AT4 wireless, S.A.U.
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c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
www.at4wireless.com · C.I.F. A29 507 456

FCC LISTED,
REGISTRATION NUMBER:
720267

Test report No:

NIE: 51746RRF.002

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 Smart
Other identification of the product .....:	FCC ID: V27SSD-51
Final HW version .....:	0201
Final SW version .....:	1.8.31
IMEI TAC .....:	356244
Características .....: Features	SATELLITE • 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 LTE • 3GPP rel10 (LTE Advanced) • FDD Cat4, DL 150 Mbit/s, UL 50 Mbit/s • Band configuration: B4 (1700), B28 (700) UMTS/HSPA • 3GPP R99 384/384kbps • 3GPP rel8, HSPA+, 42 Mbps / 5.76 Mbps • Band configuration: B2 (1900), B4 (1700), B5 (850) GSM/GPRS/EDGE • 850/900/1800/1900 MHz Other Radios • Wi-Fi 802.11 b/g/n Bluetooth 4.0
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.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) .....: Approved by (name / position & signature)	A. Llamas RF Lab. Manager
Fecha de realización .....: Date of issue	2017-03-15
Formato de informe No. .....: Report template No	FDT08_18

Index

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 conjuction 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.
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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 Nº	Description	Model	Serial Nº	Date of reception
51746/021	Satellite Smartphone	Mx Smart	---	2017-01-16
51746/016	Battery	9304576A01	---	2017-01-12

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 Nº	Description	Model	Serial Nº	Date of reception
51746/015	Satellite Smartphone	Mx Smart	---	2017-01-12
51746/020	Dummy battery	DB-6BM proto 0.1	162510006	2017-01-16

1. Sample S/02 has undergone the test(s).

   All conducted tests indicated in appendixes A, B and C.

Test sample description

The Mx Smart 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 2017-01-17 and finished on 2017-02-15.

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 ºC Max. = 35 ºC
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 ºC Max. = 35 ºC
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 ºC Max. = 35 ºC
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

INDEX

TEST RESULTS FOR FCC PART 22

TEST CONDITIONS

Power supply (V):

Vnom = 4.2Vdc

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 = -2.1 dBi (850MHz), -2.3 dBi (WCDMA Band V).

TEST FREQUENCIES:

GPRS AND EDGE 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:

$$E.R.P. = E.I.R.P. – 2.15\ dB$$

TEST SETUP

Conducted average power.

RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

GPRS MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	32.35	32.45	32.40
Maximum declared antenna gain (dBi)	-2.10	-2.10	-2.10
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	30.25	30.35	30.30
Maximum effective radiated power E.R.P. (dBm)	28.10	28.20	28.15
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

EDGE MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	27.48	27.62	27.63
Maximum declared antenna gain (dBi)	-2.10	-2.10	-2.10
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	25.38	25.52	25.53
Maximum effective radiated power E.R.P. (dBm)	23.23	23.37	23.38
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	23.49	23.56	23.62
Maximum declared antenna gain (dBi)	-2.30	-2.30	-2.30
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	21.19	21.26	21.32
Maximum effective radiated power E.R.P. (dBm)	19.04	19.11	19.17
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

HSUPA MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	22.02	22.19	22.25
Maximum declared antenna gain (dBi)	-2.30	-2.30	-2.30
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	19.72	19.89	19.95
Maximum effective radiated power E.R.P. (dBm)	17.57	17.74	17.80
Measurement uncertainty (dB)	<±0.66		

Verdict: PASS

Modulation Characteristics

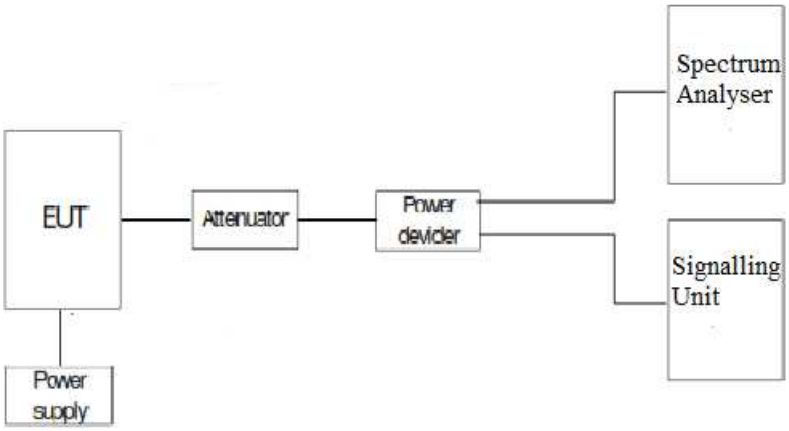
SPECIFICATION

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.

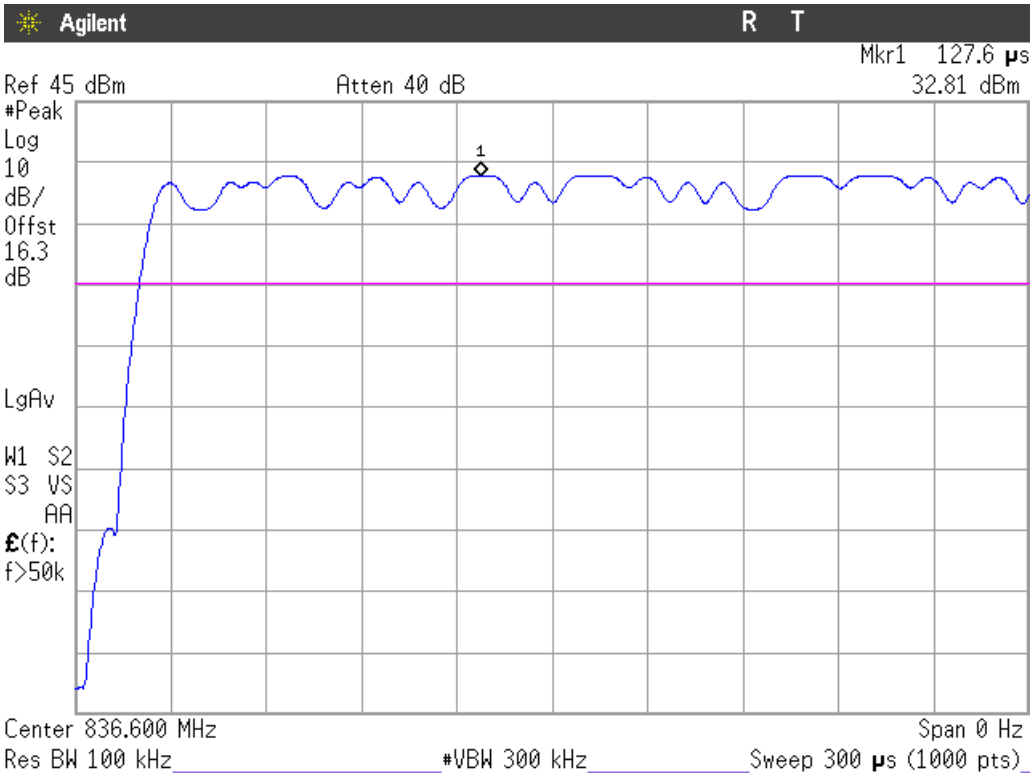
TEST SETUP



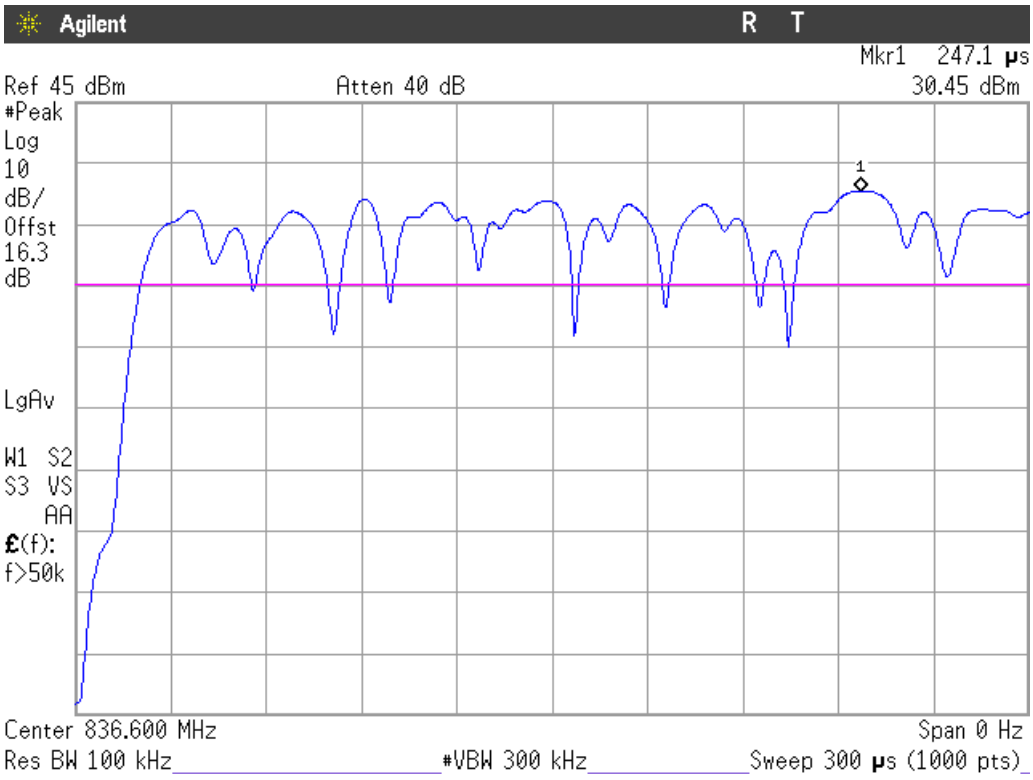
RESULTS

The following plot shows the modulation schemes in the EUT.

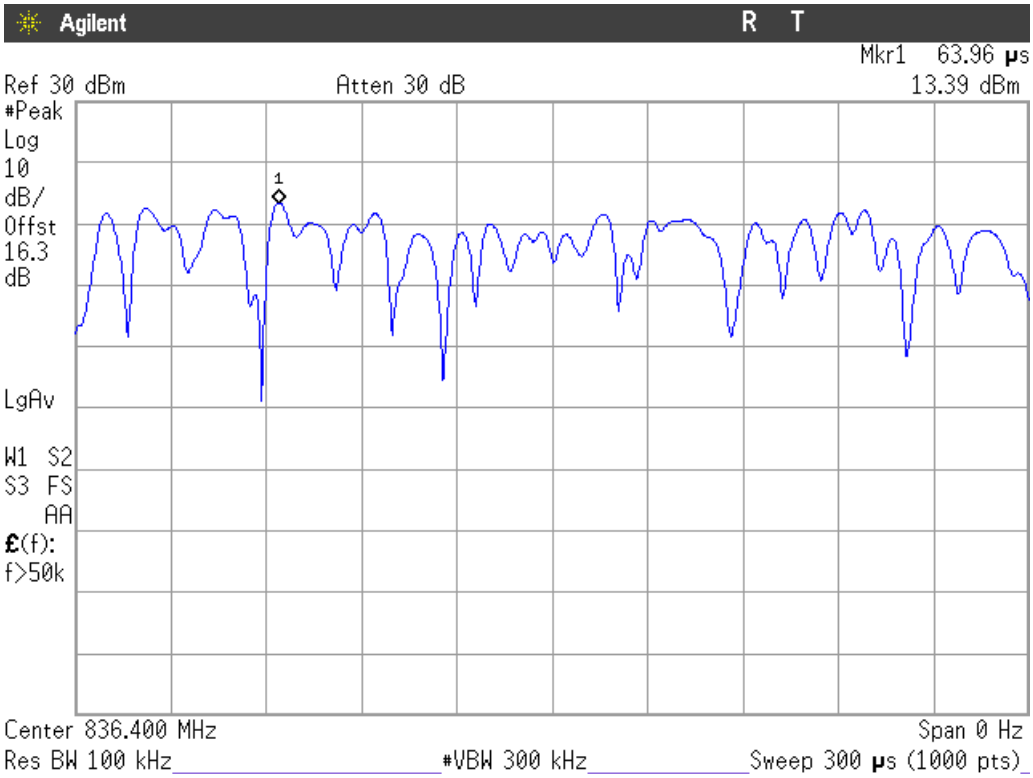
GPRS MODULATION



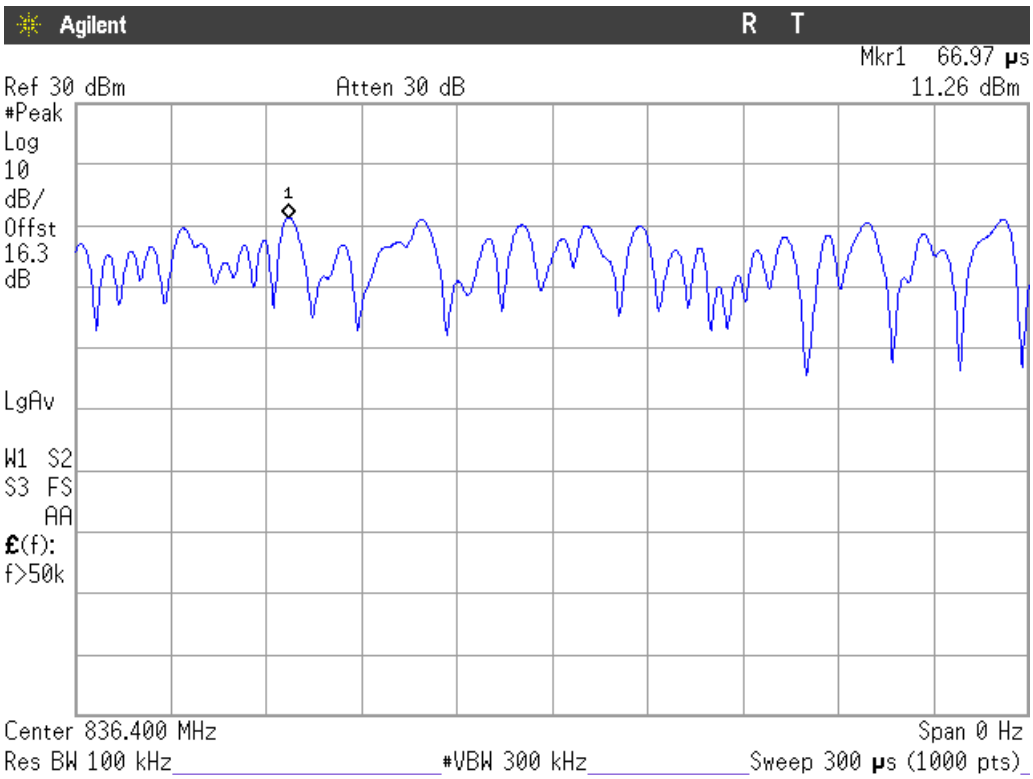
EDGE MODULATION



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.

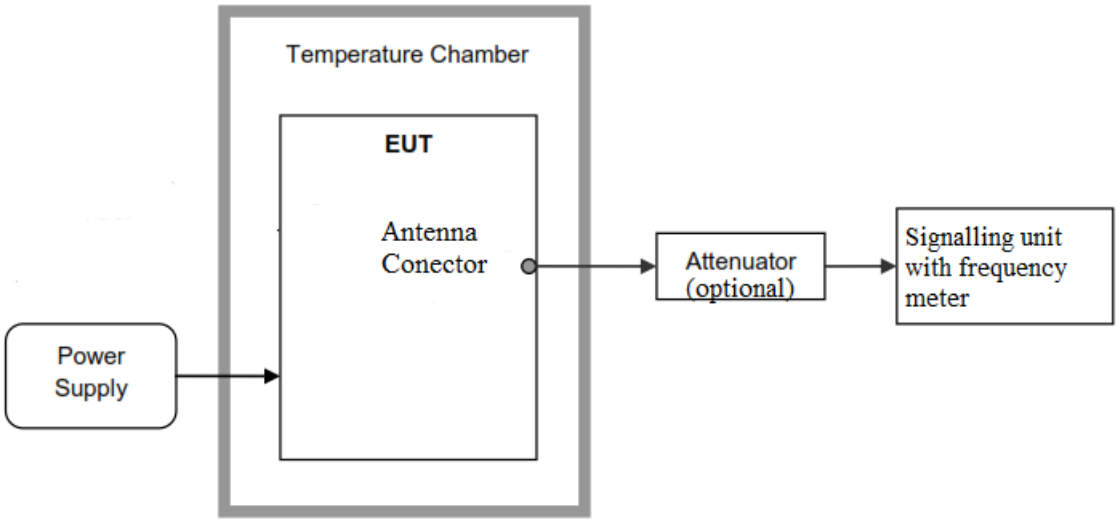
METHOD

The frequency tolerance measurements over temperature variations were made over the temperature range of –30ºC to +50ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from –30ºC up to +50ºC.

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 (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	26	0.031078174	0.000003108
+40	26	0.031078174	0.000003108
+30	26	0.031078174	0.000003108
+20	22	0.026296916	0.000002630
+10	21	0.025101602	0.000002510
0	19	0.022710973	0.000001800
-10	15	0.017929716	0.000001793
-20	16	0.019125030	0.000001912
-30	20	0.023906287	0.000002390

WCDMA AND HSUPA MODULATION

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	2.50	0.002989000	0.000000299
+40	-2.22	-0.002654232	-0.000000265
+30	3.00	0.003586801	0.000000358
+20	-3.23	-0.003861789	-0.000000386
+10	-3.03	-0.003622669	-0.000000362
0	-3.35	-0.004005261	-0.000000400
-10	-2.70	-0.003228121	-0.000000322
-20	-3.77	-0.004507413	-0.000000451
-30	-2.94	-0.003515065	-0.000000351

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	22	0.026296916	0.000002630
Vmin	3.60	24	0.028687545	0.000002869

WCDMA AND HSUPA MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	-3.23	-0.003861789	-0.000000386
Vmin	3.60	2.15	0.002570540	0.000000257

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

Verdict: PASS

Occupied Bandwidth

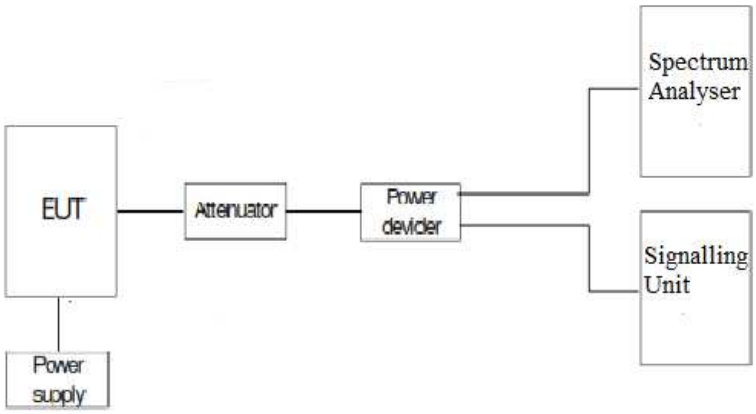
SPECIFICATION

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)	242.46	234.34	244.94
-26 dBc bandwidth (kHz)	318.34	315.55	311.11
Measurement uncertainty (kHz)	<±1.67		

EDGE MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	247.78	251.94	251.06
-26 dBc bandwidth (kHz)	315.65	319.15	315.90
Measurement uncertainty (kHz)	<±1.67		

WCDMA MODULATION

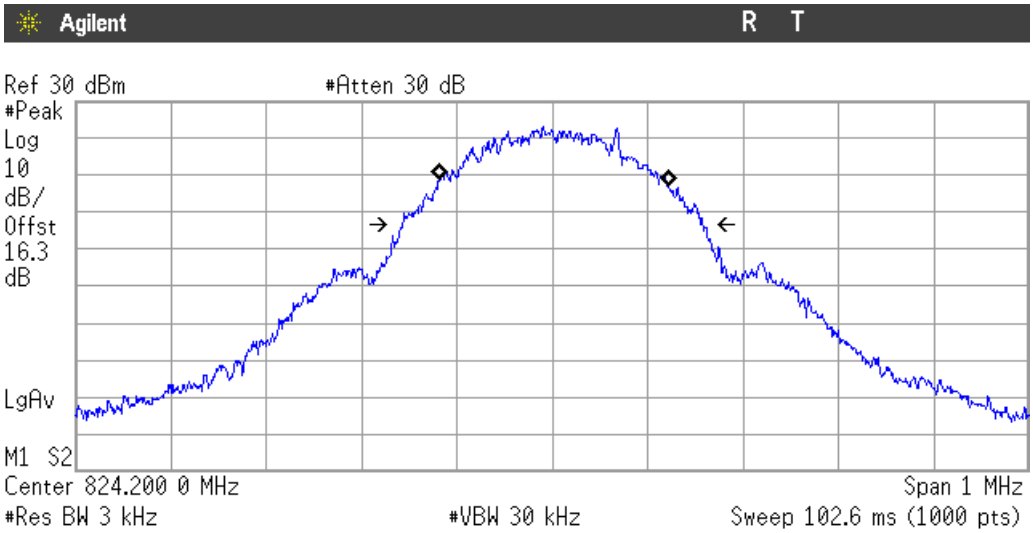
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4160.7	4167.2	4165.6
-26 dBc bandwidth (kHz)	4649	4639	4639
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4181.2	4154.2	4173.7
-26 dBc bandwidth (kHz)	4665	4639	4632
Measurement uncertainty (kHz)	<±16.67		

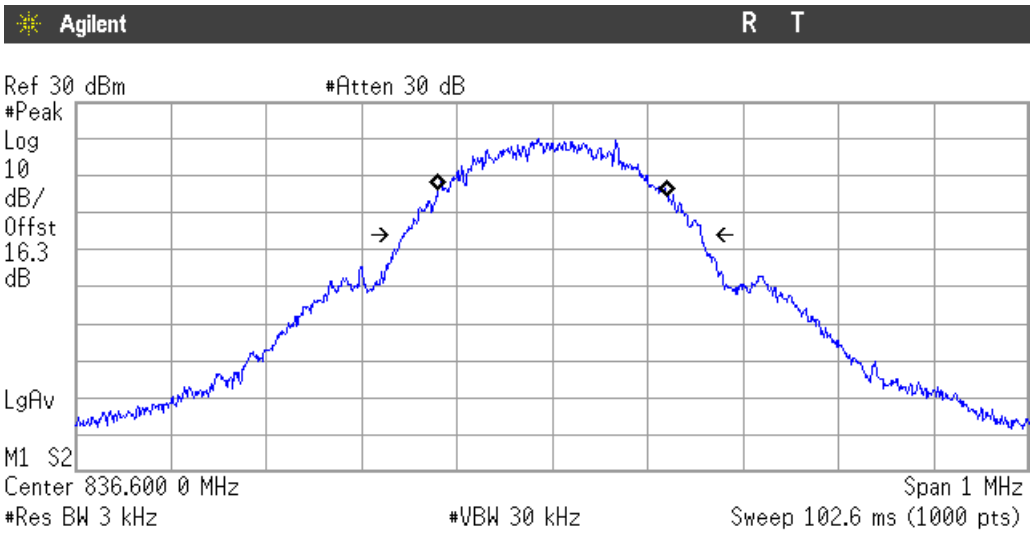
GPRS MODULATION

Lowest Channel



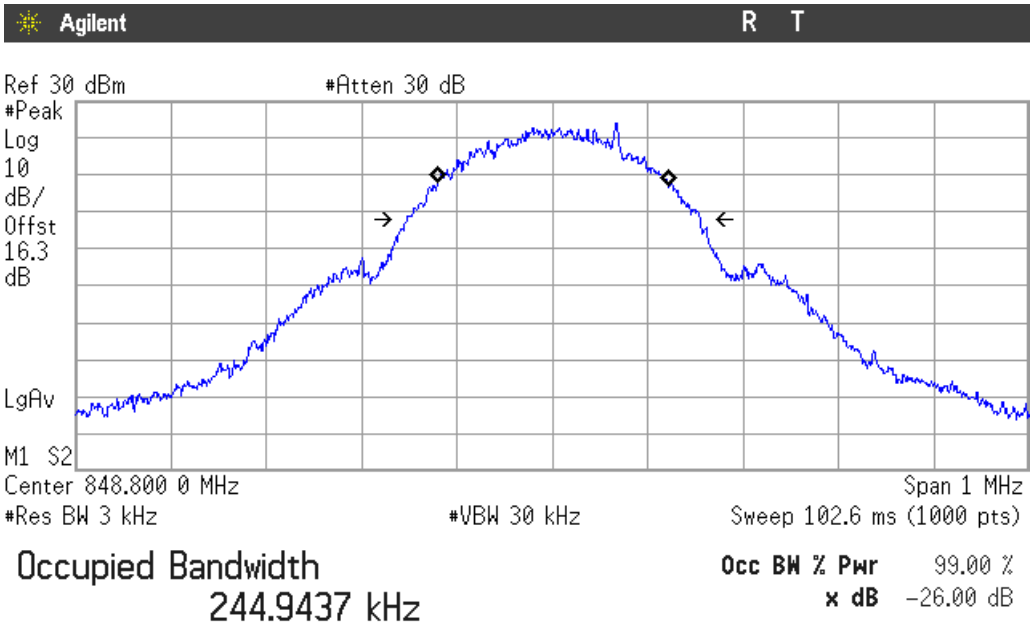
Transmit Freq Error	1.468 kHz
x dB Bandwidth	318.341 kHz

Middle Channel



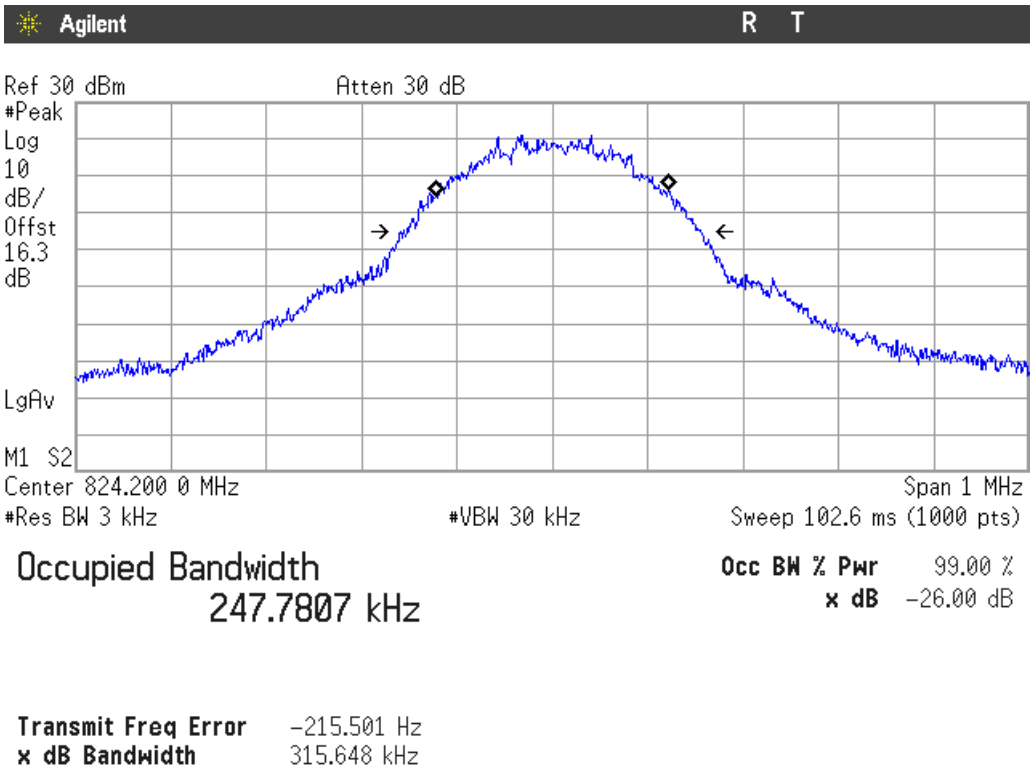
Transmit Freq Error	554.207 Hz
x dB Bandwidth	315.552 kHz

Highest Channel

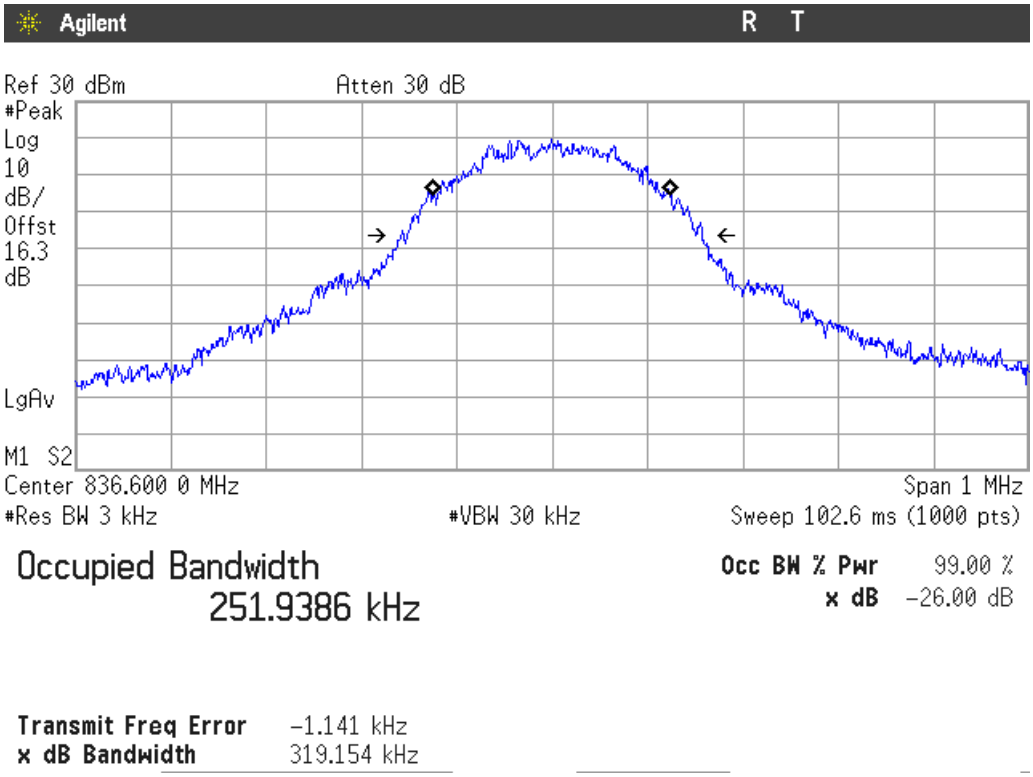


EDGE MODULATION

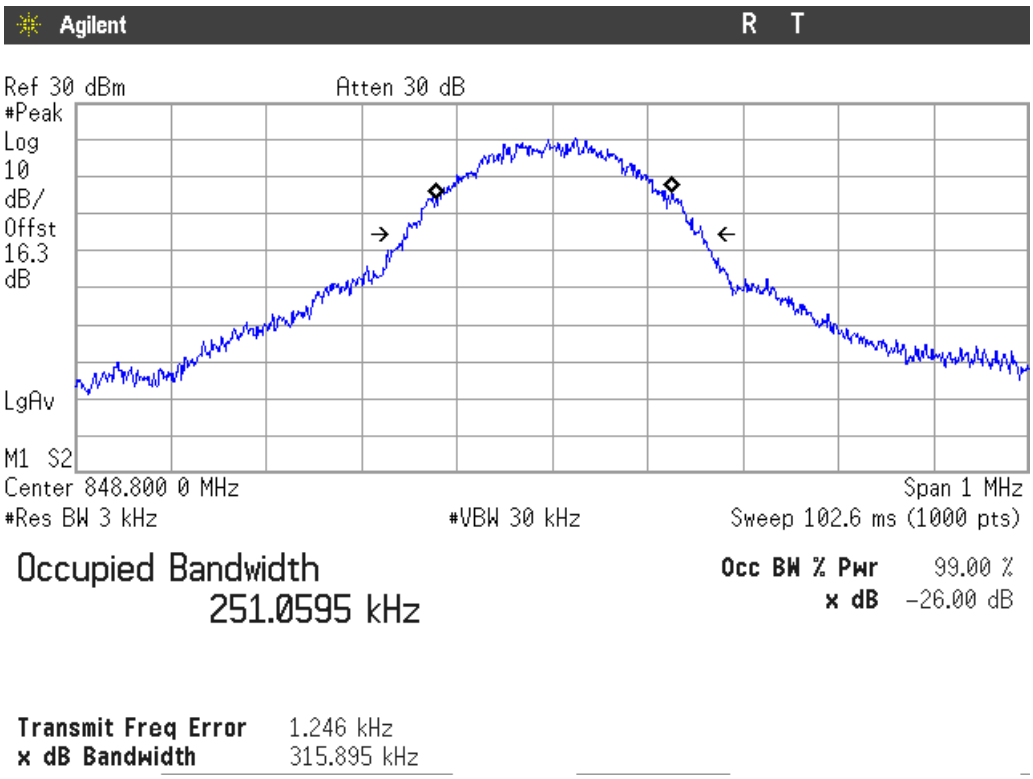
Lowest Channel



Middle Channel

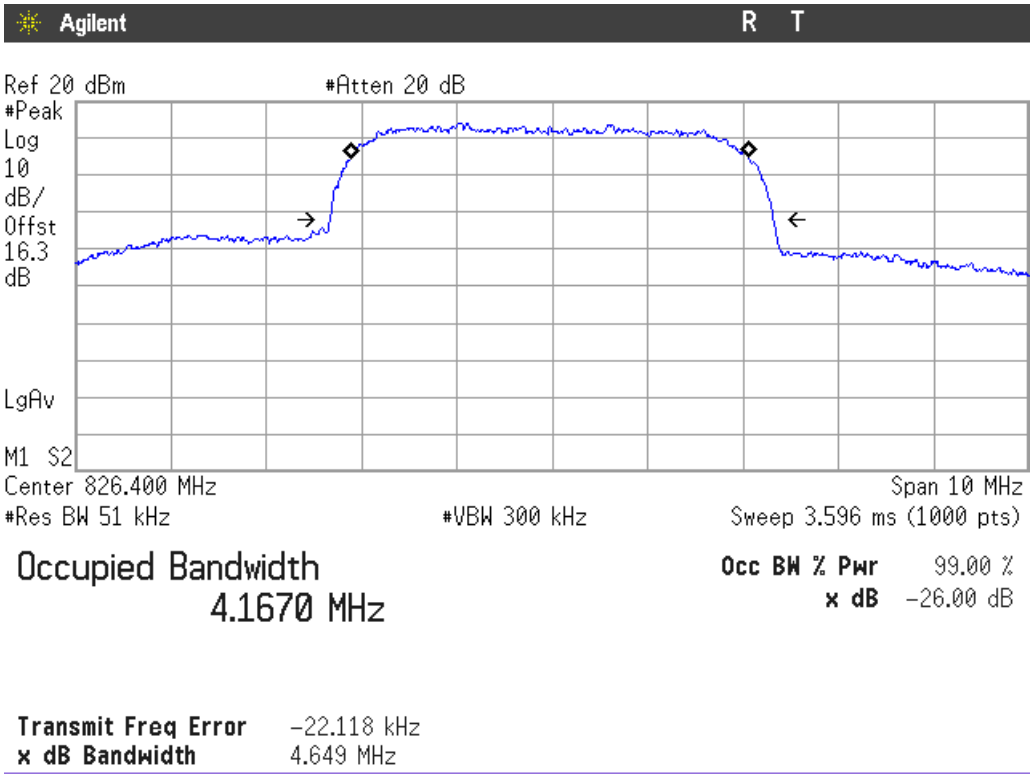


Highest Channel

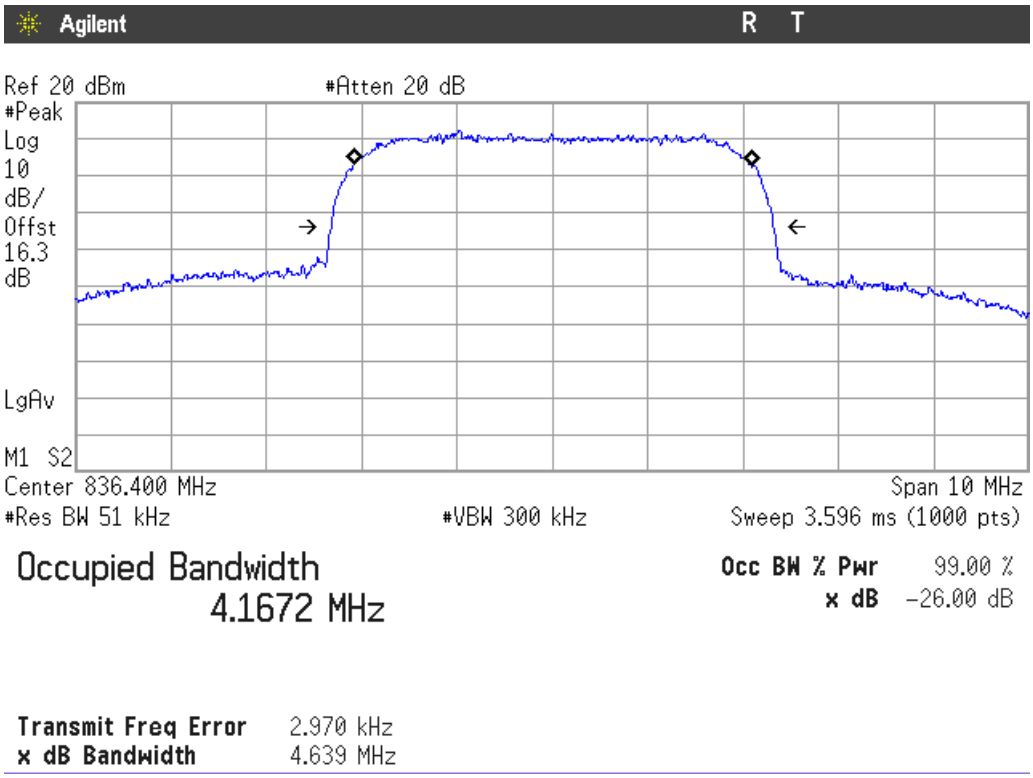


WCDMA MODULATION

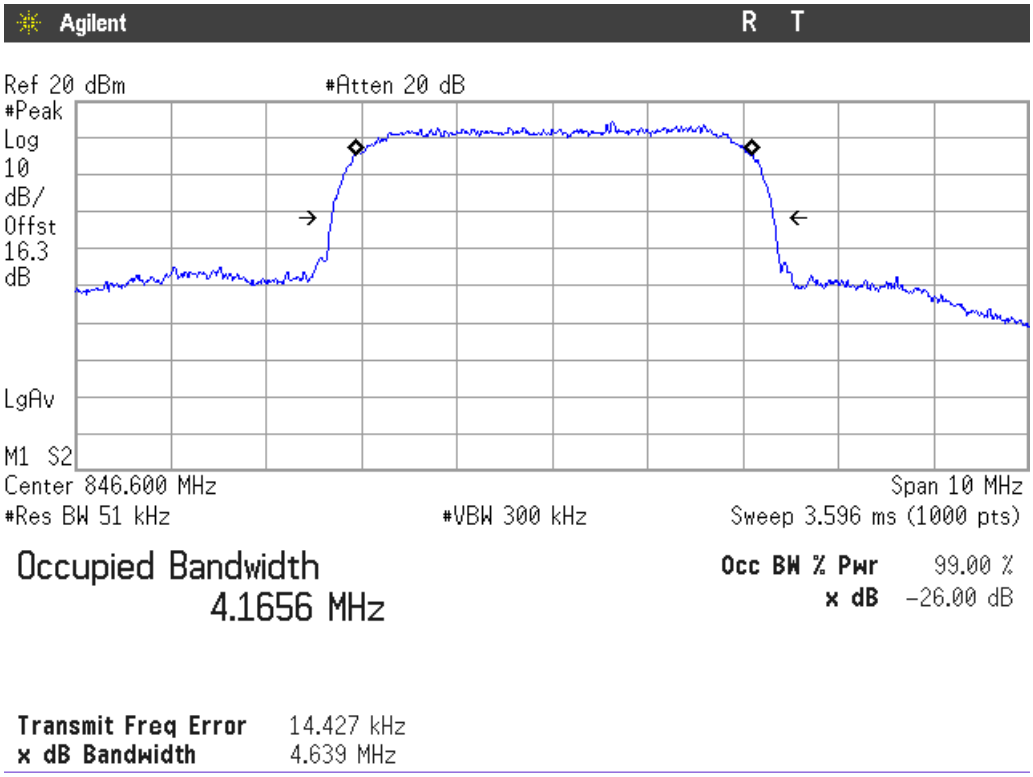
Lowest Channel



Middle Channel

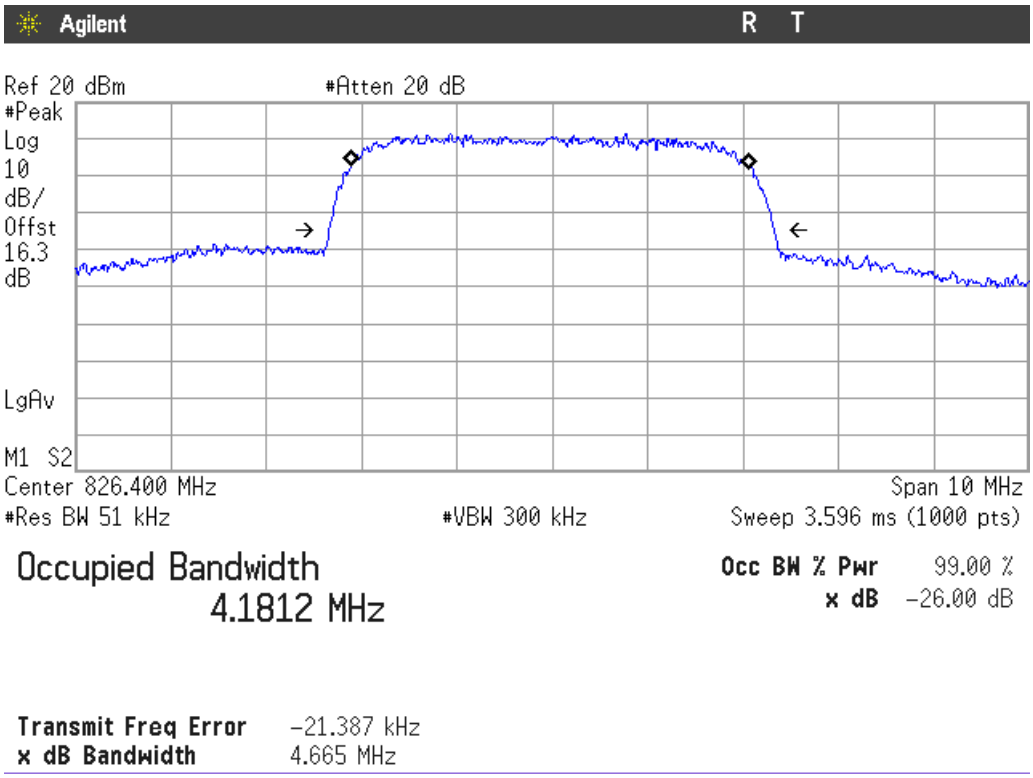


Highest Channel

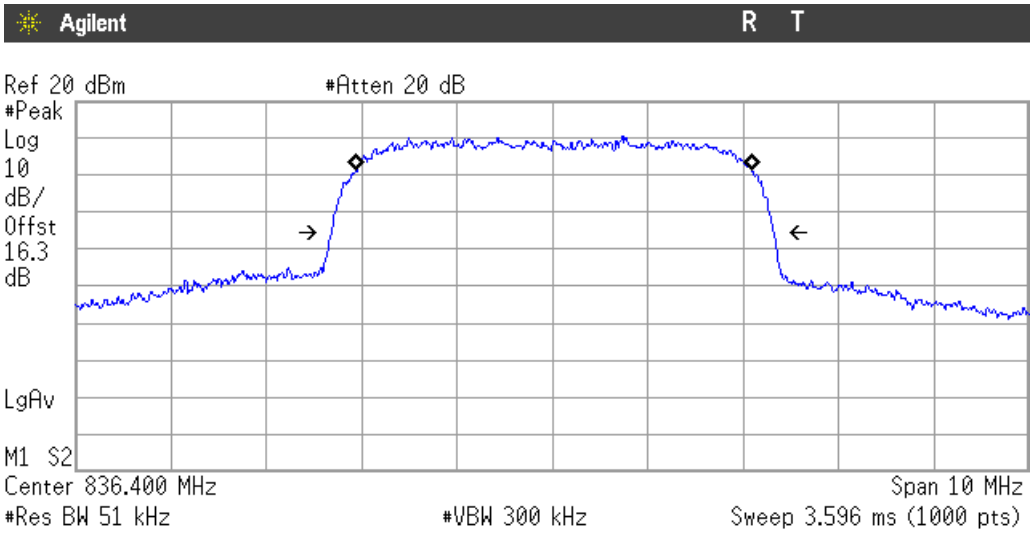


HSUPA MODULATION

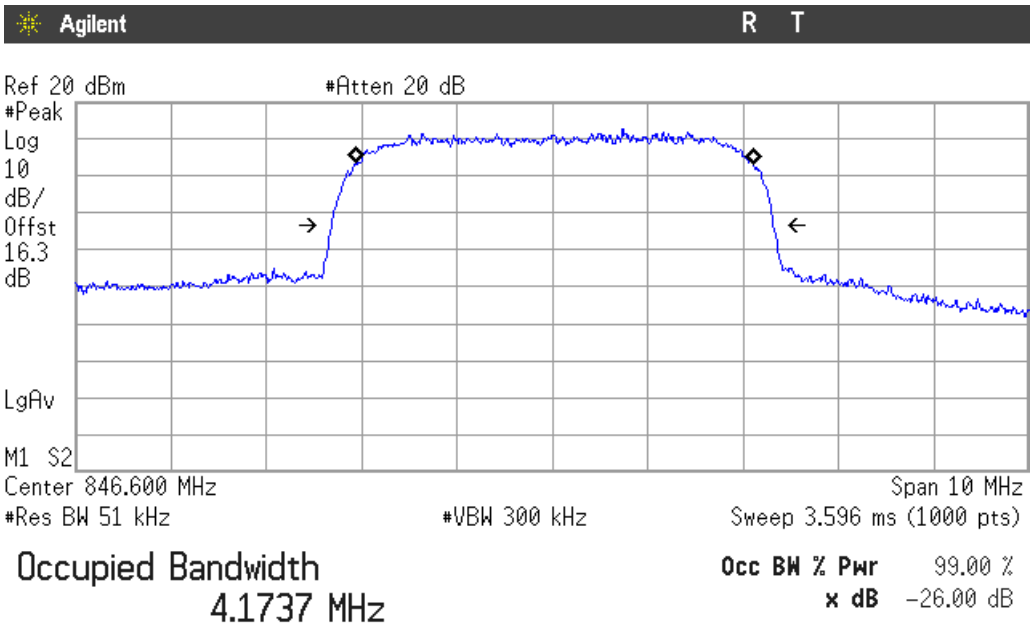
Lowest Channel



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.

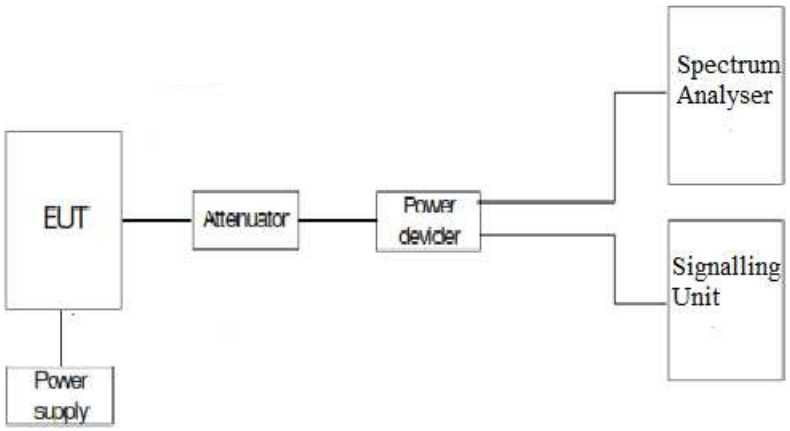
The spectrum was investigated from 9 kHz to 10 GHz.

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 Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = - 13 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.

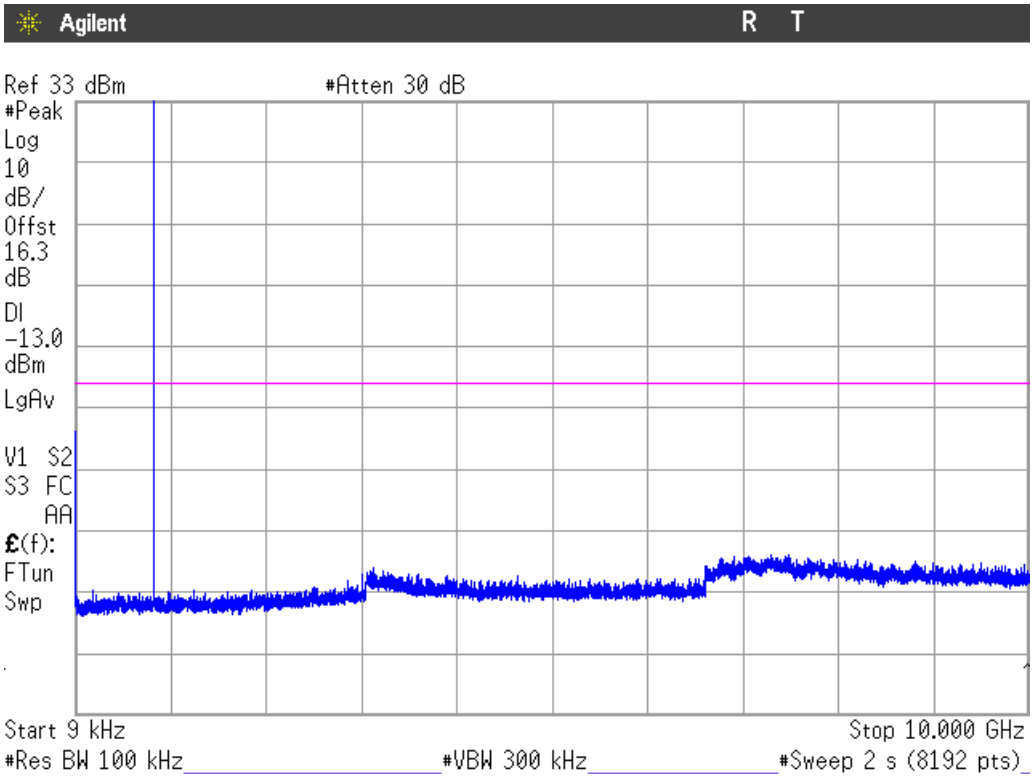
2. CHANNEL: MIDDLE
No spurious signals were found at less than 20dB respect to the limit in all the range.

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

Verdict: PASS

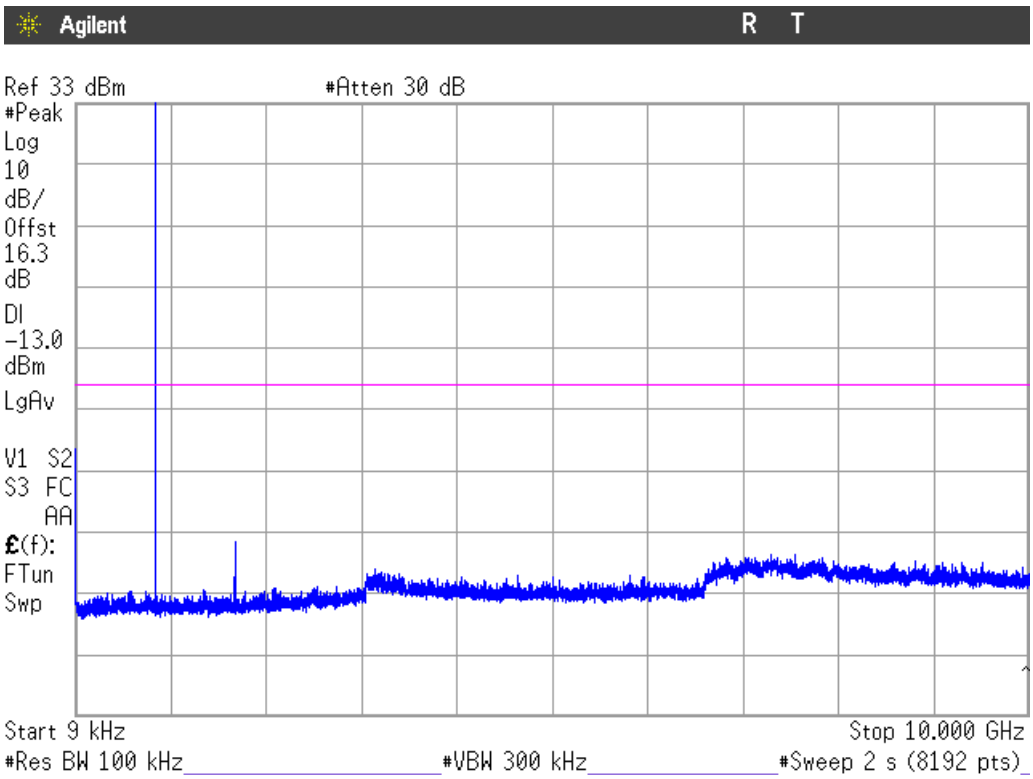
GPRS MODULATION

1. CHANNEL: LOWEST



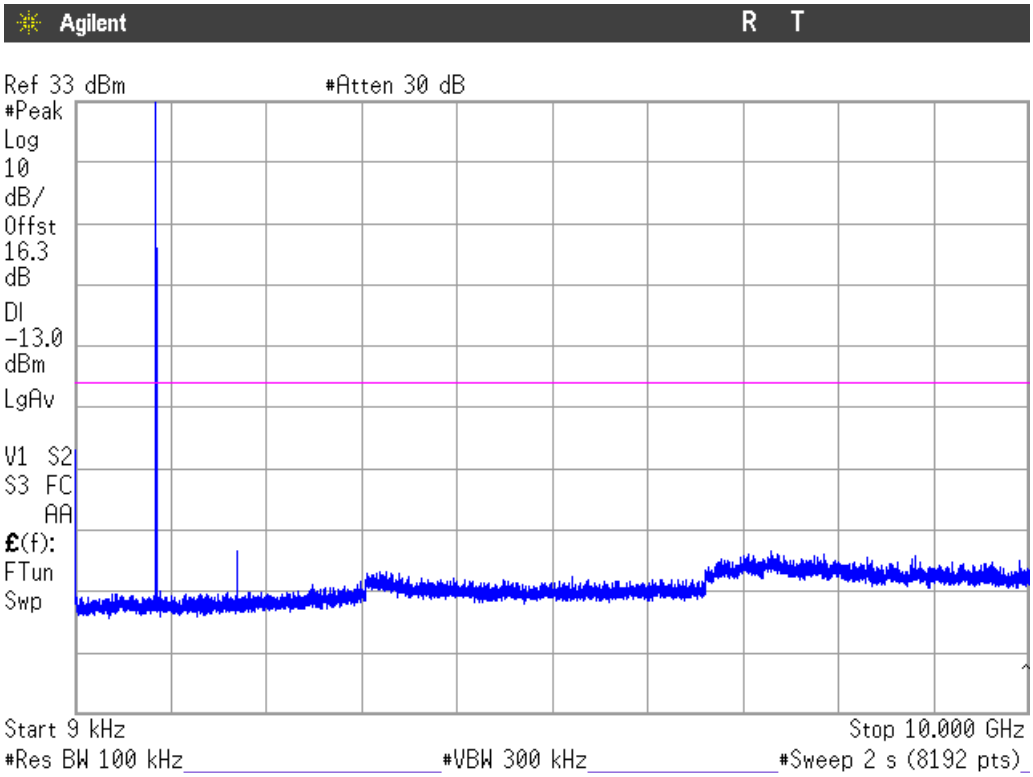
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

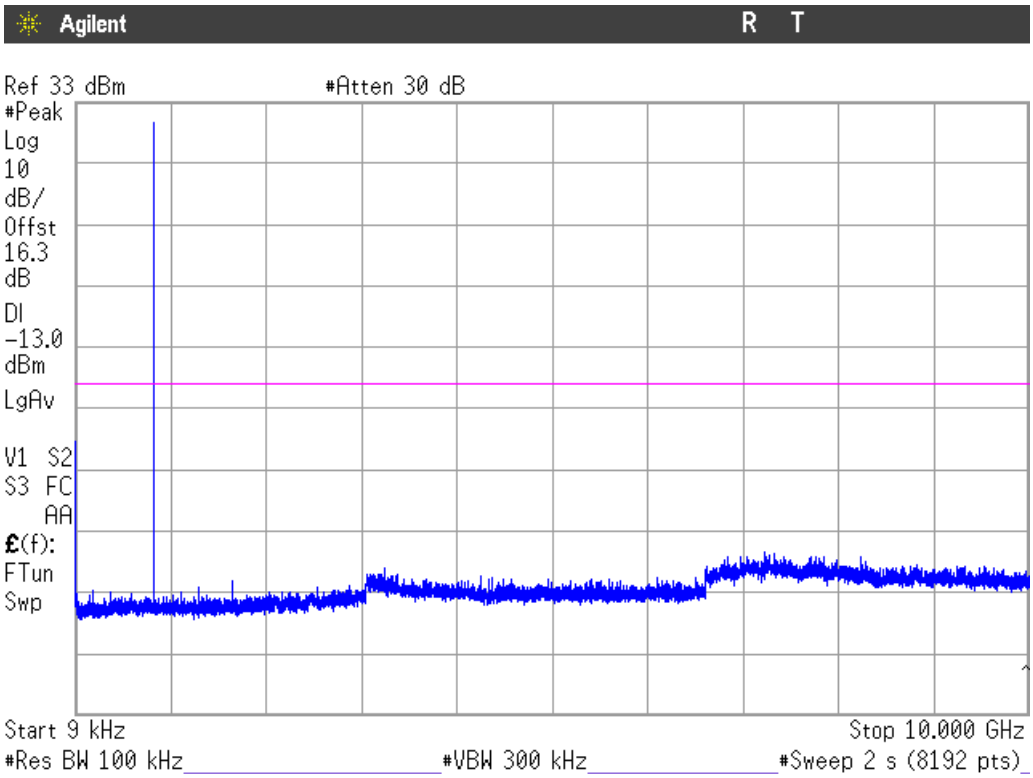
3. CHANNEL: HIGHEST



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

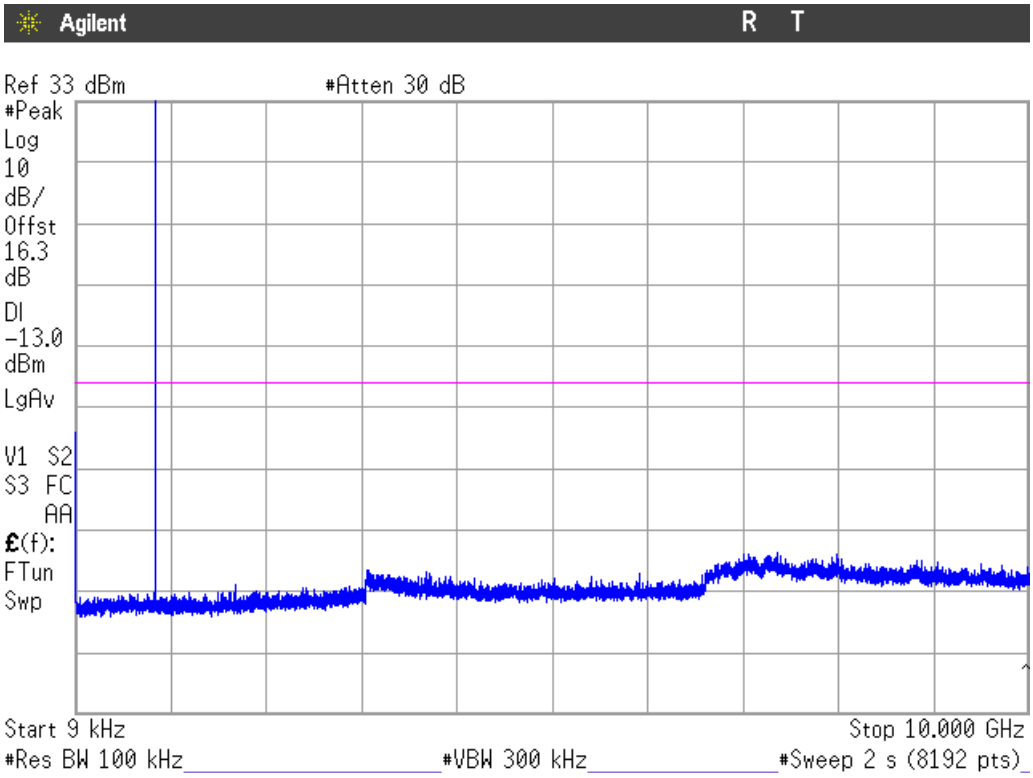
EDGE MODULATION

1. CHANNEL: LOWEST



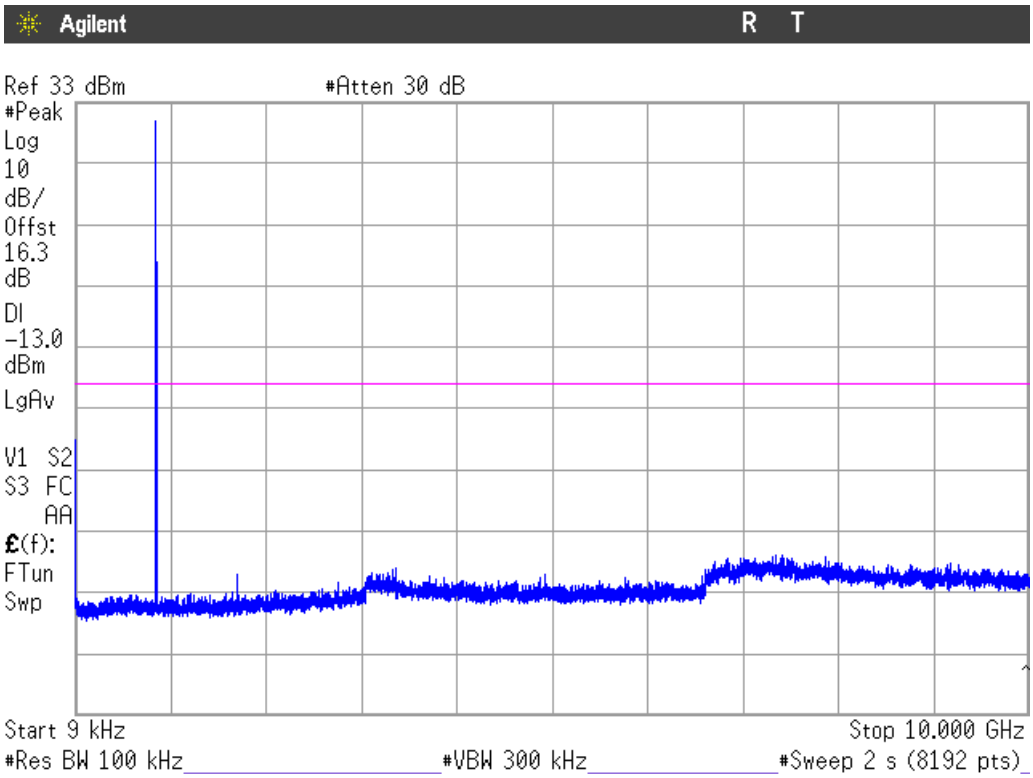
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

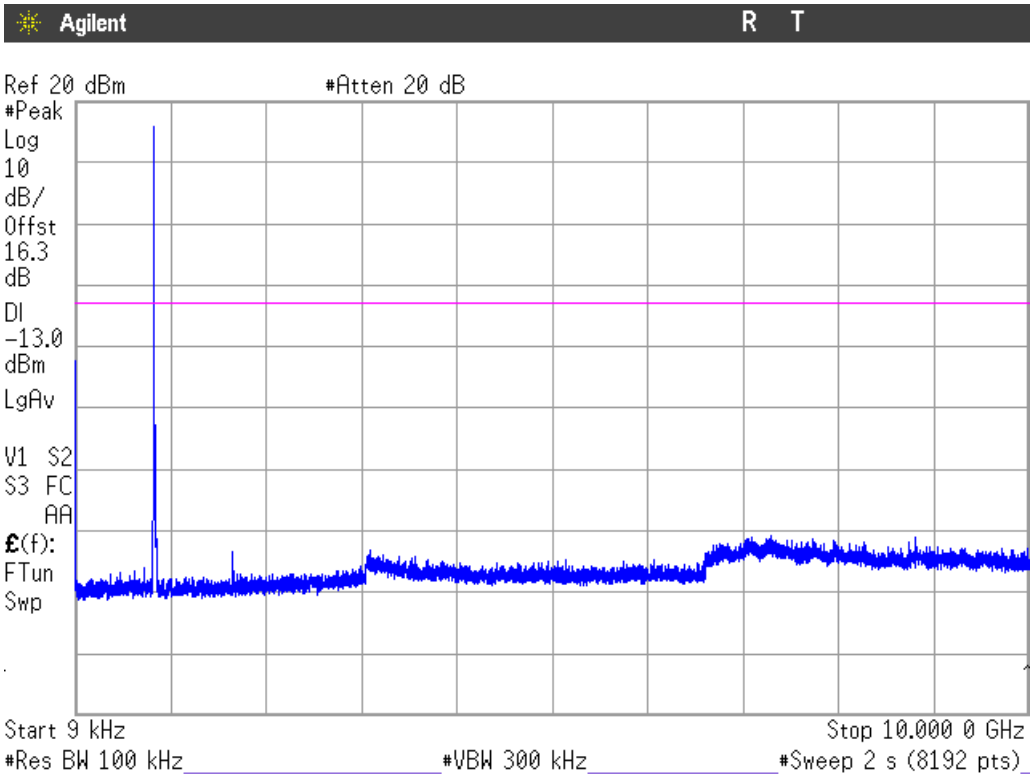
3. CHANNEL: HIGHEST



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

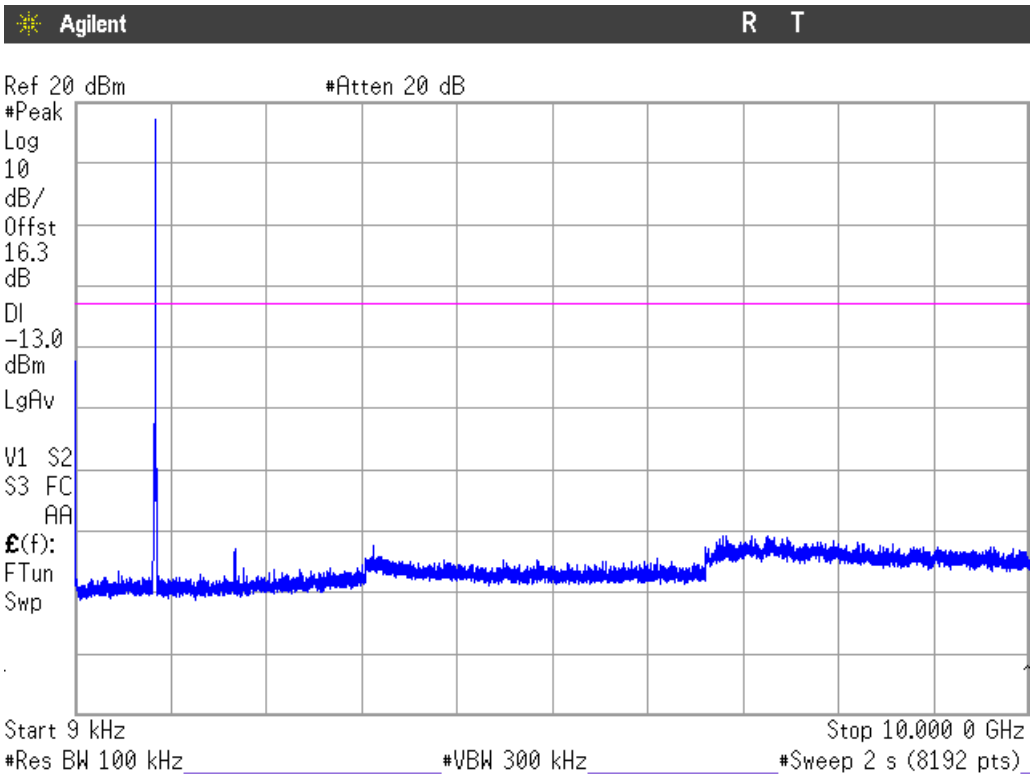
WCDMA MODULATION

1. CHANNEL: LOWEST



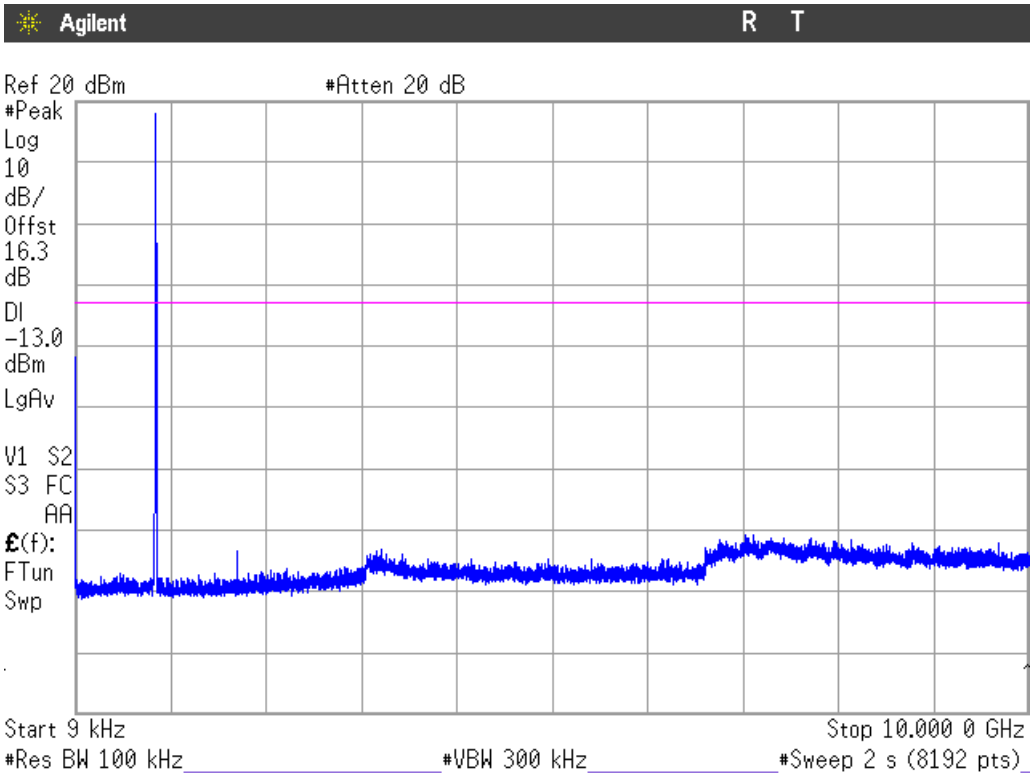
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

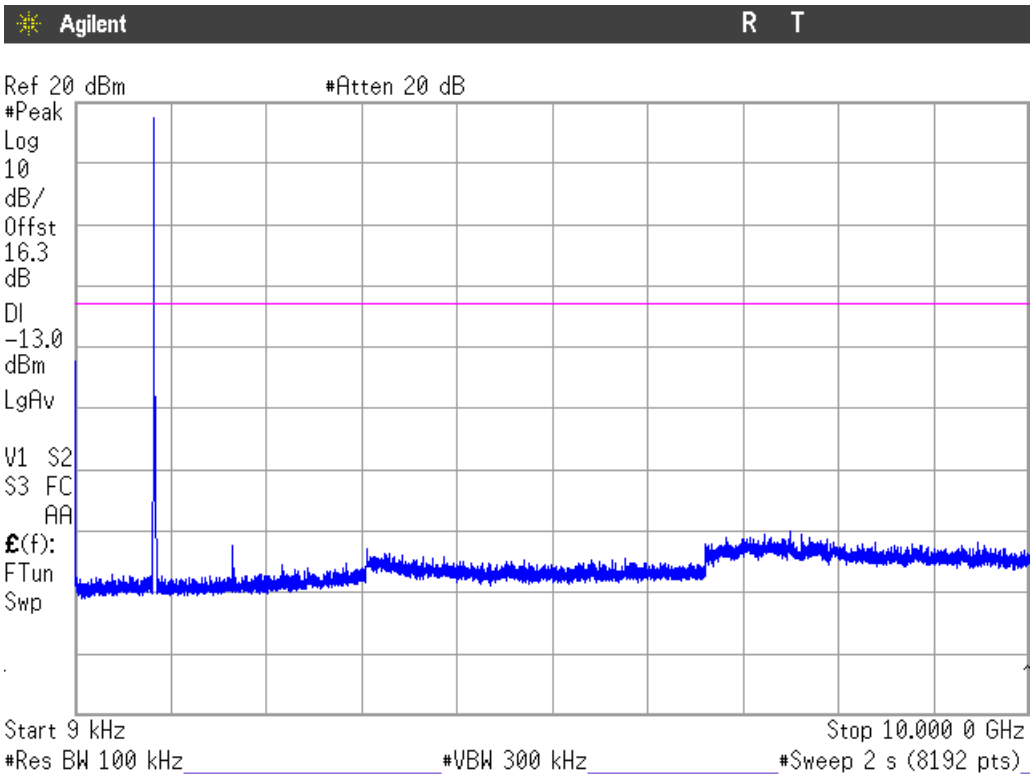
3. CHANNEL: HIGHEST



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

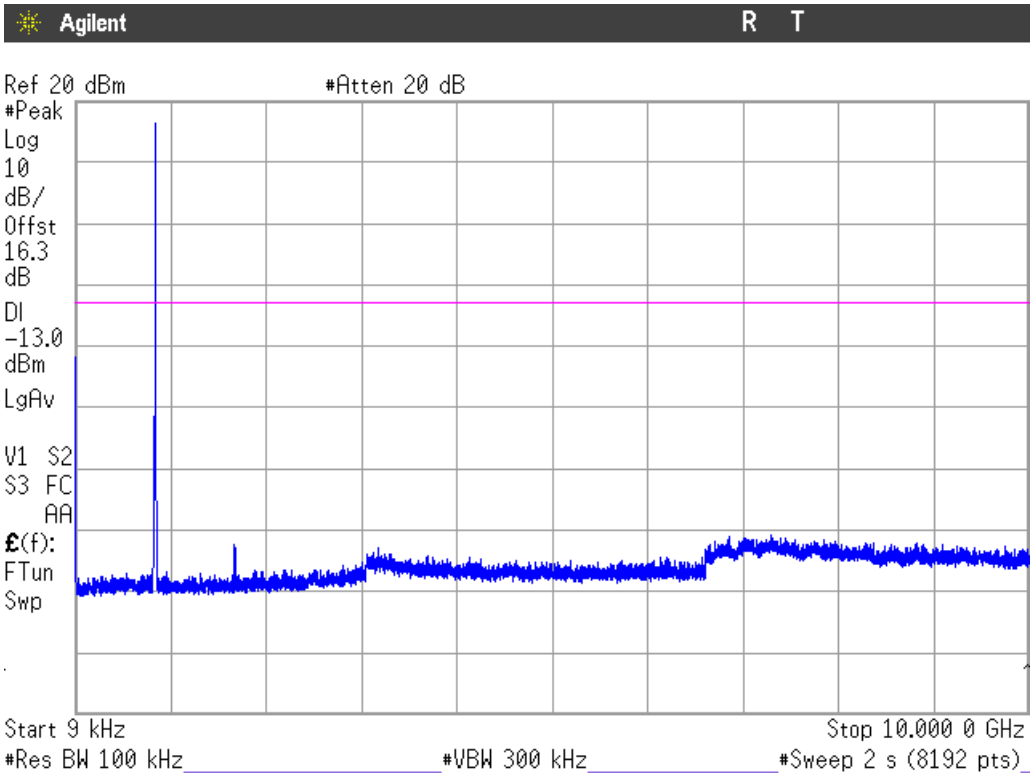
HSUPA MODULATION

1. CHANNEL: LOWEST



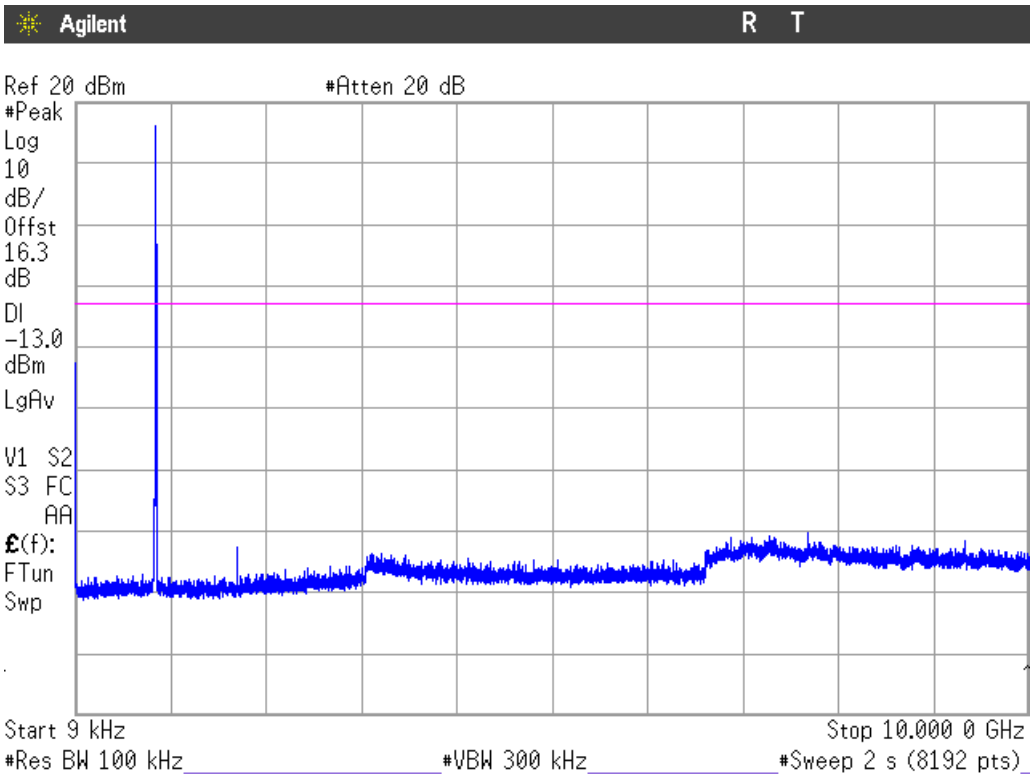
Note: The peak above the limit is the carrier frequency.

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

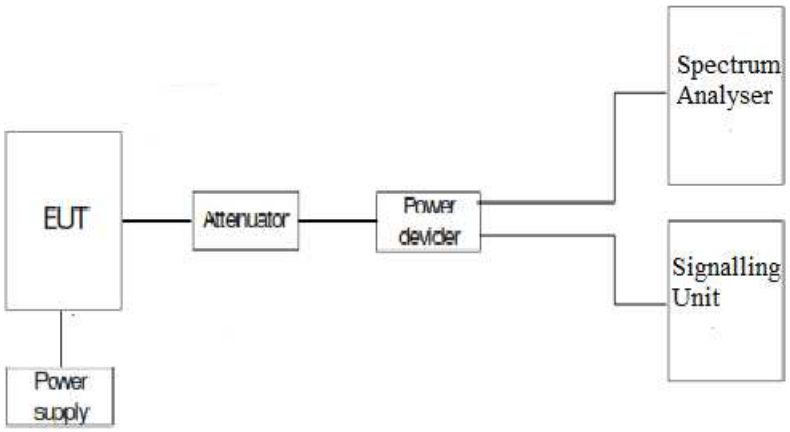
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 ohm attenuator and a power splitter.

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 Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = - 13 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)	-16.54	-21.32	-17.26	-17.43
Measurement uncertainty (dB)	<±2.03			

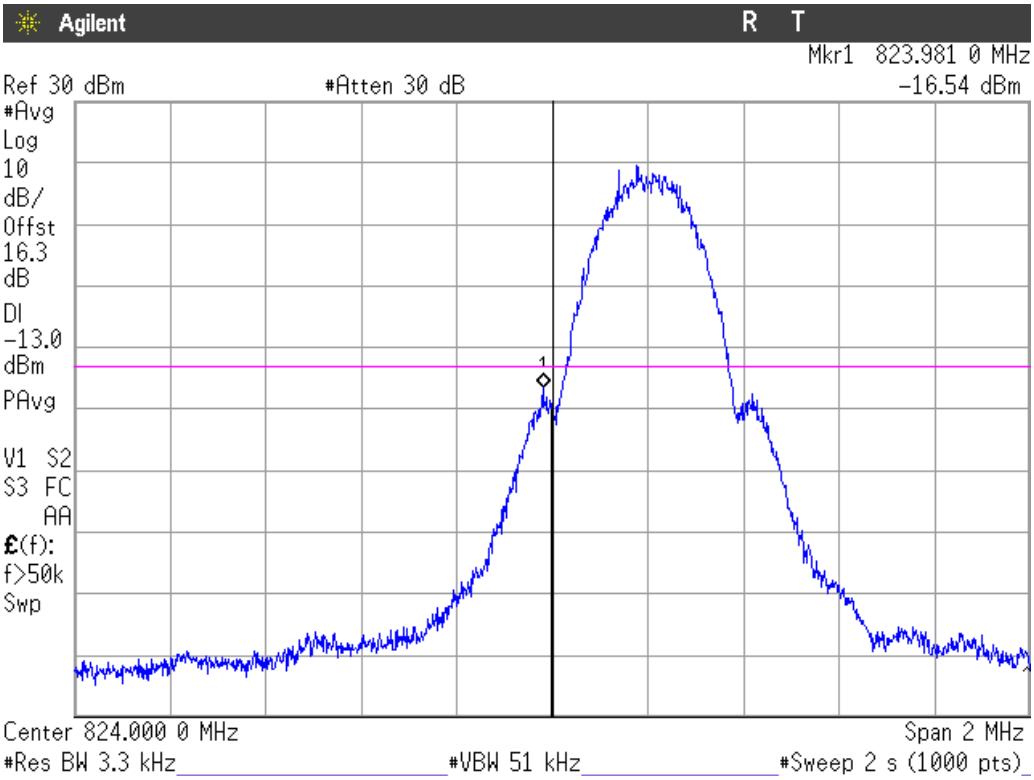
MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-18.72	-24.25	-16.13	-20.80
Measurement uncertainty (dB)	<±2.03			

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

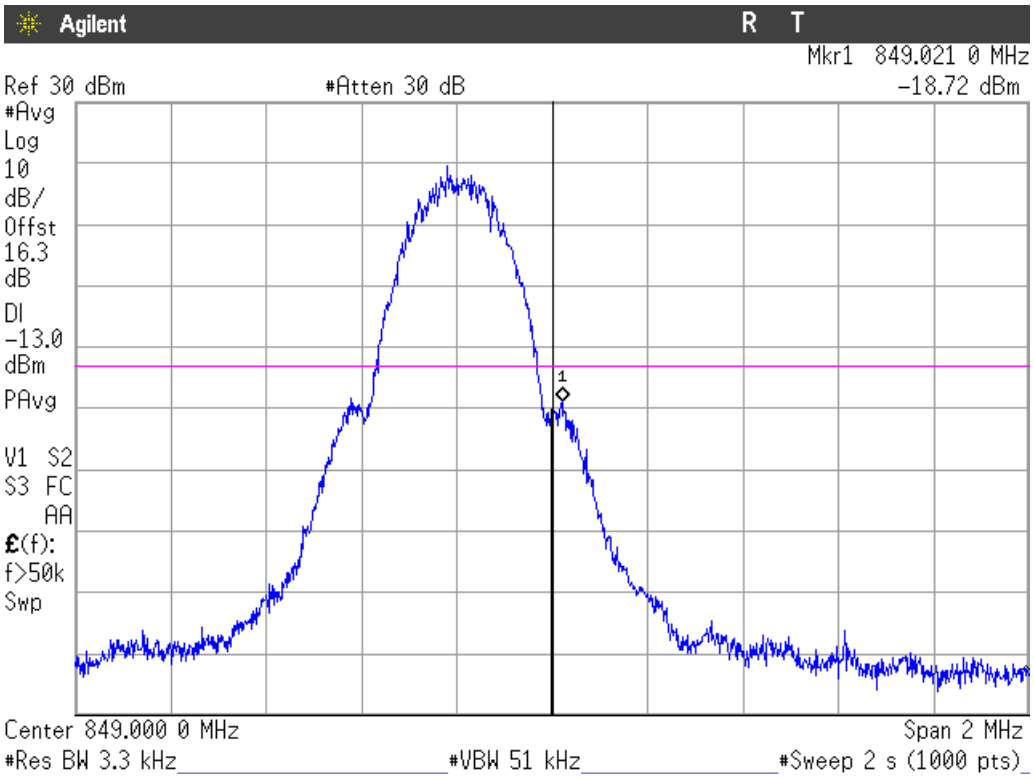
GPRS MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

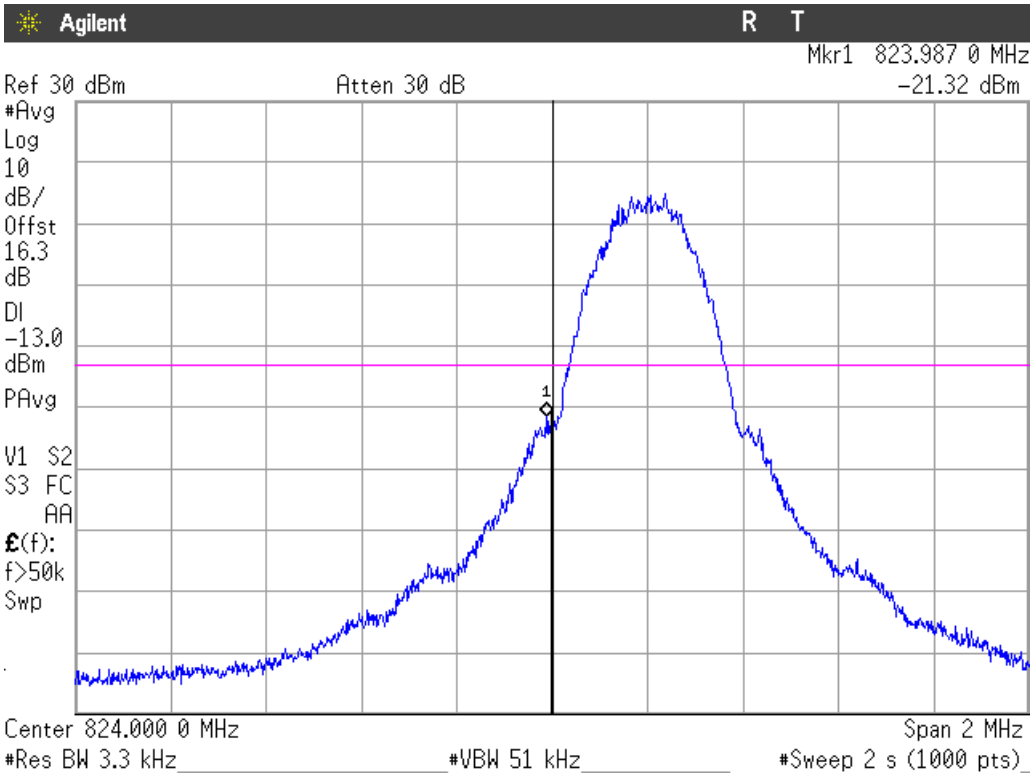
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

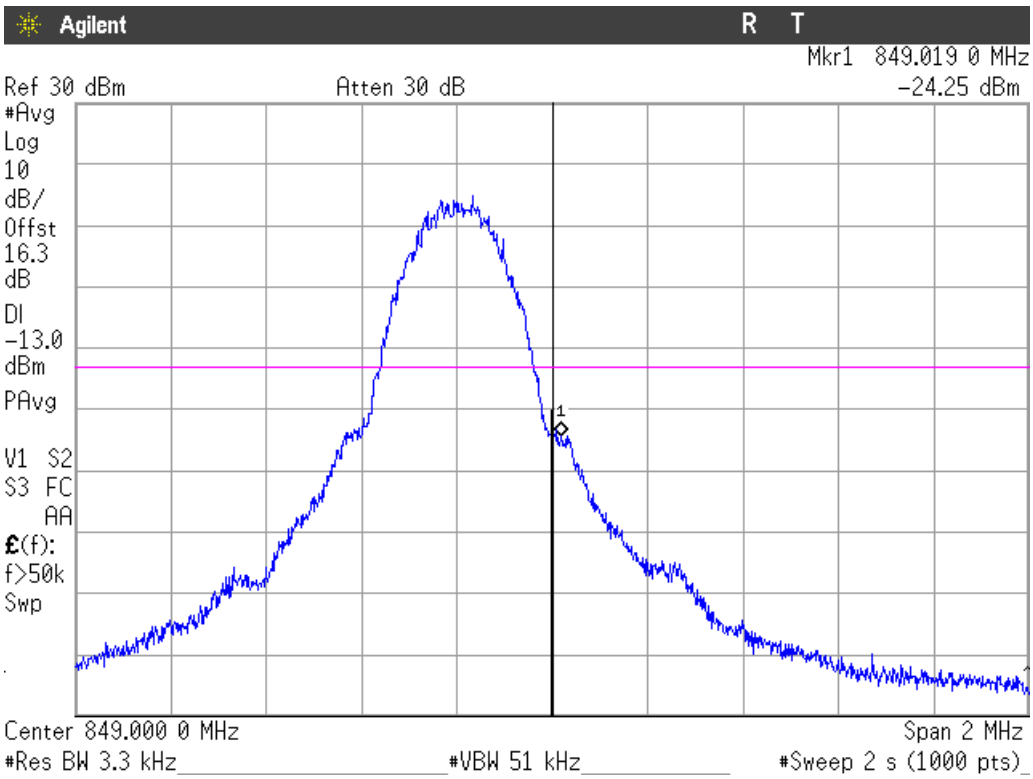
EDGE MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

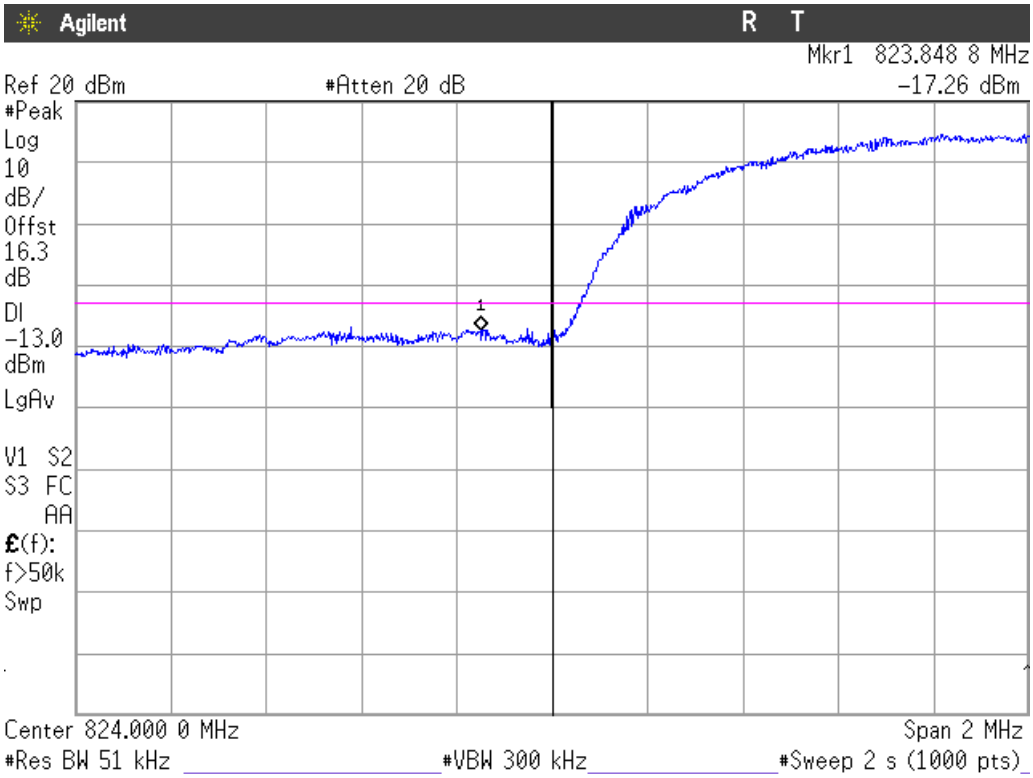
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

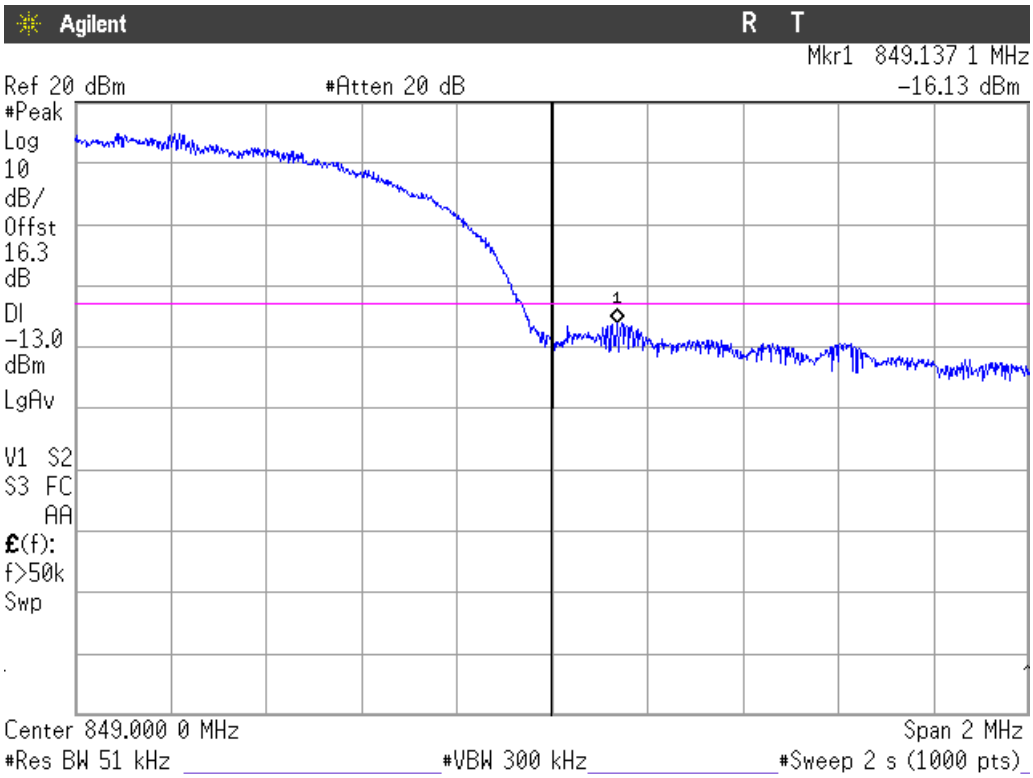
WCDMA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

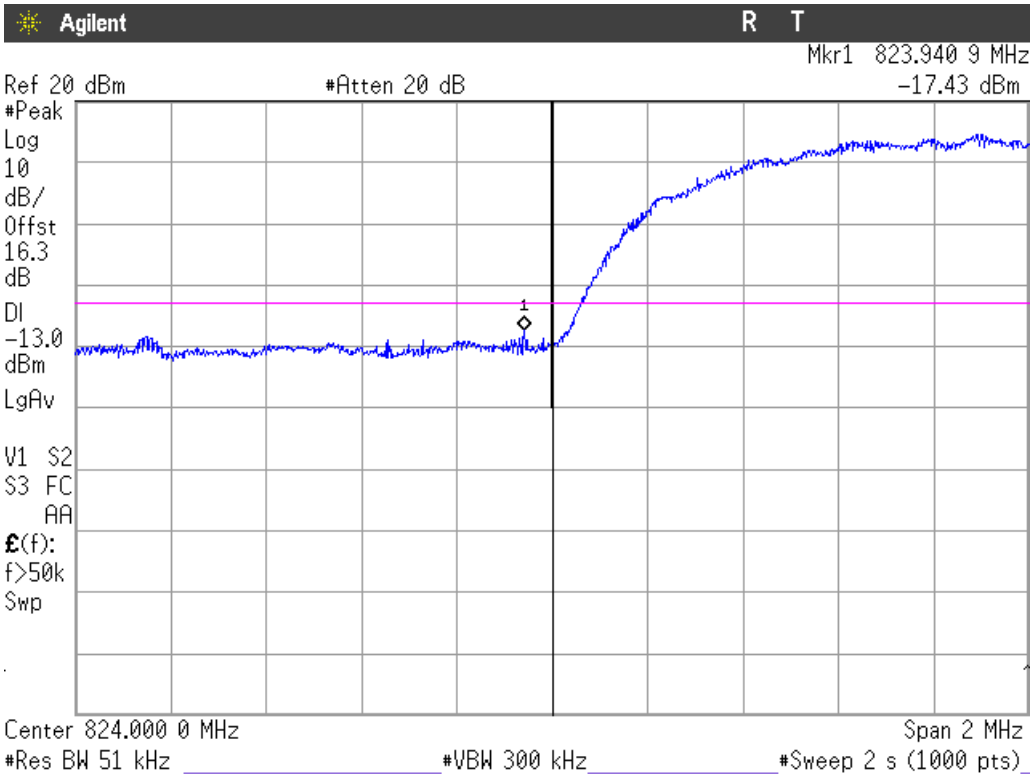
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

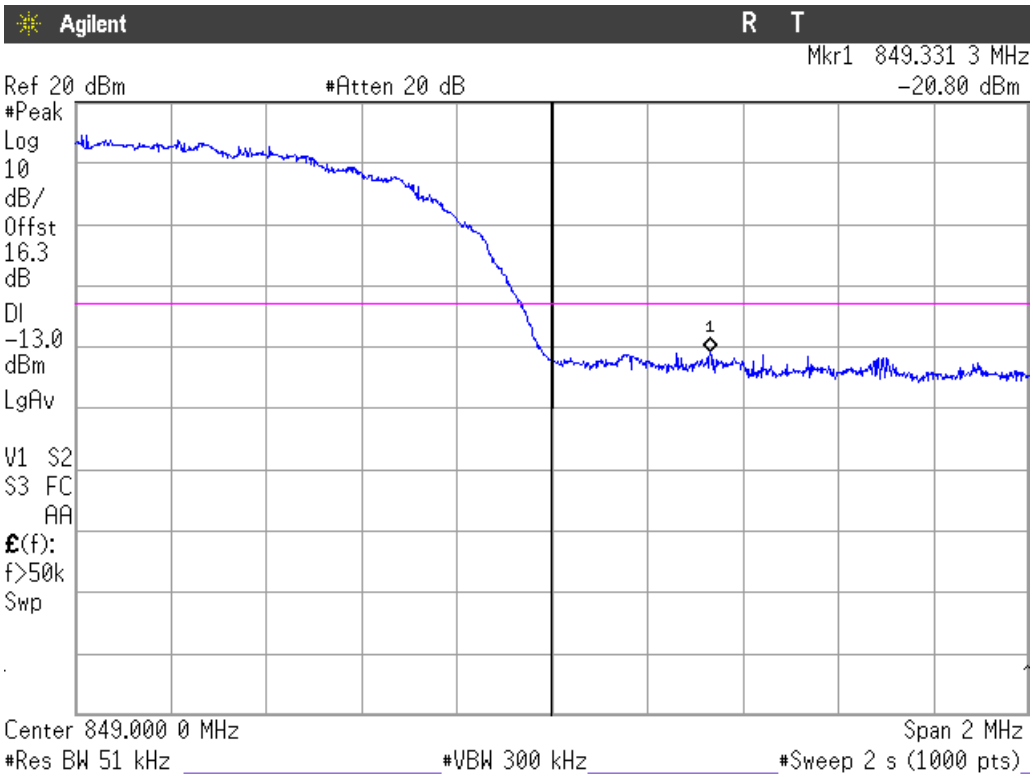
HSUPA MODULATION

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, repeated with the BT EDR/BT LE (modulation GFSK, which is the worst case) and repeated with WIFI (802.11b mode 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.

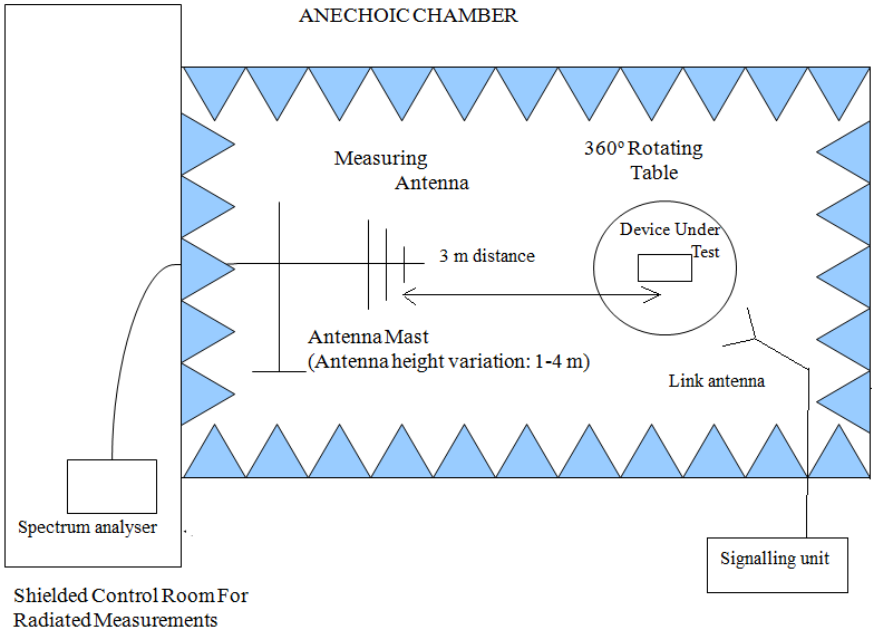
Measurement Limit**:**

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 Po transmitting power. the specified minimum attenuation becomes 43+10log (Po) and the level in dBm relative Po becomes:

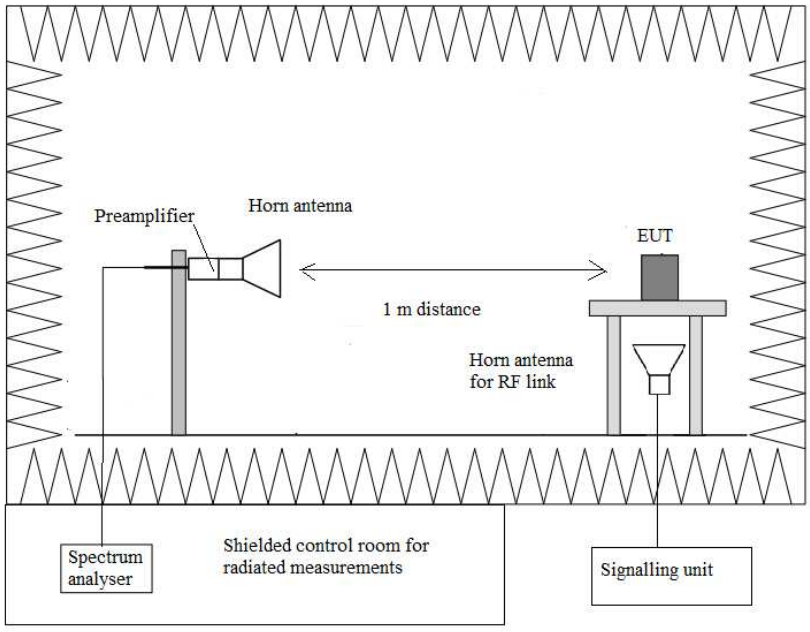
Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = - 13 dBm

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

WCDMA AND HSUPA MODULATION

A preliminary scan determined the WCDMA modulation as the worst case. The following tables and plots show the results for WCDMA 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.
No spurious signals were found 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.
No spurious signals were found 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.
No spurious signals were found at less than 20 dB respect to the limit.

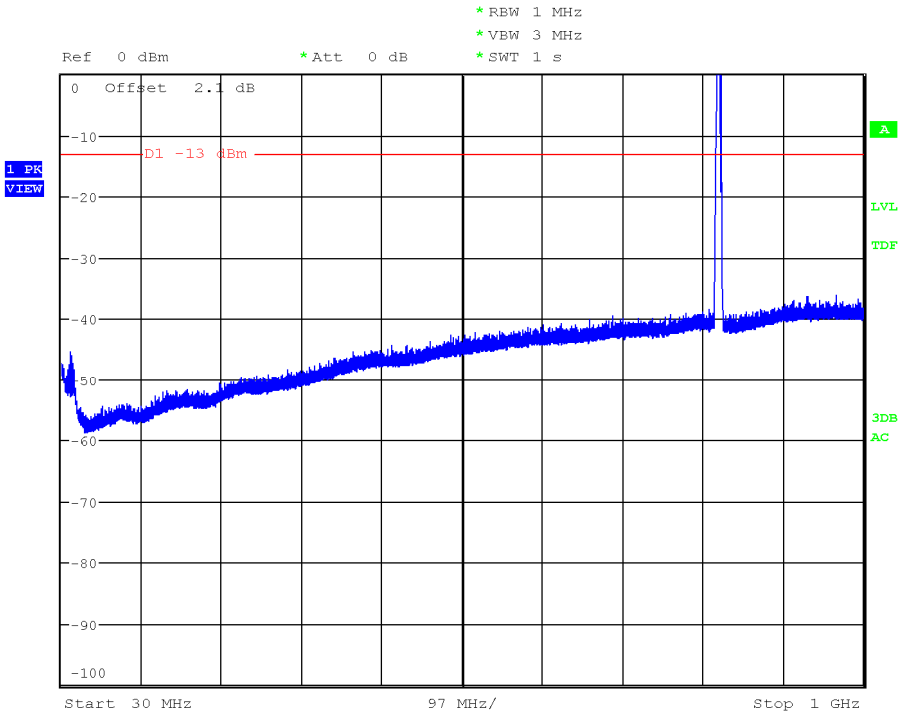
Measurement uncertainty (dB)	<±3.88 for f < 1GHz <±4.87 for f ≥ 1 GHz up to 10 GHz

Verdict: PASS

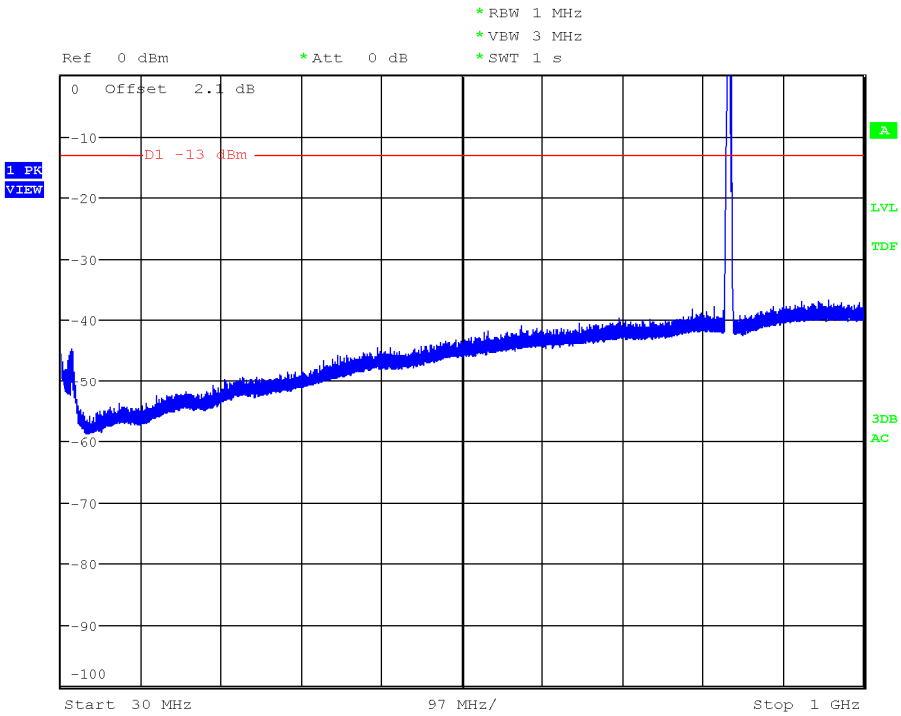
FREQUENCY RANGE 30 MHz-1000 MHz.

GPRS MODULATION

CHANNEL: LOWEST

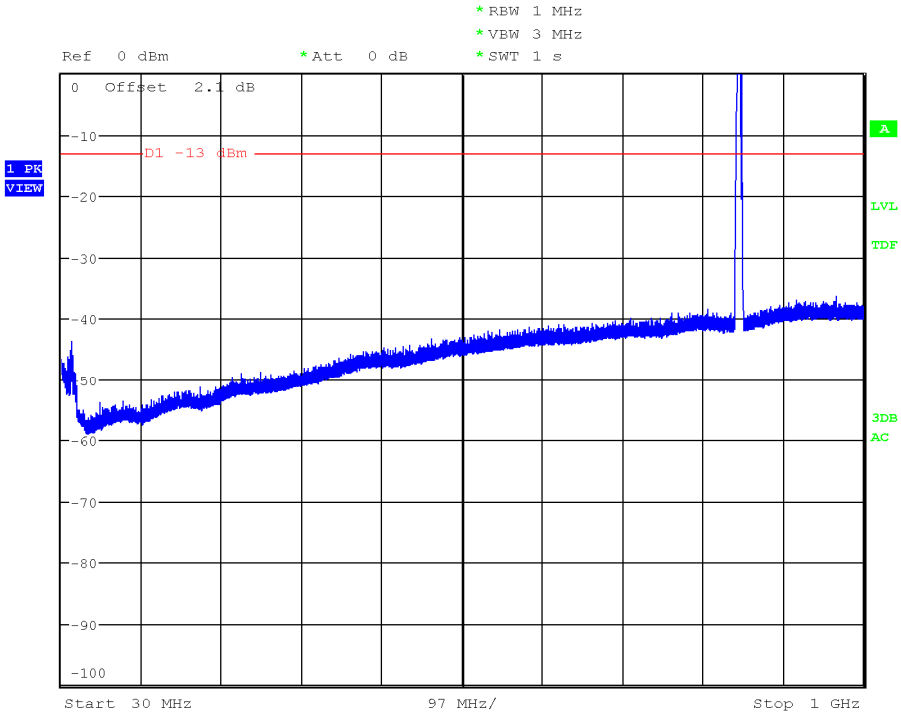


Note: The peak above the limit is the carrier frequency.
CHANNEL: MIDDLE



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

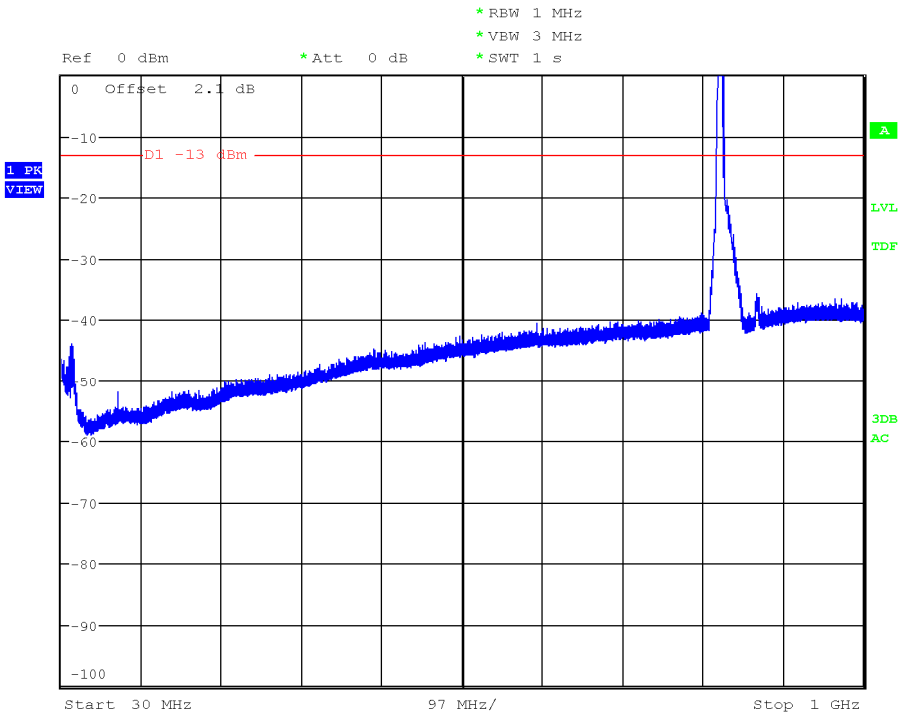
CHANNEL: HIGHEST



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

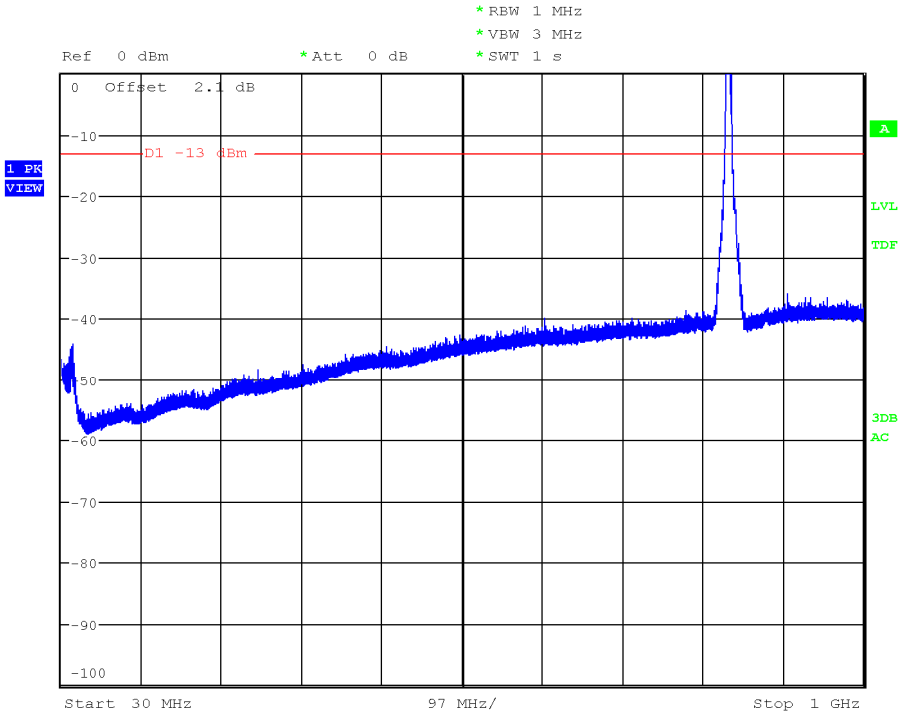
WCDMA MODULATION

CHANNEL: LOWEST



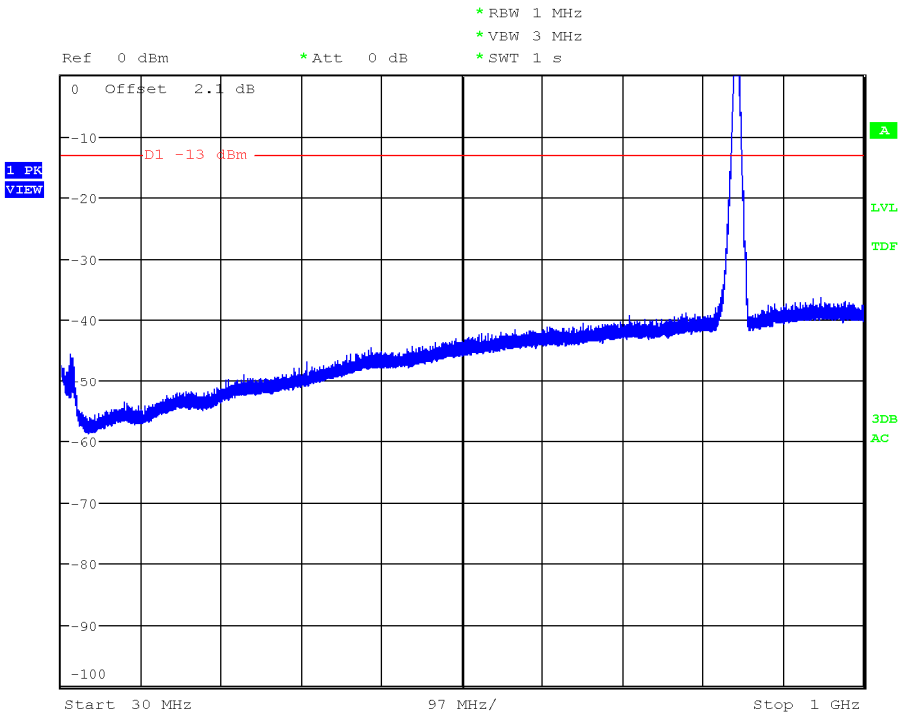
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

CHANNEL: HIGHEST

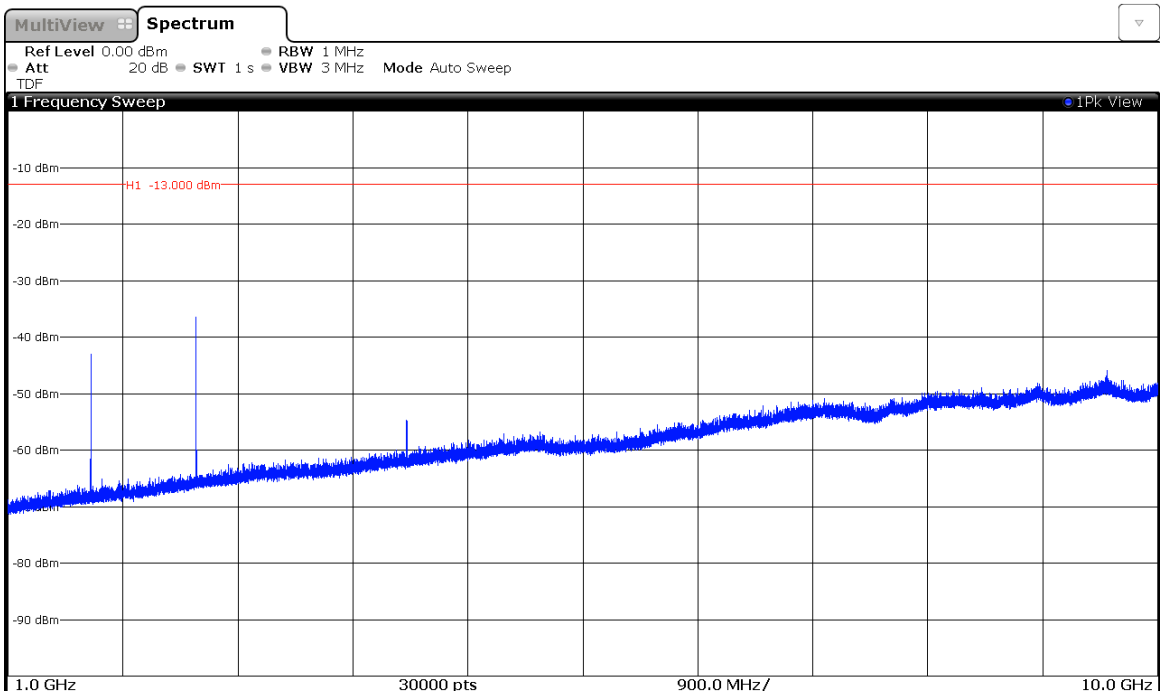


Note: The peak above the limit is the carrier frequency.

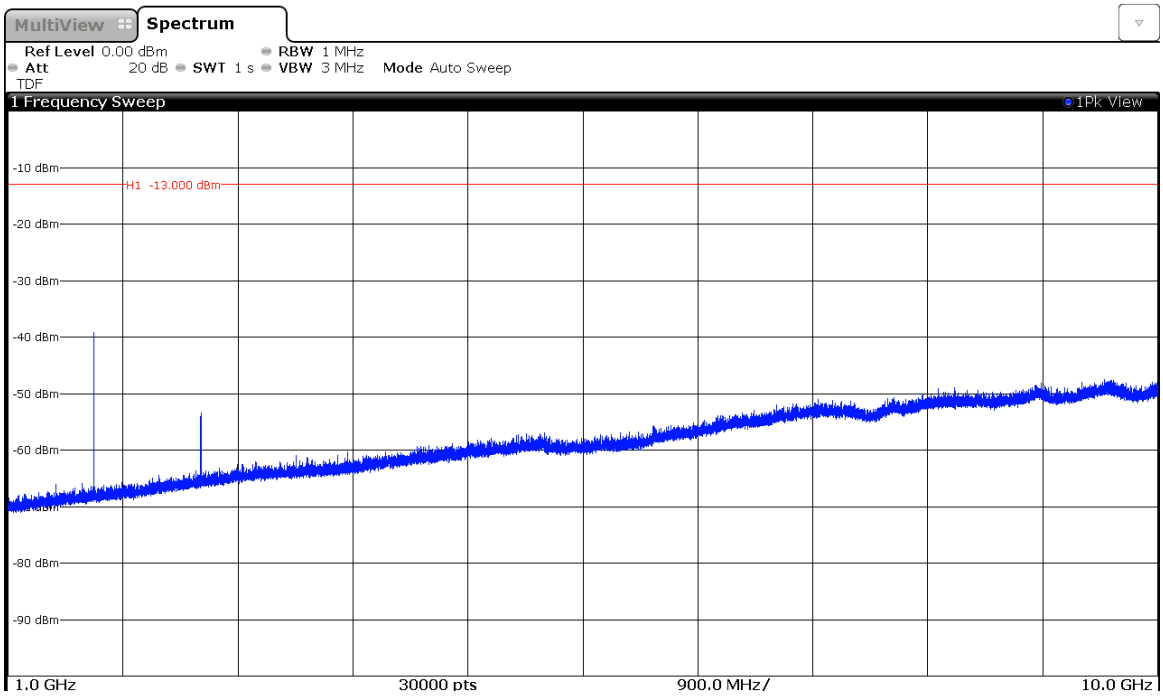
FREQUENCY RANGE 1 GHz to 10 GHz.

GPRS MODULATION

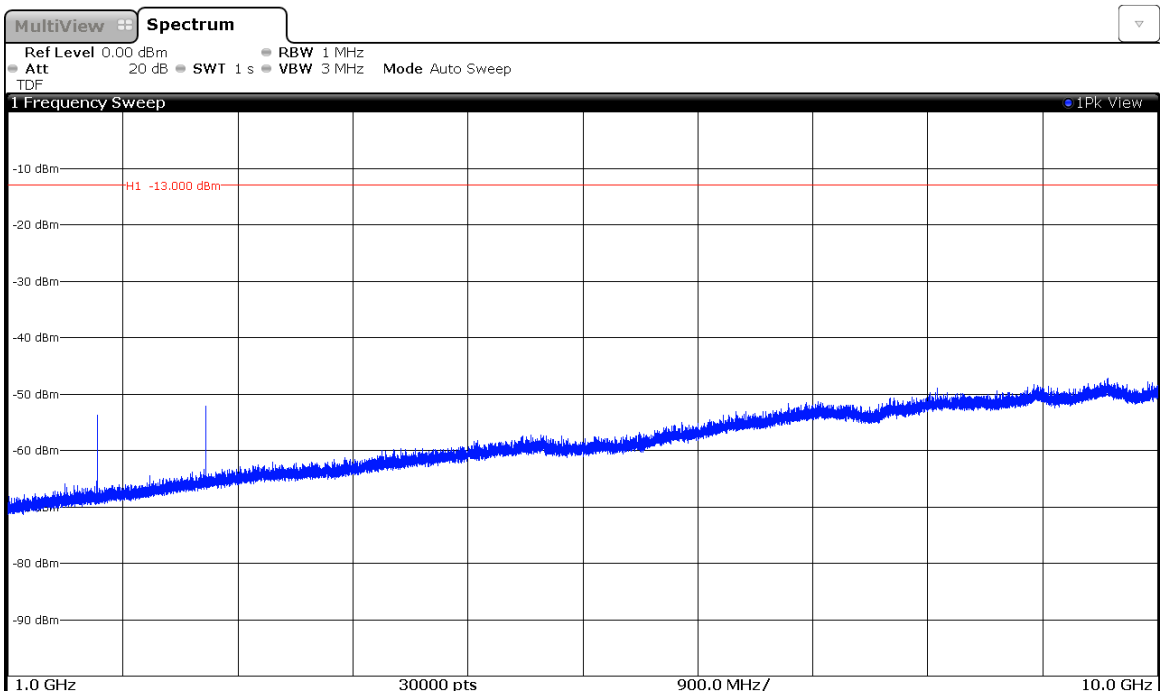
CHANNEL: LOWEST



CHANNEL: MIDDLE

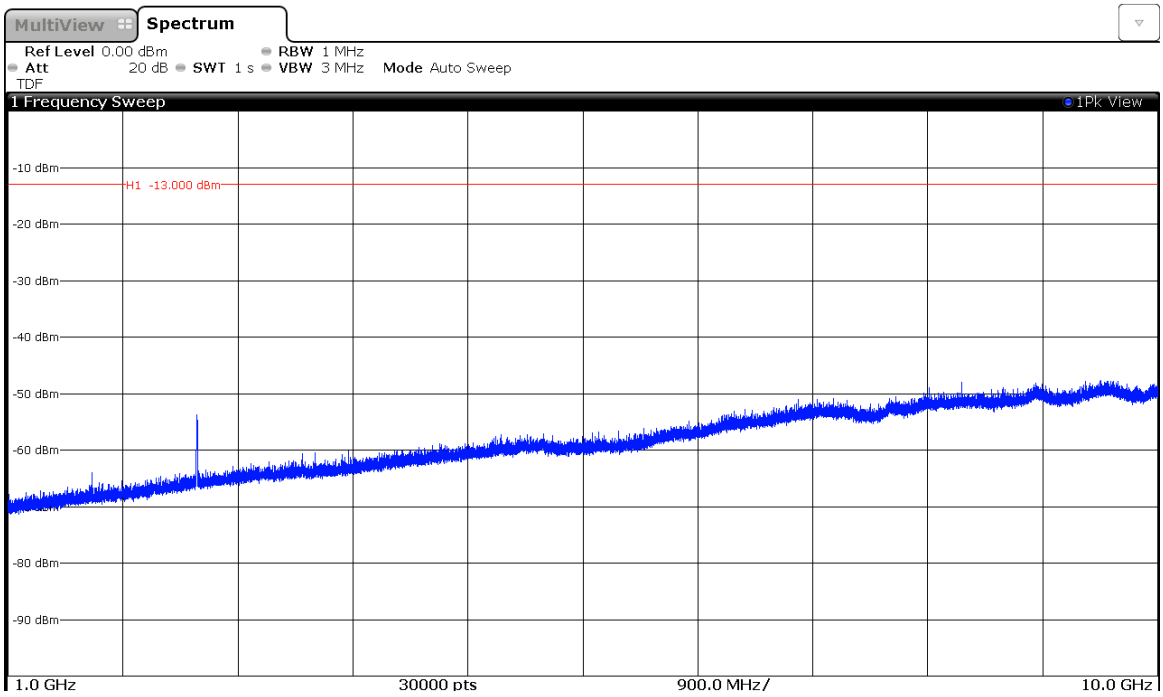


CHANNEL: HIGHEST

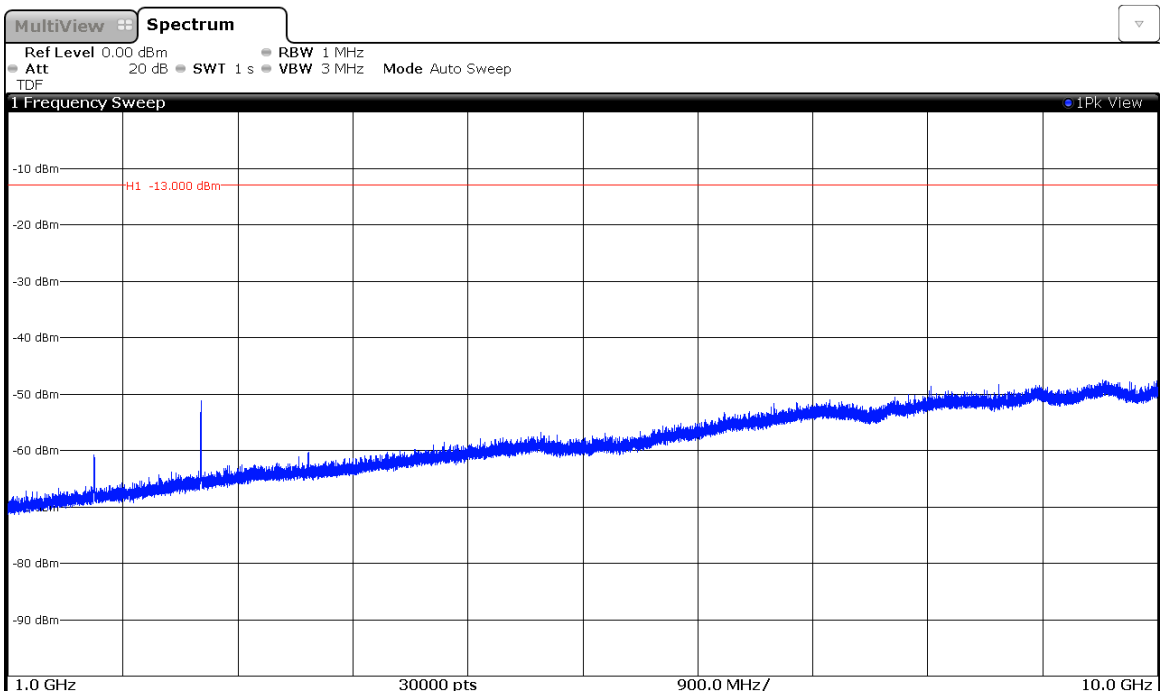


WCDMA MODULATION

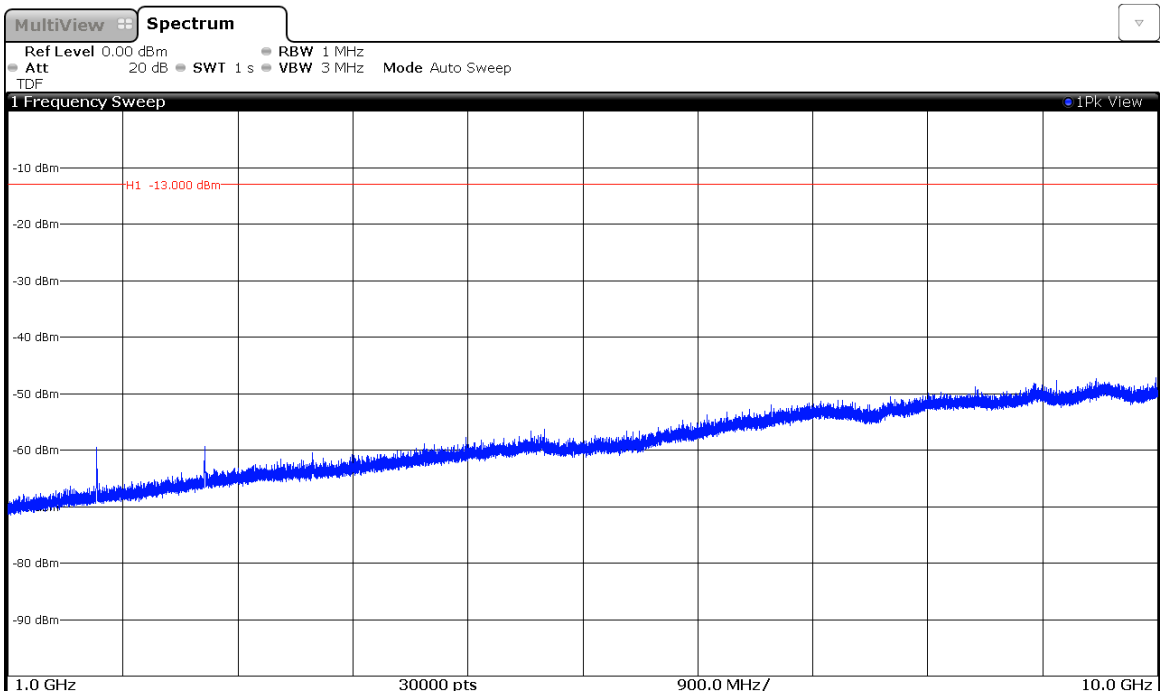
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



Appendix B – Test result for FCC Part 24

INDEX

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 = +2.6 dBi (1900MHz), +2.2 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.

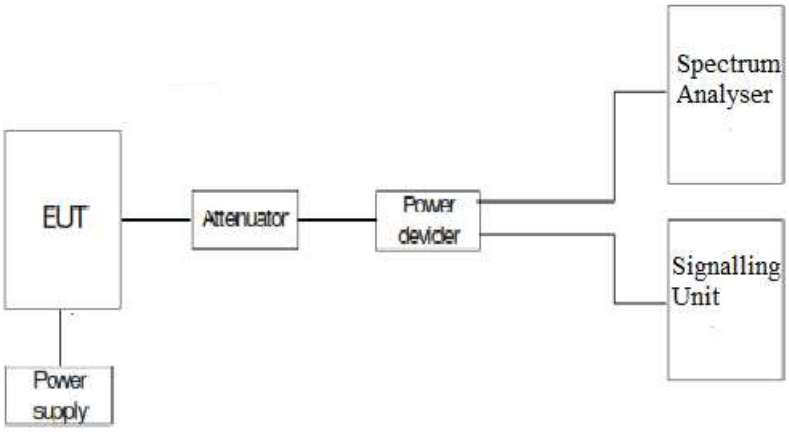
The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

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)	2.60	2.60	2.60
Measured maximum average power (dBm) at antenna port	30.15	29.86	29.87
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	32.75	32.46	32.47
Peak-to-average ratio (PAR) (dB)	0.62	0.60	0.63
Measurement uncertainty (dB)	<±0.66		

EDGE MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.60	2.60	2.60
Measured maximum average power (dBm) at antenna port	25.32	25.30	25.38
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	27.92	27.90	27.98
Peak-to-average ratio (PAR) (dB)	3.07	3.04	2.84
Measurement uncertainty (dB)	<±0.66		

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.20	2.20	2.20
Measured maximum average power (dBm) at antenna port	23.44	23.72	23.53
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	25.64	25.92	25.73
Peak-to-average ratio (PAR) (dB)	3.17	3.12	3.24
Measurement uncertainty (dB)	<±0.66		

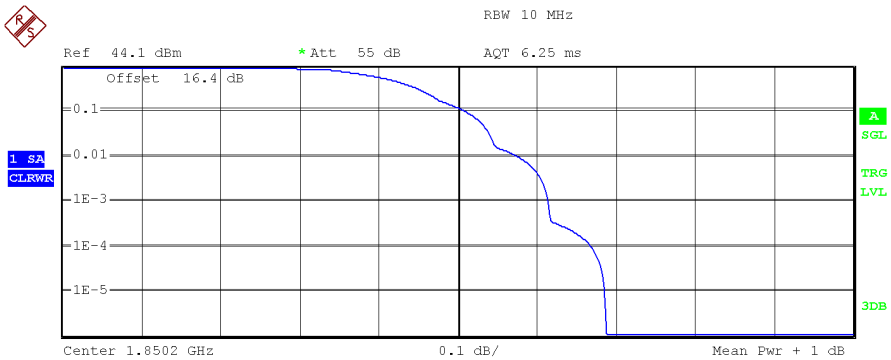
HSUPA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.20	2.20	2.20
Measured maximum average power (dBm) at antenna port	21.31	21.61	21.46
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	23.51	23.81	23.66
Peak-to-average ratio (PAR) (dB)	5.87	5.50	5.96
Measurement uncertainty (dB)	<±0.66		

PEAK-TO-AVERAGE POWER RATIO (PAPR).

GPRS MODULATION

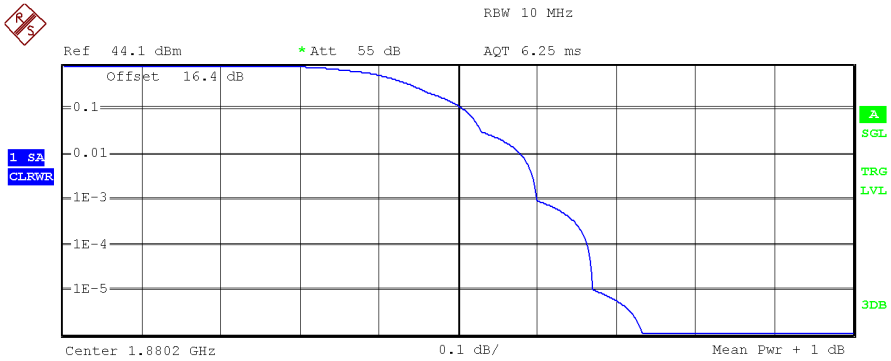
Channel Low:



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

	Trace 1
Mean	29.80 dBm
Peak	30.49 dBm
Crest	0.69 dB
10 %	0.51 dB
1 %	0.57 dB
.1 %	0.62 dB
.01 %	0.67 dB

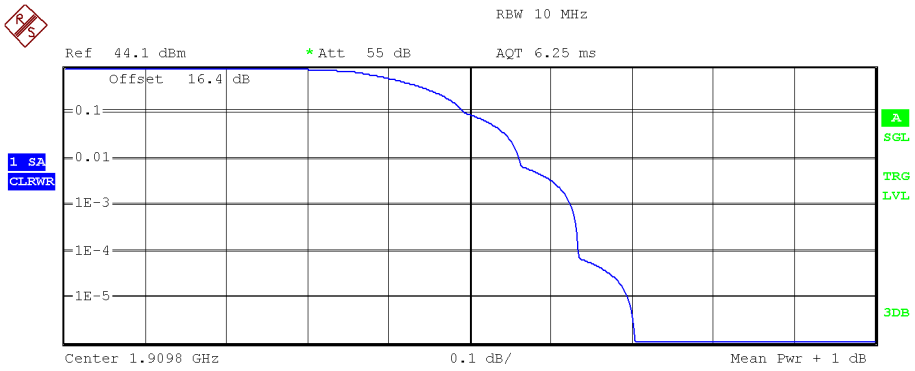
Channel Middle:



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

	Trace 1
Mean	29.49 dBm
Peak	30.23 dBm
Crest	0.74 dB
10 %	0.51 dB
1 %	0.58 dB
.1 %	0.60 dB
.01 %	0.66 dB

Channel High:

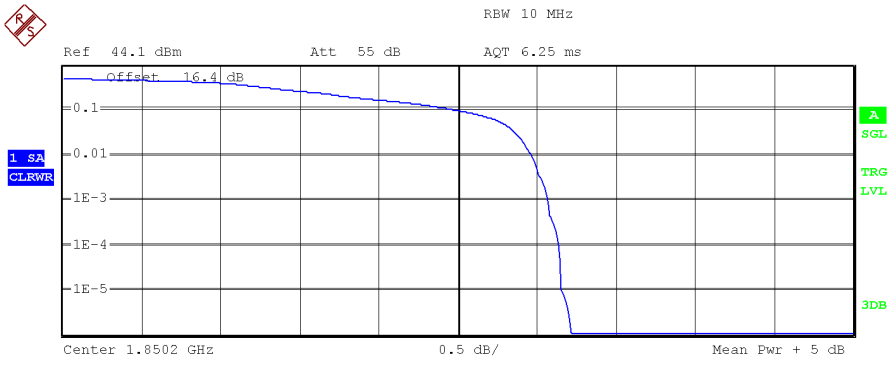


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 11.2MHz

	Trace 1
Mean	29.54 dBm
Peak	30.24 dBm
Crest	0.70 dB
10 %	0.49 dB
1 %	0.56 dB
.1 %	0.63 dB
.01 %	0.63 dB

EDGE MODULATION

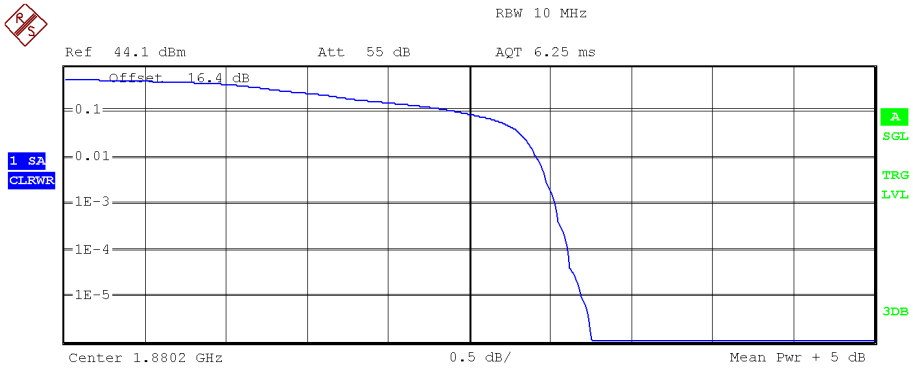
Channel Low:



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

	Trace 1
Mean	25.43 dBm
Peak	28.65 dBm
Crest	3.22 dB
10 %	2.49 dB
1 %	2.96 dB
.1 %	3.07 dB
.01 %	3.14 dB

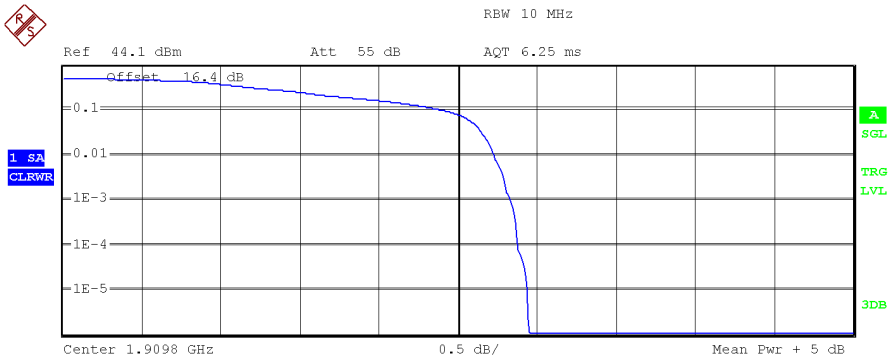
Channel Middle:



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

	Trace 1
Mean	25.28 dBm
Peak	28.54 dBm
Crest	3.26 dB
10 %	2.43 dB
1 %	2.92 dB
.1 %	3.04 dB
.01 %	3.11 dB

Channel High:

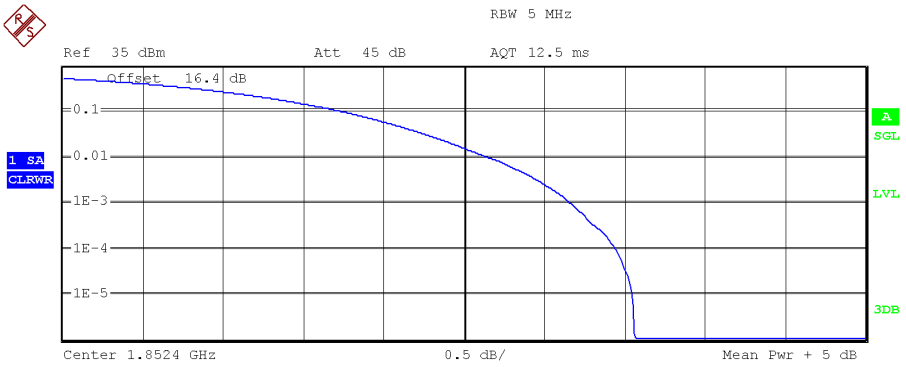


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 11.2MHz

	Trace 1
Mean	25.60 dBm
Peak	28.55 dBm
Crest	2.95 dB
10 %	2.40 dB
1 %	2.73 dB
.1 %	2.84 dB
.01 %	2.88 dB

WCDMA MODULATION

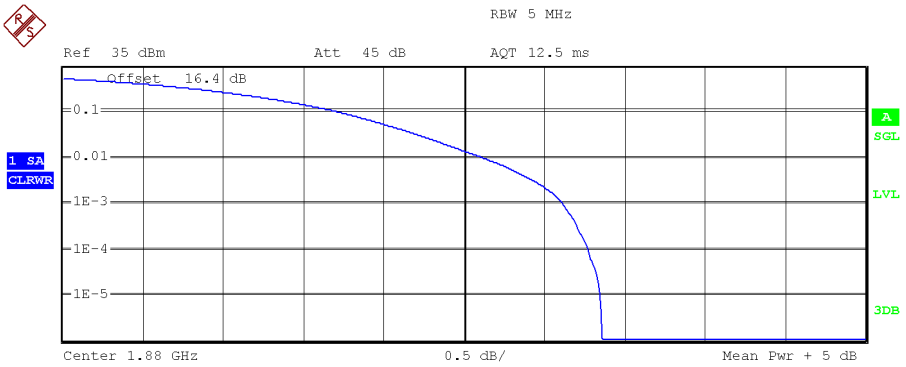
Channel Low:



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

	Trace 1
Mean	23.38 dBm
Peak	26.94 dBm
Crest	3.56 dB
10 %	1.75 dB
1 %	2.64 dB
.1 %	3.17 dB
.01 %	3.45 dB

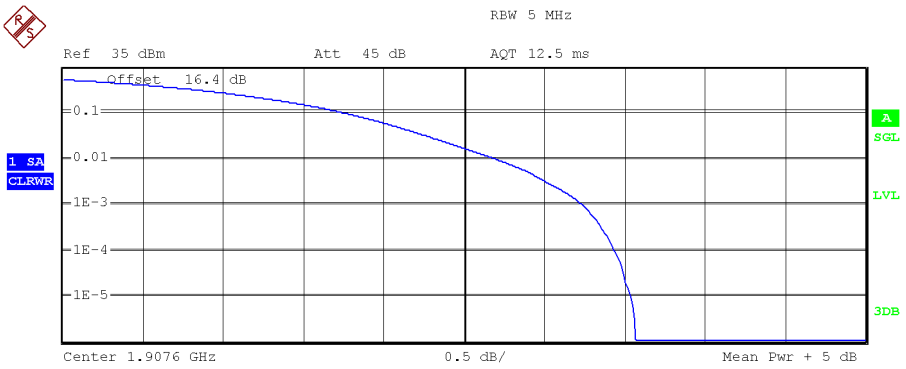
Channel Middle:



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

	Trace 1
Mean	23.51 dBm
Peak	26.87 dBm
Crest	3.36 dB
10 %	1.71 dB
1 %	2.62 dB
.1 %	3.12 dB
.01 %	3.28 dB

Channel High:

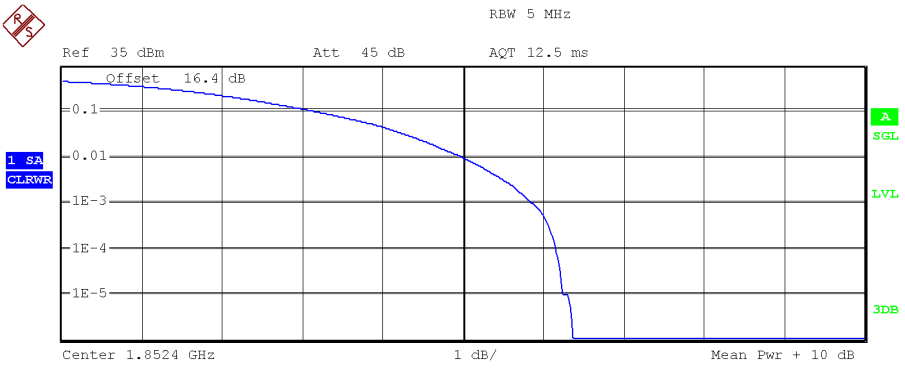


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 7.1MHz

	Trace 1
Mean	23.23 dBm
Peak	26.80 dBm
Crest	3.57 dB
10 %	1.75 dB
1 %	2.69 dB
.1 %	3.24 dB
.01 %	3.44 dB

HSUPA MODULATION

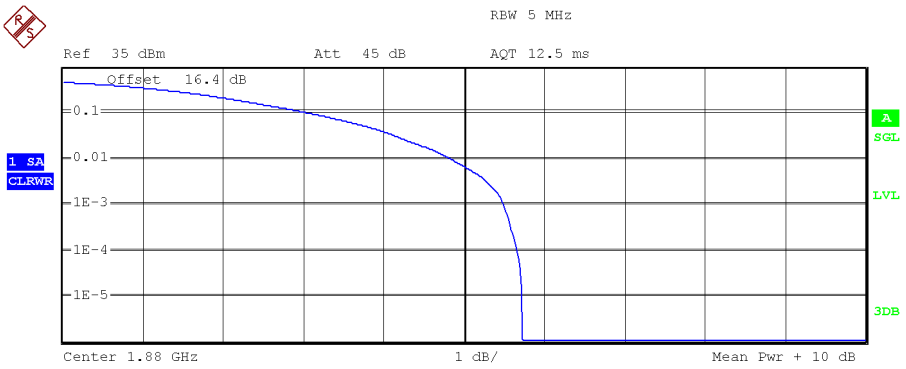
Channel Low:



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

	Trace 1
Mean	21.20 dBm
Peak	27.58 dBm
Crest	6.37 dB
10 %	3.17 dB
1 %	4.98 dB
.1 %	5.87 dB
.01 %	6.15 dB

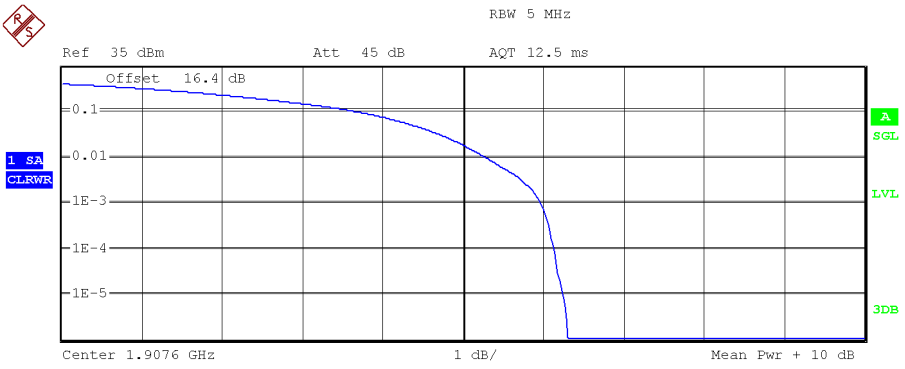
Channel Middle:



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

	Trace 1
Mean	21.36 dBm
Peak	27.08 dBm
Crest	5.72 dB
10 %	3.06 dB
1 %	4.82 dB
.1 %	5.50 dB
.01 %	5.67 dB

Channel High:



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

	Trace 1
Mean	21.05 dBm
Peak	27.36 dBm
Crest	6.31 dB
10 %	3.67 dB
1 %	5.27 dB
.1 %	5.96 dB
.01 %	6.14 dB

Modulation Characteristics

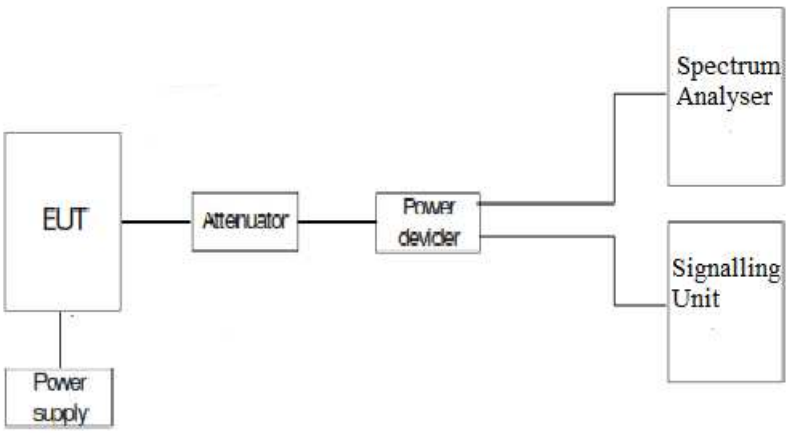
SPECIFICATION

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.

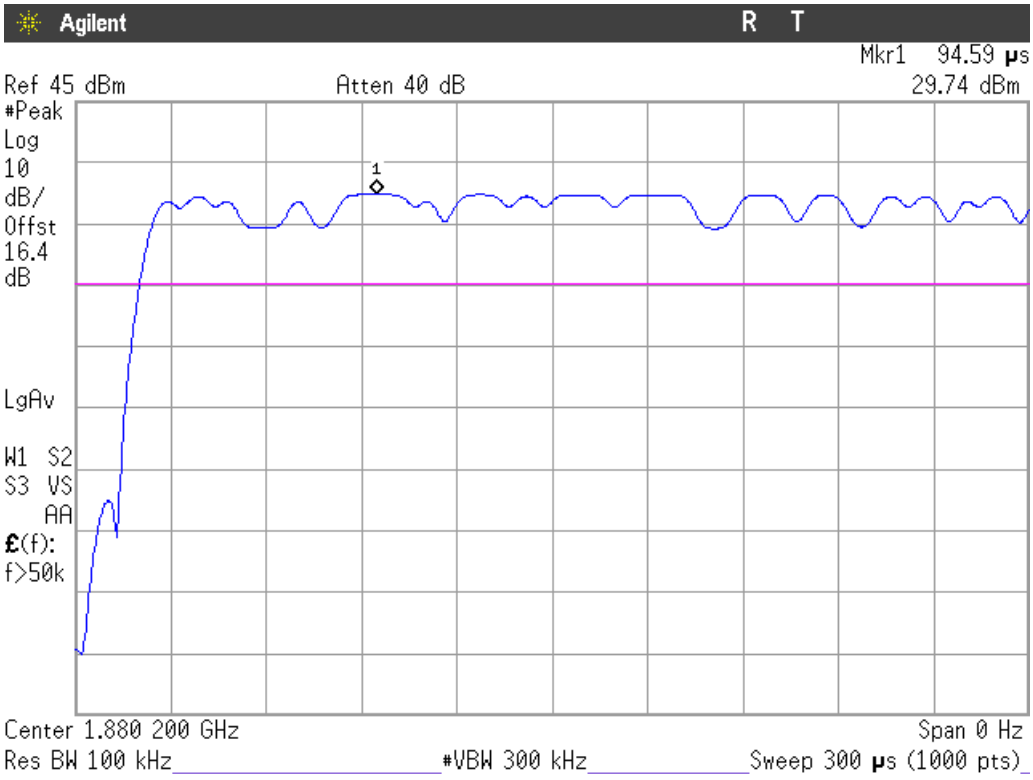
TEST SETUP



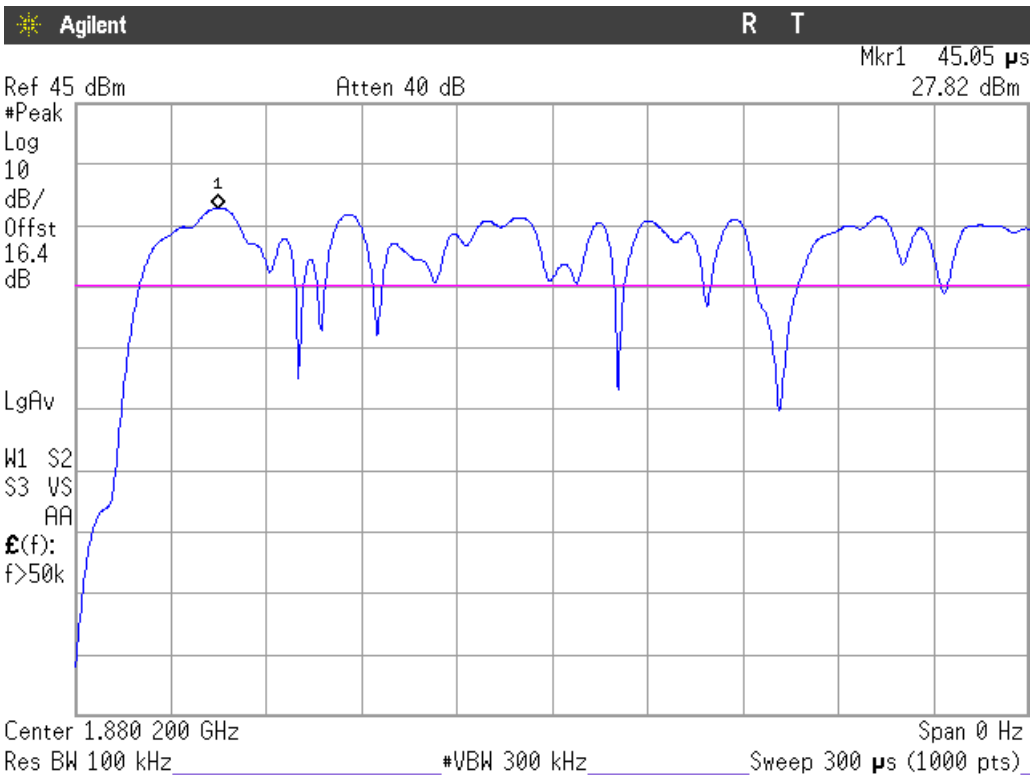
RESULTS

The following plot shows the modulation schemes in the EUT.

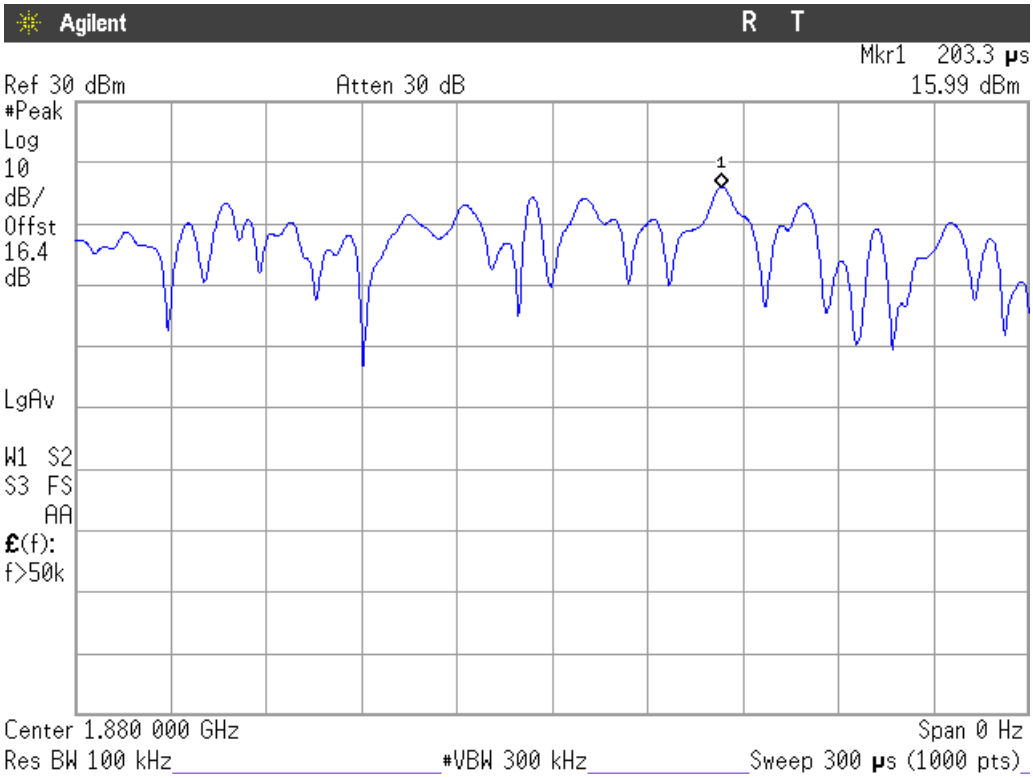
GPRS MODULATION



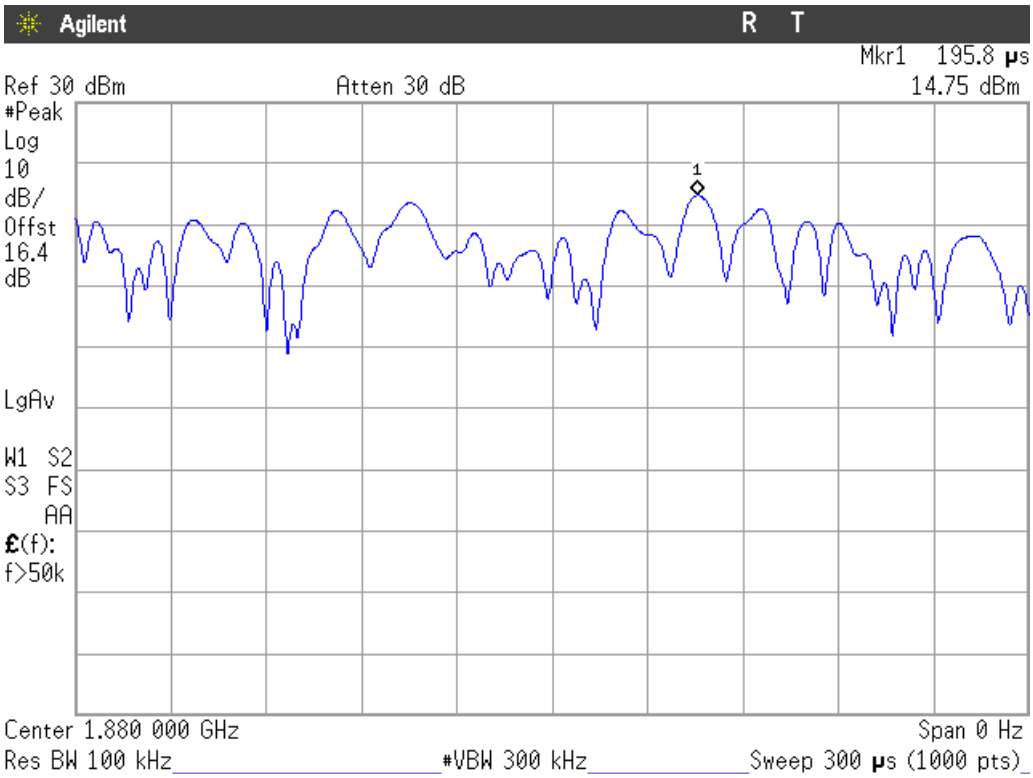
EDGE MODULATION



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 –30ºC to +50ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from –30ºC up to +50ºC.

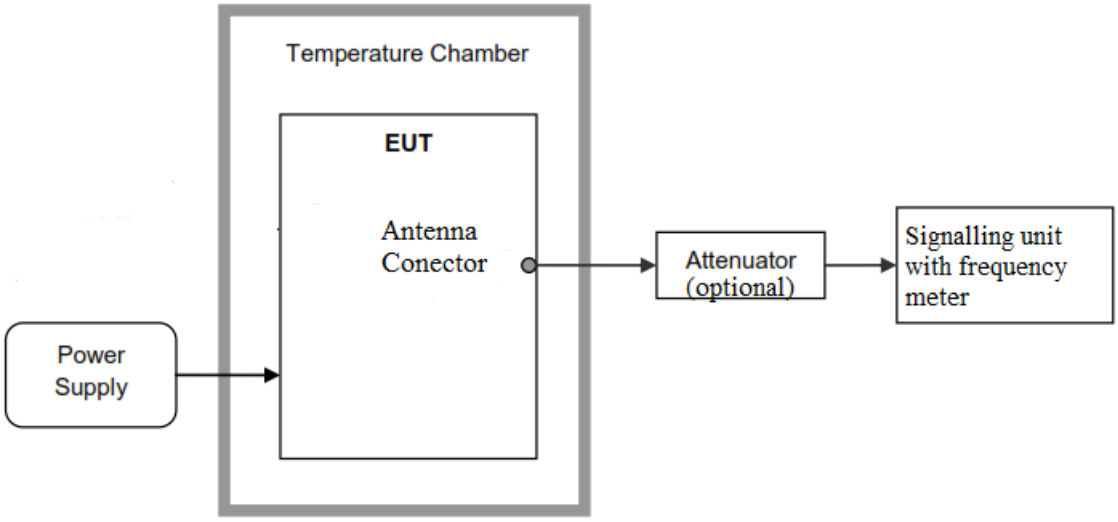
The supply voltage was varied between the values declared by the manufacturer.

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.

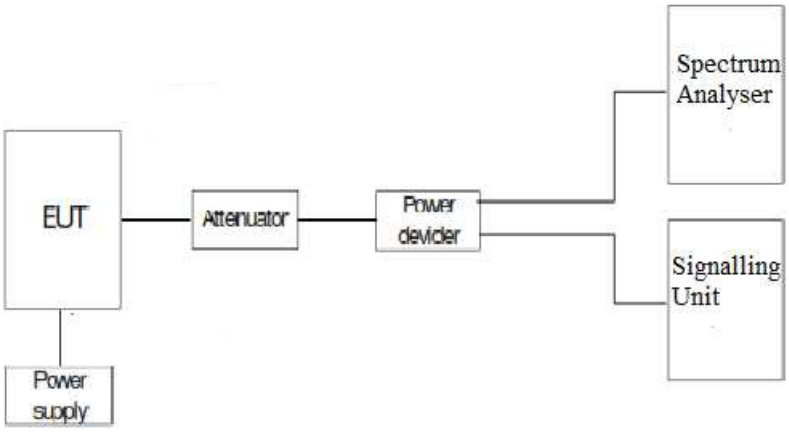
In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation are identified as *f*L and *fH* respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of *f*L and *fH* to check that the resulting frequencies remain within the band.
The reference point measurements were made at the RF output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP

Frequency tolerance.



Reference points *f*L and *fH*.



RESULTS

Frequency stability over temperature variations.

GPRS AND EDGE MODULATION

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	69	0.036698224	0.00000367
+40	70	0.037230082	0.00000372
+30	70	0.037230082	0.00000372
+20	69	0.036698224	0.00000367
+10	68	0.036166365	0.00000362
0	68	0.036166365	0.00000362
-10	63	0.033507074	0.00000335
-20	62	0.032975215	0.00000330
-30	66	0.035102649	0.00000351

WCDMA AND HSUPA MODULATION

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	6.97	0.003707447	0.00000037
+40	6.17	0.003281915	0.00000033
+30	7.87	0.00418617	0.00000042
+20	6.51	0.003462766	0.00000035
+10	6.19	0.003292553	0.00000033
0	7.92	0.004212766	0.00000042
-10	7.18	0.003819149	0.00000038
-20	8.43	0.004484043	0.00000045
-30	5.21	0.002771277	0.00000028

Frequency stability over voltage variations.

GPRS MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	69	0.036698224	0.00000367
Vmin	3.60	68	0.036166365	0.00000362

WCDMA AND HSUPA MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	6.51	0.003462766	0.00000035
Vmin	3.60	6.90	0.003670213	0.00000036

Reference points established at the applicable unwanted emissions limit:

	GPRS MODULATION	EDGE MODULATION	WCDMA MODULATION	HSUPA MODULATION
*f*L (MHz)	1852.5420	1852.3870	1852.5270	1852.5110
fH (MHz)	1907.4510	1907.5960	1907.1170	1907.1380

Reference points *f*L and *fH* with the worst-case frequency offsets added or subtracted:

	GPRS MODULATION	EDGE MODULATION	WCDMA MODULATION	HSUPA MODULATION
*f*L (MHz)	1852.5420	1852.3870	1852.5270	1852.5110
fH (MHz)	1907.4510	1907.5960	1907.1170	1907.1380

The reference frequency points stay within the authorized blocks.

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

Verdict: PASS

Occupied Bandwidth

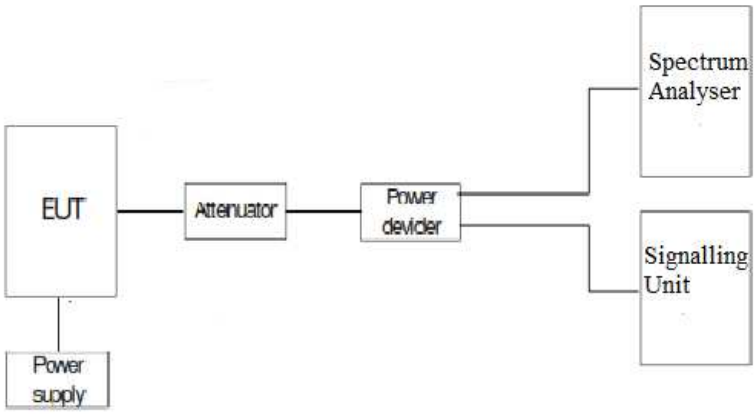
SPECIFICATION

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)	245.35	244.24	243.45
-26 dBc bandwidth (kHz)	314.24	318.11	311.36
Measurement uncertainty (kHz)	<±1.67		

EDGE MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	239.62	243.38	241.76
-26 dBc bandwidth (kHz)	301.93	299.25	309.10
Measurement uncertainty (kHz)	<±1.67		

WCDMA MODULATION

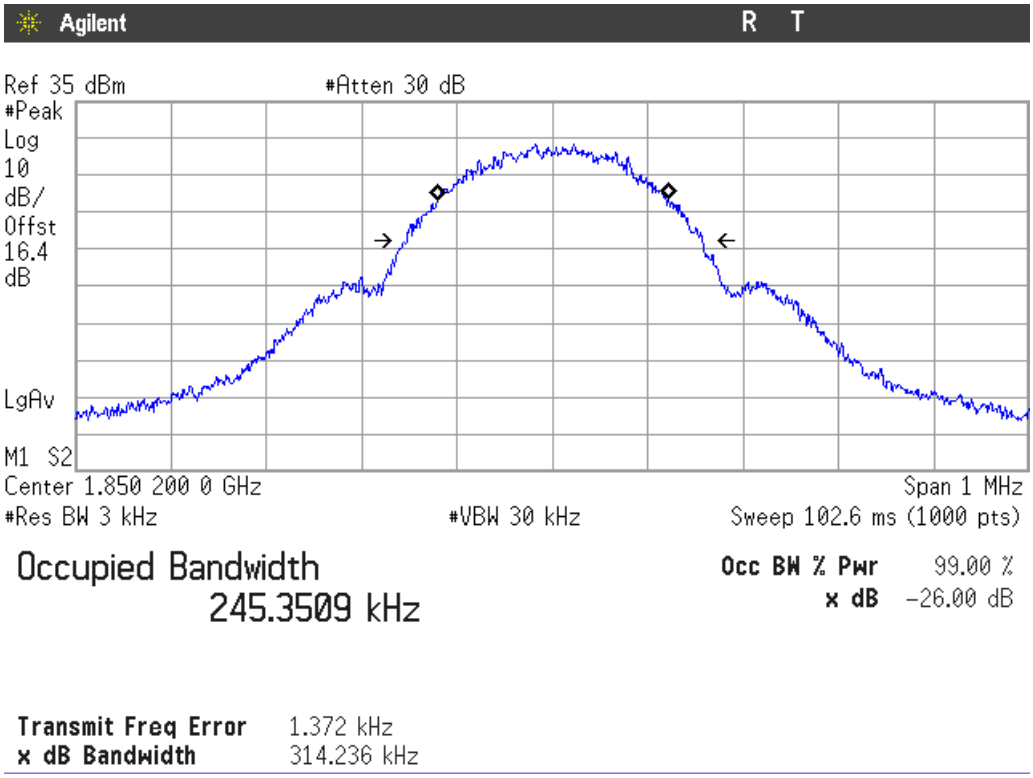
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4166.0	4164.7	4157.5
-26 dBc bandwidth (kHz)	4660.0	4649.0	4666.0
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

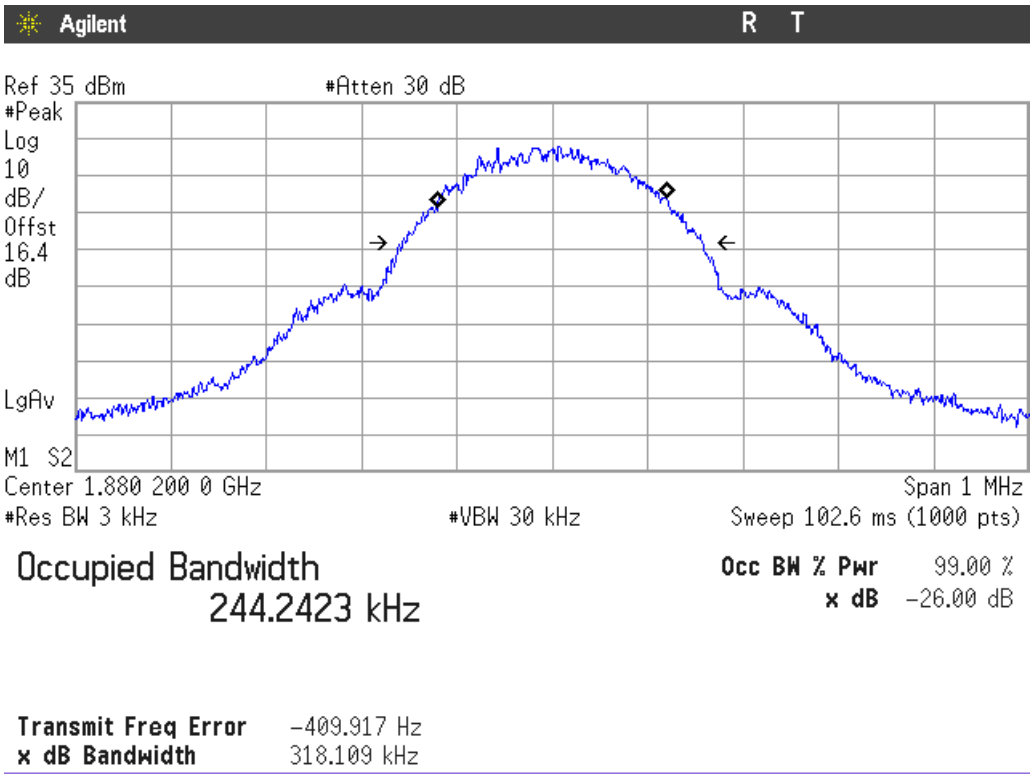
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4164.4	4171.2	4154.4
-26 dBc bandwidth (kHz)	4637.0	4639.0	4656.0
Measurement uncertainty (kHz)	<±16.67		

GPRS MODULATION

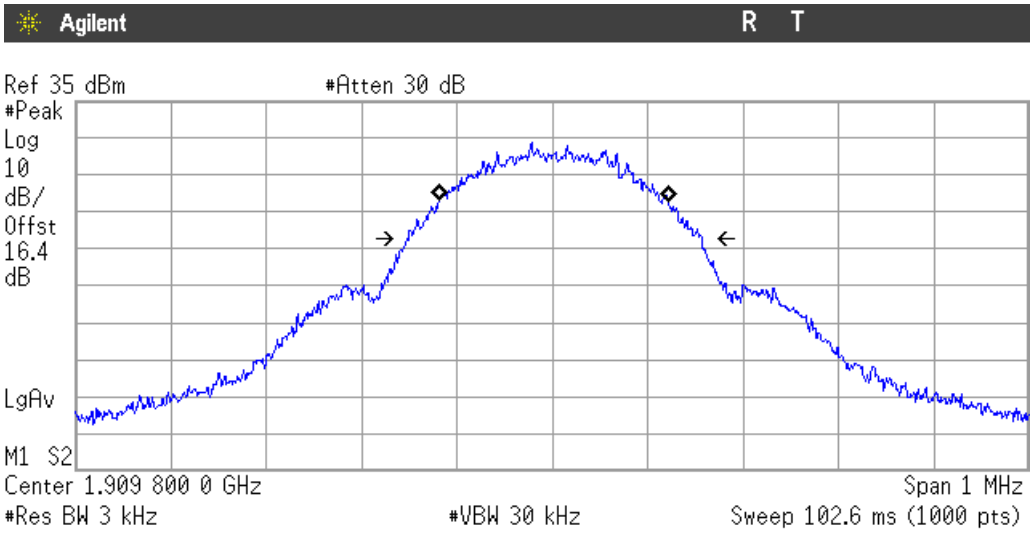
Lowest Channel



Middle Channel



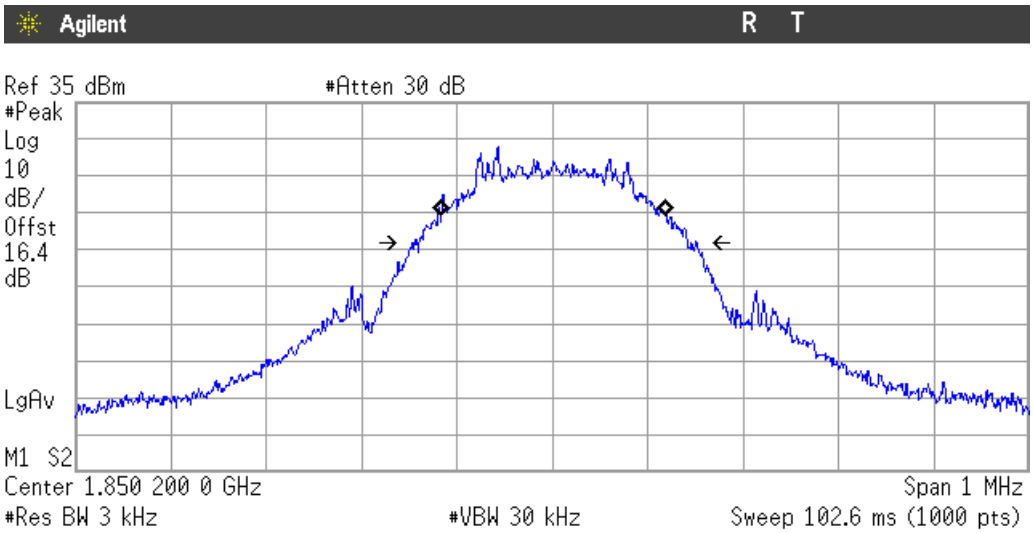
Highest Channel



Transmit Freq Error	1.256 kHz
x dB Bandwidth	311.358 kHz

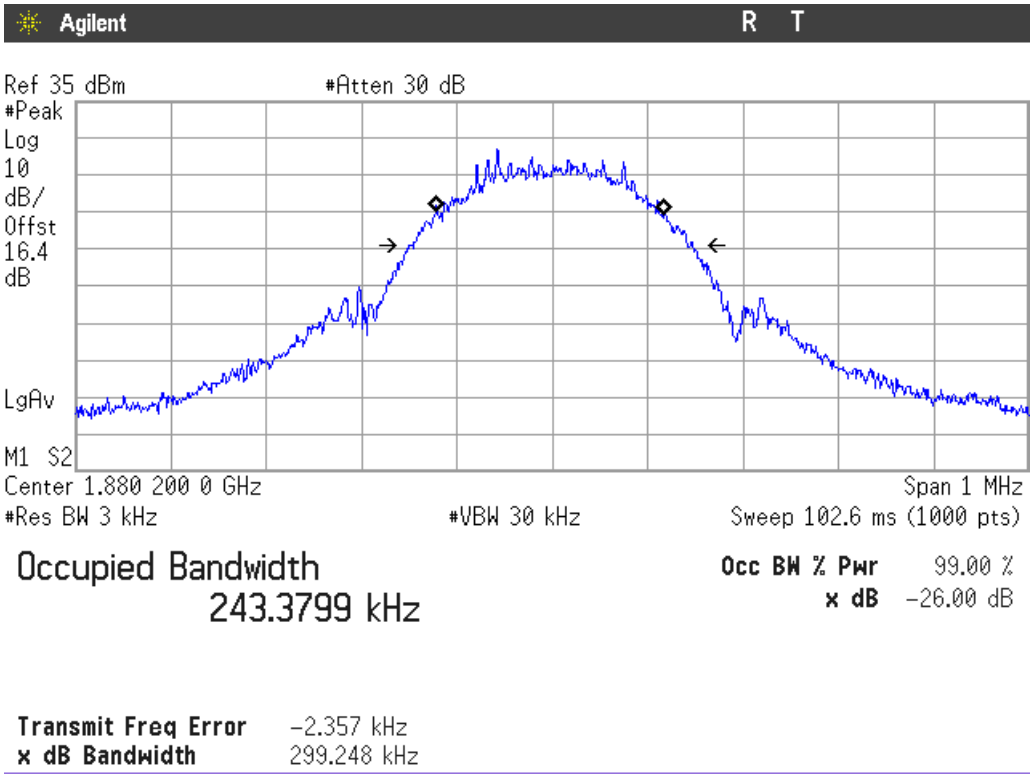
EDGE MODULATION

Lowest Channel

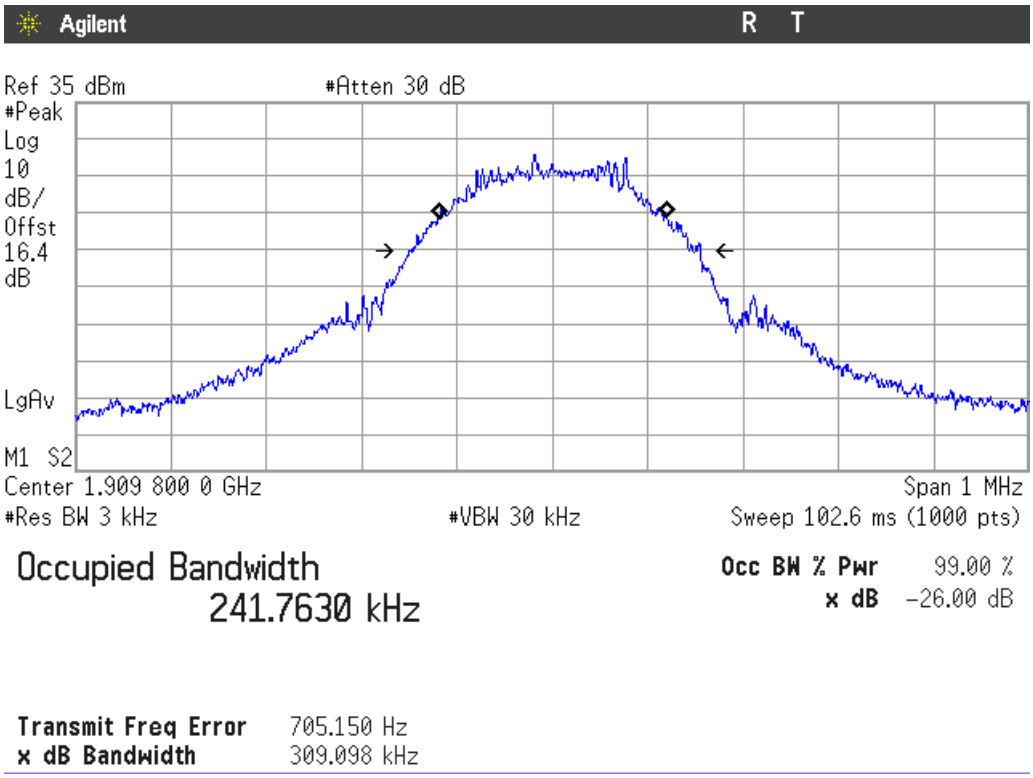


Transmit Freq Error	280.103 Hz
x dB Bandwidth	301.934 kHz

Middle Channel

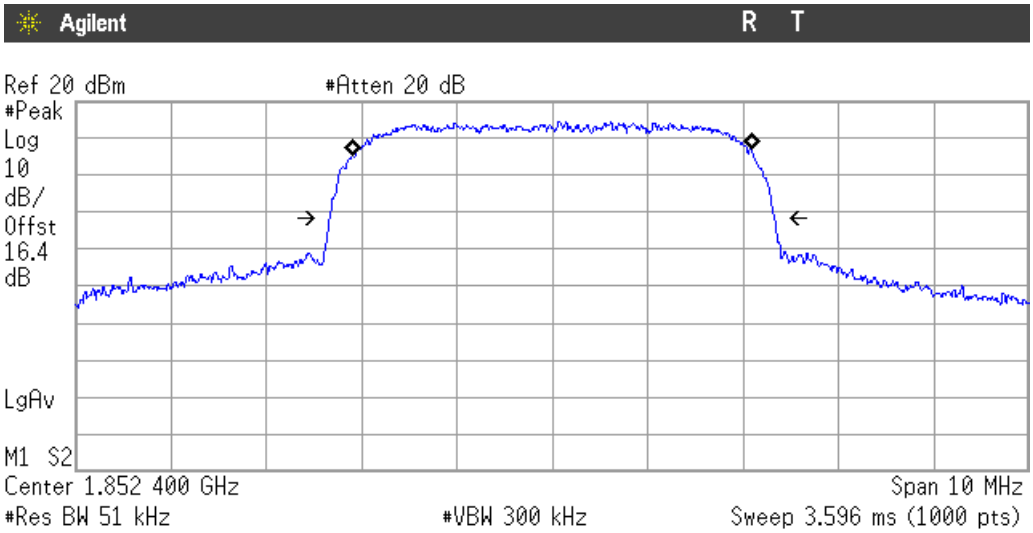


Highest Channel

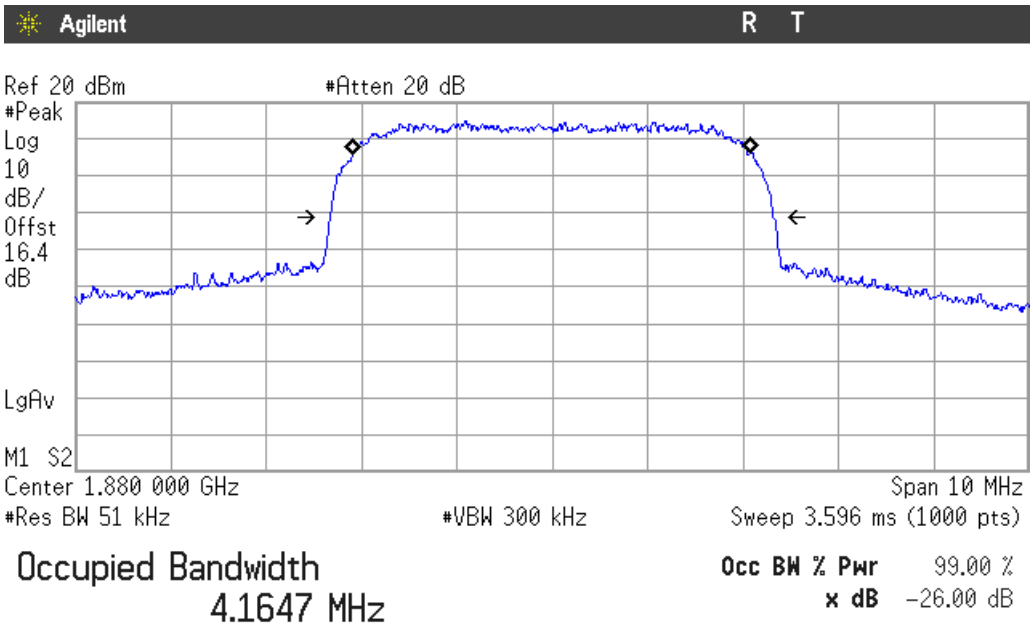


WCDMA MODULATION

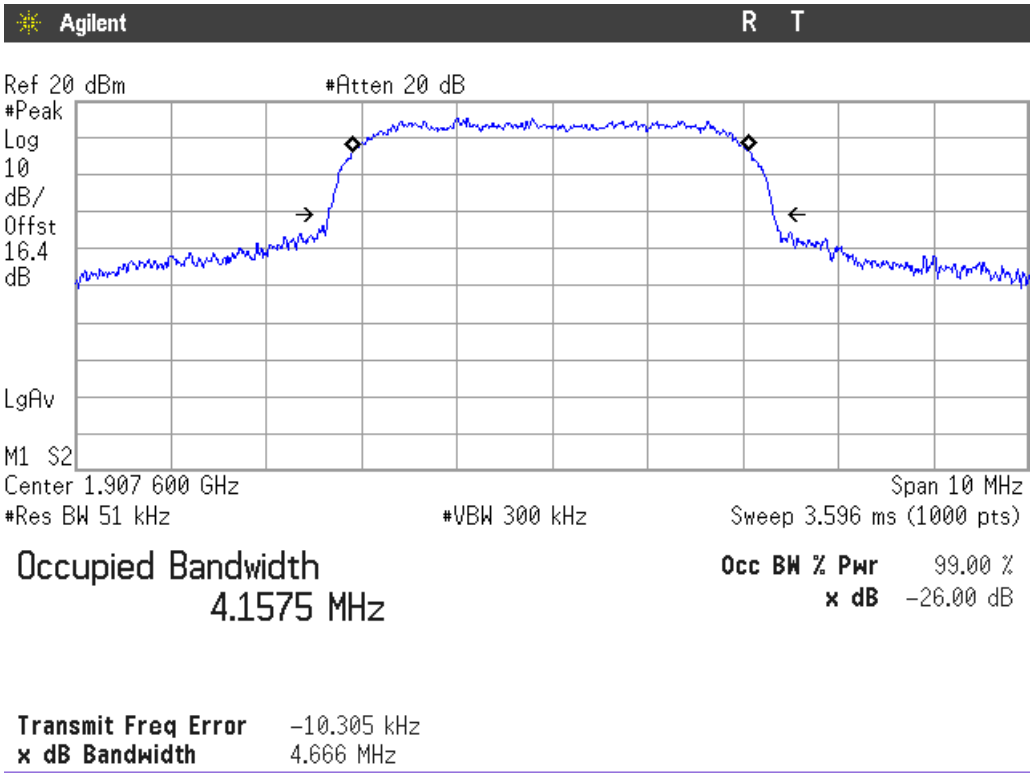
Lowest Channel



Middle Channel

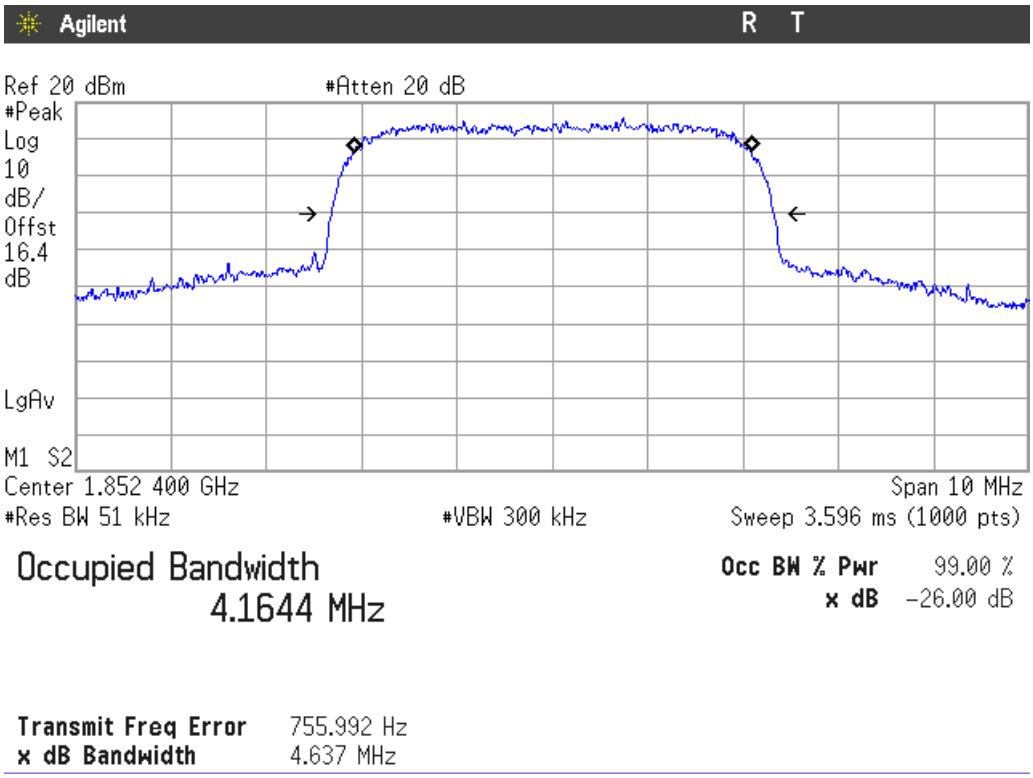


Highest Channel

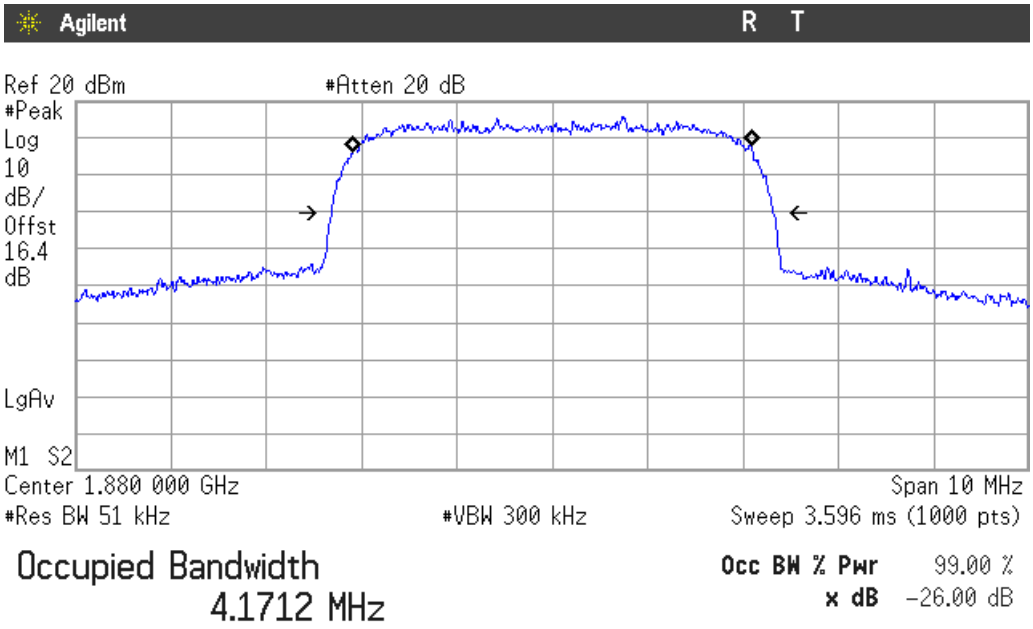


HSUPA MODULATION

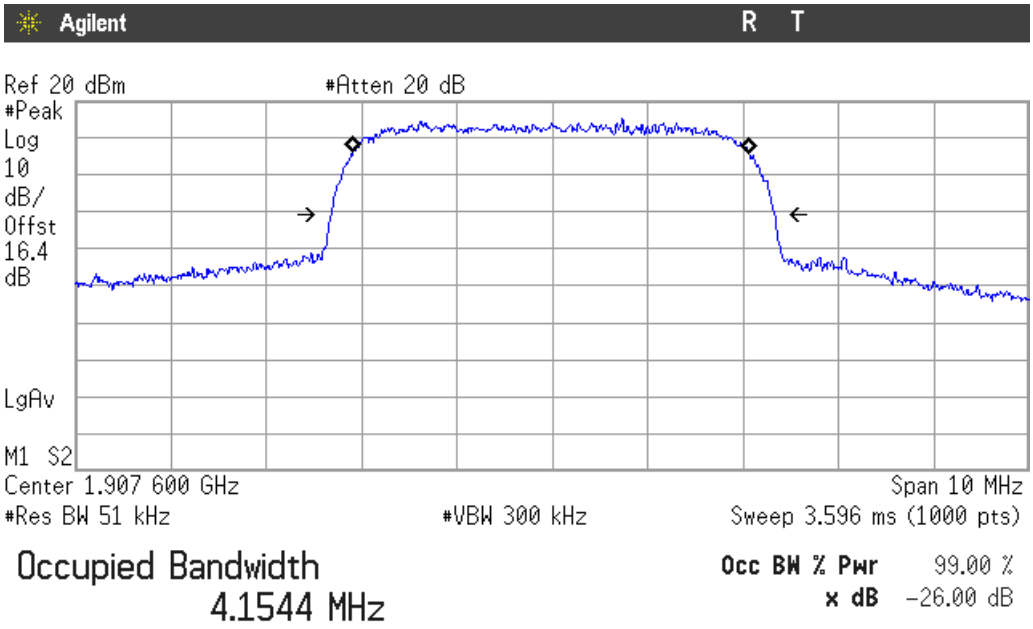
Lowest Channel



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.

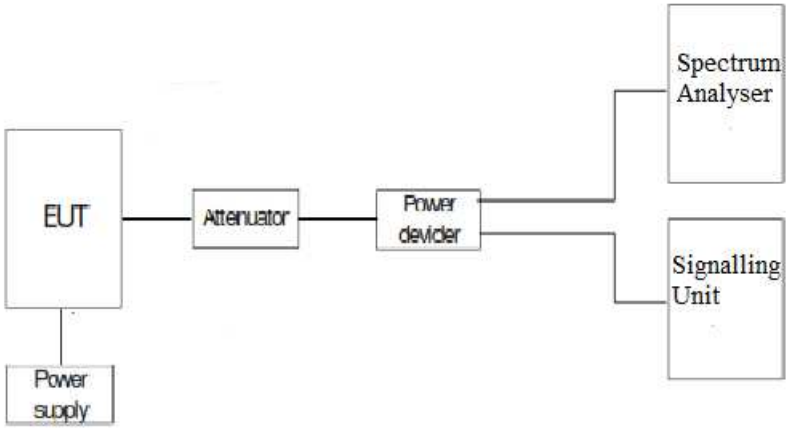
Measurement Limit**:**

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 Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = - 13 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.

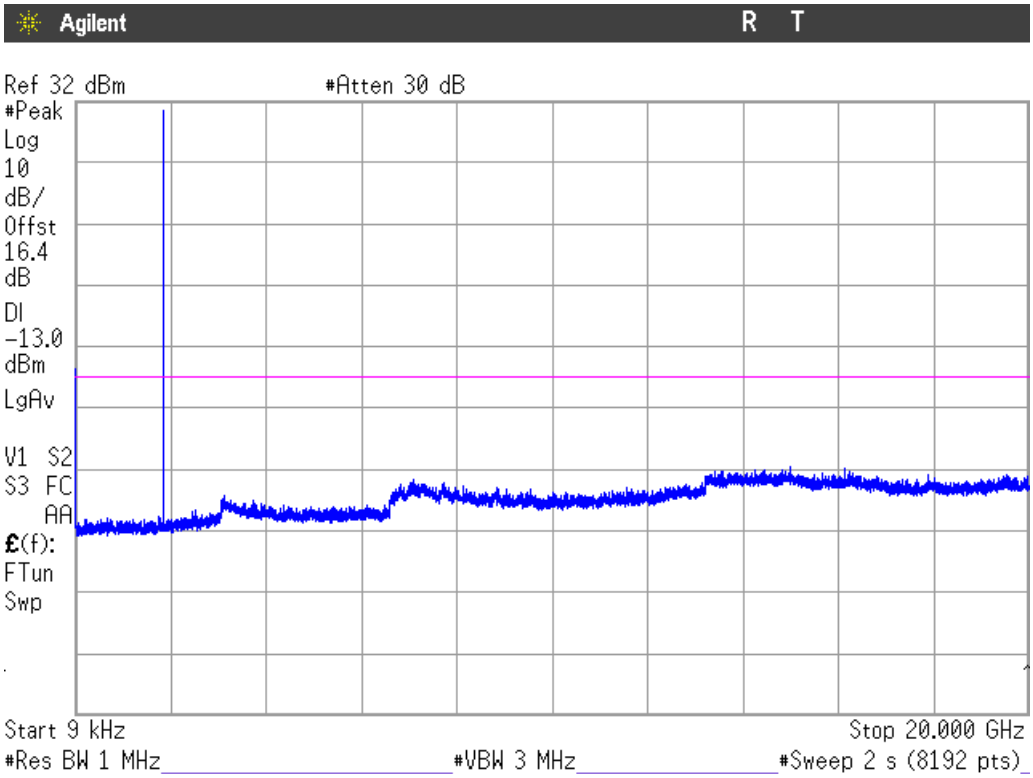
2. CHANNEL: MIDDLE
No spurious signals were found in all the range.

3. CHANNEL: HIGHEST
No spurious signals were found in all the range.

Verdict: PASS

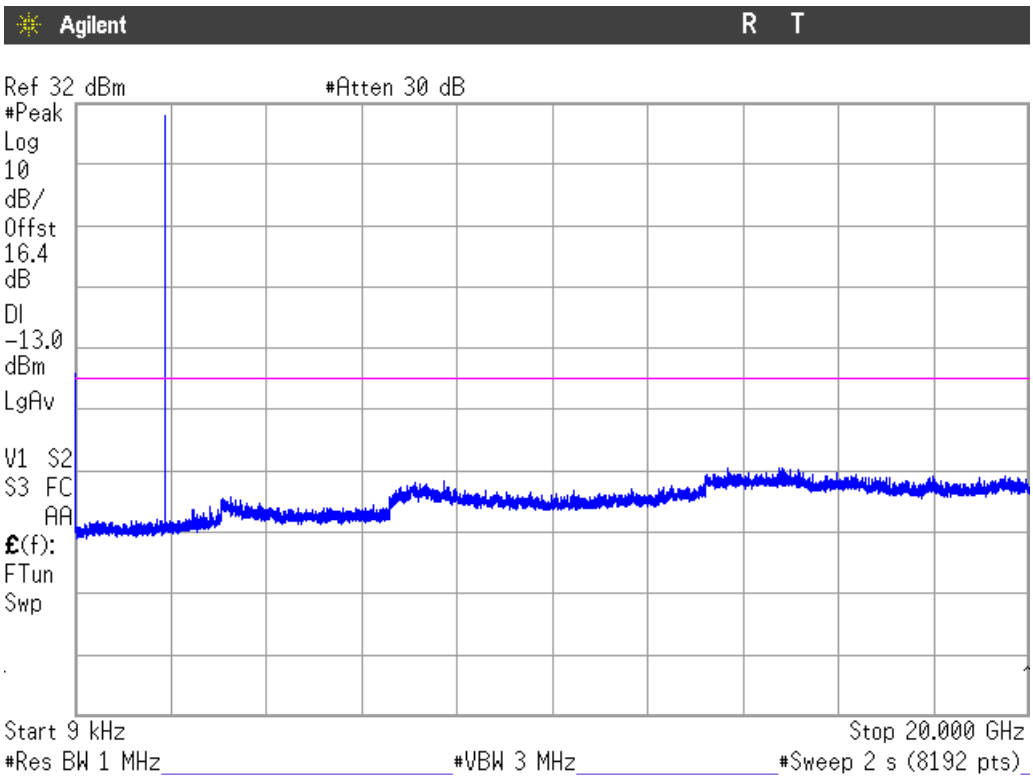
GPRS MODULATION

1. CHANNEL: LOWEST



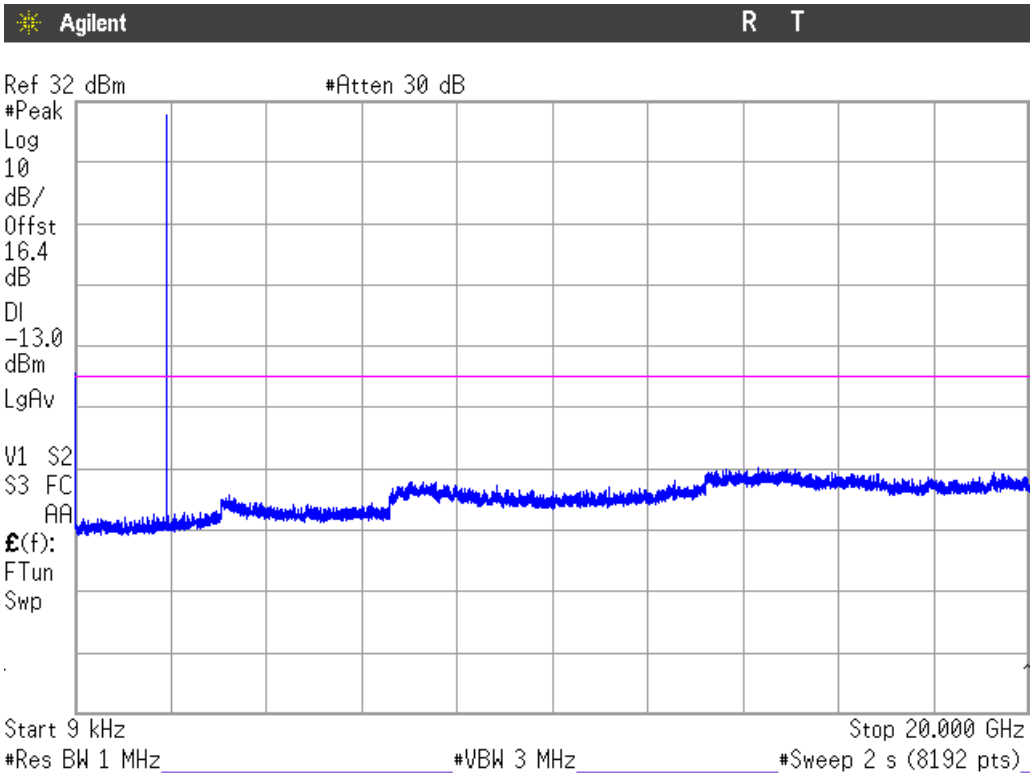
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

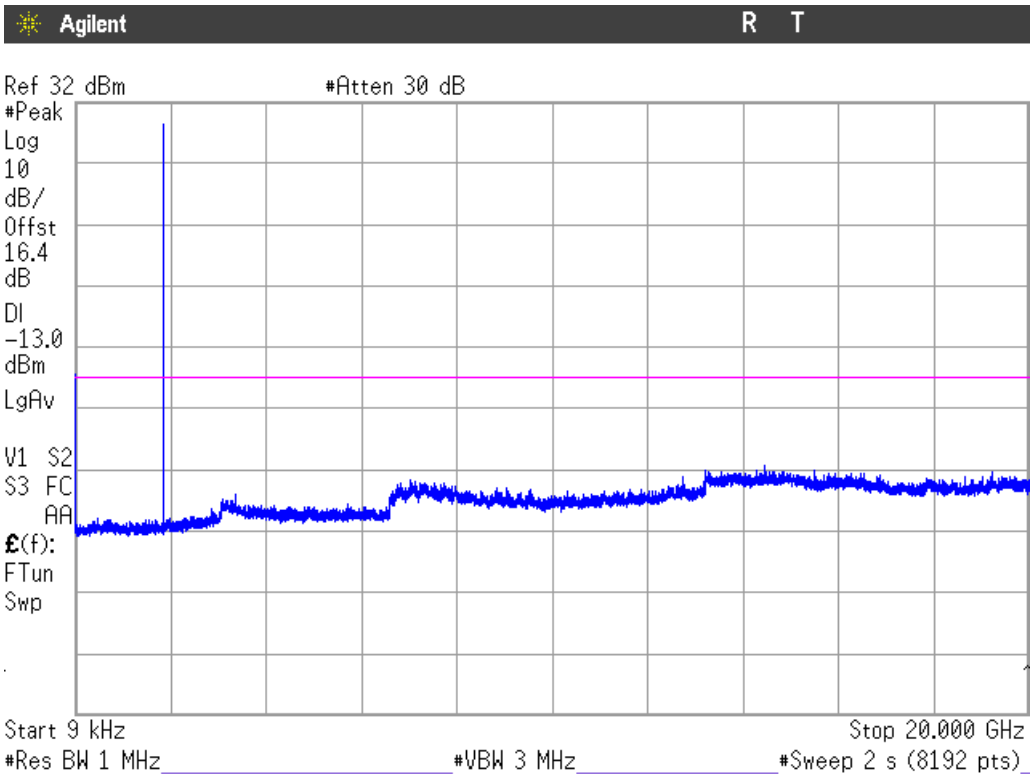
3. CHANNEL: HIGHEST



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

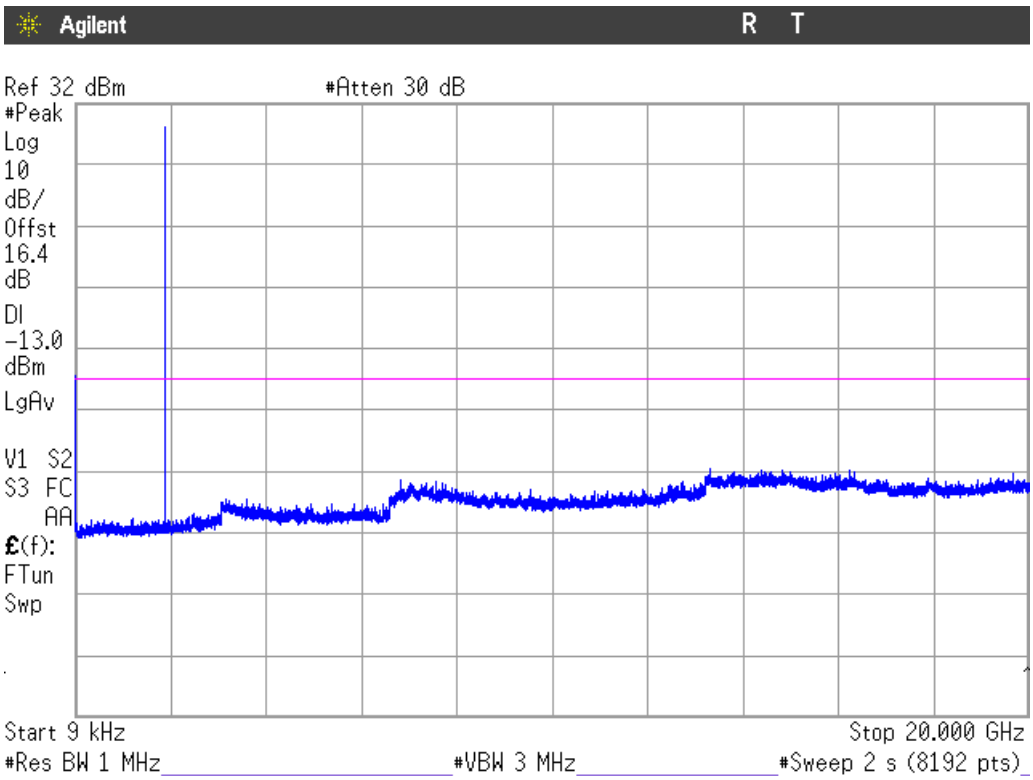
EDGE MODULATION

1. CHANNEL: LOWEST



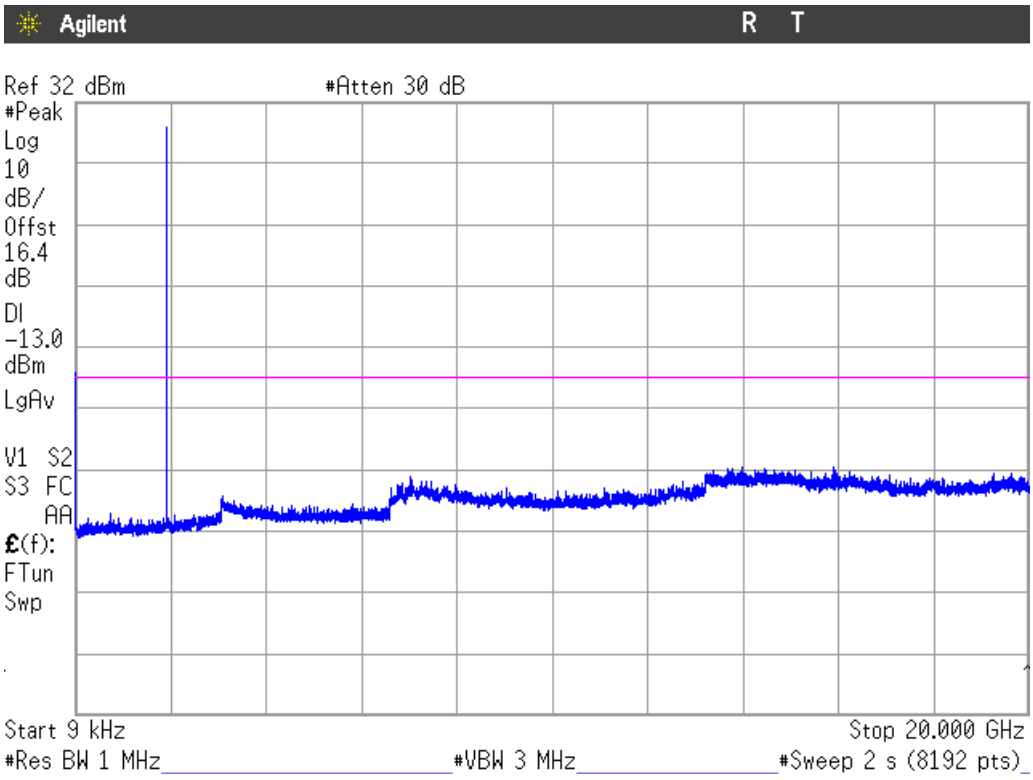
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

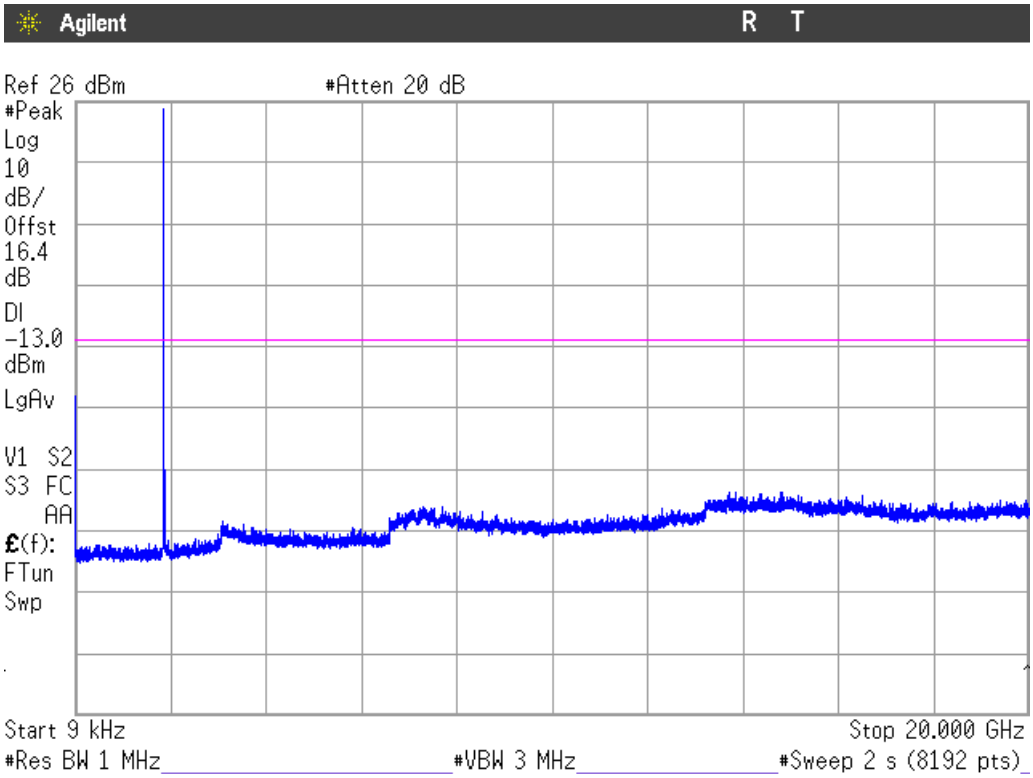
3. CHANNEL: HIGHEST



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

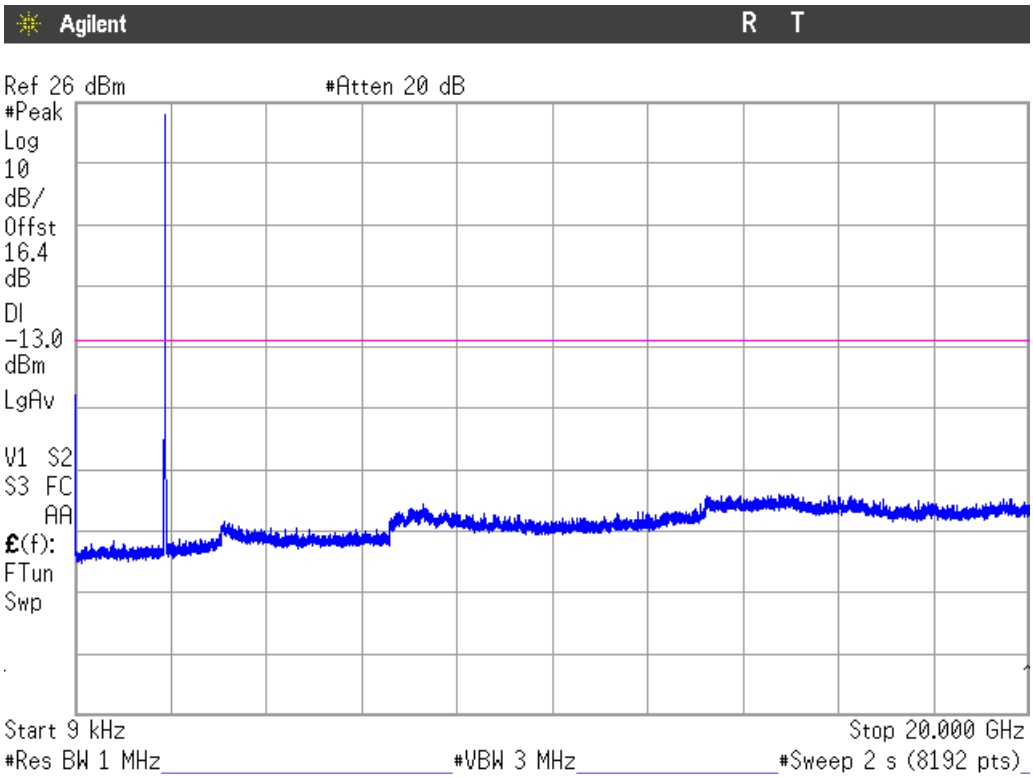
WCDMA MODULATION

1. CHANNEL: LOWEST



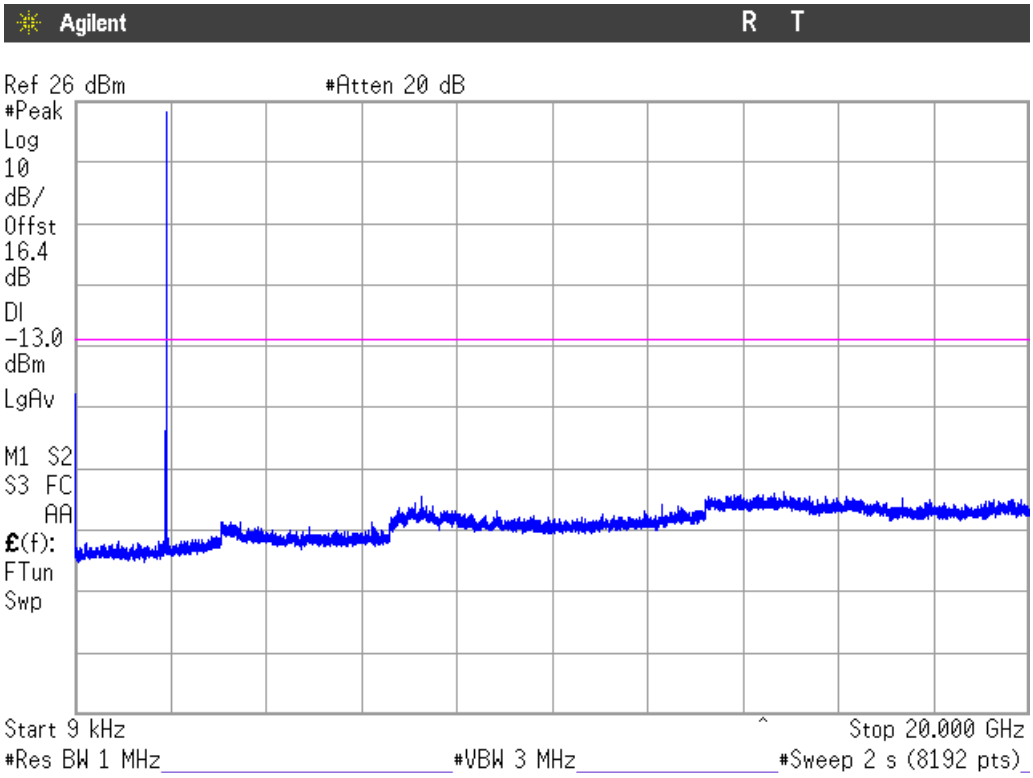
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

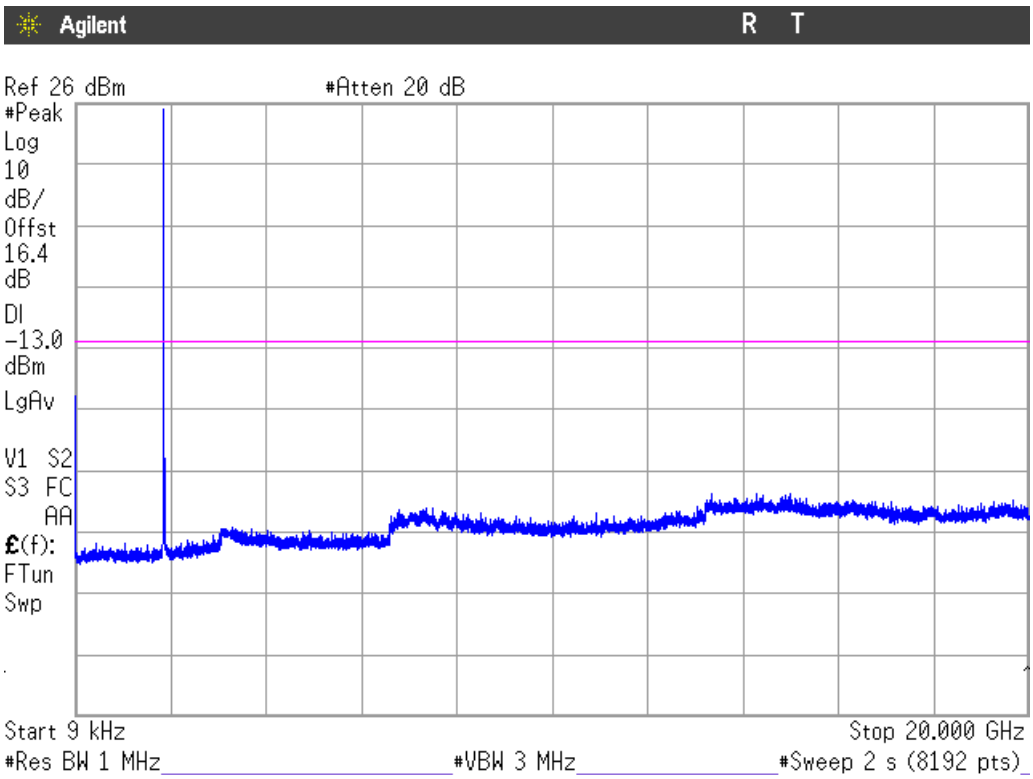
3. CHANNEL: HIGHEST



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

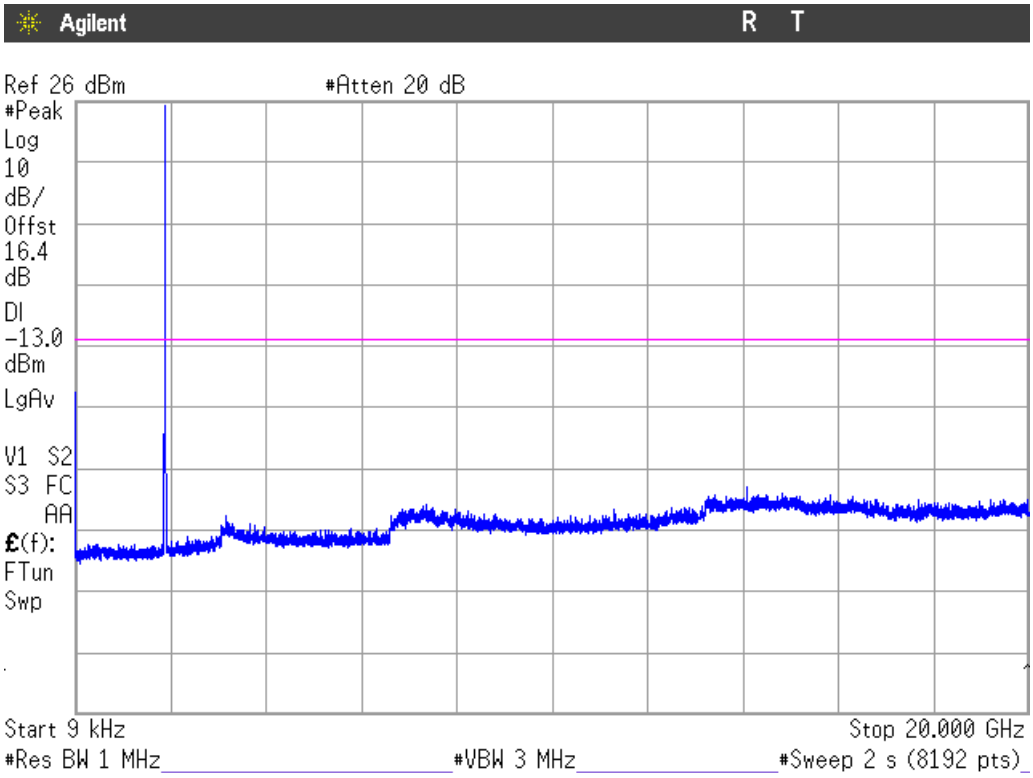
HSUPA MODULATION

1. CHANNEL: LOWEST



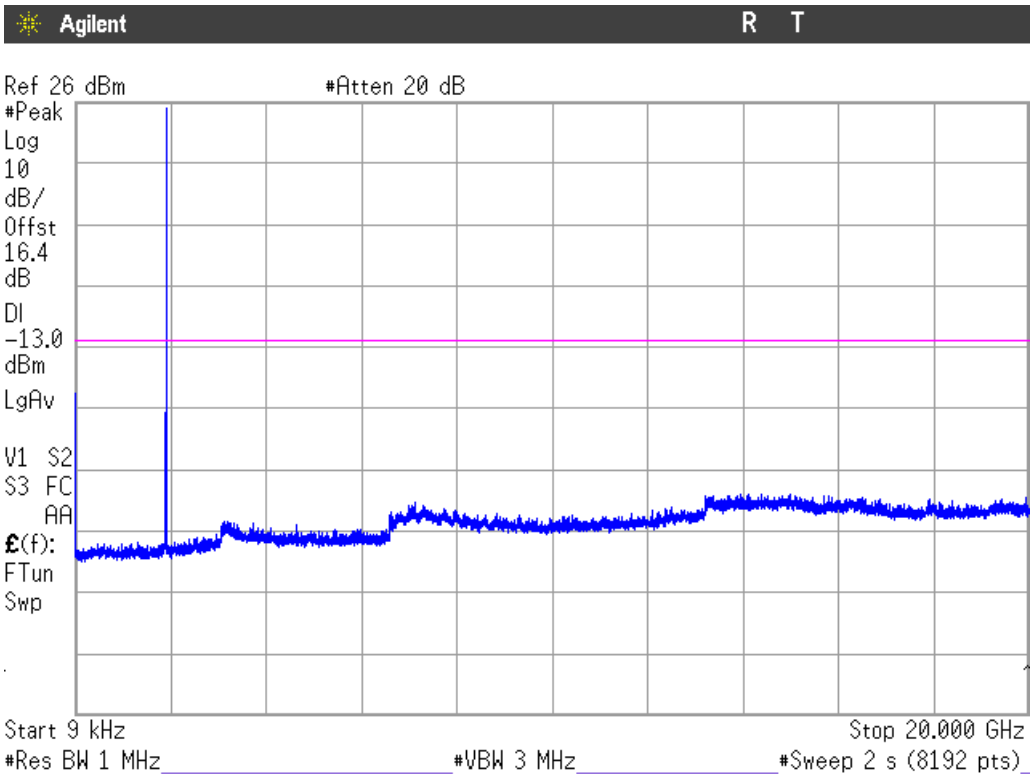
Note: The peak above the limit is the carrier frequency.

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

Spurious emissions at antenna terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §24.238

METHOD

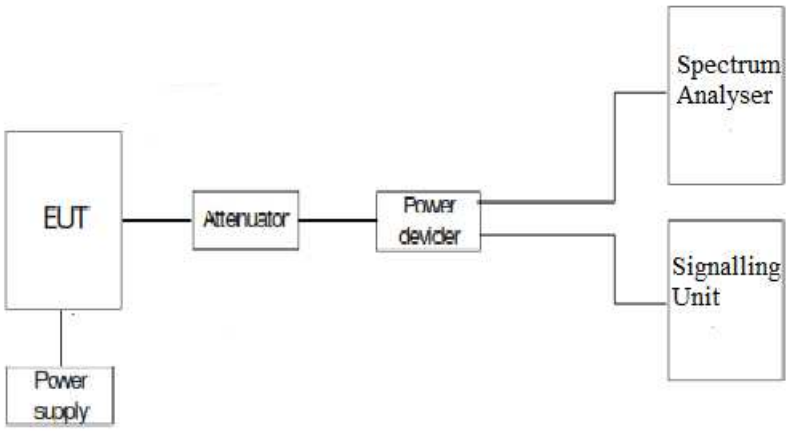
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 ohm attenuator and a power splitter.

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 Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = - 13 dBm

TEST SETUP



RESULTS (see plots in next pages)

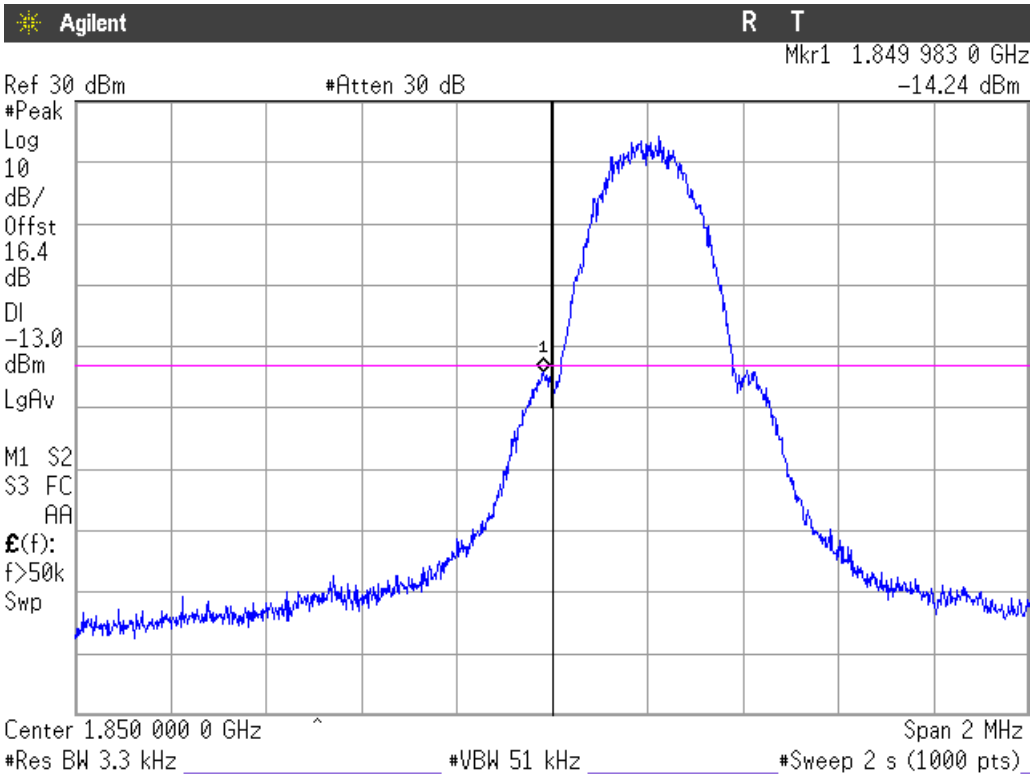
MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at lowest Block Edge at antenna port (dBm)	-14.24	-14.15	-21.35	-21.58
Measurement uncertainty (dB)	<±2.03			

MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-13.91	-19.11	-18.30	-20.36
Measurement uncertainty (dB)	<±2.03			

Verdict: PASS

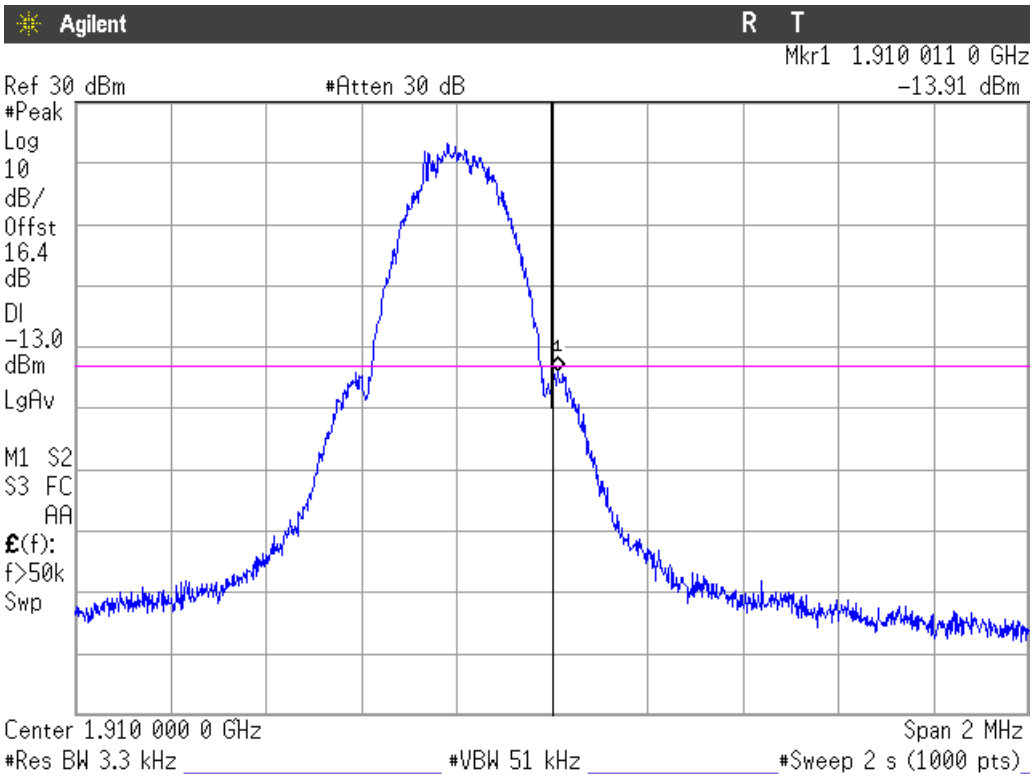
GPRS MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

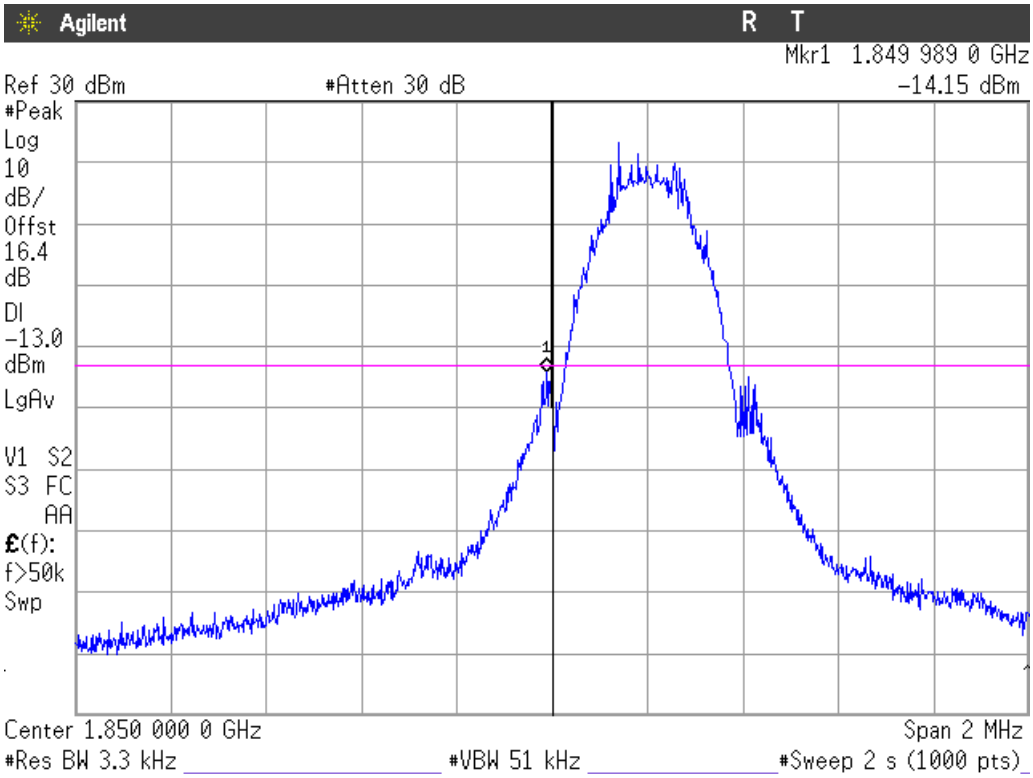
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

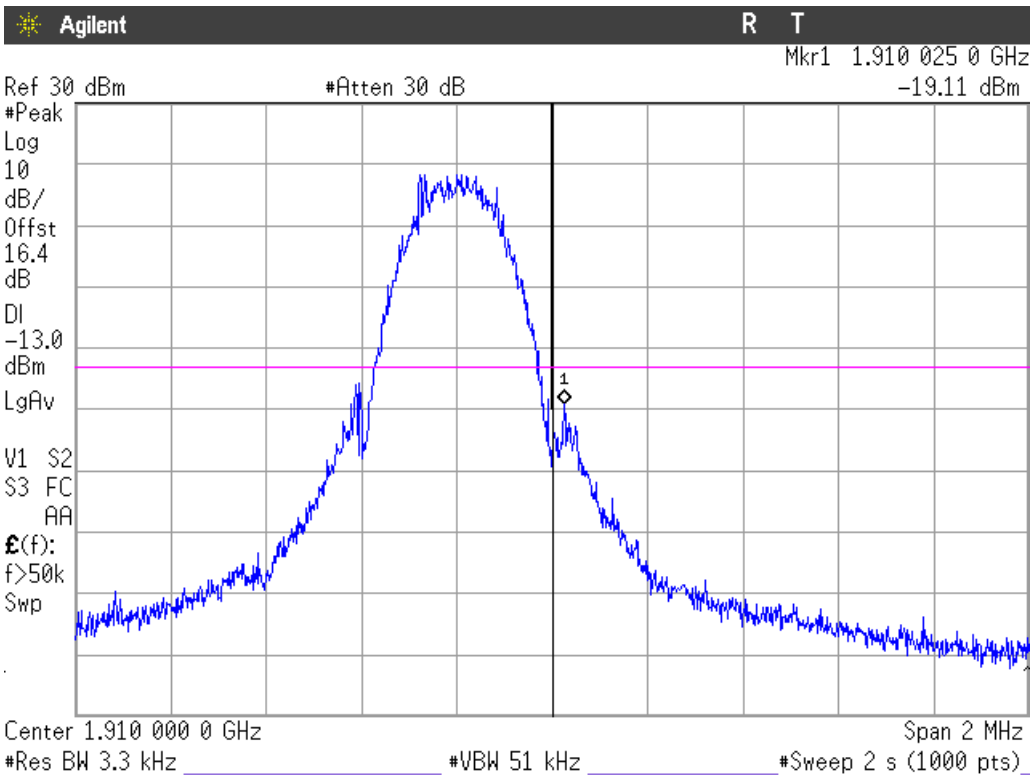
EDGE MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

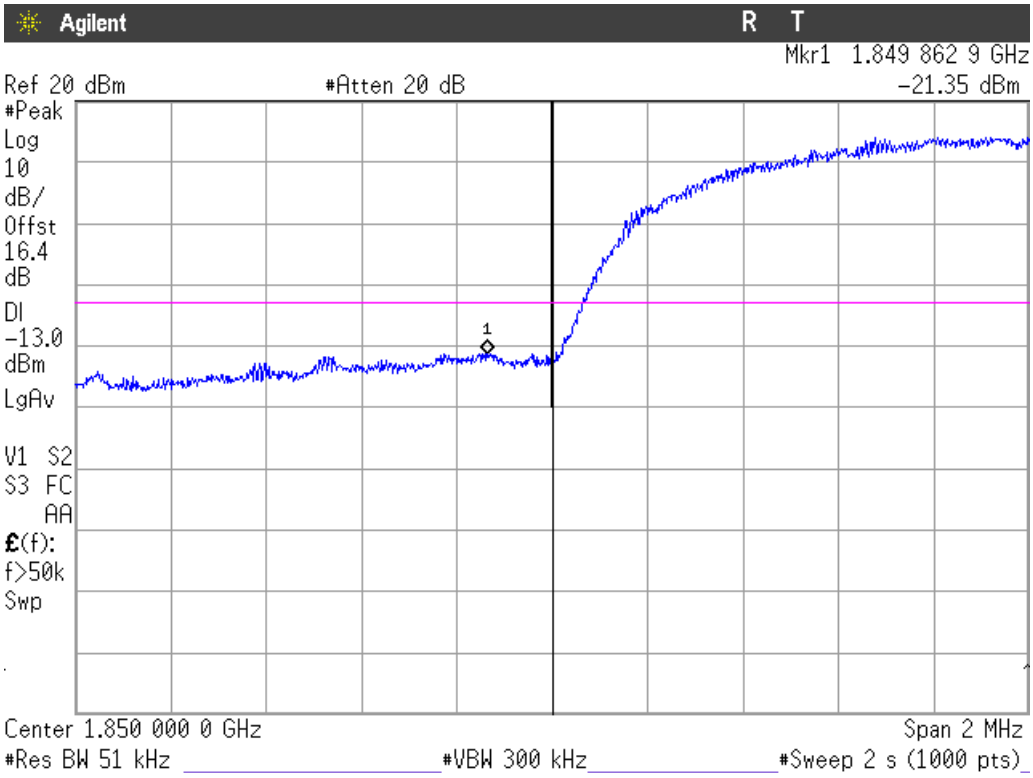
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

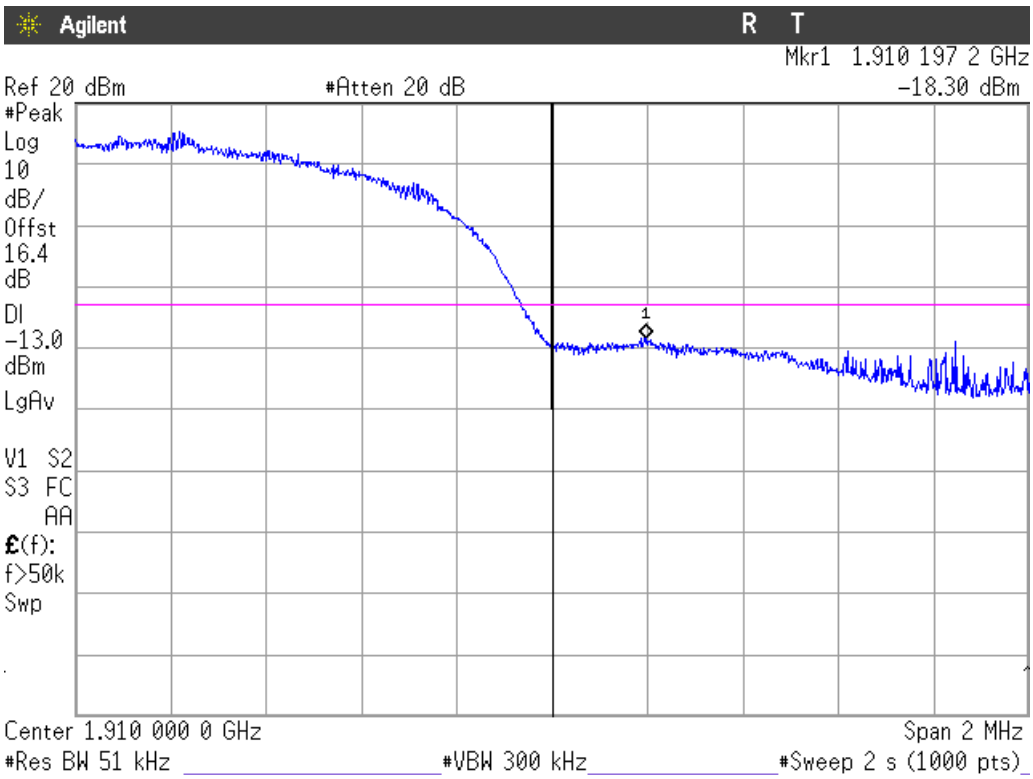
WCDMA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

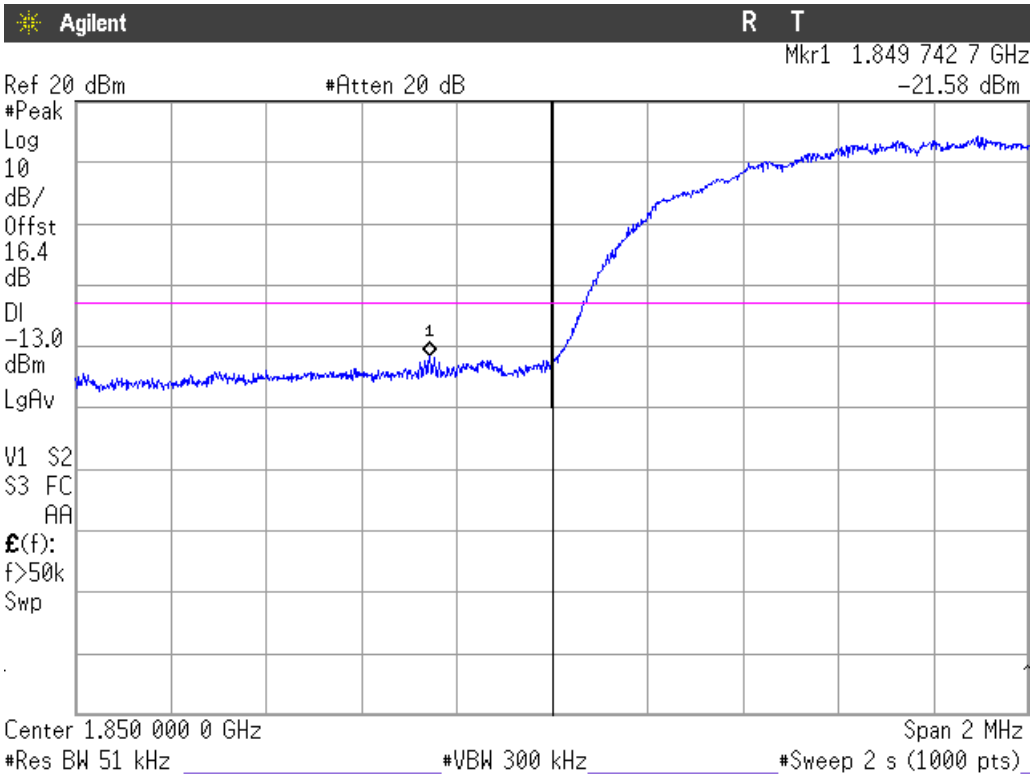
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

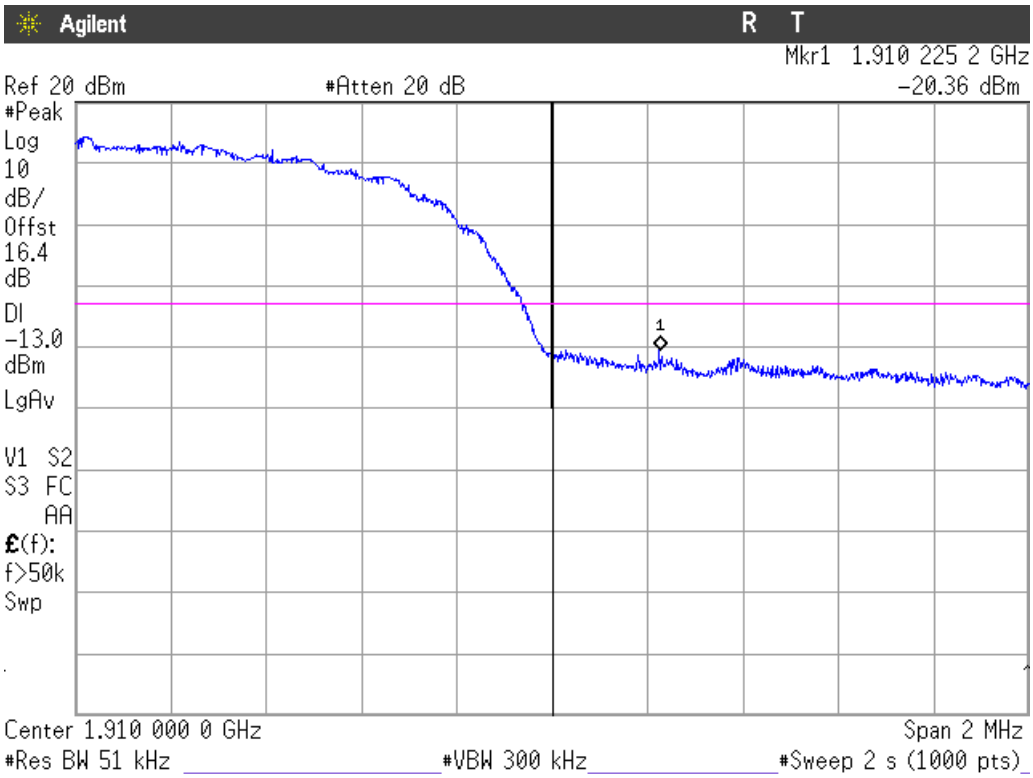
HSUPA MODULATION

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/EIA-603-D.

The test was performed with the equipment transmitting first in only cellular mode, repeated with the BT EDR/BT LE (modulation GFSK, which is the worst case) and repeated with WIFI (802.11b mode 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.

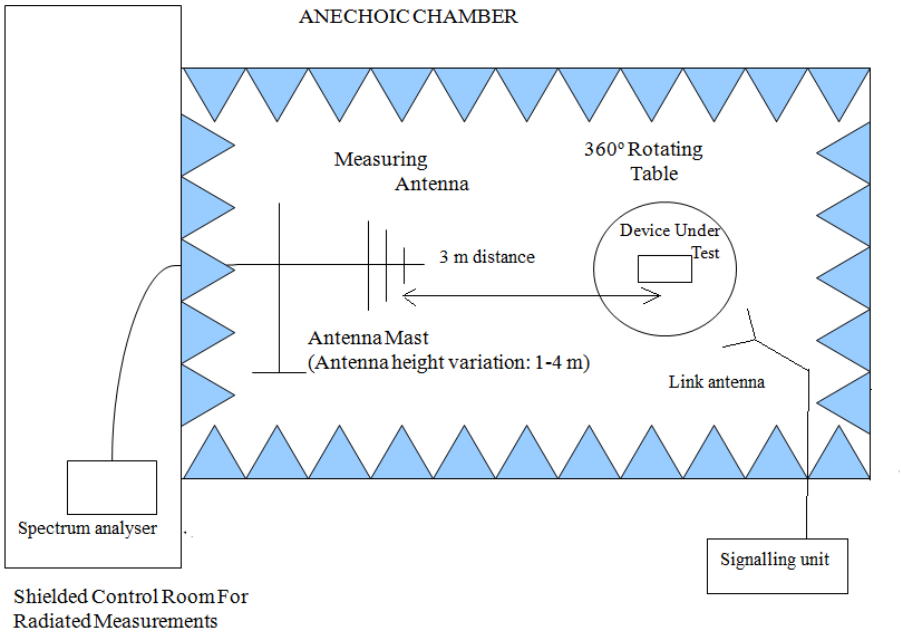
Measurement Limit**:**

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 Po transmitting power. the specified minimum attenuation becomes 43+10log (Po) and the level in dBm relative Po becomes:

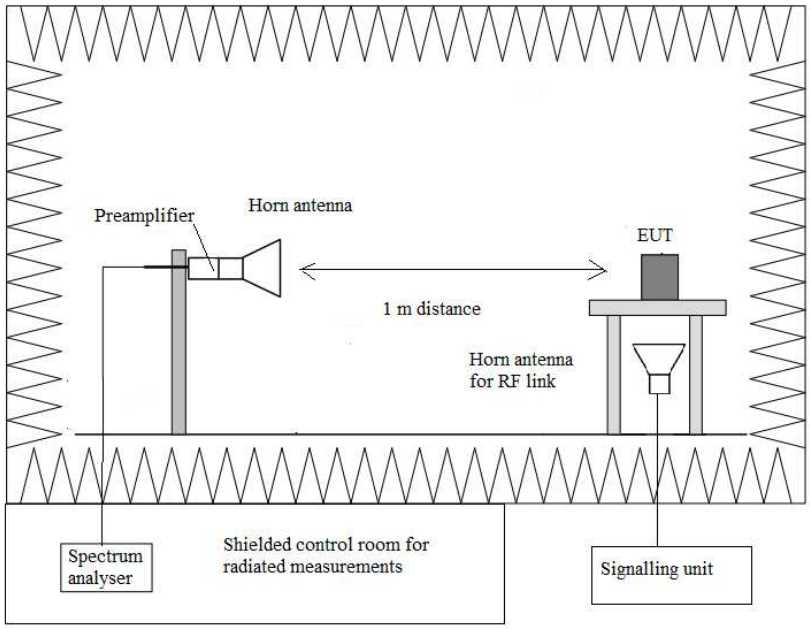
Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = - 13 dBm

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 spurious signals were found 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 Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
13162.5	-40.69	Horizontal	-35.76	6.55	12.50	-29.81

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 Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
9549.25	-38.72	Horizontal	-37.37	4.90	10.14	-32.13

Verdict: PASS

WCDMA AND HSUPA MODULATION

A preliminary scan determined the WCDMA modulation as the worst case. The following tables and plots show the results for WCDMA 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 spurious signals were found 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 spurious signals were found 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.

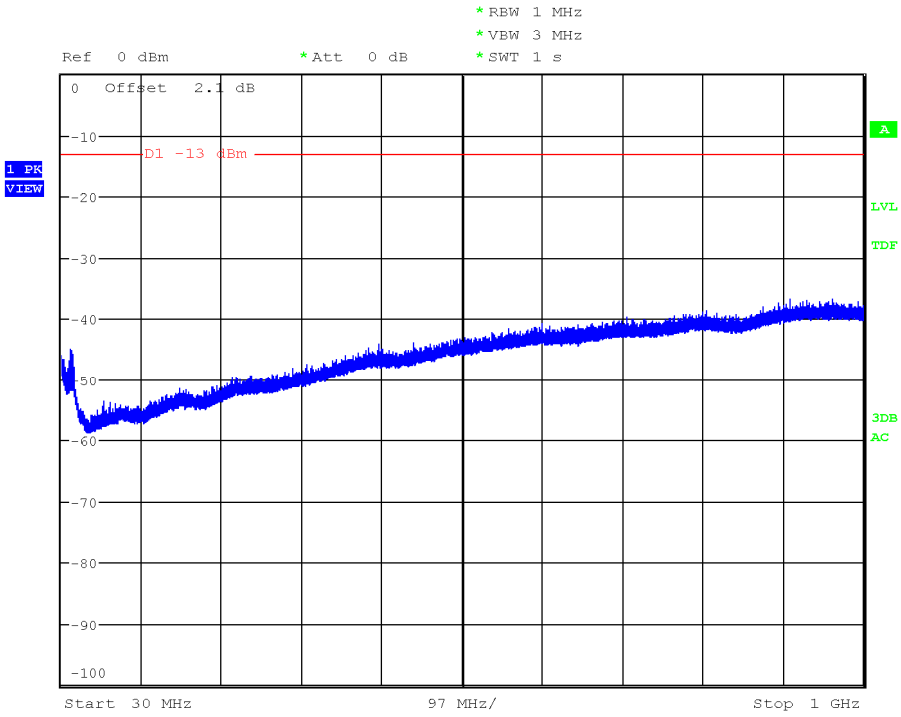
Frequency range 1 GHz-20 GHz.
No spurious signals were found at less than 20 dB respect to the limit.

Measurement uncertainty (dB)	<±3.88 for f < 1GHz <±4.87 for f ≥ 1 GHz up to 18 GHz <±3.99 for f ≥ 18 GHz up to 20 GHz

Verdict: PASS

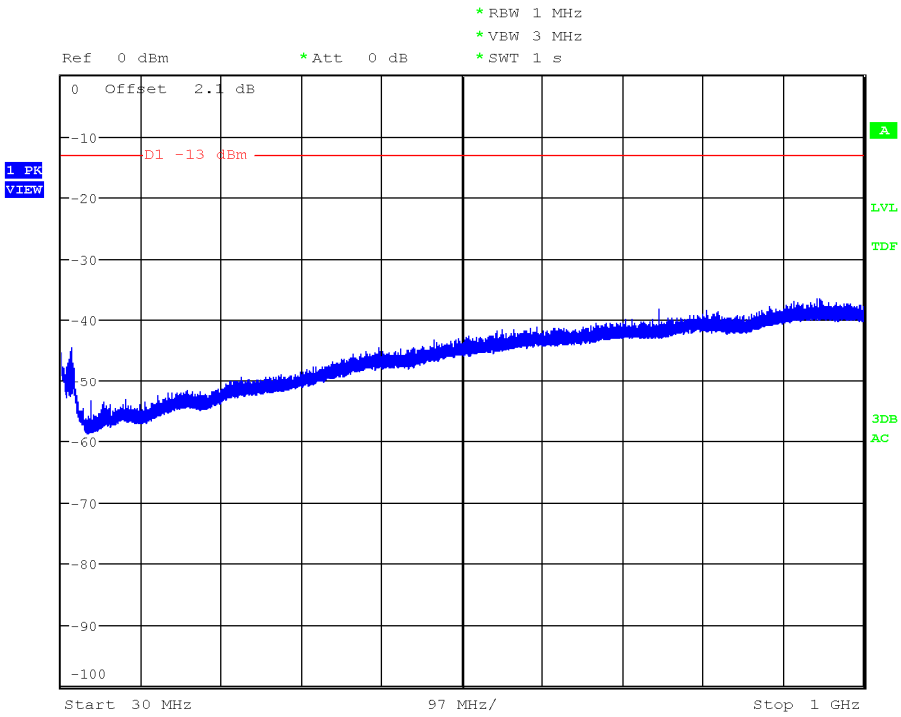
FREQUENCY RANGE 30 MHz-1000 MHz.

GPRS MODULATION



(This plot is valid for all three channels)

WCDMA MODULATION

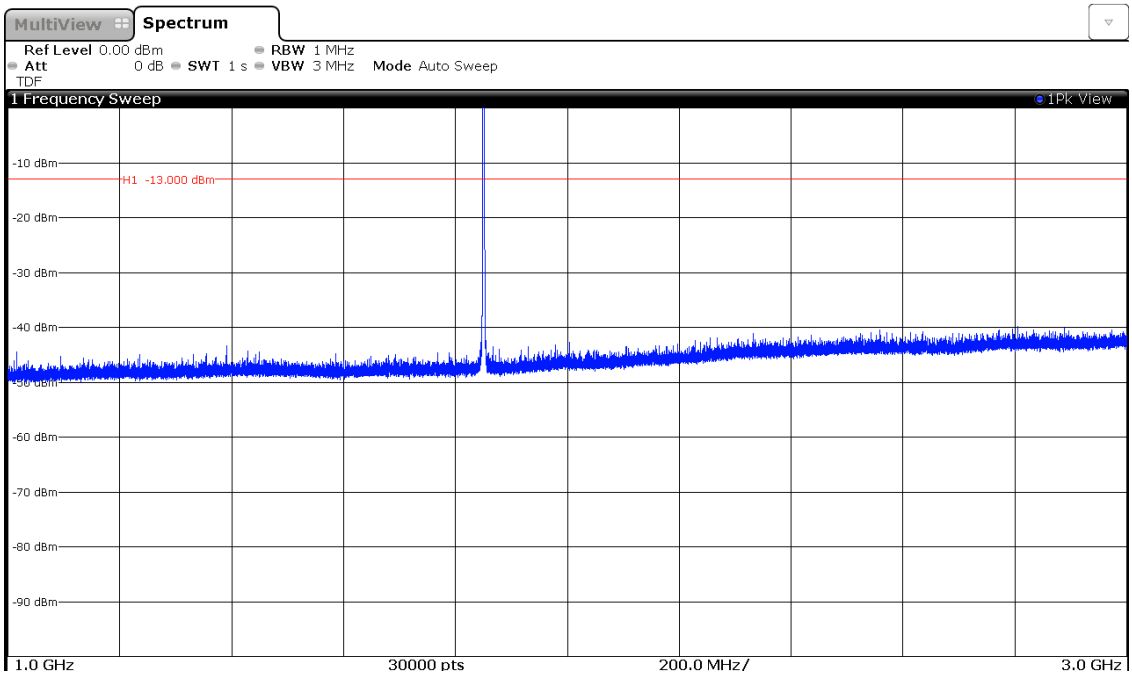


(This plot is valid for all three channels)

FREQUENCY RANGE 1 GHz to 3 GHz.

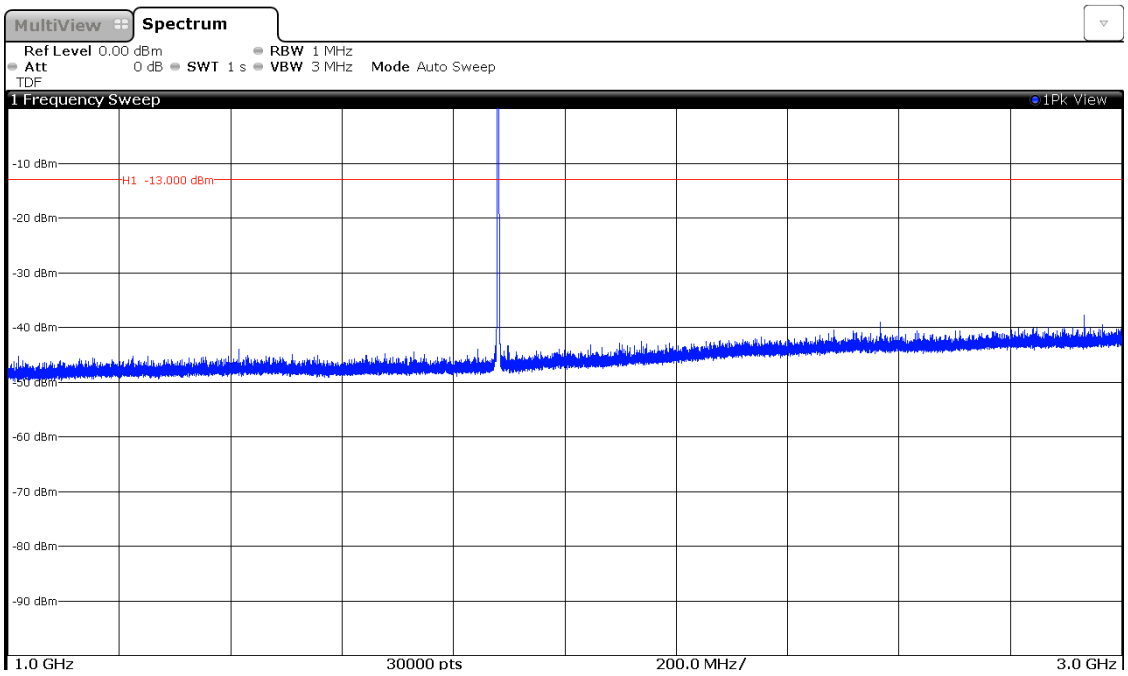
GPRS MODULATION

CHANNEL: LOWEST



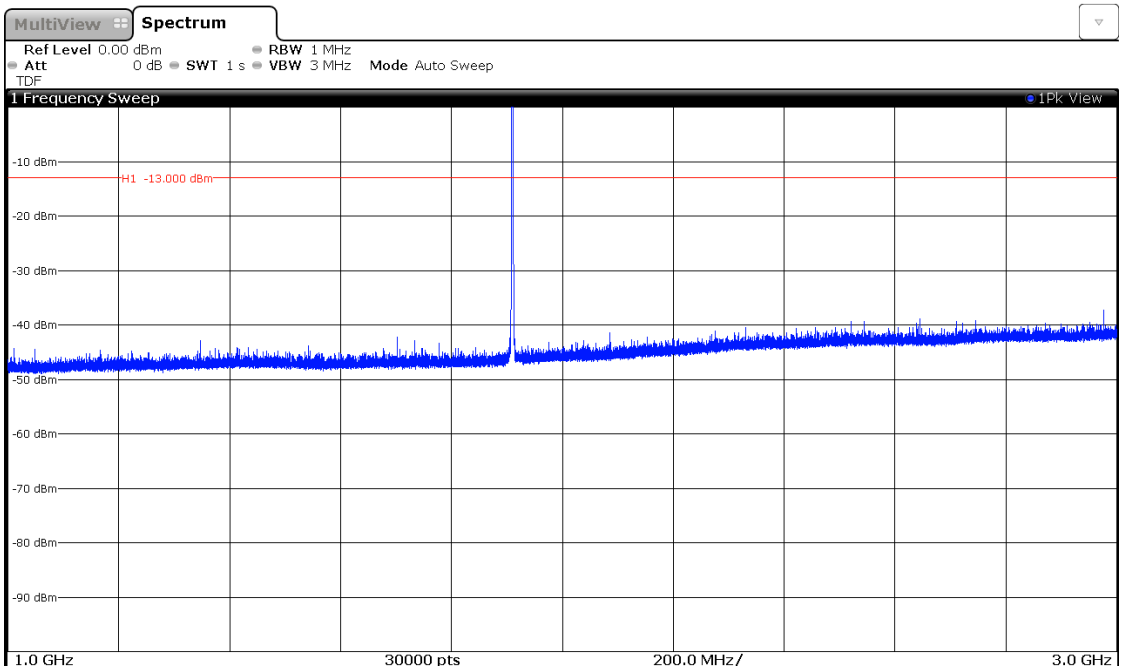
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

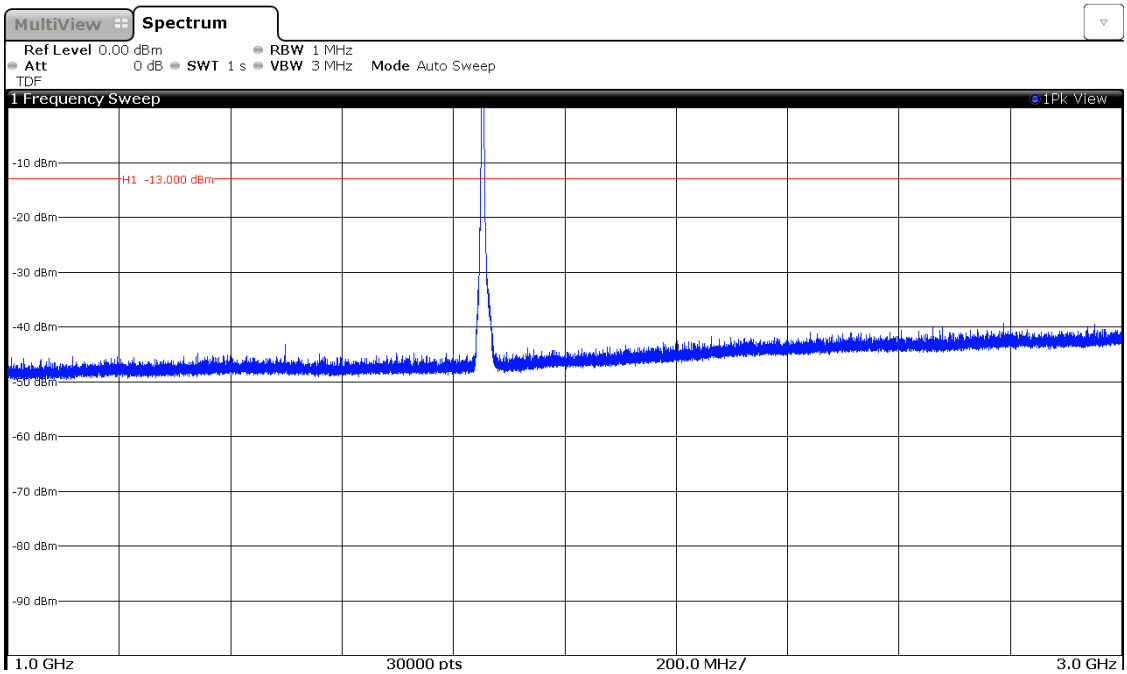
CHANNEL: HIGHEST



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

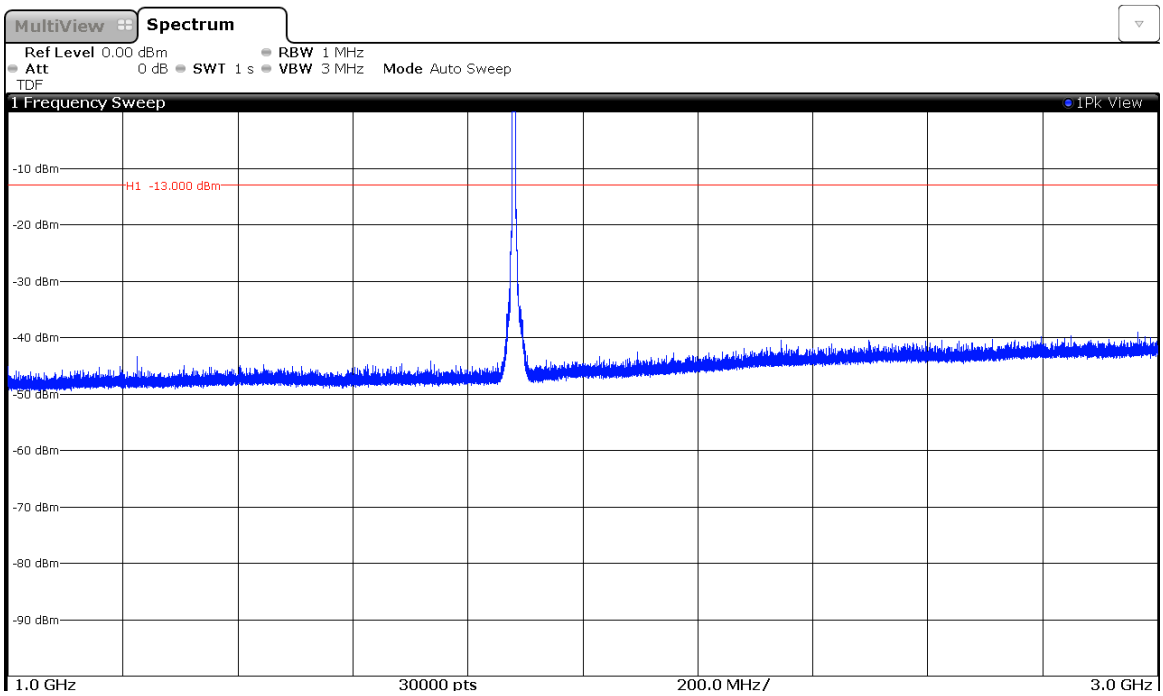
WCDMA MODULATION

CHANNEL: LOWEST



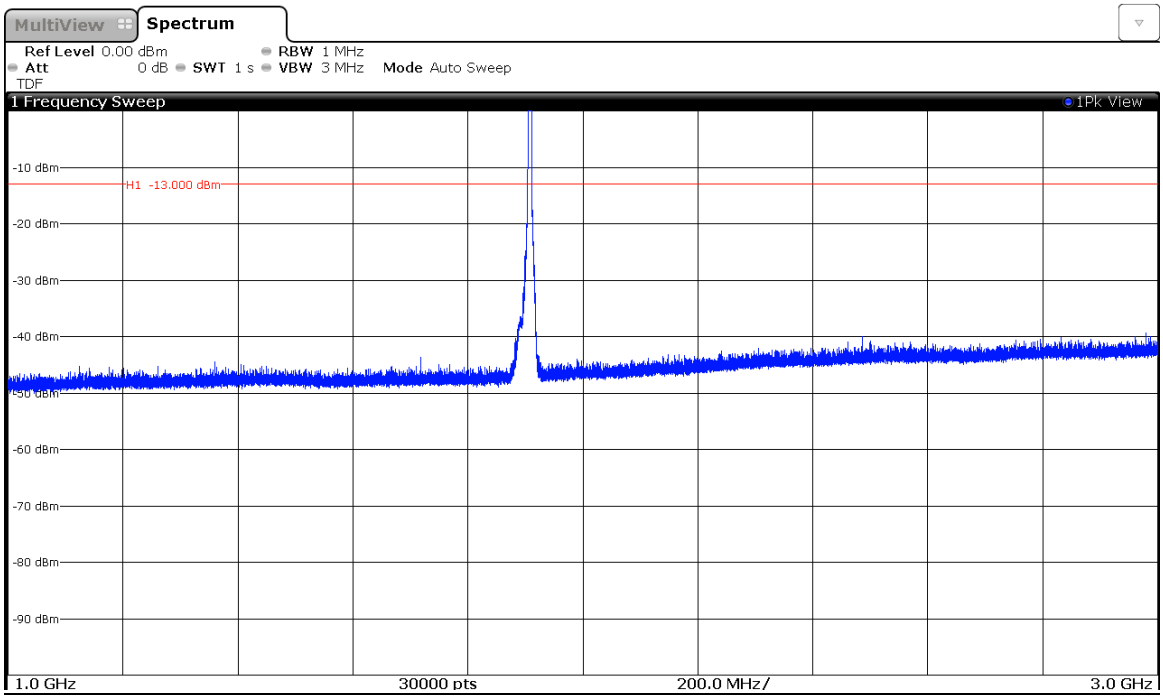
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

CHANNEL: HIGHEST

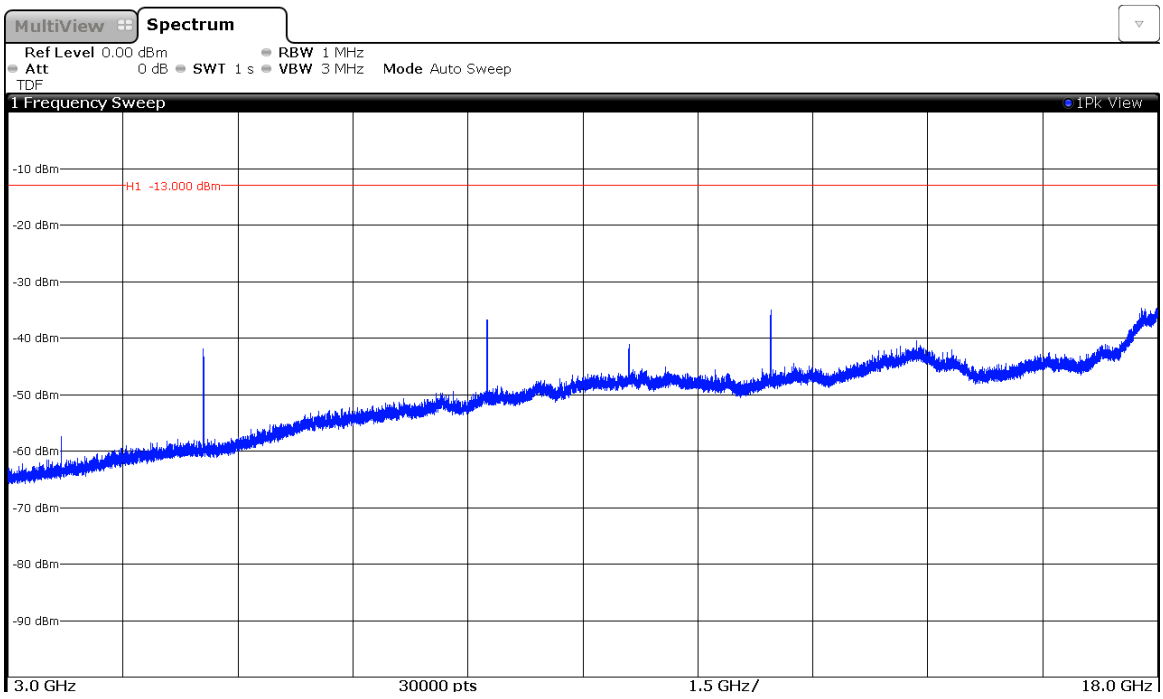


Note: The peak above the limit is the carrier frequency.

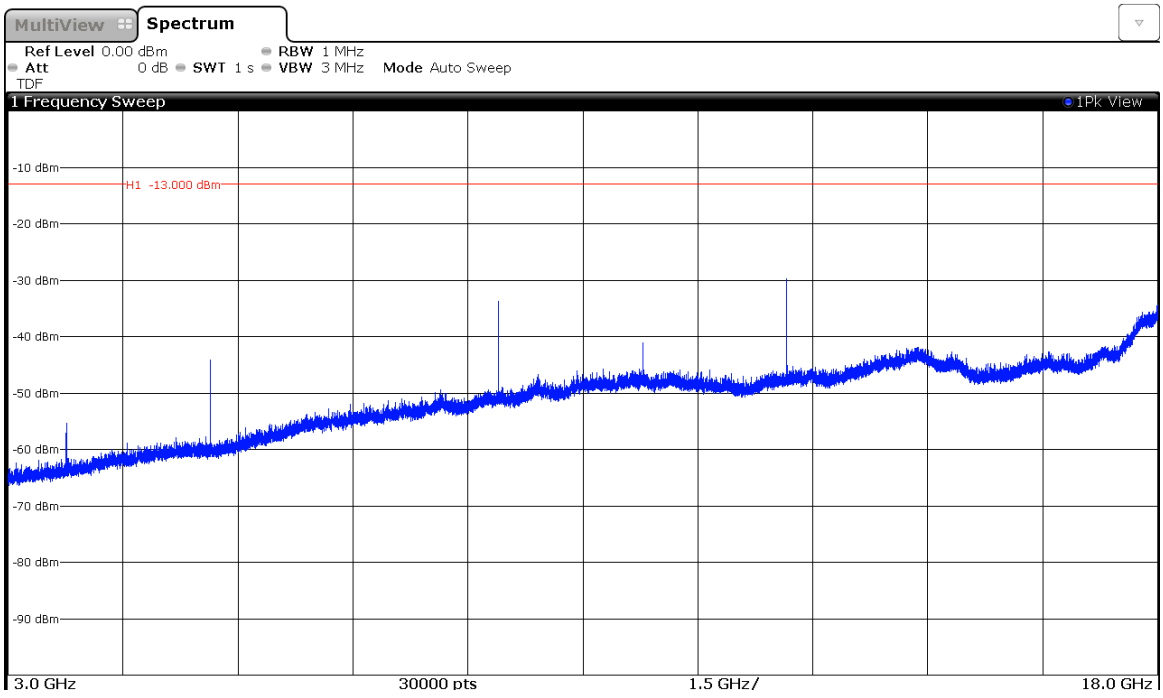
FREQUENCY RANGE 3 GHz to 18 GHz.

GPRS MODULATION

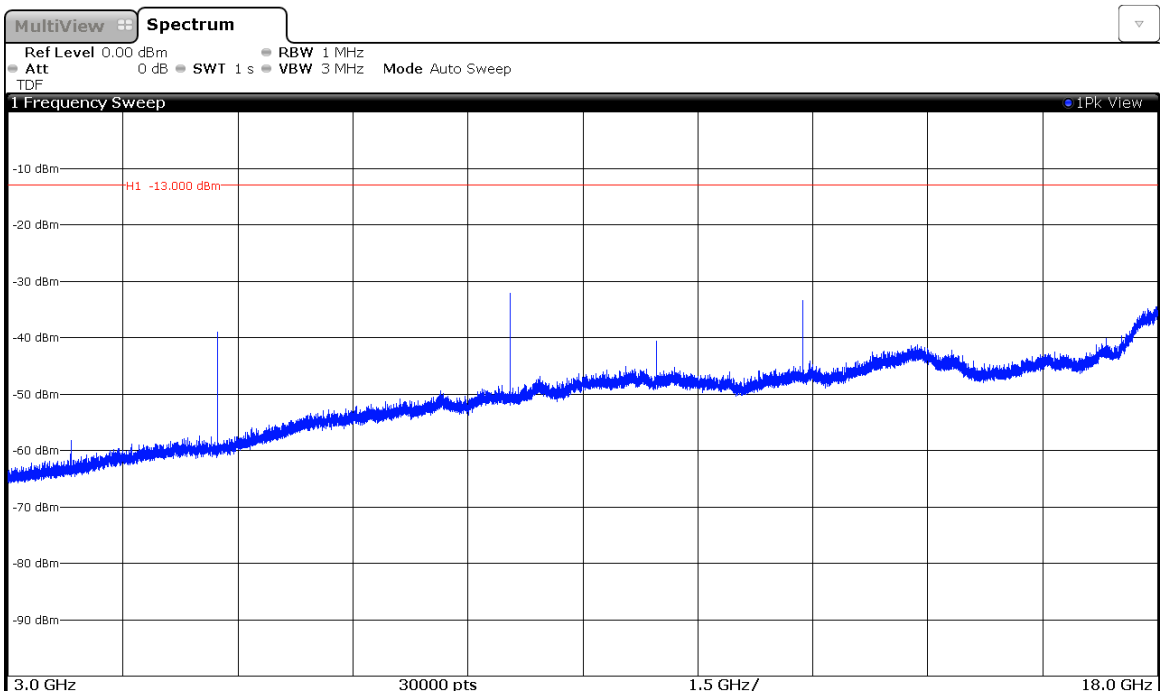
CHANNEL: LOWEST



CHANNEL: MIDDLE

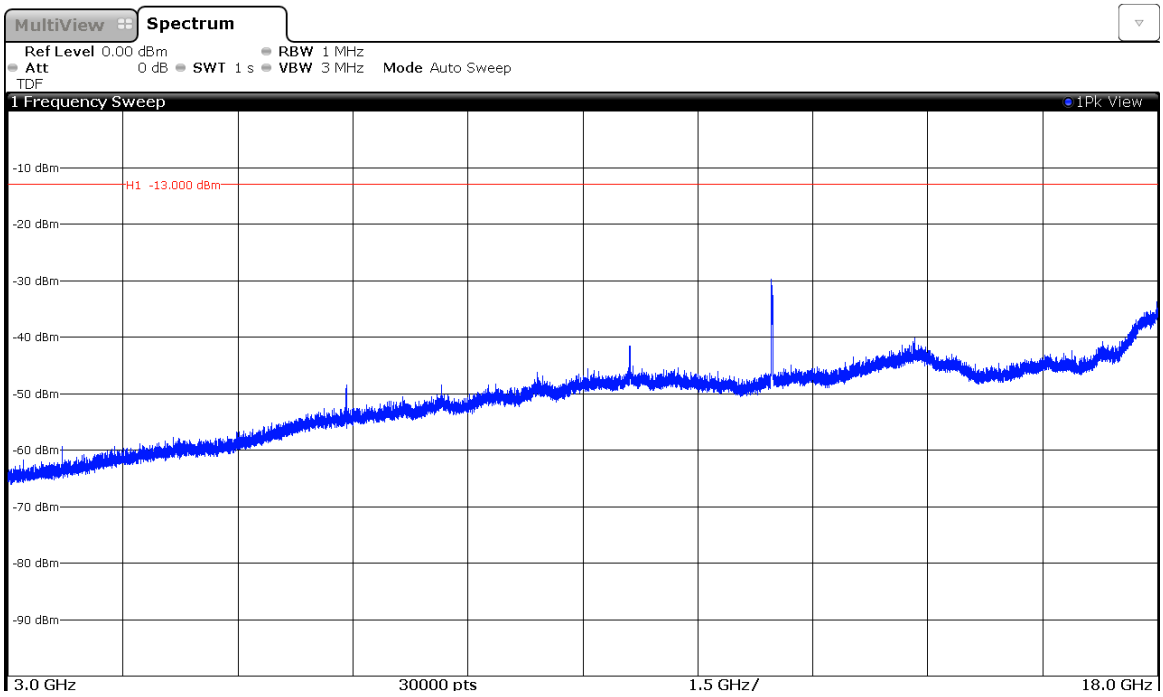


CHANNEL: HIGHEST

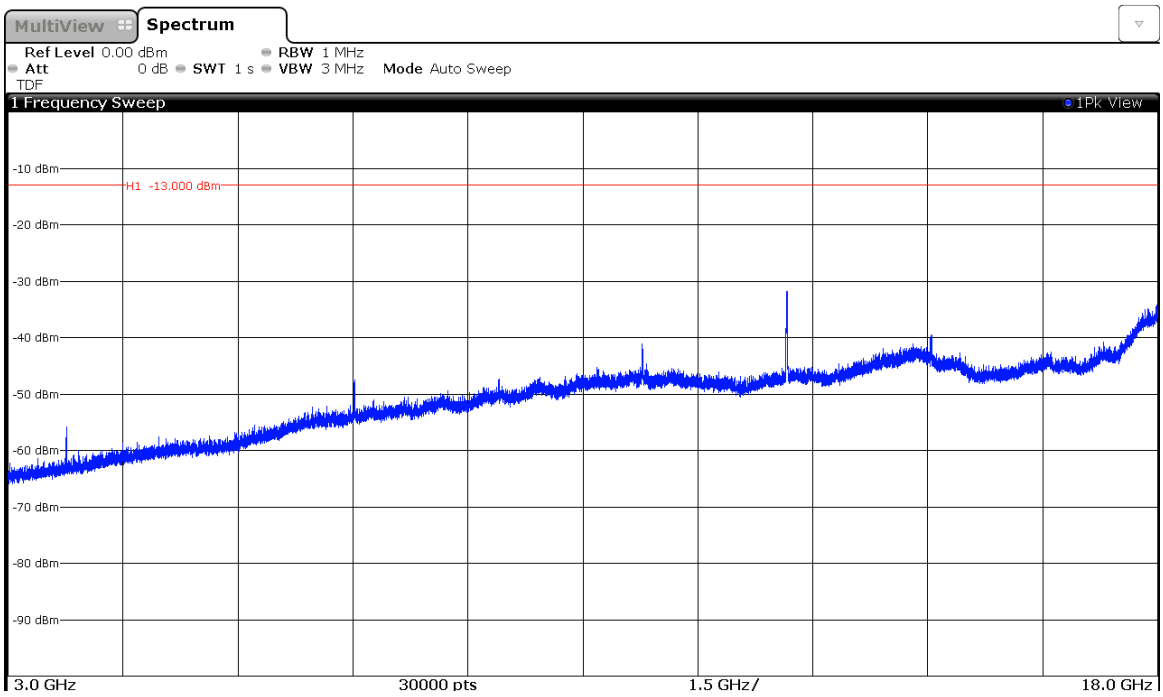


WCDMA MODULATION

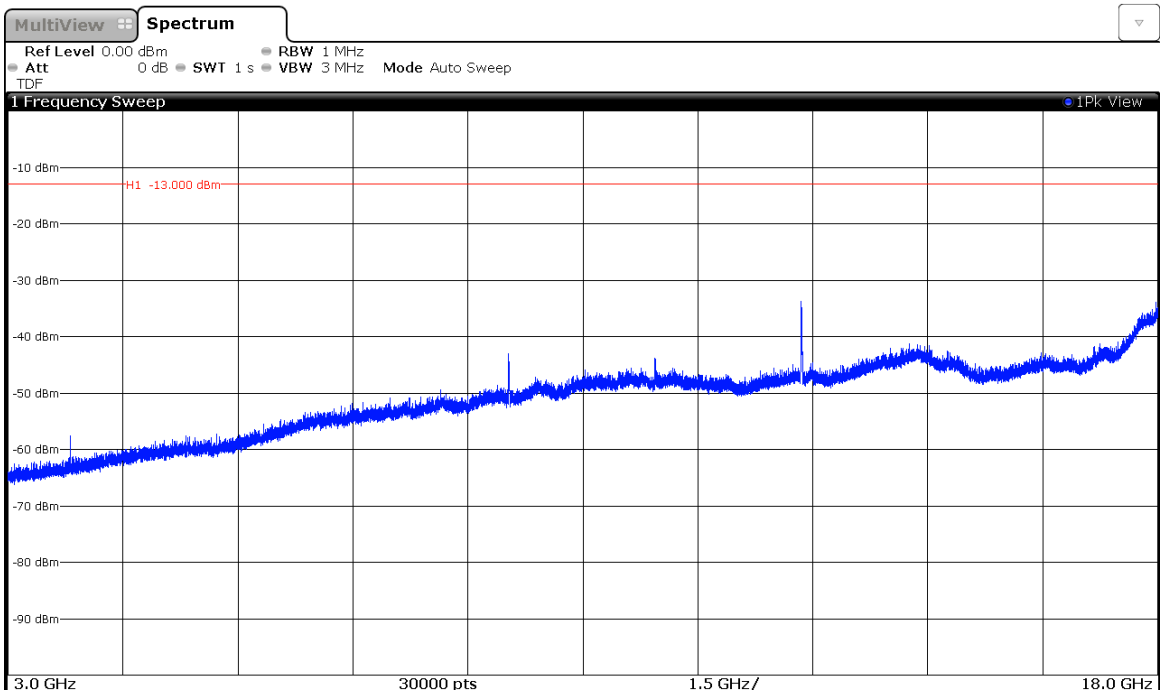
CHANNEL: LOWEST



CHANNEL: MIDDLE



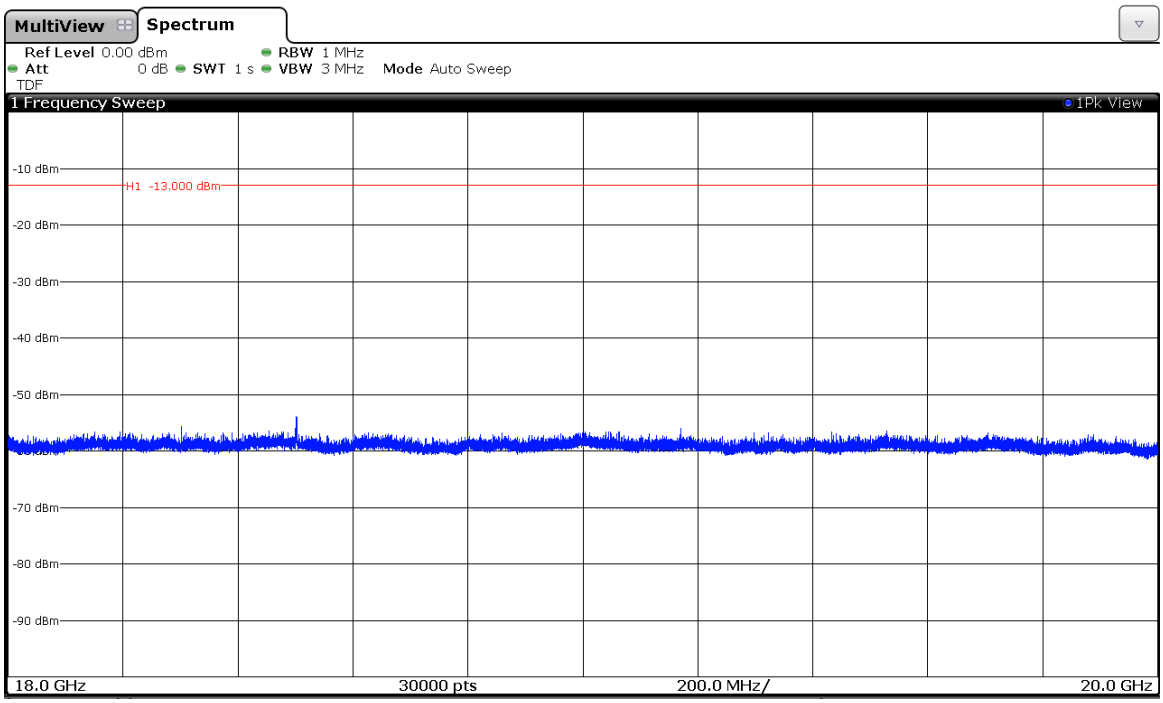
CHANNEL: HIGHEST



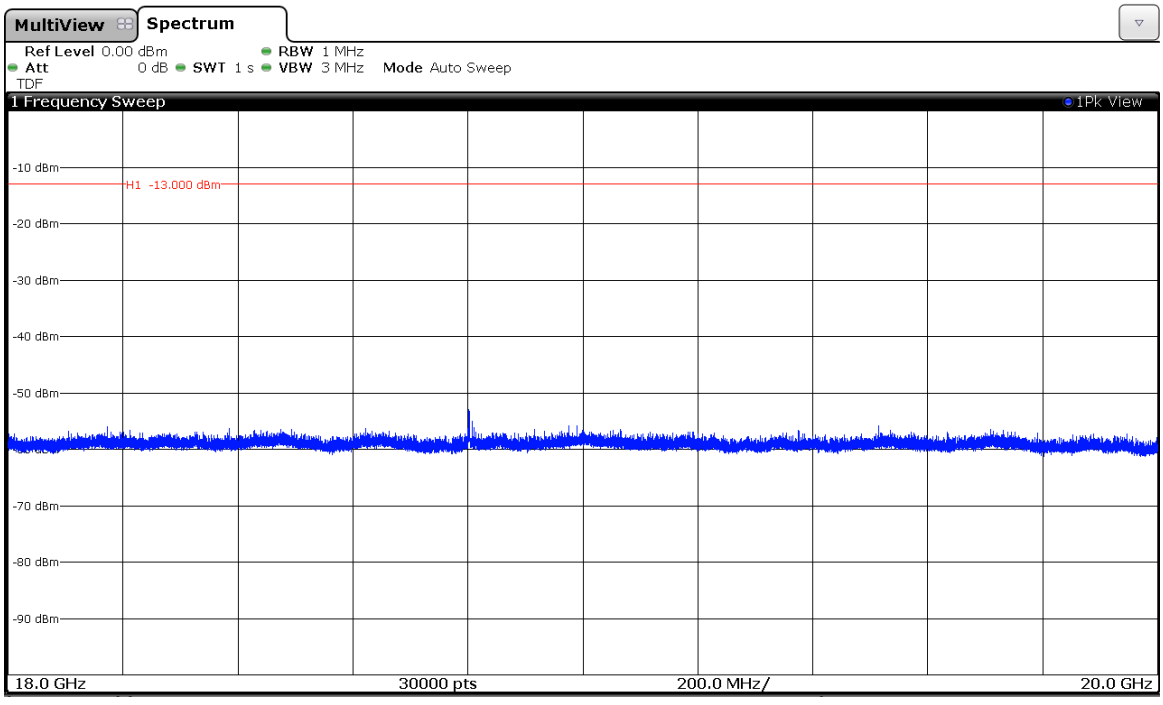
FREQUENCY RANGE 18 GHz TO 20 GHz.

GPRS MODULATION

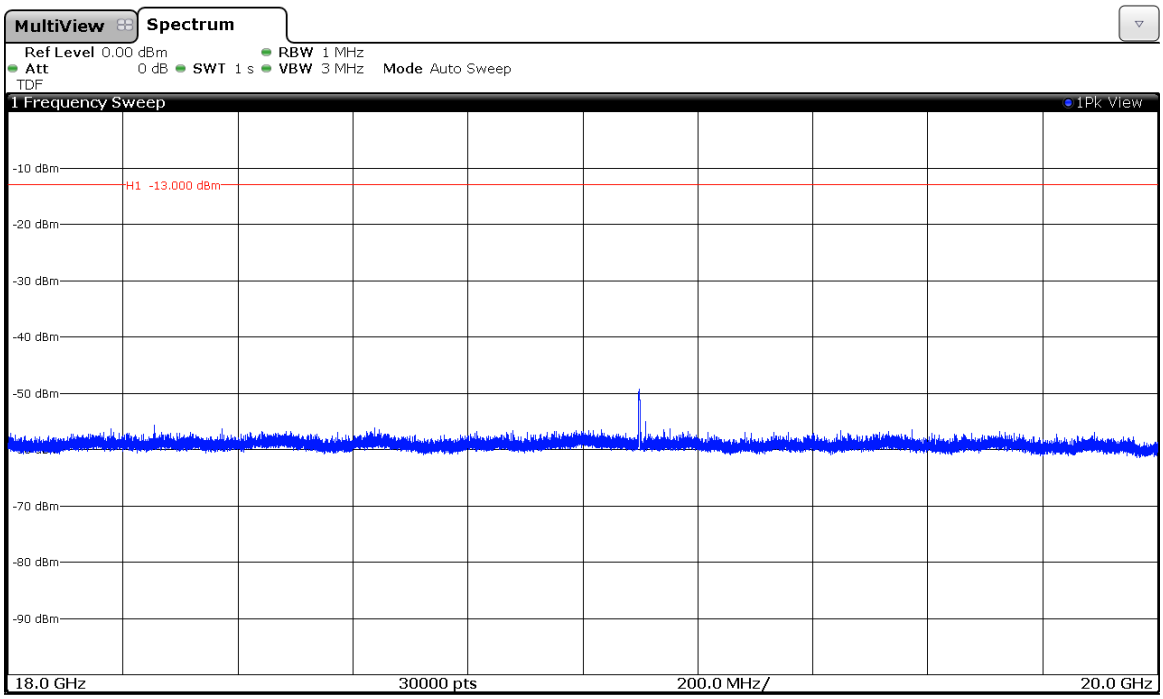
CHANNEL: LOWEST



CHANNEL: MIDDLE

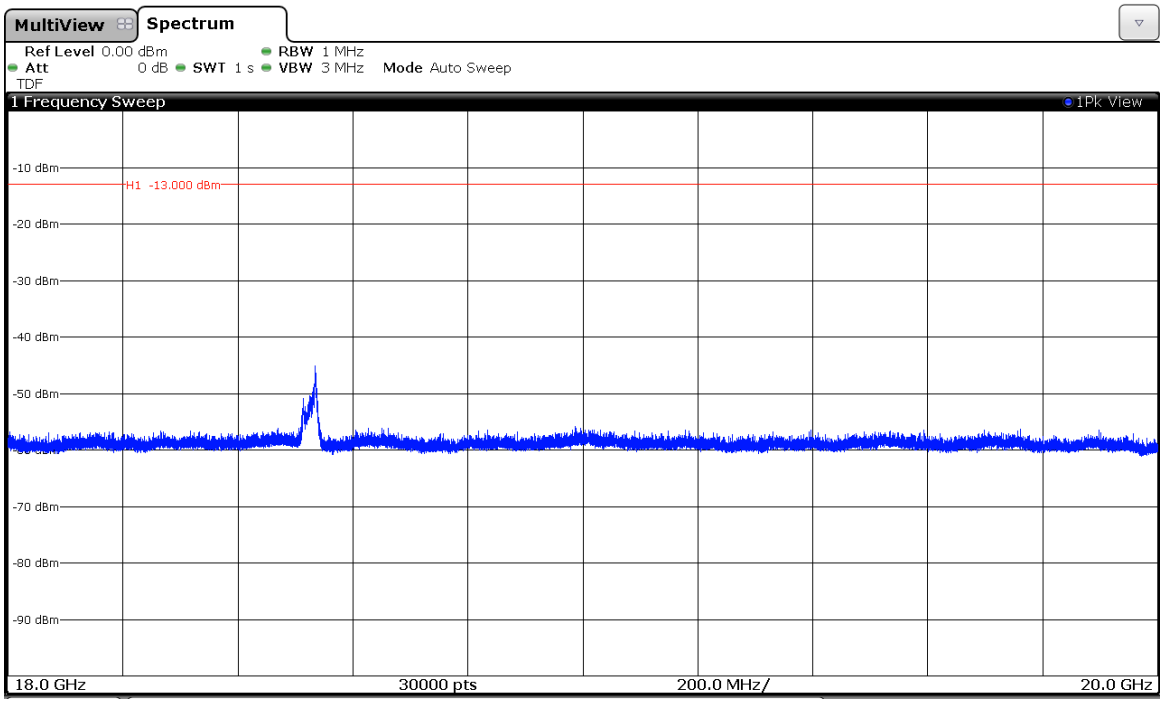


CHANNEL: HIGHEST

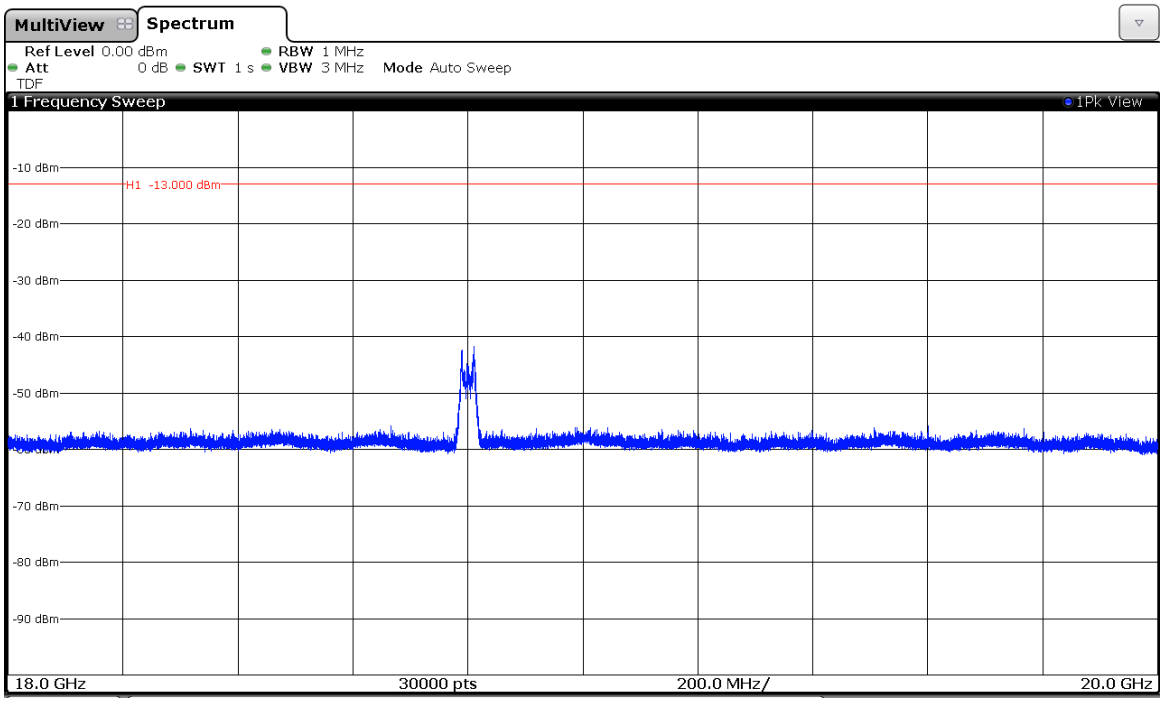


WCDMA MODULATION

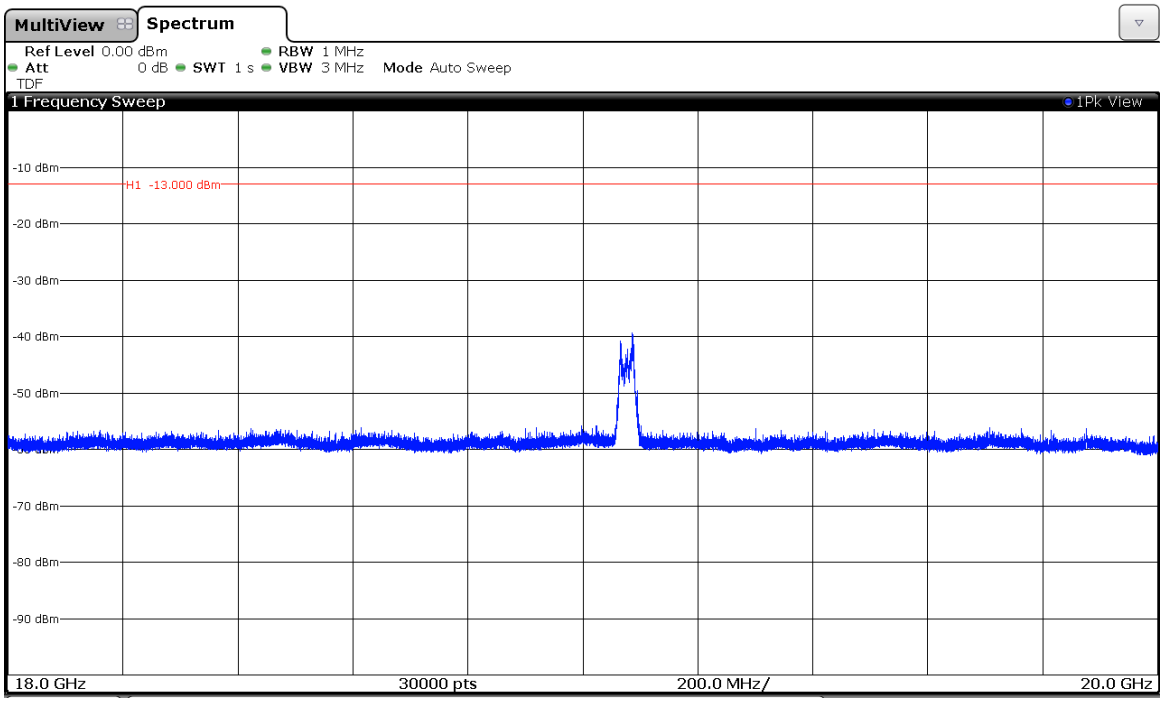
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



Appendix C – Test result for FCC Part 27

INDEX

TEST RESULTS FOR FCC PART 27

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 = +2.1 dBi (WCDMA Band IV) +2.3 dBi (LTE Band IV).

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.

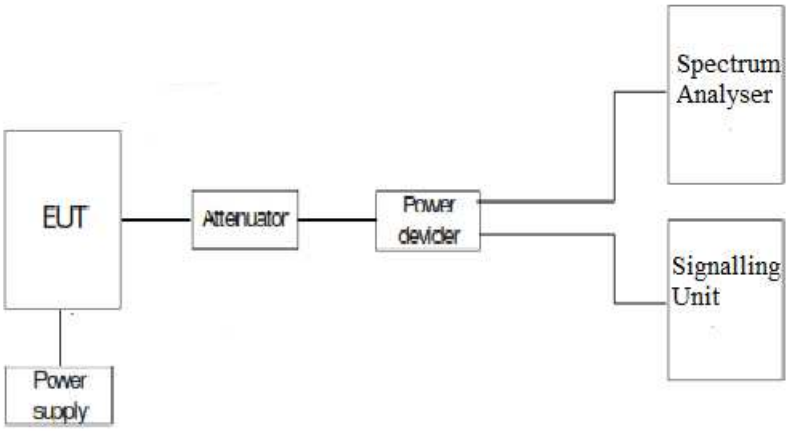
The equivalent isotropically radiated power e.i.r.p. is calculated by adding the declared maximum antenna gain (dBi).

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.

UMTS. BAND IV.

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.10	2.10	2.10
Measured maximum average power (dBm) at antenna port	23.63	23.80	23.91
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	25.73	25.90	26.01
Peak-to-average ratio (PAR) (dB)	3.09	3.13	3.12
Measurement uncertainty (dB)	<±0.66		

HSUPA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.10	2.10	2.10
Measured maximum average power (dBm) at antenna port	21.58	21.79	21.75
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	23.68	23.89	23.85
Peak-to-average ratio (PAR) (dB)	5.72	5.79	6.12
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	22.985	
				1	2	22.985	
				1	5	22.997	
				3	0	22.949	
				3	1	22.899	
				3	2	22.899	
				6	0	22.944	4.57
			16-QAM	1	0	22.905	
				1	2	22.886	
				1	5	22.896	
				3	0	22.865	
				3	1	22.844	
				3	2	22.858	
				6	0	22.368	5.48
	Middle 20175	1732.5	QPSK	1	0	23.056	
				1	2	22.978	
				1	5	23.080	
				3	0	23.003	
				3	1	22.996	
				3	2	22.978	
				6	0	23.028	4.57
			16-QAM	1	0	22.971	
				1	2	22.971	
				1	5	23.009	
				3	0	22.993	
				3	1	22.996	
				3	2	23.005	
				6	0	22.097	5.45
	High 20393	1754.3	QPSK	1	0	23.001	
				1	2	22.943	
				1	5	22.970	
				3	0	22.931	
				3	1	22.914	
				3	2	22.899	
				6	0	22.918	5.24
			16-QAM	1	0	22.981	
				1	2	22.93	
				1	5	22.974	
				3	0	22.874	
				3	1	22.86	
				3	2	22.872	
				6	0	22.483	5.85

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
3	Low 19965	1711.5	QPSK	1	0	22.967	4.86
				1	7	22.830	
				1	14	22.869	
				8	0	22.894	
				8	4	22.830	
				8	7	22.813	
				15	0	22.798	
			16-QAM	1	0	22.867	5.74
				1	7	22.781	
				1	14	22.809	
				8	0	22.363	
				8	4	22.381	
				8	7	22.332	
				15	0	22.336	
	Middle 20175	1732.5	QPSK	1	0	23.972	4.86
				1	7	23.988	
				1	14	23.990	
				8	0	23.013	
				8	4	23.072	
				8	7	23.050	
				15	0	23.019	
			16-QAM	1	0	23.217	5.79
				1	7	23.246	
				1	14	23.247	
				8	0	22.109	
				8	4	22.171	
				8	7	22.154	
				15	0	22.067	
	High 20385	1753.5	QPSK	1	0	23.007	5.32
				1	7	22.987	
				1	14	23.001	
				8	0	22.915	
				8	4	22.864	
				8	7	22.919	
				15	0	22.872	
			16-QAM	1	0	22.915	5.96
				1	7	22.893	
				1	14	22.897	
				8	0	22.409	
				8	4	22.398	
				8	7	22.417	
				15	0	22.487	

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
5	Low 19975	1712.5	QPSK	1	0	24.165	4.78
				1	12	24.167	
				1	24	24.158	
				12	0	23.277	
				12	6	23.317	
				12	11	23.338	
				25	0	23.310	
			16-QAM	1	0	23.253	5.63
				1	12	23.108	
				1	24	23.210	
				12	0	22.340	
				12	6	22.263	
				12	11	22.258	
				25	0	22.379	
	Middle 20175	1732.5	QPSK	1	0	22.934	4.78
				1	12	22.948	
				1	24	23.029	
				12	0	22.963	
				12	6	22.936	
				12	11	22.984	
				25	0	22.926	
			16-QAM	1	0	22.812	5.66
				1	12	22.829	
				1	24	22.908	
				12	0	22.144	
				12	6	22.116	
				12	11	22.161	
				25	0	22.093	
	High 20375	1752.5	QPSK	1	0	23.015	5.19
				1	12	23.043	
				1	24	23.073	
				12	0	22.898	
				12	6	22.916	
				12	11	22.932	
				25	0	22.900	
			16-QAM	1	0	22.915	5.87
				1	12	22.915	
				1	24	22.975	
				12	0	22.391	
				12	6	22.410	
				12	11	22.435	
				25	0	22.508	

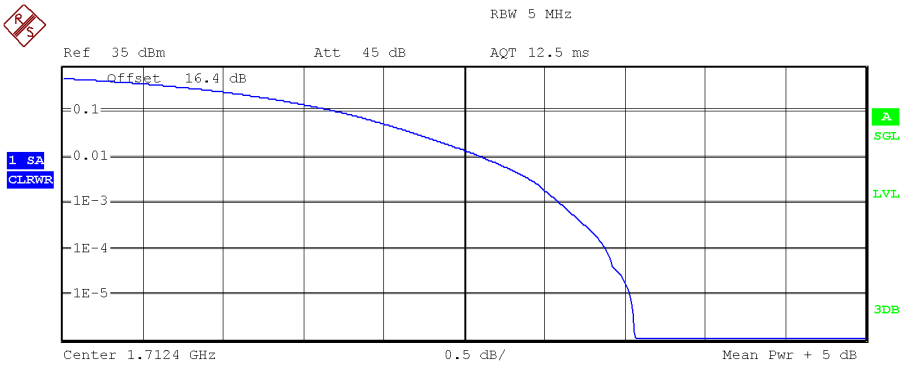
BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
10	Low 20000	1715	QPSK	1	0	24.189	4.79
				1	24	24.221	
				1	49	24.216	
				25	0	23.295	
				25	12	23.325	
				25	24	23.324	
				50	0	23.296	
			16-QAM	1	0	23.368	5.63
				1	24	23.475	
				1	49	23.487	
				25	0	22.264	
				25	12	22.238	
				25	24	22.261	
				50	0	22.262	
	Middle 20175	1732.5	QPSK	1	0	23.964	4.79
				1	24	23.884	
				1	49	24.083	
				25	0	23.003	
				25	12	22.984	
				25	24	23.068	
				50	0	22.995	
			16-QAM	1	0	22.852	5.69
				1	24	22.929	
				1	49	22.818	
				25	0	22.074	
				25	12	22.046	
				25	24	22.117	
				50	0	22.056	
	High 20350	1750	QPSK	1	0	22.817	4.97
				1	24	22.858	
				1	49	22.916	
				25	0	22.825	
				25	12	22.804	
				25	24	22.829	
				50	0	22.863	
			16-QAM	1	0	22.943	5.88
				1	24	22.965	
				1	49	23.029	
				25	0	22.346	
				25	12	22.379	
				25	24	22.440	
				50	0	22.439	

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
15	Low 20025	1717.5	QPSK	1	0	24.067	4.66
				1	37	24.092	
				1	74	24.045	
				36	0	23.198	
				36	18	23.273	
				36	37	23.169	
				75	0	23.091	
			16-QAM	1	0	23.313	5.56
				1	37	23.347	
				1	74	23.303	
				36	0	22.242	
				36	18	22.340	
				36	37	22.241	
				75	0	22.183	
	Middle 20175	1732.5	QPSK	1	0	23.091	4.70
				1	37	22.909	
				1	74	22.880	
				36	0	22.896	
				36	18	22.892	
				36	37	22.894	
				75	0	23.002	
			16-QAM	1	0	22.922	5.58
				1	37	22.885	
				1	74	22.871	
				36	0	22.069	
				36	18	22.075	
				36	37	22.142	
				75	0	22.044	
	High 20325	1747.5	QPSK	1	0	22.858	5.13
				1	37	22.818	
				1	74	22.904	
				36	0	22.770	
				36	18	22.838	
				36	37	22.870	
				75	0	22.932	
			16-QAM	1	0	23.014	5.71
				1	37	22.985	
				1	74	23.081	
				36	0	22.307	
				36	18	22.393	
				36	37	22.435	
				75	0	22.471	

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)	PAPR (dB)
20	Low 20050	1720	QPSK	1	0	23.941	4.58
				1	49	24.061	
				1	99	23.746	
				50	0	23.133	
				50	24	23.197	
				50	49	23.036	
				100	0	23.031	
			16-QAM	1	0	23.272	5.50
				1	49	23.256	
				1	99	23.132	
				50	0	22.235	
				50	24	22.303	
				50	49	22.138	
				100	0	22.112	
	Middle 20175	1732.5	QPSK	1	0	22.914	4.57
				1	49	22.914	
				1	99	22.916	
				50	0	22.854	
				50	24	22.975	
				50	49	22.898	
				100	0	22.978	
			16-QAM	1	0	22.747	5.54
				1	49	22.769	
				1	99	22.781	
				50	0	21.995	
				50	24	22.017	
				50	49	22.133	
				100	0	22.013	
	High 20300	1745	QPSK	1	0	22.819	4.84
				1	49	22.770	
				1	99	22.923	
				50	0	22.860	
				50	24	22.771	
				50	49	22.851	
				100	0	22.804	
			16-QAM	1	0	22.903	5.63
				1	49	22.861	
				1	99	23.009	
				50	0	22.385	
				50	24	22.407	
				50	49	22.401	
				100	0	22.391	

PEAK-TO-AVERAGE POWER RATIO (PAPR).

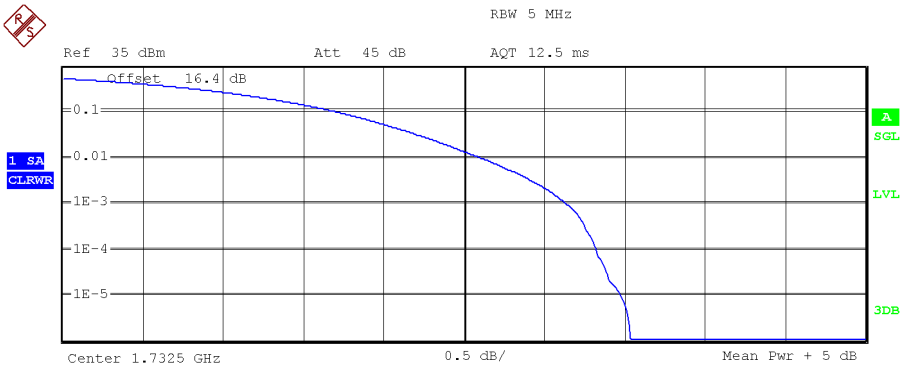
WCDMA Band IV
Channel Low:



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

	Trace 1
Mean	23.52 dBm
Peak	27.08 dBm
Crest	3.56 dB
10 %	1.71 dB
1 %	2.61 dB
.1 %	3.09 dB
.01 %	3.38 dB

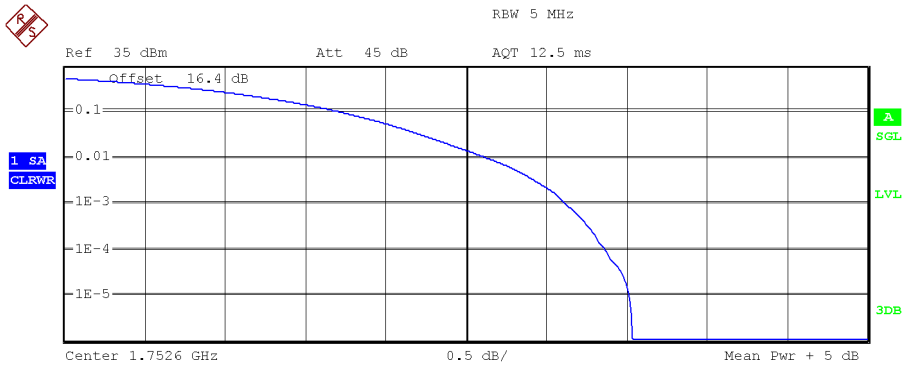
Channel Middle:



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

	Trace 1
Mean	23.82 dBm
Peak	27.36 dBm
Crest	3.54 dB
10 %	1.71 dB
1 %	2.60 dB
.1 %	3.13 dB
.01 %	3.33 dB

Channel High

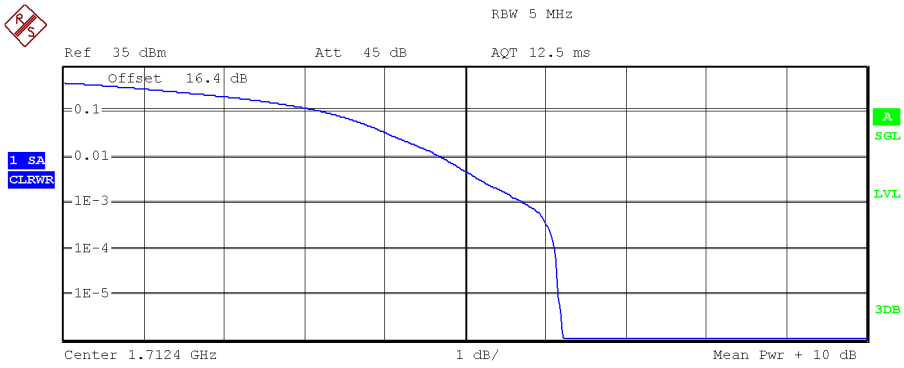


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 7.1MHz

	Trace 1
Mean	23.83 dBm
Peak	27.36 dBm
Crest	3.54 dB
10 %	1.71 dB
1 %	2.63 dB
.1 %	3.12 dB
.01 %	3.37 dB

HSUPA Band IV

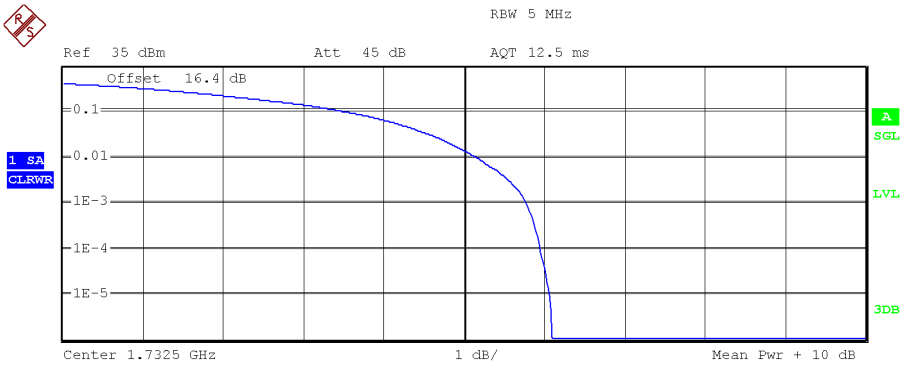
Channel Low:



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

	Trace 1
Mean	21.50 dBm
Peak	27.72 dBm
Crest	6.22 dB
10 %	3.22 dB
1 %	4.71 dB
.1 %	5.72 dB
.01 %	6.12 dB

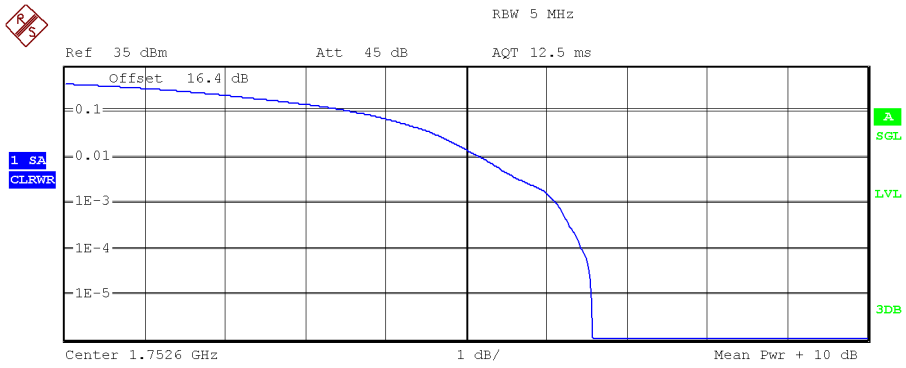
Channel Middle:



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

	Trace 1
Mean	21.62 dBm
Peak	27.72 dBm
Crest	6.10 dB
10 %	3.53 dB
1 %	5.14 dB
.1 %	5.79 dB
.01 %	5.96 dB

Channel High:

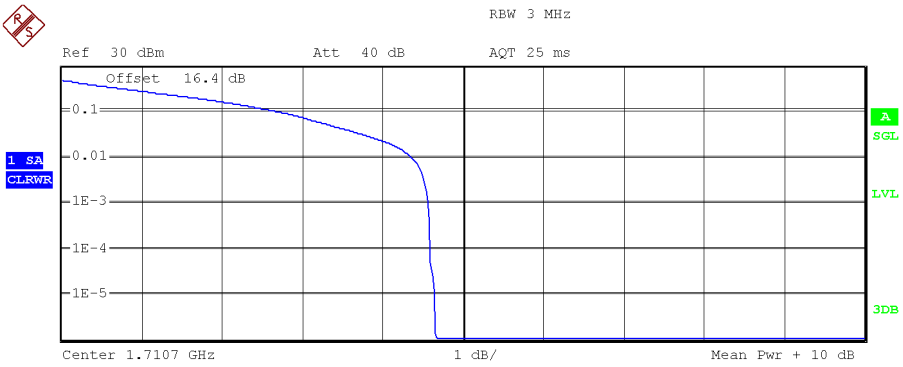


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 7.1MHz

	Trace 1
Mean	21.71 dBm
Peak	28.28 dBm
Crest	6.57 dB
10 %	3.59 dB
1 %	5.19 dB
.1 %	6.12 dB
.01 %	6.44 dB

LTE. BAND IV.

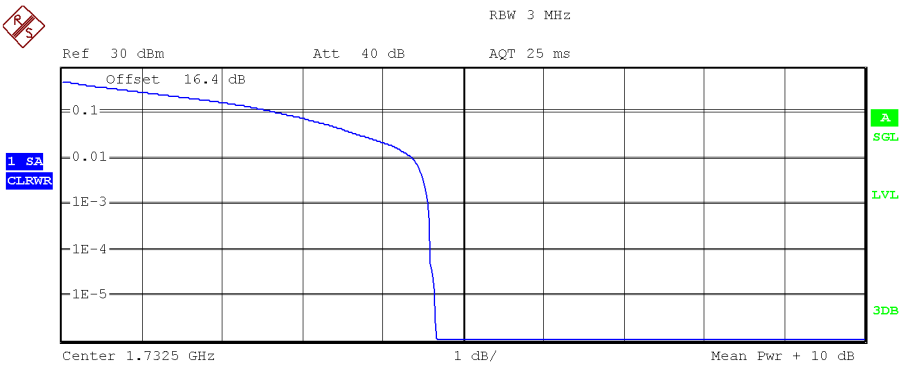
Bandwidth = 1.4 MHz. Modulation QPSK. RB Size: 6. RB Offset: 0.
Channel Low:



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

	Trace 1
Mean	23.21 dBm
Peak	27.87 dBm
Crest	4.66 dB
10 %	2.71 dB
1 %	4.36 dB
.1 %	4.57 dB
.01 %	4.60 dB

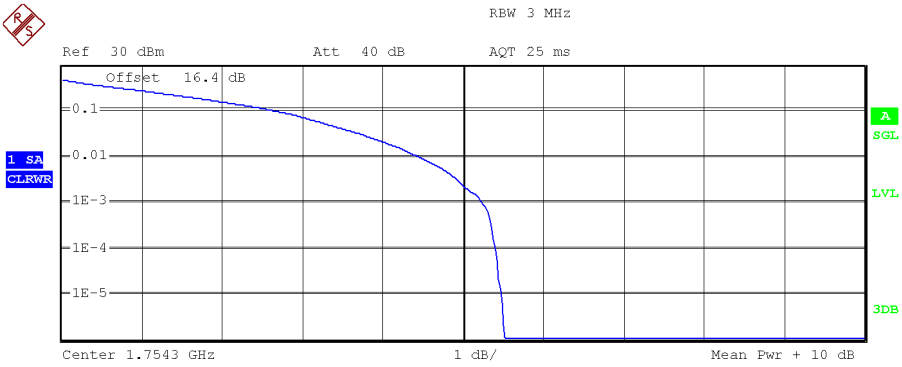
Channel Middle:



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

	Trace 1
Mean	23.00 dBm
Peak	27.66 dBm
Crest	4.66 dB
10 %	2.69 dB
1 %	4.38 dB
.1 %	4.57 dB
.01 %	4.60 dB

Channel High:

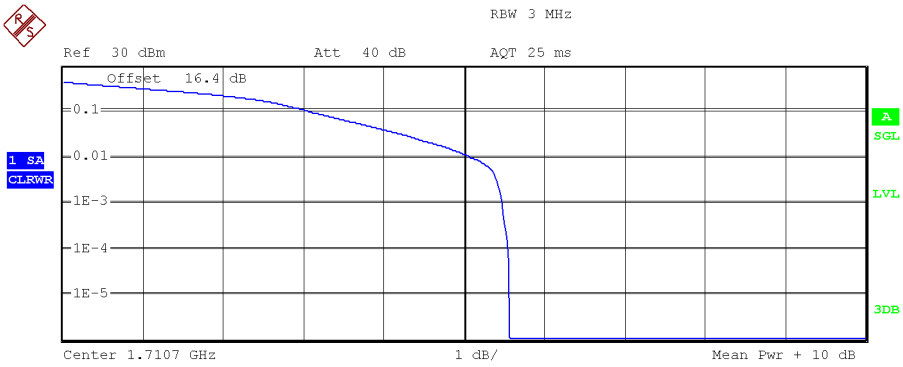


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 3.5MHz

	Trace 1
Mean	22.92 dBm
Peak	28.43 dBm
Crest	5.51 dB
10 %	2.66 dB
1 %	4.44 dB
.1 %	5.24 dB
.01 %	5.42 dB

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

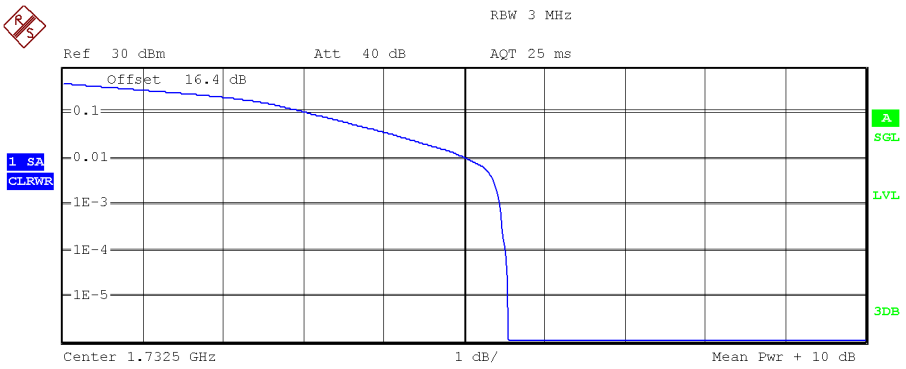
Channel Low:



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

	Trace 1
Mean	22.30 dBm
Peak	27.87 dBm
Crest	5.56 dB
10 %	3.08 dB
1 %	5.08 dB
.1 %	5.48 dB
.01 %	5.56 dB

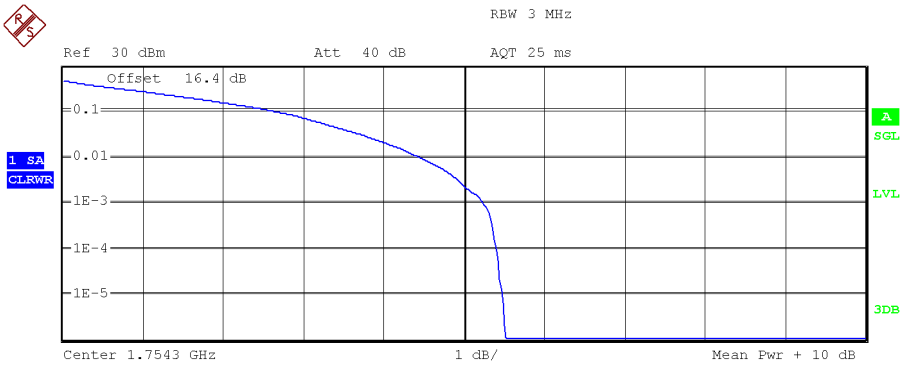
Channel Middle:



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

	Trace 1
Mean	22.11 dBm
Peak	27.66 dBm
Crest	5.55 dB
10 %	3.06 dB
1 %	5.05 dB
.1 %	5.45 dB
.01 %	5.53 dB

Channel High:

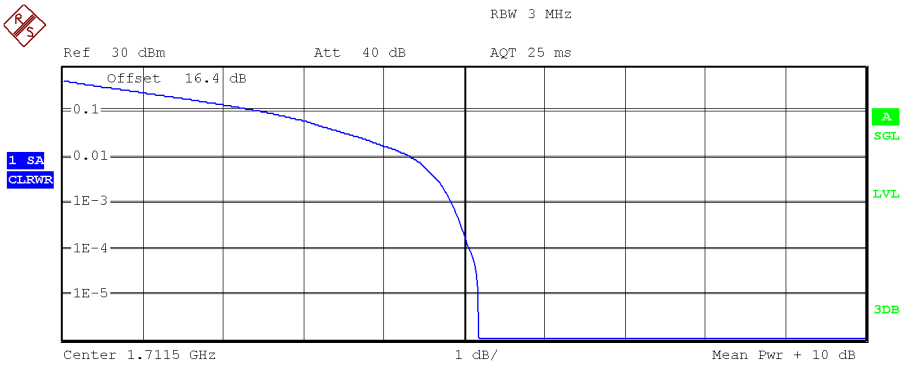


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 3.5MHz

	Trace 1
Mean	22.92 dBm
Peak	28.43 dBm
Crest	5.51 dB
10 %	2.66 dB
1 %	4.44 dB
.1 %	5.24 dB
.01 %	5.42 dB

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

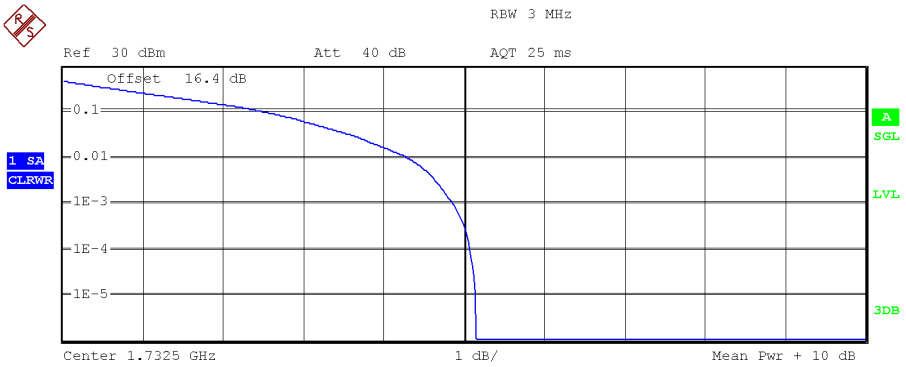
Channel Low:



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

	Trace 1
Mean	23.18 dBm
Peak	28.36 dBm
Crest	5.19 dB
10 %	2.50 dB
1 %	4.34 dB
.1 %	4.86 dB
.01 %	5.06 dB

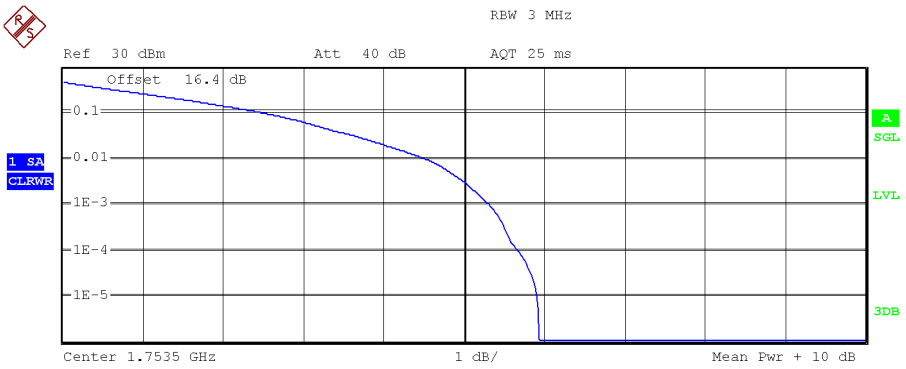
Channel Middle:



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

	Trace 1
Mean	22.93 dBm
Peak	28.08 dBm
Crest	5.15 dB
10 %	2.52 dB
1 %	4.29 dB
.1 %	4.86 dB
.01 %	5.08 dB

Channel High:

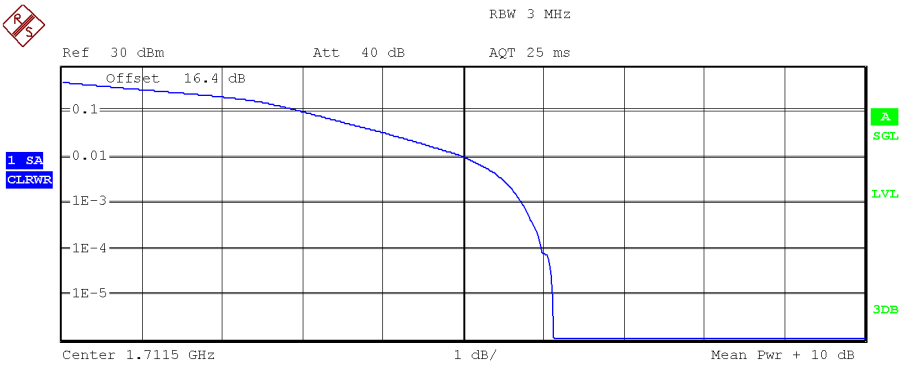


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 3.5MHz

	Trace 1
Mean	22.84 dBm
Peak	28.78 dBm
Crest	5.94 dB
10 %	2.50 dB
1 %	4.50 dB
.1 %	5.32 dB
.01 %	5.67 dB

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

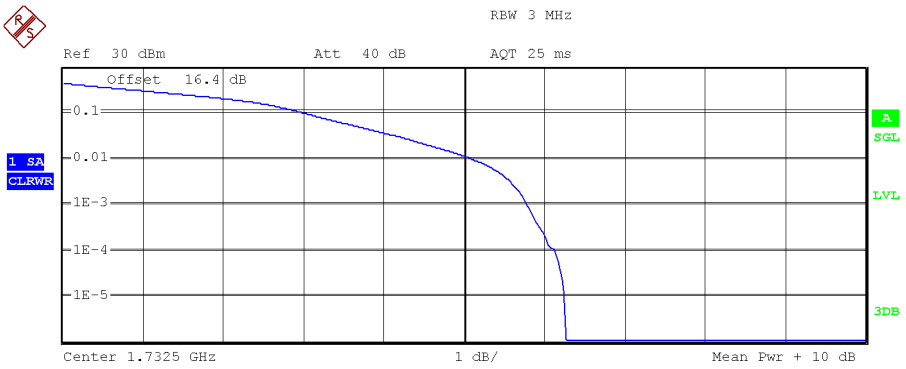
Channel Low:



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

	Trace 1
Mean	22.24 dBm
Peak	28.36 dBm
Crest	6.12 dB
10 %	3.00 dB
1 %	5.02 dB
.1 %	5.74 dB
.01 %	5.98 dB

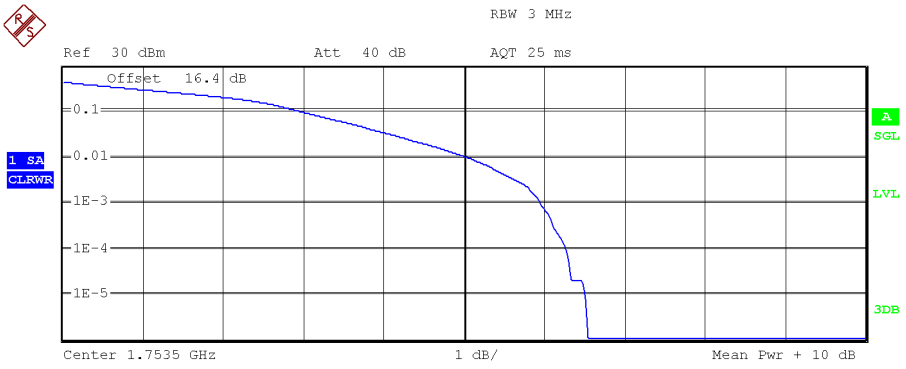
Channel Middle:



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

	Trace 1
Mean	21.96 dBm
Peak	28.22 dBm
Crest	6.26 dB
10 %	3.00 dB
1 %	5.10 dB
.1 %	5.79 dB
.01 %	6.12 dB

Channel High:

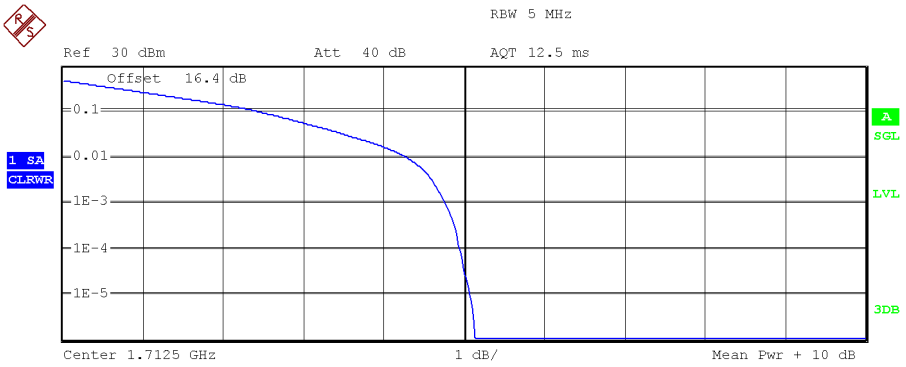


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 3.5MHz

	Trace 1
Mean	22.39 dBm
Peak	28.93 dBm
Crest	6.54 dB
10 %	2.98 dB
1 %	5.03 dB
.1 %	5.96 dB
.01 %	6.28 dB

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

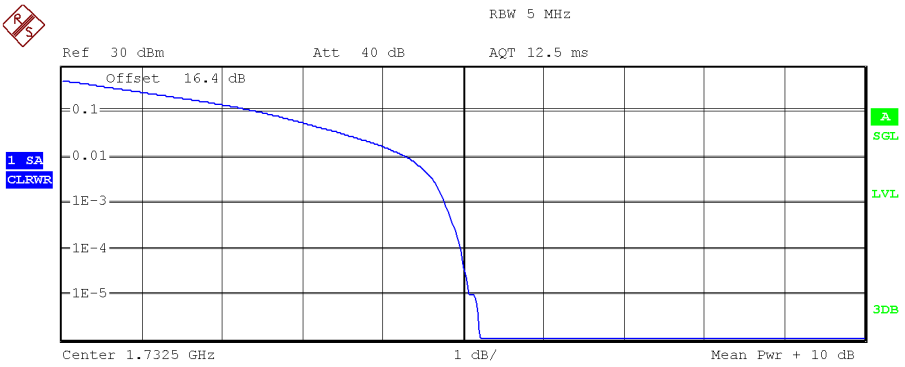
Channel Low:



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

	Trace 1
Mean	23.15 dBm
Peak	28.29 dBm
Crest	5.14 dB
10 %	2.44 dB
1 %	4.28 dB
.1 %	4.78 dB
.01 %	4.95 dB

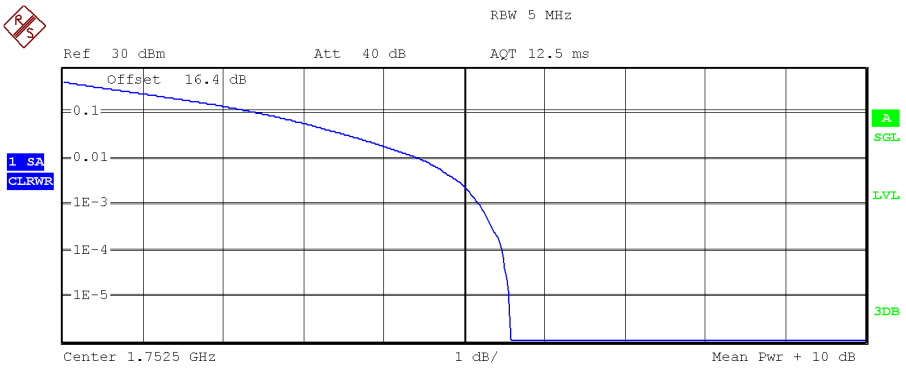
Channel Middle:



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

	Trace 1
Mean	22.87 dBm
Peak	28.08 dBm
Crest	5.21 dB
10 %	2.45 dB
1 %	4.31 dB
.1 %	4.78 dB
.01 %	4.97 dB

Channel High:

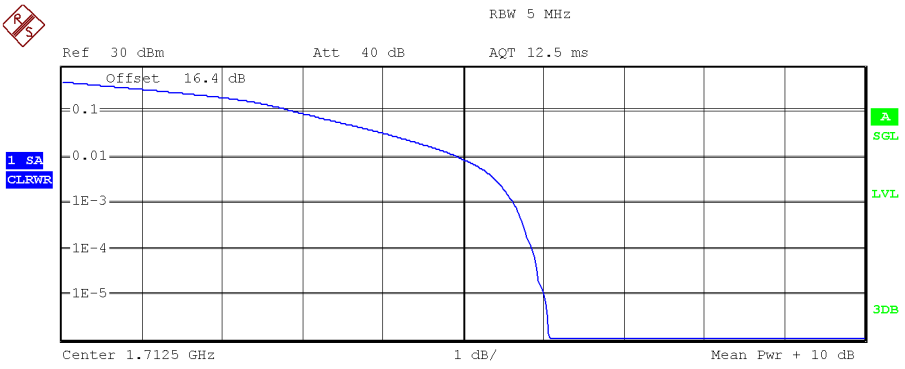


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 7.1MHz

	Trace 1
Mean	22.79 dBm
Peak	28.36 dBm
Crest	5.57 dB
10 %	2.44 dB
1 %	4.44 dB
.1 %	5.19 dB
.01 %	5.48 dB

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

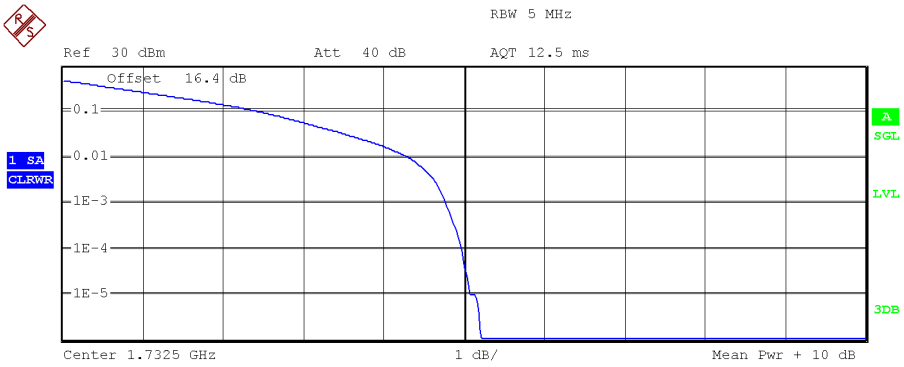
Channel Low:



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

	Trace 1
Mean	22.22 dBm
Peak	28.29 dBm
Crest	6.07 dB
10 %	2.90 dB
1 %	4.94 dB
.1 %	5.63 dB
.01 %	5.87 dB

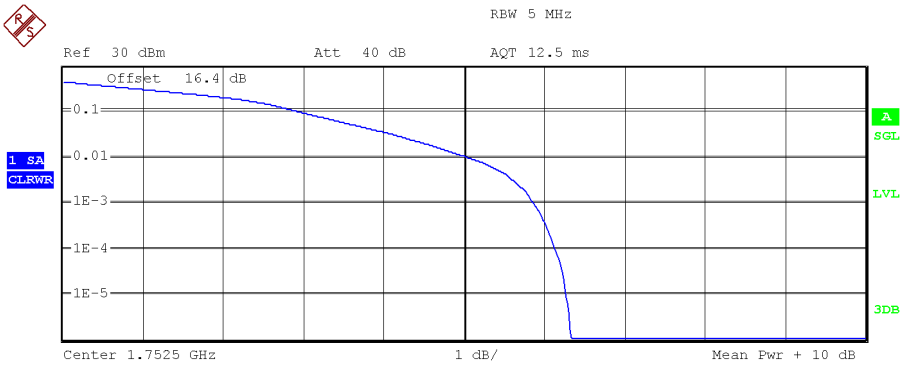
Channel Middle:



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

	Trace 1
Mean	22.87 dBm
Peak	28.08 dBm
Crest	5.21 dB
10 %	2.45 dB
1 %	4.31 dB
.1 %	4.78 dB
.01 %	4.97 dB

Channel High:

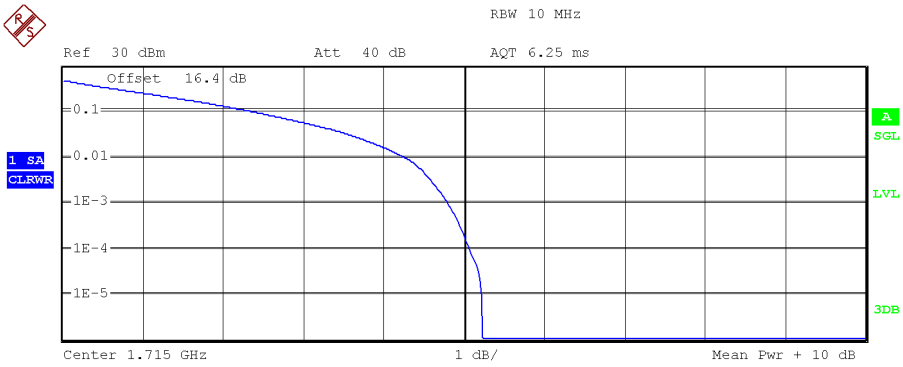


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 7.1MHz

	Trace 1
Mean	22.52 dBm
Peak	28.85 dBm
Crest	6.33 dB
10 %	2.93 dB
1 %	5.05 dB
.1 %	5.87 dB
.01 %	6.14 dB

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

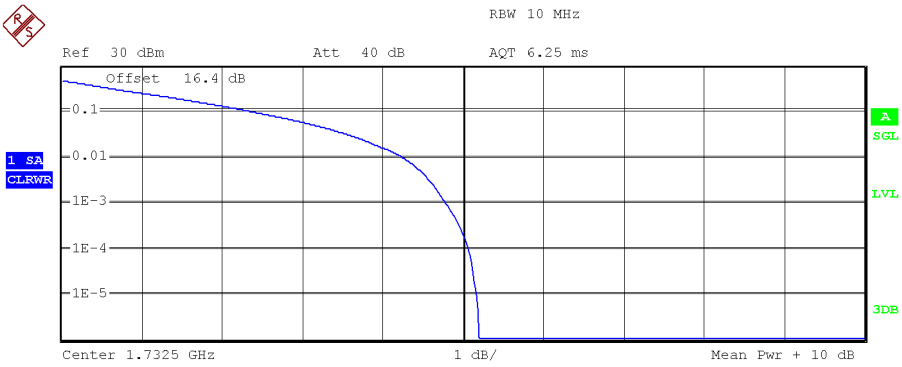
Channel Low:



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

	Trace 1
Mean	23.52 dBm
Peak	28.76 dBm
Crest	5.23 dB
10 %	2.37 dB
1 %	4.26 dB
.1 %	4.79 dB
.01 %	5.08 dB

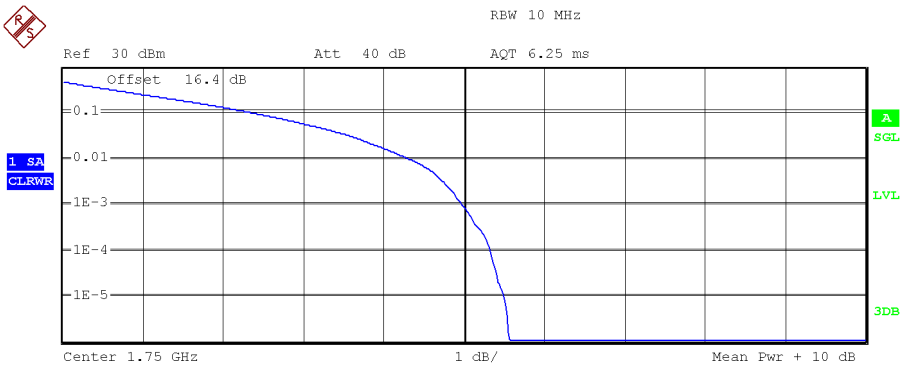
Channel Middle:



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

	Trace 1
Mean	23.32 dBm
Peak	28.52 dBm
Crest	5.20 dB
10 %	2.39 dB
1 %	4.25 dB
.1 %	4.79 dB
.01 %	5.06 dB

Channel High:

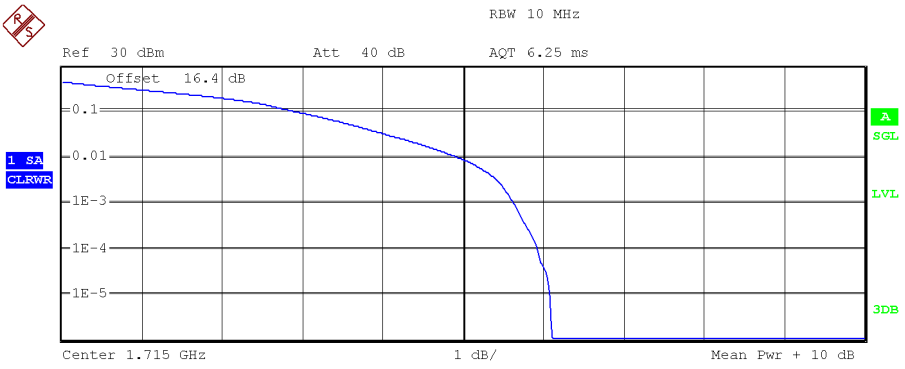


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 11.2MHz

	Trace 1
Mean	23.82 dBm
Peak	29.39 dBm
Crest	5.56 dB
10 %	2.37 dB
1 %	4.31 dB
.1 %	4.97 dB
.01 %	5.34 dB

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

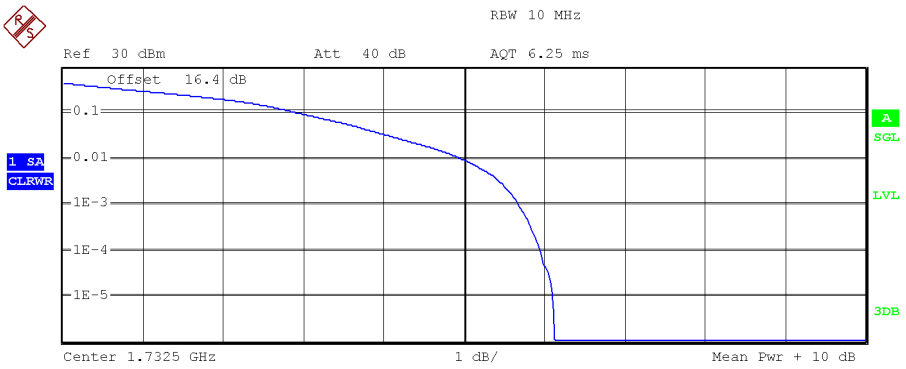
Channel Low:



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

	Trace 1
Mean	22.58 dBm
Peak	28.69 dBm
Crest	6.10 dB
10 %	2.92 dB
1 %	4.94 dB
.1 %	5.63 dB
.01 %	5.93 dB

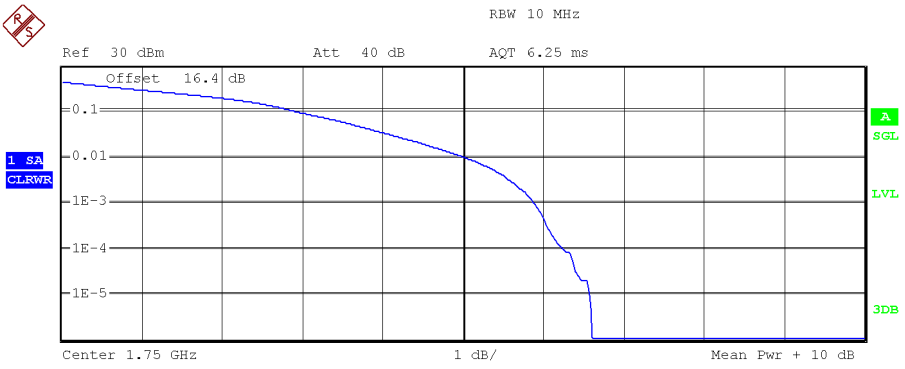
Channel Middle:



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

	Trace 1
Mean	22.39 dBm
Peak	28.52 dBm
Crest	6.12 dB
10 %	2.93 dB
1 %	4.97 dB
.1 %	5.69 dB
.01 %	5.95 dB

Channel High:

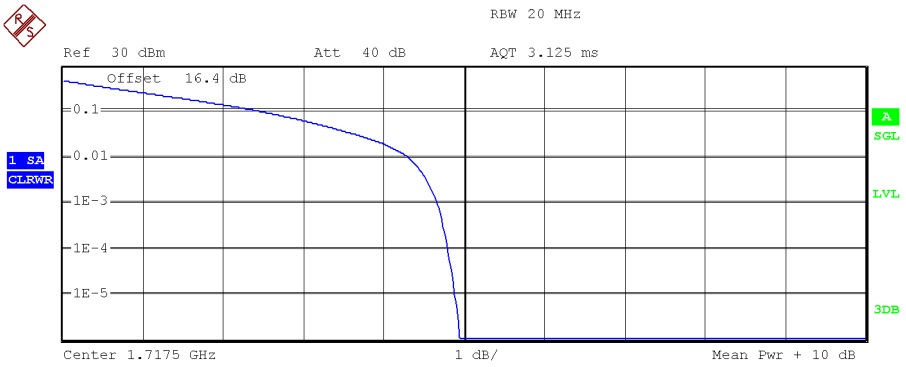


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 11.2MHz

	Trace 1
Mean	22.78 dBm
Peak	29.39 dBm
Crest	6.61 dB
10 %	2.93 dB
1 %	5.02 dB
.1 %	5.88 dB
.01 %	6.25 dB

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

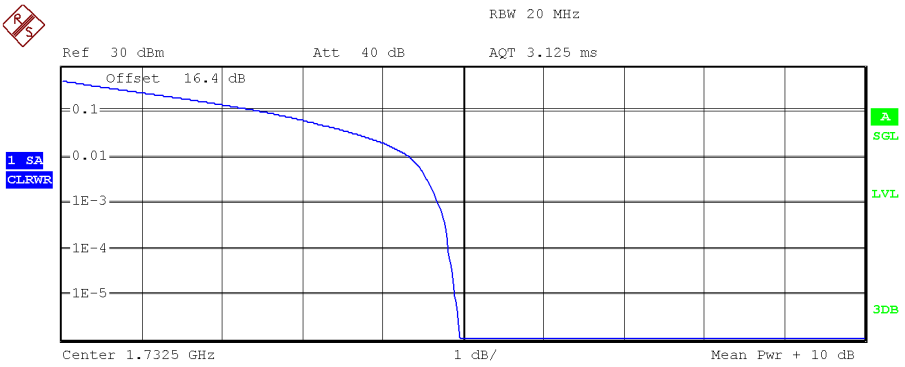
Channel Low:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	23.33 dBm
Peak	28.28 dBm
Crest	4.95 dB
10 %	2.48 dB
1 %	4.31 dB
.1 %	4.66 dB
.01 %	4.81 dB

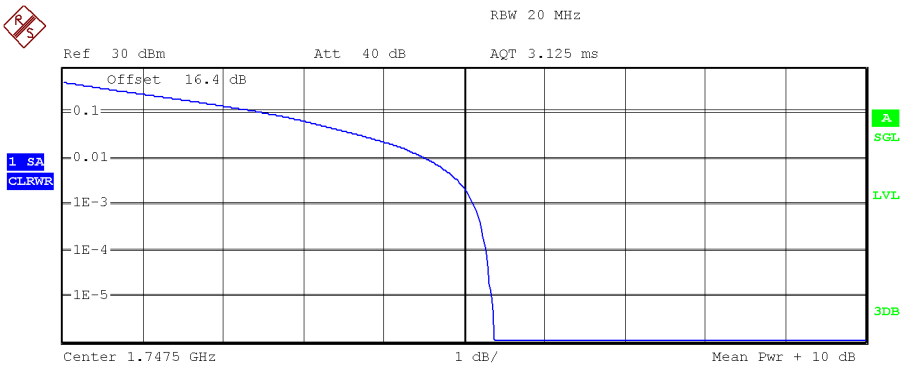
Channel Middle:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	23.23 dBm
Peak	28.18 dBm
Crest	4.96 dB
10 %	2.52 dB
1 %	4.33 dB
.1 %	4.70 dB
.01 %	4.82 dB

Channel High:

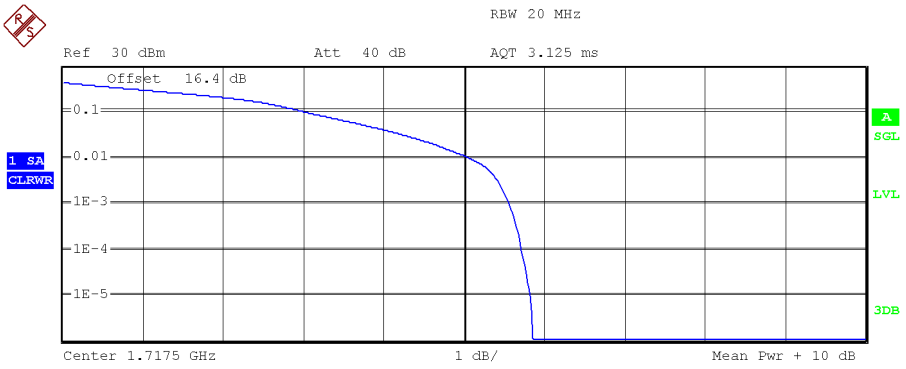


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	23.18 dBm
Peak	28.56 dBm
Crest	5.38 dB
10 %	2.52 dB
1 %	4.54 dB
.1 %	5.13 dB
.01 %	5.27 dB

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

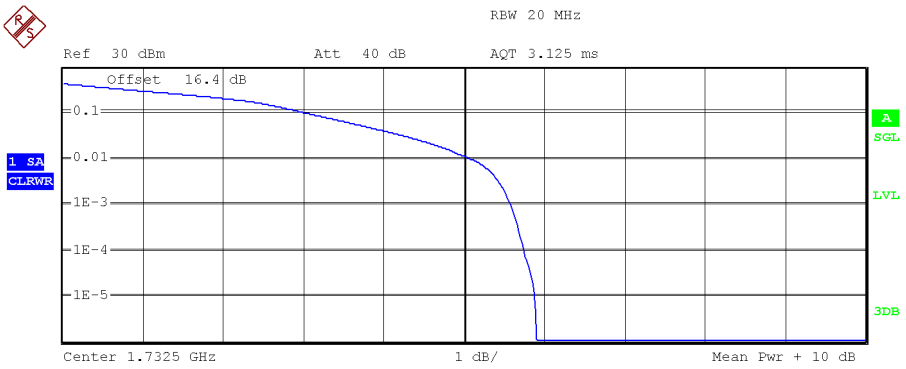
Channel Low:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	22.35 dBm
Peak	28.21 dBm
Crest	5.86 dB
10 %	3.03 dB
1 %	5.06 dB
.1 %	5.56 dB
.01 %	5.72 dB

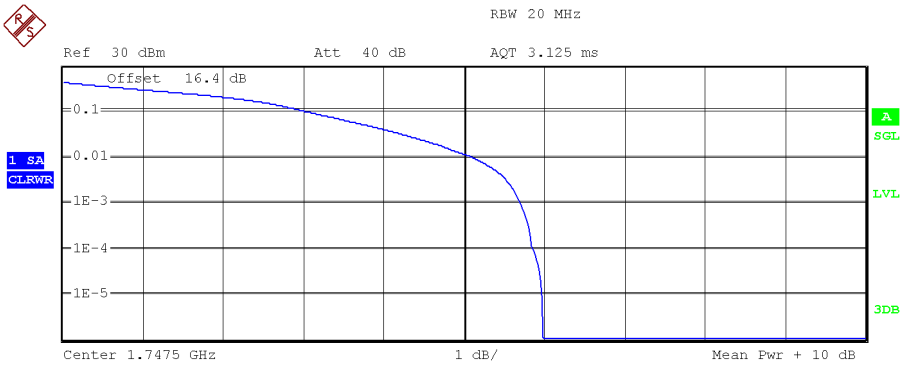
Channel Middle:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	22.28 dBm
Peak	28.18 dBm
Crest	5.90 dB
10 %	3.03 dB
1 %	5.08 dB
.1 %	5.58 dB
.01 %	5.75 dB

Channel High:

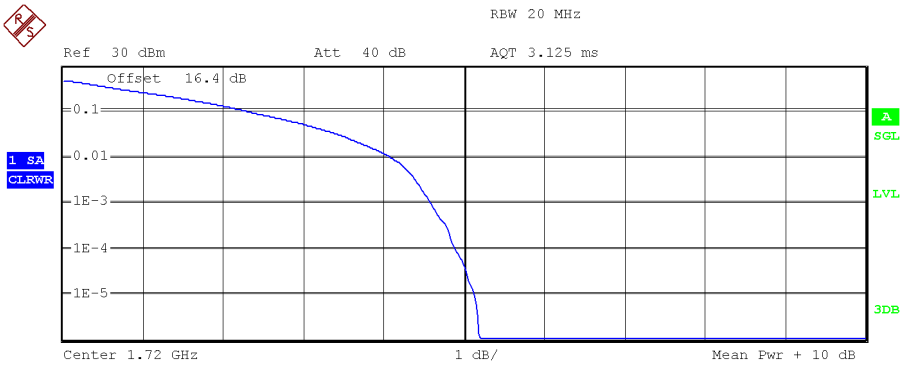


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	22.79 dBm
Peak	28.77 dBm
Crest	5.98 dB
10 %	3.04 dB
1 %	5.10 dB
.1 %	5.71 dB
.01 %	5.87 dB

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

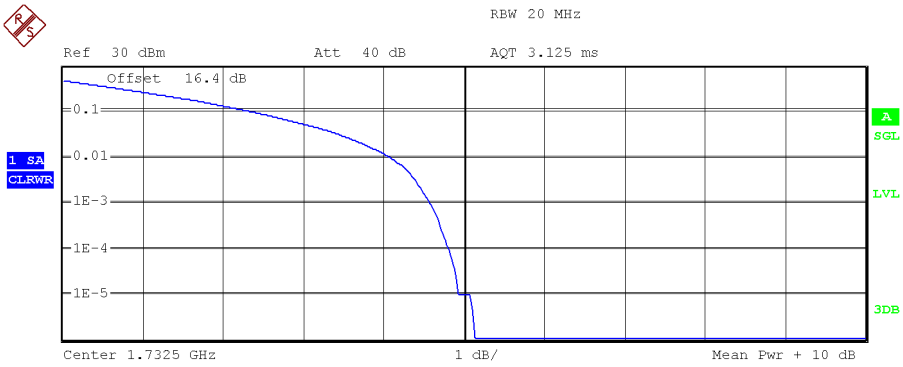
Channel Low:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	23.22 dBm
Peak	28.41 dBm
Crest	5.19 dB
10 %	2.32 dB
1 %	4.09 dB
.1 %	4.58 dB
.01 %	4.89 dB

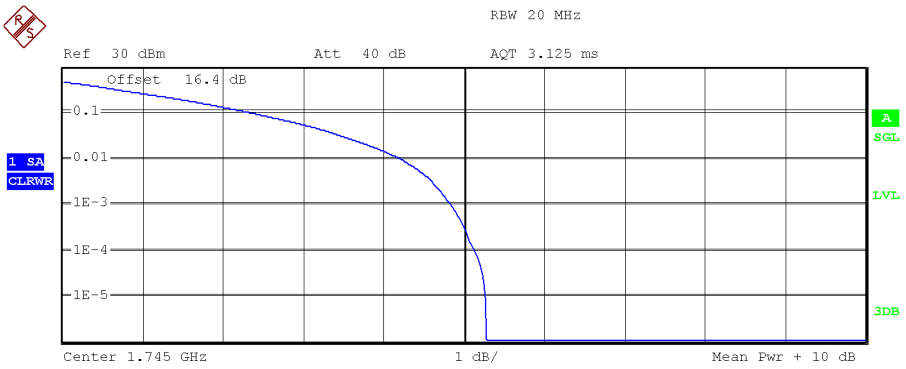
Channel Middle:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	23.19 dBm
Peak	28.33 dBm
Crest	5.14 dB
10 %	2.36 dB
1 %	4.07 dB
.1 %	4.57 dB
.01 %	4.81 dB

Channel High:

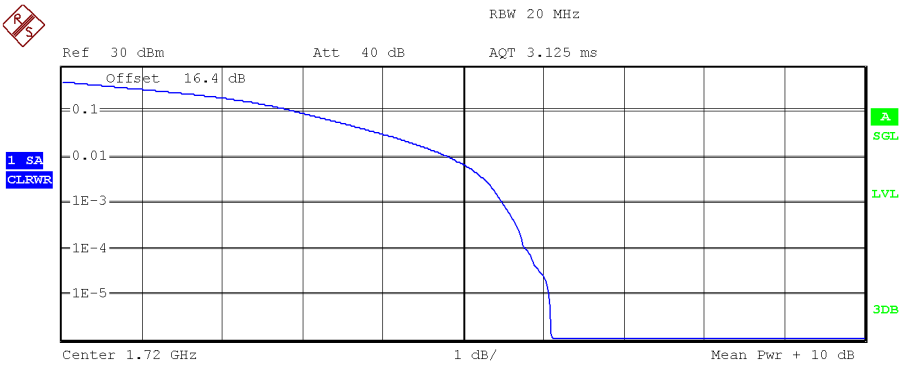


Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	23.13 dBm
Peak	28.41 dBm
Crest	5.28 dB
10 %	2.36 dB
1 %	4.20 dB
.1 %	4.84 dB
.01 %	5.13 dB

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

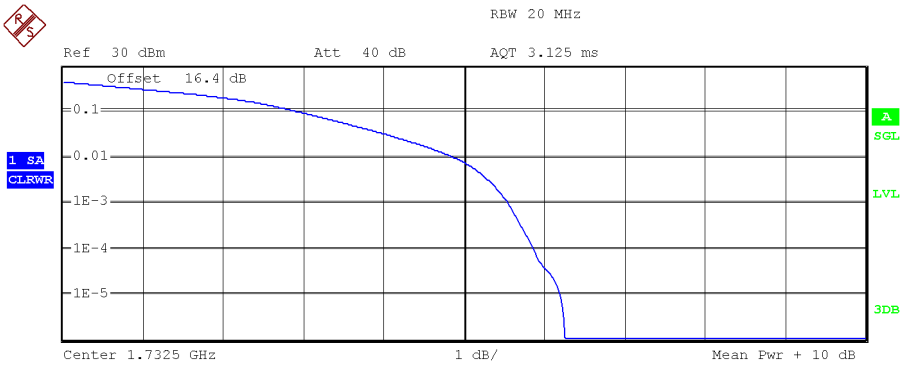
Channel Low:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	22.24 dBm
Peak	28.34 dBm
Crest	6.10 dB
10 %	2.92 dB
1 %	4.82 dB
.1 %	5.50 dB
.01 %	5.79 dB

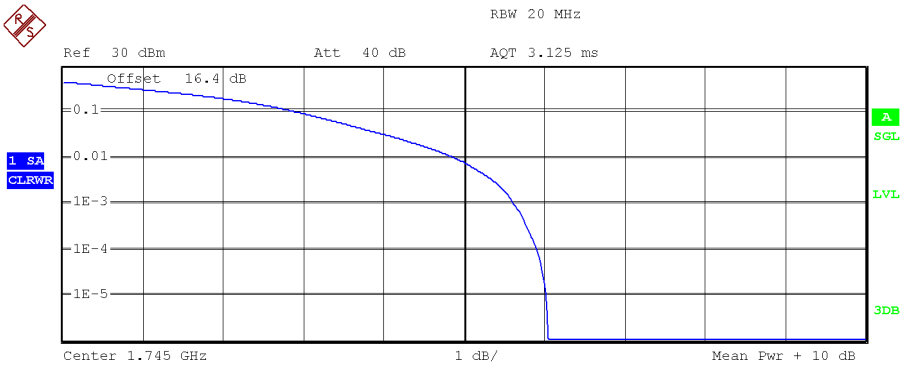
Channel Middle:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	22.21 dBm
Peak	28.47 dBm
Crest	6.26 dB
10 %	2.93 dB
1 %	4.87 dB
.1 %	5.54 dB
.01 %	5.87 dB

Channel High:



Complementary Cumulative Distribution Function
NOF samples: 100000, Usable BW: 23.7MHz

	Trace 1
Mean	22.65 dBm
Peak	28.69 dBm
Crest	6.04 dB
10 %	2.92 dB
1 %	4.87 dB
.1 %	5.63 dB
.01 %	5.91 dB

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

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.30	2.30	2.30
Measured maximum average power (dBm) at antenna port	23.00	23.08	23.00
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	25.30	25.38	25.30
Peak-to-average ratio (PAR) (dB)	5.48	5.45	5.85
Measurement uncertainty (dB)	<±1.11		

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

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.30	2.30	2.30
Measured maximum average power (dBm) at antenna port	22.97	23.99	23.01
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	25.27	26.29	25.31
Peak-to-average ratio (PAR) (dB)	5.74	5.79	5.96
Measurement uncertainty (dB)	<±1.11		

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

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.30	2.30	2.30
Measured maximum average power (dBm) at antenna port	24.17	23.03	23.07
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.47	25.33	25.37
Peak-to-average ratio (PAR) (dB)	5.63	5.66	5.87
Measurement uncertainty (dB)	<±1.11		

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

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.30	2.30	2.30
Measured maximum average power (dBm) at antenna port	24.22	24.08	23.03
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.52	26.38	25.33
Peak-to-average ratio (PAR) (dB)	5.63	5.69	5.88
Measurement uncertainty (dB)	<±1.11		

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

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.30	2.30	2.30
Measured maximum average power (dBm) at antenna port	24.09	23.09	23.08
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.39	25.39	25.38
Peak-to-average ratio (PAR) (dB)	5.56	5.58	5.71
Measurement uncertainty (dB)	<±1.11		

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

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.30	2.30	2.30
Measured maximum average power (dBm) at antenna port	24.06	22.98	23.01
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.36	25.28	25.31
Peak-to-average ratio (PAR) (dB)	5.50	5.54	5.63
Measurement uncertainty (dB)	<±1.11		

Verdict: PASS

Modulation Characteristics

SPECIFICATION

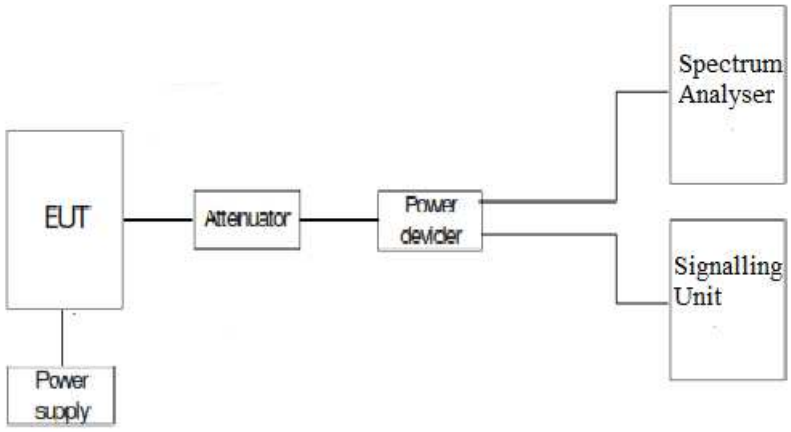
FCC §2.1047.

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.

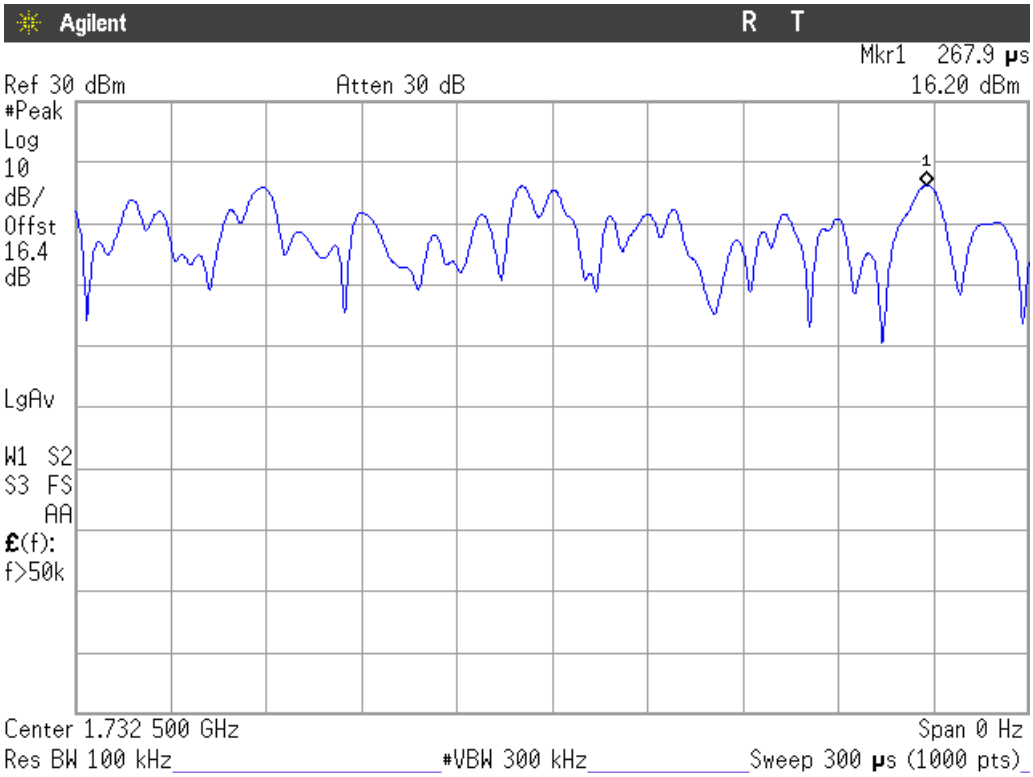
TEST SETUP



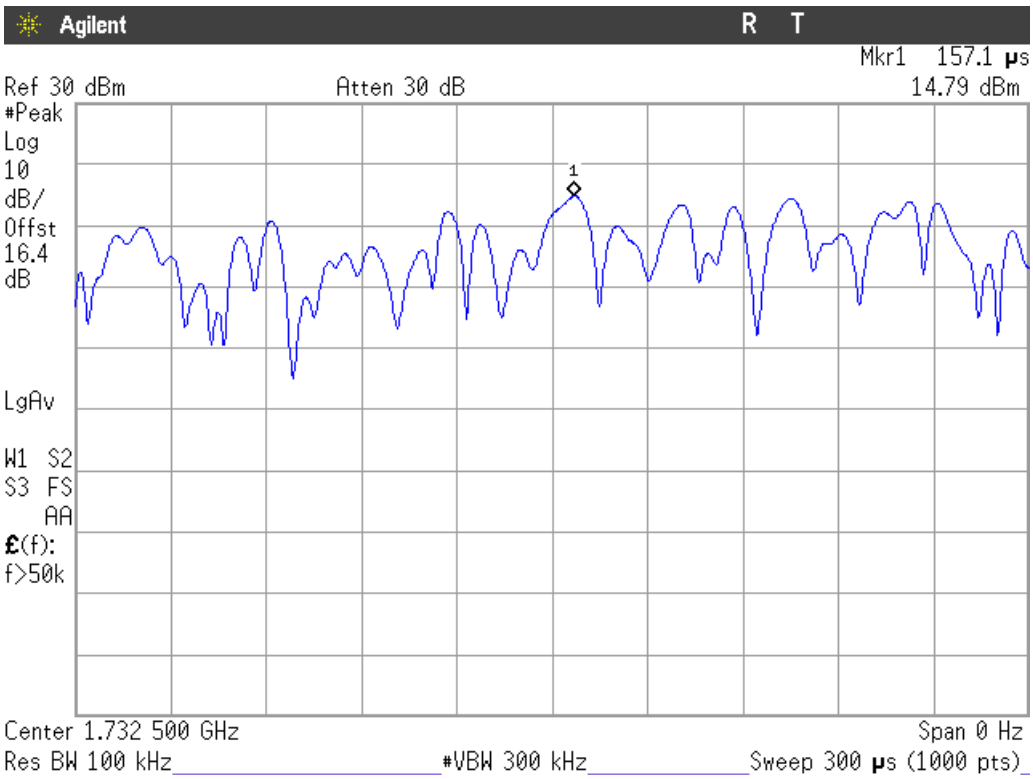
RESULTS

The following plots show the modulation schemes in the EUT.

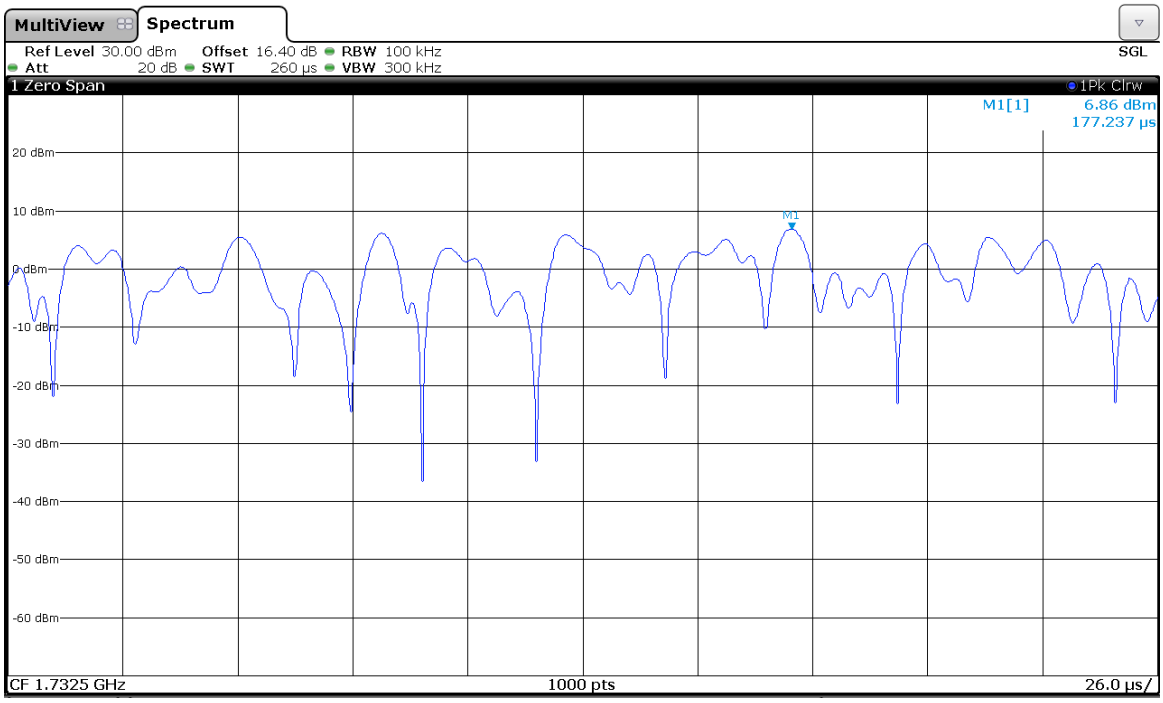
WCDMA MODULATION



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 –30ºC to +50ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from –30ºC up to +50ºC.

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.

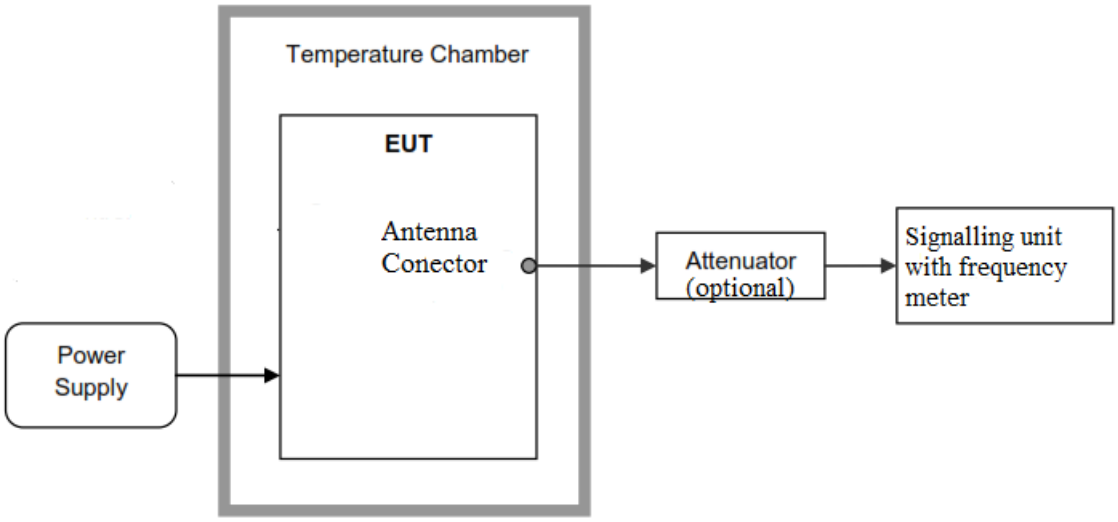
For LTE mode the QPSK modulation was used for the test as it is the worst case for conducted power.

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

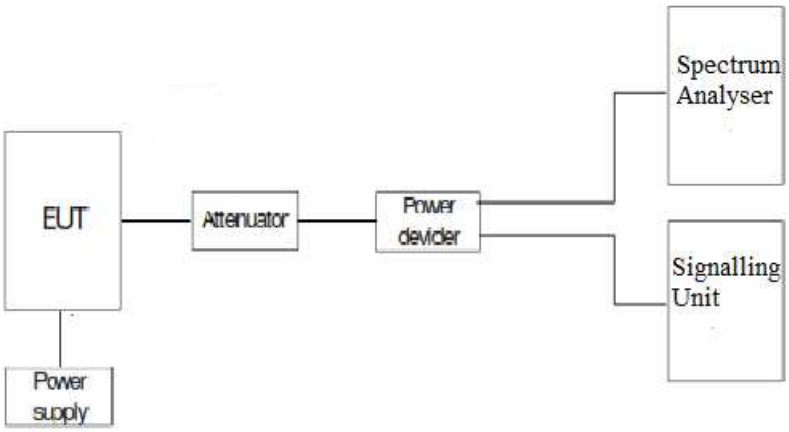
In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation are identified as *f*L and *fH* respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of *f*L and *fH* to check that the resulting frequencies remain within the band.
The reference point measurements were made at the RF output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP

Frequency tolerance.



Reference points *f*L and *fH*.



RESULTS

Frequency stability over temperature variations.

WCDMA AND HSUPA MODULATION

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	-5.61	-0.003238095	-0.00000032
+40	-7.49	-0.004323232	-0.00000043
+30	4.41	0.002545455	0.00000025
+20	6.22	0.003590188	0.00000036
+10	5.41	0.003122655	0.00000031
0	5.32	0.003070707	0.00000031
-10	-6.51	-0.003757576	0.00000037
-20	7.37	0.004253968	0.00000042
-30	7.07	0.004080808	0.00000040

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	6.22	0.003590188	0.00000036
Vmin	3.60	5.66	0.003266955	0.00000033

Reference points established at the applicable unwanted emissions limit:

	WCDMA MODULATION	HSUPA MODULATION
*f*L (MHz)	1710.0628	1710.0683
fH (MHz)	1753.2610	1753.4930

Reference points *f*L and *fH* with the worst-case frequency offsets added or subtracted:

	WCDMA MODULATION	HSUPA MODULATION
*f*L (MHz)	1710.0628	1710.0683
fH (MHz)	1753.2610	1753.4930

The reference frequency points stay within the authorized blocks.

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

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	8.57	0.004946609	0.00000049
+40	9.44	0.005448773	0.00000054
+30	8.64	0.004987013	0.00000050
+20	8.38	0.004836941	0.00000048
+10	9.26	0.005344877	0.00000053
0	9.80	0.005656566	0.00000057
-10	11.09	0.006401154	0.00000064
-20	11.49	0.006632035	0.00000066
-30	9.53	0.005500722	0.00000055

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

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	8.14	0.004698413	0.00000047
+40	-7.57	-0.004369408	-0.00000043
+30	8.58	0.004952381	0.00000049
+20	8.81	0.005085137	0.00000051
+10	10.81	0.006239538	0.00000062
0	8.04	0.004640693	0.00000046
-10	10.96	0.006326118	0.00000063
-20	11.19	0.006458874	0.00000064
-30	8.87	0.005119769	0.00000052

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

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	9.3	0.005367965	0.00000053
+40	8.33	0.004808081	0.00000048
+30	10.01	0.005777778	0.00000058
+20	7.72	0.004455988	0.00000044
+10	8.05	0.004646465	0.00000046
0	8.24	0.004756133	0.00000047
-10	10.11	0.005835498	0.00000058
-20	10.39	0.005997114	0.00000060
-30	8.54	0.004929293	0.00000049

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

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	-9.61	-0.005546898	-0.00000055
+40	11.06	0.006383838	0.00000064
+30	8.71	0.005027417	0.00000050
+20	8.47	0.004888889	0.00000049
+10	8.53	0.004923521	0.00000049
0	9.86	0.005691198	0.00000057
-10	7.42	0.004282828	0.00000043
-20	10.69	0.006170274	0.00000061
-30	6.94	0.004005772	0.00000040

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

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	6.78	0.00391342	0.00000039
+40	6.08	0.00350938	0.00000035
+30	9.04	0.005217893	0.00000052
+20	7.90	0.004559885	0.00000046
+10	8.50	0.004906205	0.00000049
0	8.68	0.005010101	0.00000050
-10	9.46	0.005460317	0.00000054
-20	10.79	0.006227994	0.00000062
-30	8.15	0.004704185	0.00000047

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

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	10.91	0.006297258	0.00000063
+40	7.08	0.00408658	0.00000041
+30	9.11	0.005258297	0.00000052
+20	7.00	0.004040404	0.00000040
+10	7.42	0.004282828	0.00000043
0	7.94	0.004582973	0.00000046
-10	8.20	0.004733045	0.00000047
-20	8.73	0.005038961	0.00000050
-30	8.38	0.004836941	0.00000048

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	4.2	8.38	0.004836941	0.00000048
Vmin	3.6	8.40	0.004848485	0.00000048

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

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	8.81	0.005085137	0.00000050
Vmin	3.60	8.93	0.005154401	0.00000051

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

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	7.72	0.004455988	0.00000044
Vmin	3.60	10.01	0.005777778	0.00000057

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

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	8.47	0.004888889	0.00000049
Vmin	3.60	10.01	0.005777778	0.00000058

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

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	7.9	0.004559885	0.00000046
Vmin	3.60	7.93	0.004577201	0.00000045

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

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.20	7.0	0.004040404	0.00000040
Vmin	3.60	8.3	0.004790765	0.00000048

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)	1710.1063	1710.0982	1710.1823	1710.0053	1710.0754	1710.2241
fH (MHz)	1753.3750	1753.5400	1753.6880	1753.2020	1753.2660	1753.5460

Reference points *f*L and *fH* 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)	1710.1063	1710.0982	1710.1823	1710.0053	1710.0754	1710.2241
fH (MHz)	1753.3750	1753.5400	1753.6880	1753.2020	1753.2660	1753.5460

The reference frequency points stay within the authorized blocks.

Verdict: PASS

Occupied Bandwidth

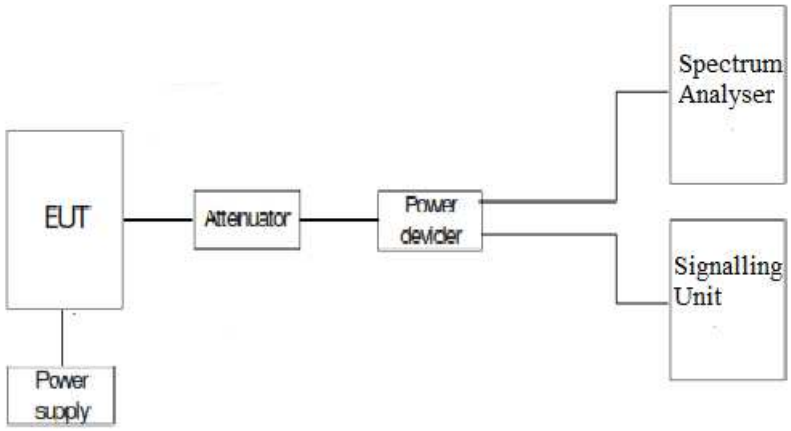
SPECIFICATION

§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)	4159	4171	4154
-26 dBc bandwidth (kHz)	4653	4643	4635
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4172	4152	4166
-26 dBc bandwidth (kHz)	4645	4616	4652
Measurement uncertainty (kHz)	<±16.67		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.108	1.094	1.097
-26 dBc bandwidth (MHz)	1.295	1.307	1.294
Measurement uncertainty (kHz)	<±4.67		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.097	1.100	1.096
-26 dBc bandwidth (MHz)	1.308	1.311	1.302
Measurement uncertainty (kHz)	<±4.67		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.752	2.745	2.744
-26 dBc bandwidth (MHz)	3.058	3.062	3.054
Measurement uncertainty (kHz)	<±10.00		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.751	2.750	2.734
-26 dBc bandwidth (MHz)	3.051	3.083	3.082
Measurement uncertainty (kHz)	<±10.00		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.521	4.536	4.521
-26 dBc bandwidth (MHz)	5.002	5.027	4.988
Measurement uncertainty (kHz)	<±16.67		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.511	4.503	4.506
-26 dBc bandwidth (MHz)	4.983	4.972	4.987
Measurement uncertainty (kHz)	<±16.67		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.057	9.063	9.089
-26 dBc bandwidth (MHz)	10.076	10.130	10.127
Measurement uncertainty (kHz)	<±33.33		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.047	9.054	9.078
-26 dBc bandwidth (MHz)	10.026	10.171	10.036
Measurement uncertainty (kHz)	<±33.33		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.470	13.440	13.430
-26 dBc bandwidth (MHz)	14.718	14.800	14.763
Measurement uncertainty (kHz)	<±50.00		

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

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.462	13.430	13.440
-26 dBc bandwidth (MHz)	14.708	14.751	14.724
Measurement uncertainty (kHz)	<±50.00		

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

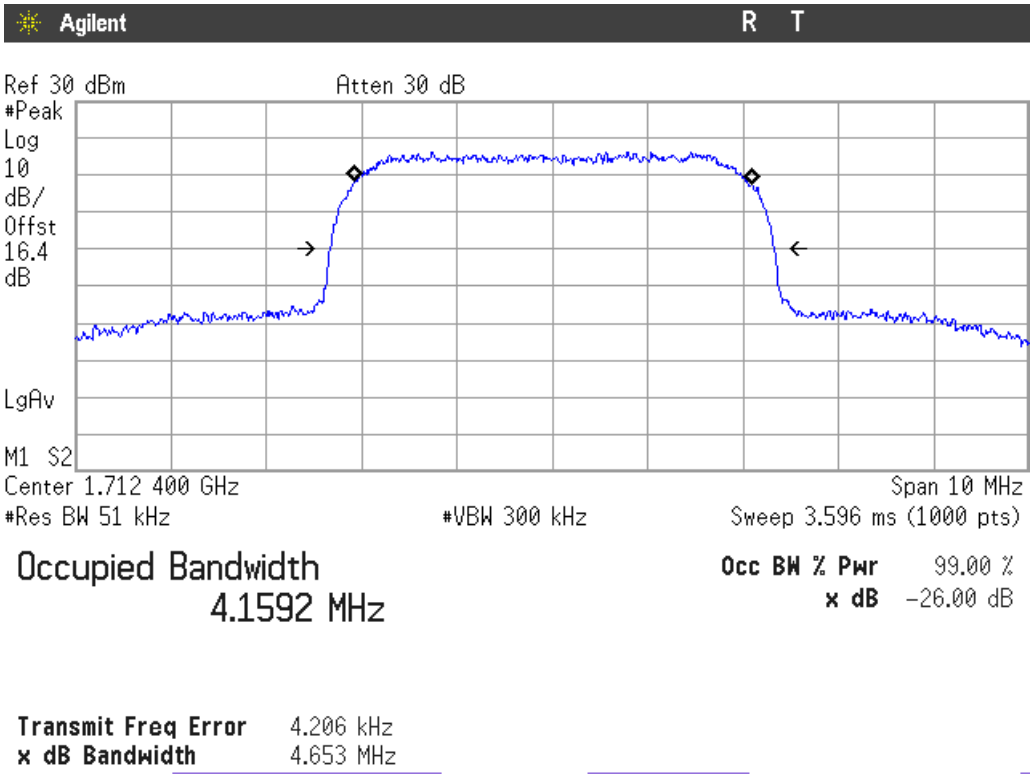
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.833	17.904	17.847
-26 dBc bandwidth (MHz)	19.227	19.352	19.243
Measurement uncertainty (kHz)	<±66.67		

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

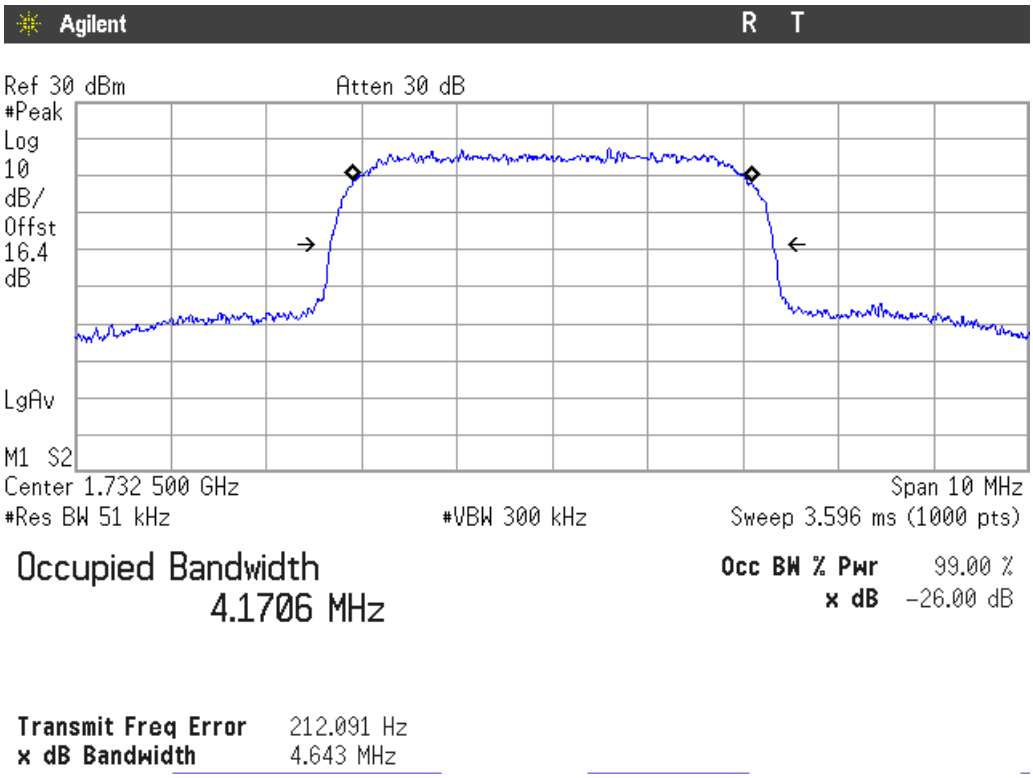
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.844	17.904	17.828
-26 dBc bandwidth (MHz)	19.335	19.443	19.311
Measurement uncertainty (kHz)	<±66.67		

WCDMA MODULATION

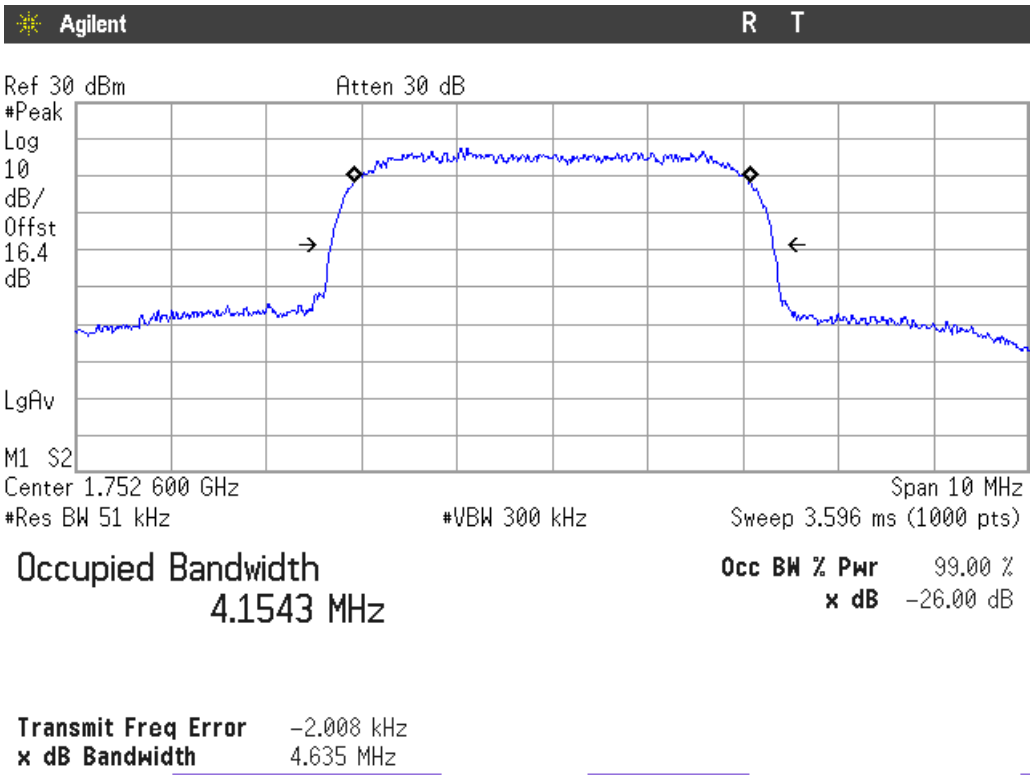
Lowest Channel



Middle Channel

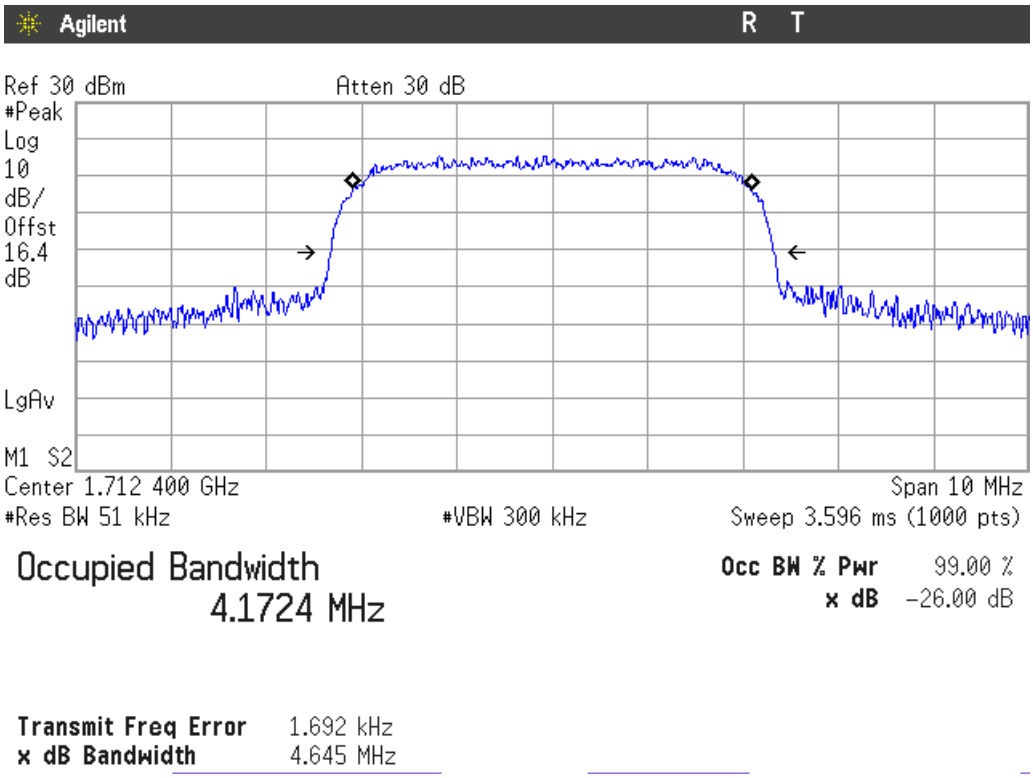


Highest Channel

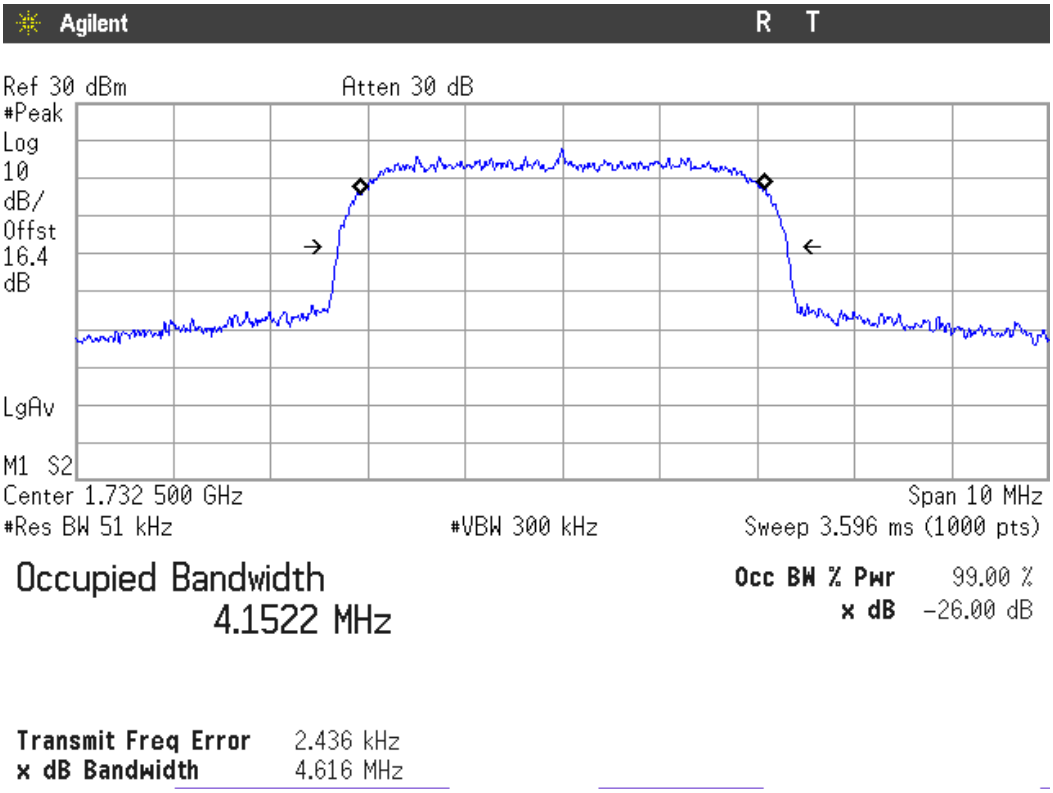


HSUPA MODULATION

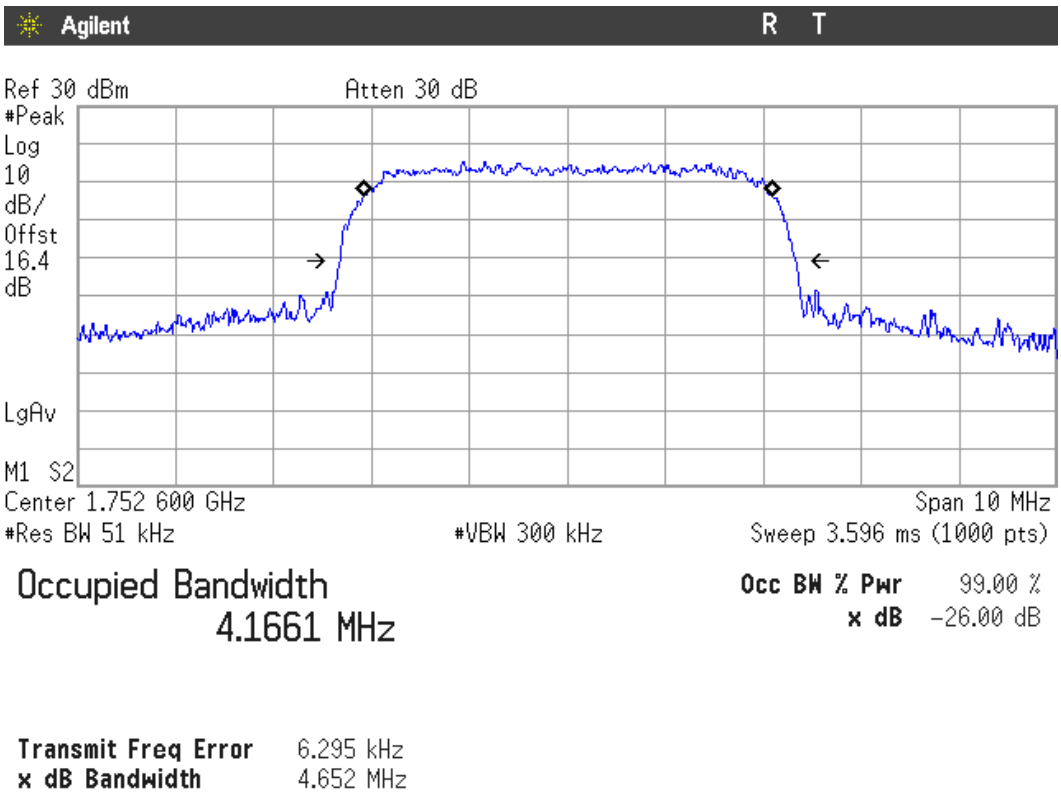
Lowest Channel



Middle Channel

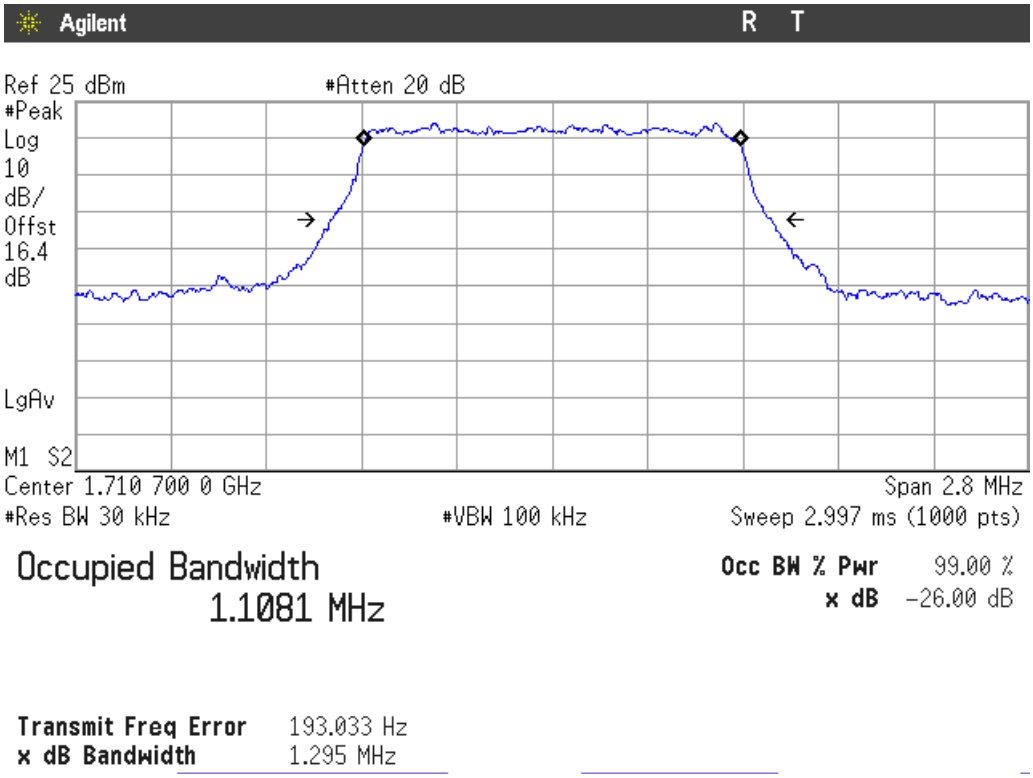


Highest Channel

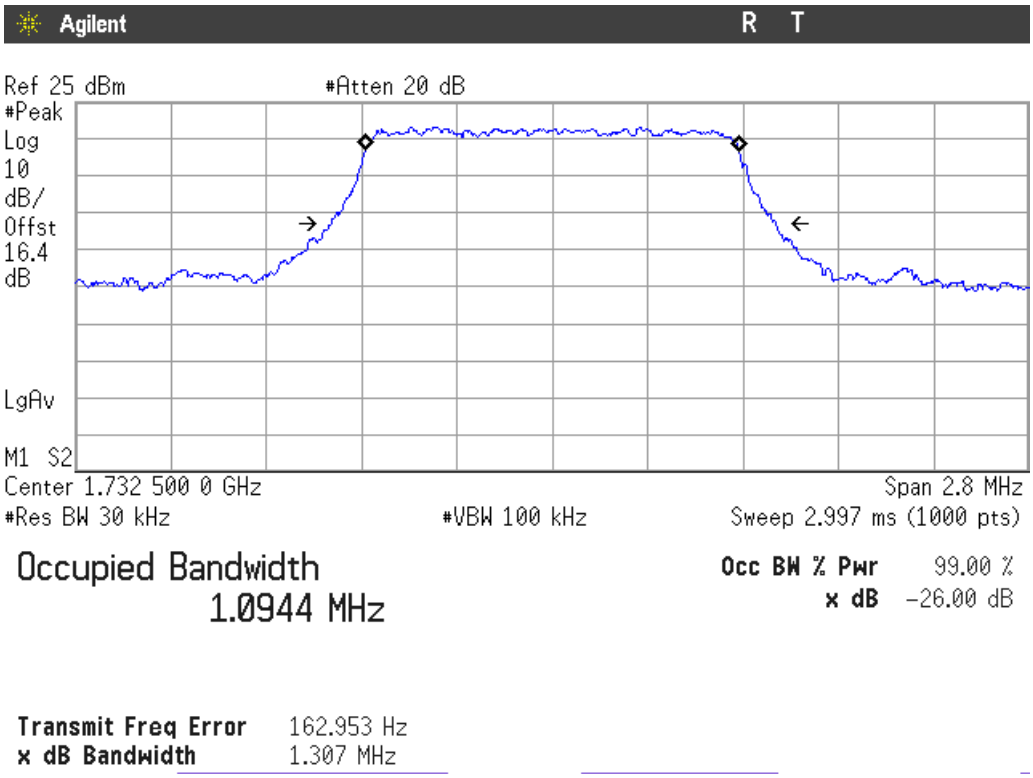


LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)

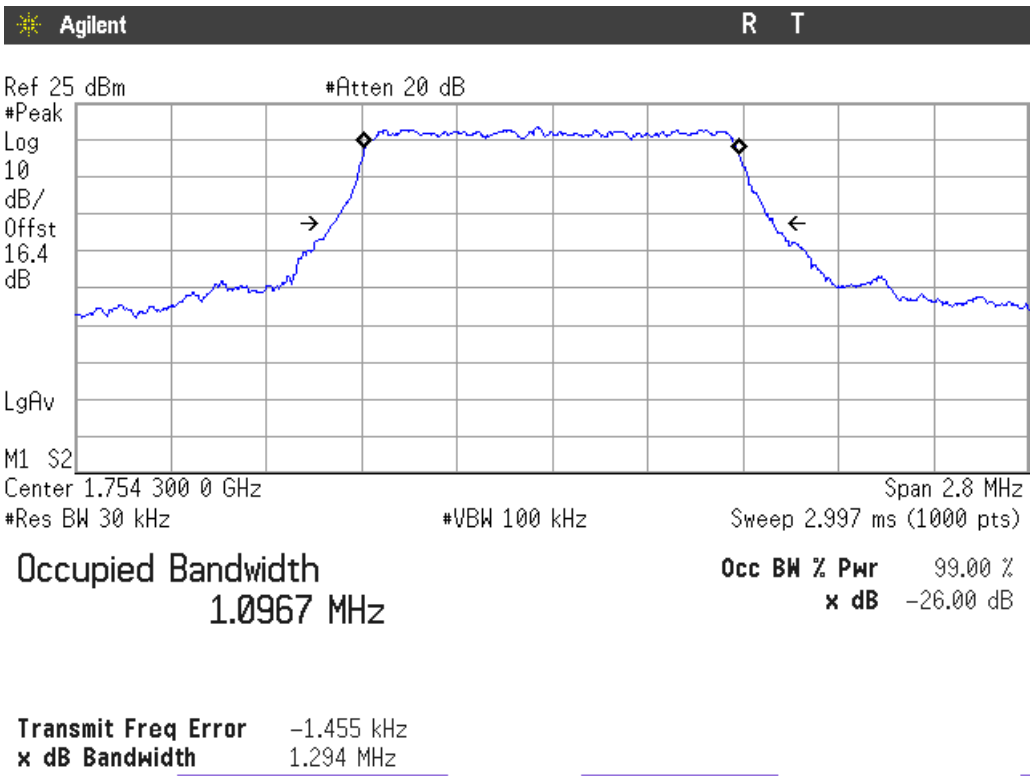
Lowest Channel



Middle Channel

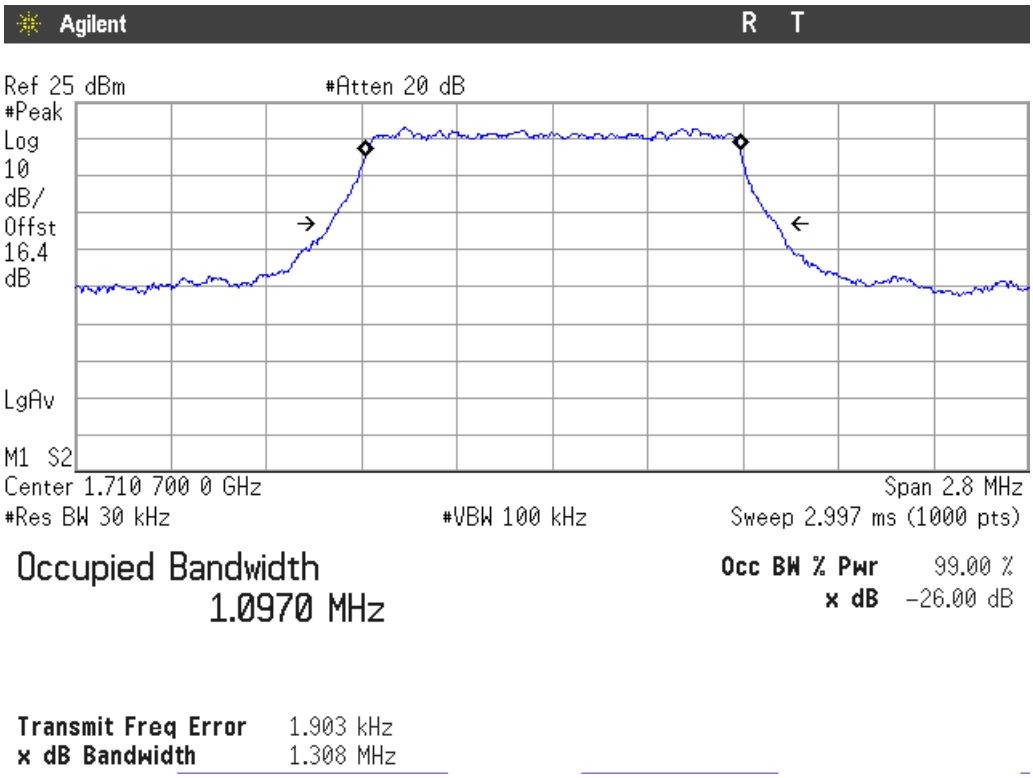


Highest Channel

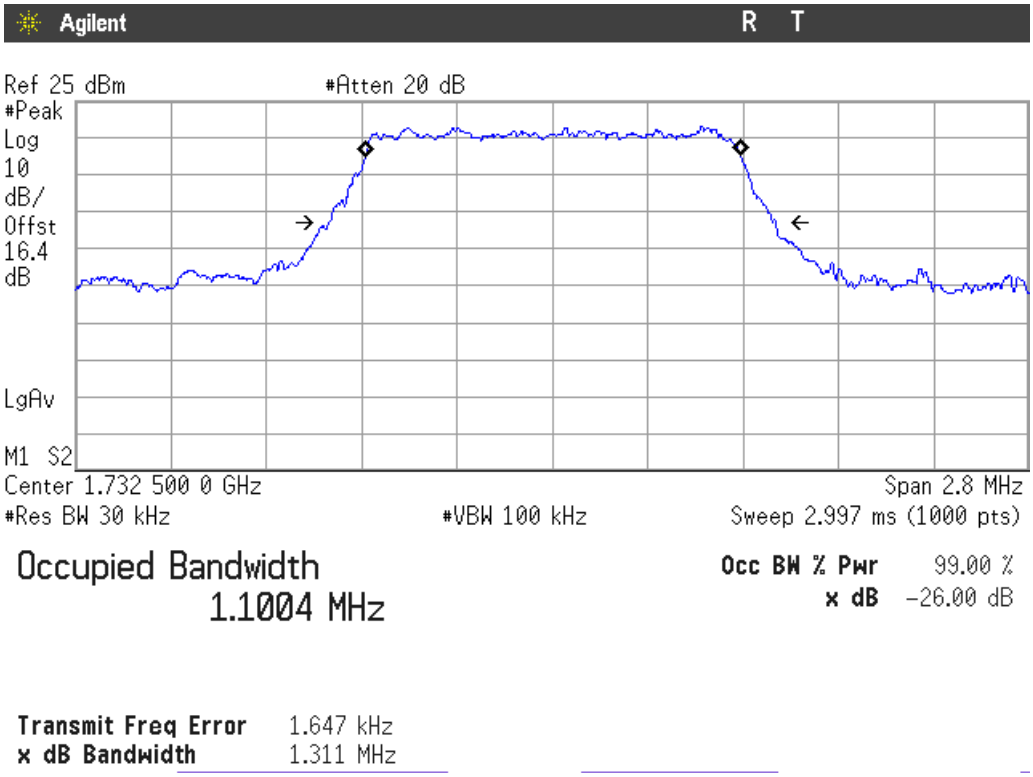


LTE 16QAM MODULATION. BW = 1.4 MHz (Band IV)

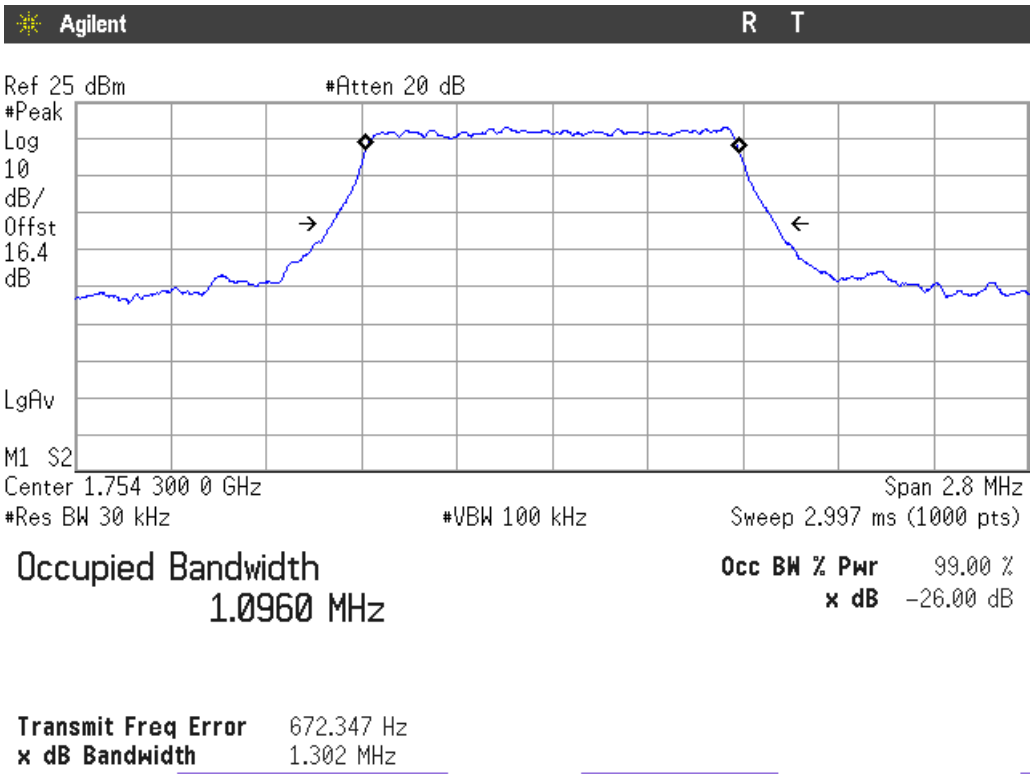
Lowest Channel



Middle Channel

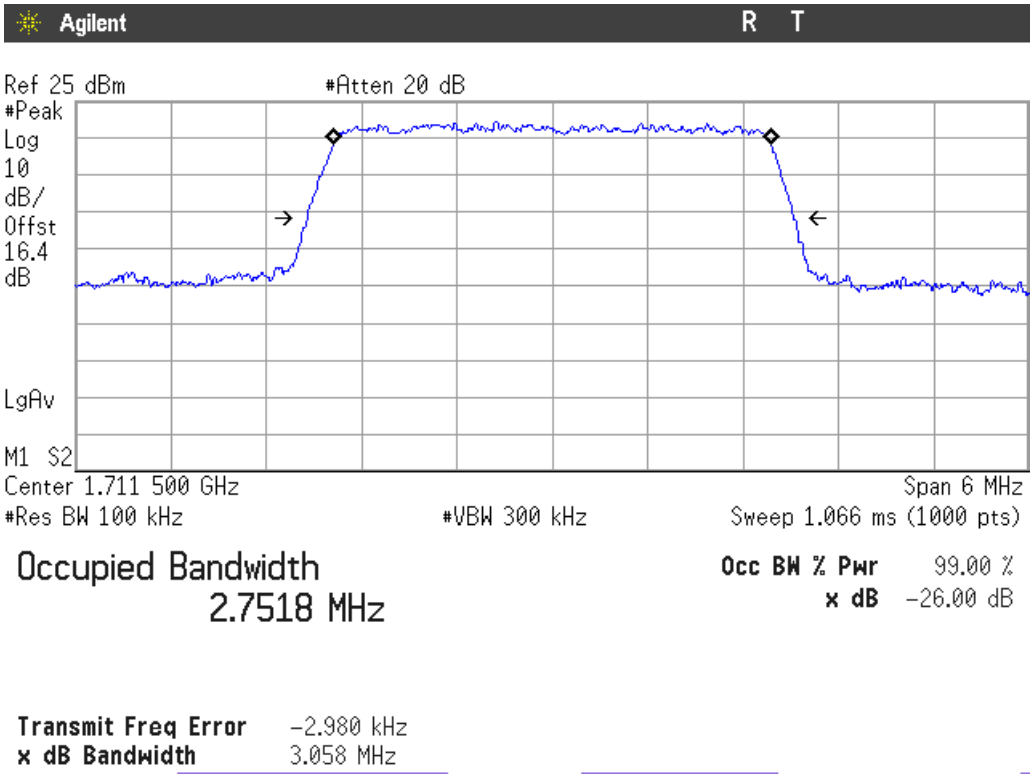


Highest Channel

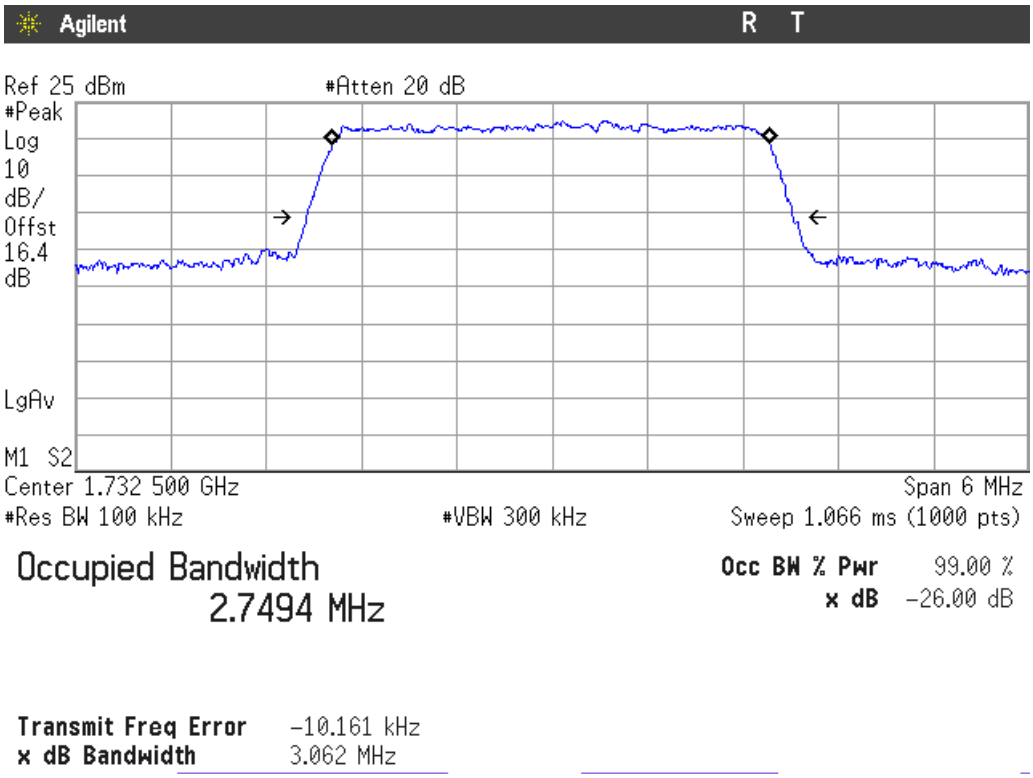


LTE QPSK MODULATION. BW = 3 MHz (Band IV)

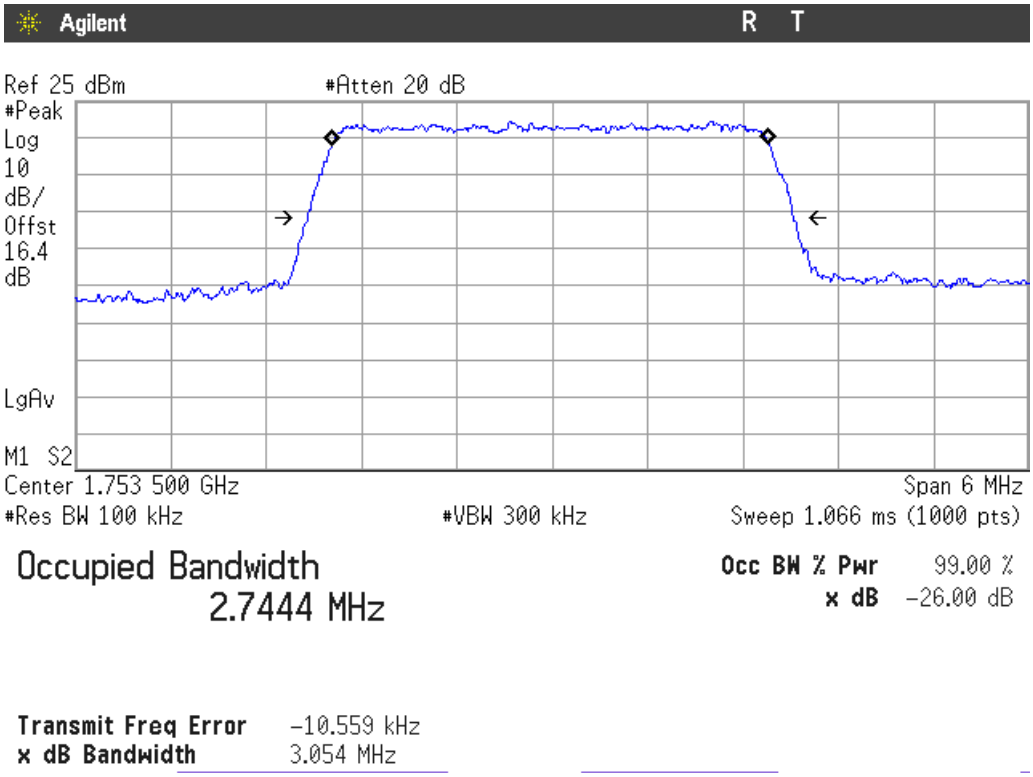
Lowest Channel



Middle Channel

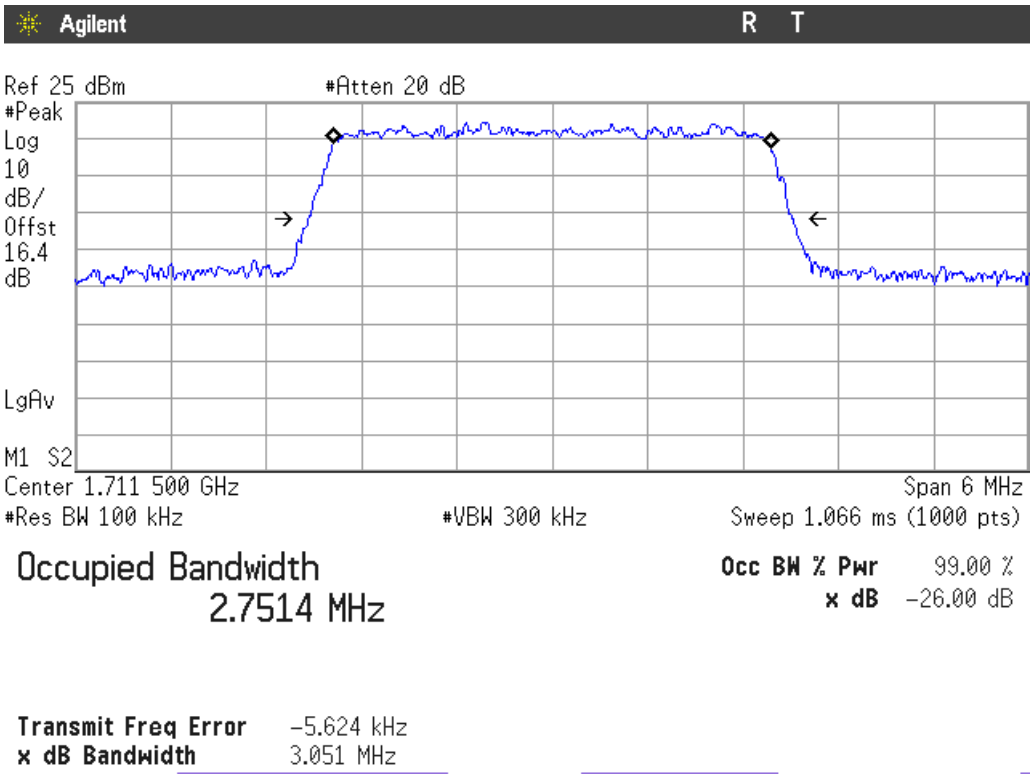


Highest Channel

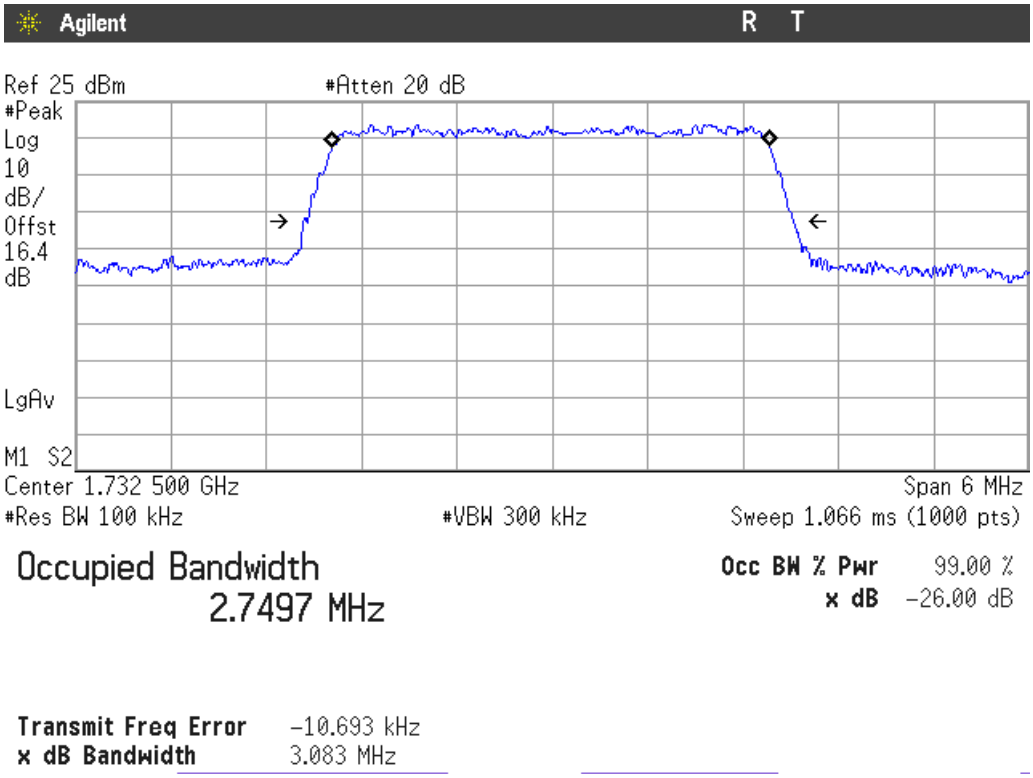


LTE 16QAM MODULATION. BW = 3 MHz (Band IV)

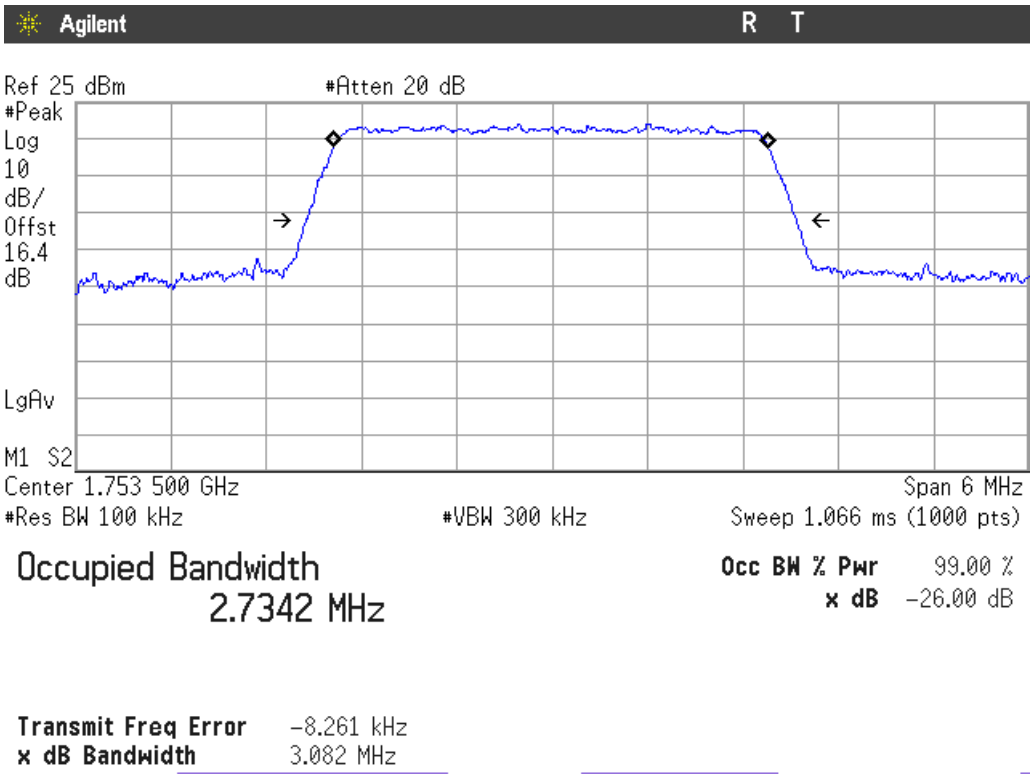
Lowest Channel



Middle Channel

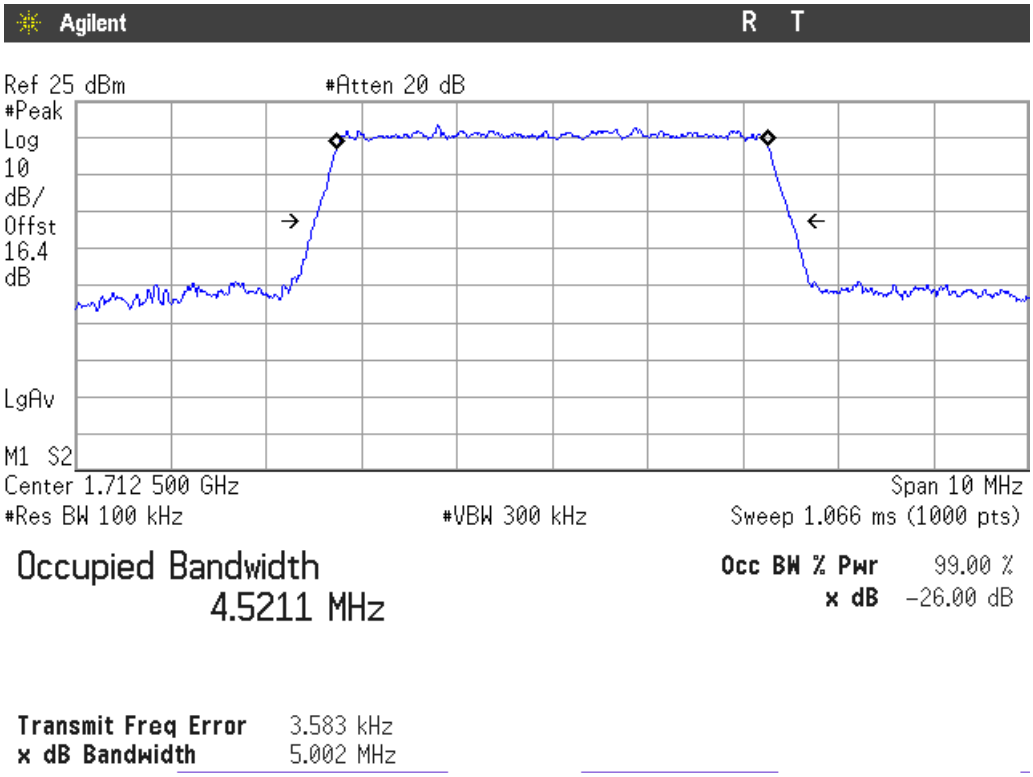


Highest Channel

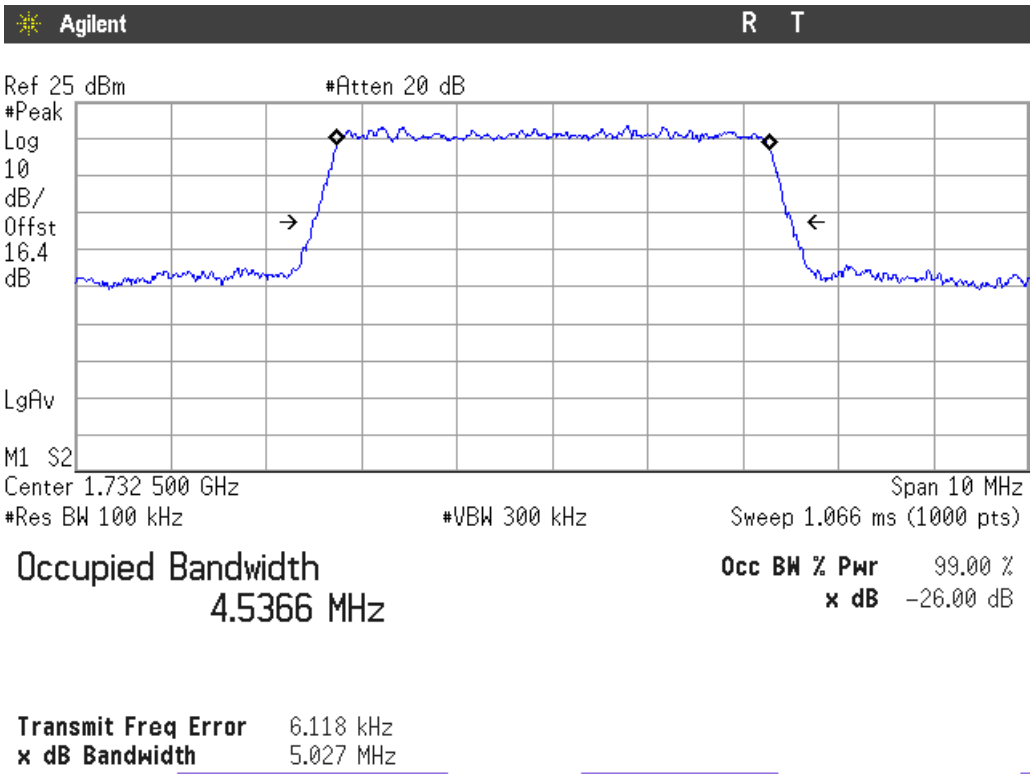


LTE QPSK MODULATION. BW = 5 MHz (Band IV)

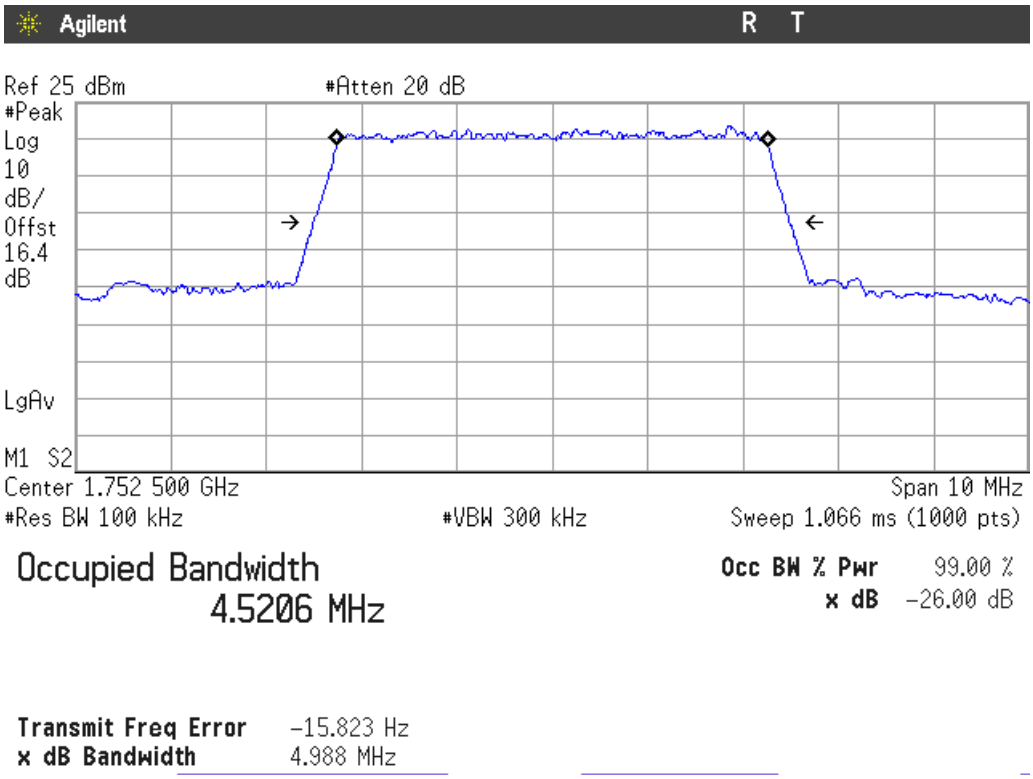
Lowest Channel



Middle Channel

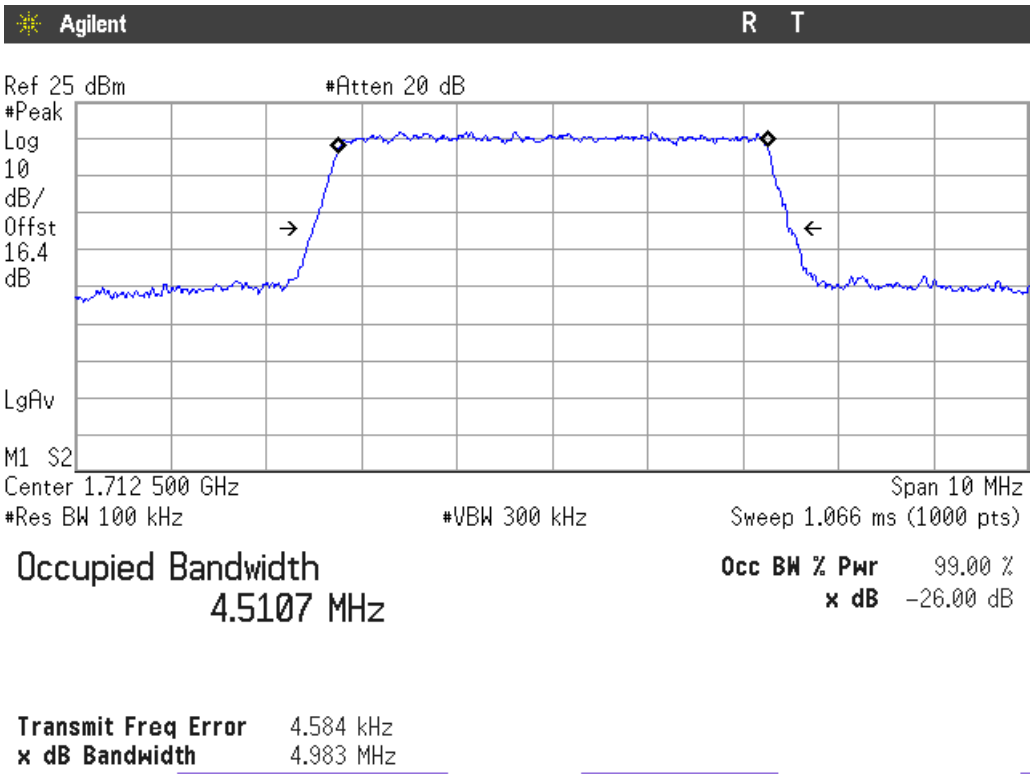


Highest Channel

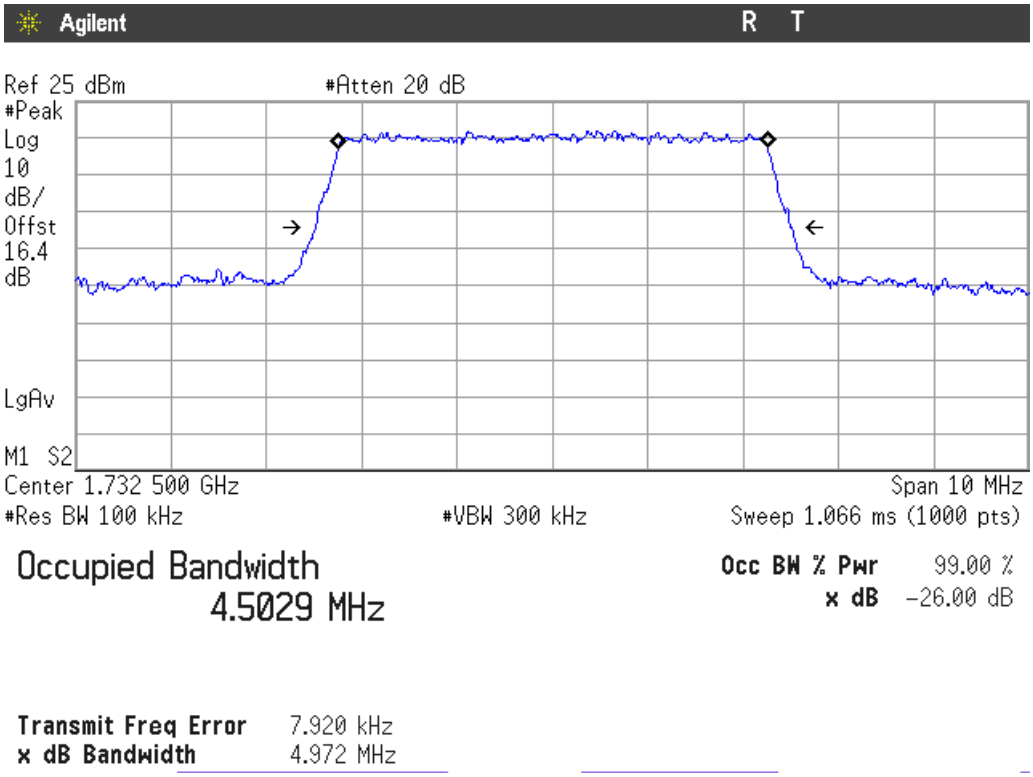


LTE 16QAM MODULATION. BW = 5 MHz (Band IV)

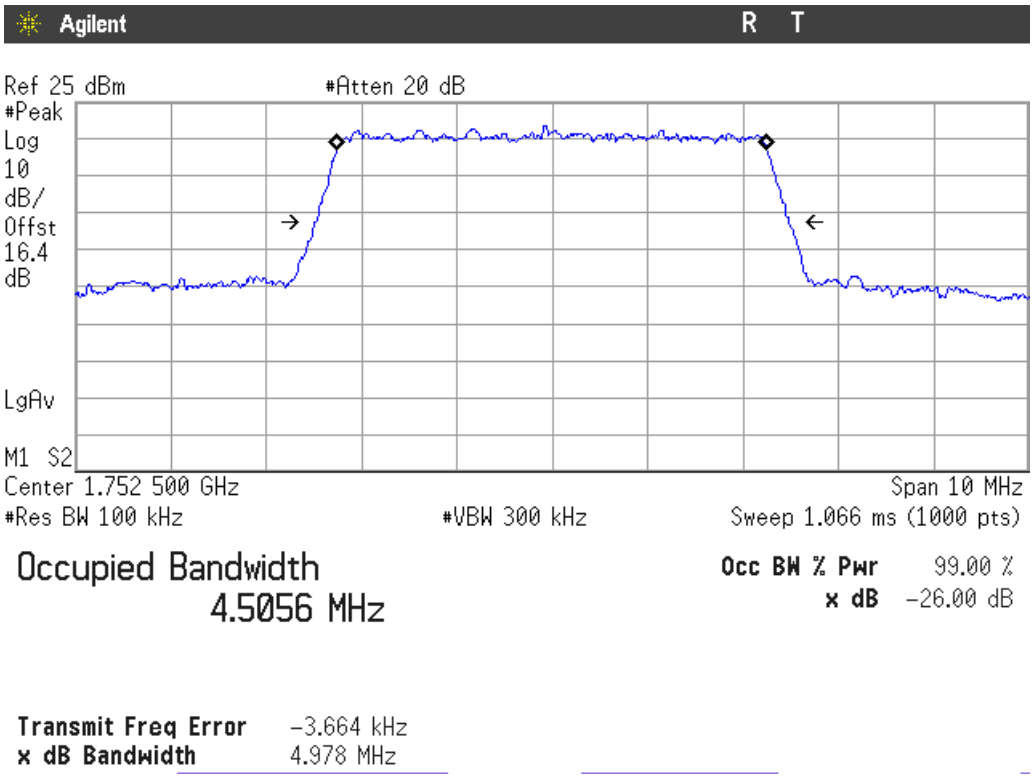
Lowest Channel



Middle Channel

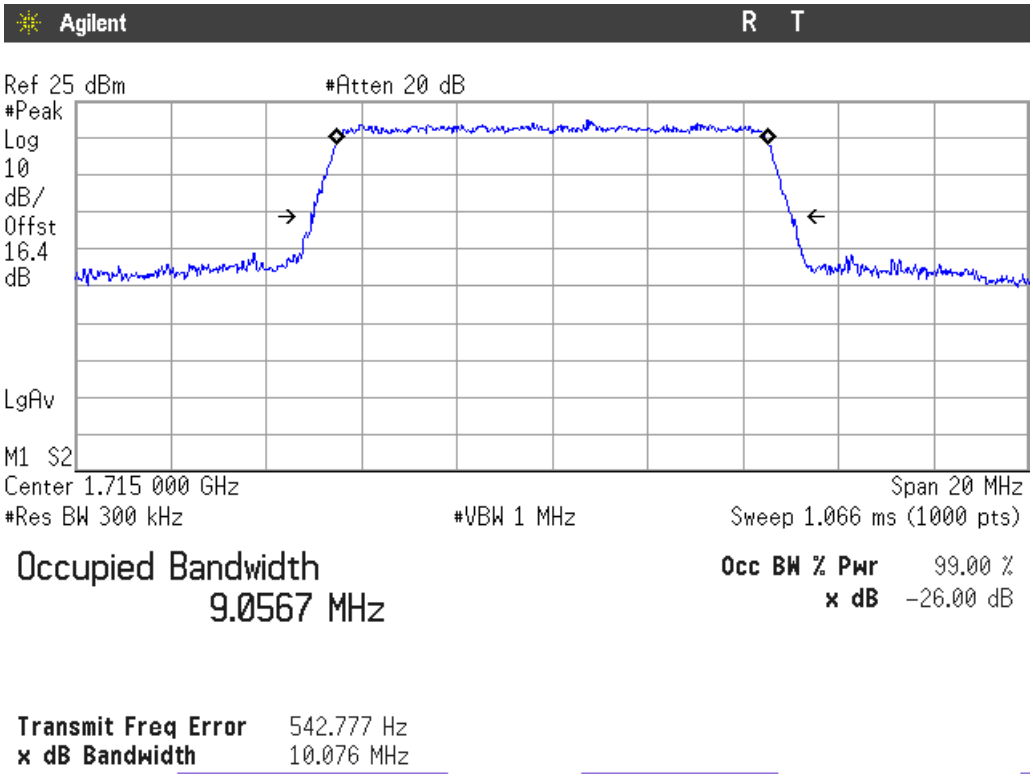


Highest Channel

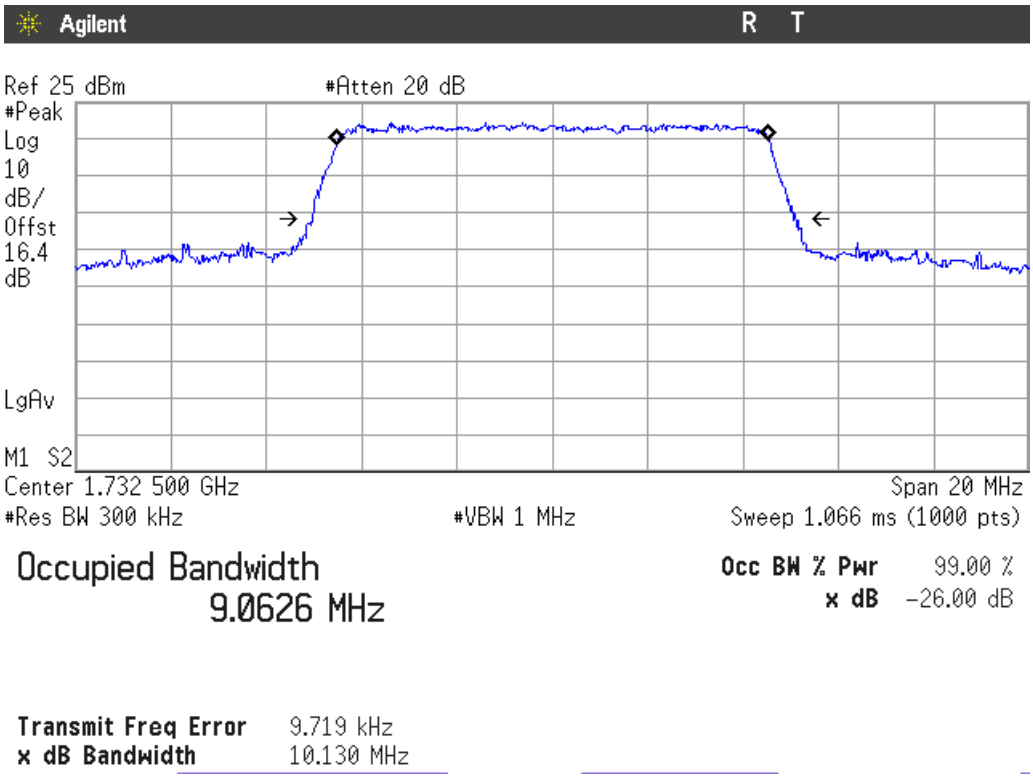


LTE QPSK MODULATION. BW = 10 MHz (Band IV)

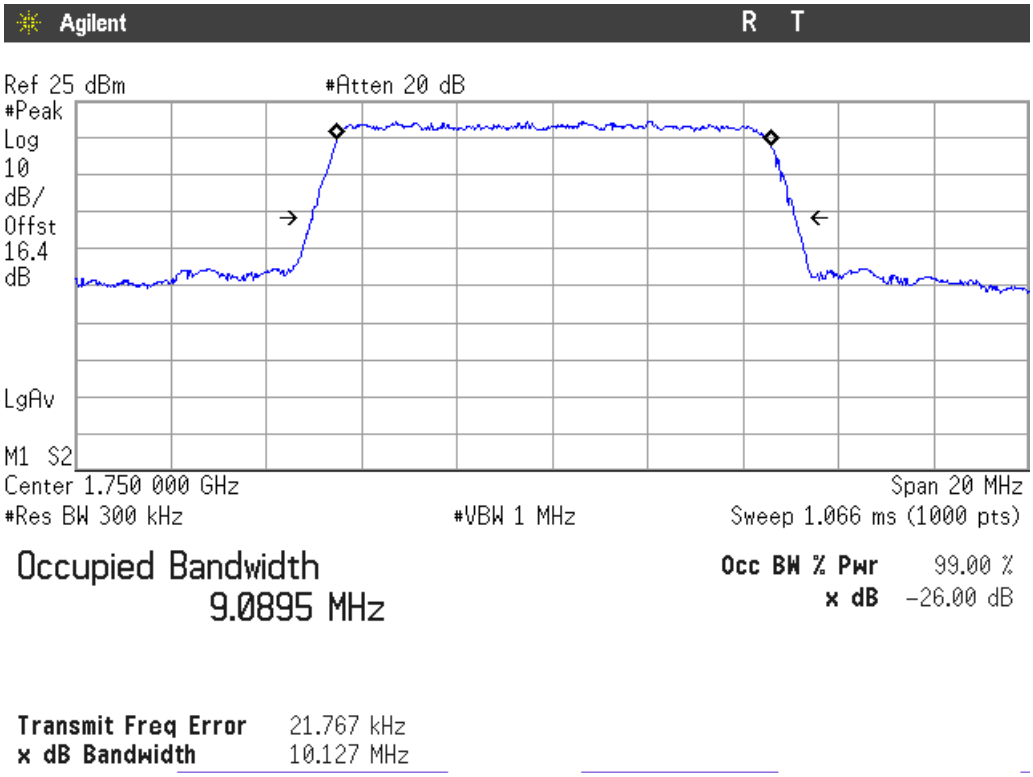
Lowest Channel



Middle Channel

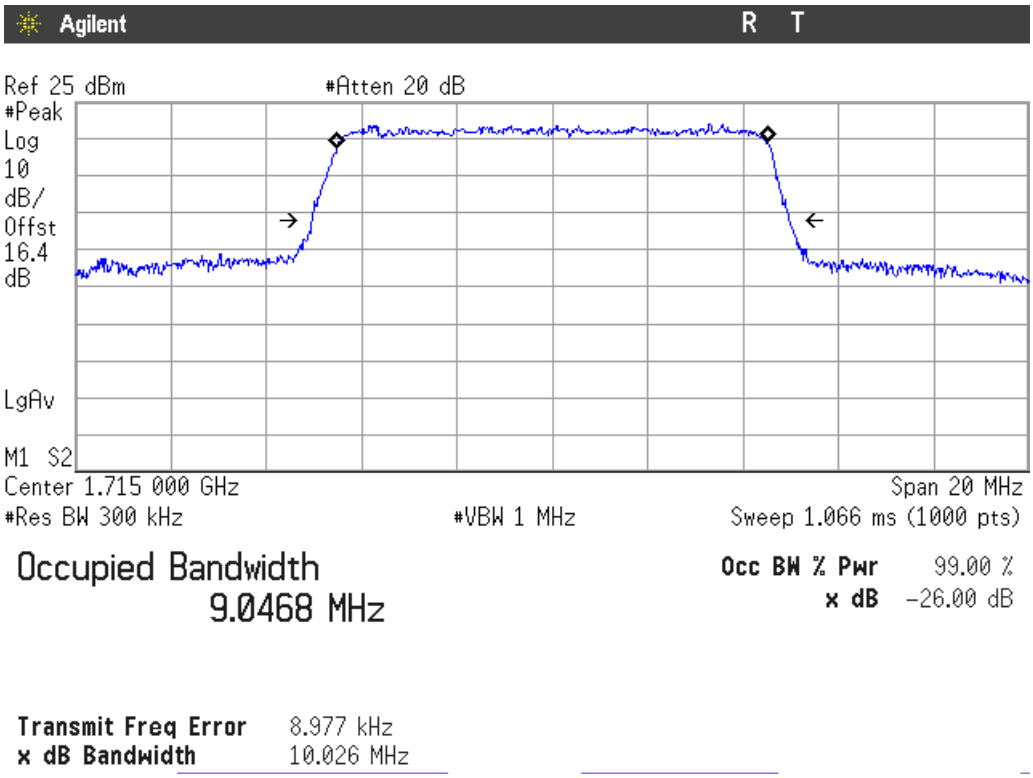


Highest Channel

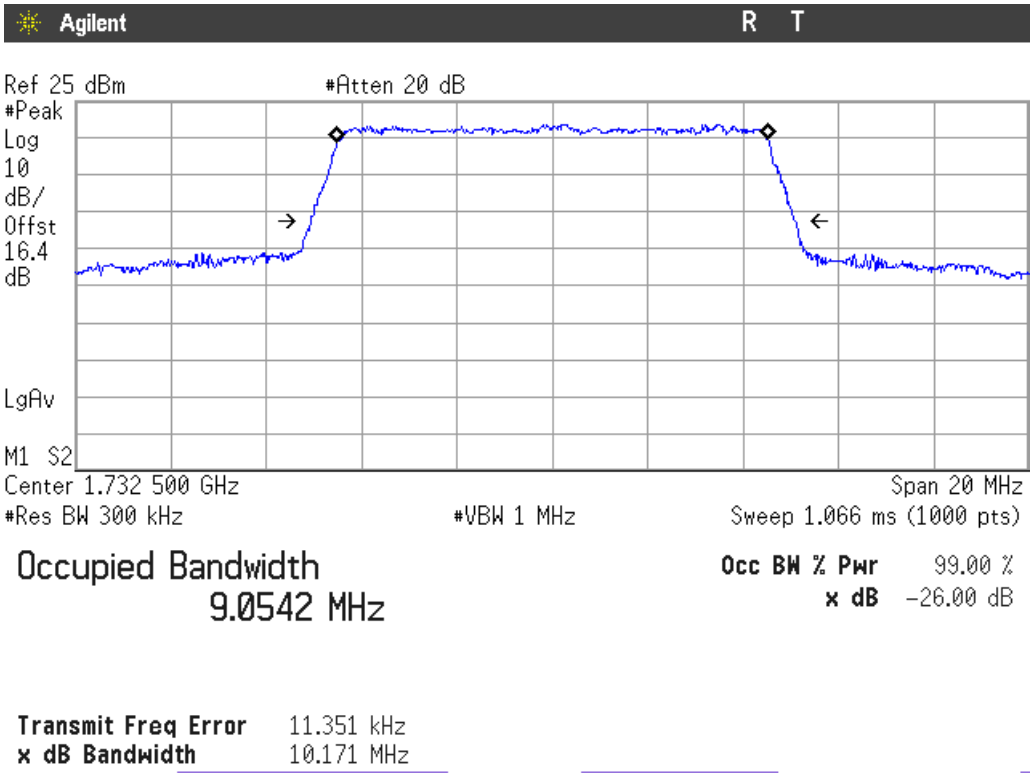


LTE 16QAM MODULATION. BW = 10 MHz (Band IV)

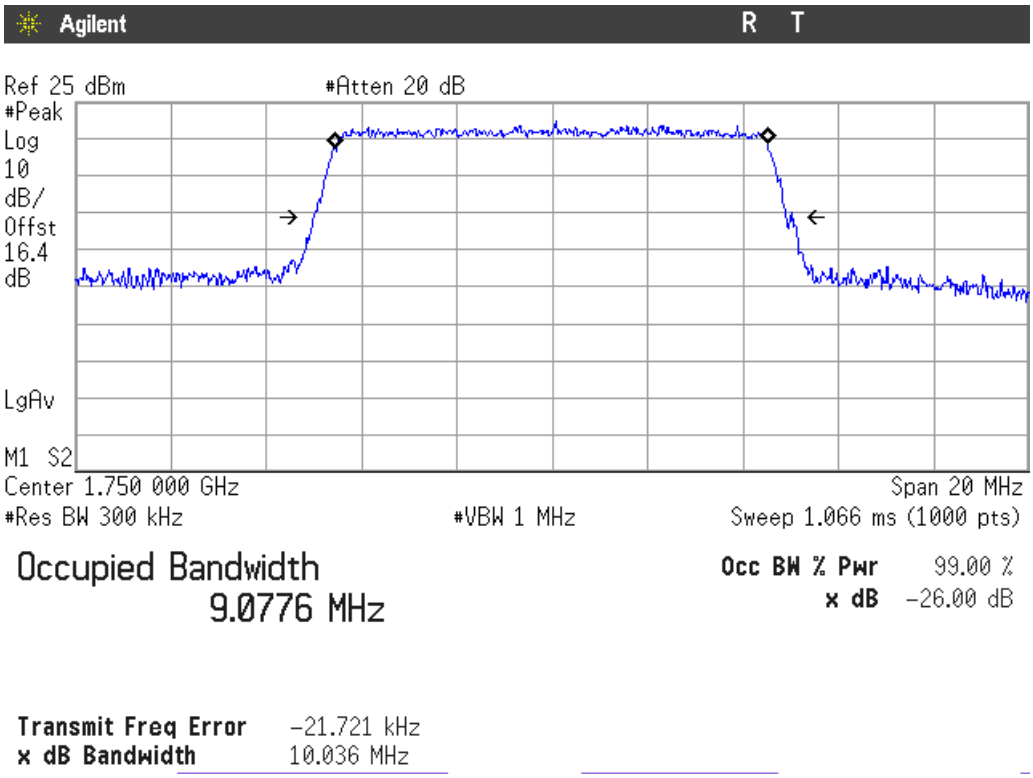
Lowest Channel



Middle Channel

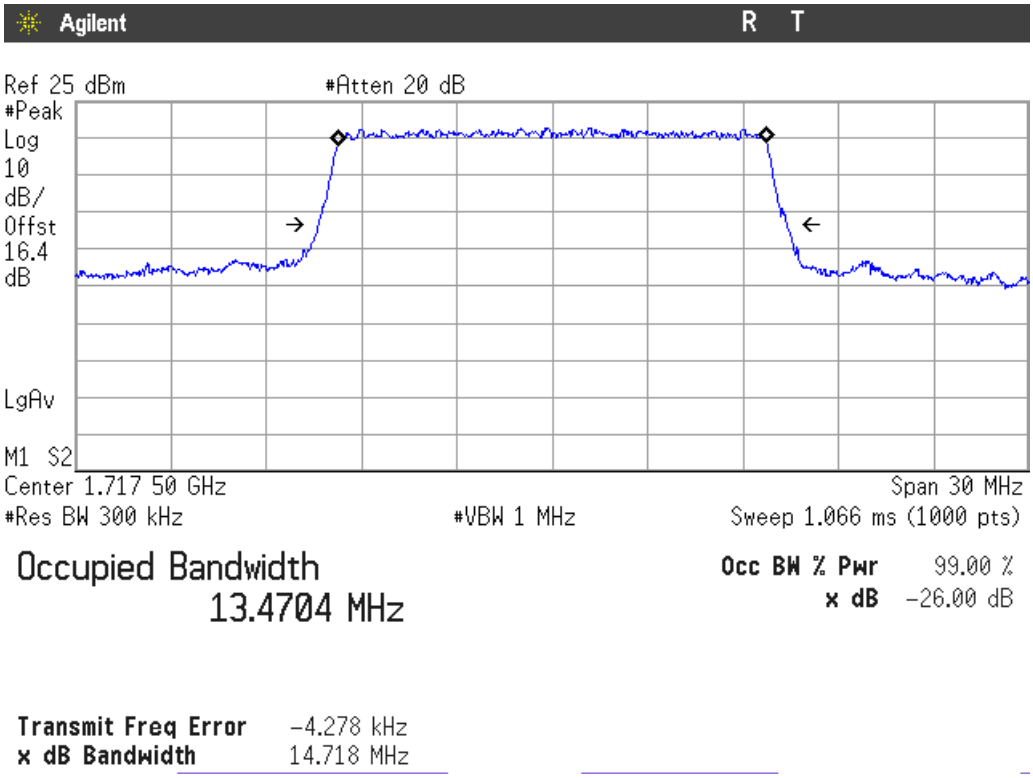


Highest Channel

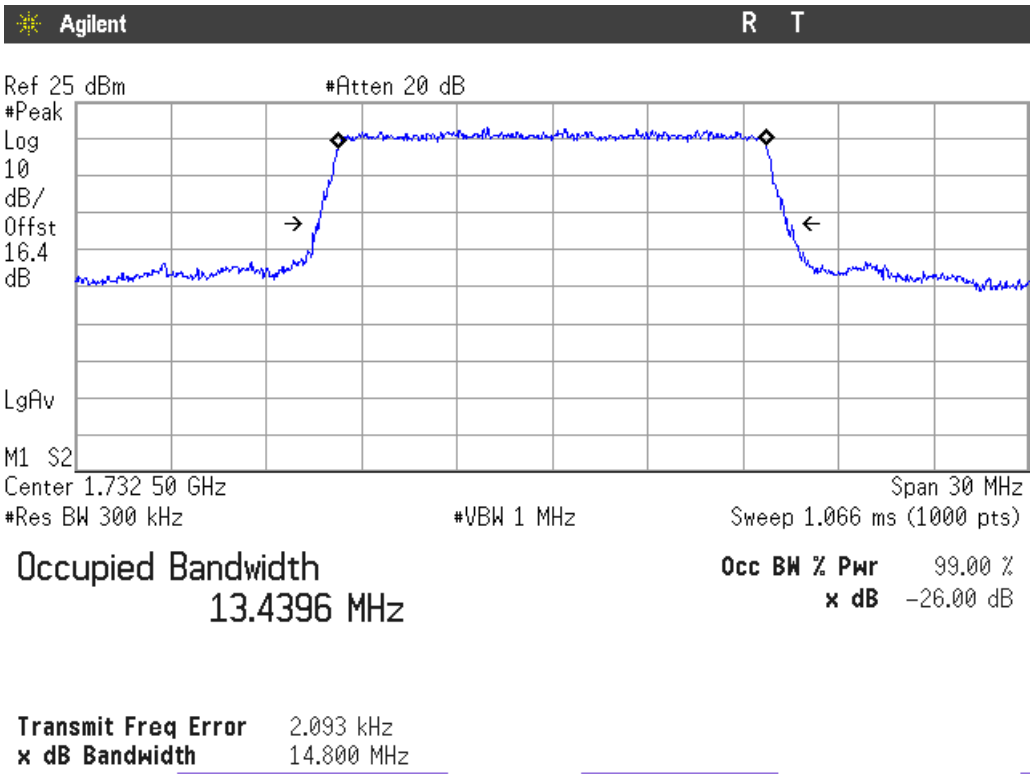


LTE QPSK MODULATION. BW = 15 MHz (Band IV)

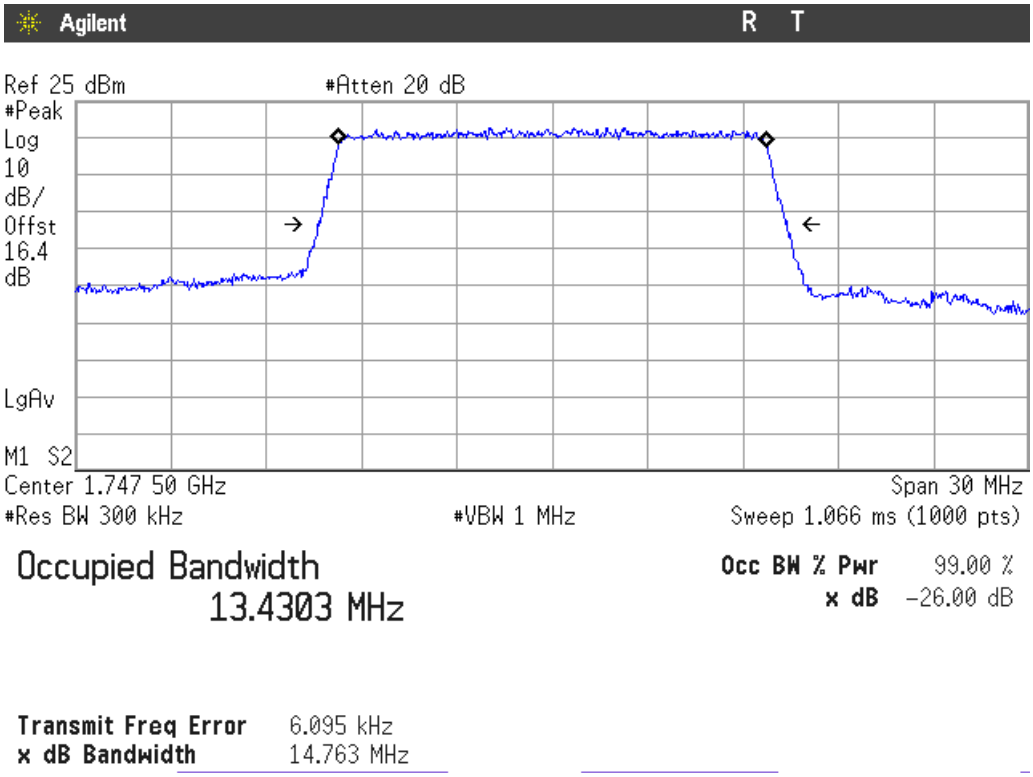
Lowest Channel



Middle Channel

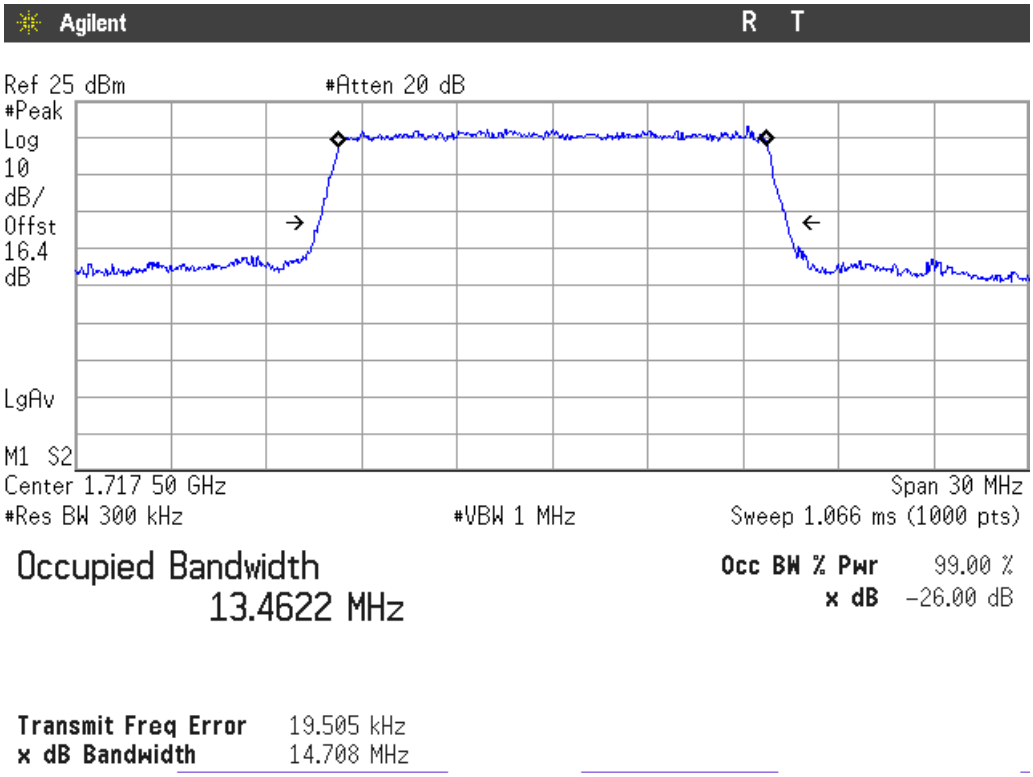


Highest Channel

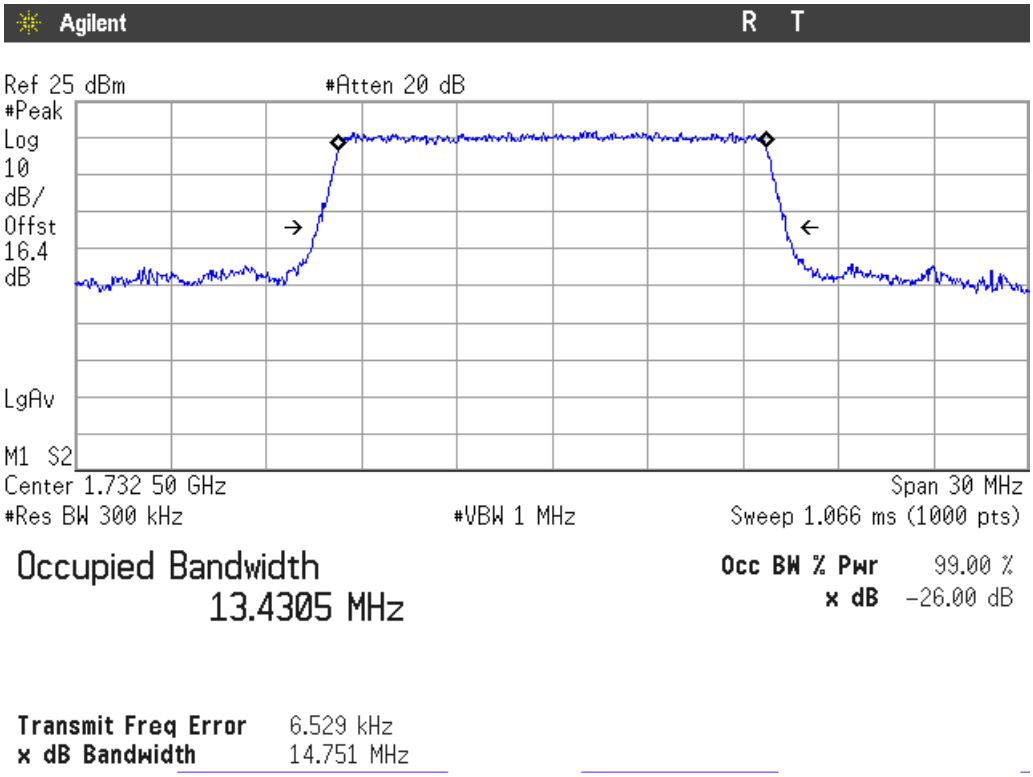


LTE 16QAM MODULATION. BW = 15 MHz (Band IV)

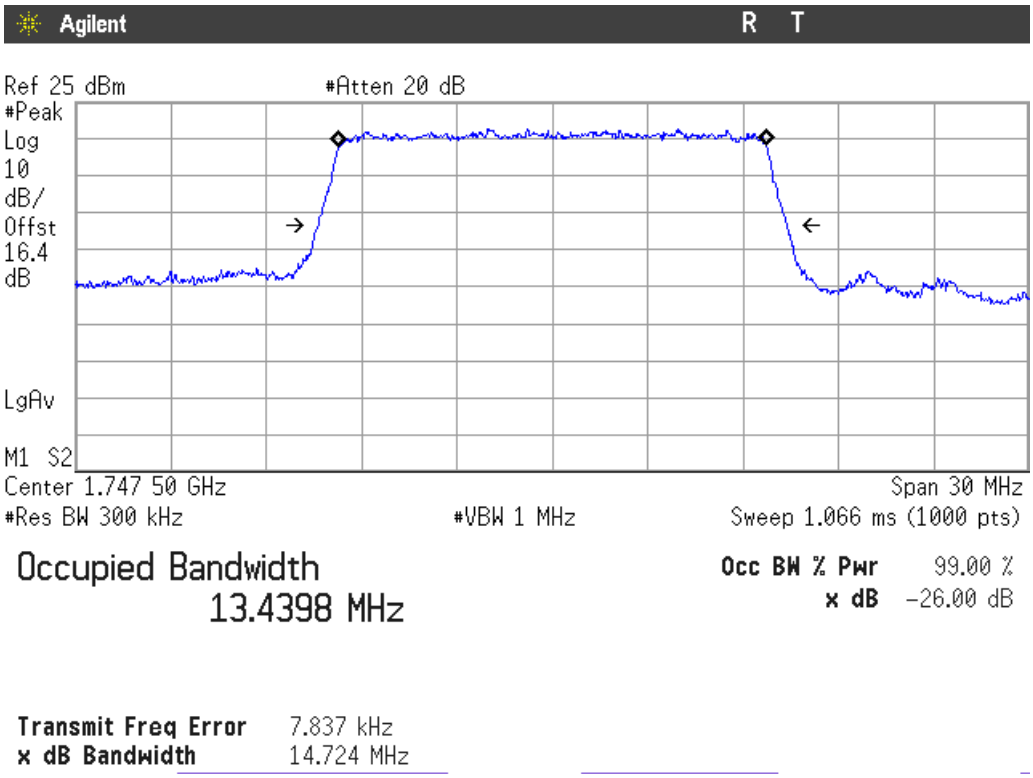
Lowest Channel



Middle Channel

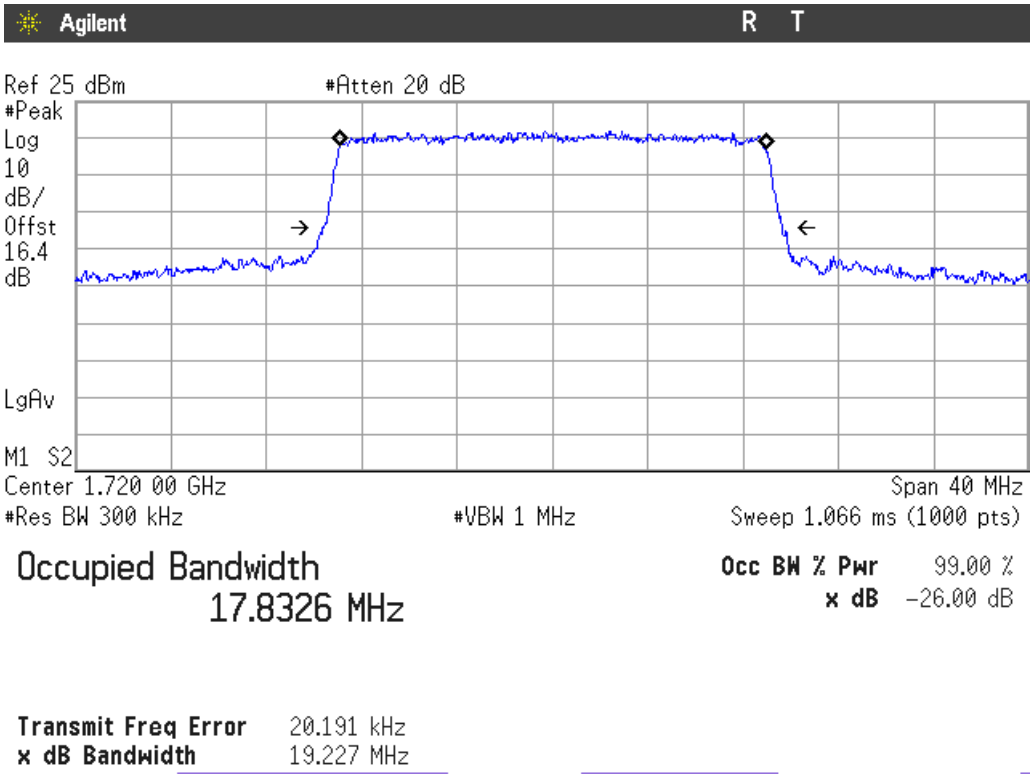


Highest Channel

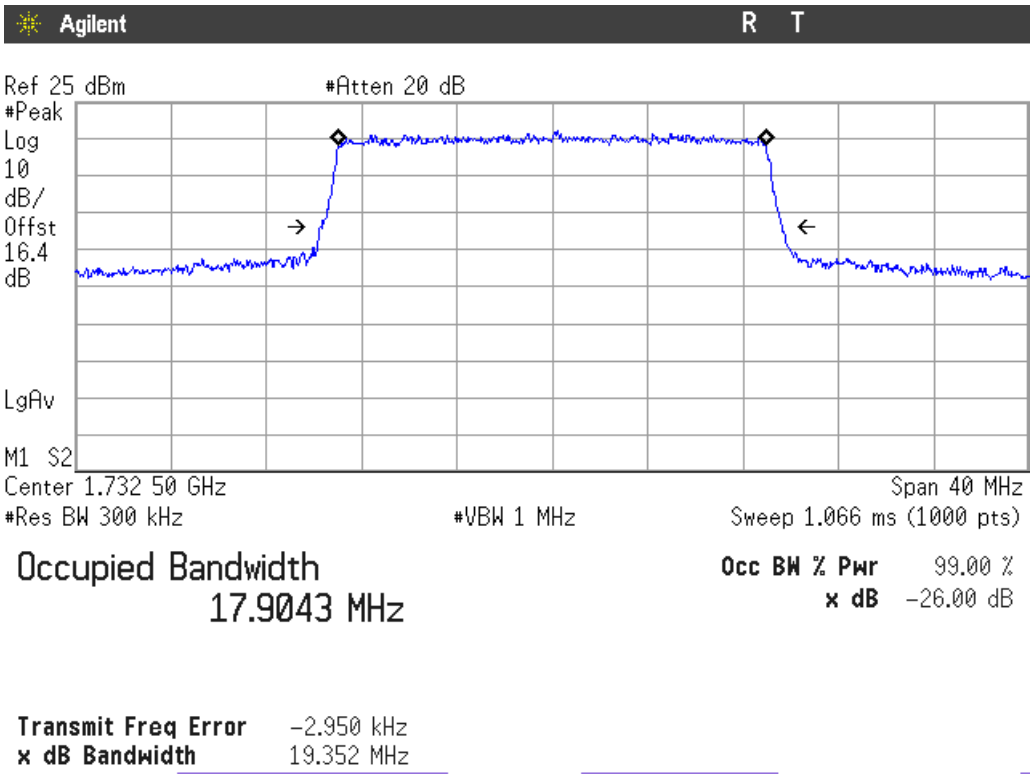


LTE QPSK MODULATION. BW = 20 MHz (Band IV)

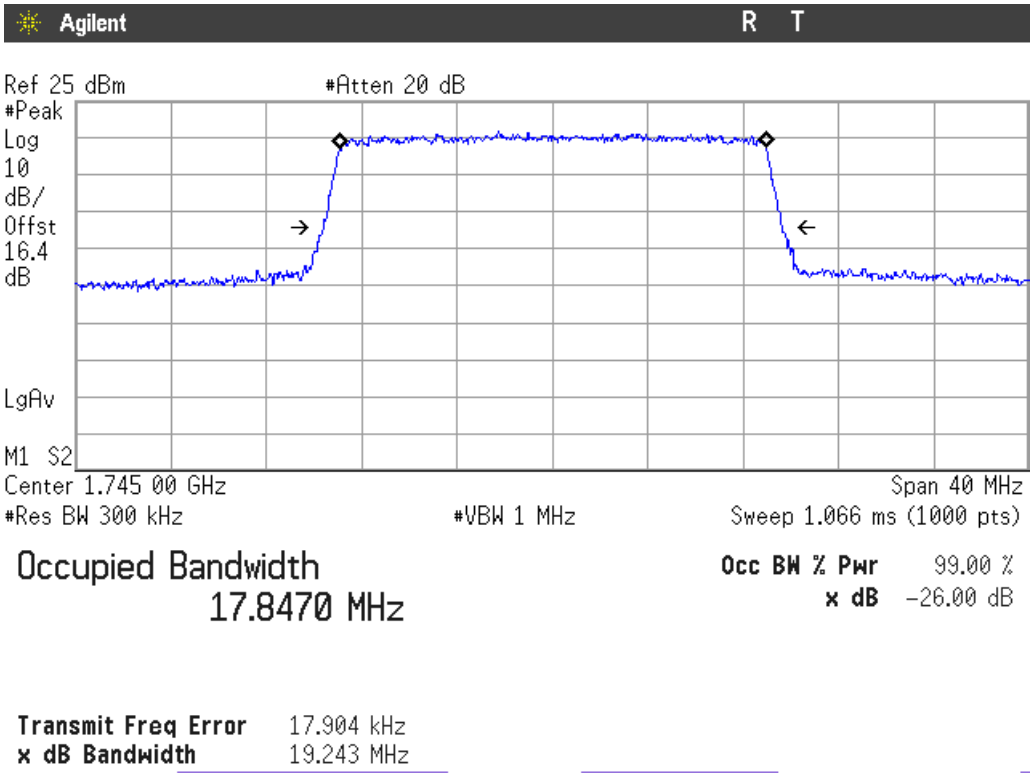
Lowest Channel



Middle Channel

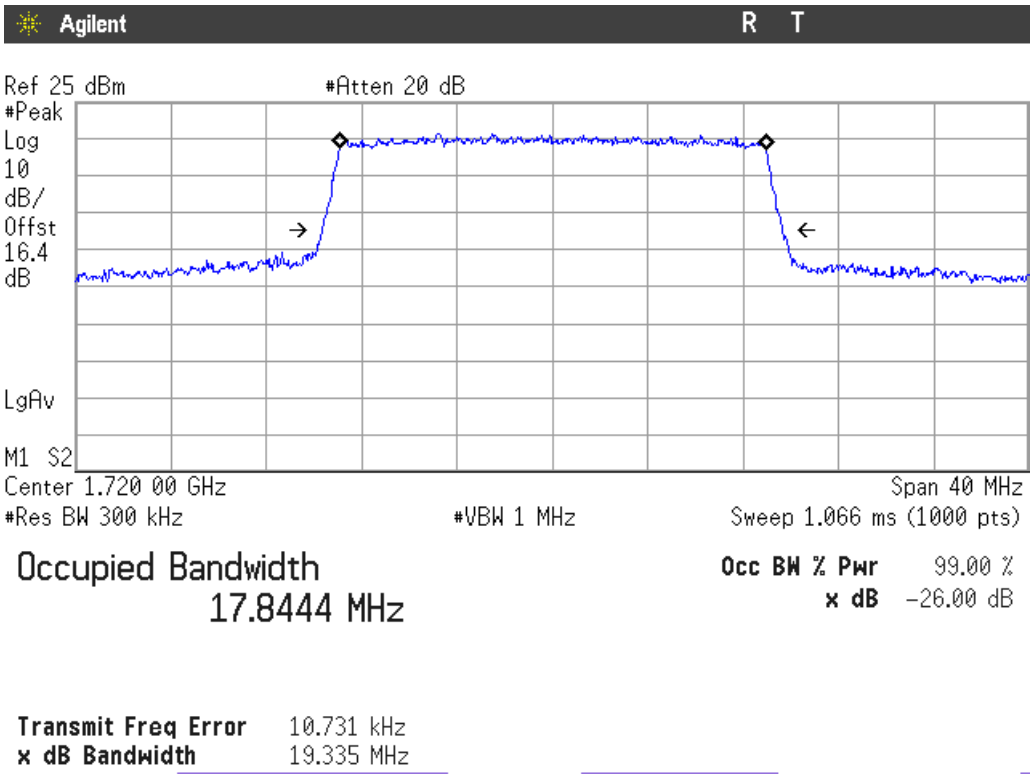


Highest Channel

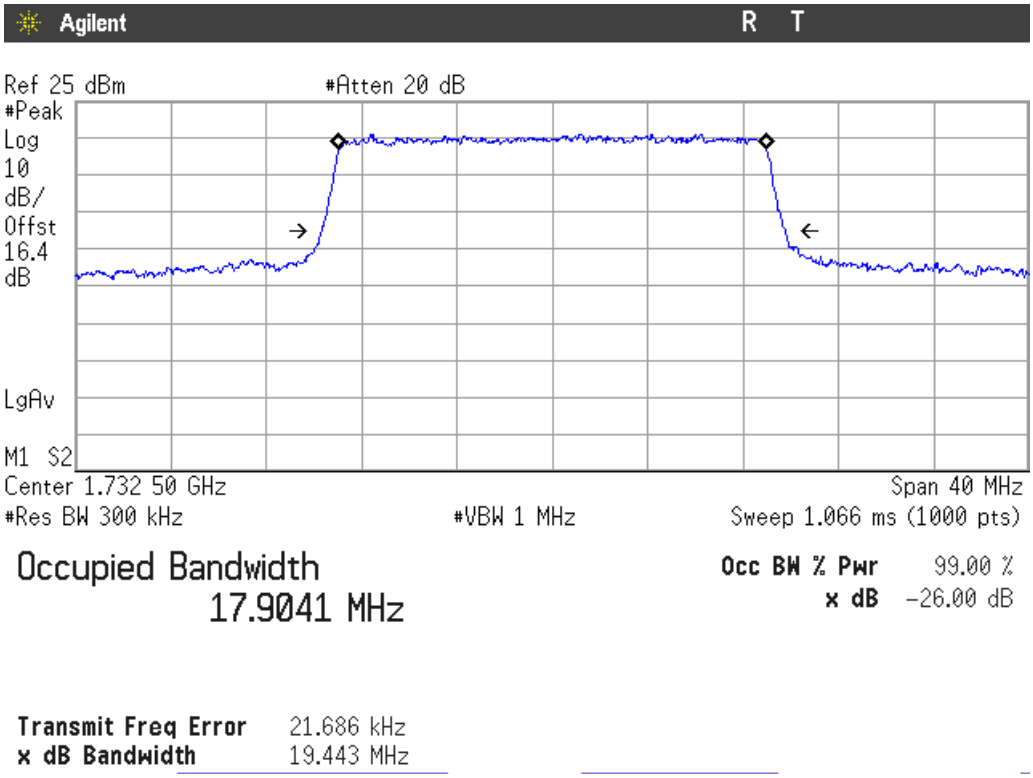


LTE 16QAM MODULATION. BW = 20 MHz (Band IV)

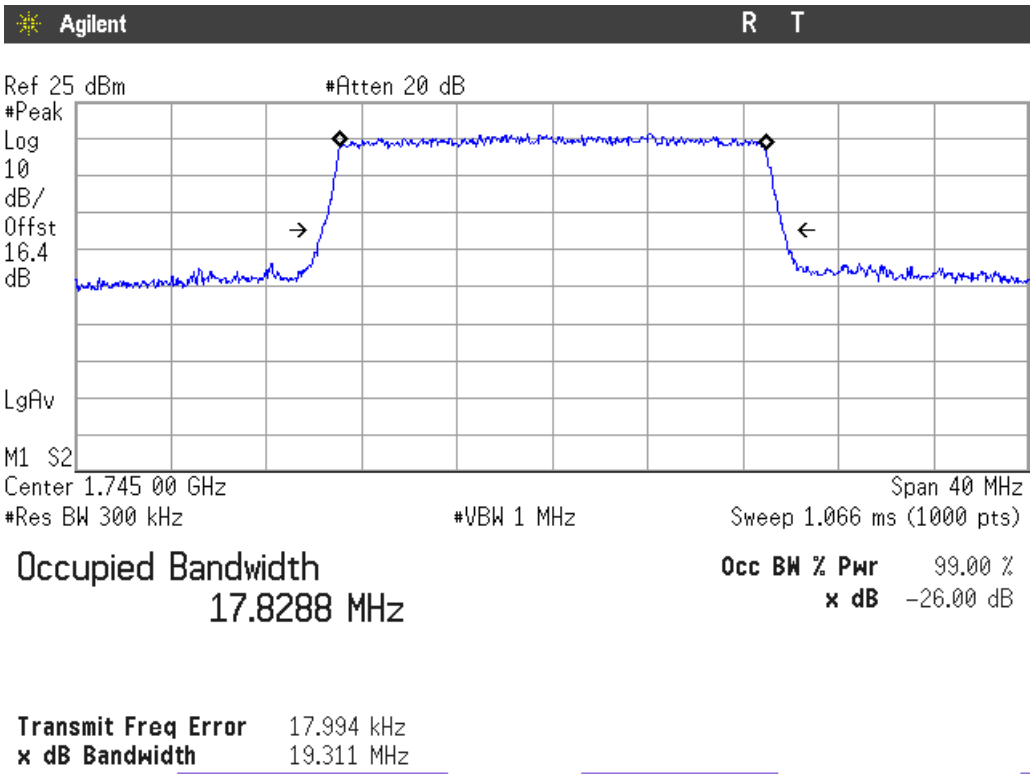
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

LTE BAND IV and UMTS 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.

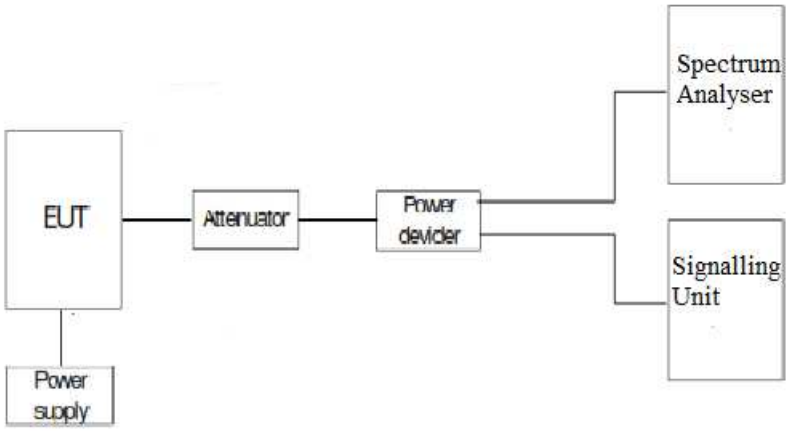
The spectrum was investigated from 9 kHz to 18 GHz for LTE Band IV.

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)
3.4221	-31.75	< ± 1.20

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4659	-30.87	< ± 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

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4203	-31.57	< ± 1.20

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4671	-30.92	< ± 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)
3.4251	-30.94	< ± 1.20

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4695	-31.70	< ± 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)
3.4299	-30.54	< ± 1.20

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4737	-31.80	< ± 1.20

3. CHANNEL: HIGHEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.5091	-31.10	< ± 1.20

LTE QPSK MODULATION. BW = 15 MHz. Band IV

1. CHANNEL: LOWEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4347	-29.79	< ± 1.20

2. CHANNEL: MIDDLE

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4515	-29.56	< ± 1.20

3. CHANNEL: HIGHEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.5085	-31.20	< ± 1.20

LTE QPSK MODULATION. BW = 20 MHz. Band IV

1. CHANNEL: LOWEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.4401	-29.57	< ± 1.20

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

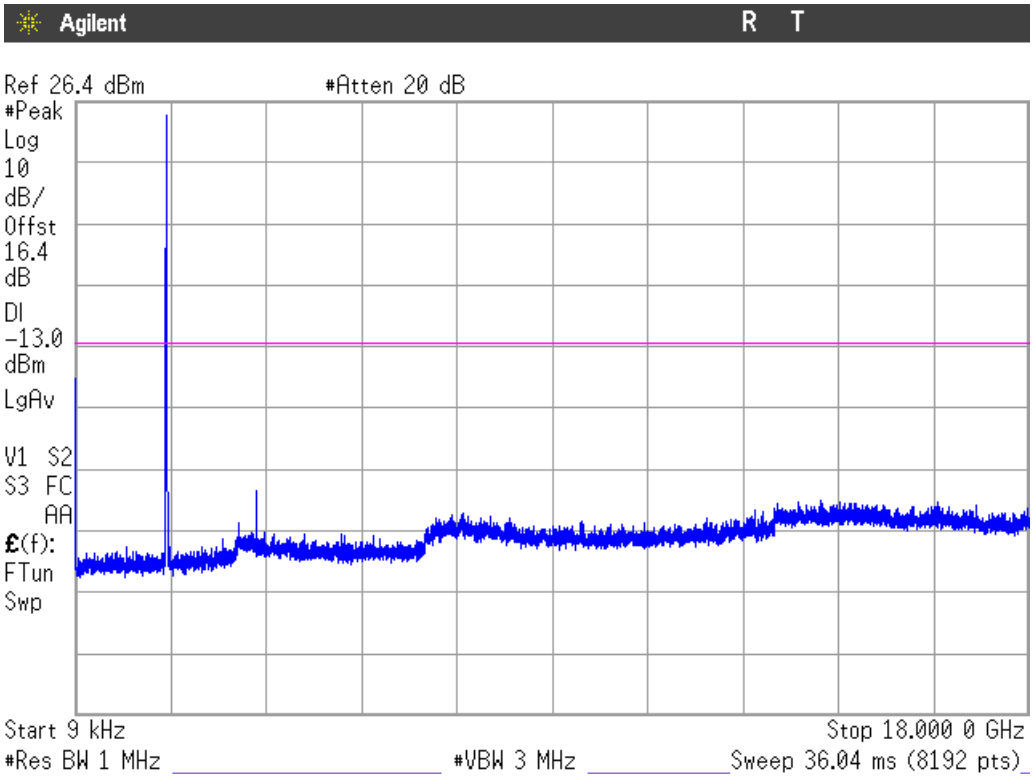
3. CHANNEL: HIGHEST

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.5079	-32.20	< ± 1.20

Verdict: PASS

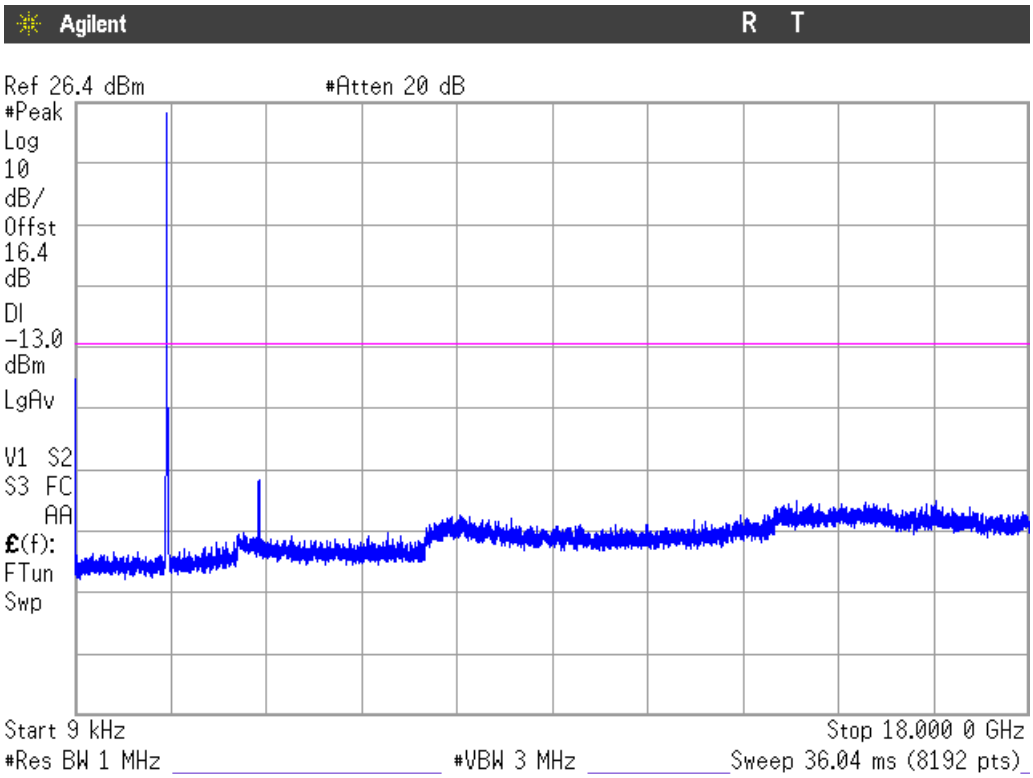
WCDMA MODULATION

1. CHANNEL: LOWEST



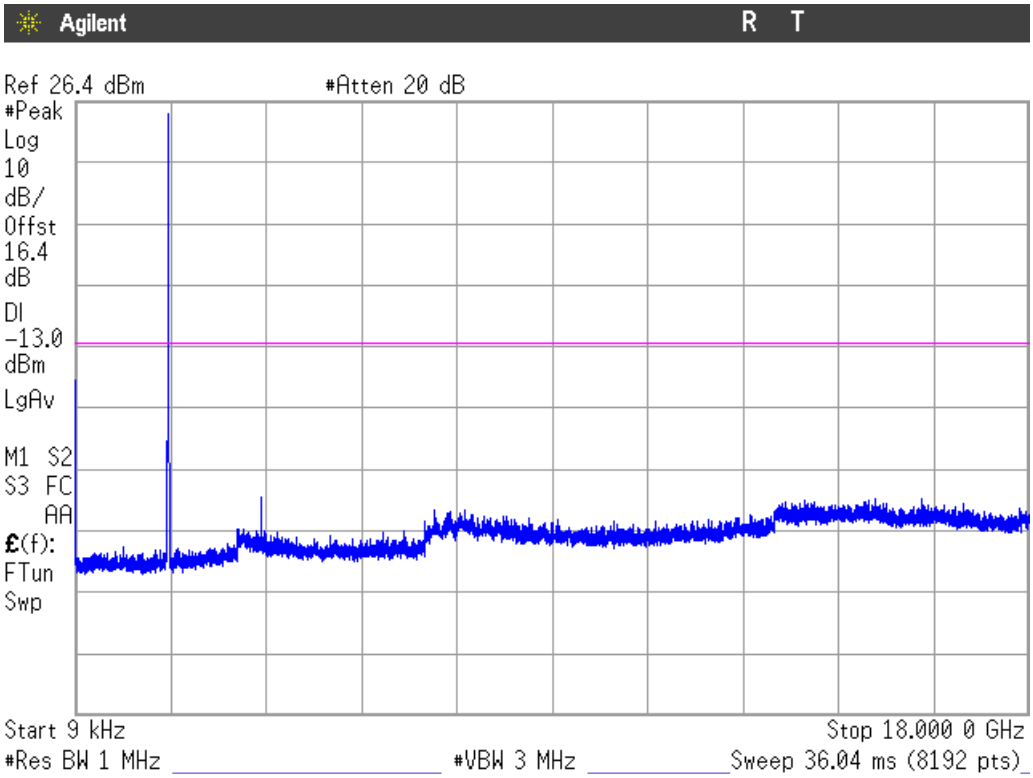
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

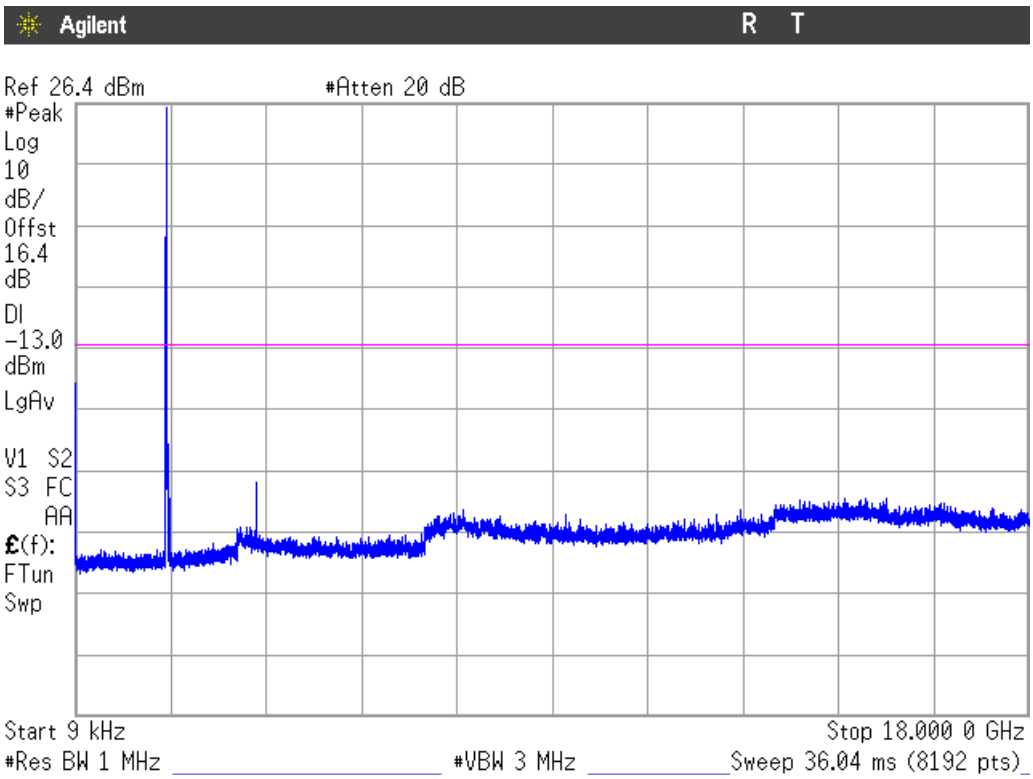
3. CHANNEL: HIGHEST



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

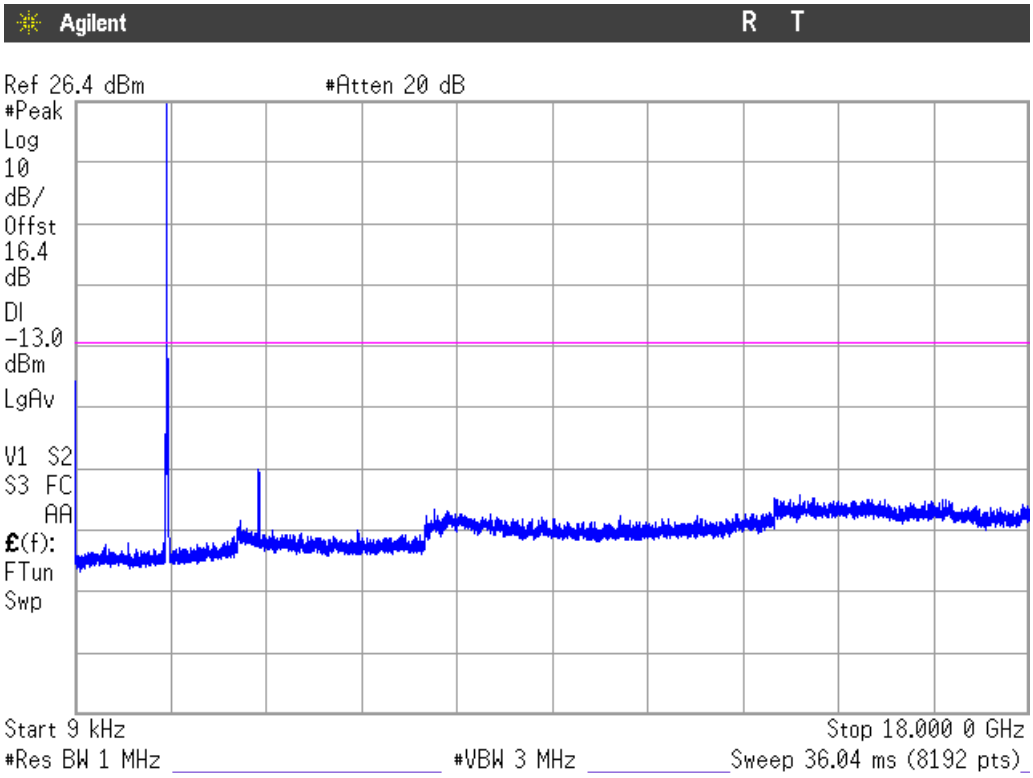
HSUPA MODULATION

1. CHANNEL: LOWEST



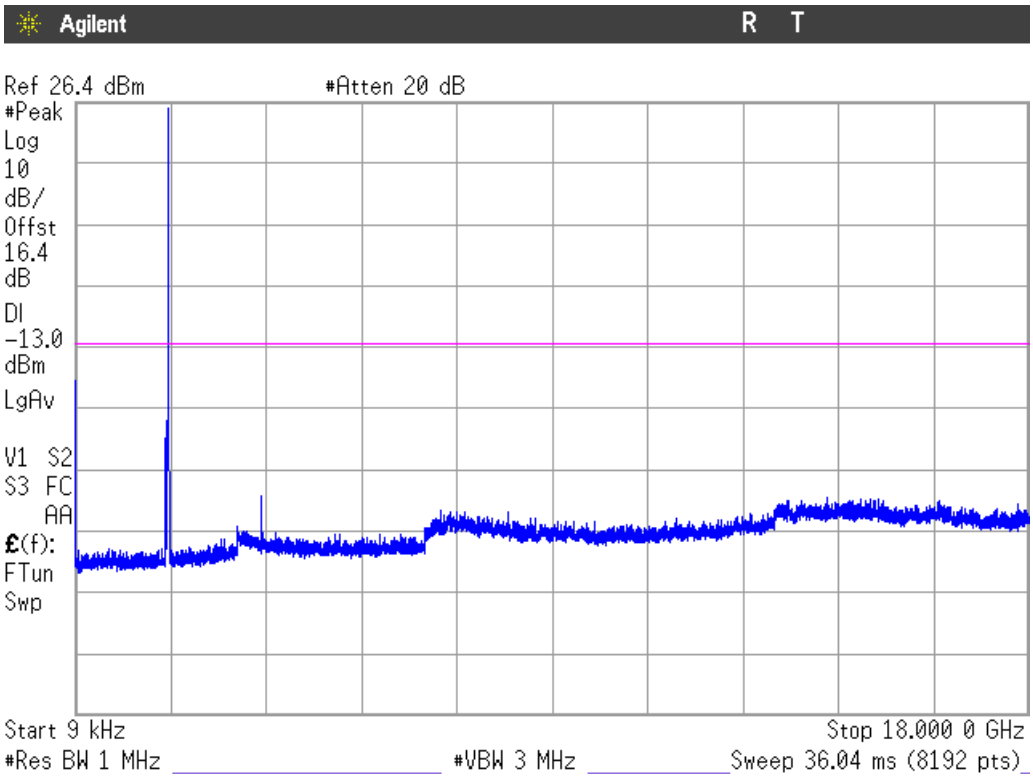
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

3. CHANNEL: HIGHEST

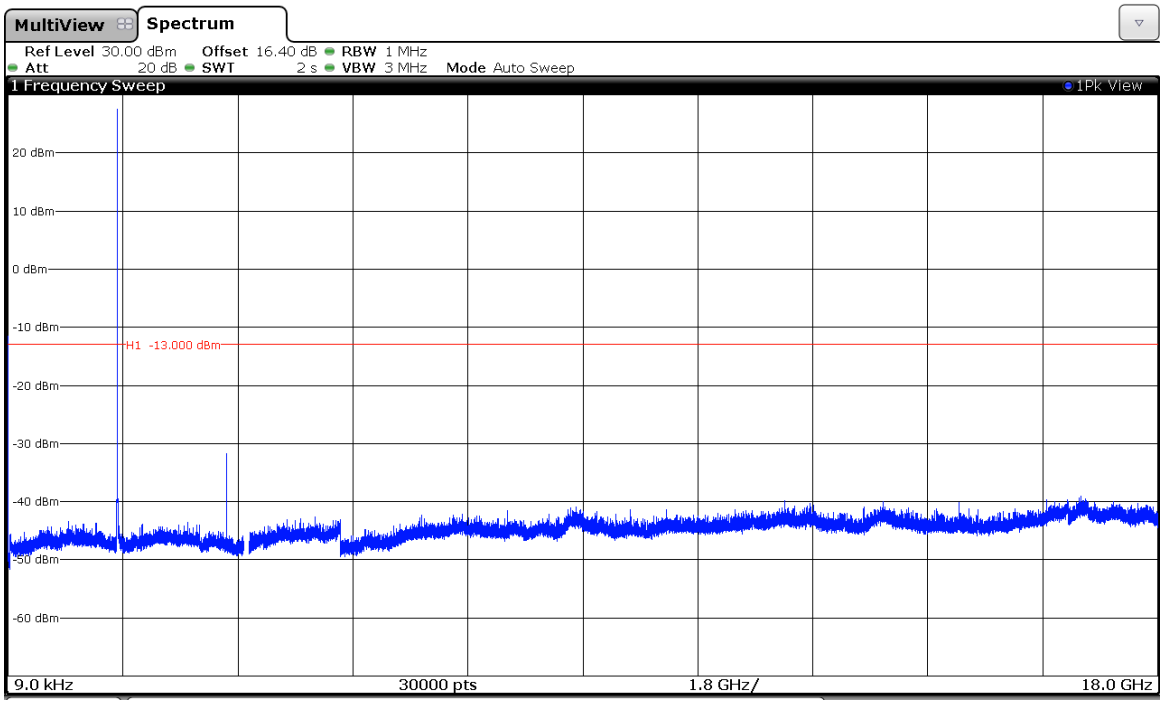


Note: The peak above the limit is the carrier frequency.

Measurement uncertainty (dB)	<±2.03

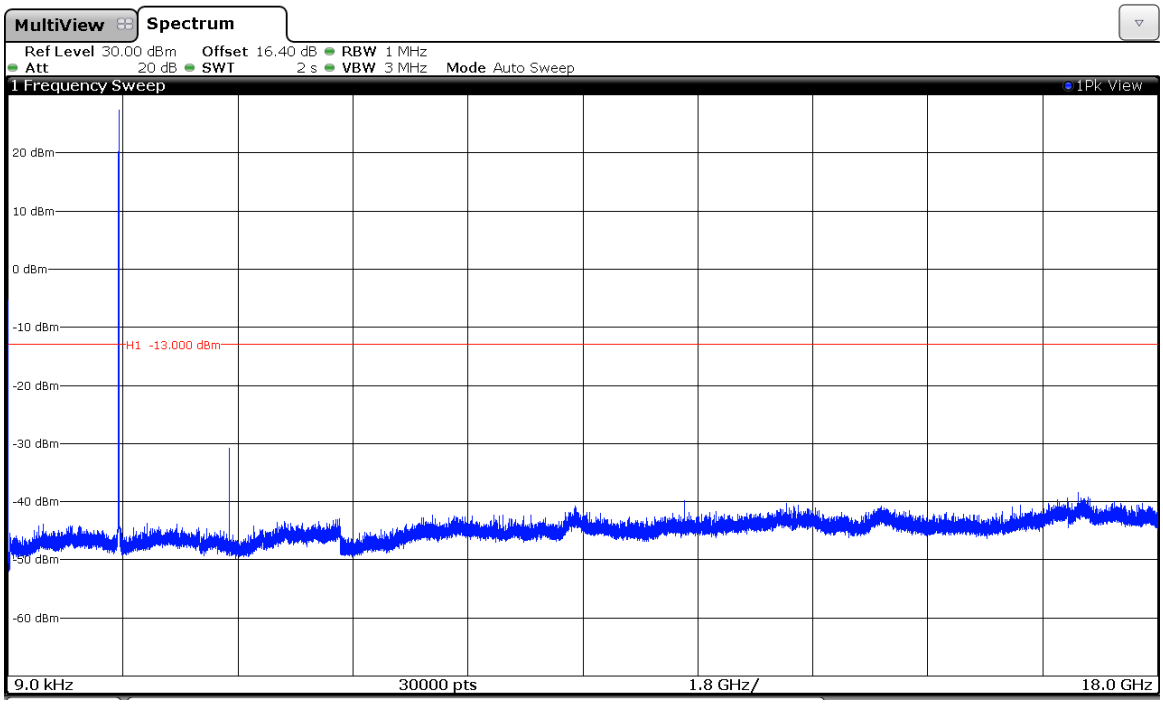
LTE QPSK MODULATION. BW = 1.4 MHz (Band IV)

1. CHANNEL: LOWEST



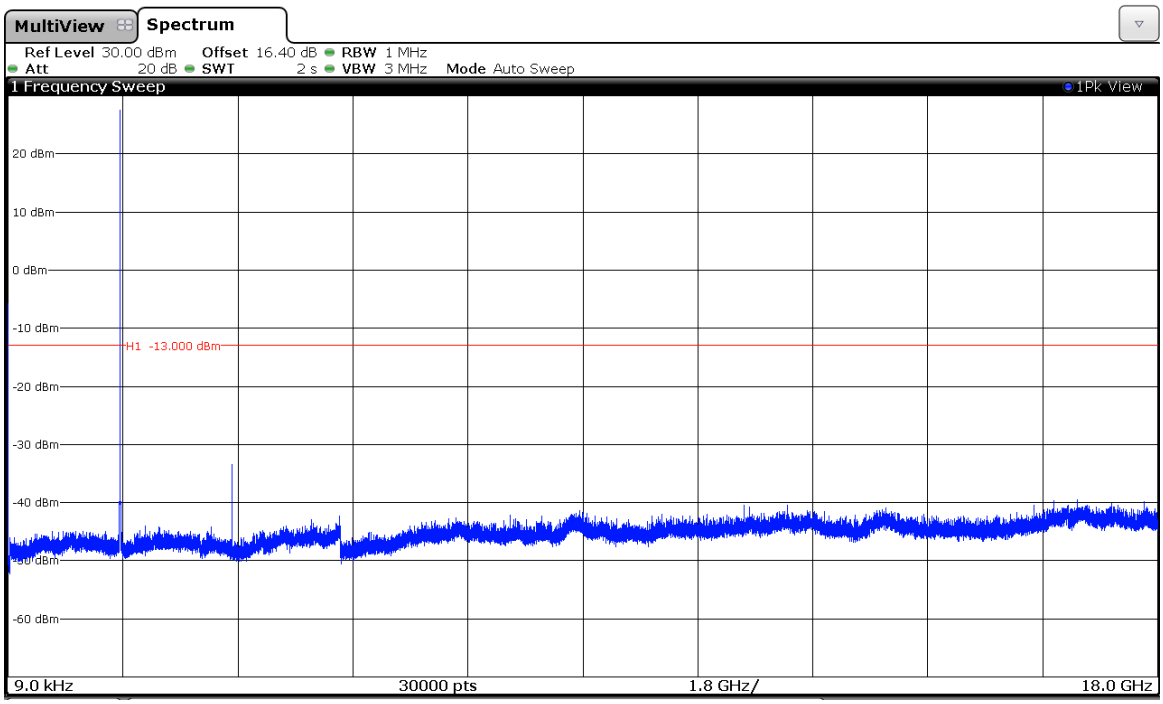
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

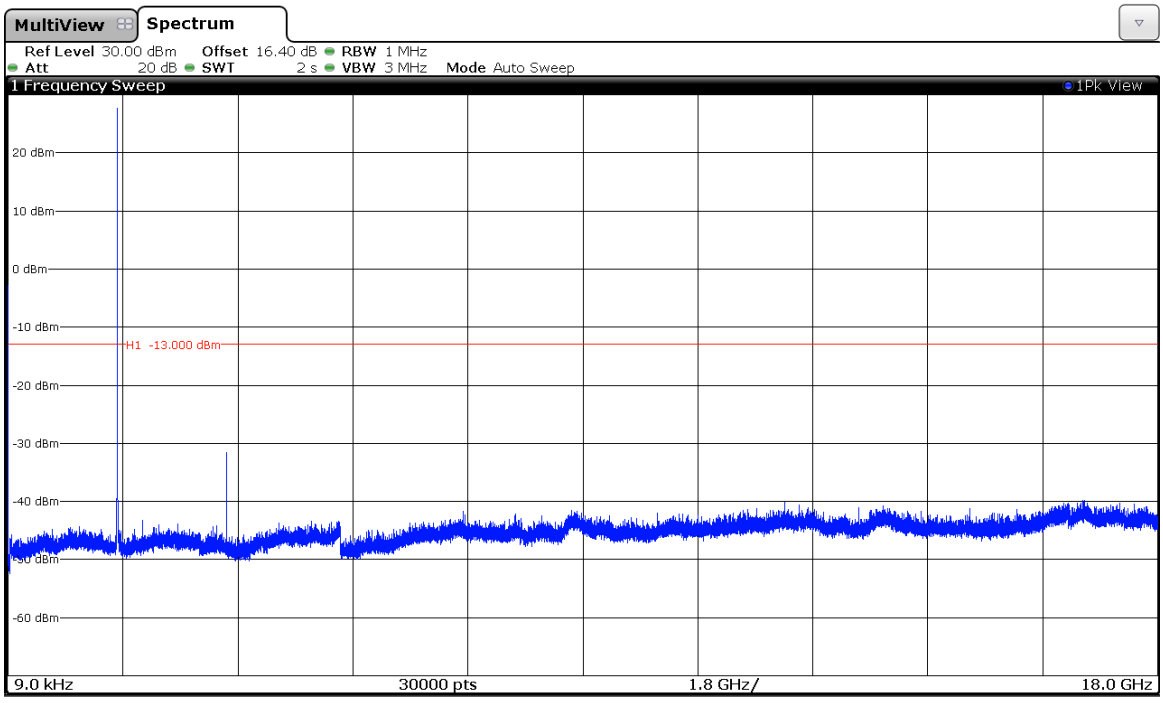
3. CHANNEL: HIGHEST



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

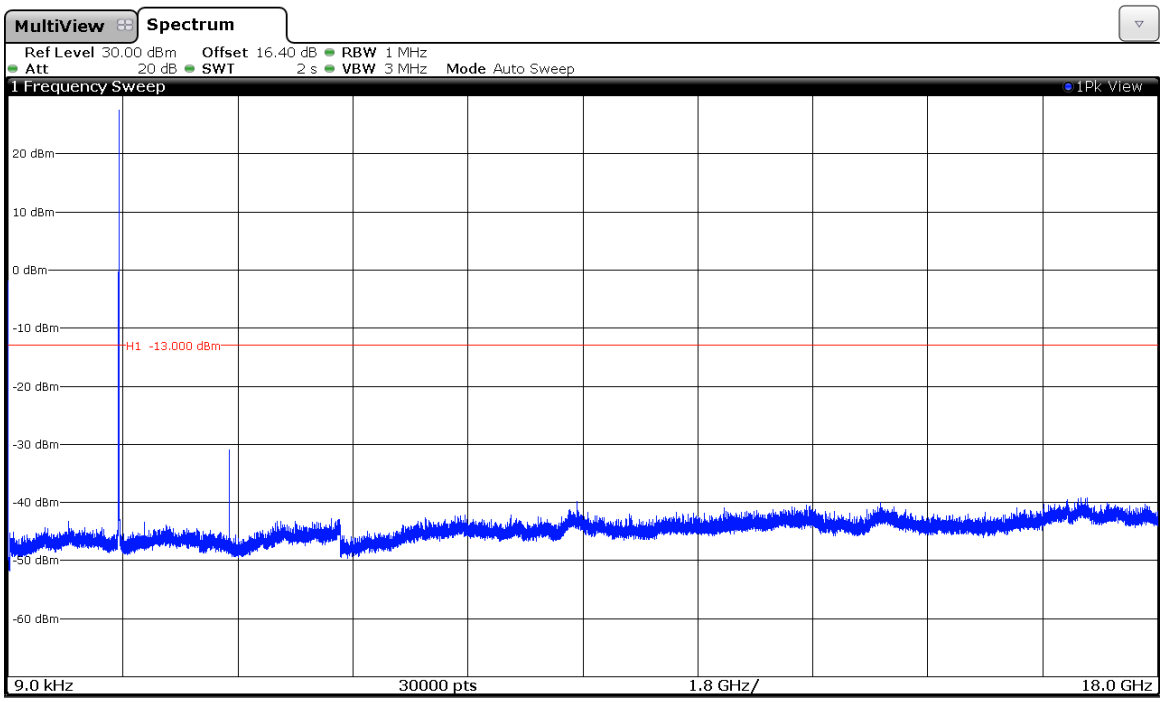
LTE QPSK MODULATION. BW = 3 MHz (Band IV)

1. CHANNEL: LOWEST



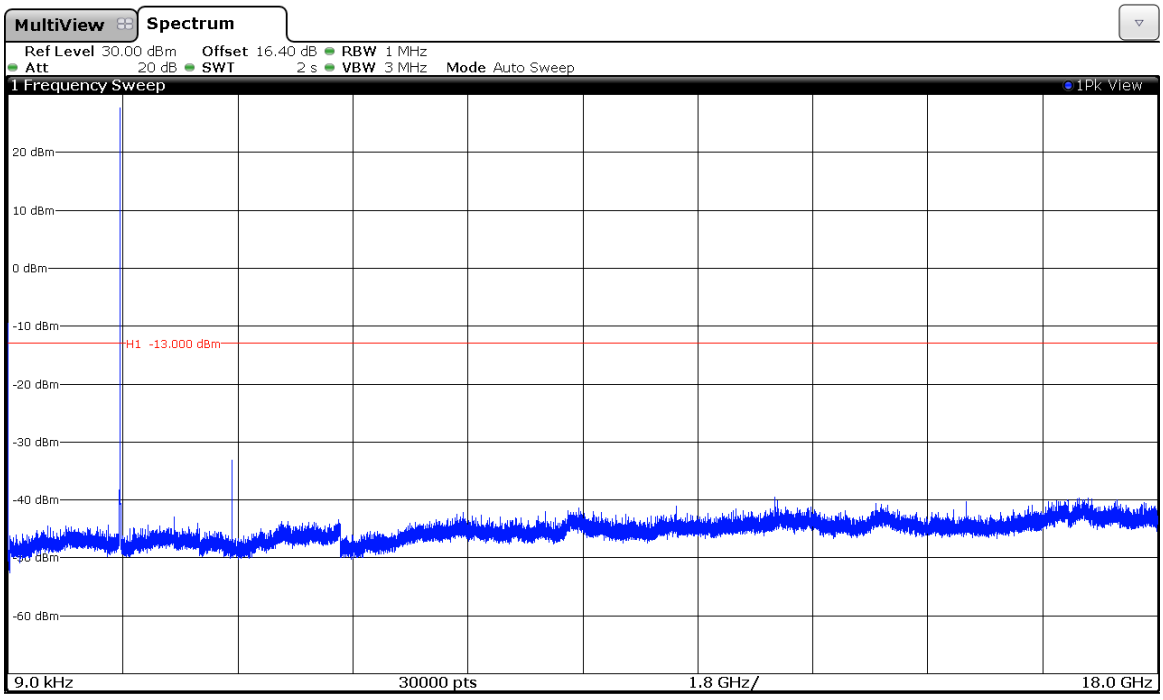
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

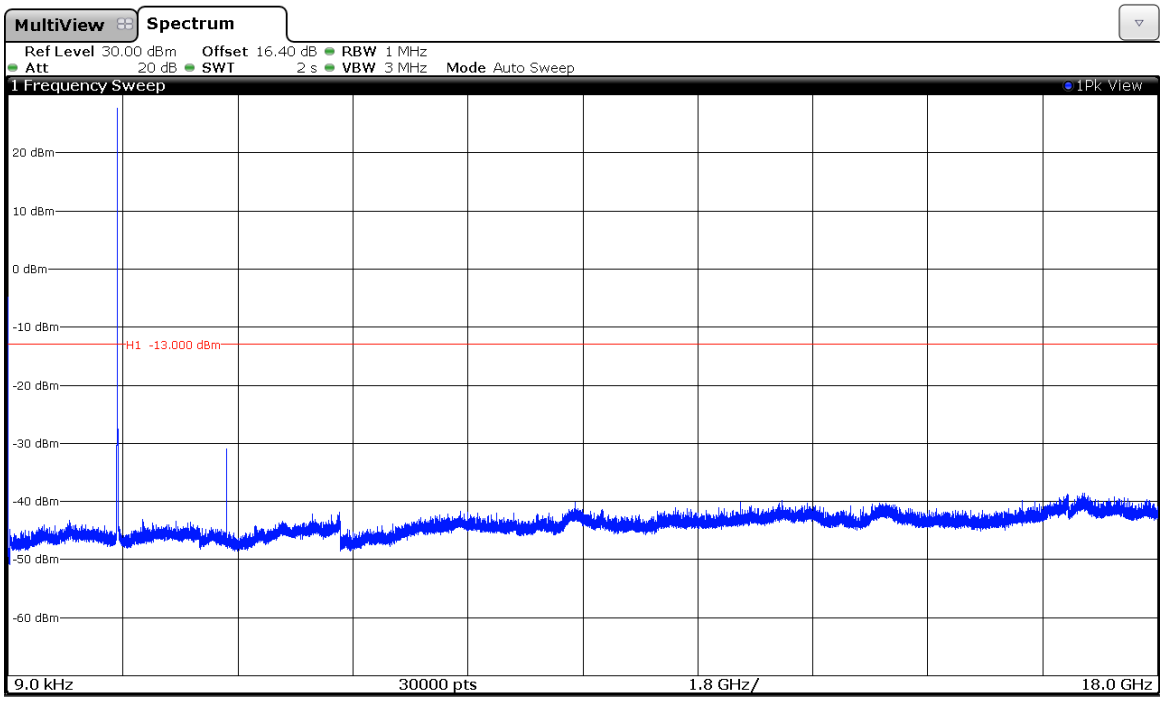
3. CHANNEL: HIGHEST



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

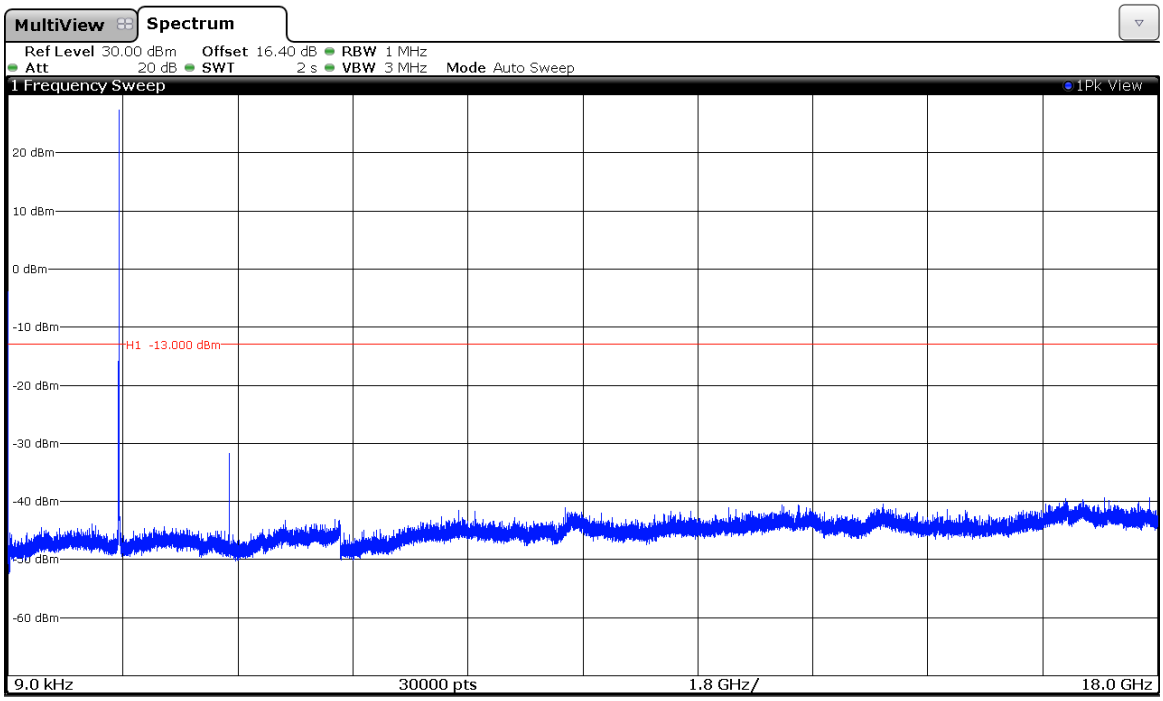
LTE QPSK MODULATION. BW = 5 MHz (Band IV)

1. CHANNEL: LOWEST



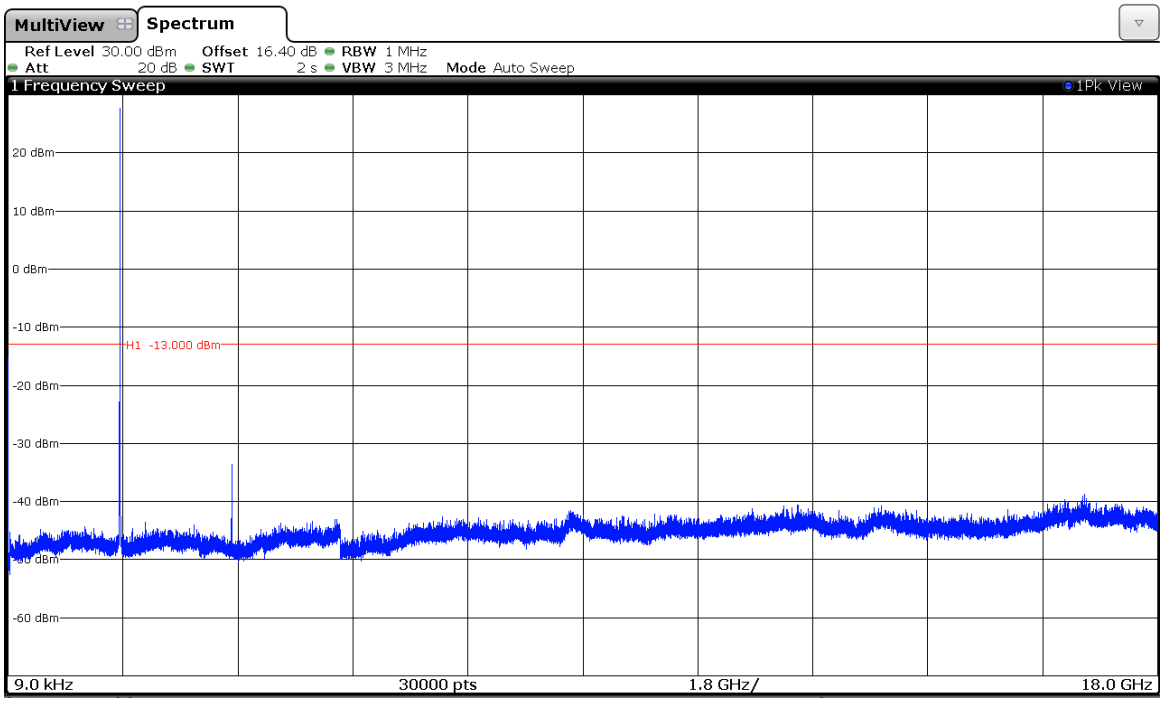
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

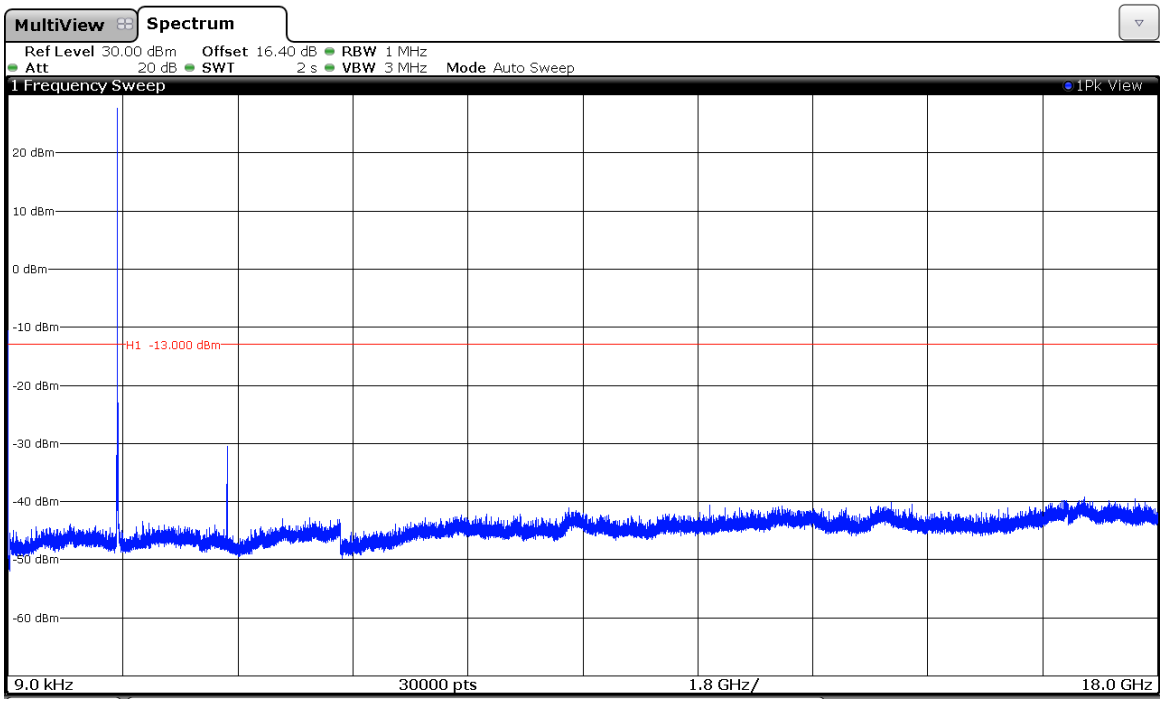
3. CHANNEL: HIGHEST



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

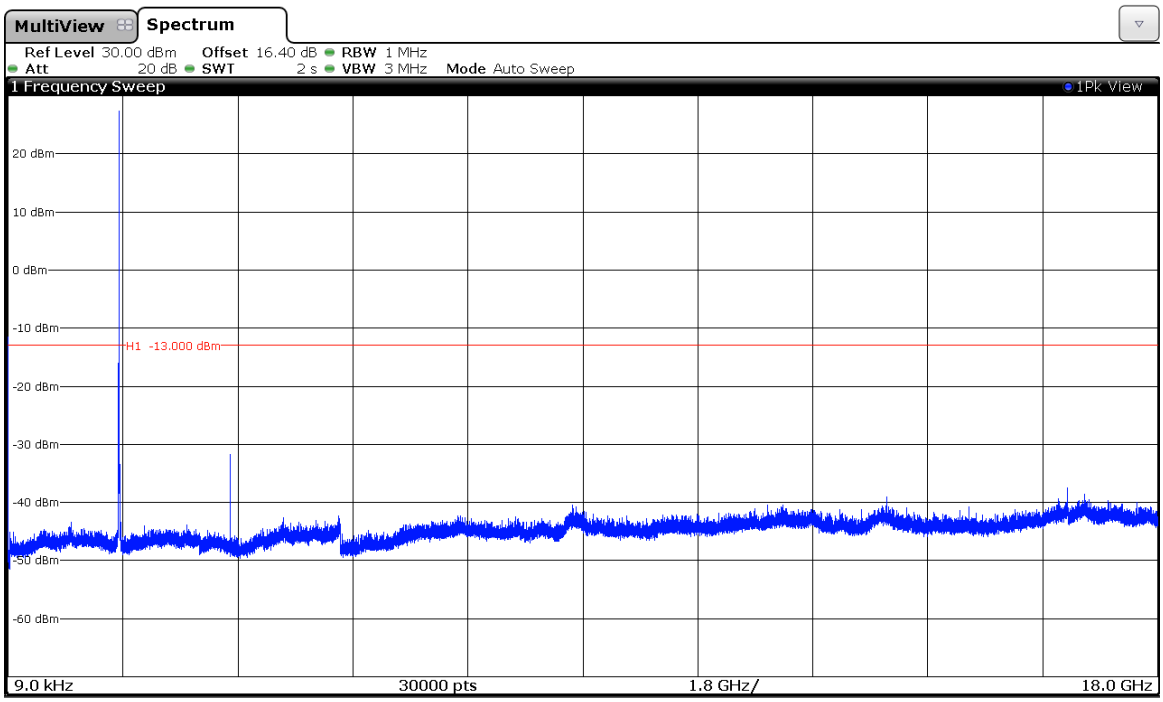
LTE QPSK MODULATION. BW = 10 MHz (Band IV)

1. CHANNEL: LOWEST



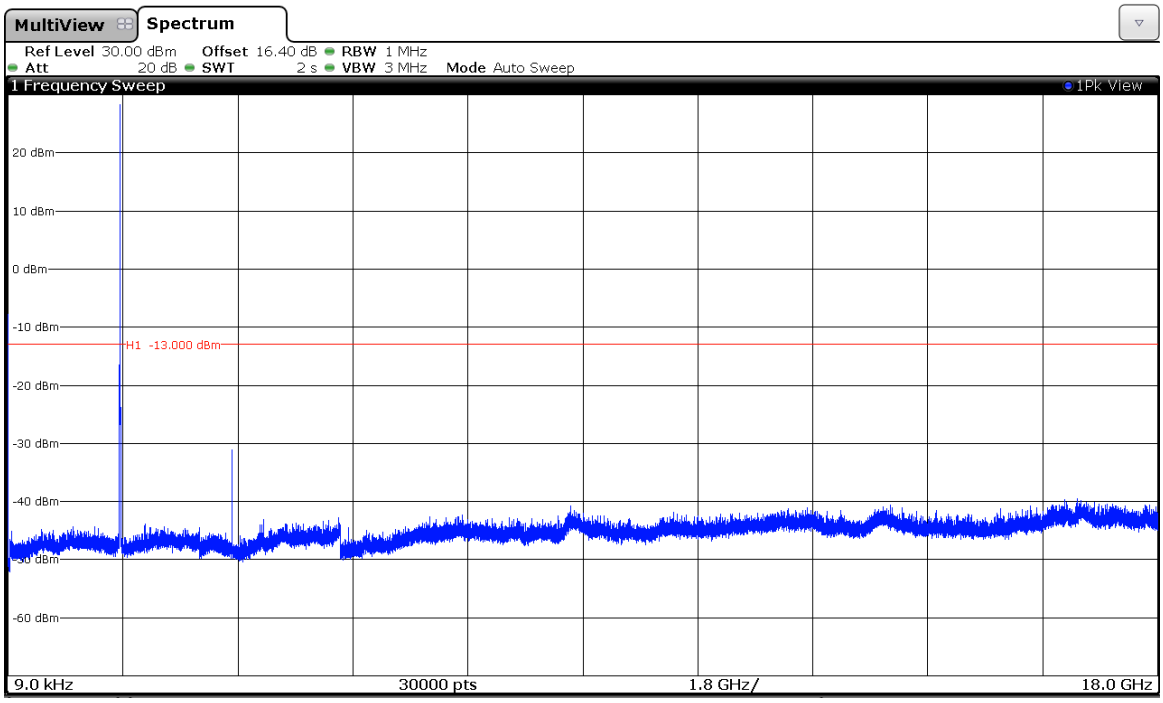
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

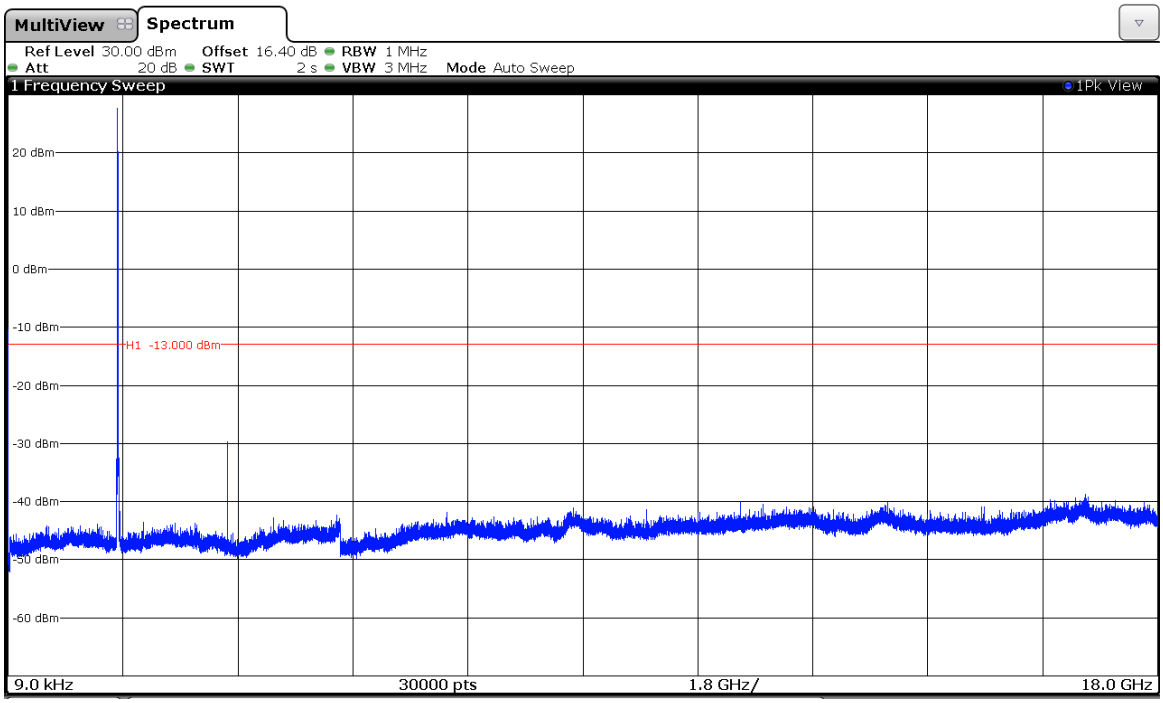
3. CHANNEL: HIGHEST



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

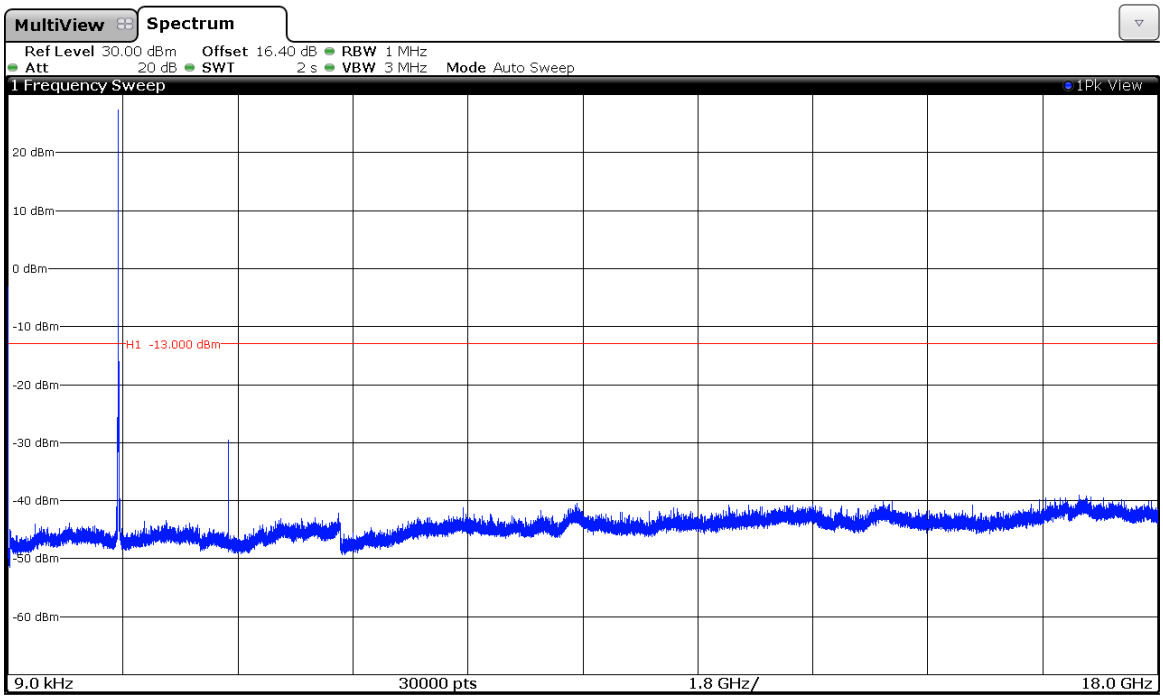
LTE QPSK MODULATION. BW = 15 MHz (Band IV)

1. CHANNEL: LOWEST



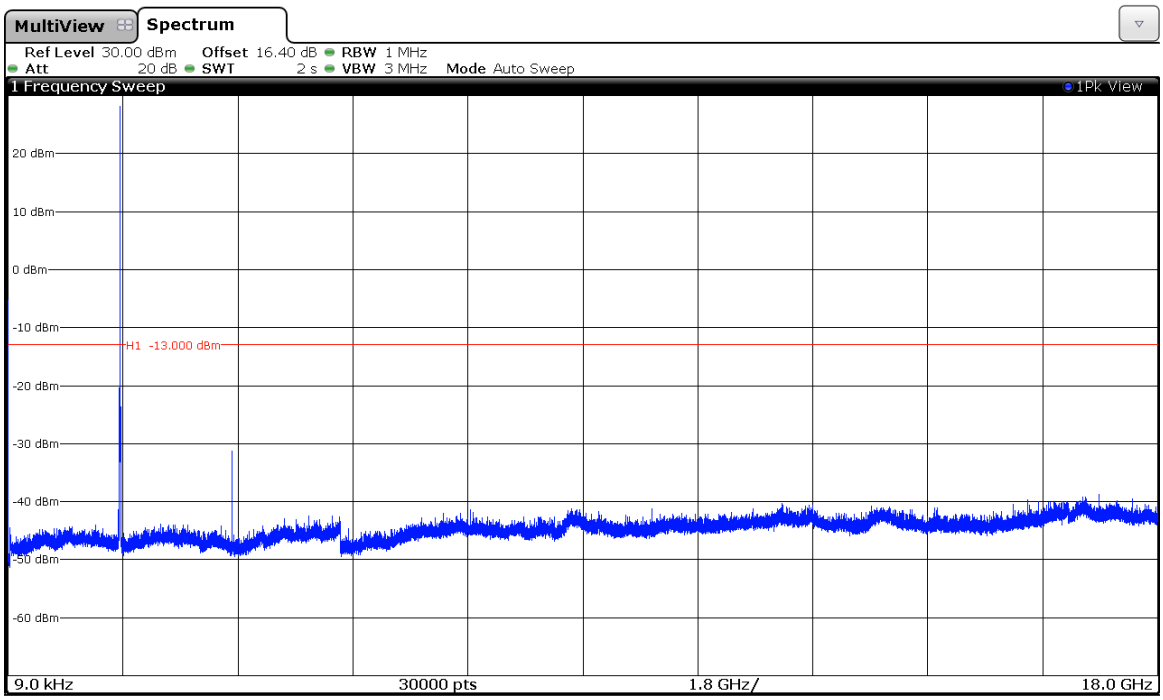
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

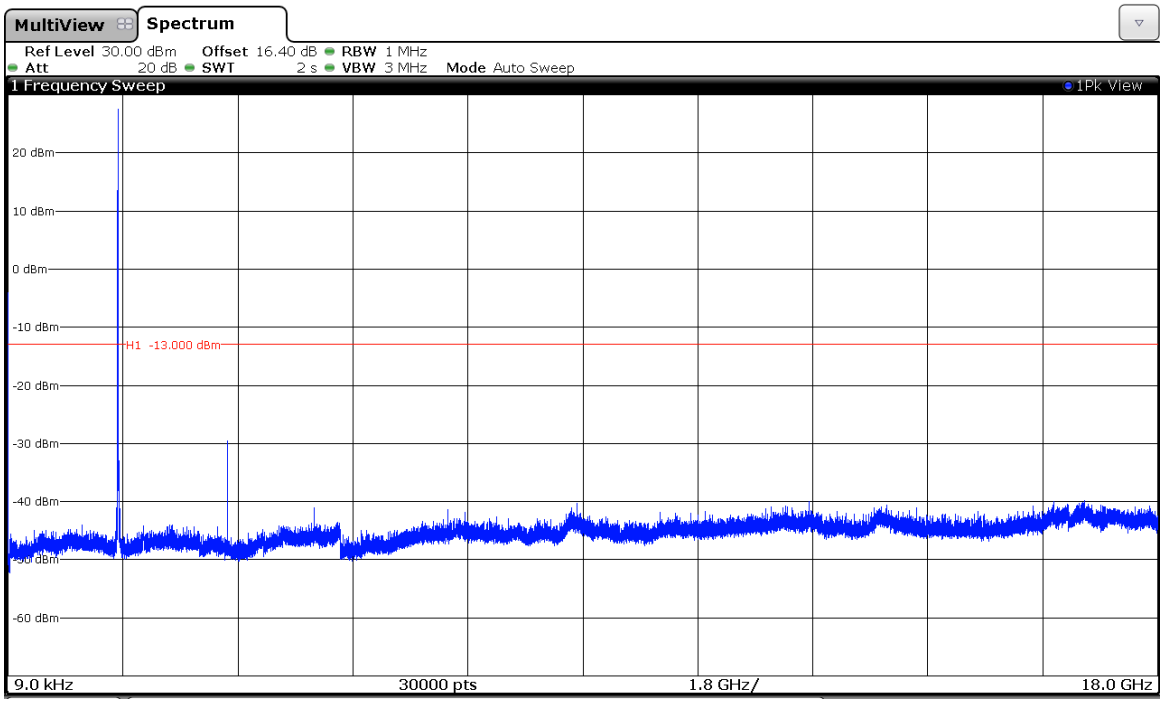
3. CHANNEL: HIGHEST



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

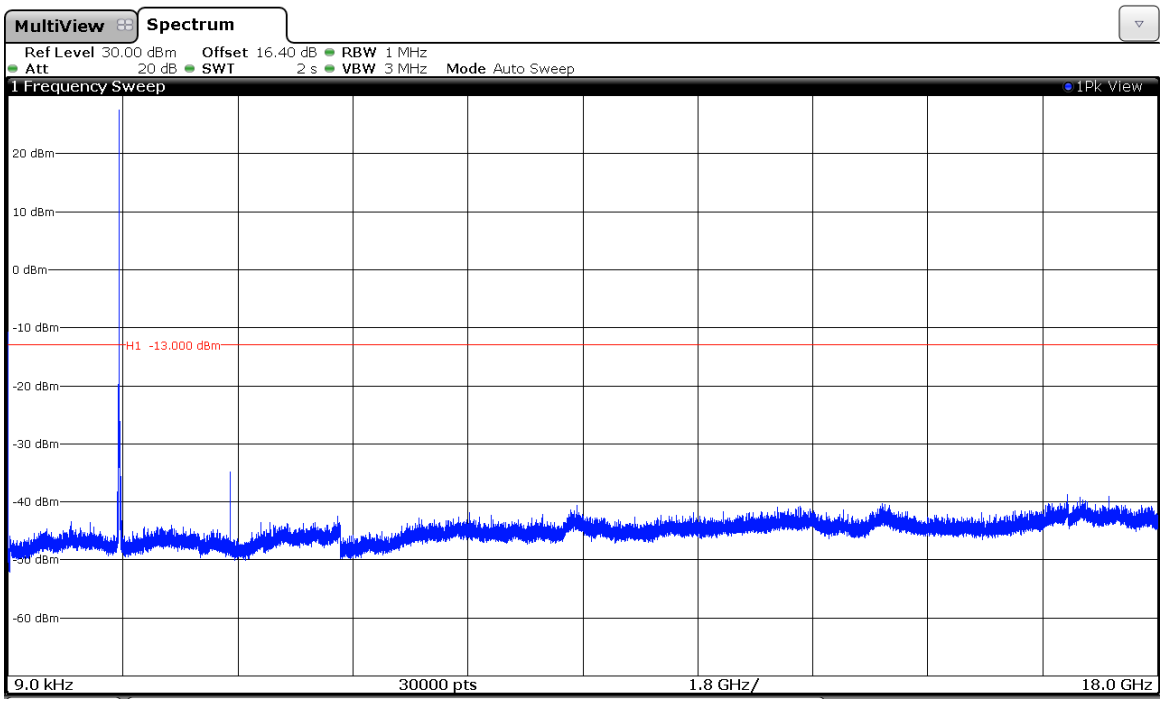
LTE QPSK MODULATION. BW = 20 MHz (Band IV)

1. CHANNEL: LOWEST



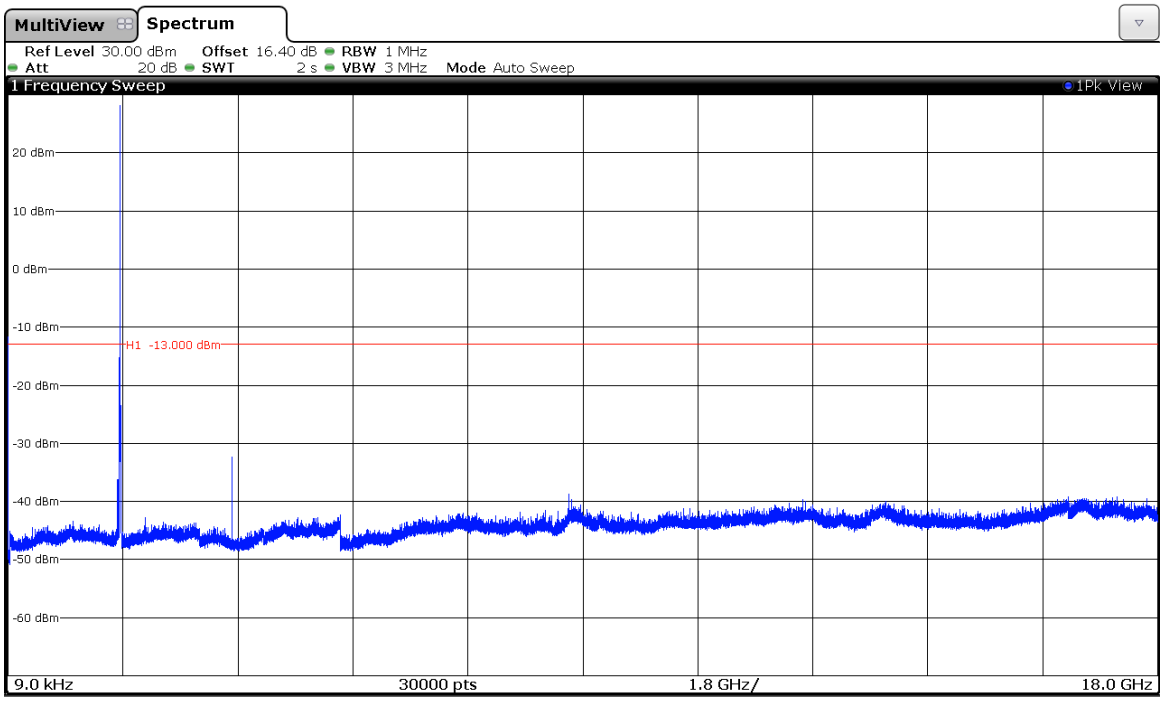
Note: The peak above the limit is the carrier frequency.

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 (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 Po transmitting power, the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:
Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = -13 dBm

METHOD

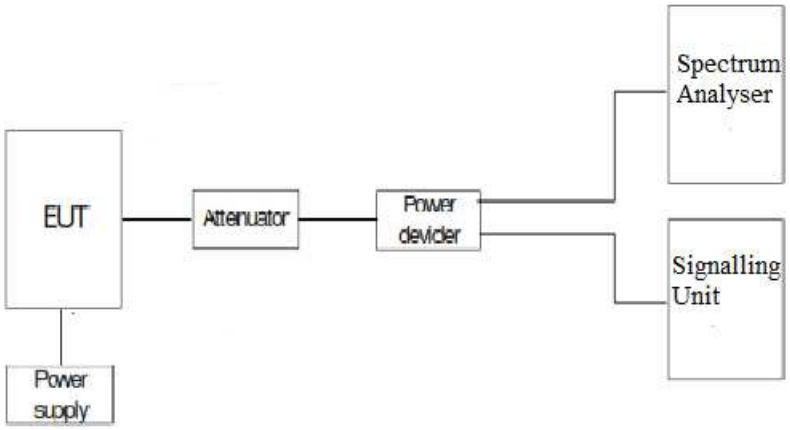
The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 ohm attenuator and a power splitter.

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)	-22.55	-18.45
Measurement uncertainty (dB)	<±2.03	

MODULATION:	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-21.55	-18.19
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)	-20.41	-19.05	-22.20	-31.51	-28.90	-30.47

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)	-29.11	-27.72	-29.74	-29.33	-26.84	-26.48

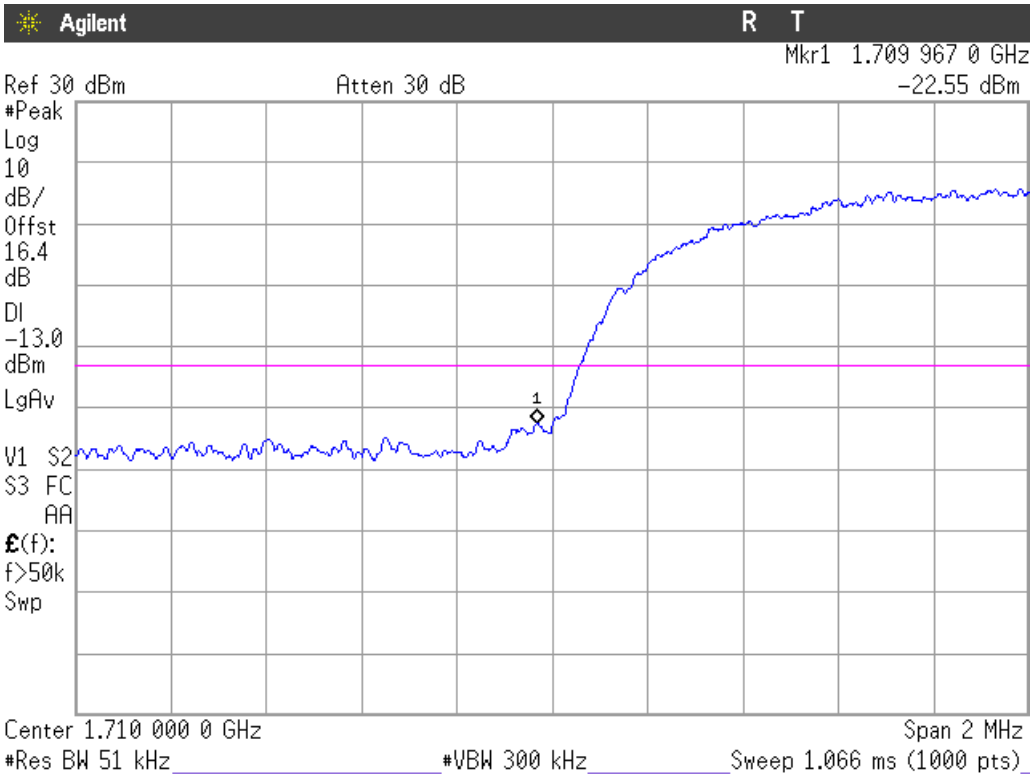
LTE QPSK MODULATION: (Channels in Band IV):	RB= 1, Offset=Max, BW=1.4 MHz	RB= 1, Offset=Max, BW = 3 MHz	RB= 1, Offset=Max, BW = 5 MHz	RB= 1, Offset=Max, BW = 10 MHz	RB= 1, Offset=Max, BW = 15 MHz	RB= 1, Offset=Max, BW = 20 MHz
Maximum measured level at highest Block Edge at antenna port (dBm)	-25.12	-19.35	-24.56	-31.46	-27.80	-29.68

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)	-29.71	-28.78	-29.73	-31.86	-30.67	-28.31

Measurement uncertainty = <±2.03 dB.

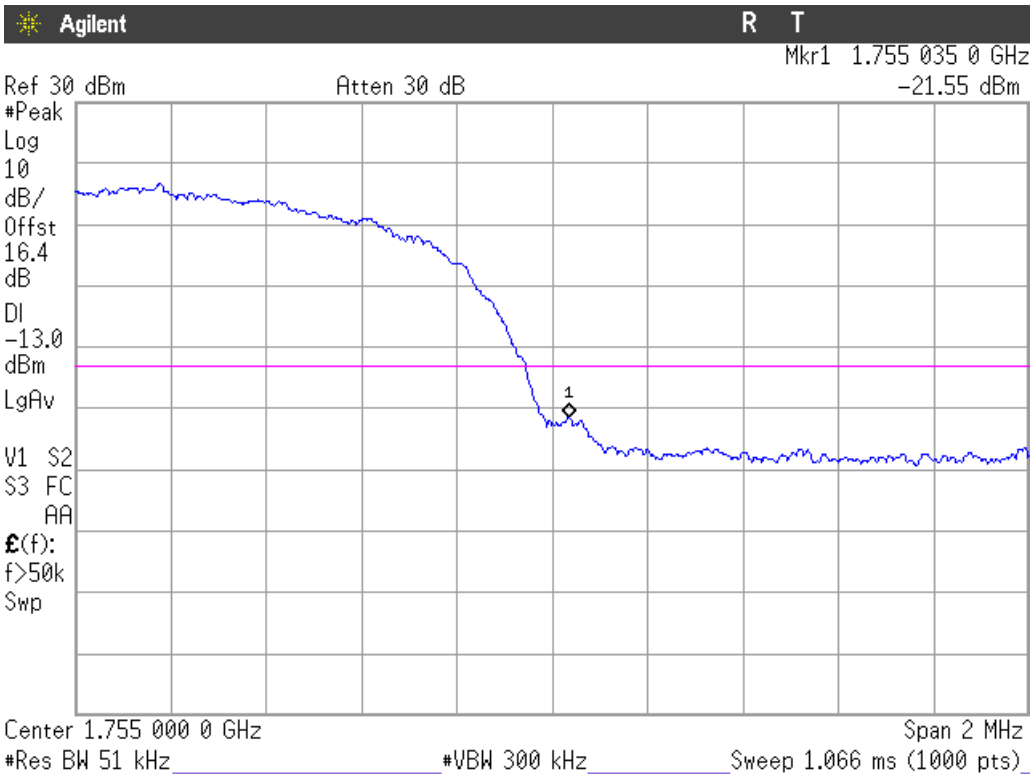
WCDMA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

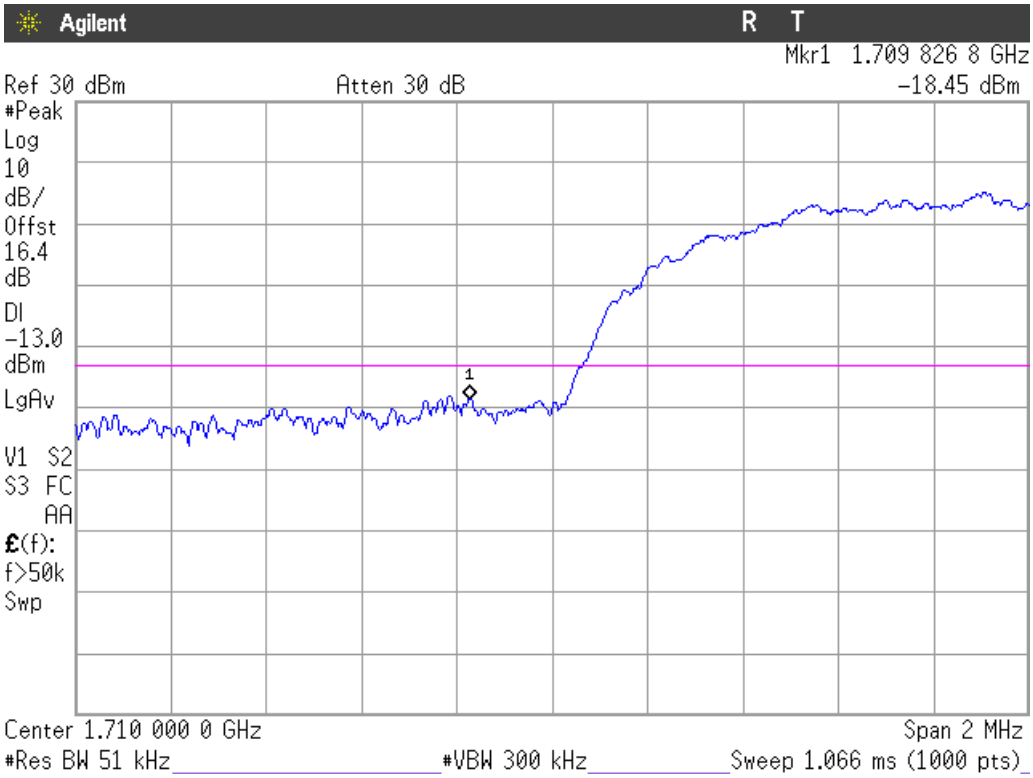
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

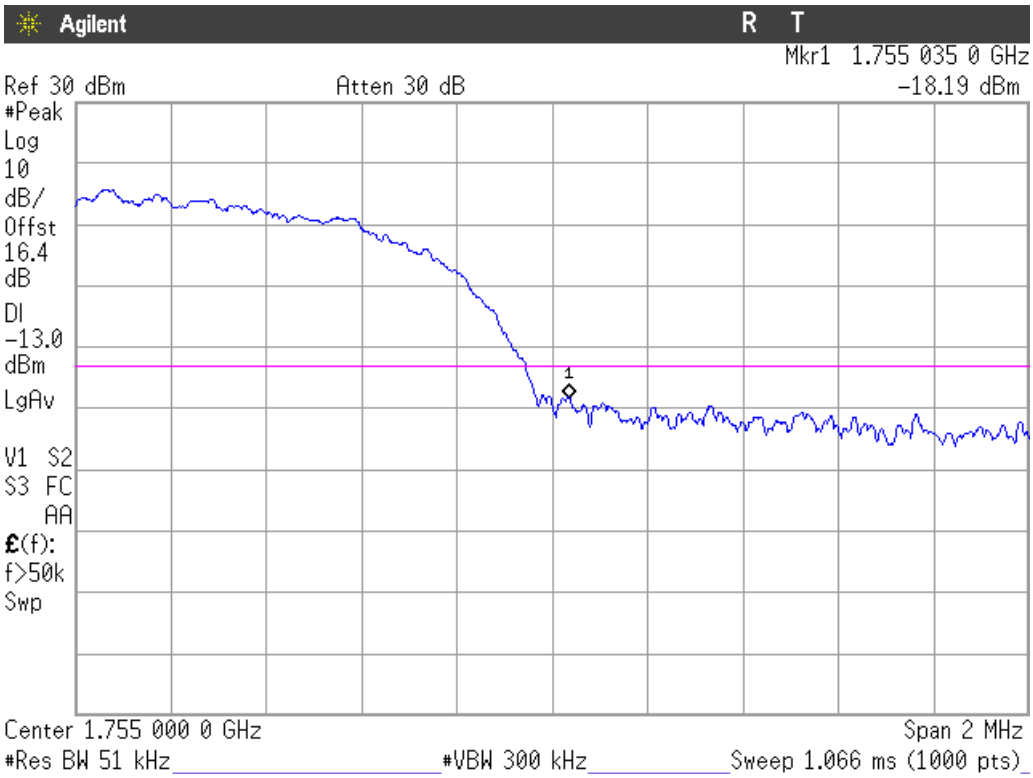
HSUPA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

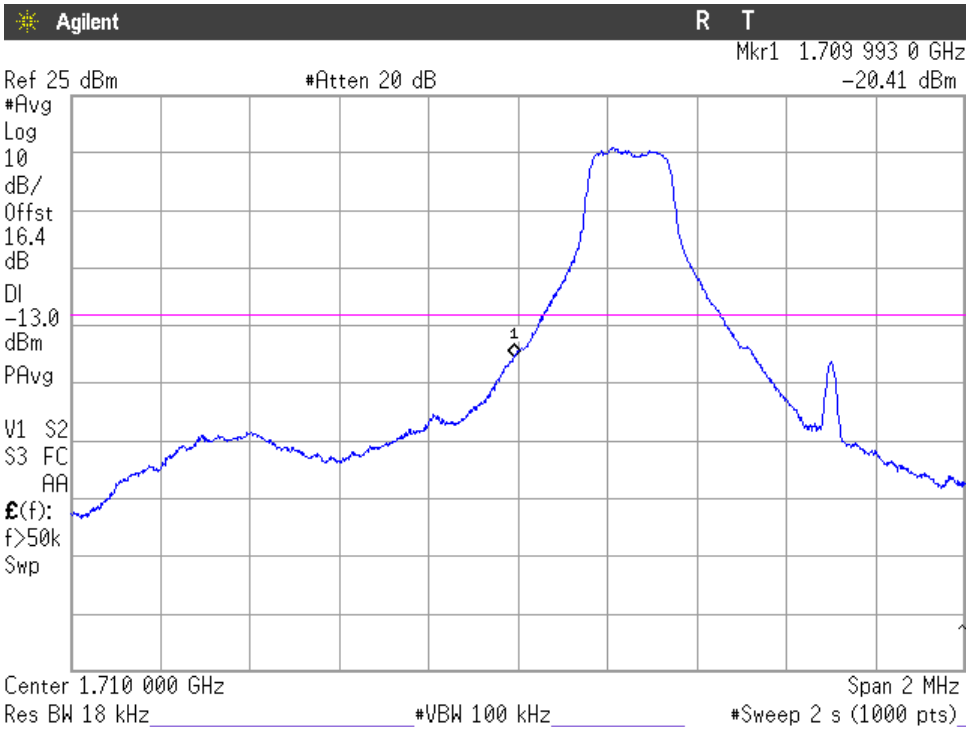
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

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

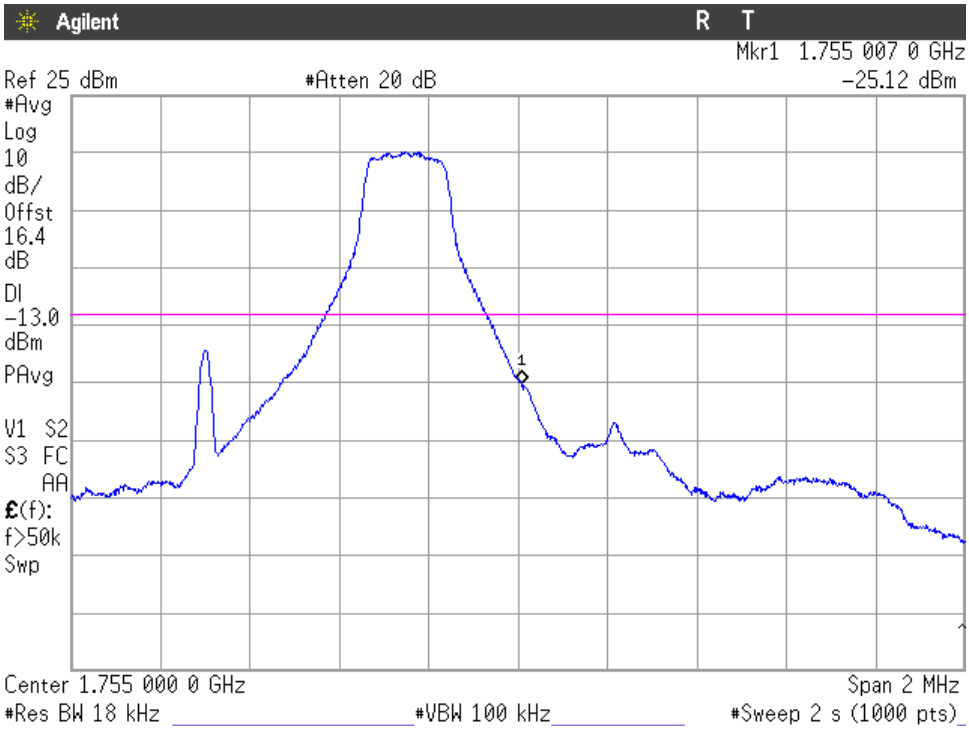
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

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

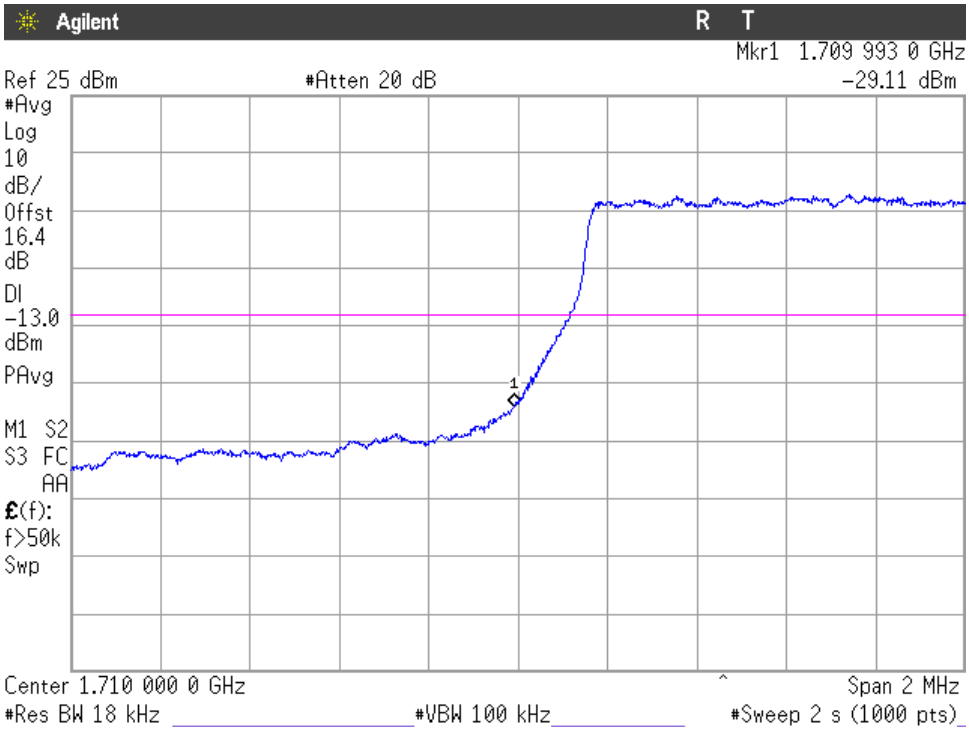
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

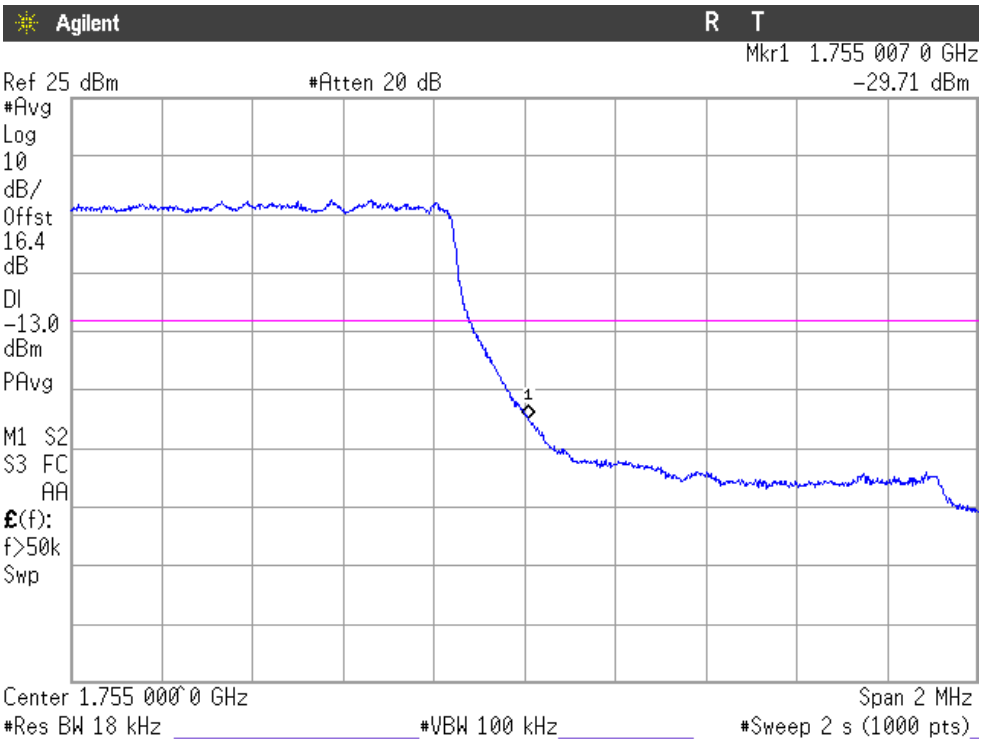
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 1.4 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

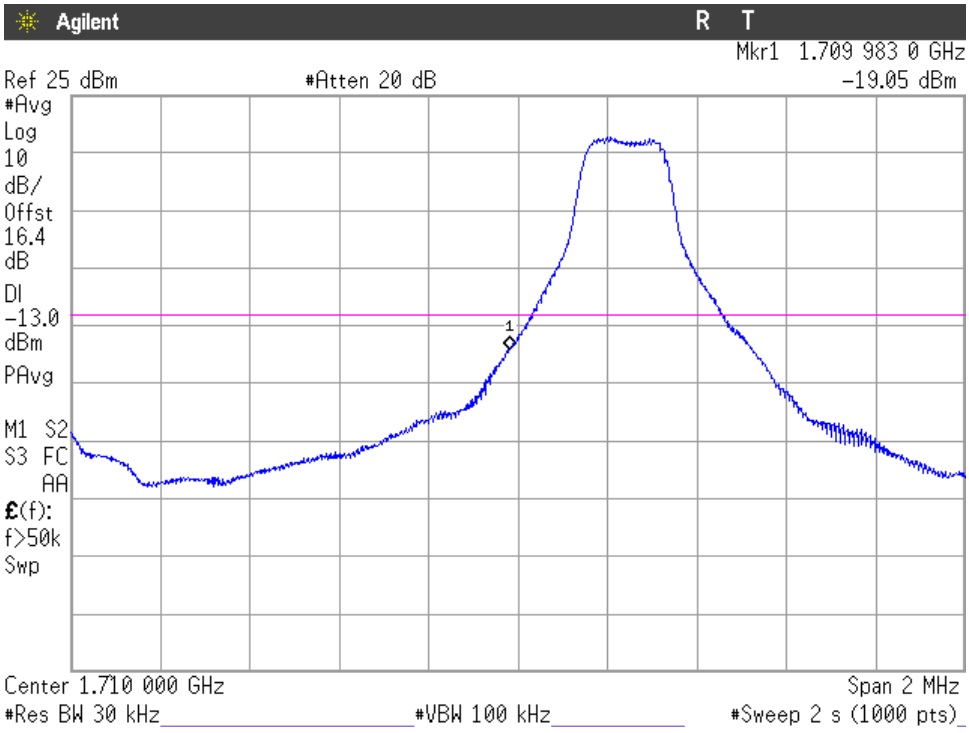


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

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

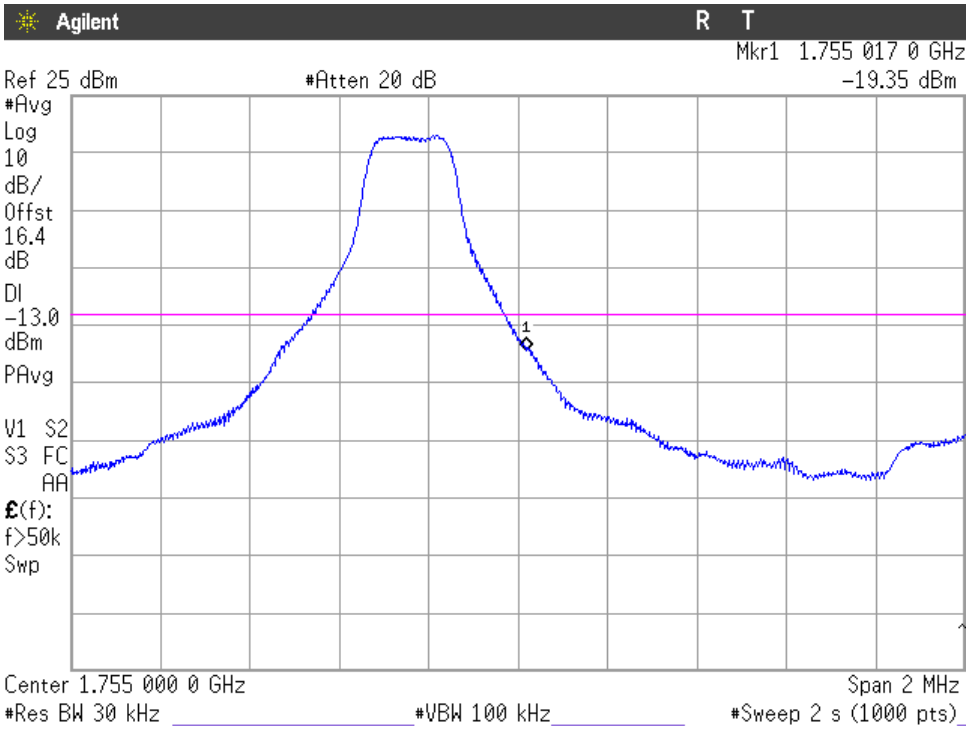
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

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

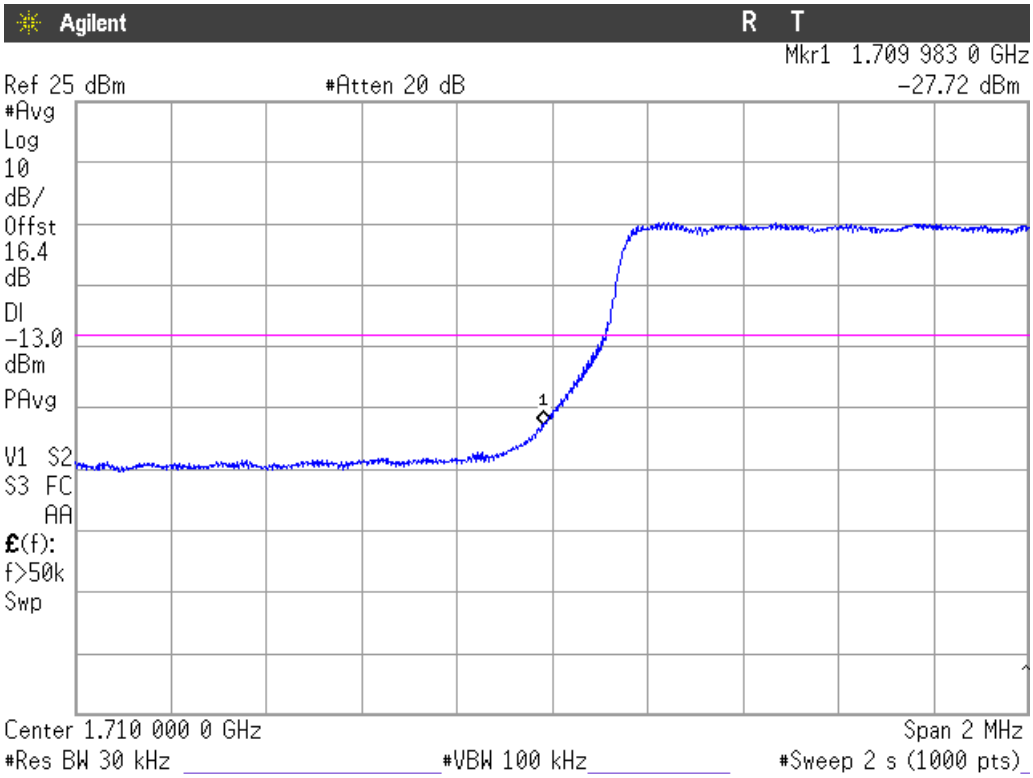
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

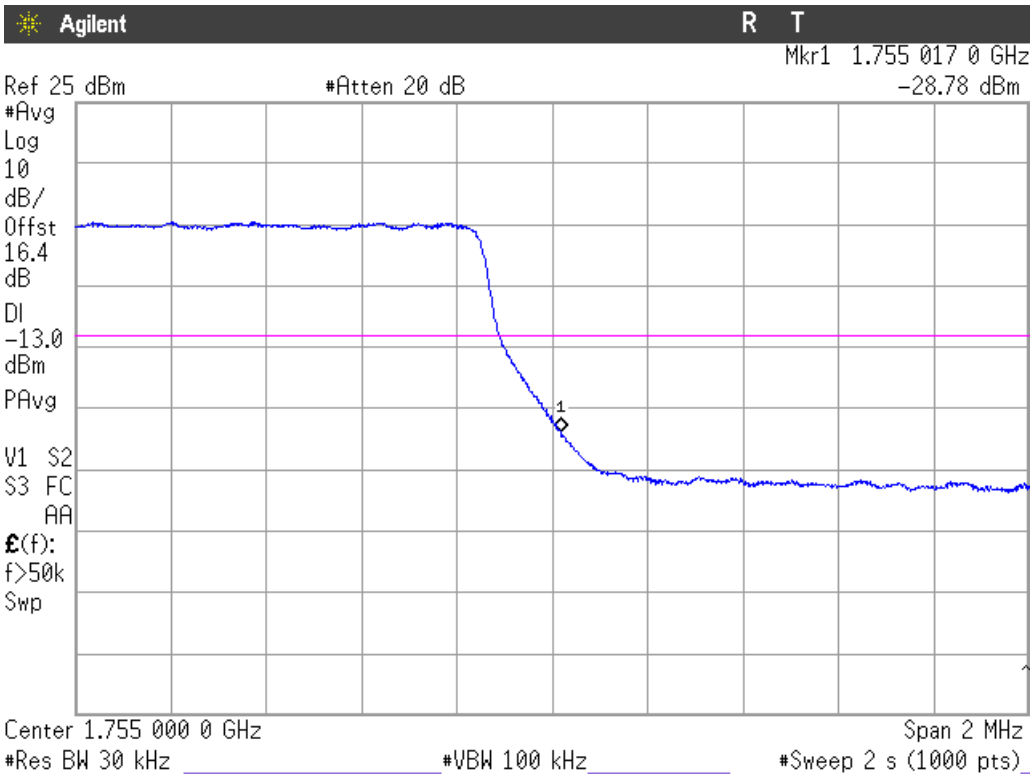
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 3 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

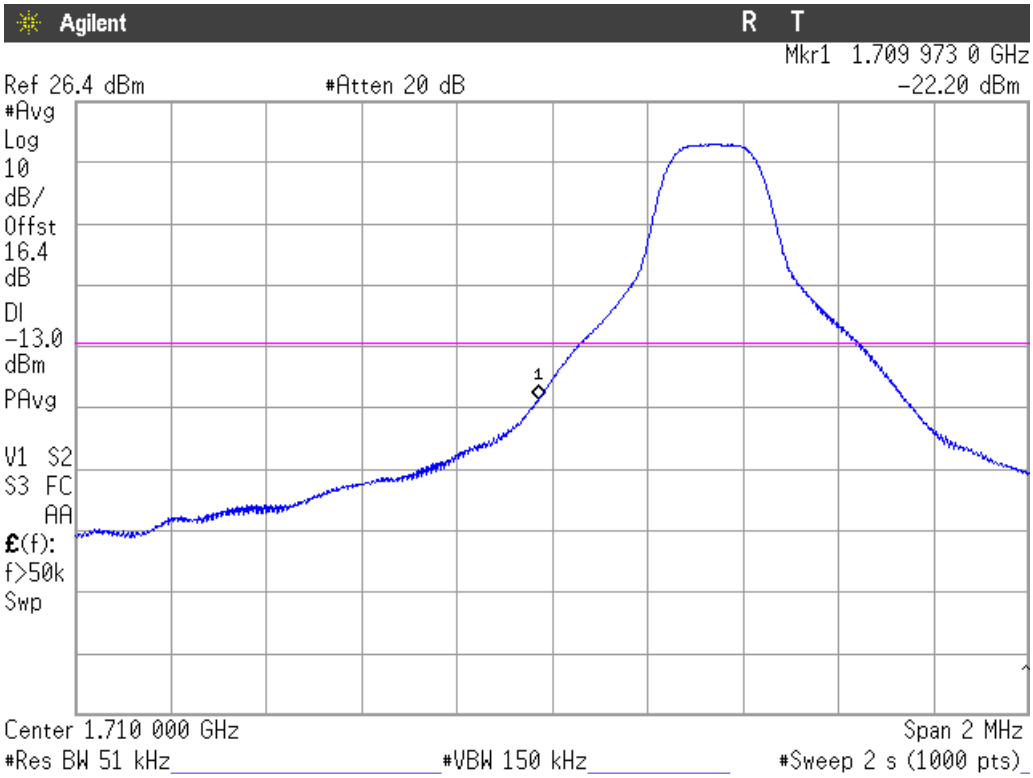


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

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

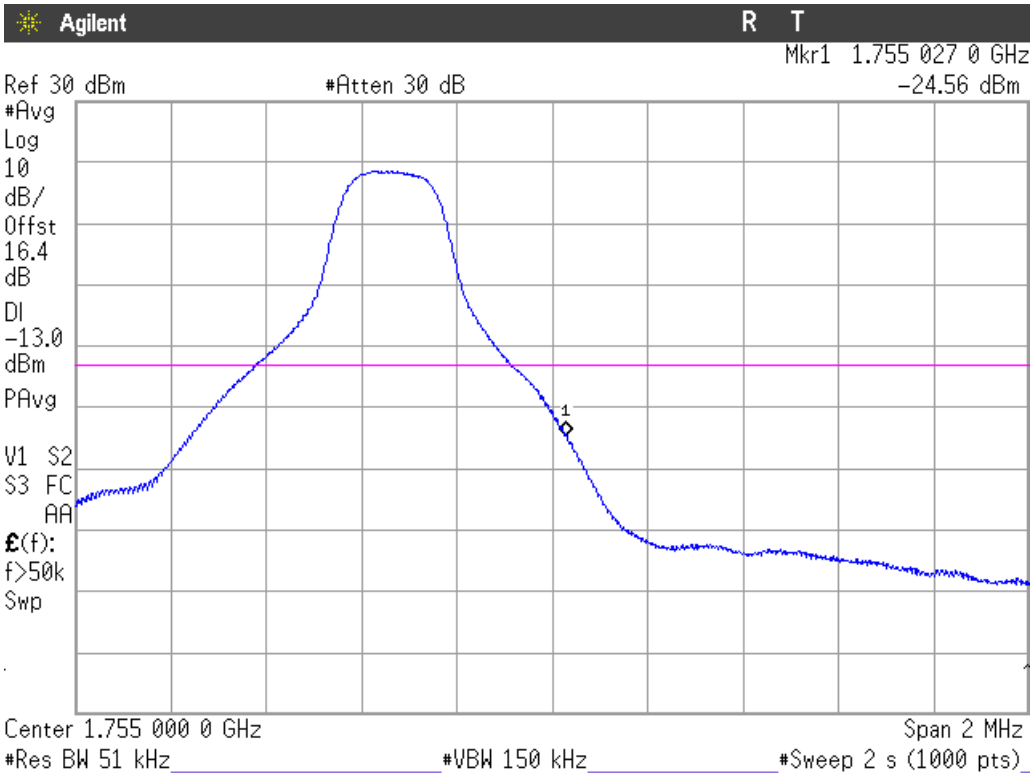
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

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

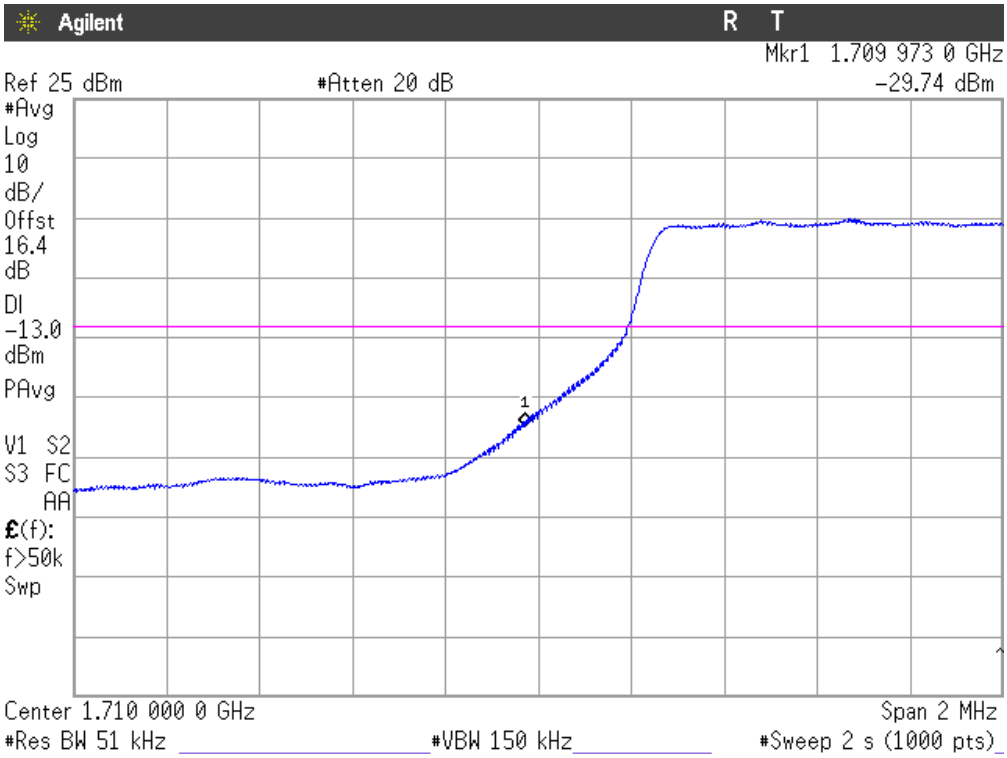
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

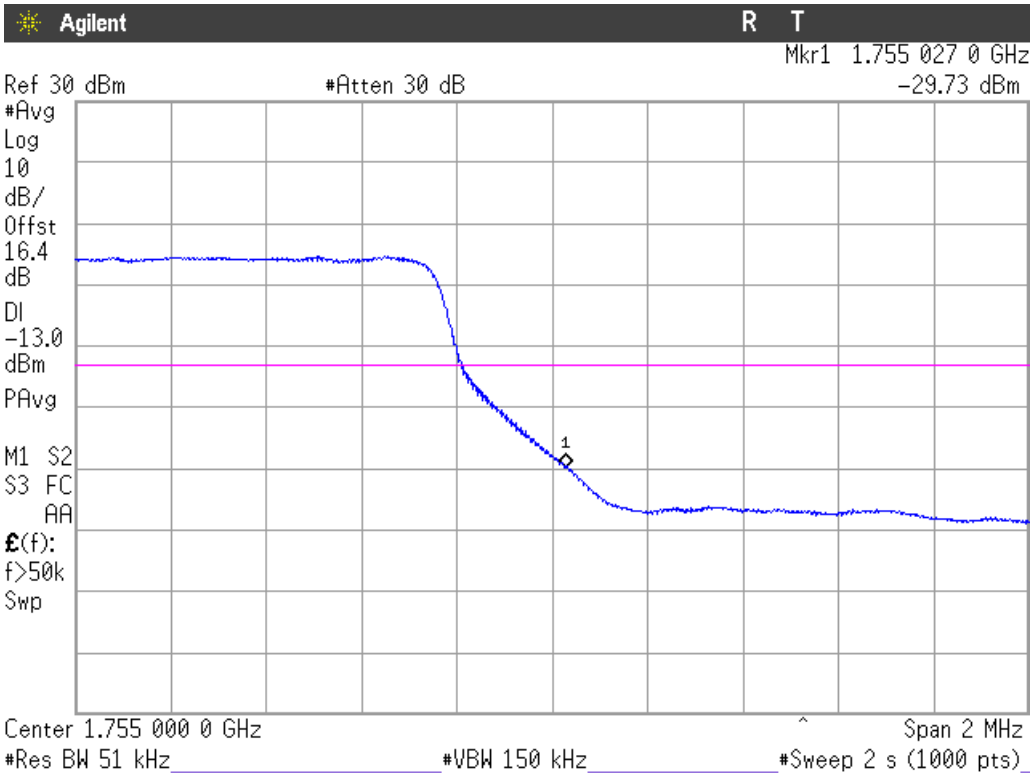
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 5 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

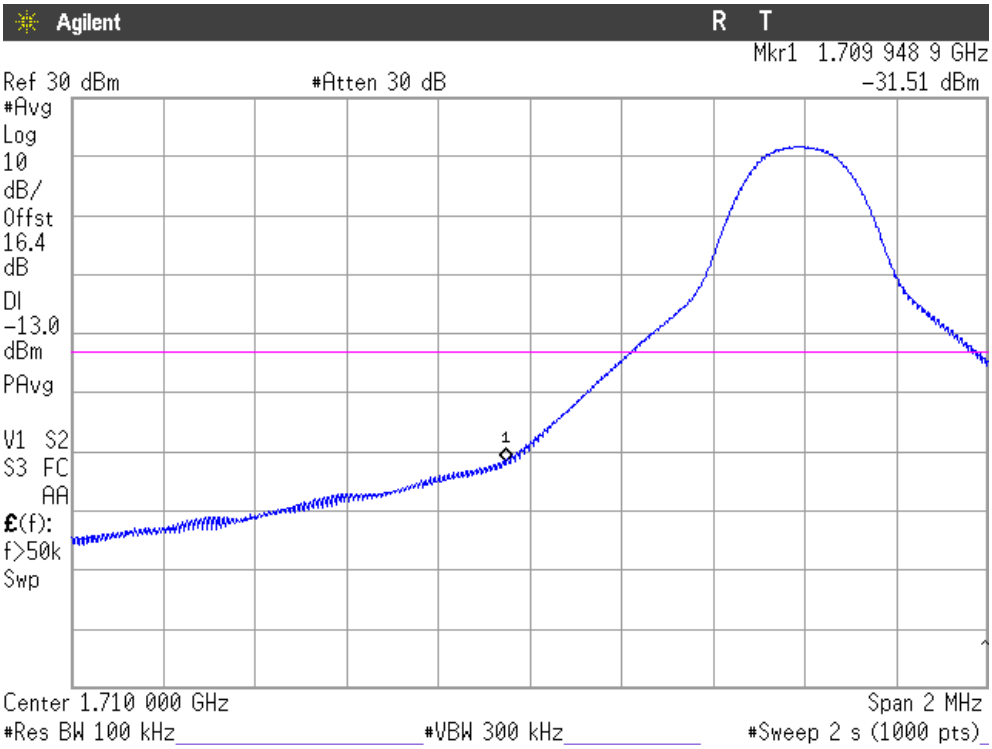


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

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

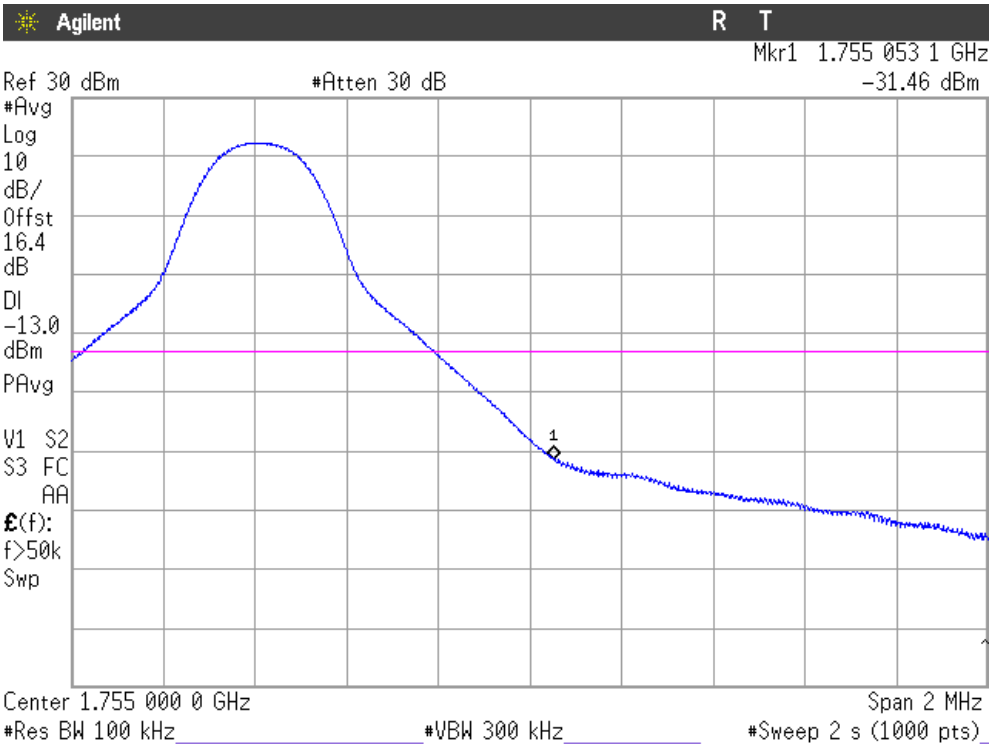
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

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

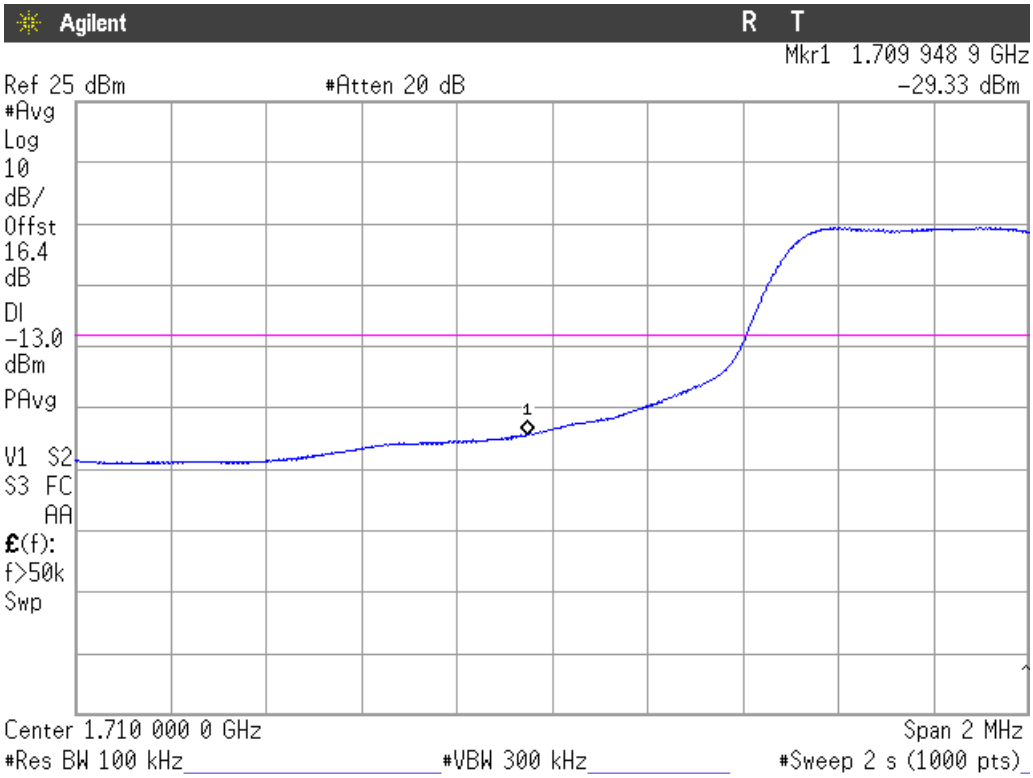
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

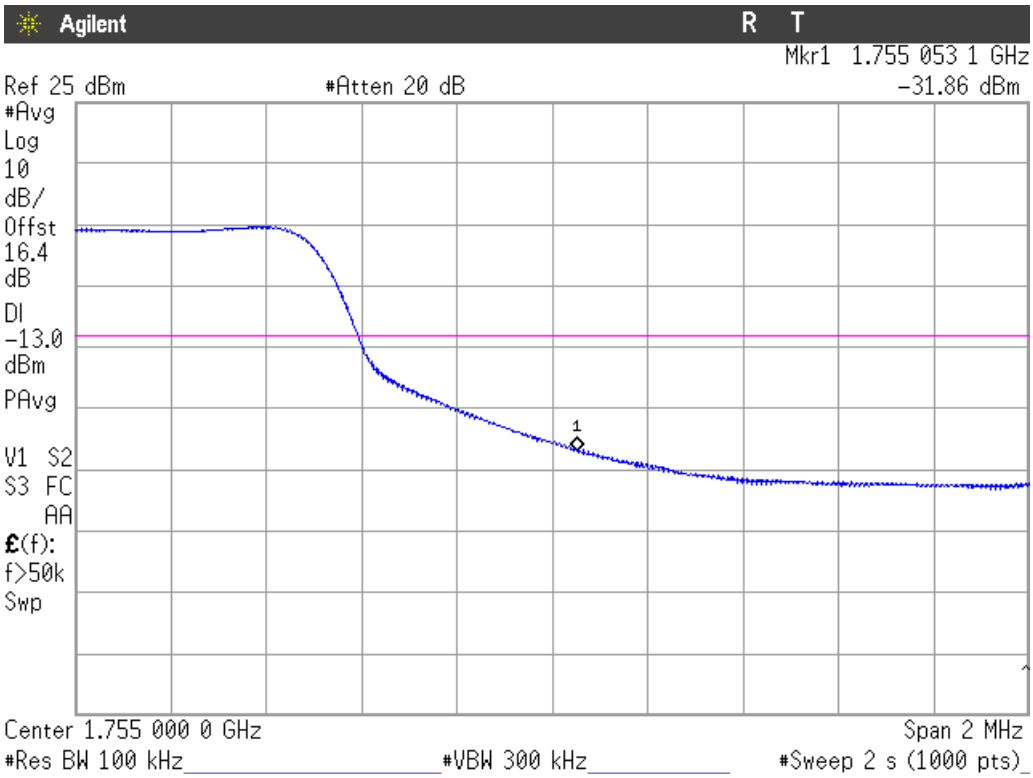
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 10 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

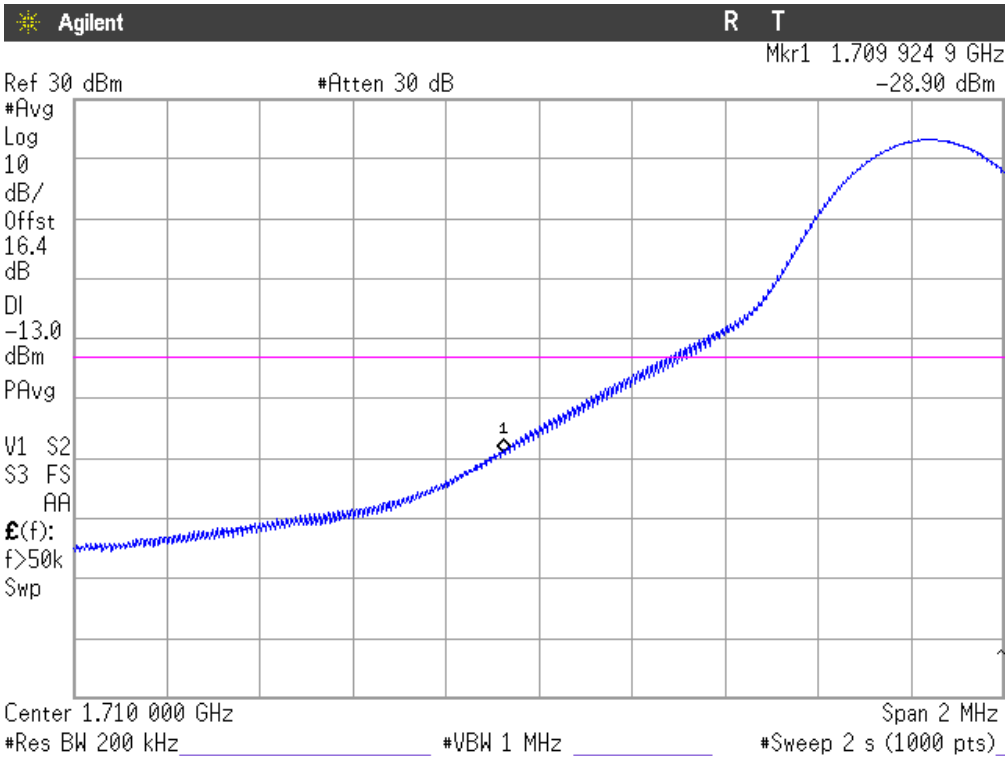


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

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

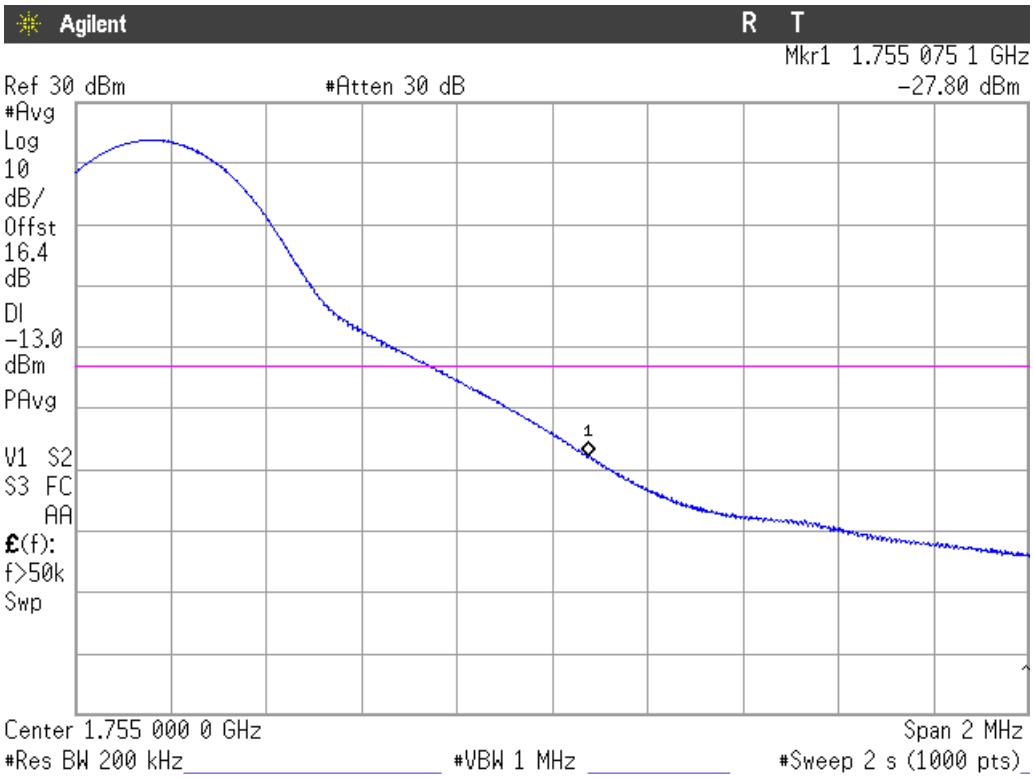
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

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

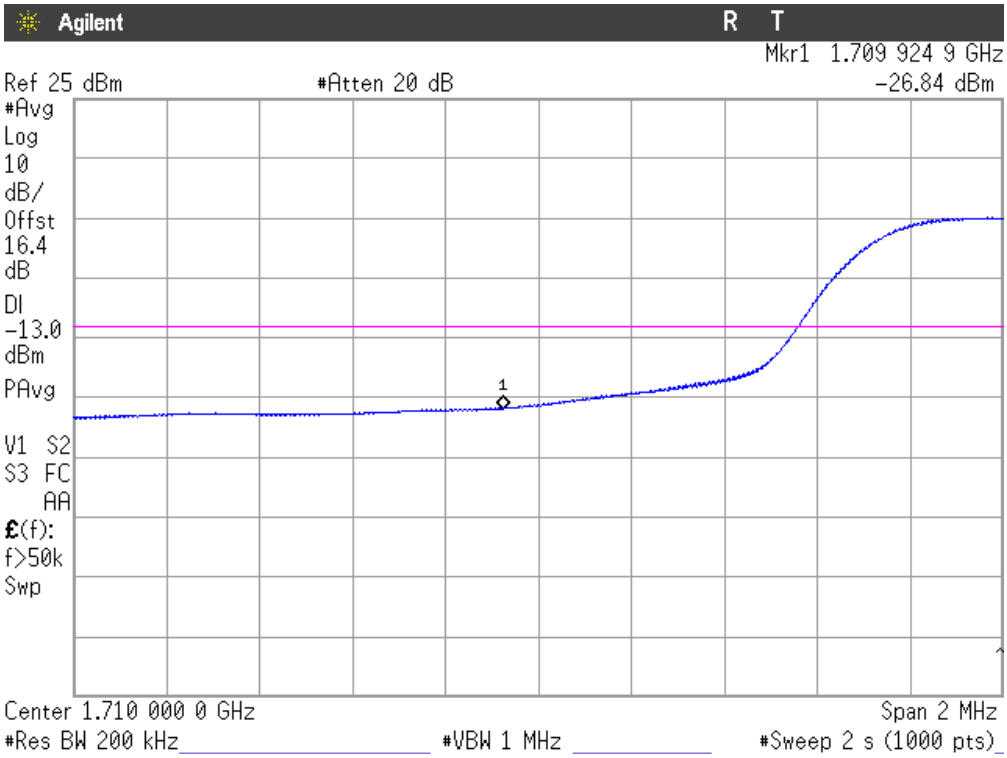
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

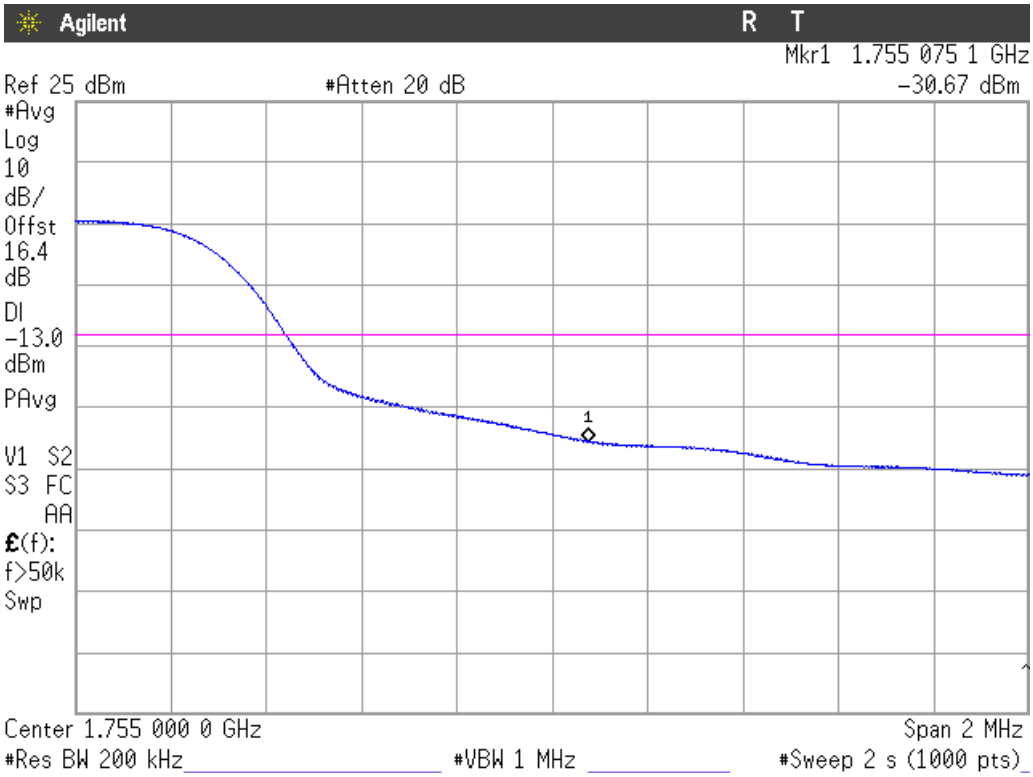
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 15 MHz (Band IV)

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

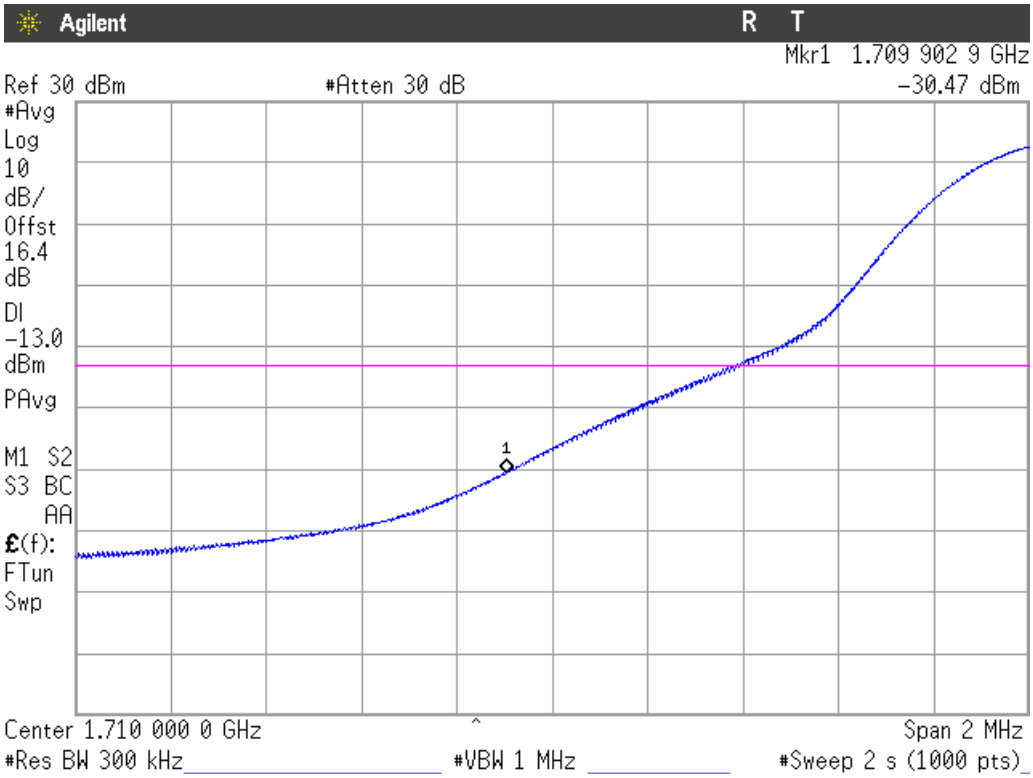


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

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

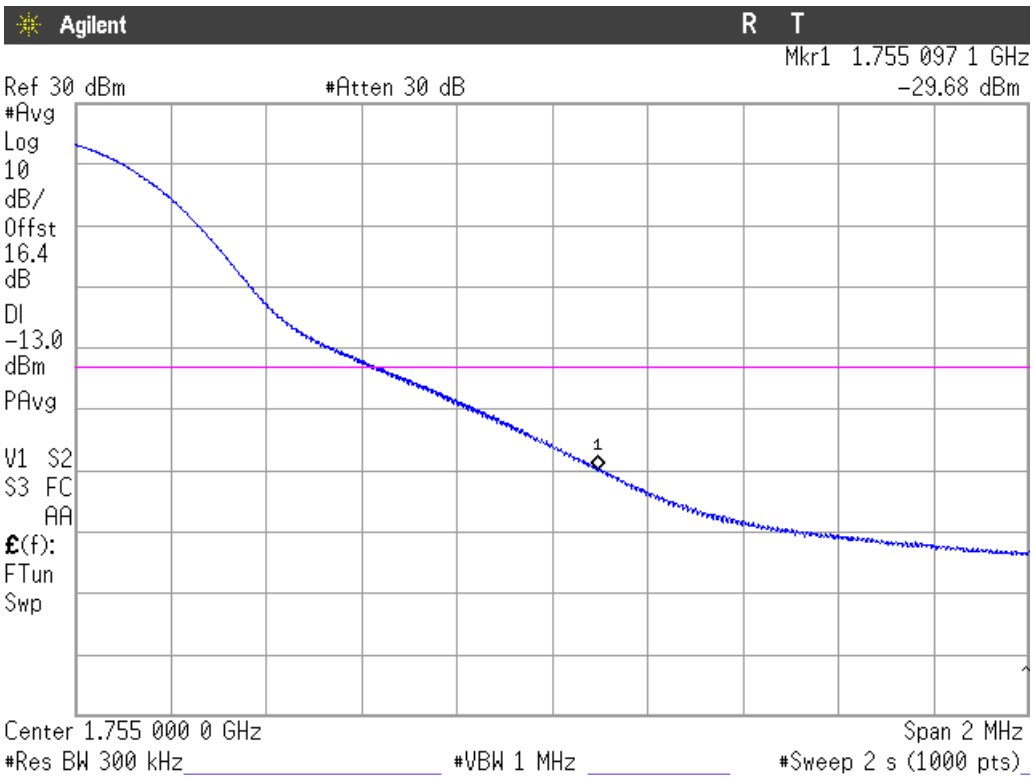
CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

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

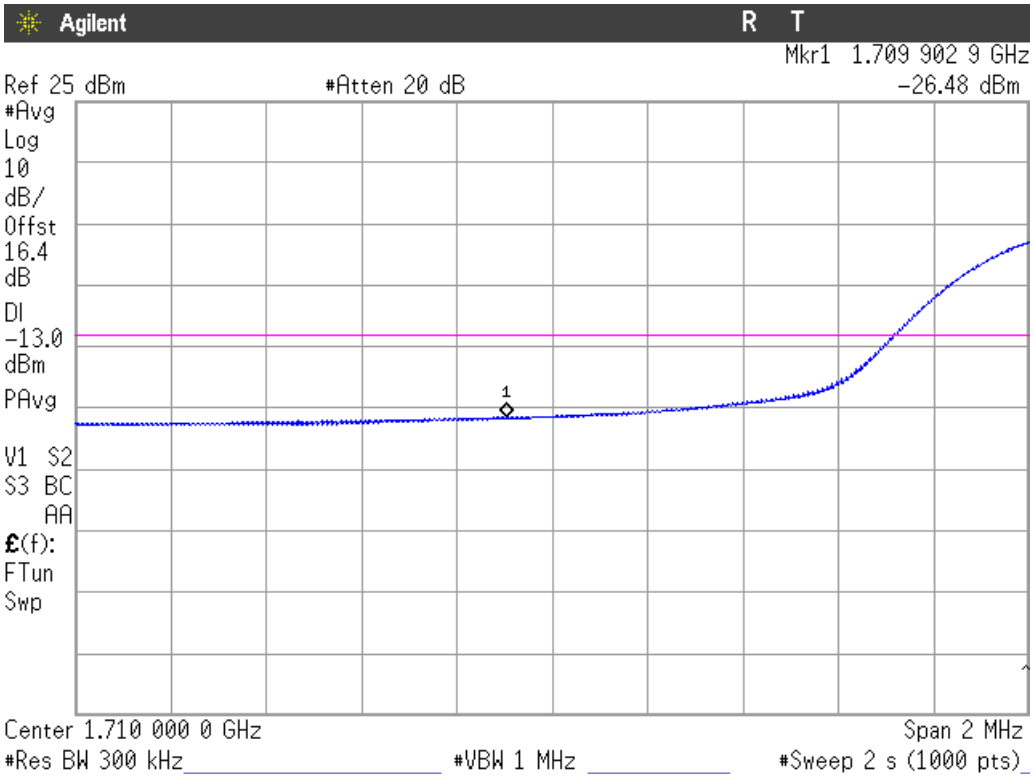
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

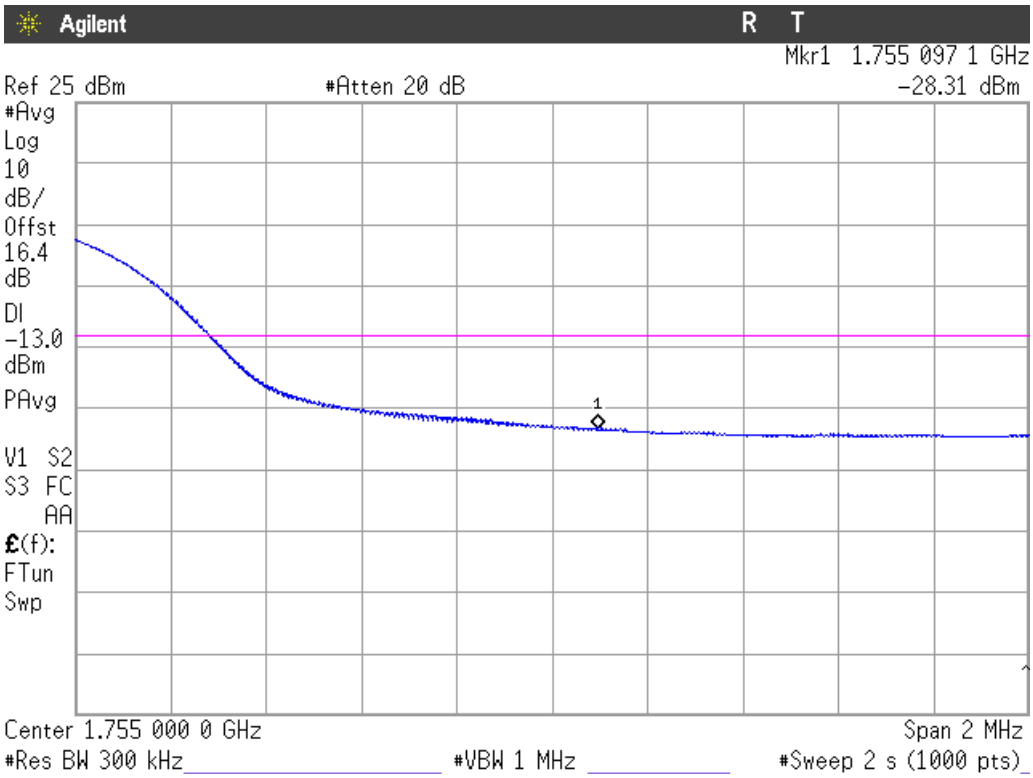
LTE QPSK MODULATION. RB = All, Offset = 0, BW = 20 MHz (Band IV)

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 Po transmitting power, the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:
Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = -13 dBm

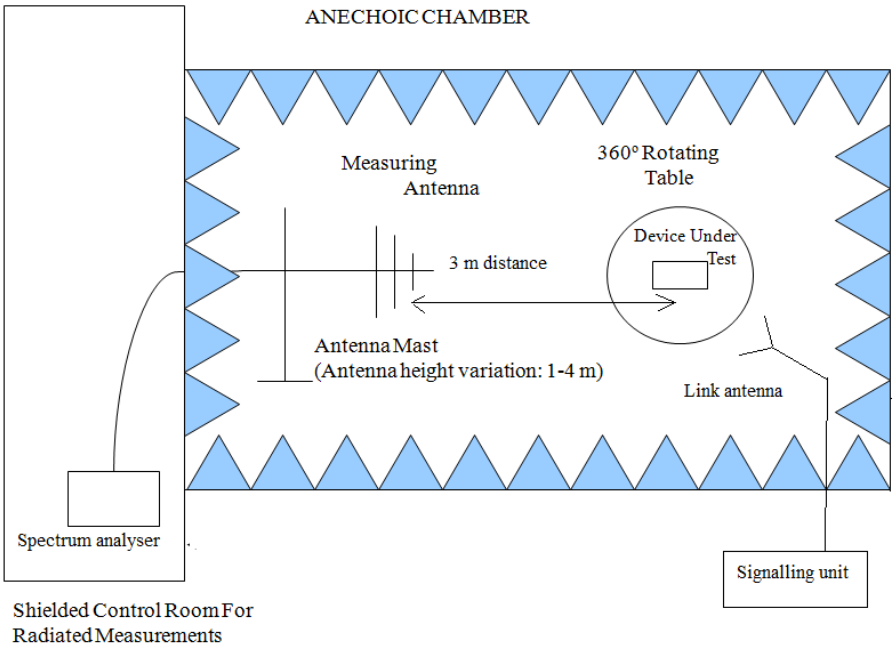
METHOD

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.

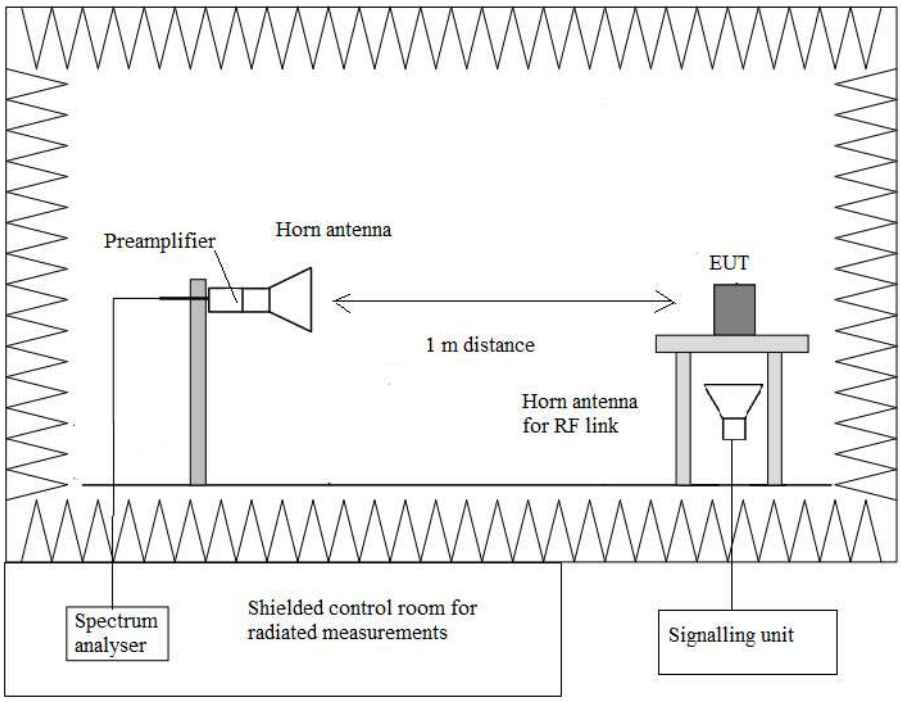
The test was performed with the equipment transmitting first in only cellular mode, repeated with the BT EDR/BT LE (modulation GFSK, which is the worst case) and repeated with WIFI (802.11b mode which is the worst case) radios transmitting simultaneously to check the impact of the co-location of both 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 WCDMA modulation as the worst case. The following tables and plots show the results for WCDMA 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 spurious signals were found 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 spurious signals were found 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 spurious signals were found 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 QPSK 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 spurious signals were found 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 spurious signals were found 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

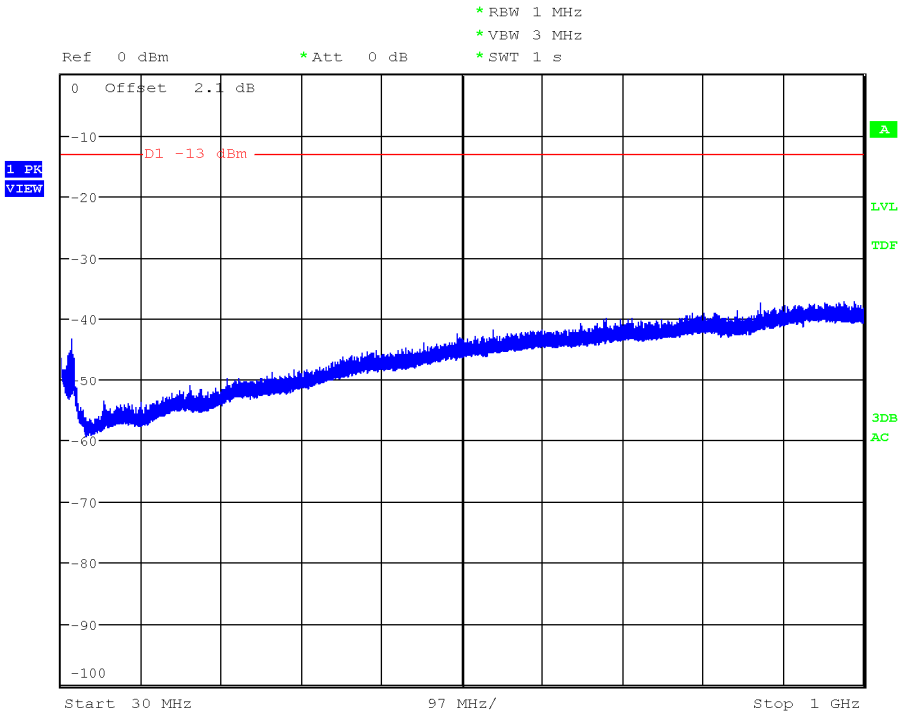
Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
17538.75	-51.58	Horizontal	-40.31	3.13	10.57	-32.87

Measurement uncertainty (dB)	<±3.88 for f < 1GHz <±4.87 for f ≥ 1 GHz up to 18 GHz

Verdict: PASS

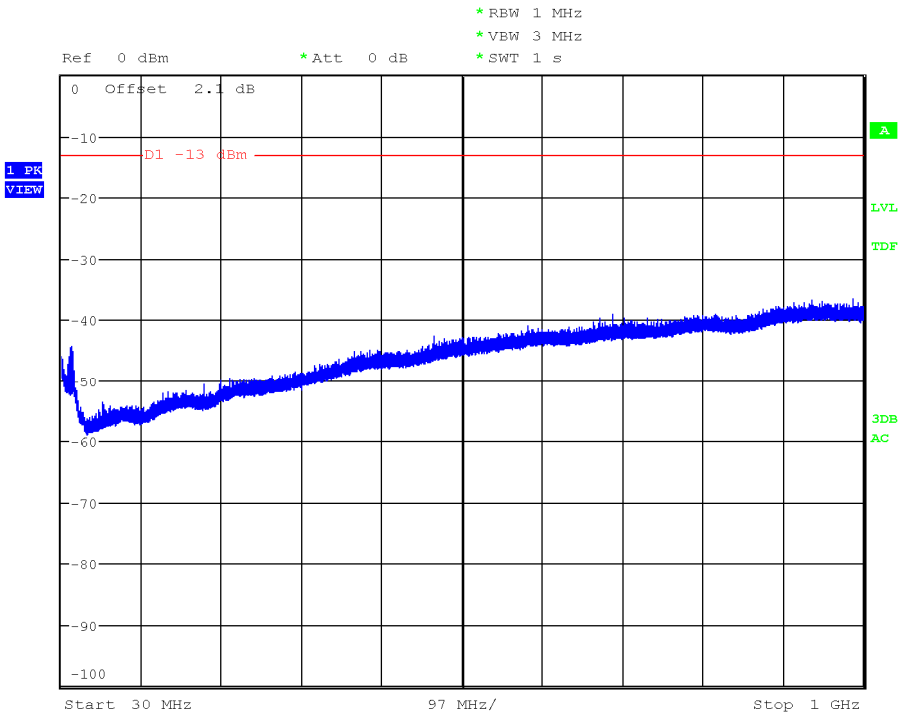
FREQUENCY RANGE 30 MHz-1000 MHz.

WCDMA Band IV



(This plot is valid for all three channels)

LTE QPSK MODULATION. BW=1.4 MHz. Band IV

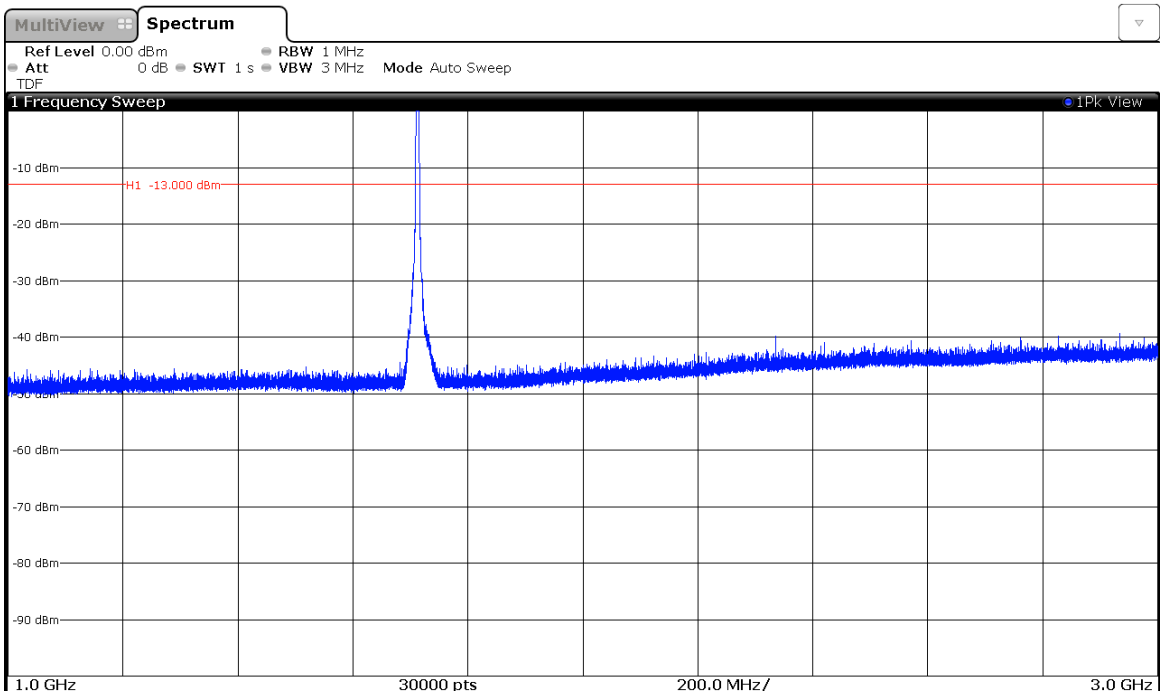


(This plot is valid for all three channels)

FREQUENCY RANGE 1 GHz to 3 GHz.

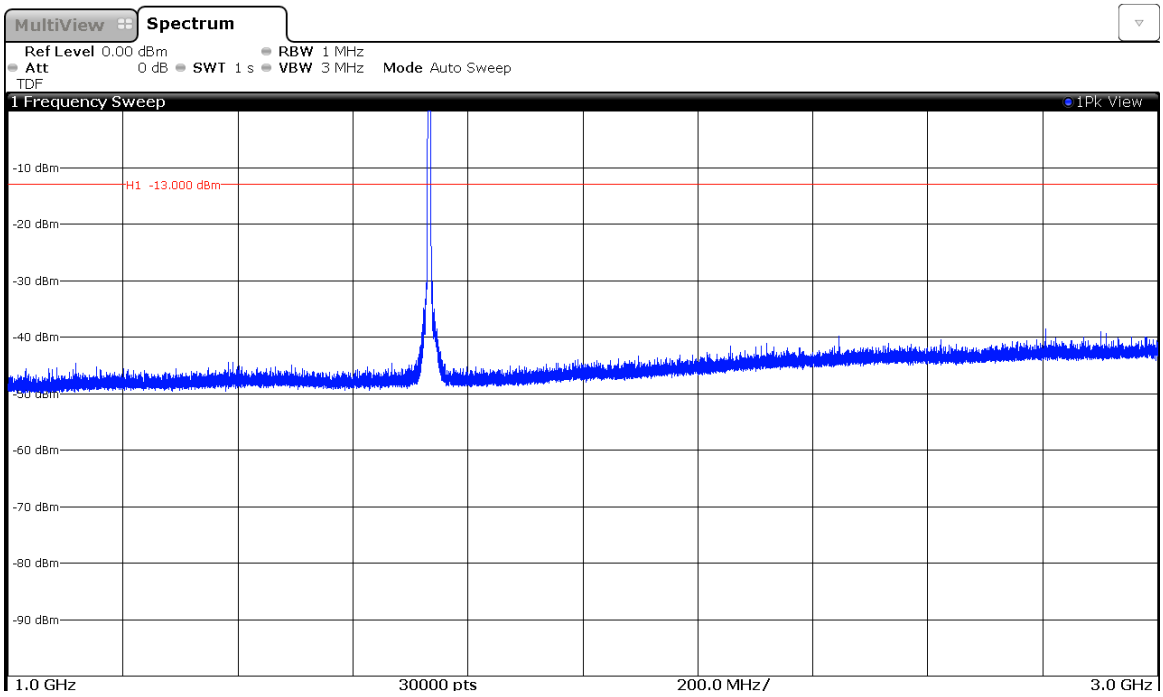
WCDMA Band IV

CHANNEL: LOWEST



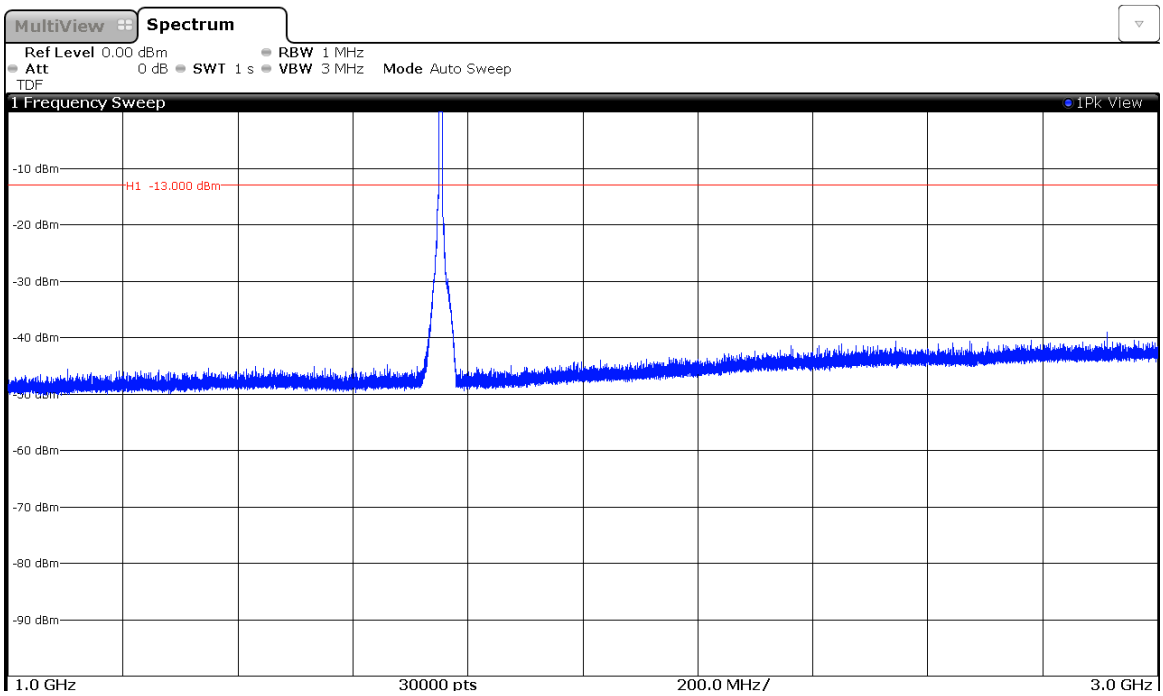
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

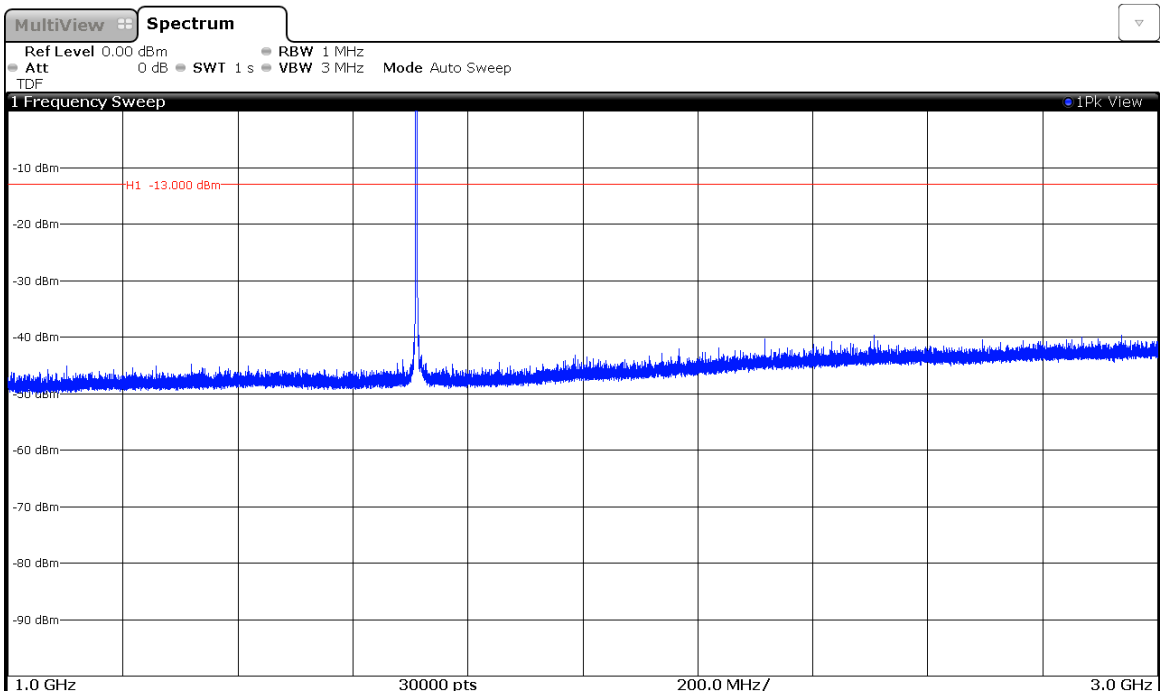
CHANNEL: HIGHEST



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

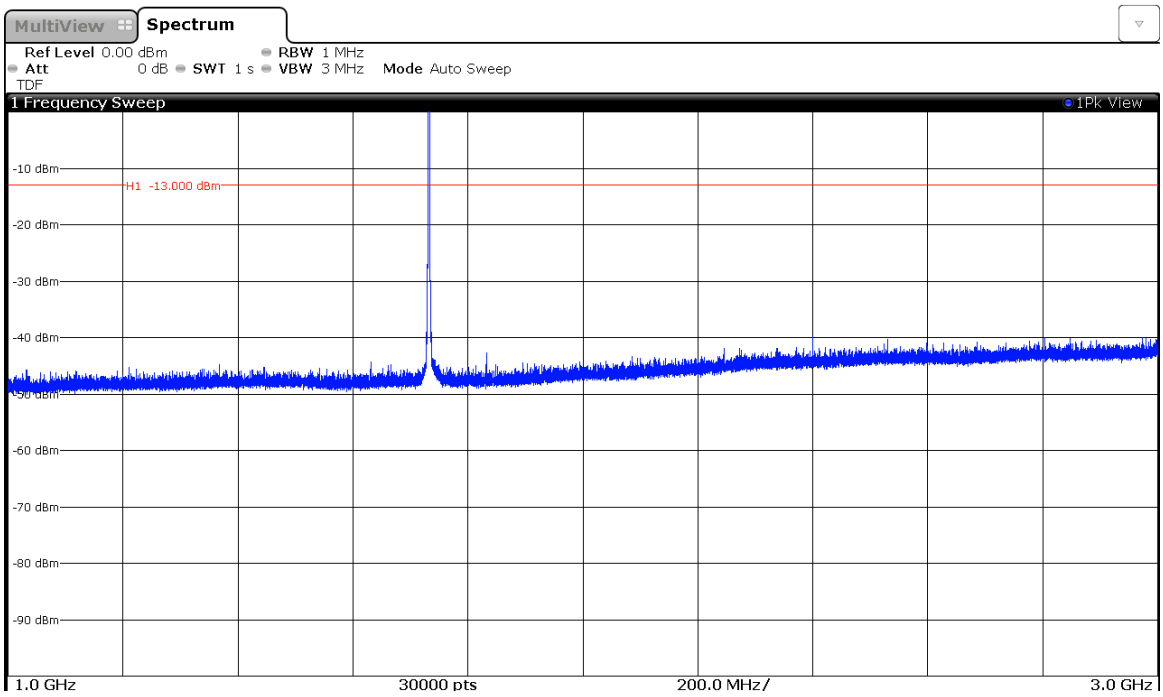
LTE QPSK MODULATION. BW=1.4 MHz. Band IV

CHANNEL: LOWEST



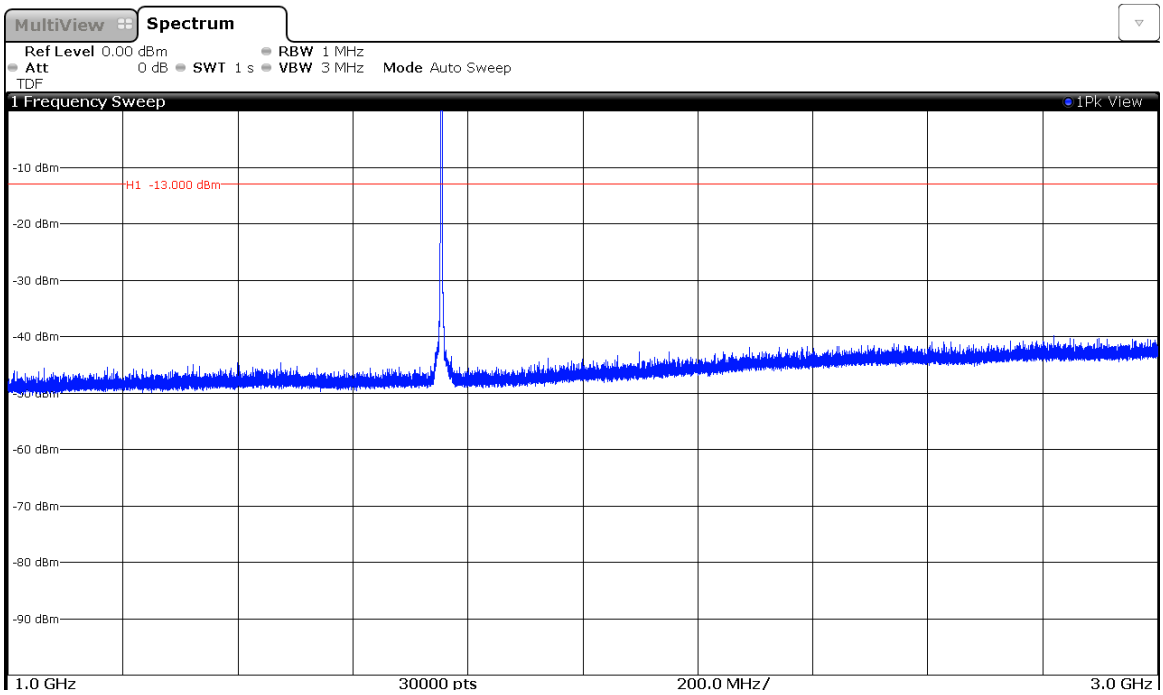
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

CHANNEL: HIGHEST

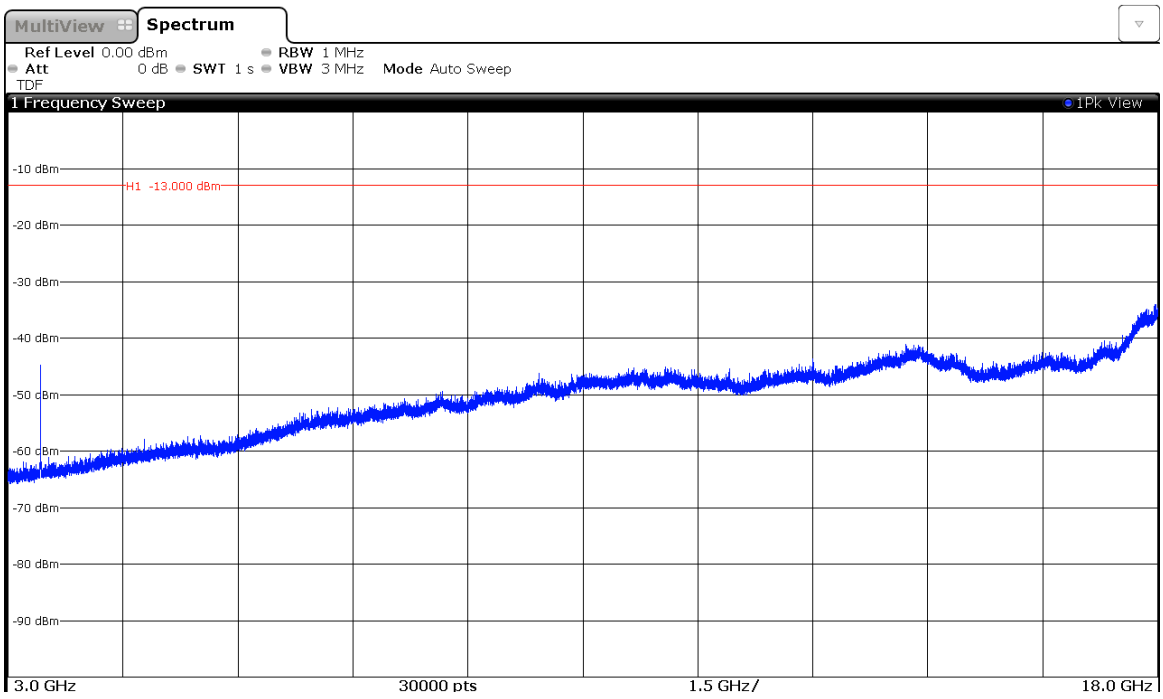


Note: The peak above the limit is the carrier frequency.

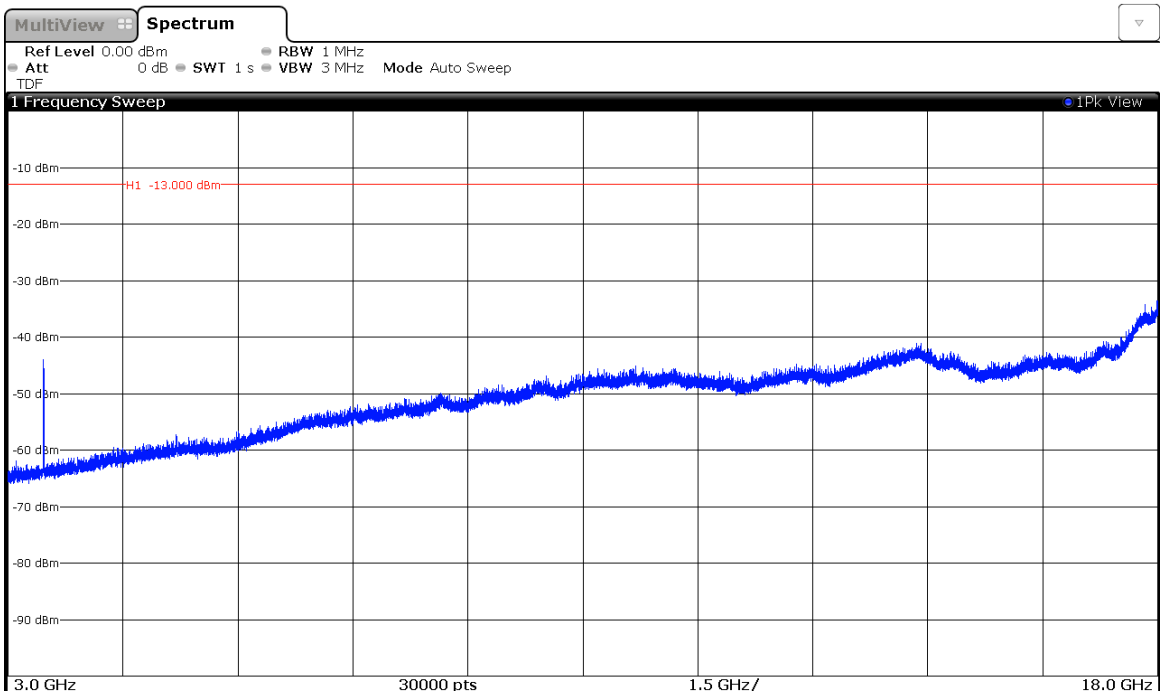
FREQUENCY RANGE 3 GHz to 18 GHz.

WCDMA Band IV

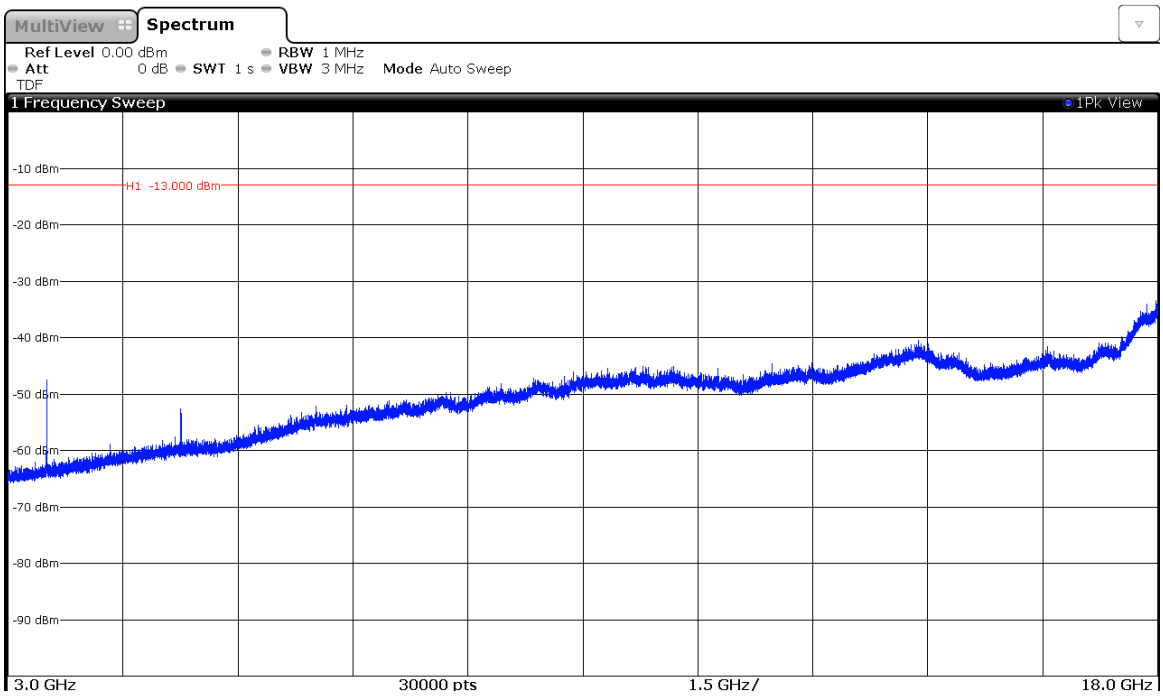
CHANNEL: LOWEST



CHANNEL: MIDDLE

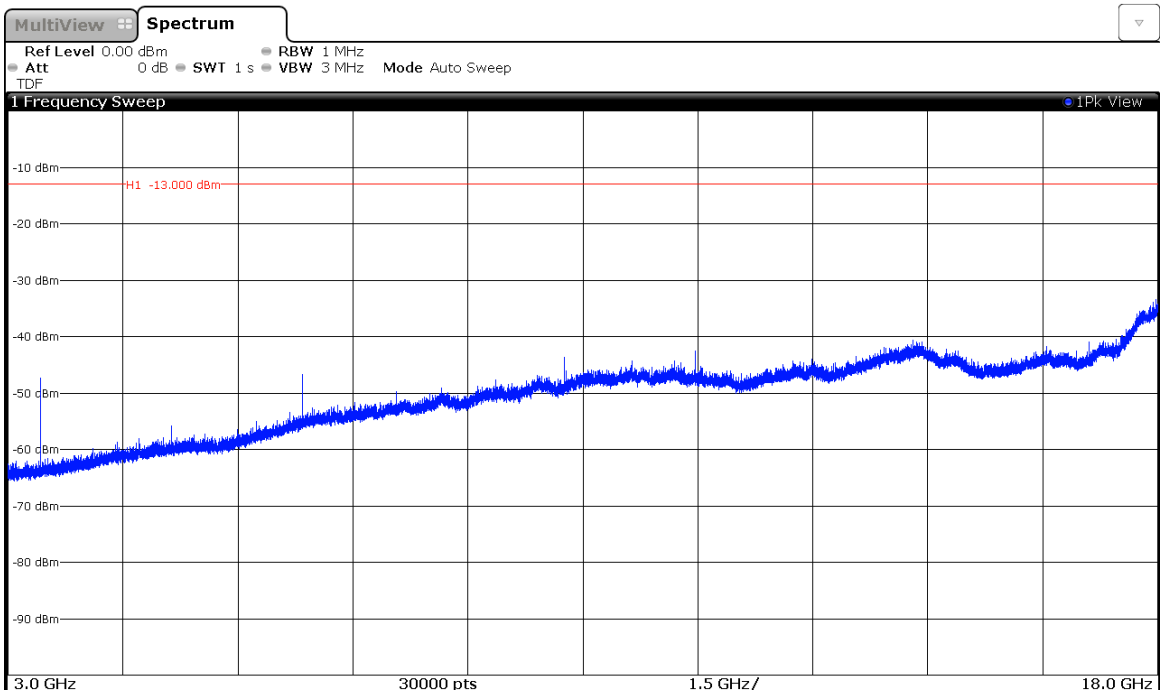


CHANNEL: HIGHEST

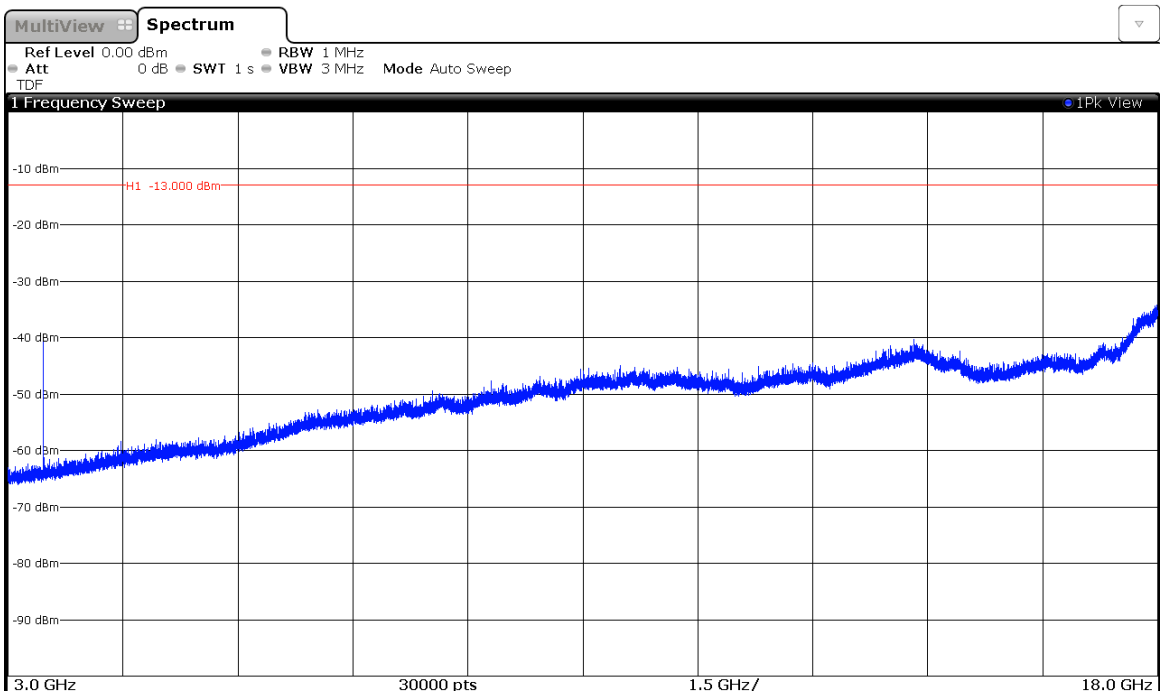


LTE QPSK MODULATION. BW=1.4 MHz. Band IV

CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST