
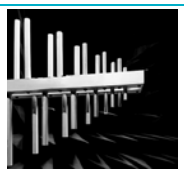
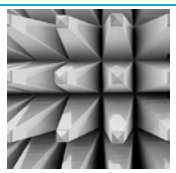

TEST REPORT

Test report no.: 1-6998_23-02-08_TR1-R1

Testing laboratory

cetecom advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://cetecomadvanced.com
e-mail: mail@cetecomadvanced.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 with the registration number:
D-PL-12047-01-00.
ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

Applicant

Leica Geosystems AG
Heinrich-Wild-Straße
9435 Heerbrugg / SWITZERLAND
Phone: +41 71 727 3131
Contact: Oezcan Tepeli
e-mail: oezcan.tepeli@leica-geosystems.com

Manufacturer

Leica Geosystems AG
Heinrich-Wild-Straße
9435 Heerbrugg / SWITZERLAND

Test standard/s

FCC - Title 47 CFR Part 22	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile services
FCC - Title 47 CFR Part 24	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 24 - Personal communications services

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

Test Item

Kind of test item:	**GNSS Sensor**
Model name:	**LG1002**
FCC ID:	**RFD-LG1002**
ISED certification number:	**3177A-LG1002**
Frequency bands:	LTE bands 2, 4, 5, 12, 13, 25, 26a, 26b, 66, 85
Technology tested:	LTE Cat. M1
Antenna:	One Quarter-Wave Monopole antenna
Power supply:	2.5 V to 4.1 V DC by Li-Ion battery
Temperature range:	-30°C to +60°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=Marco Bertolino, o=cetecom advanced GmbH, ou=BTL-230530, email=marco.bertolino@cetecomadvanced.com, c=DE
2024.09.04 13:21:30 +02'00'

Marco Bertolino
Supervisor Radio Services
Radio Labs

Test performed:

cn=René Oelmann, o=cetecom advanced GmbH, ou=OEL-230530, email=rene.oelmann@cetecomadvanced.com, c=DE
2024.09.04 14:22:44 +02'00'

René Oelmann
Lab Manager
Radio Labs

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. cetecom 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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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.

2.2 Application details

Date of receipt of order:	2023-12-20
Date of receipt of test item:	2024-01-02
Start of test:*	2024-01-02
End of test:*	2024-03-12
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

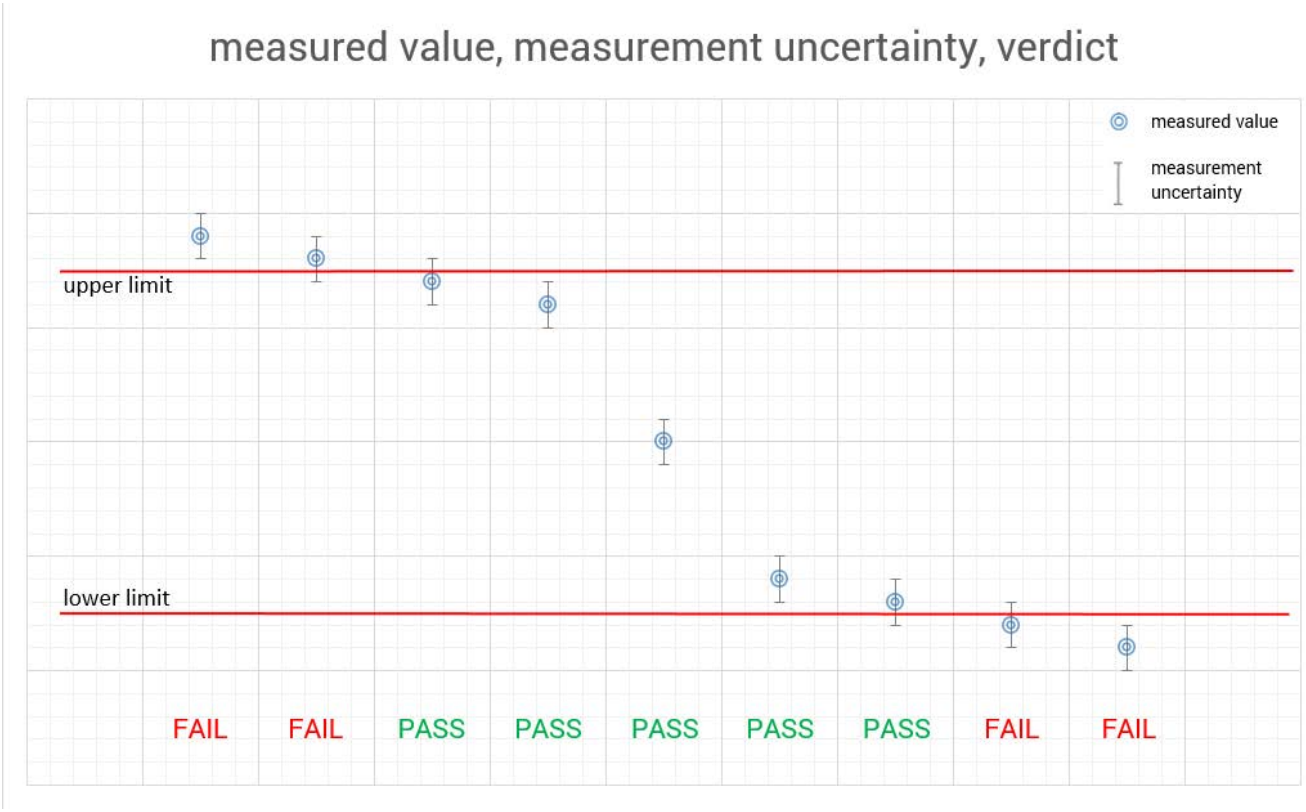
3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 22		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile services
FCC - Title 47 CFR Part 24		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 24 - Personal communications services
FCC - Title 47 CFR Part 27		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 27 - Miscellaneous wireless communications services
RSS - 132 Issue 4	January 2023	Cellular Systems Operating in the Bands 824-849 MHz and 869-894 MHz
RSS - 133 Issue 6, Amendment 1	January 2018	Spectrum Management and Telecommunications Policy - Radio Standards Specifications, 2 GHz Personal Communication Services
RSS - 139 Issue 4	September 2022	Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz
RSS – 130 Issue 2	February 2019	Equipment Operating in the Frequency Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz
FCC – Title 47 CFR Part 90		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 90 - Private Land Mobile Radio 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
Power Meas License Systems: KDB 971168 D01	v03r01	Measurement Guidance for Certification of Licensed Digital Transmitters

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 +60 °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}	3.7 V DC by Li-Ion battery 4.1 V by external power supply 2.5 V by external power supply

6 Test item

6.1 General description

Kind of test item	:	GNSS Sensor
Model name	:	LG1002
HMN	:	N/A
PMN	:	GS05 LTE
HVIN	:	LG1002
FVIN	:	N/A
S/N serial number	:	Rad. 3800165 & 3800166TBD Cond. 3800167
Hardware status	:	C
Software status	:	0.1
Firmware status	:	BSP v4.0.20
Frequency band	:	LTE bands 2, 4, 5, 12, 13, 25, 26a, 26b, 66, 85
Type of radio transmission Use of frequency spectrum	: :	OFDM
Type of modulation	:	QPSK, 16 – QAM
Antenna	:	One Quarter-Wave Monopole antenna
Power supply	:	2.5 V to 4.1 V DC by Li-Ion battery
Temperature range	:	-30°C to +60°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: 1-6998_23-02-01_TR1-A101-R1
1-6998_23-02-01_TR1-A102-R1
1-6998_23-02-01_TR1-A104-R1

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).

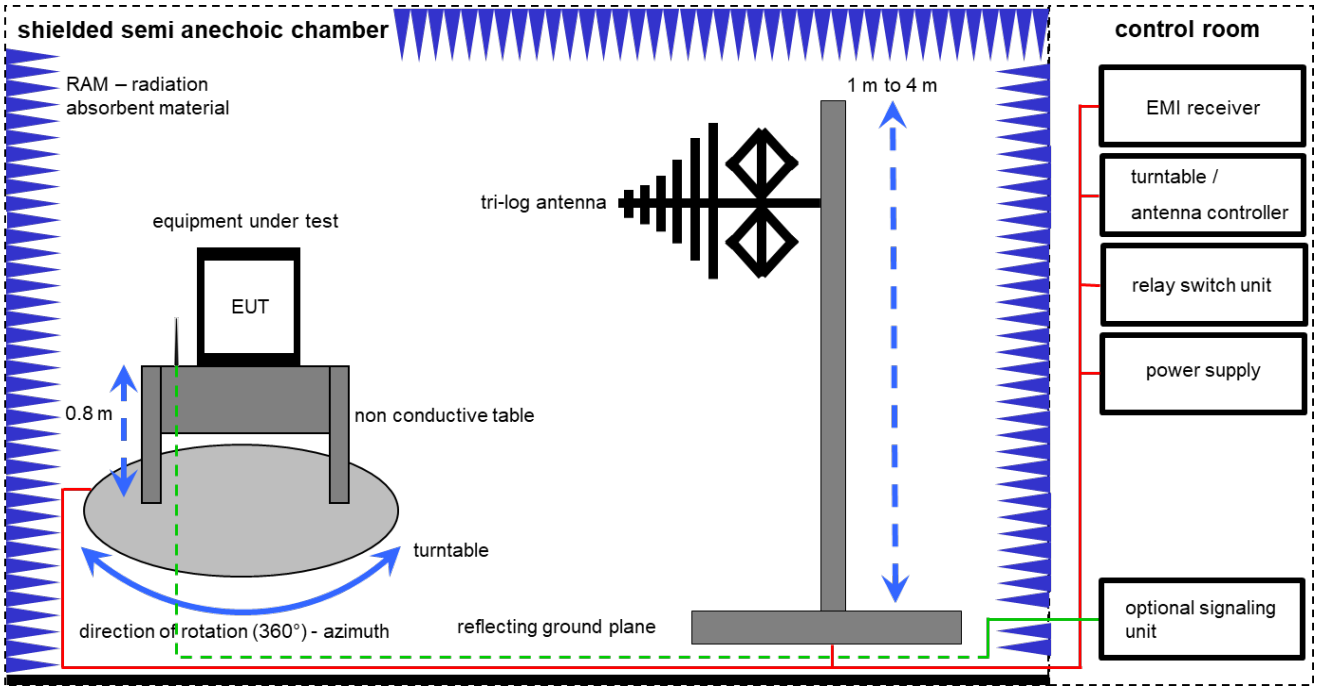
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

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

7.1 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

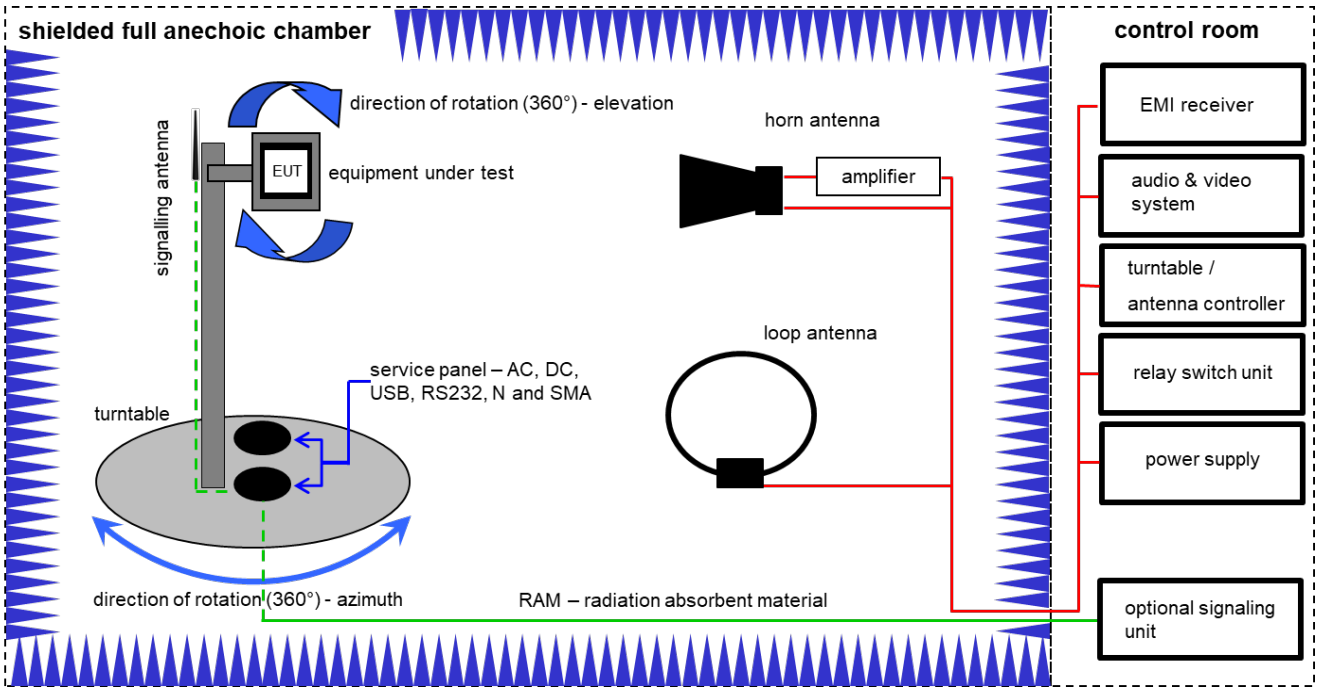
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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.	Setup	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	Semi anechoic chamber	3000023	MWB AG	-/-	300000551	ne	-/-	-/-
3	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
4	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
5	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vlKI!	31.01.2024	30.01.2026
6	A	Turntable	2089-4.0	EMCO	-/-	300004394	ne	-/-	-/-
7	A	PC	TecLine	F+W	-/-	300004388	ne	-/-	-/-
8	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	06.12.2023	31.12.2024
9	A	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	06.12.2023	31.12.2025

7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

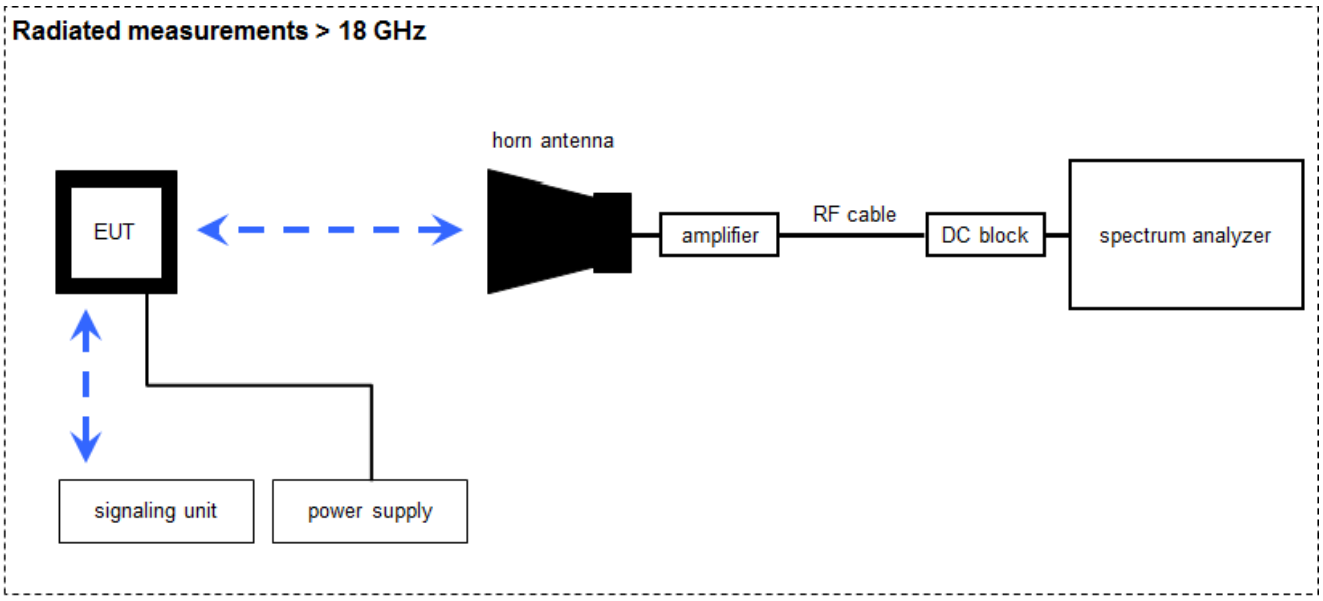
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

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
8	A, B	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	06.12.2023	31.12.2025
9	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	02.08.2023	31.08.2025
10	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3696	300001604	vlKl!	20.03.2023	19.03.2025
11	B	Tunable Band Reject Filter (FDD I)	WRCT1850/2170-5/40-10EEK	Wainwright	7	300003386	ne	-/-	-/-
13	B	Tunable Band Reject Filter	WRCT1850/2170-5/40-10EEK	Wainwright	40	300003872	ev	-/-	-/-
14	B	Tunable Band Reject Filter	WRCT824/894-5/40-8EEK	Wainwright	27	300003873	ev	-/-	-/-
15	A, B	EMI Test Receiver 9kHz-26,5GHz	ESR26	Rohde & Schwarz	101376	300005063	k	15.01.2024	14.01.2025
17	B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	37	400000148	ne	-/-	-/-
18	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
19	B	Band Reject Filter	WRCG1710/1755-1690/1775-90/14SS	Wainwright	7	300003793	ne	-/-	-/-
20	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22051	300004483	ev	-/-	-/-
21	A,B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-

7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

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)

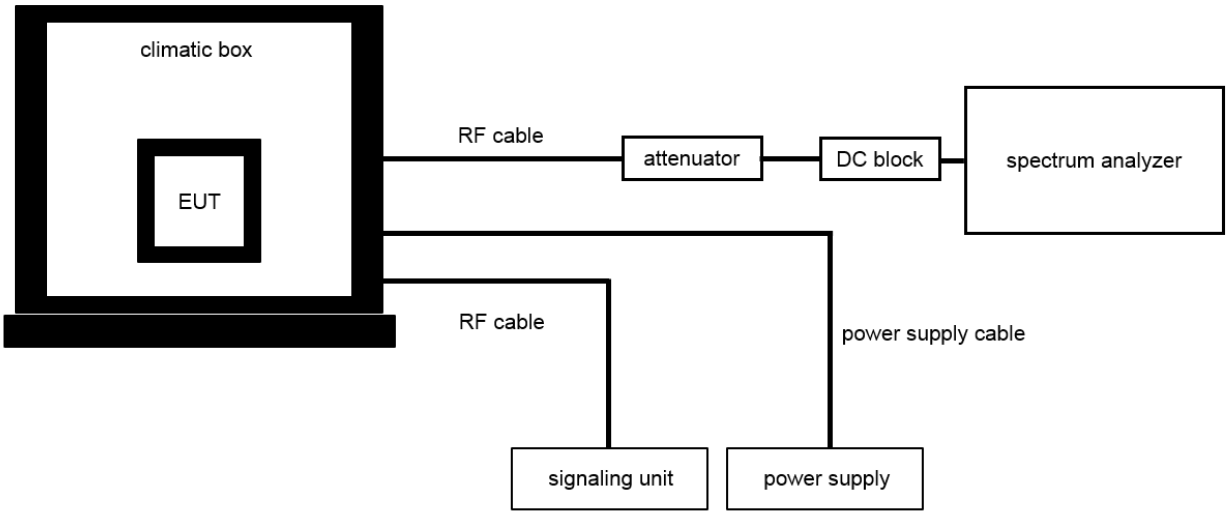
Example calculation:
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	06.12.2023	31.12.2025
2	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vlKl!	24.01.2024	23.01.2026
3	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
4	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	06.12.2023	31.12.2024

7.4 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	06.12.2023	31.12.2024
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	31.05.2024
7	A	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	06.12.2023	31.12.2025

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.

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:	1-6998_23-02 Questionnaire.pdf Anleitung GS05 Radio Zertifizierung V1.pdf
Special test descriptions:	None
Configuration descriptions:	None
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 22 ISED: RSS-Gen, Issue 5 & RSS 132, Issue 4	See table!	2024-09-04	-/-

11.1 Part 22/RSS-132: LTE band 5

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

11.2 Part 22/RSS-132: LTE band 26a

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 LTE band 5

The EUT was set to transmit the maximum power.

12.2.1 RF output power

Description:

This paragraph contains conducted average power, ERP and Peak-to-Average Power Ratio measurements for the mobile station.

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	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	See chapter 7.1 setup A & 7.4 setup A
Measurement uncertainty:	see chapter 9
Measurement procedure:	FCC: § 2.1046 ISED: RSS-Gen, 6.12

Limits:

FCC	ISED
§ 22.913(a)(5) & (d)	RSS-132, 5.4
(a)(5) The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 W. (d) The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.	The equivalent radiated power (e.r.p.) shall not exceed 7 watts for mobile equipment and 3 watts for portable equipment. The peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB […].
Power: **38.45 dBm ERP** PAPR: **13 dB**	

Results:

Output Power (conducted)

Bandwidth (MHz)	Channel No. / Frequency (MHz)	Resource block allocation	Average Output Power (dBm) QPSK	Peak to Average Ratio (dB)	Average Output Power (dBm) 16-QAM	Peak to Average Ratio (dB)
1.4	20407 / 824.7	1 RB low	16,0	5,7	14,9	6,7
		1 RB high	15,9	5,8	15,0	6,7
		100% RB	14,2	6,1	14,3	7,0
	20525 / 836.5	1 RB low	16,2	5,7	14,8	6,8
		1 RB high	15,9	5,8	14,8	6,8
		100% RB	14,3	6,1	14,3	7,0
	20643 / 848.3	1 RB low	16,2	5,7	15,2	6,6
		1 RB high	16,2	5,8	15,0	6,8
		100% RB	14,2	6,5	14,1	7,1
3	20415 / 825.5	1 RB low	16,1	5,7	14,1	7,5
		1 RB high	15,1	6,6	15,0	6,7
		100% RB	13,6	7,0	13,3	7,8
	20525 / 836.5	1 RB low	16,2	5,7	15,0	6,7
		1 RB high	16,0	5,8	15,0	6,7
		100% RB	14,2	6,1	14,4	7,0
	20635 / 847.5	1 RB low	15,4	6,5	14,6	6,9
		1 RB high	15,2	6,6	14,6	6,9
		100% RB	14,2	6,4	10,8	10,1
5	20425 / 826.5	1 RB low	17,8	4,0	17,9	4,5
		1 RB high	17,7	4,0	17,7	4,6
		100% RB	17,0	4,6	15,8	5,5
	20525 / 836.5	1 RB low	18,0	3,9	17,9	4,5
		1 RB high	17,8	4,0	17,7	4,5
		100% RB	17,0	4,5	15,9	5,5
	20625 / 846.5	1 RB low	18,3	3,8	18,1	4,3
		1 RB high	18,2	3,9	17,9	4,4
		100% RB	17,1	4,6	16,0	5,5
10	20450 / 829.0	1 RB low	17,8	4,0	17,7	4,6
		1 RB high	17,5	4,1	17,6	4,6
		100% RB	17,0	4,6	16,9	5,3
	20525 / 836.5	1 RB low	17,8	4,0	17,6	4,5
		1 RB high	17,8	4,0	17,5	4,6
		100% RB	17,1	4,5	17,0	5,2
	20600 / 844.0	1 RB low	18,1	3,8	17,9	4,3
		1 RB high	18,0	3,9	17,8	4,4
		100% RB	17,0	4,6	17,1	5,1

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

Output Power (ERP)			
Bandwidth (MHz)	**Frequency (MHz)**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**
1.4	824.7	16.0	15.0
	836.5	16.2	14.8
	848.3	16.2	15.2
3	825.5	16.1	15.0
	836.5	16.2	15.0
	847.5	15.4	14.6
5	826.5	17.8	17.9
	836.5	18.0	17.9
	846.5	18.3	18.1
10	829.0	17.8	17.7
	836.5	17.8	17.6
	844.0	18.1	17.9

12.2.2 Frequency stability

Description:

In order to measure the carrier frequency under normal conditions it is necessary to make measurements with the mobile station connected to a R&S CMW500 Wideband Radio Communication 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 CMW500 on the centre channel with channel bandwidth of 10 MHz, 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 15 minutes at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage to V_{min} and measure the carrier frequency then setup V_{max} and repeat the measurement.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Test setup:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1055 ISED: RSS-Gen, 6.11

Limits:

FCC	ISED
§ 22.355 (Mobile Station, 821 – 896 MHz)	RSS-132, 5.3
The carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1.	The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within each of the sub-bands when tested at the temperature and supply voltage variations specified in RSS-Gen.
± 2.5 ppm	

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
4.1	-10	-0.01
3.7	-9	-0.01
2.5	-5	-0.01

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-28	-0.03
-20	-32	-0.04
-10	-36	-0.04
± 0	-28	-0.03
10	-17	-0.02
20	-10	-0.01
30	-9	-0.01
40	8	0.01
50	2	0.0

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, which is the transmitted carrier that can be as high as 849 MHz. Measurement made up to 9 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE band 5.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 s
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	100 MHz Steps
Trace mode:	Max Hold
Used equipment:	See chapter 7.1 setup A & 7.2 setup A, B
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1053 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 22.917(a) & (b)	RSS-132, 5.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. (b)(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a RBW of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (b)(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.	i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10(P) (watts). ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10(P) (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.
-13 dBm	

Results:

QPSK:

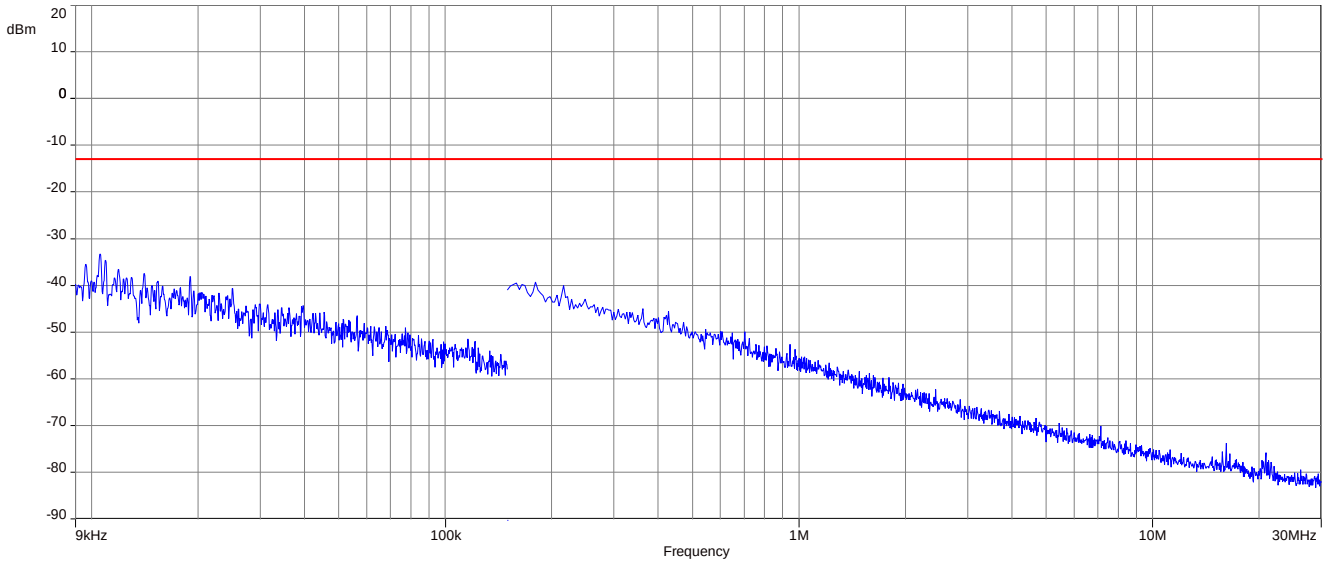
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

16-QAM:

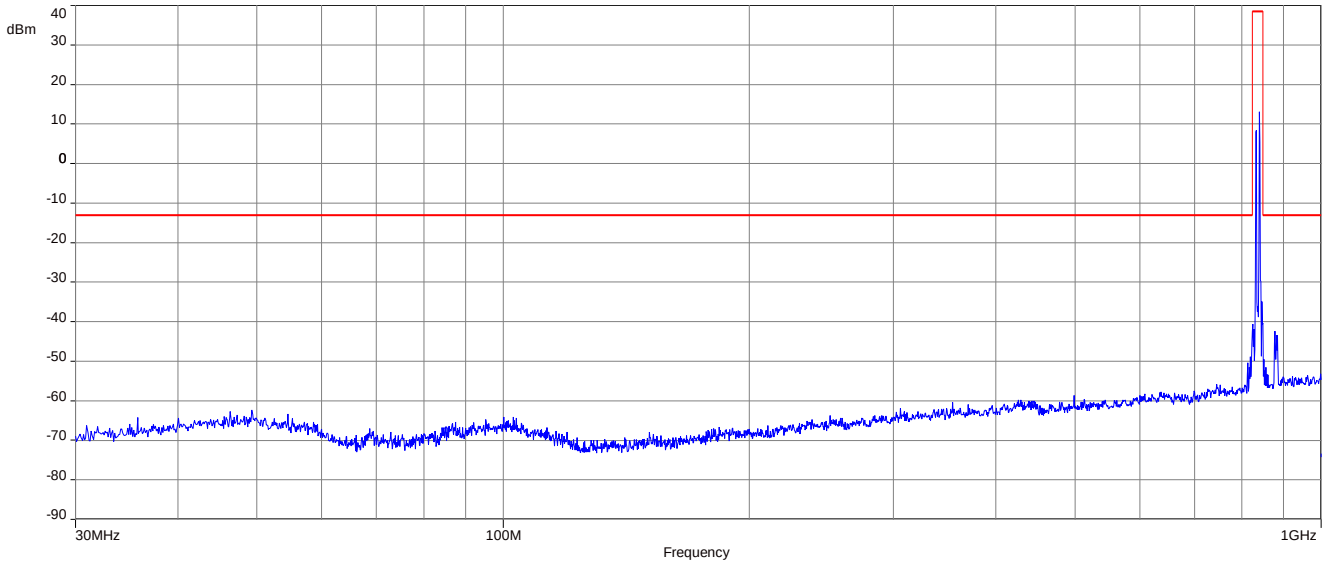
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

QPSK

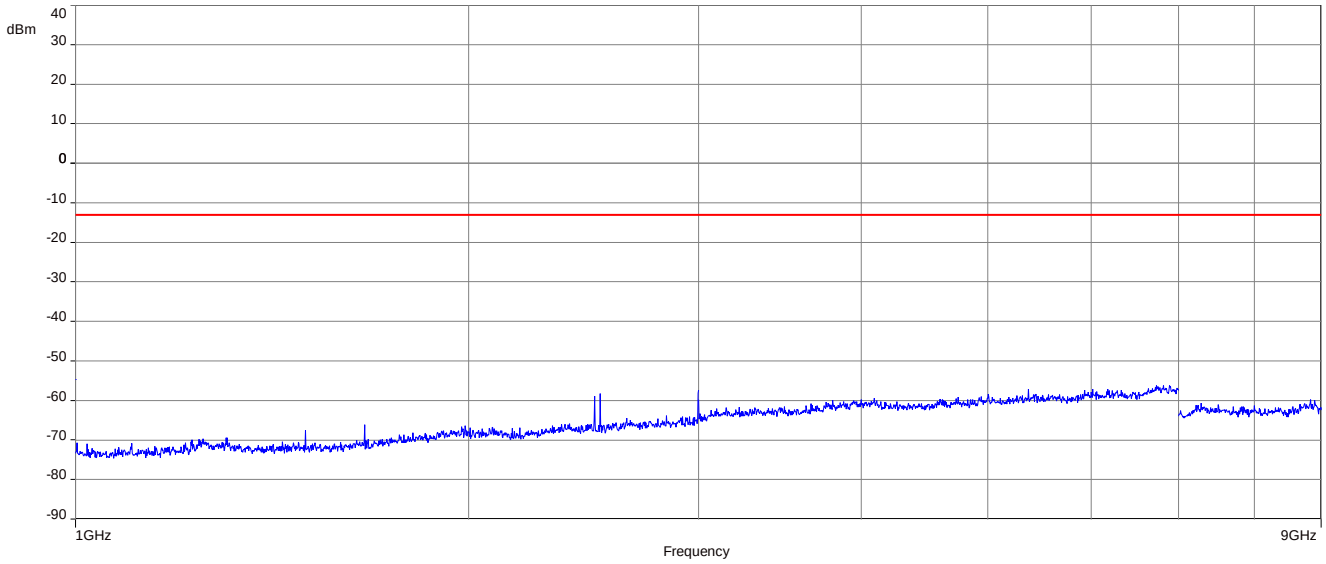
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)

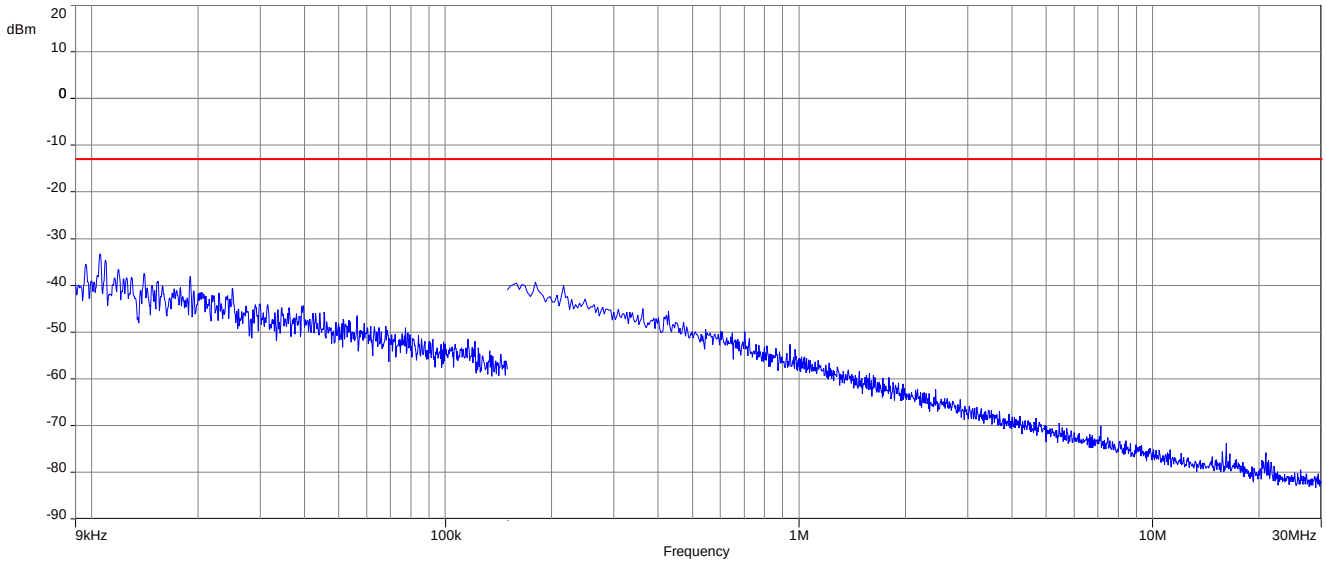


Plot 3: Mid channel (1 GHz – 9 GHz)

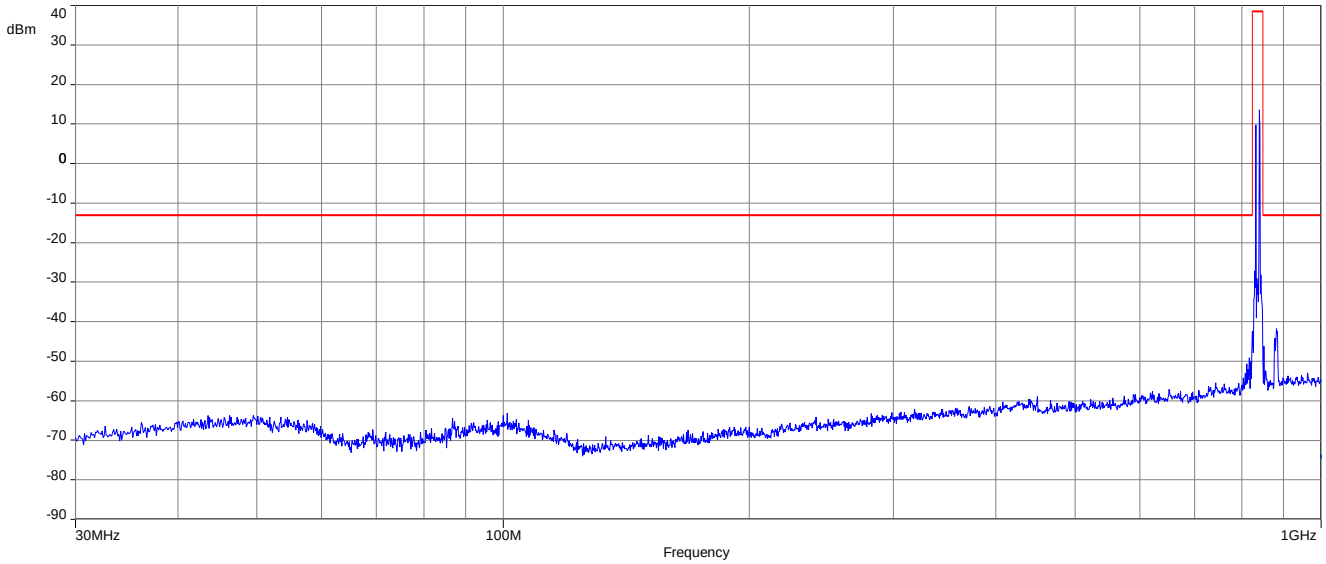


16-QAM

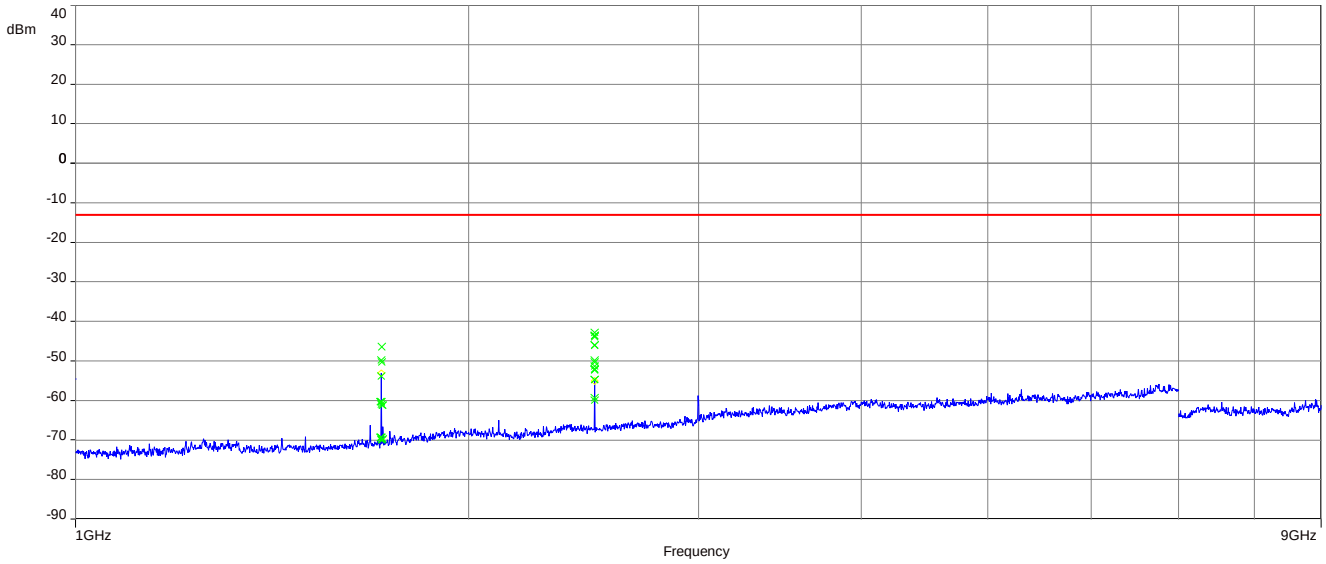
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)



Plot 3: Mid channel (1 GHz – 9 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 & RSS-Gen, 6.13.2 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
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	10 MHz – 8.5 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 22.917(a) & (b)	RSS-132, 5.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b)(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a RBW of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (b)(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.	i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.
-13 dBm	

Results: for 1.4 MHz channel bandwidth

QPSK

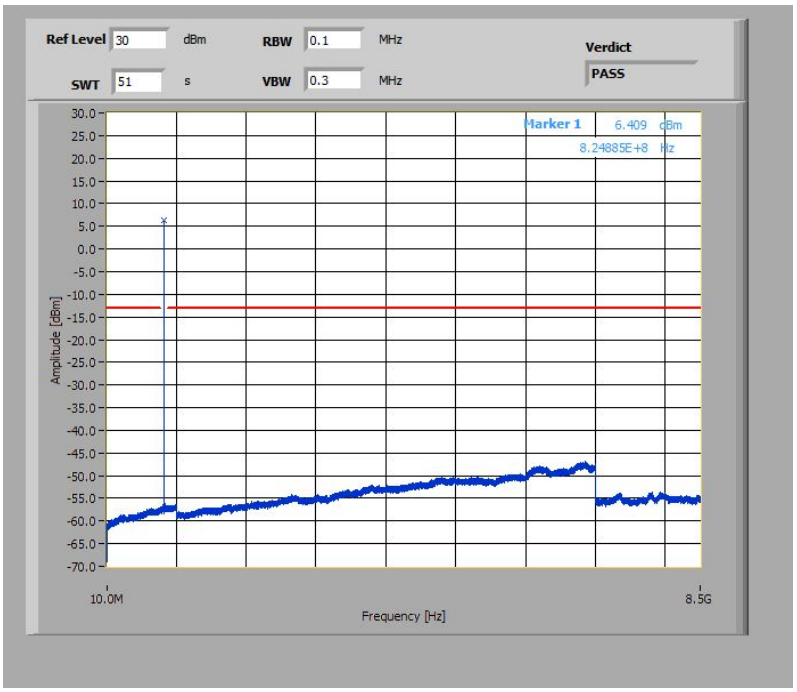
Spurious Emission Level								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

16-QAM

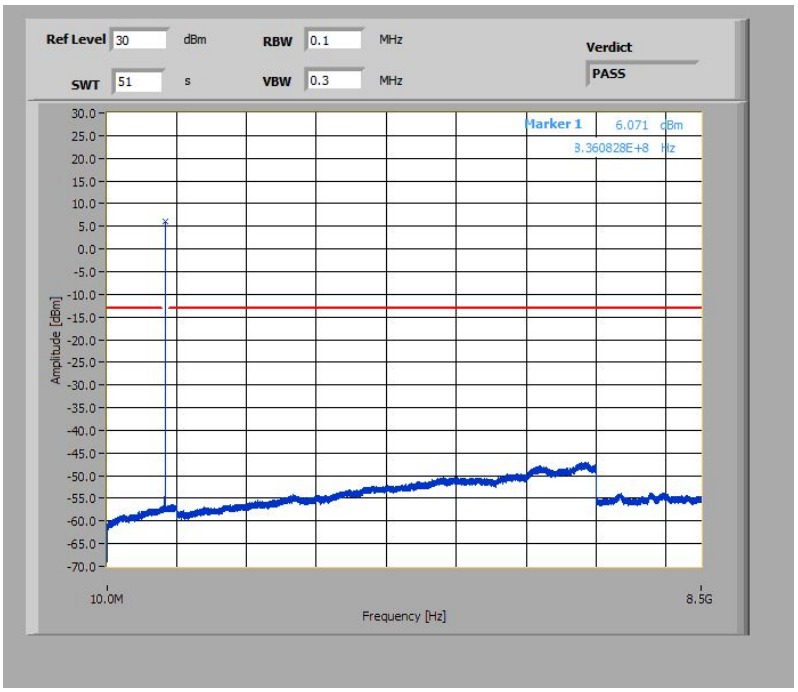
Spurious Emission LeveL								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

Plots: QPSK with 1.4 MHz channel bandwidth

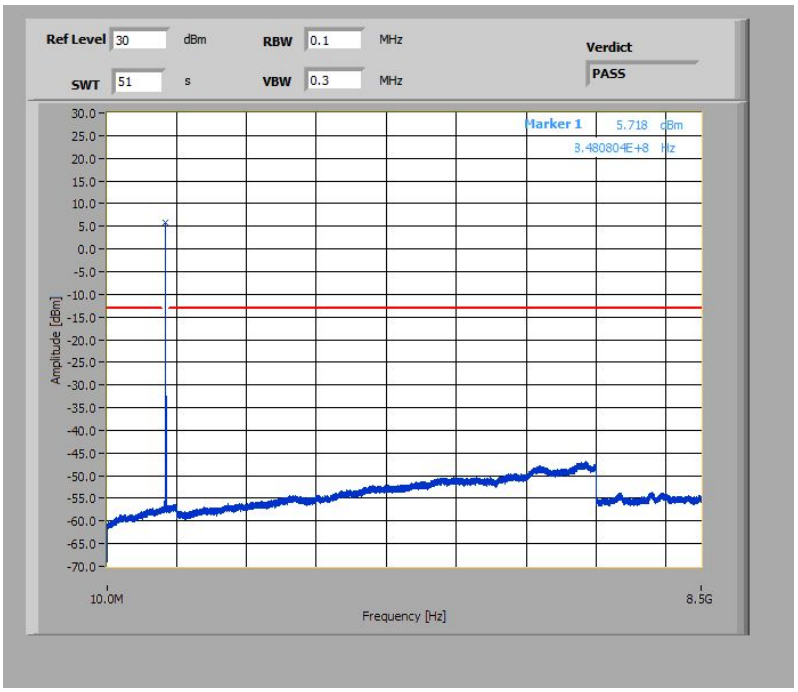
Plot 1: Lowest Channel (10 MHz – 8.5 GHz)



Plot 2: Middle Channel (10 MHz – 8.5 GHz)

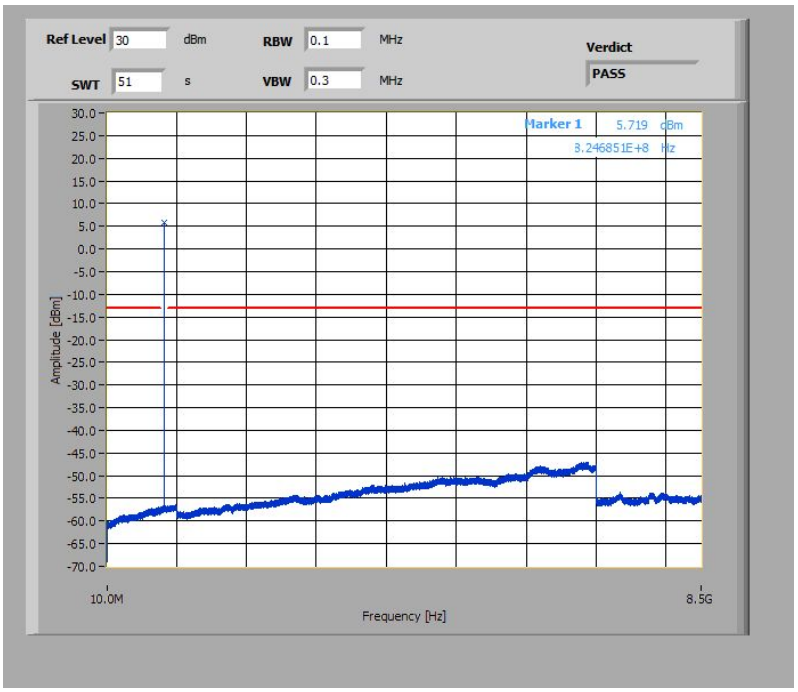


Plot 3: Highest Channel (10 MHz – 8.5 GHz)

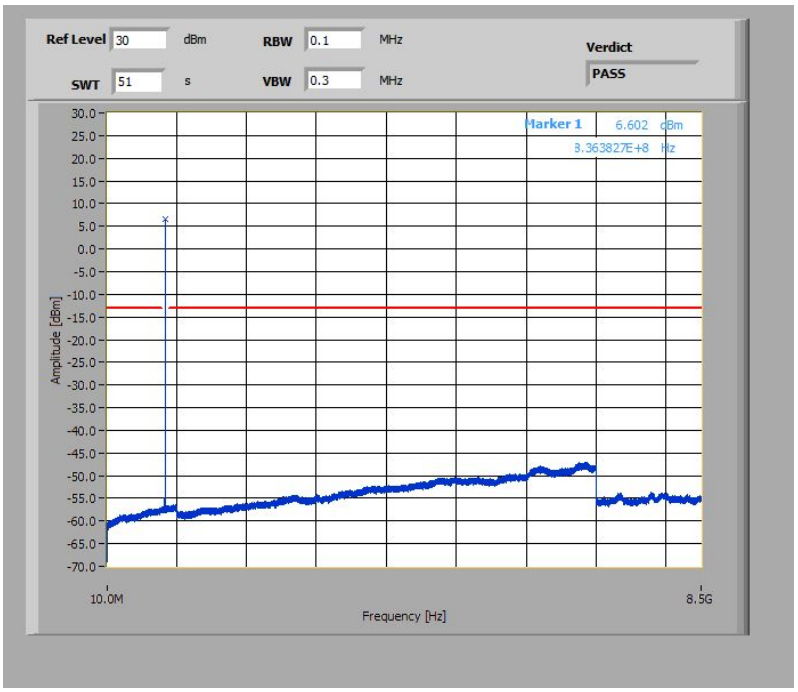


Plots: 16-QAM with 1.4 MHz channel bandwidth

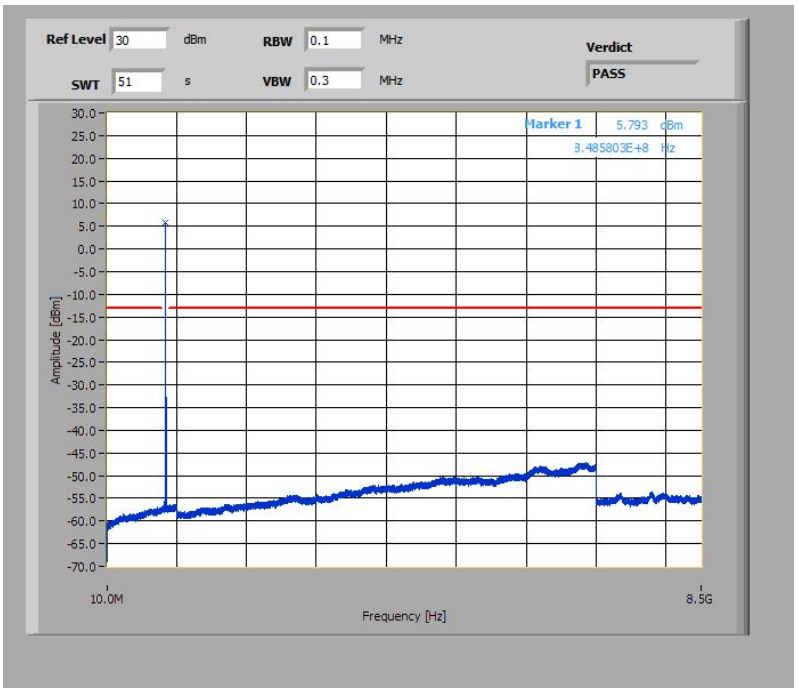
Plot 1: Lowest Channel (10 MHz – 8.5 GHz)



Plot 2: Middle Channel (10 MHz – 8.5 GHz)



Plot 3: Highest Channel (10 MHz – 8.5 GHz)



12.2.5 Block edge compliance

Description:

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

Measurement:

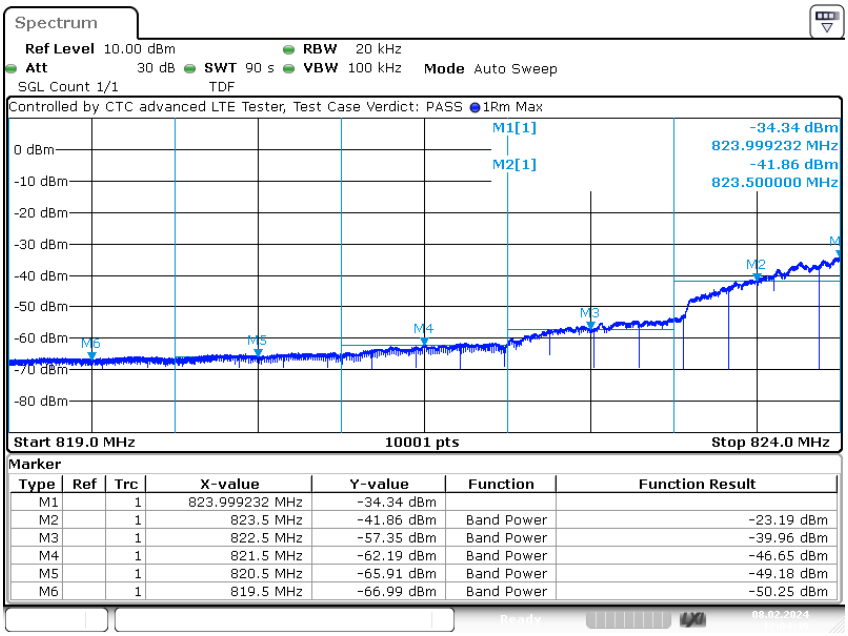
Measurement parameters	
Detector:	RMS
Sweep time:	180s
Video bandwidth:	100 kHz
Resolution bandwidth:	20 kHz
Span:	1 MHz steps
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 22.917(a) & (b)	RSS-132, 5.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b)(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a RBW of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (b)(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.	i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.
-13 dBm Correction factor according to KDB 890810 if RBW < 1 % emission bandwidth: ☒N/A here ☐10 log (RBW1/RBW2) = X dB; whereas: RBW1 = Y, RBW2 = Z	

Results: **1.4 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	823.999232 MHz	-34.34 dBm		
M2		1	823.5 MHz	-41.86 dBm	Band Power	-23.19 dBm
M3		1	822.5 MHz	-57.35 dBm	Band Power	-39.96 dBm
M4		1	821.5 MHz	-62.19 dBm	Band Power	-46.65 dBm
M5		1	820.5 MHz	-65.91 dBm	Band Power	-49.18 dBm
M6		1	819.5 MHz	-66.99 dBm	Band Power	-50.25 dBm

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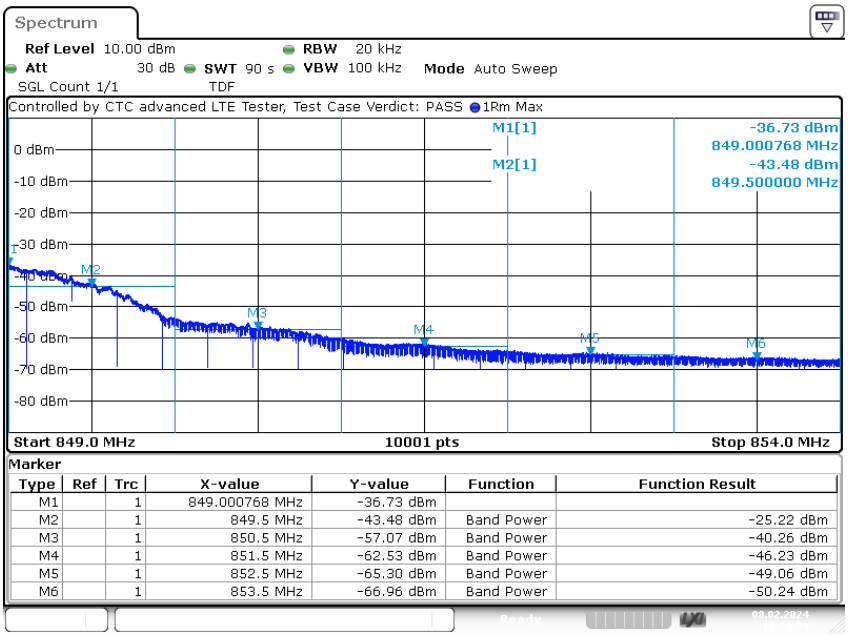
Plot 2: Highest channel – QPSK



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	849.000768 MHz	-36.73 dBm		
M2		1	849.5 MHz	-43.48 dBm	Band Power	-25.22 dBm
M3		1	850.5 MHz	-57.07 dBm	Band Power	-40.26 dBm
M4		1	851.5 MHz	-62.53 dBm	Band Power	-46.23 dBm
M5		1	852.5 MHz	-65.30 dBm	Band Power	-49.06 dBm
M6		1	853.5 MHz	-66.96 dBm	Band Power	-50.24 dBm

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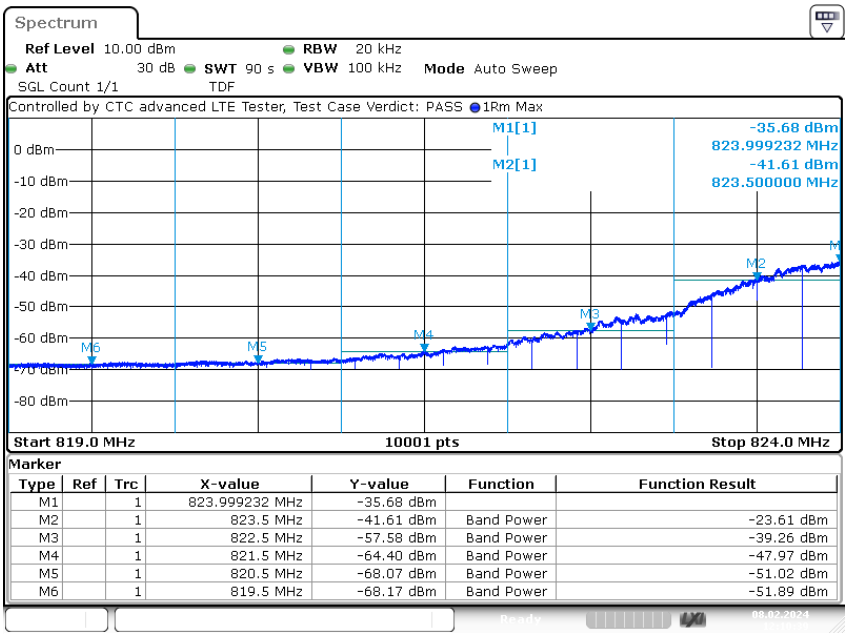
Plot 3: Lowest channel – 16-QAM

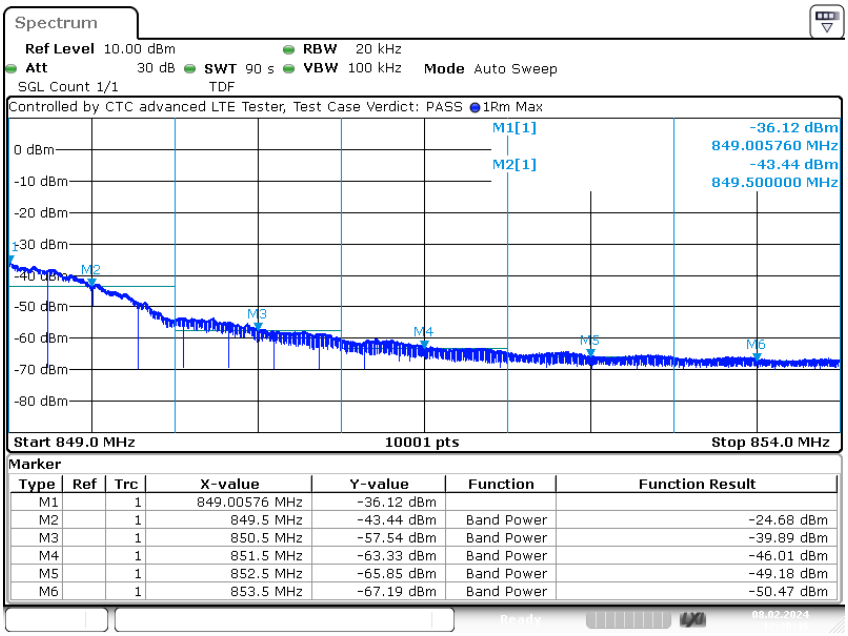


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	823.999232 MHz	-35.68 dBm		
M2		1	823.5 MHz	-41.61 dBm	Band Power	-23.61 dBm
M3		1	822.5 MHz	-57.58 dBm	Band Power	-39.26 dBm
M4		1	821.5 MHz	-64.40 dBm	Band Power	-47.97 dBm
M5		1	820.5 MHz	-68.07 dBm	Band Power	-51.02 dBm
M6		1	819.5 MHz	-68.17 dBm	Band Power	-51.89 dBm

Date: 8.FEB.2024 12:10:39

Plot 4: Highest channel – 16-QAM



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	849.00576 MHz	-36.12 dBm		
M2		1	849.5 MHz	-43.44 dBm	Band Power	-24.68 dBm
M3		1	850.5 MHz	-57.54 dBm	Band Power	-39.89 dBm
M4		1	851.5 MHz	-63.33 dBm	Band Power	-46.01 dBm
M5		1	852.5 MHz	-65.85 dBm	Band Power	-49.18 dBm
M6		1	853.5 MHz	-67.19 dBm	Band Power	-50.47 dBm

Date: 8.FEB.2024 12:30:45

12.2.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement parameters	
Detector:	Peak
Sweep time:	180s
Resolution bandwidth:	30 kHz
Video bandwidth:	100 kHz
Span:	2 x nominal BW
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1049 ISED: RSS-Gen, 6.7

Limits:

FCC	ISED
§ 2.1049	RSS-Gen, 6.7
Reporting only	

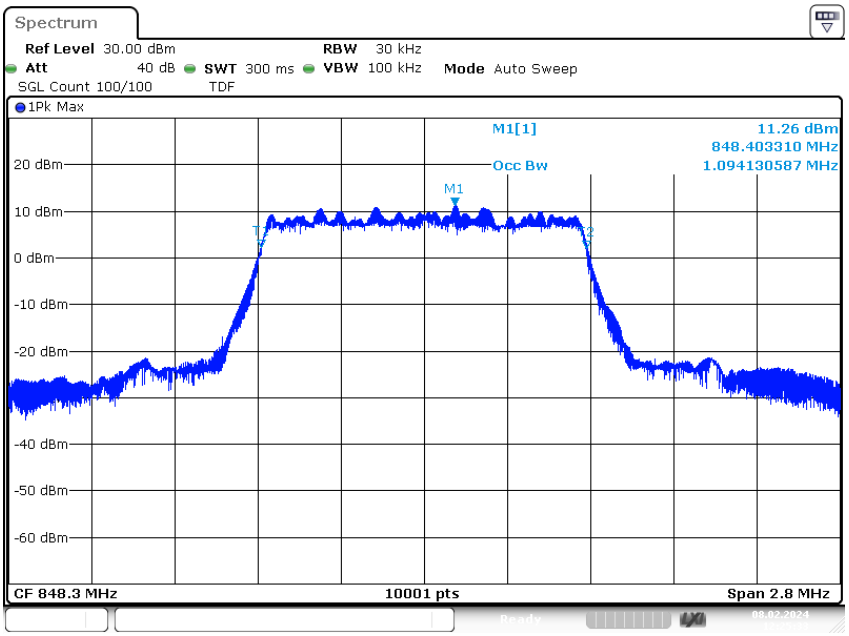
Results:

Occupied Bandwidth – QPSK		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
824.7	1093	1288
836.5	1092	1292
848.3	1094	1306

Occupied Bandwidth – 16-QAM		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
824.7	1093	1288
836.5	1093	1301
848.3	1093	1268

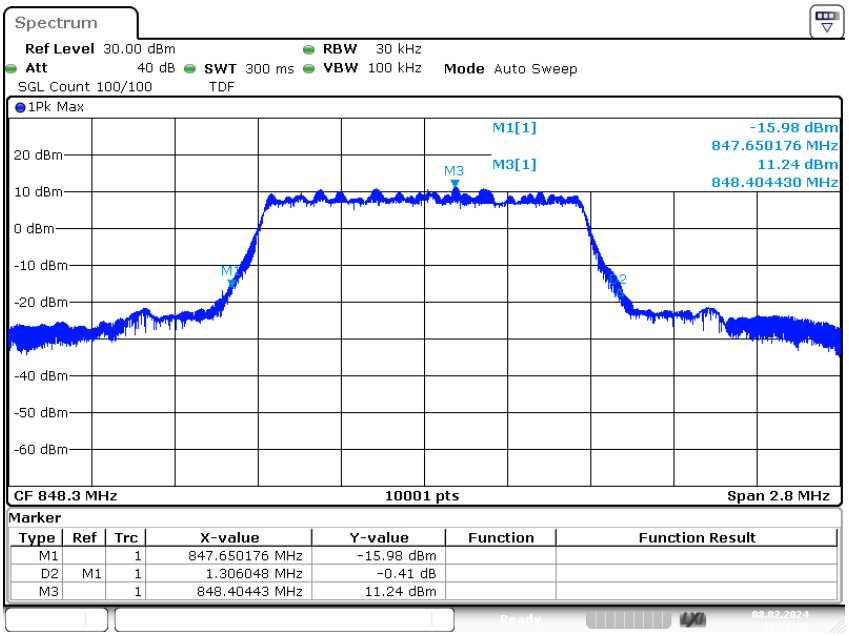
Plots: QPSK, worst case plots

Plot 1: high channel (99% - OBW)



Date: 8.FEB.2024 12:25:33

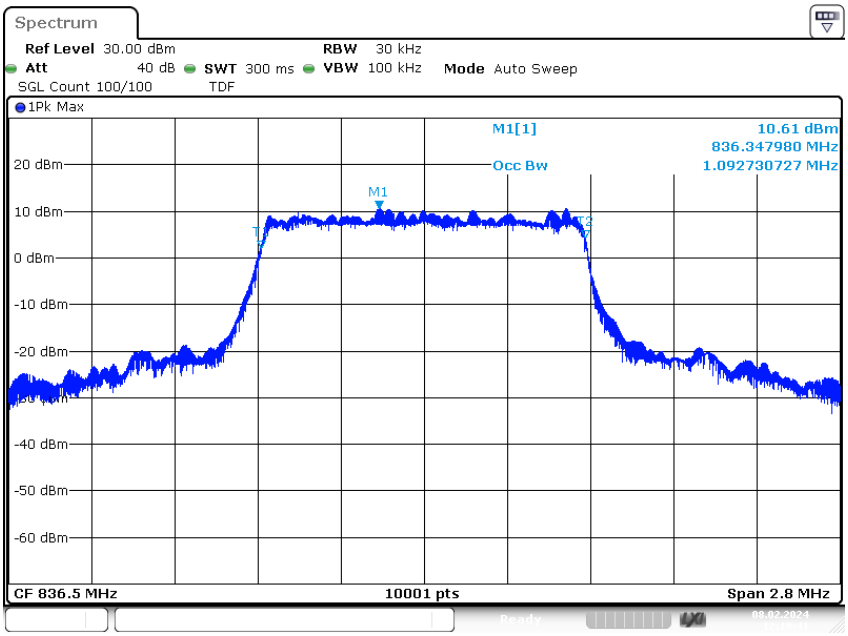
Plot 2: high channel (-26 dBc BW)



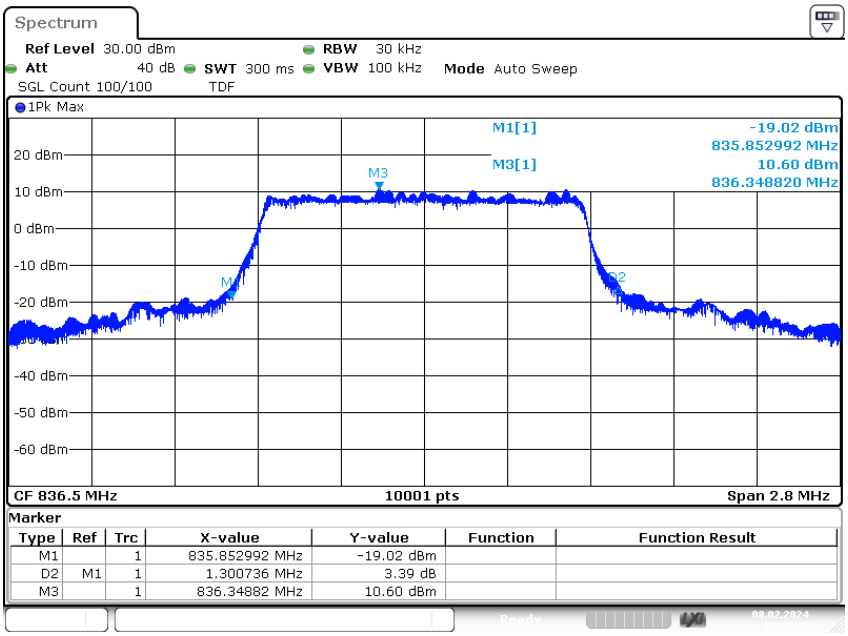
Date: 8.FEB.2024 12:26:06

Plots: 16-QAM, worst case plots

Plot 1: mid channel (99% - OBW)



Plot 2: mid channel (-26 dBc BW)



12.3 Results LTE band 26a

The EUT was set to transmit the maximum power.

12.3.1 RF output power

Description:

This paragraph contains conducted average power, ERP and Peak-to-Average Power Ratio measurements for the mobile station.

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	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	See chapter 7.1 setup A & 7.4 setup A
Measurement uncertainty:	see chapter 9
Measurement procedure:	FCC: § 2.1046 ISED: RSS-Gen, 6.12

Limits:

FCC	ISED
§ 22.913(a)(5) & (d)	RSS-132, 5.4
(a)(5) The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 W. (d) The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.	The equivalent radiated power (e.r.p.) shall not exceed 7 watts for mobile equipment and 3 watts for portable equipment. The peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB […].
Power: **38.45 dBm ERP** PAPR: **13 dB**	

Results:

Output Power (conducted)						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Peak to Average Ratio (dB)**	**Average Output Power (dBm) 16-QAM**	**Peak to Average Ratio (dB)**
1.4	20407 / 824.7	1 RB low	16.6	5.6	15.3	6.6
		1 RB high	16.5	5.7	15.4	6.7
		100% RB	14.6	6.2	14.7	7.0
	20525 / 836.5	1 RB low	16.5	5.6	15.1	6.7
		1 RB high	16.3	5.7	15.1	6.7
		100% RB	14.5	6.1	14.6	7.0
	20643 / 848.3	1 RB low	16.6	5.6	15.6	6.5
		1 RB high	16.5	5.7	15.6	6.5
		100% RB	14.6	6.4	14.6	7.1
3	20415 / 825.5	1 RB low	16.5	5.7	15.1	6.7
		1 RB high	16.2	5.7	15.2	6.8
		100% RB	14.5	6.3	14.6	7.0
	20525 / 836.5	1 RB low	16.6	5.6	15.6	6.5
		1 RB high	15.6	6.5	15.6	6.6
		100% RB	14.4	6.2	14.5	7.0
	20635 / 847.5	1 RB low	16.8	5.5	15.4	6.4
		1 RB high	16.6	5.6	15.2	6.5
		100% RB	13.8	7.1	14.4	7.0
5	20425 / 826.5	1 RB low	18.2	3.9	18.2	4.4
		1 RB high	18.1	4.0	18.1	4.4
		100% RB	17.3	4.5	16.1	5.4
	20525 / 836.5	1 RB low	18.3	3.9	18.2	4.3
		1 RB high	18.1	3.9	18.1	4.3
		100% RB	17.2	4.5	16.1	5.4
	20625 / 846.5	1 RB low	18.7	3.6	18.5	4.1
		1 RB high	18.5	3.7	18.3	4.2
		100% RB	17.4	4.5	16.4	5.4
10	20450 / 829.0	1 RB low	18.2	3.9	18.0	4.4
		1 RB high	18.0	4.0	18.0	4.4
		100% RB	17.3	4.5	17.3	5.2
	20525 / 836.5	1 RB low	18.2	3.9	18.1	4.3
		1 RB high	18.0	3.9	17.9	4.4
		100% RB	17.4	4.4	17.2	5.1
	20600 / 844.0	1 RB low	18.5	3.7	18.3	4.2
		1 RB high	18.3	3.8	18.2	4.2
		100% RB	17.4	4.5	17.5	5.0

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

Output Power (ERP)			
Bandwidth (MHz)	**Frequency (MHz)**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**
1.4	824.7	16.6	15.4
	836.5	16.5	15.1
	848.3	16.6	15.6
3	825.5	16.5	15.2
	836.5	16.6	15.6
	847.5	16.8	15.4
5	826.5	18.2	18.2
	836.5	18.3	18.2
	846.5	18.7	18.5
10	829.0	18.2	18.0
	836.5	18.2	18.1
	844.0	18.5	18.3

12.3.2 Frequency stability

Description:

In order to measure the carrier frequency under normal conditions it is necessary to make measurements with the mobile station connected to a R&S CMW500 Wideband Radio Communication Tester.

7. Measure the carrier frequency at room temperature.
8. Subject the mobile station to overnight soak at -30 C.
9. With the mobile station, powered with V_{nom}, connected to the CMW500 on the centre channel with channel bandwidth of 10 MHz, measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
10. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 15 minutes at each temperature, unpowered, before making measurements.
11. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage to V_{min} and measure the carrier frequency then setup V_{max} and repeat the measurement.
12. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Test setup:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1055 ISED: RSS-Gen, 6.11

Limits:

FCC	ISED
§ 22.355 (Mobile Station, 821 – 896 MHz)	RSS-132, 5.3 (Mobile Station)
The carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1.	The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within each of the sub-bands when tested at the temperature and supply voltage variations specified in RSS-Gen.
± 2.5 ppm	

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
4.1	9	0.01
3.7	9	0.01
2.5	7	0.01

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-22	-0.03
-20	-17	-0.02
-10	-10	-0.01
± 0	-3	0.0
10	-4	-0.01
20	9	0.01
30	0	0.0
40	-16	-0.02
50	7	0.01

12.3.3 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, which is the transmitted carrier that can be as high as 849 MHz. Measurement made up to 9 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE band 26a.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 s
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	100 MHz Steps
Trace mode:	Max Hold
Used equipment:	See chapter 7.1 setup A & 7.2 setup A, B
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1053 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 22.917(a) & (b)	RSS-132, 5.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. (b)(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a RBW of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (b)(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.	i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10(P) (watts). ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10(P) (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.
-13 dBm	

Results:

QPSK:

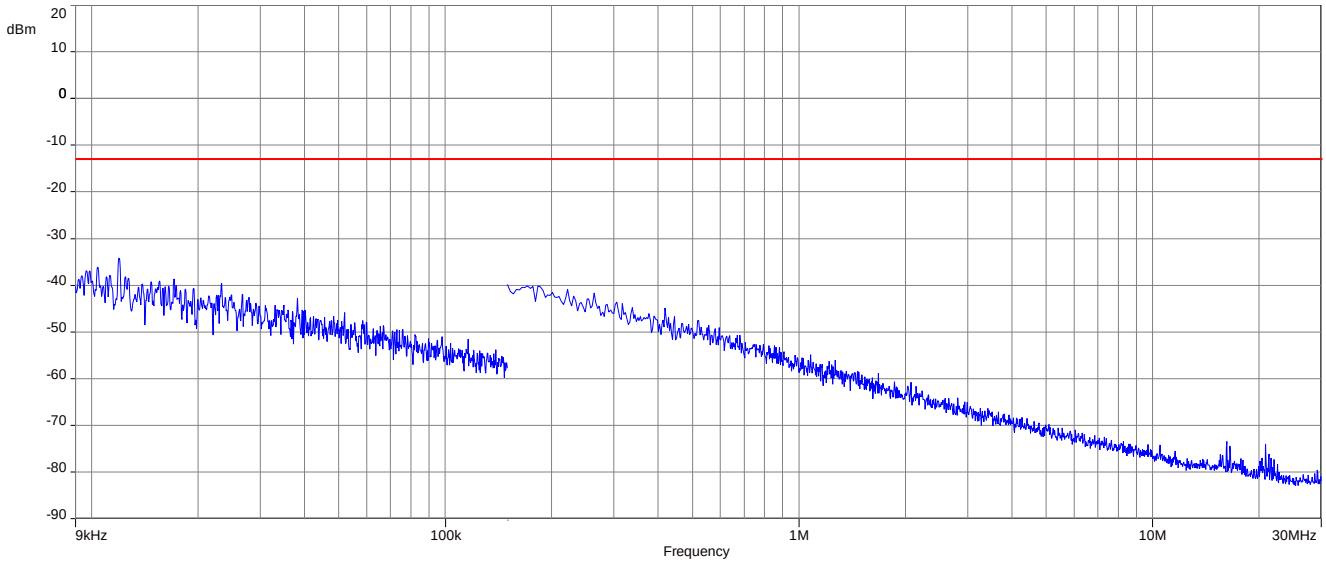
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

16-QAM:

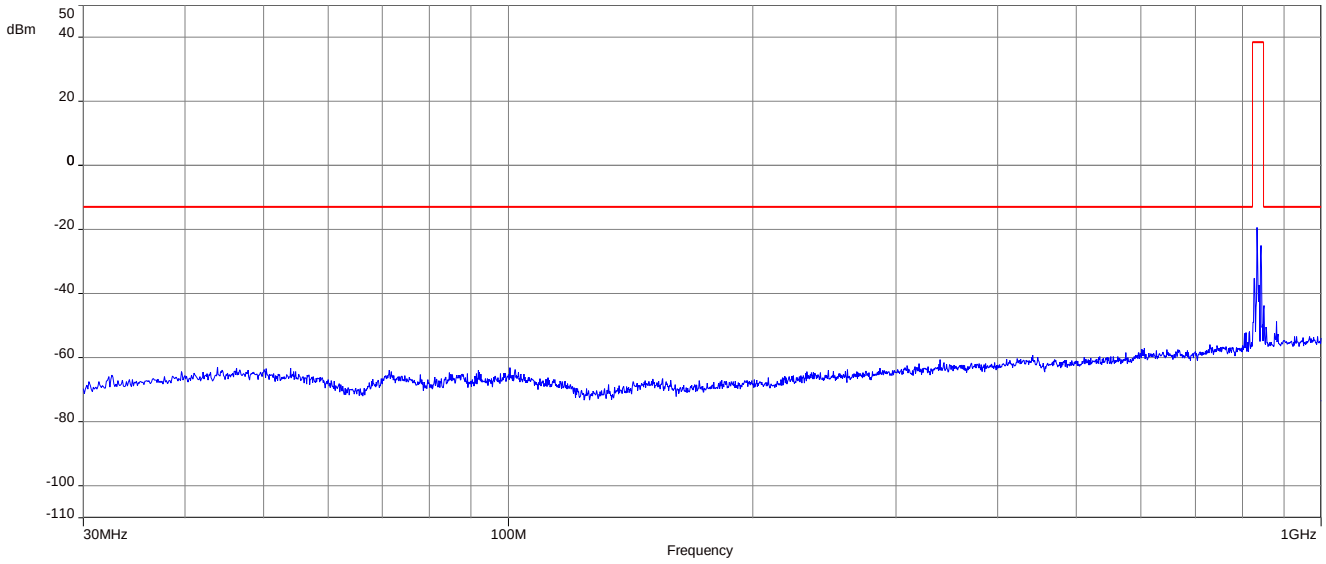
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

QPSK

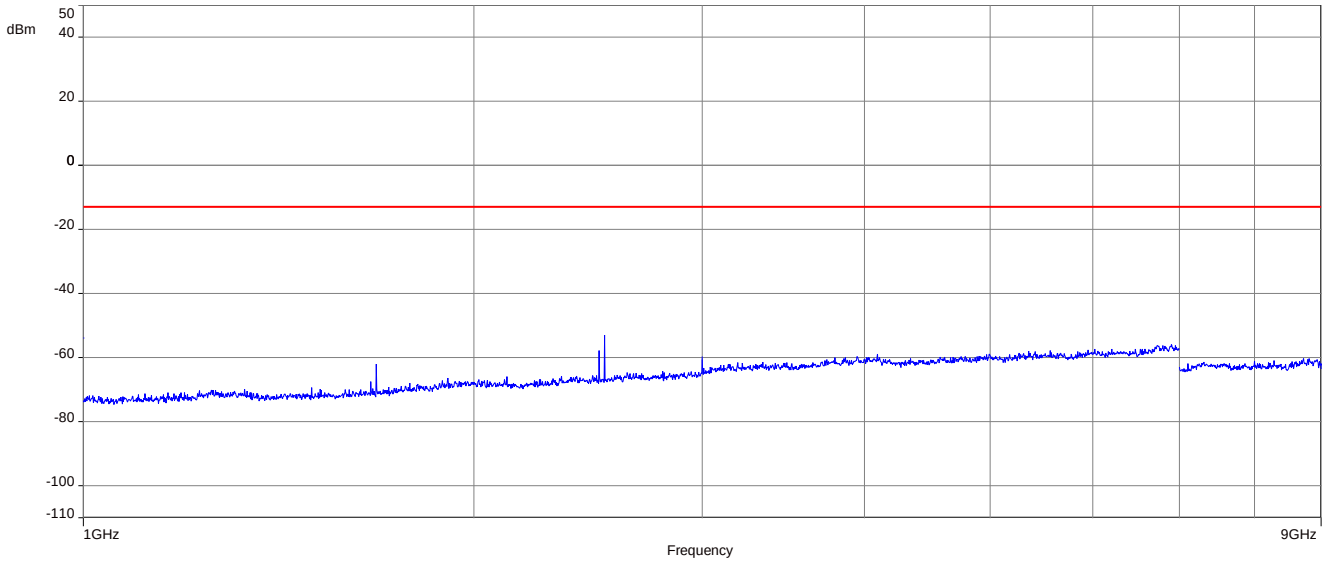
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)

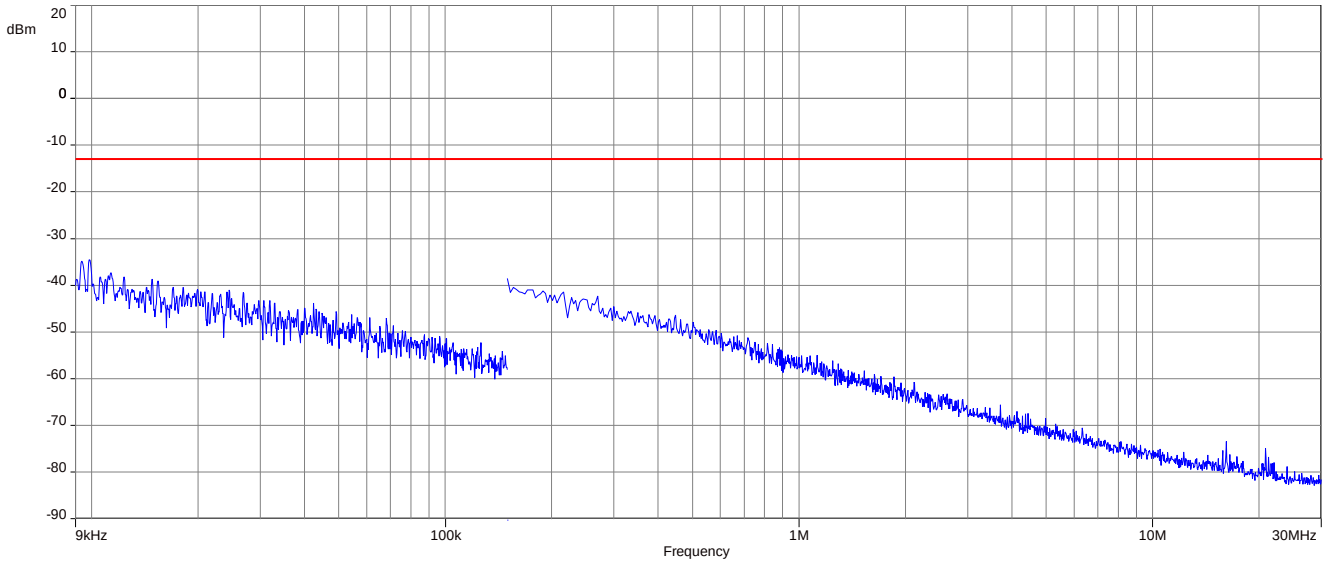


Plot 3: Mid channel (1 GHz – 9 GHz)

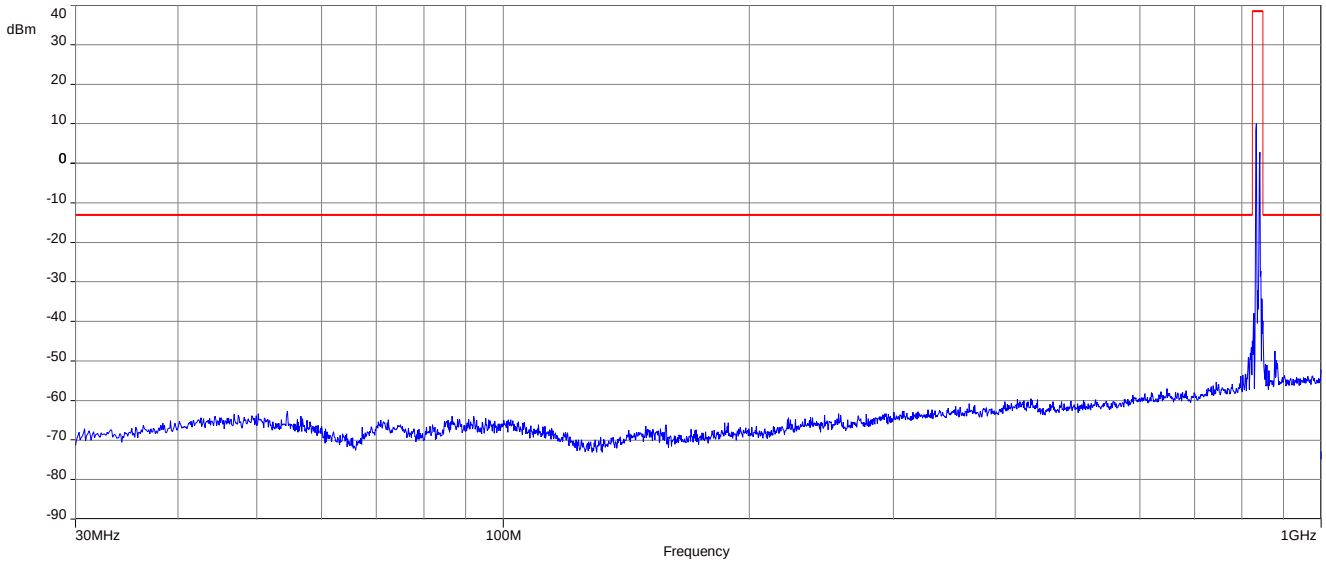


16-QAM

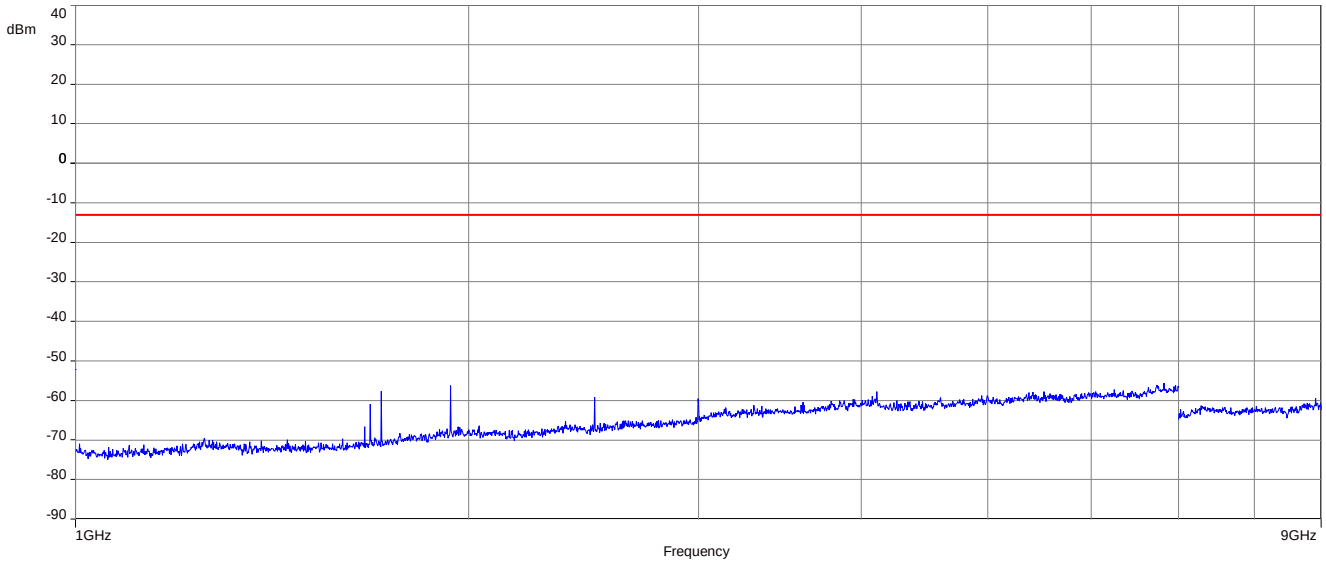
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)



Plot 3: Mid channel (1 GHz – 9 GHz)



12.3.4 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 & RSS-Gen, 6.13.2 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
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	10 MHz – 8.5 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 22.917(a) & (b)	RSS-132, 5.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b)(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a RBW of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (b)(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.	i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.
-13 dBm	

Results: for 1.4 MHz channel bandwidth

QPSK

Spurious Emission Level								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

16-QAM

Spurious Emission LeveL								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

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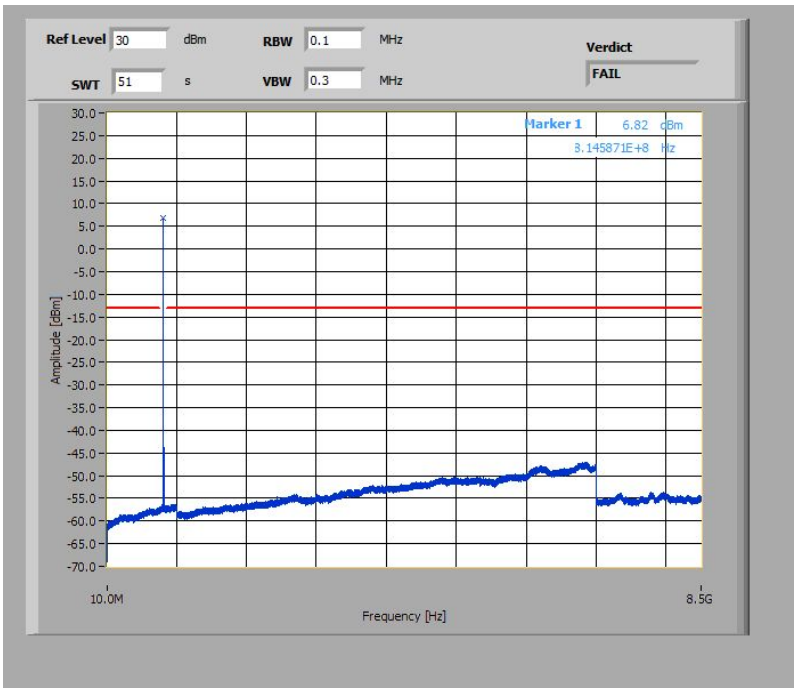
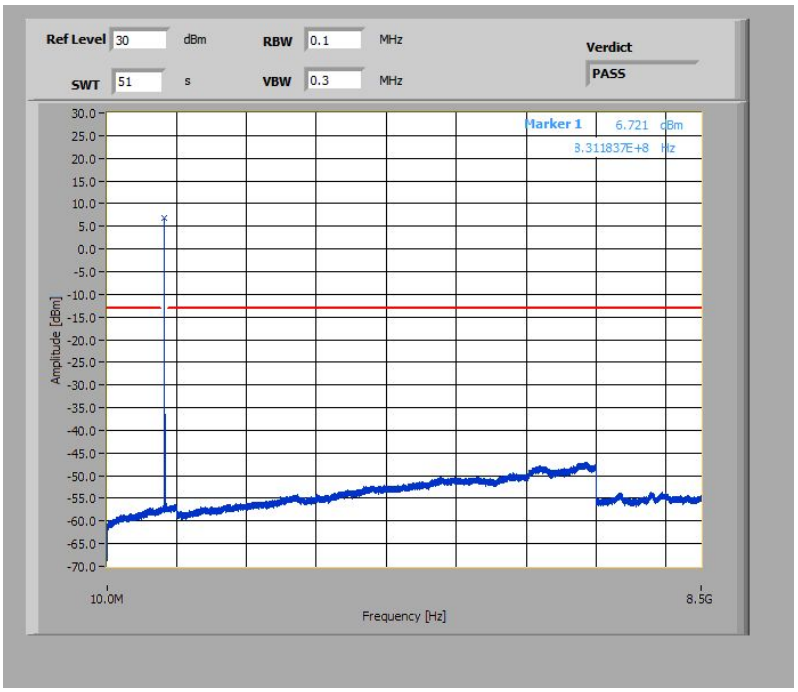
Plots: QPSK with 1.4 MHz channel bandwidth

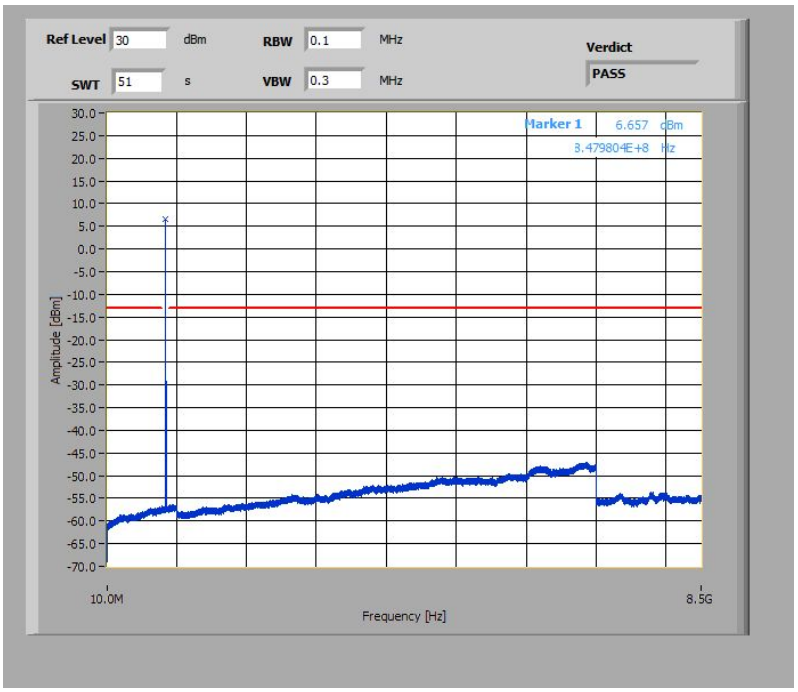
Plot 1: Lowest Channel (10 MHz – 8.5 GHz)



Plot 2: Middle Channel (10 MHz – 8.5 GHz)

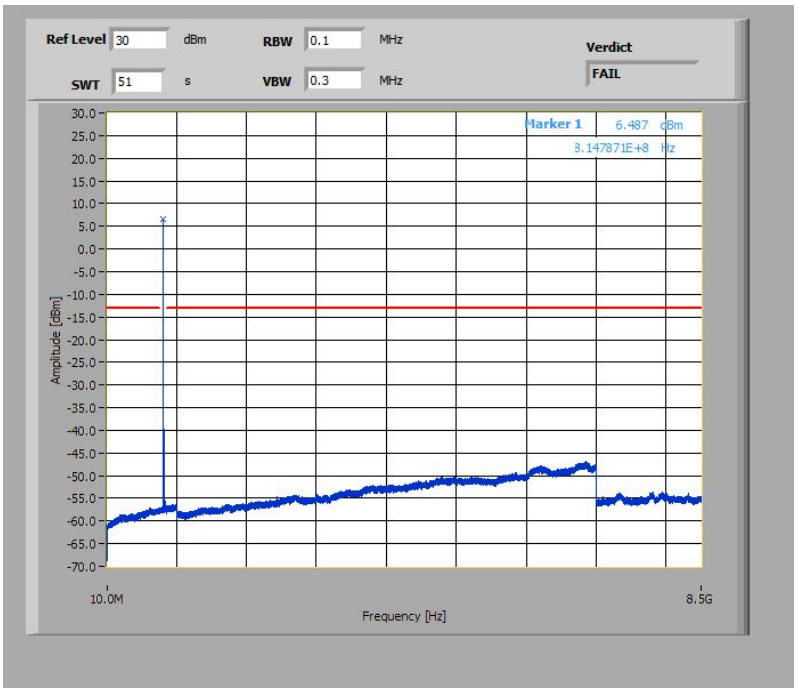


Plot 3: Highest Channel (10 MHz – 8.5 GHz)

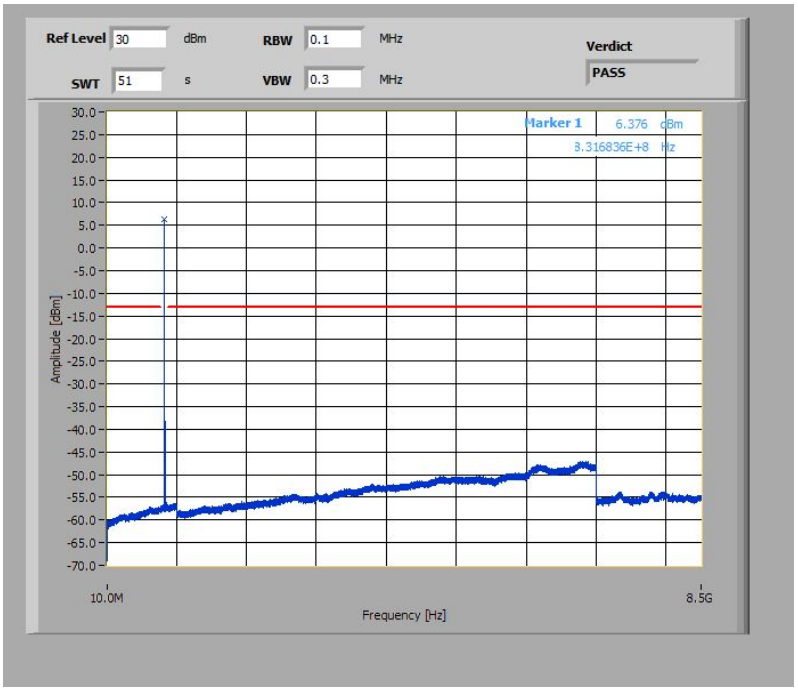


Plots: 16-QAM with 1.4 MHz channel bandwidth

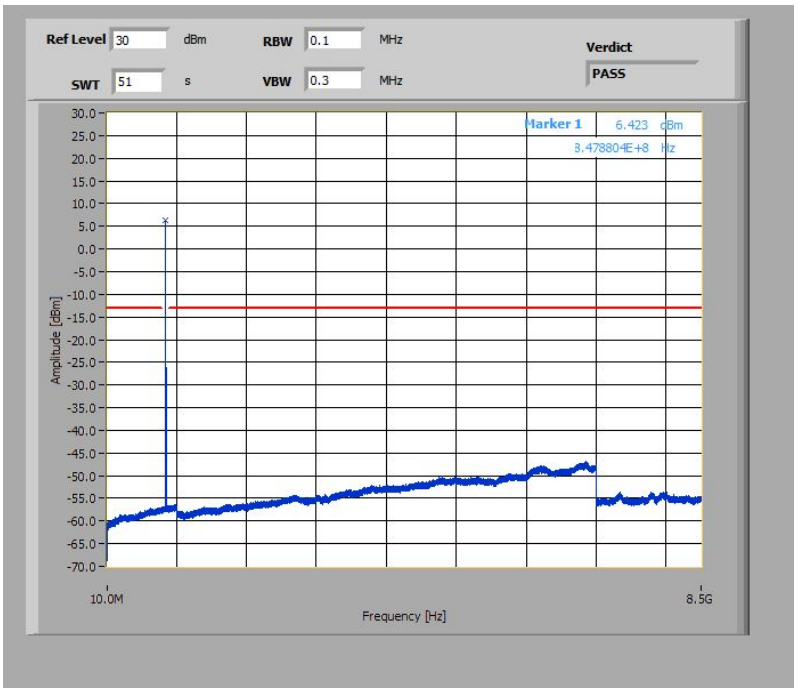
Plot 1: Lowest Channel (10 MHz – 8.5 GHz)



Plot 2: Middle Channel (10 MHz – 8.5 GHz)



Plot 3: Highest Channel (10 MHz – 8.5 GHz)



12.3.5 Block edge compliance

Description:

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

Measurement:

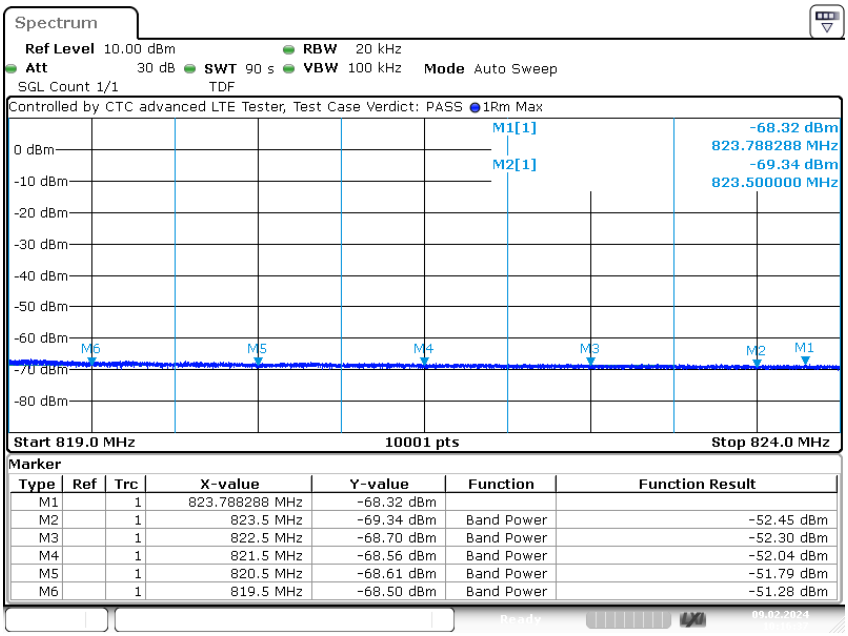
Measurement parameters	
Detector:	RMS
Sweep time:	180s
Video bandwidth:	100 kHz
Resolution bandwidth:	20 kHz
Span:	1 MHz steps
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 22.917(a) & (b)	RSS-132, 5.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b)(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a RBW of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (b)(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.	i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log10(P) (watts)**. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.
-13 dBm Correction factor according to KDB 890810 if RBW < 1 % emission bandwidth: ☒N/A here ☐10 log (RBW1/RBW2) = X dB; whereas: RBW1 = Y, RBW2 = Z	

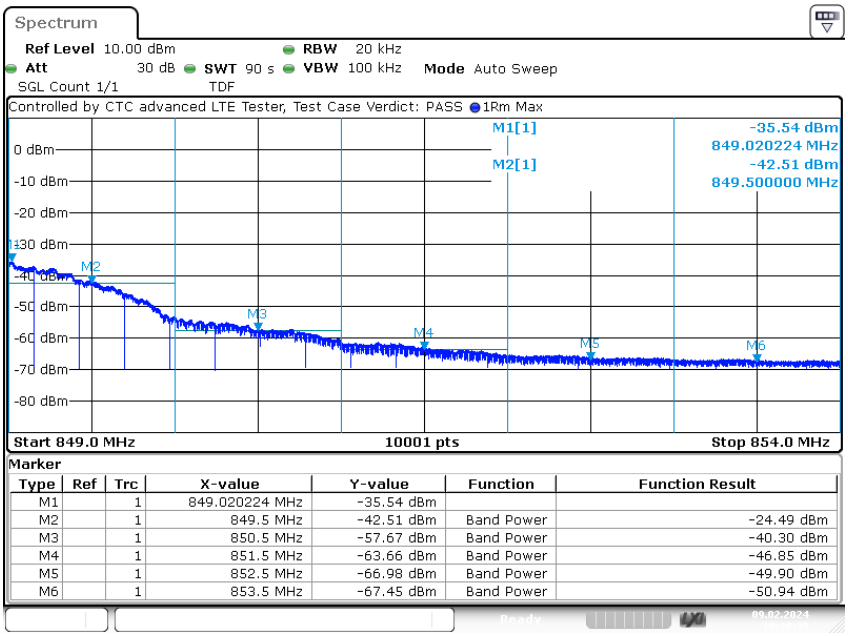
Results: **1.4 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



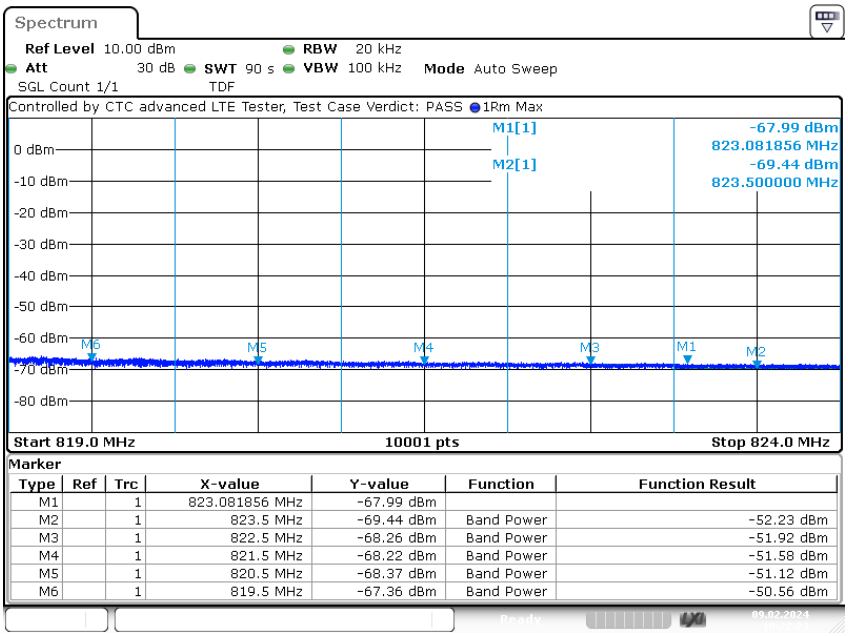
Date: 9.FEB.2024 10:16:37

Plot 2: Highest channel – QPSK



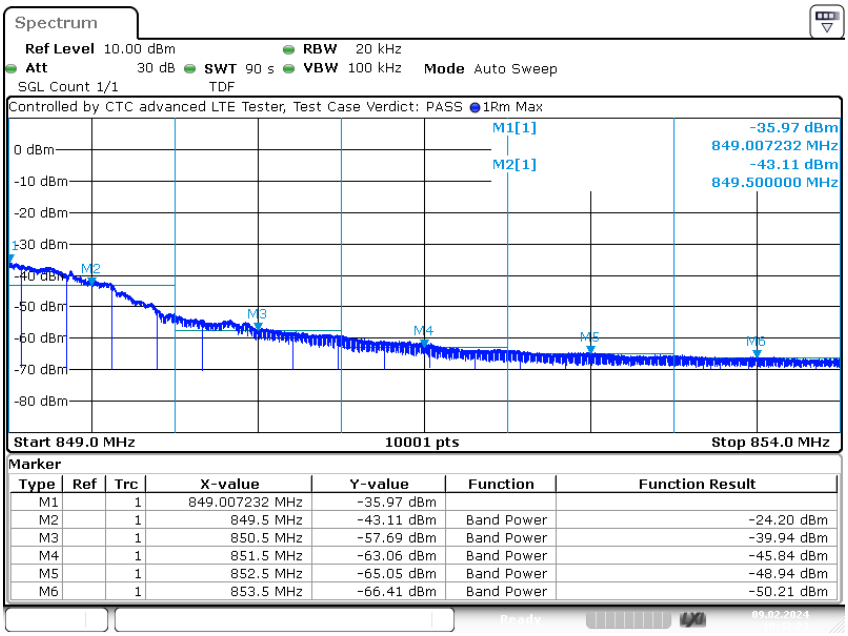
Date: 9.FEB.2024 10:36:39

Plot 3: Lowest channel – 16-QAM



Date: 9.FEB.2024 10:22:23

Plot 4: Highest channel – 16-QAM



Date: 9.FEB.2024 10:42:23

12.3.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement parameters	
Detector:	Peak
Sweep time:	180s
Resolution bandwidth:	30 kHz
Video bandwidth:	100 kHz
Span:	2 x nominal BW
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1049 ISED: RSS-Gen, 6.7

Limits:

FCC	ISED
§ 2.1049	RSS-Gen, 6.7
Reporting only	

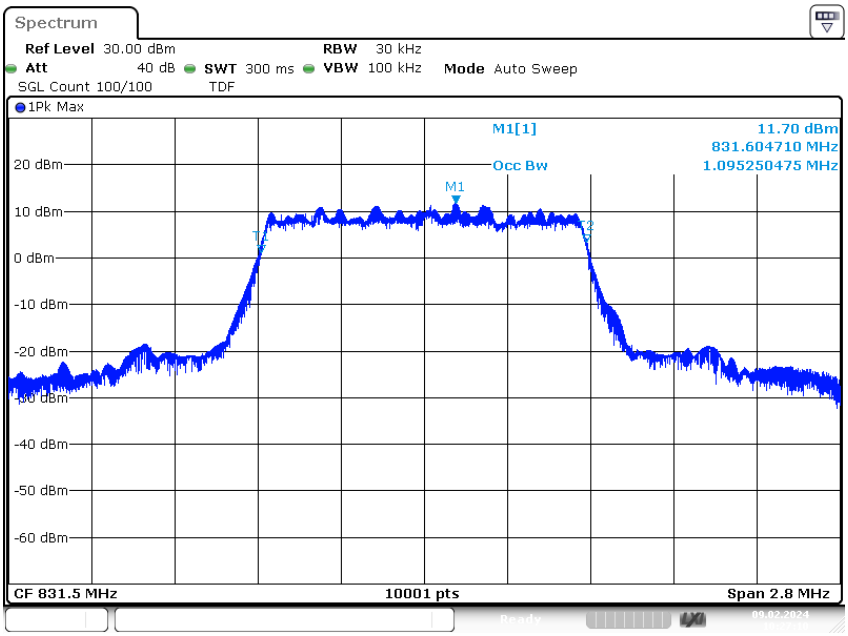
Results:

Occupied Bandwidth – QPSK		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
824.7	1089	1276
836.5	1095	1311
848.3	1087	1288

Occupied Bandwidth – 16-QAM		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
824.7	1076	1306
836.5	1092	1268
848.3	1094	1358

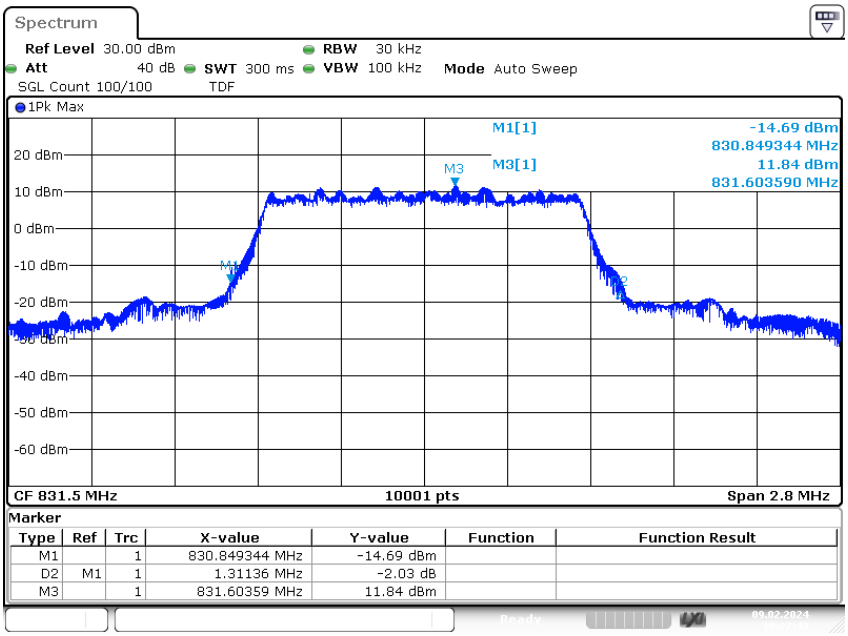
Plots: QPSK, worst case plots

Plot 1: mid channel (99% - OBW)



Date: 9.FEB.2024 10:27:10

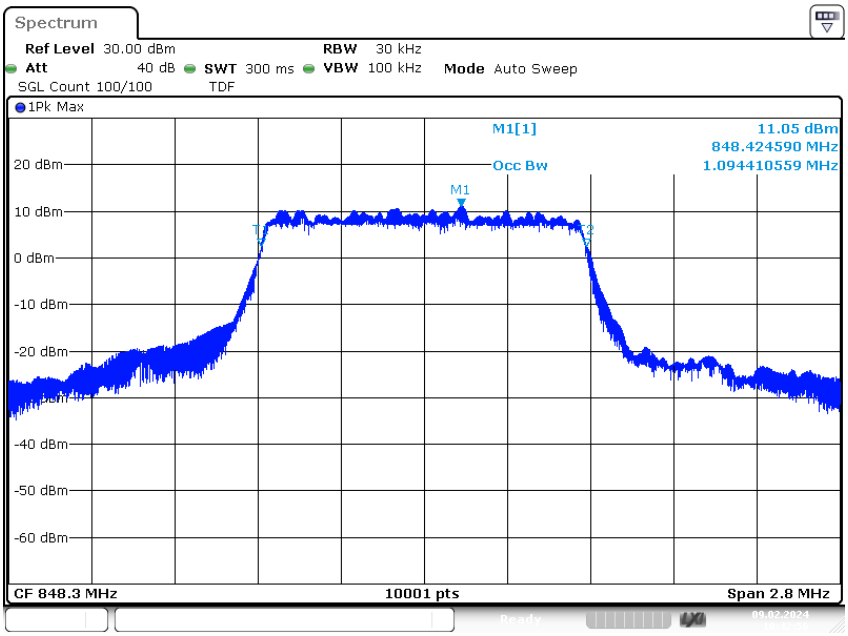
Plot 2: mid channel (-26 dBc BW)



Date: 9.FEB.2024 10:27:43

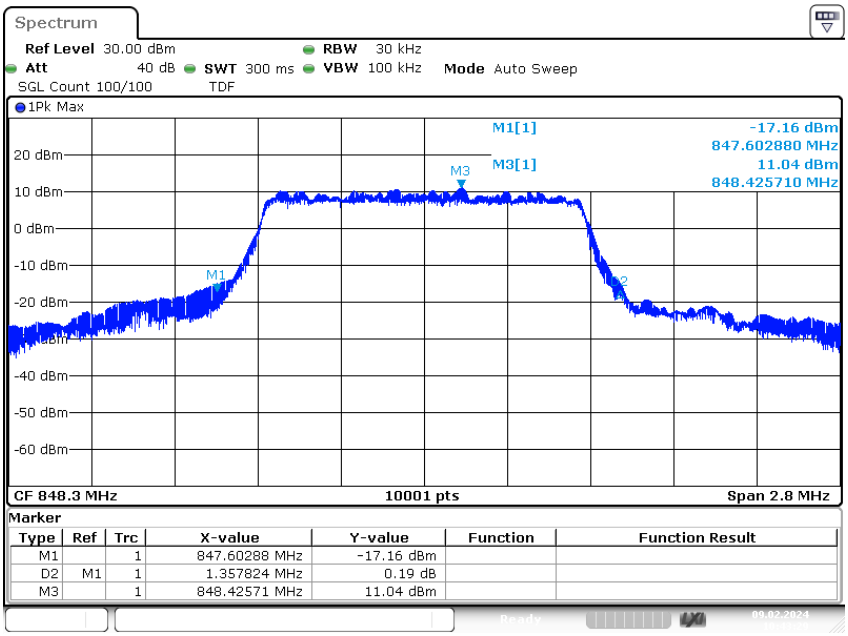
Plots: 16-QAM, worst case plots

Plot 1: high channel (99% - OBW)



Date: 9.FEB.2024 10:42:56

Plot 2: high channel (-26 dBc BW)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	847.60288 MHz	-17.16 dBm		
D2	M1	1	1.357824 MHz	0.19 dB		
M3		1	848.42571 MHz	11.04 dBm		

Date: 9.FEB.2024 10:43:29

13 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 24 ISED: RSS-Gen, Issue 5 RSS 133, Issue 6 & SRSP-510, Issue 5 RSS 132	See table!	2024-09-04	-/-

13.1 Part 24/RSS-133: LTE band 2

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

13.2 Part 24/RSS-133: LTE band 25

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

14 RF measurements

14.1 Description of test setup

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

14.2 Results LTE band 2

The EUT was set to transmit the maximum power.

14.2.1 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	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	See chapter 7.2 setup C & 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1046 ISED: RSS-Gen, 6.12

Limits:

FCC	ISED
$ 24.232(c)	RSS-133, 6.4 (referring to: SRSP-510, Issue 5)
(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications. (d) In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	SRSP-510, 5.1: Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. RSS-133, 6.4: In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.
Power: **33 dBm EIRP** PAPR: **13 dB**	

Results:

Output Power (conducted)						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Peak to Average Ratio (dB)**	**Average Output Power (dBm) 16-QAM**	**Peak to Average Ratio (dB)**
1.4	18607 / 1850.7	1 RB low	18,5	5,9	17,3	7,0
		1 RB high	17,5	6,8	17,2	7,1
		100% RB	16,3	6,8	16,3	7,5
	18900 / 1880.0	1 RB low	19,1	6,1	17,9	7,2
		1 RB high	18,8	6,2	17,7	7,3
		100% RB	16,9	6,9	17,0	7,6
	19193 / 1909.3	1 RB low	19,4	6,1	18,3	7,2
		1 RB high	19,2	6,2	18,3	7,2
		100% RB	17,4	7,0	17,5	7,6
3	18615 / 1851.5	1 RB low	18,5	5,9	17,2	7,0
		1 RB high	17,5	6,8	17,1	7,1
		100% RB	16,3	6,8	15,5	8,3
	18900 / 1880.0	1 RB low	19,0	6,1	17,9	7,2
		1 RB high	18,8	6,2	17,8	7,2
		100% RB	16,9	6,9	17,0	7,6
	19185 / 1908.5	1 RB low	19,5	6,1	18,4	7,2
		1 RB high	19,3	6,2	18,2	7,2
		100% RB	17,4	7,0	17,5	7,6
5	18625 / 1852.5	1 RB low	20,2	4,2	20,1	4,8
		1 RB high	20,0	4,3	20,0	4,9
		100% RB	19,1	4,9	18,2	5,9
	18900 / 1880.0	1 RB low	20,9	4,3	20,8	4,9
		1 RB high	20,6	4,4	20,5	5,0
		100% RB	19,6	5,0	18,5	6,1
	19175 / 1907.5	1 RB low	21,6	4,2	21,7	4,7
		1 RB high	21,4	4,3	21,6	4,7
		100% RB	20,4	5,0	19,4	6,0

10	18650 / 1855.0	1 RB low	20,2	4,2	20,0	4,8
		1 RB high	19,8	4,4	19,9	4,9
		100% RB	19,1	5,0	19,2	5,6
	18900 / 1880.0	1 RB low	20,8	4,3	20,6	4,9
		1 RB high	20,4	4,4	20,5	5,0
		100% RB	19,6	5,1	19,6	5,8
	19150 / 1905.0	1 RB low	21,3	4,3	21,5	4,7
		1 RB high	21,3	4,3	21,3	4,8
		100% RB	20,1	5,1	20,3	5,7
15	18675 / 1857.5	1 RB low	20,0	4,3	20,0	4,8
		1 RB high	19,8	4,3	19,9	4,8
		100% RB	20,0	4,6	20,1	5,0
	18900 / 1880.0	1 RB low	20,7	4,3	20,7	4,8
		1 RB high	20,7	4,3	20,4	5,0
		100% RB	20,5	4,7	20,5	5,3
	19125 / 1902.5	1 RB low	21,4	4,3	21,4	4,7
		1 RB high	21,1	4,3	21,2	4,8
		100% RB	21,0	4,8	21,1	5,2
20	18700 / 1860.0	1 RB low	19,6	4,2	19,6	4,8
		1 RB high	19,6	4,3	19,5	4,9
		100% RB	19,7	4,6	19,8	5,0
	18900 / 1880.0	1 RB low	20,4	4,2	20,1	4,9
		1 RB high	20,2	4,3	20,2	4,9
		100% RB	20,3	4,7	20,3	5,2
	19100 / 1900.0	1 RB low	21,3	4,2	21,3	4,7
		1 RB high	21,0	4,3	21,1	4,8
		100% RB	21,0	4,7	21,0	5,2

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

Output Power (EIRP)			
Bandwidth (MHz)	**Frequency (MHz)**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**
1.4	1850.7	17,7	16,5
	1880.0	17,6	16,4
	1909.3	17,5	16,4
3	1851.5	17,7	16,5
	1880.0	17,5	16,4
	1908.5	17,6	16,5
5	1852.5	19,4	19,3
	1880.0	19,4	19,3
	1907.5	19,7	19,8
10	1855.0	19,4	19,2
	1880.0	19,3	19,1
	1905.0	19,4	19,6
15	1857.5	19,2	19,3
	1880.0	19,2	19,2
	1902.5	19,5	19,5
20	1860.0	18,9	19,0
	1880.0	18,9	18,8
	1900.0	19,4	19,4

14.2.2 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 R&S CMW500 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 CMW500 and in a simulated call on channel 9400 (centre 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. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring 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 CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1055 ISED: RSS-Gen, 6.11

Limits:

FCC	ISED
§ 24.235	RSS-133, 6.3
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.	The carrier frequency shall not depart from the reference frequency, in excess of ±2.5 ppm for mobile stations and ±1.0 ppm for base stations.
± 2.5 ppm (ISED only)	

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
4.1	-14	-0.01
3.7	-10	-0.01
2.5	-11	-0.01

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-30	-0.02
-20	-19	-0.01
-10	7	0.0
± 0	3	0.0
10	-10	-0.01
20	-14	-0.01
30	-27	-0.01
40	-52	-0.03
50	-11	-0.01

14.2.3 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 24.238. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE band 2.

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 7.1 setup A; 7.2 setup A, B; 7.3 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1053 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 24.238 (a) & (b)	RSS-133, 6.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b) Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.
-13 dBm	

Results:

QPSK:

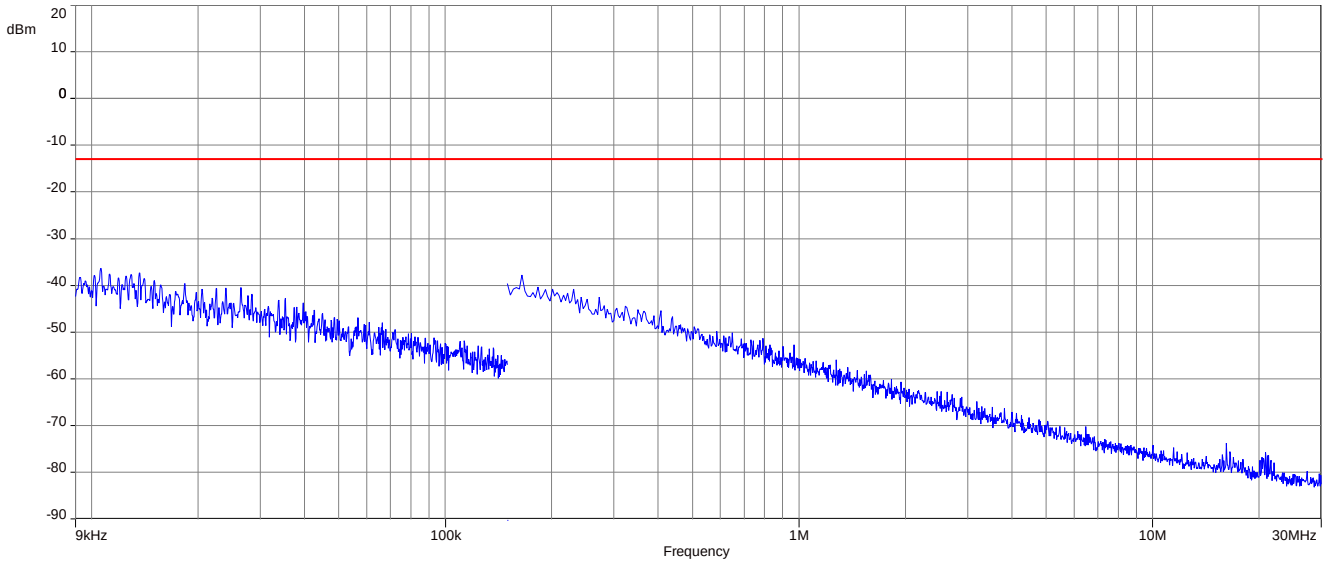
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

16-QAM:

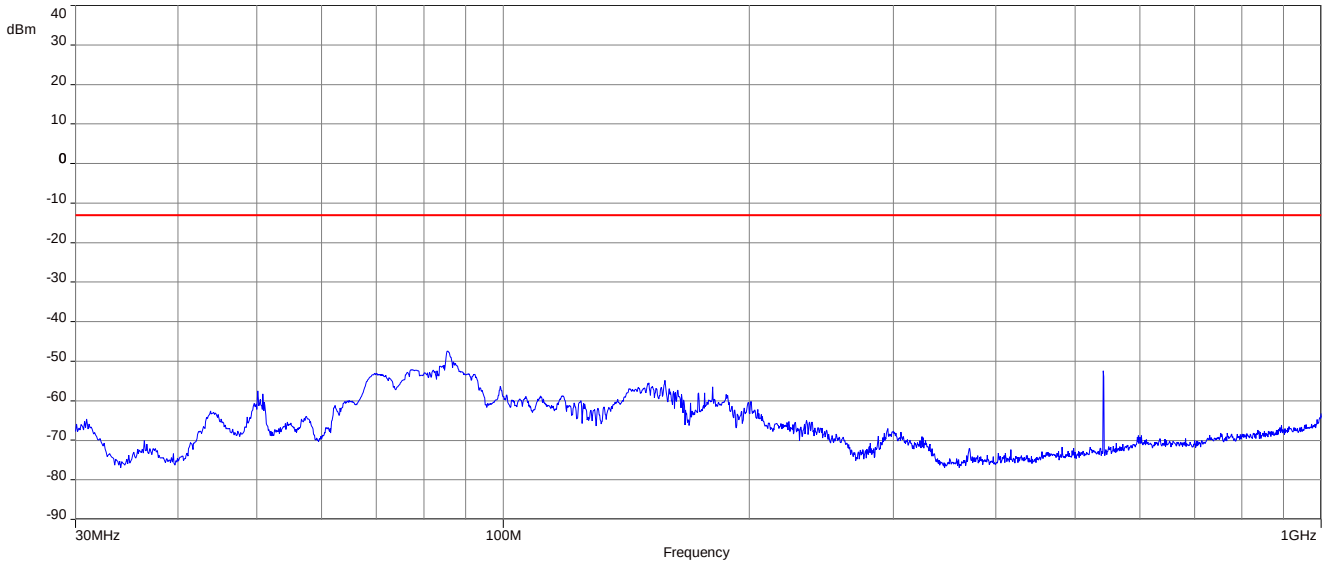
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

QPSK

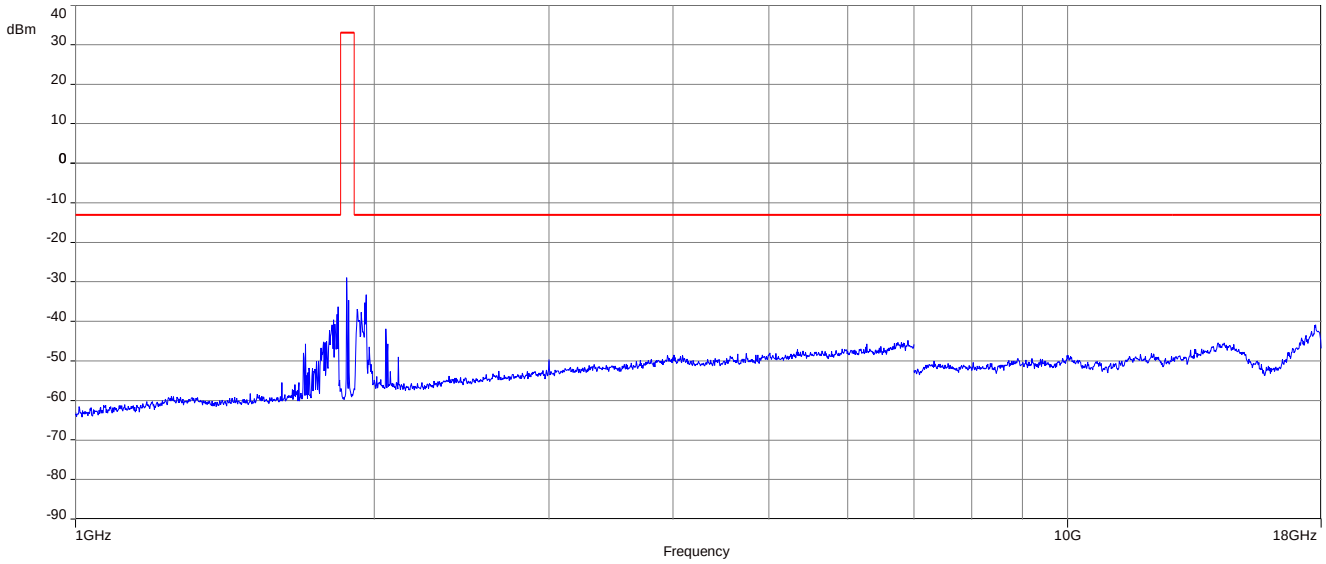
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)

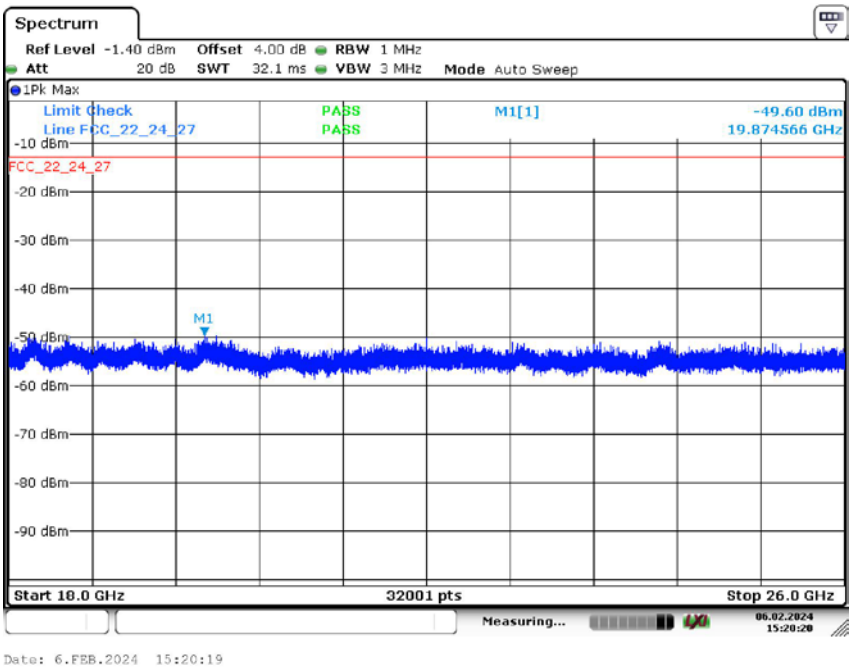


Plot 3: Mid channel (1 GHz – 18 GHz)



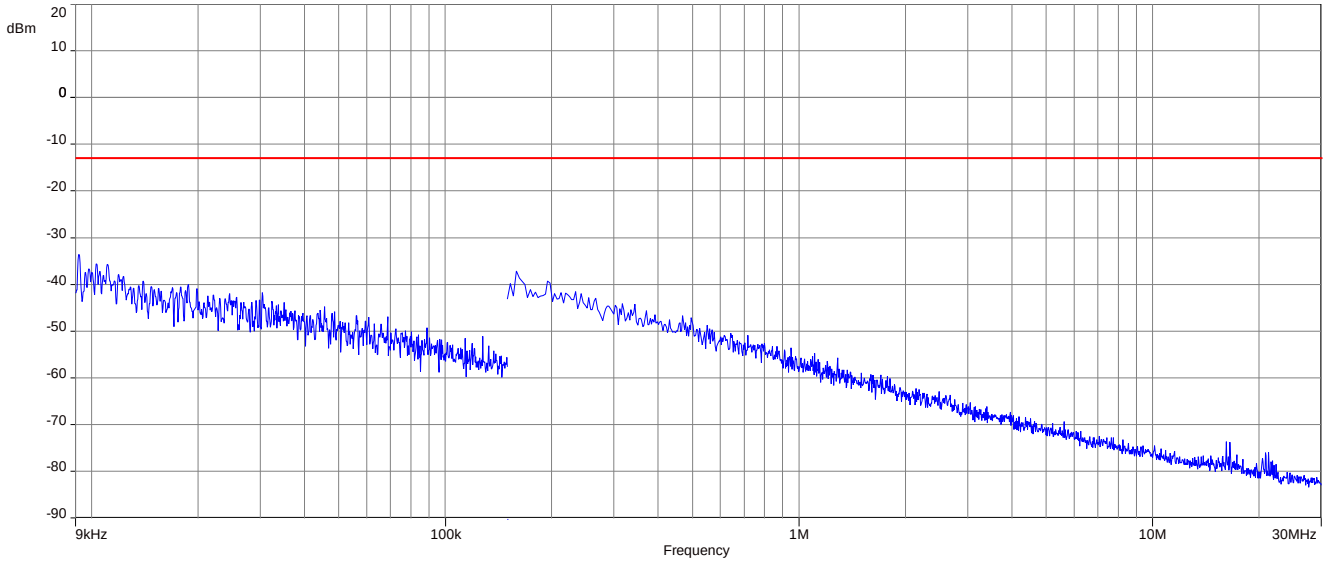
Carrier notched with 1.9 GHz rejection filter

Plot 4: Mid channel (18 GHz – 20 GHz)

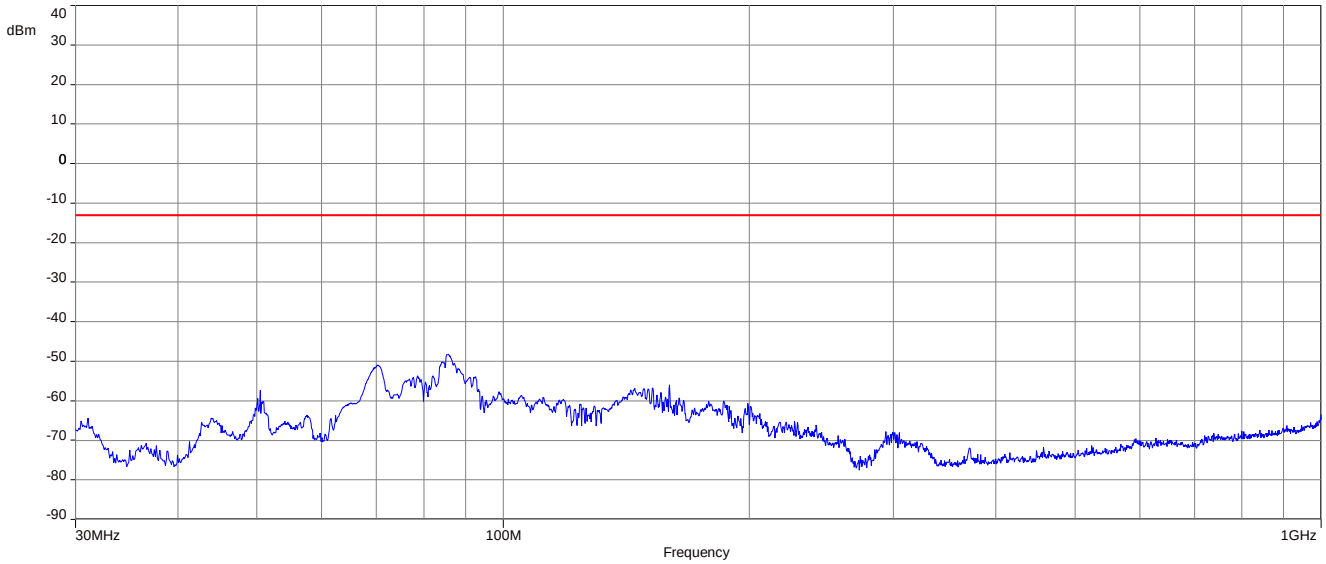


16-QAM

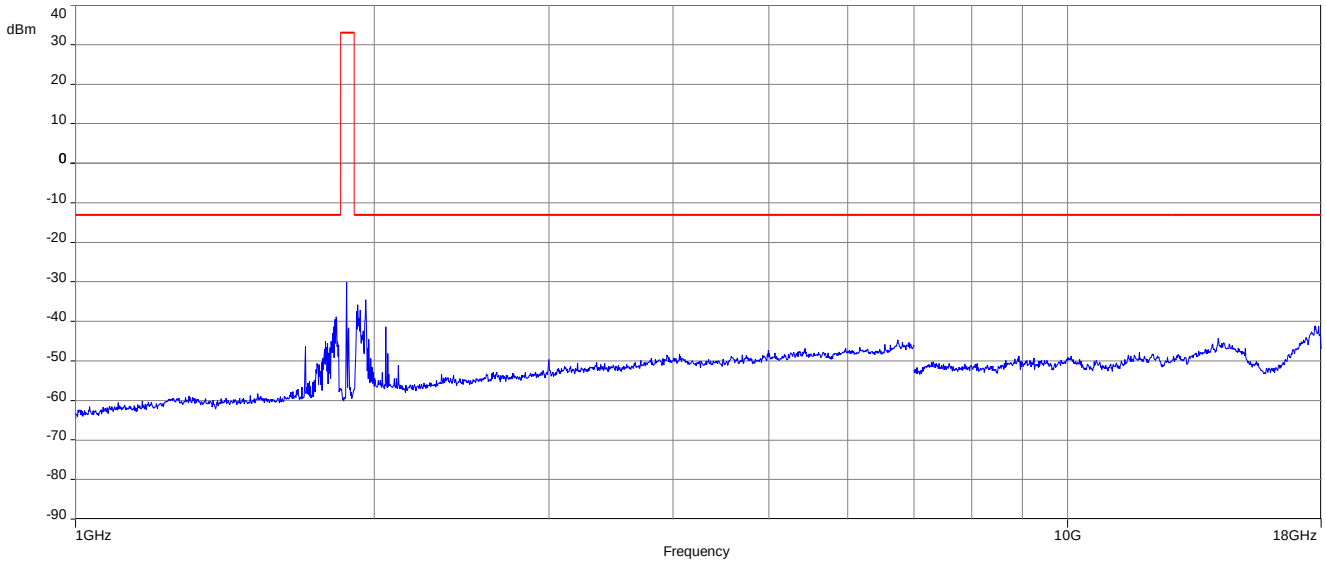
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)

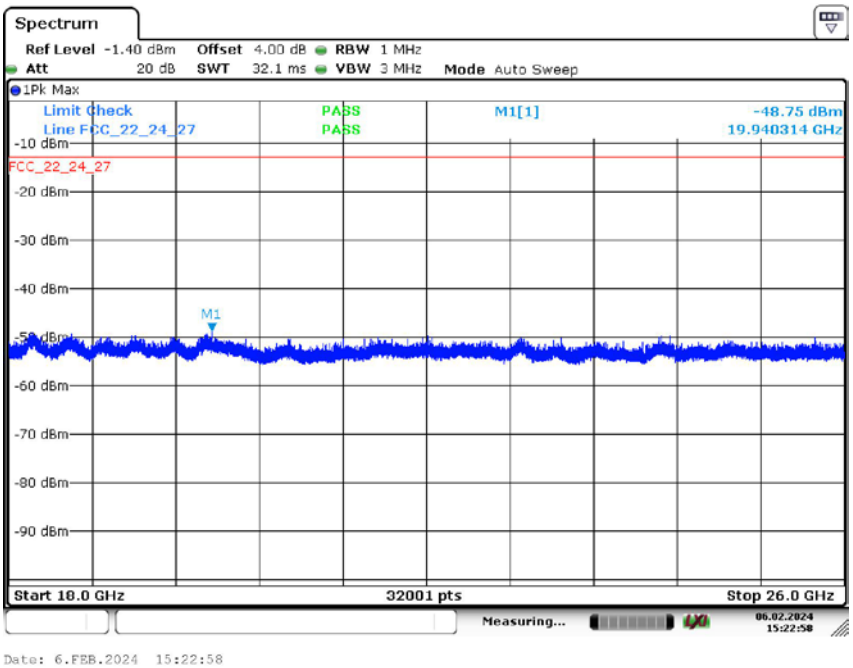


Plot 3: Mid channel (1 GHz – 18 GHz)



Carrier notched with 1.9 GHz rejection filter

Plot 4: Mid channel (18 GHz – 20 GHz)



14.2.4 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 & RSS-Gen, 6.13.2 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:	300 kHz
Resolution bandwidth:	100 kHz
Span:	30 MHz – 19.5 GHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9
Measurement procedure	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	IC
§ 24.238 (a) & (b)	RSS-133, 6.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b) Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.
-13 dBm	

Results: **for 1.4 MHz channel bandwidth**

QPSK:

Spurious Emission Level								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

16-QAM:

Spurious Emission Level								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

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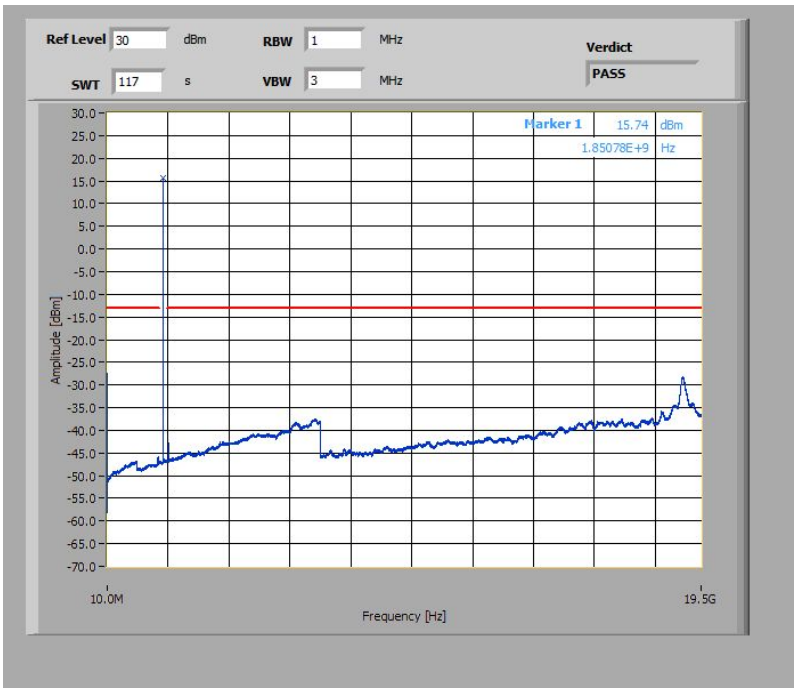
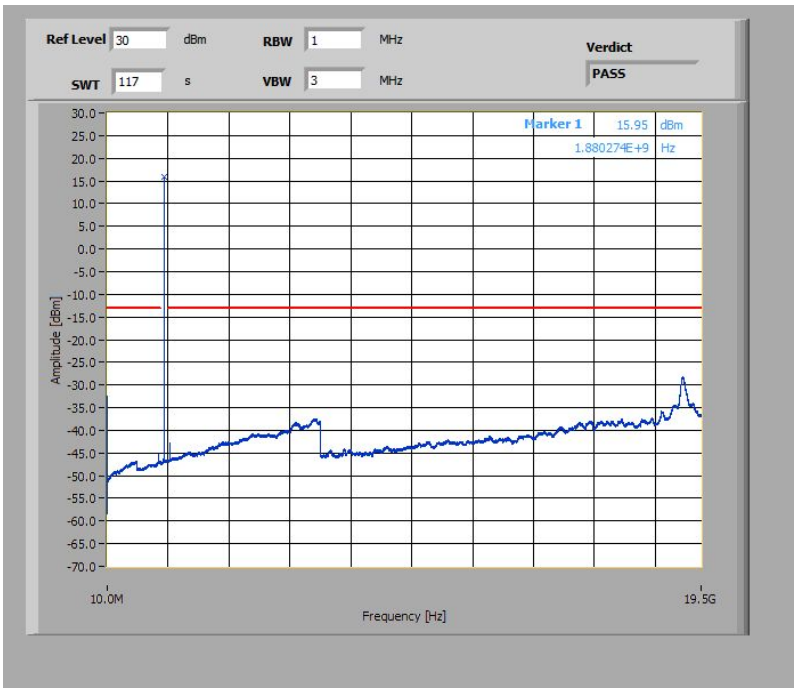
Plots: QPSK with 1.4 MHz channel bandwidth

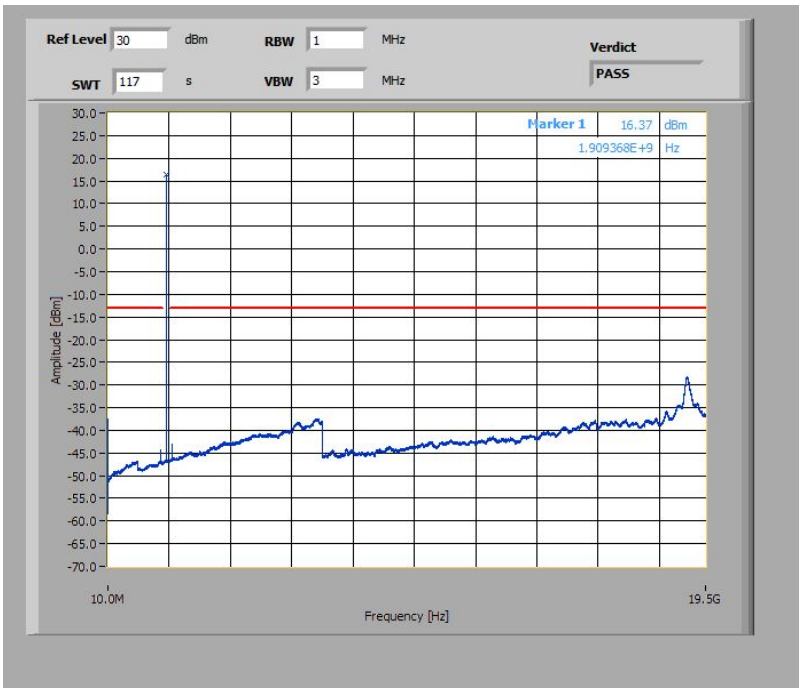
Plot 1: Lowest Channel (10 MHz – 19.5 GHz)



Plot 2: Middle Channel (10 MHz – 19.5 GHz)

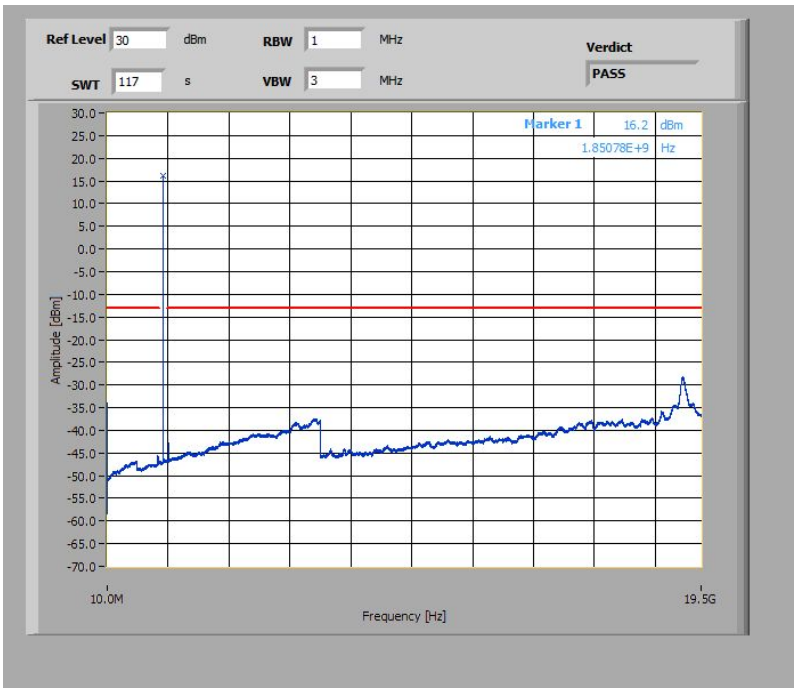


Plot 3: Highest Channel (10 MHz – 19.5 GHz)

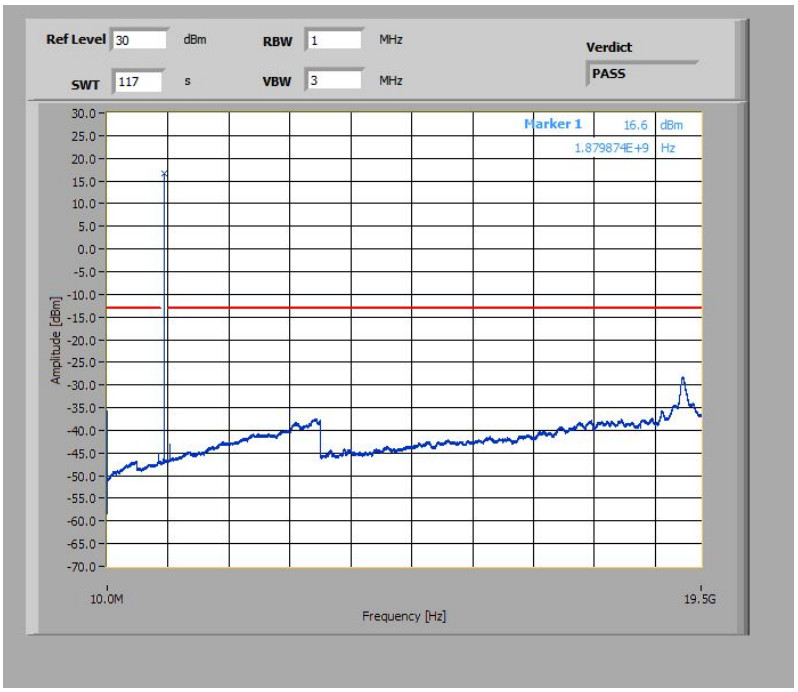


Plots: 16-QAM with 1.4 MHz channel bandwidth

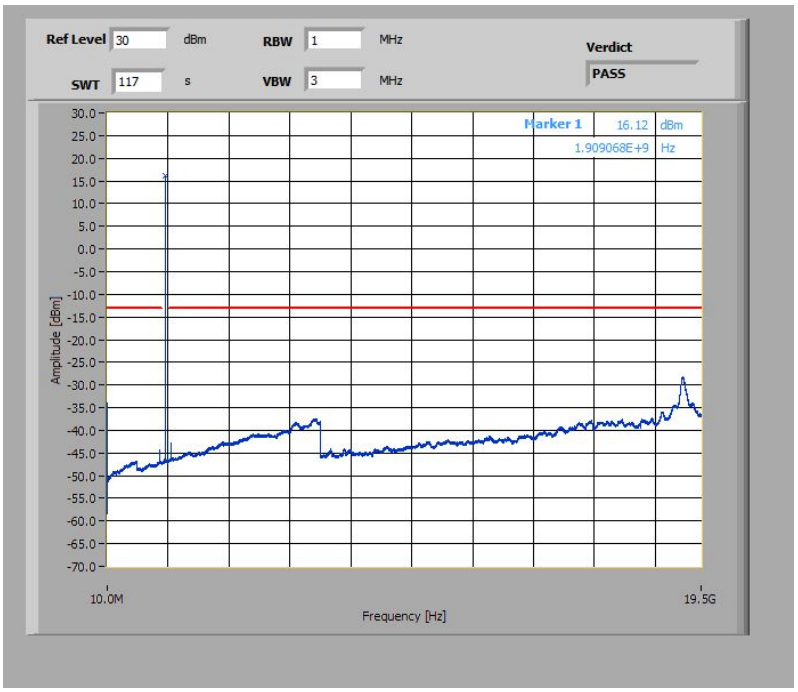
Plot 1: Lowest Channel (10 MHz – 19.5 GHz)



Plot 2: Middle Channel (10 MHz – 19.5 GHz)



Plot 3: Highest Channel (10 MHz – 19.5 GHz)



14.2.5 Block edge compliance

Description:

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

Measurement:

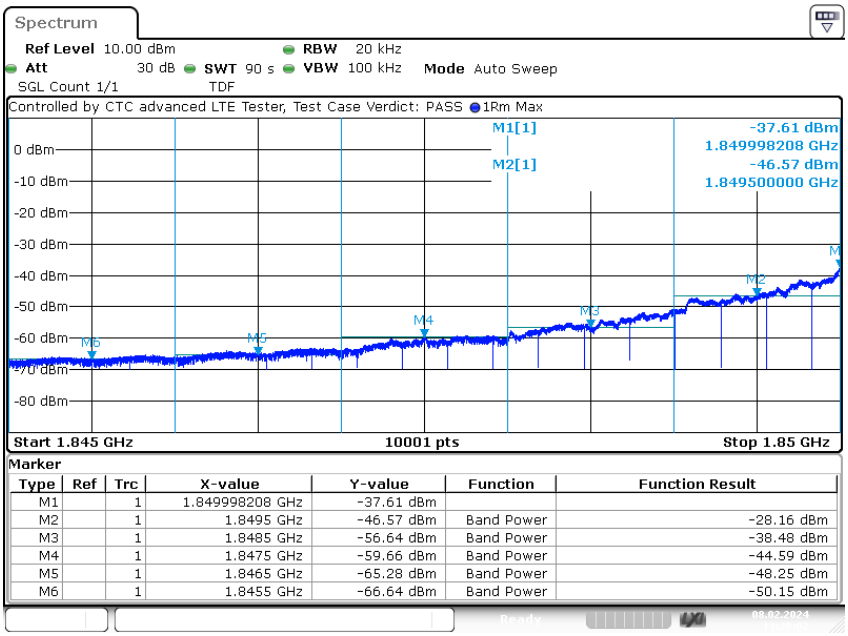
Measurement parameters	
Detector:	RMS
Sweep time:	180 sec.
Video bandwidth:	100 kHz
Resolution bandwidth:	20 kHz
Span:	1 MHz steps
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 24.238 (a) & (b)	RSS-133, 6.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b) Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.
-13 dBm Correction factor according to KDB 890810 if RBW < 1 % emission bandwidth: ☒N/A here ☐10 log (RBW1/RBW2) = X dB; whereas: RBW1 = Y, RBW2 = Z	

Results: **1.4 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.849998208 GHz	-37.61 dBm		
M2		1	1.8495 GHz	-46.57 dBm	Band Power	-28.16 dBm
M3		1	1.8485 GHz	-56.64 dBm	Band Power	-38.48 dBm
M4		1	1.8475 GHz	-59.66 dBm	Band Power	-44.59 dBm
M5		1	1.8465 GHz	-65.28 dBm	Band Power	-48.25 dBm
M6		1	1.8455 GHz	-66.64 dBm	Band Power	-50.15 dBm

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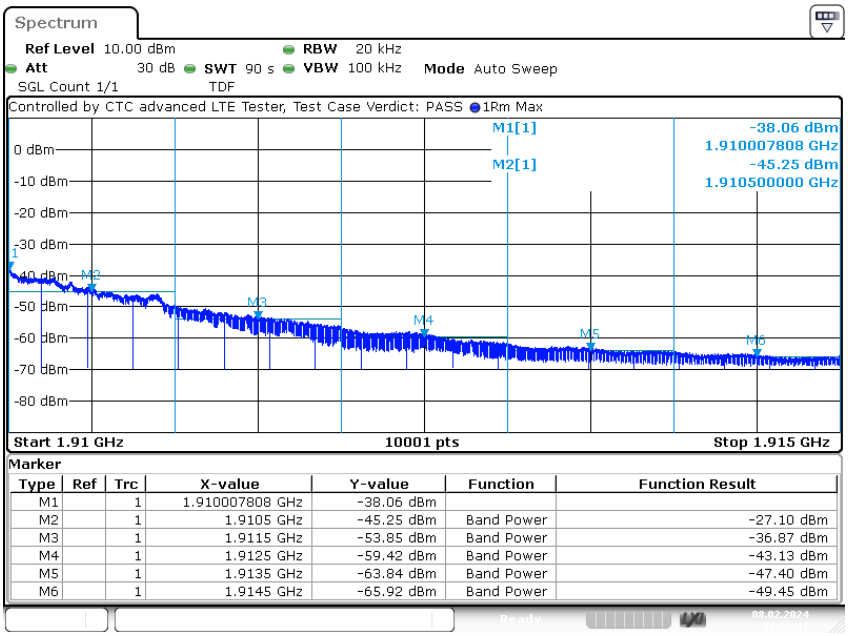
Plot 2: Highest channel – QPSK



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.910007808 GHz	-38.06 dBm		
M2		1	1.9105 GHz	-45.25 dBm	Band Power	-27.10 dBm
M3		1	1.9115 GHz	-53.85 dBm	Band Power	-36.87 dBm
M4		1	1.9125 GHz	-59.42 dBm	Band Power	-43.13 dBm
M5		1	1.9135 GHz	-63.84 dBm	Band Power	-47.40 dBm
M6		1	1.9145 GHz	-65.92 dBm	Band Power	-49.45 dBm

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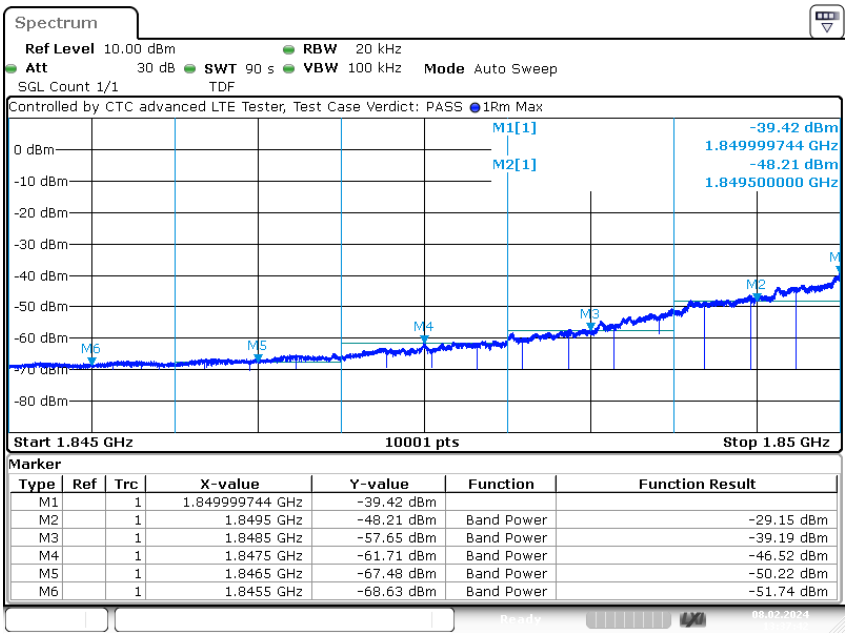
Plot 3: Lowest channel – 16-QAM



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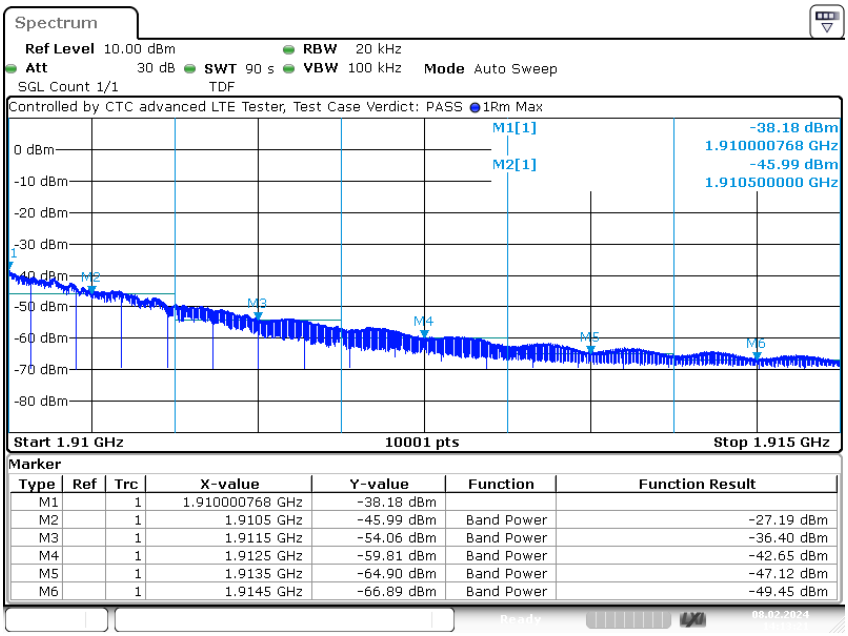
Plot 4: Highest channel – 16-QAM



Date: 8.FEB.2024 14:13:21

14.2.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement parameters	
Detector:	Peak
Sweep time:	180s
Video bandwidth:	100 kHz
Resolution bandwidth:	30 kHz
Span:	2 x nominal bandwidth
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1049 ISED: RSS-Gen, 6.7

Limits:

FCC	ISED
§ 2.1049	RSS-Gen, 6.7
Reporting only	

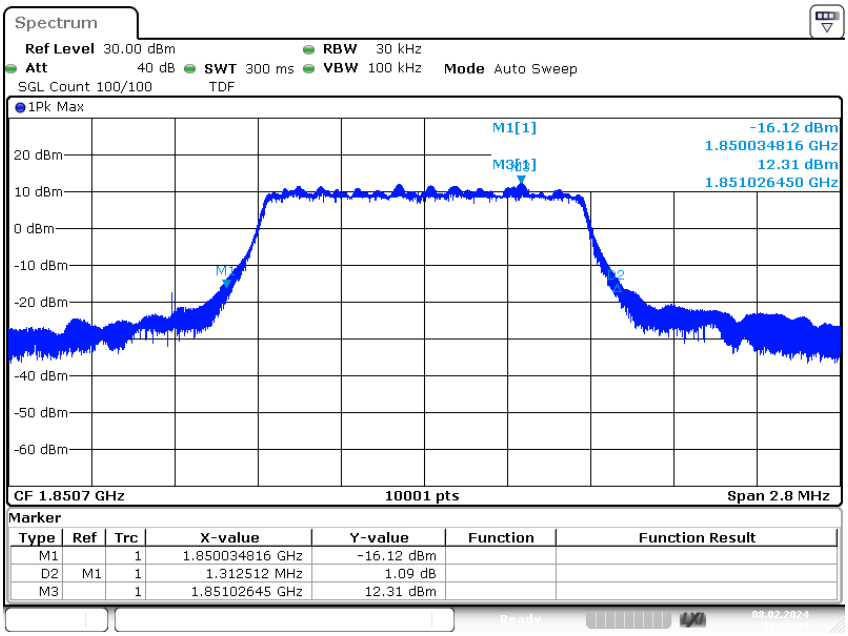
Results:

Occupied Bandwidth – QPSK		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
1850.7	1090	1313
1880.0	1090	1281
1909.3	1094	1303

Occupied Bandwidth – 16-QAM		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
1850.7	1089	1273
1880.0	1091	1286
1909.3	1090	1279

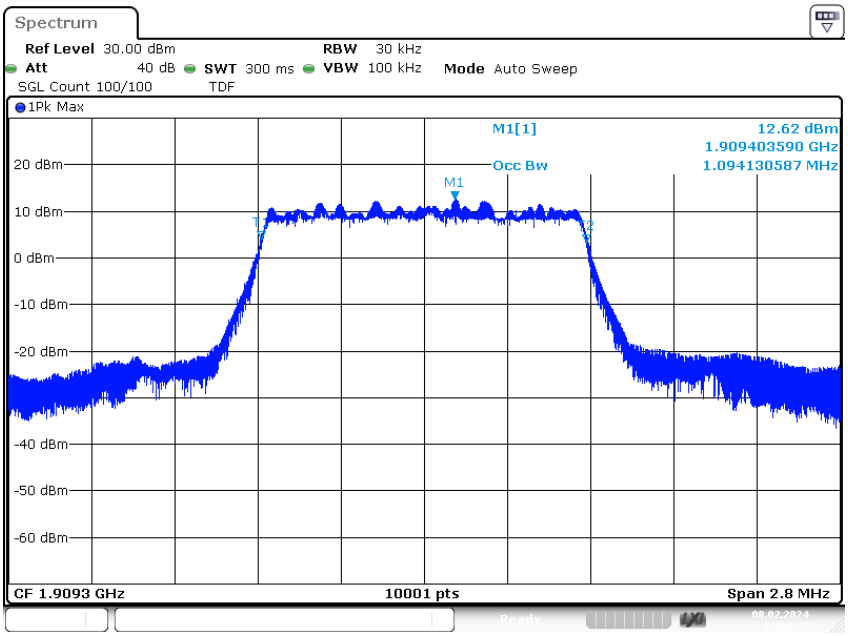
Plots: QPSK, worst case plots

Plot 1: low channel (-26 dBc BW)



Date: 8.FEB.2024 13:29:09

Plot 2: high channel (99% - OBW)



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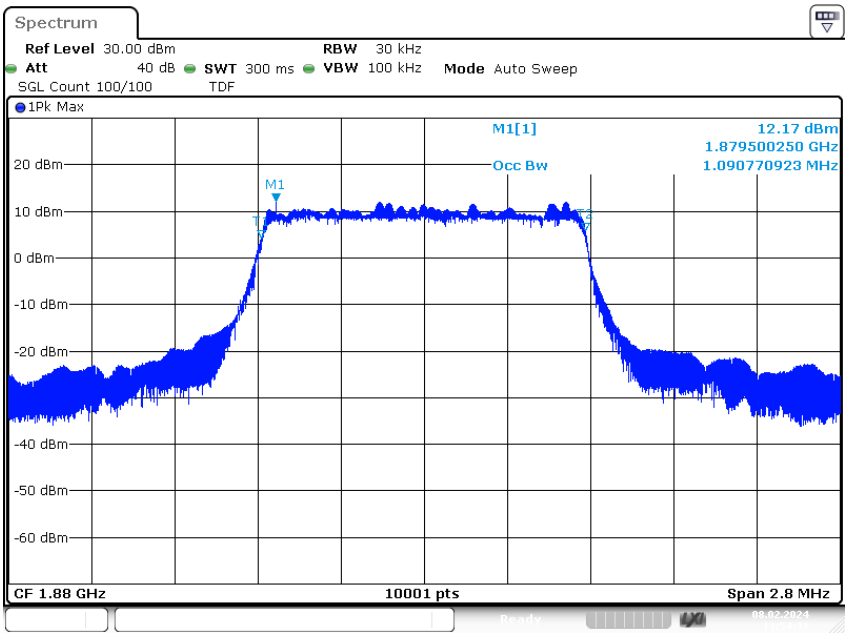
Plots: 16-QAM, worst case plots

Plot 1: mid channel (99% - OBW)



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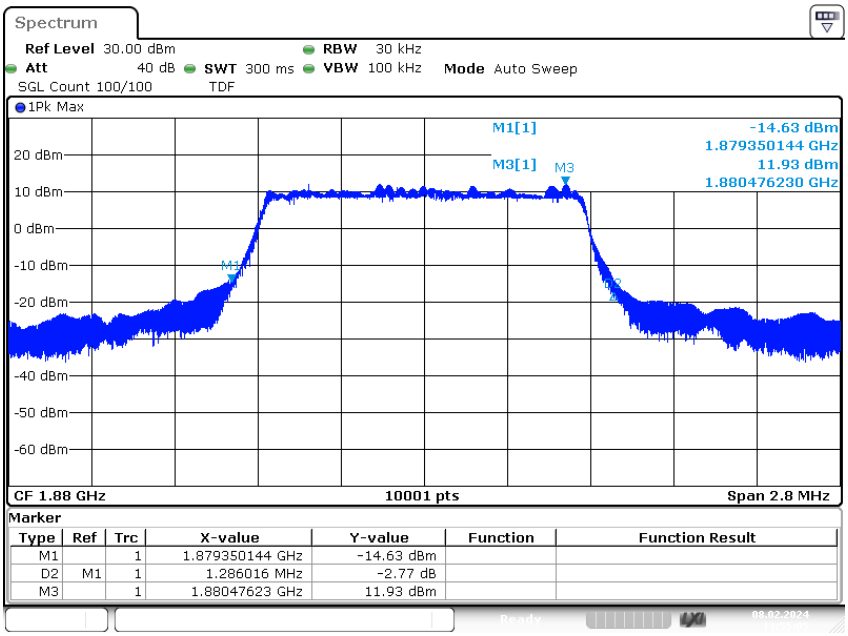
Plot 2: mid channel (-26 dBc BW)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.879350144 GHz	-14.63 dBm		
D2	M1	1	1.286016 MHz	-2.77 dB		
M3		1	1.88047623 GHz	11.93 dBm		

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14.3 Results LTE band 25

The EUT was set to transmit the maximum power.

14.3.1 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	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	See chapter 7.2 setup C & 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1046 ISED: RSS-Gen, 6.12

Limits:

FCC	ISED
$ 24.232(c)	RSS-133, 6.4 (referring to: SRSP-510, Issue 5)
(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications. (d) In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	SRSP-510, 5.1: Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. RSS-133, 6.4: In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.
Power: **33 dBm EIRP** PAPR: **13 dB**	

Results:

Output Power (conducted)						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Peak to Average Ratio (dB)**	**Average Output Power (dBm) 16-QAM**	**Peak to Average Ratio (dB)**
1.4	26047 / 1850.7	1 RB low	18,3	6,0	17,0	7,1
		1 RB high	18,0	6,1	17,0	7,1
		100% RB	16,2	6,8	16,1	7,6
	26340 / 1880.0	1 RB low	19,1	6,1	17,9	7,2
		1 RB high	18,9	6,1	17,8	7,2
		100% RB	16,9	6,9	17,0	7,6
	26683 / 1914.3	1 RB low	19,4	6,1	18,4	7,2
		1 RB high	19,2	6,2	18,1	7,2
		100% RB	17,3	7,0	17,4	7,7
3	26055 / 1851.5	1 RB low	18,2	6,0	17,0	7,1
		1 RB high	18,0	6,1	17,0	7,2
		100% RB	16,1	6,9	16,0	7,6
	26340 / 1880.0	1 RB low	18,3	6,9	17,1	8,0
		1 RB high	18,9	6,1	17,8	7,2
		100% RB	16,9	6,9	16,3	8,3
	26675 / 1913.5	1 RB low	19,3	6,2	18,3	7,2
		1 RB high	19,2	6,2	18,2	7,2
		100% RB	17,2	7,1	17,3	7,7
5	26065 / 1852.5	1 RB low	20,0	4,3	19,9	4,9
		1 RB high	19,8	4,4	19,8	5,0
		100% RB	18,9	5,0	18,0	5,9
	26340 / 1880.0	1 RB low	20,9	4,3	20,8	4,9
		1 RB high	20,6	4,4	20,5	5,0
		100% RB	19,6	5,0	18,6	6,1
	26665 / 1912.5	1 RB low	21,6	4,3	21,7	4,7
		1 RB high	21,3	4,3	21,5	4,8
		100% RB	20,2	5,1	19,2	6,0

10	26090 / 1855.0	1 RB low	19,9	4,3	19,9	4,9
		1 RB high	19,8	4,4	19,8	4,9
		100% RB	18,9	5,0	19,0	5,7
	26340 / 1880.0	1 RB low	20,7	4,3	20,6	4,9
		1 RB high	20,5	4,4	20,5	5,0
		100% RB	19,7	5,0	19,6	5,8
	26640 / 1910.0	1 RB low	21,6	4,3	21,5	4,7
		1 RB high	21,1	4,3	21,4	4,8
		100% RB	20,1	5,1	20,3	5,7
15	26115 / 1857.5	1 RB low	19,7	4,3	19,7	4,9
		1 RB high	19,6	4,4	19,6	4,9
		100% RB	19,8	4,6	19,9	5,1
	26340 / 1880.0	1 RB low	20,5	4,3	20,6	4,8
		1 RB high	20,5	4,4	20,4	5,0
		100% RB	20,4	4,7	20,5	5,3
	26615 / 1907.5	1 RB low	21,2	4,3	21,4	4,7
		1 RB high	21,0	4,3	21,1	4,8
		100% RB	20,9	4,8	20,9	5,3
20	26140 / 1860.0	1 RB low	19,4	4,3	19,4	4,8
		1 RB high	19,3	4,4	19,3	5,0
		100% RB	19,4	4,7	19,5	5,2
	26340 / 1880.0	1 RB low	20,4	4,3	20,2	4,8
		1 RB high	20,2	4,4	20,1	4,9
		100% RB	20,2	4,7	20,1	5,3
	26590 / 1905.0	1 RB low	21,2	4,3	21,3	4,7
		1 RB high	20,9	4,3	21,1	4,8
		100% RB	20,8	4,8	20,9	5,2

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

Output Power (EIRP)			
Bandwidth (MHz)	**Frequency (MHz)**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**
1.4	1850.7	17,5	16,2
	1880.0	17,6	16,4
	1914.3	17,5	16,5
3	1851.5	17,6	16,5
	1880.0	17,4	16,3
	1913.5	17,4	16,4
5	1852.5	19,2	19,1
	1880.0	19,4	19,3
	1912.5	19,7	19,8
10	1855.0	19,1	19,1
	1880.0	19,2	19,1
	1910.0	19,7	19,6
15	1857.5	19,0	19,1
	1880.0	19,0	19,1
	1907.5	19,3	19,5
20	1860.0	18,6	18,7
	1880.0	18,9	18,7
	1905.0	19,3	19,4

14.3.2 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 R&S CMW500 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 CMW500 and in a simulated call on channel 9400 (centre 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. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring 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 CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure:	FCC: § 2.1055 ISED: RSS-Gen, 6.11

Limits:

FCC	ISED
§ 24.235	RSS-133, 6.3
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.	The carrier frequency shall not depart from the reference frequency, in excess of ±2.5 ppm for mobile stations and ±1.0 ppm for base stations.
± 2.5 ppm (ISED only)	

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
4.1	-71	-0.04
3.7	-65	-0.04
2.5	-67	-0.04

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-26	-0.01
-20	-36	-0.02
-10	-26	-0.01
± 0	-41	-0.02
10	-48	-0.03
20	-71	-0.04
30	-26	-0.01
40	-14	-0.01
50	-38	-0.02

14.3.3 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 24.238. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE band 25.

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 7.1 setup A; 7.2 setup A, B; 7.3 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1053 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 24.238 (a) & (b)	RSS-133, 6.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b) Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.
-13 dBm	

Results:

QPSK:

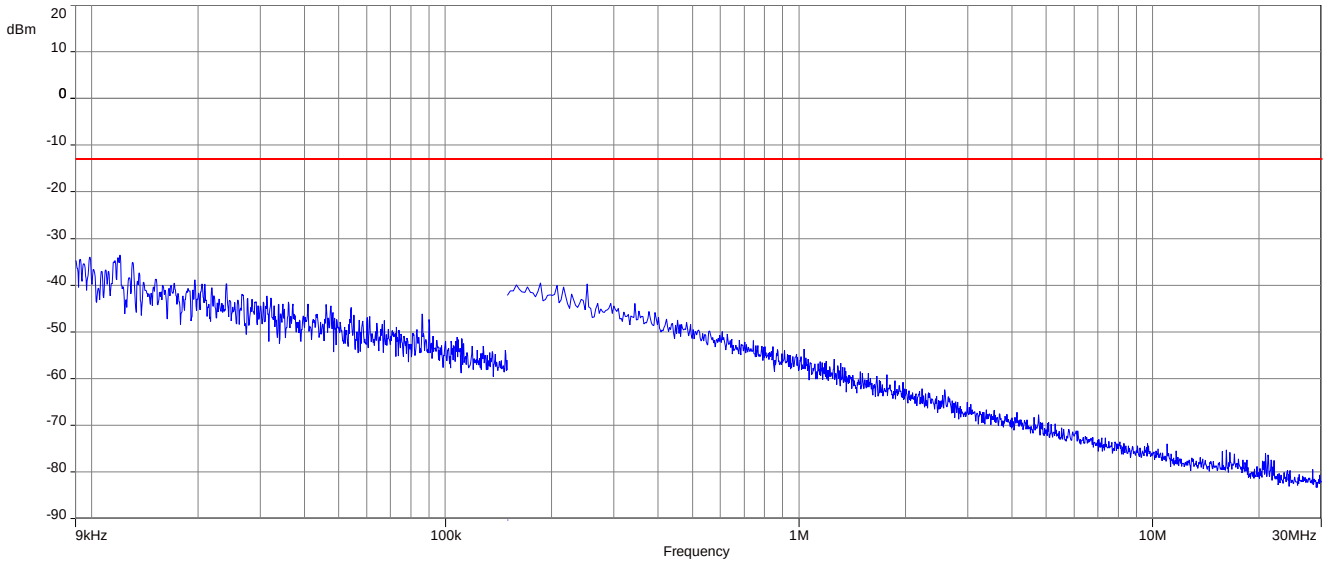
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

16-QAM:

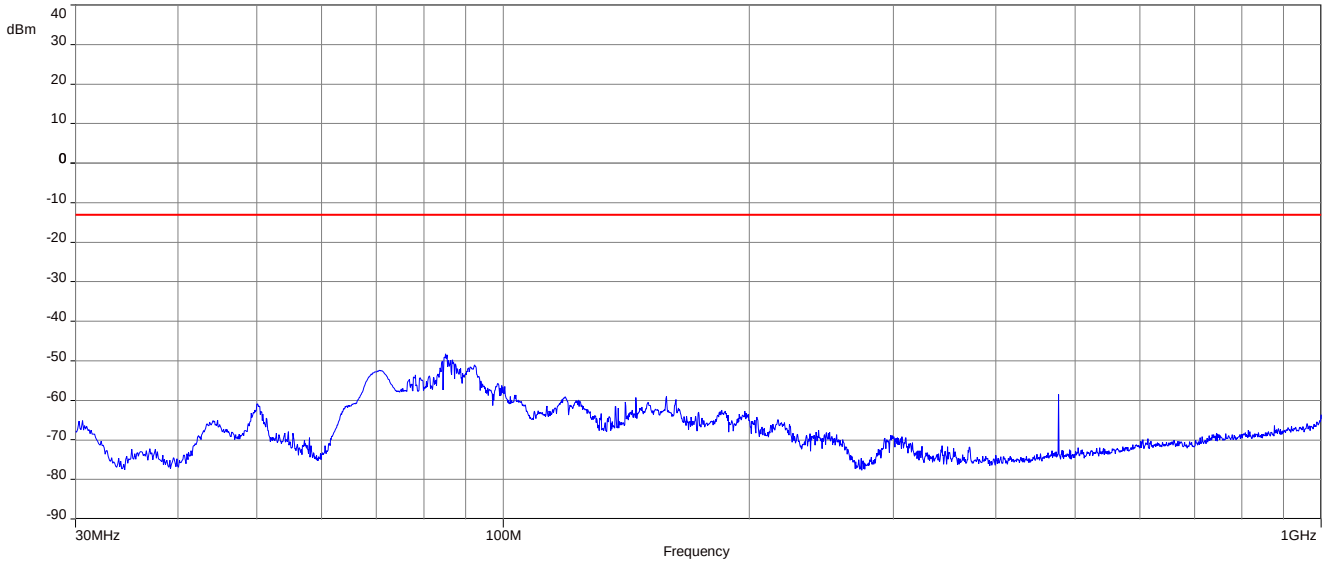
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

QPSK

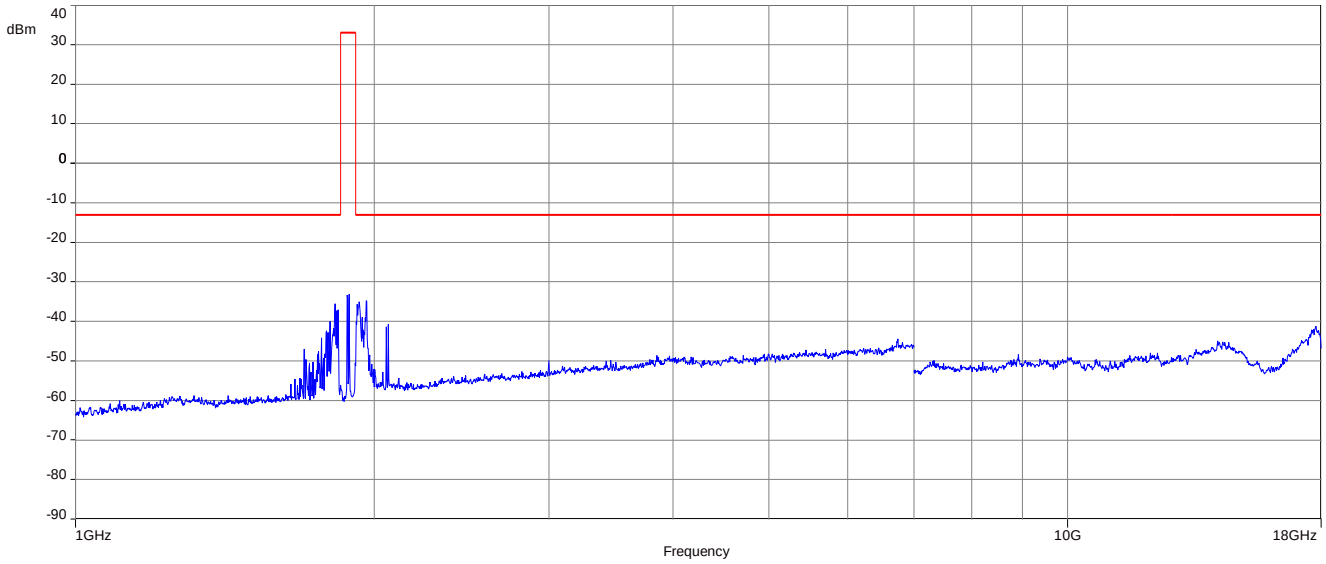
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)

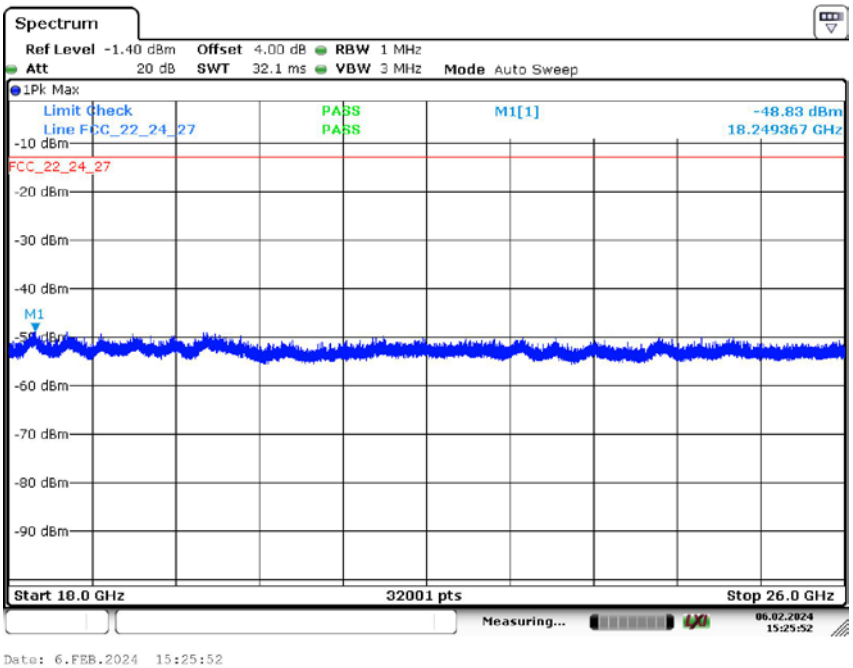


Plot 3: Mid channel (1 GHz – 18 GHz)



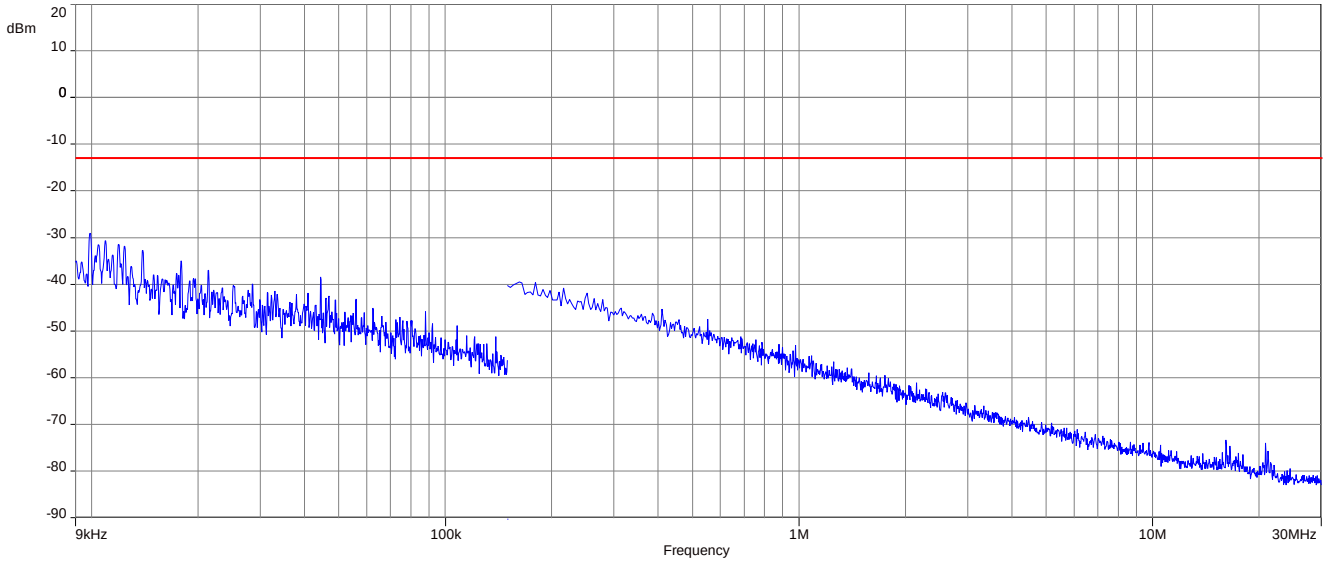
Carrier notched with 1.9 GHz rejection filter

Plot 4: Mid channel (18 GHz – 20 GHz)

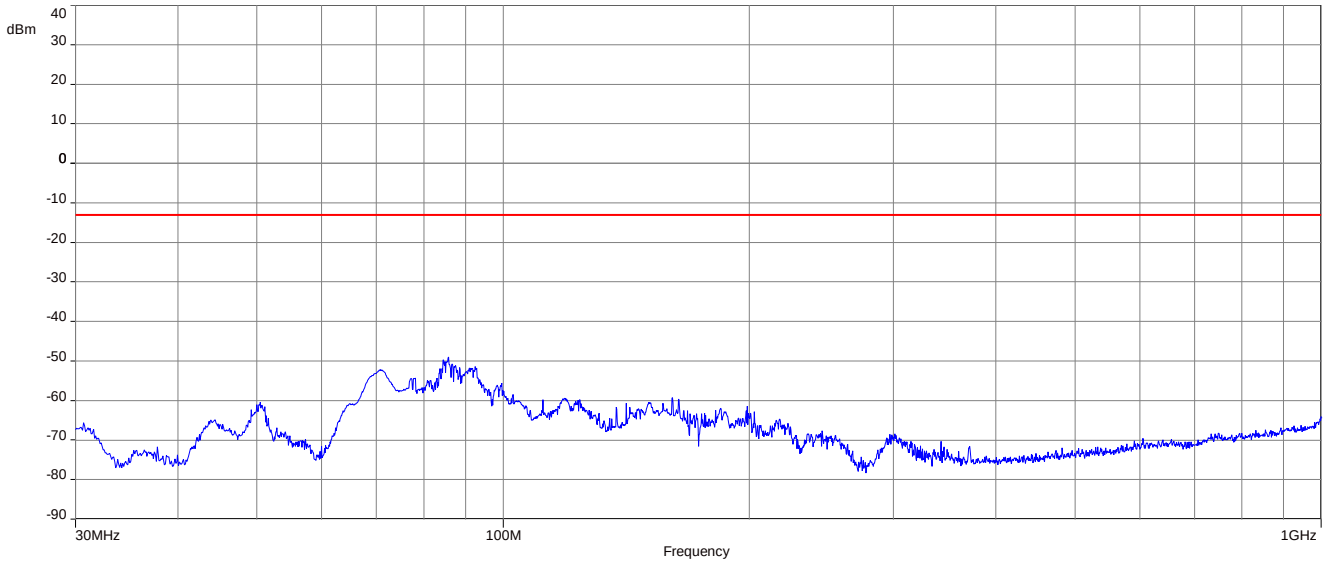


16-QAM

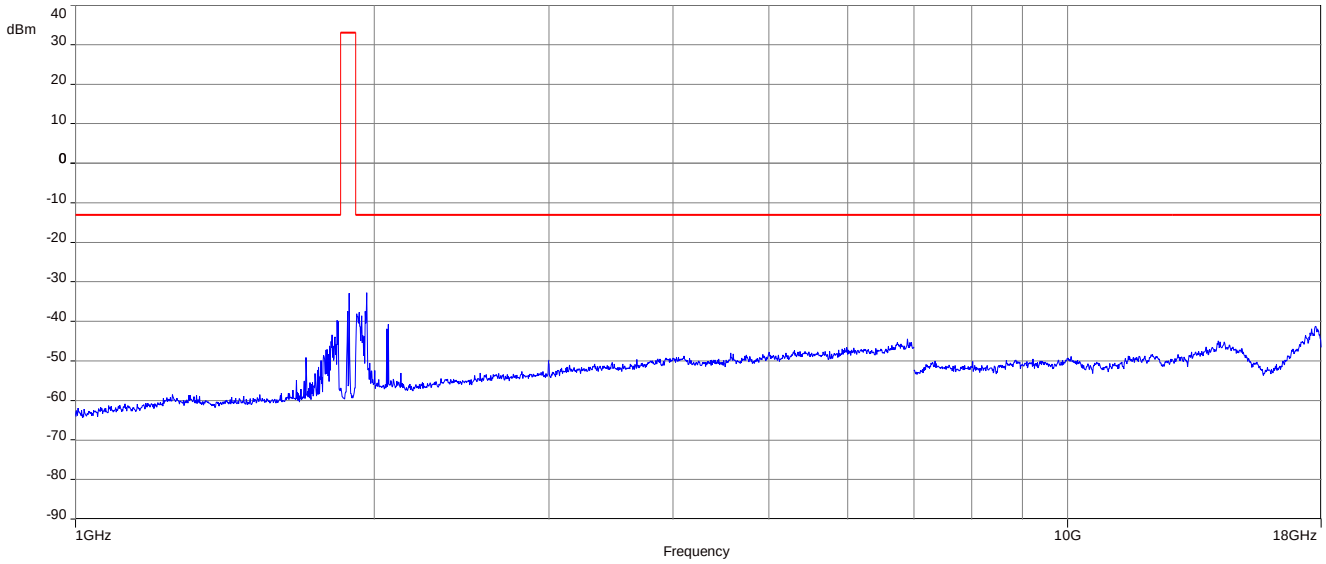
Plot 1: Mid channel (9 kHz - 30 MHz)



Plot 2: Mid channel (30 MHz – 1 GHz)

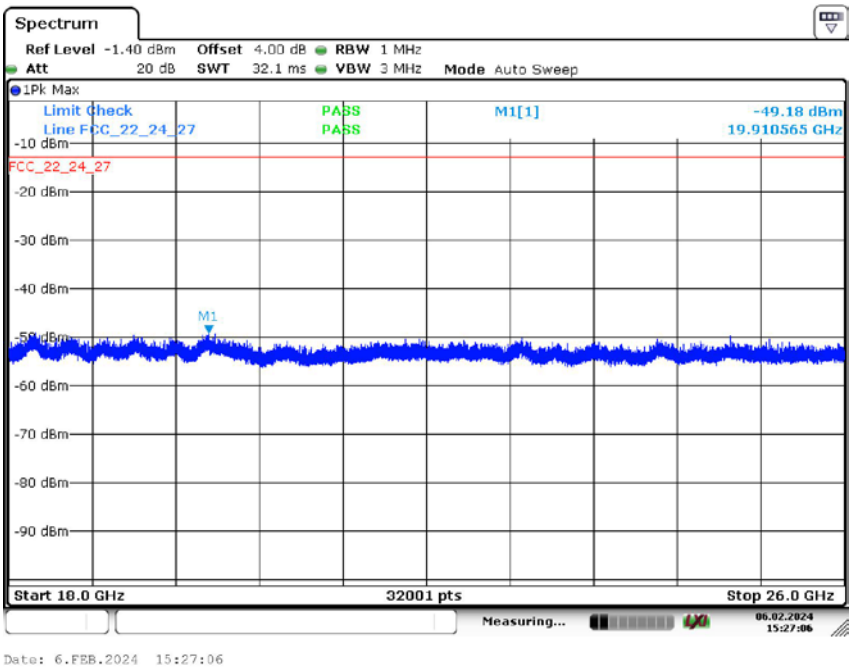


Plot 3: Mid channel (1 GHz – 18 GHz)



Carrier notched with 1.9 GHz rejection filter

Plot 4: Mid channel (18 GHz – 20 GHz)



14.3.4 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 & RSS-Gen, 6.13.2 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:	300 kHz
Resolution bandwidth:	100 kHz
Span:	30 MHz – 19.5 GHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9
Measurement procedure	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	IC
§ 24.238 (a) & (b)	RSS-133, 6.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b) Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.
-13 dBm	

Results: for 1.4 MHz channel bandwidth

QPSK:

Spurious Emission Level								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

16-QAM:

Spurious Emission Level								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

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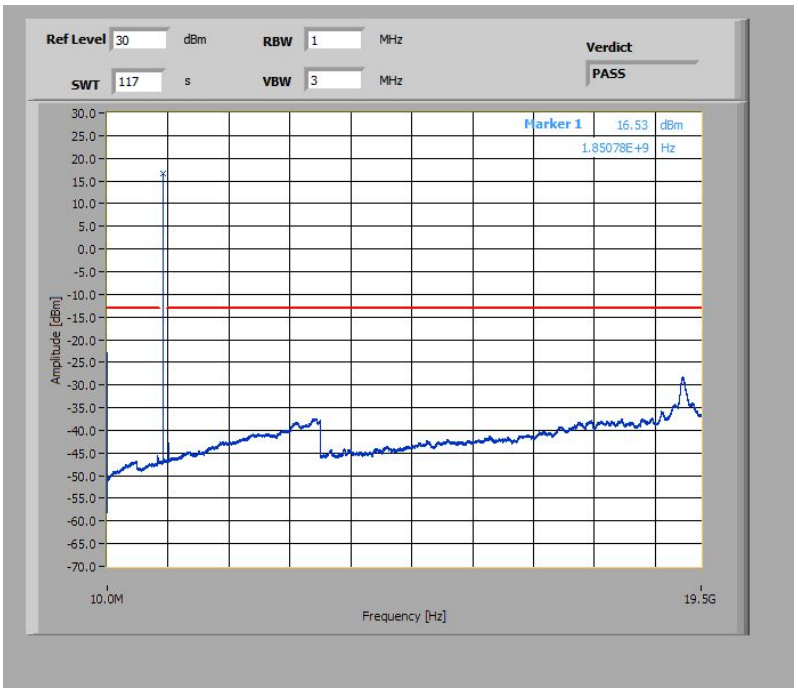
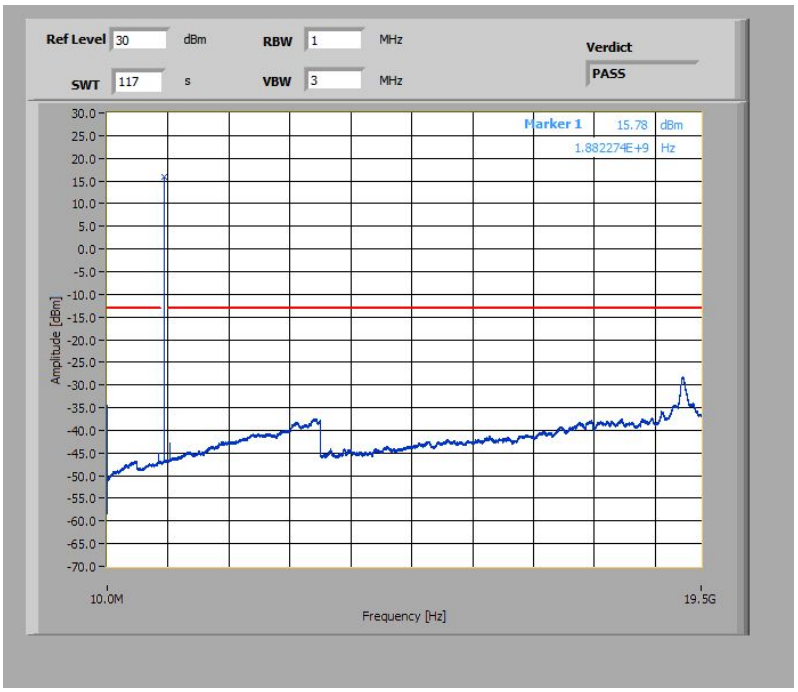
Plots: QPSK with 1.4 MHz channel bandwidth

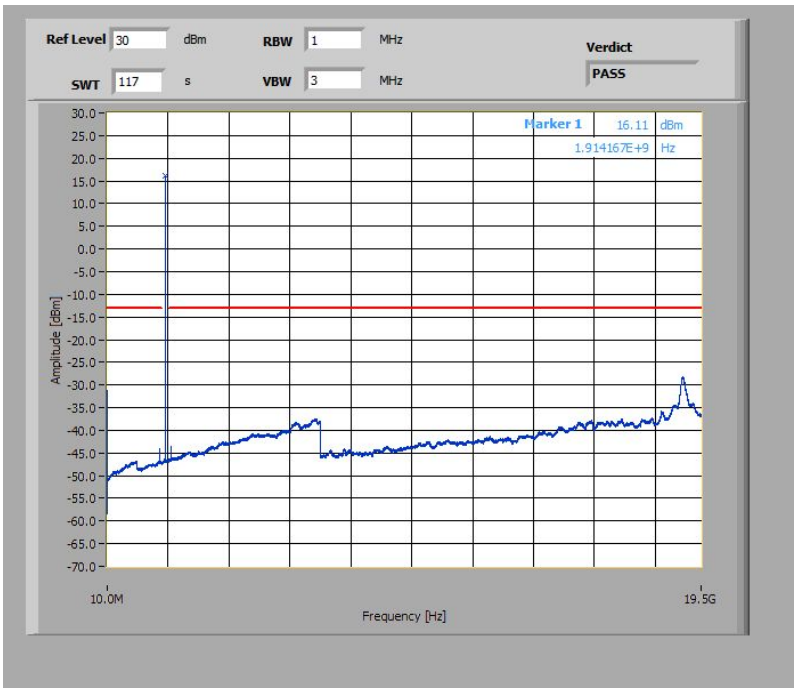
Plot 1: Lowest Channel (10 MHz – 19.5 GHz)



Plot 2: Middle Channel (10 MHz – 19.5 GHz)

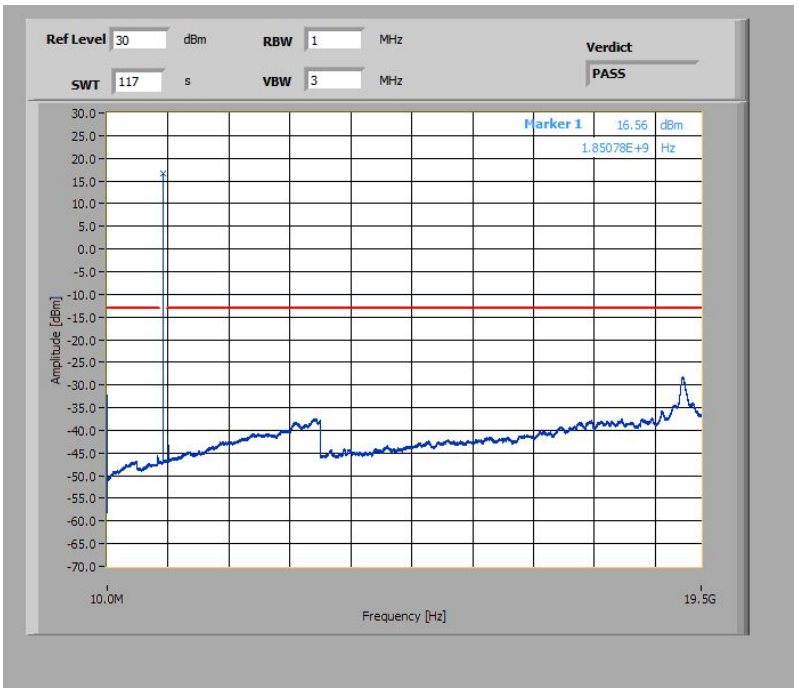


Plot 3: Highest Channel (10 MHz – 19.5 GHz)

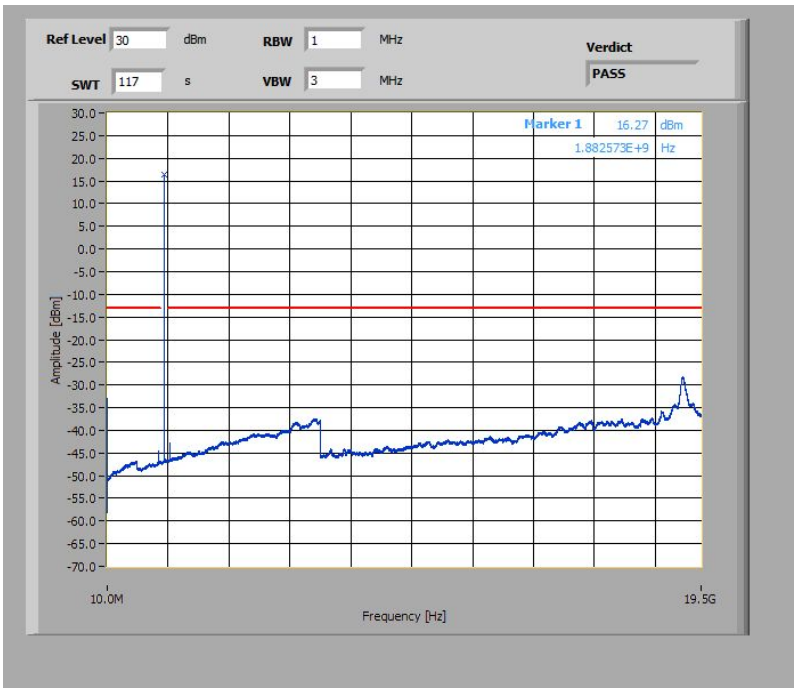


Plots: 16-QAM with 1.4 MHz channel bandwidth

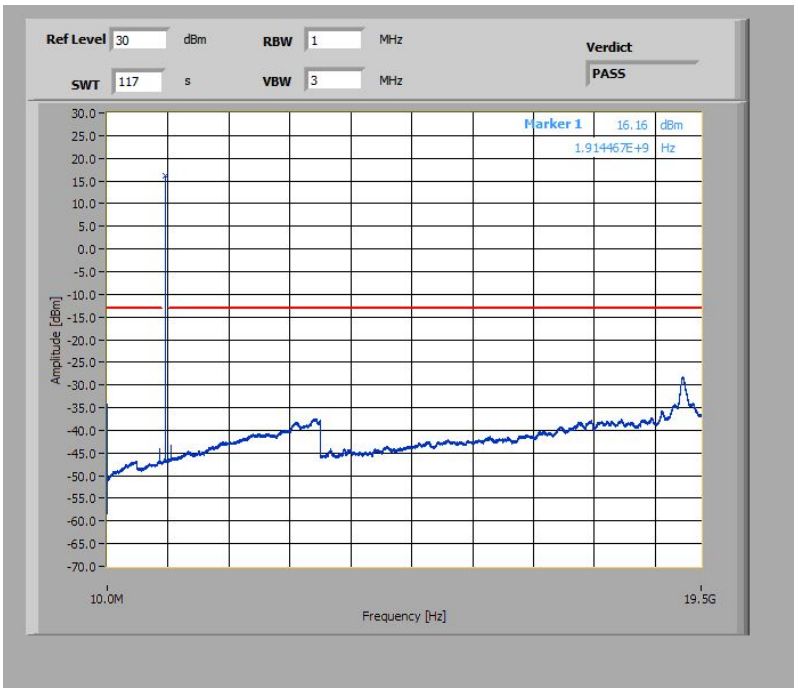
Plot 1: Lowest Channel (10 MHz – 19.5 GHz)



Plot 2: Middle Channel (10 MHz – 19.5 GHz)



Plot 3: Highest Channel (10 MHz – 19.5 GHz)



14.3.5 Block edge compliance

Description:

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

Measurement:

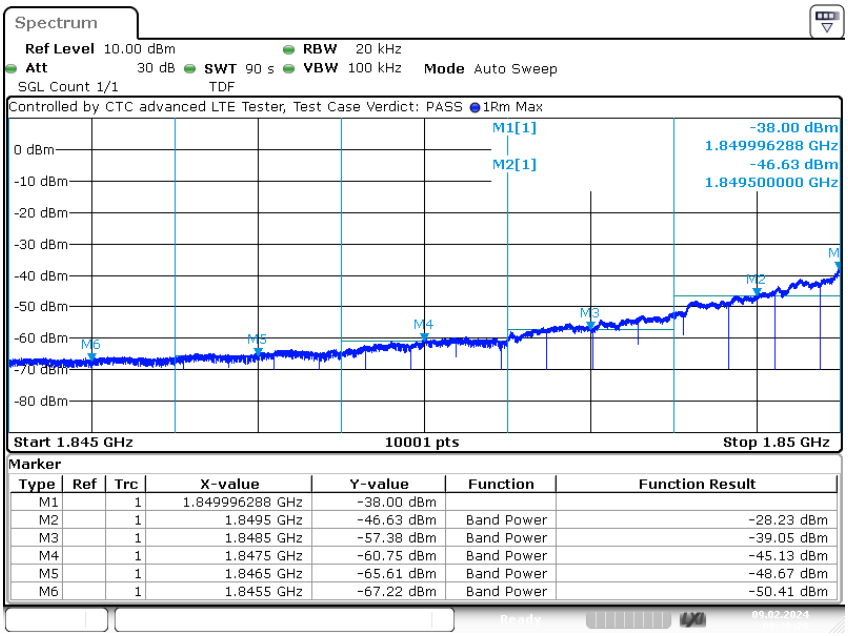
Measurement parameters	
Detector:	RMS
Sweep time:	180 sec.
Video bandwidth:	100 kHz
Resolution bandwidth:	20 kHz
Span:	1 MHz steps
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 24.238 (a) & (b)	RSS-133, 6.5
(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least **43 + 10 log(P) dB**. (b) Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least **43 + 10 log(P)** (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.
-13 dBm Correction factor according to KDB 890810 if RBW < 1 % emission bandwidth: ☒N/A here ☐10 log (RBW1/RBW2) = X dB; whereas: RBW1 = Y, RBW2 = Z	

Results: **1.4 MHz channel bandwidth**

Plot 1: Lowest channel – QPSK



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.849996288 GHz	-38.00 dBm		
M2		1	1.8495 GHz	-46.63 dBm	Band Power	-28.23 dBm
M3		1	1.8485 GHz	-57.38 dBm	Band Power	-39.05 dBm
M4		1	1.8475 GHz	-60.75 dBm	Band Power	-45.13 dBm
M5		1	1.8465 GHz	-65.61 dBm	Band Power	-48.67 dBm
M6		1	1.8455 GHz	-67.22 dBm	Band Power	-50.41 dBm

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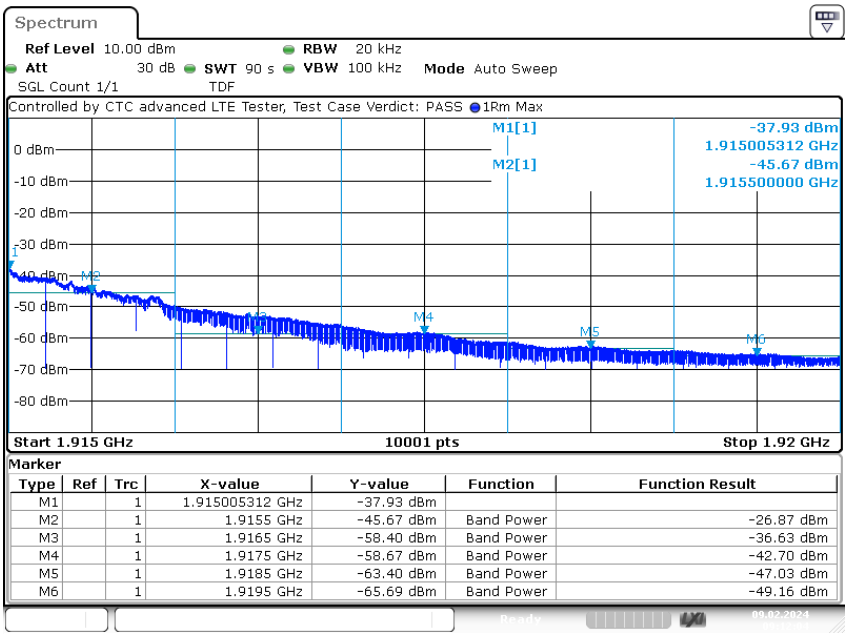
Plot 2: Highest channel – QPSK



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.915005312 GHz	-37.93 dBm		
M2		1	1.9155 GHz	-45.67 dBm	Band Power	-26.87 dBm
M3		1	1.9165 GHz	-58.40 dBm	Band Power	-36.63 dBm
M4		1	1.9175 GHz	-58.67 dBm	Band Power	-42.70 dBm
M5		1	1.9185 GHz	-63.40 dBm	Band Power	-47.03 dBm
M6		1	1.9195 GHz	-65.69 dBm	Band Power	-49.16 dBm

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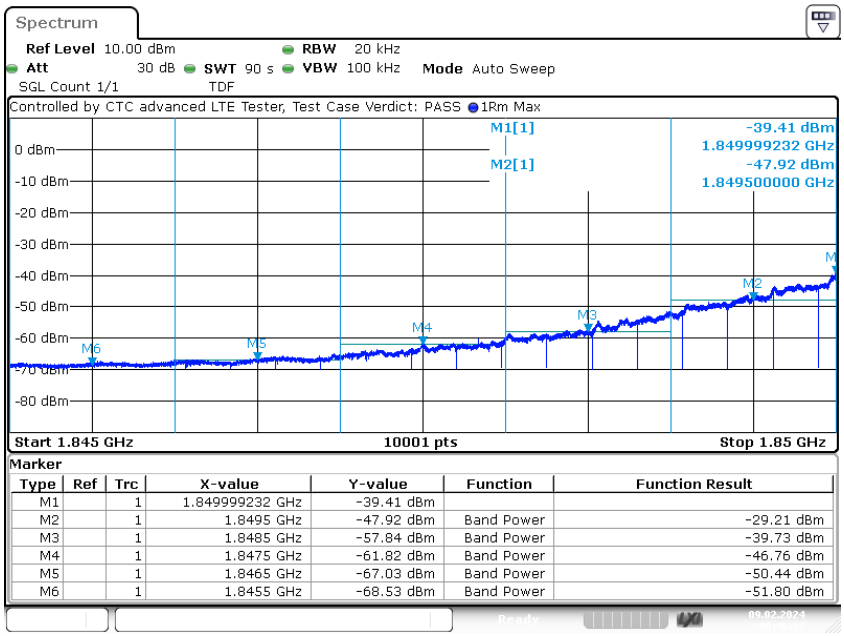
Plot 3: Lowest channel – 16-QAM



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.849999232 GHz	-39.41 dBm		
M2		1	1.8495 GHz	-47.92 dBm	Band Power	-29.21 dBm
M3		1	1.8485 GHz	-57.84 dBm	Band Power	-39.73 dBm
M4		1	1.8475 GHz	-61.82 dBm	Band Power	-46.76 dBm
M5		1	1.8465 GHz	-67.03 dBm	Band Power	-50.44 dBm
M6		1	1.8455 GHz	-68.53 dBm	Band Power	-51.80 dBm

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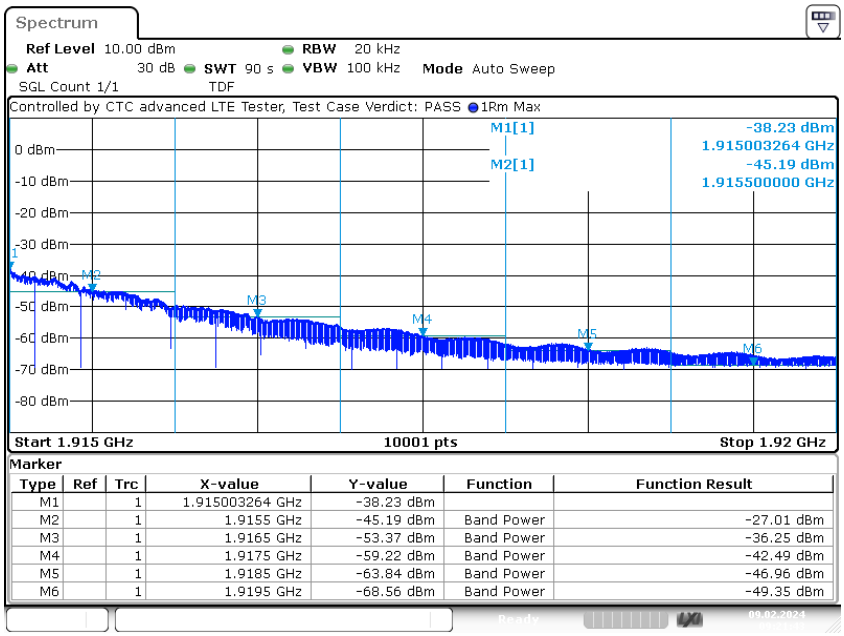
Plot 4: Highest channel – 16-QAM



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.915003264 GHz	-38.23 dBm		
M2		1	1.9155 GHz	-45.19 dBm	Band Power	-27.01 dBm
M3		1	1.9165 GHz	-53.37 dBm	Band Power	-36.25 dBm
M4		1	1.9175 GHz	-59.22 dBm	Band Power	-42.49 dBm
M5		1	1.9185 GHz	-63.84 dBm	Band Power	-46.96 dBm
M6		1	1.9195 GHz	-68.56 dBm	Band Power	-49.35 dBm

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14.3.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement parameters	
Detector:	Peak
Sweep time:	180s
Video bandwidth:	100 kHz
Resolution bandwidth:	30 kHz
Span:	2 x nominal bandwidth
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1049 ISED: RSS-Gen, 6.7

Limits:

FCC	ISED
§ 2.1049	RSS-Gen, 6.7
Reporting only	

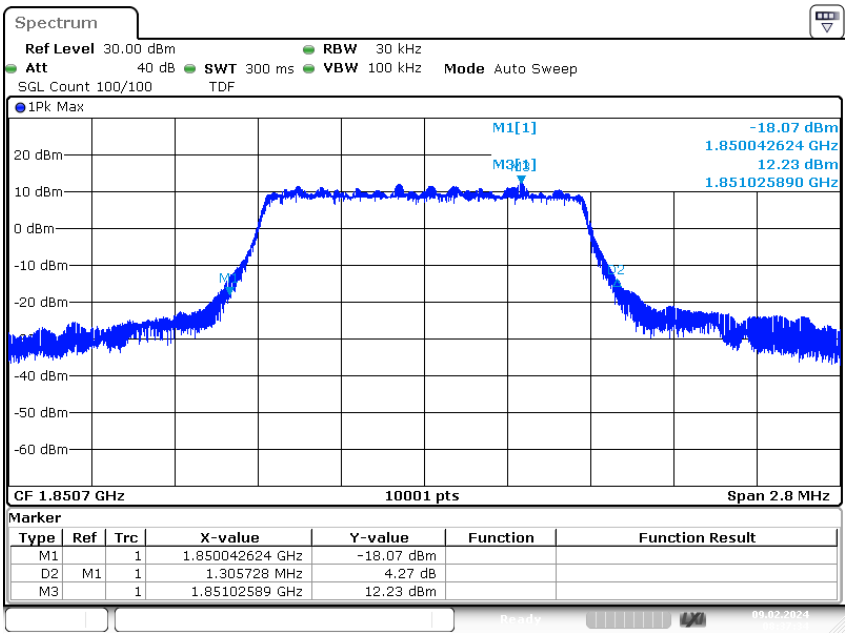
Results:

Occupied Bandwidth – QPSK		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
1850.7	1091	1306
1880.0	1089	1267
1909.3	1094	1302

Occupied Bandwidth – 16-QAM		
Frequency (MHz)	**99% OBW (kHz)**	**-26 dBc BW (kHz)**
1850.7	1089	1272
1880.0	1091	1288
1909.3	1090	1298

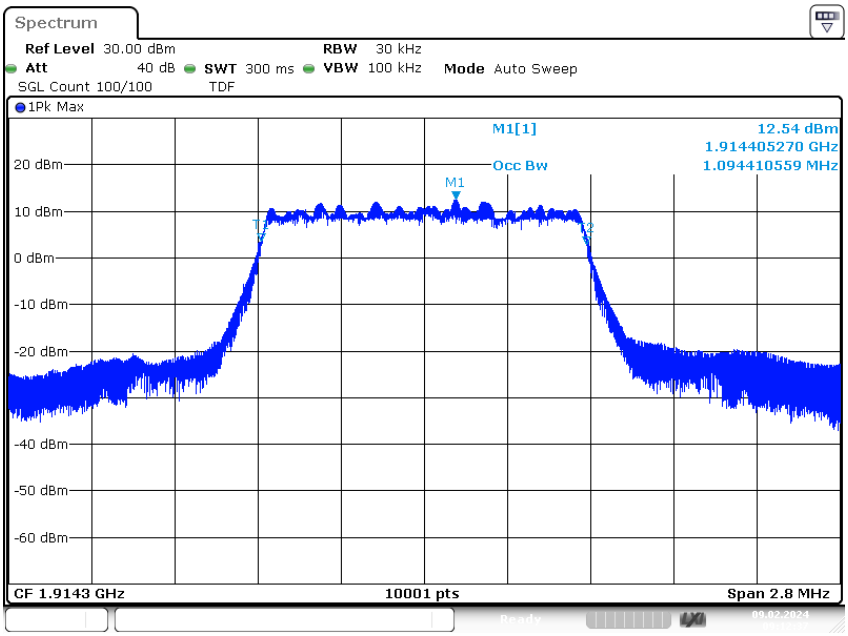
Plots: QPSK, worst case plots

Plot 1: low channel (-26 dBc BW)



Date: 9.FEB.2024 08:37:34

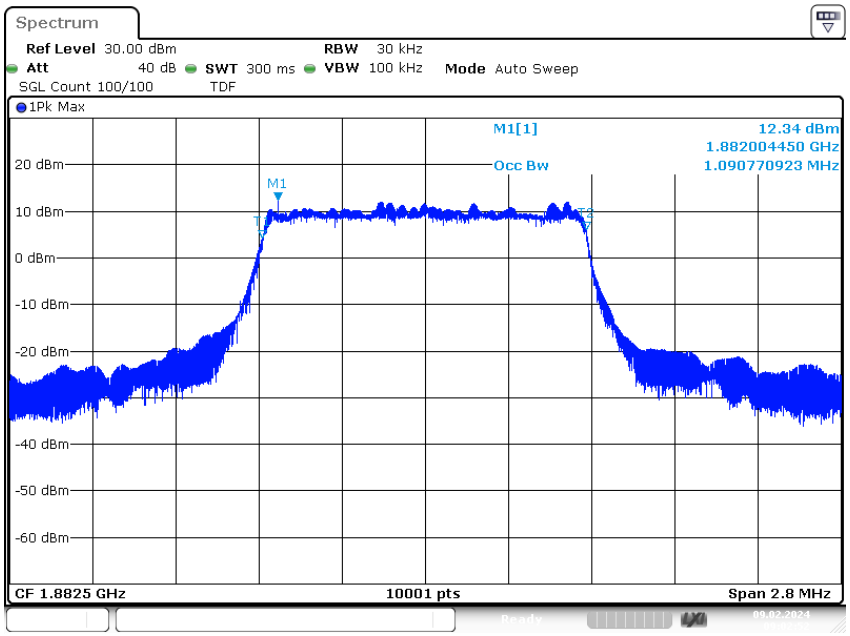
Plot 2: high channel (99% - OBW)



Date: 9.FEB.2024 09:12:37

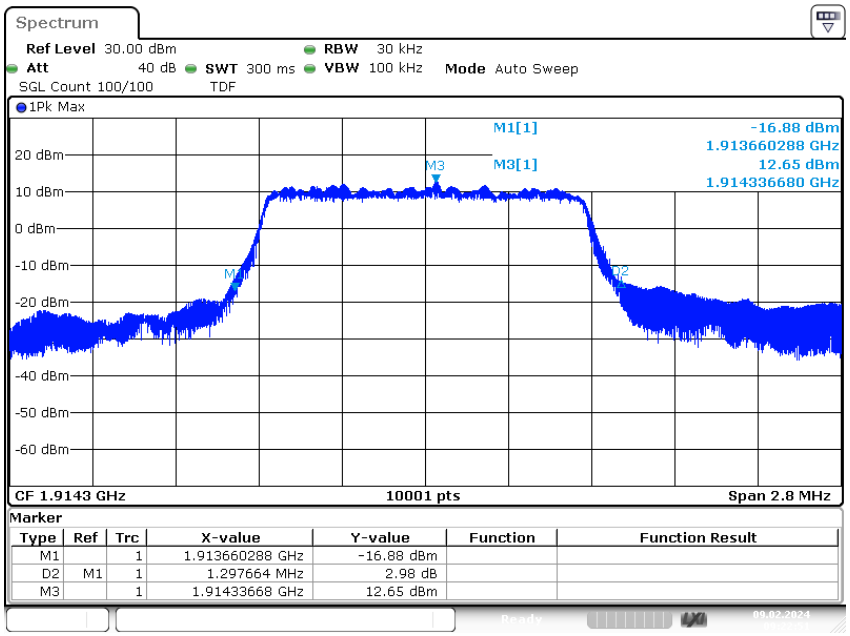
Plots: 16-QAM, worst case plots

Plot 1: mid channel (99% - OBW)



Date: 9.FEB.2024 09:02:52

Plot 2: high channel (-26 dBc BW)



Date: 9.FEB.2024 09:22:51

15 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 & Part 90 ISED: RSS-Gen, Issue 5 RSS-130, Issue 2 (LTE Bands 12, 13, 85) RSS-139, Issue 4 (LTE Band 4, 66)	See table!	2024-09-04	-/-

15.1 Part 27/RSS-139: LTE band 4

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

15.2 Part 27/RSS-130: LTE band 12

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

15.3 Part 27/RSS-130: LTE band 13

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

15.4 Part 27: LTE band 26b

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

15.5 Part 27/RSS-139: LTE band 66

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

15.6 Part 27/RSS-133: LTE band 85

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

16 RF measurements

16.1 Description of test setup

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

16.2 Results LTE band 4

The EUT was set to transmit the maximum power.

16.2.1 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	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1046 ISED: RSS-Gen, 6.12

Limits:

FCC	ISED
§ 27.50(d)(4) & (5)	RSS-139, 6.5
(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. (5) In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters shall not exceed one watt. In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.
Power: **33 dBm EIRP** PAPR: **13 dB**	

Results:

Output Power (conducted)						
Bandwidth (MHz)	**Channel No. / Frequency (MHz)**	**Resource block allocation**	**Average Output Power (dBm) QPSK**	**Peak to Average Ratio (dB)**	**Average Output Power (dBm) 16-QAM**	**Peak to Average Ratio (dB)**
1.4	19957 / 1710.7	1 RB low	17,9	5,9	16,6	7,0
		1 RB high	17,7	6,0	16,6	7,0
		100% RB	15,9	6,7	15,9	7,4
	20175 / 1732.5	1 RB low	18,0	5,9	16,8	7,1
		1 RB high	17,8	6,0	16,6	7,2
		100% RB	15,9	6,7	16,0	7,4
	20393 / 1754.3	1 RB low	18,0	6,0	16,8	7,0
		1 RB high	17,8	6,1	16,7	7,1
		100% RB	15,7	7,0	15,8	7,5
3	19965 / 1711.5	1 RB low	17,8	5,9	16,6	7,0
		1 RB high	17,0	6,8	15,8	7,8
		100% RB	15,8	6,7	15,9	7,4
	20175 / 1732.5	1 RB low	17,9	6,0	16,8	7,1
		1 RB high	17,8	6,1	16,6	7,2
		100% RB	15,9	6,8	15,1	8,2
	20385 / 1753.5	1 RB low	18,0	6,0	16,8	7,1
		1 RB high	17,9	6,1	16,7	7,1
		100% RB	15,9	6,9	15,9	7,5
5	19975 / 1712.5	1 RB low	19,8	4,1	19,6	4,7
		1 RB high	19,6	4,2	19,4	4,8
		100% RB	18,7	4,8	17,7	5,8
	20175 / 1732.5	1 RB low	19,7	4,2	19,4	4,8
		1 RB high	19,4	4,3	19,2	4,9
		100% RB	18,6	4,9	17,3	6,0
	20375 / 1752.5	1 RB low	19,9	4,2	19,7	4,8
		1 RB high	19,8	4,3	19,6	4,8
		100% RB	18,7	5,0	17,6	5,9

10	20000 / 1715.0	1 RB low	19,7	4,2	19,5	4,7
		1 RB high	19,4	4,3	19,5	4,8
		100% RB	18,6	4,8	18,8	5,5
	20175 / 1732.5	1 RB low	19,4	4,3	19,3	4,8
		1 RB high	19,4	4,3	19,1	4,9
		100% RB	18,6	4,9	18,6	5,6
	20350 / 1750.0	1 RB low	19,8	4,2	19,6	4,7
		1 RB high	19,5	4,3	19,4	4,8
		100% RB	18,4	5,0	18,8	5,6
15	20025 / 1717.5	1 RB low	19,4	4,2	19,4	4,7
		1 RB high	19,3	4,3	19,1	4,9
		100% RB	19,5	4,5	19,5	5,0
	20175 / 1732.5	1 RB low	19,5	4,2	19,2	4,8
		1 RB high	19,3	4,3	19,2	4,9
		100% RB	19,3	4,6	19,3	5,2
	20325 / 1747.5	1 RB low	19,9	4,2	19,6	4,7
		1 RB high	19,4	4,3	19,4	4,8
		100% RB	19,4	4,7	19,5	5,2
20	20050 / 1720.0	1 RB low	19,2	4,1	19,1	4,7
		1 RB high	19,1	4,3	19,0	4,8
		100% RB	19,1	4,5	19,2	5,0
	20175 / 1732.5	1 RB low	19,2	4,2	18,8	4,8
		1 RB high	19,0	4,3	18,8	4,9
		100% RB	19,0	4,6	19,0	5,2
	20300 / 1745.0	1 RB low	19,6	4,2	19,4	4,8
		1 RB high	19,3	4,3	18,9	5,0
		100% RB	19,2	4,7	19,0	5,3

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

Output Power (EIRP)			
Bandwidth (MHz)	**Frequency (MHz)**	**Average Output Power (dBm) QPSK**	**Average Output Power (dBm) 16-QAM**
1.4	1710.7	18,0	16,7
	1732.5	18,1	16,9
	1754.3	18,1	16,9
3	1711.5	18,1	16,9
	1732.5	18,0	16,9
	1753.5	18,1	16,9
5	1712.5	19,9	19,7
	1732.5	19,8	19,5
	1752.5	20,0	19,8
10	1715.0	19,8	19,6
	1732.5	19,5	19,4
	1750.0	19,9	19,7
15	1717.5	19,6	19,6
	1732.5	19,6	19,4
	1747.5	20,0	19,7
20	1720.0	19,3	19,3
	1732.5	19,3	19,1
	1745.0	19,7	19,5

16.2.2 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 R&S CMW500 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 CMW500 and in a simulated call on channel 1412 (centre 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. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring 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.

This measurement was performed with the highest channel bandwidth supported from the EUT on the middle channel

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1055 ISED: RSS-Gen, 6.11

Limits:

FCC	ISED
§ 27.54	RSS-139, 6.4
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.	The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

Results:

FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
4.1	-42	-0.02
3.7	-39	-0.02
2.5	-34	-0.02

FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-32	-0.02
-20	-27	-0.02
-10	-11	-0.01
± 0	-16	-0.01
10	-23	-0.01
20	-42	-0.02
30	-34	-0.02
40	14	0.01
50	12	0.01

16.2.3 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, which is the transmitted carrier that can be as high as 1750 MHz. Measurement made up to 18 GHz. 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, mid and high channels of the LTE band 4.

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 7.1 setup A; 7.2 setup A, B
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1053 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 27.53(h)(1) & (3)	RSS-139, 6.6
(1) Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB. (3) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 (P) (watts) dB. ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 (P) (watts) dB.
-13 dBm	

Results:

QPSK

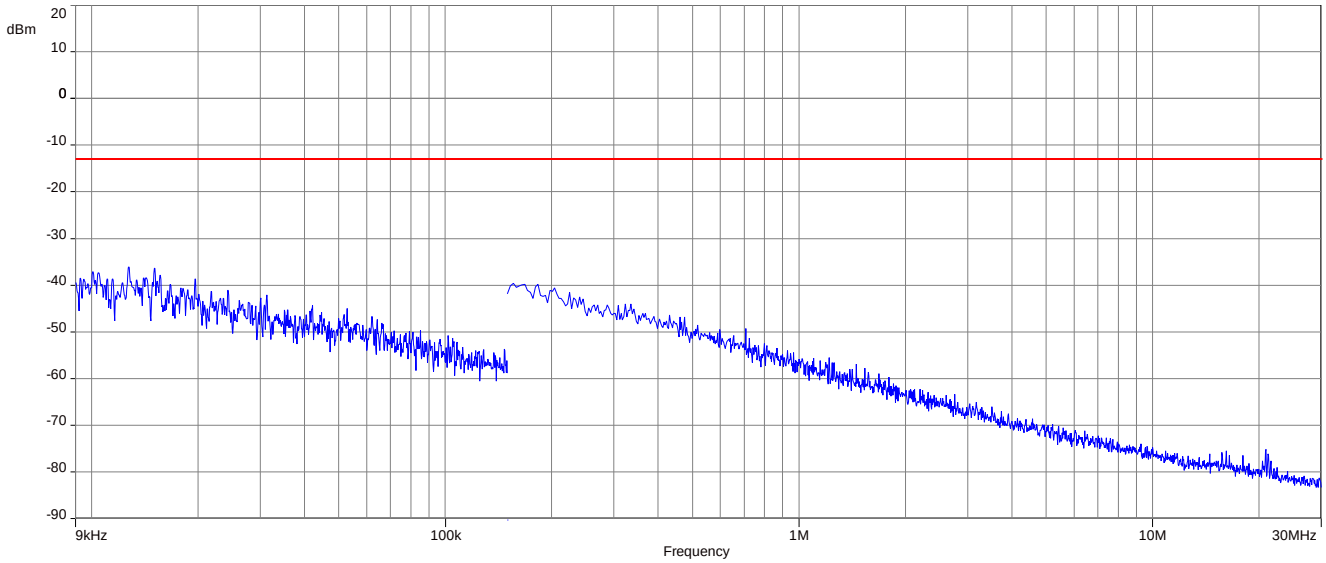
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

16-QAM

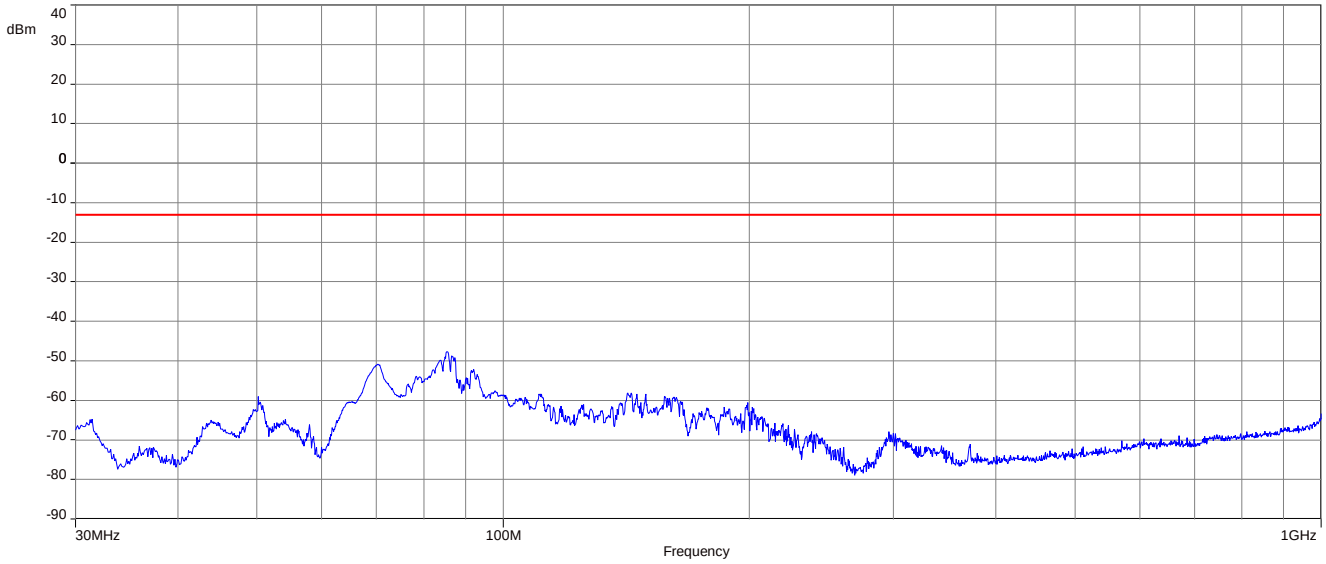
Spurious Emission Level					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
-/-		All detected emissions are more than 20 dB below the limit.		-/-	
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-

QPSK

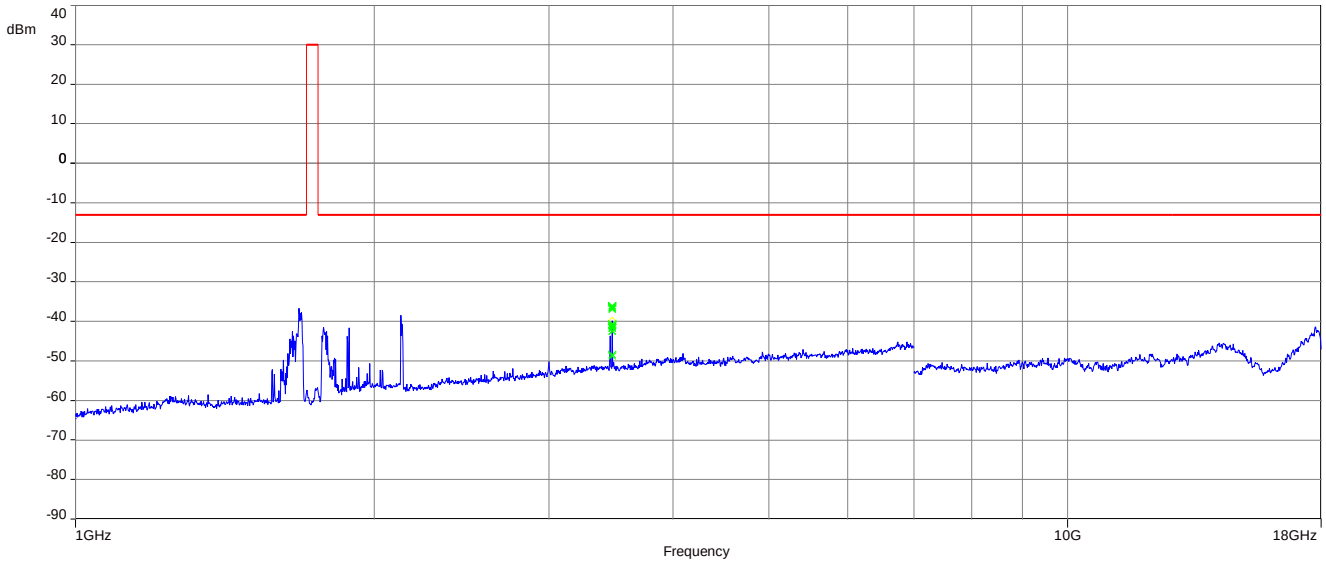
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1GHz

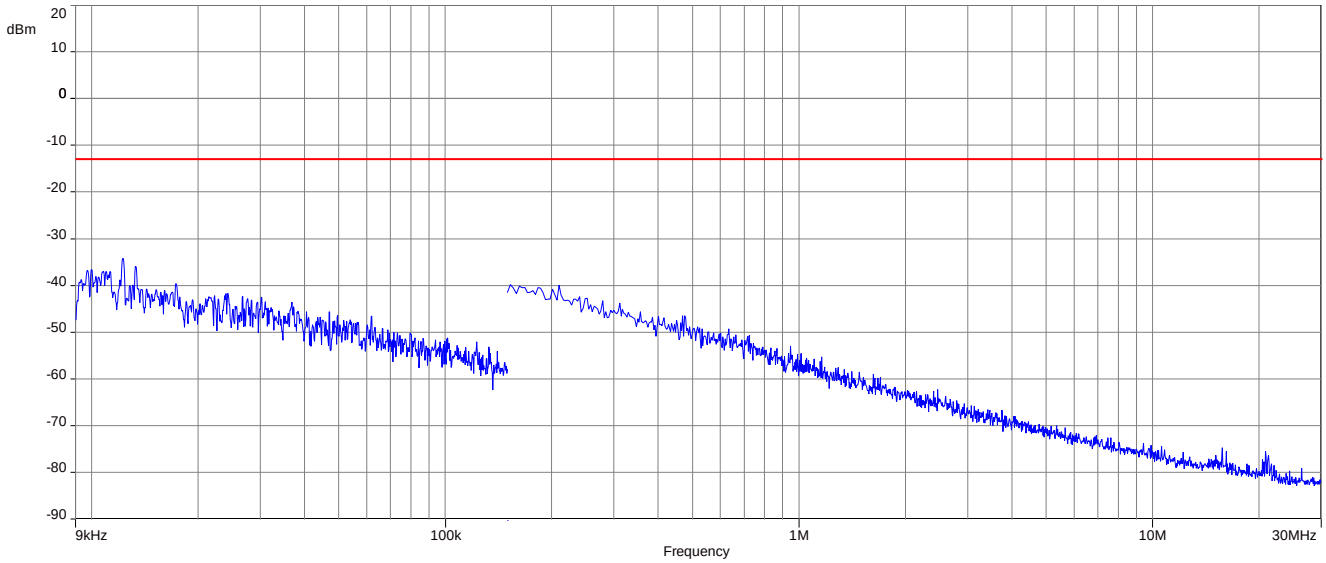


Plot 3: Middle channel, 1 GHz to 18GHz

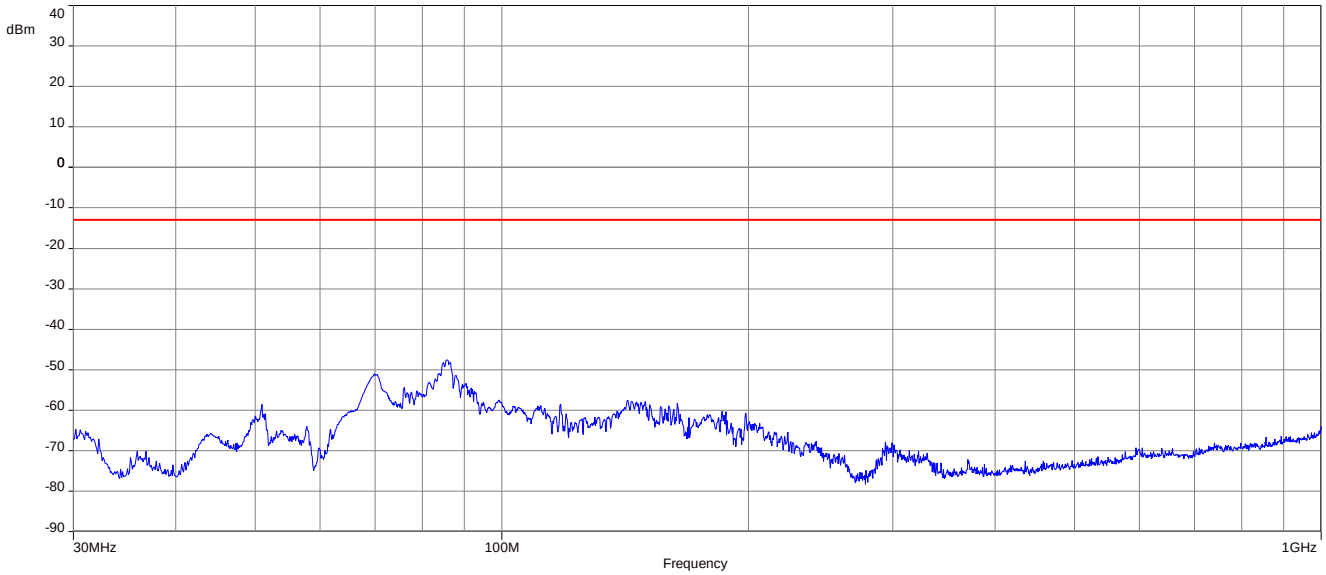


16-QAM

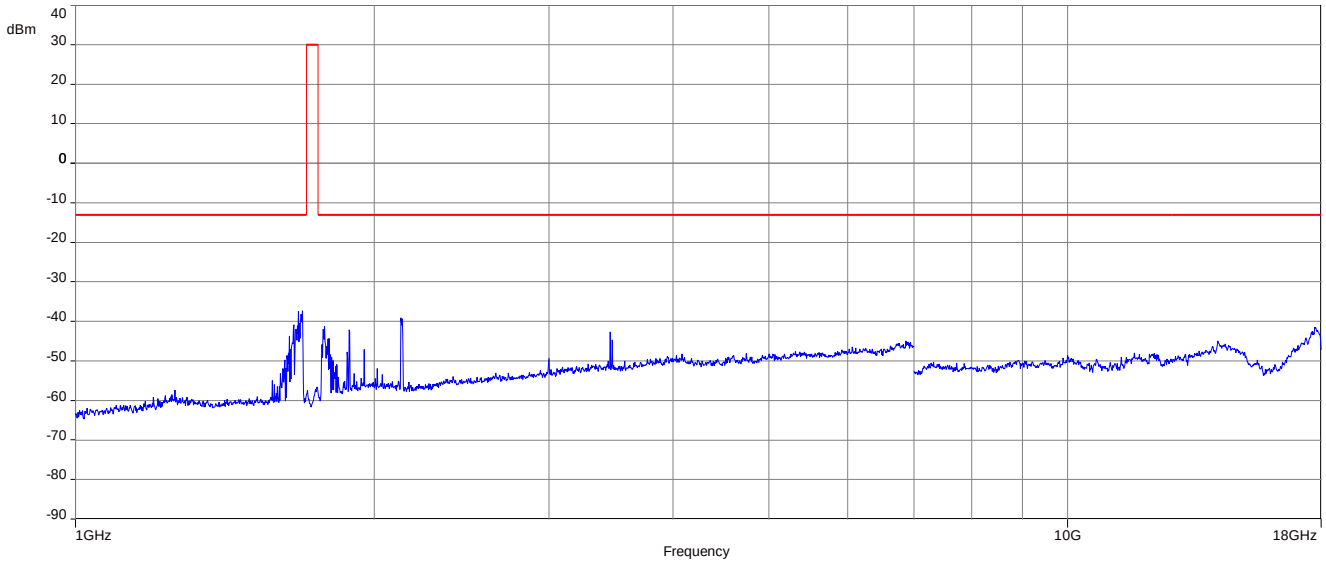
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1 GHz



Plot 3: Middle channel, 1 GHz to 18 GHz



16.2.4 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 & RSS-Gen, 6.13.2 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.

For the measurement the lowest, middle and highest channel bandwidth was used. If spurious were found the other bandwidths were measured, too.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	10 MHz – 18 GHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9
Measurement procedure	FCC: § 2.1051 ISED: RSS-Gen, 6.13

Limits:

FCC	ISED
§ 27.53(h)(1) & (3)	RSS-139, 6.6
(1) Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB. (3) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.	i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 (P) (watts) dB. ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 (P) (watts) dB.
-13 dBm	

Results: **for 1.4 MHz channel bandwidth**

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]
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-
-/-	-/-	-/-	-/-	-/-	-/-