
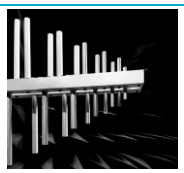
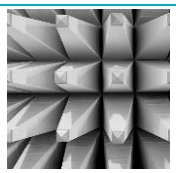

TEST REPORT

Test report no.: 1-6579-23-01-30_TR1-R01

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

Robert Bosch GmbH
Robert-Bosch-Straße 200
31139 Hildesheim / GERMANY
Phone: -/-
Contact: Thomas Dargel
e-mail: Thomas.Dargel@de.bosch.com

Manufacturer

Robert Bosch GmbH
Robert-Bosch-Straße 200
31139 Hildesheim / GERMANY

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

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

Test Item

Kind of test item:	**Telematics Control Unit Generation 2**
Model name:	**TCU2 NA IP30**
FCC ID:	**2AUXS-TCU2NAIP30A**
Frequency:	LTE bands 7; 12; 25; 26; 66; 71
Technology tested:	LTE
Antenna:	Three different external antennas
Power supply:	12.0 V DC by vehicle battery
Temperature range:	-40°C to +65°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=Andreas Luckenbill, o=cetecom advanced GmbH, ou=LUC-230601, email=andreas.luckenbill@cetecomadvanced.com, c=DE
2024.05.03 16:22:14 +02'00'

Andreas Luckenbill
Head of Radio and SAR Services
Radio Labs

Test performed:

p.o.

cn=David Lang, o=cetecom advanced GmbH, ou=LNG-230530, email=david.lang@cetecomadvanced.com, c=DE
2024.05.03 16:04:40 +02'00'

René Oelmann
Lab Manager
Radio Labs

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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:	2023-08-30
Date of receipt of test item:	2024-02-01
Start of test:*	2024-02-01
End of test:*	2024-04-24
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

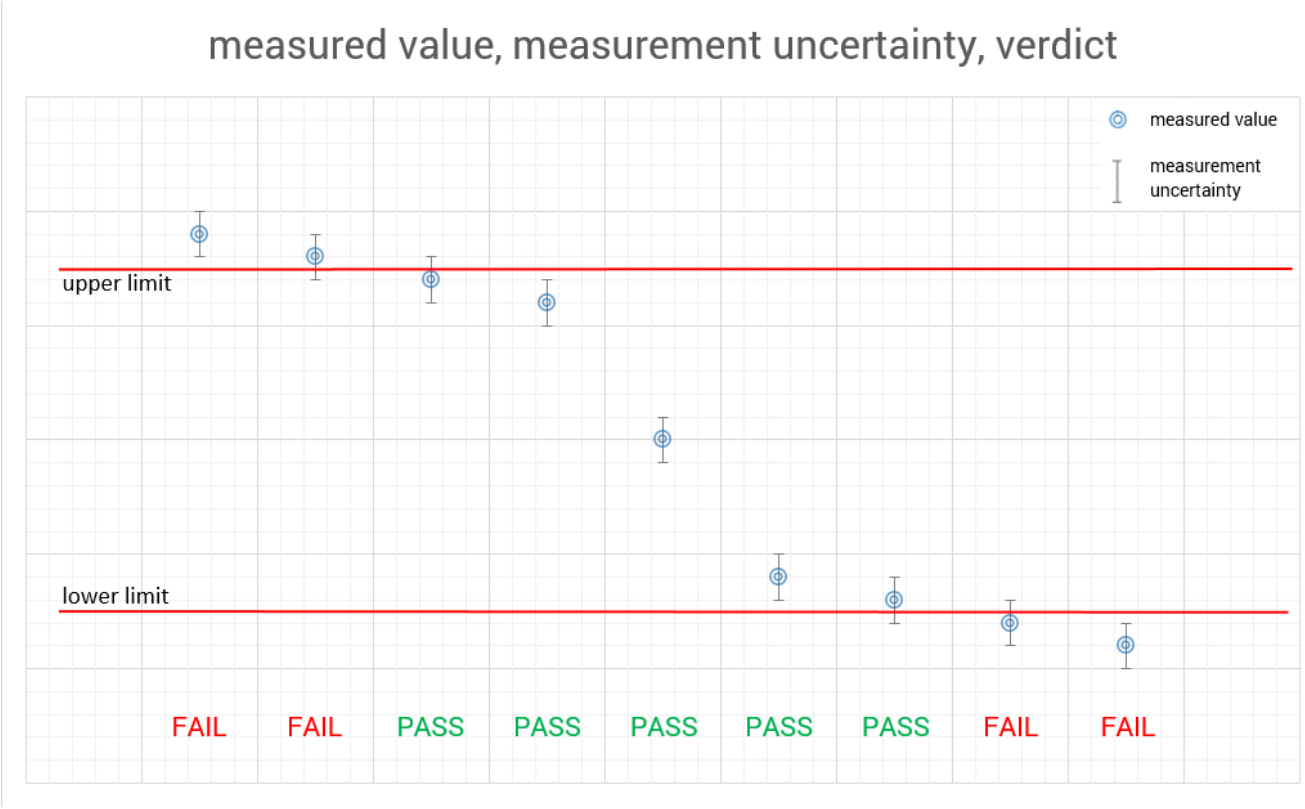
3 Test standard/s, references and accreditations

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

Guidance	Version	Description
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
KDB 996369 D04	v02	MODULAR TRANSMITTER INTEGRATION GUIDE GUIDANCE FOR HOST PRODUCT MANUFACTURERS
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}	+20 °C during room temperature tests +65 °C during room temperature tests -40 °C during room temperature tests
Relative humidity content	:		50 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	12.0 V DC by external power supply No tests under extreme conditions No tests under extreme conditions

6 Test item

6.1 General description

Kind of test item	:	Telematics Control Unit Generation 2
Model name	:	TCU2 NA IP30
S/N serial number	:	2750003683
Hardware status	:	4186H06
Software status	:	23.04.S.010.4
Firmware status	:	N/A
Frequency band	:	LTE bands 7; 12; 25; 26; 66; 71
Type of radio transmission Use of frequency spectrum	: :	OFDM
Type of modulation	:	QPSK, 16 – QAM
Antenna	:	Three different external antennas 1. Taoglas Supercombo antenna 2. Taoglas Puck antenna 3. Candy bar antenna
Power supply	:	12.0 V DC by vehicle battery
Temperature range	:	-40°C to +65°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: 1-6579_23-01-08_AnnexA
1-6579_23-01-08_AnnexD

7 Description of the test setup

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

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

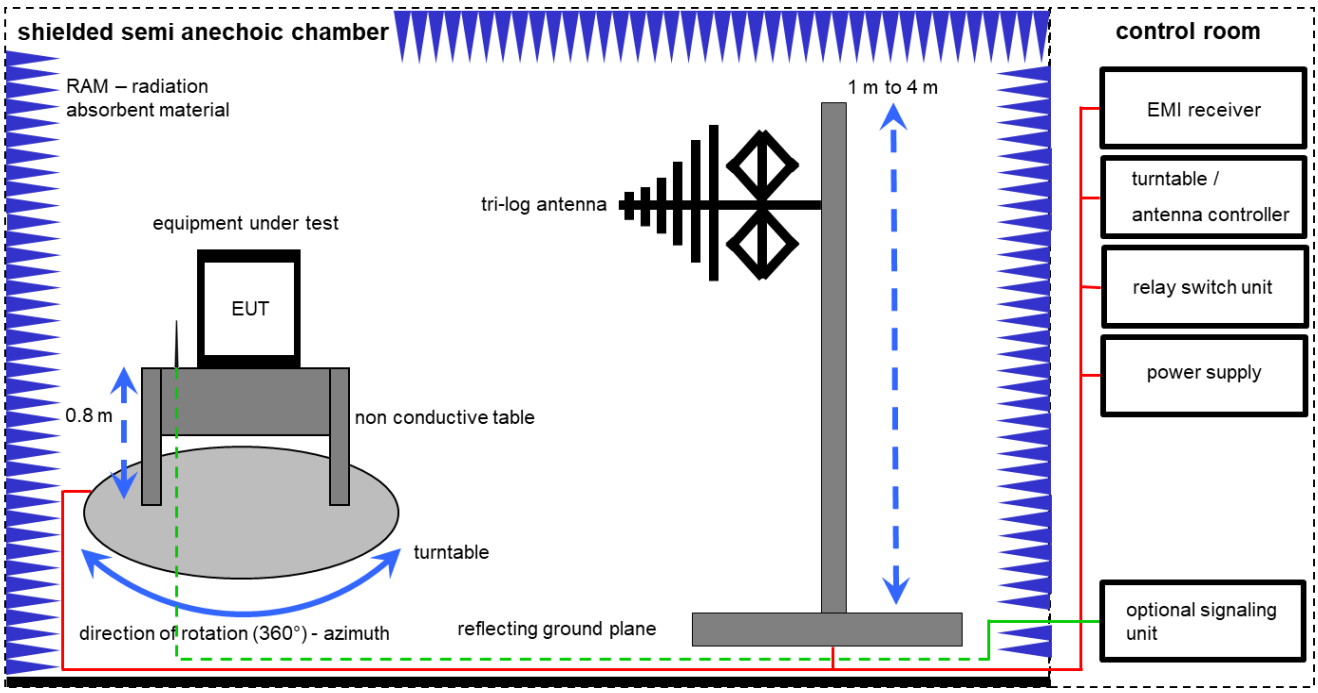
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

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

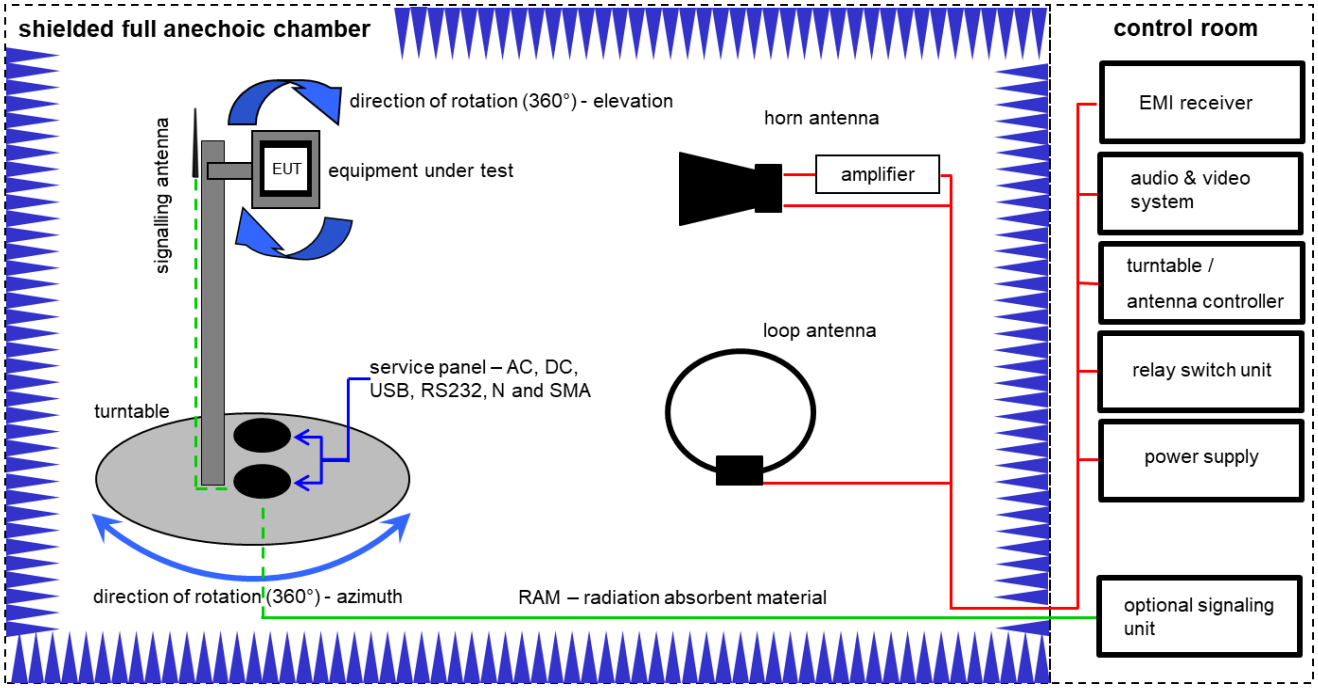
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
4	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
5	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	216	300003288	vIKI!	31.08.2023	31.08.2025
7	A	Turntable	2089-4.0	EMCO	-/-	300004394	ne	-/-	-/-
8	A	PC	TecLine	F+W	-/-	300004388	ne	-/-	-/-
9	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	06.12.2023	31.12.2024
10	A	Wideband radio communication tester	CMW500	Rohde & Schwarz	166977	300005718	k	13.12.2023	31.12.2025

7.2 Shielded fully anechoic chamber



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

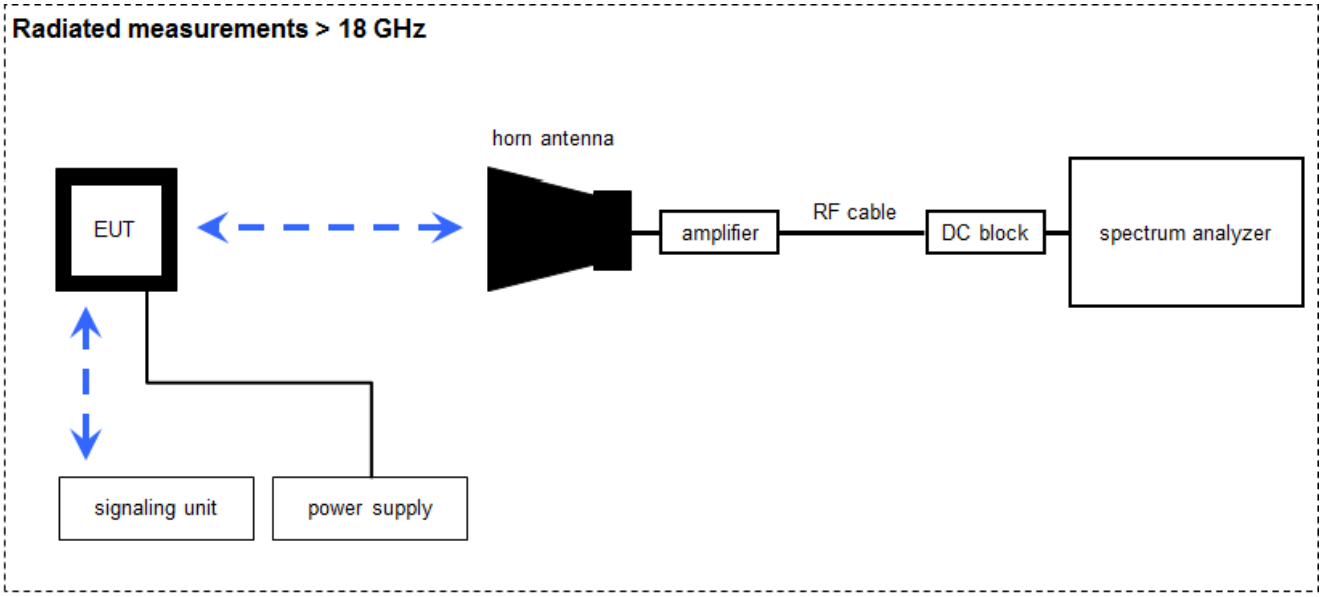
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

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
1	A, B	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vIKI!	05.12.2023	31.12.2026
2	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vIKI!	02.08.2023	31.08.2025
3	A, B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
4	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vIKI!	11.02.2022	29.02.2024
	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3696	300001604	vIKI!	20.03.2023	19.03.2025
5	B	Band Reject filter	WRCG1850/1910-1835/1925-40/8SS	Wainwright	7	300003350	ev	-/-	-/-
6	A, B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2023	31.12.2024
7	B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
8	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
9	B	High Pass Filter	VHF-3500+	Mini Circuits	-/-	400000193	ne	-/-	-/-
10	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
11	A, B	Wideband radio communication tester	CMW500	Rohde & Schwarz	166977	300005718	k	13.12.2023	31.12.2025

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)

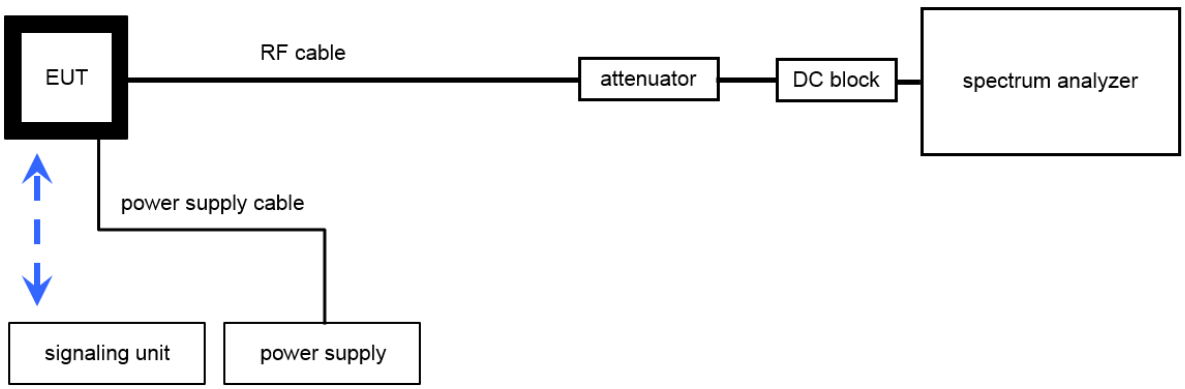
Example calculation:
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

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	166977	300005718	k	13.12.2023	31.12.2025
2	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vIKI!	24.01.2024	23.01.2026
3	A	Broadband LNA 18-50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	09.03.2022 12.04.2022	08.03.2024 21.02.2024
4	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	06.12.2023	31.12.2024
5	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-

7.4 Conducted measurements

Conducted measurements normal conditions



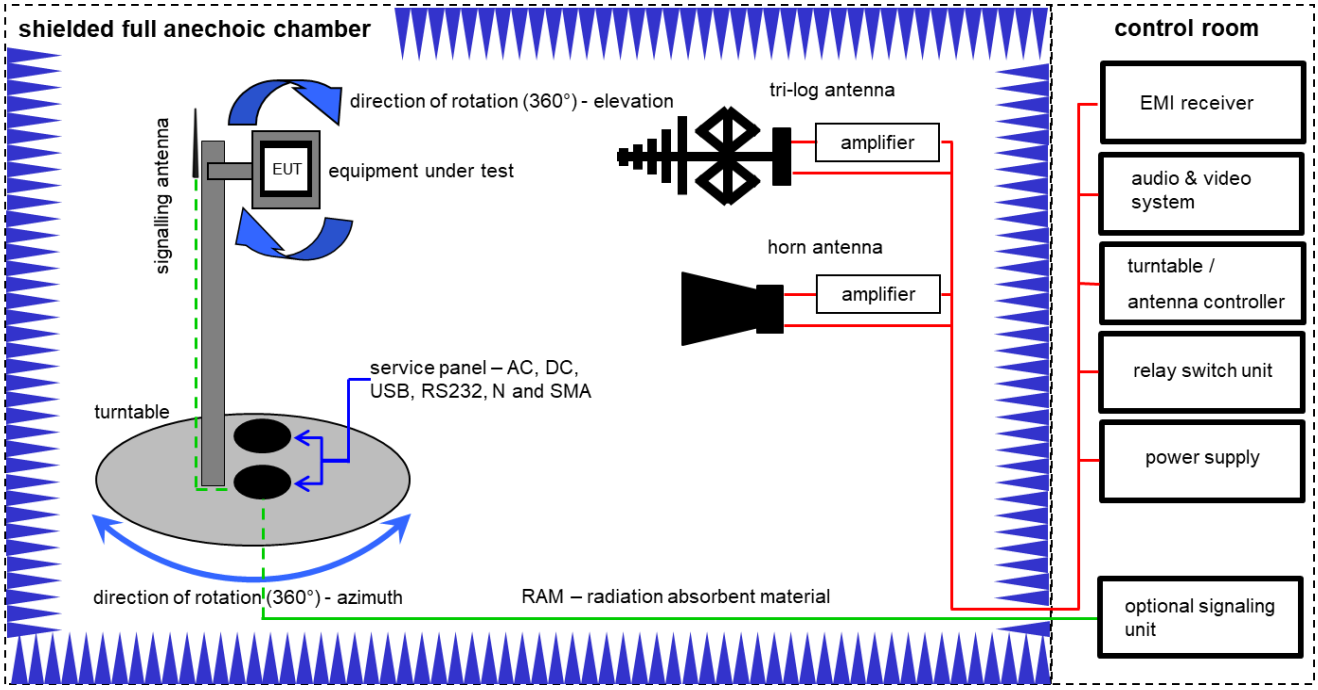
OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

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	166977	300005718	k	13.12.2023	31.12.2025

7.5 Shielded fully anechoic chamber (antenna gain tests)



Measurement distance: tri-log antenna and horn antenna 3 meter

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

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [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	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
2	A	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
3	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3696	300001604	vIKI!	20.03.2023	19.03.2025
4	A	EMI Test Receiver 20Hz-26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2023	31.12.2024
5	A	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
6	A	NEXIO EMV-Software	BAT EMC V2022.0.32.0	Nexio	-/-	300004682	ne	-/-	-/-
7	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	01029	300005379	vIKI!	09.10.2023	31.10.2025
8	A	Signal generator	SMB100A	Rohde&Schwarz	1406.6000k03/180587	300005462	vIKI!	12.12.2023	31.12.2026

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**
RF output power conducted	± 1 dB
RF output power radiated	± 3 dB
Frequency stability	± 20 Hz
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
Spurious emissions conducted	± 3 dB
Block edge compliance	± 3 dB
Occupied bandwidth	± RBW

10 Summary of measurement results LTE band 25

☐	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.

10.1 LTE – Band 25

TC identifier	Description	verdict	date	Remark
RF-Testing	CFR Part 24	See table	2024-05-03	Delta tests according to manufacturer demand!

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	Conducted power only
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 RF measurements LTE band 25

11.1 Description of test setup

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

11.2 Results

11.2.1 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	Measured with CMW500
Sweep time	
Video bandwidth	
Resolution bandwidth	
Span	
Trace mode	
Setup	See chapter 7.4 – A
Measurement uncertainty	See chapter 9

Limits:

FCC
Nominal Peak Output Power
+33.00 dBm 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.

Results:

Output Power (conducted)						
Bandwidth (MHz)	**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	1850.7	1 RB low	22.37	-/-	21.45	-/-
		1 RB high	22.5	-/-	21.44	-/-
		50% RB mid	22.57	-/-	21.84	-/-
		100% RB	21.47	-/-	20.67	-/-
	1880.0	1 RB low	22.73	-/-	22.32	-/-
		1 RB high	22.72	-/-	22.3	-/-
		50% RB mid	22.89	-/-	22.06	-/-
		100% RB	21.86	-/-	20.72	-/-
	1914.3	1 RB low	23.29	-/-	22.83	-/-
		1 RB high	23.22	-/-	22.28	-/-
		50% RB mid	23.49	-/-	23	-/-
		100% RB	22.28	-/-	21.27	-/-
3	1851.5	1 RB low	22.43	-/-	21.39	-/-
		1 RB high	22.53	-/-	21.48	-/-
		50% RB mid	21.59	-/-	20.43	-/-
		100% RB	21.55	-/-	20.6	-/-
	1880.0	1 RB low	22.81	-/-	22.32	-/-
		1 RB high	22.76	-/-	22.31	-/-
		50% RB mid	21.80	-/-	20.77	-/-
		100% RB	21.86	-/-	20.86	-/-
	1913.5	1 RB low	23.40	-/-	22.88	-/-
		1 RB high	23.25	-/-	22.1	-/-
		50% RB mid	22.42	-/-	21.51	-/-
		100% RB	22.47	-/-	21.45	-/-
5	1852.5	1 RB low	22.28	-/-	21.51	-/-
		1 RB high	22.59	-/-	21.72	-/-
		50% RB mid	21.59	-/-	20.73	-/-
		100% RB	21.54	-/-	20.55	-/-
	1880.0	1 RB low	22.64	-/-	22.23	-/-
		1 RB high	22.69	-/-	22.35	-/-
		50% RB mid	21.84	-/-	20.9	-/-
		100% RB	21.93	-/-	21.08	-/-
	1912.5	1 RB low	23.23	-/-	22.9	-/-
		1 RB high	23.26	-/-	22.45	-/-
		50% RB mid	22.45	-/-	21.61	-/-
		100% RB	22.44	-/-	21.59	-/-

10	1855	1 RB low	22.43	-/-	21.27	-/-
		1 RB high	22.71	-/-	21.80	-/-
		50% RB mid	21.70	-/-	20.74	-/-
		100% RB	21.73	-/-	20.82	-/-
	1880	1 RB low	22.84	-/-	22.31	-/-
		1 RB high	22.79	-/-	22.34	-/-
		50% RB mid	21.94	-/-	20.96	-/-
		100% RB	21.91	-/-	20.93	-/-
	1910	1 RB low	23.44	-/-	22.85	-/-
		1 RB high	23.25	-/-	22.19	-/-
		50% RB mid	22.46	-/-	21.60	-/-
		100% RB	22.55	-/-	21.64	-/-
15	1857.5	1 RB low	22.41	-/-	21.23	-/-
		1 RB high	22.82	-/-	22.10	-/-
		50% RB mid	21.82	-/-	20.89	-/-
		100% RB	21.82	-/-	20.84	-/-
	1880.0	1 RB low	22.96	-/-	22.32	-/-
		1 RB high	22.81	-/-	22.35	-/-
		50% RB mid	21.95	-/-	20.91	-/-
		100% RB	21.90	-/-	20.87	-/-
	1907.5	1 RB low	23.29	-/-	22.73	-/-
		1 RB high	23.31	-/-	22.21	-/-
		50% RB mid	22.53	-/-	21.43	-/-
		100% RB	22.60	-/-	21.55	-/-
20	1860	1 RB low	22.17	-/-	21.84	-/-
		1 RB high	22.80	-/-	22.30	-/-
		50% RB mid	21.99	-/-	20.96	-/-
		100% RB	21.94	-/-	20.97	-/-
	1880	1 RB low	22.73	-/-	22.23	-/-
		1 RB high	22.79	-/-	22.42	-/-
		50% RB mid	21.85	-/-	20.90	-/-
		100% RB	22.04	-/-	21.11	-/-
	1905	1 RB low	22.92	-/-	22.46	-/-
		1 RB high	23.15	-/-	22.77	-/-
		50% RB mid	22.44	-/-	21.54	-/-
		100% RB	22.56	-/-	21.65	-/-

NOTE: All values are within the module maximum output power values range of 20.3 dBm to 24.0 dBm (extracted from module user manual).

11.2.2 Spurious emissions radiated (Taoglas Supercombo antenna)

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 1914.3 MHz. Measurement made up to 25 GHz. 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 II.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&B ; 7.3 - A
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)
-13 dBm

QPSK:

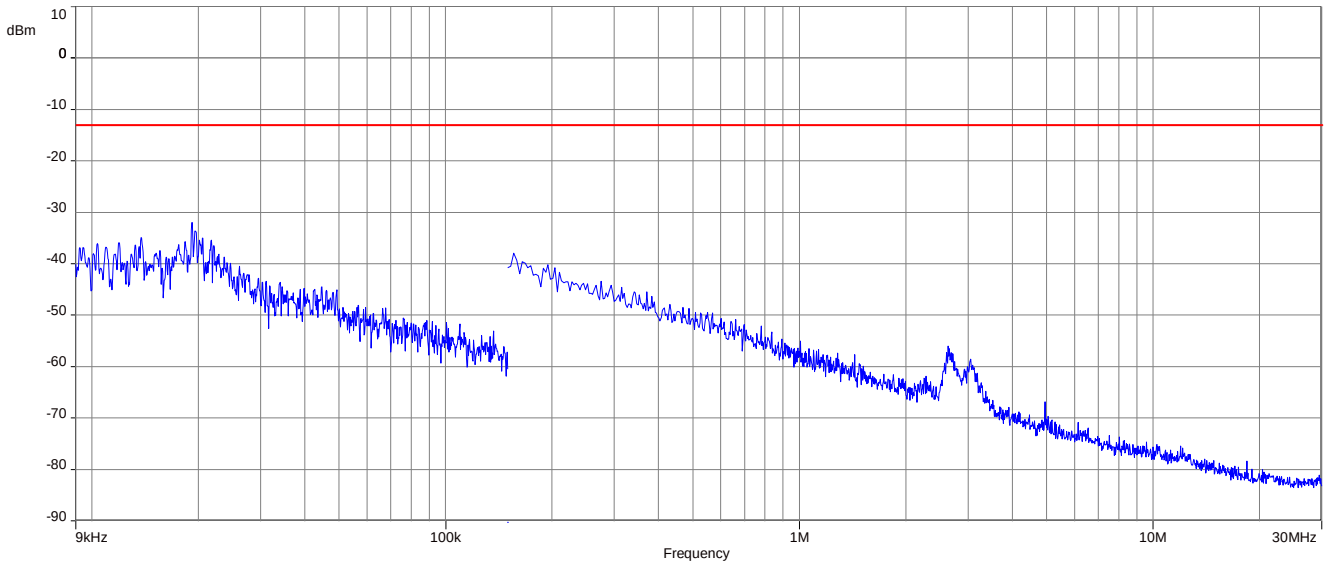
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	3710.0	All detected emissions are more than 20dB below the limit!	2	3760.0	All detected emissions are more than 20dB below the limit!	2	3810.0	All detected emissions are more than 20dB below the limit!
3	5565.0		3	5640.0		3	5715.0	
4	7420.0		4	7520.0		4	7620.0	
5	9275.0		5	9400.0		5	9525.0	
6	11130.0		6	11280.0		6	11430.0	
7	12985.0		7	13160.0		7	13335.0	
8	14840.0		8	15040.0		8	15240.0	
9	16695.0		9	16920.0		9	17145.0	
10	18550.0		10	18800.0		10	19050.0	

16-QAM:

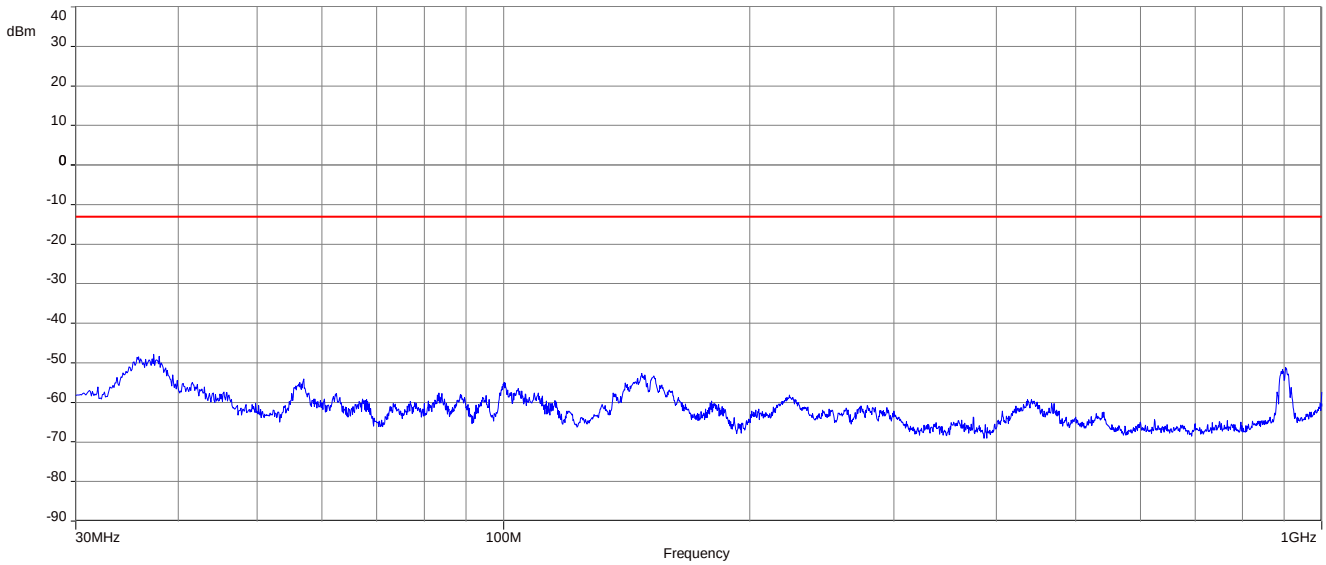
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	3710.0	All detected emissions are more than 20dB below the limit!	2	3760.0	All detected emissions are more than 20dB below the limit!	2	3810.0	All detected emissions are more than 20dB below the limit!
3	5565.0		3	5640.0		3	5715.0	
4	7420.0		4	7520.0		4	7620.0	
5	9275.0		5	9400.0		5	9525.0	
6	11130.0		6	11280.0		6	11430.0	
7	12985.0		7	13160.0		7	13335.0	
8	14840.0		8	15040.0		8	15240.0	
9	16695.0		9	16920.0		9	17145.0	
10	18550.0		10	18800.0		10	19050.0	

Results: QPSK with 10 MHz channel bandwidth

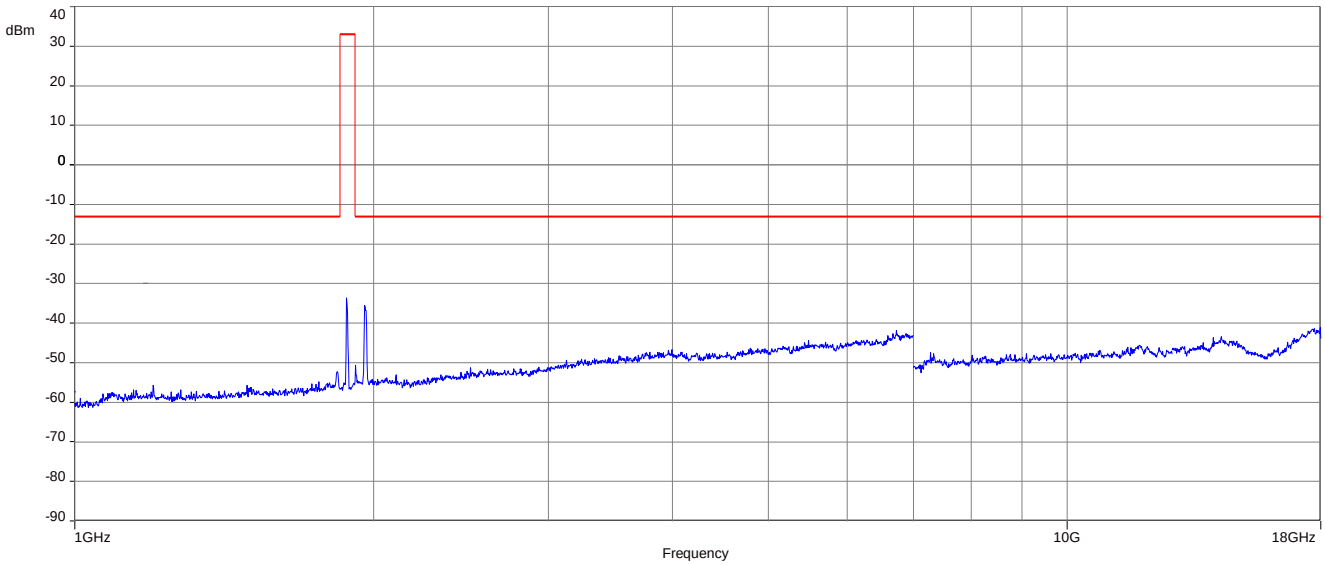
Plot 1: Channel 18900 (Traffic mode up to 30 MHz)



Plot 2: Channel 18900 (30 MHz – 1 GHz)

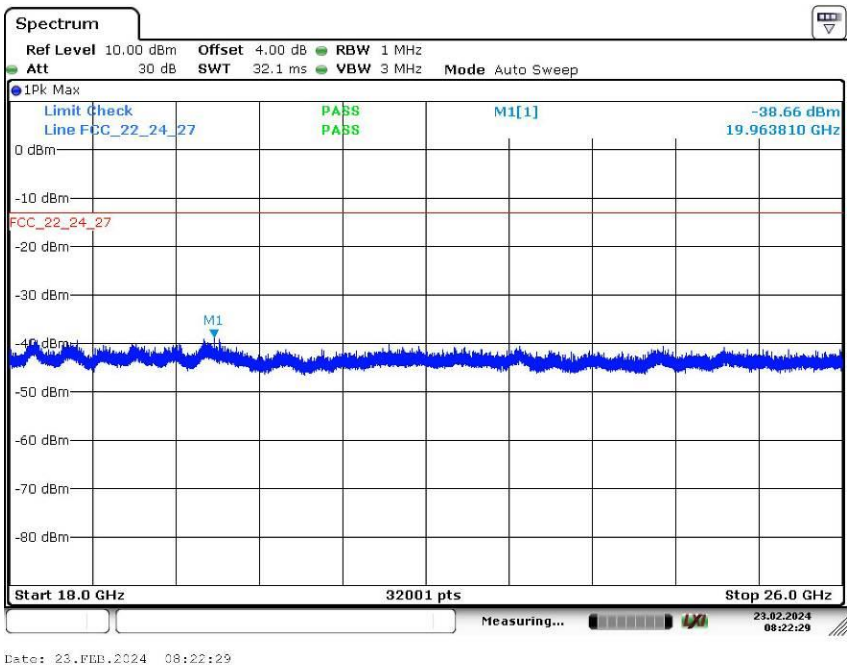


Plot 3: Channel 18900 (1 GHz – 18 GHz)



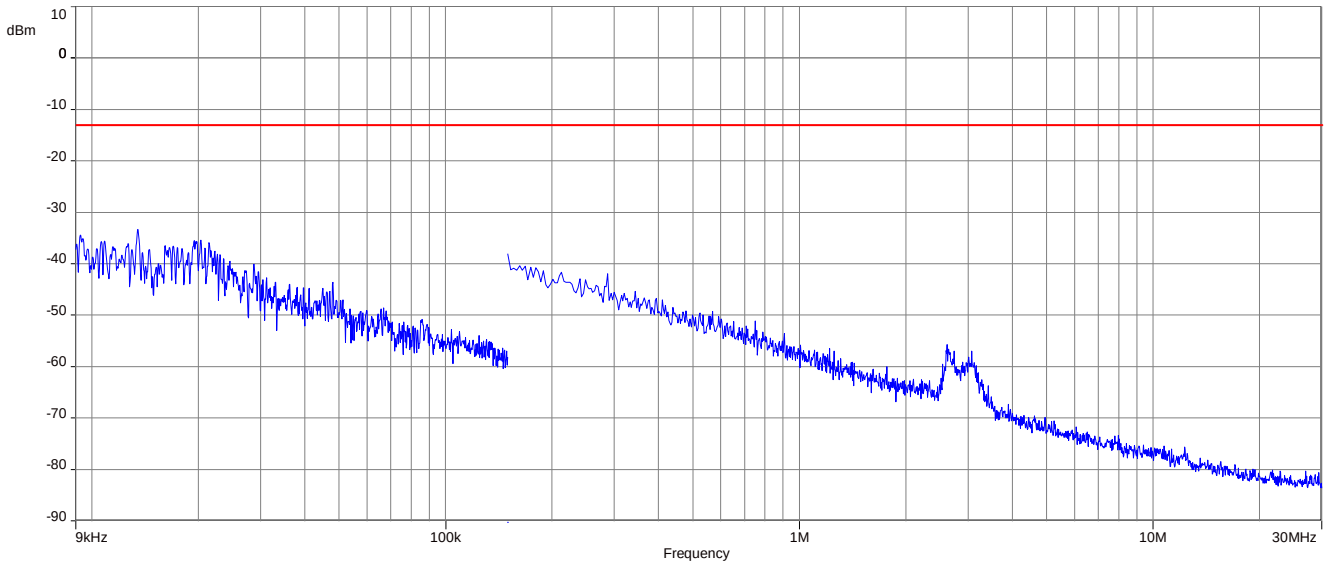
Carrier notch ed with 1.9 GHz rejection filter

Plot 4: Channel 18900 (18 GHz – 26 GHz)

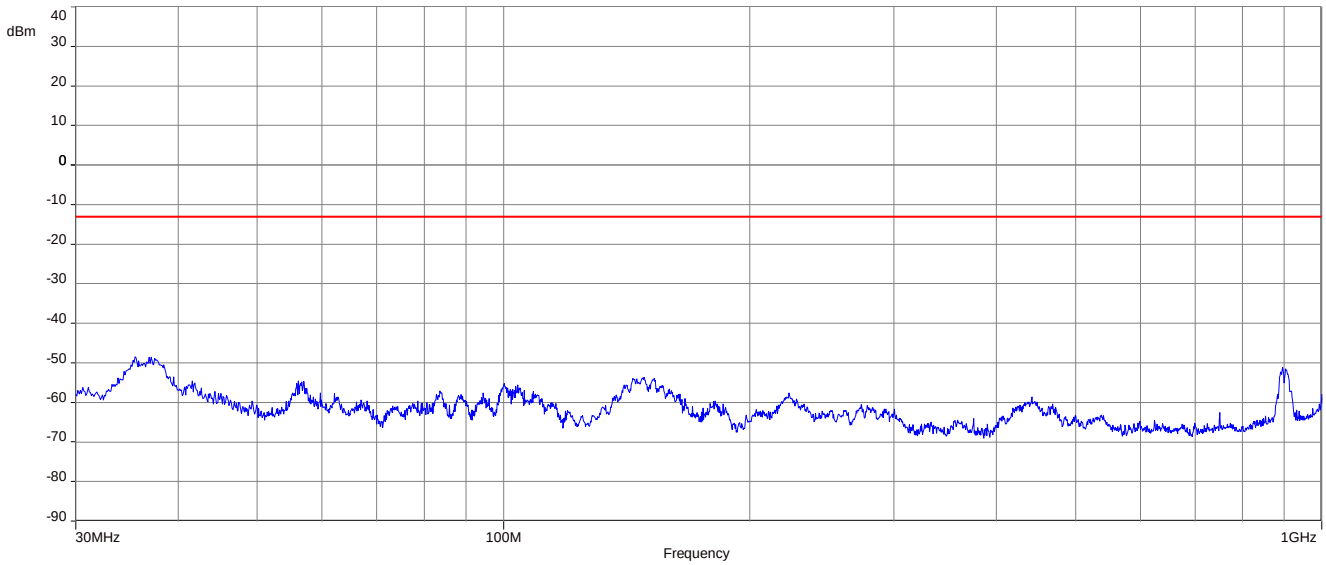


Results: 16-QAM with 10 MHz channel bandwidth

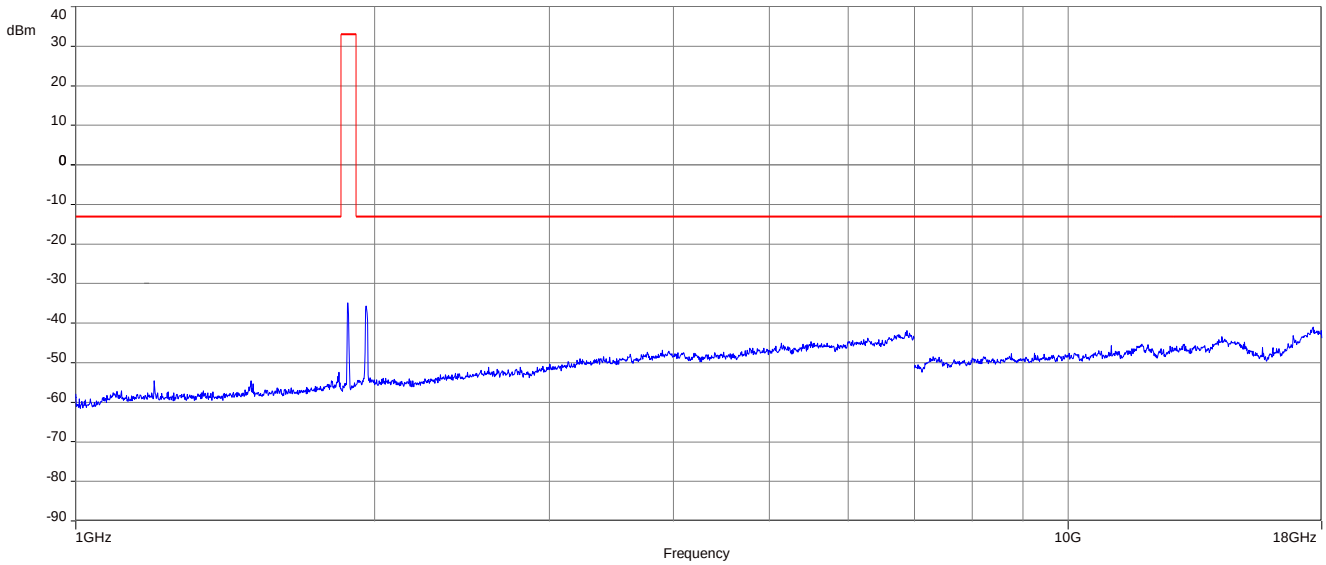
Plot 1: Channel 18900 (Traffic mode up to 30 MHz)



Plot 2: Channel 18900 (30 MHz – 1 GHz)

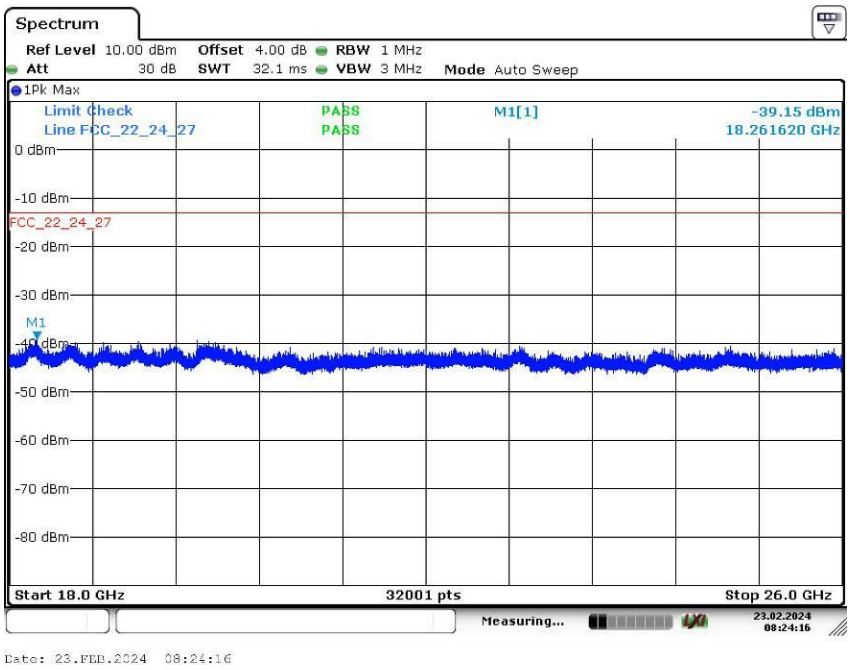


Plot 3: Channel 18900 (1 GHz – 18 GHz)



Carrier notched with 1.9 GHz rejection filter

Plot 4: Channel 18900 (18 GHz – 26 GHz)



11.2.3 Spurious emissions radiated (Taoglas Puck antenna)

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 1914.3 MHz. Measurement made up to 25 GHz. 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 II.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&B ; 7.3 - A
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)
-13 dBm

QPSK:

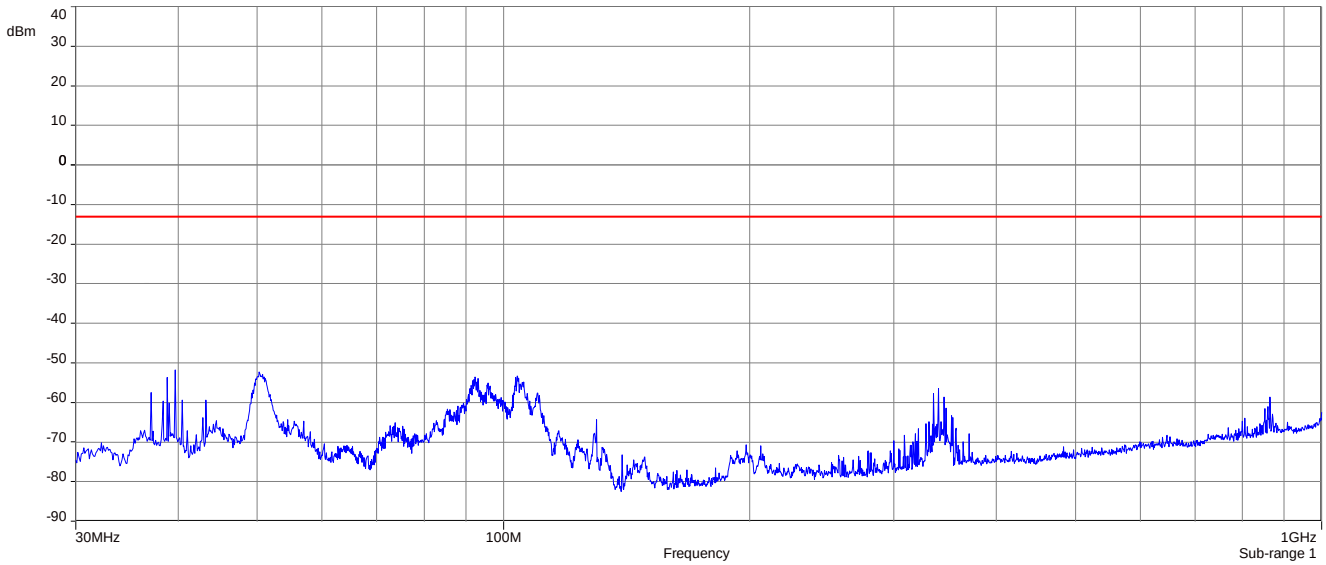
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	3710.0	All detected emissions are more than 20dB below the limit!	2	3760.0	All detected emissions are more than 20dB below the limit!	2	3810.0	All detected emissions are more than 20dB below the limit!
3	5565.0		3	5640.0		3	5715.0	
4	7420.0		4	7520.0		4	7620.0	
5	9275.0		5	9400.0		5	9525.0	
6	11130.0		6	11280.0		6	11430.0	
7	12985.0		7	13160.0		7	13335.0	
8	14840.0		8	15040.0		8	15240.0	
9	16695.0		9	16920.0		9	17145.0	
10	18550.0		10	18800.0		10	19050.0	

16-QAM:

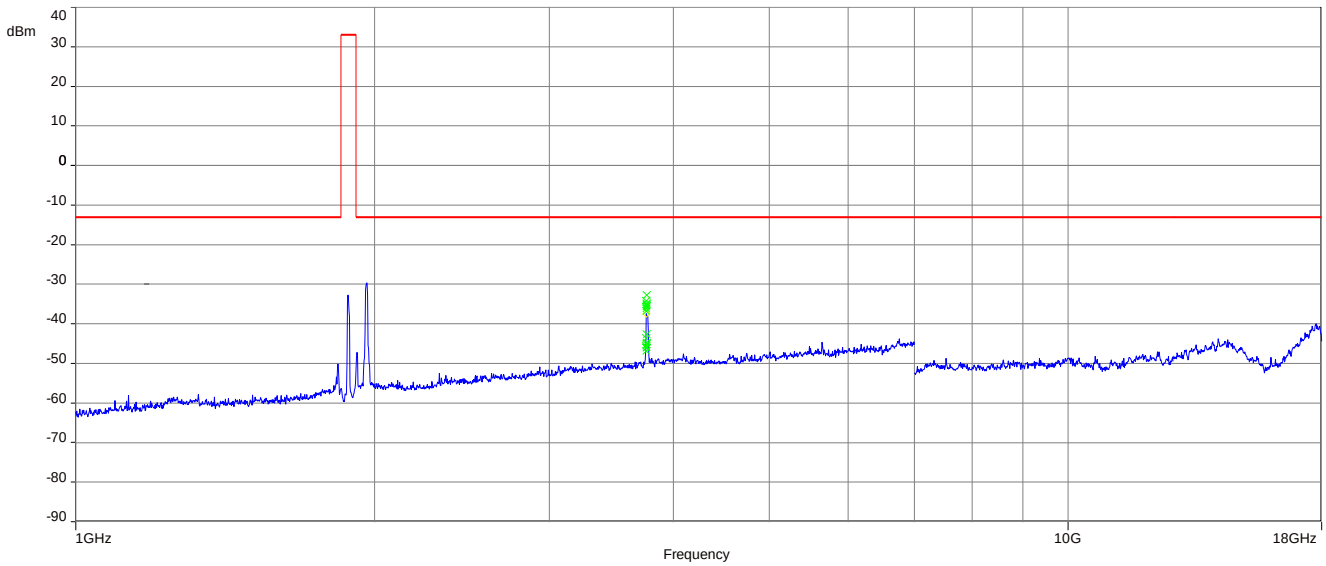
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	3710.0	All detected emissions are more than 20dB below the limit!	2	3760.0	All detected emissions are more than 20dB below the limit!	2	3810.0	All detected emissions are more than 20dB below the limit!
3	5565.0		3	5640.0		3	5715.0	
4	7420.0		4	7520.0		4	7620.0	
5	9275.0		5	9400.0		5	9525.0	
6	11130.0		6	11280.0		6	11430.0	
7	12985.0		7	13160.0		7	13335.0	
8	14840.0		8	15040.0		8	15240.0	
9	16695.0		9	16920.0		9	17145.0	
10	18550.0		10	18800.0		10	19050.0	

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Channel 18900 (30 MHz – 1 GHz)



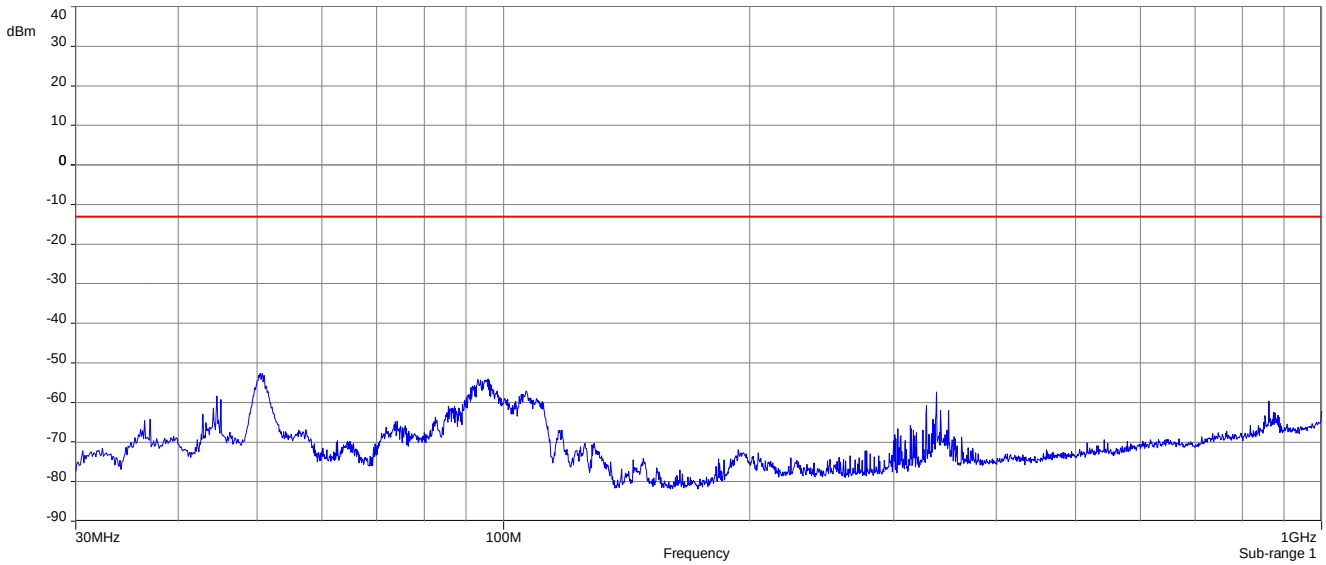
Plot 2: Channel 18900 (1 GHz – 18 GHz)



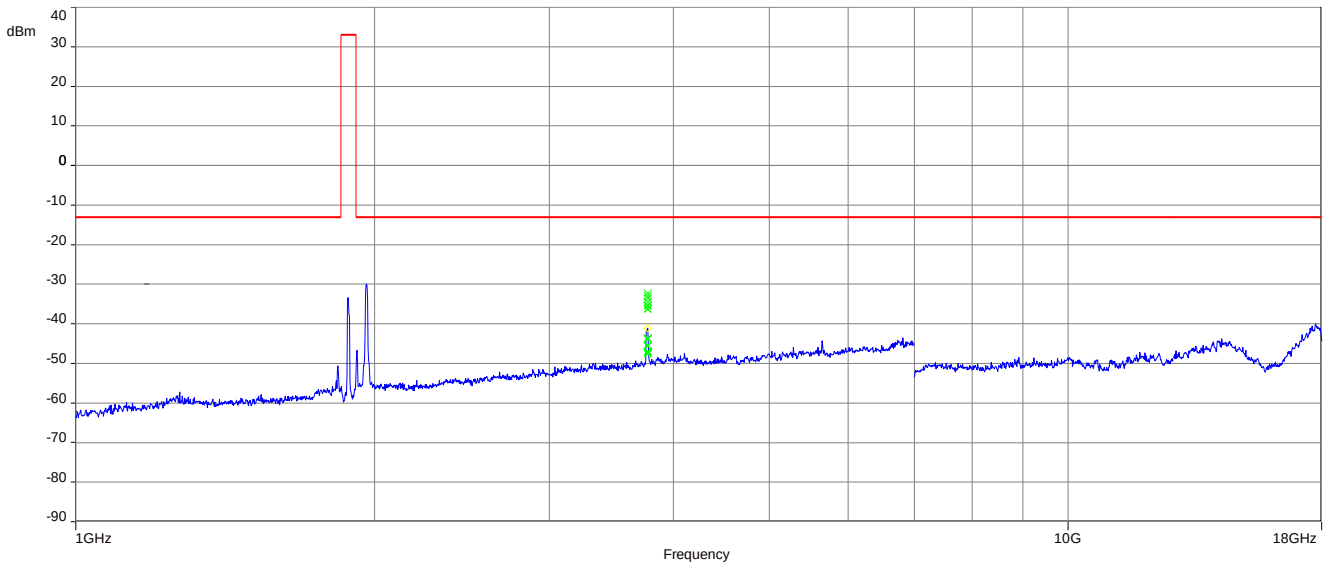
Carrier notch ed with 1.9 GHz rejection filter

Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Channel 18900 (30 MHz – 1 GHz)



Plot 2: Channel 18900 (1 GHz – 18 GHz)



Carrier notched with 1.9 GHz rejection filter

11.2.4 Spurious emissions radiated (Candy bar antenna)

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 1914.3 MHz. Measurement made up to 25 GHz. 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 II.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&B ; 7.3 - A
Measurement uncertainty	See chapter 9

Limits:

ISED
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)
-13 dBm

QPSK:

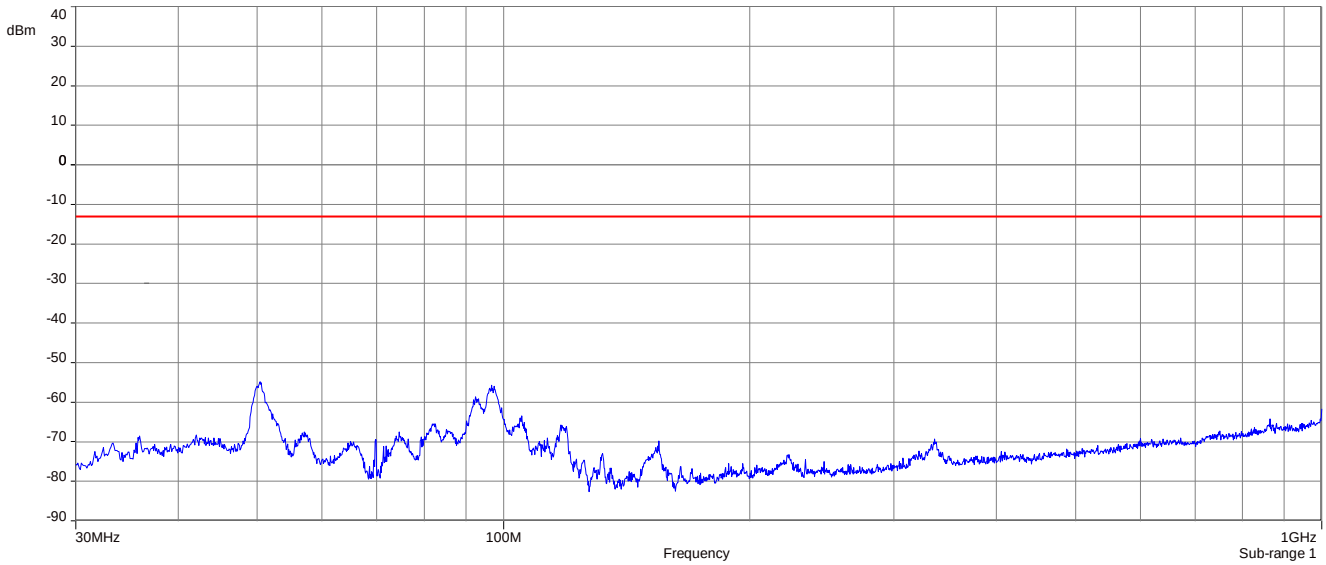
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	3710.0	All detected emissions are more than 20dB below the limit!	2	3760.0	All detected emissions are more than 20dB below the limit!	2	3810.0	All detected emissions are more than 20dB below the limit!
3	5565.0		3	5640.0		3	5715.0	
4	7420.0		4	7520.0		4	7620.0	
5	9275.0		5	9400.0		5	9525.0	
6	11130.0		6	11280.0		6	11430.0	
7	12985.0		7	13160.0		7	13335.0	
8	14840.0		8	15040.0		8	15240.0	
9	16695.0		9	16920.0		9	17145.0	
10	18550.0		10	18800.0		10	19050.0	

16-QAM:

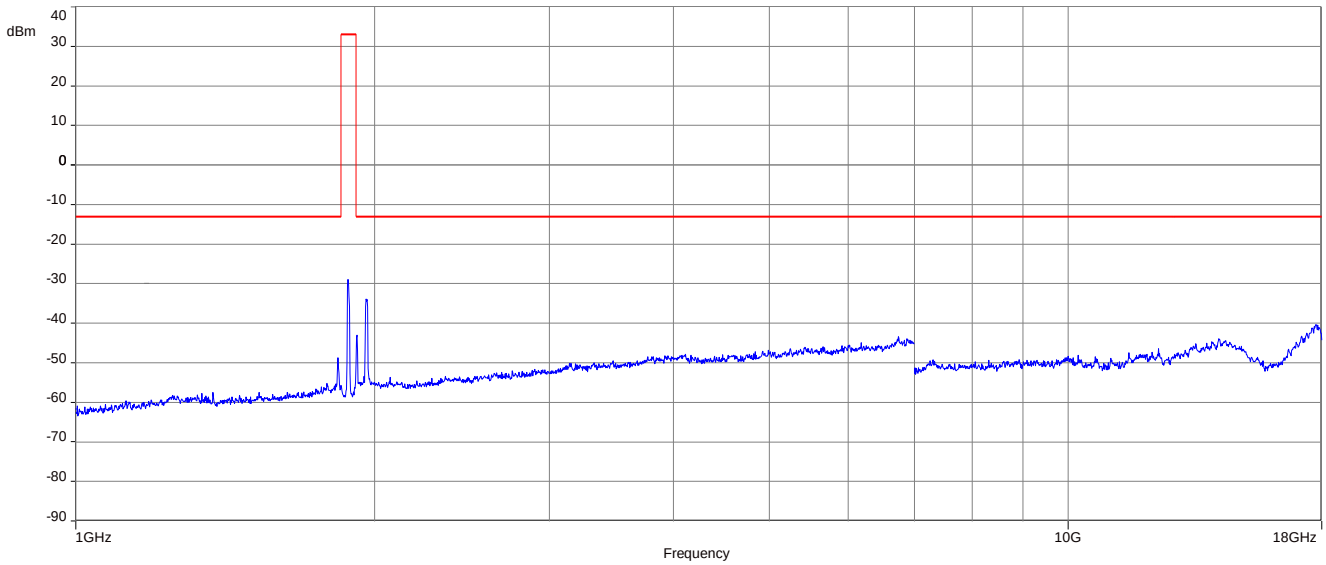
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	3710.0	All detected emissions are more than 20dB below the limit!	2	3760.0	All detected emissions are more than 20dB below the limit!	2	3810.0	All detected emissions are more than 20dB below the limit!
3	5565.0		3	5640.0		3	5715.0	
4	7420.0		4	7520.0		4	7620.0	
5	9275.0		5	9400.0		5	9525.0	
6	11130.0		6	11280.0		6	11430.0	
7	12985.0		7	13160.0		7	13335.0	
8	14840.0		8	15040.0		8	15240.0	
9	16695.0		9	16920.0		9	17145.0	
10	18550.0		10	18800.0		10	19050.0	

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Channel 18900 (30 MHz – 1 GHz)



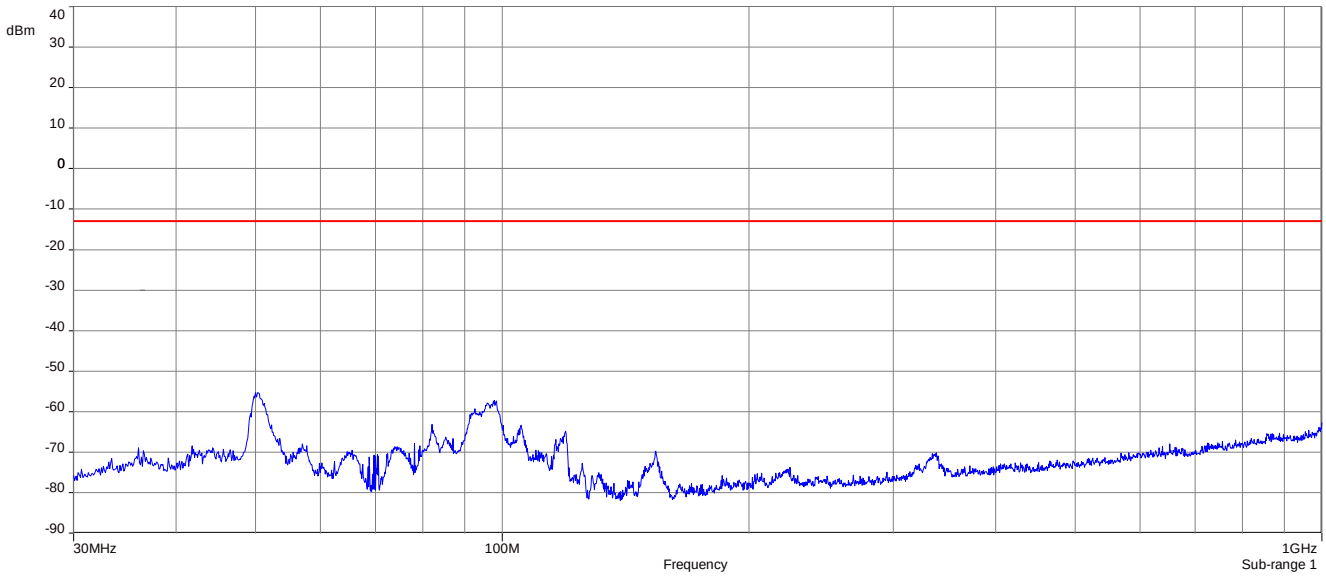
Plot 2: Channel 18900 (1 GHz – 18 GHz)



Carrier notch ed with 1.9 GHz rejection filter

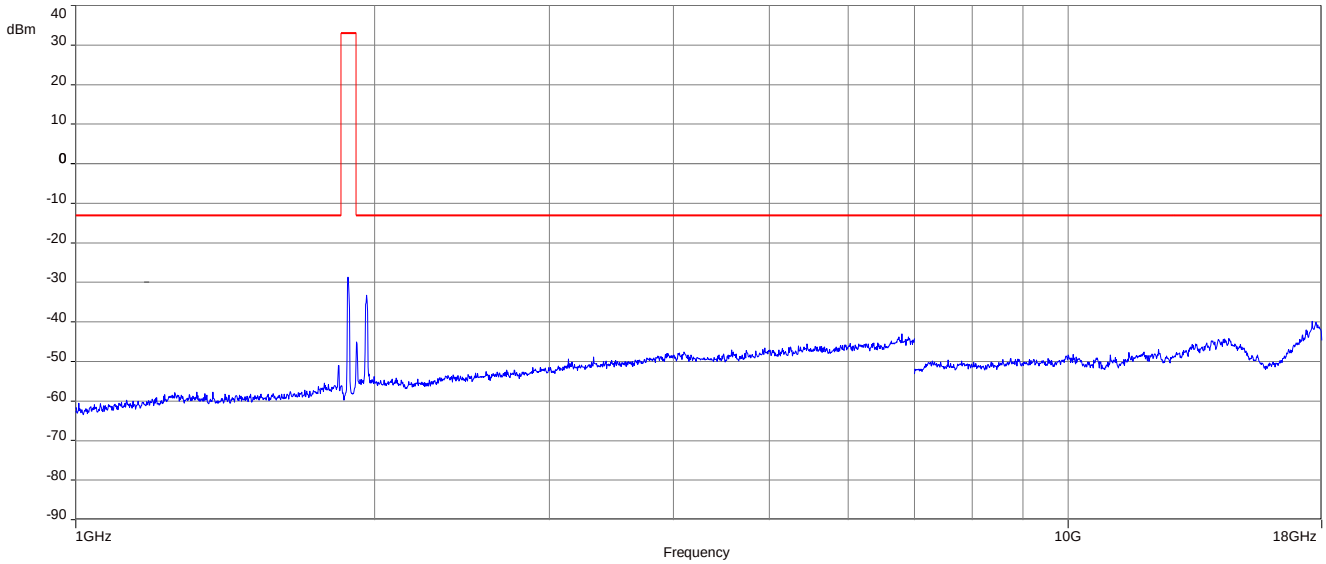
Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Channel 18900 (30 MHz – 1 GHz)



V

Plot 2: Channel 18900 (1 GHz – 18 GHz)



Carrier notched with 1.9 GHz rejection filter

12 Summary of measurement results LTE band 26

☐	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.

12.1 LTE – Band 26

TC identifier	Description	verdict	date	Remark
RF-Testing	CFR Part 22; Part 90	See table	2024-05-03	Delta tests according to manufacturer demand!

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	Conducted power only
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 RF measurements LTE band 26

13.1 Description of test setup

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

13.2 Results

The EUT was set to transmit the maximum power.

13.2.1 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	Measured with CMW500
Sweep time	
Video bandwidth	
Resolution bandwidth	
Span	
Trace mode	
Setup	See chapter 7.4 – A
Measurement uncertainty	See chapter 9

Limits:

FCC
Nominal Peak Output Power
+38.45 dBm 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.

Results:

Output Power (conducted)						
Bandwidth (MHz)	**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	814.7	1 RB low	23.75	-/-	22.7	-/-
		1 RB high	23.85	-/-	22.77	-/-
		50% RB mid	23.9	-/-	23.08	-/-
		100% RB	22.91	-/-	21.98	-/-
	831.5	1 RB low	23.82	-/-	23.36	-/-
		1 RB high	23.90	-/-	23.33	-/-
		50% RB mid	24.00	-/-	23.03	-/-
		100% RB	22.89	-/-	21.88	-/-
	848.3	1 RB low	23.66	-/-	23.12	-/-
		1 RB high	23.59	-/-	22.61	-/-
		50% RB mid	23.8	-/-	23.26	-/-
		100% RB	22.74	-/-	21.66	-/-
3	815.5	1 RB low	23.84	-/-	22.65	-/-
		1 RB high	23.73	-/-	22.79	-/-
		50% RB mid	22.97	-/-	21.66	-/-
		100% RB	22.88	-/-	21.87	-/-
	831.5	1 RB low	23.99	-/-	23.33	-/-
		1 RB high	23.89	-/-	23.37	-/-
		50% RB mid	22.97	-/-	21.84	-/-
		100% RB	23.00	-/-	21.93	-/-
	847.5	1 RB low	23.73	-/-	23.10	-/-
		1 RB high	23.73	-/-	22.47	-/-
		50% RB mid	22.82	-/-	21.95	-/-
		100% RB	22.70	-/-	21.79	-/-
5	816.5	1 RB low	23.67	-/-	22.99	-/-
		1 RB high	23.80	-/-	22.97	-/-
		50% RB mid	22.84	-/-	21.99	-/-
		100% RB	22.88	-/-	21.67	-/-
	831.5	1 RB low	23.81	-/-	23.27	-/-
		1 RB high	23.82	-/-	23.41	-/-
		50% RB mid	22.99	-/-	22.00	-/-
		100% RB	22.93	-/-	22.11	-/-
	846.5	1 RB low	23.49	-/-	23.02	-/-
		1 RB high	23.63	-/-	22.82	-/-
		50% RB mid	22.77	-/-	21.98	-/-
		100% RB	22.87	-/-	21.93	-/-

10	819	1 RB low	23.74	-/-	22.65	-/-
		1 RB high	23.82	-/-	22.81	-/-
		50% RB mid	22.86	-/-	22.00	-/-
		100% RB	22.97	-/-	21.87	-/-
	831.5	1 RB low	24.00	-/-	23.36	-/-
		1 RB high	23.89	-/-	23.32	-/-
		50% RB mid	23.00	-/-	22.02	-/-
		100% RB	23.03	-/-	22.07	-/-
	844	1 RB low	23.79	-/-	23.21	-/-
		1 RB high	23.61	-/-	22.44	-/-
		50% RB mid	22.82	-/-	21.89	-/-
		100% RB	22.85	-/-	21.84	-/-
15	821.5	1 RB low	23.80	-/-	22.56	-/-
		1 RB high	23.79	-/-	22.97	-/-
		50% RB mid	22.99	-/-	22.04	-/-
		100% RB	22.86	-/-	21.85	-/-
	831.5	1 RB low	23.93	-/-	23.27	-/-
		1 RB high	23.80	-/-	23.27	-/-
		50% RB mid	22.98	-/-	22.00	-/-
		100% RB	23.00	-/-	22.03	-/-
	844	1 RB low	23.72	-/-	23.25	-/-
		1 RB high	23.73	-/-	22.43	-/-
		50% RB mid	22.78	-/-	21.82	-/-
		100% RB	22.79	-/-	21.82	-/-

NOTE: All values are within the module maximum output power values range of 20.3 dBm to 24.0 dBm (extracted from module user manual).

13.2.2 Spurious emissions radiated (Taoglas Supercombo antenna)

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 848,3 MHz. Measurement made up to 12.75 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 V.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&C
Measurement uncertainty	See chapter 9

Limits:

FCC	
Spurious Emissions Radiated	
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)	
-13 dBm	

QPSK:

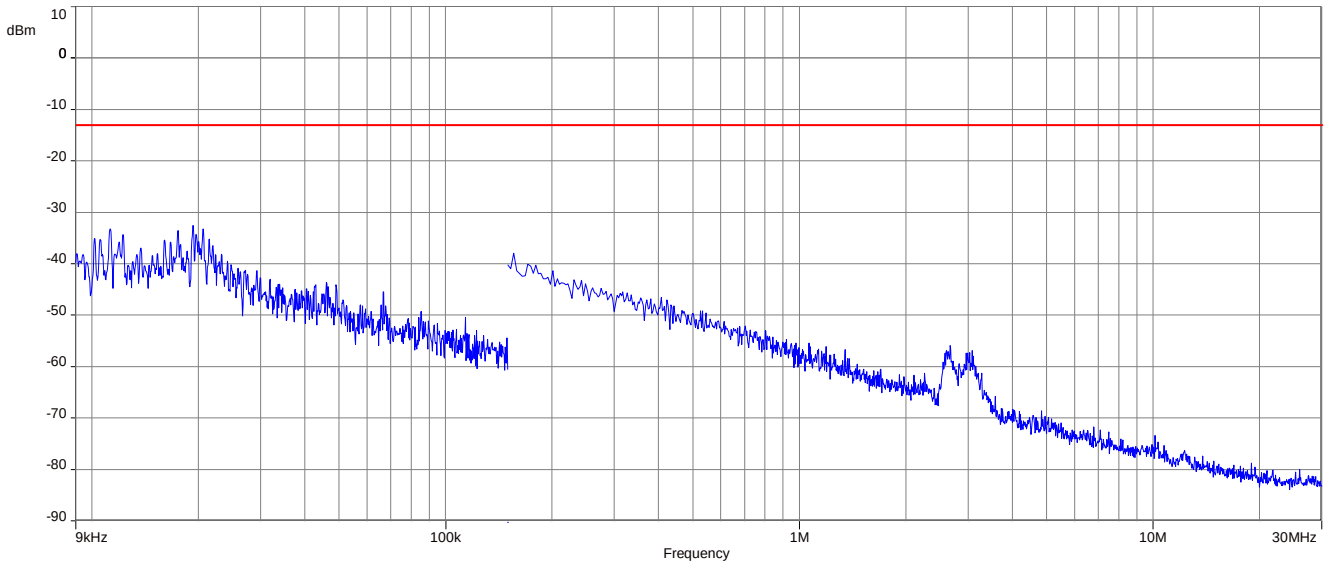
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	All detected emissions are more than 20dB below the limit!	2	1673.0	All detected emissions are more than 20dB below the limit!	2	1688.0	All detected emissions are more than 20dB below the limit!
3	2487.0		3	2509.5		3	2532.0	
4	3316.0		4	3346.0		4	3376.0	
5	4145.0		5	4182.5		5	4220.0	
6	4974.0		6	5019.0		6	5064.0	
7	5803.0		7	5855.5		7	5908.0	
8	6632.0		8	6692.0		8	6752.0	
9	7461.0		9	7528.5		9	7596.0	
10	8290.0		10	8365.0		10	8440.0	

16-QAM:

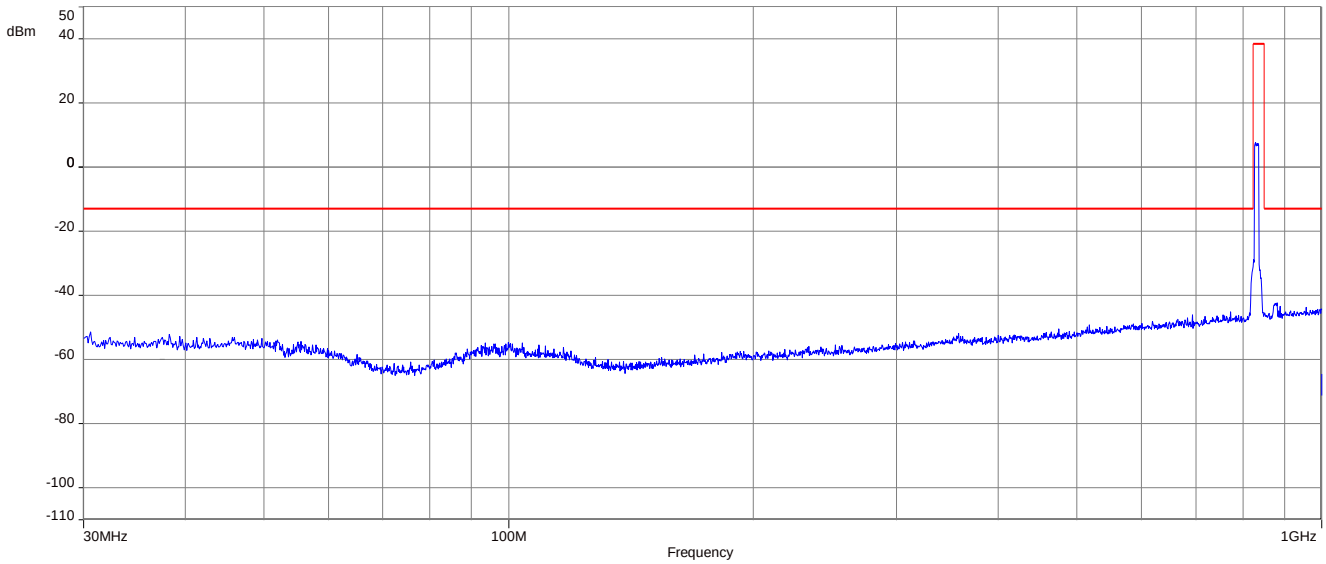
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	All detected emissions are more than 20dB below the limit!	2	1673.0	All detected emissions are more than 20dB below the limit!	2	1688.0	All detected emissions are more than 20dB below the limit!
3	2487.0		3	2509.5		3	2532.0	
4	3316.0		4	3346.0		4	3376.0	
5	4145.0		5	4182.5		5	4220.0	
6	4974.0		6	5019.0		6	5064.0	
7	5803.0		7	5855.5		7	5908.0	
8	6632.0		8	6692.0		8	6752.0	
9	7461.0		9	7528.5		9	7596.0	
10	8290.0		10	8365.0		10	8440.0	

Results: QPSK with 10 MHz channel bandwidth

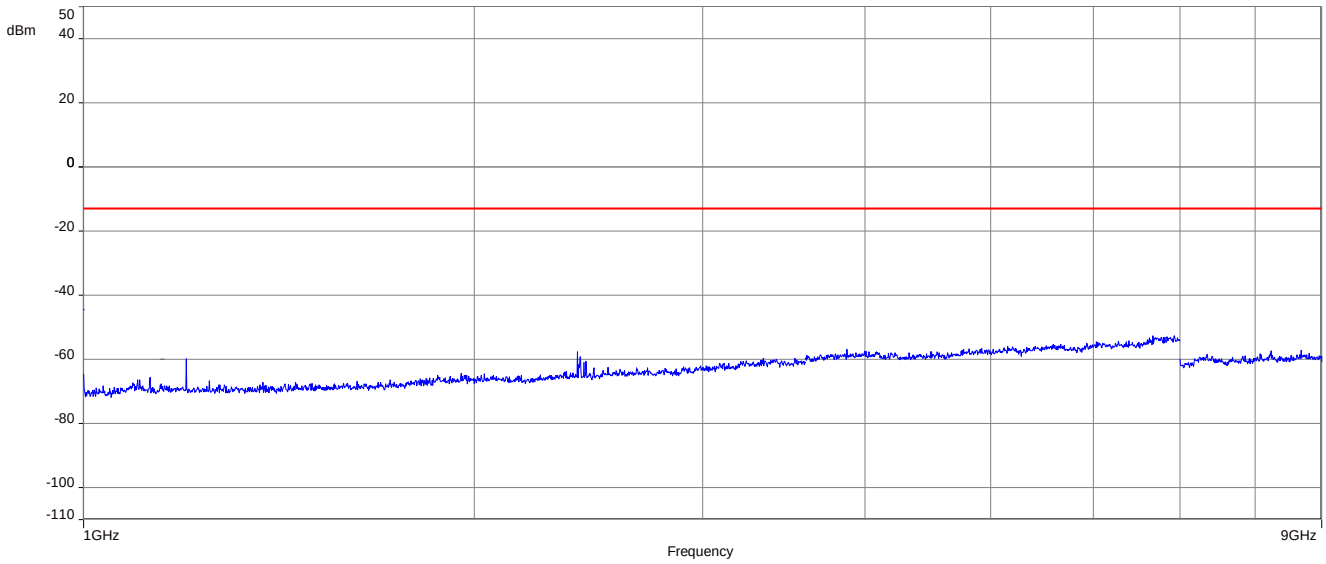
Plot 1: Channel 20525 (Traffic mode up to 30 MHz)



Plot 2: Channel 20525 (30 MHz – 1 GHz)

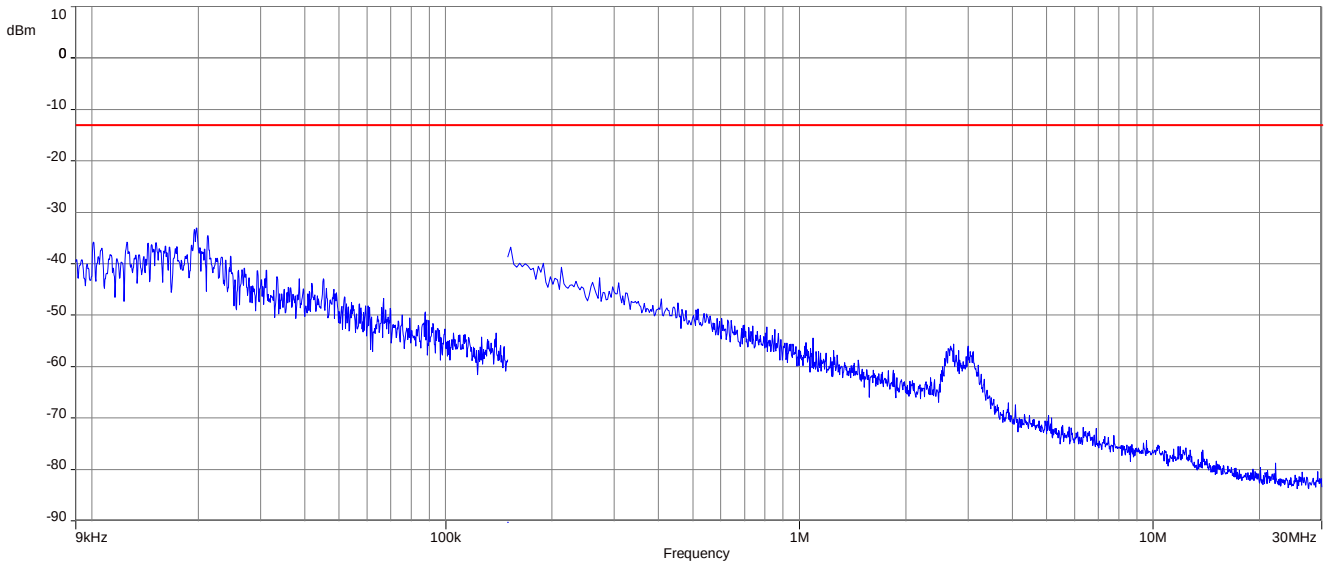


Plot 3: Channel 20525 (1 GHz – 9 GHz)

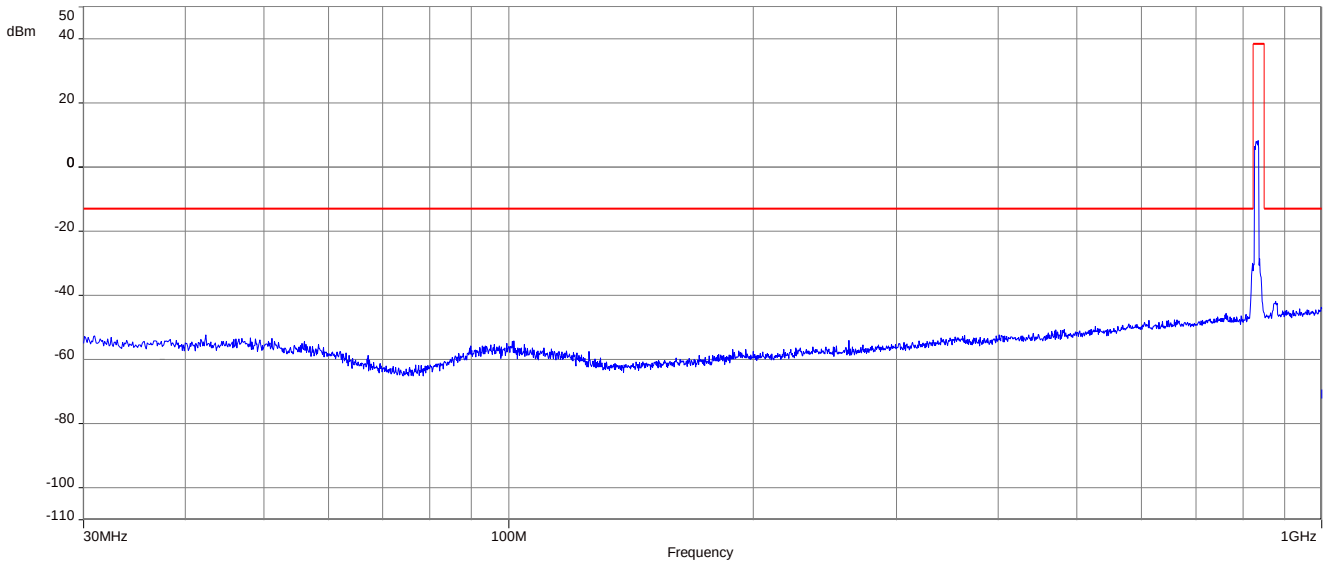


Results: 16-QAM with 10 MHz channel bandwidth

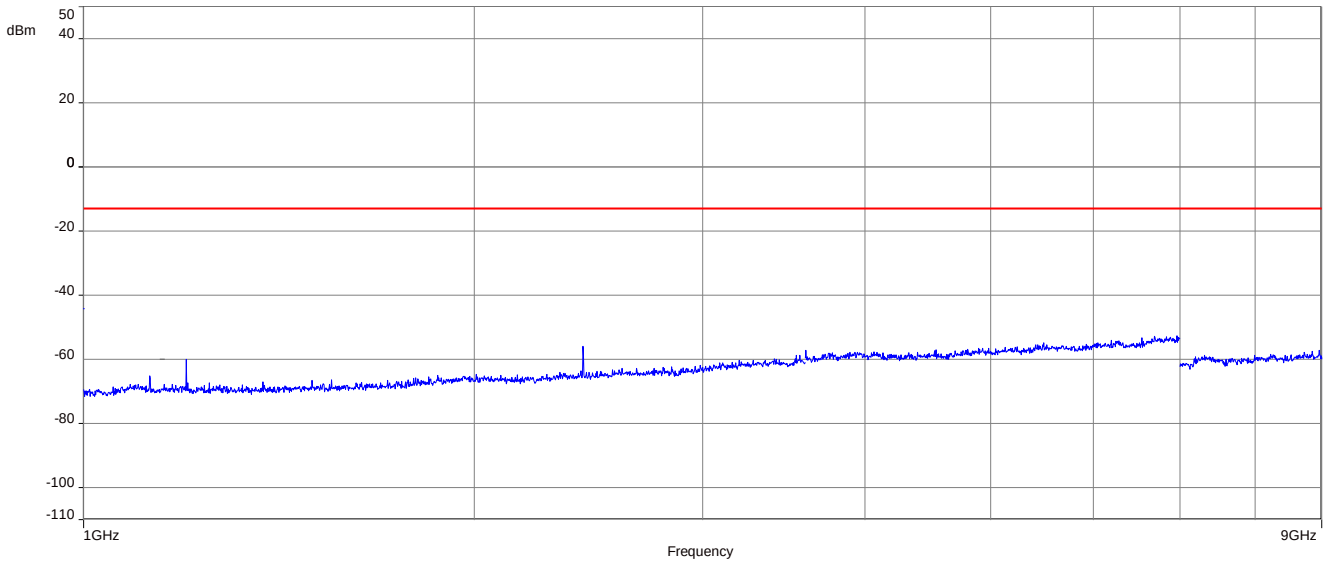
Plot 1: Channel 20525 (Traffic mode up to 30 MHz)



Plot 2: Channel 20525 (30 MHz – 1 GHz)



Plot 3: Channel 20525 (1 GHz – 9 GHz)



13.2.3 Spurious emissions radiated (Taoglas Puck antenna)

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 848,3 MHz. Measurement made up to 12.75 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 V.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&C
Measurement uncertainty	See chapter 9

Limits:

FCC	
Spurious Emissions Radiated	
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)	
-13 dBm	

QPSK:

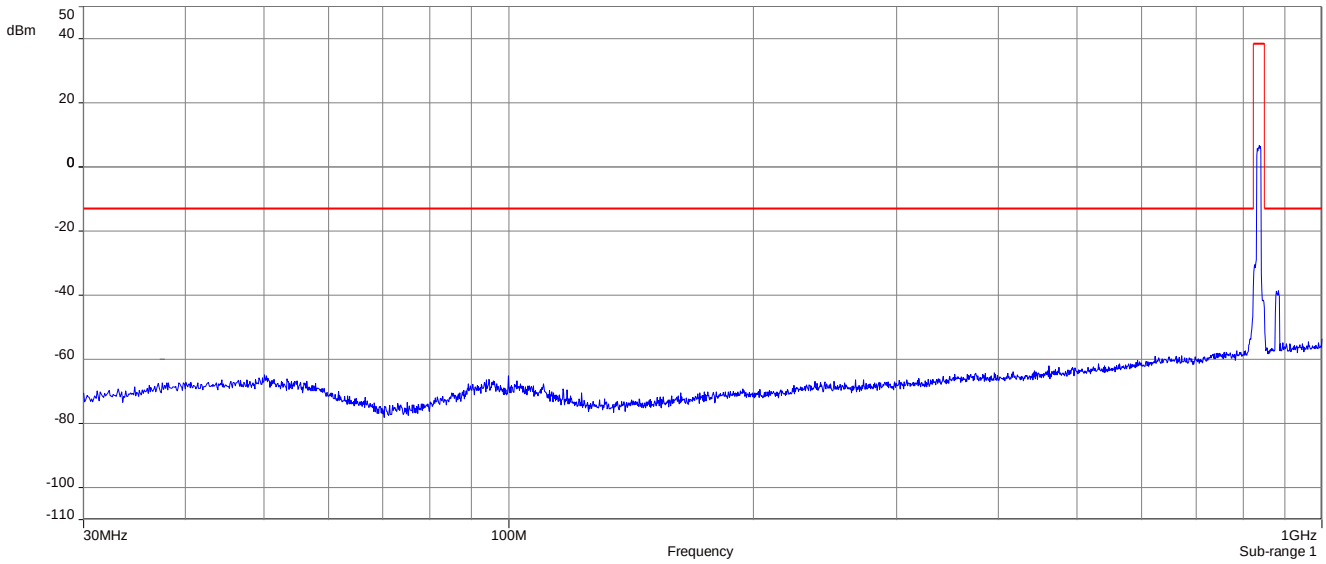
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	All detected emissions are more than 20dB below the limit!	2	1673.0	All detected emissions are more than 20dB below the limit!	2	1688.0	All detected emissions are more than 20dB below the limit!
3	2487.0		3	2509.5		3	2532.0	
4	3316.0		4	3346.0		4	3376.0	
5	4145.0		5	4182.5		5	4220.0	
6	4974.0		6	5019.0		6	5064.0	
7	5803.0		7	5855.5		7	5908.0	
8	6632.0		8	6692.0		8	6752.0	
9	7461.0		9	7528.5		9	7596.0	
10	8290.0		10	8365.0		10	8440.0	

16-QAM:

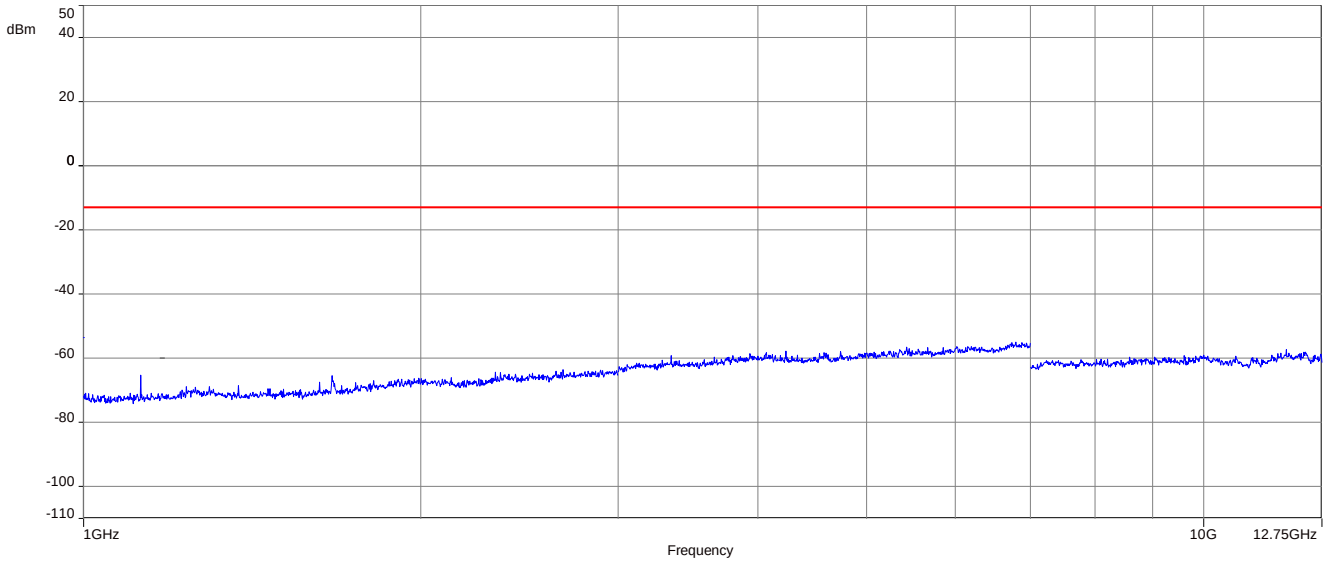
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	All detected emissions are more than 20dB below the limit!	2	1673.0	All detected emissions are more than 20dB below the limit!	2	1688.0	All detected emissions are more than 20dB below the limit!
3	2487.0		3	2509.5		3	2532.0	
4	3316.0		4	3346.0		4	3376.0	
5	4145.0		5	4182.5		5	4220.0	
6	4974.0		6	5019.0		6	5064.0	
7	5803.0		7	5855.5		7	5908.0	
8	6632.0		8	6692.0		8	6752.0	
9	7461.0		9	7528.5		9	7596.0	
10	8290.0		10	8365.0		10	8440.0	

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Channel 20525 (30 MHz – 1 GHz)

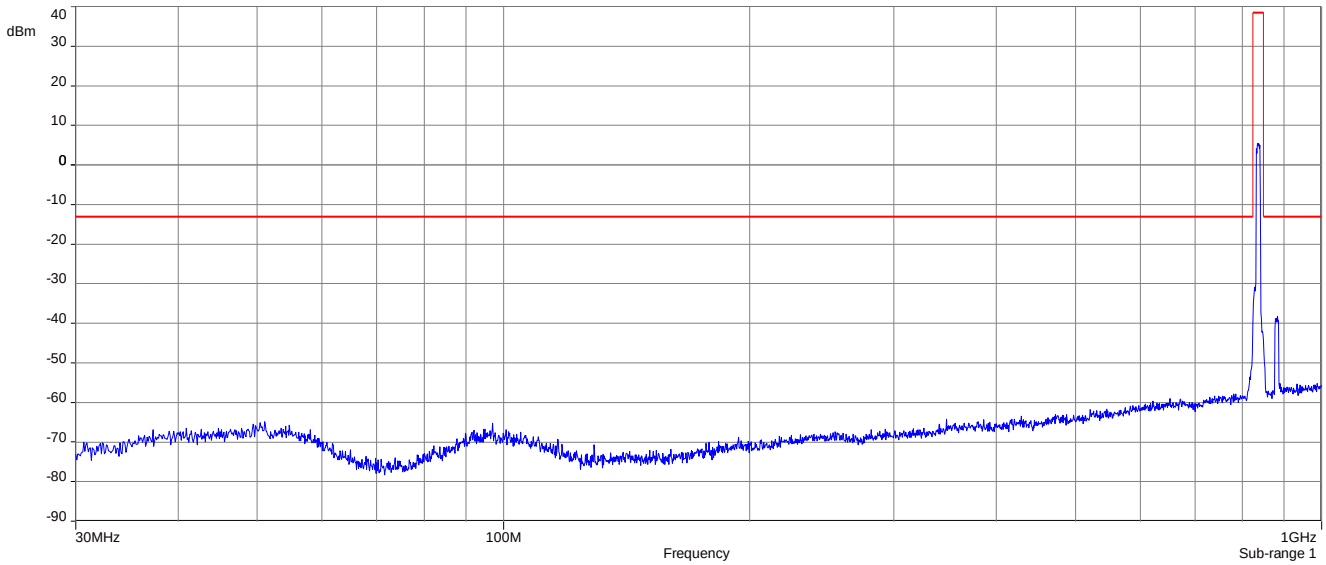


Plot 2: Channel 20525 (1 GHz – 9 GHz)

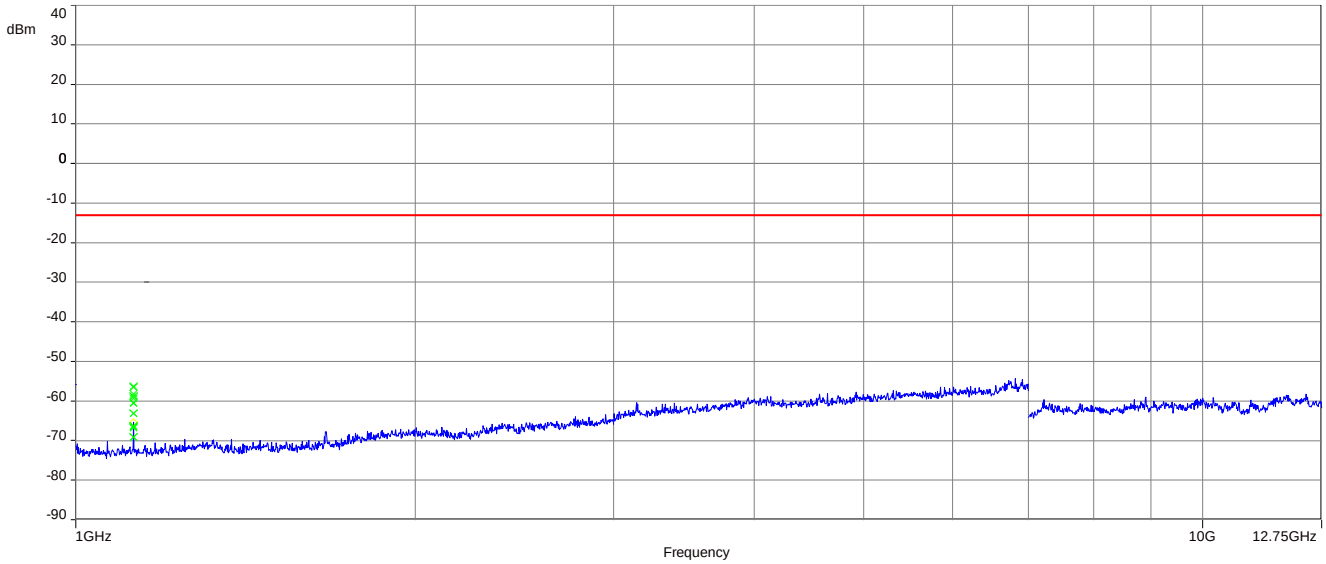


Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Channel 20525 (30 MHz – 1 GHz)



Plot 2: Channel 20525 (1 GHz – 9 GHz)



13.2.4 Spurious emissions radiated (Candy bar antenna)

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 848,3 MHz. Measurement made up to 12.75 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 V.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&C
Measurement uncertainty	See chapter 9

Limits:

FCC	
Spurious Emissions Radiated	
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)	
-13 dBm	

QPSK:

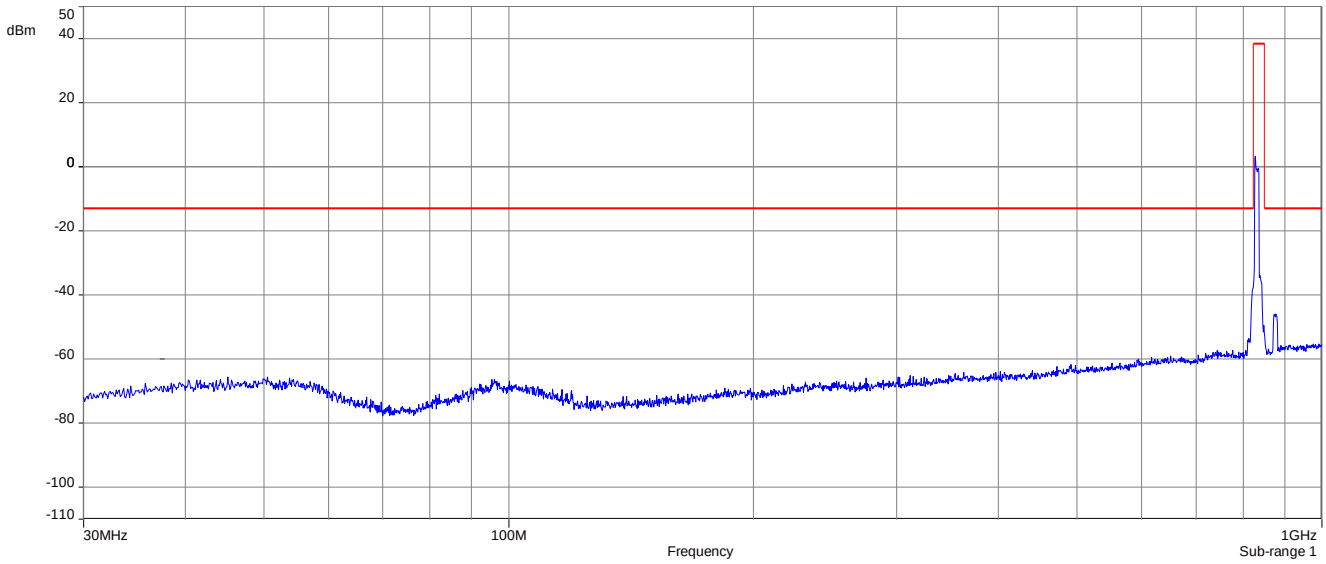
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	All detected emissions are more than 20dB below the limit!	2	1673.0	All detected emissions are more than 20dB below the limit!	2	1688.0	All detected emissions are more than 20dB below the limit!
3	2487.0		3	2509.5		3	2532.0	
4	3316.0		4	3346.0		4	3376.0	
5	4145.0		5	4182.5		5	4220.0	
6	4974.0		6	5019.0		6	5064.0	
7	5803.0		7	5855.5		7	5908.0	
8	6632.0		8	6692.0		8	6752.0	
9	7461.0		9	7528.5		9	7596.0	
10	8290.0		10	8365.0		10	8440.0	

16-QAM:

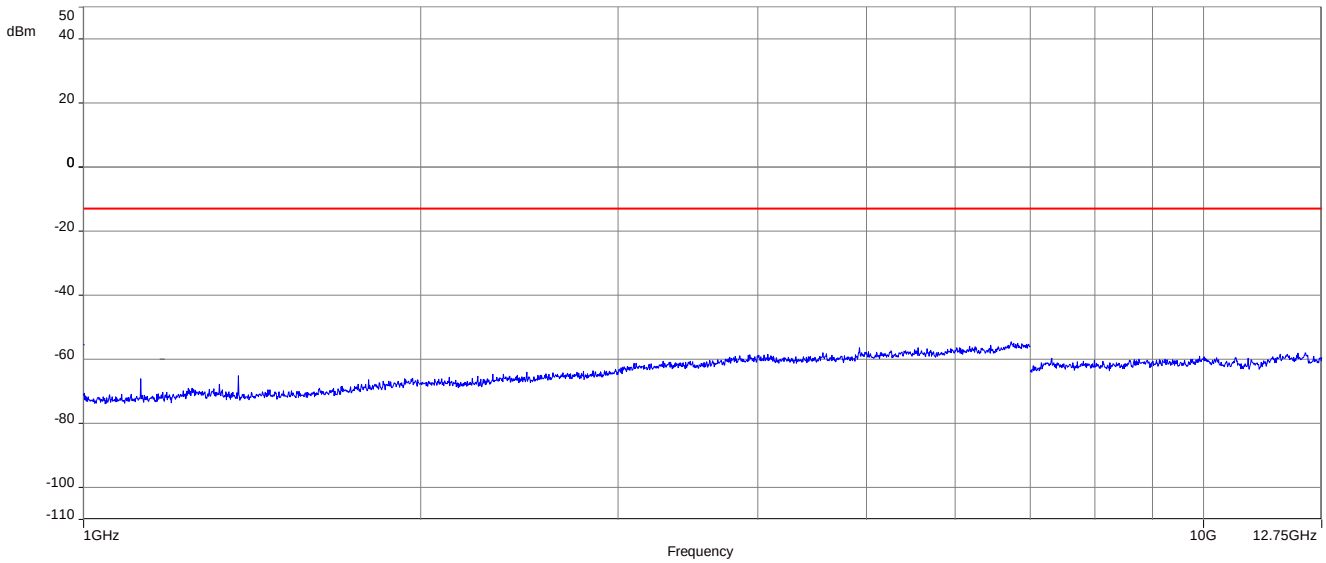
Spurious Emission Level (dBm)								
Harmonic	Lowest channel Freq. (MHz)	Level [dBm]	Harmonic	Middle channel Freq. (MHz)	Level [dBm]	Harmonic	Highest channel Freq. (MHz)	Level [dBm]
2	1658.0	All detected emissions are more than 20dB below the limit!	2	1673.0	All detected emissions are more than 20dB below the limit!	2	1688.0	All detected emissions are more than 20dB below the limit!
3	2487.0		3	2509.5		3	2532.0	
4	3316.0		4	3346.0		4	3376.0	
5	4145.0		5	4182.5		5	4220.0	
6	4974.0		6	5019.0		6	5064.0	
7	5803.0		7	5855.5		7	5908.0	
8	6632.0		8	6692.0		8	6752.0	
9	7461.0		9	7528.5		9	7596.0	
10	8290.0		10	8365.0		10	8440.0	

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Channel 20525 (30 MHz – 1 GHz)

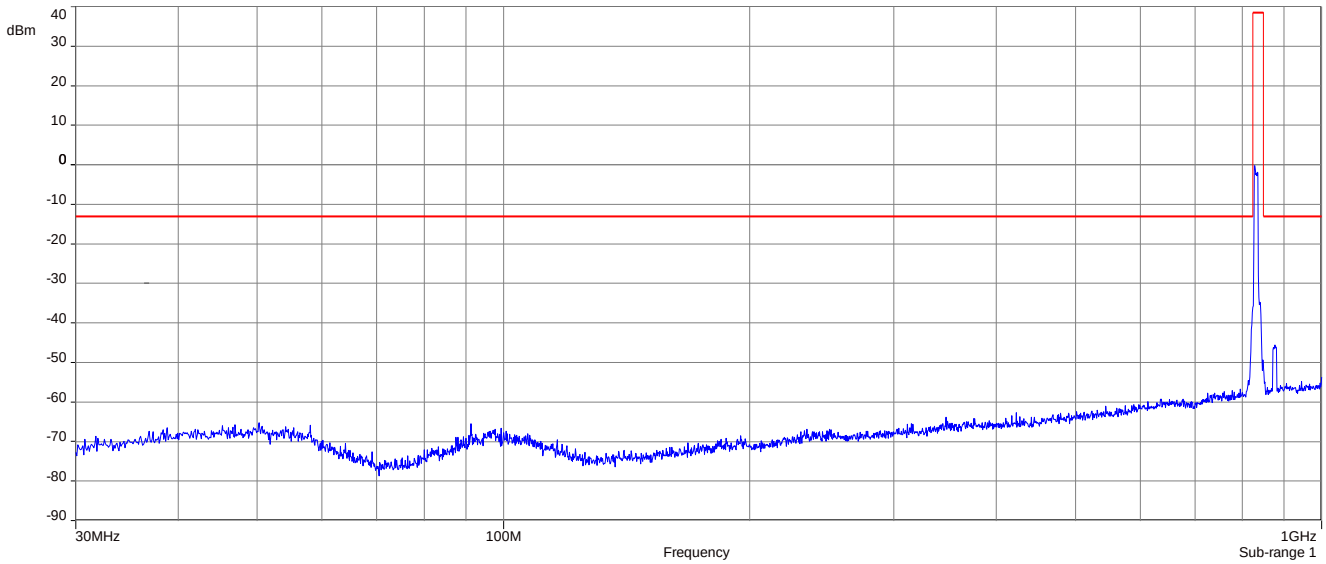


Plot 2: Channel 20525 (1 GHz – 9 GHz)

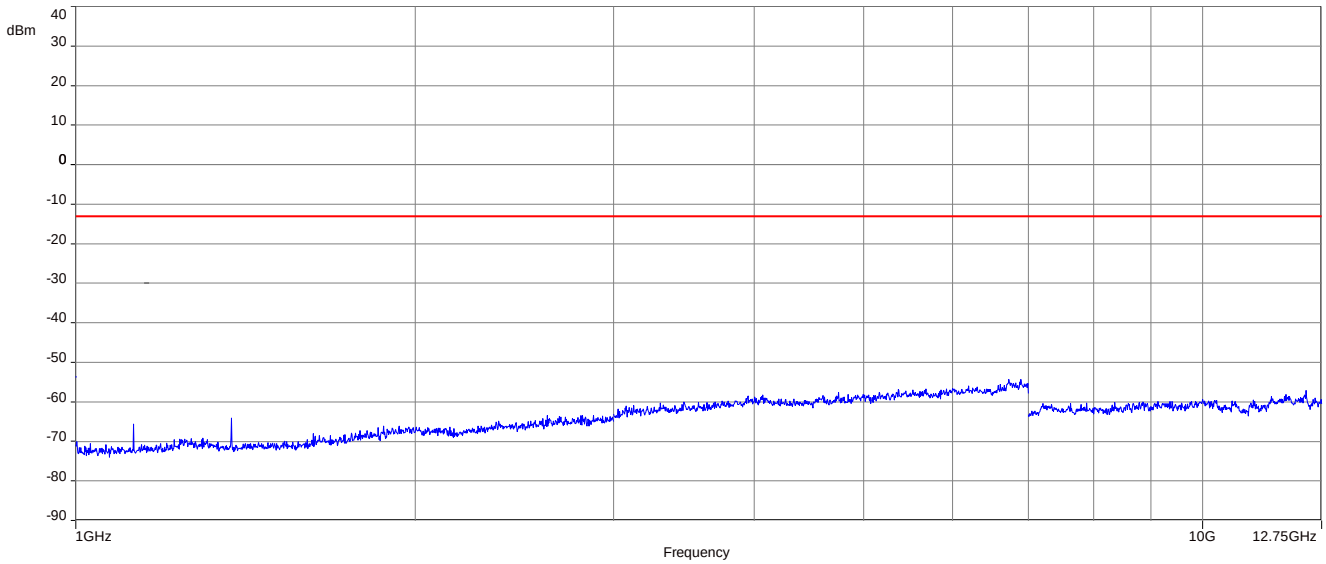


Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Channel 20525 (30 MHz – 1 GHz)



Plot 2: Channel 20525 (1 GHz – 9 GHz)



14 Summary of measurement results LTE band 7; 12; 66 & 71

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

TC identifier	Description	verdict	date	Remark
RF-Testing	CFR Part 27	See table!	2024-05-03	Delta tests according to manufacturer demand!

14.1 LTE – Band 7

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	Conducted power only
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

14.2 LTE – Band 12

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	Conducted power only
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

14.3 LTE – Band 66

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	Conducted power only
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

14.4 LTE – Band 71

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	Conducted power only
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 RF measurements

15.1 Description of test setup

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

15.2 Results LTE – Band 7

The EUT was set to transmit the maximum power.

15.2.1 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	Measured with CMW500
Sweep time	
Video bandwidth	
Resolution bandwidth	
Span	
Trace mode	
Setup	See chapter 7.4 – A
Measurement uncertainty	See chapter 9

Limits:

FCC
Nominal Peak Output Power
+33.00 dBm 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.

Results:

Output Power (conducted)						
Bandwidth (MHz)	**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)**
5	20775 / 2502.5	1 RB low	22.56	-/-	21.73	-/-
		1 RB high	22.68	-/-	21.79	-/-
		50% RB mid	21.67	-/-	20.81	-/-
		100% RB	21.65	-/-	20.59	-/-
	21100 / 2535	1 RB low	22.88	-/-	22.34	-/-
		1 RB high	22.98	-/-	22.48	-/-
		50% RB mid	21.98	-/-	21.24	-/-
		100% RB	21.95	-/-	21.23	-/-
	21425 / 2567.5	1 RB low	22.85	-/-	22.28	-/-
		1 RB high	22.86	-/-	22.11	-/-
		50% RB mid	21.99	-/-	21.20	-/-
		100% RB	22.05	-/-	21.28	-/-
10	20800 / 2505	1 RB low	22.56	-/-	21.5	-/-
		1 RB high	22.68	-/-	21.51	-/-
		50% RB mid	21.74	-/-	20.86	-/-
		100% RB	21.64	-/-	20.74	-/-
	21100 / 2535	1 RB low	22.84	-/-	22.32	-/-
		1 RB high	23.21	-/-	22.55	-/-
		50% RB mid	22.10	-/-	21.11	-/-
		100% RB	22.15	-/-	21.10	-/-
	21400 / 2565	1 RB low	23.04	-/-	22.33	-/-
		1 RB high	23.11	-/-	21.91	-/-
		50% RB mid	23.08	-/-	21.75	-/-
		100% RB	22.05	-/-	21.24	-/-
15	20825 / 2507.5	1 RB low	22.62	-/-	21.30	-/-
		1 RB high	22.52	-/-	21.69	-/-
		50% RB mid	21.68	-/-	20.79	-/-
		100% RB	21.66	-/-	20.66	-/-
	21100 / 2535	1 RB low	22.76	-/-	22.18	-/-
		1 RB high	23.04	-/-	22.58	-/-
		50% RB mid	21.95	-/-	21.03	-/-
		100% RB	21.96	-/-	21.09	-/-
	21375 / 2562.5	1 RB low	22.90	-/-	22.48	-/-
		1 RB high	22.94	-/-	21.71	-/-
		50% RB mid	22.02	-/-	21.03	-/-
		100% RB	22.10	-/-	21.11	-/-

20	20850 / 2510	1 RB low	22.31	-/-	21.93	-/-
		1 RB high	22.51	-/-	21.82	-/-
		50% RB mid	21.61	-/-	20.67	-/-
		100% RB	21.44	-/-	20.56	-/-
	21100 / 2535	1 RB low	22.56	-/-	22.16	-/-
		1 RB high	22.96	-/-	22.51	-/-
		50% RB mid	21.95	-/-	21.15	-/-
		100% RB	22.01	-/-	21.07	-/-
	21350 / 2560	1 RB low	23.02	-/-	22.53	-/-
		1 RB high	22.72	-/-	22.29	-/-
		50% RB mid	22.03	-/-	21.00	-/-
		100% RB	22.07	-/-	21.03	-/-

NOTE: All values are within the module maximum output power values range of 20.3 dBm to 24.0 dBm (extracted from module user manual).

15.2.2 Spurious emissions radiated (Taoglas Supercombo antenna)

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 2687.5 MHz. Measured up to 26 – 27 GHz (depends on the transmitter channel). 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 13.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&C
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 55 + 10log(P) (P, Power in Watts)
-25 dBm

QPSK

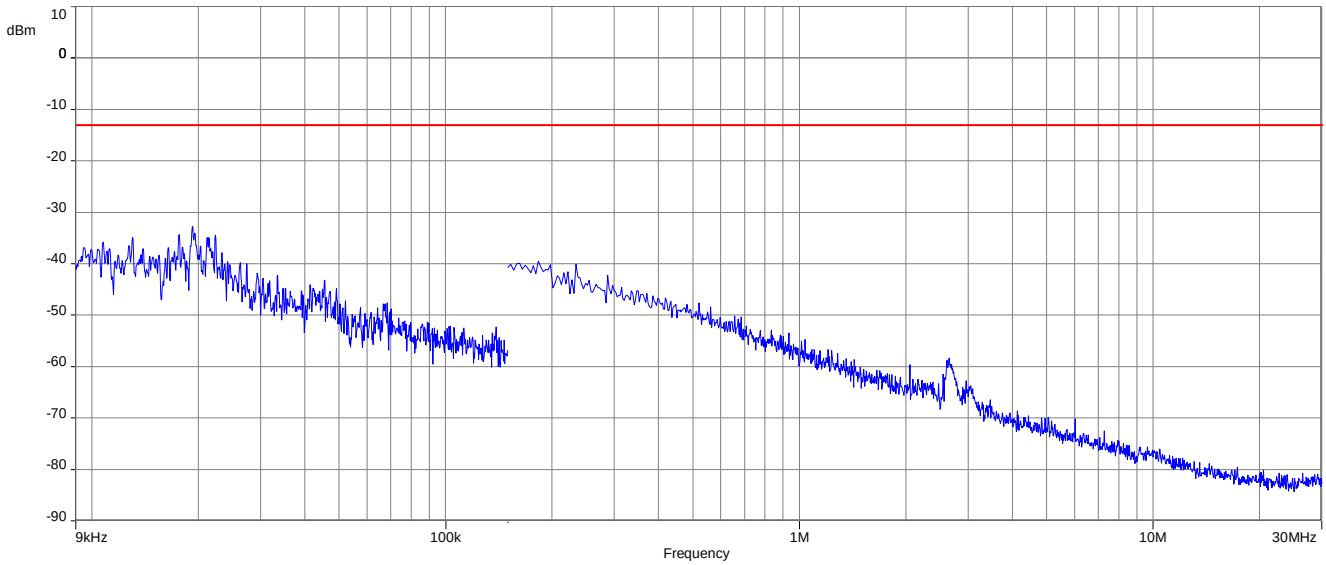
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					

16-QAM

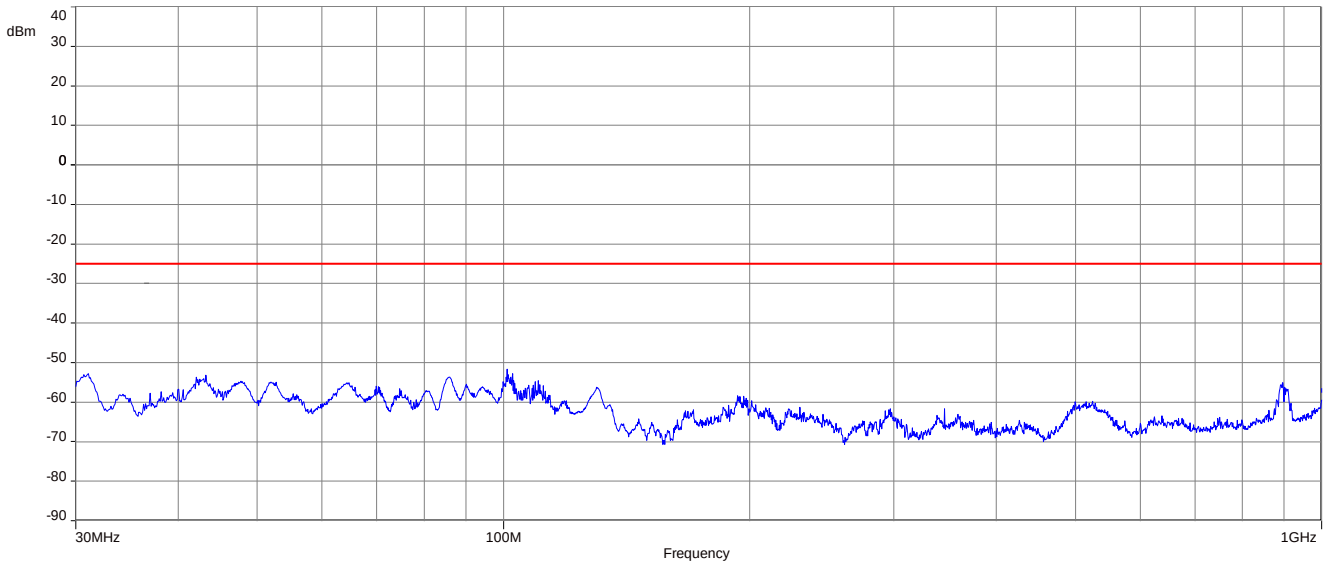
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					

Results: QPSK with 10 MHz channel bandwidth

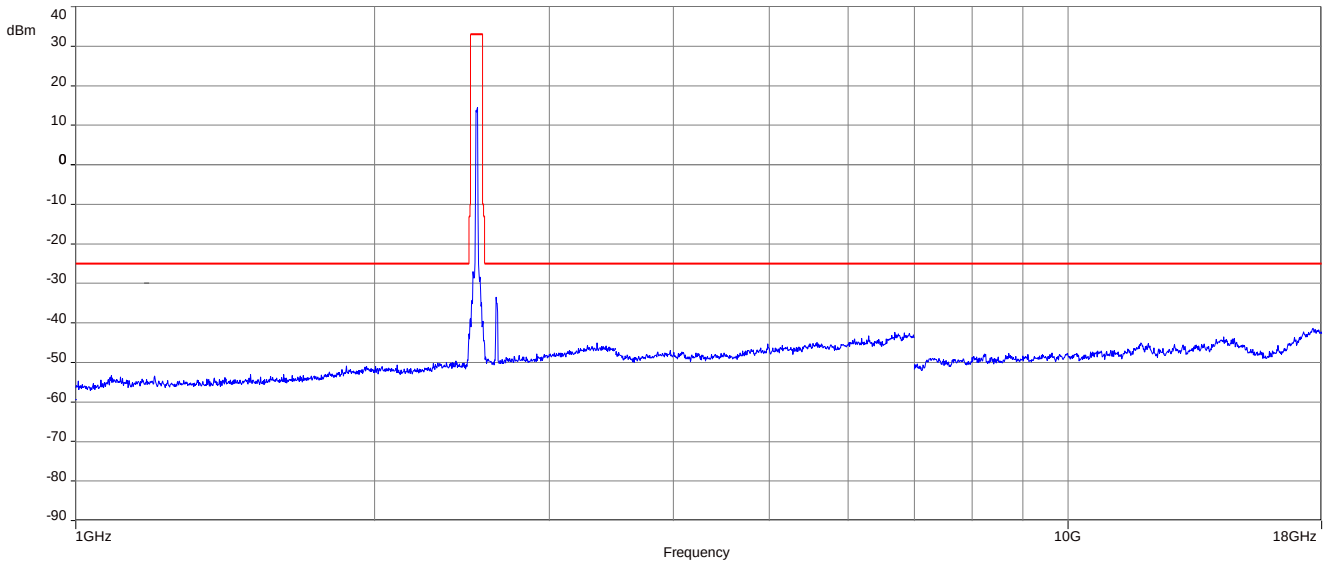
Plot 1: Middle channel, up to 30 MHz



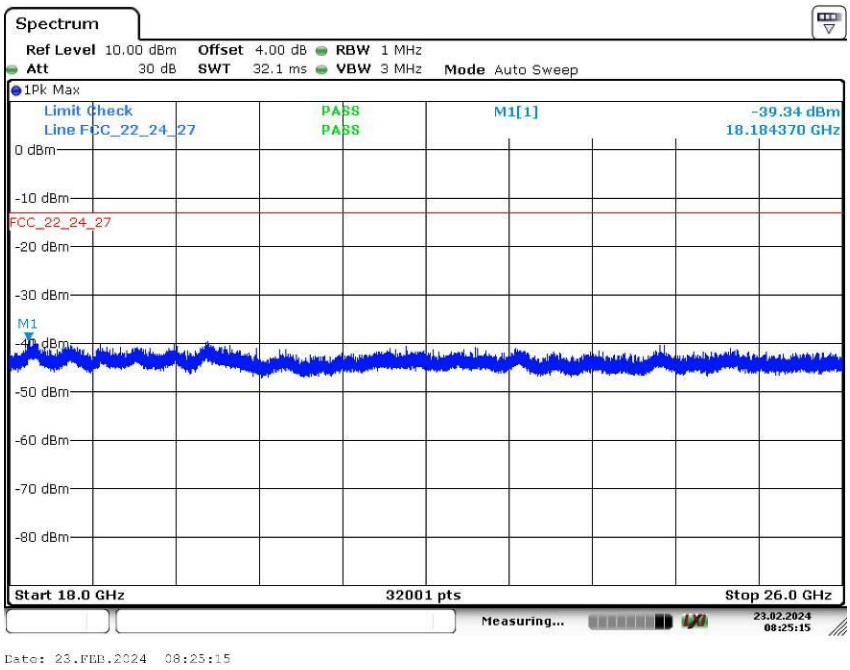
Plot 2: Middle channel, 30 MHz to 1 GHz



Plot 3: Middle channel, 1 GHz to 18 GHz

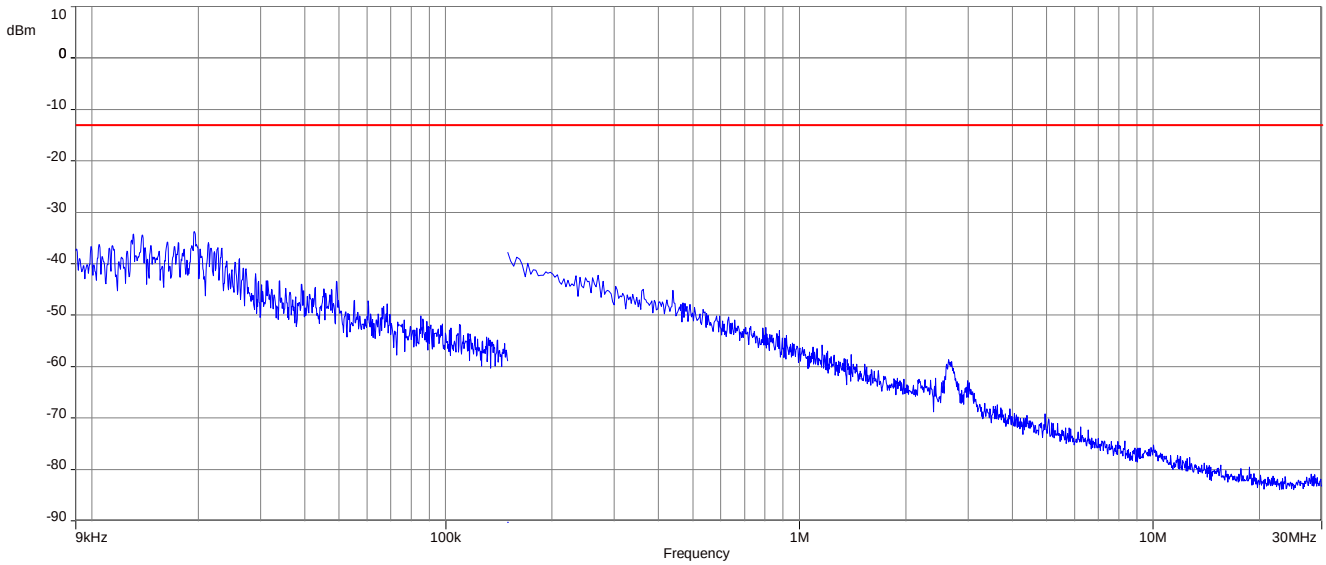


Plot 4: Middle channel, 18 GHz to 26 GHz

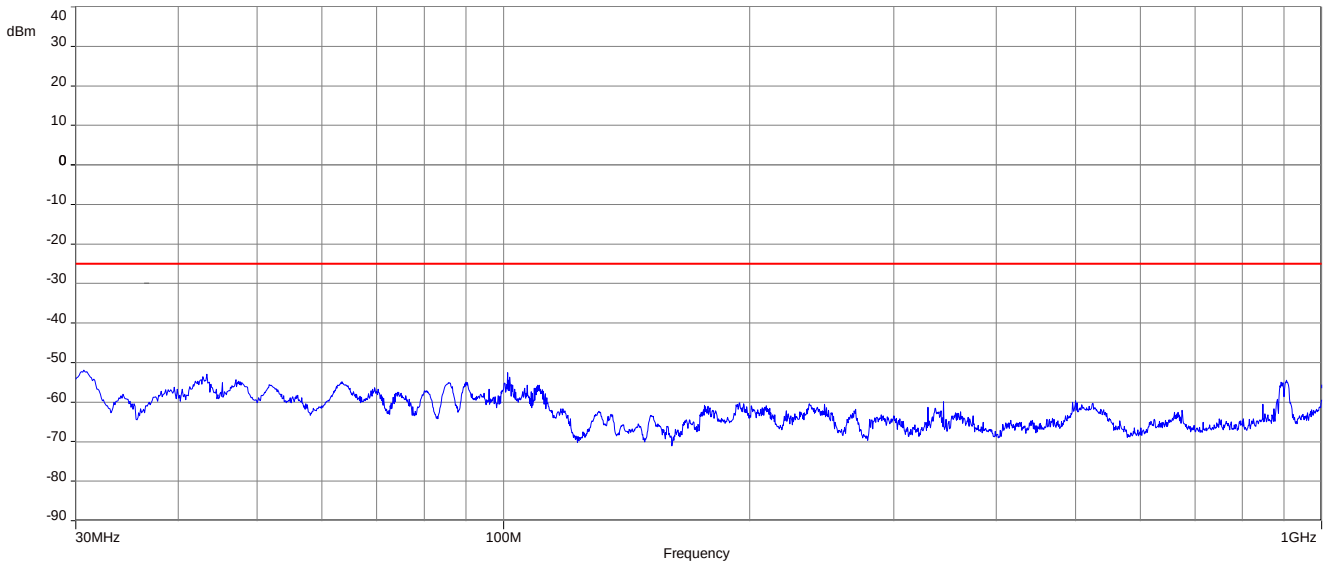


Results: 16-QAM with 10 MHz channel bandwidth

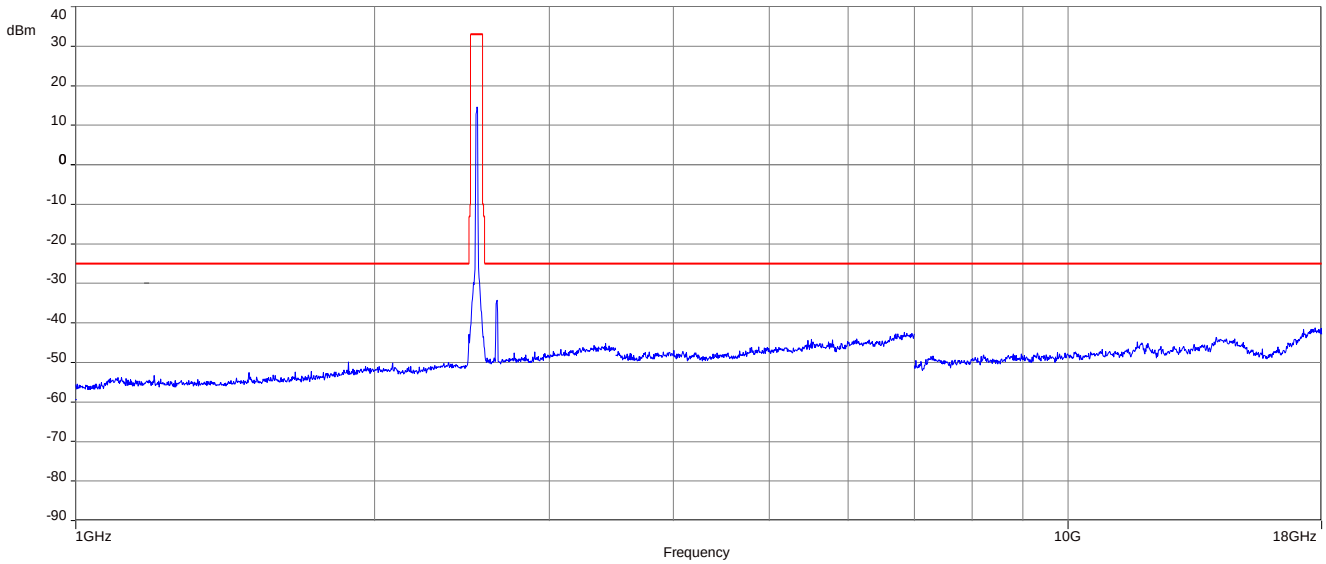
Plot 1: Middle channel, up to 30 MHz



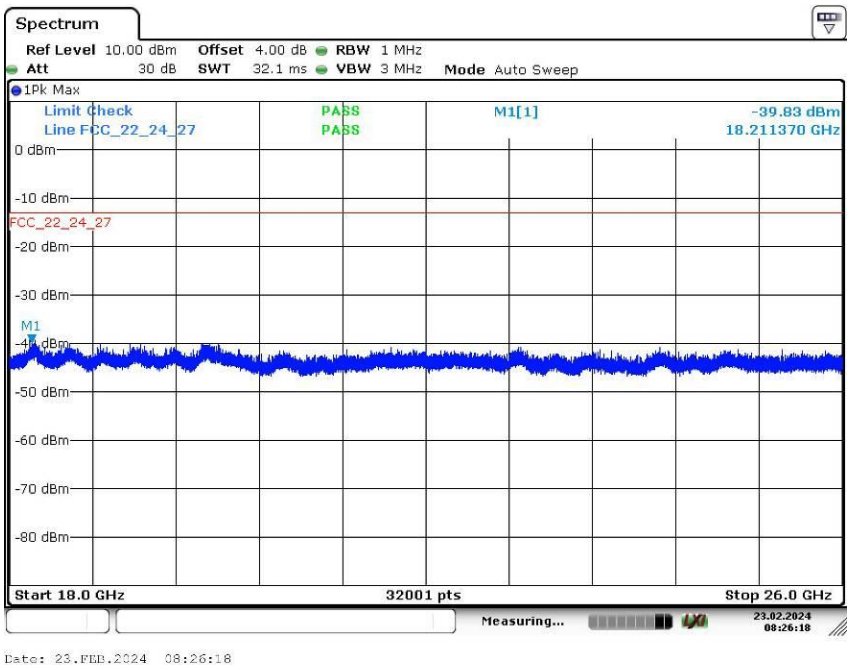
Plot 2: Middle channel, 30 MHz to 1 GHz



Plot 3: Middle channel, 1 GHz to 18 GHz



Plot 4: Middle channel, 18 GHz to 26 GHz



15.2.3 Spurious emissions radiated (Taoglas Puck antenna)

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 2687.5 MHz. Measured up to 26 – 27 GHz (depends on the transmitter channel). 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 13.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&C
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 55 + 10log(P) (P, Power in Watts)
-25 dBm

QPSK

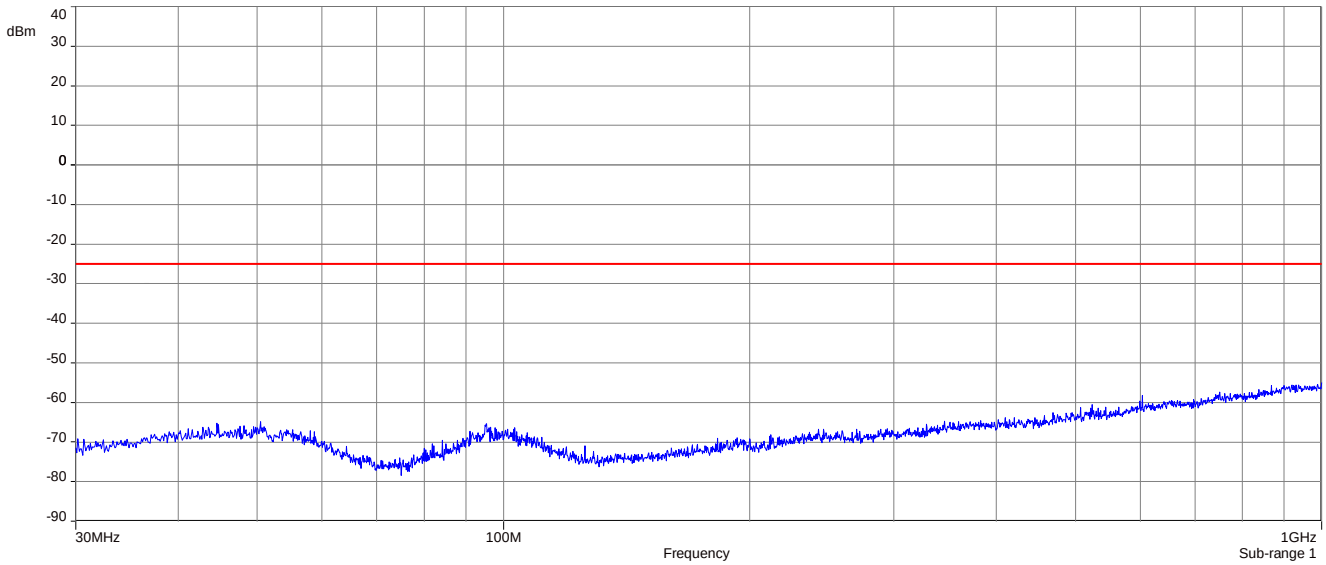
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					

16-QAM

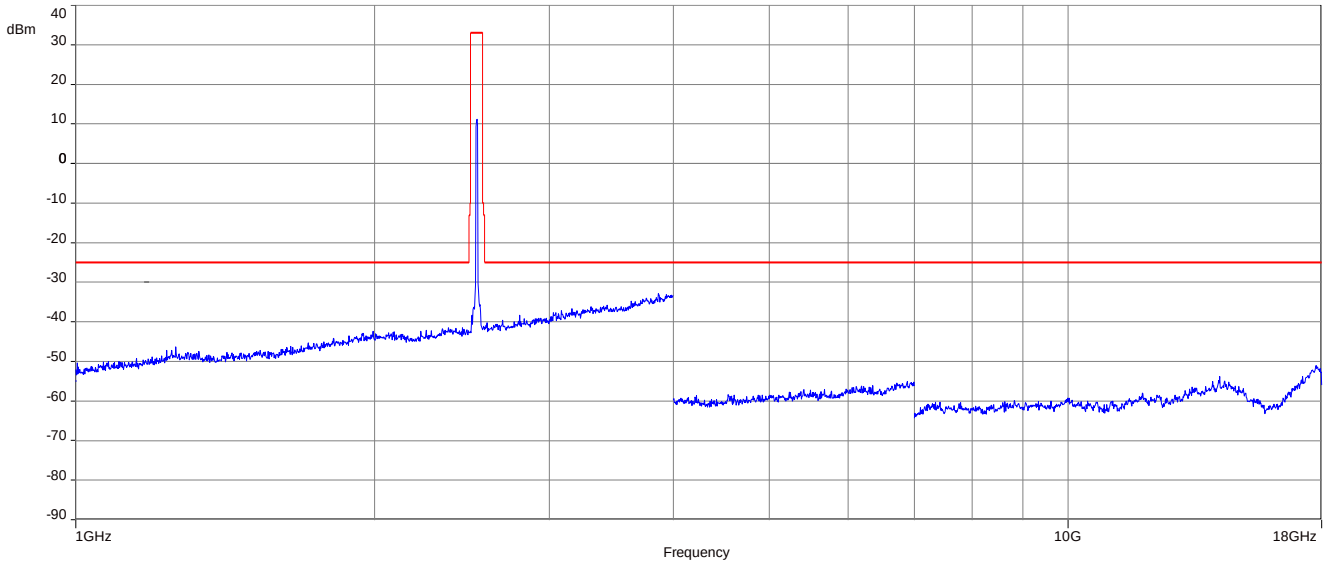
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz

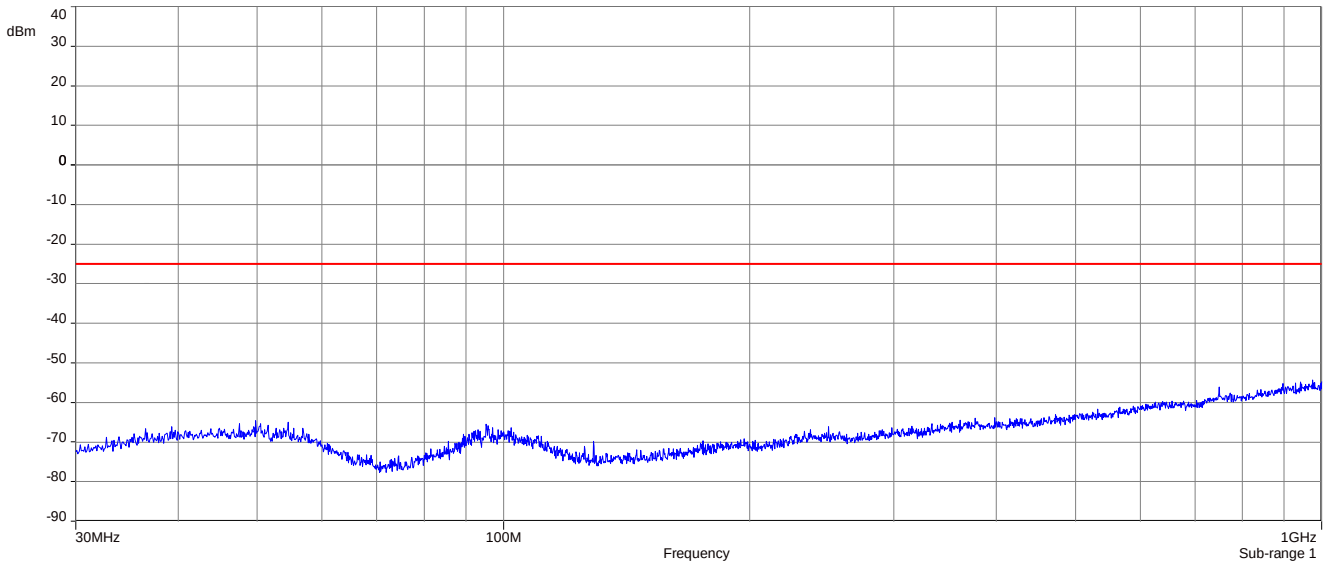


Plot 2: Middle channel, 1 GHz to 18 GHz

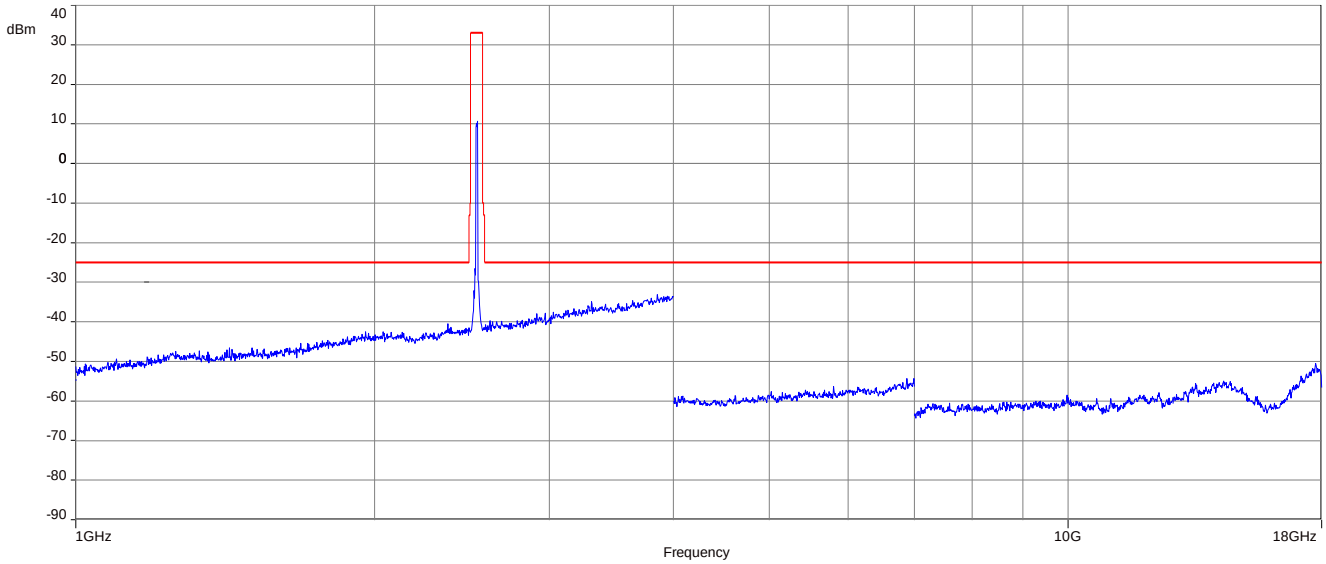


Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



Plot 2: Middle channel, 1 GHz to 18 GHz



15.2.4 Spurious emissions radiated (Candy bar antenna)

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 2687.5 MHz. Measured up to 26 – 27 GHz (depends on the transmitter channel). 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 13.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&B
Measurement uncertainty	See chapter 9

Limits:

ISED
Spurious Emissions Radiated
Attenuation ≥ 55 + 10log(P) (P, Power in Watts)
-25 dBm

QPSK

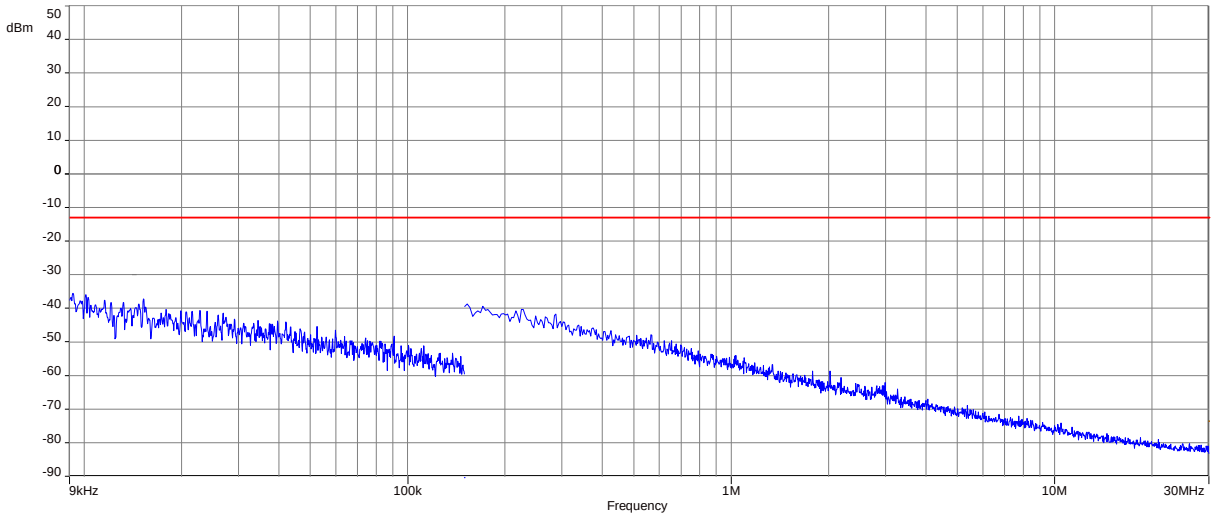
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					

16-QAM

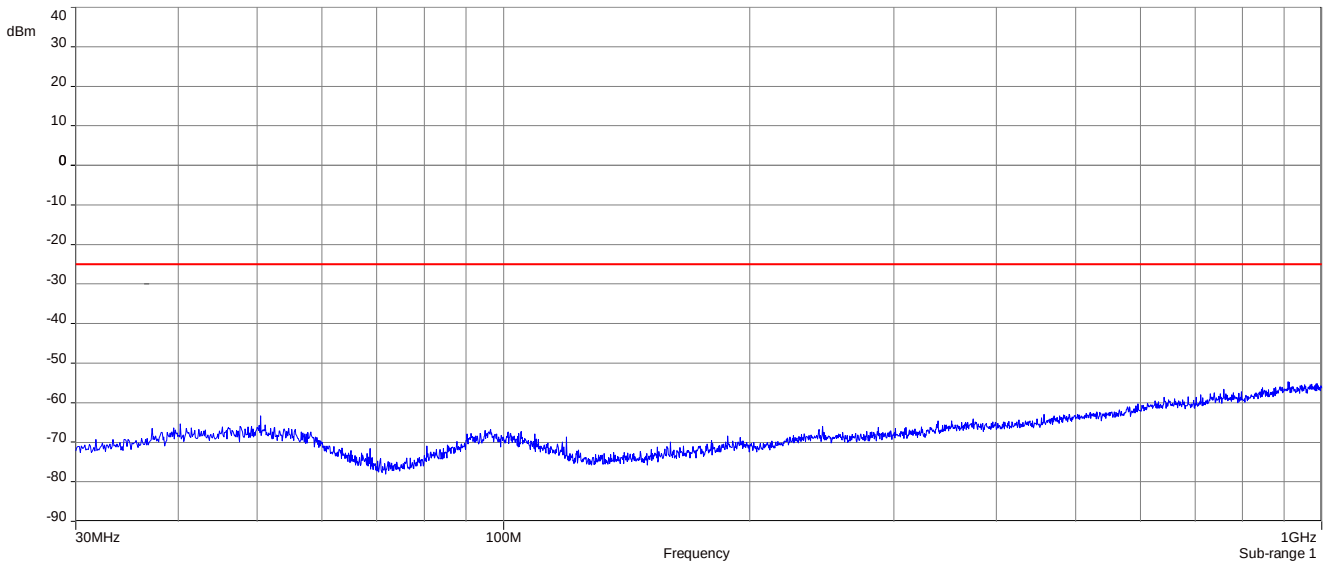
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					

Results: QPSK with 10 MHz channel bandwidth

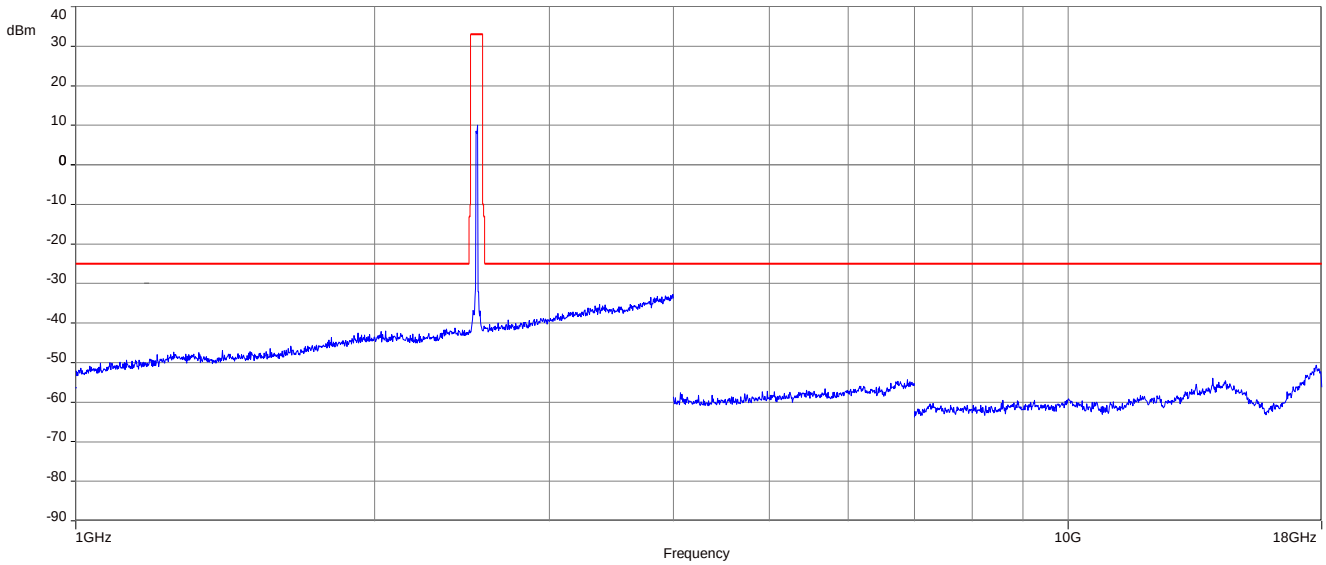
Plot 1: Middle channel (Traffic mode up to 30 MHz), this is the worst case magnetic plot of all magnetic measurements for all bands (same as for Taoglas Puck antenna)



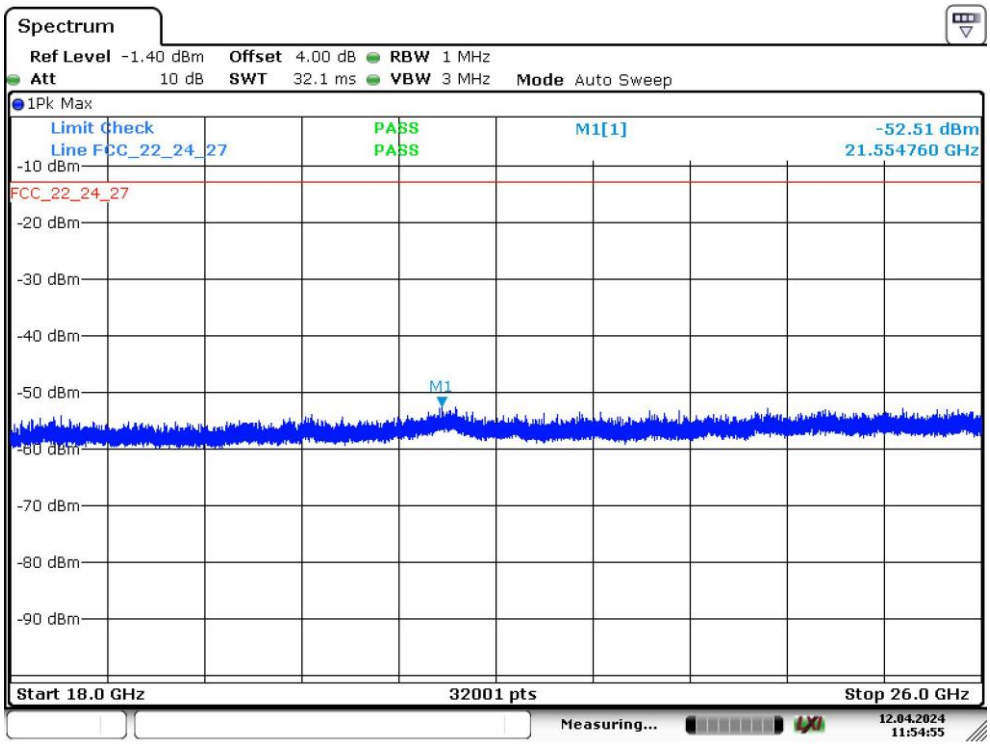
Plot 2: Middle channel, 30 MHz to 1 GHz



Plot 3: Middle channel, 1 GHz to 18 GHz



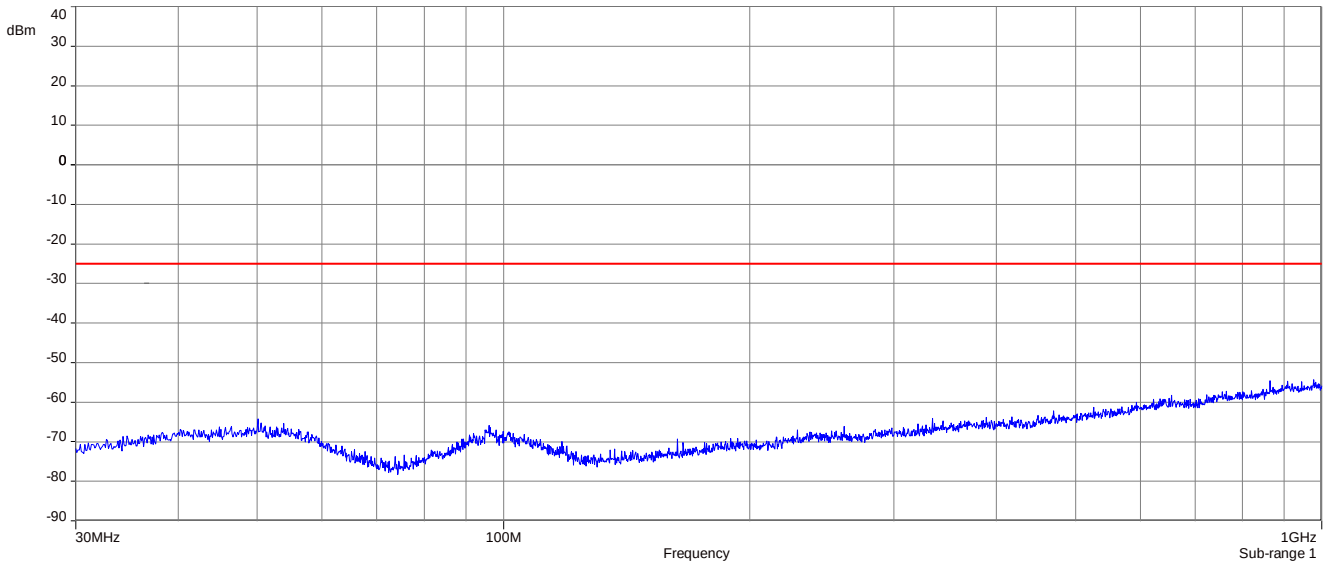
Plot 4: Middle channel (18 GHz – 26 GHz), this is the worst case 18-26 GHz plot of all measurements for all bands (same as for Taoglas Puck antenna)



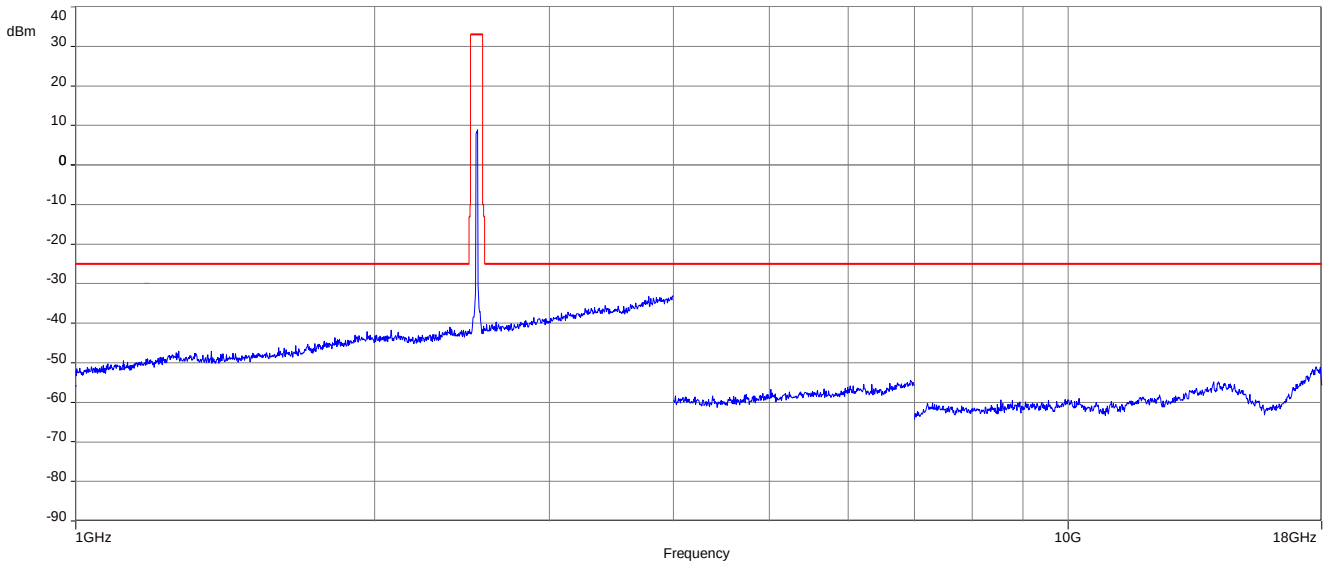
Date: 12.APR.2024 11:54:55

Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



Plot 2: Middle channel, 1 GHz to 18 GHz



15.3 Results LTE – Band 12

The EUT was set to transmit the maximum power.

15.3.1 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	Measured with CMW500
Sweep time	
Video bandwidth	
Resolution bandwidth	
Span	
Trace mode	
Setup	See chapter 7.4 – A
Measurement uncertainty	See chapter 9

Limits:

FCC
Max Output Power
+34.77 dBm 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.

Results:

Output Power (conducted)						
Bandwidth (MHz)	**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	699.7	1 RB low	22.81	-/-	21.76	-/-
		1 RB high	22.81	-/-	21.71	-/-
		50% RB mid	22.89	-/-	22.02	-/-
		100% RB	21.80	-/-	21.01	-/-
	707.5	1 RB low	22.88	-/-	22.39	-/-
		1 RB high	22.86	-/-	22.28	-/-
		50% RB mid	23.05	-/-	22.15	-/-
		100% RB	21.89	-/-	20.90	-/-
	715.3	1 RB low	22.75	-/-	22.25	-/-
		1 RB high	22.78	-/-	21.82	-/-
		50% RB mid	22.92	-/-	22.28	-/-
		100% RB	21.86	-/-	20.74	-/-
3	700.5	1 RB low	22.84	-/-	21.59	-/-
		1 RB high	22.72	-/-	21.73	-/-
		50% RB mid	21.84	-/-	20.72	-/-
		100% RB	21.82	-/-	20.86	-/-
	707.5	1 RB low	22.85	-/-	22.24	-/-
		1 RB high	22.95	-/-	22.34	-/-
		50% RB mid	21.95	-/-	20.80	-/-
		100% RB	21.89	-/-	20.92	-/-
	714.5	1 RB low	22.78	-/-	22.22	-/-
		1 RB high	22.93	-/-	21.66	-/-
		50% RB mid	21.87	-/-	20.95	-/-
		100% RB	21.86	-/-	20.93	-/-
5	701.5	1 RB low	22.72	-/-	21.85	-/-
		1 RB high	22.82	-/-	21.97	-/-
		50% RB mid	21.80	-/-	20.98	-/-
		100% RB	21.78	-/-	20.73	-/-
	707.5	1 RB low	22.76	-/-	22.29	-/-
		1 RB high	22.76	-/-	22.36	-/-
		50% RB mid	22.03	-/-	20.94	-/-
		100% RB	21.83	-/-	21.01	-/-
	713.5	1 RB low	22.75	-/-	22.26	-/-
		1 RB high	22.73	-/-	21.92	-/-
		50% RB mid	21.93	-/-	21.04	-/-
		100% RB	21.77	-/-	20.99	-/-

10	704.0	1 RB low	22.75	-/-	21.52	-/-
		1 RB high	22.90	-/-	21.78	-/-
		50% RB mid	21.91	-/-	21.00	-/-
		100% RB	22.02	-/-	20.97	-/-
	707.5	1 RB low	22.89	-/-	22.28	-/-
		1 RB high	22.82	-/-	22.29	-/-
		50% RB mid	21.96	-/-	21.02	-/-
		100% RB	22.09	-/-	21.12	-/-
	711.0	1 RB low	22.94	-/-	22.35	-/-
		1 RB high	22.84	-/-	21.62	-/-
		50% RB mid	21.97	-/-	21.14	-/-
		100% RB	21.73	-/-	20.68	-/-

NOTE: All values are within the module maximum output power values range of 20.3 dBm to 24.0 dBm (extracted from module user manual).

15.3.2 Spurious emissions radiated (Taoglas Supercombo antenna)

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 715.3 MHz. This was rounded up to 8 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 12.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&E
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

QPSK

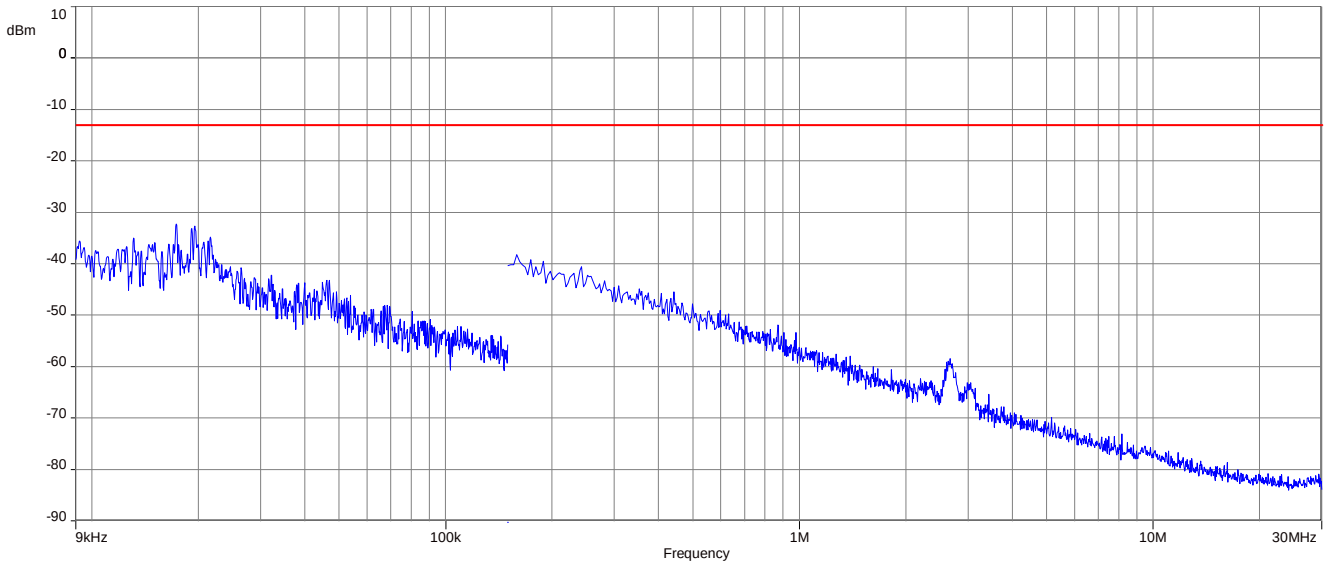
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

16-QAM

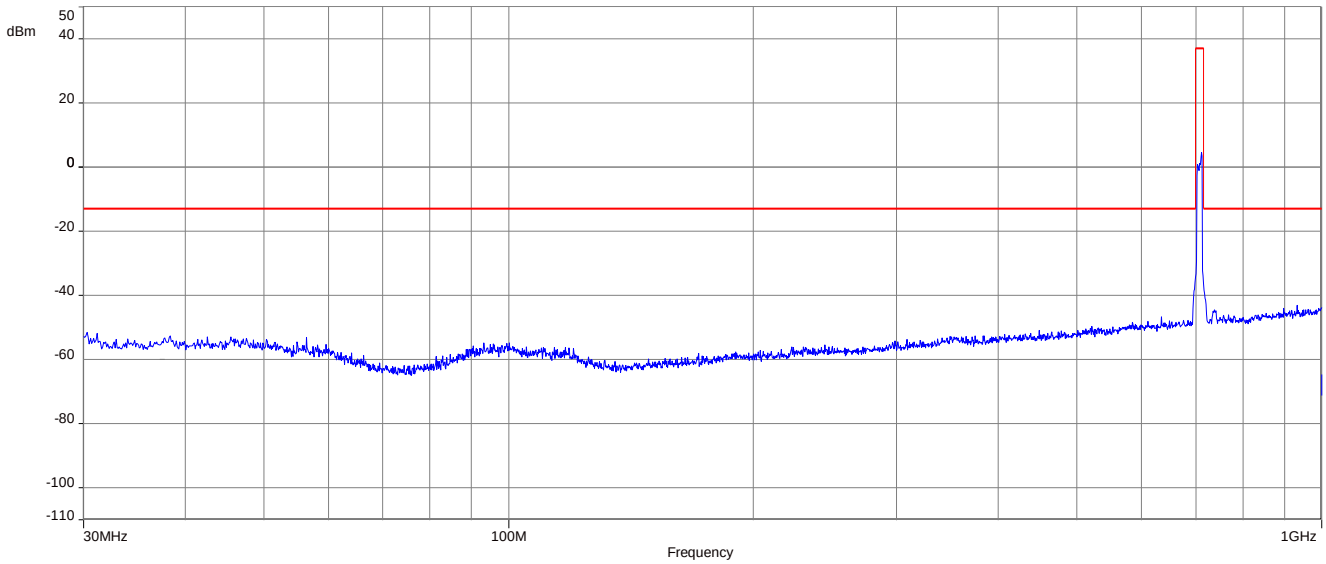
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

Results: QPSK with 10 MHz channel bandwidth

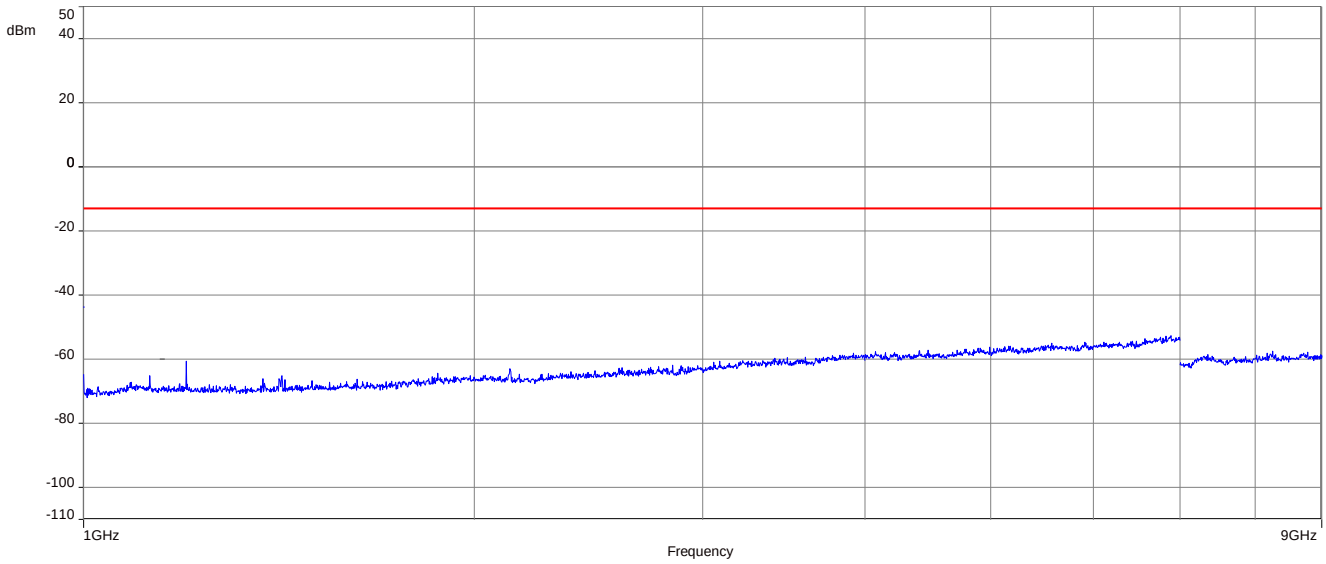
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1 GHz

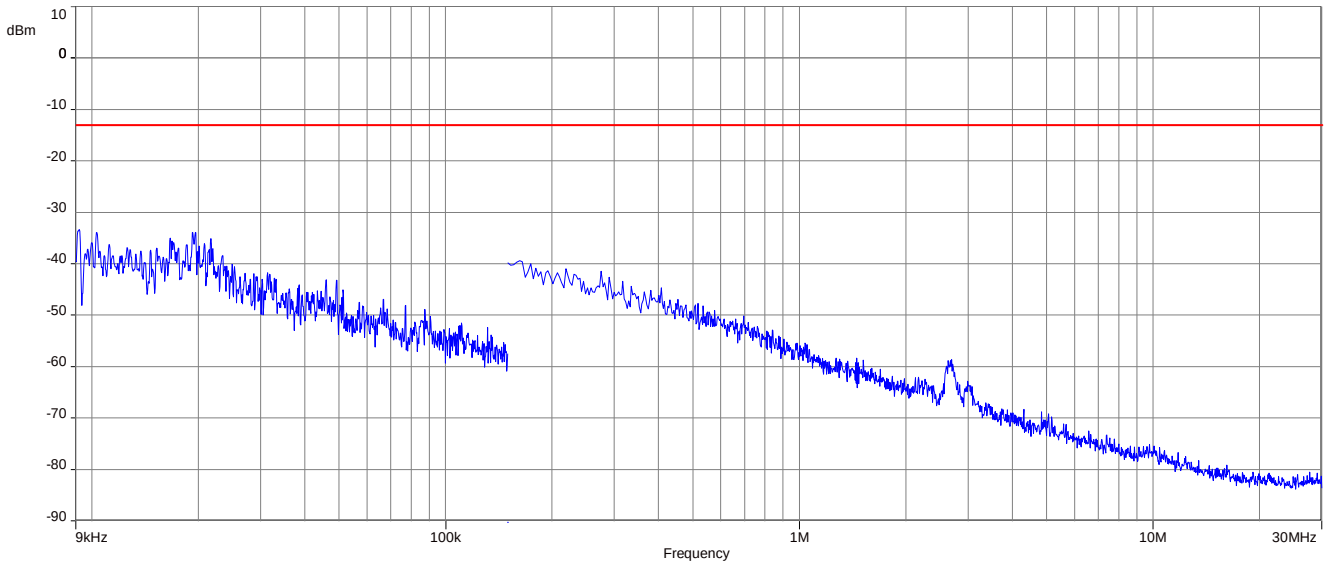


Plot 3: Middle channel, 1 GHz to 9 GHz

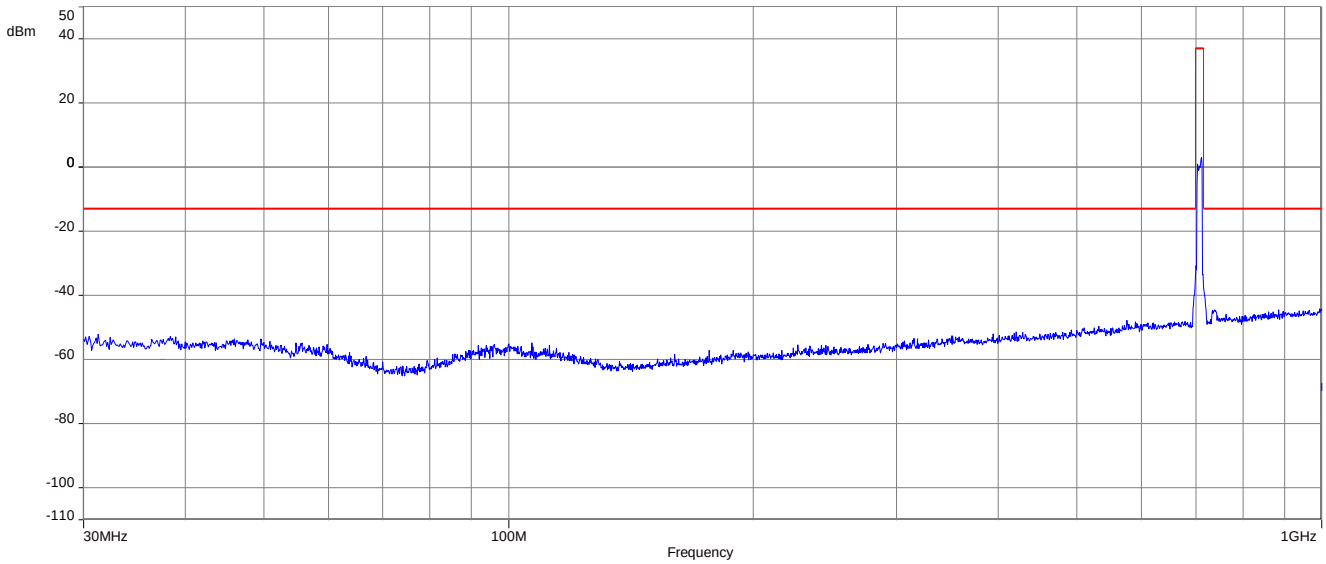


Results: 16-QAM with 10 MHz channel bandwidth

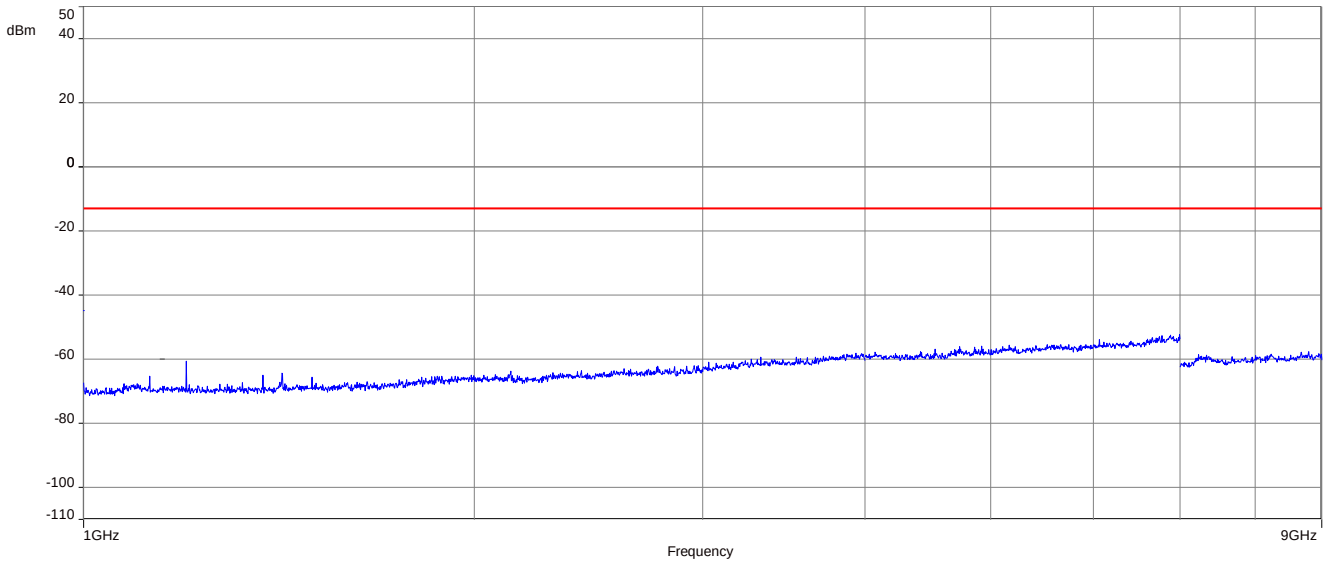
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1 GHz



Plot 3: Middle channel, 1 GHz to 9 GHz



15.3.3 Spurious emissions radiated (Taoglas Puck antenna)

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 715.3 MHz. This was rounded up to 8 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 12.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&E
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

QPSK

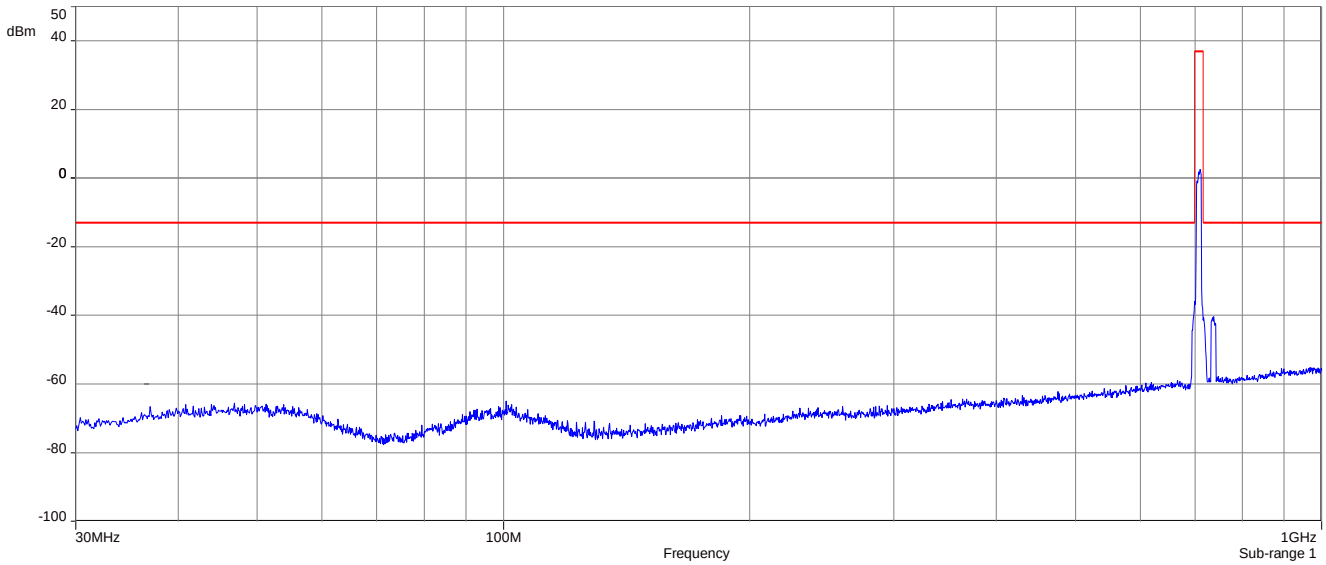
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

16-QAM

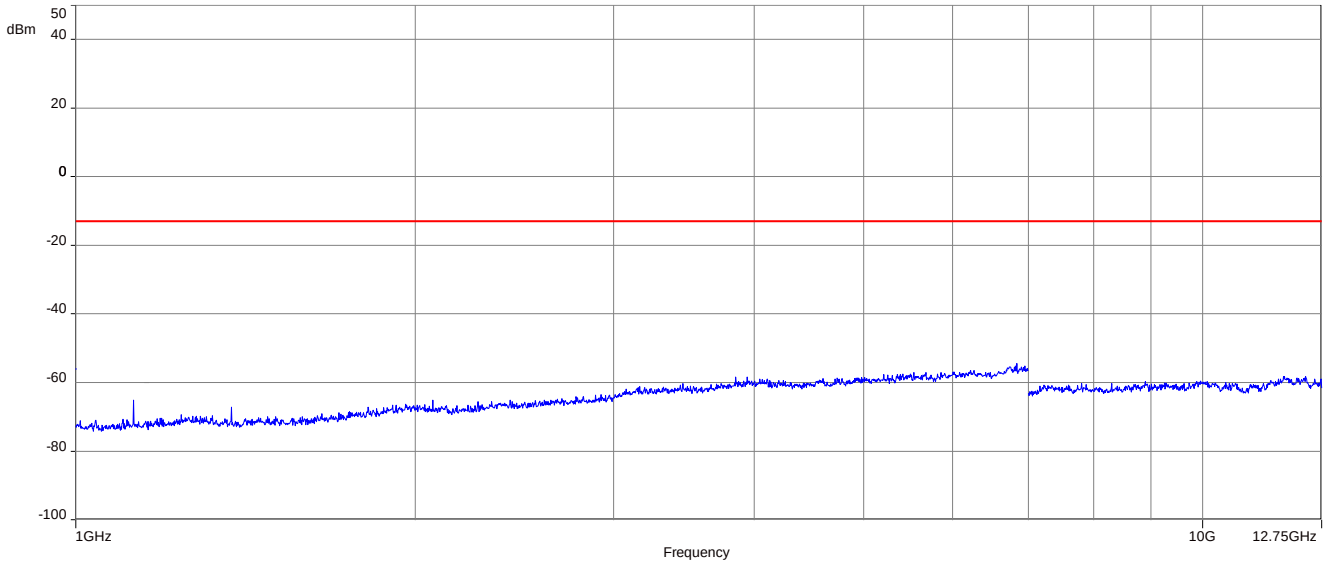
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz

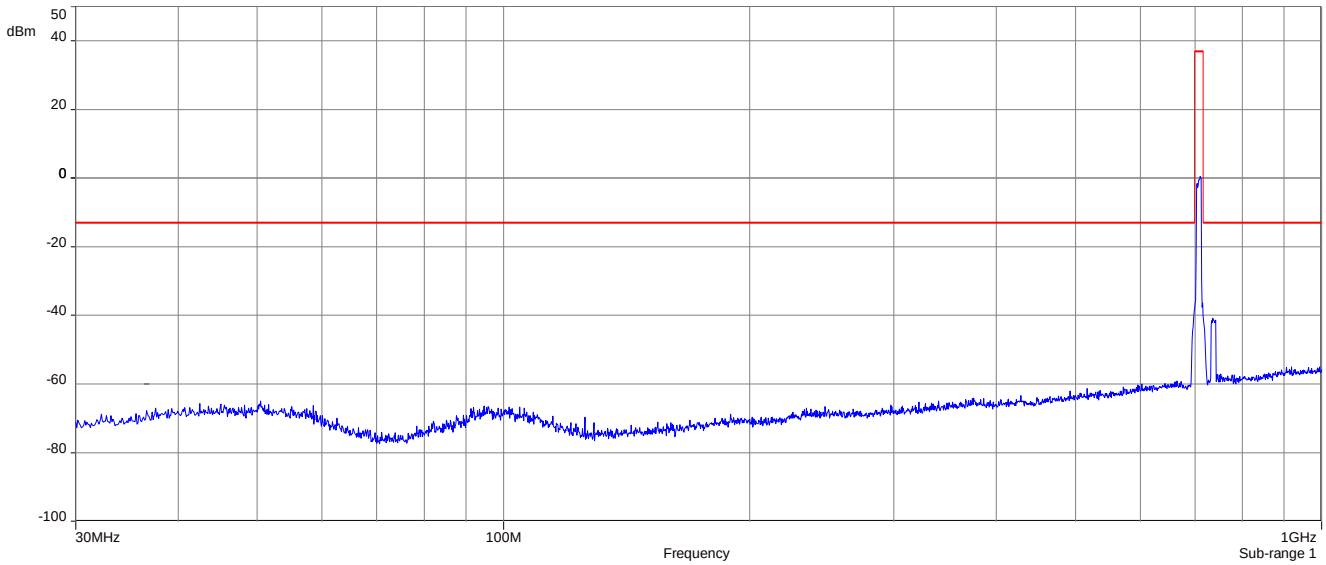


Plot 2: Middle channel, 1 GHz to 9 GHz

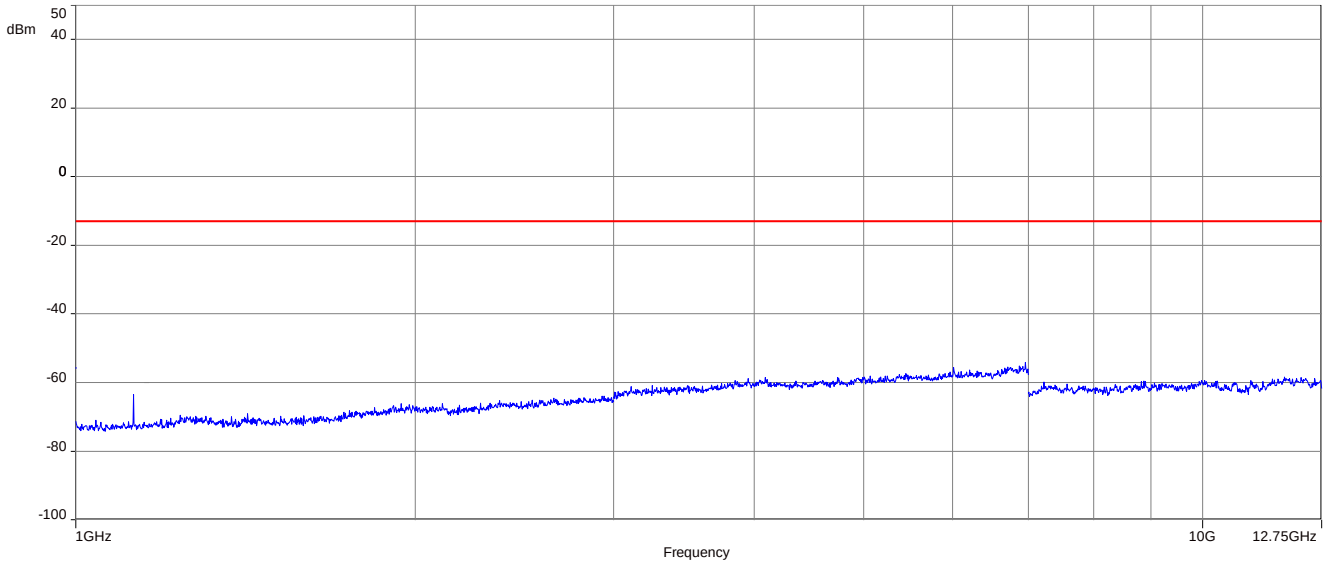


Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



Plot 2: Middle channel, 1 GHz to 9 GHz



15.3.4 Spurious emissions radiated (Candy bar antenna)

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 715.3 MHz. This was rounded up to 8 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 12.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&B
Measurement uncertainty	See chapter 9

Limits:

ISED
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

QPSK

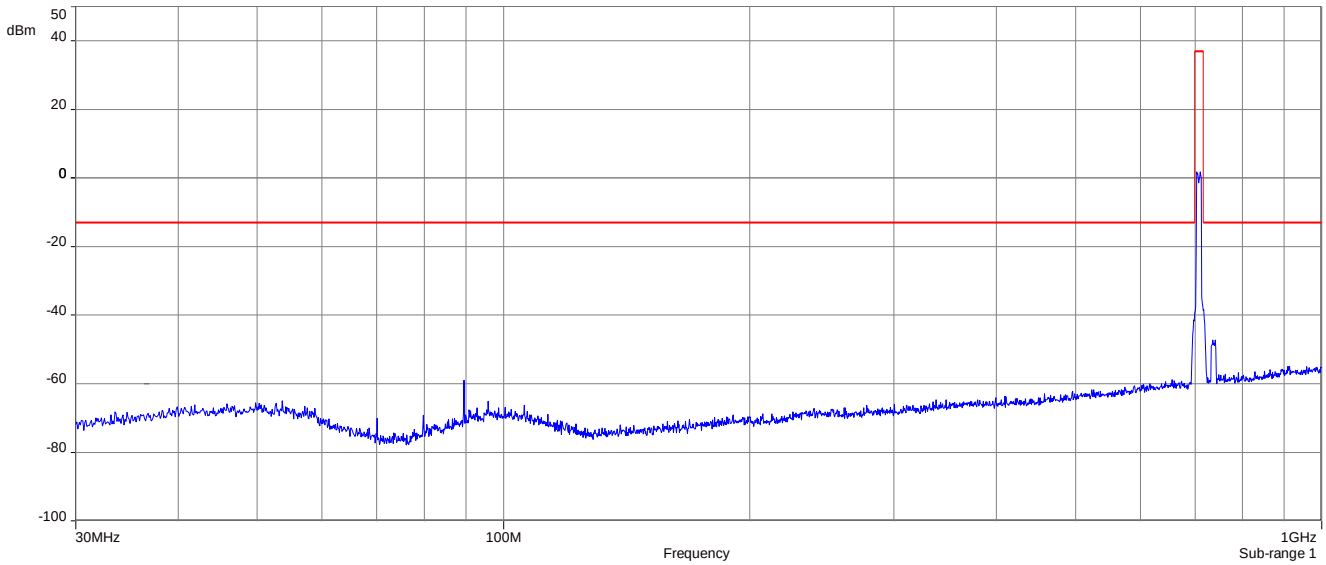
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

16-QAM

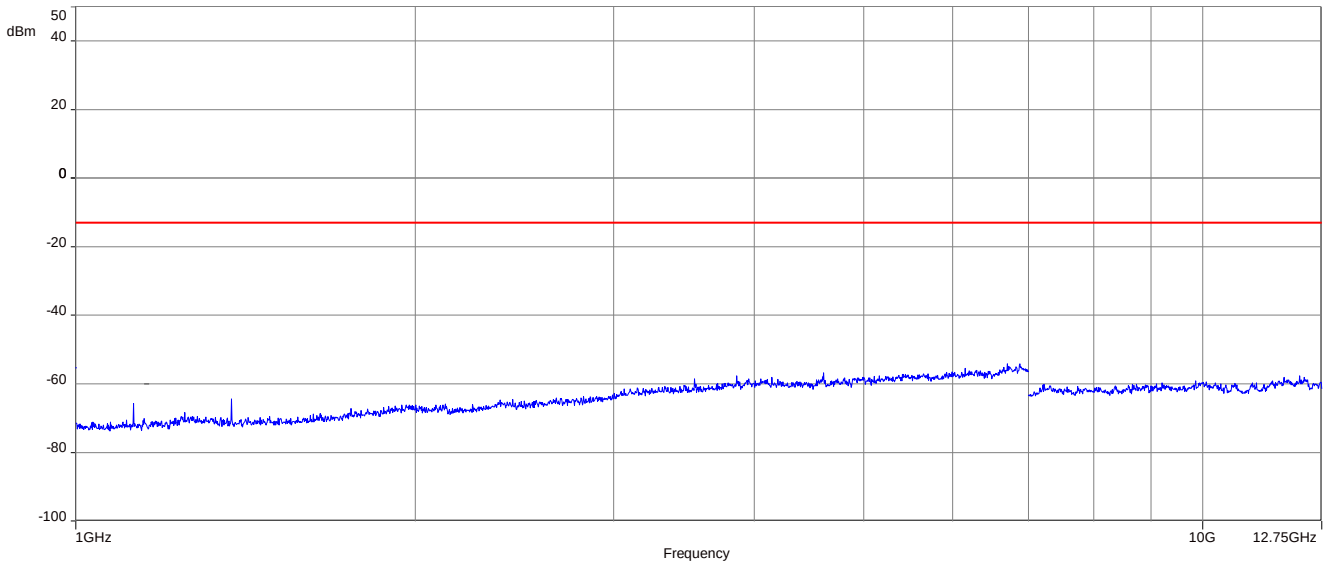
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz

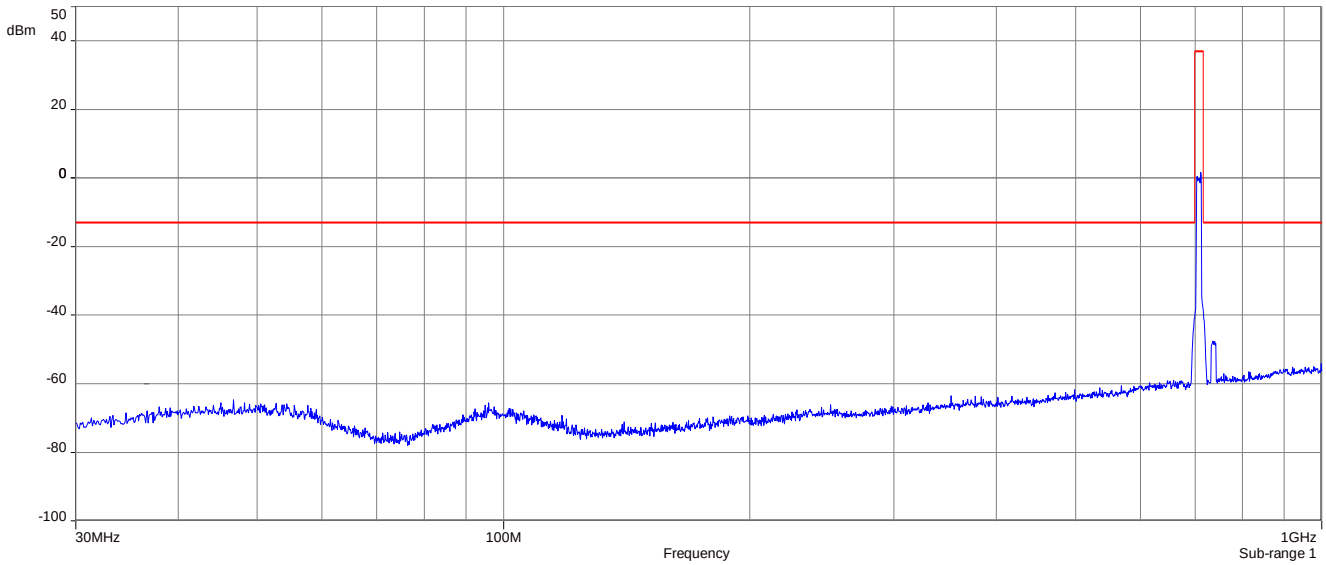


Plot 2: Middle channel, 1 GHz to 9 GHz

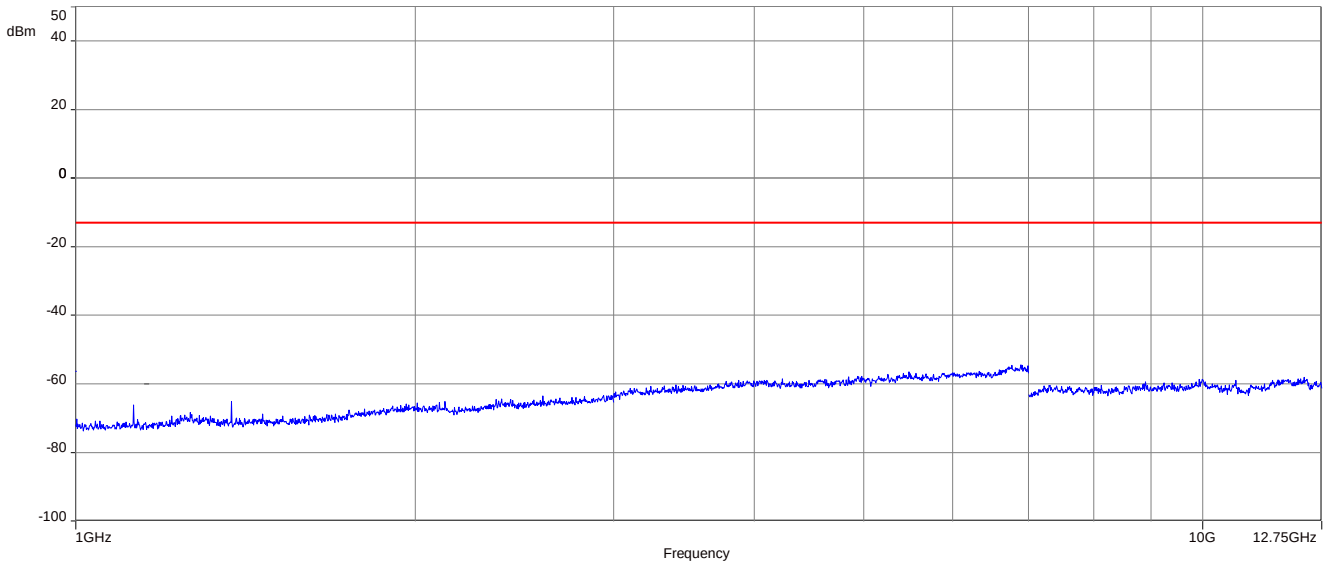


Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



Plot 2: Middle channel, 1 GHz to 9 GHz



15.4 Results LTE – Band 66

The EUT was set to transmit the maximum power.

15.4.1 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	Measured with CMW500
Sweep time	
Video bandwidth	
Resolution bandwidth	
Span	
Trace mode	
Setup	See chapter 7.4 – A
Measurement uncertainty	See chapter 9

Limits:

FCC
Nominal Peak Output Power
+30.00 dBm 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.

Results:

Output Power (conducted)						
Bandwidth (MHz)	**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	1710.7	1 RB low	23.32	-/-	22.31	-/-
		1 RB high	23.25	-/-	22.32	-/-
		50% RB mid	23.49	-/-	22.75	-/-
		100% RB	22.28	-/-	21.56	-/-
	1732.5	1 RB low	22.89	-/-	22.37	-/-
		1 RB high	22.84	-/-	22.33	-/-
		50% RB mid	23.09	-/-	22.14	-/-
		100% RB	21.85	-/-	20.84	-/-
	1754.3	1 RB low	22.70	-/-	22.20	-/-
		1 RB high	22.74	-/-	21.72	-/-
		50% RB mid	22.86	-/-	22.3	-/-
		100% RB	21.83	-/-	20.74	-/-
3	1711.5	1 RB low	23.27	-/-	22.28	-/-
		1 RB high	23.28	-/-	22.26	-/-
		50% RB mid	22.23	-/-	21.31	-/-
		100% RB	22.36	-/-	21.54	-/-
	1732.5	1 RB low	22.97	-/-	22.35	-/-
		1 RB high	22.83	-/-	22.43	-/-
		50% RB mid	21.89	-/-	20.84	-/-
		100% RB	21.95	-/-	20.96	-/-
	1753.5	1 RB low	22.80	-/-	22.13	-/-
		1 RB high	22.80	-/-	21.60	-/-
		50% RB mid	21.86	-/-	20.95	-/-
		100% RB	21.82	-/-	20.93	-/-
5	1712.5	1 RB low	23.20	-/-	22.50	-/-
		1 RB high	23.29	-/-	22.51	-/-
		50% RB mid	22.34	-/-	21.52	-/-
		100% RB	22.37	-/-	21.31	-/-
	1732.5	1 RB low	22.76	-/-	22.42	-/-
		1 RB high	22.72	-/-	22.38	-/-
		50% RB mid	21.95	-/-	21.04	-/-
		100% RB	21.98	-/-	21.06	-/-
	1752.5	1 RB low	22.69	-/-	22.25	-/-
		1 RB high	22.73	-/-	21.91	-/-
		50% RB mid	21.85	-/-	21.00	-/-
		100% RB	21.88	-/-	20.97	-/-

10	1715.0	1 RB low	23.28	-/-	22.15	-/-
		1 RB high	23.06	-/-	22.10	-/-
		50% RB mid	22.44	-/-	21.48	-/-
		100% RB	22.38	-/-	21.38	-/-
	1732.5	1 RB low	22.98	-/-	22.38	-/-
		1 RB high	22.81	-/-	22.36	-/-
		50% RB mid	21.98	-/-	21.04	-/-
		100% RB	22.01	-/-	21.01	-/-
	1750.0	1 RB low	22.83	-/-	22.28	-/-
		1 RB high	22.68	-/-	21.51	-/-
		50% RB mid	21.96	-/-	20.99	-/-
		100% RB	21.93	-/-	20.92	-/-
15	1717.5	1 RB low	23.26	-/-	22.13	-/-
		1 RB high	23.01	-/-	22.21	-/-
		50% RB mid	22.25	-/-	21.23	-/-
		100% RB	22.26	-/-	21.23	-/-
	1732.5	1 RB low	23.03	-/-	22.39	-/-
		1 RB high	22.83	-/-	22.21	-/-
		50% RB mid	21.84	-/-	20.94	-/-
		100% RB	21.90	-/-	20.95	-/-
	1747.5	1 RB low	22.78	-/-	22.26	-/-
		1 RB high	22.70	-/-	21.62	-/-
		50% RB mid	21.96	-/-	20.80	-/-
		100% RB	21.88	-/-	20.90	-/-
20	1720.0	1 RB low	23.17	-/-	22.86	-/-
		1 RB high	22.92	-/-	22.43	-/-
		50% RB mid	22.27	-/-	21.26	-/-
		100% RB	22.17	-/-	21.16	-/-
	1732.5	1 RB low	22.80	-/-	22.48	-/-
		1 RB high	22.68	-/-	22.37	-/-
		50% RB mid	22.00	-/-	20.96	-/-
		100% RB	21.97	-/-	21.02	-/-
	1745.0	1 RB low	22.75	-/-	22.24	-/-
		1 RB high	22.54	-/-	22.19	-/-
		50% RB mid	21.96	-/-	20.85	-/-
		100% RB	21.78	-/-	20.83	-/-

NOTE: All values are within the module maximum output power values range of 20.3 dBm to 24.0 dBm (extracted from module user manual).

15.4.2 Spurious emissions radiated (Taoglas Supercombo antenna)

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 1755 MHz. Measurement made up to 26 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.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&D; 7.3 - A
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)
-13 dBm

QPSK

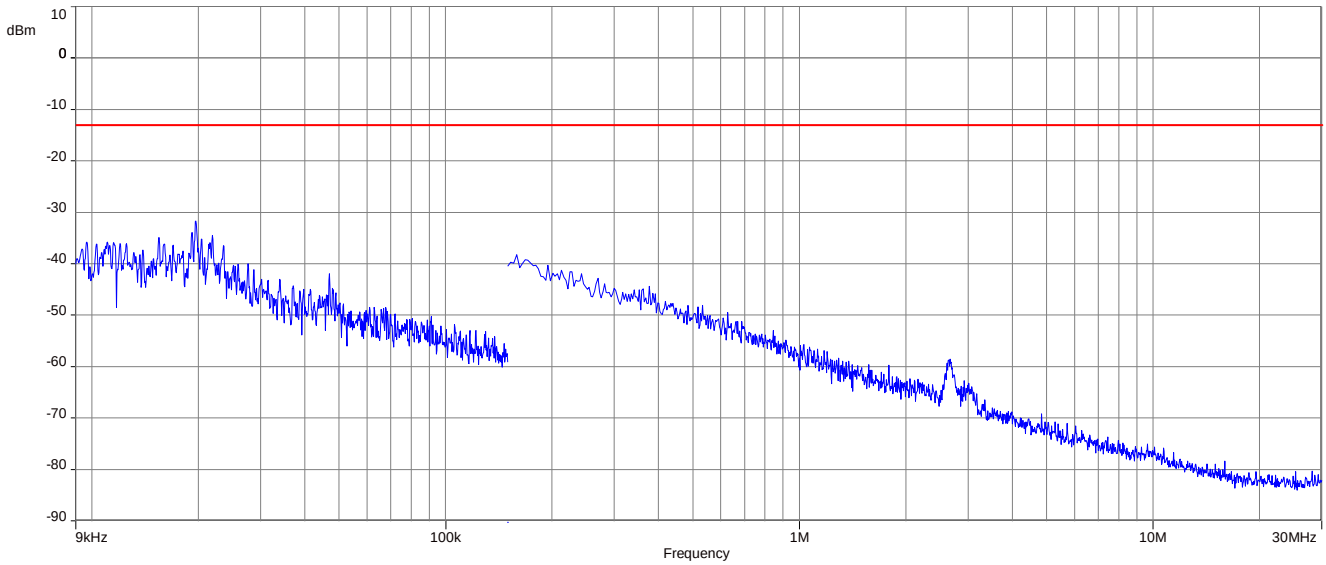
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

16-QAM

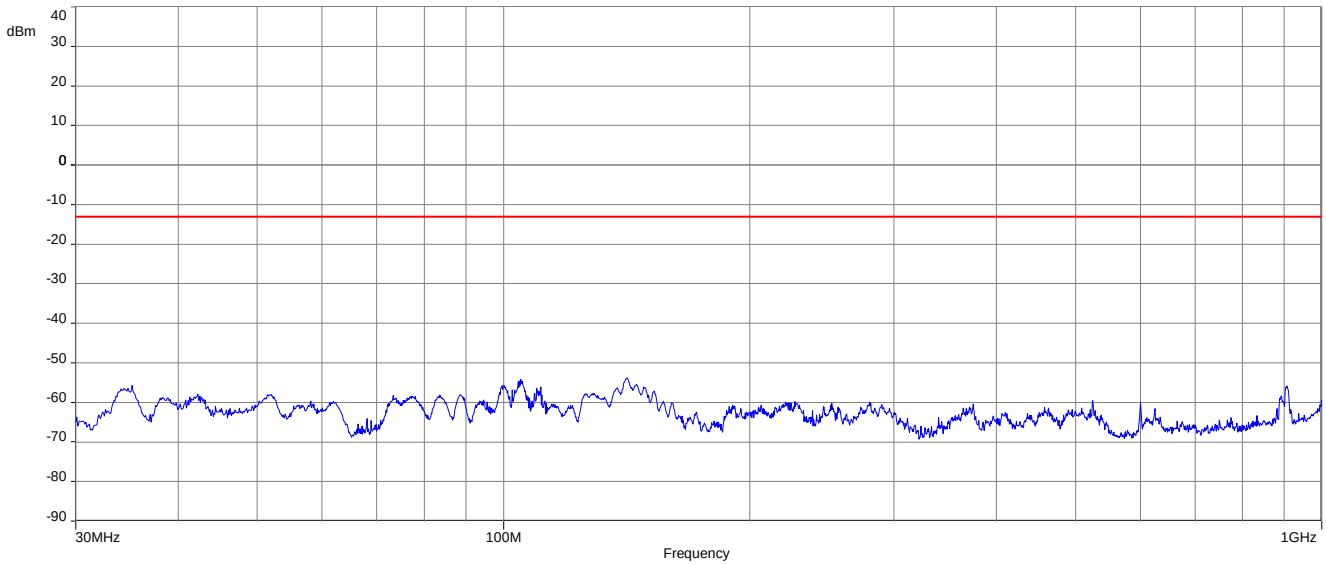
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

Results: QPSK with 10 MHz channel bandwidth

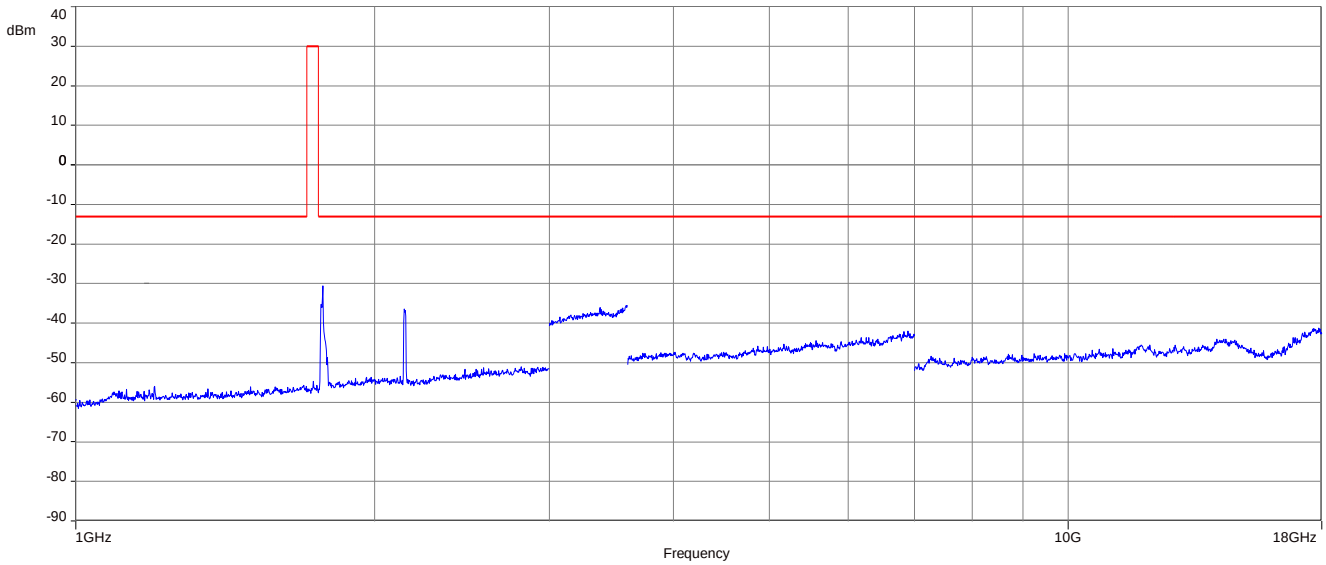
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1 GHz



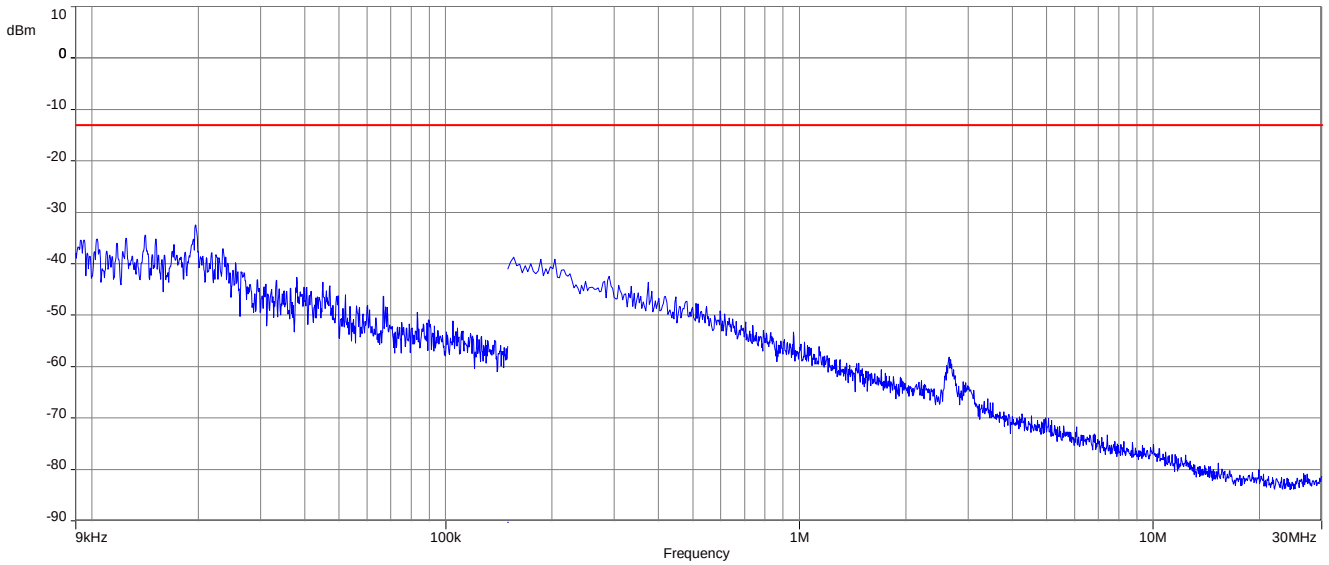
Plot 3: Middle channel, 1 GHz to 18 GHz



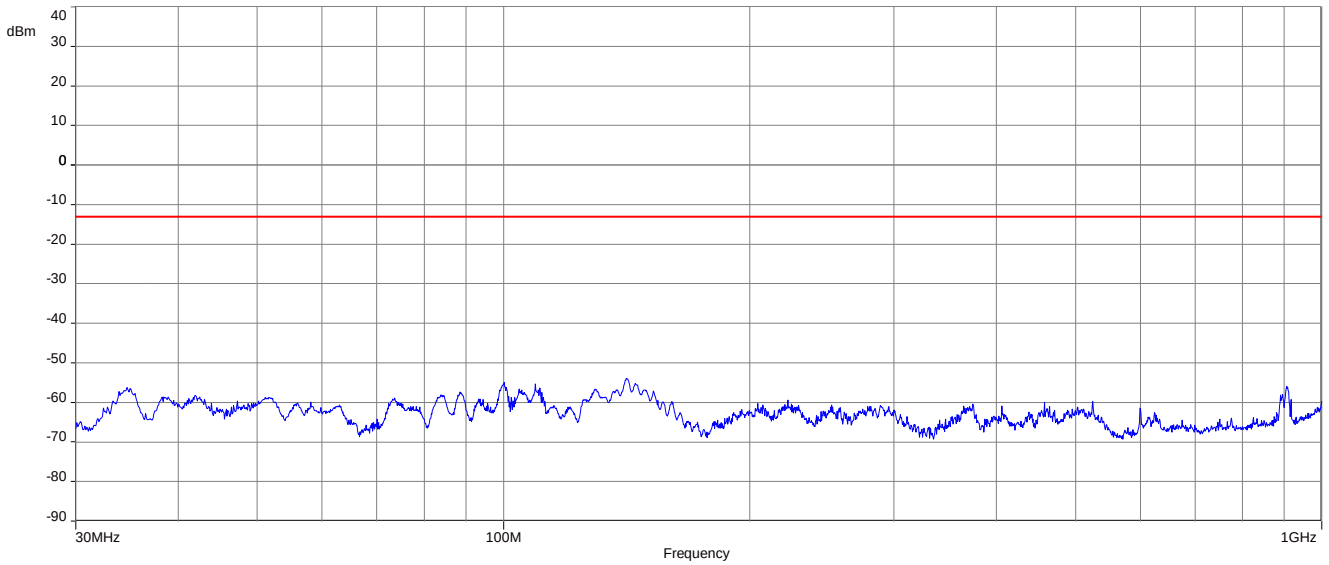
Carrier notched with 1.7 GHz rejection filter, the shown peak around 2.1 GHz is caused by the downlink signal

Results: 16-QAM with 10 MHz channel bandwidth

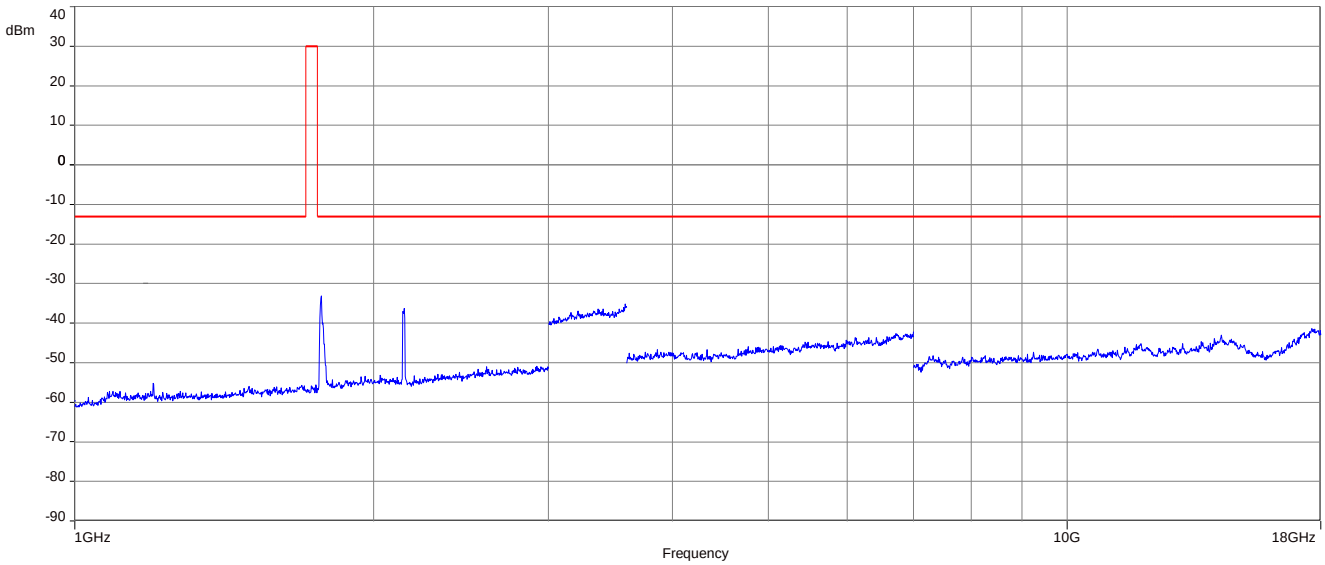
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1 GHz



Plot 3: Middle channel, 1 GHz to 18 GHz



Carrier notched with 1.7 GHz rejection filter, the shown peak around 2.1 GHz is caused by the downlink signal

15.4.3 Spurious emissions radiated (Taoglas Puck antenna)

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 1755 MHz. Measurement made up to 26 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.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&D; 7.3 - A
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)
-13 dBm

QPSK

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

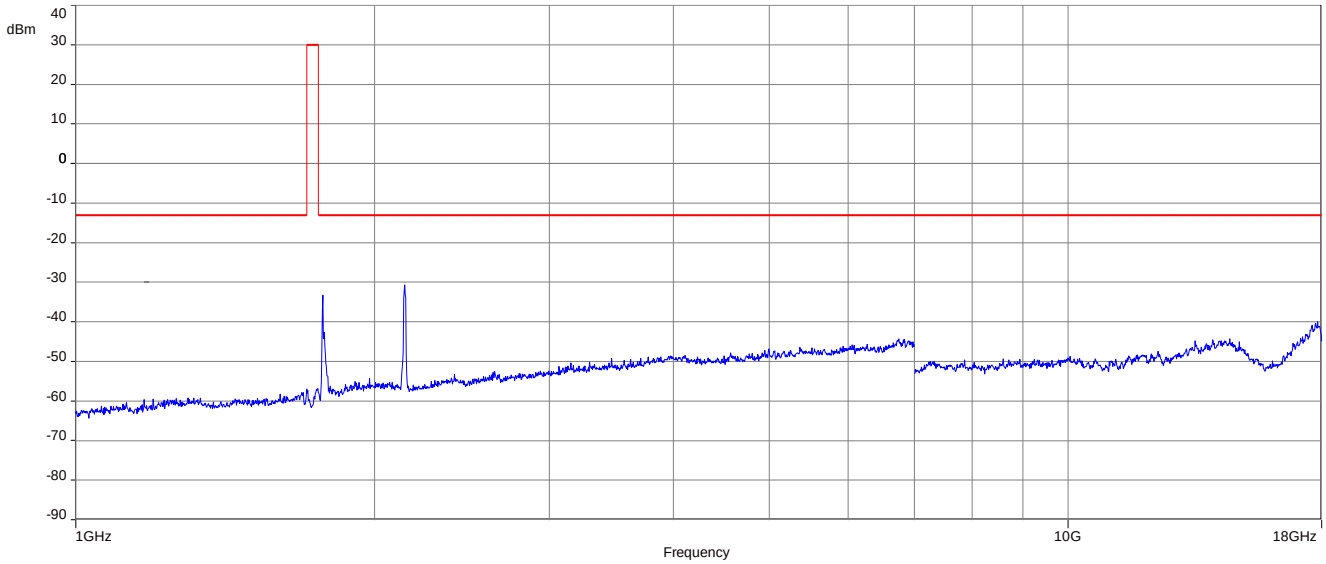
16-QAM

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

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz

Plot 2: Middle channel, 1 GHz to 18 GHz

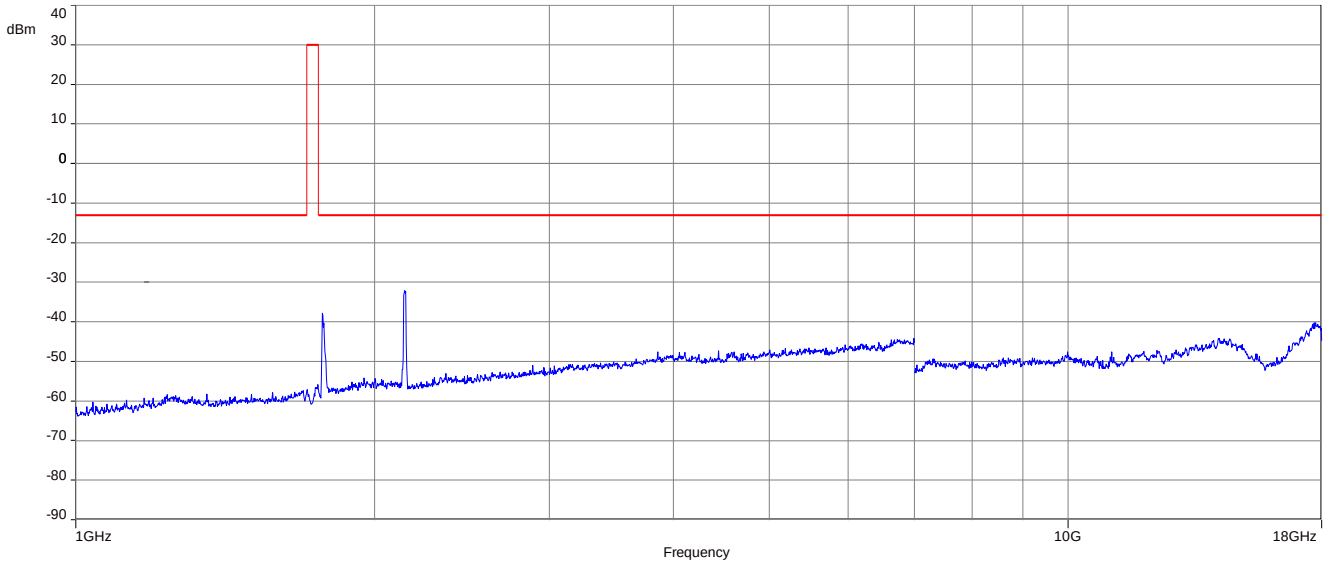


Carrier notched with 1.7 GHz rejection filter, the shown peak around 2.1 GHz is caused by the downlink signal

Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz

Plot 2: Middle channel, 1 GHz to 18 GHz



Carrier notched with 1.7 GHz rejection filter, the shown peak around 2.1 GHz is caused by the downlink signal

15.4.4 Spurious emissions radiated (Candy bar antenna)

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 1755 MHz. Measurement made up to 26 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.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&B; 7.3 - A
Measurement uncertainty	See chapter 9

Limits:

ISED
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) / (P, Power in Watts)
-13 dBm

QPSK

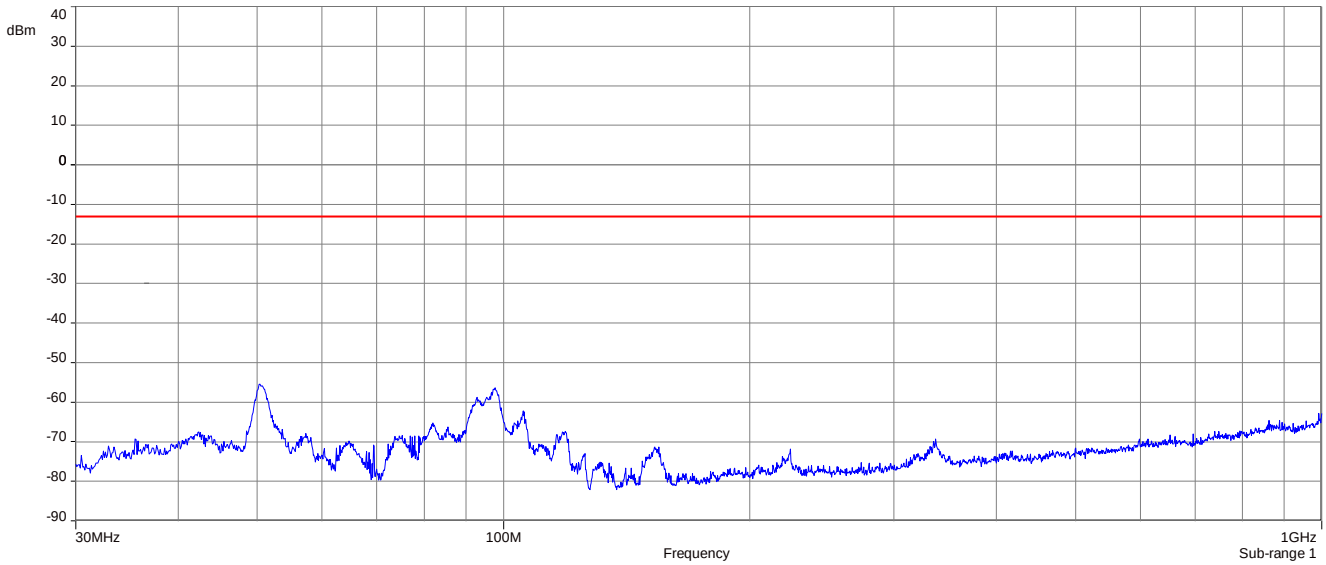
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

16-QAM

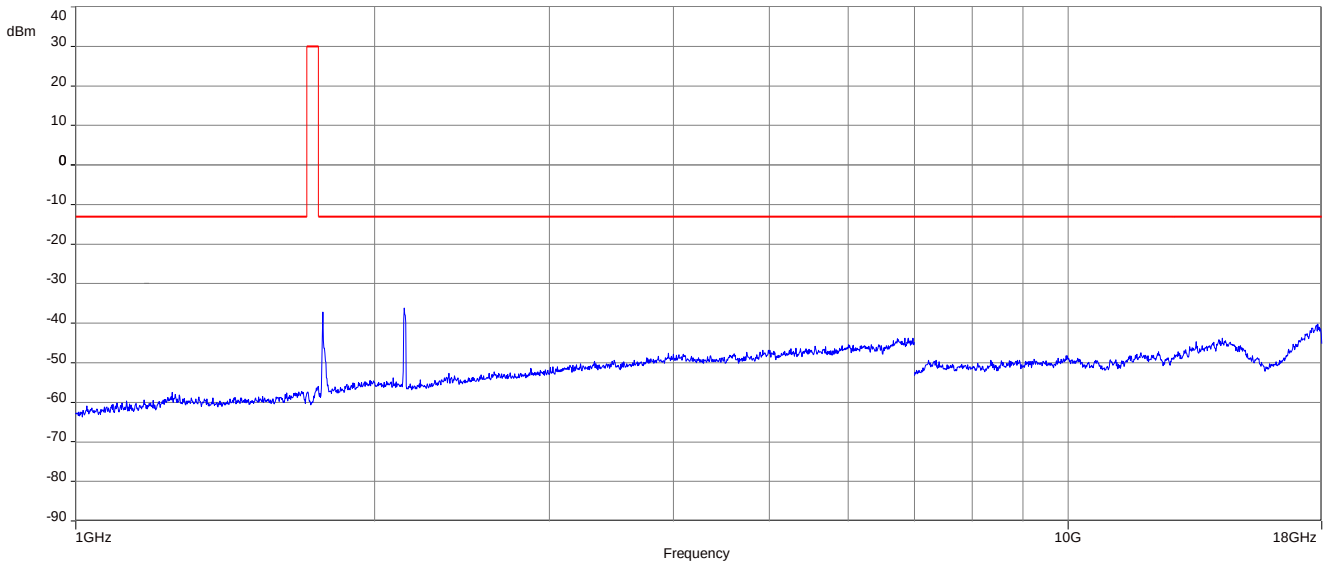
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
All detected emissions are more than 20dB below the limit!					
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-		-
	-		-	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

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



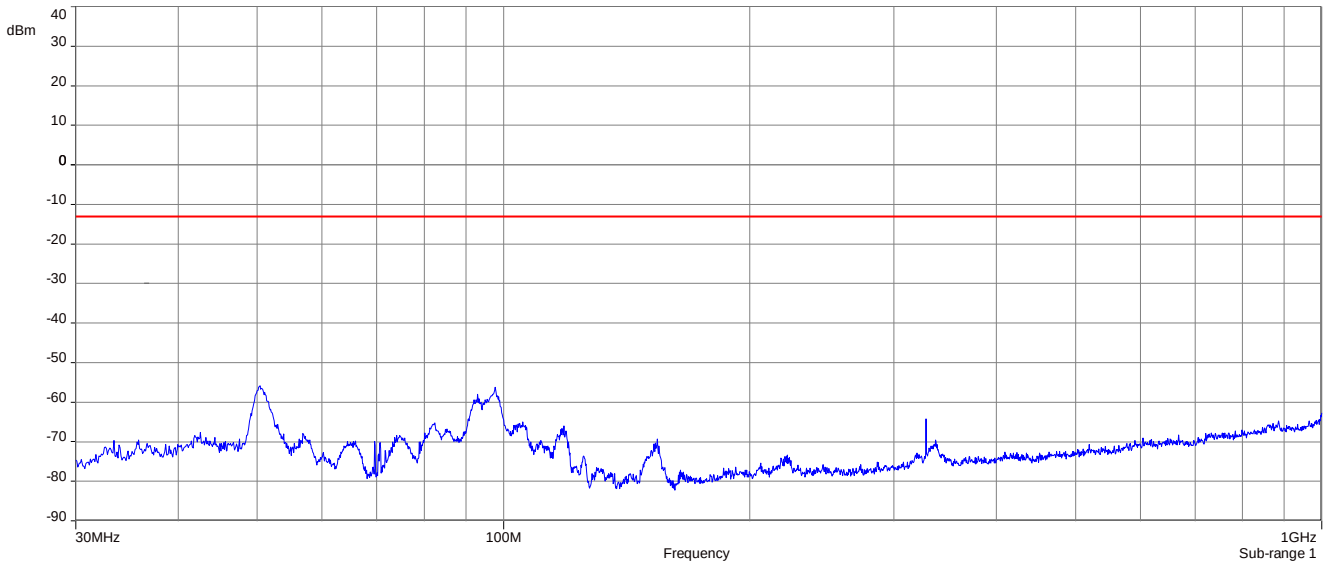
Plot 2: Middle channel, 1 GHz to 18 GHz



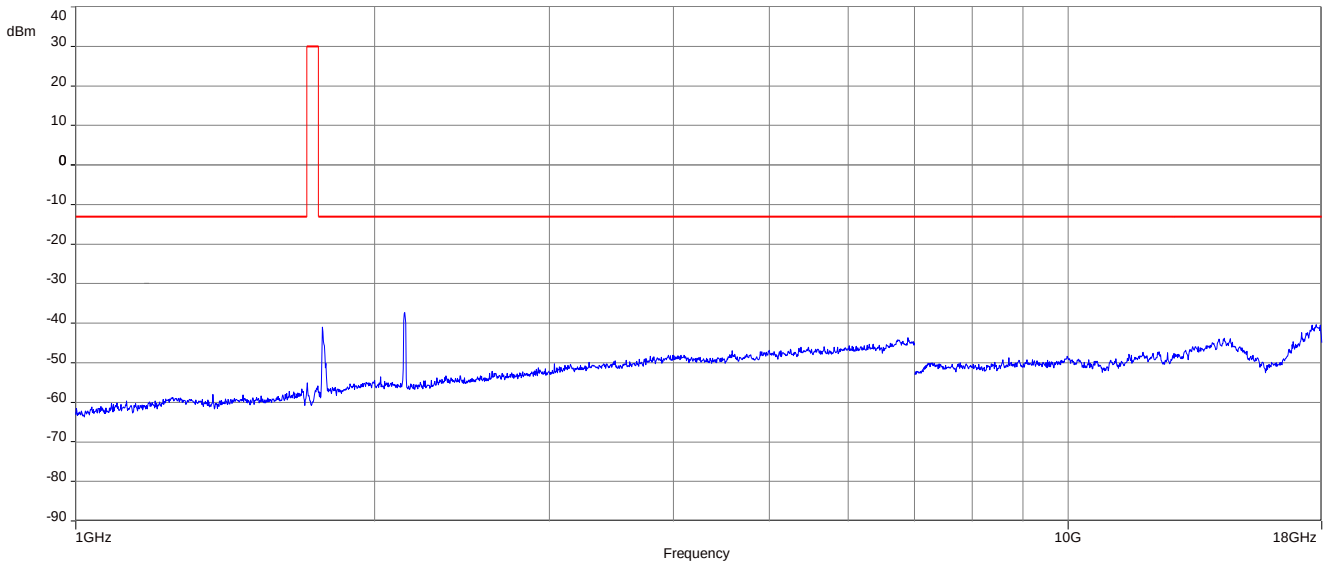
Carrier notched with 1.7 GHz rejection filter, the shown peak around 2.1 GHz is caused by the downlink signal

Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



Plot 2: Middle channel, 1 GHz to 18 GHz



Carrier notched with 1.7 GHz rejection filter, the shown peak around 2.1 GHz is caused by the downlink signal

15.5 Results LTE – Band 71

The EUT was set to transmit the maximum power.

15.5.1 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	Measured with CMW500
Sweep time	
Video bandwidth	
Resolution bandwidth	
Span	
Trace mode	
Setup	See chapter 7.4 – A
Measurement uncertainty	See chapter 9

Limits:

FCC
Nominal Peak Output Power
+33.00 dBm 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.

Results:

Output Power (conducted)						
Bandwidth (MHz)	**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)**
5	665.5	1 RB low	22.89	-/-	22.05	-/-
		1 RB high	23.06	-/-	22.18	-/-
		50% RB mid	22.02	-/-	21.18	-/-
		100% RB	21.83	-/-	20.66	-/-
	680.5	1 RB low	22.96	-/-	22.49	-/-
		1 RB high	23.03	-/-	22.51	-/-
		50% RB mid	22.10	-/-	21.16	-/-
		100% RB	22.13	-/-	21.21	-/-
	695.5	1 RB low	22.95	-/-	22.45	-/-
		1 RB high	22.93	-/-	22.12	-/-
		50% RB mid	22.08	-/-	21.29	-/-
		100% RB	21.91	-/-	21.13	-/-
10	668	1 RB low	23.10	-/-	21.73	-/-
		1 RB high	23.00	-/-	21.93	-/-
		50% RB mid	22.09	-/-	21.18	-/-
		100% RB	21.96	-/-	20.94	-/-
	680.5	1 RB low	23.08	-/-	22.51	-/-
		1 RB high	23.09	-/-	22.50	-/-
		50% RB mid	22.11	-/-	21.21	-/-
		100% RB	21.76	-/-	20.96	-/-
	693	1 RB low	23.04	-/-	22.53	-/-
		1 RB high	23.01	-/-	21.79	-/-
		50% RB mid	22.13	-/-	21.37	-/-
		100% RB	22.09	-/-	21.12	-/-

15	670.5	1 RB low	22.97		21.78	
		1 RB high	23.00		22.15	
		50% RB mid	22.06		21.18	
		100% RB	22.30		21.23	
	680.5	1 RB low	23.01		22.38	
		1 RB high	23.06		22.47	
		50% RB mid	22.14		21.18	
		100% RB	21.98		20.94	
	690.5	1 RB low	23.03		22.43	
		1 RB high	23.08		21.76	
		50% RB mid	22.12		21.06	
		100% RB	22.16		21.25	
20	673	1 RB low	22.78		22.49	
		1 RB high	22.83		22.36	
		50% RB mid	22.16		21.17	
		100% RB	22.40		21.42	
	680.5	1 RB low	22.85		22.48	
		1 RB high	22.91		22.47	
		50% RB mid	22.05		21.19	
		100% RB	21.61		20.77	
	688	1 RB low	22.94		22.46	
		1 RB high	22.76		22.39	
		50% RB mid	22.06		21.14	
		100% RB	22.44		21.34	

NOTE: All values are within the module maximum output power values range of 20.3 dBm to 24.0 dBm (extracted from module user manual).

15.5.2 Spurious emissions radiated (Taoglas Supercombo antenna)

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 784.5 MHz. Measured up to 12.75 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 13.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&C
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

QPSK

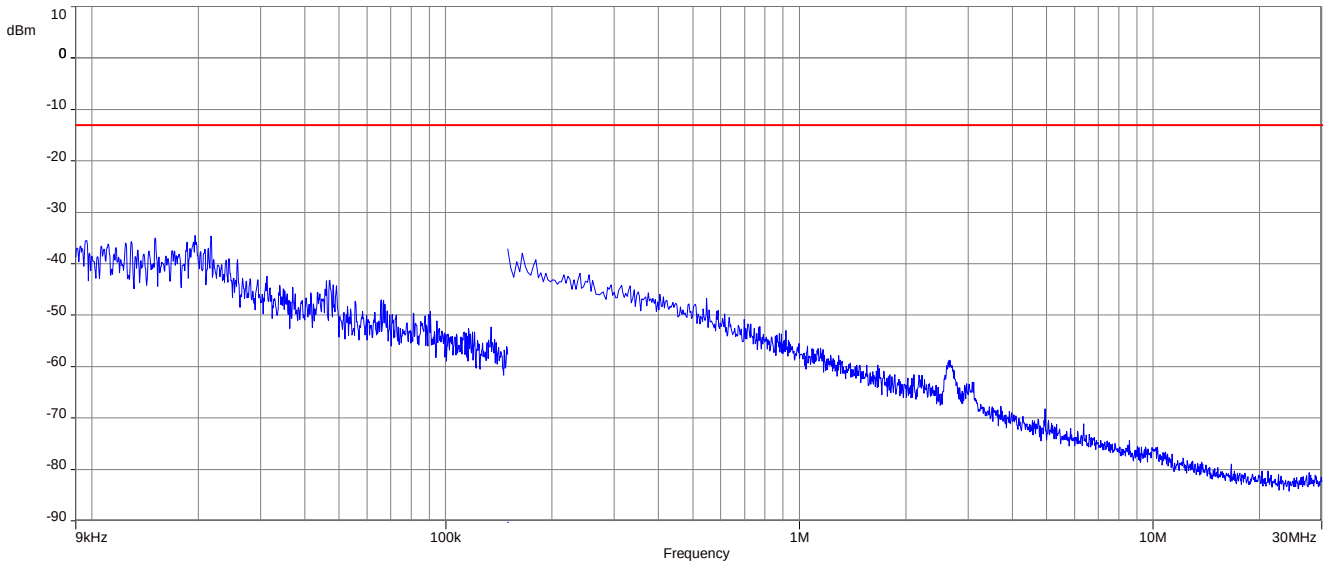
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		

16-QAM

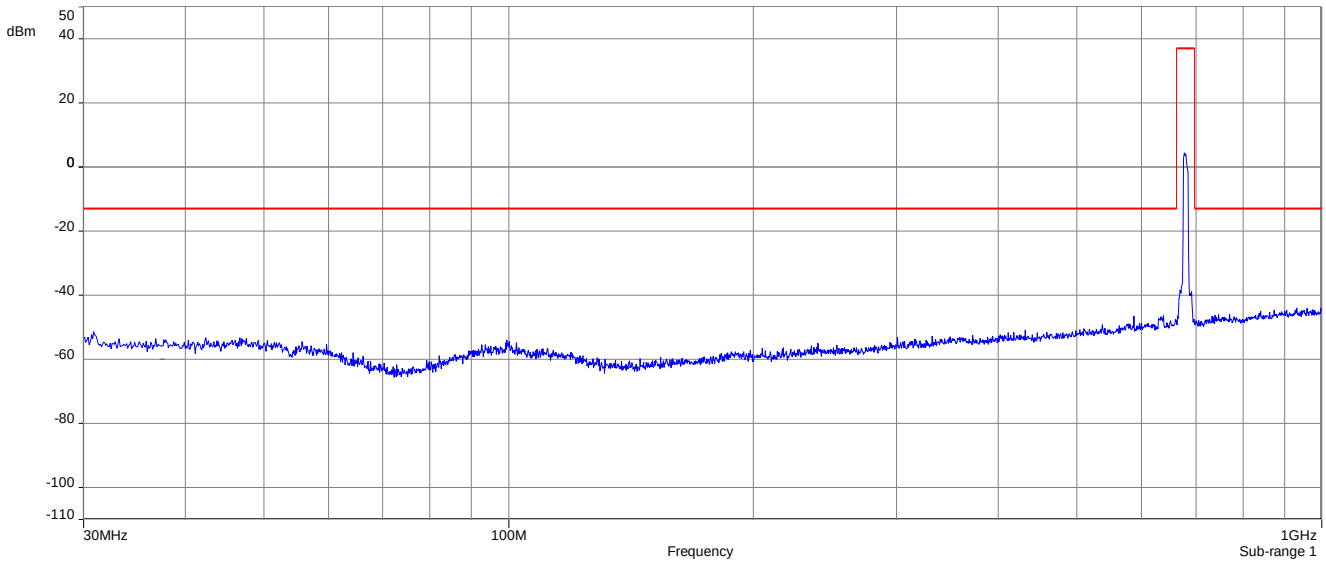
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		

Results: QPSK with 10 MHz channel bandwidth

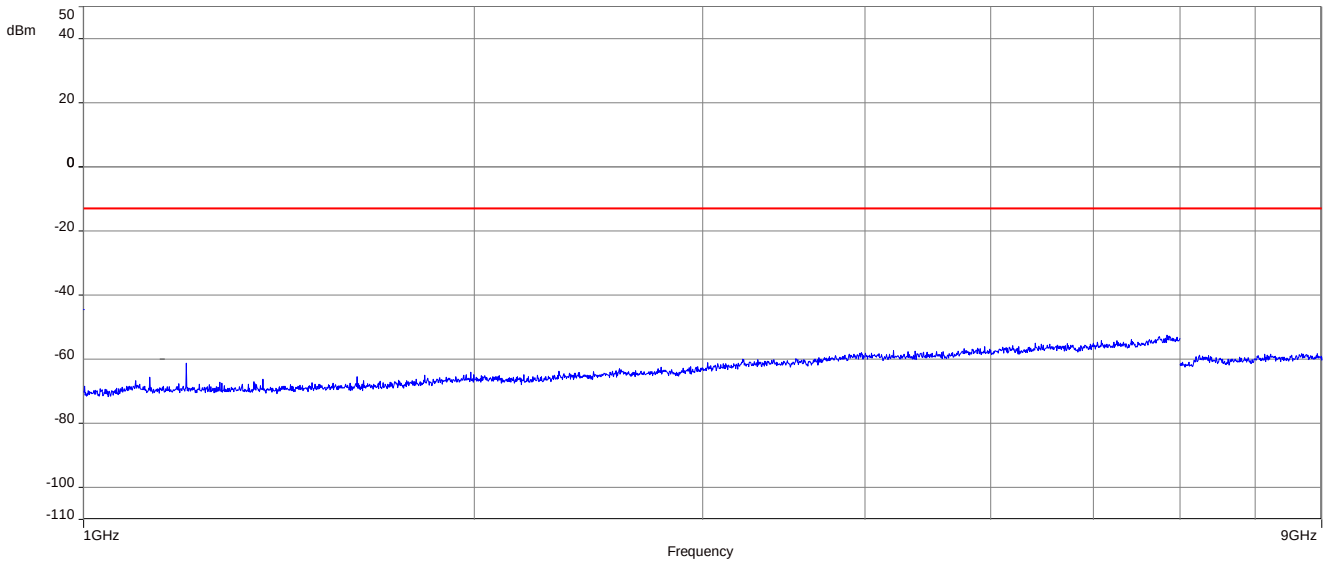
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1 GHz

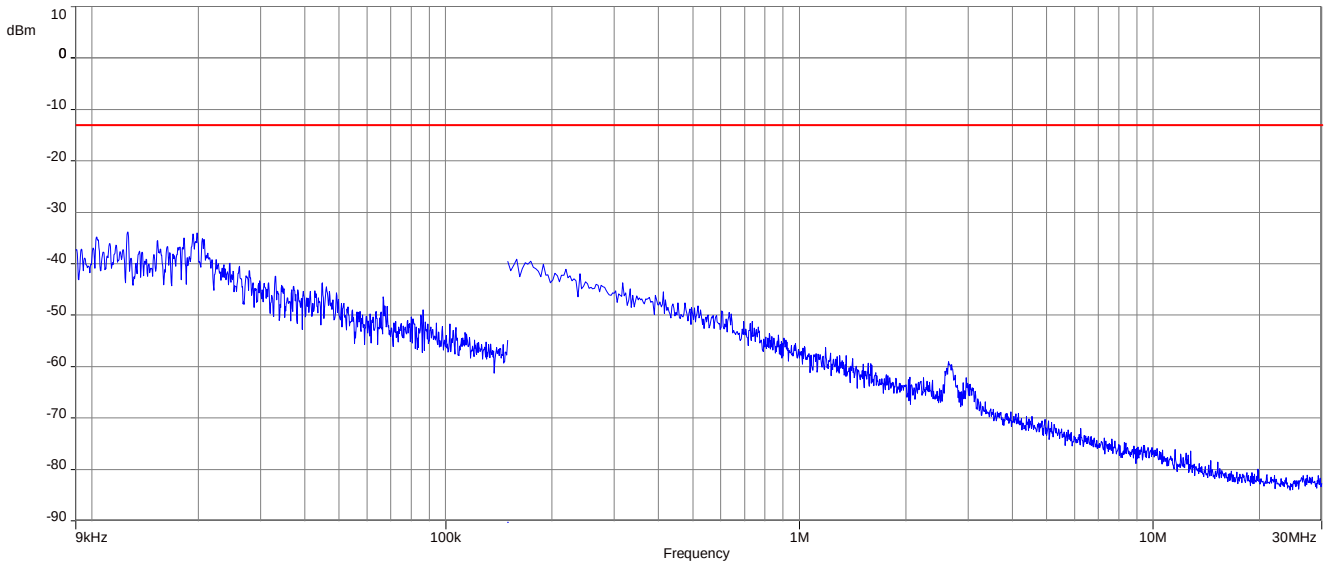


Plot 3: Middle channel, 1 GHz to 9 GHz

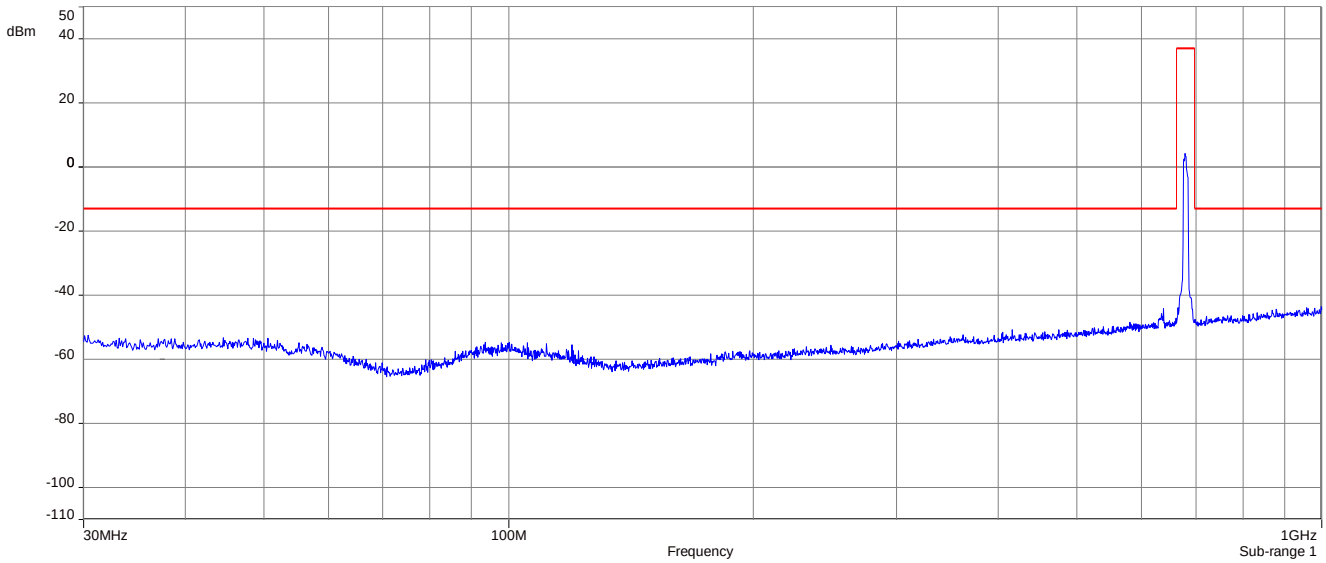


Results: 16-QAM with 10 MHz channel bandwidth

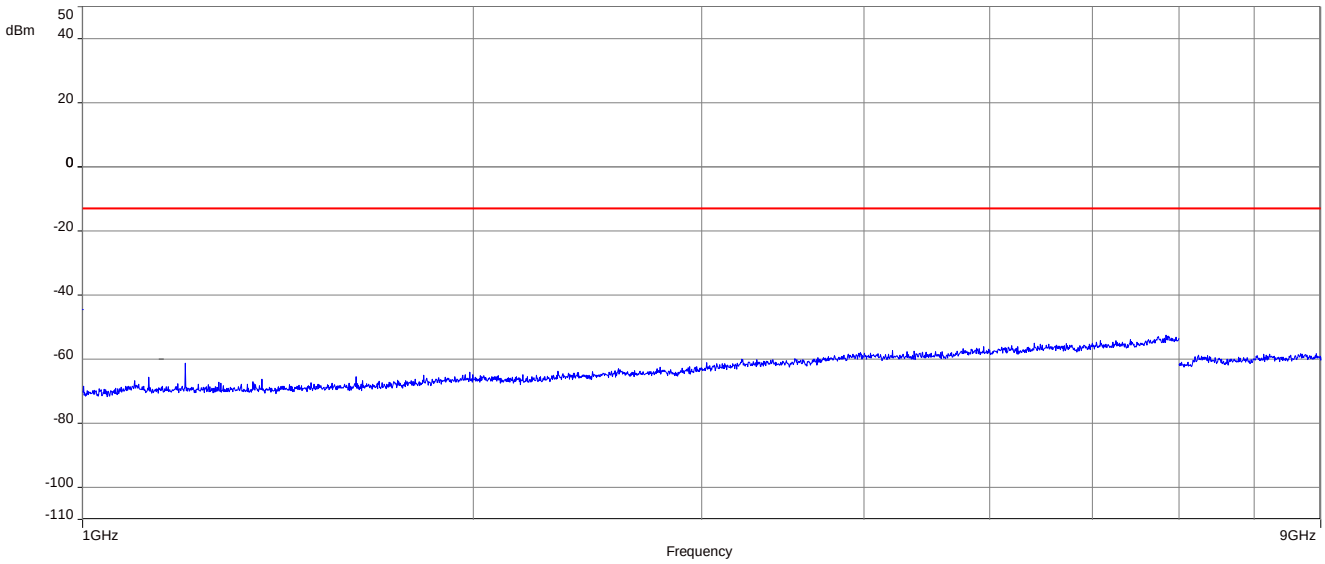
Plot 1: Middle channel, up to 30 MHz



Plot 2: Middle channel, 30 MHz to 1 GHz



Plot 3: Middle channel, 1 GHz to 9 GHz



15.5.3 Spurious emissions radiated (Taoglas Puck antenna)

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 784.5 MHz. Measured up to 12.75 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 13.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&C
Measurement uncertainty	See chapter 9

Limits:

FCC
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

QPSK

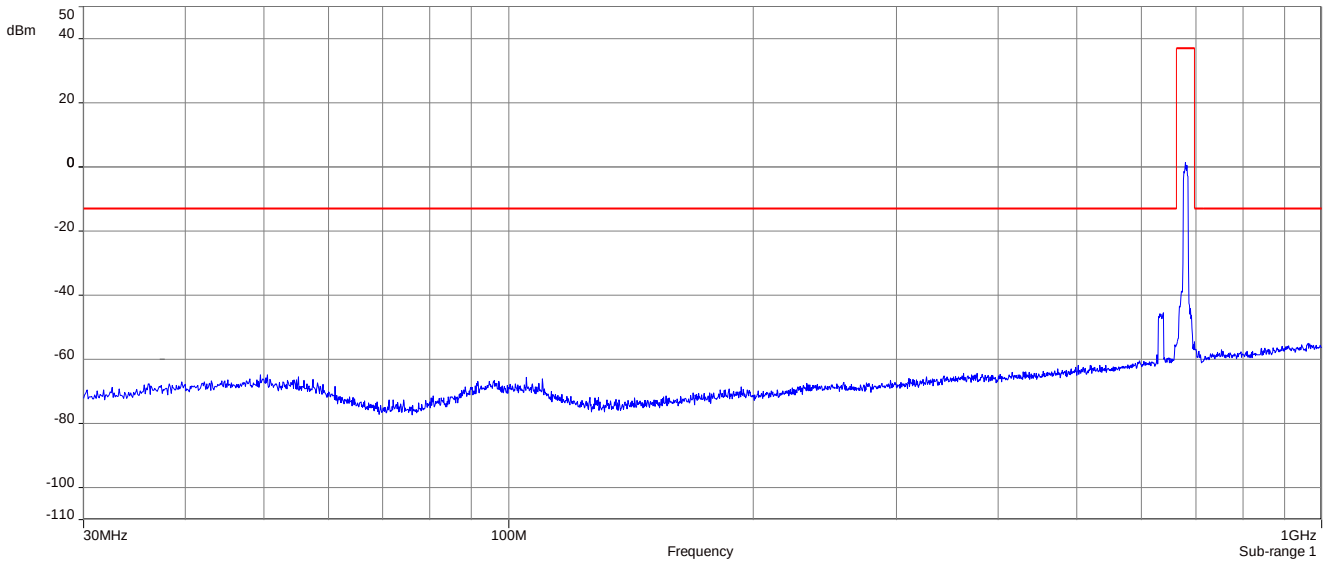
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		

16-QAM

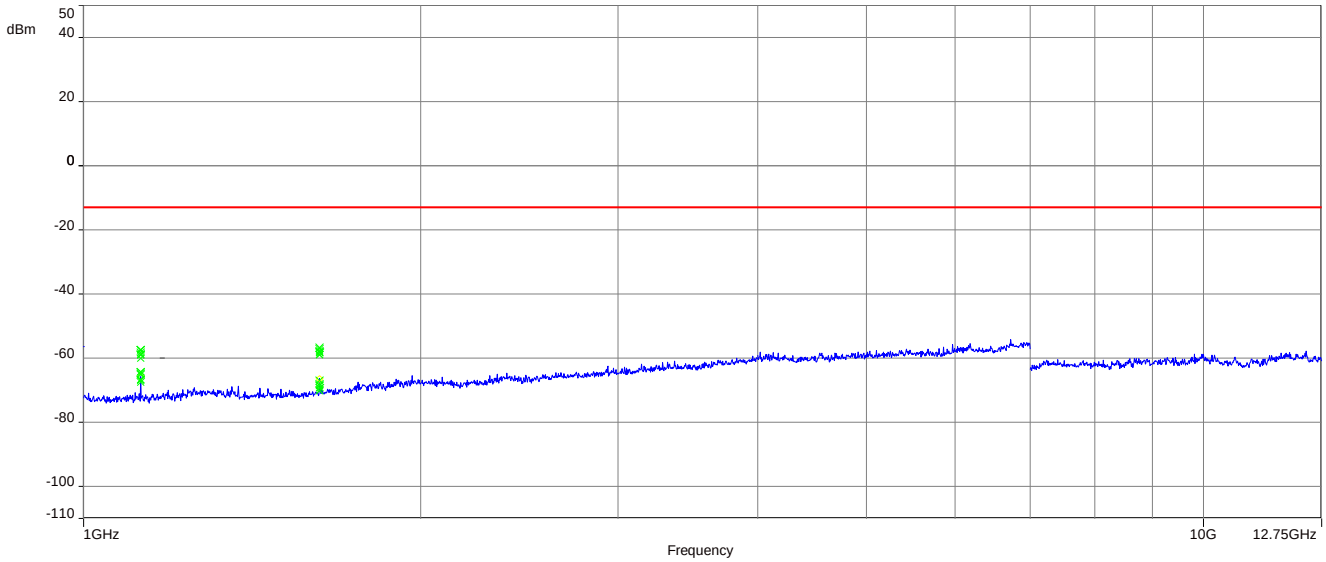
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz

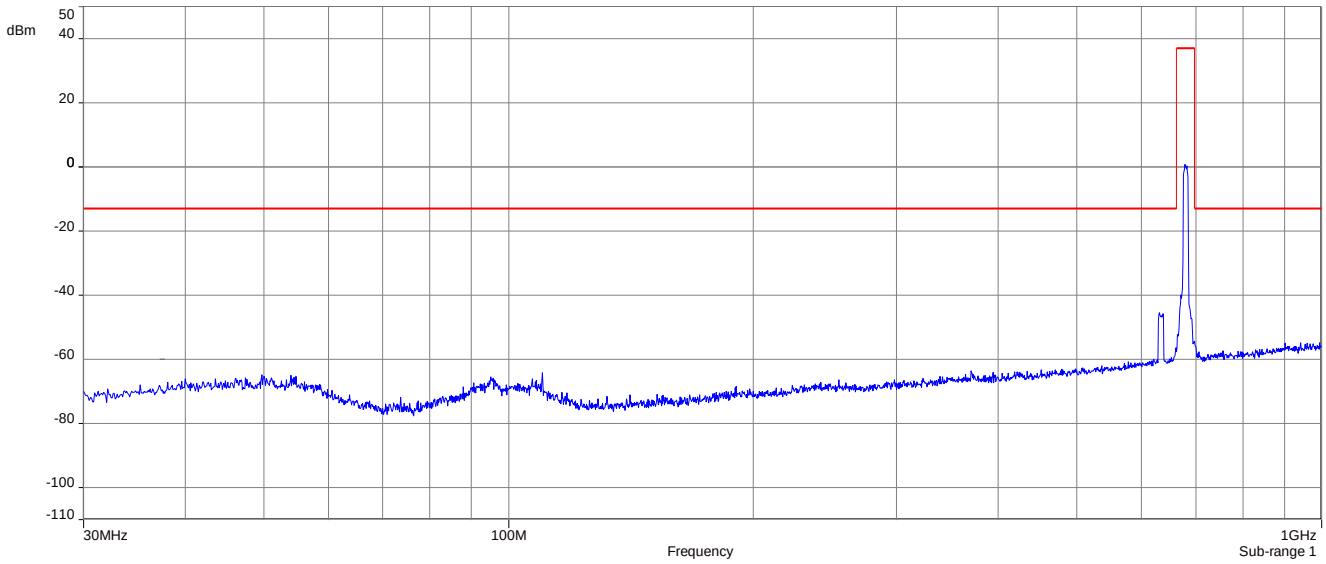


Plot 2: Middle channel, 1 GHz to 9 GHz

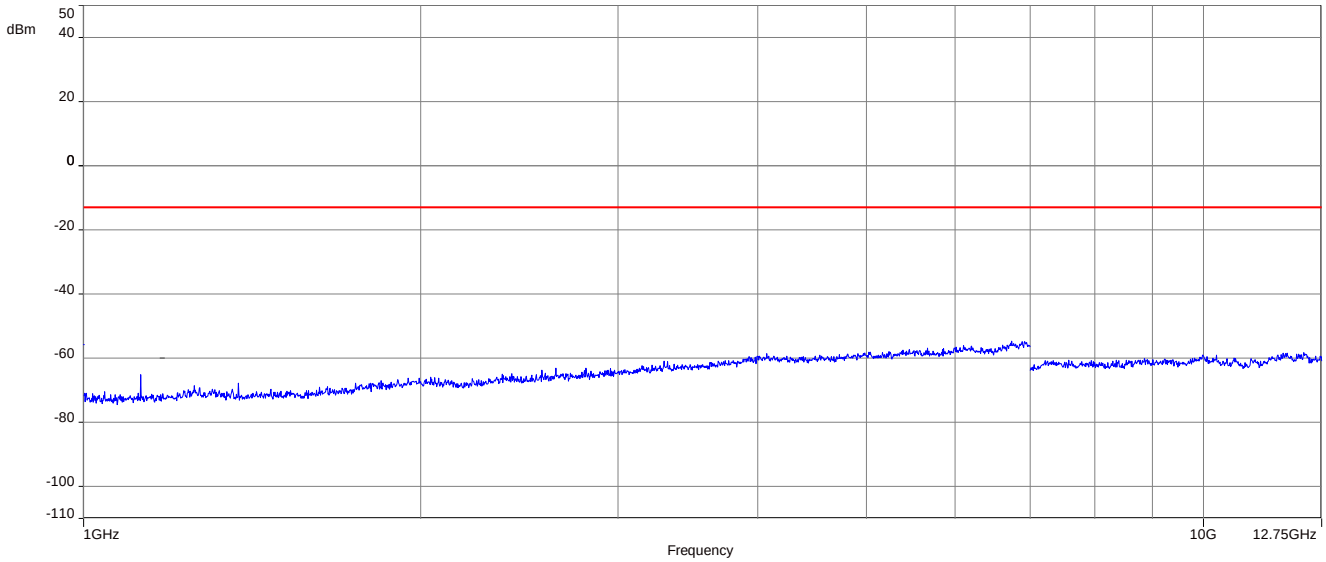


Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



Plot 2: Middle channel, 1 GHz to 9 GHz



15.5.4 Spurious emissions radiated (Candy bar antenna)

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 784.5 MHz. Measured up to 12.75 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 13.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	2 sec.
Video bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span	100 MHz Steps
Trace mode	Max Hold
Setup	See chapter 7.1 - A; 7.2 - A&B
Measurement uncertainty	See chapter 9

Limits:

ISED
Spurious Emissions Radiated
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)
-13 dBm

QPSK

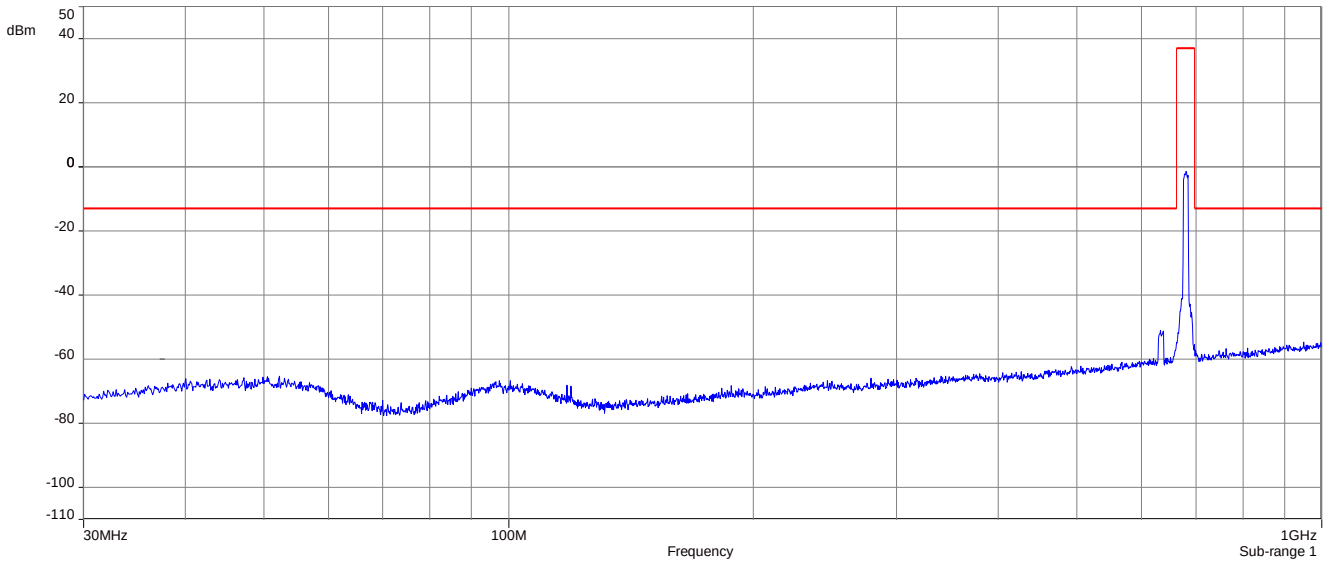
Spurious Emission Level (dBm)					
Lowest channel		**Middle channel**		**Highest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		

16-QAM

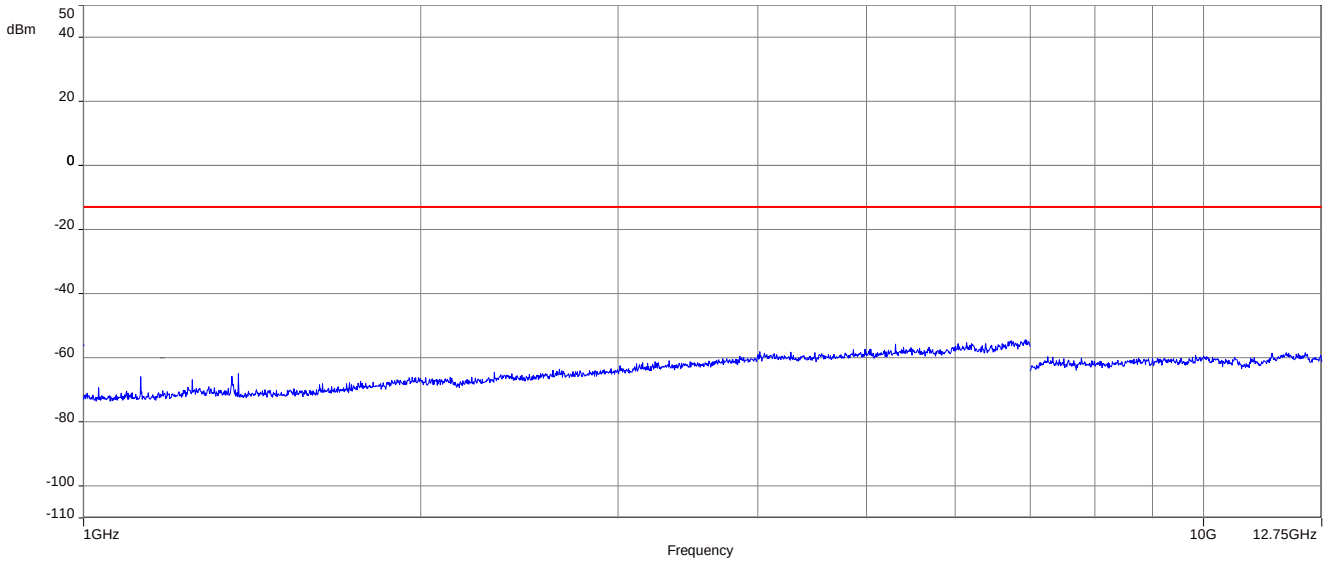
Spurious Emission Level (dBm)					
Lowest channel		**Lowest channel**		**Lowest channel**	
Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]	Spurious emissions	Level [dBm]
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		
		-/-	-/-		

Results: QPSK with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz

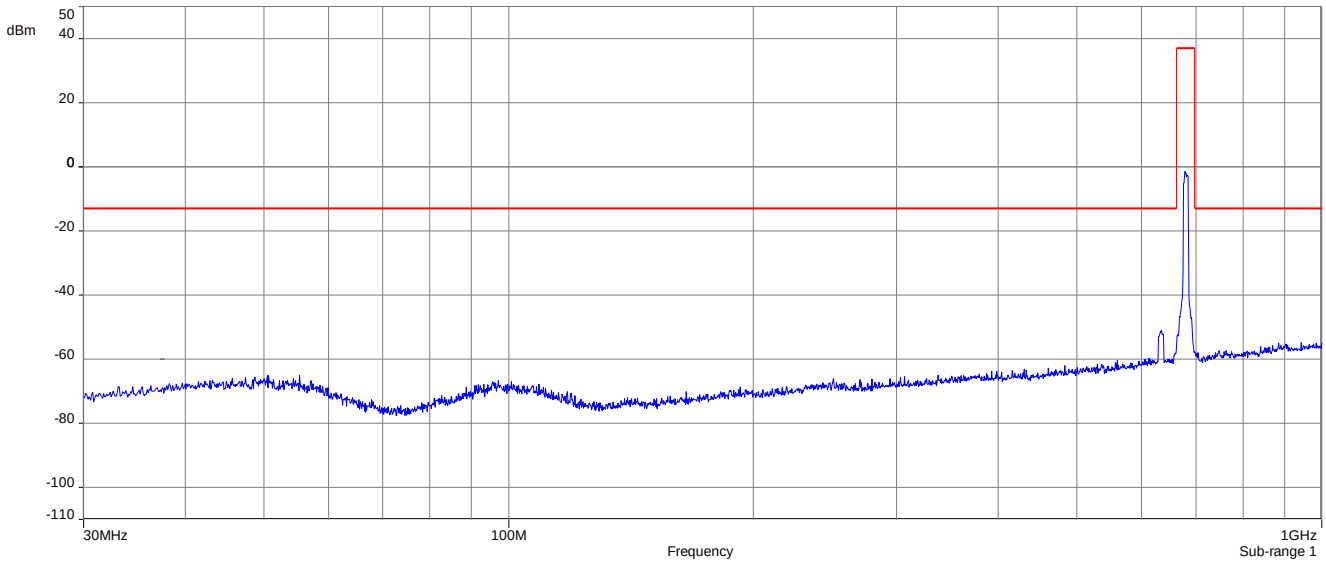


Plot 2: Middle channel, 1 GHz to 9 GHz

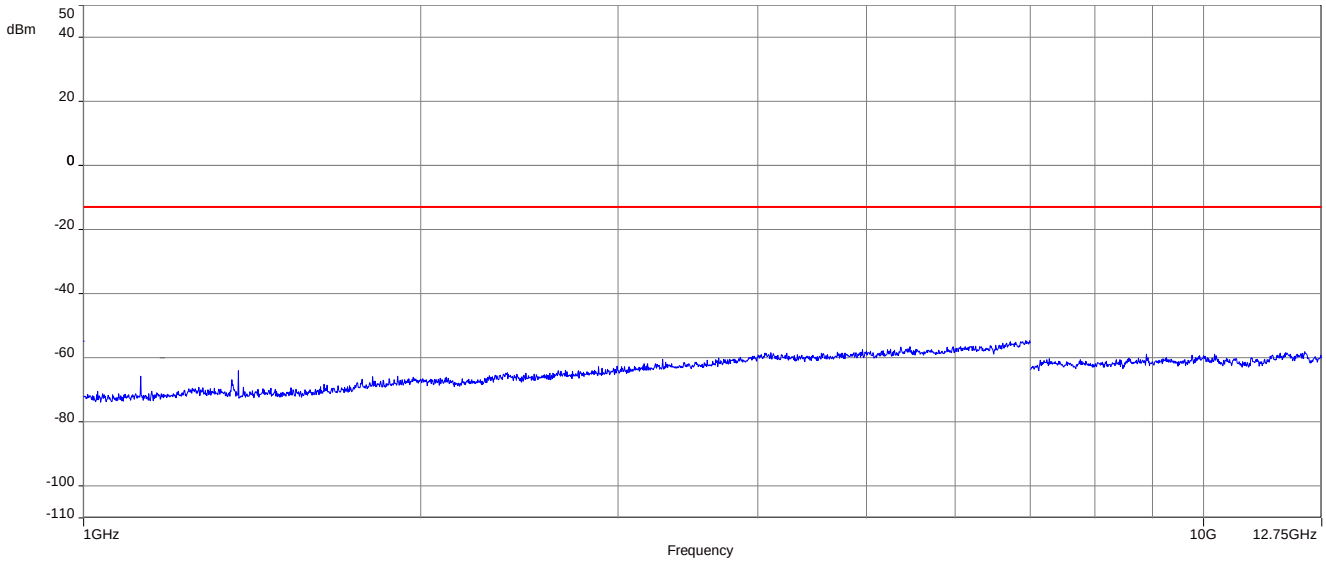


Results: 16-QAM with 10 MHz channel bandwidth

Plot 1: Middle channel, 30 MHz to 1 GHz



Plot 2: Middle channel, 1 GHz to 9 GHz



16 Antenna gain and radiated output power of the module

Measurement parameters (radiated)	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	3 MHz
Video bandwidth	3 MHz
Span	5 MHz
Trace mode	Max hold
Test setup	See sub clause 7.5 setup A
Measurement uncertainty	See sub clause 9

The tests were performed with the antennas connected directly to a CW signal generator.

The conducted output values were extracted from the module test reports.

Results: Taoglass Supercombo antenna

	Gain [dBi] Measured
LTE band 7 (2500 – 2570 MHz)	3.0
LTE band 12 (699 – 716 MHz)	0.3
LTE band 25 (1850 – 1915 MHz)	5.4
LTE band 26 (814 – 849 MHz)	-1.7
LTE band 66 (1710 – 1780 MHz)	4.3
LTE band 71 (663 – 698 MHz)	-0.1

Results: Taoglass Puck antenna

	Gain [dBi] Measured
LTE band 7 (2500 – 2570 MHz)	7.7
LTE band 12 (699 – 716 MHz)	-0.8
LTE band 25 (1850 – 1915 MHz)	3.9
LTE band 26 (814 – 849 MHz)	-0.2
LTE band 66 (1710 – 1780 MHz)	5.3
LTE band 71 (663 – 698 MHz)	-2.1

Results: Candy bar antenna

	Gain [dBi] Measured
LTE band 7 (2500 – 2570 MHz)	6.4
LTE band 12 (699 – 716 MHz)	-0.1
LTE band 25 (1850 – 1915 MHz)	3.8
LTE band 26 (814 – 849 MHz)	-0.3
LTE band 66 (1710 – 1780 MHz)	3.6
LTE band 71 (663 – 698 MHz)	-3.9

Results: Module eirp power calculation

	Module conducted output power [dBm]	Gain Taoglass Supercombo antenna [dBi]	Gain Taoglass Puck antenna [dBi]	Gain Candy bar antenna [dBi]	Calculated e.i.r.p. power of the module with Taoglass Supercombo antenna [dBm]	Calculated e.i.r.p. power of the module with Taoglass Puck antenna [dBm]	Calculated e.i.r.p. power of the module with Candy bar antenna [dBm]	Limit [dBm]
LTE band 7 (2500 – 2570 MHz)	22.23	3.0	7.7	6.4	25.23	29.93	28.63	33
LTE band 12 (699 – 716 MHz)	20.66	0.3	-0.8	-0.1	20.96	19.86	20.56	34.77
LTE band 25 (1850 – 1915 MHz)	22.7	5.4	3.9	3.8	28.1	26.6	26.5	33
LTE band 26 (814 – 849 MHz)	20.84	-1.7	-0.2	-0.3	19.14	20.64	20.54	38.45
LTE band 66 (1710 – 1780 MHz)	22.78	4.3	5.3	3.6	27.08	28.08	26.38	30
LTE band 71 (663 – 698 MHz)	20.93	-0.1	-2.1	-3.9	20.83	18.83	17.03	34.77

Conclusion: All output power values are below the applicable ERP/EIRP limits.

The power values of the module were extracted from the module test reports:
Test-Report-Part-22-1-6026706 06V0.pdf
Test-Report-Part-22-2-6026707 06V0.pdf
Test-Report-Part-24-1-6026759 06V0.pdf
Test-Report-Part-24-2-6026760 06V0.pdf
Test-Report-Part-27-1-6026761 06V0.pdf
Test-Report-Part-27-2-6026762 06V0.pdf
Test-Report-Part-27-4-6026764 06V0.pdf

17 Glossary

AVG	Average
C	Compliant
C/N$_0$	Carrier to noise-density ratio, expressed in dB-Hz
CAC	Channel availability check
CW	Clean wave
DC	Duty cycle
DFS	Dynamic frequency selection
DSSS	Dynamic sequence spread spectrum
DUT	Device under test
EN	European Standard
ETSI	European Telecommunications Standards Institute
EMC	Electromagnetic Compatibility
EUT	Equipment under test
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
FHSS	Frequency hopping spread spectrum
FVIN	Firmware version identification number
GNSS	Global Navigation Satellite System
GUE	GNSS User Equipment
HMN	Host marketing name
HVIN	Hardware version identification number
HW	Hardware
IC	Industry Canada
Inv. No.	Inventory number
MC	Modulated carrier
NA	Not applicable
NC	Not compliant
NOP	Non occupancy period
NP	Not performed
OBW	Occupied bandwidth
OC	Operating channel
OCW	Operating channel bandwidth
OFDM	Orthogonal frequency division multiplexing
OOB	Out of band
OP	Occupancy period
PER	Packet error rate
PMN	Product marketing name
PP	Positive peak
QP	Quasi peak
RLAN	Radio local area network
S/N or SN	Serial number
SW	Software
UUT	Unit under test
WLAN	Wireless local area network

18 Document history

Version	Applied changes	Date of release
-/-	Initial release	2024-05-03

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