

EMI - TEST REPORT

- FCC Part 15.247, RSS210 -

Test Report No. : T38855-00-04KJ

20. January 2015

Date of issue

Type / Model Name : US-3046

Product Description : Base Station

Applicant : smaXtec animal care sales GmbH

Address : Wastiangasse 4

8010 GRAZ, AUSTRIA

Manufacturer : smaXtec animal care sales GmbH

Address : Wastiangasse 4

8010 GRAZ, AUSTRIA

Licence holder : smaXtec animal care sales GmbH

Address : Wastiangasse 4

8010 GRAZ, AUSTRIA

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

POSITIVE



The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results
without the written permission of the test laboratory.

Contents

1	<u>TEST STANDARDS</u>	3
2	<u>EQUIPMENT UNDER TEST</u>	4
2.1	Photo documentation of the EUT – Detailed photos see attachment A	4
2.2	Equipment category	4
2.3	Short description of the equipment under test (EUT)	4
2.4	Variants of the EUT	5
2.5	Operation frequency and channel plan	5
2.6	Transmit operating modes	5
2.7	Antennas	5
2.8	Power supply system utilised	5
2.9	Peripheral devices and interface cables	6
2.10	Determination of worst case conditions for final measurement	6
3	<u>TEST RESULT SUMMERY</u>	8
3.1	Final assessment	8
4	<u>TEST ENVIRONMENT</u>	9
4.1	Address of the test laboratory	9
4.2	Environmental conditions	9
4.3	Statement of the measurement uncertainty	9
4.4	Measurement protocol for FCC and IC	10
5	<u>TEST CONDITIONS AND RESULTS</u>	11
5.1	AC power line conducted emissions	11
5.2	EBW and OBW	17
5.3	Maximum peak radiated output power	22
5.4	Power spectral density	24
5.5	Band edge compliance	27
5.6	Radiated emissions in restricted bands	30
5.7	Spurious emissions	38
5.8	Antenna application - Detailed photos see attachment A	39
6	<u>USED TEST EQUIPMENT AND ACCESSORIES</u>	40

1 TEST STANDARDS

The tests were performed according to following standards:

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

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

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2014)

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 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

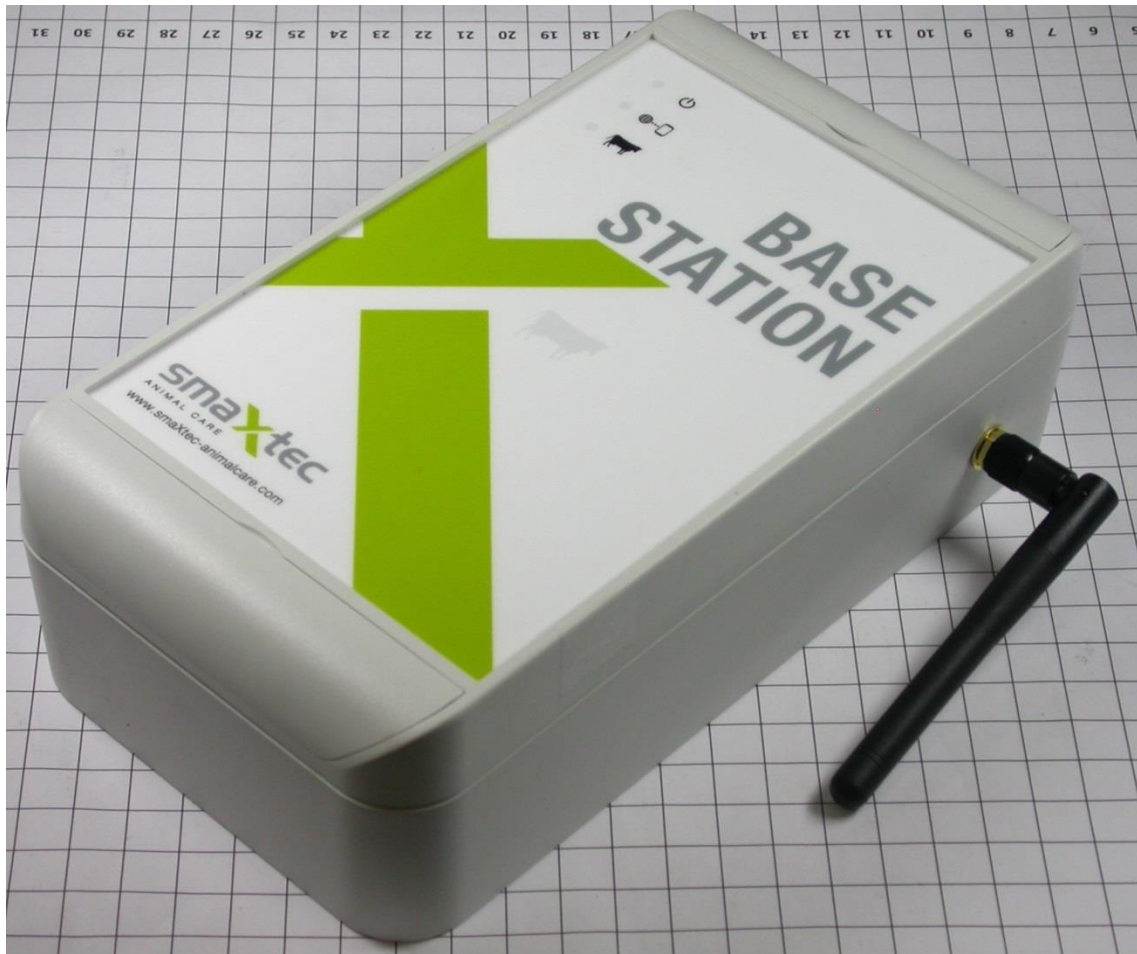
Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable device

OET Bulletin 65, 65A, 65B Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

ANSI C63.4: 2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
ANSI C95.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2013	Uncertainty in EMC measurement
KDB 558074 D01 v03r02	Guidance for performing compliance measurements on DTS operating under §15.247, June 5, 2014.

2 EQUIPMENT UNDER TEST

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



2.2 Equipment category

Zigbee Accesspoint

2.3 Short description of the equipment under test (EUT)

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

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

Number of tested samples: 1
Serial number: prototype

2.4 Variants of the EUT

There are no variants.

2.5 Operation frequency and channel plan

The operating frequency band is 2400 MHz to 2483.5 MHz.

Channel plan

Channels	Frequency
11	2405
12	2410
13	2415
14	2420
15	2425
16	2430
17	2435
18	2440
19	2445
20	2450
21	2455
22	2460
23	2465
24	2470
25	2475

Note: the marked frequencies are determined for final testing.

2.6 Transmit operating modes

The EUT uses DSSS modulation. The EUT was set in TX continuous modulated mode with a duty cycle of 70 % by the test software.

2.7 Antennas

The following antennas shall be used with the EUT:

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

2.8 Power supply system utilised

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

2.9 Peripheral devices and interface cables

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

- _____ Model : _____
- _____ Model : _____
- _____ Model : _____

2.10 Determination of worst case conditions for final measurement

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

The tests are carried out in the following frequency band:

2400 MHz – 2483.5 MHz

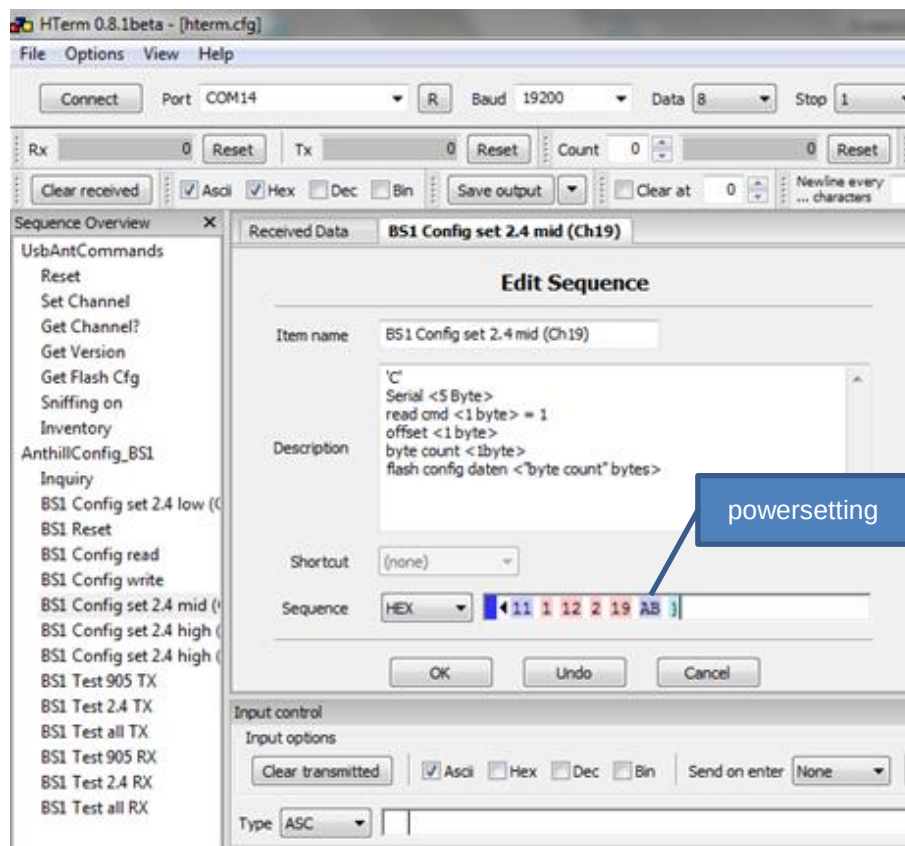
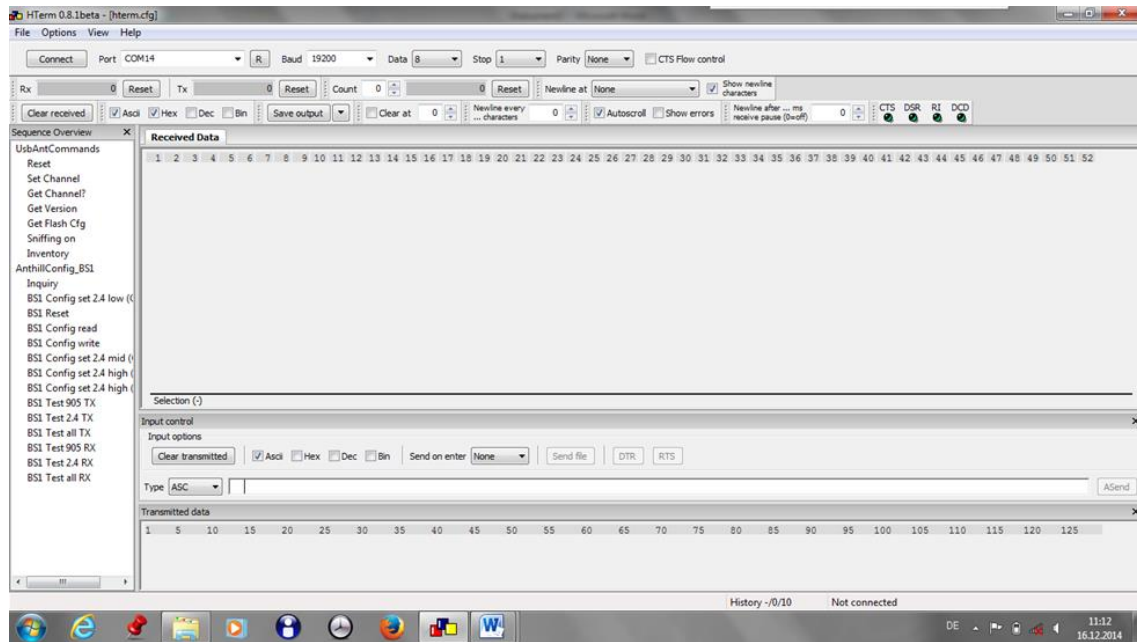
For the final test the following channels and test modes are selected:

Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
11 to 25	11, 19, 25	0xAB (15 dBm)	DSSS	0-4QPSK	250 kbps

2.10.1 Test jig

No test jig.

2.10.2 Test software



3 Test result summary

Device using digital modulation:

Operating in the 2400 MHz – 2483.5 MHz and 5725 MHz – 5850 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	passed
15.247(a)(2)	RSS210, A8.2(a)	-6 dB EBW	passed
15.247(b)(3)	RSS-210, A8.4(4)	Peak power	passed
15.247(d)	RSS-210, A8.5	Out-of-band emission, radiated	passed
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.247(e)	RSS-210, A8.2(b)	PSD	passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.247(b)(4)	RSS-210, A8.4(4)	Antenna requirement	passed
	RSS-Gen, 6.11	Transmitter frequency stability	passed
	RSS-Gen, 6.6	99 % Bandwidth	passed

The mentioned RSS Rule Parts in the above table are related to:

RSS Gen, Issue 4, November 2014

RSS 210, Issue 8, December 2010

RSS 102, Issue 4, March 2010

3.1 Final assessment

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 20 October 2014

Testing concluded on : 08 December 2014

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Josef Knab
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement protocol for FCC and IC

4.4.1 General information

4.4.1.1 Test methodology

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

IC 3009A

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

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.

5 TEST CONDITIONS AND RESULTS

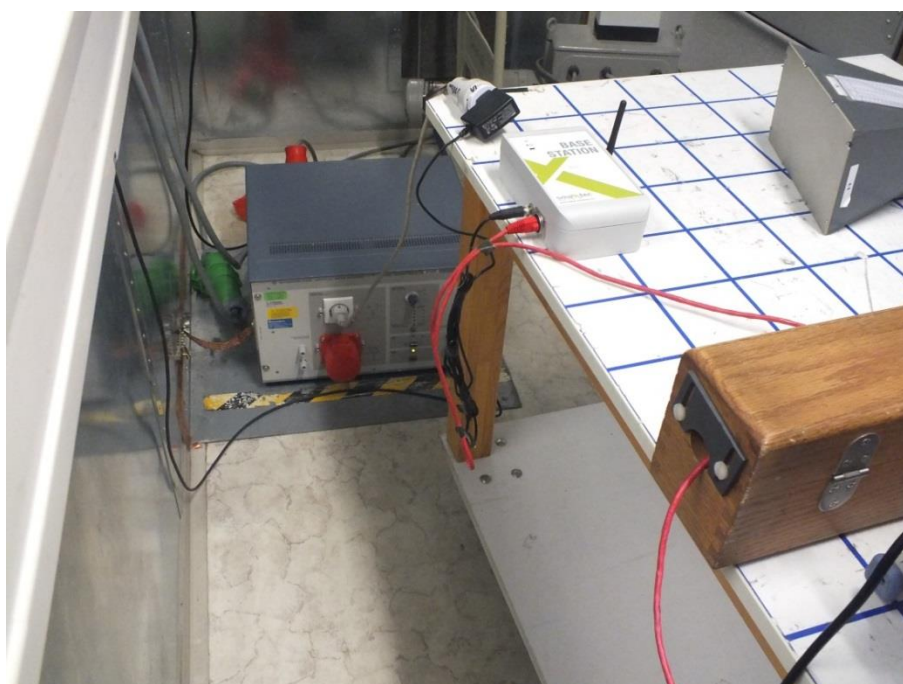
5.1 AC power line conducted emissions

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 9.9 dB at 0.195 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

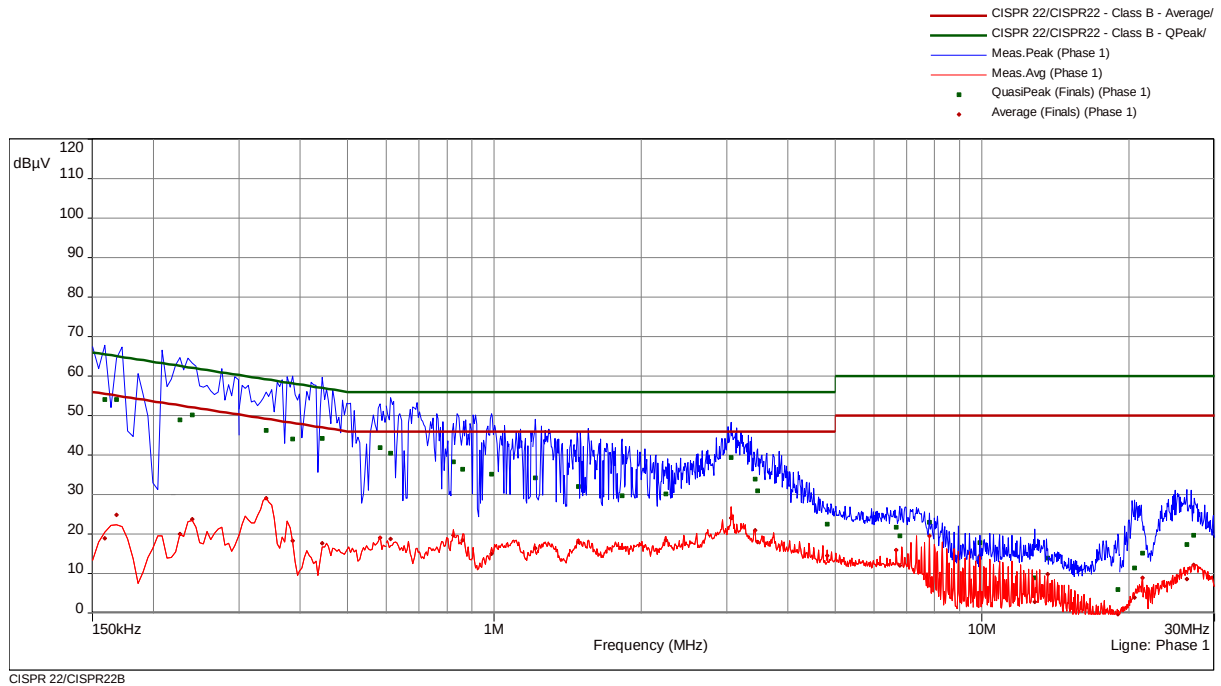
The requirements are **FULFILLED**.

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

5.1.6 Test protocol

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

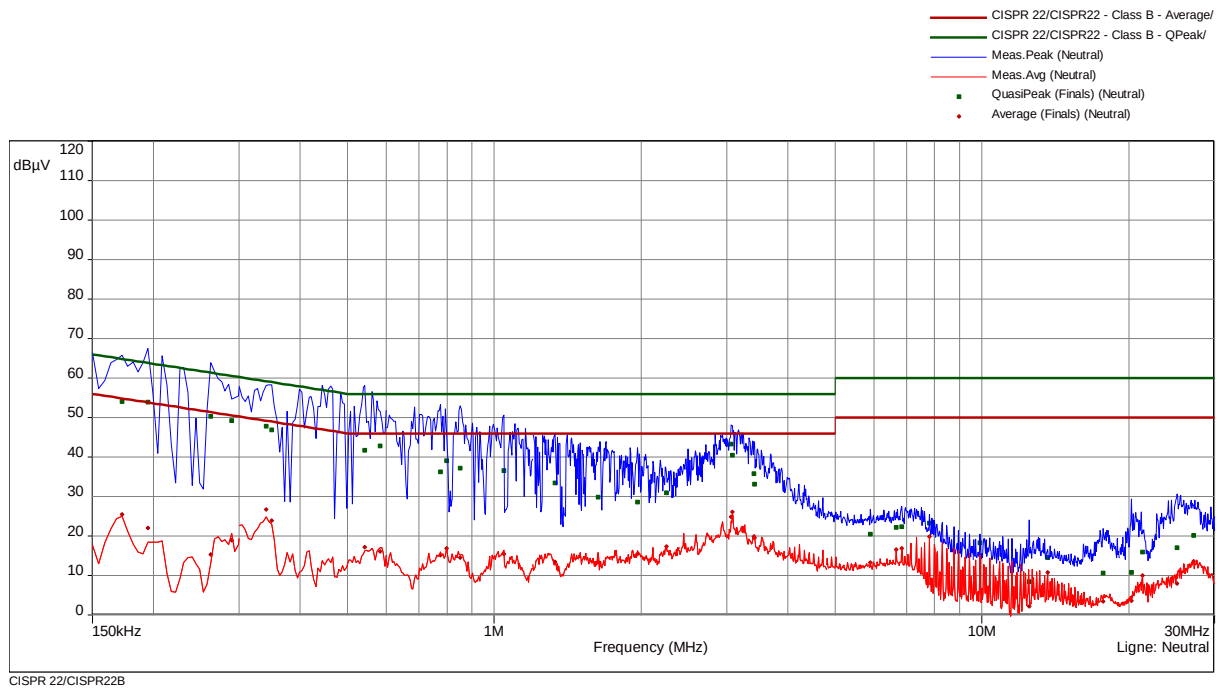
Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.159	1	54.0	11.5	65.5	18.9	36.6	55.5	Phase 1
0.168	1	54.1	10.9	65.1	24.9	30.2	55.1	Phase 1
0.227	1	49.0	13.6	62.6	20.0	32.6	52.6	Phase 1
0.240	1	50.2	11.9	62.1	23.7	28.4	52.1	Phase 1
0.341	2	46.2	13.0	59.2	29.1	20.1	49.2	Phase 1
0.386	2	44.1	14.0	58.2	18.3	29.9	48.2	Phase 1
0.444	2	44.2	12.8	57.0	17.7	29.3	47.0	Phase 1
0.584	2	41.8	14.2	56.0	19.1	26.9	46.0	Phase 1
0.614	3	40.5	15.5	56.0	18.7	27.3	46.0	Phase 1
0.825	3	38.3	17.7	56.0	19.7	26.3	46.0	Phase 1
0.861	3	36.5	19.5	56.0	18.4	27.6	46.0	Phase 1
0.987	3	35.2	20.8	56.0	15.1	31.0	46.0	Phase 1
1.214	4	34.2	21.8	56.0	16.4	29.6	46.0	Phase 1
1.488	4	32.0	24.0	56.0	18.1	28.0	46.0	Phase 1
1.830	4	29.7	26.3	56.0	16.6	29.4	46.0	Phase 1
2.249	4	30.1	25.9	56.0	18.5	27.5	46.0	Phase 1
3.062	5	39.4	16.6	56.0	24.1	21.9	46.0	Phase 1
3.426	5	33.9	22.1	56.0	21.0	25.0	46.0	Phase 1
3.471	5	30.9	25.1	56.0	18.0	28.0	46.0	Phase 1
4.814	6	22.5	33.5	56.0	14.6	31.4	46.0	Phase 1
6.668	6	21.7	38.3	60.0	16.0	34.0	50.0	Phase 1
6.794	6	19.5	40.5	60.0	12.0	38.0	50.0	Phase 1
7.811	6	23.0	37.0	60.0	19.5	30.5	50.0	Phase 1
9.906	7	17.8	42.2	60.0	14.5	35.5	50.0	Phase 1
12.854	7	8.9	51.1	60.0	2.8	47.2	50.0	Phase 1
13.623	7	14.0	46.1	60.0	9.9	40.1	50.0	Phase 1
18.987	7	5.9	54.1	60.0	-0.2	50.2	50.0	Phase 1
20.555	8	11.5	48.6	60.0	3.9	46.1	50.0	Phase 1
21.338	8	15.2	44.8	60.0	8.9	41.1	50.0	Phase 1
26.288	8	17.4	42.6	60.0	8.6	41.4	50.0	Phase 1
27.183	8	19.8	40.2	60.0	12.2	37.8	50.0	Phase 1

Test point: N
Operation mode: TX-Mode
Remarks: -

Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB	
0.173	9	54.1	10.7	64.8	25.5	29.4	54.8	Neutral
0.195	9	54.0	9.9	63.8	22.0	31.8	53.8	Neutral
0.263	9	50.3	11.1	61.4	15.3	36.1	51.4	Neutral
0.290	9	49.3	11.3	60.5	18.9	31.7	50.5	Neutral
0.341	10	47.8	11.4	59.2	26.7	22.5	49.2	Neutral
0.350	10	47.0	12.0	59.0	24.0	25.0	49.0	Neutral
0.543	10	41.7	14.3	56.0	17.2	28.8	46.0	Neutral
0.584	10	42.8	13.2	56.0	16.1	29.9	46.0	Neutral
0.776	11	36.3	19.7	56.0	15.3	30.8	46.0	Neutral
0.798	11	39.1	16.9	56.0	16.9	29.1	46.0	Neutral
0.852	11	37.3	18.7	56.0	14.5	31.5	46.0	Neutral
1.046	11	36.5	19.5	56.0	15.4	30.6	46.0	Neutral
1.331	12	33.5	22.5	56.0	13.4	32.6	46.0	Neutral
1.632	12	29.9	26.1	56.0	13.5	32.5	46.0	Neutral
1.965	12	28.5	27.5	56.0	15.5	30.5	46.0	Neutral
2.258	12	31.0	25.0	56.0	17.4	28.6	46.0	Neutral
3.062	13	43.3	12.7	56.0	24.9	21.1	46.0	Neutral
3.080	13	40.5	15.5	56.0	26.1	19.9	46.0	Neutral
3.404	13	35.8	20.3	56.0	19.8	26.2	46.0	Neutral
3.417	13	33.1	22.9	56.0	19.5	26.5	46.0	Neutral
5.898	14	20.5	39.5	60.0	13.4	36.6	50.0	Neutral
6.668	14	22.2	37.8	60.0	16.6	33.5	50.0	Neutral
6.857	14	22.4	37.6	60.0	16.9	33.1	50.0	Neutral
7.811	14	23.3	36.7	60.0	19.9	30.1	50.0	Neutral
9.906	15	18.3	41.7	60.0	15.2	34.8	50.0	Neutral
12.494	15	8.5	51.5	60.0	2.1	47.9	50.0	Neutral
13.623	15	14.6	45.5	60.0	10.8	39.3	50.0	Neutral
17.736	15	10.6	49.4	60.0	3.4	46.6	50.0	Neutral
20.280	16	10.8	49.2	60.0	3.7	46.4	50.0	Neutral
21.338	16	16.0	44.0	60.0	9.9	40.1	50.0	Neutral
25.131	16	17.0	43.0	60.0	7.9	42.1	50.0	Neutral
27.183	16	20.1	39.9	60.0	13.5	36.5	50.0	Neutral

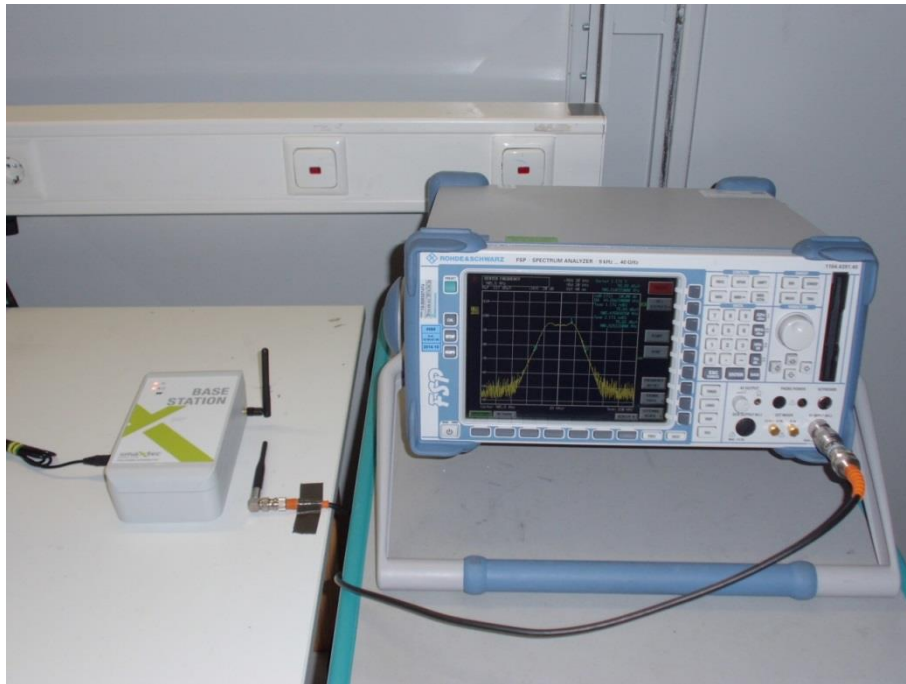
5.2 EBW and OBW

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

5.2.1 Description of the test location

Test location: Shielded room 4

5.2.2 Photo documentation of the test set-up



5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings:

RBW: 100 kHz, VBW: 300 kHz, Detector: Peak, Sweep time: 40 ms

5.2.5 Test result

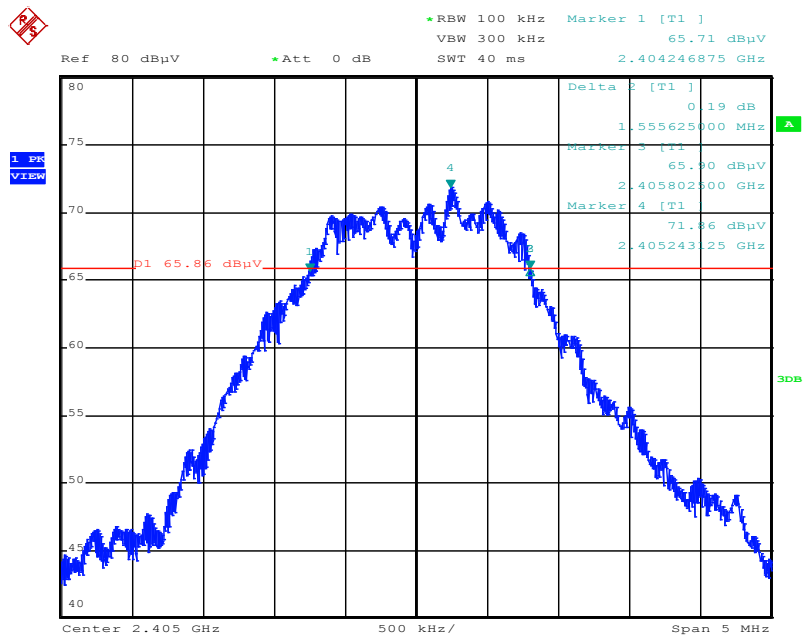
Channel	Centre frequency	6 dB bandwidth	99% OBW	Minimum limit
	(MHz)	(MHz)	(MHz)	(MHz)
11	2405	1.556	3.010	0.5
19	2445	1.617	2.781	0.5
25	2475	1.557	2.527	0.5

The requirements are **FULFILLED**.

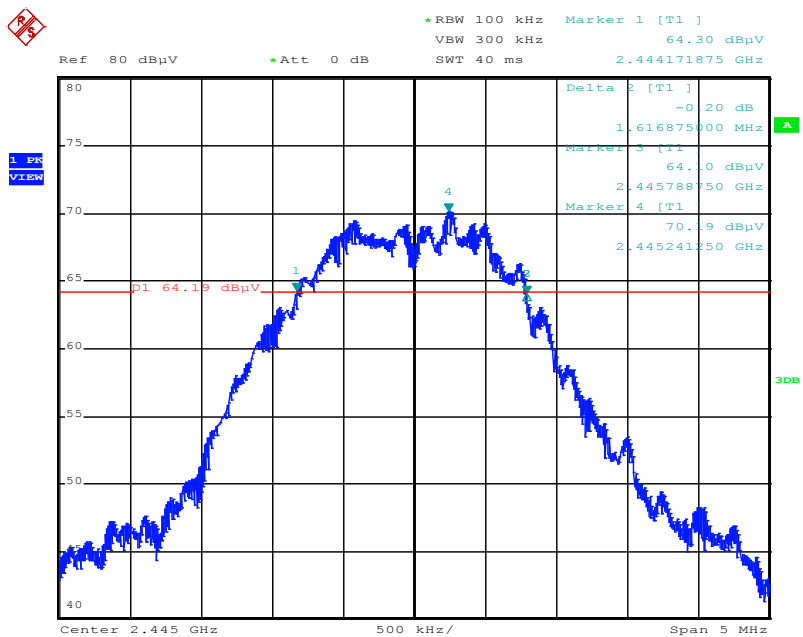
Remarks: For detailed test results please refer to following test protocols. The RSS Gen defines no limit for the occupied bandwidth!

5.2.6 Test protocols EBW

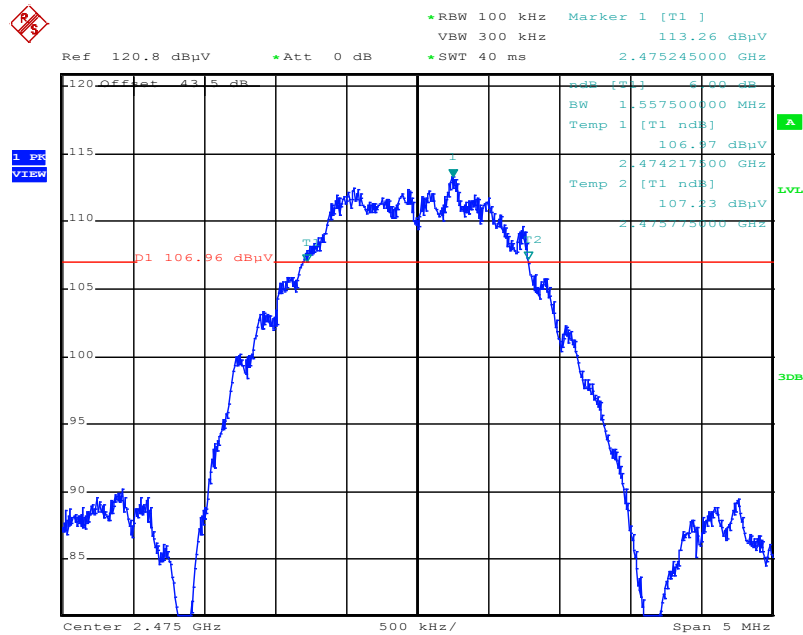
Channel 11 (2405 MHz)



Channel 19 (2445 MHz)

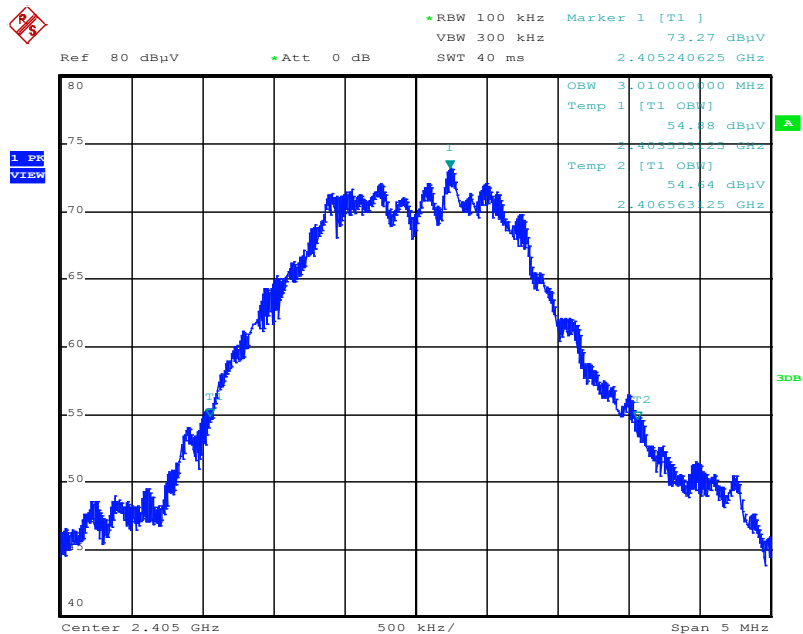


Channel 25 (2475 MHz)

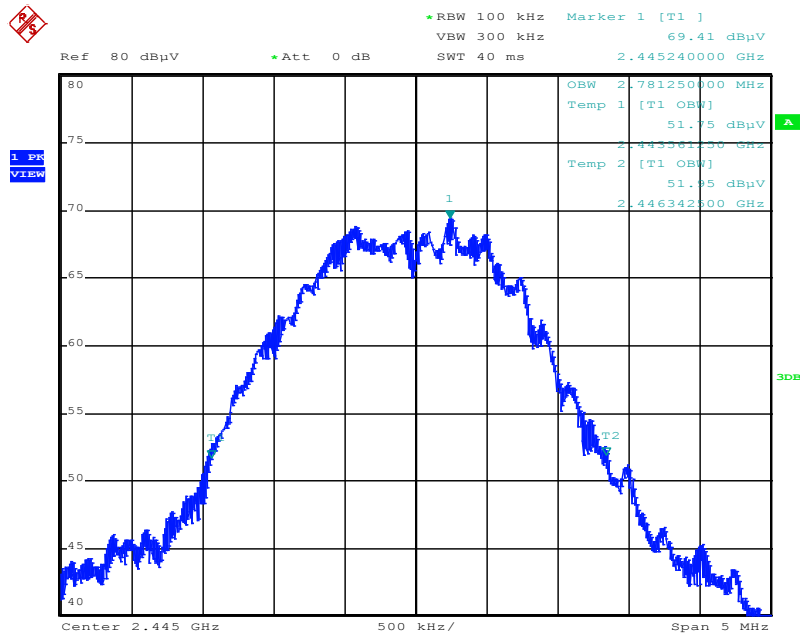


5.2.7 Test protocols OBW

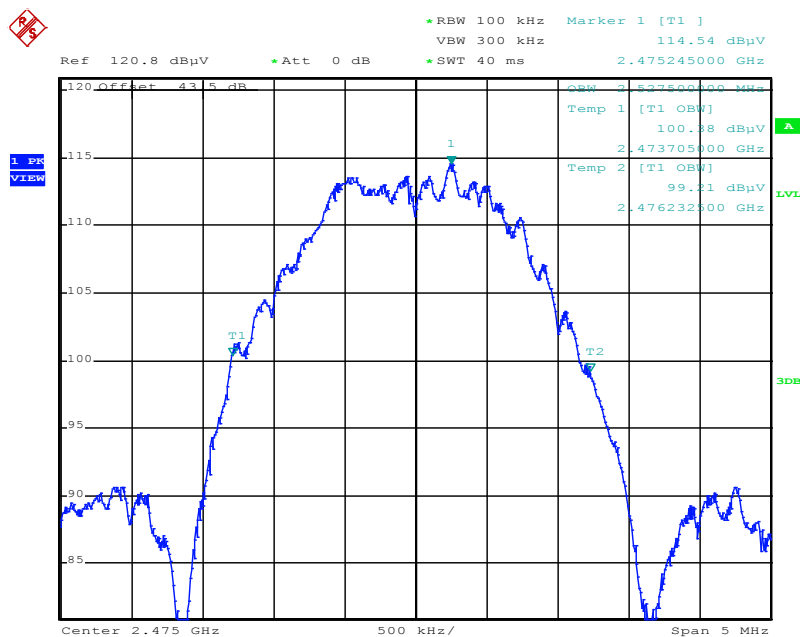
Channel 11 (2405 MHz)



Channel 19 (2445 MHz)



Channel 25 (2475 MHz)



5.3 Maximum peak radiated output power

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

5.3.1 Description of the test location

Test location: Anechoic chamber 1

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

For systems using digital modulation in the 2400-2483.5 MHz and 5725 – 5850 MHz bands, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.3.4 Description of Measurement

The maximum peak conducted output power is obtained through a radiated measurement and from the obtained value the antenna gain will be subtracted.

5.3.5 Test result radiated

		Test results radiated		
Chain 1		P [EIRP] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH11				
T_{nom}	V_{nom}	12.5	36.0	-23.5
Middle frequency: CH19				
T_{nom}	V_{nom}	12.2	36.0	-23.8
Highest frequency: CH25				
T_{nom}	V_{nom}	10.2	36.0	-25.8

Peak radiated Power Limit according to FCC Part 15, Section 15.247(b)(3)(4): 36 dBm

5.3.6 Test result conducted

		Test results conducted		
Chain 1		A (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH11				
T_{nom}	V_{nom}	9.2	30.0	-20.8
Middle frequency: CH19				
T_{nom}	V_{nom}	8.9	30.0	-21.1
Highest frequency: CH25				
T_{nom}	V_{nom}	6.9	30.0	-23.1

Peak conducted Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(Watt)
902-928	30	1.0
2400-2483.5	30	1.0
5725-5850	30	1.0

The requirements are **FULFILLED**.

Remarks:

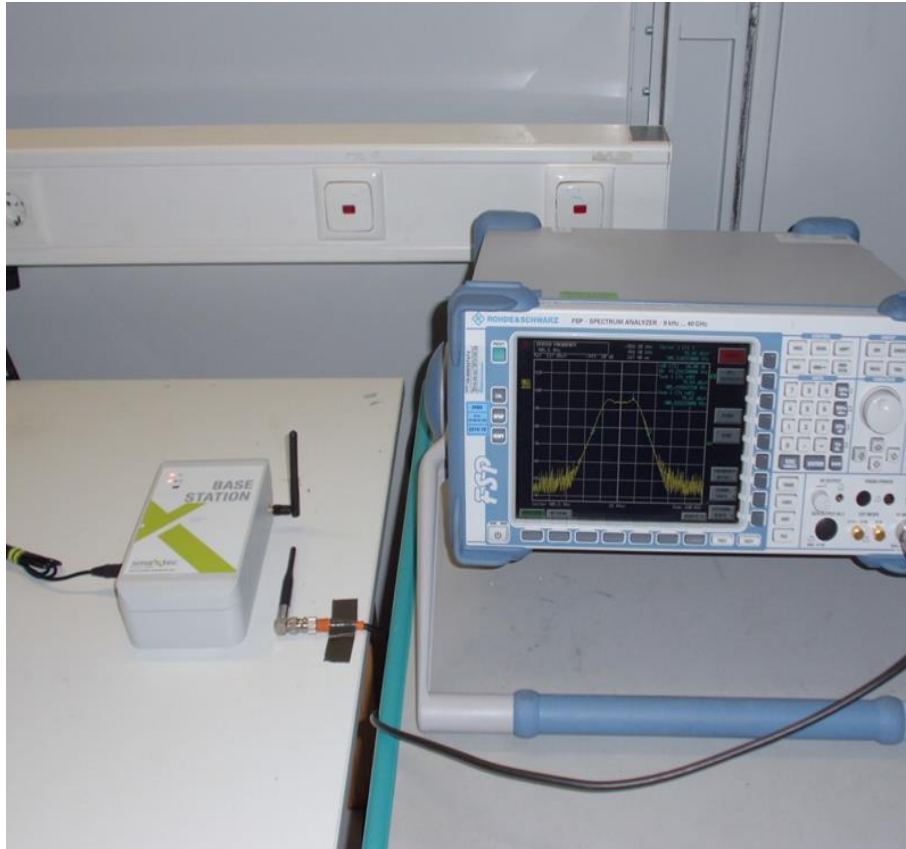
5.4 Power spectral density

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

5.4.1 Description of the test location

Test location: Shielded room 4

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 15, Section 15.247(e):

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.4.4 Description of Measurement

The measurement is performed using the procedure 10.2 set out in KDB-558074. The PKPSD is measured relatively. The max peak was located and with the spectrum analyser and a marker set to peak.

Spectrum analyser settings:

RBW: 3 kHz, VBW: 10 kHz, Detector: Peak, Sweep time: 10 s,

5.4.5 Test result

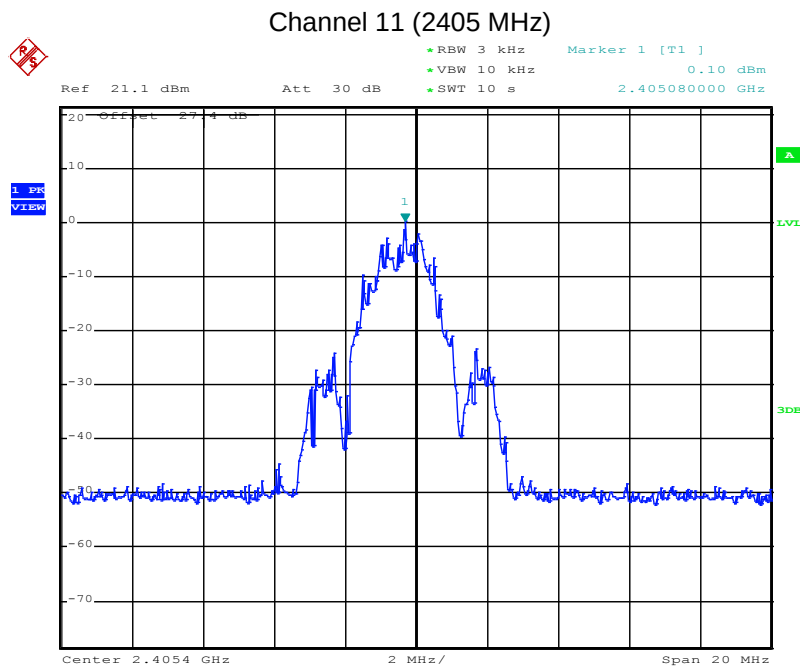
Duty cycle: 100%		Test results conducted		
Chain 1		PD [Pmax] (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Lowest frequency: CH11				
T_{nom}	V_{nom}	0.1	8.0	-7.9
Middle frequency: CH19				
T_{nom}	V_{nom}	-1.1	8.0	-9.1
Highest frequency: CH25				
T_{nom}	V_{nom}	-1.5	8.0	-9.5

Power spectral density limit according to FCC Part 15, Section 15.247(e):

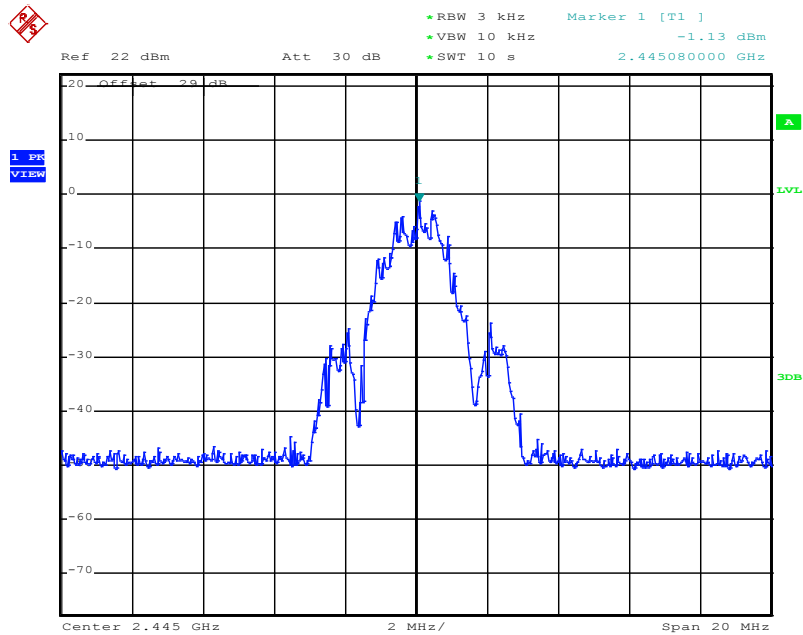
Frequency (MHz)	Power spectral density limit
	(dBm/3 kHz)
2400 - 2483.5	8

The requirements are **FULFILLED**.

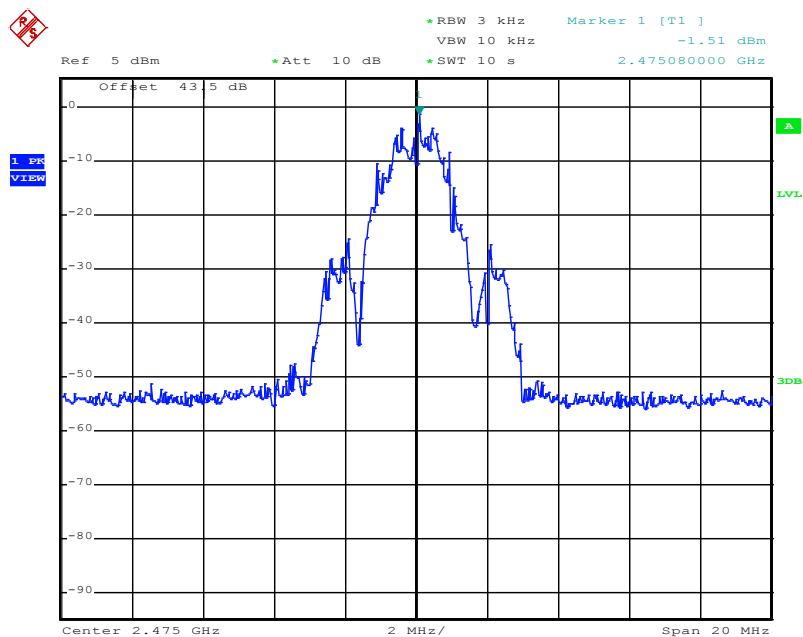
Remarks: For detailed test results please refer to following test protocols.

5.4.6 Power spectral density plots


Channel 19 (2445 MHz)



Channel 25 (2475 MHz)



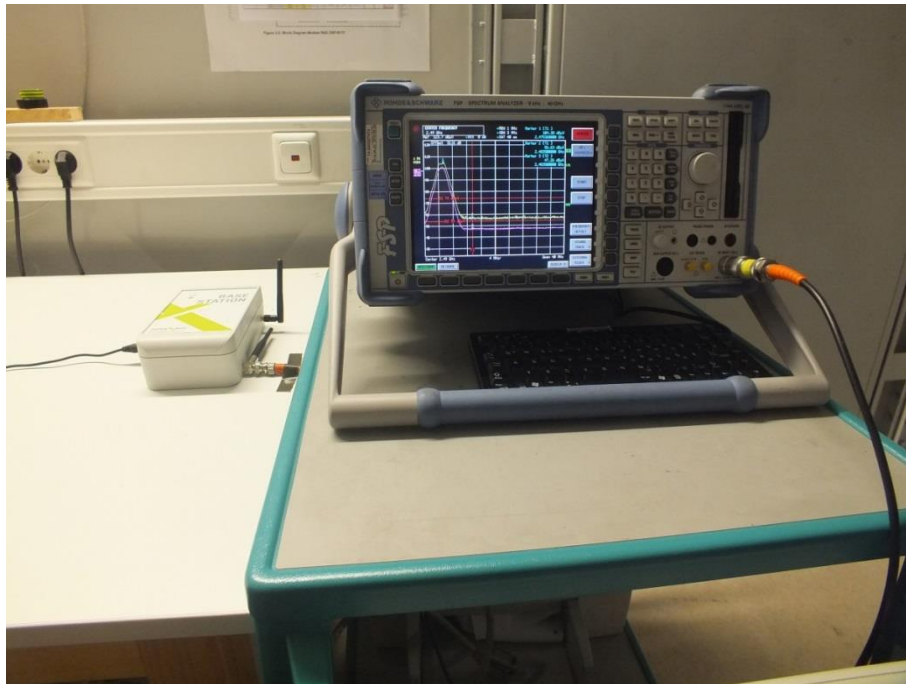
5.5 Band edge compliance

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

5.5.1 Description of the test location

Test location: Shielded room 4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to FCC Part 15C, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.5 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

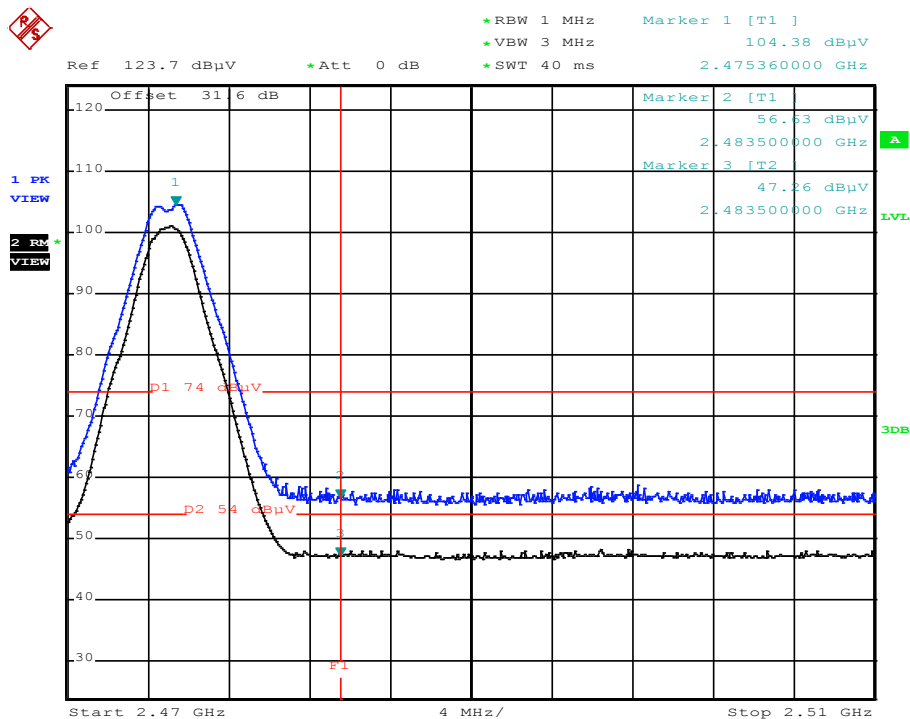
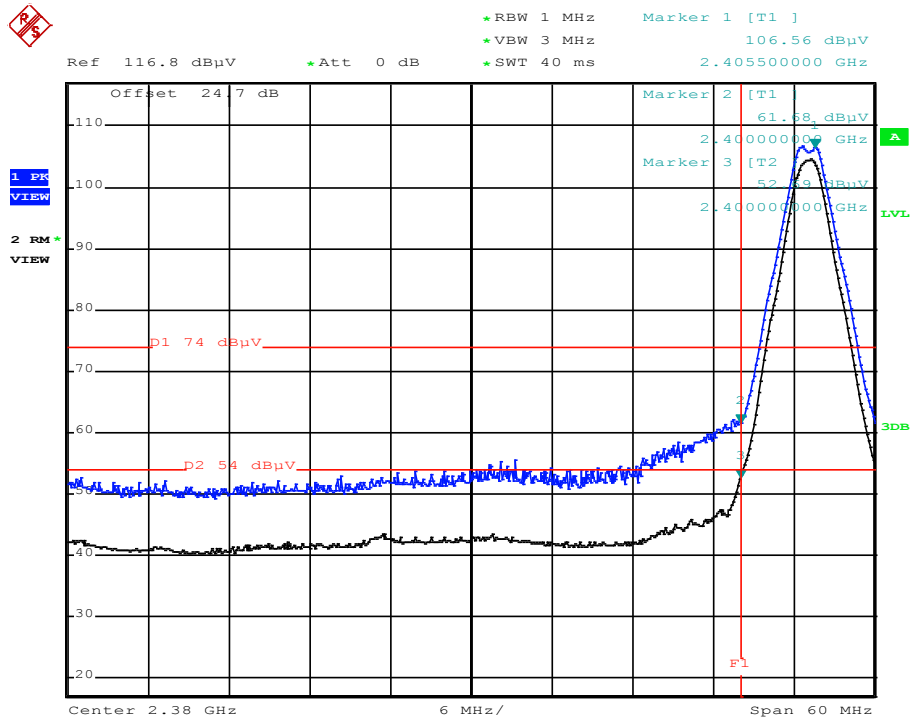
5.5.4 Description of Measurement

The measurement was performed radiated as relative measurement. The reference level offset of the spectrum analyser was adjusted to the values obtained in the measurement “Maximum peak radiated output power” (the values were calculated in fieldstrength).

Spectrum analyser settings:

RBW: 1 MHz, VBW: 3 MHz, Detector: Max peak, Trace: Max hold, Sweep: auto

5.5.5 Test result



Peak-Limit according to FCC Subpart 15.247(d):

In any 100 kHz bandwidth outside the frequency band 2400 – 2483.5 MHz, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

The requirements are **FULFILLED**.

Remarks: All values are below the general limits.

5.6 Radiated emissions in restricted bands

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

5.6.1 Description of the test location

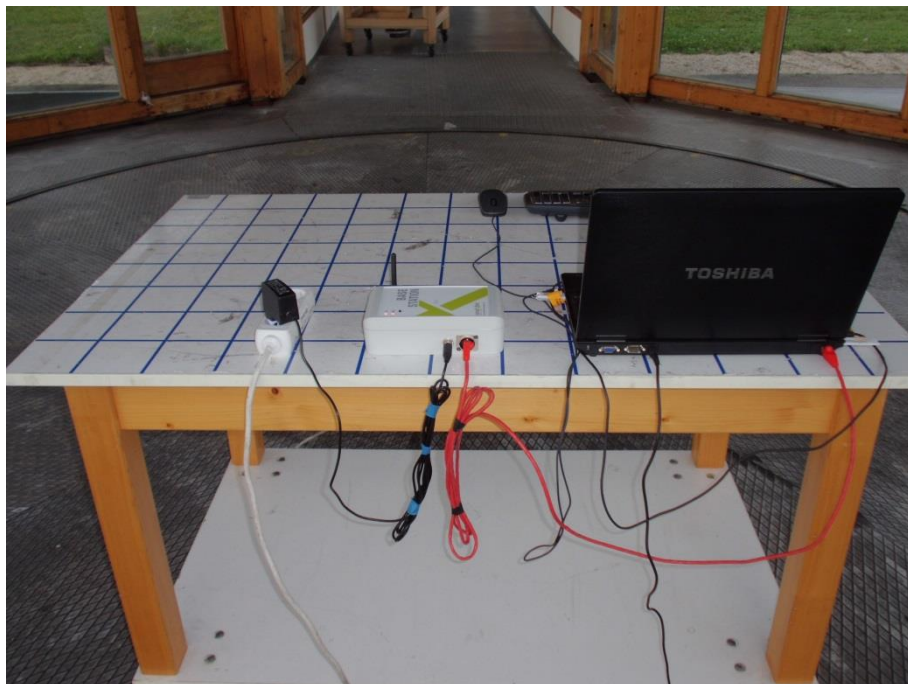
Test location: OATS 1
Test location: Anechoic chamber 1
Test distance: 3 m

5.6.2 Photo documentation of the test set-up

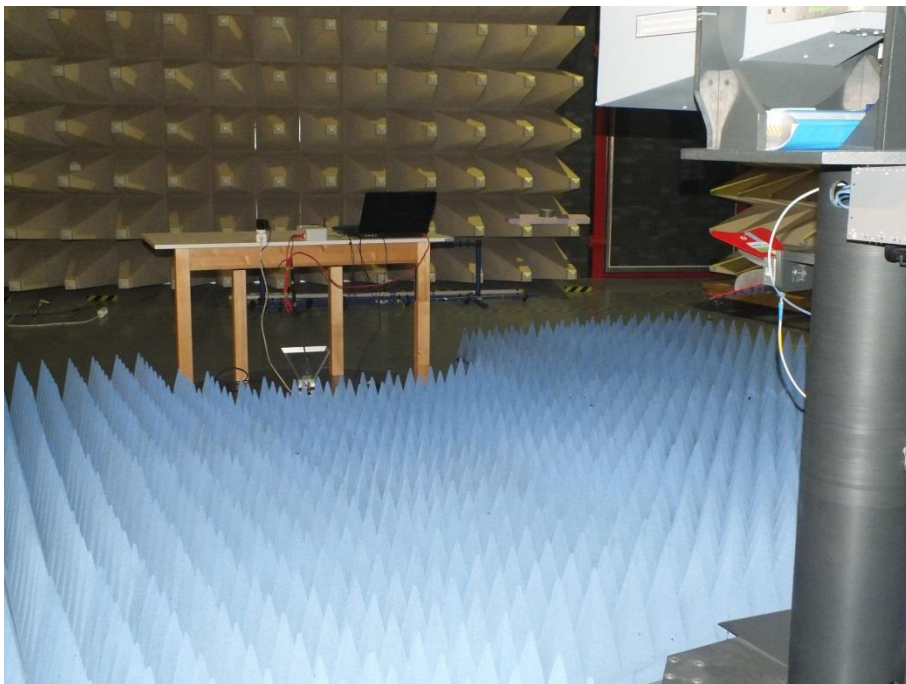
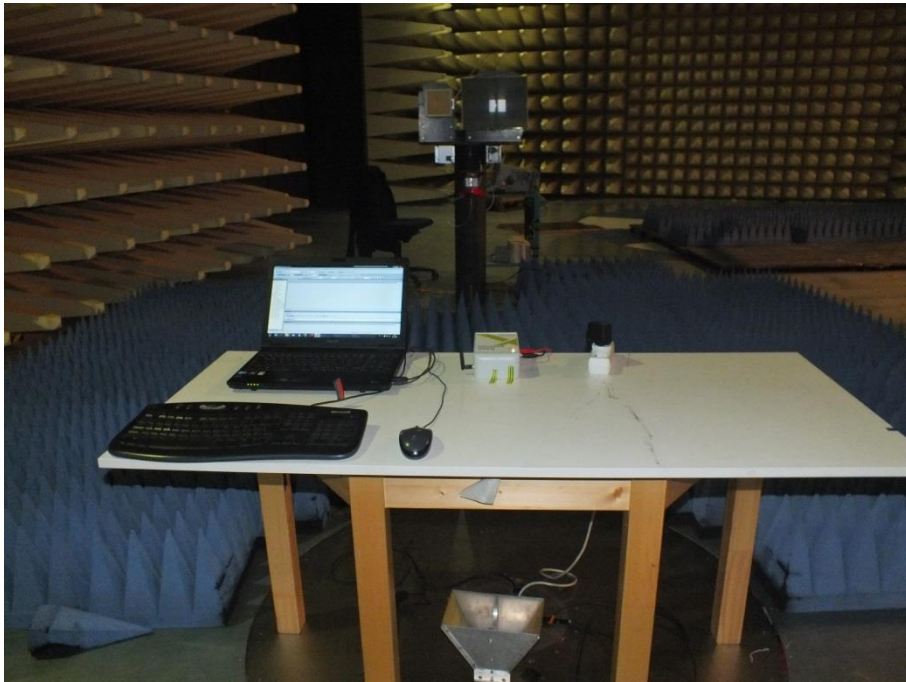
Open area test site



Open area test site



Anechoic chamber



5.6.3 Applicable standard

According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

5.6.4 Description of Measurement

The frequency range from 9 kHz to 25 GHz is measured using general limits.

Receiver settings:

9 kHz – 150 kHz: RBW: 200 Hz
 150 kHz – 30 MHz: RBW: 9 kHz
 30 MHz – 1000 MHz: RBW: 120 kHz

Spectrum analyser settings:

RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Detector function: Peak

5.6.1 Test result

Lowest frequency: CH11						
Test conditions: 1 TX , power settings 0xAB (15 dBm)						
Peak measurement						
Chain1			Test results			
Start f	Stop f	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBμV/m)	(dBμV/m)	(dB)
0.009	30	9	1.07 *	38.0	67	-29.0
30	1000	100	900	37.8	46	-8.2
1000	2400	1000	2357	45.5	54	-8.5
2483.5	5000	1000	3622	41.7	54	-12.3
5000	15000	1000	9618	51.6	54	-2.4
15000	25000	1000	24900	45.1	54	-8.9
Measurement uncertainty				±3 dB		

Remark: All peak emissions were below the limits of part 15.209. AV measurement is not required.

*Note: The level above means the noise level in the band. No emission could be detected.

Middle frequency: CH19						
Test conditions: 1 TX , power settings 0xAB (15 dBm)						
Peak measurement						
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dB μ V/m)	(dB μ V/m)	(dB)
0.009	30	9	1.07 *	38.0	67	-29.0
30	1000	100	900	37.8	46	-8.2
1000	2400	1000	2374	44.0	54	-10.0
2483.5	5000	1000	3622	42.2	54	-11.8
5000	15000	1000	11499	47.2	54	-6.8
15000	25000	1000	16660	51.1	54	-2.9
Measurement uncertainty				± 3 dB		

Remark: All peak emissions were below the limits of part 15.209. AV measurement is not required.
 *Note: The level above means the noise level in the band. No emission could be detected.

Highest frequency: CH25						
Test conditions: 1 TX , power settings 0xAB (15 dBm)						
Peak measurement						
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		AV Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dB μ V/m)	(dB μ V/m)	(dB)
0.009	30	9	1.07 *	38.0	67	-29.0
30	1000	100	900	37.8	46	-8.2
1000	2400	1000	2365	43.5	54	-10.5
2483.5	5000	1000	2509	43.4	54	-10.6
5000	15000	1000	7435	48	54	-6.0
15000	25000	1000	16562	53.2	54	-0.8
Measurement uncertainty				± 3 dB		

Remark: All peak emissions were below the limits of part 15.209. AV measurement is not required.
 *Note: The level above means the noise level in the band. No emission could be detected.

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
	(μ V/m)	dB(μ V/m)	(metres)
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

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

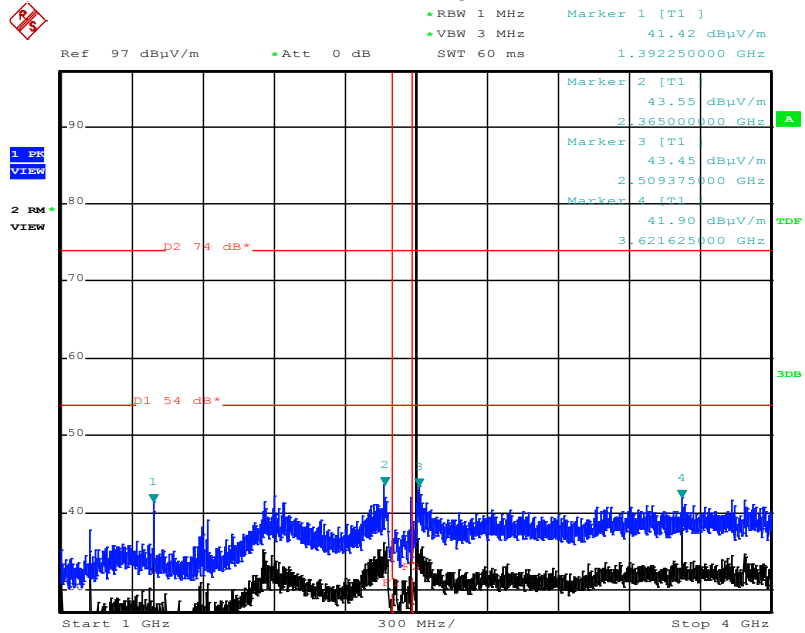
The requirements are **FULFILLED**.

Remarks: The measurement was performed up to the 10th harmonic.

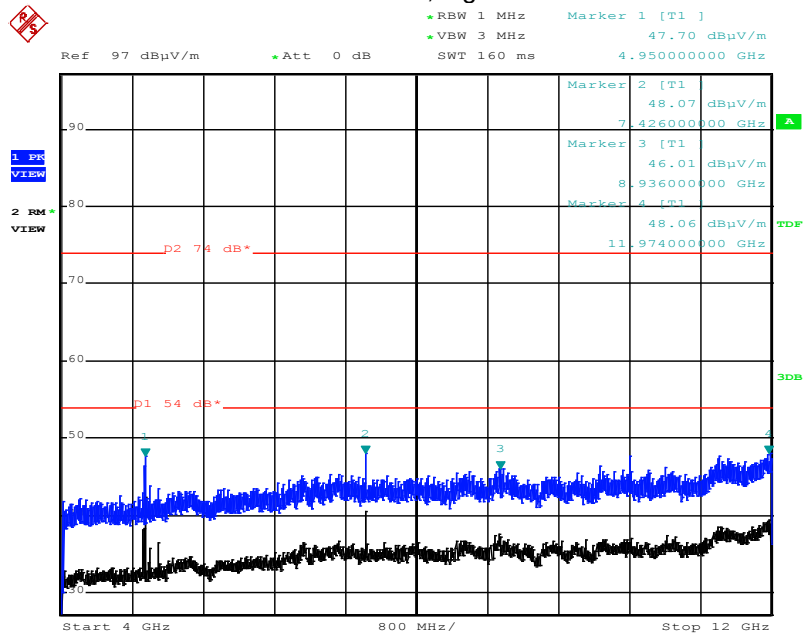
For further information see following test protocols. Only the worst case plots are listed.

5.6.2 Test protocols of radiated emissions

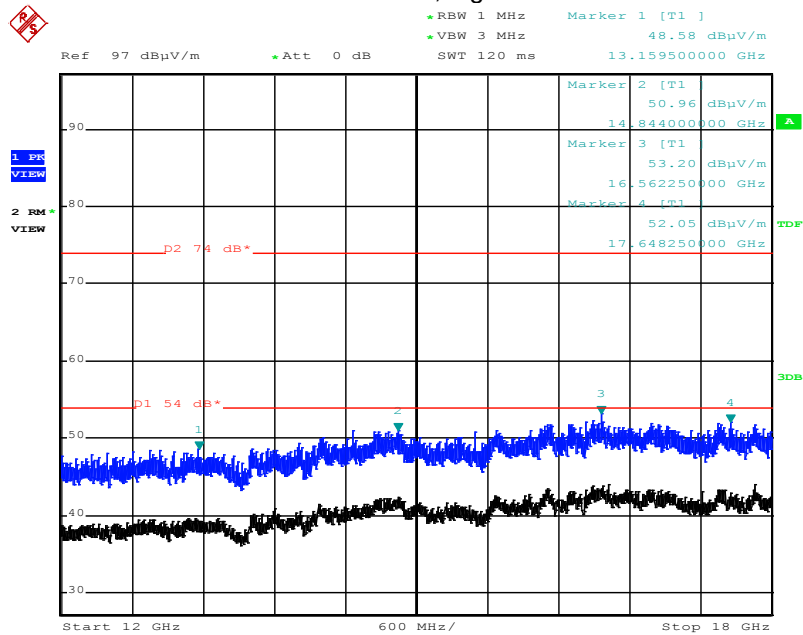
1 GHz to 4 GHz, high channel



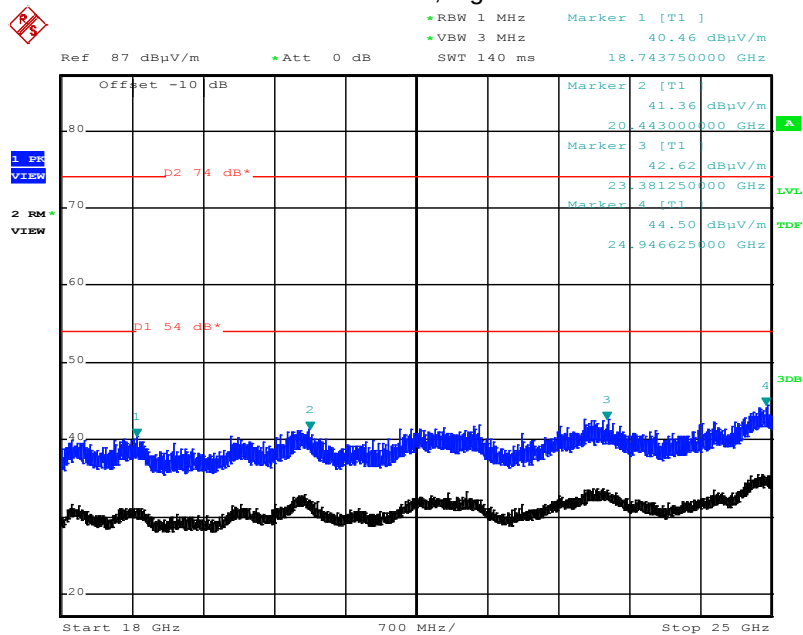
4 GHz to 12 GHz, high channel



12 GHz to 18 GHz, high channel



18 GHz to 25 GHz, high channel



Remark: All peak emissions were below the limits of part 15.209.

5.7 Spurious emissions

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

5.7.1 Description of the test location

Test location: NONE

5.7.2 Applicable standard

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a) (see Section 15.205(c)).

Remarks: The spurious emission are measured radiated with RBW=1 MHz. All emissions detected are below
the general emission limit. See item 5.6.

5.8 Antenna application - Detailed photos see attachment A

5.8.1 Applicable standard

According to FCC Part 15C, Section 15.203:

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 manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated antenna. No other antenna can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

5.8.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

defacto EIRP-Limit			P _{out} = 30 – (G _x – 6);				2.4 GHz
Antenna	G _x	Cond. limit	max. G	A [P20]	Limit P _{out}	Reduction	P set
	(dBi)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)	2.4 GHz
Print antenna	3.3	30.0	6.0	9.2	32.7	-23.5	0xAB

The output power has not to be reduced using the antenna type OMNI.

Remarks:

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESHS 30	02-02/03-05-002	17/07/2015	17/07/2014		
	ESH 2 - Z 5	02-02/20-05-004	18/10/2015	18/10/2013	02/03/2015	02/09/2014
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	19/11/2015	19/11/2014	19/05/2015	19/11/2014
CPR 3	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	07/05/2015	07/05/2014		
	WHJS 1000-10EE	02-02/50-05-070				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	WHK 3.0/18G-10EF	02-02/50-05-180				
	SF104/11N/11N/1500MM	02-02/50-13-015				
MB	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	07/05/2015	07/05/2014		
	RF Antenna	02-02/24-05-032				
	WHJS 1000-10EE	02-02/50-05-070				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	WHK 3.0/18G-10EF	02-02/50-05-180				
SER 1	SF104/11N/11N/1500MM	02-02/50-13-015				
	FMZB 1516	01-02/24-01-018			13/02/2015	13/02/2014
	ESCI	02-02/03-05-005	09/12/2015	09/12/2014		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
SER 2	NW-2000-NB	02-02/50-05-113				
	ESVS 30	02-02/03-05-006	03/07/2015	03/07/2014		
	VULB 9168	02-02/24-05-005	08/04/2015	08/04/2014	04/03/2015	04/09/2014
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
SER 3	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	FSP 40	02-02/11-11-001	02/10/2015	02/10/2014		
	JS4-18004000-30-5A	02-02/17-05-017				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	07/05/2015	07/05/2014		
	BBHA 9170	02-02/24-05-014				
	WHJS 1000-10EE	02-02/50-05-070				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	WHK 3.0/18G-10EF	02-02/50-05-180				
	KMS102-0.2 m	02-02/50-11-020				
	SF104/11N/11N/1500MM	02-02/50-13-015				