

	Test Item
Kind of test item:	SRD for RTTT and other vehicle or fixed installation
Туре:	ARS5-B
FCC ID:	OAYARS5B
IC:	4135A-ARS5B
Frequency:	76.0 – 77.0 GHz
Antenna:	Integrated patch antenna
Power supply:	8.65 V to 16.4 V DC by Battery
Temperature range:	-40°C to +85°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:
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Karsten Geraldy Lab Manager Radio Communications & EMC

# **Test performed:**

Thomas Kautenburger Testing Manager Radio Communications & EMC

## Test report no.: 1-2461/16-04-02-A



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## 2 General information

## 2.1 Notes and disclaimer

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### This test report replaces the test report with the number 1-2461/16-04-02 and dated 2018-06-18

## 2.2 Application details

Date of receipt of order:	2017-07-26
Date of receipt of test item:	2018-03-12
Start of test:	2018-03-12
End of test:	2018-04-04
Person(s) present during the test:	Mr. Anis Ben Hamouda, Mr. Thomas Reitmayer

## 2.3 Test laboratories sub-contracted

None



## 3 Test standard/s and references

Test standard	Date	Description
CFR 47 Part 95,	April 6, 2018	The 76-81 GHz Band Radar Service
Subpart M		
RSS-251, Issue 1	Nov. 2014	Field Disturbance Sensors in the Bands 46.7-46.9 GHz (Vehicular
		Radar) and 76-77 GHz (Vehicular and Airport Fixed Radar)
RSS-GEN, Issue 4,	Mar. 2018	General Requirements for Compliance of Radio Apparatus
Amendment 1		

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
KDB 653005 D01	V01	Equipment Authorization Guidance for 76-81 GHz Radar Devices

# 4 Test environment

Temperature	:	T <sub>nom</sub> T <sub>max</sub> T <sub>min</sub>	<ul> <li>+22 °C during room temperature tests</li> <li>+85 °C during high temperature tests</li> <li>-40 °C during low temperature tests</li> </ul>		
Relative humidity content	:		55 %		
Barometric pressure	:		not relevant for this kind of testing		
Power supply	:	V <sub>nom</sub> V <sub>max</sub> V <sub>min</sub>	13.5 V DC by Battery 16.4 V 8.65 V		



# 5 Test item

# 5.1 General description

Kind of test item		SRD for RTTT and other vehicle or fixed installation
	•	
Туре	:	ARS5-B
Other model / variant identifiers		ARS 510
HMN	:	N/A
PMN	:	ARS510
HVIN	:	ARS5-B
FVIN	:	RHC_11.00.08
S/N serial number	:	A2C75352404000021830200001
HW hardware status	:	C2
SW software status	:	SW_ARS510_40.11_INT-5
Frequency band	:	76.0 – 77.0 GHz
Type of modulation	:	FMCW
Number of modes		8
Antenna		Integrated patch antenna
Power supply	:	8.65 V to 16.4 V DC by Battery
Temperature range	:	-40°C to +85°C

# 5.2 Additional information

Mode	f <sub>center</sub> [GHz]	vego [km/h]	bandwidth [MHz]
1	76.250	>115	168.4
2	76.200	>115	168.4
3	76.300	>115	168.4
5	76.250	65110	234.9
6	76.200	65110	234.9
7	76.300	65110	234.9
9	76.250	≤60	407.9
160	76.360	EOL	650.9

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:

1-2461/16-04-01\_AnnexA 1-2461/16-04-01\_AnnexB 1-2461/16-04-01\_AnnexD



## 6 Description of the test setup

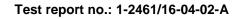
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements 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).

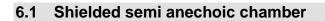
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

- k calibration / calibrated
- ne not required (k, ev, izw, zw not required)
- ev periodic self verification
- Ve long-term stability recognized
- vlkl! Attention: extended calibration interval
- NK! Attention: not calibrated

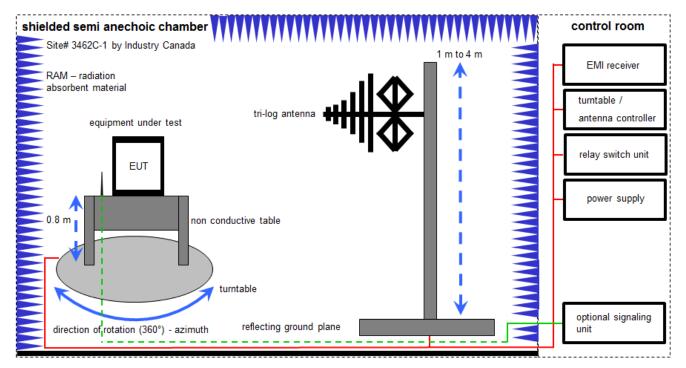
- EK limited calibration
- zw cyclical maintenance (external cyclical maintenance)
- izw internal cyclical maintenance
- g blocked for accredited testing
- \*) next calibration ordered / currently in progress





The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz 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 conform to 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.

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Measurement distance: tri-log antenna 10 meter

FS = UR + CL + AF

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

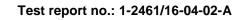
#### Example calculation:

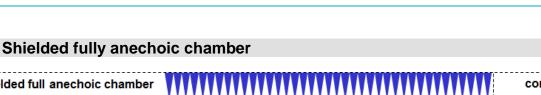
FS  $[dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$ 



# Equipment table:

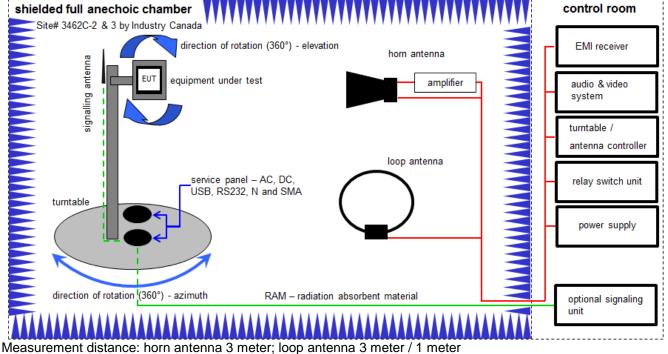
No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	50	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
2	93	Meßkabine 1	HF-Absorberhalle	MWB AG 300023		300000551	ne	-/-	-/-
3	n. a.	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	15.12.2017	14.12.2018
4	n.a.	Analyzer-Reference- System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	viKi!	15.01.2018	14.01.2020
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	295	300003787	k	25.04.2016	25.04.2018
9	n. a.	Spectrum-Analyzer	FSU26	R&S	200809	300003874	k	20.12.2017	19.12.2018





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FS = UR + CA + AF

6.2

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

# Example calculation:

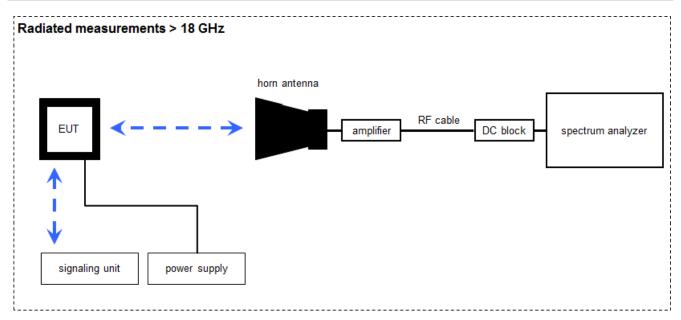
 $FS [dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$ 

# Equipment table:

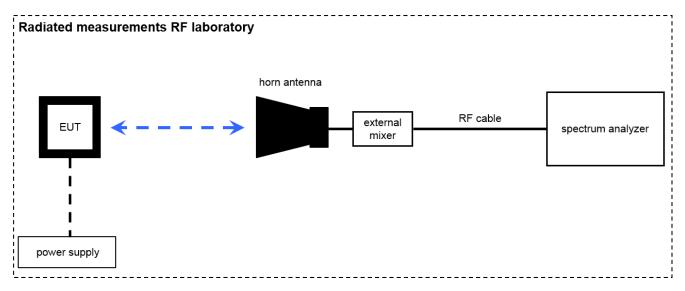
No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	viKi!	12.12.2017	11.12.2020
2	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	19	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	viKi!	14.02.2017	13.02.2019
4	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
5	9	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-
6	n. a.	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	20.12.2017	19.12.2018
7	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
8	n. a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
9	n. a.	Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22010	300004491	ev	-/-	-/-
10	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
11	n. a.	NEXIO EMV- Software	BAT EMC V3.16.0.49	EMCO		300004682	ne	-/-	-/-
12	n. a.	PC	ExOne	F+W		300004703	ne	-/-	-/-
13	n. a.	RF-Amplifier	AMF-6F06001800- 30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-



## 6.3 Radiated measurements > 18 GHz



## 6.4 Radiated measurements > 50/85 GHz



OP = AV + D - G

(OP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

#### <u>Example calculation:</u> OP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 μW)

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

# Test report no.: 1-2461/16-04-02-A



# Equipment table:

No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n.a.	Std. Gain Horn Antenna 33.0-50.1 GHz	2324-20	Flann	57	400000683	ne	-/-	-/-
2	n. a.	Harmonic Mixer 3- Port, 75-110 GHz	FS-Z110	R&S	101411	300004959	k	03.07.2017	02.07.2018
3	n. a.	Broadband LNA 18- 50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	-/-	-/-
4	n. a.	Harmonic Mixer 3- Port, 110-170 GHz	SAM-170	Radiometer Physics GmbH	100014	300004156	k	05.07.2017	04.07.2018
5	n. a.	Harmonic Mixer 2- Port, 50-75 GHz	FS-Z75	R&S	100099	300003949	k	30.06.2017	29.06.2018
6	A032	Std. Gain Horn Antenna 114-173 GHz	2924-20	Flann	*	300001999	ne	-/-	-/-
7	A028	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001991	ne	-/-	-/-
8	A026	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001986	ne	-/-	-/-
9	A023	Std. Gain Horn Antenna 39.3-59.7 GHz	2424-20	Flann	75	300001979	ne	-/-	-/-
10	n. a.	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814	g	-/-	-/-
11	A031	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	k	13.12.2017	12.12.2019
12	A027	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda		300000486	k	13.12.2017	12.12.2019
13	n. a.	Spectrum Analyzer 2 Hz - 85 GHz	FSW85	R&S	101333	-/-	k	Jan. 2018	Jan. 2019



## 7 Sequence of testing

### 7.1 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.



# 7.2 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.

- 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.



# 7.3 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.

- 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.



## 7.4 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.

- 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.



## Setup

• The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.

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- 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.

- 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.



# 8 Measurement uncertainty

Test case	Uncertainty
Equivalent isotropically radiated power (e.i.r.p.)	Conducted value ± 1 dB Radiated value ± 3 dB
Permitted range of operating frequencies	± 100 kHz
Conducted unwanted emissions in the spurious domain (up to 40 GHZ)	± 1 dB
Radiated unwanted emissions in the spurious domain (up to 40 GHz)	± 3 dB
Conducted unwanted emissions in the spurious domain (40 to 50 GHZ)	± 4 dB
Radiated unwanted emissions in the spurious domain (40 to 50 GHz)	± 4 dB
Conducted unwanted emissions in the spurious domain (50 to 300 GHZ)	± 5 dB
Radiated unwanted emissions in the spurious domain (50 to 300 GHz)	± 5 dB
DC and low frequency voltages	±3%
Temperature	± 1 °C
Humidity	±3%

## 9 Summary of measurement results

$\square$	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.

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TC Identifier	Description	Verdict	Date	Remark
RF-Testing	47 CFR Part 95 Subpart M RSS – 251 Issue 1	see below	2018-06-19	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	с	NC	NA	NP	Results (max.)
§2.1046 §95.3367 (a) / (b) RSS-251 (5.2.2)	95.3367 (a) / (b) Radiated power		Nominal	$\boxtimes$				complies
§2.1047	Modulation characteristics	-/-	-/-	$\boxtimes$				complies
§2.1049 RSS-Gen	Occupied bandwidth (99% bandwidth)	Nominal	Nominal	$\boxtimes$				complies
§2.1051	§2.1051 Spurious emissions at antenna terminals		Nominal	$\boxtimes$				see note
§2.1053 §95.3379 (a)(1) §95.3379 (a)(2) §95.3379 (a)(3) RSS-251 (5.3)	Field strength of emissions (radiated spurious)	Nominal	Nominal	$\boxtimes$				complies
§2.1055 §95.3379 (b) RSS-251 (5.4)	Frequency stability	Nominal and Extreme	Nominal and Extreme	$\boxtimes$				complies
-/-	Additional test: radiated power spectral density	Nominal	Nominal					additional test

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

## See FCC's Millimeter Wave Test Procedures:

I. A radiated method of measurements in order to demonstrate compliance with the various regulatory requirements has been chosen in consideration of test equipment availability and the limitations of many external harmonic mixers. A conducted method of measurement could be employed if EUT and mixer waveguides both are accessible and of the same type (WG number) and if waveguide sections and transitions can be found. Another potential problem is that the peak power output of devices operating under Sections 15.253 and 15.255 may exceed the +20 dBm input power limit of many commercially available mixers. For these reasons a radiated method is preferred.



## 10 Measurement results

# 10.1 Radiated power

## **Description:**

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as shown below.

## Measurement:

Parameters						
Detector:	RMS / Pos-Peak					
Sweep time:	120 s					
Resolution bandwidth:	1 MHz					
Video bandwidth:	3 MHz					
Trace-Mode:	Max Hold					

### Limits:

## FCC §95.3367 (a) (b)

Frequency	Measurement distance	Power Density 🗲 EIRP			
76.0 - 81.0 GHz	3.0 m	88 $\mu$ W/cm <sup>2</sup> $\rightarrow$ 50 dBm (Average) 279 $\mu$ W/cm <sup>2</sup> $\rightarrow$ 55 dBm (PEAK)			

### Limits:

## RSS-251 (5.2.2)

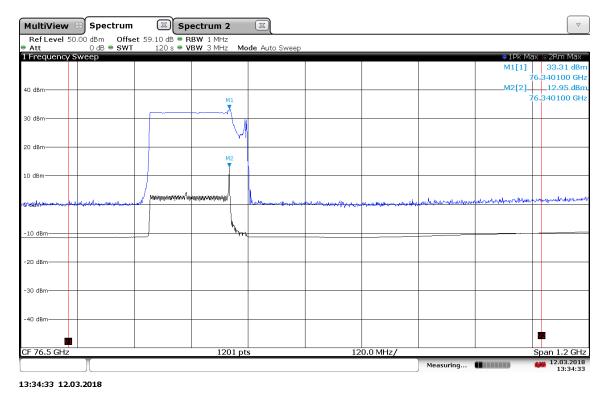
Frequency	Measurement distance	Power Density → EIRP
76.0 - 77.0 GHz	3.0 m	88 µW/cm <sup>2</sup> → 50 dBm (Average) 279 µW/cm <sup>2</sup> → 55 dBm (PEAK)

## Measurement results:

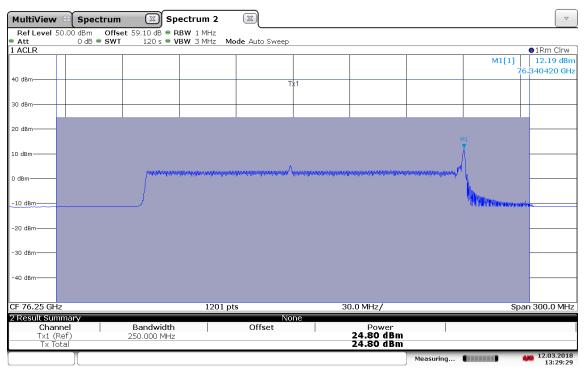
Mode	Test conditions	Radiated peak power (eirp) [dBm]	Radiated mean power (eirp) / Channel power [dBm]
1	T <sub>nom</sub> / V <sub>nom</sub>	33.3	24.8
2	T <sub>nom</sub> / V <sub>nom</sub>	32.9	24.2
3	T <sub>nom</sub> / V <sub>nom</sub>	32.4	24.0
5	T <sub>nom</sub> / V <sub>nom</sub>	32.1	24.3
6	T <sub>nom</sub> / V <sub>nom</sub>	33.4	24.3
7	T <sub>nom</sub> / V <sub>nom</sub>	33.1	24.2
9	T <sub>nom</sub> / V <sub>nom</sub>	33.0	24.2
154 (bottom)	T <sub>nom</sub> / V <sub>nom</sub>	32.4	-/-
155 (middle)	T <sub>nom</sub> / V <sub>nom</sub>	32.7	-/-
156 (top)	T <sub>nom</sub> / V <sub>nom</sub>	33.1	-/-
160	T <sub>nom</sub> / V <sub>nom</sub>	32.9	24.3



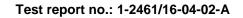
## Plot 1: Mode 1, Radiated peak power, Tnom / Vnom



Plot 2: Mode 1, Radiated mean power, Tnom / Vnom

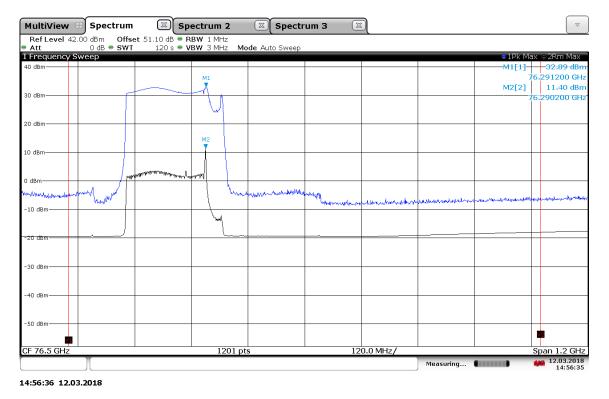


13:29:29 12.03.2018

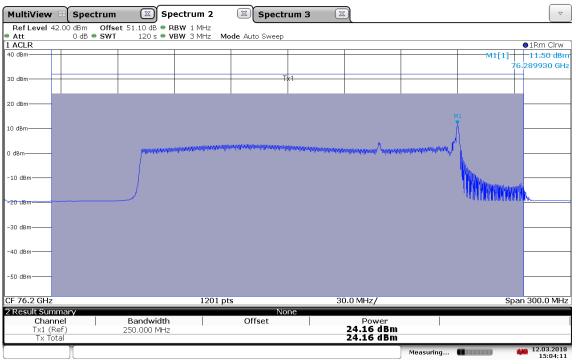




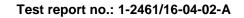
Plot 3: Mode 2, Radiated peak power, Tnom / Vnom



Plot 4: Mode 2, Radiated mean power, Tnom / Vnom

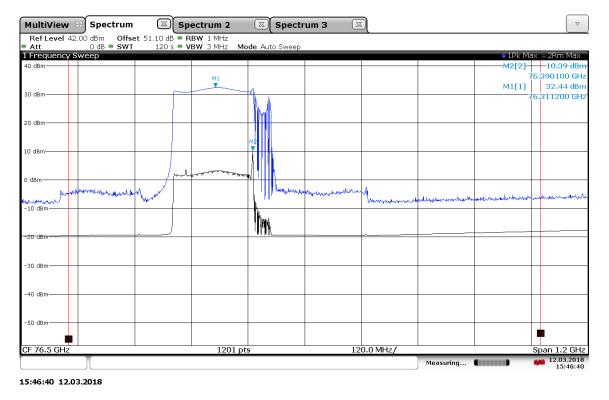


15:04:11 12.03.2018

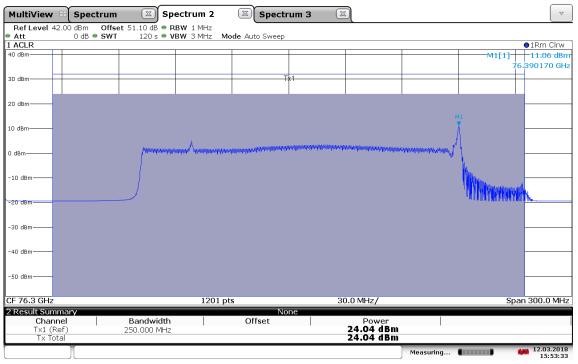




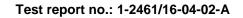
Plot 5: Mode 3, Radiated peak power, Tnom / Vnom



Plot 6: Mode 3, Radiated mean power, Tnom / Vnom

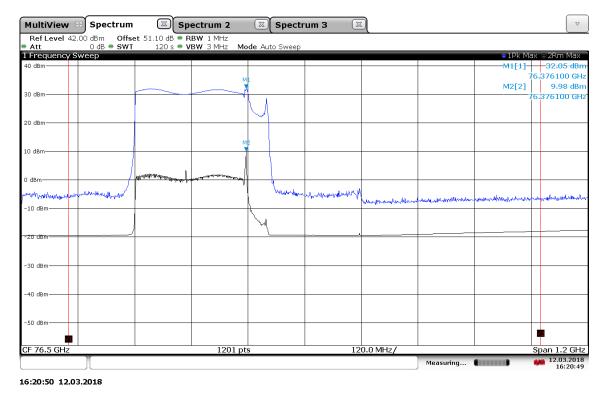


15:53:34 12.03.2018

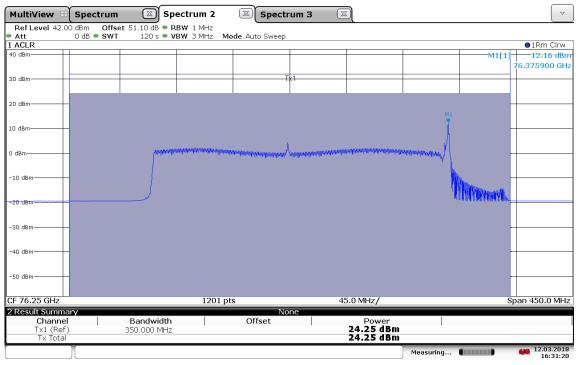




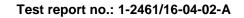
## Plot 7: Mode 5, Radiated peak power, Tnom / Vnom



Plot 8: Mode 5, Radiated mean power, Tnom / Vnom

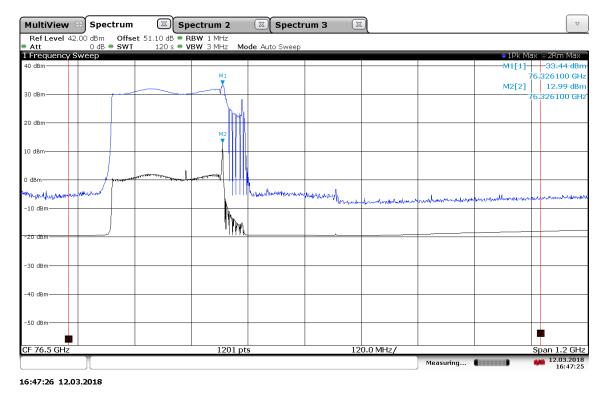


16:31:20 12.03.2018

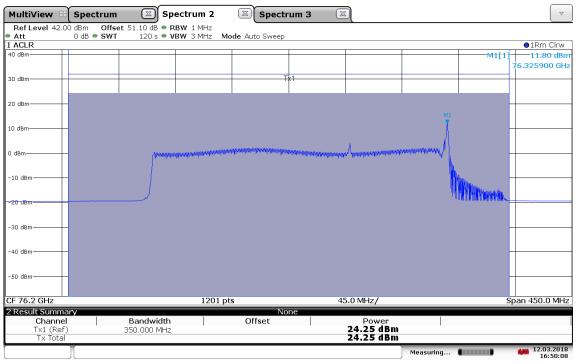




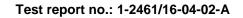
Plot 9: Mode 6, Radiated peak power, Tnom / Vnom



Plot 10: Mode 6, Radiated mean power, Tnom / Vnom

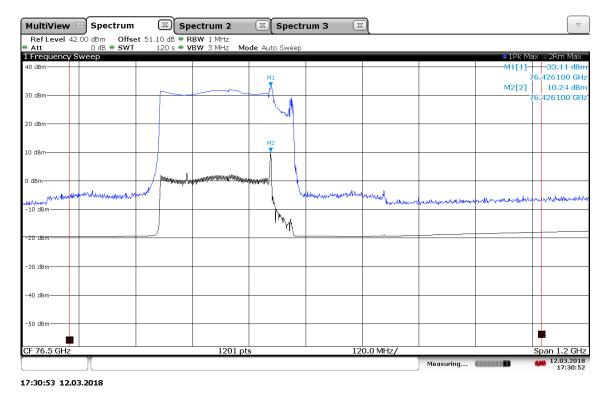


16:50:09 12.03.2018

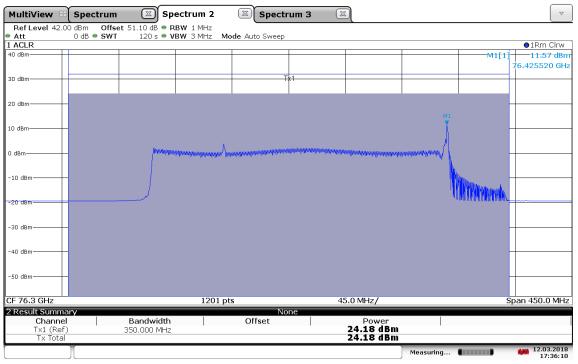




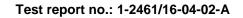
### Plot 11: Mode 7, Radiated peak power, Tnom / Vnom



Plot 12: Mode 7, Radiated mean power, Tnom / Vnom

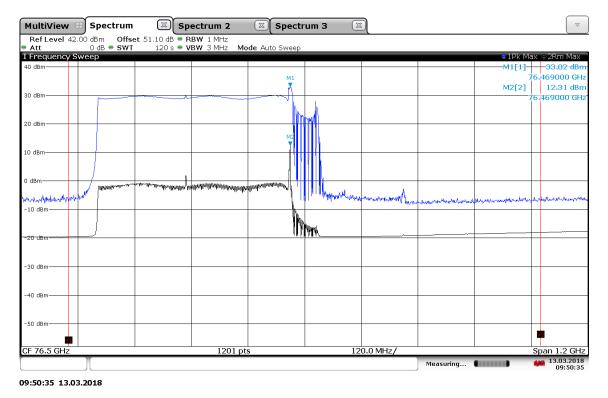


17:36:10 12.03.2018

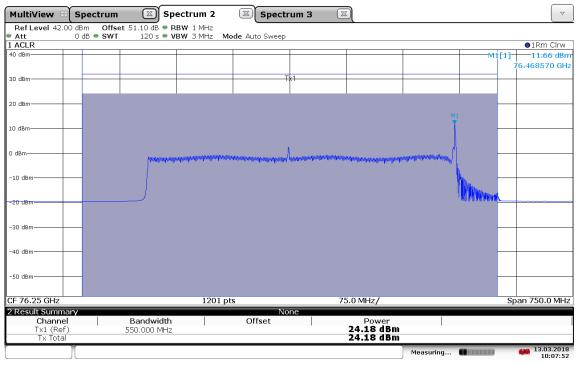




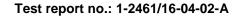
Plot 13: Mode 9, Radiated peak power, Tnom / Vnom



Plot 14: Mode 9, Radiated mean power, Tnom / Vnom



10:07:53 13.03.2018





Spectrum 2  $\bigtriangledown$ MultiView Spectrum Spectrum 3 X 
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 • RBW
 1 MHz

 Att
 0 dB
 • SWT
 120 s
 • VBW
 3 MHz
 Mode Auto Sweep Att 1 Frequency \$ veep IPk M 32.41 dBm 76.061400 GHa M1[1] 40 dBi M2[2] 22.33 dBm м1 Х 6.061400 GHz M3 30 dBi 20 dBi 10 dB n de -10 dB 30 dBi 40 dB 2 11 120<u>1 pts</u> CF 76.5 GHz 120.0 MHz/ Snan 1.2 GHz 2 Marker Table X-Value 76.0614 GHz 76.0614 GHz 76.2482 GHz 76.2482 GHz Y-Value 32.41 dBm 22.33 dBm 29.68 dBm 0.78 dBm Type | Ref | Trc | Function Function Result M1 M2 M3 M4 44 13.03.2018 11:17:58 Measuring... . 11:17:58 13.03.2018

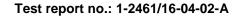
Plot 15: Stop-Mode, bottom, Radiated peak power, Tnom / Vnom

Plot 16: Stop-Mode, middle, Radiated peak power, Tnom / Vnom

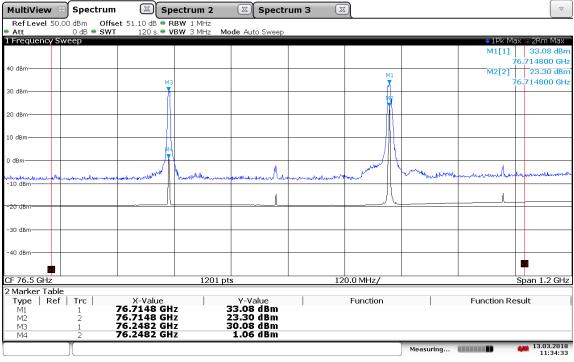
MultiView 8 Spectrum Spectrum 2 Spectrum 3 X  $\bigtriangledown$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Freq 1Pk Ma× 2Rm Max M1[1] 32.72 dBr 388100 GH 40 dBr M2[2] 21.85 dBm 388100 GHz MB 30 dBr 20 d 10 dB -10 dB 30 d 42 1 1201 pts 120.0 MHz/ Span 1.2 GHz CF 76.5 GHz 2 Marker Table Y-Value 32.72 dBm 21.85 dBm 29.97 dBm 1.46 dBm X-Value 76.3881 GHz 76.3881 GHz 76.2482 GHz 76.2482 GHz | Ref | Trc | Function Result Туре Function Ι M1 M2 М3 М4 13.03.2018 11:26:07 Measuring...

11:26:07 13.03.2018



Plot 17: Stop-Mode, Top, Radiated peak power, Tnom / Vnom



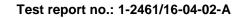
11:34:34 13.03.2018

Plot 18: Mode 160, Radiated peak power, Tnom / Vnom

MultiView 😁 Spectrum Spectrum 2 Spectrum 3 X  $\bigtriangledown$  
 Ref Level 42.00 dBm
 Offset 51.10 dB
 RBW 1 MHz

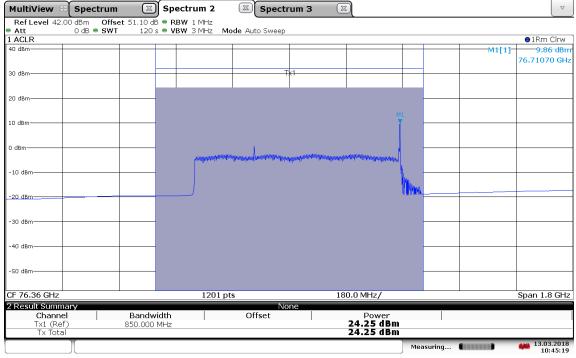
 Att
 0 dB
 SWT
 120 s
 VBW 3 MHz

 1 Frequency Sweep
 Mode Auto Sweep 1 Pk Ma 2Rm Max ⊧0 dBn M1[1] -32.93 dBr 711800 GHz м1 M2[2] 9.86 dBm 30 dBr 10800 GHz 20 dBr 10 dB 0 dBr nowhere -10 dBn M. ю., -30 dBn 40 dBn -50 dBm 22 /1 CF 76.5 GHz 1201 pts 120.0 MHz/ Measuring... -----10:27:56 13.03.2018





## Plot 19: Mode 160, Radiated mean power, Tnom / Vnom

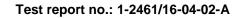


10:45:19 13.03.2018

## Plot 20: Mode 1, Time domain 76.25 GHz

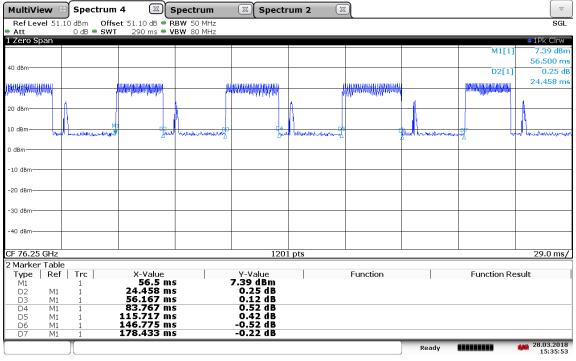
MultiView	·		pectrum	🖾 Spectr	um 2 🛛 🗵	s)			
Ref Level 5 Att	1.10 dBm C 0 dB • S	Offset 51.10 dB ● RE SWT 640 ms ● VE							SGL
1 Zero Span			0011112						1Pk Clrw
								M1[1]	7.96 dBm
40 dBm									64.667 ms
WARRAN DI MANDA	001020015200	Novierable united	naturbahu IB60/00	2004 #50000500	n haadiraanaa	a contrasta	NAMAGING	D10[1]	
<b>NGNAHATA</b>	odiotan La		<b>likatika</b> a hoosat	tow whiteh		all	<b>MANDAN</b>	<b>NAME AND AND AND AND AND AND AND AND AND AND</b>	556,138 ms
20 dBm							A   ] A		4
[] [] [] [] [] [] [] [] [] [] [] [] [] [		na D5							1 10
10 dBm	J Blorn	N41	DE WANNE	- Colonardan	A ampeter	Hannand In	human a	personal follow	vent the
0 dBm	4		4	2					<u>ь</u> ь
U UBIII									
-10 dBm									
-20 dBm									
-30 dBm									
00 000									
-40 dBm									
CF 76.25 GHz				1201	. pts				64.0 ms/
2 Marker Tal									
Type   Re M1	ef   Trc	X-Value 64.667 ms		Y-Value 7.96 dBm		Function		Function Re	sult
D2 M	-	24.4 ms		-0.41 dB					
D3M		55.867 ms		1.69 dB					
D4 M		83.6 ms 115.6 ms		-0.24 dB 2.15 dB					
D5 M D6 M		146.533 ms		-0.33 dB					
D7 M		178.0 ms		0.98 dB					
D8 M		202.0 ms		-0.53 dB					
D9 M		531.067 ms 556.133 ms		-0.47 dB -0.41 dB					
D10 M	· ·	5551155 113							28.03.2018
							Ready		15:26:48

15:26:48 28.03.2018





### Plot 21: Mode 1, Time domain 76.25 GHz



15:35:53 28.03.2018

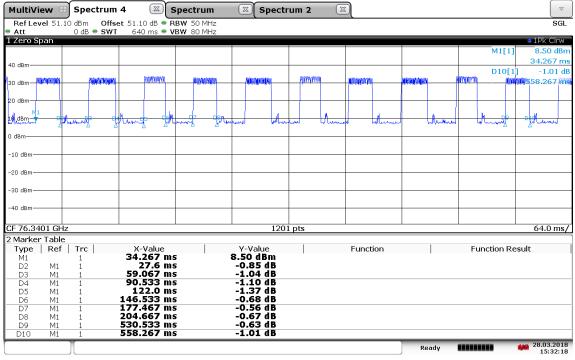
### Plot 22: Mode 1, Time domain 76.25 GHz

40 dBm	MultiViev	w 🕄 Spectrur	n 4 🖾 Spec	trum 🖾 Spectr	um 2 🛛 🖾	D			
1 Zero Span       • 12k Cirv         40 dsm       M1[1]       7.52 dsm         30 dsm       D7[1]       1.01 ds         30 dsm       0 dsm       D7[1]         10 dsm       0 dsm       0 dsm         10 dsm       0 dsm       0 dsm         20 dsm       0 dsm       0 dsm         11 0 dsm       0 dsm       0 dsm         20 dsm       0 dsm       0 dsm         11 0 dsm       0 dsm       0 dsm         20 dsm       0 dsm       0 dsm         210 dsm       1 23.8 ms       3.80 ds         23 dsm       1.03 ds       0.88 ds         24 ml									SGL
Miling         7.52 dBm           40 dBm         0				50 14112					• 1Pk Clrw
40 dBm     D7[1]     -1.01 dB       30 dBm     0 dBm     0 dBm     0 dBm       10 dBm     0 dBm     0 dBm       -10 dBm     0 dBm     0 dBm       -20 dBm     0 dBm     0 dBm       -30 dBm     0 dBm     0 dBm       -40 dBm     0 dBm     0 dBm       -55 GHz     1201 pts     14.0 ms/       201 nt     23.8 ms     -1.03 dB       D3 M1 1     29.283 ms     -1.03 dB       D4 M1 1     31.733 ms     -0.45 dB       D5 M1 1     55.767 ms     -0.45 dB </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>M1[1]</td> <td>7.52 dBm</td>								M1[1]	7.52 dBm
30 dbm     0 dbm									7.700 ms
30 dam       10 dam	40 dBm							D7[1]	-1.01 dB
30 dam       10 dam			muru					4.4	
10 dbm     10 d	30 dBm	<u>na na kana na kana na kana kana kana ka</u>	WWW	PANA A	AN ANNAL AN ARANA	MMMM		NA NA	ka ka wa wina ba ba k
10 dbm     10 d	20 dBm			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	and the sheet	i niti			ություն հերհեր
10 dBm       10 dBm	20 0011				1 10 10 10 10		đ		ihun inm
0 dBm	10 dBm 1		4				8		
-10 dBm / / / / / / / / / / / / / / /	marmalla		Marchan M. Brandward	wanter and a second second second second		Z. Mar Mar	1 en with which when then	and a solution of the solution of	
-20 dBm	0 dBm								
-20 dBm									
-30 dBm	-10 dBm								
-30 dBm									
-40 dBm     1201 pts     14.0 ms/       -40 dBm     1201 pts     14.0 ms/       CF 76.25 GHz     1201 pts     14.0 ms/       2 Marker Table     Trc     X-Value     Y-Value       Type     Ref     Trc     X-Value       M1     1     7.7 ms     7.52 dBm       D2     M1     1     23.8 ms     3.80 dB       D3     M1     1     29.283 ms     -1.03 dB       D4     M1     1     31.733 ms     0.488 dB       D5     M1     1     55.767 ms     -0.45 dB       D6     M1     1     83.067 ms     -0.64 dB       D7     M1     1     88.55 ms     -1.01 dB       D8     M1     1     91.0 ms     -0.23 dB	-20 dBm								
-40 dBm     1201 pts     14.0 ms/       -40 dBm     1201 pts     14.0 ms/       CF 76.25 GHz     1201 pts     14.0 ms/       2 Marker Table     Trc     X-Value     Y-Value       Type     Ref     Trc     X-Value       M1     1     7.7 ms     7.52 dBm       D2     M1     1     23.8 ms     3.80 dB       D3     M1     1     29.283 ms     -1.03 dB       D4     M1     1     31.733 ms     0.488 dB       D5     M1     1     55.767 ms     -0.45 dB       D6     M1     1     83.067 ms     -0.64 dB       D7     M1     1     88.55 ms     -1.01 dB       D8     M1     1     91.0 ms     -0.23 dB									
CF 76.25 GHz         1201 pts         14.0 ms/           2 Marker Table         Type         Ref         Trc         X-Value         Function         Function Result           1         7.7 ms         7.52 dBm         Function         Function Result           D2         M1         1         23.8 ms         3.80 dB         Function           D3         M1         1         29.283 ms         -1.03 dB         Function           D4         M1         1         31.733 ms         0.88 dB         Function           D5         M1         1         55.767 ms         -0.45 dB         Function           D6         M1         1         83.067 ms         -0.64 dB         Function           D7         M1         1         88.55 ms         -1.01 dB         Function           D8         M1         1         91.0 ms         -0.23 dB         Function	-30 dBm								
CF 76.25 GHz         1201 pts         14.0 ms/           2 Marker Table         Type         Ref         Trc         X-Value         Function         Function Result           1         7.7 ms         7.52 dBm         Function         Function Result           D2         M1         1         23.8 ms         3.80 dB         Function           D3         M1         1         29.283 ms         -1.03 dB         Function           D4         M1         1         31.733 ms         0.88 dB         Function           D5         M1         1         55.767 ms         -0.45 dB         Function           D6         M1         1         83.067 ms         -0.64 dB         Function           D7         M1         1         88.55 ms         -1.01 dB         Function           D8         M1         1         91.0 ms         -0.23 dB         Function	40 - 40								
2 Marker Table         Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         7.7 ms         7.52 dBm         Function         Function Result           D2         M1         1         23.8 ms         3.80 dB         Function         Function Result           D3         M1         1         29.283 ms         -1.03 dB         Function         Function Result           D4         M1         1         31.733 ms         0.88 dB         Function         Function Result           D5         M1         1         55.767 ms         -0.45 dB         Function         Function           D6         M1         1         83.067 ms         -0.64 dB         Function         Function           D7         M1         1         88.55 ms         -1.01 dB         Function         Function         Function	-40 UBm								
2 Marker Table         Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         7.7 ms         7.52 dBm         Function         Function Result           D2         M1         1         23.8 ms         3.80 dB         Function         Function Result           D3         M1         1         29.283 ms         -1.03 dB         Function         Function Result           D4         M1         1         31.733 ms         0.88 dB         Function         Function Result           D5         M1         1         55.767 ms         -0.45 dB         Function         Function           D6         M1         1         83.067 ms         -0.64 dB         Function         Function           D7         M1         1         88.55 ms         -1.01 dB         Function         Function         Function	0F 76 0F 0	<u> </u>		1001					14.0 mm /
Type         Ref         Trc         X-Value         Y-Value         Function         Function Result           M1         1         7.7 ms         7.52 dBm         Function         Function Result           D2         M1         1         23.8 ms         3.80 dB         Function         Function Result           D3         M1         1         29.283 ms         -1.03 dB         Function         Function Result           D4         M1         1         31.733 ms         0.88 dB         Function         Function           D5         M1         1         55.767 ms         -0.45 dB         Function         Function           D6         M1         1         83.067 ms         -0.64 dB         Function         Function           D7         M1         1         88.55 ms         -1.01 dB         Function         Function         28.03.2018				120.	. pts				14.0 ms/
Mi         1         7.7 ms         7.52 dBm           D2         M1         1         23.8 ms         3.80 dB           D3         M1         1         29.283 ms         -1.03 dB           D4         M1         1         31.733 ms         0.88 dB           D5         M1         1         55.767 ms         -0.45 dB           D6         M1         1         83.067 ms         -0.64 dB           D7         M1         1         88.55 ms         -1.01 dB           D8         M1         1         91.0 ms         -0.23 dB			V-Value	V-Value		Eurotion		Euroction Re	eult
D2       M1       1       23.8 ms       3.80 dB         D3       M1       1       29.283 ms       -1.03 dB         D4       M1       1       31.733 ms       0.88 dB         D5       M1       1       55.767 ms       -0.45 dB         D6       M1       1       83.067 ms       -0.64 dB         D7       M1       1       88.55 ms       -1.01 dB         D8       M1       1       91.0 ms       -0.23 dB						Tunction		TUNCUUTING	suit
D4         M1         1         31,733 ms         0.88 dB           D5         M1         1         55,767 ms         -0.45 dB           D6         M1         1         83.067 ms         -0.64 dB           D7         M1         1         88,55 ms         -1.01 dB           D8         M1         1         91.0 ms         -0.23 dB		M1 1							
D5       M1       1       55.767 ms       -0.45 dB         D6       M1       1       83.067 ms       -0.64 dB         D7       M1       1       88.55 ms       -1.01 dB         D8       M1       1       91.0 ms       -0.23 dB									
D6         M1         1         83,067 ms         -0.64 dB           D7         M1         1         88.55 ms         -1.01 dB           D8         M1         1         91.0 ms         -0.23 dB									
D7 M1 1 88.55 ms -1.01 dB D8 M1 1 91.0 ms -0.23 dB									
Postu <b>100</b> 28.03.2018	D7	M1 1	88.55 ms	-1.01 dB					
	D8	M1 1	91.0 ms	-0.23 dB					
		T T					Ready		

15:38:02 28.03.2018



### Plot 23: Mode 1, Time domain 76.34 GHz

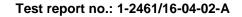


15:32:18 28.03.2018

### Plot 24: Duty Cycle, Stop-Mode, bottom

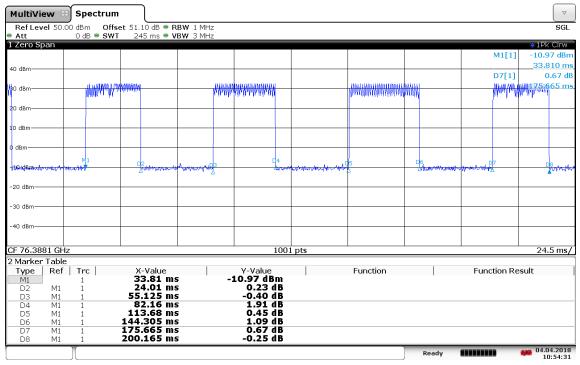
MultiView	B Spectrum								
Ref Level 3	50.00 dBm Offse	t 51.10 dB ● RE							SGL
Att 1 Zero Span	0 dB 🖷 SWT	245 ms 🔍 VB	W 3 MHz						●1Pk Clrw
1 Zero Span								M1[1]	-10.91 dBn
									21.070 m
40 dBm								D7[1]	-0.64 d
30 dBm	AND DESCRIPTION OF A DES		ALLIANALIJIMMALIA		- UNI	ALL MANAGER AND		GARAMANALAJIMINAAAAAA	<u>m 176.155 m</u>
55 4511	a she dalar a she a bar a bar a b		all hard the relief	millauth	P 11	little to constitute of		l shikhshikhshikh	μr
20 dBm									·
LO dBm									
) dBm									
M	1		1	D4					
LO GBONNAN		WWW Marshamer	WW	AN WAR	m transmithet	9	moundation	7	- CAMACOLINACOM
					_			4	12
-20 dBm									
-30 dBm									
40 dBm									
F 76.0614	GHz			1001	pts				24.5 ms
Marker Ta	ble								
	ef   Trc	X-Value		Y-Value		Function		Function Re	sult
M1	1	21.07 ms	-1	10.91 dBm					
	41 1 41 1	27.685 ms 59.045 ms		0.40 dB 0.64 dB					
	11 1 11 1	90.0 ms		2.00 dB					
	11 1	121.275 ms		0.26 dB					
	11 1	145.04 ms		0.22 dB					
	11 1	176.155 ms 202.86 ms		-0.64 dB -0.82 dB					
D8 N	11 1	202.80 MS		-v.82 aB					
							Ready		04.04.2014 10:56:21

10:56:27 04.04.2018





Plot 25: Duty Cycle, Stop-Mode, middle



10:54:32 04.04.2018

Plot 26: Duty Cycle, Stop-Mode, top

MultiView 😁	Spectrum								
Ref Level 50.00	)dBm Offse 0dB●SWT	t 51.10 dB • RI 245 ms • VE							SGL
1 Zero Span		245 ms - Vi	STALE STALE						1Pk Clrw
								M1[1]	-10.95 dBm
40 dBm									<u>36.750 m</u>
								D7[1]	0.53 dl
dBm	MANANA INA INA INA INA INA INA INA INA IN		, MANA	AMMAMAMAMA -		MMMMMMMM			175.665 m
	· · ·						<u>'</u> '	'	· · ·   ·
20 dBm									
10 dBm									
) dBm									
	M1		DЗ						De
-10wd&rp-n-humbdy-row	man from the second	- Burner	an Mymuth	D4 	from from when	05 #~	- Dant water	and the second sec	thorast
-20 dBm									
-30 dBm									
30 dbm									
40 dBm									
F 76.7148 GHz				100	pts				24.5 ms
Marker Table									
Type   Ref	Trc	X-Value		Y-Value		Function		Function Re	sult
M1	1	36.75 ms		LO.95 dBm					
D2 M1 D3 M1	1	24.01 ms 55.125 ms		0.43 dB 2.88 dB					
D4 M1	1	82.405 ms		1.16 dB					
D5 M1		113.925 ms		0.89 dB					
D6 M1 D7 M1		144.305 ms 175.665 ms		0.05 dB 0.53 dB					
D7 MI D8 M1		200.165 ms		1.67 dB					
	Υſ						Boodu		04.04.2018
	ال						Ready		10:51:59

10:51:59 04.04.2018



## **10.2 Modulation characteristics**

## **Description:**

§2.1047 (d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

## Declaration of manufacturer on modulation characteristics as required by KDB 653005 D01:

Parameter						
Duty Cycle	52% active (RF on)					
Timing	In average: 26.6 ms RF on (256 Ramps).					
	2 ms CW at 76.25 GHz					
	26.4 ms RF off.					
	Typical Cycle Time: 55ms					
	Duty Cylce: 0.52					
Power	Power constant during RF on					
Steepness of Ramps	Fixed steepness during given operation mode.					
	Only varies for different bandwidth.					
Calibration	No calibration routines applied					
Antenna Beam Steering (Tx)	No beam steering					

Modulation Type	
Characteristic	Negative Sawtooth & 1 x CW
Sweep Bandwidth	168.4/234.9/407.9/650.9 MHz Occupied Bandwidth
Sweeprate	4654 sweeps/second
Sweeptime	26.6 ms
CW Frequency	76.25 GHz
CW Timing	2ms



# 10.3 Occupied bandwidth

### **Description:**

§2.1049 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 percent of the total mean power radiated by a given emission.

### Measurement:

Parameters				
Detector:	Pos-Peak			
Sweep time:	120 s			
Resolution bandwidth:	1 MHz			
Video bandwidth:	3 MHz			
Trace-Mode:	Max Hold			
Measurement uncertainty	Span/1000			

## Limits:

## FCC §95.3379 (b)

Frequency range	f(lowest) > 76.0 GHz	f(highest) < 81.0 GHz	
-----------------	----------------------	-----------------------	--

## Limits:

RSS-251 (5.2.2) / (5.4)

Frequency rangef(lowest) > 76.0 GHzf(highest) < 77.0 GHz
--

## Measurement results:

Mode	Test conditions	Operating Frequency Range			
		f∟ [GHz]	f <sub>H</sub> [GHz]		
1	T <sub>nom</sub> / V <sub>nom</sub>	76.172484	76.352983		
2	T <sub>nom</sub> / V <sub>nom</sub>	76.122751	76.323335		
3	T <sub>nom</sub> / V <sub>nom</sub>	76.222640	76.424022		
5	T <sub>nom</sub> / V <sub>nom</sub>	76.142449	76.417616		
6	T <sub>nom</sub> / V <sub>nom</sub>	76.092797	76.367832		
7	T <sub>nom</sub> / V <sub>nom</sub>	76.192242	76.468710		
9	T <sub>nom</sub> / V <sub>nom</sub>	76.063673	76.523930		
160	T <sub>nom</sub> / V <sub>nom</sub>	76.062240	76.765610		

### Test report no.: 1-2461/16-04-02-A



### Plot 27: Mode 1, Tnom / Vnom

MultiView	B Spectrum	ı 🖾 s	pectrum 2	Spect	rum 3 🛛 🖾				
Ref Level         50.00 dBm         Offset         59.10 dB         ■ RBW         1 MHz           Att         0 dB         SWT         120 s         VBW         3 MHz         Mode         Auto Sweep									
Att 0 dB • SWT 120 s • VBW 3 MHz Mode Auto Sweep 1 Occupied Bandwidth • • • • • • • • • • • • • • • • • • •									
								M1[1]	33.20 dBm
									6.341920 GHz
40 dBm							M1		
			T1						
30 dBm			1						
20 dBm									
10 dBm			1						
10 0.000			/						
		محيهما والمعادية	r				1 M.	the start other so	
~Q. B. Howard a growthere	الدوار مناجع المعالم مخطيف المراجع المراجع المراجع	density A trade to a part of					9 19 Sectional.	1000 - 1000 - 1000 - 1000	All Mark It's All Mark Charles Mark
-10 dBm			_						
-20 dBm									
-30 dBm									
-40 dBm									
10 0011									
CF 76.25 GHz			120	01 pts	40	0.0 MHz/		Sp	an 400.0 MHz
2 Marker Tab									
Type Re		X-Value 76.34192	CH2	Y-Value 33.20 dBm	Ore Rui	Function		Function Re 80.4990597	
M1 T1	1	76.172484		31.52 dBm	Occ Bw Occ Bw Cer	ntroid	10		92 MINZ 3464 GHz
T2	ĩ	76.352983		26.36 dBm	Occ Bw Fre				4107 MHz
							Measuring		12.03.2018 13:51:31

13:51:32 12.03.2018

Plot 28: Mode 2, Tnom / Vnom

Spectrum 2 Spectrum 3 MultiView 🕀 Spectrum  $\mathbb{X}$  $\bigtriangledown$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep dwidth 1Pk Max 1 Occi M1[1] 33.03 dBn 6.290260 GH 40 dBn м1 **Д** 30 dBm 20 dBi 10 dBn 0 dBm -10 dB -20 dBi -30 dB 40 dBr 1201 pts Span 400.0 MHz 40.0 MHz/ CF 76.2 GHz 2 Marker Table 
 Marker Table

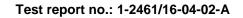
 Type
 Ref
 Trc

 M1
 1

 T1
 1

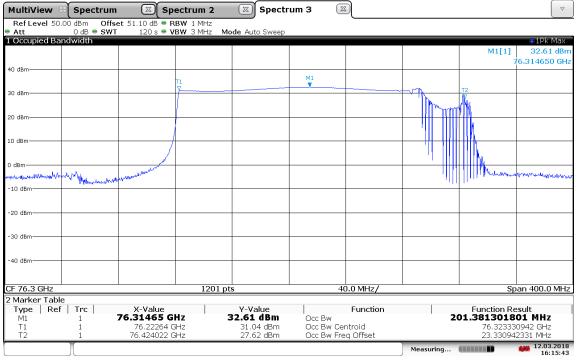
 T2
 1
 X-Value 76.29026 GHz Y-Value 33.03 dBm Function Ι Function Result 200.584037766 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset 76.122751 GHz 76.323335 GHz 30.92 dBm 29.55 dBm 76.223043195 GHz 23.043195464 MHz 12.03.2018 15:21:33 Measuring... 

15:21:33 12.03.2018





#### Plot 29: Mode 3, Tnom / Vnom



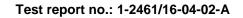
16:15:43 12.03.2018

Plot 30: Mode 5, Tnom / Vnom

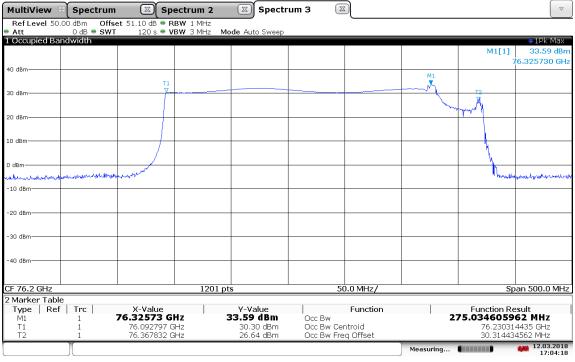
Spectrum 2 Spectrum MultiView 8 🛛 🖾 Spectrum 3 X  $\bigtriangledown$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1Pk Max 1 Occu dwidth M1[1] 32.14 dBn 6.375730 GH 40 dBr м1 30 dBn 20 dBi 10 dBm 0 dBm فلسأليتهم -10 dBr -20 dBi -30 dB 40 dBr Span 500.0 MHz CF 76.25 GHz 1201 pts 50.0 MHz/ 2 Marker Table Type | Ref | Trc | X-Value 76.37573 GHz Y-Value 32.14 dBm Function Ι Function Result 275.166784533 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.142449 GHz 76.417616 GHz 30.99 dBm 28.98 dBm 76.280032109 GHz 30.032108919 MHz T2 12.03.2018 16:38:55 ..... Measuring...

16:38:55 12.03.2018



#### Plot 31: Mode 6, Tnom / Vnom



17:04:18 12.03.2018

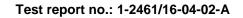
Plot 32: Mode 7, Tnom / Vnom

Spectrum 2 Spectrum MultiView 8 🛛 🖾 Spectrum 3 X  $\bigtriangledown$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Occi dwidth 1Pk Max 33.01 dBn M1[1] 6.425730 GH 40 dBr ма "Ж Т1 30 dBn 20 dBi 10 dBn 0 dBm Mandall mound -10 dBr -20 dBi -30 dBi 40 dBr Span 500.0 MHz CF 76.3 GHz 1201 pts 50.0 MHz/ 2 Marker Table Type | Ref | Trc | X-Value 76.42573 GHz Y-Value 33.01 dBm Function 1 Function Result 276.467911808 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.192242 GHz 76.46871 GHz 31.39 dBm 30.01 dBm 76.330476093 GHz 30.476092688 MHz T2 12.03.2018 17:42:36 Measuring... 

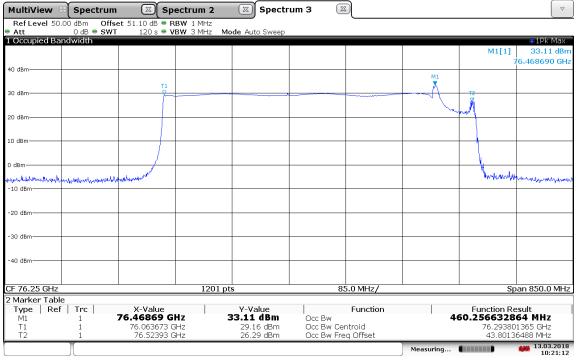
17:42:36 12.03.2018

member of RWTÜV group





#### Plot 33: Mode 9, Tnom / Vnom



10:21:12 13.03.2018

Plot 34: Mode 160, Tnom / Vnom

MultiView 8 Spectrum Spectrum 2 🛛 🖾 Spectrum 3  $\mathbb{X}$  $\bigtriangledown$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Occi dwidth 1Pk Max M1[1] 33.05 dBn 76.71170 GH 40 dBr м1 7 30 dBn 20 dBi 10 dBn 0 dBm ۰٨ ash. -10 dBn -20 dB -30 dB 40 dBi 1201 pts Span 1.6 GHz CF 76.36 GHz 160.0 MHz/ 2 Marker Table Type | Ref | Trc | X-Value 76.7117 GHz Y-Value 33.05 dBm Function I Function Result 703.36916182 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.06224 GHz 76.76561 GHz 27.58 dBm 21.46 dBm 76.413924068 GHz 53.924068472 MHz T2 13.03.2018 10:50:40 Measuring... 

10:50:41 13.03.2018



# 10.4 Band edge compliance

# **Description:**

Investigation of the emission limits at the band edge.

### Measurement:

Parameters					
Detector:	RMS / Pos-Peak				
Sweep time:	100s				
Resolution bandwidth:	1 MHz				
Video bandwidth:	3 MHz				
Trace-Mode:	Max Hold				

### Limits:

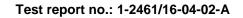
# FCC §95.3379 (a) (2) (i) + (ii) / ANSI C63.10-2013 / 6.10

Frequency Range [GHz]	Measurement distance	Power Density
40 – 200	3.0 m	600 pW/cm² → -1.7 dBm

<u>Limits:</u>		FCC §95.3379 (b)
Frequency range	f(lowest) > 76.0 GHz	f(highest) < 81.0 GHz
Limits:		RSS-251 (5.2.2)
Frequency range	f(lowest) > 76.0 GHz	f(highest) < 77.0 GHz

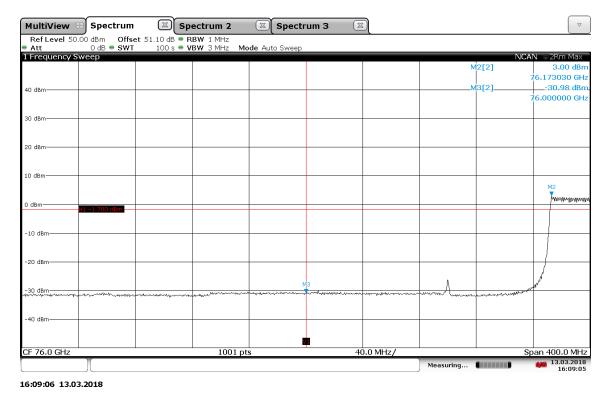
### Measurement results:

See plots below.





### Plot 35: Mode 1, lower BEC

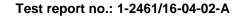


Plot 36: Mode 160, lower BEC

MultiView 🕄 Spectrum Spectrum 2 🛛 🖾 Spectrum 3 X  $\bigtriangledown$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

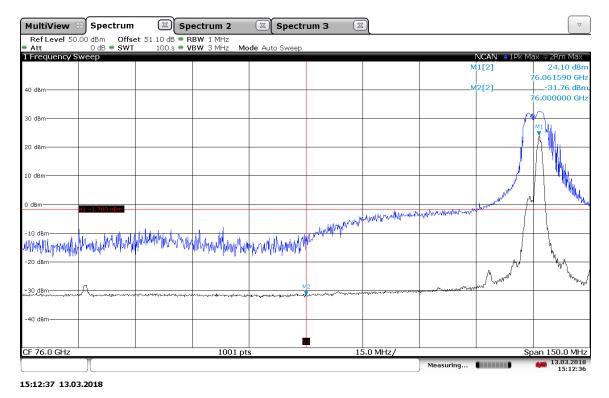
 Att
 0 dB
 SWT
 100 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Freau 2Rm Max 1[2] 2.88 dBr 6.061590 GHz 2[2] -31.47 dBm 40 dBm 6.000000 GHz 30 dBi 20 dBm 10 dBn 0 dB "Myyamana -10 dBn -20 dBn -30 dBn -40 dBn V1 CF 76.0 GHz 1001 pts 15.0 MHz/ Span 150.0 MHz Measuring... 13.03.2018 15:04:20 -----

15:04:20 13.03.2018





Plot 37: Stop-Mode, Bottom, lower BEC

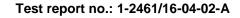


Plot 38: Mode 1, upper BEC

Spectrum 2 MultiView 😁 Spectrum Spectrum 3 X  $\bigtriangledown$  
 Ref Level 50.00 dBm
 Offset 51.10 dB
 RBW 1 MHz

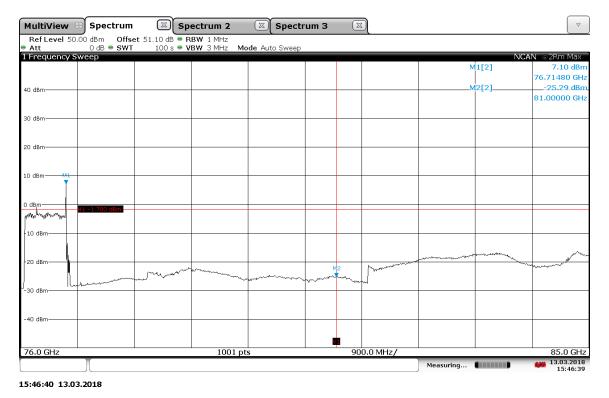
 Att
 0 dB
 SWT
 100 s
 VBW 3 MHz
 Mode Auto Sweep 1 Freq 2Rm Max 1[2] 3.72 dBr 76.33720 GH 2[2] -25.54 dBm 40 dBm 81.00000 GHz 30 dB 20 dBn 10 dBm dB - 1 d 40 dBn V1 1001 pts 900.0 MHz/ 76.0 GHz 85.0 GHz 13.03.2018 15:43:46 Measuring... 

15:43:47 13.03.2018





### Plot 39: Mode 160, upper BEC



Plot 40: Mode 6, upper BEC

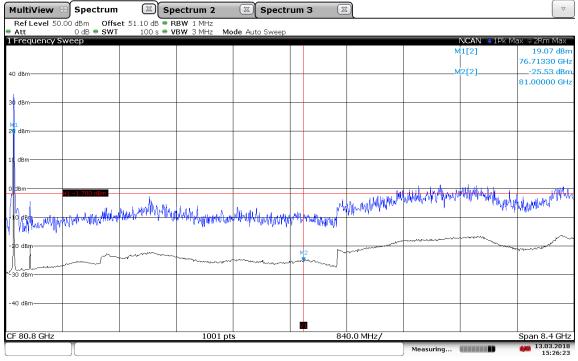
MultiView 🕄 Spectrum Spectrum 2 🛛 🖾 Spectrum 3 X  $\bigtriangledown$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 100 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Freau 2Rm Max 1[2] 5.64 dBn 76.32820 GHz <u>-25.13 dBm</u> 81.00000 GHz 12[2] 40 dBm 30 dBi 20 dBm 10 dBmn Me 10 d ٨A 30 d -40 dBn V1 1001 pts 900.0 MHz/ 85.0 GHz 76.0 GHz 13.03.2018 15:36:44 Measuring...

15:36:45 13.03.2018



### Plot 41: Stop-Mode, Top, upper BEC



15:26:23 13.03.2018

# **10.5 Field strength of spurious emissions**

# **Description:**

The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

### Limits:

### FCC §95.3379 / RSS-Gen

CTC I advanced

FCC										
CFR Part 95.3379 (a) (1) / CFR Part 95.3379 (a) (3) / RSS-Gen										
	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								
960 - 40 000	54.0	3								

### Limits:

### FCC §95.3379 (a) (2) (i) + (ii) / RSS-251 (5.3)

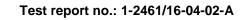
Frequency Range [GHz]	Measurement distance	Power Density
40 – 200	3.0 m	600 pW/cm <sup>2</sup> → -1.7 dBm
200 – 231	3.0 m	1000 pW/cm <sup>2</sup> → +0.5 dBm

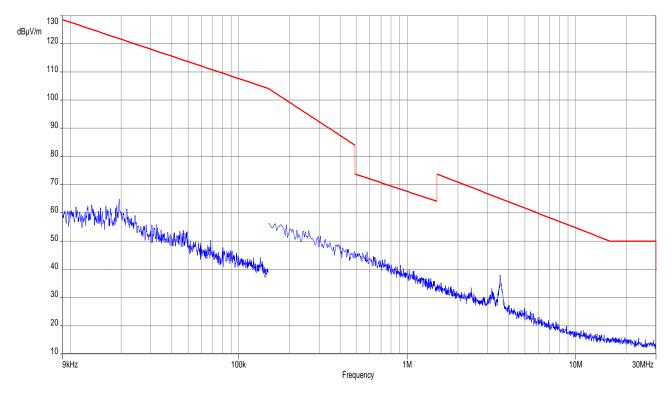
#### Measurement results:

Frequency in GHZ	Detector	Bandwidth	Level	Distance	Limit	Margin in dB
38.3571	RMS	1 MHz	35.94 dBµV	3 m	54 dBµV	-18.06
38.3571	Peak	1 MHz	43.39 dBµV	3 m	74 dBµV	-30.61
73.1175	RMS	1 MHz	-21.92 dBm	3 m	-1.7 dBm	-22.22*
73.1175	Peak	1 MHz	14.46 dBm	3 m	18.3 dBm	-3.84*
152.7762	RMS	1 MHz	-30.31 dBm	3 m	-1.7 dBm	-28.61
152.7762	Peak	1 MHz	-20.56 dBm	3 m	18.3 dBm	-38,86

\*emission is only visible during stop mode and not during normal operation

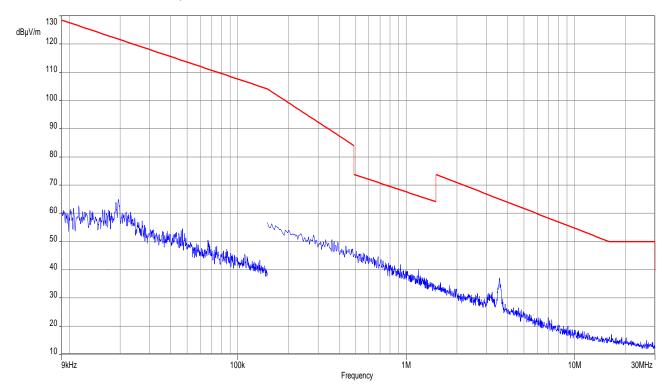
For emissions between 30 MHz and 1 GHz, please refer to plot 45 to 47.

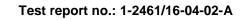


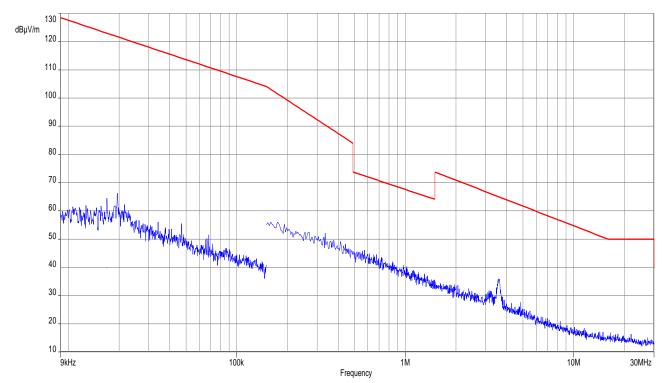


Plot 42: 9 kHz to 30 MHz, Stop-Mode, bottom

Plot 43: 9 kHz to 30 MHz, Stop-Mode, middle

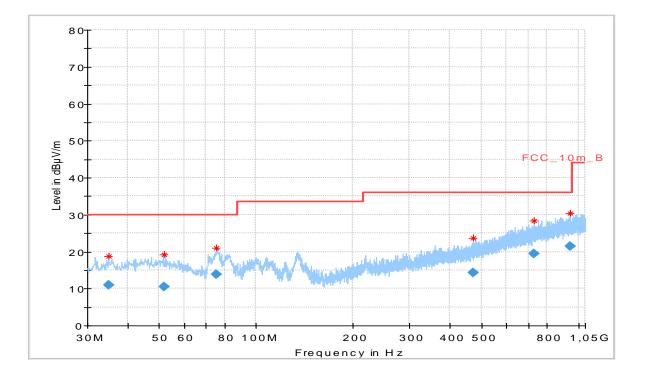






Plot 44: 9 kHz to 30 MHz, Stop-Mode, top

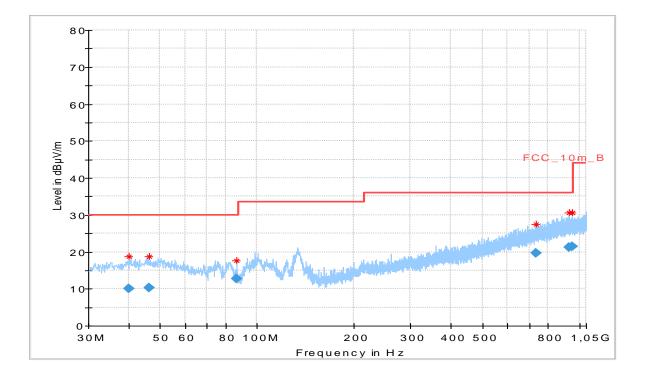
Plot 45: 30 MHz to 1 GHz, Stop-Mode, bottom



# Final\_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.026	10.85	30.0	19.15	1000	120	170.0	V	180.0	12.7
51.918	10.52	30.0	19.48	1000	120	101.0	V	90.0	13.5
75.638	13.87	30.0	16.13	1000	120	101.0	V	0.0	8.8
473.298	14.24	36.0	21.76	1000	120	98.0	V	90.0	18.2
726.982	19.46	36.0	16.54	1000	120	170.0	V	270.0	22.2
947.429	21.43	36.0	14.57	1000	120	98.0	V	90.0	24.3

Plot 46: 30 MHz to 1 GHz, Stop-Mode, middle

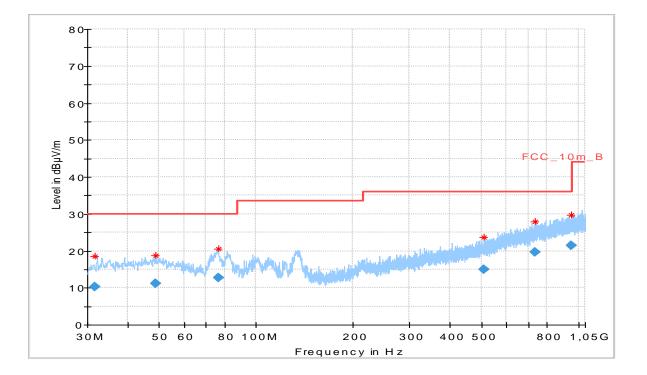


# Final\_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.074	10.13	30.0	19.87	1000	120	101.0	V	180.0	13.2
46.380	10.33	30.0	19.67	1000	120	101.0	V	0.0	13.7
86.680	12.66	30.0	17.34	1000	120	101.0	V	90.0	8.9
735.348	19.66	36.0	16.34	1000	120	170.0	Н	180.0	22.4
928.605	21.31	36.0	14.69	1000	120	98.0	Η	270.0	24.3
949.072	21.52	36.0	14.48	1000	120	170.0	Н	90.0	24.3

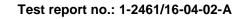


Plot 47: 30 MHz to 1 GHz, Stop-Mode, top

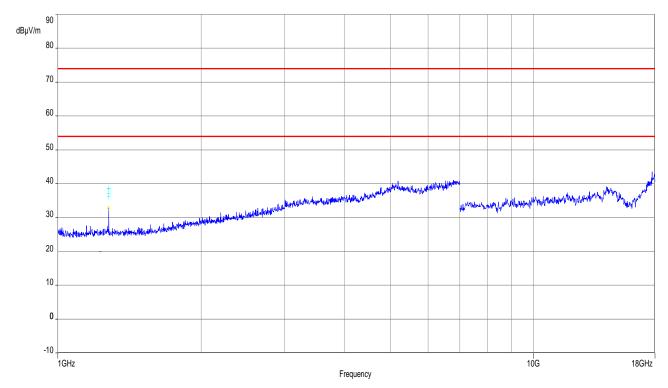


# Final\_Result

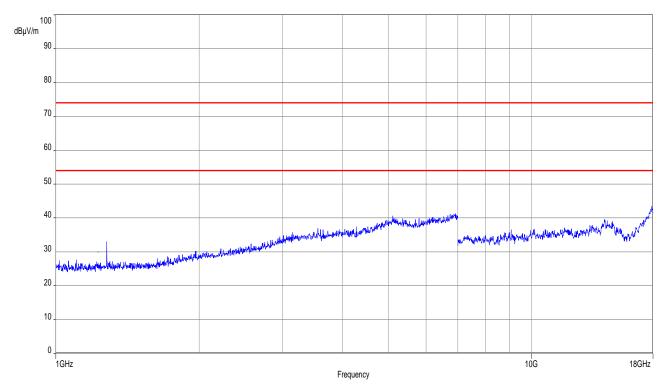
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
31.722	10.38	30.0	19.62	1000	120	101.0	V	0.0	12.1
48.793	11.23	30.0	18.77	1000	120	101.0	V	0.0	13.7
76.492	12.72	30.0	17.28	1000	120	101.0	V	180.0	8.6
509.442	14.87	36.0	21.13	1000	120	170.0	V	0.0	18.8
735.926	19.67	36.0	16.33	1000	120	170.0	V	0.0	22.4
954.407	21.49	36.0	14.51	1000	120	170.0	Н	0.0	24.4



Plot 48: 1 GHz to 18 GHz, Stop-Mode, bottom



Plot 49: 1 GHz to 18 GHz, Stop-Mode, middle



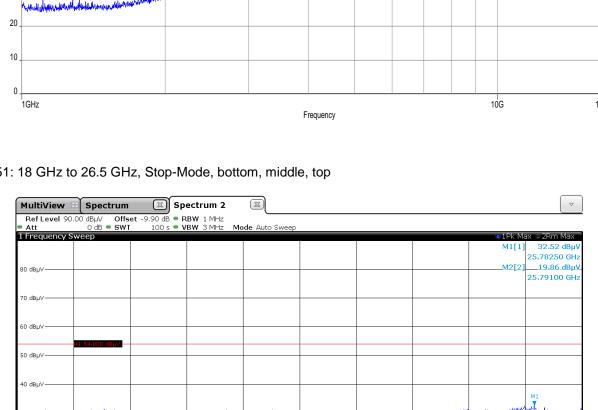
100 dBµV/m 90 80 70 60 50 40 nergen and and a sea believe allow a distribution of the second second northe and a rate of the for Warman and and any 30 والمليلة ومرادية والملاوية والملومة والمعاد ومراد والمطلق 20 10 0. 1GHz 10G 18GHz

Plot 50: 1 GHz to 18 GHz, Stop-Mode, top

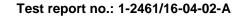
# Plot 51: 18 GHz to 26.5 GHz, Stop-Mode, bottom, middle, top

 $\bigtriangledown$ Spectrum 2 MultiView Spectrum X 
 Ref Level
 90.00 dBµV
 Offset
 -9.90 dB
 ● RBW
 1 MHz

 Att
 0 dB
 SWT
 100 s
 ● VBW
 3 MHz
 Mode Auto Si 1 Frequency 1Pk Ma 2Rm Max M1[1] 32.52 dBµ 25.78250 GH \_\_19.86 dBµ\ M2[2] 80 dBµ . 25.79100 GHz 70 dBu' 60 dBµ\ 50 dBu\ 40 dBu\ м1 "Л 30\d м2 20 dBµ' 10 dBuV o dBµ۱ 1001 pts 850.0 MHz/ 18.0 GHz 26.5 GHz 16.03.2018 13:09:48 Measuring... 13:09:48 16.03.2018









### Plot 52: 26.5 GHz to 40 GHz, Stop-Mode, bottom, middle, top

MultiView	8 Spectrum		Spectrum 2	X					
Ref Level 9			RBW 1 MHz						
Att 1 Frequency	0 dB • SW1 Sween	I IUU s	• VBW 3 MHz	Mode Auto Sweep				●1Pk M	ax ⊜2Rm Max
								M1[1]	42.33 dBµV
									38.1190 GHz
80 dBµV								M2[2]	27.76 dBµV
									38.1190 GHz
70 dBµV									
60 dBµV									
00 000									
	H1 54.000 dBμV								
50 dBµ∨									
								M1	
								Τ.	
40 dBµV					mmmmmmmmmm	about the second	martine .	All have all is	a remainder
upper and a start of the start	un when any men	manname	mongentudash	manustant	man man man and the second	and the second	and the second second	A CALL MANUTARY	and a constant the constant of
30 dBµV								M2	
~~~~~								- u	
20 dBµV									
10 dBµV									
0 dBµ∨		-							
26.5 GHz	~		1001	pts	1	.35 GHz/			40.0 GHz
	Л						Measuring		16.03.2018 11:44:11
							-		
11:44:12 16.0	3.2018								

Plot 53: 40 GHz to 50 GHz, Stop-Mode, bottom

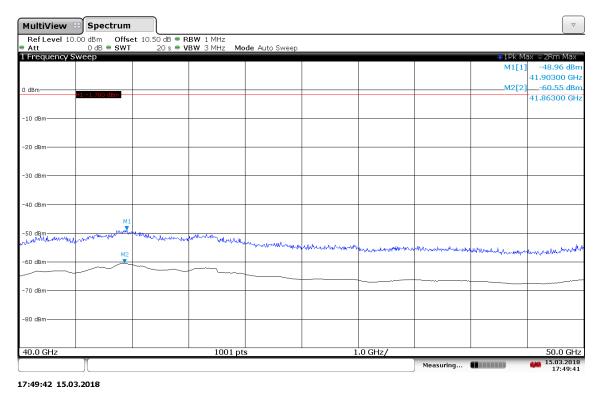
MultiView 🙁 Spectrum  $\bigtriangledown$  
 Ref Level
 10.00 dBm
 Offset
 10.50 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 20 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Freau 1Pk Max ∋2Rm Max M2[2 -60.47 dBn 41.82300 GHz M1[1] \_-47.92 dBm 0 dBm 41.82300 GHz -10 dBm -20 dBm -30 dBn -40 dBm м1 "Л -50 dBm----war Muluplanes Ma -60 dBm -70 dBm -80 dBm 40.0 GHz 1001 pts 1.0 GHz/ 50.0 GHz 15.03.2018 17:45:41 Measuring...

17:45:42 15.03.2018



Plot 54: 40 GHz to 50 GHz, Stop-Mode, middle



Plot 55: 40 GHz to 50 GHz, Stop-Mode, top

MultiView 🙁 Spectrum  $\bigtriangledown$  
 Ref Level
 10.00 dBm
 Offset
 10.50 dB
 RBW
 1 MHz

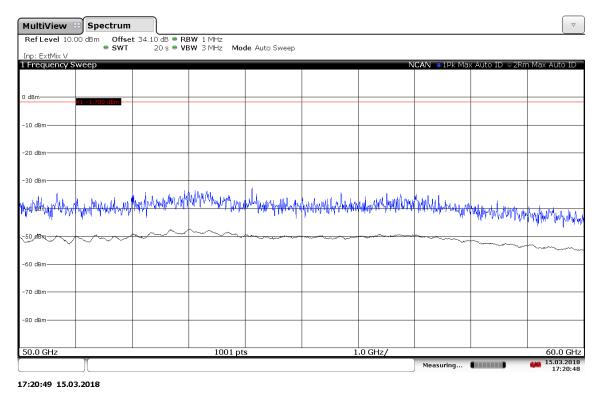
 Att
 0 dB
 SWT
 20 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Frea 1Pk Max 2Rm Max M1[1 48.85 dBn 41.76300 GHz -60.53 dBm M2[2 0 dBm 41.88300 GHz -10 dBr -20 dBm 30 dBr 40 dBn м1 -50 dBm-Western Maloren moun a route have allowed a myhalle down rown has M -60 dBm -70 dBm -80 dBm 40.0 GHz 1001 pts 1.0 GHz/ 50.0 GHz 15.03.2018 17:50:34 Measuring...

17:50:34 15.03.2018

Test report	no.: 1-24	461/16-04-02-A
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Plot 56: 50 GHz to 60 GHz, Stop-Mode, bottom



Plot 57: 50 GHz to 60 GHz, Stop-Mode, middle

MultiView	B) Spectrun	1							
Ref Level 10.0	00 dBm Offs SWT	et 34.10 dB • R		la Auto Cuisso					
Inp: ExtMix V		20 s 🖷 🖣	BAA DIMINIZ IMIOO	le Auto Sweep					
Frequency S	weep					N	ICAN ⊙1Pk Ma	k Auto ID ⊜2Rm	ı Max Auto ID
) dBm									
ubili	H1 -1.700 dBm -								
10 dBm									
20 dBm									
-30 dBm									
		La di calitat		1.					
an have have have have a	Hildrennin	11. 1. M. 11991 199	1494 All March 100	Males fait hi matel Asta	is contract tool. As	AWAMANAWA	Margaretes bern	hater a start of the start of t	
Manuel a cuttle a confidence	a Areata . Manambud a	diff and a	1 · · · · · · · · · · · · · · · · · · ·		these with the other	adam contration	C. A the standard of the second s	(~~h/Mh/1/1/M/M/Mph)	MMM Mar Maria
-50_#Bmq		$h \sim \sim$	h		r	•			i ilitaria
	$\sim\sim\sim$		~	and the second se			- areaning	name	mm -
-60 dBm									
-70 dBm									
-80 dBm									
			1001		<b>.</b>				(0,0,0).
50.0 GHz			1001 pt	5	1	.0 GHz/			60.0 GHz 15.03.2018 17:24:24

17:24:25 15.03.2018

Test report	no.: 1-2461/	16-04-02-A
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Plot 58: 50 GHz to 60 GHz, Stop-Mode, top

MultiView	B) Spectrum								
Ref Level 10.	00 dBm Offse ● SWT	t 34.10 dB • RE	3WI1 MHz 3WI3 MHz Moo	le Auto Sween					
Inp: ExtMix V		203 0 00	1100						
1 Frequency S	weep					N	CAN 💿 1 Pk Ma:	k Auto ID ⊜2Rm	i Max Auto ID
0 dBm									ļ
	H1 -1.700 dBm								
-10 dBm									
10 dbm									
00 40-									
-20 dBm									
-30 dBm									
h line within a	4.1.4.1.617	the twee descriptions	have all and an	WALL & LUCARDON N	a addar tot i hi	unin Musian	Laborer the 1		
Had ben and the state	LAN HAMAN AND A MAN	had wall	attan , darahadi	<u>taa dii Alima Nootaa aa ta dii a</u>	<del>la Maria de Maria de Maria</del>	a tablahan tahu ana t	an A AMAPAMA	mandamena	MWM Inastal J
1			~ ~		· · ·		,	1.4.4.4.4.4.4	c sanah adalah
-50 eBm	$\sim\sim\sim\sim$	$\sim\sim\sim$		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		a	Summer and a second		
-60 dBm									
-70 dBm									
-80 dBm									
50.0 GHz	T		1001 pt	5	1	.0 GHz/			60.0 GHz
							Measuring		17:25:03
7:25:03 15.0	3.2018								

Plot 59: 60 GHz to 76 GHz, Stop-Mode, bottom, middle, top

MultiView 😁 Spectrum  $\bigtriangledown$  
 Ref Level 30.00 dBm
 Offset 43.30 dB
 RBW 1 MHz

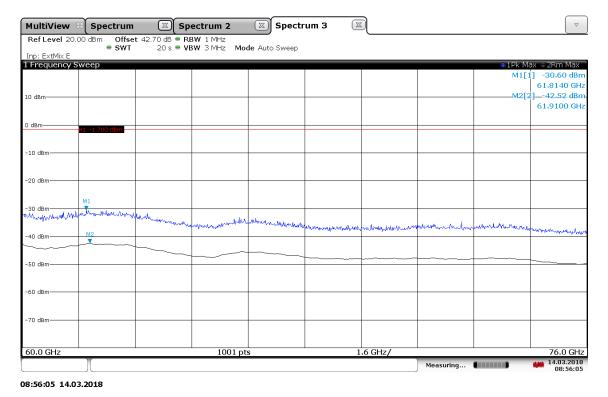
 Att
 0 dB
 SWT
 100 s
 VBW 3 MHz
 Mode Auto Sweep 1 Frea 1Pk Ma 2Rm Max M1[1 13.07 dBn 73.0800 GHz M2[2 -23.88 dBm 20 dBm 74.1520 GHz м1 **Т** 10 dBr 0 dBm -10 dBn MA -20 dBm 7 -30 dBm 40 dBrr -50 dBr -60 dBm 60.0 GHz 1000 pts 1.6 GHz/ 76.0 GHz 04.04.2018 12:47:20 Measuring... 12:47:20 04.04.2018

Note: Emissions are caused by stop mode, see also plot below

Test report	no.: 1-2461	/16-04-02-A
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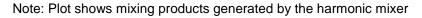
### Plot 60: 60 GHz to 76 GHz, Mode 1

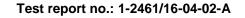


### Plot 61: 77 GHz to 110 GHz, Stop-Mode, bottom, middle, top

MultiView 🕮 Spectrum Spectrum 2 Spectrum 3 X  $\nabla$  
 Ref Level
 12.30 dBm
 Offset
 35.00 dB
 RBW
 1 MHz

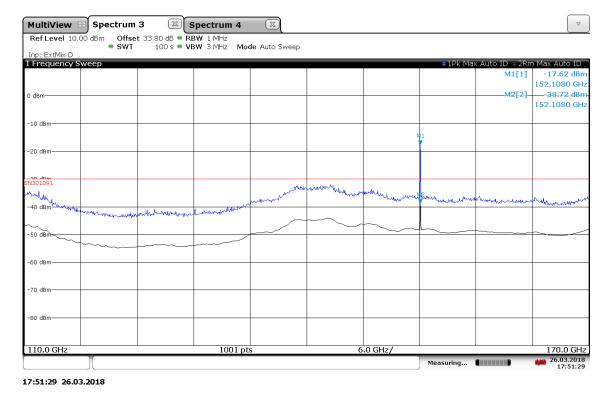
 • SWT
 20 s
 • VBW
 3 MHz
 Mode
 Auto Sweep
 ExtMix W 1 Frequency Sweep 10 dBm M1[1 -26.47 dBr 104.9400 GHz M2[2] -45.95 dBm 0 dBn 105.0050 GHz -10 dBr -20 dBm М1 μľ 30 dBn I. 40 dBm marking the M2 X -50 dBm -60 dBm 70 dB -80 dBn 77.0 GHz 1001 pts 3.3 GHz/ 110.0 GHz 44.03.2018 10:00:31 Measuring... 10:00:32 14.03.2018





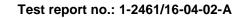


### Plot 62: 110 GHz to 170 GHz, Stop-Mode, bottom



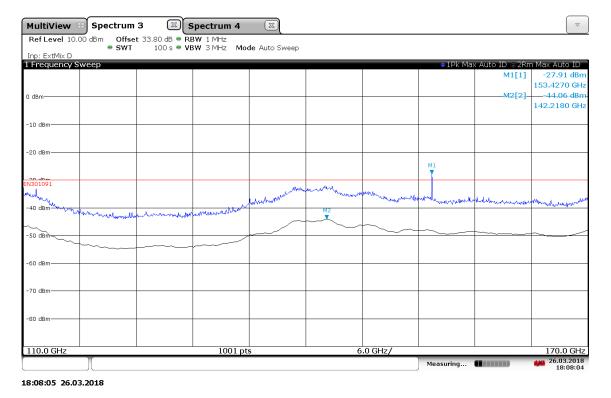
### Plot 63: 110 GHz to 170 GHz, Stop-Mode, middle

 $\nabla$ MultiView 😁 Spectrum 3 Spectrum 4 X Ref Level 10.00 dBm Offset 33.80 dB RBW 1 MHz • SWT 100 s • VBW 3 MHz Mode Auto Sweep Inn: ExtMix D 1 Frequency Sweep 1Pk Max Auto ID ⊝2Rm Max Auto ID 24.59 dBr M1[1] 152,7670 GHz M2[2] \_-44.03 dBm 0 dBm 142.2780 GHz -10 dBm -20 dBm 301091 44 -40 dBn -50 dBn -60 dBm -70 dBm -80 dBm 1001 pts 110.0 GHz 6.0 GHz/ 170.0 GHz 26.03.2018 26:03:57 Measuring... 18:03:58 26.03.2018





### Plot 64: 110 GHz to 170 GHz, Stop-Mode, top



Plot 65: 170 GHZ to 220 GHZ, Stop-Mode, bottom, middle, top

 $\bigtriangledown$ MultiView 🙁 Spectrum 
 Ref Level
 12.00 dBm
 Offset
 34.70 dB
 RBW
 1 MHz

 • SWT
 100 s
 • VBW 3 MHz
 Mode Auto Sweep
 Inn: ExtMix G 1 Frequency Sweep ●1Pk Max Auto ID ©2Rm Max Auto ID 10 dBr M1[1]-32.09 dBı 197,7970 GH; M2[2] -44.44 dBm 0 dBm 197.4480 GHz -10 dBm -20 dBm -30 dBn Mun MA noniphip 40 dBn -50 dBm -60 dBm -70 dBm -80 dBm 170.0 GHz 1001 pts 5.0 GHz/ 220.0 GHz 44.03.2018 16:40:11 Measuring... 16:40:11 14.03.2018

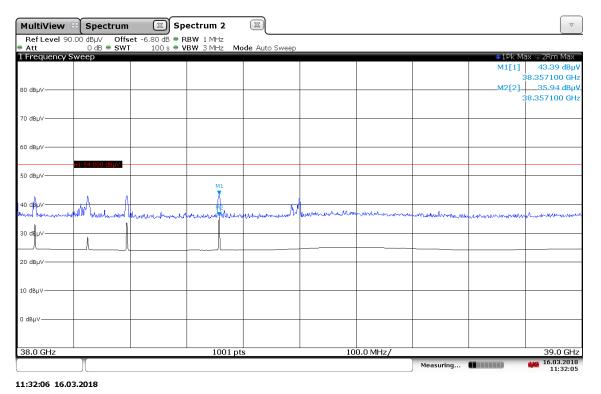
Test report	no.:	1-2461/16-04-02-A
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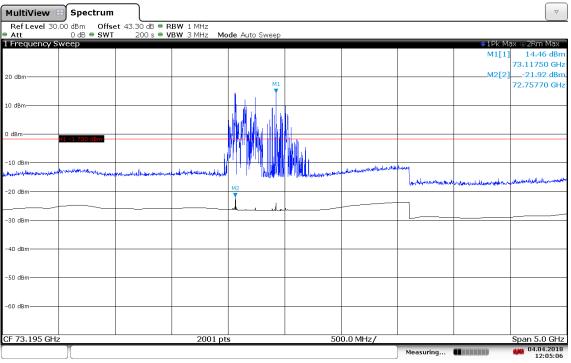
Plot 66: 220 GHz to 231 GHz, Stop-Mode, bottom, middle, top

	B Spectrum								
Ref Level 20.0	00 dBm Offse ● SWT		RBW 1 MHz VBW 3 MHz Mo⊶	de Auto Sween					
np: ExtMix J		1000							
Frequency S	weep								/lax ⊚2Rm Ma
								M1[1]	-14.44 dB
									220.7310 G
I dBm								M2[2]	
									222.5000 G
18m	H1 0.530 dBm								
0 dBm M1									
MI									
	mannotation	mananthe	mm warmater and	mon men when help	manument	marchen have men	mannahurma	alle dans a contrar a se	
0 dBm									man and a start of the
		M2							
30 dBm			+		~				
o ubiii									
0 dBm									
0 dBm									
0 dBm									
0 dBm									
20.0 GHz	1	1		s	1	1.1 GHz/	1	1	231.0 G
	)(						Measuring	()	14.03.20
							J		17:14:

Plot 67: Final measurement, 38 GHz, Stop-Mode, bottom, middle, top



© CTC advanced GmbH

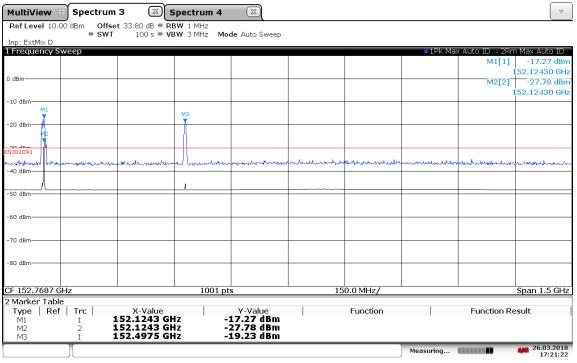


Plot 68: Final measurement, 73 GHz, Stop-Mode, bottom, middle, top

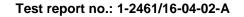
12:05:06 04.04.2018

Note: Emissions are caused by stop mode and are not visible during normal operation.

Plot 69: Final measurement, 2<sup>nd</sup> harmonic, Stop-Mode, bottom

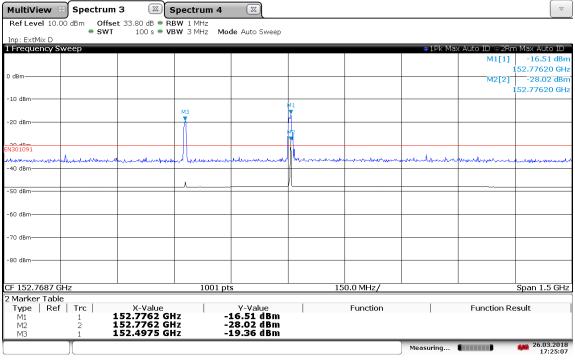


17:21:22 26.03.2018



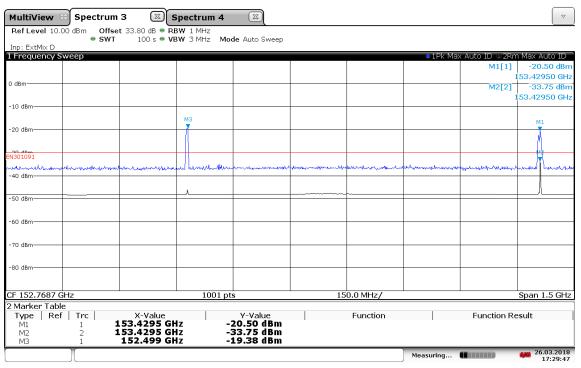


### Plot 70: Final measurement, 2<sup>nd</sup> harmonic, Stop-Mode, middle



17:25:07 26.03.2018

### Plot 71: Final measurement, 2<sup>nd</sup> harmonic, Stop-Mode, top



17:29:47 26.03.2018



# 10.6 Frequency stability

# **Description:**

(b) 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.

<u>Limits:</u>		FCC §95.3379 (b)
Frequency range	f(lowest) > 76.0 GHz	f(highest) < 81.0 GHz

### Limits:

### RSS-251 (5.2.2) / (5.4) and RSS-Gen

Note: Worst case measurement on mode 160.

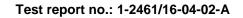
# Measurement results:

### **Temperature variation**

Temperature in °C	f∟in GHz	f <sub>H</sub> in GHz
-40	76.06462	76.78184
-30	76.06471	76.77359
-20	76.06443	76.77466
-10	76.06426	76.77599
0	76.06391	76.77519
10	76.06331	76.77034
20	76.06293	76.77257
30	76.06267	76.77222
40	76.06267	76.77183
50	76.06231	76.76957
60	76.06244	76.76756
85	76.06349	76.76942

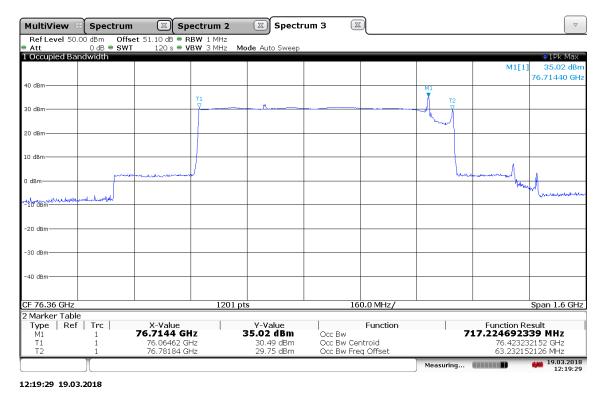
### Voltage variation

Voltage variation of rated input voltage	f⊾in GHz	f <sub>H</sub> in GHz					
85 %	Valtage variation does not offe	Voltage variation does not affect the radiated signal (see plot 74)					
115 %	vollage variation does not are						





### Plot 72: OBW, -40 °C

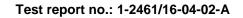


Plot 73: OBW, -30 °C

MultiView 🕫 Spectrum Spectrum 2 🛛 🖾 Spectrum 3 X  $\nabla$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

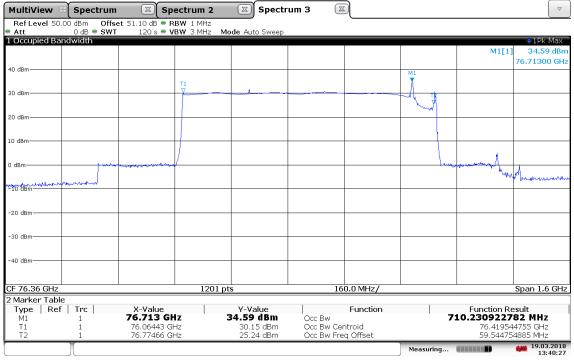
 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Occur andwidth 1Pk Max M1[1 34.82 dBn 76.71440 GHz 40 dB) 30 dBn 20 dB 10 dBm 0 dBn -10 dBm -20 dBr -30 dBn 40 dBm 12<u>01 pts</u> Span 1.6 GHz CF 76.36 GHz 160.0 MHz/ 2 Marker Table Type | Ref | Trc | X-Value 76.7144 GHz Y-Value 34.82 dBm Function Function Result 708.873294691 MHz Τ Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.06471 GHz 76.77359 GHz 30.09 dBm 24.50 dBm 76.419149105 GHz 59.149104741 MHz 19.03.2018 12:59:17 Measuring...

12:59:18 19.03.2018





### Plot 74: OBW, -20 °C



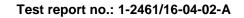
13:40:28 19.03.2018

### Plot 75: OBW, -10 °C

MultiView 🕫 Spectrum Spectrum 2 🛛 🖾 Spectrum 3 X  $\nabla$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

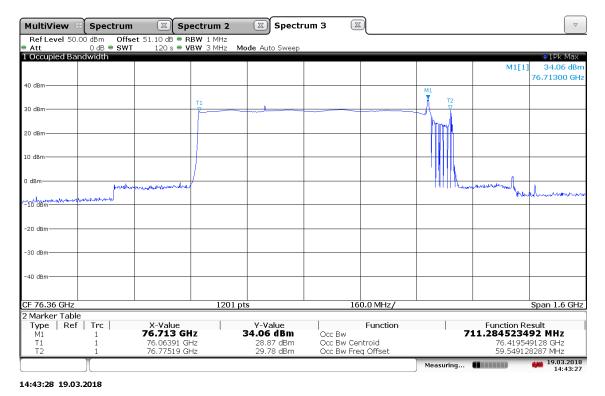
 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Occur andwidth 1Pk Max M1[1 34.30 dBn 76.71300 GHz 40 dB) N 30 dBn 20 dB 10 dBm 0 dBn Phyli -10 dBm--20 dBr -30 dBn 40 dBm 12<u>01 pts</u> CF 76.36 GHz 160.0 MHz/ Span 1.6 GHz 2 Marker Table Type | Ref | Trc | X-Value 76.713 GHz Y-Value 34.30 dBm Function Function Result 711.731341678 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.06426 GHz 76.77599 GHz 29.37 dBm 28.23 dBm 76.420126161 GHz 60.126161078 MHz 19.03.2018 14:10:42 ..... Measuring...

14:10:42 19.03.2018





### Plot 76: OBW, 0 °C

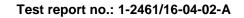


Plot 77: OBW, 10 °C

MultiView 😁 Spectrum Spectrum 2 Spectrum 3 Spectrum 4 X  $\nabla$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

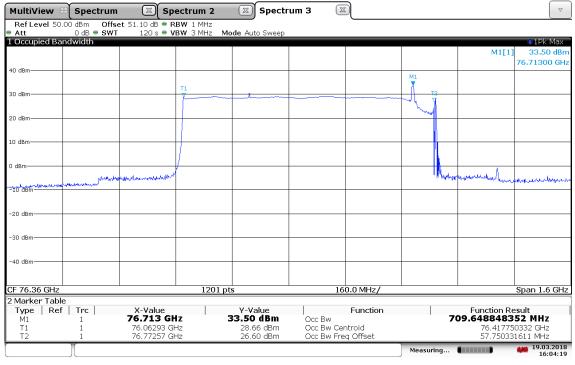
 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Occur d Bandwidth o1Pk Max M1[1 33.83 dBn 76.71300 GHz 40 dB) м1 **У** 30 dBn 20 de 10 dBm 0 dBn when when the has IIIII mound -10 dBm -20 dBr -30 dBn 40 dBm 12<u>01 pts</u> CF 76.36 GHz 160.0 MHz/ Span 1.6 GHz 2 Marker Table Type | Ref | Trc | X-Value 76.713 GHz Y-Value 33.83 dBm Function Function Result 707.030621805 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.06331 GHz 76.77034 GHz 29.05 dBm 22.23 dBm 76.416825813 GHz 56.825812587 MHz 19.03.2018 15:23:10 Measuring... 

15:23:10 19.03.2018





### Plot 78: OBW, 20 °C

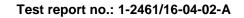


16:04:19 19.03.2018

# Plot 79: OBW, 30 °C

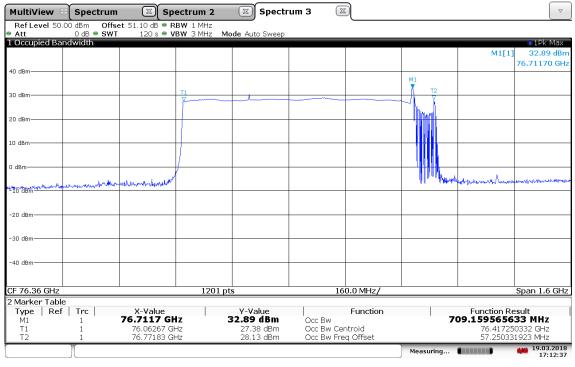
MultiView	Spectrum	🖾 s	pectrum 2	🖾 Spectr	-um 3 🛛 🖾	)				
Ref Level 50.0		et 51.10 dB 🖷								
Att 1 Occupied Ban	0 dB  SWT	120 s 🛡	VBW 3 MHz M	ode Auto Sweep						●1Pk Max
r occupied built	awidan								M1[1]	33.22 dBm
										76.71170 GHz
40 dBm										70171170 0112
							M1			
30 dBm			T1							
oo abiii			X				≁~\ ¥			
							mayor			
20 dBm										
10 dBm										
0 dBm			1							
	Box Is	his multi can amb	Á					harndin	mendenehmen	mer mar and
-10"dBm	and the second second	ana ke nga malangkan di Consa, da							and a server parallel	P.C. C.
10 0011										
-20 dBm										
-30 dBm										
-40 dBm										
CF 76.36 GHz			1201 p	ts	16	0.0 MHz/				Span 1.6 GHz
2 Marker Table										
Type Ref		X-Value		Y-Value		Function			Function Re	
M1 T1	1	76.7117 G		27.88 dBm	Occ Bw Occ Bw Cer	stroid		70	9.5539118 76.41744	
T2	1	76.77222		27.88 aBm 24.96 dBm	Occ Bw Cer				76.41744 57.44531	
	Ϋ́			2.000 0000	0000000000	9 0.000				19.03.2018
	儿						Measurin	g		16:35:56

16:35:56 19.03.2018





### Plot 80: OBW, 40 °C



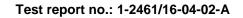
17:12:37 19.03.2018

### Plot 81: OBW, 50 °C

MultiView 🕫 Spectrum Spectrum 2 🛛 🖾 Spectrum 3 X  $\nabla$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

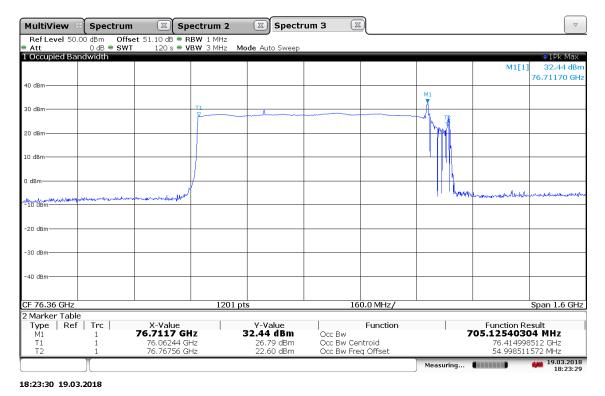
 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Occu indwidth 1Pk Max M1[1 32.37 dBn 76.71170 GHz 40 dB) м1 30 dBn 20 dB 10 dBm 0 dBn -10 dBm -20 dBr -30 dBr 40 dBm 12<u>01 pts</u> CF 76.36 GHz 160.0 MHz/ Span 1.6 GHz 2 Marker Table Type | Ref | Trc | X-Value 76.7117 GHz Y-Value 32.37 dBm Function Function Result 707.25880434 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.06231 GHz 76.76957 GHz 27.25 dBm 23.08 dBm 76.415944236 GHz 55.944236379 MHz 19.03.2018 17:56:09 Measuring...

17:56:10 19.03.2018





### Plot 82: OBW, 60 °C



Plot 83: OBW, 85 °C

MultiView 🕮 Spectrum 🖾 Spectrum 2 🛛 🖾 Spectrum 3 X  $\nabla$  
 Ref Level
 50.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweep 1 Occu indwidth 1Pk Max 31.51 dBn M1[1 76.71300 GHz 40 dB) м1 **Т** 30 dBn 20 dB 10 dBm 0 dBr Un -10 dBm -20 dBr -30 dBn 40 dBm 12<u>01 pts</u> CF 76.36 GHz 160.0 MHz/ Span 1.6 GHz 2 Marker Table Type | Ref | Trc | X-Value 76.713 GHz Y-Value 31.51 dBm Function Function Result 705.926177141 MHz Occ Bw Occ Bw Centroid Occ Bw Freq Offset M1 T1 76.06349 GHz 76.76942 GHz 27.00 dBm 26.63 dBm 76.416456366 GHz 56.456365559 MHz 19.03.2018 19:15:54 (....) Measuring...

19:15:54 19.03.2018



# 10.7 Additional test: radiated power spectral density

# **Description:**

Additional test: radiated power spectral density according to customer requirements.

### Measurement:

Parameters			
Detector:	RMS		
Sweep time:	120 s		
Resolution bandwidth:	1 MHz		
Video bandwidth:	3 MHz		
Trace-Mode:	Max Hold		

### Limits:

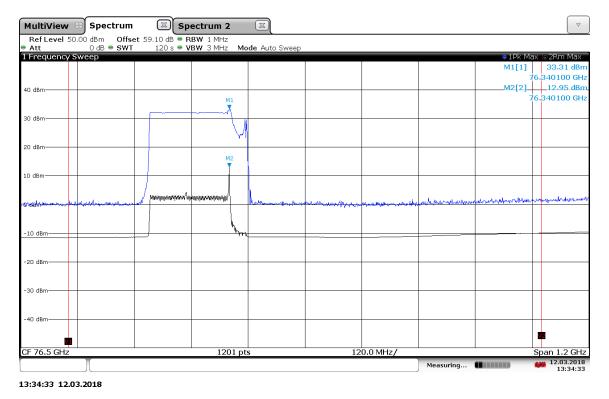
Frequency	Radiated power spectral density
76.0 - 81.0 GHz	23.5 dBm (Average)

### Measurement results:

Mode	Test conditions	Radiated power spectral density [dBm]
1	T <sub>nom</sub> / V <sub>nom</sub>	13.0
2	T <sub>nom</sub> / V <sub>nom</sub>	11.4
3	T <sub>nom</sub> / V <sub>nom</sub>	10.4
5	T <sub>nom</sub> / V <sub>nom</sub>	10.0
6	T <sub>nom</sub> / V <sub>nom</sub>	13.0
7	T <sub>nom</sub> / V <sub>nom</sub>	10.2
9	T <sub>nom</sub> / V <sub>nom</sub>	12.3
160	T <sub>nom</sub> / V <sub>nom</sub>	9.9



# Plot 84: Mode 1, Tnom / Vnom

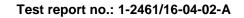


Plot 85: Mode 2, Tnom / Vnom

MultiView 😁 Spectrum Spectrum 2 Spectrum 3 X  $\nabla$  
 Ref Level
 42.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

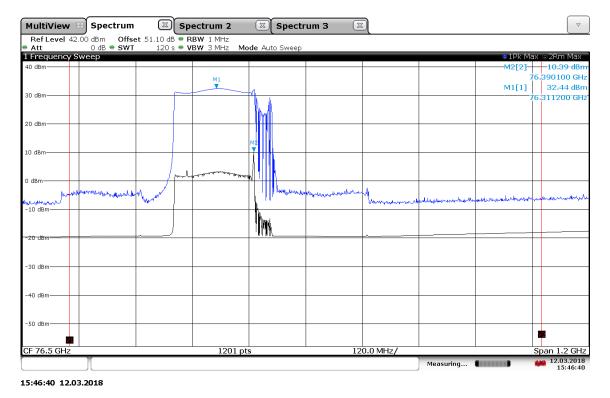
 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz

 1 Frequency Sweep
 Mode Auto Sweep 1Pk Max 2Rm Max 40 dBr M1[1] -32.89 dBr 291200 GHz м1 M2[2] 11.40 dBm 30 dBr 290200 GHz 20 dBm М2 10 dBm mi 0 dBm м a. salah maria 1 -10 dBm 20 de -30 dBn 40 dBm -50 dBr V2 vi. 120.0 MHz/ Span 1.2 GHz CF 76.5 GHz 1201 pts Measuring... 12.03.2018 14:56:35 14:56:36 12.03.2018





# Plot 86: Mode 3, Tnom / Vnom

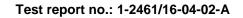


Plot 87: Mode 5, Tnom / Vnom

Spectrum 2  $\bigtriangledown$ MultiView 😁 Spectrum Spectrum 3 X 
 Ref Level
 42.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

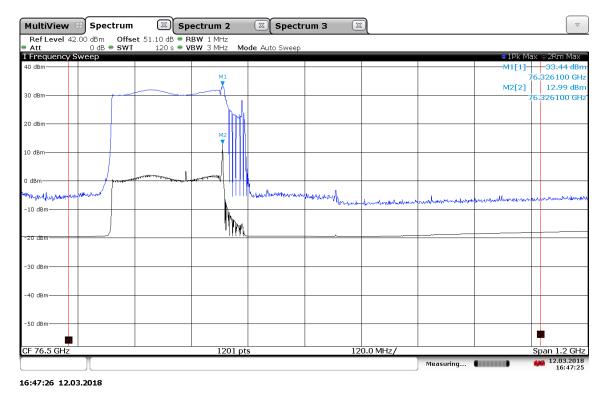
 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweer 1 Frequency Sweep 1Pk Ma 40 dBm M1[1] -32.05 dB 376100 GH M2[2] 9.98 dBm 30 dBm 76100 GHz 20 dB 10 dBm 0 dBr March manuthanter Low through out month -10 dBm 20 dB -30 dBn -40 dBm -50 dBn **V**2 ¢۵ 1201 pts Span 1.2 GHz CF 76.5 GHz 120.0 MHz/ 12.03.2018 16:20:49 Measuring...

16:20:50 12.03.2018





# Plot 88: Mode 6, Tnom / Vnom

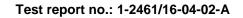


Plot 89: Mode 7, Tnom / Vnom

Spectrum 2  $\bigtriangledown$ MultiView 😁 Spectrum Spectrum 3 X 
 Ref Level
 42.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

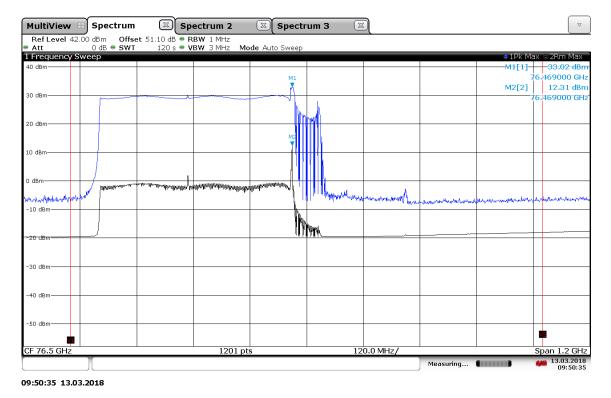
 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweet 1 Frequency Sweep 1Pk Ma Rm Max 40 dBrr M1[1] -33.11 dBr 426100 GH M1 M2[2] 10.24 dBm 30 dBm 426100 GHz 20 dB 10 dBm 0 dBr . Ma -10 dB  $\overline{h}_{M}$ 20 d8 -30 dBn -40 dBm -50 dBn **V**2 ¢۵ 1201 pts Span 1.2 GHz CF 76.5 GHz 120.0 MHz/ 12.03.2018 17:30:52 Measuring...

17:30:53 12.03.2018





### Plot 90: Mode 9, Tnom / Vnom



Plot 91: Mode 160, Tnom / Vnom

Spectrum 2  $\bigtriangledown$ MultiView 😁 Spectrum Spectrum 3 X 
 Ref Level
 42.00 dBm
 Offset
 51.10 dB
 RBW
 1 MHz

 Att
 0 dB
 SWT
 120 s
 VBW
 3 MHz
 Mode Auto Sweet 1 Frequency Sweep 1Pk Max 40 dBrr M1[1] -32,93 dB 711800 GH м1 M2[2] 9.86 dBm 30 dBn 10800 GHz 20 dB 10 dBm 0 dBr multiple М., -10 dB Without 20 dE -30 dBn 40 dBm -50 dBn **V**2 <u>ينم</u> 1201 pts Span 1.2 GHz CF 76.5 GHz 120.0 MHz/ 13.03.2018 10:27:56 Measuring... ...... 10:27:56 13.03.2018



#### 11 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 Hardware version identification number
HVIN	
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
00	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 <sub>0</sub>	Carrier to noise-density ratio, expressed in dB-Hz



# **12** Document history

Version	Applied changes	Date of release
DRAFT	Initial release – DRAFT	2018-04-13
DRAFT #2	Editorial changes based on applicant's comments	2018-05-19
	Modulation characteristics as declared by manufacturer included in report	2018-06-13
-A	Additional test results according to customer requirements included	2018-06-19

# **13** Accreditation Certificate

first page	last page
Deutsche Akkreditierungsstelle Deutsche Akkreditierungsstelle GmbH Entrastd according to Section 8 subsection 1 AkkStelleß in connection with Section 1 subsection 1 AkkStelleß Signatory to a he Multilateria Agreements of EA, ILAC and IAF for Mutual Recognition	Deutsche Akkreditierungsstelle GmbH Office Berlin Spittelmarkt 10 10117 Berlin G0327 Frankfurt am Main Gffice Braunschweig 38116 Braunschweig
Accreditation With the beutsche Akkreditierungsstelle GmbH attests that the testing laboratory. CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken Is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields: Telecommunication	The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkk5). Exempted is the unchanged form of separate
The accreditation certificate shall only apply in connection with the notice of accreditation of 02.06.2017 with the accreditation number D-P1-12076-01 and is valid until 21.04.2021. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 43 pages. Registration number of the certificate: D-P4-12076-01-83	disseminations of the cover sheet by the conformity assessment body mentioned overleaf. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAKKS. The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette 1, p. 2623) and the Regulation (EC) No 755/2008 of the European Parliament and of the Council of July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union 1.218 of July 2008, p. 30). DAKAS is a signatory to the Multilateral Agreements for Murual Recognition of the European co-operation for Accreditation (EA). International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILCL). The signatories to thes agreements recognise each other's accreditations. The up-to-date state of membership can be retrieved from the following websites:
registration number of the certificate: D-PL-L2076-0L-03	EA: www.duropean-accreditation.org ILAC: www.dlac.org IAF: www.iaf.nu

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

http://www.dakks.de/as/ast/d/D-PL-12076-01-03.pdf