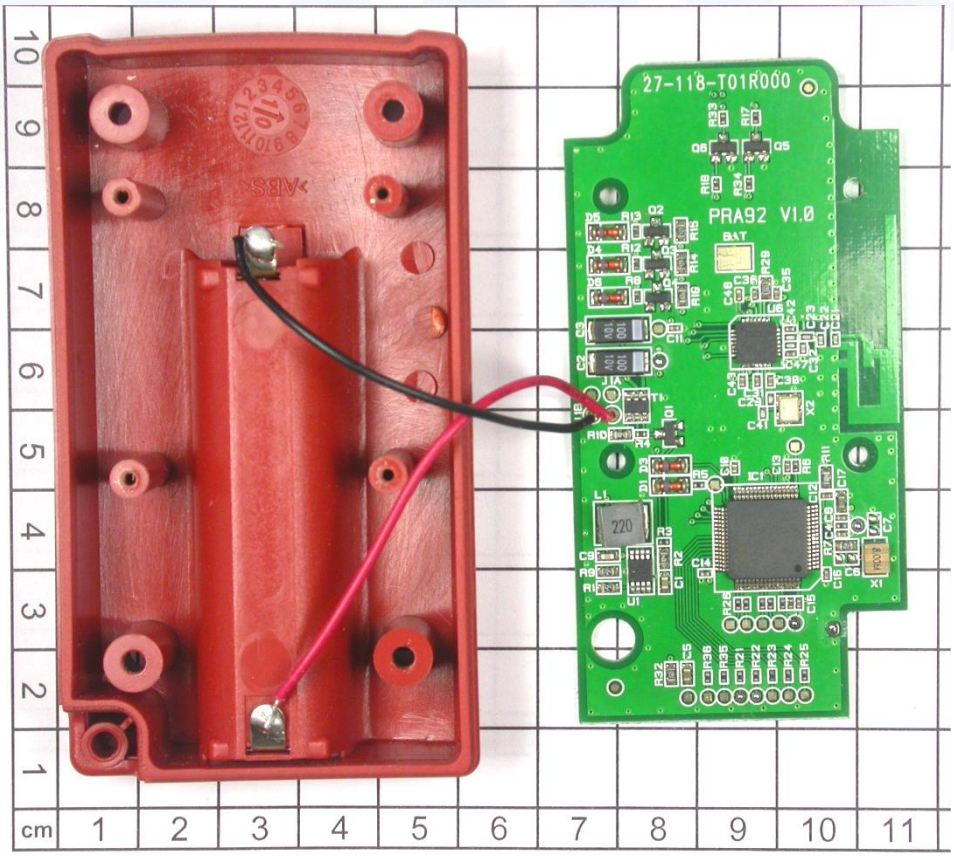
External view:



Internal view:




GF-01
94V-0
E246338
GP


27-118-T01R000
PRA92 V1.0

3.2 Power supply system utilised

Power supply voltage : 1.5 VDC, Mignon battery

3.3 Short description of the equipment under test (EUT)

The EUT is a radio remote transceiver operating on one channel at 2405 MHz. This proprietary wireless application works together with the controllable tripods. The relation between the tripod and the radio remote control is done by a pairing procedure. After that the tripod can be controlled.

Number of tested samples: 1 pc for TX continuous, 1 pc for RX;
Serial number: Prototypes

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:

- - 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 and IC

4.4.1 GENERAL INFORMATION

4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.3 Details of test procedures

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.4 Conducted emission

The final level, expressed in dBμV, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit or to the CISPR limit.

To convert between dBμV and μV, the following conversion formula apply:

$$dB\mu V = 20*\log(\mu V);$$
$$\mu V = 10\text{^}(dB\mu V/20);$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin of a peak mode measurement appears to be less than 20 dB, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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

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 cm to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 cm 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 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 dBµV/m is calculated by add on the reading value from the EMI receiver (level dBµV) the correction factor. 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	+	Corr. Factor	=	Level	-	CISPR Limit	=	Delta
(MHz)	(dBµV)		(dB/m)		(dBµV/m)		(dBµV/m)		(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

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

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 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 emissions under better uncertainty and are calculated at the specified test distance.

4.5 Determination of worst case measurement conditions

Measurements have been made in all three orthogonal axes. There is no access to any setting of the EUT. The EUT is pre-set for testing in TX continuous mode with max output power. The user is not able to change any setting and can operate the EUT only manually. For the further measurement the EUT is set in X position.

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: NONE

Remarks: The EUT has no AC mains connection.

5.2 Field strength 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

5.2.1 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 spectrum analyser and appropriate linear polarized antennas.

Analyser settings:

Peak measurement:	RBW:	1 MHz	VBW:	3 MHz	Detector:	Max peak
AV measurement:	RBW:	1 MHz	VBW:	10 Hz	Detector:	Max peak

5.2.3 Test result

Frequency (MHz)	Reading level PK (dBµV)	Bandwidth (kHz)	Correction factor (dB)	Corrected level PK dB(µV/m)	Limit PK dB(µV/m)	Delta (dB)
2405	-	1000	-	97.2	114.0	-16.8

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

Frequency (MHz)	Reading level AV (dBµV)	Bandwidth (kHz)	Correction factor (dB)	Corrected level AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
2405	-	1000	-	34.1	94.0	-59.9

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

Average-Limit according to FCC Part 15C, Section 15.249(a):

Frequency	Field strength of fundamental	
(MHz)	(mV/m)	dB(µV/m)
902 - 928	50	94
2400 - 2483.5	**50**	**94**
5725-5875	50	94
24000 - 24250	250	108

Peak-Limit according to FCC Part 15C, Section 15.249(e):
However the peak field strength shall not exceed the maximum permitted average limit by more than 20 dB.

The requirements are **FULFILLED.**

Remarks: _____

5.3 Spurious emissions radiated

For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3**.

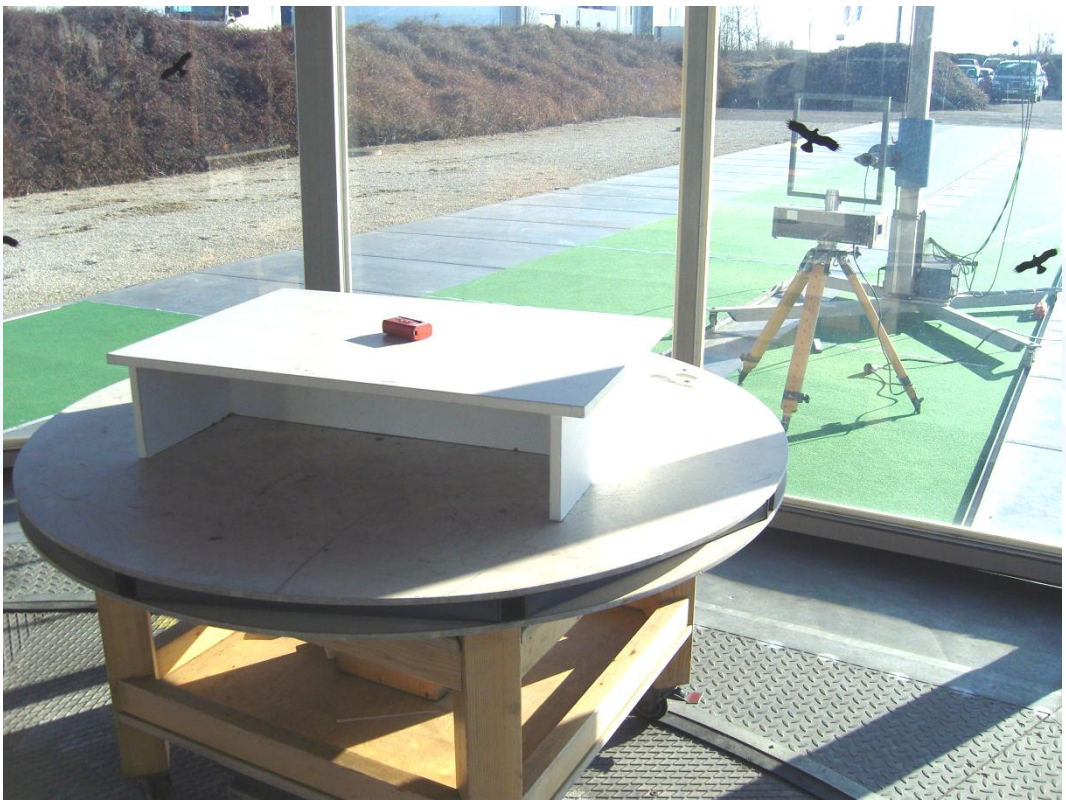
5.3.1 Description of the test location

Test location: OATS1
Test location: Anechoic Chamber A2

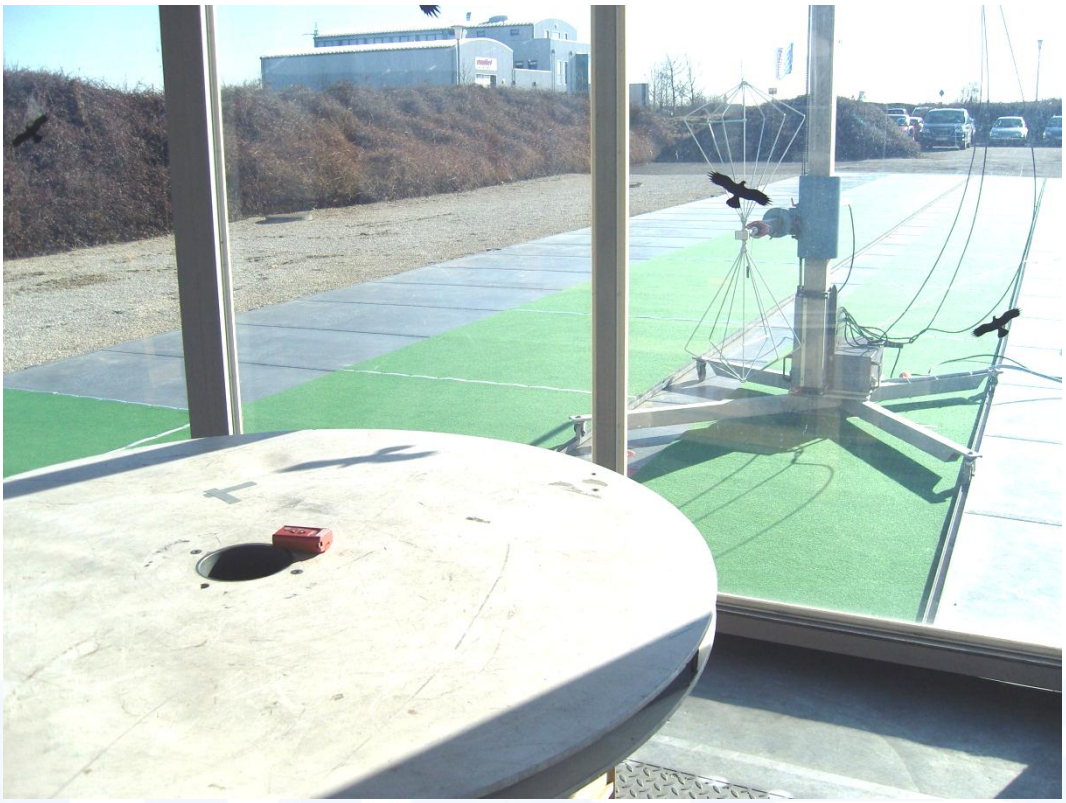
Test distance: 3 metres

5.3.2 Photo documentation of the test set-up

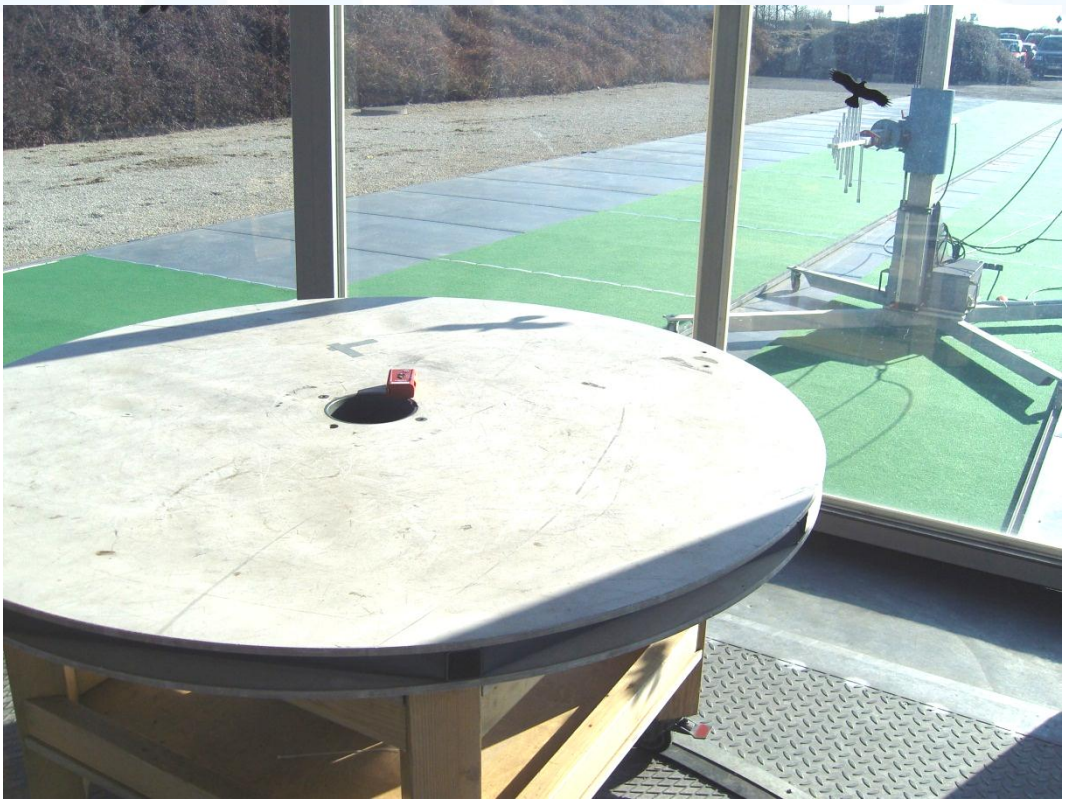
Test setup for 9 kHz to 30 MHz



Test setup for 30 MHz to 300 MHz

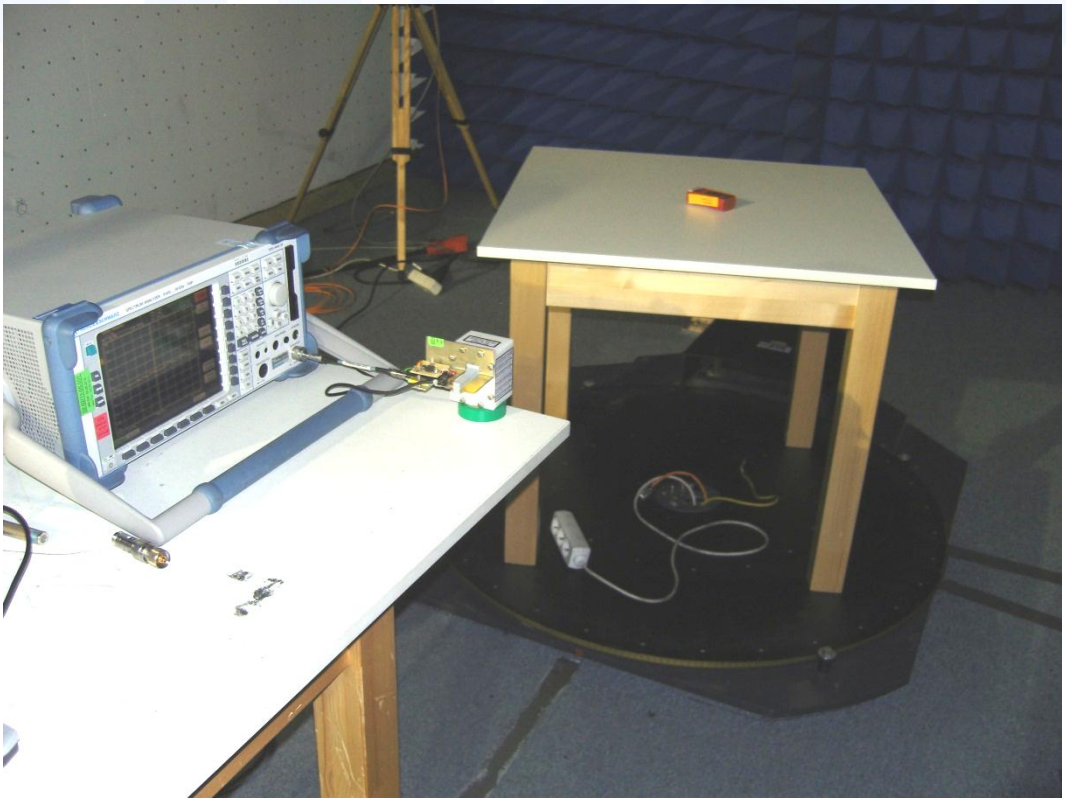


Test setup for 300 MHz to 1000 MHz



Test setup for 1 GHz to 18 GHz

Test setup for 18 GHz to 26 GHz



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 EMI receiver and above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. The setup of the EUT will be as described in item 4.4. 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 – 26 GHz	RBW: 1 MHz

5.3.5 Test result f < 1 GHz

Channel 1

Frequency (MHz)	Reading level QP (dBµV)	Reading level AV (dBµV)	Bandwidth (kHz)	Correction factor (dB/m)	Corrected level QP dB(µV/m)	Corrected level AV dB(µV/m)	Limit dB(µV/m)	Delta (dB)
-	-							

5.3.6 Test result f > 1 GHz

Channel 1

Frequency (MHz)	Level PK (dBµV)	Duty Cycle Correction (dB)	Level AV (dBµV)*)	Correction factor (dB/m)	Corrected level PK dB(µV/m)	Corrected level AV dB(µV/m)	Limit PK dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
-	-								

No emission was found within 20 dB to the peak limit. No emission exceeds the AV limit of Section 15.209.

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

Average limit according to FCC Part 15C, Section 15.249(a):

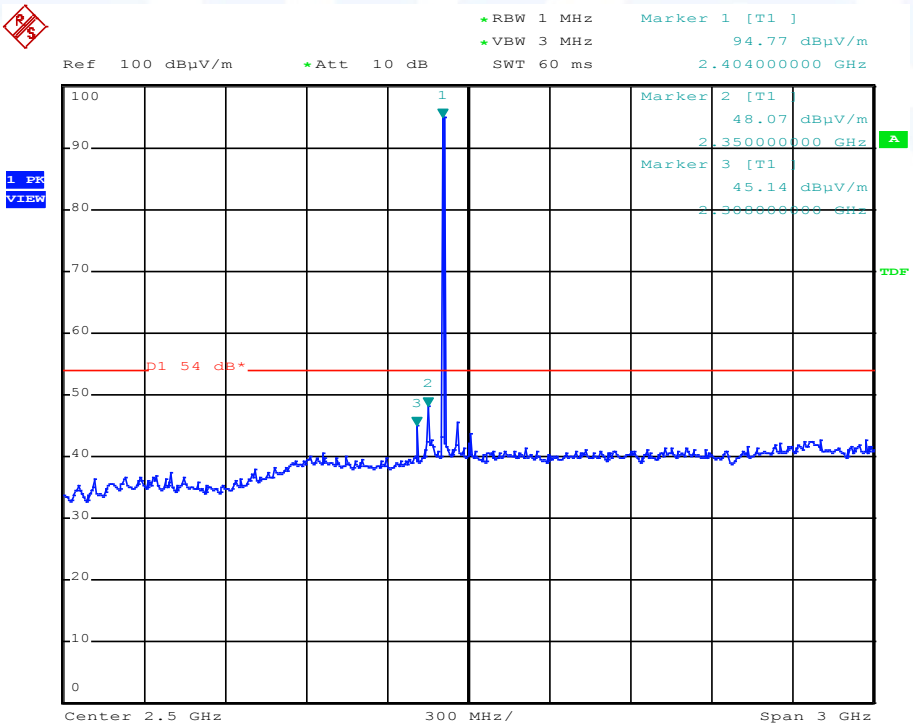
Fundamental frequency	Field strength of harmonics	
(MHz)	(µV/m)	dB(µV/m)
902 - 928	500	54
2400 - 2483.5	500	54
5725-5875	500	54
24000 - 24250	2500	68

The requirements are **FULFILLED.**

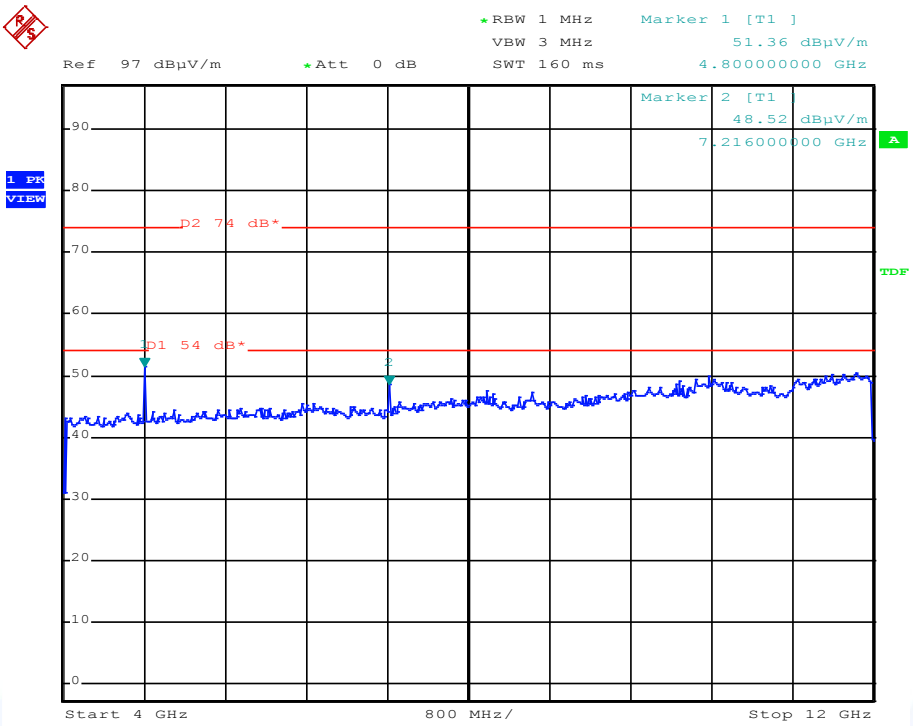
Remarks: The measurement was performed up to the 10th harmonic (26000 MHz). For detailed test result please see to following test protocols. Only the worst cases of the plots are listed.

5.3.7 Test protocols

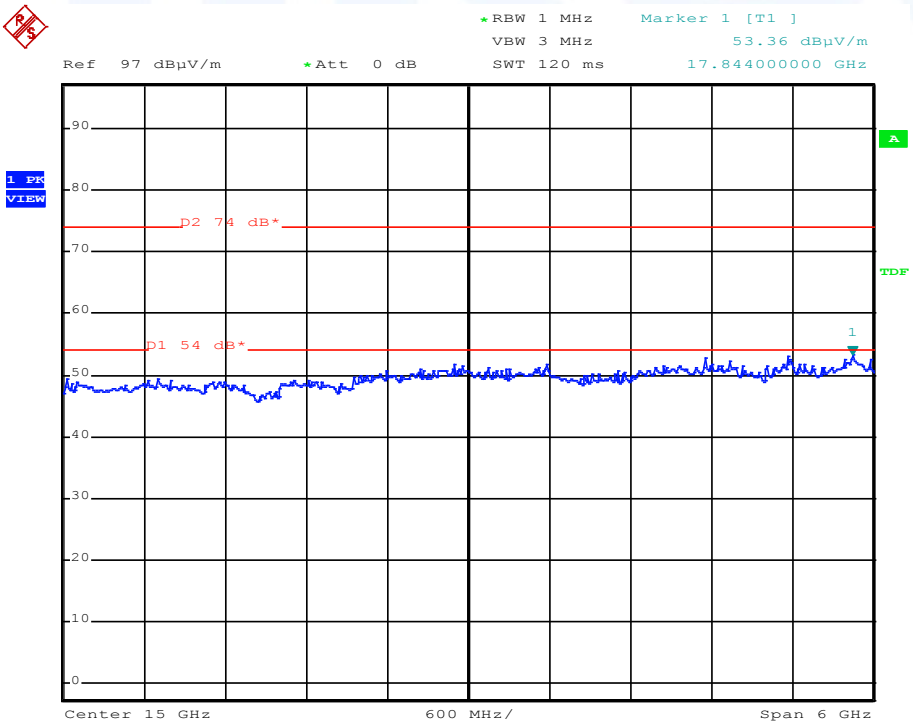
Spurious emissions from 1 to 4 GHz
(Incl. fundamental carrier)



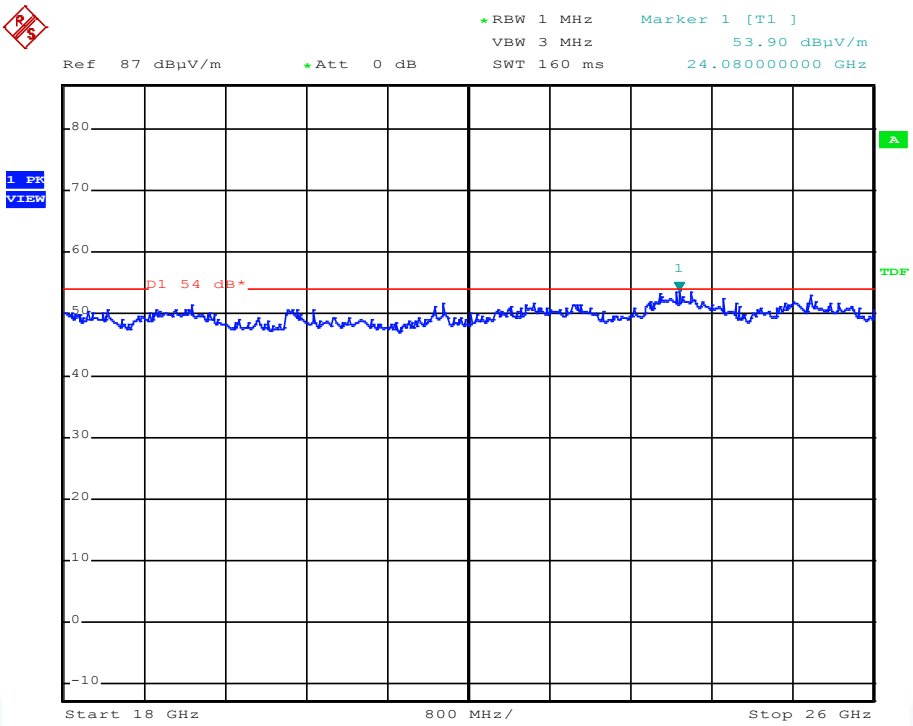
Spurious emissions from 4 to 12 GHz



Spurious emissions from 12 to 18 GHz



Spurious emissions from 18 to 26 GHz



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: Anechoic Chamber A2

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 alternative 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 than directly shown in the marker display. The measurement is performed with normal modulation and a transfer rate means the worst case.

Spectrum analyser settings:
RBW: 100 kHz VBW: 300 kHz Span: 5 MHz

5.4.5 Test result

Operating frequency band (MHz)	20 dB Bandwidth (MHz)
f_{low} > 2400	f_{low} = 2404.730
f_{high}< 2483.5	f_{high} = 2405.010

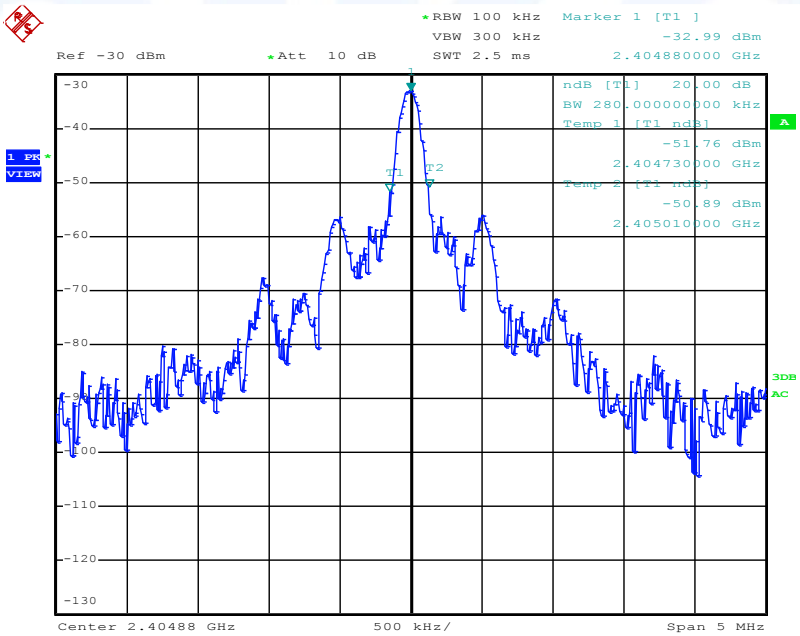
Limit according to FCC Part 15C, Section 15.215(c):
The 20 dB bandwidth of the emission is contained within the frequency band designated.

The requirements are **FULFILLED.**

Remarks: For detailed test result please see to following test protocol.

5.4.6 Test protocol

20 dB bandwidth



5.5 Antenna application

5.5.1 Applicable standard

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

5.5.2 Result

The EUT use an integrated PCB antenna. No other antenna than that furnished by the responsible party or external power amplifier can be applied by a customer.

The antenna of the EUT meets the requirements of FCC Part 15C, Section 15.203.

Remarks: _____

_____

5.6 Occupied bandwidth

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

5.6.1 Description of the test location

Test location: Anechoic Chamber A2

5.6.2 Photo documentation of the test set-up

5.6.3 Applicable standard

According to RSS-Gen, 4.6.1:
When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

5.6.4 Description of Measurement

The bandwidth was measured with the function “bandwidth measurement” of the spectrum analyser and recorded.
Spectrum analyser settings: RBW: 100 kHz, VBW: 300 kHz;

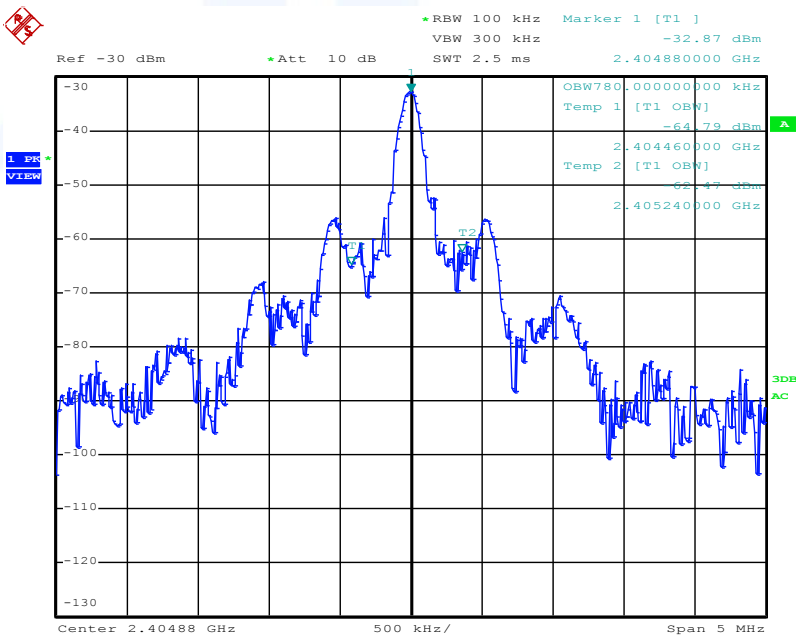
5.6.5 Test result

Channel number	Fundamental frequency (MHz)	99 % Bandwidth (MHz)
1	2405	0.78

Remarks: For detailed test result please refer to following test protocols. The RSS Gen defines no limit for the occupied bandwidth!

5.6.6 Test protocols

Channel 1 (2405 MHz)



5.7 Frequency range

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

5.7.1 Description of the test location

Test location: NONE

5.7.2 Applicable standard

According to RSS-Gen, Section 7.2.6:
Transmitter frequency stability for licence-exempt LPDs shall be measured at temperature range of -20°C, 20°C and +50°C.
If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standards, measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands of Table 1 and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz.

Remarks: The measurement is not required. The occupied bandwidth lies entirely outside the restricted bands of Table 1.

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.
CPR 3	FSP 30	02-02/11-05-001	04/05/2011	04/05/2010		
	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	11/02/2012	11/02/2011		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
DC	FSP 30	02-02/11-05-001	04/05/2011	04/05/2010		
MB	FSP 30	02-02/11-05-001	04/05/2011	04/05/2010		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	3117	02-02/24-05-009	11/02/2012	11/02/2011		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
SER 1	FMZB 1516	01-02/24-01-018			16/02/2012	16/02/2011
	ESCI	02-02/03-05-005	19/11/2011	19/11/2010		
	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 2	ESVS 30	02-02/03-05-006	11/06/2011	11/06/2010		
	BBA 9106 / VHA 9103	02-02/24-05-001	12/12/2011	12/12/2008	17/09/2011	17/03/2011
	UHALP 9108 A	02-02/24-05-004	12/12/2011	12/12/2008	08/09/2011	08/03/2011
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 3	FSP 30	02-02/11-05-001	04/05/2011	04/05/2010		
	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	11/02/2012	11/02/2011		
	R1 _ 18 - 30 GHz	02-02/30-09-002			02/02/2012	02/02/2011
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				