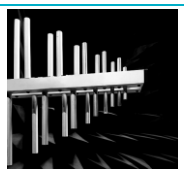
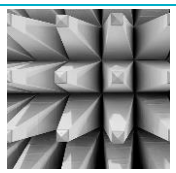




CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-2201/20-01-02-A

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-03

Testing laboratory

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

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

Applicant

Intellian Technologies, Inc.
18-7, Jinwisandan-ro, Jinwi-myeon (Chungho-ri)
17709 Pyeongtaek-si, Gyeonggi-do / SOUTH KOREA
Phone: +82-31-379-1000
Contact: Jun-Hui Lee
e-mail: Junhui.lee@intelliantech.com
Phone: +82-2-511-244
Fax: +82-2-515-4923

Manufacturer

Intellian Technologies, Inc.
18-7, Jinwisandan-ro, Jinwi-myeon (Chungho-ri)
17709 Pyeongtaek-si, Gyeonggi-do / SOUTH KOREA

Test standard/s

47 CFR Part 25	Title 47 of the Code of Federal Regulations; Chapter I; Part 25 - Satellite Communications
SRSP-101	Technical Requirements for Fixed Earth Stations Operating above 1 GHz in Space Radiocommunication Services and Earth Stations On Board Vessels (ESVs) Operating in the Fixed-Satellite Service

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

Test Item

Kind of test item:	**OneWeb OW70L UT (12dB/K)**
Model name:	**PS-OW70P**
FCC ID:	**XXZ-INTOW70LDAC**
Frequency:	RX: 10.7 GHz – 12.7 GHz TX: 14.0 GHz – 14.5 GHz
Power supply:	100 – 240 V AC, 50/60 Hz
Temperature range:	-25 °C to +55 °C

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

Test report authorized:

M. Walla
cn=Meheza Walla, o=CTC advanced GmbH, ou=WAL-200806, email=meheza.walla@ctcadvanced.com, c=DE
2021.07.22 10:48:27 +02'00'

Meheza Walla
Lab Manager
Radio Communications & EMC

Test performed:

p.o. A. Luckenbill
cn=Andreas Luckenbill, o=CTC advanced GmbH, ou=LUC-180217, email=andreas.luckenbill@ctcadvanced.com, c=DE
2021.07.22 11:08:15 +02'00'

Thomas Vogler
Lab Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.
The testing service provided by CTC advanced GmbH has been rendered under the current "General Terms and Conditions for CTC advanced GmbH".
CTC advanced GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.
Under no circumstances does the CTC advanced GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.
Under no circumstances does the CTC advanced GmbH test report include or imply any product or service warranties from CTC advanced GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CTC advanced GmbH.
All rights and remedies regarding vendor's products and services for which CTC advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by CTC advanced GmbH.
In no case this test report can be considered as a Letter of Approval.

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.

This test report replaces the test report with the number 1-2201/20-01-02 and dated 2021-06-07

2.2 Application details

Date of receipt of order:	2021-05-07
Date of receipt of test item:	2021-05-14
Start of test:	2021-05-17
End of test:	2021-05-28
Person(s) present during the test:	-/-

3 Test standard/s and references

3.1 Test standards

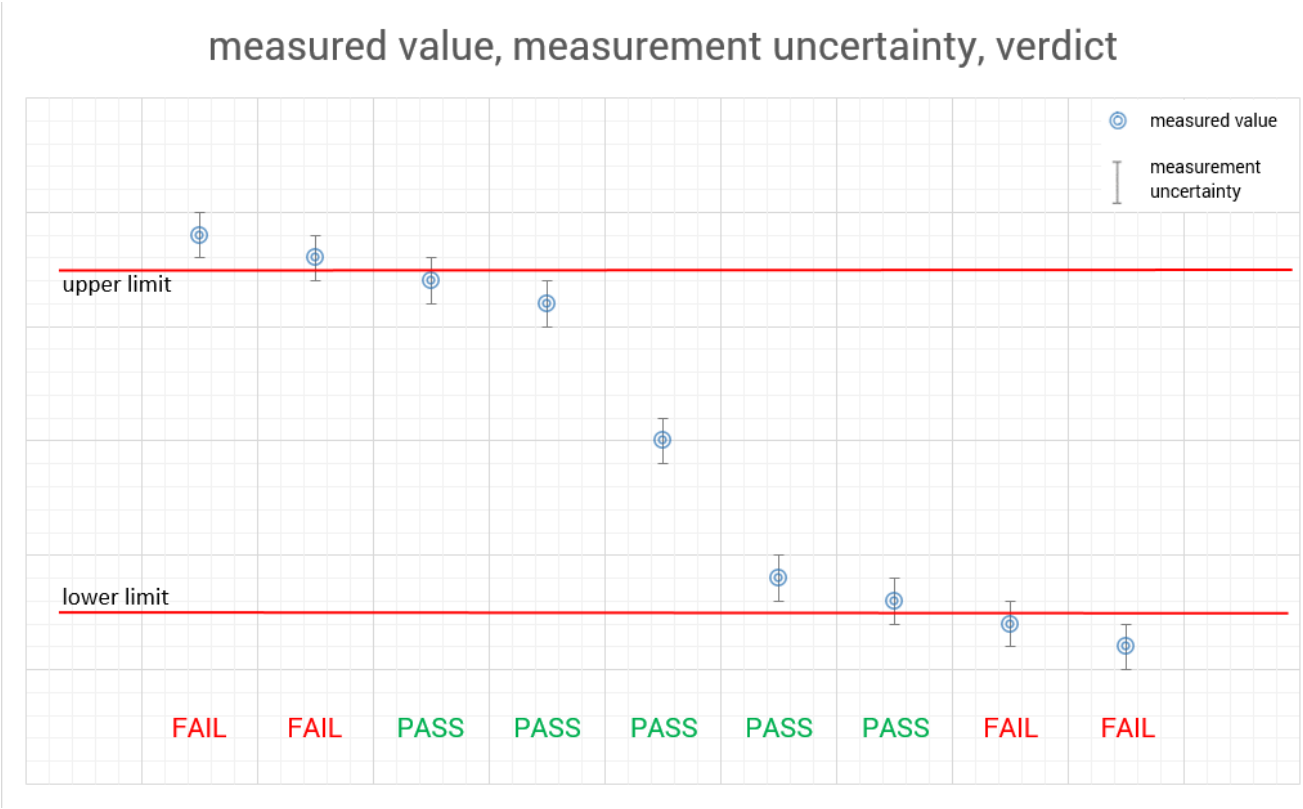
Test standard	Date	Test standard description
47 CFR Part 25	2021-03	Title 47 of the Code of Federal Regulations; Chapter I; Part 25 - Satellite Communications
SRSP-101	2019-08	Technical Requirements for Fixed Earth Stations Operating above 1 GHz in Space Radiocommunication Services and Earth Stations On Board Vessels (ESVs) Operating in the Fixed-Satellite Service

3.2 Measurement guidance

Guidance	Version	Description
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American national standard of procedures for compliance testing of unlicensed wireless devices
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

3.3 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



4 Test environment

Temperature:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests +55 °C during high temperature tests -25 °C during low temperature tests
Relative humidity content:		45 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	V_{nom} V_{max} V_{min}	120 V AC 138 V AC 102 V AC

5 Test laboratories sub-contracted

None

6 Test item

6.1 General description

Kind of test item	:	OneWeb OW70L UT (12dB/K)
Product name	:	OW70L-Dac
Model name	:	PS-OW70P
hardware version	:	prototype
software version	:	prototype
Frequency band	:	RX: 10.7 GHz – 12.7 GHz TX: 14.0 GHz – 14.5 GHz
TX output power cond	:	25.1 dBm/20 MHz (single carrier) 28.1 dBm/40 MHz (dual carrier)
Antenna gain	:	38.5 dBic at mid band
TX output power rad. (EIRP):		33.6 dBW/20 MHz (single carrier) 36.6 dBW/40 MHz (dual carrier)
Att. betw. HPA/Feed	:	0 dB
Type of radio transmission **Use of frequency spectrum**	: :	FDMA
Type of modulation	:	Tx: QPSK, 8PSK, 16QAM Rx: QPSK, 8PSK, 16APSK
Emission designator	:	18M0D7W, 36M0D7W, 18M0G7W, 36M0G7W
Channel spacing	:	Tx: 20 MHz, Rx: 250 MHz
Number of channels **Bandwidth**	: :	Tx_Dual carrier (Bandwidth 36 MHz): 20 Tx_Single carrier (Bandwith 18 MHz): 24
Power supply	:	100 – 240 V AC, 50/60 Hz 56 V DC at modem input
Temperature range	:	-25 °C to +55 °C

6.2 List of components

No.	Equipment	Manufacturer	Model name	(version, model/part number)	Serial number	Note no.	tested (Y/N)
1	CNX Broadband modem	Cybertan Technology Inc.	CNX-BB		17	-	Y
2	primary antenna unit	Intellian Technologies, Inc.	OW70L-Dac	LV-W2000-000C	OW1A21010009	-	Y
3	secondary antenna unit	Intellian Technologies, Inc.	OW70L-Dac	LV-W2000-000D	OW1B21010009	-	Y
4	RCM of primary ant. unit	Microelectronics Technology Inc.	3W-ASIC-RCM	P/N: VKU0-B23-X002 REV: R5	A000019A917	-	N
5	RCM of secondary ant. unit	Microelectronics Technology Inc.	3W-ASIC-RCM	P/N: VKU0-B23-X002 REV: R5	A000019A915	-	N
6	RCM (EUT)	Microelectronics Technology Inc.	3W-ASIC-RCM	P/N: VKU0-B23-X002 REV: R7	A000003B010	-	Y
7	AC Adaptor	Adapter Tech.	ATS250T-P560	Input: 100-240V Output: 56 V	--	-	Y

Note:
1) The item can optionally be equipped with this additional component.
2) The item can optionally be equipped with this component instead of no. xxx
3) Because of conceptional and electrical equality no. xxx was/were representatively tested as worst case.
4) This component corresponds with the no. xxx but it's not fully provided.
5) The item can be combined with this component. The test of this component is documented in test report no. xxxxx/xxxxx/xx.
6) This component was sufficiently taken into account, see test report no. xxxxx/xxxxx/xx.
7) This component is not part of the test item - it was representatively used to establish the operation and test modes.
8) This component is integrated repeatedly in the item because of redundancy - the redundant components were not tested because of equality to the primary parts.
9) This component is not relevant relating to the requirements of the test specification as well as baseband equipment - the EMC conformity and eventually the approval for connection to public telecommunication networks are only expected.

6.3 Antenna system(s)

Reflector size (m)	Concept	Manufacturer	Type	TX gain dBi (mid)	Polarization	data sheet	pattern / test report
0.70	Parabolic	Intellian	<part of OW70L-Dac>	38.5	circular RHCP & LHCP	X	report available

Note:
Verification of Antenna pattern or antenna test reports is not part of this test report.
Above listed antennas should be compliant to test standard(s) listed under section 3!

6.4 Operating conditions

Operating condition 1: QPSK single carrier, 20 MHz, channel 1 carrier 1 (=fl), channel 3 carrier 1 (=fm), channel 4 carrier 6 (= fh)
Operating condition 2: 8PSK single carrier, 20 MHz, channel 1 carrier 1 (=fl), channel 3 carrier 1 (=fm), channel 4 carrier 6 (= fh)
Operating condition 3: 16QAM single carrier, 20 MHz, channel 1 carrier 1 (=fl), channel 3 carrier 1 (=fm), channel 4 carrier 6 (= fh)
Operating condition 4: QPSK dual carrier, 40 MHz, channel 1 carrier 1/2 (=fl), channel 3 carrier 1/2 (=fm), channel 4 carrier 5/6 (= fh)
Operating condition 5: 8PSK dual carrier, 40 MHz, channel 1 carrier 1/2 (=fl), channel 3 carrier 1/2 (=fm), channel 4 carrier 5/6 (= fh)
Operating condition 6: 16QAM dual carrier, 40 MHz, channel 1 carrier 1 (=fl), channel 3 carrier 1/2 (=fm), channel 4 carrier 5/6 (= fh)

Power settings: fl = -7 dBm, fm = -7 dBm, fh = -6 dBm

Operating condition 7: Emissions disabled, TX Off, TX Keyline Off

Channel number	Carriers	Input IF Frequency (MHz)			LO (GHz)	RF Output Frequency (GHz)		
		Low	Center	High		Low	Center	High
1	1	4.0525	4.0625	4.0725	9.950	14.0025	14.0125	14.0225
	2	4.0725	4.0825	4.0925		14.0225	14.0325	14.0425
	3	4.0925	4.1025	4.1125		14.0425	14.0525	14.0625
	4	4.1125	4.1225	4.1325		14.0625	14.0725	14.0825
	5	4.1325	4.1425	4.1525		14.0825	14.0925	14.1025
	6	4.1525	4.1625	4.1725		14.1025	14.1125	14.1225
2	1	4.0525	4.0625	4.0725	10.075	14.1275	14.1375	14.1475
	2	4.0725	4.0825	4.0925		14.1475	14.1575	14.1675
	3	4.0925	4.1025	4.1125		14.1675	14.1775	14.1875
	4	4.1125	4.1225	4.1325		14.1875	14.1975	14.2075
	5	4.1325	4.1425	4.1525		14.2075	14.2175	14.2275
	6	4.1525	4.1625	4.1725		14.2275	14.2375	14.2475
3	1	4.0525	4.0625	4.0725	10.200	14.2525	14.2625	14.2725
	2	4.0725	4.0825	4.0925		14.2725	14.2825	14.2925
	3	4.0925	4.1025	4.1125		14.2925	14.3025	14.3125
	4	4.1125	4.1225	4.1325		14.3125	14.3225	14.3325
	5	4.1325	4.1425	4.1525		14.3325	14.3425	14.3525
	6	4.1525	4.1625	4.1725		14.3525	14.3625	14.3725
4	1	4.0525	4.0625	4.0725	10.325	14.3775	14.3875	14.3975
	2	4.0725	4.0825	4.0925		14.3975	14.4075	14.4175
	3	4.0925	4.1025	4.1125		14.4175	14.4275	14.4375
	4	4.1125	4.1225	4.1325		14.4375	14.4475	14.4575
	5	4.1325	4.1425	4.1525		14.4575	14.4675	14.4775
	6	4.1525	4.1625	4.1725		14.4775	14.4875	14.4975

6.5 Additional information

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:	1-2201/20-01-01_AnnexA 1-2201/20-01-01_AnnexB 1-2201/20-01-01_AnnexC
Test plots are included in test report:	1-2201/20-01-01_AnnexD

7 Description of the test setup

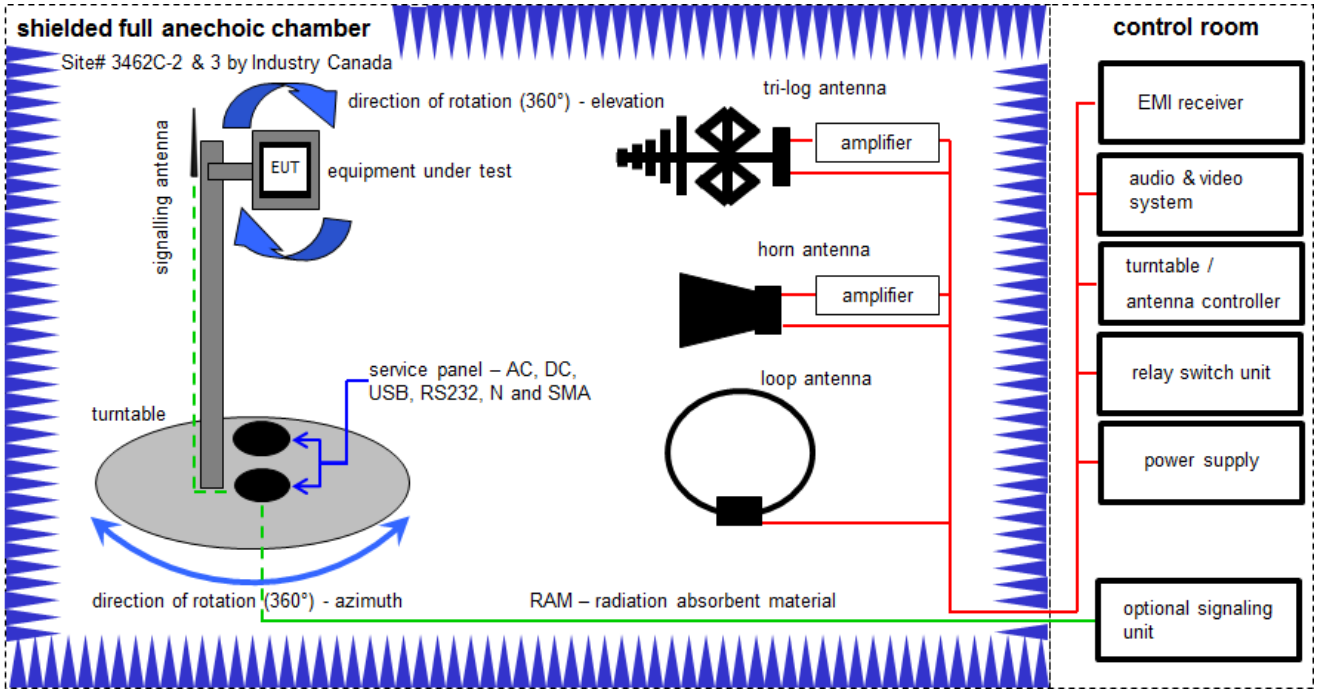
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements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

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

Agenda: Kind of Calibration

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

7.1 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter; loop antenna 3 meter
BAT-EMC software version: 3.16.0.49

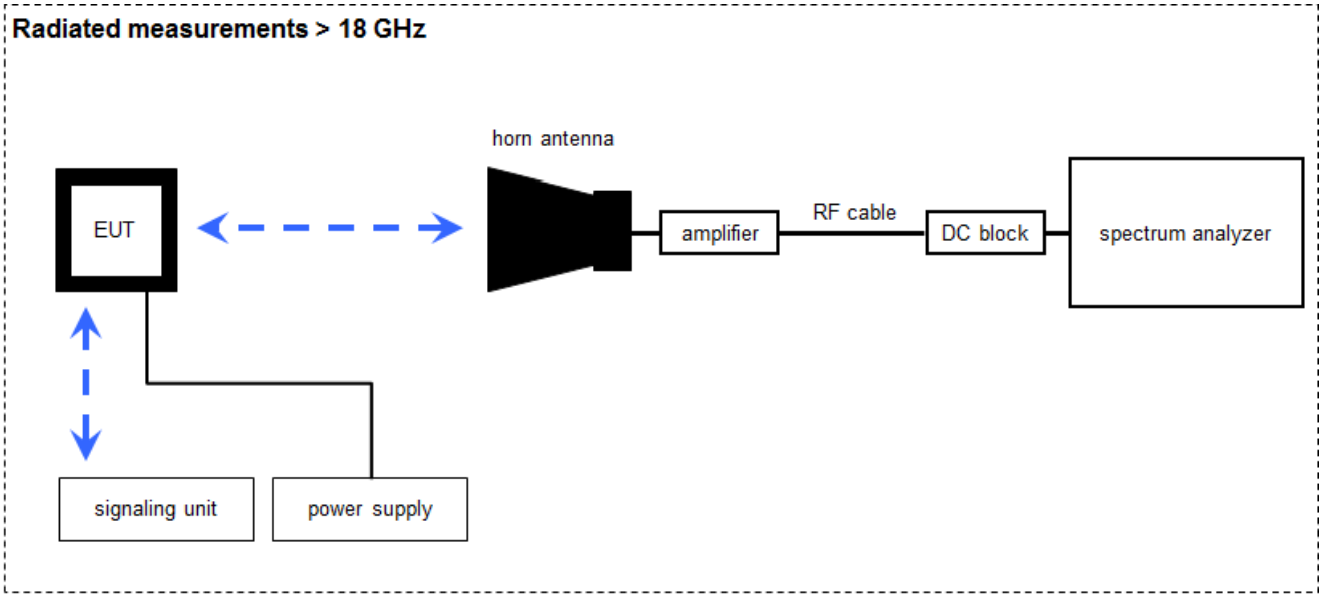
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

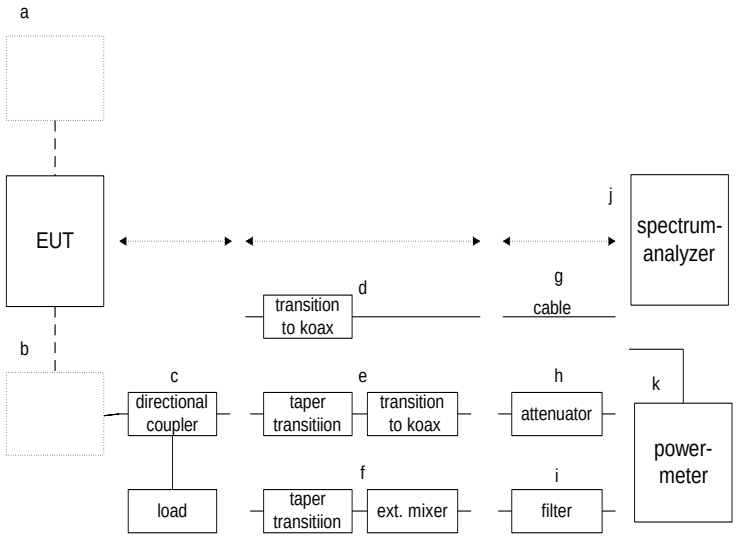
Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vIKI!	09.12.2020	08.12.2023
2	n. a.	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vIKI!	13.06.2019	12.06.2021
3	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	371	300003854	vIKI!	14.01.2020	13.01.2022
5	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5289	300000213	vIKI!	14.07.2020	13.07.2022
6	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
7	n. a.	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-
8	n. a.	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2020	10.12.2021
9	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
10	n. a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
11	n. a.	Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22010	300004491	ev	-/-	-/-
12	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
13	n. a.	NEXIO EMV-Software	BAT EMC V3.16.0.49	EMCO		300004682	ne	-/-	-/-
14	n. a.	PC	ExOne	F+W		300004703	ne	-/-	-/-
15	n. a.	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-

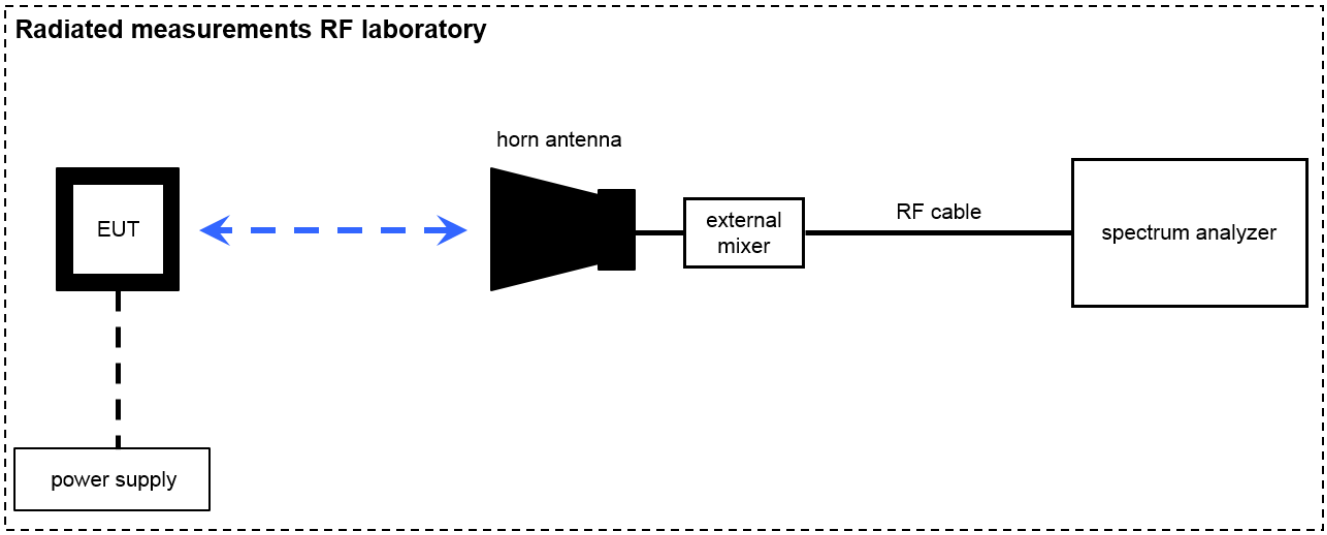
7.2 Radiated measurements > 18 GHz



7.3 Conducted measurements



7.4 Radiated measurements > 50 GHz

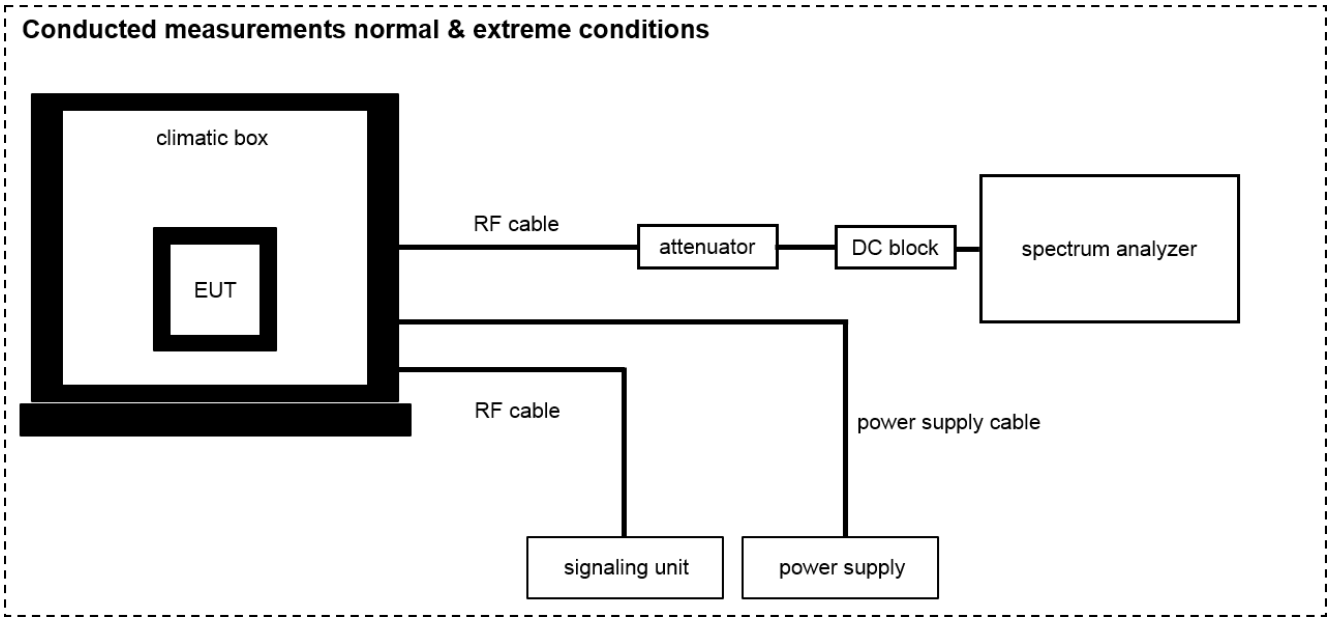


OP = AV + D - G
(OP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

Example calculation:
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.

7.5 Conducted measurements extreme conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A019	Std. Gain Horn Antenna 17.6-26.7 GHz	2024-20	Flann	156	300001968	ne	-/-	-/-
2	A021	Std. Gain Horn Antenna 26.4-40.1 GHz	2224-20	Flann	233	300001973	ne	-/-	-/-
3	A023	Std. Gain Horn Antenna 39.3-59.7 GHz	2424-20	Flann	75	300001979	ne	-/-	-/-
4	A025	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne	-/-	-/-
5	R011	Dual-channel power meter with GPIB	438A	HP	2730U00683	300000852	vlKl!	08.12.2020	07.12.2022
6	W009	Directional Coupler 40 dB 9.84-15.0 GHz	17132-40	Flann	62	300002156	ev	-/-	-/-
7	W019	Dummy Load	HPT75-120	CMT	921726-002	300002139	ne	-/-	-/-
8	W022	Waveguide Taper-transitions	several	Flann		300001615	ev	-/-	-/-
9	W063	Waveguide to K Type Coax Adaptor 17.6-26.7 GHz	20094-KF	Flann	85	300002009	ev	-/-	-/-
10	W065	Waveguide to K Type Coax Adaptor 26.4-40.1 GHz	22093-KF20	Flann	1151	300000940	ne	-/-	-/-
11	R009	Power Sensor, 10 MHz to 18 GHz, -30 to +20 dBm	8481A	HP	2702A65984	300001197	vlKl!	16.12.2019	15.12.2021
12	n. a.	Coaxial Adaptor 2,4-Waveguide	410B	mi-wave	none	300002848	ne	-/-	-/-
13	C107	Coax cables	div.	H&S	div.	-/-	ev	-/-	-/-
14	n.a.	Temperature Test Chamber	T-40/50	CTS GmbH	064023	300003540	ev	08.05.2020	07.05.2022
15	R001	Signal- and Spectrum Analyzer 3 Hz - 50 GHz	PXA N9030A	Agilent Technologies	US51350267	300004338	k	01.04.2021	31.03.2022
16	R025	Harmonic Mixer, 50-80 GHz	M1970V	Keysight	MY51390914	300005116	k	19.08.2020	18.08.2021

8 Sequence of testing

8.1 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.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

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

Premeasurement

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

Final measurement

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

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

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

Premeasurement

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

Final measurement

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

8.4 Sequence of testing radiated spurious above 18 GHz

Setup

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

Premeasurement

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

Final measurement

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

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

Setup

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

Premeasurement

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

Final measurement

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

9 Measurement results

9.1 Summary

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

TC identifier	Description	Verdict	Date	Remark
RF-Testing	CFR 47 Part 25 (Ku-Band)	see below	2021-07-22	-/-

Test Specification Clause	Test Case	C	NC	NA	NP	Remark
§2.1046 §25.218	Measurements required: RF power output / Off-axis EIRP spectral density	X				
§2.1046 §25.204	Measurements required: RF power output / Power limits	X				
§2.1049	Measurements required: Occupied bandwidth	X				
§2.1051 §25.202	Measurements required: Spurious emissions at antenna terminals / Emission limitations (conducted emissions)	X				
§2.1053 §25.202	Measurements required: Field strength of spurious radiation / Emission limitations (radiated emissions)	X				
§2.1055 §25.202	Measurements required: Frequency stability / Frequency tolerances	X				

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

9.2 Off-Axis EIRP Spectral Density

Description / Limit:

§2.1046 Measurements required: RF power output.
§25.218 Off-axis EIRP density envelopes for FSS earth stations transmitting in certain frequency bands.
(f) *Digital earth station operation in the conventional Ku-band.*
(1) For co-polarized transmissions in the plane tangent to the GSO arc:

$15-25\log_{10}\theta$	dBW/4 kHz	for $1.5° \le \theta \le 7°$.
−6	dBW/4 kHz	for $7° < \theta \le 9.2°$.
$18-25\log_{10}\theta$	dBW/4 kHz	for $9.2° < \theta \le 19.1°$.
−14	dBW/4 kHz	for $19.1° < \theta \le 180°$.

Where θ is as defined in paragraph (c)(1) of this section. The EIRP density levels specified for θ > 7° may be exceeded by up to 3 dB in up to 10% of the range of theta (θ) angles from ±7-180°, and by up to 6 dB in the region of main reflector spillover energy.
(2) For co-polarized transmissions in the plane perpendicular to the GSO arc:

$18-25\log_{10}\theta$	dBW/4 kHz	for $3° \le \theta \le 19.1°$.
−14	dBW/4 kHz	for $19.1° < \theta \le 180°$.

Where θ is as defined in paragraph (c)(1) of this section. These EIRP density levels may be exceeded by up to 6 dB in the region of main reflector spillover energy and in up to 10% of the range of θ angles not included in that region, on each side of the line from the earth station to the target satellite.
(3) For cross-polarized transmissions in the plane tangent to the GSO arc and in the plane perpendicular to the GSO arc:

$5-25\log_{10}\theta$	dBW/4 kHz	for $1.5° \le \theta \le 7°$.

Where θ is as defined in paragraph (c)(1) of this section.

Subtracting the antenna gain values given in **§25.209 Earth station antenna performance standards** from these limits, leads to a maximum conducted output power limit of -14 dBW/40kHz.

Test setup:
Test setup 7.3

Plots:
see Annex K, chap. 2, plots 81 - 90

9.3 RF power output / Power limits / Occupied bandwidth

Description / Limit:

§25.204 Power limits
(a) In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits except as provided for in paragraph (c) of this section:
+40 dBW in any 4 kHz band for $\theta \leq 0°$
+40 + 3 * θ dBW in any 4 kHz band for $0° < \theta \leq 5°$
θ = elevation angle above horizon

(c) For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.

Measurement results:

Power measurement with power meter

state	freq. (range)	reading level	data of correction attenuation / loss			result					remark
			direct coupl.	cable	att.	conducted power			ant. gain	EIRP	
	GHz	dBm	dB	dB	dB	dBm	dBW	W	dBi	dBW	
mod	14.0125	-14.1	39.6	--	--	25.5	-4.5	0.35	38.5	34	QPSK, single carrier
mod	14.0125	-13.8	39.6	--	--	25.8	-4.2	0.38	38.5	34.3	8PSK, single carrier
mod	14.0125	-14.4	39.6	--	--	25.2	-4.8	0.33	38.5	33.7	16QAM, single carrier
mod	14.2625	-14.6	39.5	--	--	24.9	-5.1	0.31	38.5	33.4	QPSK, single carrier
mod	14.2625	-14.1	39.5	--	--	25.4	-4.6	0.35	38.5	33.9	8PSK, single carrier
mod	14.2625	-14.9	39.5	--	--	24.6	-5.4	0.29	38.5	33.1	16QAM, single carrier
mod	14.4875	-14.5	39.4	--	--	24.9	-5.1	0.31	38.5	33.4	QPSK, single carrier
mod	14.4875	-14.2	39.4	--	--	25.2	-4.8	0.33	38.5	33.7	8PSK, single carrier
mod	14.4875	-14.8	39.4	--	--	24.6	-5.4	0.29	38.5	33.1	16QAM, single carrier
mod	14.0225	-11.2	39.6	--	--	28.4	-1.6	0.69	38.5	36.9	QPSK, dual carrier
mod	14.0225	-10.8	39.6	--	--	28.8	-1.2	0.76	38.5	37.3	8PSK, dual carrier
mod	14.0225	-11.5	39.6	--	--	28.1	-1.9	0.65	38.5	36.6	16QAM, dual carrier
mod	14.2725	-11.6	39.5	--	--	27.9	-2.1	0.62	38.5	36.4	QPSK, dual carrier
mod	14.2725	-11.3	39.5	--	--	28.2	-1.8	0.66	38.5	36.7	8PSK, dual carrier
mod	14.2725	-11.9	39.5	--	--	27.6	-2.4	0.58	38.5	36.1	16QAM, dual carrier
mod	14.4775	-11.6	39.4	--	--	27.8	-2.2	0.60	38.5	36.3	QPSK, dual carrier
mod	14.4775	-11.3	39.4	--	--	28.1	-1.9	0.65	38.5	36.6	8PSK, dual carrier
mod	14.4775	-12.0	39.4	--	--	27.4	-2.6	0.55	38.5	35.9	16QAM, dual carrier

cw = continuous wave mod = modulated

Test setup(s):
Test setup 7.3

Plots:
Measurement with power meter.

Determination of occupied bandwidth (99% bandwidth)

Operating condition	Frequency	Modulation	Modulation of subcarriers	Occupied bandwidth [MHz]	Annex K / Plot
1	fl, fm, fh	FDMA	QPSK	17.9	3, 7, 15
2	fl, fm, fh	FDMA	8PSK	17.9	8
3	fl, fm, fh	FDMA	16QAM	17.9	9
4	fl, fm, fh	FDMA	QPSK	37.5	4, 10, 16
5	fl, fm, fh	FDMA	8PSK	37.5	11
6	fl, fm, fh	FDMA	16QAM	37.5	12

Operating conditions of DUT:
Carrier-on radio state (for more details see table above)

Test setup(s):
Test setup 7.3

Plots:
see annex D, chap. 2, plot 1 – 16

9.4 Emission limitations (RF spectrum mask)

Description / Limit:

§25.202 Frequencies, frequency tolerance and emission limitations
(f) Emission limitations. Except for SDARS terrestrial repeaters, the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.
(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth:
An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;
(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

Test setup:
Test setup 7.3

Plots:
see Annex D, chap. 2, plots 21 – 26, 41 – 46, 61 - 66

9.5 Emissions limitations (conducted emissions)

Description / Limit:

§25.202 Frequencies, frequency tolerance and emission limitations
(f) Emission limitations. Except for SDARS terrestrial repeaters, the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The outof-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.
(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth:
An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;
(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

Measurement results:

Conducted Spurious Emissions [dBm]								
Low Channel fl			Middle Channel fm			High Channel fh		
F [GHz]	Detector	Level [dBm]	F [GHz]	Detector	Level [dBm]	F [GHz]	Detector	Level [dBm]
No critical peaks detected.			No critical peaks detected.			No critical peaks detected.		
Measurement uncertainty			± 2 dB					

Test setup:
Test setup 7.3

Plots:
see also Annex D, chap. 2, plots 27 – 40, 47 – 60, 67 - 80

9.6 Emissions limits (radiated emissions)

Description / Limit:

§2.1053 Measurements required: Field strength of spurious radiation.
§25.202 Frequencies, frequency tolerance and emission limitations
(f) Emission limitations. Except for SDARS terrestrial repeaters, the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The outof-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.
(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth:
An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;
(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

Measurement results:

Radiated Spurious Emissions [dBm]								
Low Channel fl			Middle Channel fm			High Channel fh		
F [GHz]	Detector	Level [dBm]	F [GHz]	Detector	Level [dBm]	F [GHz]	Detector	Level [dBm]
No critical peaks detected.			No critical peaks detected.			No critical peaks detected.		
Measurement uncertainty			± 3 dB					

v / h = vertical / horizontal

Test setup:
Test setup 7.1 – 7.3

Plots:
see Annex D, chap. 2, plots 17 - 20
and Annex D, chap. 3, plots 1, 2

9.7 Transmitter frequency tolerance

Description / Limit:

§2.1055 Measurements required: Frequency stability.
§25.202 Frequencies, frequency tolerance and emission limitations
(d) *Frequency tolerance, Earth stations.* The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent of the reference frequency (10 ppm).

Measurement results:

Temperature [°C]	Voltage [V AC]	Reference Frequency [GHz]	Measured Frequency [GHz]	Deviation [kHz]	Deviation [ppm]
-20	120	14.272500000	14.272500849188	0.849	0.0595
-10	120	14.272500000	14.272500849273	0.849	0.0595
0	120	14.272500000	14.272500848951	0.849	0.0595
10	120	14.272500000	14.272500848357	0.848	0.0594
20	120	14.272500000	14.272500848502	0.849	0.0595
20	132	14.272500000	14.272500848390	0.848	0.0594
20	102	14.272500000	14.272500848367	0.848	0.0594
30	120	14.272500000	14.272500848379	0.848	0.0594
40	120	14.272500000	14.272500848313	0.848	0.0594
50	120	14.272500000	14.272500848104	0.848	0.0594
55	120	14.272500000	14.272500848831	0.849	0.0595

Test setup:
Test setup 7.3 + Climatic Chamber

Note:
For performing the frequency stability test the RCM was placed in the climatic chamber and forced to transmit an unmodulated carrier (CW).

10 Glossary

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

11 Document history

Version	Applied changes	Date of release
-/-	Initial release	2021-06-07
-A	Minor changes	2021-07-20

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

first page	last page
	

Note: The current certificate annex is published on the websites (link see below).

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05.pdf
https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf
or
https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

########## END OF TEST REPORT ##########