EMI – TEST REPORT

- FCC Part 15.247, RSS-247 -

Type / Model Name : smaXtec Classic Bolus SX.2, smaXtec pH Plus Bolus SX.2

Product Description : Animal sensor with RF interface

Applicant : smaXtec animal care GmbH

Address : Belgiergasse 3

8020 GRAZ, AUSTRIA

Manufacturer : smaXtec animal care GmbH

Address : Belgiergasse 3

8020 GRAZ, AUSTRIA

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

Test Report No. : T47447-00-00HS	28. September 2021 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2020)

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 2020)

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
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
ETSI TR 100 028 V1.3.1: 2001-03,	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
KDB 558074 D01 v05r02	Guidance for compliance measurements on DTS; FHSS and hybrid system devices operating under Section 15.247 of the FCC rules, April 2, 2019.

FCC ID: OHCSXPAMP1 IC: 10671A-SXPAMP1

2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

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

2.4 Equipment type

Hybrid device

2.5 Short description of the equipment under test (EUT)

The EUT use a RF interface with LoRa modulation. The EUT is intended to be used inside of a cow in order to monitor the animal well-being.

Number of tested samples:	1 radiated sample, 1 conducted sample
Serial number:	1B00000006, 1B00000002
Firmware version:	v10
Hardware version	UX-2042, UX-2142P

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

2.6 Variants of the EUT

There are two variants:
1. smaXtec Classic Bolus SX.2
2. smaXtec pH Plus Bolus SX.2, additional pH sensor.

Note: For testing the smaXtec pH Plus Bolus SX.2 is used.

2.7 Operation frequency and channel plan

Upstream LoRa 125 kHz BW, DR0-DR3

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	902.3	16	905.5	32	908.7	48	911.9
1	902.5	17	905.7	33	908.9	49	912.1
2	902.7	18	905.9	34	909.1	50	912.3
3	902.9	19	906.1	35	909.3	51	912.5
4	903.1	20	906.3	36	909.5	52	912.7
5	903.3	21	906.5	37	909.7	53	912.9
6	903.5	22	906.7	38	909.9	54	913.1
7	903.7	23	906.9	39	910.1	55	913.3
8	903.9	24	907.1	40	910.3	56	913.5
9	904.1	25	907.3	41	910.5	57	913.7
10	904.3	26	907.5	42	910.7	58	913.9
11	904.5	27	907.7	43	910.9	59	914.1
12	904.7	28	907.9	44	911.1	60	914.3
13	904.9	29	908.1	45	911.3	61	914.5
14	905.1	30	908.3	46	911.5	62	914.7
15	905.3	31	908.5	47	911.7	63	914.9

Note: the marked frequencies are determined for final testing.

Note: If the readout network (built by one or more base stations) provides more than 50 channels, the EUT operates in hopping mode. In case of a maximized readout network (networks provide 64 channels), the EUT operates in hopping mode using 64 channels with 125 kHz bandwidth. In case of a minimal readout network (base station provides the least number of 8 channels), the EUT operates in DTS mode and use 8 channels with 125 kHz.

2.8 Transmit operating modes

DataRate	Configuration	Indicative physical bit rate (bit/sec)
0	LoRa: SF10 / 125 kHz	250
1	LoRa: SF9 / 125 kHz	1760
2	LoRa: SF8 / 125 kHz	3125
3	LoRa: SF7 / 125 kHz	5470
5:7	RFU	

2.9 Antenna

The following antenna shall be used with the EUT:
PCB-meander-antenna, Gain = -13.3 dbi.

2.10 Power supply system utilised

Power supply voltage, V_{nom} : 3.0 VDC (lithium battery)

2.11 Peripheral devices and interface cables

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

- - Model : -

2.12 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. For the further measurement the EUT is set in Y position.
The tests are carried out in the following frequency band: **902 MHz – 915 MHz**

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

Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
0 to 63	0, 32, 63	P14	CSS	LoRa	DR0

2.12.1 Test jig

The conducted measurements are performed under the support of a special prerared PCB, where the PCB antenna is cutted and a temporary connector is placed.

2.12.2 Test software

The test software for the EUT provides max power setting and the special test mode TX continuous, modulated. The EUT was set with test modulation to transmit data during the tests with a maximum duty cycle (x) from an internal packet generator. Only for the test the appropiate test software is available.

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3 TEST RESULT SUMMARY

The EUT is a hybrid device:

Operating in the 902 MHz – 915 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	not applicable
15.247(a)(1)	RSS-247, 5.1(a)	20 dB EBW	passed
15.247(a)(2)	RSS-247, 5.1(b)	6 dB EBW, OBW	passed
15.247(a)(1)	RSS-247, 5.1(d)	Dwell time	passed
15.247(b)(1)	RSS-247, 5.4(b)	Peak power	passed
15.247(f)		Power Spectral Density	passed
15.247(d)	RSS-247, 5.5	Out-of-band emission	passed
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.247(a)	RSS-247, 5.4(b)	Number of hopping channels	passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	not applicable
15.203	RSS-247, 5.4(b)	Antenna requirement	passed

The mentioned RSS Rule Parts in the above table are related to:
RSS-Gen, Issue 5, Amendment March 2019
RSS-247, Issue 2, February 2017

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 April 2021

Testing concluded on : 23 April 2021

Checked by:

Klaus Gegenfurtner
I confirm the correctness and integrity of this document
2021.09.28 09:09:51 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

I am the author of this document
2021.09.28 08:49:06 +02'00'

Hermann Smetana
Radio Team

FCC ID: OHCSXPAMP1 IC: 10671A-SXPAMP1

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 / 2011 + A1 / 2014 „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.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 30000 MHz	95%	± 2.5 x 10^{-7}
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB

4.1 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

4.2 Measurement protocol for FCC and ISED

4.2.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISED: DE0009

4.2.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

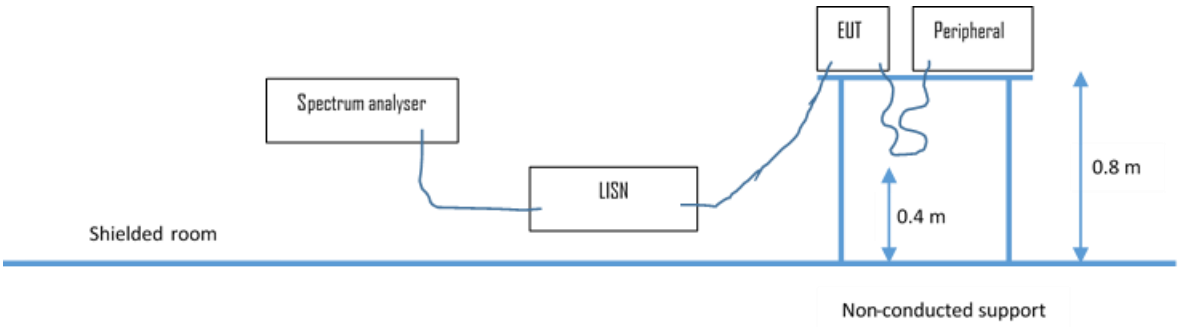
4.2.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

4.2.3 Details of test procedures

4.2.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dBμV, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dBμV and μV, the following conversions apply:

dBμV = 20(log μV)
μV = Inverse log(dBμV/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 50 Ω / 50 μH (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. 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 appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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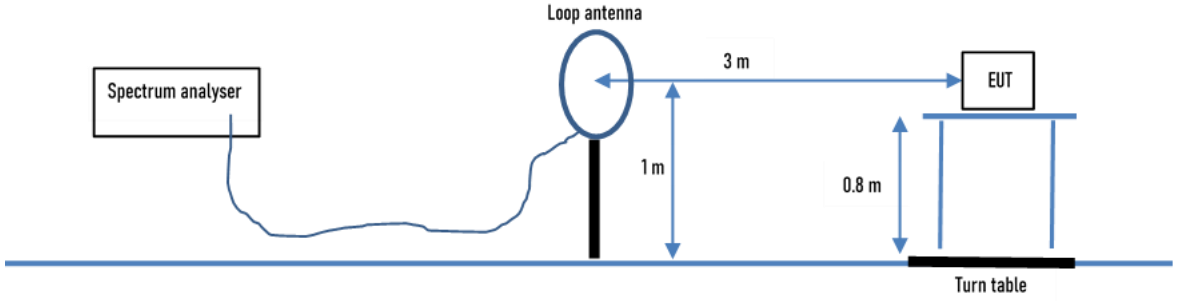
4.2.3.2 Radiated emission

4.2.3.2.1 OATS1 test site (9 kHz - 30 MHz):

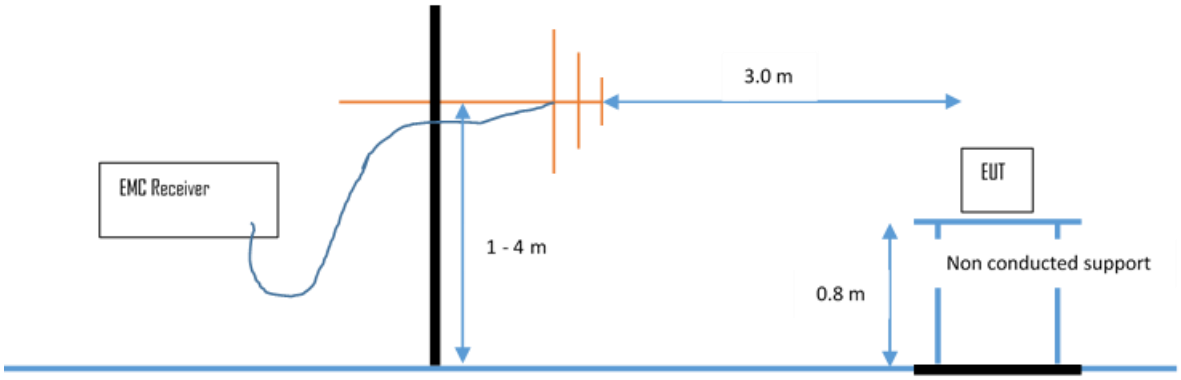
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

4.2.3.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



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. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. 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 limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

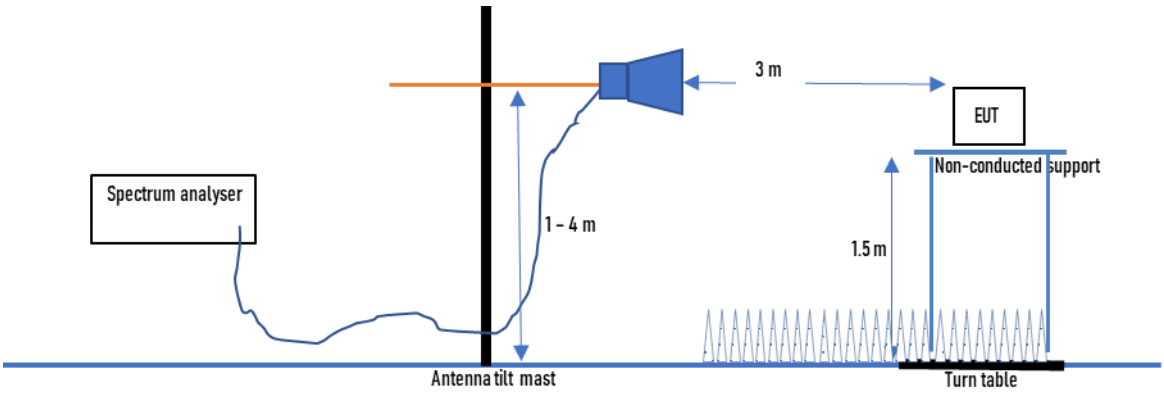
The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

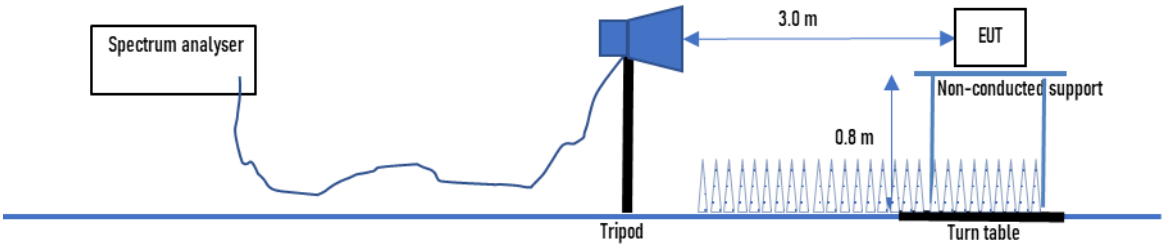
4.2.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz 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 non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

4.2.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz 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 non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limits are adopted.

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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 measurement is not applicable the EUT has no AC mains connection.

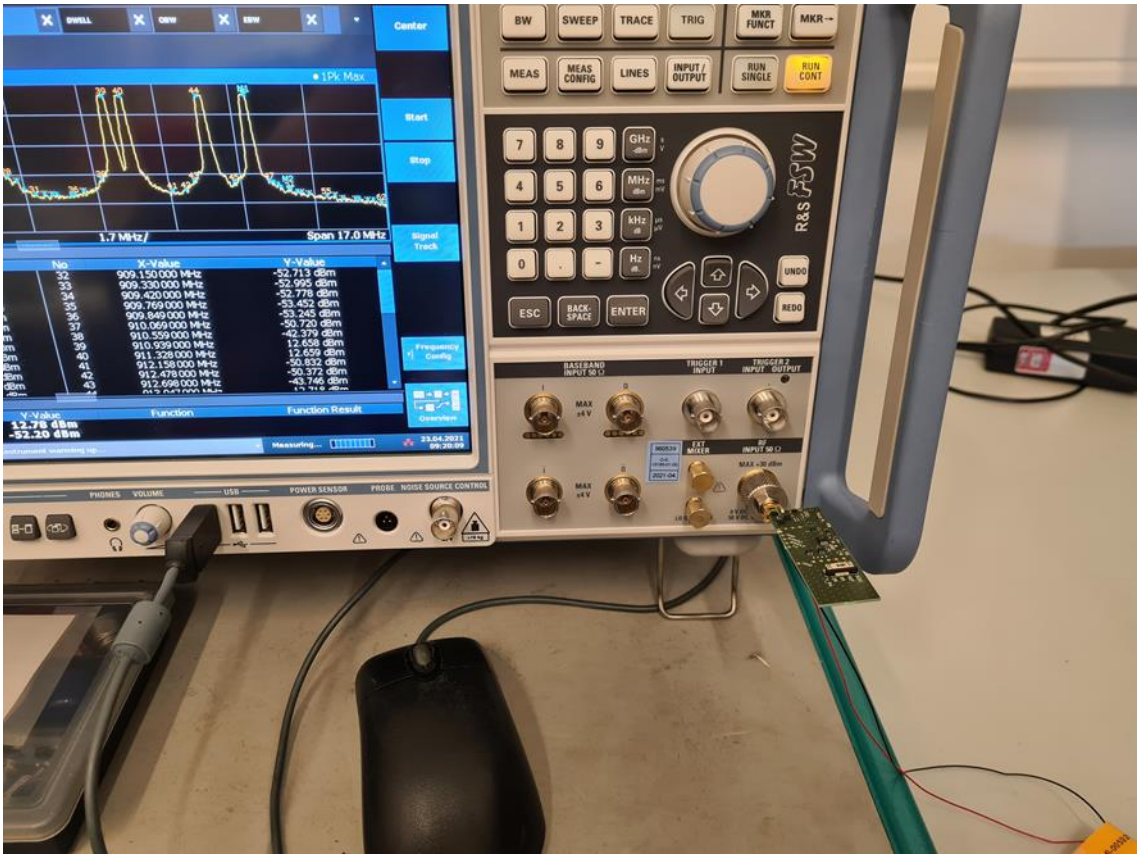
5.2 Emission bandwidth

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

5.2.1 Description of the test location

Test location: Shielded Room S6

5.2.2 Photo documentation of the test set-up



5.2.3 Applicable standard

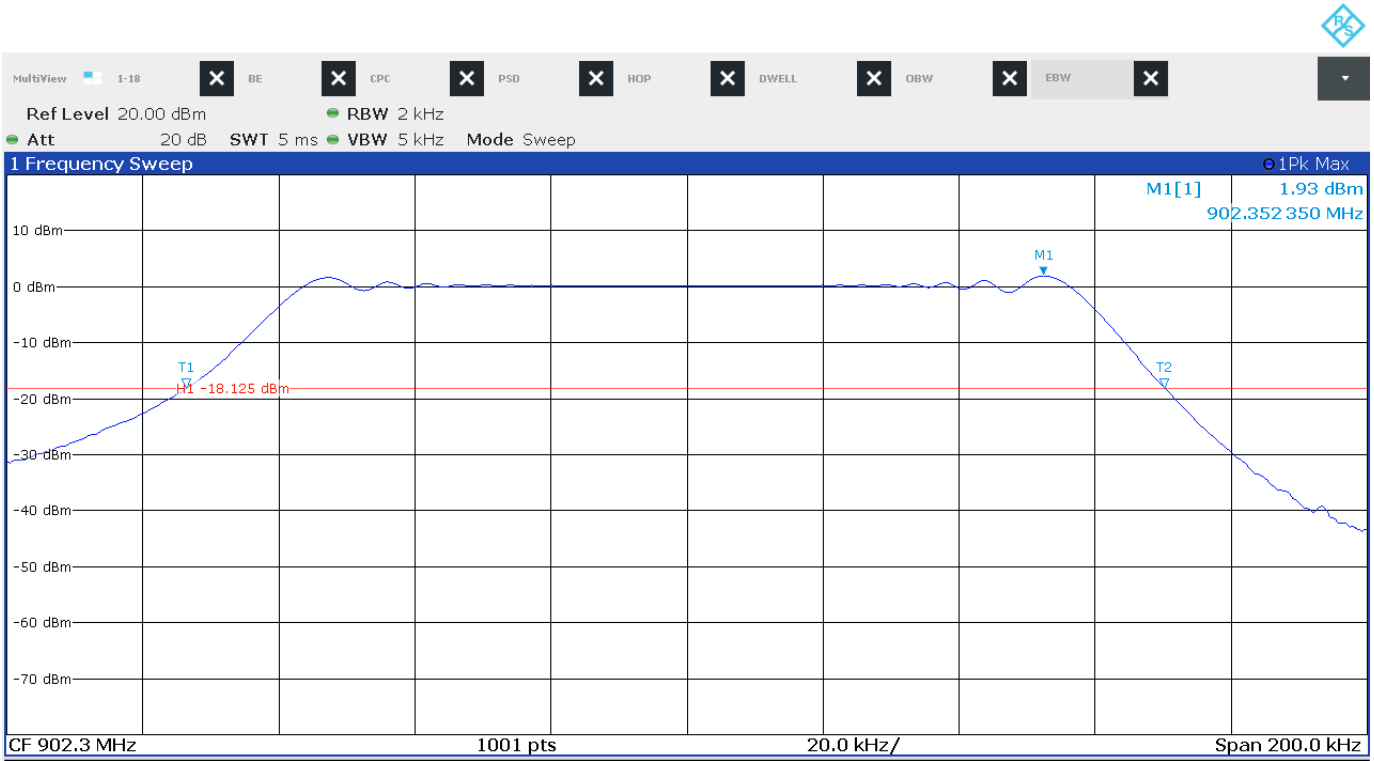
According to FCC Part 15C, Section 15.247(a):
(a)(1i) Frequency hopping systems shall have hopping carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
(a)(2) Systems using digital modulation techniques may operate in the 902-928 MHz, 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 is measured at an amplitude level reduced from the seeence level by a specified ratio of -20 dB. The seeence level is the level of the highest signal amplitude observed from 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.
Analyser settings for 125 kHz:
RBW: 2 kHz, VBW: 5 kHz, Sweep time: auto, Detector: Peak, Trace mode: Max hold
Analyser settings for 500 kHz:
RBW: 30 kHz, VBW: 50 kHz, Sweep time: auto, Detector: Peak, Trace mode: Max hold

5.2.5 Test result

EBW20dB:
Channels 125 kHz Bandwidth, Data rate 0:



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**902.352 35 MHz**	**1.93 dBm**	ndB	20.0 dB
T1		1	902.226 47 MHz	-18.11 dBm	ndB down BW	**143.66 kHz**
T2		1	902.370 13 MHz	-18.08 dBm	Q Factor	6 281.3

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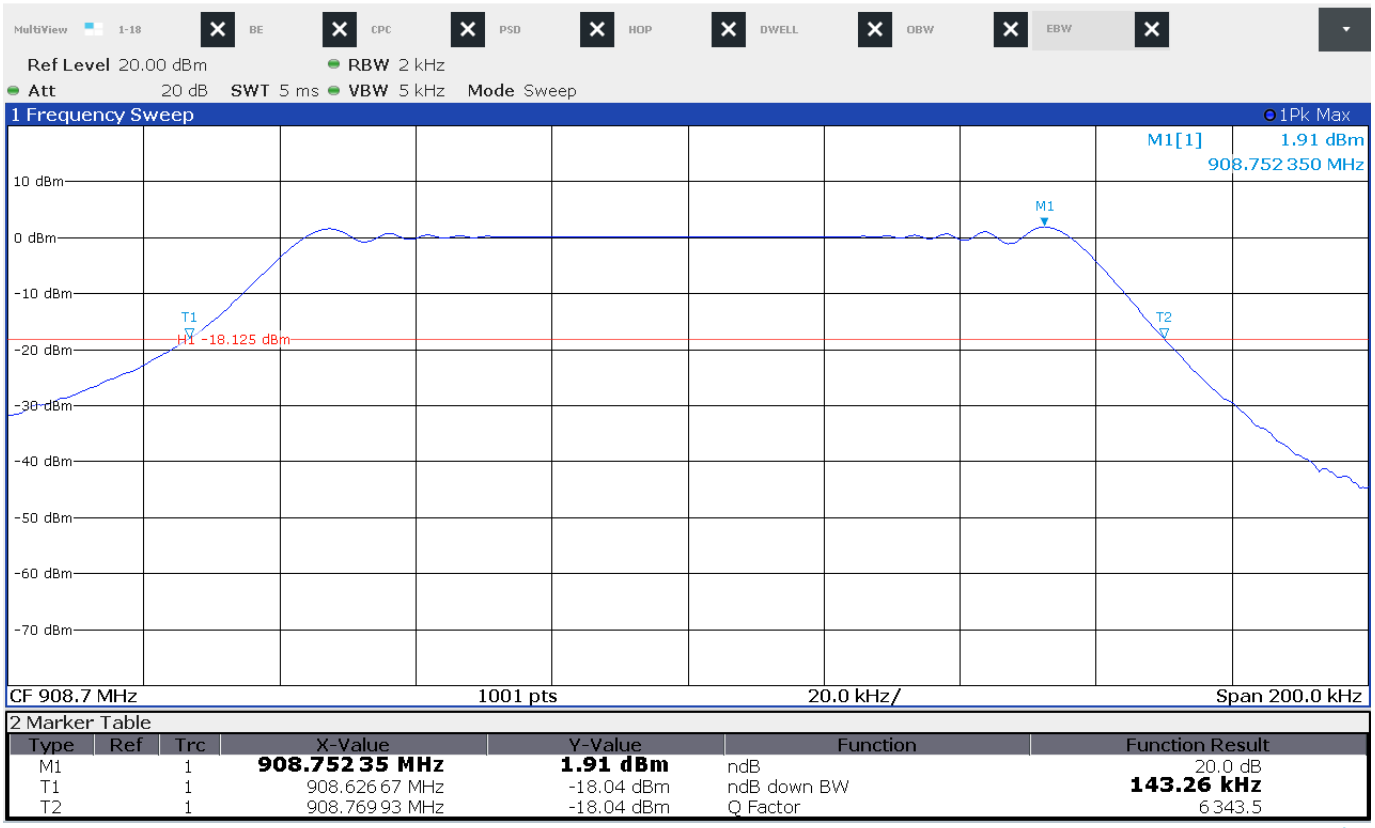
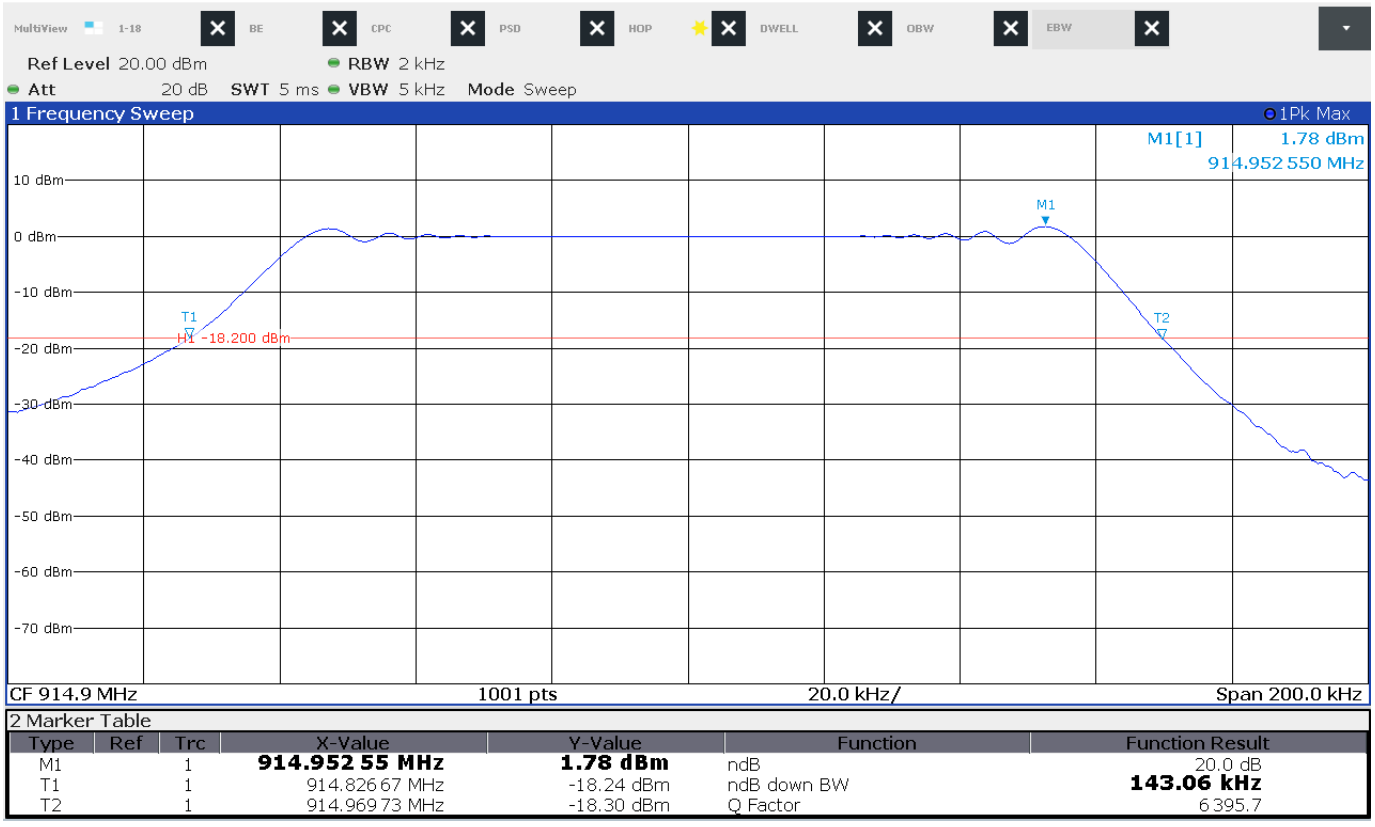


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**908.752 35 MHz**	**1.91 dBm**	ndB	20.0 dB
T1		1	908.626 67 MHz	-18.04 dBm	ndB down BW	**143.26 kHz**
T2		1	908.769 93 MHz	-18.04 dBm	Q Factor	6 343.5



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**914.952 55 MHz**	**1.78 dBm**	ndB	20.0 dB
T1		1	914.826 67 MHz	-18.24 dBm	ndB down BW	**143.06 kHz**
T2		1	914.969 73 MHz	-18.30 dBm	Q Factor	6 395.7

There is no bandwidth limit according to FCC Part15C, Section 15.247(a).

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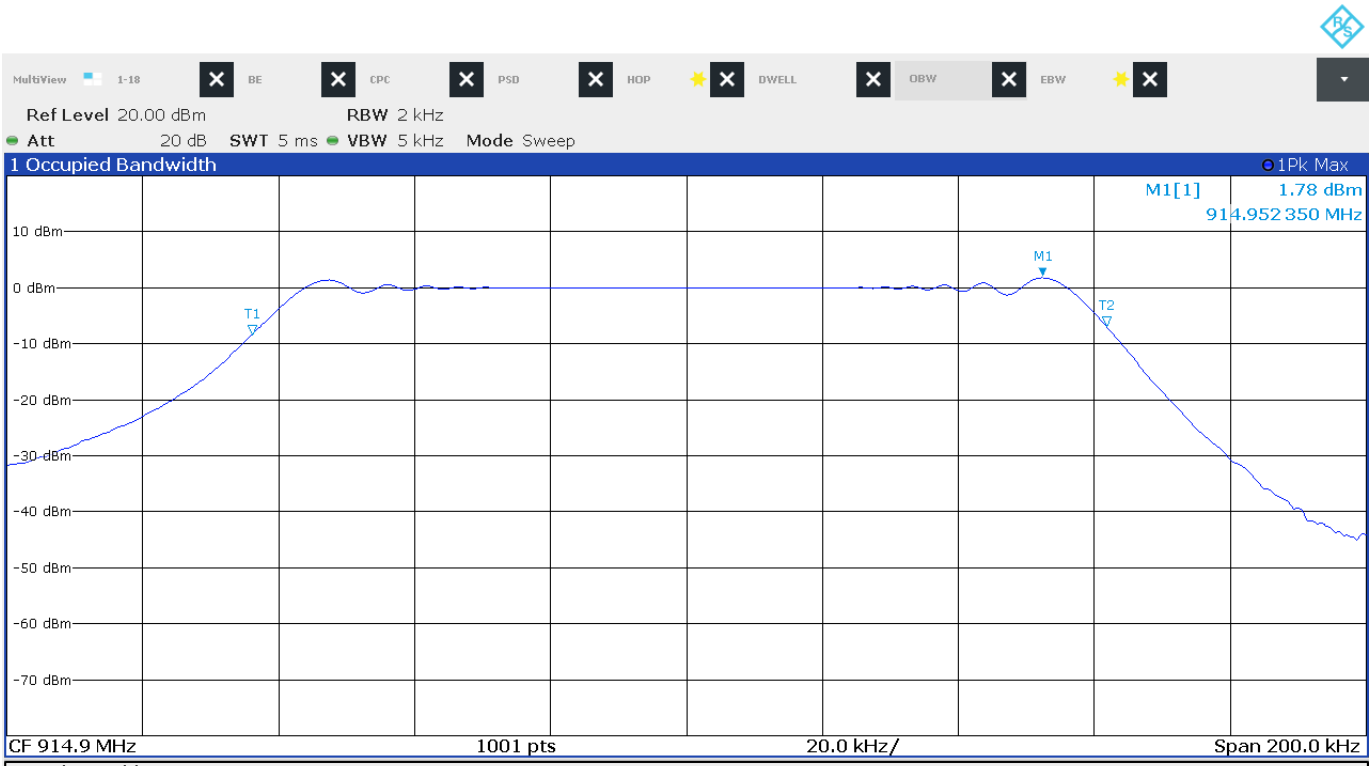
OBW99:

Channels 125 kHz Bandwidth, Data rate 0:

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**



Bandwidth limit 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.

The requirements are **FULFILLED.**

Remarks: -

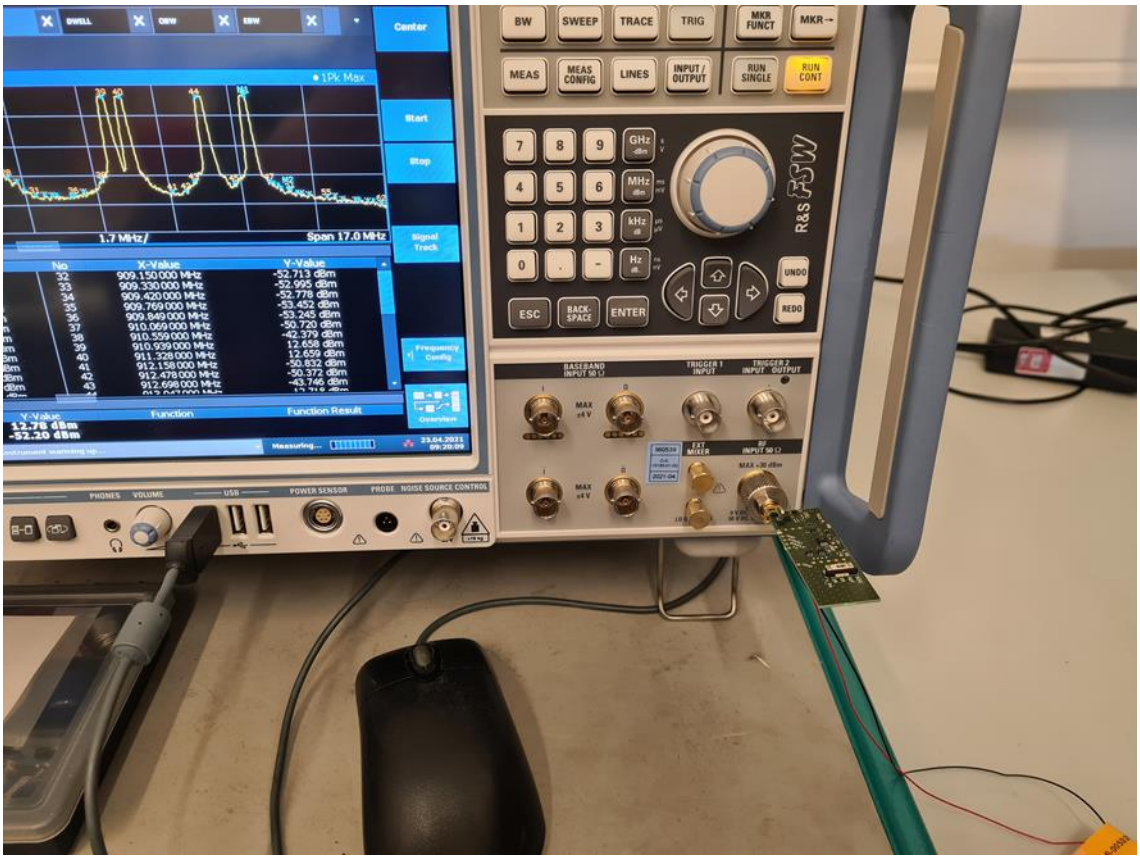
5.3 Maximum peak output power conducted

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

5.3.1 Description of the test location

Test location: Shielded Room S6

5.3.2 Photo documentation of the test set-up



5.3.3 Applicable standard

According to FCC Part 15C, Section 15.247(b)(2):
For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

5.3.4 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT is operating in transmit mode using the assigned frequency according to ANSI C63.10, 7.8.5.

Analyser settings:
RBW: 3 MHz, VBW ≥ RBW, Detector: Max peak, Trace: Max hold, Sweep time: auto

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5.3.5 Test result

Channels 125 kHz Bandwidth, P14, Data rate 0:

Channel	f	A	Limit	Delta
	(MHz)	(dBm)	(dBm)	(dB)
CH0	902.3	11.6	30	-18.4
CH32	908.7	11.4	30	-18.6
CH63	914.9	11.4	30	-18.6

Peak Power Limit according to FCC Part 15C, Section 15.247(b)(2):

Frequency	Peak power limit	
(MHz)	(dBm)	(Watt)
902 - 928	30	1

The requirements are **FULFILLED.**

Remarks: _____

_____

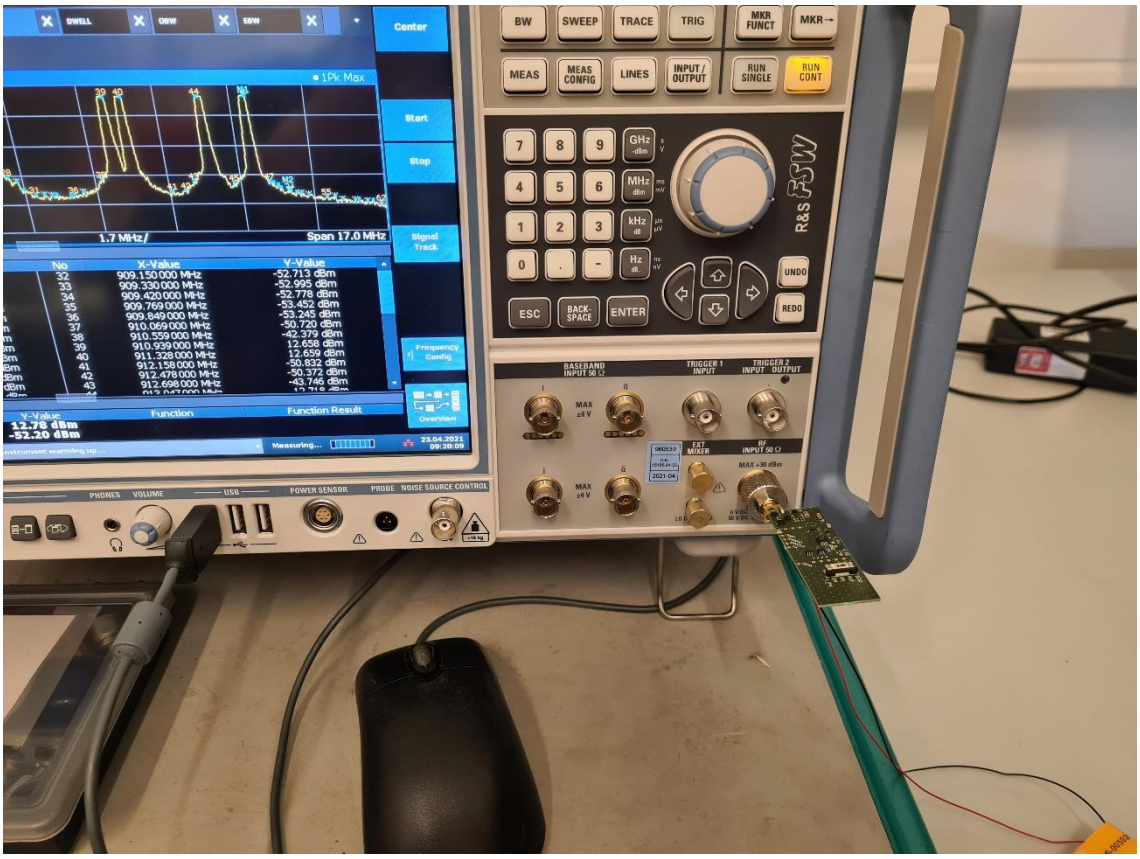
5.4 Power spectral density

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

5.4.1 Description of the test location

Test location: Shielded Room S6

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 set out in 11.10 of ANSI C63.10. The power measurement was done as peak power measurement. Therefore, the PKPSD is measured. 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: auto

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5.4.5 Test result

Channels 125 kHz Bandwidth, P14, Data rate 0:

Channel	f	PSD	Limit	Delta
	(MHz)	(dBm/3kHz)	(dBm/3kHz)	(dB)
CH0	902.3	5.3	8.0	-2.7
CH32	908.7	5.1	8.0	-2.9
CH63	914.9	5.0	8.0	-3.0

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

Frequency (MHz)	Power spectral density limit (dBm/3 kHz)
902 - 928	8

The requirements are **FULFILLED.**

Remarks: -

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

5.5 Spurious emissions

For test instruments and accessories used see section 6 Part **SEC2 and SEC3**.

5.5.1 Description of the test location

Test location: Shielded Room S6

5.5.2 Applicable standard

According to FCC Part 15C, Section 15.247(d):
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

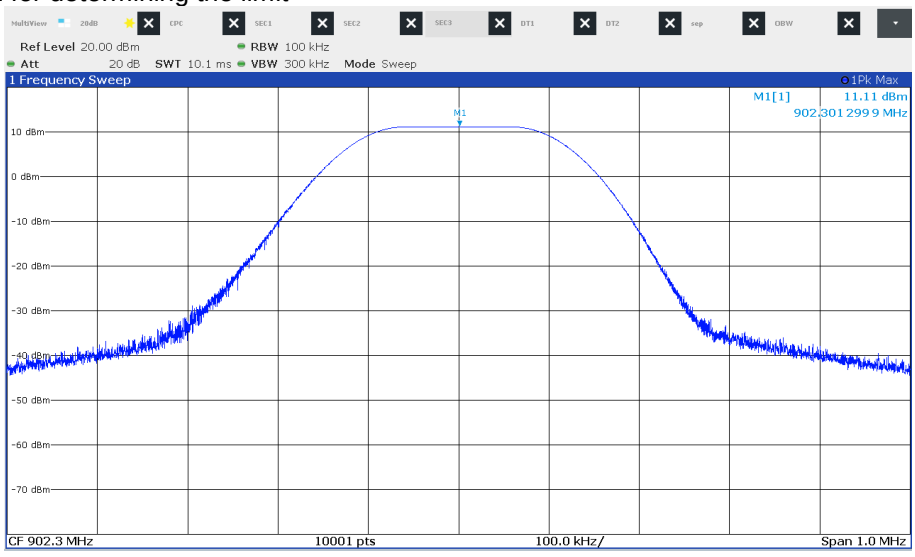
5.5.3 Description of measurement

The spurious emissions are measured conducted using a spectrum analyser in a test setup following the procedures set out in ANSI C64.10, item 7.8.8. The measurement is performed at normal test conditions in modulated TX continuous mode.

Spectrum analyser search setting:
RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Trace Mode: Max hold, Sweep time: 1 s

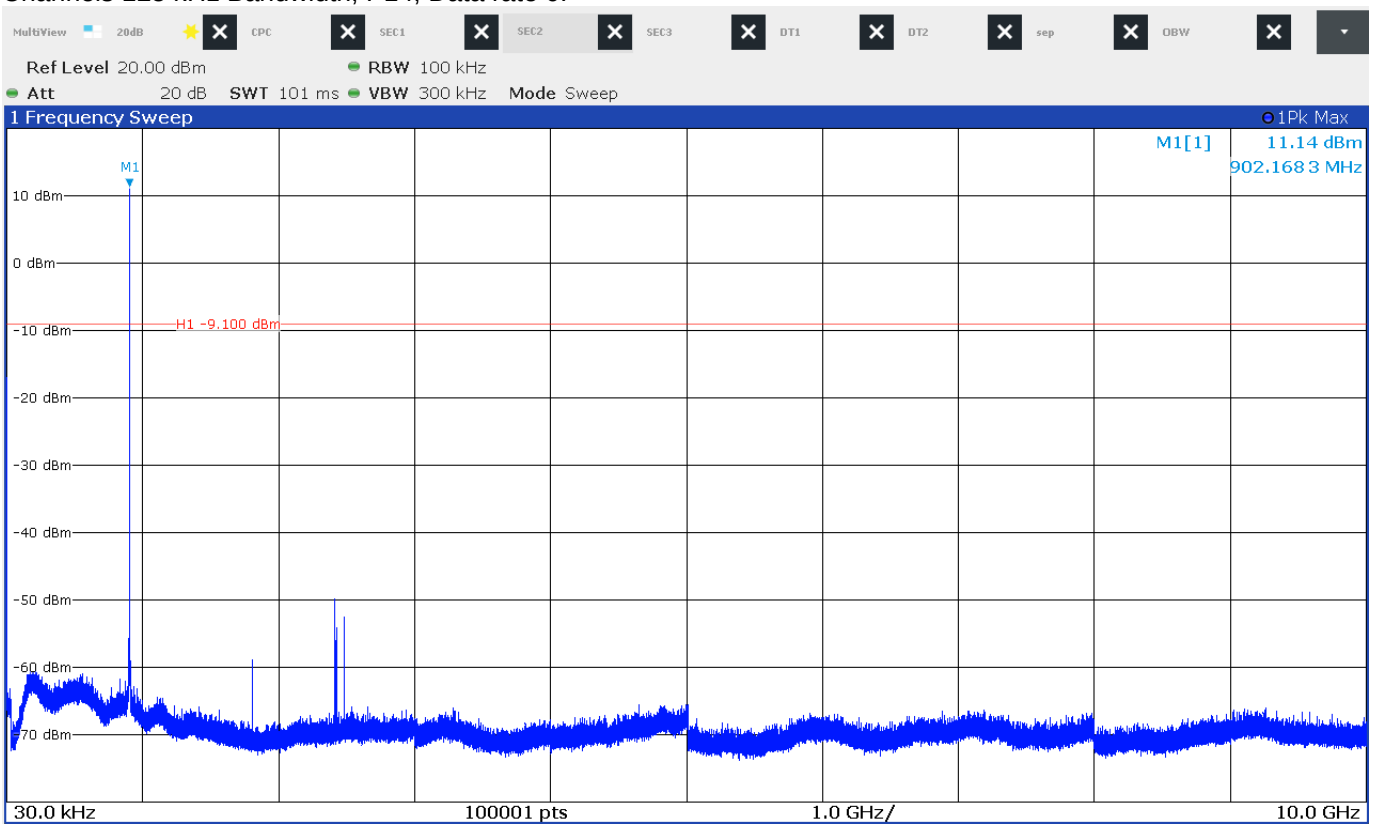
5.5.4 Test result

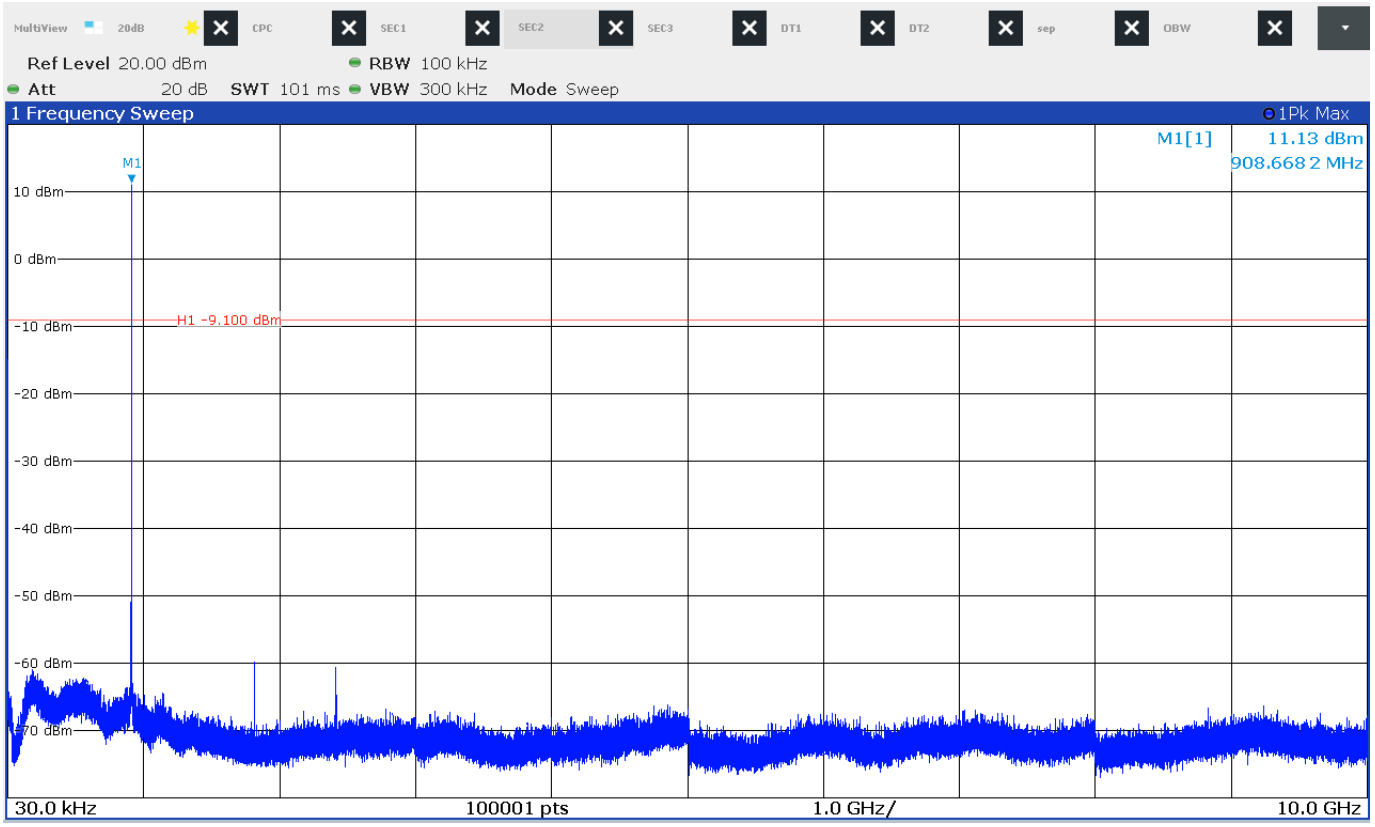
Reference Channel for determining the limit



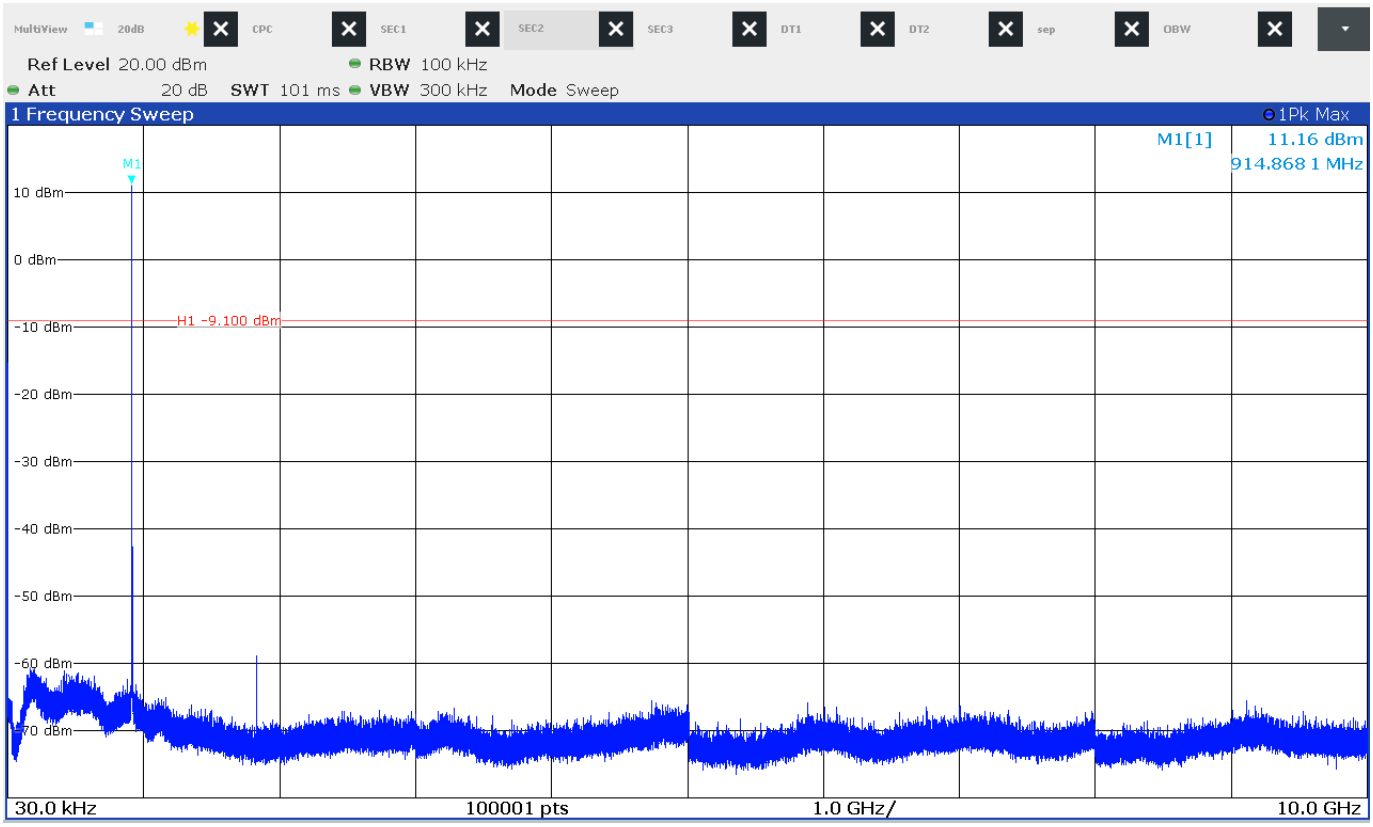
FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

Channels 125 kHz Bandwidth, P14, Data rate 0:





FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**



Limit according to FCC Part 15, Section 15.247(d):
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, 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, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in Section 15.209(a) is not required.

Frequency (MHz)	Spurious emission limit
Below 960	20 dB below the highest level of the desired power
Above 960	20 dB below the highest level of the desired power

The requirements are **FULFILLED.**

Remarks: _____

_____

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

5.6 Band edge compliance

For test instruments and accessories used see section 6 Part **SEC2**.

5.6.1 Description of the test location

Test location: Shielded Room S6

5.6.2 Applicable standard

According to FCC Part 15C, Section 15.247(d):
In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

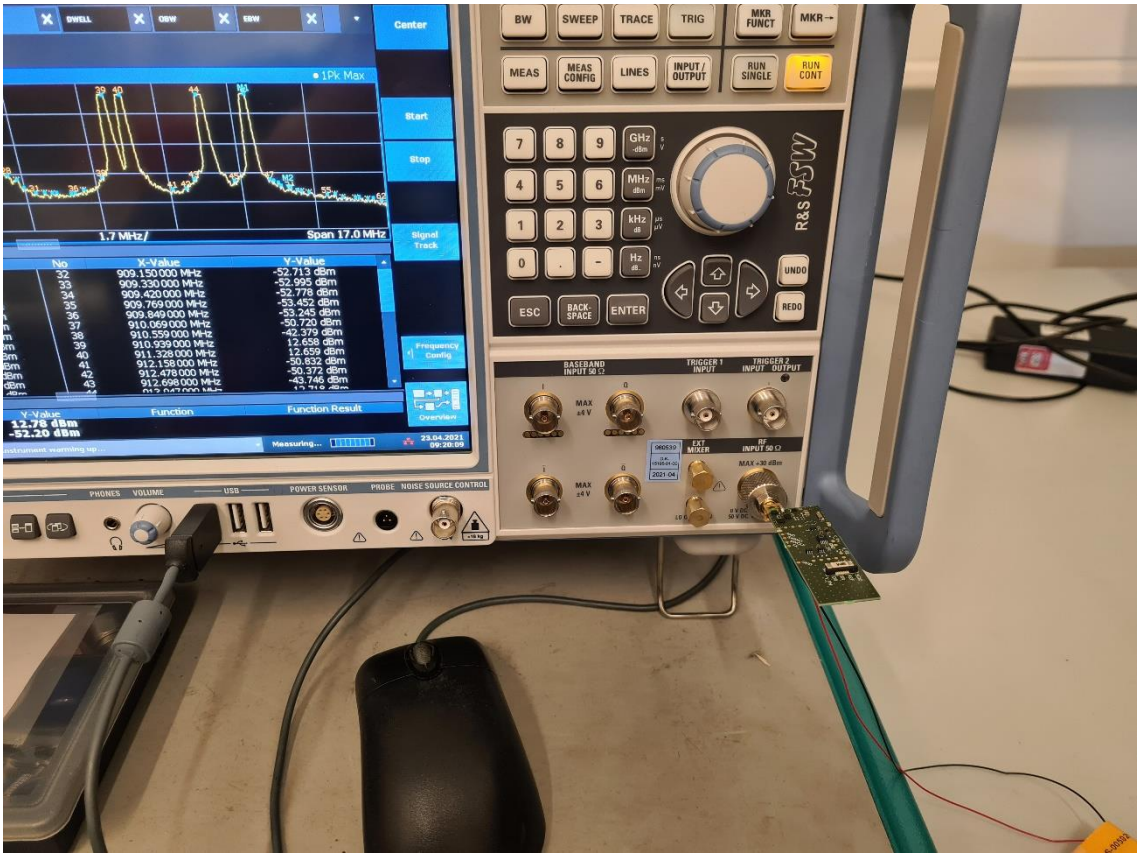
ANSI C63.10, 7.8.6: For band-edge measurements, use the band-edge procedure in 6.10. Band-edge measurements shall be tested both on single channels, and with the EUT hopping.

5.6.3 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode at the assigned frequency according ANSI C63.10, 6.10.

Spectrum analyser settings:
RBW: 100 kHz, VBW: 300 kHz, Detector: RMS, Trace: Max hold, Sweep: auto

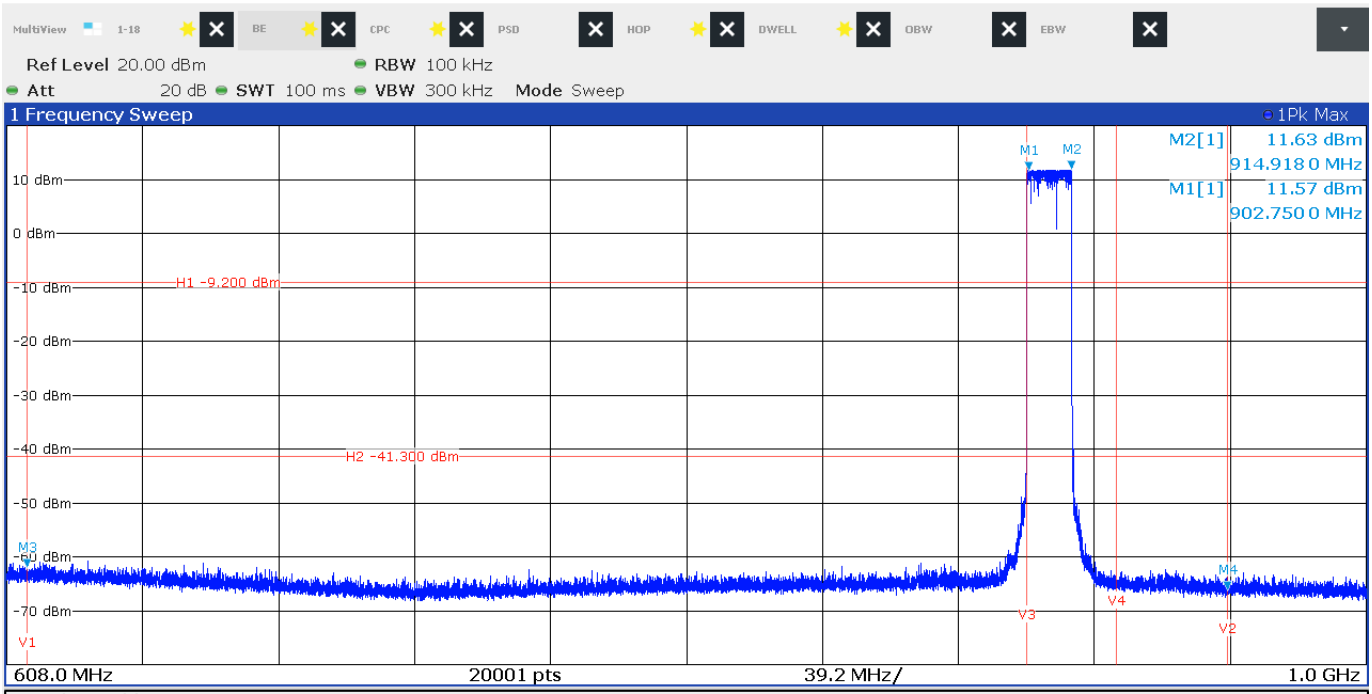
5.6.4 Photo documentation of the test set-up



FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

5.6.5 Test result

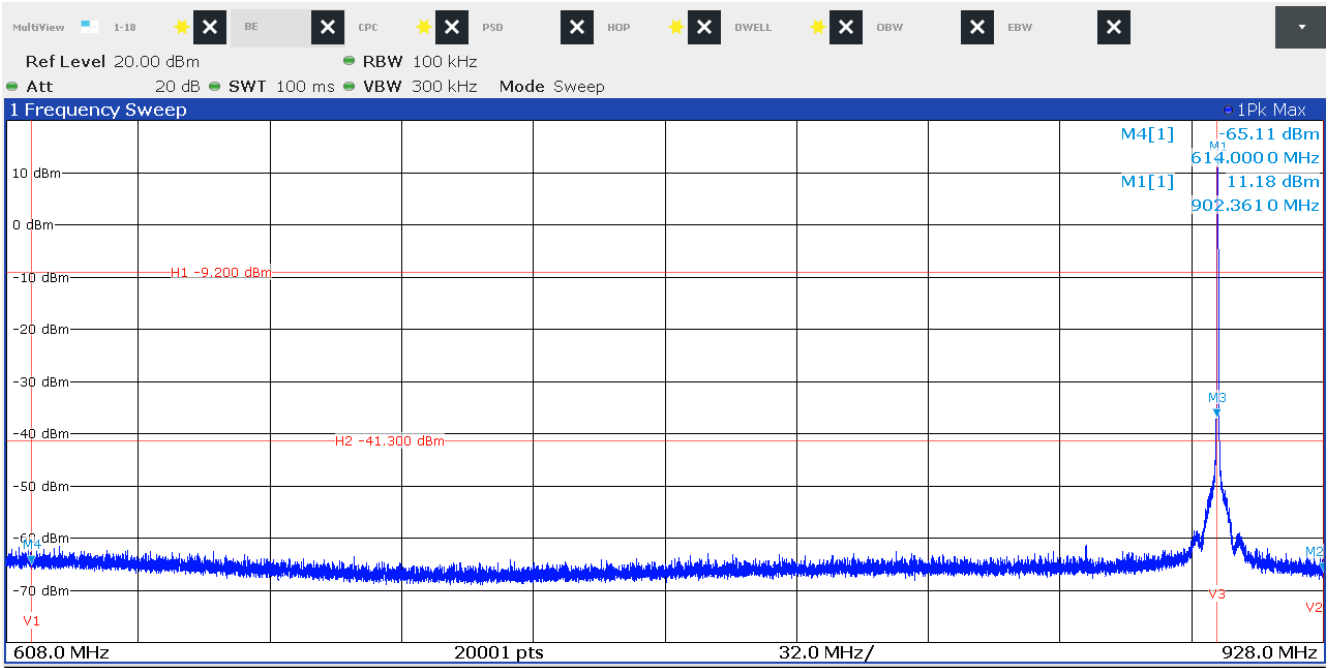
Channels 125 kHz Bandwidth:
Hopping:



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**902.75 MHz**	**11.57 dBm**		
M2		1	**914.918 MHz**	**11.63 dBm**		
M3		1	**614.0 MHz**	**-62.26 dBm**		
M4		1	**960.0 MHz**	**-66.34 dBm**		

Channels 125 kHz Bandwidth:
CH0

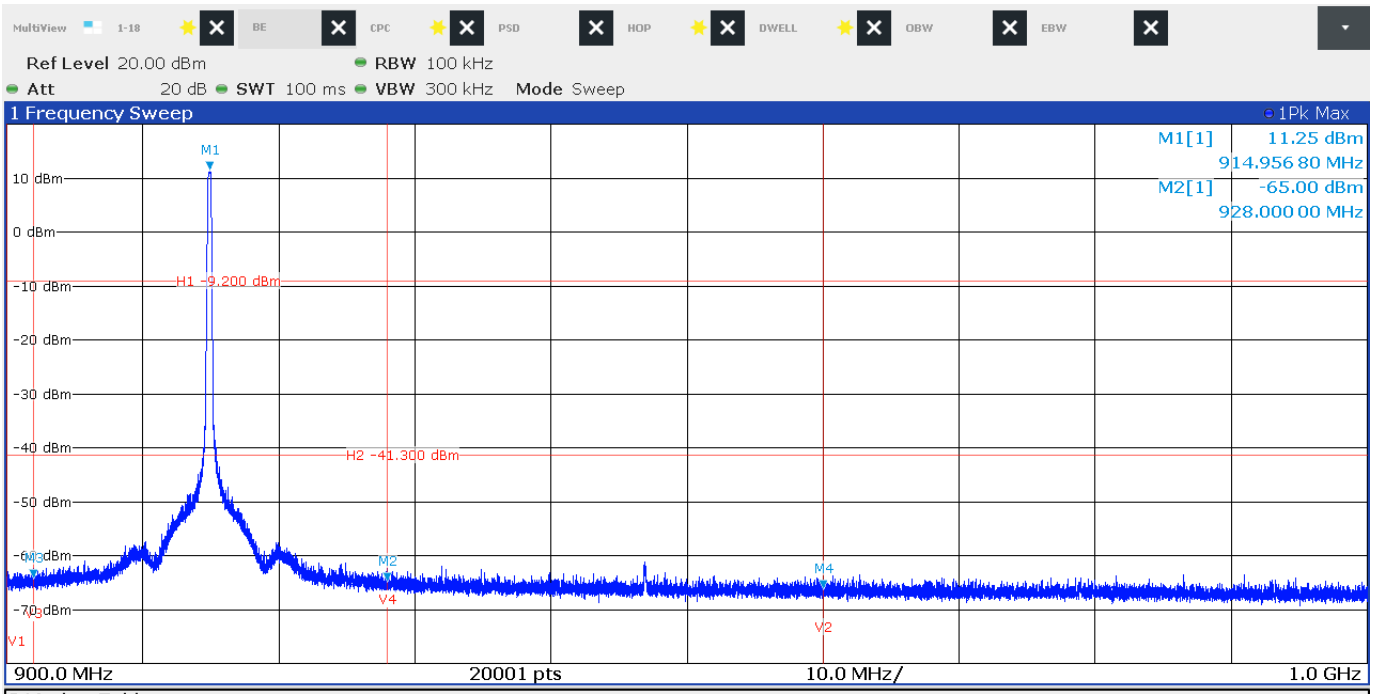


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**902.361 MHz**	**11.18 dBm**		
M2		1	**928.0 MHz**	**-66.63 dBm**		
M3		1	**902.0 MHz**	**-37.03 dBm**		
M4		1	**614.0 MHz**	**-65.11 dBm**		

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

CH63



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**914.956 8 MHz**	**11.25 dBm**		
M2		1	**928.0 MHz**	**-65.00 dBm**		
M3		1	**902.0 MHz**	**-64.26 dBm**		
M4		1	**960.0 MHz**	**-66.35 dBm**		

The requirements are **FULFILLED.**

Remarks: -

5.7 Radiated emissions in restricted bands

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

5.7.1 Description of the test location

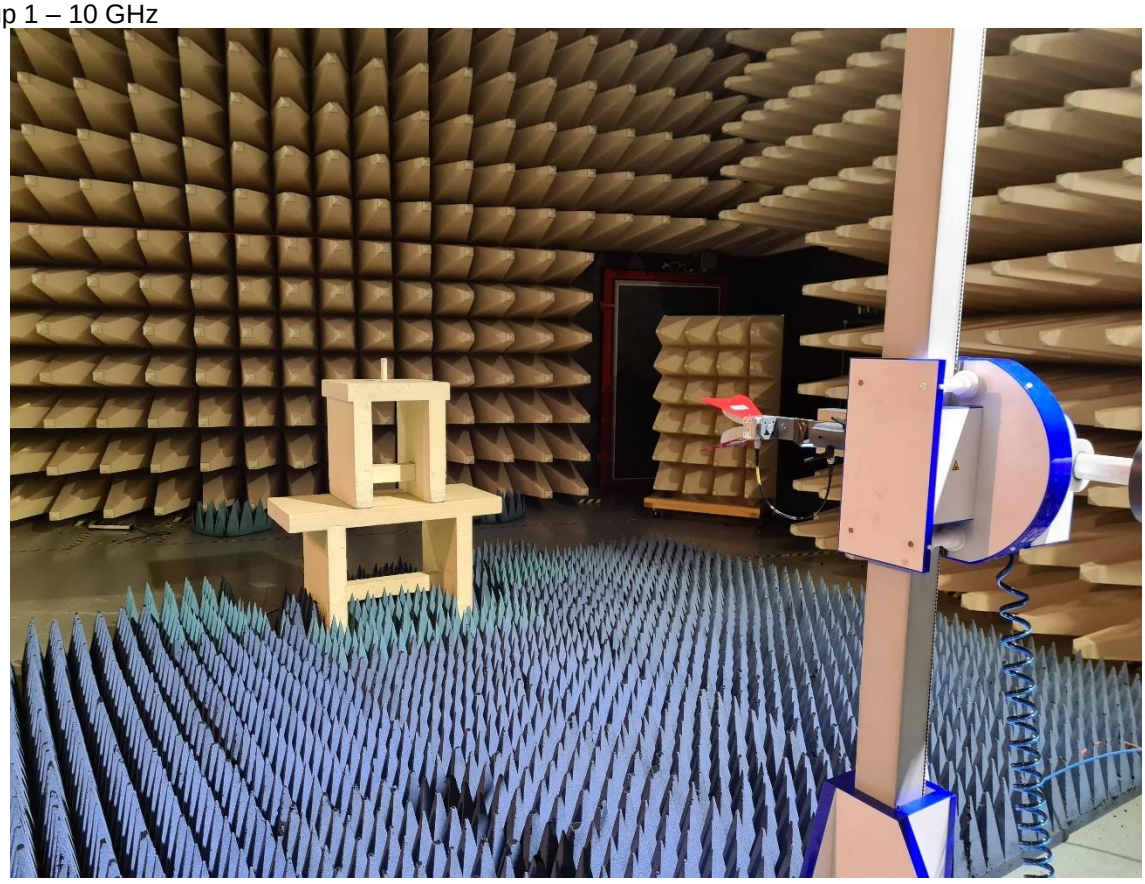
Test location: OATS 1
Test distance: 3 m

Test location: Anechoic chamber 1
Test distance: 3 m

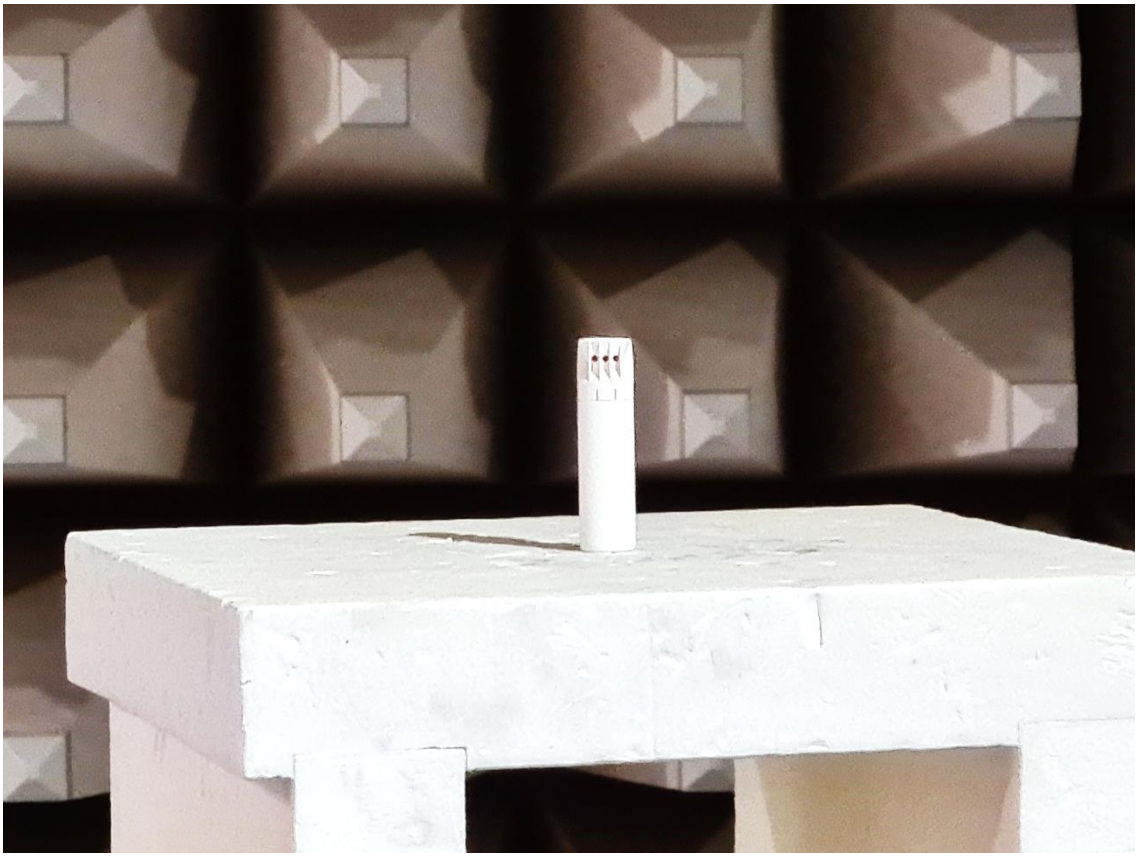
5.7.2 Photo documentation of the test set-up

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

Test setup 1 – 10 GHz



FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**



5.7.3 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).

5.7.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser was set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.

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

5.7.5 Test result

f < 1000 MHz
Hopping channels

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
42.50	7.4	-2.2	14.5	15.3	21.9	13.1	40.0	-18.1
852.80	5.4	4.0	29.2	29.6	34.6	33.6	46.0	-11.4
868.60	0.9	-0.5	29.4	29.8	30.3	29.3	46.0	-15.7
881.00	0.8	2.1	29.6	30.0	30.4	32.1	46.0	-13.9
943.00	1.5	0.7	30.3	30.7	31.8	31.4	46.0	-14.2

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

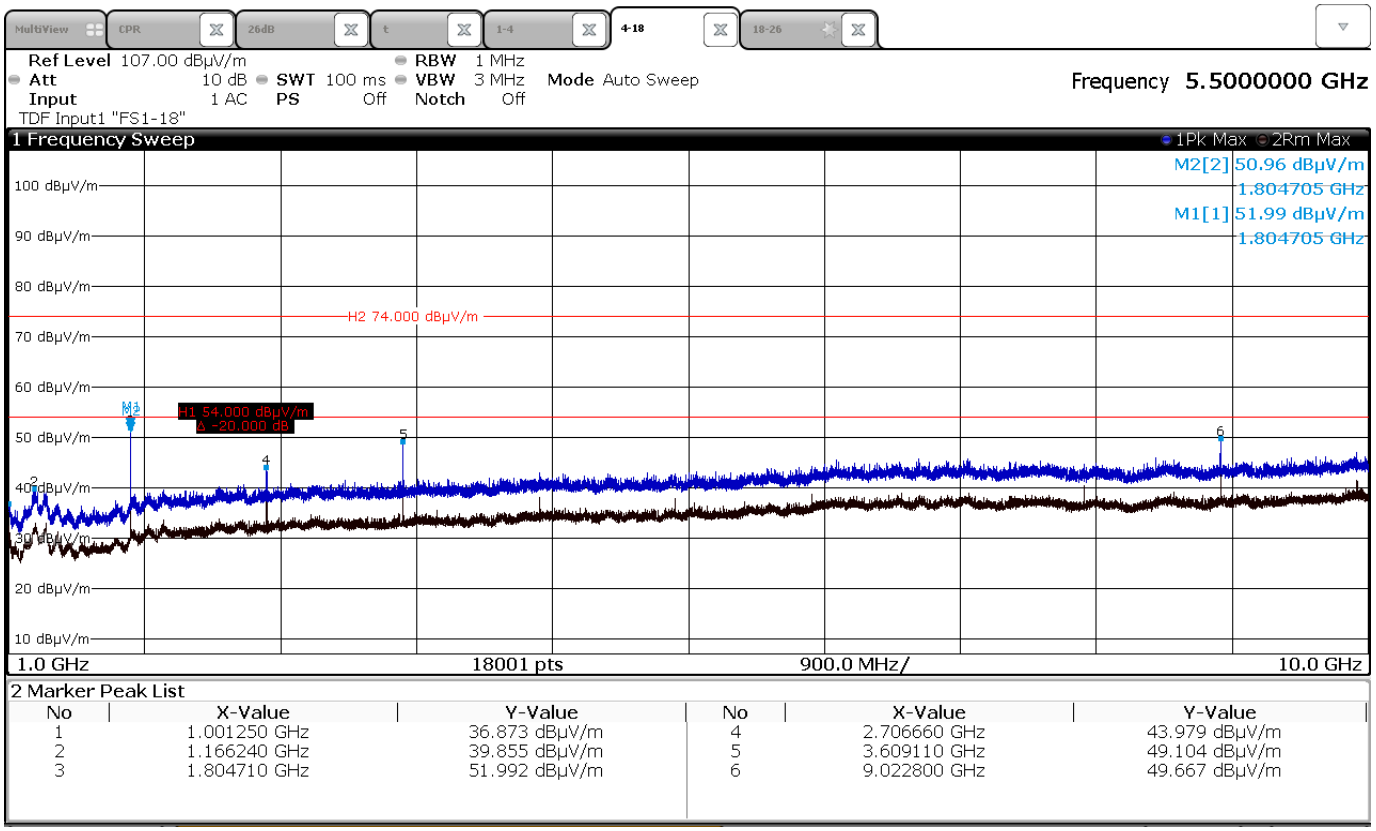
Non hopping channels

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
43.20	6.6	0.5	14.6	15.4	21.2	15.9	40.0	-18.8
70.90	2.3	-0.8	12.6	13.1	14.9	12.3	40.0	-25.1
766.00	-0.6	1.7	27.9	28.3	27.3	30.0	46.0	-16.0
943.00	1.7	0.8	30.3	30.7	32.0	31.5	46.0	-14.0
963.00	0.3	-1.5	30.5	30.9	30.8	29.4	54.0	-23.2

f > 1000 MHz

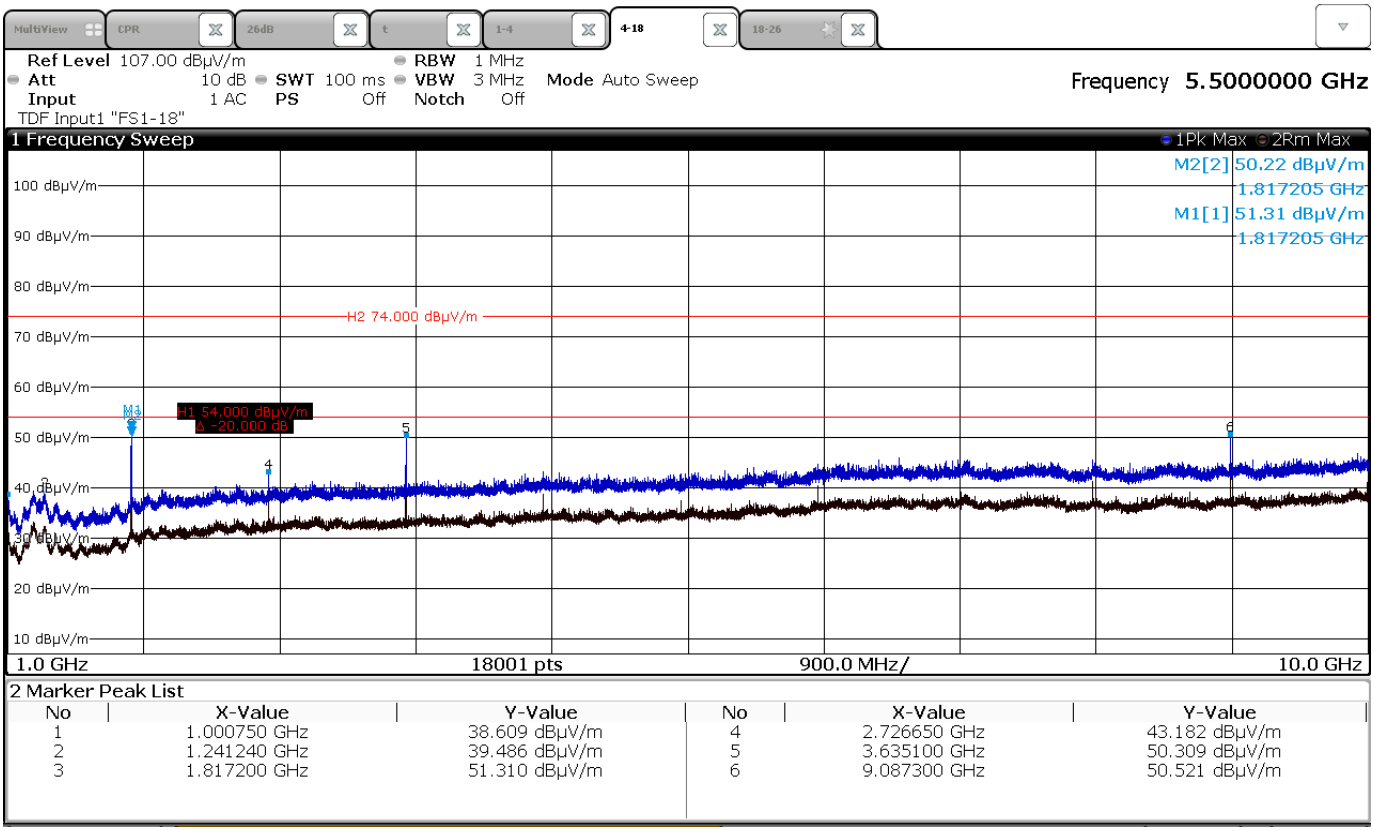
5.7.5.1 Channels 125 kHz Bandwidth, P 14dBm, Data rate 0 :

CH0



FCC ID: OHCSXPAMP1 IC: 10671A-SXPAMP1

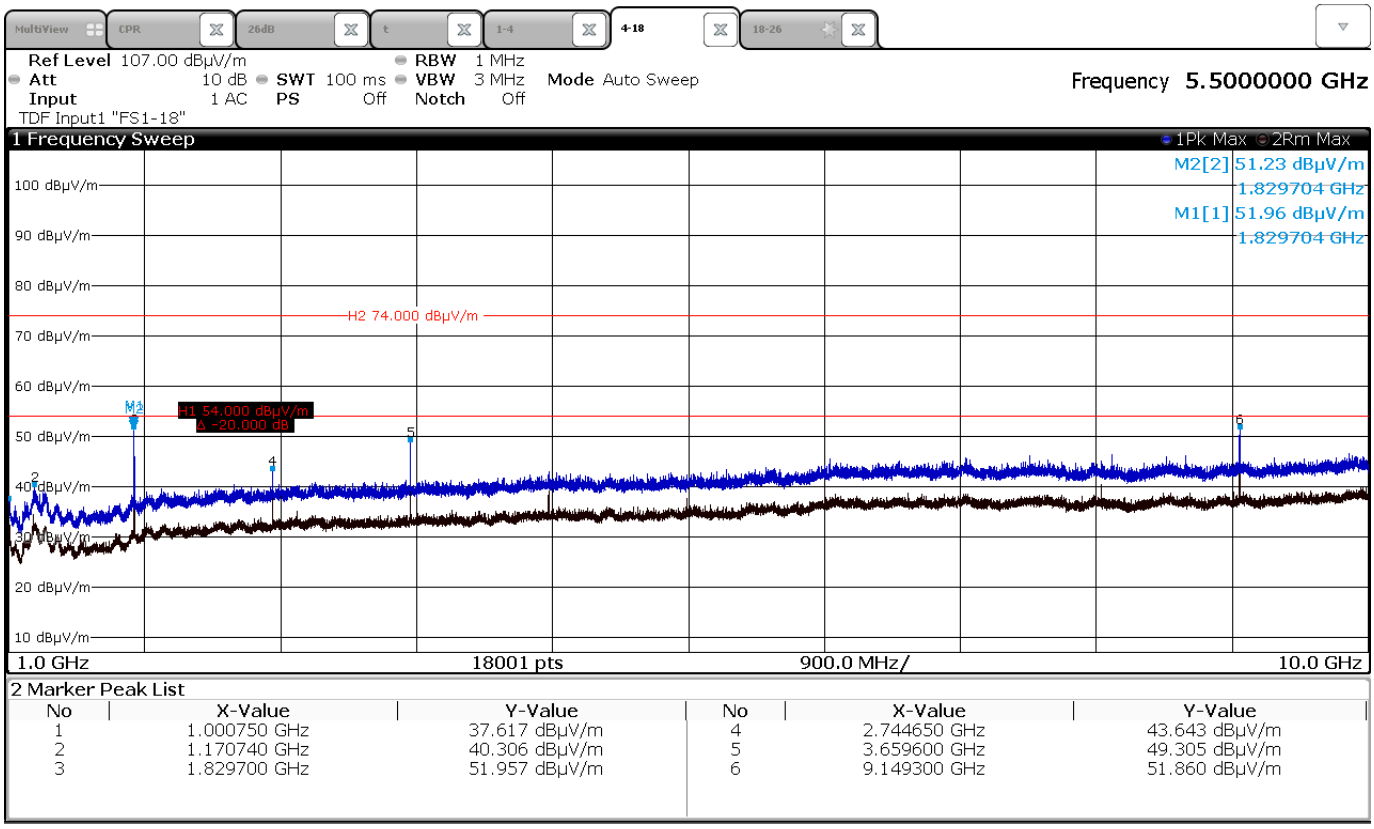
CH32



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.000750 GHz	38.609 dBµV/m	4	2.726650 GHz	43.182 dBµV/m
2	1.241240 GHz	39.486 dBµV/m	5	3.635100 GHz	50.309 dBµV/m
3	1.817200 GHz	51.310 dBµV/m	6	9.087300 GHz	50.521 dBµV/m

CH63



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.000750 GHz	37.617 dBµV/m	4	2.744650 GHz	43.643 dBµV/m
2	1.170740 GHz	40.306 dBµV/m	5	3.659600 GHz	49.305 dBµV/m
3	1.829700 GHz	51.957 dBµV/m	6	9.149300 GHz	51.860 dBµV/m

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

Peak-Limit according to FCC Part 15C, 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).

Frequency	Limits acc. 15.209		Measurement distance
(MHz)	PK dB(µV/m)	AV dB(µV/m)	(m)
Above 960	74	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

RSS-Gen, Table 6 – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 – 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 – 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	

The requirements are **FULFILLED.**

Remarks: Only the worst-case plots are listed.

5.8 Dwell time

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

5.8.1 Description of the test location

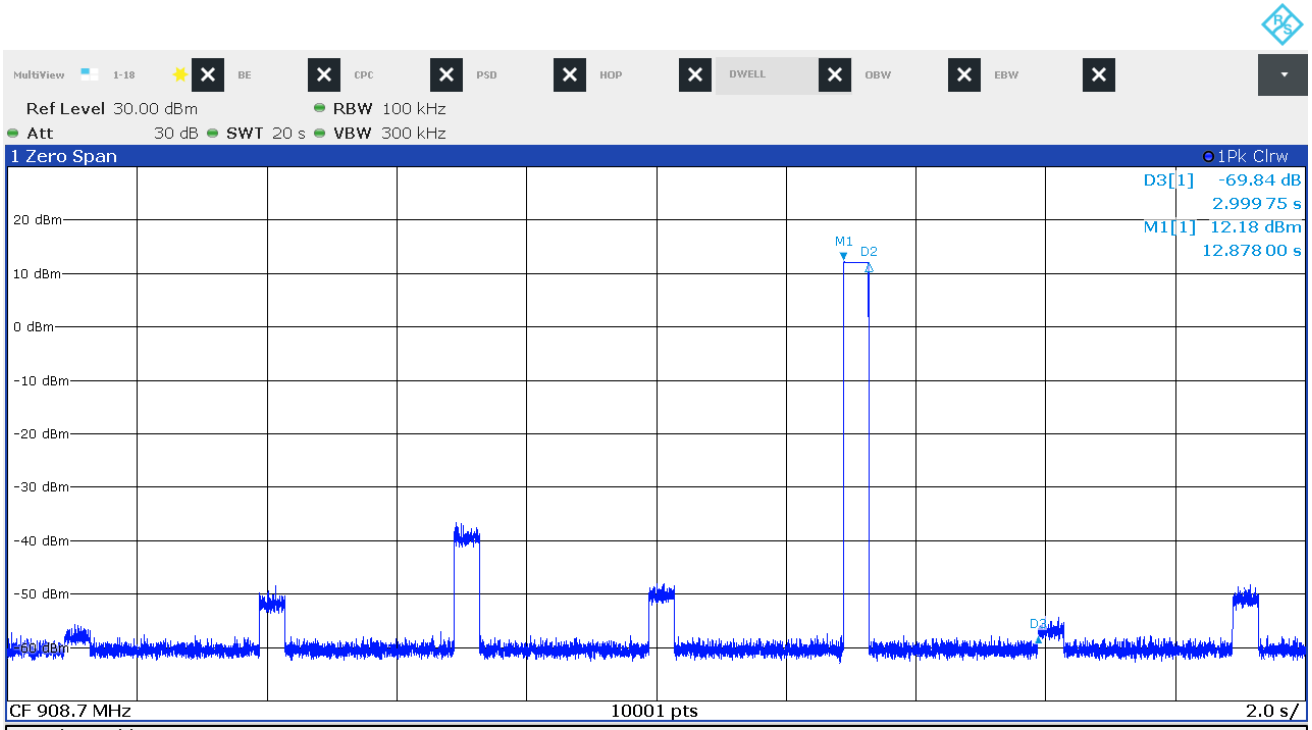
Test location: Shielded Room S6

5.8.1 Applicable standard

According to FCC Part 15, Section 15.247(a):
In Section 15.247(a)(1)(i) are dwell times defined for the special frequency ranges should not exceed by a frequency hopping system.

5.8.2 Test result

Channel 32, 125 kHz Bandwidth, P14, Data rate 0:



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	12.878 s	12.18 dBm		
D2	M1	1	398.8 ms	-0.03 dB		
D3	M1	1	2.999 75 s	-69.84 dB		

Limit according to FCC Part 15C, Section 15.247(1)(i):
For frequency hopping systems operating in the 902-928 MHz band:
The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;

The requirements are **FULFILLED.**

Remarks: -

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

5.9 Number of hopping channels

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

5.9.1 Description of the test location

Test location: Shielded Room S6

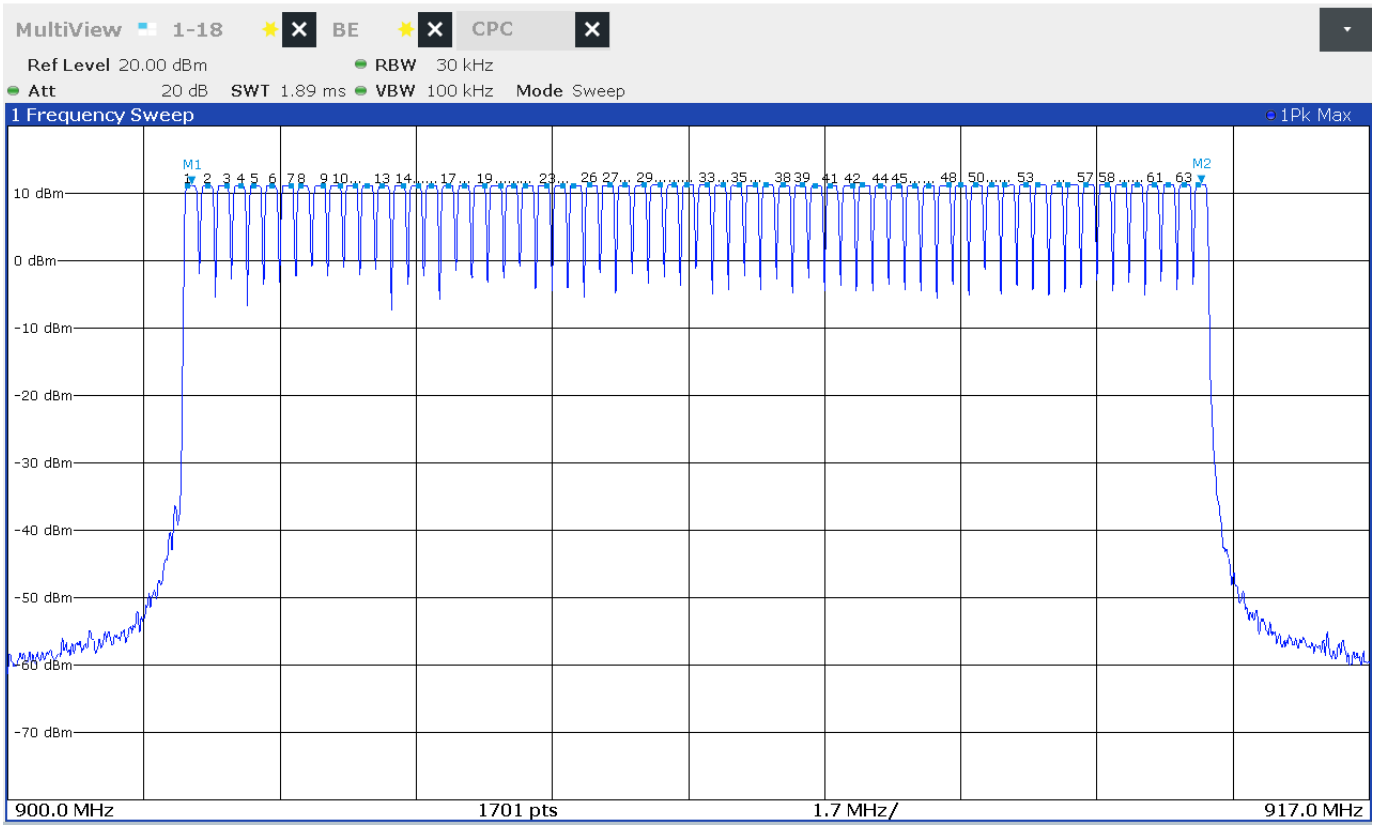
5.9.2 Applicable standard

According to FCC Part 15, Section 15.247(a)(1)(i):
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

5.9.3 Description of Measurement

The method of measurement is used set out in ANSI C63.10, 7.8.3.

5.9.4 Test result



Hopping channel frequency range	Number of all available hopping channels
902 - 928	64

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

Limit according to FCC Part 15C, Section 15.247(1)(i):

Frequency range (MHz)	LIMIT (Number of Hopping Channels)			
	20dB Bandwidth < 250kHz	20dB Bandwidth > 250kHz	20dB Bandwidth < 1 MHz	20dB Bandwidth > 1MHz
902 - 928	-	50	-	-

The requirements are **FULFILLED.**

Remarks: -

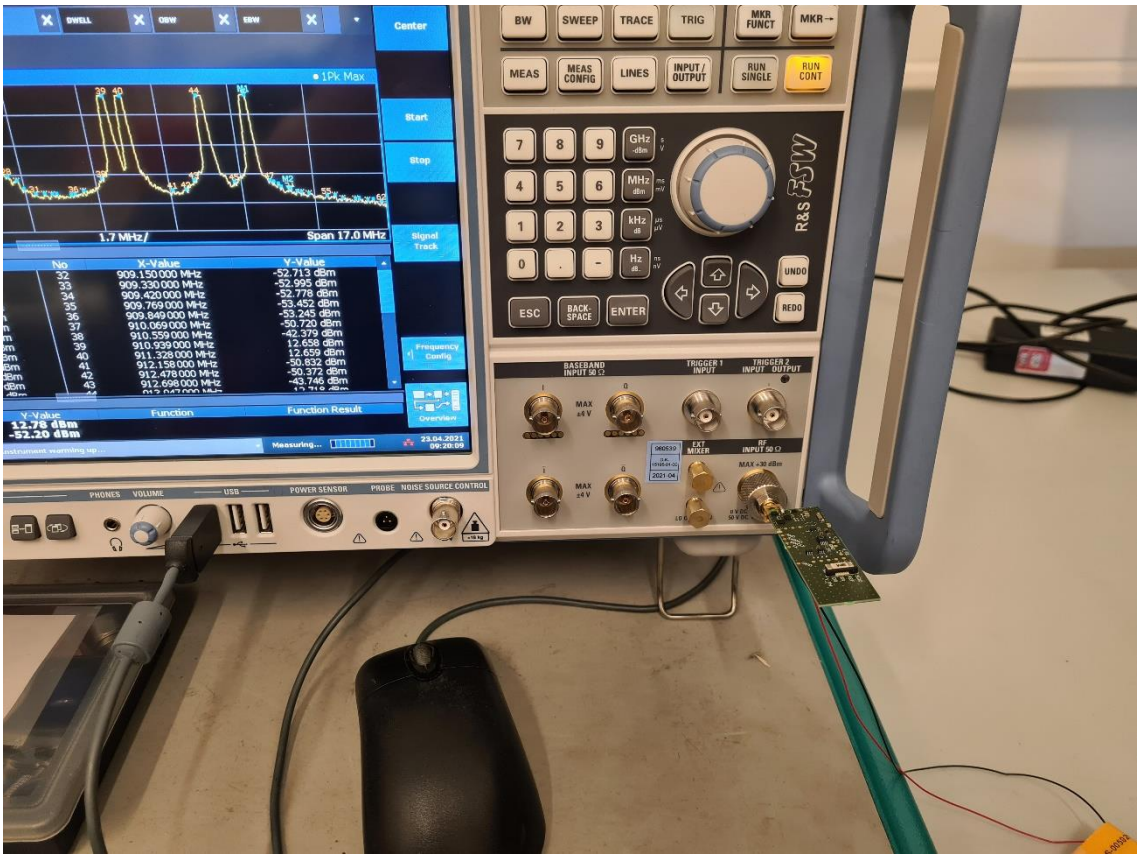
5.10 Carrier frequency separation

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

5.10.1 Description of the test location

Test location: Shielded Room S6

5.10.2 Photo documentation of the test set-up



FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

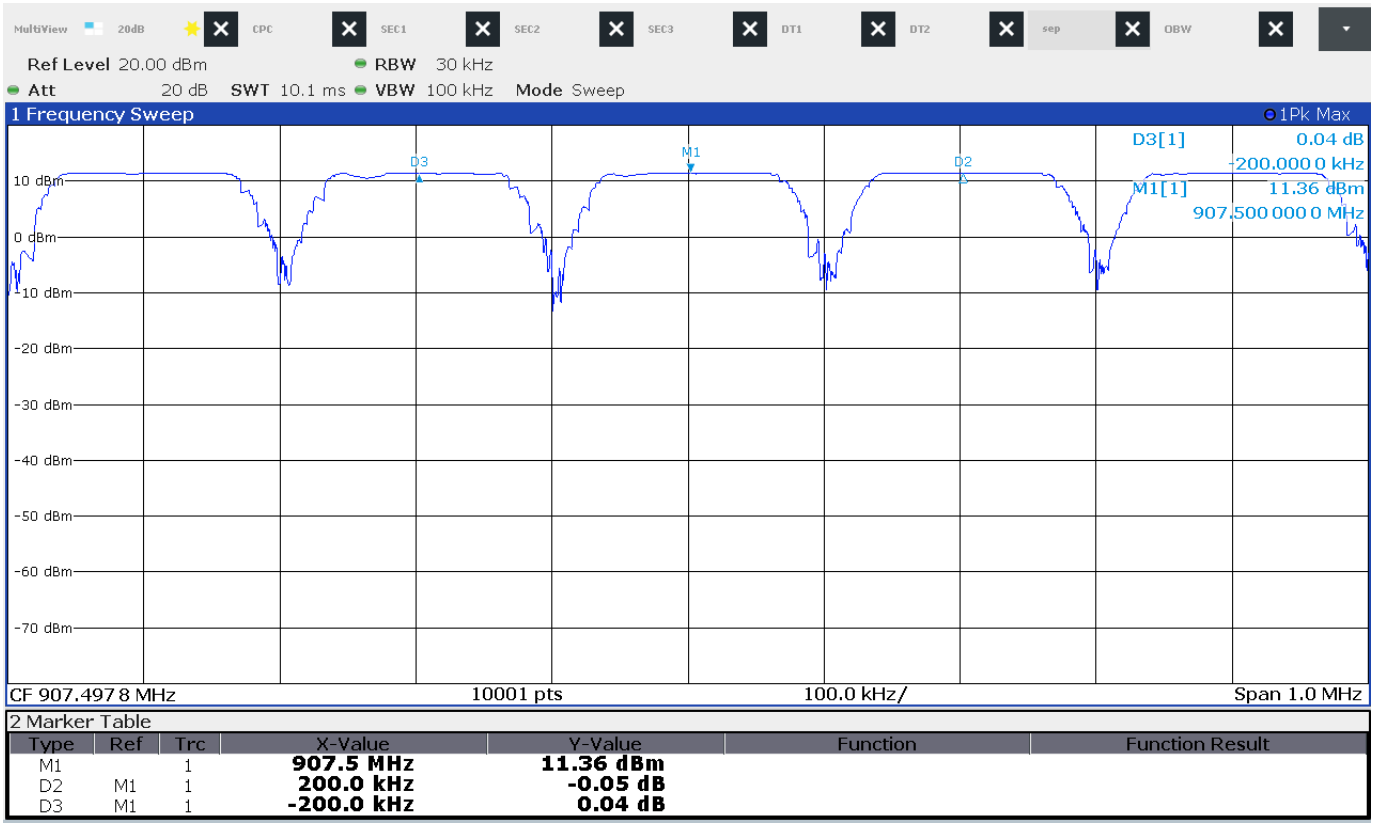
5.10.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(1):
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

5.10.4 Description of Measurement

The method of measurement is used set out in ANSI C63.10, 7.8.2.

5.10.5 Test result



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**907.5 MHz**	**11.36 dBm**		
D2	M1	1	**200.0 kHz**	**-0.05 dB**		
D3	M1	1	**-200.0 kHz**	**0.04 dB**		

Channel	Separation (kHz)
32	200

Limit according to FCC Part 15C, Section 15.247(a):

System	Limit channel separation
FHSS	> 25 kHz or 20 dB bandwidth, whichever is greater

The requirements are **FULFILLED.**

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

FCC ID: OHCSXPAMP1 **IC: 10671A-SXPAMP1**

5.11 Antenna application

5.11.1 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 PCB antenna; no replacing of the antenna is possible that prevents manipulation by a user. No external power amplifier can be connected. The requirements of part 15.203 and 15.204 are met.

5.11.2 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:

$$Pout = 30 – (Gx – 6);$$

Remarks: The anntenna is < 6 dBi gain, no Defacto limit results.

FCC ID: OHCSXPAMP1 IC: 10671A-SXPAMP1

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.
CPC 2	FSW43	02-02/11-21-001	08/04/2022	08/04/2021		
	HM 8143	02-02/50-10-016				
MB	FSW43	02-02/11-21-001	08/04/2022	08/04/2021		
	HM 8143	02-02/50-10-016				
SEC 2-3	FSW43	02-02/11-21-001	08/04/2022	08/04/2021		
	HM 8143	02-02/50-10-016				
SER 2	ESVS 30	02-02/03-05-006	15/07/2021	15/07/2020		
	VULB 9168	02-02/24-05-005	18/12/2021	18/12/2020		
	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	FSW43	02-02/11-21-001	08/04/2022	08/04/2021		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	18/06/2021	18/06/2020		
	WHJS 1000-10EF	02-02/50-13-003				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	BAT-EMC 3.19.1.24	02-02/68-13-001				