

FCC LISTED, REGISTRATION
NUMBER: 720267

Test report No:

IC LISTED REGISTRATION
NUMBER IC 4621A-2

NIE: 50716RRF.003A1

Test report (Modification 1) REFERENCE STANDARD: USA FCC Part 22 & Part 24 CANADA IC RSS-132, RSS-133

Identificación del objeto ensayado.....: Identification of item tested	Cellular Module
Marca Trademark	TEIT
Modelo y/o referencia tipo Model and /or type reference	HE922-3GR
Other identification of the product	FCC ID: RI7HE9223GR IC: 5131A-HE9223GR
Final HW version	CS1772b-A
Final SW version	SF_3GR_MAINT_01.1637.02_EB01_IOTG_217101_274675 (MR1.1)
IMEI TAC	35986007
Características Features	Cellular (2G/3G), Connectivity (Wifi, BT & GNSS)
Solicitante Applicant	TELIT COMMUNICATIONS S.P.A. Via Stazione di Prosecco n. 5/B 34010 Sgornico (TS) - ITALY
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 22 10-1-15 Edition. USA FCC Part 24 10-1-15 Edition. CANADA IC RSS-132 Issue 3, Jan. 2013. CANADA IC RSS-133 Issue 6, Jan. 2013. Measurement Guidance 971168 D01 v02r02 for certification of Licensed Digital Transmitters. ANSI/TIA-603-D (2010). ANSI C63.26 (2015).
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) Approved by (name / position & signature)	A. Llamas RF Lab. Manager
Fecha de realización Date of issue	2016-12-13
Formato de informe No.: Report template No	FDT11_18

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Competences and guarantees

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

AT4 wireless is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621A-1.

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

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of AT4 wireless.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

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

Usage of samples

Samples undergoing test have been selected by: **the client**.

Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
50716/003	Cellular Module	HE922-3GR	359860070001973	2016-09-27
50716/008	Cradle with display	---	1742B 10 9000257	2016-09-27
50431/005	GPS antenna	---	---	2016-06-16
50431/006	Cellular antenna	---	---	2016-06-16
50716/016	BT+WiFi antenna	---	---	2016-09-27
50716/019	DC power supply cable	---	---	2016-09-27

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

Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
50716/003	Cellular Module	HE922-3GR	359860070001973	2016-09-27
50716/008	Cradle with display	---	1742B 10 9000257	2016-09-27
50716/019	DC power supply cable	---	---	2016-09-27

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

Test sample description

The test sample consists of a Module integrating Intel Sofia-3R chipset solution with cellular (2G+3G), BT, Wifi and GNSS features.

Identification of the client

TELIT AUTOMOTIVE SOLUTIONS
5, Esplanade Anton Philips
14460 COLOMBELLES FRANCE

Testing period

The performed test started on 2016-09-29 and finished on 2016-10-27.

The tests have been performed at AT4 wireless.

Environmental conditions

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Modifications to the reference test report

It was introduced the following modifications in respect to the test report number 50716RRF.003 related with the same samples, in the next clauses and sub-clauses:

Clauses / Sub-clauses	Modification	Justification
Remarks and comments	Note regarding measured radiated spurious emissions in co-location is added.	FCC specification requirement
Testing verdicts tables	Notes are added	FCC specification requirement

This modification test report cancels and replaces the test report 50716RRF.003.

Remarks and comments

1: Used instrumentation.

Conducted Measurements

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

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2014/03	2017/03
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2013/11	2016/11
5.	Broadband Horn antenna 18-40 GHz Schwarbeck BBHA 9170	2014/03	2017/03
6.	EMI Test Receiver R&S ESU 40	2016/03	2018/03
7.	Spectrum analyser Rohde & Schwarz FSW50	2015/12	2017/12
8.	RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2016/04	2017/04
9.	RF pre-amplifier 1-18 GHz BONN ELEKTRONIK BLMA 0118-3A	2016/02	2018/02
10.	RF pre-amplifier 18-40 GHz BONN ELEKTRONIK BLMA 1840-1M	2015/12	2017/12
11.	Universal Radio communication Tester R&S CMW500	2014/07	2017/07

2. GSM mode has not been tested to prove USA FCC Part 22 and Part 24 and Canada IC RSS-132 and RSS-133 compliance because the modulation scheme and the power maximum levels are the same as for GPRS mode.

Taking into account the above comments, testing in GSM mode is redundant for FCC Parts 22 and Part 24 and IC RSS-132 and RSS-133 as it is the same as GPRS mode. GPRS mode has been tested as indicated on the present test report.

3. HSDPA modulation mode has not been tested to prove USA FCC Part 22 and Part 24 and Canada IC RSS-132 and RSS-133 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 Parts 22 and Part 24 and IC RSS-132 and RSS-133 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.

4. Radiated emissions were not affected when operating simultaneously with WLAN or Bluetooth transmitter.

Testing verdicts

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

FCC PART 22/IC RSS-132 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 22.913/RSS-132 Clause 5.4: RF output power		P		
Clause 2.1047/RSS-132 Clause 5.2: Modulation characteristics		P		
Clause 22.355/RSS-132 Clause 5.3: Frequency stability		P		
Clause 2.1049: Occupied Bandwidth		P		
Clause 22.917/RSS-132 Clause 5.5: Spurious emissions at antenna terminals		P		
Clause 22.917/RSS-132 Clause 5.5: Radiated emissions		P ⁴		

4: see section "Remarks and comments"

FCC PART 24/IC RSS-133 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 24.232/RSS-133 Clause 6.4: RF output power		P		
Clause 2.1047/RSS-133 Clause 6.2: Modulation characteristics		P		
Clause 24.235/RSS-133 Clause 6.3: Frequency stability		P		
Clause 2.1049: Occupied Bandwidth		P		
Clause 24.238/RSS-133 Clause 6.5: Spurious emissions at antenna terminals		P		
Clause 24.238/RSS-133 Clause 6.5: Radiated emissions		P ⁴		

4: see section "Remarks and comments"

Appendix A – Test result for FCC Part 22/IC RSS-132

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TEST RESULTS FOR FCC PART 22 AND IC RSS-132

TEST CONDITIONS

Power supply (V):

$V_{\text{nominal}} = 3.8 \text{ Vdc}$

$V_{\text{max}} = 4.37 \text{ Vdc}$

$V_{\text{min}} = 3.23 \text{ Vdc}$

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

Type of power supply = External DC Voltage

Type of antenna = External antenna (Vertical line, $\frac{1}{4}$ wave)

Antenna gain = +2.14 dBi.

TEST FREQUENCIES:

GPRS MODULATION

Lowest channel (128): 824.2 MHz

Middle channel (190): 836.6 MHz

Highest channel (251): 848.8 MHz

WCDMA AND HSUPA MODULATION

Lowest channel (4132): 826.4 MHz

Middle channel (4182): 836.4 MHz

Highest channel (4233): 846.6 MHz

RF Output Power

SPECIFICATION

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

RSS-132. Clause 5.4. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts (38.45 dBm E.I.R.P.).

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

METHOD

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMU200 and CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

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

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

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

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

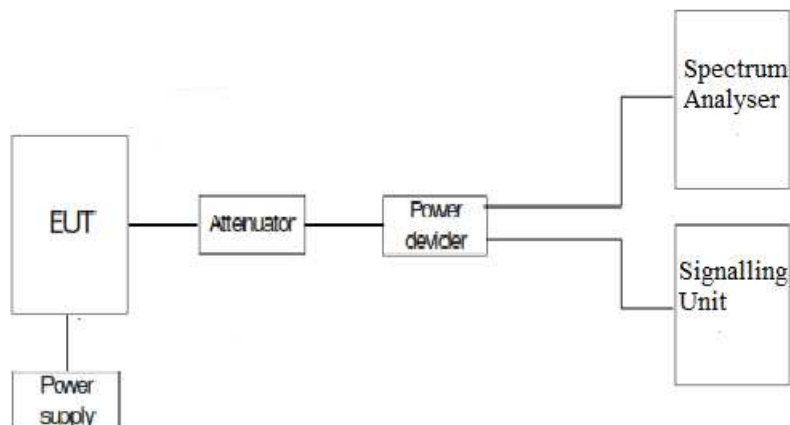
The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The measurement is performed for the highest power levels measured.

TEST SETUP

Conducted average power.



Peak-to-average power ratio (PAPR)



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

GPRS MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	32.12	32.02	32.45
Maximum declared antenna gain (dBi)	2.14	2.14	2.14
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	34.26	34.16	34.59
Maximum effective radiated power E.R.P. (dBm)	32.11	32.01	32.44
PAPR (dB)	0.80	0.83	0.40
Measurement uncertainty (dB)	±0.66		

Verdict: PASS

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	23.11	23.13	22.83
Maximum declared antenna gain (dBi)	2.14	2.14	2.14
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	25.25	25.27	24.97
Maximum effective radiated power E.R.P. (dBm)	23.10	23.12	22.82
PAPR (dB)	3.59	3.31	3.44
Measurement uncertainty (dB)	±0.66		

Verdict: PASS

HSUPA MODULATION

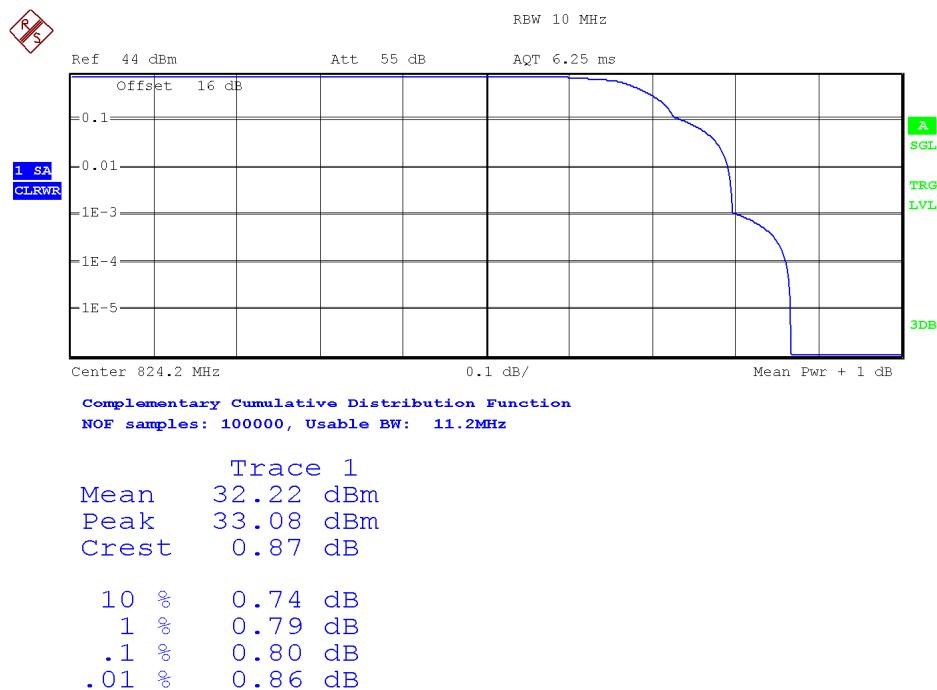
Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	22.59	22.72	22.54
Maximum declared antenna gain (dBi)	2.14	2.14	2.14
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	24.73	24.86	24.68
Maximum effective radiated power E.R.P. (dBm)	22.58	22.71	22.53
PAPR (dB)	3.59	3.30	3.46
Measurement uncertainty (dB)	±0.66		

Verdict: PASS

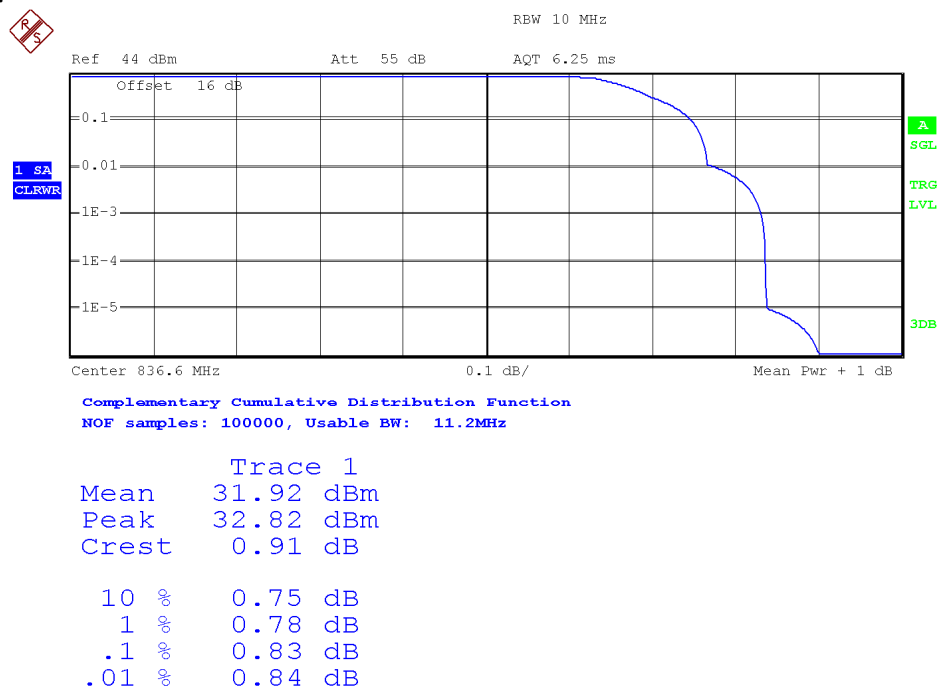
PEAK-TO-AVERAGE POWER RATIO (PAPR).

GPRS MODULATION

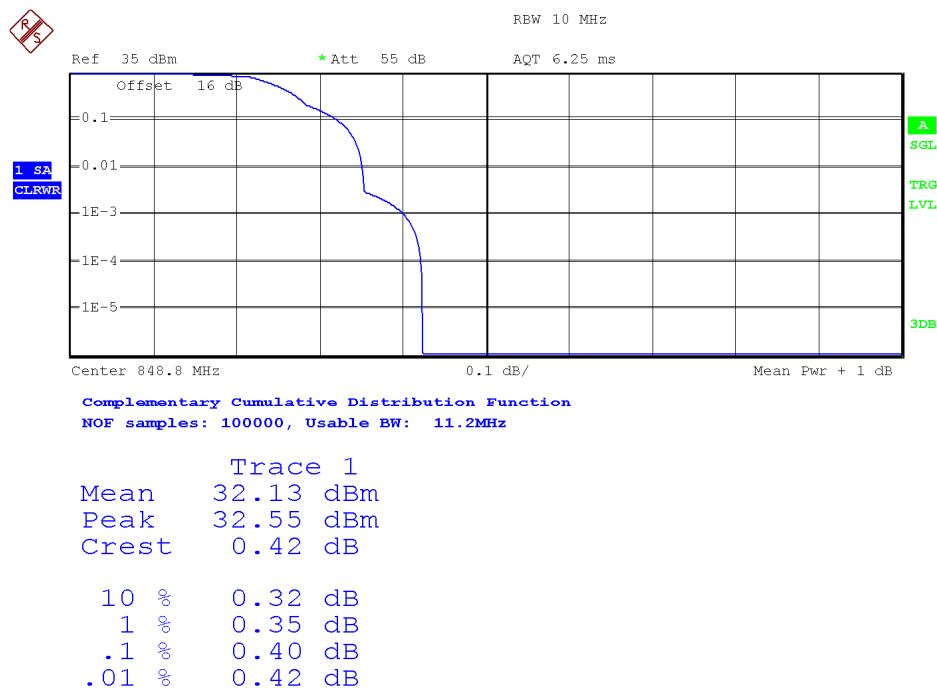
Channel Low:



Channel Middle:

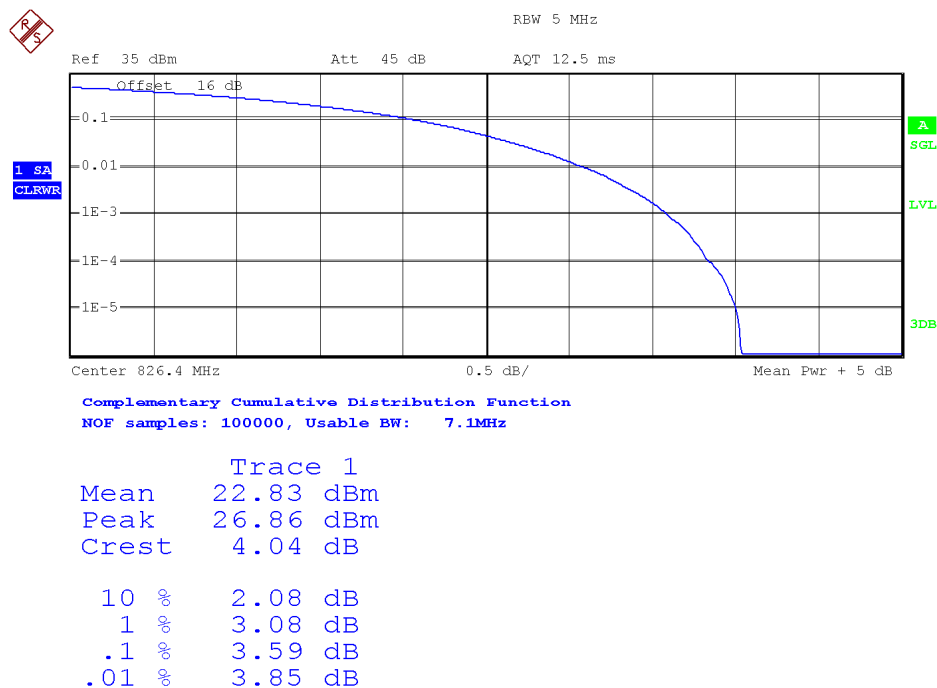


Channel High:

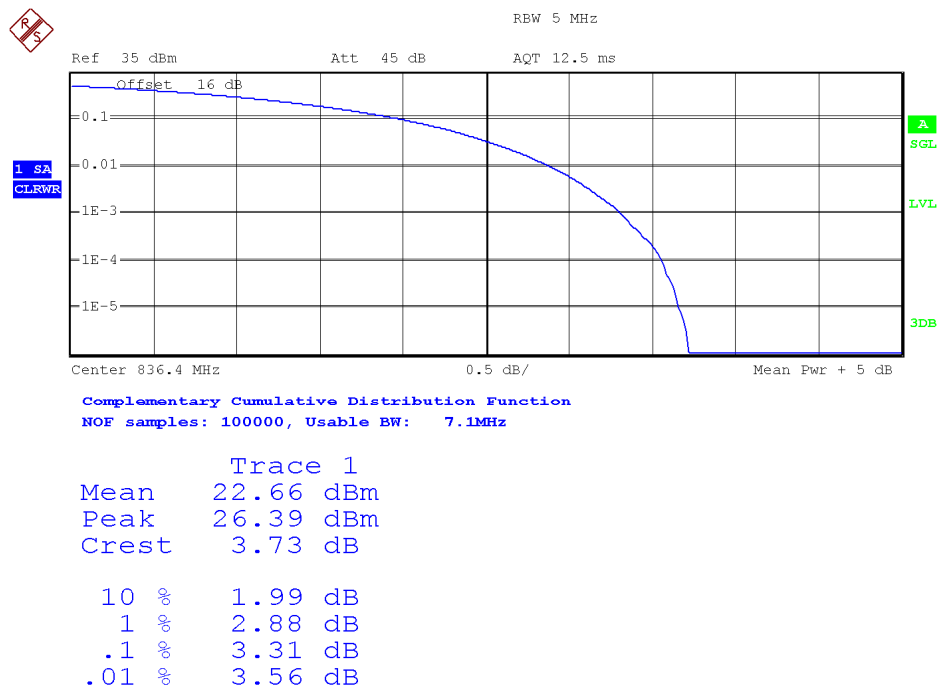


WCDMA MODULATION

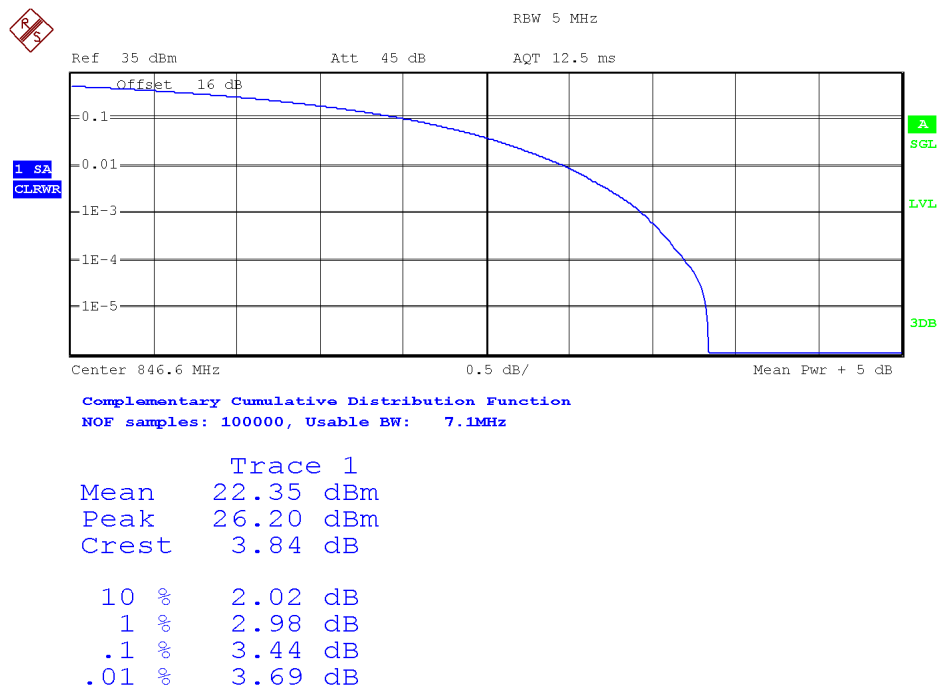
Channel Low:



Channel Middle:

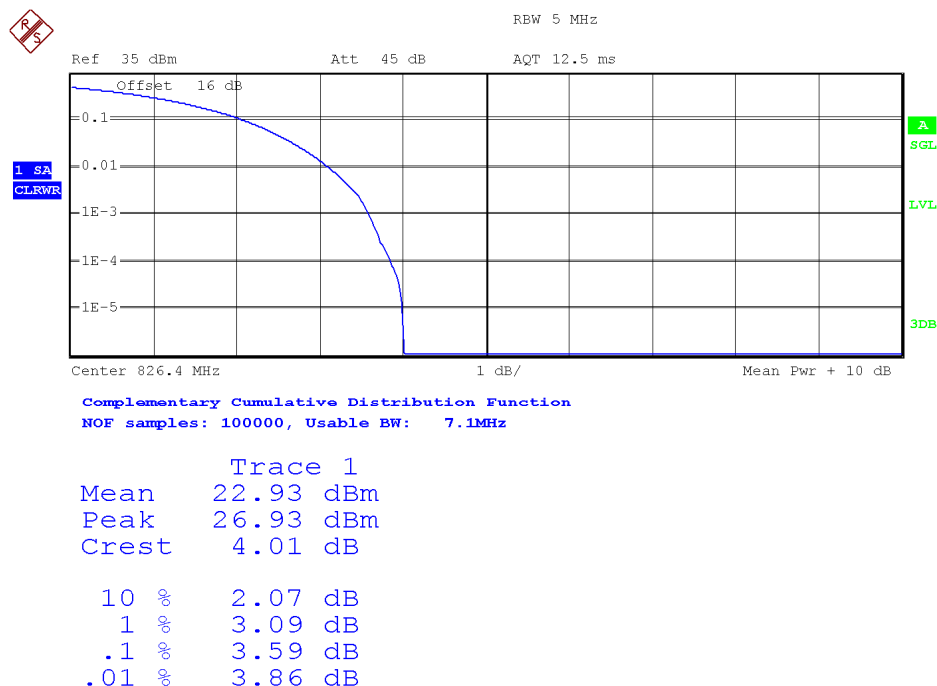


Channel High:

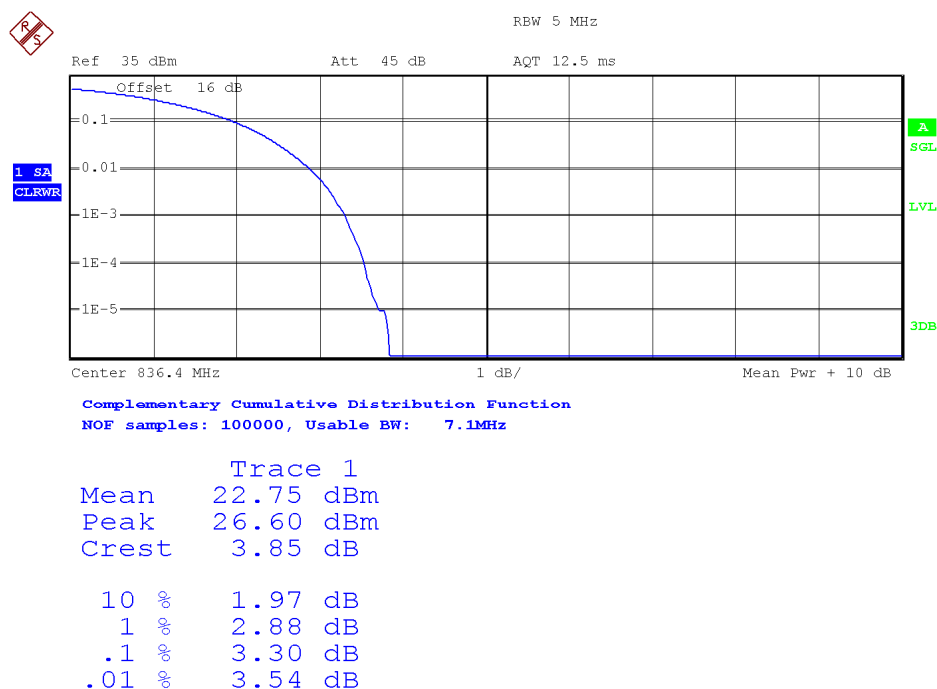


HSUPA MODULATION

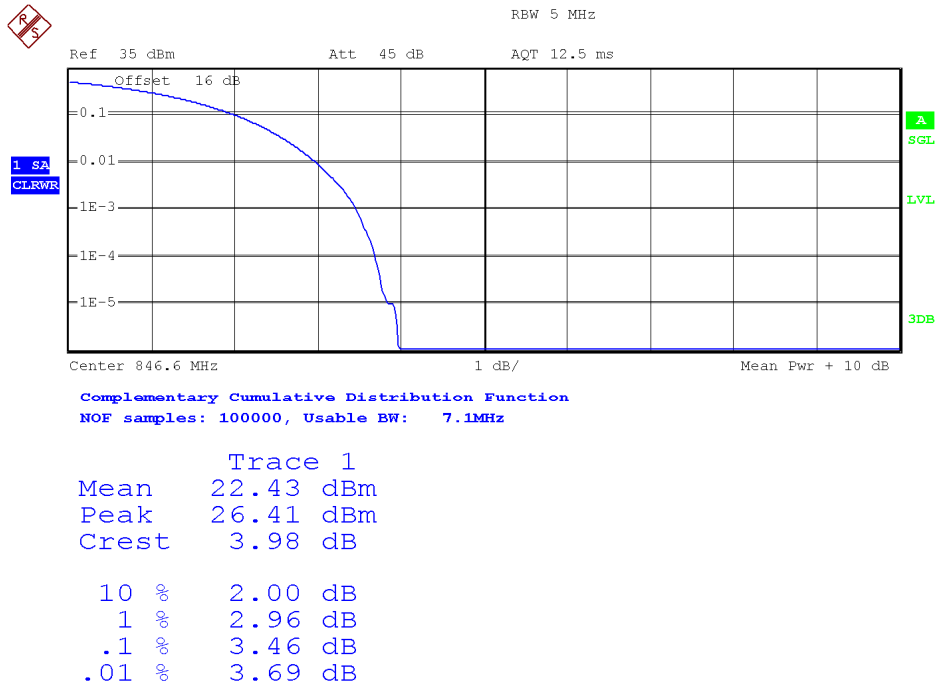
Channel Low:



Channel Middle:



Channel High:



Modulation Characteristics

SPECIFICATION

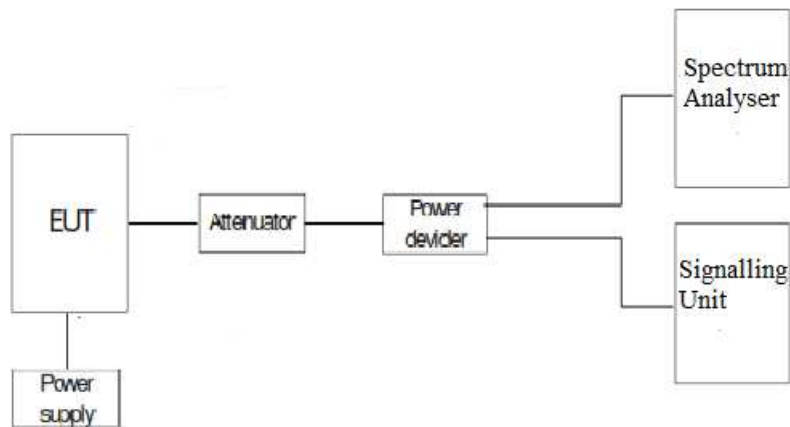
FCC §2.1047

RSS-132. Clause 5.2. Equipment certified under this standard shall use digital modulation.

METHOD

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

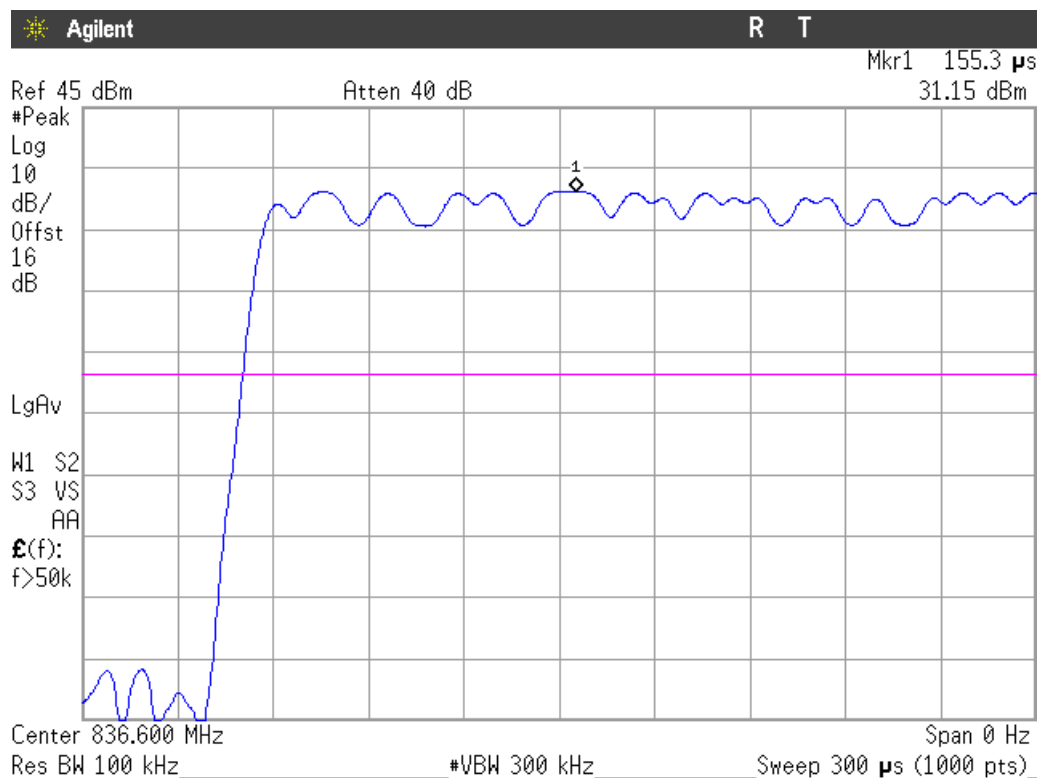
TEST SETUP



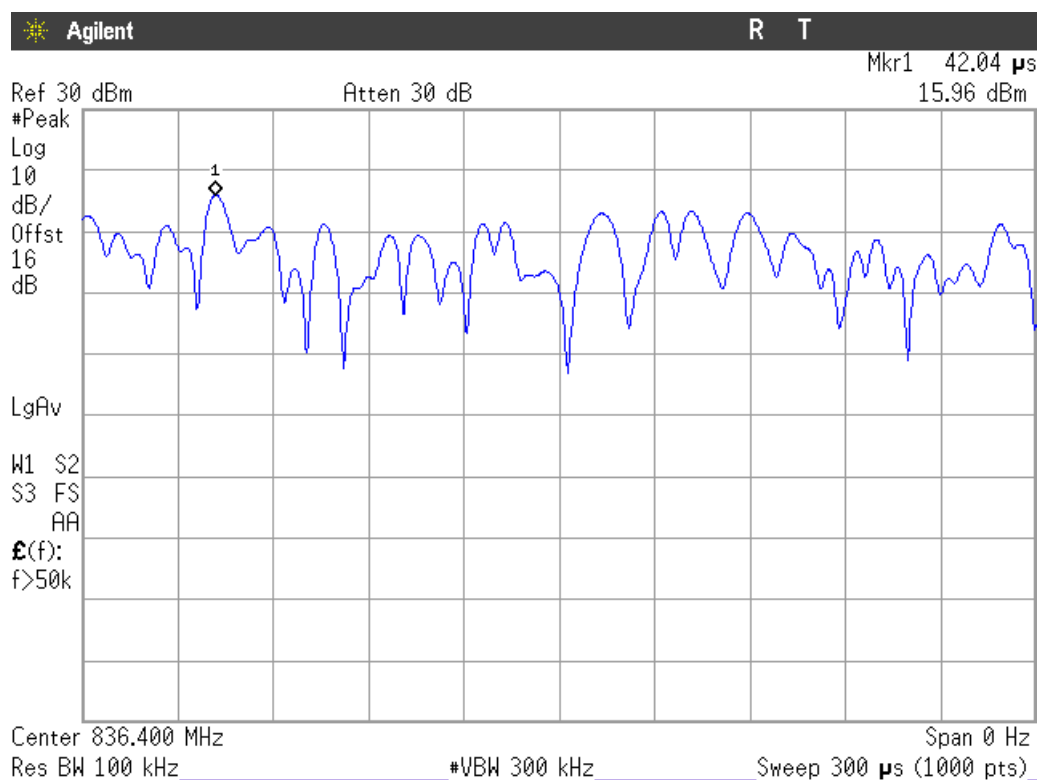
RESULTS

The following plot shows the modulation schemes in the EUT.

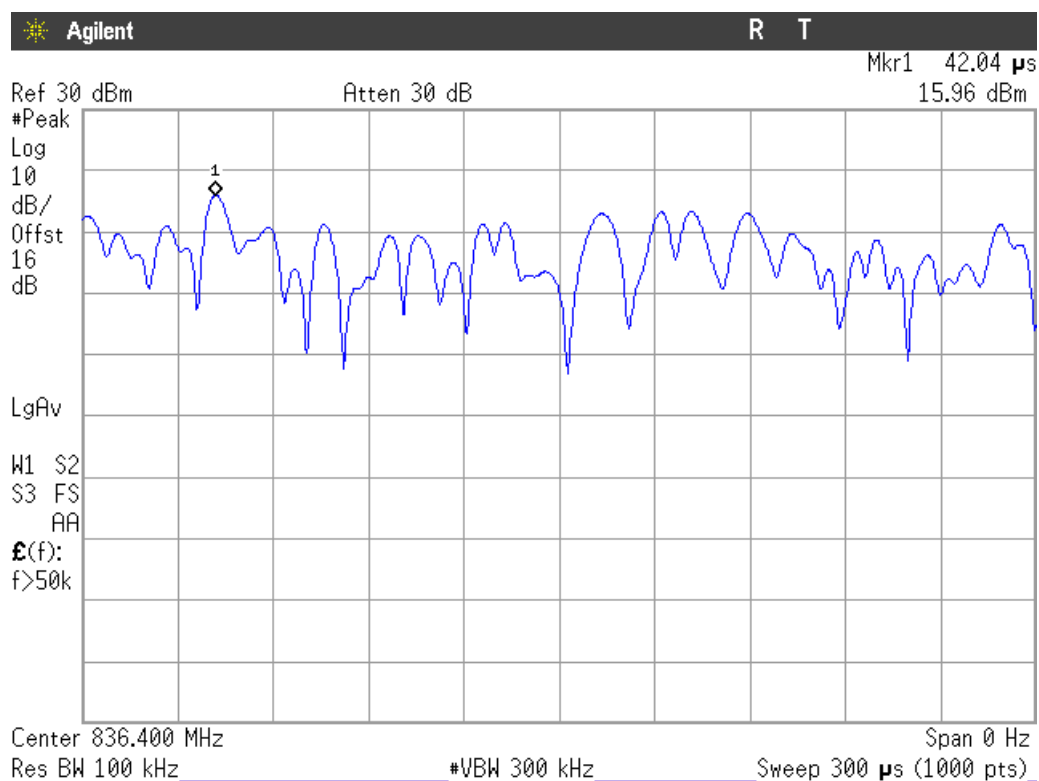
GPRS MODULATION



WCDMA MODULATION



HSUPA MODULATION



Frequency Stability

SPECIFICATION

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

RSS-132. Clause 5.3. The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

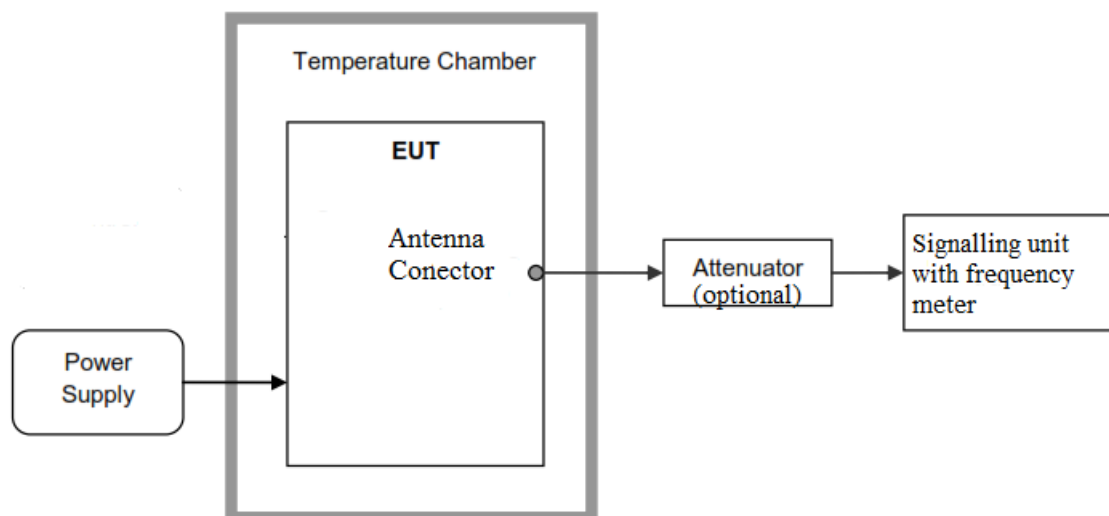
METHOD

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

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

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

TEST SETUP



RESULTS

Frequency stability over temperature variations.

GPRS MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	-22.41	-0.0268	-0.00000268
+40	-21.95	-0.0262	-0.00000262
+30	-12.04	-0.0144	-0.00000144
+20	-16.27	-0.0194	-0.00000194
+10	-8.91	-0.0107	-0.00000107
0	-13.27	-0.0159	-0.00000159
-10	-12.56	-0.0150	-0.00000150
-20	-16.89	-0.0202	-0.00000202
-30	-12.07	-0.0144	-0.00000144

WCDMA AND HSUPA MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	12.15	0.0145	0.00000145
+40	11.15	0.0133	0.00000133
+30	8.83	0.0106	0.00000106
+20	9.07	0.0108	0.00000108
+10	10.75	0.0129	0.00000129
0	-11.94	-0.0143	-0.00000143
-10	-5.18	-0.0062	-0.00000062
-20	19.73	0.0236	0.00000236
-30	13.29	0.0159	0.00000159

Frequency stability over voltage variations.

GPRS MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.37	-14.21	-0.0170	-0.00000170
Vmin	3.23	-18.98	-0.0227	-0.00000227

WCDMA AND HSUPA MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.37	-7.25	-0.0087	-0.00000087
Vmin	3.23	12.31	0.0147	0.00000147

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

Verdict: PASS

Occupied Bandwidth

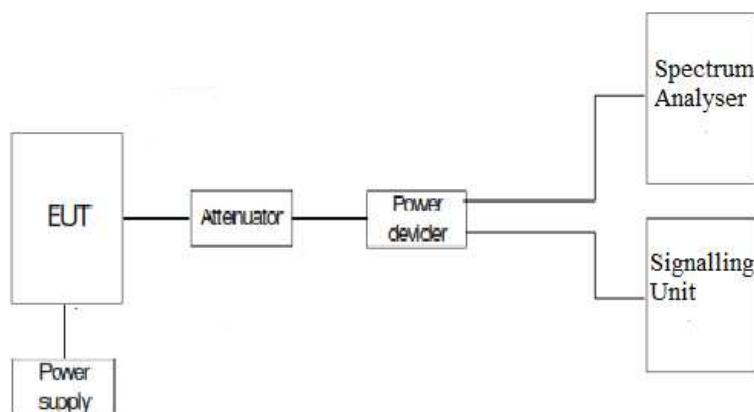
SPECIFICATION

FCC §2.1049

METHOD

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S R&S CMU200 or CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

TEST SETUP



RESULTS

GPRS MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	238.28	238.53	237.54
-26 dBc bandwidth (kHz)	310.59	314.66	311.34
Measurement uncertainty (kHz)	<±1.67		

WCDMA MODULATION

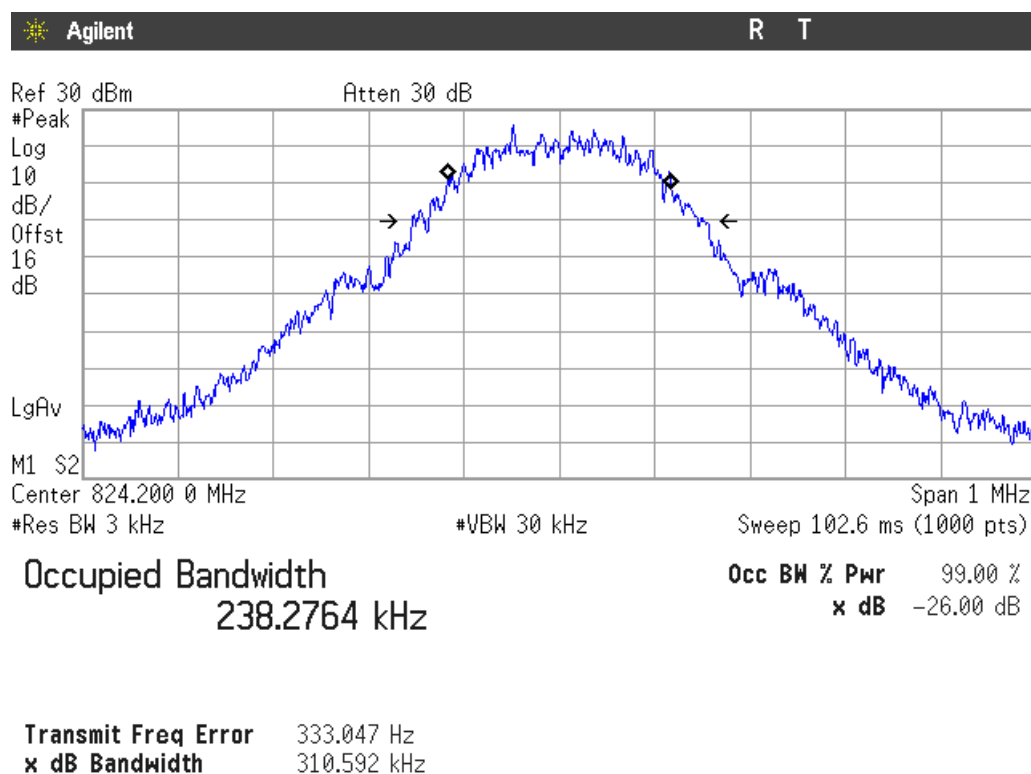
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4054.50	4056.20	4051.30
-26 dBc bandwidth (kHz)	4574.00	4590.00	4558.00
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

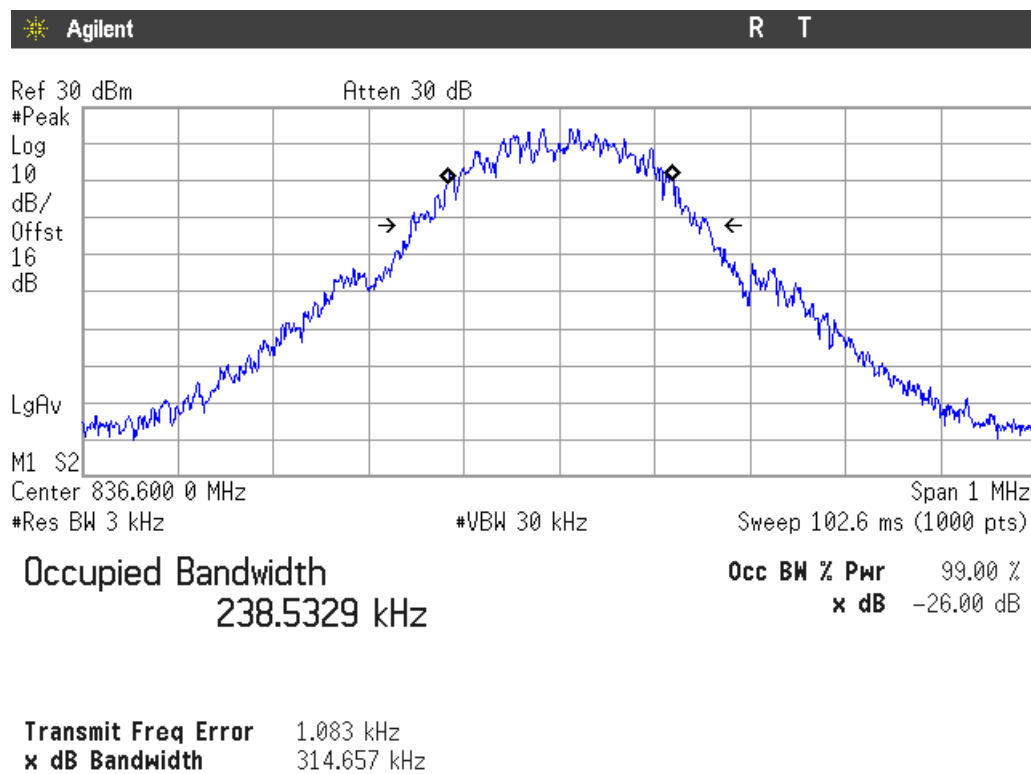
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4051.30	4056.60	4048.50
-26 dBc bandwidth (kHz)	4567.00	4593.00	4561.00
Measurement uncertainty (kHz)	<±16.67		

GPRS MODULATION

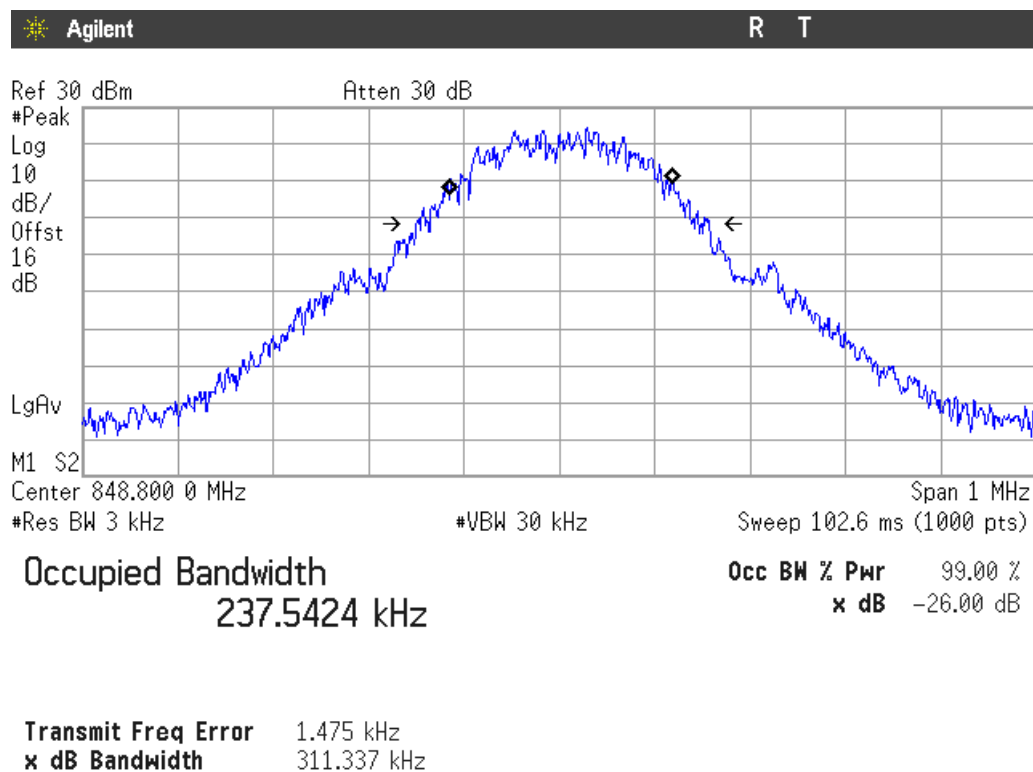
Lowest Channel



Middle Channel

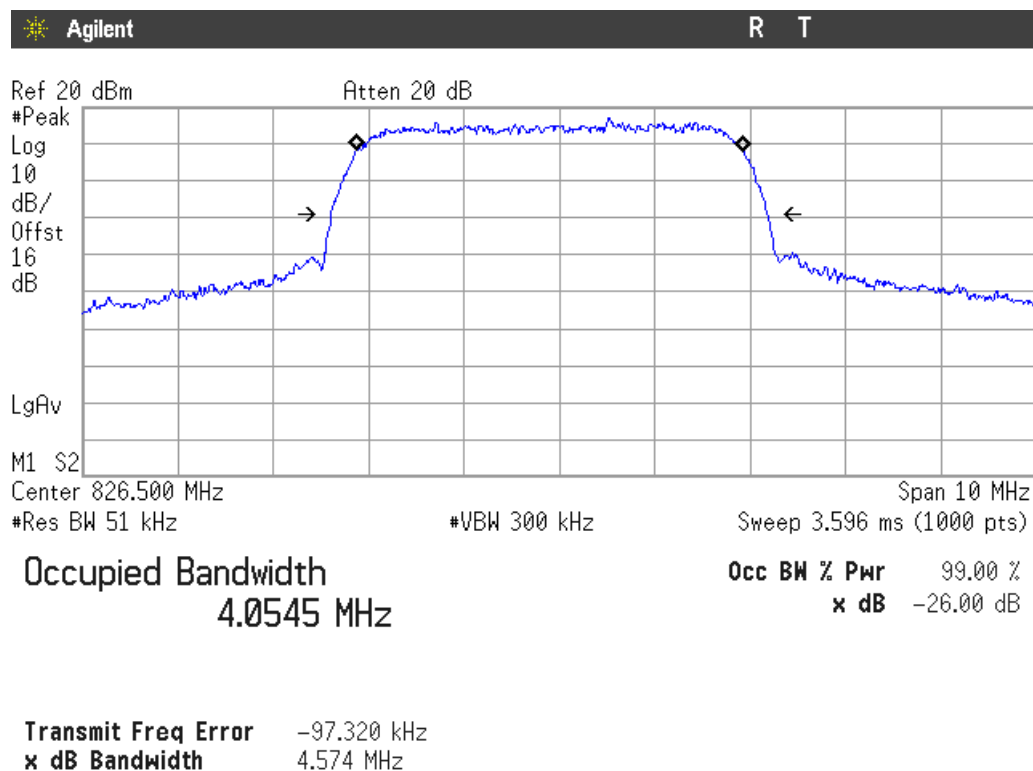


Highest Channel

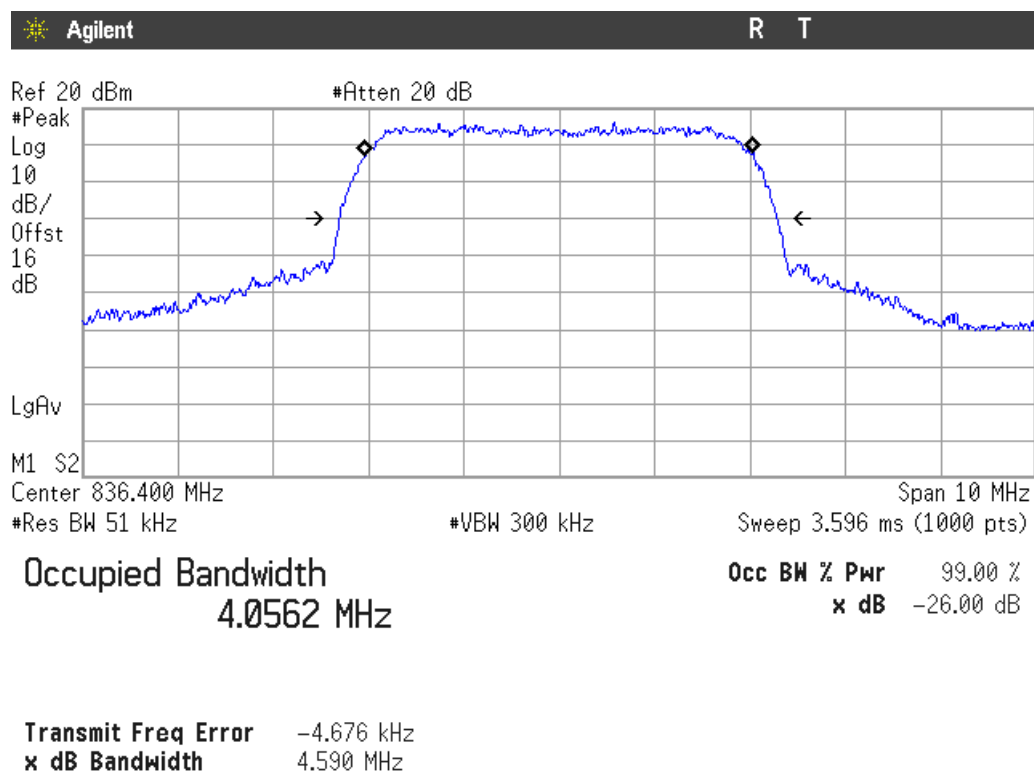


WCDMA MODULATION

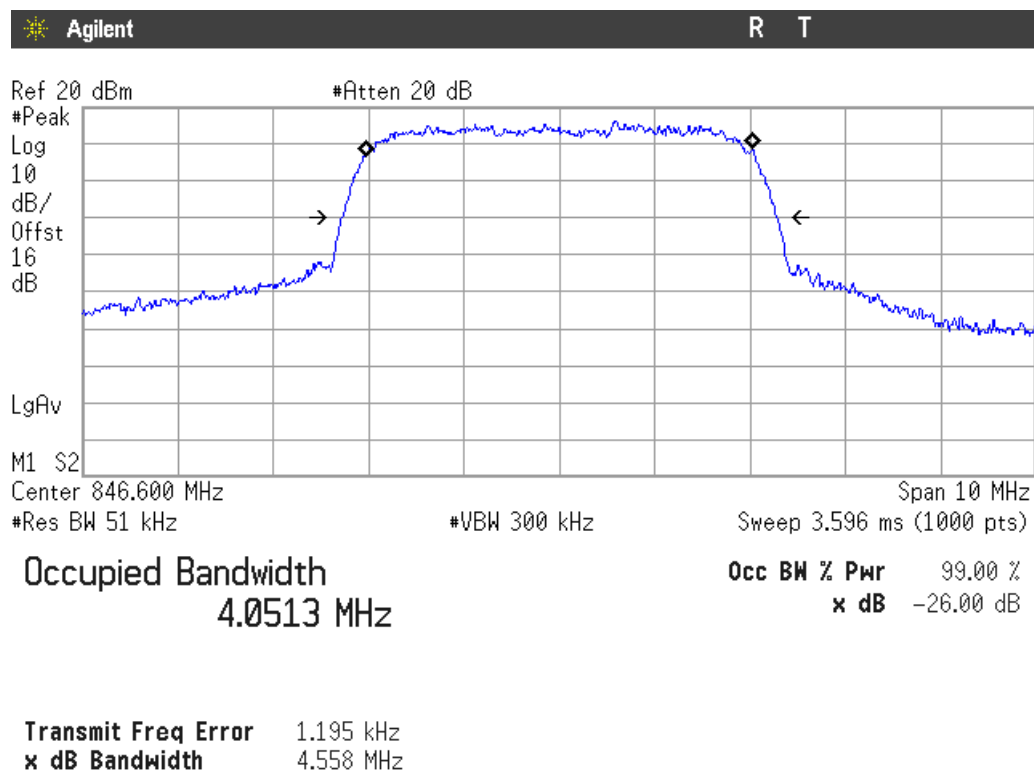
Lowest Channel



Middle Channel

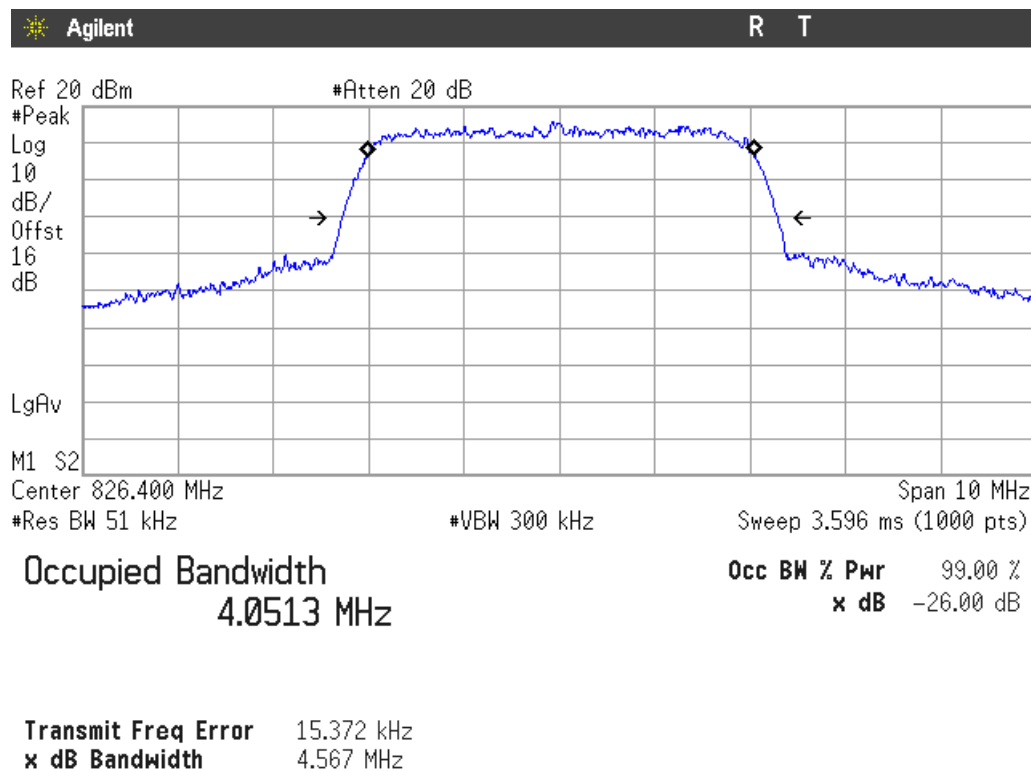


Highest Channel

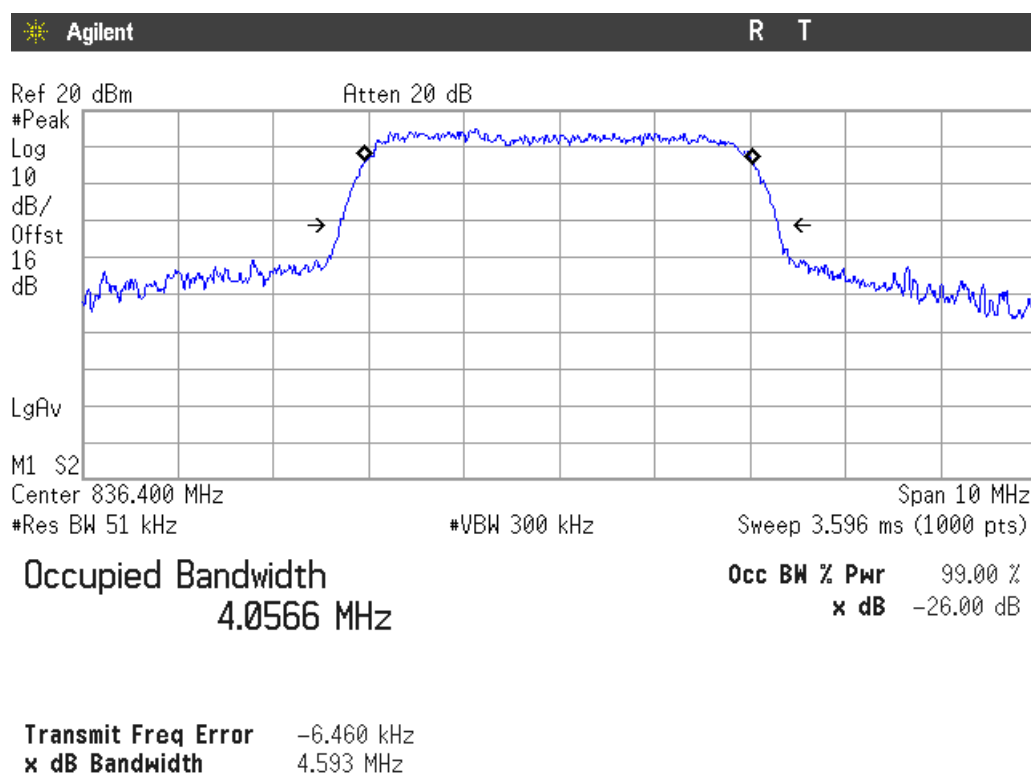


HSUPA MODULATION

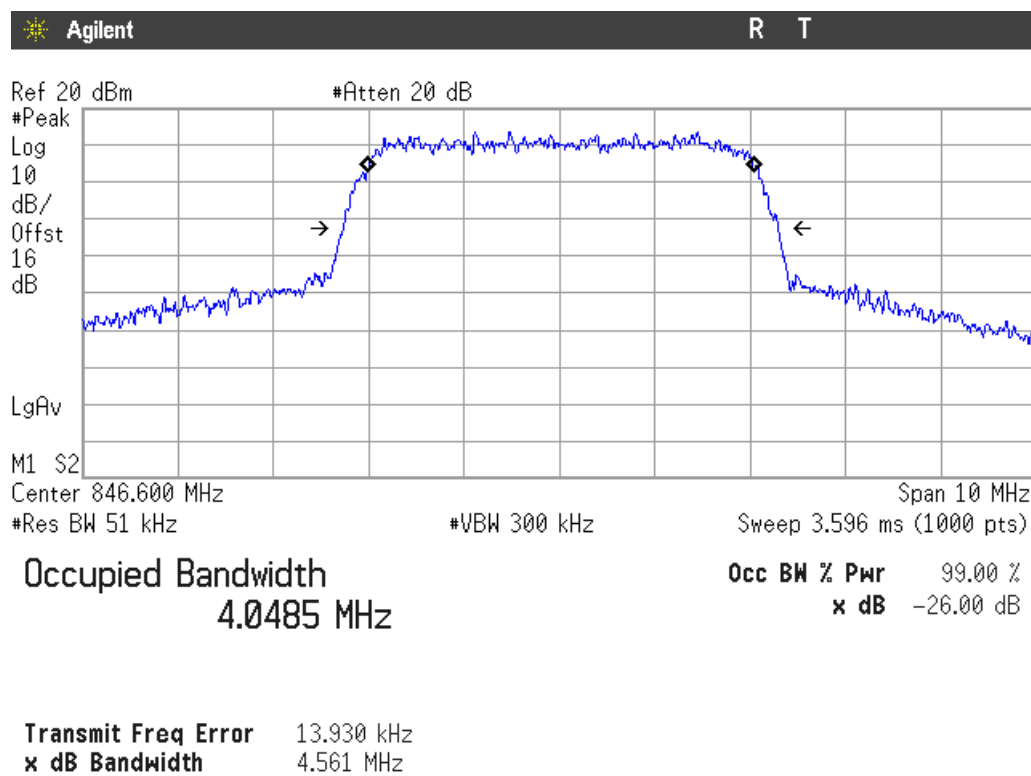
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051 and §22.917

RSS-132. Clause 5.5.

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

The spectrum was investigated from 9 kHz to 10 GHz.

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

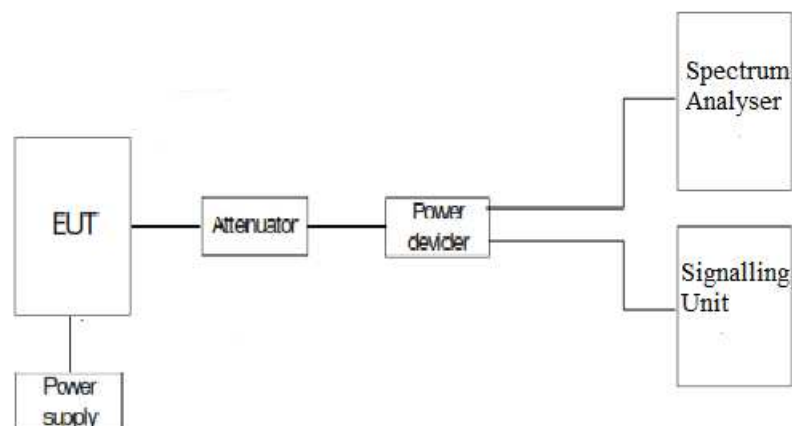
Measurement Limit:

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

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

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

TEST SETUP



RESULTS (see plots in next pages)

GPRS MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

3. CHANNEL: HIGHEST

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

WCDMA MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

3. CHANNEL: HIGHEST

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

HSUPA MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

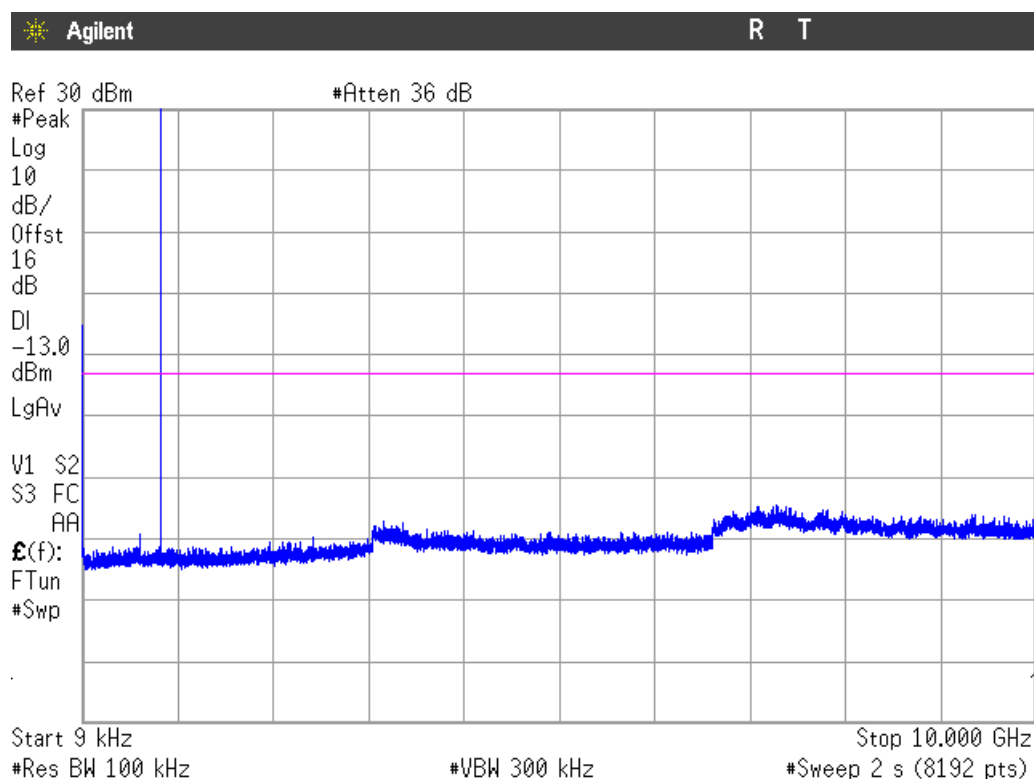
3. CHANNEL: HIGHEST

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

Verdict: PASS

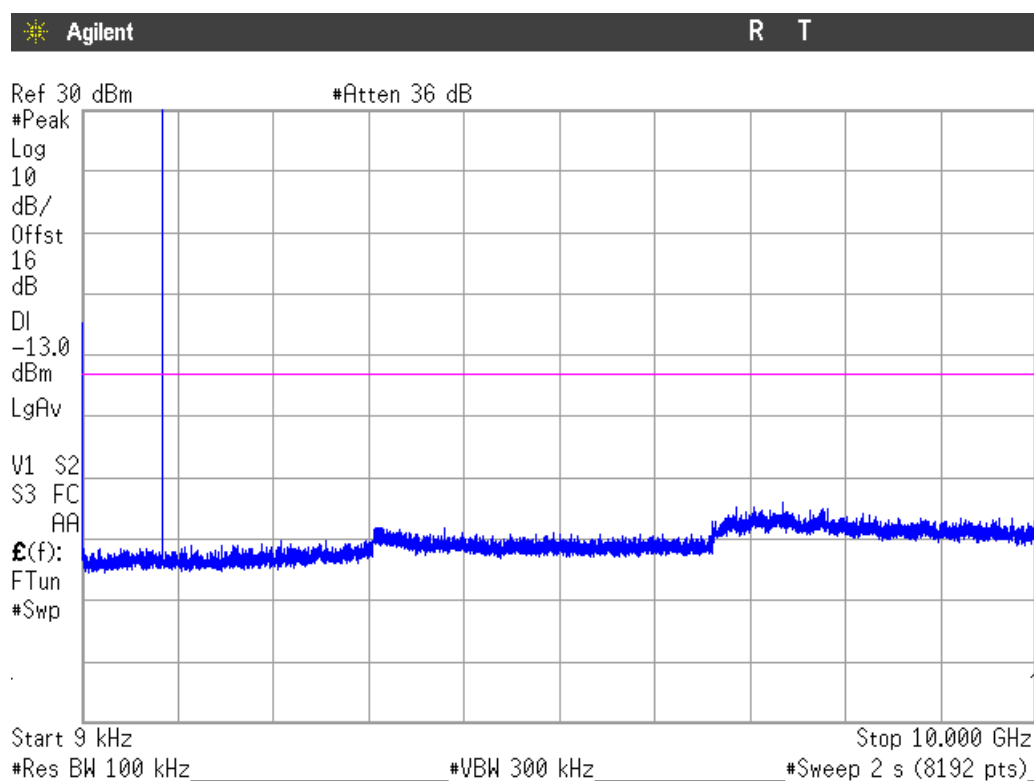
GPRS MODULATION

1. CHANNEL: LOWEST



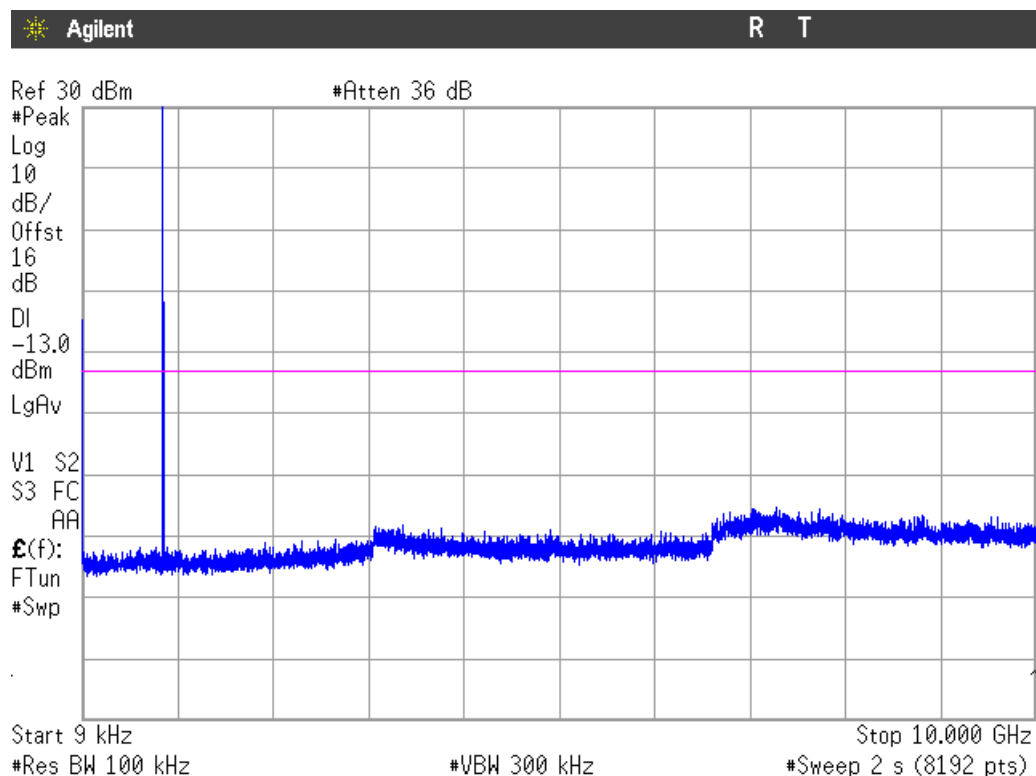
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

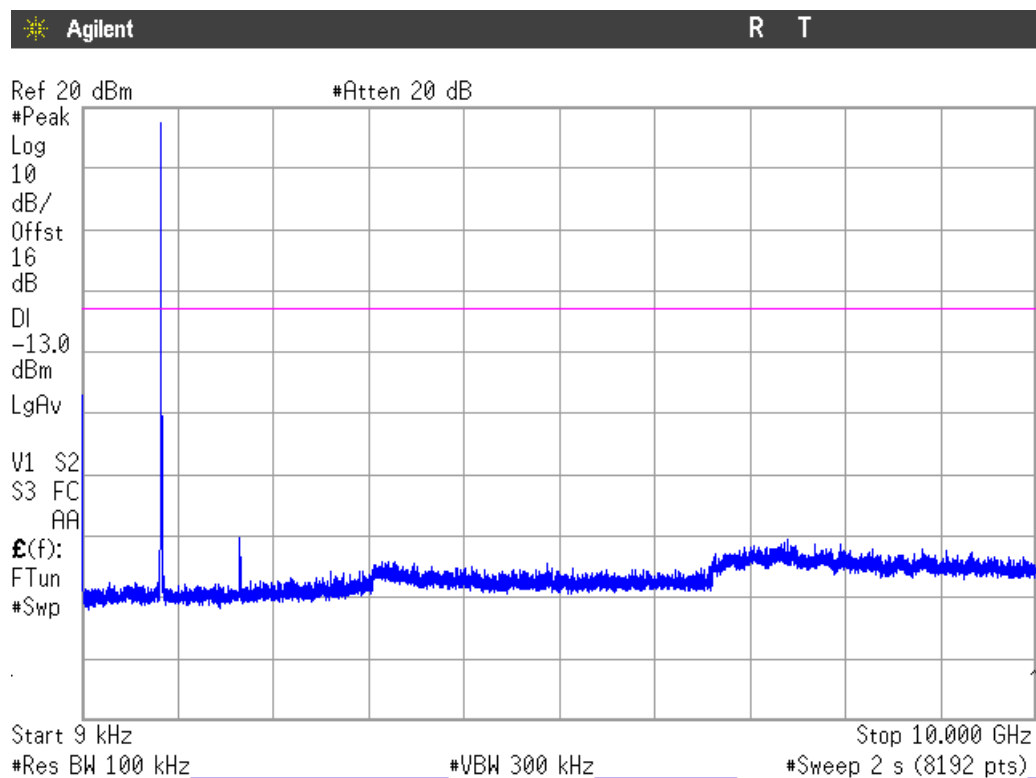
3. CHANNEL: HIGHEST



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

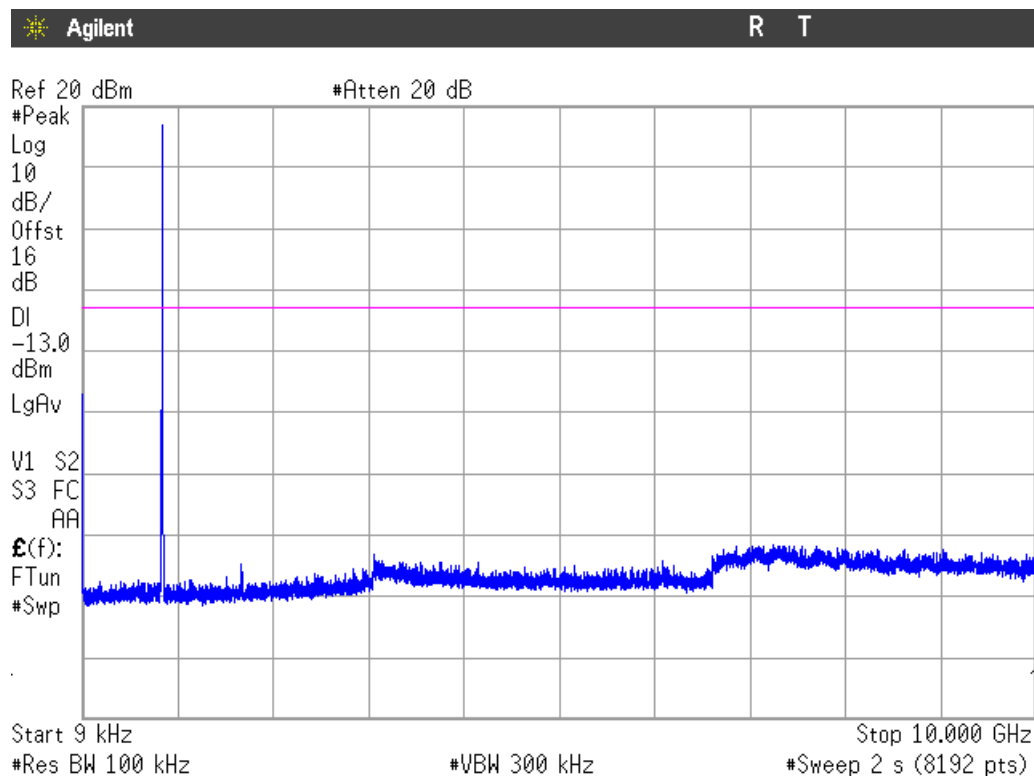
WCDMA MODULATION

1. CHANNEL: LOWEST



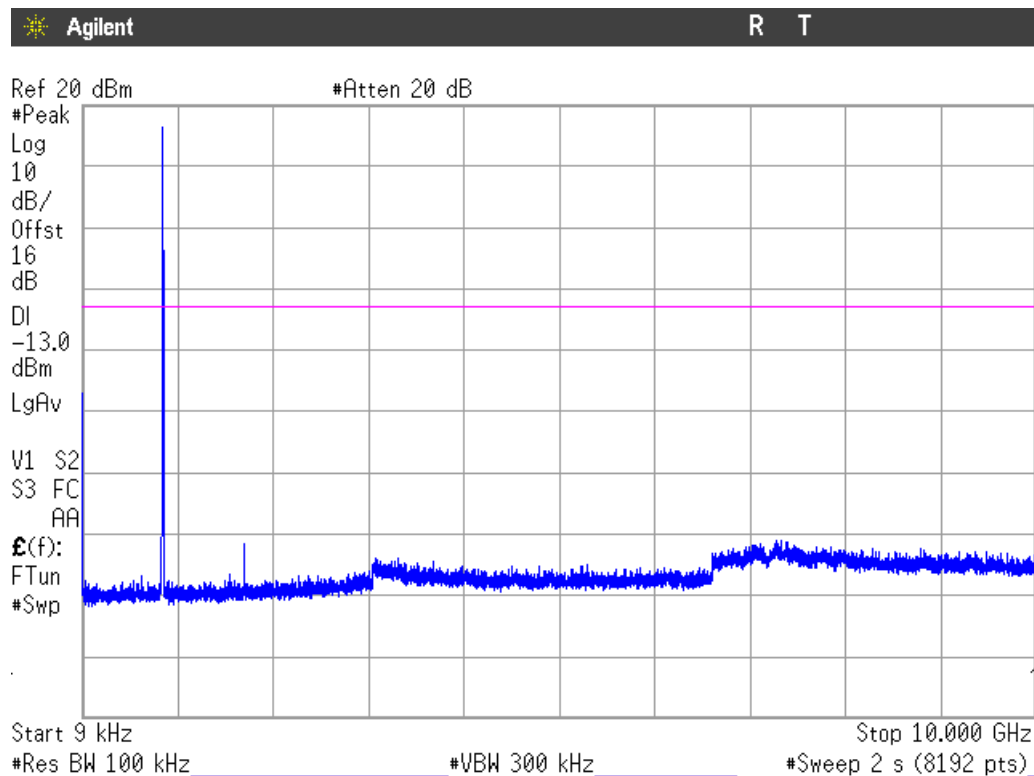
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

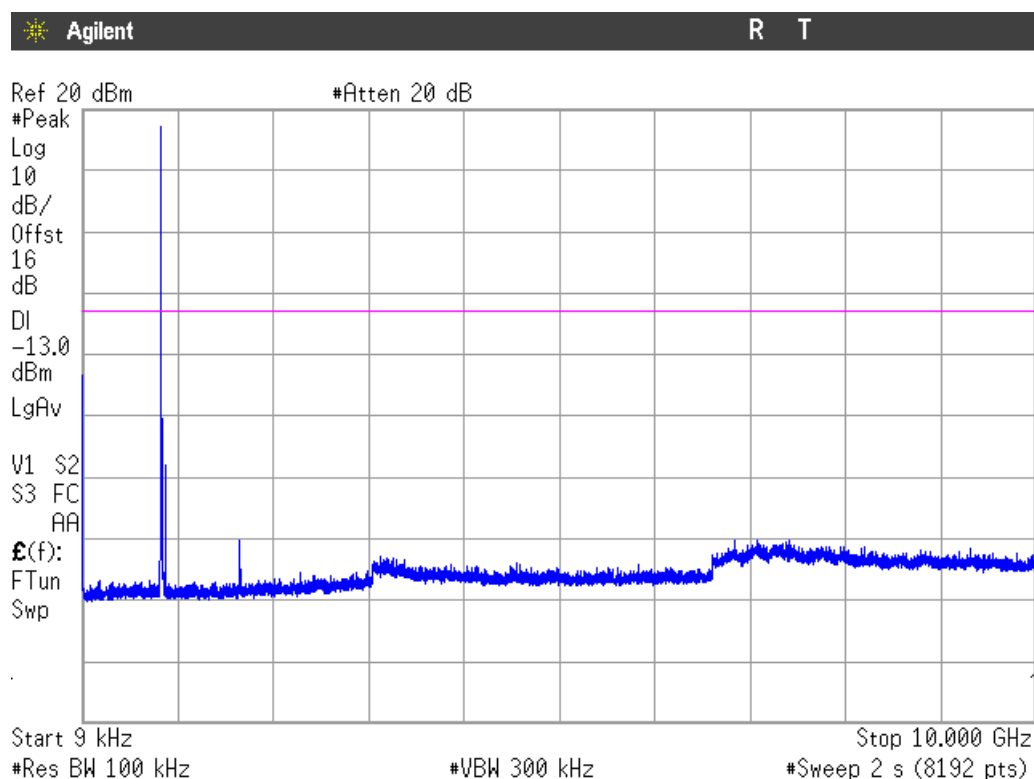
3. CHANNEL: HIGHEST



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

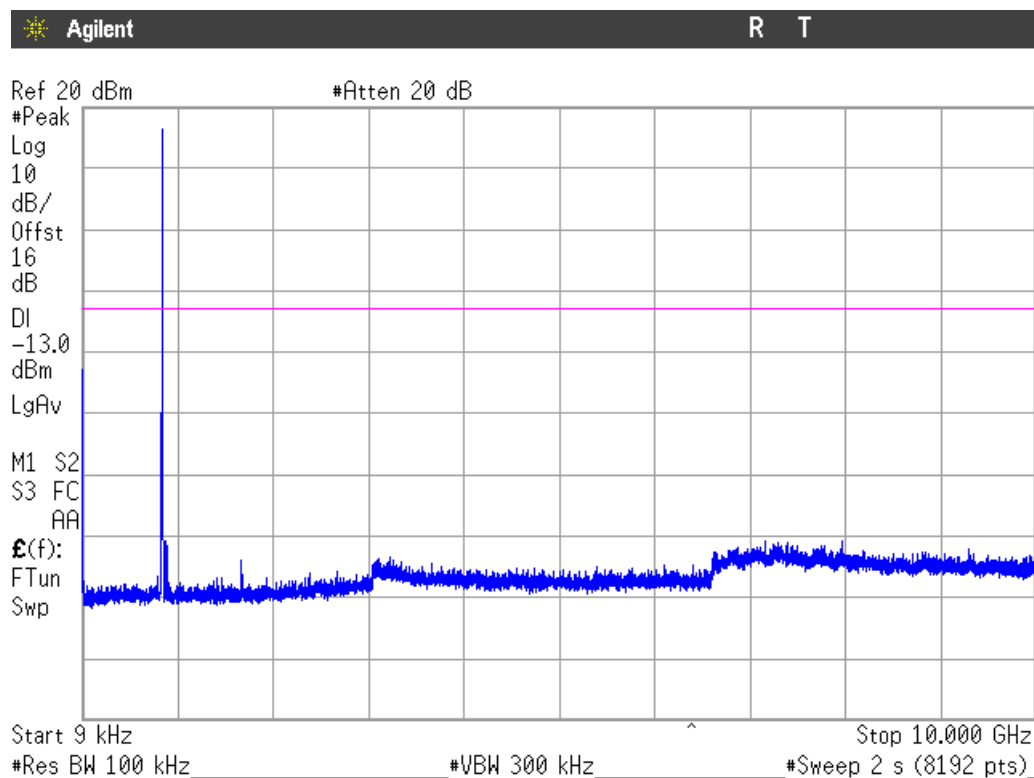
HSUPA MODULATION

1. CHANNEL: LOWEST



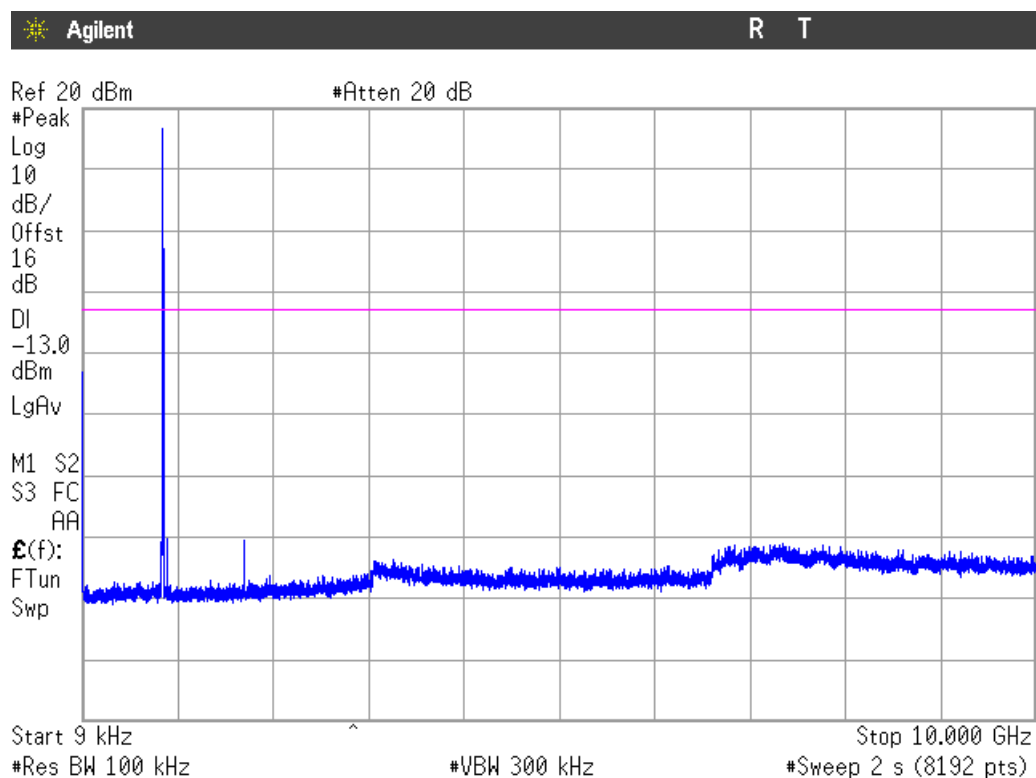
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

3. CHANNEL: HIGHEST



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

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

Spurious emissions at antenna terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §22.917

RSS-132. Clause 5.5.

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

As indicated in FCC part 22/RSS-132, in the 1 MHz bands immediately outside and adjacent to the frequency block or band a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

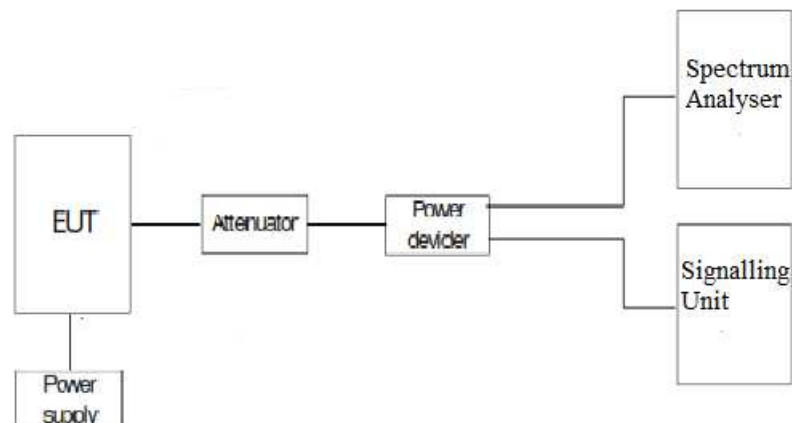
Measurement Limit:

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

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

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

TEST SETUP



RESULTS (see plots in next pages)

MODULATION:	GPRS	WCDMA	HSUPA
Maximum measured level at lowest Block Edge at antenna port (dBm)	-17.69	-19.10	-19.54
Measurement uncertainty (dB)	±2.03		

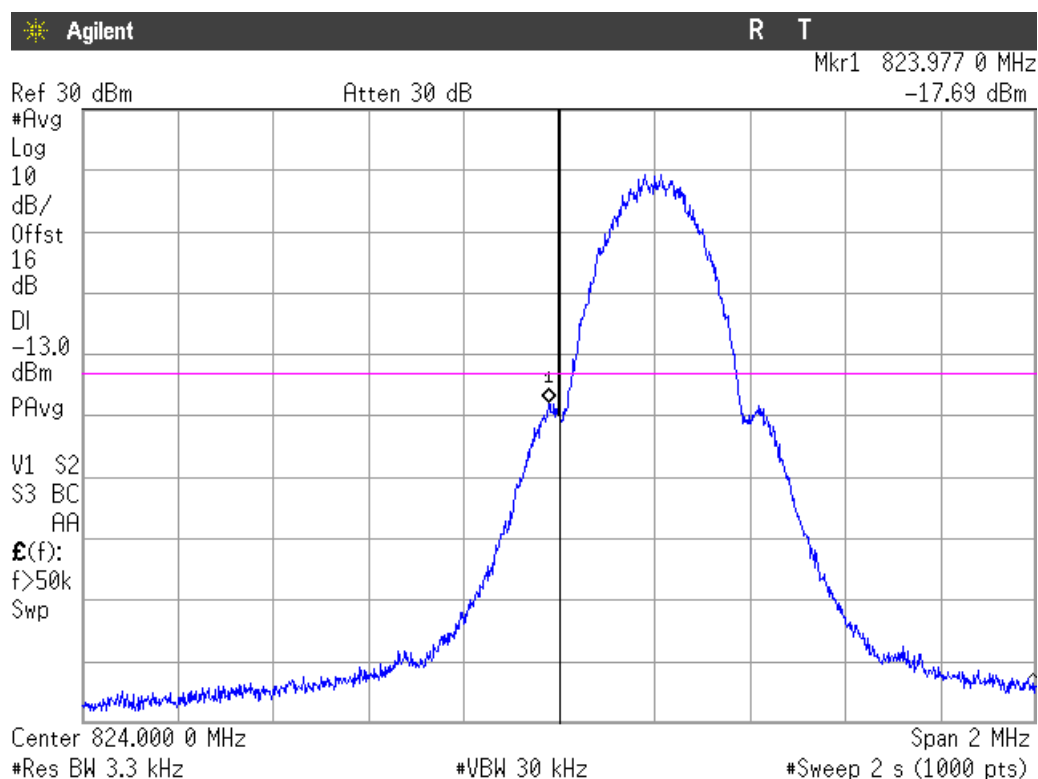
MODULATION:	GPRS	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-17.67	-22.42	-20.04
Measurement uncertainty (dB)	±2.03		

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

Verdict: PASS

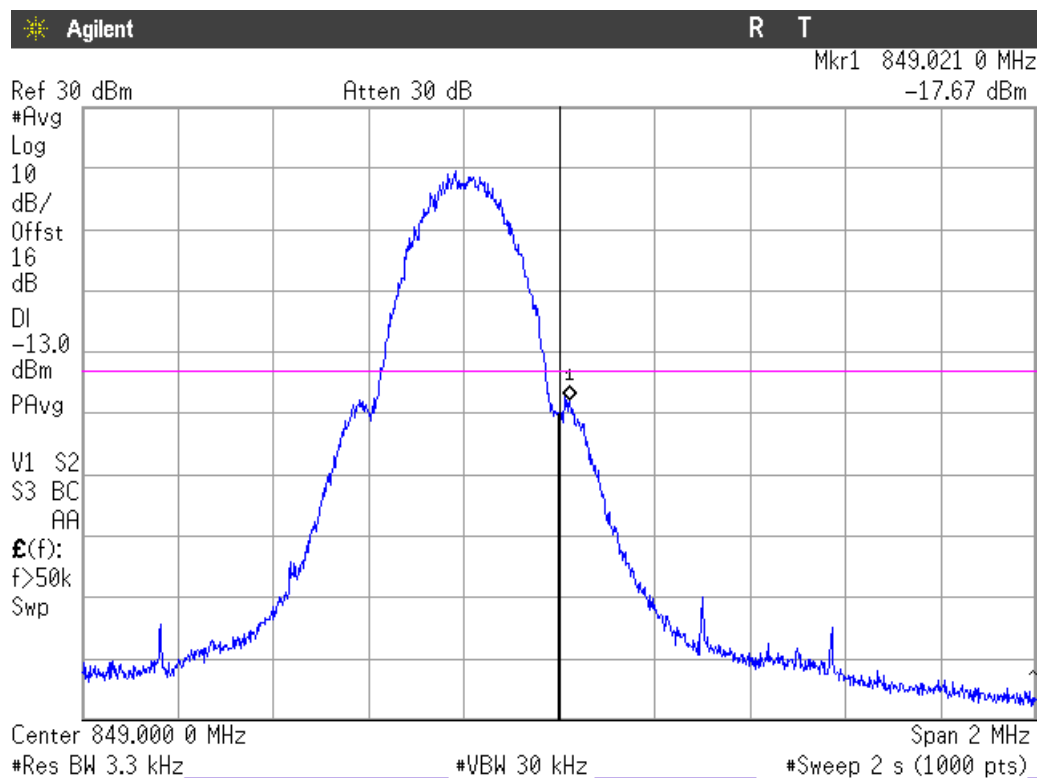
GPRS MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

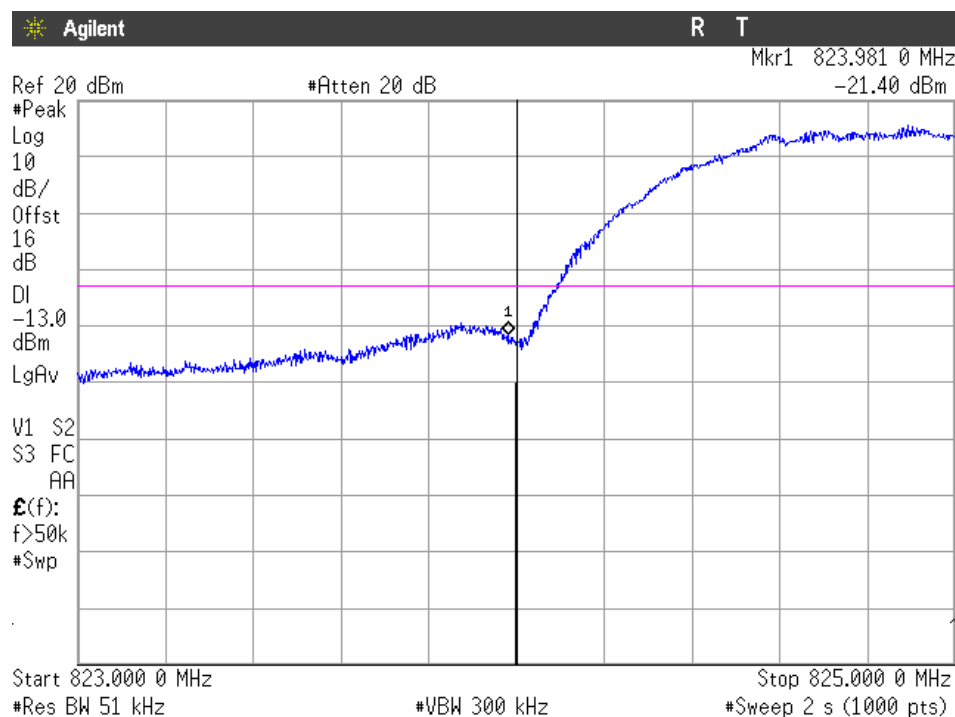
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

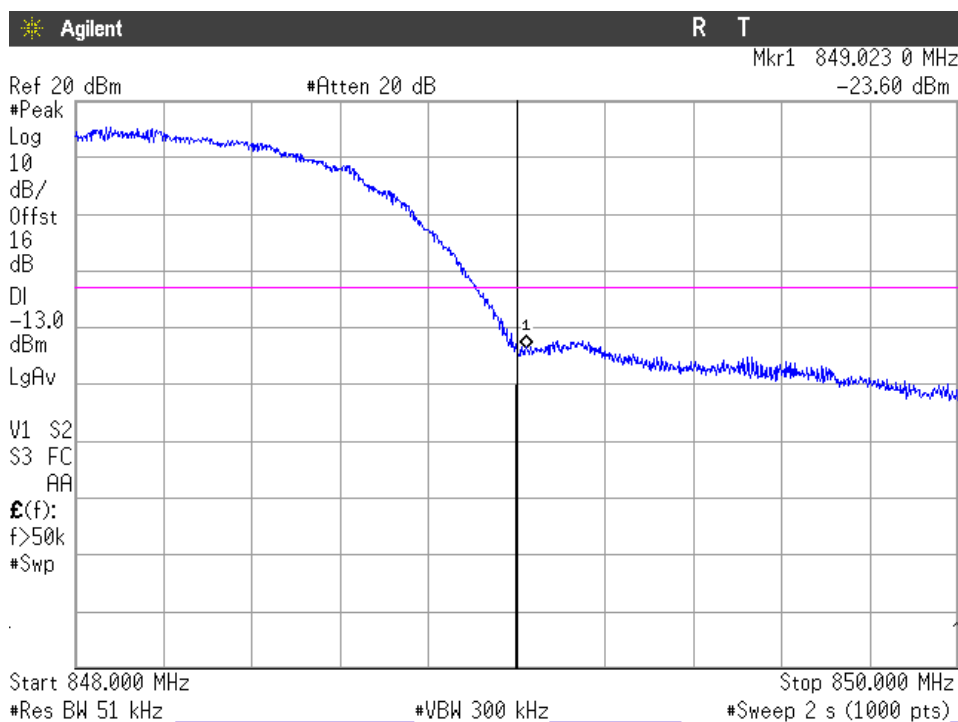
WCDMA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

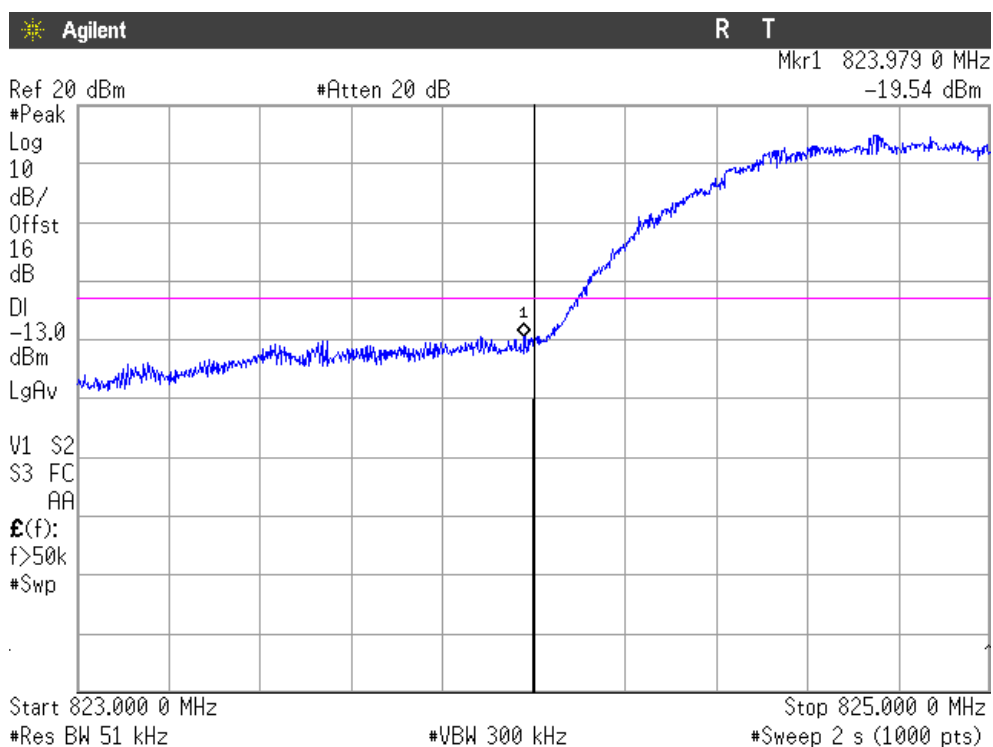
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

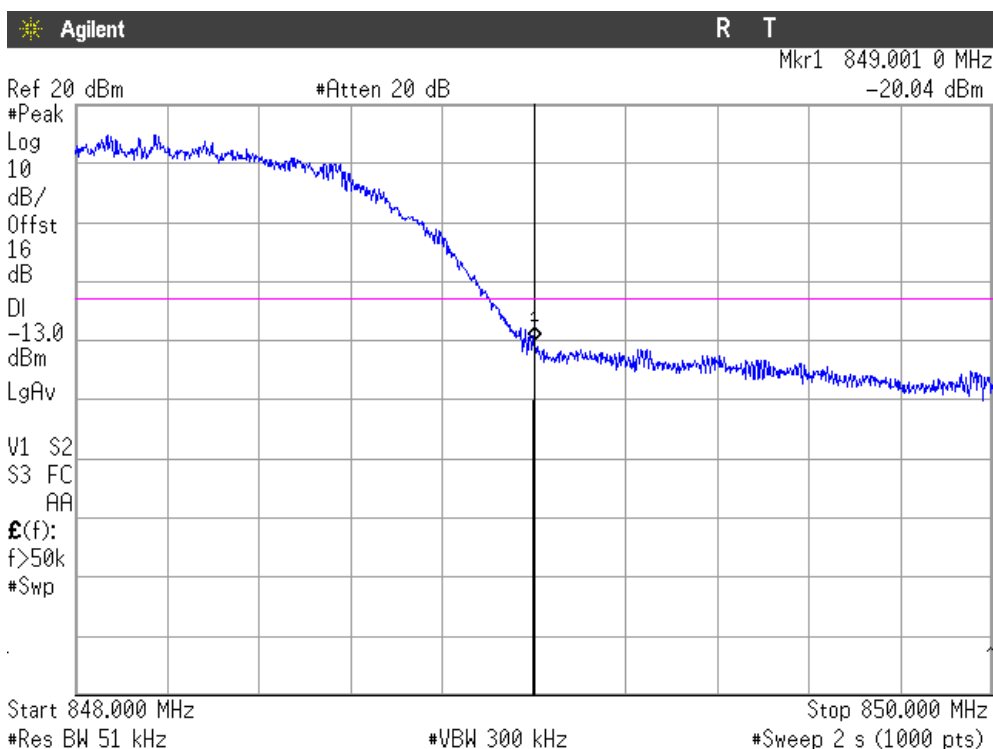
HSUPA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

Radiated emissions

SPECIFICATION

FCC § 22.917

RSS-132. Clause 5.5.

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. The radiated emissions were measured with peak detector and 1 MHz bandwidth.

Each detected emission is substituted by the Substitution method, in accordance with the ANSI/TIA-603-D: 2010.

Measurement Limit:

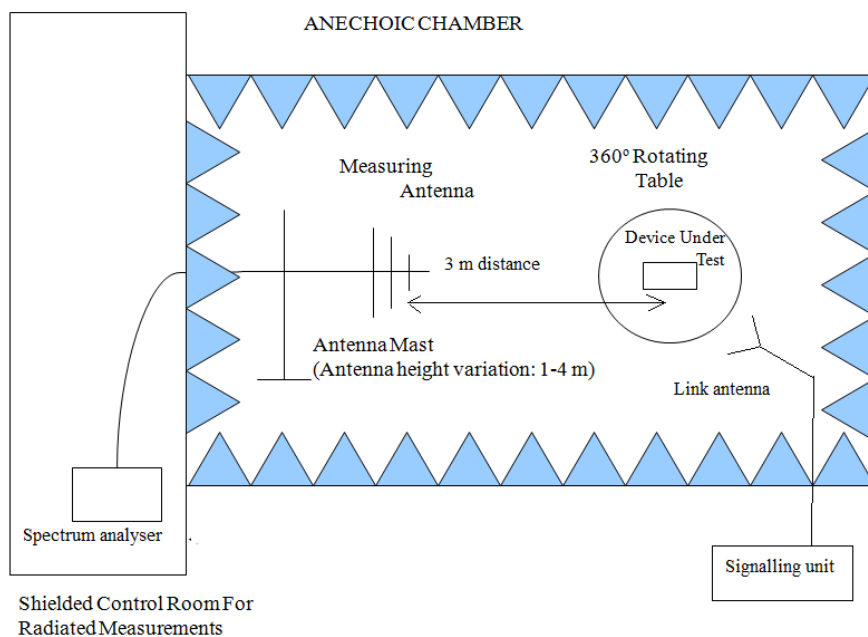
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

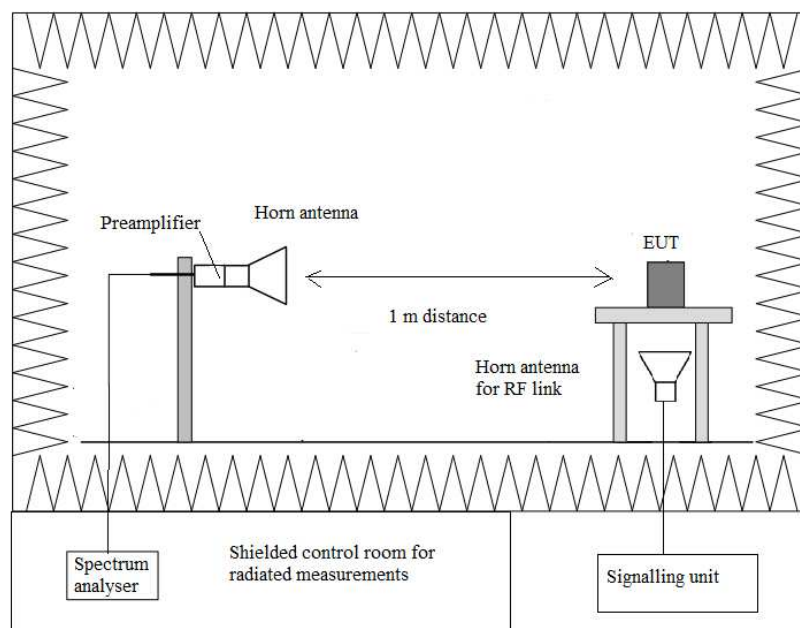
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS MODULATION

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1648.43	-37.53	Vertical	-55.70	1.90	8.63	-48.96
2472.70	-31.33	Vertical	-49.09	2.10	10.66	-40.53
3296.92	-39.16	Vertical	-55.24	2.50	11.43	-46.30
4120.82	-50.47	Vertical	-64.92	2.82	11.93	-55.81
4944.95	-51.13	Vertical	-62.97	3.14	11.52	-54.59
5569.08	-51.82	Vertical	-62.73	4.27	12.62	-54.38

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1672.97	-30.08	Vertical	-48.22	1.95	8.72	-41.44
2509.97	-27.68	Vertical	-45.38	2.10	10.70	-36.78
3346.62	-37.24	Vertical	-53.33	2.50	11.52	-44.31
4183.12	-47.84	Vertical	-62.04	2.88	11.89	-53.03
5019.15	-46.51	Vertical	-58.16	3.22	11.55	-49.83

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1697.57	-38.57	Vertical	-56.68	2.00	8.81	-49.86
2546.43	-32.17	Vertical	-49.77	2.10	10.72	-41.15
3394.92	-41.96	Vertical	-58.08	2.50	11.61	-48.97
4244.25	-49.22	Vertical	-63.20	2.90	11.85	-54.25
5093.12	-46.43	Vertical	-58.09	3.29	11.72	-49.66

WCDMA AND HSUPA MODULATION

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

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

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)
1651.23	-39.46	Vertical	-57.62	1.90	8.64	-50.88
2482.77	-45.43	Vertical	-63.18	2.10	10.67	-54.61
3300.42	-43.95	Vertical	-60.02	2.50	11.44	-51.08
4125.72	-50.14	Vertical	-64.57	2.83	11.92	-55.47

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1674.63	-37.95	Vertical	-56.09	1.95	8.73	-49.31
2511.43	-44.84	Vertical	-62.53	2.10	10.70	-53.93
3350.12	-45.31	Vertical	-61.41	2.50	11.53	-52.38
4185.68	-52.00	Vertical	-66.18	2.89	11.89	-57.18

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-10 GHz.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1695.63	-38.55	Vertical	-56.66	1.99	8.80	-49.85
2543.10	-45.98	Vertical	-63.59	2.10	10.72	-54.97
3380.92	-47.44	Vertical	-63.56	2.50	11.59	-54.47
4226.28	-52.62	Vertical	-66.66	2.90	11.86	-57.70

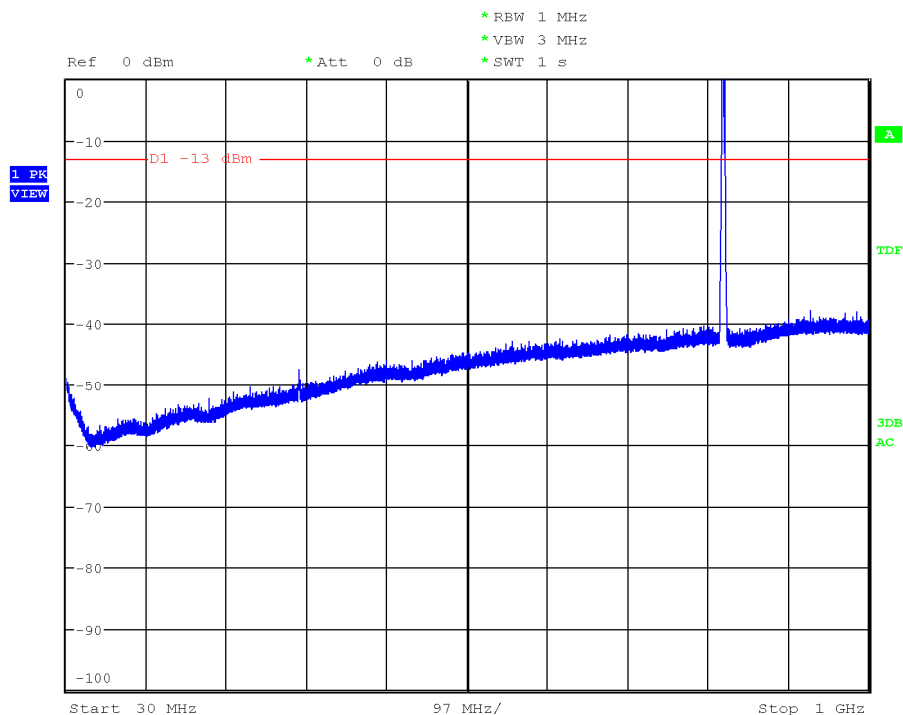
Measurement uncertainty (dB)	$< \pm 3.88$ for $f < 1\text{GHz}$ $< \pm 4.87$ for $f \geq 1\text{ GHz up to } 10\text{ GHz}$
------------------------------	---

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

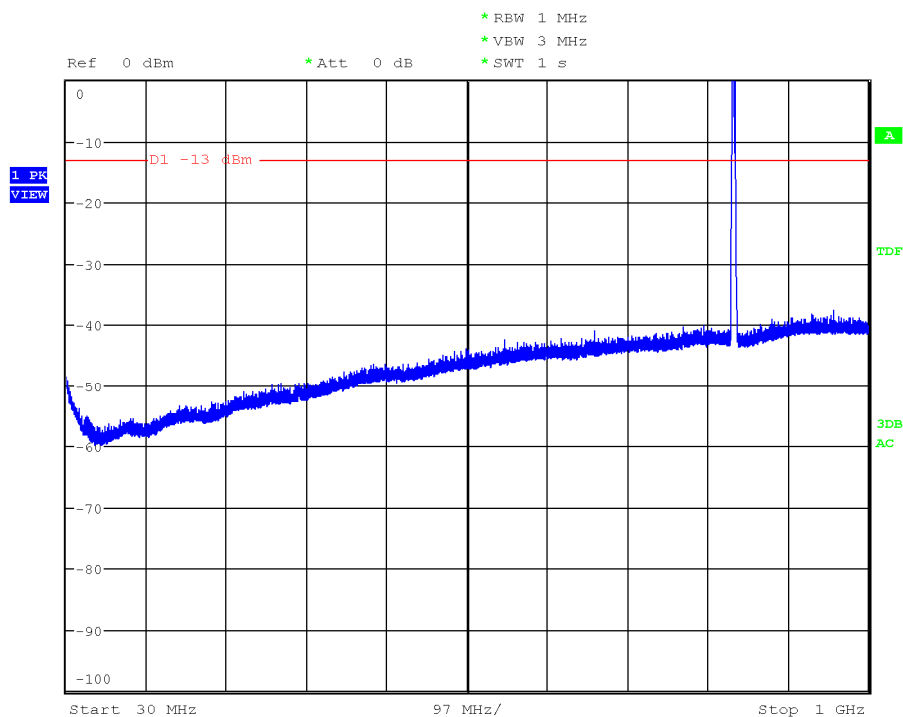
GPRS MODULATION

CHANNEL: LOWEST



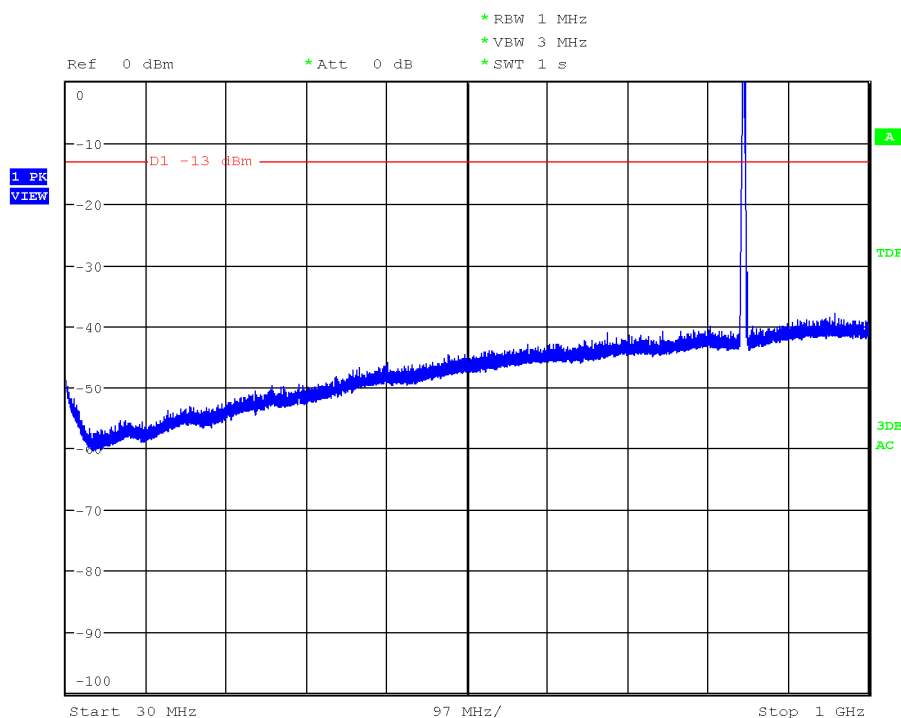
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

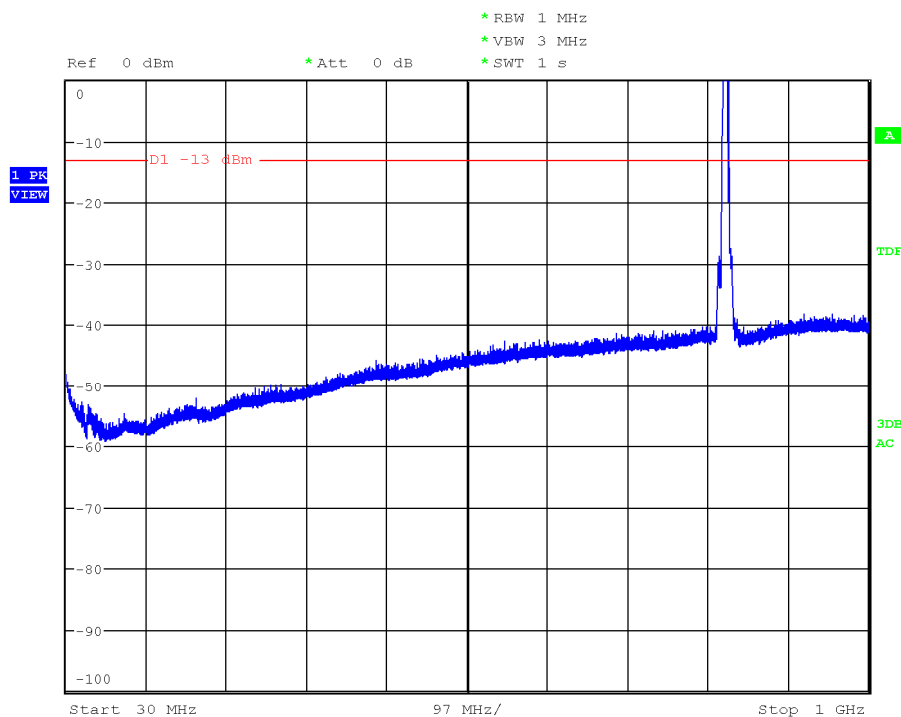
CHANNEL: HIGHEST



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

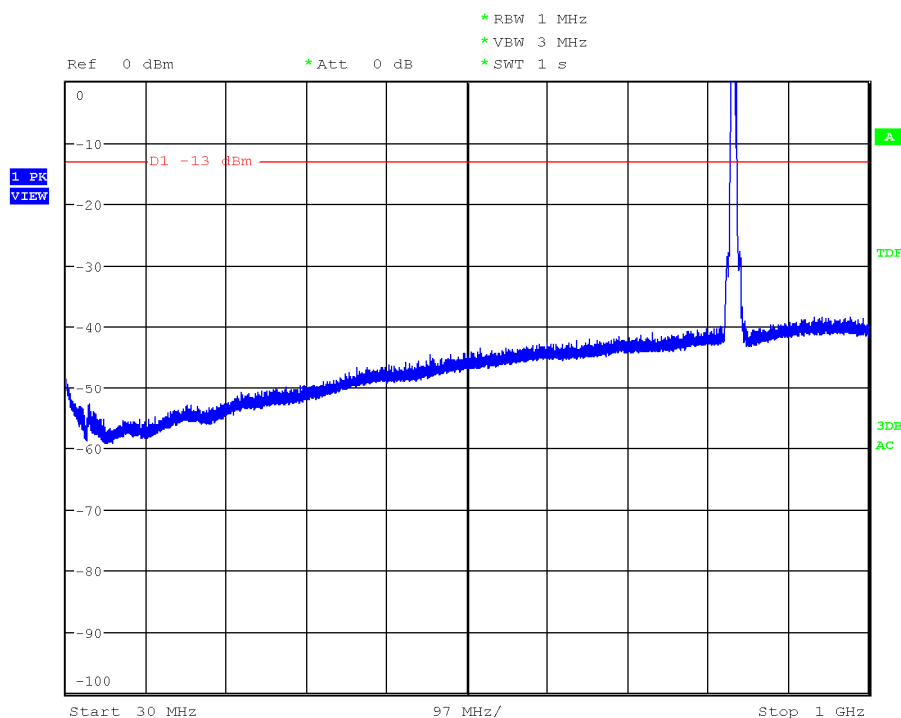
WCDMA MODULATION

CHANNEL: LOWEST



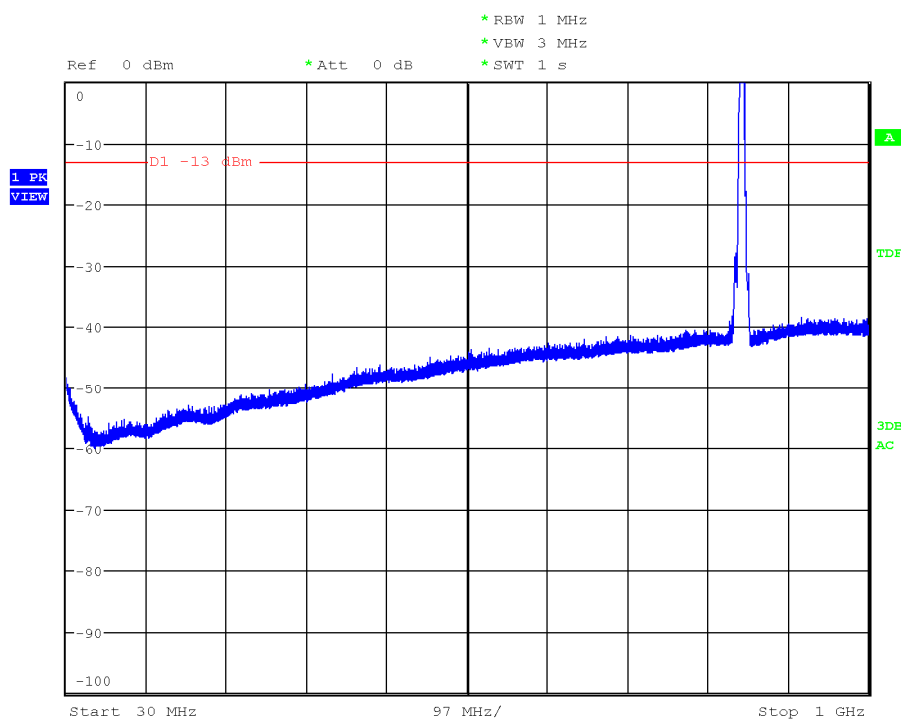
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

CHANNEL: HIGHEST

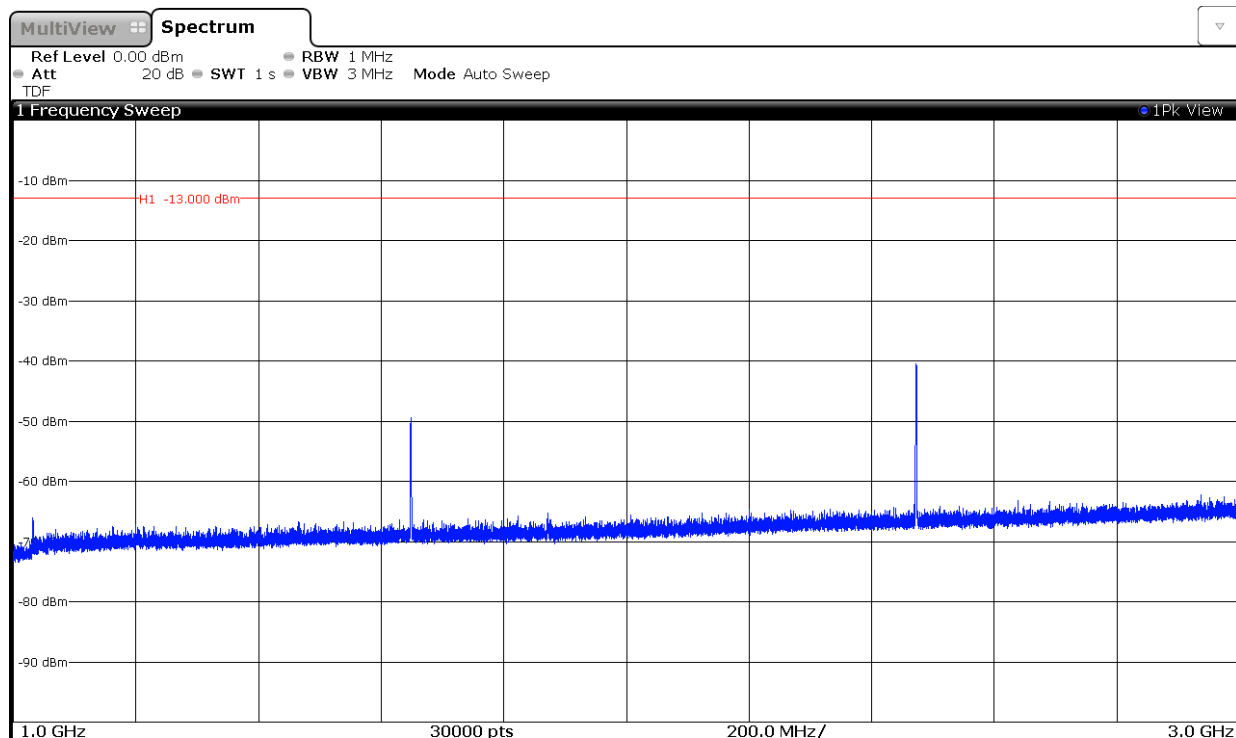


Note: The peak above the limit is the carrier frequency.

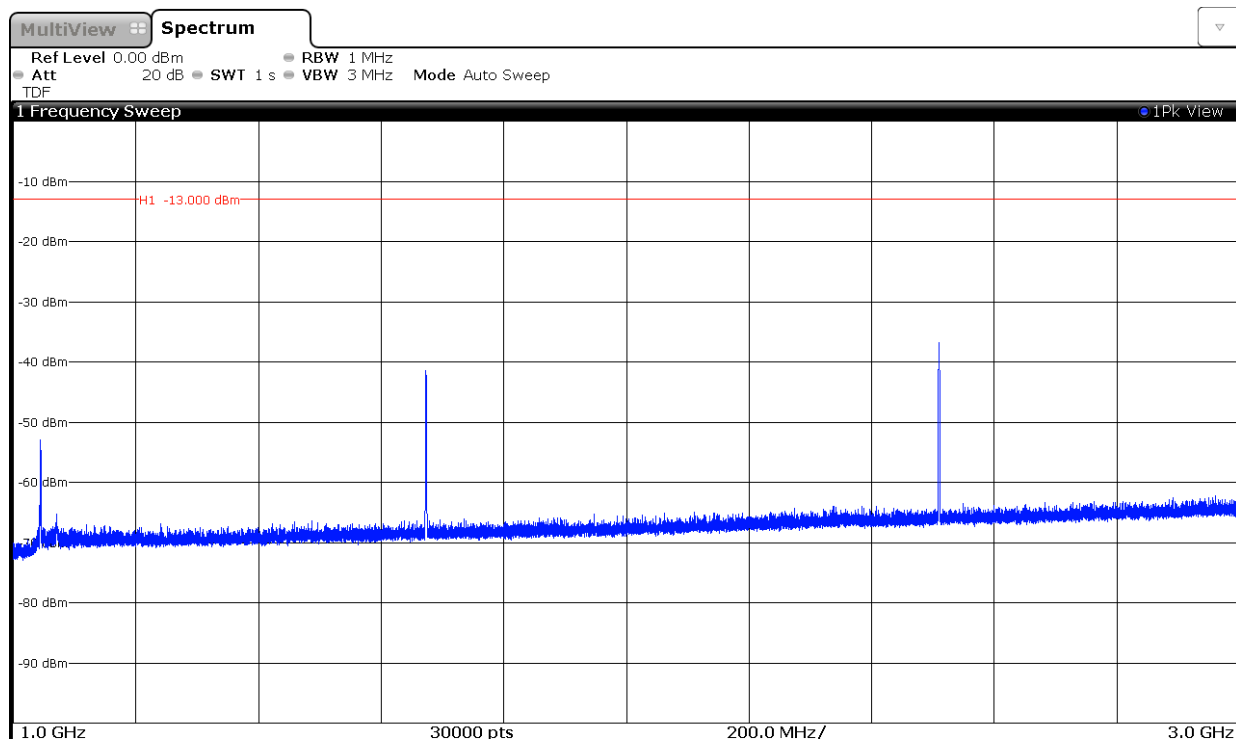
FREQUENCY RANGE 1 GHz to 3 GHz.

GPRS MODULATION

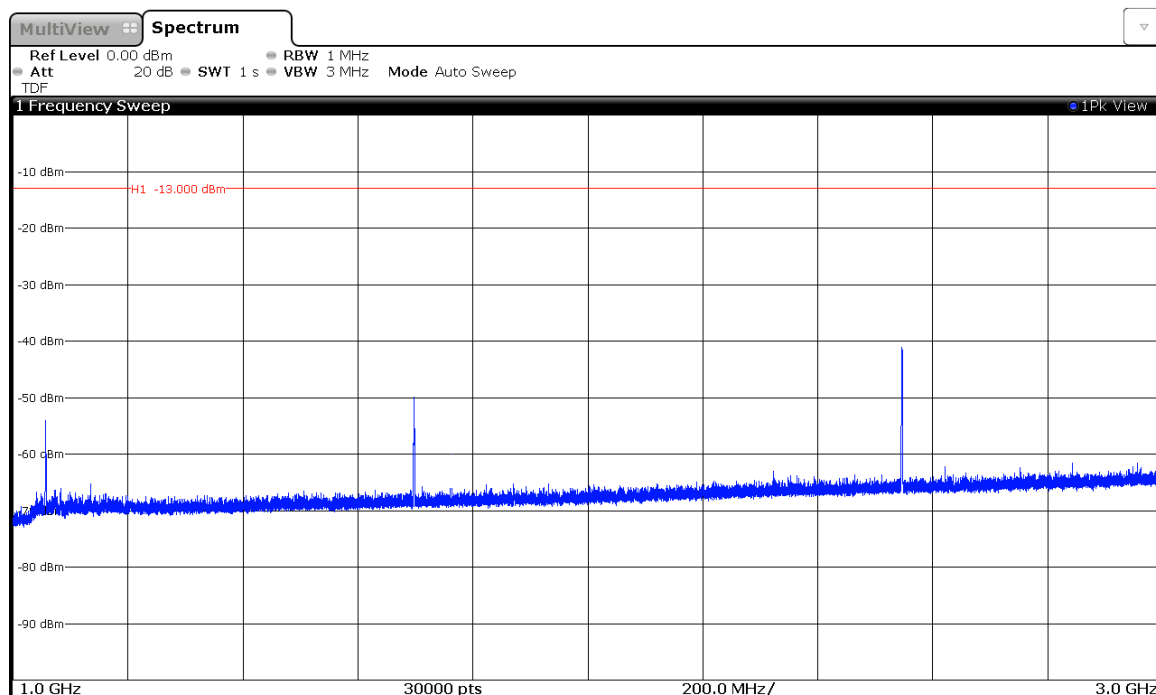
CHANNEL: LOWEST



CHANNEL: MIDDLE

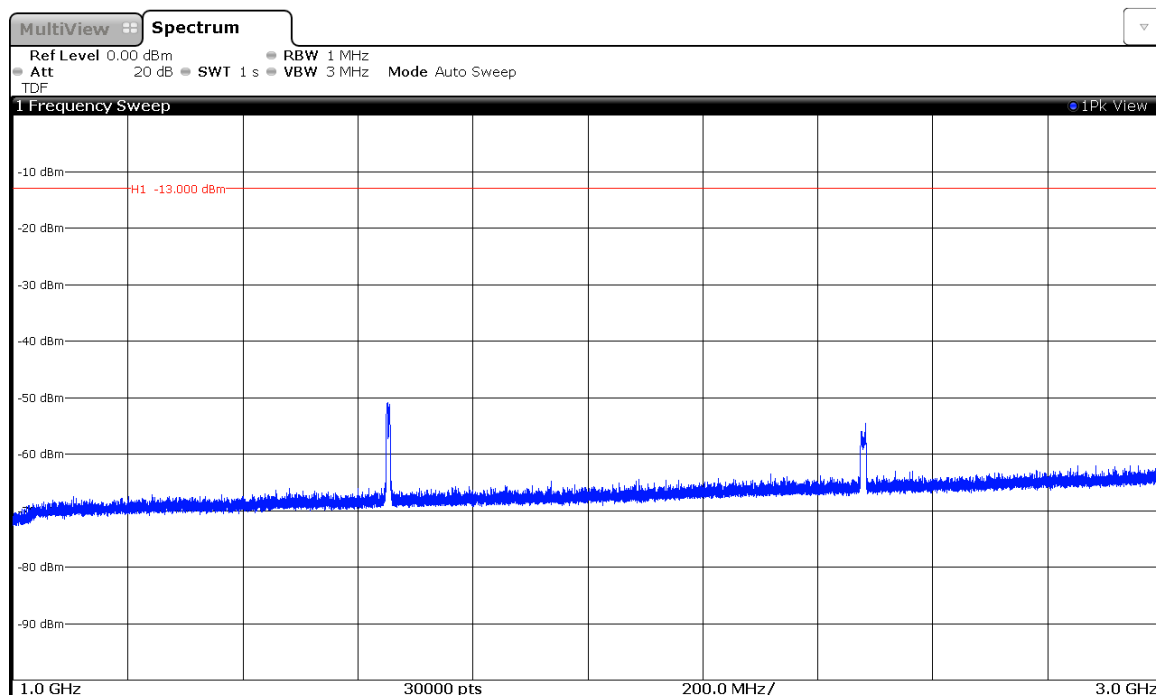


CHANNEL: HIGHEST

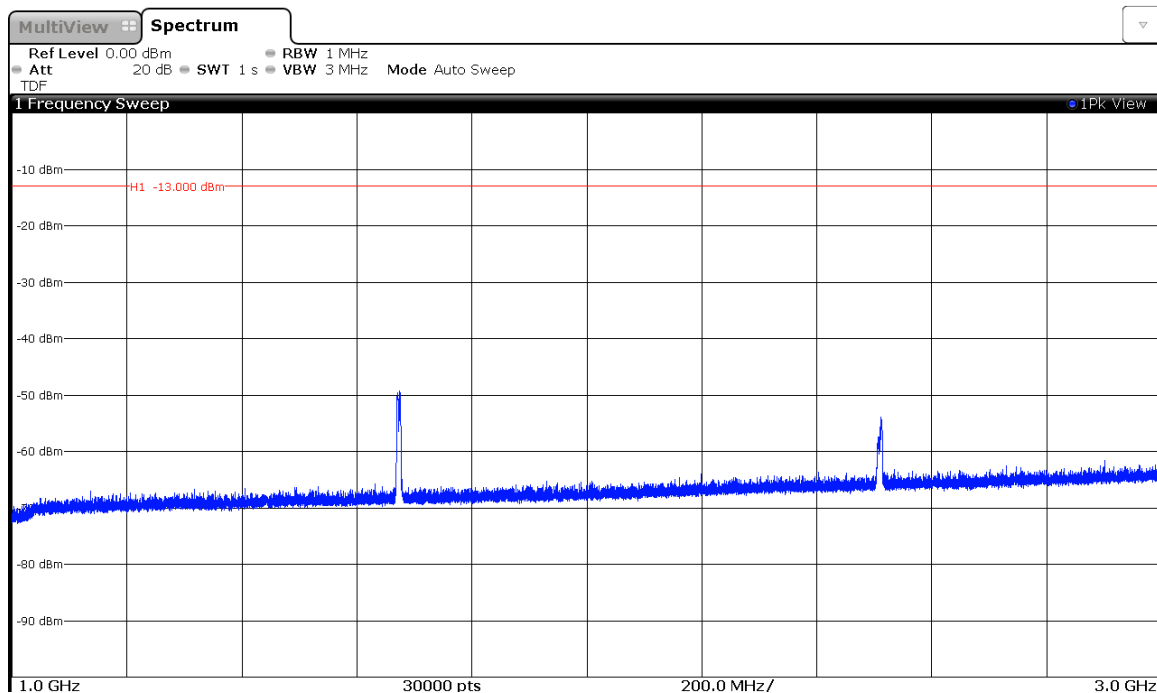


WCDMA MODULATION

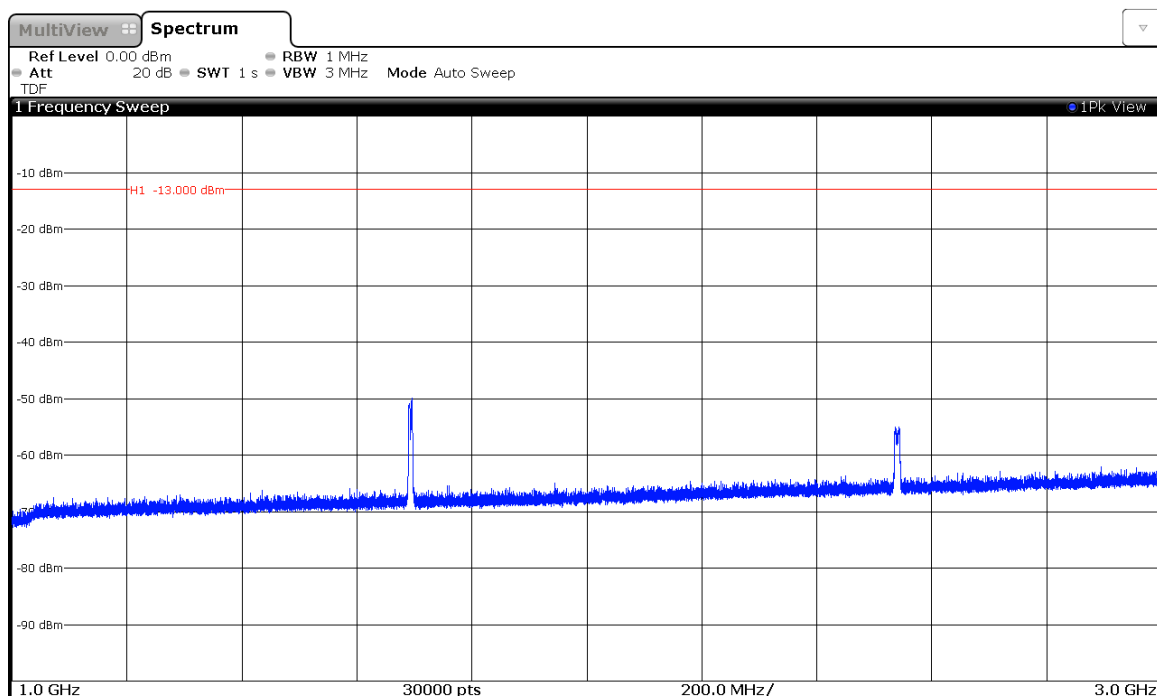
CHANNEL: LOWEST



CHANNEL: MIDDLE



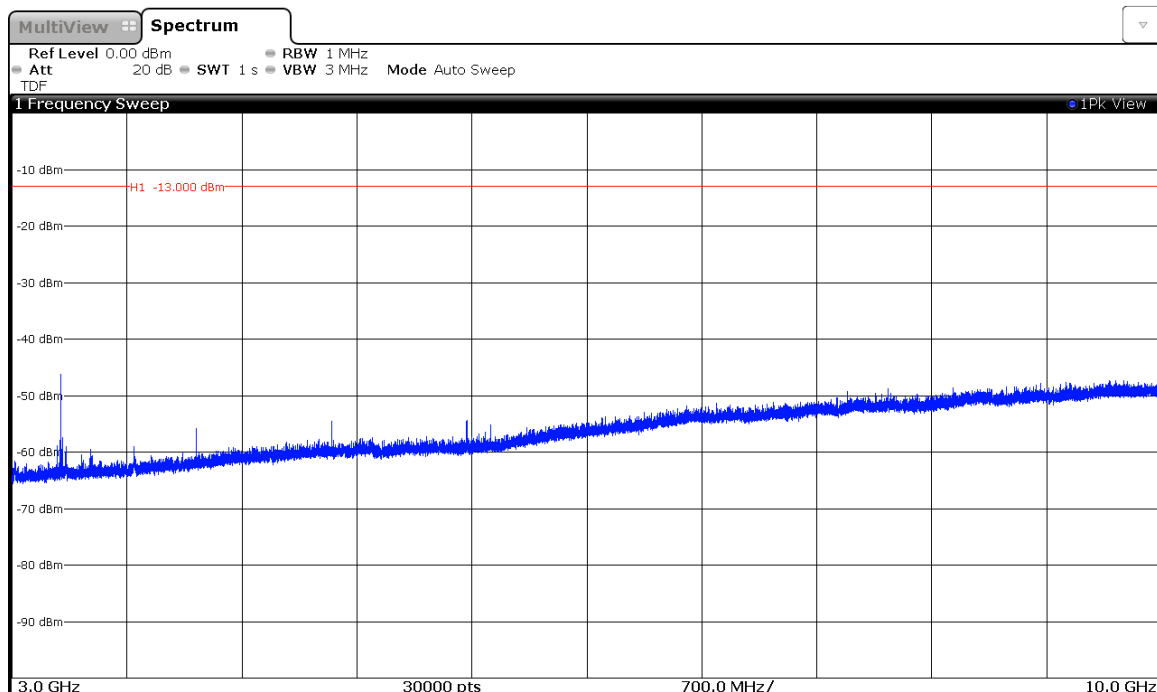
CHANNEL: HIGHEST



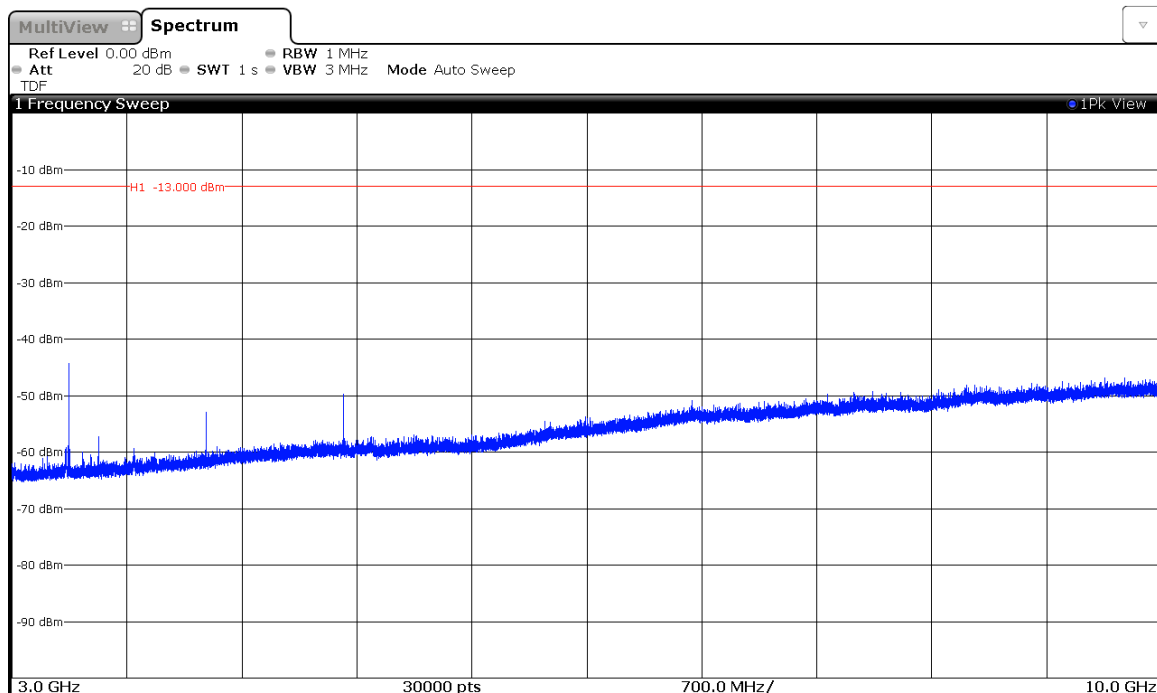
FREQUENCY RANGE 3 GHz to 10 GHz.

GPRS MODULATION

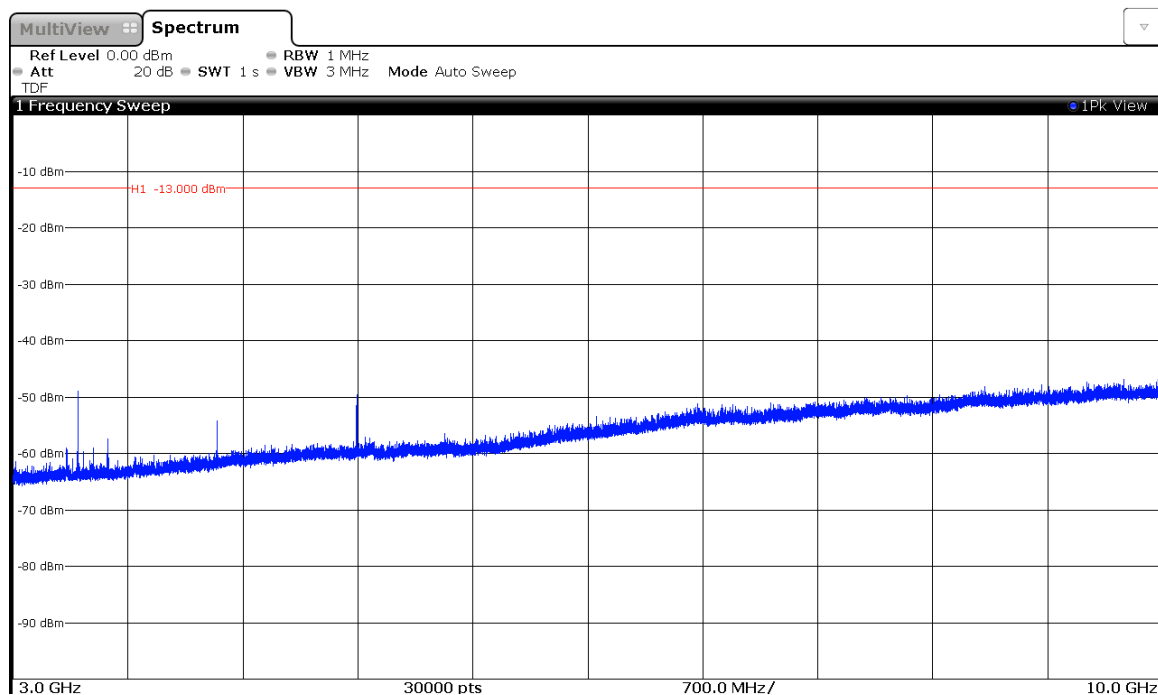
CHANNEL: LOWEST



CHANNEL: MIDDLE

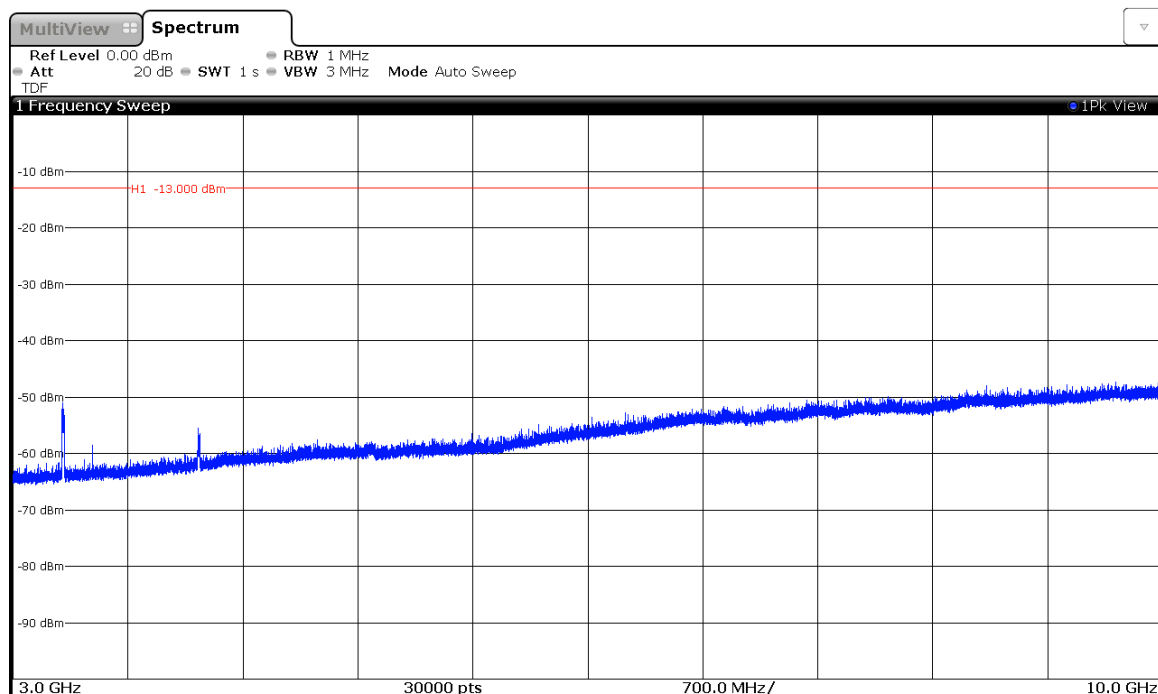


CHANNEL: HIGHEST

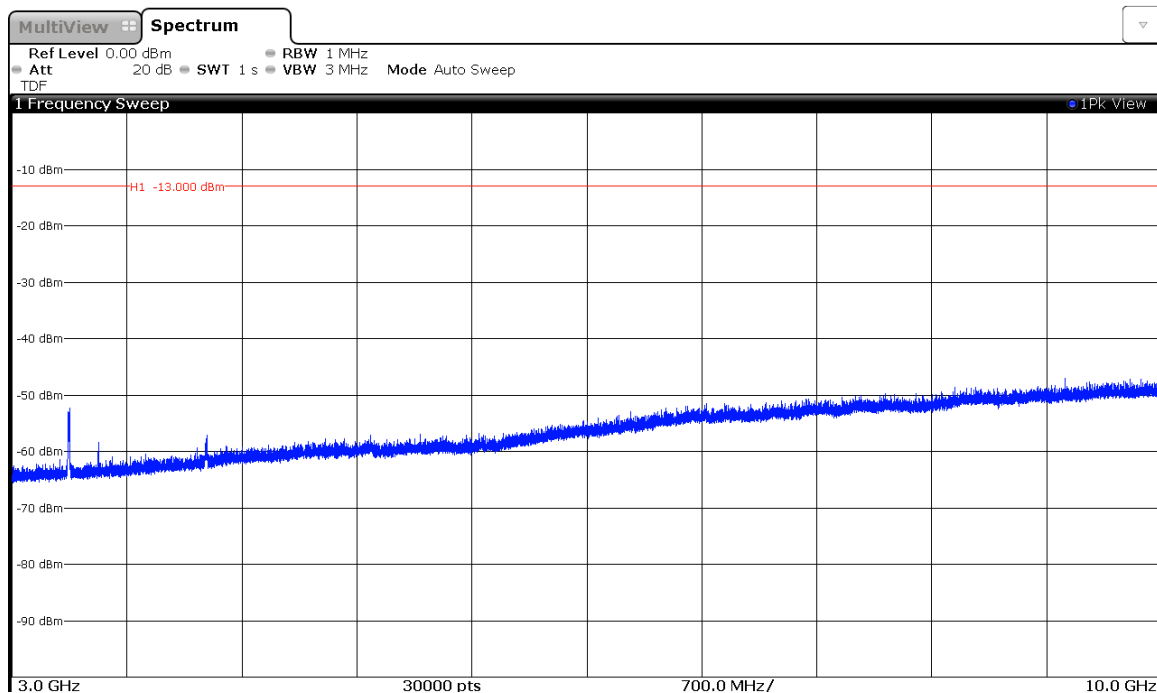


WCDMA MODULATION

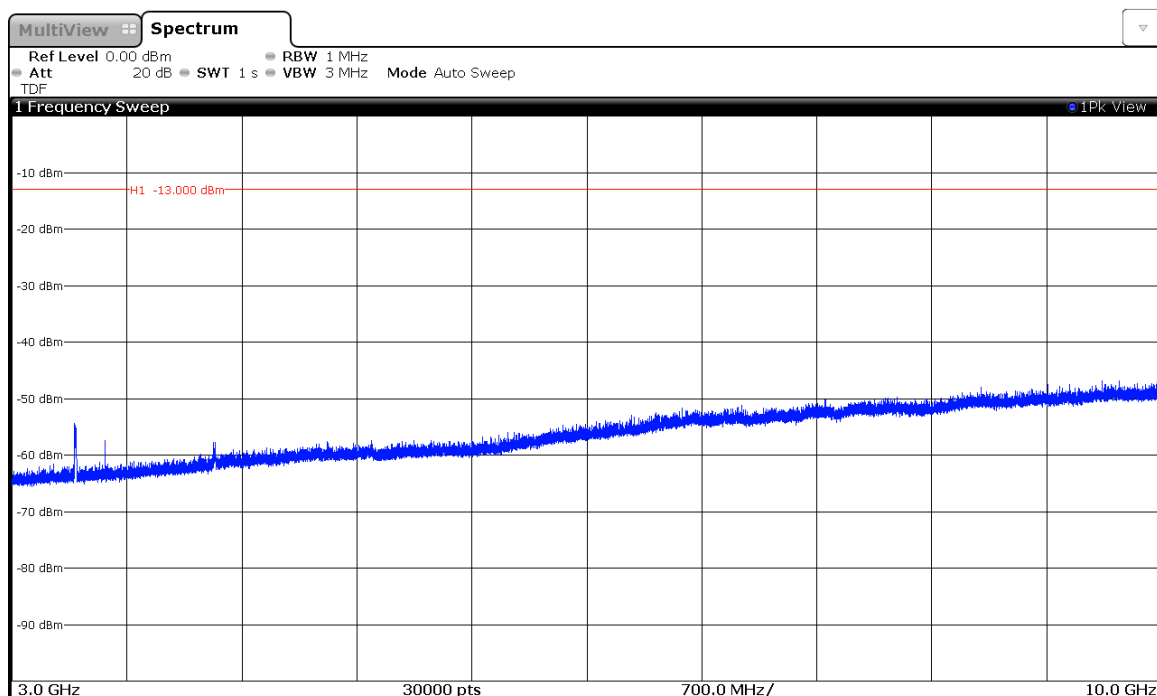
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



Appendix B – Test result for FCC Part 24/IC RSS-133

INDEX

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TEST RESULTS FOR FCC PART 24 AND IC RSS-133

TEST CONDITIONS

Power supply (V):

V_{nominal} = 3.8 Vdc

V_{max} = 4.37 Vdc

V_{min} = 3.23 Vdc

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

Type of power supply = External DC Voltage

Type of antenna = External antenna (Vertical line, ¼ wave)

Antenna gain = +2.14 dBi.

TEST FREQUENCIES:

GPRS MODULATION

Lowest channel (512): 1850.2 MHz

Middle channel (662): 1880.2 MHz

Highest channel (810): 1909.8 MHz

WCDMA AND HSUPA MODULATION

Lowest channel (9262): 1852.4 MHz

Middle channel (9400): 1880.0 MHz

Highest channel (9538): 1907.6 MHz

RF Output Power

SPECIFICATION

FCC §2.1046 and 24.232

RSS-133. Clause 6.4.

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

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

METHOD

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMU200 and CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

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

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

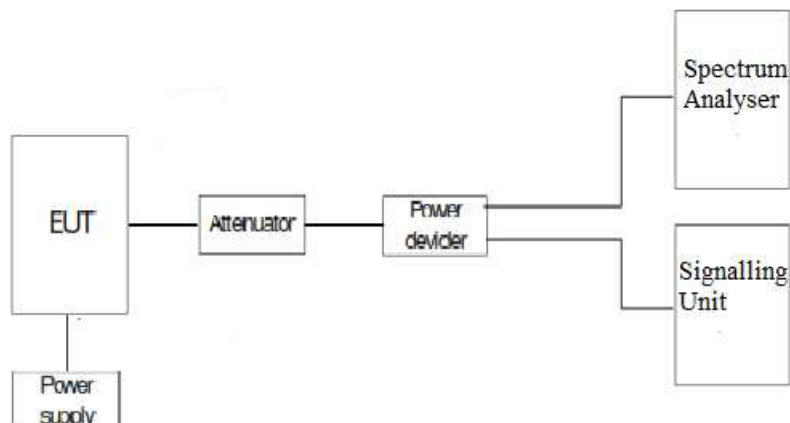
The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The measurement is performed for the highest power levels measured.

TEST SETUP

Conducted average power.



Peak-to-average power ratio (PAPR)



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

GPRS MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.14	2.14	2.14
Measured maximum average power (dBm) at antenna port	30.63	30.69	30.56
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	32.77	32.83	32.70
Peak-to-average ratio (PAR) (dB)	0.42	0.45	0.44
Measurement uncertainty (dB)	±0.66		

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.14	2.14	2.14
Measured maximum average power (dBm) at antenna port	22.63	23.30	23.31
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	24.77	25.44	25.45
Peak-to-average ratio (PAR) (dB)	3.03	3.15	3.10
Measurement uncertainty (dB)	±0.66		

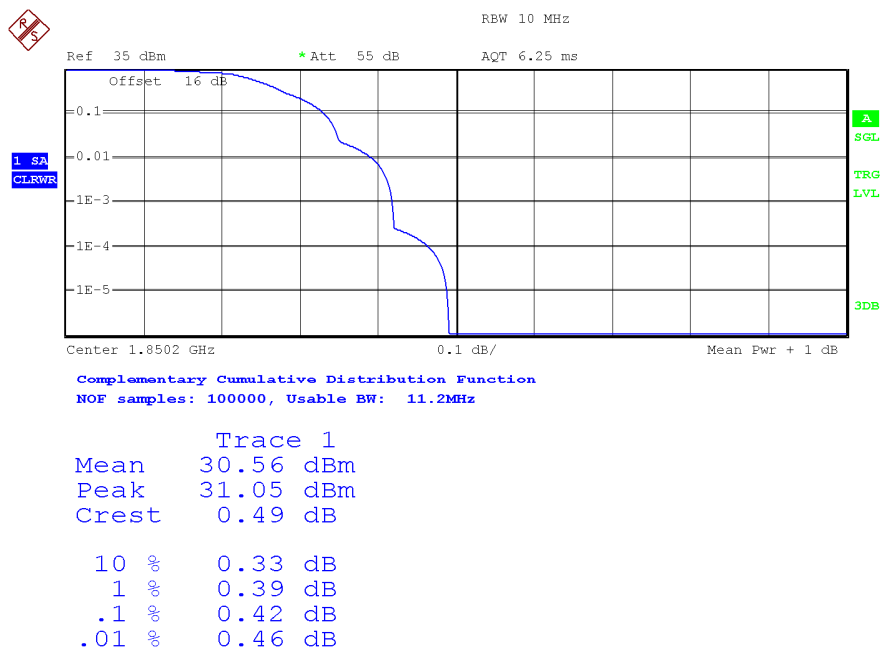
HSUPA MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	2.14	2.14	2.14
Measured maximum average power (dBm) at antenna port	22.20	22.82	22.93
Maximum effective isotropically radiated average power E.I.R.P. (dBm)	24.34	24.96	25.07
Peak-to-average ratio (PAR) (dB)	3.57	3.14	3.16
Measurement uncertainty (dB)	±0.66		

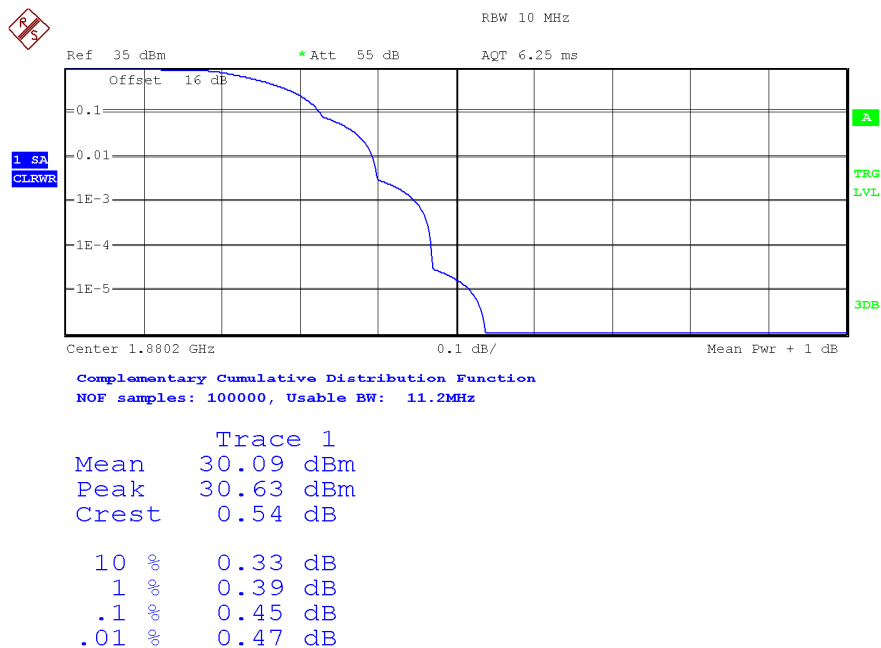
PEAK-TO-AVERAGE POWER RATIO (PAPR).

GPRS MODULATION

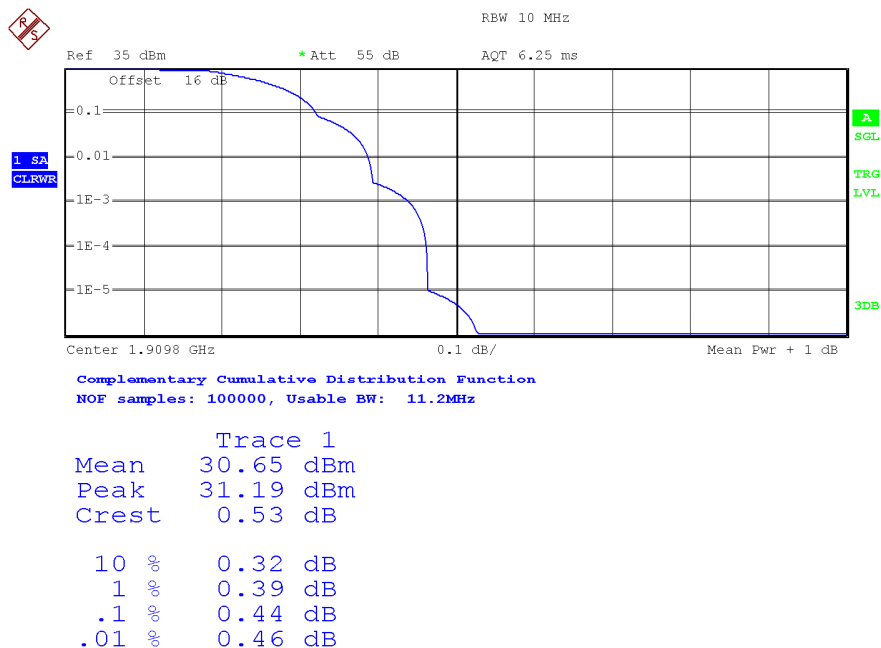
Channel Low:



Channel Middle:

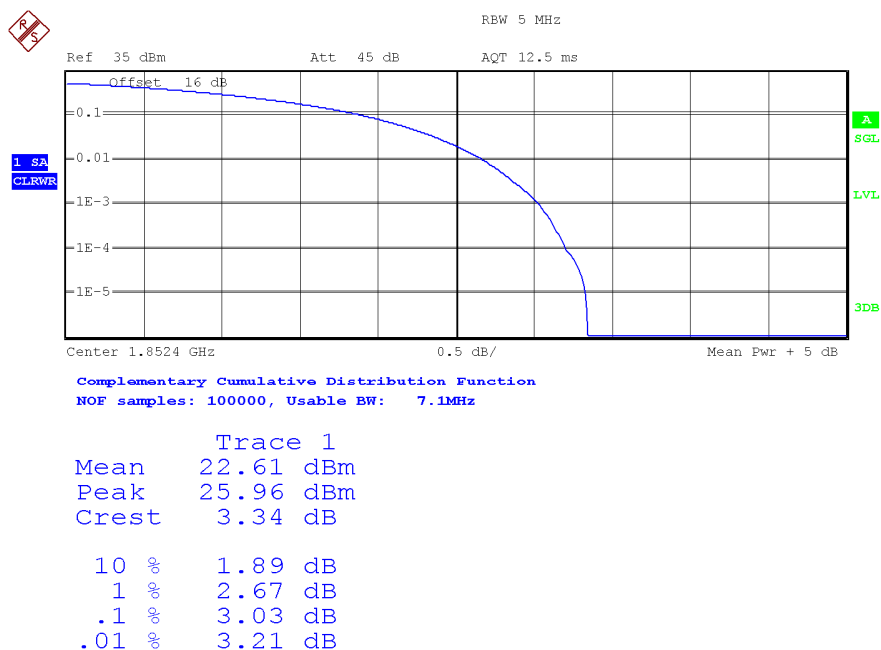


Channel High:

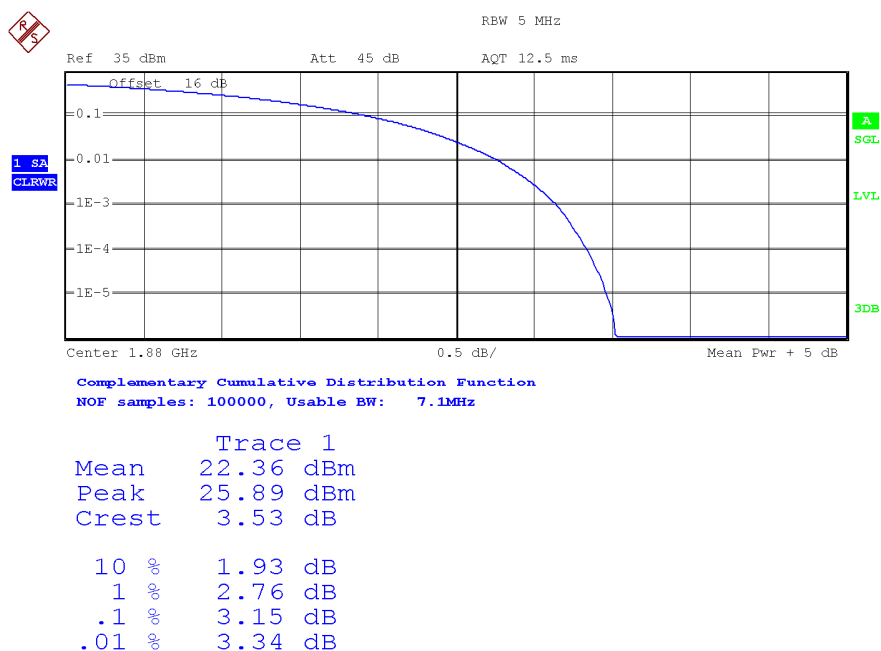


WCDMA MODULATION

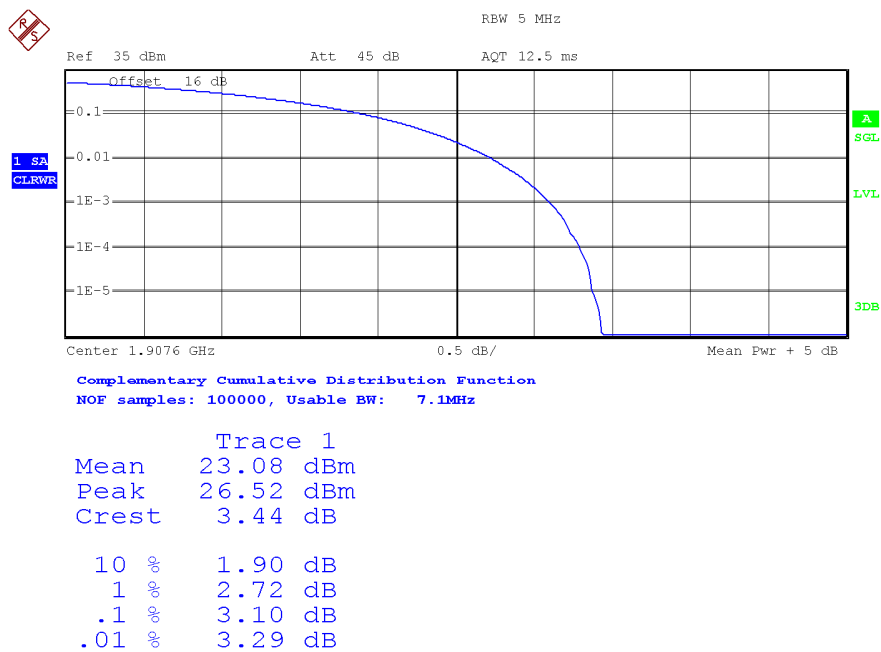
Channel Low:



Channel Middle:

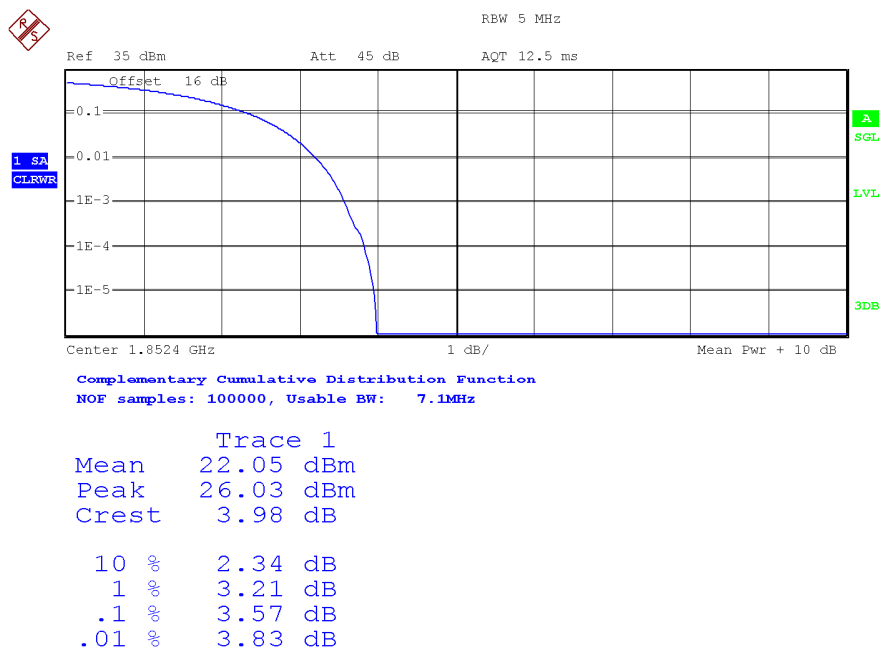


Channel High:

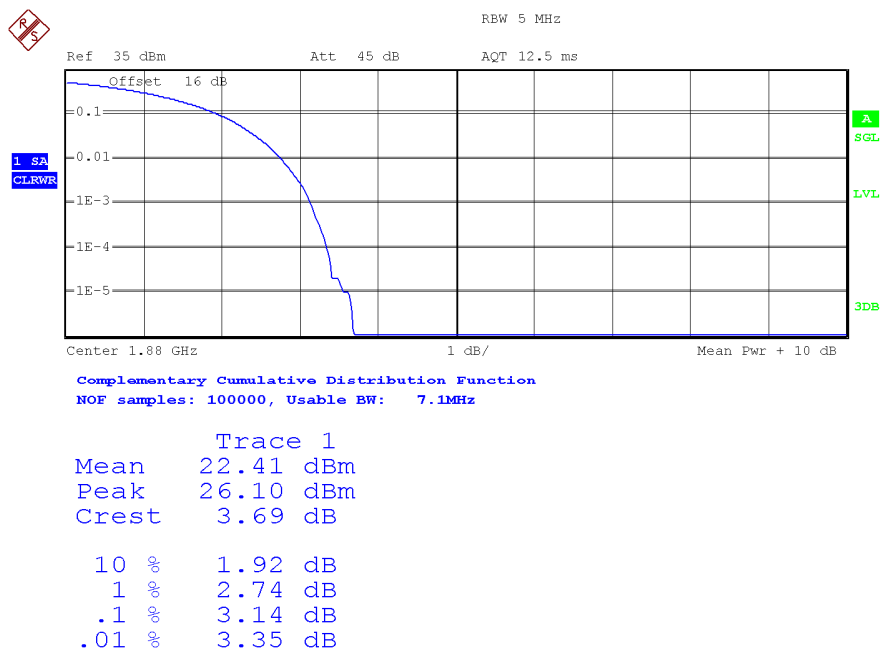


HSUPA MODULATION

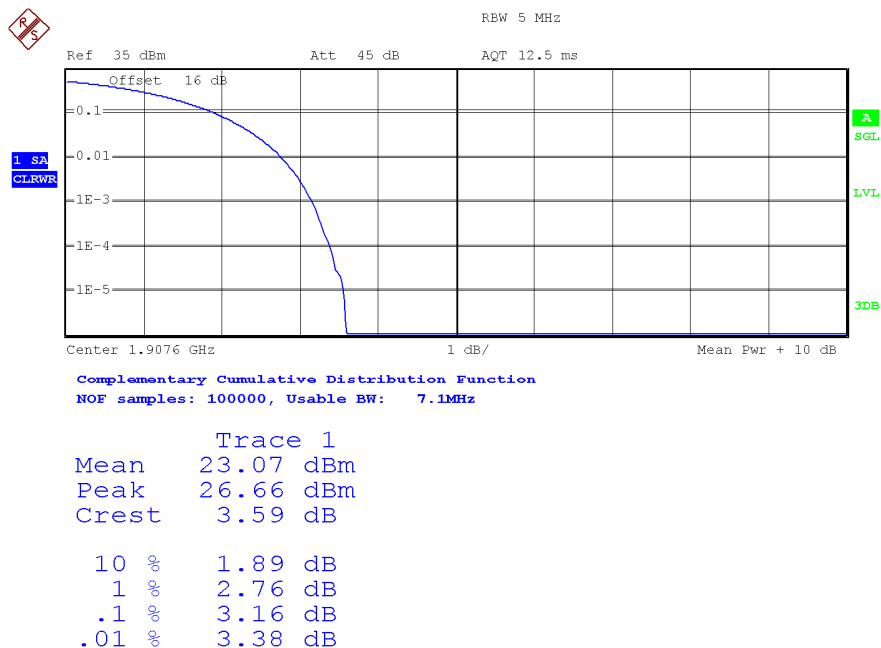
Channel Low:



Channel Middle:



Channel High:



Modulation Characteristics

SPECIFICATION

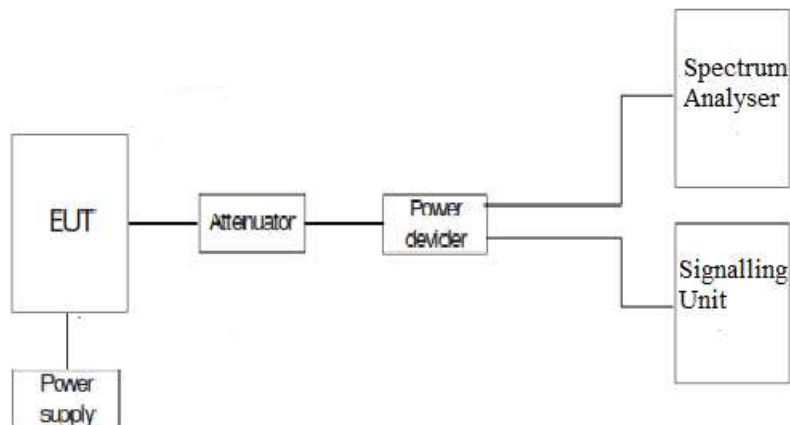
FCC §2.1047

RSS-133. Clause 6.2. The devices shall employ digital modulation techniques.

METHOD

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

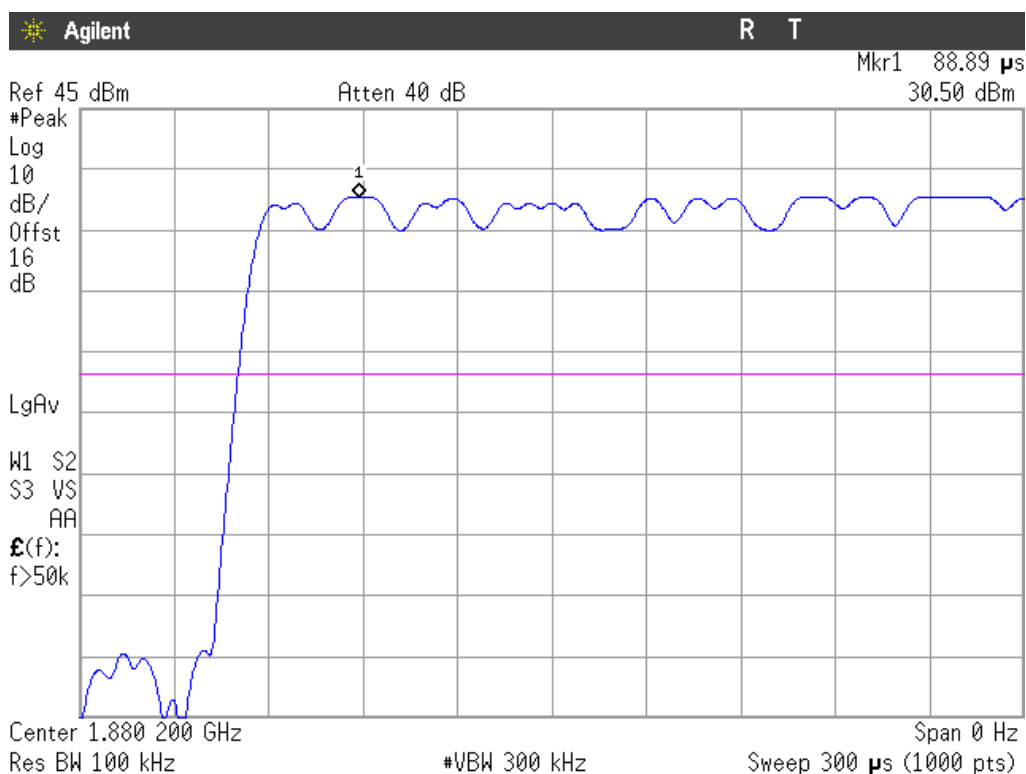
TEST SETUP



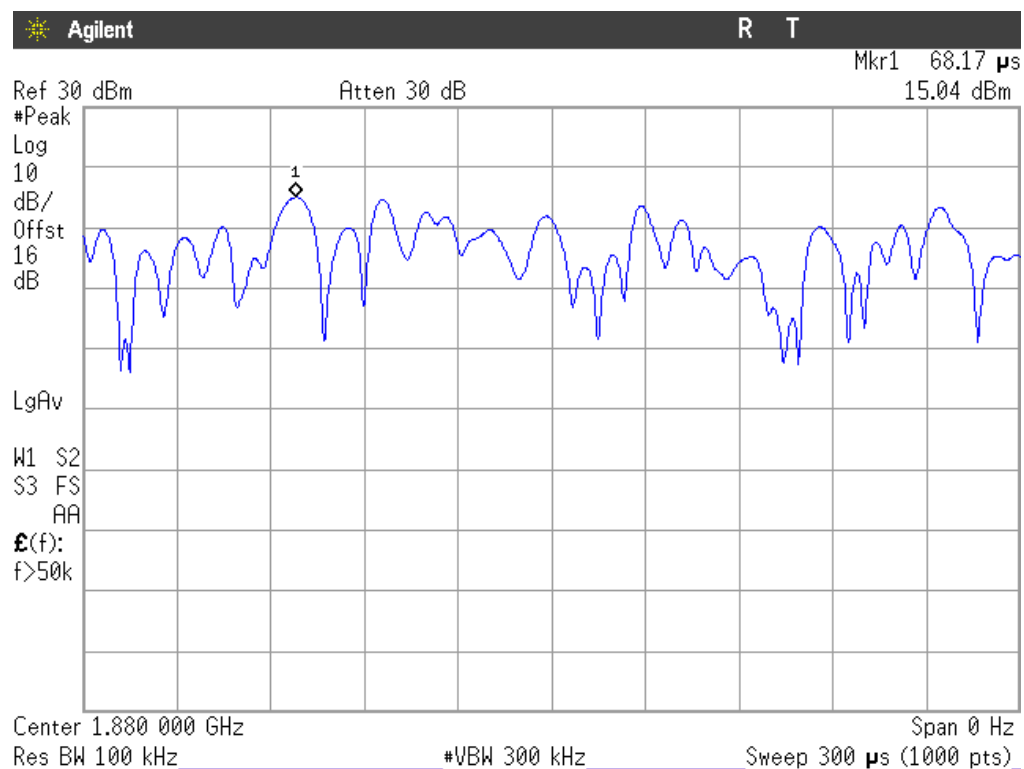
RESULTS

The following plot shows the modulation schemes in the EUT.

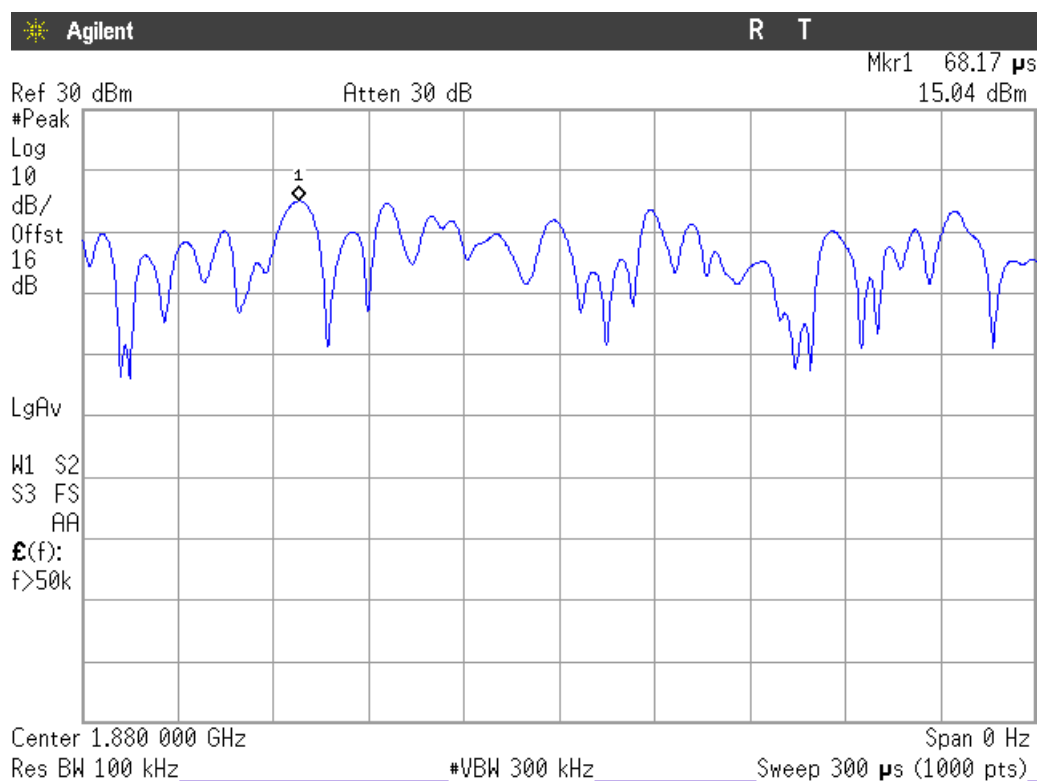
GPRS MODULATION



WCDMA MODULATION



HSUPA MODULATION



Frequency Stability

SPECIFICATION

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

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

METHOD

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

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

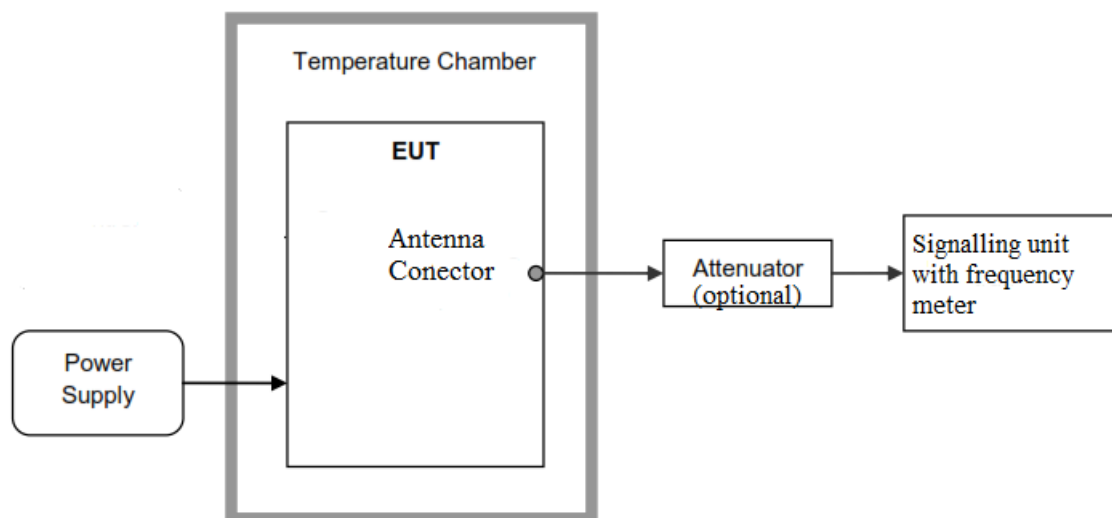
The EUT was set in “call mode” in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.

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

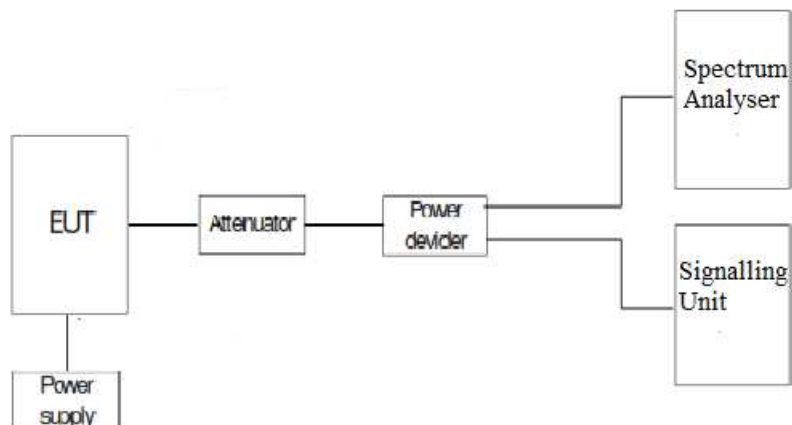
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP

Frequency tolerance.



Reference points f_L and f_H .



RESULTS

Frequency stability over temperature variations.

GPRS MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	-11.62	-0.0062	-0.00000062
+40	-11.85	-0.0063	-0.00000063
+30	-10.01	-0.0053	-0.00000053
+20	8.72	0.0046	0.00000046
+10	-6.72	-0.0036	-0.00000036
0	-1.55	-0.0008	-0.00000008
-10	12.14	0.0065	0.00000065
-20	7.59	0.0040	0.00000040
-30	4.91	0.0026	0.00000026

WCDMA AND HSUPA MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	24.12	0.0128	0.00000128
+40	17.70	0.0094	0.00000094
+30	20.16	0.0107	0.00000107
+20	-20.37	-0.0108	-0.00000108
+10	-15.26	-0.0081	-0.00000081
0	12.54	0.0067	0.00000067
-10	-12.25	-0.0065	-0.00000065
-20	-20.56	-0.0109	-0.00000109
-30	-30.64	-0.0163	-0.00000163

Frequency stability over voltage variations.

GPRS MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.37	-7.59	-0.0040	-0.00000040
Vmin	3.23	10.01	0.0053	0.00000053

WCDMA AND HSUPA MODULATION

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.37	-30.91	-0.0164	-0.00000164
Vmin	3.23	-21.55	-0.0115	-0.00000115

Reference points established at the applicable unwanted emissions limit:

	GPRS MODULATION	WCDMA MODULATION	HSUPA MODULATION
f_L (MHz)	1850.0325	1850.1692	1850.1792
f_H (MHz)	1909.9660	1909.8068	1909.8008

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

	GPRS MODULATION	WCDMA MODULATION	HSUPA MODULATION
f_L (MHz)	1850.0325	1850.1692	1850.1792
f_H (MHz)	1909.9660	1909.8068	1909.8008

The reference frequency points stay within the authorized blocks.

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

Occupied Bandwidth

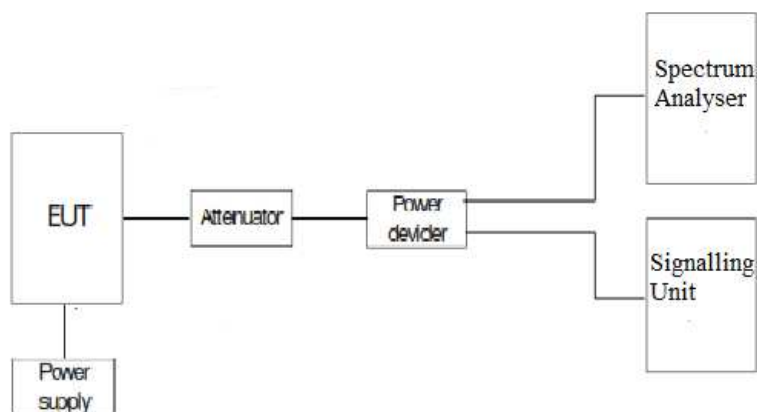
SPECIFICATION

FCC §2.1049

METHOD

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S R&S CMU200 or CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

TEST SETUP



RESULTS

GPRS MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	244.47	243.54	244.37
-26 dBc bandwidth (kHz)	315.24	315.88	315.15
Measurement uncertainty (kHz)	<±1.67		

WCDMA MODULATION

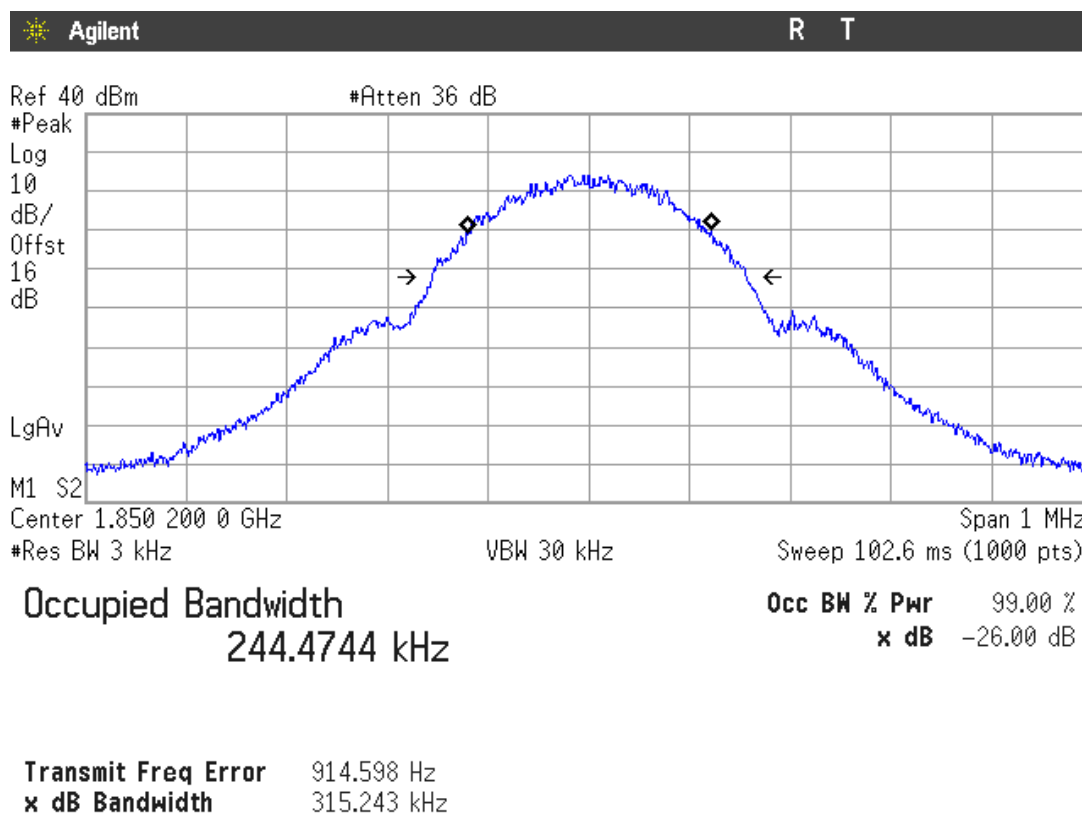
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4071.30	4060.40	4055.20
-26 dBc bandwidth (kHz)	4643.00	4618.00	4625.00
Measurement uncertainty (kHz)	<±16.67		

HSUPA MODULATION

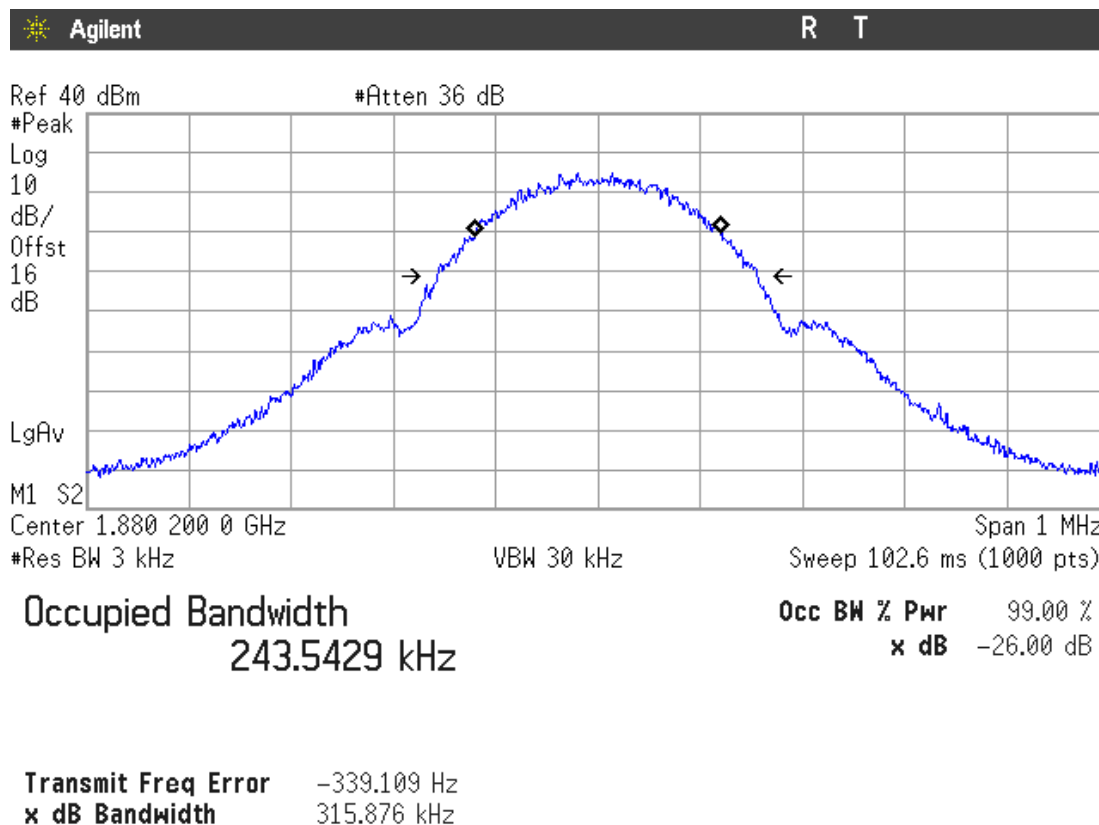
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4071.30	4065.90	4057.40
-26 dBc bandwidth (kHz)	4631.00	4614.00	4636.00
Measurement uncertainty (kHz)	<±16.67		

GPRS MODULATION

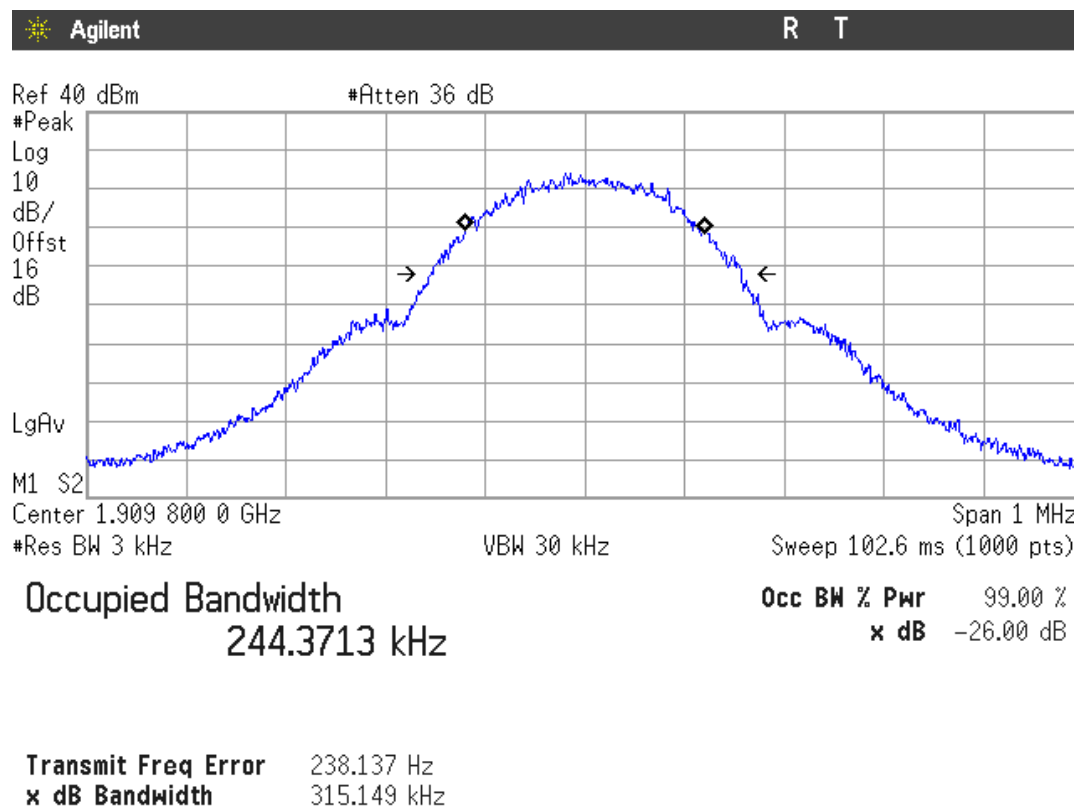
Lowest Channel



Middle Channel

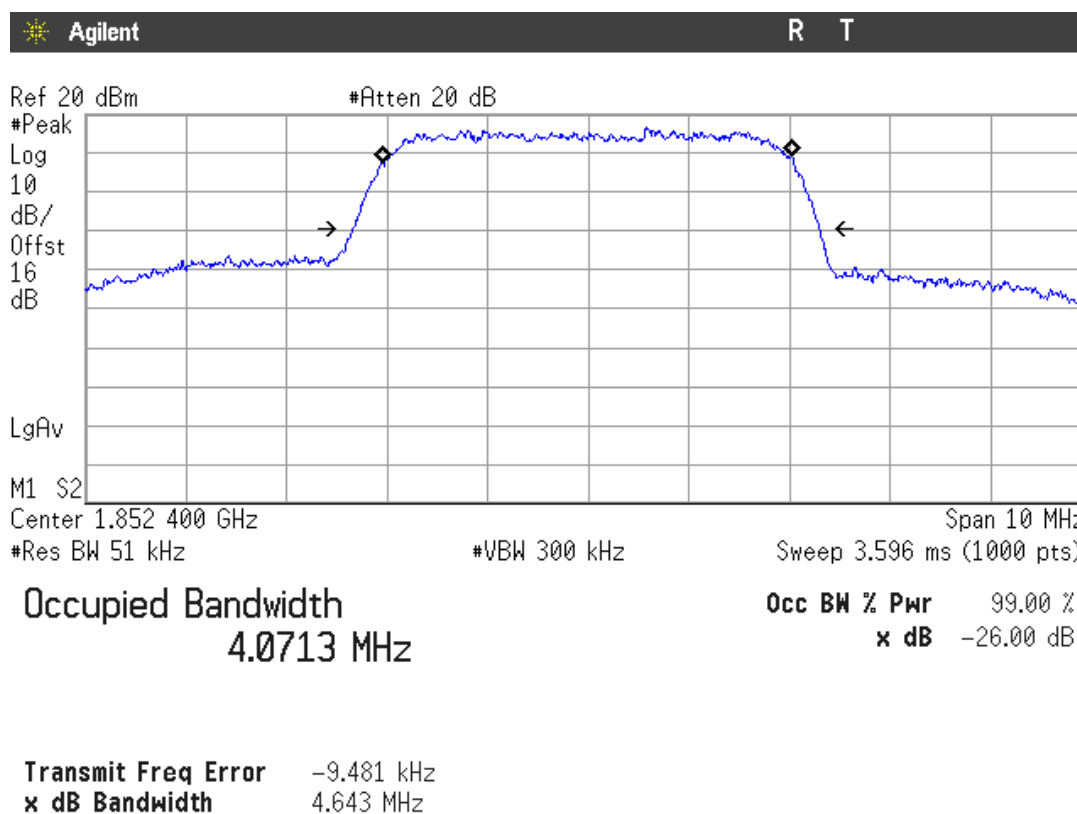


Highest Channel

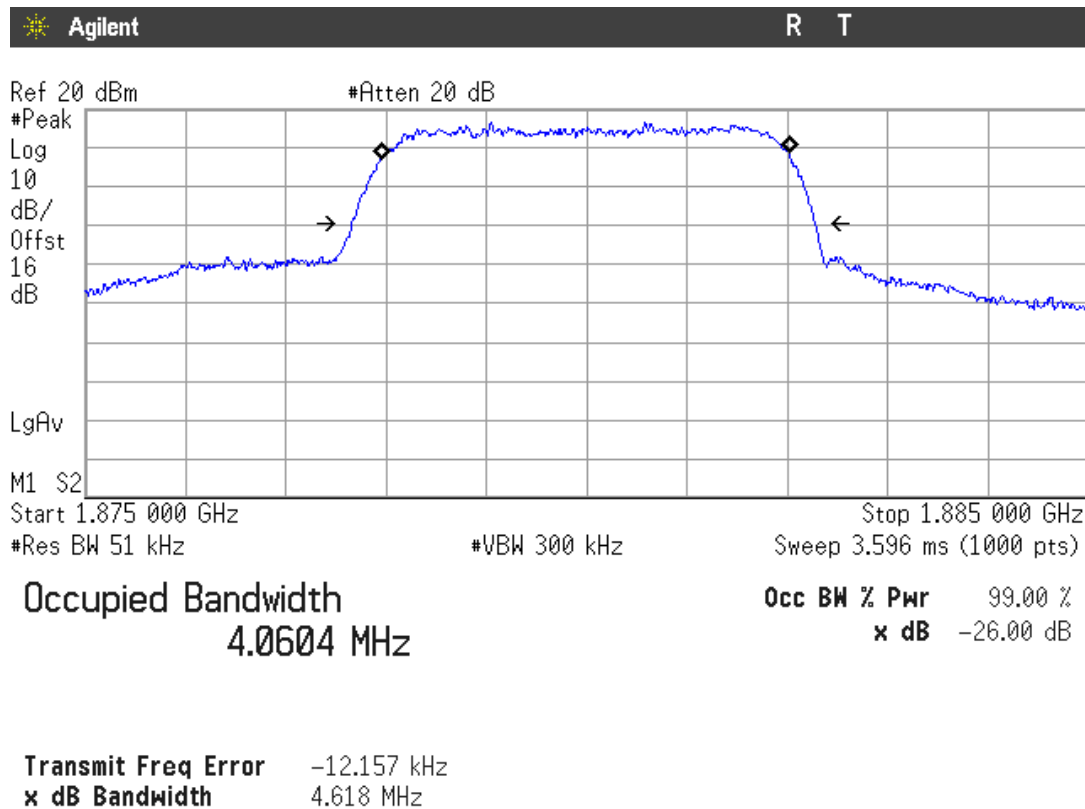


WCDMA MODULATION

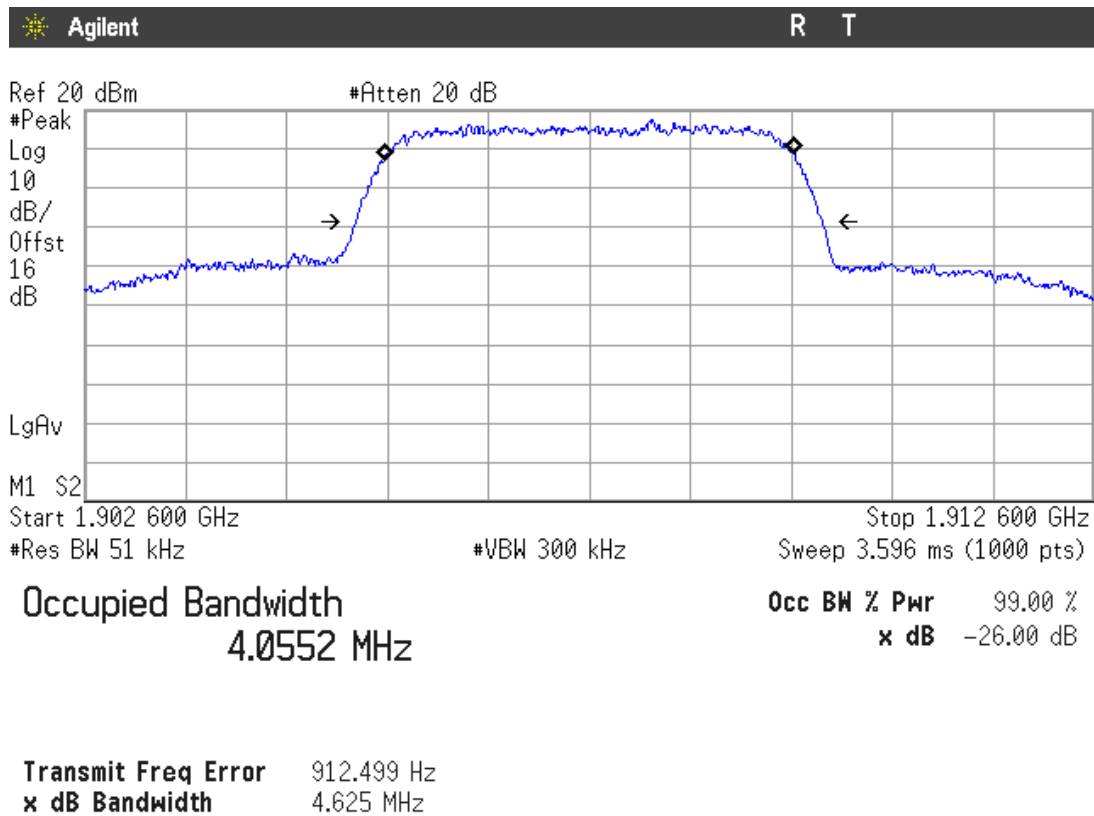
Lowest Channel



Middle Channel

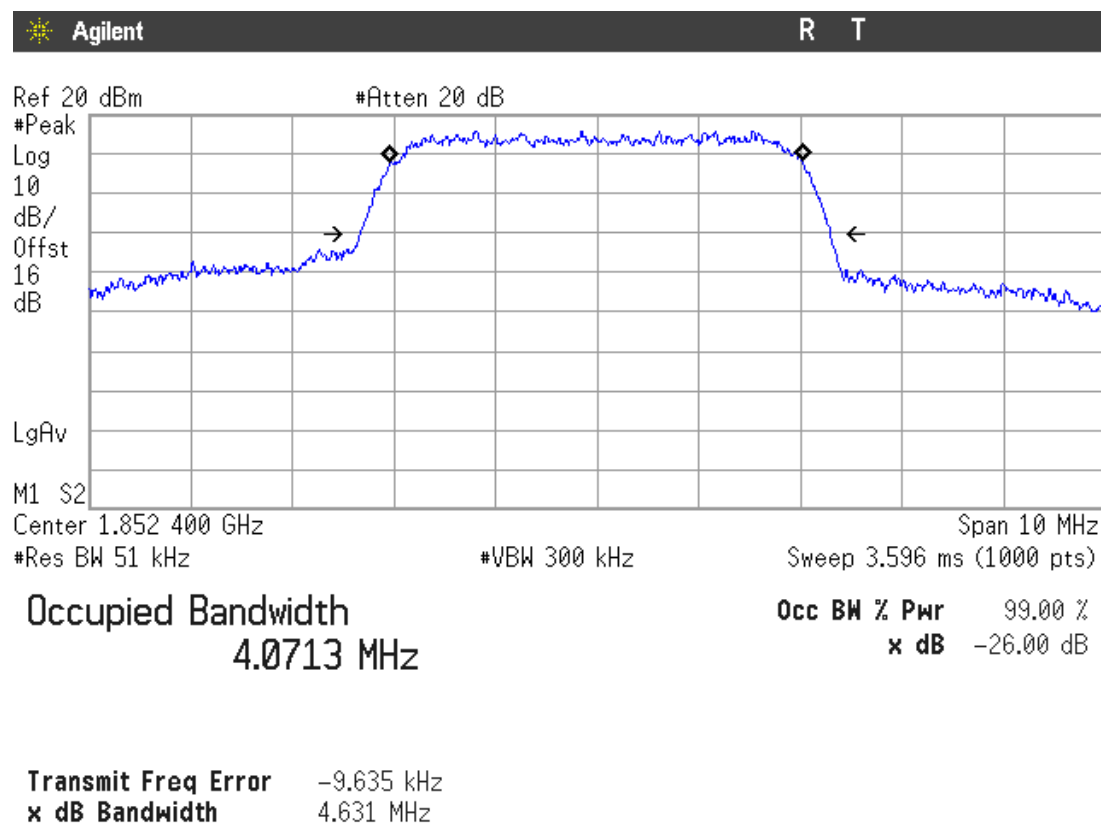


Highest Channel

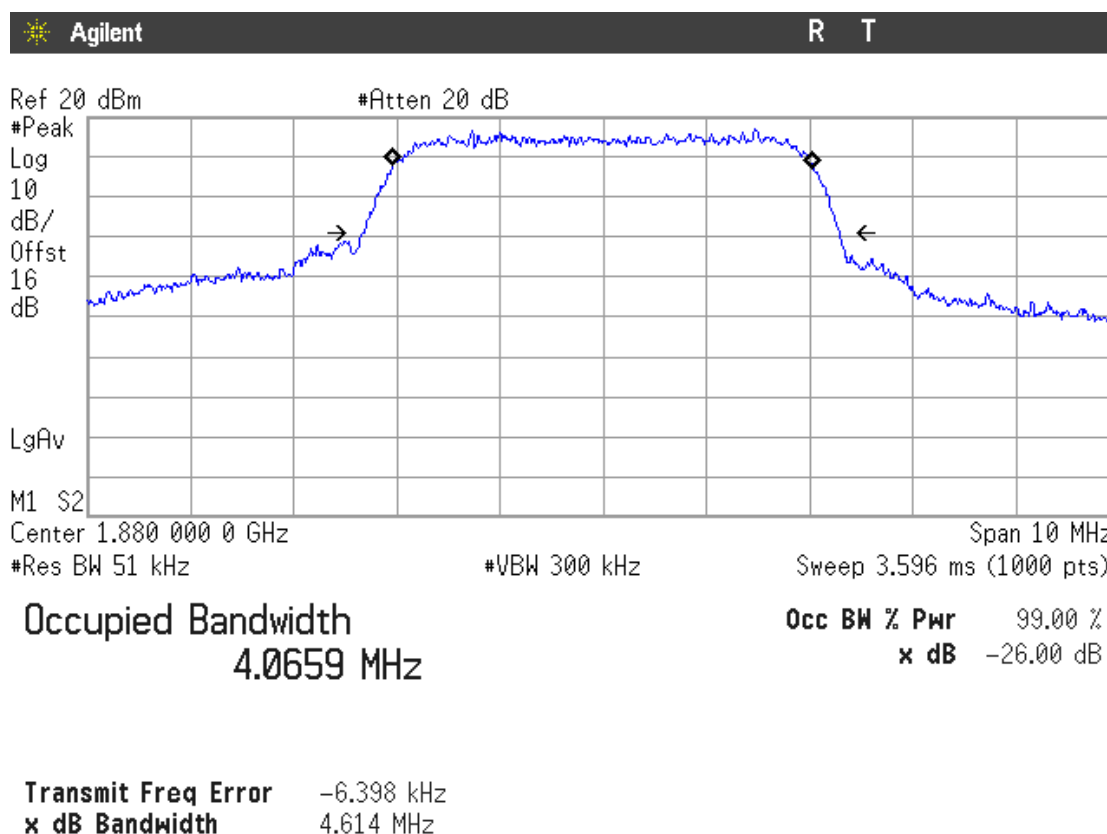


HSUPA MODULATION

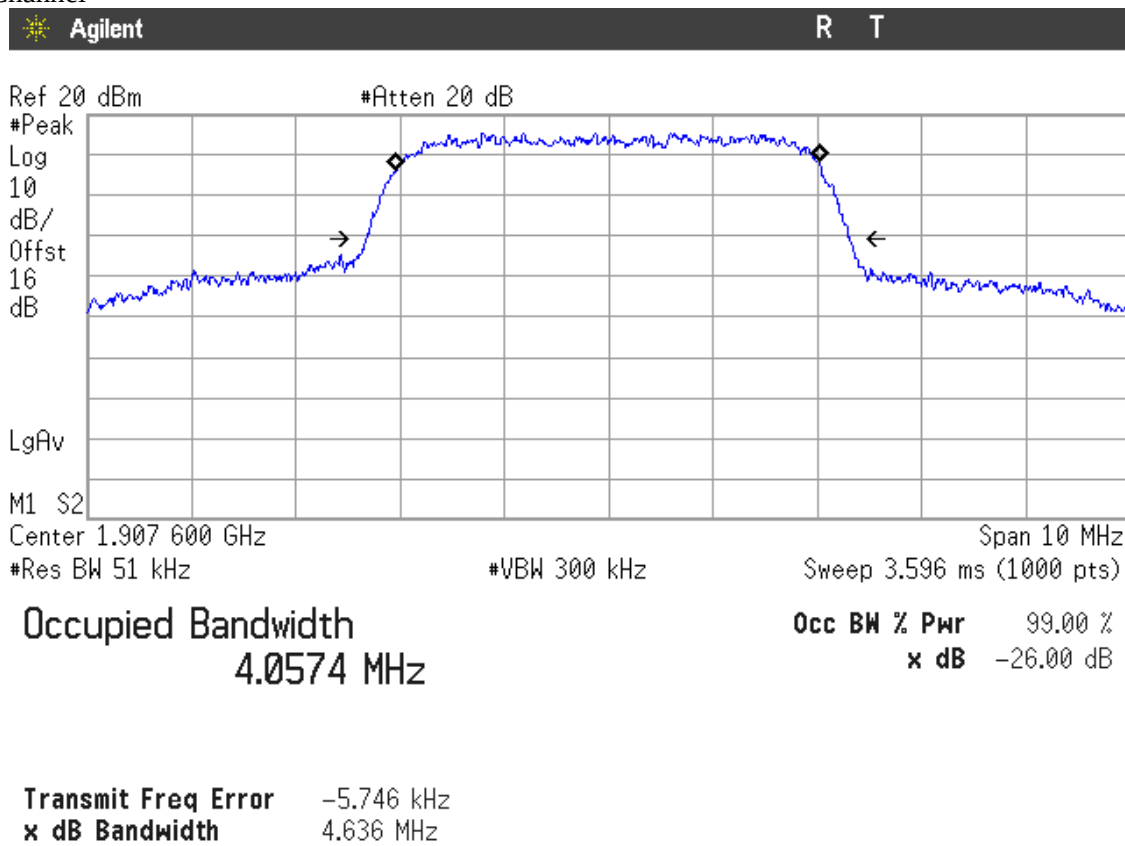
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051 and §24.238

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

The spectrum was investigated from 9 kHz to 20 GHz.

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

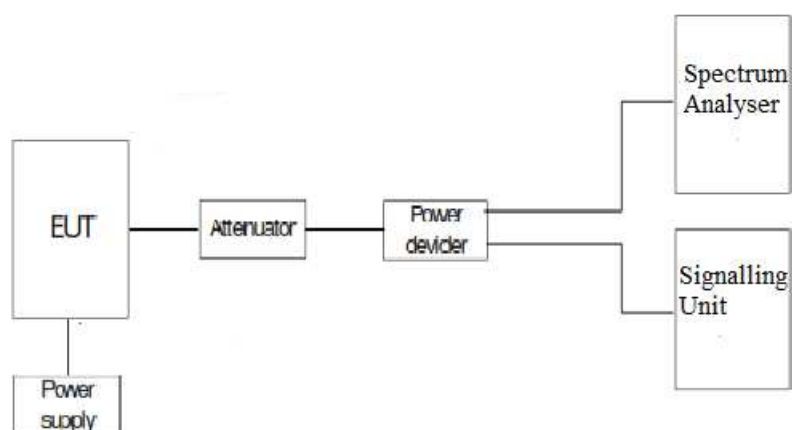
Measurement Limit:

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

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

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

TEST SETUP



RESULTS (see plots in next pages)

GPRS MODULATION

1. CHANNEL: LOWEST

No spurious signals were found in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found in all the range.

3. CHANNEL: HIGHEST

No spurious signals were found in all the range.

WCDMA MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

3. CHANNEL: HIGHEST

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

HSUPA MODULATION

1. CHANNEL: LOWEST

No spurious signals were found in all the range.

2. CHANNEL: MIDDLE

No spurious signals were found in all the range.

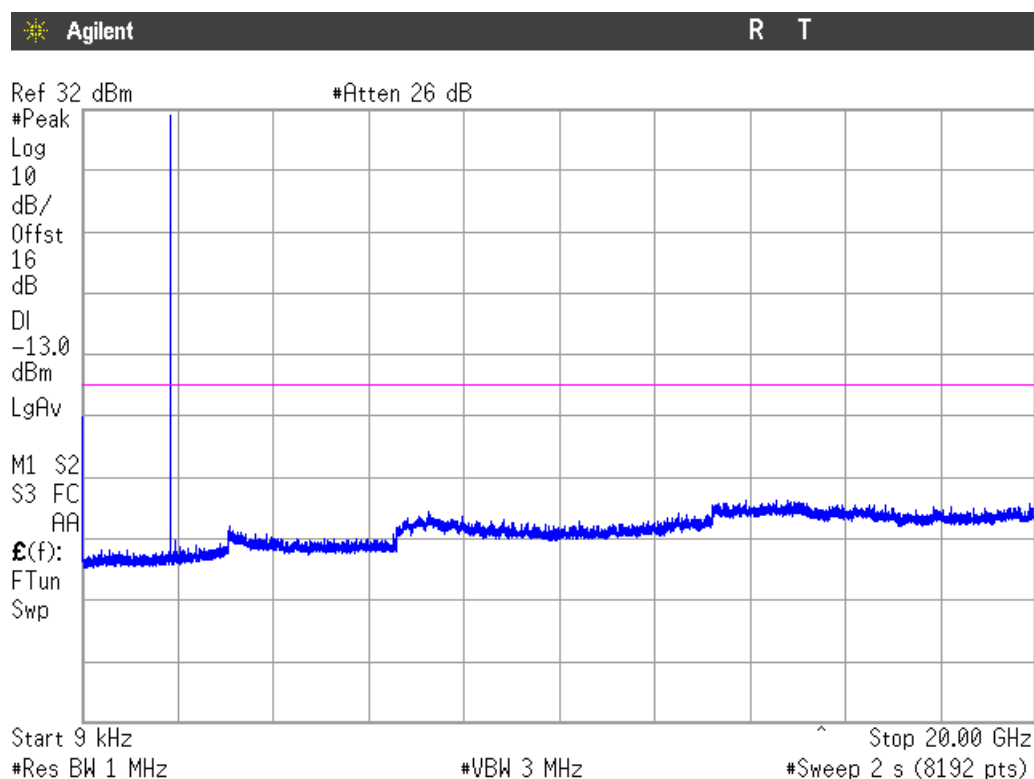
3. CHANNEL: HIGHEST

No spurious signals were found in all the range.

Verdict: PASS

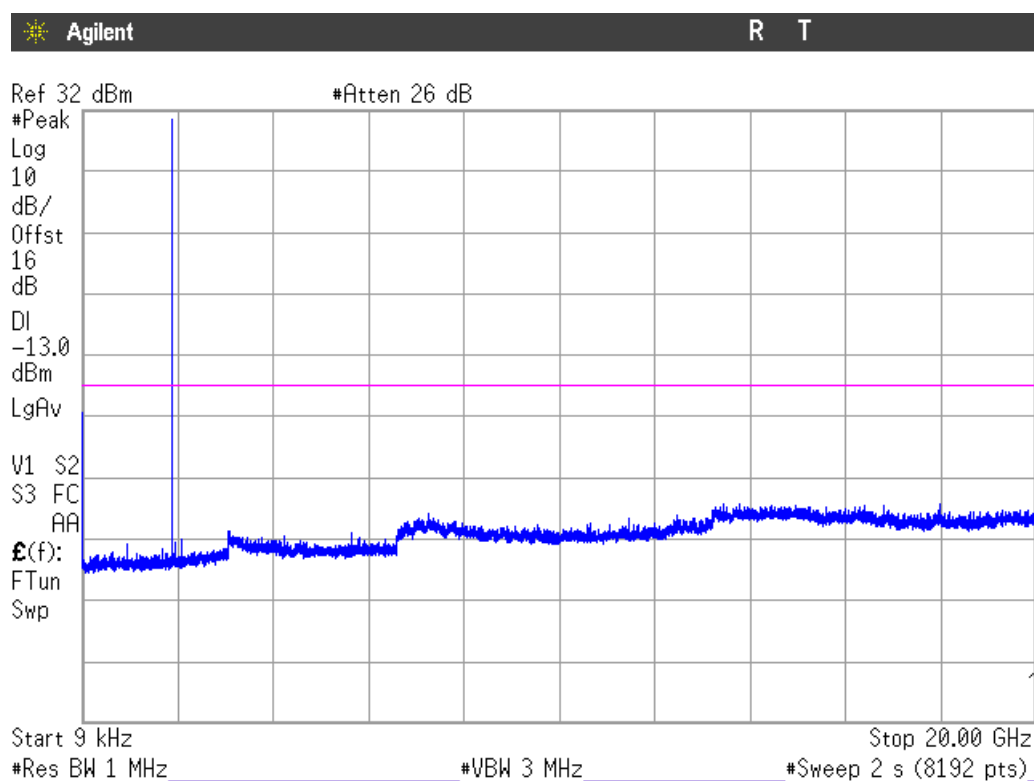
GPRS MODULATION

1. CHANNEL: LOWEST



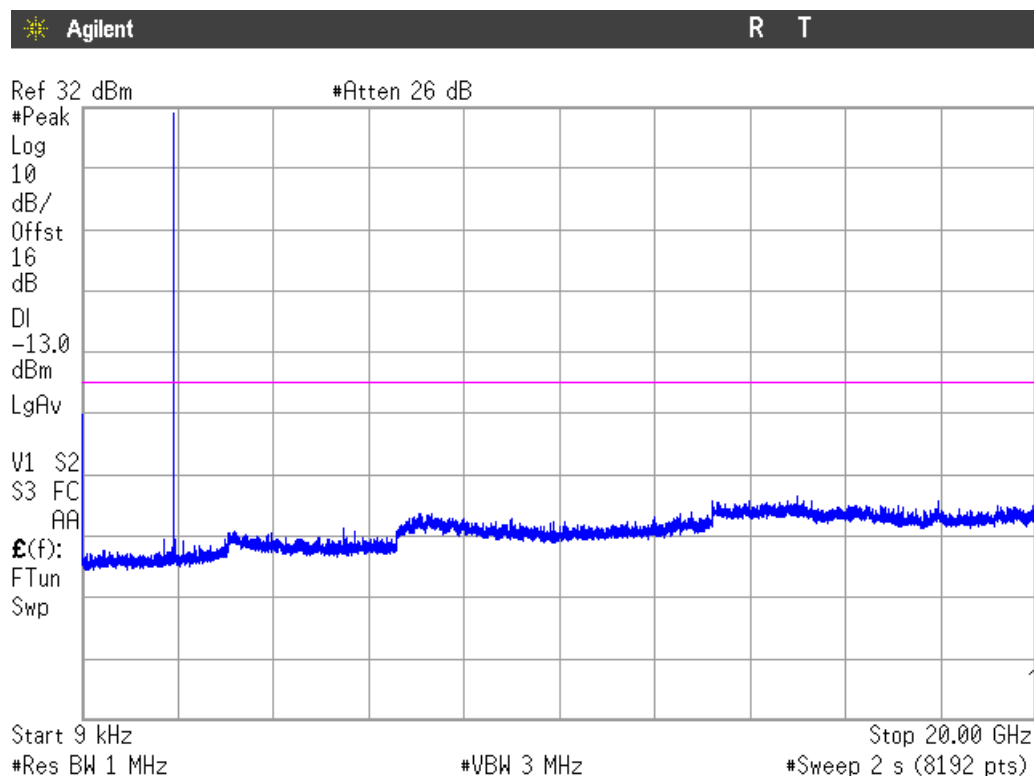
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

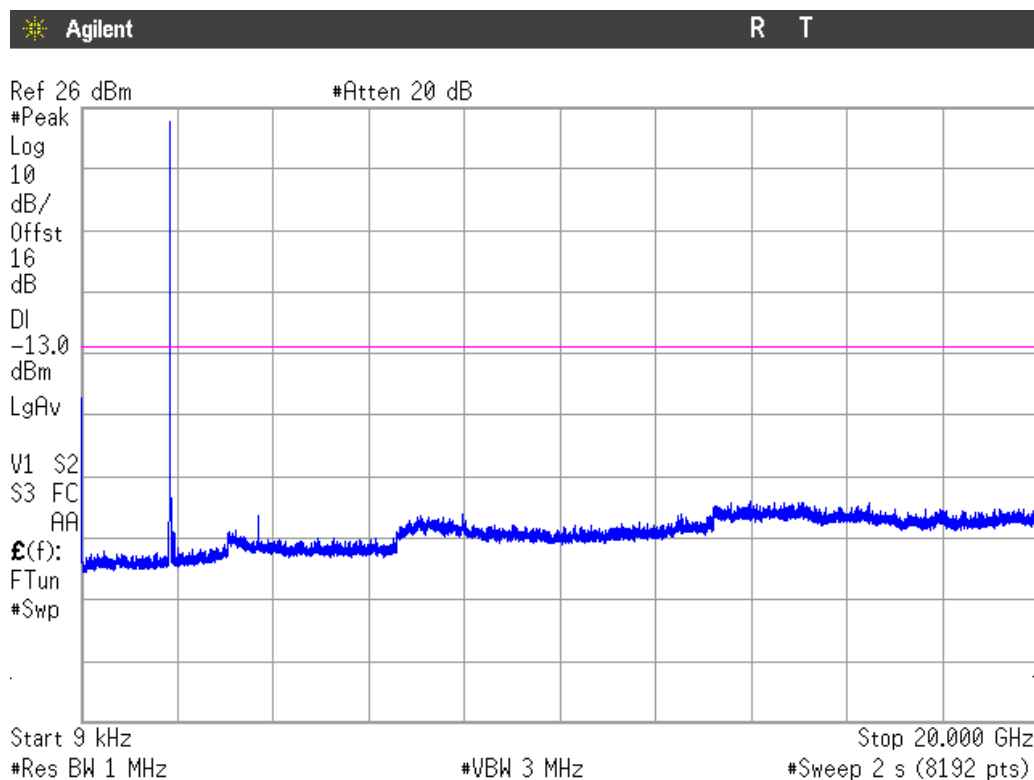
3. CHANNEL: HIGHEST



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

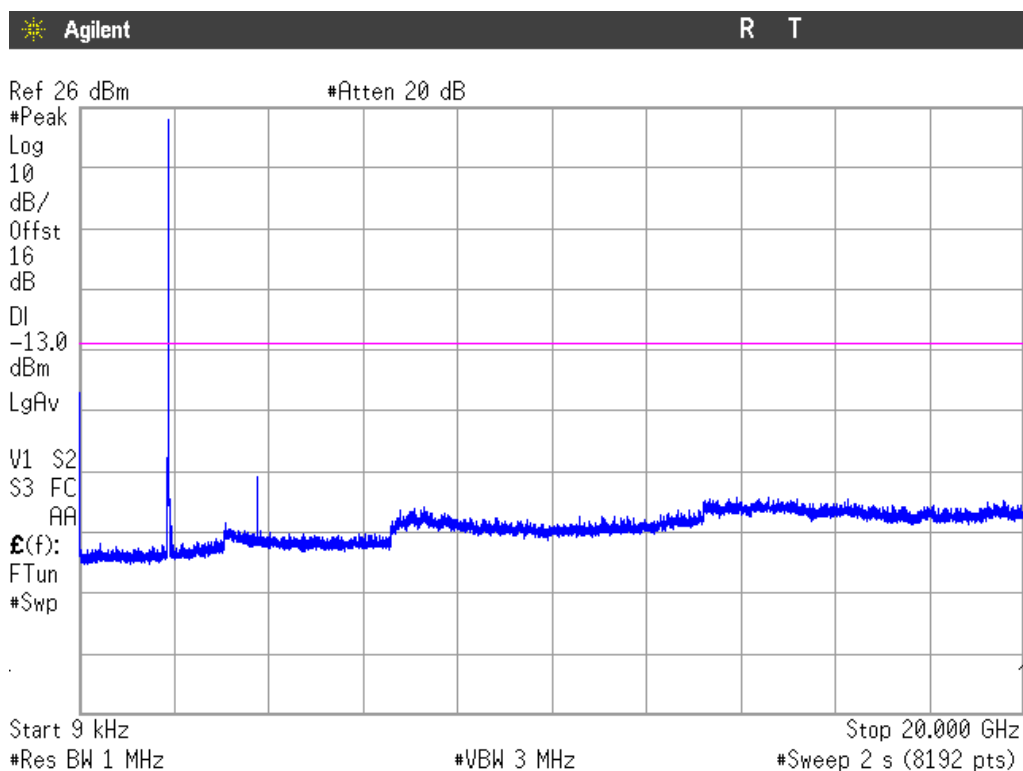
WCDMA MODULATION

1. CHANNEL: LOWEST



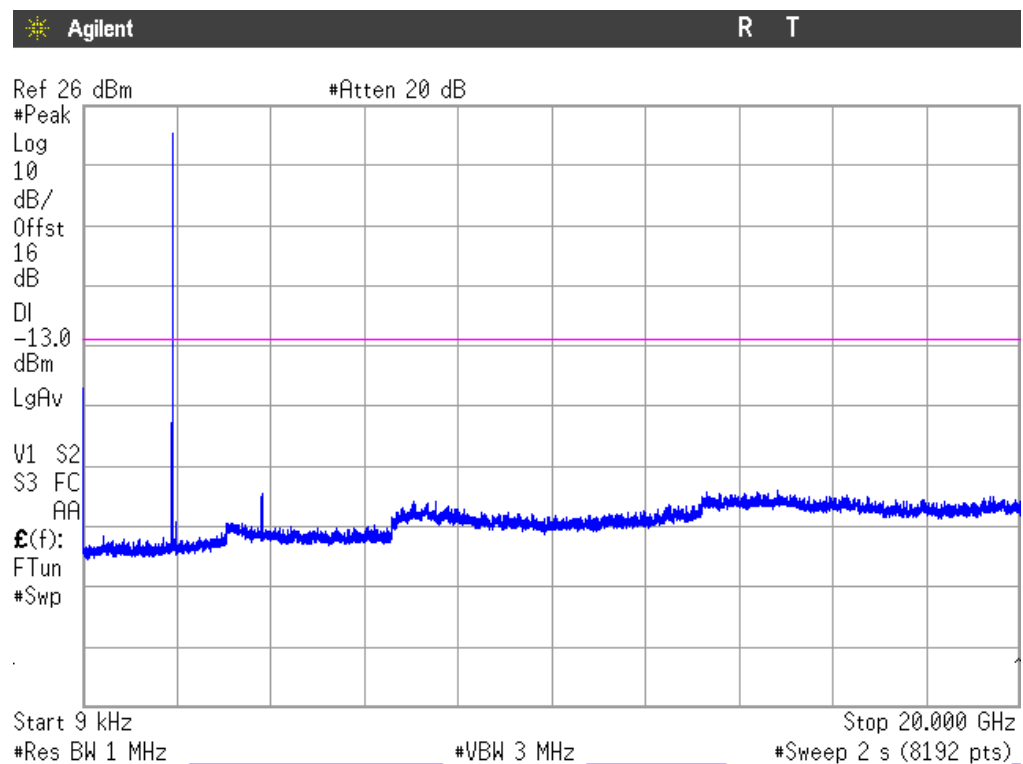
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

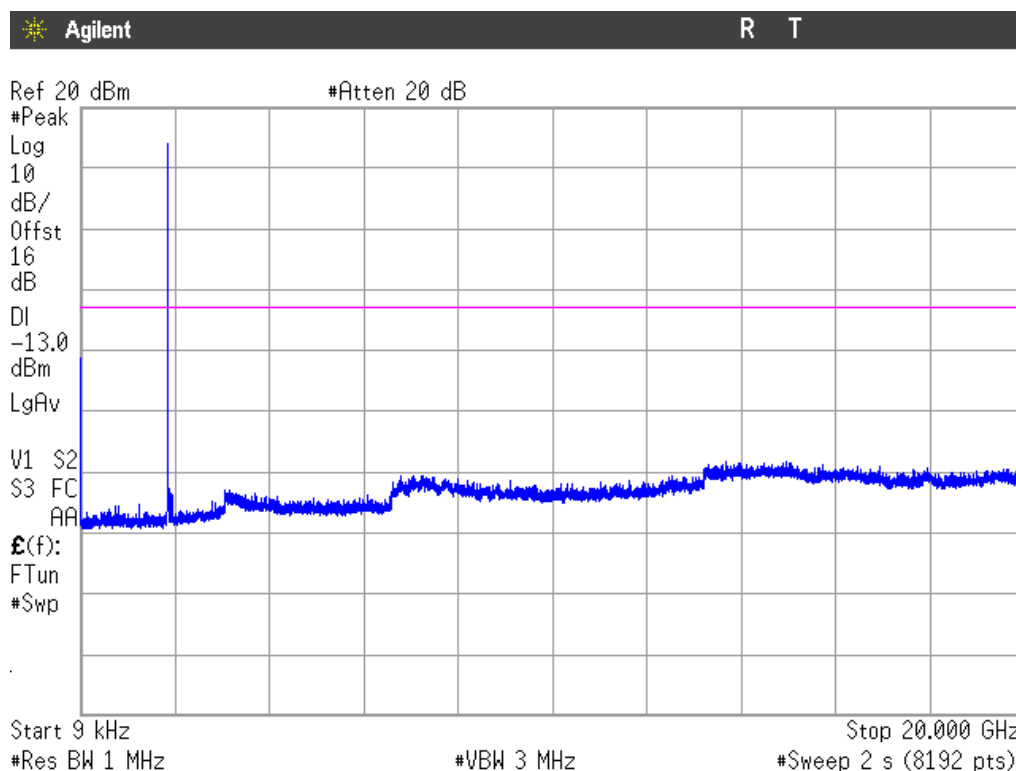
3. CHANNEL: HIGHEST



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

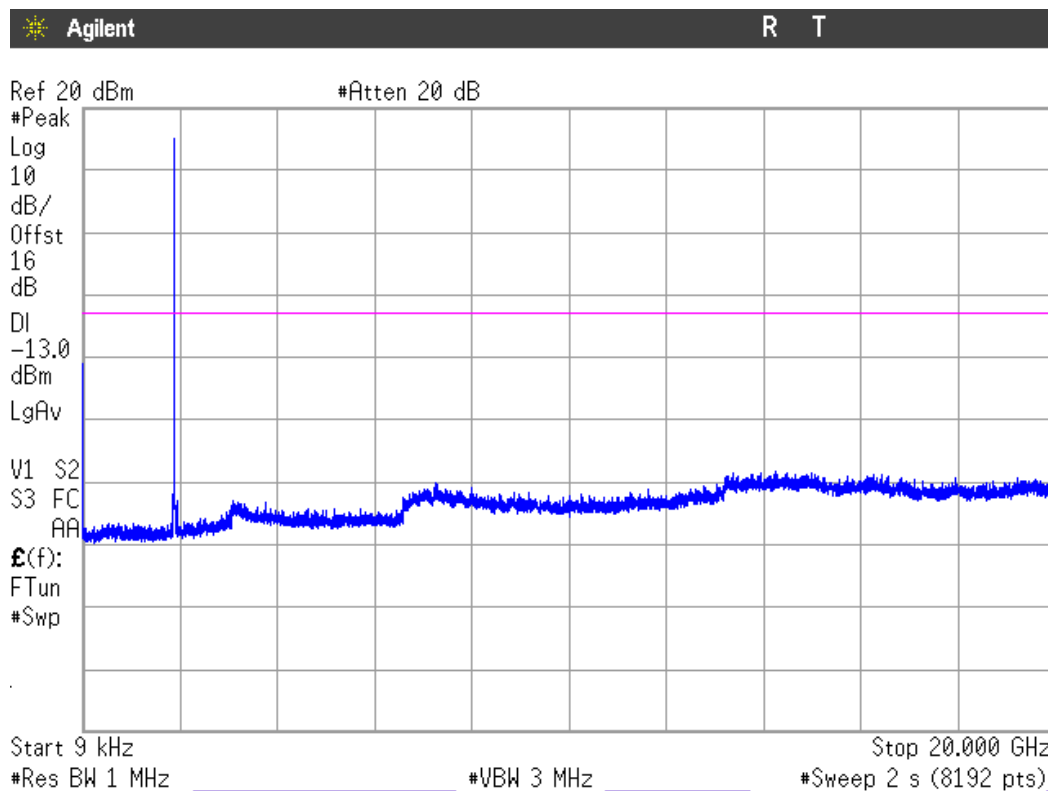
HSUPA MODULATION

1. CHANNEL: LOWEST



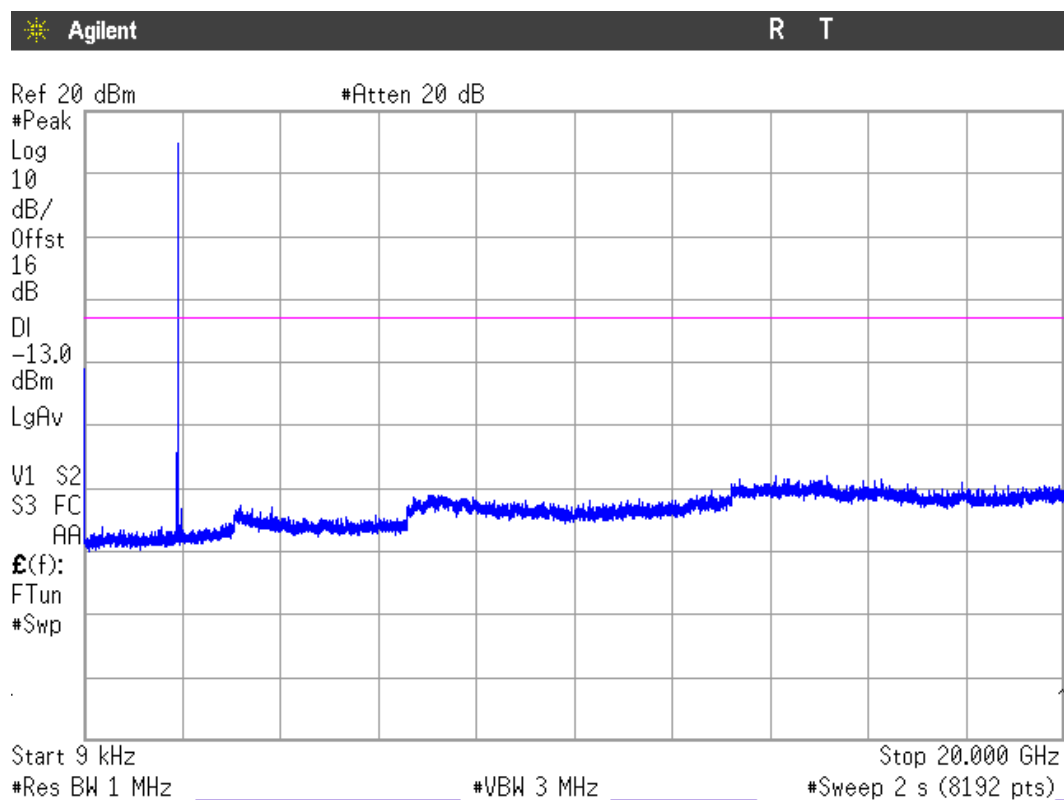
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

3. CHANNEL: HIGHEST



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

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

SPECIFICATION

FCC §2.1051 and §24.238

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.

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.

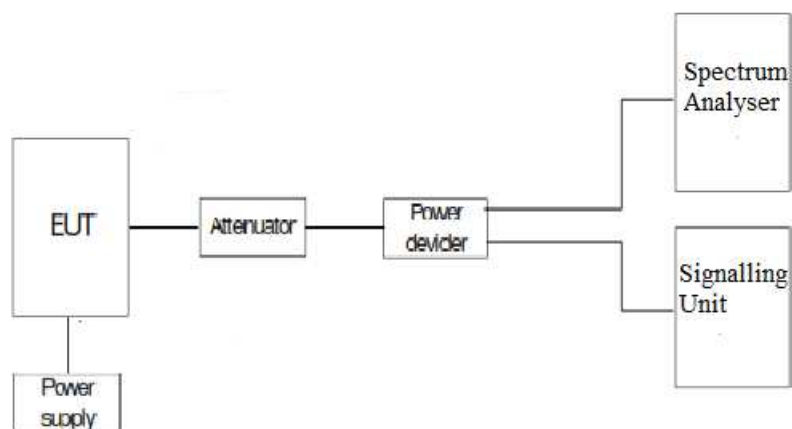
Measurement Limit:

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

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

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

TEST SETUP



RESULTS (see plots in next pages)

MODULATION:	GPRS	WCDMA	HSUPA
Maximum measured level at lowest Block Edge at antenna port (dBm)	-13.47	-14.00	-22.90
Measurement uncertainty (dB)	±2.03		

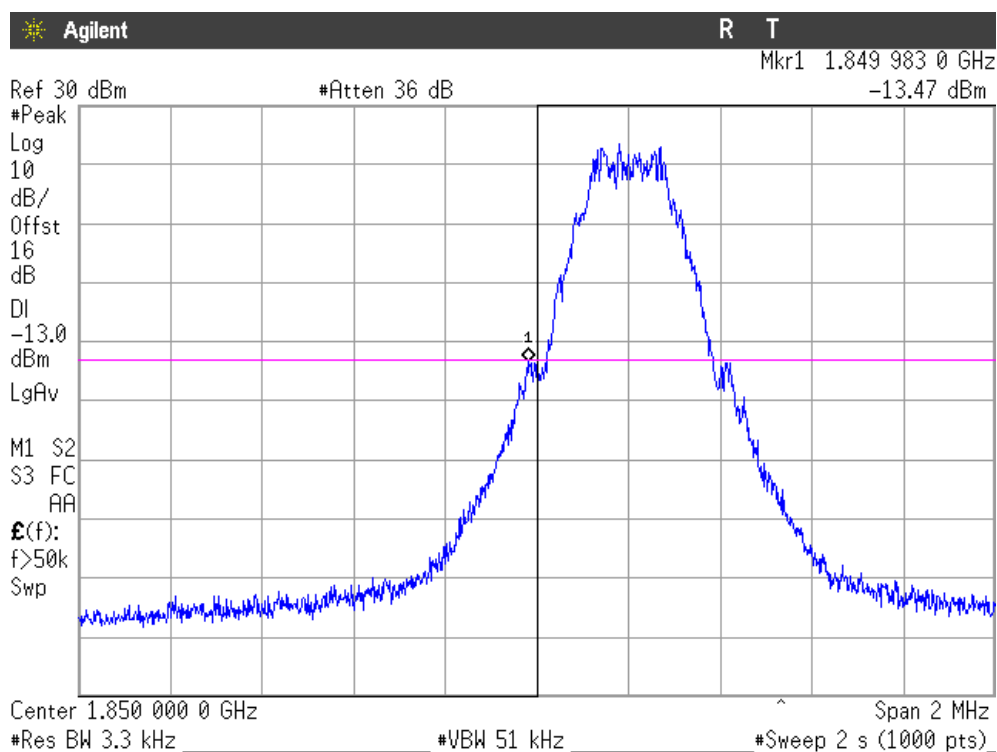
MODULATION:	GPRS	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-13.52	-18.83	-26.68
Measurement uncertainty (dB)	±2.03		

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

Verdict: PASS

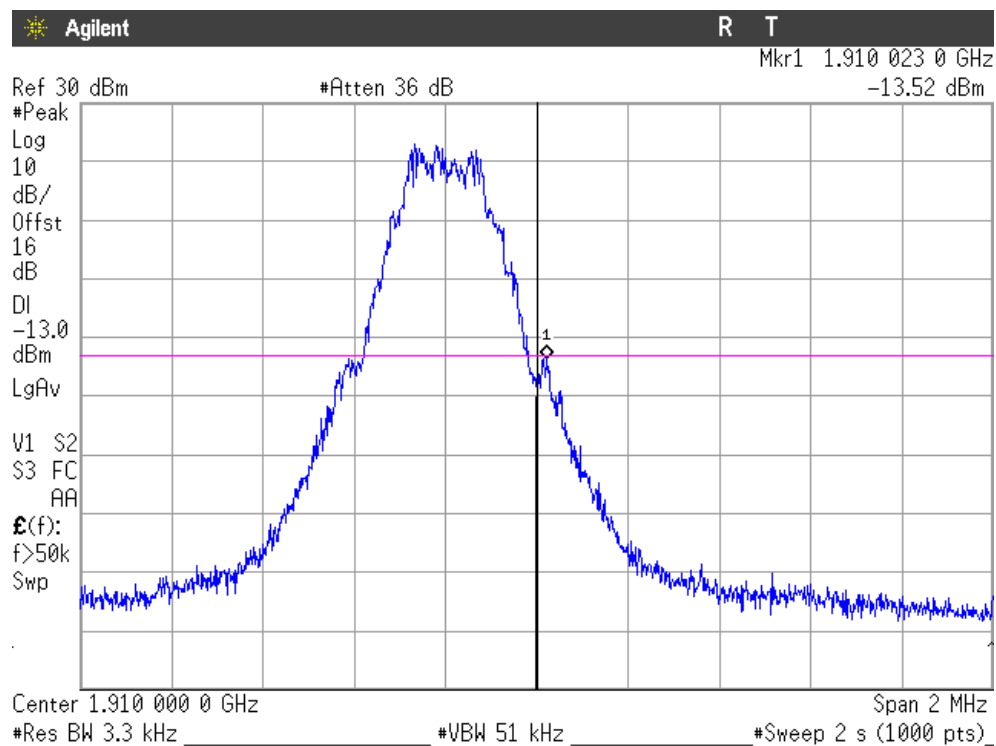
GPRS MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

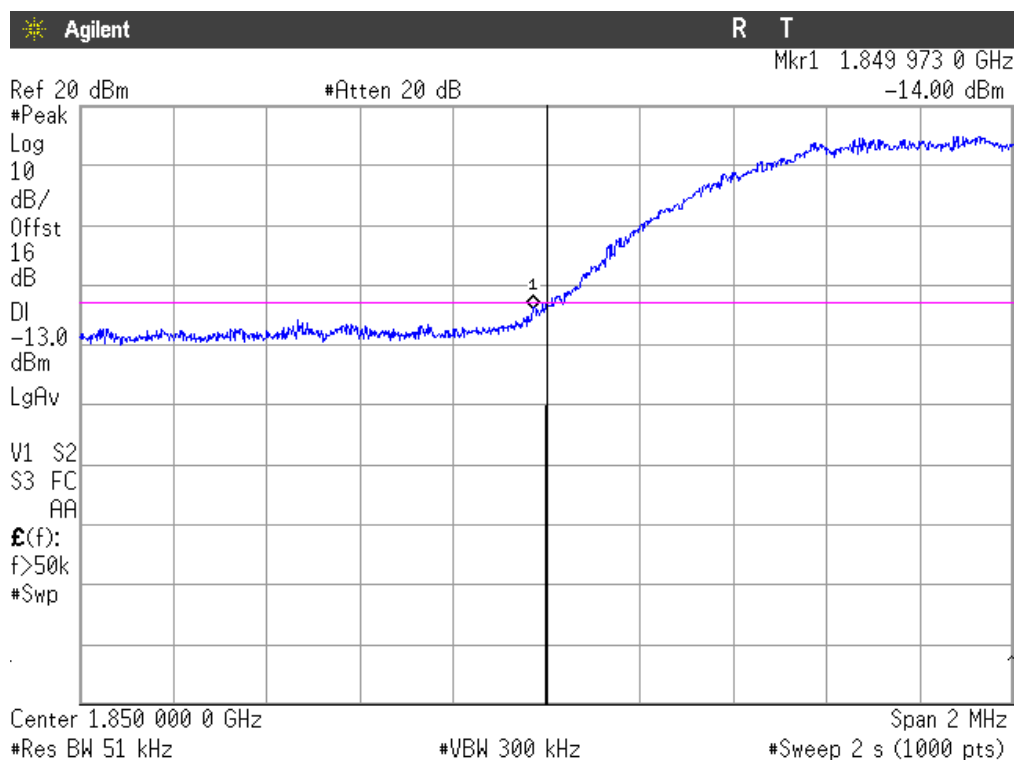
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

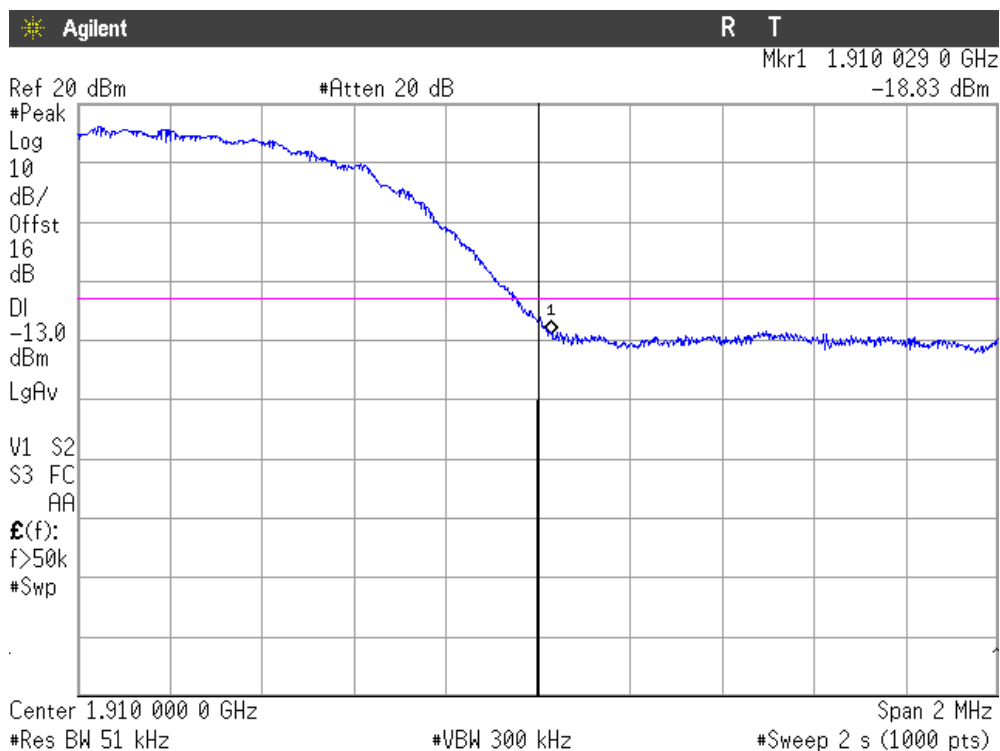
WCDMA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

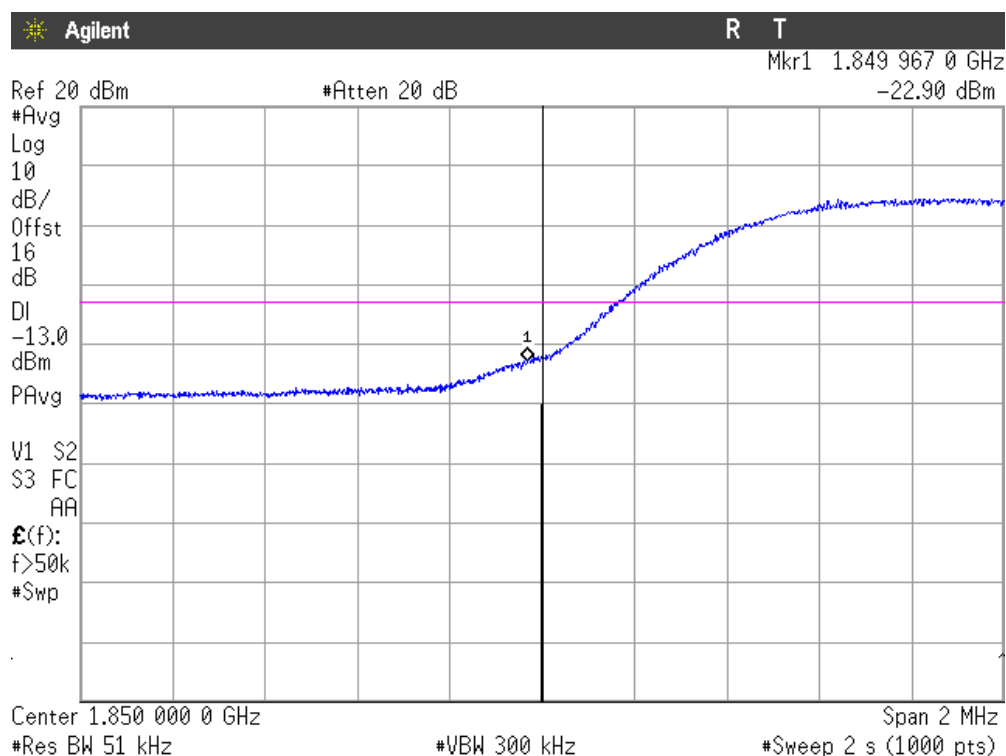
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

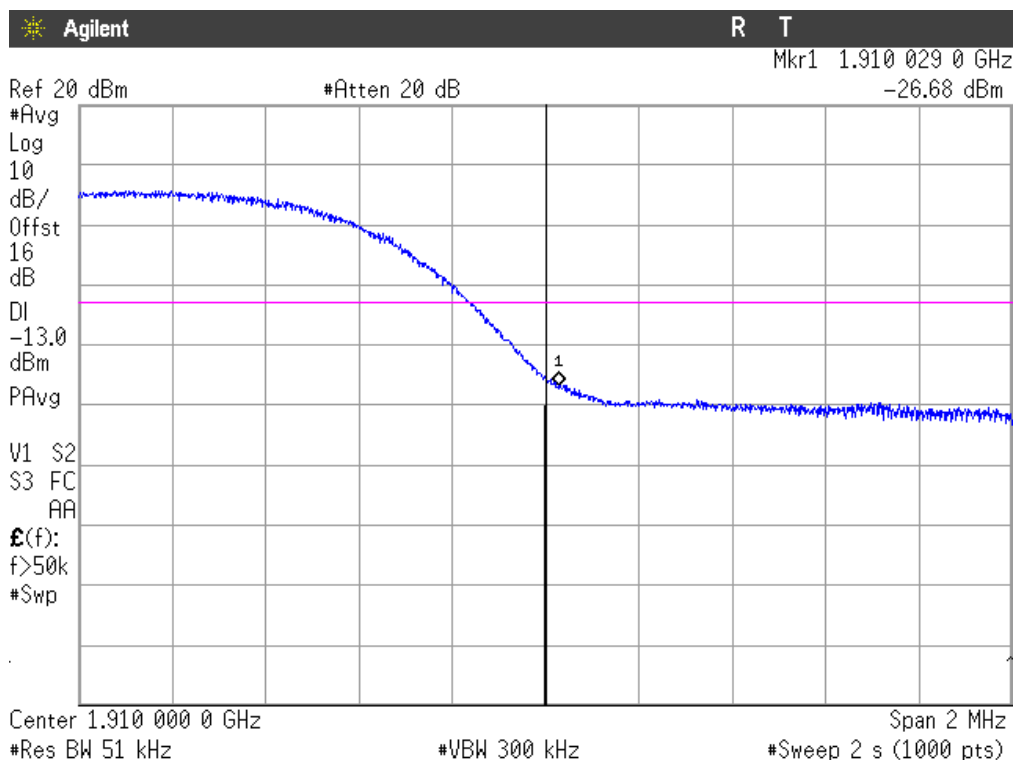
HSUPA MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

Radiated emissions

SPECIFICATION

FCC § 24.238

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. The radiated emissions were measured with peak detector and 1 MHz bandwidth.

Each detected emissions are substituted by the Substitution method, in accordance with the ANSI/TIA/EIA-603-D.

Measurement Limit:

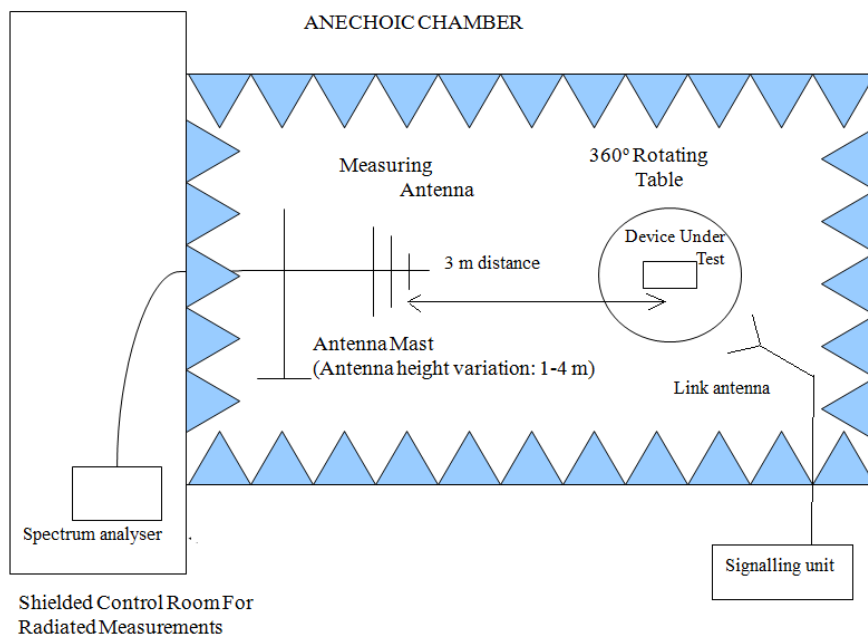
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

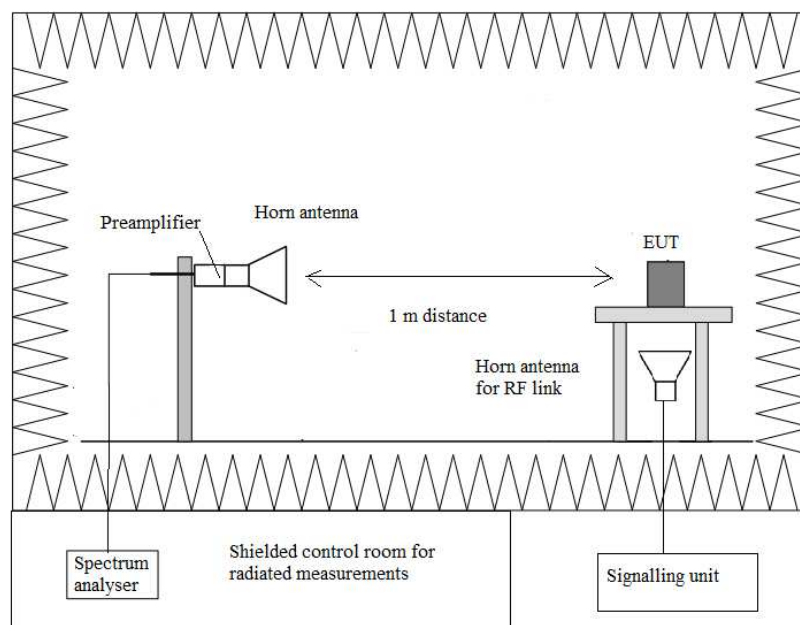
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS MODULATION

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

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)
3700.25	-33.37	Vertical	-48.93	2.70	11.88	-39.75
5551.25	-39.13	Vertical	-50.98	3.51	12.76	-41.73
18501.37	-52.05	Vertical	-55.65	8.30	17.60	-46.35

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3760.25	-34.18	Vertical	-49.62	2.70	11.90	-40.42
5640.75	-37.94	Vertical	-49.83	3.40	12.87	-40.36
18801.37	-56.77	Vertical	-60.37	8.40	17.60	-51.17

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3819.25	-35.69	Vertical	-51.01	2.70	11.93	-41.78
5729.25	-37.45	Vertical	-49.02	3.66	12.98	-39.71
15278.75	-51.00	Vertical	-43.33	7.72	15.11	-35.94
19097.97	-54.63	Vertical	-58.45	8.40	17.70	-49.15

Verdict: PASS

WCDMA AND HSUPA MODULATION

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

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3703.25	-33.34	Vertical	-48.89	2.70	11.88	-39.71
5555.75	-46.55	Vertical	-58.33	3.57	12.77	-49.13
9255.75	-52.48	Vertical	-52.35	4.76	10.62	-46.49

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3762.75	-27.74	Vertical	-43.18	2.70	11.90	-33.98
5636.25	-43.05	Vertical	-54.95	3.40	12.87	-45.48
9398.25	-51.70	Vertical	-51.02	4.70	10.32	-45.40

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

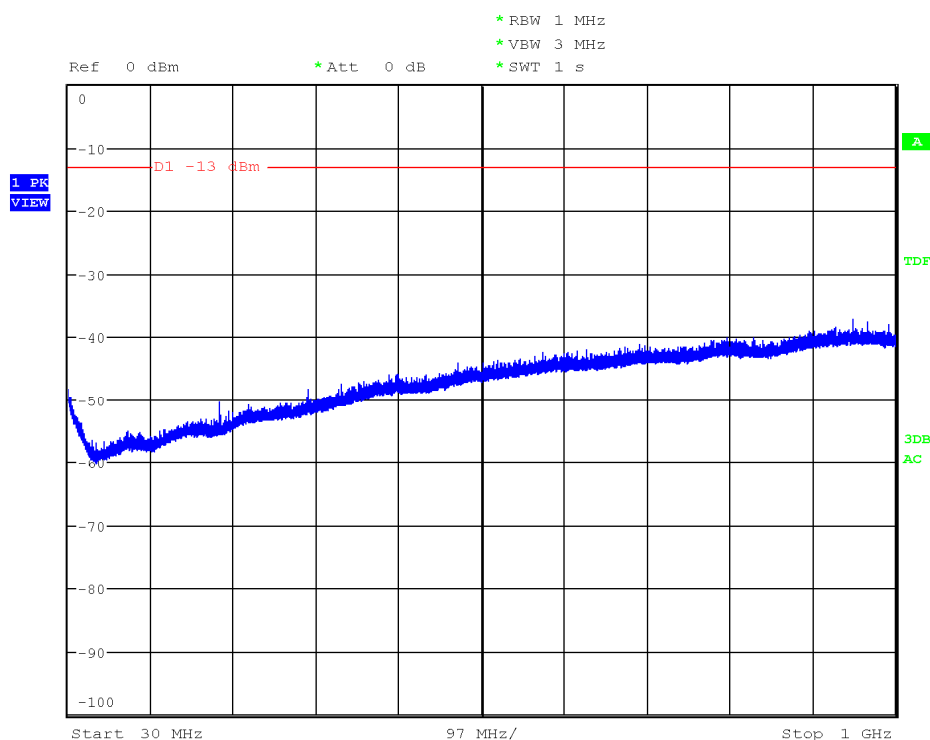
Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain G_i (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
3812.75	-30.95	Vertical	-46.28	2.70	11.93	-37.05
5719.25	-43.62	Vertical	-55.17	3.69	12.97	-45.89
9539.25	-51.28	Vertical	-49.93	4.90	10.13	-44.70

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

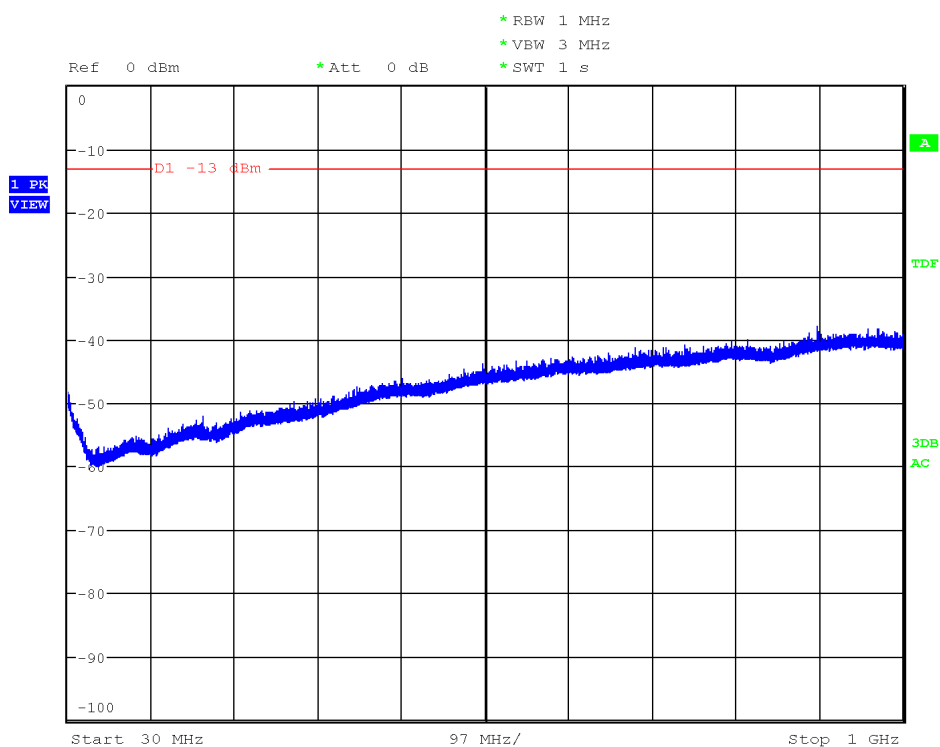
FREQUENCY RANGE 30 MHz-1000 MHz.

GPRS MODULATION



(This plot is valid for all three channels)

WCDMA MODULATION

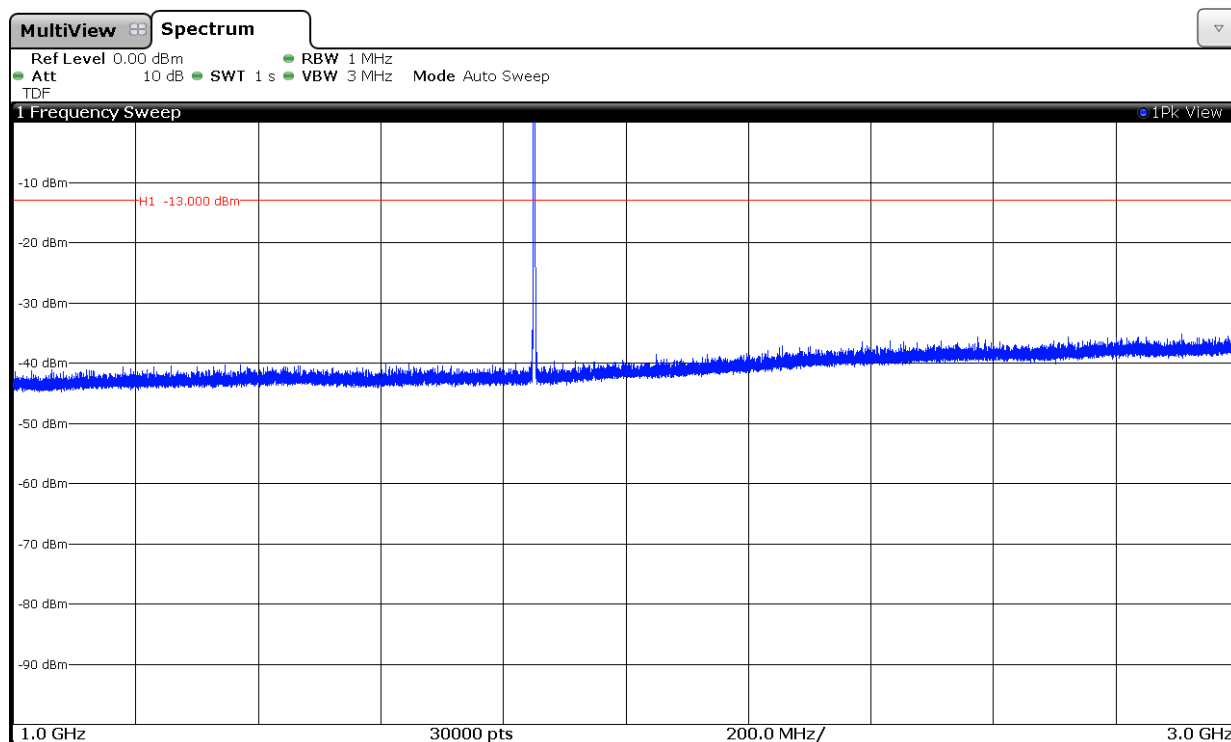


(This plot is valid for all three channels)

FREQUENCY RANGE 1 GHz to 3 GHz.

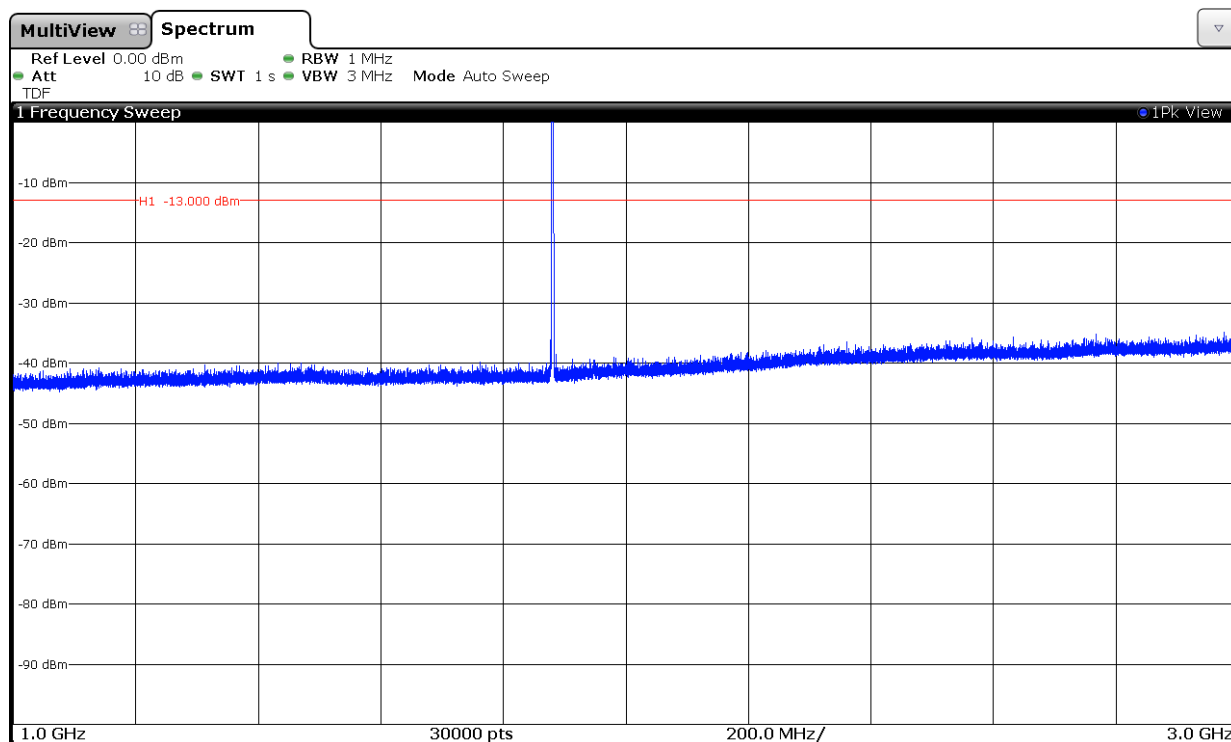
GPRS MODULATION

CHANNEL: LOWEST



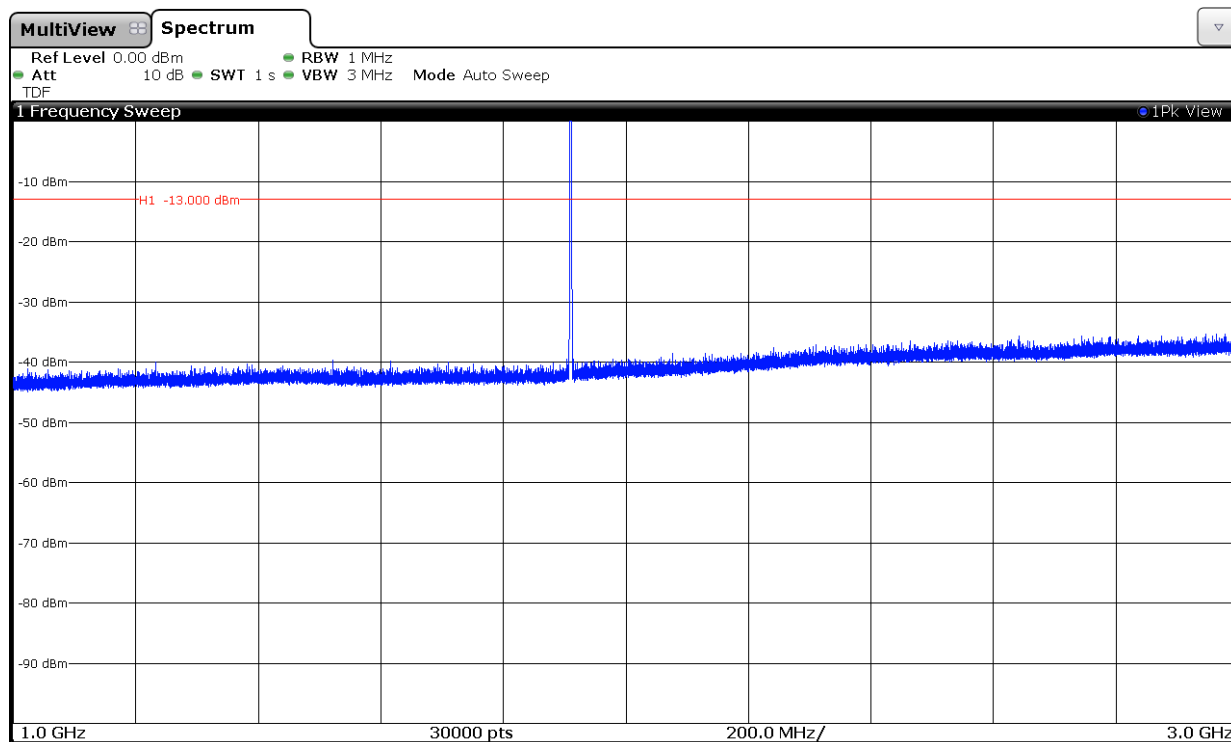
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

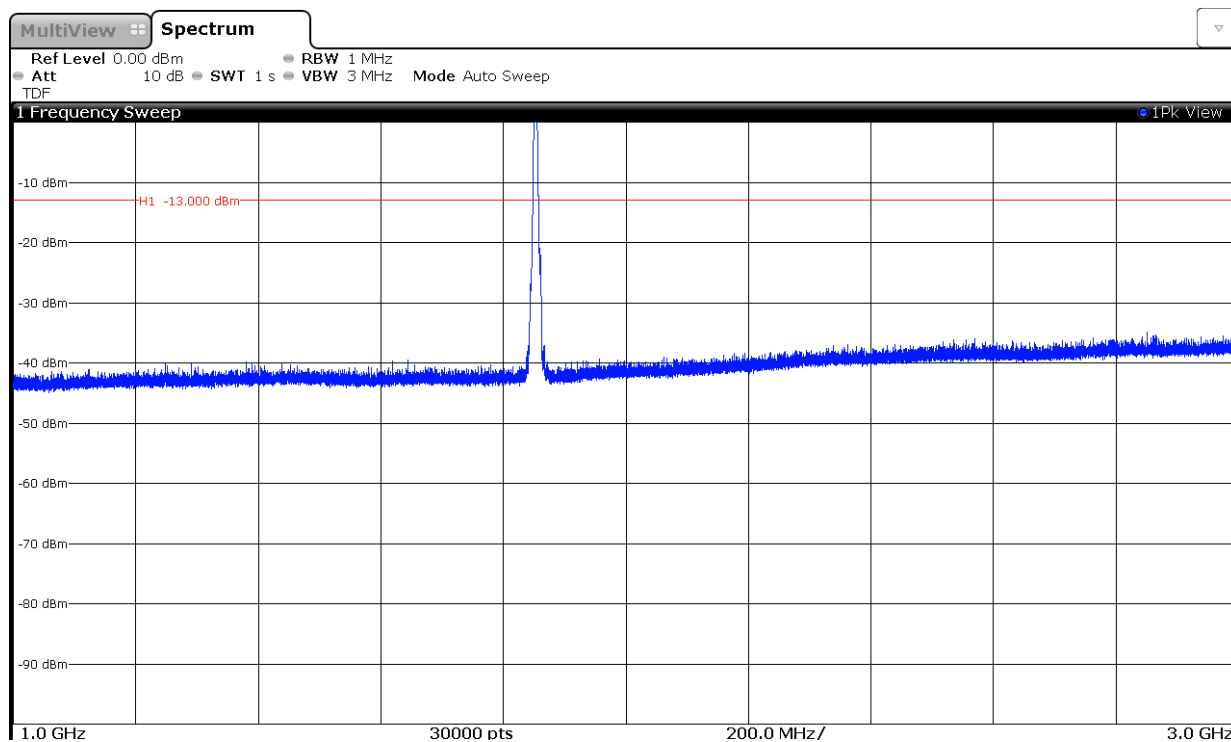
CHANNEL: HIGHEST



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

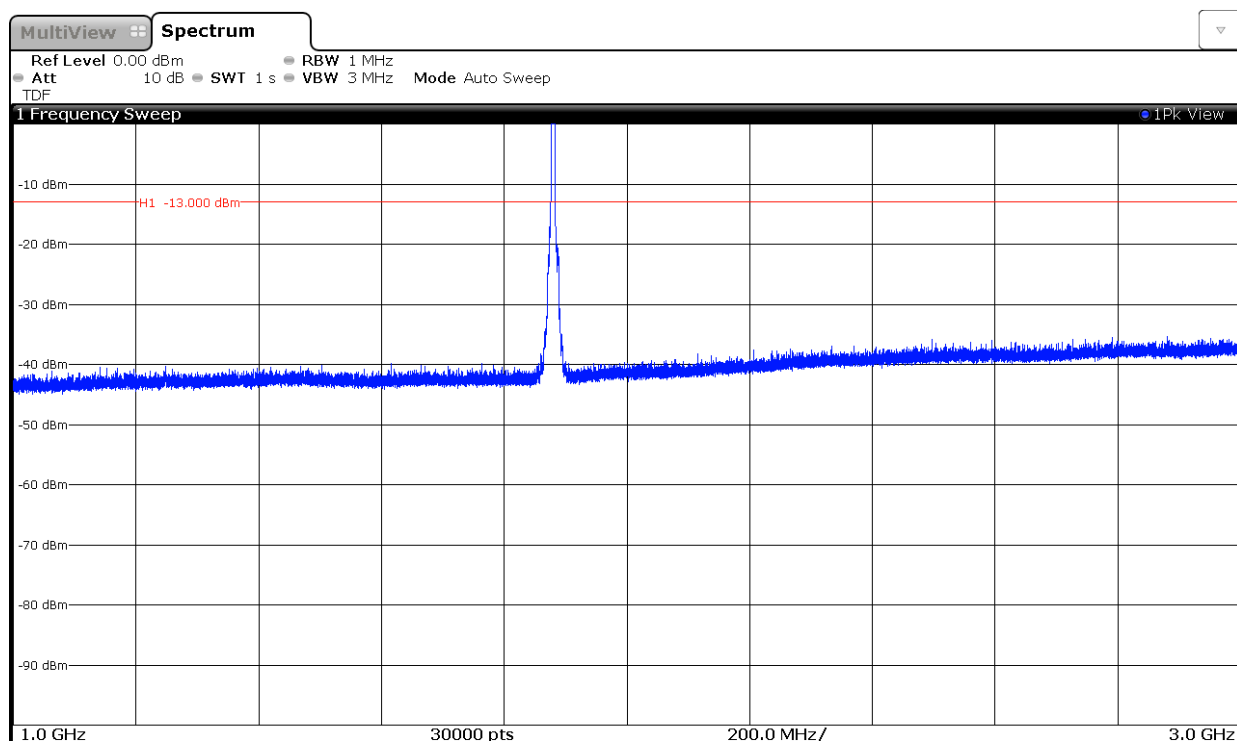
WCDMA MODULATION

CHANNEL: LOWEST



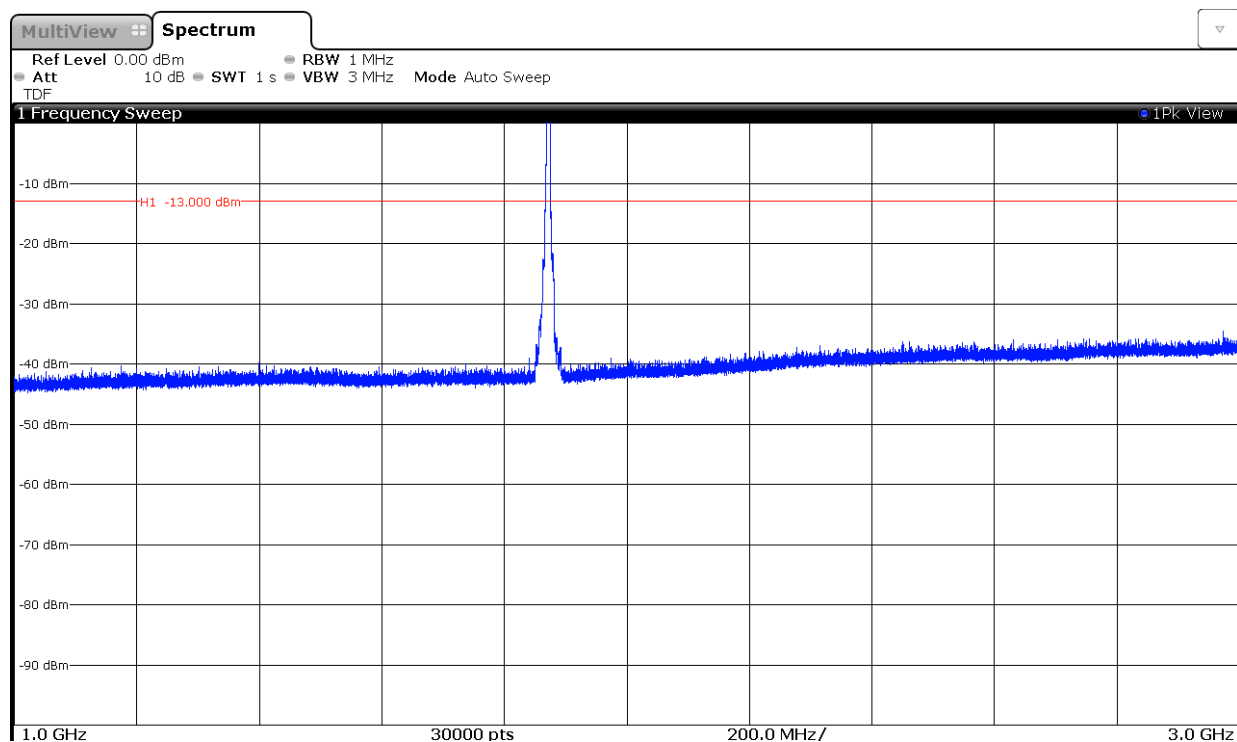
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

CHANNEL: HIGHEST

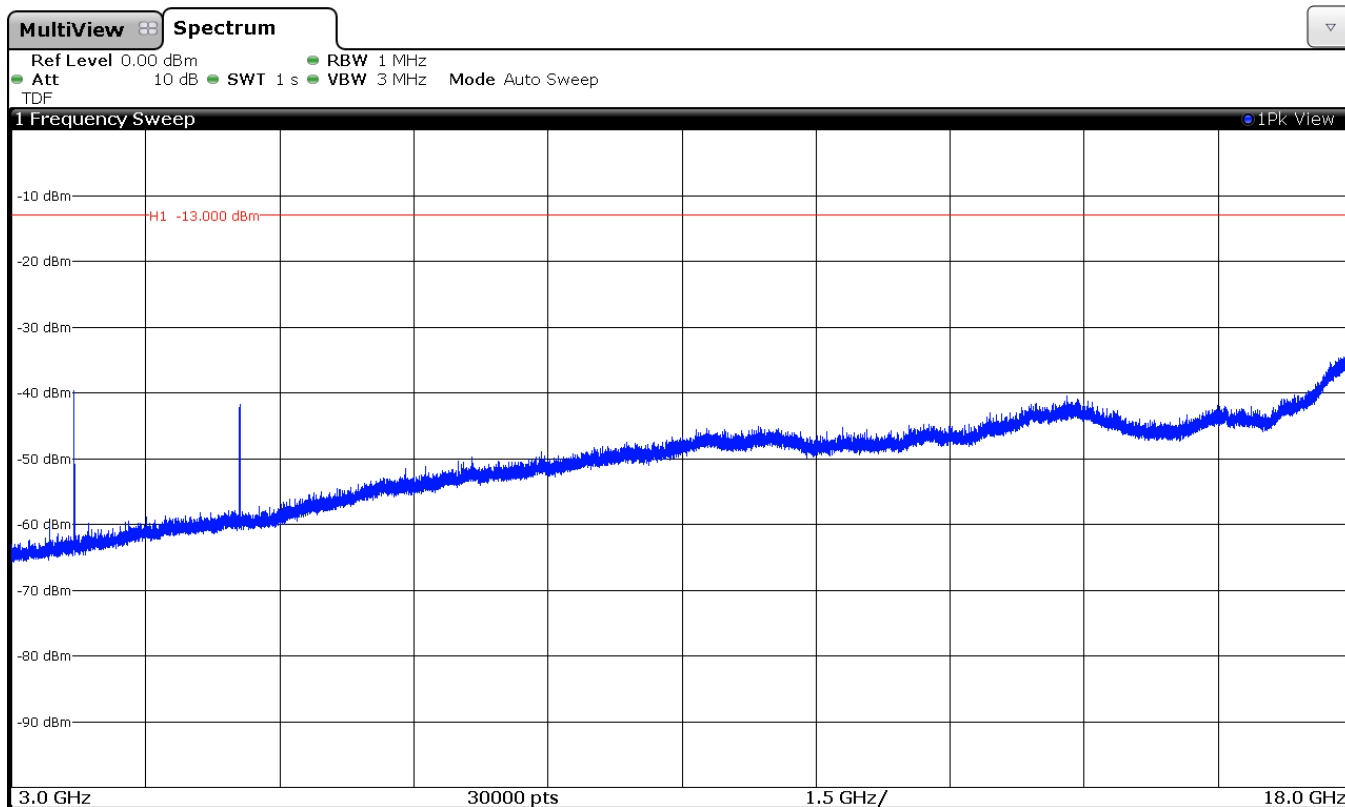


Note: The peak above the limit is the carrier frequency.

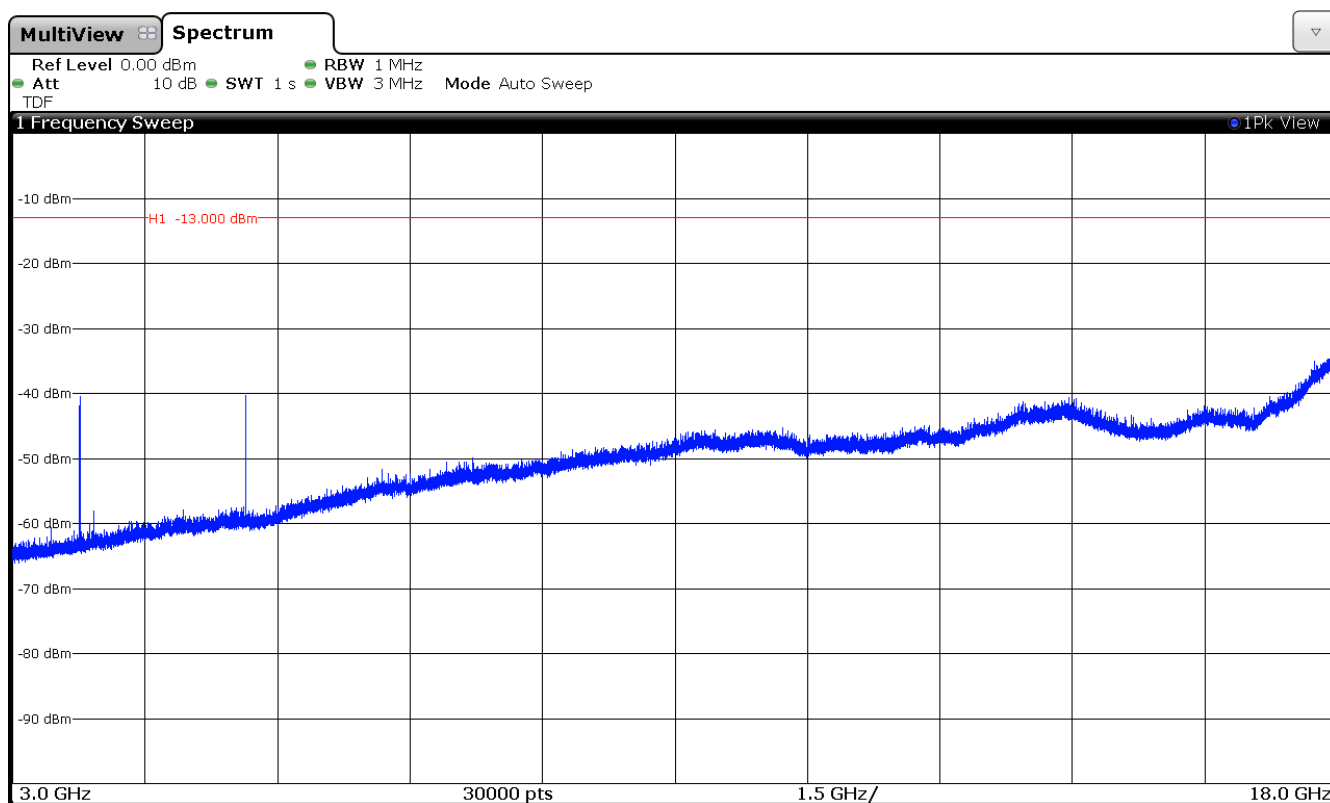
FREQUENCY RANGE 3 GHz to 18 GHz.

GPRS MODULATION

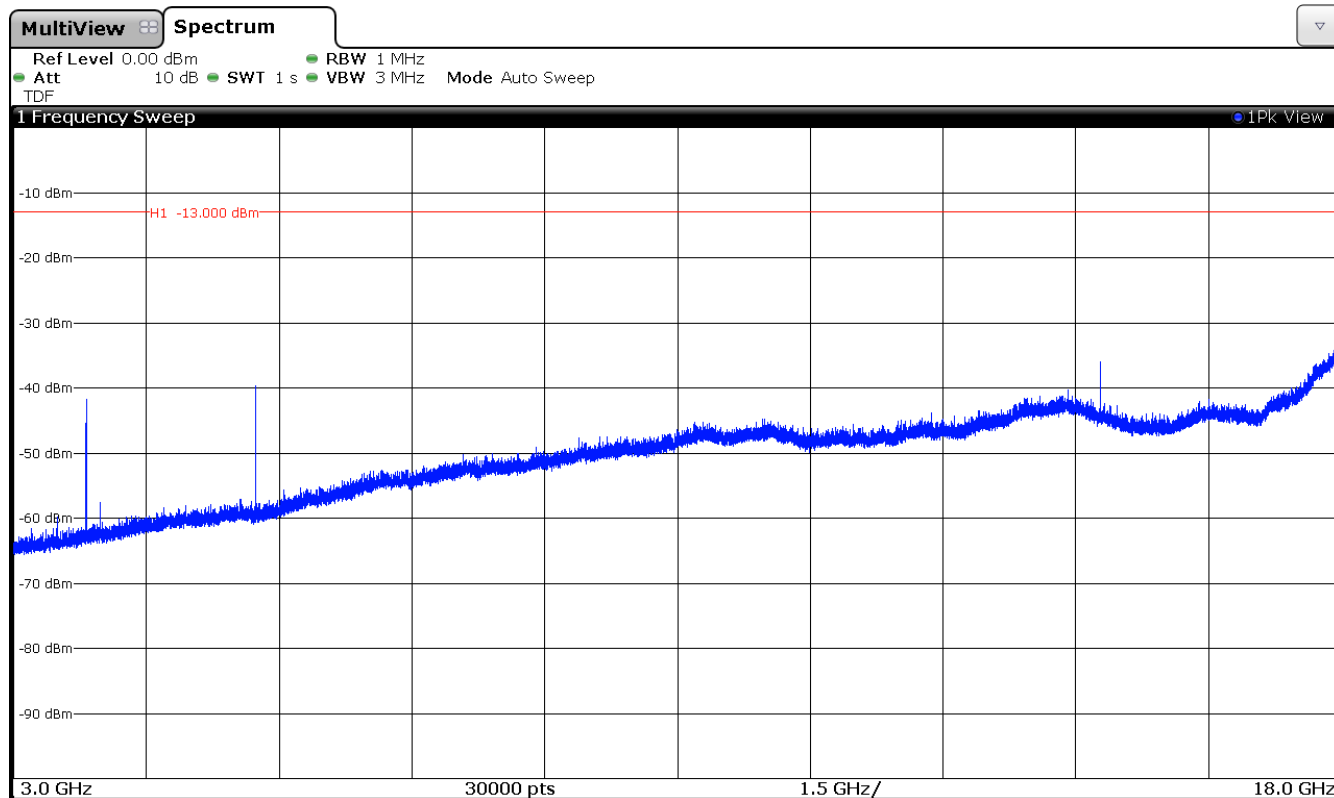
CHANNEL: LOWEST



CHANNEL: MIDDLE

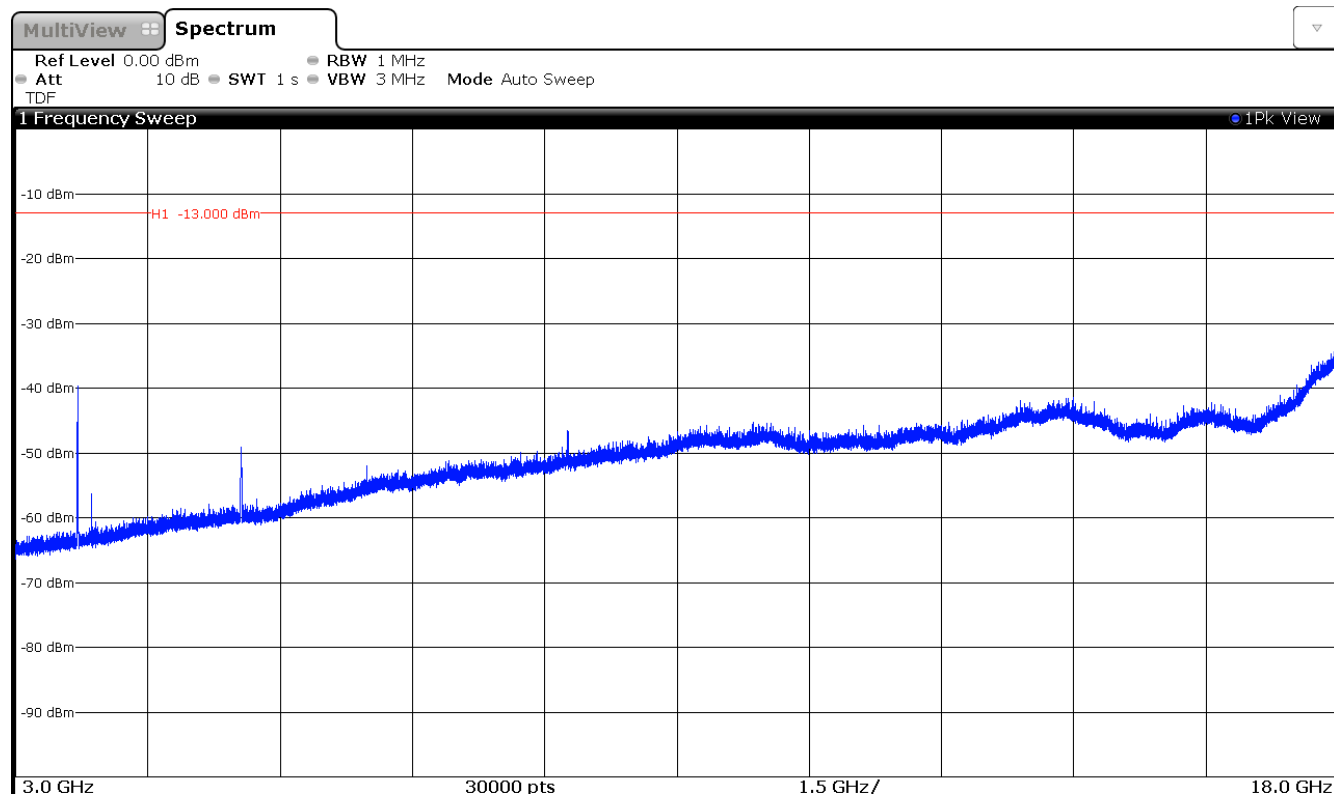


CHANNEL: HIGHEST

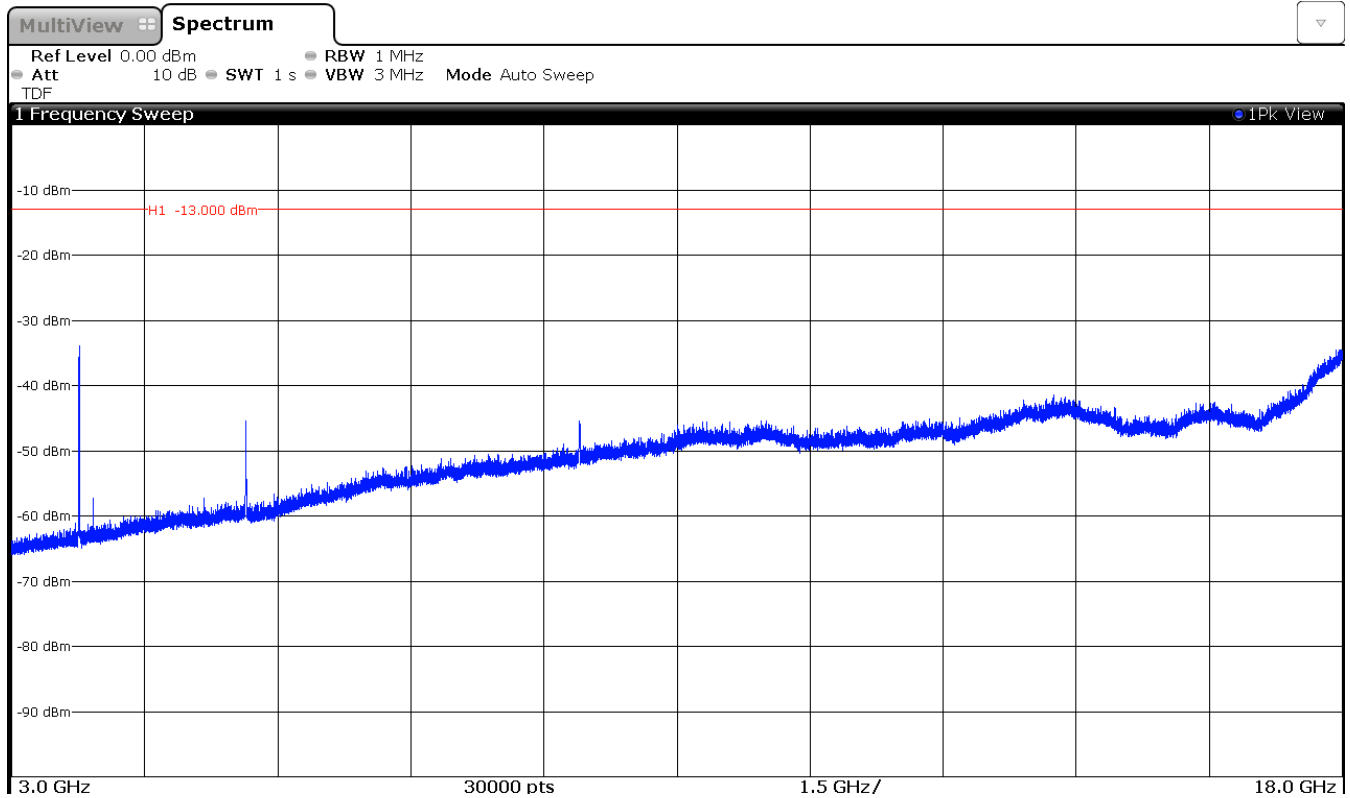


WCDMA MODULATION

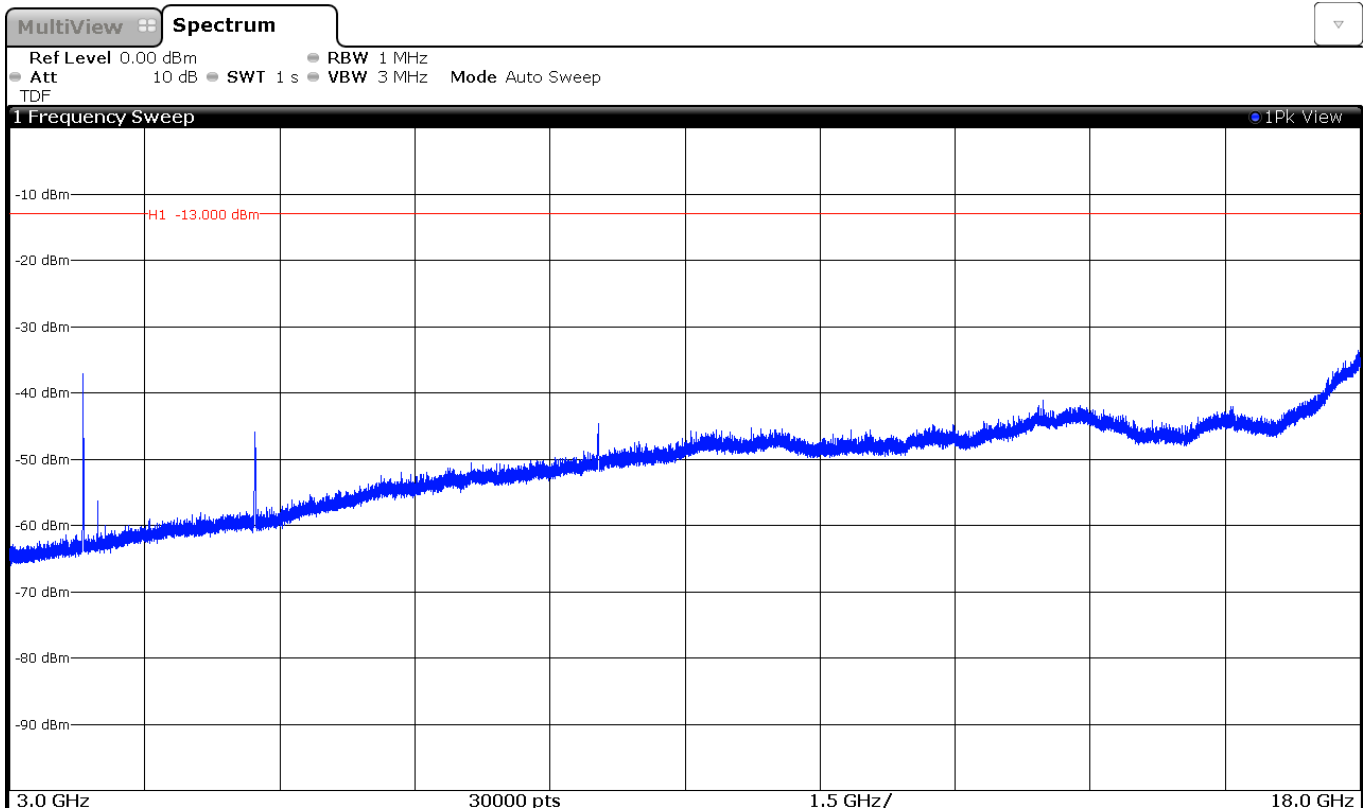
CHANNEL: LOWEST



CHANNEL: MIDDLE



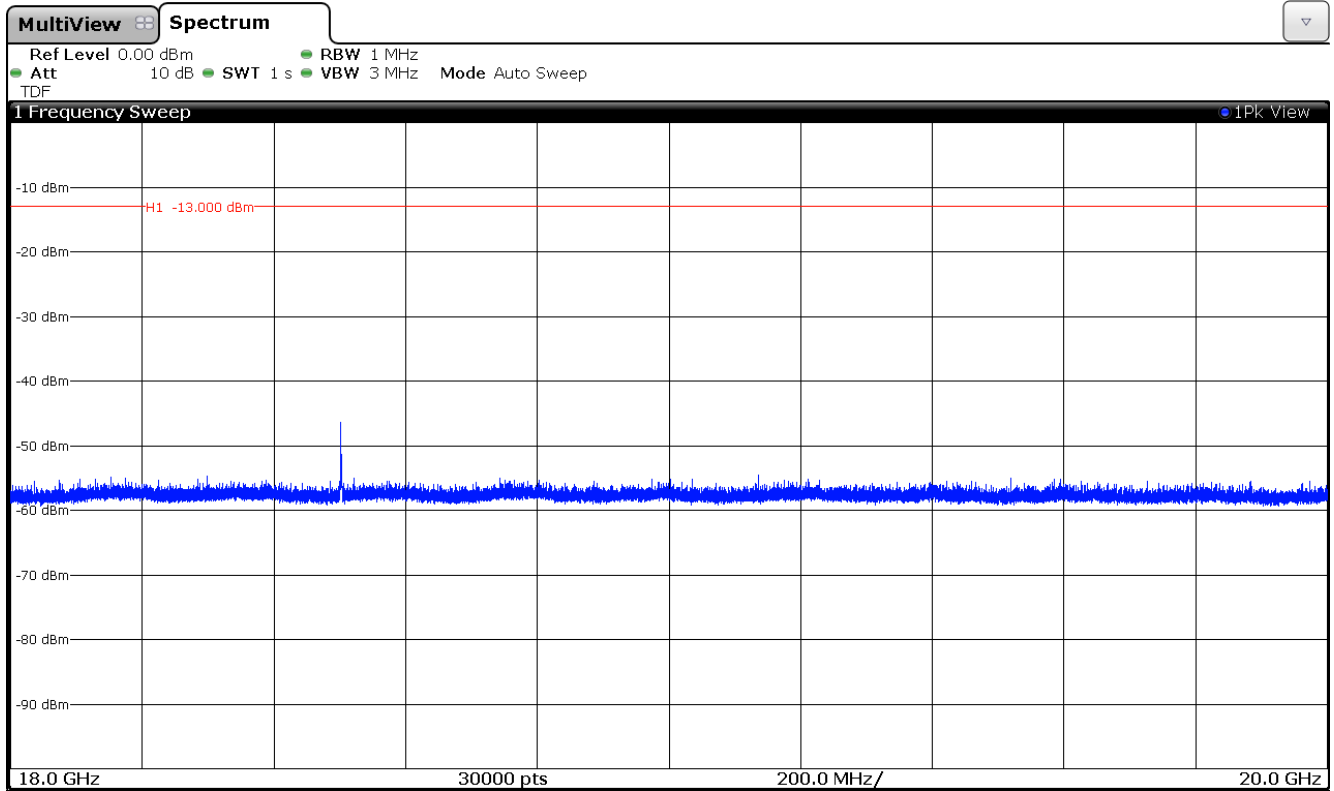
CHANNEL: HIGHEST



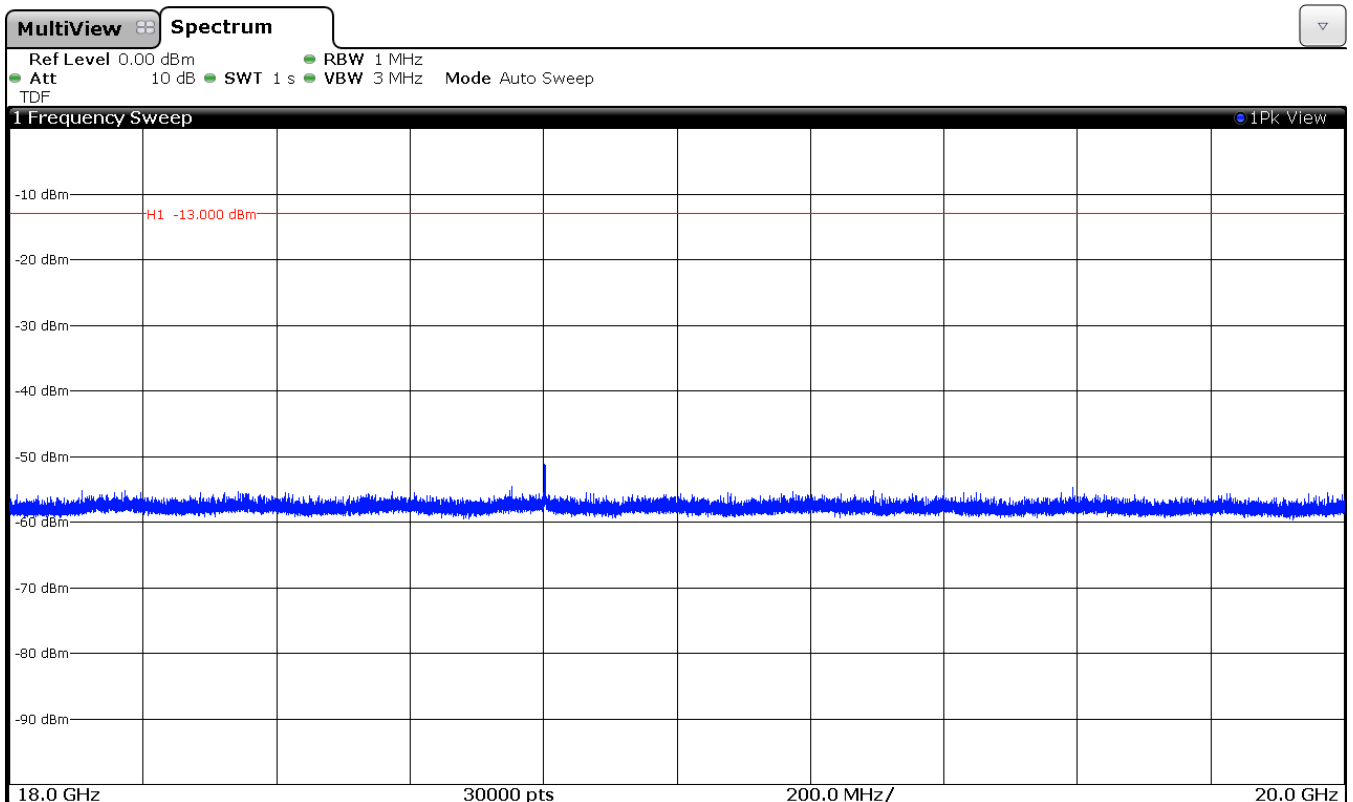
FREQUENCY RANGE 18 GHz TO 20 GHz.

GPRS MODULATION

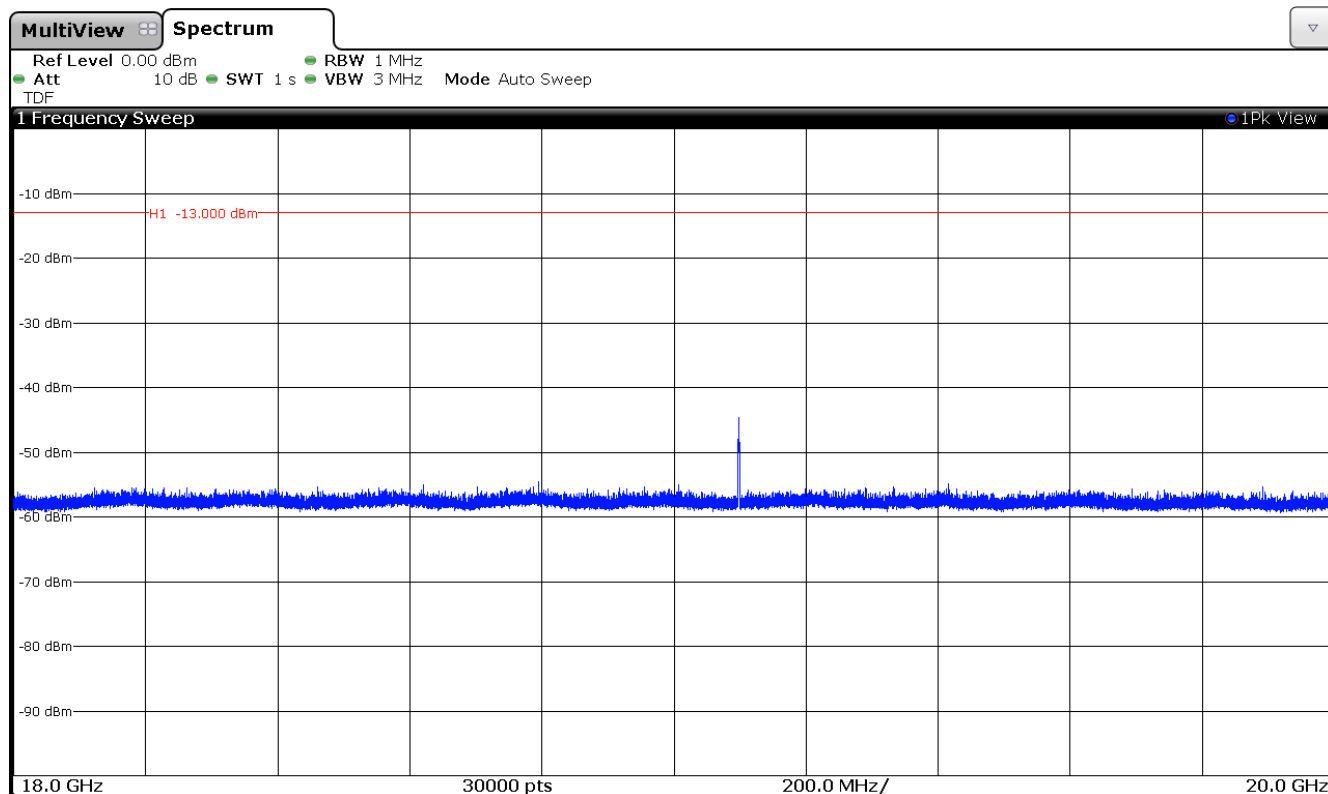
CHANNEL: LOWEST



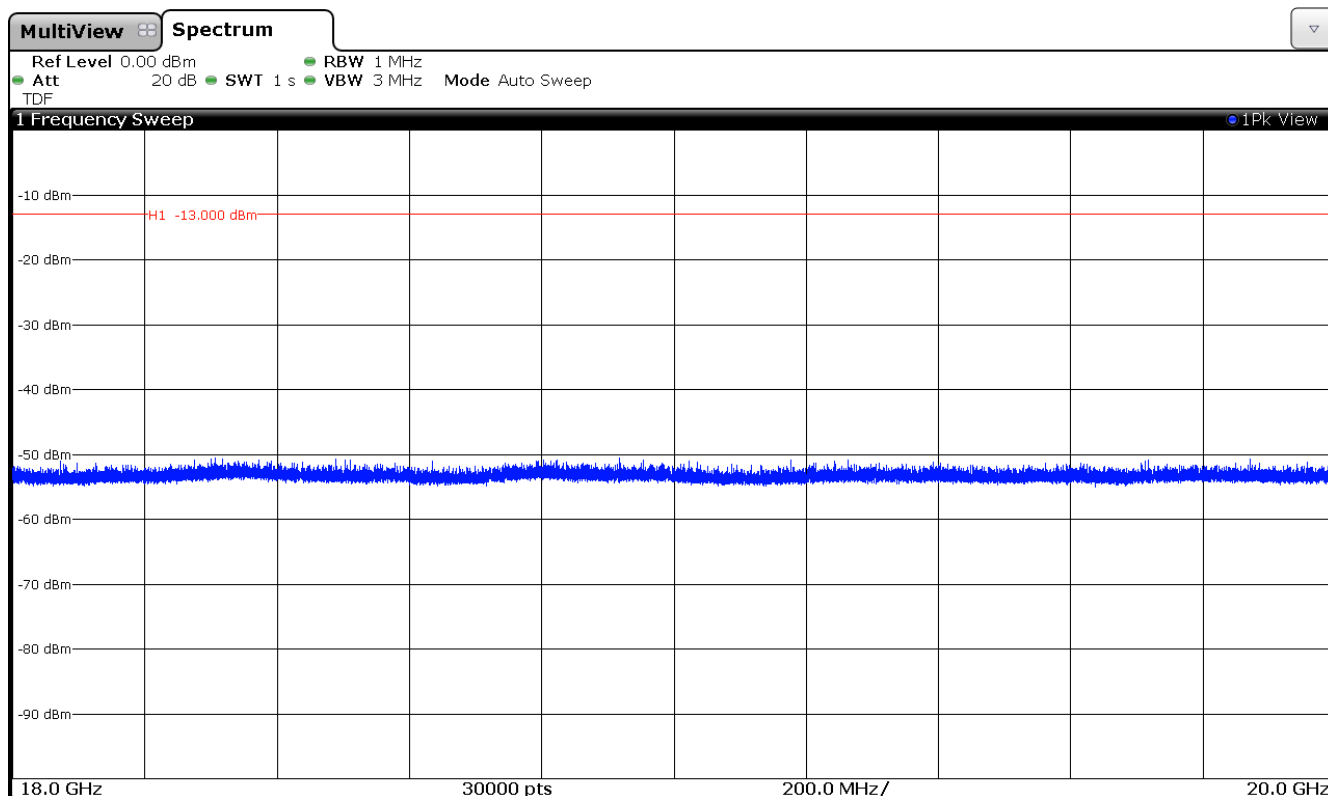
CHANNEL: MIDDLE



CHANNEL: HIGHEST



WCDMA MODULATION



(This plot is valid for all three channels)