



FCC LISTED,
 REGISTRATION NUMBER:
 720267

Test report No:

NIE: 51746RRF.005

Test report

REFERENCE STANDARD: USA FCC Part 22 & Part 24 & Part 27

Identificación del objeto ensayado.....: Identification of item tested	Satellite Smartphone
Marca Trademark	Bittium
Modelo y/o referencia tipo Model and /or type reference	Mx Rugged E
Other identification of the product	FCC ID: V27SSD-53
Final HW version	1201
Final SW version	1.8.31
IMEI TAC	
Características Features	<p>SATELLITE</p> <ul style="list-style-type: none"> • L-band 1525 – 1660.5 MHz • GMR-1 3G 45.005; Radio Transmission and Reception DL 186kbps, UL 30kbps • GMR-1 3G with internal antenna DL 21kbps, UL 2.6kbps • GMR-1 3G AMBE2+ voice call <p>LTE</p> <ul style="list-style-type: none"> • 3GPP rel10 (LTE Advanced) • FDD Cat4, DL 150 Mbit/s, UL 50 Mbit/s • Band configuration: B4 (1700), B28 (700) <p>UMTS/HSPA</p> <ul style="list-style-type: none"> • 3GPP R99 384/384kbps • 3GPP rel8, HSPA+, 42 Mbps / 5.76 Mbps • Band configuration: B2 (1900), B4 (1700), B5 (850) <p>GSM/GPRS/EDGE</p> <ul style="list-style-type: none"> • 850/900/1800/1900 MHz <p>Bluetooth 4.0</p>
Solicitante Applicant	BITTIUM WIRELESS LTD. Tutkijantie 8 90590 Oulu, Finland
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 22 10-1-15 Edition. USA FCC Part 24 10-1-15 Edition. USA FCC Part 27 10-1-15 Edition. Measurement Guidance 971168 D01 v02r02 for certification of Licensed Digital Transmitters.

	ANSI/TIA-603-D (2010).
Resultado	IN COMPLIANCE
Summary	
Aprobado por (nombre / cargo y firma)	A. Llamas
Approved by (name / position & signature)	RF Lab. Manager
Fecha de realización	2017-03-28
Date of issue	
Formato de informe No.	FDT08_18
Report template No	

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Competences and guarantees

AT4 wireless is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

AT4 wireless is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance program for its measurement equipment.

AT4 wireless 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 AT4 wireless at the time of performance of the test.

AT4 wireless 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.

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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 AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the AT4 wireless internal document PODT000.

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
51746/044	Satellite Smartphone	Mx Rugged E (SSD-53)	---	2017-01-23
51746/030	Battery	9304576A02	---	2017-01-16
51746/038	Antenna	---	---	2017-01-16

1. Sample S/01 has undergone the test(s).
All radiated tests indicated in appendixes A, B and C.

Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
51746/035	Satellite Smartphone	Mx Rugged E (SSD-53)	---	2017-01-16
51746/020	Dummy battery	DB-6BM proto 0.1	162510006	2017-01-16

- Sample S/02 has undergone the test(s).
 All conducted tests indicated in appendixes A, B and C.

Test sample description

The Rugged E is a satellite and terrestrial phone targeted for professional Public Safety use.

Identification of the client

Bittium Wireless Ltd.
 Tutkijantie 8 90590 Oulu, Finland

Testing period

The performed test started on 2017-01-24 and finished on 2017-02-24.
 The tests have been performed at AT4 wireless.

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 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1: Used instrumentation.

Conducted Measurements

	Last Cal. date	Cal. due date
1. Spectrum analyser Agilent PSA E4440A	2015/10	2017/10
2. Climatic chamber HERAEUS VM 07/100	2016/03	2018/03
3. Vector signal analyzer Rohde & Schwarz FSQ8	2016/06	2018/06
4. DC power supply R&S NGPE 40/40	2014/11	2017/11
5. Universal Radio communication Tester R&S CMW500	2016/02	2018/02
6. Universal Radio communication Tester R&S CMW500	2014/07	2017/07
7. Spectrum analyser Rohde & Schwarz FSW50	2015/12	2017/12

Radiated Measurements

	Last Cal. date	Cal. due date
1. Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2. BiconicalLog antenna ETS LINDGREN 3142E	2014/03	2017/03
3. Multi Device Controller EMCO 2090	N.A.	N.A.
4. Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2016/11	2019/11
5. Broadband Horn antenna 18-40 GHz Schwarbeck BBHA 9170	2014/03	2017/03
6. EMI Test Receiver R&S ESU 40	2016/03	2018/03
7. Spectrum analyser Rohde & Schwarz FSW50	2015/12	2017/12
8. RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2016/04	2017/04
9. RF pre-amplifier 1-18 GHz BONN ELEKTRONIK BLMA 0118-3A	2016/02	2018/02
10. RF pre-amplifier 18-40 GHz BONN ELEKTRONIK BLMA 1840-1M	2015/12	2017/12
11. Universal Radio communication Tester R&S CMW500	2014/07	2017/07

2. GSM mode has not been tested to prove USA FCC Part 22 and Part 24 compliance because the modulation scheme and the power maximum levels are the same as for GPRS mode.

Taking into account the above comments, testing in GSM mode is redundant for FCC Parts 22 and Part 24 as it is the same as GPRS mode. GPRS mode has been tested as indicated on the present test report.

3. HSDPA modulation mode has not been tested to prove USA FCC Part 22, Part 24 and Part 27 compliance because it is an improved mode of operation only for Downlink (UE reception), but using the normal WCDMA mode for UL (Up Link,

UE transmission). Therefore HSDPA has no associated a Power class or modulation scheme different than WCDMA mode for the UL transmission.

Taking into account the above comments, testing in HSDPA modulation mode is redundant for FCC Part 22, Part 24 and Part 27 as it is the same as WCDMA mode as long as UE transmission is concerned. WCDMA modulation mode has been tested as indicated on the present test report.

Testing verdicts

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

FCC PART 22 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 22.913: Clause 5.4: RF output power		P		
Clause 2.1047: Modulation characteristics		P		
Clause 22.355: Frequency stability		P		
Clause 2.1049: Occupied Bandwidth		P		
Clause 22.917: Spurious emissions at antenna terminals		P		
Clause 22.917: Radiated emissions		P		

FCC PART 24 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 24.232: RF output power		P		
Clause 2.1047: Modulation characteristics		P		
Clause 24.235: Frequency stability		P		
Clause 2.1049: Occupied Bandwidth		P		
Clause 24.238: Spurious emissions at antenna terminals		P		
Clause 24.238: Radiated emissions		P		

FCC PART 27 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 27.50.: RF output power		P		
Clause 2.1047.: Modulation characteristics		P		
Clause 27.54: Frequency stability		P		
Clause 2.1049: Occupied Bandwidth		P		
Clause 27.53: Spurious emissions at antenna terminals		P		
Clause 27.53: Radiated emissions		P		

Appendix A – Test result for FCC Part 22

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TEST RESULTS FOR FCC PART 22

TEST CONDITIONS

Power supply (V):

$V_{nom} = 4.2V_{dc}$

$V_{max} = 4.2 V_{dc}$

$V_{min} = 3.6 V_{dc}$

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 rechargeable battery

Type of antenna = Internal antenna (PIFA antenna)

Antenna gain = -1.8 dBi (850 MHz), -0.4 dBi (WCDMA Band V).

TEST FREQUENCIES:

GPRS MODULATION

Lowest channel (128): 824.2 MHz

Middle channel (190): 836.6 MHz

Highest channel (251): 848.8 MHz

WCDMA AND HSUPA MODULATION

Lowest channel (4132): 826.4 MHz

Middle channel (4182): 836.4 MHz

Highest channel (4233): 846.6 MHz

RF Output Power

SPECIFICATION

FCC §2.1046 and §22.913. The Effective Radiated Power (E.R.P.) of mobile transmitter and auxiliary test transmitter must not exceed 7 Watts (38.45 dBm E.R.P.).

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 CMU200 and 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:

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

TEST SETUP

Conducted average power.



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

GPRS MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	33.62	33.66	33.50
Maximum declared antenna gain (dBi)	-1.80	-1.80	-1.80
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	31.82	31.86	31.70
Maximum effective radiated power E.R.P. (dBm)	29.67	29.71	29.55
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

EDGE MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	28.07	28.12	28.06
Maximum declared antenna gain (dBi)	-1.80	-1.80	-1.80
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	26.27	26.32	26.26
Maximum effective radiated power E.R.P. (dBm)	24.12	24.17	24.11
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	23.59	23.68	23.58
Maximum declared antenna gain (dBi)	-0.40	-0.40	-0.40
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.19	23.28	23.18
Maximum effective radiated power E.R.P. (dBm)	21.04	21.13	21.03
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

HSUPA MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	22.43	22.52	22.44
Maximum declared antenna gain (dBi)	-0.40	-0.40	-0.40
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	22.03	22.12	22.04
Maximum effective radiated power E.R.P. (dBm)	19.88	19.97	19.89
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

Modulation Characteristics

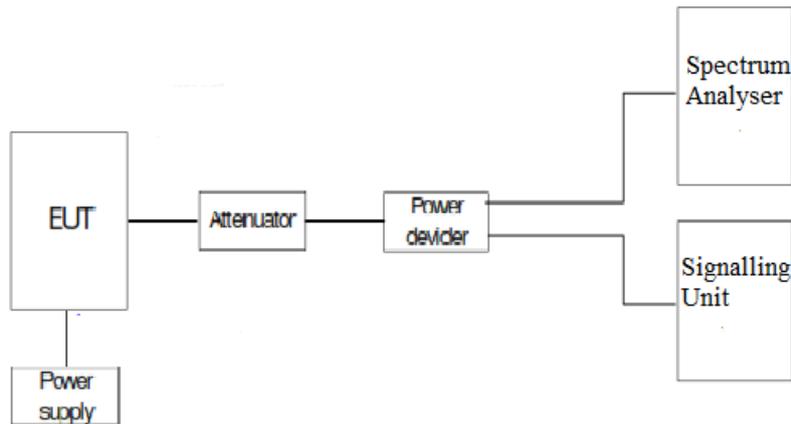
SPECIFICATION

FCC §2.1047

METHOD

For 2G/3G, the EUT operates with GPRS (GMSK), EDGE (8PSK), WCDMA (QPSK) and HSUPA (QPSK) modes, in which the information is digitized and coded into a bit stream.

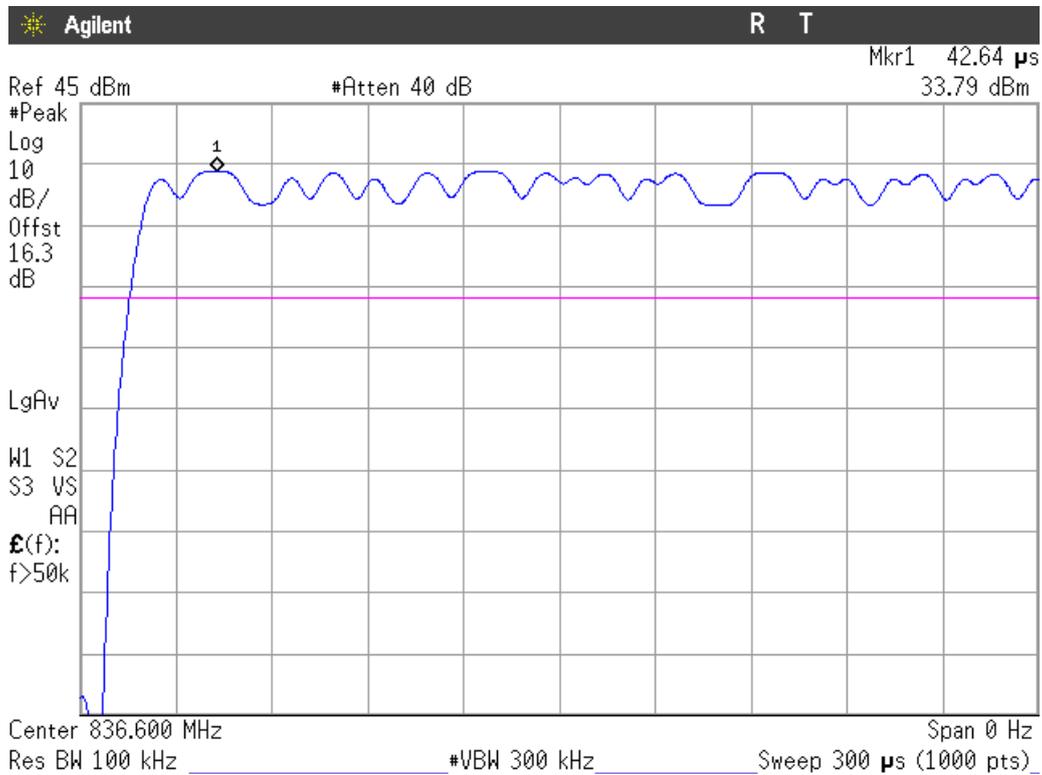
TEST SETUP



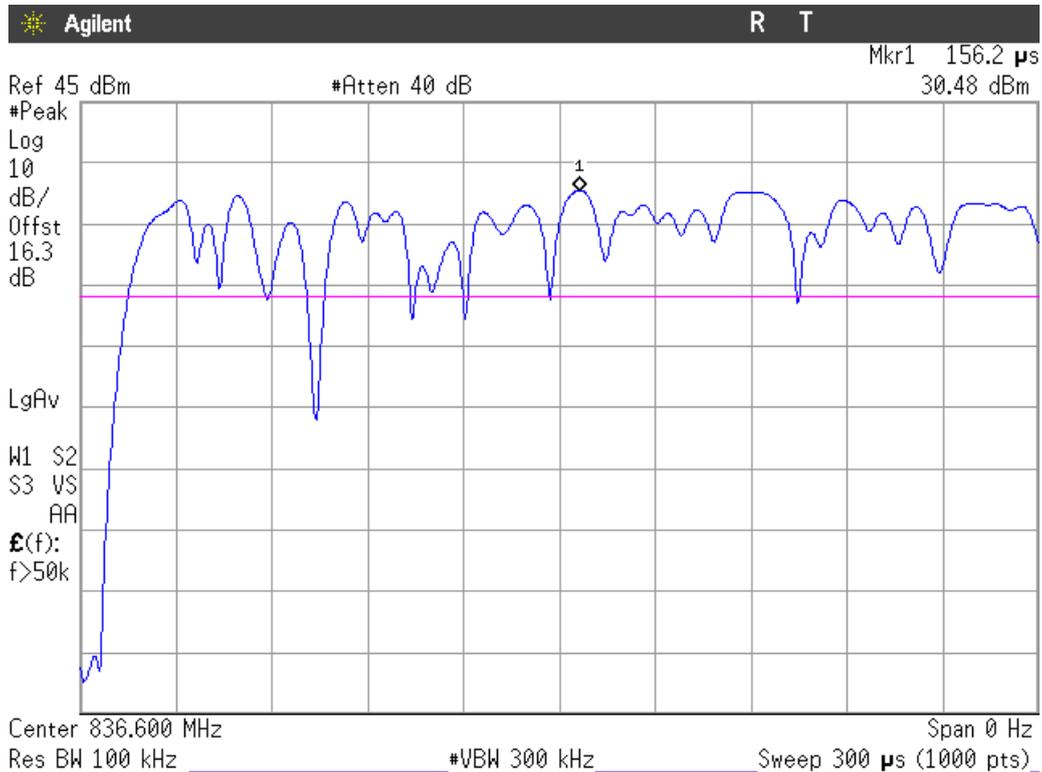
RESULTS

The following plot shows the modulation schemes in the EUT.

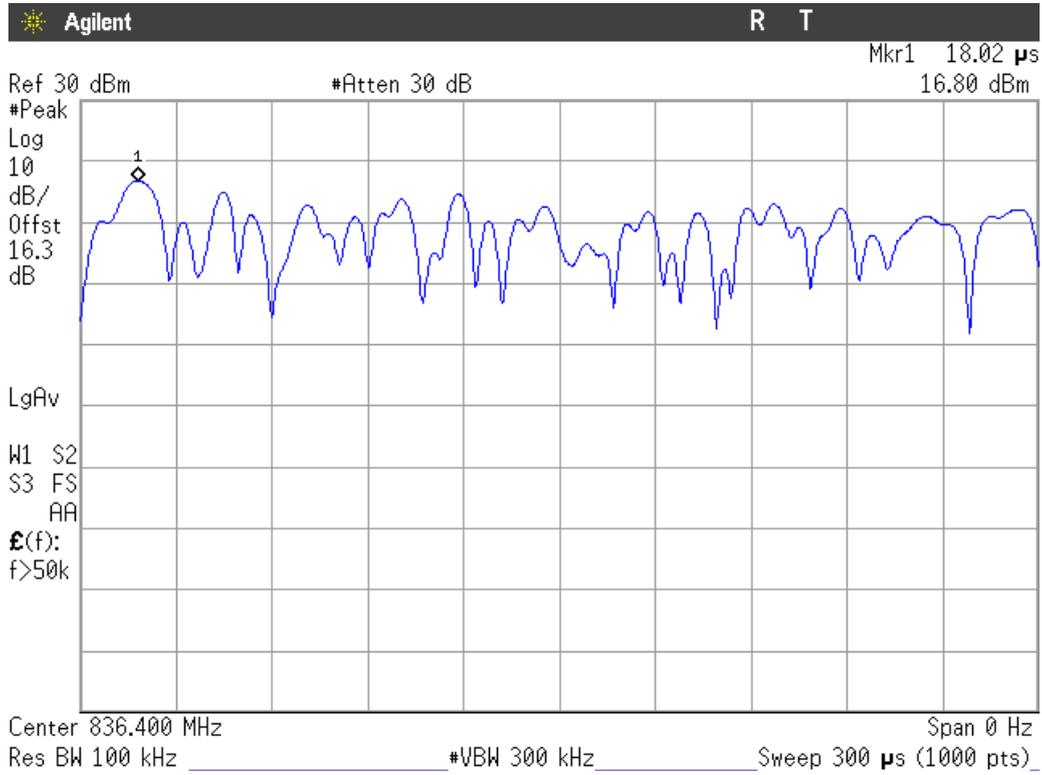
GPRS MODULATION



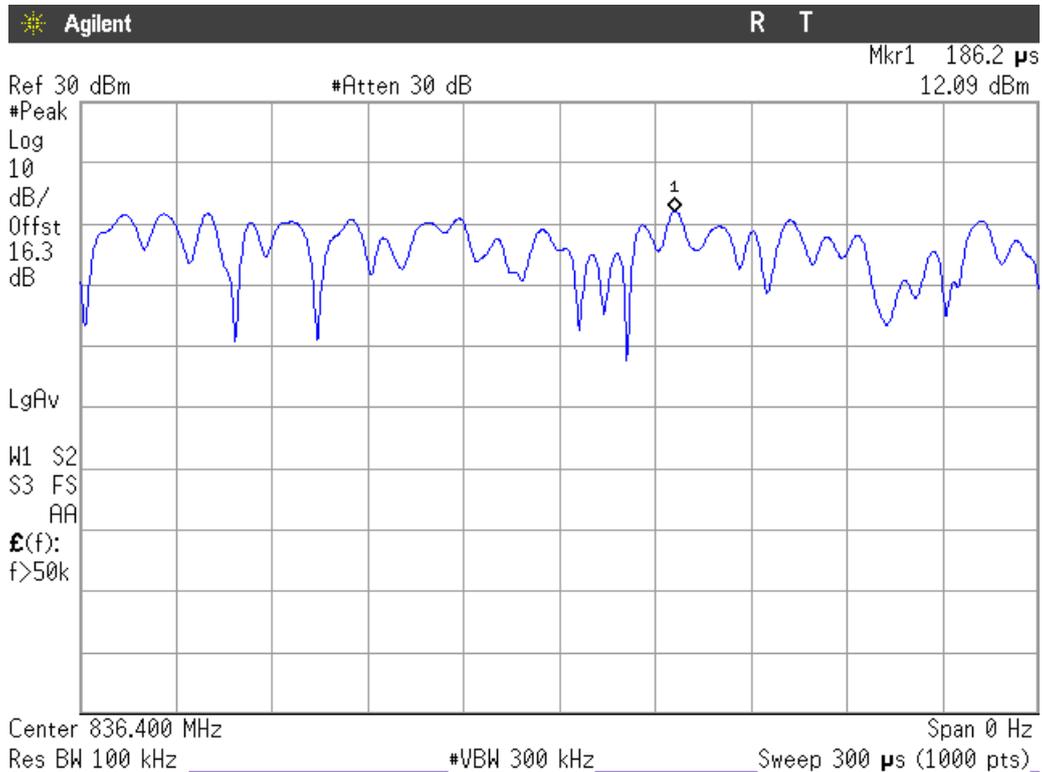
EDGE MODULATION



WCDMA MODULATION



HSUPA MODULATION



Frequency Stability

SPECIFICATION

FCC §2.1055 and §22.355. ± 2.5 ppm for mobile stations operating in the range 821 to 896 MHz.

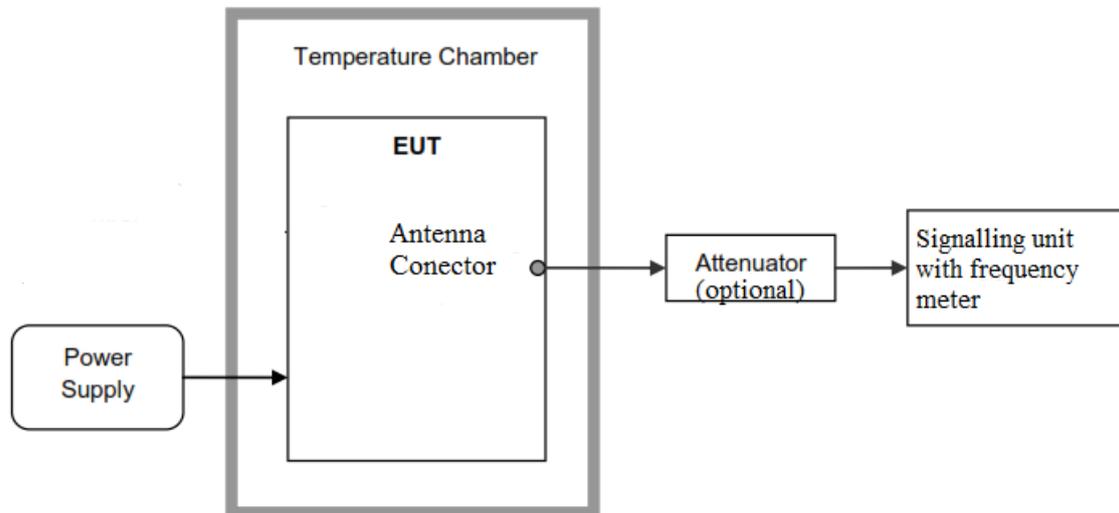
METHOD

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 the values declared by the manufacturer.

The EUT was set in “call mode” in the middle channel using the Universal Radio Communication tester R&S CMU200 or CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.

TEST SETUP



RESULTS

Frequency stability over temperature variations.

GPRS AND EDGE MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	39	0.046617260	0.0000046
+40	39	0.046617260	0.0000046
+30	38	0.045421946	0.0000045
+20	37	0.044226632	0.0000044
+10	35	0.041836003	0.0000042
0	32	0.038250060	0.0000038
-10	29	0.034664117	0.0000037
-20	27	0.032273488	0.0000032
-30	30	0.035859431	0.0000036

WCDMA AND HSUPA MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	0.08	0.000095640	0.000000009
+40	-0.46	-0.000549976	-0.00000005
+30	-0.35	-0.000418460	-0.00000004
+20	-0.44	-0.000526064	-0.00000005
+10	0.11	0.000131516	-0.00000001
0	-0.19	-0.000227164	-0.00000002
-10	-0.09	-0.000107604	-0.00000001
-20	-0.36	-0.000430416	-0.00000004
-30	-0.21	-0.000251076	-0.00000002

Frequency stability over voltage variations.

GPRS AND EDGE MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	37	0.044226632	0.0000044
Vmin	3.60	37	0.044226632	0.0000044

WCDMA AND HSUPA MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	-0.44	-0.000526064	-0.00000005
Vmin	3.60	-0.24	-0.000286944	-0.00000002

Measurement uncertainty	$<\pm 1 \times 10^{-6}$
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Verdict: PASS

Occupied Bandwidth

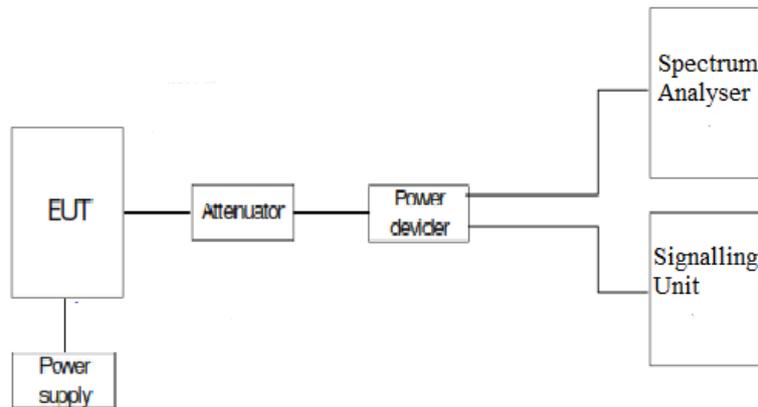
SPECIFICATION

FCC §2.1049

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 R&S CMU200 or 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

GPRS MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	241.40	243.49	243.32
-26 dBc bandwidth (kHz)	314.42	317.91	315.14
Measurement uncertainty (kHz)	<±1.67		

EDGE MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	248.81	249.36	247.71
-26 dBc bandwidth (kHz)	320.58	314.24	318.58
Measurement uncertainty (kHz)	<±1.67		

WCDMA MODULATION

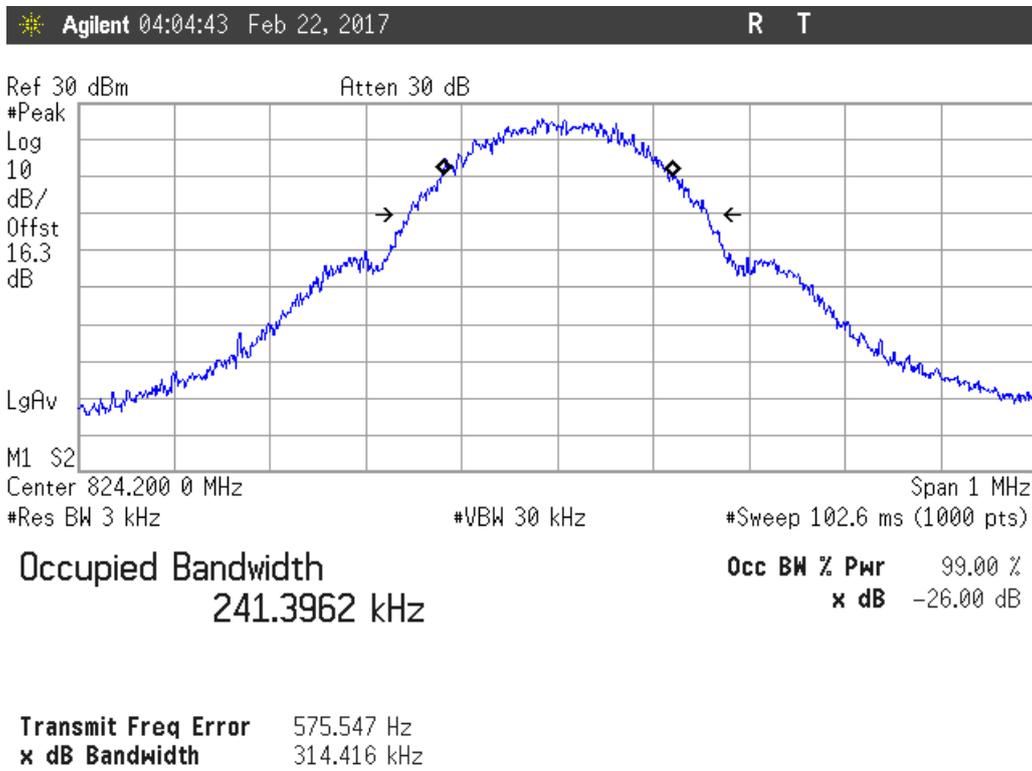
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4175.9	4175.6	4150.9
-26 dBc bandwidth (kHz)	4642.0	4639.0	4636.0
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

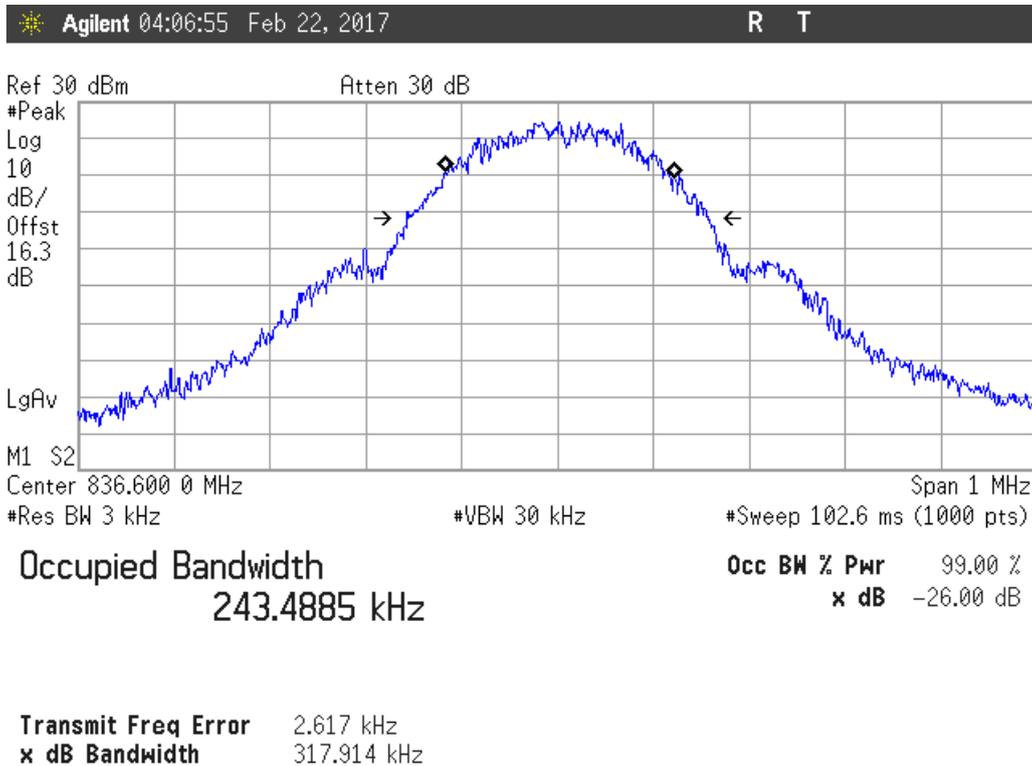
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4162.4	4145.6	4164.5
-26 dBc bandwidth (kHz)	4643.0	4641.0	4629.0
Measurement uncertainty (kHz)	<±16.67		

GPRS MODULATION

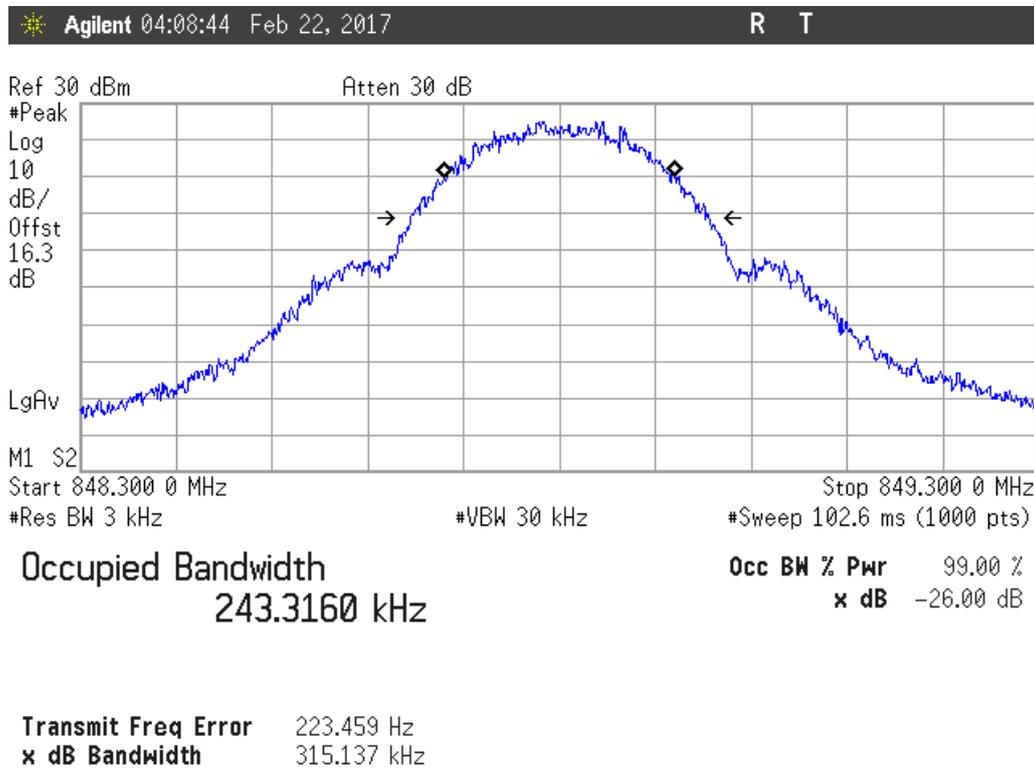
Lowest Channel



Middle Channel

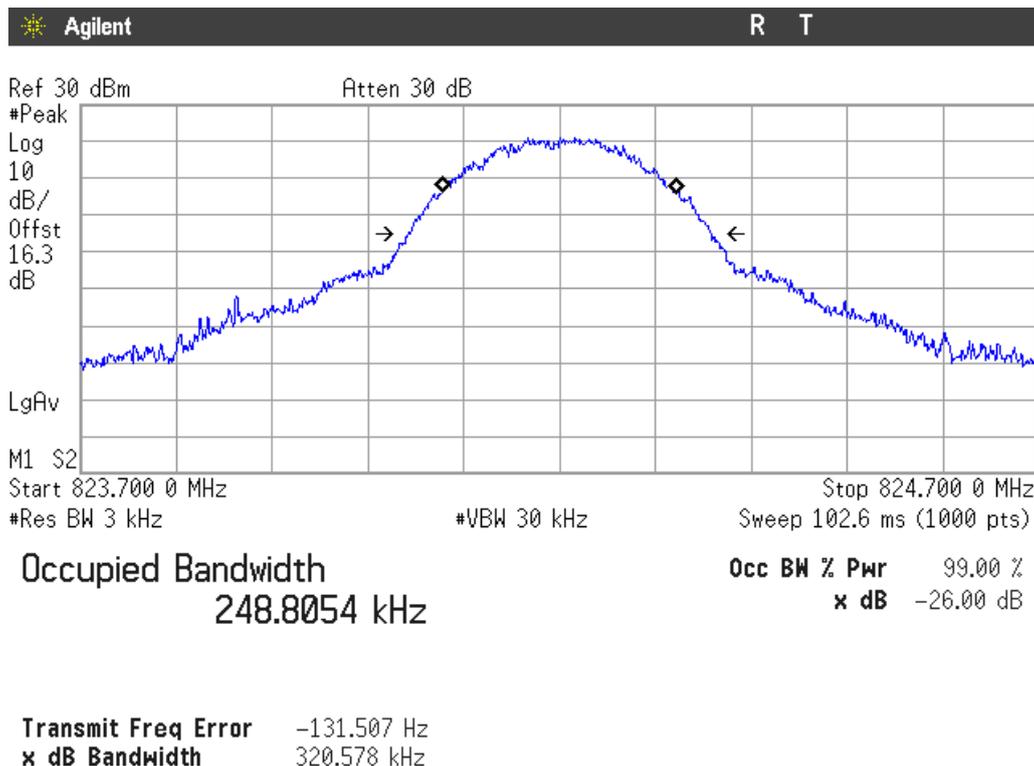


Highest Channel

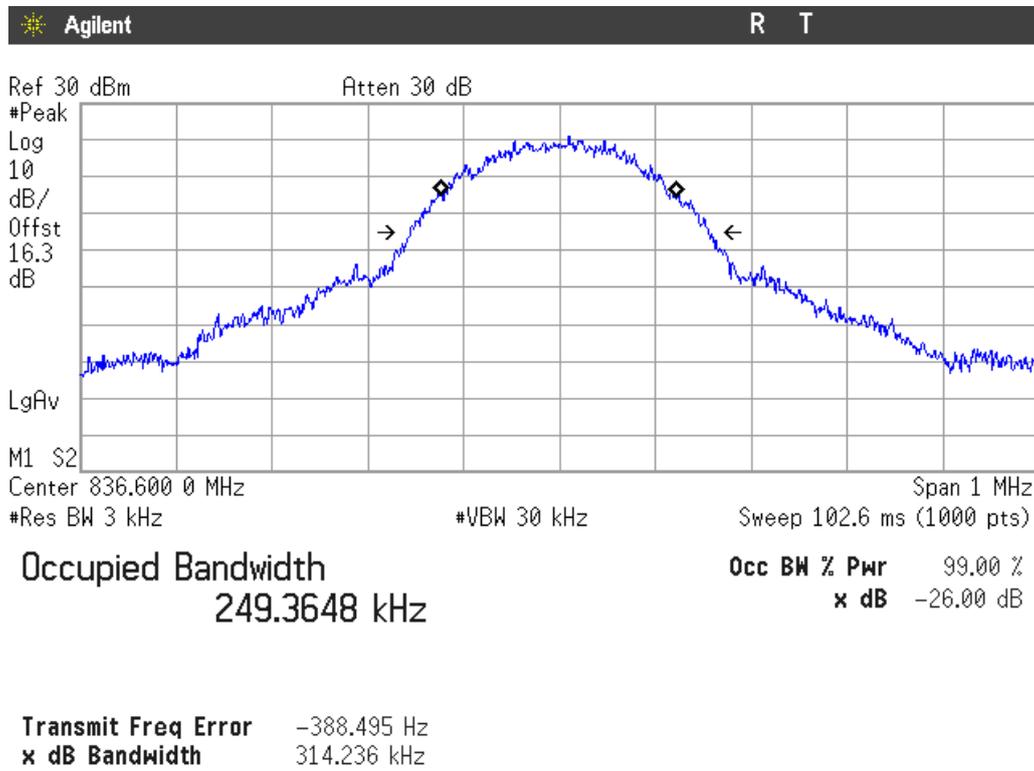


EDGE MODULATION

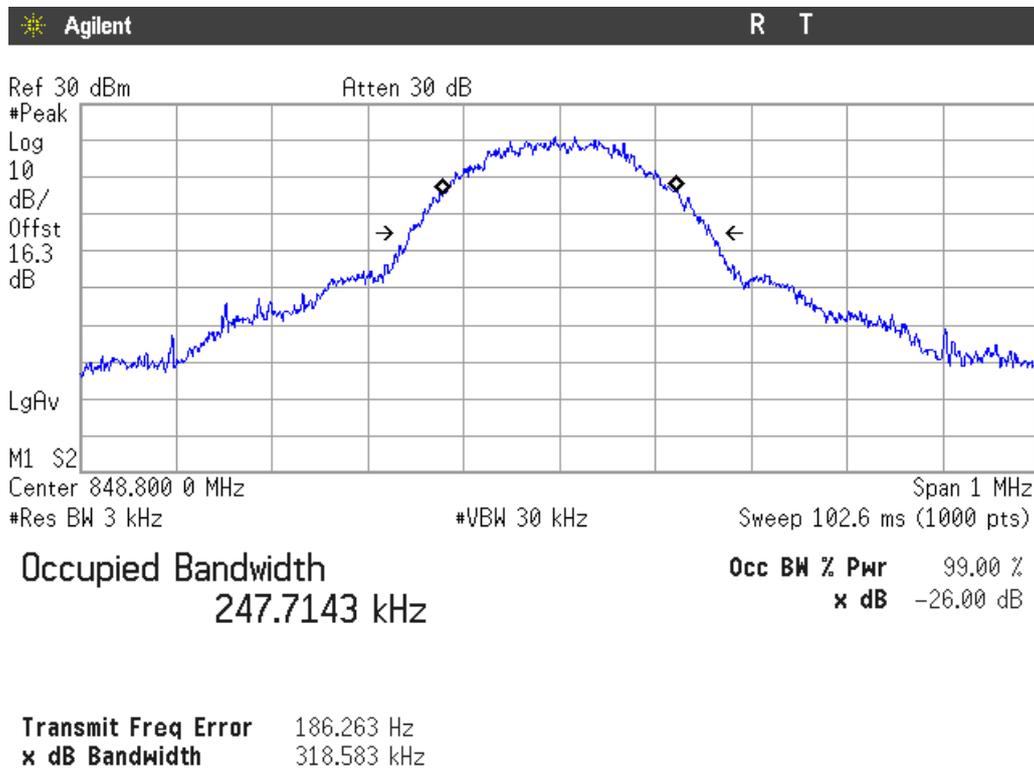
Lowest Channel



Middle Channel

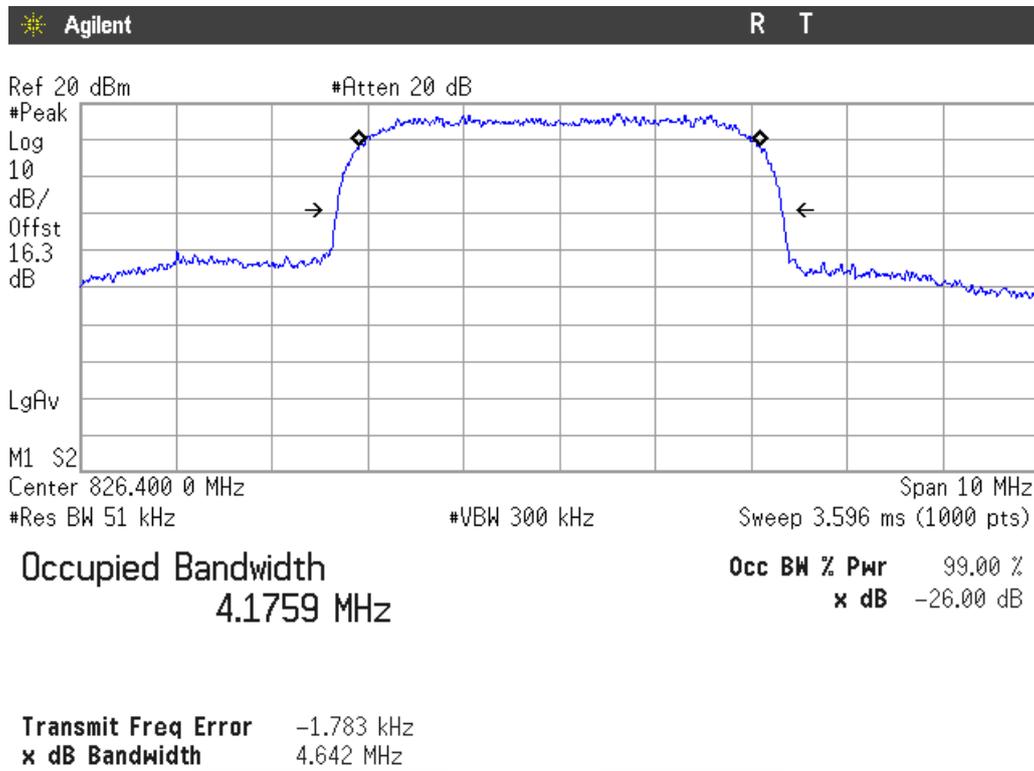


Highest Channel

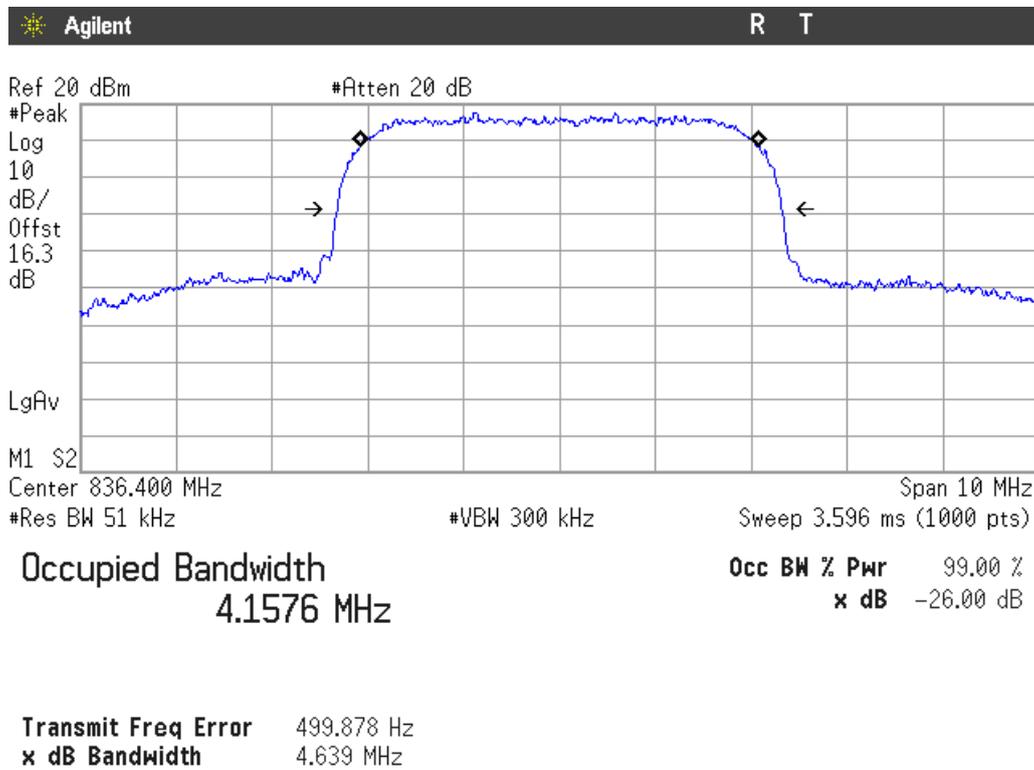


WCDMA MODULATION

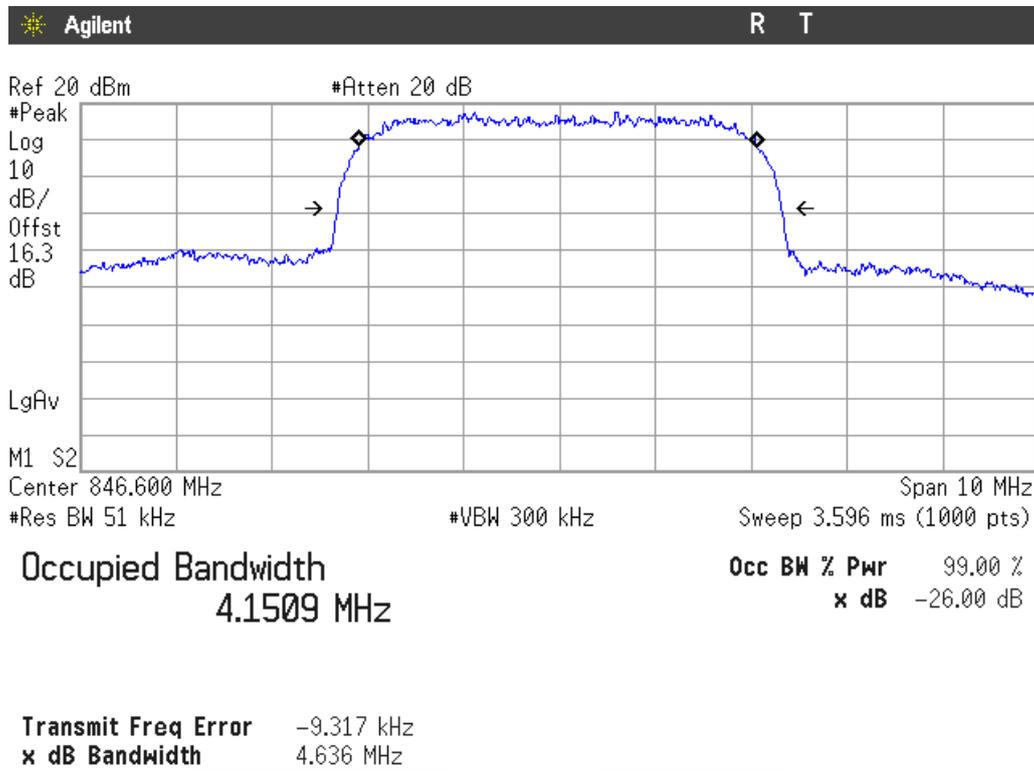
Lowest Channel



Middle Channel

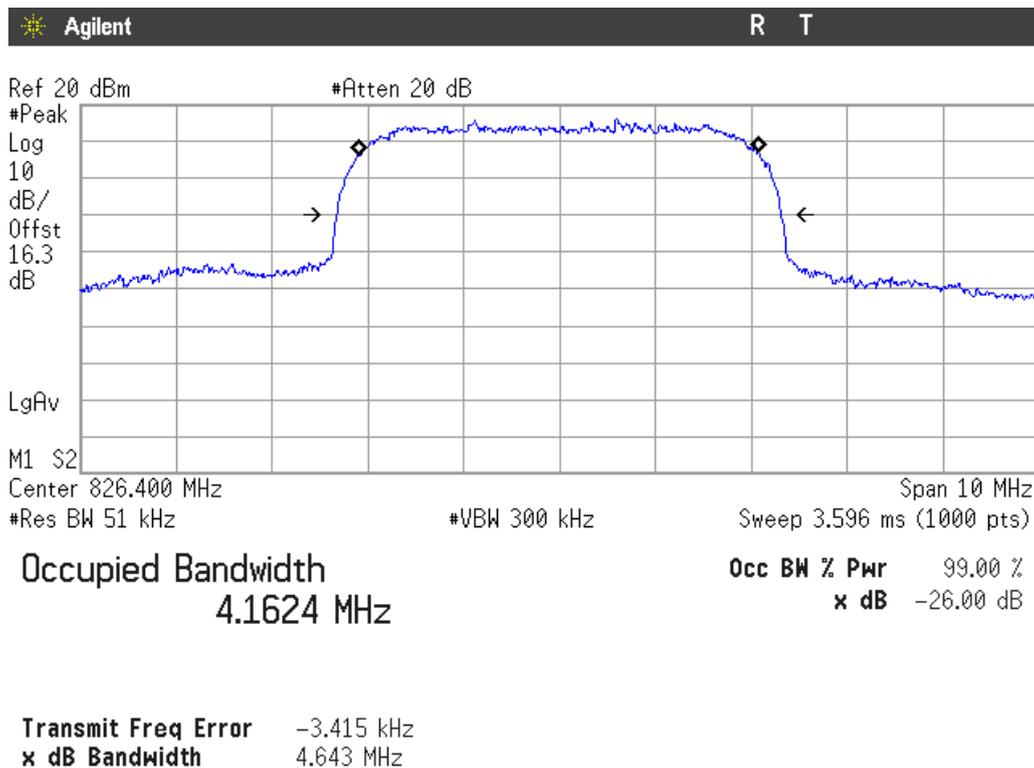


Highest Channel

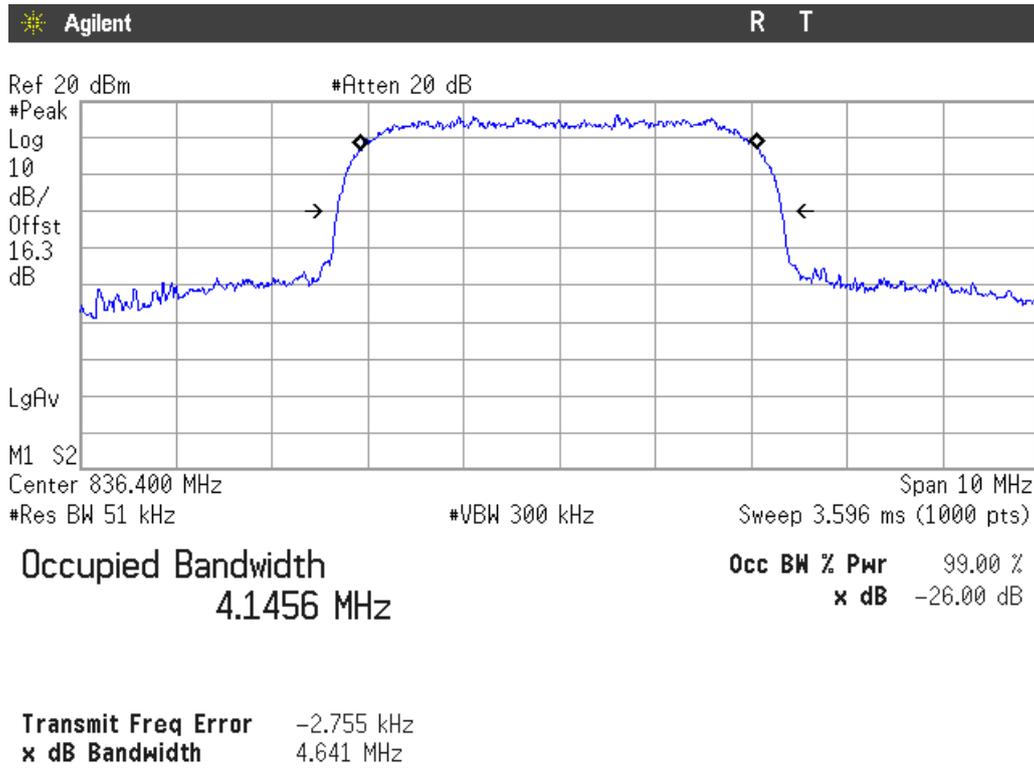


HSUPA MODULATION

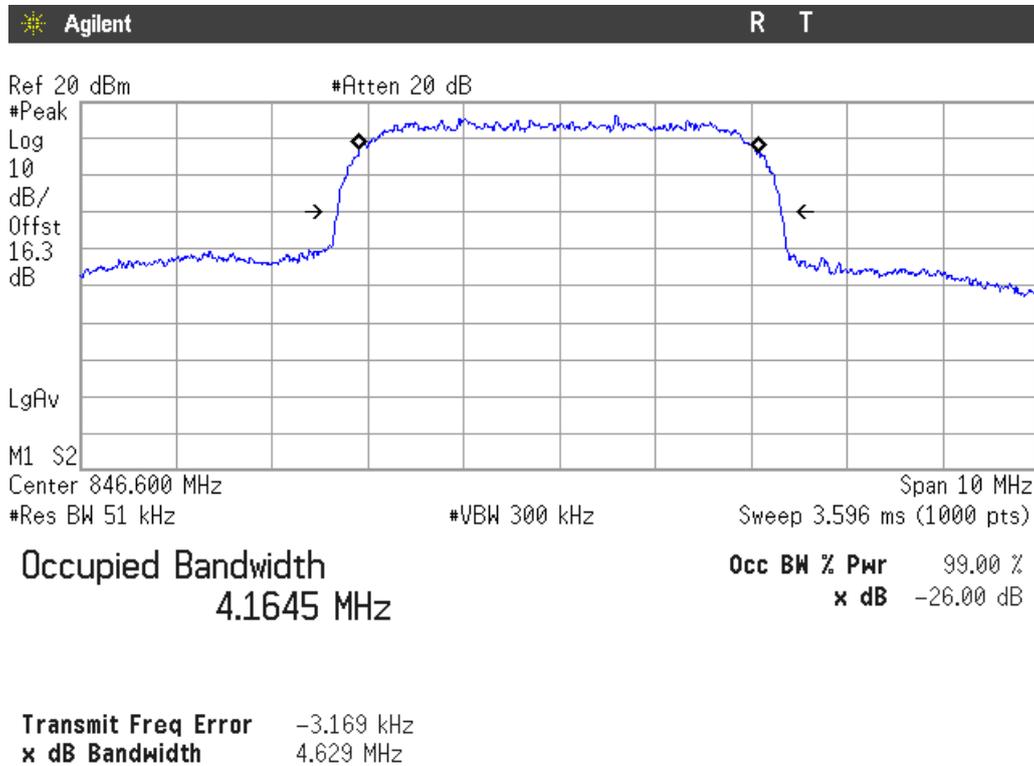
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051 and §22.917

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.

METHOD

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMU200 and CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 ohm attenuator and a power splitter.

The spectrum was investigated from 9 kHz to 10 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.

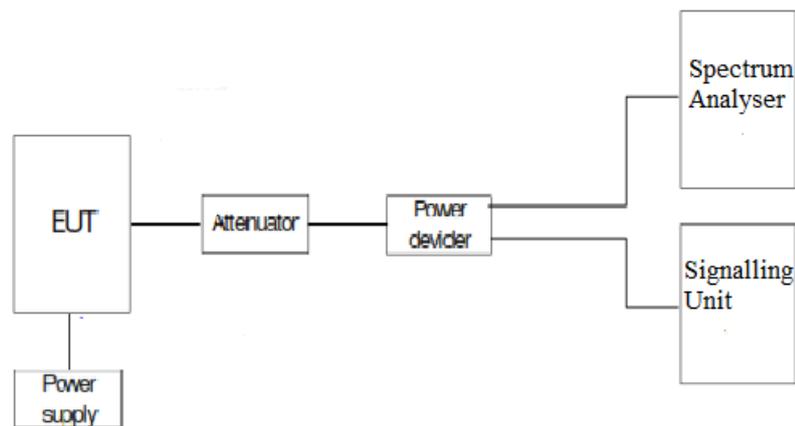
Measurement Limit:

According to specification, 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 P_o becomes:

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

TEST SETUP



RESULTS (see plots in next pages)

GPRS MODULATION

1. CHANNEL: LOWEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found at less than 20dB respect to the limit in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

EDGE MODULATION

1. CHANNEL: LOWEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found at less than 20dB respect to the limit in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

WCDMA MODULATION

1. CHANNEL: LOWEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found at less than 20dB respect to the limit in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

HSUPA MODULATION

1. CHANNEL: LOWEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found at less than 20dB respect to the limit in all the range.

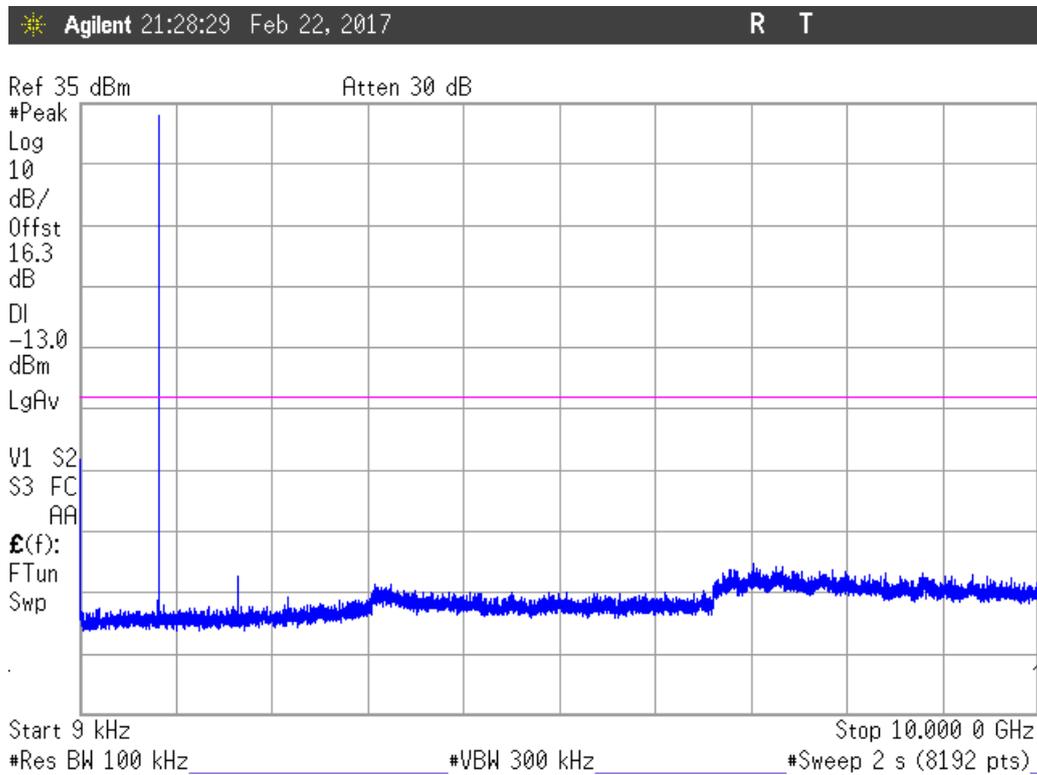
3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

Verdict: PASS

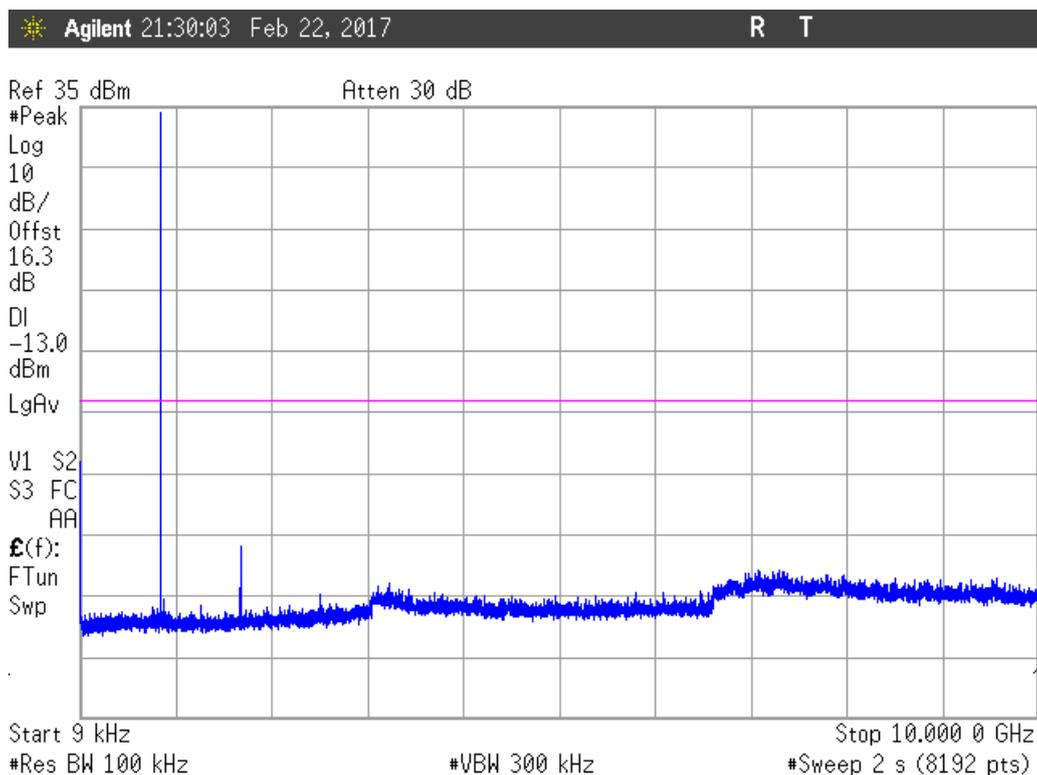
GPRS MODULATION

1. CHANNEL: LOWEST



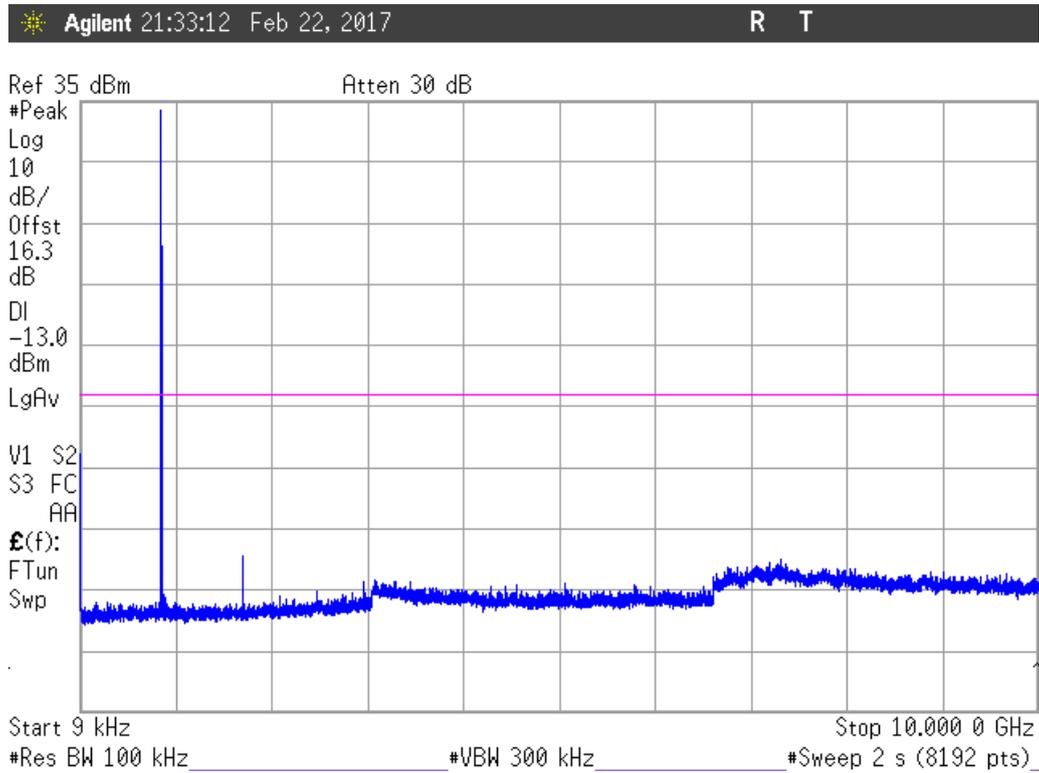
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

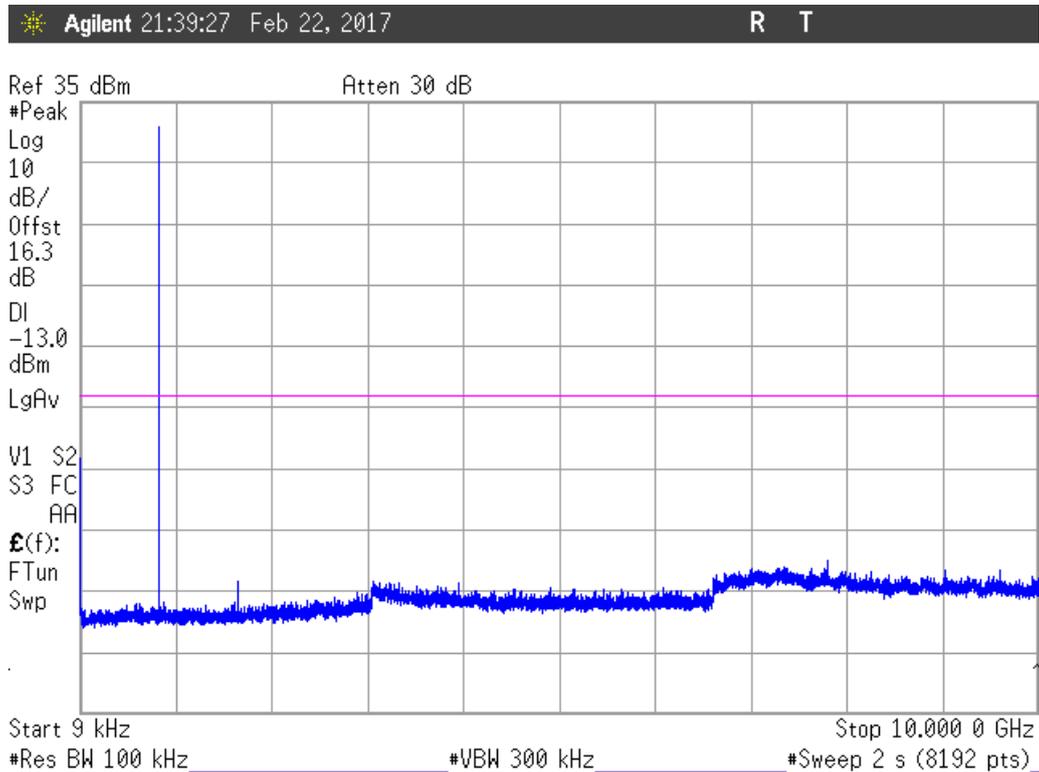
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

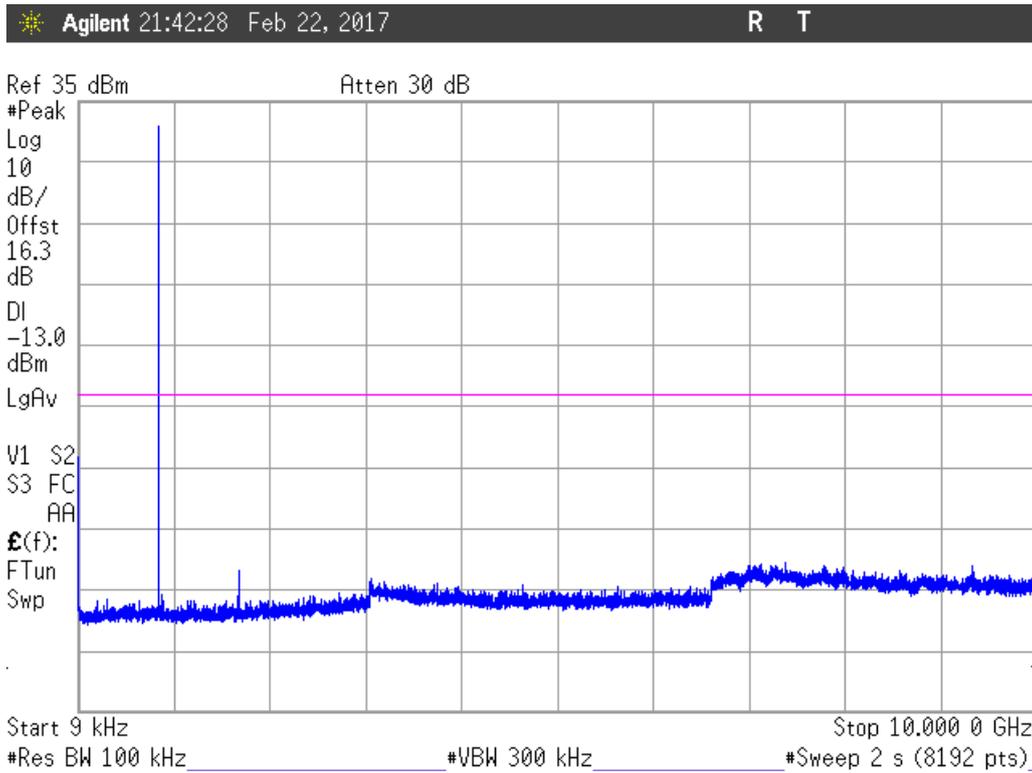
EDGE MODULATION

1. CHANNEL: LOWEST



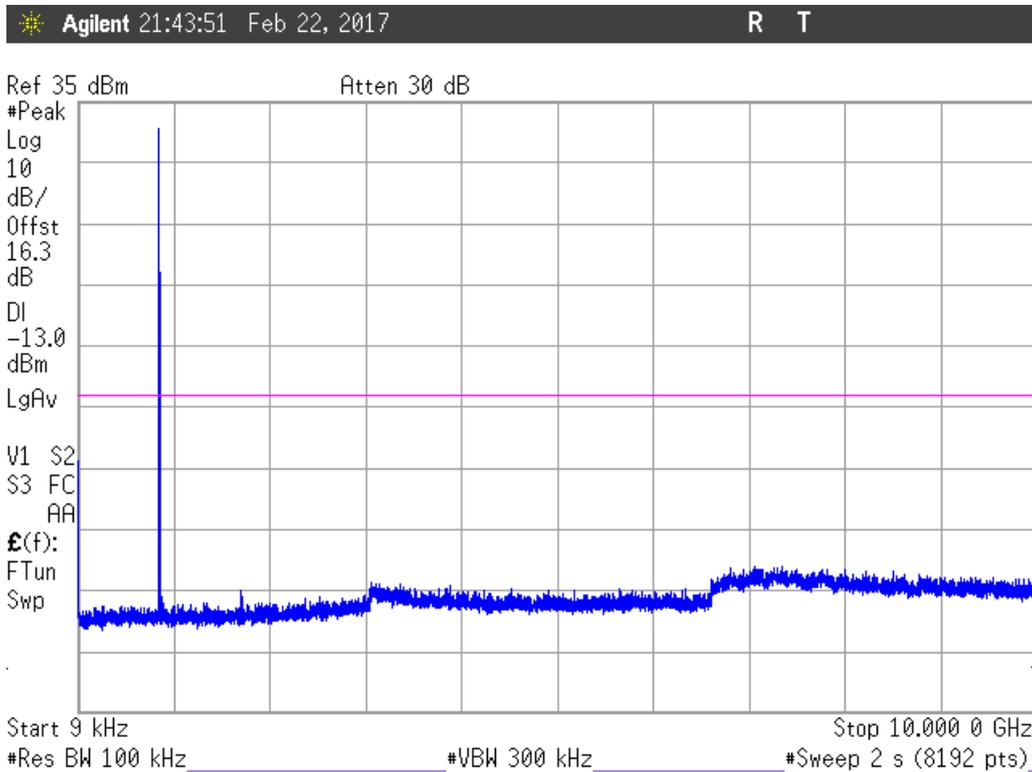
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

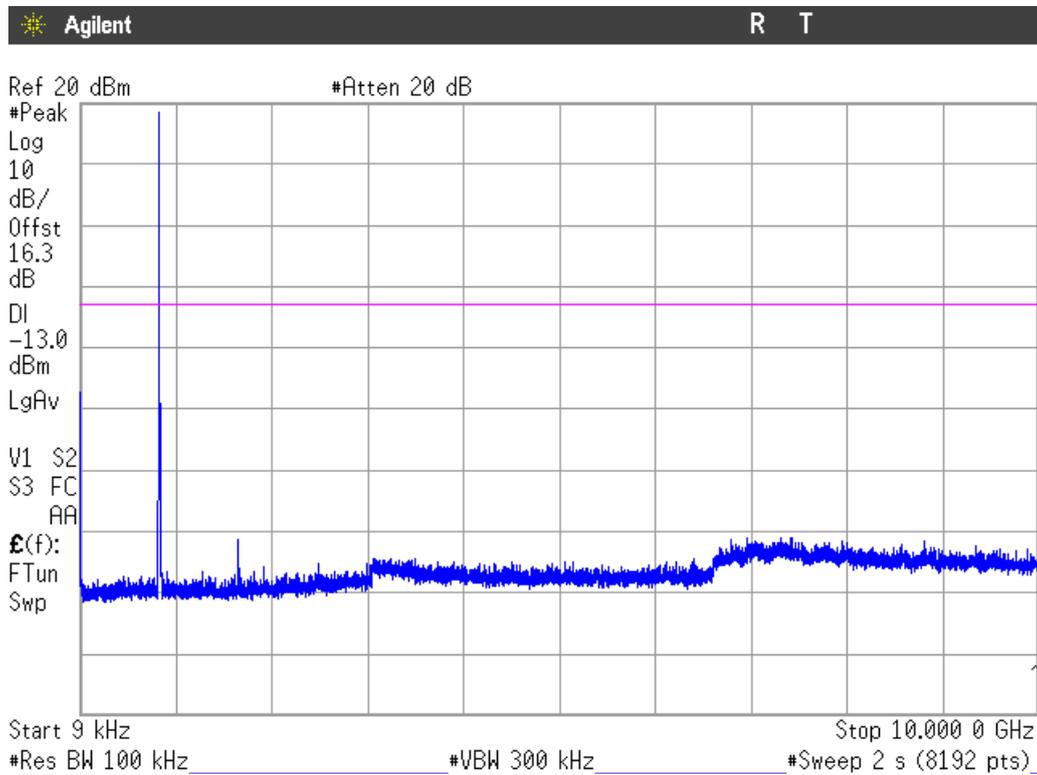
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

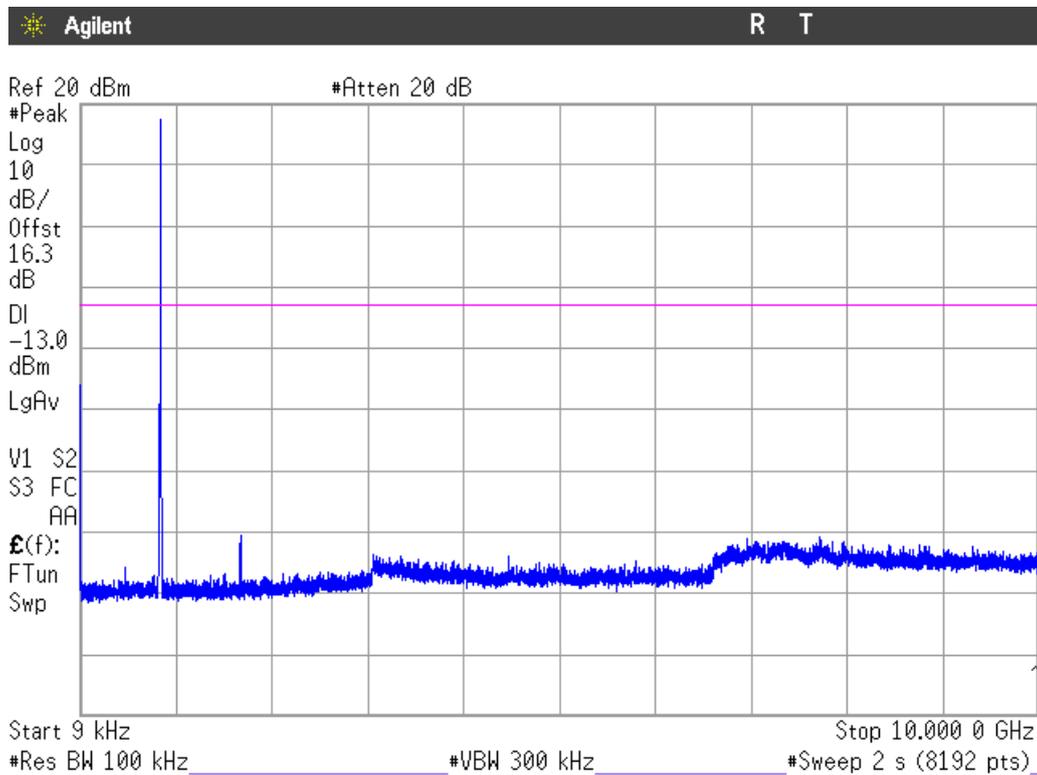
WCDMA MODULATION

1. CHANNEL: LOWEST



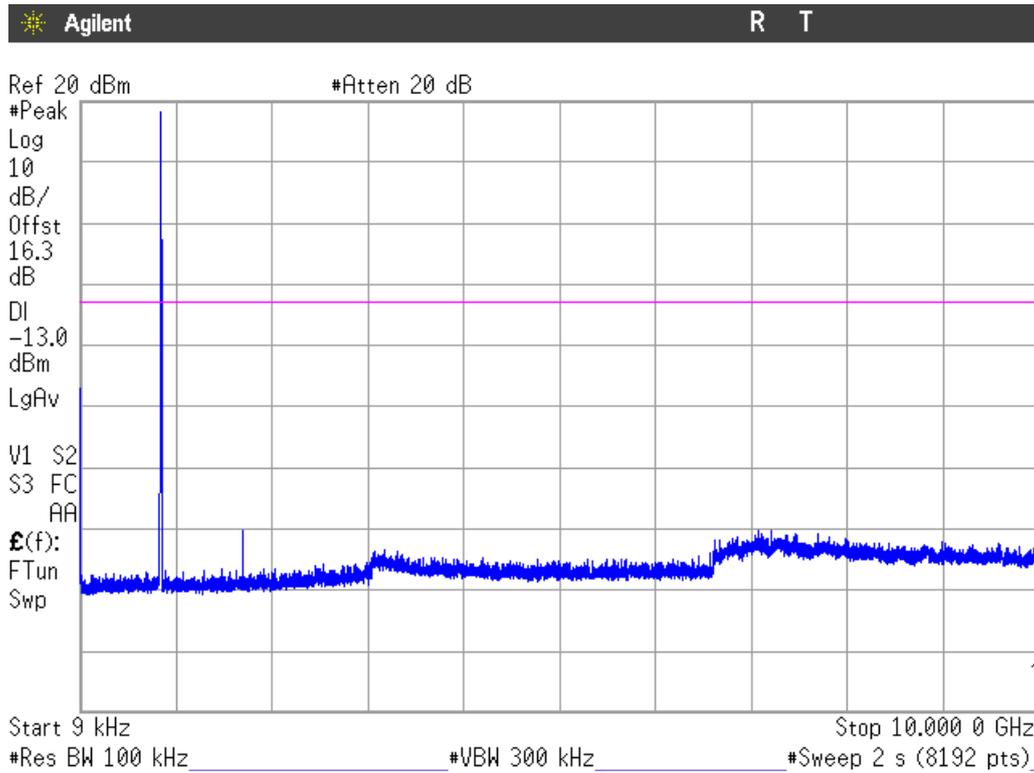
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

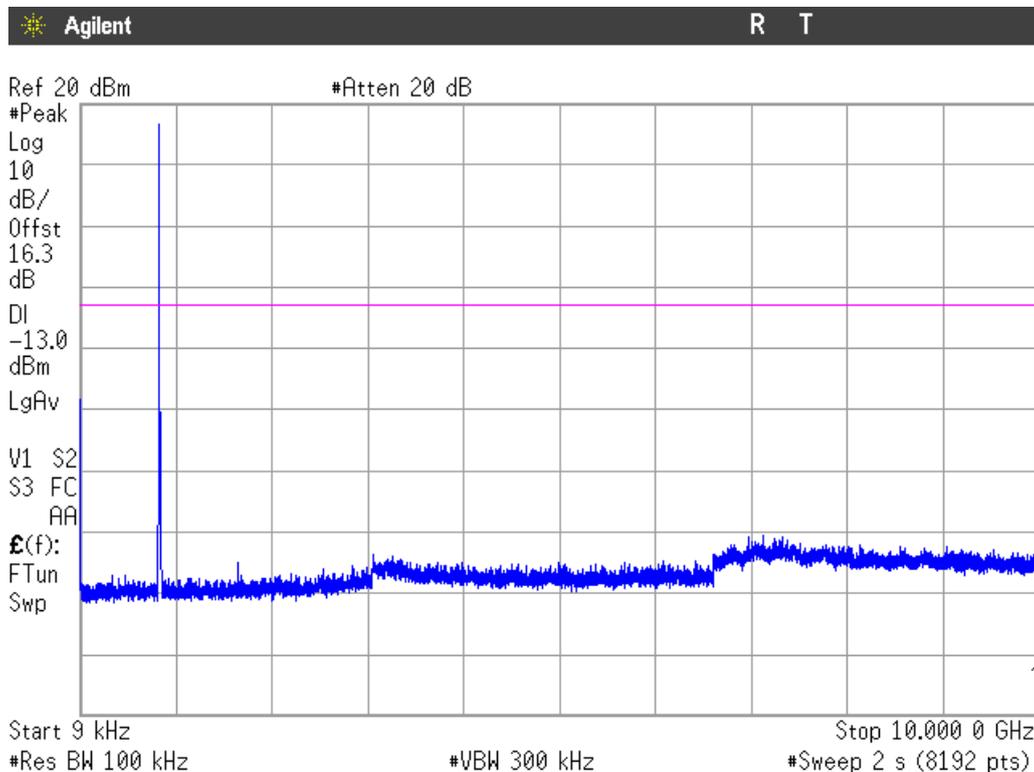
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

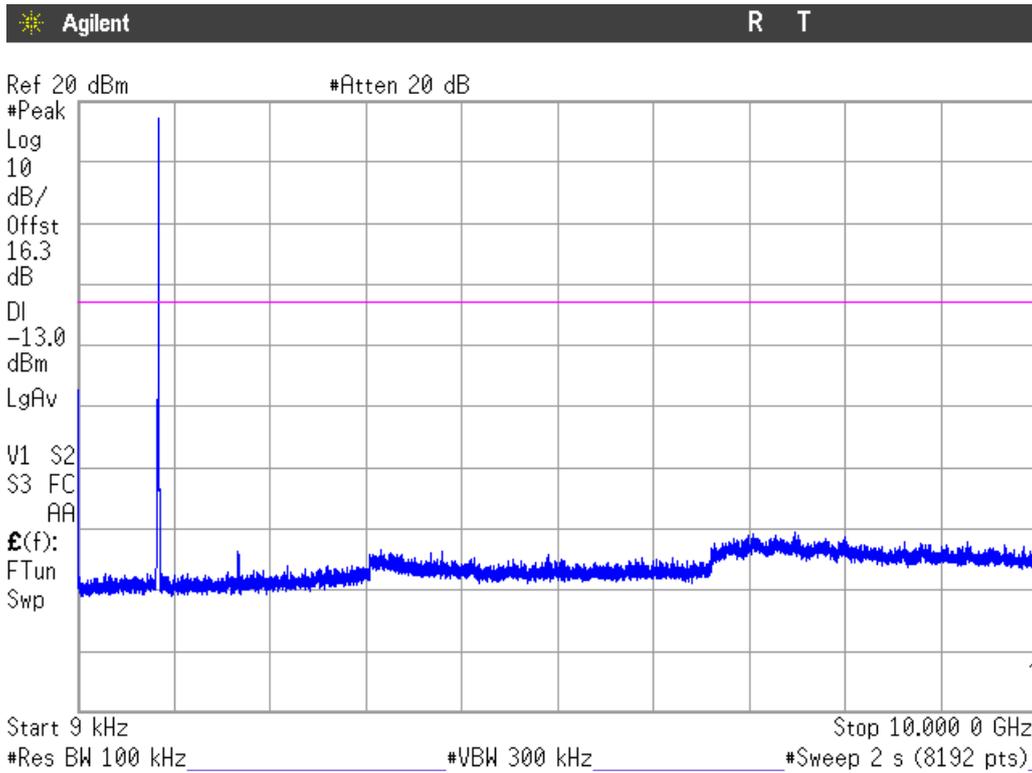
HSUPA MODULATION

1. CHANNEL: LOWEST



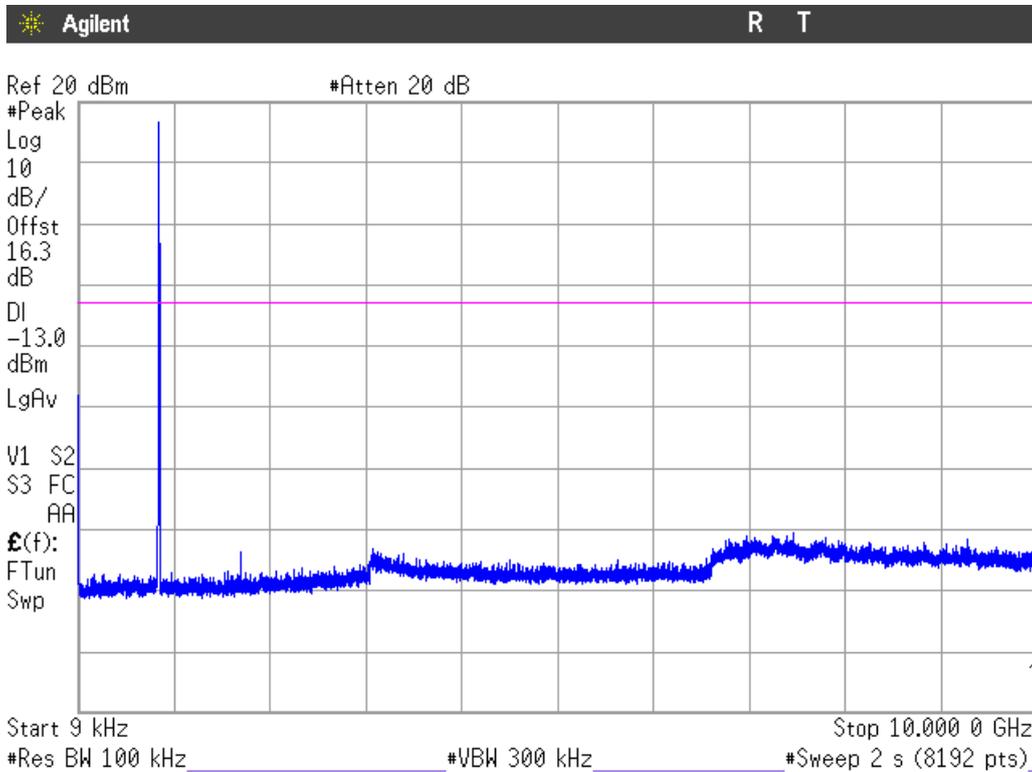
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

Measurement uncertainty (dB)	<±2.03
------------------------------	--------

Spurious emissions at antenna terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §22.917

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.

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.

As indicated in FCC part 22, 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.

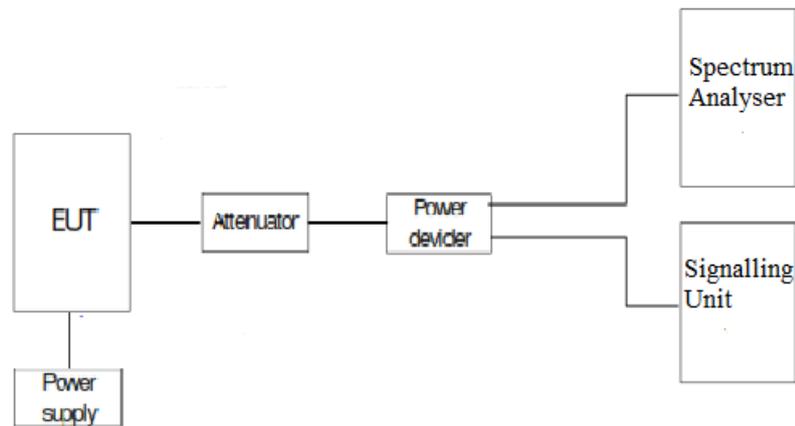
Measurement Limit:

According to specification, 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 P_o becomes:

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

TEST SETUP



RESULTS (see plots in next pages)

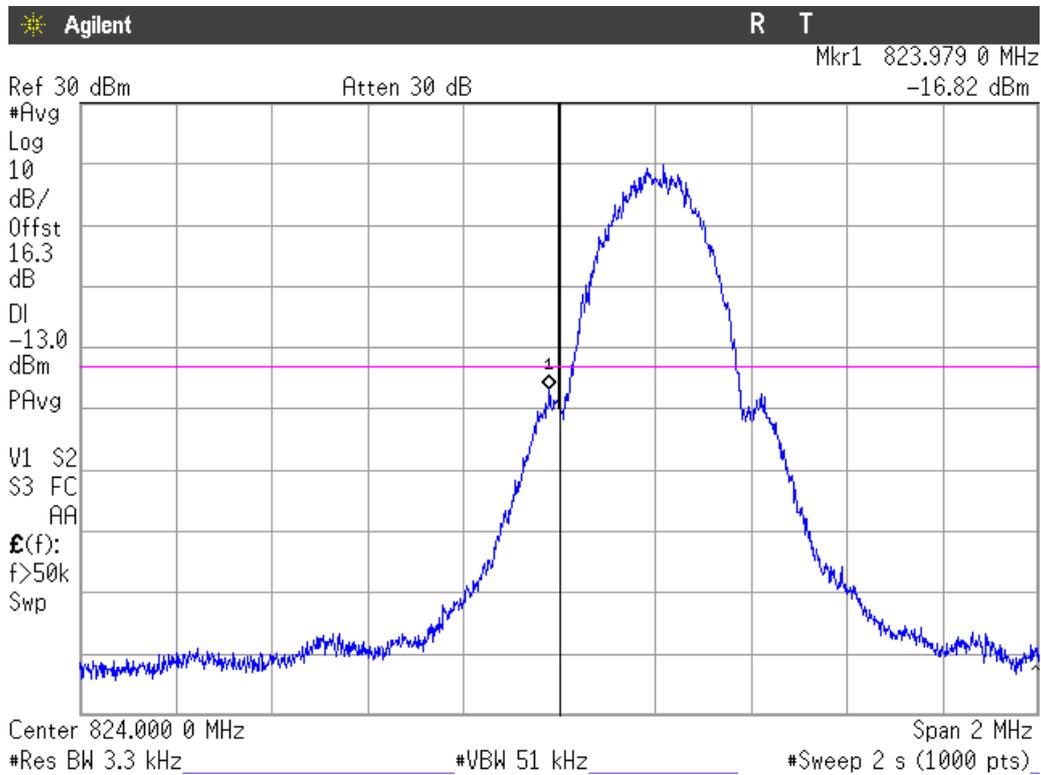
MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at lowest Block Edge at antenna port (dBm)	-16.82	-21.41	-19.68	-20.95
Measurement uncertainty (dB)	±2.03			

MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-19.34	-21.93	-19.85	-20.63
Measurement uncertainty (dB)	<±2.03			

NOTE: The GPRS and EDGE modulation was measured using gate triggered such that the analyzer only sweeps when the device is transmitting at full power and with average detector.

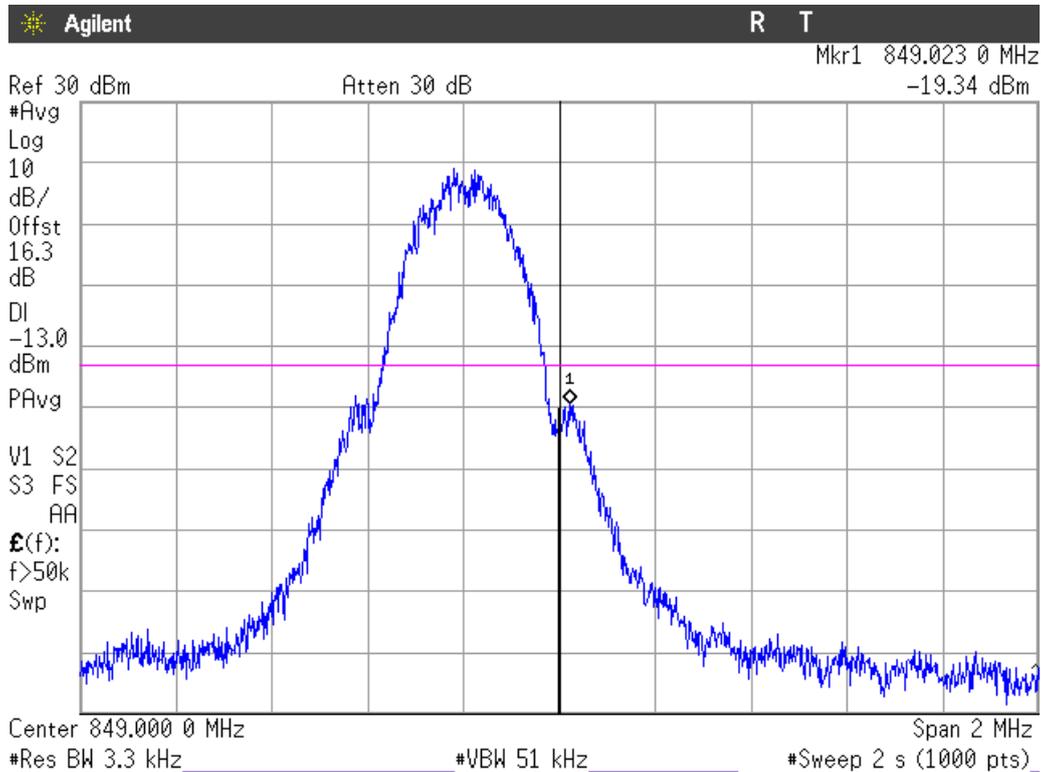
Verdict: PASS

GPRS MODULATION
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

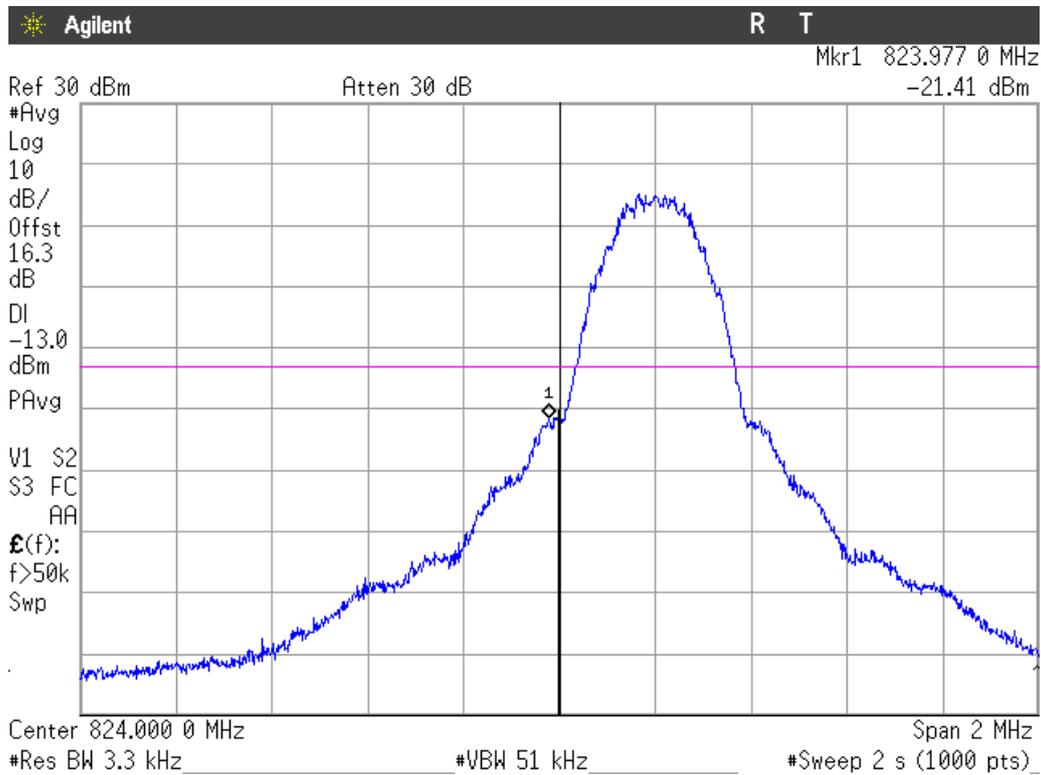
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

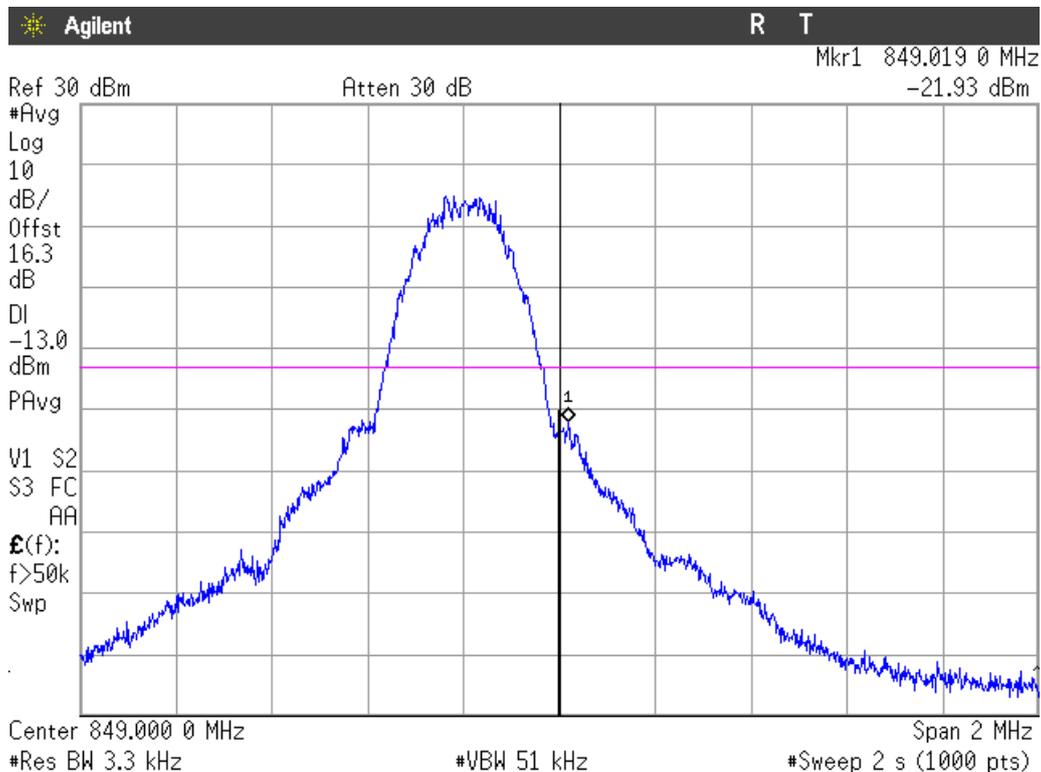
EDGE MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

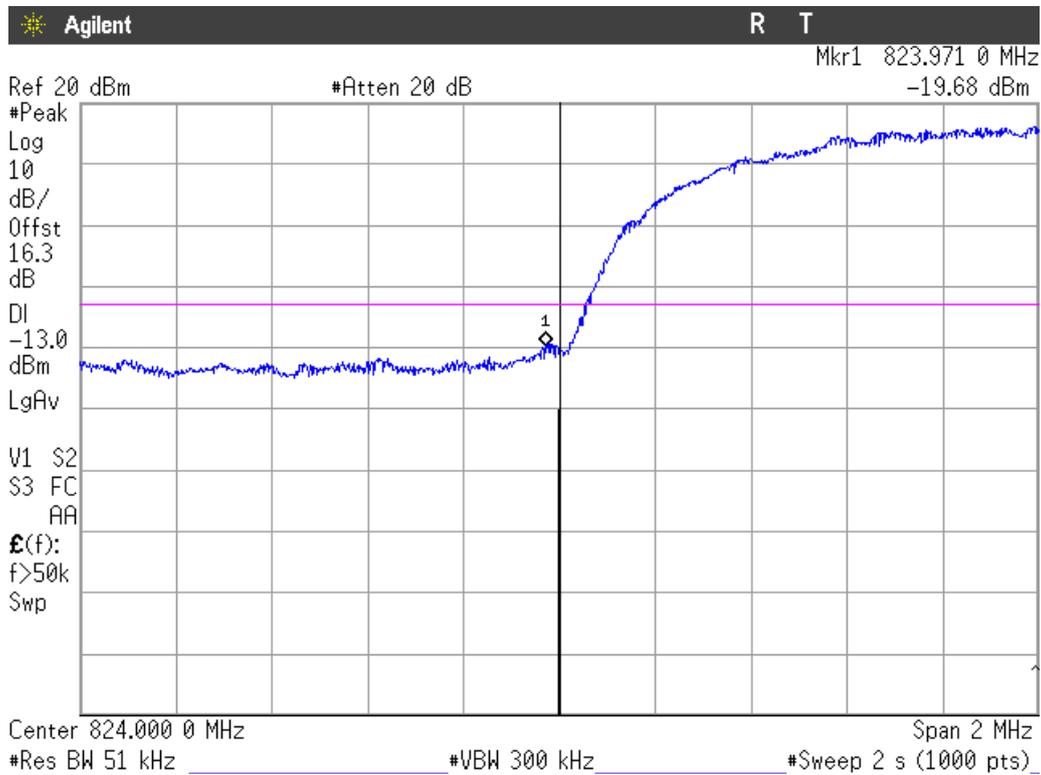
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

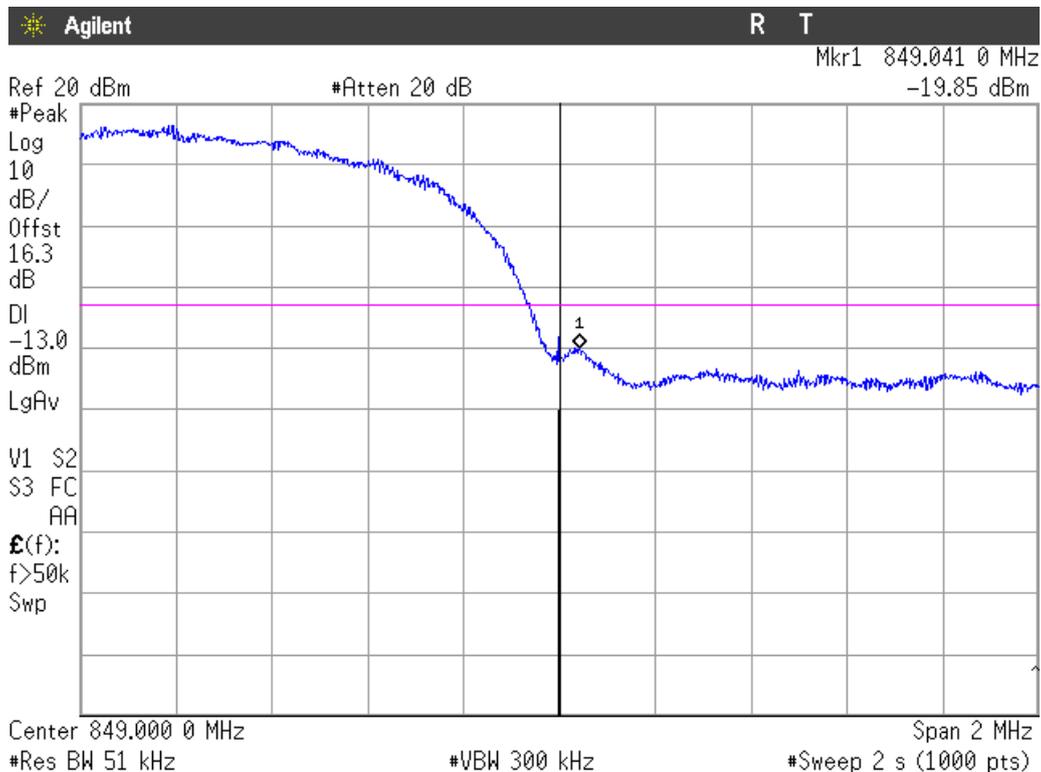
WCDMA MODULATION

CHANNEL LOWEST



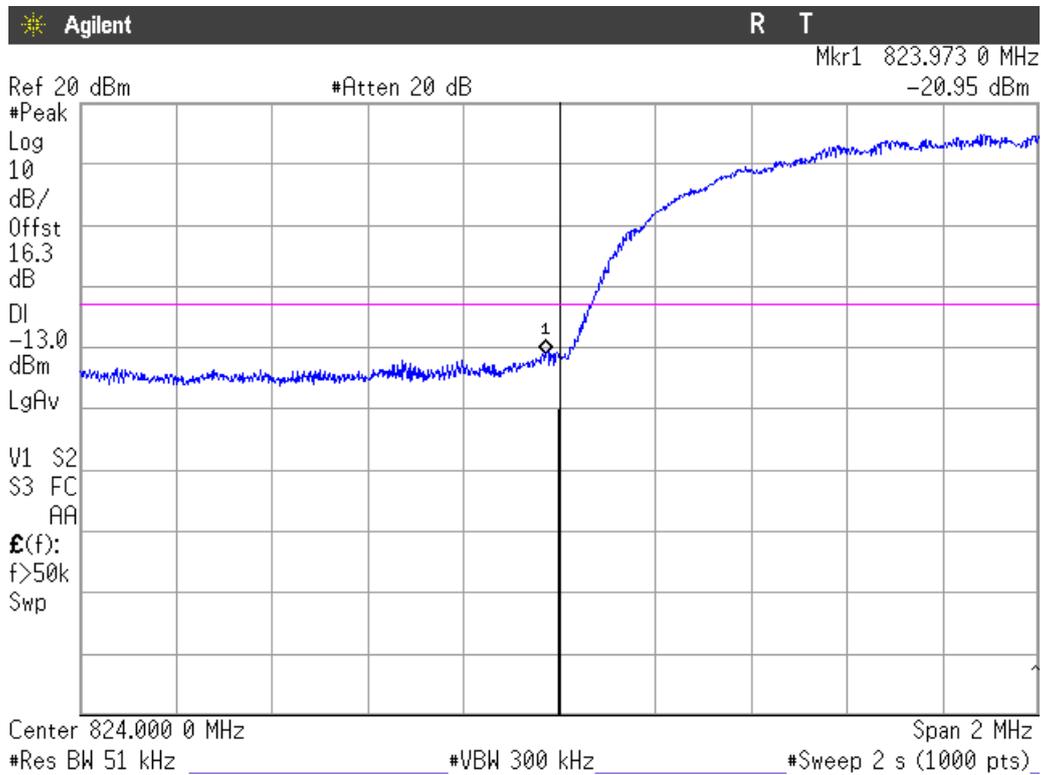
NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



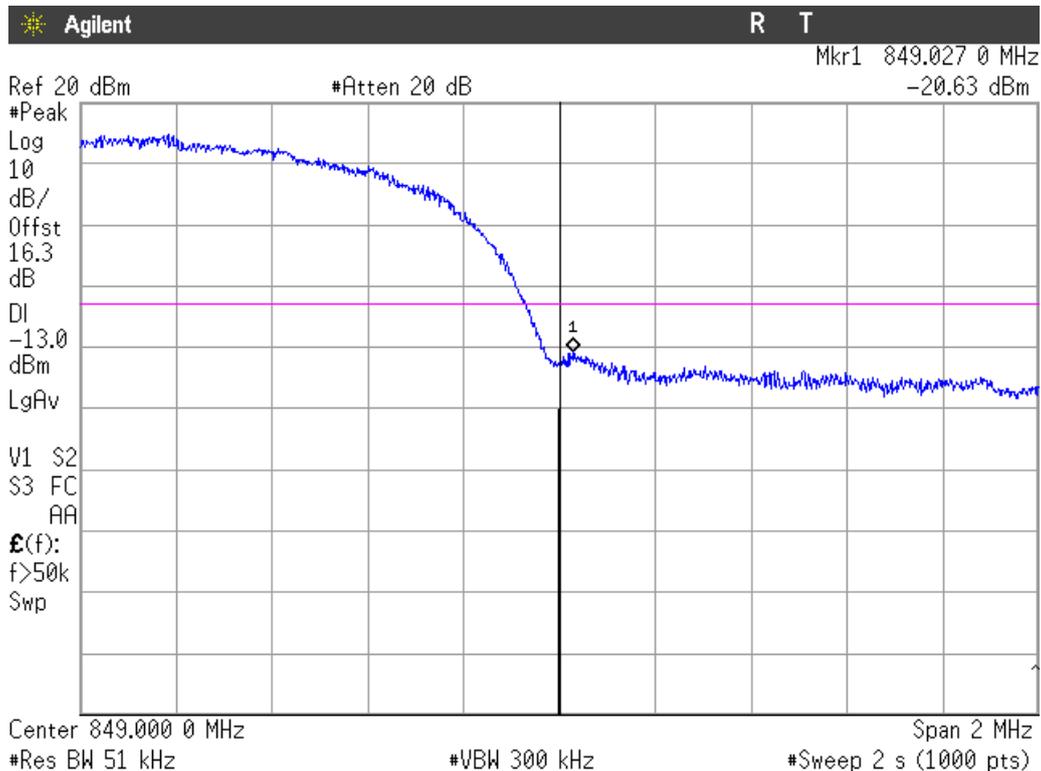
NOTE: The equipment transmits at the maximum output power

HSUPA MODULATION
 CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

Radiated emissions

SPECIFICATION

FCC § 22.917

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.

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 below 1 GHz and at 1 m distance for measurements above 1 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 radiated emissions were measured with peak detector and 1 MHz bandwidth.

Each detected emission at less than 20 dB respect to the limit is substituted by the Substitution method, in accordance with the ANSI/TIA-603-D: 2010.

The test was performed with the equipment transmitting first in only cellular mode, and then repeated with the BT EDR/BT LE (modulation GFSK, which is the worst case) radio transmitting simultaneously to check the impact of the co-location of both radio interfaces. The results and plots below show the worst results obtained in both modes.

Measurement Limit:

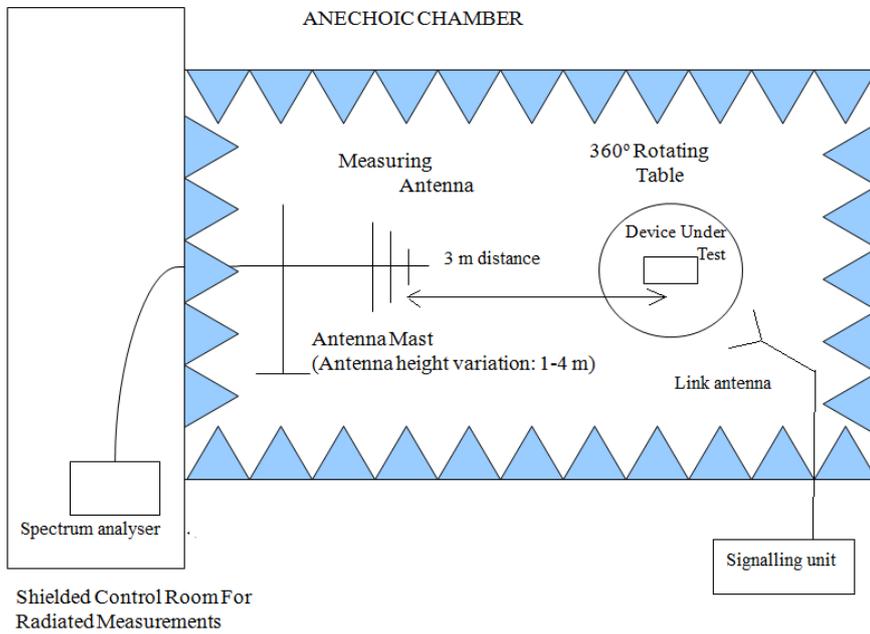
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

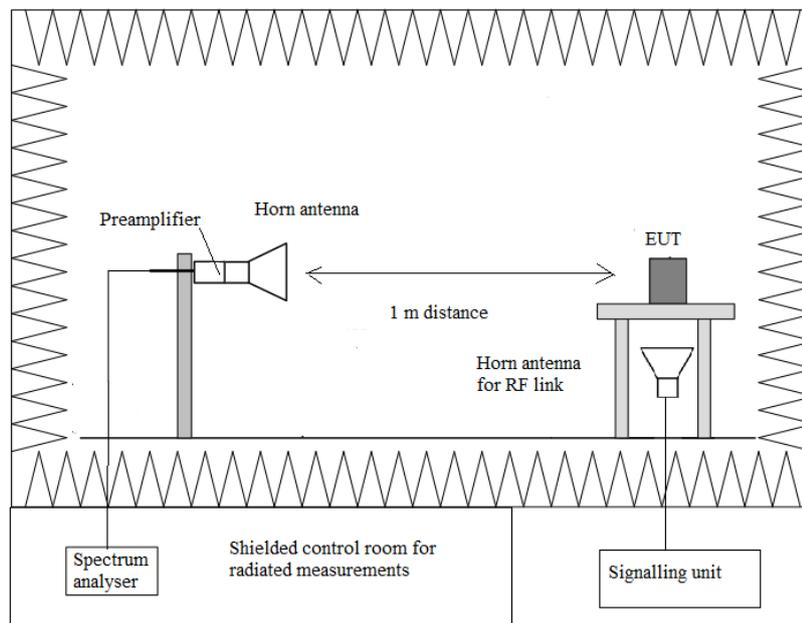
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = - 13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS AND EDGE MODULATION

A preliminary scan determined the GPRS modulation as the worst case. The following tables and plots show the results for GPRS modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1647.85	-7.62	Horizontal	-25.79	1.90	8.63	-19.06

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1673.35	-9.24	Horizontal	-27.38	1.95	8.72	-20.61

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1697.65	-8.75	Horizontal	-26.86	2.00	8.81	-20.05

WCDMA AND HSUPA MODULATION

A preliminary scan determined the HSUPA modulation as the worst case. The following tables and plots show the results for HSUPA modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

No radiated spurious signals were detected at less than 20 dB respect to the limit.

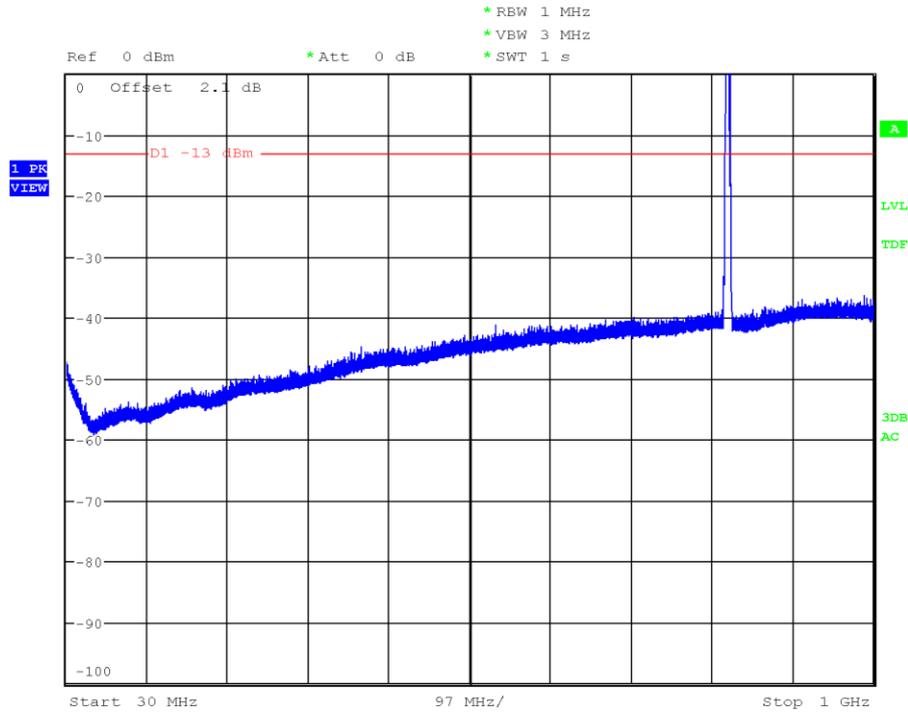
Measurement uncertainty (dB)	<±3.88 for $f < 1\text{GHz}$ <±4.87 for $f \geq 1\text{GHz}$ up to 10 GHz
------------------------------	--

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

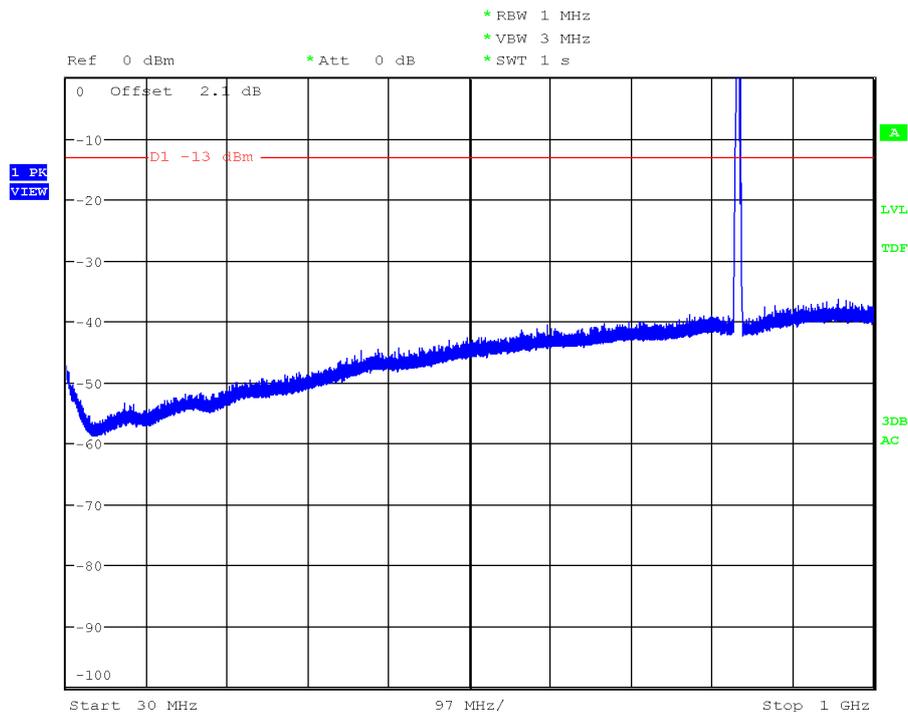
GPRS MODULATION

CHANNEL: LOWEST



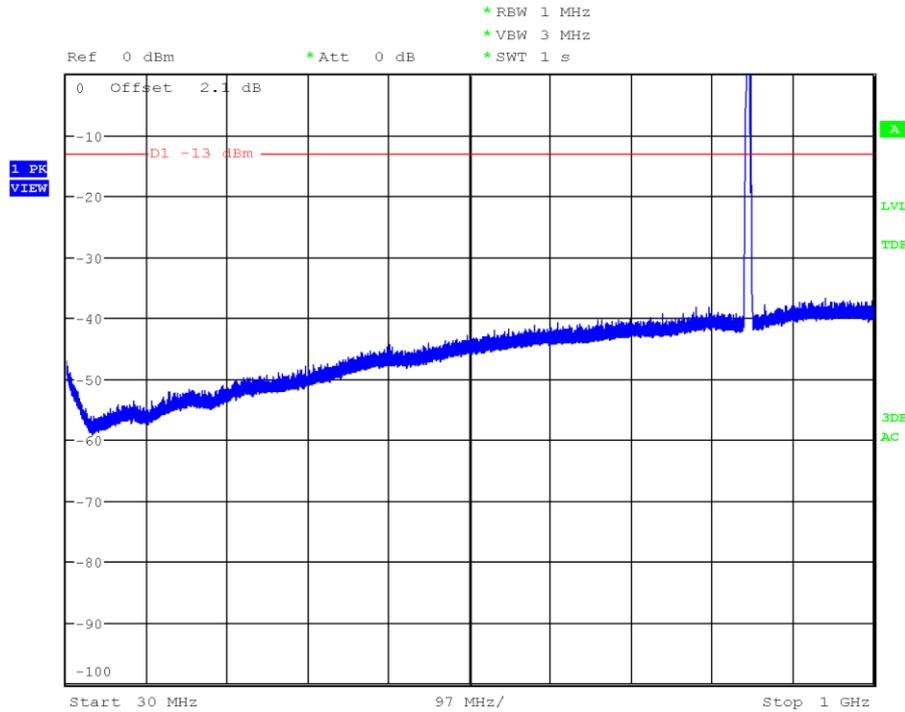
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

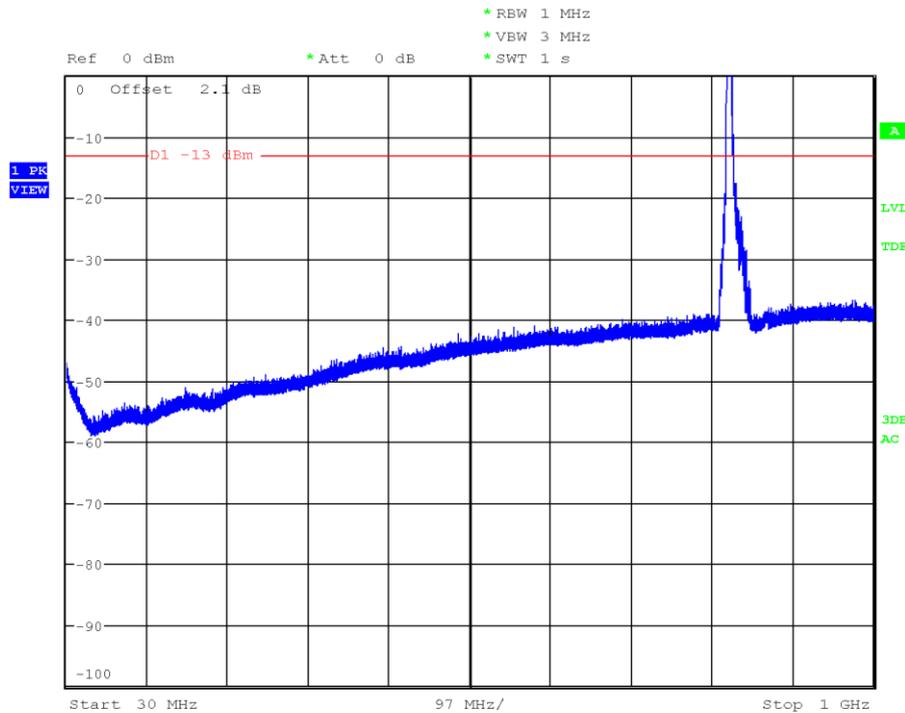
CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

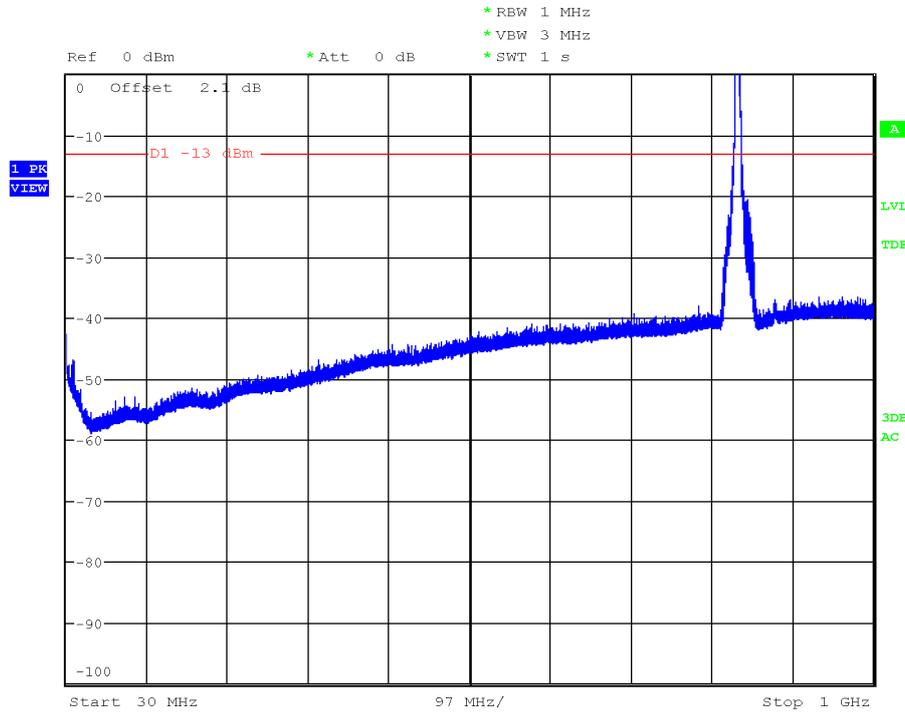
HSUPA MODULATION

CHANNEL: LOWEST



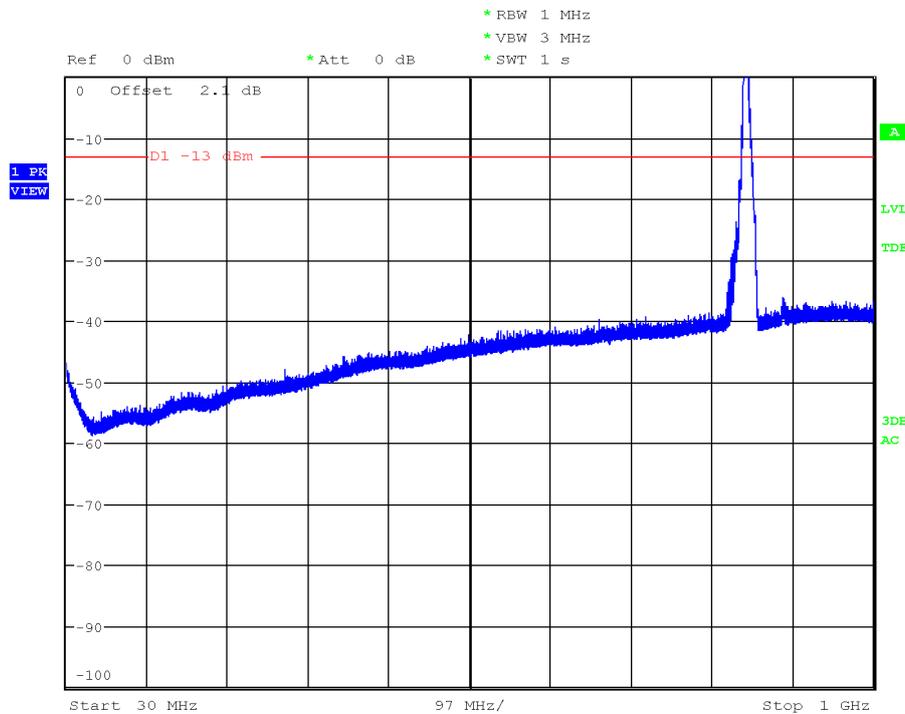
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

CHANNEL: HIGHEST

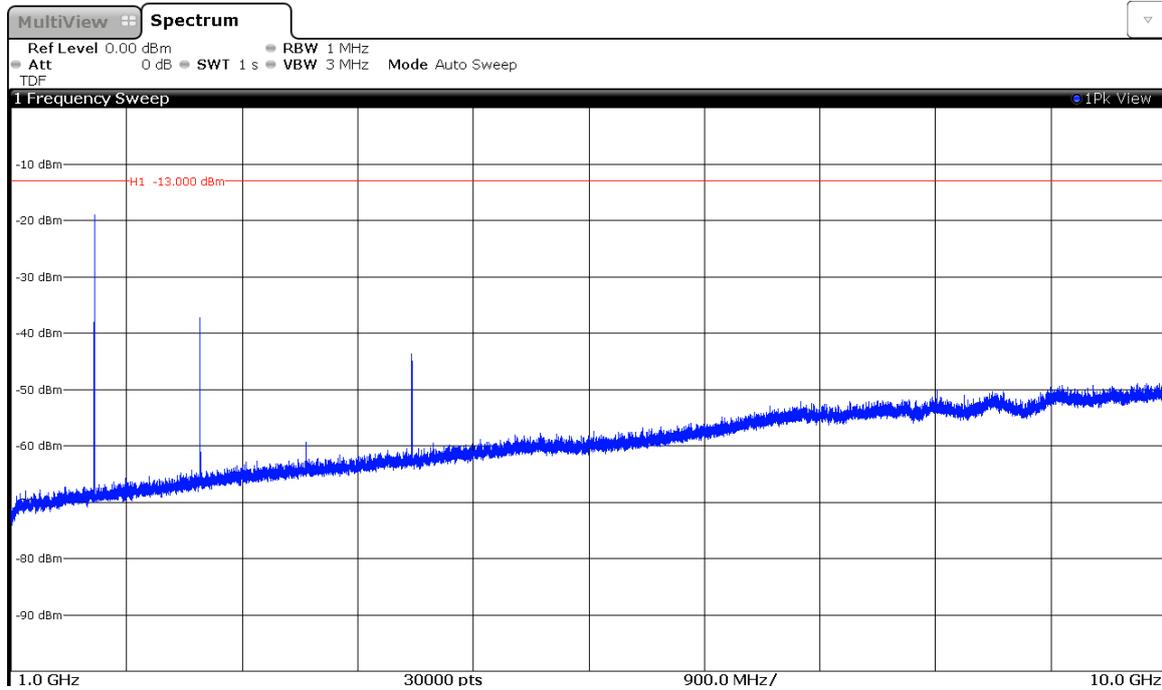


Note: The peak above the limit is the carrier frequency.

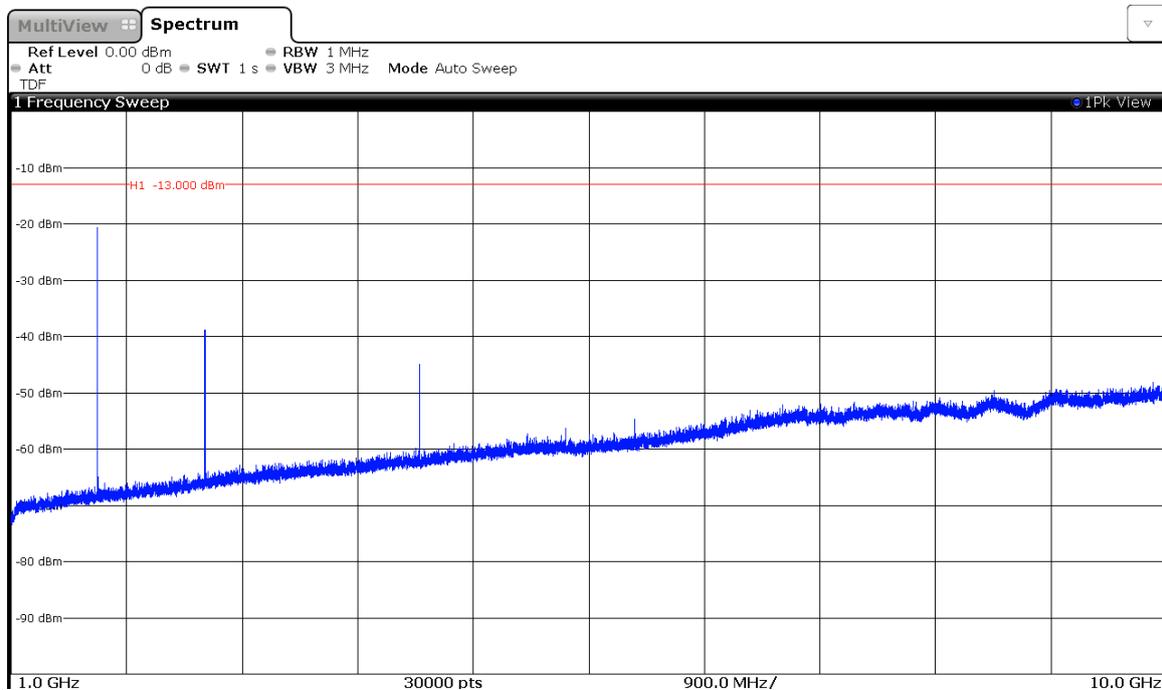
FREQUENCY RANGE 1 GHz to 10 GHz.

GPRS MODULATION

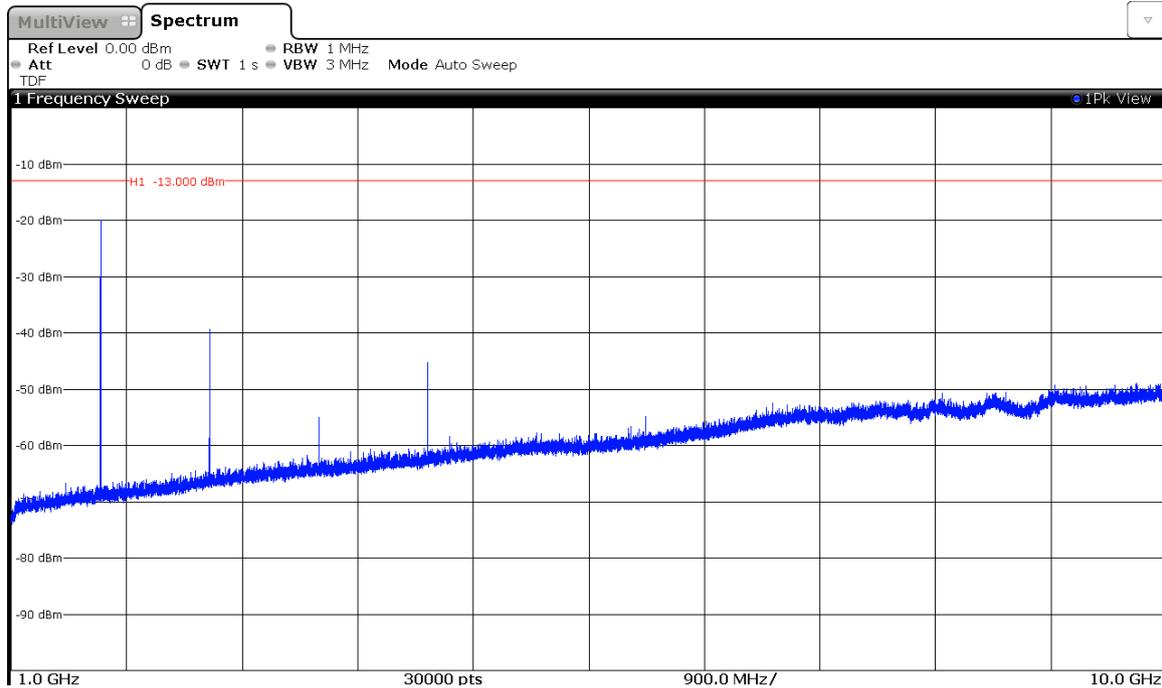
CHANNEL: LOWEST



CHANNEL: MIDDLE

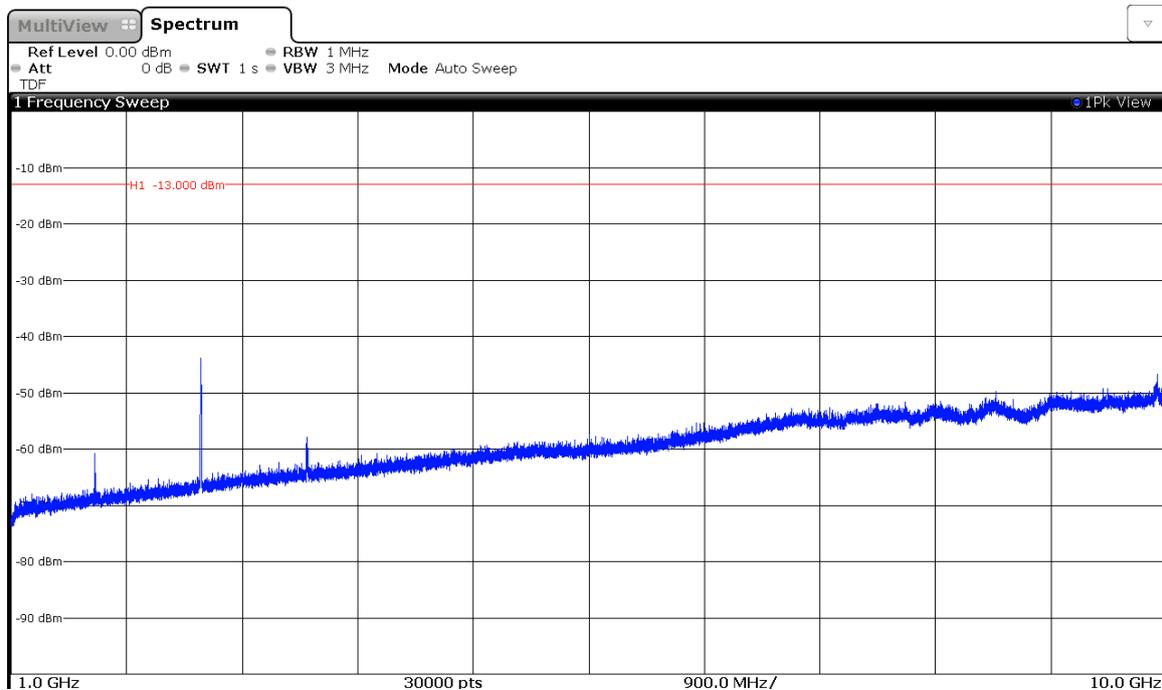


CHANNEL: HIGHEST

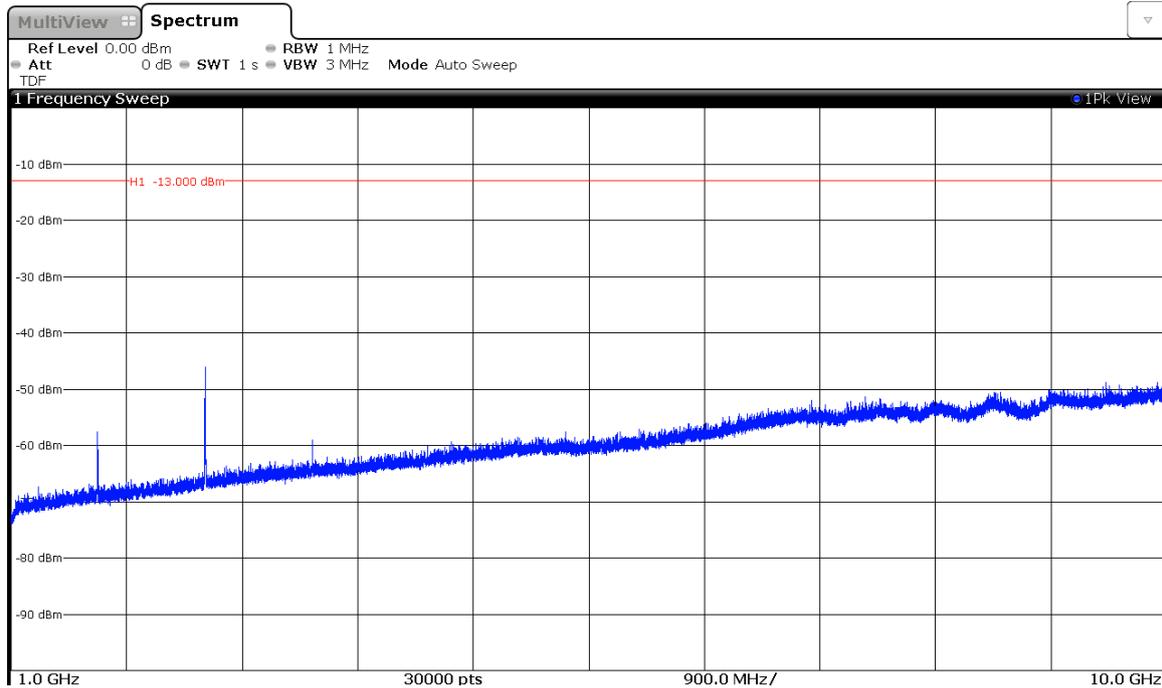


HSUPA MODULATION

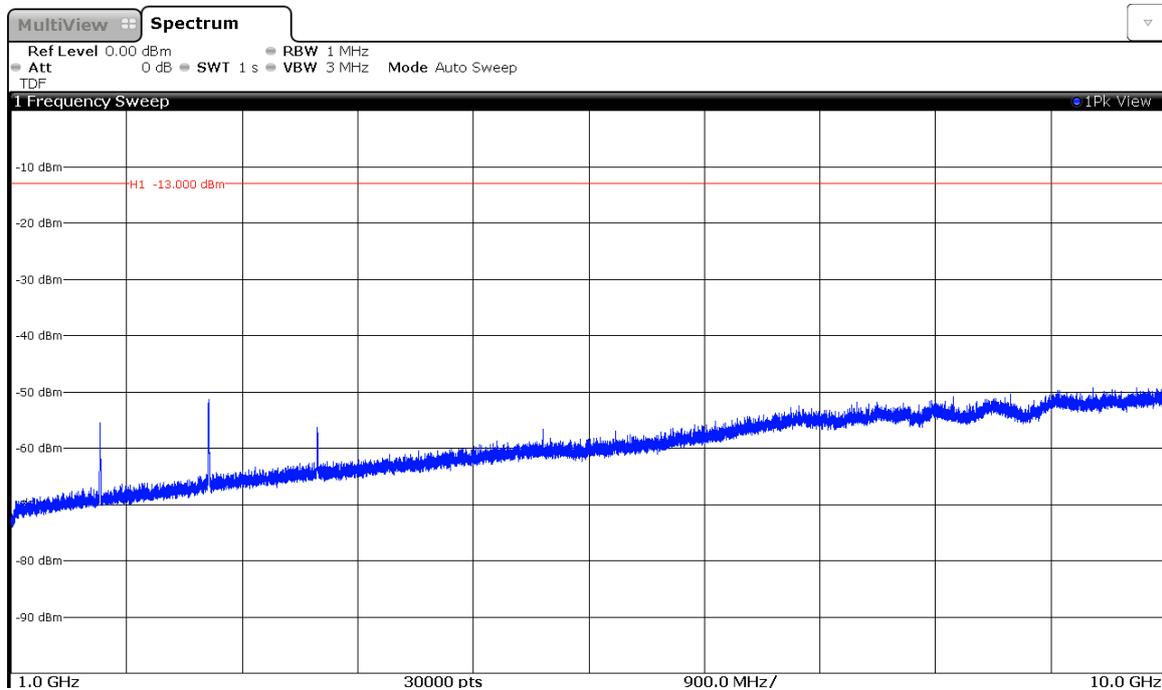
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



Appendix B – Test result for FCC Part 24

INDEX

TEST CONDITIONS	55
RF Output Power	56
Modulation Characteristics	65
Frequency Stability	68
Occupied Bandwidth	72
Spurious emissions at antenna terminals	80
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TEST RESULTS FOR FCC PART 24

TEST CONDITIONS

Power supply (V):

Vnom = 4.2 Vdc

Vmax = 4.2 Vdc

Vmin = 3.6 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 rechargeable battery

Type of antenna = Internal antenna (PIFA antenna)

Antenna gain = +2.2 dBi (1900MHz), +2.5 dBi (WCDMA Band II).

TEST FREQUENCIES:

GPRS MODULATION

Lowest channel (512): 1850.2 MHz

Middle channel (662): 1880.2 MHz

Highest channel (810): 1909.8 MHz

WCDMA AND HSUPA MODULATION

Lowest channel (9262): 1852.4 MHz

Middle channel (9400): 1880.0 MHz

Highest channel (9538): 1907.6 MHz

RF Output Power

SPECIFICATION

FCC §2.1046 and 24.232

Mobile/portable stations are limited to 2 Watts (33 dBm) Effective Isotropically Radiated Power (E.I.R.P.).

When measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

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 CMU200 and 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 peak-to-average power ratio (PAPR) is measured using an attenuator, power splitter and spectrum analyser with a Complementary Cumulative Distribution Function implemented.

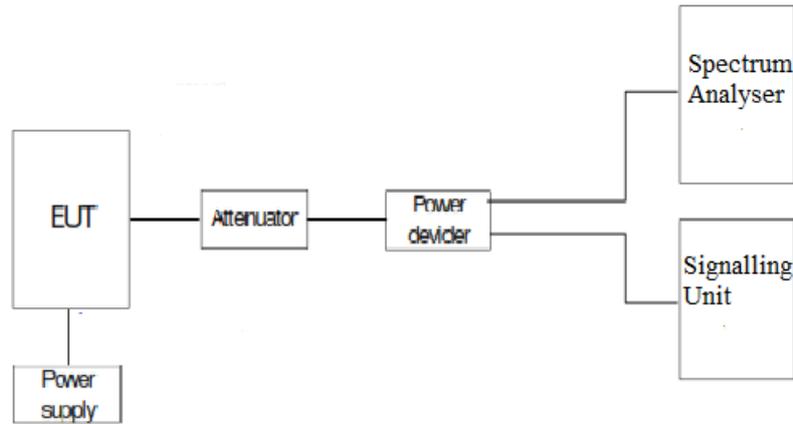
The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The measurement is performed for the highest power levels measured.

TEST SETUP

Conducted average power.



Peak-to-average power ratio (PAPR)



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

GPRS MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.20	2.20	2.20
Measured maximum average power (dBm) at antenna port	30.66	30.51	30.45
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	32.86	32.71	32.65
Peak-to-average ratio (PAR) (dB)	0.70	0.70	0.66
Measurement uncertainty (dB)	<±0.66		

EDGE MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.20	2.20	2.20
Measured maximum average power (dBm) at antenna port	30.70	30.50	30.46
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	32.90	32.70	32.66
Peak-to-average ratio (PAR) (dB)	3.45	3.32	3.04
Measurement uncertainty (dB)	<±0.66		

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.50	2.50	2.50
Measured maximum average power (dBm) at antenna port	23.54	23.84	23.67
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.04	26.34	26.17
Peak-to-average ratio (PAR) (dB)	2.91	3.11	3.14
Measurement uncertainty (dB)	<±0.66		

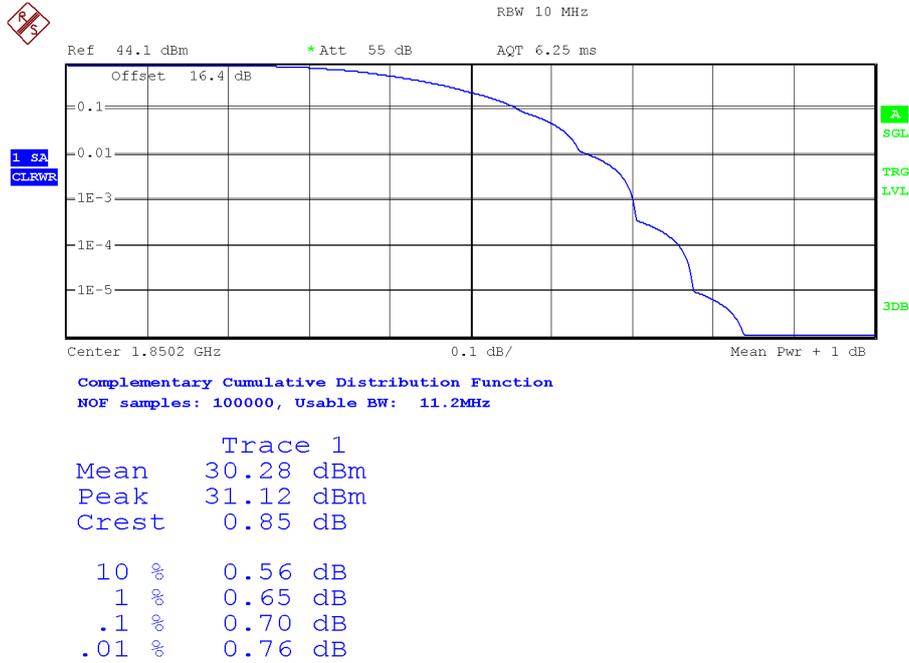
HSUPA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.50	2.50	2.50
Measured maximum average power (dBm) at antenna port	22.40	22.66	22.50
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	24.90	25.16	25.00
Peak-to-average ratio (PAR) (dB)	3.45	3.37	3.46
Measurement uncertainty (dB)	<±0.66		

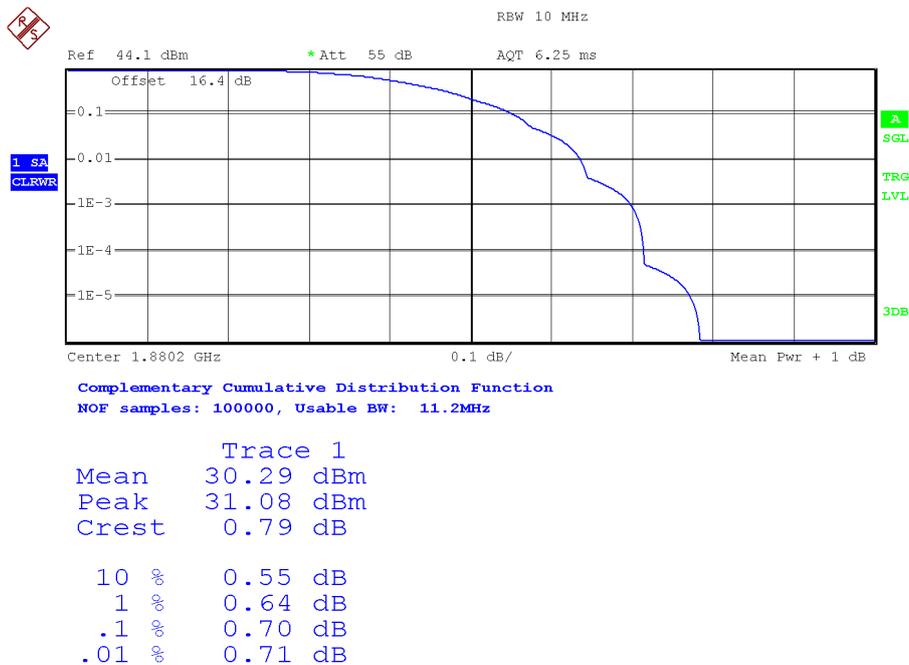
PEAK-TO-AVERAGE POWER RATIO (PAPR).

GPRS MODULATION

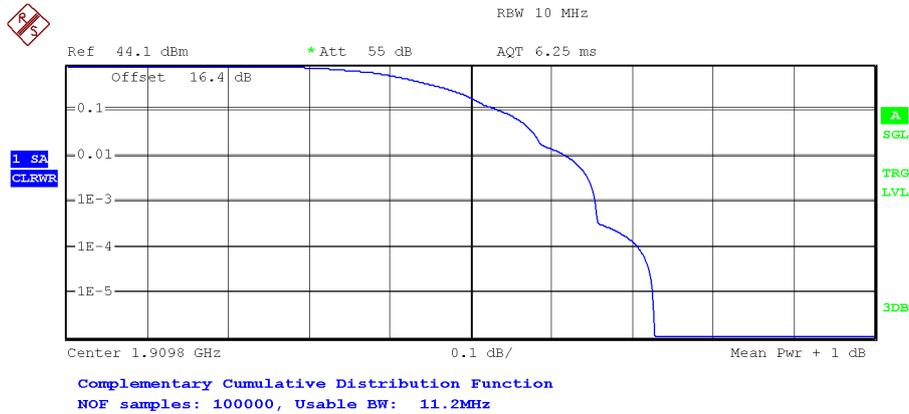
Channel Low:



Channel Middle:



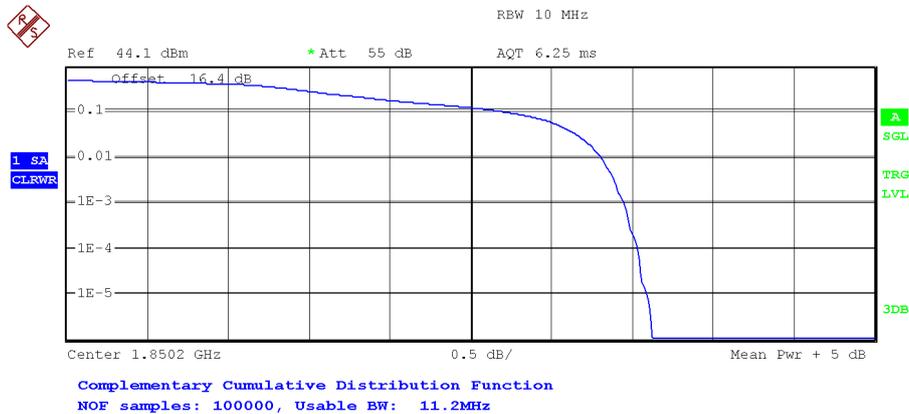
Channel High:



Trace 1	
Mean	30.36 dBm
Peak	31.09 dBm
Crest	0.73 dB
10 %	0.54 dB
1 %	0.62 dB
.1 %	0.66 dB
.01 %	0.71 dB

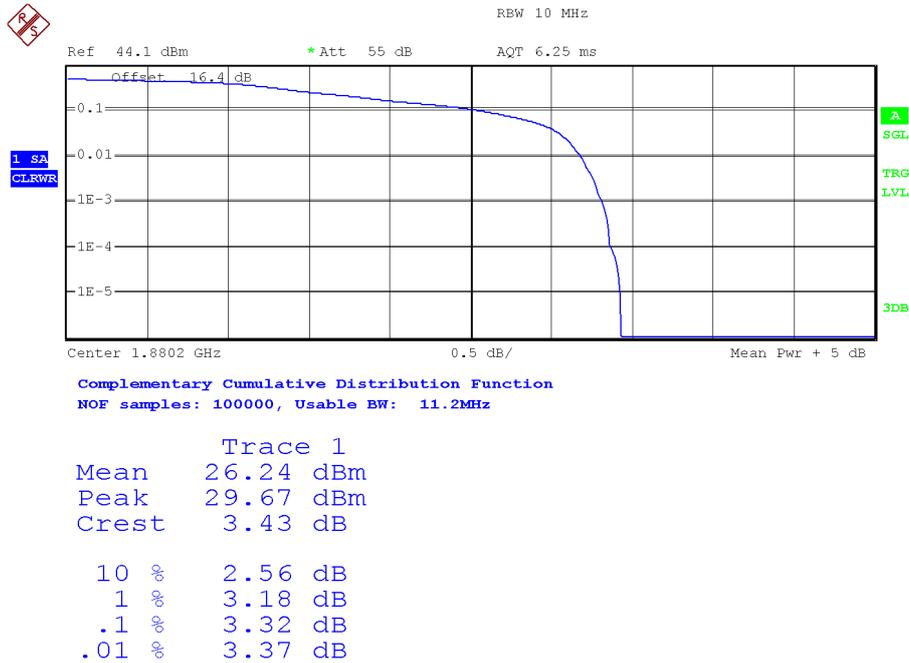
EDGE MODULATION

Channel Low:

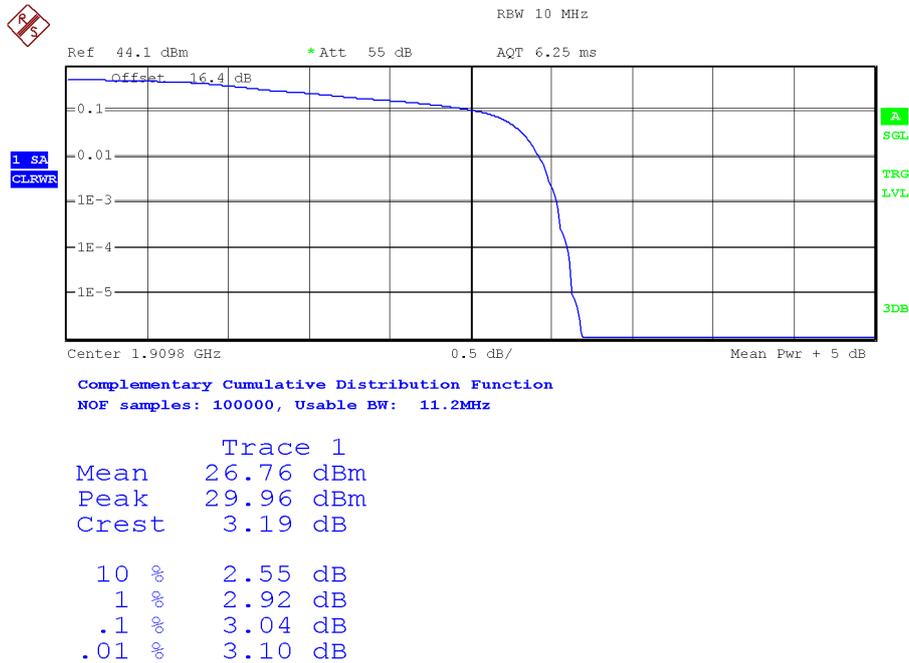


Trace 1	
Mean	26.02 dBm
Peak	29.64 dBm
Crest	3.63 dB
10 %	2.72 dB
1 %	3.31 dB
.1 %	3.45 dB
.01 %	3.53 dB

Channel Middle:

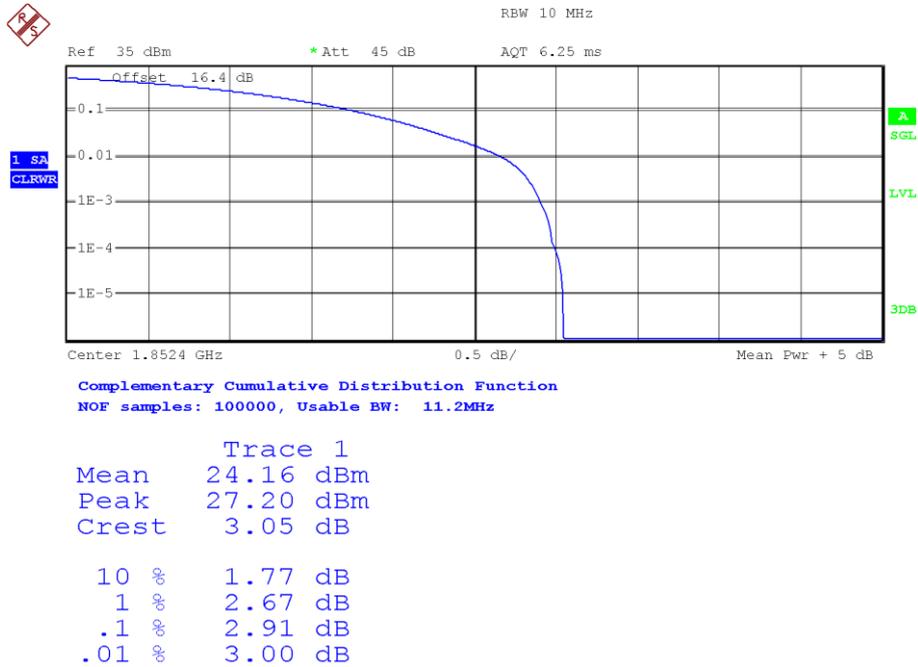


Channel High:

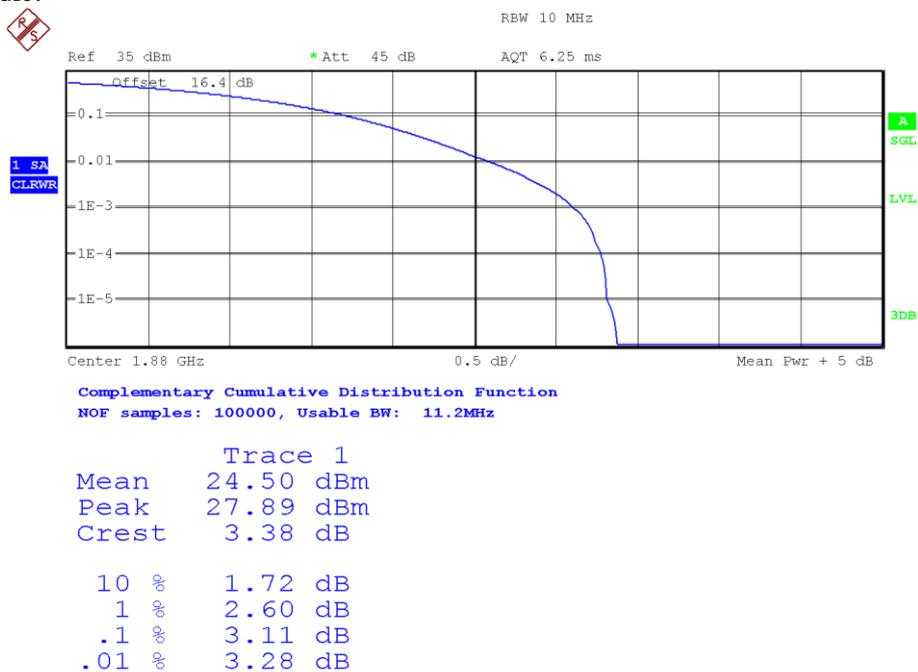


WCDMA MODULATION

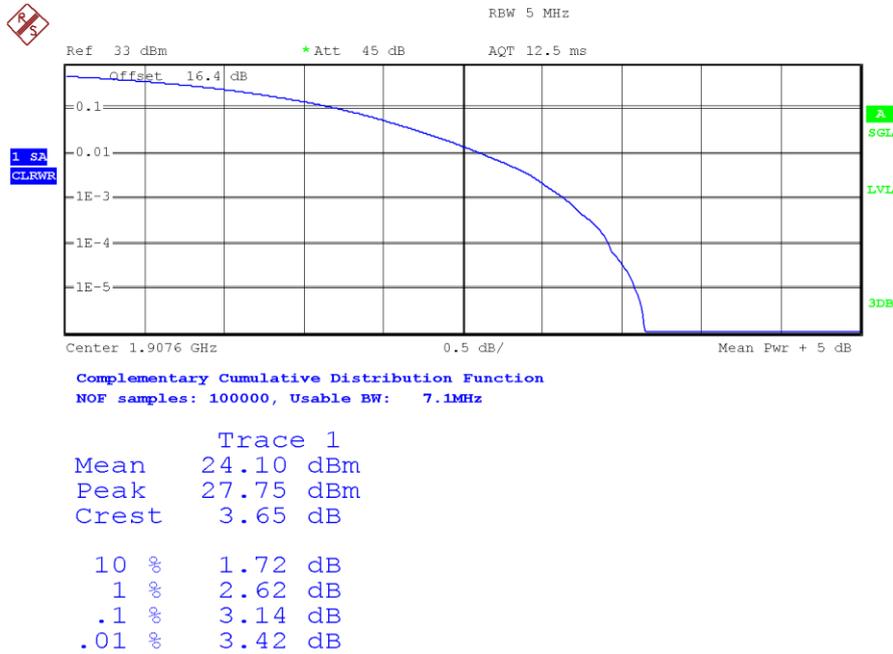
Channel Low:



Channel Middle:

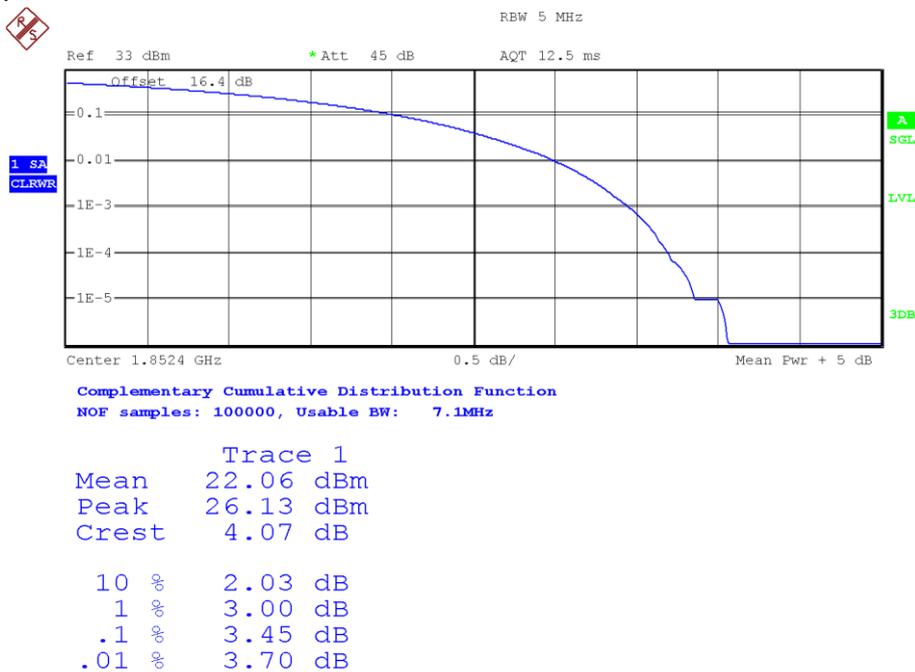


Channel High:

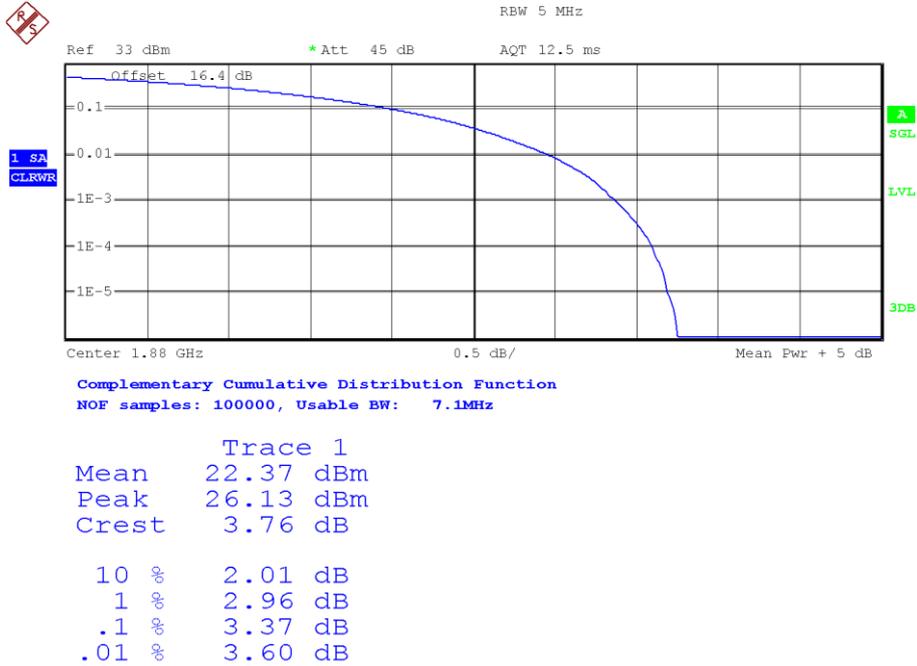


HSUPA MODULATION

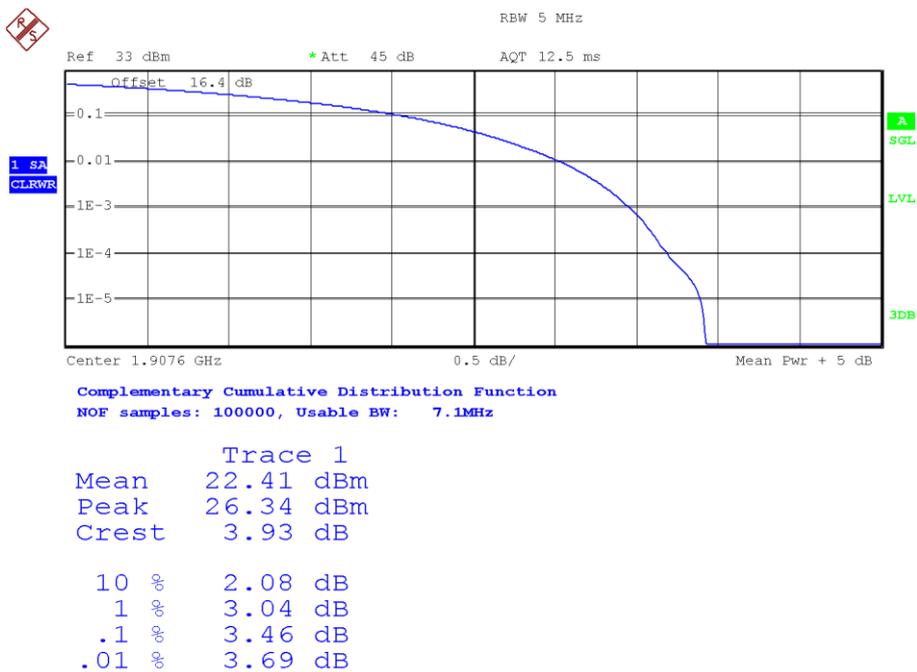
Channel Low:



Channel Middle:



Channel High:



Modulation Characteristics

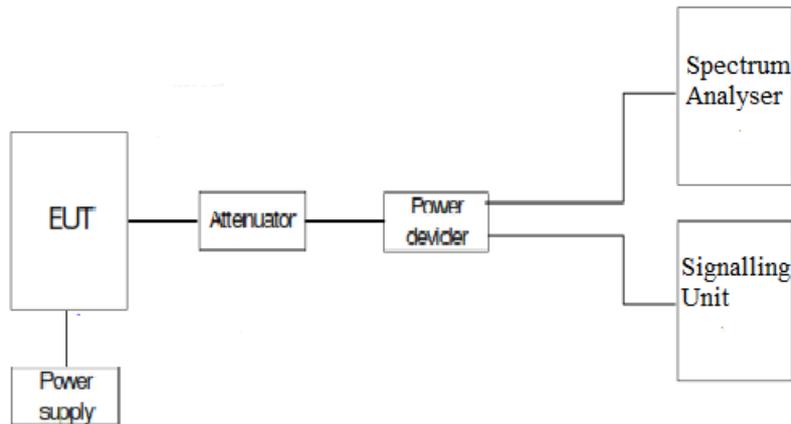
SPECIFICATION

FCC §2.1047

METHOD

For 2G/3G, the EUT operates with GPRS (GMSK), EDGE (8PSK), WCDMA (QPSK) and HSUPA (QPSK) modes, in which the information is digitized and coded into a bit stream.

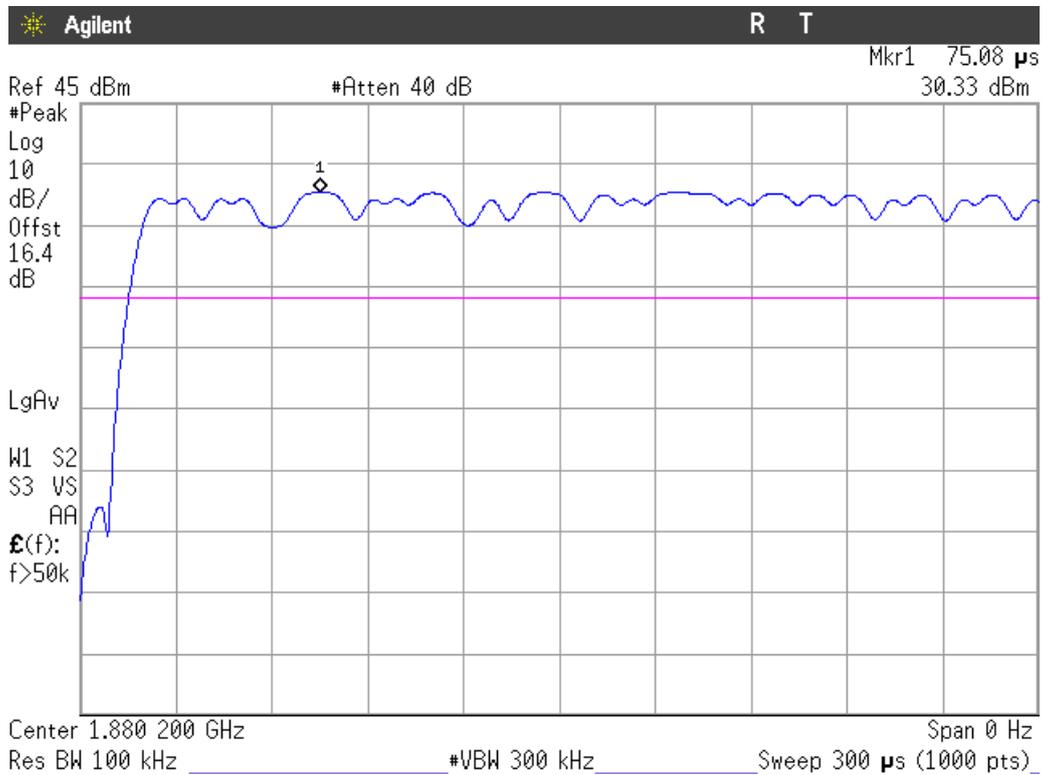
TEST SETUP



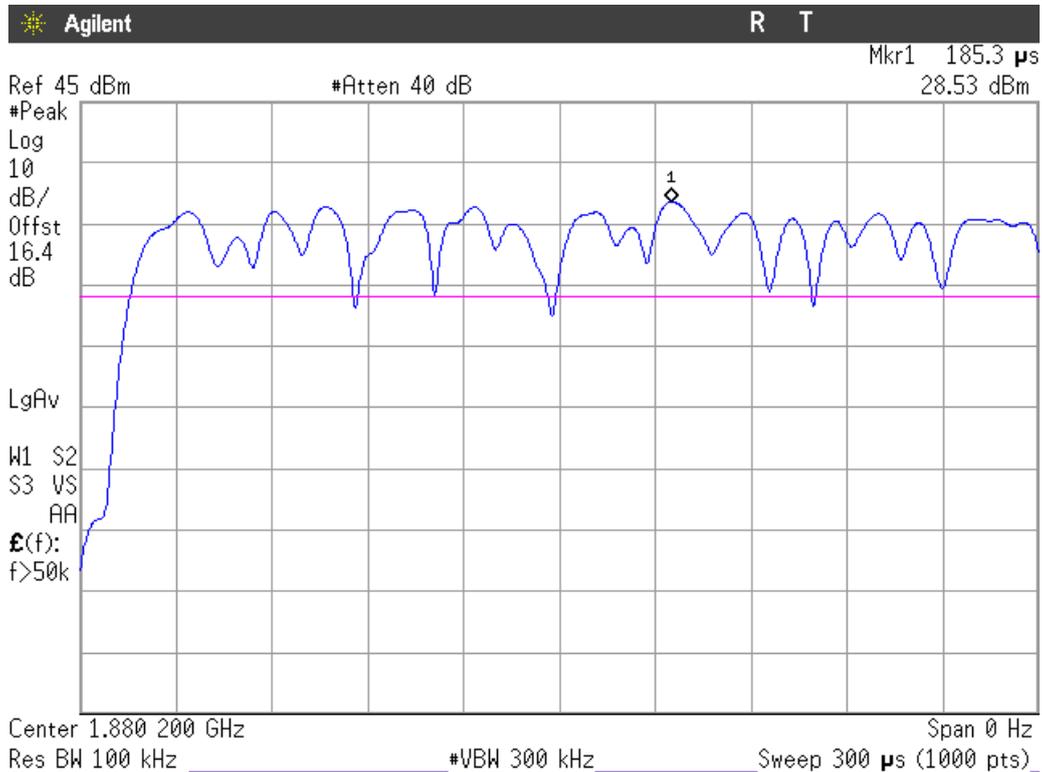
RESULTS

The following plot shows the modulation schemes in the EUT.

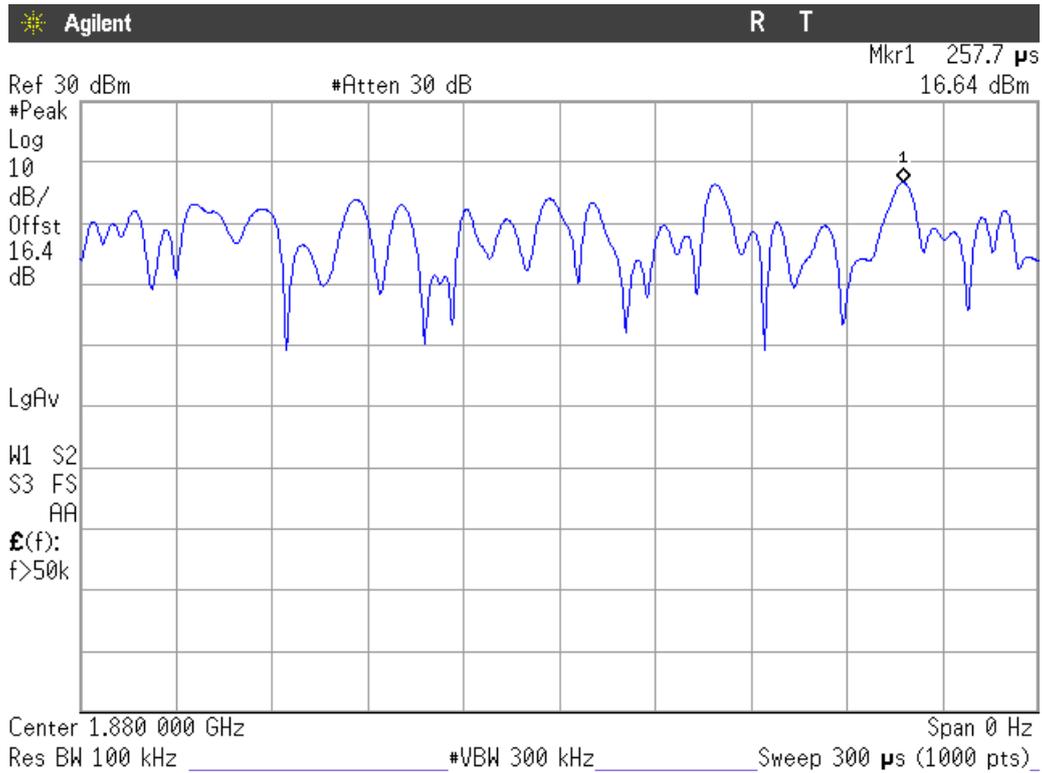
GPRS MODULATION



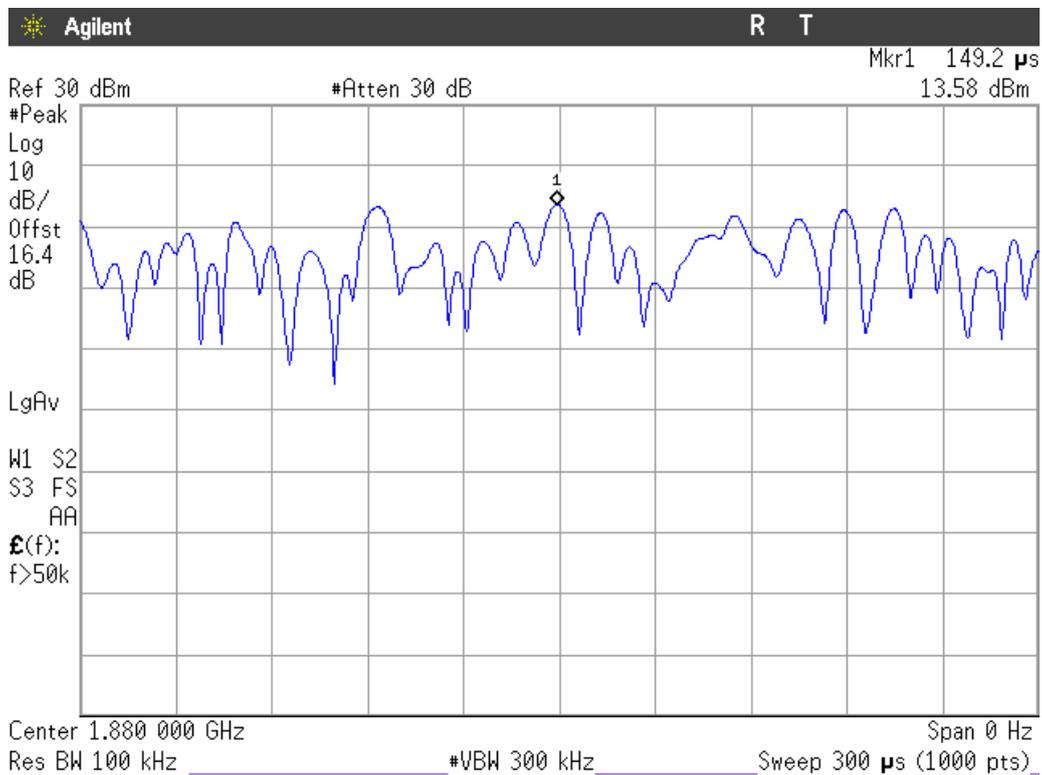
EDGE MODULATION



WCDMA MODULATION



HSUPA MODULATION



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.

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 the values declared by the manufacturer.

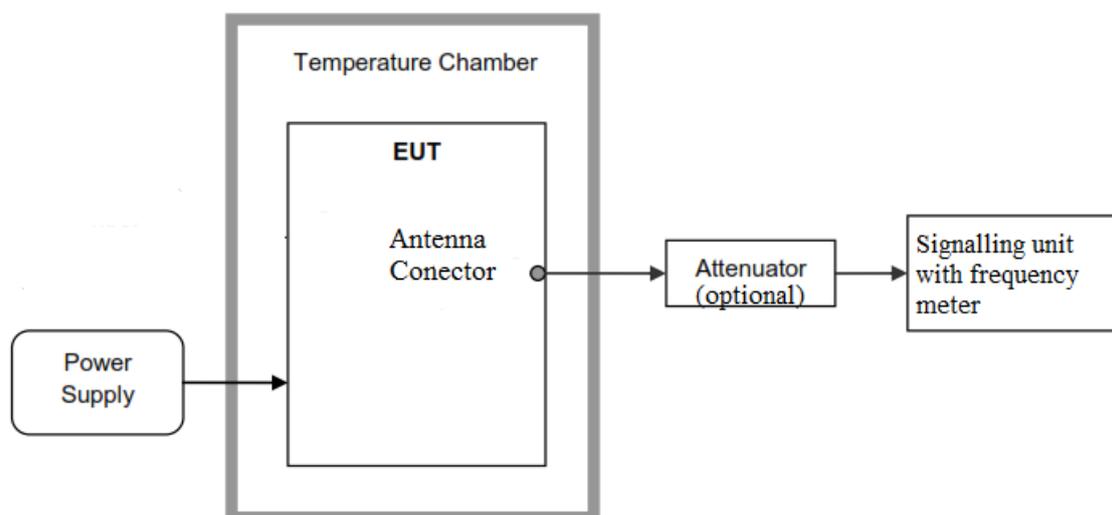
The EUT was set in “call mode” in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.

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 highest channel of operation are identified as f_L and f_H respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of f_L and f_H to check that the resulting frequencies remain within the band.

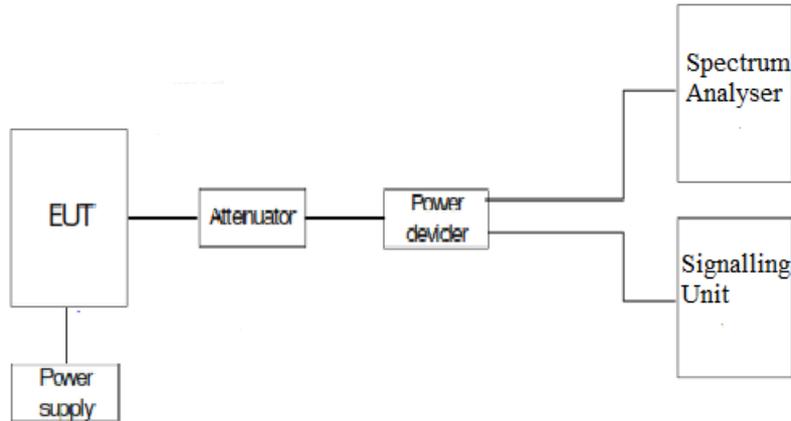
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP

Frequency tolerance.



Reference points f_L and f_H .



RESULTS

Frequency stability over temperature variations.

GPRS AND EDGE MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	76	0.040421232	0.0000040
+40	79	0.042016807	0.0000042
+30	82	0.043612382	0.0000044
+20	78	0.041484948	0.0000041
+10	77	0.040953090	0.0000041
0	73	0.038825657	0.0000039
-10	70	0.037230082	0.0000037
-20	70	0.037230082	0.0000037
-30	70	0.037230082	0.0000037

WCDMA AND HSUPA MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	2.88	0.001531915	0.00000015
+40	3.49	0.001856383	0.00000018
+30	3.77	0.002005319	0.00000020
+20	3.67	0.002058511	0.00000021
+10	3.81	0.002026596	0.00000020
0	4.58	0.002436170	0.00000024
-10	3.83	0.002037234	0.00000020
-20	3.52	0.001872340	0.00000018
-30	1.59	0.000845745	0.00000008

Frequency stability over voltage variations.

GPRS MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	78	0.041484948	0.00000041
Vmin	3.60	81	0.043080523	0.00000043

WCDMA AND HSUPA MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	3.87	0.002058511	0.00000020
Vmin	3.60	2.39	0.001271277	0.00000012

Reference points established at the applicable unwanted emissions limit:

	GPRS MODULATION	EDGE MODULATION	WCDMA MODULATION	HSUPA MODULATION
f_L (MHz)	1852.4120	1852.2130	1851.4590	1851.9480
f_H (MHz)	1907.5960	1907.6130	1907.3090	1907.8670

Reference points f_L and f_H with the worst-case frequency offsets added or subtracted:

	GPRS MODULATION	EDGE MODULATION	WCDMA MODULATION	HSUPA MODULATION
f_L (MHz)	1852.4120	1852.2130	1851.4590	1851.9480
f_H (MHz)	1907.5960	1907.6130	1907.3090	1907.8670

The reference frequency points stay within the authorized blocks.

Measurement uncertainty	$<\pm 1 \times 10^{-6}$
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Verdict: PASS

Occupied Bandwidth

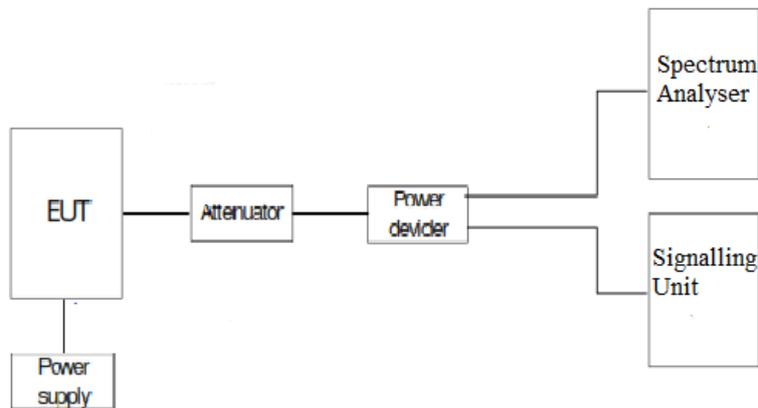
SPECIFICATION

FCC §2.1049

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 R&S CMU200 or 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

GPRS MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	242.27	242.85	239.50
-26 dBc bandwidth (kHz)	316.19	311.90	311.33
Measurement uncertainty (kHz)	<±1.67		

EDGE MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	243.25	245.71	243.41
-26 dBc bandwidth (kHz)	315.71	310.60	312.49
Measurement uncertainty (kHz)	<±1.67		

WCDMA MODULATION

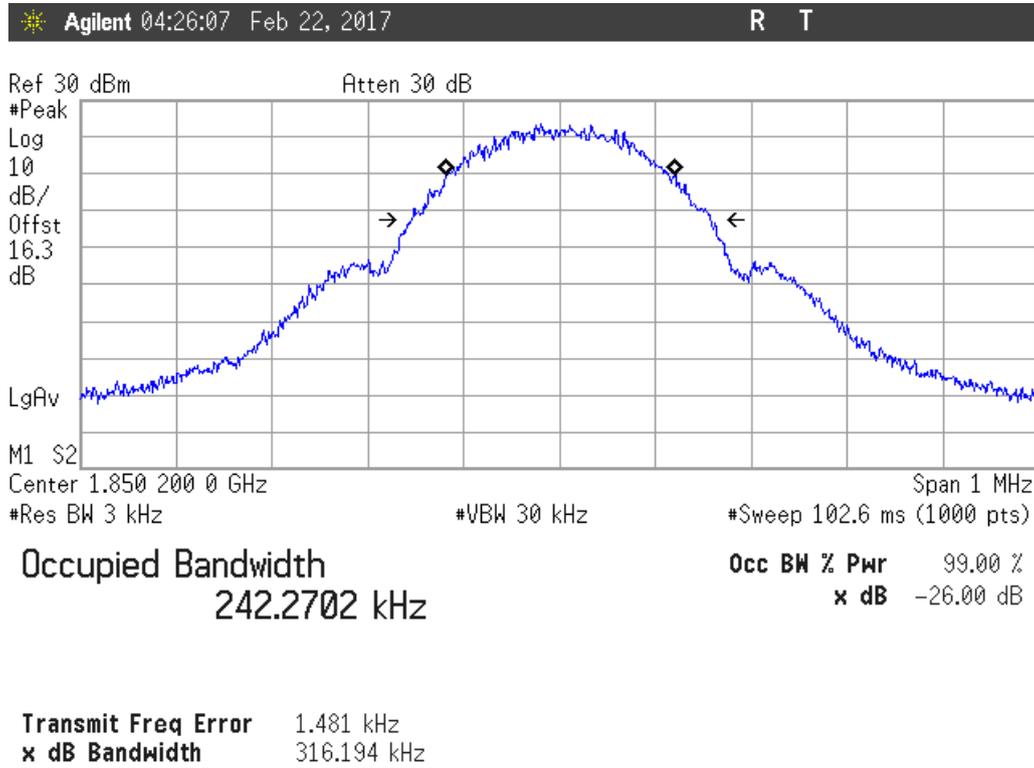
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4180.0	4160.0	4180.0
-26 dBc bandwidth (kHz)	4630.0	4640.0	4630.0
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

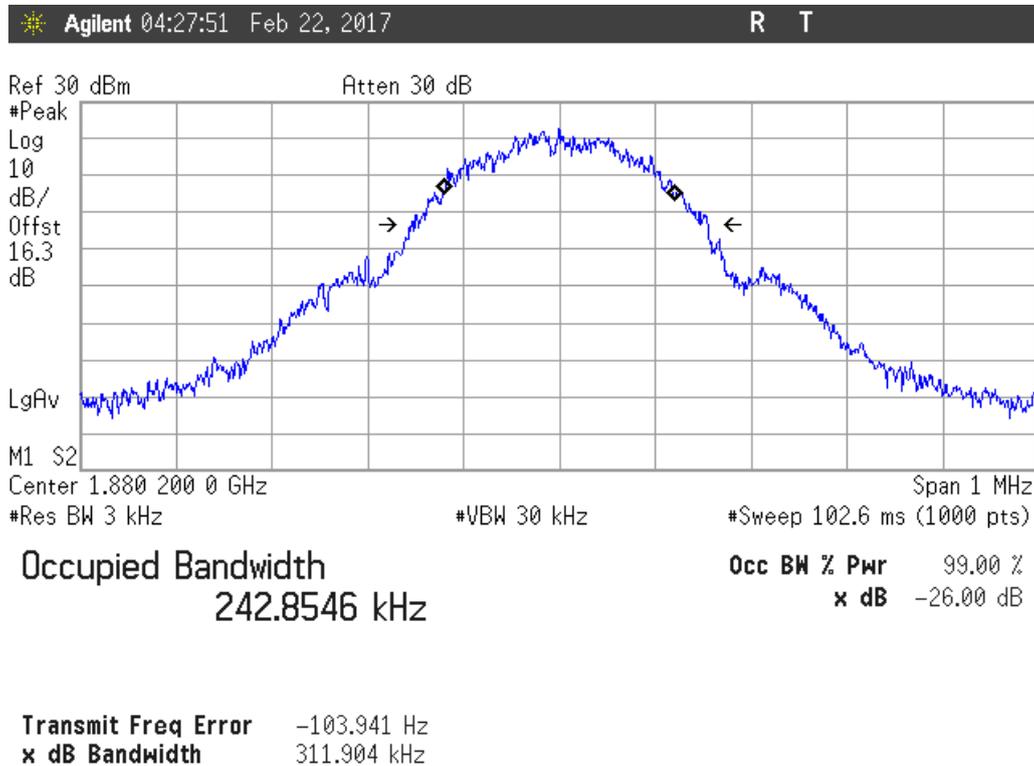
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4150.0	4160.0	4160.0
-26 dBc bandwidth (kHz)	4630.0	4650.0	4640.0
Measurement uncertainty (kHz)	<±16.67		

GPRS MODULATION

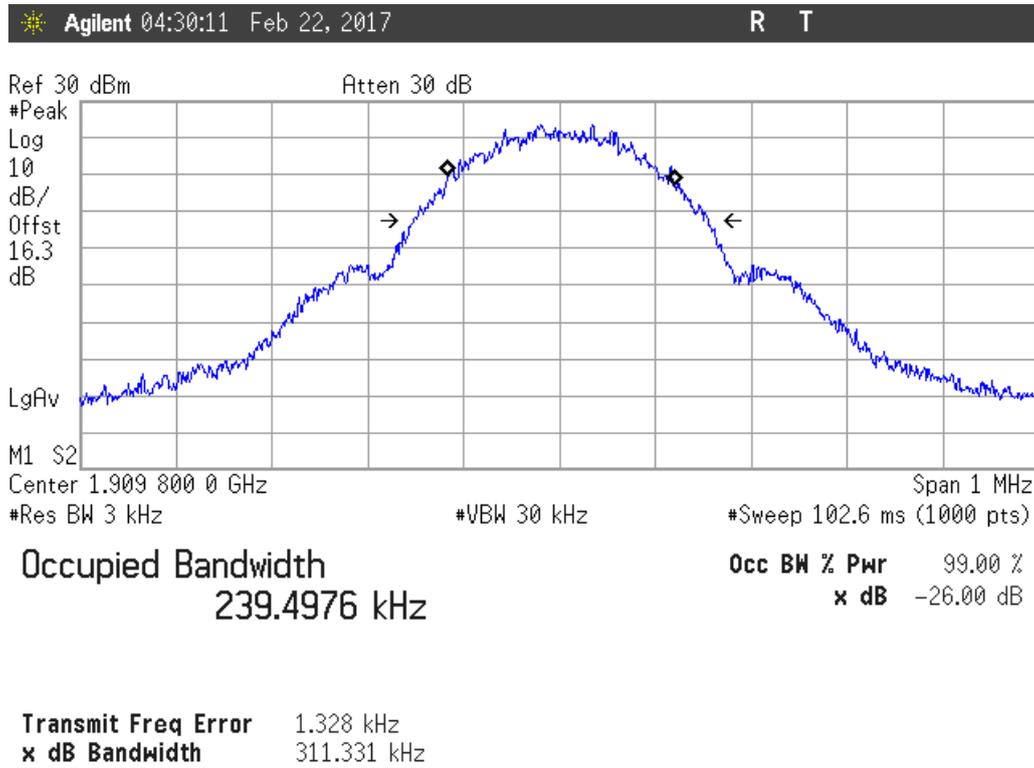
Lowest Channel



Middle Channel

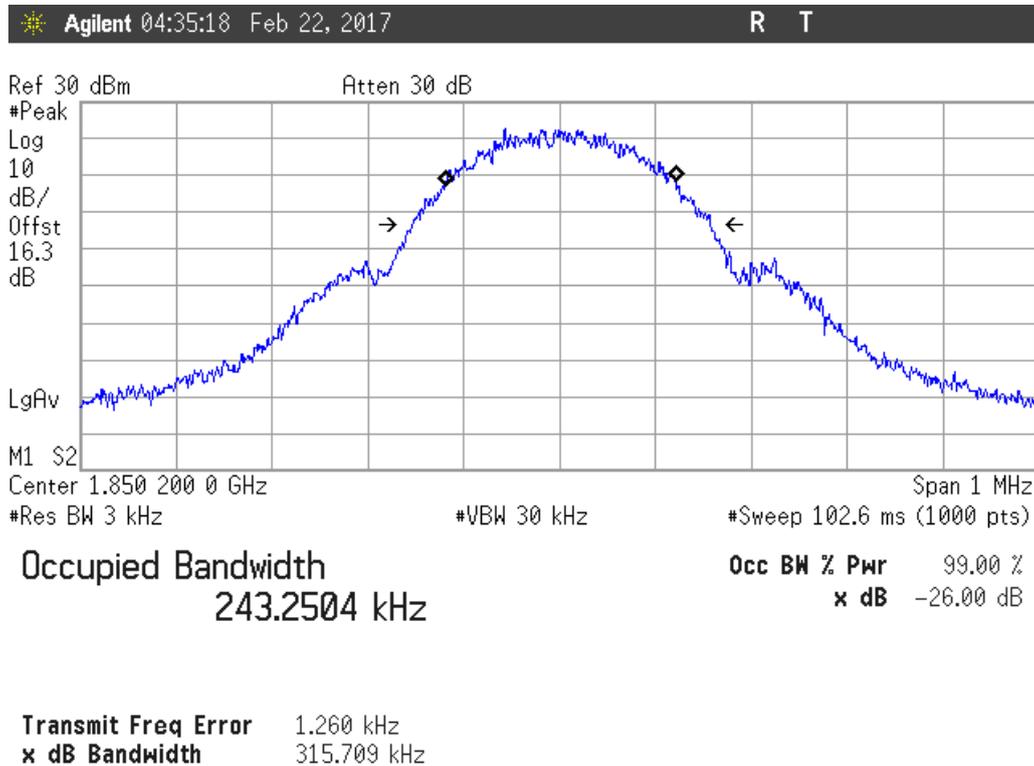


Highest Channel

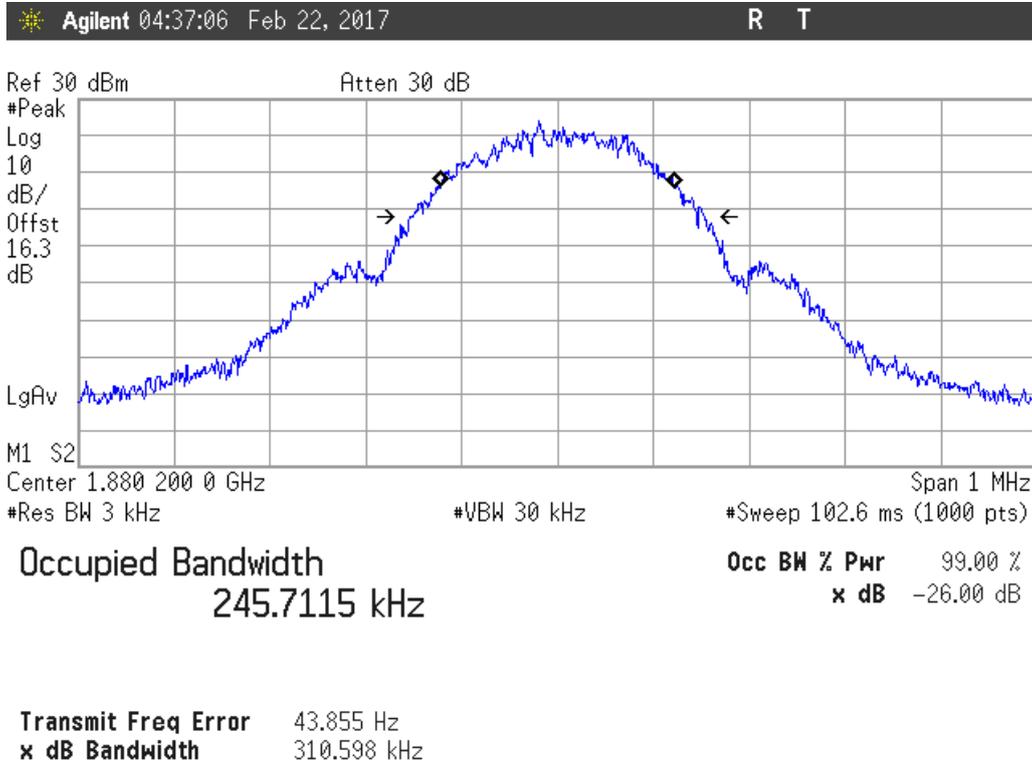


EDGE MODULATION

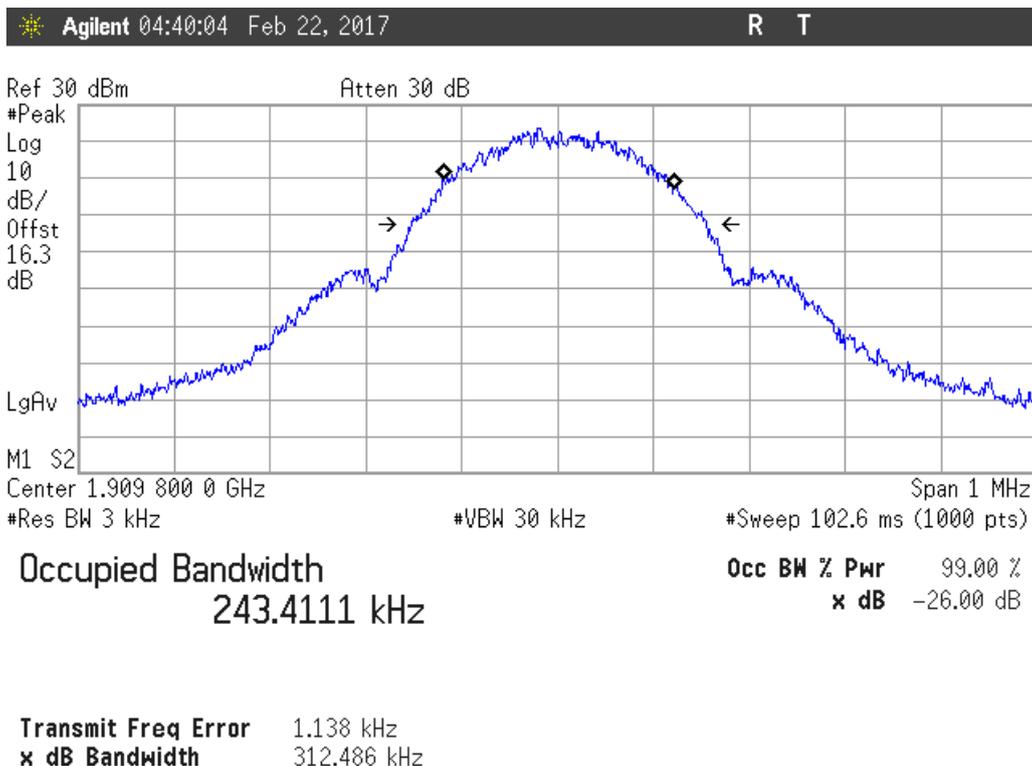
Lowest Channel



Middle Channel

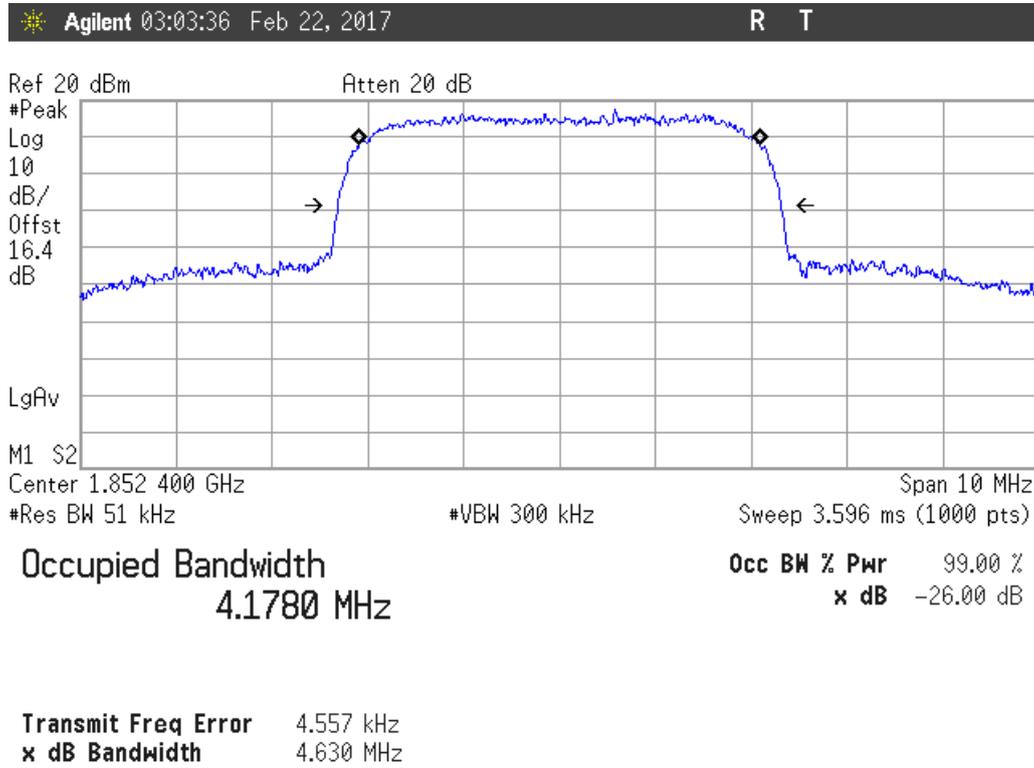


Highest Channel

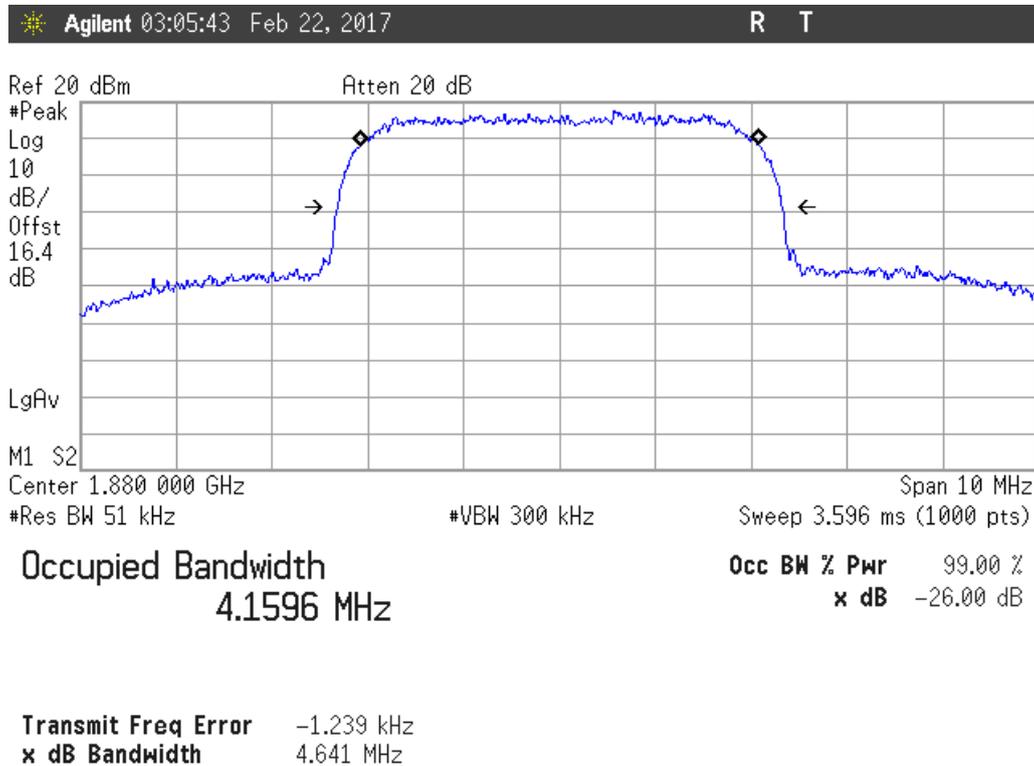


WCDMA MODULATION

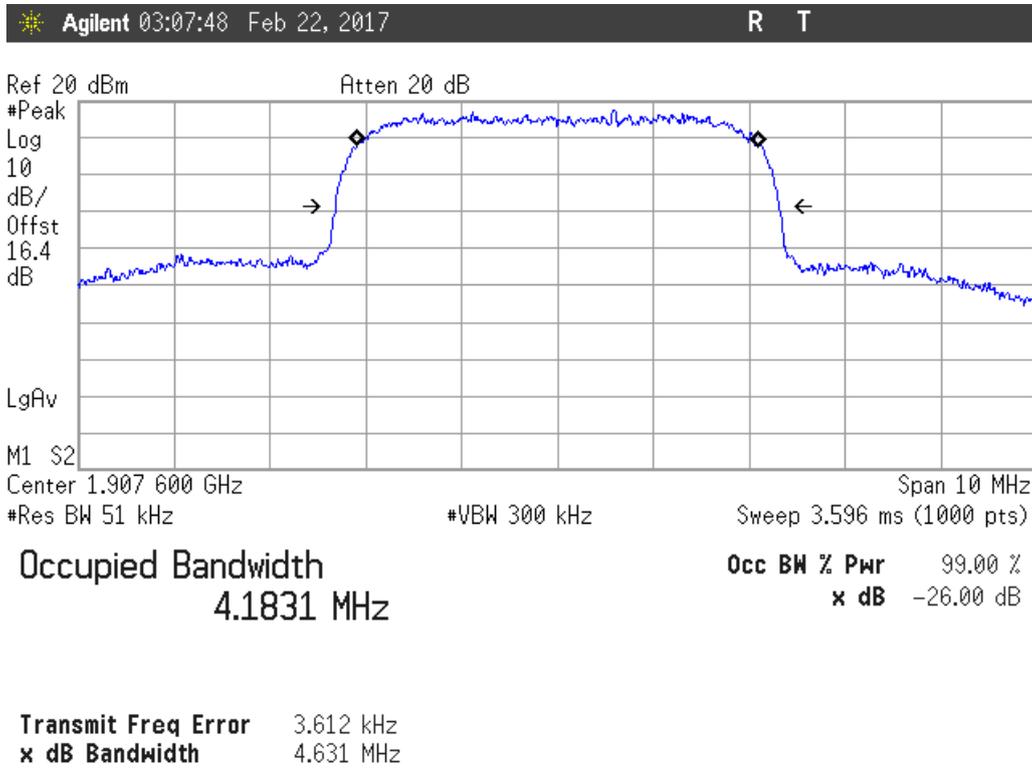
Lowest Channel



Middle Channel

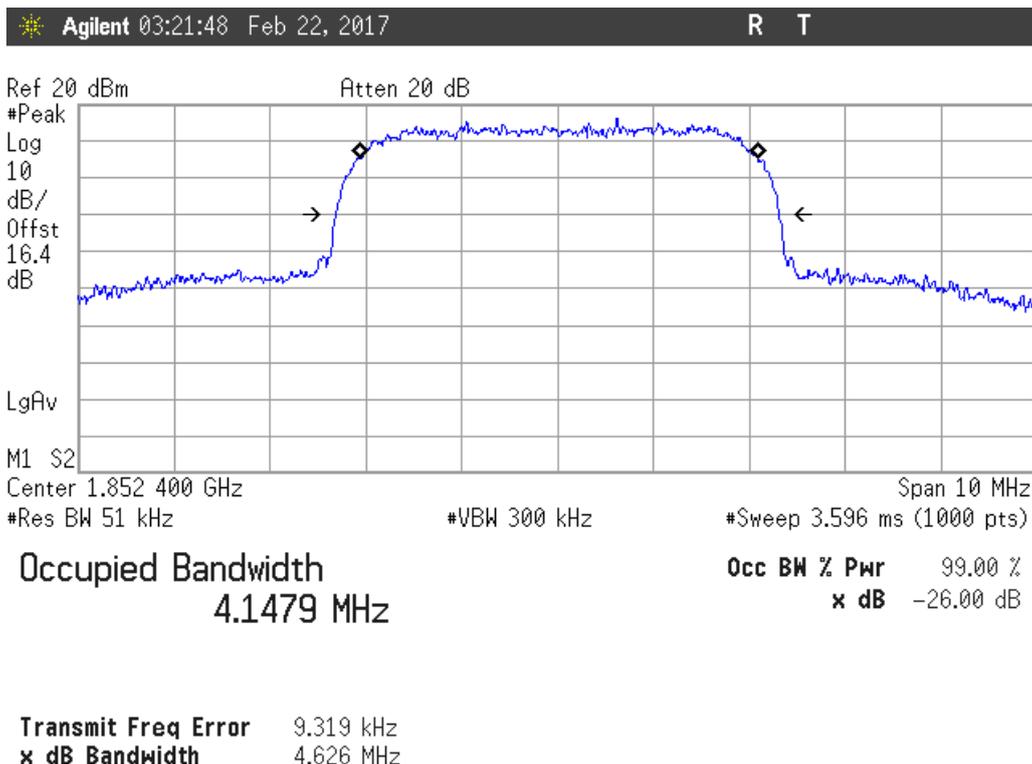


Highest Channel

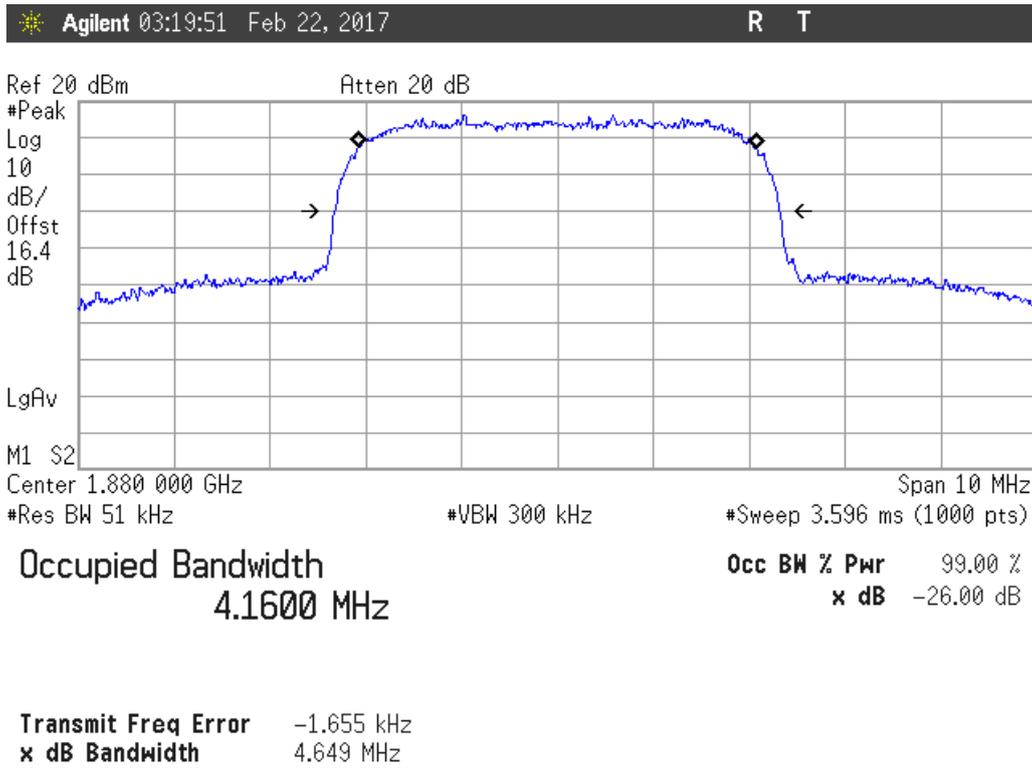


HSUPA MODULATION

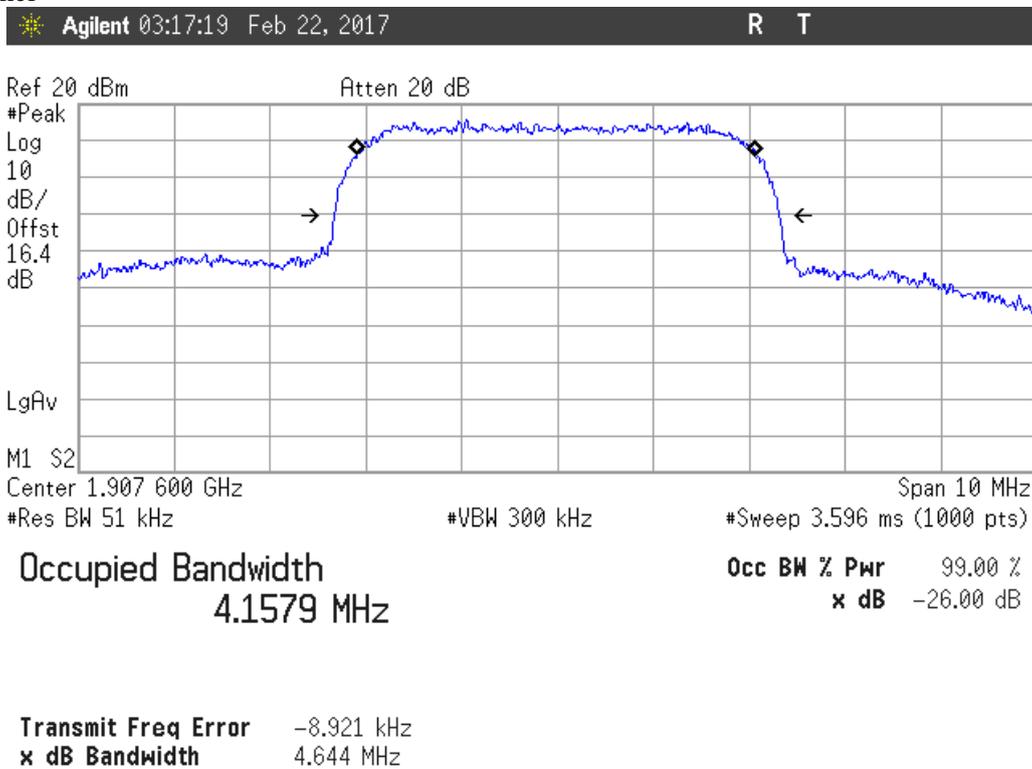
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051 and §24.238

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.

METHOD

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMU200 and CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 ohm attenuator and a power splitter.

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.

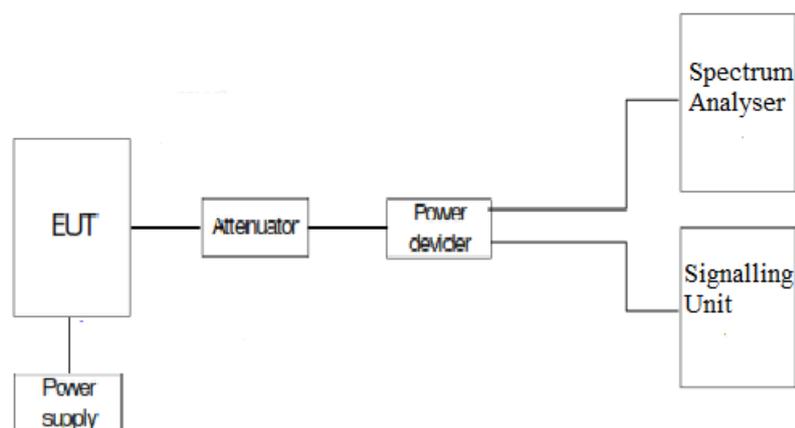
Measurement Limit:

According to specification, 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 P_o becomes:

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

TEST SETUP



RESULTS (see plots in next pages)

GPRS MODULATION

1. CHANNEL: LOWEST

No spurious signals were found in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found in all the range.

EDGE MODULATION

1. CHANNEL: LOWEST

No spurious signals were found in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found in all the range.

WCDMA MODULATION

1. CHANNEL: LOWEST

No spurious signals were found in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found in all the range.

HSUPA MODULATION

1. CHANNEL: LOWEST

No spurious signals were found in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found in all the range.

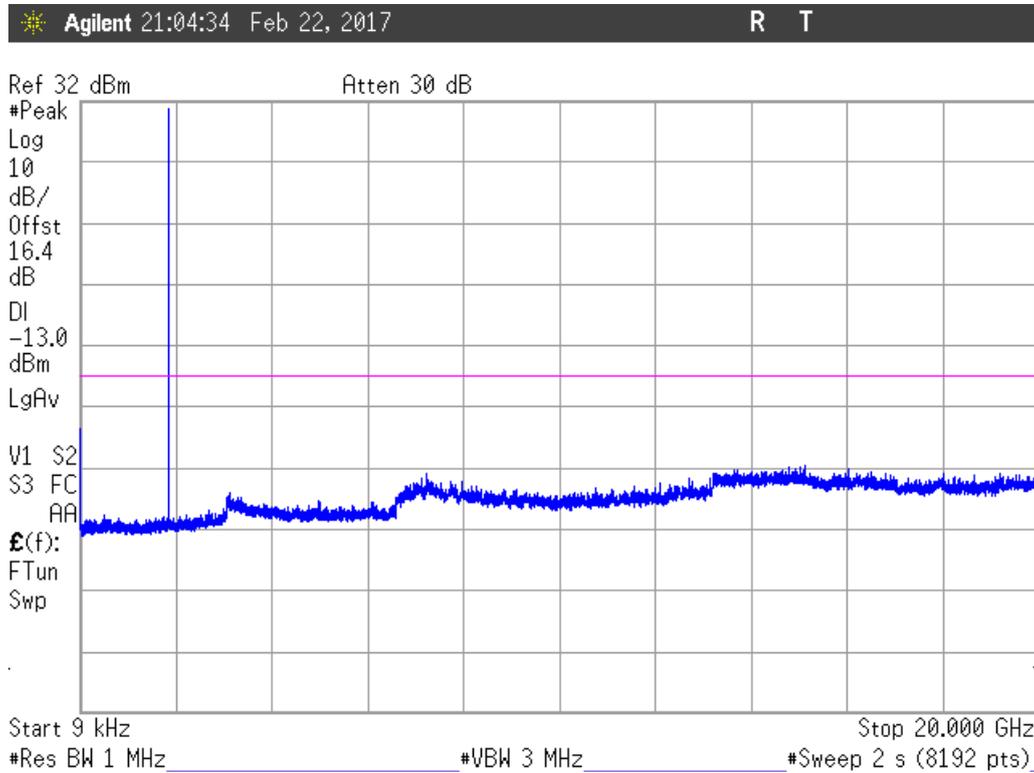
3. CHANNEL: HIGHEST

No spurious signals were found in all the range.

Verdict: PASS

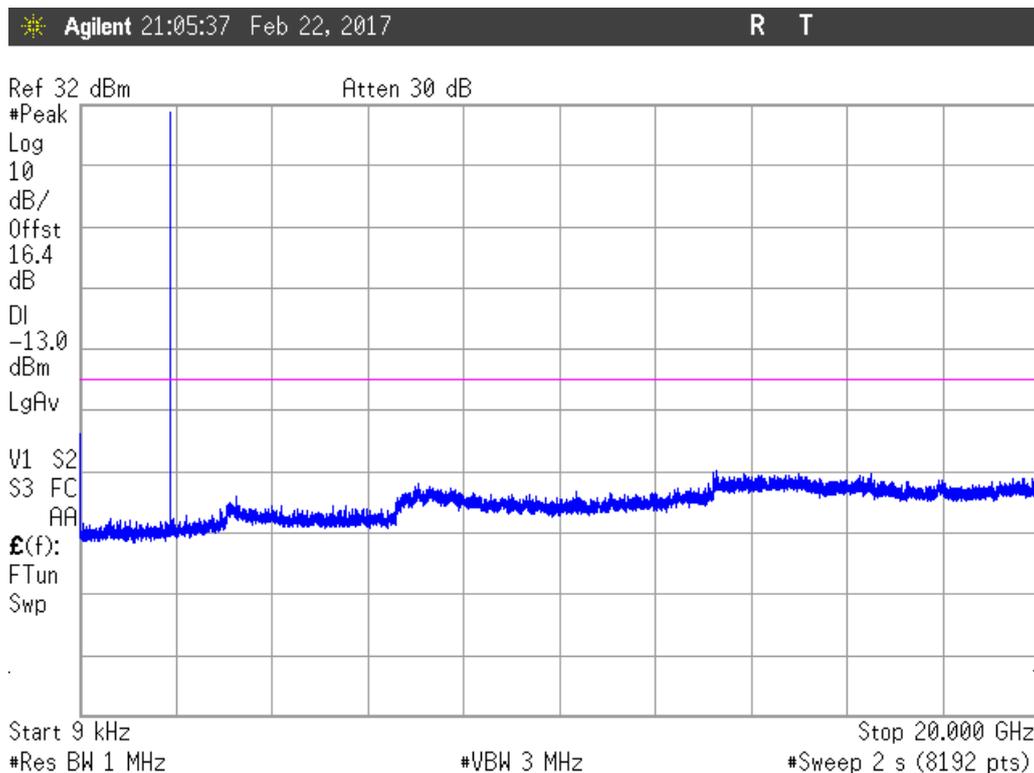
GPRS MODULATION

1. CHANNEL: LOWEST



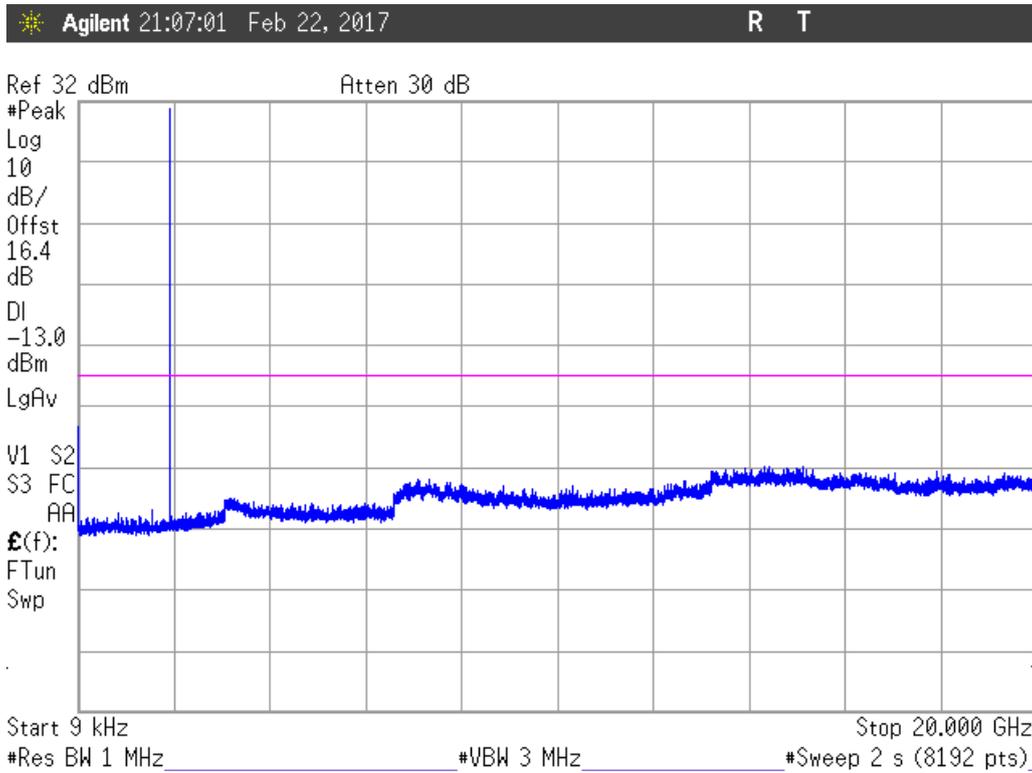
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

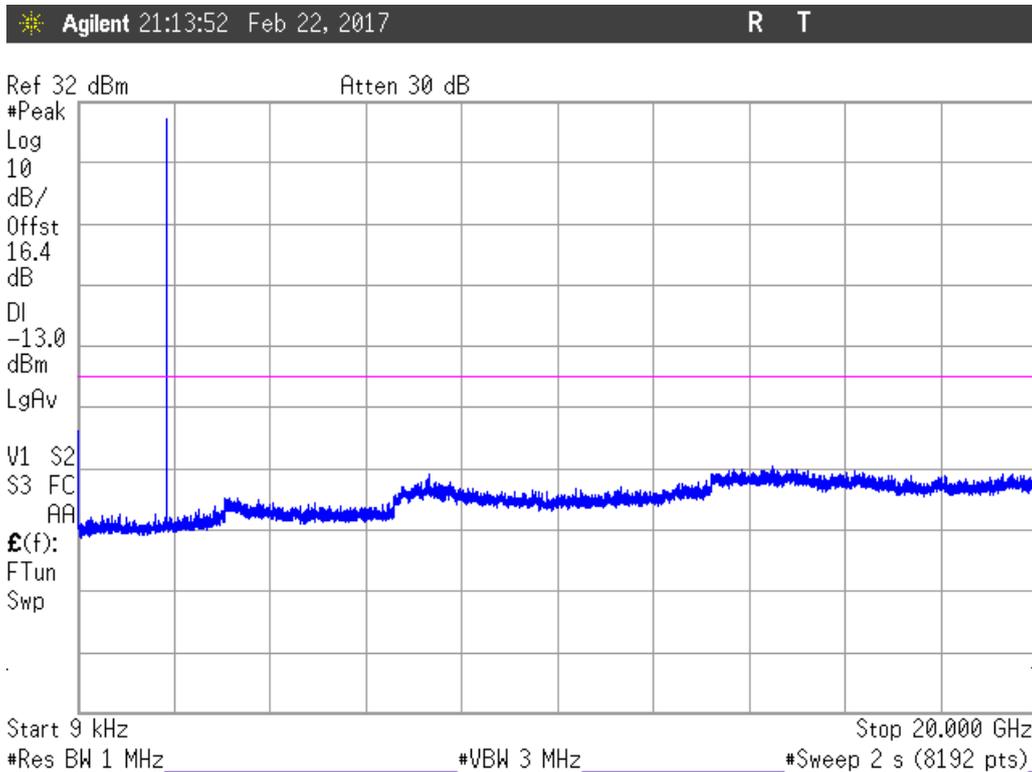
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

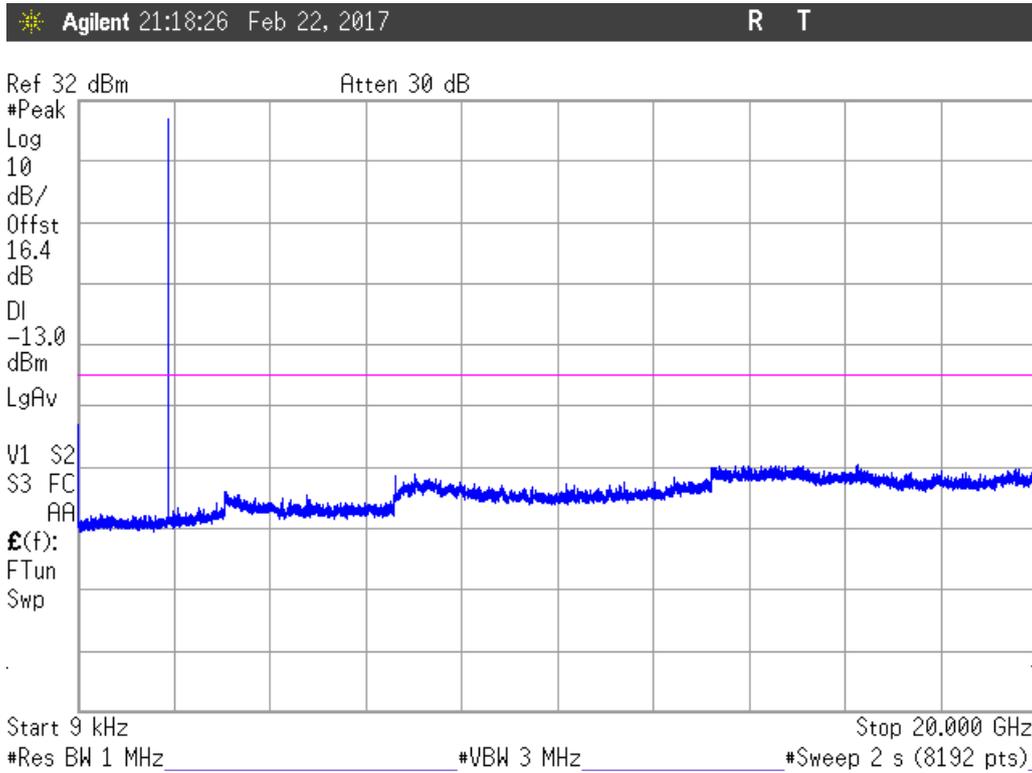
EDGE MODULATION

1. CHANNEL: LOWEST



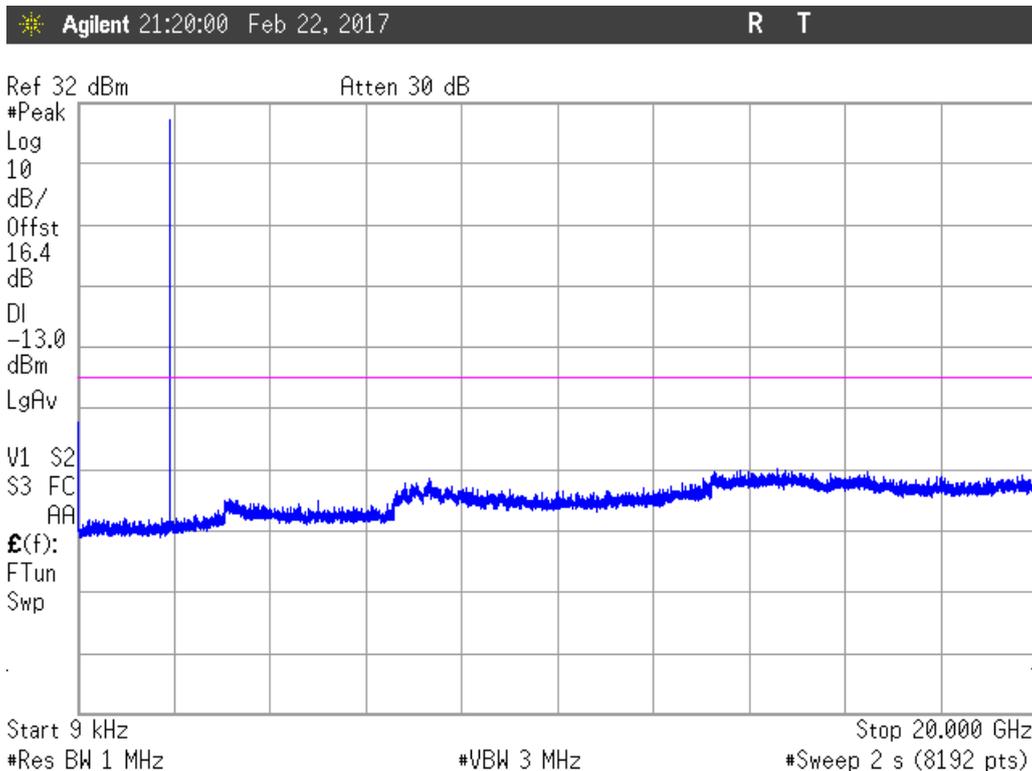
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

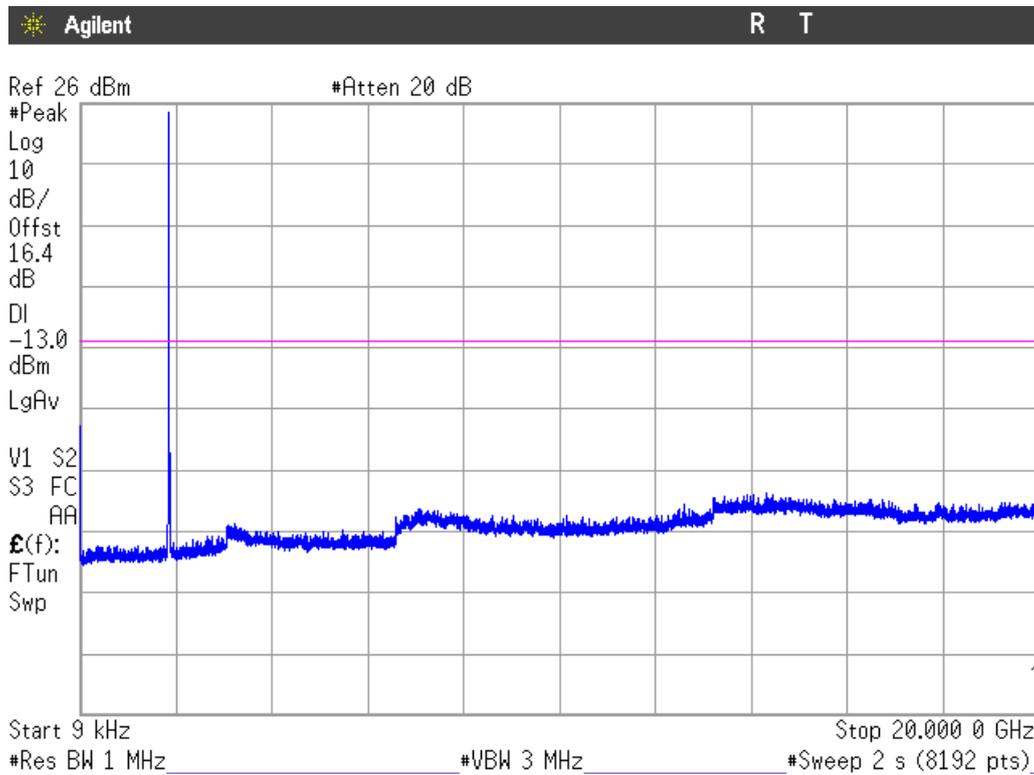
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

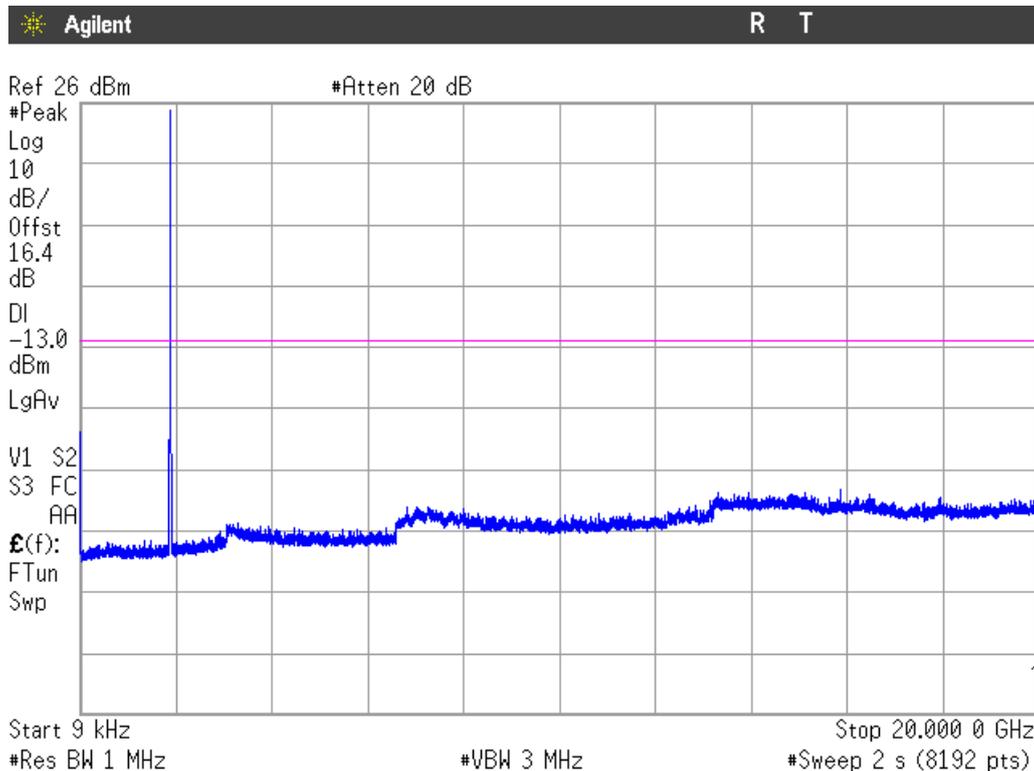
WCDMA MODULATION

1. CHANNEL: LOWEST



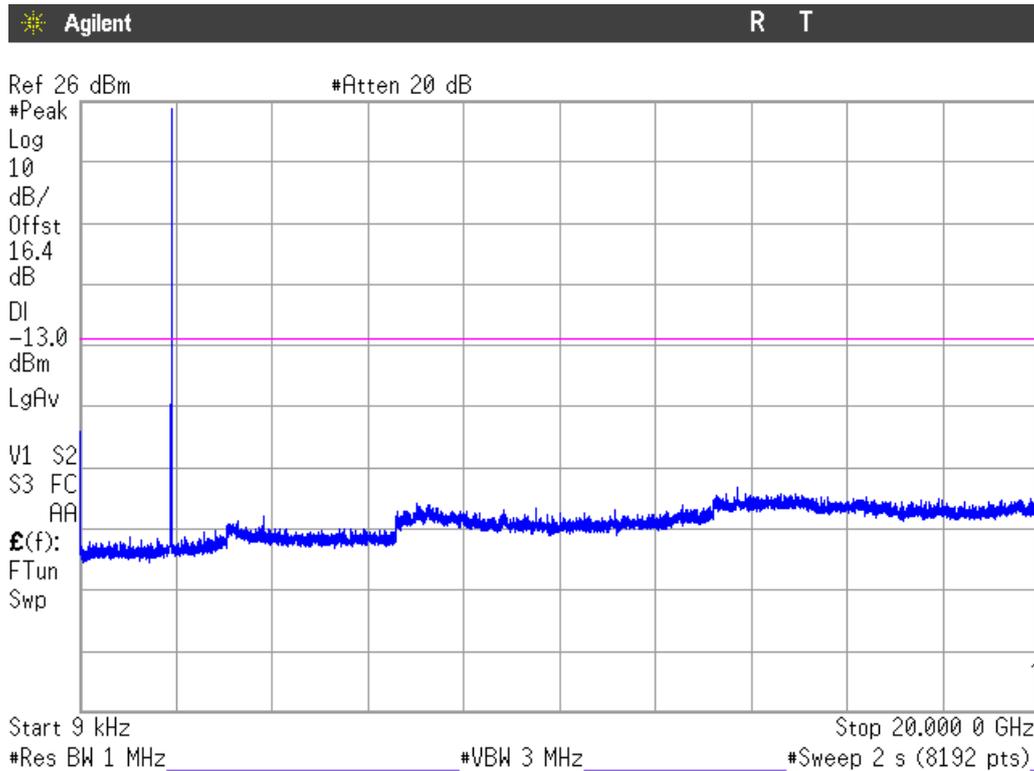
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

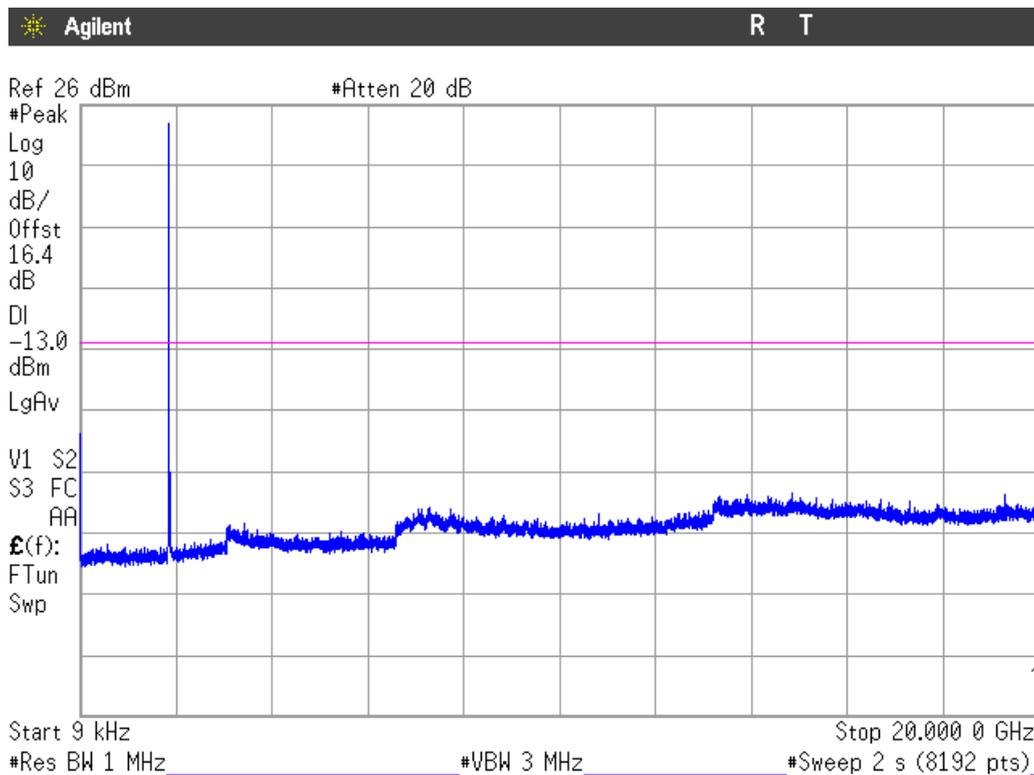
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

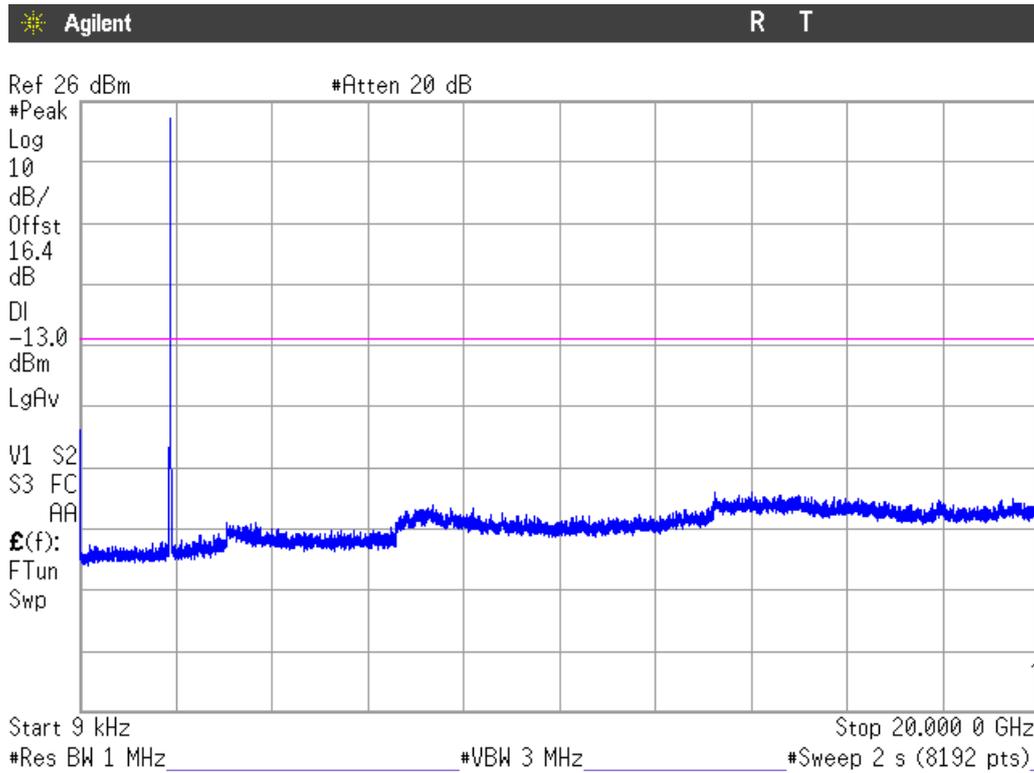
HSUPA MODULATION

1. CHANNEL: LOWEST



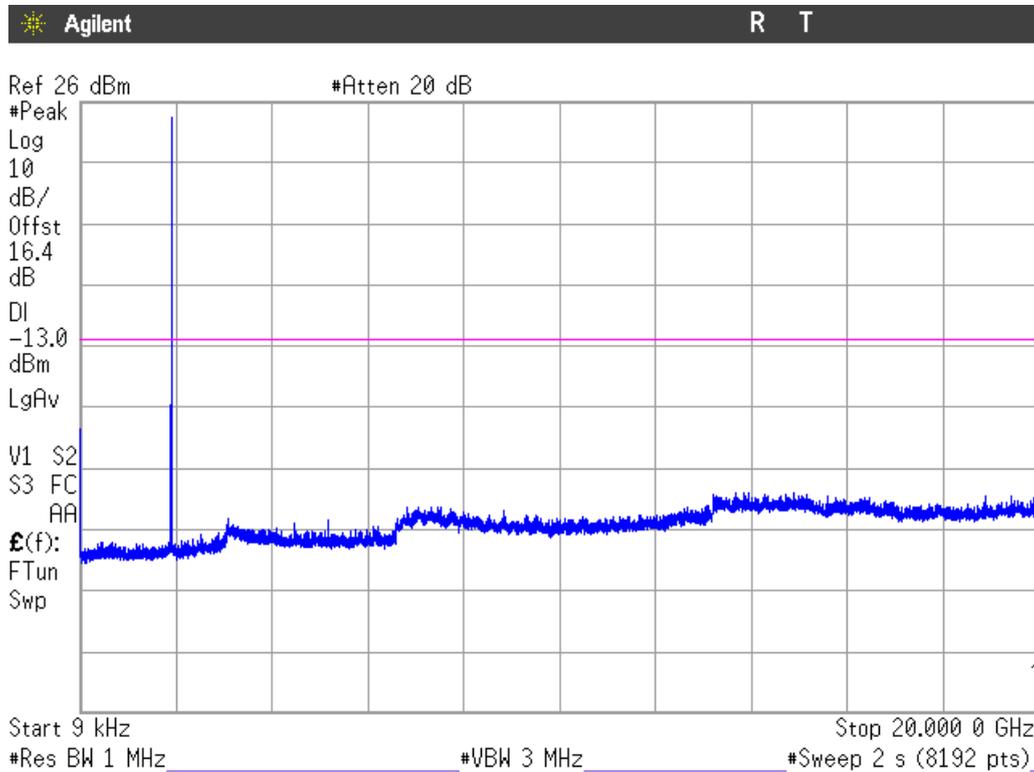
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

Measurement uncertainty (dB)	<±2.03
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Spurious emissions at antenna terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §24.238

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.

As indicated in FCC part 24, 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.

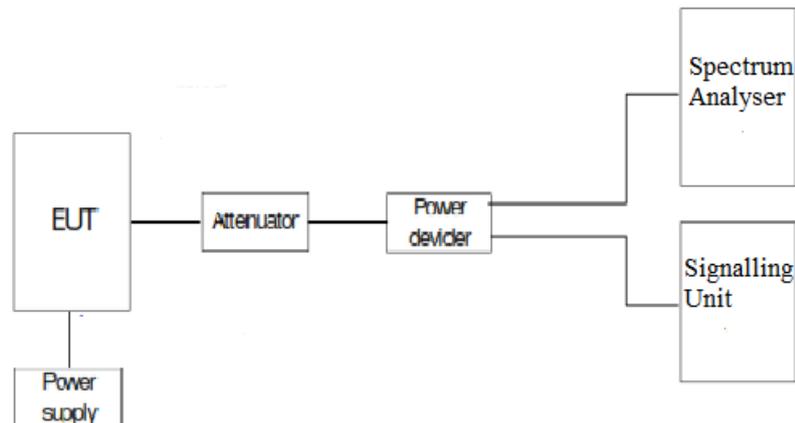
Measurement Limit:

According to specification, 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 P_o becomes:

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

TEST SETUP



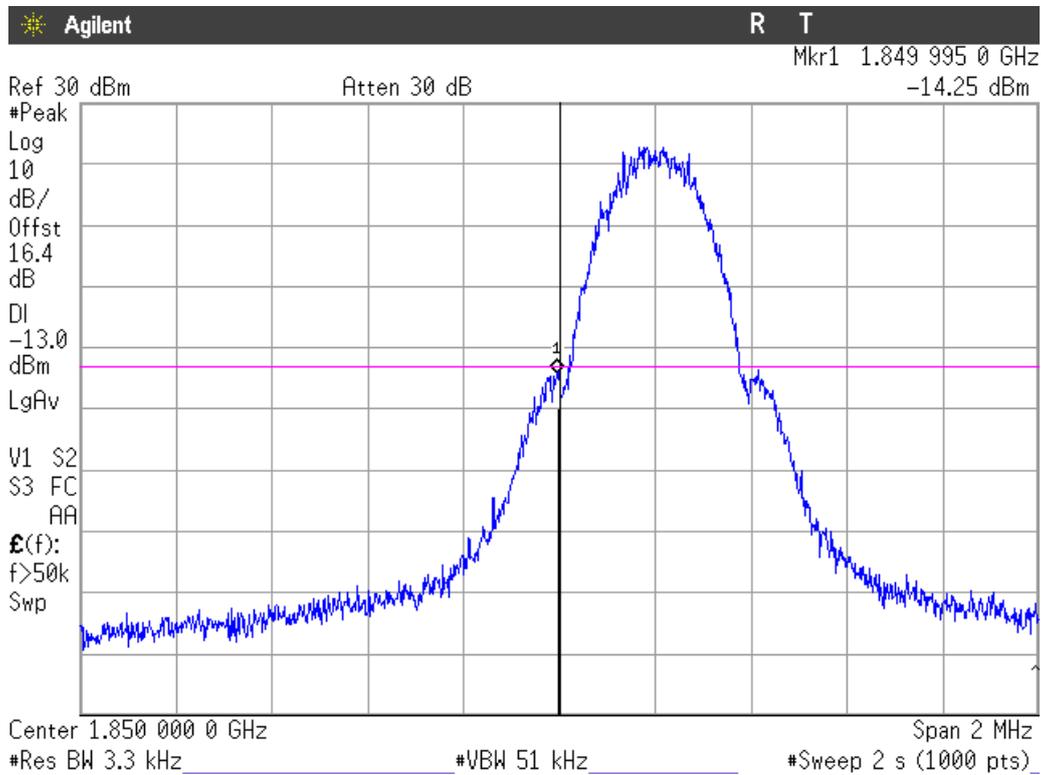
RESULTS (see plots in next pages)

MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at lowest Block Edge at antenna port (dBm)	-14.25	-19.05	-19.28	-19.84
Measurement uncertainty (dB)	<±2.03			

MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-14.84	-16.22	-21.35	-20.97
Measurement uncertainty (dB)	<±2.03			

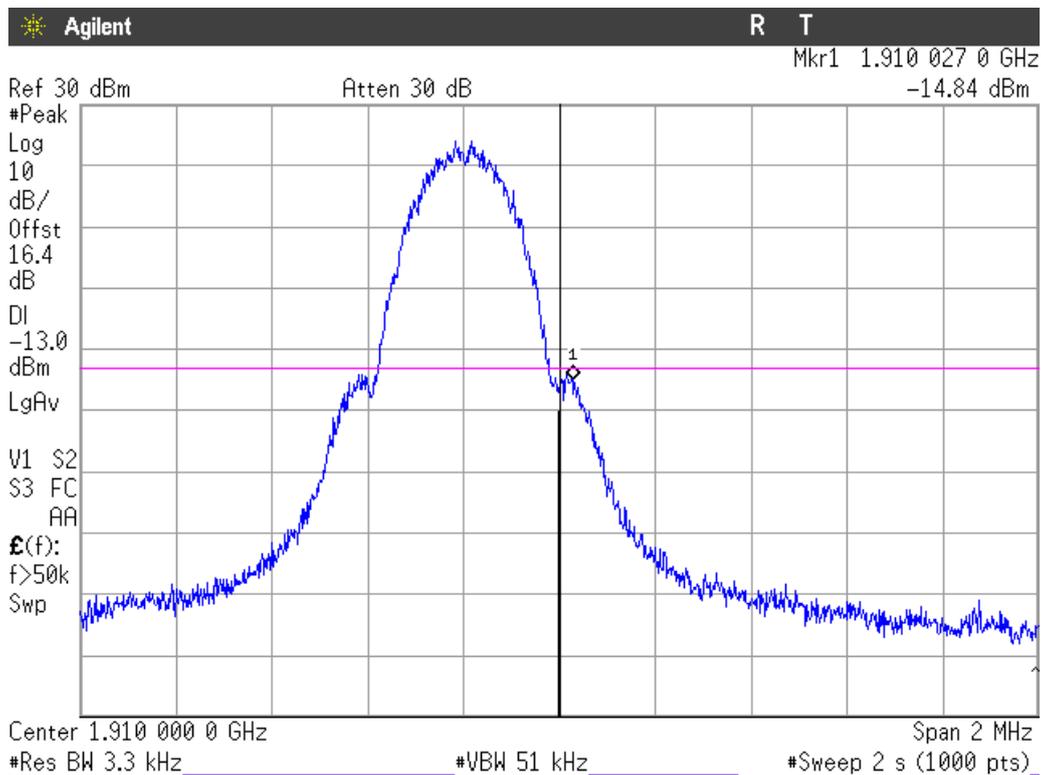
Verdict: PASS

GPRS MODULATION
 CHANNEL LOWEST



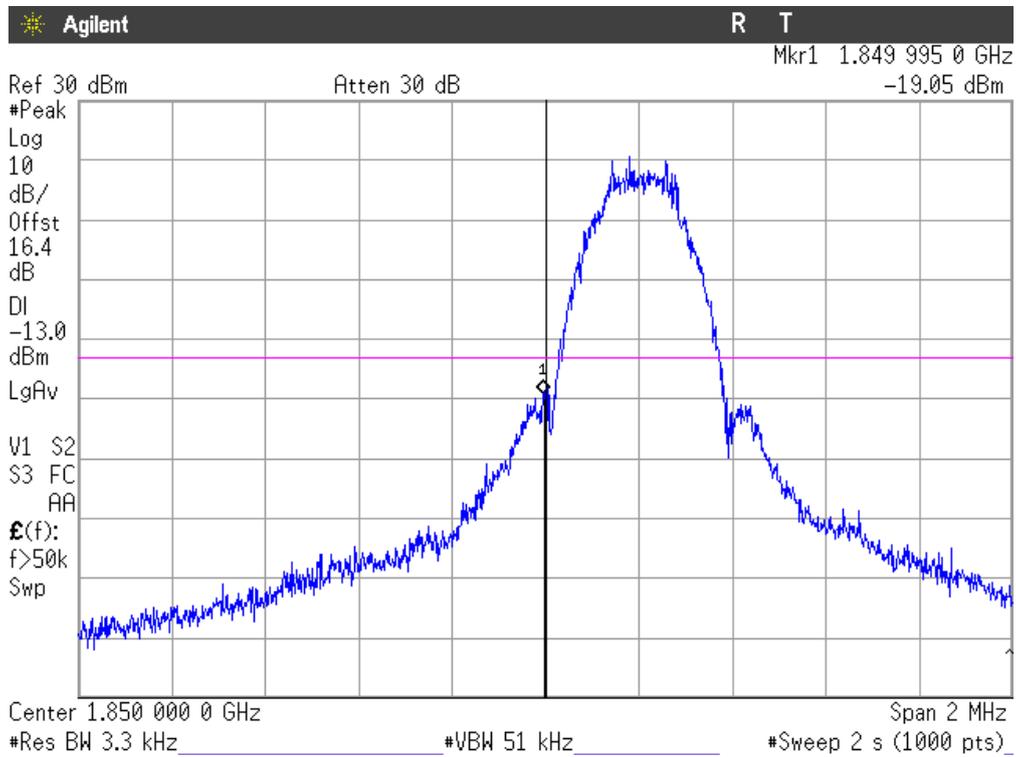
NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



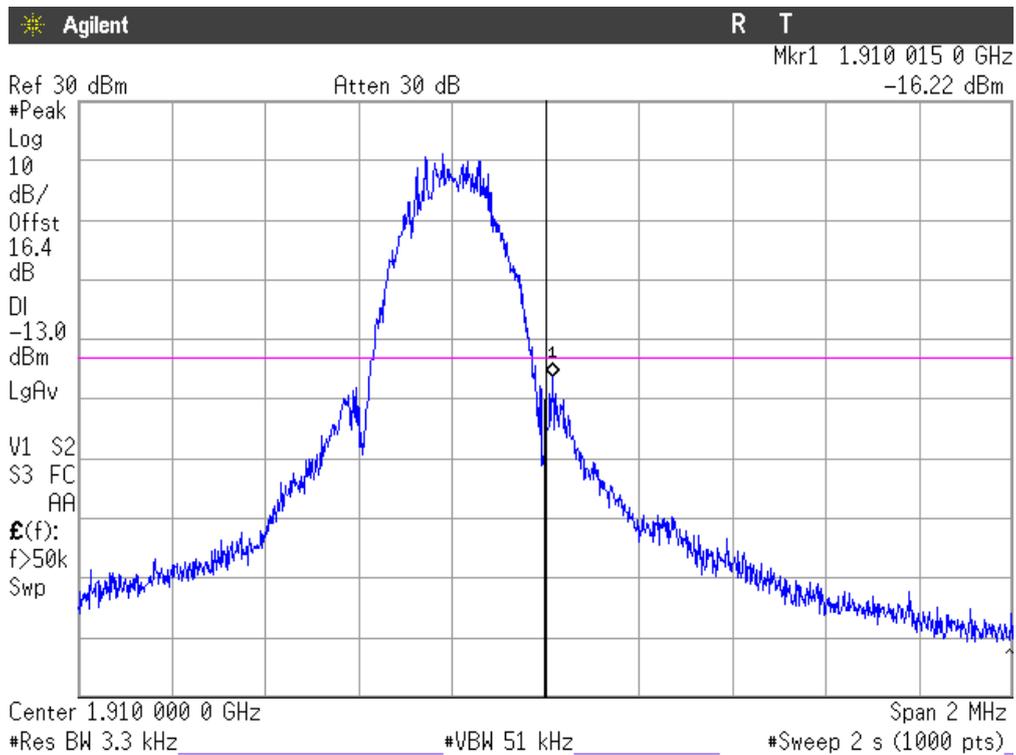
NOTE: The equipment transmits at the maximum output power

EDGE MODULATION
 CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

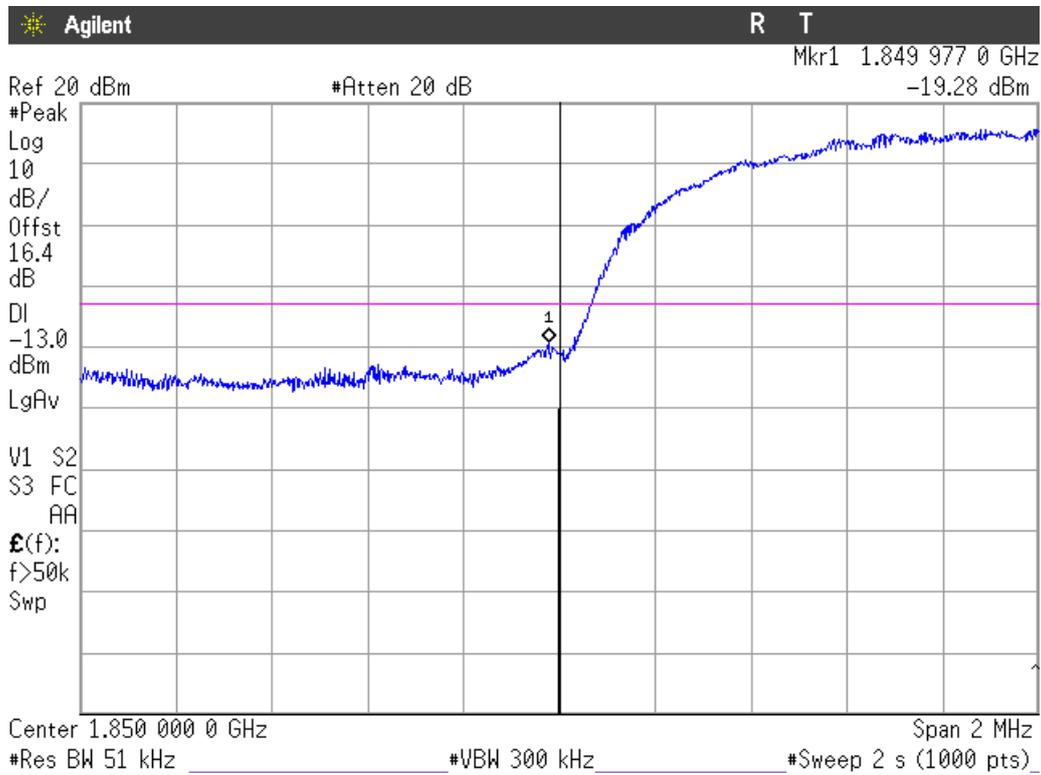
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

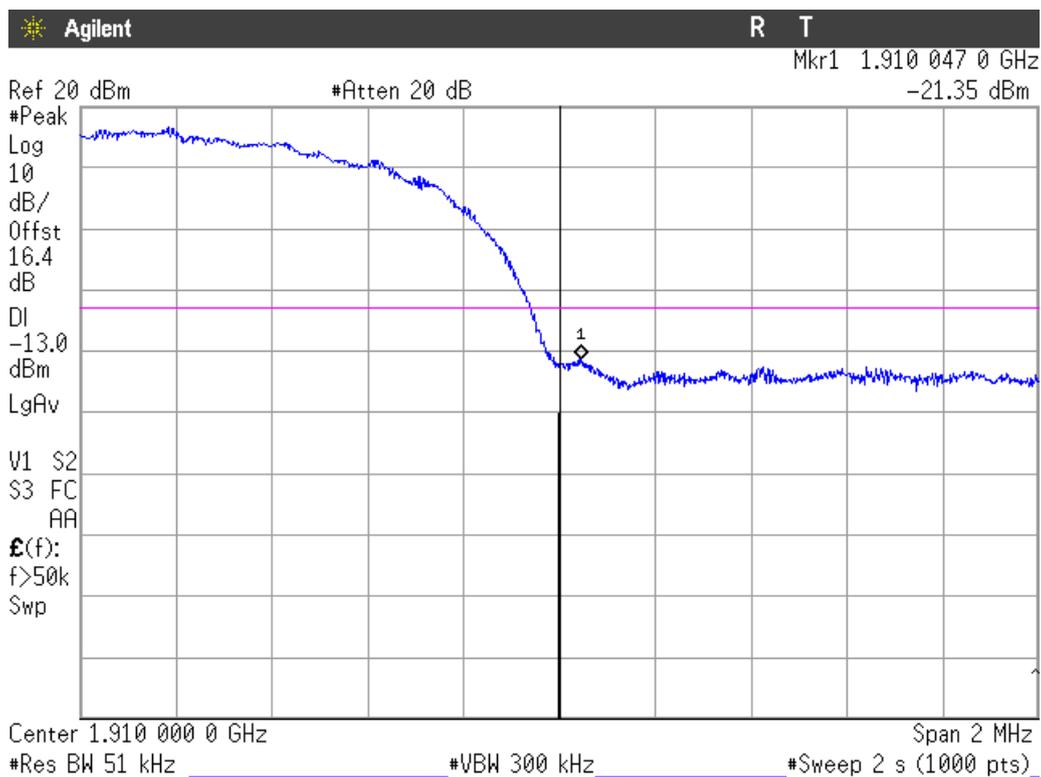
WCDMA MODULATION

CHANNEL LOWEST



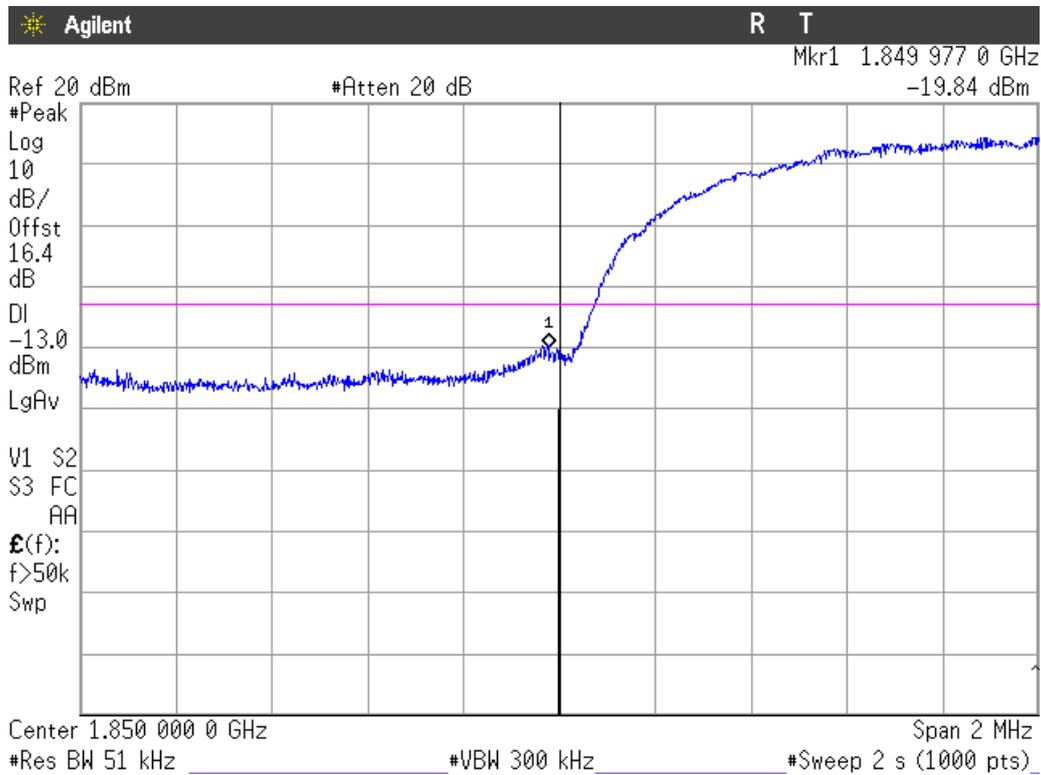
NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



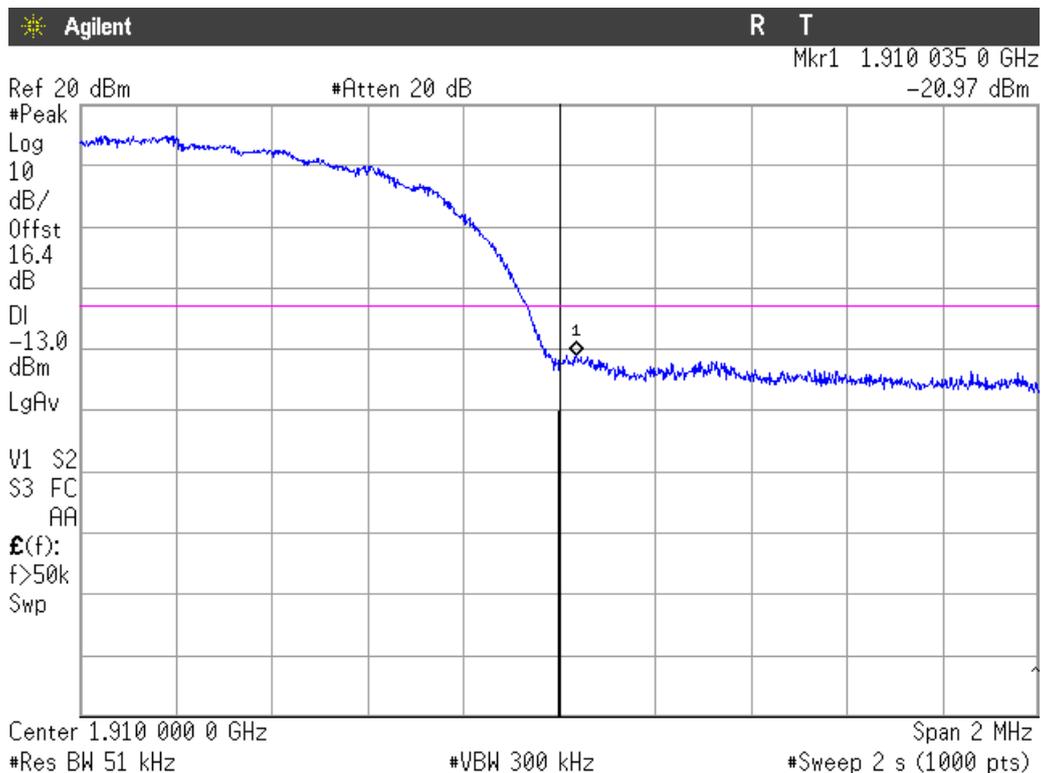
NOTE: The equipment transmits at the maximum output power

HSUPA MODULATION
 CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

Radiated emissions

SPECIFICATION

FCC § 24.238

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.

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 below 1 GHz and at 1 m distance for measurements above 1 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 radiated emissions were measured with peak detector and 1 MHz bandwidth.

Each detected emission at less than 20 dB respect to the limit is substituted by the Substitution method, in accordance with the ANSI/TIA-603-D: 2010.

The test was performed with the equipment transmitting first in only cellular mode and then repeated with the BT EDR/BT LE (modulation GFSK, which is the worst case) radios transmitting simultaneously to check the impact of the co-location of both radio interfaces. The results and plots below show the worst results obtained in all modes.

Measurement Limit:

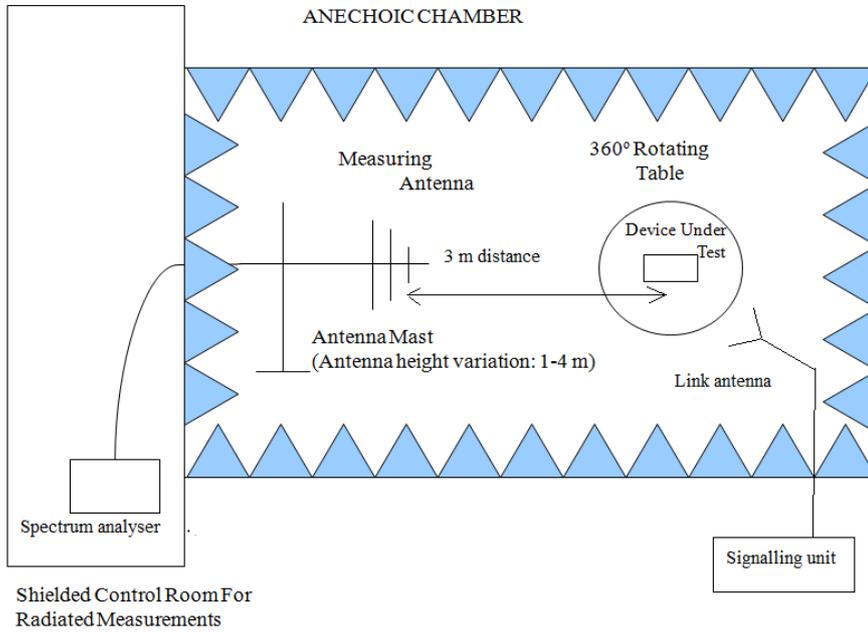
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

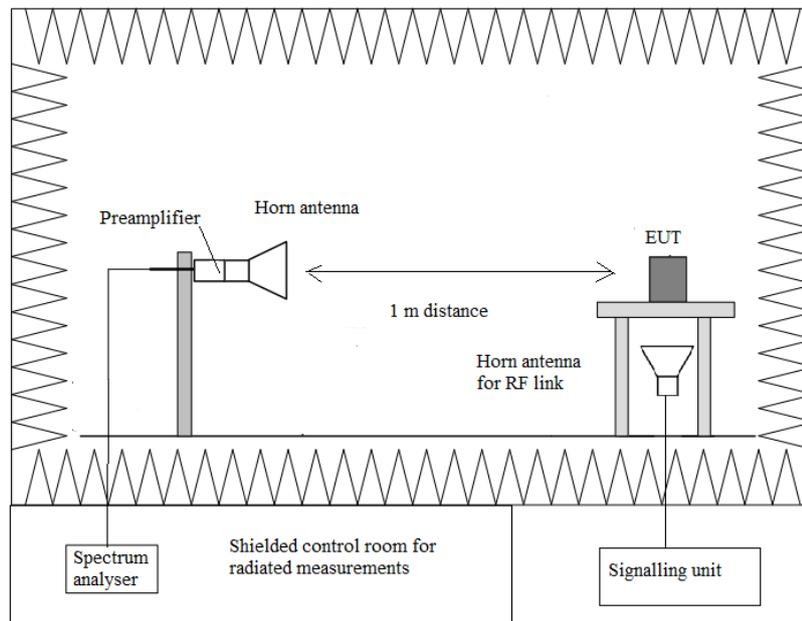
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = - 13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS AND EDGE MODULATION

A preliminary scan determined the GPRS modulation as the worst case. The following tables and plots show the results for GPRS modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

Verdict: PASS

WCDMA AND HSUPA MODULATION

A preliminary scan determined the HSUPA modulation as the worst case. The following tables and plots show the results for HSUPA modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
13152.75	-42.34	Horizontal	-37.47	6.51	12.50	-31.48

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

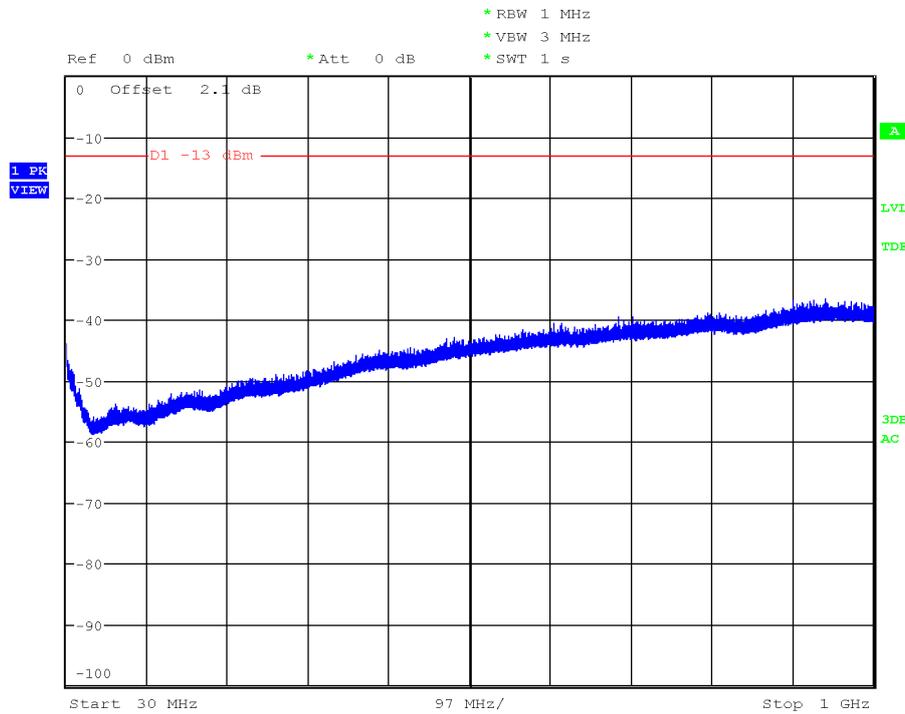
Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
13344.25	-43.44	Horizontal	-38.13	6.46	12.50	-32.09

Measurement uncertainty (dB)	$\leq \pm 3.88$ for $f < 1\text{GHz}$ $\leq \pm 4.87$ for $f \geq 1\text{GHz}$ up to 18 GHz $\leq \pm 3.99$ for $f \geq 18\text{GHz}$ up to 20 GHz
------------------------------	--

Verdict: PASS

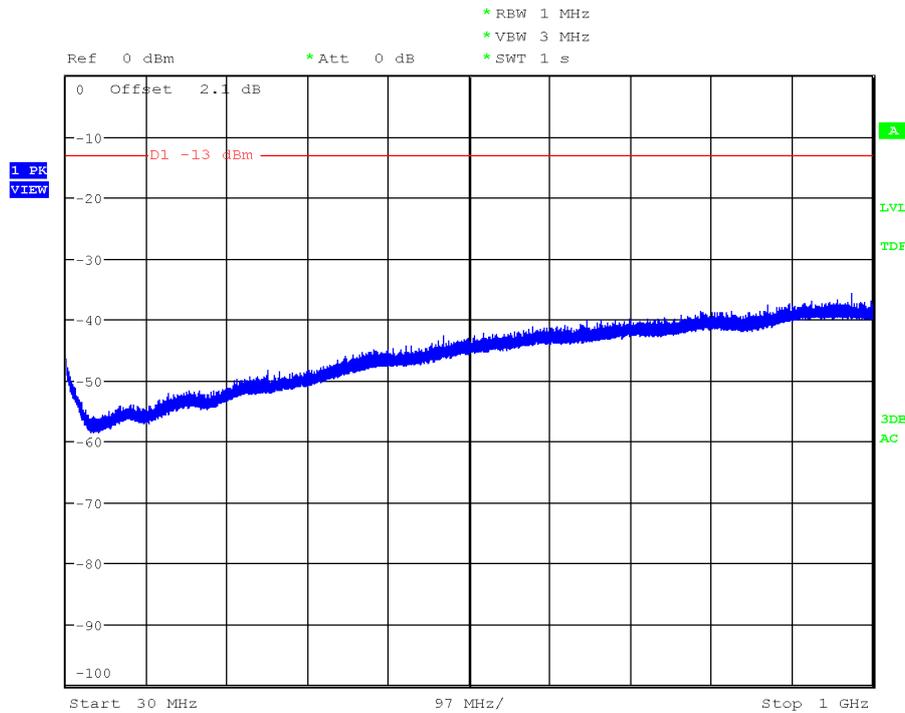
FREQUENCY RANGE 30 MHz-1000 MHz.

GPRS MODULATION



(This plot is valid for all three channels)

HSUPA MODULATION

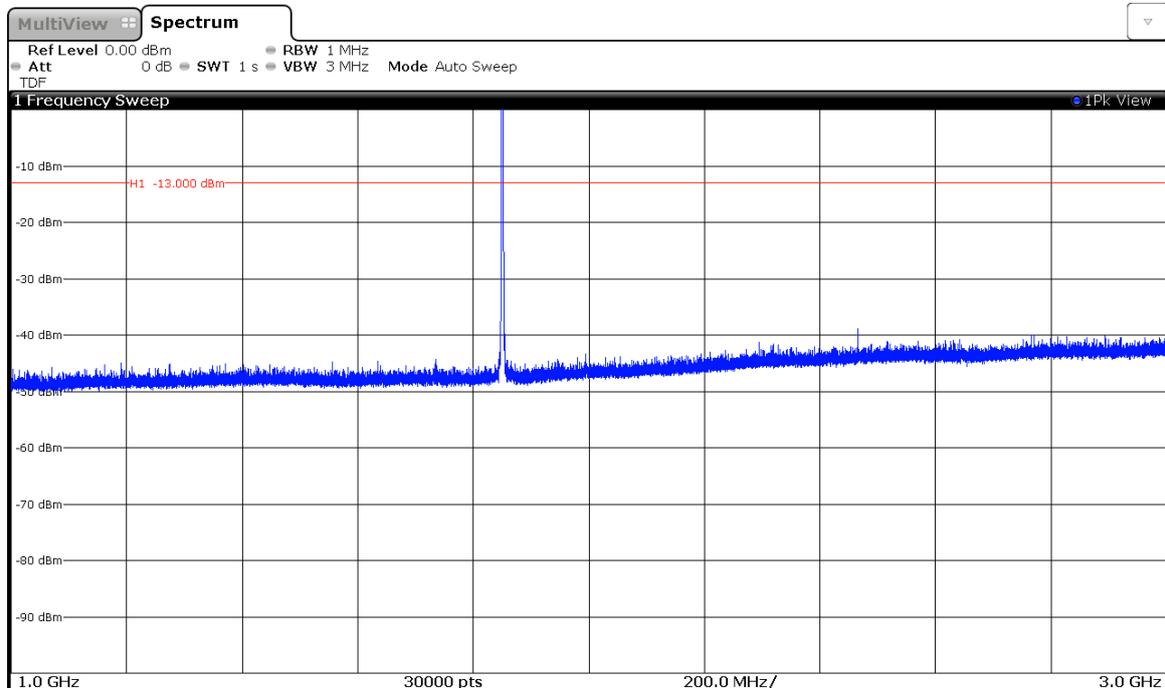


(This plot is valid for all three channels)

FREQUENCY RANGE 1 GHz to 3 GHz.

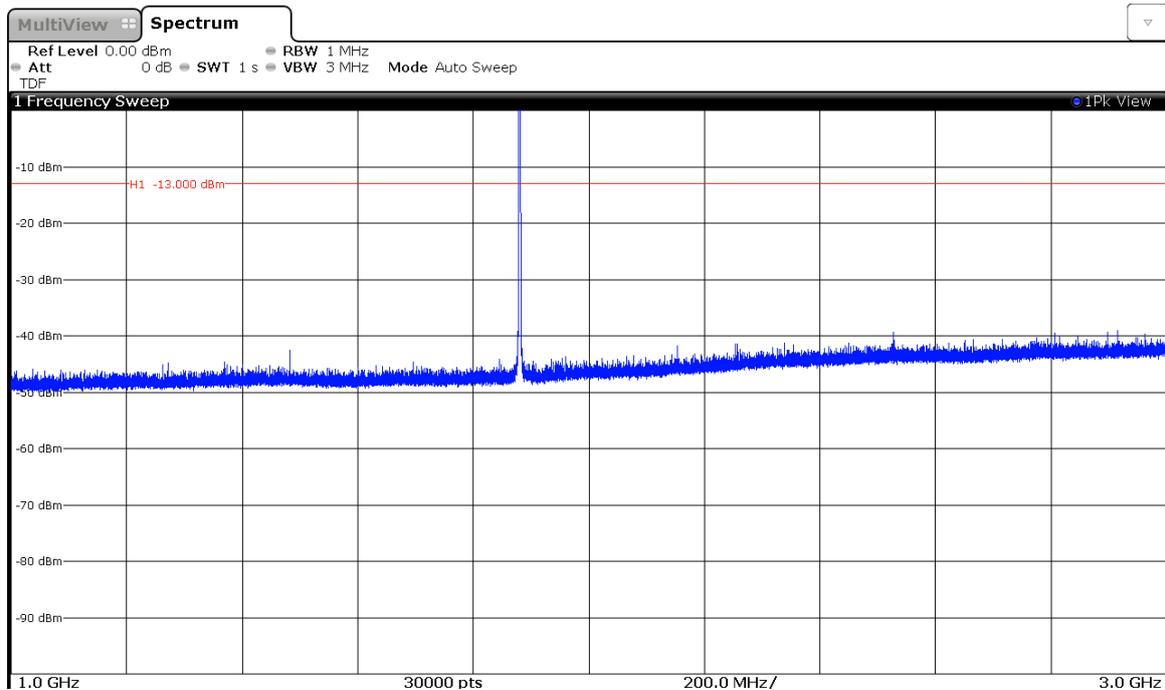
GPRS MODULATION

CHANNEL: LOWEST



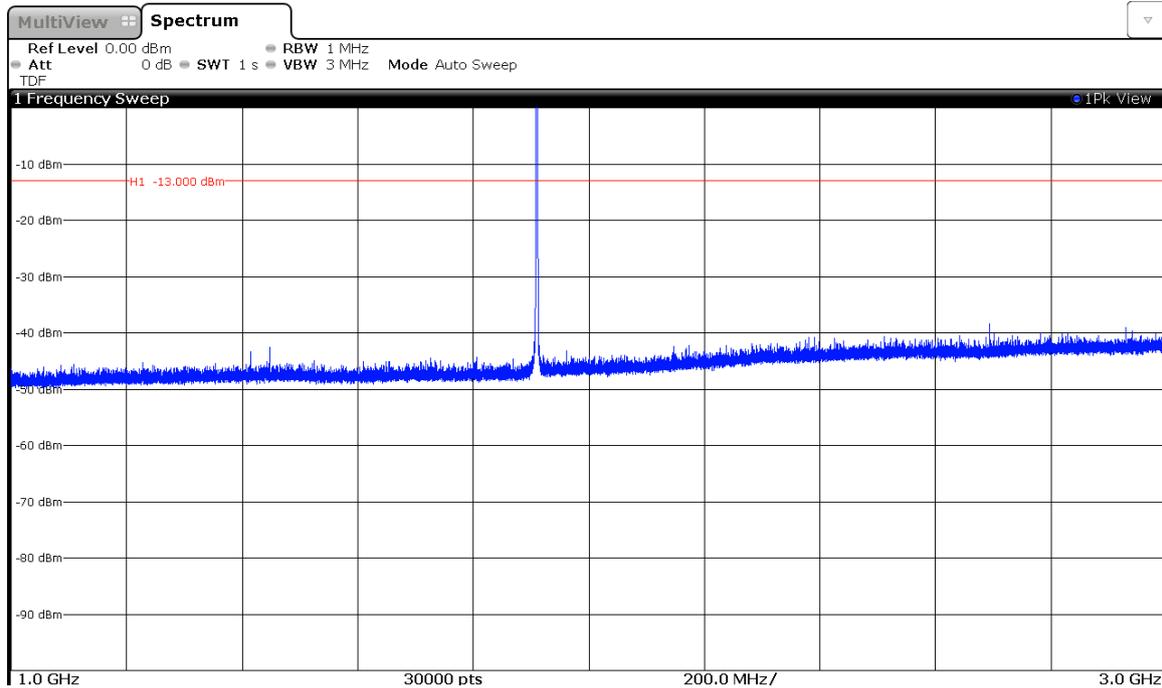
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

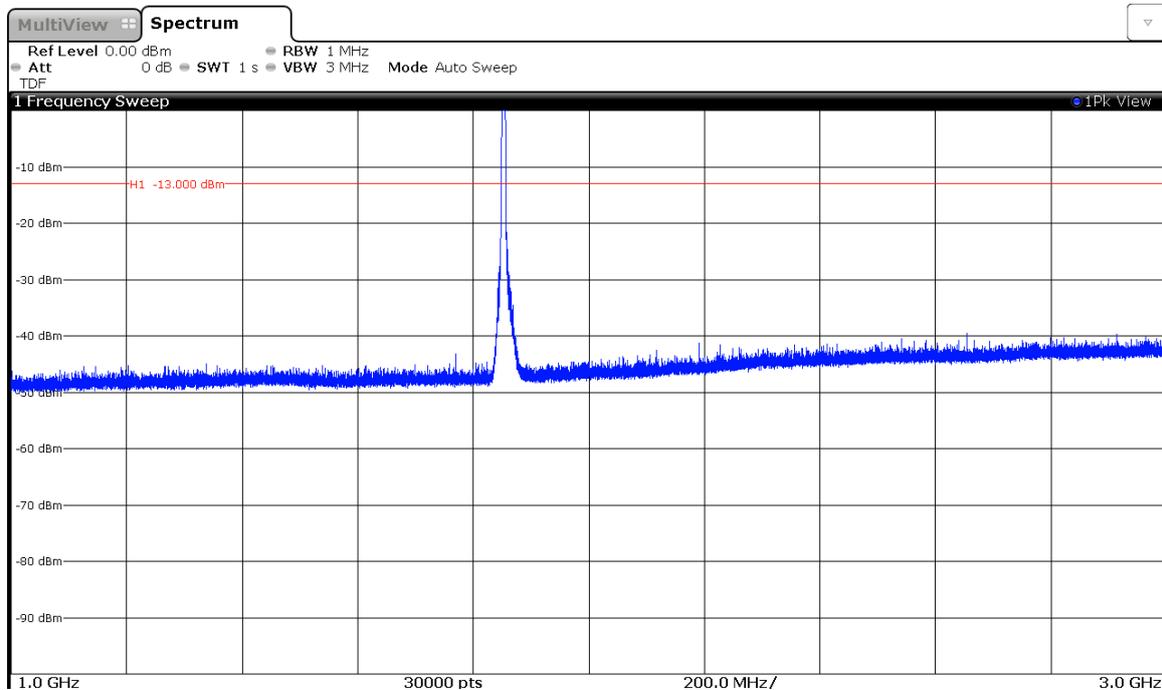
CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

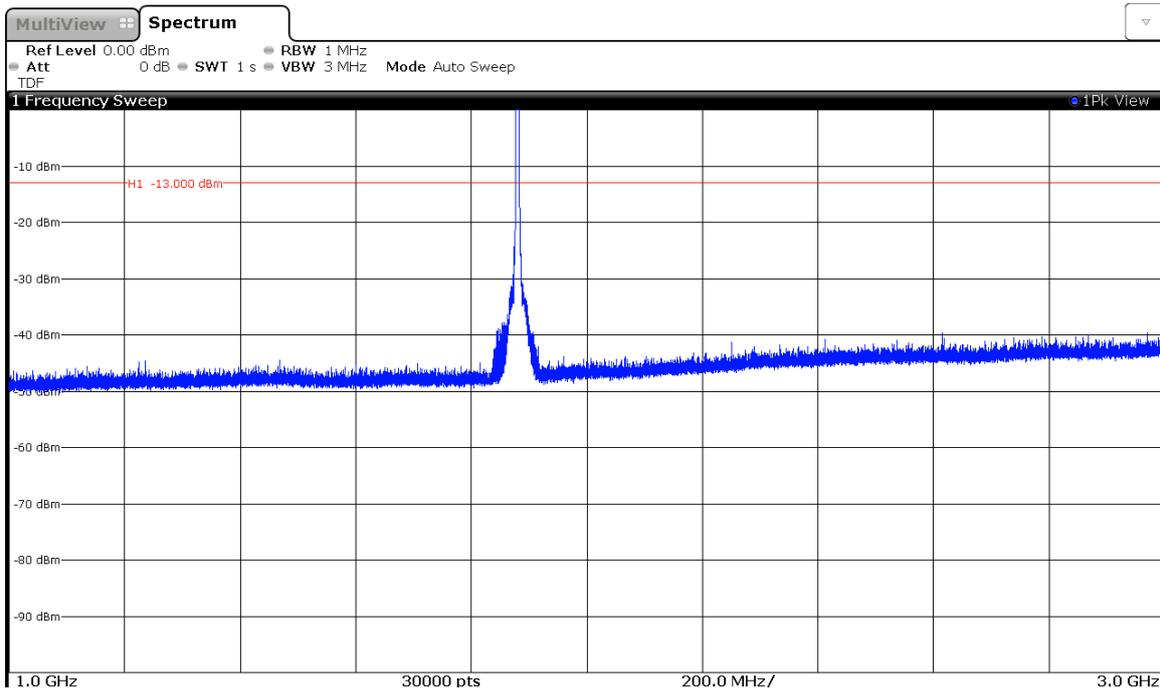
HSUPA MODULATION

CHANNEL: LOWEST



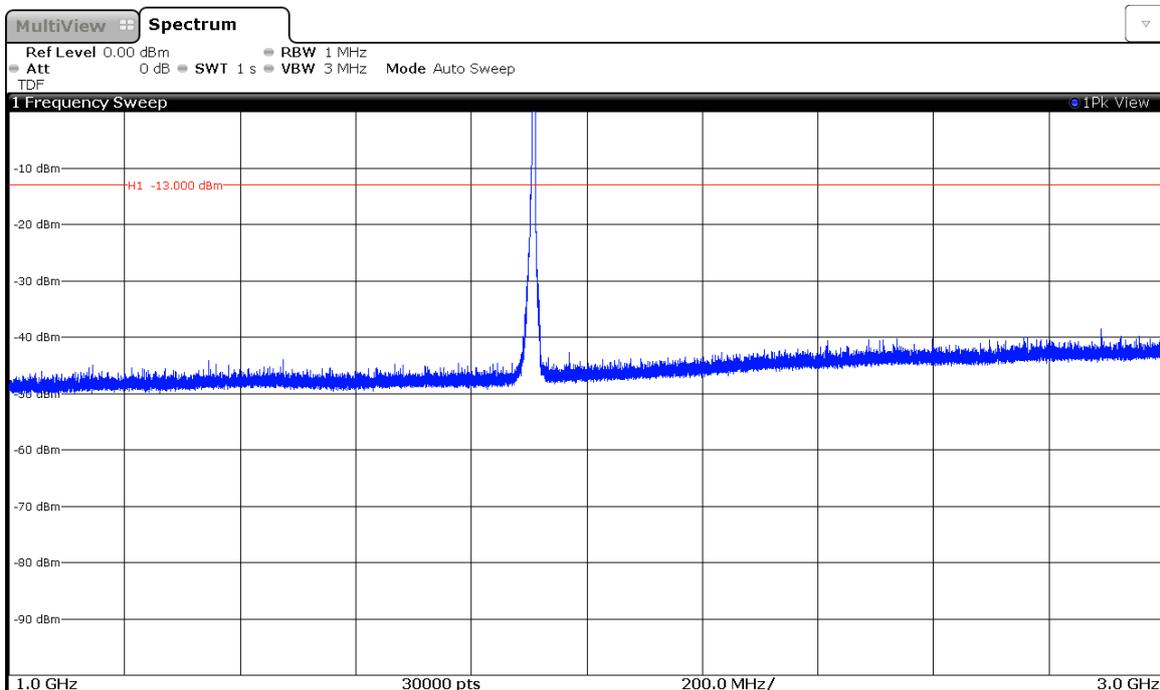
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

CHANNEL: HIGHEST

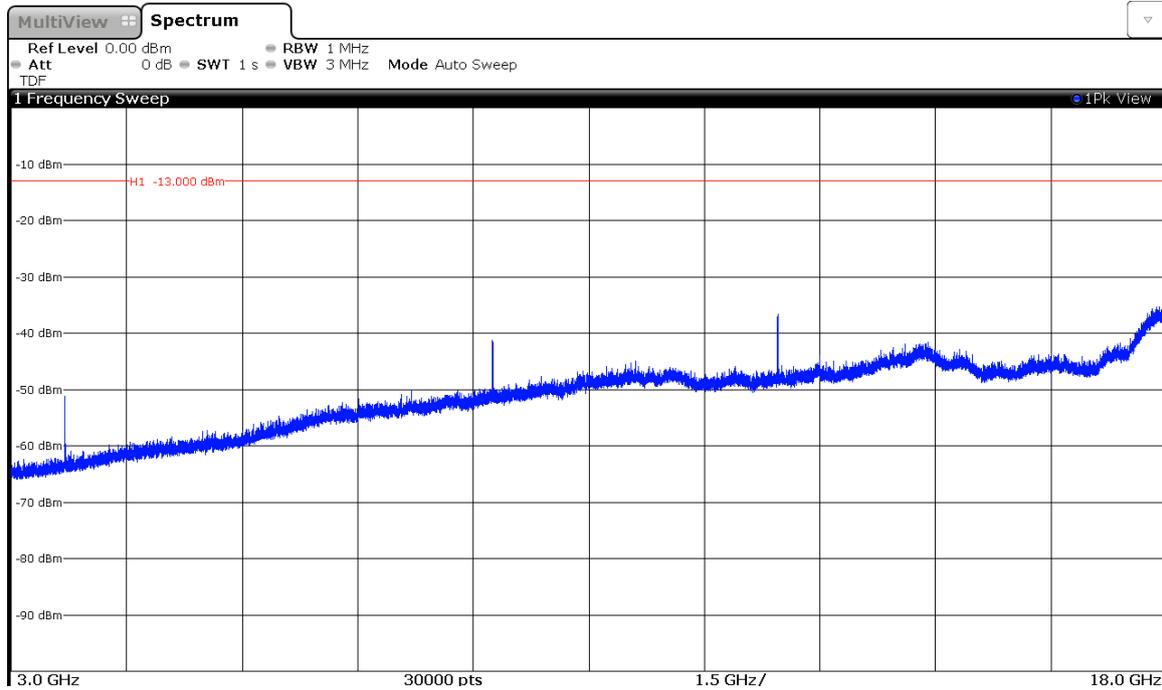


Note: The peak above the limit is the carrier frequency.

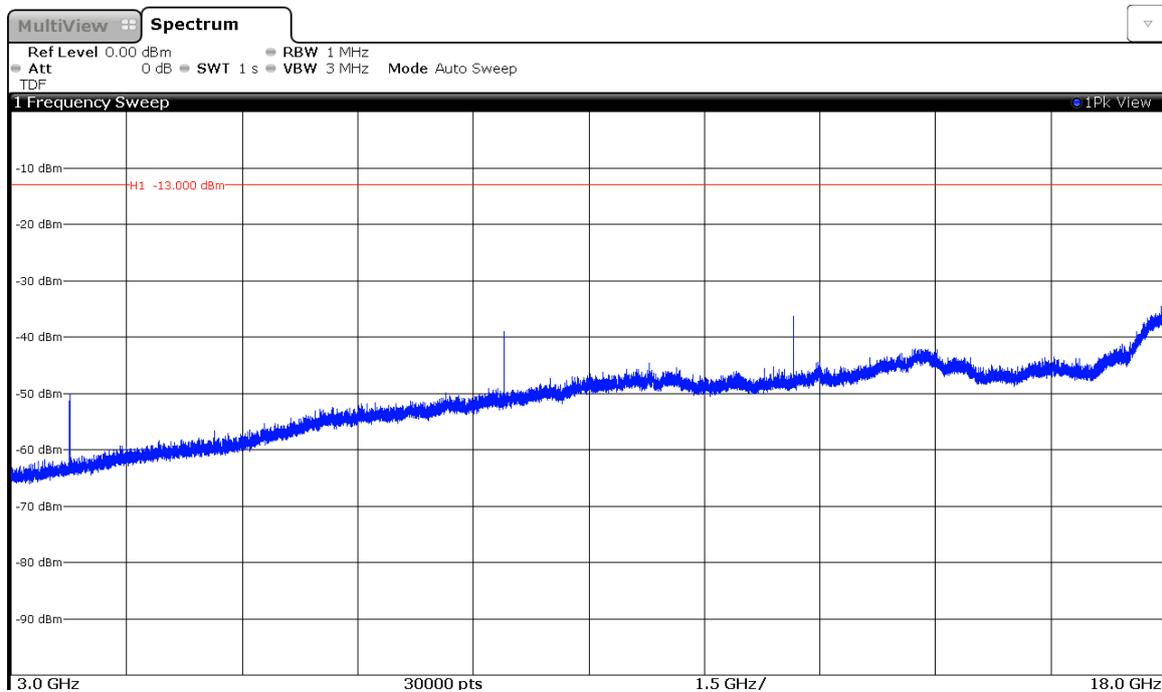
FREQUENCY RANGE 3 GHz to 18 GHz.

GPRS MODULATION

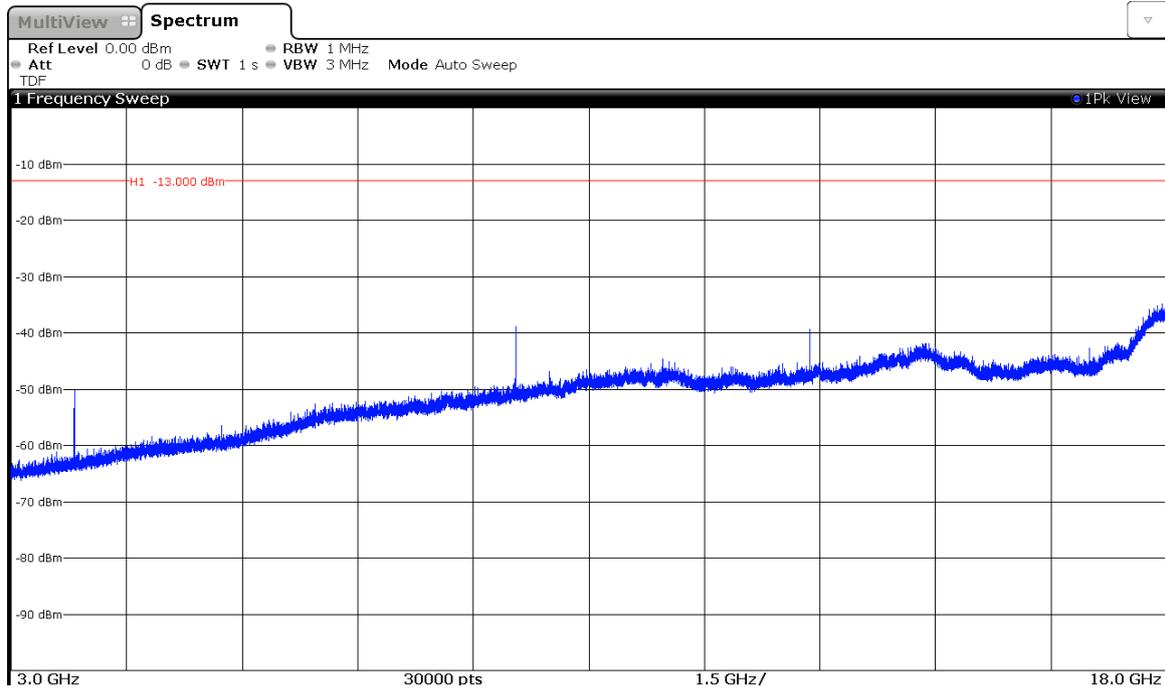
CHANNEL: LOWEST



CHANNEL: MIDDLE

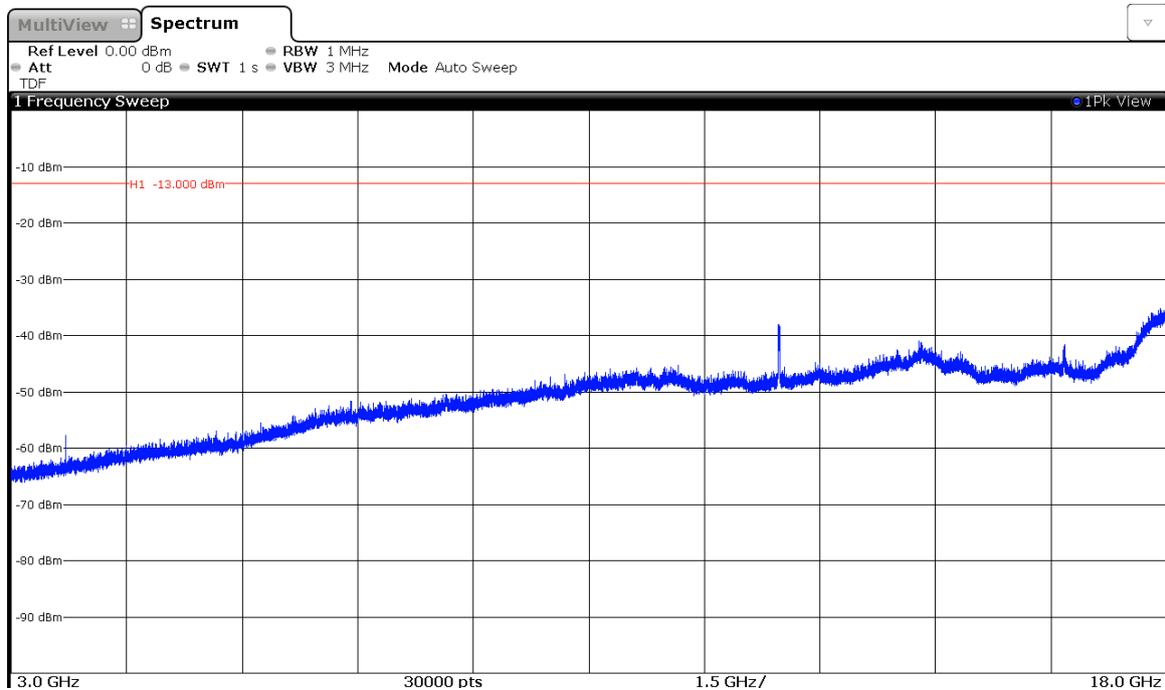


CHANNEL: HIGHEST

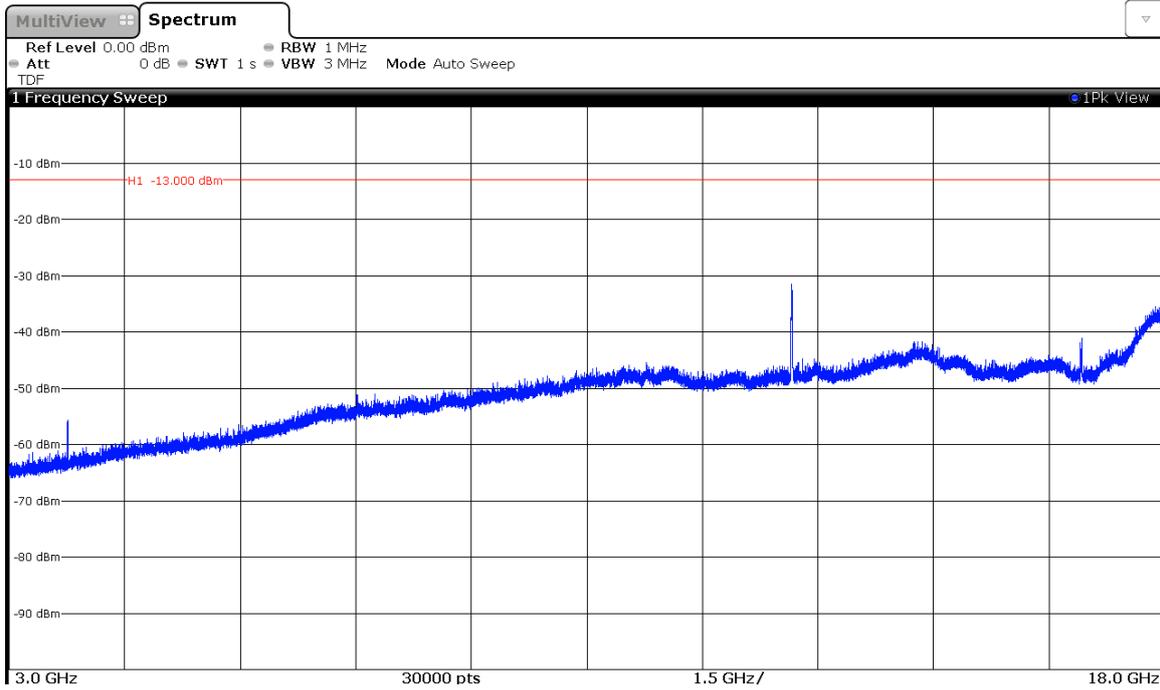


HSUPA MODULATION

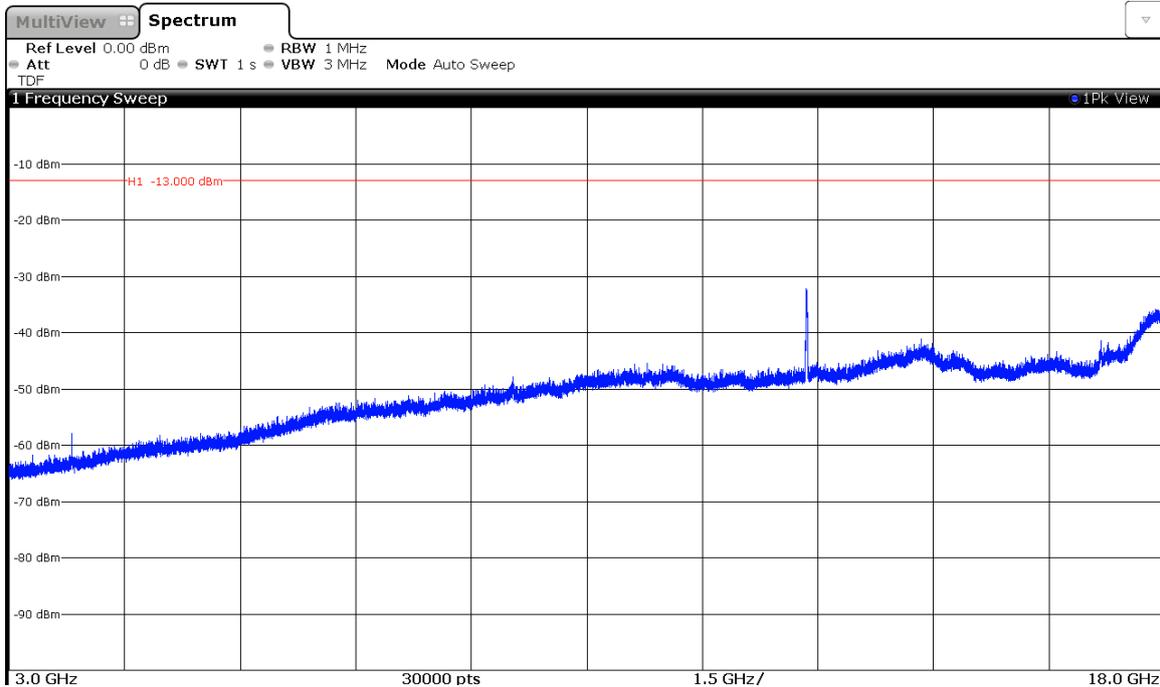
CHANNEL: LOWEST



CHANNEL: MIDDLE



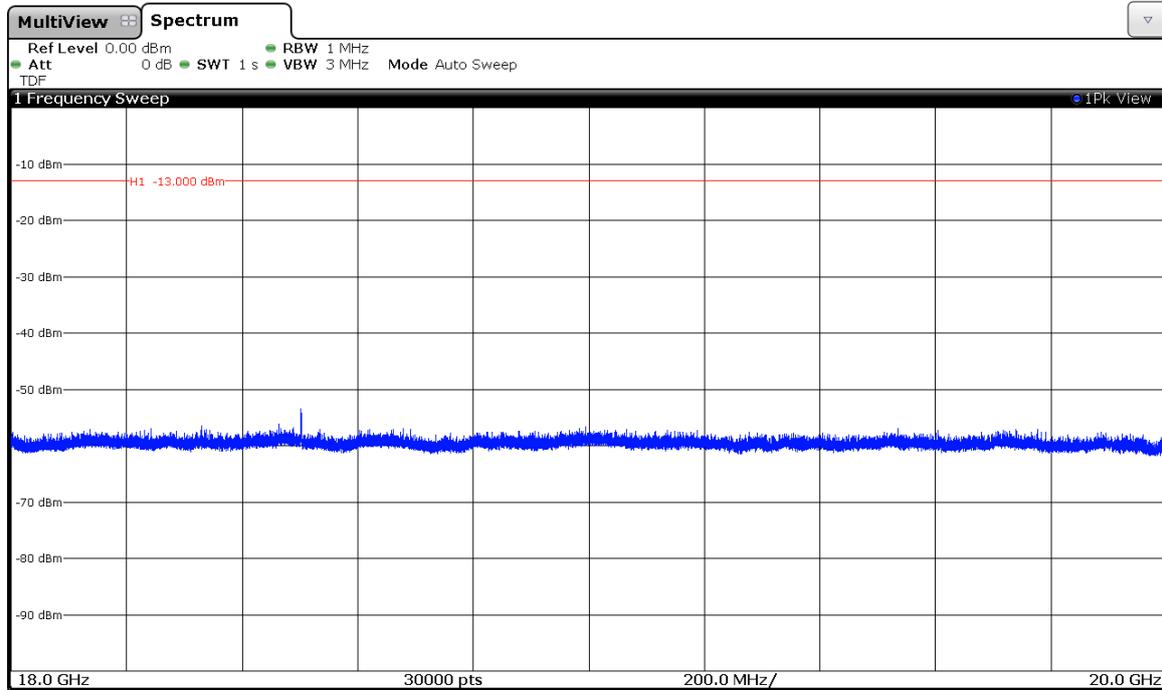
CHANNEL: HIGHEST



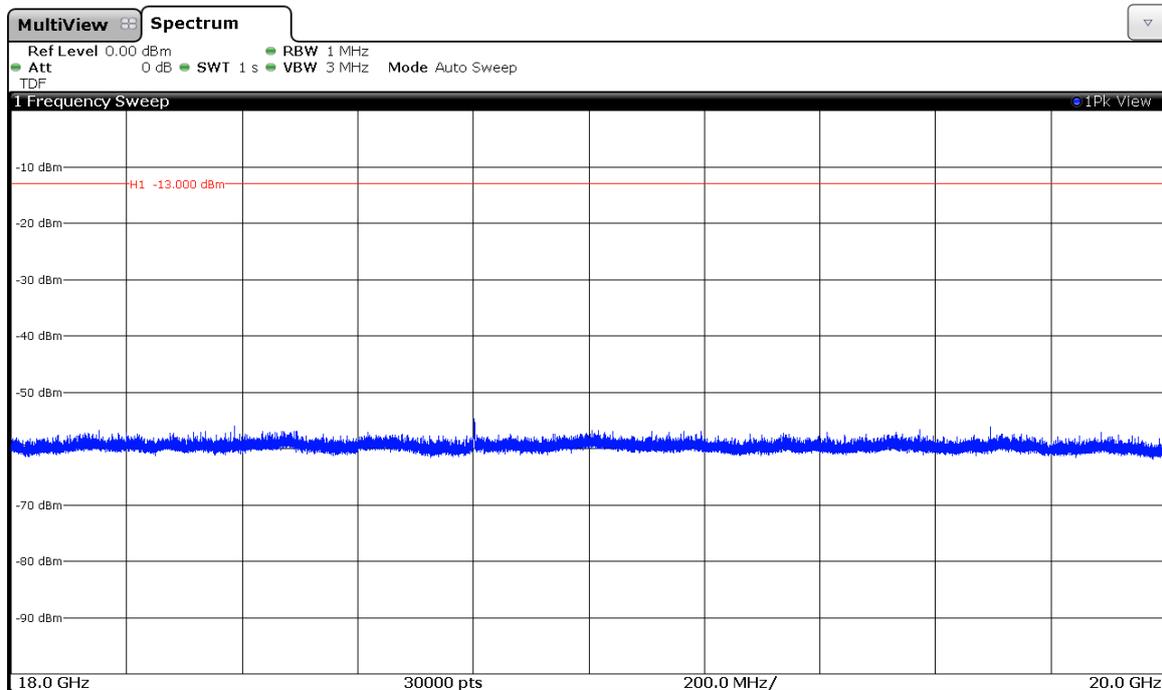
FREQUENCY RANGE 18 GHz TO 20 GHz.

GPRS MODULATION

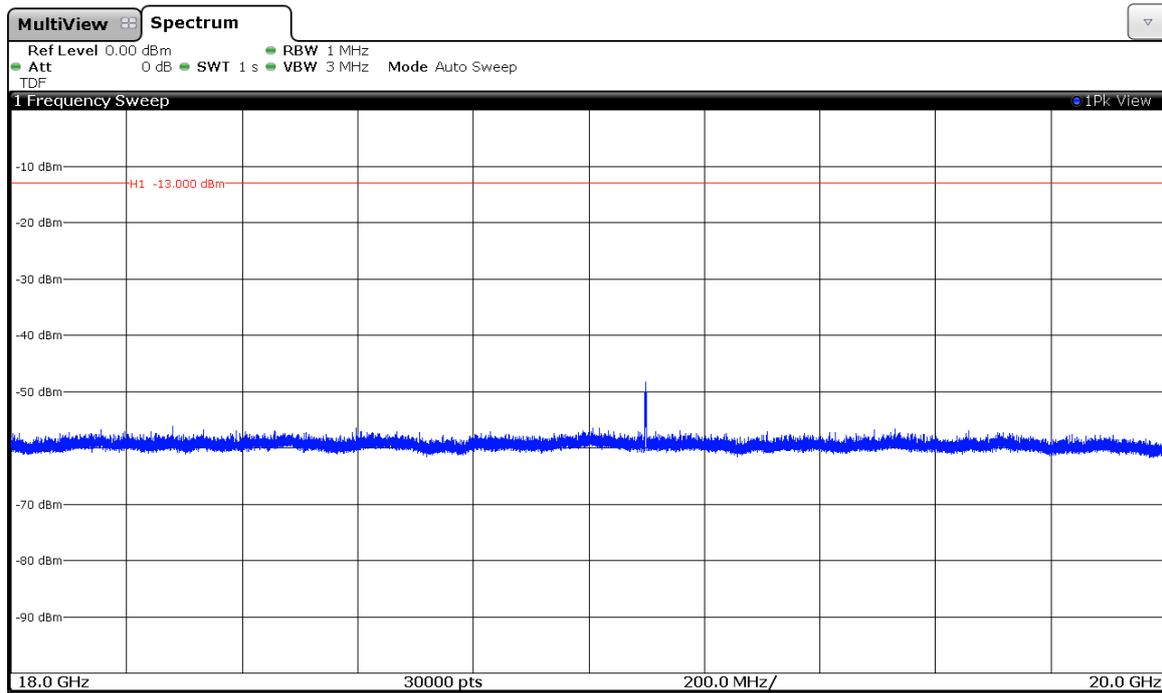
CHANNEL: LOWEST



CHANNEL: MIDDLE

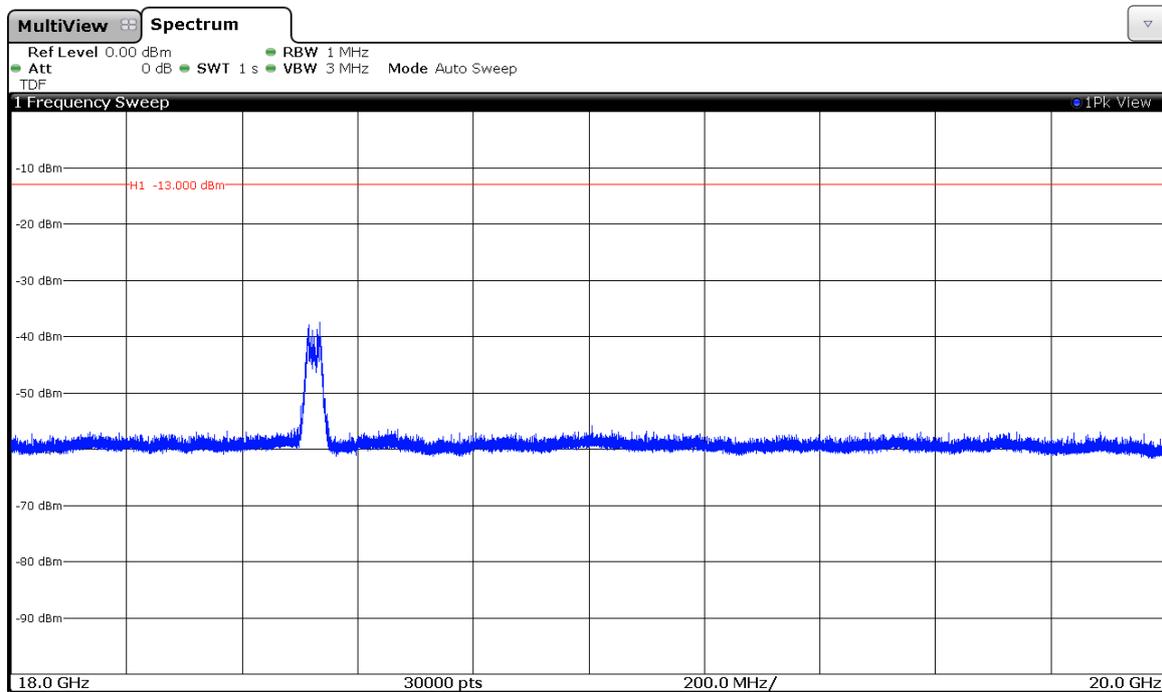


CHANNEL: HIGHEST

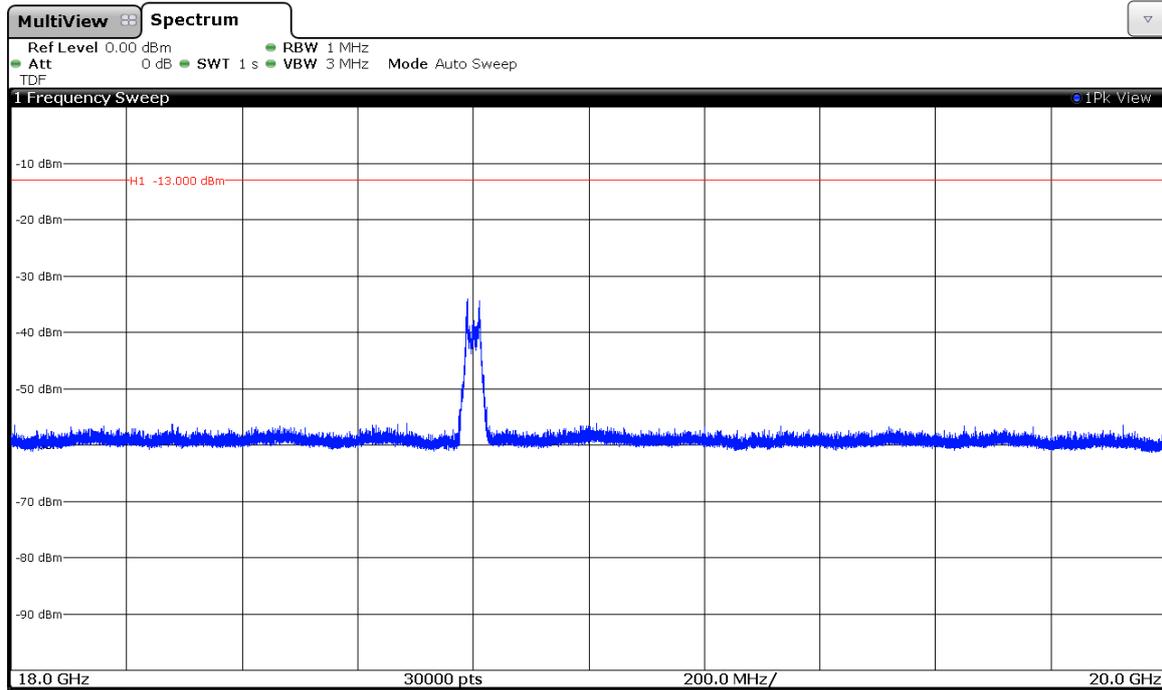


HSUPA MODULATION

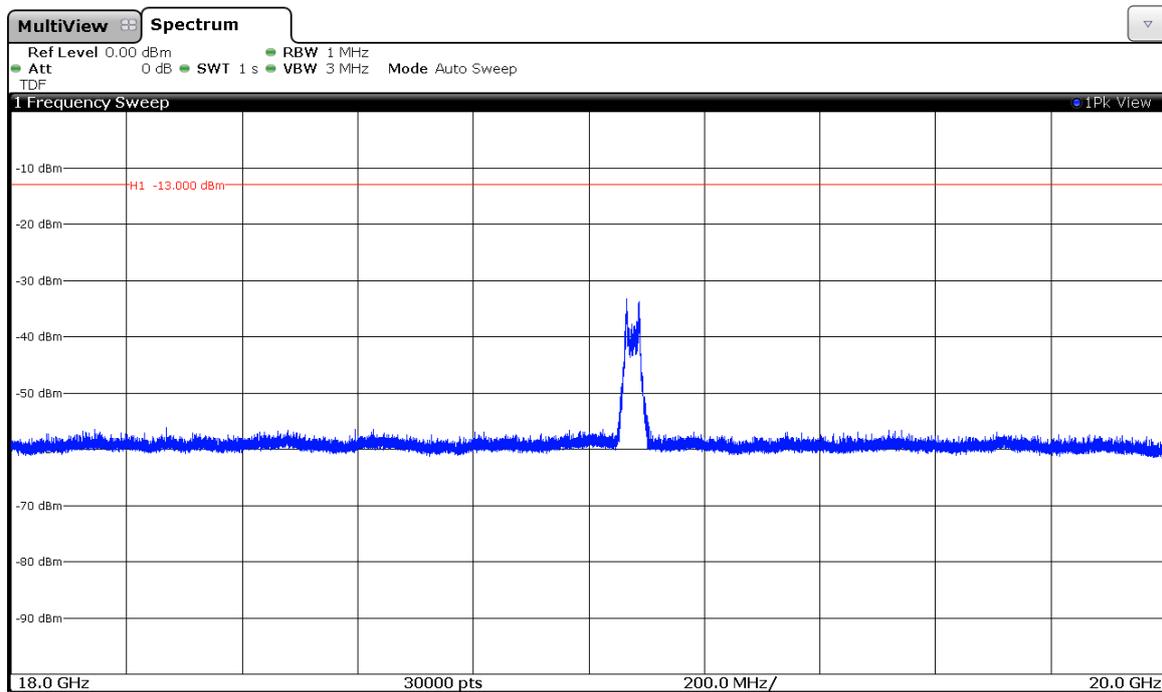
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



Appendix C – Test result for FCC Part 27

INDEX

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TEST RESULTS FOR FCC PART 27

TEST CONDITIONS

Power supply (V):

$$V_{nom} = 4.2V_{dc}$$

$$V_{max} = 4.2 V_{dc}$$

$$V_{min} = 3.6 V_{dc}$$

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 rechargeable battery

Type of antenna = Internal antenna (PIFA antenna)

Antenna gain = +2.5 dBi (WCDMA Band IV) +2.0 dBi (LTE Band II).

TEST FREQUENCIES:

WCDMA AND HSUPA MODULATION

Lowest channel (1312): 1712.4 MHz

Middle channel (1762): 1732.5 MHz

Highest channel (1513): 1752.6 MHz

LTE. QPSK AND 16QAM MODULATION (BAND IV)

	Channel (Frequency, MHz)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Lowest	19957 (1710.7)	19965 (1711.5)	19975 (1712.5)	20000 (1715.0)	20025 (1717.5)	20050 (1720.0)
Middle	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)	20175 (1732.5)
Highest	20393 (1754.3)	20385 (1753.5)	20375 (1752.5)	20350 (1750.0)	20325 (1747.5)	20300 (1745.0)

RF Output Power (conducted and E.I.R.P.)

SPECIFICATION

FCC §2.1046 and §27.50.

Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP (30 dBm). Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

The peak-to-average ratio (PAR) of the transmission shall not exceed 13 dB.

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

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

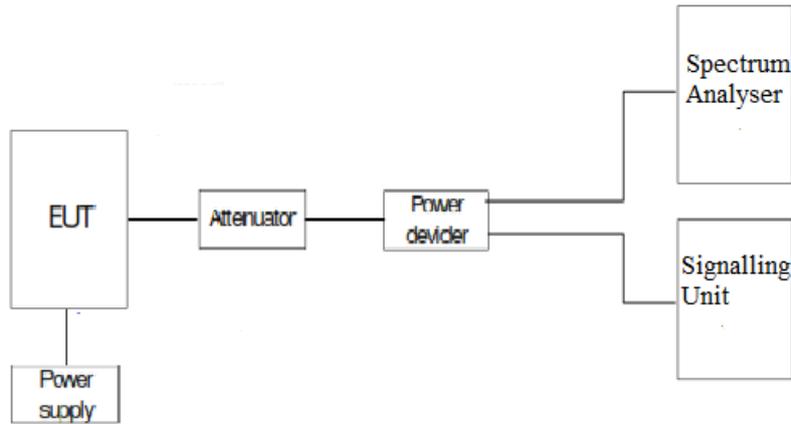
The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The measurement is performed for the highest power levels measured.

TEST SETUP

Conducted average power.



Peak-to-average power ratio (PAPR)



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

UMTS. BAND IV.

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.5	2.5	2.5
Measured maximum average power (dBm) at antenna port	23.75	23.80	23.89
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.25	26.30	26.39
Peak-to-average ratio (PAR) (dB)	3.29	3.36	3.33
Measurement uncertainty (dB)	<±0.66		

HSUPA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.5	2.5	2.5
Measured maximum average power (dBm) at antenna port	22.06	22.15	22.26
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	24.56	24.65	24.76
Peak-to-average ratio (PAR) (dB)	3.37	3.35	3.36
Measurement uncertainty (dB)	<±0.66		

LTE. BAND IV.

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)	
1.4	Low 19957	1710.7	QPSK	1	0	24.17	5.24	
				1	2	24.00		
				1	5	24.12		
				3	0	24.01		
				3	1	24.01		
				3	2	24.02		
			6	0	23.00			
			16-QAM	1	0	23.08		5.29
				1	2	23.27		
				1	5	22.93		
				3	0	22.89		
				3	1	23.03		
	3	2		22.98				
	Middle 20175	1732.5	QPSK	1	0	23.04	4.71	
				1	2	22.99		
				1	5	23.15		
				3	0	23.00		
				3	1	22.99		
				3	2	22.96		
			6	0	23.03			
			16-QAM	1	0	23.49		4.86
				1	2	23.35		
				1	5	23.11		
				3	0	23.05		
3				1	22.93			
3	2	23.08						
High 20393	1754.3	QPSK	1	0	24.14	5.34		
			1	2	24.14			
			1	5	24.01			
			3	0	24.08			
			3	1	23.99			
			3	2	23.94			
		6	0	22.97				
		16-QAM	1	0	23.00		6.12	
			1	2	23.08			
			1	5	22.75			
			3	0	23.01			
			3	1	22.86			
3	2		22.96					
6	0	22.08						

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)	
3	Low 19965	1711.5	QPSK	1	0	24.14	5.18	
				1	7	24.01		
				1	14	24.08		
				8	0	23.04		
				8	4	23.00		
				8	7	22.96		
			15	0	23.07			
			16-QAM	1	0	23.09		5.34
				1	7	23.24		
				1	14	22.97		
				8	0	22.02		
				8	4	22.03		
	8	7		21.99				
	Middle 20175	1732.5	QPSK	1	0	23.08	5.00	
				1	7	23.09		
				1	14	23.16		
				8	0	23.05		
				8	4	22.98		
				8	7	23.06		
			15	0	23.00			
			16-QAM	1	0	22.87		5.05
				1	7	23.03		
				1	14	23.03		
				8	0	22.16		
8				4	22.09			
8	7	22.12						
High 20385	1753.5	QPSK	1	0	23.04	5.29		
			1	7	23.03			
			1	14	23.11			
			8	0	22.92			
			8	4	22.93			
			8	7	22.97			
		15	0	22.96				
		16-QAM	1	0	22.98		5.34	
			1	7	22.95			
			1	14	22.94			
			8	0	21.99			
			8	4	21.97			
8	7		22.00					
15	0	22.03						

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
5	Low 19975	1712.5	QPSK	1	0	24.11	5.10
				1	12	24.09	
				1	24	24.13	
				12	0	23.00	
				12	6	23.00	
				12	11	23.01	
				25	0	23.01	
				16-QAM	1	0	
	1	12	23.03				
	1	24	23.06				
	12	0	21.99				
	12	6	21.98				
	12	11	21.99				
	25	0	22.04				
	Middle 20175	1732.5	QPSK		1	0	23.00
				1	12	23.01	
				1	24	23.10	
				12	0	23.01	
				12	6	23.03	
				12	11	23.01	
				25	0	23.08	
				16-QAM	1	0	22.85
	1	12	22.87				
	1	24	22.94				
12	0	21.99					
12	6	22.00					
12	11	22.07					
25	0	22.13					
High 20375	1752.5	QPSK	1		0	23.11	5.18
			1	12	23.07		
			1	24	23.13		
			12	0	22.93		
			12	6	22.95		
			12	11	22.97		
			25	0	22.99		
			16-QAM	1	0	22.96	
1	12	22.99					
1	24	23.04					
12	0	21.99					
12	6	21.99					
12	11	21.97					
25	0	22.04					

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)	
10	Low 20000	1715	QPSK	1	0	24.05	5.05	
				1	24	24.08		
				1	49	24.15		
				25	0	22.97		
				25	12	23.06		
				25	24	23.05		
			16-QAM	50	0	23.07		5.95
				1	0	23.01		
				1	24	22.99		
				1	49	23.08		
				25	0	22.05		
				25	12	22.08		
	Middle 20175	1732.5	QPSK	1	0	23.00	4.87	
				1	24	23.07		
				1	49	22.96		
				25	0	23.01		
				25	12	23.06		
				25	24	23.11		
			16-QAM	50	0	23.06		5.8
				1	0	23.13		
				1	24	23.18		
				1	49	23.06		
				25	0	22.05		
				25	12	22.03		
High 20350	1750	QPSK	1	0	22.99	5.26		
			1	24	22.99			
			1	49	23.07			
			25	0	22.96			
			25	12	22.94			
			25	24	22.97			
		16-QAM	50	0	22.99		6.06	
			1	0	22.91			
			1	24	22.97			
			1	49	23.01			
			25	0	21.98			
			25	12	22.00			
			25	24	22.02			
			50	0	21.99			

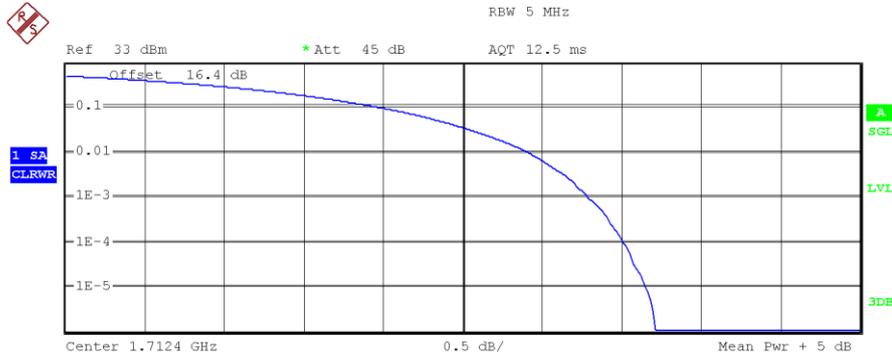
BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)	
15	Low 20025	1717.5	QPSK	1	0	24.05	4.82	
				1	37	24.06		
				1	74	24.07		
				36	0	23.04		
				36	18	23.12		
				36	37	23.16		
				75	0	23.19		
			16-QAM	1	0	22.99		5.87
				1	37	23.01		
				1	74	23.05		
				36	0	22.08		
				36	18	22.09		
	36	37		22.13				
	75	0		22.17				
	Middle 20175	1732.5	QPSK	1	0	23.06	4.74	
				1	37	23.04		
				1	74	23.03		
				36	0	23.00		
				36	18	23.07		
				36	37	23.06		
				75	0	23.18		
			16-QAM	1	0	23.19		5.66
				1	37	23.18		
				1	74	23.24		
36				0	22.05			
36				18	22.10			
36	37	22.02						
75	0	22.20						
High 20325	1747.5	QPSK	1	0	23.1	5.24		
			1	37	22.95			
			1	74	23.06			
			36	0	23.00			
			36	18	22.96			
			36	37	23.00			
			75	0	23.04			
		16-QAM	1	0	23.23		6.12	
			1	37	23.11			
			1	74	23.18			
			36	0	22.03			
			36	18	22.01			
36	37		22.00					
75	0		22.07					

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
20	Low 20050	1720	QPSK	1	0	23.99	4.73
				1	49	24.02	
				1	99	24.06	
				50	0	23.06	
				50	24	23.06	
				50	49	23.09	
				100	0	23.08	
				16-QAM	1	0	
	1	49	23.00				
	1	99	22.97				
	50	0	22.1				
	50	24	22.11				
	50	49	22.10				
	100	0	22.13				
	Middle 20175	1732.5	QPSK		1	0	23.04
				1	49	23.01	
				1	99	23.09	
				50	0	22.96	
				50	24	23.06	
				50	49	23.03	
				100	0	23.04	
				16-QAM	1	0	22.92
	1	49	22.88				
	1	99	23.00				
50	0	22.07					
50	24	22.09					
50	49	22.10					
100	0	22.13					
High 20300	1745	QPSK	1		0	23.02	4.94
			1	49	22.88		
			1	99	23.01		
			50	0	22.94		
			50	24	22.95		
			50	49	23.03		
			100	0	22.93		
			16-QAM	1	0	23.05	
1	49	22.92					
1	99	23.11					
50	0	22.05					
50	24	21.98					
50	49	22.10					
100	0	21.99					

PEAK-TO-AVERAGE POWER RATIO (PAPR).

WCDMA Band IV

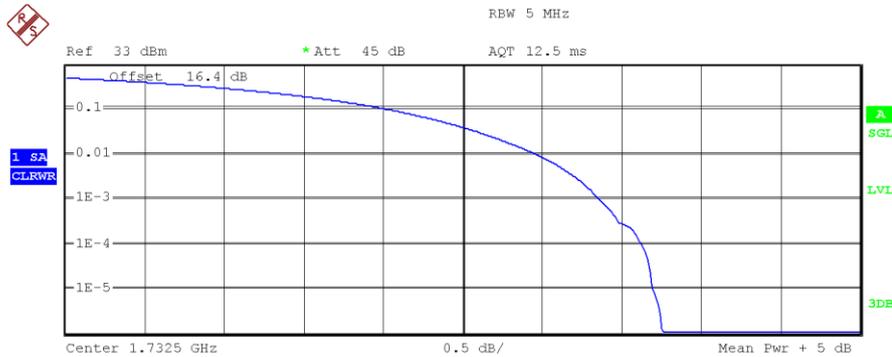
Channel Low:



Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 7.1MHz

Trace 1	
Mean	22.83 dBm
Peak	26.55 dBm
Crest	3.72 dB
10 %	1.98 dB
1 %	2.91 dB
.1 %	3.29 dB
.01 %	3.51 dB

Channel Middle:



Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 7.1MHz

Trace 1	
Mean	23.00 dBm
Peak	26.76 dBm
Crest	3.76 dB
10 %	2.04 dB
1 %	2.96 dB
.1 %	3.36 dB
.01 %	3.63 dB

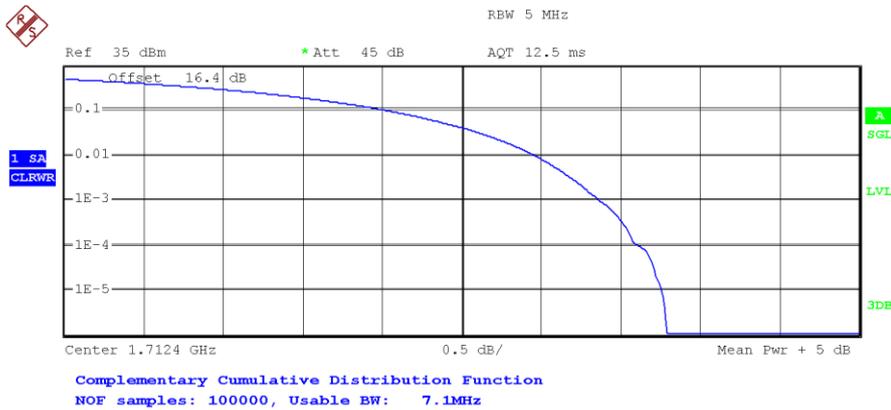
Channel High



Trace 1	
Mean	22.99 dBm
Peak	26.76 dBm
Crest	3.78 dB
10 %	2.01 dB
1 %	2.94 dB
.1 %	3.33 dB
.01 %	3.60 dB

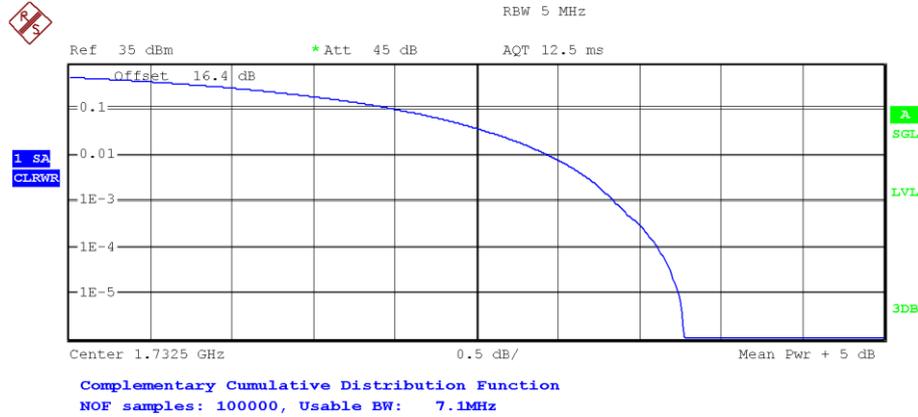
HSUPA Band IV

Channel Low:



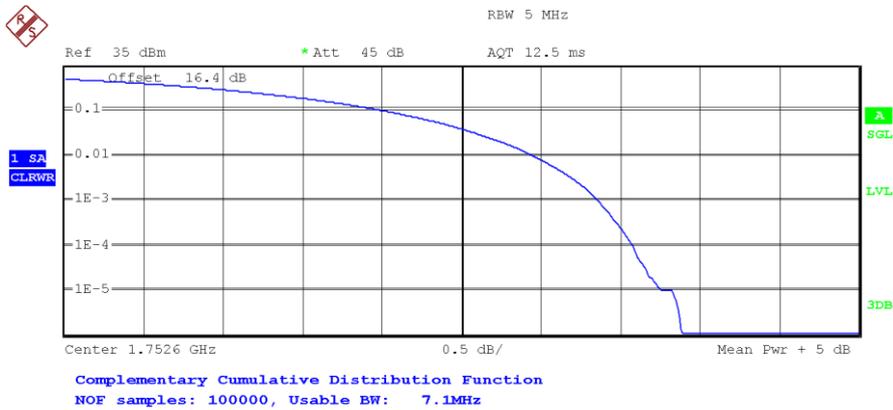
Trace 1	
Mean	22.44 dBm
Peak	26.24 dBm
Crest	3.79 dB
10 %	2.04 dB
1 %	2.96 dB
.1 %	3.37 dB
.01 %	3.61 dB

Channel Middle:



	Trace 1
Mean	22.39 dBm
Peak	26.16 dBm
Crest	3.77 dB
10 %	2.01 dB
1 %	2.94 dB
.1 %	3.35 dB
.01 %	3.61 dB

Channel High:

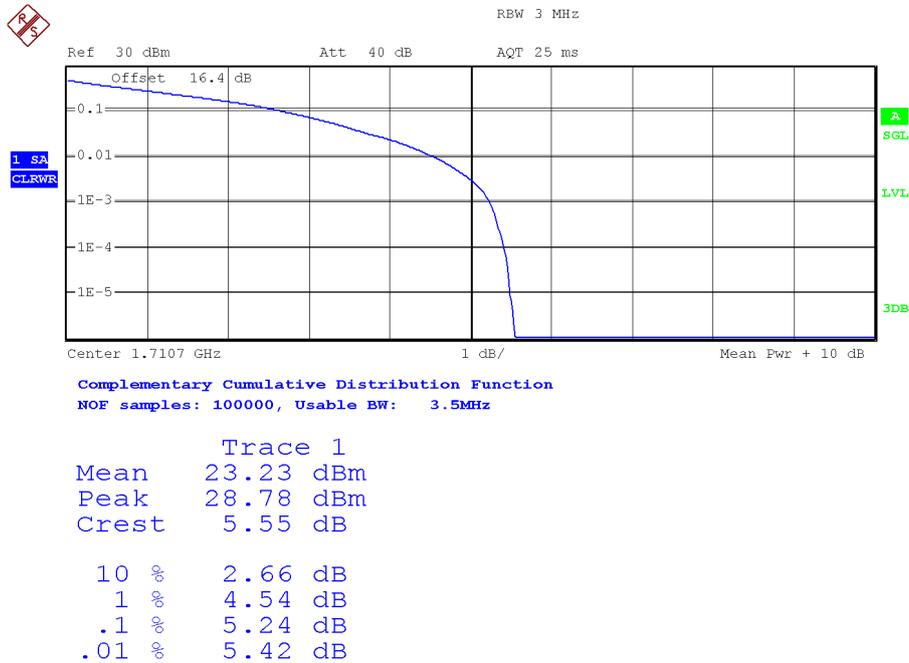


	Trace 1
Mean	22.56 dBm
Peak	26.45 dBm
Crest	3.89 dB
10 %	2.01 dB
1 %	2.95 dB
.1 %	3.36 dB
.01 %	3.57 dB

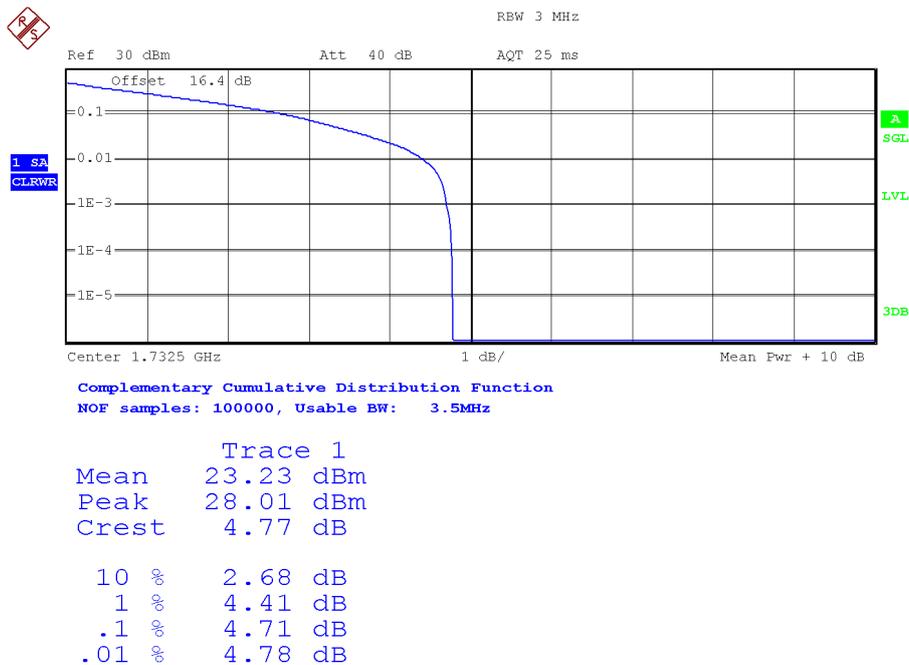
LTE. BAND IV.

Bandwidth = 1.4 MHz. Modulation QPSK. RB Size: 6. RB Offset: 0.

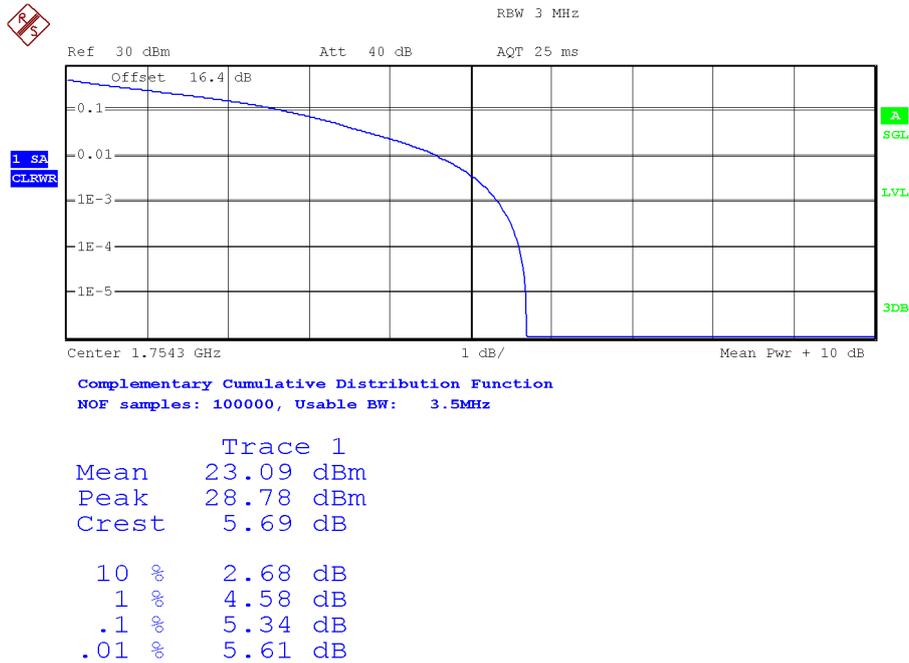
Channel Low:



Channel Middle:

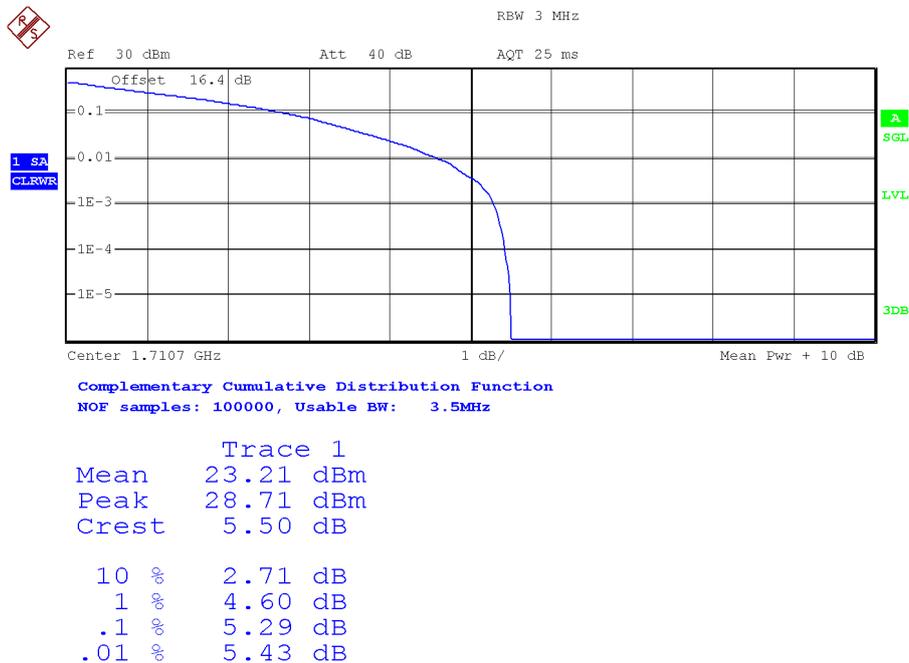


Channel High:

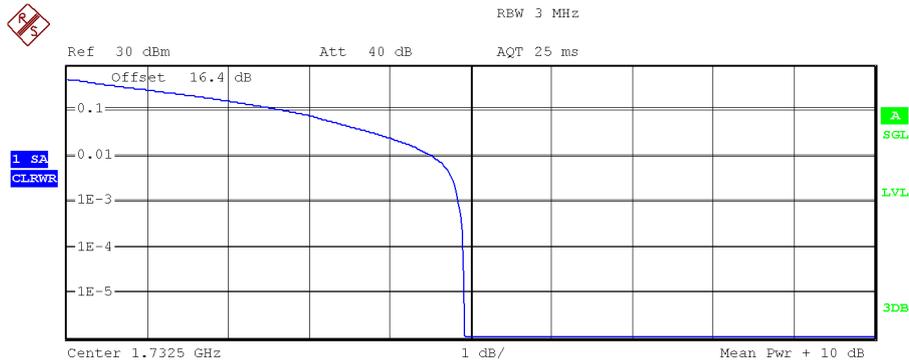


Bandwidth = 1.4 MHz. Modulation 16 QAM. RB Size: 6. RB Offset: 0.

Channel Low:



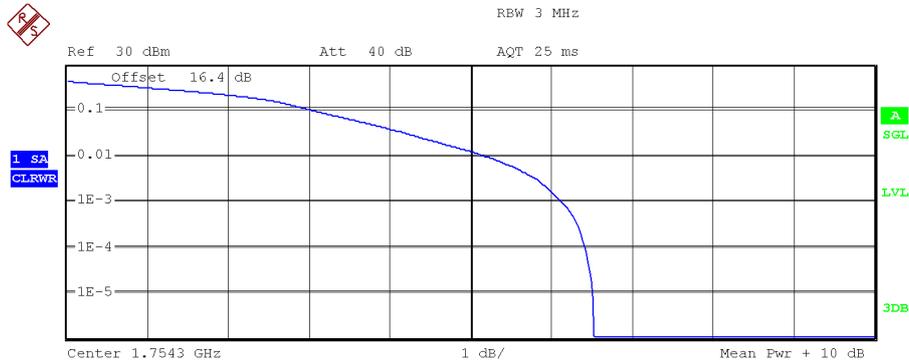
Channel Middle:



Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 3.5MHz

Trace 1	
Mean	23.09 dBm
Peak	28.01 dBm
Crest	4.91 dB
10 %	2.71 dB
1 %	4.52 dB
.1 %	4.86 dB
.01 %	4.92 dB

Channel High:

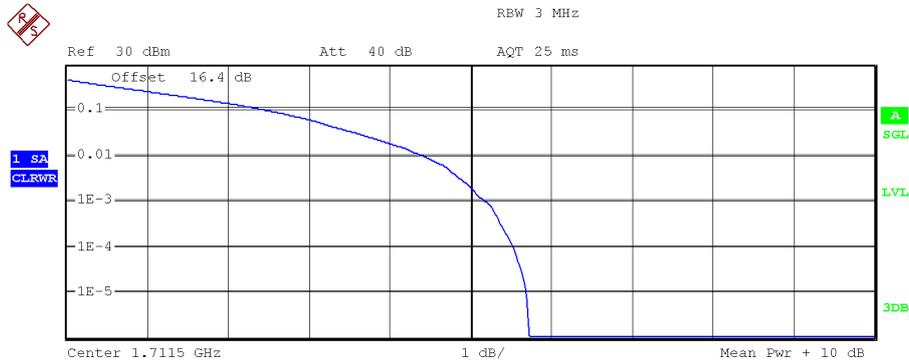


Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 3.5MHz

Trace 1	
Mean	22.19 dBm
Peak	28.71 dBm
Crest	6.53 dB
10 %	3.04 dB
1 %	5.18 dB
.1 %	6.12 dB
.01 %	6.43 dB

Bandwidth = 3 MHz. Modulation QPSK. RB Size: 15. RB Offset: 0.

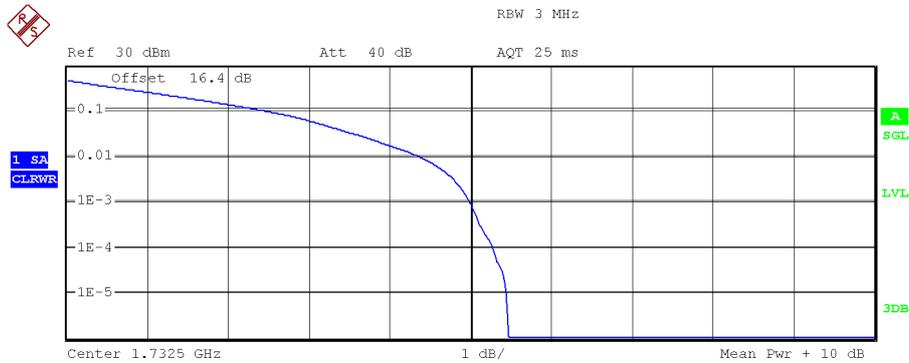
Channel Low:



Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 3.5MHz

Trace 1	
Mean	23.13 dBm
Peak	28.85 dBm
Crest	5.72 dB
10 %	2.50 dB
1 %	4.41 dB
.1 %	5.18 dB
.01 %	5.53 dB

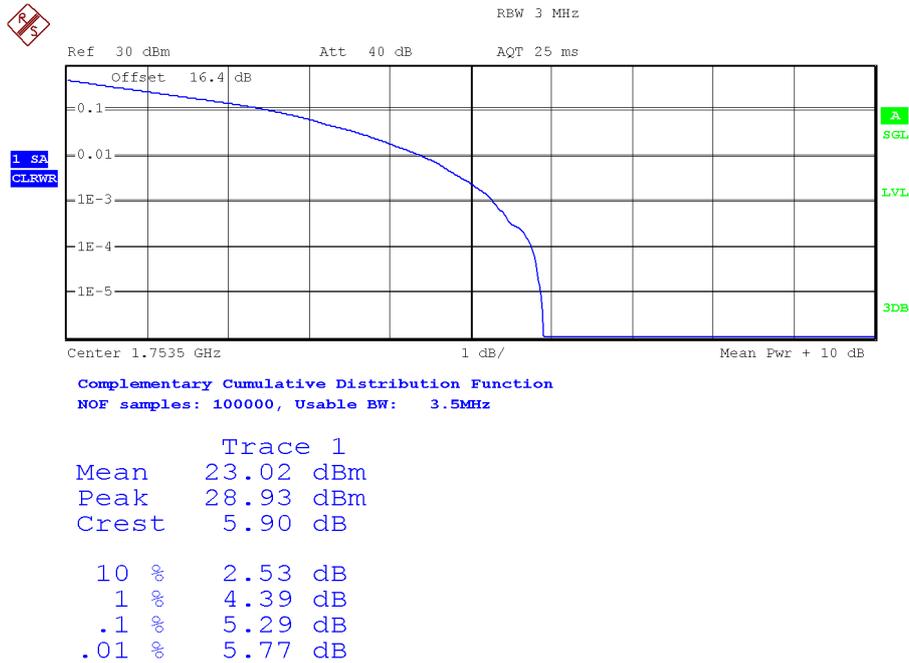
Channel Middle:



Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 3.5MHz

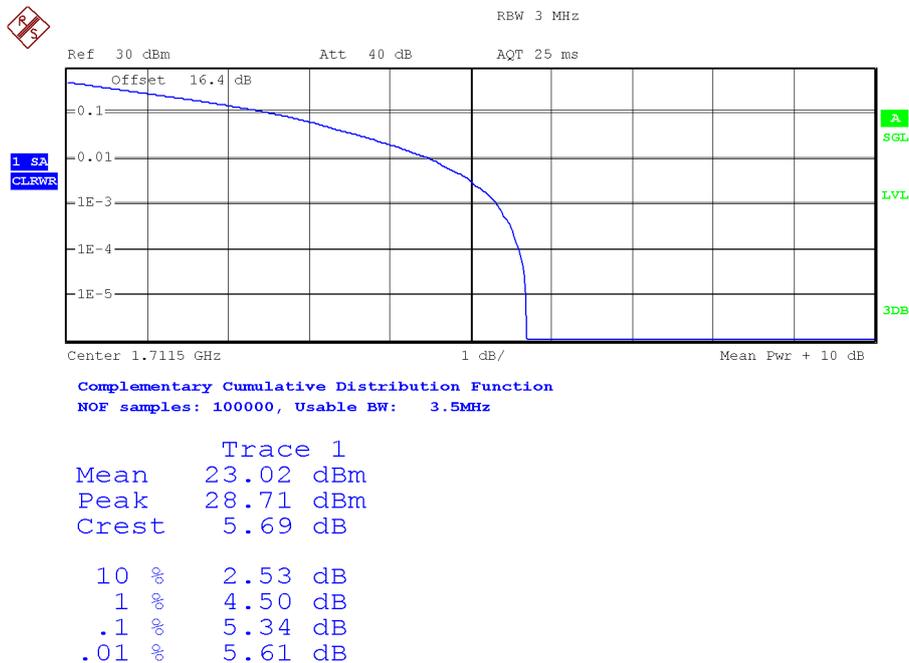
Trace 1	
Mean	23.11 dBm
Peak	28.57 dBm
Crest	5.46 dB
10 %	2.48 dB
1 %	4.36 dB
.1 %	5.00 dB
.01 %	5.29 dB

Channel High:

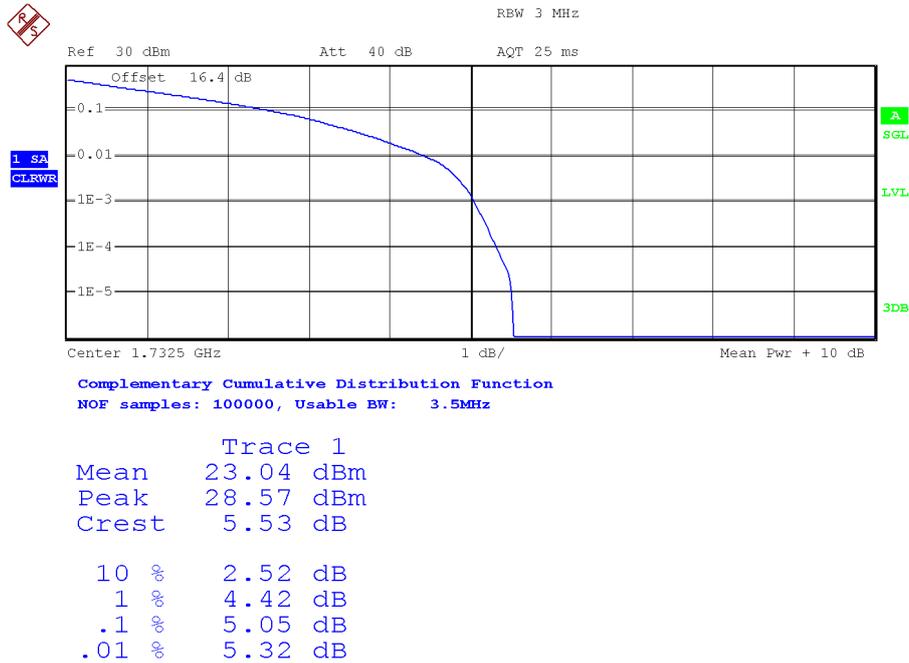


Bandwidth = 3 MHz. Modulation 16 QAM. RB Size: 15. RB Offset: 0.

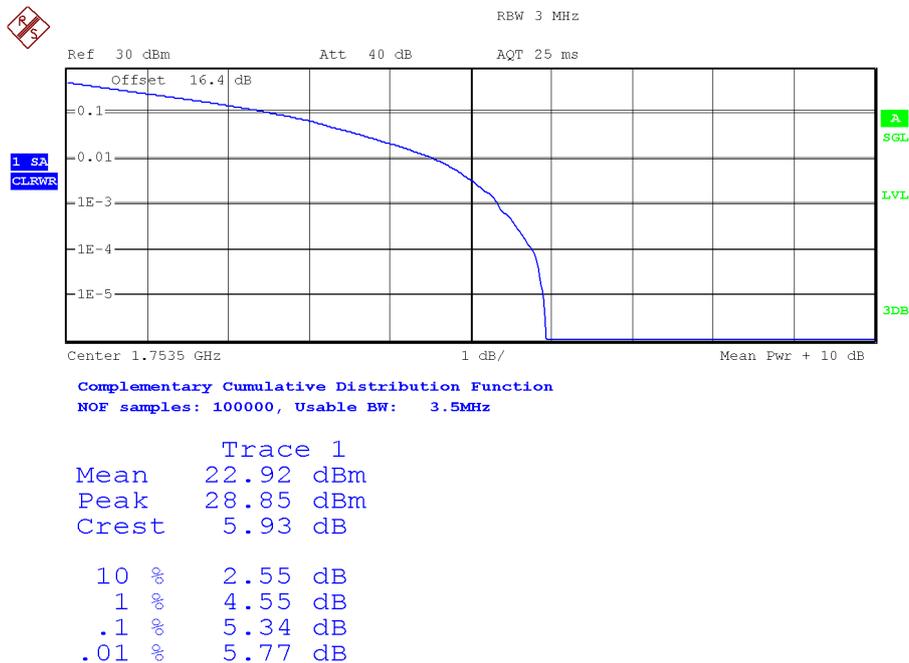
Channel Low:



Channel Middle:

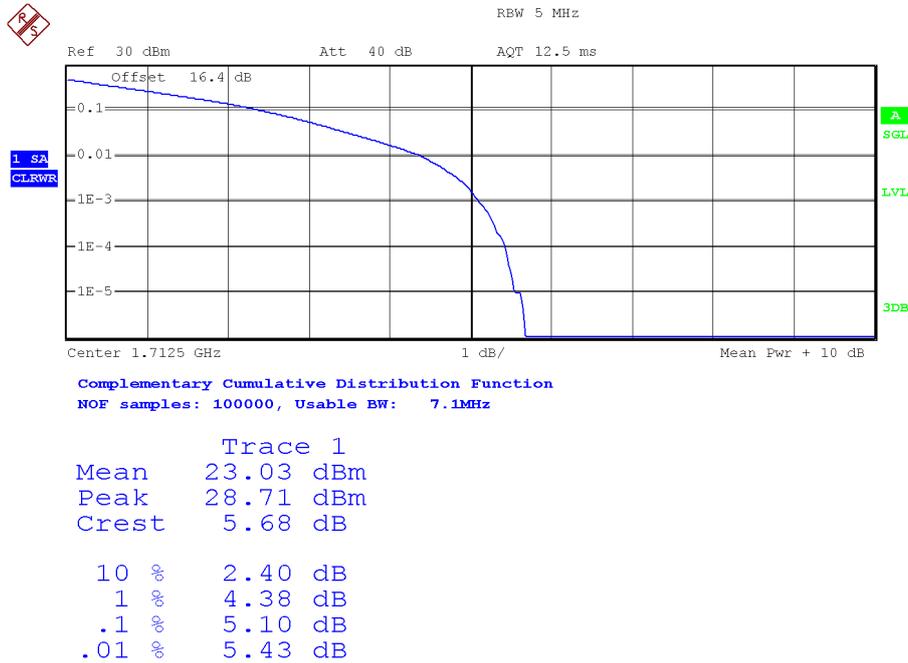


Channel High:

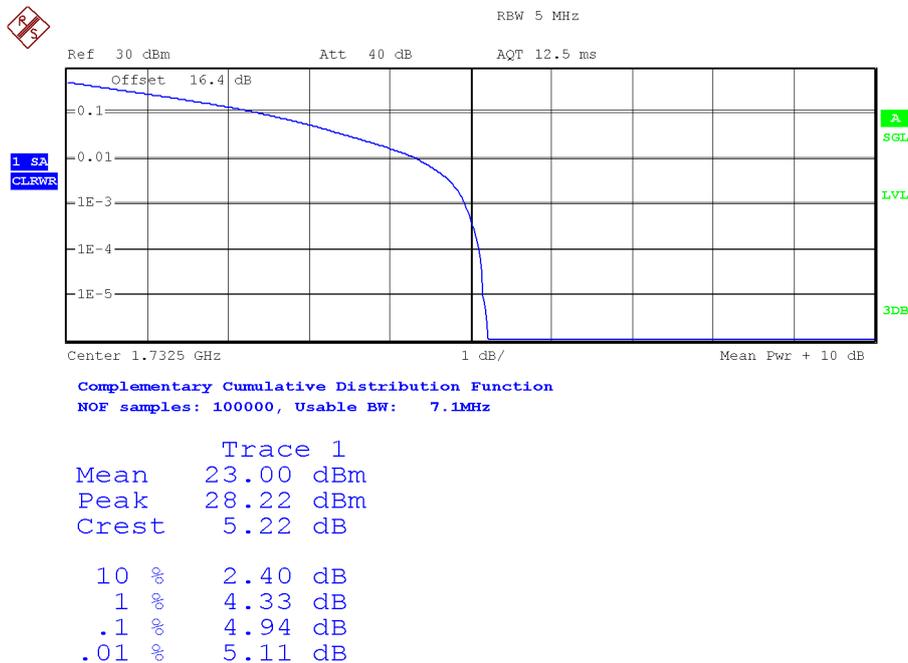


Bandwidth = 5 MHz. Modulation QPSK. RB Size: 25. RB Offset: 0.

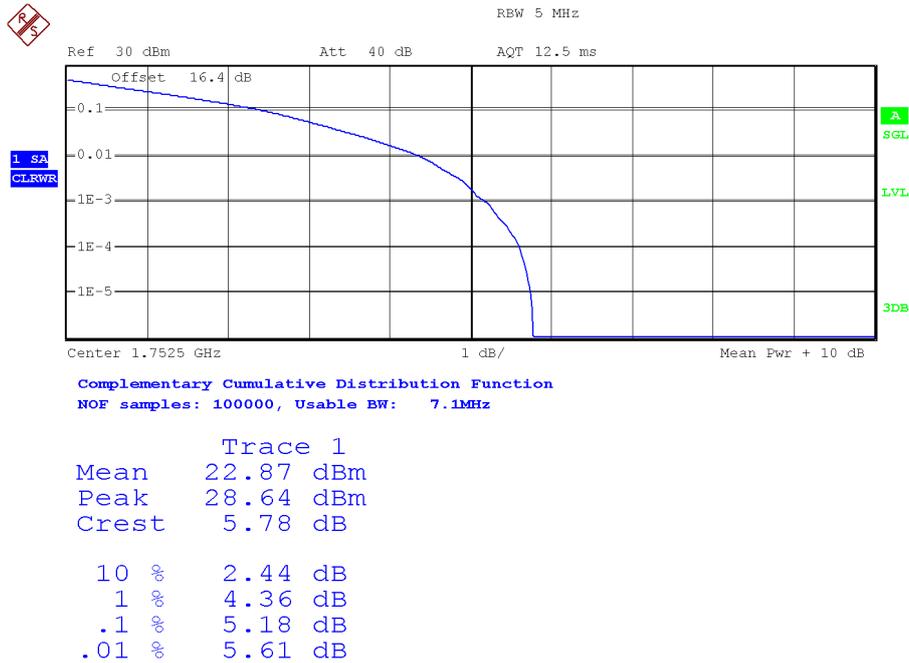
Channel Low:



Channel Middle:

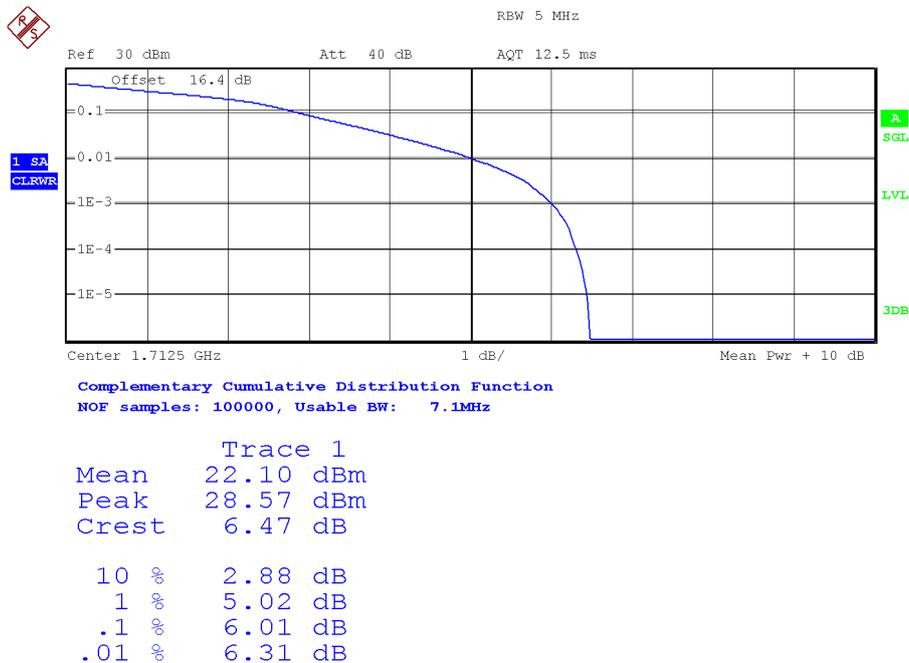


Channel High:

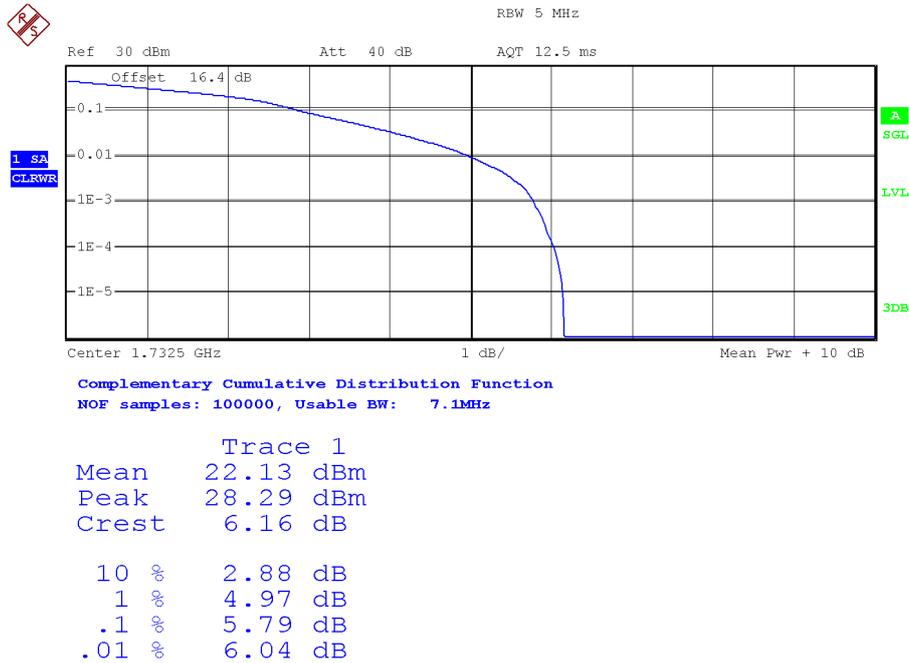


Bandwidth = 5 MHz. Modulation 16 QAM. RB Size: 25. RB Offset: 0.

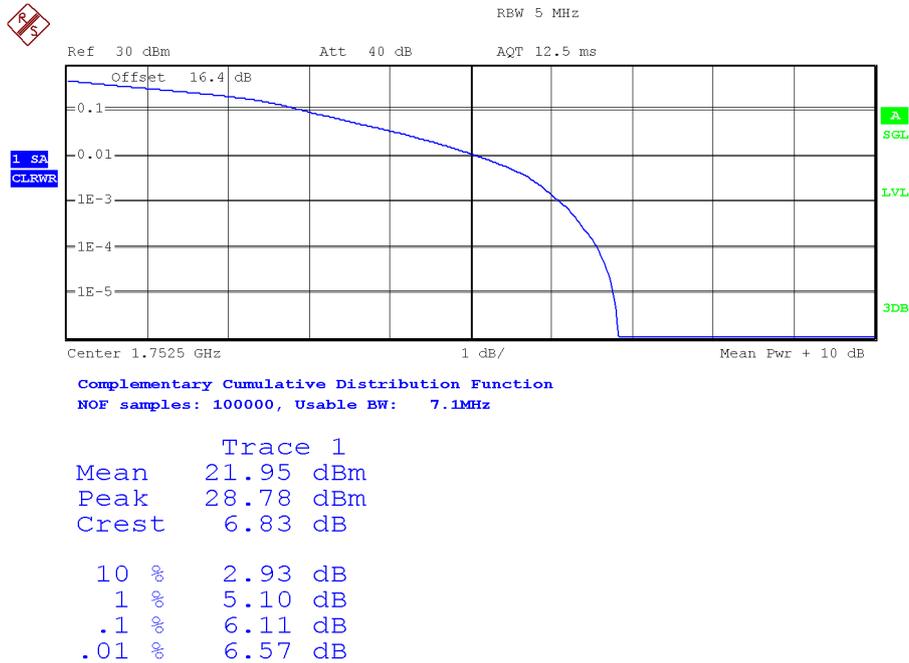
Channel Low:



Channel Middle:

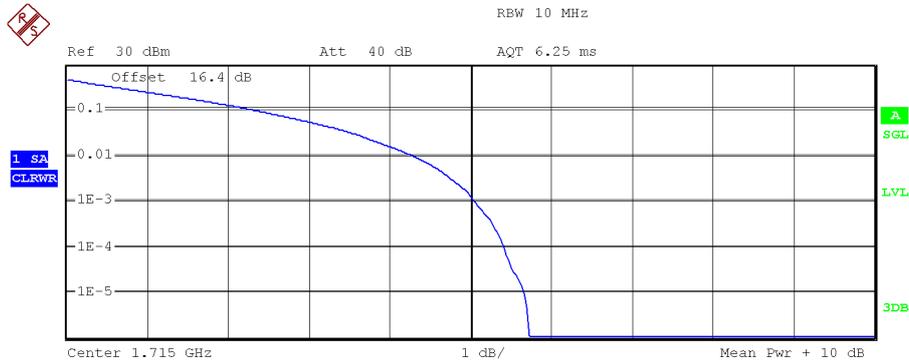


Channel High:



Bandwidth = 10 MHz. Modulation QPSK. RB Size: 50. RB Offset: 0.

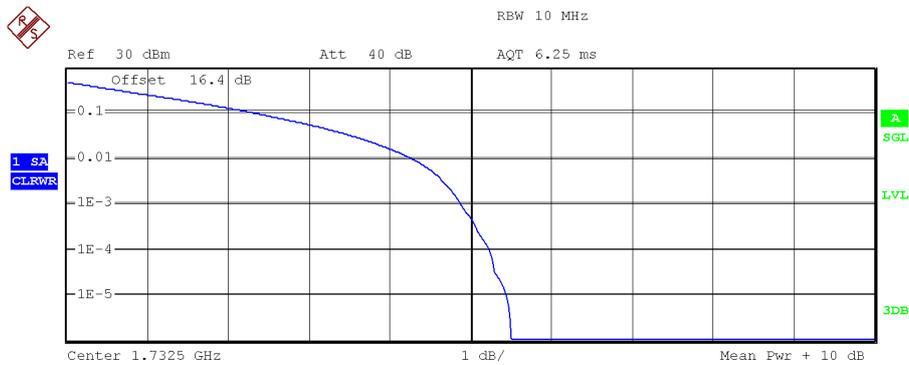
Channel Low:



Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 11.2MHz

Trace 1	
Mean	23.59 dBm
Peak	29.32 dBm
Crest	5.73 dB
10 %	2.34 dB
1 %	4.28 dB
.1 %	5.05 dB
.01 %	5.42 dB

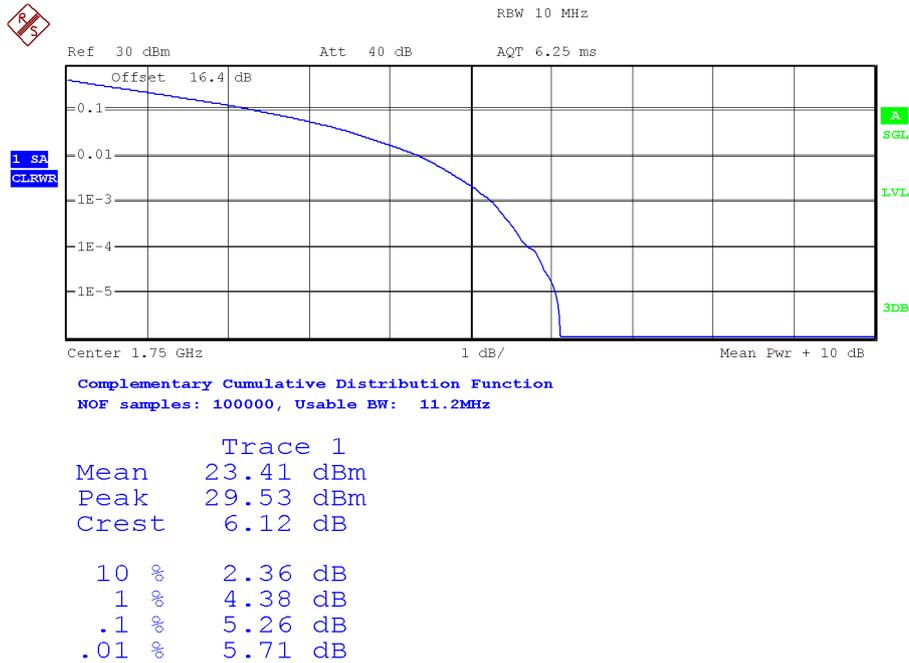
Channel Middle:



Complementary Cumulative Distribution Function
 NOF samples: 100000, Usable BW: 11.2MHz

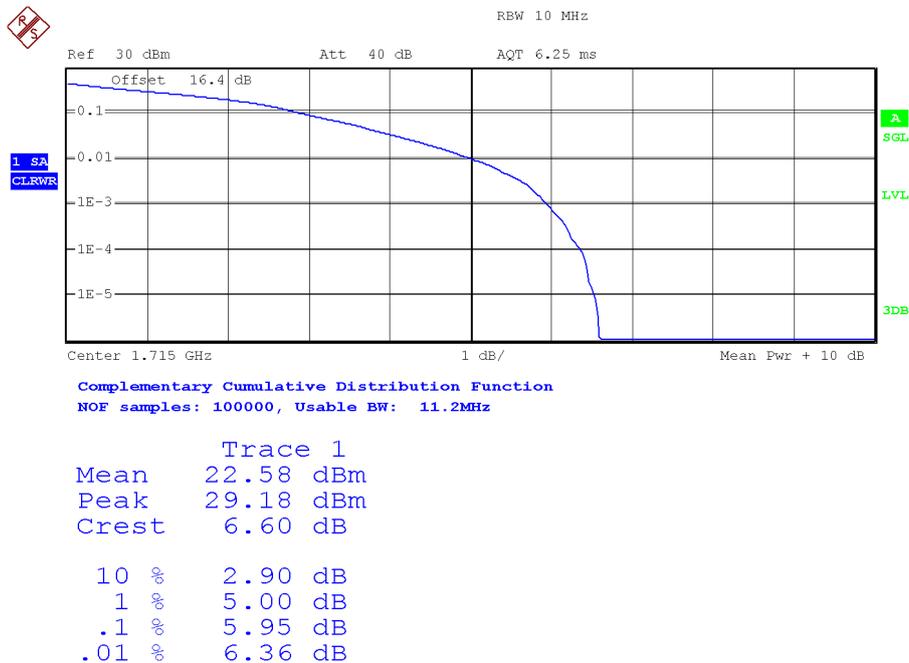
Trace 1	
Mean	23.57 dBm
Peak	29.08 dBm
Crest	5.51 dB
10 %	2.34 dB
1 %	4.28 dB
.1 %	4.87 dB
.01 %	5.24 dB

Channel High:

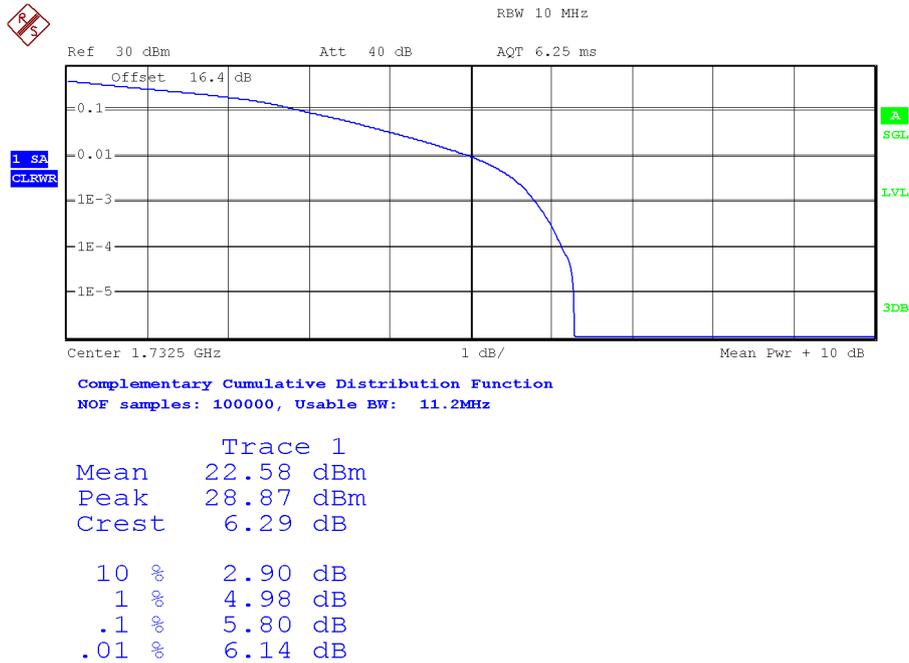


Bandwidth = 10 MHz. Modulation 16 QAM. RB Size: 50. RB Offset: 0.

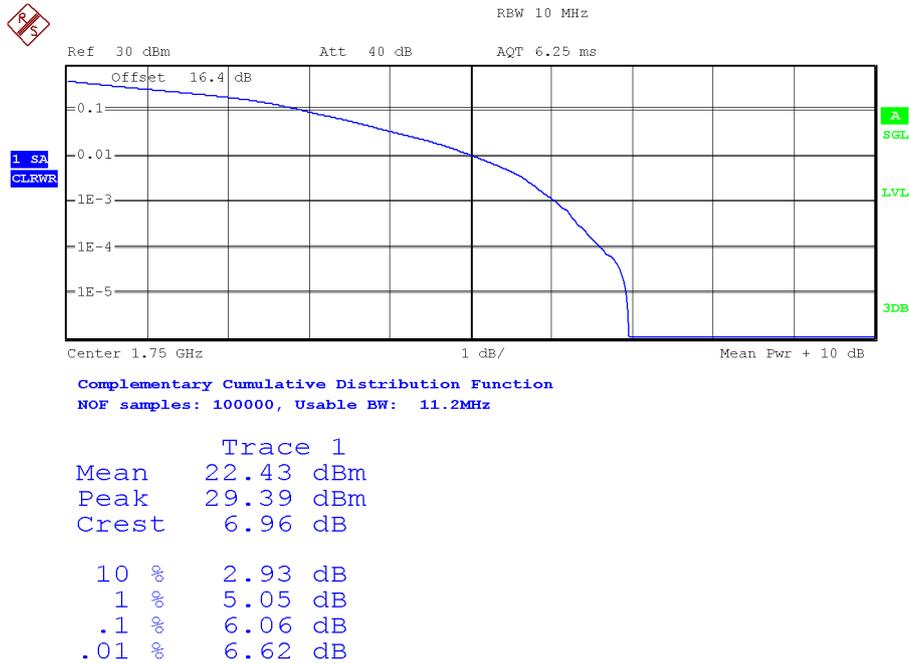
Channel Low:



Channel Middle:

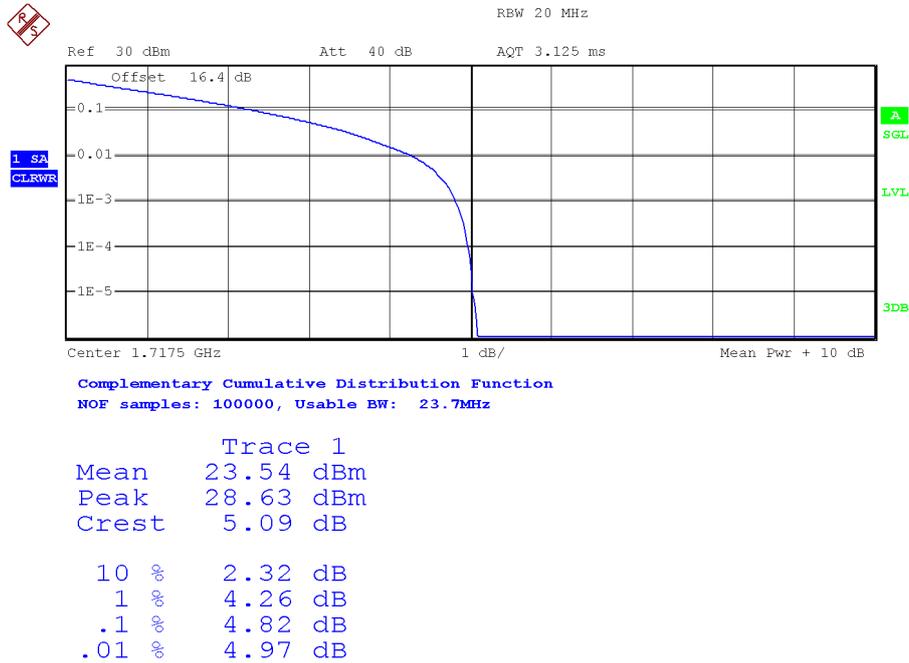


Channel High:

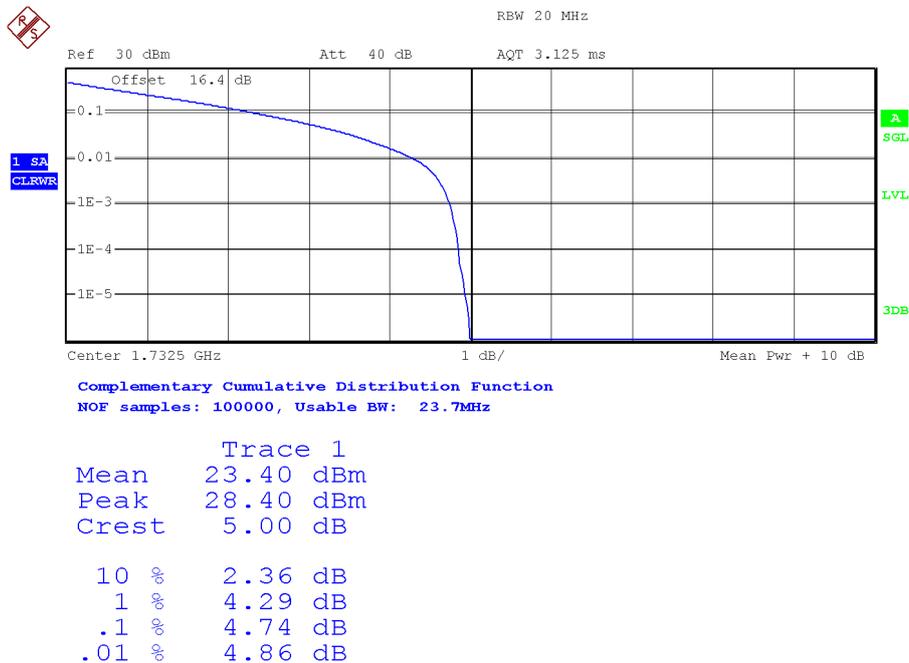


Bandwidth = 15 MHz. Modulation QPSK. RB Size: 75. RB Offset: 0.

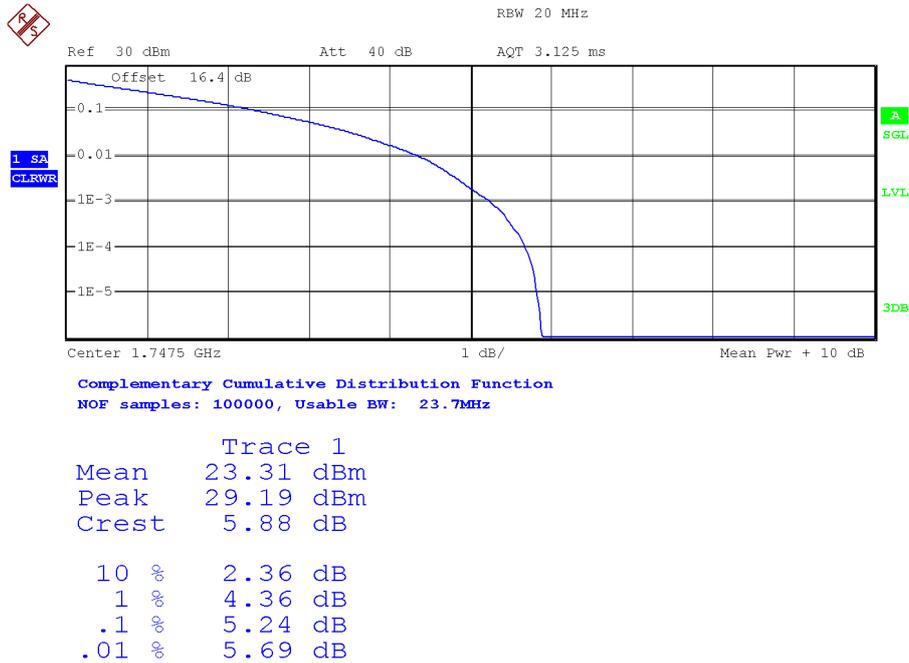
Channel Low:



Channel Middle:

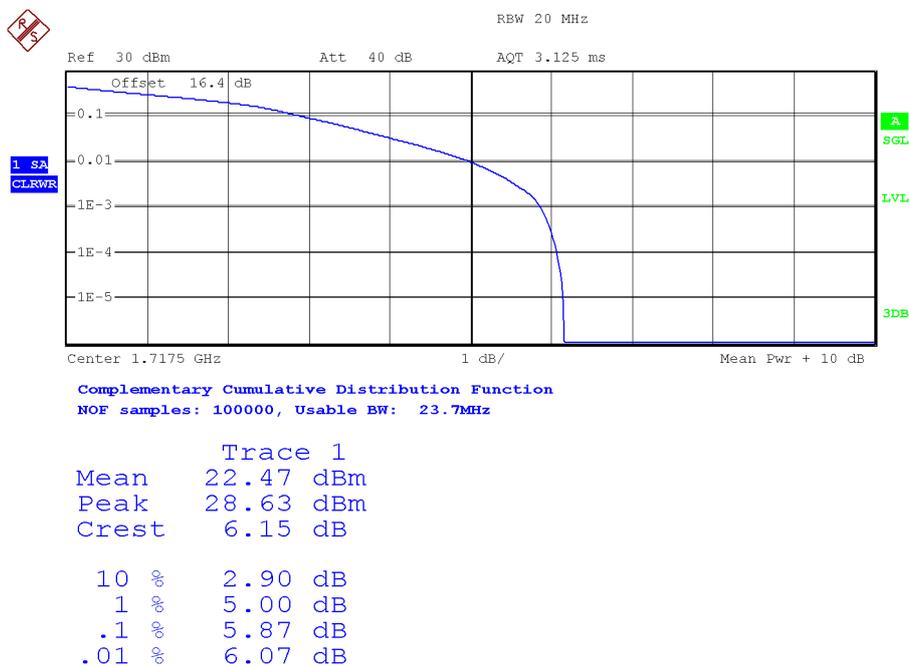


Channel High:

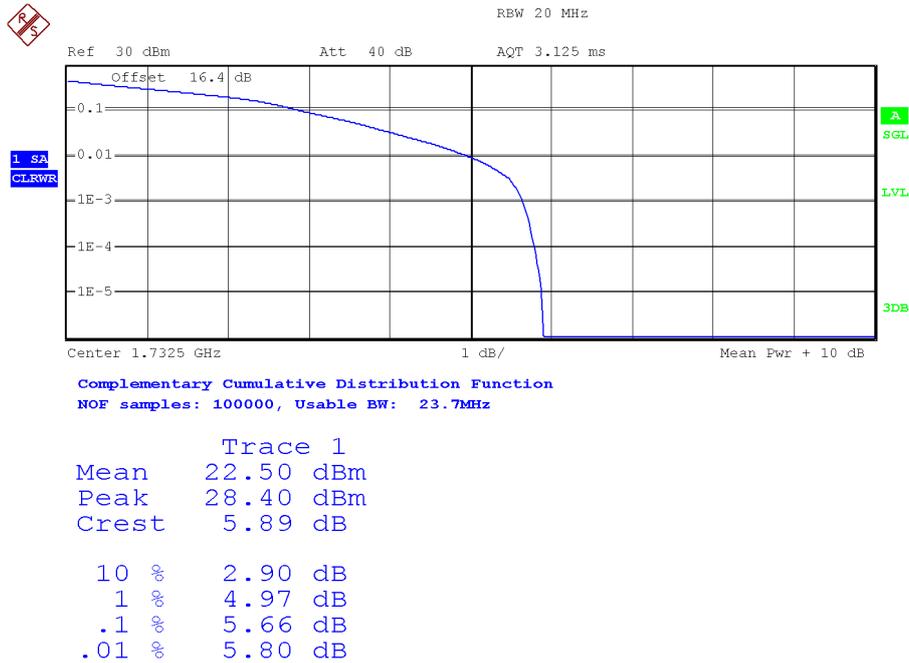


Bandwidth = 15 MHz. Modulation 16 QAM. RB Size: 75. RB Offset: 0.

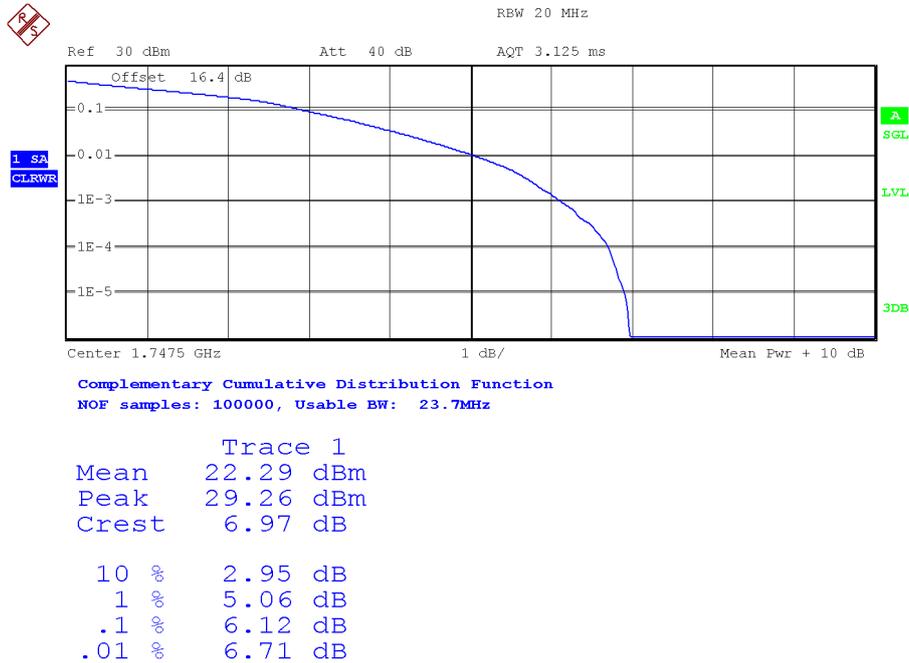
Channel Low:



Channel Middle:

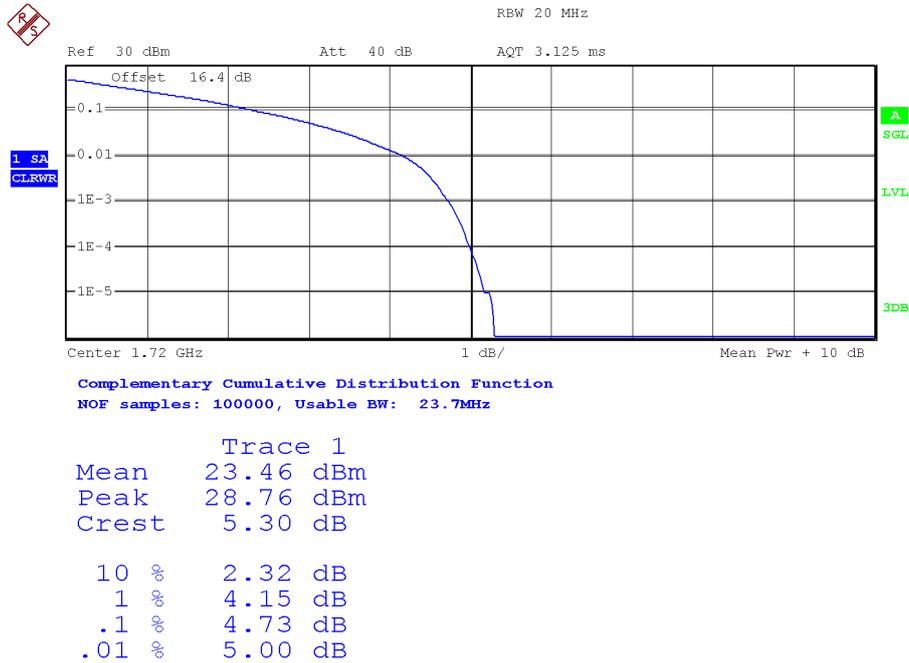


Channel High:

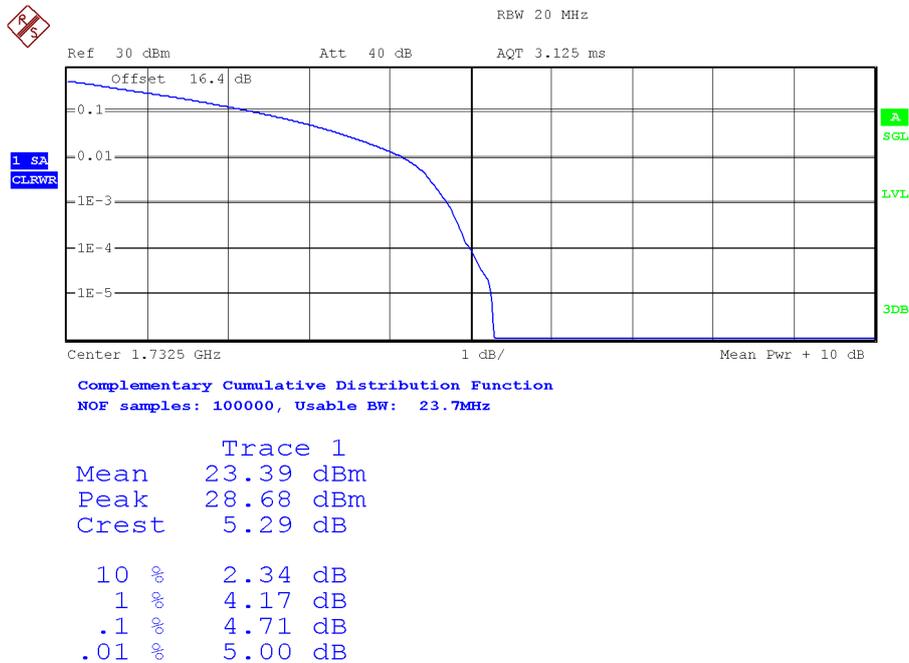


Bandwidth = 20 MHz. Modulation QPSK. RB Size: 100. RB Offset: 0.

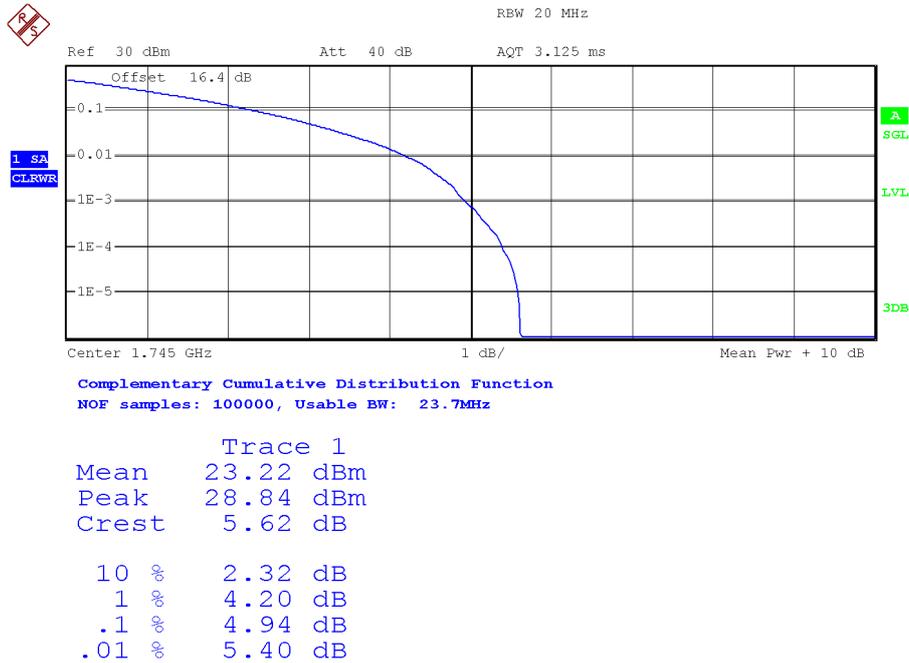
Channel Low:



Channel Middle:

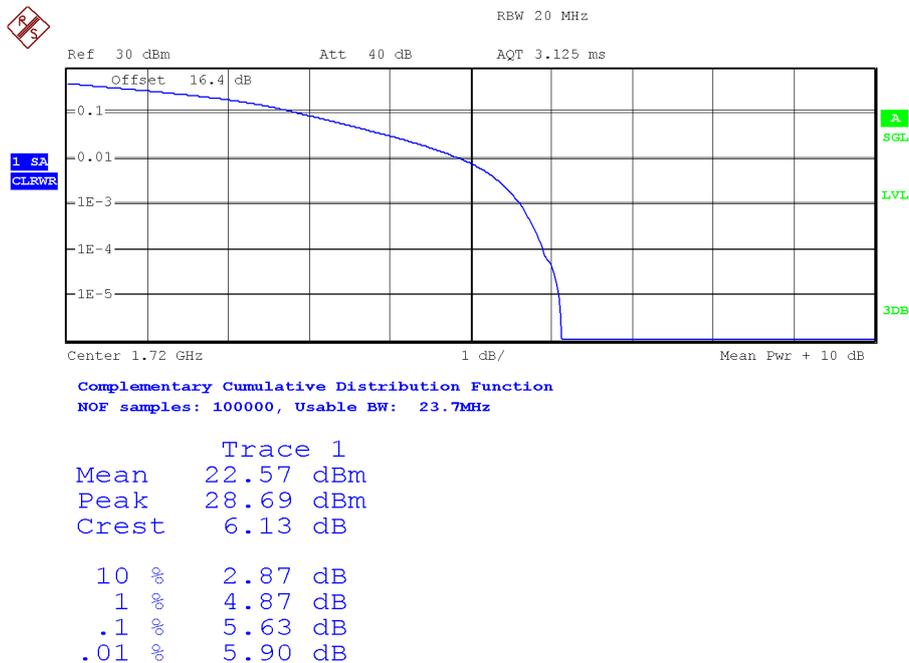


Channel High:

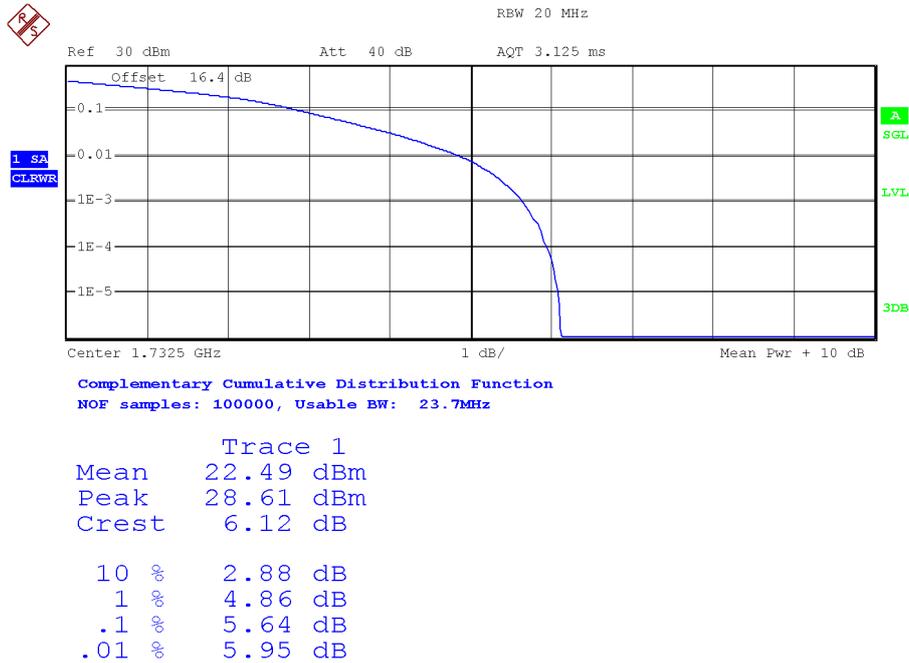


Bandwidth = 20 MHz. Modulation 16 QAM. RB Size: 100. RB Offset: 0.

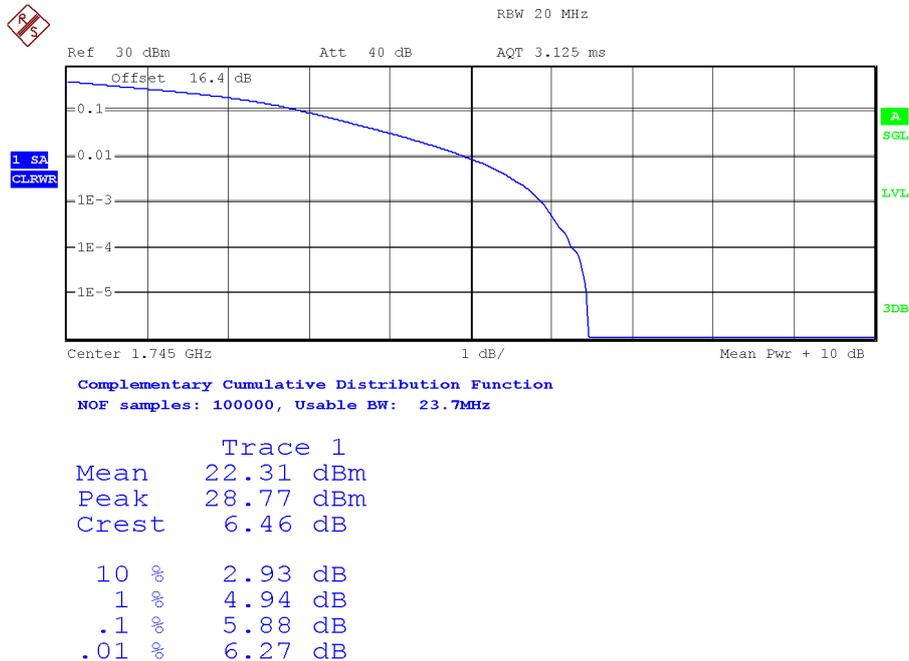
Channel Low:



Channel Middle:



Channel High:



LTE QPSK AND 16QAM MODULATION. BAND IV. Bandwidth = 1.4 MHz

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.00	2.00	2.00
Measured maximum average power (dBm) at antenna port	24.17	23.49	24.14
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.17	25.49	26.14
Peak-to-average ratio (PAR) (dB)	5.29	5.86	6.12
Measurement uncertainty (dB)	<±1.11		

LTE QPSK AND 16QAM MODULATION. BAND IV. Bandwidth = 3 MHz

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.00	2.00	2.00
Measured maximum average power (dBm) at antenna port	24.14	23.16	23.11
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.14	25.16	25.11
Peak-to-average ratio (PAR) (dB)	5.34	5.05	5.34
Measurement uncertainty (dB)	<±1.11		

LTE QPSK AND 16QAM MODULATION. BAND IV. Bandwidth = 5 MHz

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.00	2.00	2.00
Measured maximum average power (dBm) at antenna port	24.13	23.10	23.13
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.13	25.10	25.13
Peak-to-average ratio (PAR) (dB)	6.01	5.79	6.11
Measurement uncertainty (dB)	<±1.11		

LTE QPSK AND 16QAM MODULATION. BAND IV. Bandwidth = 10 MHz

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.00	2.00	2.00
Measured maximum average power (dBm) at antenna port	24.15	23.18	23.07
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.15	25.18	25.07
Peak-to-average ratio (PAR) (dB)	5.95	5.80	6.06
Measurement uncertainty (dB)	<±1.11		

LTE QPSK AND 16QAM MODULATION. BAND IV. Bandwidth = 15 MHz

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.00	2.00	2.00
Measured maximum average power (dBm) at antenna port	24.07	23.24	23.23
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.07	25.24	25.23
Peak-to-average ratio (PAR) (dB)	5.87	5.66	6.12
Measurement uncertainty (dB)	<±1.11		

LTE QPSK AND 16QAM MODULATION. BAND IV. Bandwidth = 20 MHz

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.00	2.00	2.00
Measured maximum average power (dBm) at antenna port	24.06	23.09	23.11
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.06	25.09	25.11
Peak-to-average ratio (PAR) (dB)	5.63	5.64	5.88
Measurement uncertainty (dB)	<±1.11		

Verdict: PASS

Modulation Characteristics

SPECIFICATION

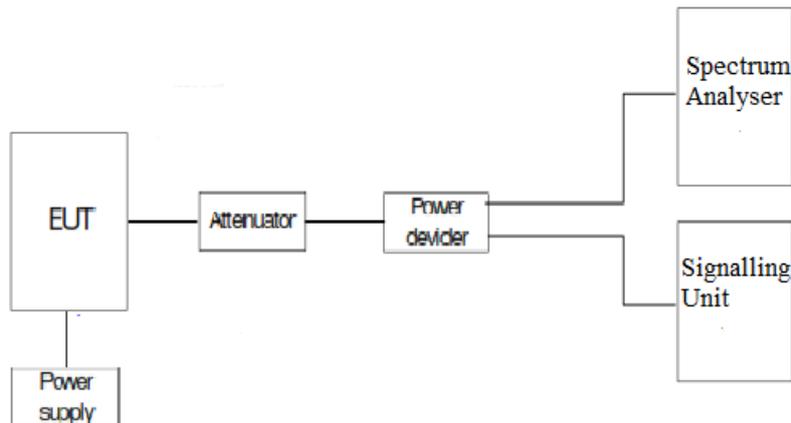
FCC §2.1047.

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).

For 3G, the EUT operates with WCDMA (QPSK) and HSUPA (QPSK) modes, in which the information is digitized and coded into a bit stream.

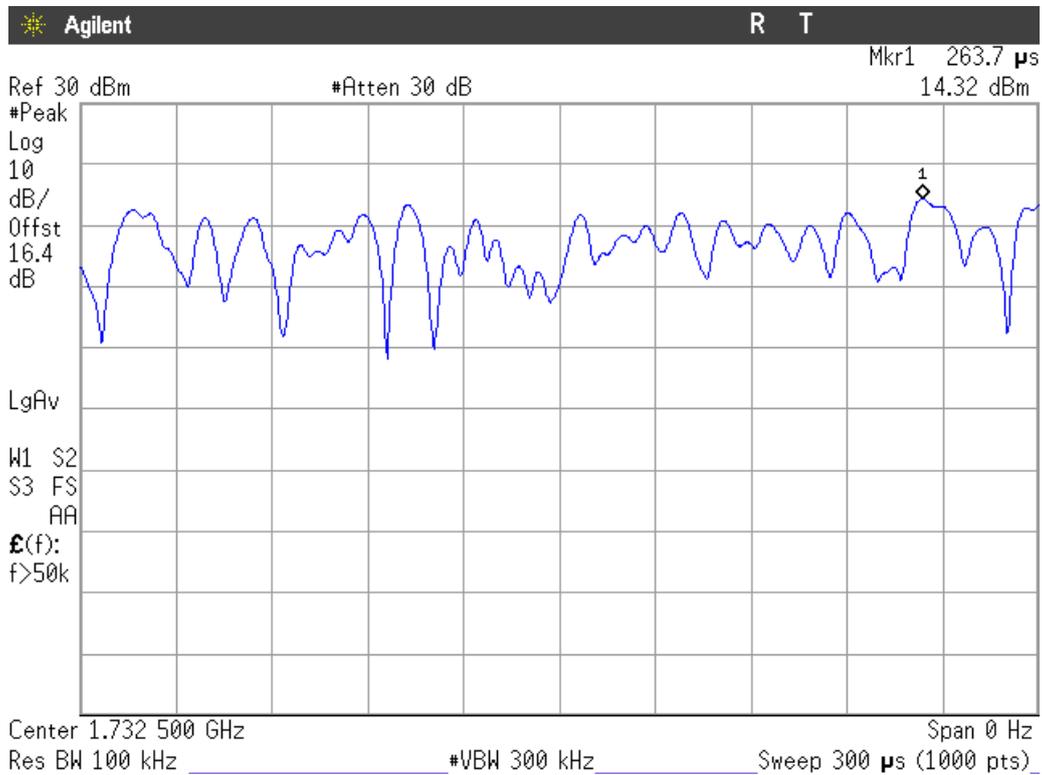
TEST SETUP



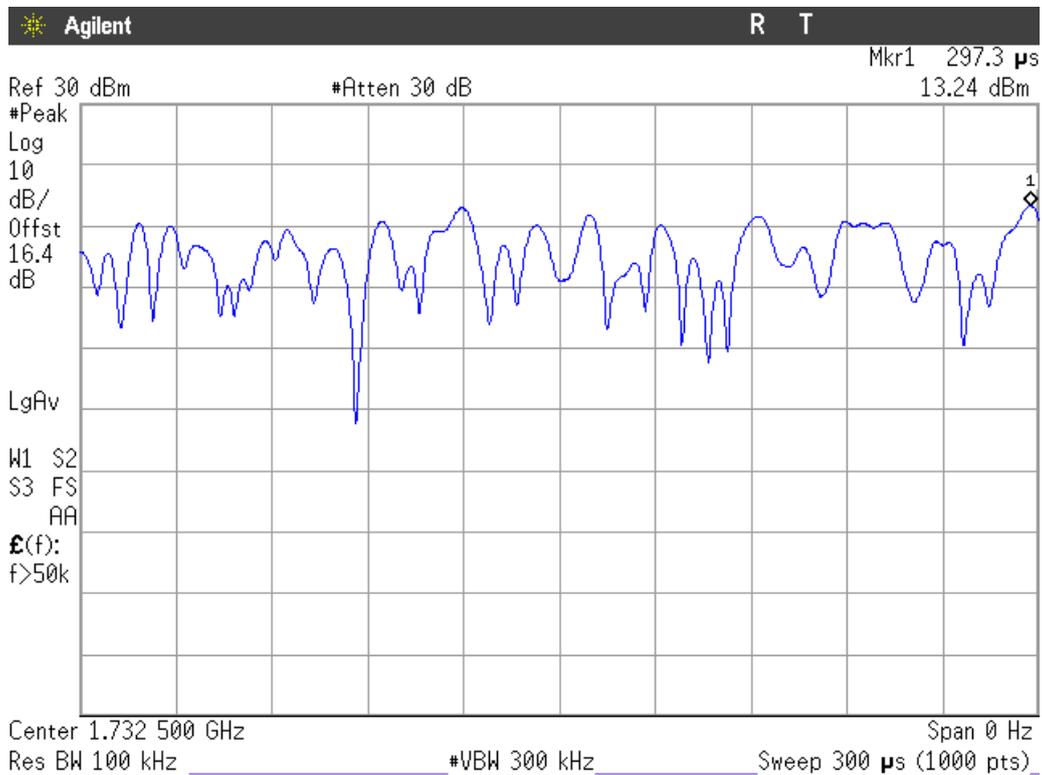
RESULTS

The following plots show the modulation schemes in the EUT.

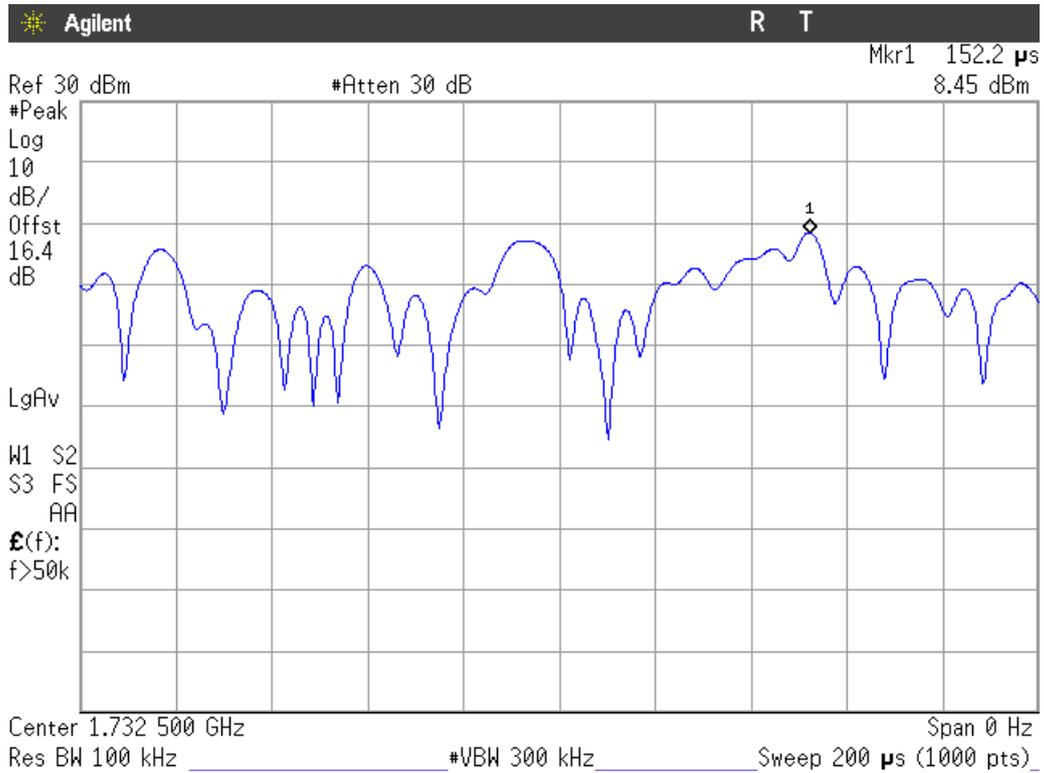
WCDMA MODULATION



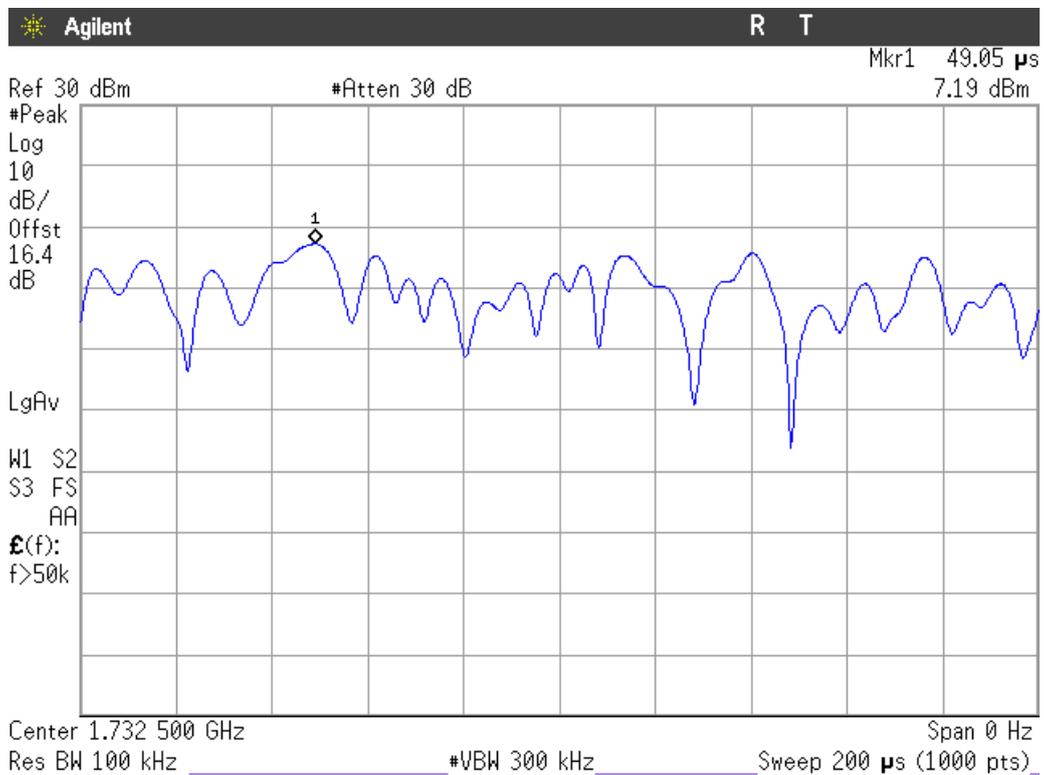
HSUPA MODULATION



LTE MODULATION. QPSK. Band IV



LTE MODULATION. 16QAM. Band IV



Frequency Stability

SPECIFICATION

FCC §2.1055 and §27.54.

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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 the values declared by the manufacturer.

The EUT was set in “call 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.

For LTE mode the QPSK modulation was used for the test as it is the worst case for conducted power.

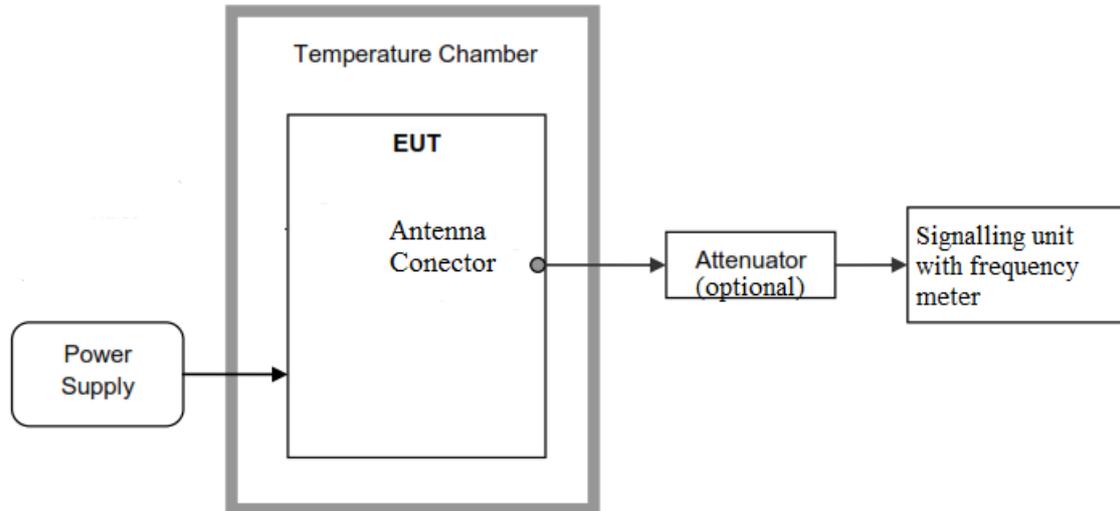
For 3G mode the WCDMA modulation was used for the test as it is the worst case for conducted power.

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 highest channel of operation are identified as f_L and f_H respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of f_L and f_H to check that the resulting frequencies remain within the band.

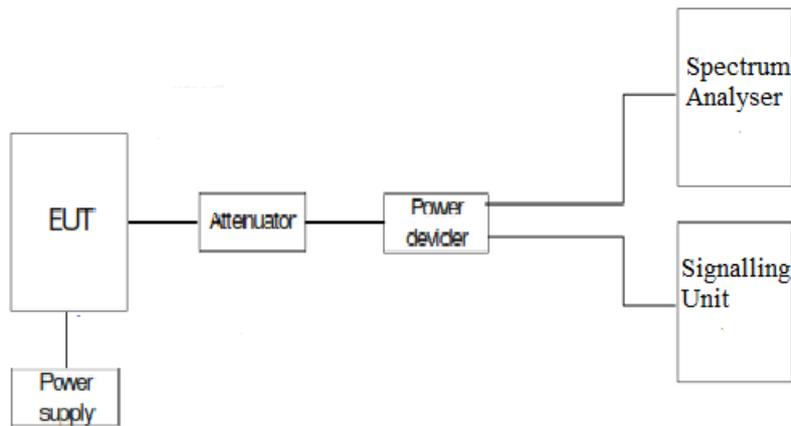
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP

Frequency tolerance.



Reference points f_L and f_H .



RESULTS

Frequency stability over temperature variations.

WCDMA AND HSUPA MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	0.62	0.000357864	0.000000035
+40	0.08	0.000046176	0.000000004
+30	-0.18	-0.000103896	-0.000000010
+20	0.27	0.000155844	0.000000015
+10	1.22	0.000704185	0.000000070
0	1.04	0.000600289	0.000000060
-10	1.44	0.000831169	0.000000083
-20	0.94	0.000542569	0.000000054
-30	-0.36	-0.000207792	-0.000000020

Frequency stability over voltage variations.

WCDMA AND HSUPA MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	0.27	0.000155844	0.000000015
Vmin	3.60	0.72	0.000415584	0.000000041

Reference points established at the applicable unwanted emissions limit:

	WCDMA MODULATION	HSUPA MODULATION
f_L (MHz)	1710.1131	1710.1251
f_H (MHz)	1754.4880	1754.8729

Reference points f_L and f_H with the worst-case frequency offsets added or subtracted:

	WCDMA MODULATION	HSUPA MODULATION
f_L (MHz)	1710.1131	1710.1251
f_H (MHz)	1754.4880	1754.8729

The reference frequency points stay within the authorized blocks.

LTE QPSK MODULATION. BW = 1.4 MHz. (Band IV)

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	8.78	0.005067821	0.00000051
+40	8.45	0.004877345	0.00000049
+30	8.96	0.005171717	0.00000051
+20	10.36	0.005979798	0.00000060
+10	11.87	0.006851371	0.00000069
0	12.30	0.007099567	0.00000071
-10	11.90	0.006868687	0.00000069
-20	10.06	0.005806638	0.00000058
-30	10.56	0.006095238	0.00000061

LTE QPSK MODULATION. BW = 3 MHz. (Band IV)

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	9.24	0.005333333	0.00000053
+40	13.16	0.007595960	0.00000076
+30	10.70	0.006176046	0.00000062
+20	11.37	0.006562771	0.00000066
+10	12.77	0.007370851	0.00000074
0	13.10	0.007561328	0.00000076
-10	12.27	0.007082251	0.00000071
-20	11.92	0.006880231	0.00000069
-30	10.77	0.006216450	0.00000062

LTE QPSK MODULATION. BW = 5 MHz. (Band IV)

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	10.01	0.005777778	0.00000058
+40	10.89	0.006285714	0.00000063
+30	8.75	0.005050505	0.00000050
+20	15.16	0.008750361	0.00000087
+10	11.62	0.006707071	0.00000067
0	10.27	0.00592785	0.00000059
-10	13.33	0.007694084	0.00000077
-20	11.37	0.006562771	0.00000066
-30	13.72	0.007919192	0.00000079

LTE QPSK MODULATION. BW = 10 MHz. (Band IV)

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	10.31	0.005950938	0.00000060
+40	9.61	0.005546898	0.00000055
+30	10.61	0.006124098	0.00000061
+20	10.11	0.005835498	0.00000058
+10	9.56	0.005518038	0.00000055
0	11.52	0.006649351	0.00000066
-10	11.16	0.006441558	0.00000064
-20	11.64	0.006718615	0.00000067
-30	10.49	0.006054834	0.00000060

LTE QPSK MODULATION. BW = 15 MHz. (Band IV)

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	9.20	0.005310245	0.00000053
+40	8.65	0.004992785	0.00000050
+30	8.00	0.004617605	0.00000046
+20	9.78	0.005645022	0.00000056
+10	9.66	0.005575758	0.00000056
0	11.40	0.006580087	0.00000066
-10	10.99	0.006343434	0.00000063
-20	12.55	0.007243867	0.00000072
-30	12.39	0.007151515	0.00000072

LTE QPSK MODULATION. BW = 20 MHz. (Band IV)

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	9.61	0.005546898	0.00000055
+40	8.10	0.004675325	0.00000046
+30	10.17	0.00587013	0.00000059
+20	10.83	0.006251082	0.00000062
+10	11.10	0.006406926	0.00000064
0	10.66	0.006152958	0.00000062
-10	11.44	0.006603175	0.00000066
-20	12.32	0.007111111	0.00000071
-30	13.73	0.007924964	0.00000079

Frequency stability over voltage variations.

LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	10.36	0.005979798	0.00000060
Vmin	3.60	8.83	0.005096681	0.00000051

LTE QPSK MODULATION. BW = 3 MHz (Band IV)

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	11.37	0.006562771	0.00000066
Vmin	3.60	10.34	0.005968254	0.00000060

LTE QPSK MODULATION. BW = 5 MHz (Band IV)

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	15.16	0.008750361	0.00000087
Vmin	3.60	10.14	0.005852814	0.00000059

LTE QPSK MODULATION. BW = 10 MHz (Band IV)

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	10.11	0.005835498	0.00000058
Vmin	3.60	10.76	0.006210678	0.00000062

LTE QPSK MODULATION. BW = 15 MHz (Band IV)

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	9.78	0.005645022	0.00000056
Vmin	3.60	12.20	0.007041847	0.00000070

LTE QPSK MODULATION. BW = 20 MHz (Band IV)

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	10.83	0.006251082	0.00000062
Vmin	3.60	9.78	0.005645022	0.00000056

Reference points established at the applicable unwanted emissions limit (worst case):

	LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)	LTE QPSK MODULATION. BW = 3 MHz (Band IV)	LTE QPSK MODULATION. BW = 5 MHz (Band IV)	LTE QPSK MODULATION. BW = 10 MHz (Band IV)	LTE QPSK MODULATION. BW = 15 MHz (Band IV)	LTE QPSK MODULATION. BW = 20 MHz (Band IV)
f_L (MHz)	1710.1131	1710.3031	1710.1852	1710.4054	1710.5556	1710.7037
f_H (MHz)	1754.8769	1754.8909	1754.4808	1754.5866	1754.4436	1754.2763

Reference points f_L and f_H with the worst-case frequency offsets added or subtracted:

	LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)	LTE QPSK MODULATION. BW = 3 MHz (Band IV)	LTE QPSK MODULATION. BW = 5 MHz (Band IV)	LTE QPSK MODULATION. BW = 10 MHz (Band IV)	LTE QPSK MODULATION. BW = 15 MHz (Band IV)	LTE QPSK MODULATION. BW = 20 MHz (Band IV)
f_L (MHz)	1710.1131	1710.3031	1710.1852	1710.4054	1710.5556	1710.7037
f_H (MHz)	1754.8769	1754.8909	1754.4808	1754.5866	1754.4436	1754.2763

The reference frequency points stay within the authorized blocks.

Verdict: PASS

Occupied Bandwidth

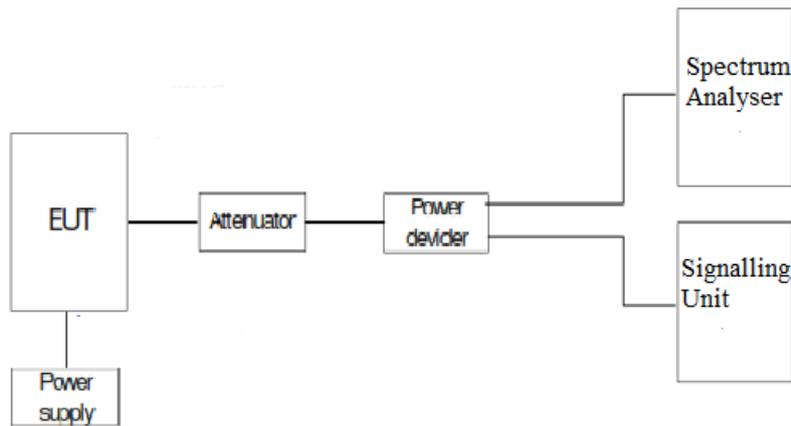
SPECIFICATION

§2.1049

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

WCDMA MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4.161	4.156	4.172
-26 dBc bandwidth (kHz)	4.628	4.646	4.640
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4.162	4.181	4.154
-26 dBc bandwidth (kHz)	4.639	4.647	4.630
Measurement uncertainty (kHz)	<±16.67		

LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.094	1.112	1.092
-26 dBc bandwidth (MHz)	1.299	1.325	1.303
Measurement uncertainty (kHz)	<±4.67		

LTE 16QAM MODULATION. BW = 1.4 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.106	1.096	1.095
-26 dBc bandwidth (MHz)	1.312	1.296	1.300
Measurement uncertainty (kHz)	<±4.67		

LTE QPSK MODULATION. BW = 3 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.753	2.741	2.744
-26 dBc bandwidth (MHz)	3.075	3.051	3.058
Measurement uncertainty (kHz)	<±10.00		

LTE 16QAM MODULATION. BW = 3 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.724	2.735	2.742
-26 dBc bandwidth (MHz)	3.074	3.081	3.090
Measurement uncertainty (kHz)	<±10.00		

LTE QPSK MODULATION. BW = 5 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.519	4.510	4.509
-26 dBc bandwidth (MHz)	5.042	4.957	4.984
Measurement uncertainty (kHz)	<±16.67		

LTE 16QAM MODULATION. BW = 5 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.536	4.513	4.513
-26 dBc bandwidth (MHz)	4.978	5.024	4.994
Measurement uncertainty (kHz)	<±16.67		

LTE QPSK MODULATION. BW = 10 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.042	9.047	9.003
-26 dBc bandwidth (MHz)	10.002	10.041	10.030
Measurement uncertainty (kHz)	<±33.33		

LTE 16QAM MODULATION. BW = 10 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.038	9.046	9.059
-26 dBc bandwidth (MHz)	10.006	10.035	10.053
Measurement uncertainty (kHz)	<±33.33		

LTE QPSK MODULATION. BW = 15 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.464	13.469	13.455
-26 dBc bandwidth (MHz)	14.530	14.650	14.765
Measurement uncertainty (kHz)	<±50.00		

LTE 16QAM MODULATION. BW = 15 MHz (Band IV)

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.454	13.431	13.439
-26 dBc bandwidth (MHz)	14.646	14.660	14.632
Measurement uncertainty (kHz)	<±50.00		

LTE QPSK MODULATION. BW = 20 MHz (Band IV)

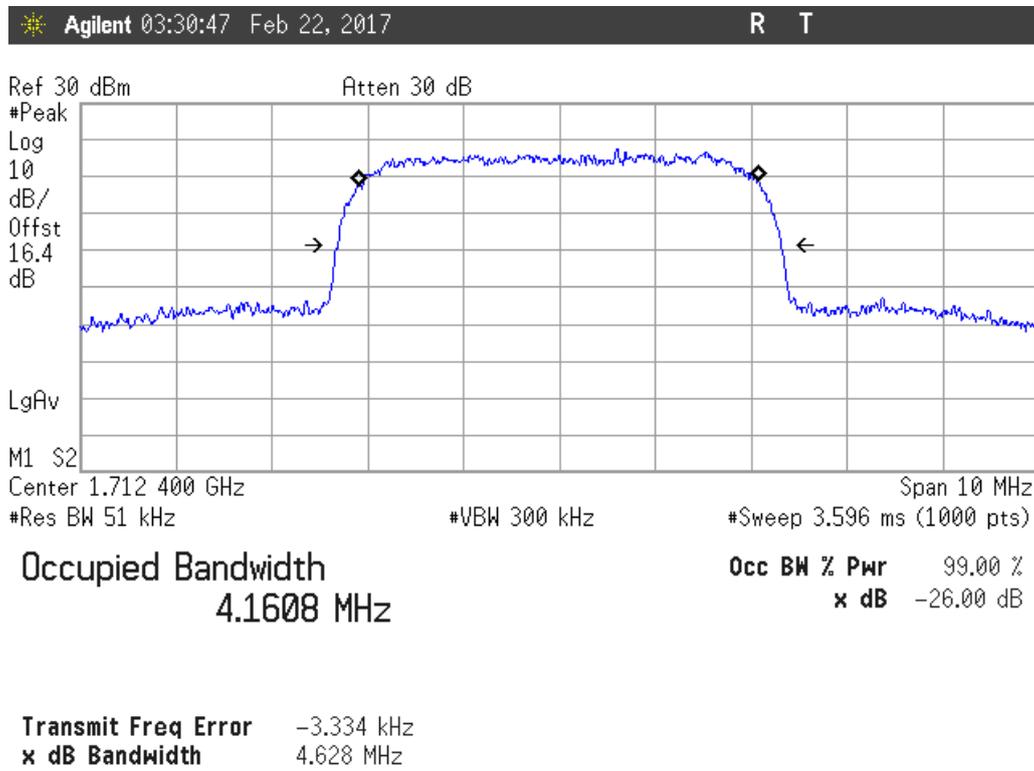
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.886	17.889	17.807
-26 dBc bandwidth (MHz)	19.121	19.254	19.282
Measurement uncertainty (kHz)	<±66.67		

LTE 16QAM MODULATION. BW = 20 MHz (IV)

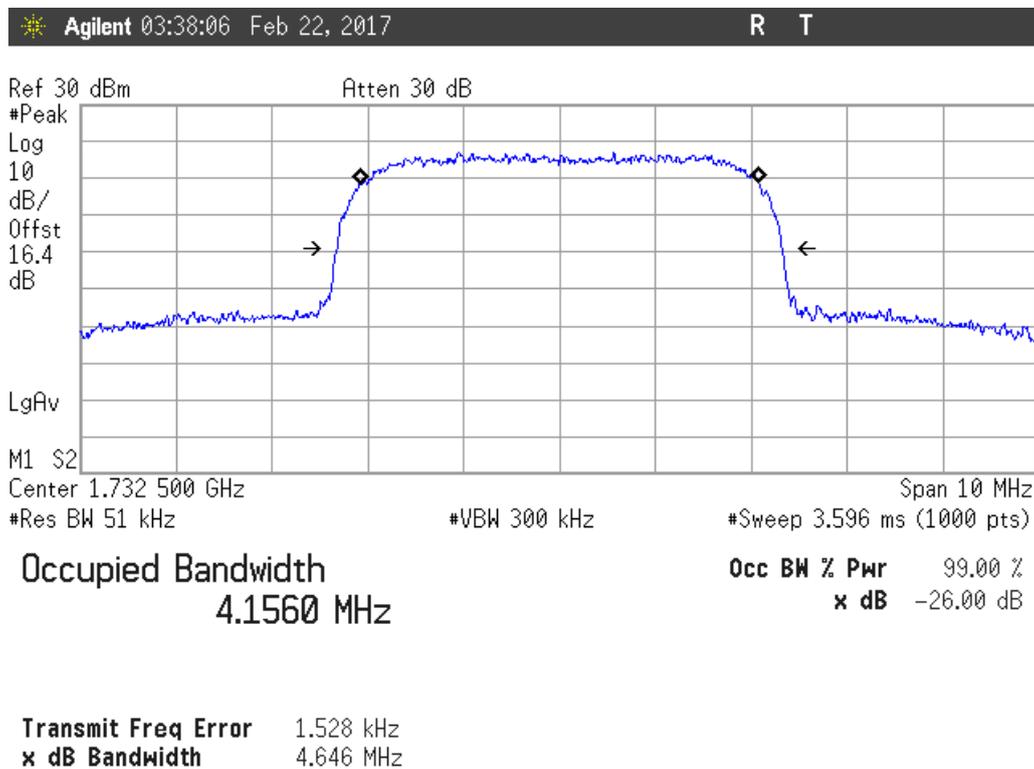
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.871	17.899	17.840
-26 dBc bandwidth (MHz)	19.297	19.362	19.279
Measurement uncertainty (kHz)	<±66.67		

WCDMA MODULATION

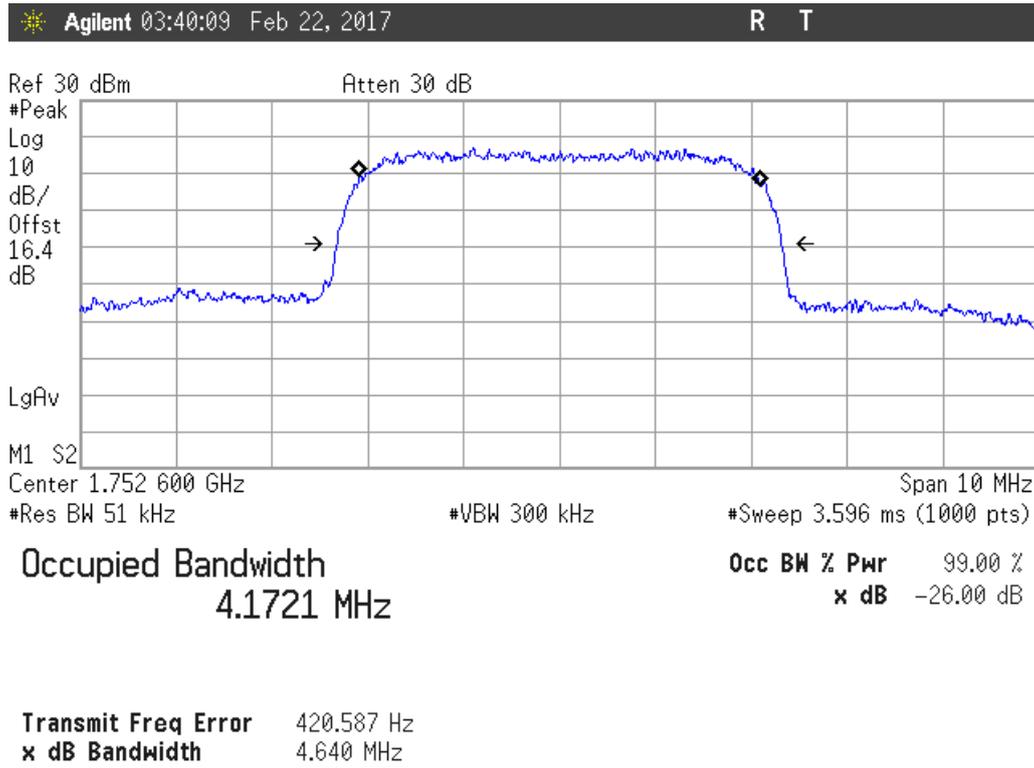
Lowest Channel



Middle Channel

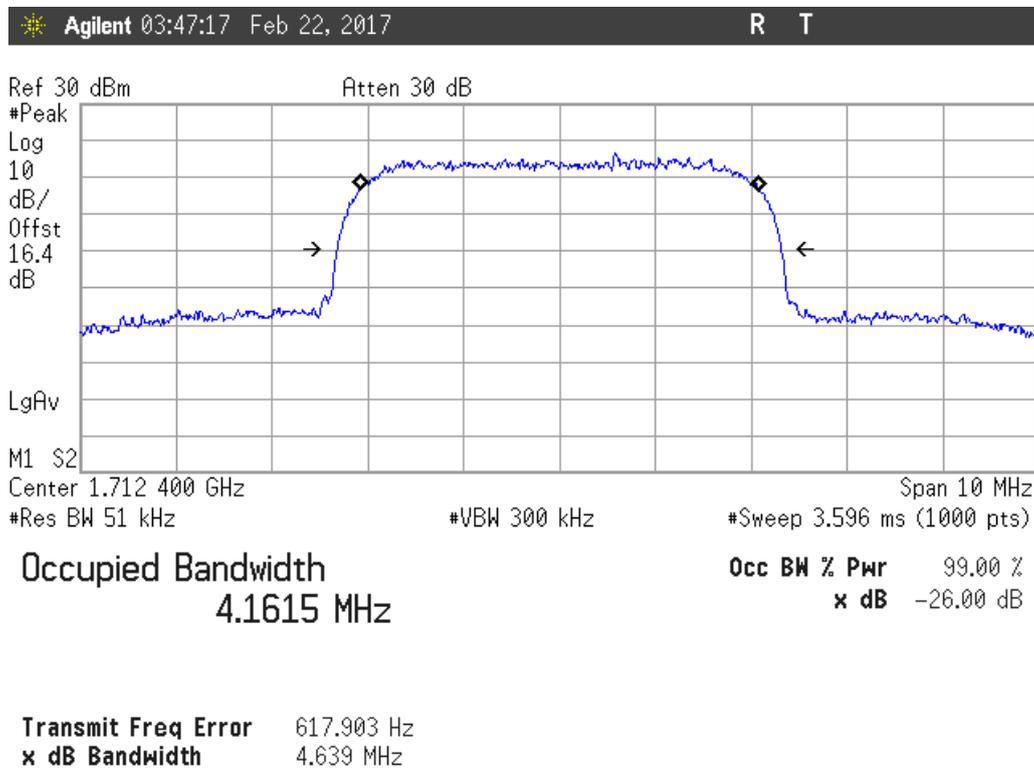


Highest Channel

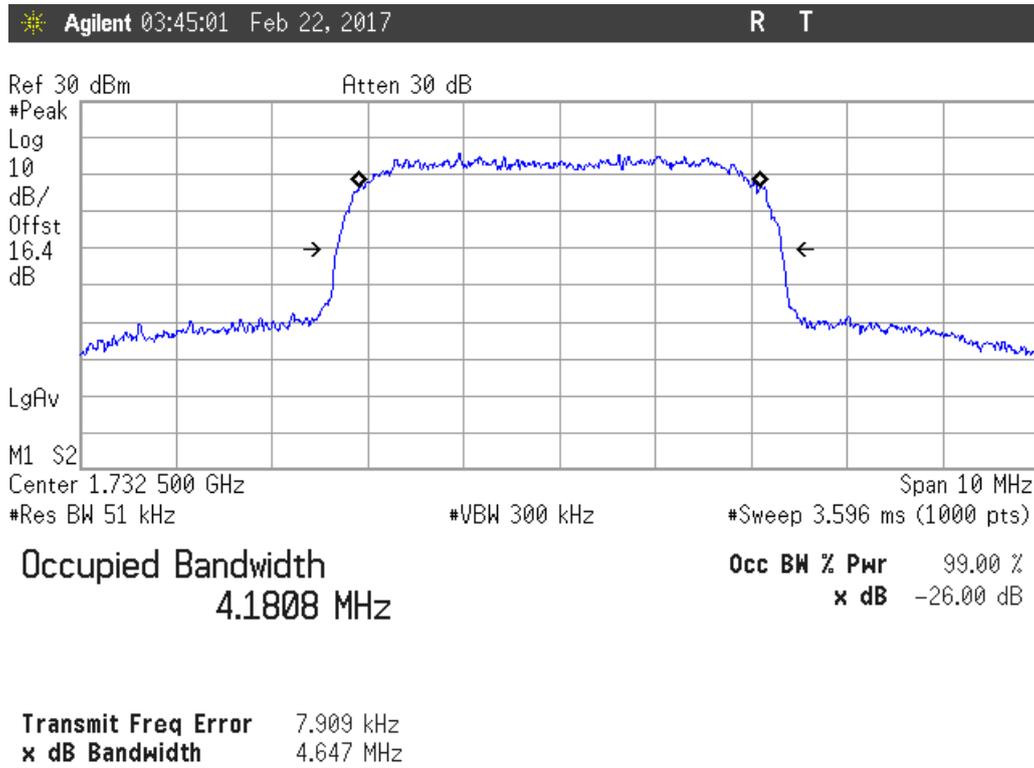


HSUPA MODULATION

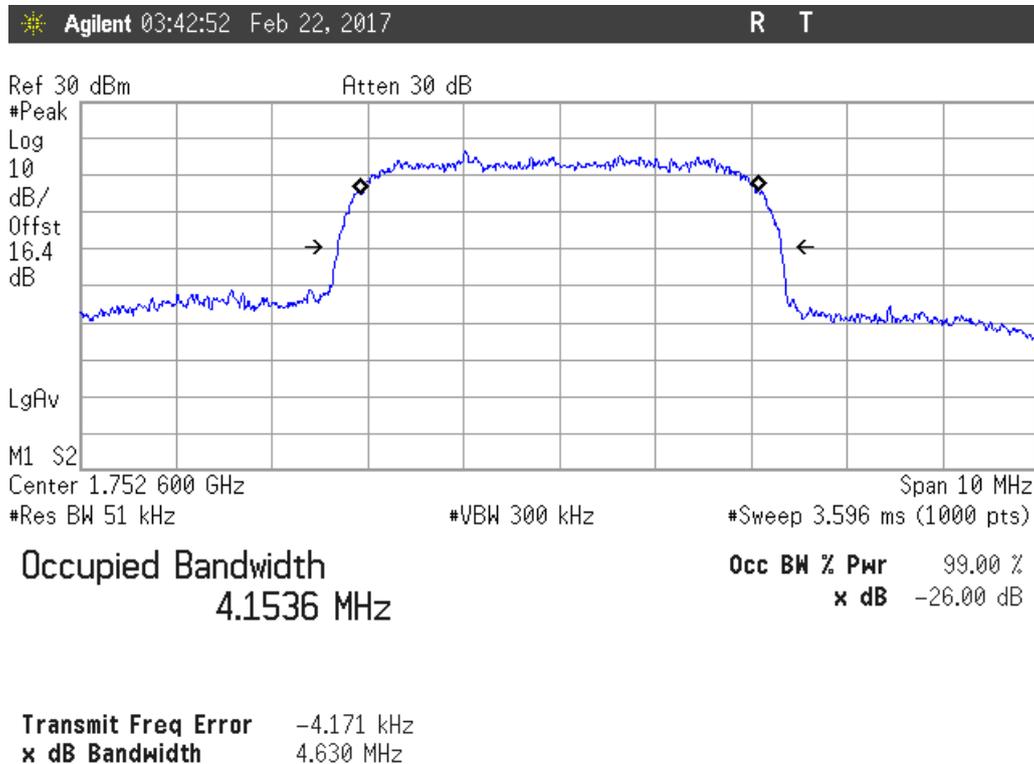
Lowest Channel



Middle Channel

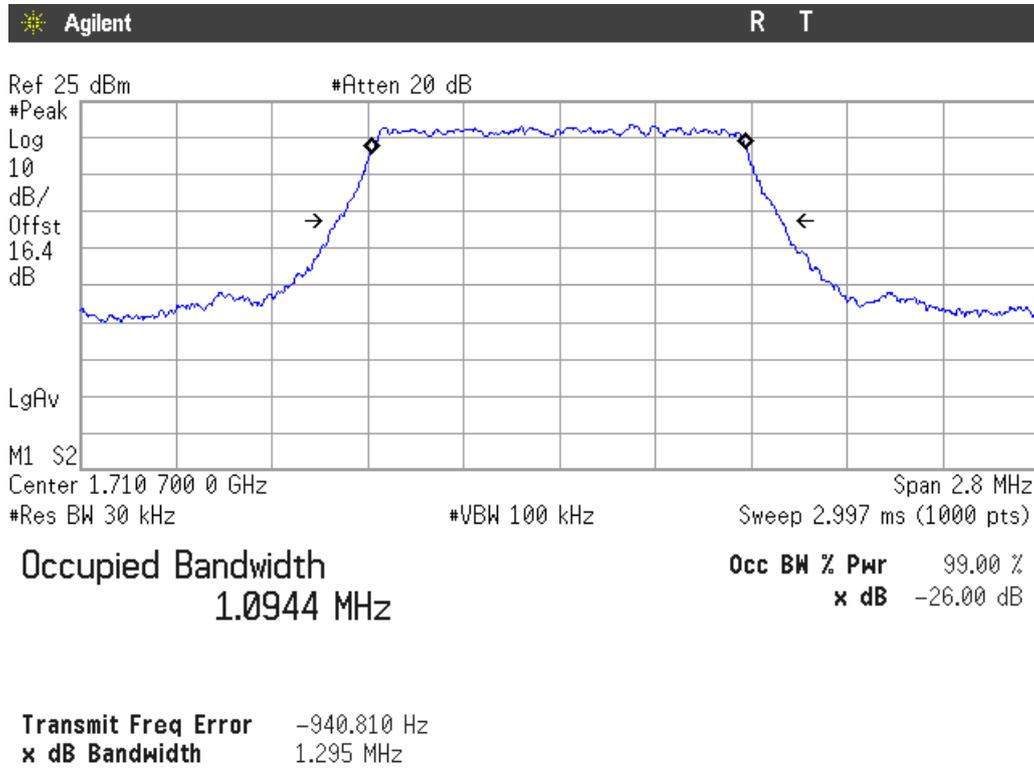


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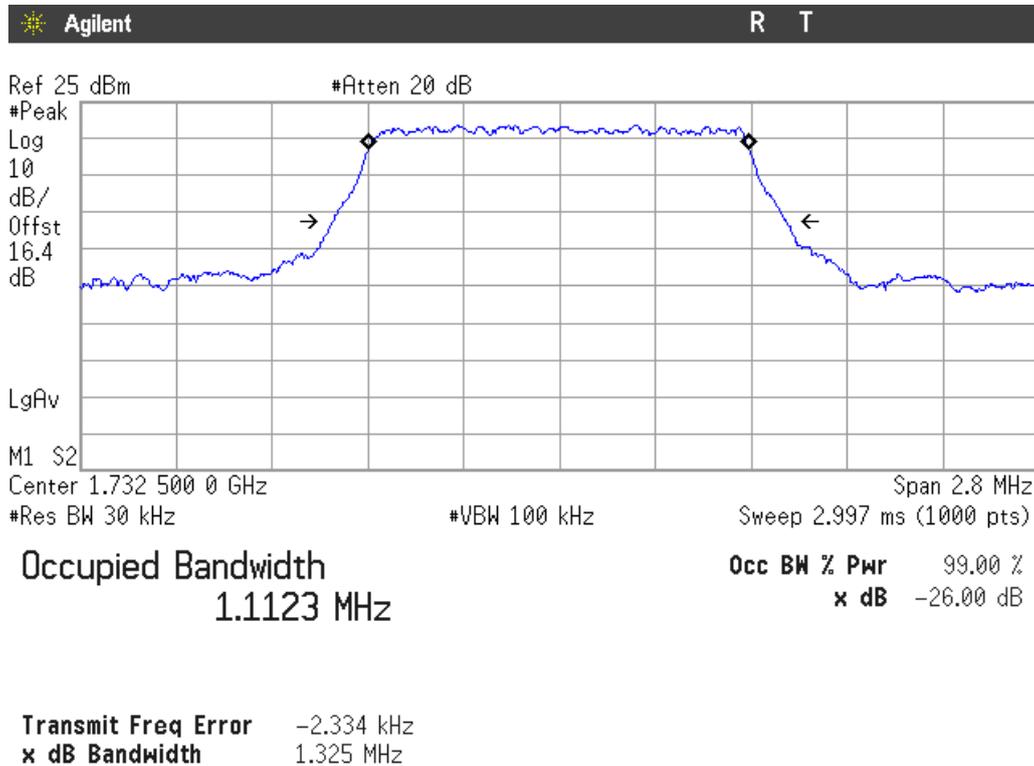


LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)

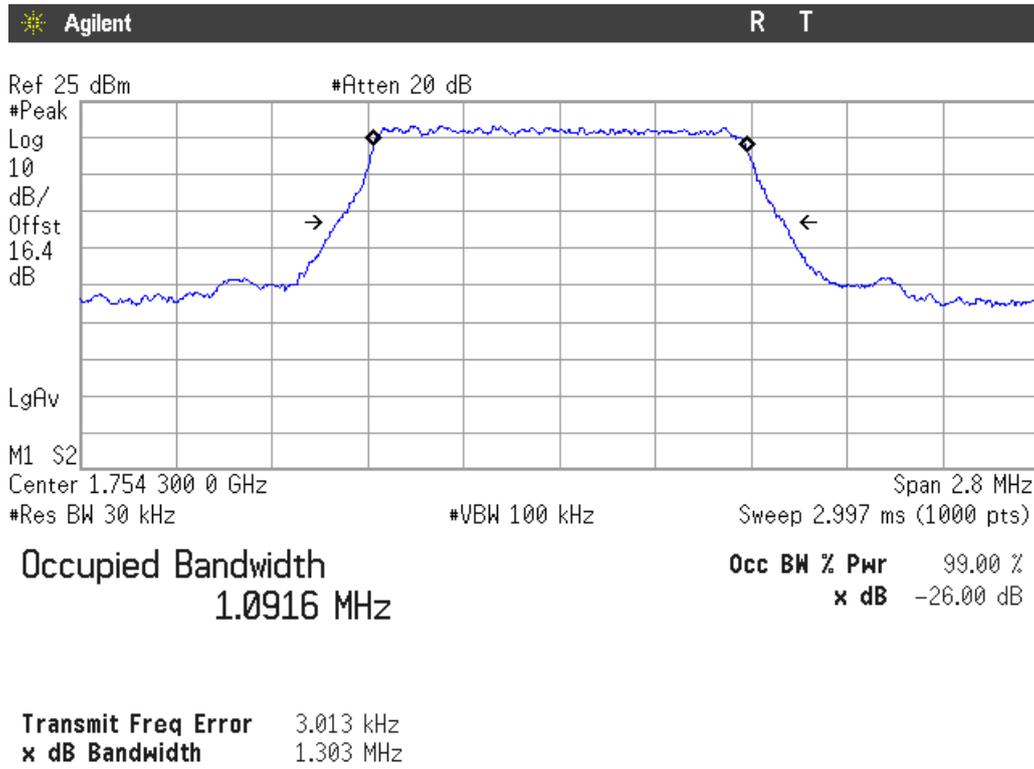
Lowest Channel



Middle Channel

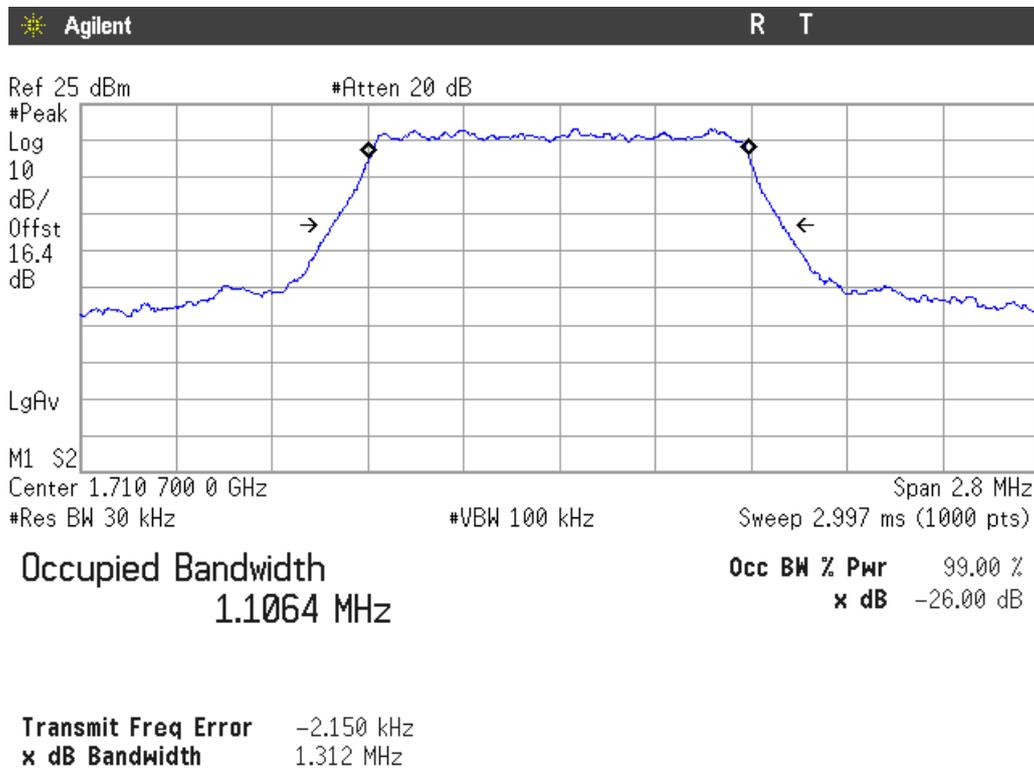


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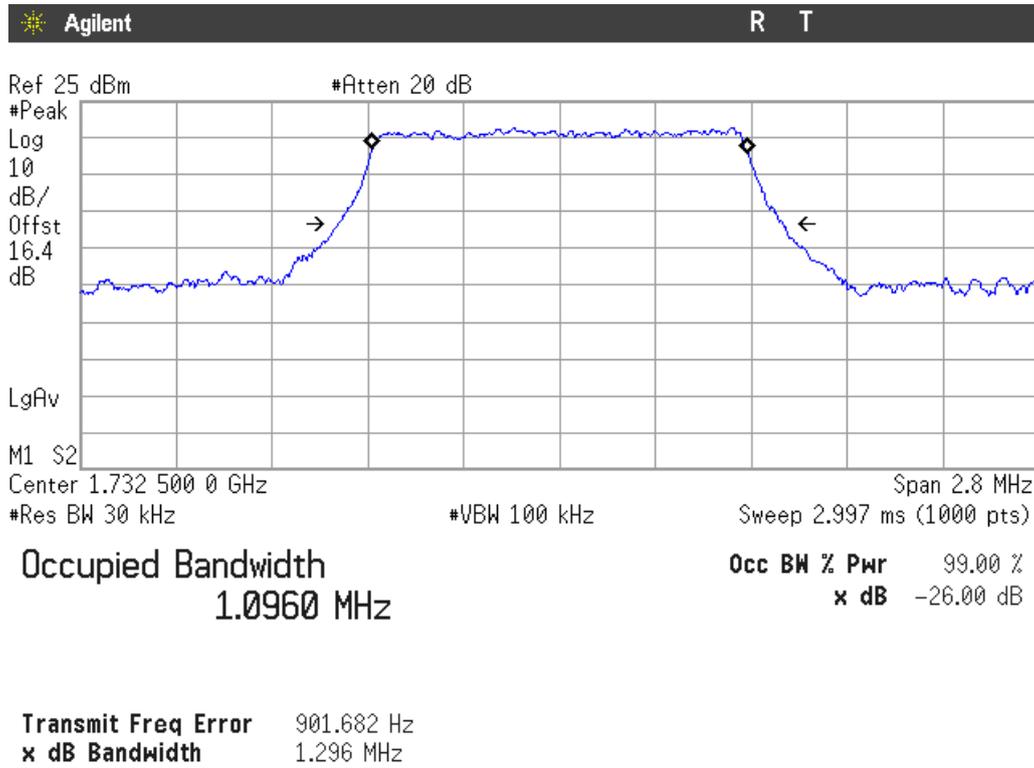


LTE 16QAM MODULATION. BW = 1.4 MHz (Band IV)

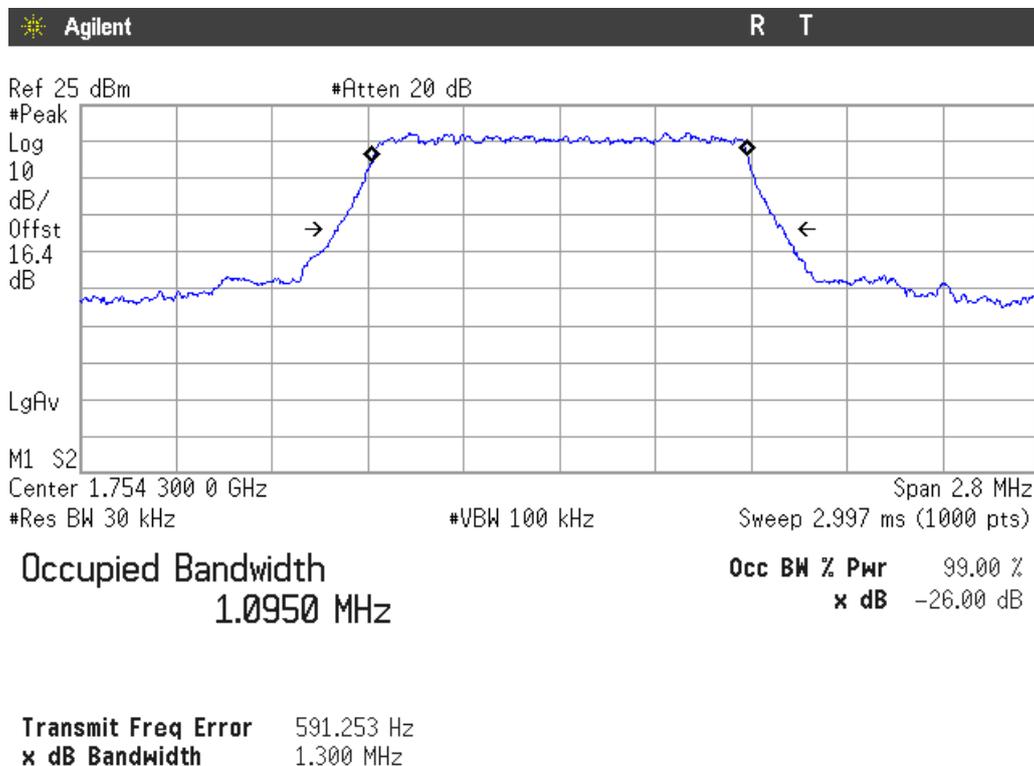
Lowest Channel



Middle Channel

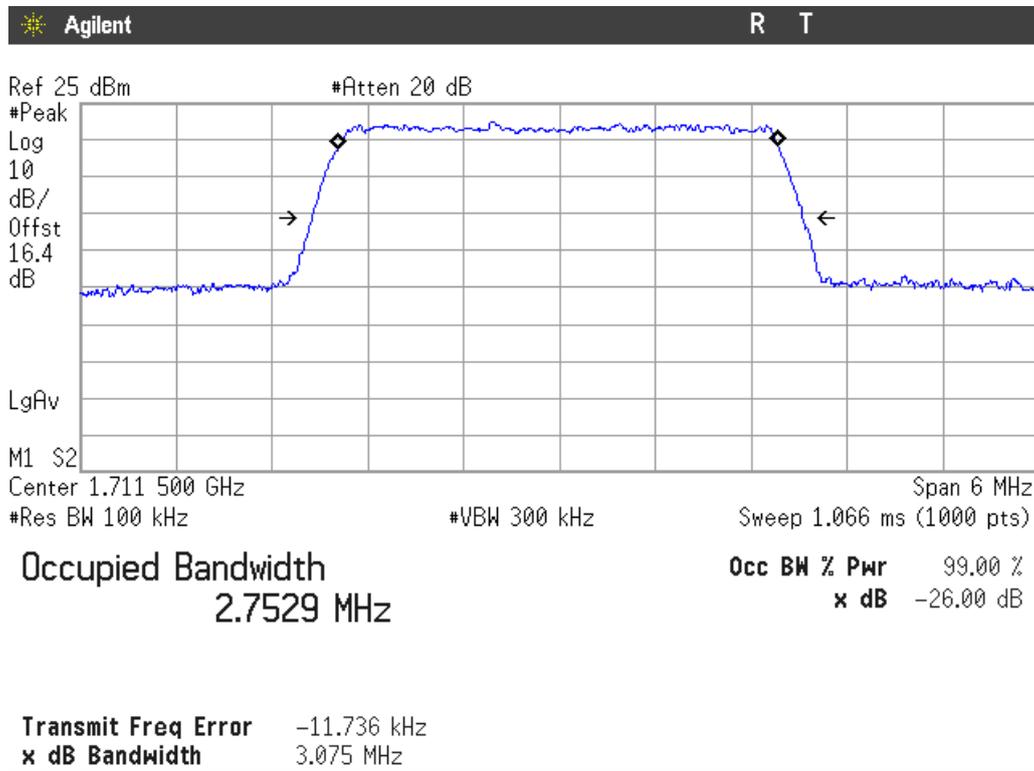


Highest Channel

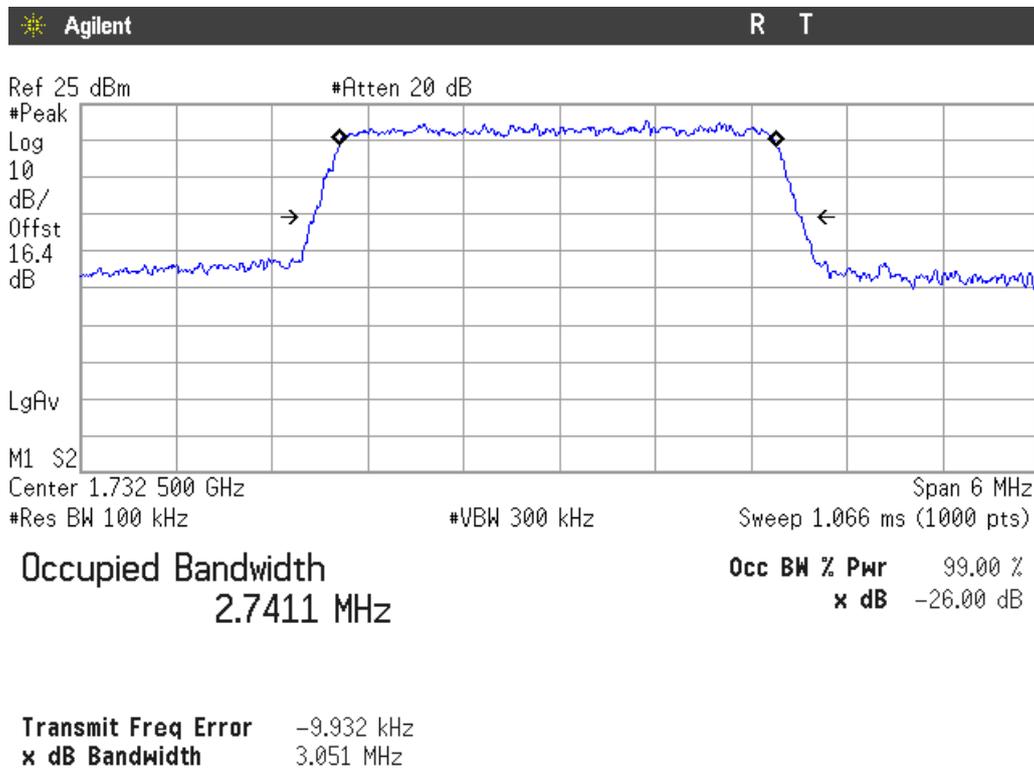


LTE QPSK MODULATION. BW = 3 MHz (Band IV)

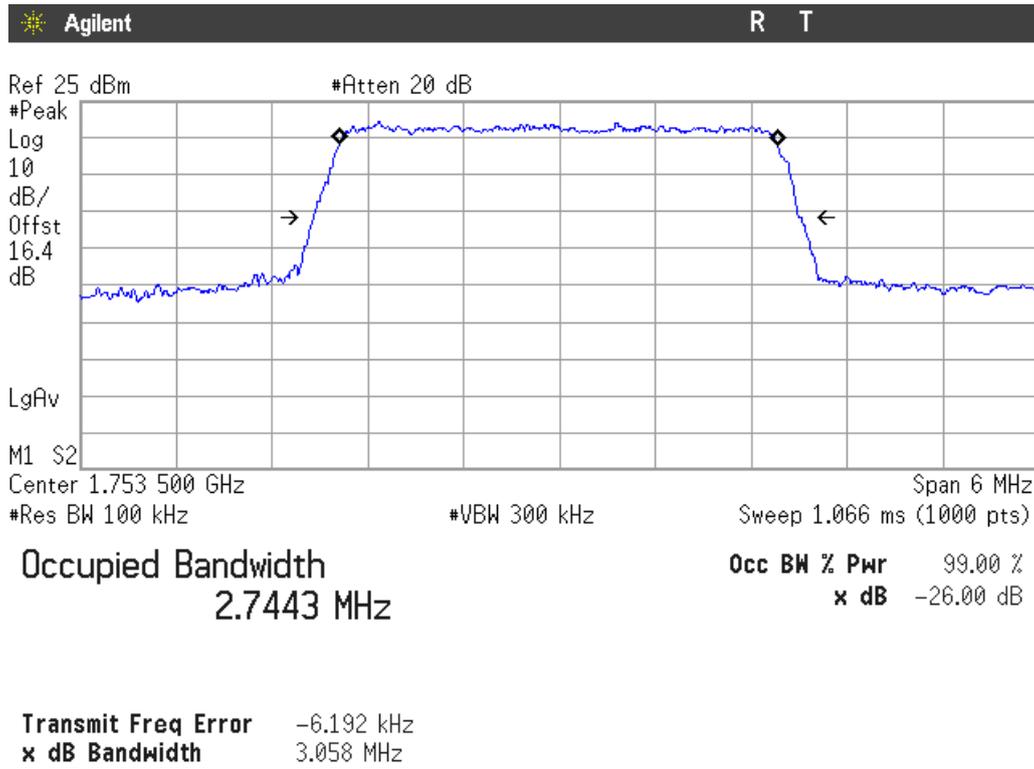
Lowest Channel



Middle Channel

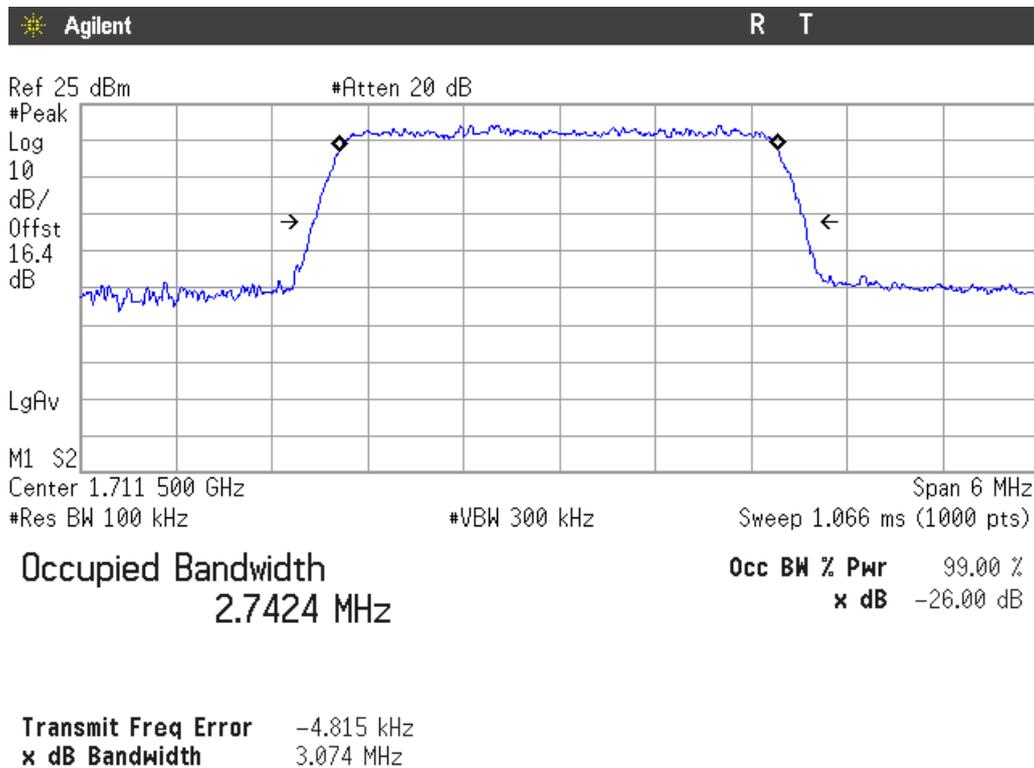


Highest Channel

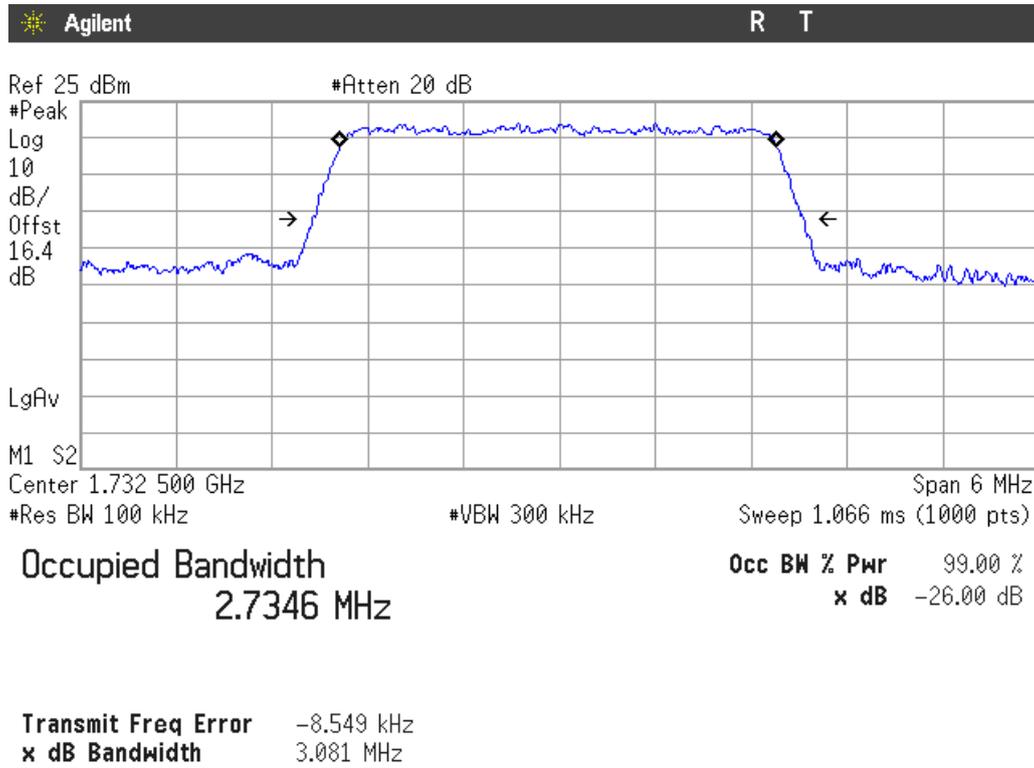


LTE 16QAM MODULATION. BW = 3 MHz (Band IV)

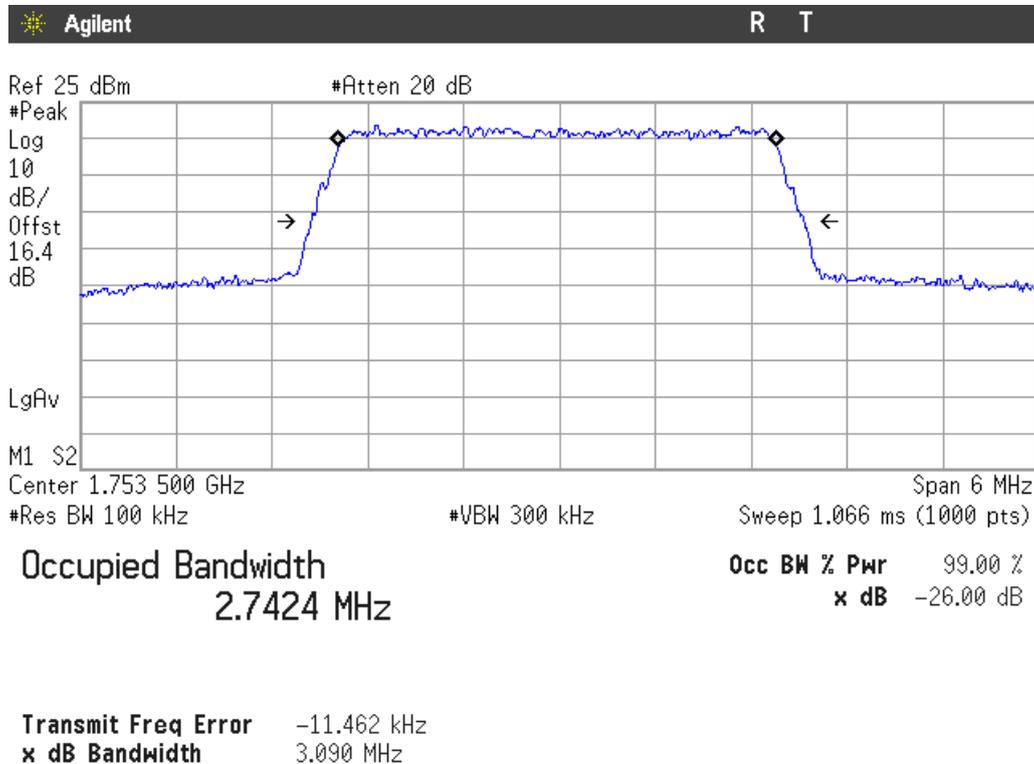
Lowest Channel



Middle Channel

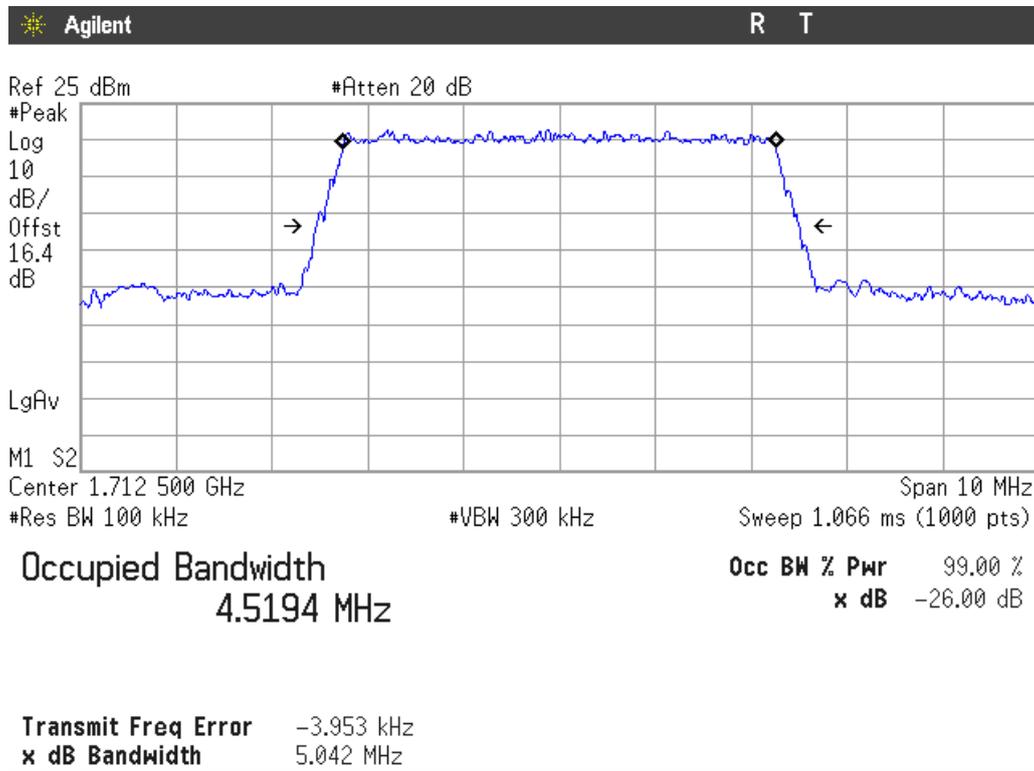


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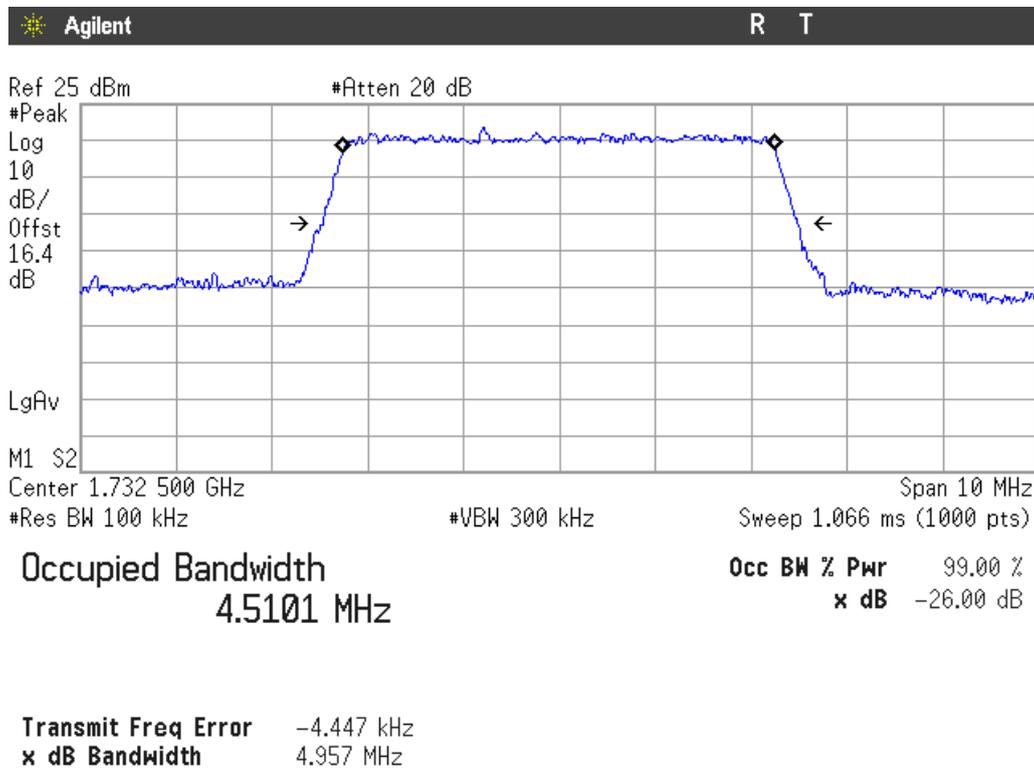


LTE QPSK MODULATION. BW = 5 MHz (Band IV)

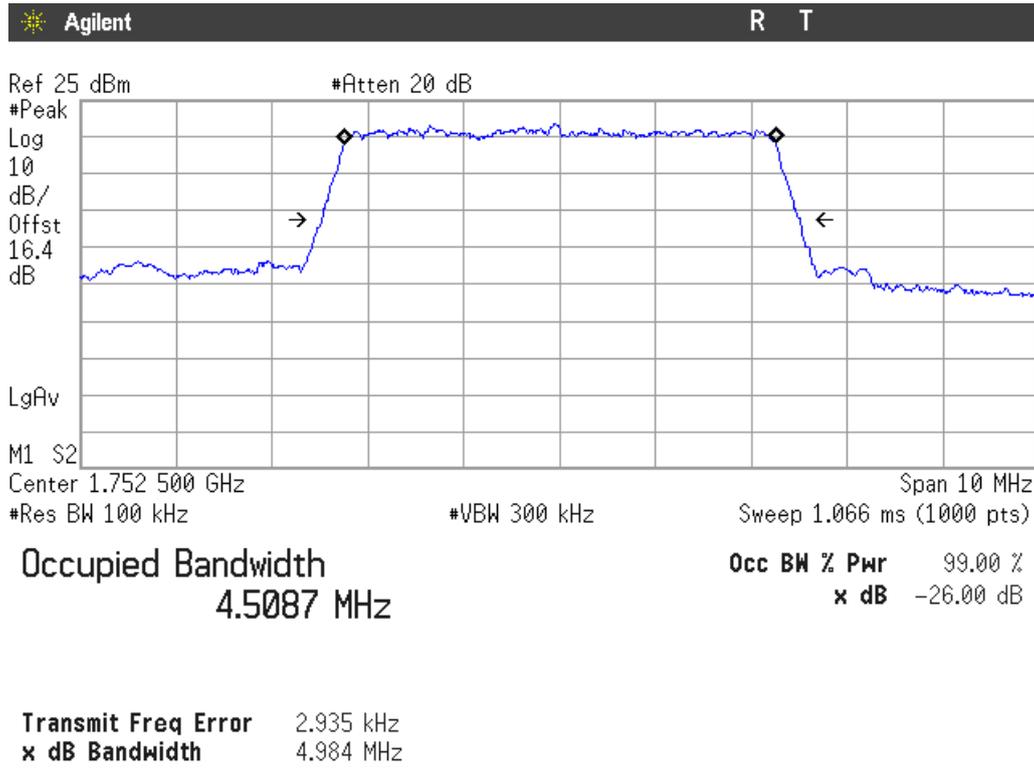
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Middle Channel

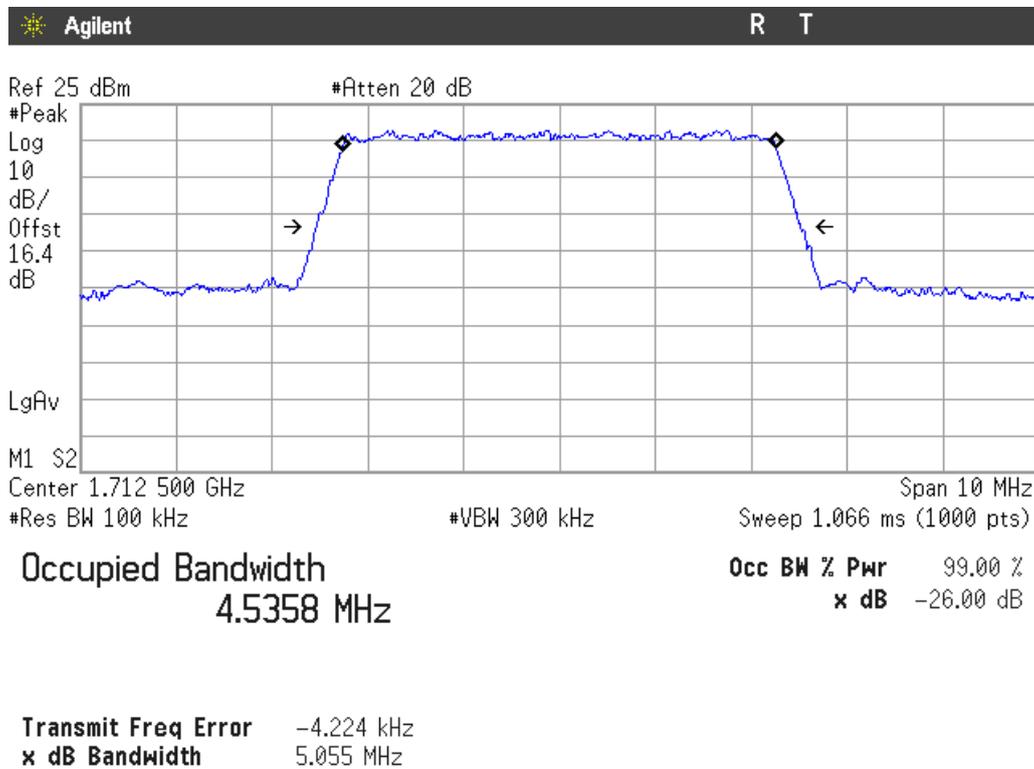


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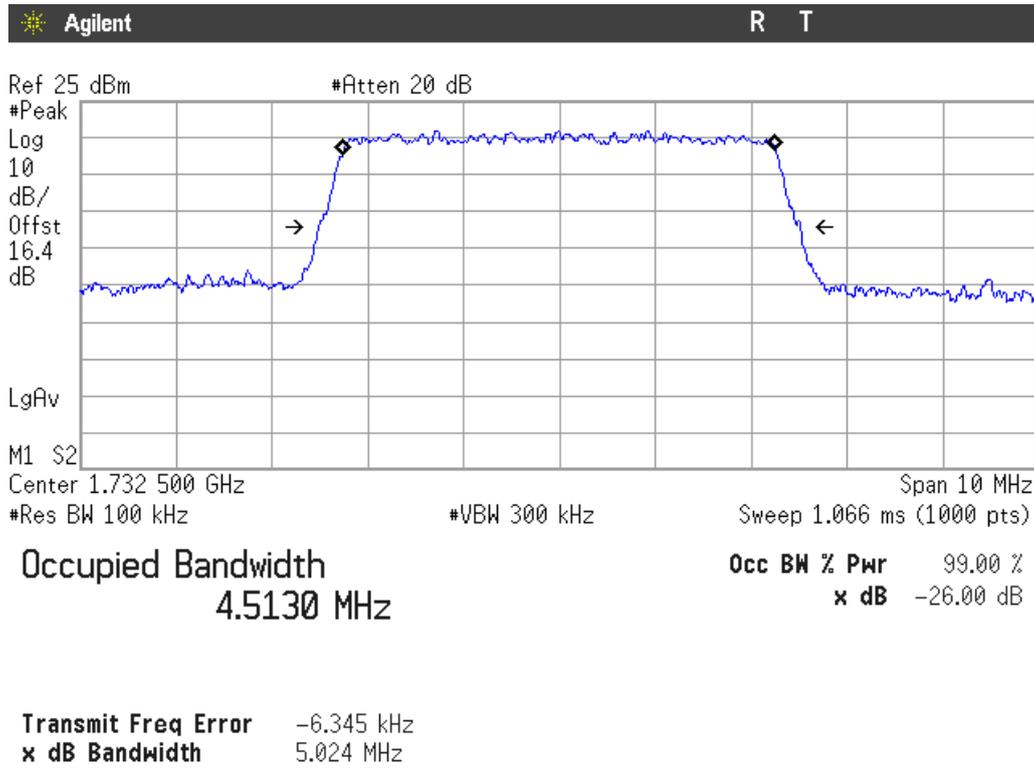


LTE 16QAM MODULATION. BW = 5 MHz (Band IV)

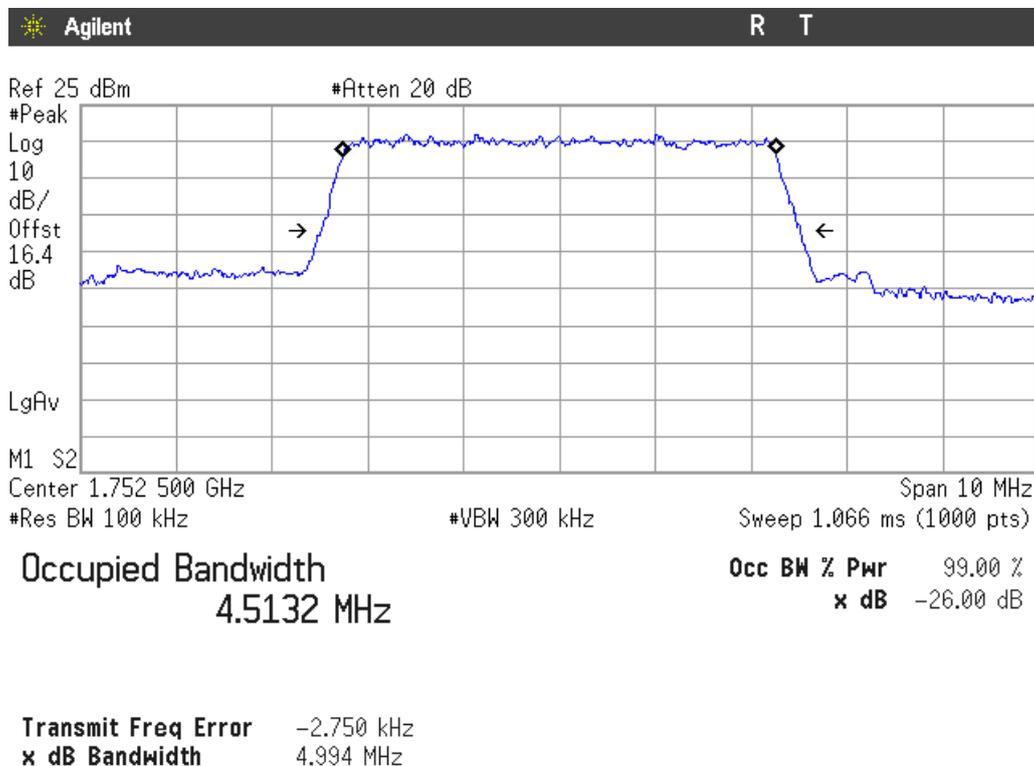
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Middle Channel

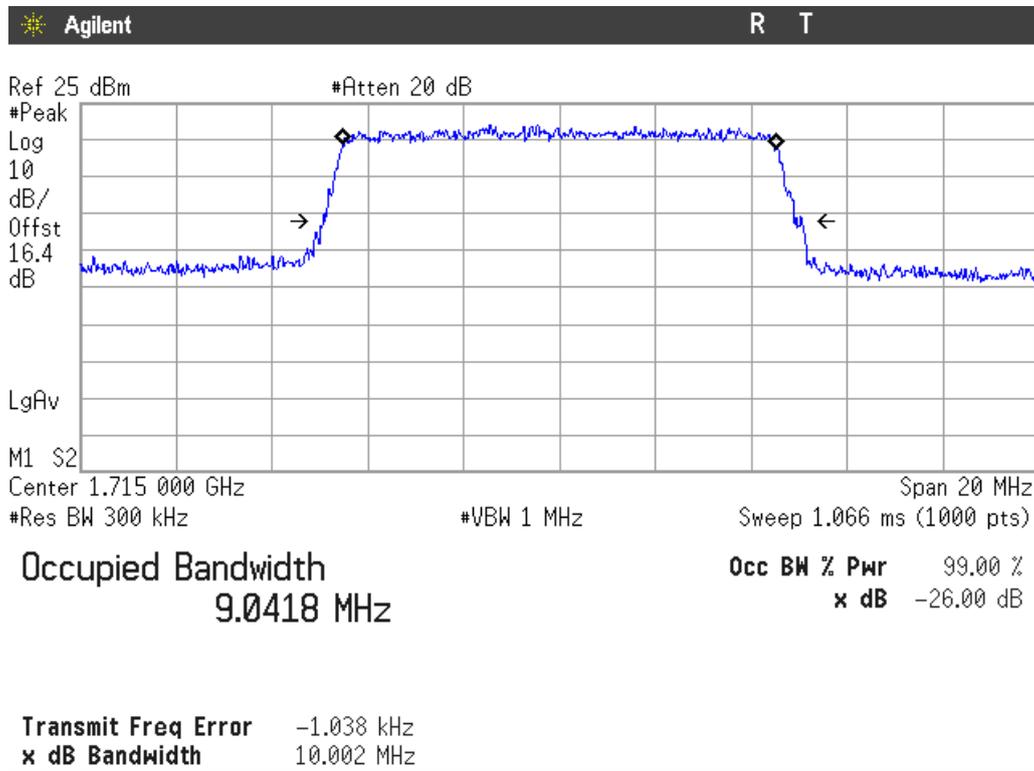


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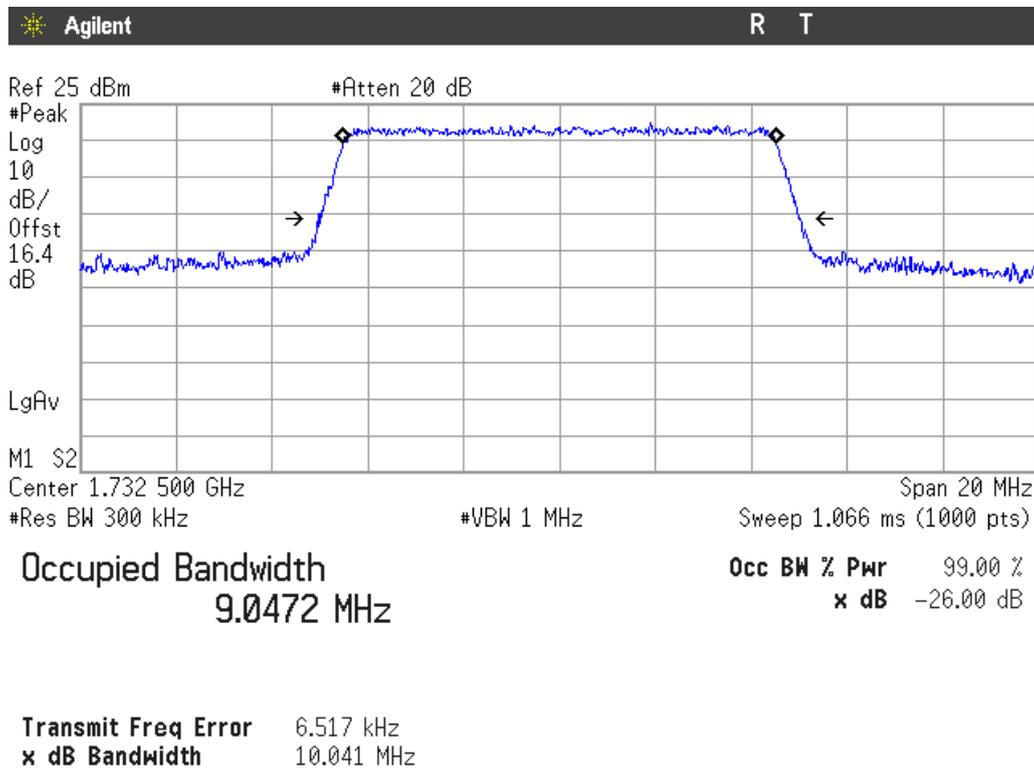


LTE QPSK MODULATION. BW = 10 MHz (Band IV)

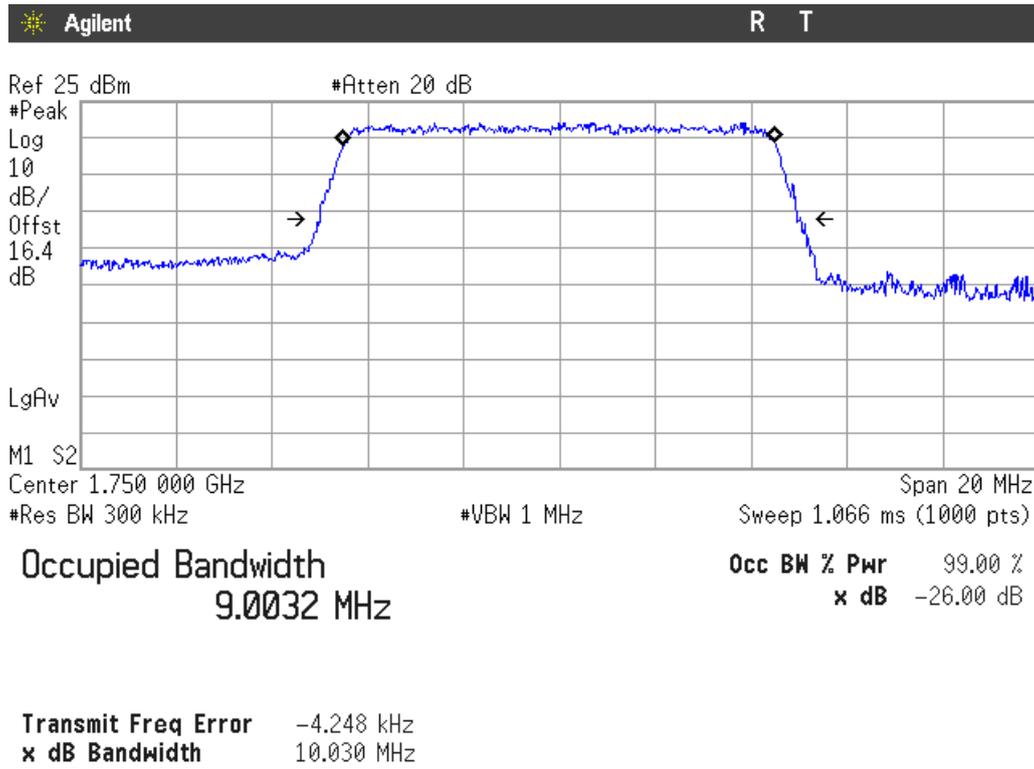
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Middle Channel

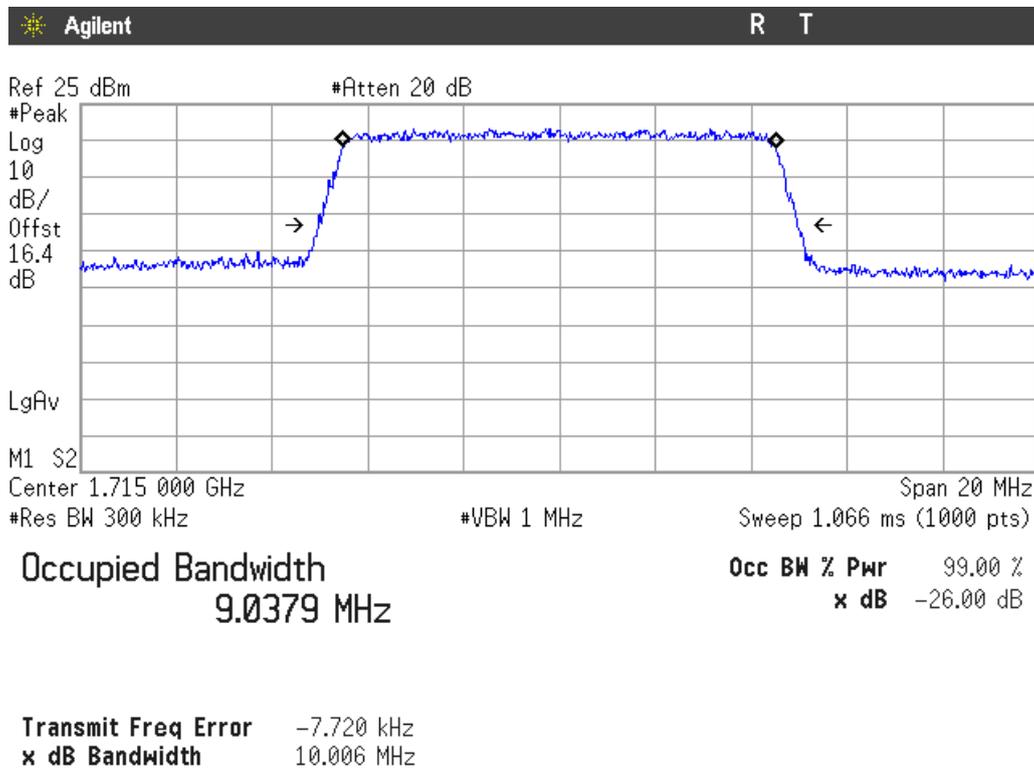


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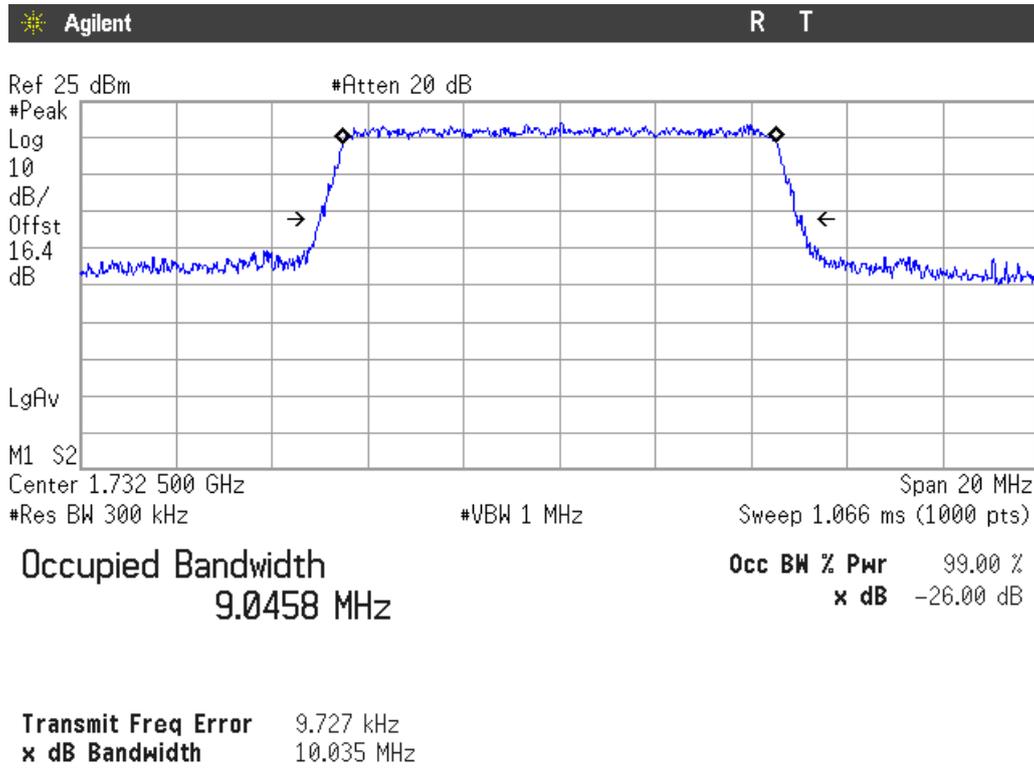


LTE 16QAM MODULATION. BW = 10 MHz (Band IV)

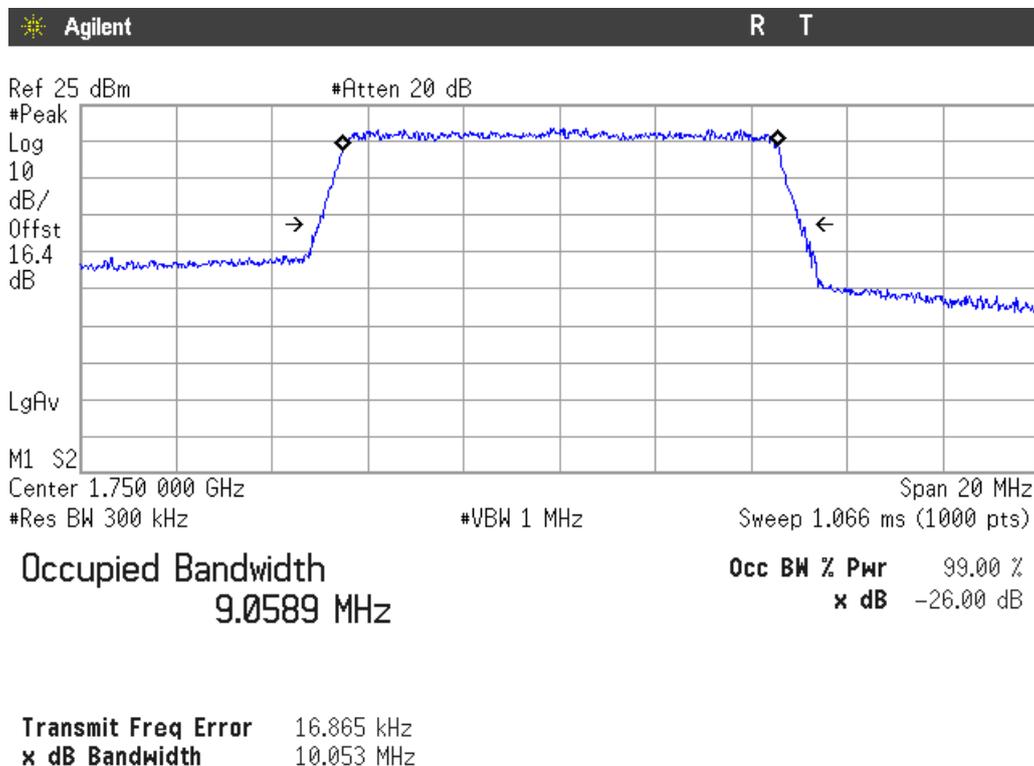
Lowest Channel



Middle Channel

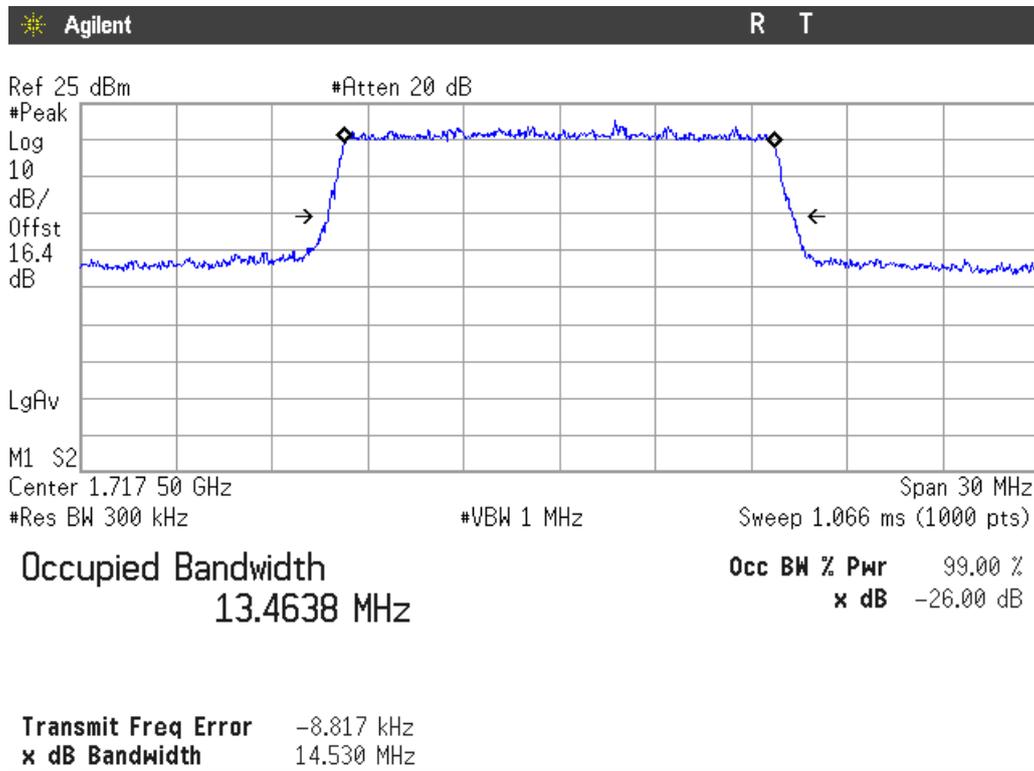


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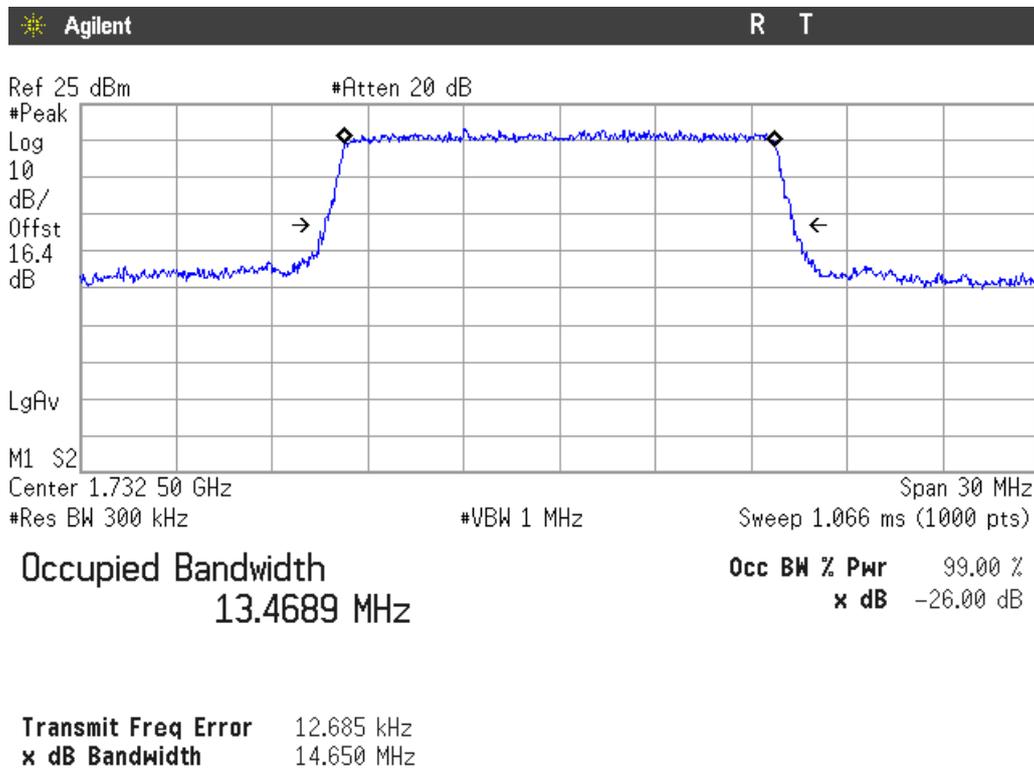


LTE QPSK MODULATION. BW = 15 MHz (Band IV)

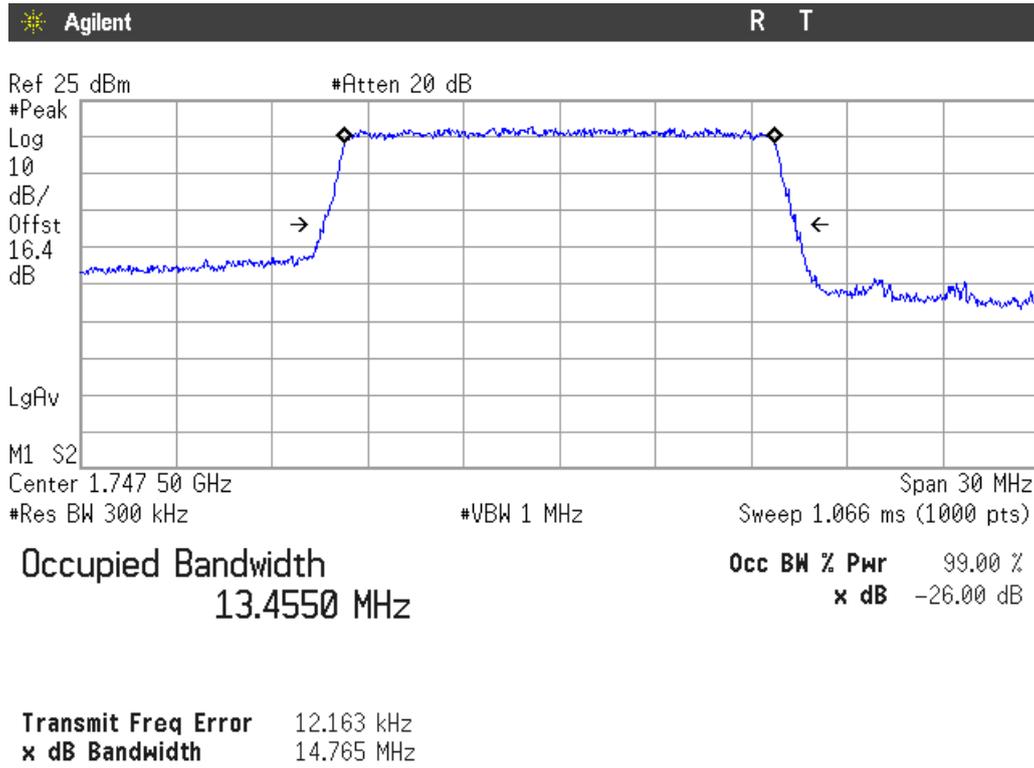
Lowest Channel



Middle Channel

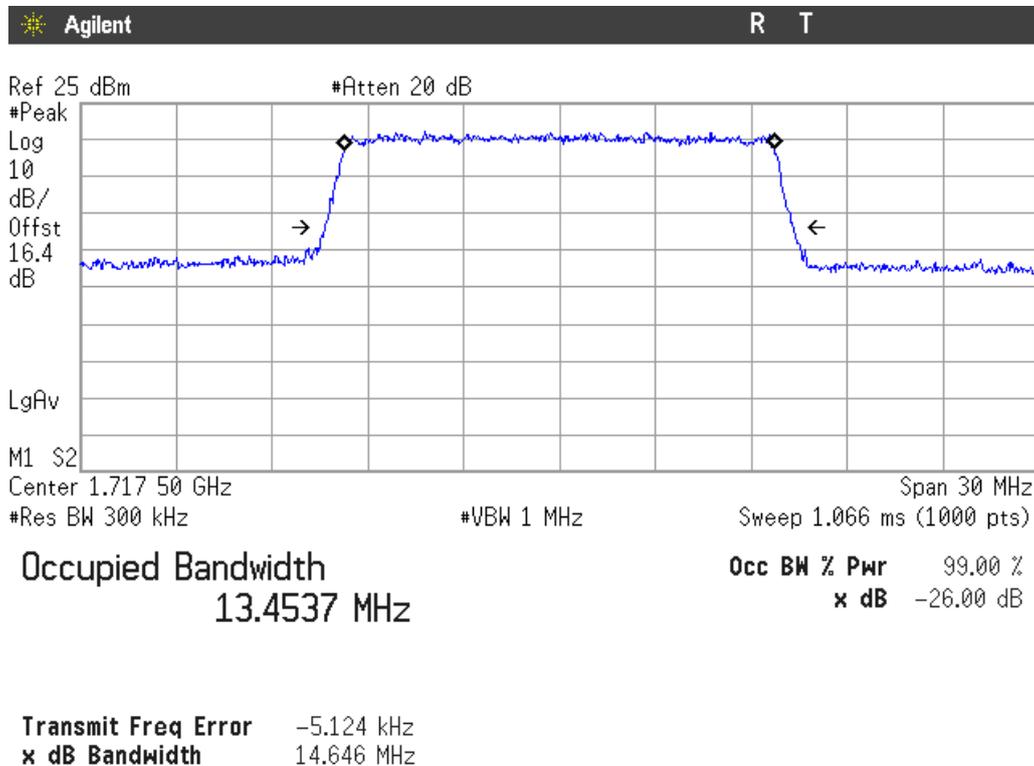


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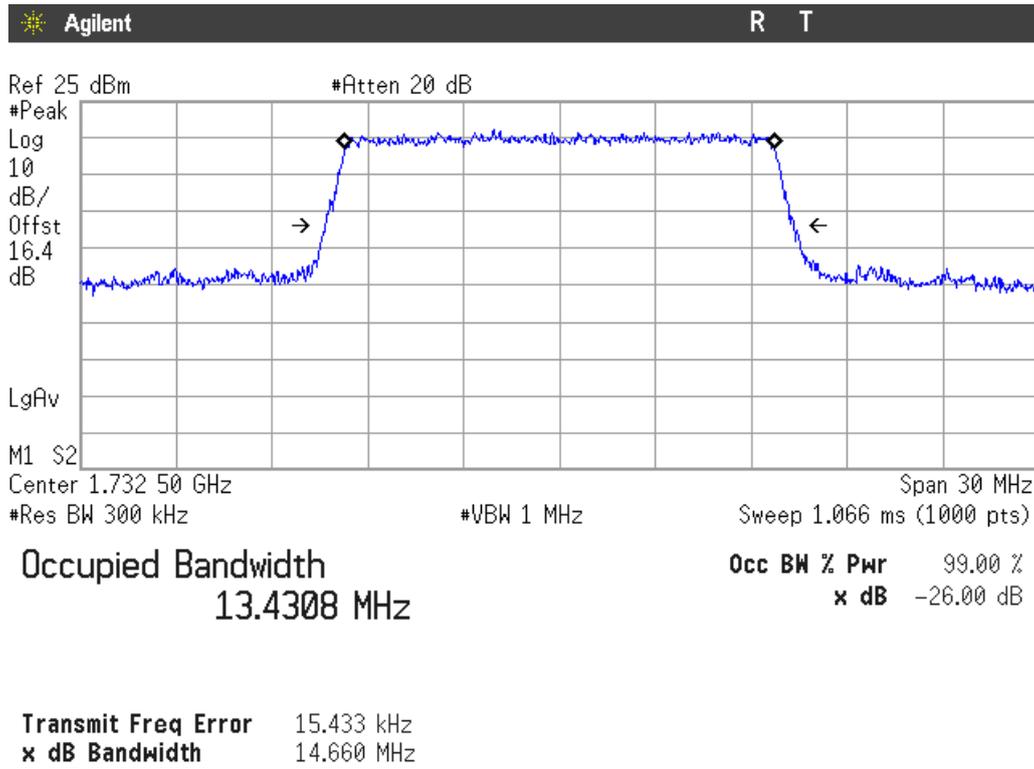


LTE 16QAM MODULATION. BW = 15 MHz (Band IV)

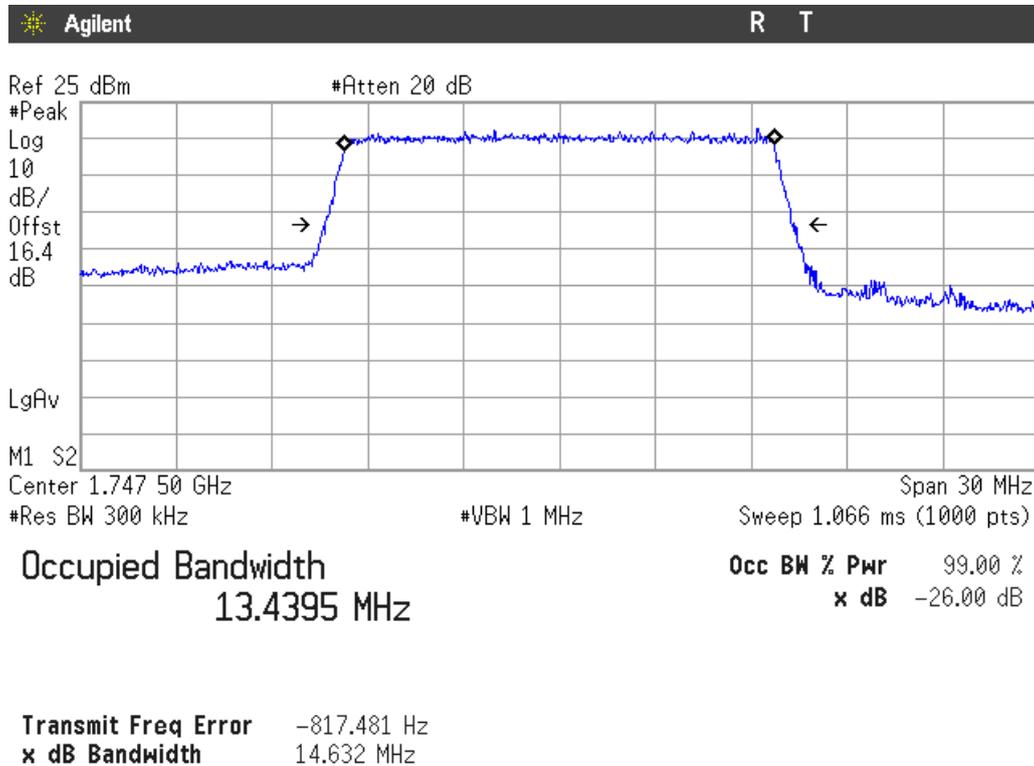
Lowest Channel



Middle Channel

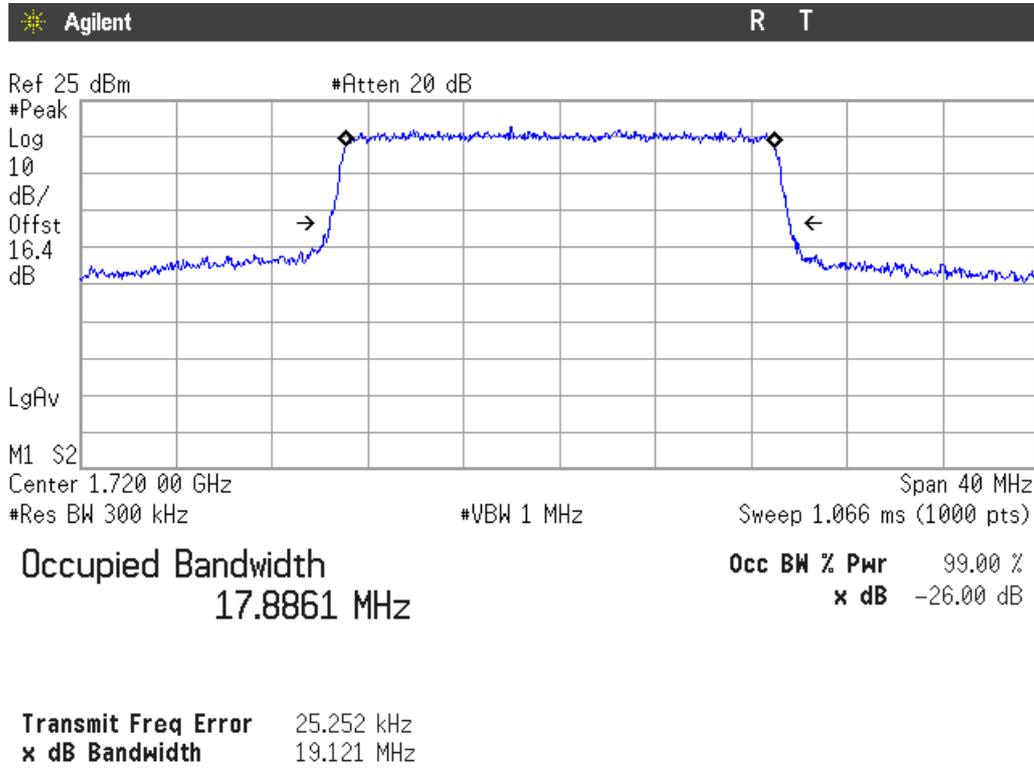


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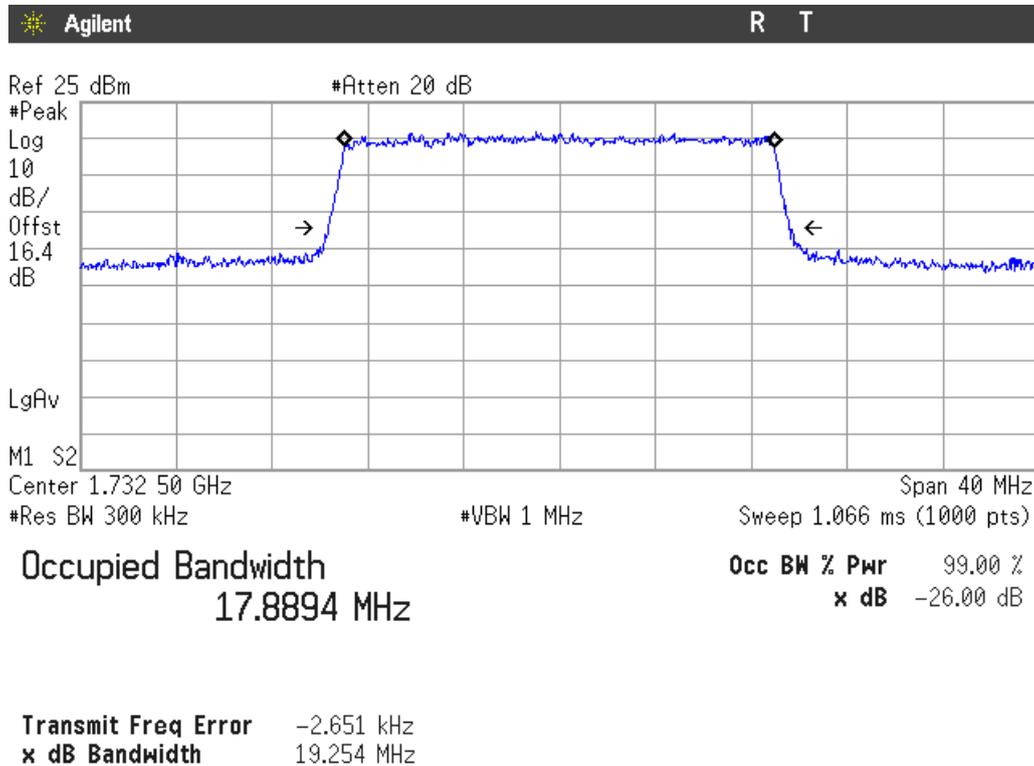


LTE QPSK MODULATION. BW = 20 MHz (Band IV)

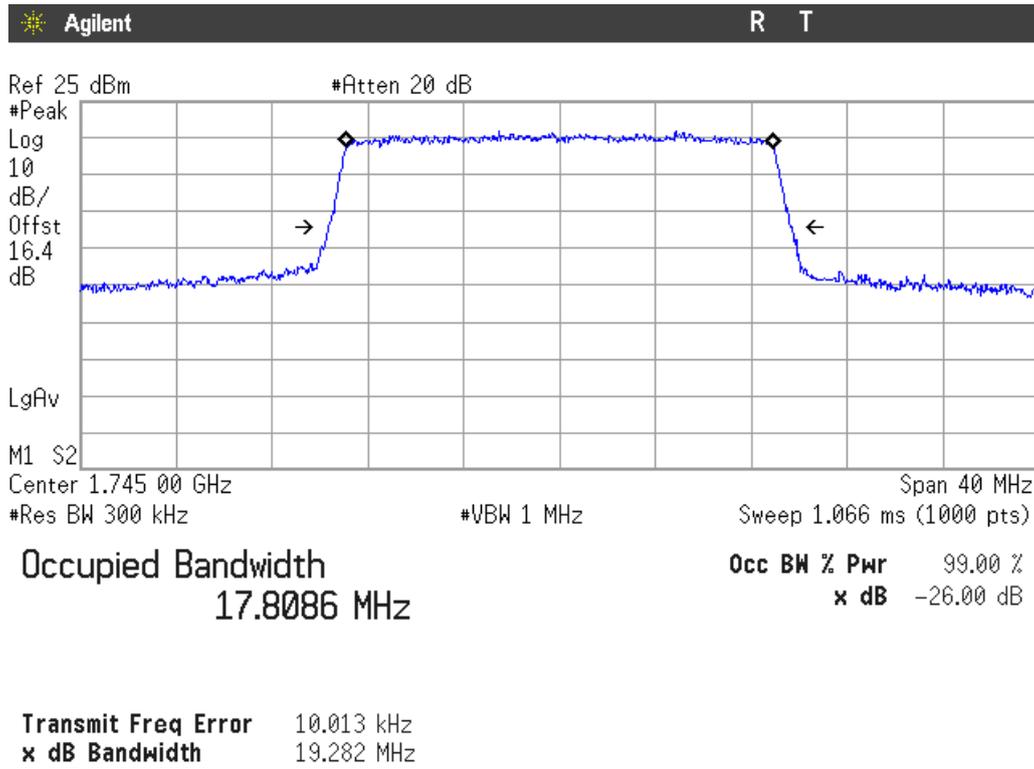
Lowest Channel



Middle Channel

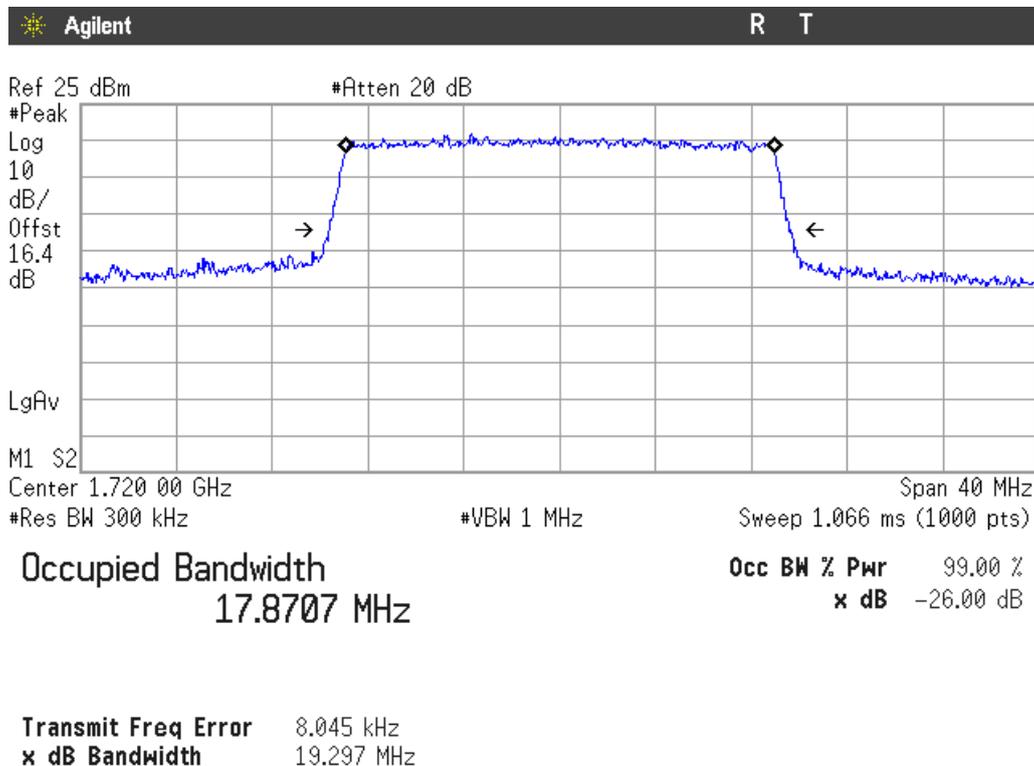


Highest Channel

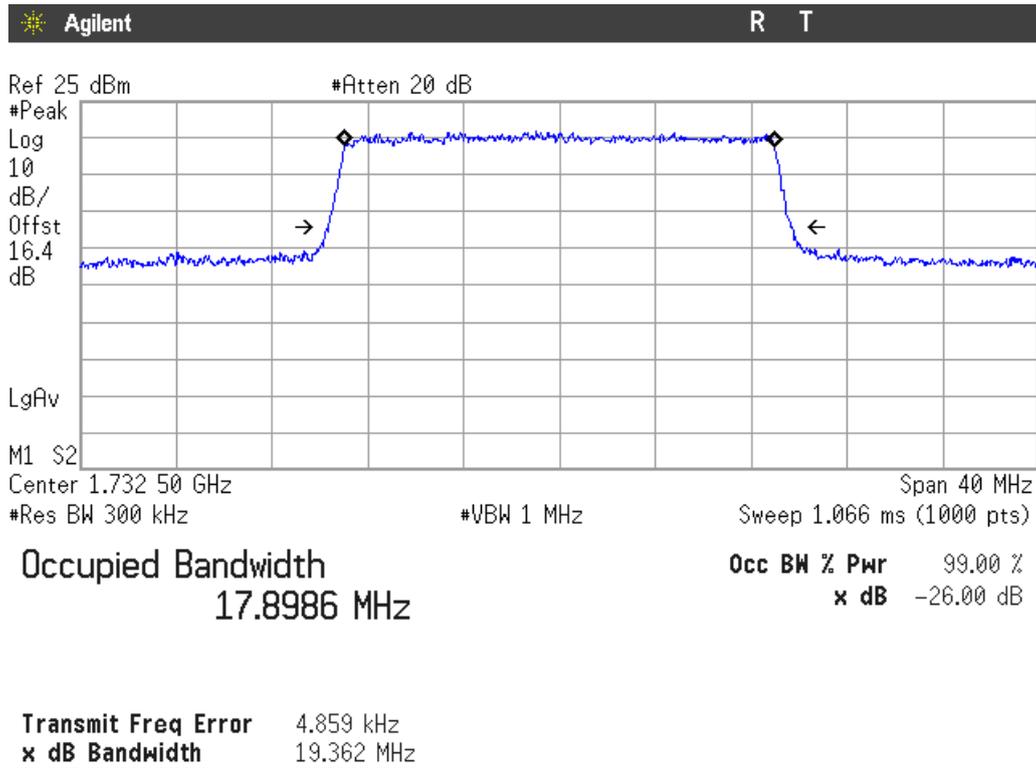


LTE 16QAM MODULATION. BW = 20 MHz (Band IV)

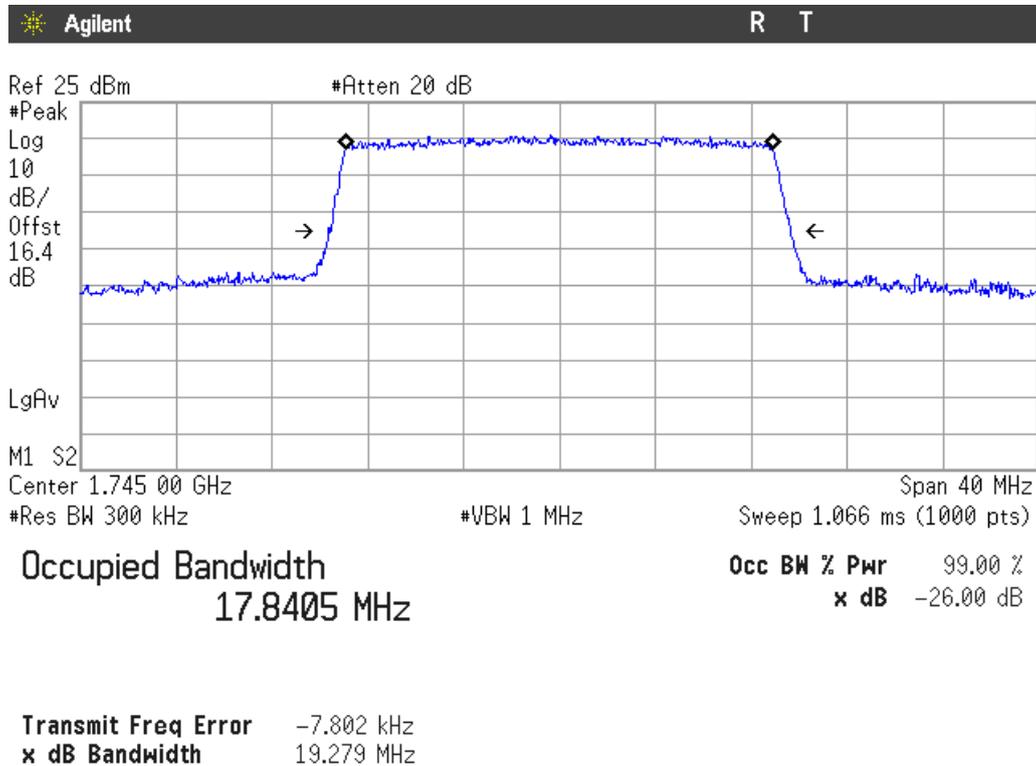
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

LTE BAND IV. FCC §2.1051 and §27.53 (h).

According to specification, 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.

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.

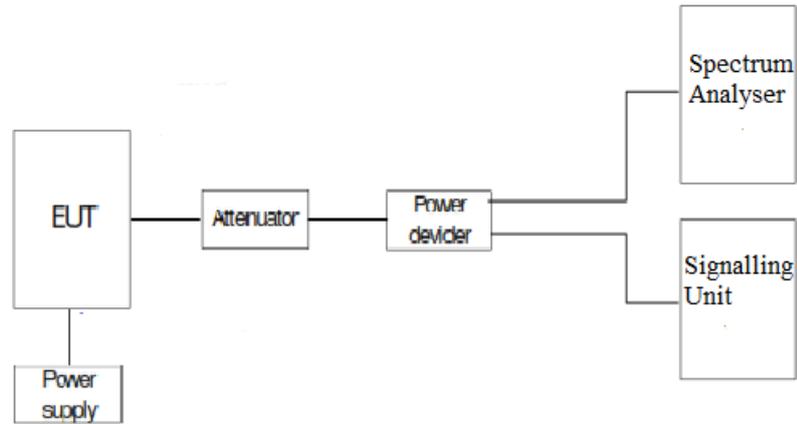
The spectrum was investigated from 9 kHz to 18 GHz for LTE Band IV.

The spectrum was investigated from 9 kHz to 18 GHz for WCDMA and HSUPA Band IV.

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.

For LTE mode 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)

WCDMA MODULATION. Band IV.

1. CHANNEL: LOWEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found at less than 20dB respect to the limit in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

HSUPA MODULATION. Band IV.

1. CHANNEL: LOWEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found at less than 20dB respect to the limit in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

LTE QPSK MODULATION. BW = 1.4 MHz. Band IV

1. CHANNEL: LOWEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.424	-31.92	$< \pm 1.20$

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4641	-31.00	$< \pm 1.20$

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

LTE QPSK MODULATION. BW = 3 MHz. Band IV

1. CHANNEL: LOWEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4677	-31.06	$< \pm 1.20$

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

LTE QPSK MODULATION. BW = 5 MHz. Band IV

1. CHANNEL: LOWEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.429	-32.76	$< \pm 1.20$

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4689	-31.75	$< \pm 1.20$

3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

LTE QPSK MODULATION. BW = 10 MHz. Band IV

1. CHANNEL: LOWEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4389	-30.67	< ± 1.20

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.465	-31.37	< ± 1.20

3. CHANNEL: HIGHEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.505	-35.18	< ± 1.20

LTE QPSK MODULATION. BW = 15 MHz. Band IV

1. CHANNEL: LOWEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.448	-30.67	< ± 1.20

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.478	-32.32	< ± 1.20

3. CHANNEL: HIGHEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4815	-32.74	< ± 1.20

LTE QPSK MODULATION. BW = 20 MHz. Band IV

1. CHANNEL: LOWEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4575	-31.53	< ± 1.20

2. CHANNEL: MIDDLE

No spurious signals were found at less than 20dB respect to the limit in all the range.

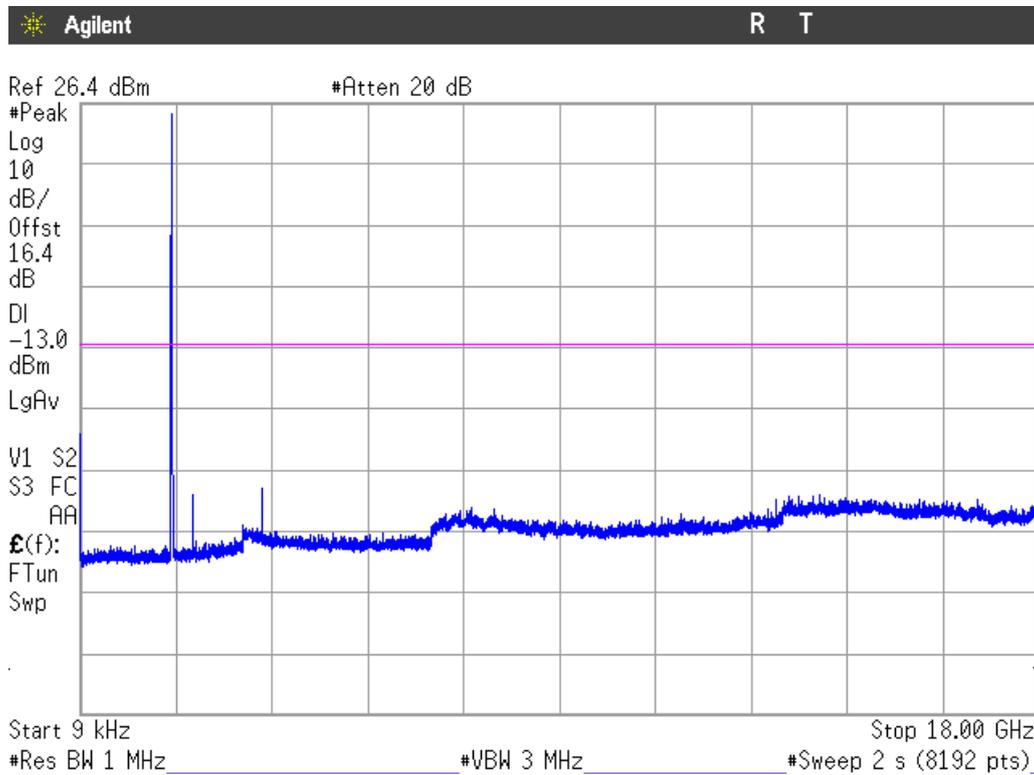
3. CHANNEL: HIGHEST

No spurious signals were found at less than 20dB respect to the limit in all the range.

Verdict: PASS

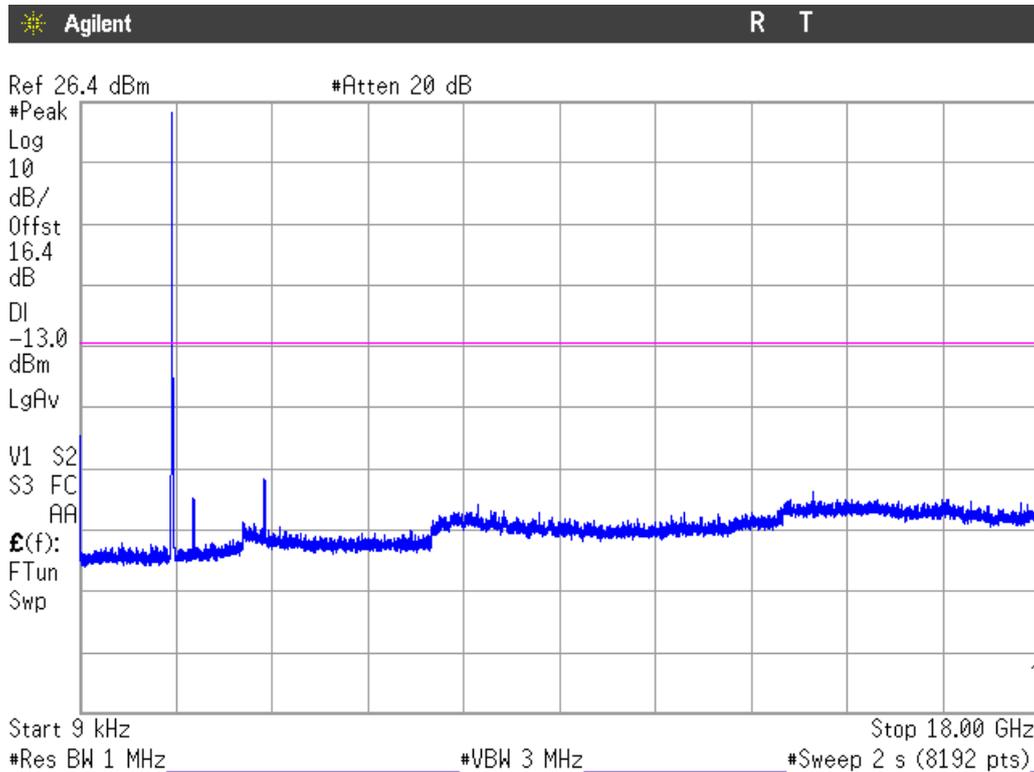
WCDMA MODULATION

1. CHANNEL: LOWEST



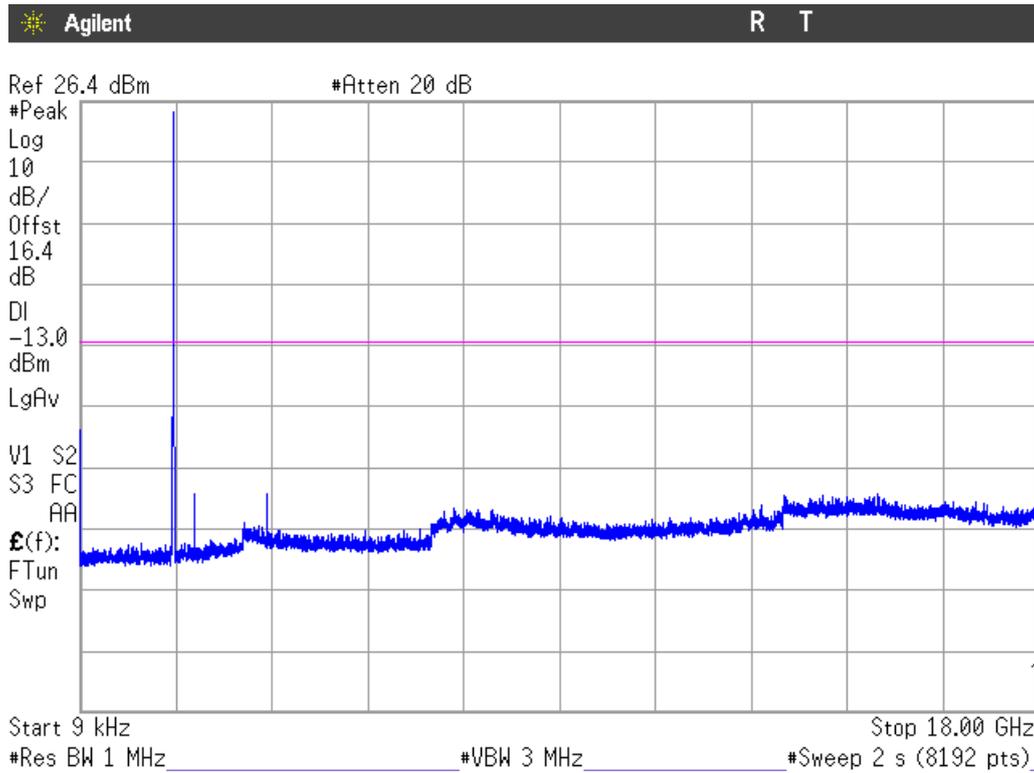
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

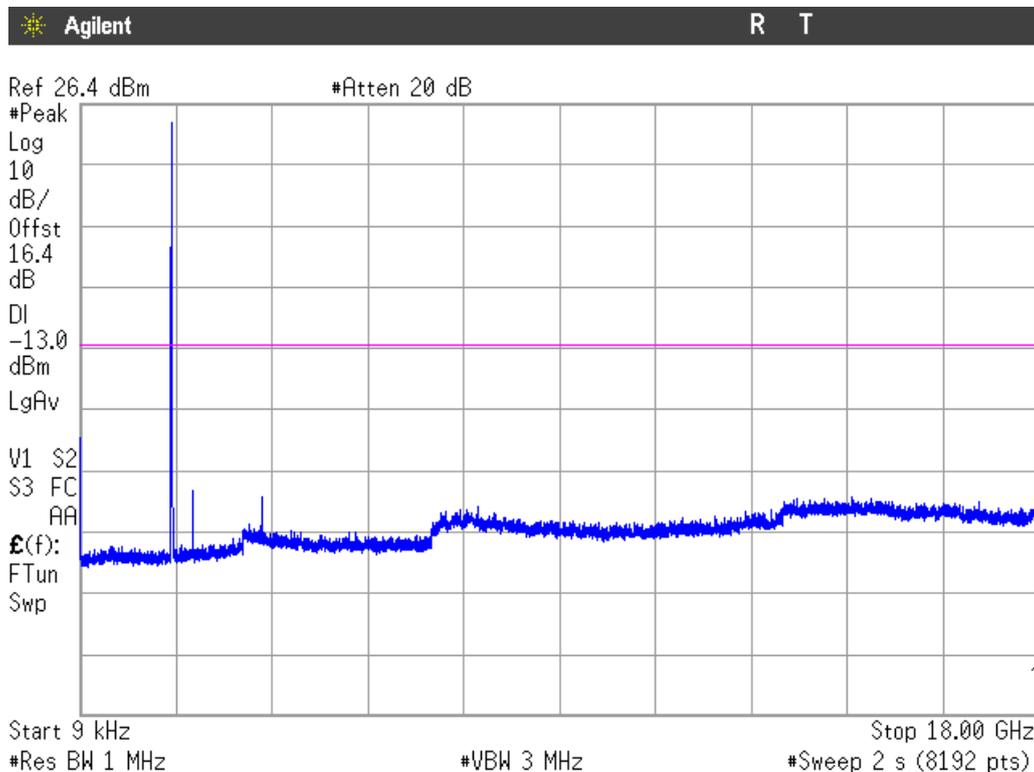
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

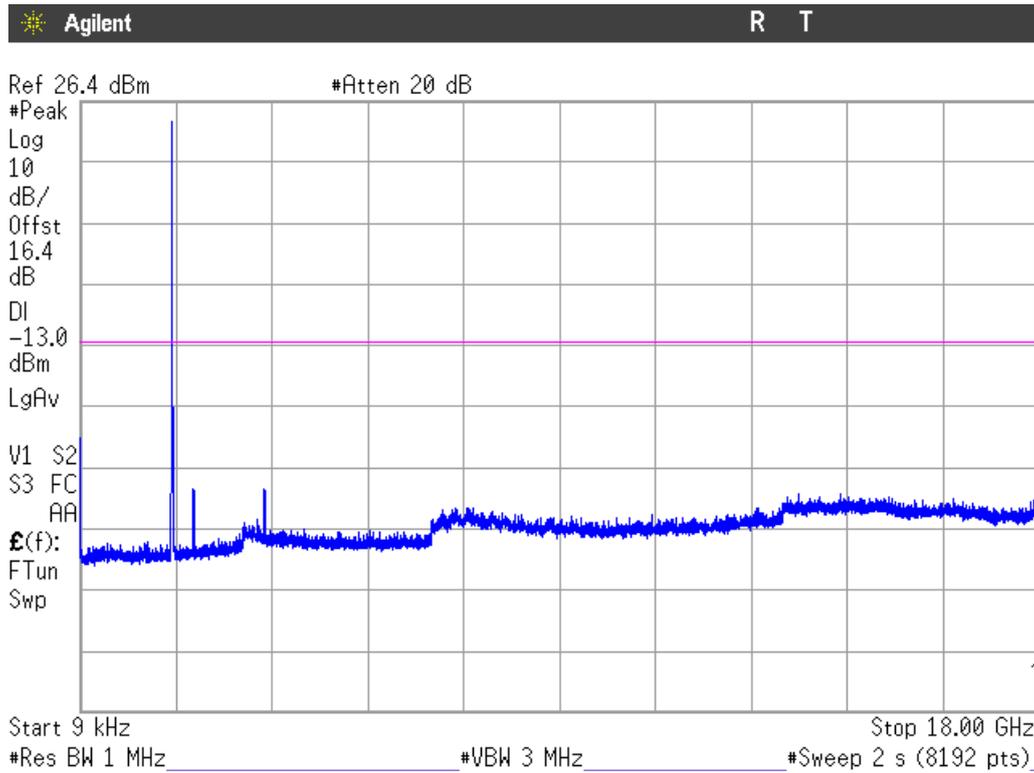
HSUPA MODULATION

1. CHANNEL: LOWEST



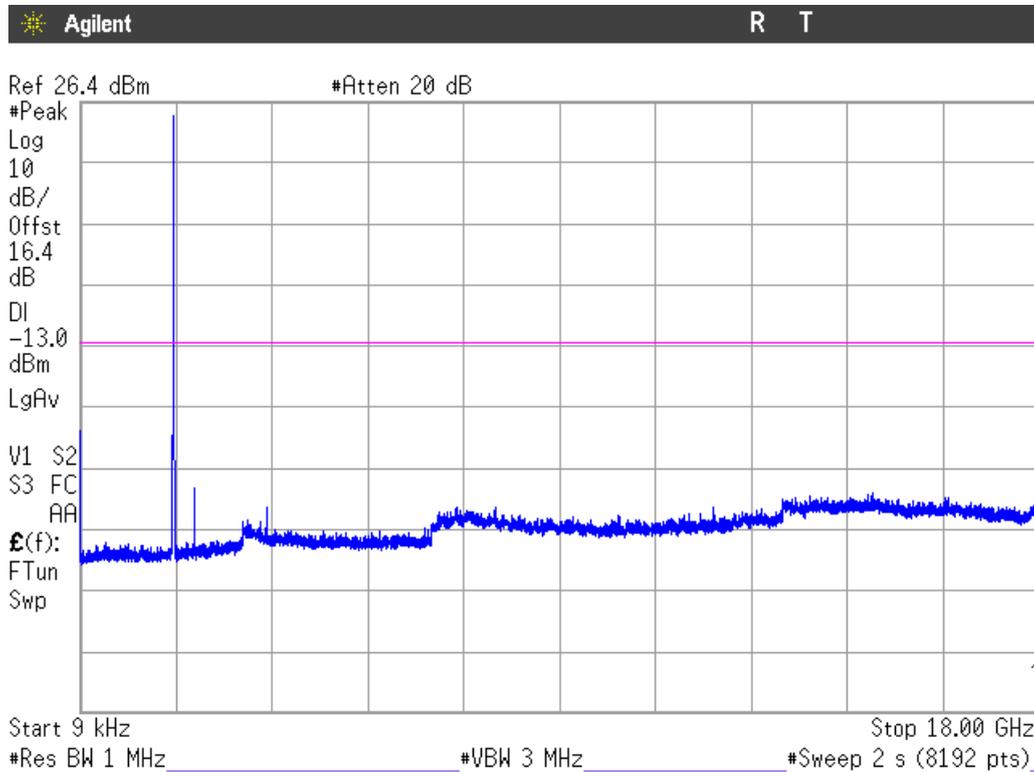
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

3. CHANNEL: HIGHEST

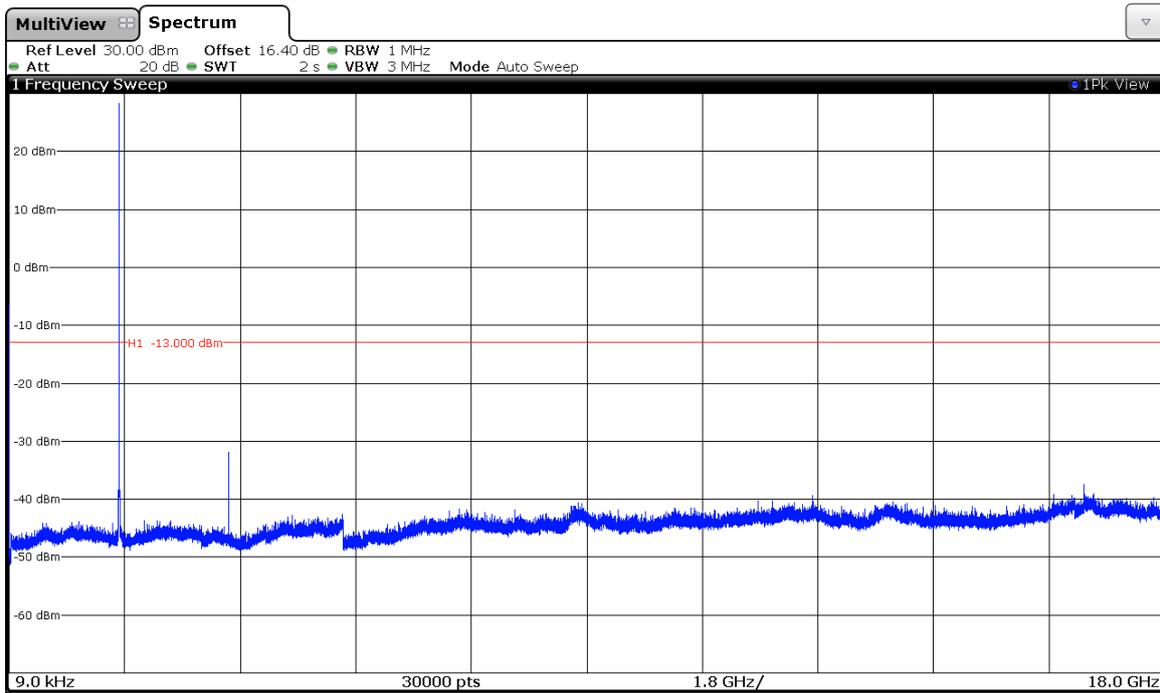


Note: The peak above the limit is the carrier frequency.

Measurement uncertainty (dB)	<±2.03
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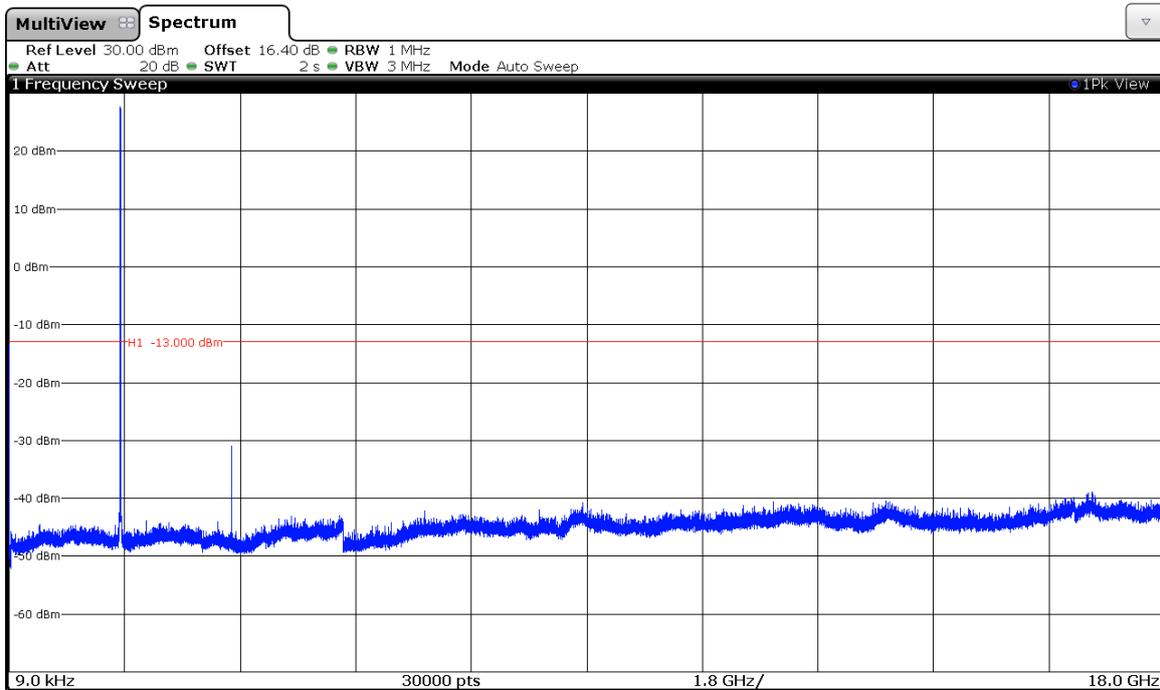
LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)

1. CHANNEL: LOWEST



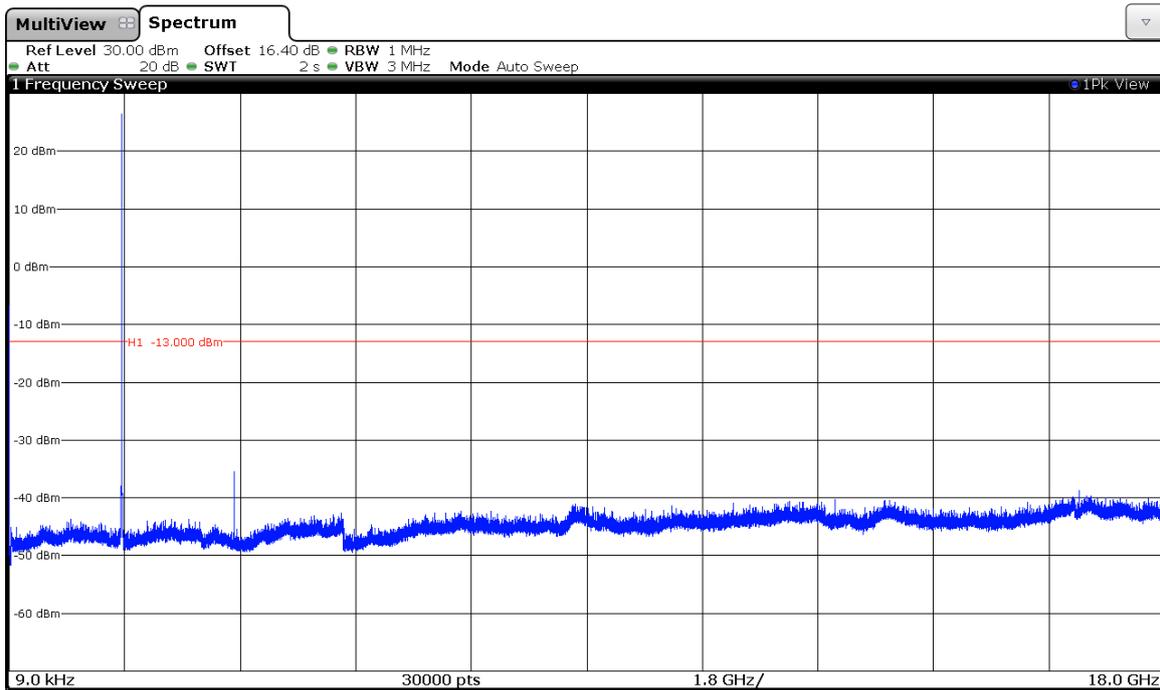
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

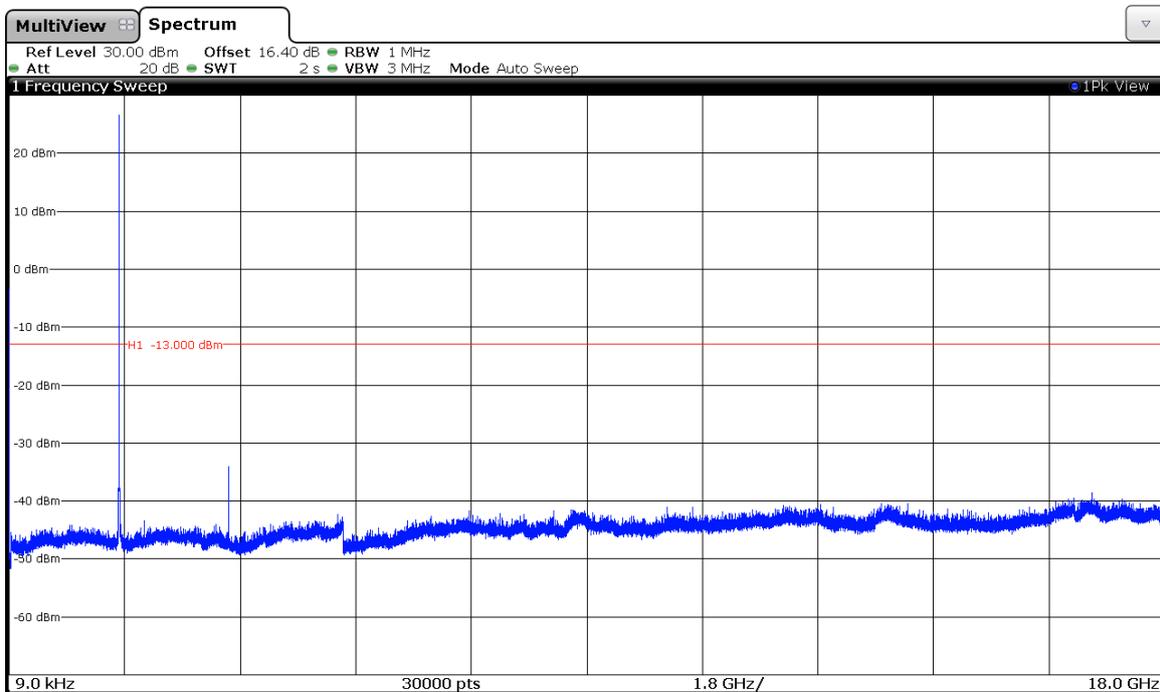
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

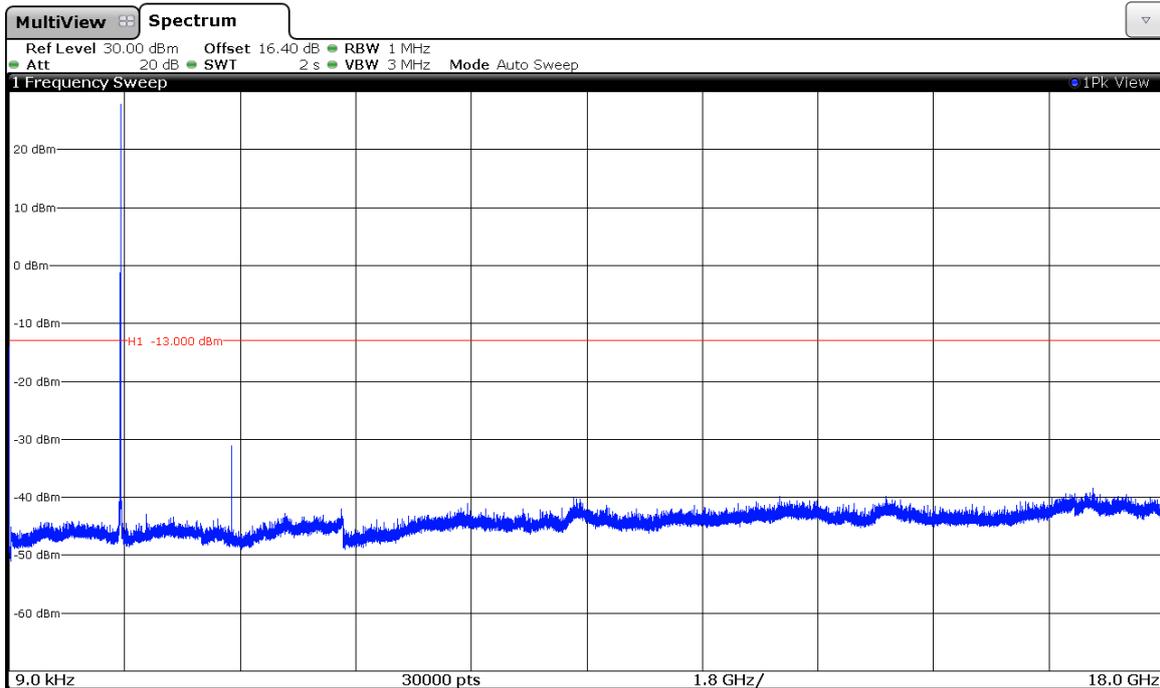
LTE QPSK MODULATION. BW = 3 MHz (Band IV)

1. CHANNEL: LOWEST



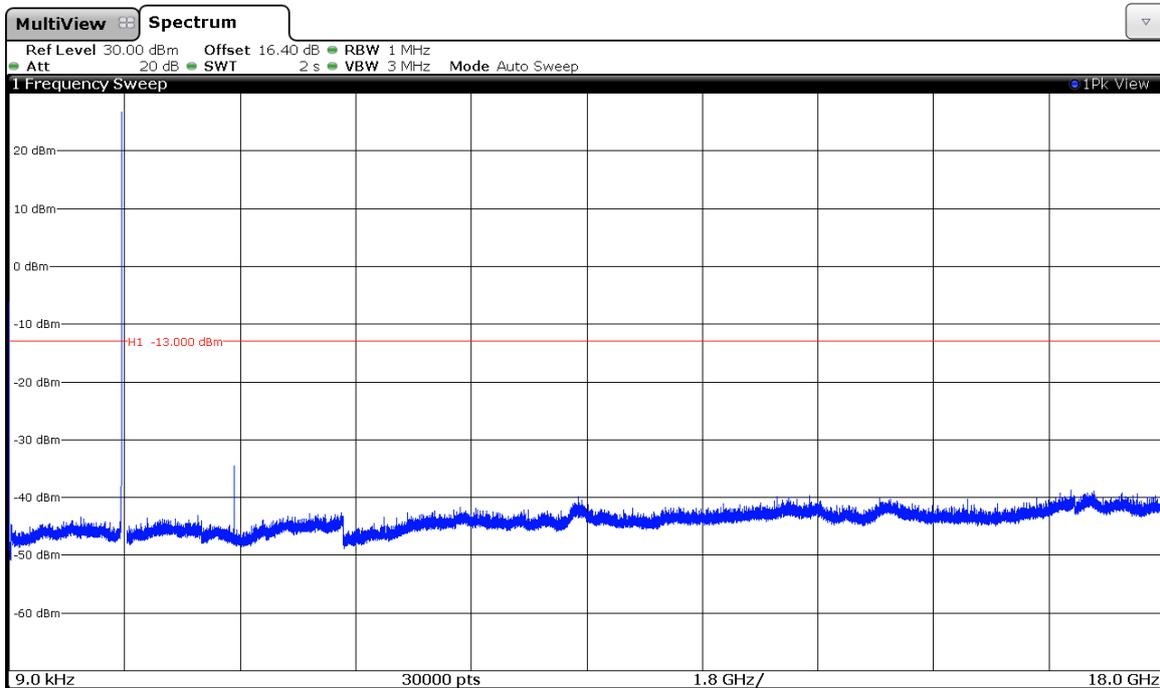
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

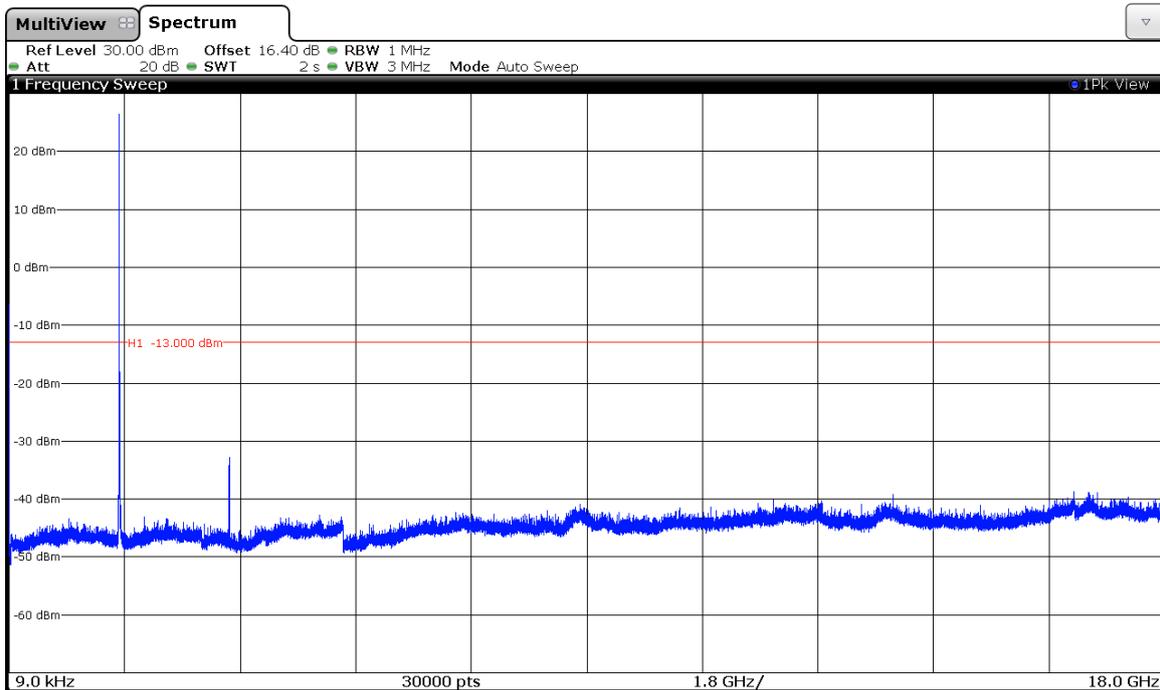
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

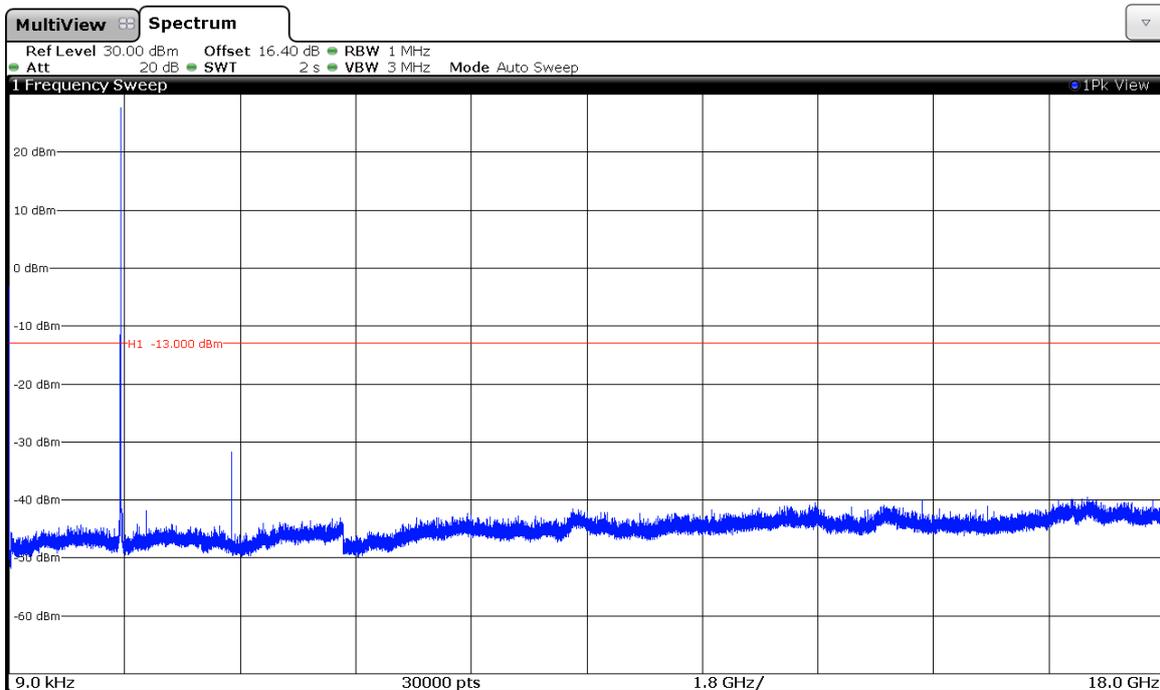
LTE QPSK MODULATION. BW = 5 MHz (Band IV)

1. CHANNEL: LOWEST



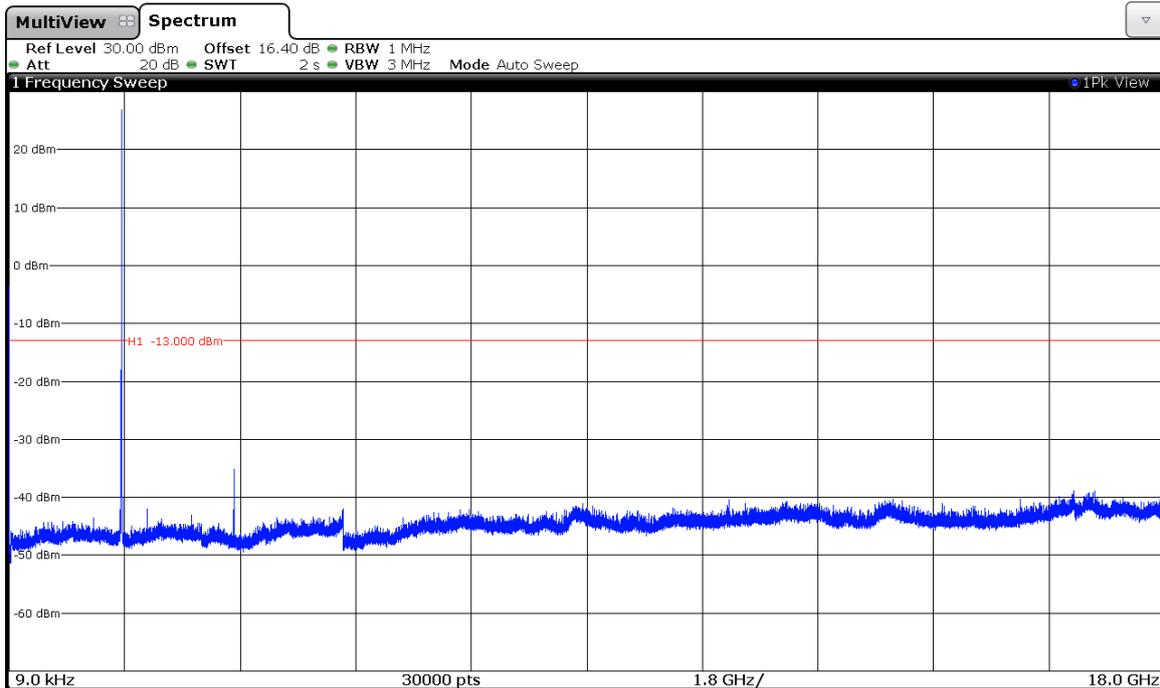
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

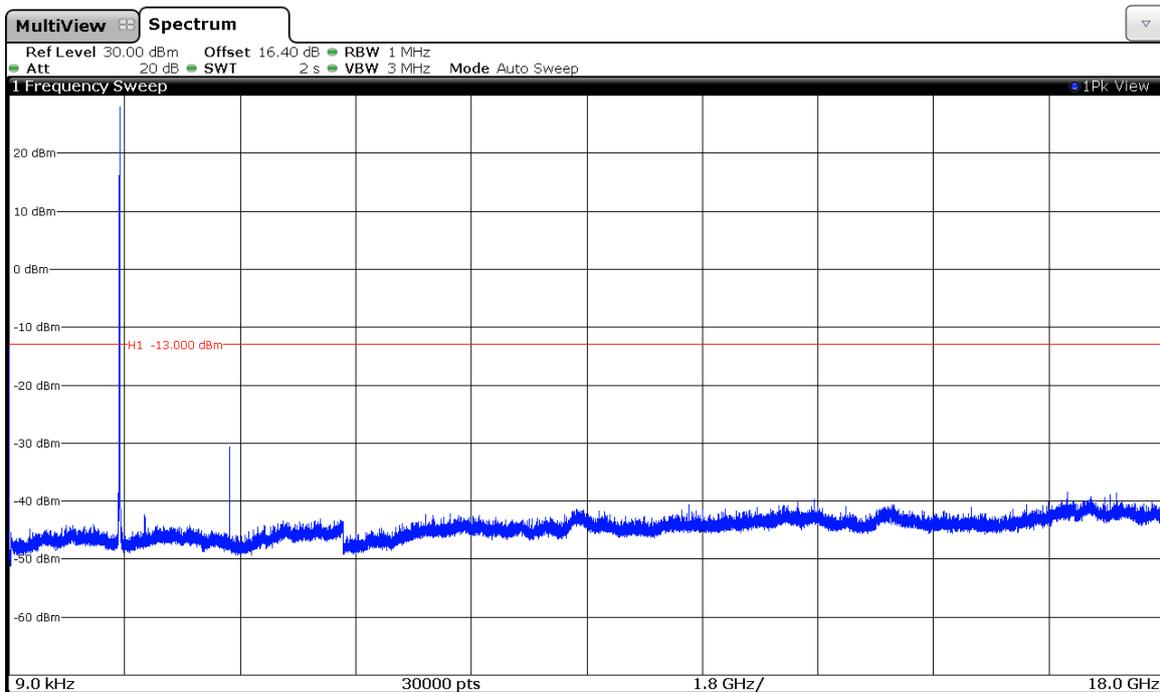
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

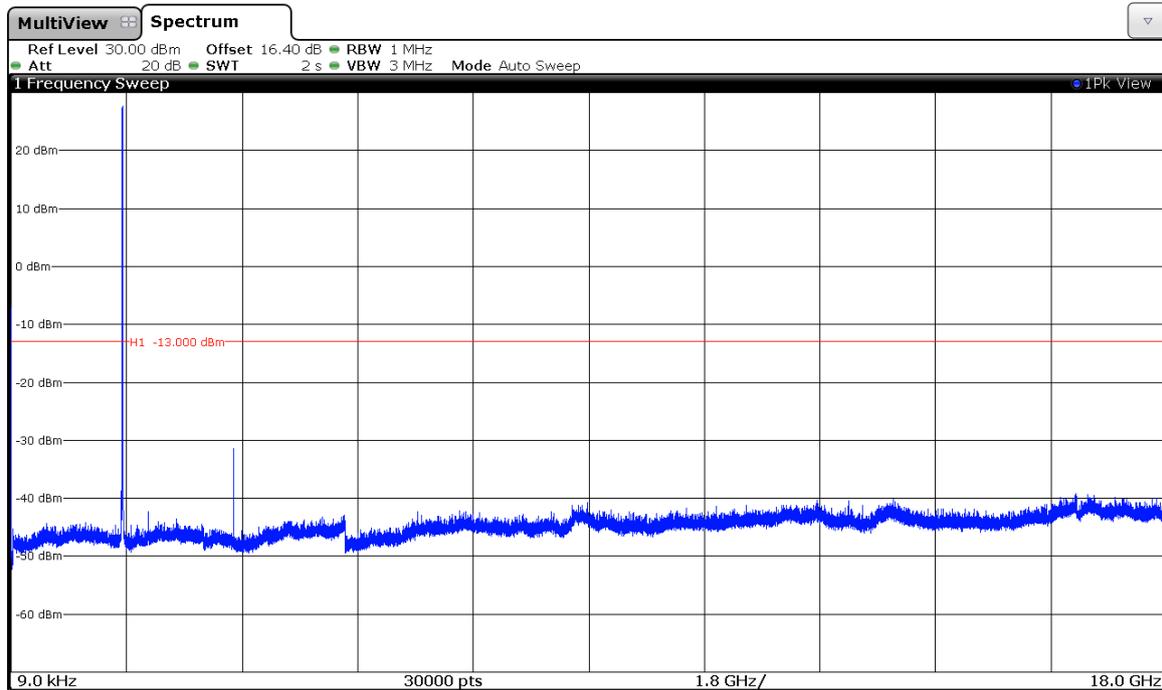
LTE QPSK MODULATION. BW = 10 MHz (Band IV)

1. CHANNEL: LOWEST



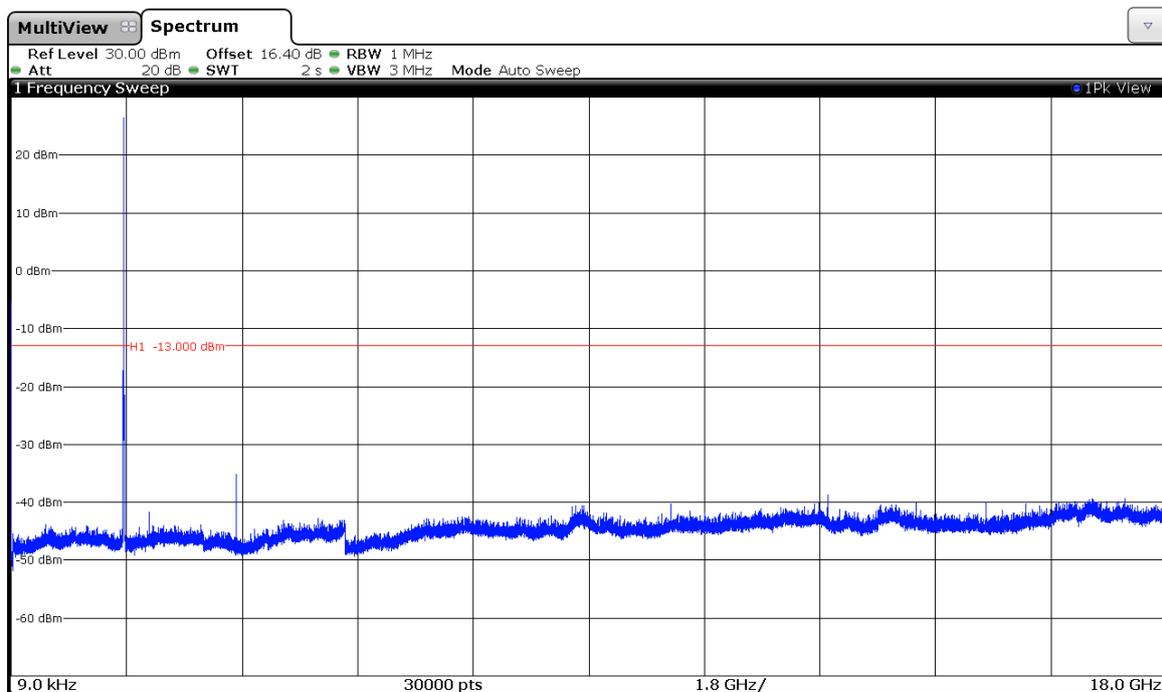
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

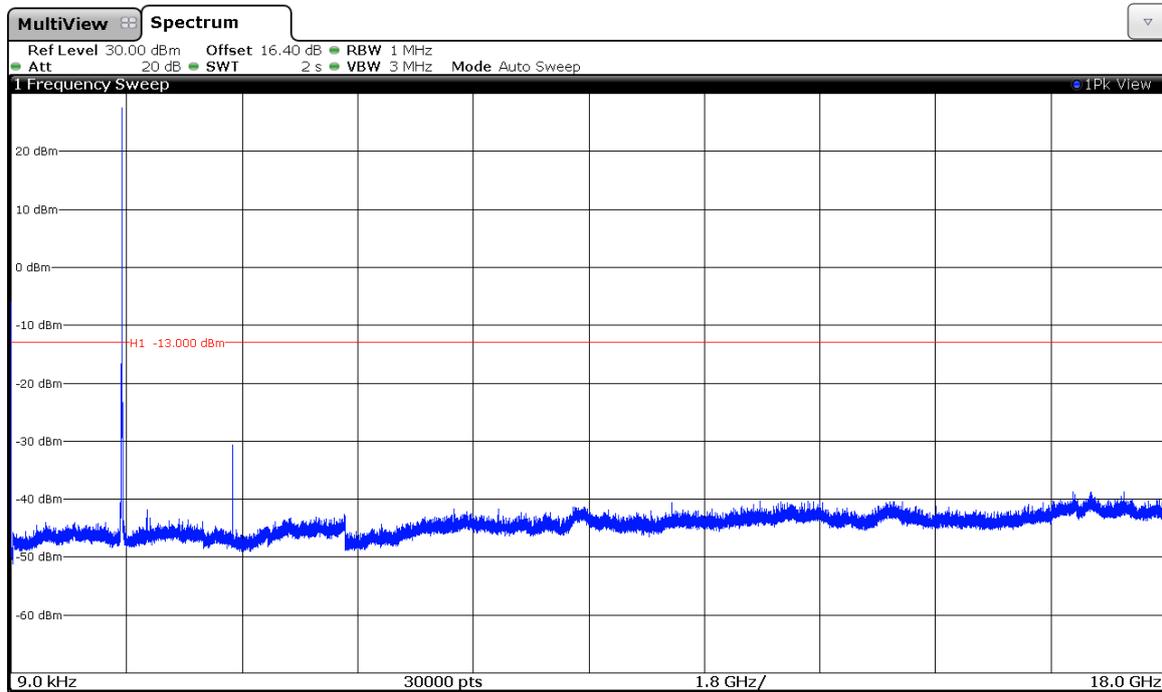
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

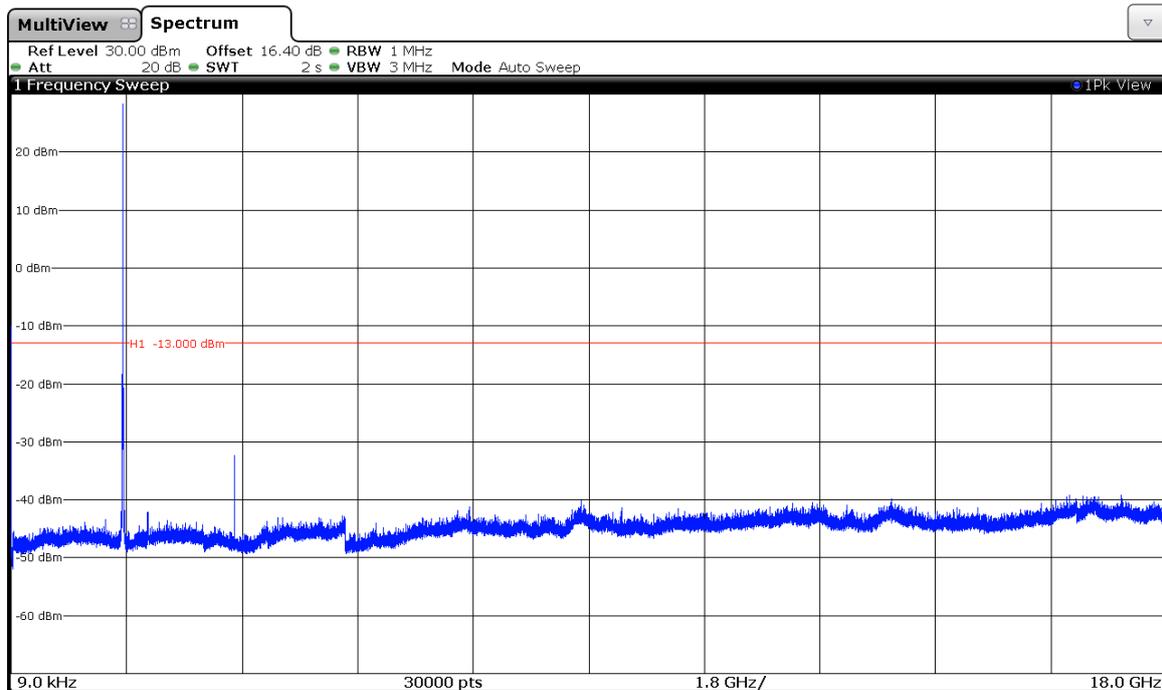
LTE QPSK MODULATION. BW = 15 MHz (Band IV)

1. CHANNEL: LOWEST



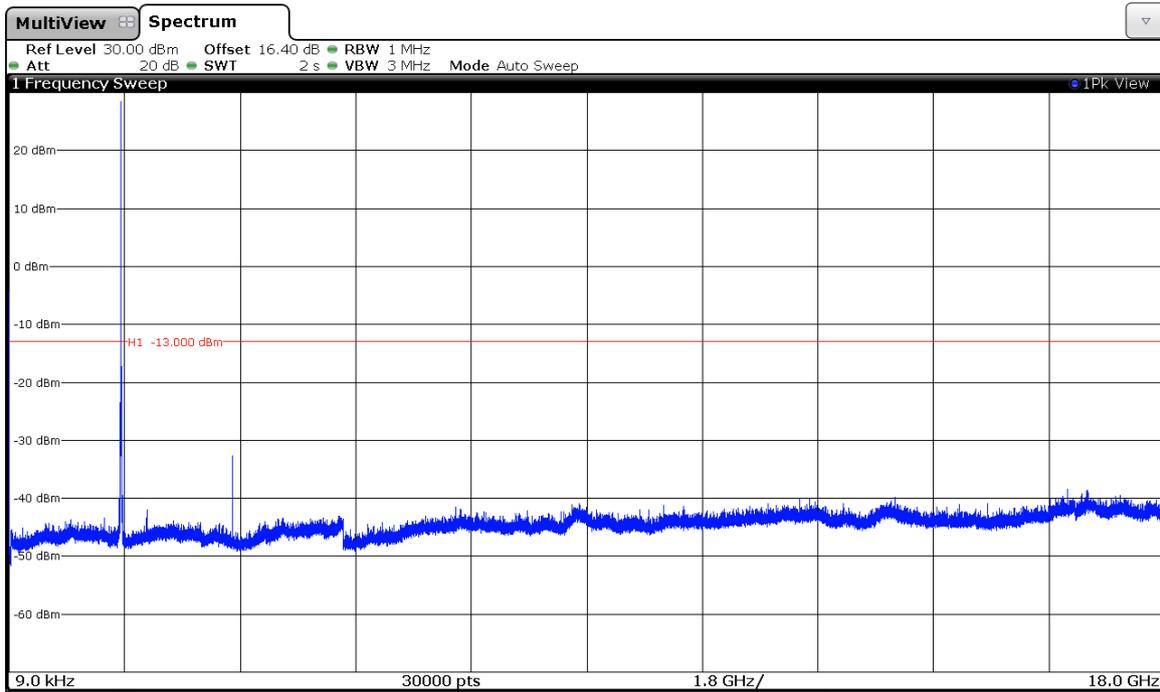
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

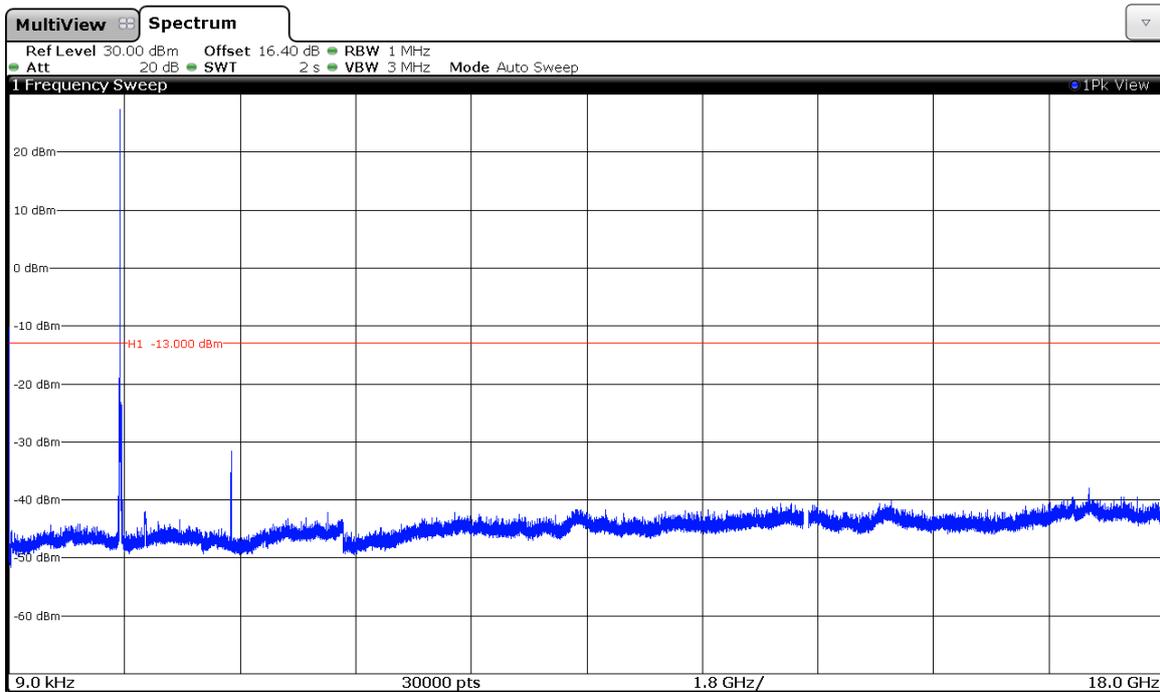
3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

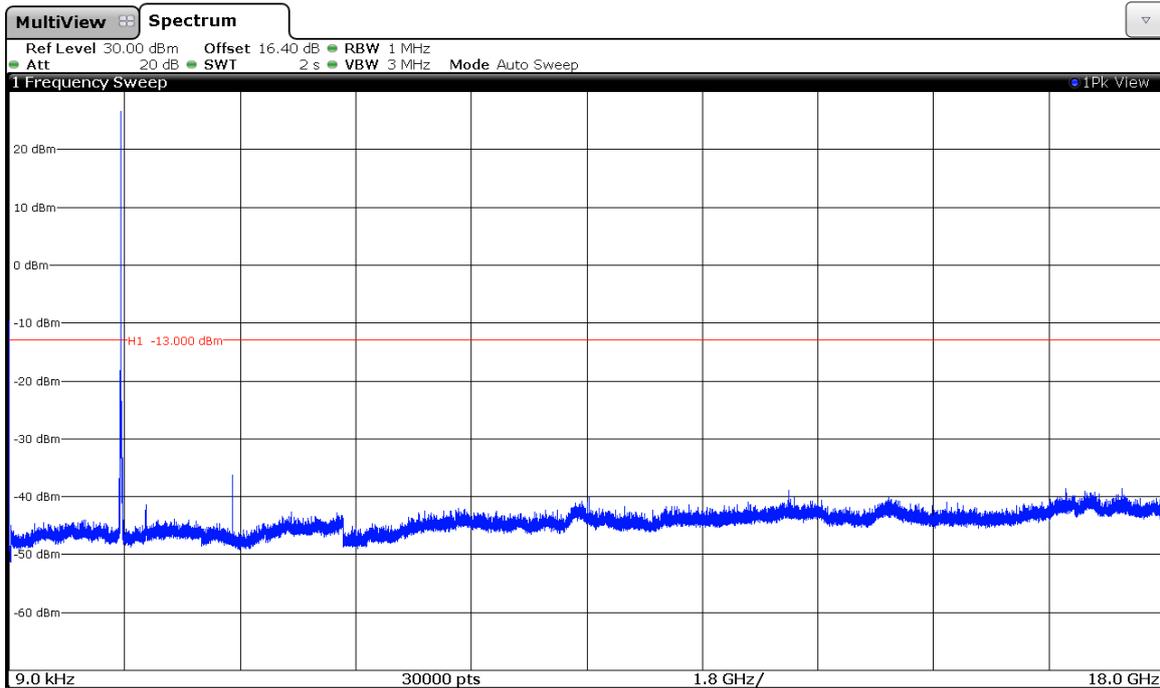
LTE QPSK MODULATION. BW = 20 MHz (Band IV)

1. CHANNEL: LOWEST



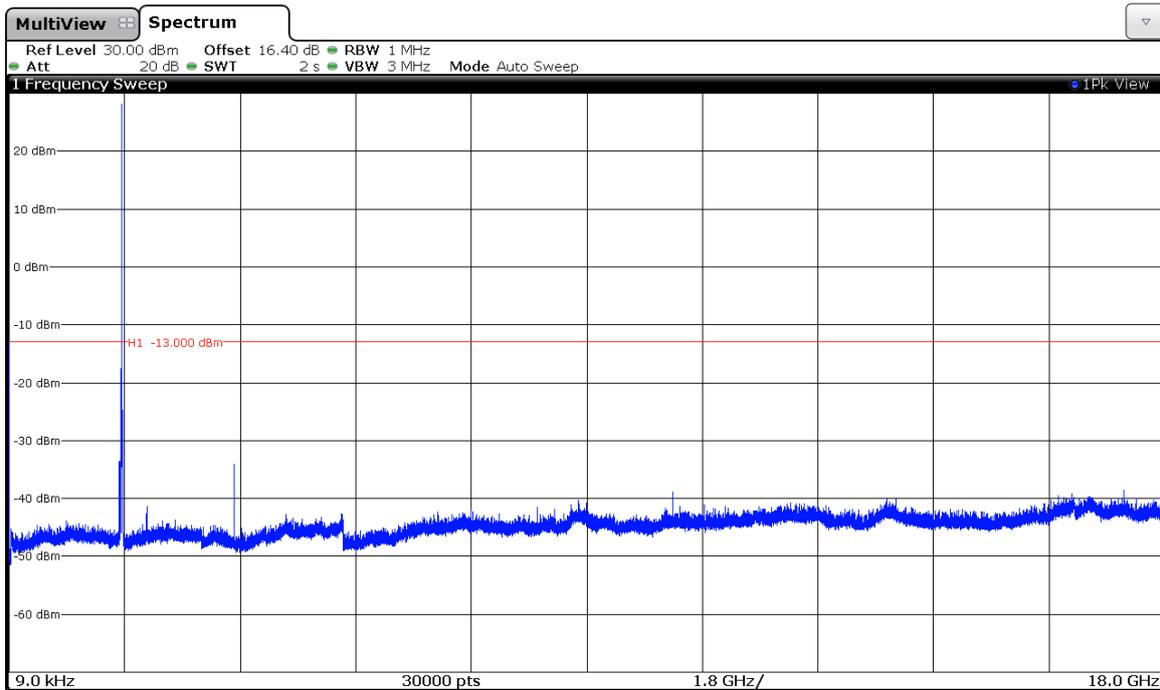
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

3. CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

Spurious emissions at antenna terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §27.53(c) (h).

According to specification, 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 P_o becomes:

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

METHOD

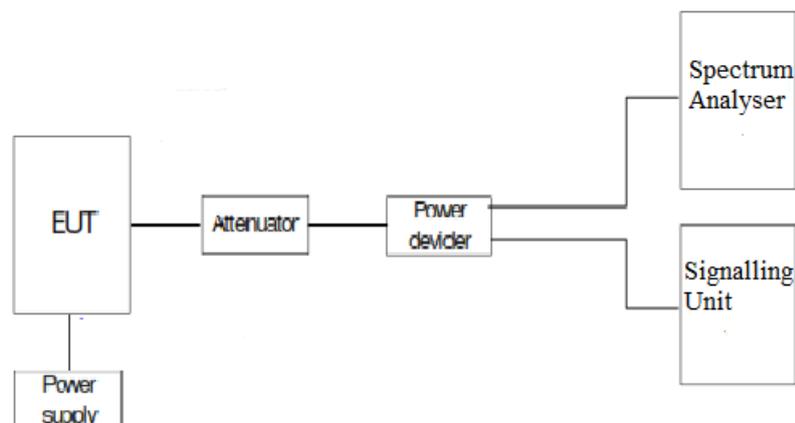
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 ohm attenuator and a power splitter.

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.

For LTE mode the configuration of modulation which is the worst case for conducted power was used.

For LTE Band IV and WCDMA Band IV, as indicated in FCC part 27.53 (h) (3), in the 1 MHz bands immediately outside and adjacent to the licensee's 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)

MODULATION:	WCDMA	HSUPA
Maximum measured level at lowest Block Edge at antenna port (dBm)	-20.88	-21.43
Measurement uncertainty (dB)	<±2.03	

MODULATION:	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-20.34	-21.56
Measurement uncertainty (dB)	<±2.03	

LTE QPSK MODULATION (Channels in Band IV):	RB=1, Offset=0, BW=1.4 MHz	RB=1, Offset =0, BW = 3 MHz	RB=1, Offset =0, BW = 5 MHz	RB=1, Offset =0, BW = 10 MHz	RB=1, Offset =0, BW = 15 MHz	RB=1, Offset =0, BW = 20 MHz
Maximum measured level at lowest Block Edge at antenna port (dBm)	-21.91	-20.22	-21.57	-31.77	-27.97	-30.82

LTE QPSK MODULATION: (Channels in Band IV):	RB= All, Offset=0, BW=1.4 MHz	RB= All, Offset =0, BW = 3 MHz	RB= All, Offset =0, BW = 5 MHz	RB= All, Offset =0, BW = 10 MHz	RB= All, Offset =0, BW = 15 MHz	RB= All, Offset =0, BW = 20 MHz
Maximum measured level at lowest Block Edge at antenna port (dBm)	-30.15	-28.16	-27.76	-28.24	-25.85	-25.97

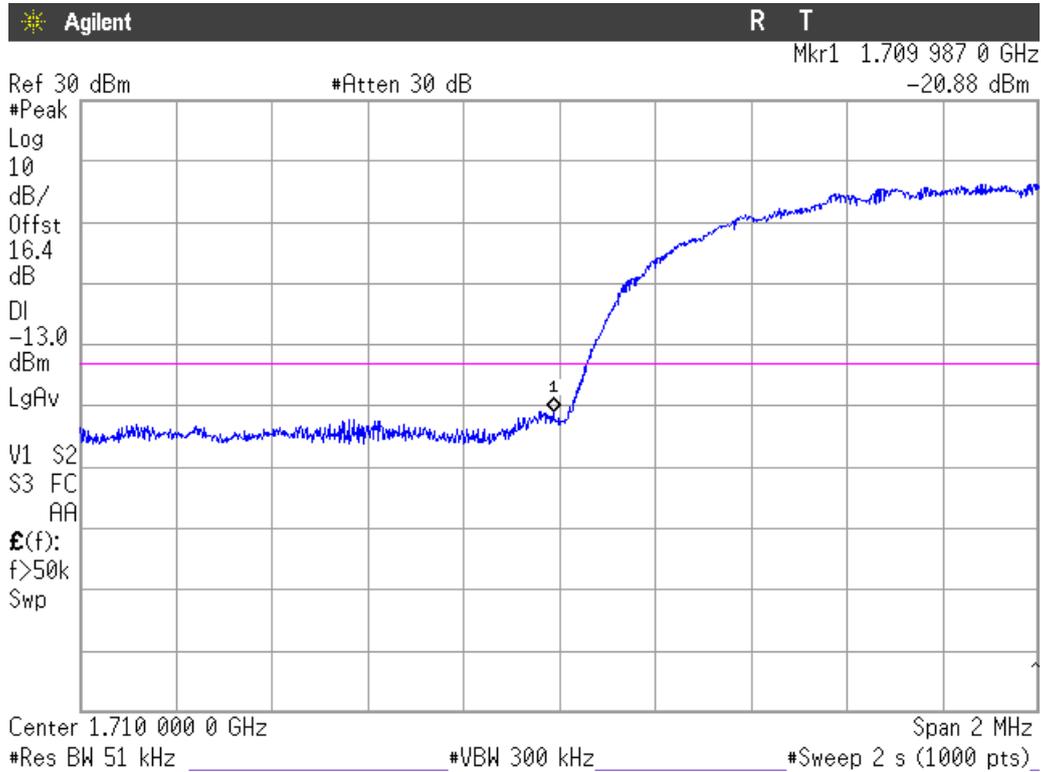
LTE QPSK MODULATION: (Channels in Band IV):	RB= 1, Offset=Max, BW=1.4 MHz	RB= 1, Offset=Max, BW = 3 MHz	RB= 1, Offset=Max, BW = 5 MHz	RB= 1, Offset=Max, BW = 10 MHz	RB= 1, Offset=Max, BW = 15 MHz	RB= 1, Offset=Max, BW = 20 MHz
Maximum measured level at highest Block Edge at antenna port (dBm)	-21.70	-20.49	-22.83	-33.68	-29.33	-31.66

LTE QPSK MODULATION: (Channels in Band IV):	RB= All, Offset=0, BW=1.4 MHz	RB= All, Offset =0, BW = 3 MHz	RB= All, Offset =0, BW = 5 MHz	RB= All, Offset =0, BW = 10 MHz	RB= All, Offset =0, BW = 15 MHz	RB= All, Offset =0, BW = 20 MHz
Maximum measured level at highest Block Edge at antenna port (dBm)	-30.30	-29.92	-30.01	-32.37	-33.13	-31.57

Measurement uncertainty = ± 2.03 dB.

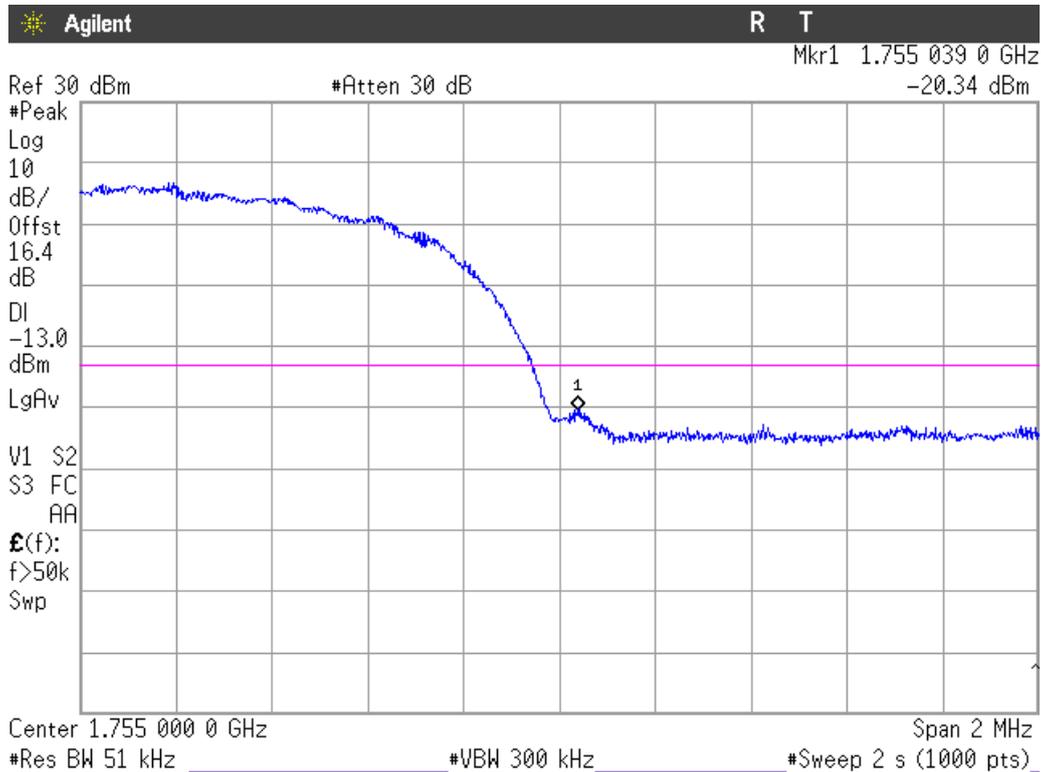
WCDMA MODULATION

CHANNEL LOWEST



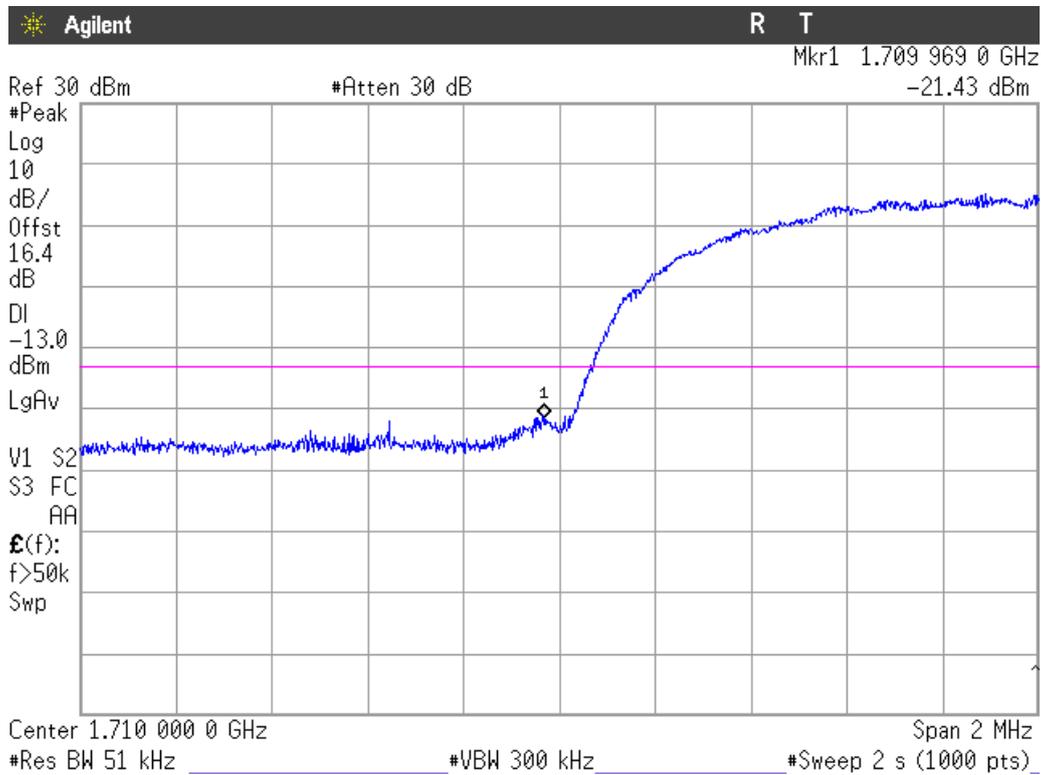
NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



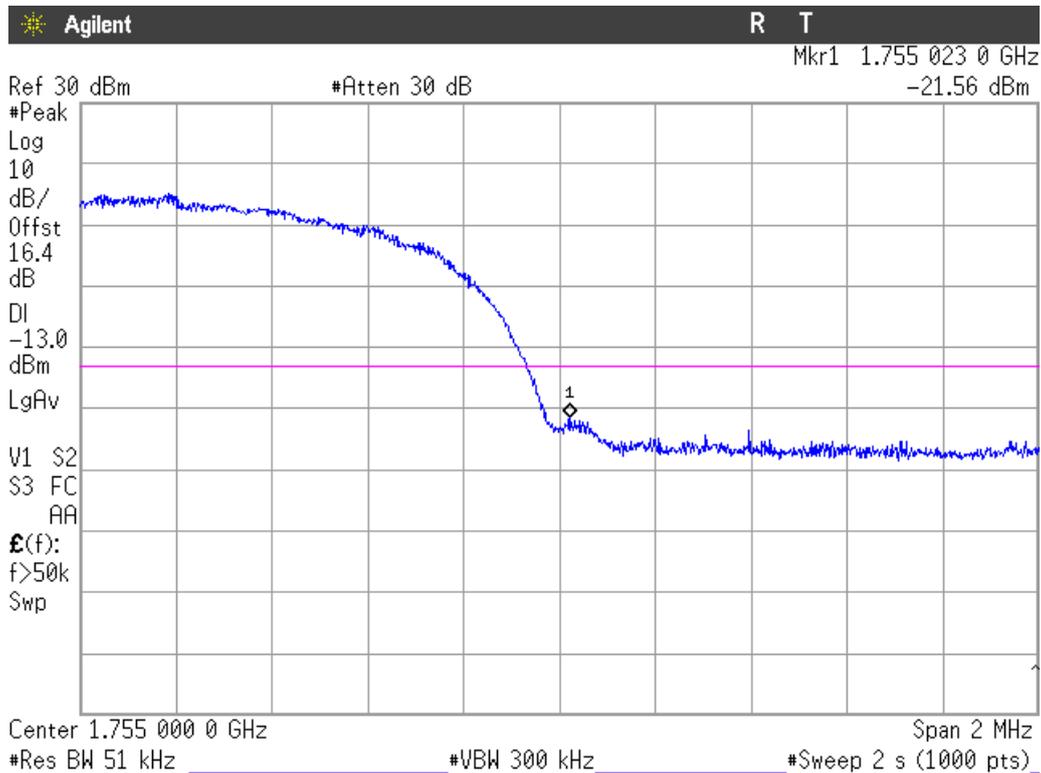
NOTE: The equipment transmits at the maximum output power

HSUPA MODULATION
 CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

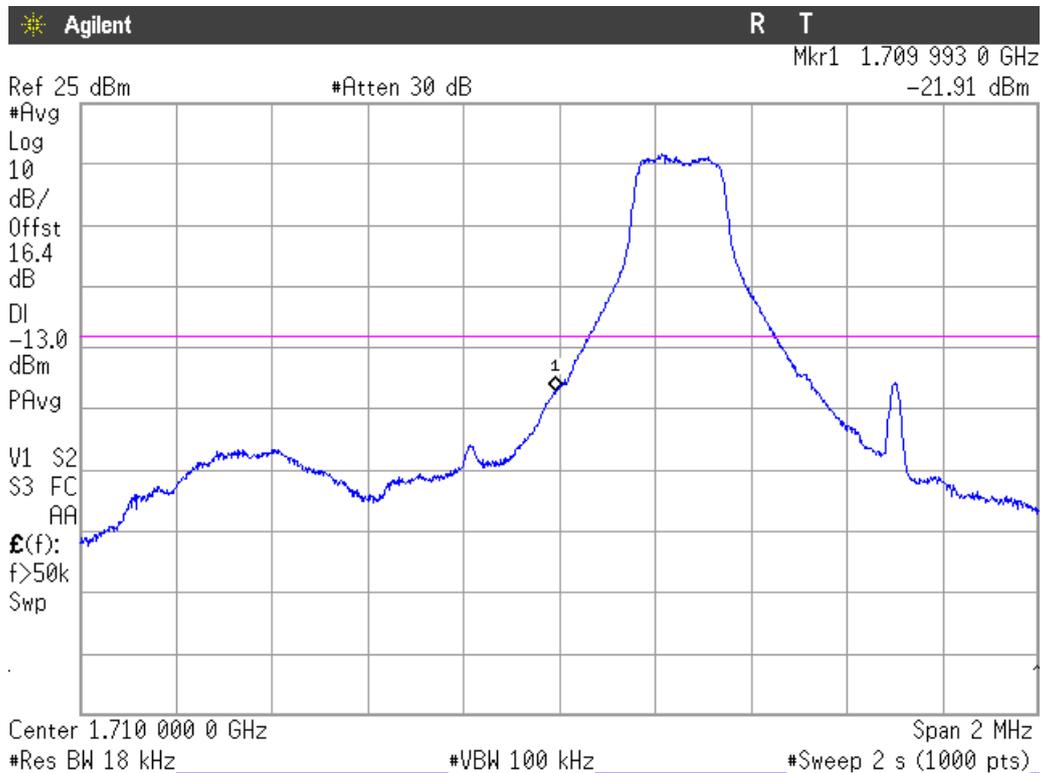
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

LTE QPSK MODULATION. RB = 1, Offset = 0, BW = 1.4 MHz (Band IV)

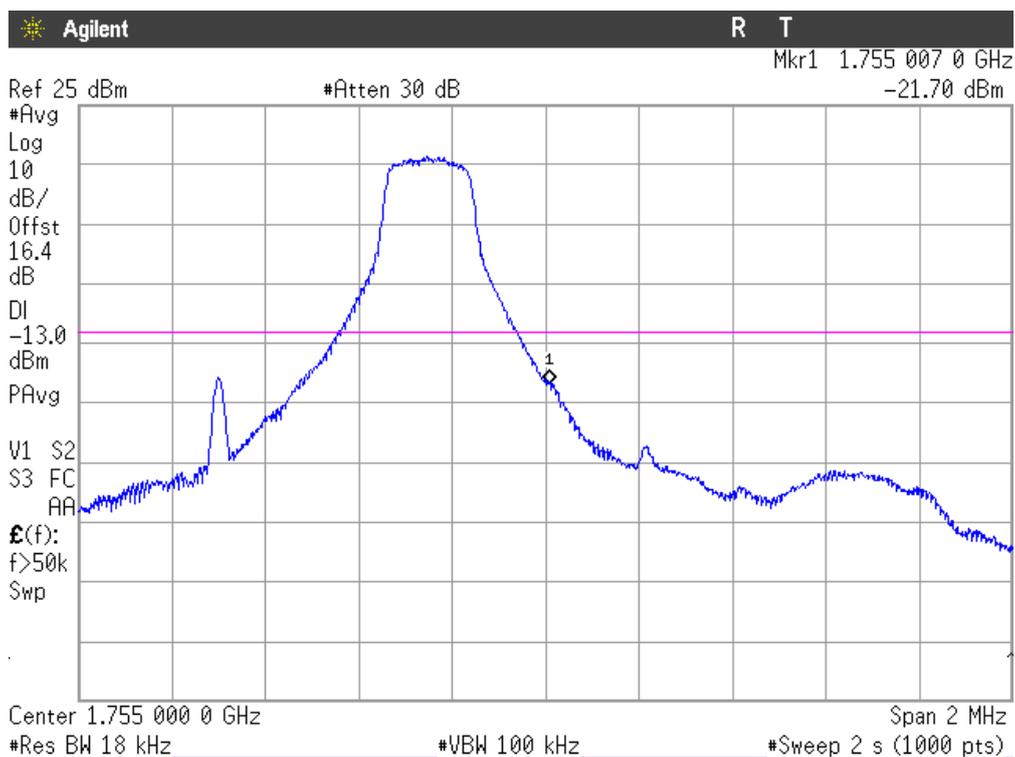
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

LTE QPSK MODULATION. RB = 1, Offset = Max, BW = 1.4 MHz (Band IV)

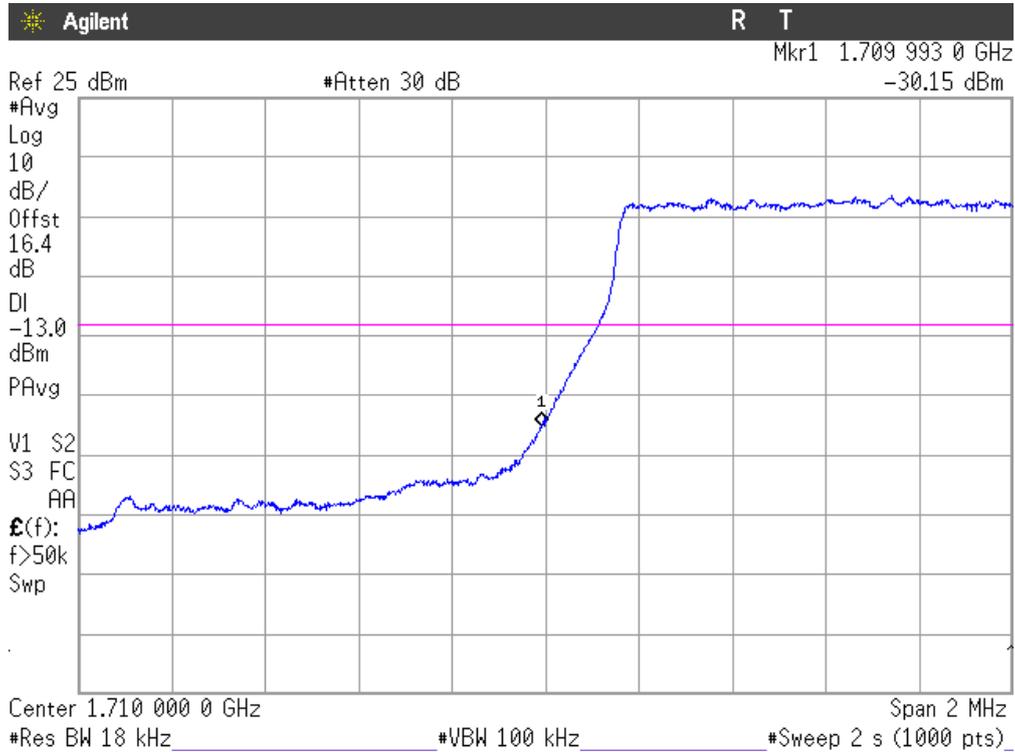
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

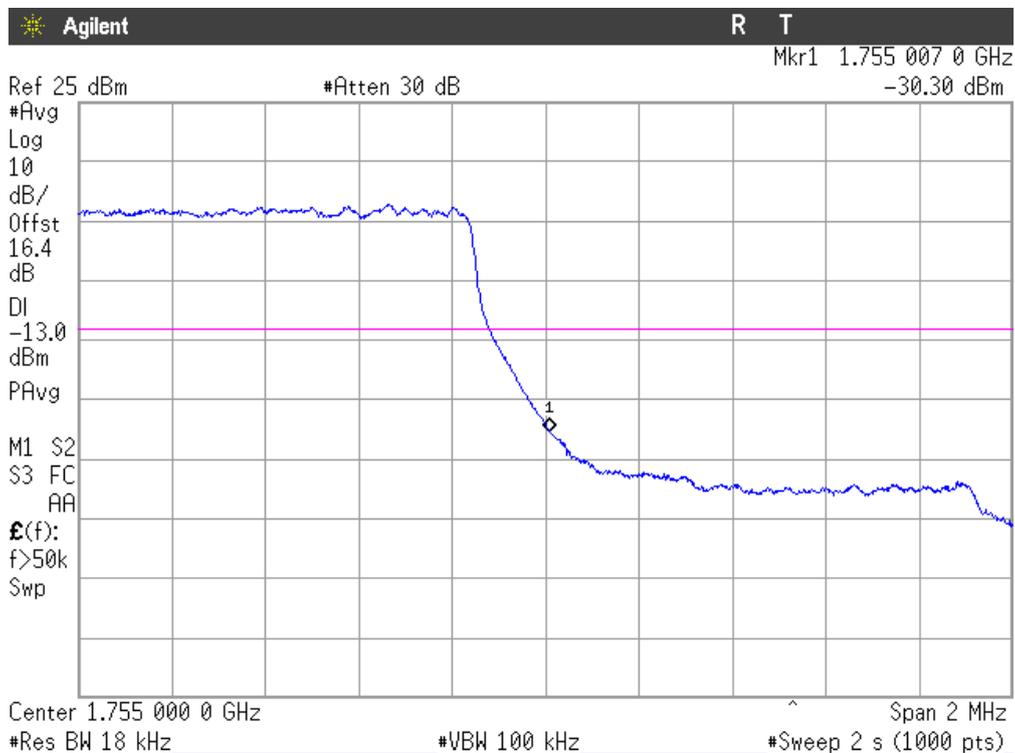
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 1.4 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

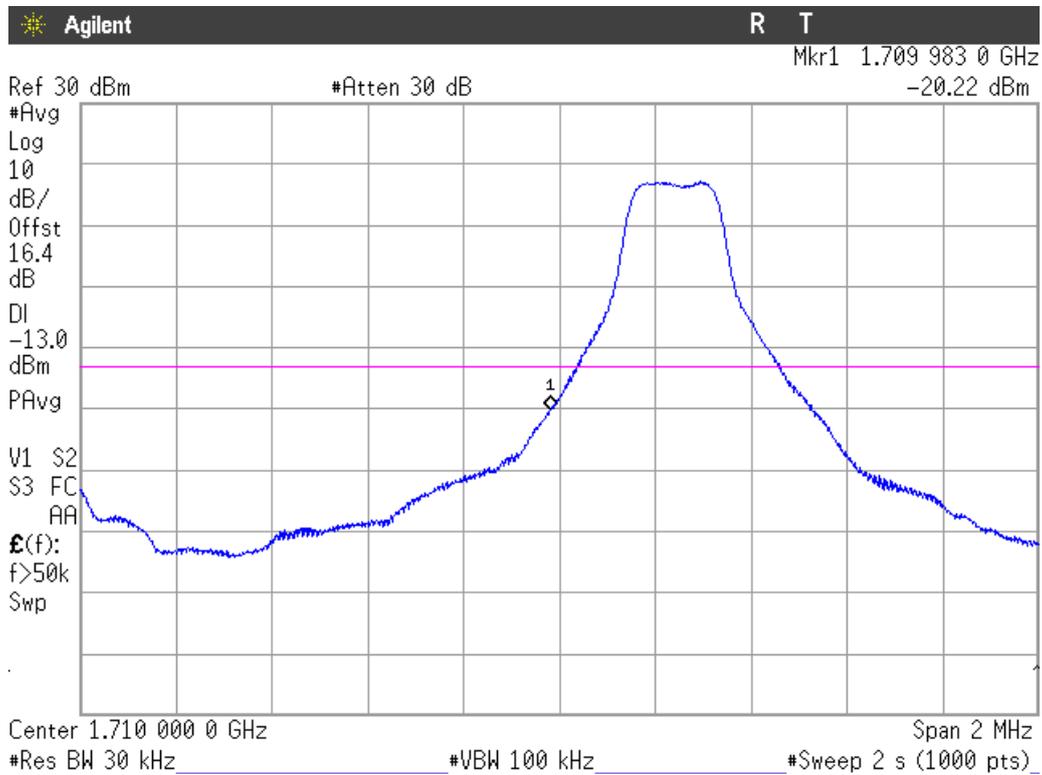


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

LTE QPSK MODULATION. RB = 1, Offset = 0, BW = 3 MHz (Band IV)

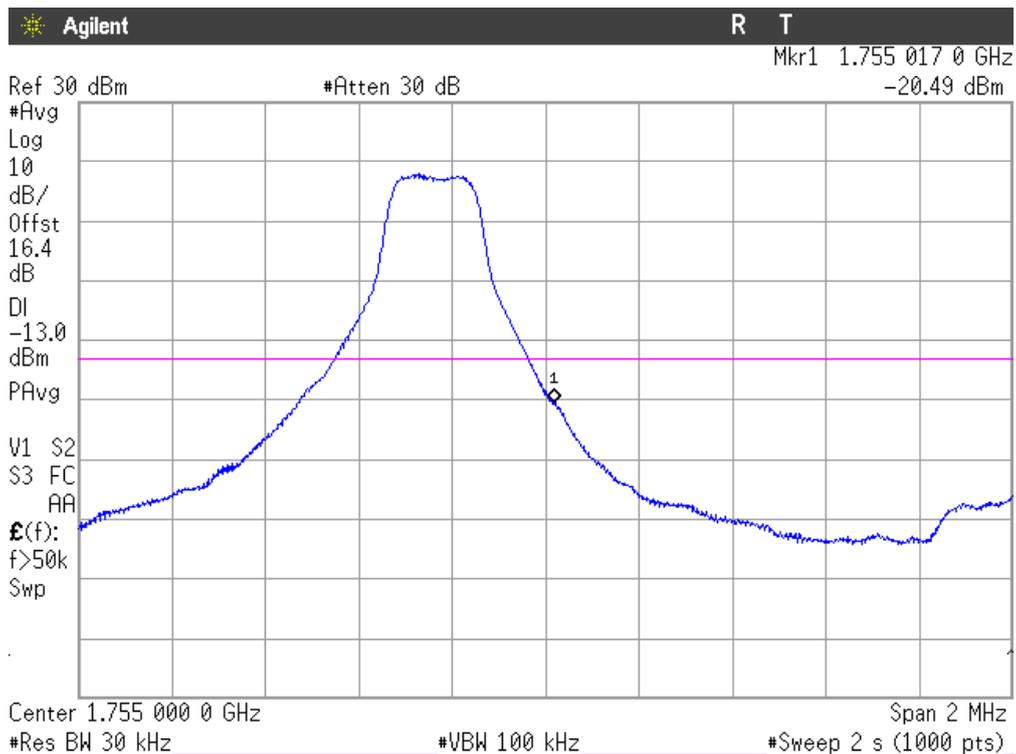
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

LTE QPSK MODULATION. RB = 1, Offset = Max, BW = 3 MHz (Band IV)

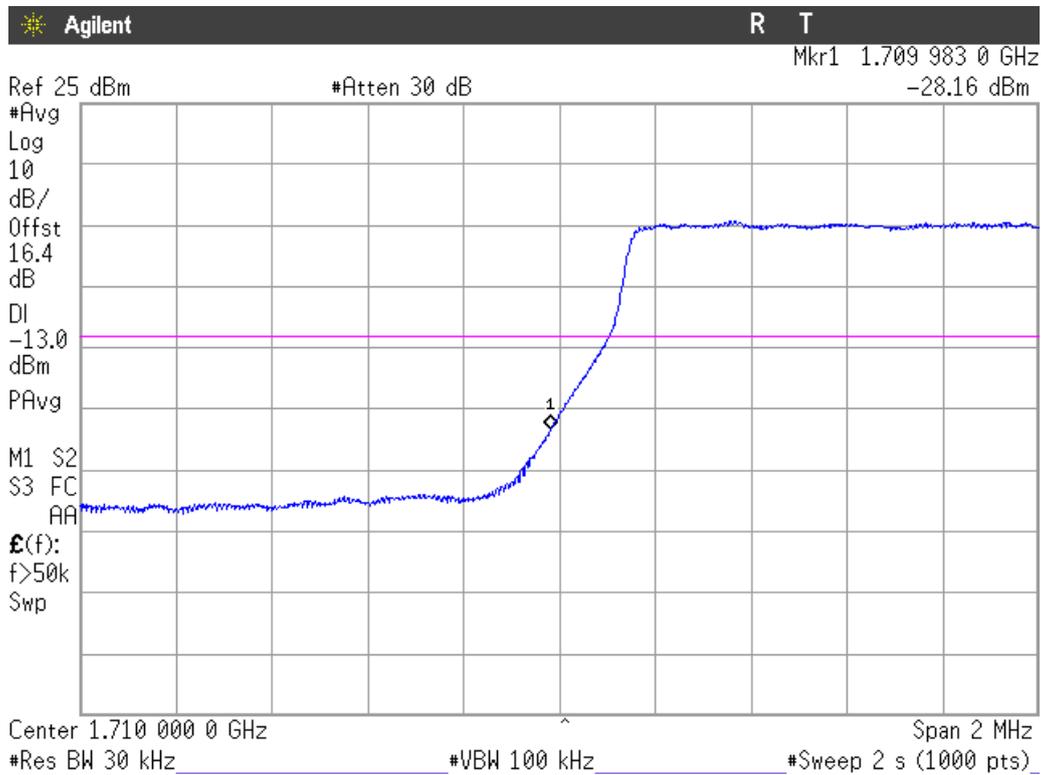
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

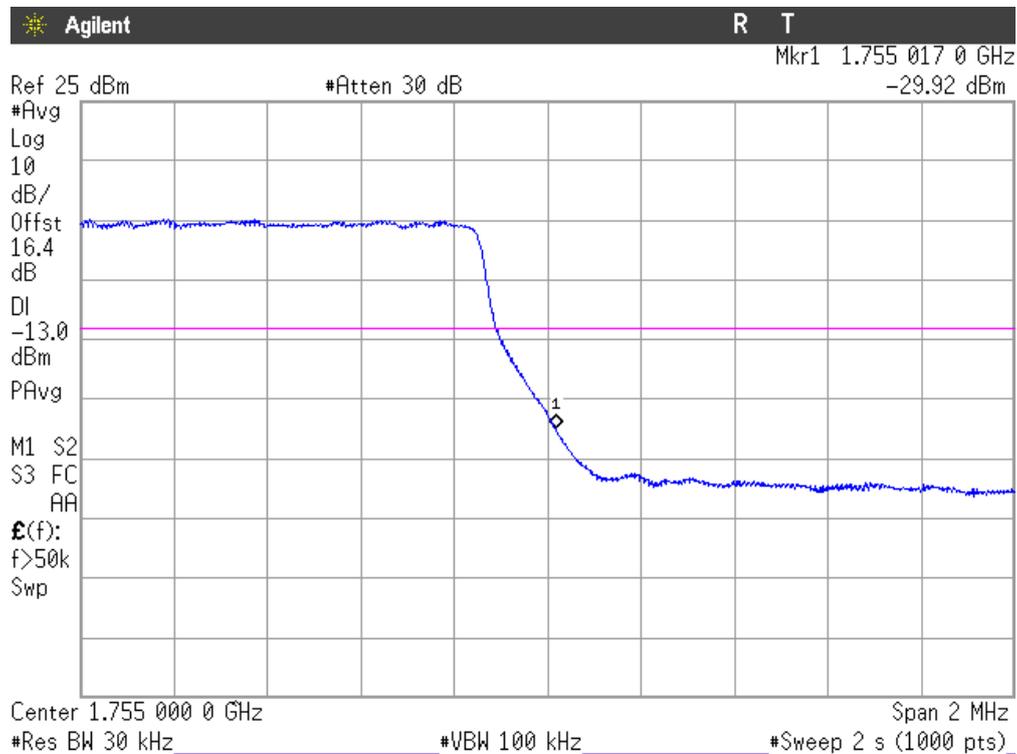
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 3 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

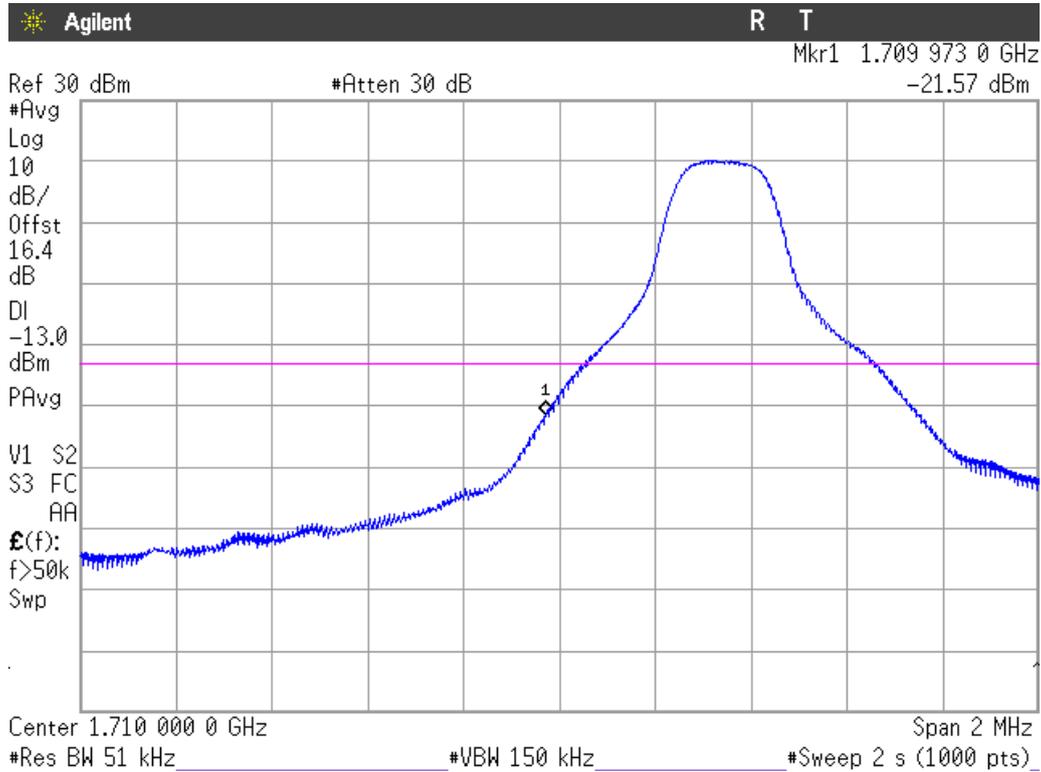


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

LTE QPSK MODULATION. RB = 1, Offset = 0, BW = 5 MHz (Band IV)

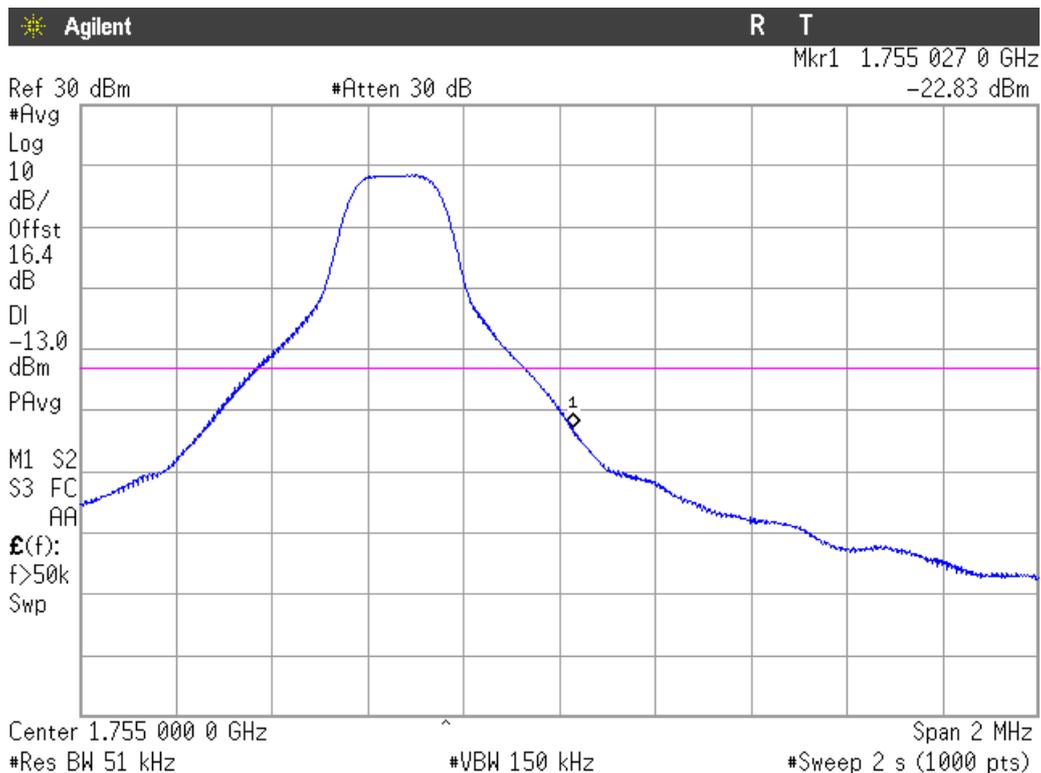
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

LTE QPSK MODULATION. RB = 1, Offset = Max, BW = 5 MHz (Band IV)

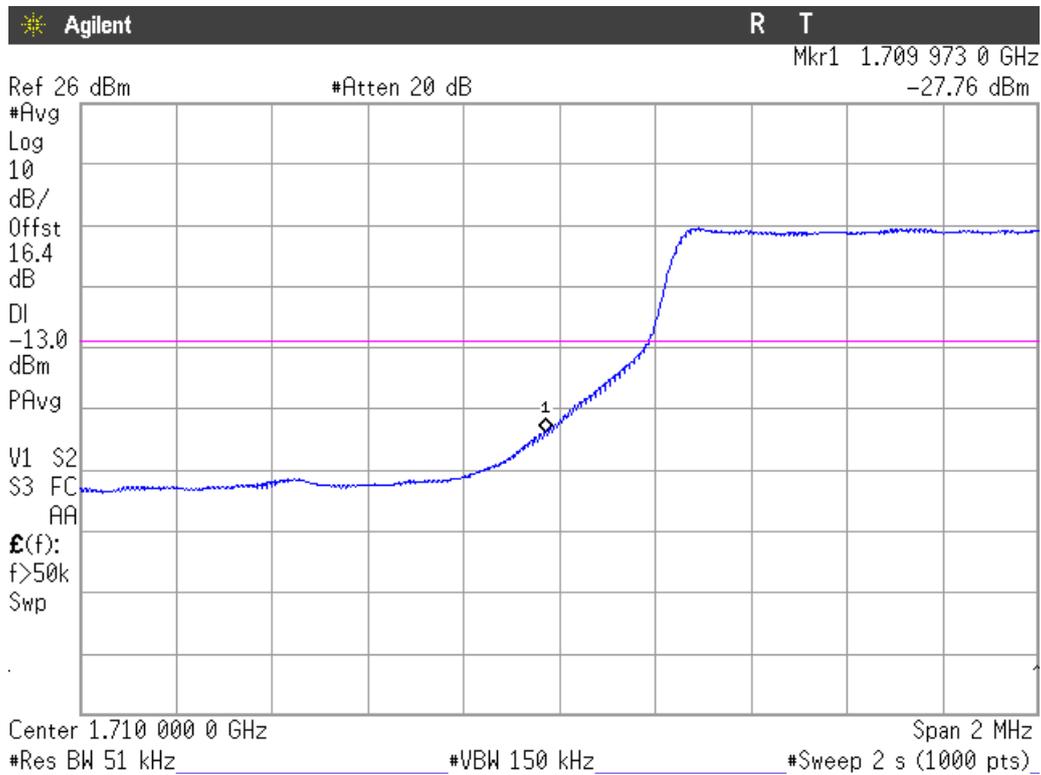
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

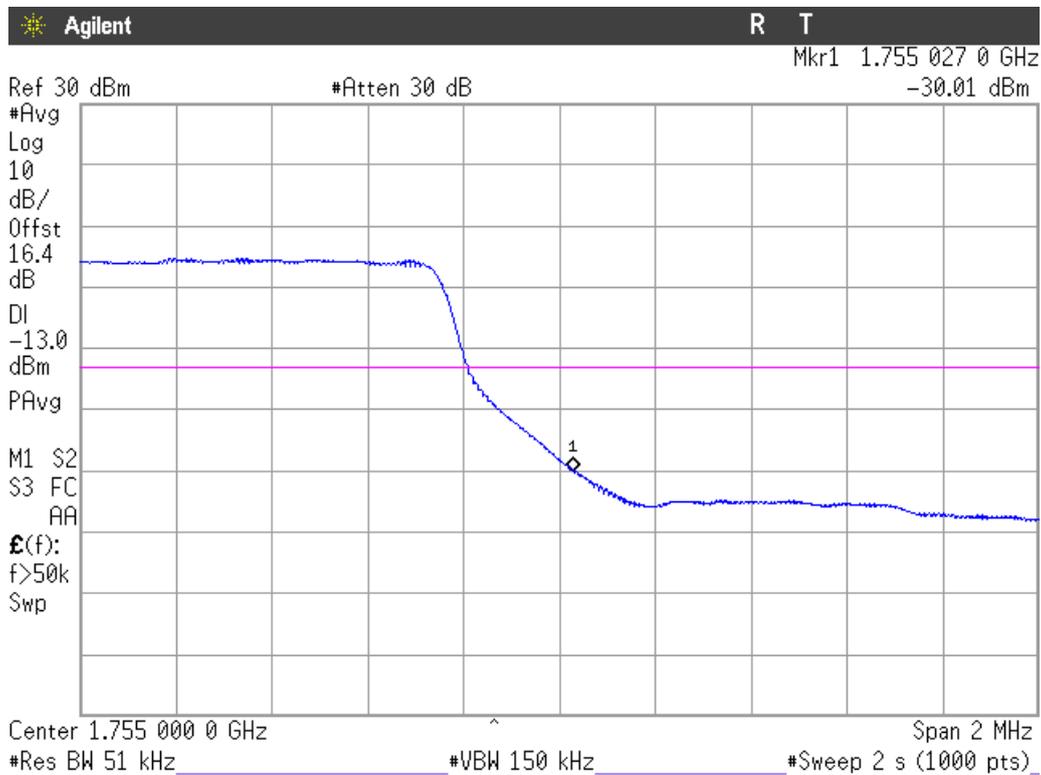
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 5 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

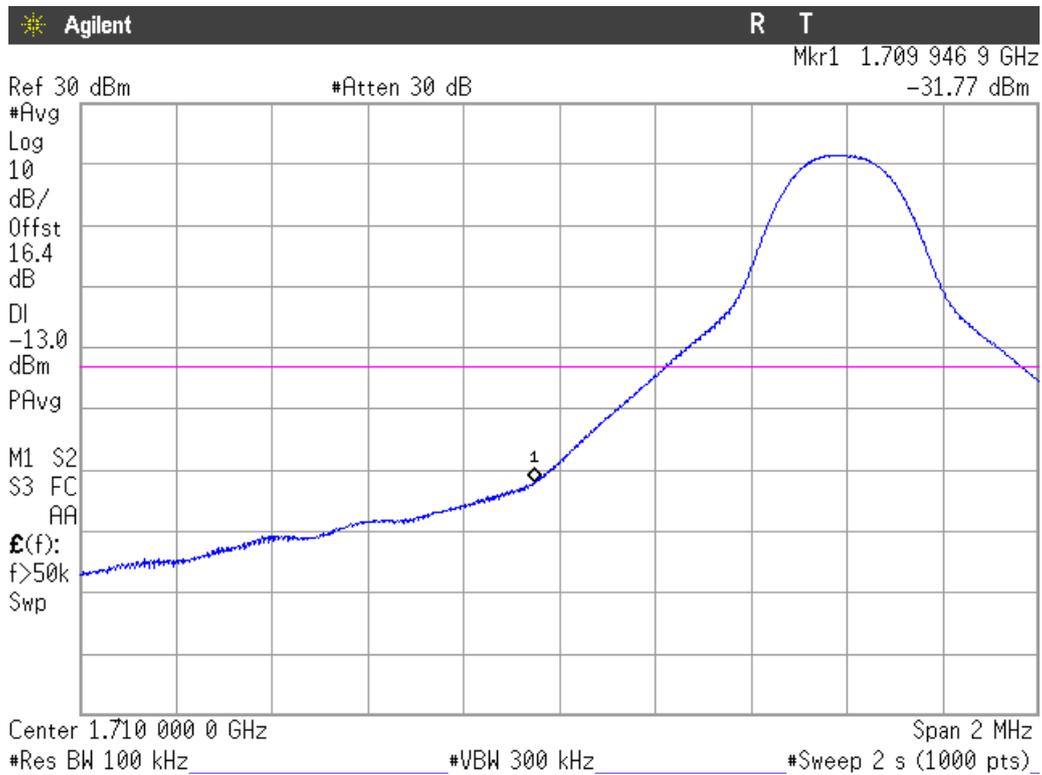


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

LTE QPSK MODULATION. RB = 1, Offset = 0, BW = 10 MHz (Band IV)

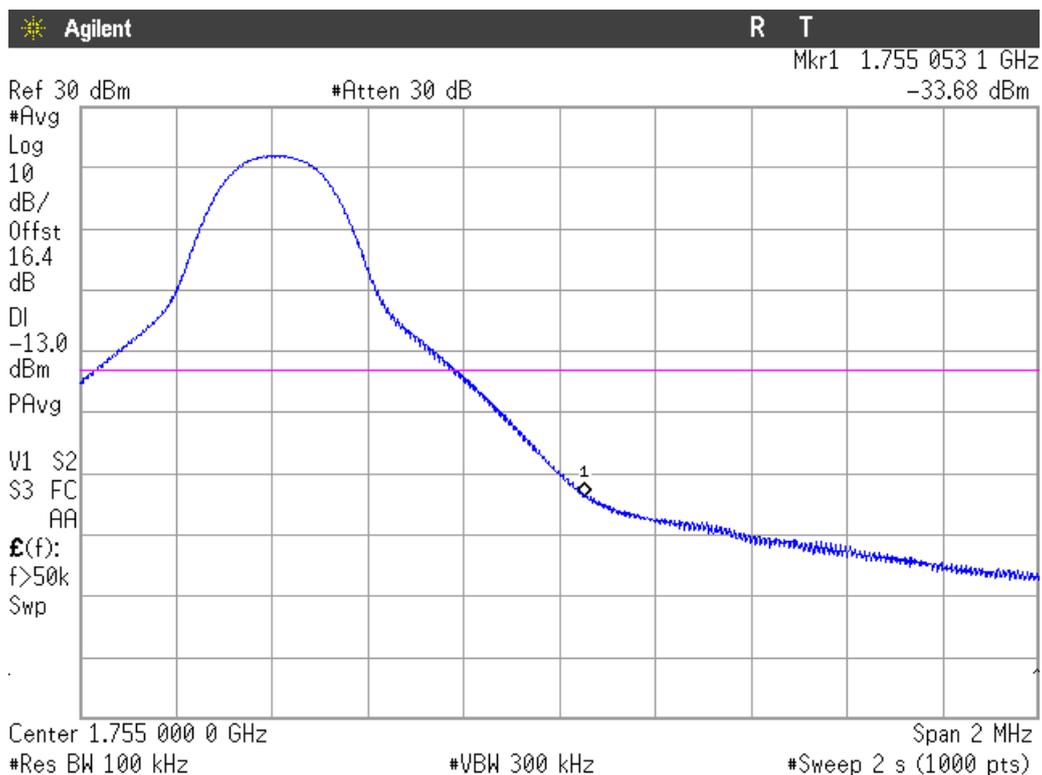
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

LTE QPSK MODULATION. RB = 1, Offset = Max, BW = 10 MHz (Band IV)

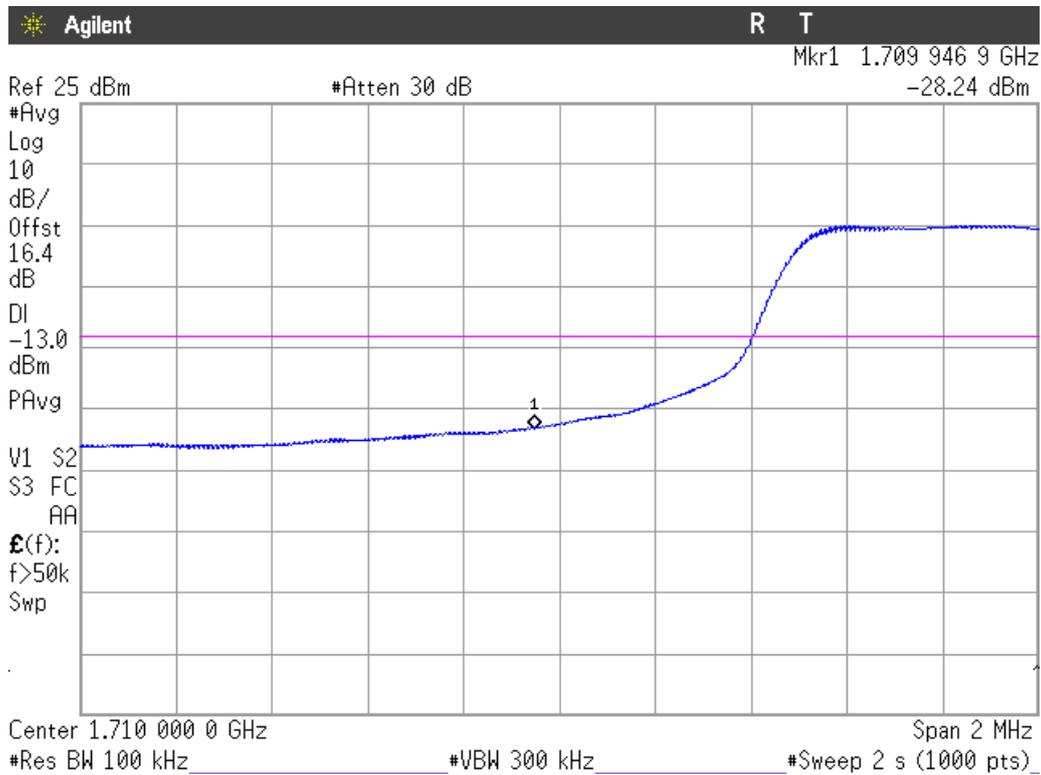
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

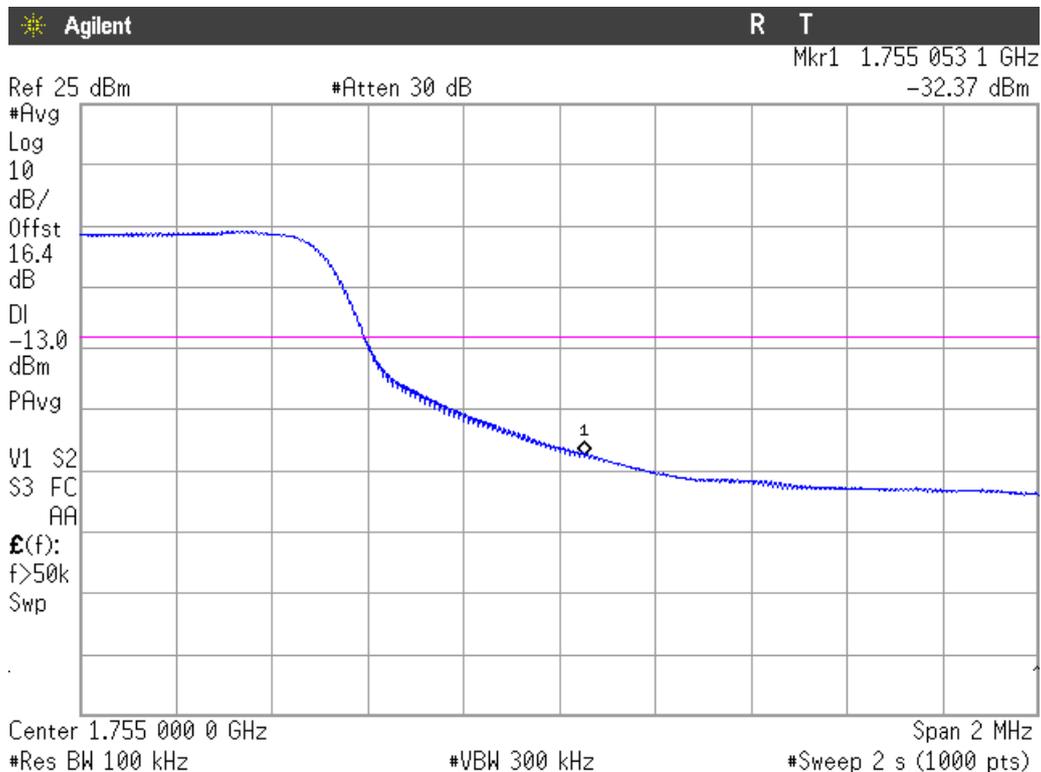
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 10 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

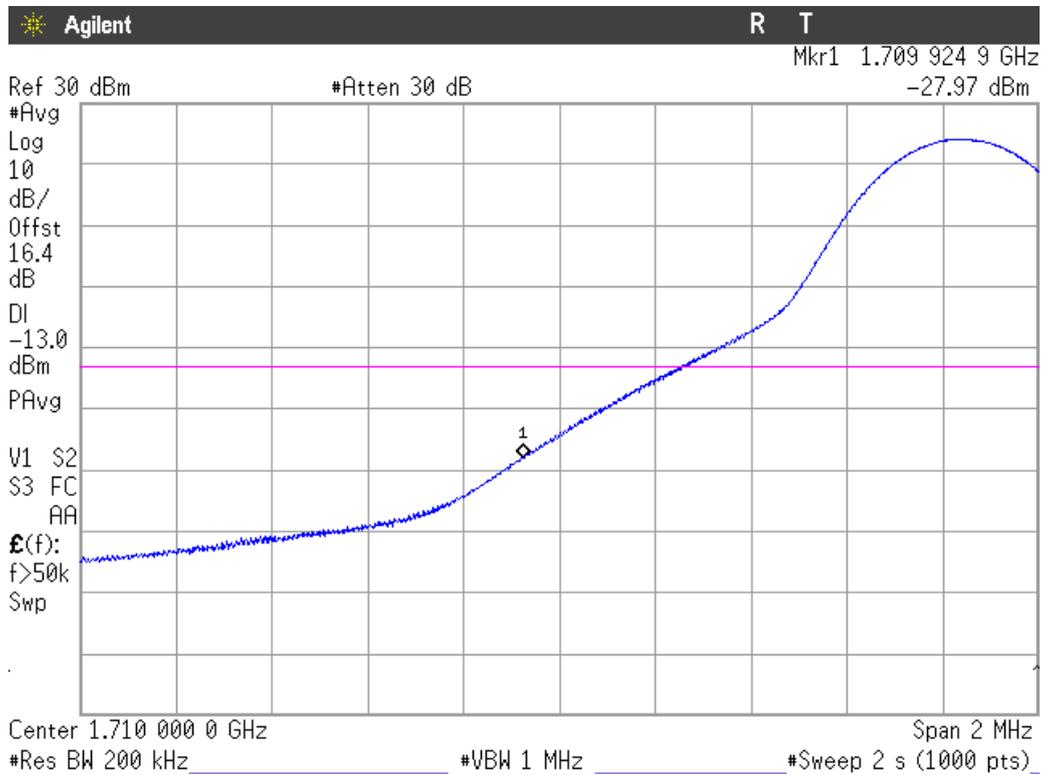


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

LTE QPSK MODULATION. RB = 1, Offset = 0, BW = 15 MHz (Band IV)

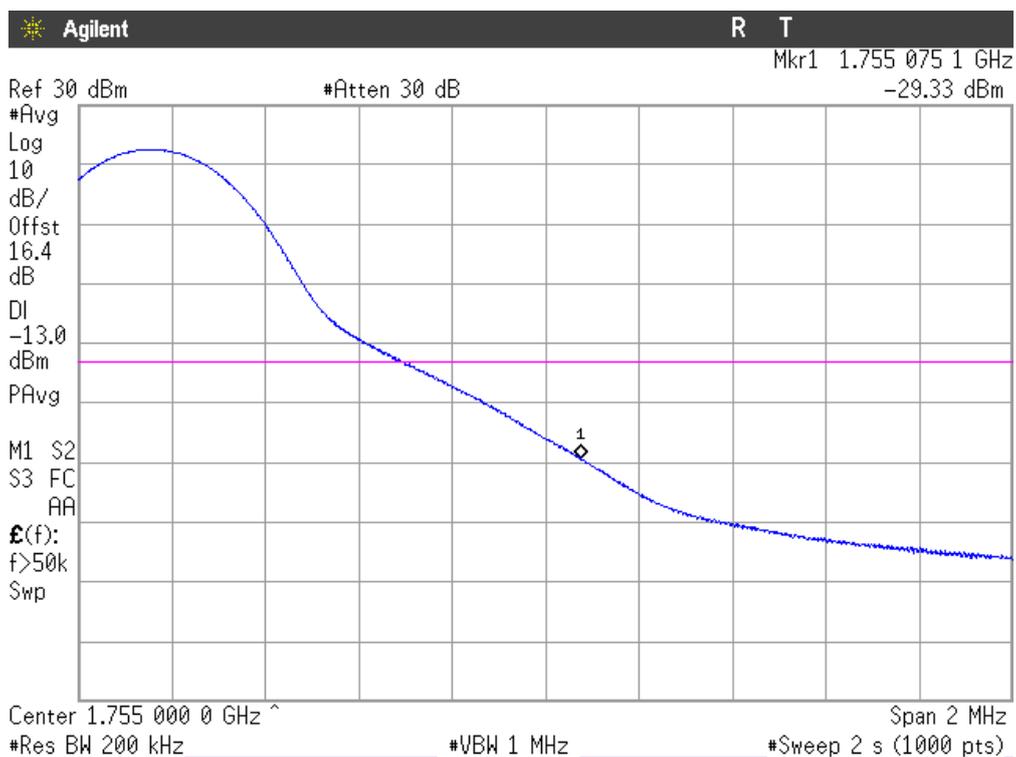
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

LTE QPSK MODULATION. RB = 1, Offset = Max, BW = 15 MHz (Band IV)

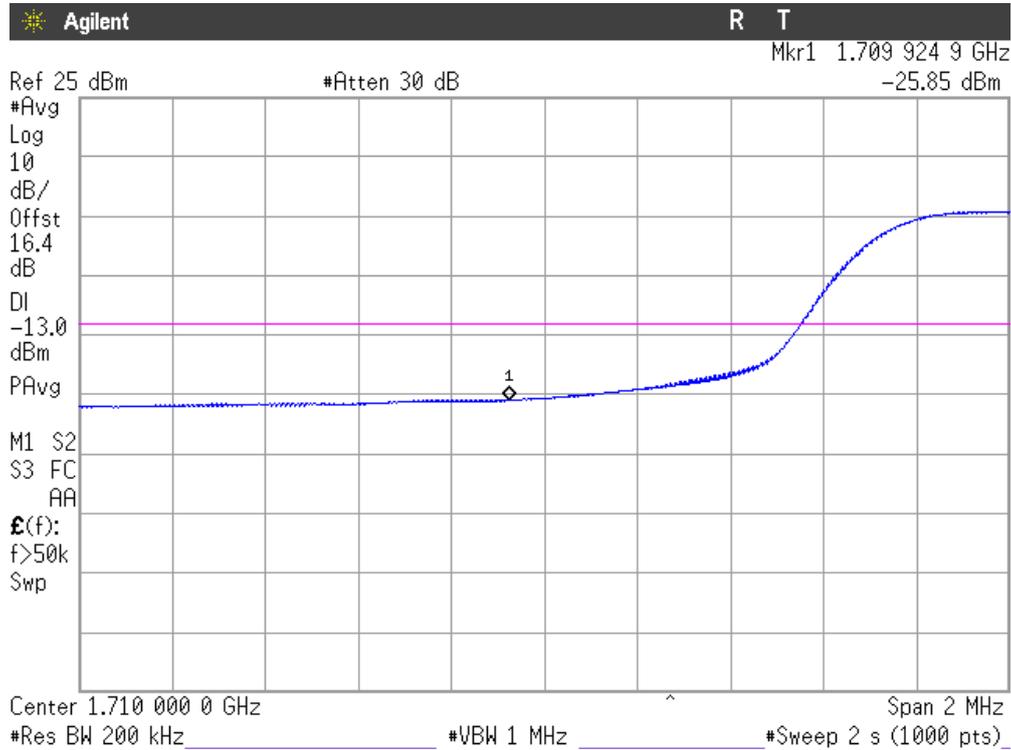
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

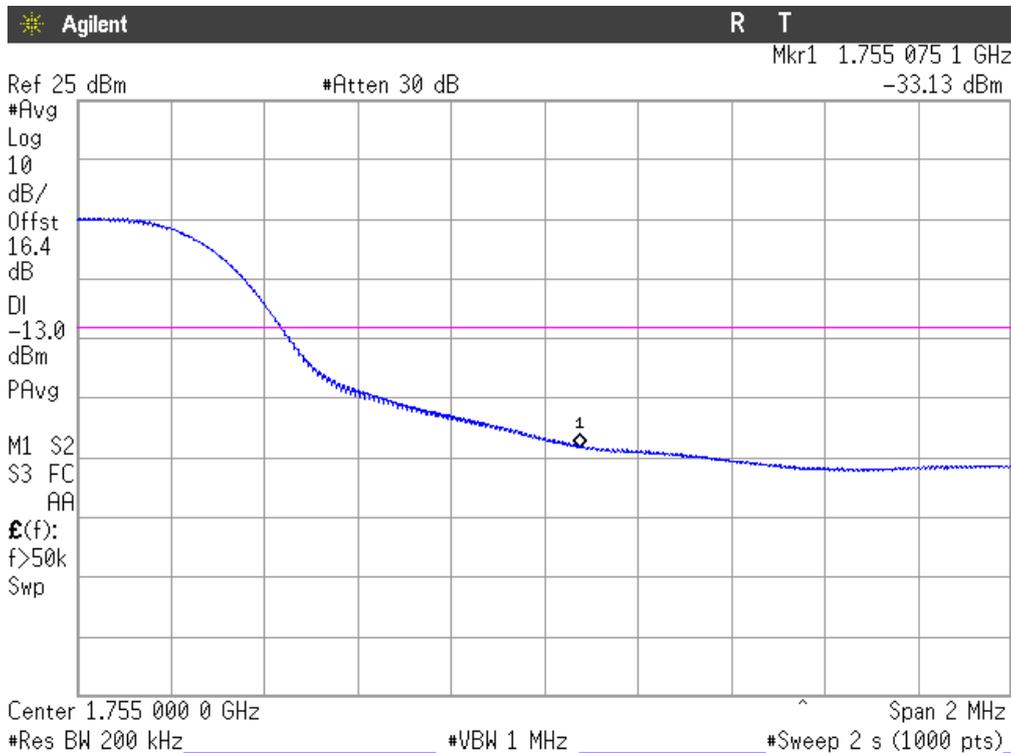
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 15 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

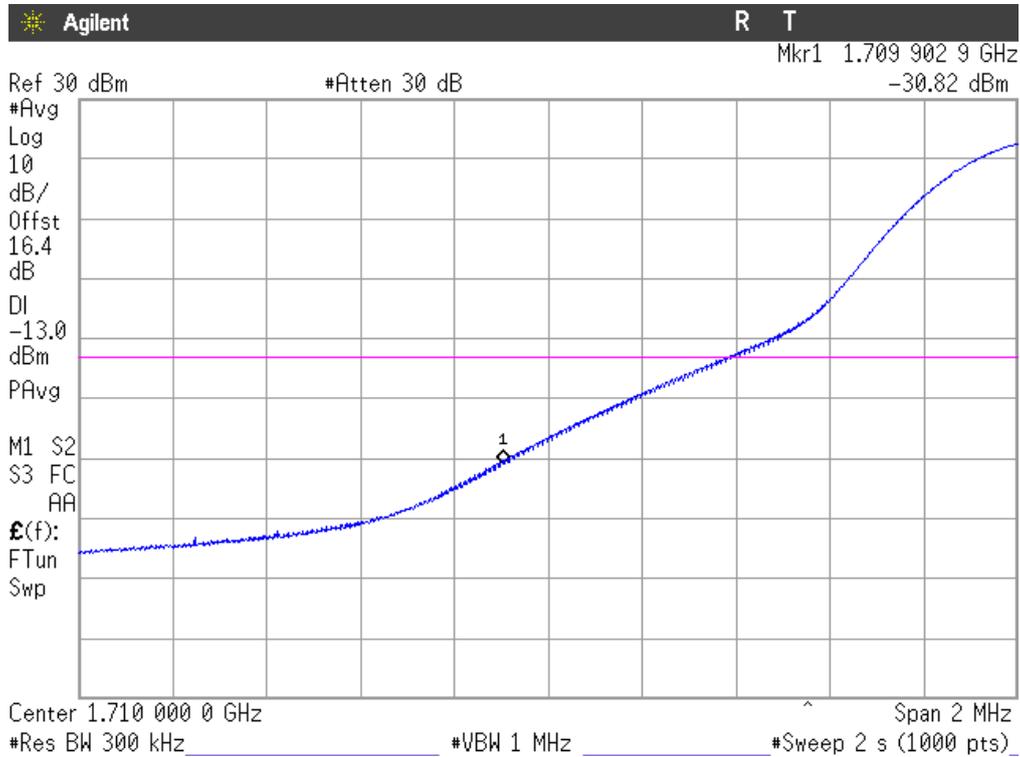


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

LTE QPSK MODULATION. RB = 1, Offset = 0, BW = 20 MHz (Band IV)

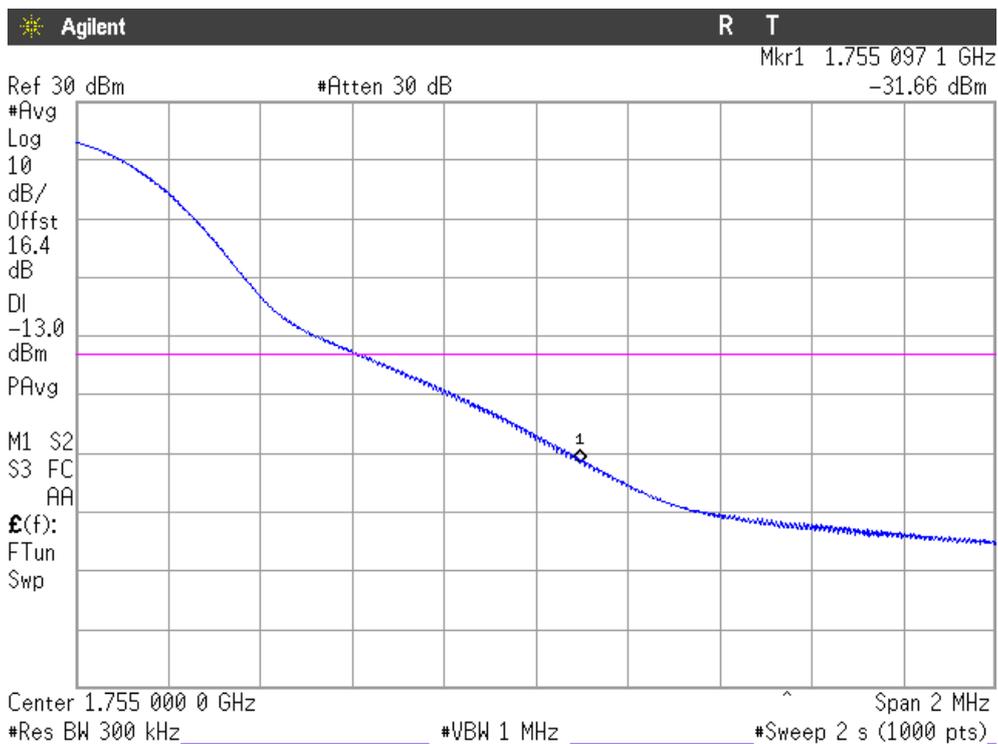
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

LTE QPSK MODULATION. RB = 1, Offset = Max, BW = 20 MHz (Band IV)

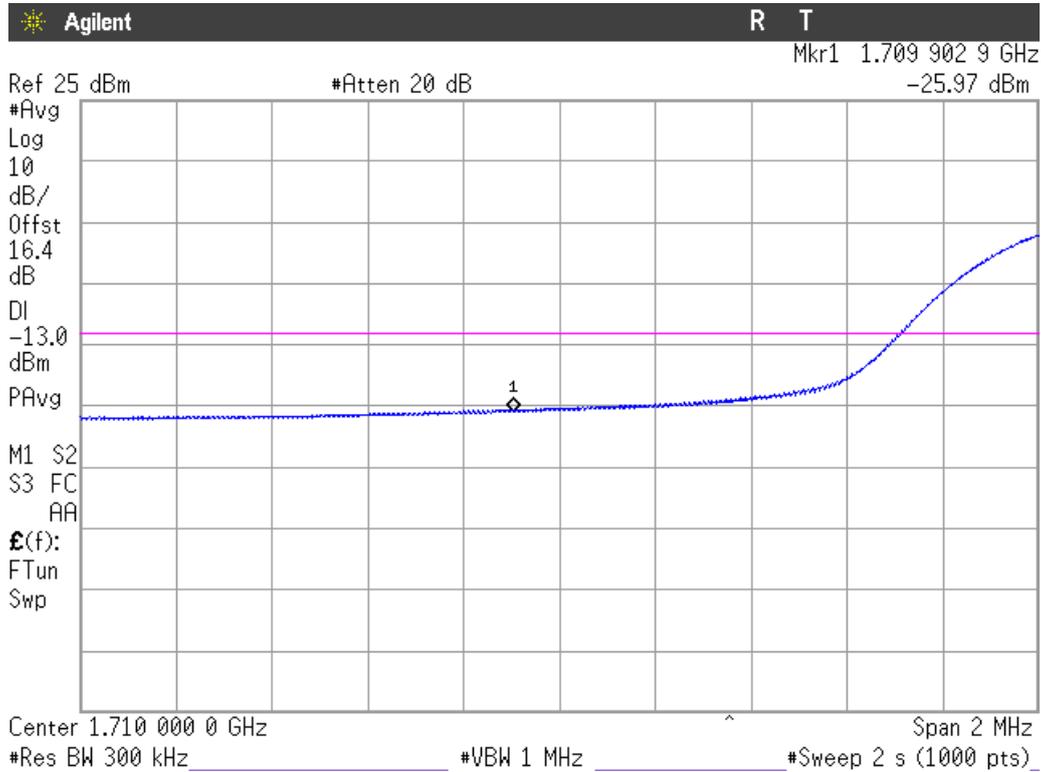
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

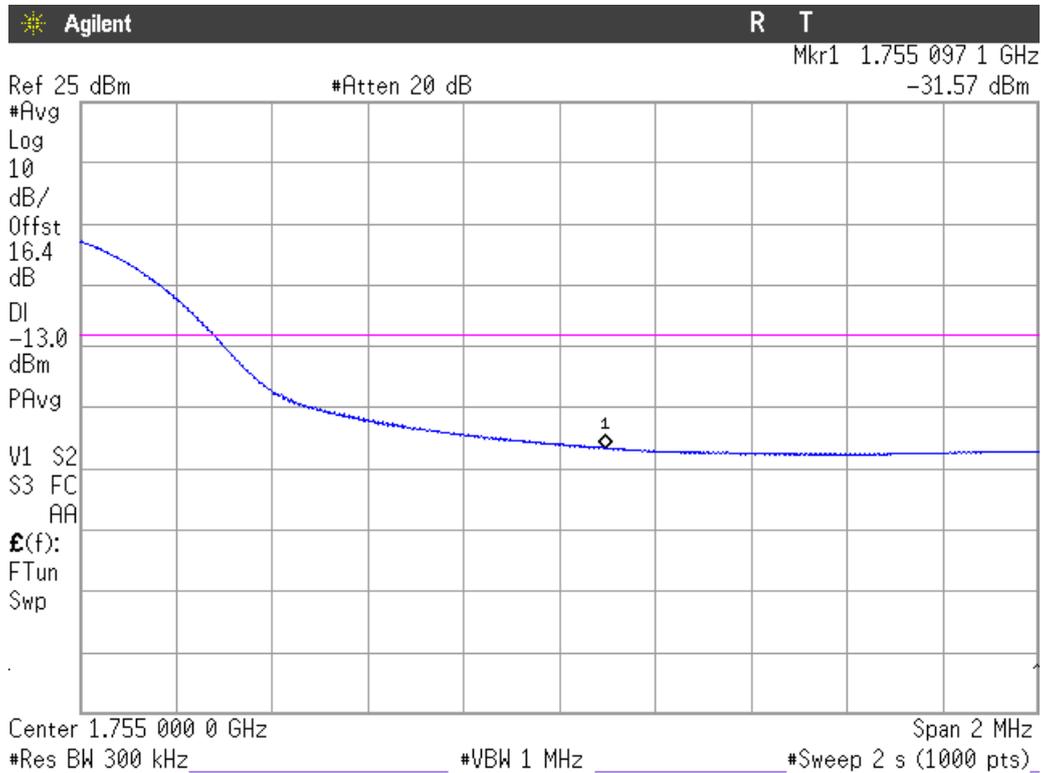
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 20 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

Verdict: PASS

Radiated emissions

SPECIFICATION

FCC §2.1051 and §27.53 (h).

According to specification, 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 P_o becomes:

P_o (dBm) – $[43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13$ 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 below 1 GHz and at 1 m distance for measurements above 1 GHz.

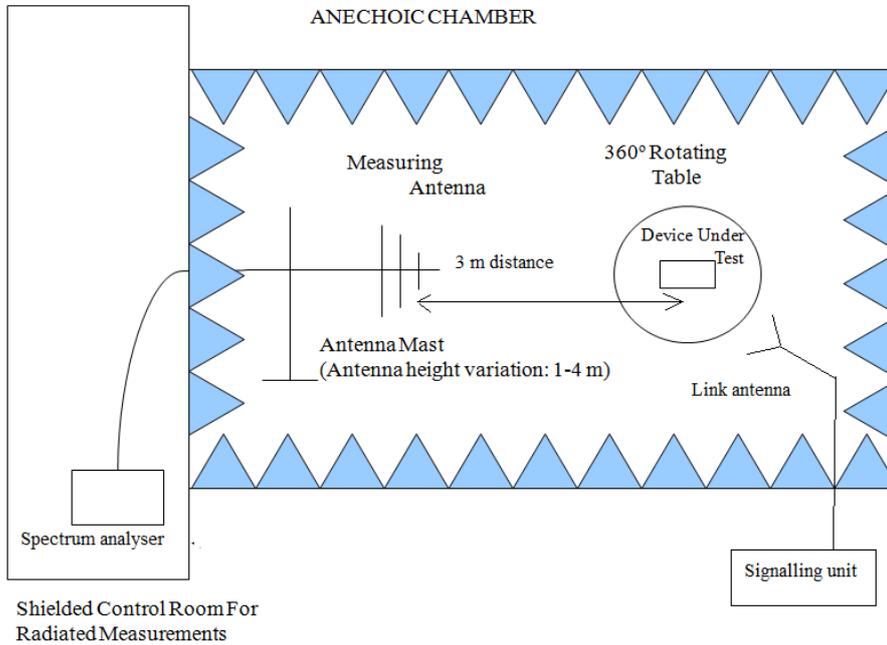
Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.

Each detected emission at less than 20 dB respect to the limit is substituted by the Substitution method, in accordance with the ANSI/TIA-603-D: 2010.

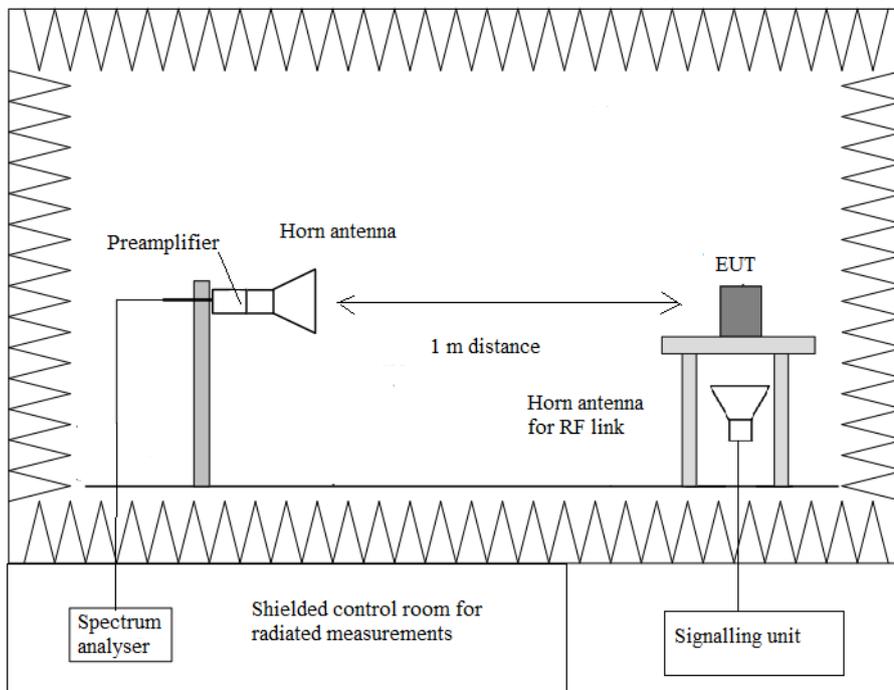
The test was performed with the equipment transmitting first in only cellular mode, and then repeated with the BT EDR/BT LE (modulation GFSK, which is the worst case) radios transmitting simultaneously to check the impact of the co-location of both radio interfaces. The results and plots below show the worst results obtained in all modes.

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

WCDMA AND HSUPA MODULATION

A preliminary scan determined the HSUPA modulation as the worst case. The following tables and plots show the results for HSUPA modulation.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-18 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-18 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-18 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

LTE QPSK AND 16QAM MODULATION. Band IV. BW = 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz.

A preliminary scan determined the 16QAM 1.4 MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following tables and plots show the results for this configuration.

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected.

Frequency range 1 GHz-18 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected.

Frequency range 1 GHz-18 GHz.

No radiated spurious signals were detected at less than 20 dB respect to the limit.

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No radiated spurious signals were detected.

Frequency range 1 GHz-18 GHz.

Substitution method data

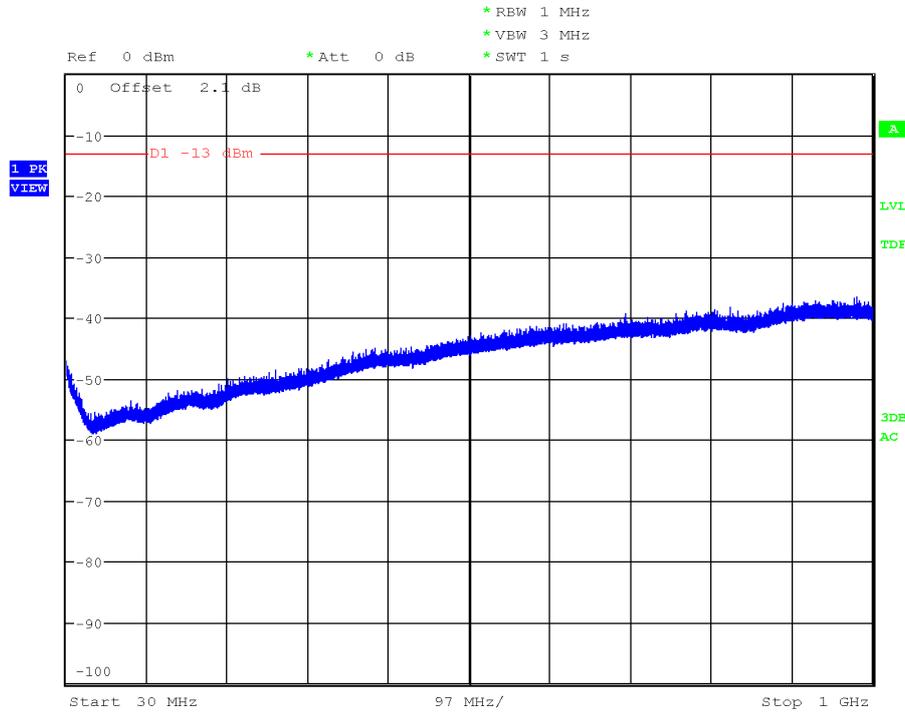
Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
14030.75	-45.10	Vertical	-40.88	2.76	12.09	-31.55

Measurement uncertainty (dB)	$\leq \pm 3.88$ for $f < 1\text{GHz}$ $\leq \pm 4.87$ for $f \geq 1\text{GHz}$ up to 18 GHz
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Verdict: PASS

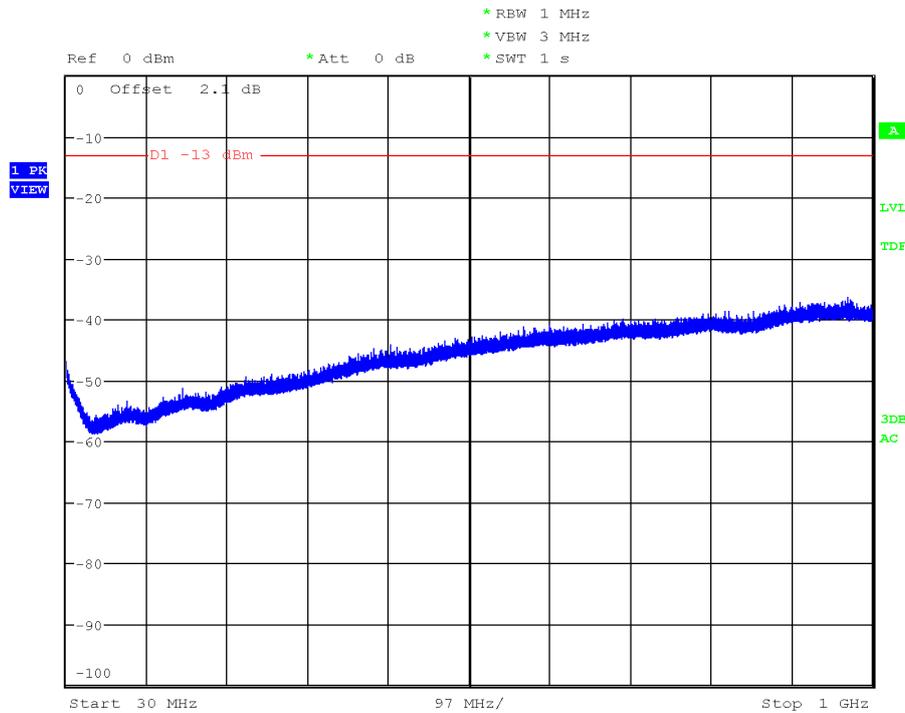
FREQUENCY RANGE 30 MHz-1000 MHz.

HSUPA Band IV



(This plot is valid for all three channels)

LTE 16QAM MODULATION. BW=1.4 MHz. Band IV

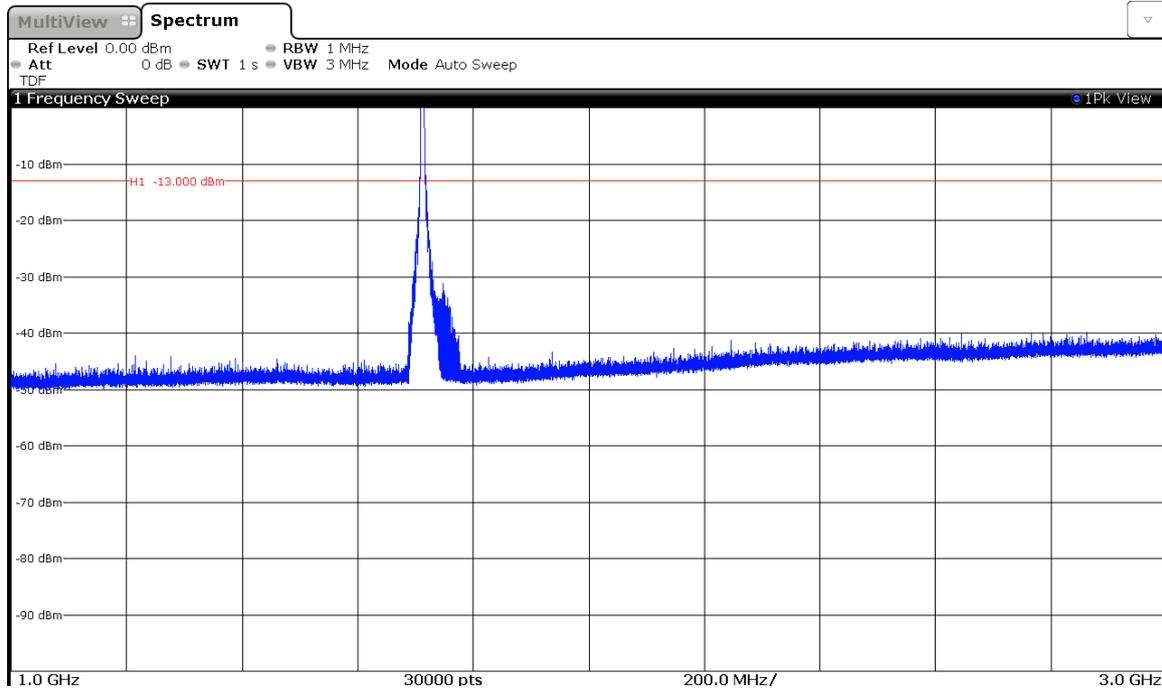


(This plot is valid for all three channels)

FREQUENCY RANGE 1 GHz to 3 GHz.

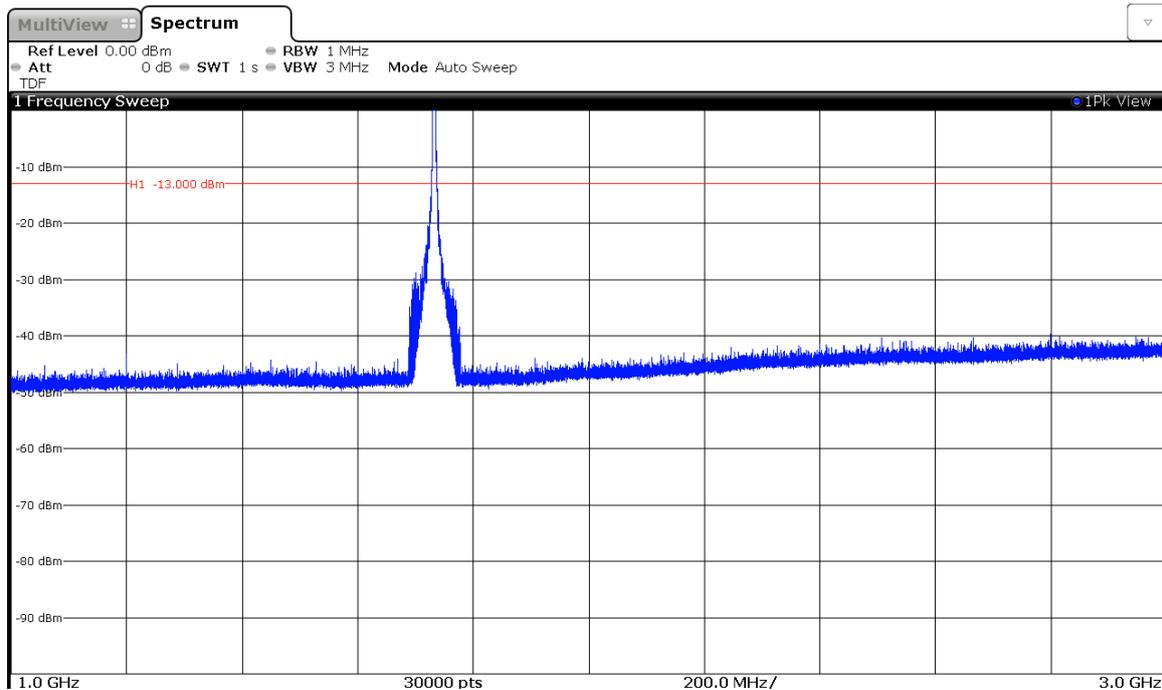
HSUPA Band IV

CHANNEL: LOWEST



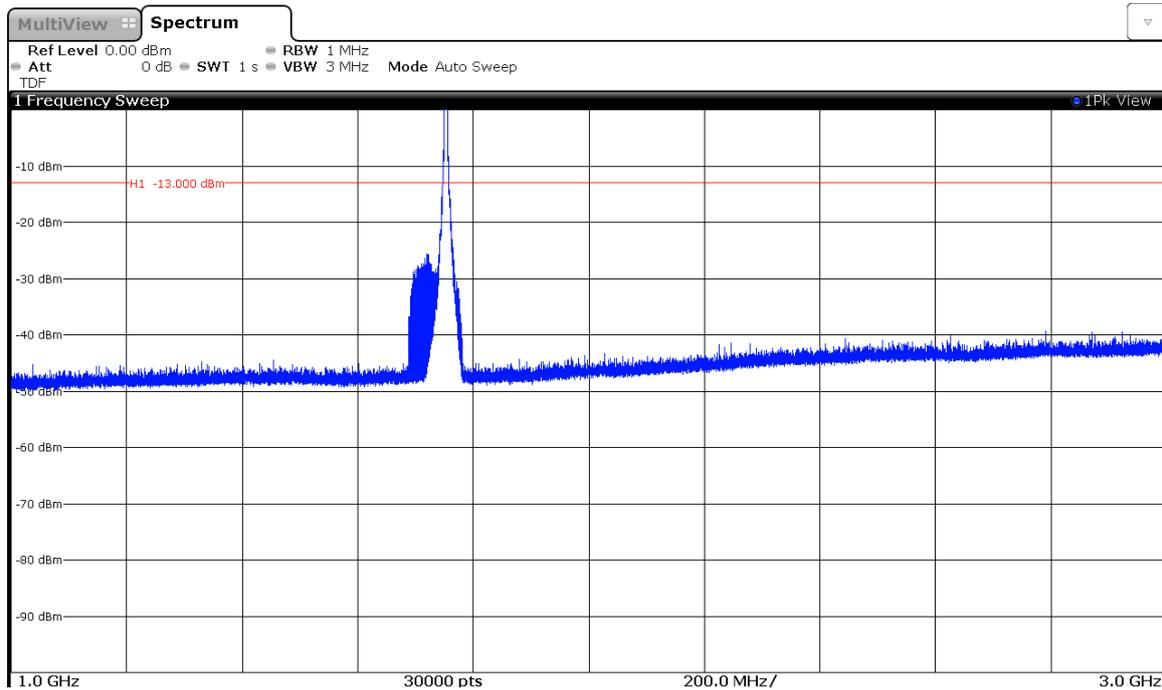
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

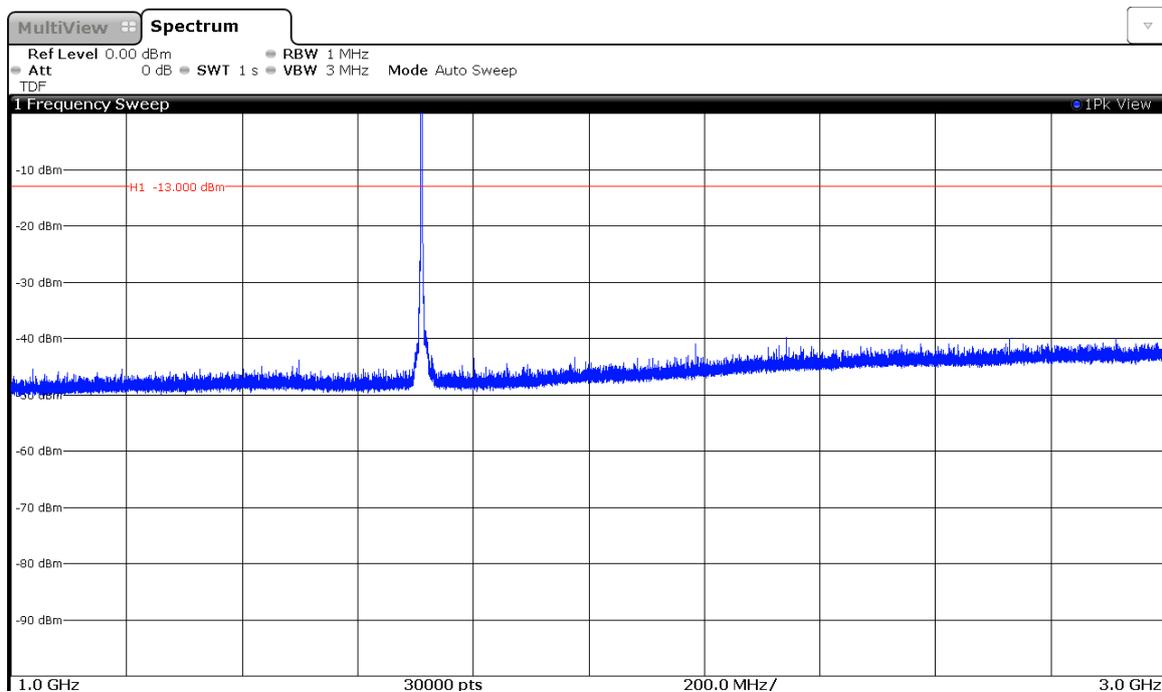
CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.

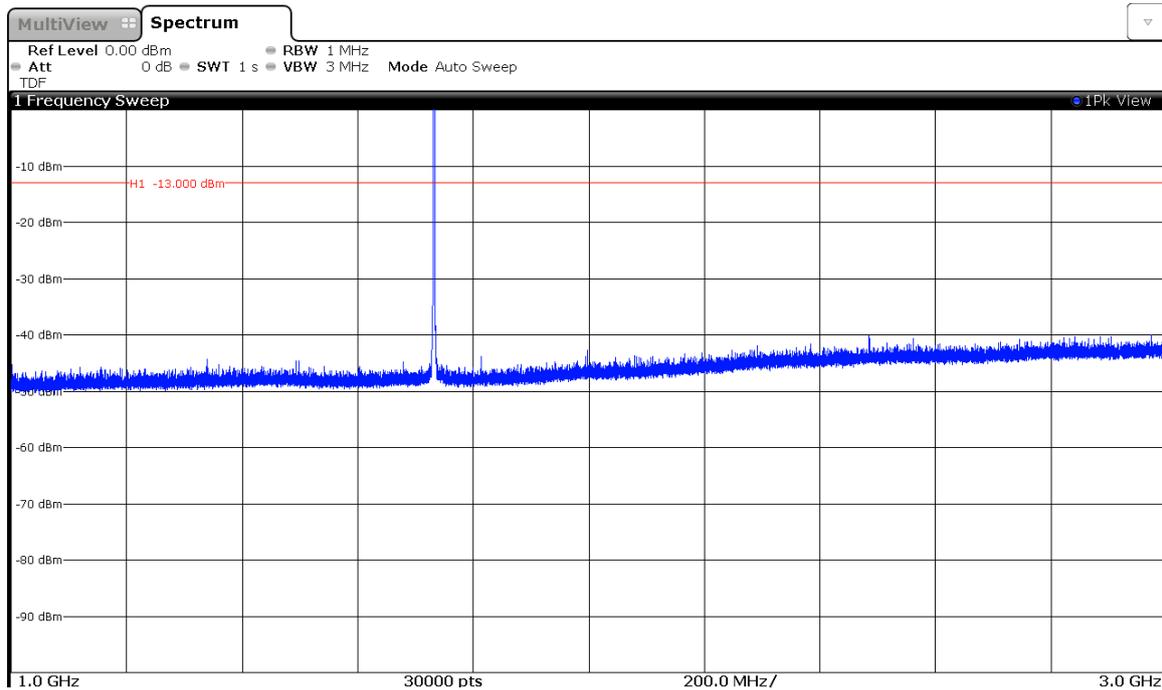
LTE 16QAM MODULATION. BW=1.4 MHz. Band IV

CHANNEL: LOWEST



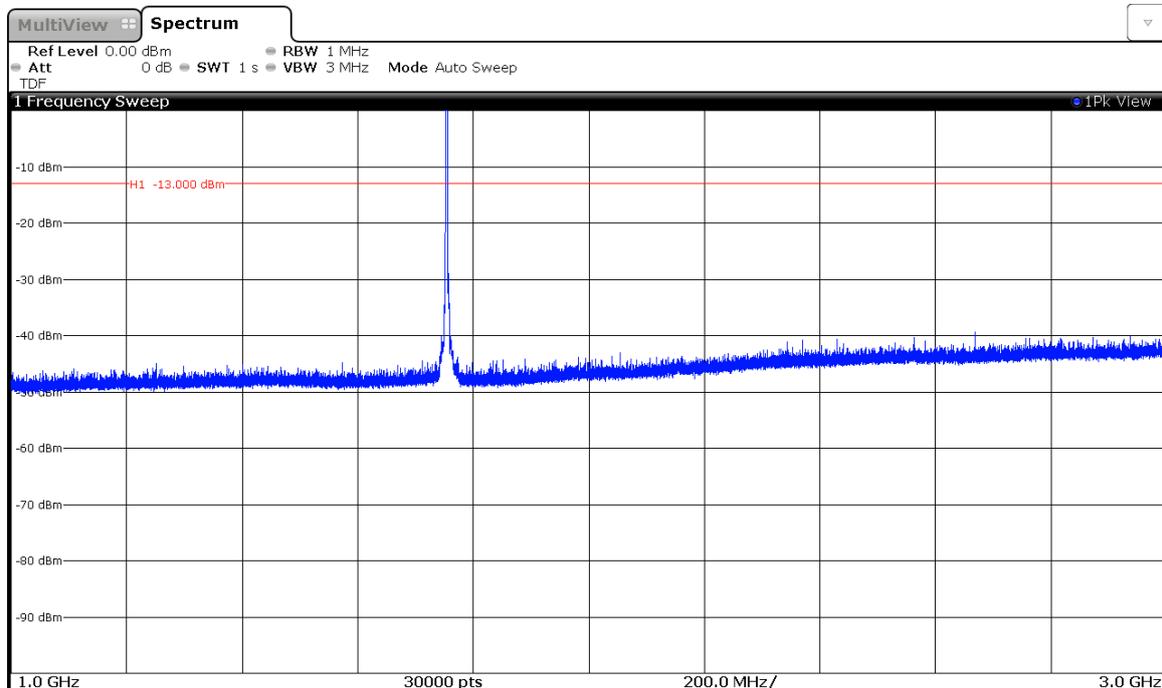
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



Note: The peak above the limit is the carrier frequency.

CHANNEL: HIGHEST

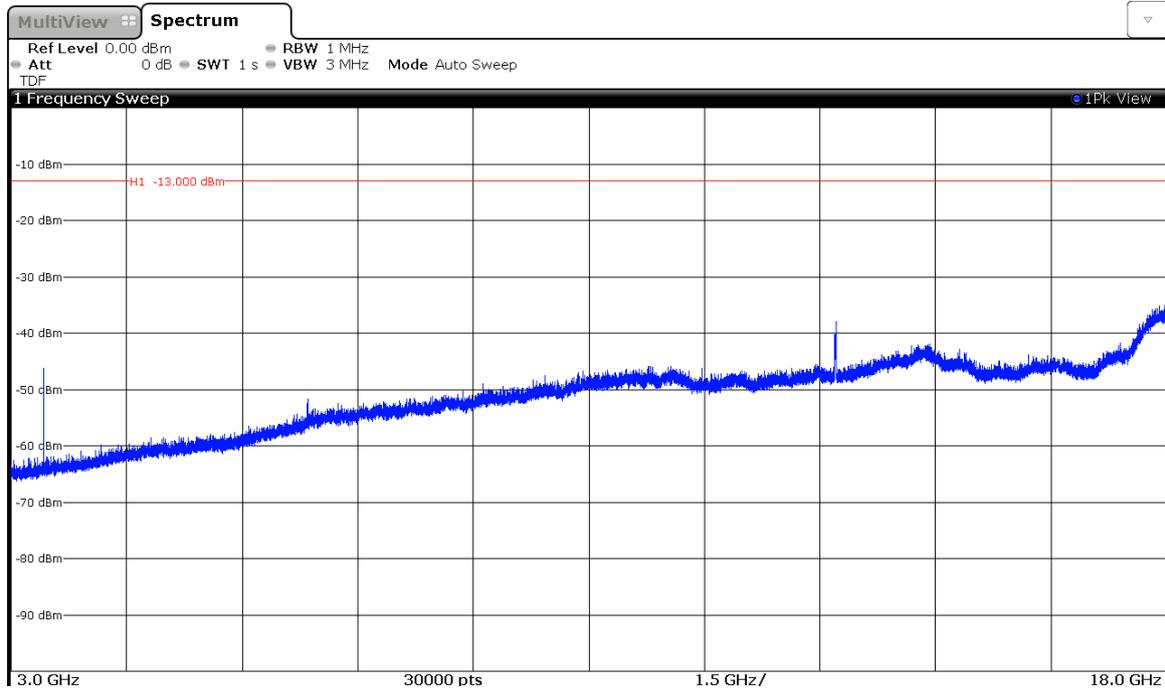


Note: The peak above the limit is the carrier frequency.

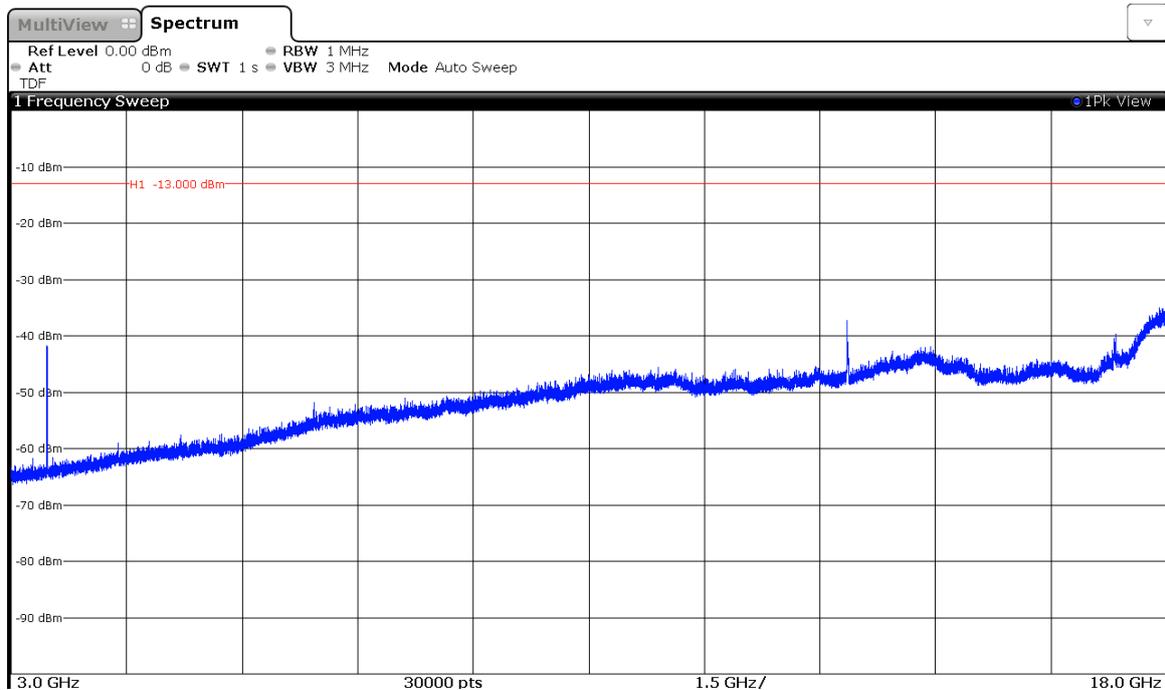
FREQUENCY RANGE 3 GHz to 18 GHz.

HSUPA Band IV

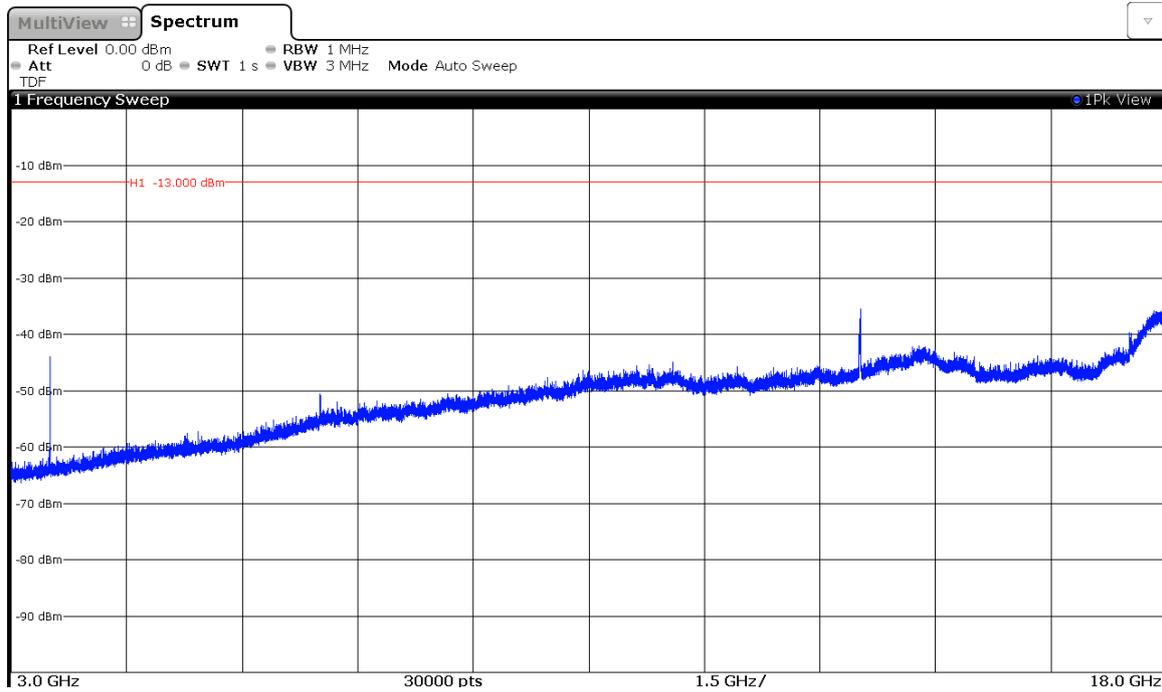
CHANNEL: LOWEST



CHANNEL: MIDDLE

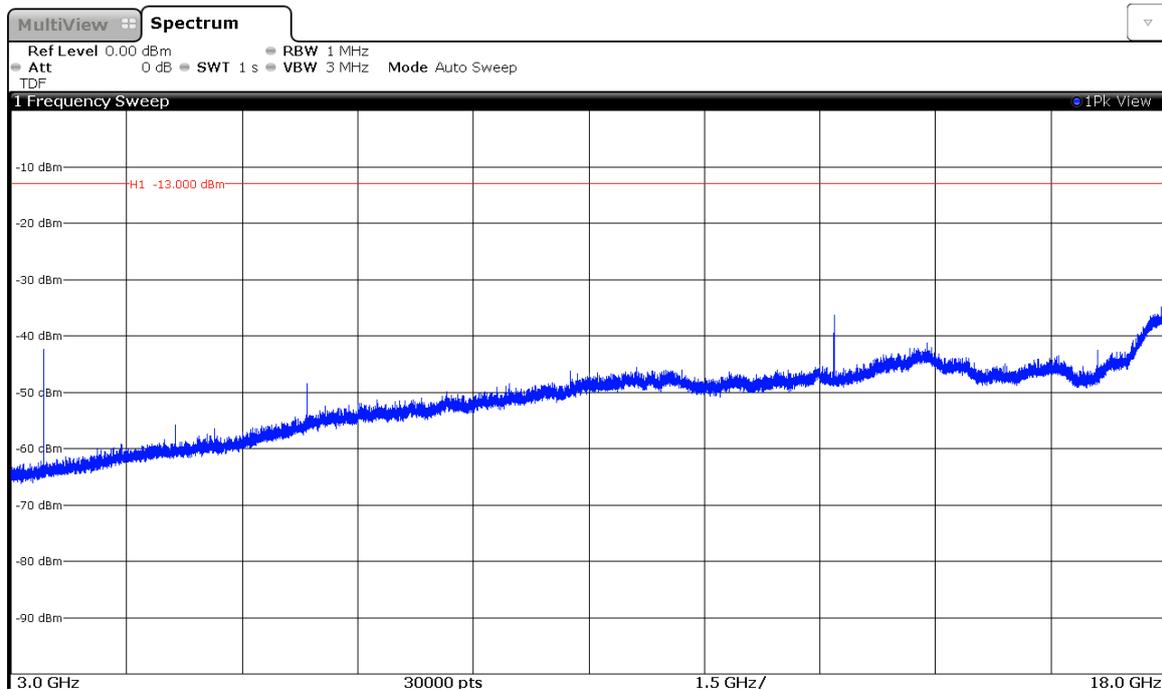


CHANNEL: HIGHEST

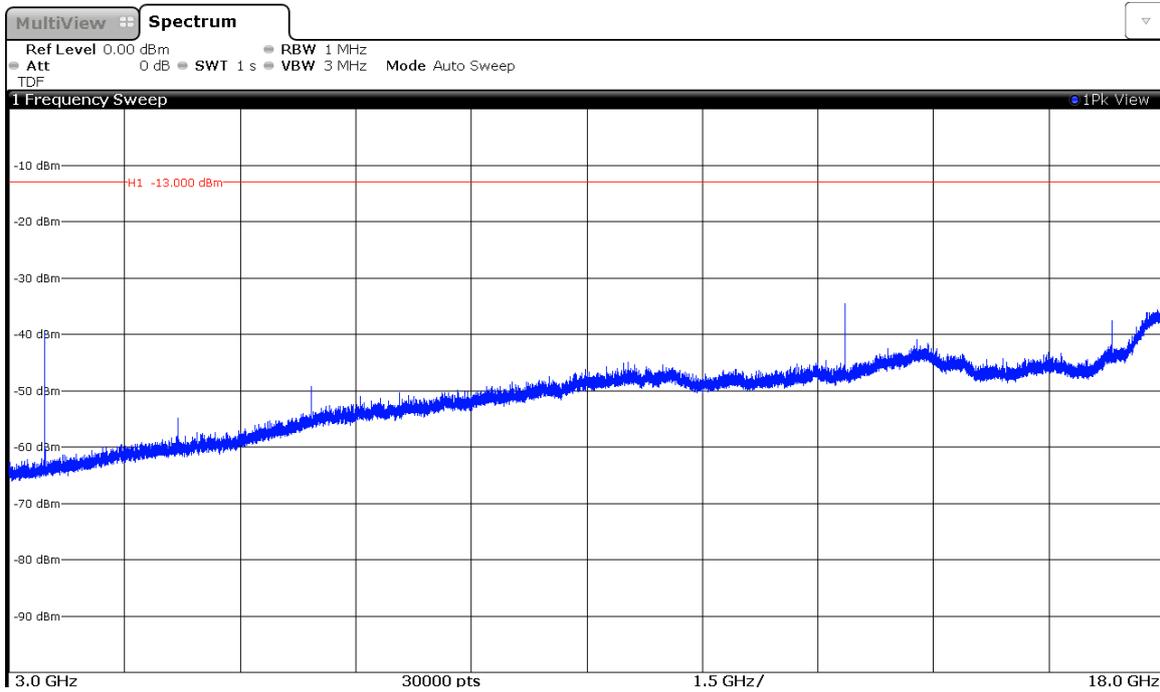


LTE 16QAM MODULATION. BW=1.4 MHz. Band IV

CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST

