

Test report No:
NIE: 66697RRF.001

Test report

Reference Standard:
USA FCC Part 24
CANADA IC RSS-133

(*) Identification of item tested	LTE Cat-M Cellular communication module
(*) Trademark	Sequans Communications
(*) Model and /or type reference	GM02S
Other identification of the product	HW version: GM02Sv1 SW version: LR8.0.0.1-51281 FCC ID: 2AAGMGM02S IC: 12732A-GM02S IMEI TAC: 01577000
(*) Features	LTE-M, 3GPP LTE Release 13
Applicant	Sequans Communications 55 Boulevard Charles de Gaulle, 92700 Colombes, France
Test method requested, standard	USA FCC Part 24 (10-1-19 Edition). CANADA RSS-133 Issue 6, Amendment 1, Jan. 2018. ANSI C63.26: 2015. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Rafael López EMC Consumer & RF Lab. Manager  RAFAEL LÓPEZ MARTÍN 2020.12.29 14:20:31 +01'00'
Date of issue	2020-12-29
Report template No	FDT08_23 (*) "Data provided by the client"

Index

Competences and guarantees3

General conditions3

Uncertainty3

Data provided by the client.....3

Usage of samples4

Test sample description4

Identification of the client.....6

Testing period and place6

Document history6

Environmental conditions6

Remarks and comments7

Testing verdicts.....7

Summary8

Appendix A: Test results for FCC 24 / RSS-133.....9

Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory competent to carry out the tests described in this report.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document. **IMPORTANT:** No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification S.A.U.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model GM02S is a multi-band module supporting cellular LTE-M Release 13. It supports HD-FDD.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: the client.

- Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
66697B/001	LTE Cat-M Cellular communication module	GM02S	58K2050000181	2020/11/30
66697B/006	External Antenna	OmniLOG 90200	--	2020/11/30

Auxiliary elements used with the Sample S/01:

Control N°	Description	Model	Serial N°	Date of reception
66697B/005	USB Cable	--	--	2020/11/30

Sample S/01 has undergone the following test(s): The Radiated tests indicated in Appendix A.

- Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
66697B/004	LTE Cat-M Cellular communication module	GM02S	58K2050000182	2020/11/30

Auxiliary elements used with the Sample S/02:

Control N°	Description	Model	Serial N°	Date of reception
66697B/005	USB Cable	--	--	2020/11/30

Sample S/02 has undergone the following test(s): The Conducted tests indicated in Appendix A.

Test sample description

Ports.....:	Port name and description	Cable				
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾	
		USB	2	☒	☐	☐
Supplementary information to the ports.....:	N/A					
Rated power supply	Voltage and Frequency		Reference poles			
	☐ AC:		☐	☐	☐	☐
	☒ DC: 3.3Vdc USB port					
Rated Power	Not provided data					
Clock frequencies.....:	Not provided data					

Other parameters	Not provided data		
Software version	LR8.0.0.1-51281		
Hardware version	GM02Sv1		
Dimensions in cm (W x H x D)	Not provided data		
Mounting position	☒	Table top equipment	
	☐	Wall/Ceiling mounted equipment	
	☐	Floor standing equipment	
	☐	Hand-held equipment	
	☐	Other: Variable equipment	
Modules/parts.....	Module/parts of test item	Type	Manufacturer
	NEKTAR-B-GM02S	Eval Kit	Sequans
	USB Cable		
	External antenna: http://www.aaronia.com/Datasheets/Antennas/Aaronia_Broadband_Antenna_Omnilog_90200_datasheet.pdf		
Accessories (not part of the test item)	Description	Type	Manufacturer
	N/A		
Documents as provided by the applicant	Description	File name	Issue date
	User Manual	NEKTAR-B_EvalKitUserManual-Rev2	2020-11-20
	AT Commands Reference Manual	GM02S -LR80-ATCommandsRefManual_Rev2	2020-11-13

(3) Only for Medical Equipment

Identification of the client

SEQUANS COMMUNICATIONS

55 Boulevard Charles de Gaulle, 92700 Colombes, France

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-11-30
Date (finish)	2020-12-16

Document history

Report number	Date	Description
66697RRF.001	2020-12-29	First release

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: José Manuel Jiménez, Miguel Manuel López and Nicolás Salguero.

Used instrumentation:

Conducted Measurements

	Last Cal. date	Cal. due date
1. Shielded Room ETS LINDGREN S101	N.A.	N.A.
2. Spectrum analyser Rohde & Schwarz FSV40	2020/03	2022/03
3. Signal analyzer Rohde & Schwarz FSQ8	2020/10	2022/10
4. Climatic chamber BINDER MK 56	2020/03	2021/03
5. DC Power Supply Keysight Technologies U8002A	--	--
6. Digital multimeter FLUKE 179	2020/10	2021/10
7. Universal Radio communication Tester R&S CMW50	2020/04	2021/04

Radiated Measurements

	Last Cal. date	Cal. due date
1. Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2. Shielded Room ETS LINDGREN S101	N.A.	N.A.
3. BiconicalLog antenna ETS LINDGREN 3142E	2020/10	2023/10
4. Broadband Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2020/08	2023/08
5. Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2020/05	2023/05
6. EMI Test Receiver Rohde & Schwarz ESR7	2019/10	2021/10
7. Spectrum analyser Rohde & Schwarz FSV40	2019/10	2021/10
8. RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-3A	2020/10	2021/10
9. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
10. Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2020/04	2021/04

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

FCC PART 24 / RSS-133 PARAGRAPH		
Requirement – Test case	Verdict	Remark
FCC 24.232 / RSS-133 6.4: RF Output Power	P	
FCC 2.1047 / RSS-133 6.2: Modulation Characteristics	P	
FCC 24.235 / RSS-133 6.3: Frequency Stability	P	
FCC 2.1049: Occupied Bandwidth	P	
FCC 24.238 / RSS-133 6.5: Spurious Emissions at Antenna Terminals	P	
FCC 24.238 / RSS-133 6.5: Radiated Emissions	P	
<u>Supplementary information and remarks:</u>		
None.		

Appendix A: Test results for FCC Part 24 / RSS-133

INDEX

TEST CONDITIONS11

RF Output Power12

Frequency Stability15

Modulation Characteristics18

Occupied Bandwidth20

Spurious Emissions at Antenna Terminals24

Spurious Emissions at Antenna Terminals at Block Edges28

Radiated Emissions32

TEST CONDITIONS

Power supply (V):

$V_n = 3.3 \text{ Vdc}$

$V_{min} = 2.805 \text{ Vdc}$

$V_{max} = 3.795 \text{ Vdc}$

The subscripts nom, min and max indicate voltage test conditions (nominal, minimum and maximum respectively), as declared by the applicant.

Type of power supply: DC Voltage from USB port.

ANTENNA:

Device with external and internal antennas.

After a preliminary scan, the determined worst case for the Radiated tests is the external antenna.

For the Conducted tests, the gain of the internal antenna is used.

Declared Gain for antennas:

Middle band	Gain (dBi)	Antenna type
LTE Band 2	+2.4	Internal
	+2.1	External

TEST FREQUENCIES:

LTE Band 2. QPSK AND 16QAM MODULATIONS:

Channel per Nominal Bandwidth (Frequency, MHz)						
	BW = 1.4 MHz (*)	BW = 3 MHz (*)	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Low	18607 (1850.7)	18615 (1851.5)	18625 (1852.5)	18650 (1855)	18675 (1857.5)	18700 (1860)
Middle	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)
High	19193 (1909.3)	19185 (1908.5)	19175 (1907.5)	19150 (1905)	19125 (1902.5)	19100 (1900)

(*) The EUT does not support the Nominal Bandwidths 1.4 MHz, 3 MHz.

RF Output Power

SPECIFICATION

FCC §2.1046 and §24.232:

Mobile/portable stations are limited to 2 Watts (33 dBm) Effective Isotropic Radiated Power (E.I.R.P.).
The peak-to-average ratio (PAR) of the transmission shall not exceed 13 dB.

RSS-133. Clause 6.4:

The peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

METHOD

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

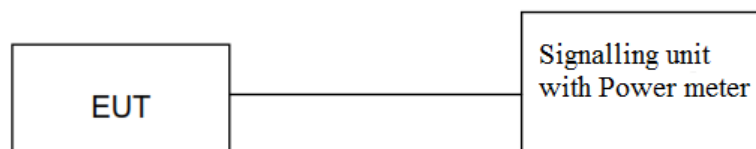
$$E.R.P. = E.I.R.P. - 2.15 \text{ dB}$$

The peak-to-average power ratio (PAPR) is measured using an attenuator, power splitter and spectrum analyser with a Complementary Cumulative Distribution Function implemented.

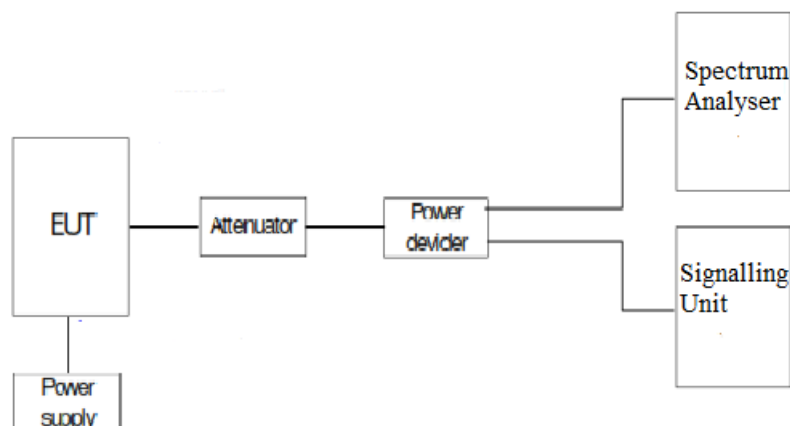
The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP

1. CONDUCTED AVERAGE POWER:



2. PEAK-TO-AVERAGE POWER RATIO (PAPR):



RESULTS

LTE BAND 2:

1. CONDUCTED AVERAGE POWER:

Preliminary measurements determined the narrow band = 0 and Nominal Bandwidth of 20 MHz as the worst case. The next results are for the worst-case configuration.

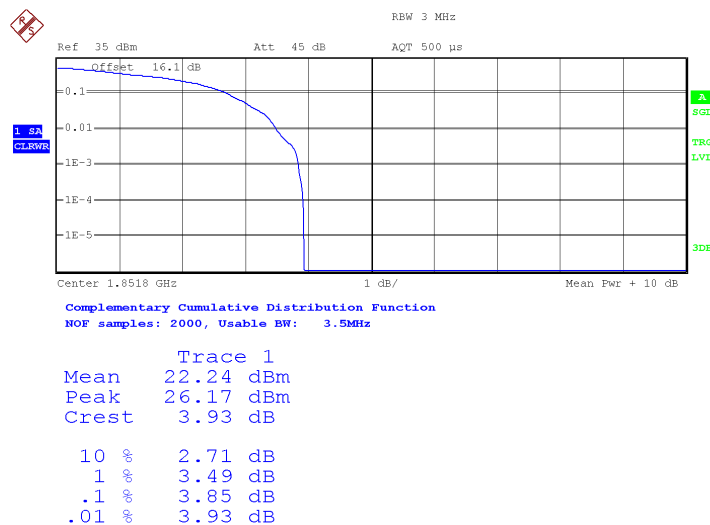
BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
20	18700	1860	QPSK	1	0	21.64	
				6	0	22.11	3.73
			16-QAM	1	0	21.57	
				5	0	21.99	3.93
	18900	1880	QPSK	1	0	21.71	
				6	0	22.12	3.75
			16-QAM	1	0	21.33	
				5	0	21.81	3.99
	19100	1900	QPSK	1	0	21.34	
				6	0	21.77	3.72
			16-QAM	1	0	21.27	
				5	0	21.67	4.33

2. PEAK-TO-AVERAGE POWER RATIO (PAPR):

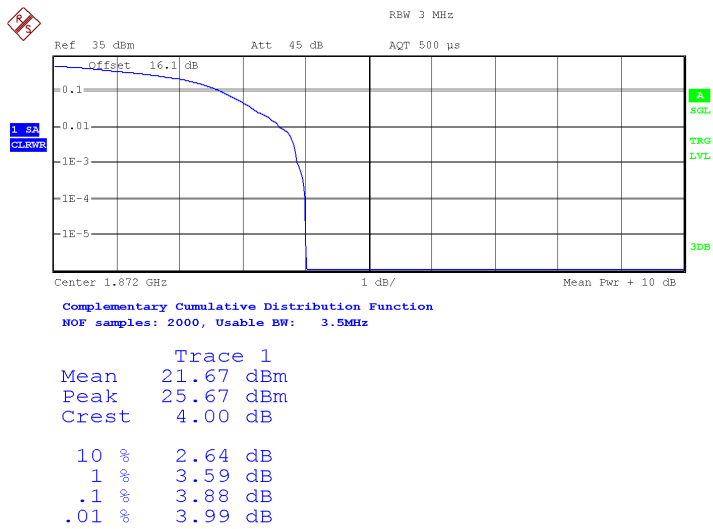
Preliminary measurements determined the narrow band = 0, Nominal Bandwidth of 20 MHz, 16-QAM modulation and 5 RB size offset 0 as the worst case.

The next results are for this worst-case configuration.

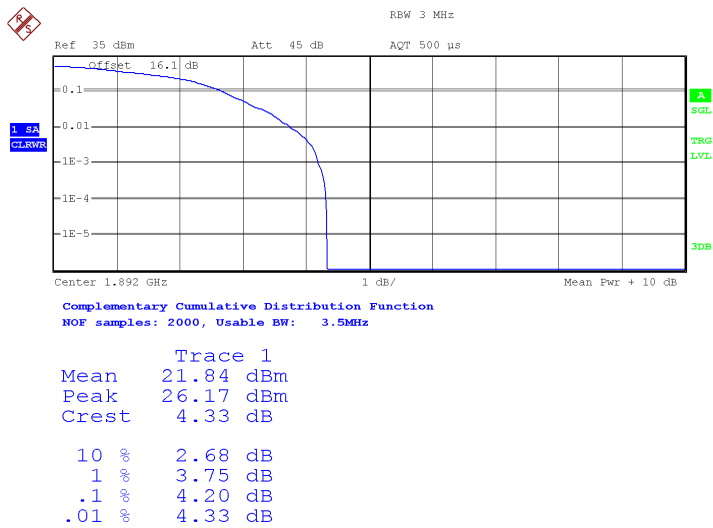
Low Channel:



Middle Channel:



High Channel:



Channel	Measured maximum average power (dBm) at antenna port	Maximum declared antenna gain (dBi)	Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	Maximum effective radiated power E.R.P. (dBm)	PAPR (dB)
Low	21.99	2.4	24.39	22.24	3.93
Middle	21.81	2.4	24.21	22.06	3.99
High	21.67	2.4	24.07	21.92	4.33
Measurement uncertainty (dB)	< $\pm$ 0.94				

Verdict: PASS

Frequency Stability

SPECIFICATION

FCC §2.1055 and §24.235. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

RSS-133. Clause 6.3. The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

METHOD

The frequency tolerance measurements over temperature variations were made over the temperature range of -30°C to $+50^{\circ}\text{C}$. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10°C steps from -30°C up to $+50^{\circ}\text{C}$.

The supply voltage was varied between 85% and 115% of nominal voltage.

The EUT was set in "Radio Resource Control (RRC) mode" in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.

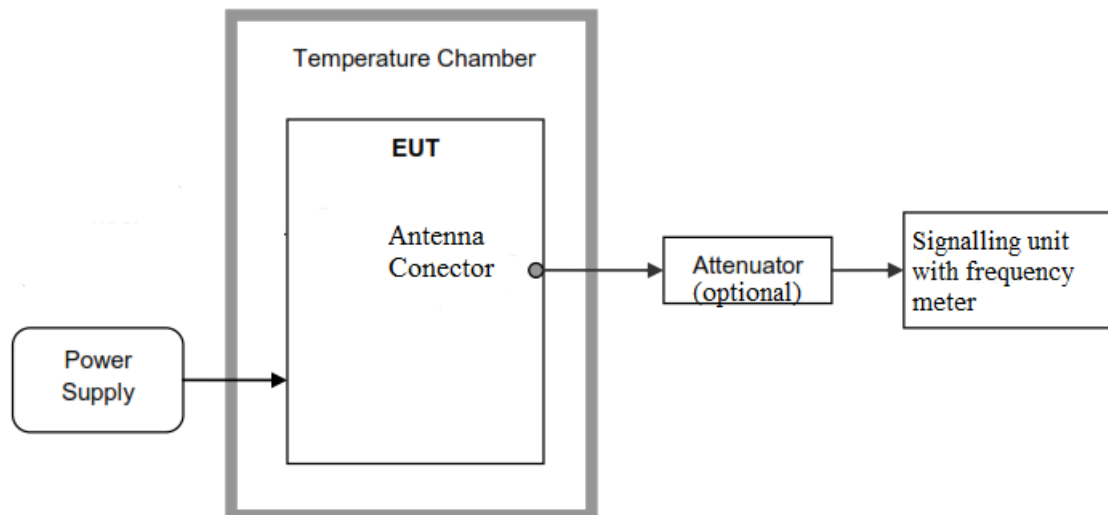
The worst case LTE mode for conducted power was used for the test.

In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and High Channel of operation are identified as fL and fH respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.

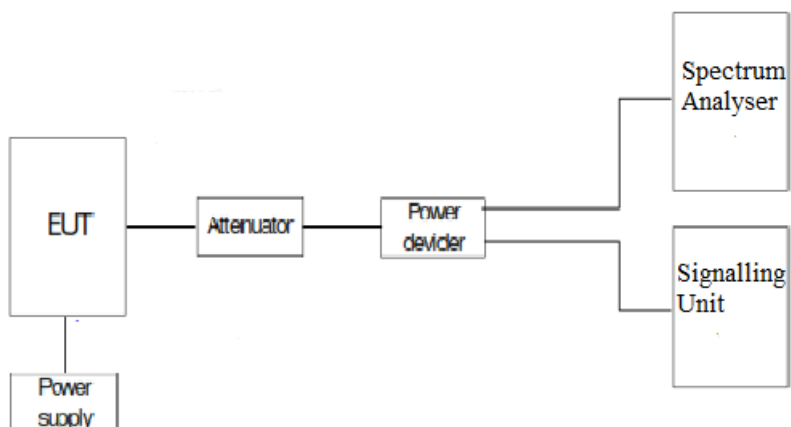
The reference point measurements were made at the RF output terminals of the EUT using an attenuator. Power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP

Frequency tolerance:



Reference points f_L and f_H :



RESULTS

LTE Band 2:

1. FREQUENCY TOLERANCE:

- Frequency stability over temperature variations.

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
+50	2.57	0.001367021
+40	6.91	0.003675532
+30	2.5	0.001329787
+20	4.82	0.00256383
+10	-9.56	-0.005085106
0	-8.53	-0.004537234
-10	-7.64	-0.00406383
-20	-5.58	-0.002968085
-30	-8.43	-0.004484043

- Frequency stability over voltage variations.

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	3.795	5.51	0.002930851
Vmin	2.805	7.74	0.004117021

2. REFERENCE FREQUENCY POINTS f_L AND f_H:

The worst-case frequency offsets added or subtracted per band and bandwidth:

QPSK. Nominal Bandwidth 5 MHz.

f _L (MHz)	1850.1268
f _H (MHz)	1909.8792

The reference frequency points f_L and f_H stay within the authorized blocks for the band above.

Measurement uncertainty (Hz): <±223.65

Verdict: PASS

Modulation Characteristics

SPECIFICATION

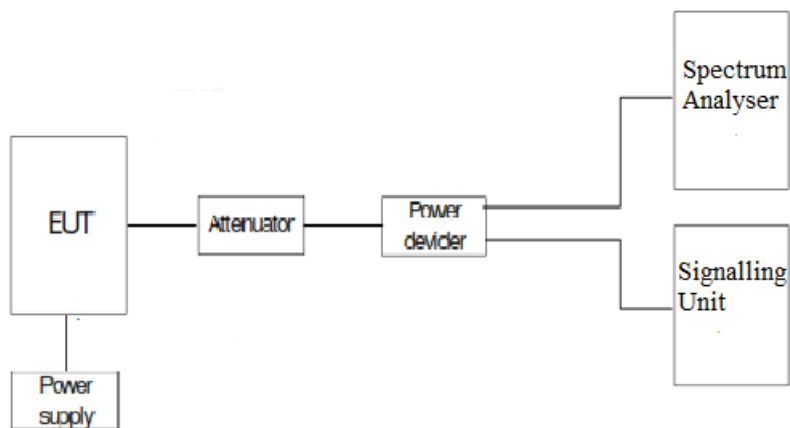
FCC §2.1047.

RSS-133. Clause 6.2. Equipment certified under this standard shall use digital modulation.

METHOD

For LTE the EUT operates with QPSK and 16QAM modulation modes in which the information is digitised and coded into a bit stream. The RF transmission is multiplexed using *Orthogonal Frequency Division Multiplexing (OFDM)* using different possible arrangement of subcarriers (Resource Blocks RB).

TEST SETUP

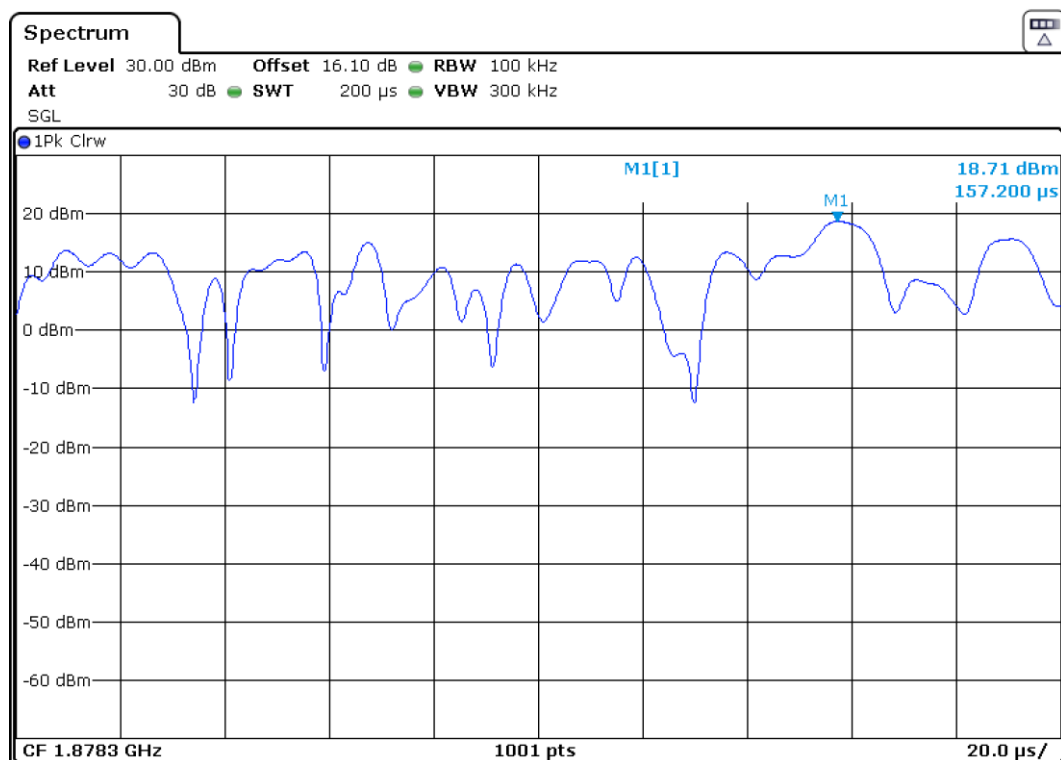


RESULTS

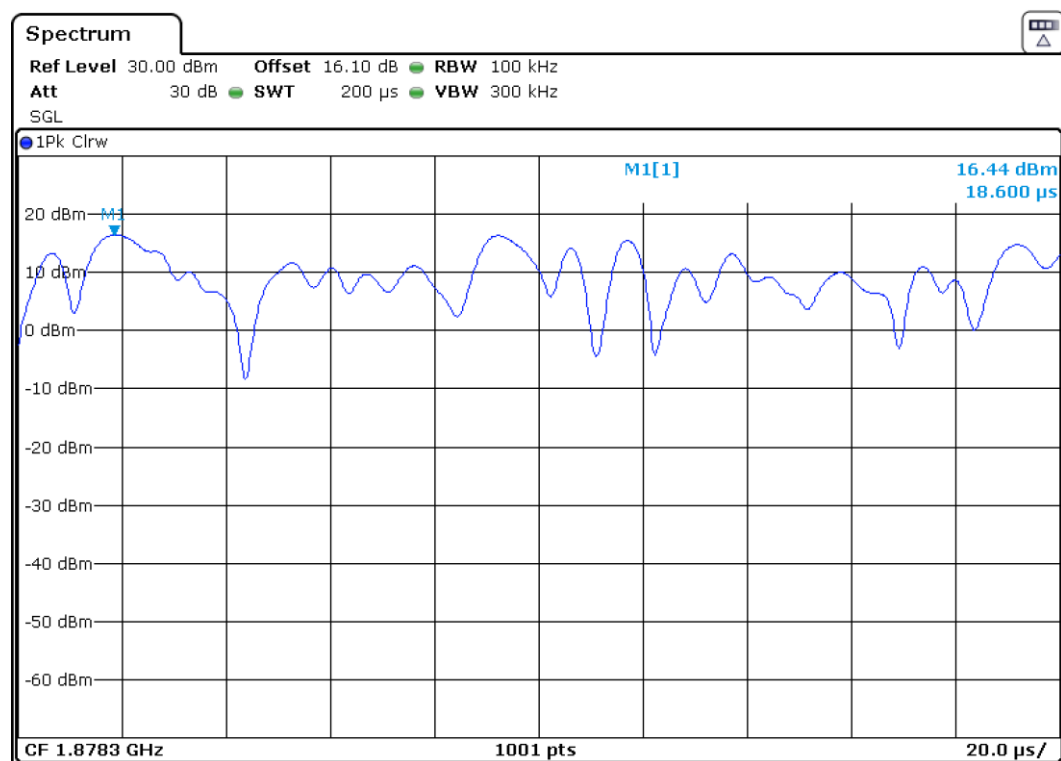
The following plots show the modulation schemes in the EUT.

LTE Band 2:

QPSK. Nominal Bandwidth 5 MHz



16QAM. Nominal Bandwidth 5 MHz



Occupied Bandwidth

SPECIFICATION

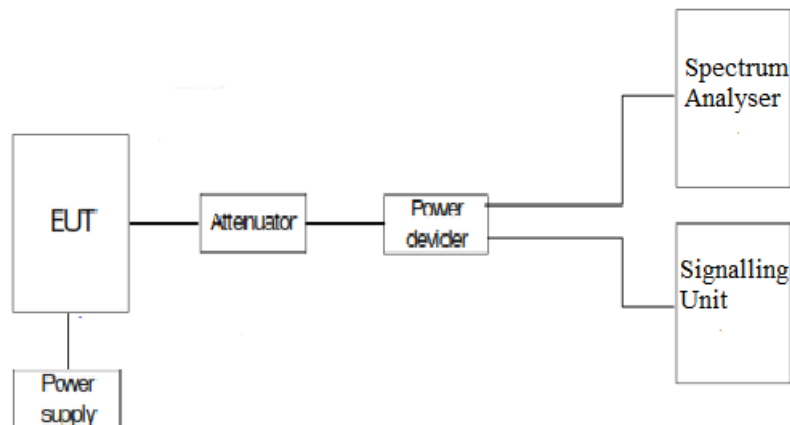
FCC §2.1049. Measurements required: Occupied bandwidth.

RSS-Gen Clause 6.7.

METHOD

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

TEST SETUP



RESULTS (see next plots)

The worst case of occupied bandwidth corresponds to all Resource Blocks (RB) offset 0 regardless either the Narrow band position or the Nominal Bandwidth selected.

LTE Band 2:

QPSK. Nominal Bandwidth 5 MHz. Narrow band = 0, Position 1.

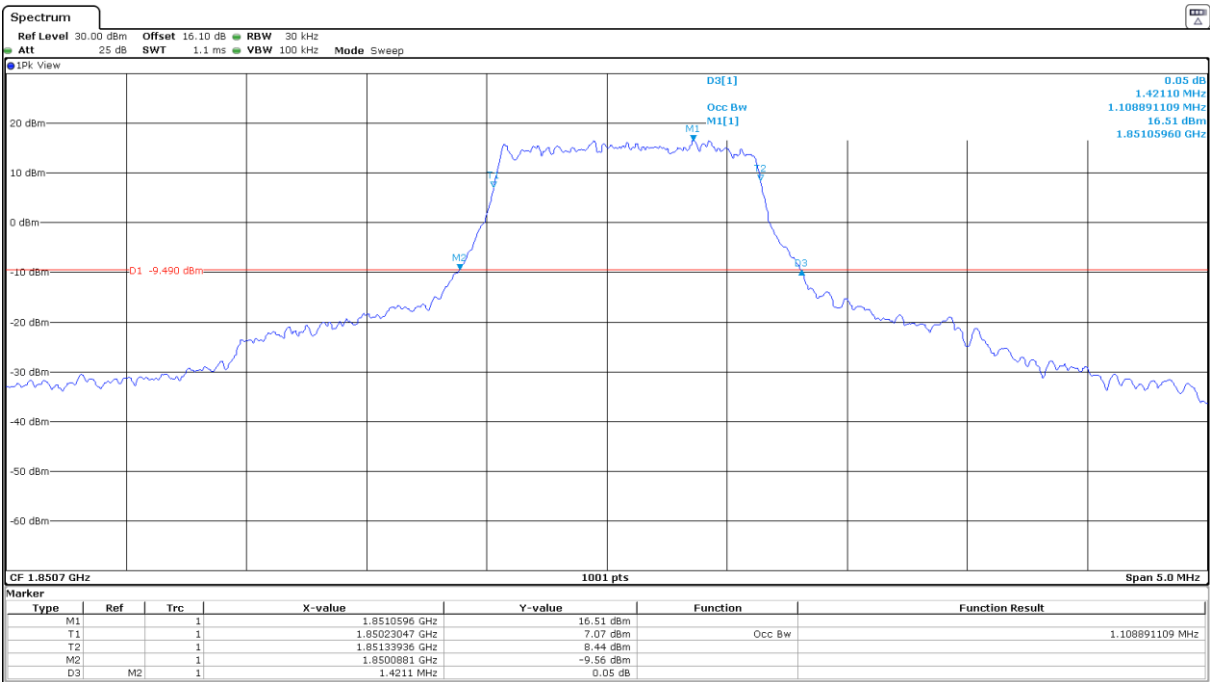
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	1.108891109	1.108891109	1.108891109
-26 dBc Bandwidth (MHz)	1.42110	1.42750	1.44890
Measurement uncertainty (kHz)	<±6.35		

16QAM. Nominal Bandwidth 5 MHz. Narrow band = 0, Position 1.

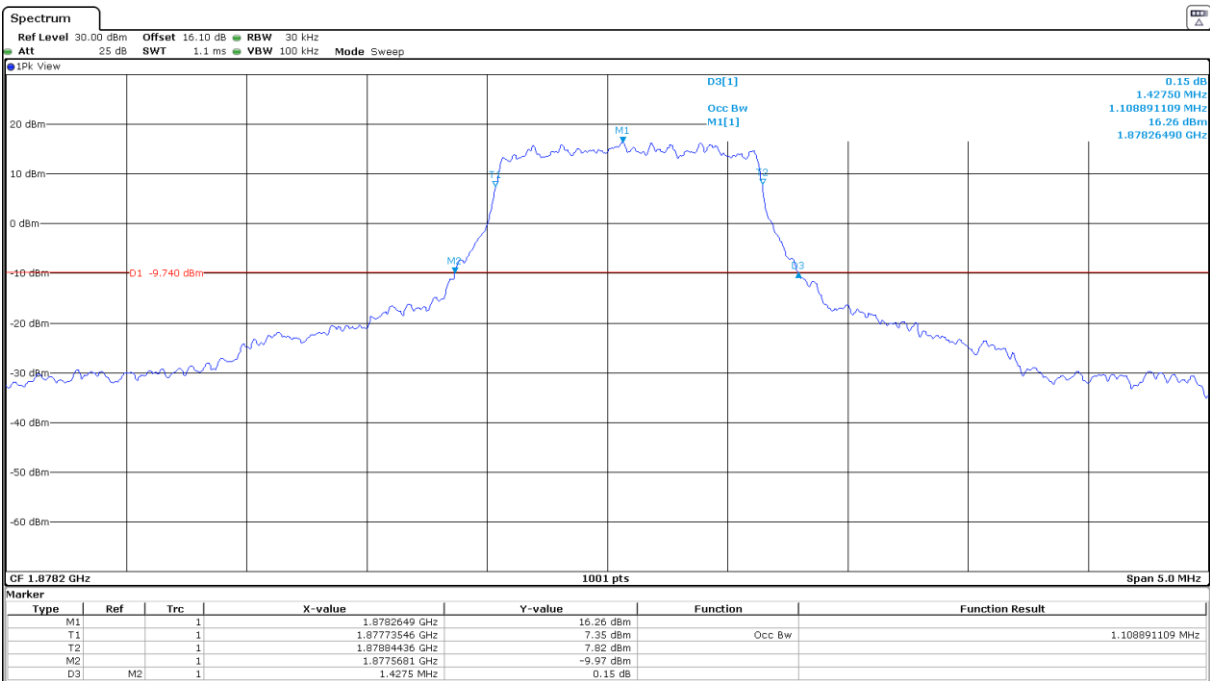
Channel	Low	Middle	High
99% Occupied Bandwidth (MHz)	0.954045954	0.969030969	0.944055944
-26 dBc Bandwidth (MHz)	1.36620	1.39250	1.34900
Measurement uncertainty (kHz)	<±6.35		

QPSK. Nominal Bandwidth 5 MHz. Narrow band = 0. Position 1.

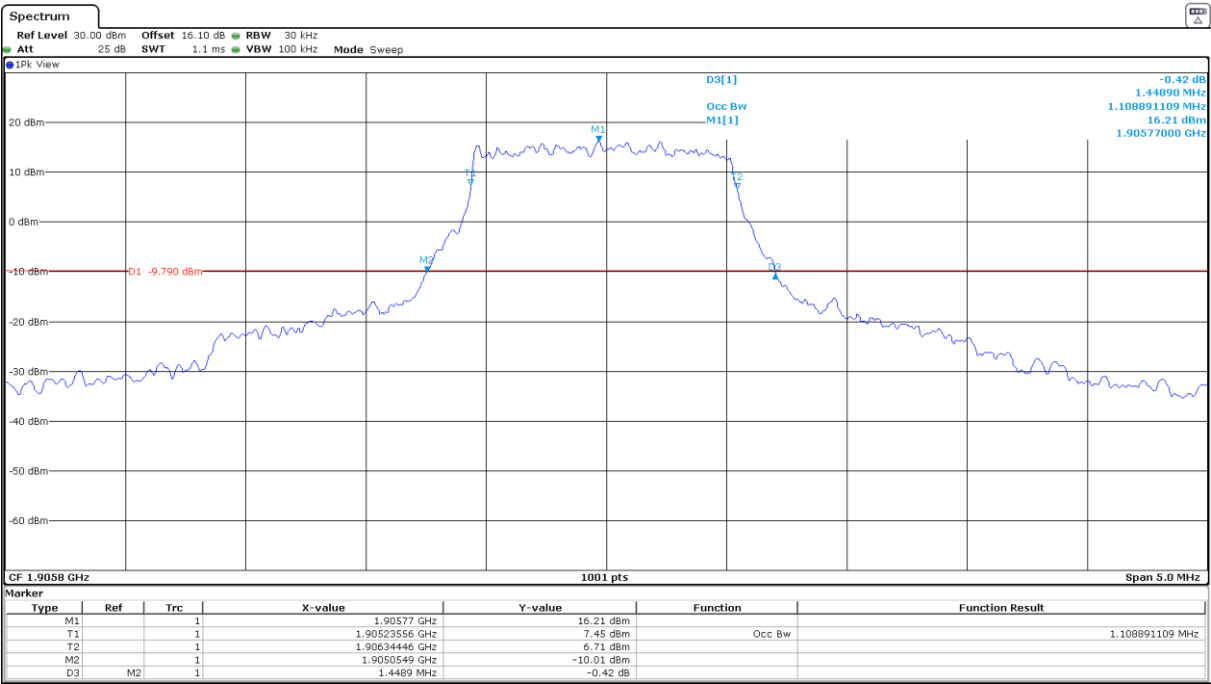
Low Channel:



Middle Channel:

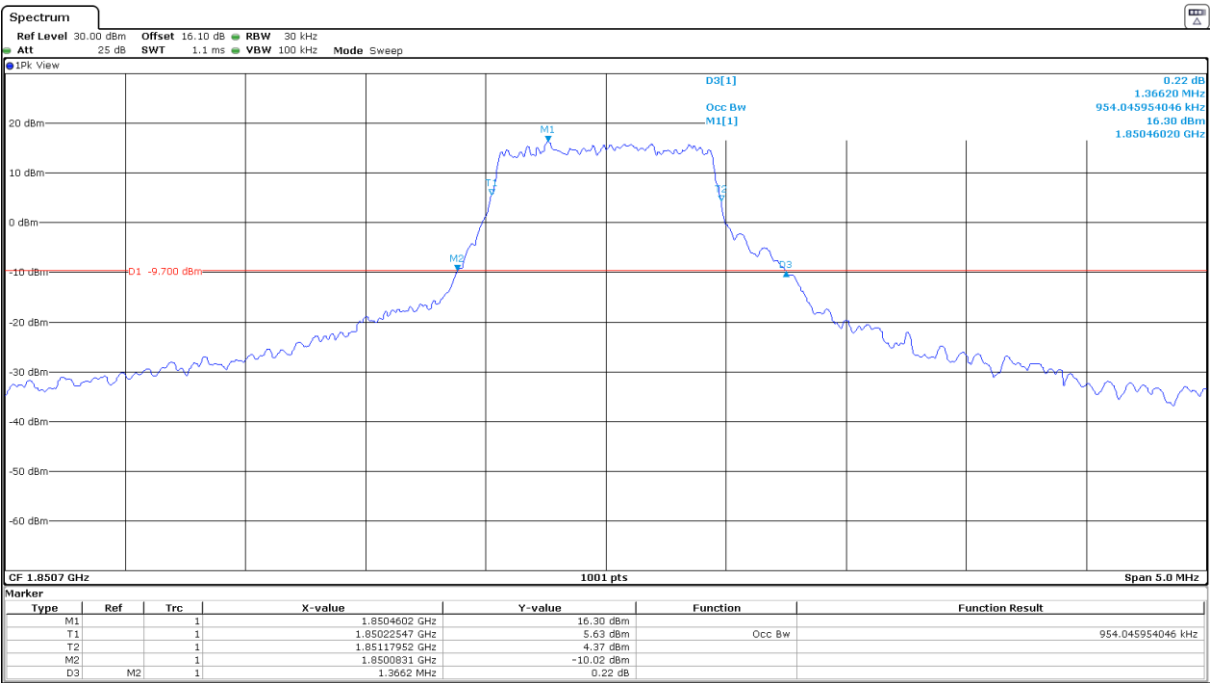


High Channel:

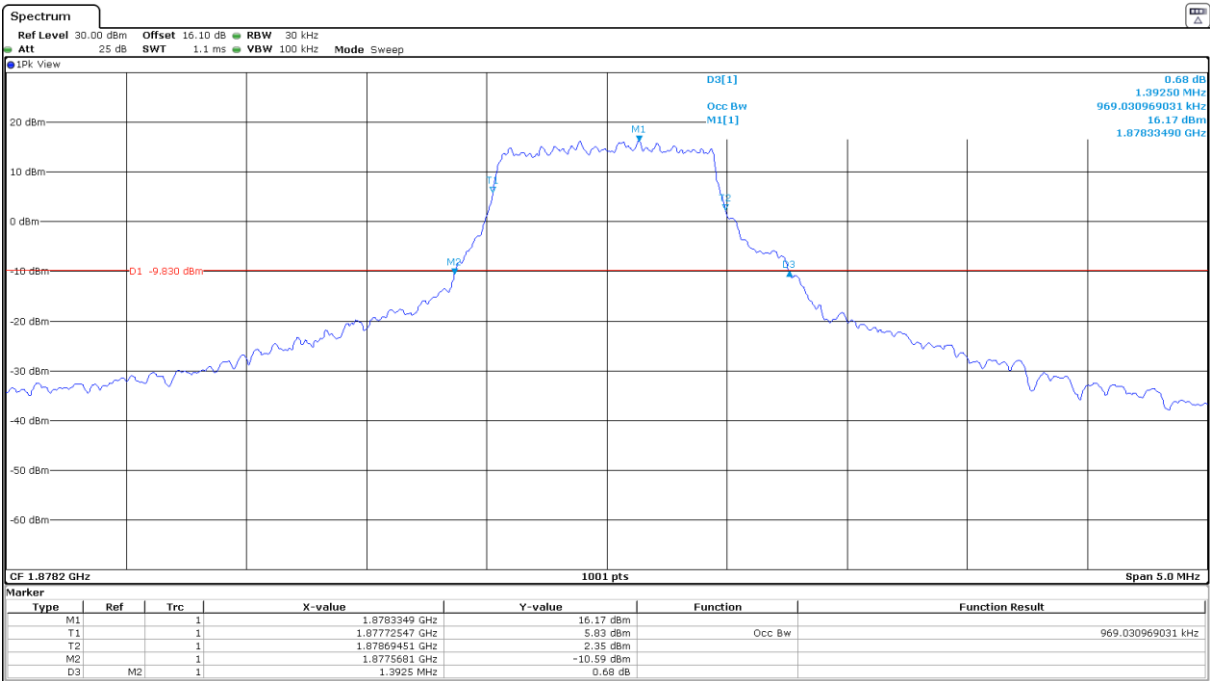


16QAM. Nominal Bandwidth 5 MHz. Narrow band = 0. Position 1.

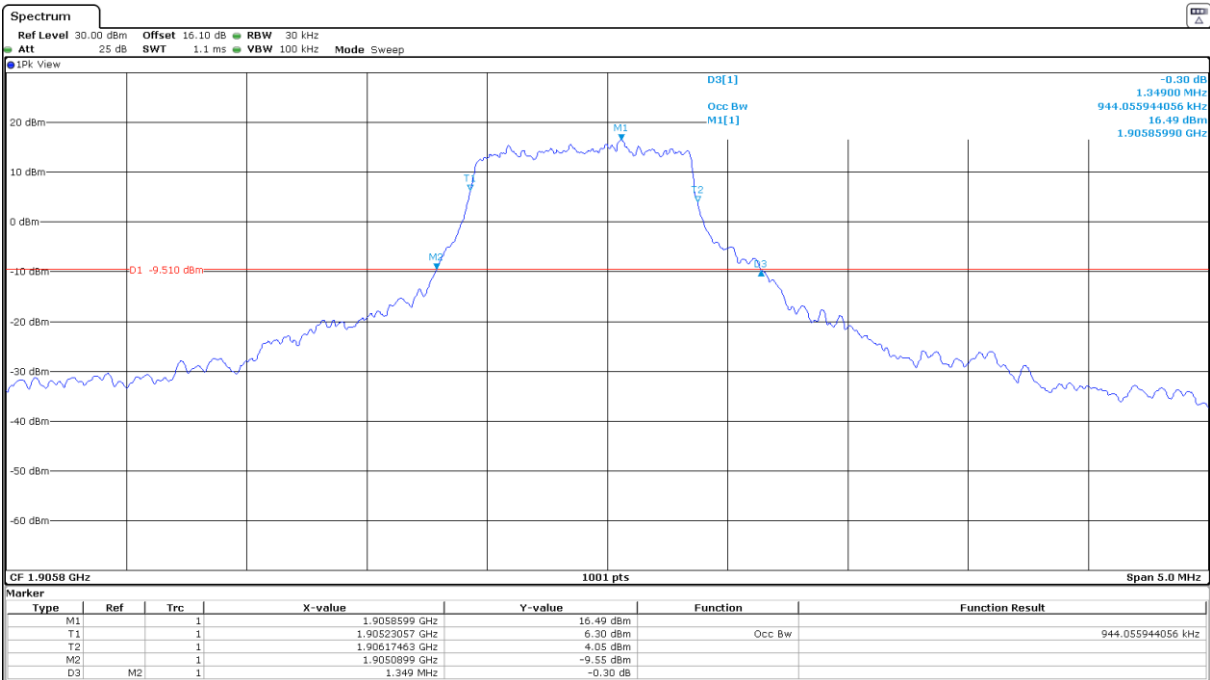
Low Channel:



Middle Channel:



High Channel:



Spurious Emissions at Antenna Terminals

SPECIFICATION

FCC §2.1051 and §24.238. RSS-133. Clause 6.5.

The power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log (P_o)$, and the level in dBm relative to P_o becomes:

$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mW}) - 30] = -13 \text{ dBm}$$

METHOD

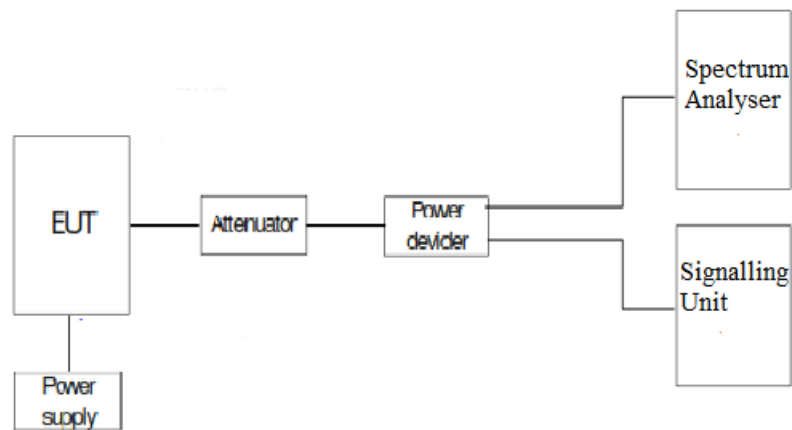
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50-Ohm attenuator and a power divider.

The spectrum was investigated from 9 kHz to 20 GHz.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

The configuration of Resource Blocks and modulation which is the worst case for conducted power was used.

TEST SETUP



RESULTS (see plots in next pages)

LTE Band 2: QPSK. Nominal Bandwidth 20 MHz. RB Size 6, RB Offset 0. Narrow band = 0, Position 1.

- Low Channel: Spurious frequencies at less than 20 dB below the limit:

Spurious Frequency (MHz)	Emission Limitations Conducted (dBm)
1938.339	-24.23

- Middle Channel: Spurious frequencies at less than 20 dB below the limit:

Spurious Frequency (MHz)	Emission Limitations Conducted (dBm)
1961.009	-23.53

- High Channel: Spurious frequencies at less than 20 dB below the limit:

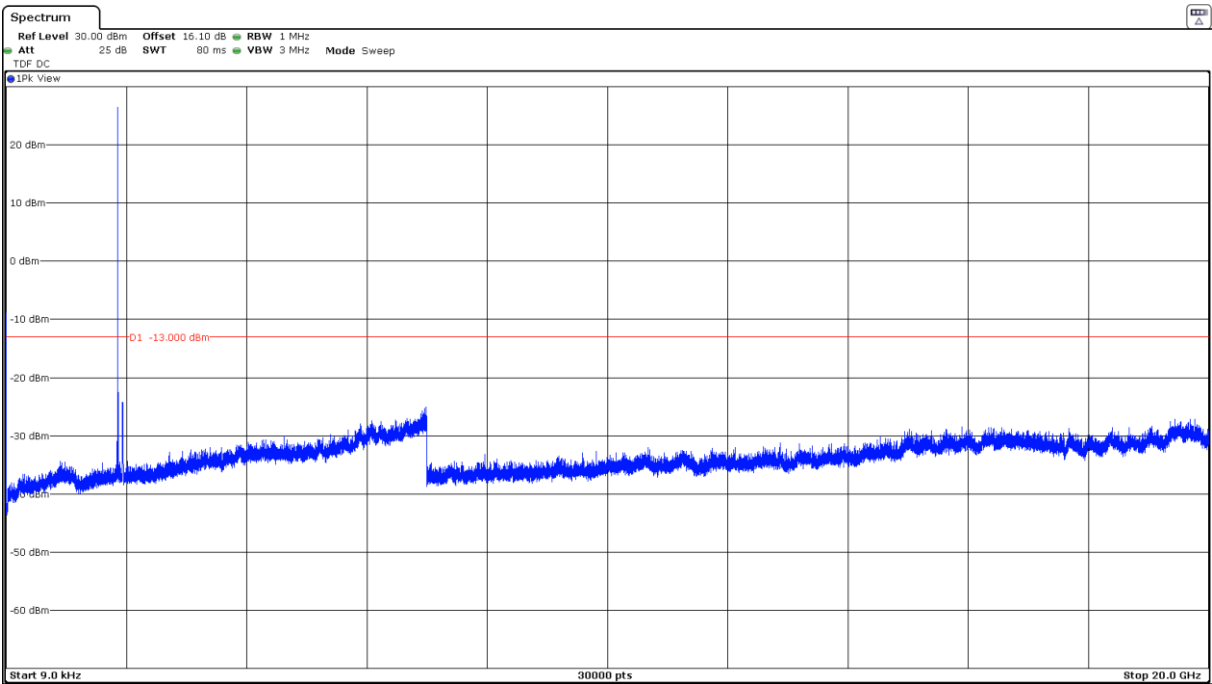
Spurious Frequency (MHz)	Emission Limitations Conducted (dBm)
1976.339	-23.53

Measurement uncertainty (dB): $<\pm 2.61$

Verdict: PASS

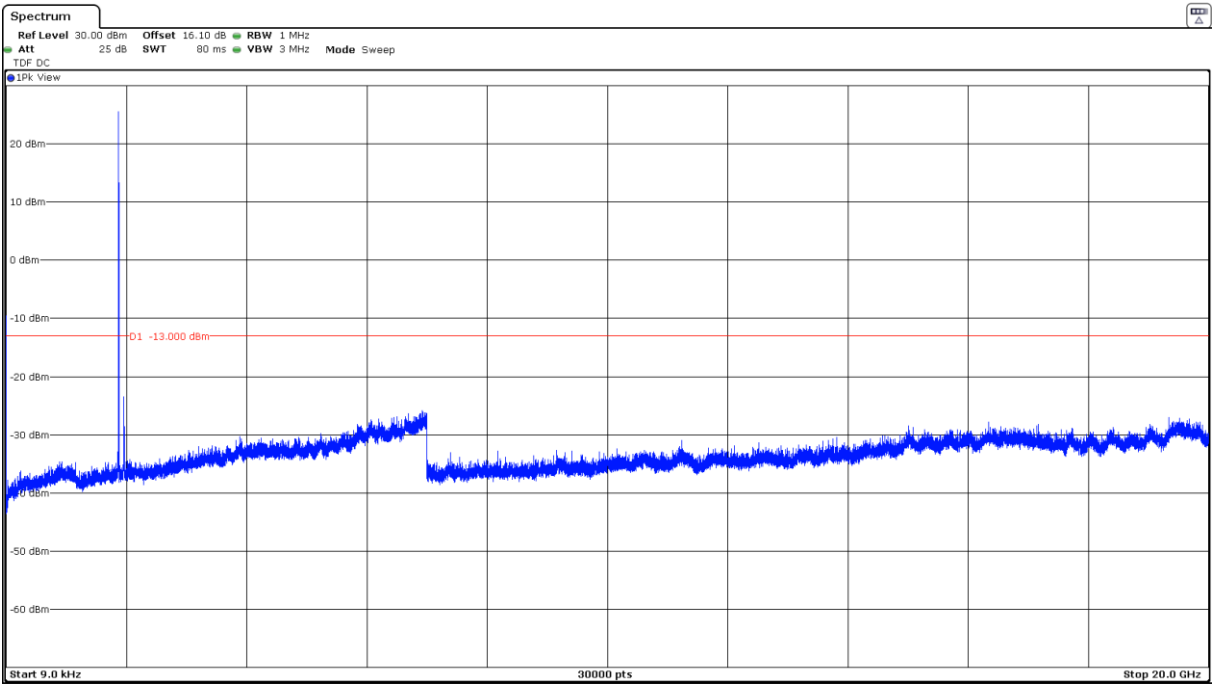
QPSK. Nominal Bandwidth 20 MHz. RB Size 6, RB Offset 0. Narrow band = 0, Position 1.

Low Channel:



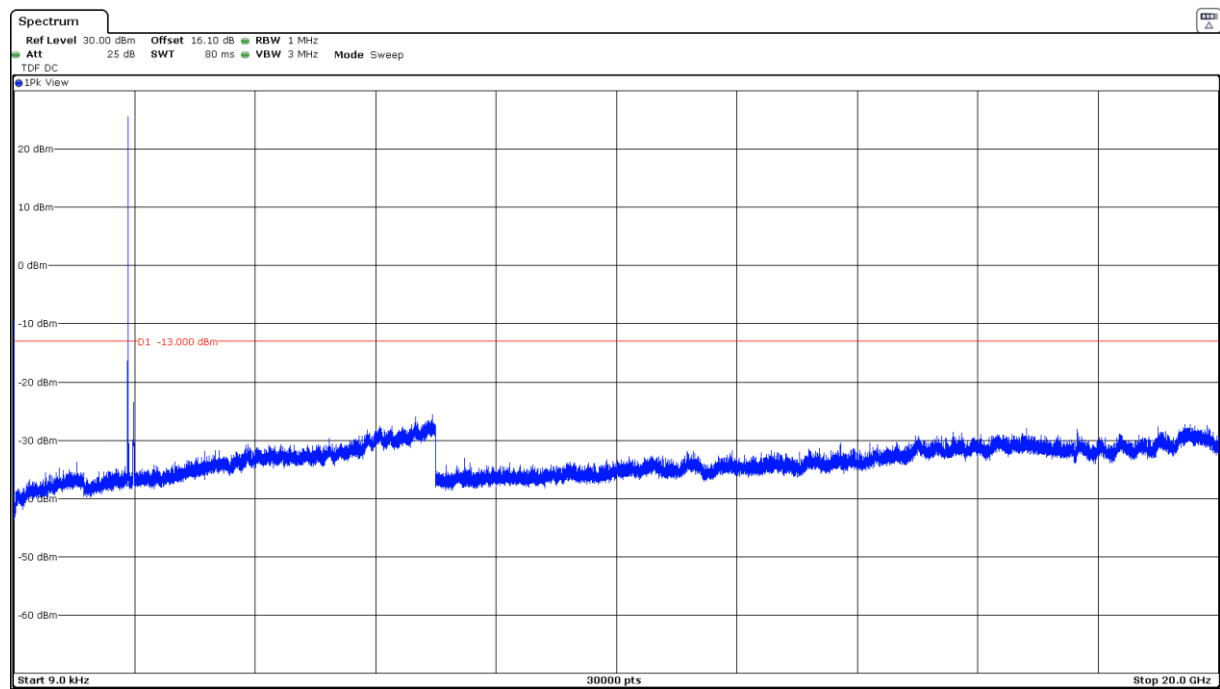
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

High Channel:



The peak above the limit is the carrier frequency.

Spurious Emissions at Antenna Terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §24.238. RSS-133 Clause 6.5.

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log(P_o)$, and the level in dBm relative to P_o becomes:

$$P_o \text{ (dBm)} - [43 + 10 \log(P_o \text{ in mW}) - 30] = -13 \text{ dBm}$$

METHOD

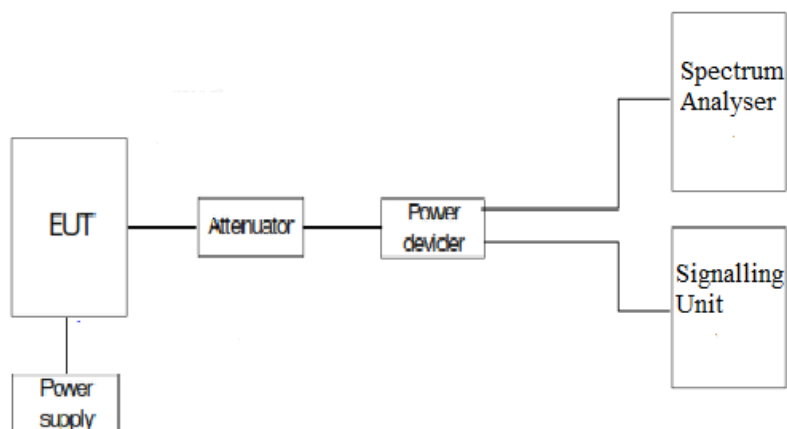
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50-Ohm attenuator and a power splitter.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

The configuration of modulation which is the worst case for conducted power was used.

As indicated in FCC part 24.238 / RSS-133133 Clause 6.5, in the 1 MHz bands immediately outside and adjacent to the frequency block or band a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

TEST SETUP



RESULTS (see plots in next pages)

LTE Band 2:

Preliminary measurements determined the Nominal Bandwidth of 5 MHz, QPSK modulation as the worst case. The next results are for this worst-case configuration.

LTE QPSK MODULATION:	RB = 1 Offset = 0 BW = 5 MHz Narrow band = 0
Maximum measured level at <u>Lowest Block Edge</u> at antenna port (dBm)	-32.21

LTE QPSK MODULATION:	RB = All Offset = 0 BW = 5 MHz Narrow band = 0
Maximum measured level at <u>Lowest Block Edge</u> at antenna port (dBm)	-27.74

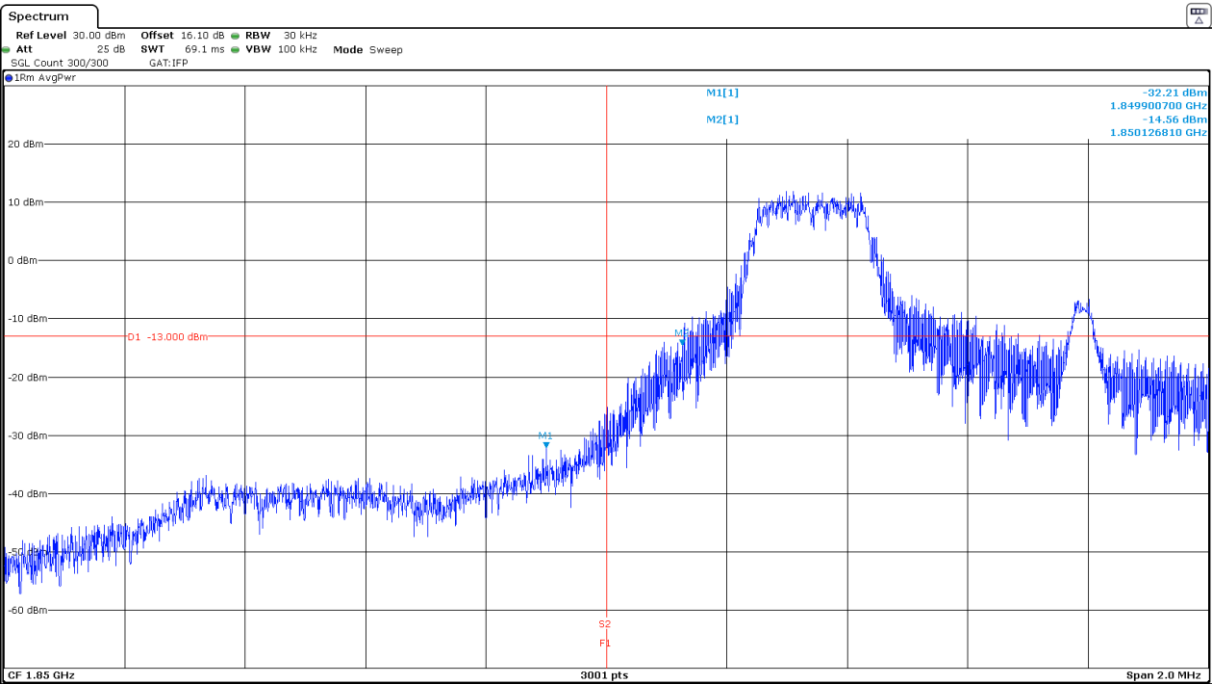
LTE QPSK MODULATION:	RB = 1 Offset = Max. BW = 5 MHz Narrow band = 3
Maximum measured level at <u>Highest Block Edge</u> at antenna port (dBm)	-30.64

LTE QPSK MODULATION:	RB = All Offset = 0 BW = 5 MHz Narrow band = 3
Maximum measured level at <u>Highest Block Edge</u> at antenna port (dBm)	-26.37

Measurement uncertainty (dB): $<\pm 2.10$

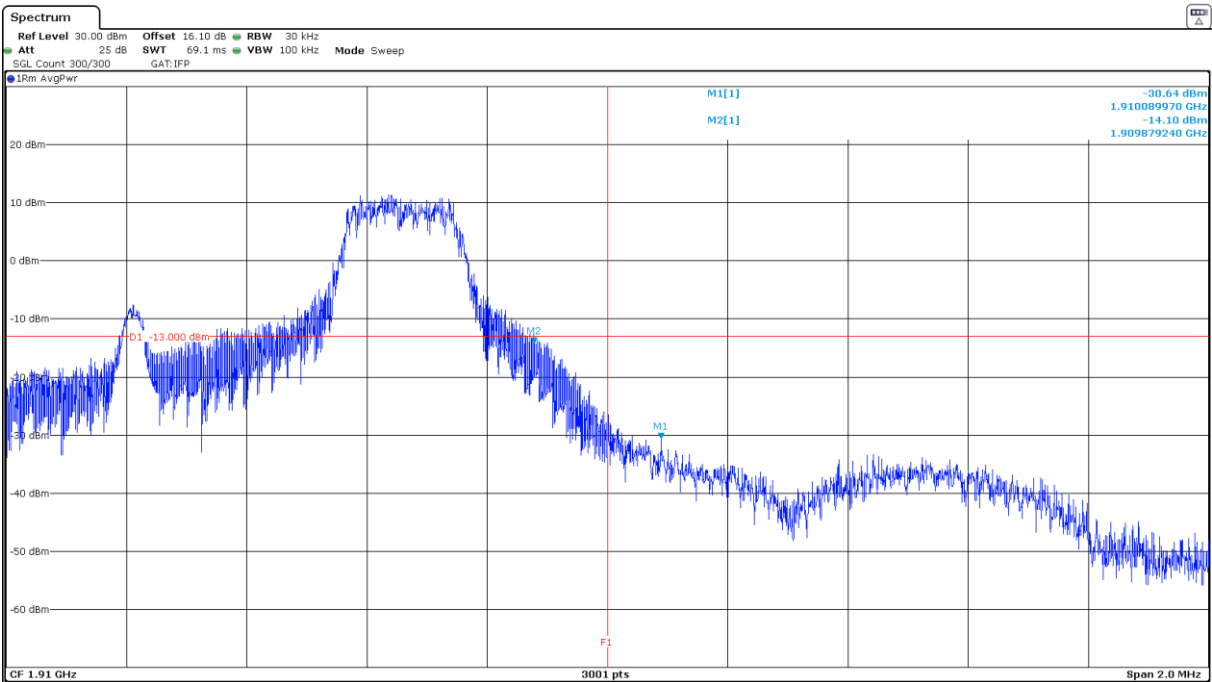
Verdict: PASS

QPSK. Nominal Bandwidth 5 MHz. RB Size 1, RB Offset 0. Narrow band = 0. Lowest Block Edge:



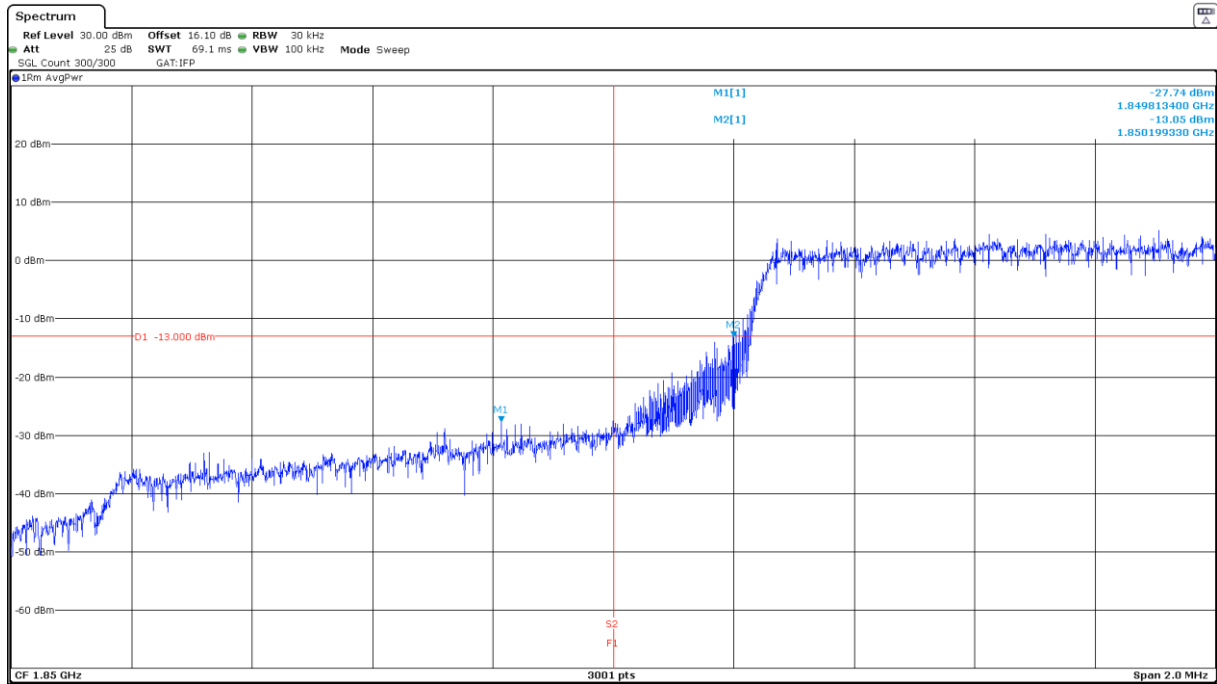
NOTE: The equipment transmits at the maximum output power.

QPSK. Nominal Bandwidth 5 MHz. RB Size 1, RB Offset Max. Narrow band = 3. Highest Block Edge:



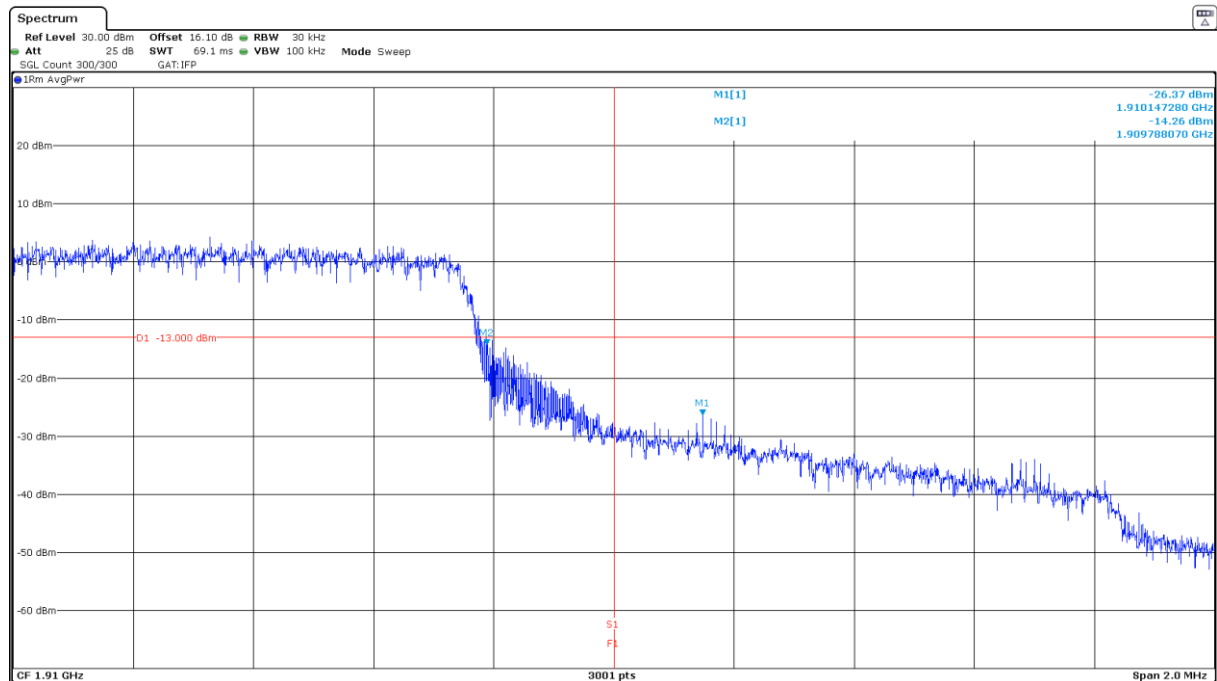
NOTE: The equipment transmits at the maximum output power.

QPSK. Nominal Bandwidth 5 MHz. RB Size All, RB Offset 0. Narrow band = 0. Lowest Block Edge:



NOTE: The equipment transmits at the maximum output power.

QPSK. Nominal Bandwidth 5 MHz. RB Size All, RB Offset 0. Narrow band = 3. Highest Block Edge:



NOTE: The equipment transmits at the maximum output power.

Radiated Emissions

SPECIFICATION

FCC §24.238. RSS-133 Clause 6.5.

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

At P_o transmitting power, the specified minimum attenuation becomes $43 + 10 \log(P_o)$, and the level in dBm relative to P_o becomes:

$$P_o \text{ (dBm)} - [43 + 10 \log(P_o \text{ in mW}) - 30] = -13 \text{ dBm}$$

METHOD

The measurement was performed with the EUT inside an anechoic chamber. The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.

The EUT was placed on a non-conductive stand at a 3 meter distance from the measuring antenna for measurements from 30 MHz up to 18 GHz.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.

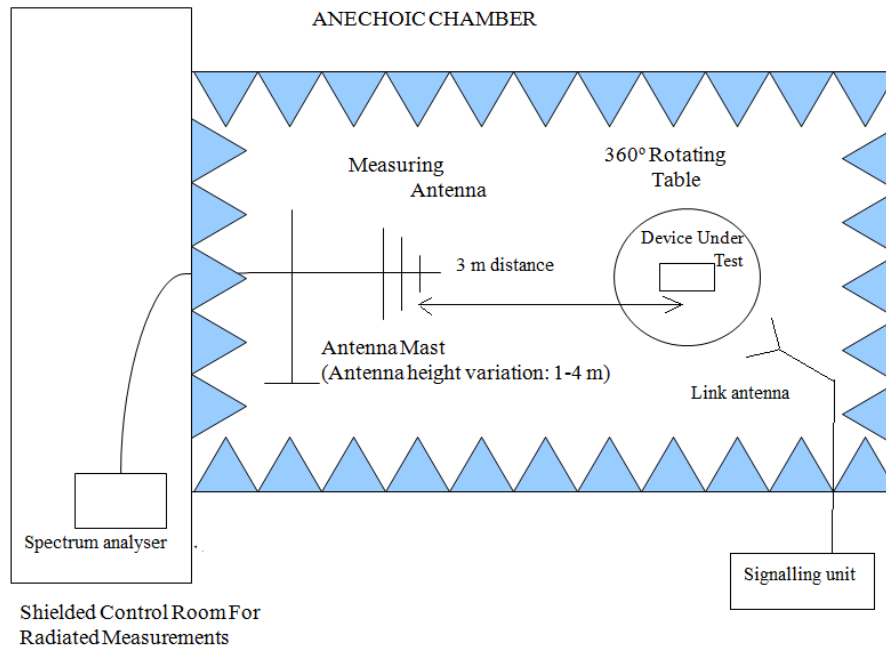
The maximum field strength (dB μ V/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

$$\text{EIRP (dBm)} = E(\text{dB}\mu\text{V/m}) + 20 \log(D) - 104.8$$

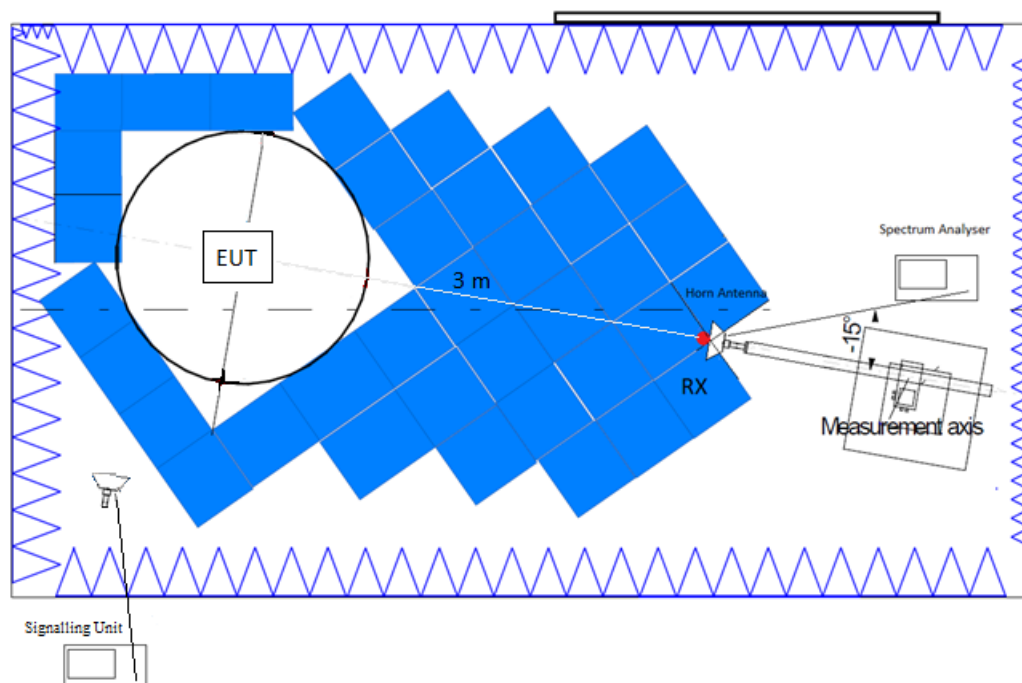
Where D is the measurement distance (in the far field region) in m. $D = 3$ m.

TEST SETUP

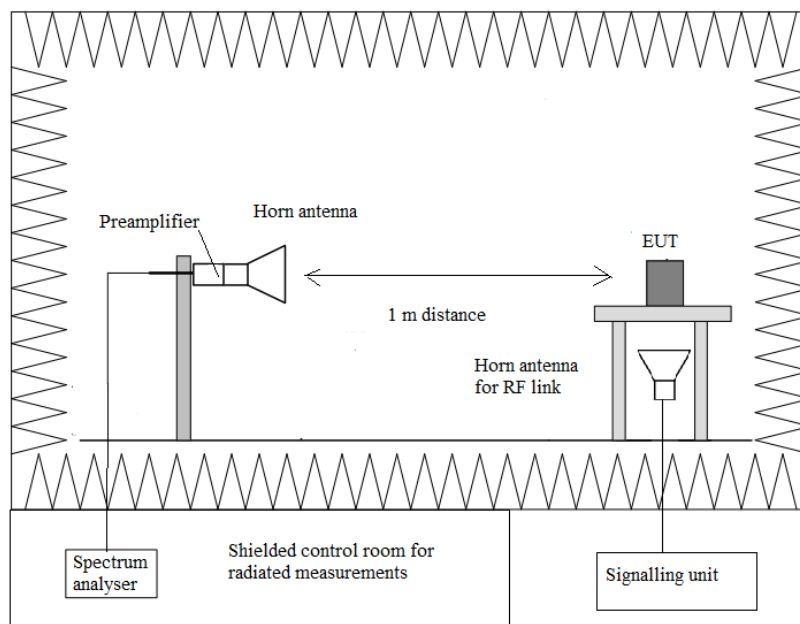
Radiated measurements below 1 GHz.



Radiated measurements between 1 GHz and 18 GHz.



Radiated measurements above 18 GHz.



RESULTS (see plots in next pages)

LTE Band 2:

Preliminary measurements determined QPSK modulation, Nominal Bandwidth of 20 MHz, RB Size 6, RB Offset 0, Narrow band = 0 as the worst case.

The next results are for this worst-case configuration.

- **Low Channel:**

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 18 GHz

Spurious frequencies at less than 20 dB below the limit:

Spurious Frequency (GHz)	E.I.R.P (dBm)	Polarization	Detector
1.8345	-32.81	V	Peak
1.8395	-24.70	V	Peak
1.841	-23.11	V	Peak
1.843	-20.64	V	Peak

Frequency range 18 - 20 GHz

No spurious frequencies at less than 20 dB below the limit.

- **Middle Channel:**

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 GHz-18 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 18 - 20 GHz

No spurious frequencies at less than 20 dB below the limit.

- **High Channel:**

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 GHz-18 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 18 - 20 GHz

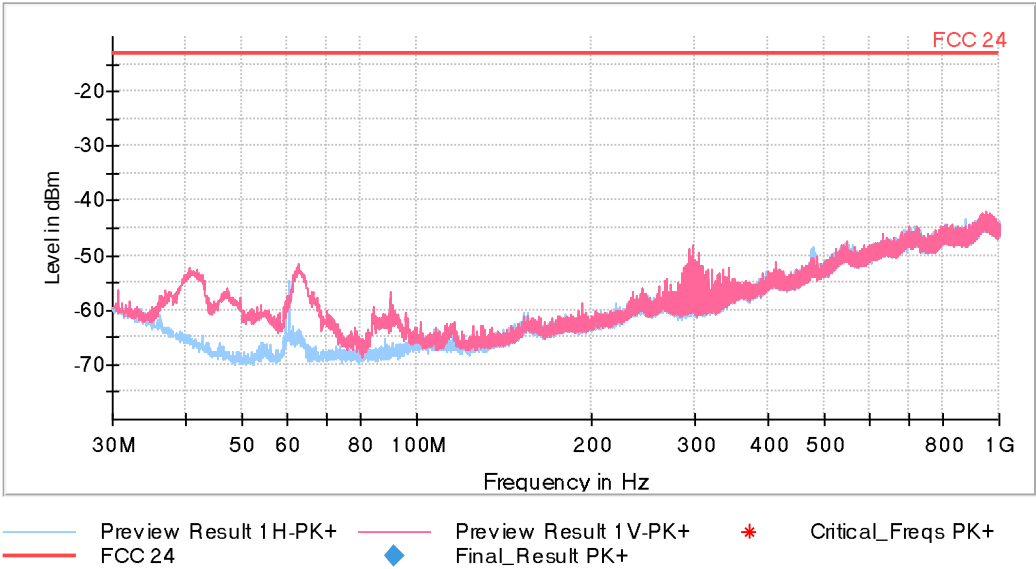
No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):
<± 4.89 for $f \geq 30$ MHz up to 1 GHz
<± 4.11 for $f \geq 1$ GHz up to 3 GHz
<± 5.13 for $f \geq 3$ GHz up to 18 GHz
<± 4.81 for $f \geq 17$ GHz up to 20 GHz

Verdict: PASS

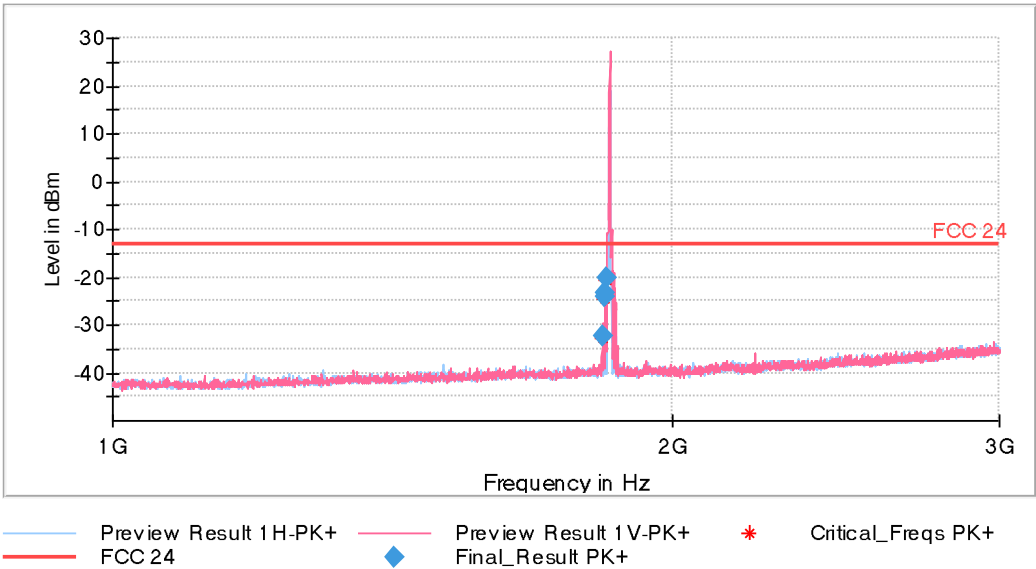
FREQUENCY RANGE 30 MHz - 1 GHz:

This plot is valid for the Low, Middle and High Channels:



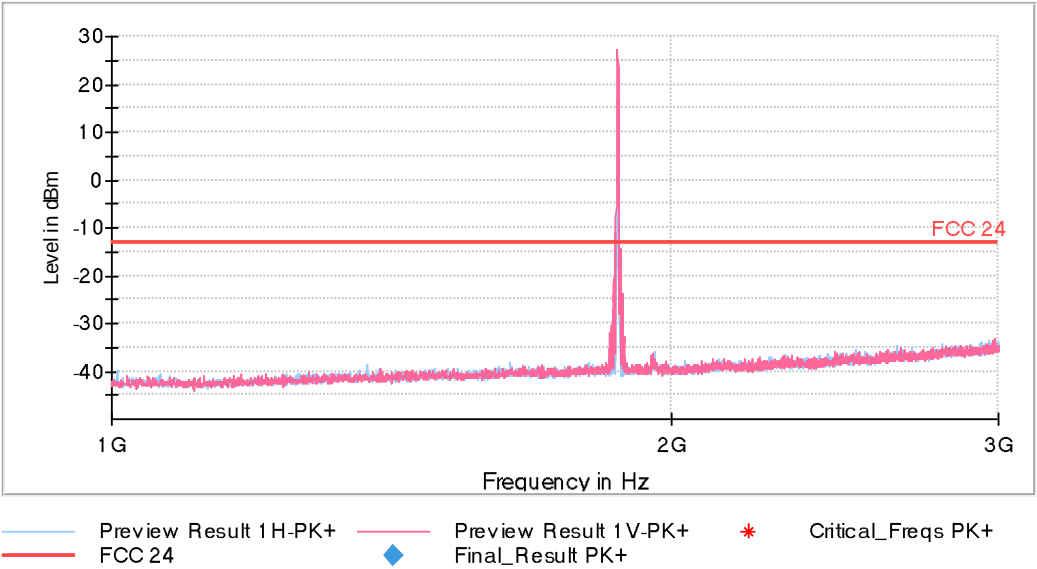
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



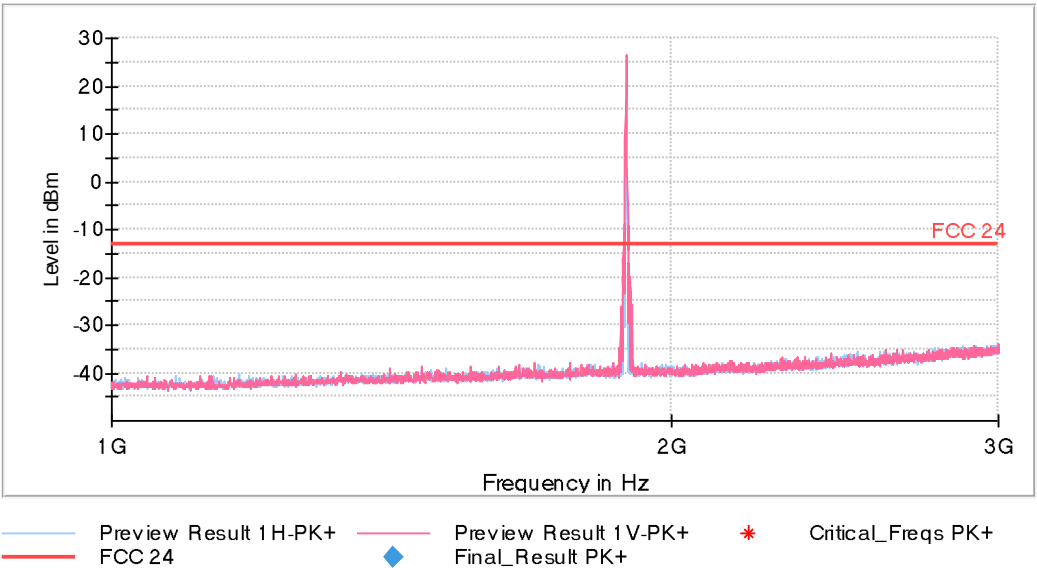
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

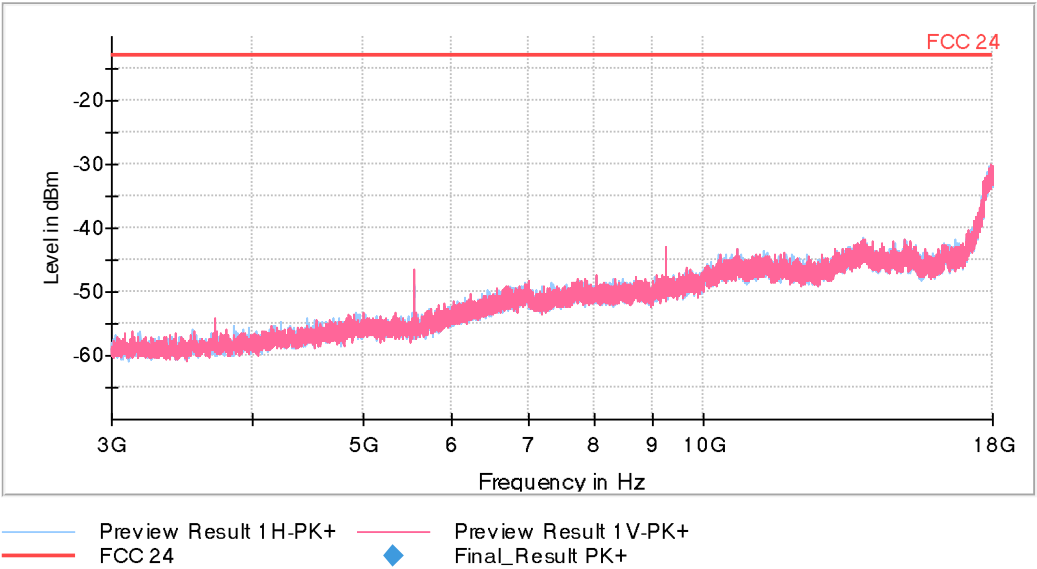
- High Channel:



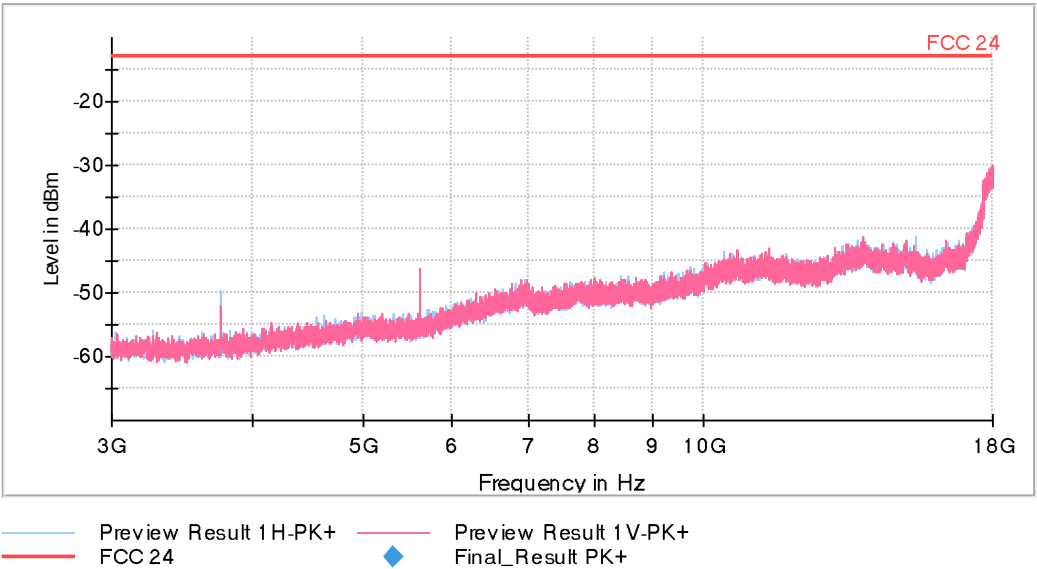
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 18 GHz:

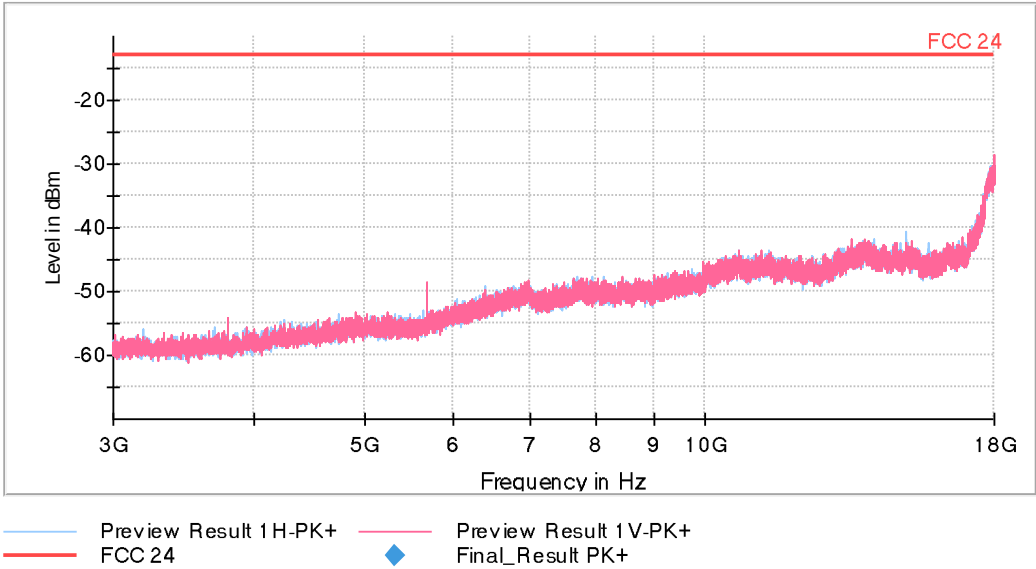
- Low Channel:



- Middle Channel:



- High Channel:



FREQUENCY RANGE 18 - 20 GHz:

This plot is valid for the Low, Middle and High Channels:

