
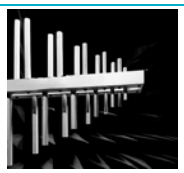
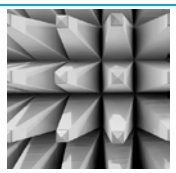

CTC advanced member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-3977/22-03-18

Testing laboratory

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

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

Applicant

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE
Phone: -/-
Contact: Ludovic Bomba
e-mail: ludovic.bomba@sagemcom.com

Manufacturer

SAGEMCOM BROADBAND SAS
250, route de l´ Empereur
92848 Rueil-Malmaison Cedex / FRANCE

Test standard/s

FCC - Title 47 CFR Part 27	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 27 - Miscellaneous wireless communications services

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

Test Item

Kind of test item:	**Gateway**
Model name:	**F5688W**
FCC ID:	**VW3F5688W**
Frequency:	Band 41
Technology tested:	5G NR
Antenna:	4 integrated antennas
Power supply:	120 V AC by power supply unit
Temperature range:	0°C to +50°C

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

Test report authorized:

cn=Michael Dorongovski, o=CTC advanced GmbH, ou=DOR-210422, email=Michael.Dorongovski@ctcadvanced.com, c=DE
2023.01.19 10:04:36 +01'00'

Michael Dorongovski
Lab Manager
Radio Communications

Test performed:

cn=Andreas Luckenbill, o=CTC advanced GmbH, ou=LUC-180217, email=andreas.luckenbill@ctcadvanced.com, c=DE
2023.01.18 16:25:04 +01'00'

Andreas Luckenbill
Head of Department
Radio Communications

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

2.2 Application details

Date of receipt of order:	2022-12-07
Date of receipt of test item:	2022-09-27
Start of test:*	2022-10-04
End of test:*	2022-12-14
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 27		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 27 - Miscellaneous wireless communications services

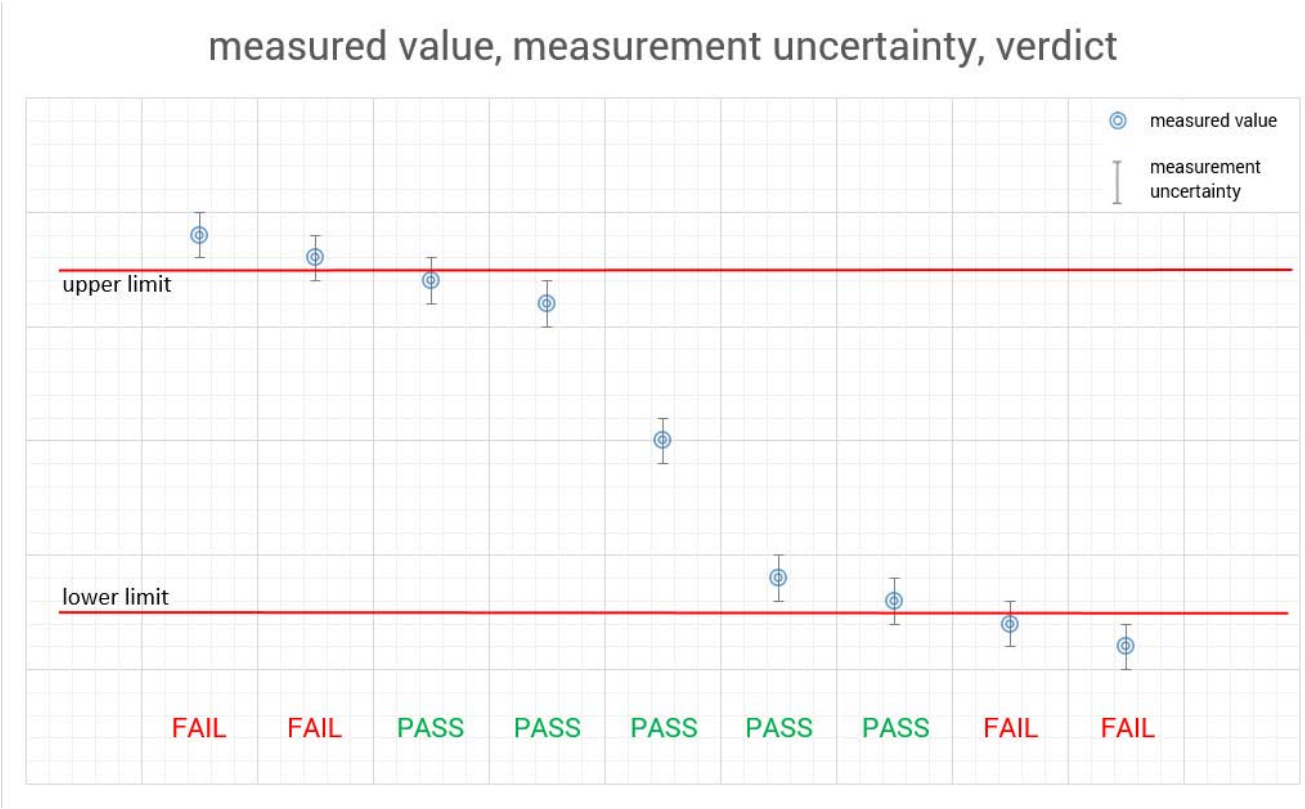
Guidance	Version	Description
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
KDB 662911 D01	v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
Power Meas License Systems: KDB 971168 D01	v03r01	Measurement Guidance for Certification of Licensed Digital Transmitters

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

FCC designation number: DE0002

4 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, see chapter 9, 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."



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests +50 °C during high temperature tests -30 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	120 V AC by power supply unit. 138 V AC by external power supply. 102 V AC by external power supply.

6 Test item

6.1 General description

Kind of test item	:	Gateway
Model name	:	F5688W
S/N serial number	:	Radiated unit: QS2212959002899 (IMEI: 359509840135591) – WALSIN QS2212959002968 (IMEI: 359509840060641) – COLFLY QS2212959002883 (IMEI: 359509840060278) – HL Conducted units: IMEI: 359509840061128
Hardware status	:	V1.2
Software status	:	SG520TMDAR02A02M4G_01.001.01.001_V01
Firmware status	:	SG520TMDAR02A02M4G_01.001.01.001_V01
Frequency band	:	Band 41
Type of radio transmission Use of frequency spectrum	: :	Modulated carrier
Type of modulation	:	BPSK, QPSK, 16-QAM, 64-QAM,256-QAM
Antenna	:	4 integrated antennas
Power supply	:	120 V AC by power supply unit
Temperature range	:	0°C to +50°C

6.2 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: 1-3977/22-03-01_AnnexA
1-3977/22-03-01_AnnexB
1-3977/22-03-01_AnnexC

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.

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.

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.

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.

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.

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 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).

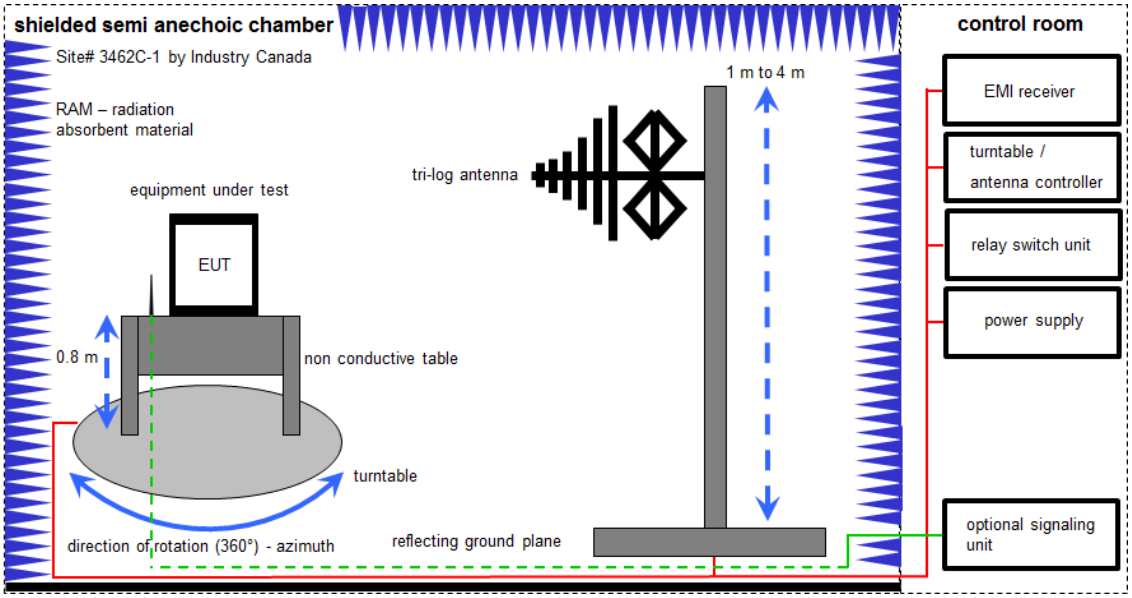
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

Agenda: Kind of Calibration

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

8.1 Shielded semi anechoic chamber

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.



Measurement distance: tri-log antenna 10 meter; EMC32 software version: 10.59.00

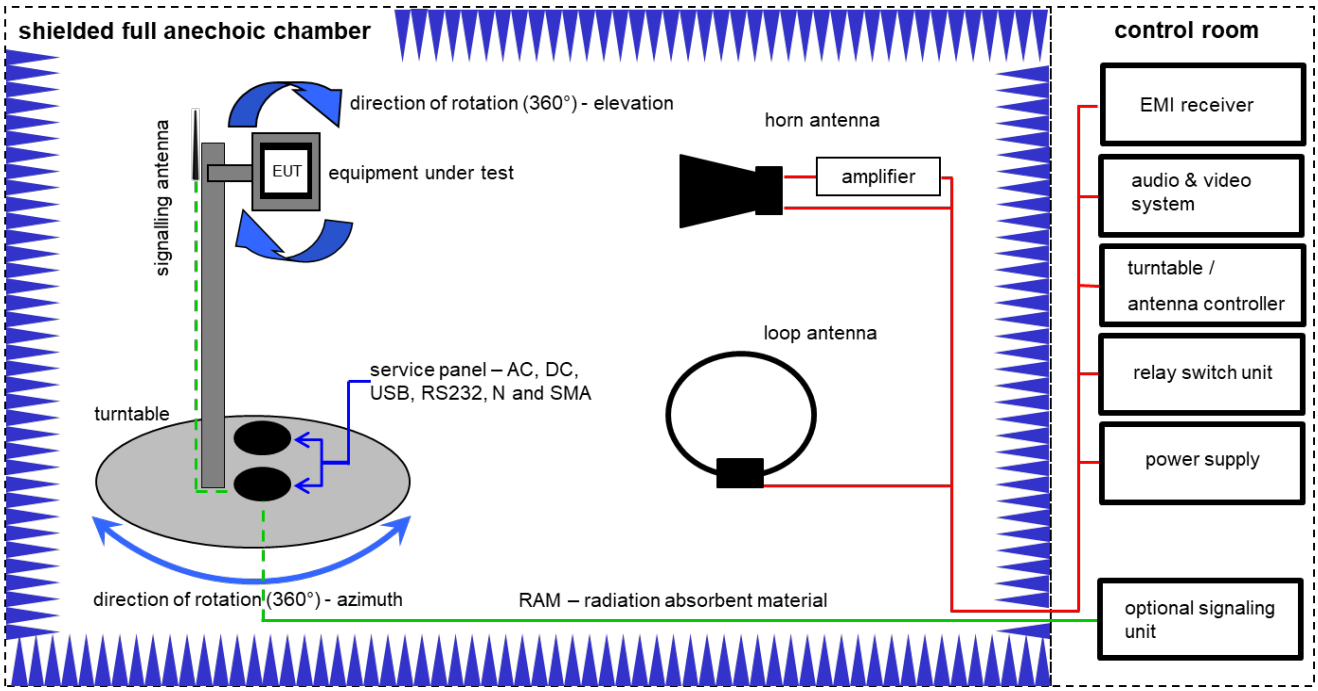
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	Meßkabine 1	HF-Absorberhalle	MWB AG 300023	Batch no. 699714	300000551	ne	-/-	-/-
3	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
4	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
5	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	295	300003787	vIKI!	21.04.2021	20.04.2023
7	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	20.05.2022	31.05.2023
8	A	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	16.09.2021	30.09.2023

8.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter

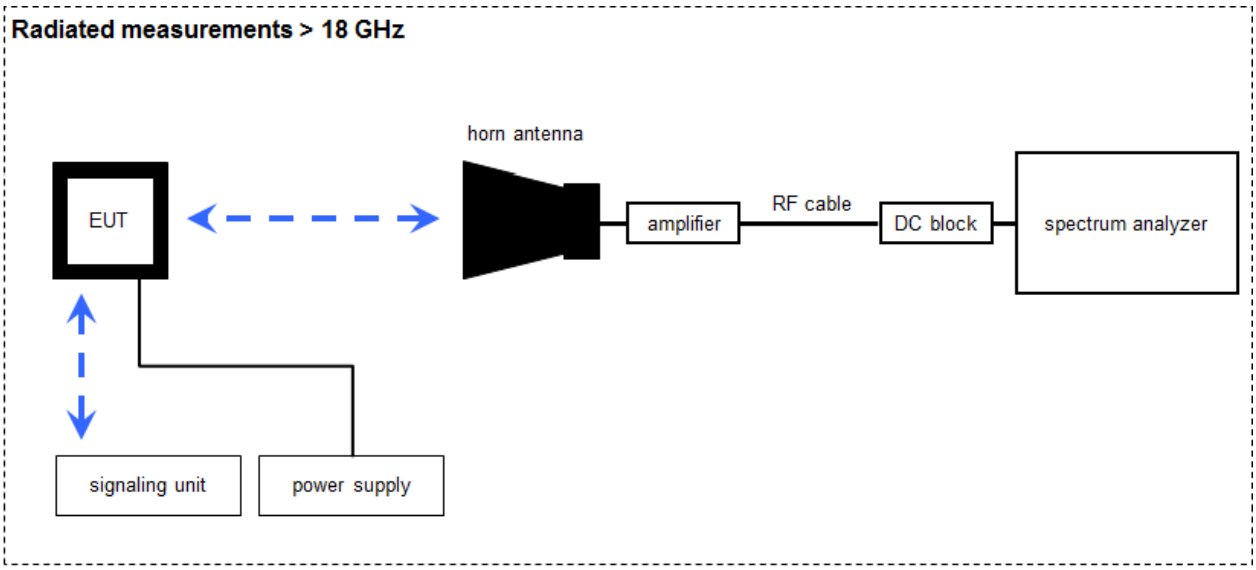
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -39.0 [dBm] + 57.0 [dB] - 12.0 [dBi] + (-36.0) [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	B	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	01.07.2021	31.07.2023
2	A, B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vlKl!	11.02.2022	29.02.2024
4	A, B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	09.12.2021	31.12.2022
5	A, B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
6	A, B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
7	A	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
8	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
9	A, B	NEXIO EMV-Software	BAT EMC V3.21.0.27	EMCO		300004682	ne	-/-	-/-
10	A	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-
11	A, B	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	16.09.2021	30.09.2023

8.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

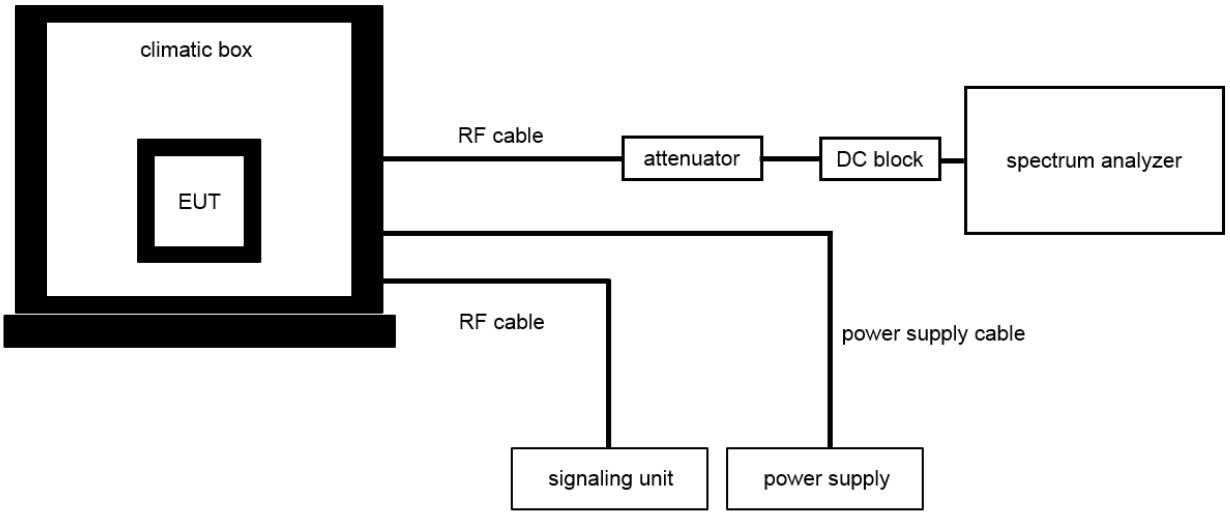
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
2	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vlKl!	17.01.2022	31.01.2024
3	A	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	vlKl!	17.01.2022	31.01.2024
4	A	Broadband Low Noise Amplifier 18-50 GHz	CBL18503070-XX	CERNEX	19338	300004273	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMAm /48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
6	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	25.01.2022	31.01.2023
7	A	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	16.09.2021	30.09.2023

8.4 Conducted measurements normal and extreme conditions

Conducted measurements normal & 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.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	25.01.2022	31.01.2023
2	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH		300004590	ne	-/-	-/-
3	A	RF-Cable	ST18/SMAm/SMAm /72	Huber & Suhner	Batch no. 699714	400001184	ev	-/-	-/-
4	A	DC-Blocker 0.1-40 GHz	8141A	Inmet		400001185	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMAm /36	Huber & Suhner	Batch no. 601494	400001309	ev	-/-	-/-
6	A	Temperature Test Chamber	T-40/50	CTS GmbH	064023	300003540	ev	09.05.2022	08.05.2024
7	A	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	16.09.2021	30.09.2023

9 Measurement uncertainty

Measurement uncertainty		
Test case	**Uncertainty**	
Antenna gain	± 3 dB	
99 % bandwidth	± RBW	
-26 dB bandwidth	± RBW	
Frequency stability	10^{-6}	
Maximum output power conducted	± 1.56 dB	
Block edge compliance	± 1.56 dB	
Spurious emissions conducted	> 3.6 GHz	± 1.56 dB
	> 7 GHz	± 1.56 dB
	> 18 GHz	± 2.31 dB
	≥ 40 GHz	± 2.97 dB
Spurious emissions radiated below 30 MHz	± 3 dB	
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB	
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB	
Spurious emissions radiated above 12.75 GHz	± 4.5 dB	

10 Additional information and comments

Reference documents: Customer Questionnaire_F5688W_Sagemcom_v3.docx
F5866WTMO_ANTENNA MAPPING_v2.xlsx
1-3977_22-03-18_Annex_MR_A1 (5G NR plots)

Special test descriptions: Although the device has 4 integrated antennas, for 5G NR band 41 only 2 antennas are used for TX mode (LTE_M and 5GNR_P).

CP-OFDM and DFT-s-OFDM were investigated for SISO and DFT-s-OFDM was found to be the worst case for SISO.
CP-OFDM is used for MIMO.
For 5G NR tests the MT8000A from Anritsu was used.

Configuration descriptions: ANT1 = LTE_M
ANT2 = 5GNR_P

EUT selection:

☐ Only one device available

☐ Devices selected by the customer

☒ Devices selected by the laboratory (Randomly)

11 Summary of measurement results

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

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC: CFR Part 2 & Part 27	See table!	2023-01-18	-/-

11.1 Part 27: 5G NR band 41

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	-/-
Frequency Stability	Extreme	Extreme	☒	☐	☐	☐	-/-
Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
Spurious Emissions Conducted	Nominal	Nominal	☒	☐	☐	☐	-/-
Block Edge Compliance	Nominal	Nominal	☒	☐	☐	☐	-/-
Occupied Bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-

Notes:

C	Compliant	**NC**	Not compliant	**NA**	Not applicable	**NP**	Not performed

12 RF measurements

12.1 Description of test setup

For the spurious measurements we use the substitution method according TIA/EIA 603.

12.2 Results 5G NR band 41

The EUT was set to transmit the maximum power.

12.2.1 RF output power

Description:

This paragraph contains average power, peak output power and EIRP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Power meter and MT8000A	
Used equipment:	See chapter 8.2 setup A & 8.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1046

Limits:

FCC
§27.50(h)(2)
Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.
Power: 33 dBm EIRP PAPR: Reporting only

Results:

Output Power (conducted) ANT1 + ANT2 sum									ANT2
Band-width (MHz)	Channel / Frequency (MHz)	Resource block allocation			Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)
		RB configuration	RB Allocation	RB Offset	QPSK	16-QAM	64-QAM	256-QAM	PI/2BPSK
20	501204 / 2506.02	1 RB low	1	0	21.4	21.6	21.3	21.4	23.5
		1 RB low+1	1	1	27.8	26.9	24.9	24.8	25.0
		1 RB high-1	1	49	28.0	27.0	24.9	24.9	25.0
		1 RB high	1	50	28.0	27.2	24.9	24.9	25.0
		50% RB mid	25	12	28.0	27.0	25.0	25.1	25.1
		100% RB	51	0	26.0	25.1	24.6	24.6	23.5
	518598 / 2592.99	1 RB low	1	0	21.5	21.5	21.4	21.4	19.0
		1 RB low+1	1	1	28.1	27.2	25.2	25.1	25.3
		1 RB high-1	1	49	28.1	27.0	25.2	25.2	25.1
		1 RB high	1	50	28.1	27.0	25.2	25.2	25.0
		50% RB mid	25	12	28.1	27.1	25.1	25.0	25.1
		100% RB	51	0	26.0	25.1	24.6	24.6	23.7
	535998 / 2679.99	1 RB low	1	0	21.5	21.8	21.6	21.6	18.9
		1 RB low+1	1	1	28.0	27.0	25.2	25.1	24.9
		1 RB high-1	1	49	28.1	27.1	25.3	25.3	25.1
		1 RB high	1	50	28.1	27.0	25.2	25.3	25.1
		50% RB mid	25	12	28.0	27.1	25.0	25.0	24.9
		100% RB	51	0	26.0	25.0	24.5	24.5	23.4
30	502200 / 2511.00	1 RB low	1	0	21.4	21.5	21.6	21.5	23.7
		1 RB low+1	1	1	27.9	27.0	25.1	25.1	25.1
		1 RB high-1	1	76	28.2	27.3	25.4	25.4	25.2
		1 RB high	1	77	28.2	27.4	25.3	25.3	25.2
		50% RB mid	39	19	28.1	27.2	25.3	25.2	25.1
		100% RB	78	0	26.1	25.1	24.7	24.6	23.6
	518598 / 2592.99	1 RB low	1	0	21.6	21.7	21.8	21.7	19.2
		1 RB low+1	1	1	28.1	27.2	25.3	25.3	25.4
		1 RB high-1	1	76	28.2	27.3	25.3	25.2	25.3
		1 RB high	1	77	28.2	27.2	25.2	25.3	25.3
		50% RB mid	39	19	28.1	27.1	25.2	25.2	25.3
		100% RB	78	0	26.2	25.2	24.7	24.7	23.8

Output Power (conducted) ANT1 + ANT2 sum									ANT2
Band-width (MHz)	Channel / Frequency (MHz)	Resource block allocation			Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)
		RB configuration	RB Allocation	RB Offset	QPSK	16-QAM	64-QAM	256-QAM	PI/2BPSK
	534996 / 2674.98	1 RB low	1	0	21.7	21.9	21.7	21.7	19.1
		1 RB low+1	1	1	28.1	27.4	25.3	25.3	25.1
		1 RB high-1	1	76	28.2	27.7	25.4	25.4	25.1
		1 RB high	1	77	28.2	27.7	25.5	25.4	25.2
		50% RB mid	39	19	28.1	27.3	25.3	25.3	25.1
		100% RB	78	0	26.1	25.2	24.6	24.6	23.5
40	503202 / 2516.01	1 RB low	1	0	21.5	21.7	21.5	21.5	23.7
		1 RB low+1	1	1	28.0	27.0	25.3	25.3	25.2
		1 RB high-1	1	104	28.2	27.1	25.5	25.4	25.3
		1 RB high	1	105	28.2	27.3	25.4	25.3	25.2
		50% RB mid	53	26	28.0	27.1	25.2	25.1	25.1
		100% RB	106	0	26.1	25.1	24.7	24.7	23.6
	518598 / 2592.99	1 RB low	1	0	21.7	21.8	21.8	21.8	19.2
		1 RB low+1	1	1	28.2	27.3	25.4	25.5	25.4
		1 RB high-1	1	104	28.2	27.3	25.4	25.3	25.4
		1 RB high	1	105	28.2	27.4	25.4	25.3	25.3
		50% RB mid	53	26	28.1	27.1	25.2	25.2	25.3
		100% RB	106	0	26.2	25.2	24.8	24.7	23.8
	534000 / 2670.00	1 RB low	1	0	21.6	21.6	21.7	21.7	19.1
		1 RB low+1	1	1	28.1	27.2	25.2	25.2	25.1
		1 RB high-1	1	104	28.1	27.2	25.1	25.2	25.0
		1 RB high	1	105	28.1	27.1	25.2	25.1	25.0
		50% RB mid	53	26	28.0	27.1	25.1	25.1	24.9
		100% RB	106	0	26.2	25.1	24.7	24.6	23.6
50	504204 / 2521.02	1 RB low	1	0	26.1	21.6	21.4	21.4	23.6
		1 RB low+1	1	1	27.9	26.9	25.1	25.1	25.0
		1 RB high-1	1	131	28.2	27.2	25.3	25.3	25.2
		1 RB high	1	132	28.2	27.2	25.3	25.4	25.2
		50% RB mid	66	33	28.2	27.2	25.2	25.2	25.2
		100% RB	133	0	26.2	25.2	24.7	24.7	23.7
	518598 / 2592.99	1 RB low	1	0	21.6	21.7	21.7	21.7	19.0
		1 RB low+1	1	1	28.1	27.1	25.2	25.2	25.2

Output Power (conducted) ANT1 + ANT2 sum									ANT2
Band-width (MHz)	Channel / Frequency (MHz)	Resource block allocation			Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)
		RB configuration	RB Allocation	RB Offset	QPSK	16-QAM	64-QAM	256-QAM	PI/2BPSK
		1 RB high-1	1	131	28.2	27.2	25.3	25.1	25.3
		1 RB high	1	132	28.2	27.2	25.2	25.2	25.4
		50% RB mid	66	33	28.1	27.0	25.0	25.1	25.2
		100% RB	133	0	26.1	25.1	24.6	24.5	23.6
	532998 / 2664.99	1 RB low	1	0	21.4	21.5	21.7	21.5	18.9
		1 RB low+1	1	1	28.0	27.1	25.2	25.1	25.0
		1 RB high-1	1	131	28.0	27.3	25.2	25.3	25.0
		1 RB high	1	132	28.1	27.2	25.2	25.2	25.1
		50% RB mid	66	33	28.1	27.0	25.1	25.1	25.1
		100% RB	133	0	26.0	25.1	24.5	24.5	23.5
60	505200 / 2526.00	1 RB low	1	0	26.1	21.6	21.4	21.4	23.6
		1 RB low+1	1	1	27.8	26.8	25.1	25.1	25.0
		1 RB high-1	1	160	27.9	26.9	25.2	25.2	25.0
		1 RB high	1	161	21.5	21.5	21.8	21.8	19.0
		50% RB mid	81	40	28.1	27.1	25.2	25.1	25.2
		100% RB	162	0	26.1	25.0	24.6	24.6	23.6
	518598 / 2592.99	1 RB low	1	0	21.6	21.6	21.7	21.6	18.9
		1 RB low+1	1	1	28.2	27.2	25.2	25.2	25.0
		1 RB high-1	1	160	28.0	27.1	25.1	25.1	25.2
		1 RB high	1	161	21.5	21.5	21.9	21.9	19.0
		50% RB mid	81	40	28.1	27.1	25.1	25.1	25.1
		100% RB	162	0	26.1	25.1	24.6	24.6	23.7
	531996 / 2659.98	1 RB low	1	0	21.4	21.6	21.4	21.5	18.9
		1 RB low+1	1	1	28.0	26.9	25.3	25.0	25.0
		1 RB high-1	1	160	27.9	26.9	25.1	25.2	24.9
		1 RB high	1	161	21.5	21.5	21.8	21.8	18.9
		50% RB mid	81	40	28.0	27.0	25.1	25.1	25.1
		100% RB	162	0	26.0	25.0	24.5	24.5	23.5
70	506202 / 2531.01	1 RB low	1	0	25.9	21.2	21.2	21.3	23.6
		1 RB low+1	1	1	27.6	26.8	24.9	24.9	24.8
		1 RB high-1	1	187	27.8	27.1	25.0	25.0	25.0
		1 RB high	1	188	27.9	27.0	25.0	25.0	24.9

Output Power (conducted) ANT1 + ANT2 sum									ANT2
Band-width (MHz)	Channel / Frequency (MHz)	Resource block allocation			Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)
		RB configuration	RB Allocation	RB Offset	QPSK	16-QAM	64-QAM	256-QAM	PI/2BPSK
		50% RB mid	95	47	28.0	27.0	25.1	25.0	24.9
		100% RB	189	0	26.0	25.0	24.6	24.6	23.4
	518598 / 2592.99	1 RB low	1	0	21.5	21.8	21.6	21.6	18.7
		1 RB low+1	1	1	28.1	27.1	25.3	25.4	24.9
		1 RB high-1	1	187	28.0	26.9	25.1	25.2	24.9
		1 RB high	1	188	27.8	26.9	25.1	25.1	25.0
		50% RB mid	95	47	28.0	26.9	25.0	24.9	25.1
		100% RB	189	0	26.0	25.0	24.5	24.5	23.5
	531000 / 2655.00	1 RB low	1	0	21.4	21.8	21.5	21.6	18.7
		1 RB low+1	1	1	27.9	27.0	25.3	25.1	25.1
		1 RB high-1	1	187	27.7	26.7	24.9	24.9	24.6
		1 RB high	1	188	27.8	26.8	25.0	25.0	24.6
		50% RB mid	95	47	27.8	26.8	24.9	24.9	24.8
		100% RB	189	0	25.8	24.8	24.4	24.4	23.3
80	507204 / 2536.02	1 RB low	1	0	25.9	21.1	21.2	21.2	23.5
		1 RB low+1	1	1	27.6	26.7	24.9	24.9	24.7
		1 RB high-1	1	215	27.7	26.9	24.9	24.9	25.1
		1 RB high	1	216	27.7	26.8	24.9	24.9	25.0
		50% RB mid	108	54	28.0	26.9	25.0	24.9	24.9
		100% RB	217	0	26.0	25.3	24.4	24.6	23.5
	518598 / 2592.99	1 RB low	1	0	21.5	21.6	21.6	21.7	18.6
		1 RB low+1	1	1	28.0	27.2	25.2	25.2	24.7
		1 RB high-1	1	215	27.9	26.9	25.0	24.9	25.0
		1 RB high	1	216	27.8	26.9	24.9	25.0	25.0
		50% RB mid	108	54	28.0	27.0	25.0	25.0	25.1
		100% RB	217	0	26.1	25.0	24.6	24.5	23.6
	529998 / 2649.99	1 RB low	1	0	21.4	21.6	21.5	21.5	18.8
		1 RB low+1	1	1	28.0	26.9	25.1	25.1	25.0
		1 RB high-1	1	215	27.9	26.9	25.0	25.1	24.7
		1 RB high	1	216	27.8	26.9	25.1	25.0	24.8
		50% RB mid	108	54	28.0	26.9	24.9	24.9	25.0
		100% RB	217	0	26.0	24.9	24.5	24.4	23.5

Output Power (conducted) ANT1 + ANT2 sum									ANT2
Band-width (MHz)	Channel / Frequency (MHz)	Resource block allocation			Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)
		RB configuration	RB Allocation	RB Offset	QPSK	16-QAM	64-QAM	256-QAM	PI/2BPSK
90	508200 / 2541.00	1 RB low	1	0	21.2	21.3	21.2	21.2	23.6
		1 RB low+1	1	1	27.6	27.0	24.9	24.9	24.8
		1 RB high-1	1	243	27.8	27.1	25.0	25.0	25.1
		1 RB high	1	244	27.8	27.0	25.0	25.1	25.1
		50% RB mid	122	61	27.9	27.3	25.1	25.2	25.0
		100% RB	245	0	26.0	25.0	24.5	24.5	23.5
	518598 / 2592.99	1 RB low	1	0	21.4	21.6	21.6	21.6	18.6
		1 RB low+1	1	1	28.0	27.1	25.2	25.2	24.7
		1 RB high-1	1	243	27.9	27.6	25.1	25.0	24.9
		1 RB high	1	244	27.9	26.9	25.2	25.1	24.9
		50% RB mid	122	61	28.1	27.2	25.4	25.4	25.2
		100% RB	245	0	26.4	25.1	24.6	24.5	23.6
	528996 / 2644.98	1 RB low	1	0	21.3	21.5	21.4	21.4	18.7
		1 RB low+1	1	1	27.8	26.8	25.1	25.1	25.0
		1 RB high-1	1	243	28.0	27.2	25.2	25.2	24.8
		1 RB high	1	244	28.0	27.0	25.2	25.3	24.8
		50% RB mid	122	61	28.0	27.0	25.1	25.2	25.2
		100% RB	245	0	26.0	25.0	24.5	24.5	23.5
100	509202 / 2546.01	1 RB low	1	0	21.2	21.4	21.2	21.3	23.7
		1 RB low+1	1	1	27.7	26.8	25.0	25.0	25.0
		1 RB high-1	1	271	27.6	26.7	24.9	24.9	25.2
		1 RB high	1	272	27.6	26.7	25.0	25.1	25.2
		50% RB mid	136	68	28.0	27.0	25.1	25.0	25.0
		100% RB	273	0	25.9	24.8	24.4	24.5	23.4
	518598 / 2592.99	1 RB low	1	0	21.4	21.7	21.6	21.6	18.6
		1 RB low+1	1	1	28.0	27.1	25.3	25.2	24.8
		1 RB high-1	1	271	27.9	26.9	25.1	25.1	25.0
		1 RB high	1	272	28.0	26.9	25.1	25.1	24.9
		50% RB mid	136	68	28.0	27.0	25.0	25.0	25.1
		100% RB	273	0	26.0	25.0	24.5	24.6	23.6
	528000 / 2640.00	1 RB low	1	0	21.4	21.4	21.4	21.4	18.8
		1 RB low+1	1	1	27.8	26.9	24.9	24.9	24.9

Output Power (conducted) ANT1 + ANT2 sum									ANT2
Band-width (MHz)	Channel / Frequency (MHz)	Resource block allocation			Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)	Average Output Power (dBm)
		RB configuration	RB Allocation	RB Offset	QPSK	16-QAM	64-QAM	256-QAM	PI/2BPSK
		1 RB high-1	1	271	27.9	26.9	24.9	24.9	24.7
		1 RB high	1	272	27.9	27.0	24.9	24.9	24.9
		50% RB mid	136	68	27.9	26.9	24.9	24.8	24.8
		100% RB	273	0	25.9	24.9	24.4	24.3	23.3

PAPR conducted (ANT1) – 100% RB					
Bandwidth (MHz)	Channel / Frequency (MHz)	Average Output Power (dBm) QPSK	Average Output Power (dBm) 16-QAM	Average Output Power (dBm) 64-QAM	Average Output Power (dBm) 256-QAM
20	518598 / 2592.99	6.70	6.70	7.10	6.00
30	518598 / 2592.99	6.03	6.34	5.03	5.41
40	518598 / 2592.99	5.20	7.01	6.53	6.65
50	518598 / 2592.99	6.07	5.09	6.06	7.36
60	518598 / 2592.99	7.41	7.20	6.01	6.47
70	518598 / 2592.99	6.20	6.70	5.90	7.30
80	518598 / 2592.99	6.60	7.21	6.00	7.07
90	518598 / 2592.99	7.01	5.00	7.00	5.71
100	518598 / 2592.99	5.09	7.10	5.83	6.88

PAPR conducted (ANT2) – 100% RB					
Bandwidth (MHz)	Channel / Frequency (MHz)	Average Output Power (dBm) QPSK	Average Output Power (dBm) 16-QAM	Average Output Power (dBm) 64-QAM	Average Output Power (dBm) 256-QAM
20	518598 / 2592.99	7.50	7.50	7.90	7.21
30	518598 / 2592.99	6.17	7.35	6.51	6.16
40	518598 / 2592.99	6.73	6.17	7.62	5.95
50	518598 / 2592.99	7.05	6.29	6.48	7.62
60	518598 / 2592.99	7.79	5.02	5.34	6.00
70	518598 / 2592.99	6.50	7.00	6.40	6.90
80	518598 / 2592.99	6.04	5.40	6.61	7.37
90	518598 / 2592.99	6.85	7.02	5.27	5.12
100	518598 / 2592.99	5.86	6.00	7.16	6.01

The radiated output power is measured in the mode with the highest conducted output power.

Output Power (EIRP)						
-/-		MIMO				SISO
Bandwidth (MHz)	Channel / Frequency (MHz)	Average Output Power (dBm) QPSK	Average Output Power (dBm) 16-QAM	Average Output Power (dBm) 64-QAM	Average Output Power (dBm) 256-QAM	Average Output Power (dBm) PI/2BPSK
20	501204 / 2506.02	31.9	31.1	28.9	29.0	29.0
	518598 / 2592.99	32.0	31.1	29.1	29.1	29.2
	535998 / 2679.99	32.0	31.0	29.2	29.2	29.0
30	502200 / 2511.00	32.1	31.3	29.3	29.3	29.1
	518598 / 2592.99	32.1	31.2	29.2	29.2	29.3
	534996 / 2674.98	32.1	31.6	29.4	29.3	29.1
40	503202 / 2516.01	32.1	31.2	29.4	29.3	29.2
	518598 / 2592.99	32.1	31.3	29.3	29.4	29.3
	534000 / 2670.00	32.0	31.1	29.1	29.1	29.0
50	504204 / 2521.02	32.1	31.1	29.2	29.3	29.1
	518598 / 2592.99	32.1	31.1	29.2	29.1	29.3
	532998 / 2664.99	32.0	31.2	29.1	29.2	29.0
60	505200 / 2526.00	32.0	31.0	29.1	29.1	29.1
	518598 / 2592.99	32.1	31.1	29.1	29.1	29.1
	531996 / 2659.98	31.9	30.9	29.2	29.1	29.0
70	506202 /2531.01	31.9	31.0	29.0	28.9	28.9
	518598 / 2592.99	32.0	31.0	29.2	29.3	29.0
	531000 / 2655.00	31.8	30.9	29.2	29.0	29.0
80	507204 / 2536.02	31.9	30.8	28.9	28.8	29.0
	518598 / 2592.99	31.9	31.1	29.1	29.1	29.0
	529998 / 2649.99	31.9	30.8	29.0	29.0	28.9
90	508200 / 2541.00	31.8	31.2	29.0	29.1	29.0
	518598 / 2592.99	32.0	31.5	29.3	29.3	29.1
	528996 / 2644.98	31.9	31.1	29.1	29.2	29.1
100	509202 / 2546.01	31.9	30.9	29.0	29.0	29.1
	518598 / 2592.99	31.9	31.0	29.2	29.1	29.0
	528000 / 2640.00	31.8	30.9	28.8	28.8	28.8

12.2.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a “call mode”. This is accomplished with the use of a MT8000A DIGITAL RADIOCOMMUNICATION TESTER.
1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom}, connected to the MT8000A and in a simulated call on channel 18900 (center channel), measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Re-measure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps re-measuring carrier frequency at each voltage. Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with MT8000A
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace mode:	
Used equipment:	See chapter 8.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1055

Limits:

FCC
§27.54
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
102	19	0.0101
120	21	0.0112
138	17	0.0090

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	12	0.0064
-20	19	0.0101
-10	13	0.0069
± 0	21	0.0112
10	16	0.0085
20	13	0.0069
30	15	0.0080
40	-15	-0.0080
50	10	0.0053

12.2.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2014 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment. The resolution bandwidth is set as outlined in Part 27.53. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, middle and highest channels of the 5G NR band 41.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 sec.
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	100 MHz Steps
Trace mode:	Max Hold
Used equipment:	See chapter 8.1 setup A & 8.2 setup A+B & setup 8.3 A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1053

Limits:

FCC
§ 27.53 (m) (4)
For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.
-25 dBm

Results:

QPSK:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

16-QAM:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

64-QAM:

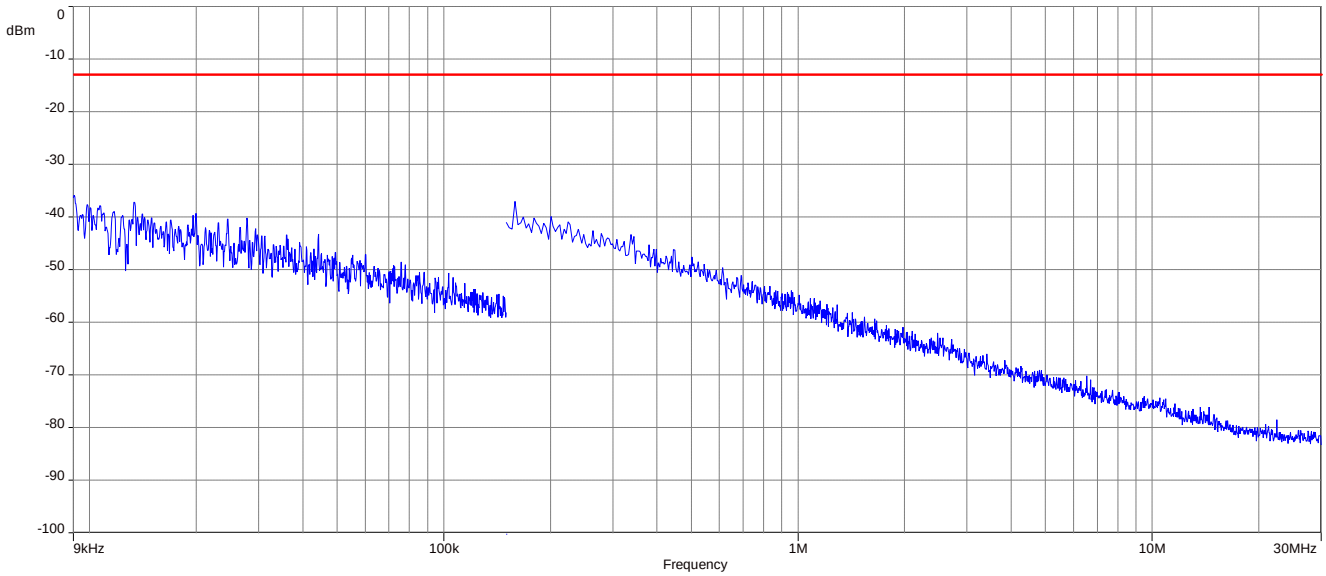
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

256-QAM:

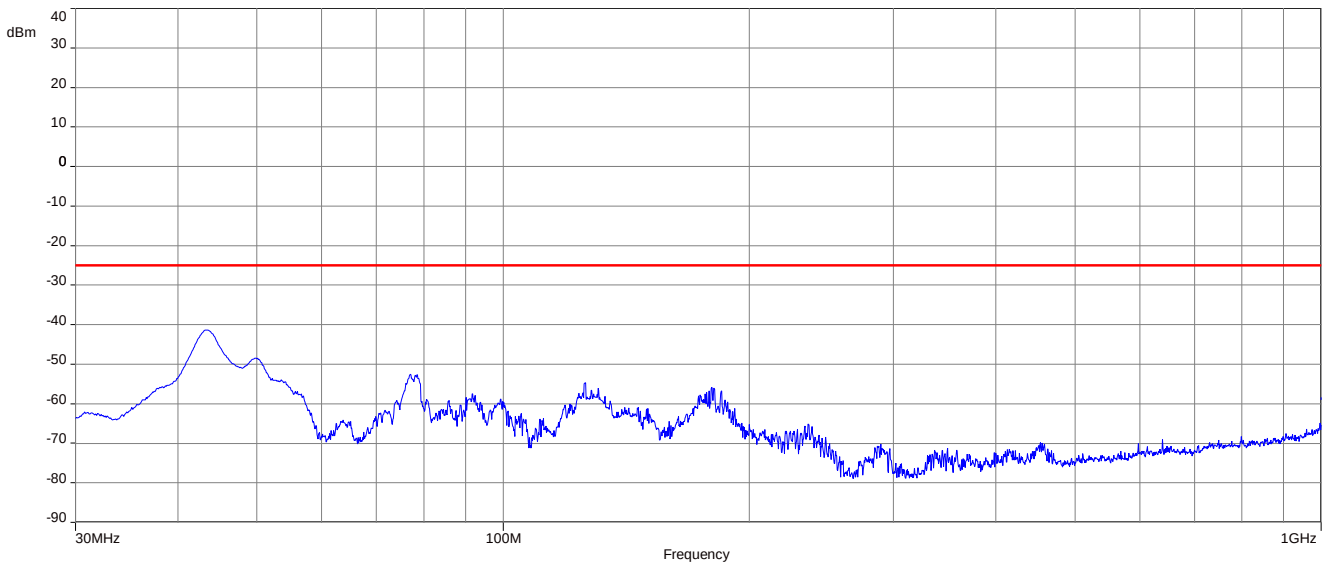
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

Plots:

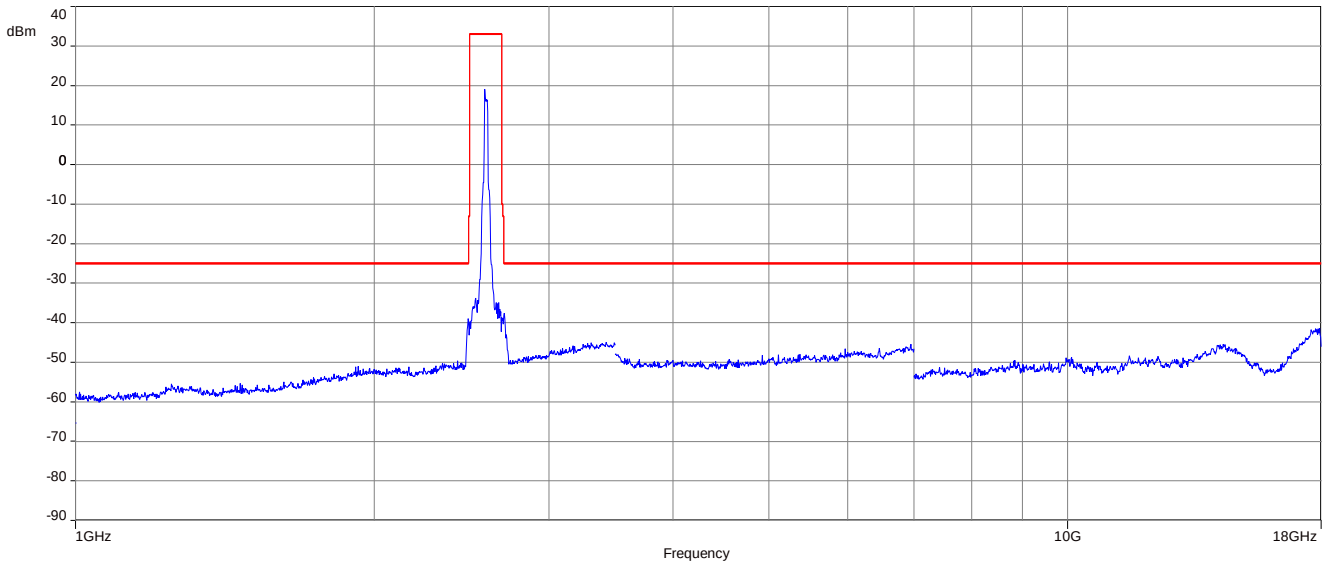
Plot 1: QPSK - Middle channel (9 kHz - 30 MHz)



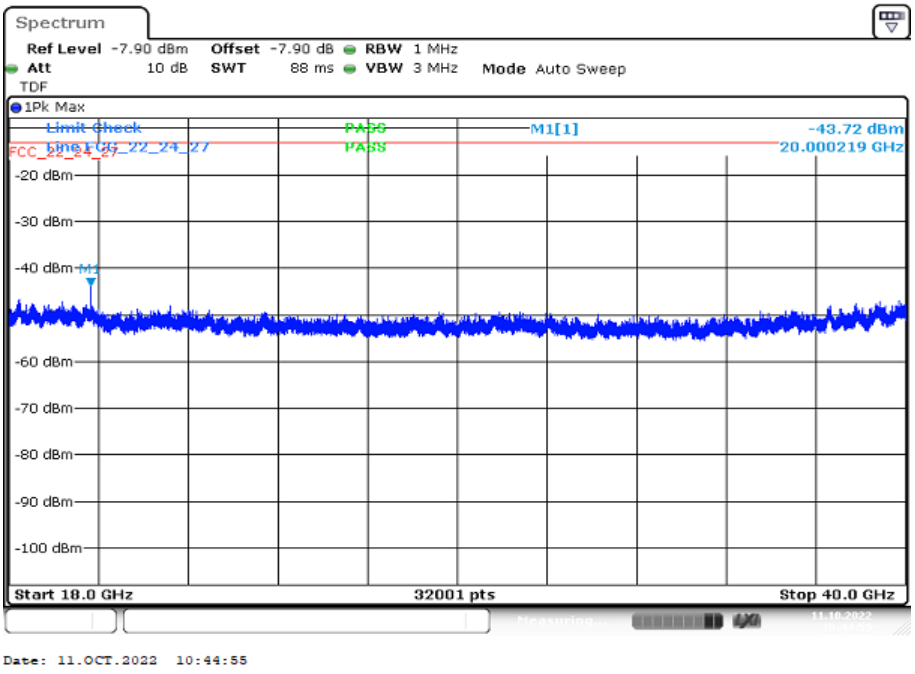
Plot 2: QPSK - Middle channel (30 MHz – 1 GHz)



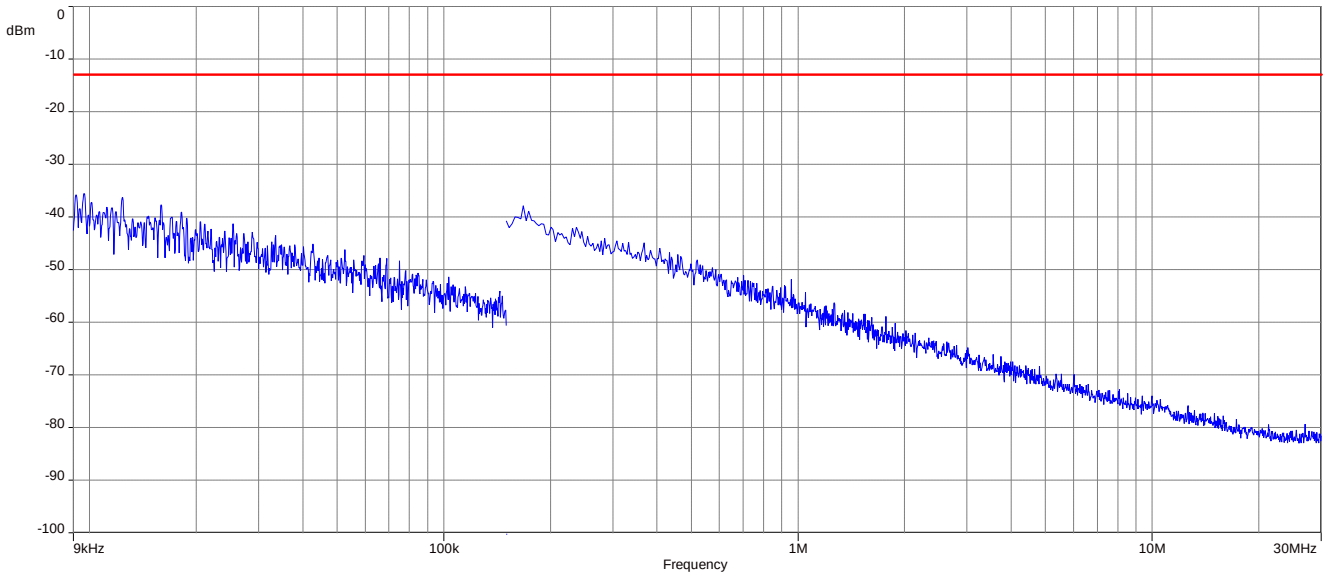
Plot 3: QPSK - Middle channel (1 GHz – 18 GHz)



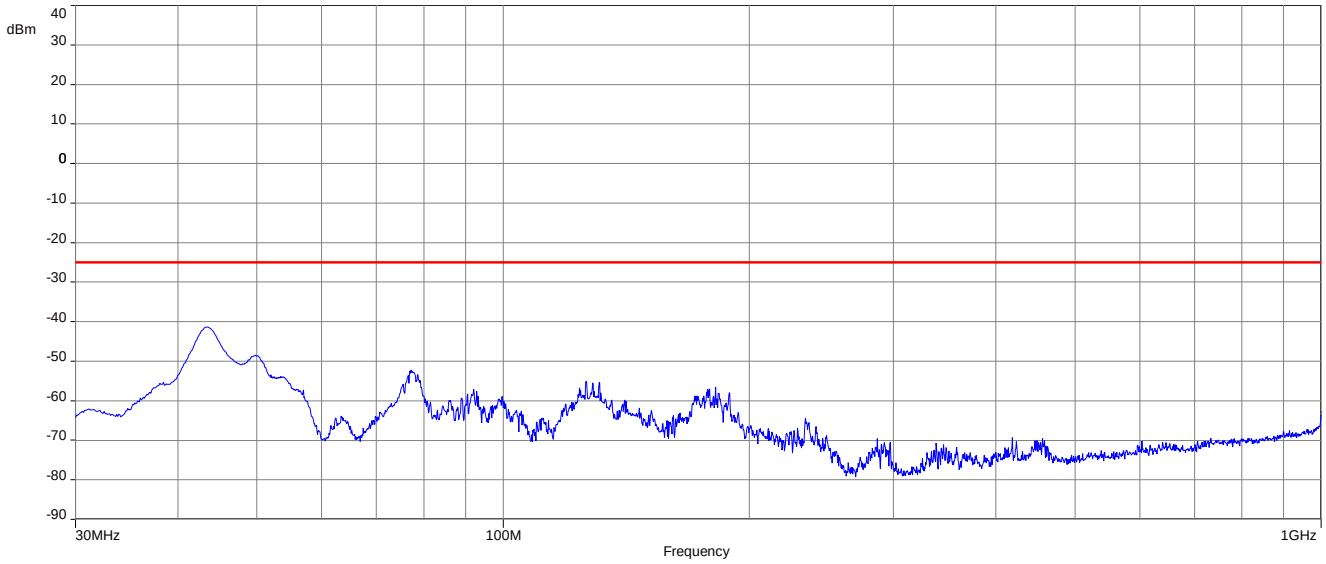
Plot 4: QPSK - Middle channel (18 GHz – 40 GHz)



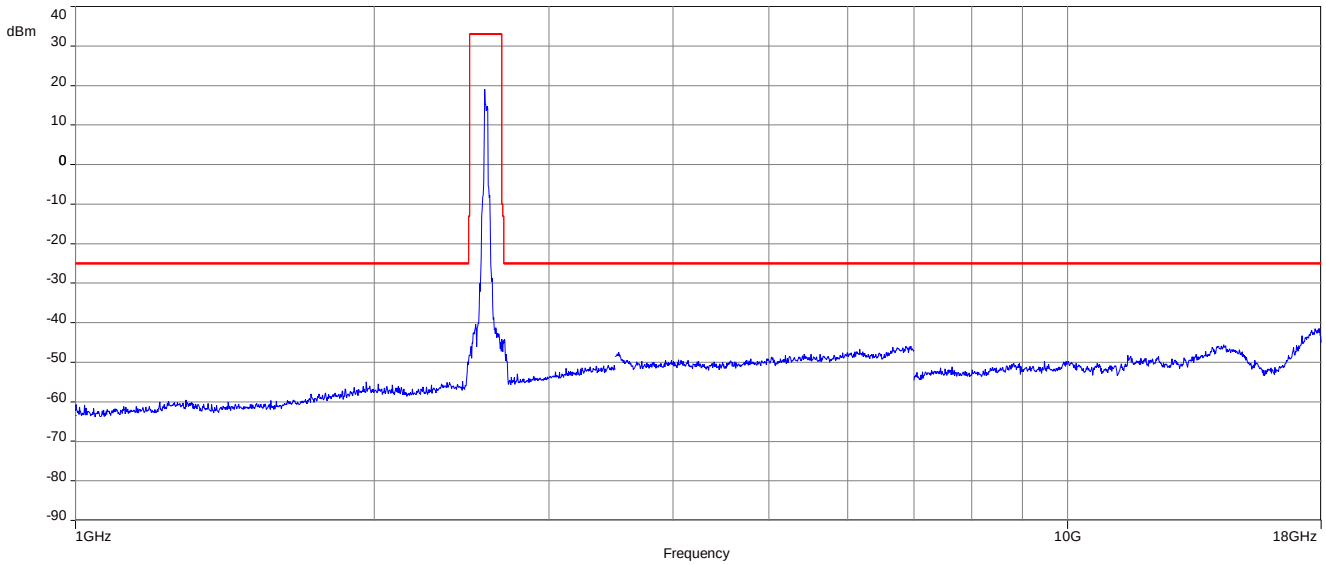
Plot 5: 16-QAM - Middle channel (9 kHz - 30 MHz)



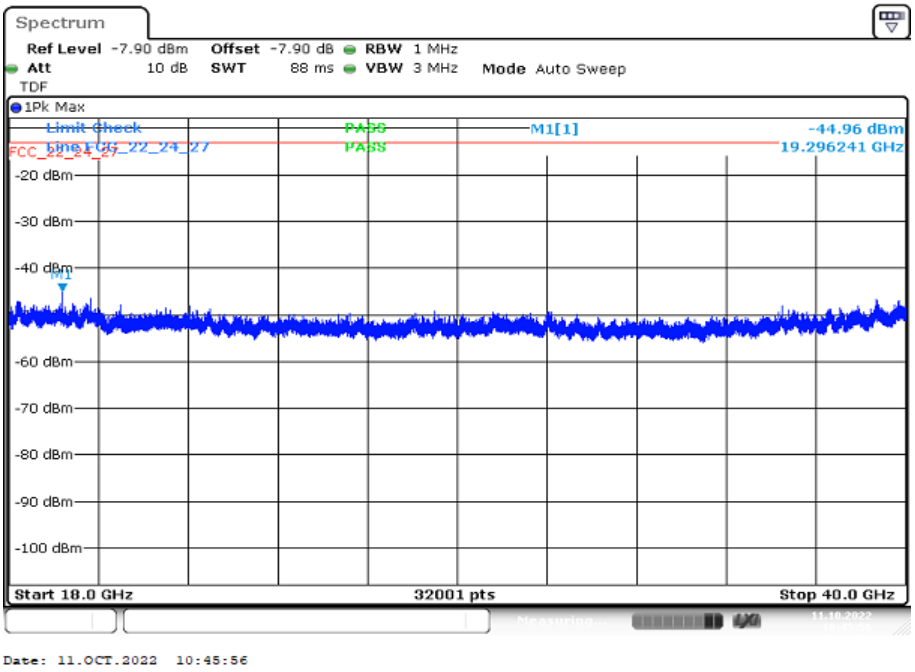
Plot 6: 16-QAM - Middle channel (30 MHz – 1 GHz)



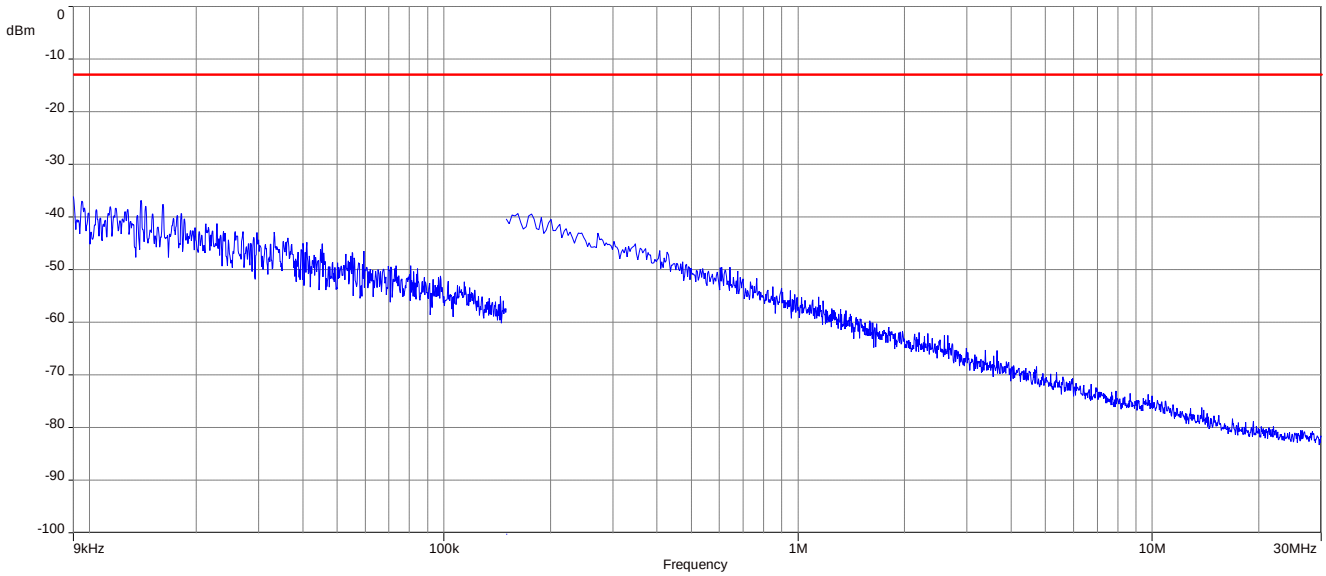
Plot 7: 16-QAM - Middle channel (1 GHz – 18 GHz)



Plot 8: 16-QAM - Middle channel (18 GHz – 40 GHz)

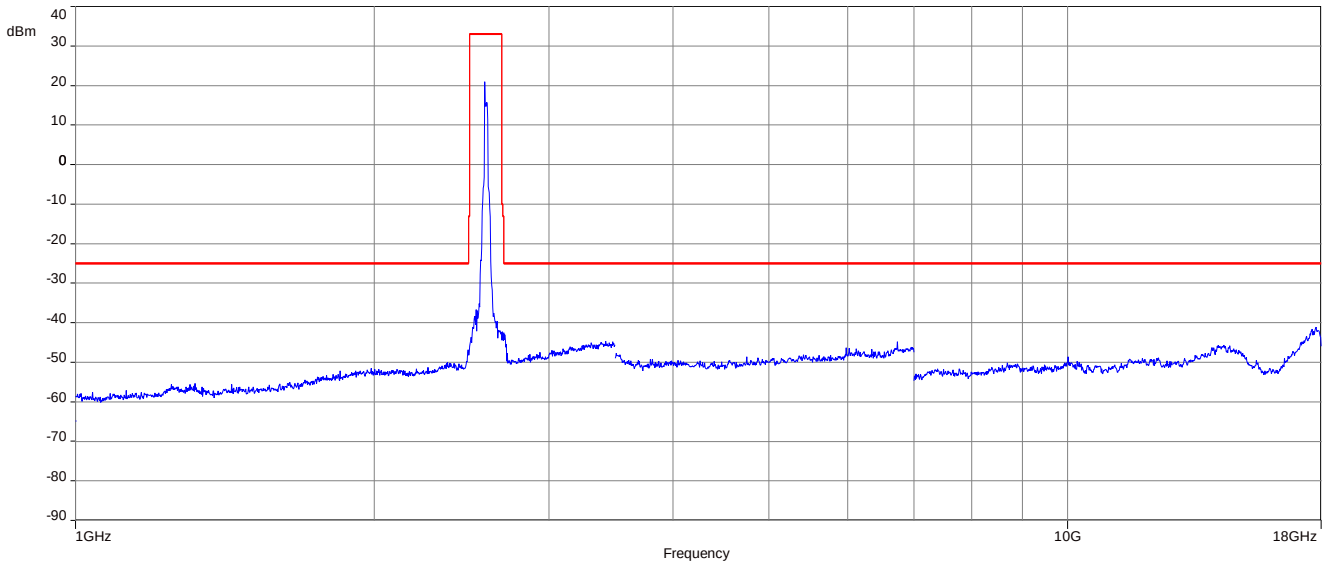


Plot 9: 64-QAM - Middle channel (9 kHz - 30 MHz)

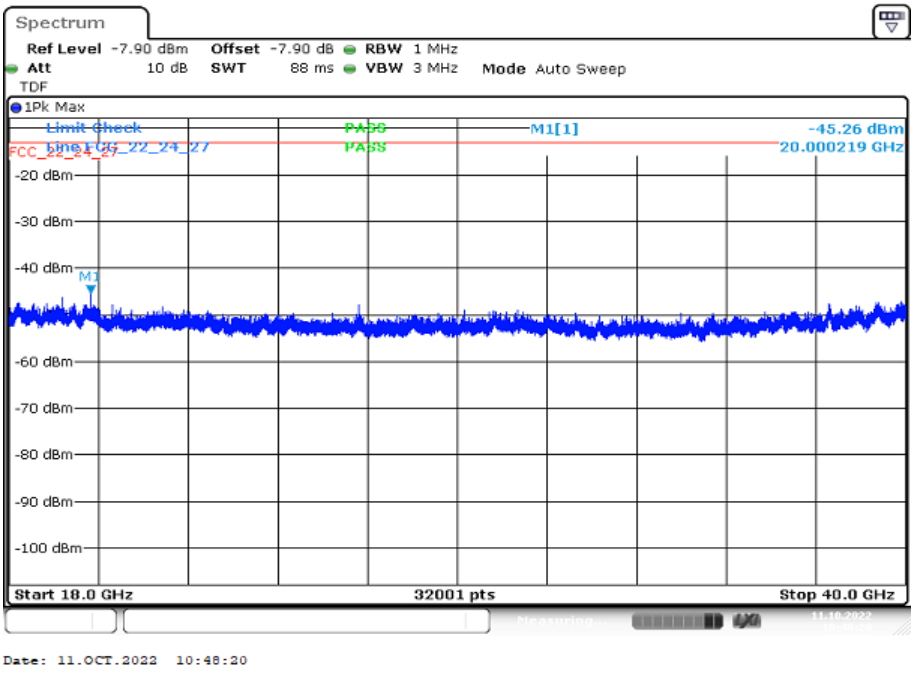


Plot 10: 64-QAM - Middle channel (30 MHz – 1 GHz)

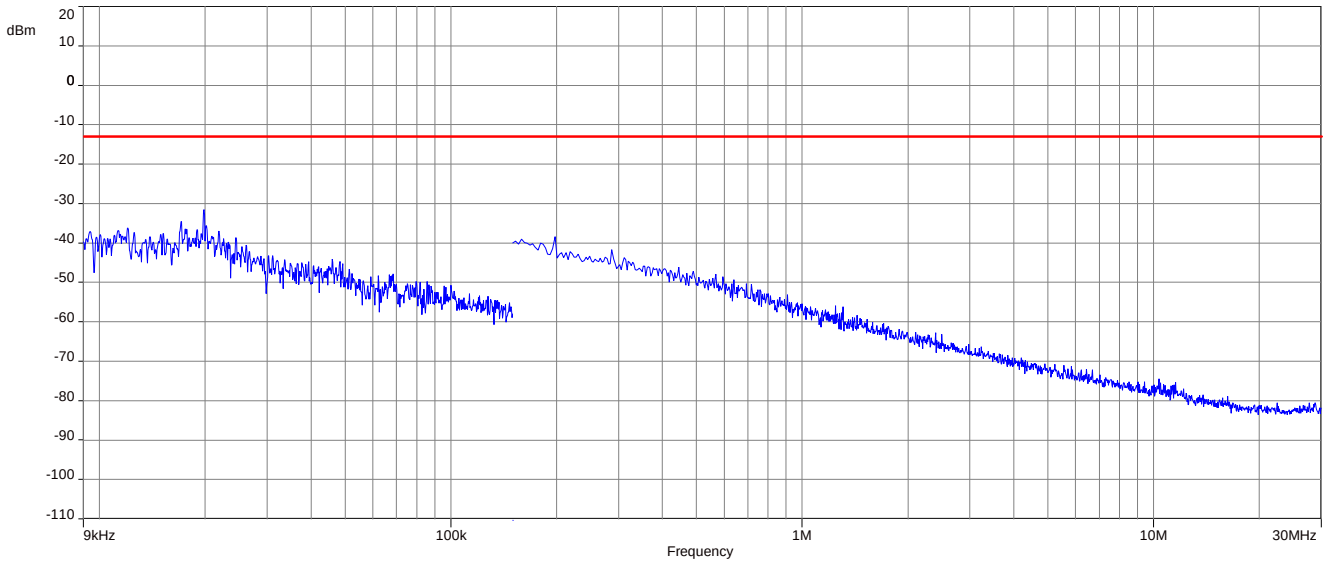
Plot 11: 64-QAM - Middle channel (1 GHz – 18 GHz)



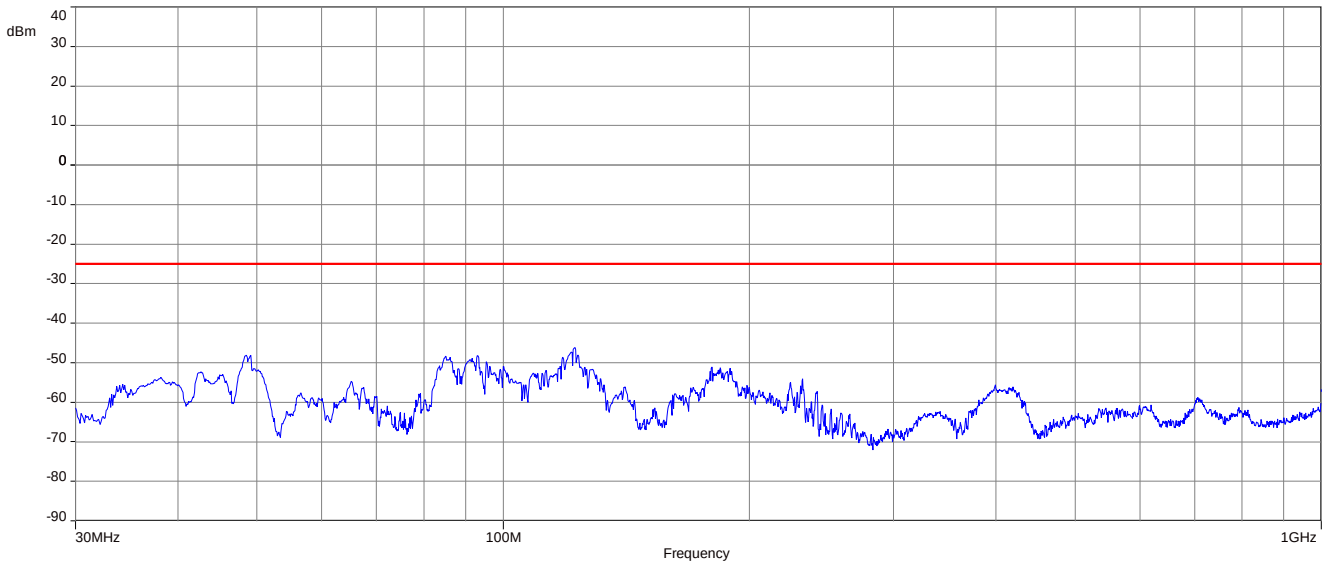
Plot 12: 64-QAM - Middle channel (18 GHz – 40 GHz)



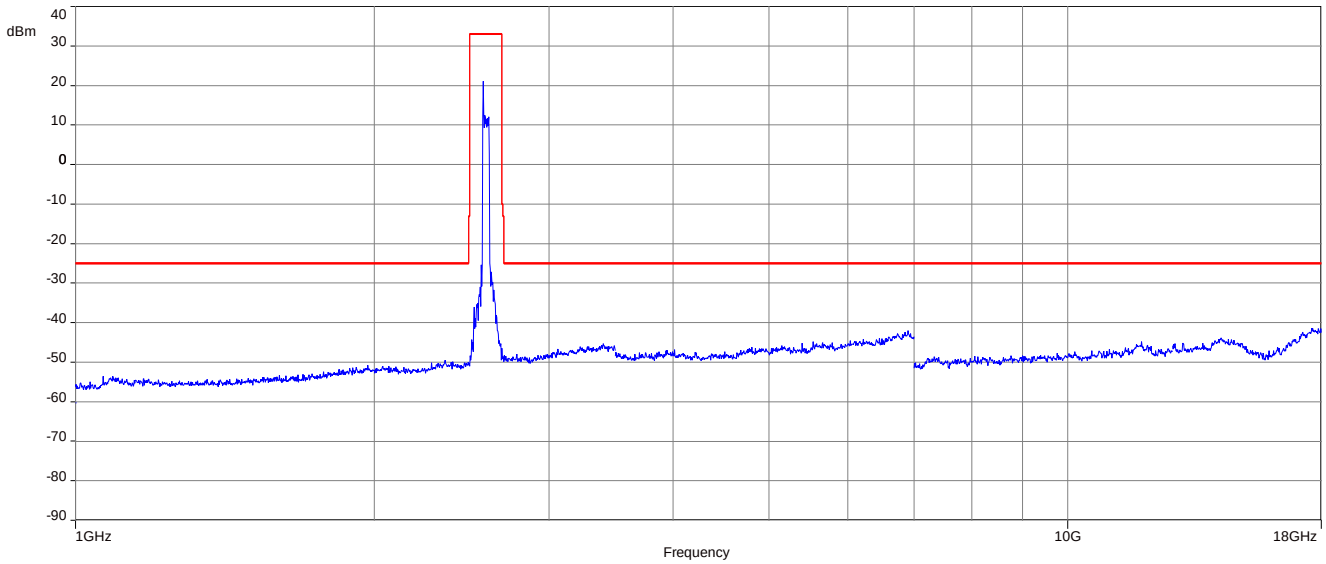
Plot 13: 256-QAM - Middle channel (9 kHz - 30 MHz)



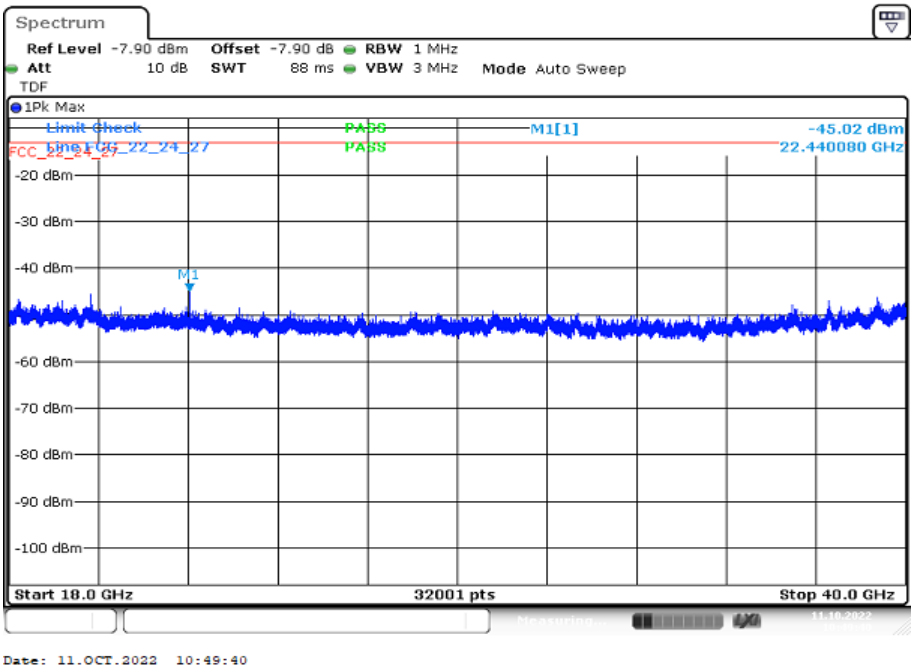
Plot 14: 256-QAM - Middle channel (30 MHz – 1 GHz)



Plot 15: 256-QAM - Middle channel (1 GHz – 18 GHz)



Plot 16: 256-QAM - Middle channel (18 GHz – 40 GHz)



12.2.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.
1. Determine frequency range for measurements: From § 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	3 MHz
Resolution bandwidth:	1 MHz
Log file:	1-3977_22-03-18_Annex_MR_A1
Span:	30 MHz – 26 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 8.4 setup A
Measurement uncertainty:	see chapter 9
Measurement procedure	FCC: § 2.1051

Limits:

FCC
§ 27.53 (m) (4)
For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.
-25 dBm

Results: **ANT1**

QPSK:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

NOTE: The limit of -25 dBm is fulfilled.

16-QAM:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

NOTE: The limit of -25 dBm is fulfilled.

64-QAM:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

NOTE: The limit of -25 dBm is fulfilled.

256-QAM:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

NOTE: The limit of -25 dBm is fulfilled.

Results: **ANT2**

QPSK:

Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		-/-		-/-	

NOTE: The limit of -25 dBm is fulfilled.

12.2.5 Block edge compliance

Description:

The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

Measurement parameters	
Detector:	RMS
Sweep time:	See plots
Video bandwidth:	See plots
Resolution bandwidth:	See plots
Log file:	1-3977_22-03-18_Annex_MR_A1
Span:	1 MHz steps
Trace mode:	Max Hold
Used equipment:	See chapter 8.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1051

Limits:

FCC
§ 27.53 (m) (4)
For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.
-13 dBm

Results: PASS (See log files)

12.2.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the 5G NR band 41 frequency band. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Measurement parameters	
Detector:	Peak
Sweep time:	See plots
Video bandwidth:	See plots
Resolution bandwidth:	See plots
Log file:	1-3977_22-03-18_Annex_MR_A1
Span:	2 x nominal bandwidth
Trace mode:	Max Hold
Used equipment:	See chapter 8.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1049

Limits:

FCC
§ 2.1049
Reporting only

Results: ANT1

Occupied Bandwidth – QPSK			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	mid	18232	19800
30 MHz	mid	27348	28800
40 MHz	mid	36464	39100
50 MHz	mid	46578	48750
60 MHz	mid	58591	61200
70 MHz	mid	65385	67550
80 MHz	mid	78921	82800
90 MHz	mid	88561	92250
100 MHz	mid	98152	102250

Occupied Bandwidth – 16-QAM			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	mid	18332	19800
30 MHz	mid	27273	28800
40 MHz	mid	36663	38900
50 MHz	mid	46578	48750
60 MHz	mid	58741	61200
70 MHz	mid	65210	67550
80 MHz	mid	78921	82600
90 MHz	mid	88786	92250
100 MHz	mid	98152	102250

Occupied Bandwidth – 64-QAM			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	mid	18332	19800
30 MHz	mid	27348	28800
40 MHz	mid	36663	38800
50 MHz	mid	46703	48625
60 MHz	mid	58741	61050
70 MHz	mid	65385	67550
80 MHz	mid	79121	82600
90 MHz	mid	88561	92250
100 MHz	mid	98402	102000

Occupied Bandwidth – 256-QAM			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	mid	18332	19800
30 MHz	mid	27273	28725
40 MHz	mid	36663	38900
50 MHz	mid	46703	48625
60 MHz	mid	58741	61050
70 MHz	mid	65210	67550
80 MHz	mid	79121	82600
90 MHz	mid	88561	92250
100 MHz	mid	98402	102000

Results: ANT2

Occupied Bandwidth – PI/2 BPSK			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	low	18.282	20.050
	mid	18.282	19.950
	high	18.232	20.050
30 MHz	low	27.273	29.100
	mid	27.273	29.175
	high	27.273	29.100
40 MHz	low	36.563	39.100
	mid	36.563	39.000
	high	36.563	39.000
50 MHz	low	46.578	49.000
	mid	46.578	48.750
	high	46.578	48.875
60 MHz	low	58.741	61.200
	mid	58.741	61.200
	high	58.741	60.900
70 MHz	low	65.035	67.725
	mid	65.035	67.725
	high	65.035	67.550
80 MHz	low	78.521	82.800
	mid	78.921	82.600
	high	78.721	82.800
90 MHz	low	88.561	92.475
	mid	88.561	92.475
	high	88.561	92.475
100 MHz	low	98.152	102.25
	mid	98.152	102.25
	high	98.152	102.25

Occupied Bandwidth – QPSK			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	low	18.282	19.950
	mid	18.282	20.000
	high	18.232	20.000
30 MHz	low	27.348	28.725
	mid	27.198	28.725
	high	27.273	29.025
40 MHz	low	36.464	39.000
	mid	36.464	38.800
	high	36.563	38.900
50 MHz	low	46.578	48.875
	mid	46.578	48.875
	high	46.454	48.875
60 MHz	low	58.741	61.200
	mid	58.741	61.050
	high	58.591	61.200
70 MHz	low	65.210	67.725
	mid	65.385	67.550
	high	65.210	67.550
80 MHz	low	78.721	83.000
	mid	79.121	82.800
	high	78.921	83.000
90 MHz	low	88.561	92.475
	mid	88.337	92.250
	high	88.337	92.250
100 MHz	low	97.902	102.25
	mid	97.902	102.25
	high	97.902	102.25

Occupied Bandwidth 16-QAM			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	low	18.282	20.200
	mid	18.282	20.050
	high	18.332	19.900
30 MHz	low	27.348	28.800
	mid	27.273	28.875
	high	27.273	28.800
40 MHz	low	36.563	39.000
	mid	36.663	38.900
	high	36.763	39.000
50 MHz	low	46.578	48.750
	mid	46.578	49.000
	high	46.454	48.875
60 MHz	low	58.591	61.200
	mid	58.741	60.900
	high	58.741	61.200
70 MHz	low	65.210	67.550
	mid	65.210	67.375
	high	65.210	67.550
80 MHz	low	78.721	82.800
	mid	78.721	82.600
	high	78.721	82.800
90 MHz	low	88.561	92.700
	mid	88.561	92.475
	high	88.337	92.250
100 MHz	low	98.152	102.25
	mid	98.152	102.25
	high	97.902	102.25

Occupied Bandwidth 64-QAM			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	low	18.332	20.050
	mid	18.332	19.850
	high	18.282	19.800
30 MHz	low	27.348	28.650
	mid	27.273	28.875
	high	27.273	28.875
40 MHz	low	36.663	38.900
	mid	36.663	39.000
	high	36.763	38.700
50 MHz	low	46.578	48.875
	mid	46.578	48.500
	high	46.703	48.500
60 MHz	low	58.741	60.900
	mid	58.741	61.050
	high	58.741	60.900
70 MHz	low	65.385	67.375
	mid	65.385	67.550
	high	65.210	67.550
80 MHz	low	78.921	82.800
	mid	79.121	82.600
	high	78.921	82.800
90 MHz	low	88.337	92.250
	mid	88.561	92.250
	high	88.561	92.250
100 MHz	low	98.152	102.25
	mid	98.402	102.00
	high	97.902	102.00

Occupied Bandwidth 256-QAM			
Bandwidth	**Channel**	**99% OBW (MHz)**	**-26 dBc BW (MHz)**
20 MHz	low	18.332	20.100
	mid	18.232	19.800
	high	18.282	19.850
30 MHz	low	27.348	28.725
	mid	27.273	28.800
	high	27.273	28.800
40 MHz	low	36.663	38.900
	mid	36.663	38.800
	high	36.763	38.900
50 MHz	low	46.578	48.625
	mid	46.703	48.625
	high	46.578	48.625
60 MHz	low	58.741	61.200
	mid	58.741	60.900
	high	58.741	61.050
70 MHz	low	65.385	67.375
	mid	65.210	67.375
	high	65.210	67.375
80 MHz	low	78.921	82.800
	mid	79.121	82.600
	high	78.921	82.800
90 MHz	low	88.337	92.475
	mid	88.561	92.475
	high	88.561	92.250
100 MHz	low	98.152	101.75
	mid	98.402	102.00
	high	98.402	102.00

13 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

14 Document history

Version	Applied changes	Date of release
-/-	Initial release	2023-01-18

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

first page

DAkkS Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche 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 17025:2018 to carry out tests in the following fields:

Telecommunication (FCC Requirements)

The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages.

Registration number of the certificate: **D-PL-12076-01-05**

Frankfurt am Main, 09.06.2020

by order Dipl.-Ing. (FH) Ralf Egner
Head of Division

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.
https://www.dakks.de/en/content/accredited-bodies-dakks

See notes overleaf.

last page

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The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate 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 I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

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

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

or

https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

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