EMI – TEST REPORT

- FCC 90.217 -

Type / Model Name	:	LOG RI-PLUS-913
Product Description	:	Radio interface for communication with LOG N-3
Applicant	:	Seba Dynatronic Mess- und Ortungstechnik GmbH
Address	:	Dr.-Herbert-Iann-Str. 6
		96148 BAUNACH, GERMANY
Manufacturer	:	Seba Dynatronic Mess- und Ortungstechnik GmbH
Address	:	Dr.-Herbert-Iann-Str. 6
		96148 BAUNACH, GERMANY
Licence holder	:	Seba Dynatronic Mess- und Ortungstechnik GmbH
Address	:	Dr.-Herbert-Iann-Str. 6
		96148 BAUNACH, GERMANY

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

Test Report No. : T42988-00-00KJ	10. October 2017 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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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ATTACHMENT (PHOTO DOCUMENTATION OF THE EUT) A

ATTACHMENT (RF EXPOSURE EVALUATION) B

Attachment A & B as separatly supplement

1 TEST STANDARDS

The tests were performed according to following standards:

FCC 47 CFR Part 2: 2016	Frequency allocations and radio treaty matters; General rules and regulations
FCC 47 CFR Part 2.1046	Measurements required: RF power output.
FCC 47 CFR Part 2.1047	Measurements required: Modulation characteristics.
FCC 47 CFR Part 2.1049	Measurements required: Occupied bandwidth.
FCC 47 CFR Part 2.1051	Measurements required: Spurious emissions at antenna terminals.
FCC 47 CFR Part 2.1053	Measurements required: Field strength of spurious radiation.
FCC 47 CFR Part 2.1055	Measurements required: Frequency stability.
FCC 47 CFR Part 15: 2016	Radio frequency devices
FCC 47 CFR Part 90: 2016	Private land mobile radio services
ANSI/TIA-603-E: 2016	Land Mobile FM or PM-Communications Equipment - Measurement and Performance Standards
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.
KDB 412172 D01: 2010	Determining ERP and EIRP

2 EQUIPMENT UNDER TEST

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

2.2 Short description of the equipment under test (EUT)

The LOG RI-PLUS is used as a communication tool between PC and other devices from the LOG N-3 system. All communication packets are sent at 913 MHz short range radio.
The antenna of the LOG RI-PLUS is an external TNC stub antenna. As power supply it has the 5V PC USB output.

Handling:
The LOG RI / LOG RI+ is easily connected to the computer using a USB port. This turns it on automatically. The device is automatically recognised by the computer and is immediately ready to set up a radio connection. No other settings need to be made.

Status LED:
The LOG RI / LOG RI+ device is equipped with an LED as a status indicator:

- Flashes 1x red, 1x green - When switched on
- Lights up in blue - During radio operation
- Lights up in red - Malfunction

2.3 Variants of the EUT

- There are no other variants.

2.4 Test Jig

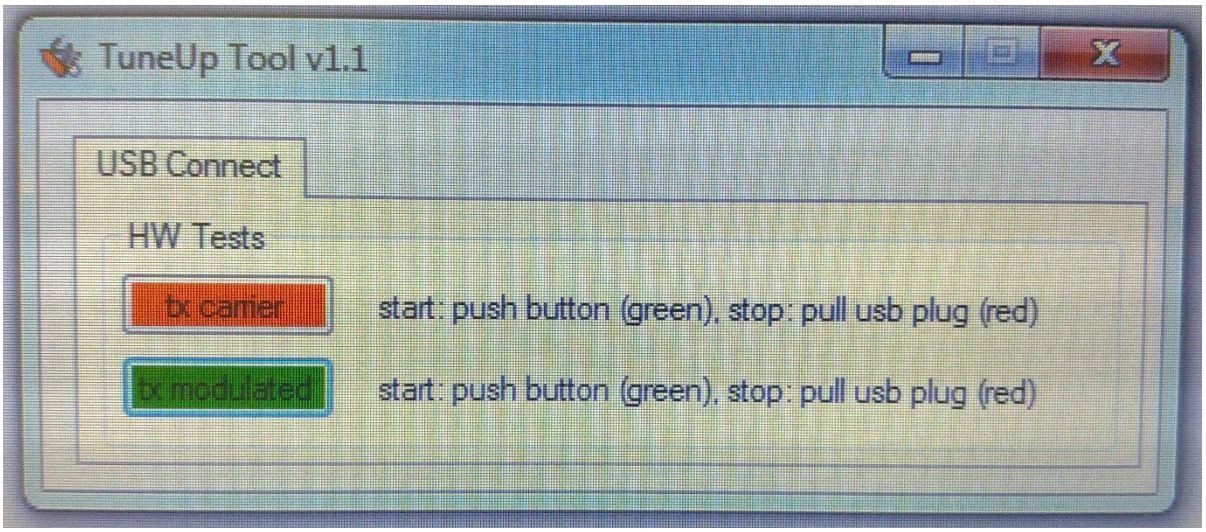
- No test jig is used.

2.5 Technical description of the equipment under test (EUT)

Items	Description
Power supply - internal	V_{nom} = 5.0 V DC (powered over USB port) (V_{min} = 4.4 V DC, V_{max} = 5.3 V DC)
Digital radio:	
Type of modulation	2-FSK
Operating frequency	913.02 MHz
Frequency band	902 MHz to 928 MHz
Data rate	9.6 kBd
Channel spacing	-
Number of channels	1
Antenna type	Stub antenna (MC0114015 + BFME-TNC)
Antenna connector	TNC
Antenna gain	0 dBd
Lowest internal frequency	32.768 kHz
Highest internal frequency	26.000 MHz
Serial number	12136860005
Firmware version	1.14.06
Number of tested samples	1

2.6 Test software

- A special test software was used, to perform the different radio tests.



2.7 Transmit operating modes

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

- cont. TX at 913.02 MHz (unmodulated)

- cont. TX at 913.02 MHz (modulated)

- cont. RX mode

2.8 Peripheral devices and interface cables

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

- USB adapter cable — Model : Seba
- Laptop — Model : Siemens Lifebook

2.9 Determination of worst case conditions for final measurement

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting of the EUT produce the maximum of the emissions (with stub antenna and magnet socket antenna).
For the further measurement, the EUT is set in horizontal position with TX antenna in vertical orientation.

3 Test result summary

FCC Rule Part	Test Procedure	Description	Result
15.107(a)	ANSI C63.4:2014	AC power line conducted emissions	passed
90.217 (2.1046)	ANSI/TIA-603-E-2016	Maximum output power	passed
90.217(a) (2.1053)	ANSI/TIA-603-E-2016	Spurious emissions radiated	passed
90.217 (2.1046)	ANSI/TIA-603-E-2016	Conducted carrier output power rating	passed
90.217(a) (2.1051)	ANSI/TIA-603-E-2016	Unwanted emissions conducted	passed
90.217(a) (2.1047)	ANSI/TIA-603-E-2016	Modulation characteristics	passed
(2.1049)	ANSI/TIA-603-E-2016	Occupied bandwith	passed
90.213(a)(b) (2.1055)	ANSI/TIA-603-E-2016	Frequency stability	passed
15.109	ANSI C63.4:2014	Receiver spurious emissions	passed

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 : 19 June 2017

Testing concluded on : 30 June 2017

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this document
2017.10.10 10:07:57 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Josef Knab
I'm the autor of this document
2017.10.10 09:54:14 +02'00'

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.

5 TEST RESULTS

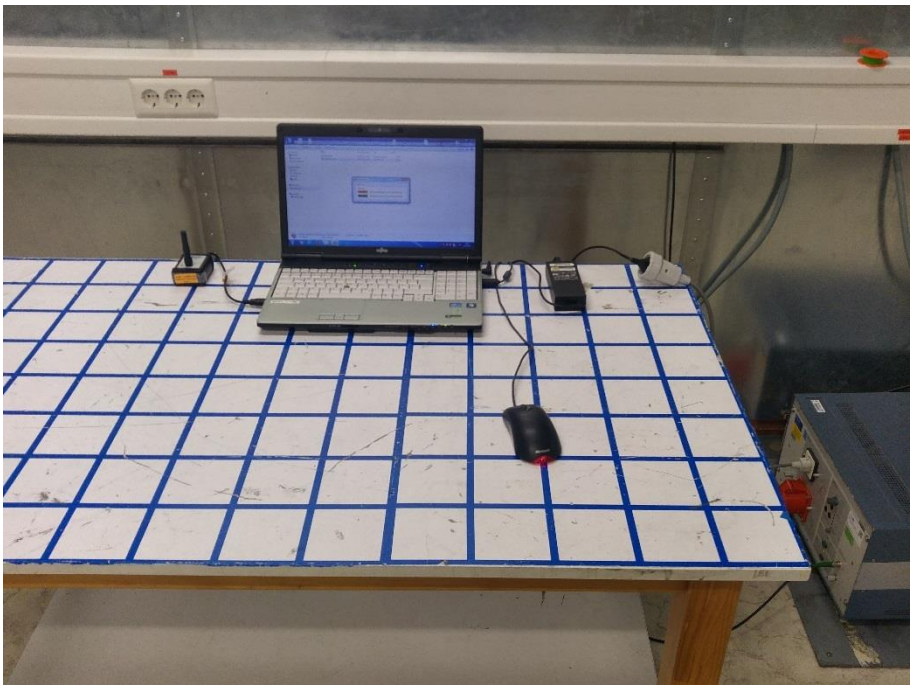
5.1 Conducted emissions

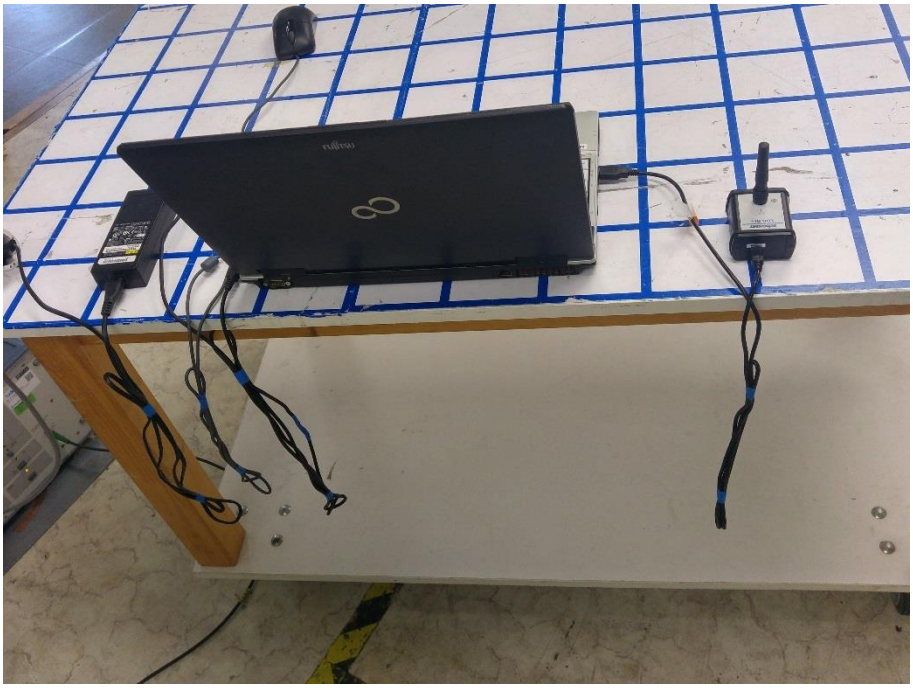
For test instruments and accessories used see section 6 Part **A 4**.

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 15.107(a):
Except for Class A devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 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 > 10 dB

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

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

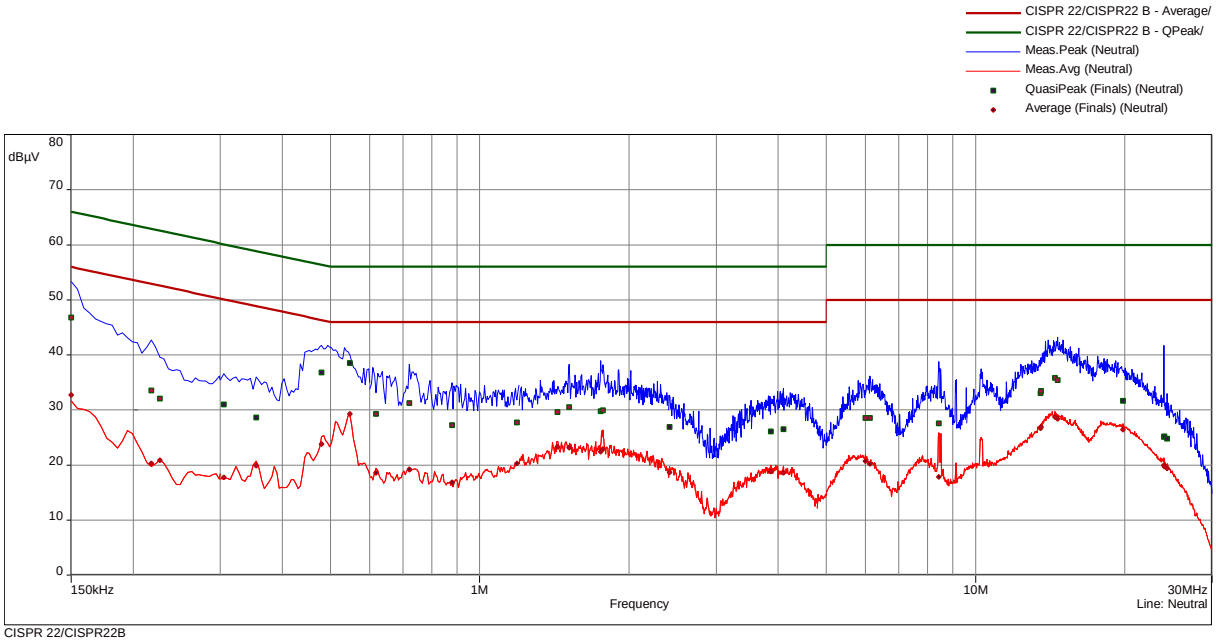
* Decreases with the logarithm of the frequency

The requirements are **FULFILLED.**

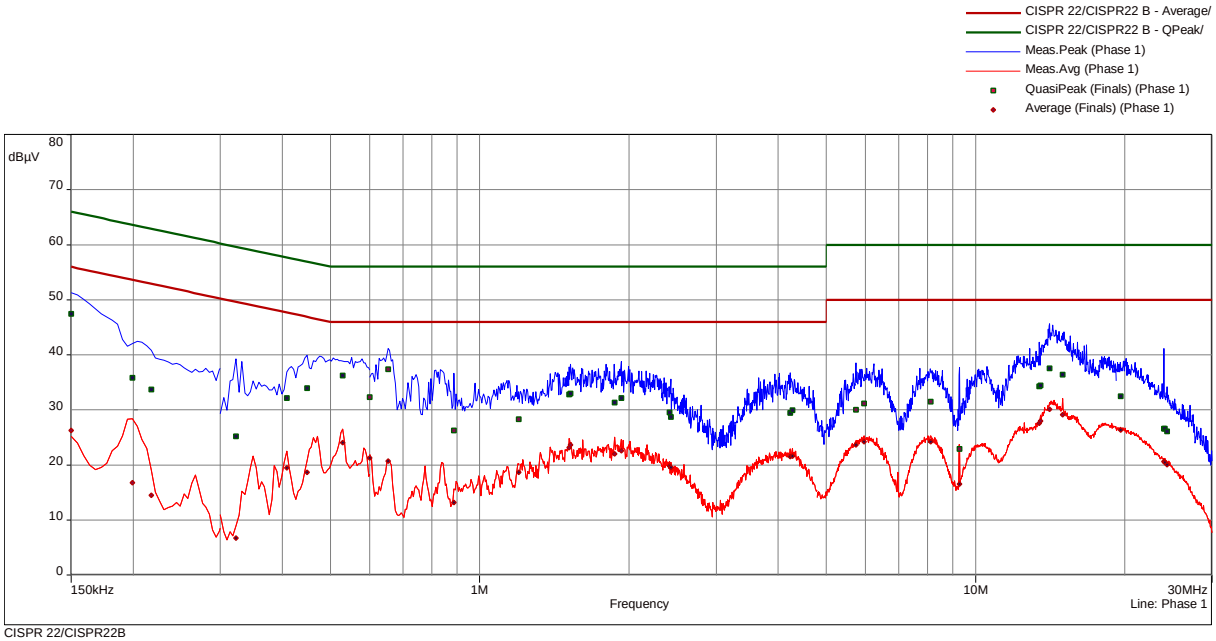
Remarks: For detailed test results please see the following test protocols.

5.1.6 Test protocol

Test point	N & L1	Result: passed
Operation mode:	standby mode	
Remarks:	Powered over laptop	
Date:	21 June 2017	



CISPR 22/CISPR22B

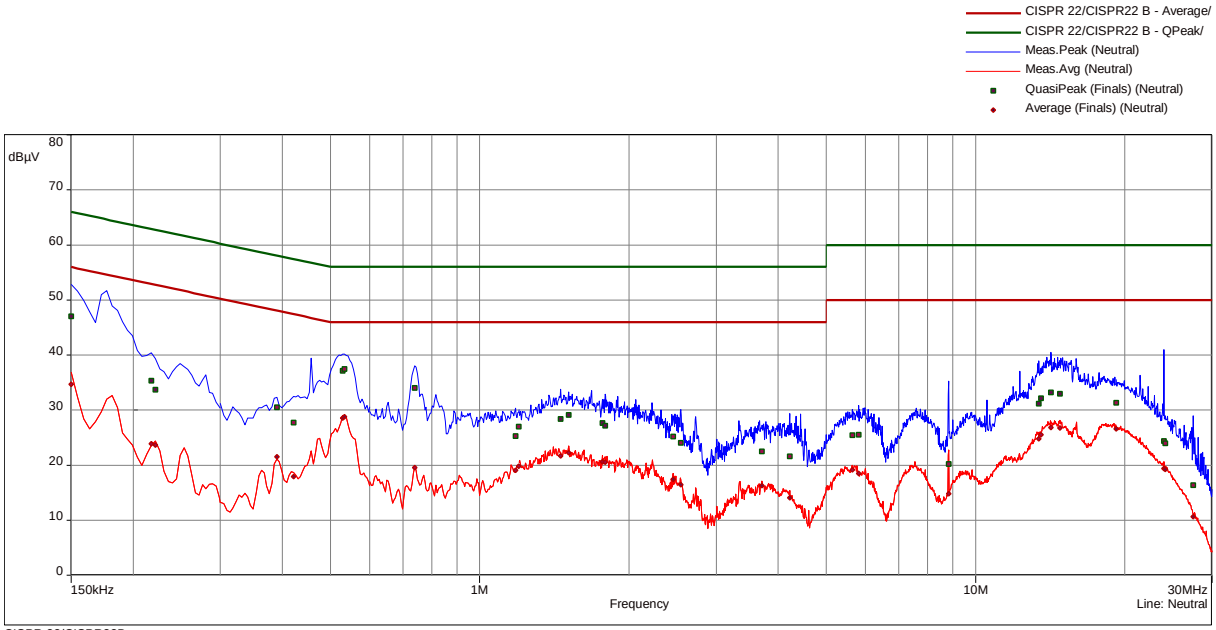


CISPR 22/CISPR22B

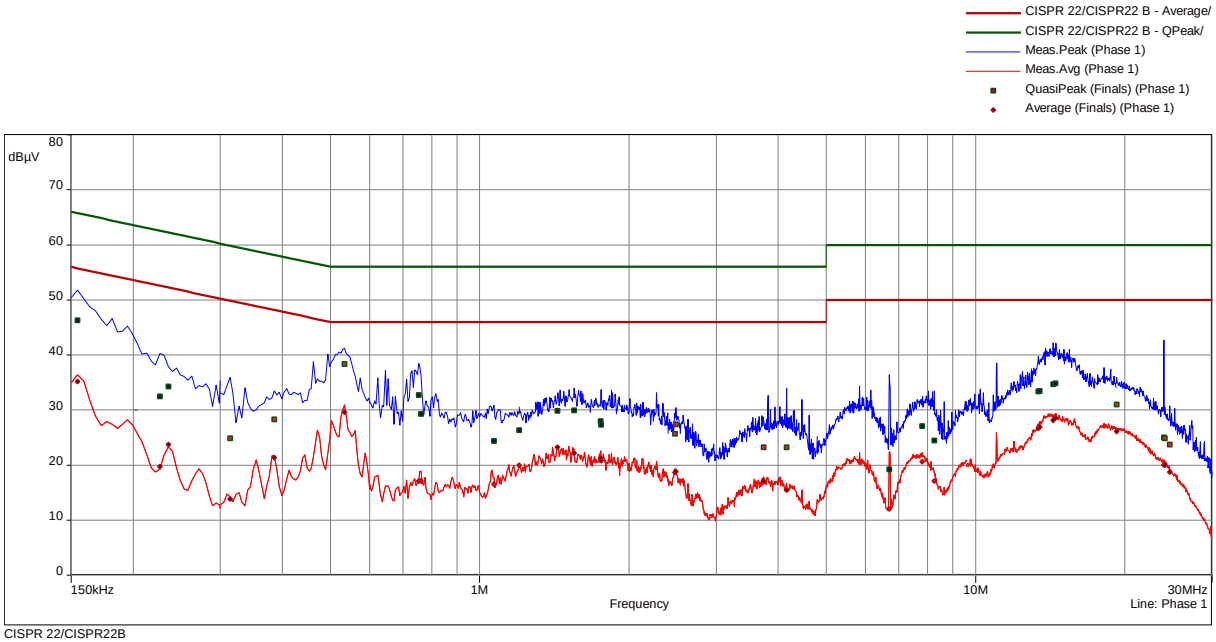
FCC ID: OV8-LOGRIP

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.15	1	47.42	18.58	66.00	26.28	29.72	56.00	Phase 1	10.08
0.1995	1	35.86	27.77	63.63	16.76	36.87	53.63	Phase 1	10.10
0.2175	1	33.68	29.24	62.91	14.47	38.45	52.91	Phase 1	10.10
0.3225	2	25.17	34.48	59.64	6.73	42.91	49.64	Phase 1	10.14
0.408	2	32.16	25.53	57.69	19.51	28.18	47.69	Phase 1	10.15
0.4485	2	33.93	22.97	56.90	18.66	28.24	46.90	Phase 1	10.16
0.5295	2	36.23	19.77	56.00	24.06	21.94	46.00	Phase 1	10.16
0.6	3	32.31	23.69	56.00	21.30	24.70	46.00	Phase 1	10.17
0.654	3	37.42	18.58	56.00	20.70	25.30	46.00	Phase 1	10.18
0.888	3	26.26	29.74	56.00	13.18	32.82	46.00	Phase 1	10.20
1.1985	3	28.30	27.70	56.00	18.66	27.34	46.00	Phase 1	10.24
1.515	4	32.85	23.15	56.00	23.18	22.82	46.00	Phase 1	10.27
1.524	4	32.93	23.07	56.00	23.61	22.39	46.00	Phase 1	10.28
1.8705	4	31.36	24.64	56.00	22.05	23.95	46.00	Phase 1	10.28
1.929	4	32.15	23.85	56.00	22.58	23.42	46.00	Phase 1	10.28
2.4135	5	29.58	26.42	56.00	19.77	26.23	46.00	Phase 1	10.33
2.4315	5	28.75	27.25	56.00	19.53	26.47	46.00	Phase 1	10.33
4.227	5	29.47	26.53	56.00	21.52	24.48	46.00	Phase 1	10.44
4.272	5	29.97	26.03	56.00	21.62	24.38	46.00	Phase 1	10.45
5.7405	6	30.00	30.00	60.00	23.62	26.38	50.00	Phase 1	10.55
5.961	6	31.19	28.81	60.00	24.19	25.81	50.00	Phase 1	10.56
8.1255	6	31.48	28.52	60.00	24.25	25.75	50.00	Phase 1	10.70
9.2865	6	22.94	37.06	60.00	16.51	33.49	50.00	Phase 1	10.76
13.452	7	34.29	25.71	60.00	27.57	22.43	50.00	Phase 1	11.09
13.5375	7	34.47	25.53	60.00	27.98	22.02	50.00	Phase 1	11.10
14.1135	7	37.52	22.48	60.00	30.13	19.87	50.00	Phase 1	11.15
14.982	7	36.45	23.55	60.00	29.13	20.87	50.00	Phase 1	11.22
19.641	8	32.44	27.56	60.00	26.33	23.67	50.00	Phase 1	11.49
23.997	8	26.59	33.41	60.00	20.66	29.34	50.00	Phase 1	11.60
24.078	8	26.58	33.42	60.00	20.45	29.55	50.00	Phase 1	11.60
24.3255	8	26.12	33.88	60.00	20.05	29.95	50.00	Phase 1	11.60
0.15	9	46.76	19.24	66.00	32.69	23.31	56.00	Neutral	10.09
0.2175	9	33.56	29.36	62.91	20.31	32.60	52.91	Neutral	10.11
0.2265	9	32.09	30.49	62.58	20.86	31.72	52.58	Neutral	10.12
0.3045	10	30.98	29.14	60.12	17.72	32.40	50.12	Neutral	10.14
0.354	10	28.63	30.23	58.87	19.89	28.98	48.87	Neutral	10.15
0.48	10	36.82	19.52	56.34	23.81	22.53	46.34	Neutral	10.16
0.5475	10	38.56	17.44	56.00	29.25	16.75	46.00	Neutral	10.17
0.618	11	29.33	26.67	56.00	18.58	27.42	46.00	Neutral	10.18
0.7215	11	31.23	24.77	56.00	19.26	26.74	46.00	Neutral	10.20
0.879	11	27.23	28.77	56.00	16.86	29.14	46.00	Neutral	10.20
1.1895	11	27.73	28.27	56.00	20.28	25.72	46.00	Neutral	10.24
1.434	12	29.65	26.35	56.00	23.35	22.65	46.00	Neutral	10.27
1.515	12	30.52	25.48	56.00	23.15	22.85	46.00	Neutral	10.27
1.7535	12	29.78	26.22	56.00	22.45	23.55	46.00	Neutral	10.29
1.7715	12	29.98	26.02	56.00	22.91	23.09	46.00	Neutral	10.29
2.4135	13	26.94	29.06	56.00	18.67	27.33	46.00	Neutral	10.33
3.867	13	26.06	29.94	56.00	18.82	27.18	46.00	Neutral	10.42
4.0965	13	26.47	29.53	56.00	18.60	27.40	46.00	Neutral	10.45
5.9925	14	28.57	31.43	60.00	20.72	29.28	50.00	Neutral	10.60
6.1185	14	28.57	31.43	60.00	20.25	29.75	50.00	Neutral	10.61
8.4315	14	27.60	32.40	60.00	17.87	32.13	50.00	Neutral	10.78
13.5375	15	33.02	26.98	60.00	26.65	23.35	50.00	Neutral	11.24
13.5645	15	33.48	26.52	60.00	26.88	23.12	50.00	Neutral	11.24
14.46	15	35.86	24.14	60.00	28.74	21.26	50.00	Neutral	11.32
14.6445	15	35.41	24.59	60.00	28.40	21.60	50.00	Neutral	11.34
19.839	16	31.64	28.36	60.00	26.43	23.57	50.00	Neutral	11.72
23.997	16	25.10	34.90	60.00	19.93	30.07	50.00	Neutral	11.91
24.0555	16	25.24	34.76	60.00	19.76	30.24	50.00	Neutral	11.91
24.33	16	24.81	35.19	60.00	19.38	30.62	50.00	Neutral	11.92

Test point	N & L1	Result: passed
Operation mode:	cont. TX @ 913 MHz	
Remarks:	Powered over laptop	
Date:	21 June 2017	



CISPR 22/CISPR22B



CISPR 22/CISPR22B

FCC ID: OV8-LOGRIP

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.1545	1	46.29	19.46	65.75	35.19	20.56	55.75	Phase 1	10.09
0.2265	1	32.50	30.07	62.58	19.71	32.86	52.58	Phase 1	10.11
0.2355	1	34.28	27.98	62.25	23.74	28.51	52.25	Phase 1	10.11
0.3135	2	24.84	35.03	59.88	13.86	36.02	49.88	Phase 1	10.13
0.3855	2	28.27	29.89	58.16	21.34	26.82	48.16	Phase 1	10.15
0.534	2	38.37	17.63	56.00	29.65	16.35	46.00	Phase 1	10.16
0.753	3	32.71	23.29	56.00	17.12	28.88	46.00	Phase 1	10.20
0.762	3	29.29	26.71	56.00	17.08	28.92	46.00	Phase 1	10.20
1.068	3	24.38	31.62	56.00	16.56	29.44	46.00	Phase 1	10.22
1.2	3	26.32	29.68	56.00	19.98	26.02	46.00	Phase 1	10.24
1.434	4	29.90	26.10	56.00	23.25	22.75	46.00	Phase 1	10.27
1.551	4	29.95	26.05	56.00	22.14	23.86	46.00	Phase 1	10.28
1.7535	4	27.96	28.04	56.00	21.25	24.75	46.00	Phase 1	10.29
1.758	4	27.36	28.64	56.00	20.82	25.18	46.00	Phase 1	10.29
2.4765	5	25.71	30.29	56.00	18.69	27.31	46.00	Phase 1	10.33
2.4855	5	27.37	28.63	56.00	18.83	27.17	46.00	Phase 1	10.34
3.7365	5	23.24	32.76	56.00	17.07	28.93	46.00	Phase 1	10.40
4.1595	5	23.26	32.74	56.00	15.48	30.52	46.00	Phase 1	10.44
6.7035	6	19.21	40.79	60.00	12.05	37.95	50.00	Phase 1	10.63
7.8105	6	27.08	32.92	60.00	20.64	29.36	50.00	Phase 1	10.69
8.2515	6	24.50	35.50	60.00	17.09	32.91	50.00	Phase 1	10.71
13.389	7	33.39	26.61	60.00	26.68	23.32	50.00	Phase 1	11.09
13.4745	7	33.42	26.58	60.00	26.92	23.08	50.00	Phase 1	11.10
14.3475	7	34.68	25.32	60.00	28.12	21.88	50.00	Phase 1	11.16
14.4825	7	34.83	25.17	60.00	28.52	21.48	50.00	Phase 1	11.17
19.2495	8	31.05	28.95	60.00	26.10	23.90	50.00	Phase 1	11.47
23.997	8	25.02	34.98	60.00	20.02	29.98	50.00	Phase 1	11.60
24.0645	8	24.91	35.09	60.00	19.93	30.07	50.00	Phase 1	11.60
24.627	8	23.69	36.31	60.00	18.75	31.25	50.00	Phase 1	11.60
0.15	9	47.03	18.97	66.00	34.69	21.31	56.00	Neutral	10.09
0.2175	9	35.32	27.59	62.91	23.89	29.03	52.91	Neutral	10.11
0.222	9	33.68	29.07	62.74	23.63	29.11	52.74	Neutral	10.11
0.39	10	30.53	27.53	58.06	21.49	26.57	48.06	Neutral	10.16
0.4215	10	27.74	29.68	57.42	17.89	29.52	47.42	Neutral	10.16
0.5295	10	37.18	18.82	56.00	28.54	17.46	46.00	Neutral	10.16
0.534	10	37.44	18.56	56.00	28.80	17.20	46.00	Neutral	10.16
0.7395	11	34.00	22.00	56.00	19.54	26.46	46.00	Neutral	10.20
1.1805	11	25.25	30.75	56.00	19.07	26.93	46.00	Neutral	10.23
1.1985	11	27.03	28.97	56.00	19.81	26.19	46.00	Neutral	10.24
1.4565	12	28.38	27.62	56.00	21.70	24.30	46.00	Neutral	10.27
1.5105	12	29.11	26.89	56.00	22.28	23.72	46.00	Neutral	10.27
1.767	12	27.68	28.32	56.00	20.60	25.40	46.00	Neutral	10.29
1.7895	12	27.13	28.87	56.00	20.50	25.50	46.00	Neutral	10.28
2.4585	13	25.20	30.80	56.00	17.41	28.59	46.00	Neutral	10.34
2.544	13	24.02	31.98	56.00	16.44	29.56	46.00	Neutral	10.34
3.7095	13	22.48	33.52	56.00	16.31	29.69	46.00	Neutral	10.41
4.218	13	21.63	34.37	56.00	14.12	31.88	46.00	Neutral	10.46
5.6415	14	25.41	34.59	60.00	19.13	30.87	50.00	Neutral	10.57
5.817	14	25.49	34.51	60.00	18.46	31.54	50.00	Neutral	10.58
8.8275	14	20.21	39.79	60.00	14.83	35.17	50.00	Neutral	10.80
13.425	15	31.16	28.84	60.00	24.82	25.18	50.00	Neutral	11.23
13.551	15	32.14	27.86	60.00	25.55	24.45	50.00	Neutral	11.24
14.199	15	33.25	26.75	60.00	26.82	23.18	50.00	Neutral	11.30
14.793	15	33.00	27.00	60.00	26.74	23.26	50.00	Neutral	11.36
19.2135	16	31.37	28.63	60.00	26.55	23.45	50.00	Neutral	11.69
23.997	16	24.38	35.62	60.00	19.41	30.59	50.00	Neutral	11.91
24.1185	16	24.00	36.00	60.00	19.26	30.74	50.00	Neutral	11.91
27.4665	16	16.34	43.66	60.00	10.65	39.35	50.00	Neutral	11.95

5.2 Maximum output power radiated

For test instruments and accessories used see section 6 Part **CPR 2**.

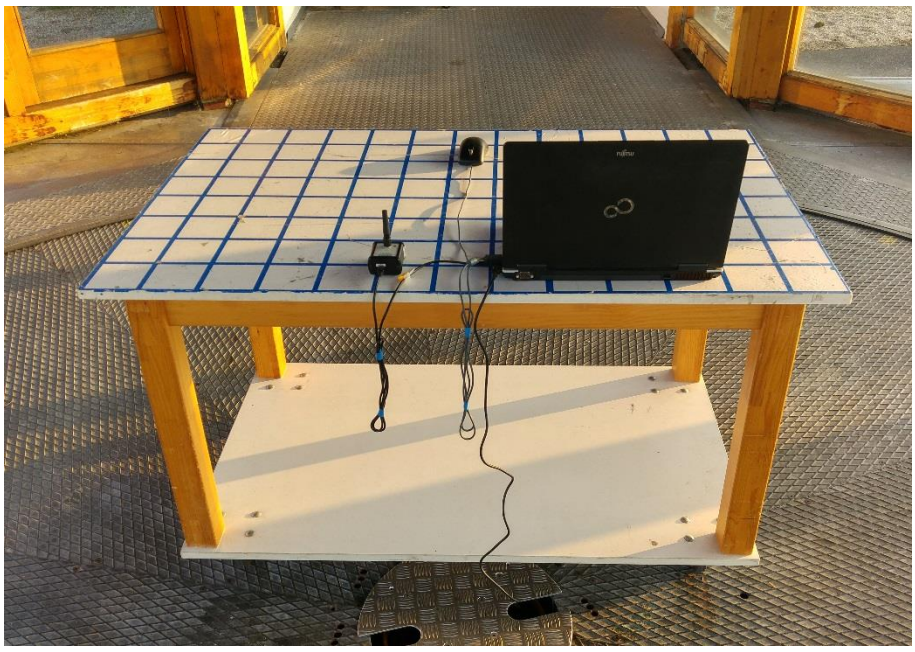
5.2.1 Description of the test location

Test location: OATS 1

Test distance: 10 m

5.2.2 Photo documentation of the test set-up

OATS1 – 10 m – 30 MHz to 1000 MHz



OATS1 – 10 m – 30 MHz to 1000 MHz

5.2.3 Applicable standard

According to FCC Part 90.217:
Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 mW are exempt from the technical requirements set out in this subpart, but must instead comply with the following:
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

5.2.4 Description of Measurement

The maximum output power from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and 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 interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 10 metres 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 metres and the EUT is rotated 360 degrees.
The final level in dBm is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors (cable loss, antenna gain, free space attenuation). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The substitution antenna is used to replace the EUT for test the effective radiated. For measurements in the frequency band 30 MHz to 1 000 MHz, the substitution antenna is a ½ wave dipole antenna. The centre of this antenna should coincide with either the phase centre or volume centre. A signal generator is connected to the dipole and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the dipole antenna and its gain.

The radiated power of the fundamental emission from the EUT is measured in a test setup following the procedures set out in ANSI/TIA-603-E Section 2.2.17.

The resolution bandwidth during the measurement is as follows:
30 MHz – 1000 MHz: RBW: 120 kHz

5.2.5 Test result

EuT in horizontal position – TX antenna vertrical

Frequency (MHz)	Level PK (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected power ERP (dBm)	Power limit (dBm)	Delta (dB)
913.02	72.3	120	-61.3	11.0	20.8	9.8

EuT in vertical position – TX antenna horizontal

Frequency (MHz)	Level PK (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected power ERP (dBm)	Power limit (dBm)	Delta (dB)
913.02	70.4	120	-61.8	8.6	20.8	12.2

Power limit according to FCC Part 90.217:

Frequency	Radiated power limit	
(MHz)	(dBm)	(mW)
>800	20.8	120

The requirements are **FULFILLED.**

Remarks: _____

_____

5.3 Spurious emissions radiated (electric field)

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

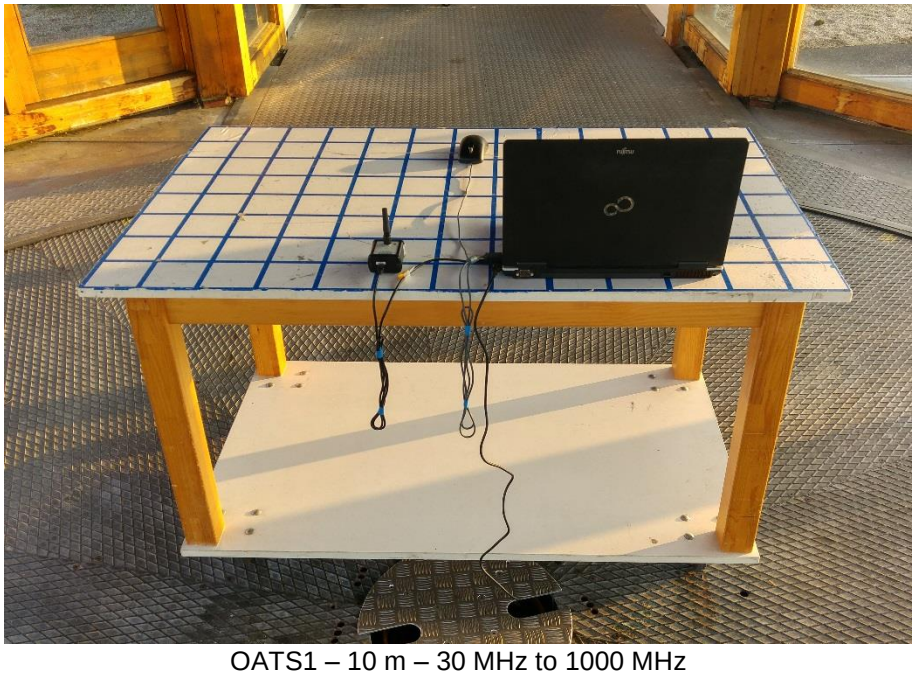
5.3.1 Description of the test location

Test location: OATS 1
Test distance: 10 m

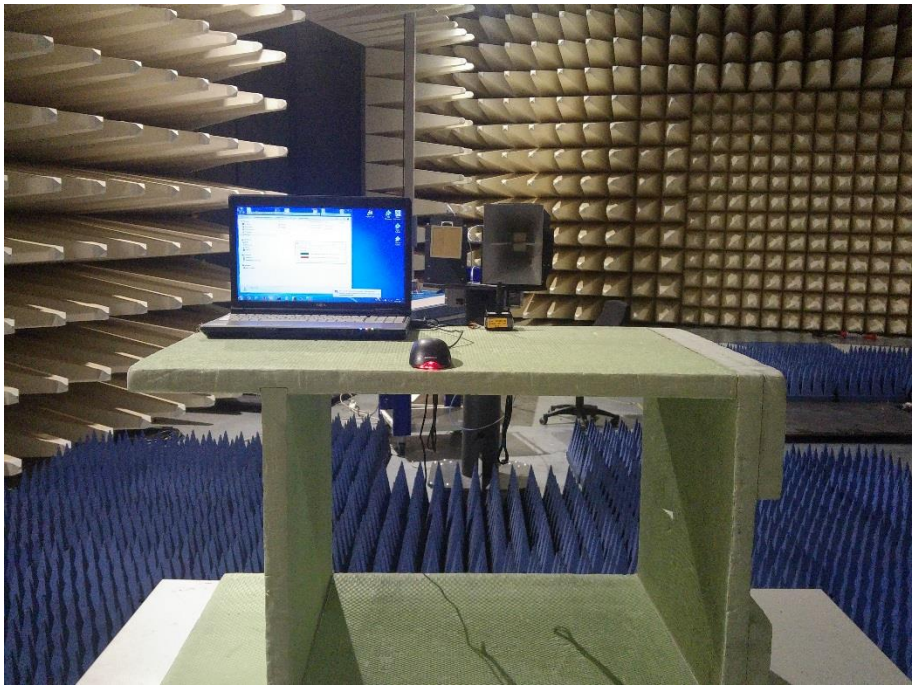
Test location: Anechoic chamber 1
Test distance: 3 m

5.3.2 Photo documentation of the test set-up

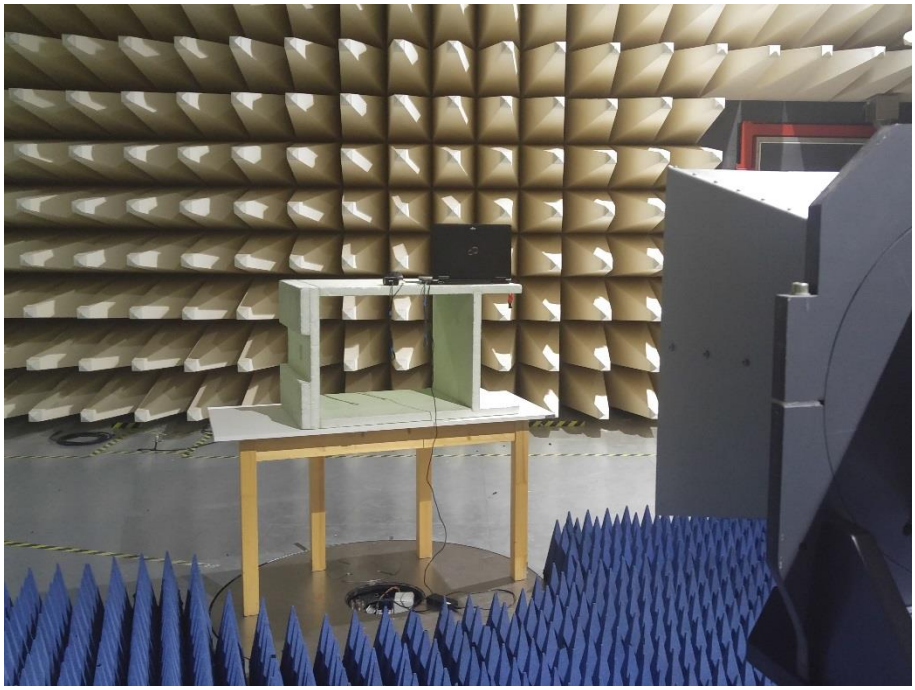
OATS1 – 10 m – 30 MHz to 1000 MHz



OATS1 – 10 m – 30 MHz to 1000 MHz



A1 – 3 m – 1 GHz to 12.75 GHz



A1 – 3 m – 1 GHz to 12.75 GHz

5.3.3 Applicable standard

According to FCC Part 90.217(a):
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

5.3.4 Description of Measurement

Spurious emission from the EUT is measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and 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 interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 10 metres 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 metres and the EUT is rotated 360 degrees.
The final level in dBm is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors (cable loss, antenna gain, free space attenuation). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

Spurious emission from the EUT are measured in the frequency range 1 GHz up to 12.75 GHz, 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 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.

The final level in dBm is calculated by taking the reading from the spectrum analyser (Level dBm) and adding the correction factors (cable loss, antenna gain, free space attenuation). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The substitution antenna is used to replace the EUT for test the effective radiated power and spurious emissions. For measurements in the frequency band 30 MHz to 1 000 MHz, the substitution antenna is a ½ wave dipole antenna. For measurements above 1000 MHz, a waveguide horn is taken. The centre of this antenna should coincide with either the phase centre or volume centre. A signal generator is connected to the dipole (horn antenna for frequencies above 1 GHz), and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the dipole antenna and its gain; the power (dBm) into an ideal ½ wave dipole antenna is determined for each radiated spurious emission.

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI/TIA-603-E Section 2.2.12.

Instrument settings:

30 MHz – 1000 MHz:	RBW: 120 kHz
1000 MHz – 12750 MHz	RBW: 1 MHz

5.3.5 Test result f < 1 GHz

EuT in horizontal position – TX antenna vertrical

Frequency (MHz)	Level PK (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected power ERP (dBm)	Power limit (dBm)	Delta (dB)
30.00	5.0	120	-68.9	-63.9	-19.0	-44.9
200.00	-2.1	120	-78.4	-80.5	-19.0	-61.5
400.00	-3.4	120	-72.7	-76.1	-19.0	-57.1
600.00	-3.0	120	-69.1	-72.1	-19.0	-53.1
800.00	-1.3	120	-63.5	-64.8	-19.0	-45.8
1000.00	-1.8	120	-63.6	-65.4	-19.0	-46.4

Note: In the frequency range from 30 MHz to 1000 MHz, no spurious emission could be measured. The frequencys and levels above, shown the noise floor.

5.3.6 Test result f > 1 GHz:

EuT in horizontal position – TX antenna vertrical

Frequency (MHz)	Level PK (dBm)	Bandwidth (kHz)	Correct. factor (dB)	Corrected power ERP (dBm)	Power limit (dBm)	Delta (dB)
1826.13	-20.9	1000	-15.8	-36.7	-19.0	-17.7
2739.25	-49.4	1000	-11.6	-61.0	-19.0	-42.0
3652.38	-53.8	1000	-8.9	-62.7	-19.0	-43.7
4234.06	-65.3	1000	3.1	-62.2	-19.0	-43.2
5477.66	-63.9	1000	6.5	-57.4	-19.0	38.4

Spurious emission limit according to FCC Part 90.217:

Spurious emission limit (dBm)	
30 dB down	-19.0

The requirements are **FULFILLED.**

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

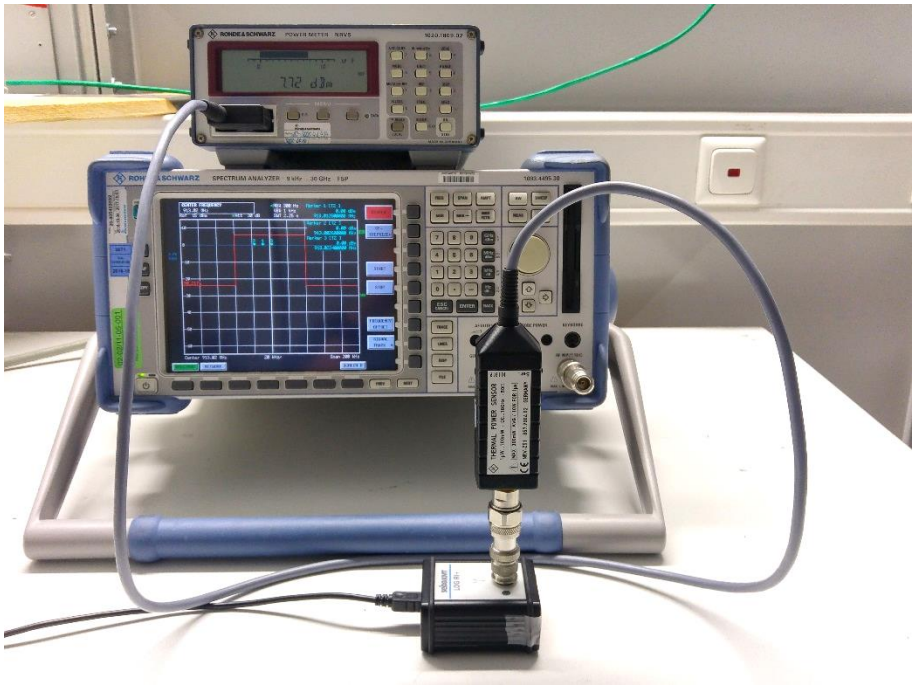
5.4 Conducted carrier output power

For test instruments and accessories used see section 6 Part **CPC 2**.

5.4.1 Description of the test location

Test location: Shielded Room S4

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

According to FCC Part 90.217:
Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 mW are exempt from the technical requirements set out in this subpart, but must instead comply with the following:
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

5.4.4 Description of Measurement

The maximum conducted carrier output power is measured using a power meter in a test setup following the procedures set out in ANSI/TIA-603-E Section 2.2.1. The EUT is set in TX continuous mode while measuring.

5.4.5 Test result

Frequency (MHz)	Power (dBm)	Power limit (dBm)	Delta (dB)
913.02	7.7	20.8	13.1

Power limit according to FCC Part 90.217:

Frequency	Radiated power limit	
(MHz)	(dBm)	(mW)
>800	20.8	120

The requirements are **FULFILLED.**

Remarks: _____

_____

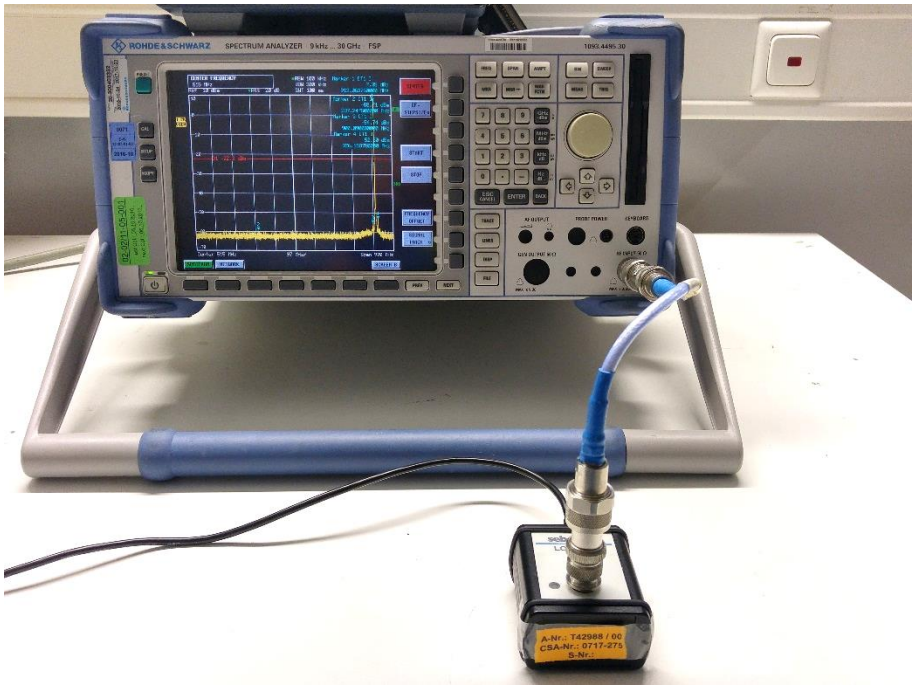
5.5 Conducted spurious emissions

For test instruments and accessories used see section 6 Part **SEC 1-3**.

5.5.1 Description of the test location

Test location: Shielded Room S4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to FCC Part 90.217(a):
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

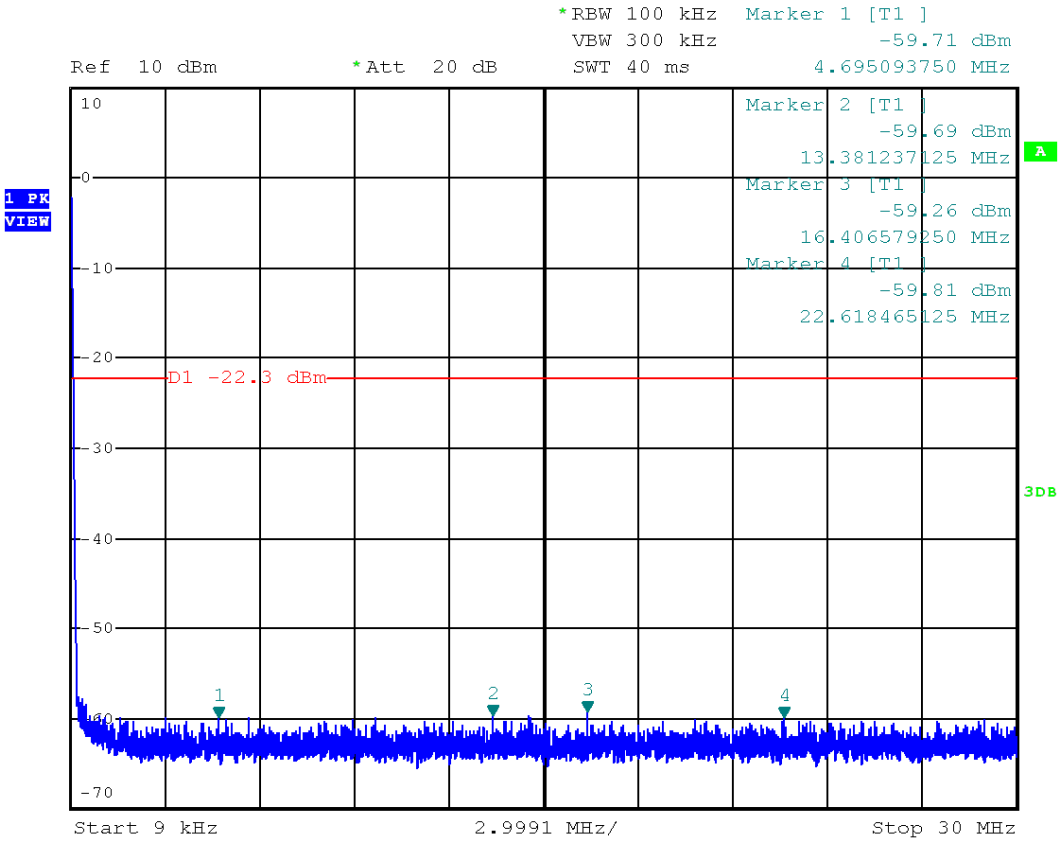
5.5.4 Description of Measurement

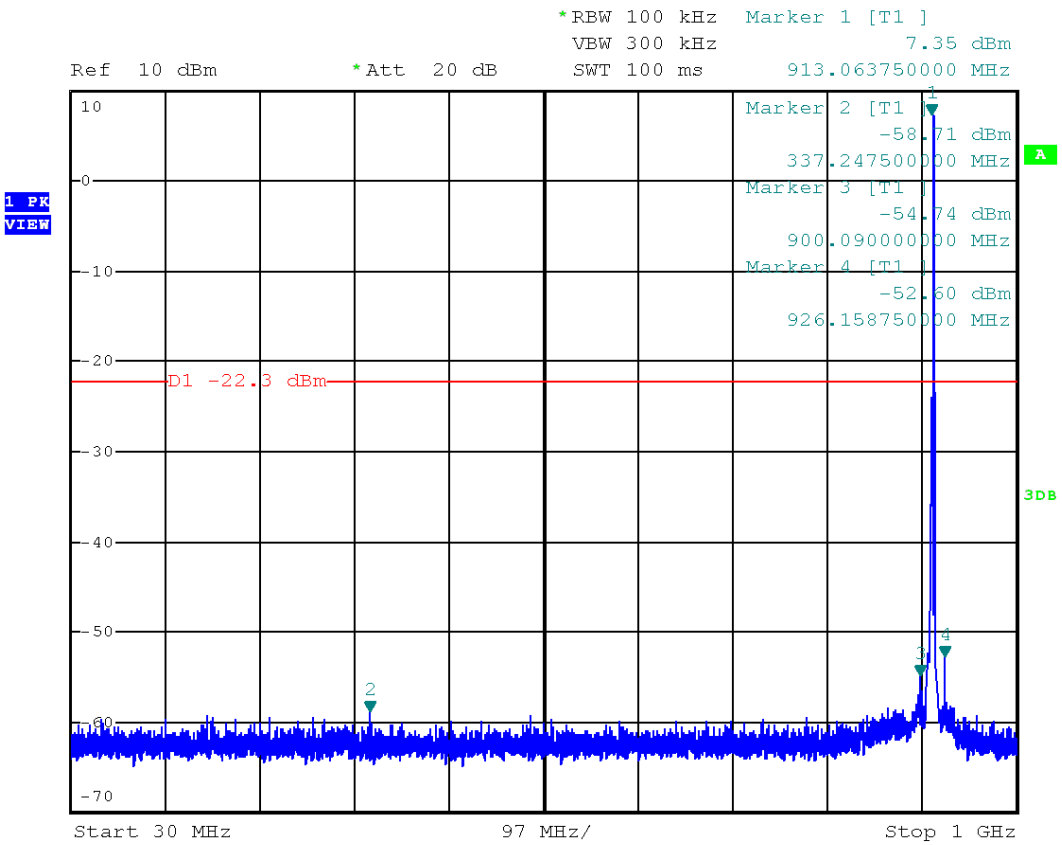
The spurious emissions are measured conducted using a spectrum analyser in a test setup following the procedures set out in ANSI/TIA-603-E Section 2.2.13. The measurement is performed at normal test conditions in modulated TX continuous mode.

Instrument settings:

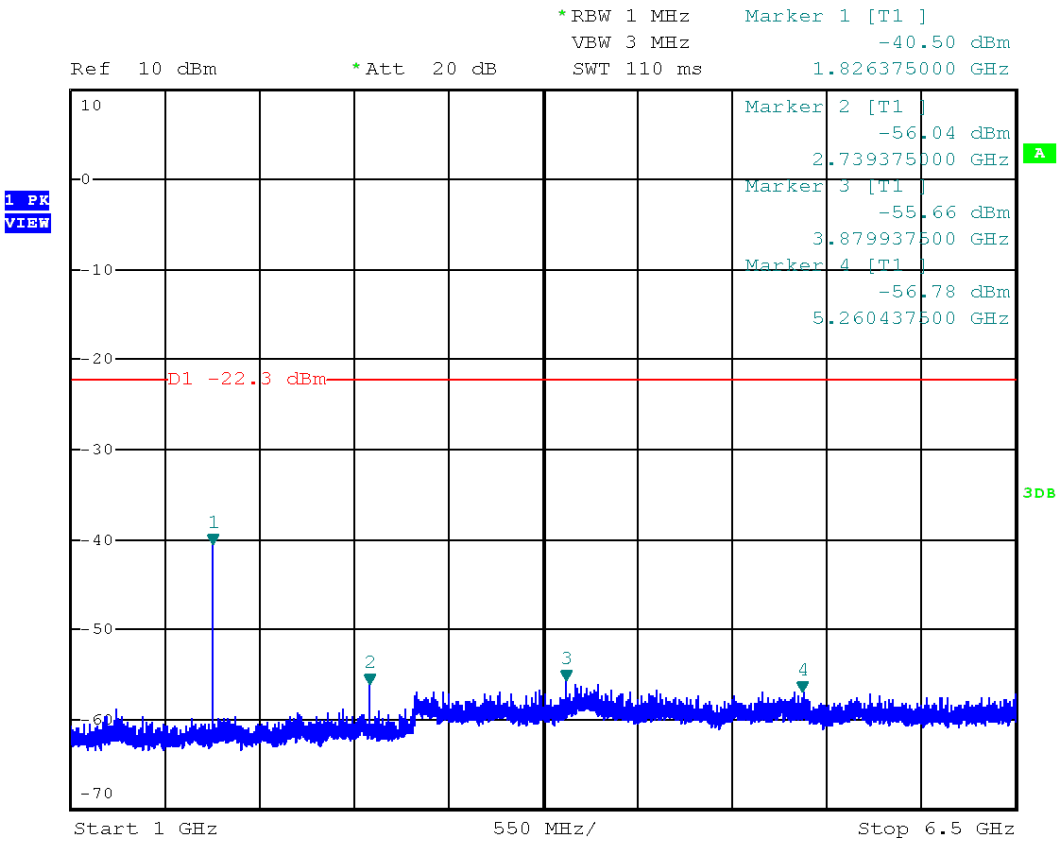
9 kHz – 1000 MHz:	RBW: 100 kHz
1000 MHz – 12750 MHz	RBW: 1 MHz

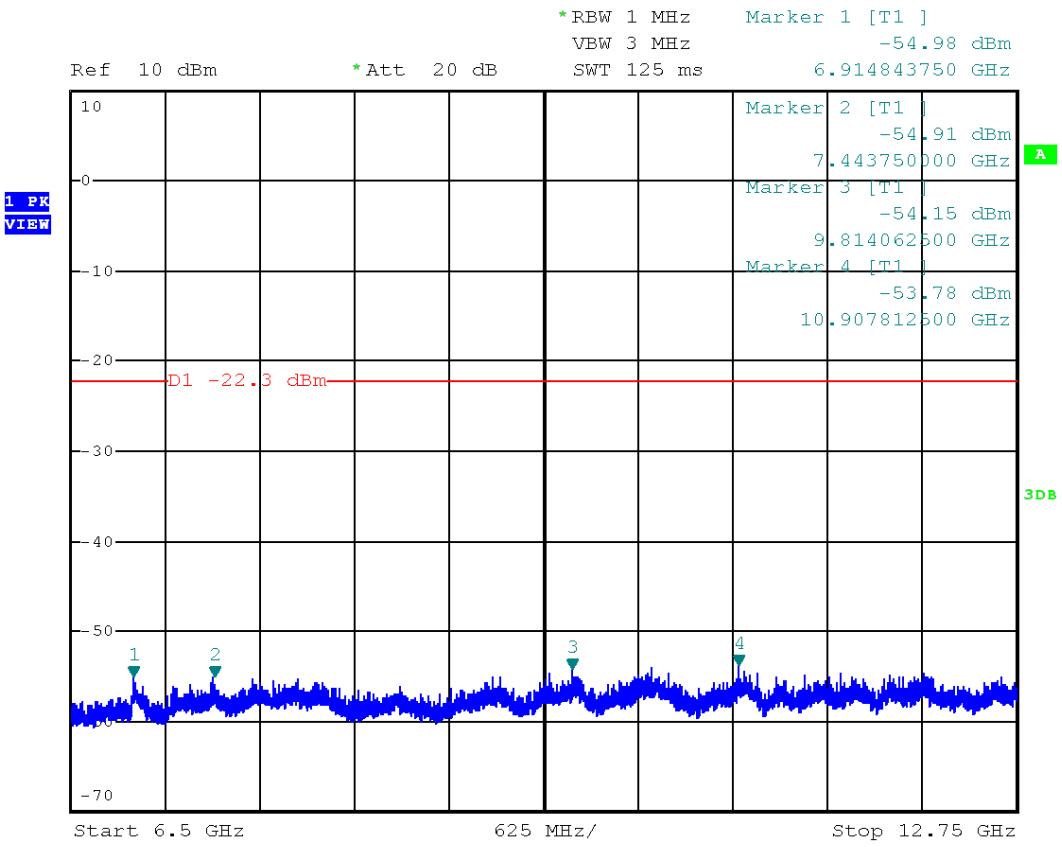
5.5.5 Test result plot f < 1 GHz





5.5.6 Test result plot f > 1 GHz





5.5.7 Test result table

Frequency (MHz)	Corrected power ERP (dBm)	Bandwidth (kHz)	Power limit (dBm)	Delta (dB)
4.70	-59.2	100	-22.3	-36.9
13.38	-59.7	100	-22.3	-37.4
16.41	-59.3	100	-22.3	-37.0
22.62	-59.8	100	-22.3	-37.5
337.25	-58.7	100	-22.3	-36.4
900.09	-54.7	100	-22.3	-32.4
926.16	-52.6	100	-22.3	-30.3
1826.38	-40.5	1000	-22.3	-18.2
2739.38	-56.0	1000	-22.3	-33.7
3879.94	-55.7	1000	-22.3	-33.4
5260.44	-56.8	1000	-22.3	-34.5
6914.84	-55.0	1000	-22.3	-32.7
7443.75	-54.9	1000	-22.3	-32.6
9814.06	-54.2	1000	-22.3	-31.9
10907.81	-53.8	1000	-22.3	-31.5

Spurious emission limit according to FCC Part 90.217:

Spurious emission limit (dBm)	
30 dB down	-22.3

The requirements are **FULFILLED.**

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

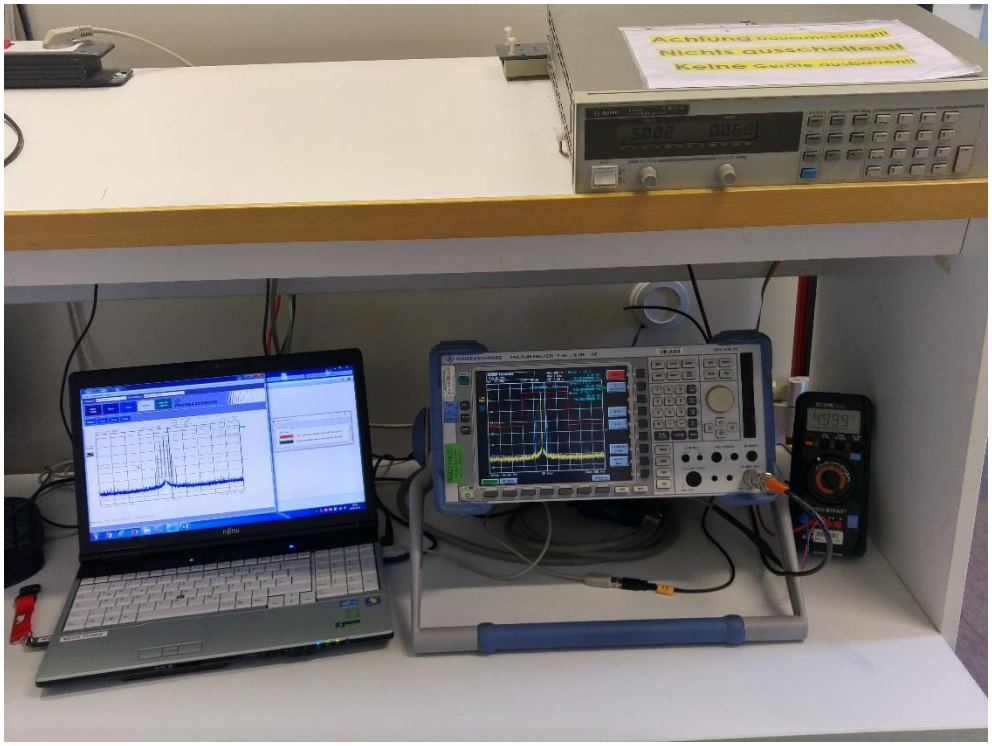
5.6 Modulation characteristics

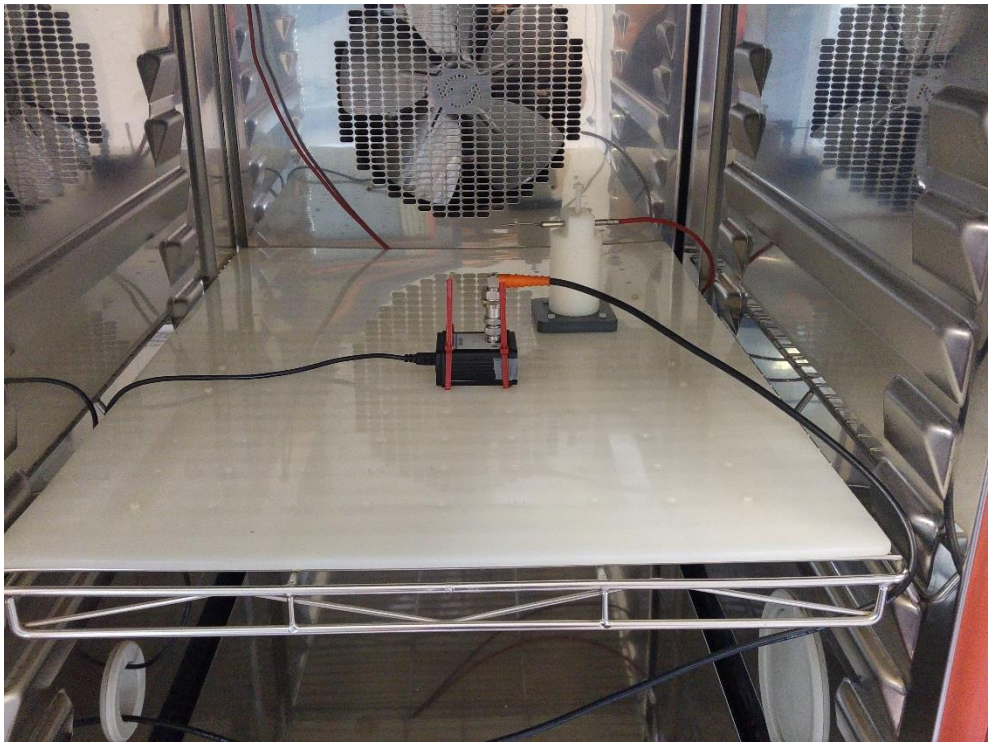
For test instruments and accessories used see section 6 Part **MB**.

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up





5.6.3 Applicable standard

According to FCC Part 90.217(a):
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

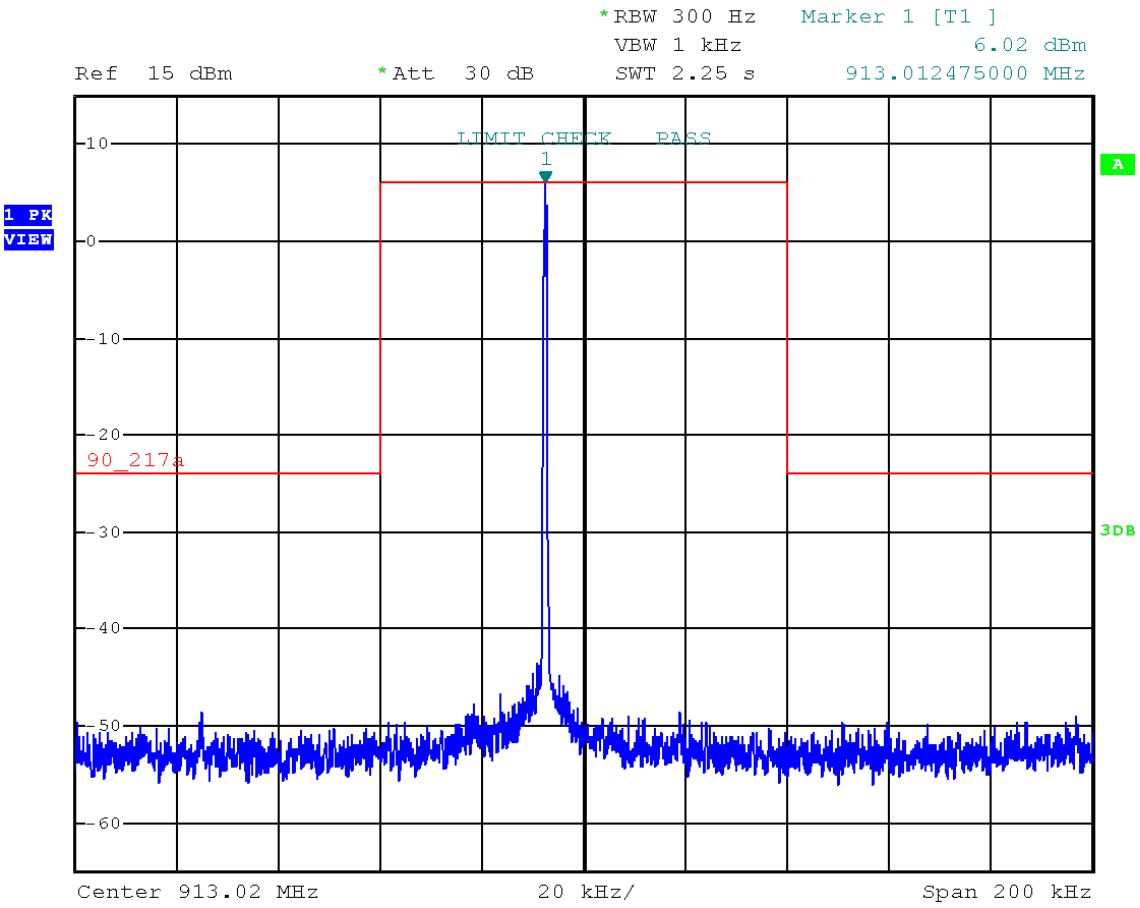
5.6.4 Description of Measurement

The measurement was performed conducted with intentional modulation on and off. The emission mask defined for 25 kHz channel bandwidth devices is shown on each plot. The 0 dB reference for the mask is the measured output power of the unmodulated carrier at that frequency.

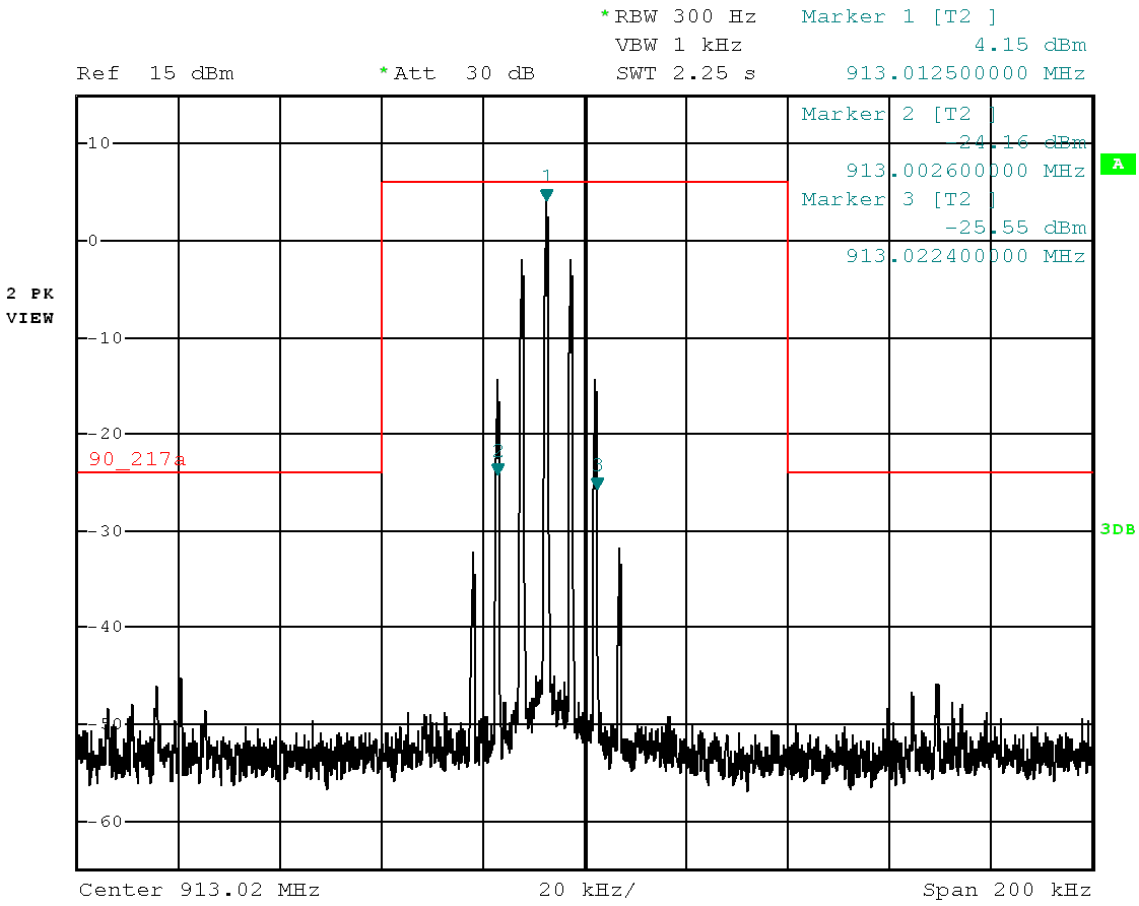
Spectrum analyser settings:
RBW: 300 Hz, VBW: 1 kHz, Detector: PK sampling detector, Sweep time: auto

5.6.5 Test result

Cont. TX without modulation



Cont. TX with modulation



Peak power limit according to FCC Part 90.217(a):

Limit	Lower envelope point minimum frequency	Upper envelope point maximum frequency
30 dB down	912.9905 MHz ($f_{e, lower}$ - 40 kHz)	913.0224 MHz ($f_{e, upper}$ + 40 kHz)

The requirements are **FULFILLED.**

Remarks: _____

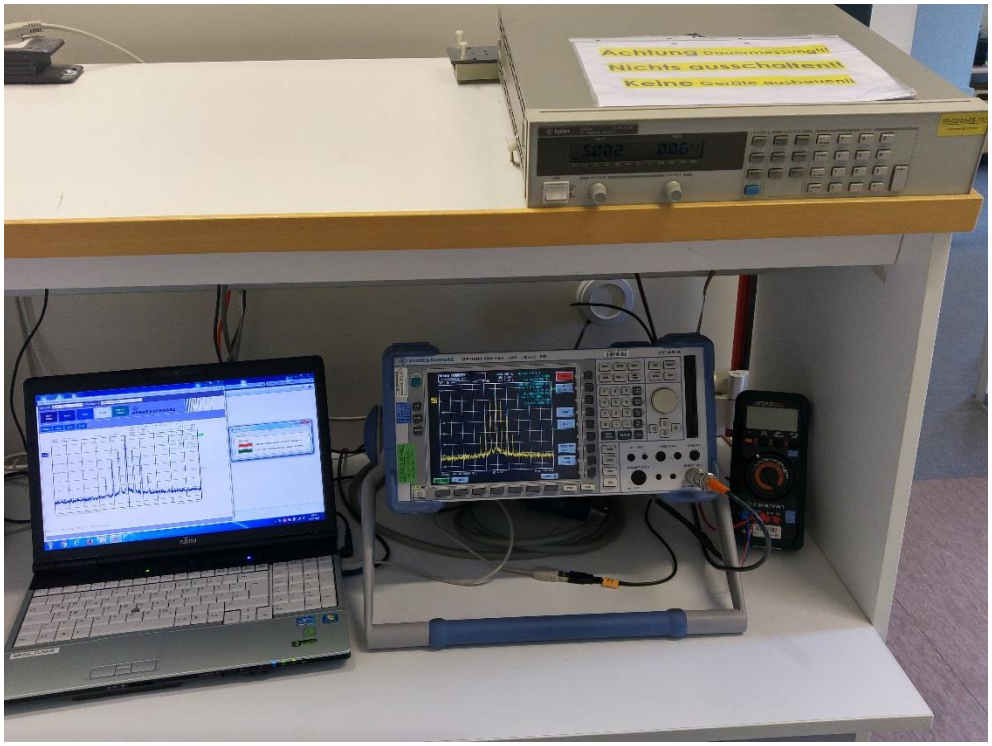
5.7 Occupied bandwidth

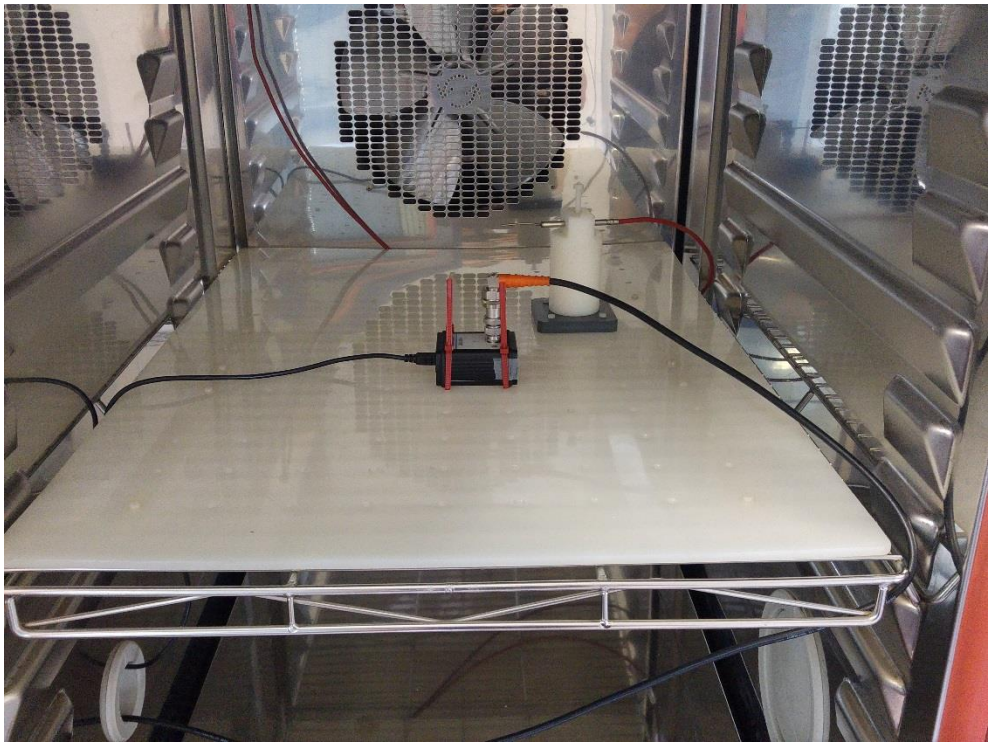
For test instruments and accessories used see section 6 Part **MB**.

5.7.1 Description of the test location

Test location: AREA4

5.7.2 Photo documentation of the test set-up





5.7.3 Applicable standard

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 per cent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:
Transmitters in which the modulating baseband comprises not more than three independent channels—when modulated by the full complement of signals for which the transmitter is rated. The level of modulation for each channel should be set to that prescribed in rule parts applicable to the services for which the transmitter is intended. If specific modulation levels are not set forth in the rules, the tests should provide the manufacturer's maximum rated condition.

5.7.4 Description of Measurement

The bandwidth was measured conducted with the function “bandwidth measurement” of the spectrum analyser.

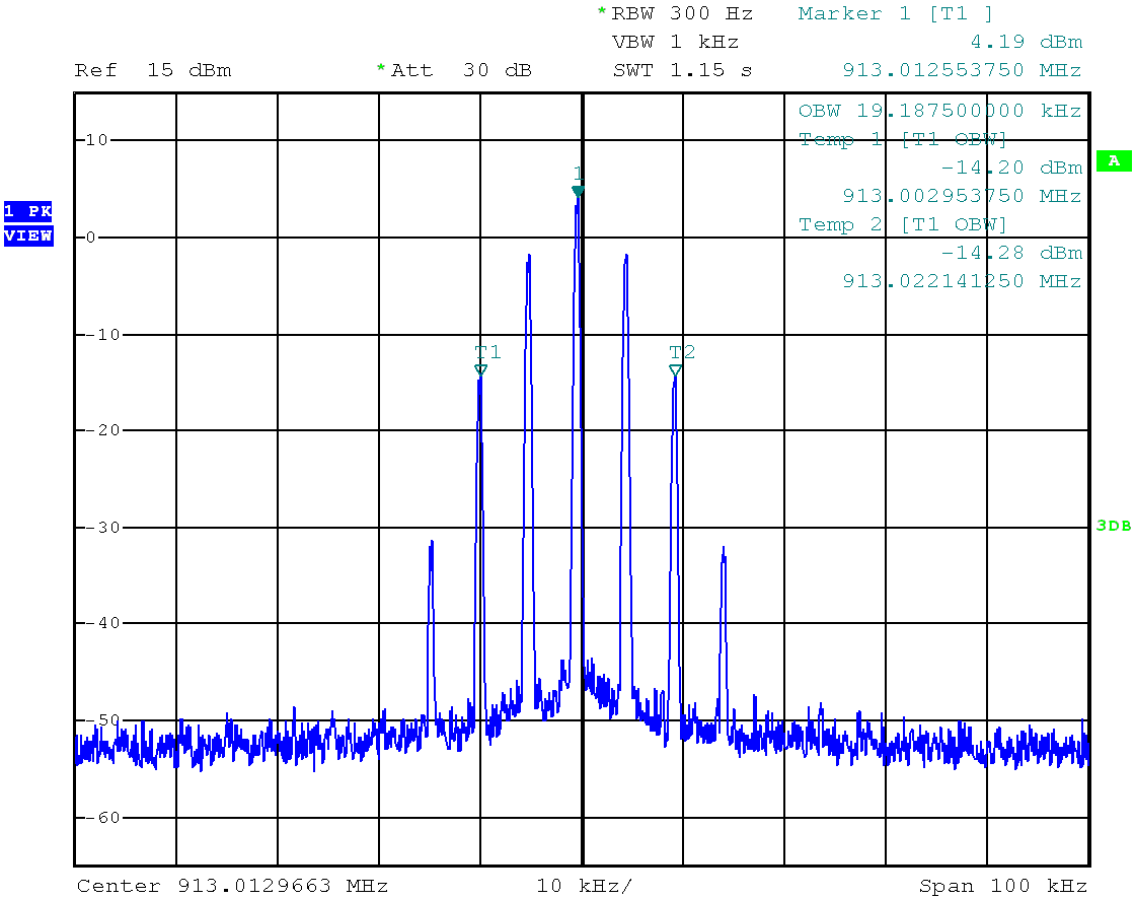
Spectrum analyser settings:
RBW: 300 Hz, VBW: 1 kHz, Detector: PK sampling detector, Sweep time: auto

5.7.5 Test result

Channel number	Fundamental frequency (MHz)	99 % Bandwidth (kHz)
1	913.02	19.2

5.7.6 Test protocol

99% Bandwidth measurement plots



The requirements are **FULFILLED.**

Remarks: _____

_____

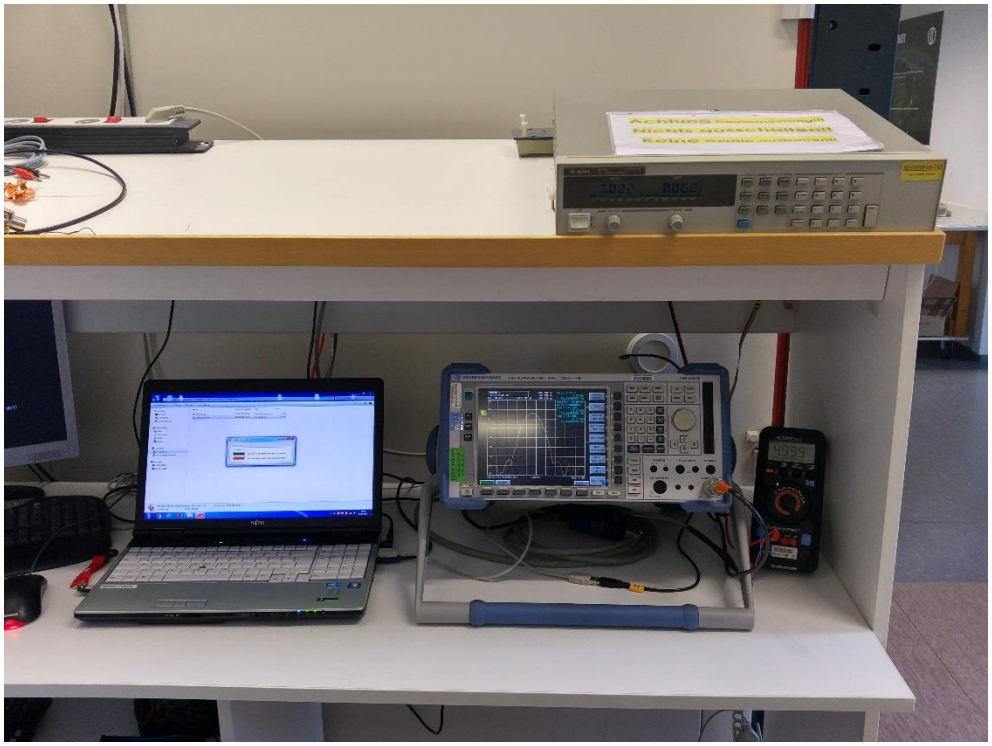
5.8 Frequency stability

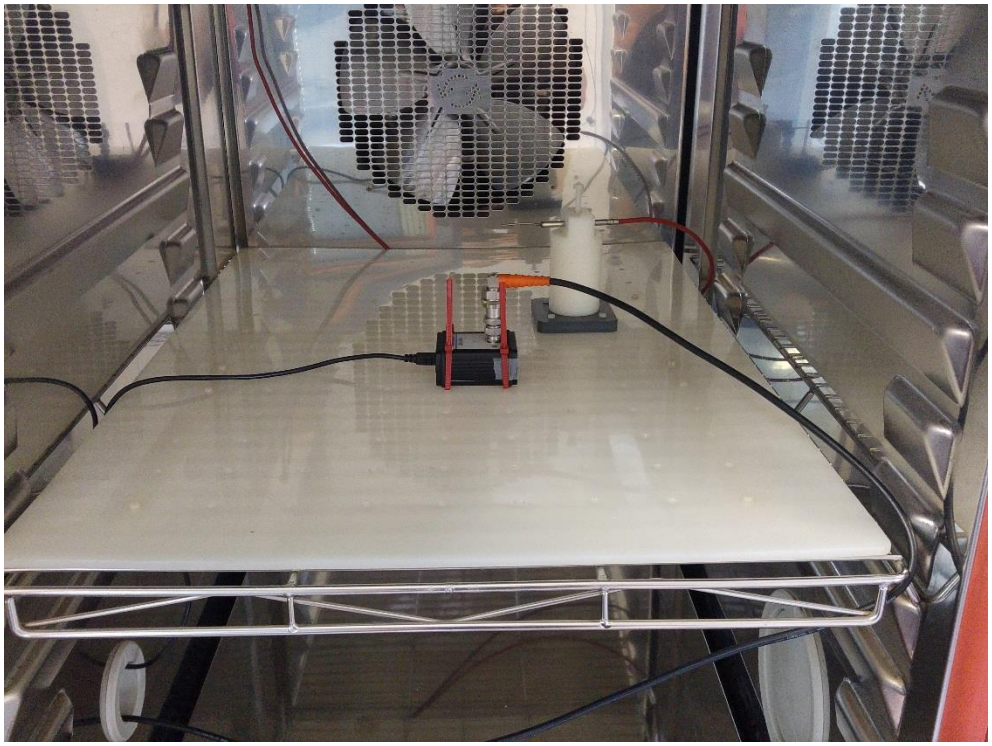
For test instruments and accessories used see section 6 Part **MB**.

5.8.1 Description of the test location

Test location: AREA4

5.8.2 Photo documentation of the test set-up





5.8.3 Applicable standard

According to FCC Part 90.217(a):
(a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

5.8.4 Description of Measurement

This test has been performed over variation in temperature. The temperature stability was measured with the EUT in a climatic chamber. During normal operation mode, the EuT has no external power supply connection. For this reason, the test was performend with full charges accus. The frequency stability of the transmitter was examinedat over the temperature range of -30°C to +50°C. The carrier frequency was measured conducted with a spectrum analyser.

5.8.5 Test result

Test conditions		Test result	
		Frequency reading (MHz)	Frequency error (kHz)
T (50°C)	V_{min}	913.007898	-12.102
	V_{nom}	913.007897	-12.103
	V_{max}	913.007897	-12.103
T (40°C)	V_{min}	913.009351	-10.649
	V_{nom}	913.009348	-10.652
	V_{max}	913.009341	-10.659
T (30°C)	V_{min}	913.011661	-8.339
	V_{nom}	913.011677	-8.323
	V_{max}	913.011684	-8.316
T_{nom} (20°C)	V_{min}	913.014615	-5.385
	V_{nom}	913.014612	-5.388
	V_{max}	913.014601	-5.399
T (10°C)	V_{min}	913.017197	-2.803
	V_{nom}	913.017196	-2.804
	V_{max}	913.017163	-2.837
T (0°C)	V_{min}	913.019069	-0.931
	V_{nom}	913.019071	-0.929
	V_{max}	913.019073	-0.927
T (-10°C)	V_{min}	913.019974	-0.026
	V_{nom}	913.019976	-0.024
	V_{max}	913.019984	-0.016
T (-20°C)	V_{min}	913.019301	-0.699
	V_{nom}	913.019309	-0.691
	V_{max}	913.019329	-0.671
T (-30°C)	V_{min}	913.016607	-3.393
	V_{nom}	913.016631	-3.369
	V_{max}	913.016673	-3.327
Measurement uncertainty		± 500 Hz	

Measured frequency 30 dB down nearest at the lower frequency (see sub point 5.6.5):

f_L + FE $_{min}$ = 913.0026 MHz - 12.1 kHz = **912.9905 MHz**

Measured frequency 30 dB down nearest at the higher frequency (see sub point 5.6.5):

f_H + FE $_{max}$ = 913.0224 MHz + 0.0 kHz = **913.0224 MHz**

Bandwidth limit according to FCC Part 90.217(a):

Limit	Lower envelope point minimum frequency	Upper envelope point maximum frequency
30 dB down	912.98 MHz ($f_{e, lower}$ - 40 kHz)	913.06 MHz ($f_{e, upper}$ + 40 kHz)

The requirements are **FULFILLED.**

Remarks:

5.9 Receiver spurious emissions, radiated

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

5.9.1 Description of the test location

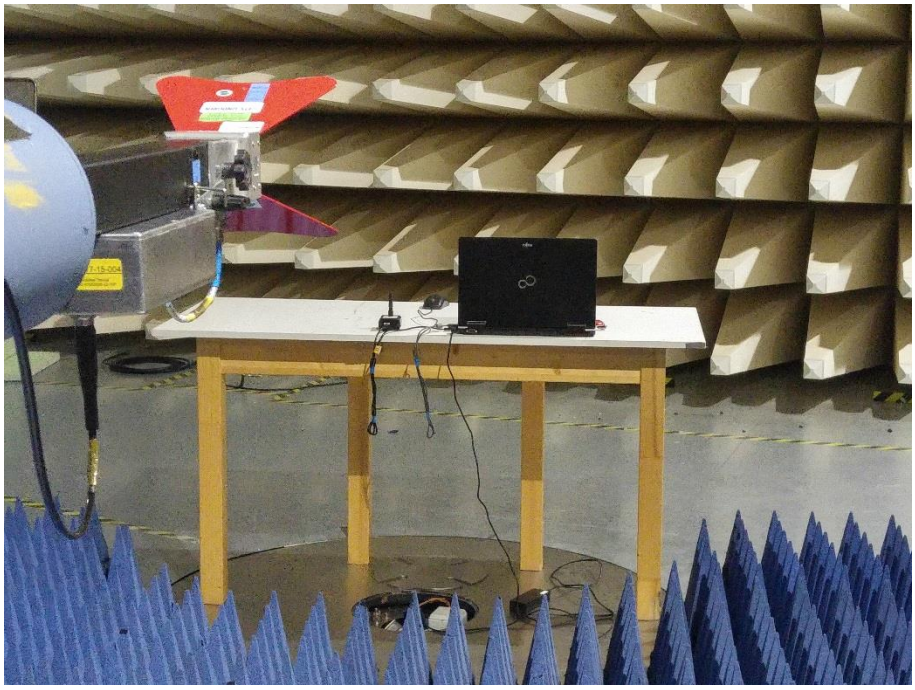
Test location: OATS 1
Test distance: 3 m

Test location: Anechoic chamber 1
Test distance: 3 m

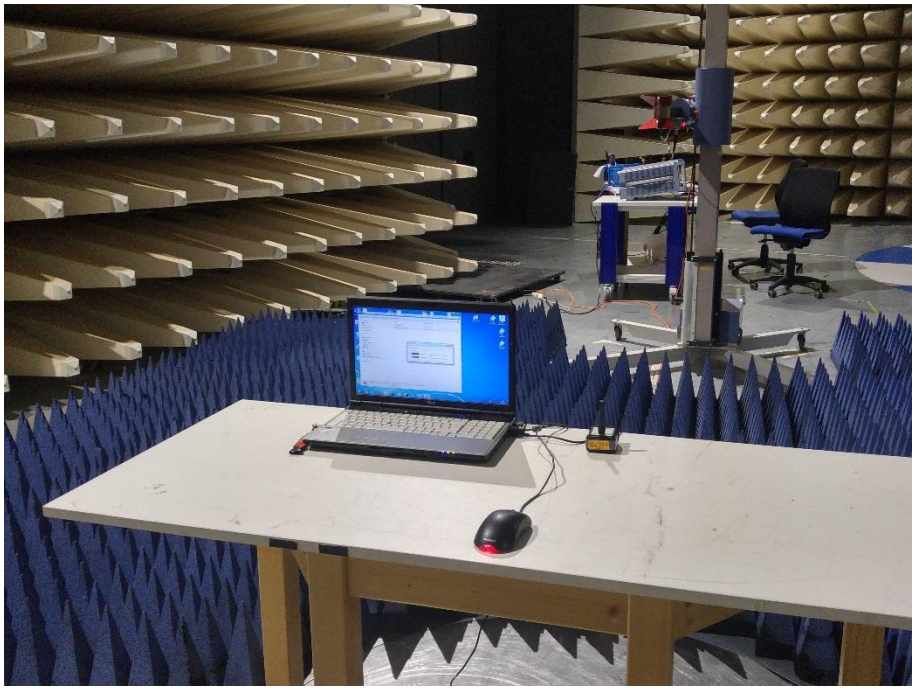
5.9.2 Photo documentation of the test set-up

OATS1 – 3 m – 30 MHz to 1000 MHz

OATS1 – 3 m – 30 MHz to 1000 MHz



A1 – 3 m – 1 GHz to 12.75 GHz



A1 – 3 m – 1 GHz to 12.75 GHz

5.9.3 Applicable standard

According to ANSI/TIA-603-E Section 3.1.1 and FCC Part 15B, Section 15.109 (a) and:
Except for Class A digital devices, the field strength of radiated emission from unintentional radiators at a distance of 3 m shall not exceed the given limit.

5.9.4 Description of Measurement

Spurious emission 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 interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3 metres 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 metres and the EUT is rotated 360 degrees.
The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

Spurious emission from the EUT are measured in the frequency range 1 GHz up to 12.75 GHz, 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 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.

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 – 5000 MHz	RBW: 1 MHz

5.9.5 Test result

EuT in horizontal position – TX antenna vertrical

Frequency (MHz)	Level QP (dBµV)	Level AV (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Level QP (dBµV/m)	Level AV (dBµV/m)	Limit (dBµV/m)	Delta (dB)
30.00	5.0	-	120	12.5	17.5	-	40.0	-22.5
200.00	-2.1	-	120	12.0	9.9	-	43.5	-33.6
400.00	-3.4	-	120	19.8	16.4	-	46.0	-29.6
600.00	-3.0	-	120	25.5	22.5	-	46.0	-23.5
800.00	-1.7	-	120	29.5	27.8	-	46.0	-18.2
1000.00	-2.2	-	120	32.4	30.2	-	54.0	-23.8

Note: In the frequency range from 30 MHz to 1000 MHz, no spurious emission could be measured. The frequencys and levels above, shown the noise floor.

EuT in horizontal position – TX antenna vertrical

Frequency (MHz)	Level PK (dBµV)	Level AV (dBµV)	Bandwidth (kHz)	Correct. factor (dB)	Level PK (dBµV/m)	Level AV (dBµV/m)	Limit AV (dBµV/m)	Delta (dB)
1063.80	63.4	-	1000	-21.1	42.3	-	54.0	-11.7
1309.00	58.6	-	1000	-19.4	39.2	-	54.0	-14.8
1551.63	64.9	-	1000	-20.7	44.2	-	54.0	-9.8
1596.63	67.2	-	1000	-20.9	46.3	-	54.0	-7.7
1675.75	65.0	-	1000	-20.0	45.0	-	54.0	-9.0
2132.50	67.8	-	1000	-16.0	51.8	-	54.0	-2.2
2398.38	58.5	-	1000	-14.6	43.9	-	54.0	-10.1
2776.00	55.2	-	1000	-13.3	41.9	-	54.0	-12.1
3631.75	53.7	-	1000	-13.0	40.7	-	54.0	-13.3
4979.00	42.5	-	1000	5.1	47.6	-	54.0	-6.4

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

Frequency (MHz)	Limit (µV/m)	Limit (dBµV/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 5 GHz.

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	ESCI	02-02/03-15-001	31/05/2018	31/05/2017		
	ESH 2 - Z 5	02-02/20-05-004	26/10/2017	26/10/2015	18/01/2018	18/07/2017
	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	18/11/2019	18/11/2016	21/10/2017	21/04/2017
CPC 2	NRVS	02-02/07-06-003				
	NRV-Z51	02-02/07-06-006	03/07/2018	03/07/2017		
CPR 2	ESVS 30	02-02/03-05-006	03/07/2018	03/07/2017		
	VULB 9168	02-02/24-05-005	12/04/2018	12/04/2017	12/10/2017	12/04/2017
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
MB	FSP 30	02-02/11-05-001	06/10/2017	06/10/2016		
	METRA HIT World	02-02/32-10-001	17/10/2017	17/10/2016		
	WK-340/40	02-02/45-05-001	13/04/2018	13/04/2017		
	6543A	02-02/50-05-157				
SEC 1-3	FSP 30	02-02/11-05-001	06/10/2017	06/10/2016		
	SF104/11N/11N/300MM	02-02/50-13-009				
SER 2	ESVS 30	02-02/03-05-006	03/07/2018	03/07/2017		
	VULB 9168	02-02/24-05-005	12/04/2018	12/04/2017	12/10/2017	12/04/2017
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSP 40	02-02/11-11-001	13/10/2017	13/10/2016		
	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				
	BBHA 9120 E 251	02-02/24-05-006	27/04/2018	27/04/2017	27/01/2018	27/07/2017
	3117	02-02/24-05-009	10/05/2018	10/05/2017		
	WBH2-18NHG	02-02/24-08-002	27/04/2018	27/04/2017	27/01/2018	27/07/2017
	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				
	SF104/11SMA/11N/1500MM	02-02/50-13-016				
	SF104/11SMA/11N/1500MM	02-02/50-13-017				