
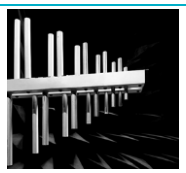
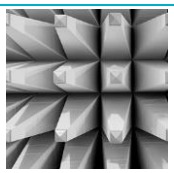

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-0796/20-01-02-A

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

Globtel Holding d.o.o.
Panonska 30
2000 Maribor / SLOVENIA
Phone:
Contact: Borut Štumberger
e-mail: borut.stumberger@air-tv.net
Phone: +386 2 620 2 000

Manufacturer

Globtel Holding d.o.o.
Panonska 30
2000 Maribor / SLOVENIA

Test standard/s

FCC - Title 47 CFR Part 15	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**AIR Base Station**
Model name:	**AIR GIGARAY 7080G BS**
FCC ID:	**2AWXTAIRGRMP70801**
Frequency:	57 – 71 GHz (EUT 70.66 – 70.88 GHz)
Antenna:	Sector horn antenna V and H polarization, ~19 dBi
Power supply:	48 V DC ±15%
Temperature range:	-30°C to +70°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

cn=Sebastian Janoschka, o=CTC advanced GmbH, ou=JKA-190527, email=sebastian.janoschka@ctcadvanced.com, c=DE
2020.11.27 13:08:08 +01'00'

Sebastian Janoschka
Lab Manager
Radio Communications & EMC

Test performed:

cn=Thomas Vogler, o=CTC advanced GmbH, ou=VOG-161125, email=thomas.vogler@ctcadvanced.com, c=DE
2020.11.27 13:01:39 +01'00'

Thomas Vogler
Lab Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report replaces the test report with the number 1-0796/20-01-02 and dated 2020-10-02.

2.2 Application details

Date of receipt of order:	2020-07-17
Date of receipt of test item:	2020-09-14
Start of test:	2020-09-14
End of test:	2020-09-24
Person(s) present during the test:	Mr. Iztok Kodrič (during set-up) Mr. Črtomir Potočnik (during set-up)

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

Guidance	Version	Description
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

Accreditation	Description	
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf	

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests +70 °C during high temperature tests -30 °C during low temperature tests
Relative humidity content	:		45 %
Barometric pressure	:		1006 hpa
Power supply	:	V_{nom}	48 V DC

5 Test item

5.1 General description

Kind of test item	:	AIR Base Station
Type identification	:	AIR GIGARAY 7080G BS
S/N serial number	:	MP35-0002
HW hardware status	:	1.0
SW software status	:	1.0
Frequency band TX	:	57 – 71 GHz (EUT 70.66 – 70.88 GHz)
Frequency band RX	:	81 – 83 GHz
Type of radio transmission Use of frequency spectrum	: :	OFDM
Type of modulation	:	512QAM
Number of channels	:	1
Conducted output power	:	20 dBm (avg.)
Antenna	:	Sector horn antenna V and H polarization, ~19 dBi
Power supply	:	48 V DC ±15%
Temperature range	:	-30°C to +70°C

5.2 Additional information

The tested DUT is only a transceiver/booster. The modulation is usually done in an external device (CMTS-Cable Modem Termination System). For testing the DUT a DOCSIS generator was used to generate modulated signals as described by the applicant (OFDM with 512QAM at 1.2 GHz and 192 MHz bandwidth acc. to DOCSIS 3.1 protocol).

Due to limitations of the DOCSIS generator an input frequency of 1218 MHz was selected, which is converted to 70.782 GHz close to the upper edge of the frequency band defined by FCC 15.255.
It was levelled to the maximum input power level of the EUT of –5 dBm by using a power meter, with the expected output power of 15 - 20 dBm close to saturation. The EUT additionally required a 10 MHz reference combined to the RF signal at the input port of the EUT.

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-0796/20-01-01_AnnexA
1-0796/20-01-01_AnnexB
1-0796/20-01-01_AnnexC

6 Sequence of testing

6.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

*)Note: The sequence will be repeated three times with different EUT orientations.

6.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

6.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

6.4 Sequence of testing radiated spurious above 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

6.5 Sequence of testing radiated spurious above 50 GHz with external mixers

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate for far field (e.g. 0.25 m).
- The EUT is set into operation.

Premeasurement

- The test antenna with external mixer is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.
- Caution is taken to reduce the possible overloading of the external mixer.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- As external mixers may generate false images care is taken to ensure that any emission measured by the spectrum analyzer does indeed originate in the EUT. Signal identification feature of spectrum analyzer is used to eliminate false mixer images (i.e., it is not the fundamental emission or a harmonic falling precisely at the measured frequency).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

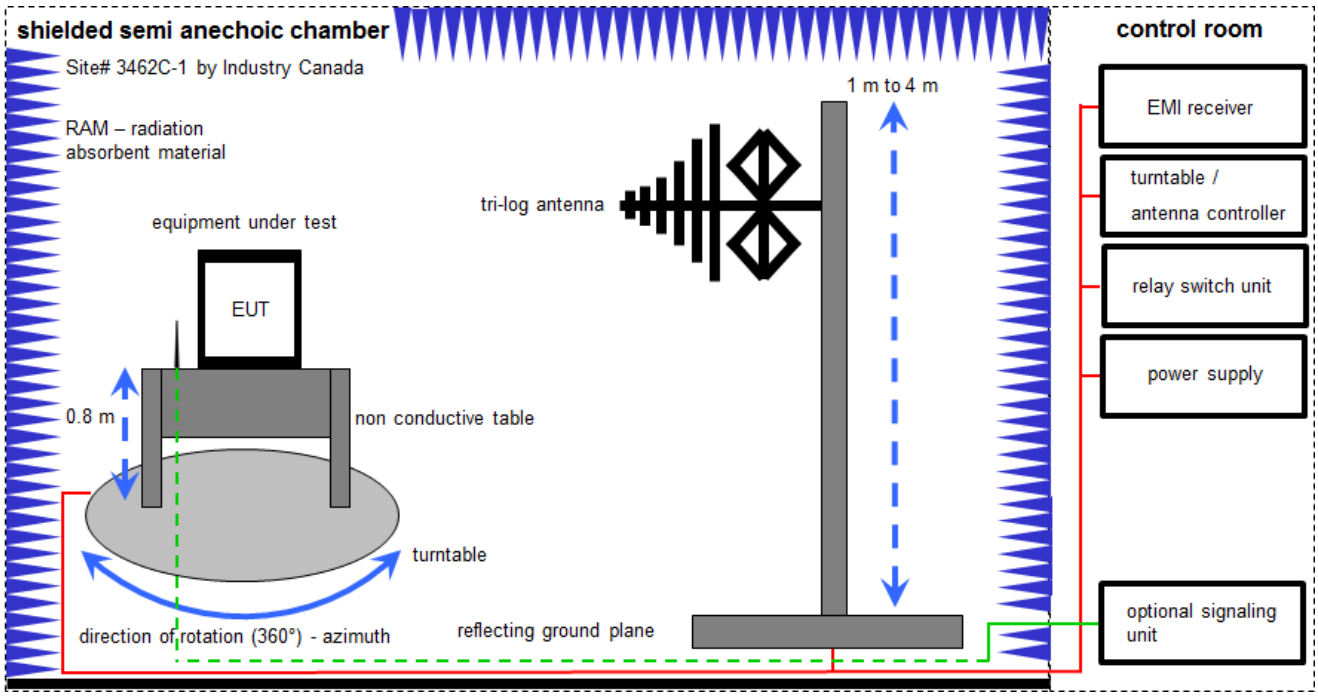
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.

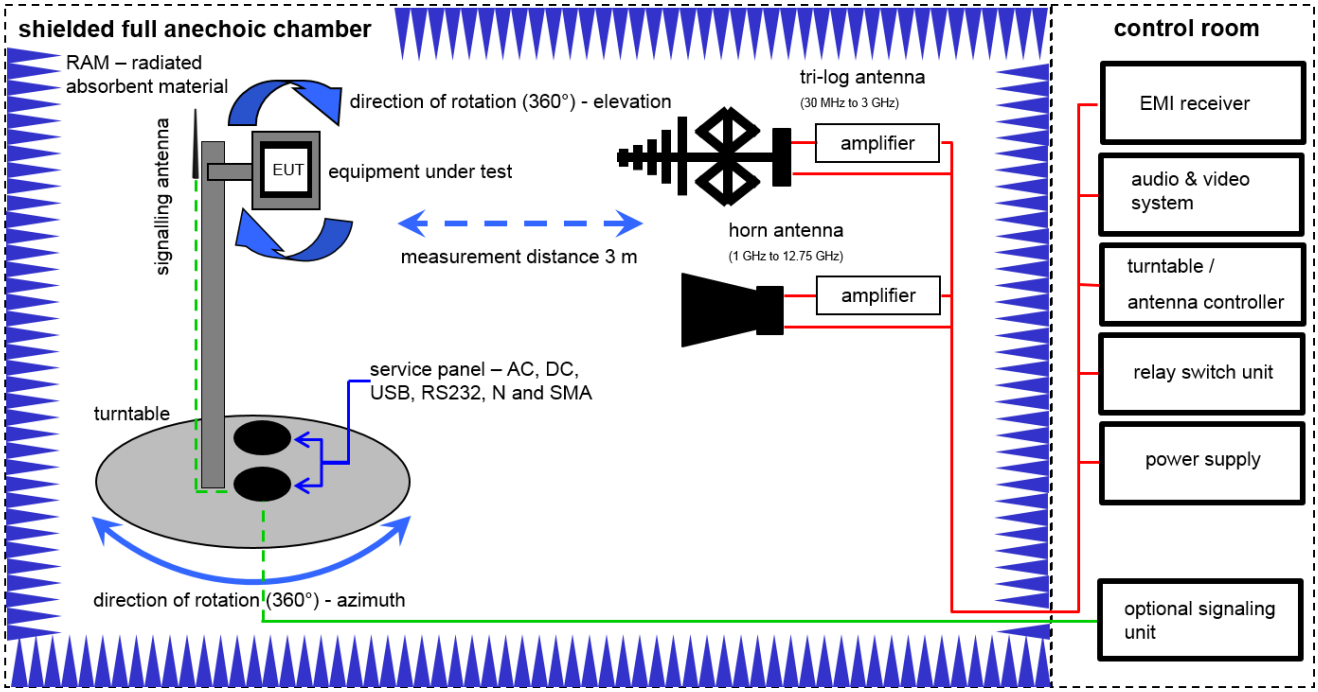


Measurement distance: tri-log antenna 10 meter

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	n. a.	Meßkabine 1	HF-Absorberhalle	MWB AG 300023		300000551	ne	-/-	-/-
4	n. a.	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	10.12.2019	09.12.2020
5	n. a.	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
6	n. a.	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
7	n. a.	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
8	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	371	300003854	vIKI!	14.01.2020	13.01.2023
9	n. a.	Spectrum-Analyzer	FSU26	R&S	200809	300003874	k	16.12.2019	15.12.2020
10	n. a.	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-

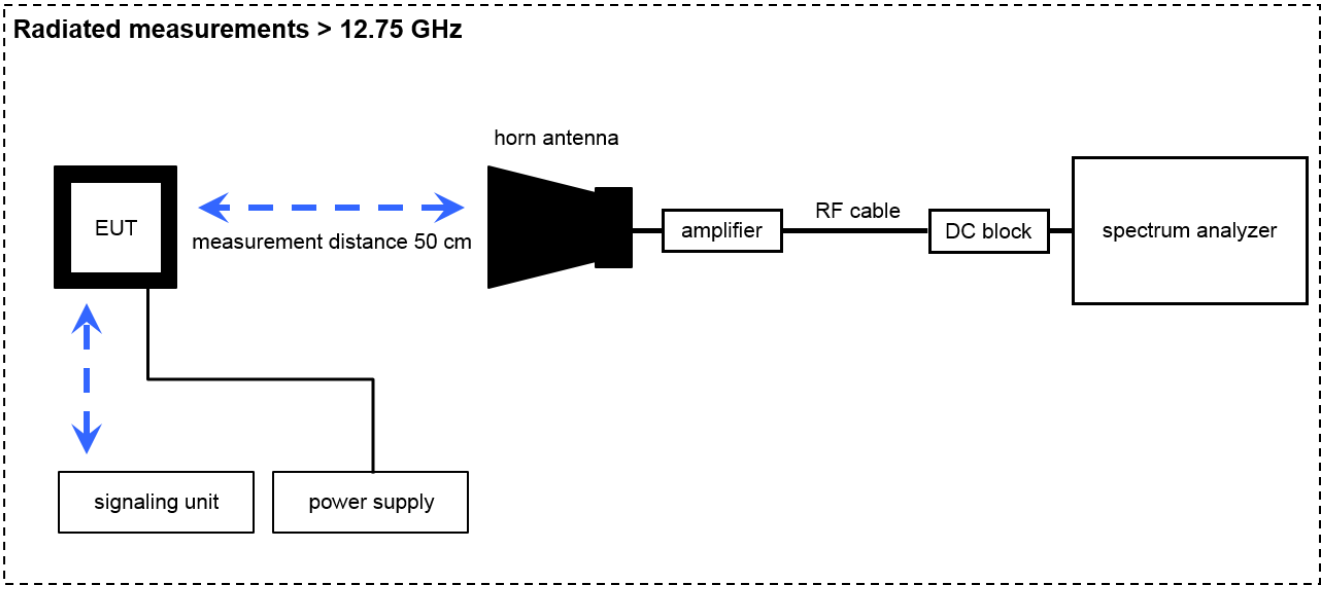
7.2 Radiated measurements fully anechoic chamber



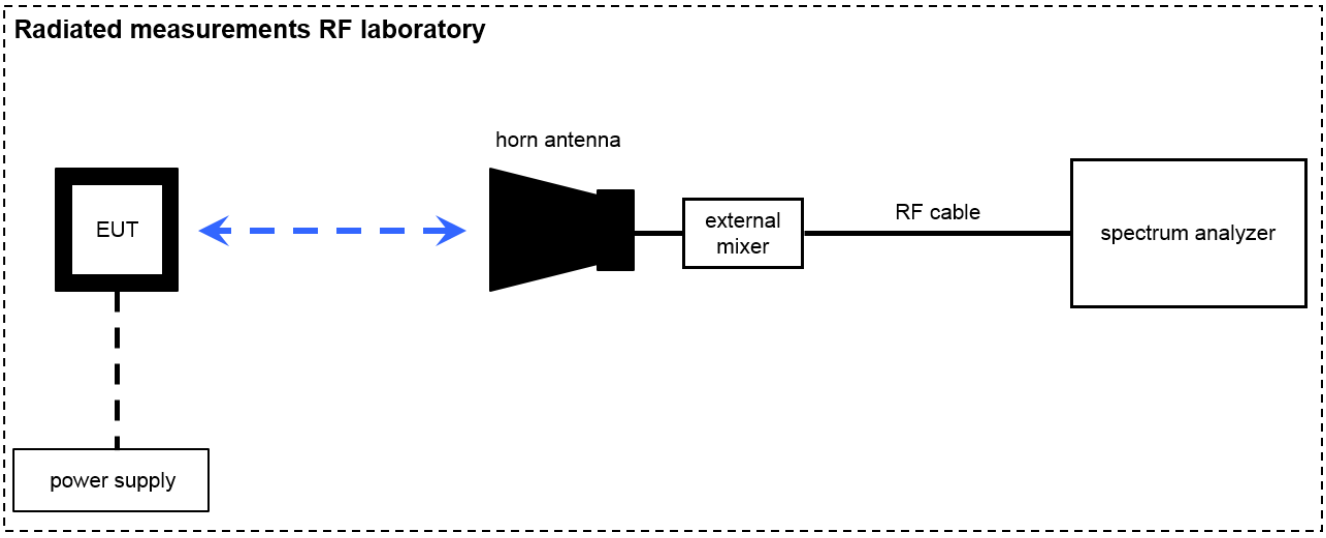
Equipment table (Chamber C):

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vIKI!	12.12.2017	11.12.2020
2	n. a.	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vIKI!	13.06.2019	12.06.2021
3	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	vIKI!	27.12.2019	26.02.2021
5	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
6	n. a.	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-
7	n. a.	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2019	10.12.2020
8	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
9	n. a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
10	n. a.	Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22010	300004491	ev	-/-	-/-
11	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
12	n. a.	NEXIO EMV-Software	BAT EMC V3.16.0.49	EMCO		300004682	ne	-/-	-/-
13	n. a.	PC	ExOne	F+W		300004703	ne	-/-	-/-
14	n. a.	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-
15	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	01029	300005379	vIKI!	02.07.2019	01.07.2021

7.3 Radiated measurements 18 GHz to 50 GHz in test lab

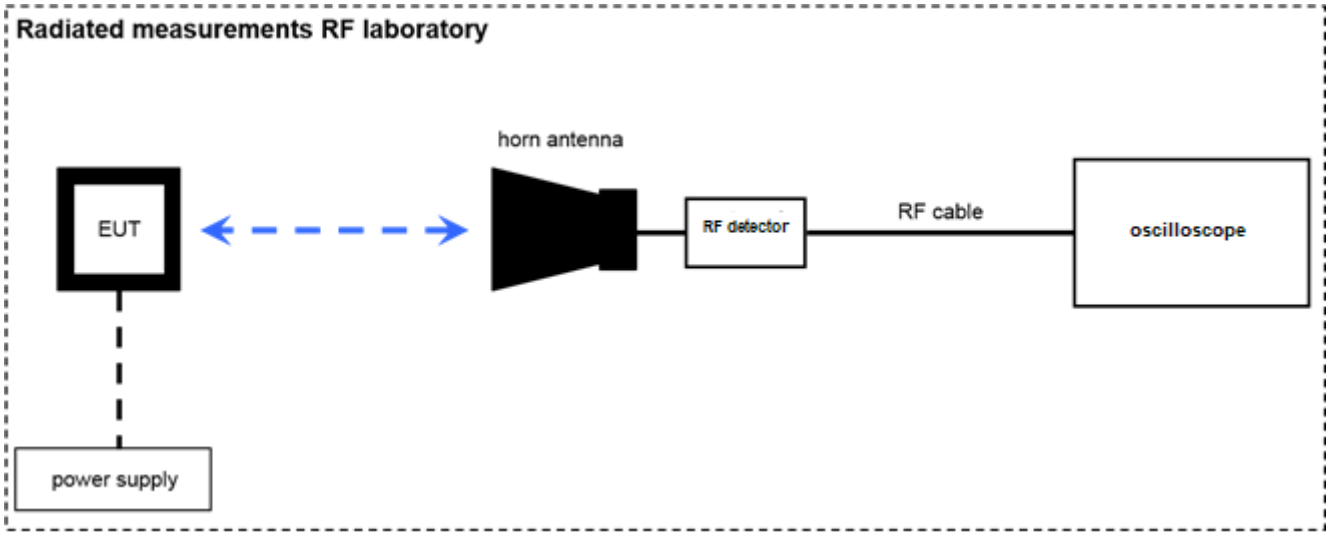


7.4 Radiated measurements > 50 GHz in test lab



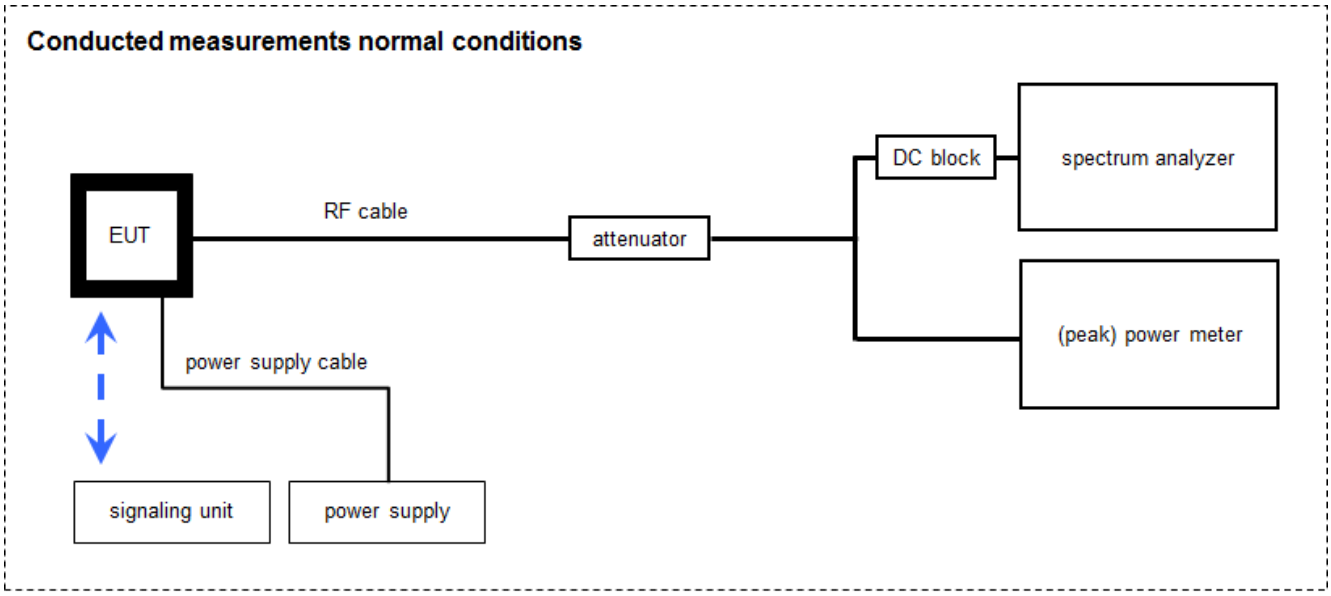
Note: conversion loss of mixer is already included in analyzer value.

7.5 Radiated measurements with RF detector > 50 GHz in test lab



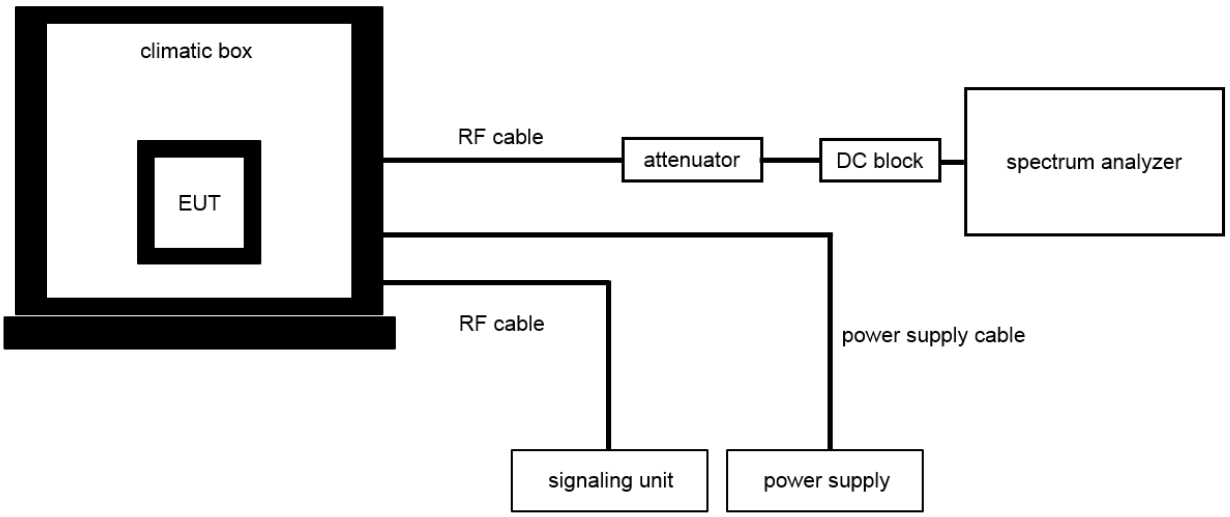
Note: EUT is replaced by reference source for substitution measurement

7.6 Conducted measurements with power meter & spectrum analyzer



7.7 Conducted measurements under extreme conditions (frequency error)

Conducted measurements normal & extreme conditions



Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda		300000486	vIKI!	21.01.2020	20.01.2022
2	n. a.	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	7911	300001751	ne	23.01.2020	22.01.2022
3	n. a.	Std. Gain Horn Antenna 39.3-59.7 GHz	2424-20	Flann	75	300001979	ne	-/-	-/-
4	n. a.	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814	ev	-/-	-/-
5	n. a.	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001988	ne	-/-	-/-
6	n. a.	Std. Gain Horn Antenna 114-173 GHz	2924-20	Flann	*	300001999	ne	-/-	-/-
7	n. a.	Std. Gain Horn Antenna 145-220 GHz	3024-20	Flann	*	300002000	ne	-/-	-/-
8	n. a.	Broadband LNA 18-50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	09.03.2020	08.03.2022
9	n. a.	Harmonic Mixer 3-Port, 75-110 GHz	FS-Z110	R&S	101411	300004959	k	19.06.2020	18.06.2021
10	n. a.	Harmonic Mixer 3-Port, 110-170 GHz	FS-Z170	Radiometer Physics GmbH	100014	300004156	k	28.05.2020	27.05.2021
11	n. a.	Harmonic Mixer 3-Port, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157	k	14.07.2020	13.07.2021
12	n. a.	Harmonic Mixer 3-Port, 60-90 GHz	FS-Z90	R&S	101555	300004691	k	08.07.2020	07.07.2021
13	n. a.	Signal- and Spectrum Analyzer 2 Hz - 85 GHz	FSW85	Rohde & Schwarz	101333	300005568	k	17.06.2020	16.06.2021
14	n.a.	Spectrum Analyzer 20 Hz - 50 GHz	FSU50	Rohde & Schwarz	200012	300003443	k	19.02.2019	18.02.2021
15	n.a.	Waveguide, 60.5 to 92.0 GHz, 800 mm	26441-800MM UG387/U-AC	Flann	227502	300004809 -0007	ev	-/-	-/-
16	n.a.	Waveguide, 60.5 to 92.0 GHz, 150 mm	26441-150MM UG387/U-AC	Flann	227499	300004809 -0006	ev	-/-	-/-
17	n.a.	Waveguide Termination 60.5 to 92.0 GHz	26040 UG387/U-AC	Flann	227492	300004809 -0004	ev	-/-	-/-
18	n.a.	Directional Coupler, 3 Port, 10 dB	26136-10	Flann	227494	300004809 -0009	ev	-/-	-/-
19	n.a.	Waveguide Attenuator 10dB, max. 30 dBm	QAF-E20000	Quinstar	1142400028	Customer Property	ev	-/-	-/-
20	n.a.	Waveguide Attenuator 10dB, WR12, 60-90GHz	CAF-1210-S1	Ducommun	1012800-01	300004841	ev	-/-	-/-
21	n.a.	Cable Load Generator	CLGD	Rohde & Schwarz	101576	Property of Rohde & Schwarz	ev	-/-	-/-
22	n.a.	Thermal Power Sensor, DC-110GHz, 300nW-100mW	NRP-Z58	Rohde & Schwarz	100913	300004808	k	07.01.2020	06.01.2022
23	n.a.	Power Meter	NRP	Rohde & Schwarz	100212	300003780	k	11.12.2019	10.12.2021
24	n.a.	Impedance Matching Pad	AIR IMP1-N50-75F	AIR	n.a.	Customer Property	ev	-/-	-/-
25	n.a.	Power Splitter/Combiner	15542 ZFSC-2-2500 0 9839	Mini-Circuits	n.a	n.a.	ev	-/-	-/-
26	n.a.	SG Extension Module 50 – 75 GHz	E8257DV15	VDI	US54250124	300005541	ev	-/-	-/-
27	n.a.	Std. Gain Horn Antenna 50-75 GHz	COR 50_75	Thomson CSF		300000813	ev	-/-	-/-
28	n.a.	Std. Gain Horn Antenna 50-75 GHz	COR 50_75	Thomson CSF		300000813 -0001	ev	-/-	-/-
29	n.a.	RF Detector	SFD-503753-15SF-P1	Eravant	07353-1	300000813 -0001	ev	-/-	-/-
30	n.a.	Oscilloscope	HDO 6034	LeCroy	LCR3561N16697	300005601 -0008	k	13.12.2019	12.12.2020

8 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Spectrum bandwidth	span/1000
Output power	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB
DC and low frequency voltages	± 3 %
Temperature	± 1 °C
Humidity	± 3 %

9 Far field consideration for measurements above 18 GHz

Far field distance calculation:

$D_{ff} = 2 \times D^2/\lambda$

with
D_{ff} Far field distance
D Antenna dimension
λ wavelength

Spurious emission measurements:

Antenna frequency range in GHz	Highest measured frequency in GHz	D in cm	λ in cm	D_{ff} in cm
18-26	26	3.4	1.15	20.04
26-40	40	2.2	0.75	12.91
40-50	50	2.77	0.60	25.58
50-75	75	1.85	0.40	17.11
75-110	110	1.24	0.27	11.28
110-170	170	0.85	0.18	8.19
170-220	220	0.68	0.14	6.78

In band measurement (EIRP, OBW):

Antenna frequency range in GHz	Highest measured frequency in GHz	Antenna dimension in cm	Wavelength in cm	far field distance in cm
50-75	71	5	0.46	116

10 Measurement results

10.1 Summary

☒	**No deviations from the technical specifications were ascertained**
☐	There were deviations from the technical specifications ascertained
☐	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC 47 CFR Part 15	see below	2020-11-27	-/-

Test specification clause	Test case	Temperature conditions	Power supply	Pass	Fail	NA	NP	Results (max.)
§15.215	Occupied bandwidth	Nominal	Nominal	☒	☐	☐	☐	complies
§15.255(a) / (c) (1) (i)	Maximum E.I.R.P.	Nominal	Nominal	☒	☐	☐	☐	complies
§15.255(d)	Spurious Emissions	Nominal	Nominal	☒	☐	☐	☐	complies
§15.255(e)	Maximum conducted output power	Nominal	Nominal	☒	☐	☐	☐	complies
§15.255(f)	Frequency stability	Extreme Nominal	Extreme Nominal	☒	☐	☐	☐	complies
§15.255(h)	Beamforming	Nominal	Nominal	☐	☐	☒	☐	--

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

11 Measurement results

11.1 Occupied bandwidth (99%, 20 dB Bandwidth)

Description:

Measurement of the Bandwidth of the wanted signal.

Measurement:

Measurement parameter	
Detector:	Pos-Peak
Sweep time:	1 s
Resolution bandwidth:	1 MHz
Video bandwidth:	10 MHz
Span:	See plot
Trace-Mode:	Max Hold (99%) / ClearWrite (20 dB)

Limits:

FCC
CFR Part 15.255
The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following:
Frequency range
57 GHz – 71 GHz

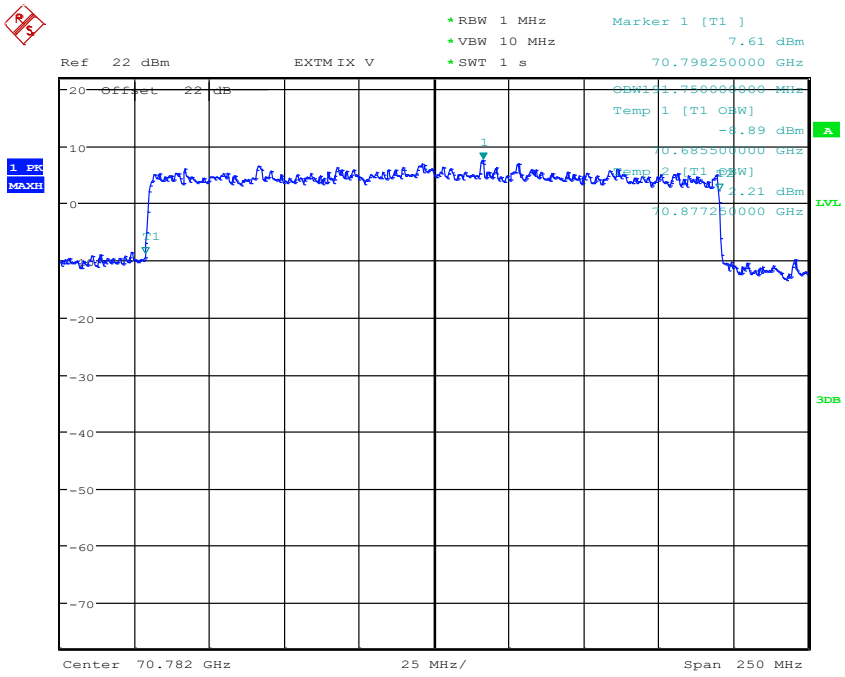
Measurement results:

Test condition T_{nom} / V_{nom}	F_L in GHz	F_H in GHz	Occupied bandwidth in MHz
99% OBW	70.685 500	70.877 250	191.75
20 dB OBW	70.664 500	70.880 000	215.5
Measurement uncertainty	± span/1000		

Note: Occupied bandwidth measurements show the 192 MHz nominal bandwidth of the DOCSIS input signal generated by the R&S CLCD.

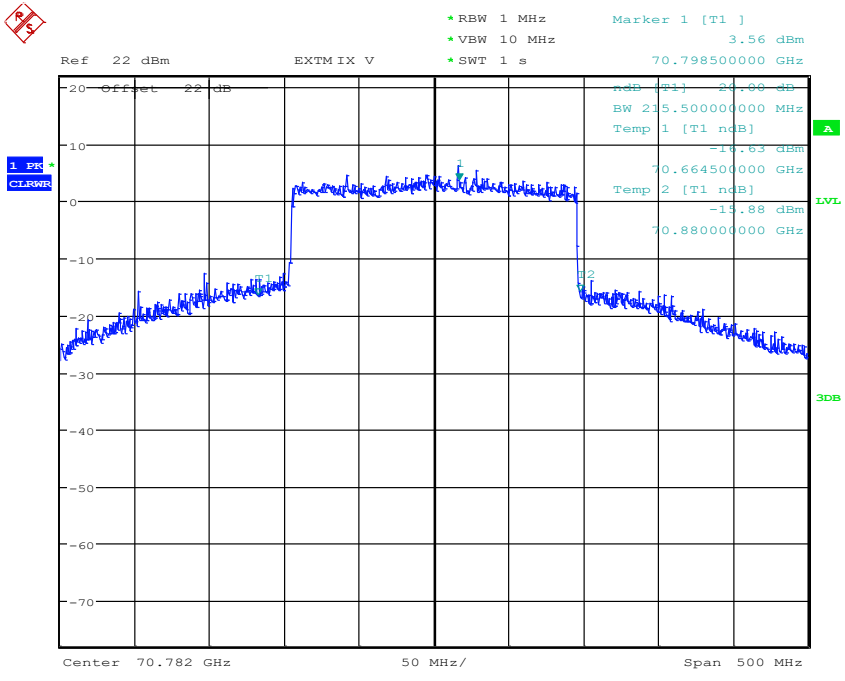
Result: The measurement is passed.

Plot 1: 99% OBW



Date: 22.SEP.2020 16:10:47

Plot 2: 20 dB OBW



Date: 22.SEP.2020 13:54:09

11.2 Maximum E.I.R.P.

Description:

Measurement of the maximum radiated e.i.r.p. of the wanted signal.

Limits: **FCC Part 15.255 (c)**

Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm

The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

Measurement:

Measurement parameter	
Detector:	Pos-Peak (RF-Detector)
Video bandwidth:	10 MHz
Trace-Mode:	Max Hold

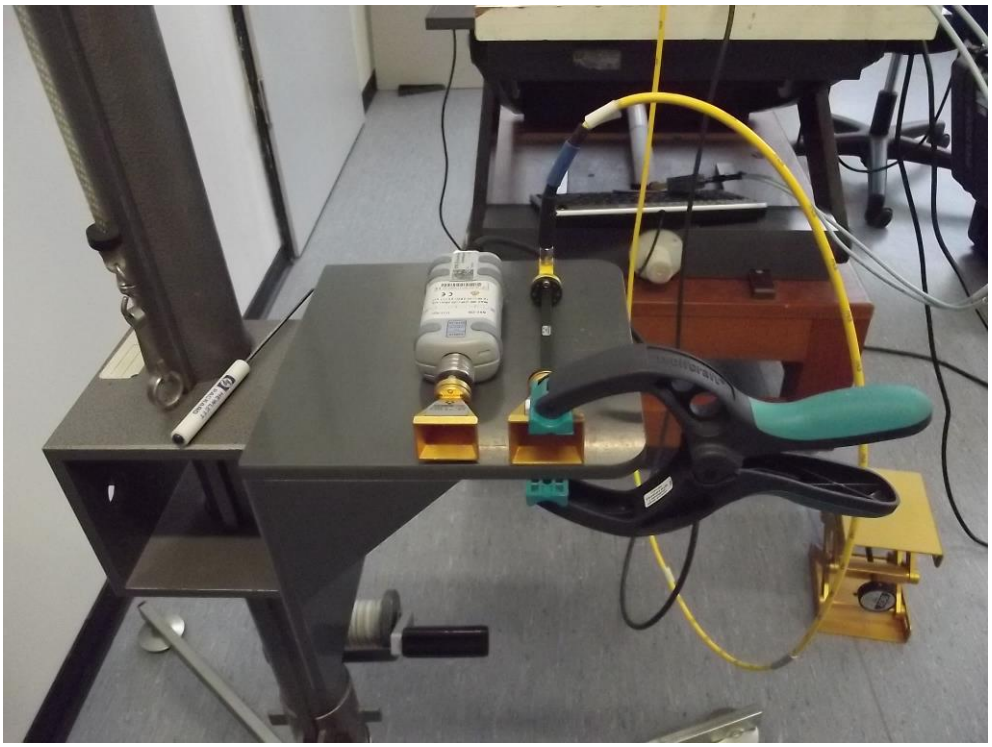
Measurement results:

Test condition	Peak E.I.R.P. 10 MHz VBW	Average E.I.R.P. 10 MHz VBW
T_{nom} / V_{nom}	35.0 dBm	34.0 dBm
Measurement uncertainty	± 3 dB	

Note: The measured values represent a DOCSIS 3.1 signal of 192 MHz bandwidth.

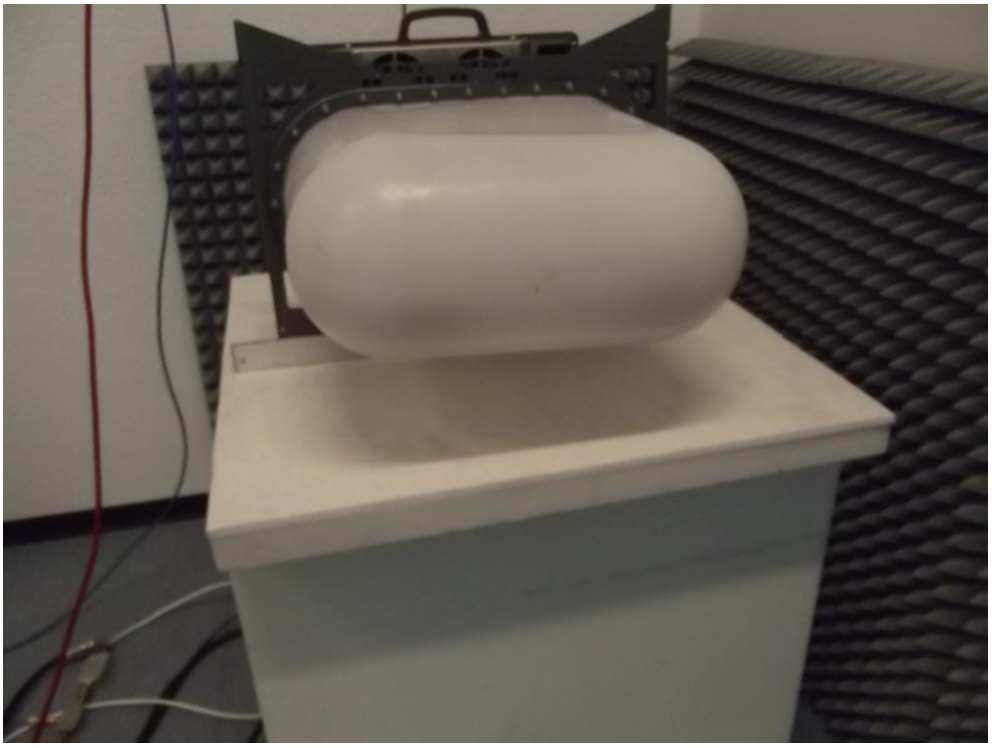
Result: **The measurement is passed.**

11.2.1 Set-up of radiated RF-detector- and power measurement:

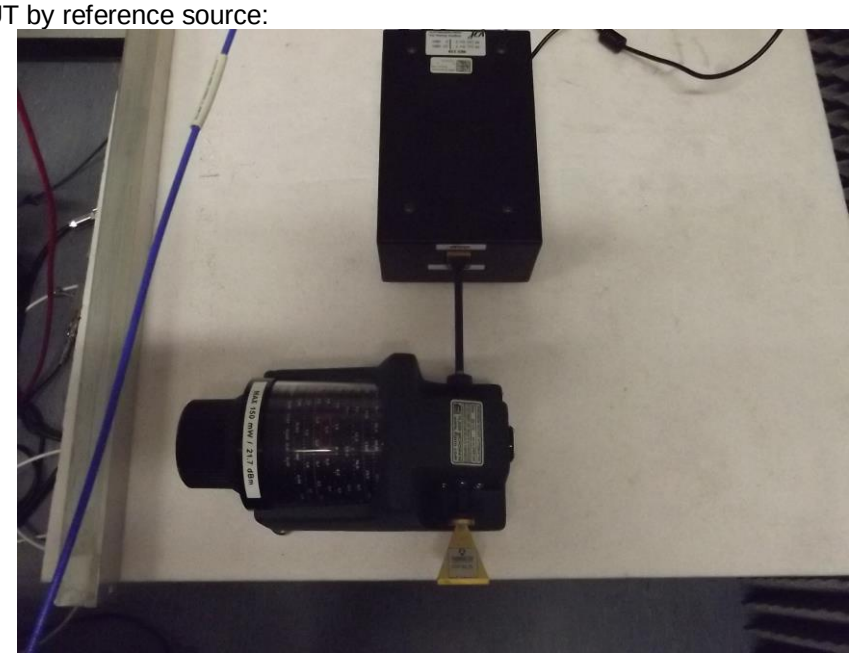


RF-detector measured values peak: 5.6 mV; average 4.4 mV

EUT position:



Replacement of EUT by reference source:



Attenuation of rotary attenuator to align peak level at oscilloscope to values given above:

EIRP of reference source measured by power sensor:

Measurement:	Peak	Average
Gain of measurement antenna	20.4 dBi	20.4 dBi
Far field attenuation at 2 m	75.5 dB	75.5 dB
Total correction	**55.1 dB**	**55.1 dB**
Readout value of power sensor	-20.1 dBm	-21.1 dBm
Calculated EIRP	**35.0 dBm**	**34.0 dBm**

11.3 Spurious emissions radiated

Description:

Measurement of the radiated spurious emissions in transmit mode.

Limits: **FCC Part 15.255**

(c) Limits on spurious emissions:

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

FCC / IC		
CFR Part 15.209(a)		
Radiated Spurious Emissions		
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 (-10dBm) at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Limit conversion:

P[dBm] = 10×log(4×π×d²×P[W/m²])

d = distance of the limit defined in W/m²

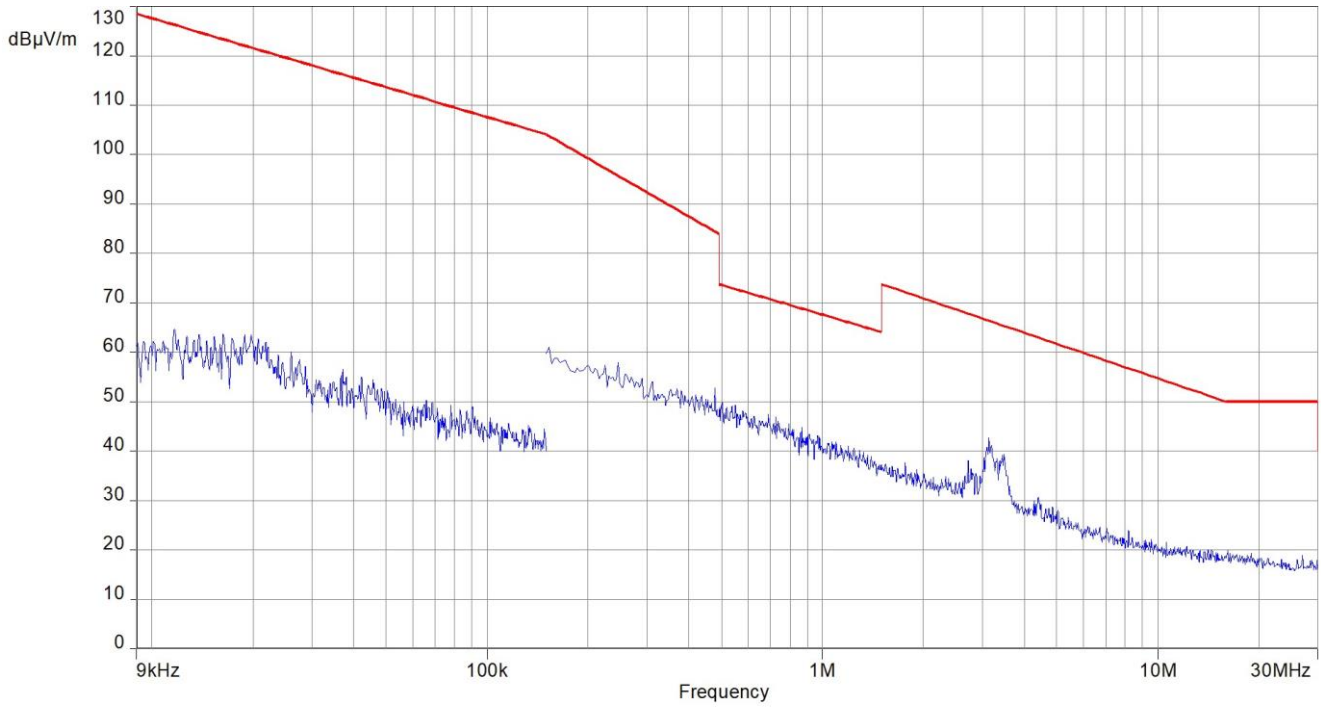
With this calculation an emission limit of 90 pW/cm² corresponds to -10 dBm.

Measurement:

Measurement parameter	
Detector:	Quasi Peak / Pos-Peak / RMS
Sweep time:	Auto
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Video bandwidth:	Auto
Frequency range:	30 MHz to 220 GHz
Trace-Mode:	Max Hold

Result: **The measurement is passed.**

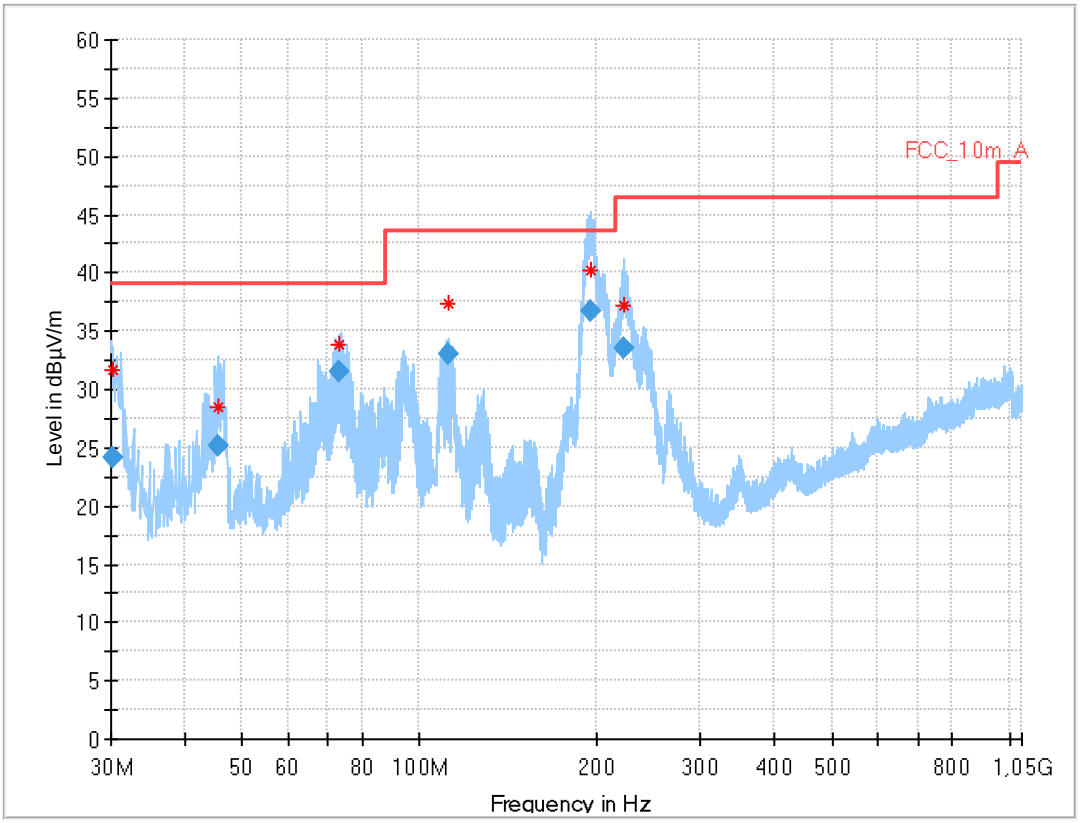
Plot 3: 9 kHz – 30 MHz, horizontal / vertical polarization



Plot 4: 30 MHz – 1 GHz, horizontal / vertical polarization

Common Information

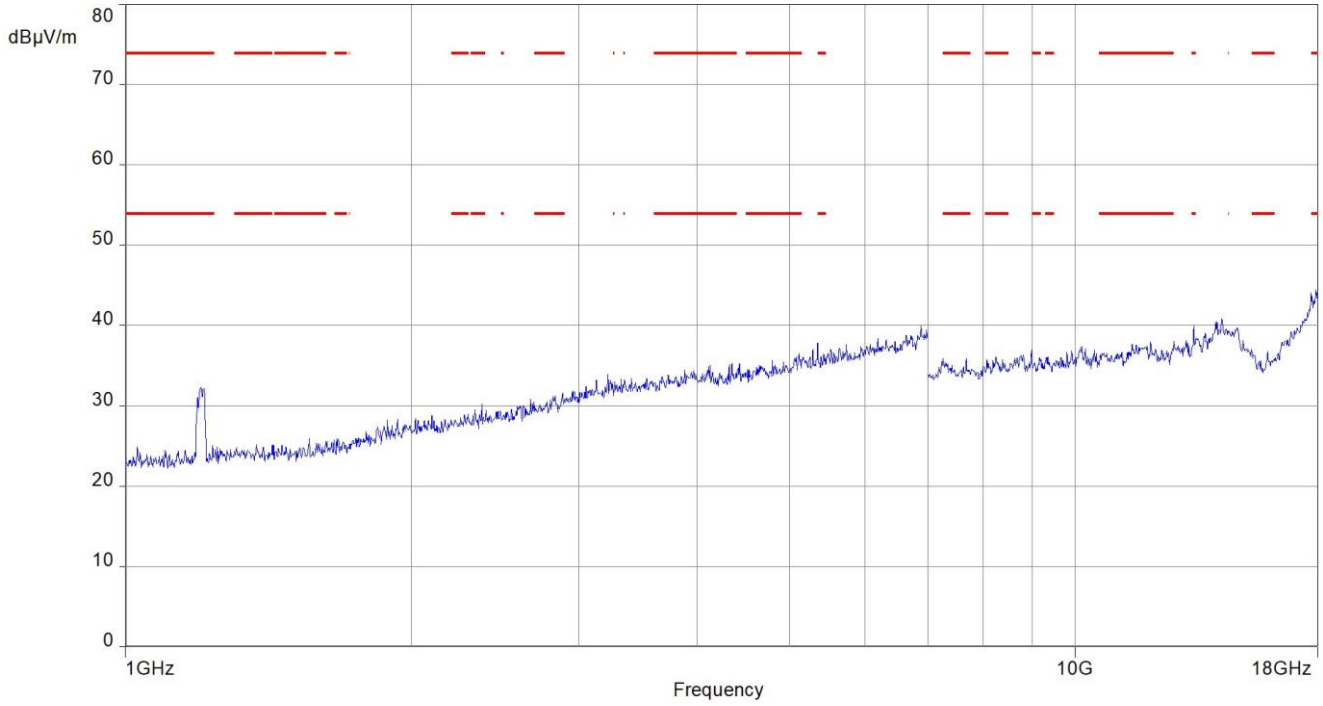
EUT:	AIR GIGARAY
Serial number:	
Test description:	FCC part 15 class A @ 10 m
Operating condition:	active / radio on
Operator name:	KHN
Comment:	DC 48 V



Final_Result

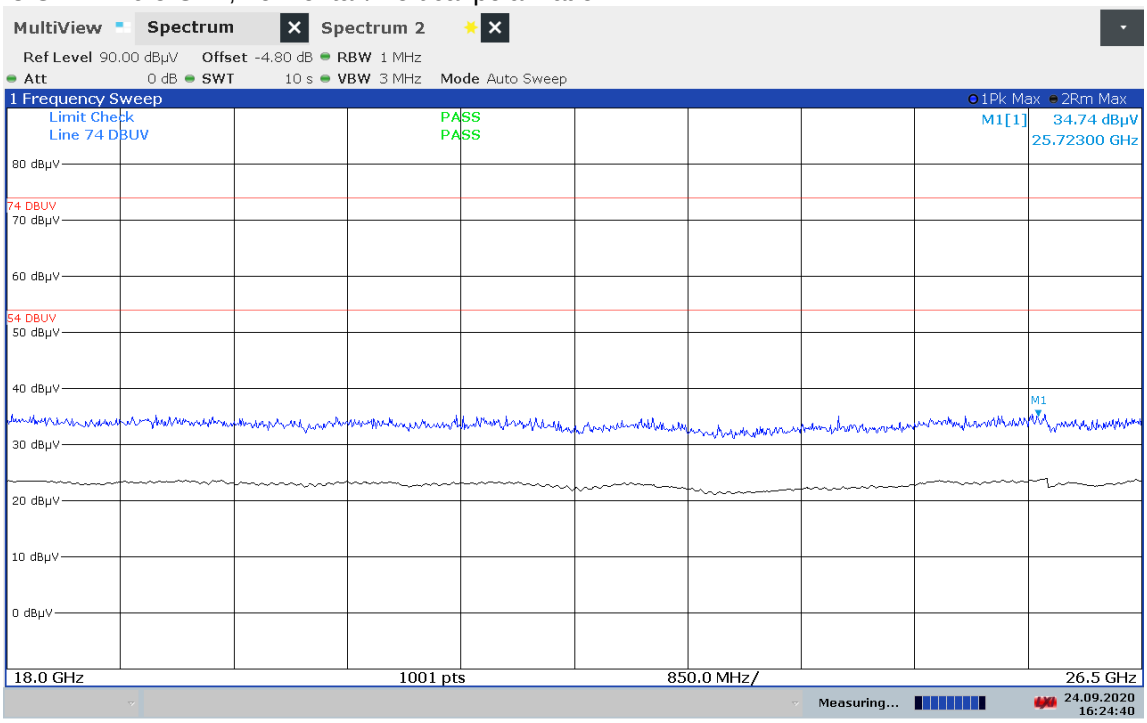
Frequency (MHz)	QuasiPeak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.205	24.06	39.1	15.04	1000	120.0	200.0	V	149	12
45.544	25.18	39.1	13.92	1000	120.0	104.0	V	264	14
73.074	31.46	39.1	7.64	1000	120.0	285.0	V	-44	9
111.700	32.95	43.5	10.55	1000	120.0	151.0	V	64	12
195.382	36.74	43.5	6.76	1000	120.0	200.0	V	-13	12
222.473	33.48	46.4	12.92	1000	120.0	111.0	V	117	12

Plot 5: 1 GHz – 18 GHz, horizontal / vertical polarization



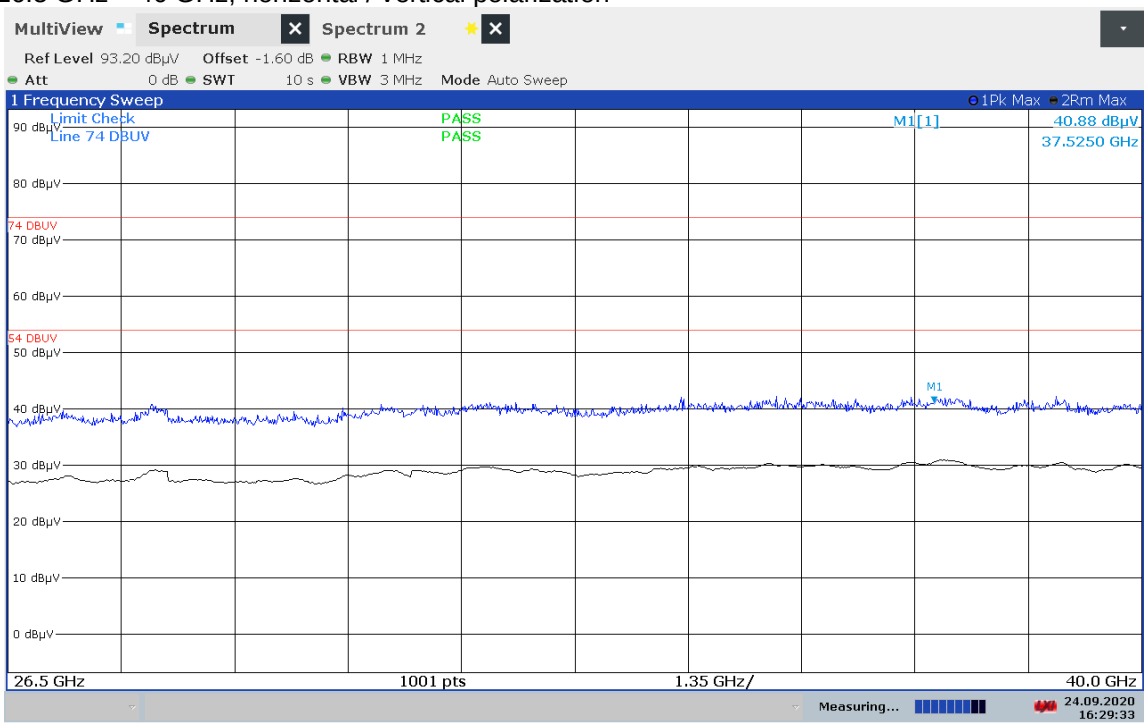
Note: RF input signal visible on plot

Plot 6: 18 GHz – 26.5 GHz, horizontal / vertical polarization



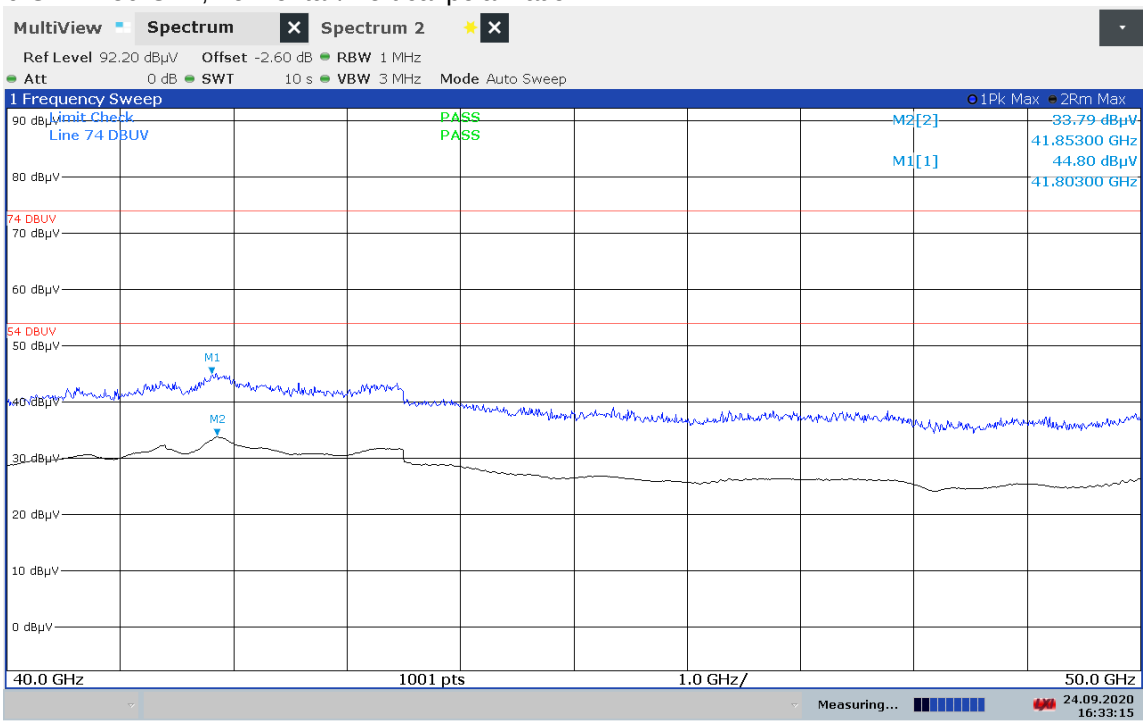
16:24:40 24.09.2020

Plot 7: 26.5 GHz – 40 GHz, horizontal / vertical polarization



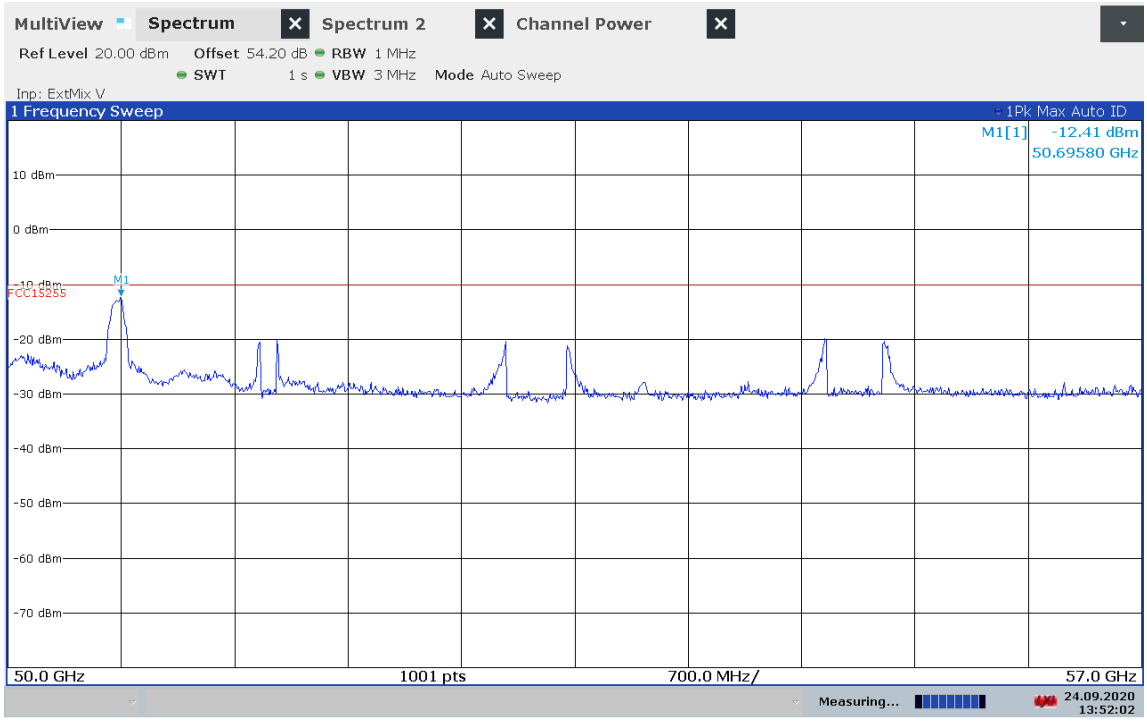
16:29:34 24.09.2020

Plot 8: 40 GHz – 50 GHz, horizontal / vertical polarization



16:33:16 24.09.2020

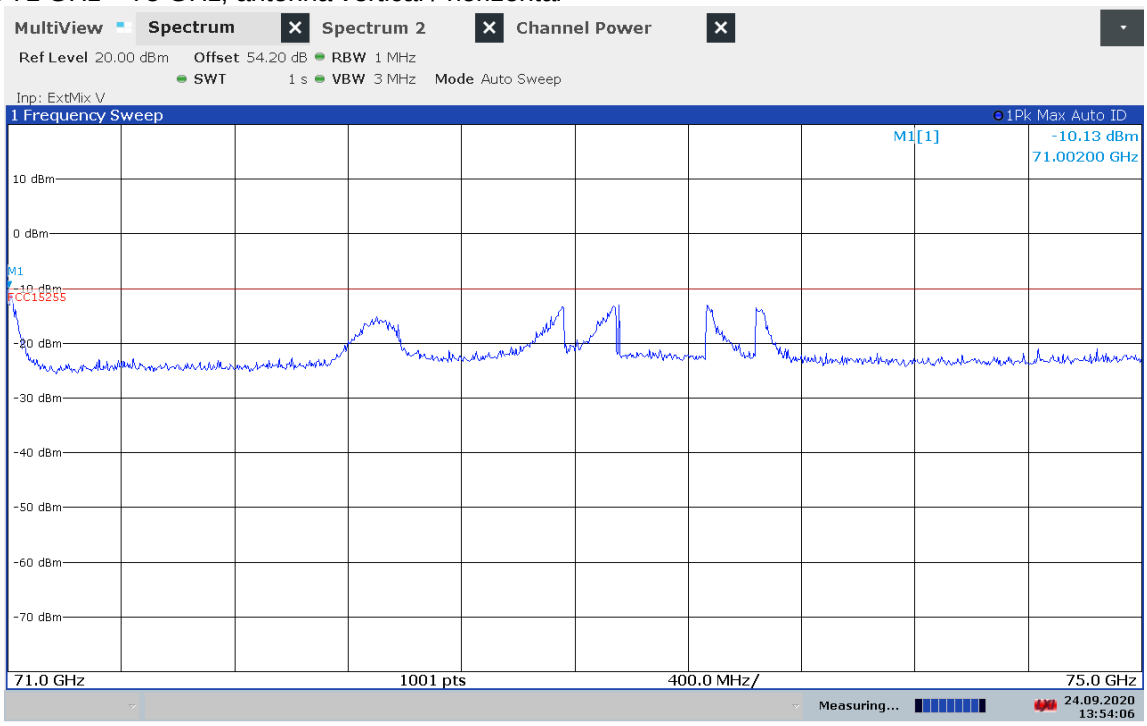
Plot 9: 50 GHz – 57 GHz, antenna vertical / horizontal



13:52:02 24.09.2020

Note: mixer products visible on plot

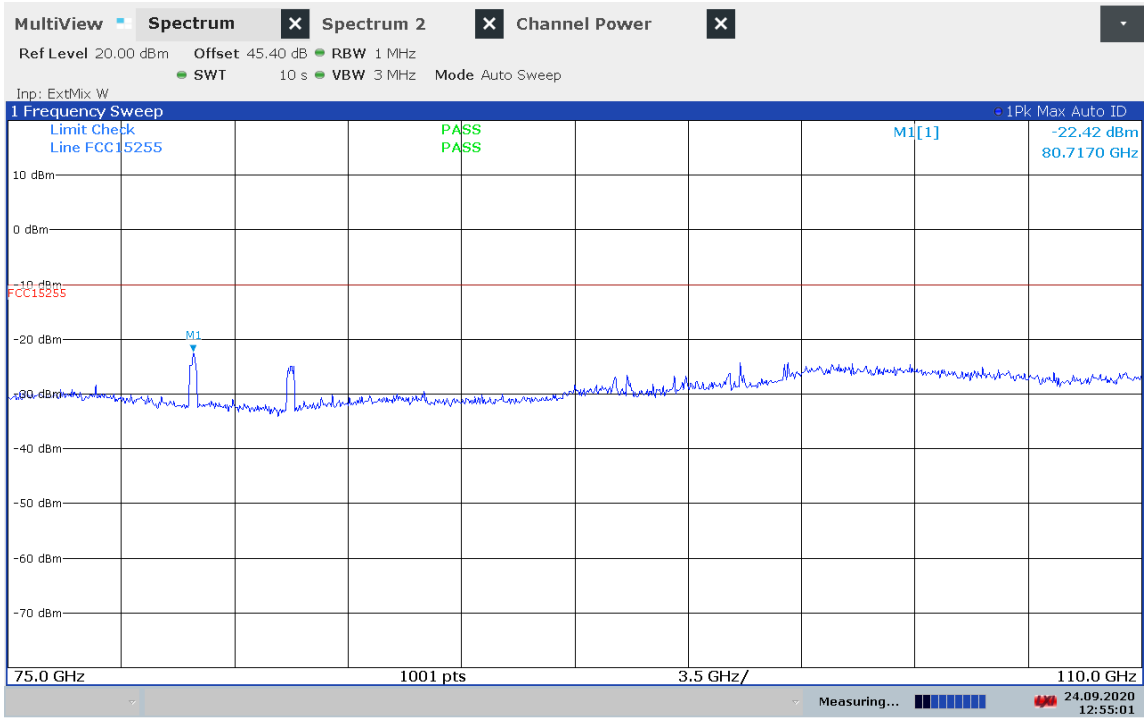
Plot 10: 71 GHz – 75 GHz, antenna vertical / horizontal



13:54:07 24.09.2020

Note: mixer products visible on plot

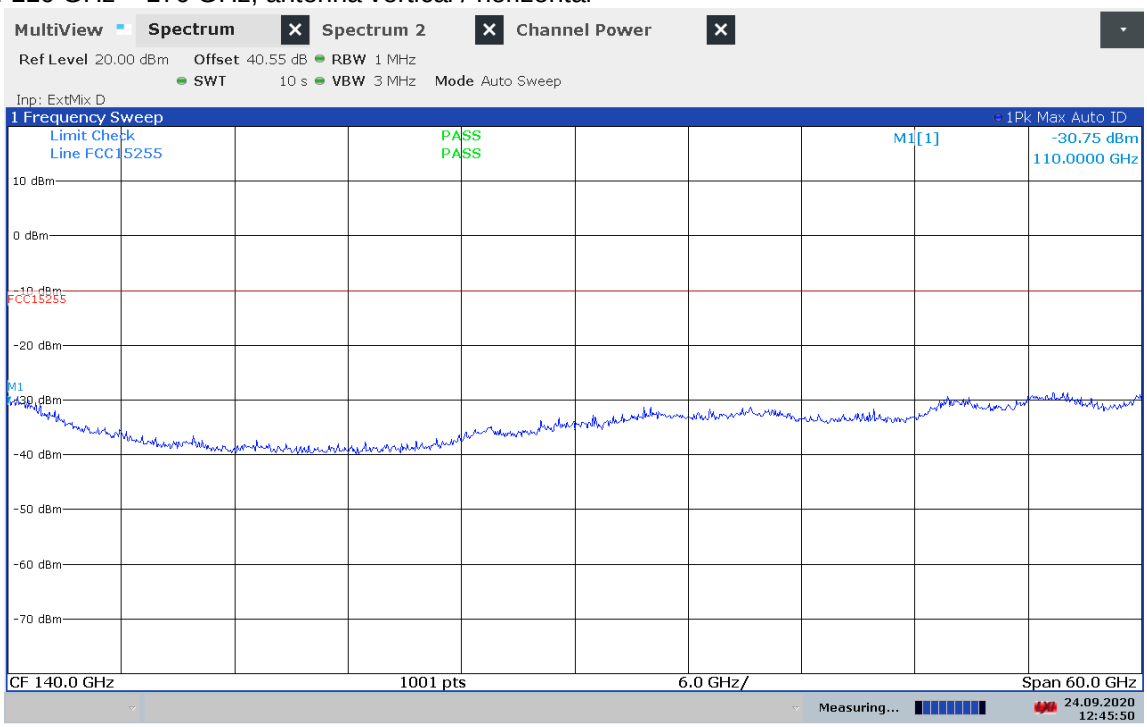
Plot 11: 75 GHz – 110 GHz, antenna vertical / horizontal



12:55:02 24.09.2020

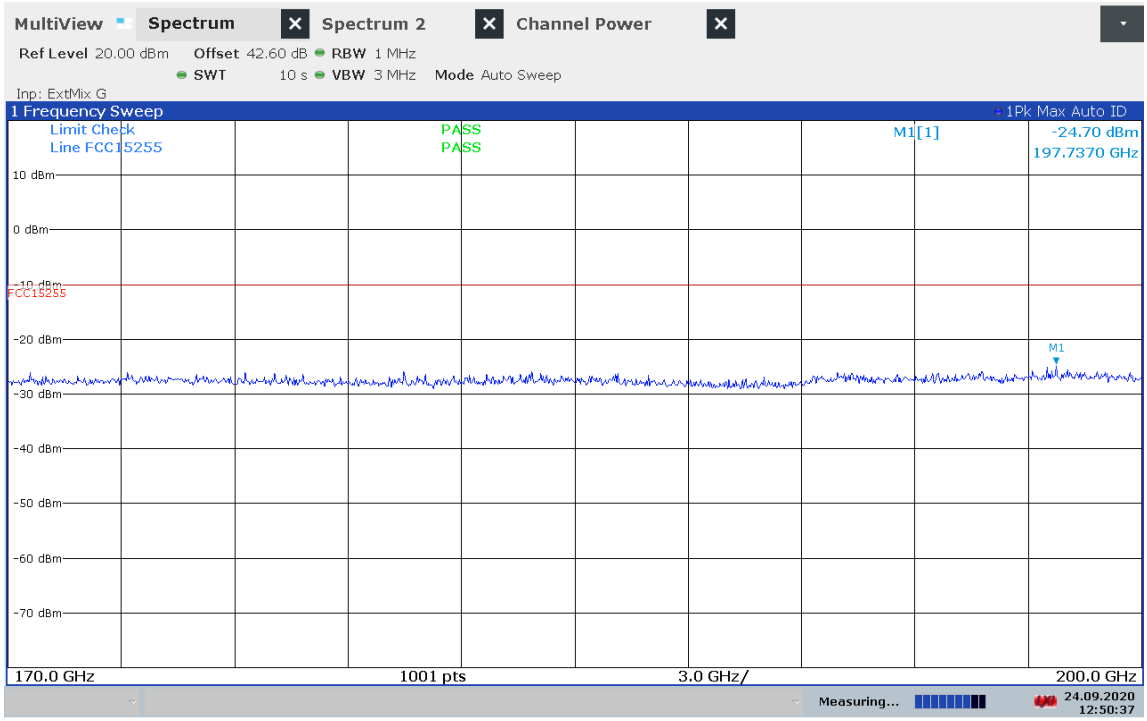
Note: mixer products visible on plot

Plot 12: 110 GHz – 170 GHz, antenna vertical / horizontal



12:45:51 24.09.2020

Plot 13: 170 GHz – 220 GHz, antenna vertical / horizontal



12:50:38 24.09.2020

11.4 Maximum Transmitter Output Power

Description:

Measurement of the maximum conducted output power of the wanted signal.

Limits: **FCC Part 15.255 (e)**

The peak transmitter conducted output power shall not exceed 500 mW = 27 dBm.

The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

Measurement:

Measurement parameter	
Detector:	Pos-Peak (RF-Detector)
Video bandwidth:	10 MHz
Trace-Mode:	Max Hold

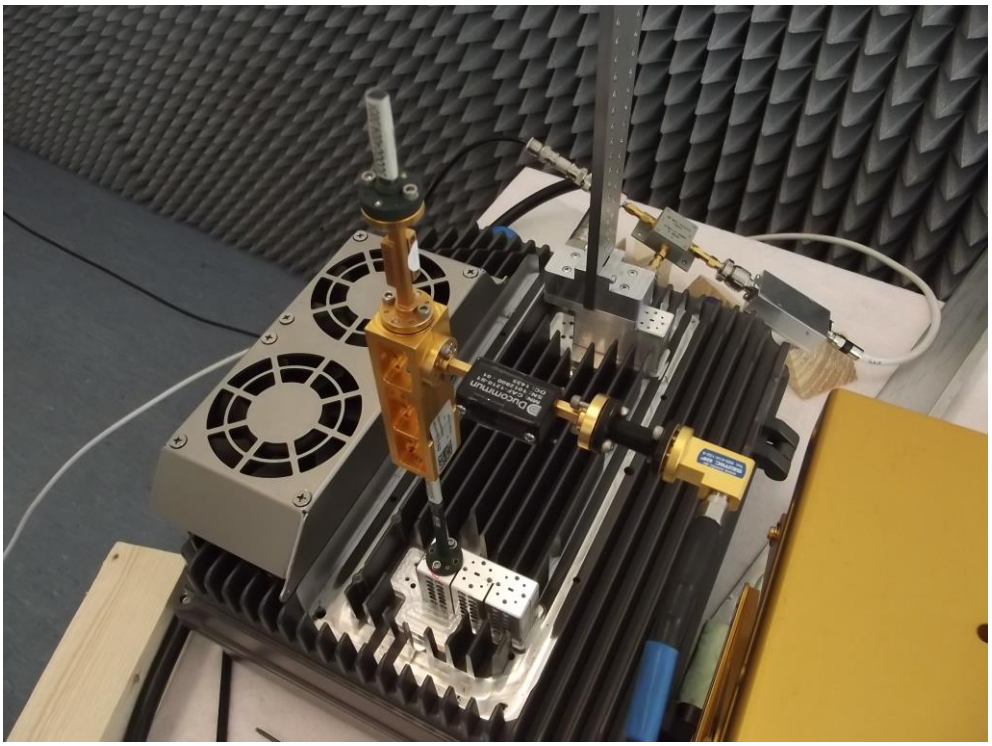
Measurement results:

Test condition	Peak Conducted Output Power 10 MHz VBW
T_{nom} / V_{nom}	15.6 dBm (at nominal maximum input signal level of -5 dBm)
Measurement uncertainty	± 3 dB

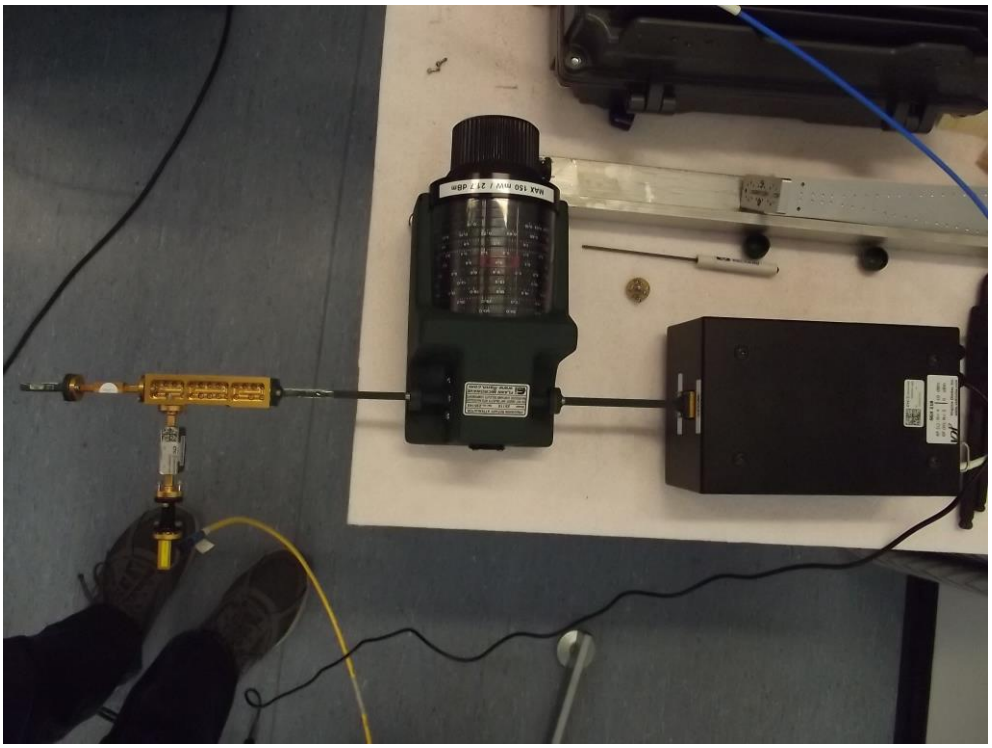
Result: **The measurement is passed.**

11.4.1 Set-up and Calculation of the conducted output power:

Measurement value (peak) of RF Detector at waveguide coupler output: 128 mV



Changing waveguide set-up from EUT to 20 dBm reference source and adjusting output power with rotary attenuator to 128 mV:



Measuring conducted output power of reference source with wideband power sensor:

11.5 Frequency Stability

Description:

§15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Measurement:

f_C is the point in the radiation where the power is at maximum. The frequency points where the power falls 10 dB below the f_C level and above f_C level are designated as f_L and f_H respectively.
The operating frequency range (i.e. the frequency band of operation) is defined as f_H - f_L.

Measurement parameter	
Detector:	Peak
Sweep time:	10 s
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	250 MHz
Trace-Mode:	Max Hold
Temperature:	-20 °C / +50 °C

Note: Occupied bandwidth measurements show the 192 kHz nominal bandwidth of the DOCSIS input signal generated by the R&S CLCD.

Limits:

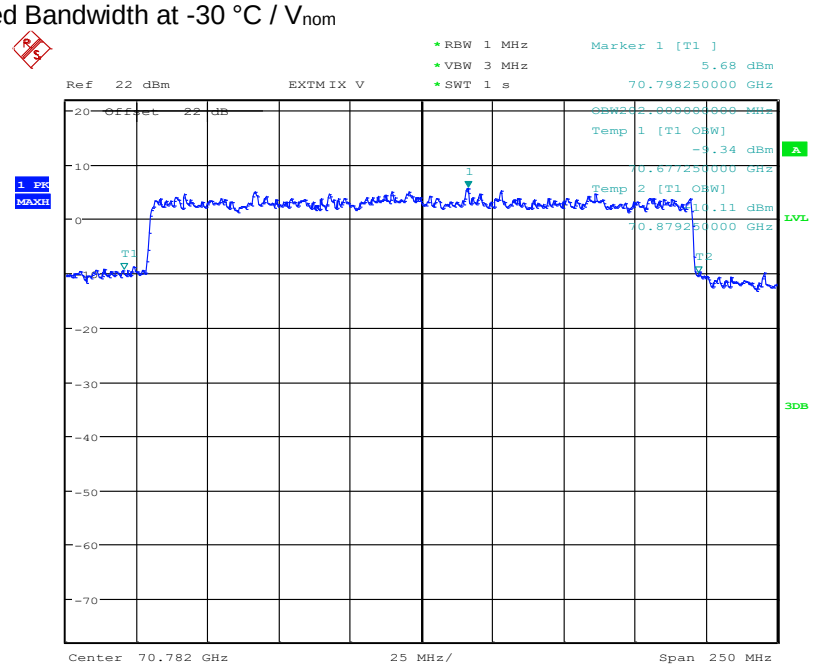
FCC
CFR Part 15.255 (f)
The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following:
Frequency range
57 GHz – 71 GHz

Measurement Results:

Test Conditions	Transmitter Frequency Range [GHz]		Occupied Bandwidth [MHz]
	f_L	f_H	
-30 °C / V_{nom}	70.67725	70.87925	202.00
-20 °C / V_{nom}	70.69750	70.87775	198.25
-10 °C / V_{nom}	70.68225	70.87725	195.00
0 °C / V_{nom}	70.68325	70.87725	194.00
10 °C / V_{nom}	70.68550	70.87725	191.75
20 °C / V_{min}	70.68600	70.87700	191.00
20 °C / V_{nom}	70.68675	70.87700	190.25
20 °C / V_{max}	70.68575	70.87700	191.25
30 °C / V_{nom}	70.68675	70.87700	190.25
40 °C / V_{nom}	70.68775	70.87700	190.25
50 °C / V_{nom}	70.68700	70.87675	189.75
60 °C / V_{nom}	70.68700	70.87675	189.75
70 °C / V_{nom}	70.68700	70.87675	189.75

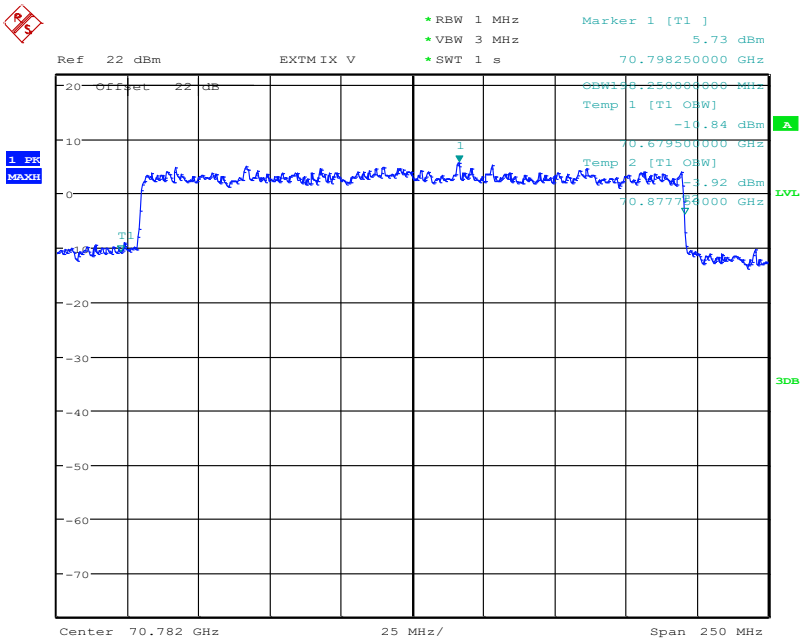
Result: The measurement is passed.

Plot 14: Occupied Bandwidth at -30 °C / V_{nom}



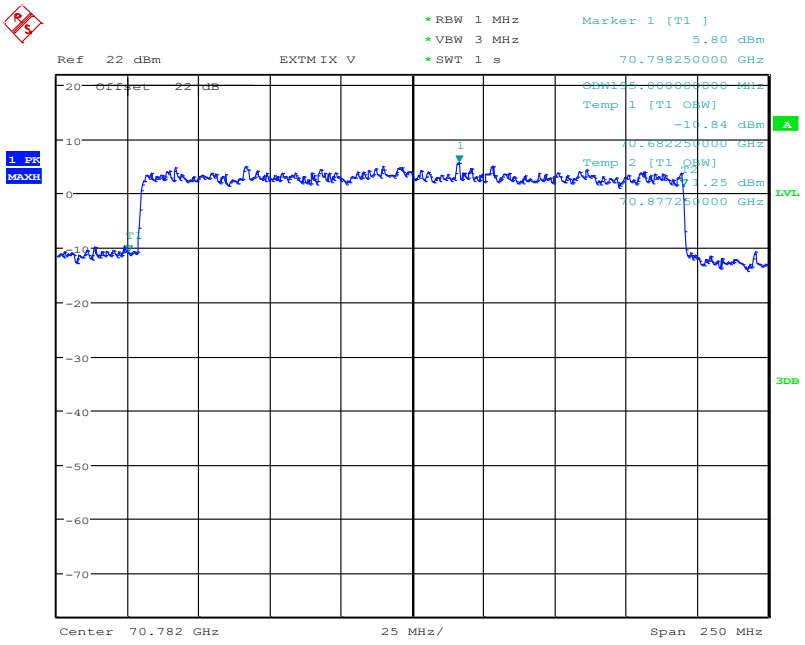
Date: 23.SEP.2020 14:42:35

Plot 15: Occupied Bandwidth at -20 °C / V_{nom}



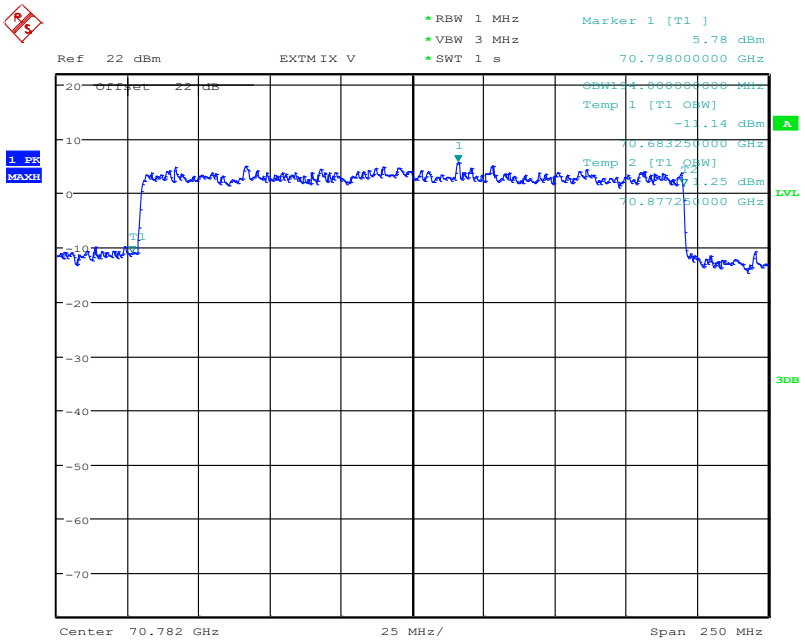
Date: 23.SEP.2020 14:23:43

Plot 16: Occupied Bandwidth at -10 °C / V_{nom}



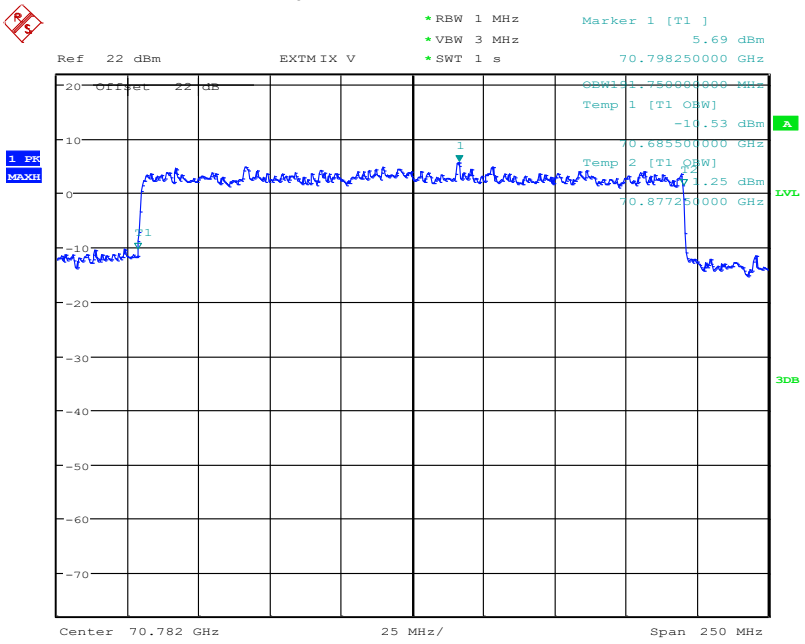
Date: 23.SEP.2020 14:10:47

Plot 17: Occupied Bandwidth at 0 °C / V_{nom}



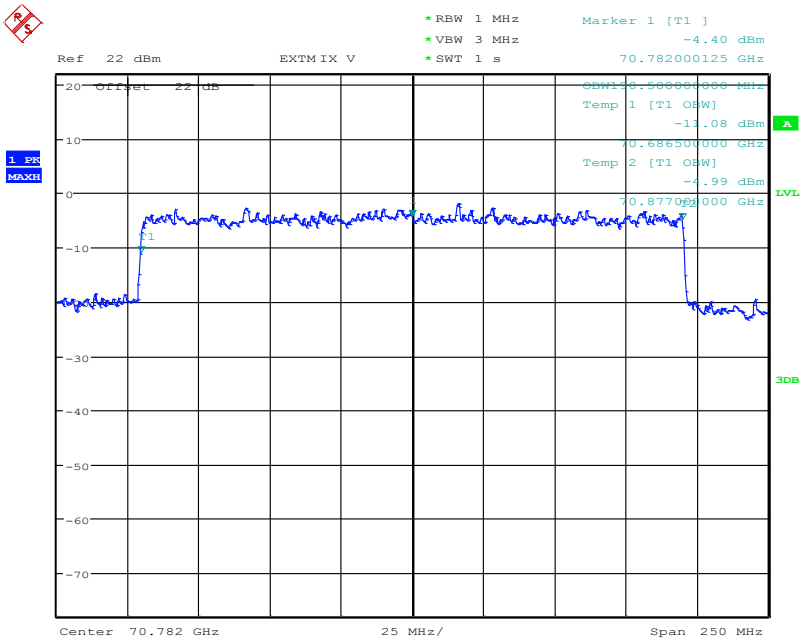
Date: 23.SEP.2020 13:56:43

Plot 18: Occupied Bandwidth at 10 °C / V_{nom}



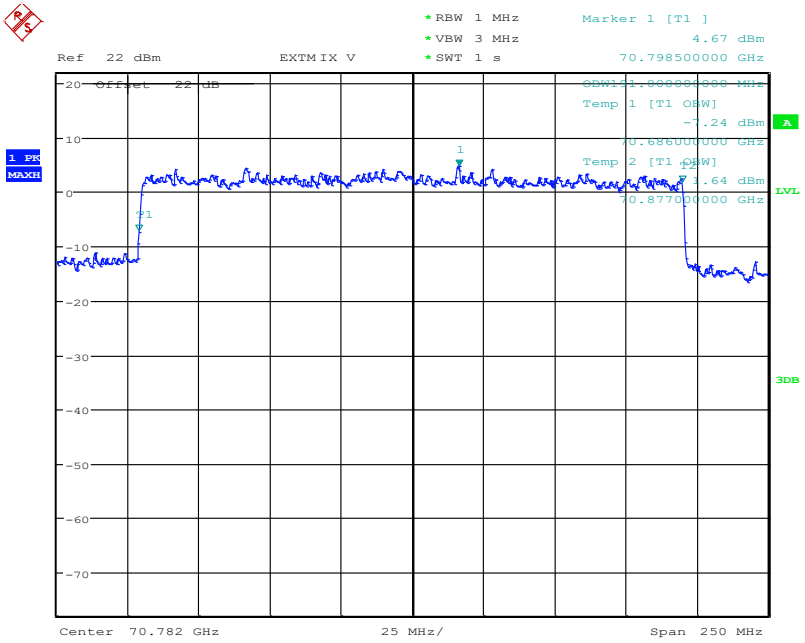
Date: 23.SEP.2020 13:39:05

Plot 19: Occupied Bandwidth at 20 °C / V_{nom}



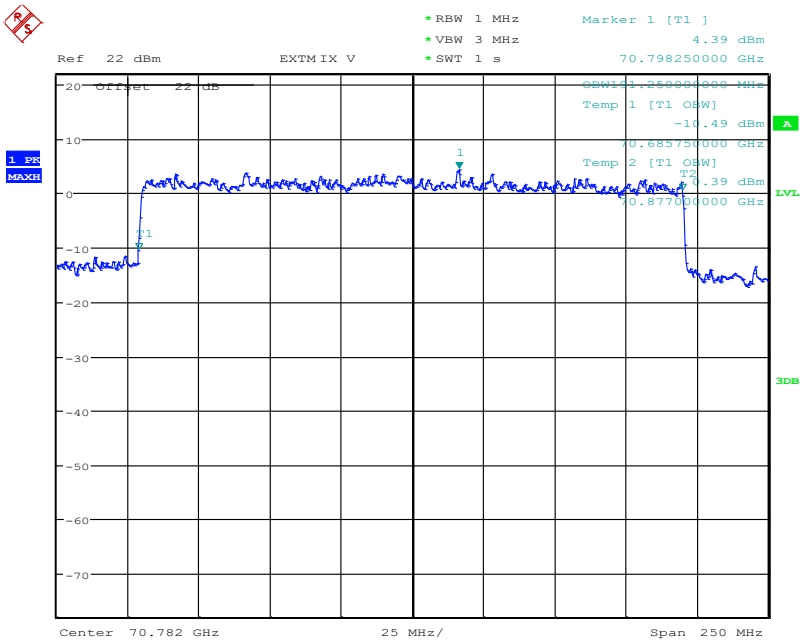
Date: 23.SEP.2020 11:40:56

Plot 20: Occupied Bandwidth at 20 °C / V_{min}



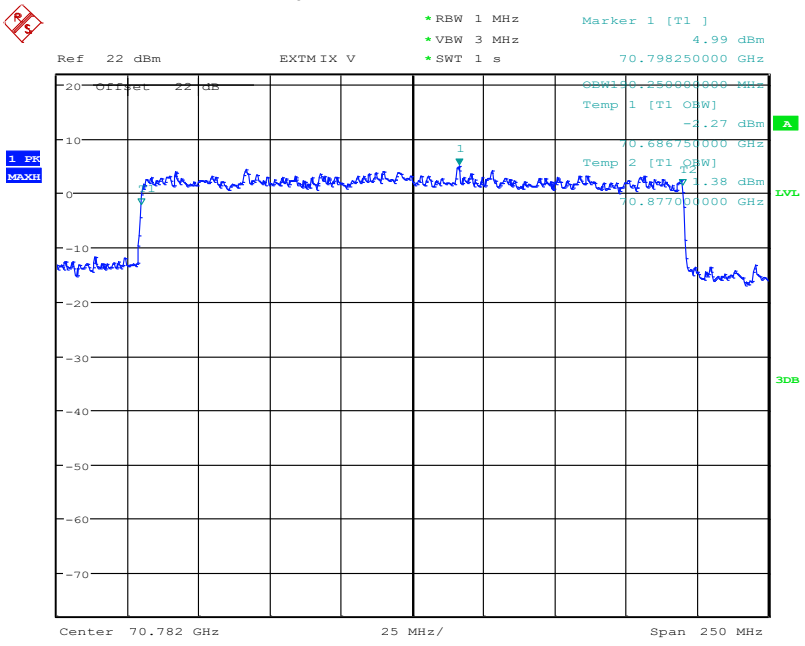
Date: 23.SEP.2020 15:35:30

Plot 21: Occupied Bandwidth at 20 °C / V_{max}



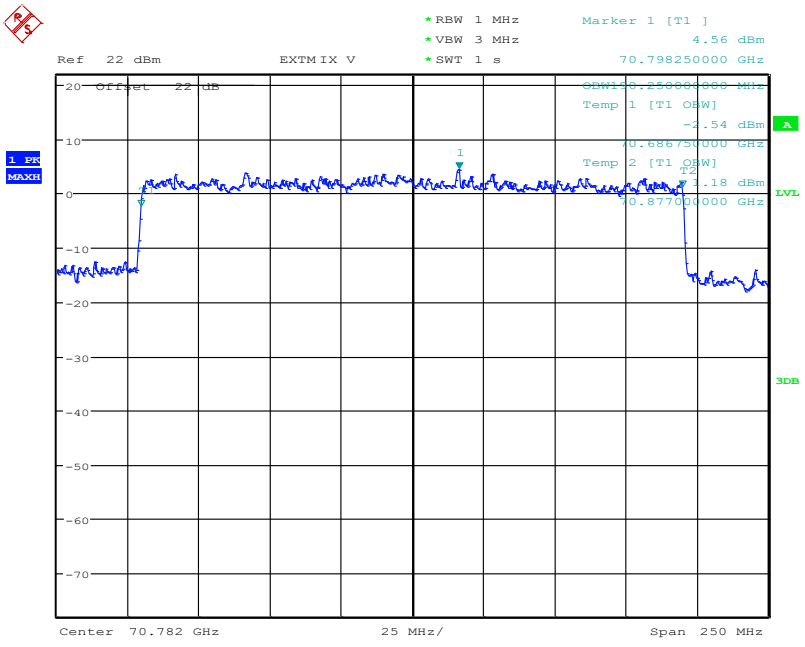
Date: 23.SEP.2020 15:37:41

Plot 22: Occupied Bandwidth at 30 °C / V_{nom}



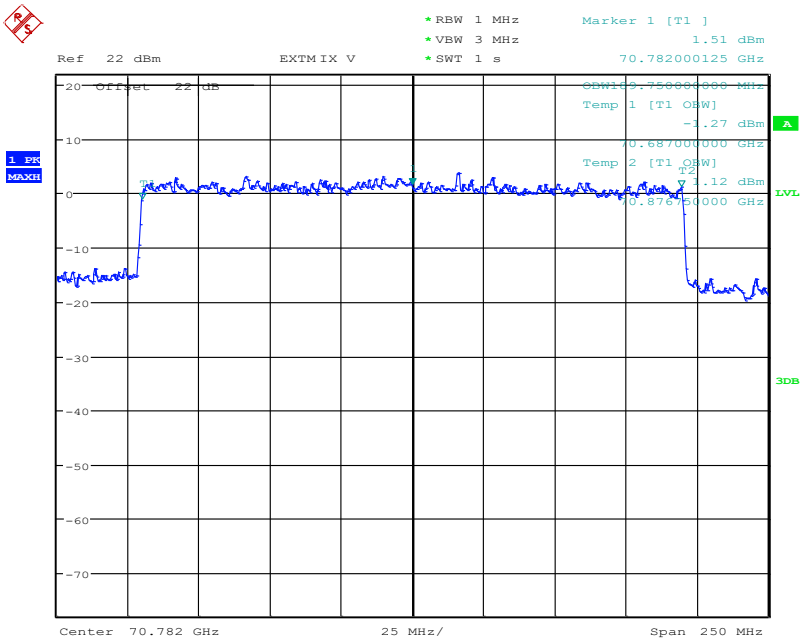
Date: 23.SEP.2020 13:16:48

Plot 23: Occupied Bandwidth at 40 °C / V_{nom}



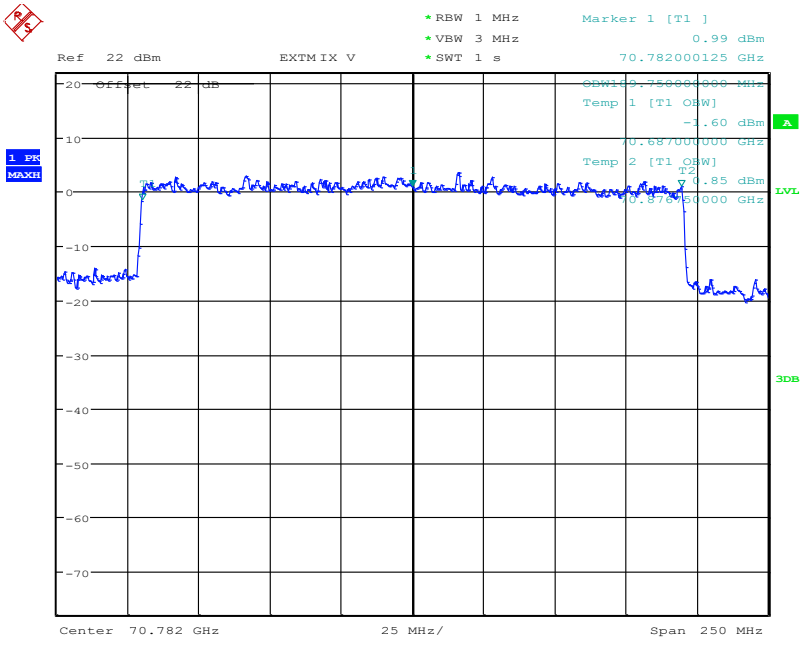
Date: 23.SEP.2020 13:04:43

Plot 24: Occupied Bandwidth at 50 °C / V_{nom}



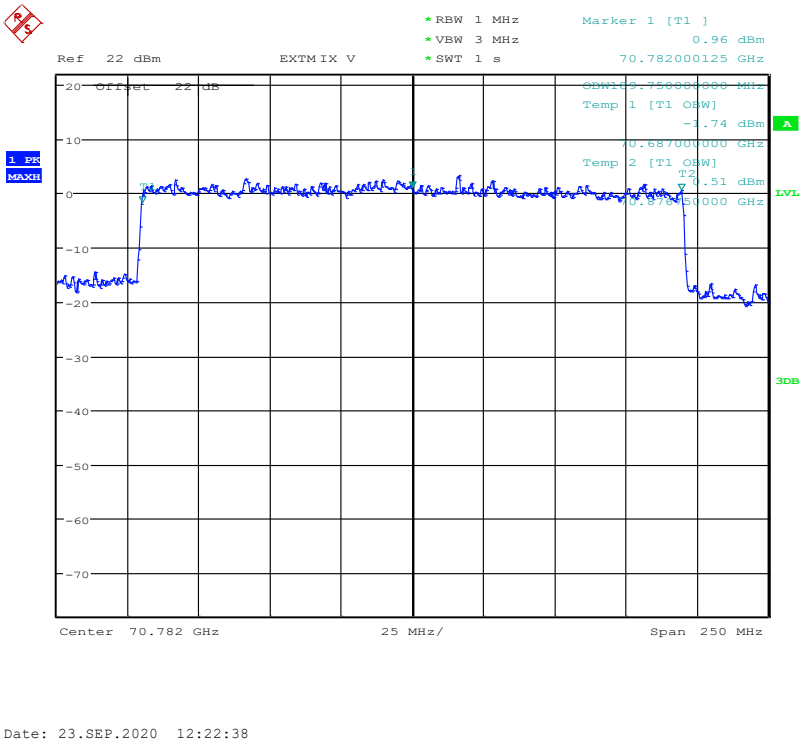
Date: 23.SEP.2020 12:47:35

Plot 25: Occupied Bandwidth at 60 °C / V_{nom}



Date: 23.SEP.2020 12:38:25

Plot 26: Occupied Bandwidth at 70 °C / V_{nom}



11.6 Simultaneous operation

Description:

§15.255 (h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

Result: No beamforming in use

12 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

13 Document history

Version	Applied changes	Date of release
-/-	Initial release – DRAFT	2020-09-25
	Final version	2020-10-02
A	Update of section 11.2 and 11.5 and further details added.	2020-11-13

14 Accreditation Certificate – D-PL-12076-01-05

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Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

END OF TEST REPORT