



Test report No:
NIE: 57478RRF.013A1

Test report

REFERENCE STANDARD:
USA FCC Part 24
CANADA RSS-133

(*) Identification of item tested	Secure Smartphone
(*) Trademark	Bittium
(*) Model and /or type reference	Tough Mobile 2
Other identification of the product	HW Version: 0302 SW Version: 40.1 FCC ID: V27SD-61 IC: 3282B-SD61
(*) Features	LTE <ul style="list-style-type: none">• 3GPP Rel12• FDD/TDD Cat13/5,• DL 400Mbit/s,• UL 75 Mbit/s UMTS/HSPA <ul style="list-style-type: none">• 3GPP rel8, HSPA+,• DL 42 Mbit/s,• UL 5.76 Mbit/s GSM/GPRS/EDGE Complementary Radios <ul style="list-style-type: none">• Wi-Fi 802.11 a/b/g/n/ac (2.4 and 5 GHz), 2 x 2 MIMO <ul style="list-style-type: none">• BT 5.0• NFC
Applicant	BITTIUM WIRELESS OY Ritaharjuntie 1, 90590 Oulu, Finland
Test method requested, standard	USA FCC Part 24 (10-1-18 Edition). CANADA RSS-133 Issue 6, Jan. 2013. ANSI C63.26-2015. ANSI/TIA-603-E: 2016. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Summary	IN COMPLIANCE

Approved by (name / position & signature)	José Carlos Luque RF Lab. Supervisor
Date of issue	2019-10-22
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification S.A.U. 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.

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Uncertainty

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

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of Tough Mobile 2 consists of a Secure Smartphone targeted for professional use where High Security is required.

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

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control Nº	Description	Model	Serial Nº	Date of reception
57478C/032	Secure Smartphone	Tough Mobile 2	---	2018-11-26
57478C/033	USB cable	---	---	2018-11-26
57478C/034	AC/DC power adapter	---	---	2018-11-26
57478C/039	Headphones	---	---	2018-11-26

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

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

Control Nº	Description	Model	Serial Nº	Date of reception
57478C/016	Secure Smartphone	Tough Mobile 2	---	2018-10-25

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

Test sample description

Ports.....:	Port name and description	Cable				
		Specified length [m]	Attached during test		Shielded	
	Not provided.		<input type="checkbox"/>		<input type="checkbox"/>	
	-		<input type="checkbox"/>		<input type="checkbox"/>	
	-		<input type="checkbox"/>		<input type="checkbox"/>	
	-		<input type="checkbox"/>		<input type="checkbox"/>	
Supplementary information to the ports.....:	N/A					
Rated power supply	Voltage and Frequency	Reference poles				
		L1	L2	L3	N	PE
	<input type="checkbox"/> AC:	<input type="checkbox"/>				
	<input checked="" type="checkbox"/> DC: 3.6 – 4.35 Vdc.					
	<input type="checkbox"/> DC:					
Rated Power	Not provided					
Clock frequencies.....:	Not provided					
Other parameters	FCC ID: V27SD-61					
	IC: 3282B-SD61					
Software version	40.1					
Hardware version	0302					
Dimensions in cm (L x W x D).....:	Not provided					
Mounting position	<input type="checkbox"/> Table top equipment					
	<input type="checkbox"/> Wall/Ceiling mounted equipment					
	<input type="checkbox"/> Floor standing equipment					
	<input checked="" type="checkbox"/> Hand-held equipment					
	<input type="checkbox"/> Other:					
Modules/parts.....:	Module/parts of test item			Type	Manufacturer	
	-					
Accessories (not part of the test item)	Description		Type		Manufacturer	
	-					
	-					
	-					
Documents as provided by the applicant	Description		File name		Issue date	
	-					

Identification of the client

BITIUM WIRELESS OY
Ritaharjuntie 1, 90590 Oulu, Finland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2018-10-26
Date (finish)	2019-04-30

Document history

Report number	Date	Description
57478RRF.013	2019-08-27	First release
57478RRF.013A1	2019-10-22	Second release. RF Output Power measurements were added on the modulation 16 QAM

Environmental conditions

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

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

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 35
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Jaime Barranquero, Ignacio Cabra, Nicolás Salguero, Miguel Ángel Torres and José Alberto Aranda.

Used instrumentation:

<u>Conducted Measurements</u>		Last Calibration	Due Calibration
1.	Chamber HERAEUS VMT 04/35	2018/06	2020/06
2.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2018/05	2019/05
3.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2019/02	2020/02
4.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2018/04	2019/04
5.	Spectrum Analyzer PSA 3Hz-26.5 GHz AGILENT TECHNOLOGIES E4440A	2017/10	2019/10
6.	Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2018/02	2020/02
7.	Signal Analyzer 20 Hz to 8 GHz ROHDE AND SCHWARZ FSQ8	2018/08	2020/08
8.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2017/07	2019/07
9.	DC Power Supply 40V/40A Rohde & Schwarz NGPE40	2018/02	2021/02

<u>Radiated Measurements</u>		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2018/10	2021/10
3.	EMI Test Receiver R&S ESR7	2018/08	2020/08
4.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2018/02	2020/02
5.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
6.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2019/05	2020/05
7.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-1M	2019/04	2020/04
8.	RF Pre-amplifier 30 dB, 18 GHz-40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
9.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2018/07	2021/07

Testing verdicts

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

Summary

FCC PART 24 / RSS-133 PARAGRAPH		
Requirement – Test case	Verdict	Remark
Clause 24.232/RSS-133 Clause 6.4: RF output power	P	(1) (2)
Clause 2.1047/RSS-133 Clause 6.2: Modulation characteristics	P	(1) (2)
Clause 24.235/RSS-133 Clause 6.3: Frequency stability	P	(1) (2)
Clause 2.1049: Occupied Bandwidth	P	(1) (2)
Clause 24.238/RSS-133 Clause 6.5: Spurious emissions at antenna terminals	P	(1) (2)
Clause 24.238/RSS-133 Clause 6.5: Radiated emissions	P	(1) (2)
Supplementary information and remarks:		
(1) GSM mode has not been tested to prove USA FCC 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 Part 24 as it is the same as GPRS mode. GPRS mode has been tested as indicated on the present test report.		
(2) HSDPA modulation mode has not been tested to prove USA FCC Part 24 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 24 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.		

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

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TEST CONDITIONS

POWER SUPPLY (V):

Vn: 3.8 Vdc
Vmin: 3.6 Vdc (*)
Vmax: 4.2 Vdc (*)

Type of Power Supply: Rechargeable battery.

The subscripts 'n', 'min' and 'max' indicate temperature test conditions (normal, minimum and maximum respectively).

(*): Declared by applicant.

ANTENNA GAIN:

MIDDLE Bands		ANTENNA TYPE
2G 1900	+0.1 dBi	Monopole with parasitic resonator
3G WCDMA Band II	+0.1 dBi	Monopole with parasitic resonator
LTE Band 25	+0.2 dBi	Monopole with parasitic resonator

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 MODULATIONS:

Lowest channel (9262): 1852.4 MHz
Middle channel (9400): 1880.0 MHz
Highest channel (9538): 1907.6 MHz

LTE Band 2. QPSK AND 16QAM MODULATIONS:

	Channel (Frequency. MHz)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Lowest	18607 (1850.7)	18615 (1851.5)	18650 (1852.5)	18675 (1855)	18675 (1857.5)	18700 (1860)
Middle	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)	18900 (1880)
Highest	19193 (1909.3)	19185 (1908.5)	19150 (1907.5)	19150 (1905)	19125 (1902.5)	19100 (1900)

NOTE: LTE Band 2 is completely included in LTE Band 25, so the channels of Band 25 were tested to give conformity to the assigned block.

LTE Band 25. QPSK AND 16QAM MODULATIONS:

	Channel (Frequency. MHz)					
	BW = 1.4 MHz	BW = 3 MHz	BW = 5 MHz	BW = 10 MHz	BW = 15 MHz	BW = 20 MHz
Lowest	26047 (1850.7)	26055 (1851.5)	26065 (1852.5)	26090 (1855)	26115 (1857.5)	26140 (1860)
Middle	26365 (1882.5)	26365 (1882.5)	26365 (1882.5)	26365 (1882.5)	26365 (1882.5)	26365 (1882.5)
Highest	26683 (1914.3)	26675 (1913.5)	26665 (1912.5)	26640 (1910)	26615 (1907.5)	26590 (1905)

RF Output Power

SPECIFICATION:

FCC §2.1046 and §24.232

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

RSS-133. Clause 6.4.

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

METHOD:

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester 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.

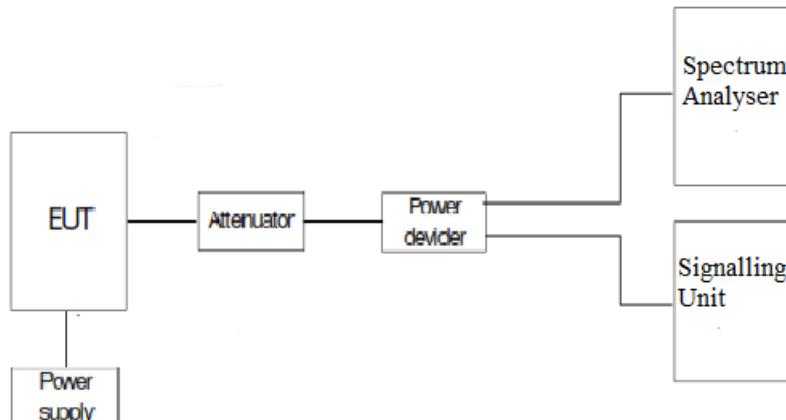
The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP:

1. CONDUCTED AVERAGE POWER:



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



RESULTS:

1. AVERAGE POWER:

2G Band 1900 MHz:

GPRS MODULATION:

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.1	0.1	0.1
Measured maximum average power (dBm) at antenna port	30.14	29.92	29.84
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	30.24	30.02	29.94
Peak-to-average ratio (PAR) (dB)	0.31	0.30	0.31
Measurement uncertainty (dB)	<±0.66		

EDGE MODULATION:

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.1	0.1	0.1
Measured maximum average power (dBm) at antenna port	25.98	25.63	25.69
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	26.08	25.73	25.79
Peak-to-average ratio (PAR) (dB)	0.31	0.31	0.31
Measurement uncertainty (dB)	<±0.66		

3G Band II:

WCDMA MODULATION:

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.1	0.1	0.1
Measured maximum average power (dBm) at antenna port	23.73	24.35	24.06
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	23.83	24.45	24.16
Peak-to-average ratio (PAR) (dB)	3.16	3.16	3.09
Measurement uncertainty (dB)	<±0.66		

HSUPA MODULATION:

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.1	0.1	0.1
Measured maximum average power (dBm) at antenna port	21.98	21.95	21.92
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	22.08	22.05	22.02
Peak-to-average ratio (PAR) (dB)	4.04	3.30	3.35
Measurement uncertainty (dB)	<±0.66		

LTE BAND 25:

LTE Band 25. QPSK MODULATION. Bandwidth = 1.4 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	24.04	23.72	23.91
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	24.24	23.92	24.11
PAPR (dB)	(*)	(*)	(*)
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 2.

(*): Preliminary measurements determined that the modulation 16QAM, RB Size: 6, RB Offset: 0 as the worst case.
 The results in the next tables shows the results for this configuration.

LTE Band 25. 16QAM MODULATION. Bandwidth = 1.4 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.73	23.36	21.51
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.93	23.56	21.71
PAPR (dB)	5.45	6.03	5.48
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 3. RB Offset: 1.

Worst case PAPR: Modulation 16QAM. RB Size: 6. RB Offset: 0.

LTE Band 25. QPSK MODULATION. Bandwidth = 3 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.77	23.46	22.90
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.97	23.66	23.10
PAPR (dB)	(*)	(*)	(*)
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 7.

(*): Preliminary measurements determined that the modulation 16QAM, RB Size: 15, RB Offset: 0 as the worst case.
 The results in the next tables shows the results for this configuration.

LTE Band 25. 16QAM MODULATION. Bandwidth = 3 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.82	22.94	22.03
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	24.02	23.14	22.23
PAPR (dB)	5.74	6.09	5.71
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 1. RB Offset: 7.

Worst case PAPR: Modulation 16QAM. RB Size: 15. RB Offset: 0.

LTE Band 25. QPSK MODULATION. Bandwidth = 5 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.73	23.42	23.09
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.93	23.62	23.29
PAPR (dB)	(*)	(*)	(*)
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 0.

(*): Preliminary measurements determined that the modulation 16QAM, RB Size: 25, RB Offset: 0 as the worst case.
 The results in the next tables shows the results for this configuration.

LTE Band 25. 16QAM MODULATION. Bandwidth = 5 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.67	23.20	23.38
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.87	23.40	23.58
PAPR (dB)	5.69	5.93	5.67
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 1. RB Offset: 0.

Worst case PAPR: Modulation 16QAM. RB Size: 25. RB Offset: 0.

LTE Band 25. QPSK MODULATION. Bandwidth = 10 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	24.02	23.71	22.37
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	24.22	23.91	22.57
PAPR (dB)	(*)	(*)	(*)
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 0.

(*): Preliminary measurements determined that the modulation 16QAM, RB Size: 50, RB Offset: 0 as the worst case.
 The results in the next tables shows the results for this configuration.

LTE Band 25. 16QAM MODULATION. Bandwidth = 10 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.86	23.13	22.68
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	24.06	23.33	22.88
PAPR (dB)	5.87	5.96	5.72
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 1. RB Offset: 0.

Worst case PAPR: Modulation 16QAM. RB Size: 50. RB Offset: 0.

LTE Band 25. QPSK MODULATION. Bandwidth = 15 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	24.01	23.88	22.69
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	24.21	24.08	22.89
PAPR (dB)	(*)	(*)	(*)
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 0.

(*): Preliminary measurements determined that the modulation 16QAM, RB Size: 50, RB Offset: 0 as the worst case.
 The results in the next tables shows the results for this configuration.

LTE Band 25. 16QAM MODULATION. Bandwidth = 15 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.75	23.67	22.36
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.95	23.87	22.56
PAPR (dB)	6.04	6.12	5.82
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 1. RB Offset: 0.

Worst case PAPR: Modulation 16QAM. RB Size: 75. RB Offset: 0.

LTE Band 25. QPSK MODULATION. Bandwidth = 20 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.65	23.90	22.82
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.85	24.10	23.02
PAPR (dB)	(*)	(*)	(*)
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 0.

(*): Preliminary measurements determined that the modulation 16QAM, RB Size: 50, RB Offset: 0 as the worst case.
 The results in the next tables shows the results for this configuration.

LTE Band 25. 16QAM MODULATION. Bandwidth = 20 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	0.2	0.2	0.2
Measured maximum average power (dBm) at antenna port	23.71	24	22.79
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	23.91	24.20	22.99
PAPR (dB)	6.03	6.01	6.06
Measurement uncertainty (dB)	<±0.66		

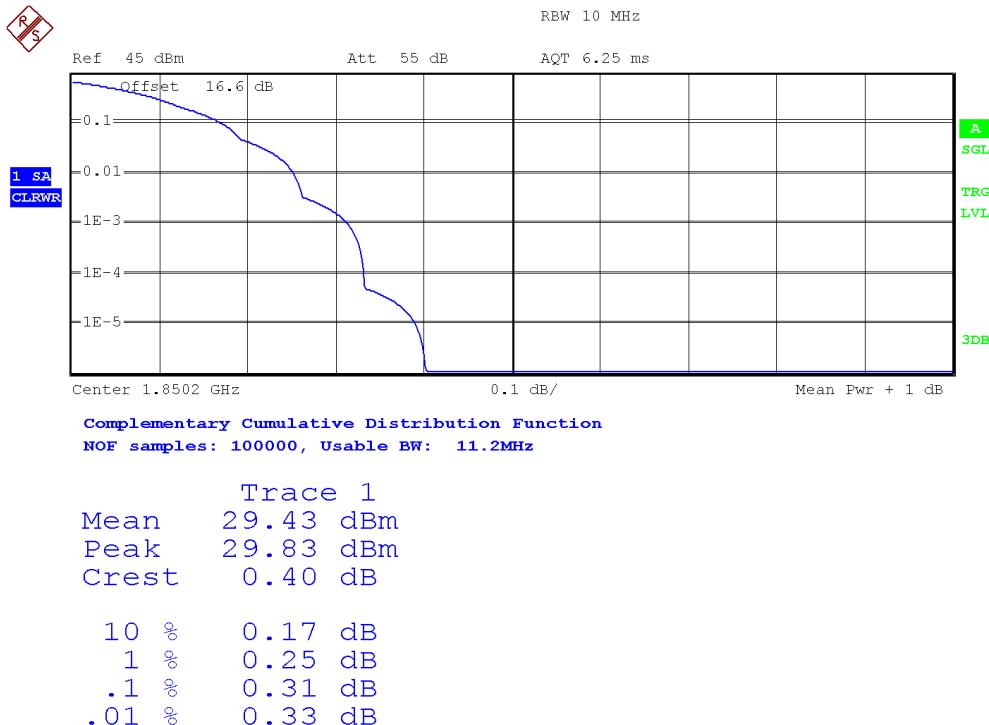
Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 1. RB Offset: 0.
Worst case PAPR: Modulation 16QAM. RB Size: 100. RB Offset: 0.

Verdict: PASS

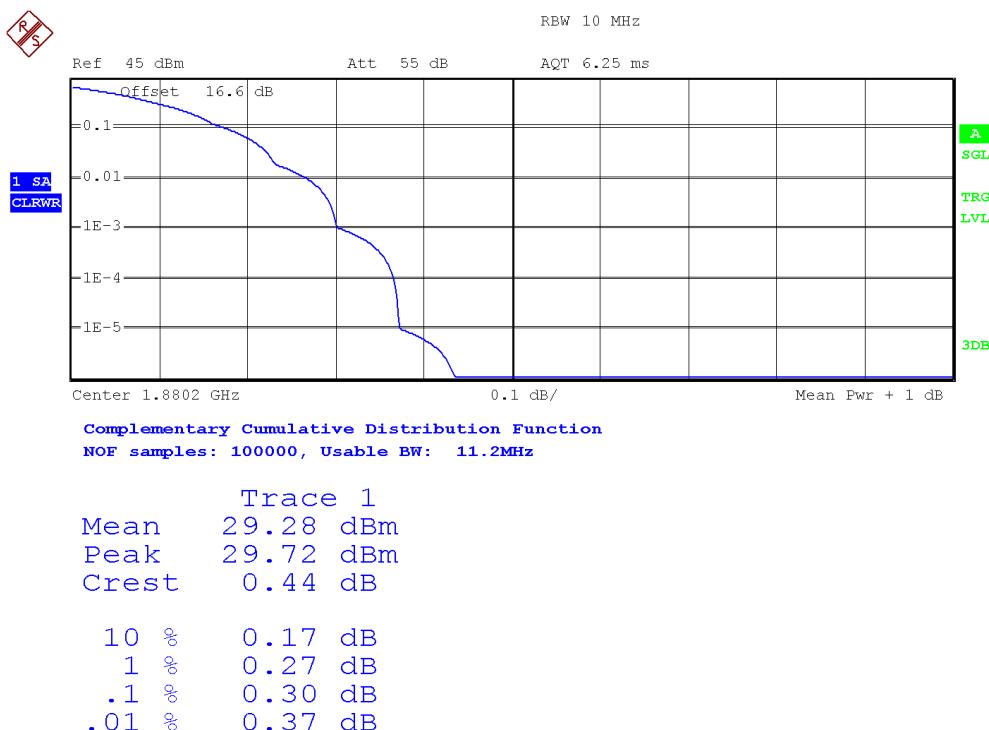
2. PEAK-TO-AVERAGE POWER RATIO (PAPR):

2G Band 1900 MHz. GPRS MODULATION.

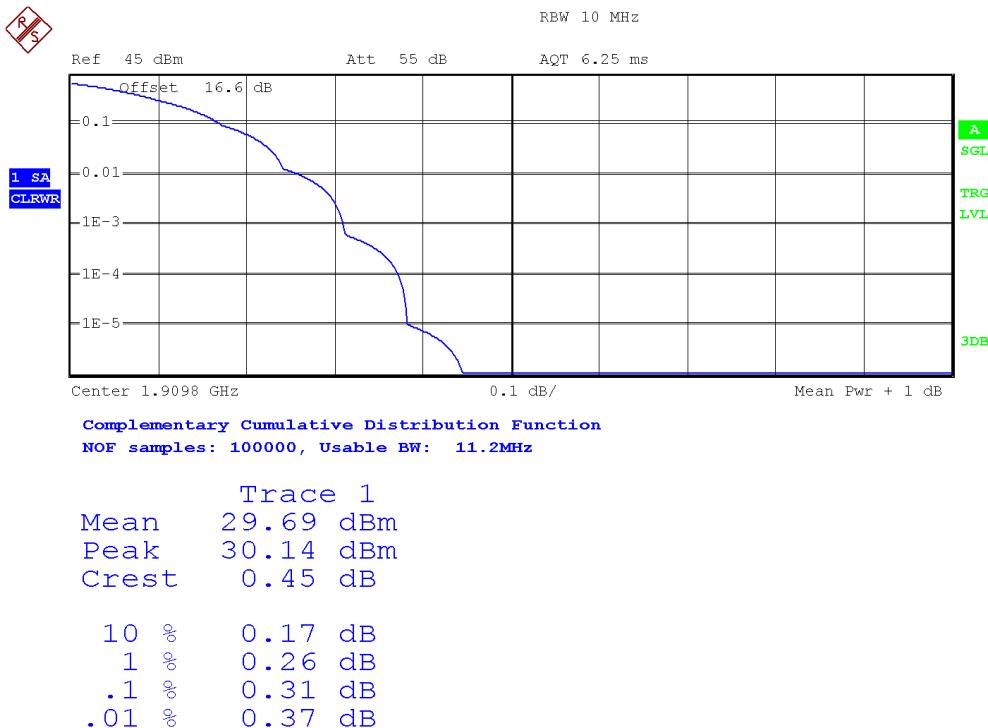
Lowest Channel :



Middle Channel:

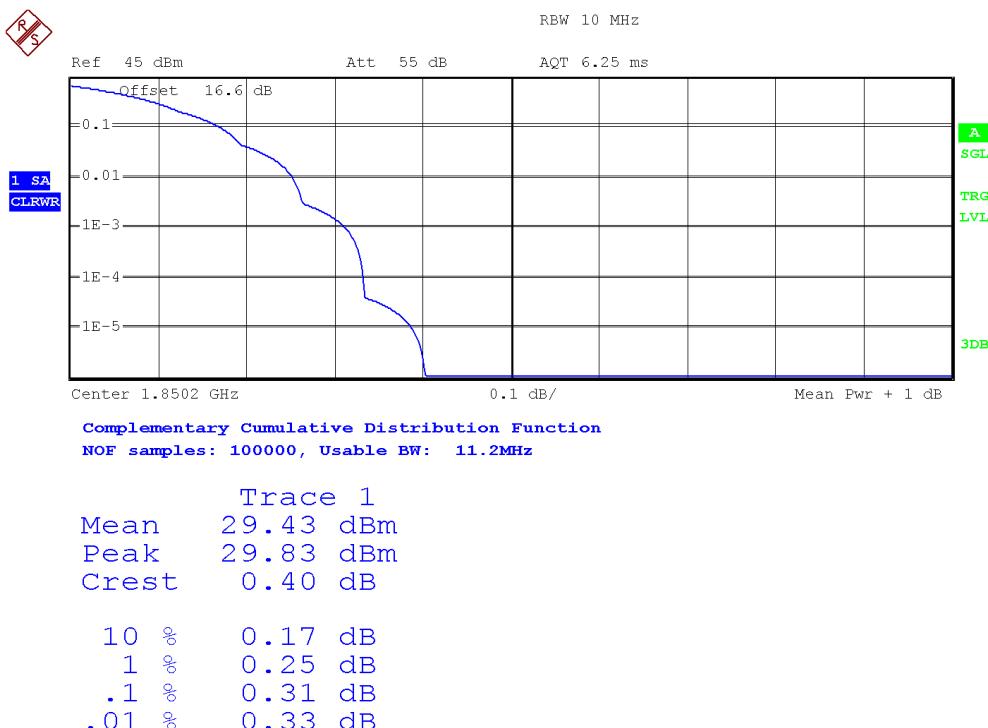


Highest Channel:

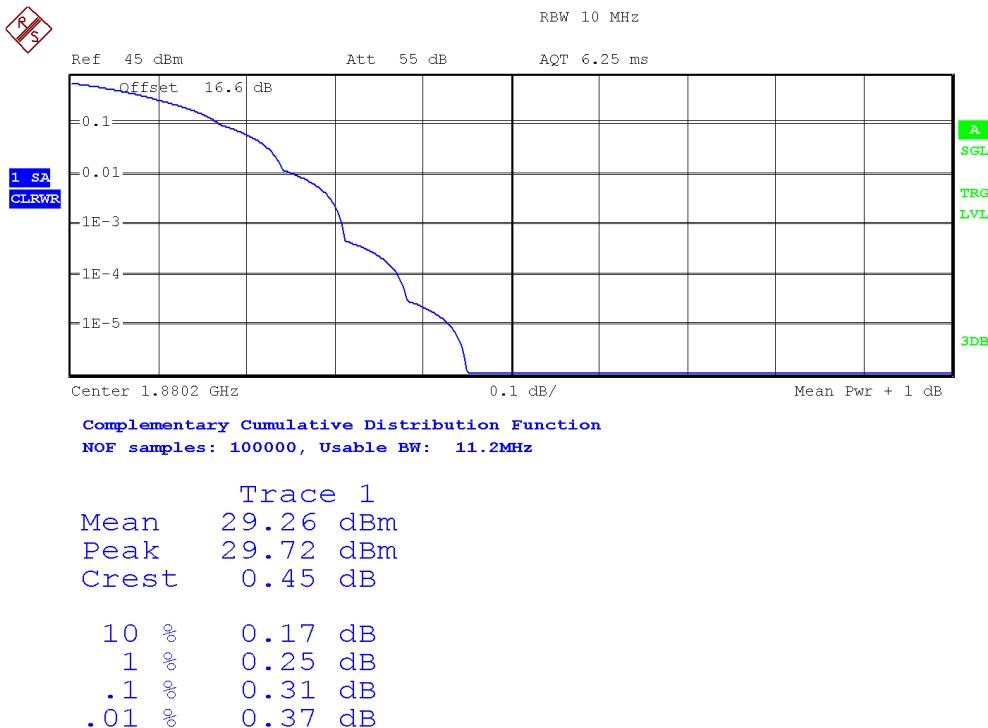


2G Band 1900 MHz. EDGE MODULATION.

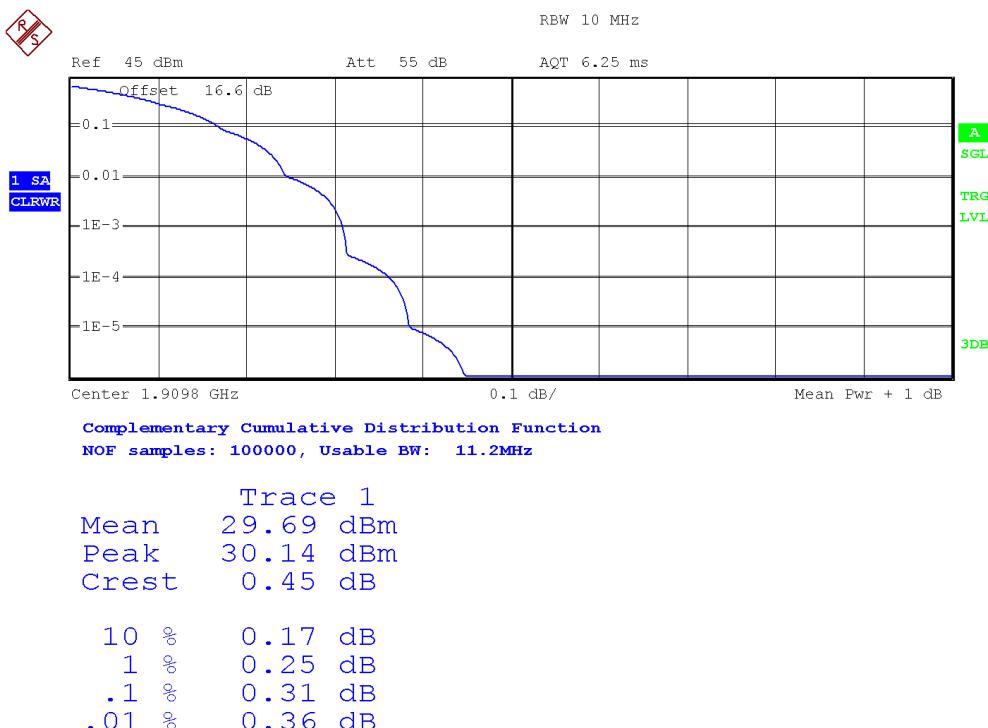
Lowest Channel:



Middle Channel:

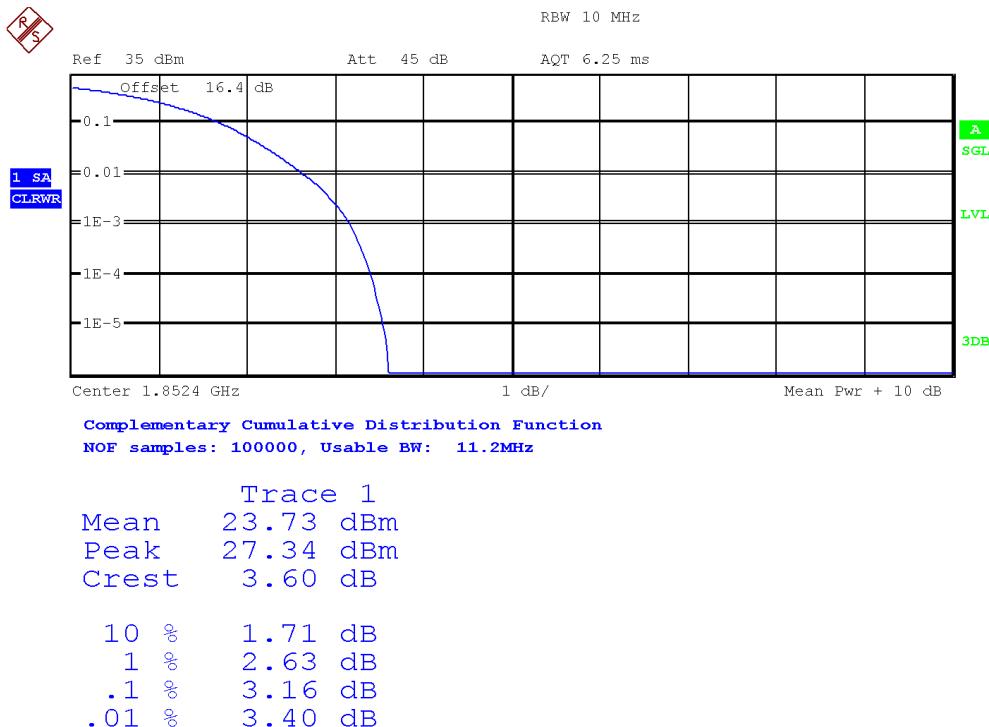


Highest Channel:

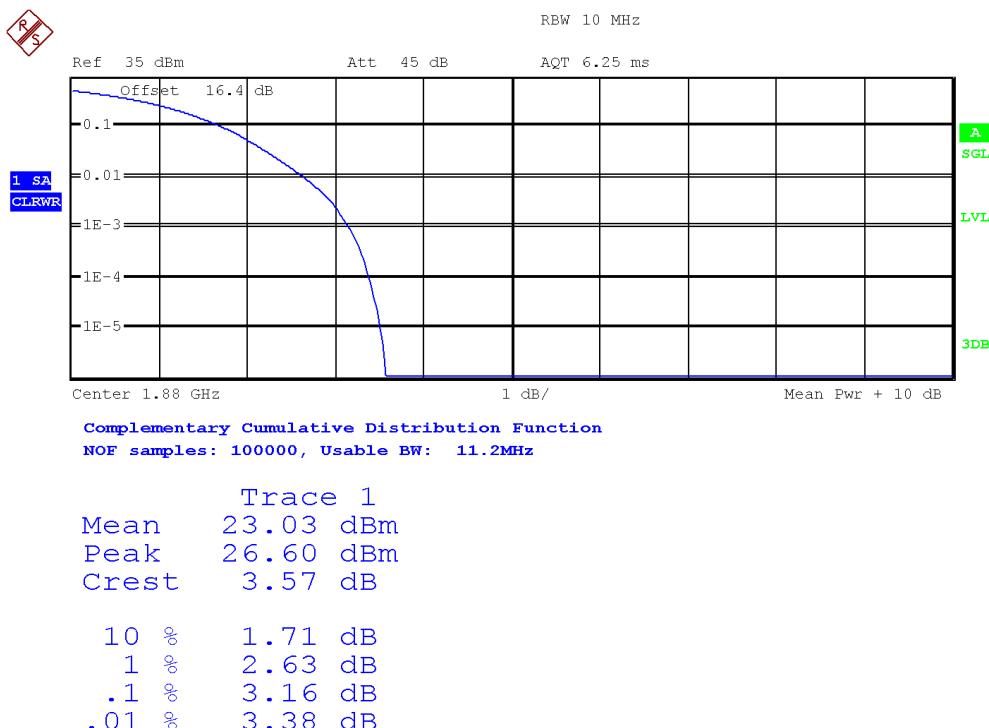


3G Band II. WCDMA MODULATION.

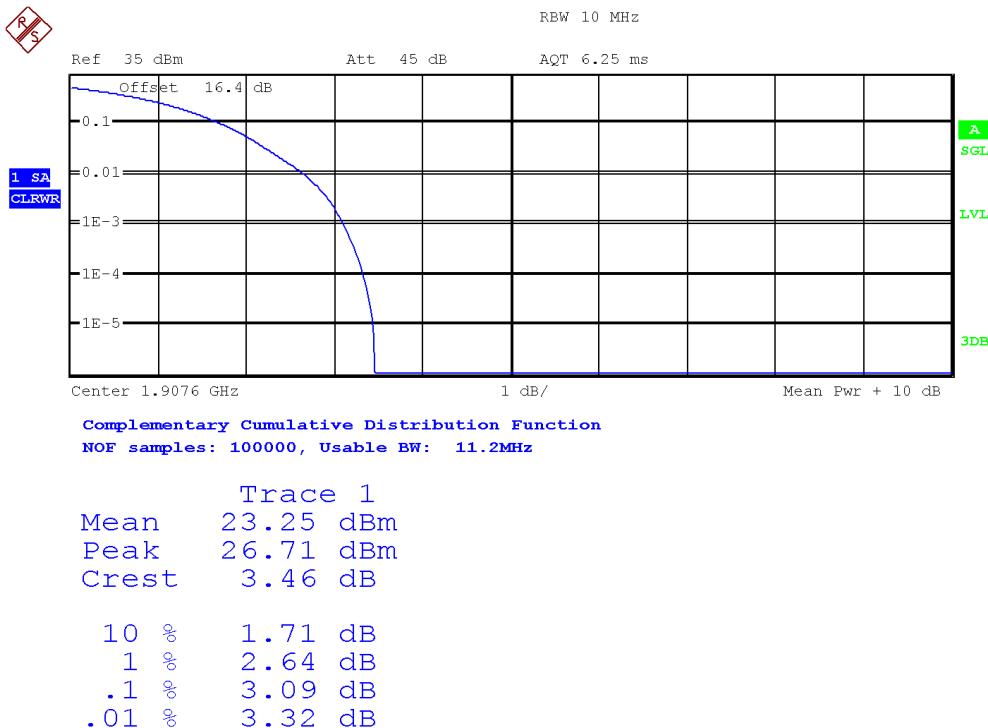
Lowest Channel:



Middle Channel:

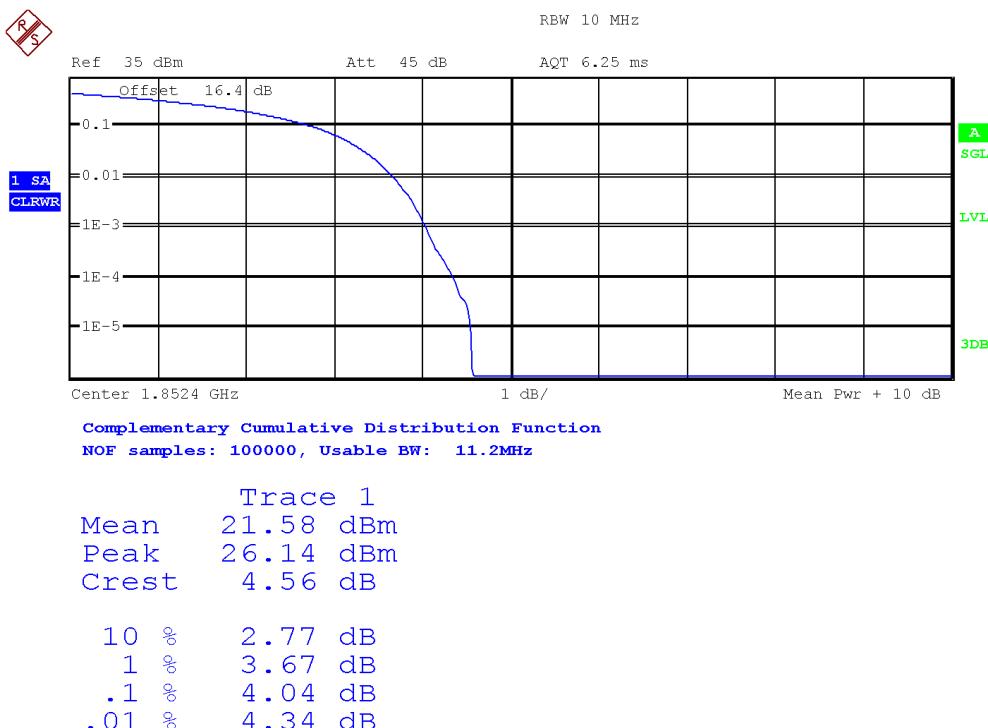


Highest Channel:

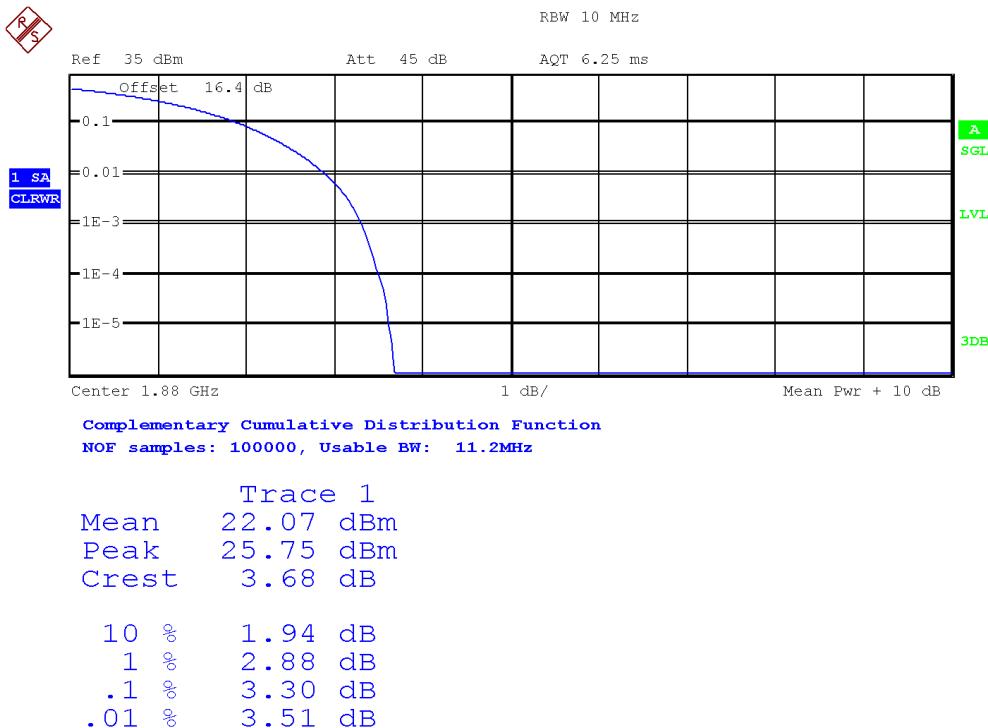


3G Band II. HSUPA MODULATION.

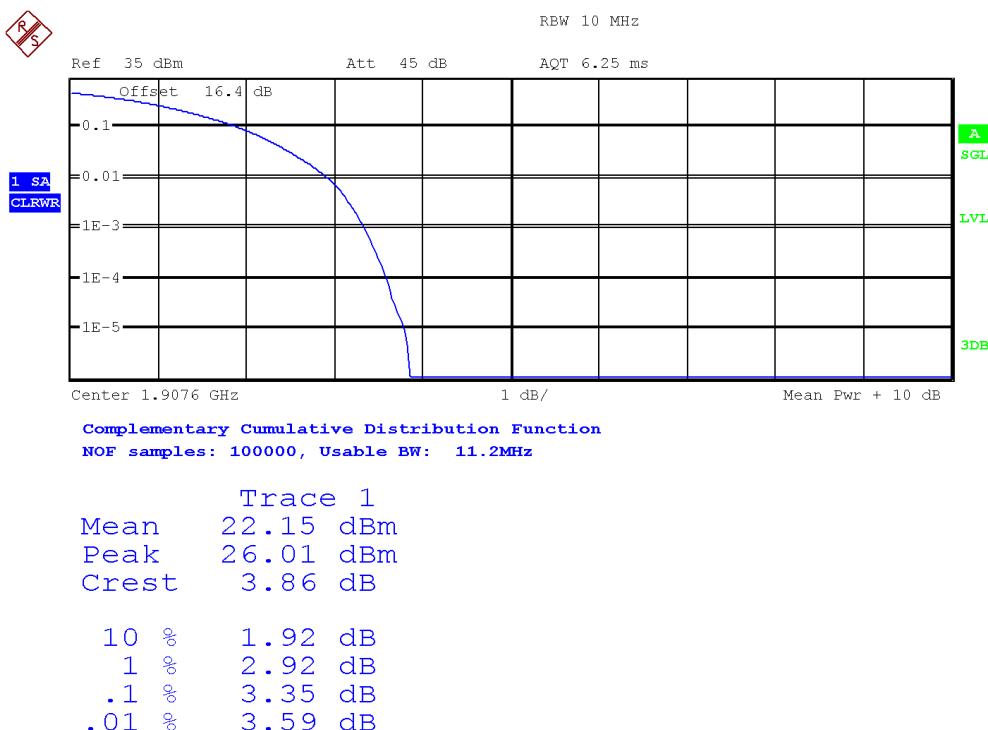
Lowest Channel:



Middle Channel:

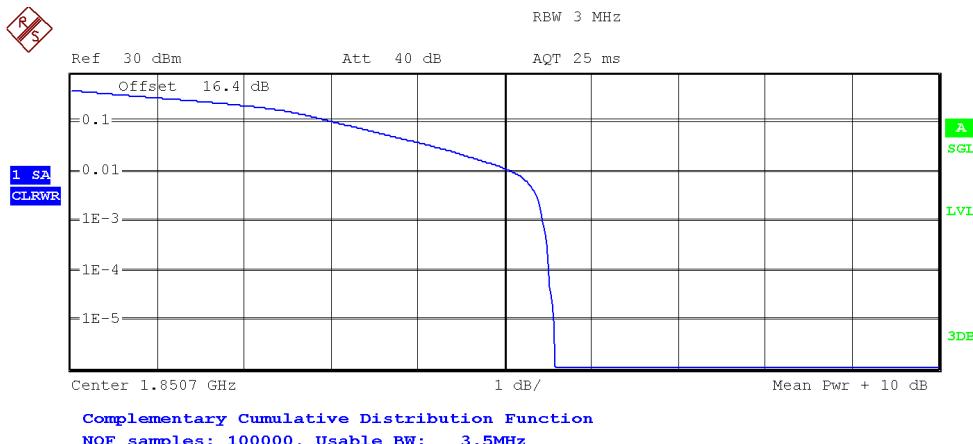


Highest Channel:

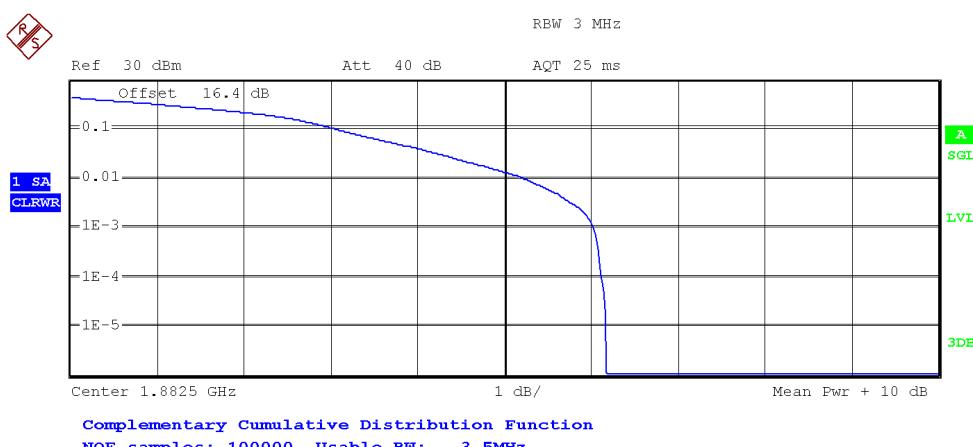


LTE Band 25. Bandwidth = 1.4 MHz. Modulation 16 QAM. RB Size: 6. RB Offset: 0.

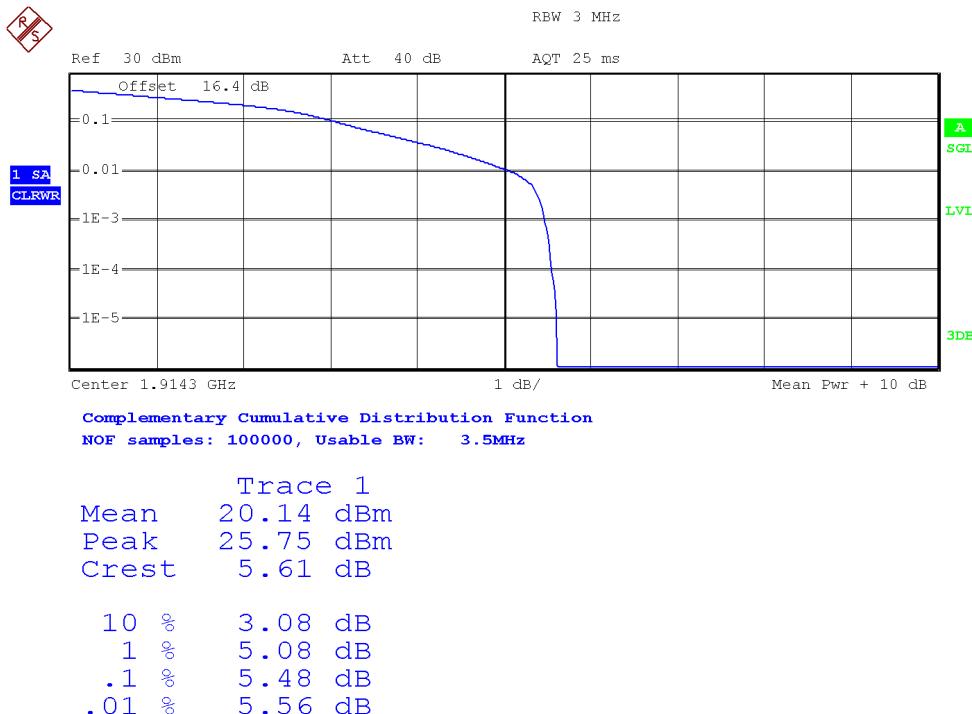
Lowest Channel:



Middle Channel:

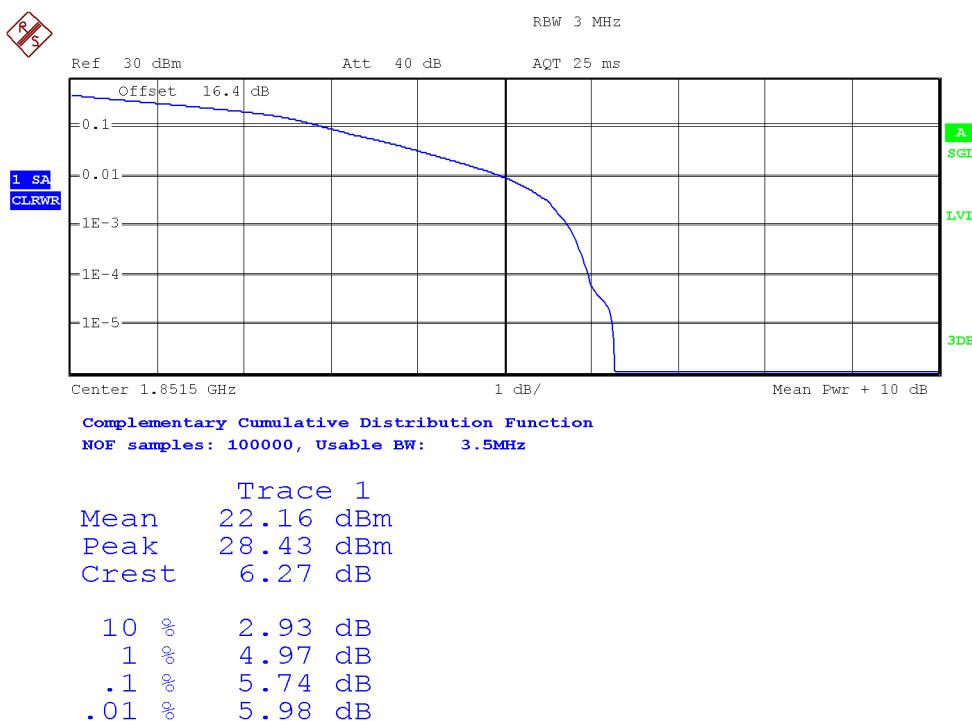


Highest Channel:

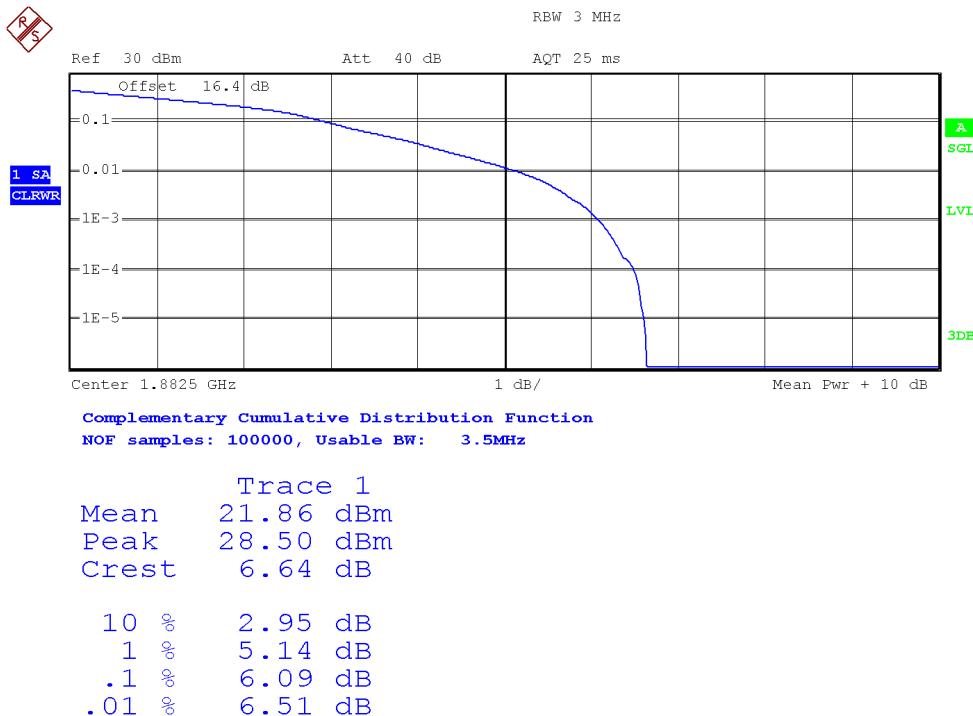


LTE Band 25. Bandwidth = 3 MHz. Modulation 16 QAM. RB Size: 15. RB Offset: 0.

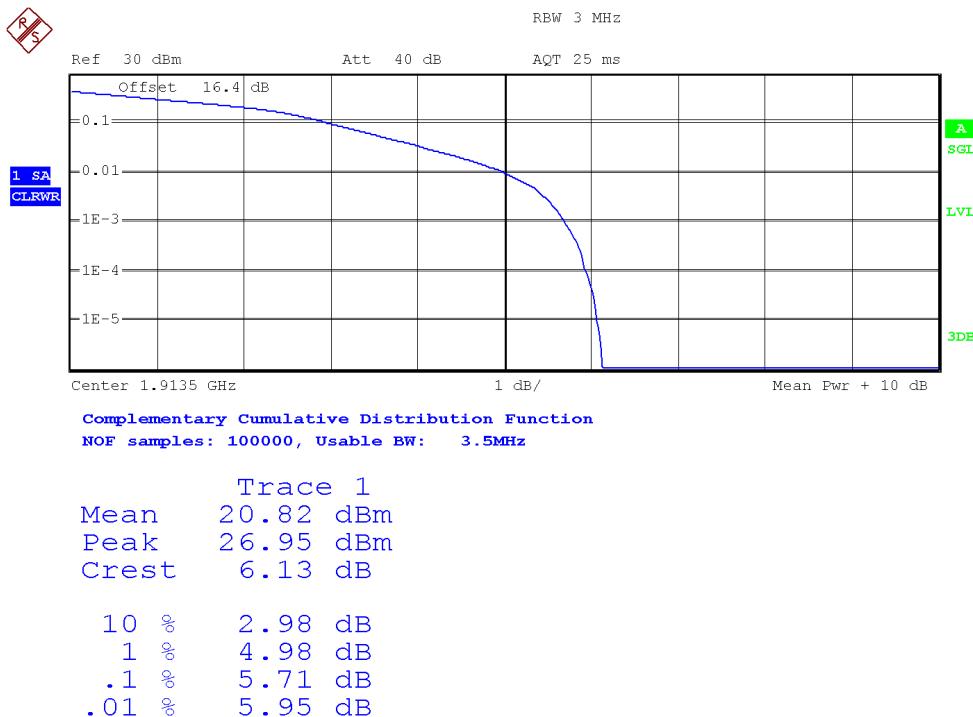
Lowest Channel:



Middle Channel:

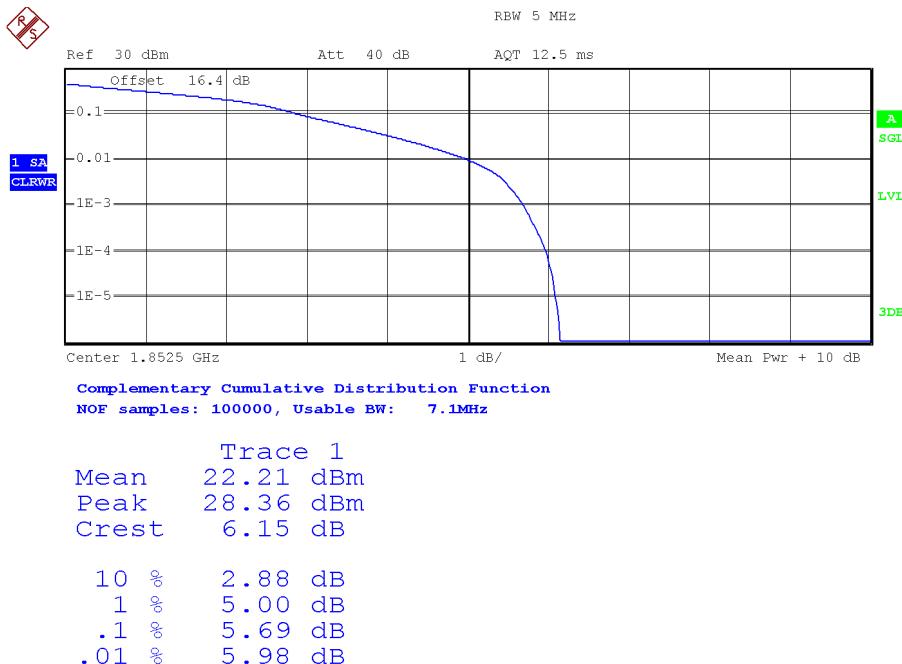


Highest Channel:

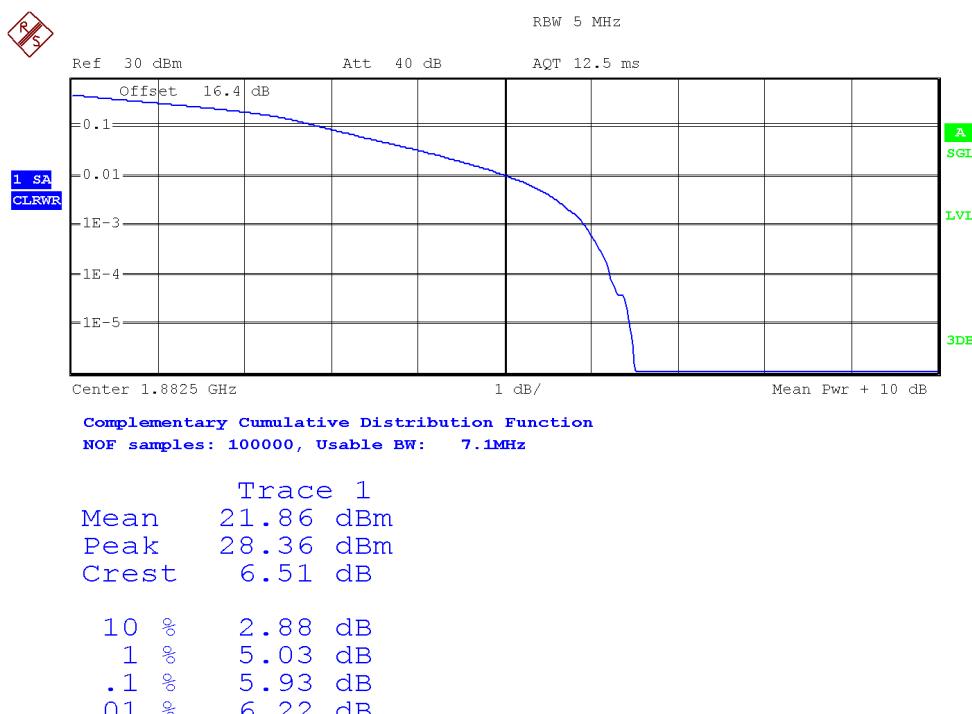


LTE Band 25. Bandwidth = 5 MHz. Modulation 16 QAM. RB Size: 25. RB Offset: 0.

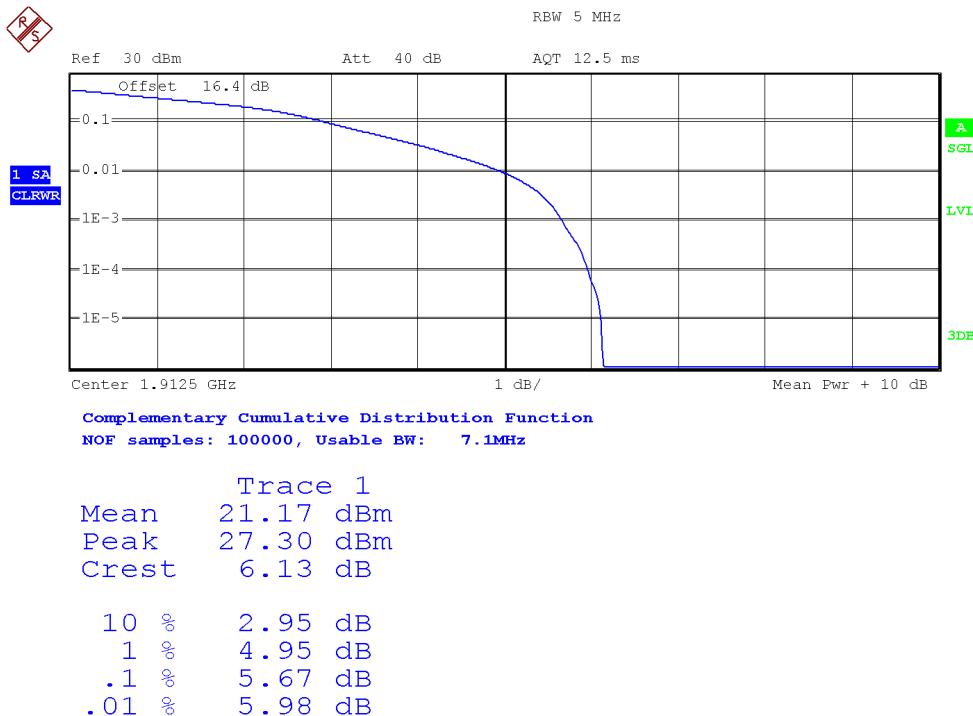
Lowest Channel:



Middle Channel:

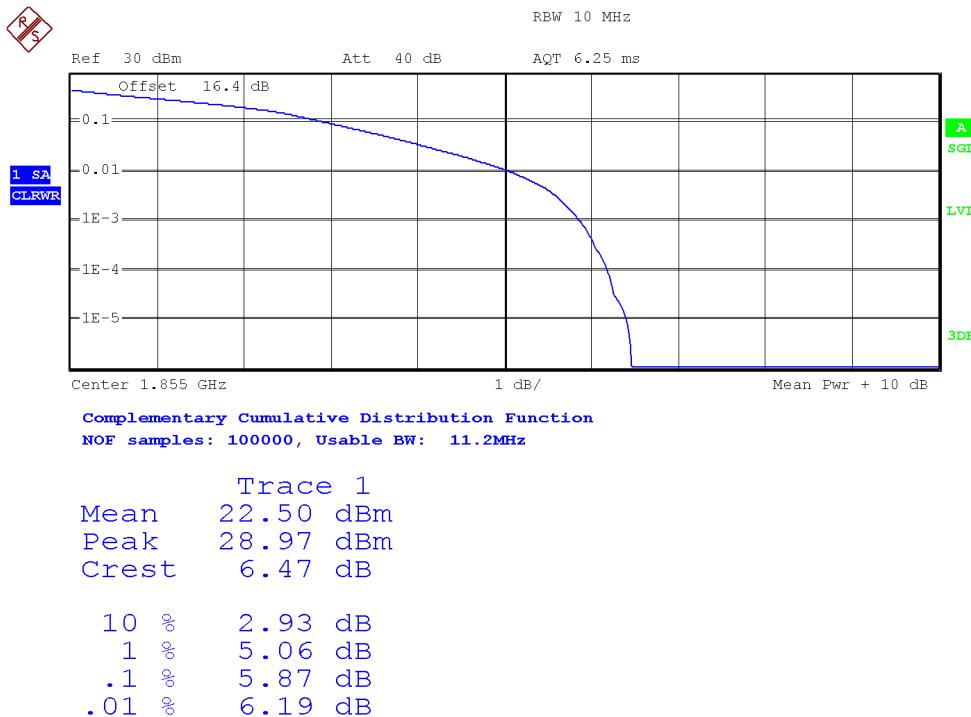


Highest Channel:

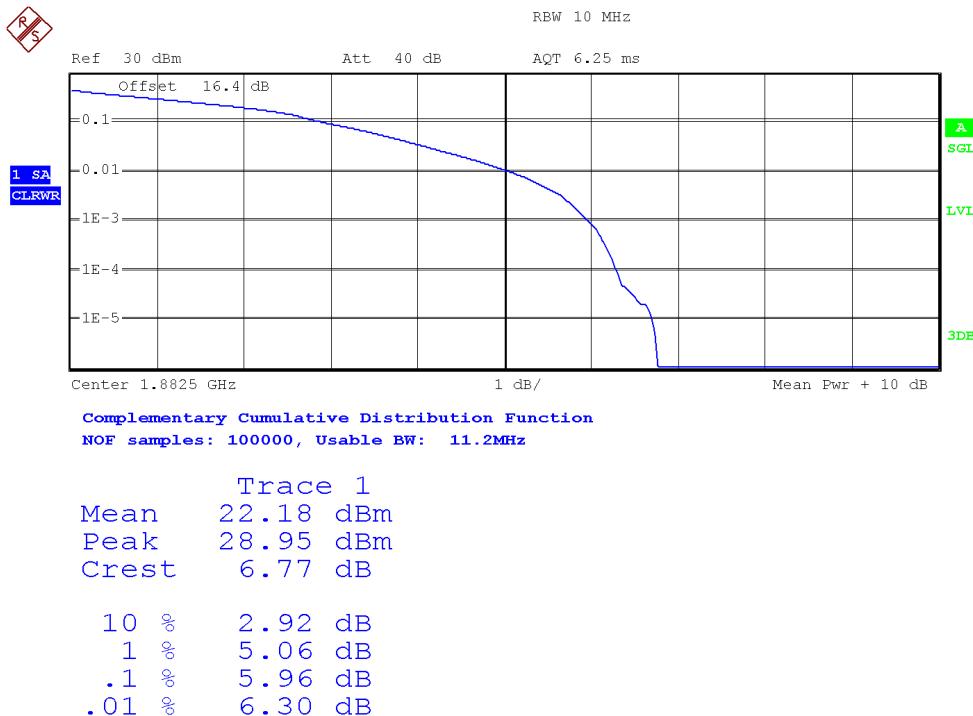


LTE Band 25. Bandwidth = 10 MHz. Modulation 16 QAM. RB Size: 50. RB Offset: 0.

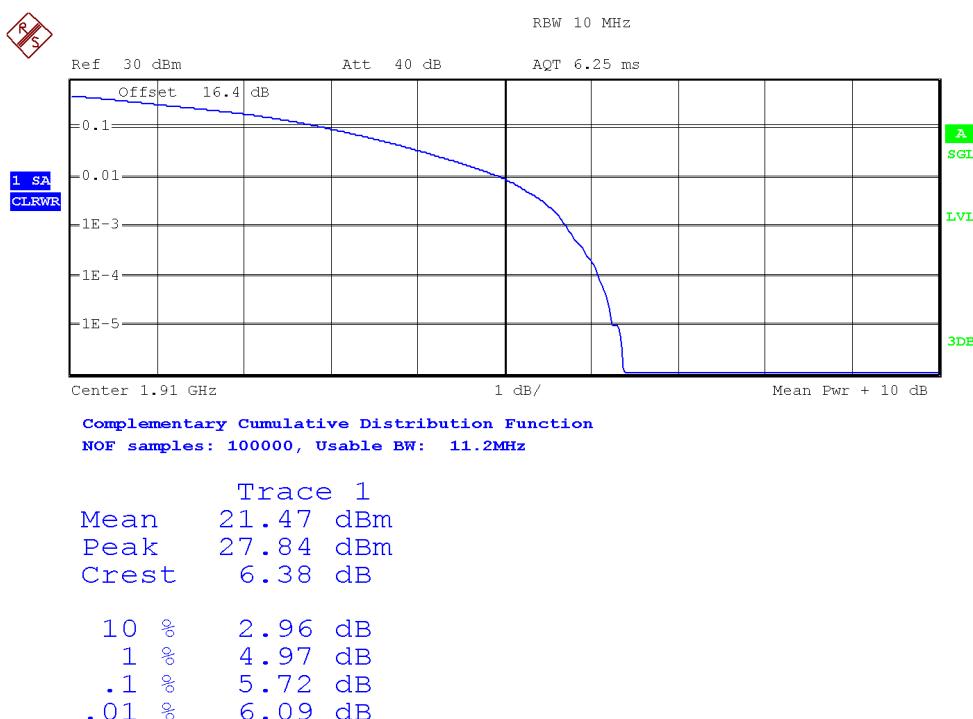
Lowest Channel:



Middle Channel:

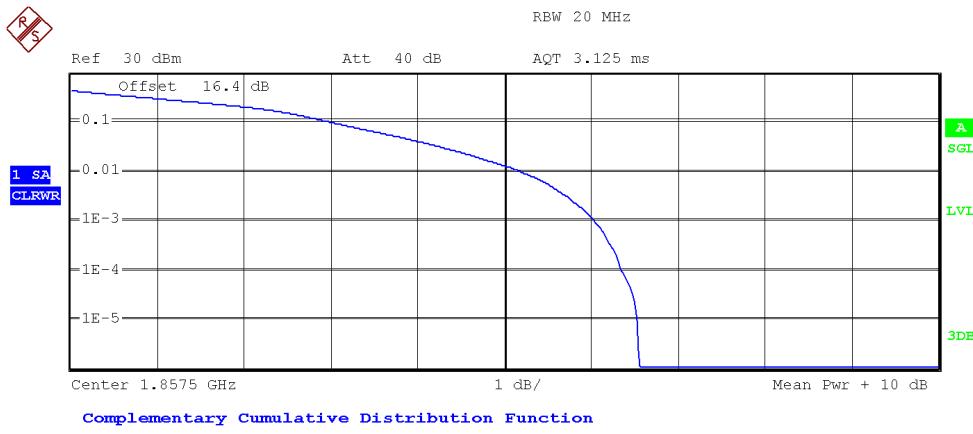


Highest Channel:

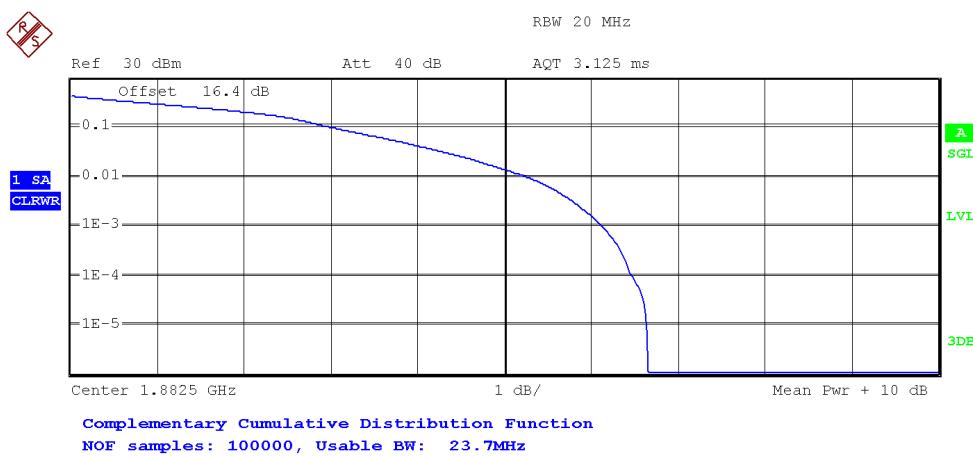


LTE Band 25. Bandwidth = 15 MHz. Modulation 16 QAM. RB Size: 25. RB Offset: 0.

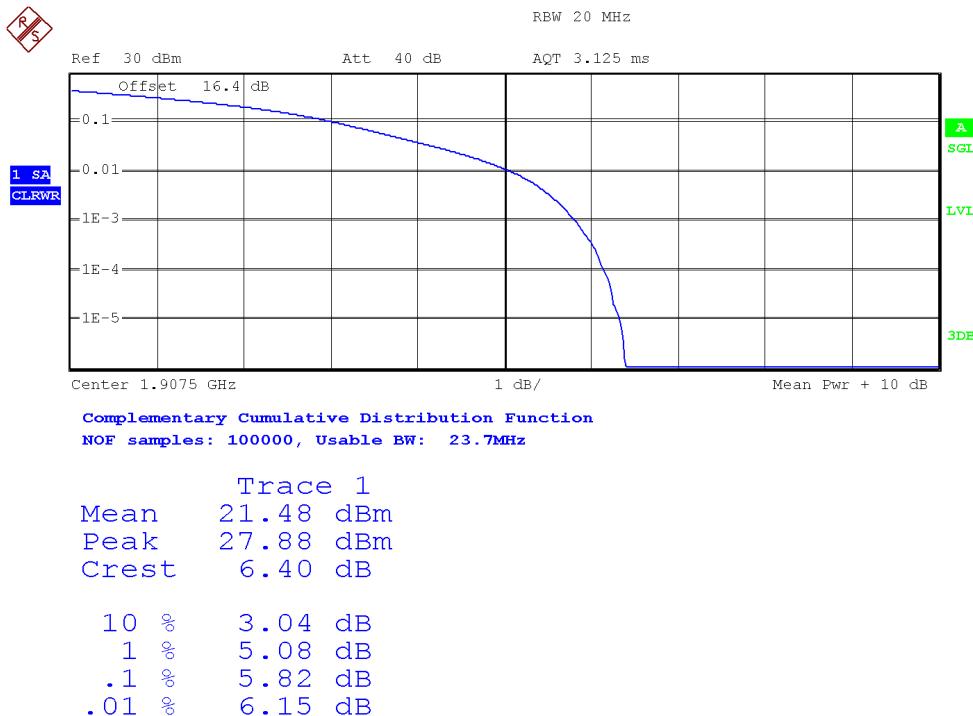
Lowest Channel:



Middle Channel:

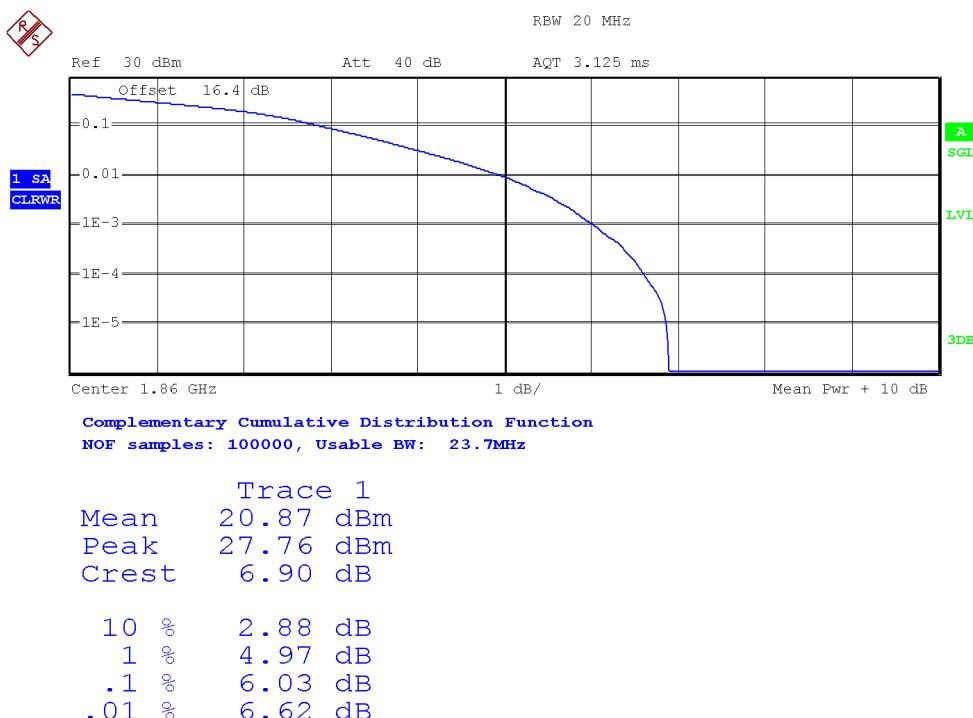


Highest Channel:

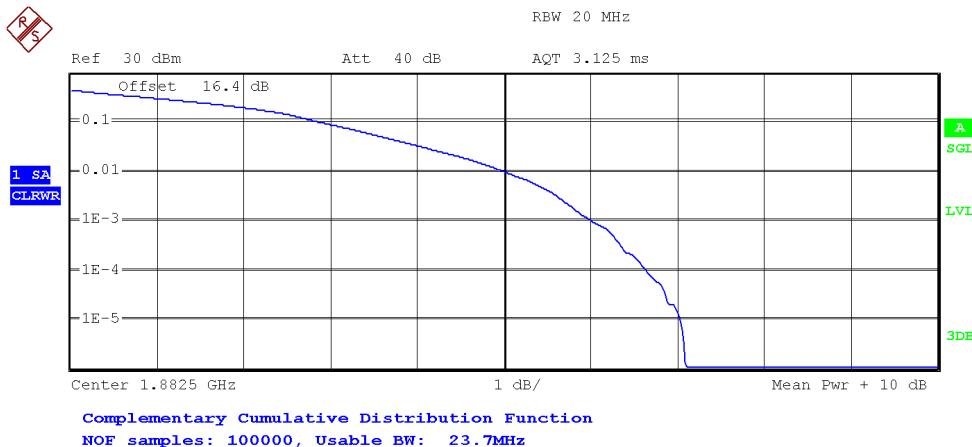


LTE Band 25. Bandwidth = 20 MHz. Modulation 16 QAM. RB Size: 50. RB Offset: 0.

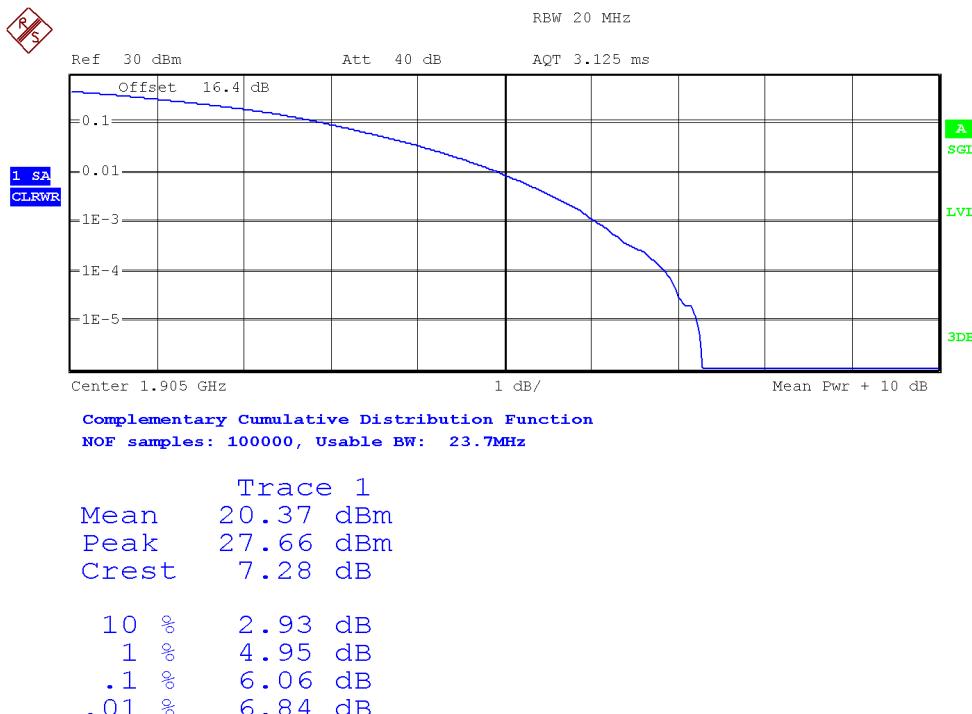
Lowest Channel:



Middle Channel:



Highest Channel:



Frequency Stability

SPECIFICATION:

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

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

METHOD:

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

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

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

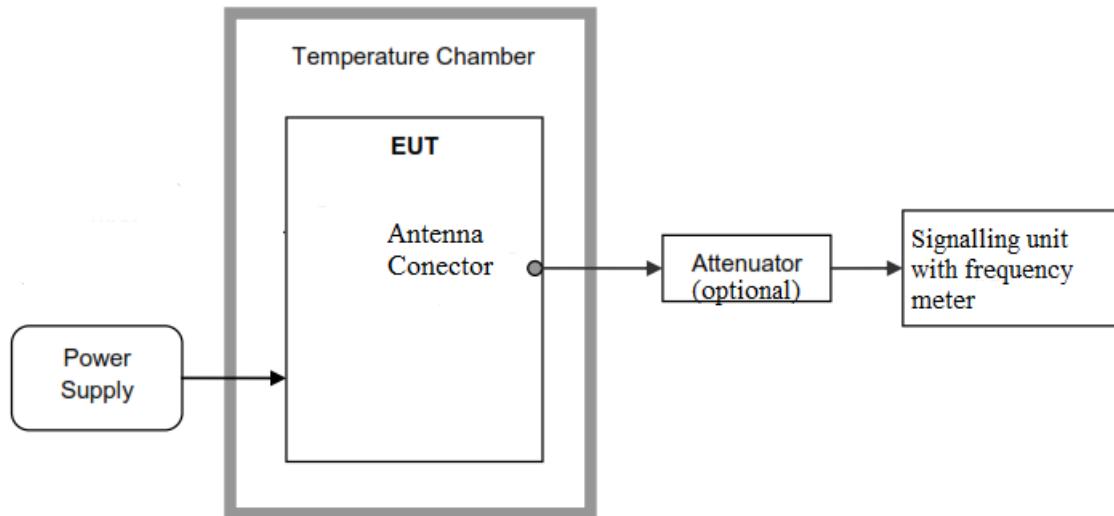
The worst case LTE mode for conducted power was used for the test.

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

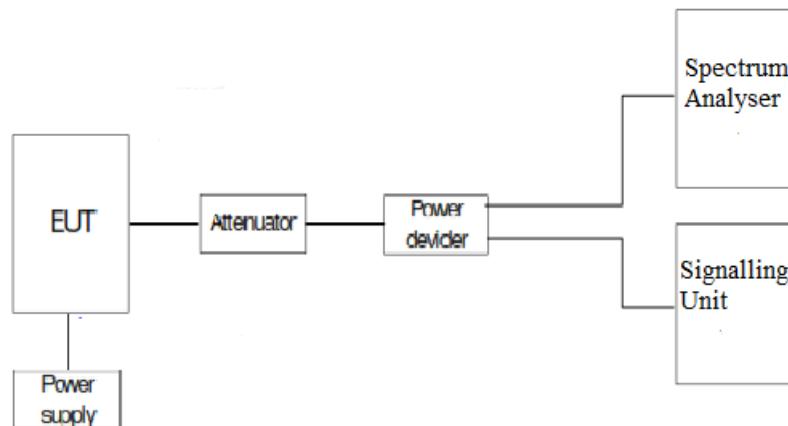
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP:

1. Frequency Tolerance:



2. Reference Frequency Points fL and fH:



RESULTS:

1. Frequency Tolerance:

• **Frequency Stability over Temperature Variations:**

2G Band 1900 MHz. GPRS AND EDGE MODULATIONS.

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
+50	3.46	0.002
+40	4.26	0.002
+30	5.39	0.003
+20	3.16	0.002
+10	2.76	0.001
0	6.91	0.004
-10	0.36	0.0001
-20	-4.00	-0.002
-30	-6.1	-0.003

3G Band II. WCDMA AND HSUPA MODULATION.

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
+50	12.81	0.007
+40	11.7	0.006
+30	12.2	0.006
+20	11.79	0.006
+10	12.07	0.006
0	11.66	0.006
-10	10.96	0.006
-20	11.24	0.006
-30	11.44	0.006

LTE Band 25. QPSK MODULATION. BW = 3 MHz.

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)
+50	-4.59	-0.002
+40	-6.74	-0.004
+30	-4.33	-0.002
+20	-5.05	-0.003
+10	-7.72	-0.004
0	-5.22	-0.003
-10	-4.48	-0.002
-20	-6.24	-0.003
-30	-5.88	-0.003

- Frequency Stability over Voltage Variations.

2G Band 1900 MHz. GPRS AND EDGE MODULATIONS.

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.2	2.13	0.0011
Vmin (*)	3.6	-0.9	-0.0004

(*): Operating end point specified by the manufacturer.

3G Band II. WCDMA AND HSUPA MODULATIONS.

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.2	11.69	0.0062
Vmin(*)	3.6	11.66	0.0062

(*): Operating end point specified by the manufacturer.

LTE Band 25. QPSK MODULATION. BW = 3 MHz.

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.20	-4.26	-0.0023
Vmin(*)	3.60	-6.34	-0.0034

(*): Operating end point specified by the manufacturer.

2. Reference Frequency Points f_L and f_H :

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

2G Band 1900 MHz:

	GPRS MODULATION
f_L (MHz)	1850.036994
f_H (MHz)	1909.955007

3G Band II:

	WCDMA MODULATION
f_L (MHz)	1850.205189
f_H (MHz)	1909.907613

LTE Band 25:

	LTE QPSK MODULATION. BW = 3 MHz
fL (MHz)	1850.030892
fH (MHz)	1914.940804

Measurement uncertainty	<±1x 10 ⁻⁶
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The reference frequency points fL and fH stay within the authorized blocks for all the bands above.

Verdict: PASS

Modulation Characteristics

SPECIFICATION:

FCC §2.1047

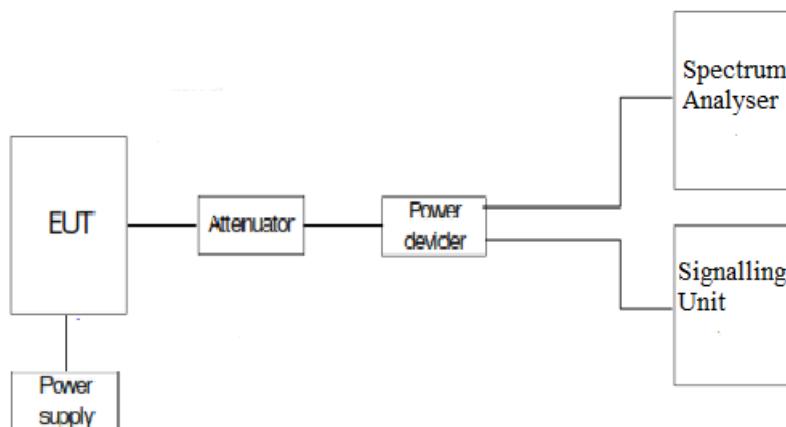
RSS-133. Clause 6.2. Equipment certified under this standard shall use digital modulation.

METHOD:

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

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

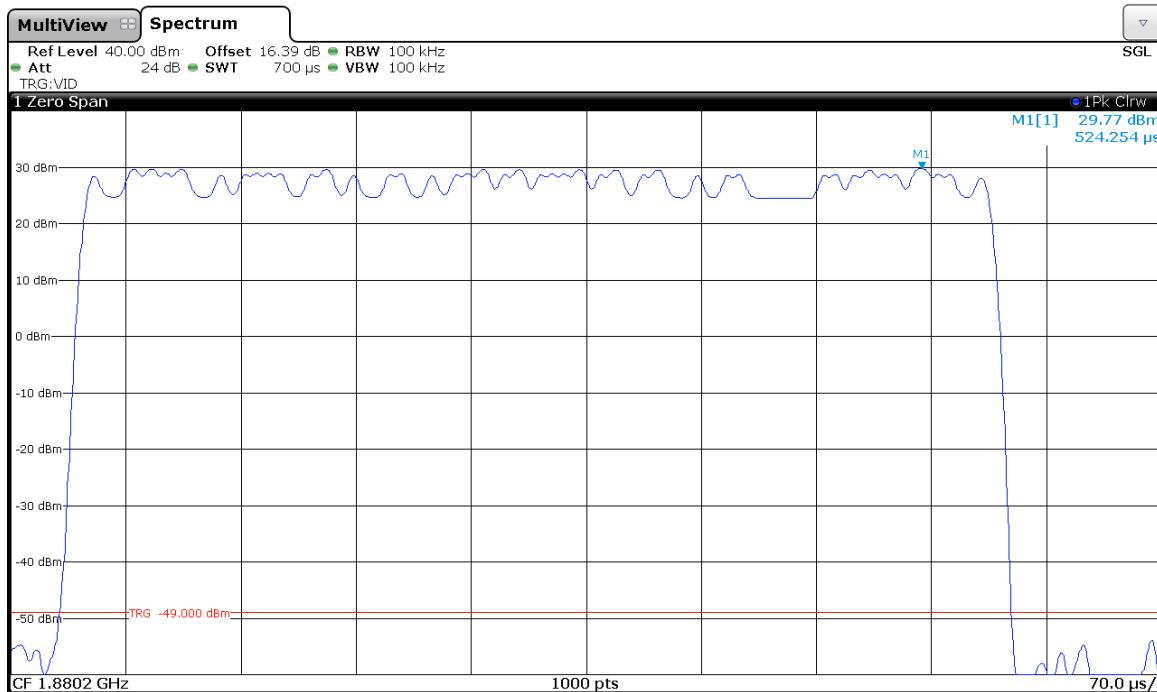
TEST SETUP:



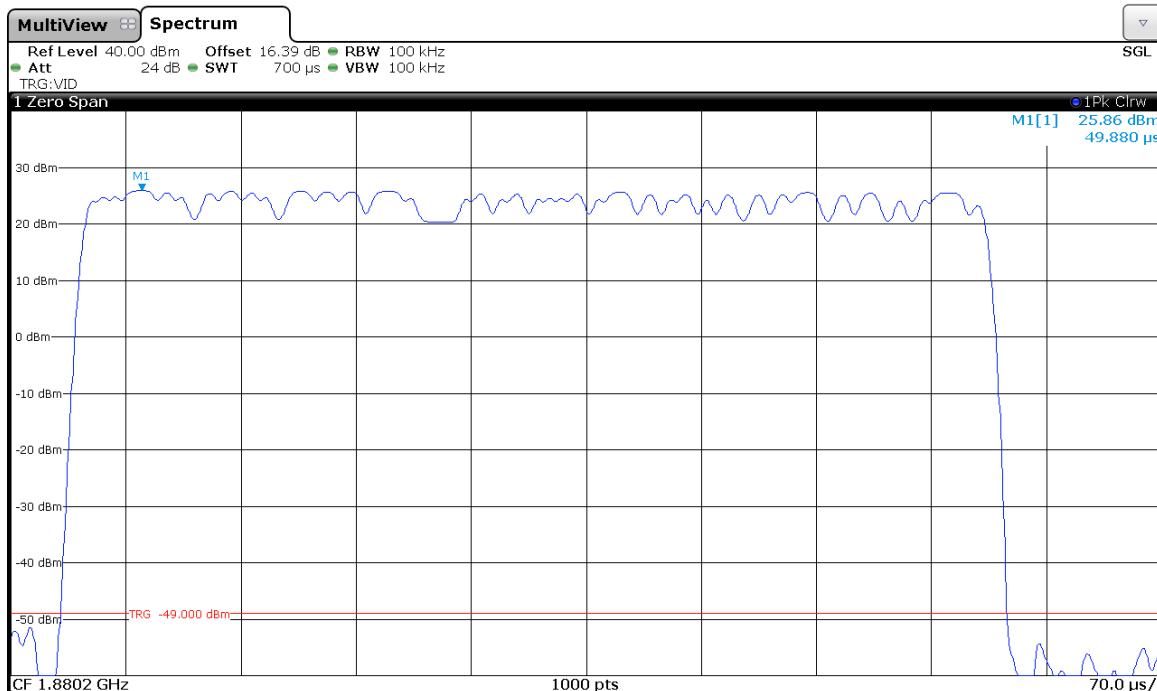
RESULTS:

The following plots show the modulation schemes in the EUT.

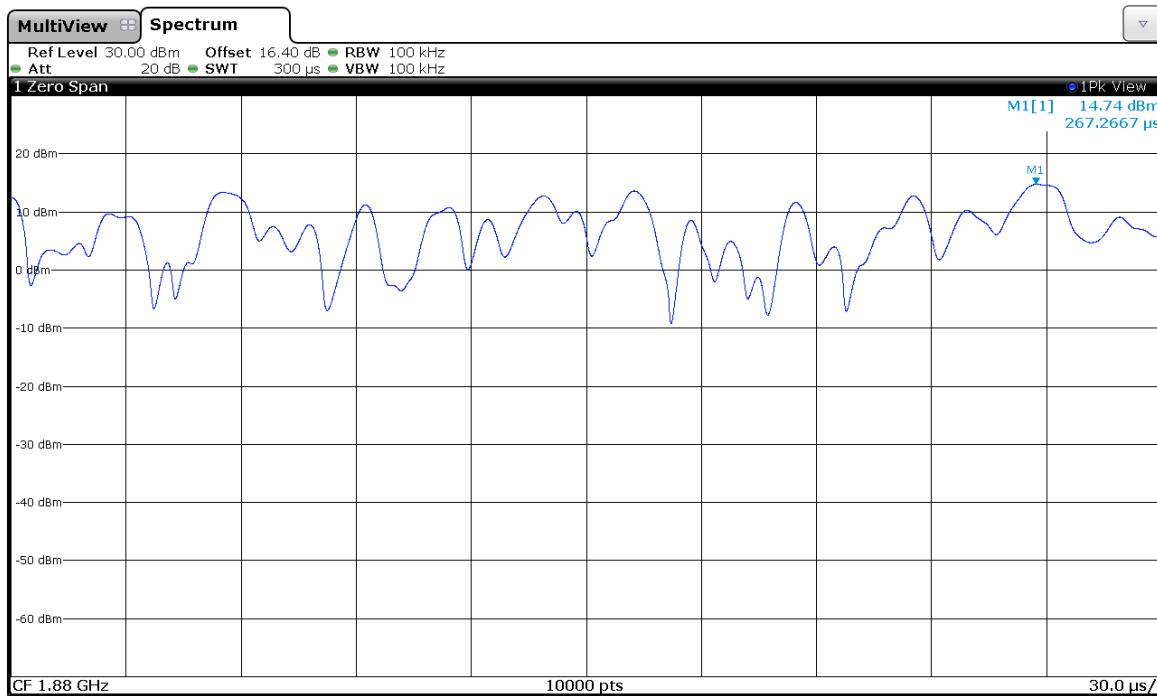
2G Band 1900 MHz. GPRS MODULATION.



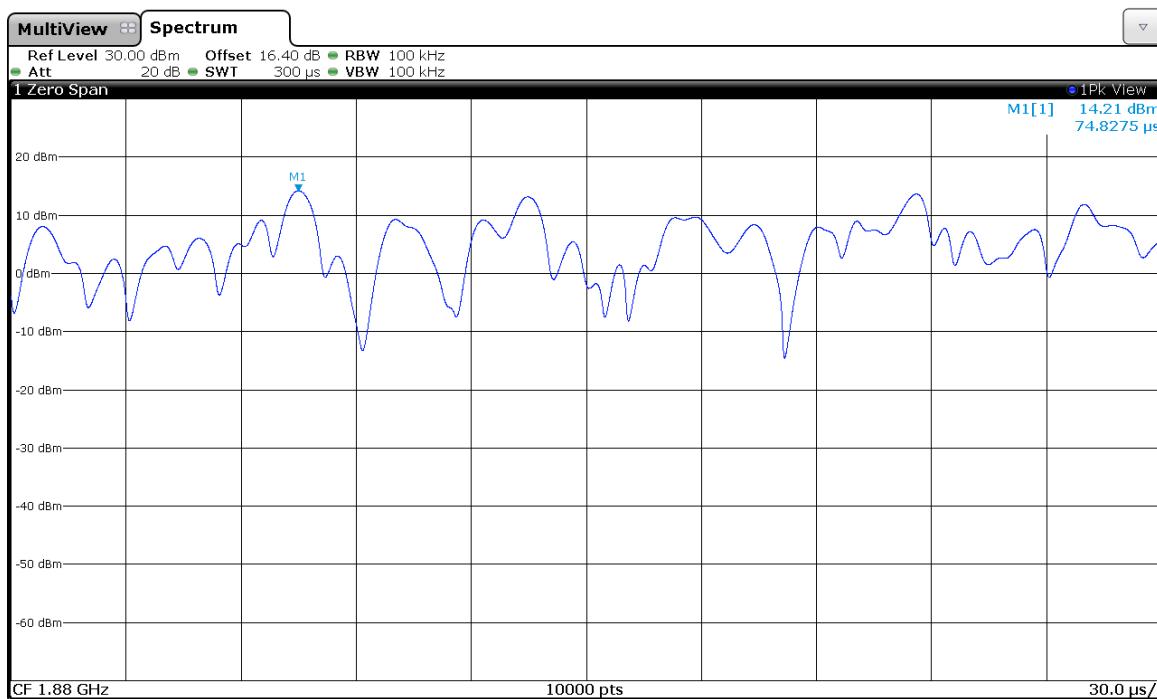
2G Band 1900 MHz. EDGE MODULATION.



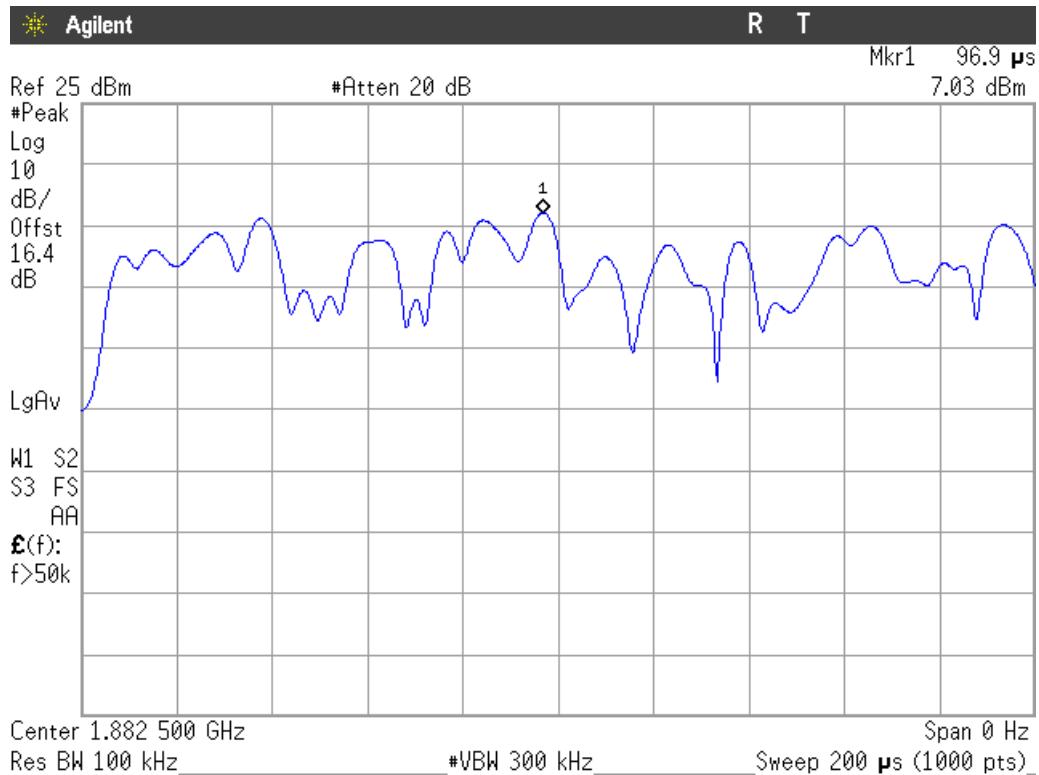
3G Band II. WCDMA MODULATION.



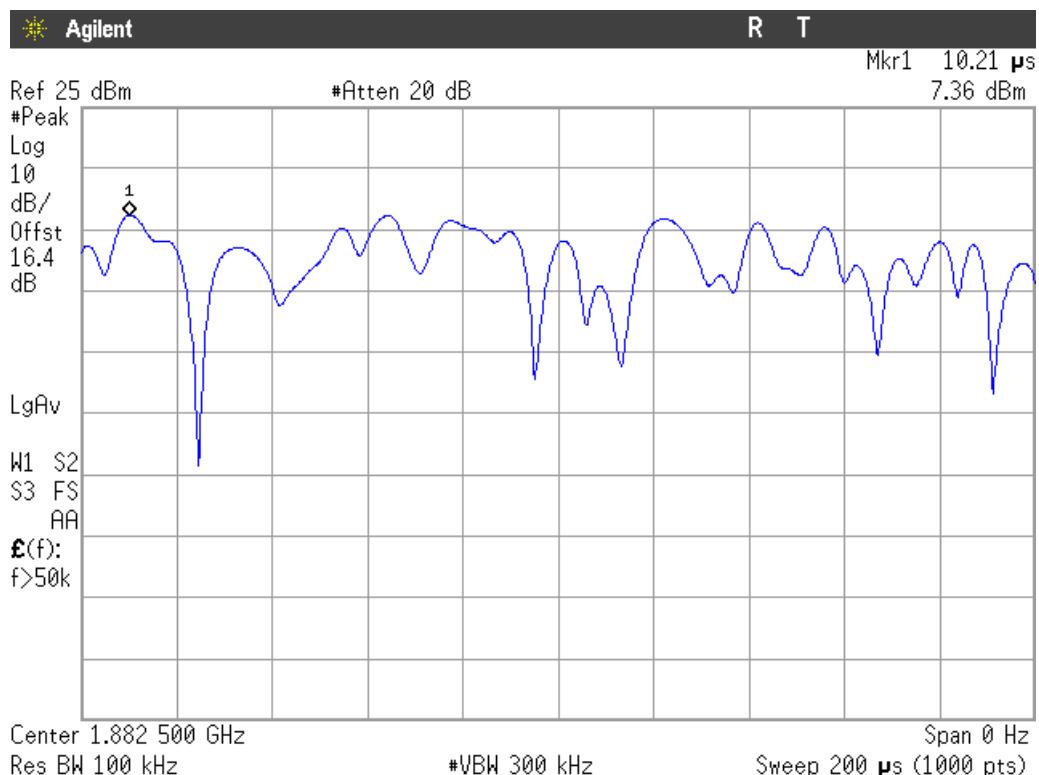
3G Band II. HSUPA MODULATION.



LTE Band 25. QPSK MODULATION. BW = 10 MHz.



LTE Band 25. 16QAM MODULATION. BW = 10 MHz.



Occupied Bandwidth

SPECIFICATION:

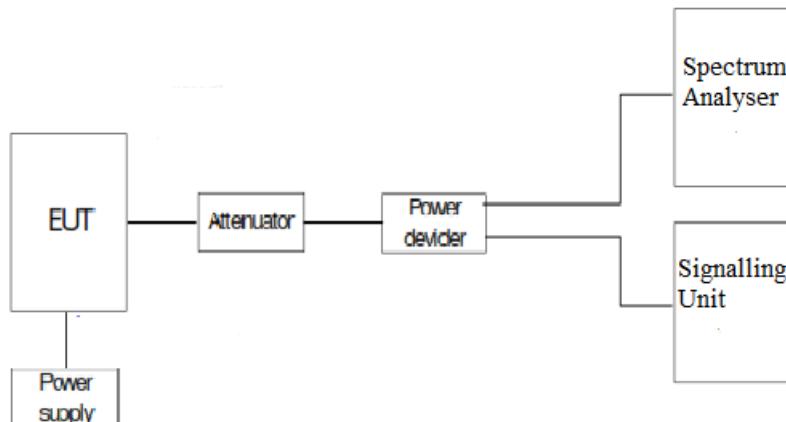
FCC §2.1049. Measurements required: Occupied bandwidth.

RSS-Gen Clause 6.7.

METHOD:

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

TEST SETUP:



RESULTS:

2G Band 1900 MHz:

2G Band 1900 MHz. GPRS MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	244.091	242.346	242.569
-26 dBc bandwidth (kHz)	303.164	300.174	300.666
Measurement uncertainty (kHz)	<±1.67		

2G Band 1900 MHz. EDGE MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	242.671	243.493	242.522
-26 dBc bandwidth (kHz)	300.459	300.408	299.926
Measurement uncertainty (kHz)	<±1.67		

3G Band II:

3G Band II. WCDMA MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4137.9	4134.4	4123.3
-26 dBc bandwidth (kHz)	4728.0	4698.0	4702.0
Measurement uncertainty (kHz)	<±16.67		

3G Band II. HSUPA MODULATION.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4148.8	4127.5	4133.6
-26 dBc bandwidth (kHz)	4693.0	4697.0	4686.0
Measurement uncertainty (kHz)	<±16.67		

LTE Bands: The worst case of Occupied Bandwidth corresponds to all Resource Blocks (RB) with Offset 0, regardless the nominal bandwidth selected.

LTE Band 25:

LTE Band 25. QPSK MODULATION. BW = 1.4 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.105	1.089	1.096
-26 dBc bandwidth (MHz)	1.252	1.243	1.262
Measurement uncertainty (kHz)	<±4.67		

LTE Band 25. 16QAM MODULATION. BW = 1.4 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	1.086	1.096	1.095
-26 dBc bandwidth (MHz)	1.241	1.249	1.244
Measurement uncertainty (kHz)	<±4.67		

LTE Band 25. QPSK MODULATION. BW = 3 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.779	2.753	2.750
-26 dBc bandwidth (MHz)	3.097	3.092	3.100
Measurement uncertainty (kHz)	<±10		

LTE Band 25. 16QAM MODULATION. BW = 3 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	2.745	2.749	2.742
-26 dBc bandwidth (MHz)	3.086	3.062	3.076
Measurement uncertainty (kHz)	<±10		

LTE Band 25. QPSK MODULATION. BW = 5 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.521	4.503	4.505
-26 dBc bandwidth (MHz)	4.975	4.964	4.958
Measurement uncertainty (kHz)	<±16.67		

LTE Band 25. 16QAM MODULATION. BW = 5 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	4.506	4.520	4.503
-26 dBc bandwidth (MHz)	4.958	4.961	4.960
Measurement uncertainty (kHz)	<±16.67		

LTE Band 25. QPSK MODULATION. BW = 10 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.037	9.067	9.086
-26 dBc bandwidth (MHz)	10.039	10.126	10.047
Measurement uncertainty (kHz)	<±33.33		

LTE Band 25. 16QAM MODULATION. BW = 10 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	9.060	9.066	9.073
-26 dBc bandwidth (MHz)	9.948	9.981	9.993
Measurement uncertainty (kHz)	<±33.33		

LTE Band 25. QPSK MODULATION. BW = 15 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.488	13.434	13.450
-26 dBc bandwidth (MHz)	14.716	14.733	14.742
Measurement uncertainty (kHz)	<±50		

LTE Band 25. 16QAM MODULATION. BW = 15 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	13.471	13.449	13.476
-26 dBc bandwidth (MHz)	14.625	14.702	14.814
Measurement uncertainty (kHz)	<±50		

LTE Band 25. QPSK MODULATION. BW = 20 MHz.

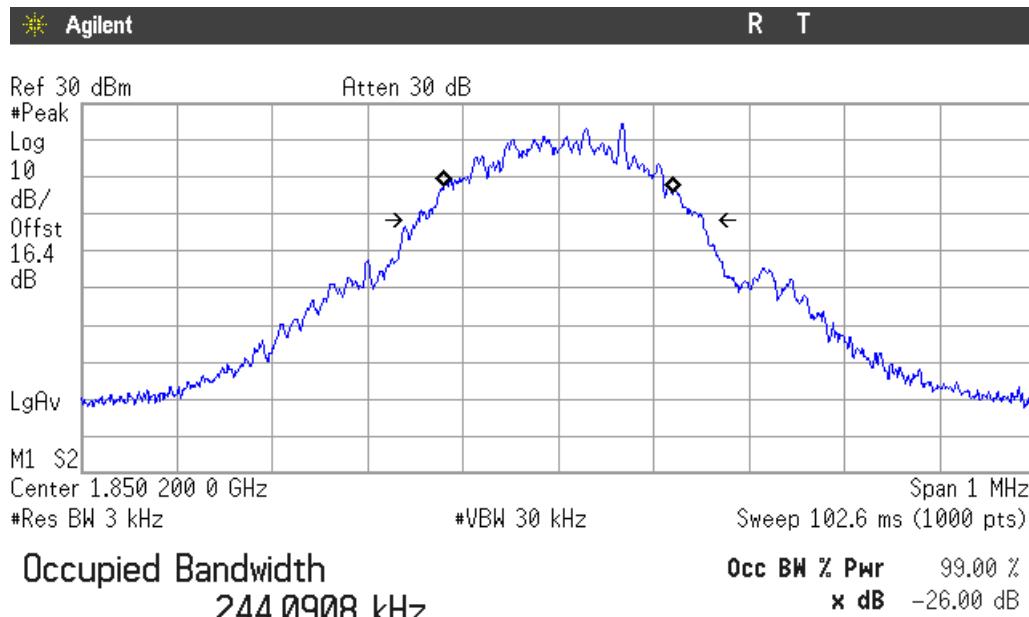
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.933	17.855	17.866
-26 dBc bandwidth (MHz)	19.523	19.305	19.453
Measurement uncertainty (kHz)	<±66.67		

LTE Band 25. 16QAM MODULATION. BW = 20 MHz.

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (MHz)	17.912	17.870	17.879
-26 dBc bandwidth (MHz)	19.301	19.294	19.267
Measurement uncertainty (kHz)	<±66.67		

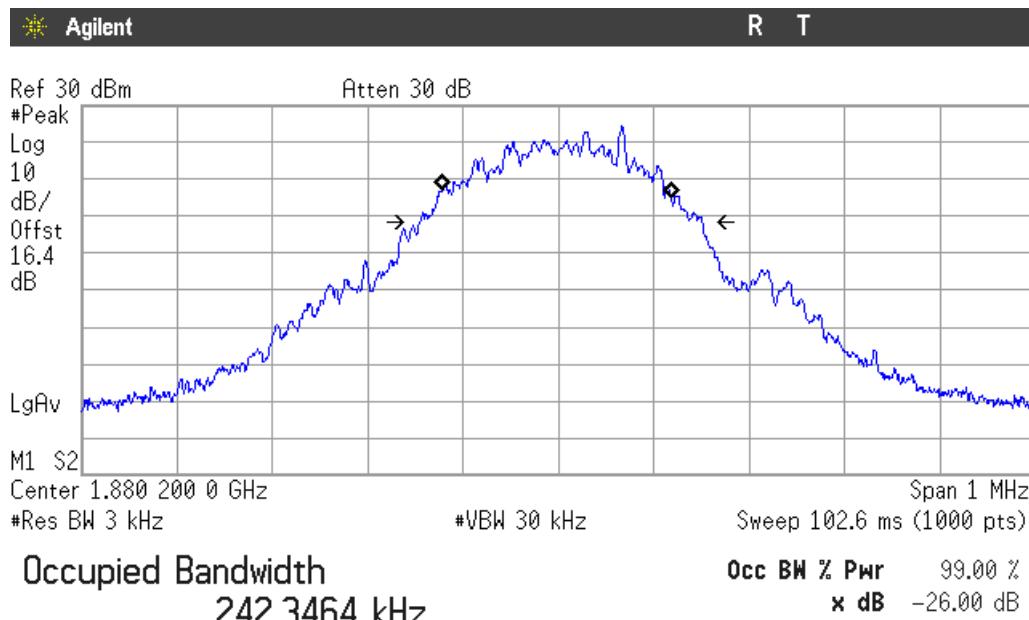
2G Band 1900 MHz. GPRS MODULATION.

Lowest Channel:



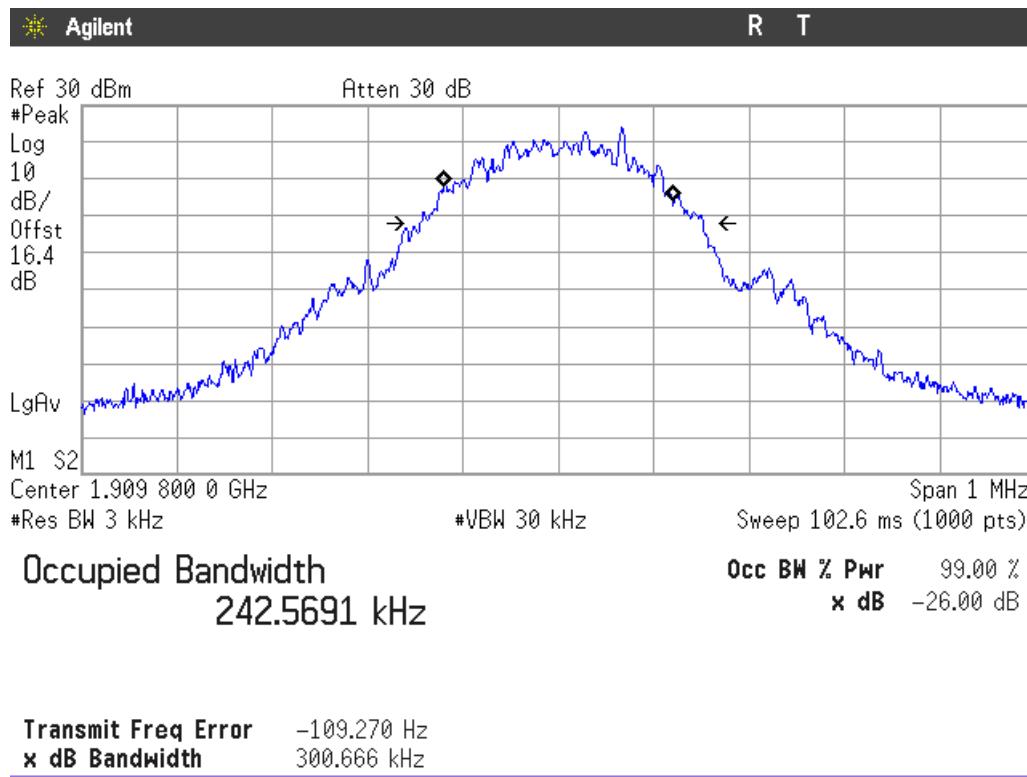
Transmit Freq Error 561.125 Hz
x dB Bandwidth 303.164 kHz

Middle Channel:



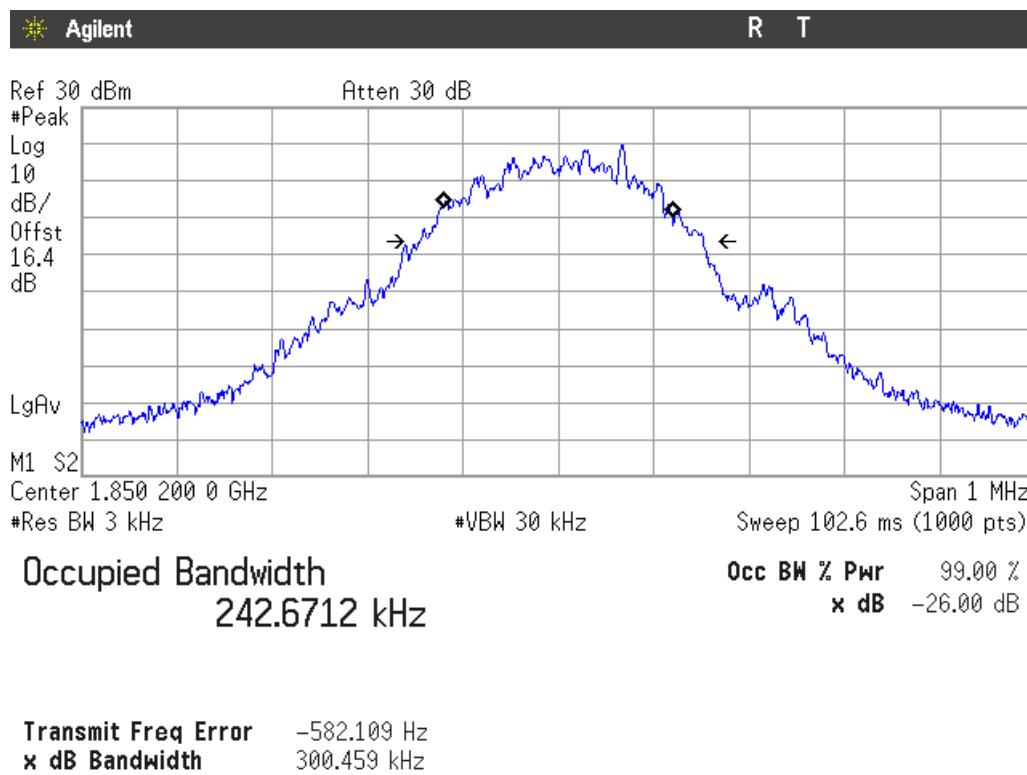
Transmit Freq Error -1.365 kHz
x dB Bandwidth 300.174 kHz

Highest Channel:

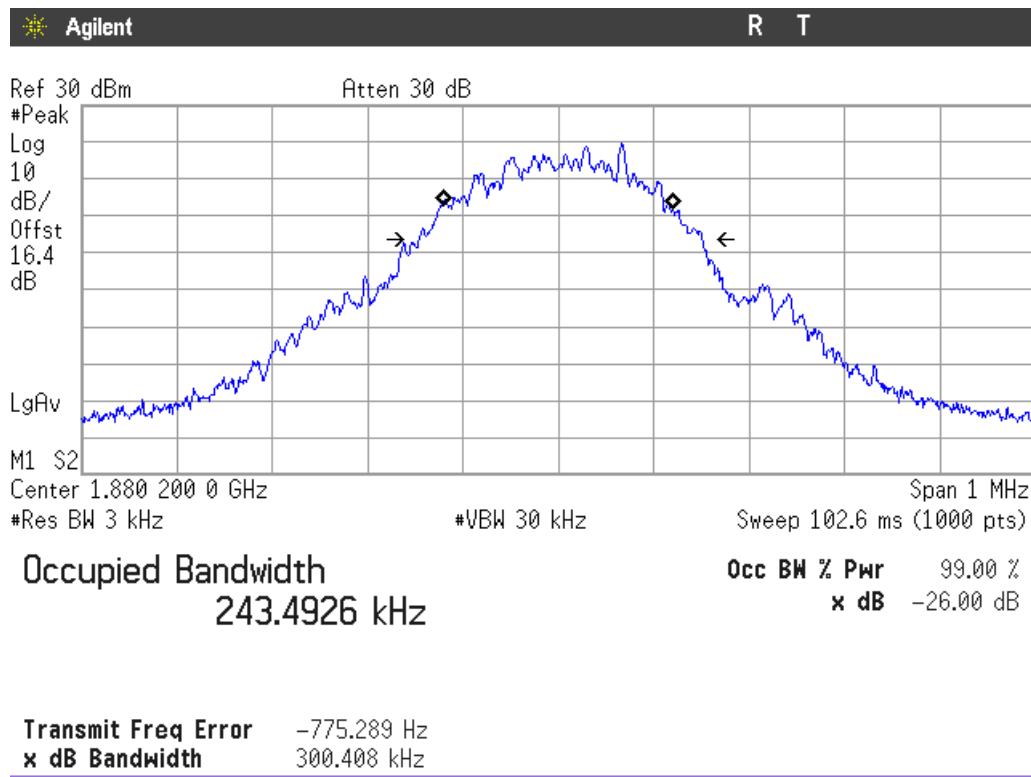


2G Band 1900 MHz. EDGE MODULATION.

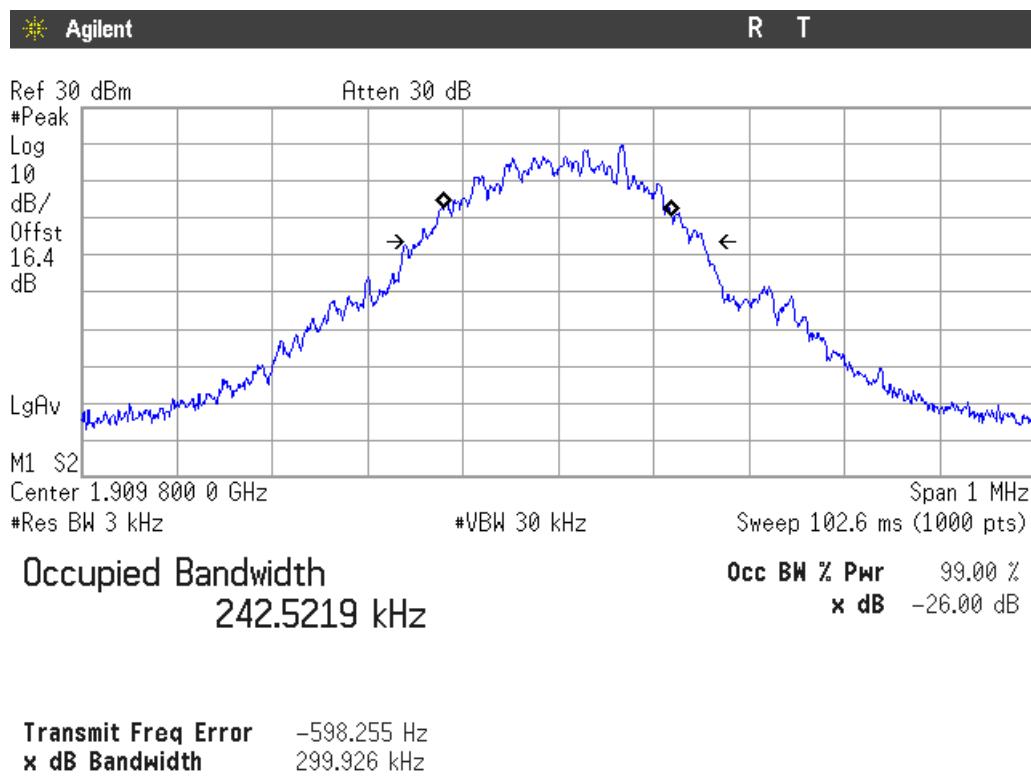
Lowest Channel:



Middle Channel:

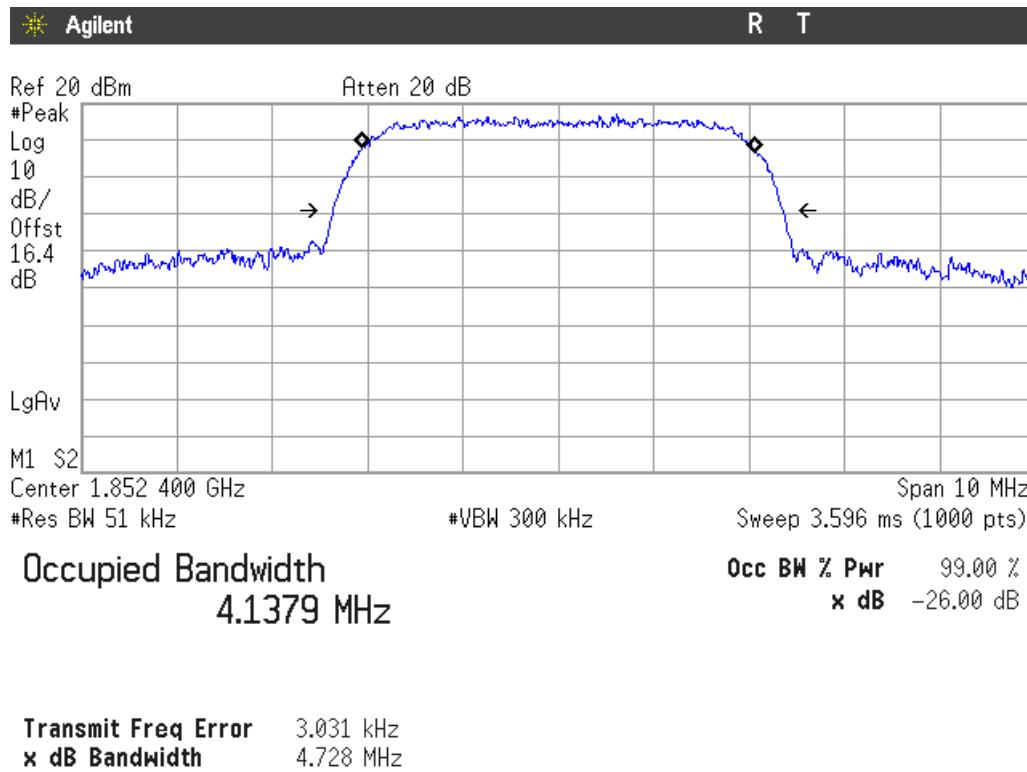


Highest Channel:

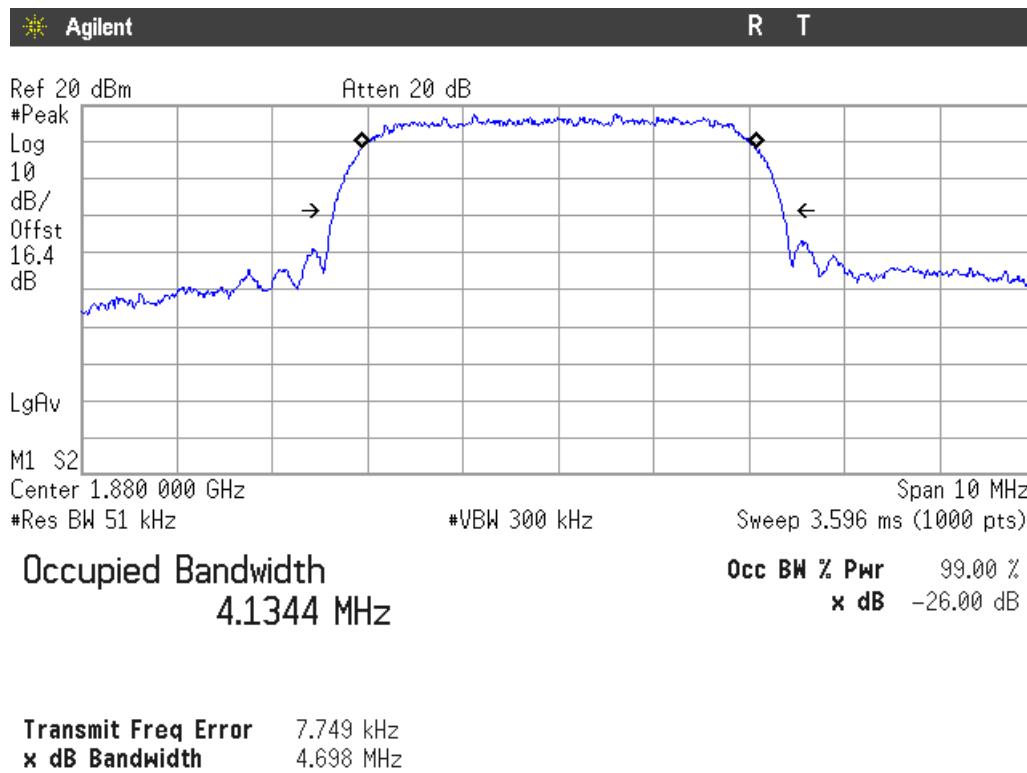


3G Band II. WCDMA MODULATION.

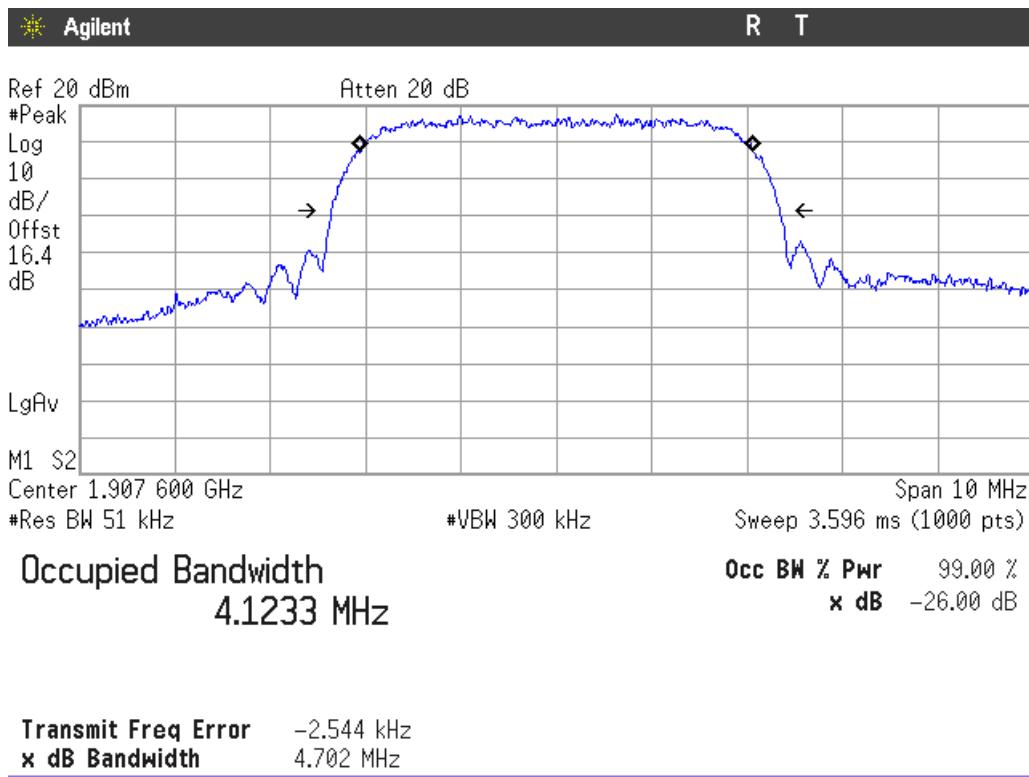
Lowest Channel:



Middle Channel:

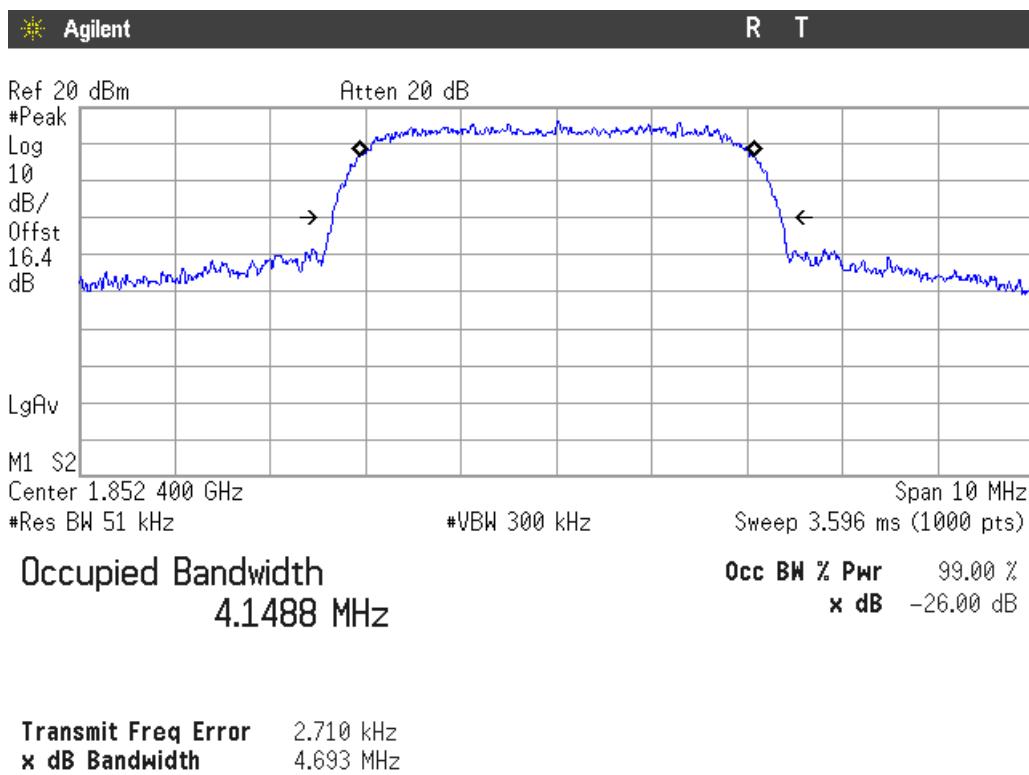


Highest Channel:

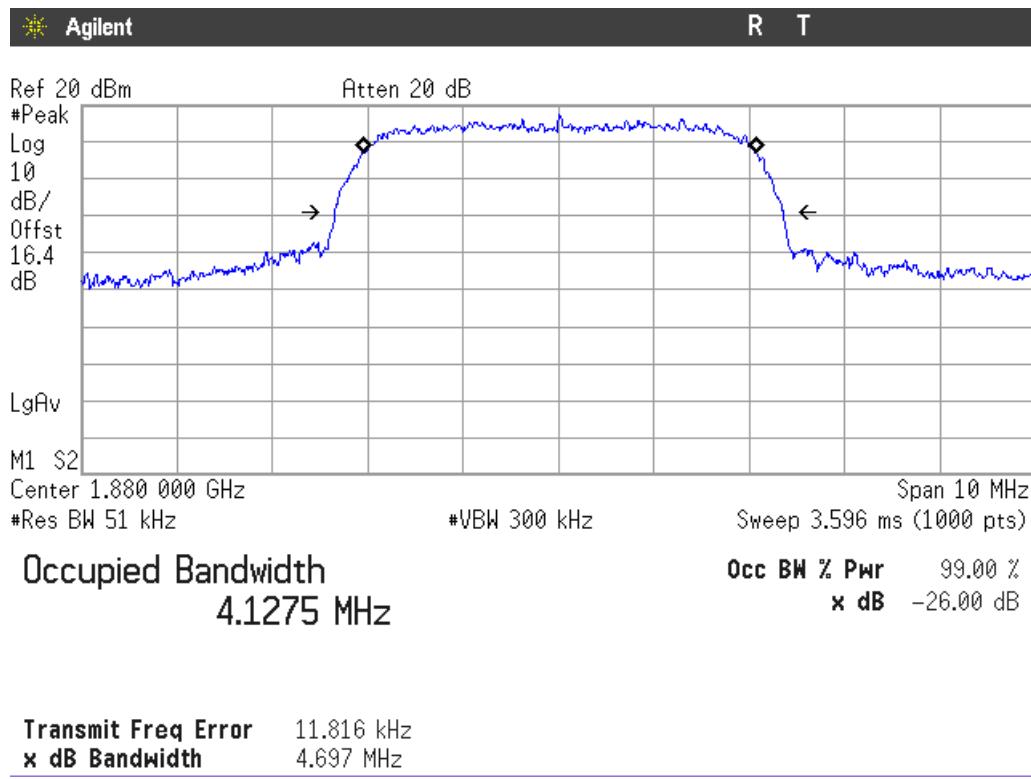


3G Band II. HSUPA MODULATION.

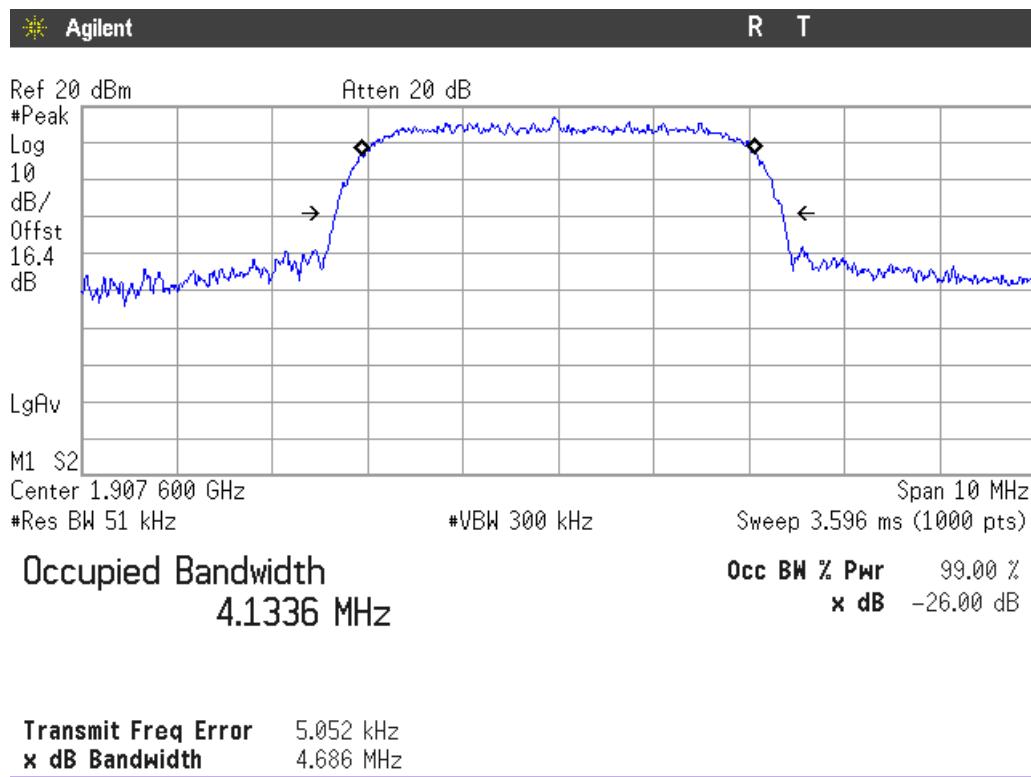
Lowest Channel:



Middle Channel:

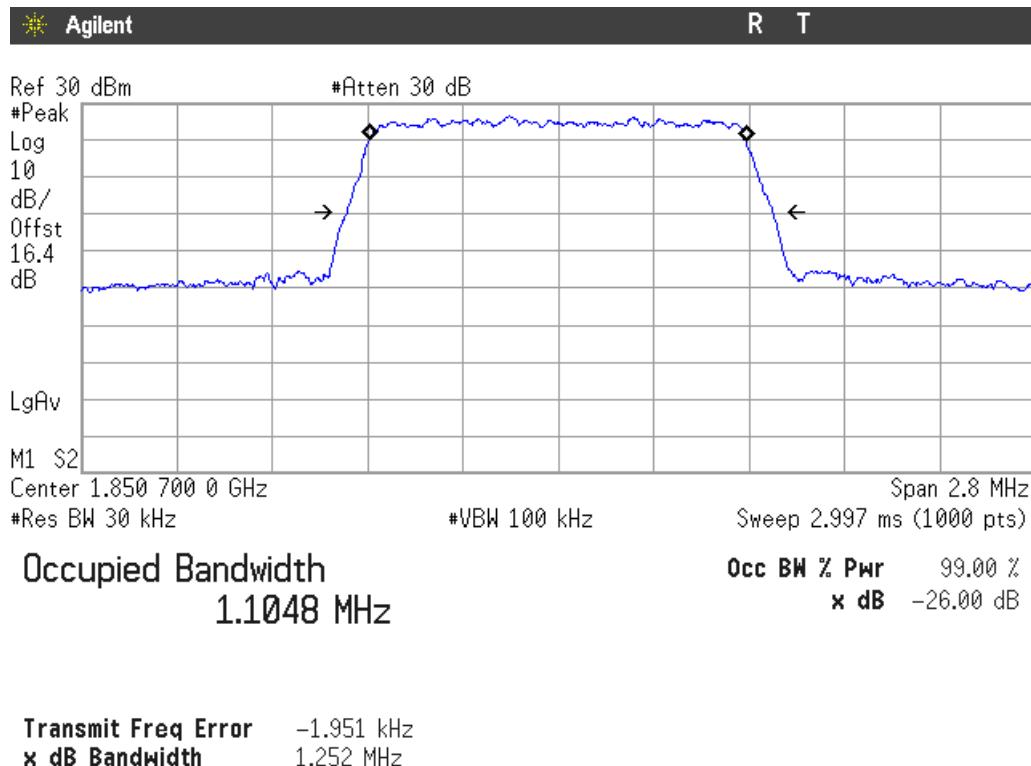


Highest Channel:

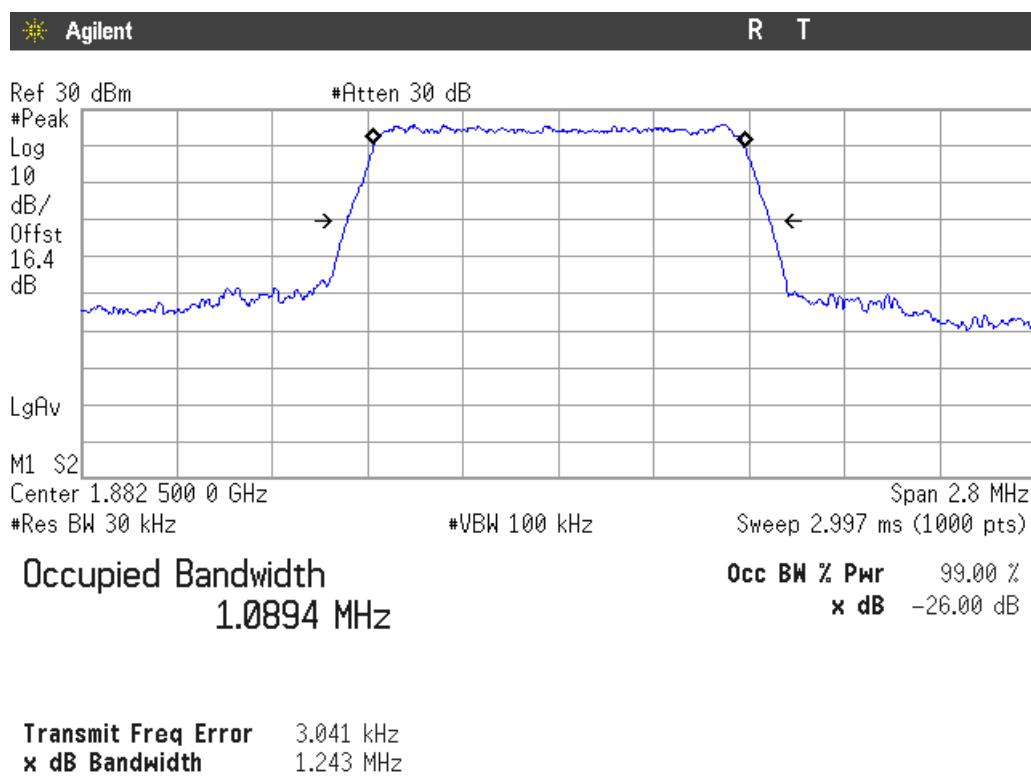


LTE Band 25. QPSK MODULATION. BW = 1.4 MHz.

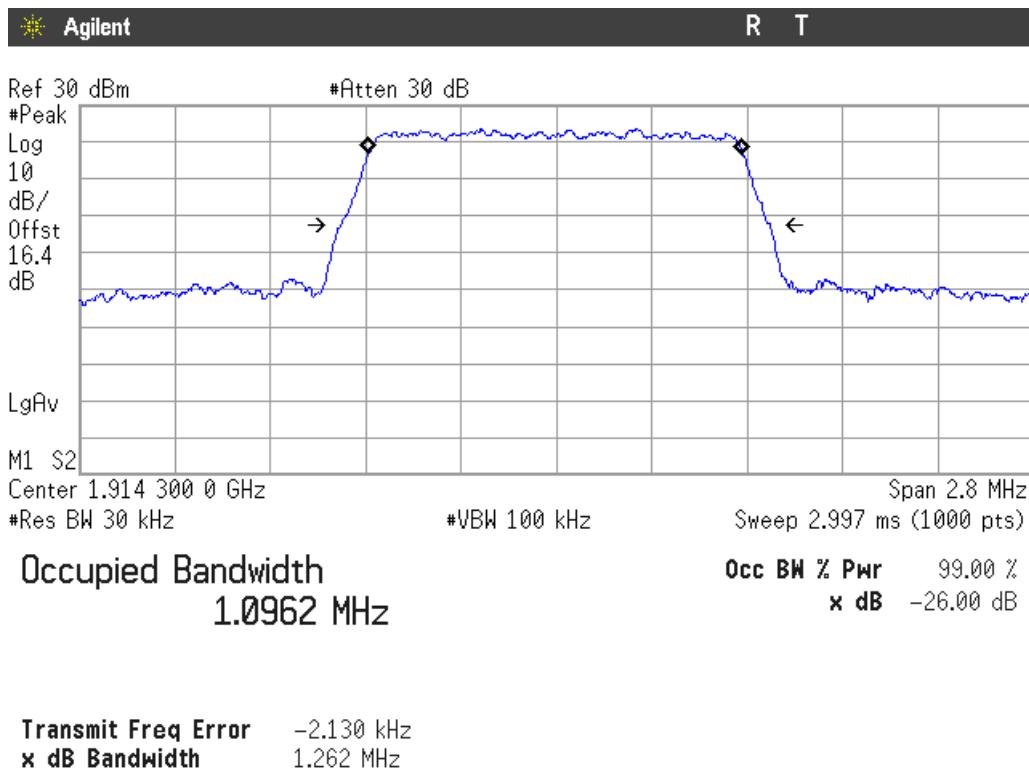
Lowest Channel:



Middle Channel:

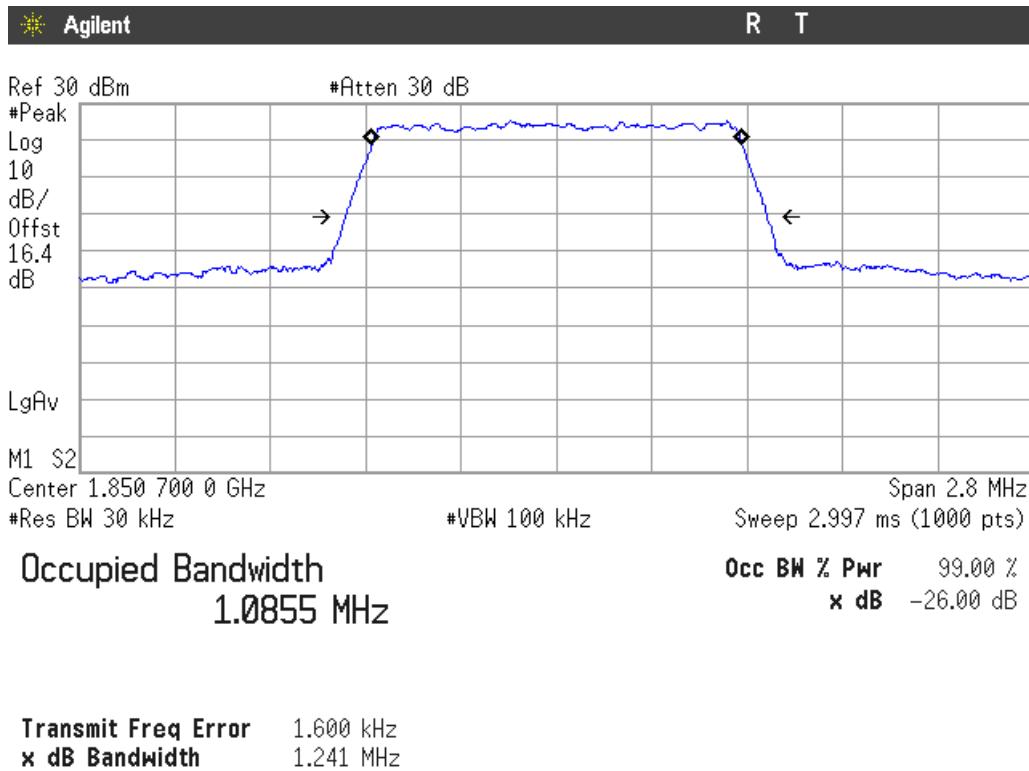


Highest Channel:

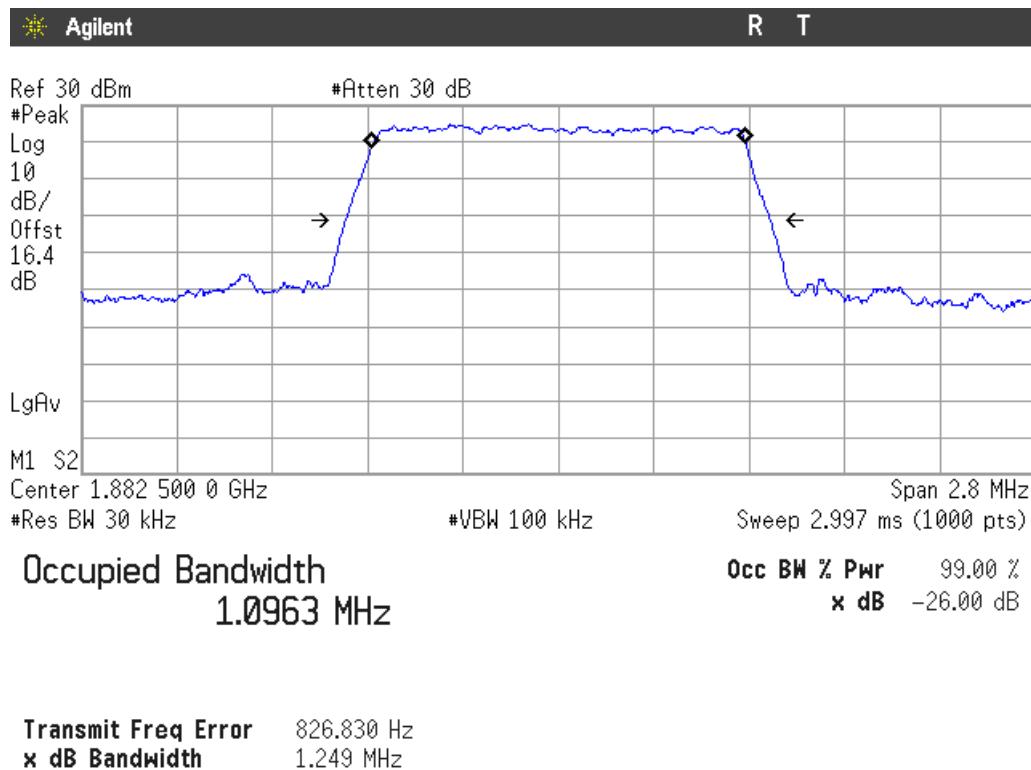


LTE Band 25. 16QAM MODULATION. BW = 1.4 MHz.

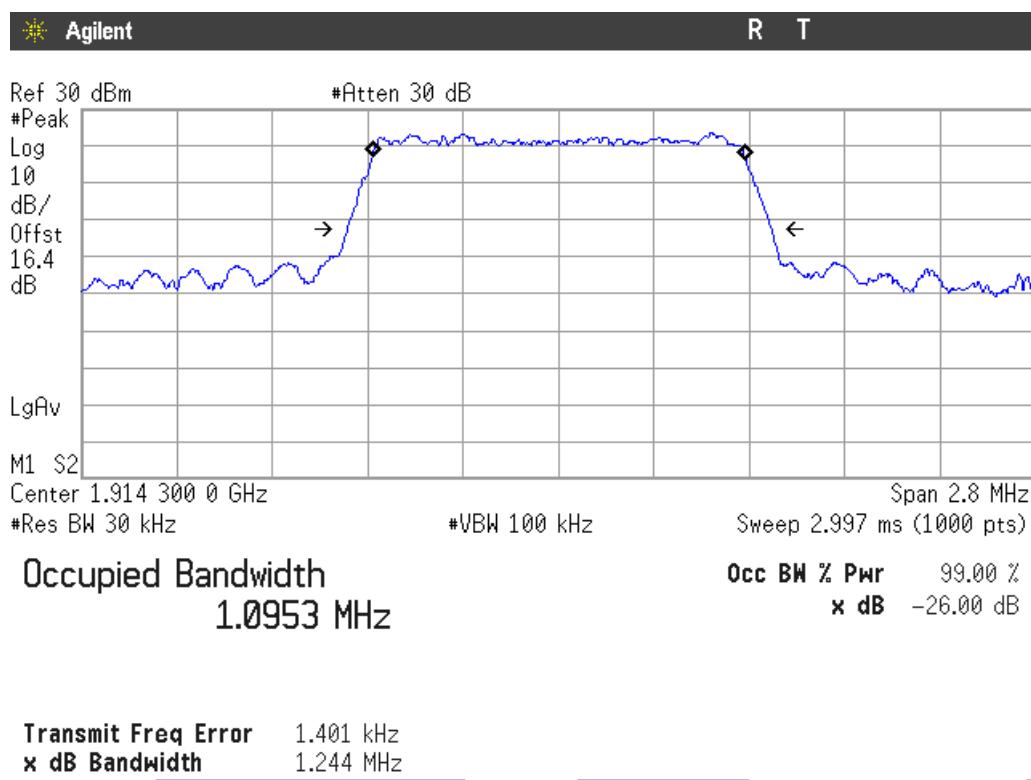
Lowest Channel:



Middle Channel:

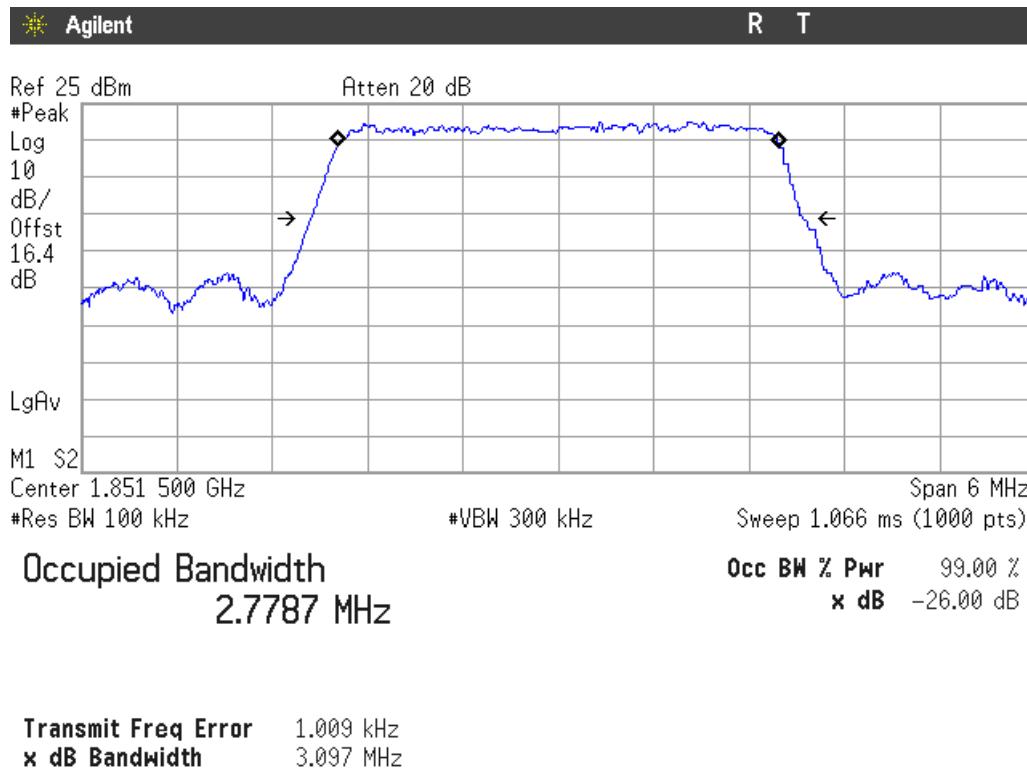


Highest Channel:

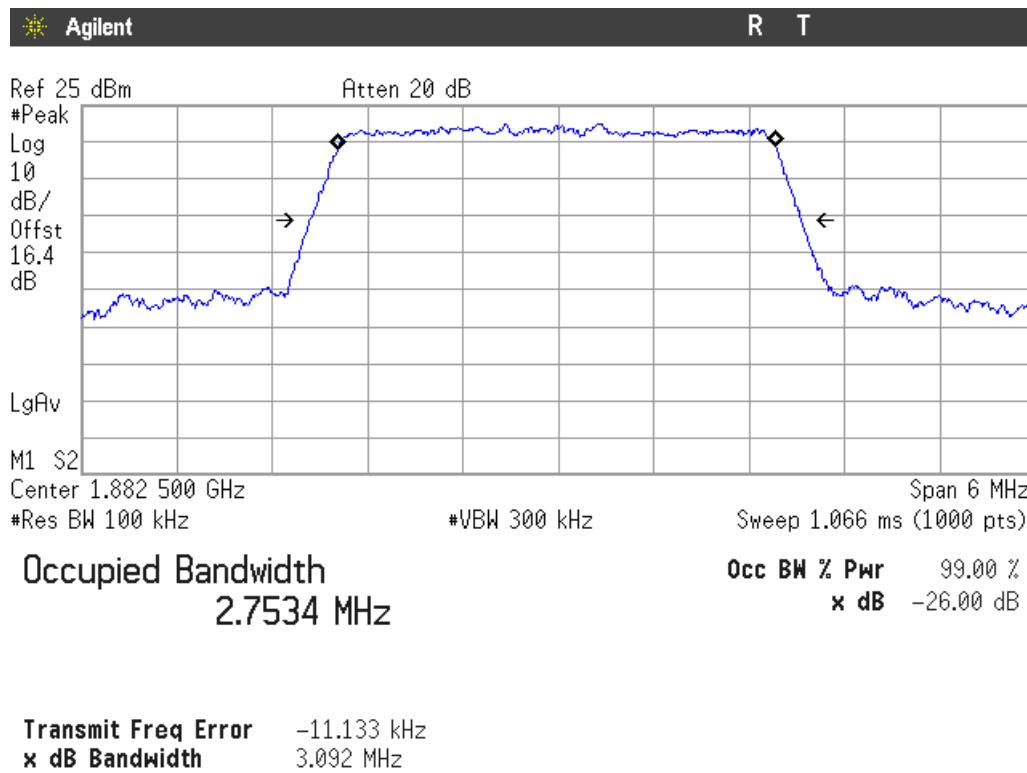


LTE Band 25. QPSK MODULATION. BW = 3 MHz.

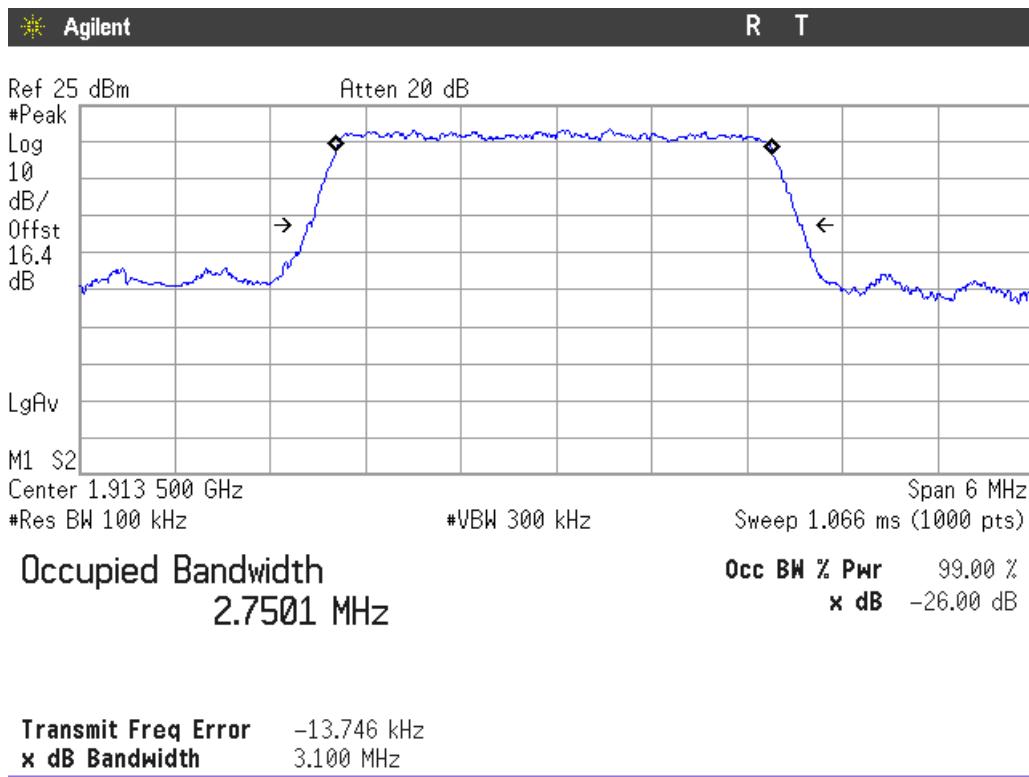
Lowest Channel:



Middle Channel:

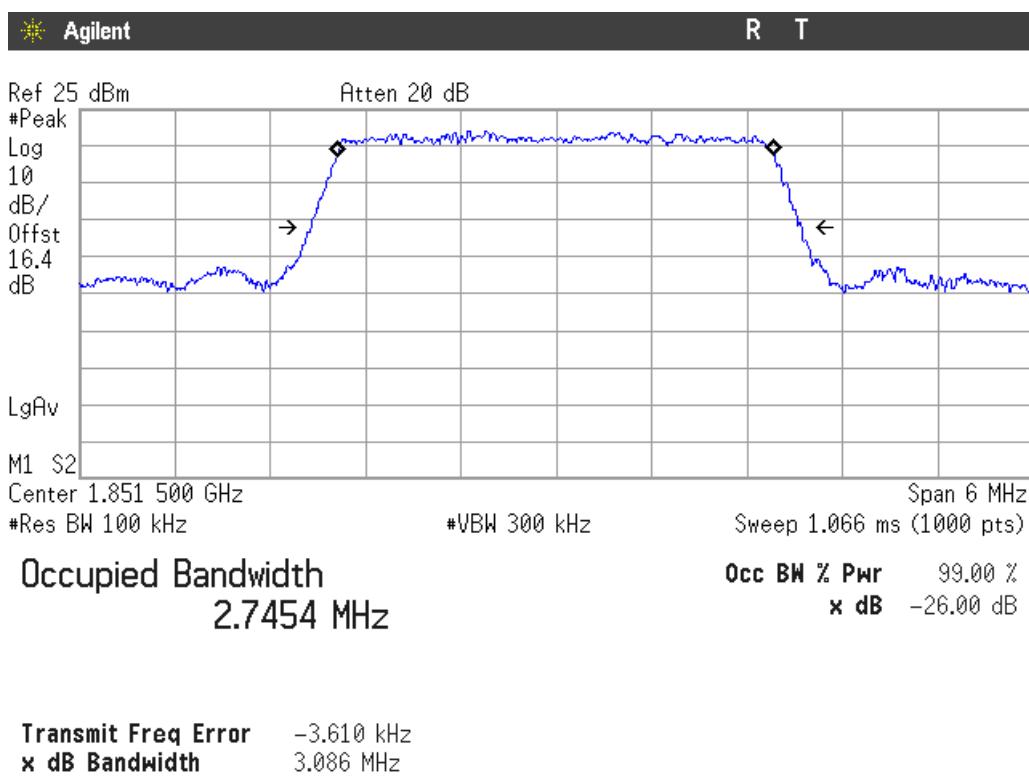


Highest Channel:

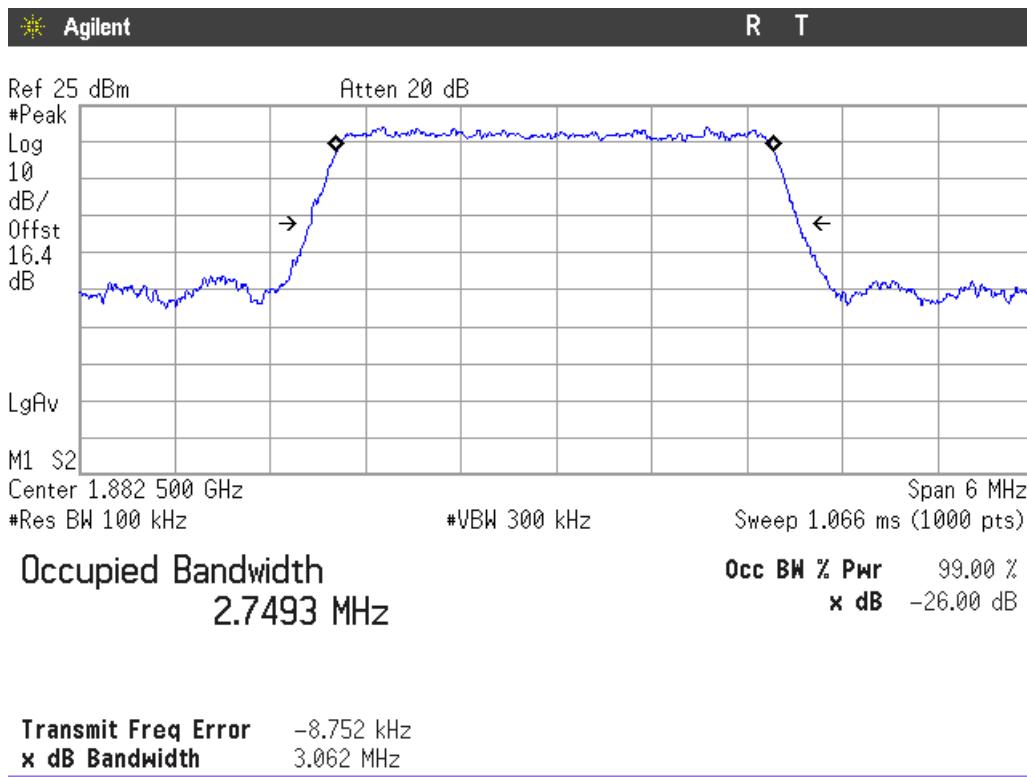


LTE Band 25. 16QAM MODULATION. BW = 3 MHz.

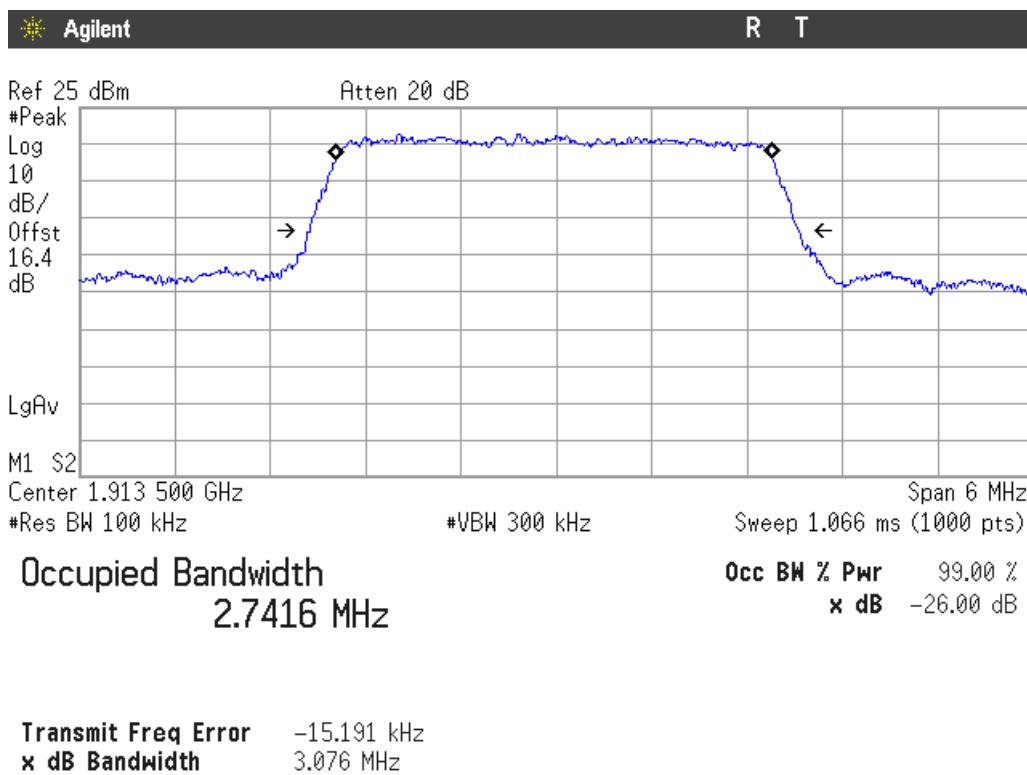
Lowest Channel:



Middle Channel:

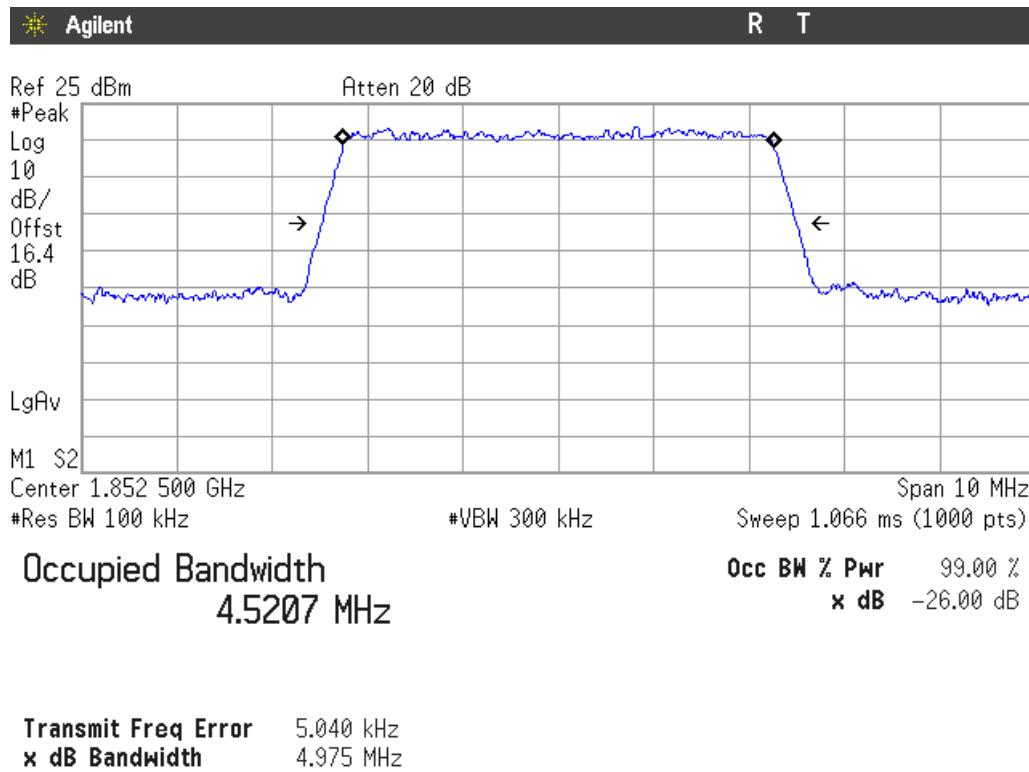


Highest Channel:

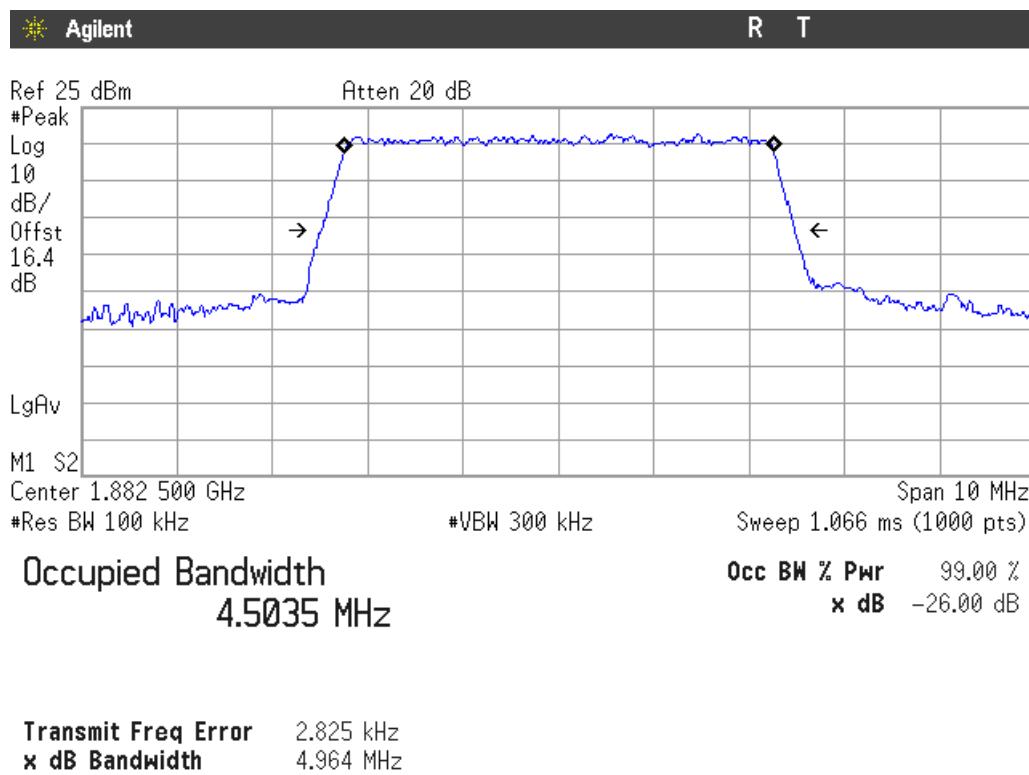


LTE Band 25. QPSK MODULATION. BW = 5 MHz.

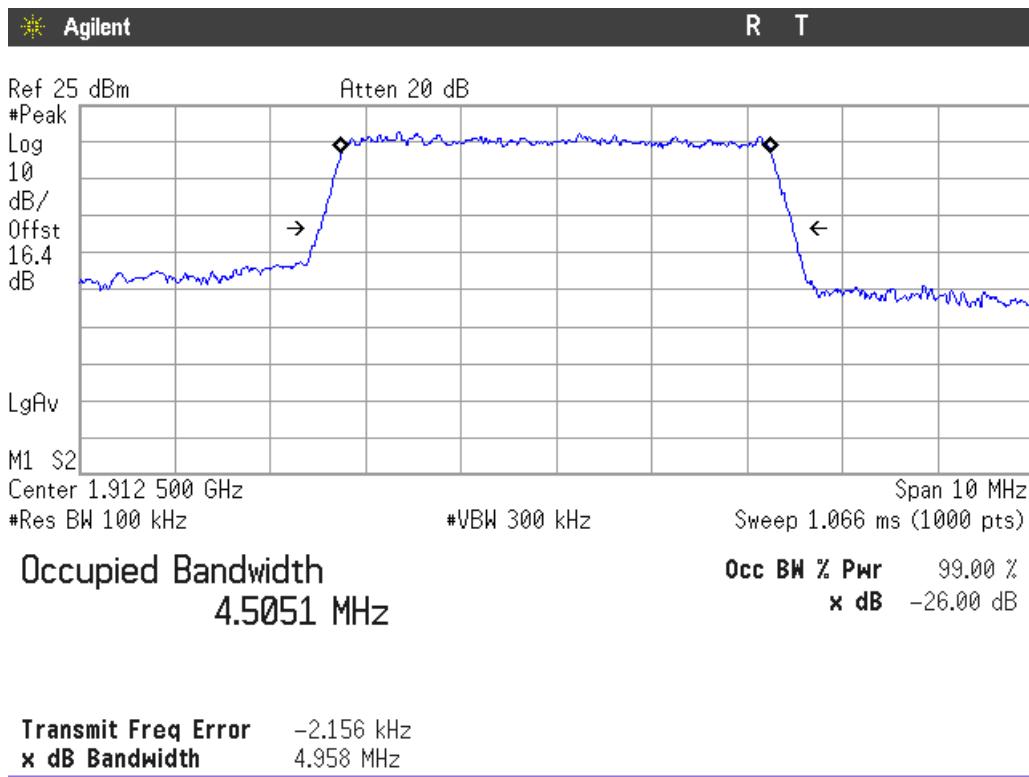
Lowest Channel:



Middle Channel:

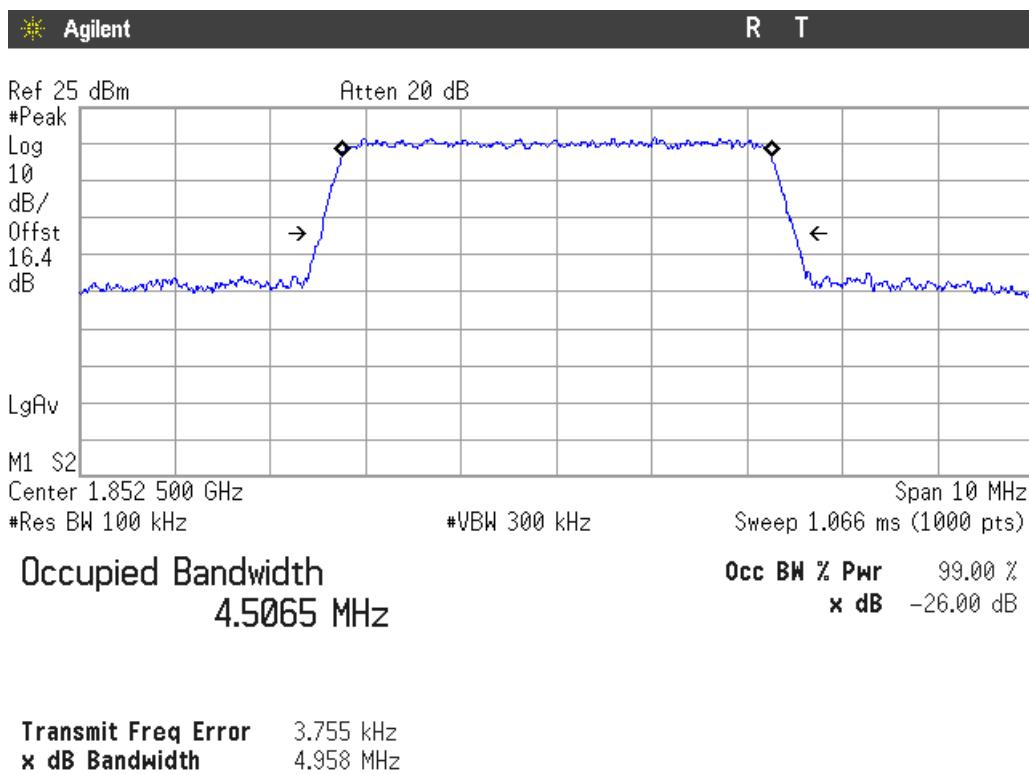


Highest Channel:

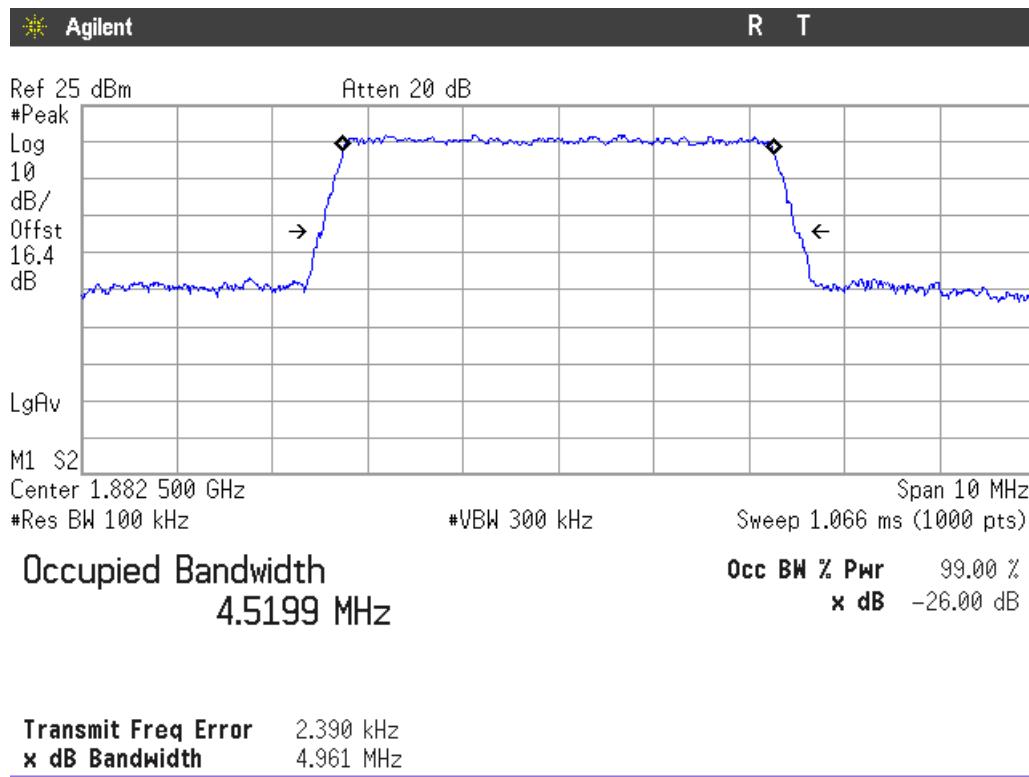


LTE Band 25. 16QAM MODULATION. BW = 5 MHz.

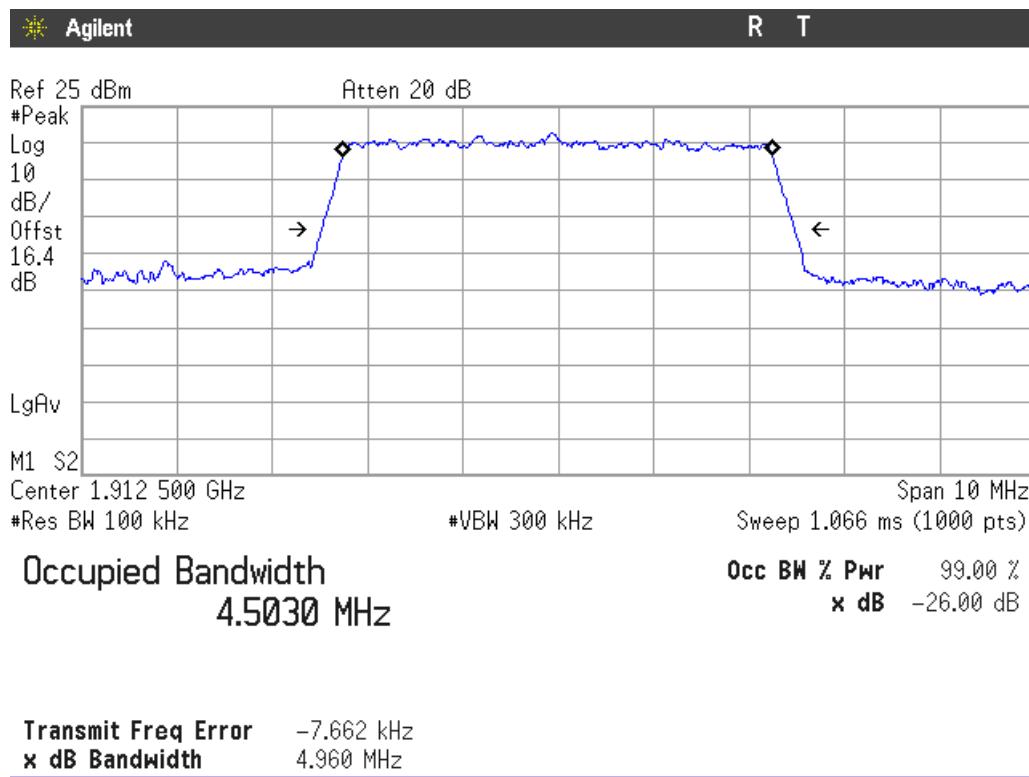
Lowest Channel:



Middle Channel:

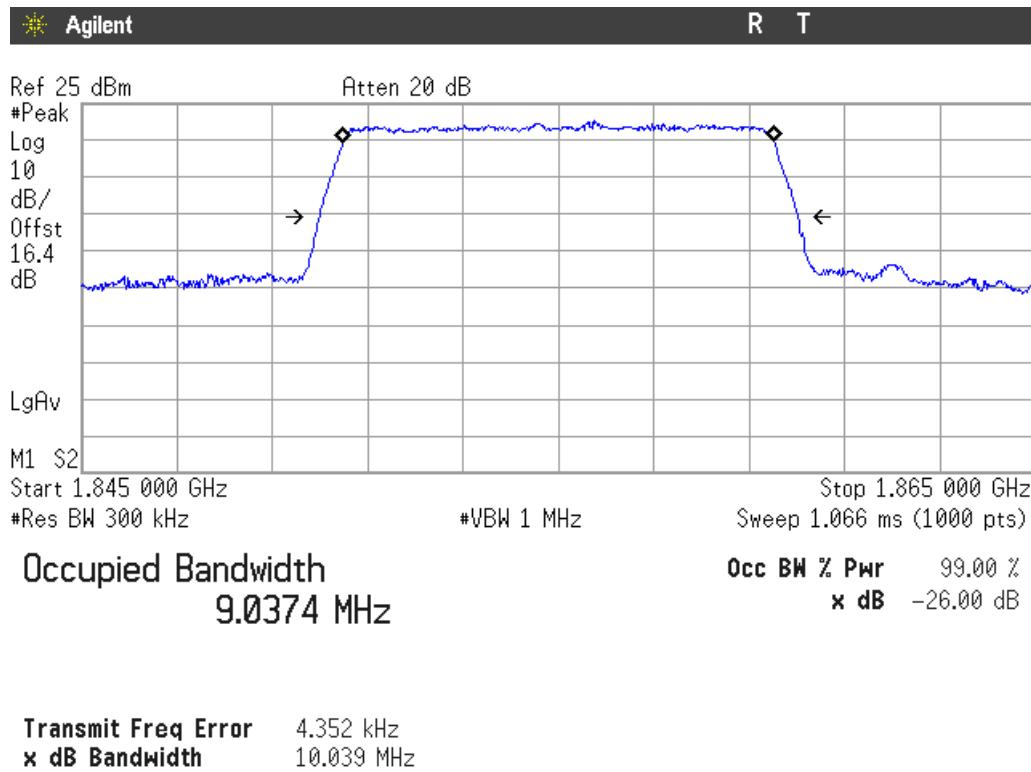


Highest Channel:

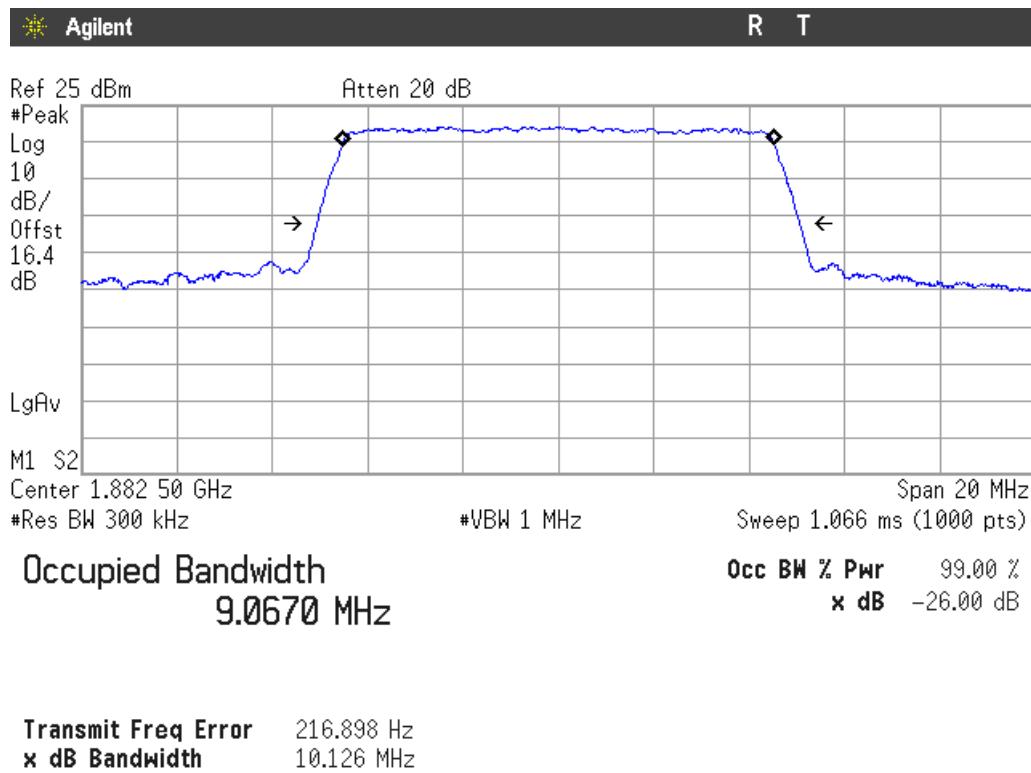


LTE Band 25. QPSK MODULATION. BW = 10 MHz.

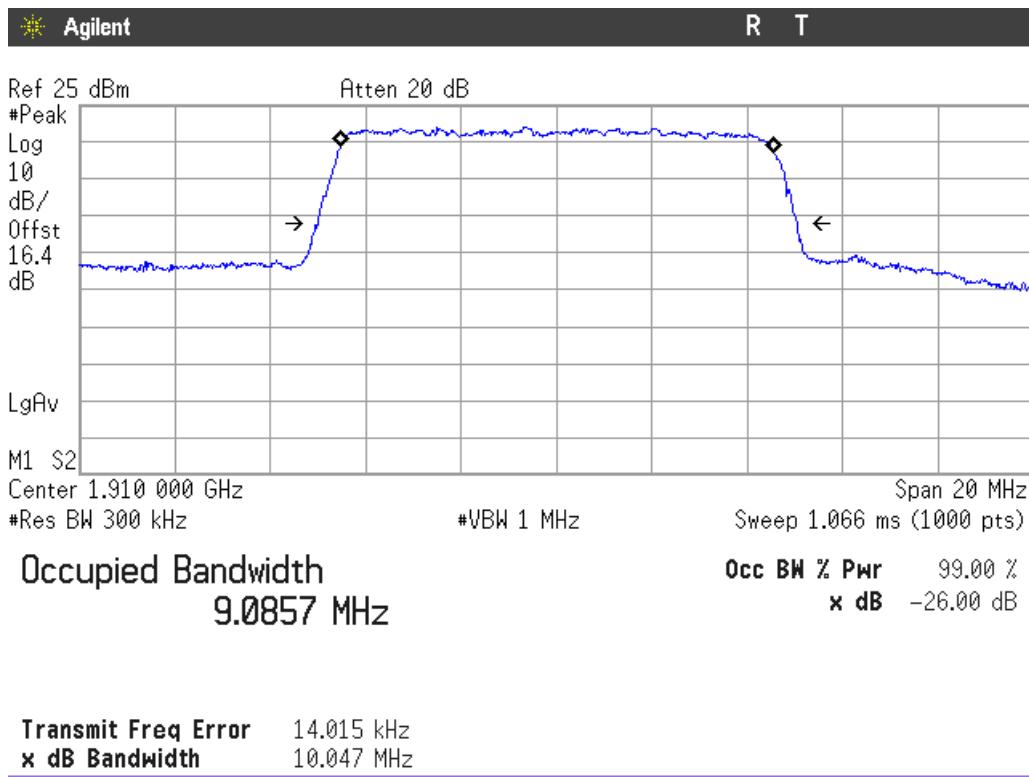
Lowest Channel:



Middle Channel:

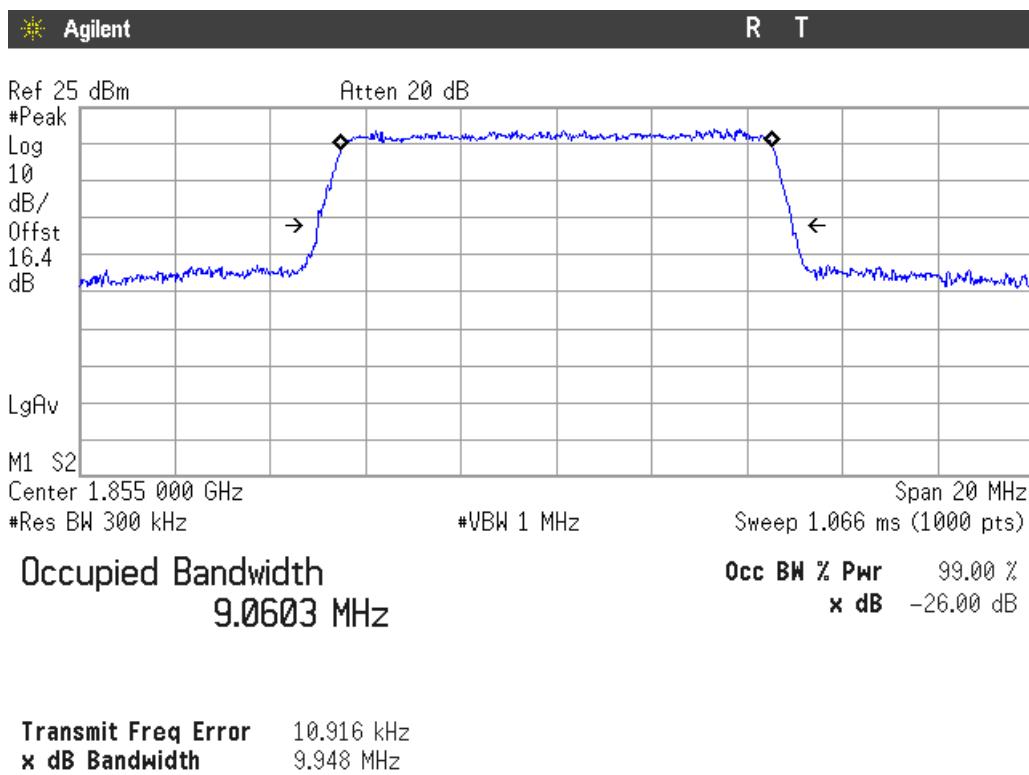


Highest Channel:

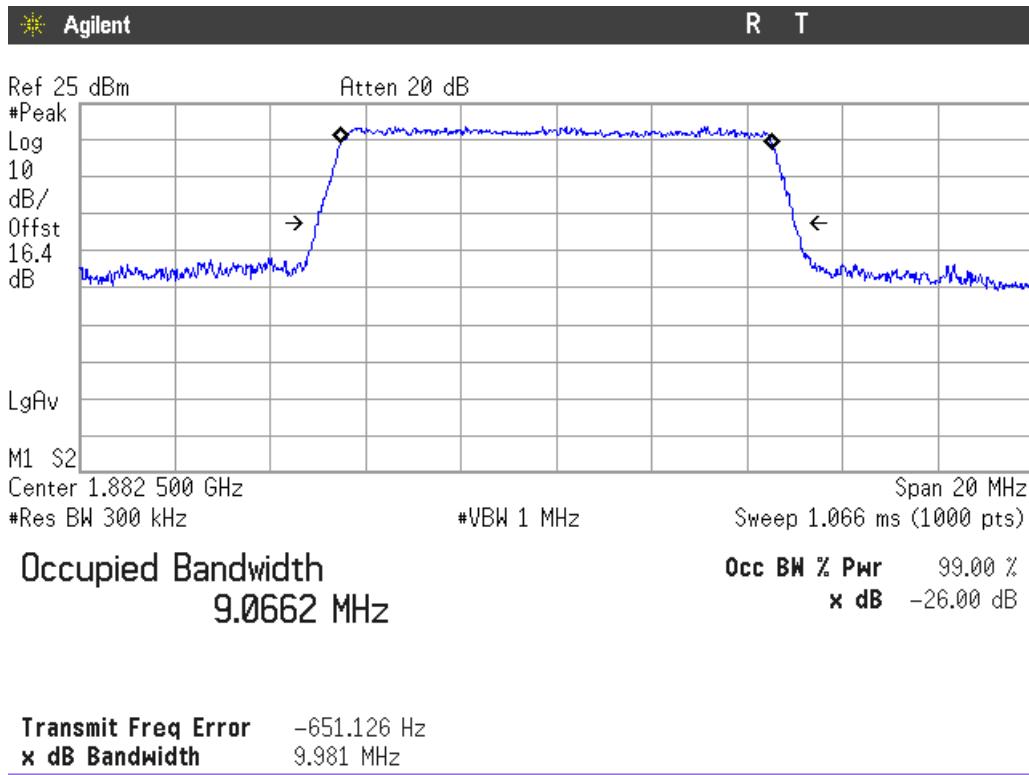


LTE Band 25. 16QAM MODULATION. BW = 10 MHz.

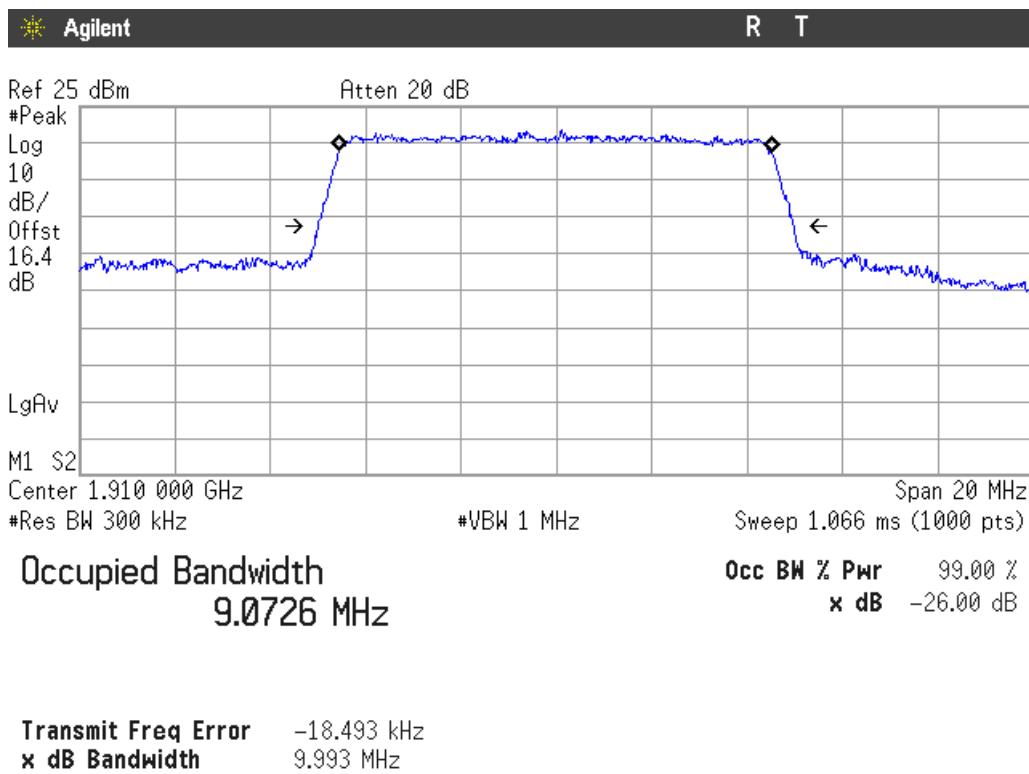
Lowest Channel:



Middle Channel:

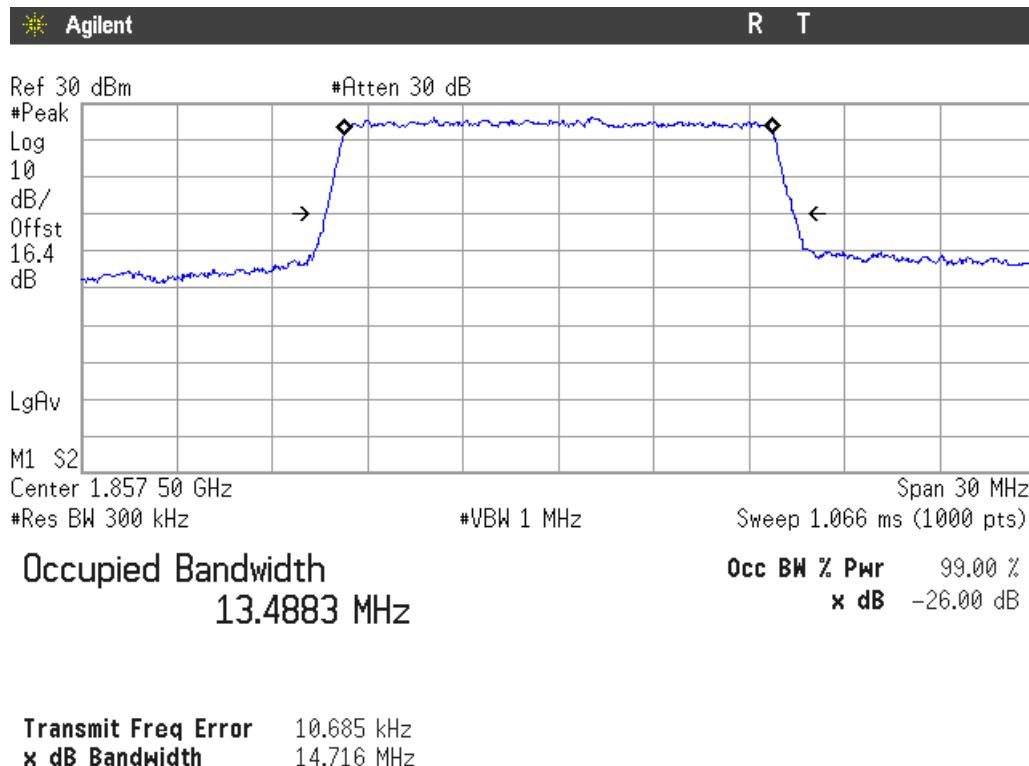


Highest Channel:

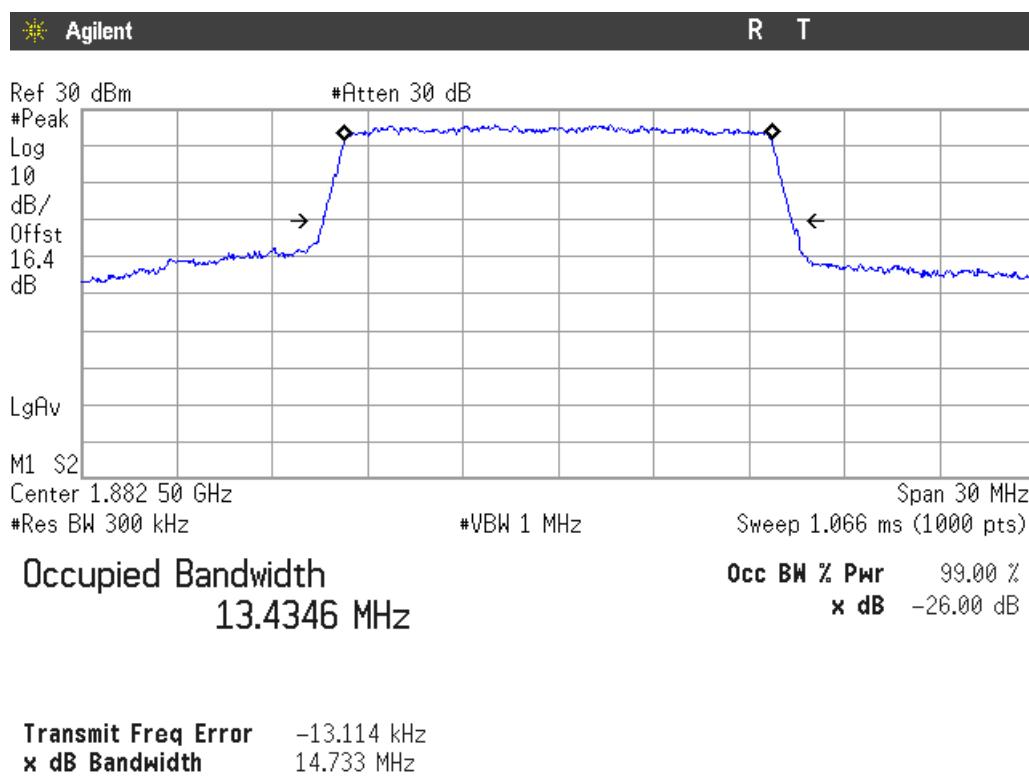


LTE Band 25. QPSK MODULATION. BW = 15 MHz.

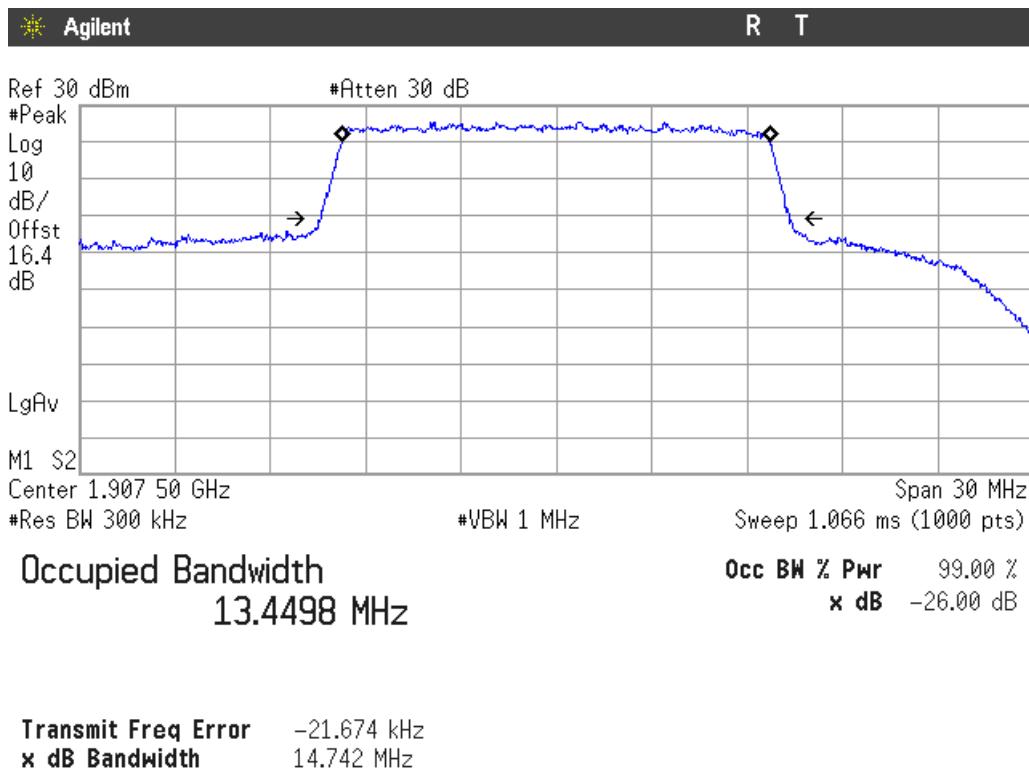
Lowest Channel:



Middle Channel:

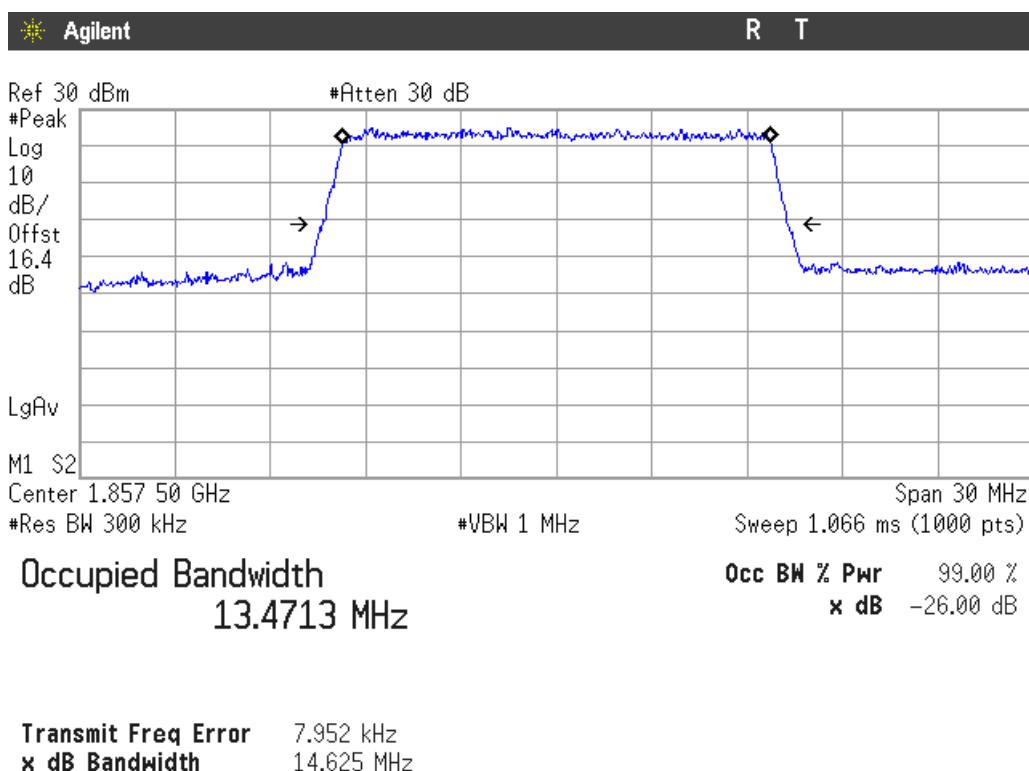


Highest Channel:

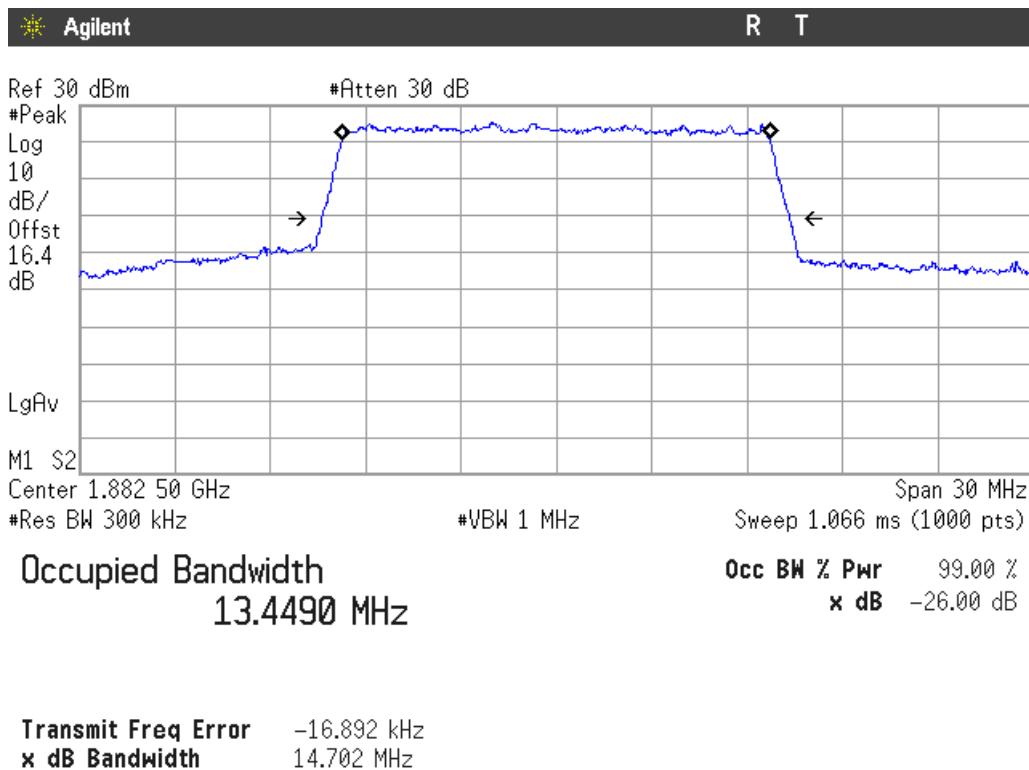


LTE Band 25. 16QAM MODULATION. BW = 15 MHz.

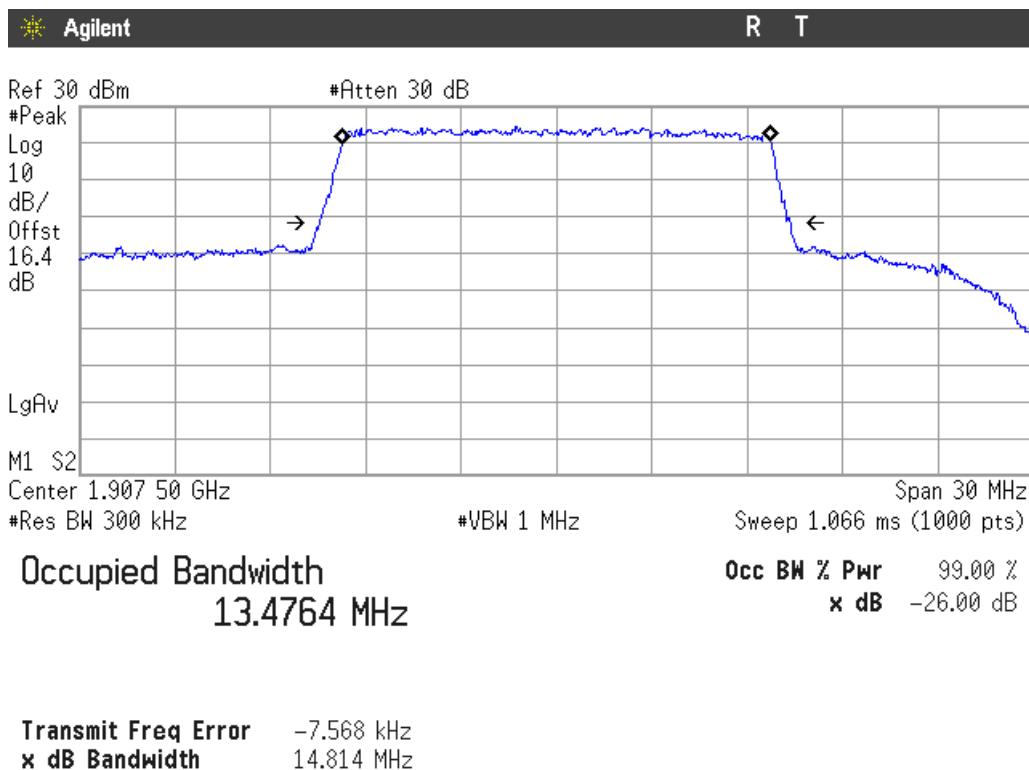
Lowest Channel:



Middle Channel:

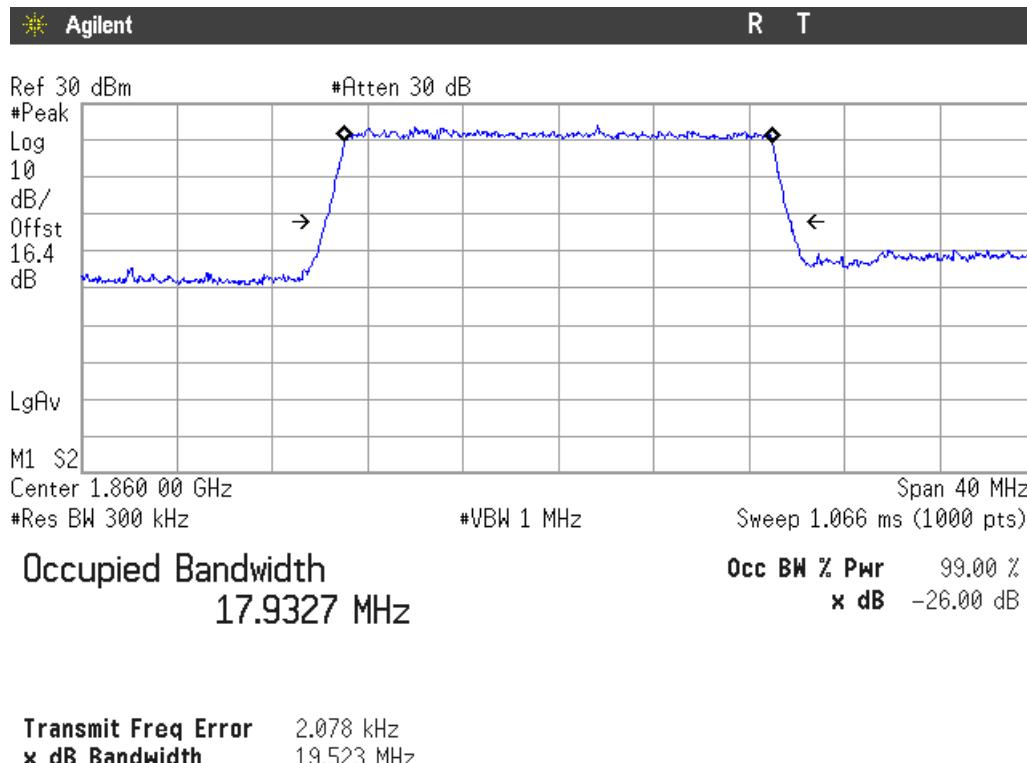


Highest Channel:

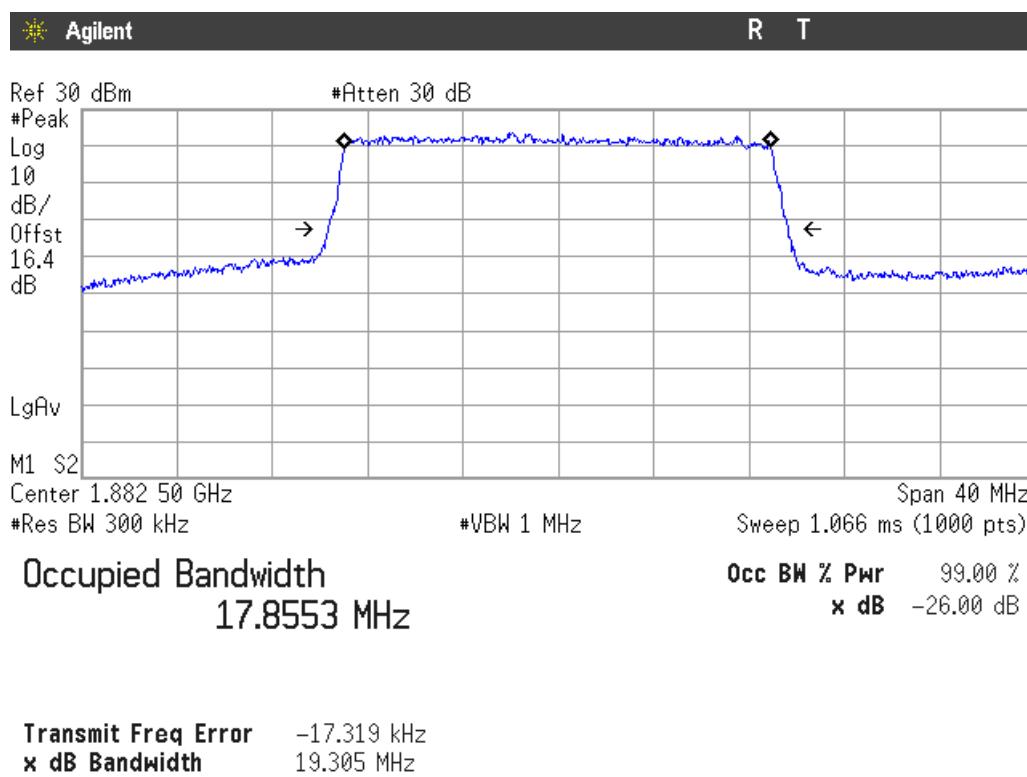


LTE Band 25. QPSK MODULATION. BW = 20 MHz.

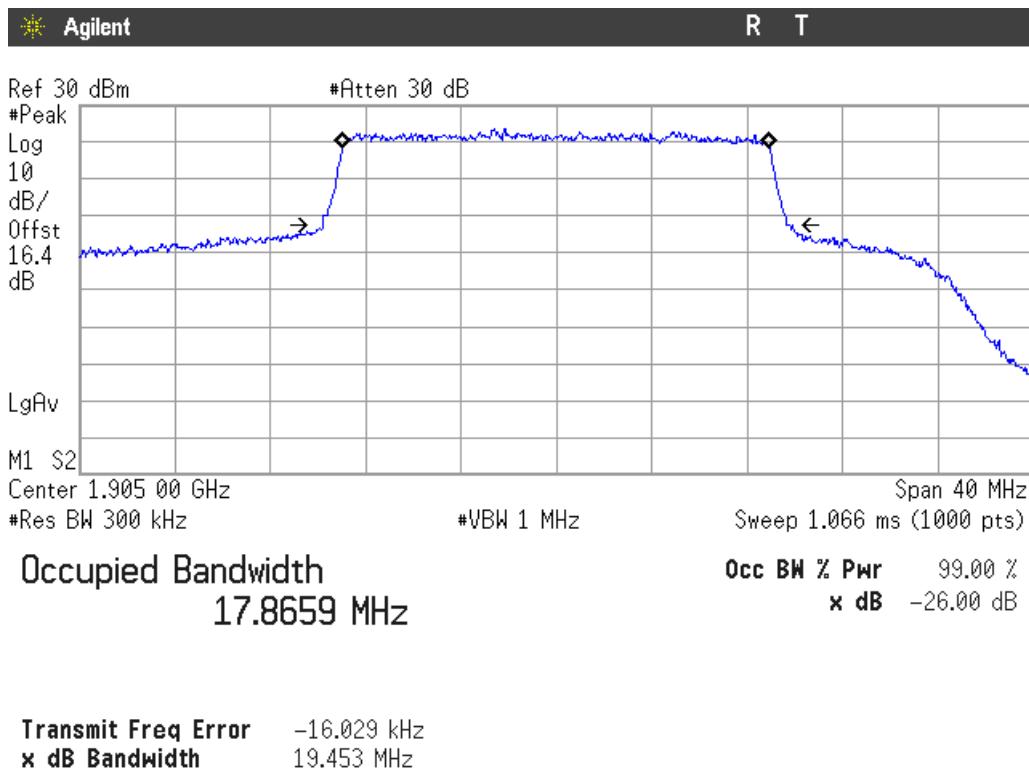
Lowest Channel:



Middle Channel:

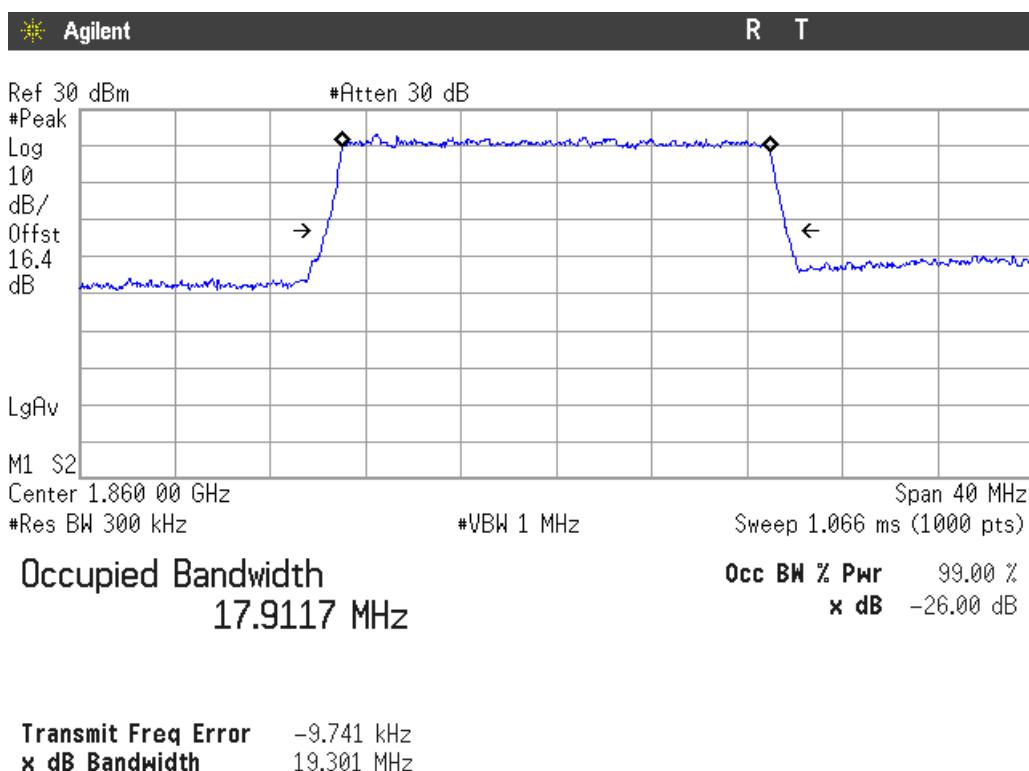


Highest Channel:

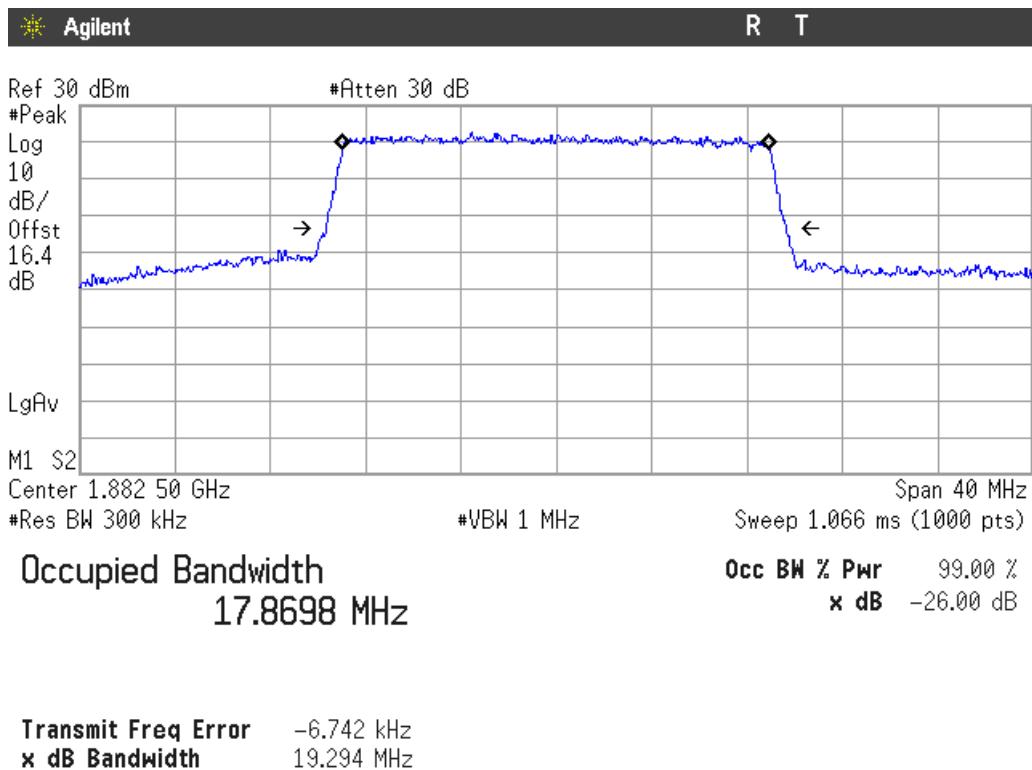


LTE Band 25. 16QAM MODULATION. BW = 20 MHz.

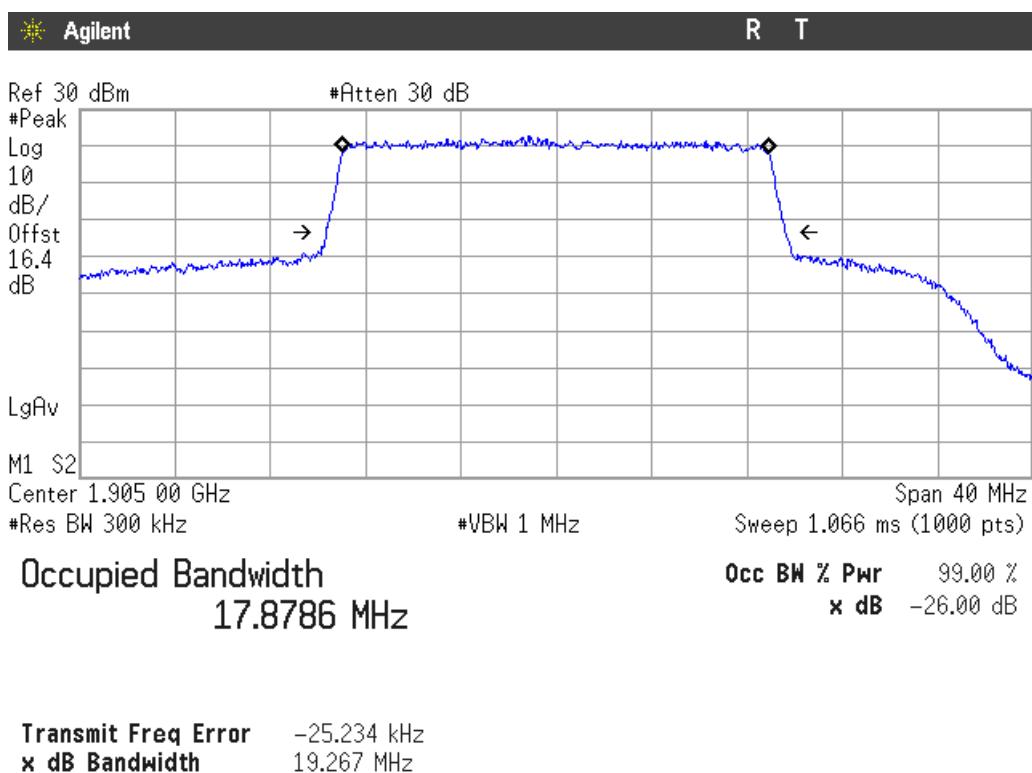
Lowest Channel:



Middle Channel:



Highest Channel:



Spurious emissions at antenna terminals

SPECIFICATION:

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

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

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

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

METHOD:

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S 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.

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

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

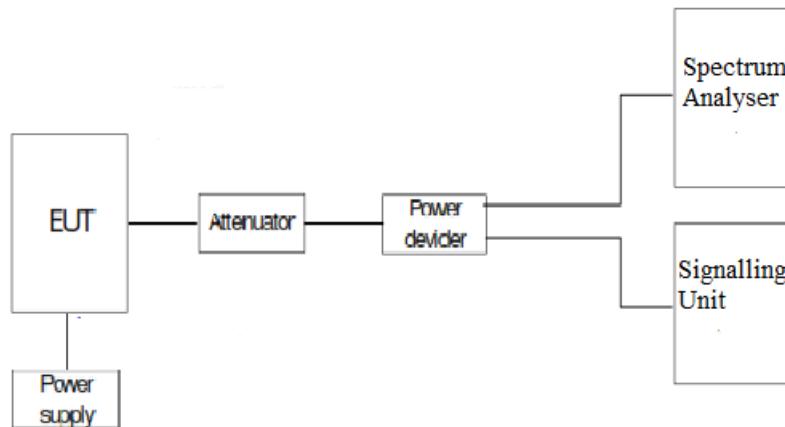
Measurement Limit:

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

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

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

TEST SETUP:



RESULTS:

2G Band 1900 MHz. GPRS MODULATION.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range

- Highest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

2G Band 1900 MHz. EDGE MODULATION.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

3G Band II. WCDMA MODULATION.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
7.6254	-30.84	< ± 2.03

3G Band II. HSUPA MODULATION.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
7.6254	-32.43	< ± 2.03

LTE Band 25. QPSK MODULATION. BW = 1.4 MHz.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Level (dBm)	Measurement uncertainty (dB)
3.829009	-32.91	< ± 1.20

LTE Band 25. QPSK MODULATION. BW = 3 MHz.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

LTE Band 25. QPSK MODULATION. BW = 5 MHz.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

LTE Band 25. QPSK MODULATION. BW = 10 MHz.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

LTE Band 25. QPSK MODULATION. BW = 15 MHz.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

LTE Band 25. QPSK MODULATION. BW = 20 MHz.

- Lowest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Middle Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

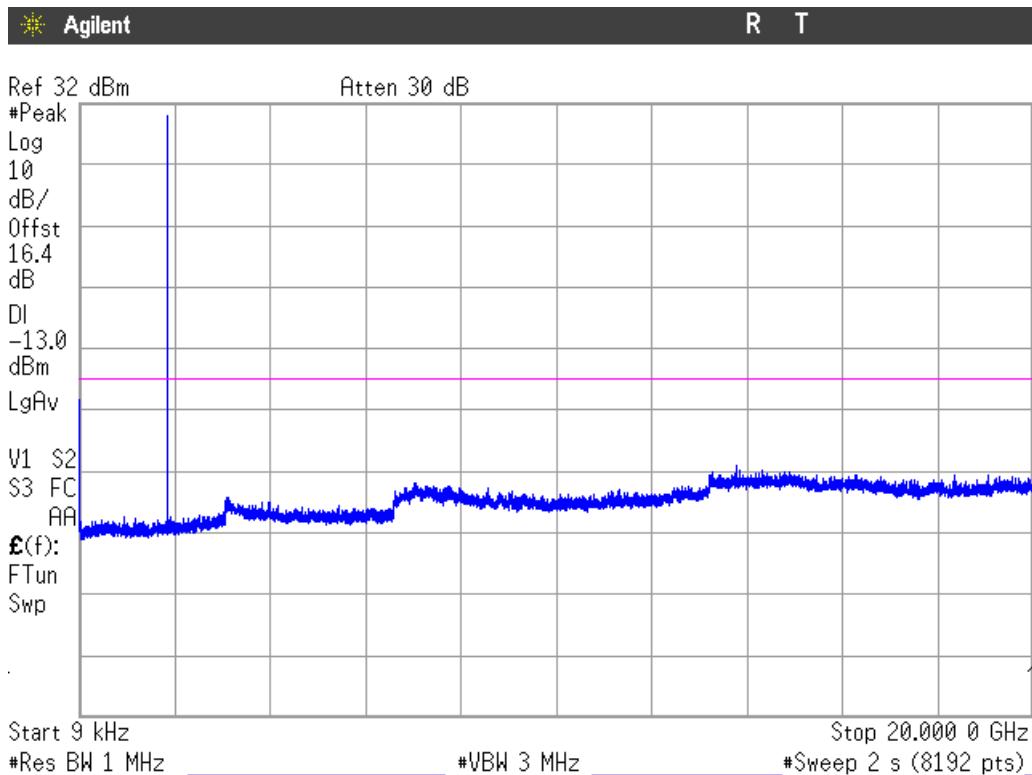
- Highest Channel:

No spurious frequencies detected at less than 20 dB below the limit in all the range.

Verdict: PASS

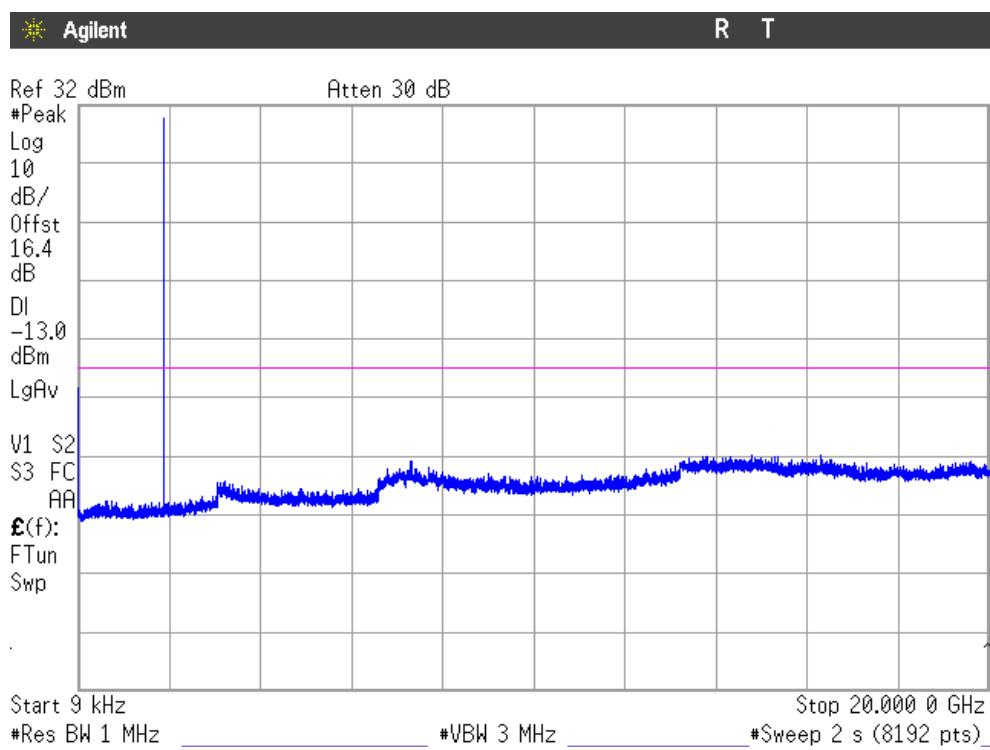
2G Band 1900 MHz. GPRS MODULATION.

Lowest Channel:



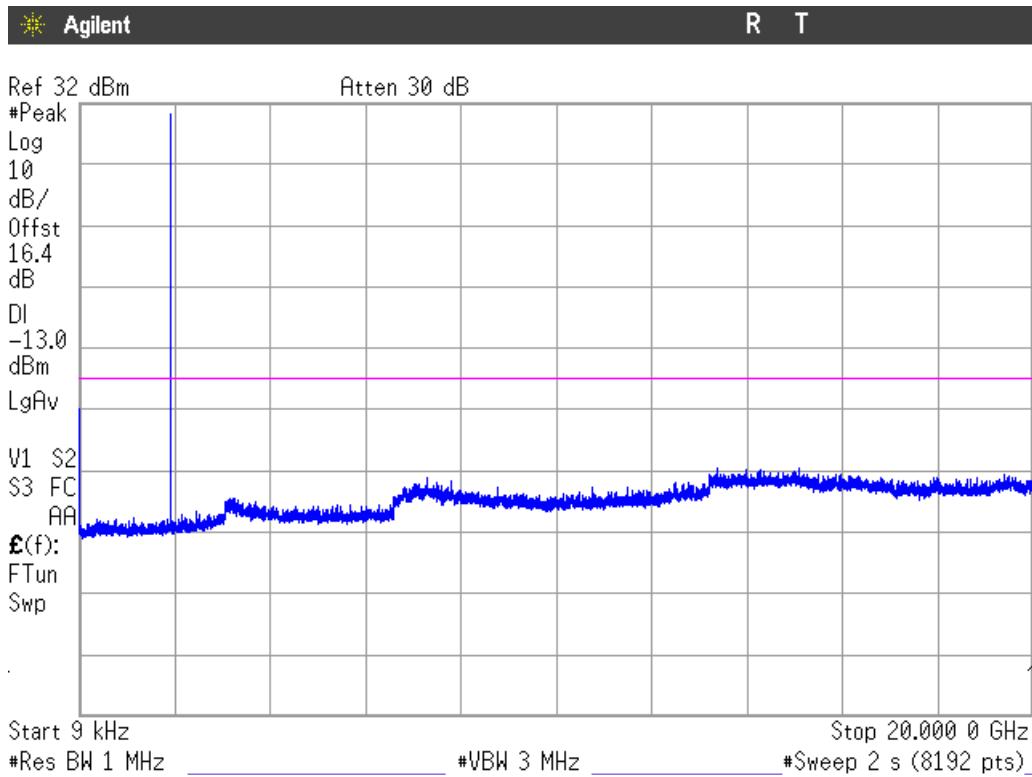
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

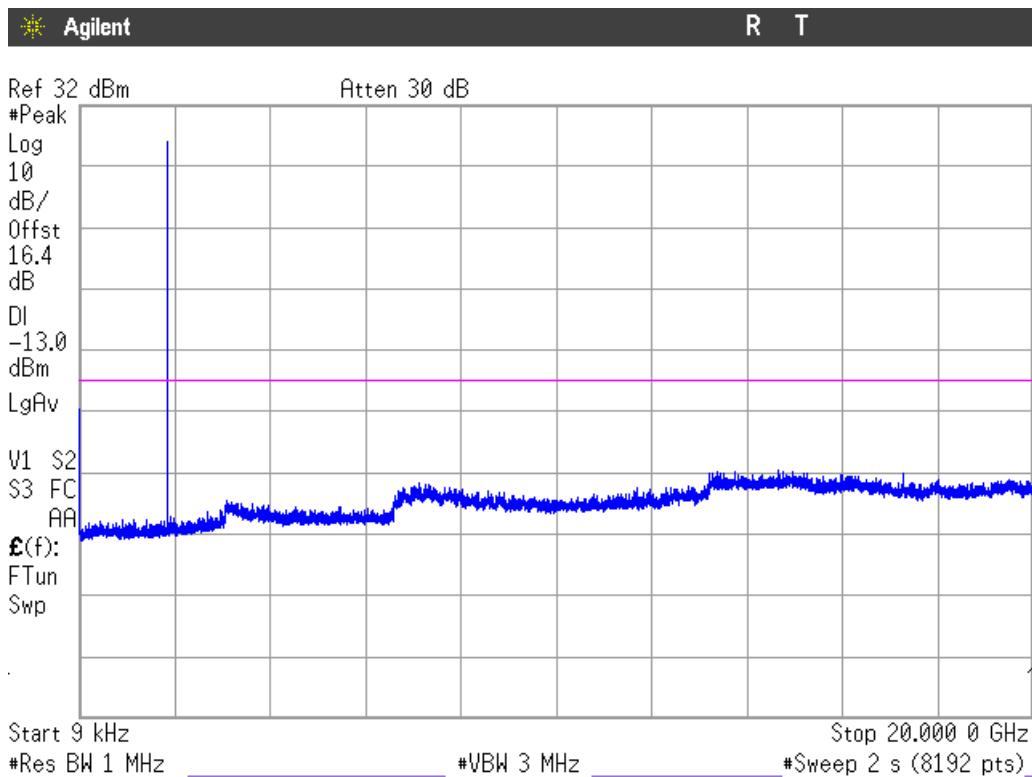
Highest Channel:



The peak above the limit is the carrier frequency.

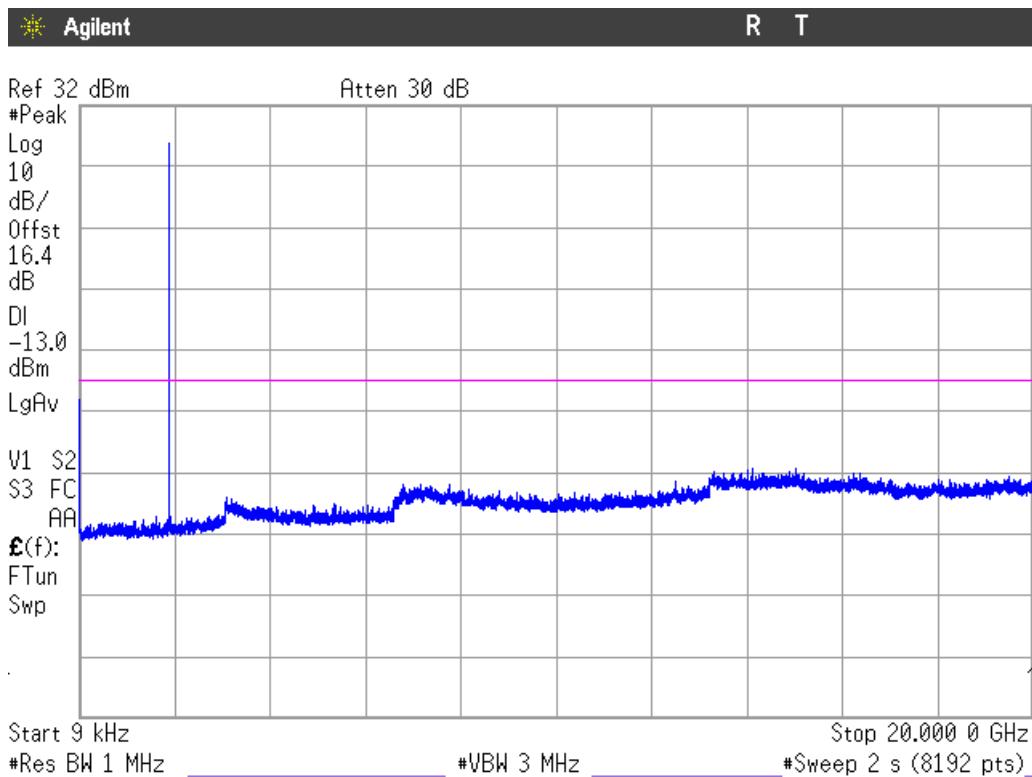
2G Band 1900 MHz. EDGE MODULATION.

Lowest Channel:



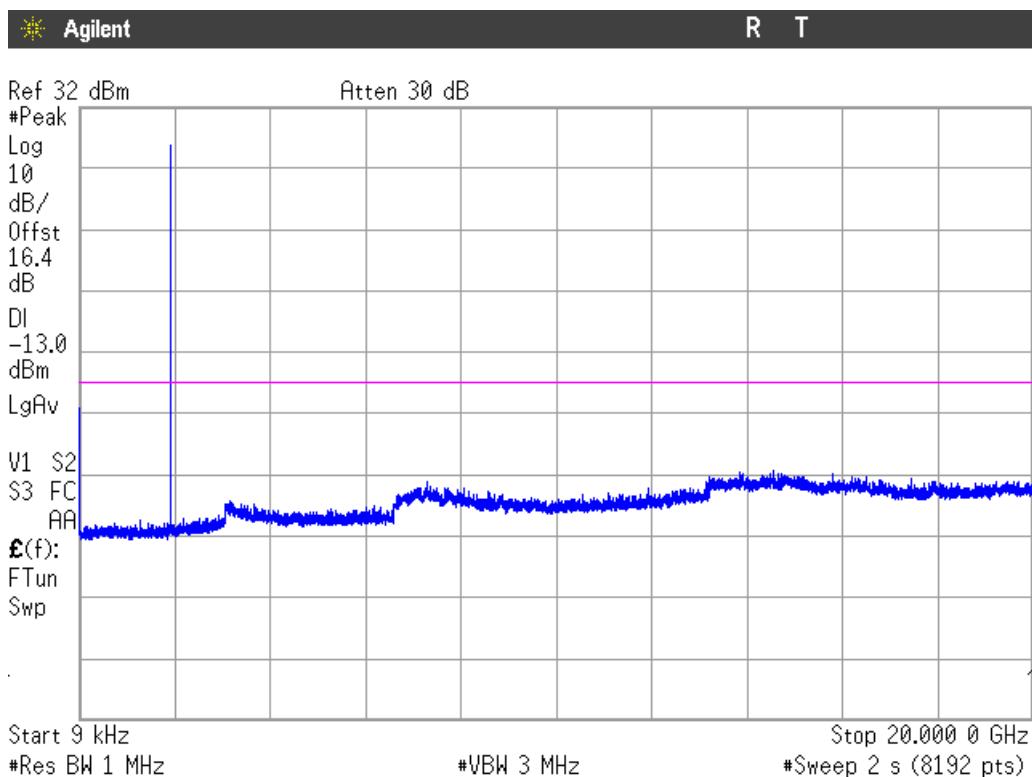
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

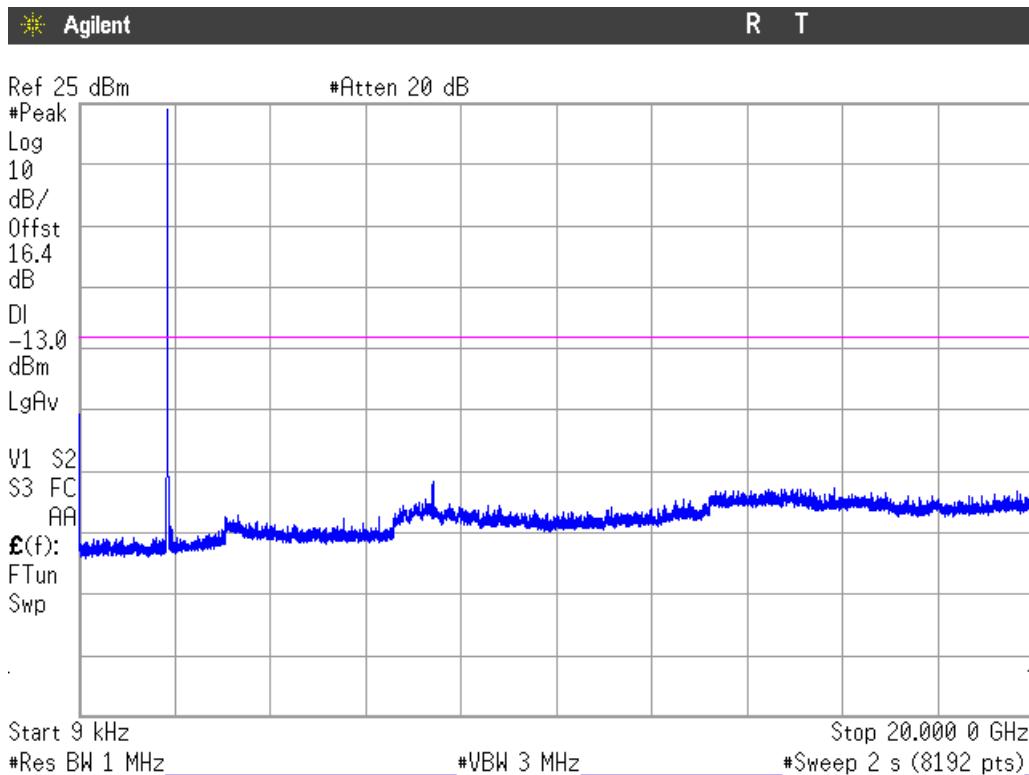
Highest Channel:



The peak above the limit is the carrier frequency.

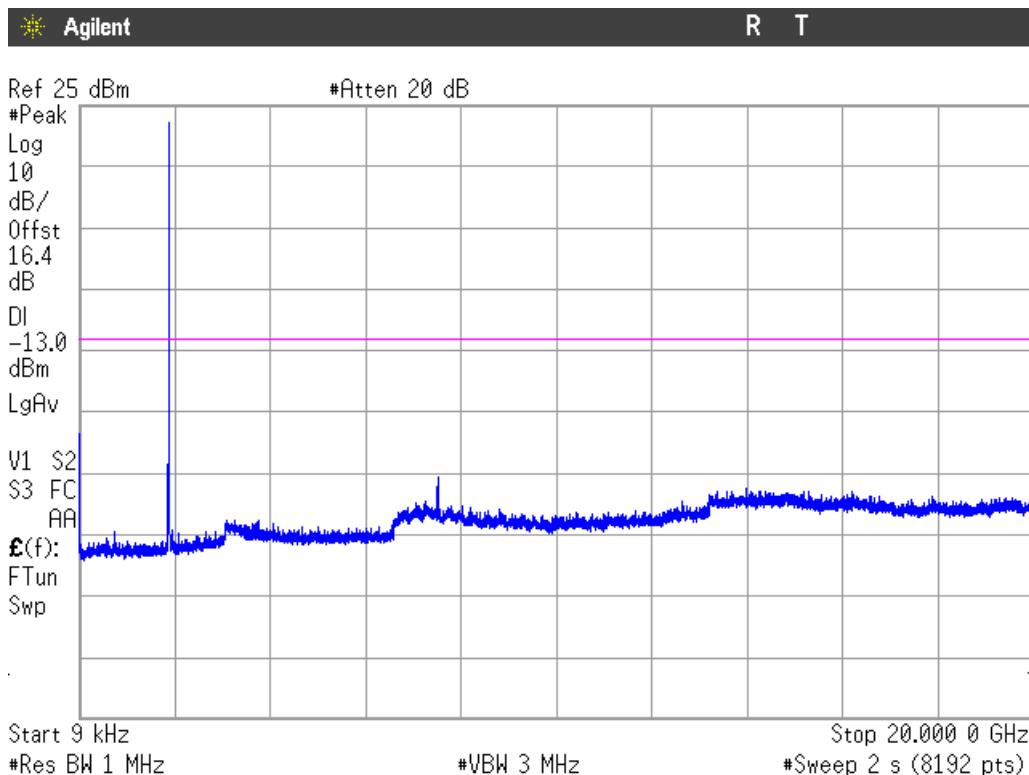
3G Band II. WCDMA MODULATION.

Lowest Channel:



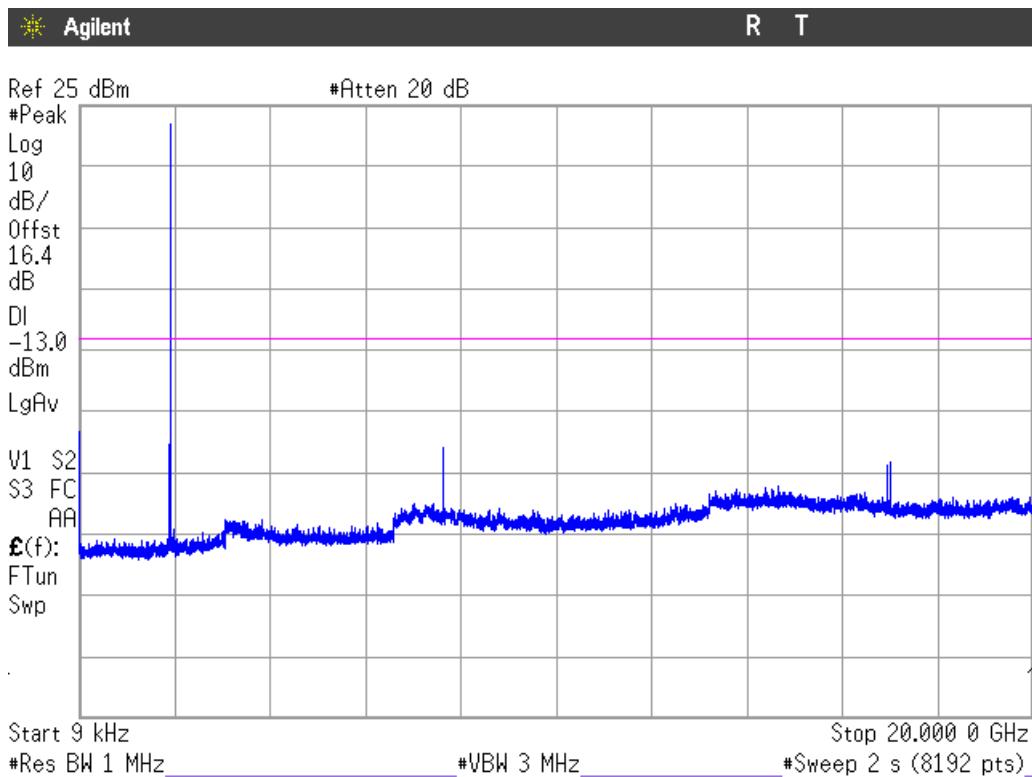
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

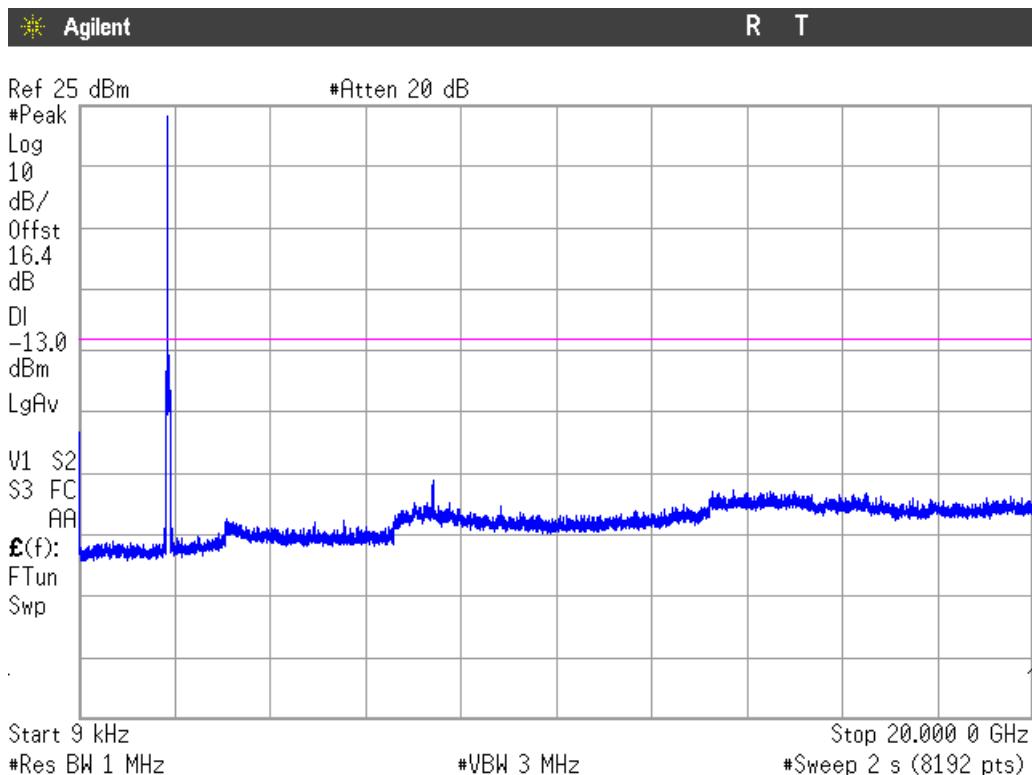
Highest Channel:



The peak above the limit is the carrier frequency.

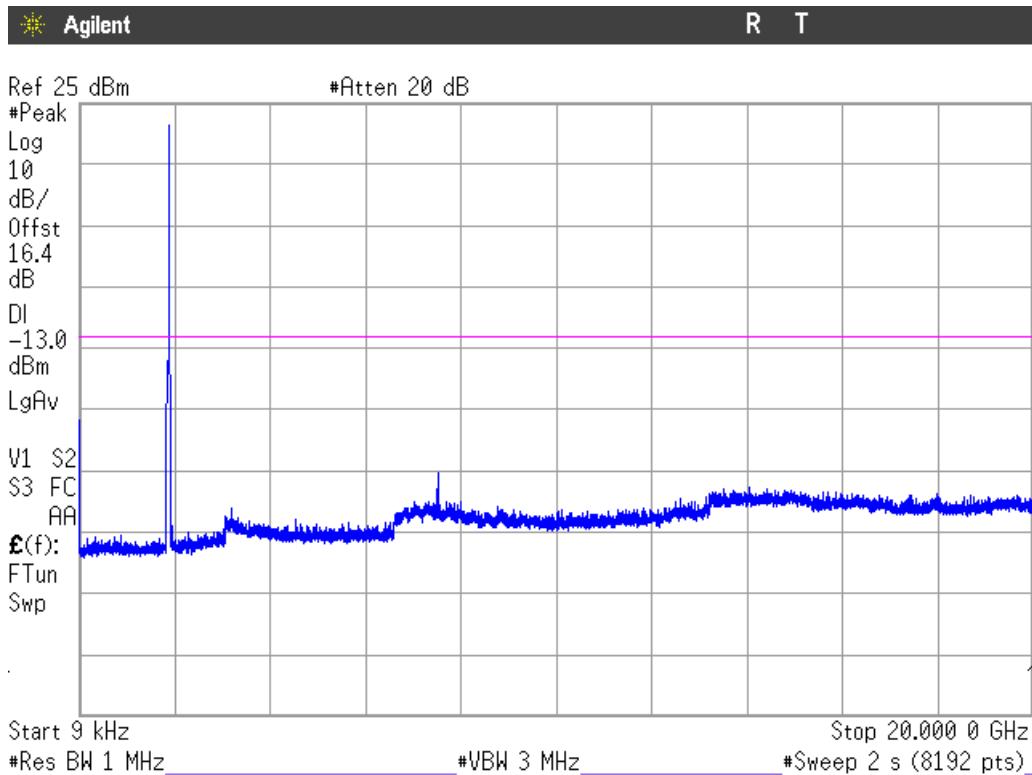
3G Band II. HSUPA MODULATION.

Lowest Channel:



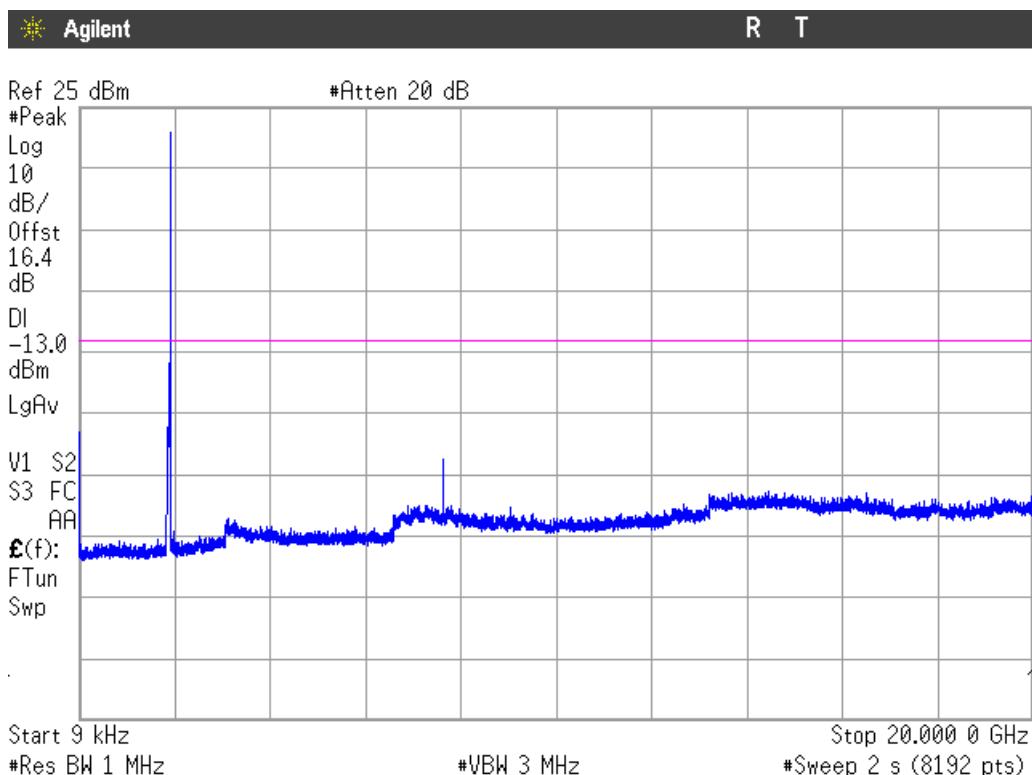
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

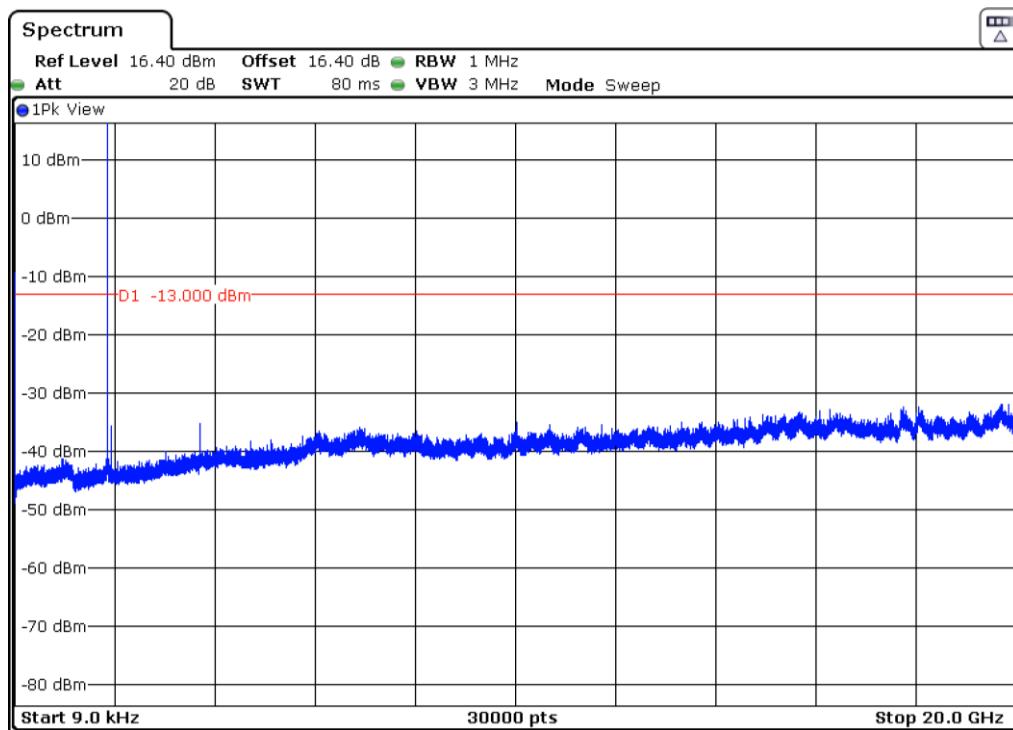
Highest Channel:



The peak above the limit is the carrier frequency.

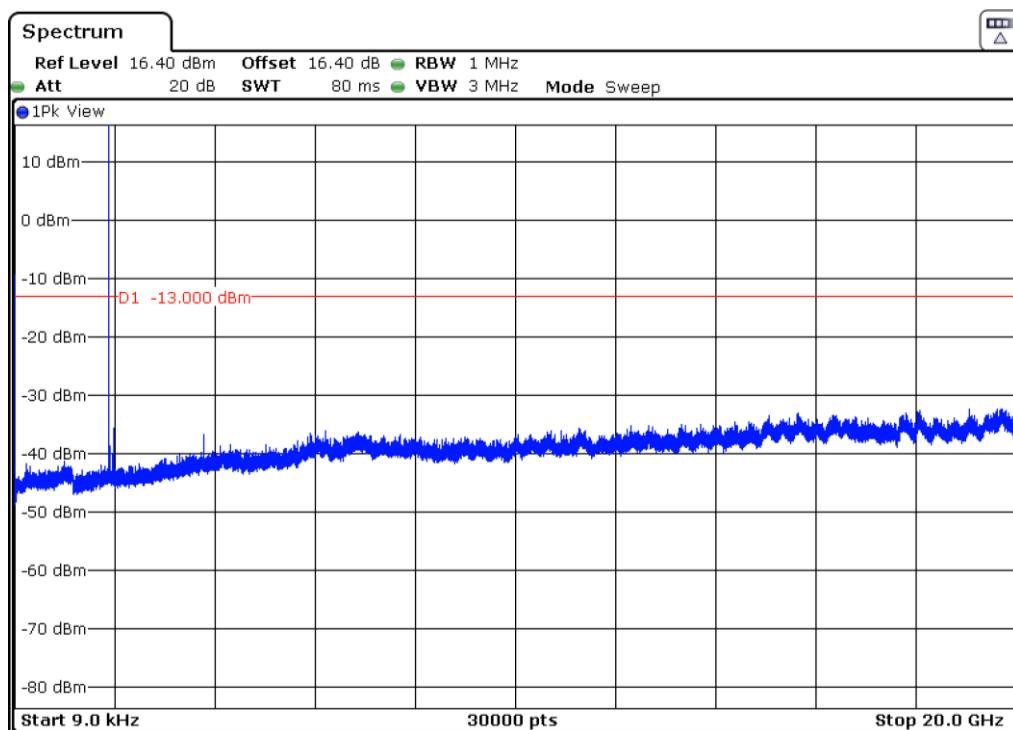
LTE Band 25. QPSK MODULATION. BW = 1.4 MHz.

Lowest Channel:



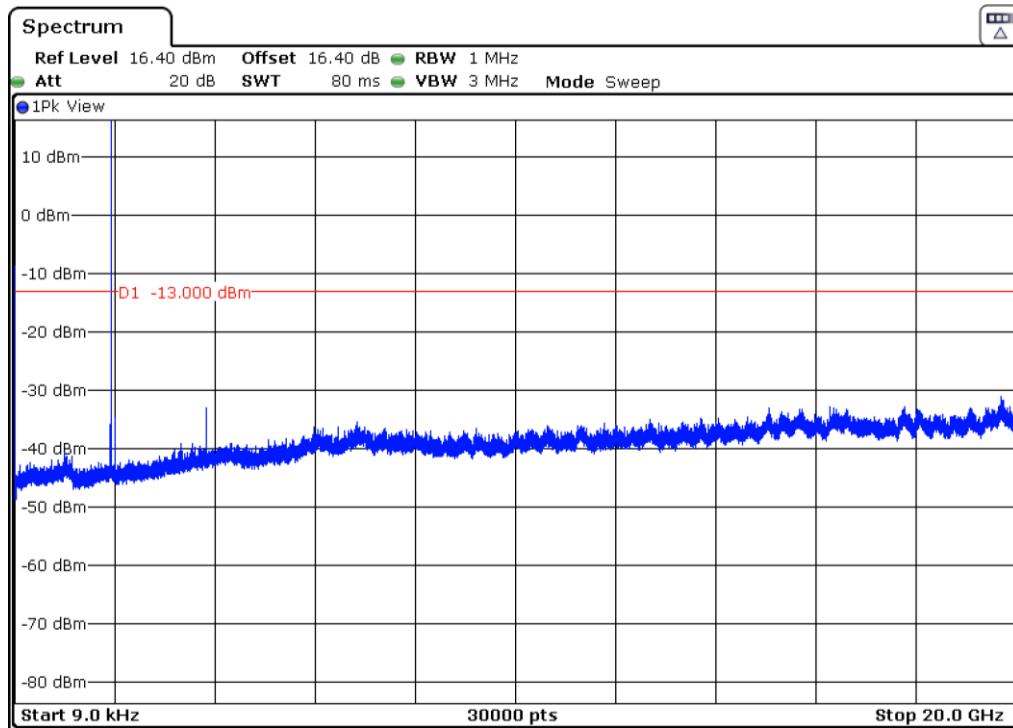
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

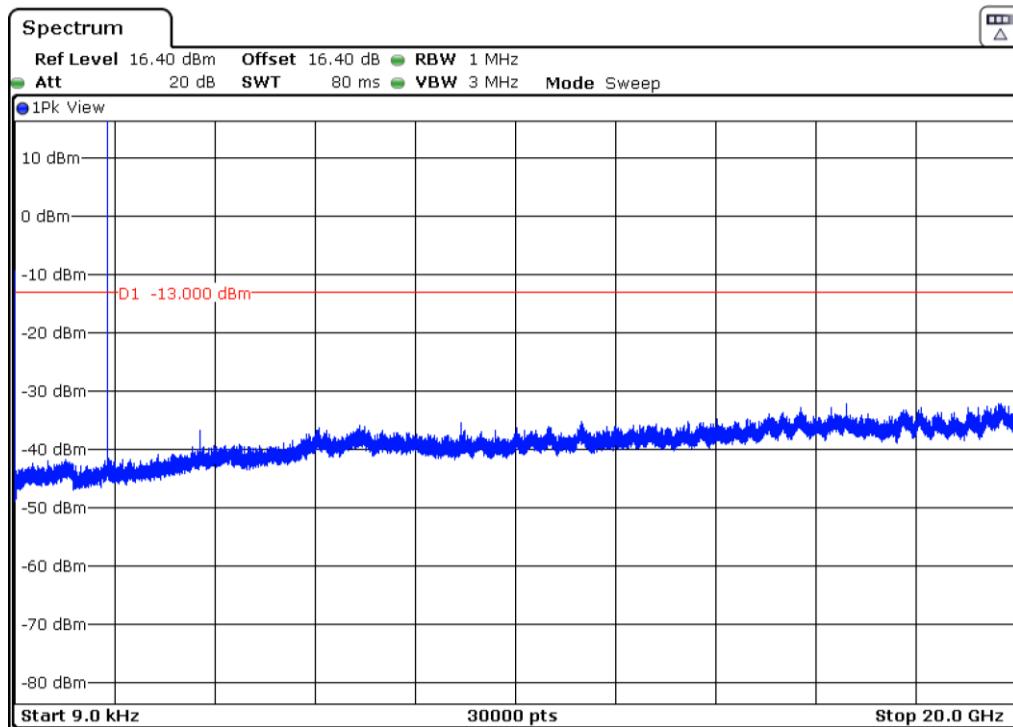
Highest Channel:



The peak above the limit is the carrier frequency.

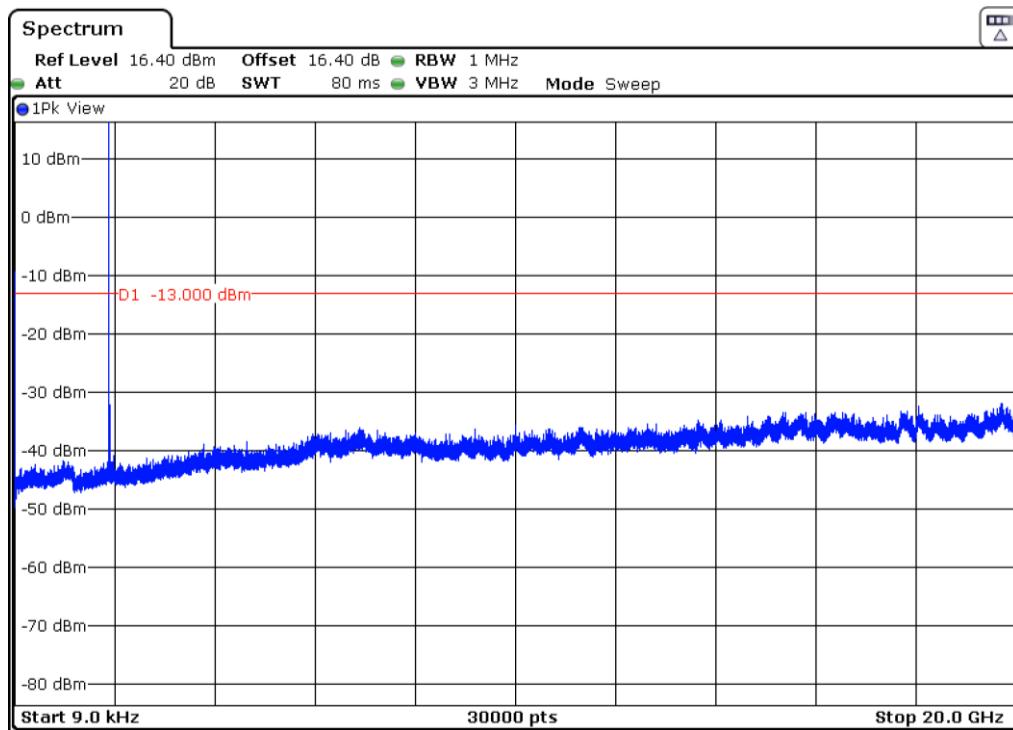
LTE Band 25. QPSK MODULATION. BW = 3 MHz.

Lowest Channel:



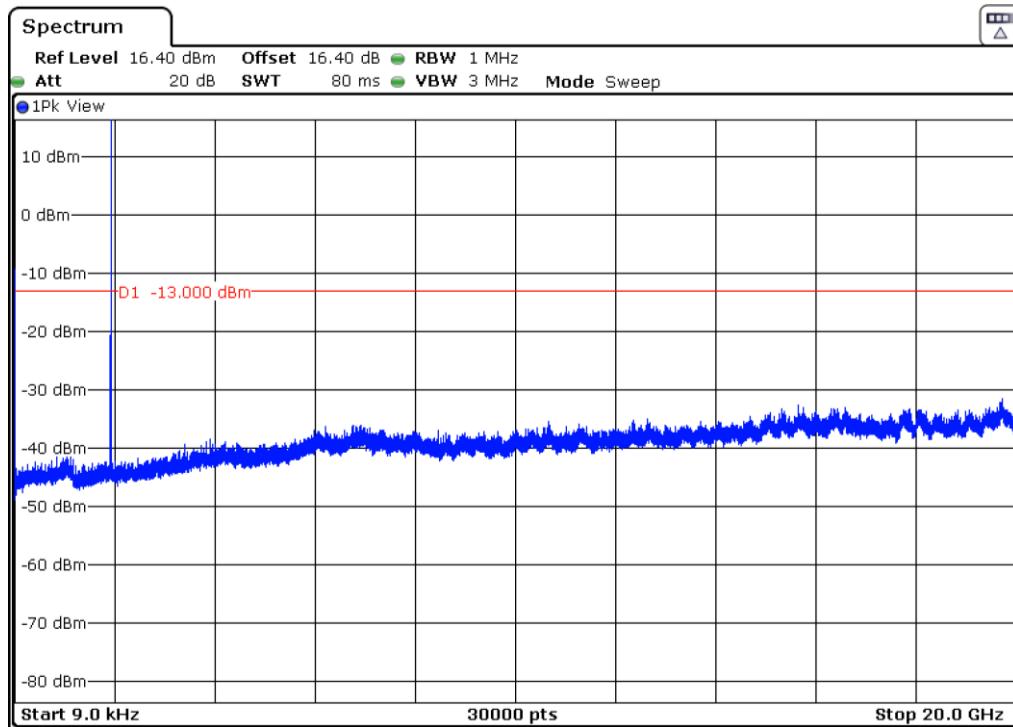
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

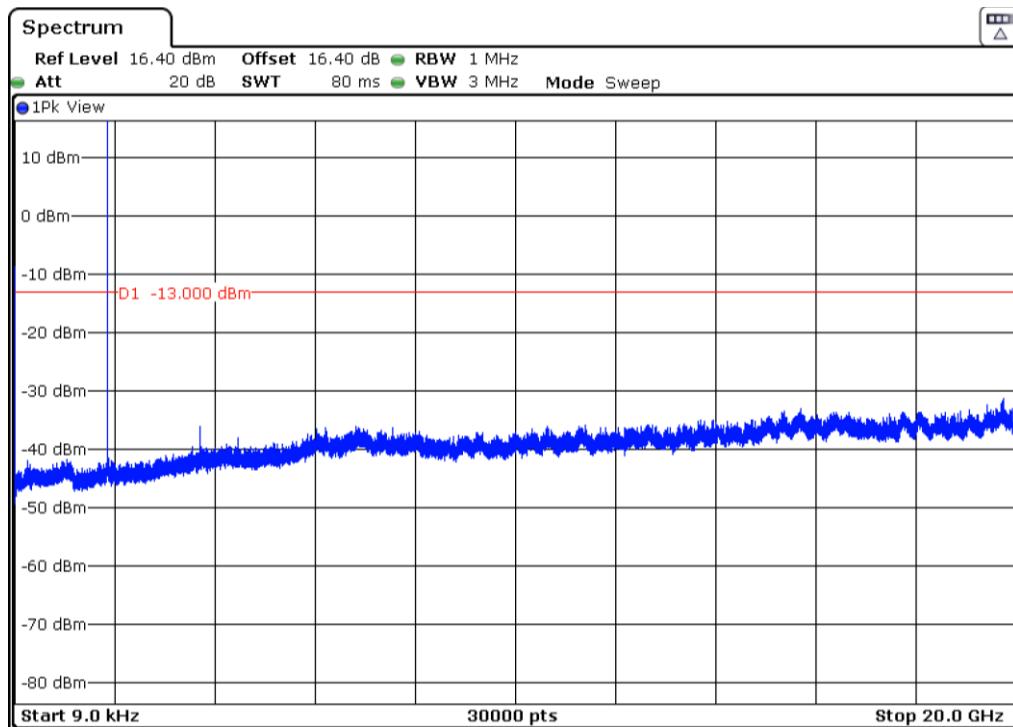
Highest Channel:



The peak above the limit is the carrier frequency.

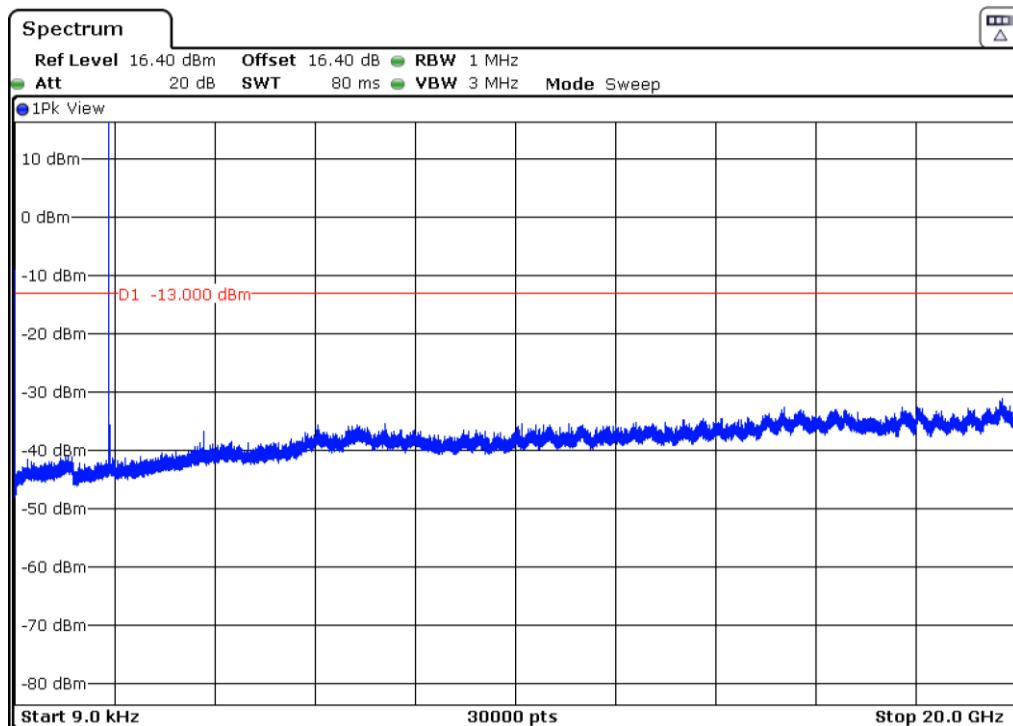
LTE Band 25. QPSK MODULATION. BW = 5 MHz.

Lowest Channel:



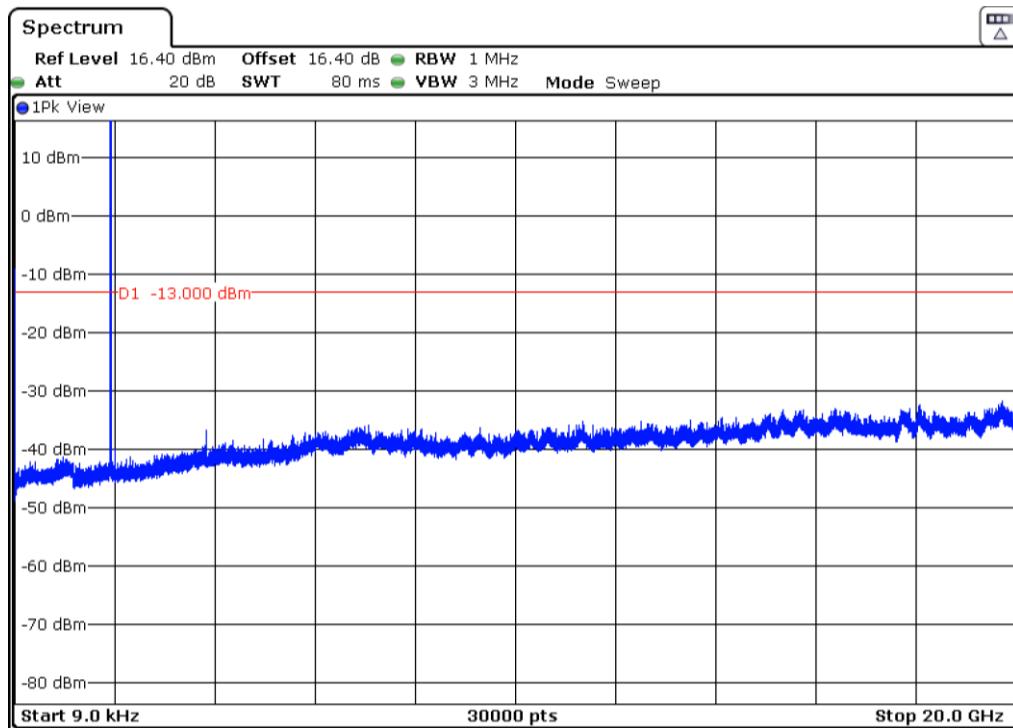
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

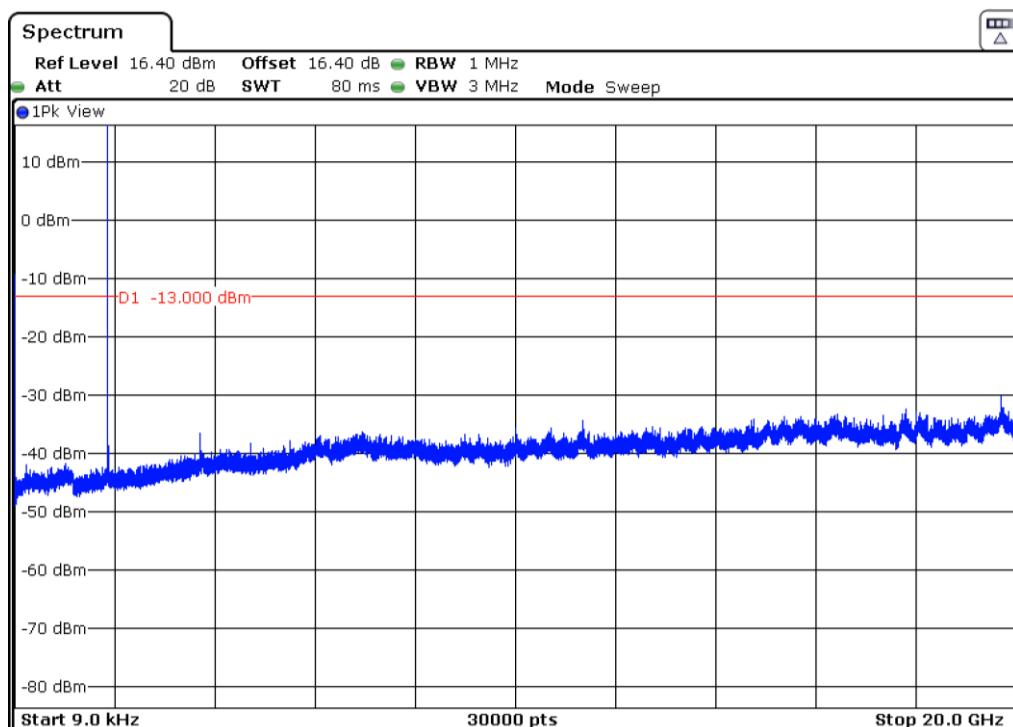
Highest Channel:



The peak above the limit is the carrier frequency.

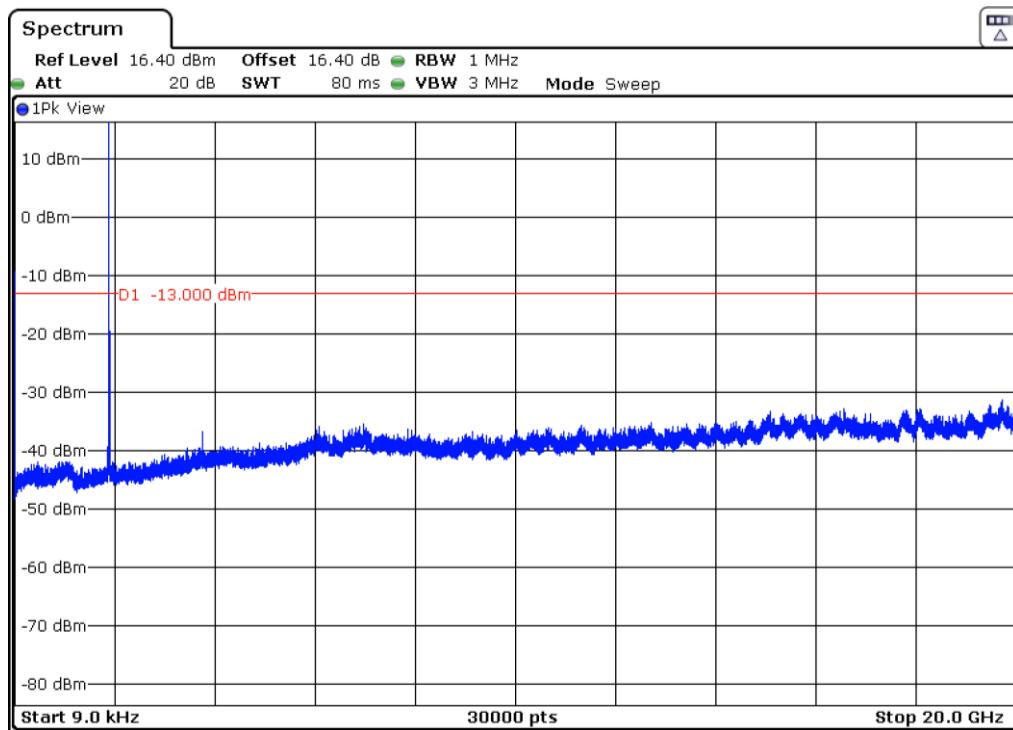
LTE Band 25. QPSK MODULATION. BW = 10 MHz.

Lowest Channel:



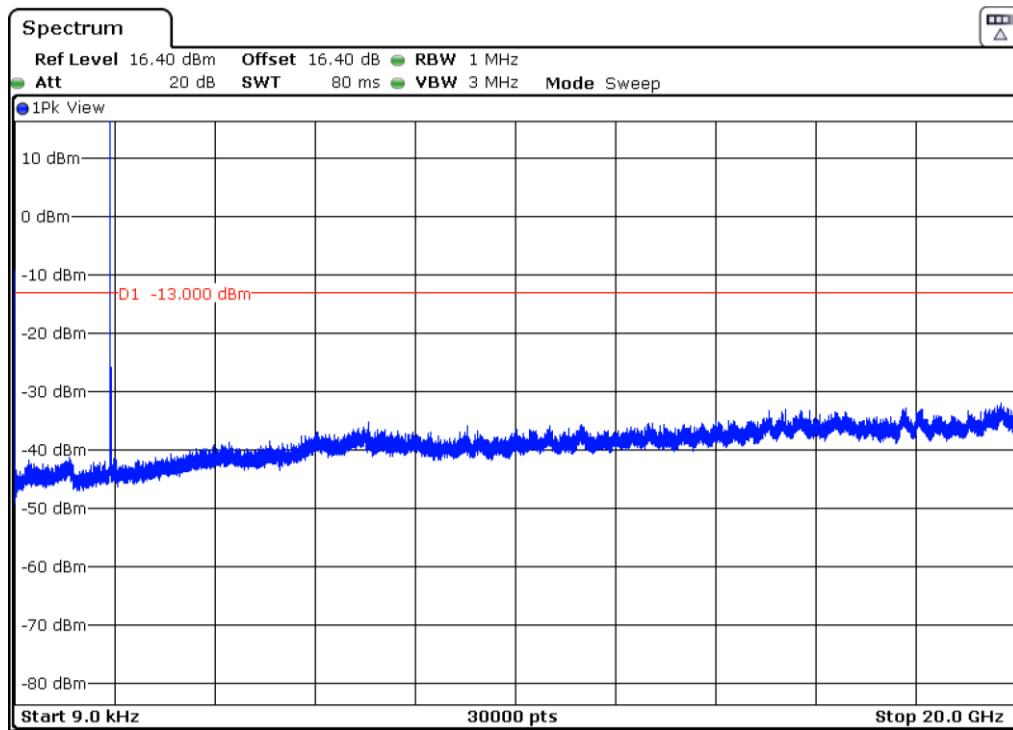
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

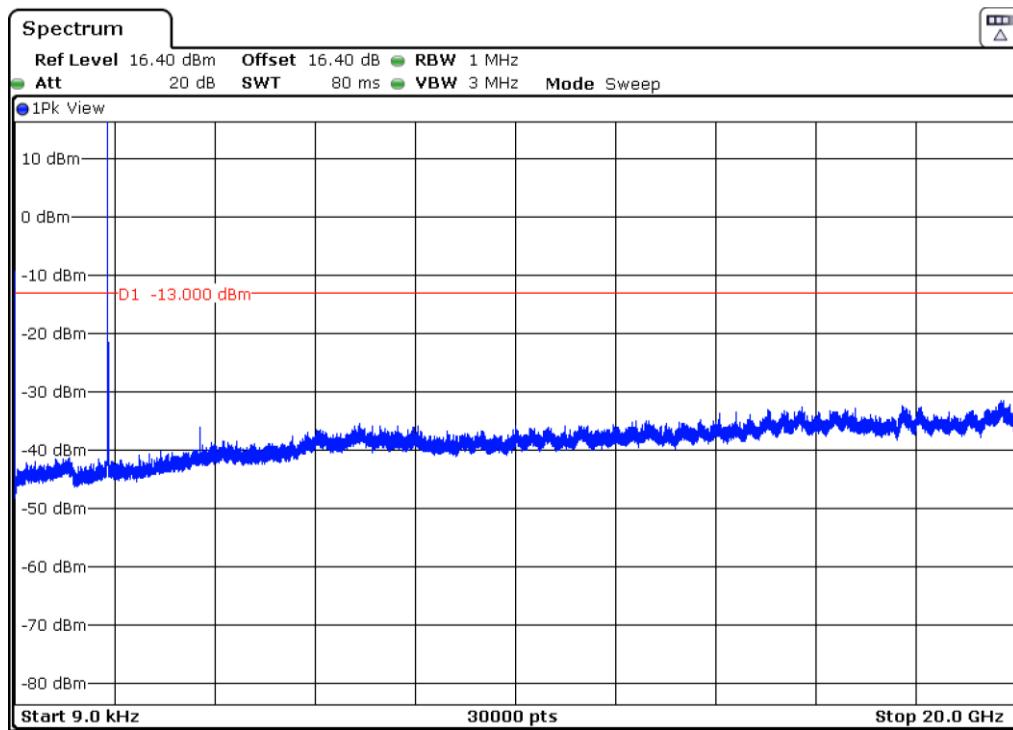
Highest Channel:



The peak above the limit is the carrier frequency.

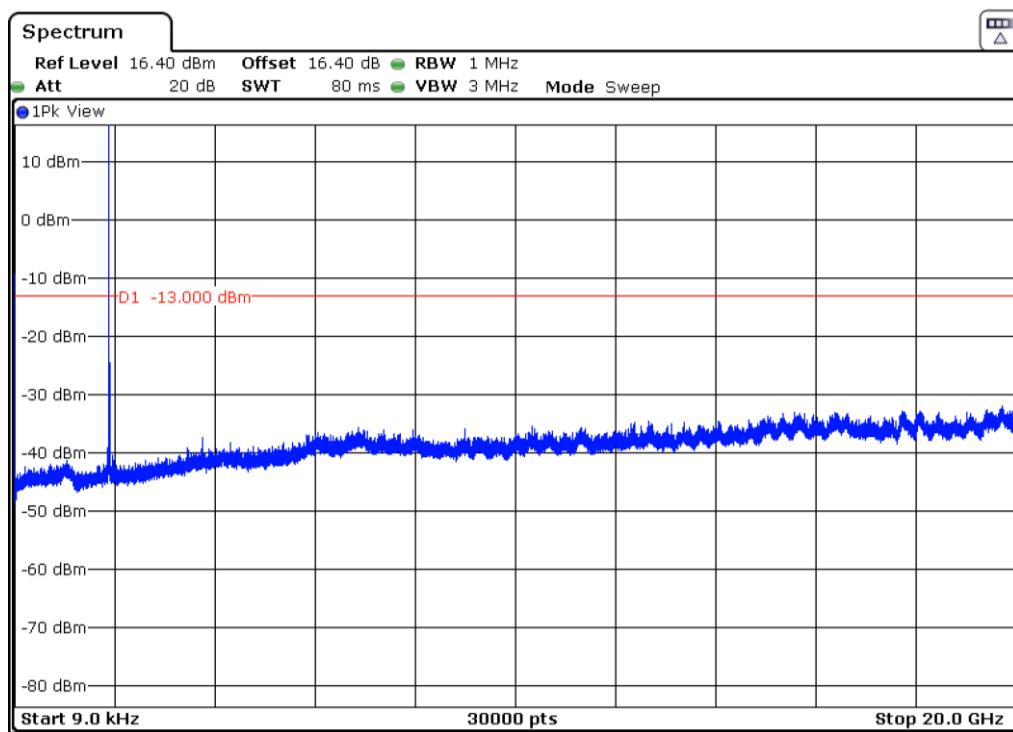
LTE Band 25. QPSK MODULATION. BW = 15 MHz.

Lowest Channel:



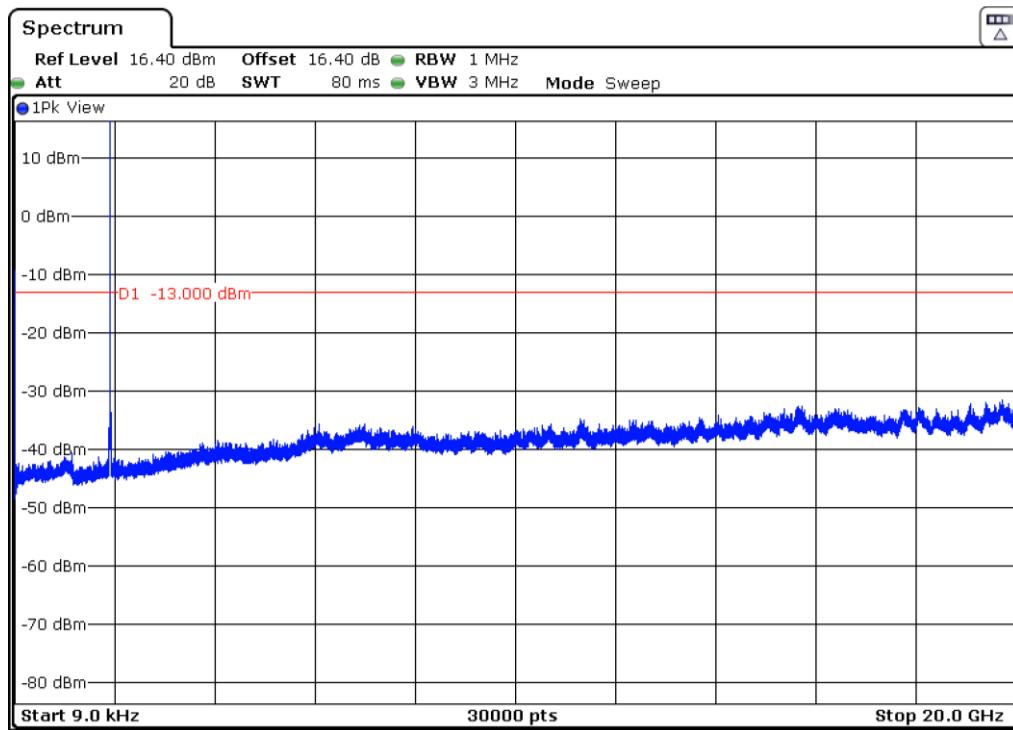
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

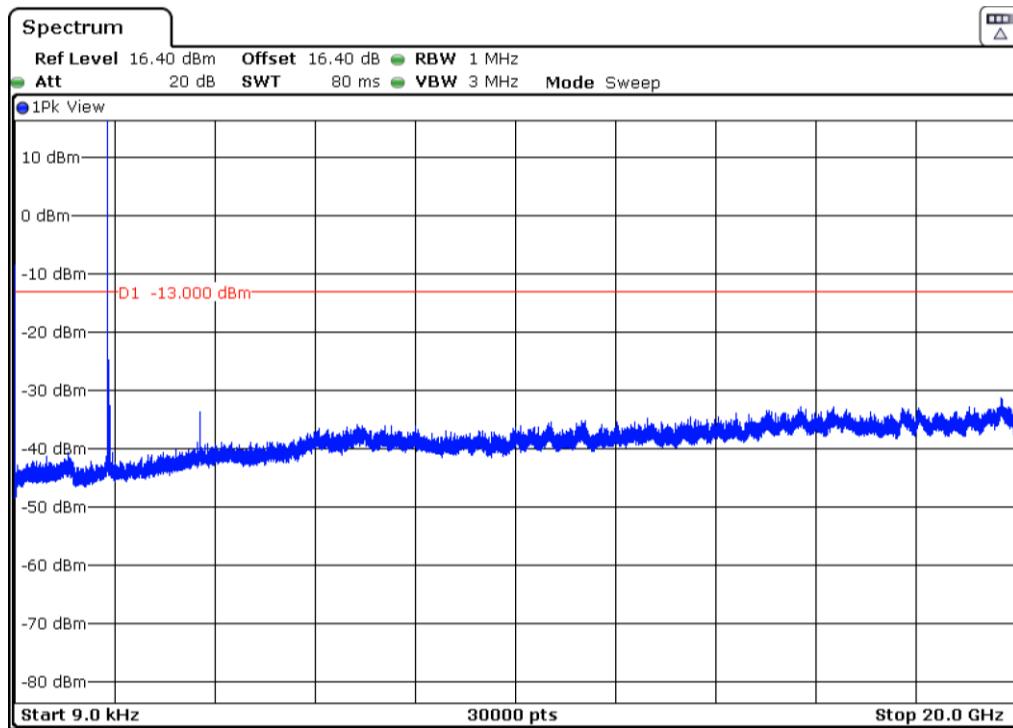
Highest Channel:



The peak above the limit is the carrier frequency.

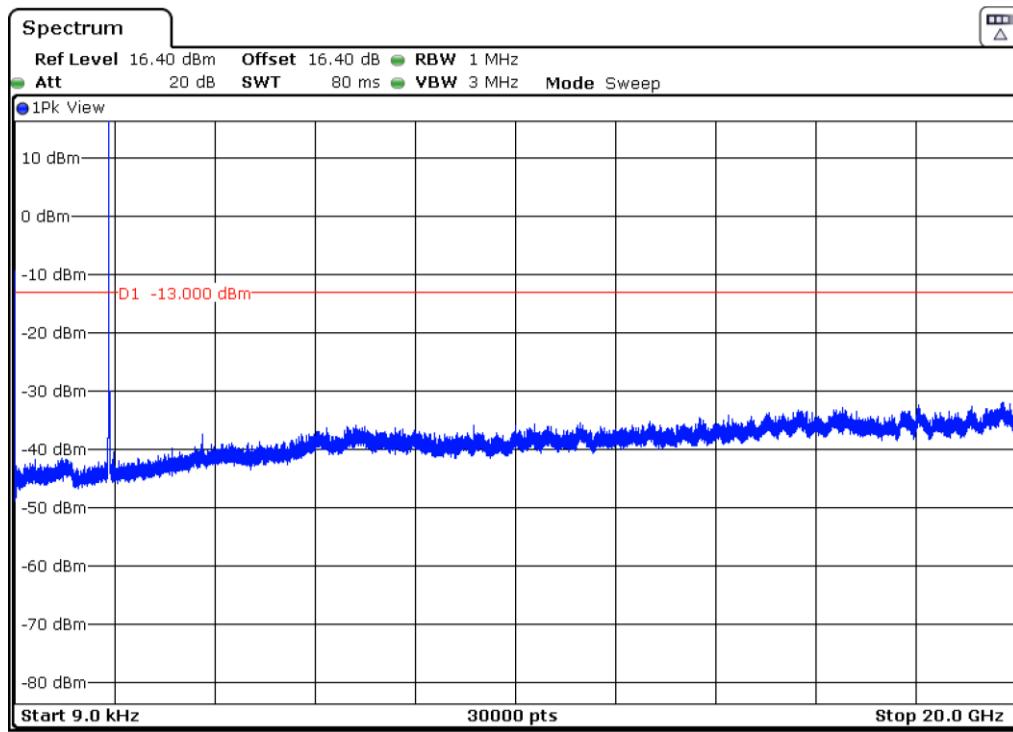
LTE Band 25. QPSK MODULATION. BW = 20 MHz.

Lowest Channel:



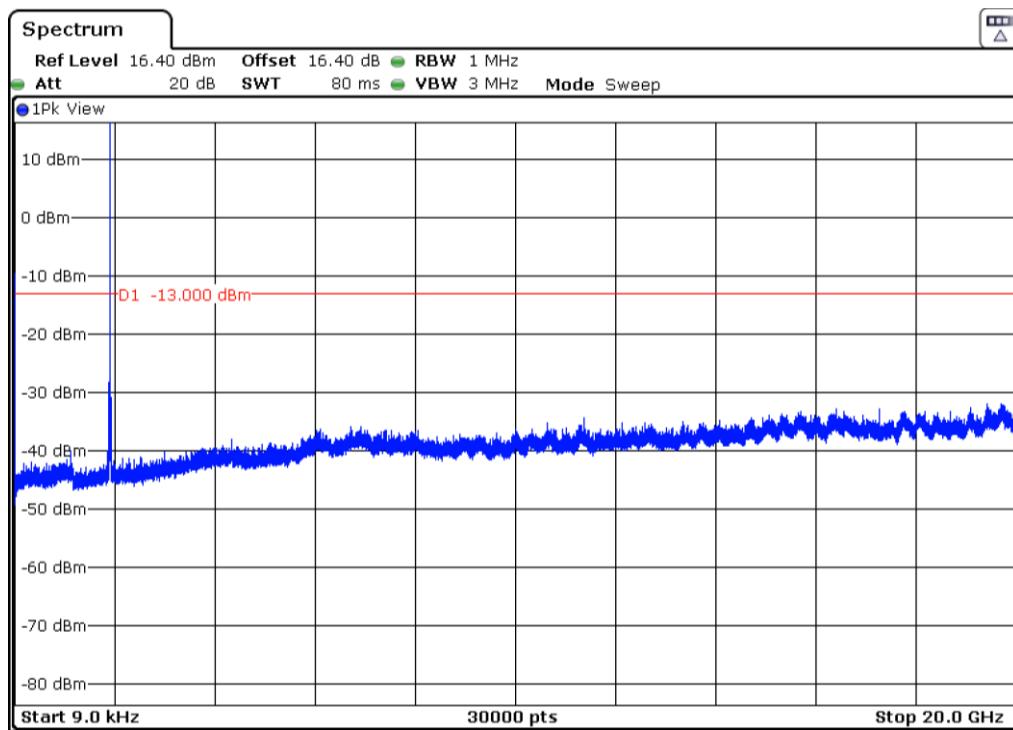
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

Highest Channel:



The peak above the limit is the carrier frequency.

Spurious emissions at antenna terminals at Block Edges

SPECIFICATION:

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

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.

As indicated in FCC part 24/RSS-133, 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.

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

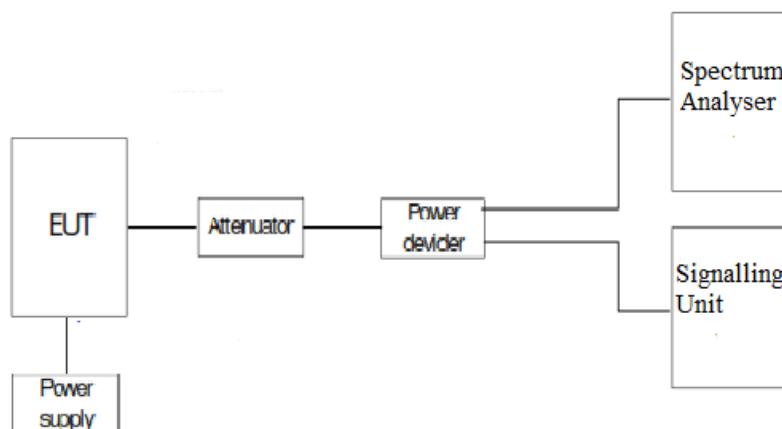
Measurement Limit:

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

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

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

TEST SETUP:



RESULTS:2G Band 1900 MHz.

MODULATION:	GPRS	EDGE
Maximum measured level at <u>Lowest Block Edge</u> at antenna port (dBm)	-19.70	-27.55

MODULATION:	GPRS	EDGE
Maximum measured level at <u>Highest Block Edge</u> at antenna port (dBm)	-22.99	-26.77

3G Band II.

MODULATION:	WCDMA	HSUPA
Maximum measured level at <u>Lowest Block Edge</u> at antenna port (dBm)	-25.17	-24.79

MODULATION:	WCDMA	HSUPA
Maximum measured level at <u>Highest Block Edge</u> at antenna port (dBm)	-23.35	-29.42

LTE Band 25.

LTE QPSK MODULATION:	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 <u>Lowest Block Edge</u> at antenna port (dBm)	-32.85	-18.94	-24.28	-33.15	-33.9	-33.34

LTE QPSK MODULATION:	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 <u>Lowest Block Edge</u> at antenna port (dBm)	-38.23	-24.85	-27.90	-30.28	-28.81	-30.98

LTE QPSK MODULATION:	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 <u>Highest Block Edge</u> at antenna port (dBm)	-36.56	-22.91	-28.39	-36.57	-34.11	-37.31

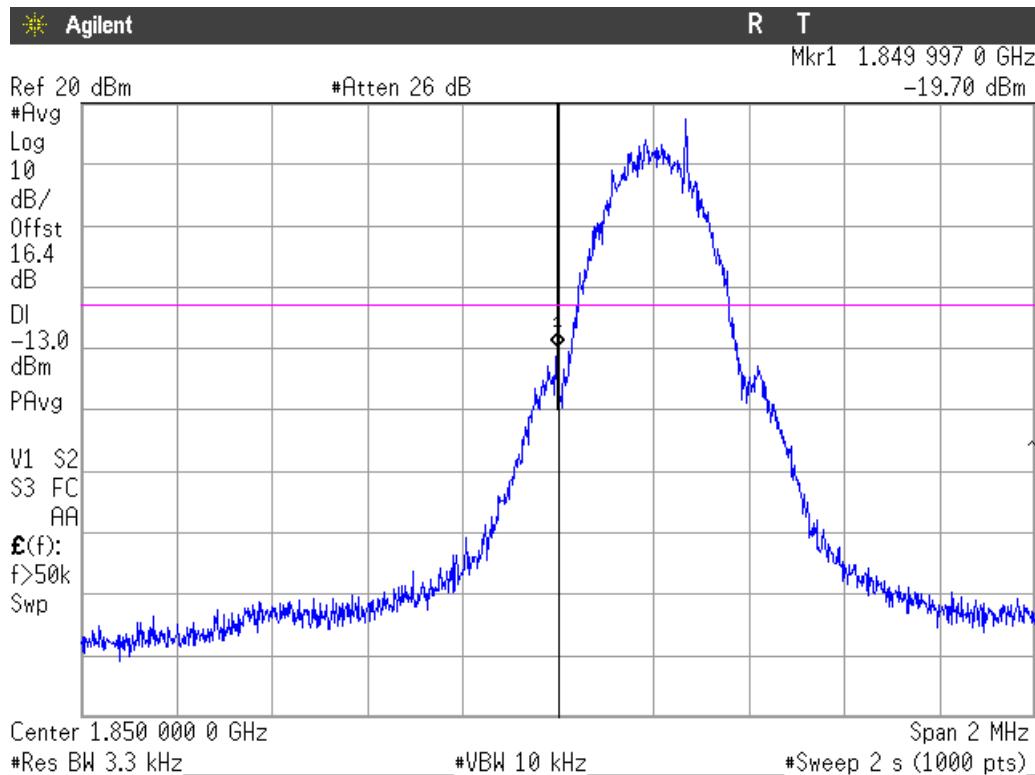
LTE QPSK MODULATION:	RB= All. Offset=0. BW=1.4 MHz	RB= All. Offset =0. BW = 3 MHz	RB= All. Offset =0. BW = 5 MHz	RB= All. Offset =0. BW = 10 MHz	RB= All. Offset =0. BW = 15 MHz	RB= All. Offset =0. BW = 20 MHz
Maximum measured level at <u>Highest Block Edge</u> at antenna port (dBm)	-40.93	-28.03	-32.12	-30.08	-25.76	-23.62

Measurement uncertainty: $\leq \pm 2.03$ dB

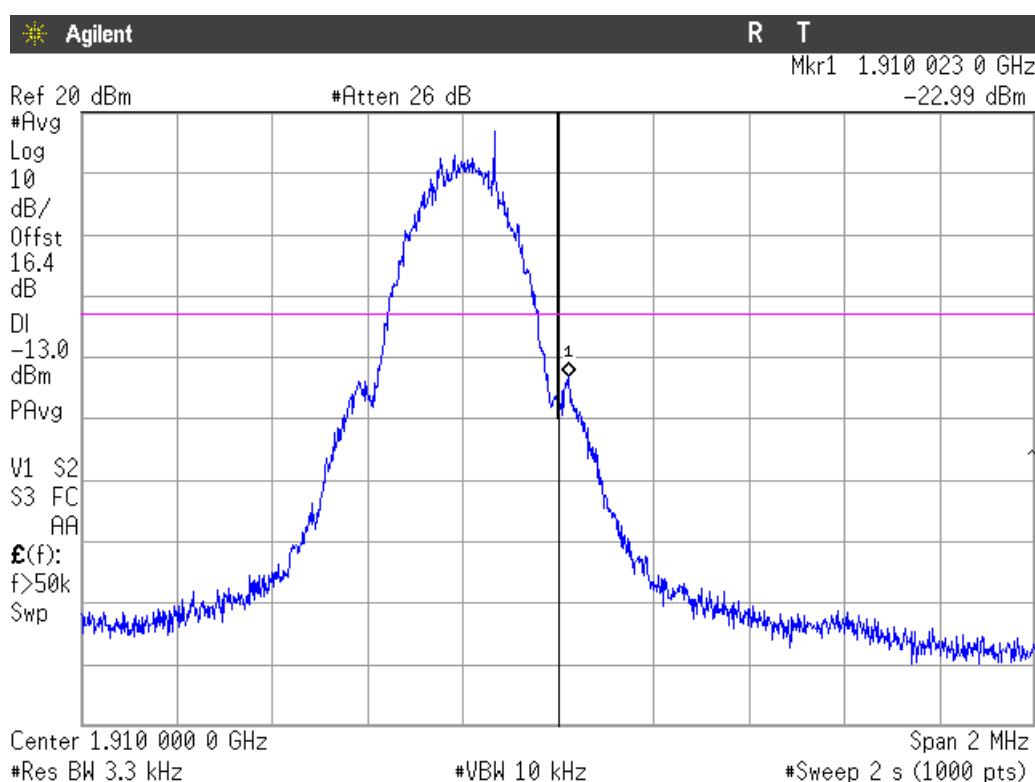
Verdict: PASS

2G Band 1900 MHz. GPRS MODULATION.

Lowest Channel:

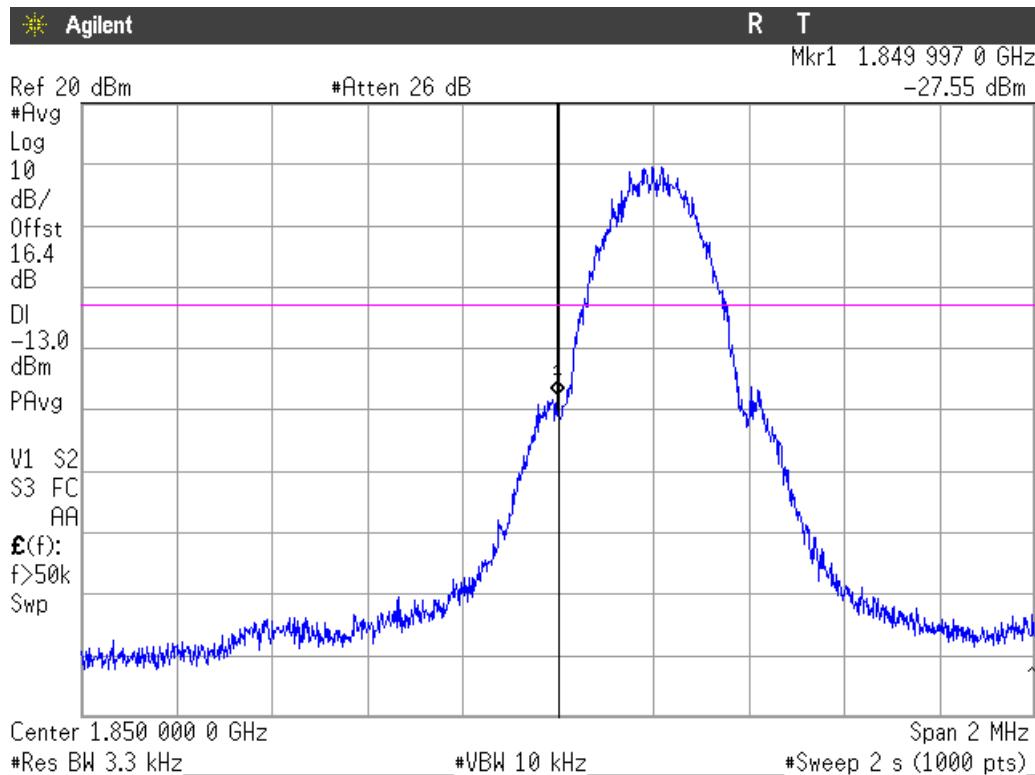


Highest Channel:



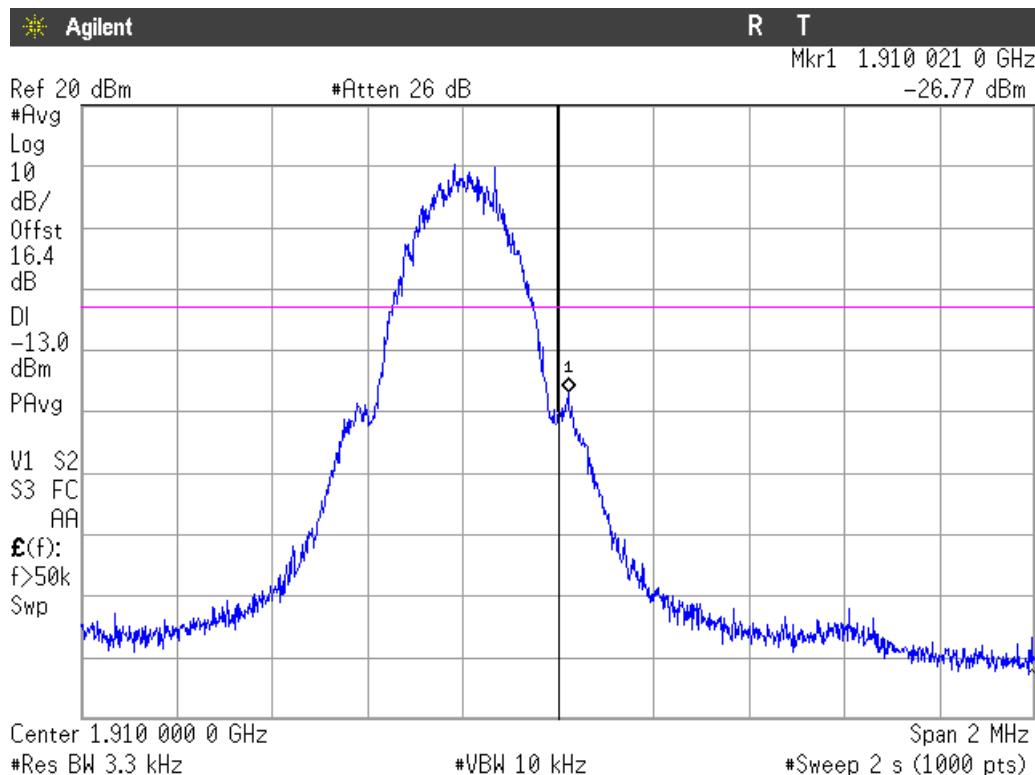
2G Band 1900 MHz. EDGE MODULATION.

Lowest Channel:



The equipment transmits at the maximum output power

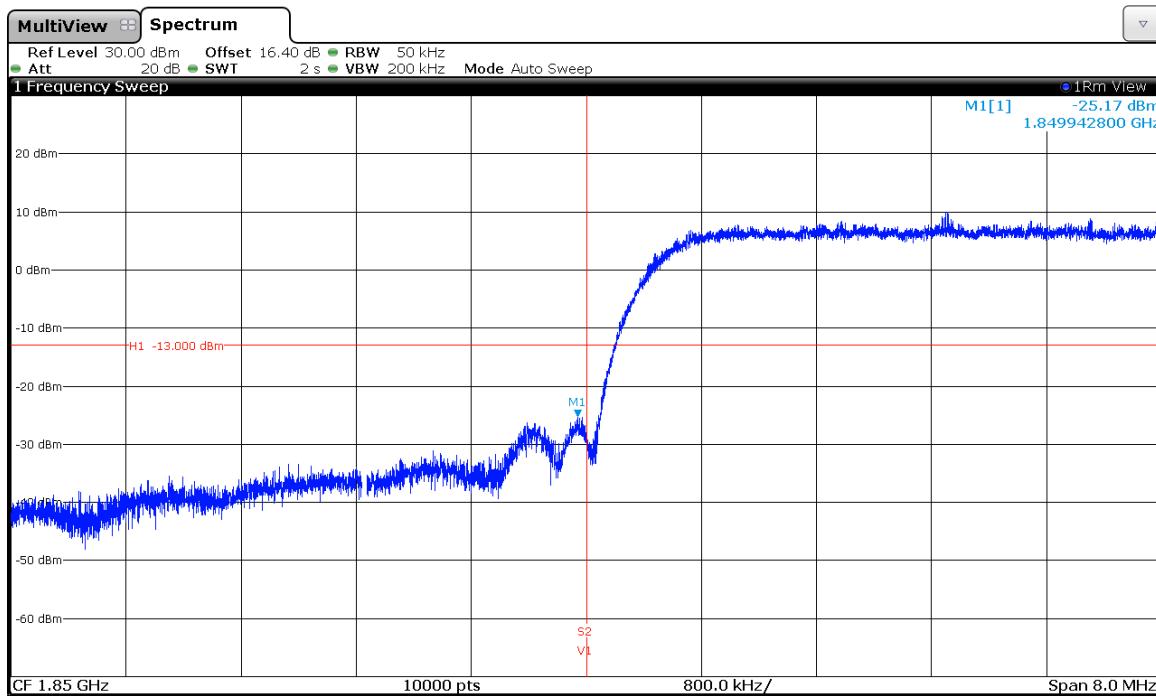
Highest Channel:



The equipment transmits at the maximum output power

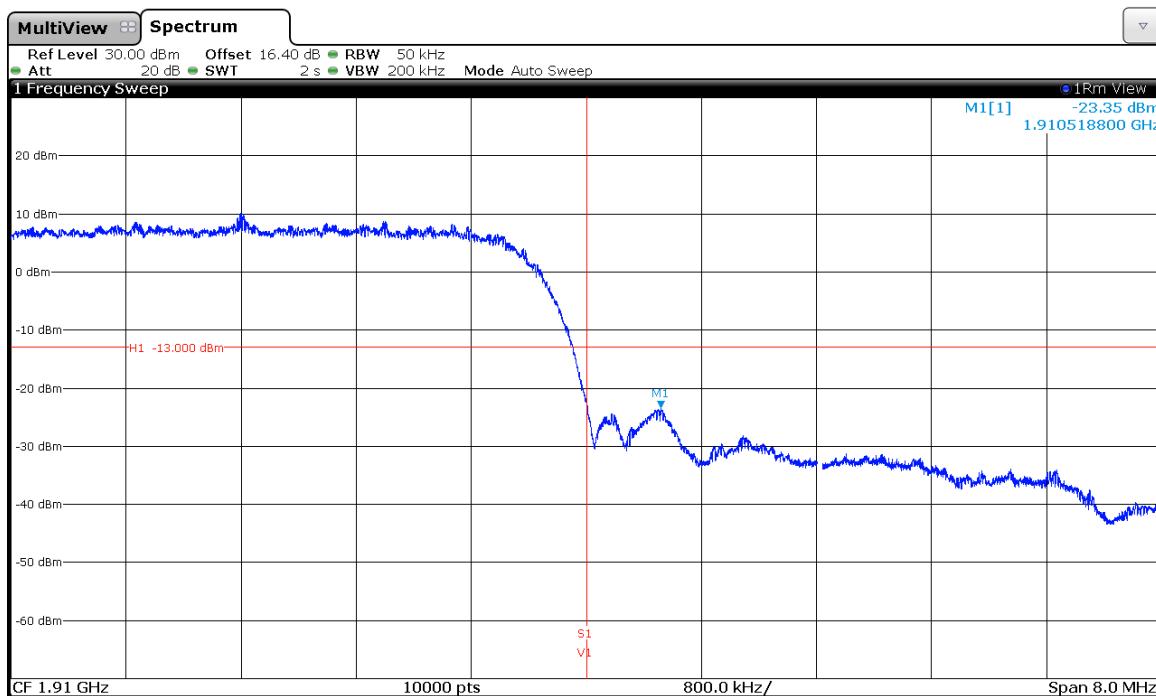
3G Band II. WCDMA MODULATION.

Lowest Channel:



The equipment transmits at the maximum output power

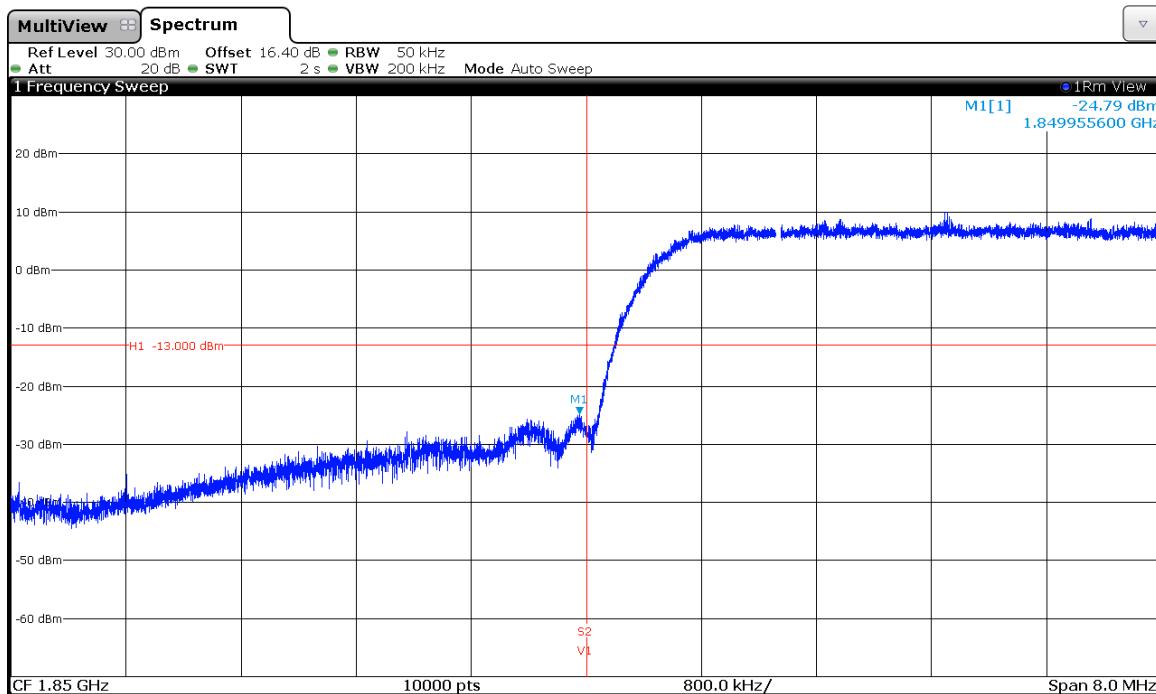
Highest Channel:



The equipment transmits at the maximum output power

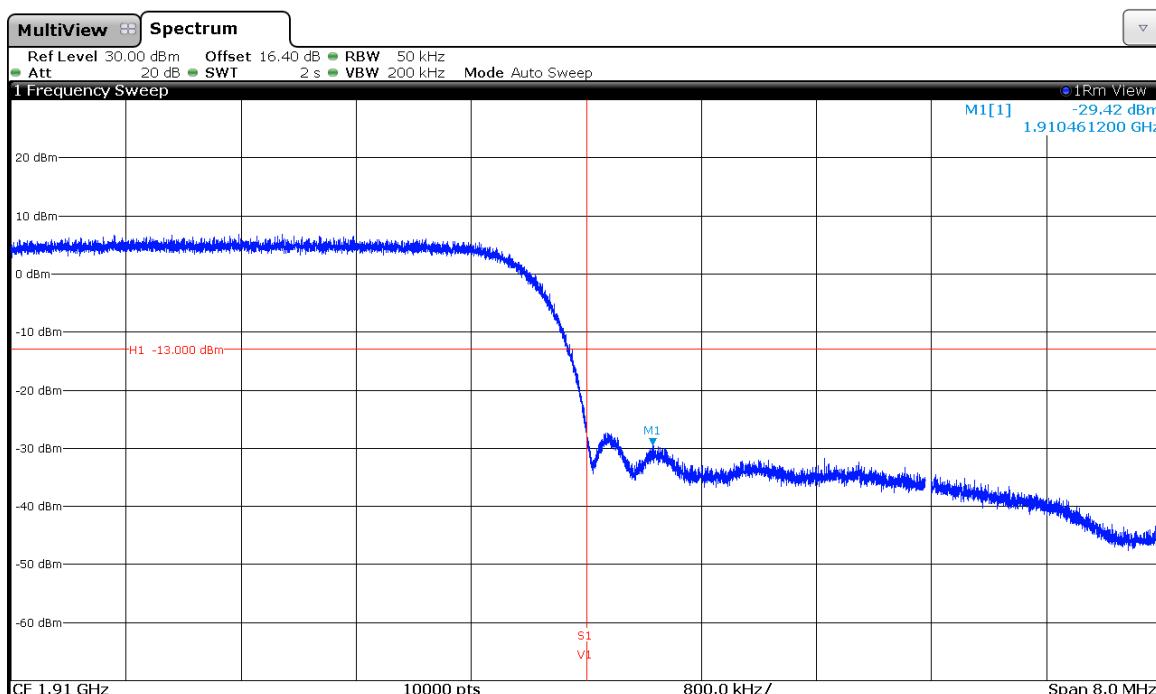
3G Band II. HSUPA MODULATION.

Lowest Channel:



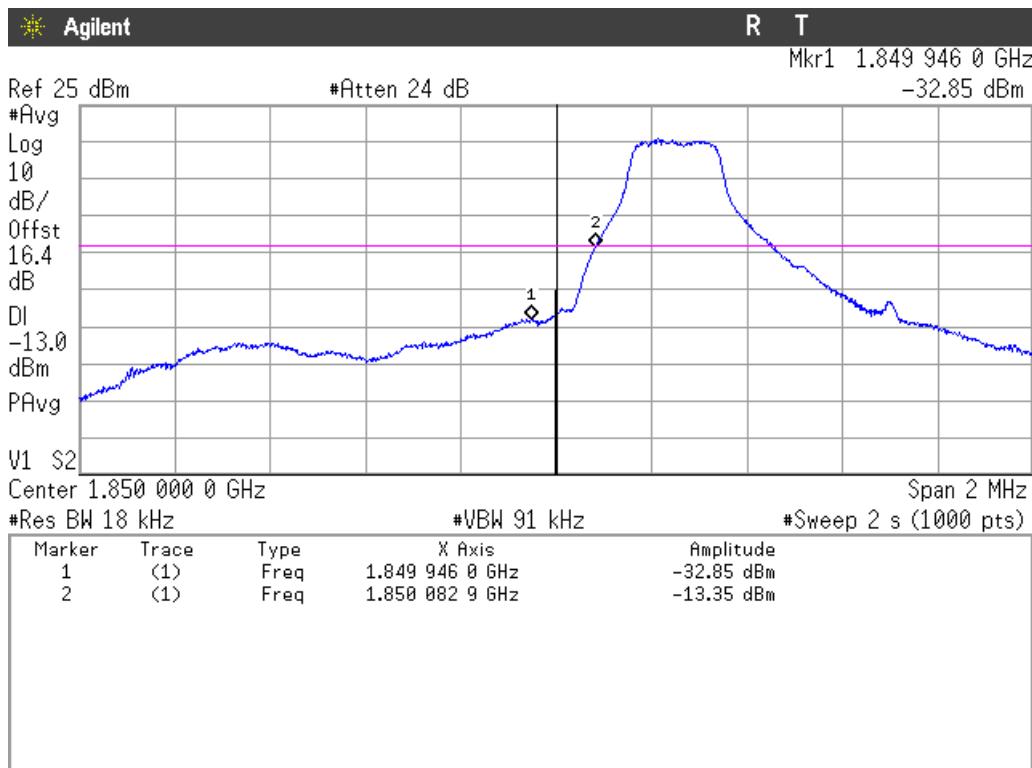
The equipment transmits at the maximum output power

Highest Channel:



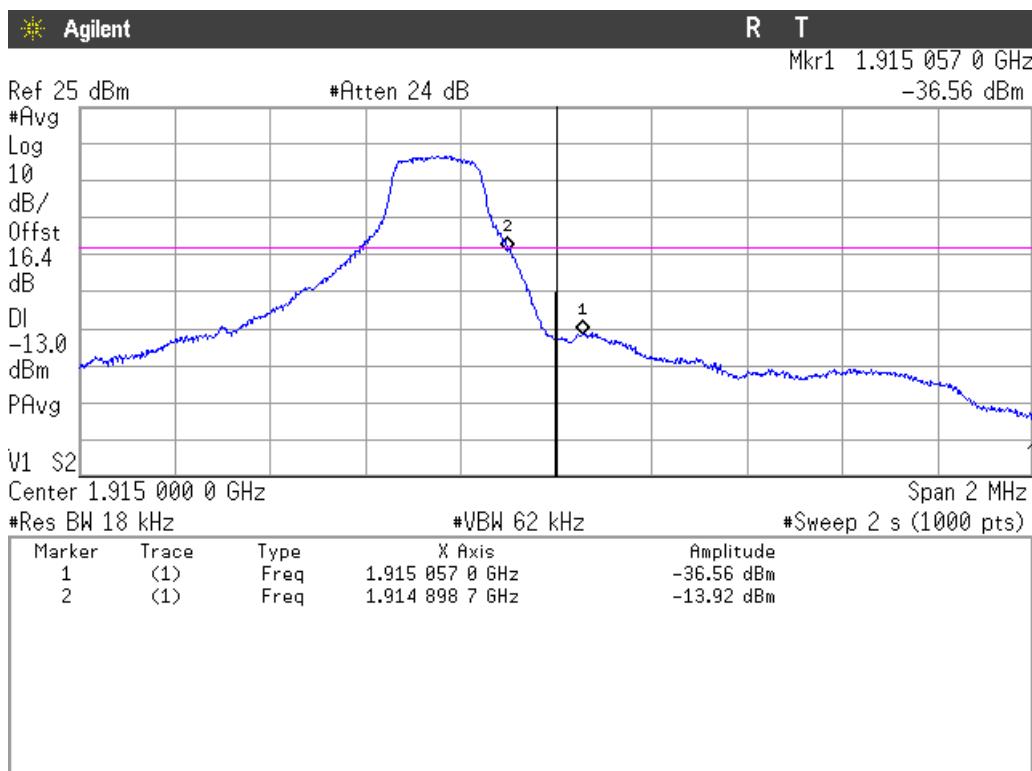
The equipment transmits at the maximum output power

LTE Band 25. QPSK MODULATION. BW=1.4 MHz. RB=1. Offset=0. Lowest Block Edge:



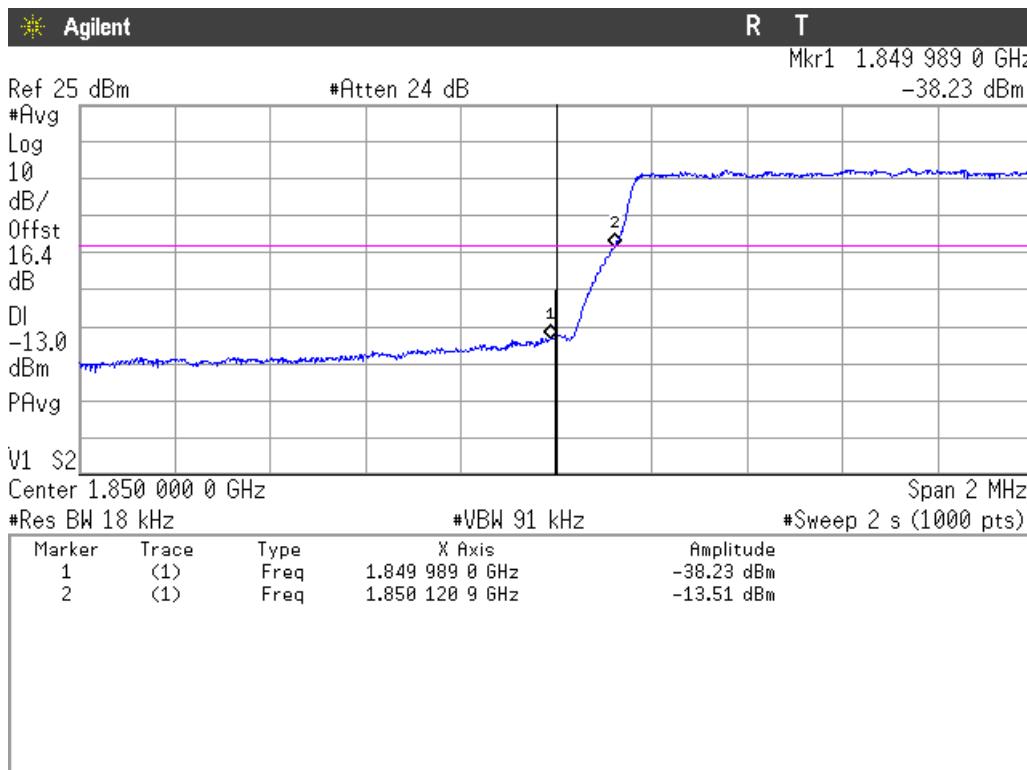
The equipment transmits at the maximum output power

LTE Band 25. QPSK MODULATION. BW=1.4 MHz. RB=1. Offset=Max. Highest Block Edge:

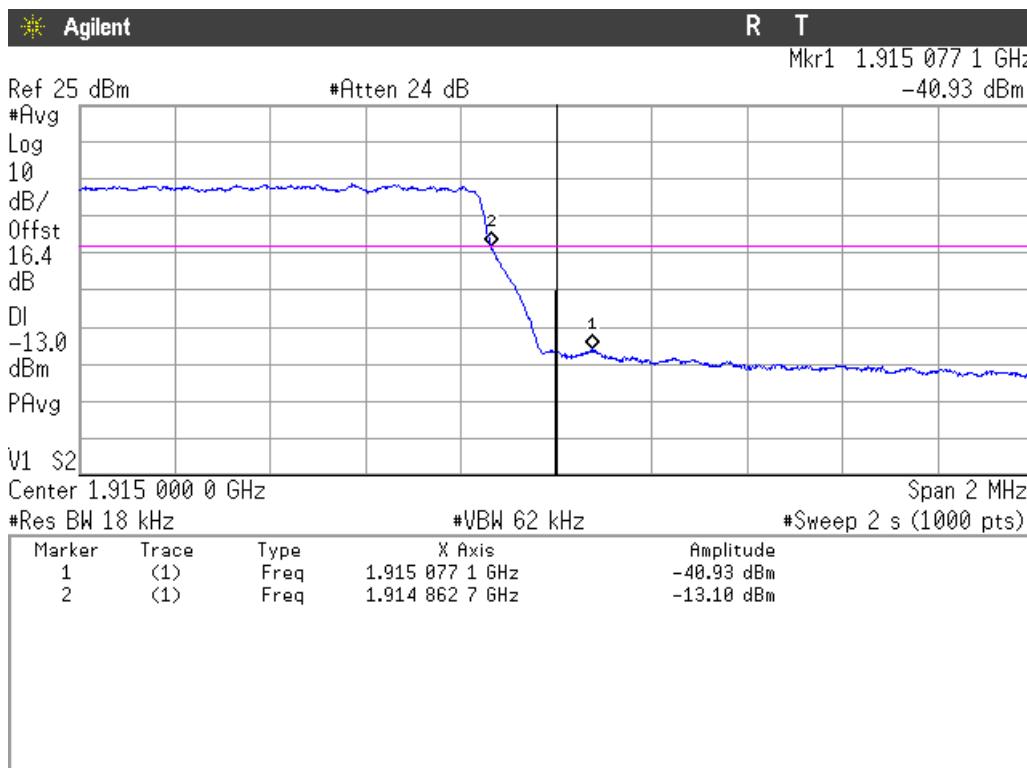


The equipment transmits at the maximum output power

LTE Band 25. QPSK MODULATION. BW=1.4 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



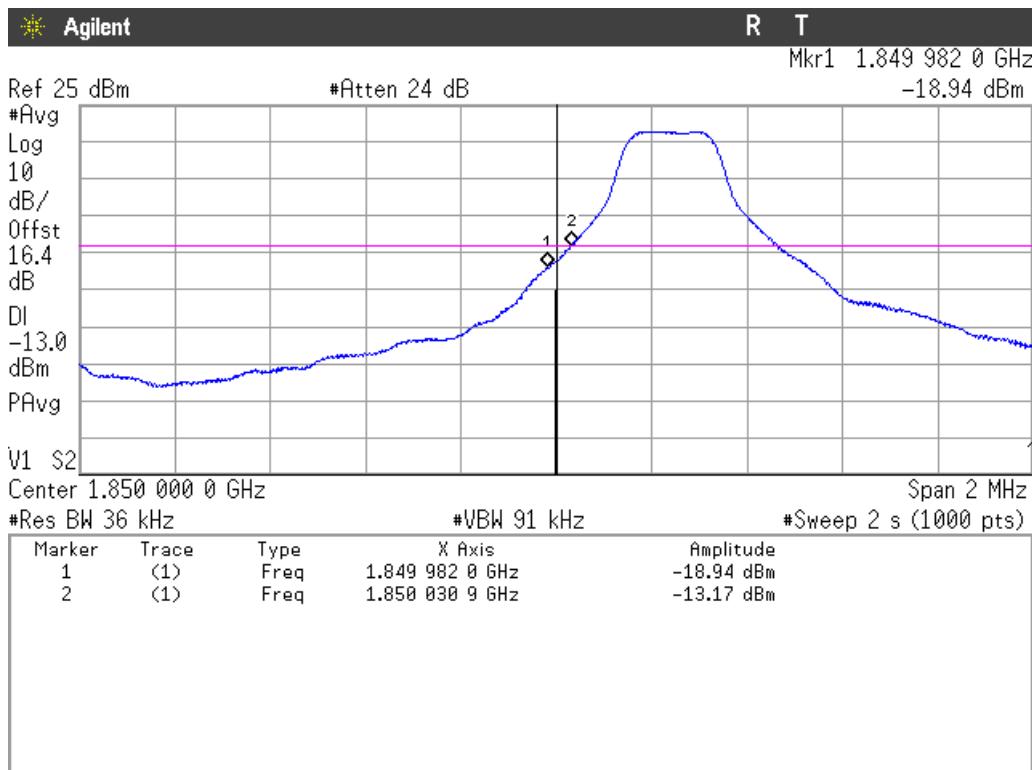
The equipment transmits at the maximum output power



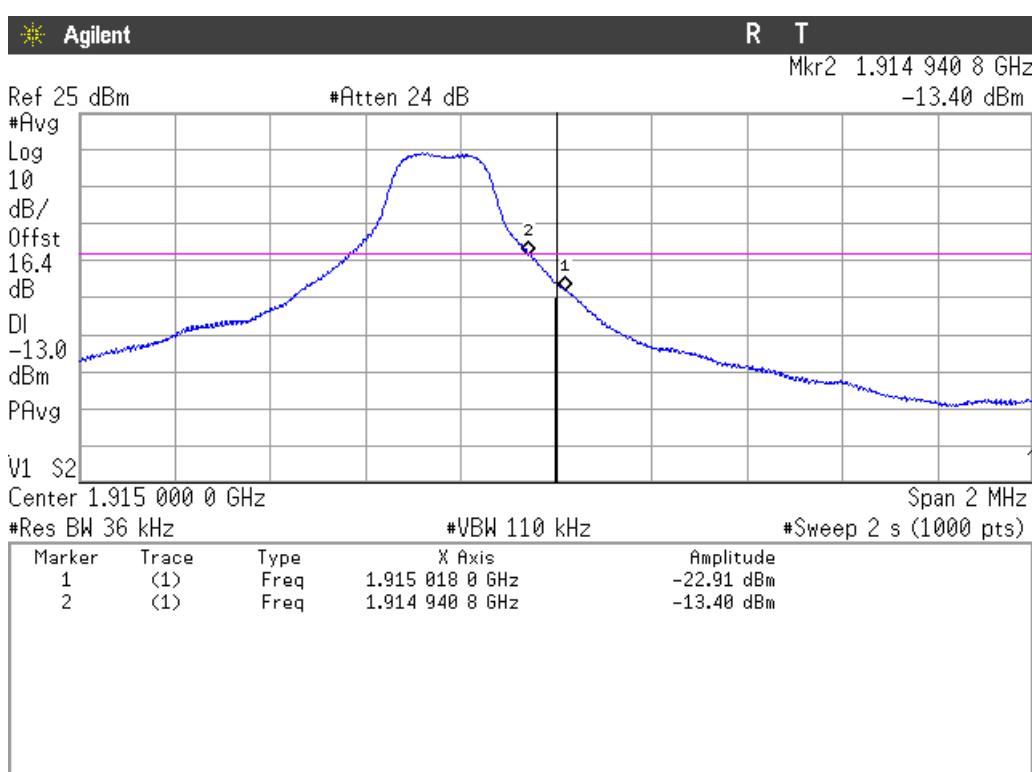
The equipment transmits at the maximum output power

Verdict: PASS

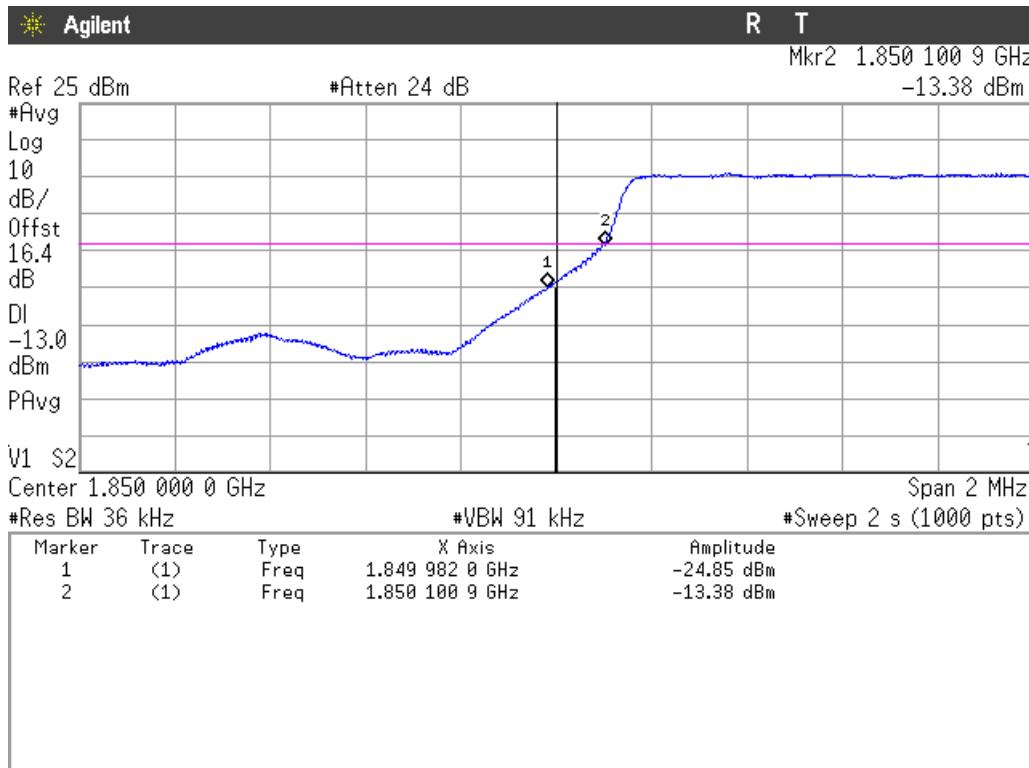
LTE Band 25. QPSK MODULATION. BW=3 MHz. RB=1. Offset=0. Lowest Block Edge:



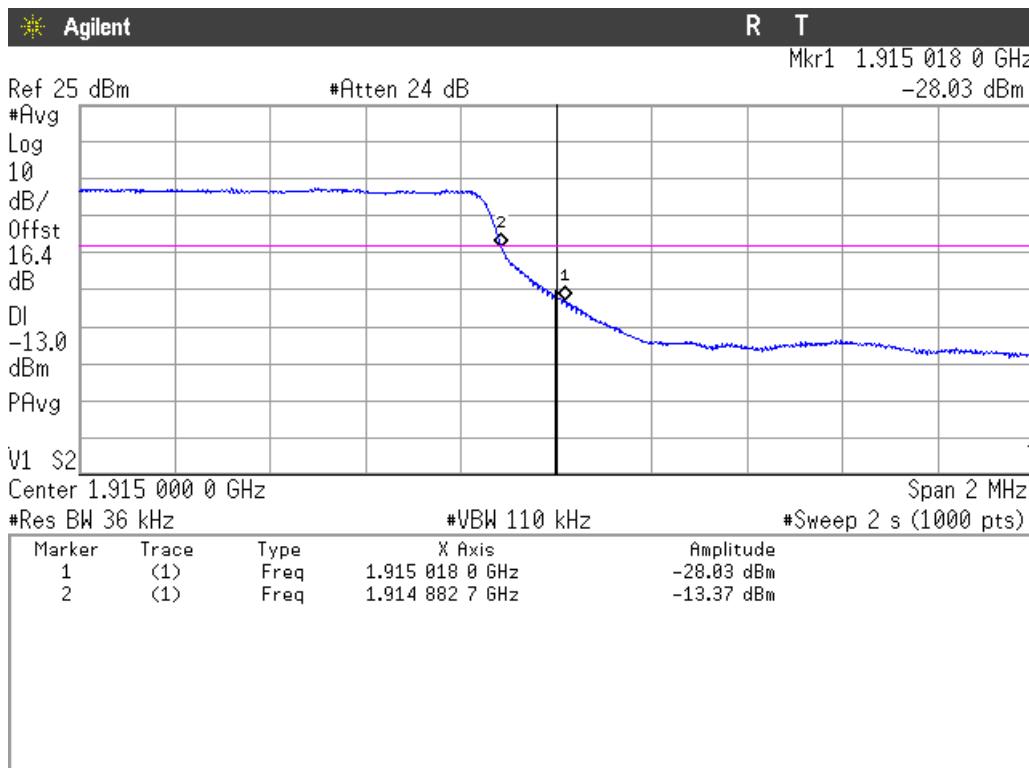
LTE Band 25. QPSK MODULATION. BW=3 MHz. RB=1. Offset=Max. Highest Block Edge:



LTE Band 25. QPSK MODULATION. BW=3 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:

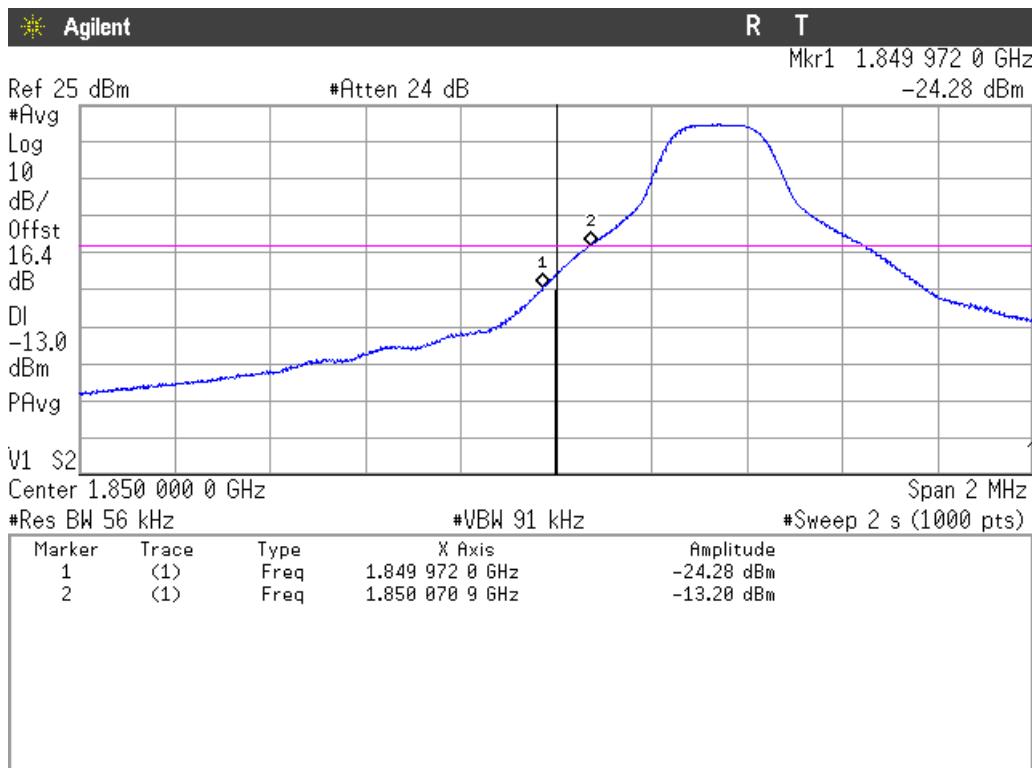


The equipment transmits at the maximum output power

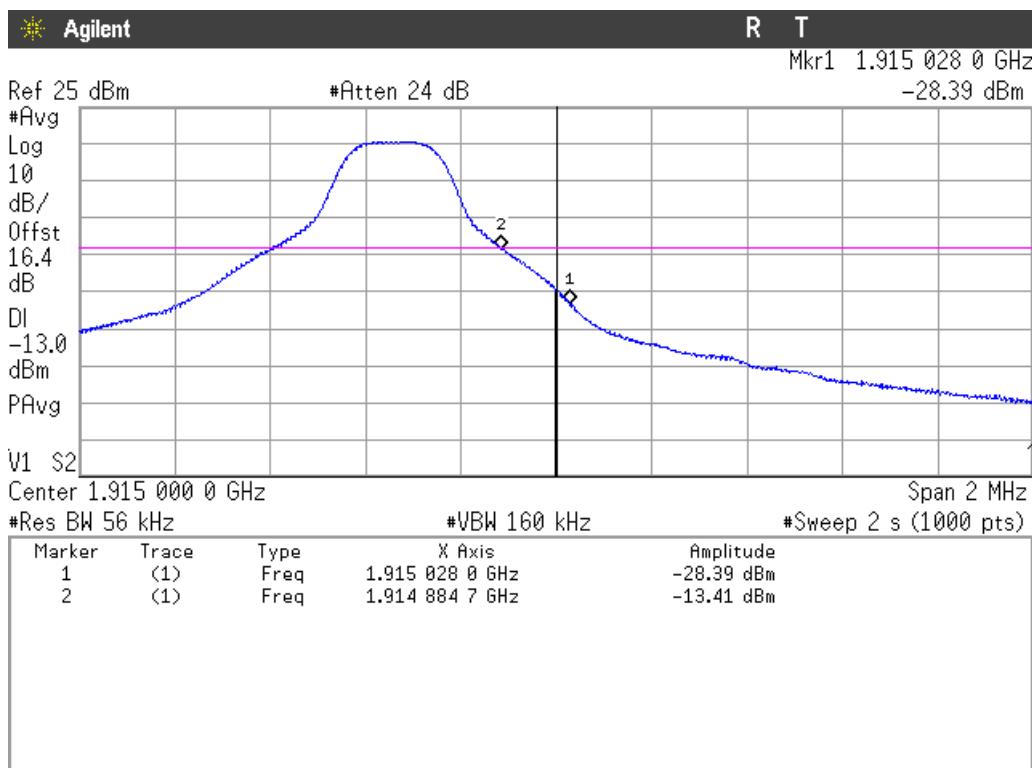


The equipment transmits at the maximum output power

Verdict: PASS

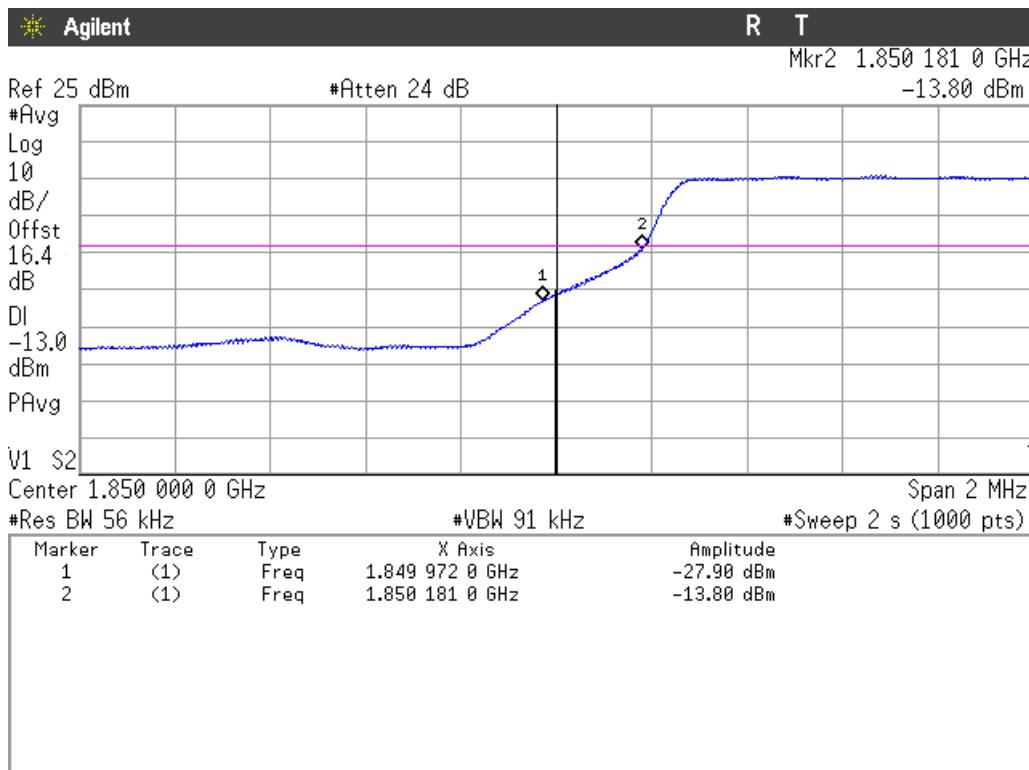
LTE Band 25. QPSK MODULATION. BW=5 MHz. RB=1. Offset=0. Lowest Block Edge:


The equipment transmits at the maximum output power

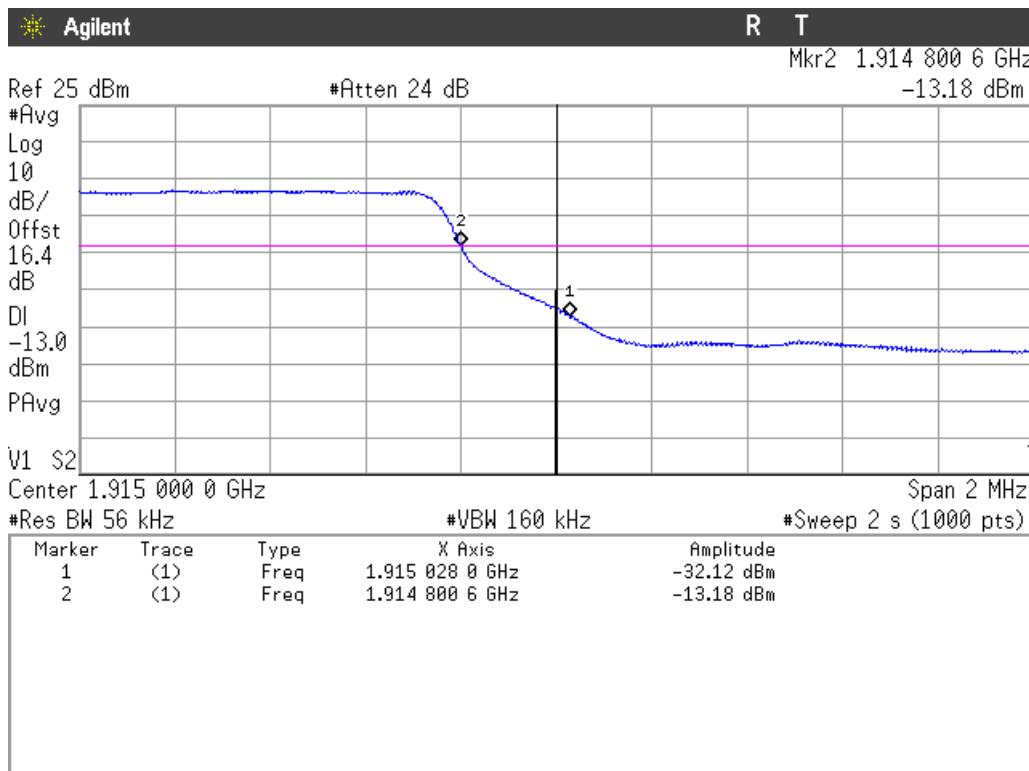
LTE Band 25. QPSK MODULATION. BW=5 MHz. RB=1. Offset=Max. Highest Block Edge:


The equipment transmits at the maximum output power

LTE Band 25. QPSK MODULATION. BW=5 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:

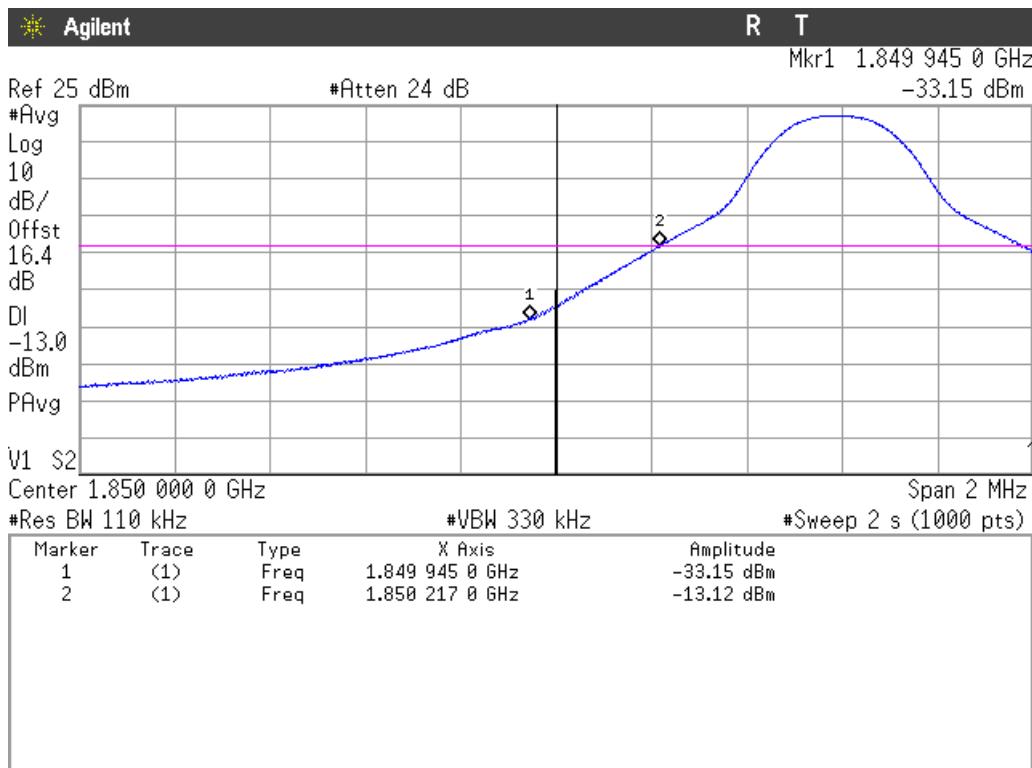


The equipment transmits at the maximum output power

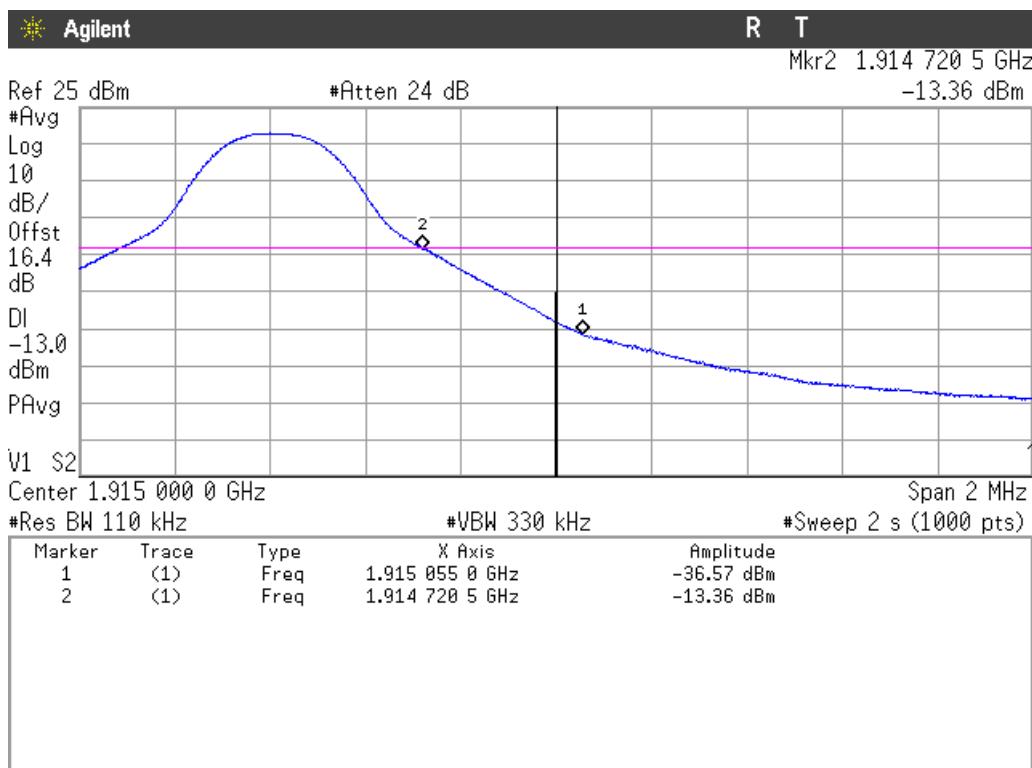


The equipment transmits at the maximum output power

Verdict: PASS

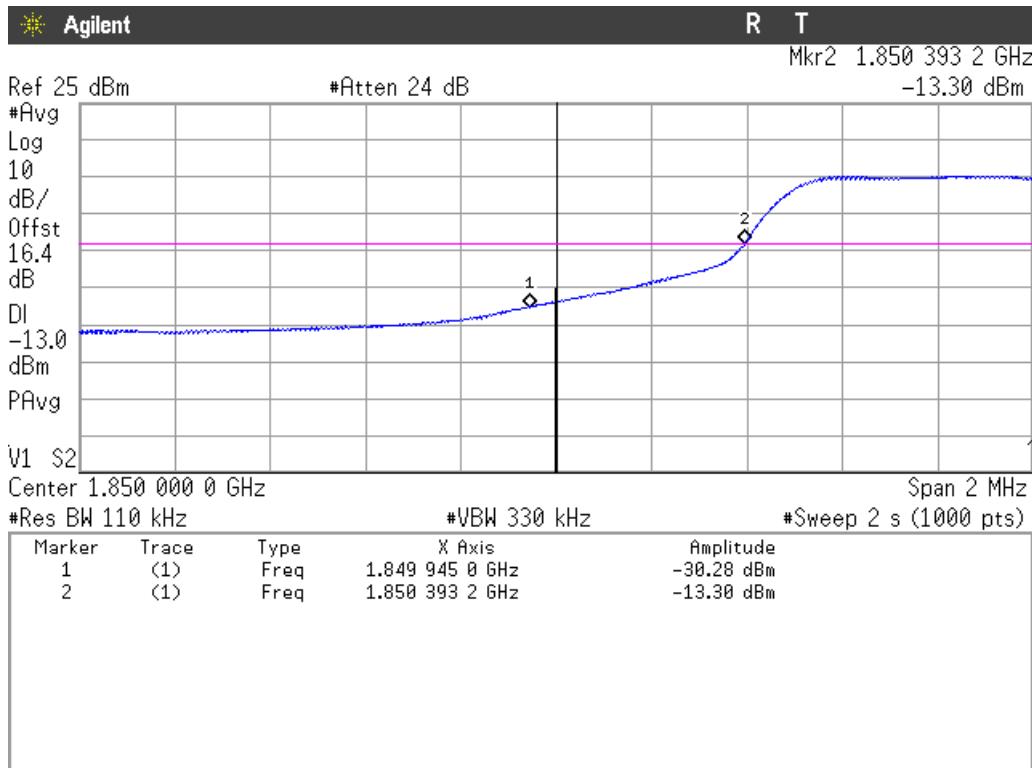
LTE Band 25. QPSK MODULATION. BW=10 MHz. RB=1. Offset=0. Lowest Block Edge:


The equipment transmits at the maximum output power

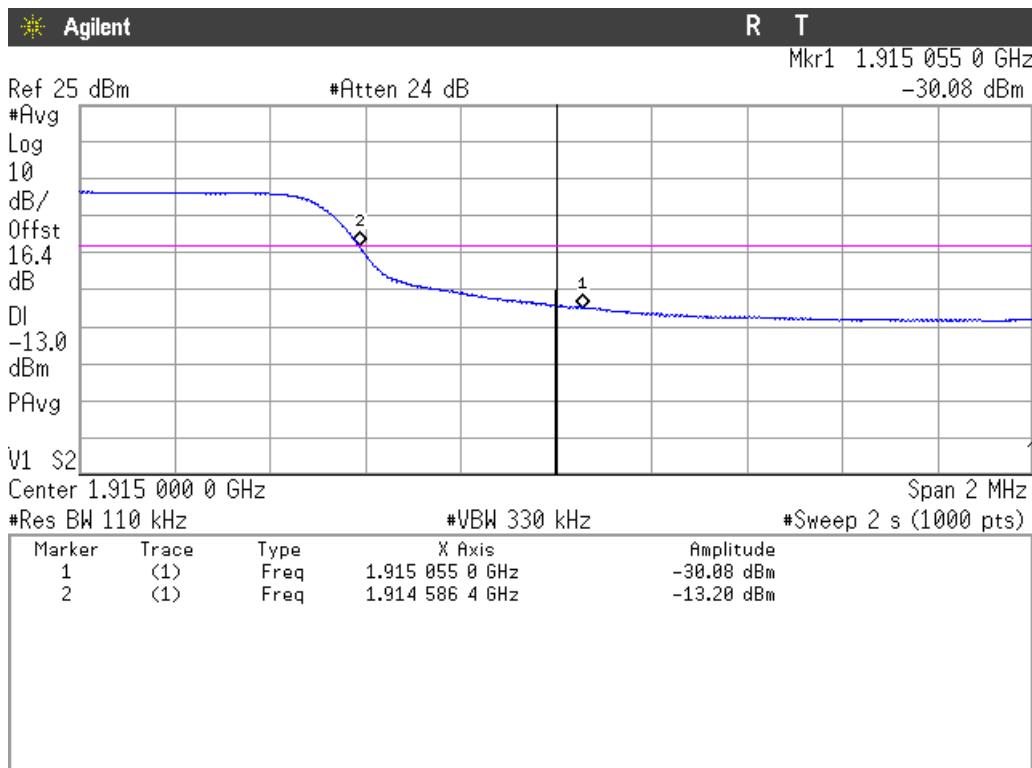
LTE Band 25. QPSK MODULATION. BW=10 MHz. RB=1. Offset=Max. Highest Block Edge:


The equipment transmits at the maximum output power

LTE Band 25. QPSK MODULATION. BW=10 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:

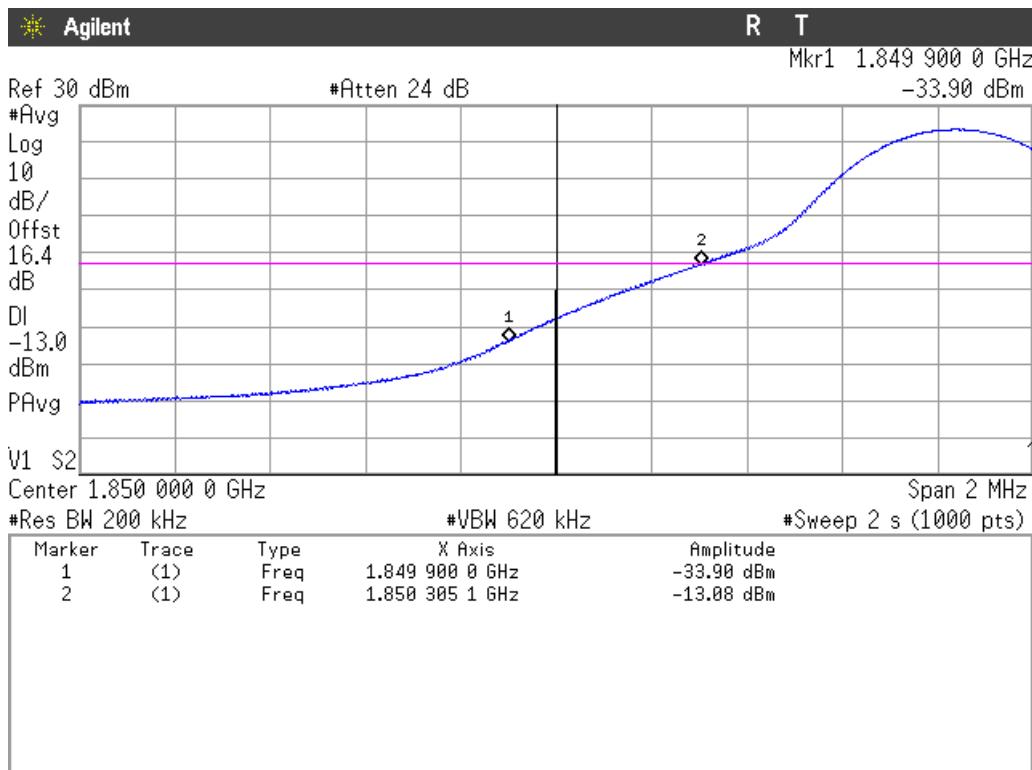


The equipment transmits at the maximum output power

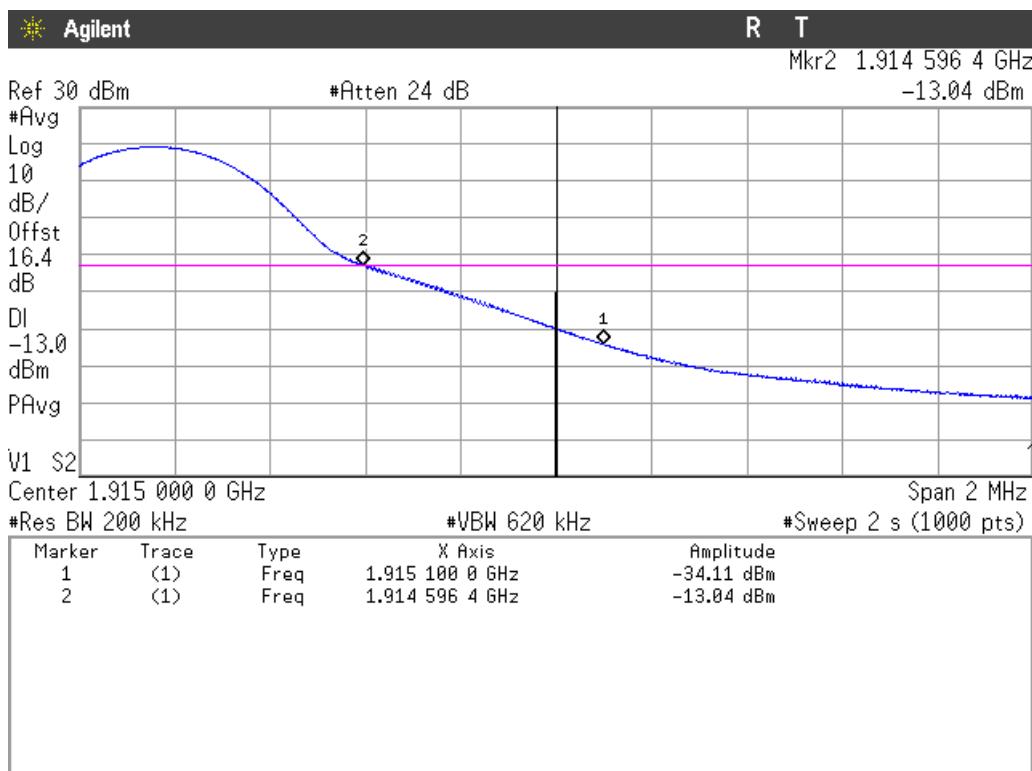


The equipment transmits at the maximum output power

Verdict: PASS

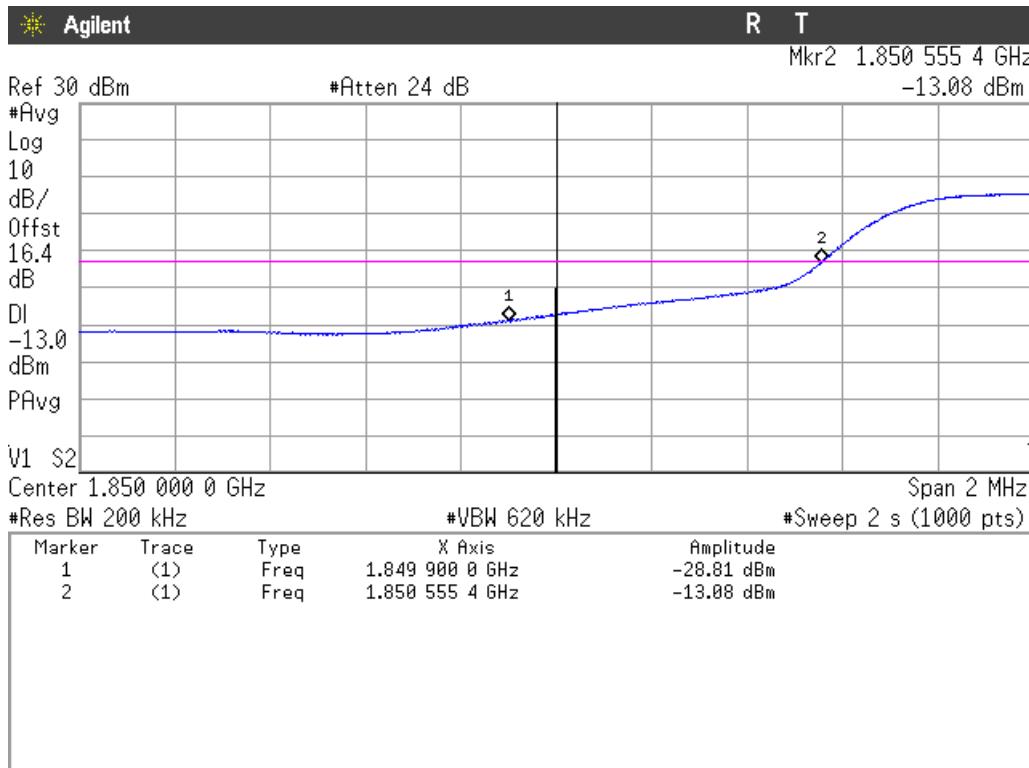
LTE Band 25. QPSK MODULATION. BW=15 MHz. RB=1. Offset=0. Lowest Block Edge:


The equipment transmits at the maximum output power

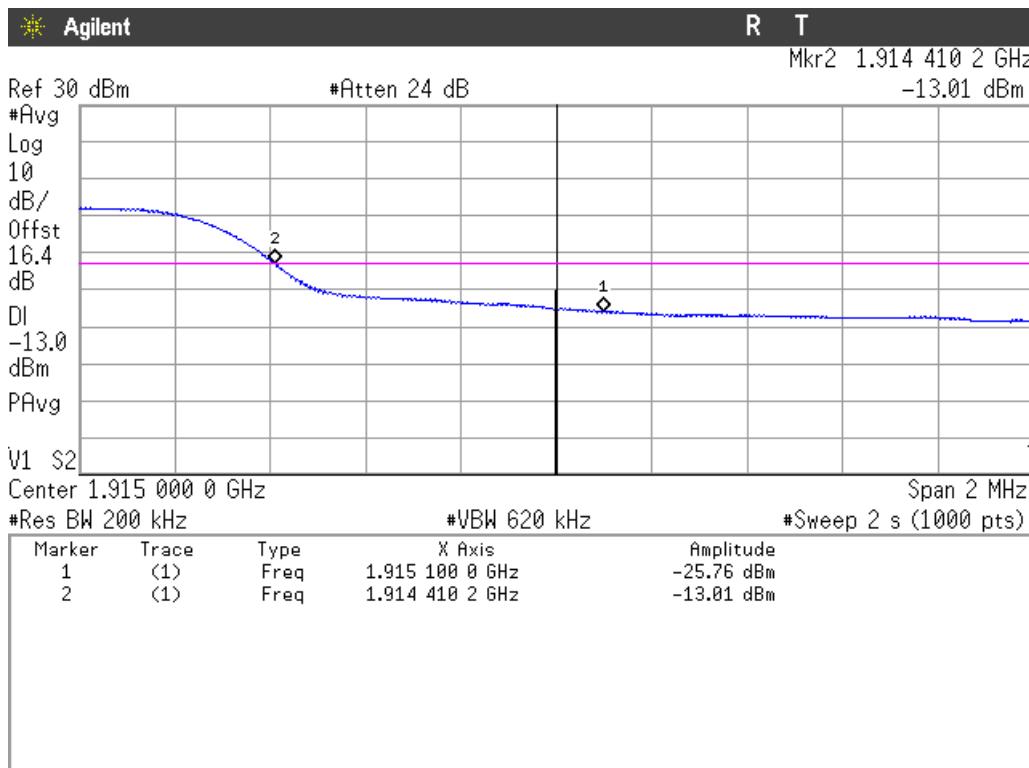
LTE Band 25. QPSK MODULATION. BW=15 MHz. RB=1. Offset=Max. Highest Block Edge:


The equipment transmits at the maximum output power

LTE Band 25. QPSK MODULATION. BW=15 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:

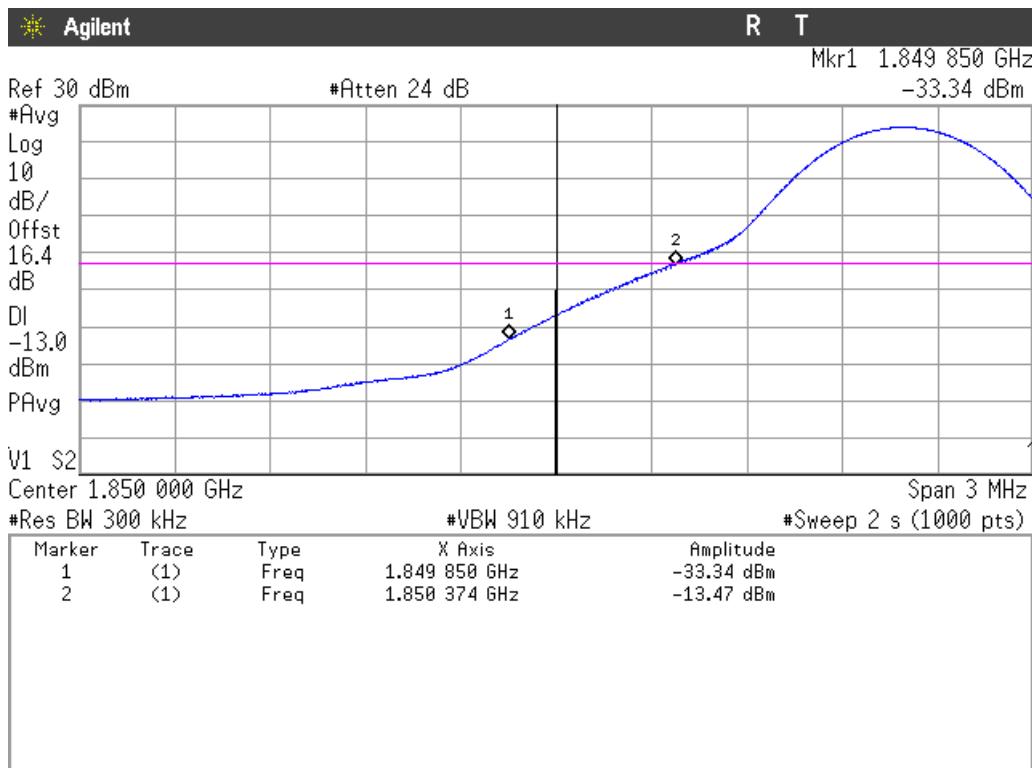


The equipment transmits at the maximum output power

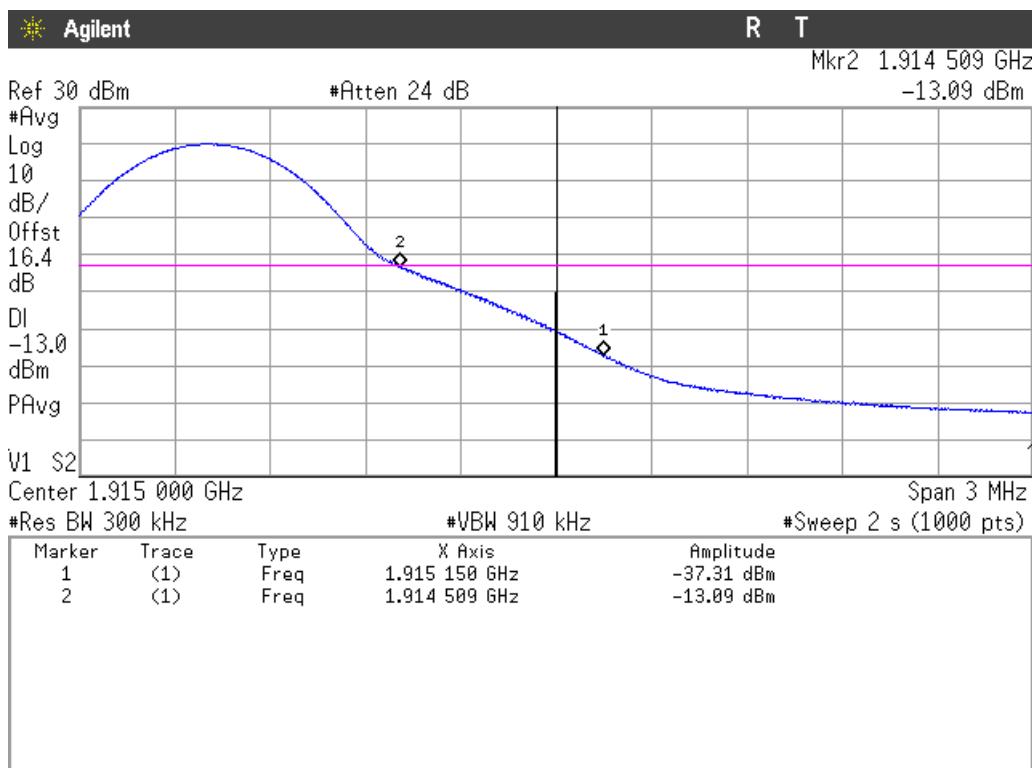


The equipment transmits at the maximum output power

Verdict: PASS

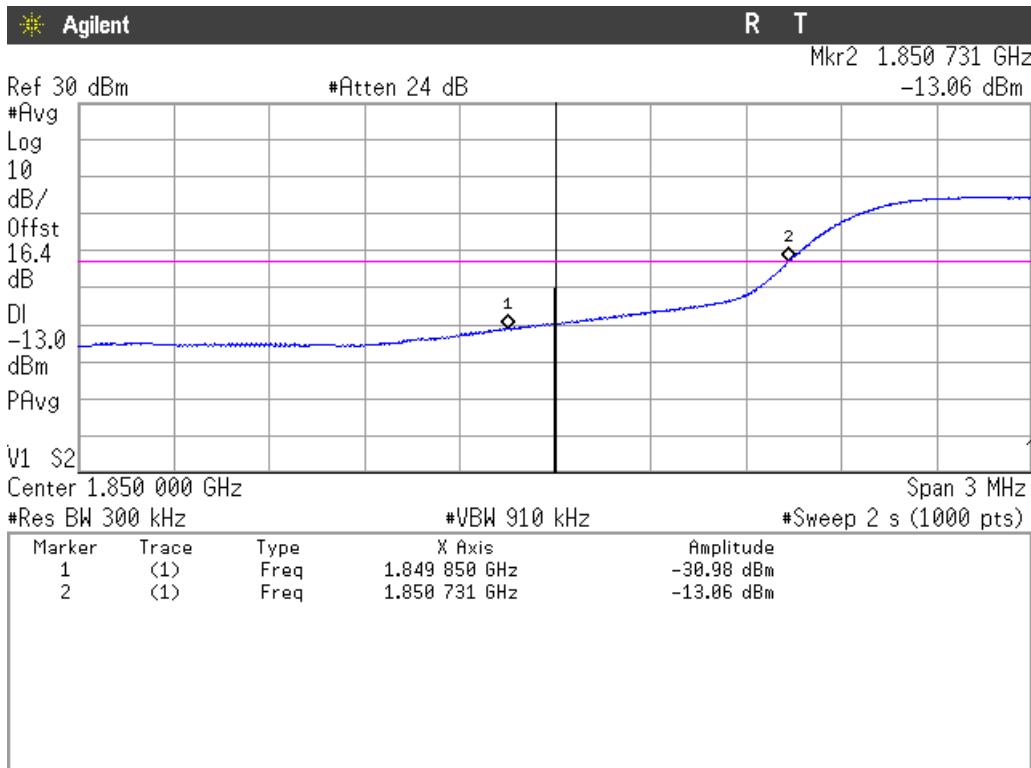
LTE Band 25. QPSK MODULATION. BW=20 MHz. RB=1. Offset=0. Lowest Block Edge:


The equipment transmits at the maximum output power

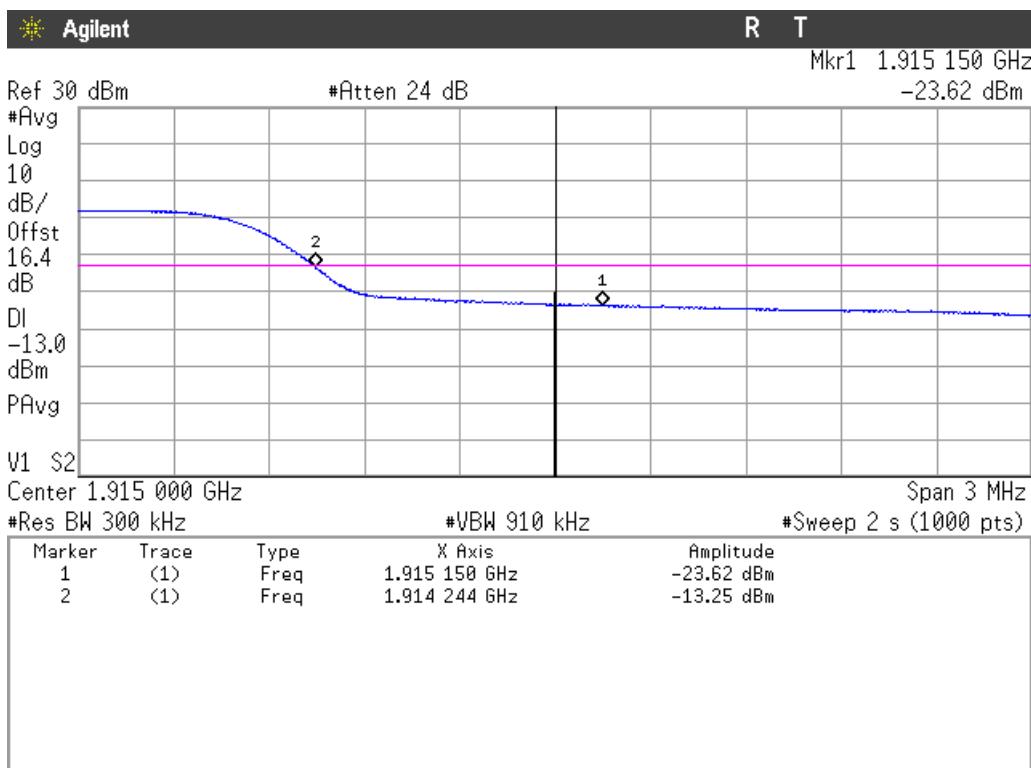
LTE Band 25. QPSK MODULATION. BW=20 MHz. RB=1. Offset=Max. Highest Block Edge:


The equipment transmits at the maximum output power

LTE Band 25. QPSK MODULATION. BW=20 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:



The equipment transmits at the maximum output power



The equipment transmits at the maximum output power

Verdict: PASS

Radiated emissions

SPECIFICATION:

FCC § 24.238. RSS-133 Clause 6.5.

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

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-E.

Measurement Limit:

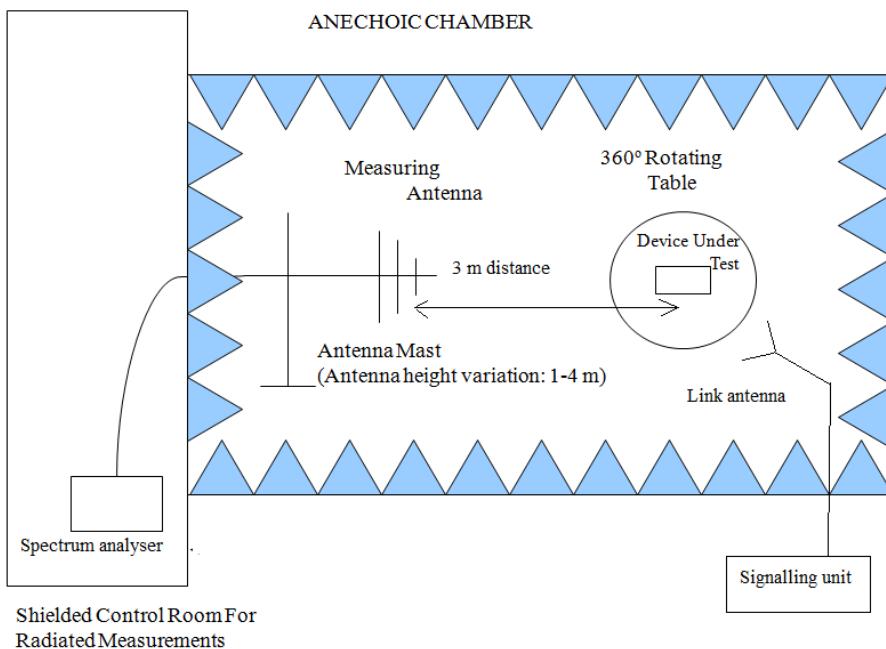
According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

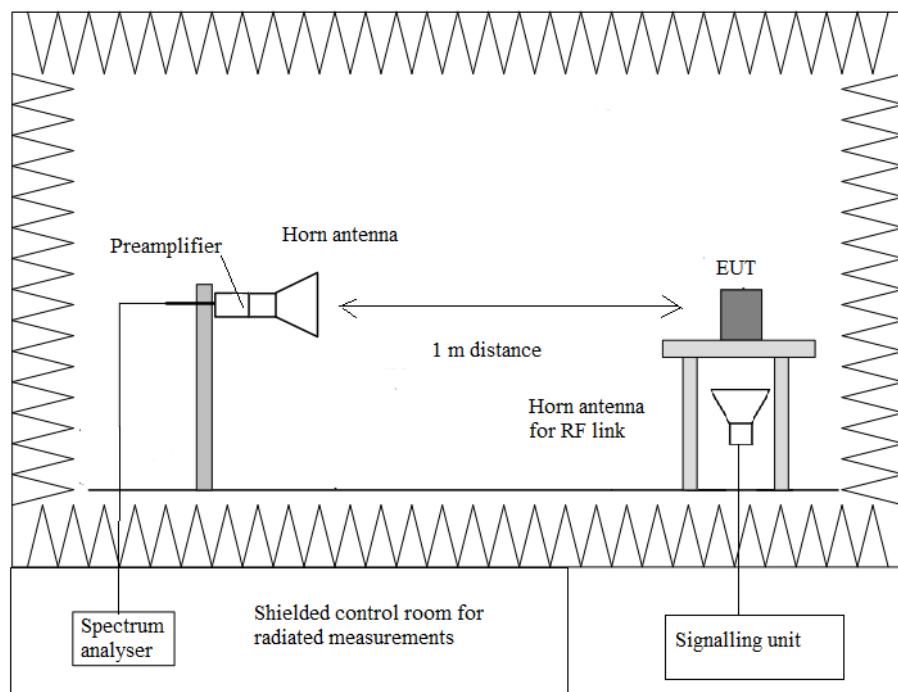
$$Po (\text{dBm}) - [43 + 10 \log (Po \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP:

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS:

2G Band 1900 MHz:

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.

- Lowest Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 18 GHz.

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

Frequency range 18 - 20 GHz

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

- Middle Channel:

Frequency range 30 MHz-1000 MHz

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

Frequency range 1 - 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)
5550.25	-39.17	Vertical	-42.07	3.51	12.76	-32.82

Frequency range 18 - 20 GHz

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

- Highest Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 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)
5729.75	-39.01	Vertical	-41.73	3.66	12.98	-32.42

Frequency range 18 - 20 GHz

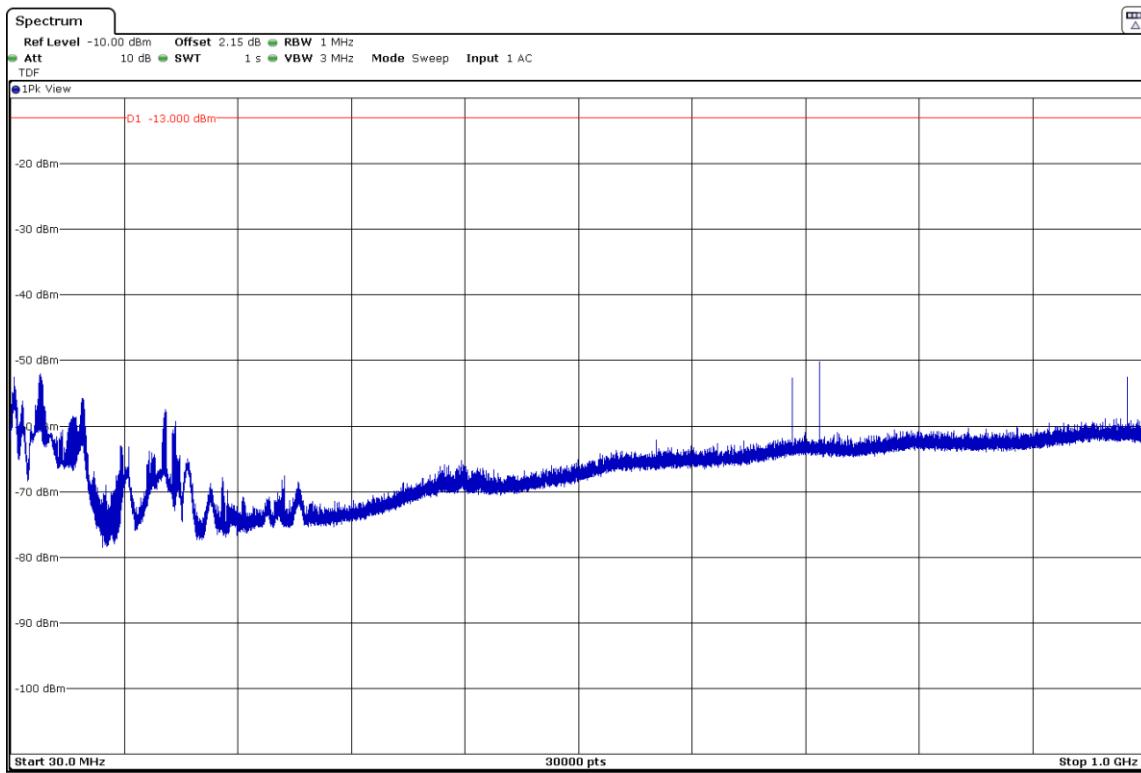
No spurious signals were found at less than 20 dB below the limit.

Verdict: PASS

Measurement uncertainty (dB)	<±2.07 for f < 1GHz <±4.88 for f ≥ 1 GHz up to 18 GHz <±3.31 for f ≥ 18 GHz up to 26 GHz
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FREQUENCY RANGE 30 MHz - 1 GHz

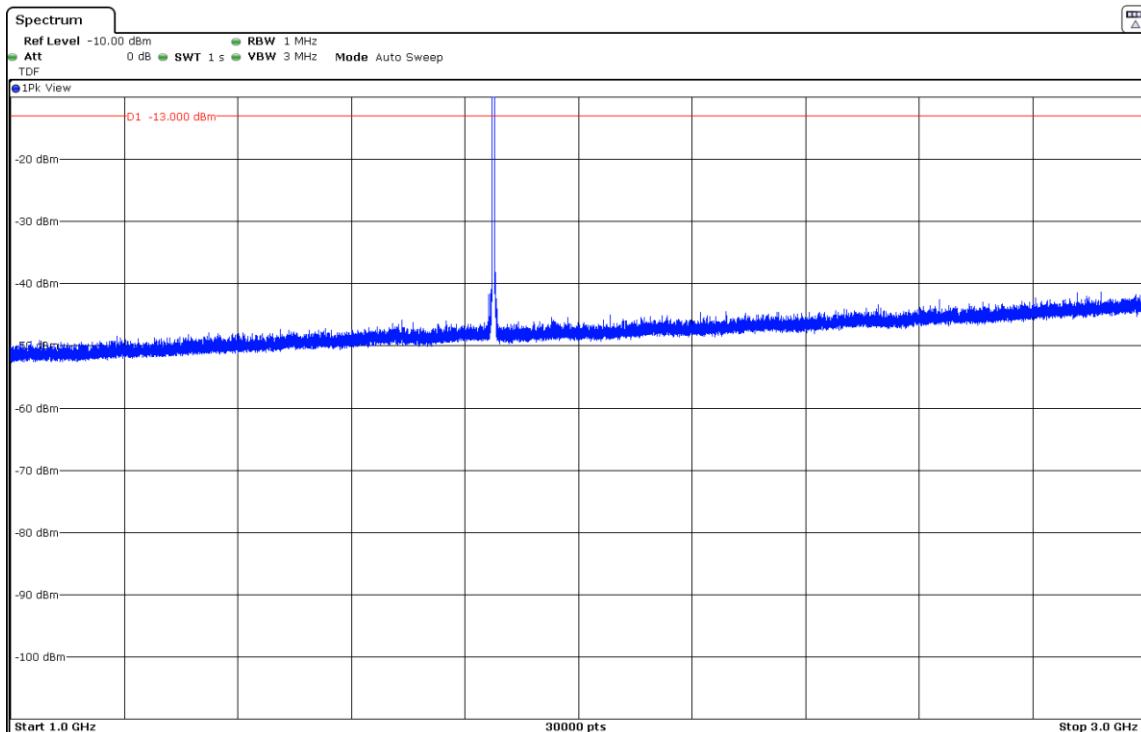
This plot is valid for the Lowest, Middle and Highest Channels:



FREQUENCY RANGE 1 - 3 GHz

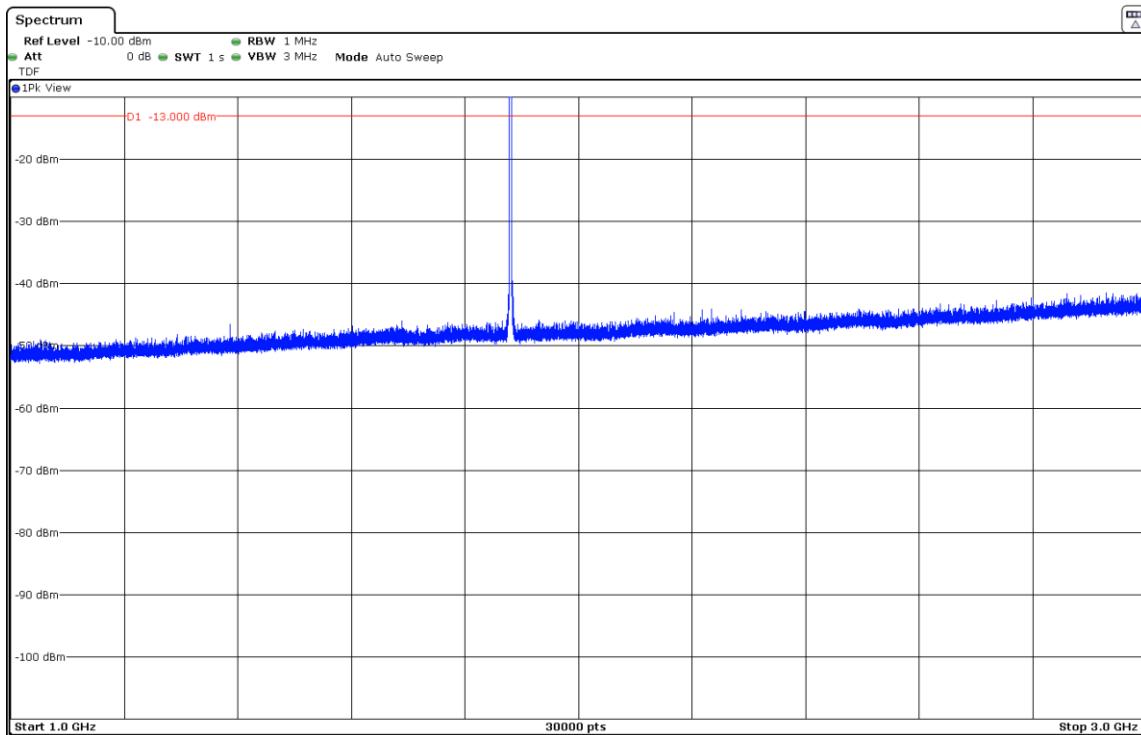
GPRS MODULATION

- Lowest Channel:



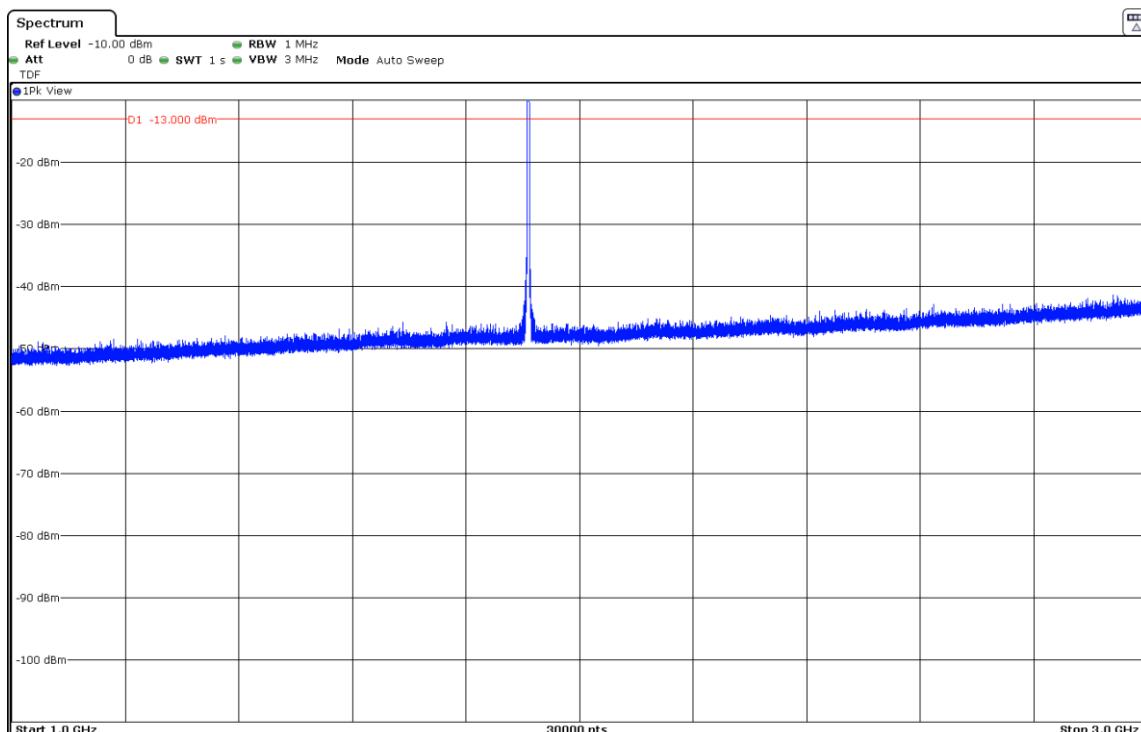
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

- Highest Channel:

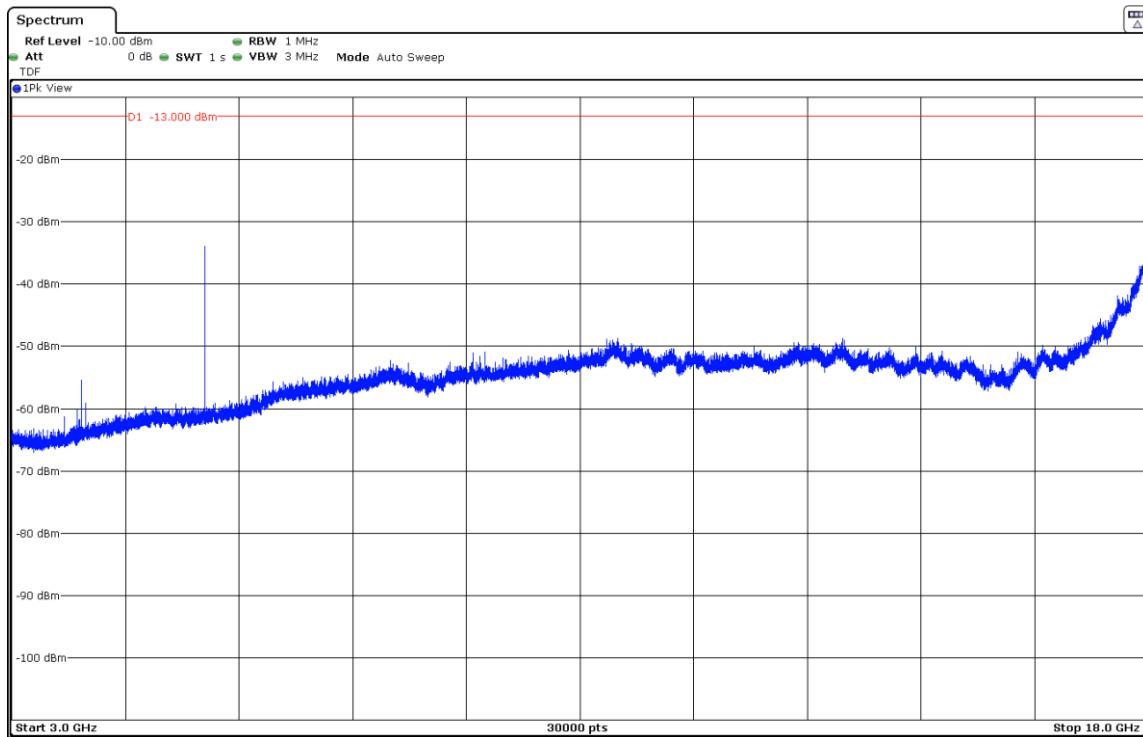


The peak above the limit is the carrier frequency.

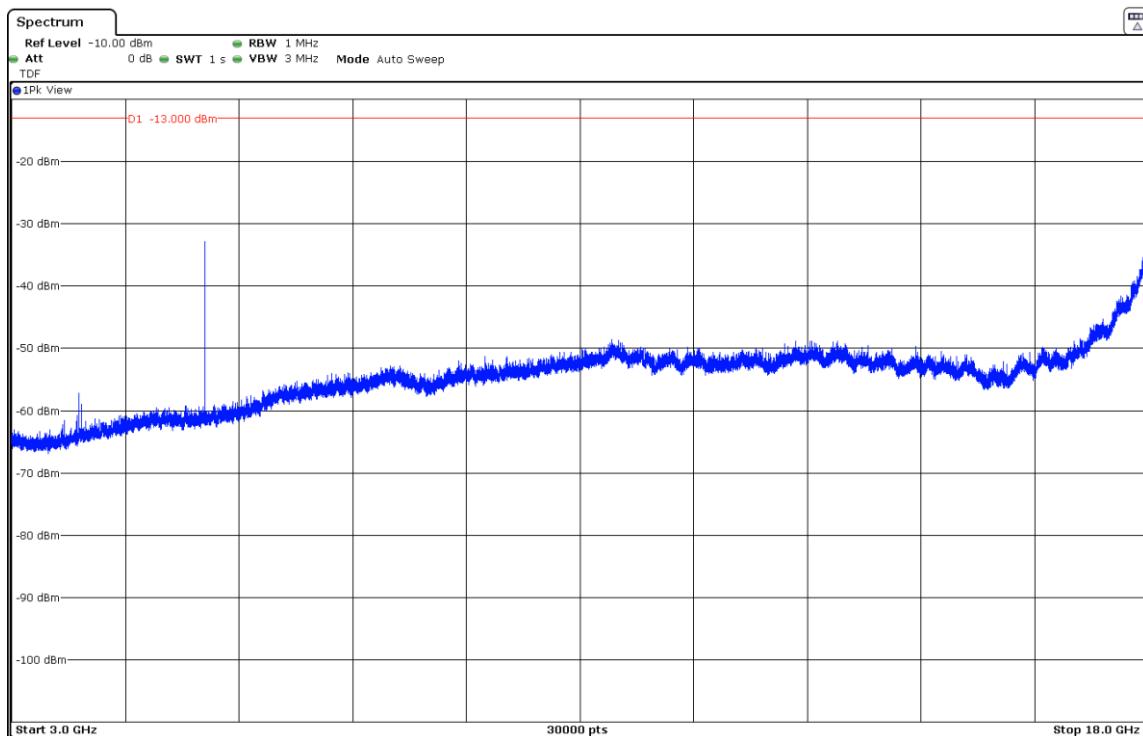
FREQUENCY RANGE 3 - 18 GHz

GPRS MODULATION

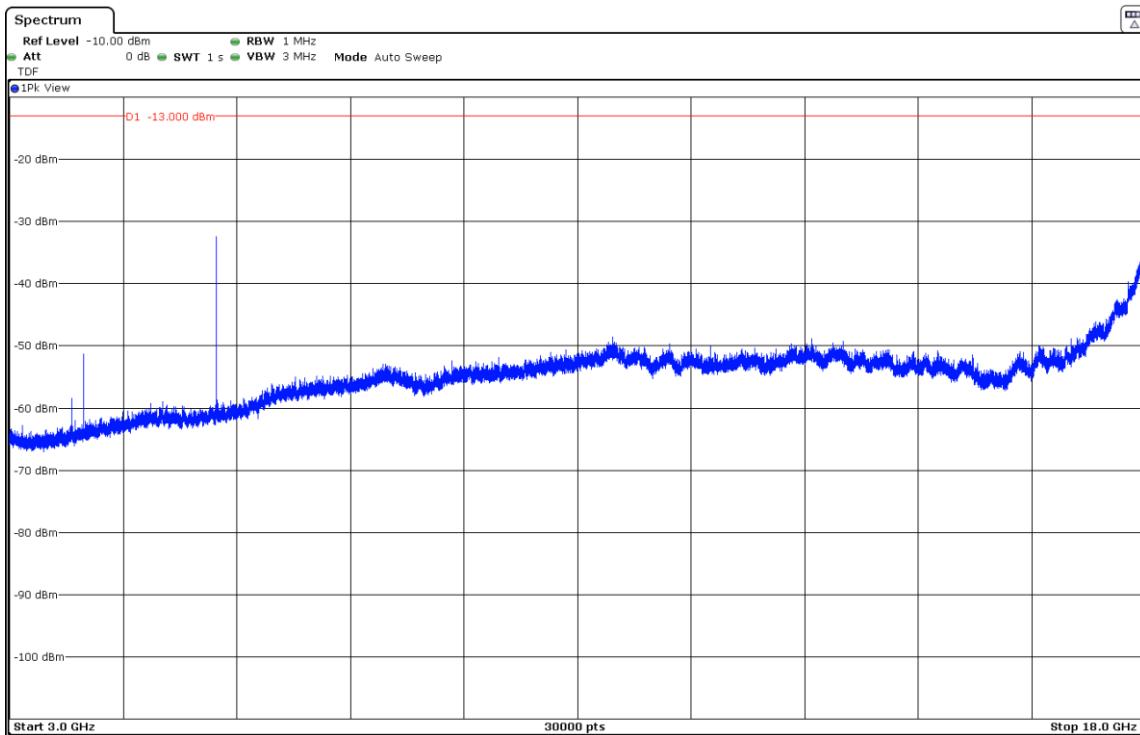
- Lowest Channel:



- Middle Channel:



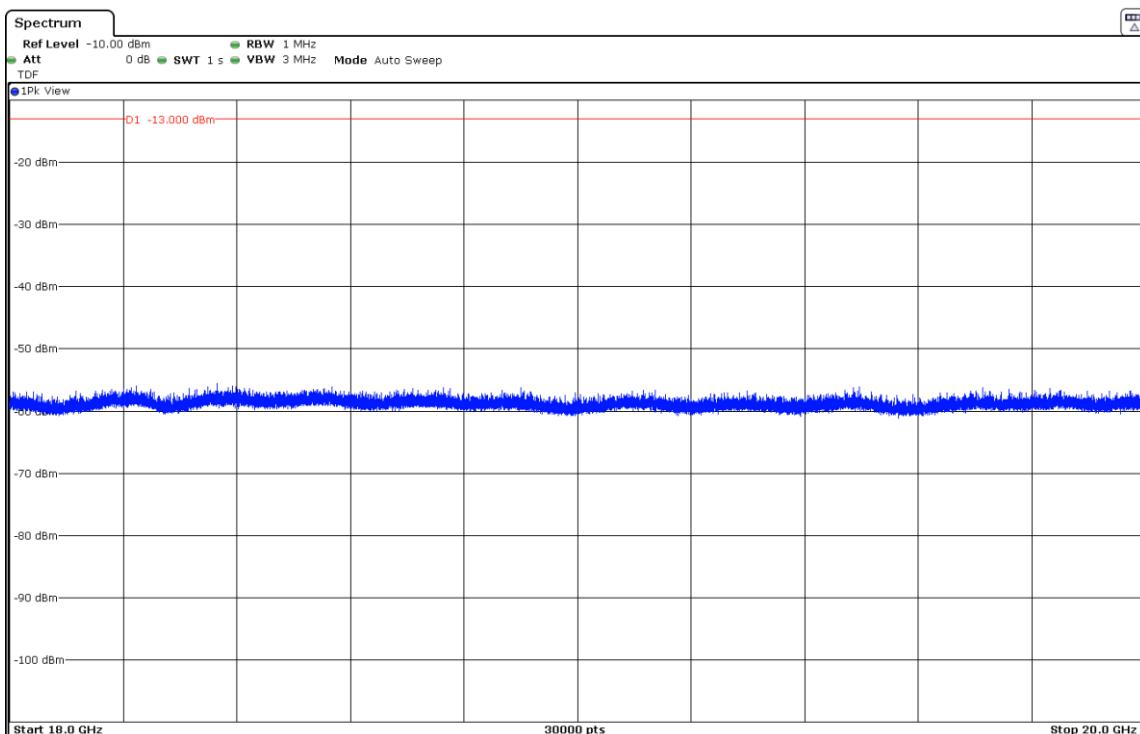
- Highest Channel:



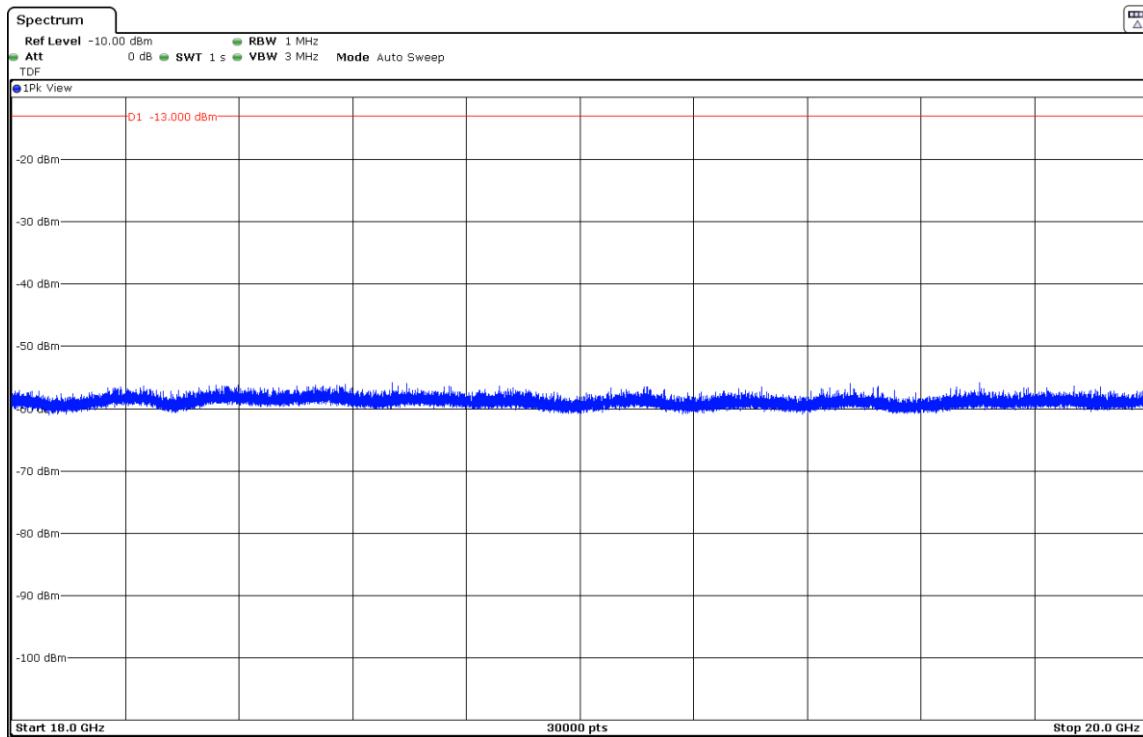
FREQUENCY RANGE 18 - 20 GHz

GPRS MODULATION

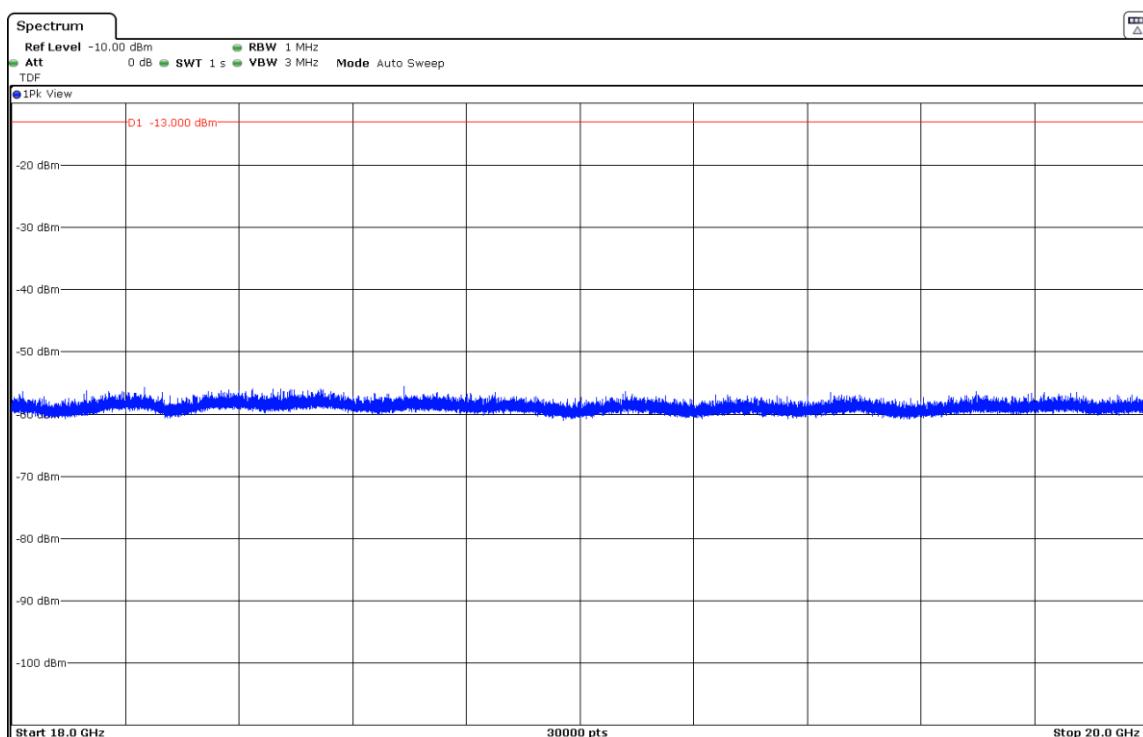
- Lowest Channel:



- Middle Channel:



- Highest Channel:



3G Band II:

WCDMA AND HSUPA MODULATION:

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

- Lowest Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 18 GHz

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

Frequency range 18 - 20 GHz

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

- Middle Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 18 GHz

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

Frequency range 18 - 20 GHz

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

- Highest Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 18 GHz

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

Frequency range 18 - 20 GHz

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

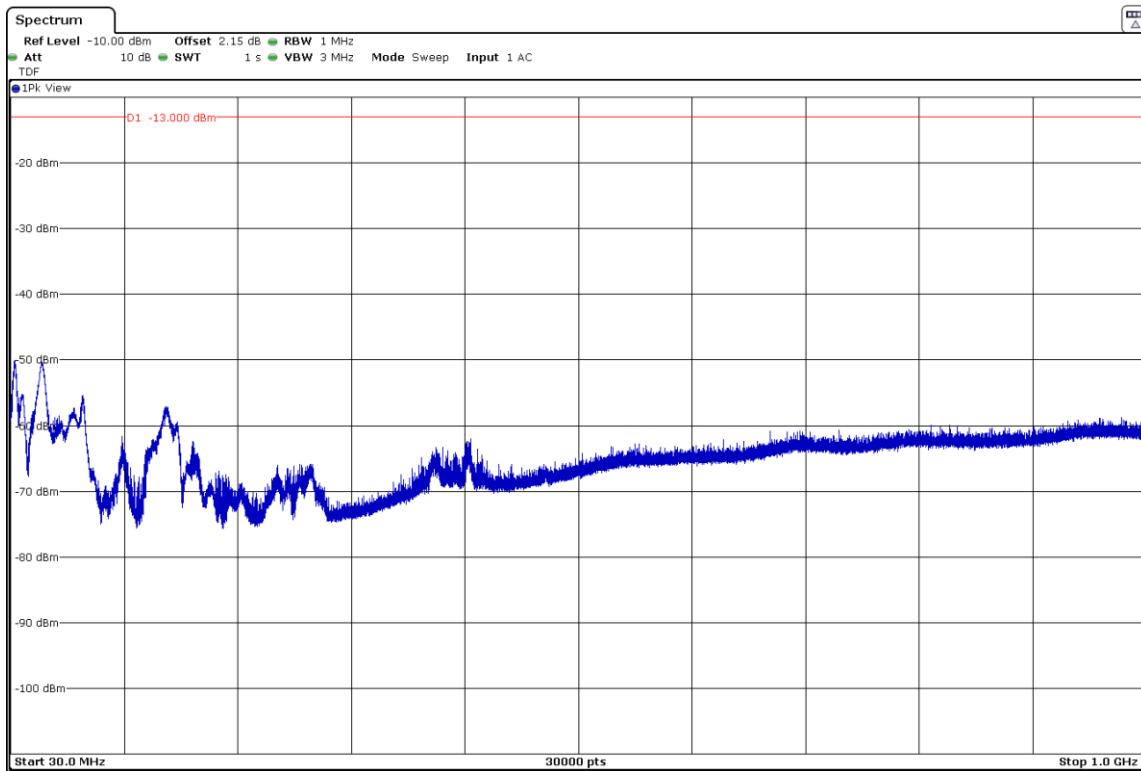
Verdict: PASS

Measurement uncertainty (dB)	<±2.07 for f < 1GHz <±4.88 for f ≥ 1 GHz up to 18 GHz <±3.31 for f ≥ 18 GHz up to 26 GHz
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FREQUENCY RANGE 30 MHz - 1 GHz

HSUPA MODULATION

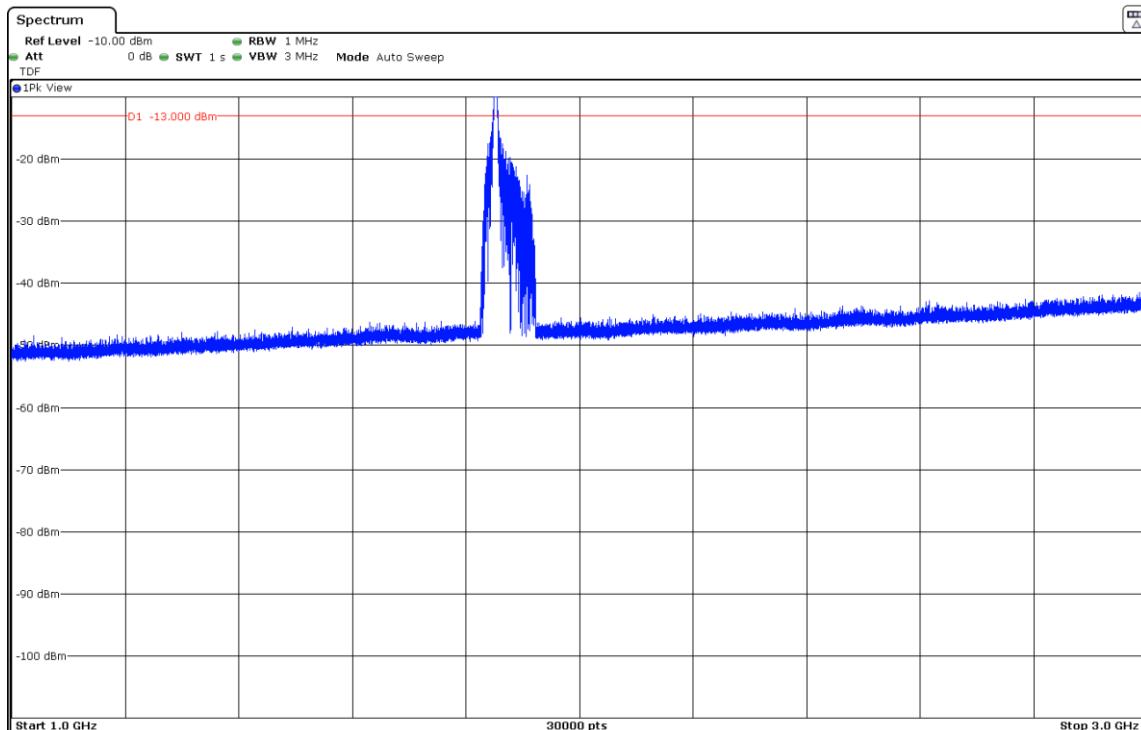
This plot is valid for the Lowest, Middle and Highest Channels:



FREQUENCY RANGE 1 - 3 GHz

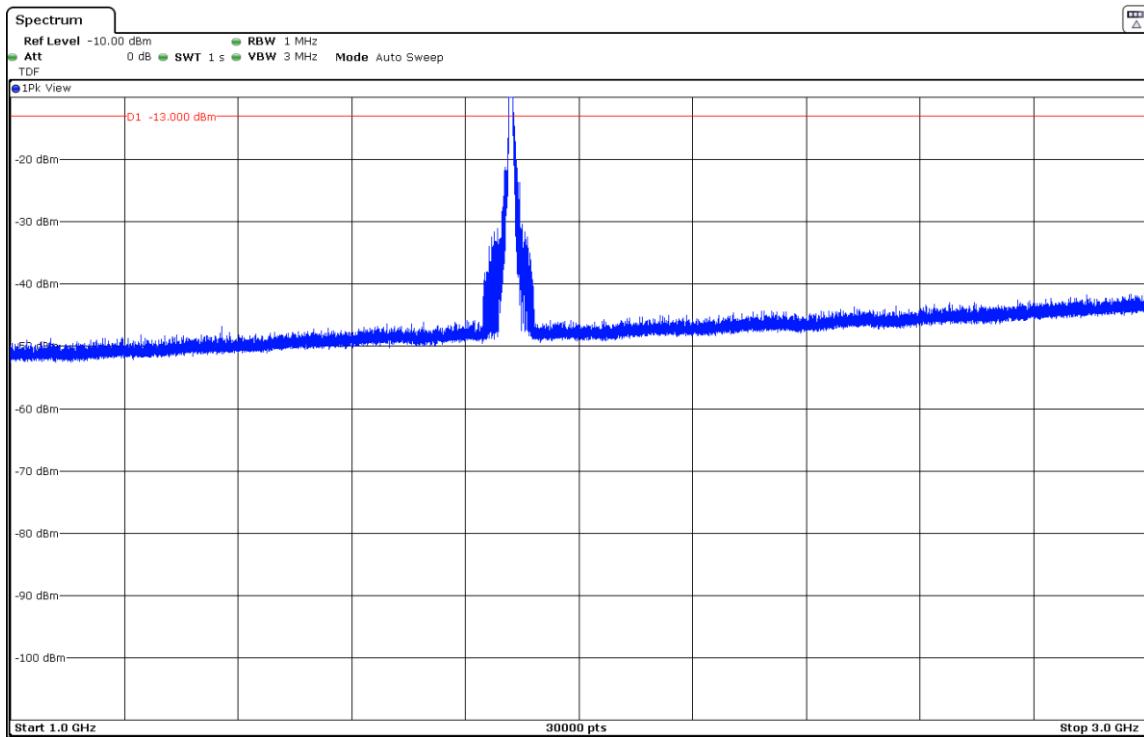
HSUPA MODULATION

- Lowest Channel:



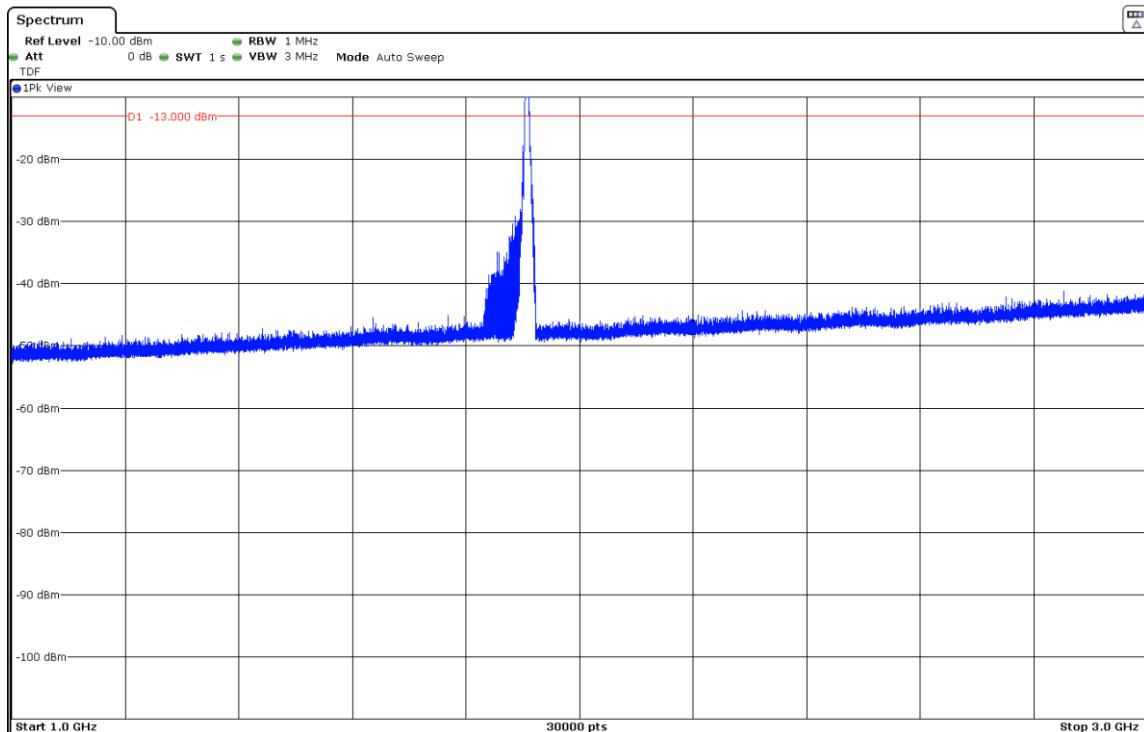
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

- Highest Channel:

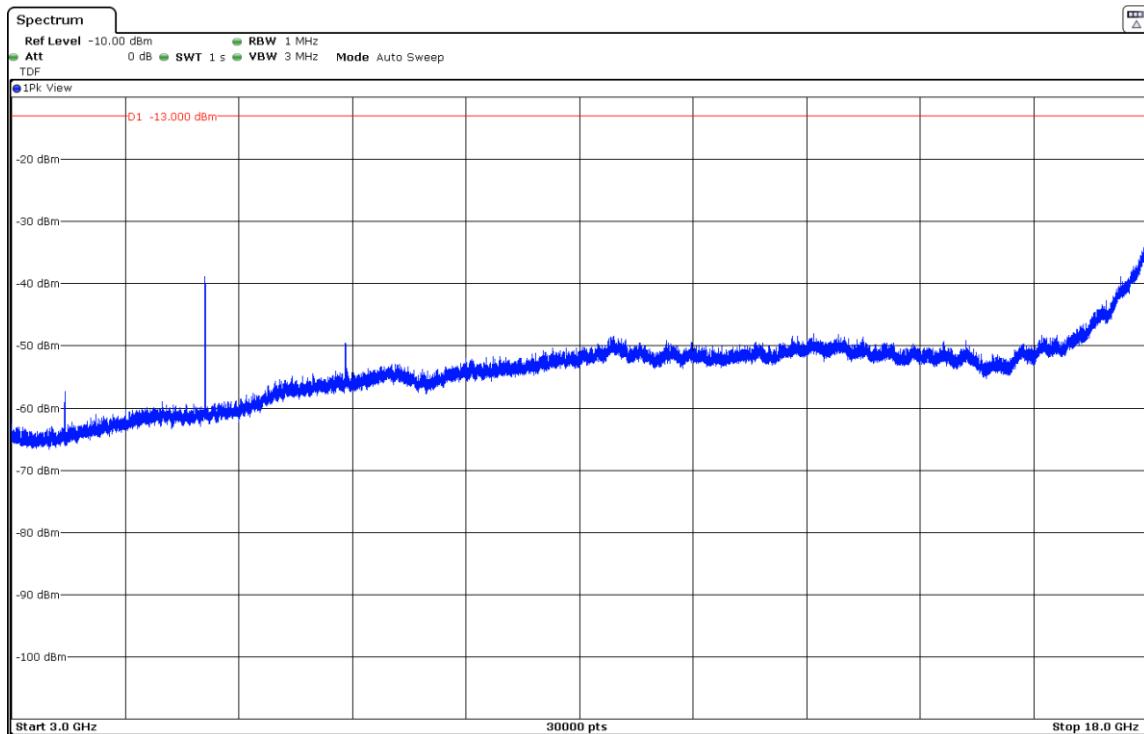


The peak above the limit is the carrier frequency.

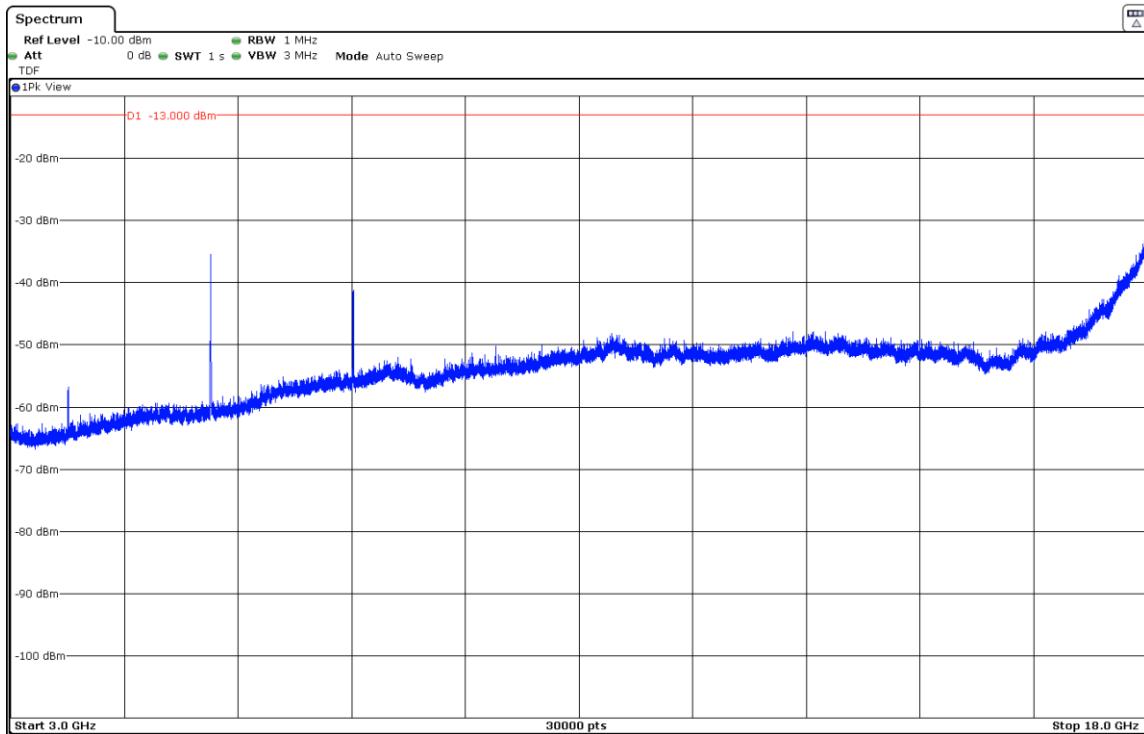
FREQUENCY RANGE 3 - 18 GHz

HSUPA MODULATION

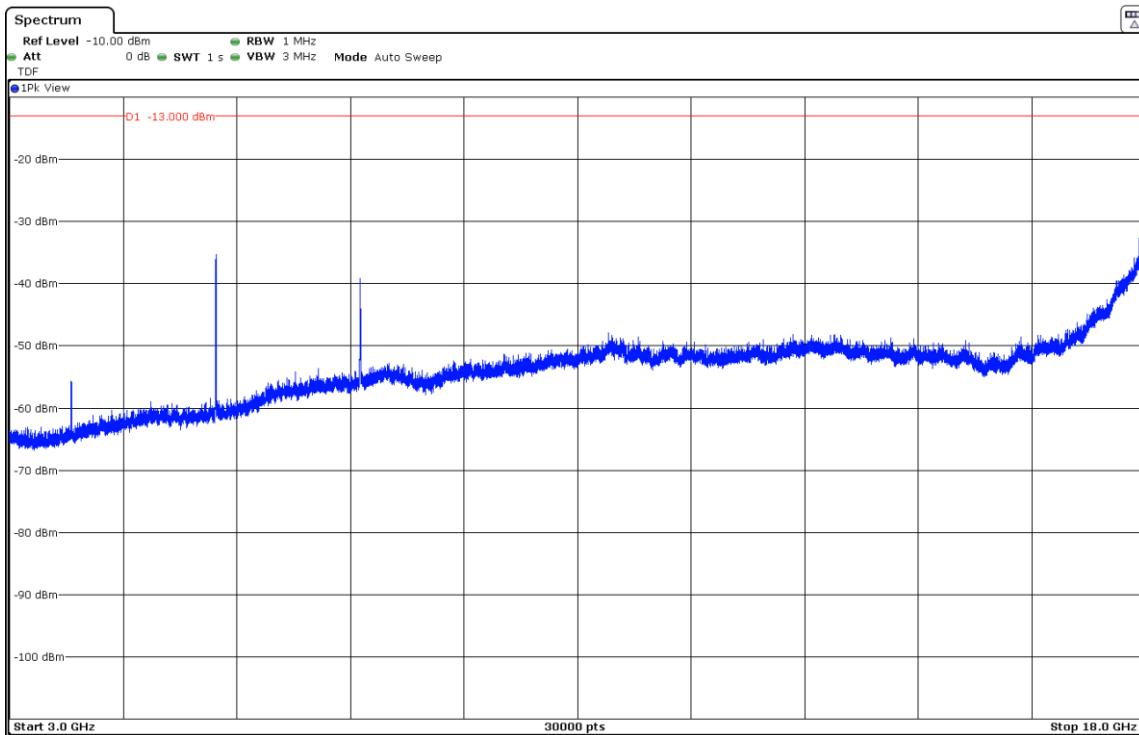
- Lowest Channel:



- Middle Channel:



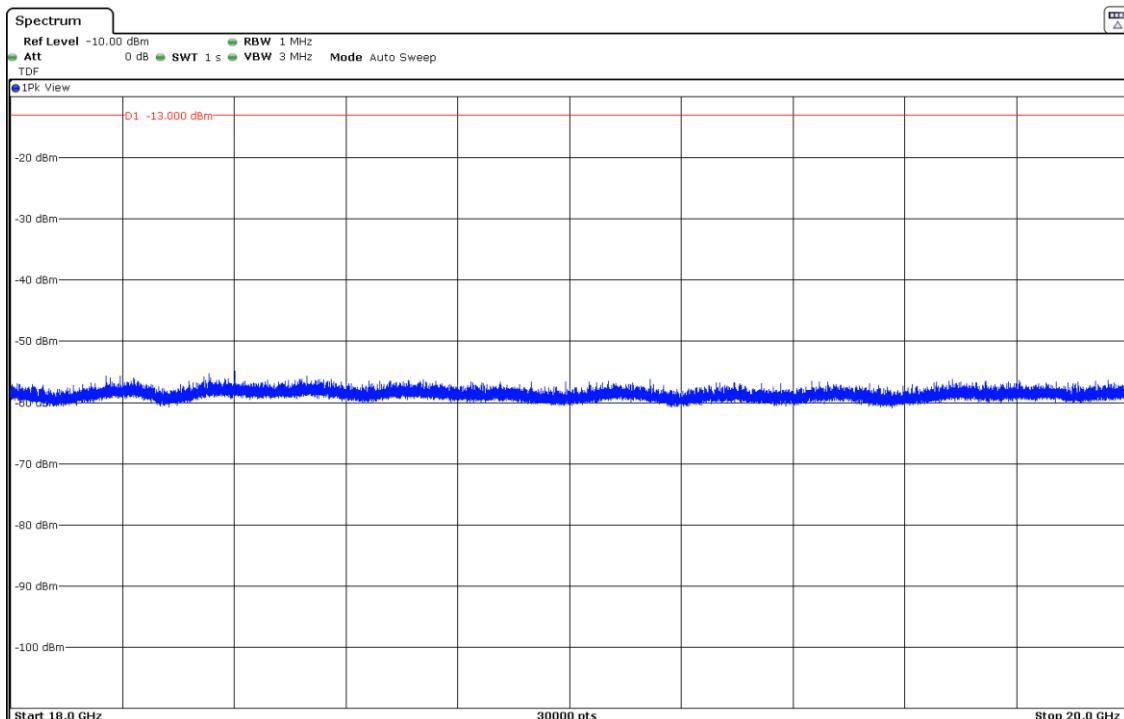
- Highest Channel:



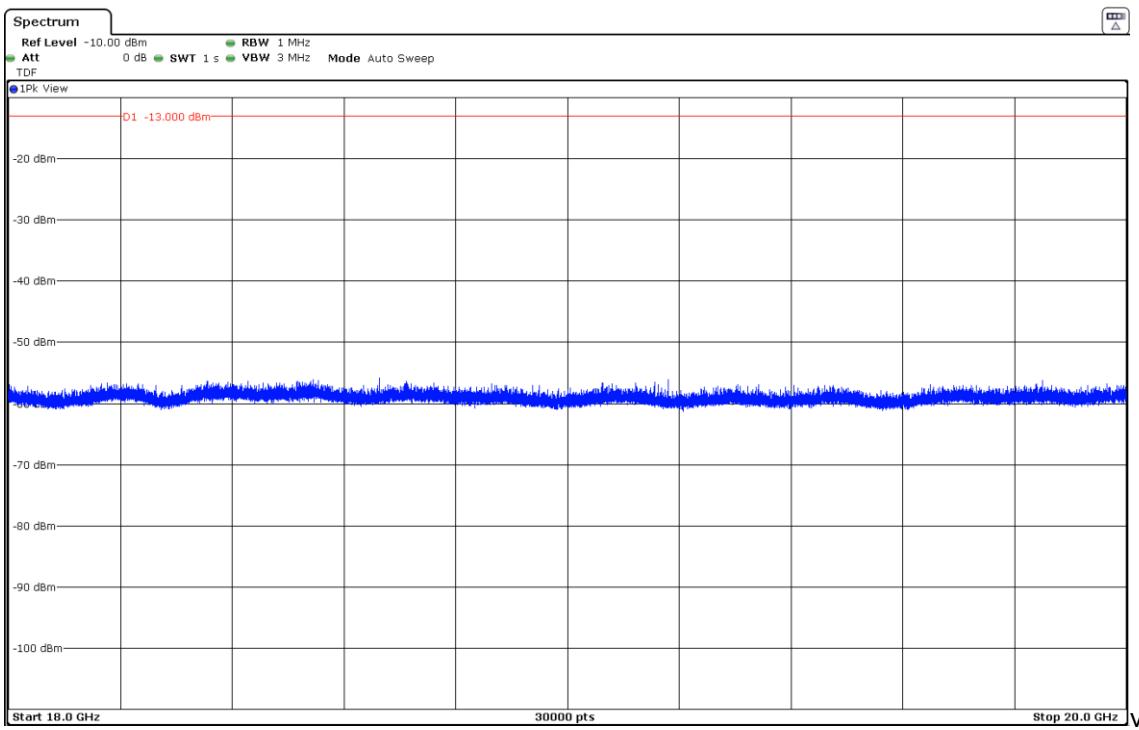
FREQUENCY RANGE 18 - 20 GHZ

HSUPA MODULATION

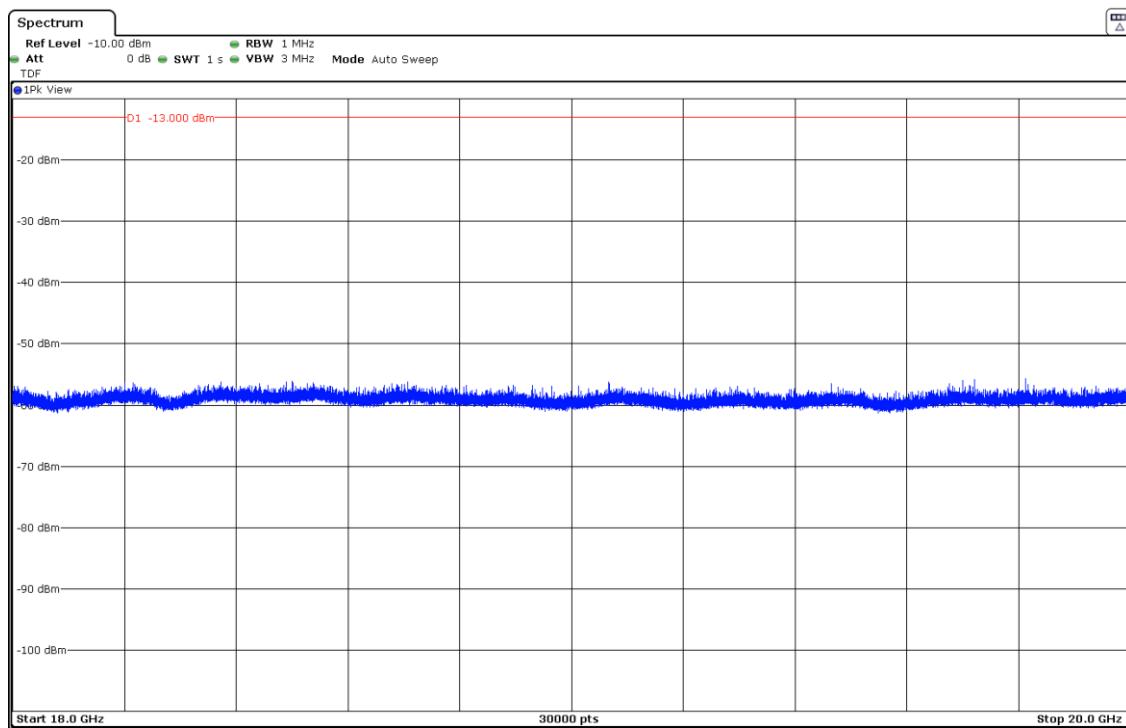
- Lowest Channel:



- Middle Channel:



- Highest Channel:



LTE Band 25:

QPSK and 16QAM Modulations:

A preliminary scan determined the QPSK modulation, BW=20 MHz, RB=1, Offset=0 as the worst case.

- Lowest Channel:

Frequency range 30 MHz - 1 GHz

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

Frequency range 1 - 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)
7440.25	-42.71	Vertical	-38.18	4.06	10.59	-31.65

Frequency range 18 - 20 GHz

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

- Middle Channel:

Frequency range 30 MHz - 1 GHz

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

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)
5620.75	-39.89	Vertical	-40.73	3.40	12.84	-31.29
7494.25	-45.87	Vertical	-38.53	4.09	10.70	-31.92

Frequency range 18 - 20 GHz

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

- Highest Channel:

Frequency range 30 MHz - 1 GHz

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

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)
7584.25	-45.61	Vertical	-38.08	4.23	10.65	-31.66

Frequency range 18 - 20 GHz

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

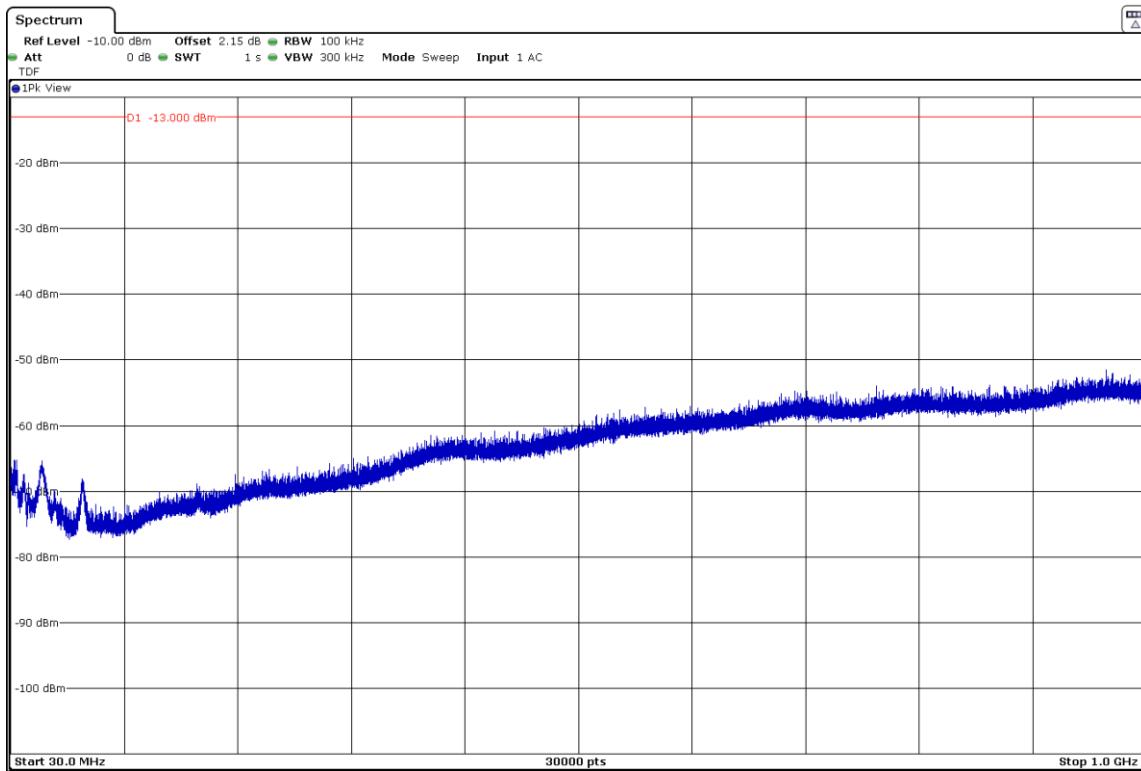
Measurement uncertainty (dB)	<±2.07 for f < 1GHz <±4.88 for f ≥ 1 GHz up to 18 GHz <±3.31 for f ≥ 18 GHz up to 26 GHz
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Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

QPSK MODULATION

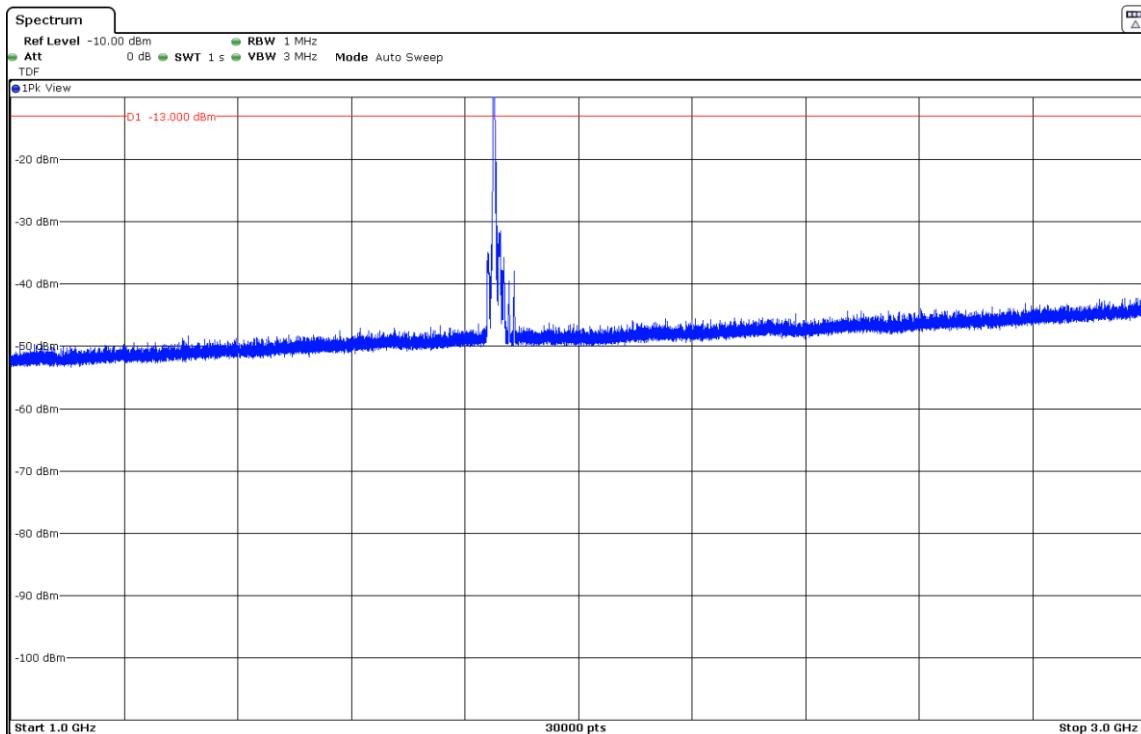
This plot is valid for the Lowest, Middle and Highest Channels:



FREQUENCY RANGE 1 - 3 GHz

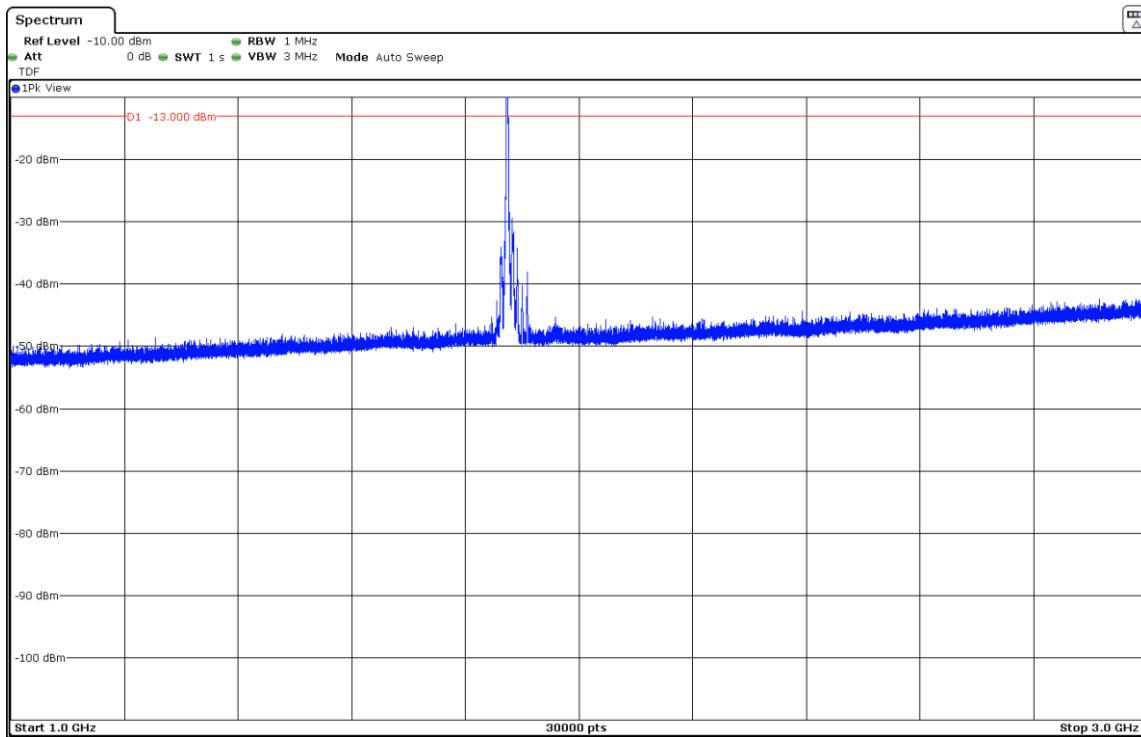
QPSK MODULATION

- Lowest Channel:



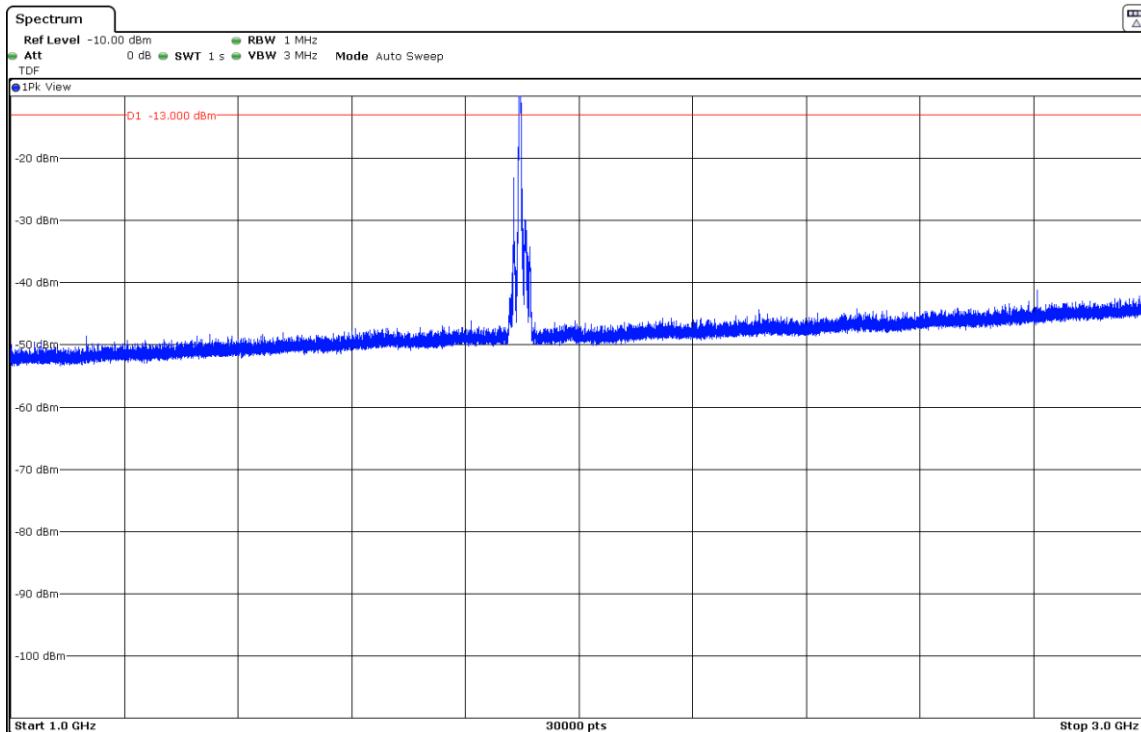
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

- Highest Channel:

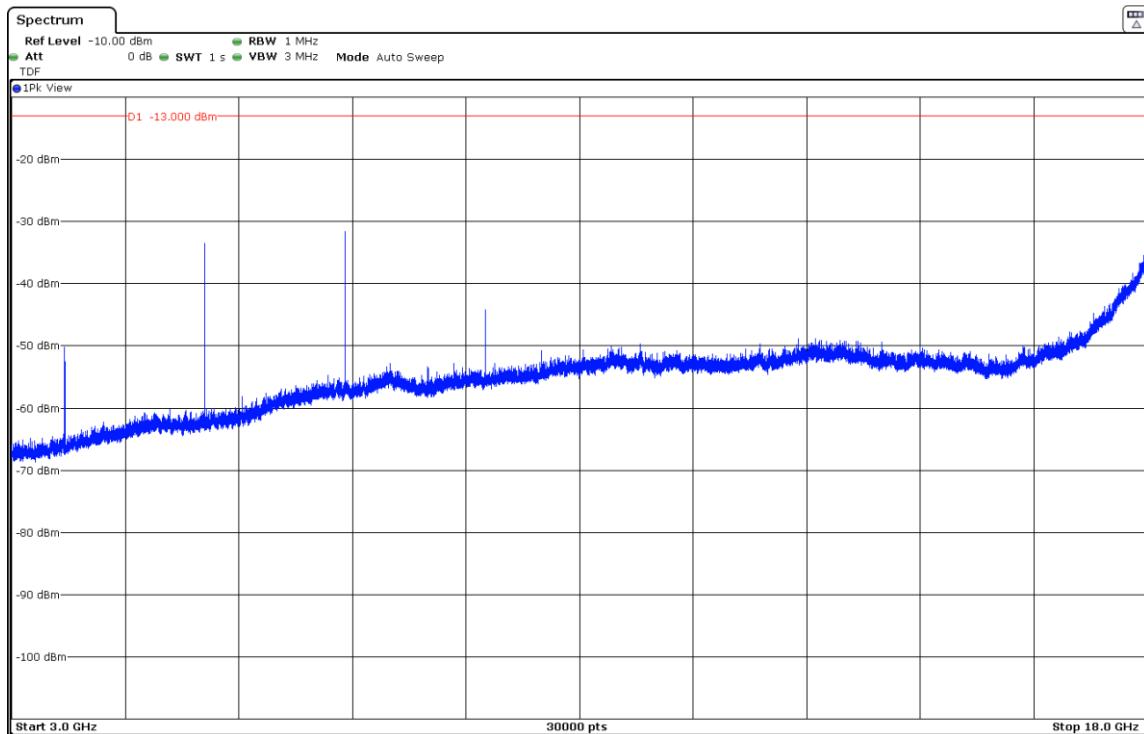


The peak above the limit is the carrier frequency.

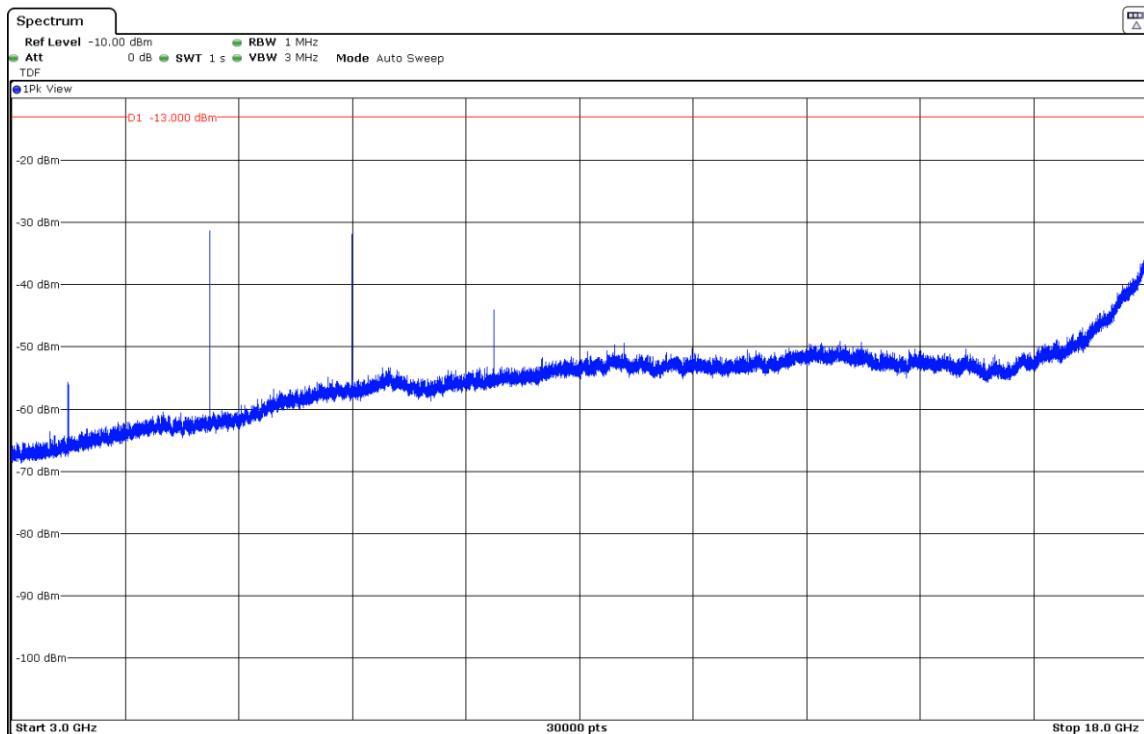
FREQUENCY RANGE 3 - 18 GHz

QPSK MODULATION

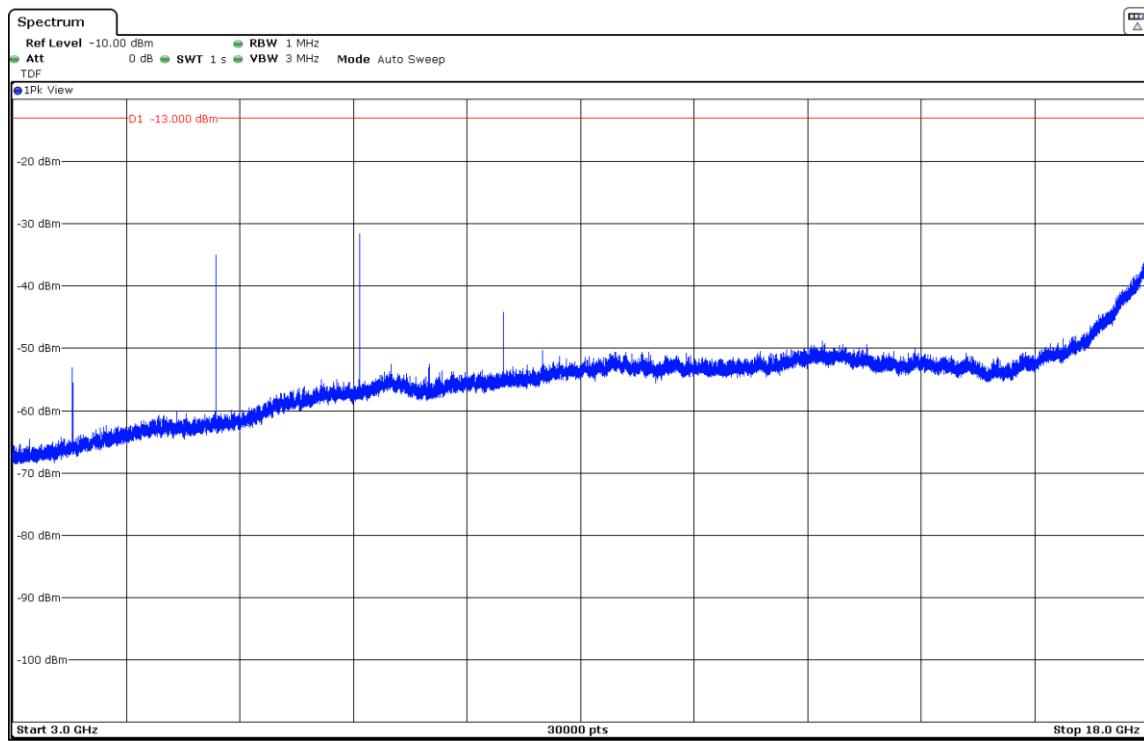
- Lowest Channel:



- Middle Channel:



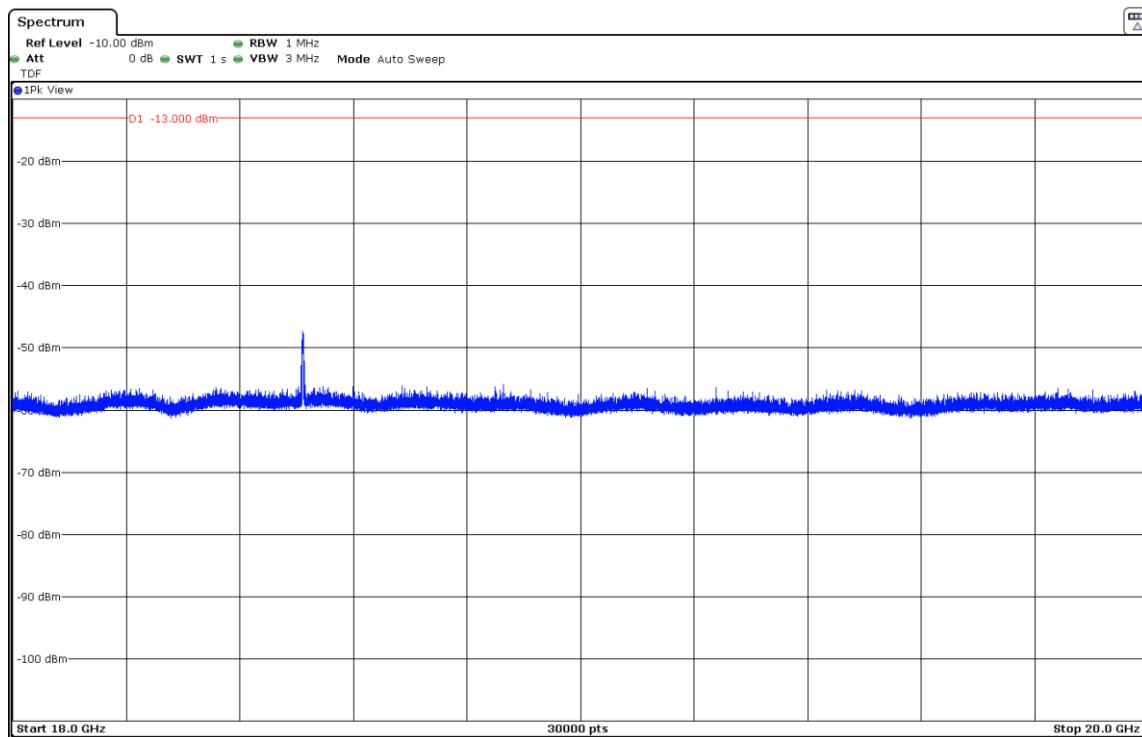
- Highest Channel:



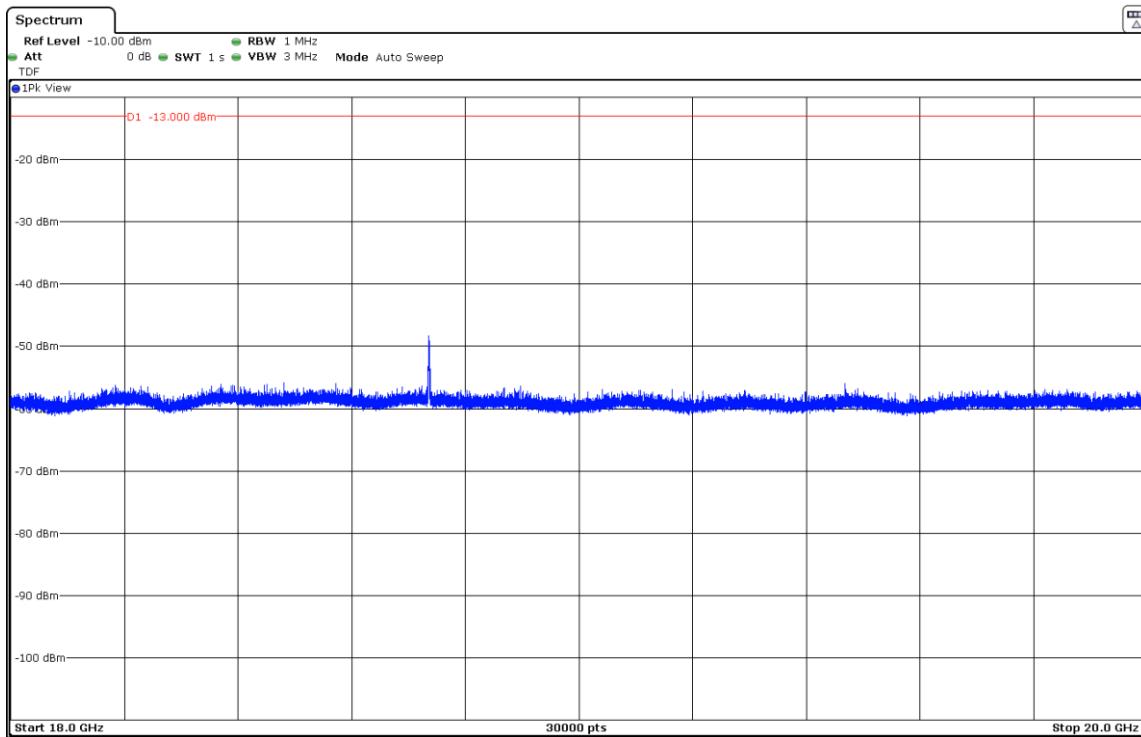
FREQUENCY RANGE 18 - 20 GHz

QPSK MODULATION

- Lowest Channel:



- Middle Channel:



- Highest Channel:

