



FCC LISTED,
REGISTRATION NUMBER:
720267

Test report No:

NIE: 46883RRF.001

Test report

REFERENCE STANDARD: USA FCC Part 22 & Part 24

Identificación del objeto ensayado.....: Identification of item tested	WIRELESS COMMUNICATION MODULE
Marca Trademark	NTT Docomo
Modelo y/o referencia tipo Model and /or type reference	UM04-KO
Other identification of the product	FCC ID: TTIUM04KO
Final HW version	Version 0.80
Final SW version	Version 0.56
IMEI TAC	00440131
Características Features	GSM: 850MHz, 900MHz, 1800MHz, 1900MHz W-CDMA: Band1, Band5 LTE: Band1, Band19 Packet communication, SMS
Fabricante Manufacturer	HITACHI KOKUSAI ELECTRIC INC. 32, Miyuki-cho, Kodaira-shi, Tokyo 187-8511, JAPAN
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 22 10-1-14 Edition. USA FCC Part 24 10-1-14 Edition. Measurement Guidance 971168 D01 v02r01 for certification of Licensed Digital Transmitters. ANSI/TIA-603-C (2004).
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	2015-09-16
Formato de informe No.: Report template No	FDT08_17

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Competences and guarantees

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

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

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

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

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

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

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General conditions

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

Uncertainty

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

Usage of samples

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

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
46536/002	Wireless communication module	UM04-KO	LX301-SW-001	2015-06-10
46536/003	Testing board	---	---	2015-06-10
46883/013	Antenna	DP-BRO-AD	---	2015-07-20
46883/014	Antenna	DP-BRO-AD	---	2015-07-20
46883/038	AC power adapter	US300520	F05-0316734	2015-07-20

1. Sample S/01 has undergone the test(s).

All tests indicated in appendix A for FCC part 22.

Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
46883/055	Wireless communication module	UM04-KO	LX301-SW-011	2015-07-20
46536/003	Testing board	---	---	2015-06-10
46883/013	Antenna	DP-BRO-AD	---	2015-07-20
46883/014	Antenna	DP-BRO-AD	---	2015-07-20
46883/038	AC power adapter	US300520	F05-0316734	2015-07-20

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

All tests indicated in appendix A for FCC part 24.

Test sample description

The test sample consists of a wireless communication module which unified in combination with the radio part of the cellular telephone and the modem part.

Identification of the client

HITACHI KOKUSAI ELECTRIC INC.

32, Miyuki-cho, Kodaira-shi, Tokyo 187-8511, JAPAN

Testing period

The performed test started on 2015-07-21 and finished on 2015-08-11.

The tests have been performed at AT4 wireless.

Environmental conditions

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

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

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

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

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

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

Remarks and comments

1: Used instrumentation.

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Spectrum analyser Agilent PSA E4440A	2014/05	2016/05
2.	EMI Test Receiver R&S ESU 40	2014/02	2016/02
3.	Spectrum analyser Rohde & Schwarz FSW50	2013/10	2015/10
4.	Climatic chamber HERAEUS VMT 04/35	2014/03	2016/03
5.	DC power supply R&S NGPE 40/40	2014/11	2017/11
6.	Universal Radio communication Tester R&S CMU200	2014/02	2016/02
7.	Universal Radio communication Tester R&S CMW500	2014/09	2016/09

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.	SHF-EHF Horn antenna 15-40 GHz Schwarbeck BBHA 9170	2014/03	2017/03
6.	EMI Test Receiver R&S ESU 40	2014/02	2016/02
7.	Spectrum analyser Rohde & Schwarz FSW50	2013/10	2015/10
8.	RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2015/03	2016/03
9.	RF pre-amplifier 1-18 GHz BONN ELEKTRONIK BLMA 0118-3A	2015/05	2016/05
10.	RF pre-amplifier BONN BLMA 1840-1M 18-40 GHz.	2014/02	2016/02
11.	Universal Radio communication Tester R&S CMW500	2014/09	2016/09
12.	DC power supply AGILENT U8002A	-	-

2. GSM mode has not been tested to prove USA FCC Part 22 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 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 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 as it is the same as WCDMA mode as long as UE transmission is concerned. WCDMA modulation mode has been tested as indicated on the present test report.

Testing verdicts

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

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

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

Appendix A – Test result for FCC Part 22 & FCC Part 24

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TEST RESULTS FOR FCC PART 22

TEST CONDITIONS

Power supply (V):

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

$$V_{\text{max}} = 3.3 \text{ Vdc (*)}$$

$$V_{\text{min}} = 4.2 \text{ Vdc (*)}$$

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

Type of power supply = DC Voltage from external power supply

Type of antenna = External attachable antenna

(*): Declared by the applicant.

TEST FREQUENCIES:

GPRS AND EDGE MODULATION

Lowest channel (128): 824.2 MHz

Middle channel (190): 836.6 MHz

Highest channel (251): 848.8 MHz

WCDMA AND HSUPA MODULATION

Lowest channel (4132): 826.4 MHz

Middle channel (4182): 836.4 MHz

Highest channel (4233): 846.6 MHz

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

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).

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 effective radiated power e.r.p. is calculated by adding the declared maximum antenna gain (dBd).

TEST SETUP



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

GPRS MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	32.30	32.16	32.03
Maximum declared antenna gain (dBd)	-3.25	-3.25	-3.25
Maximum effective radiated power E.R.P. (dBm)	29.05	28.91	28.78
Measurement uncertainty (dB)	±0.5		

EDGE MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	27.35	27.33	27.32
Maximum declared antenna gain (dBd)	-3.25	-3.25	-3.25
Maximum effective radiated power E.R.P. (dBm)	24.10	24.08	24.07
Measurement uncertainty (dB)	±0.5		

WCDMA MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	22.43	22.76	22.88
Maximum declared antenna gain (dBd)	-3.25	-3.25	-3.25
Maximum effective radiated power E.R.P. (dBm)	19.18	19.51	19.63
Measurement uncertainty (dB)	±0.5		

HSUPA MODULATION

Channel	Lowest	Middle	Highest
Measured maximum average power (dBm) at antenna port	22.40	22.47	22.53
Maximum declared antenna gain (dBd)	-3.25	-3.25	-3.25
Maximum effective radiated power E.R.P. (dBm)	19.15	19.22	19.28
Measurement uncertainty (dB)	±0.5		

Verdict: PASS

Modulation Characteristics

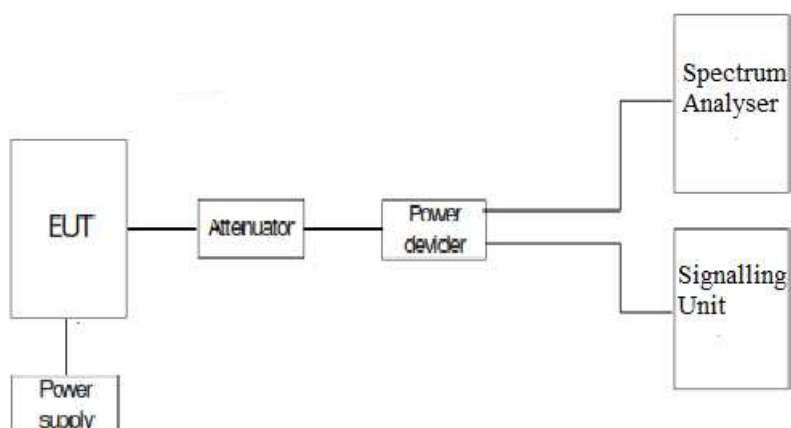
SPECIFICATION

FCC §2.1047

METHOD

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

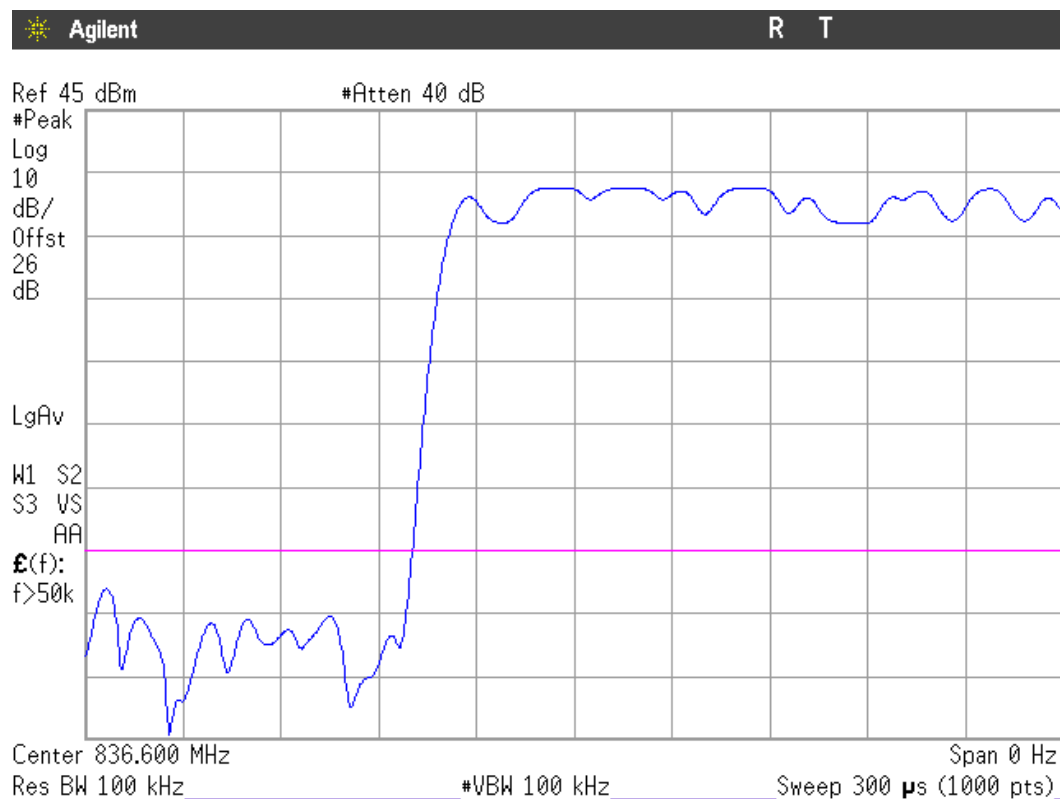
TEST SETUP



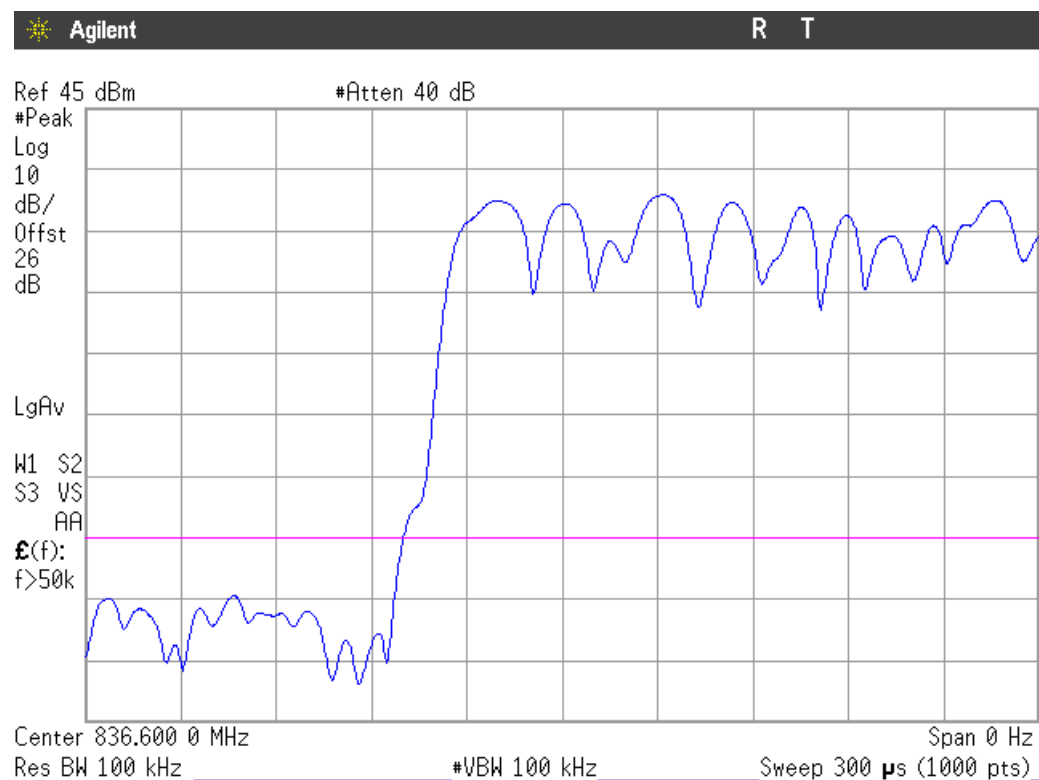
RESULTS

The following plot shows the modulation schemes in the EUT.

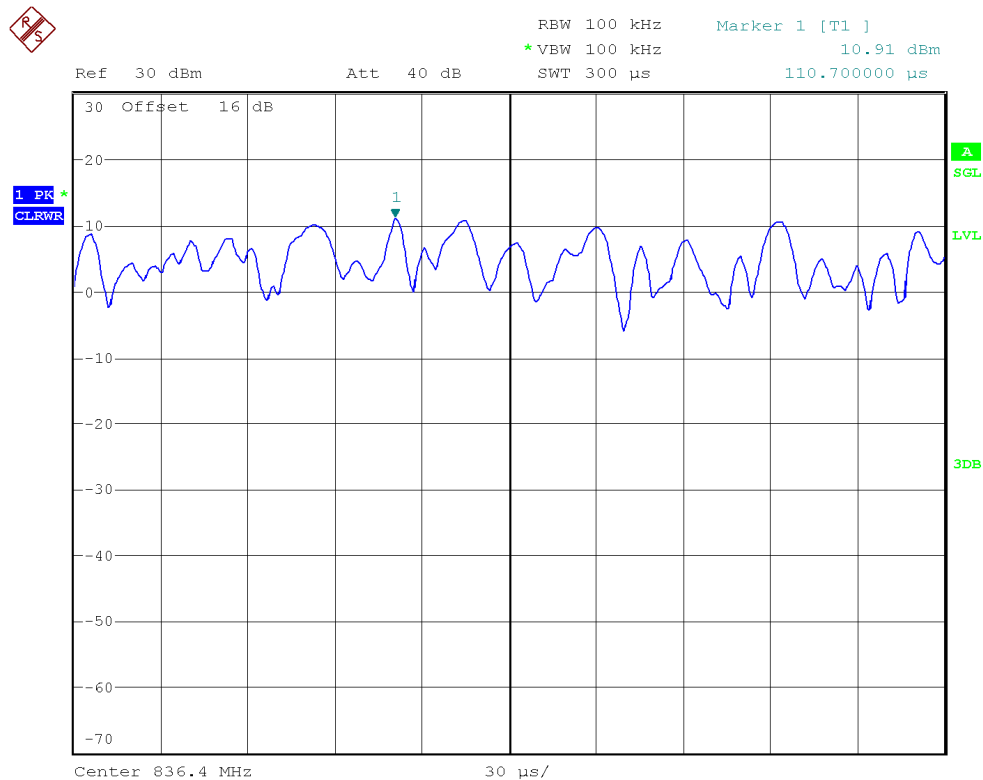
GPRS MODULATION



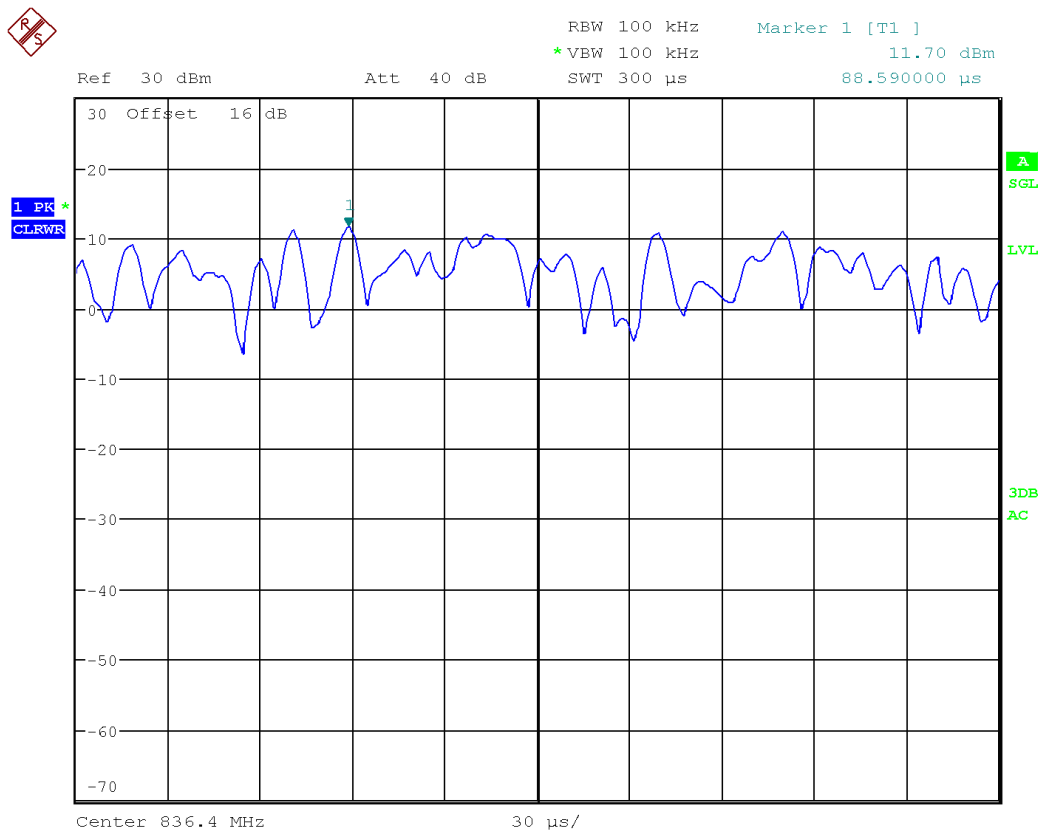
EDGE MODULATION



WCDMA MODULATION



HSUPA MODULATION



Frequency Stability

SPECIFICATION

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

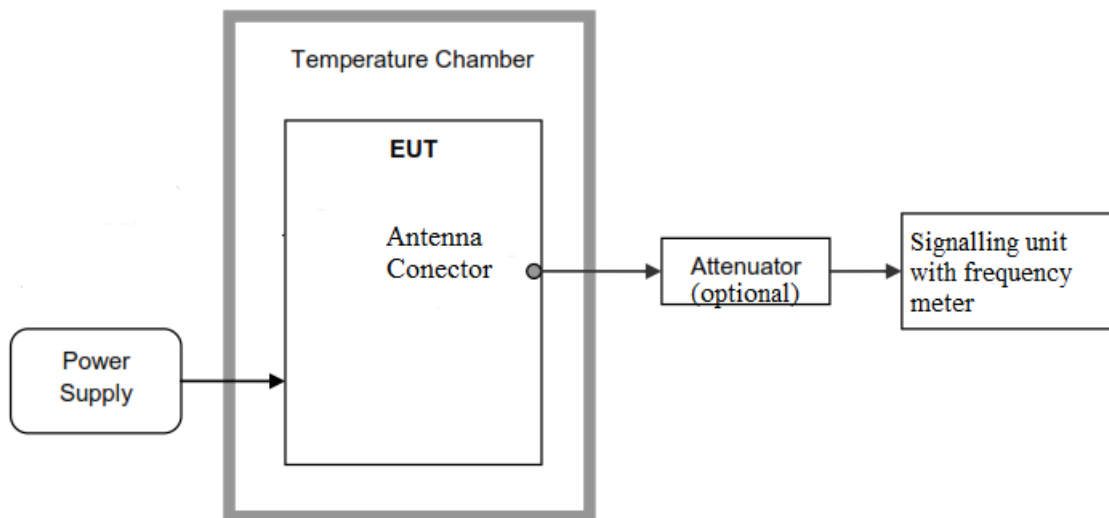
METHOD

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

The supply voltage was varied between the extreme voltages indicated by the applicant.

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

TEST SETUP



RESULTS

Frequency stability over temperature variations.

GPRS AND EDGE MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	-19	-0.0227	-0.00000227
+40	16	0.0191	0.00000191
+30	-20	-0.0239	-0.00000239
+20	17	0.0203	0.00000203
+10	-20	-0.0239	-0.00000239
0	-18	-0.0215	-0.00000215
-10	23	0.0275	0.00000275
-20	-14	-0.0167	-0.00000167
-30	-24	-0.0287	-0.00000287

WCDMA AND HSUPA MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	10	0.0120	0.00000120
+40	-11	-0.0131	-0.00000131
+30	-8	-0.0096	-0.00000096
+20	7	0.0084	0.00000084
+10	11	0.0131	0.00000131
0	6	0.0072	0.00000072
-10	-11	-0.0131	-0.00000131
-20	12	0.0143	0.00000143
-30	15	0.0179	0.00000179

Frequency stability over voltage variations.

GPRS AND EDGE MODULATION

DC Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.2	14	0.0167	0.00000167
Vmin	3.3	14	0.0167	0.00000167

WCDMA AND HSUPA MODULATION

DC Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.2	9	0.0108	0.00000108
Vmin	3.3	-13	-0.0155	-0.00000155

Occupied Bandwidth

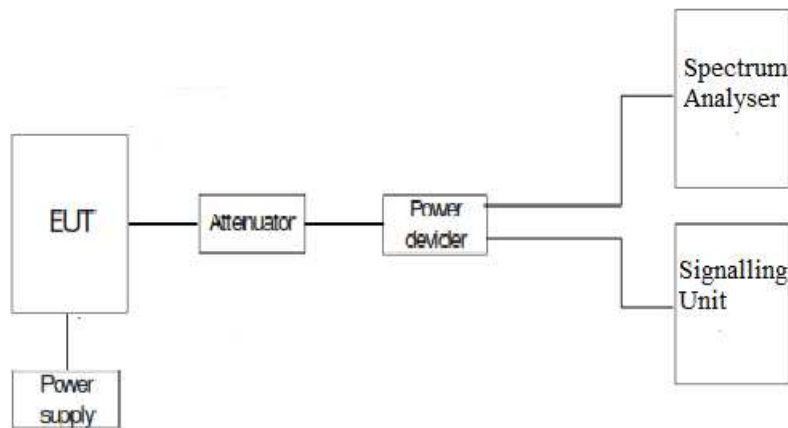
SPECIFICATION

FCC §2.1049

METHOD

The EUT was configured to transmit a modulated carrier signal with different possible modulations and nominal bandwidths, where applicable. The 99% occupied bandwidth and the -26 dBc bandwidth were measured with the spectrum analyser.

TEST SETUP



RESULTS

GPRS MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	244.22	241.12	243.98
-26 dBc bandwidth (kHz)	309.64	312.53	316.40
Measurement uncertainty (kHz)	<±3.15		

EDGE MODULATION

Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	239.86	244.68	244.60
-26 dBc bandwidth (kHz)	312.78	298.67	313.05
Measurement uncertainty (kHz)	<±3.15		

WCDMA MODULATION

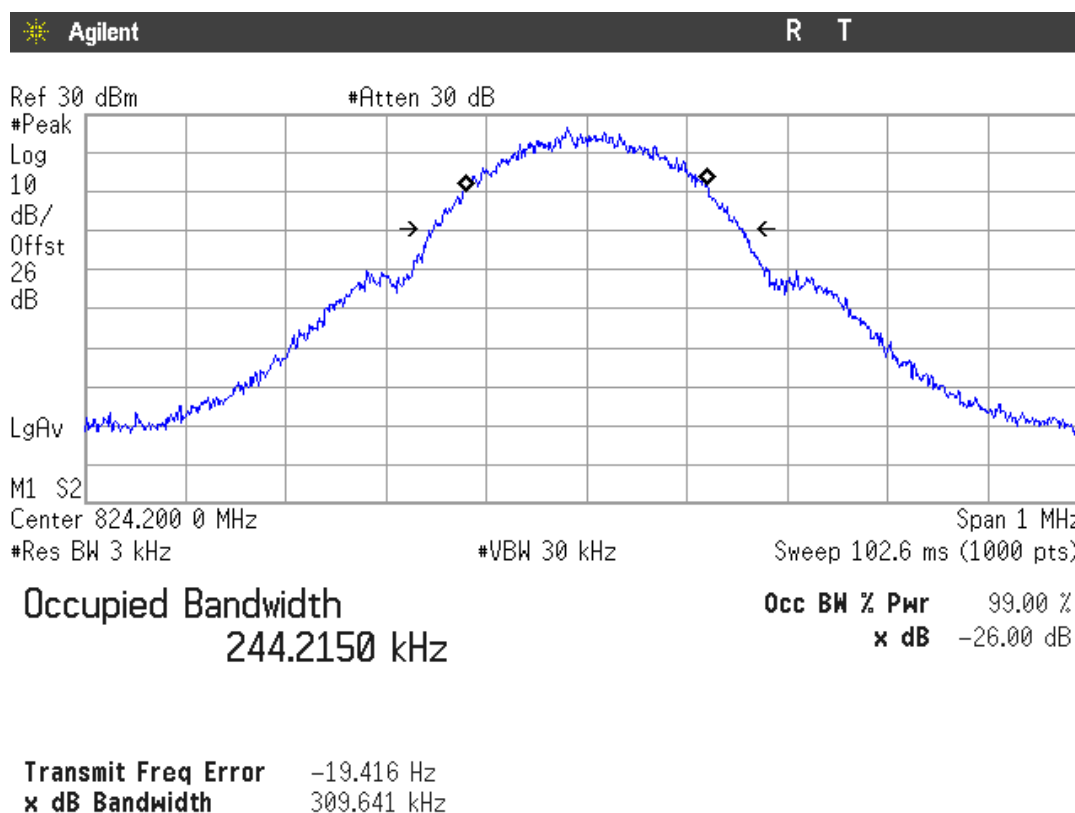
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4133.0	4128.0	4119.0
-26 dBc bandwidth (kHz)	4666.6	4662.7	4679.5
Measurement uncertainty (kHz)	<±27.1		

HSUPA MODULATION

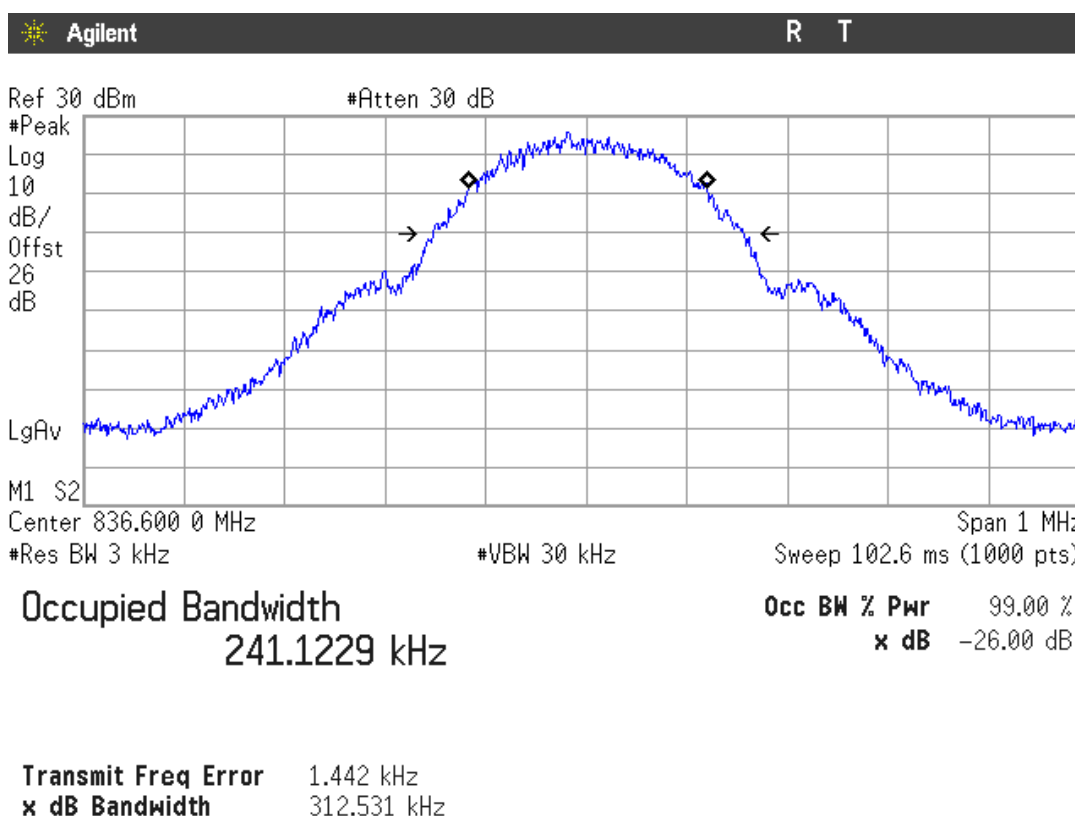
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	4137.6	4135.2	4128.8
-26 dBc bandwidth (kHz)	4679.5	4659.5	4679.5
Measurement uncertainty (kHz)	<±27.1		

GPRS MODULATION

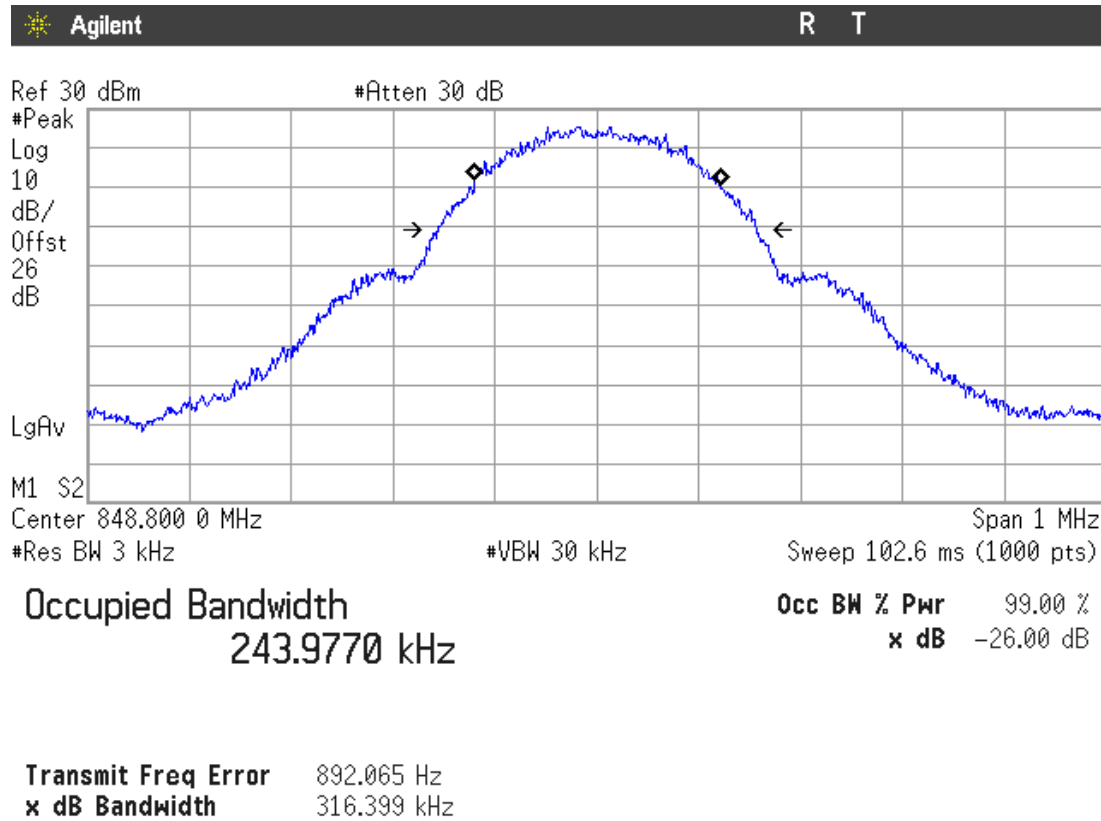
Lowest Channel



Middle Channel

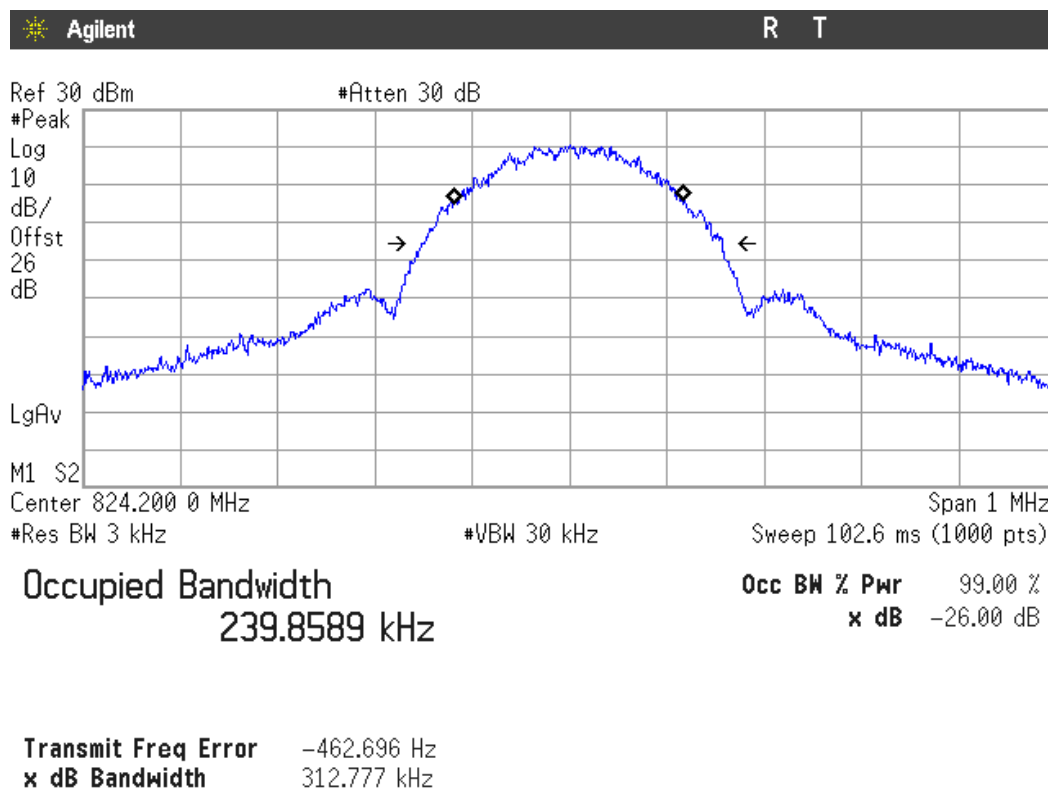


Highest Channel

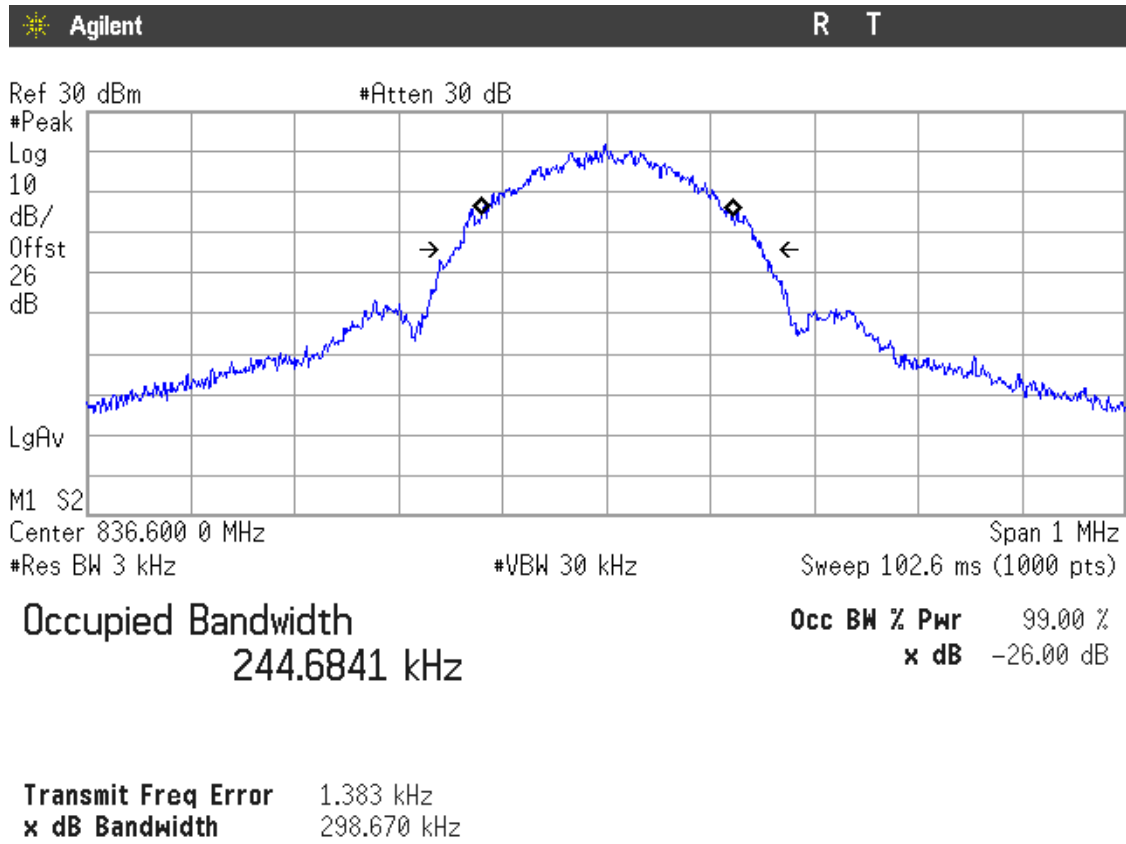


EDGE MODULATION

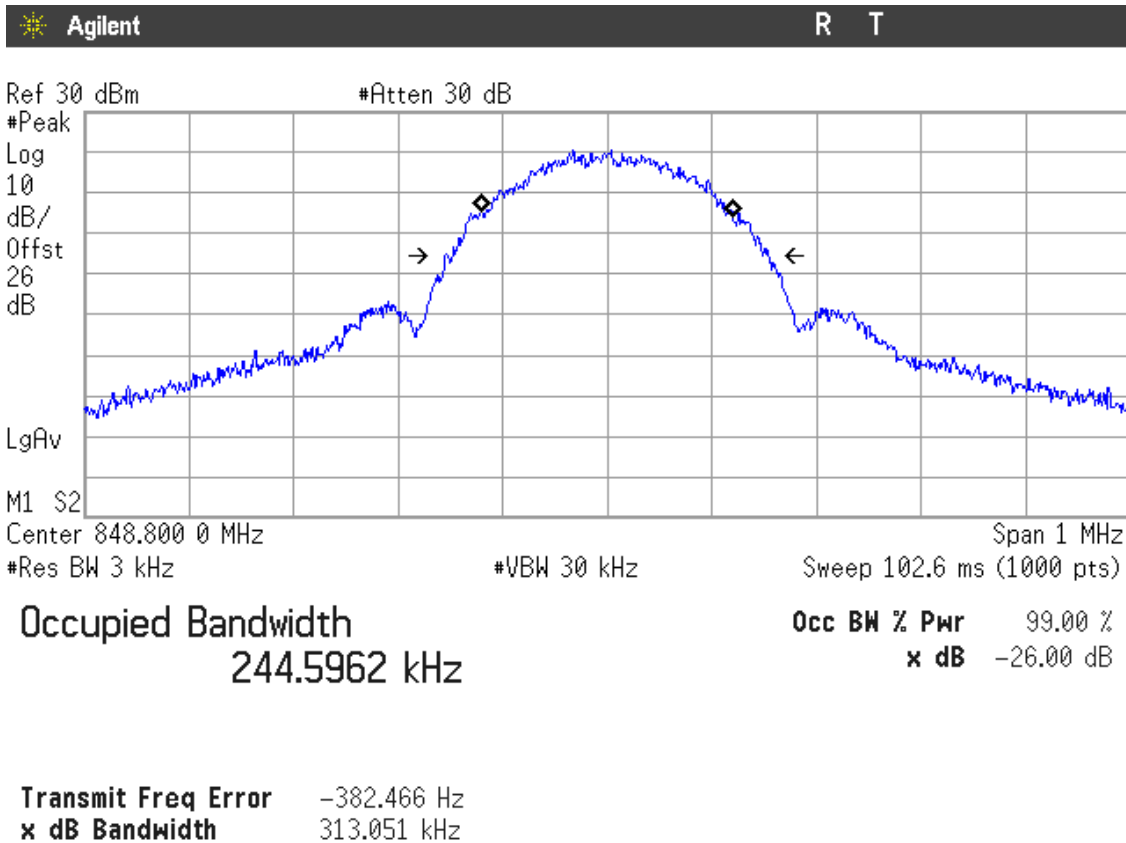
Lowest Channel



Middle Channel

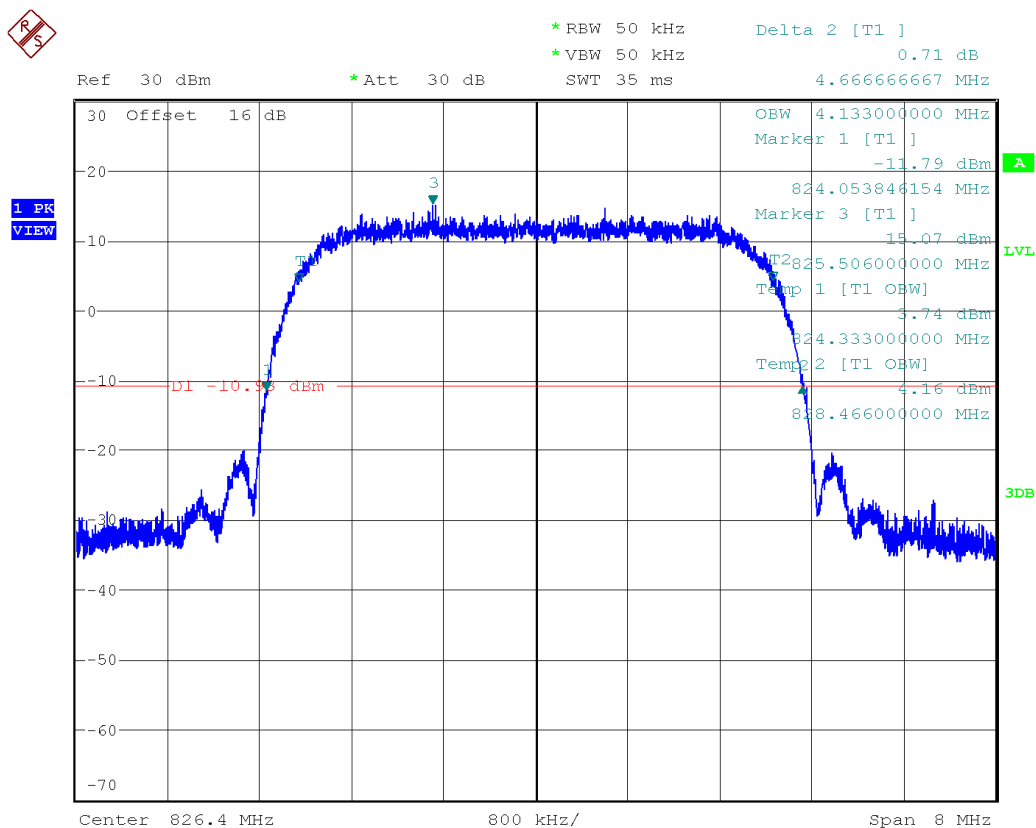


Highest Channel

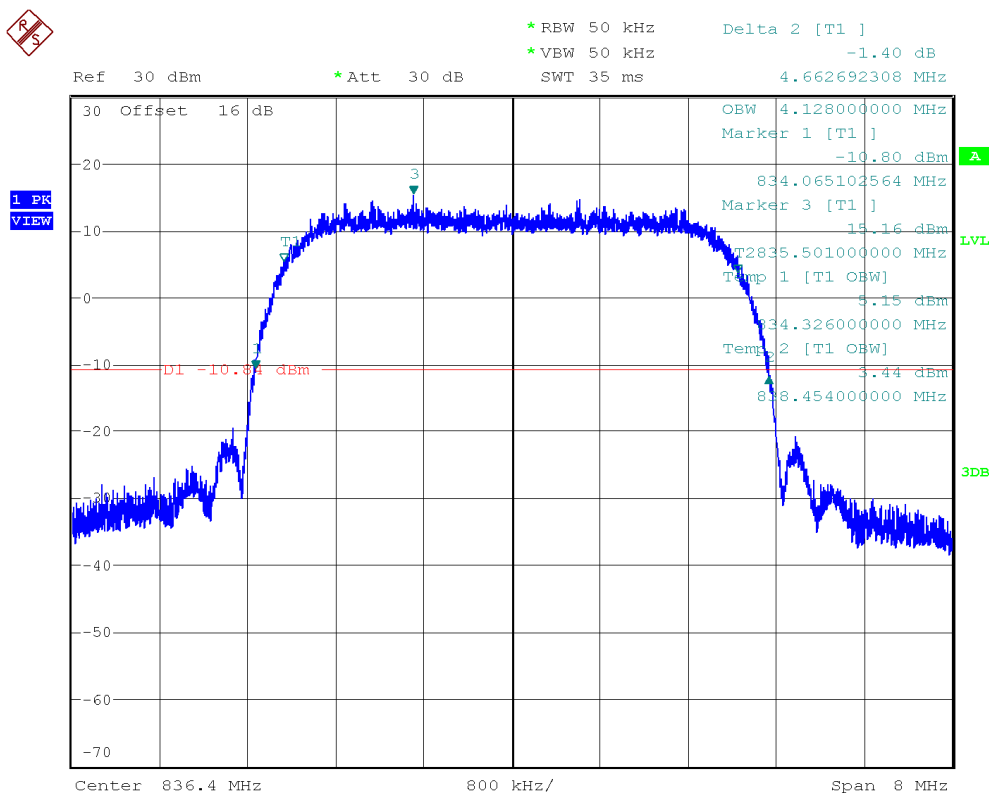


WCDMA MODULATION

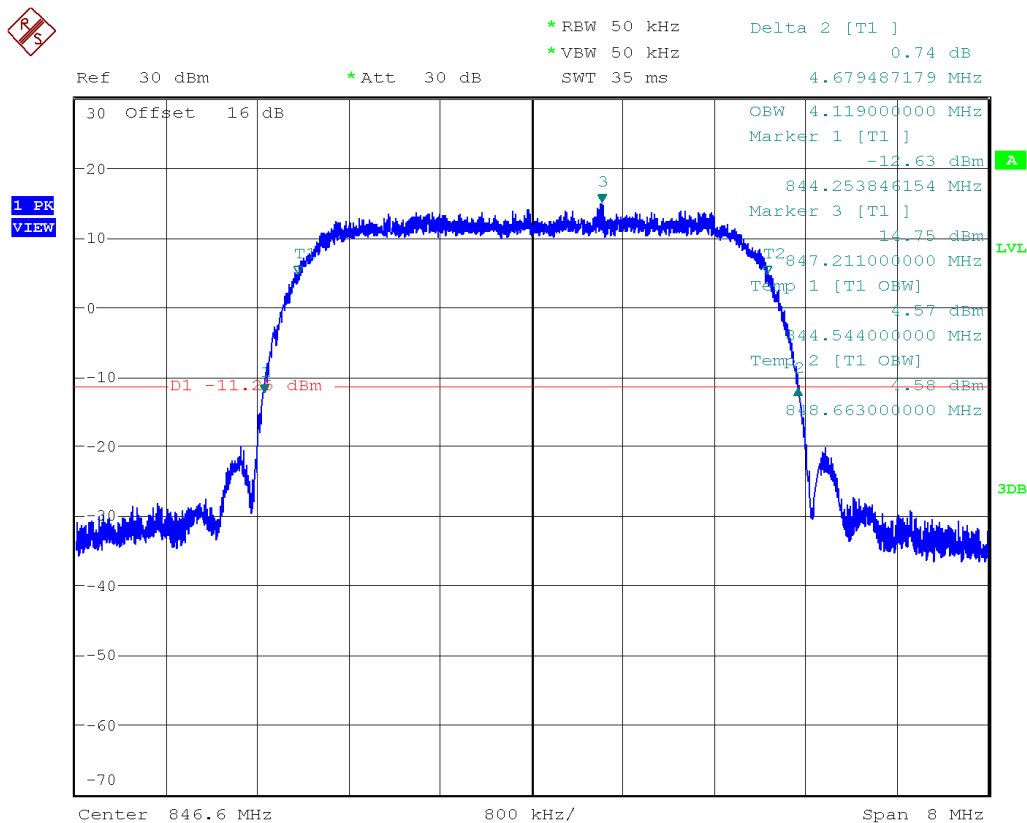
Lowest Channel



Middle Channel

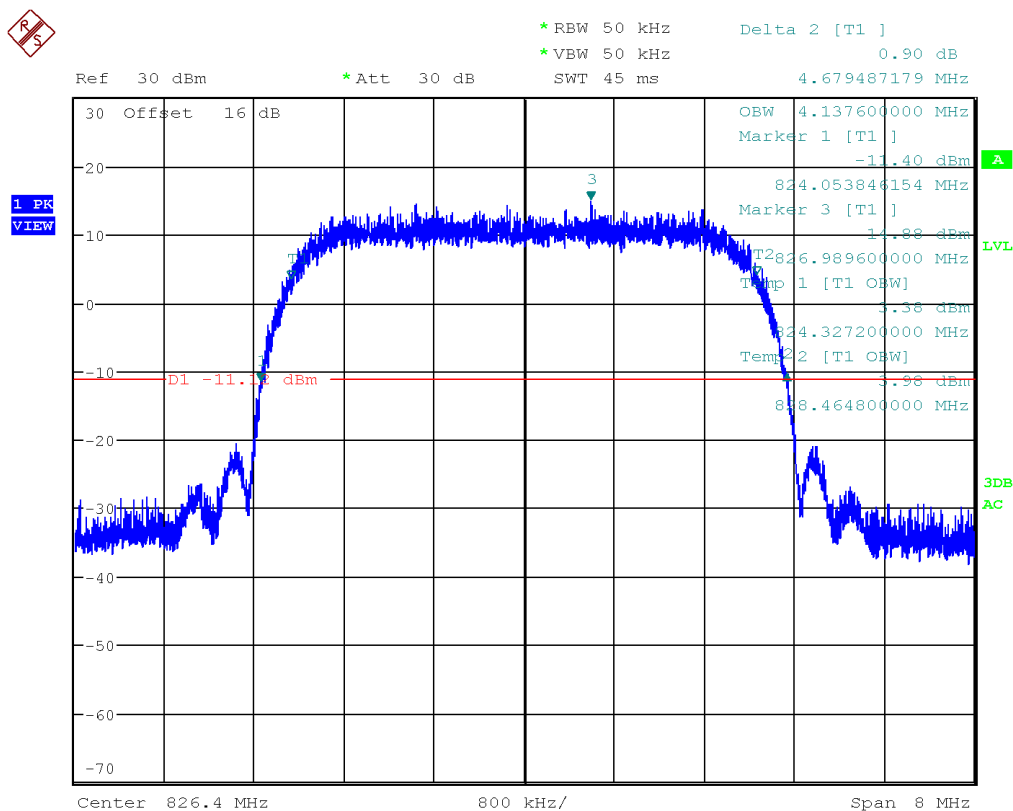


Highest Channel

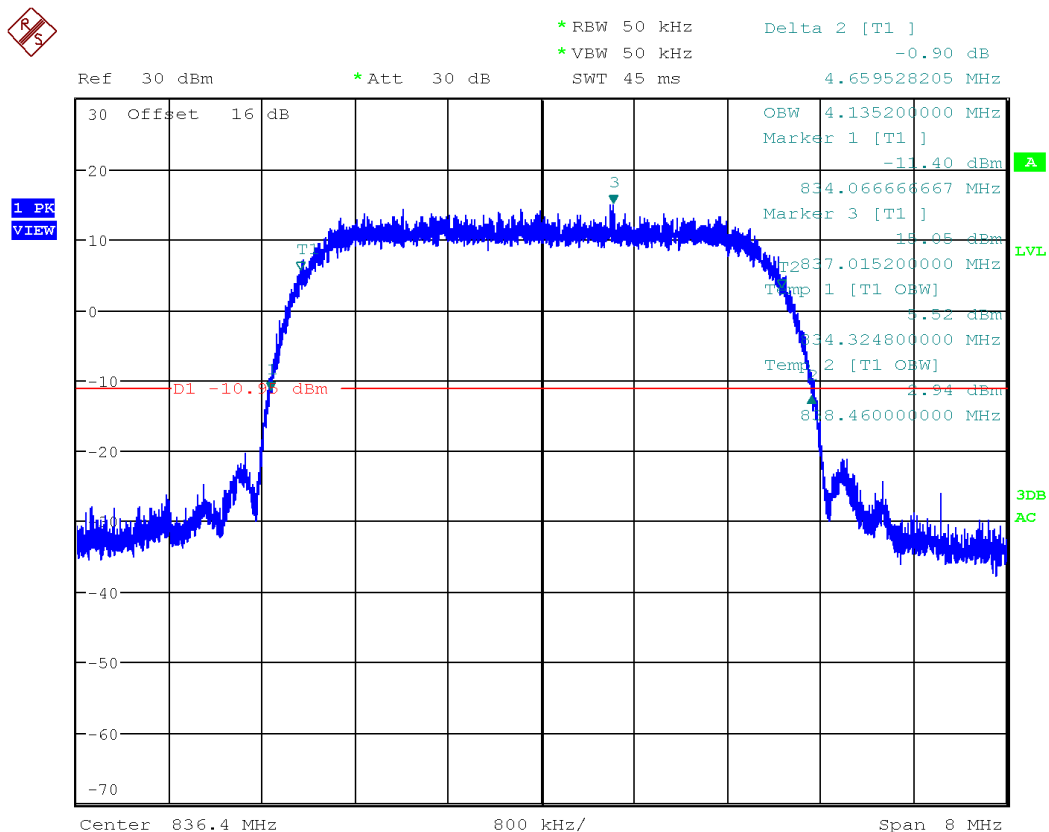


HSUPA MODULATION

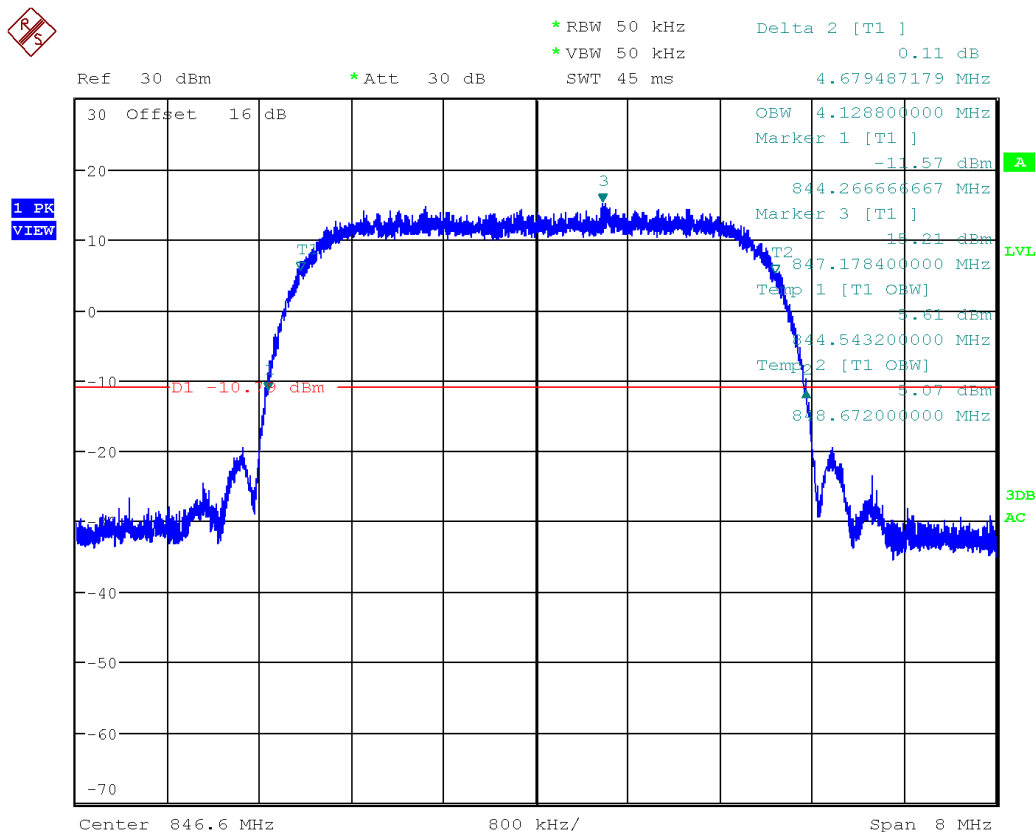
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051 and §22.917

METHOD

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

The spectrum was investigated from 9 kHz to 10 GHz.

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

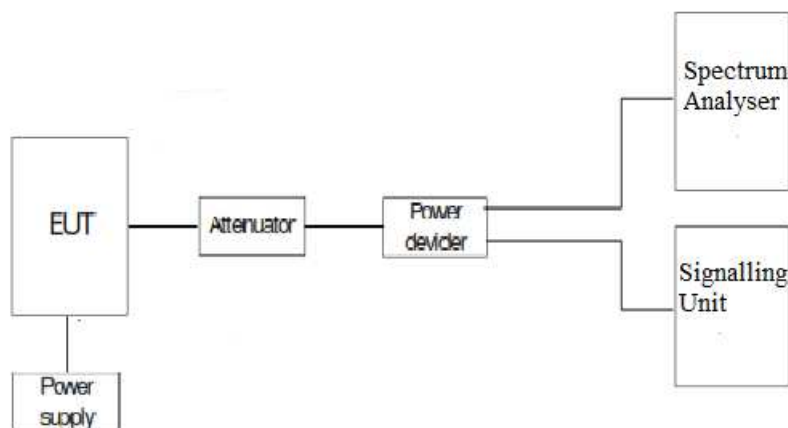
Measurement Limit:

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

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

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

TEST SETUP



RESULTS (see plots in next pages)

GPRS MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

3. CHANNEL: HIGHEST

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

EDGE MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

3. CHANNEL: HIGHEST

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

WCDMA MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

3. CHANNEL: HIGHEST

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

HSUPA MODULATION

1. CHANNEL: LOWEST

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

2. CHANNEL: MIDDLE

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

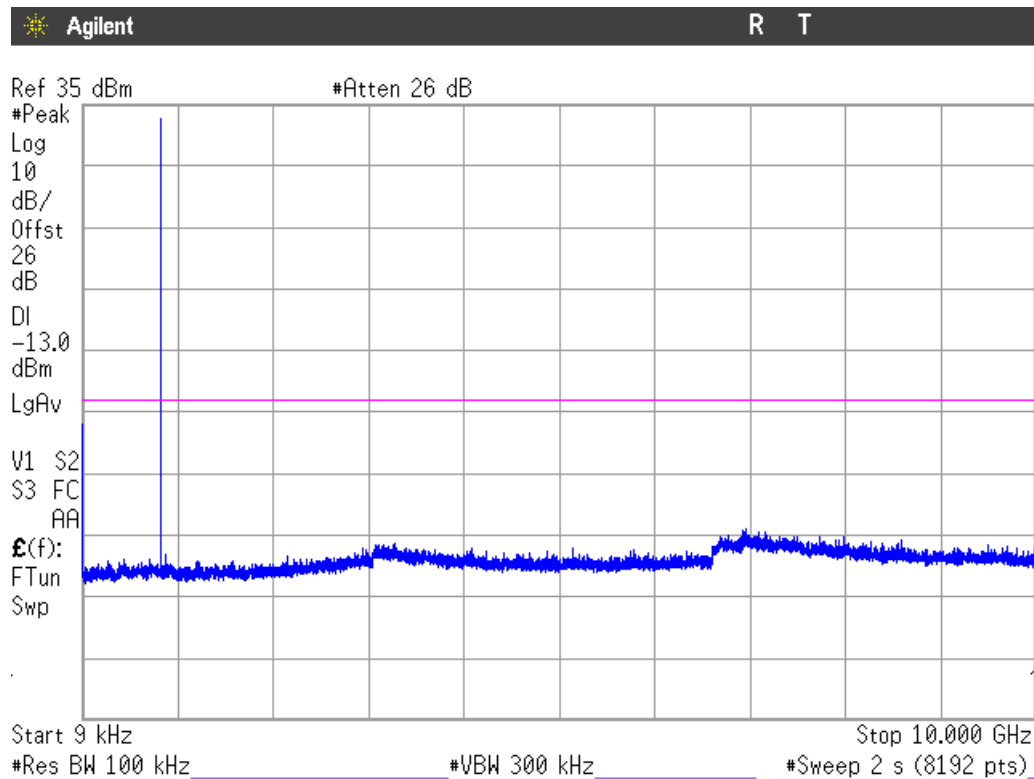
3. CHANNEL: HIGHEST

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

Verdict: PASS

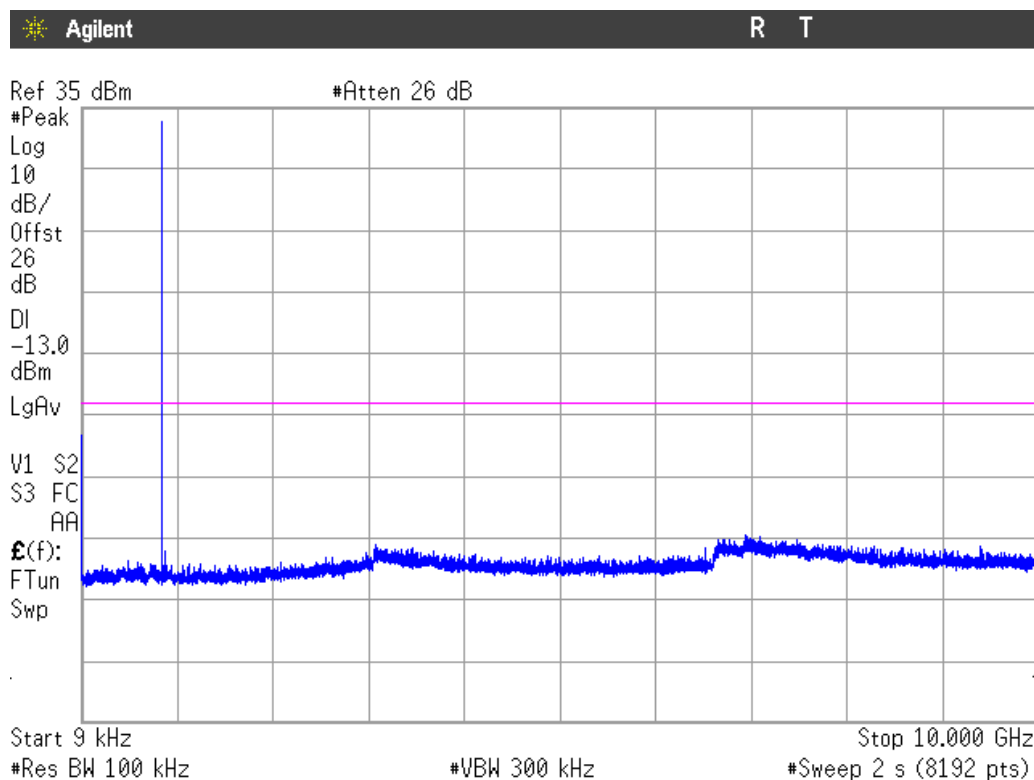
GPRS MODULATION

1. CHANNEL: LOWEST



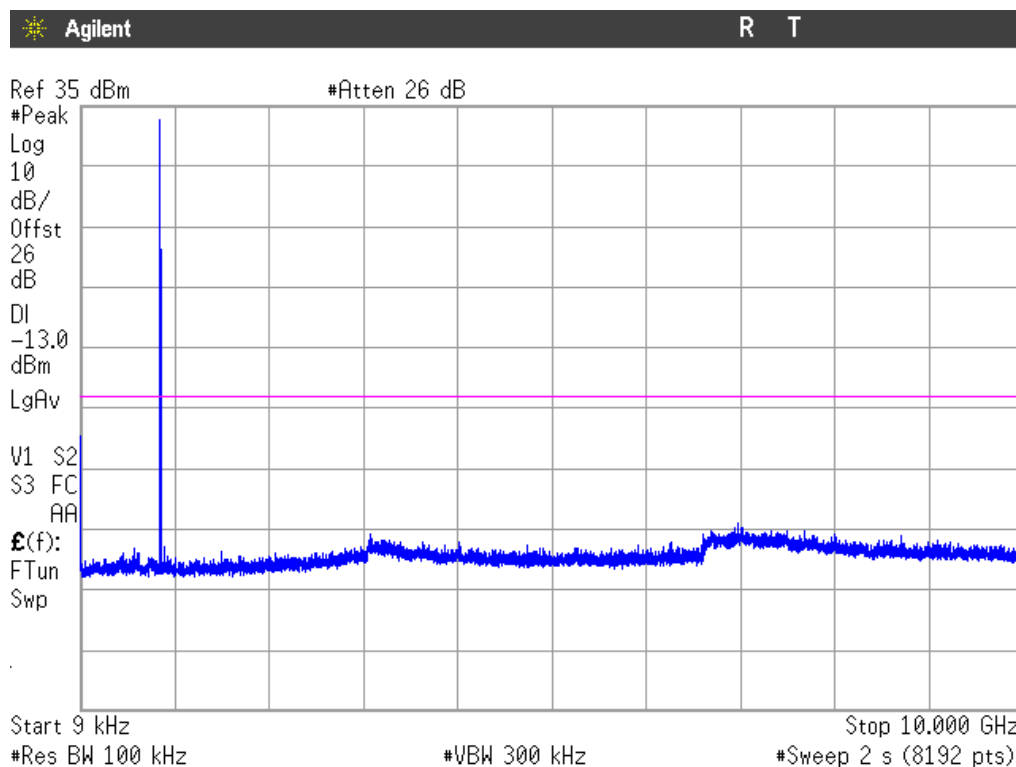
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

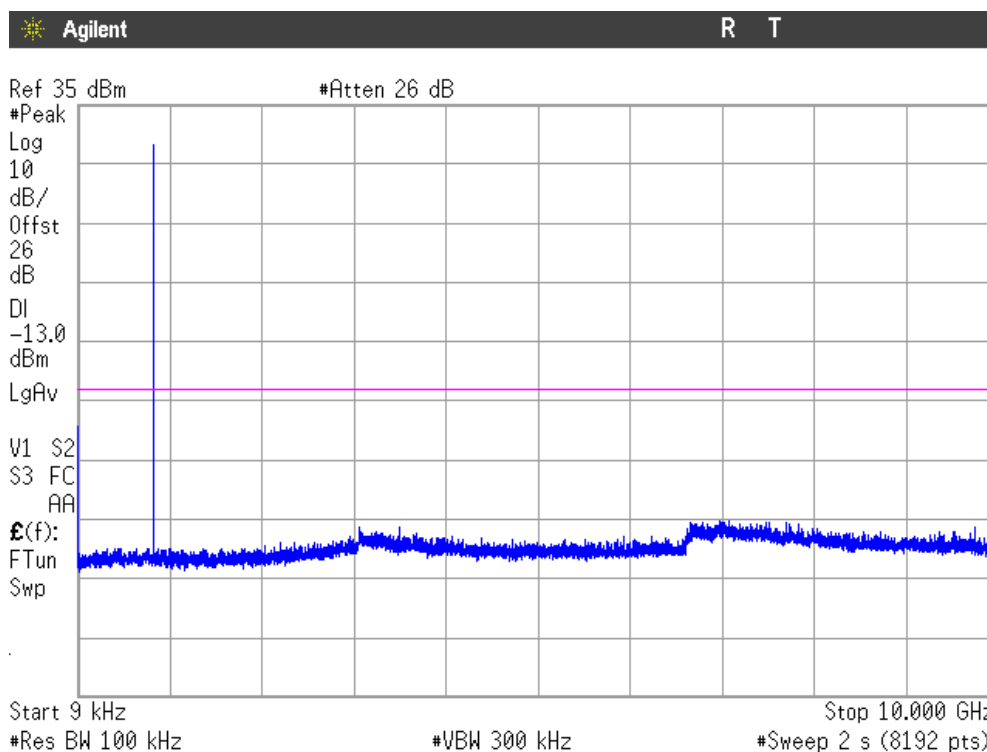
3. CHANNEL: HIGHEST



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

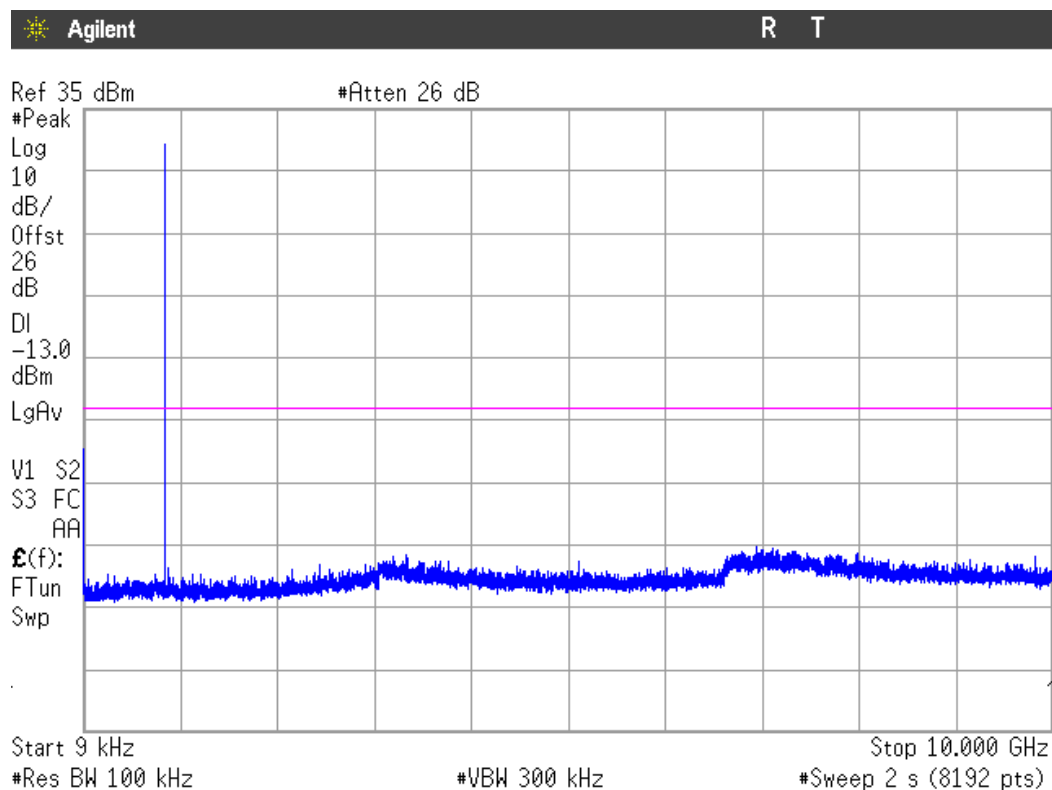
EDGE MODULATION

1. CHANNEL: LOWEST



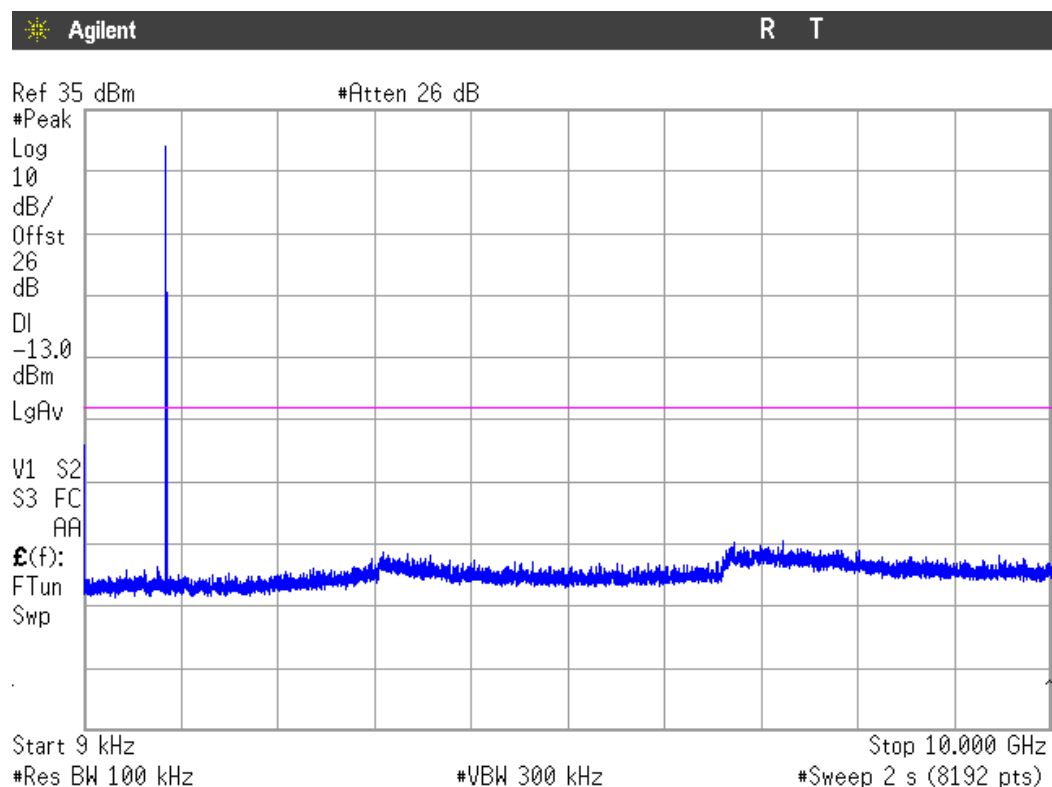
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

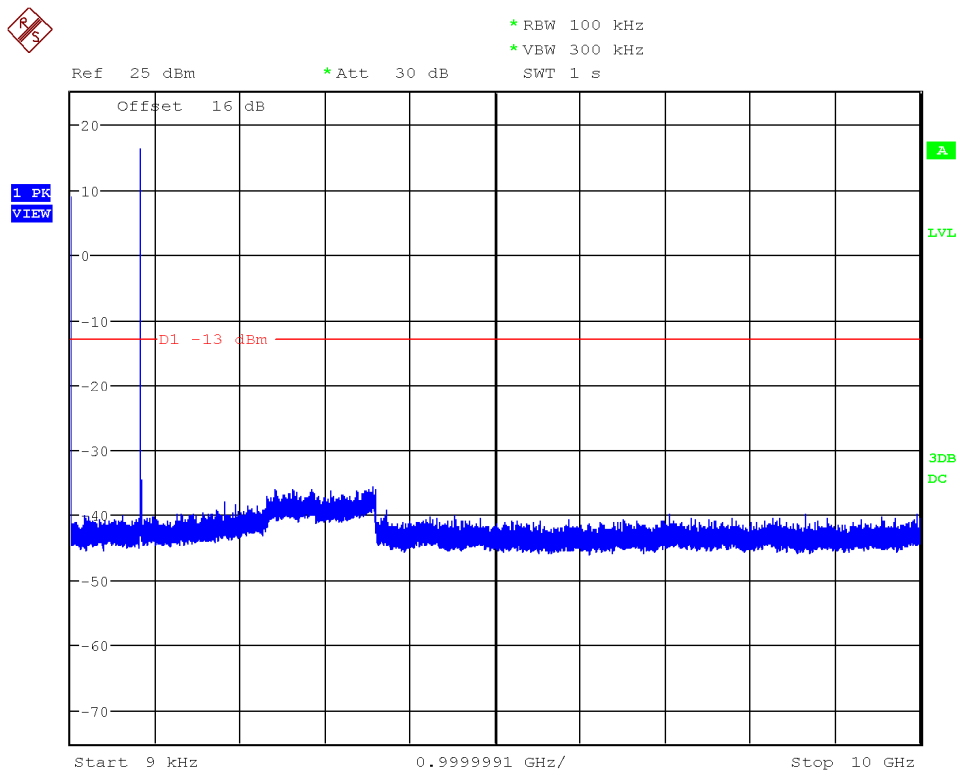
3. CHANNEL: HIGHEST



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

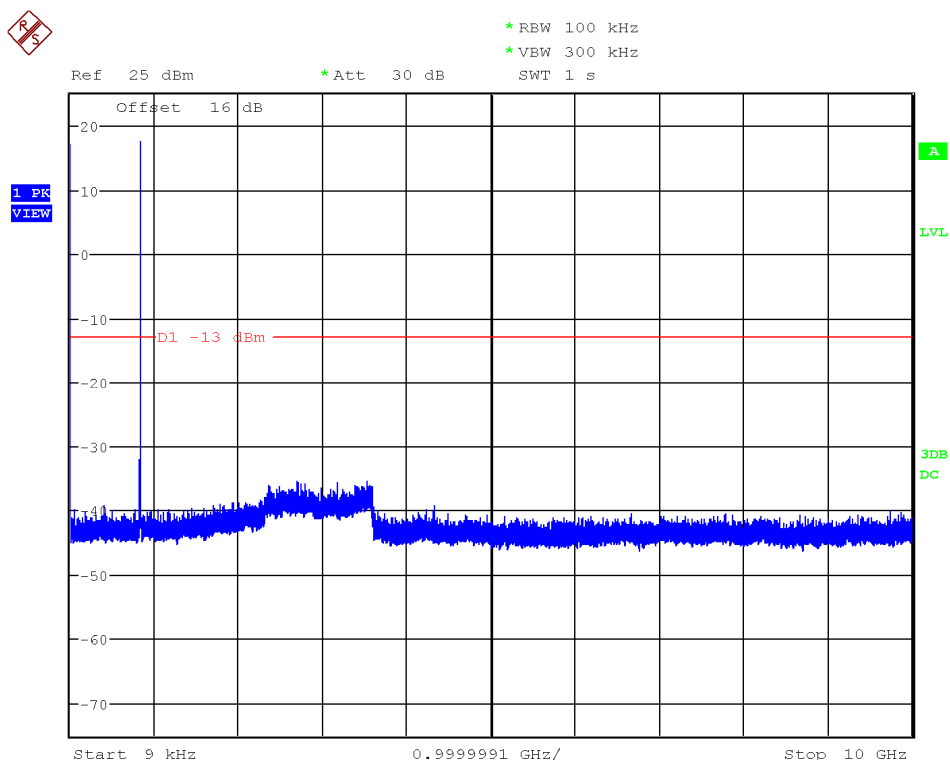
WCDMA MODULATION

1. CHANNEL: LOWEST



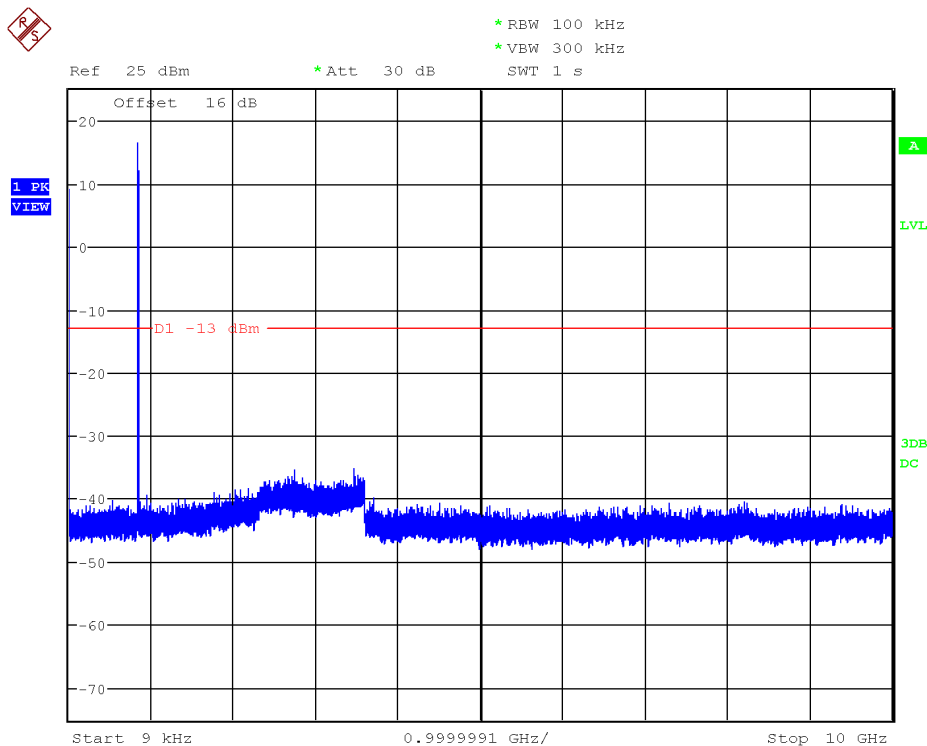
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

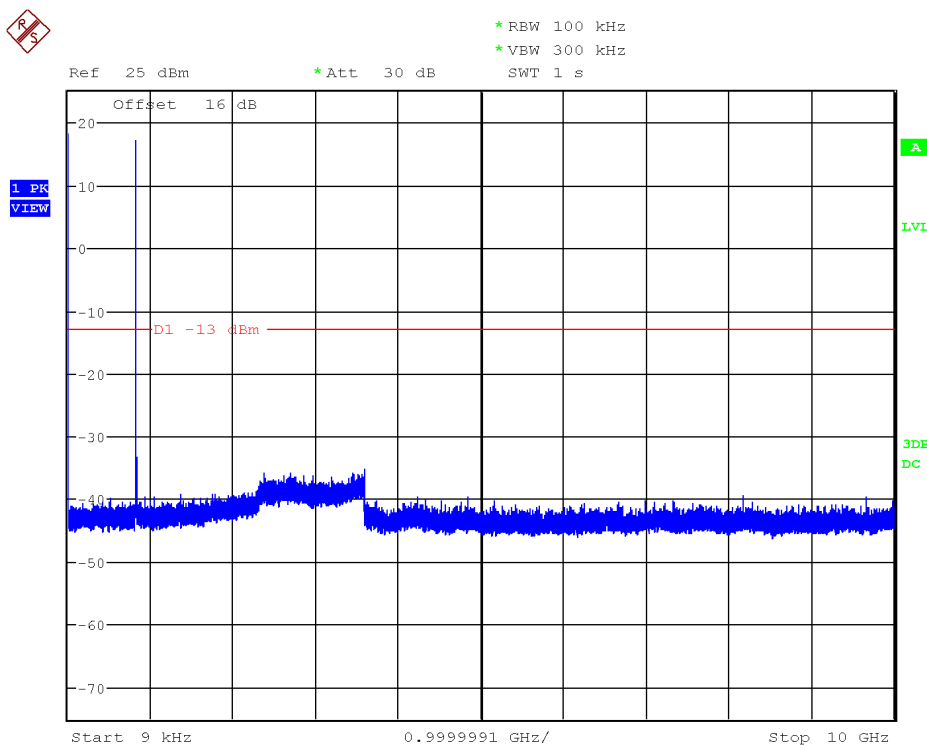
3. CHANNEL: HIGHEST



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

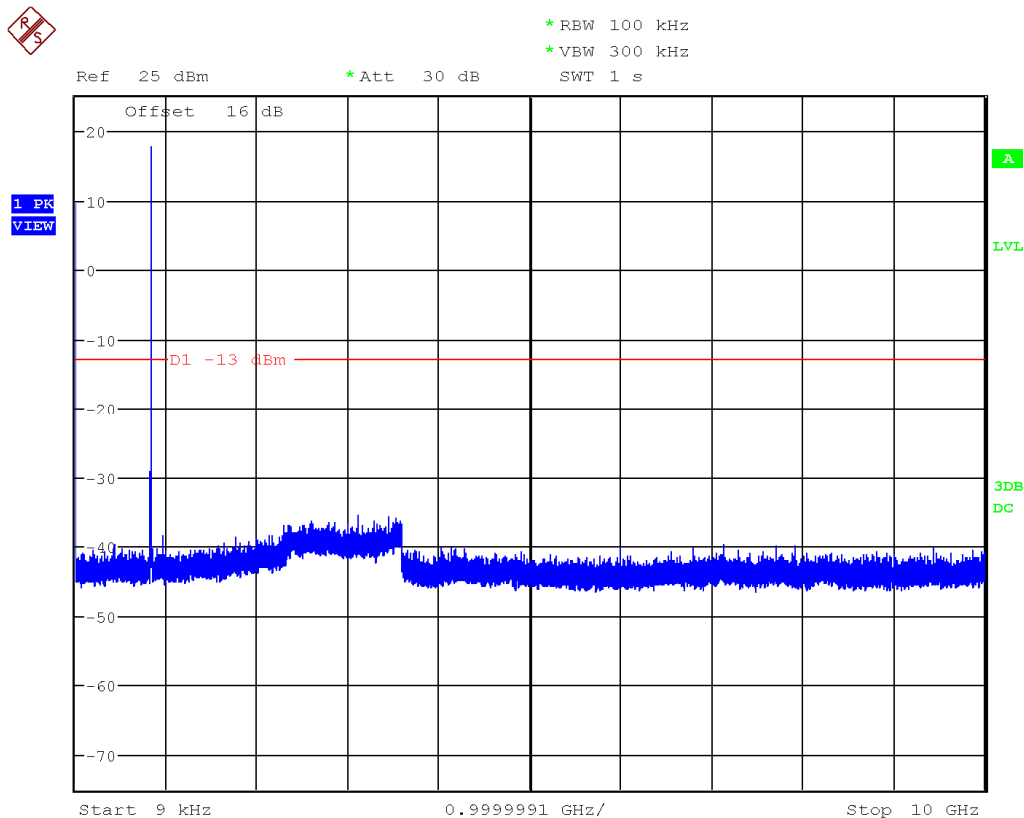
HSUPA MODULATION

1. CHANNEL: LOWEST



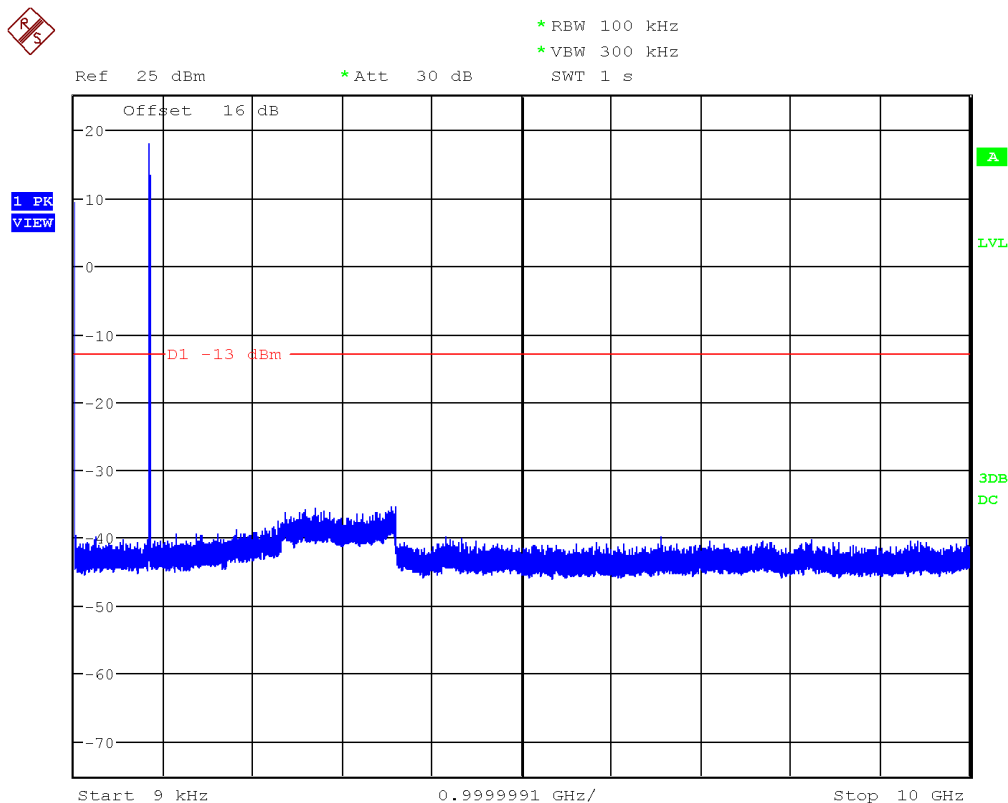
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

3. CHANNEL: HIGHEST



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

Spurious emissions at antenna terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §22.917

METHOD

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

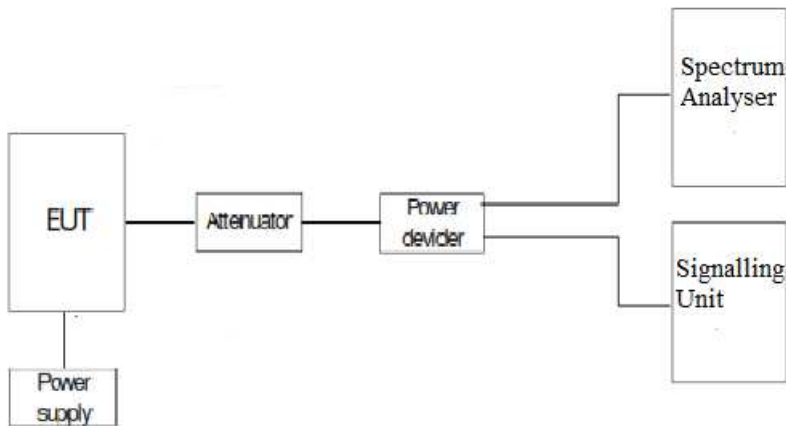
Measurement Limit:

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

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

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

TEST SETUP



RESULTS (see plots in next pages)

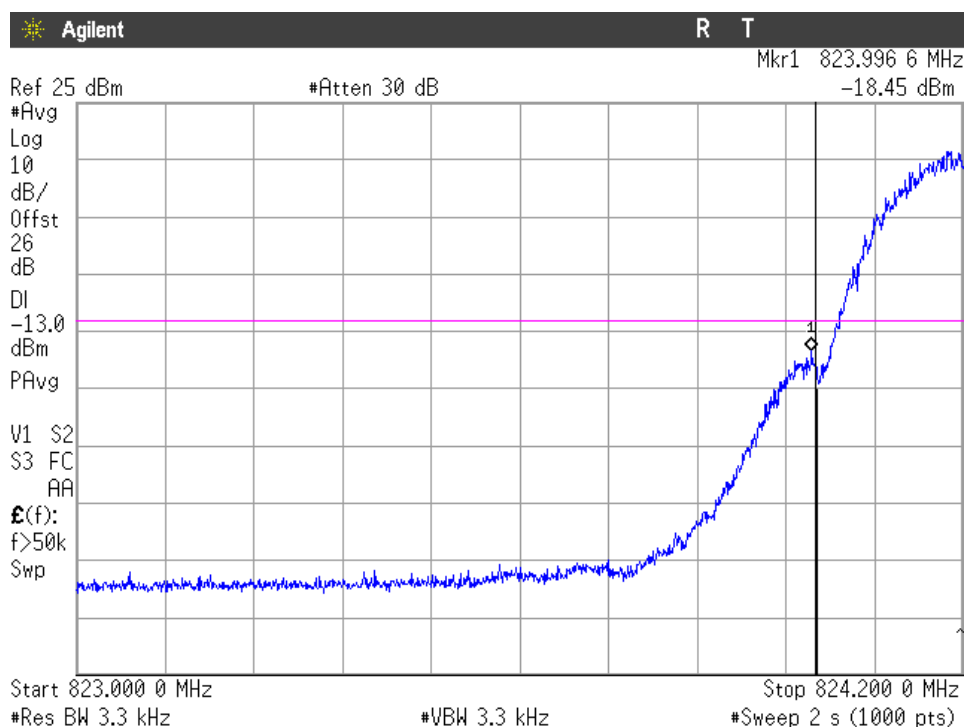
MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at lowest Block Edge at antenna port (dBm)	-18.45	-26.93	-28.16	-28.56

MODULATION:	GPRS	EDGE	WCDMA	HSUPA
Maximum measured level at highest Block Edge at antenna port (dBm)	-20.35	-26.85	-29.12	-28.91

Measurement uncertainty = ± 1.57 dB.

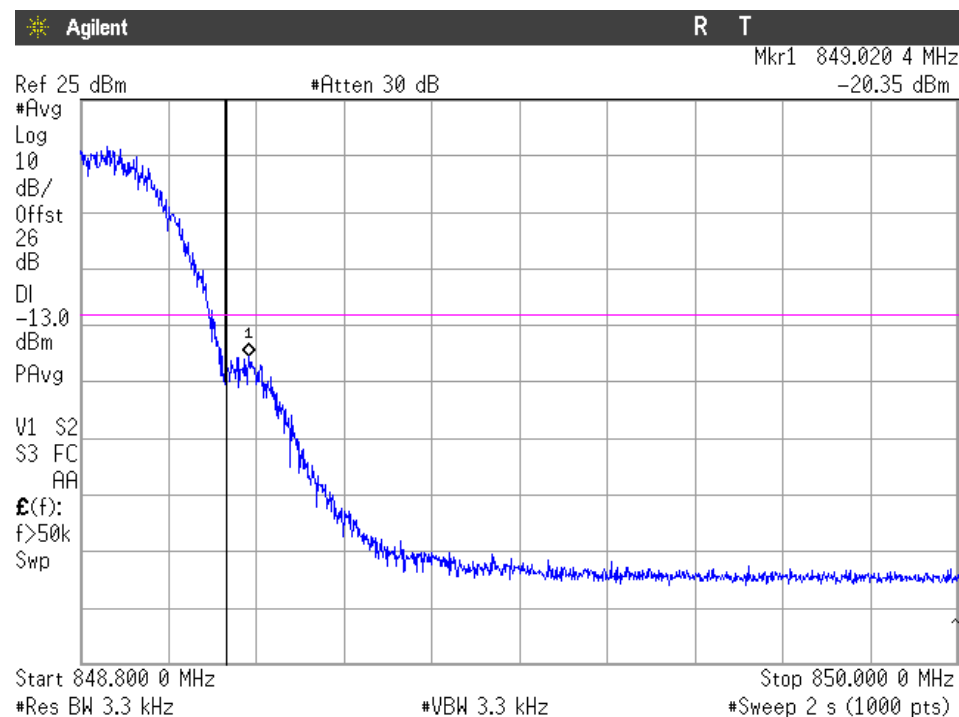
GPRS MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

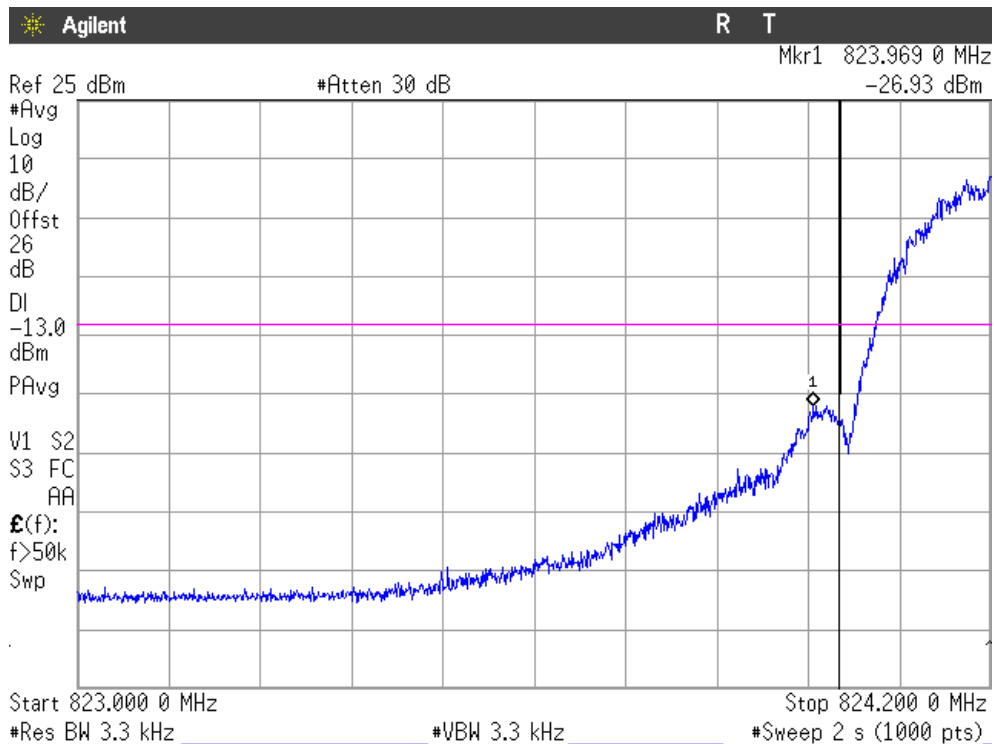
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

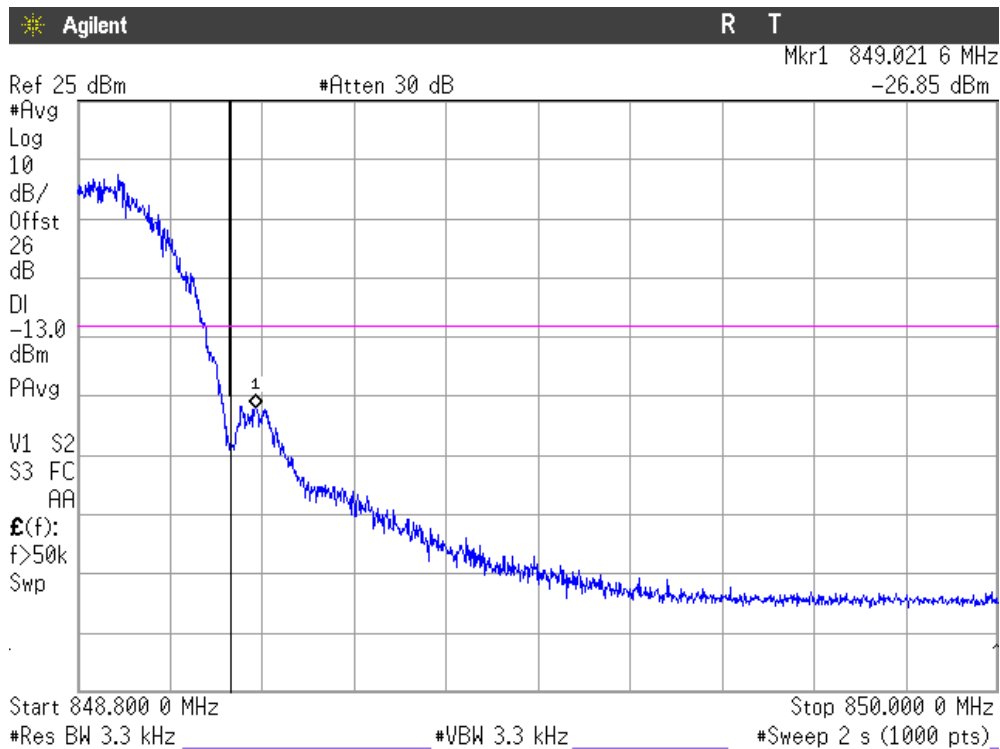
Verdict: PASS

EDGE MODULATION CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

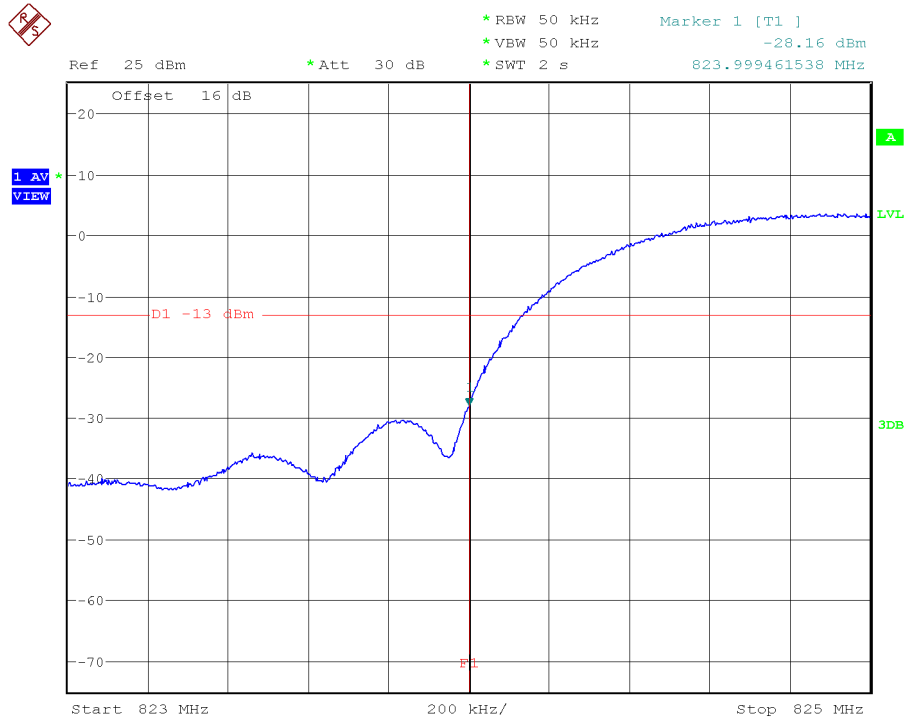
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

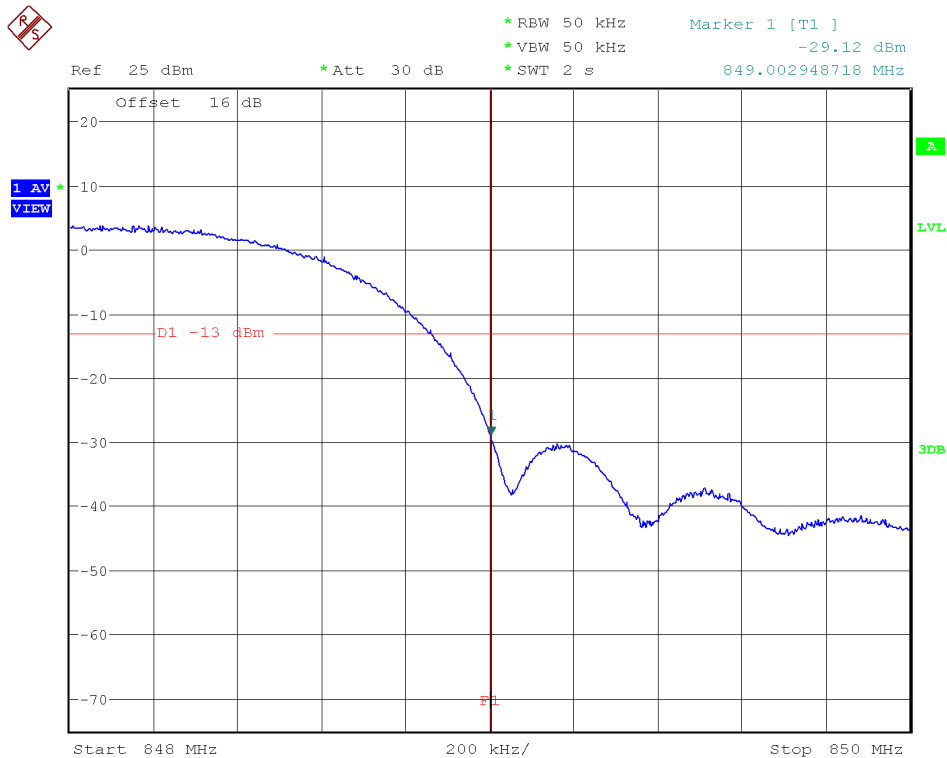
Verdict: PASS

WCDMA MODULATION CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

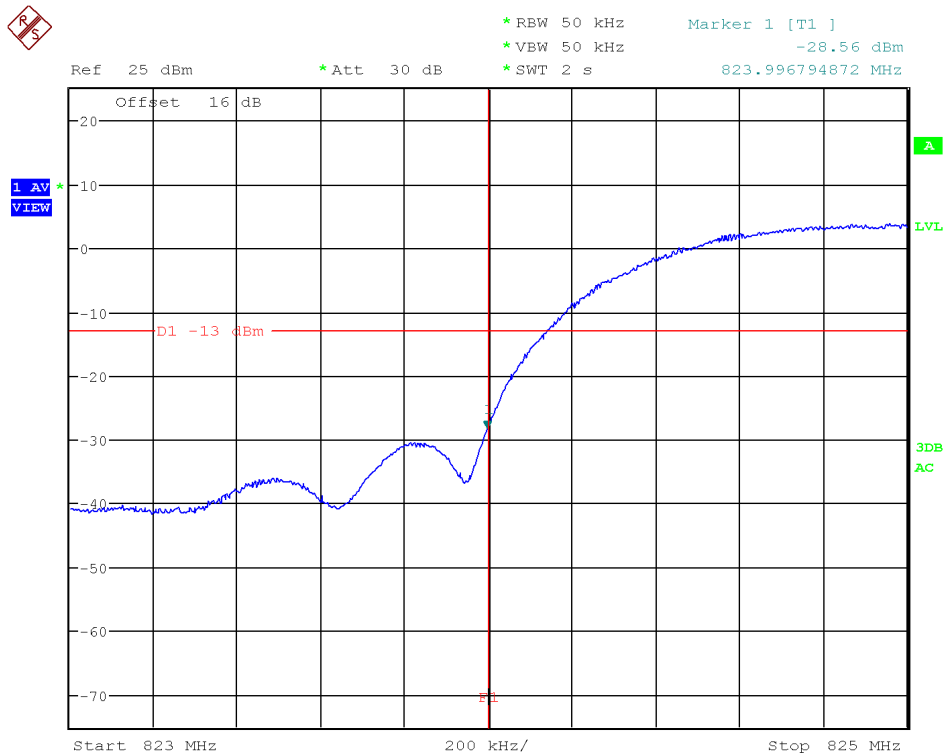
CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

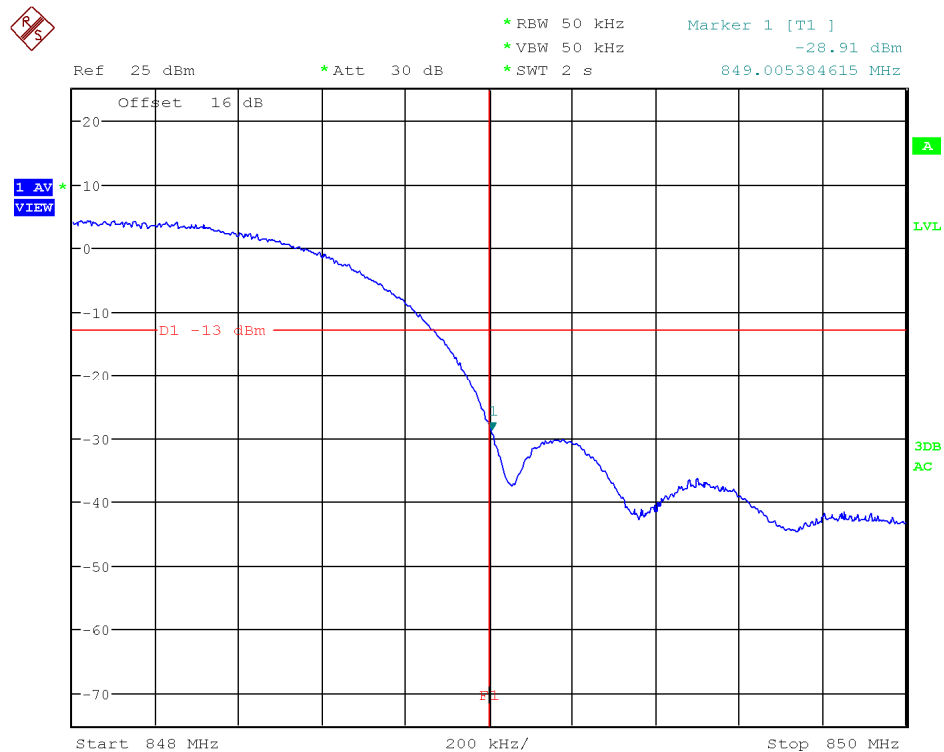
Verdict: PASS

HSUPA MODULATION CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

Verdict: PASS

Radiated emissions

SPECIFICATION

FCC § 22.917

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 1 meter high 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/EIA-603-C: 2004.

Measurement Limit:

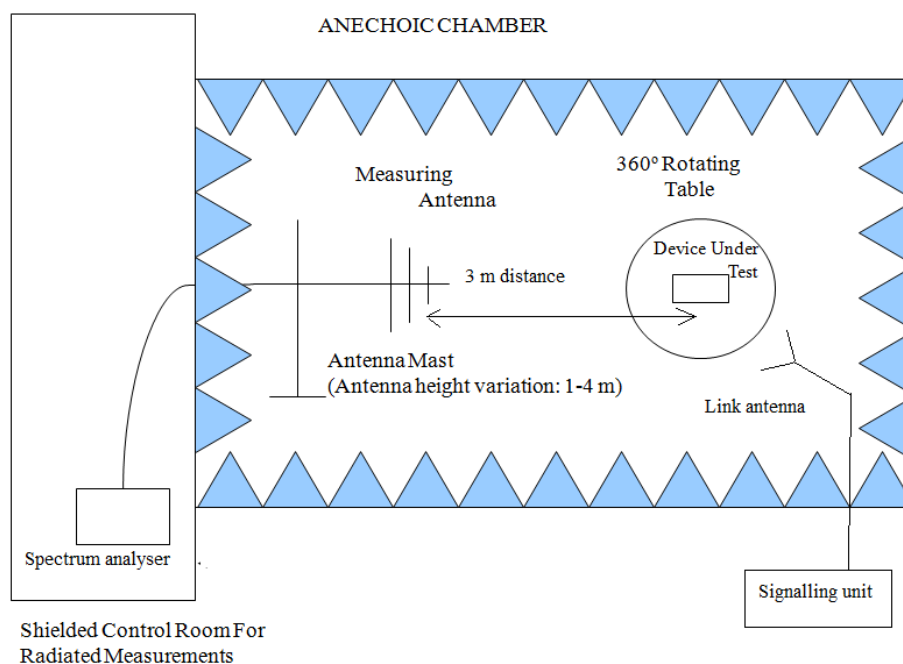
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

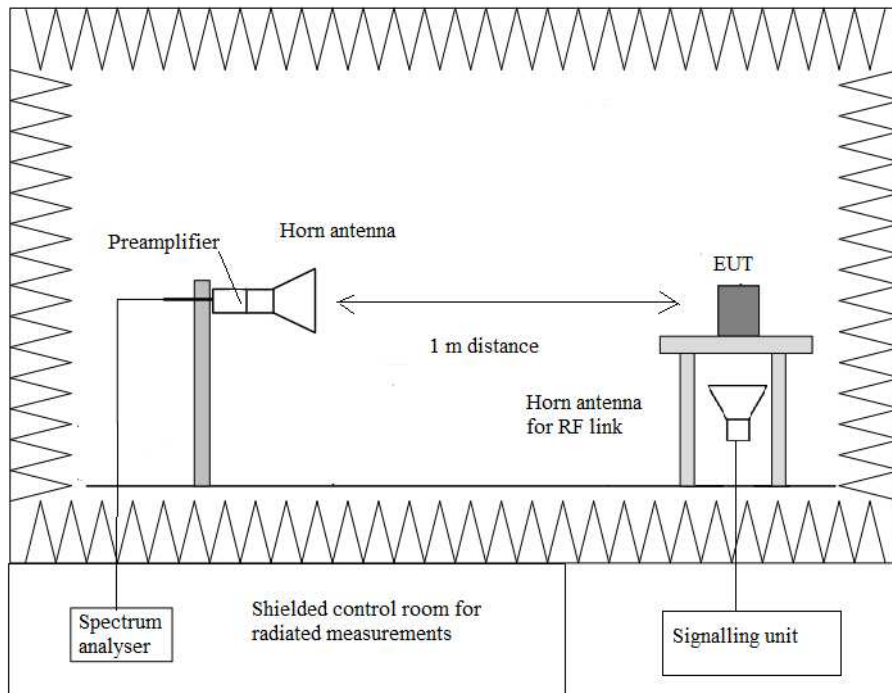
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS AND EDGE MODULATION

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

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

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

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

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

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

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

WCDMA AND HSUPA MODULATION

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

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

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

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

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

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-12.75 GHz.

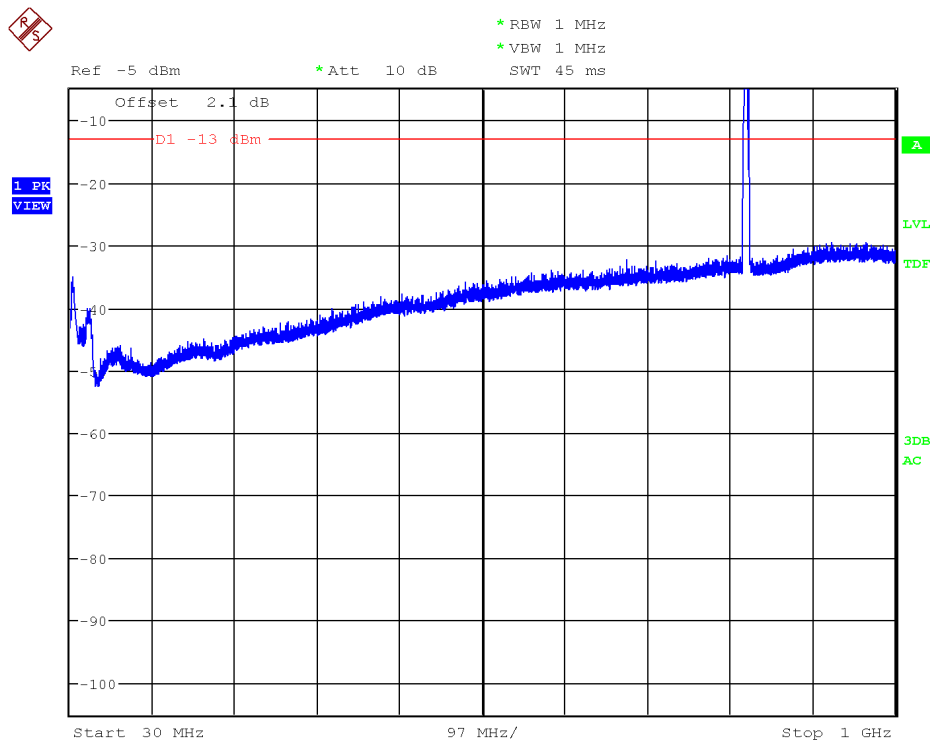
No radiated spurious signals were detected at less than 20 dB respect to the limit.

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

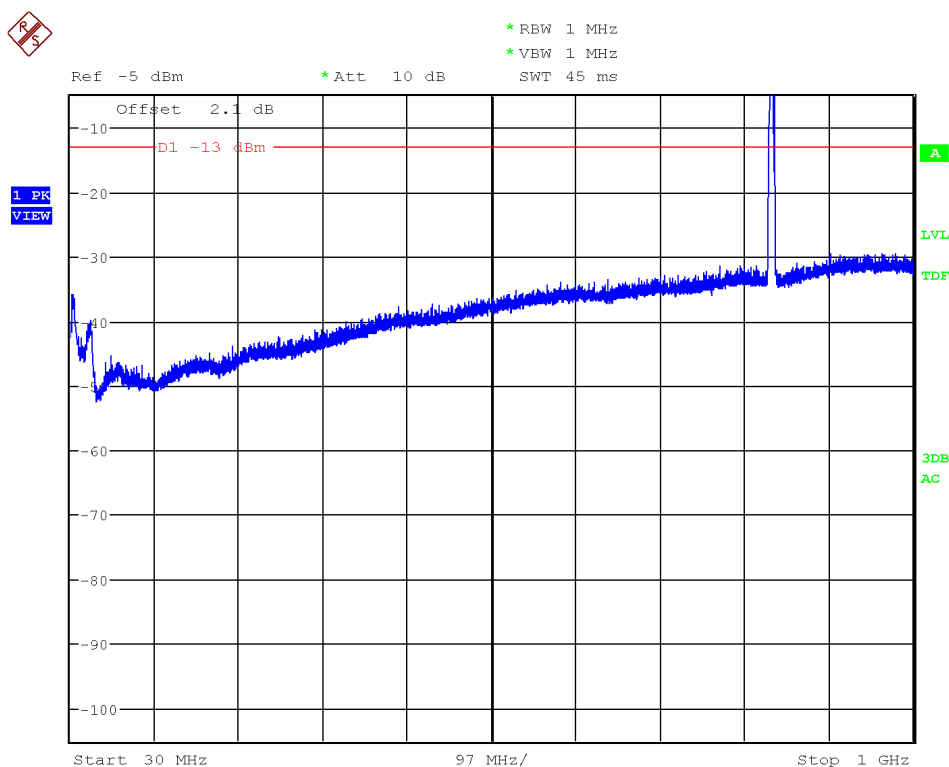
GPRS MODULATION

CHANNEL: LOWEST



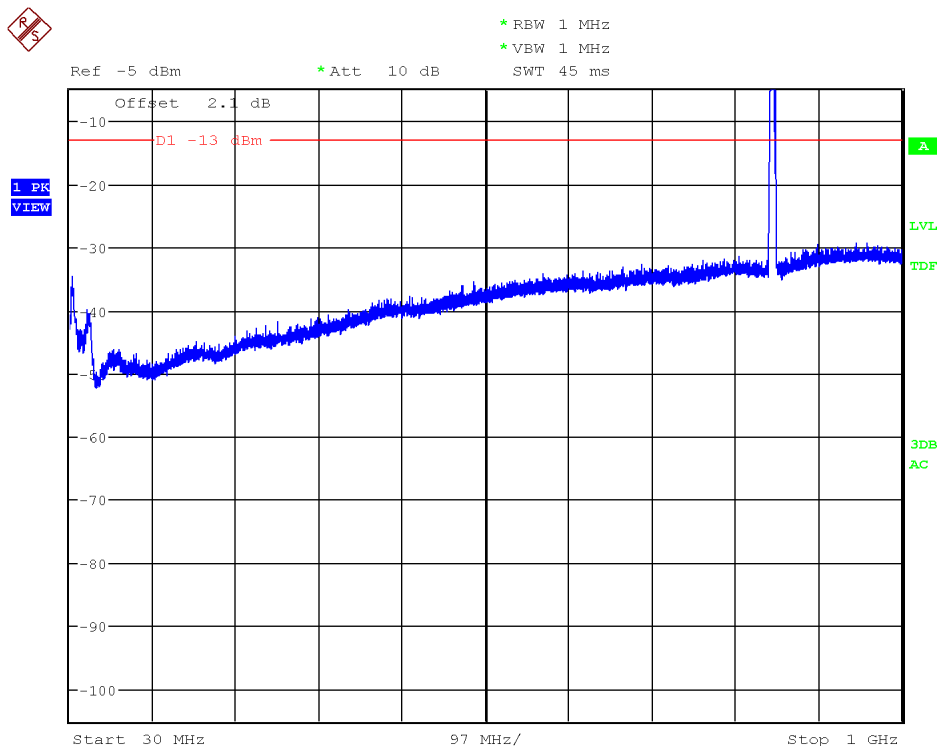
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

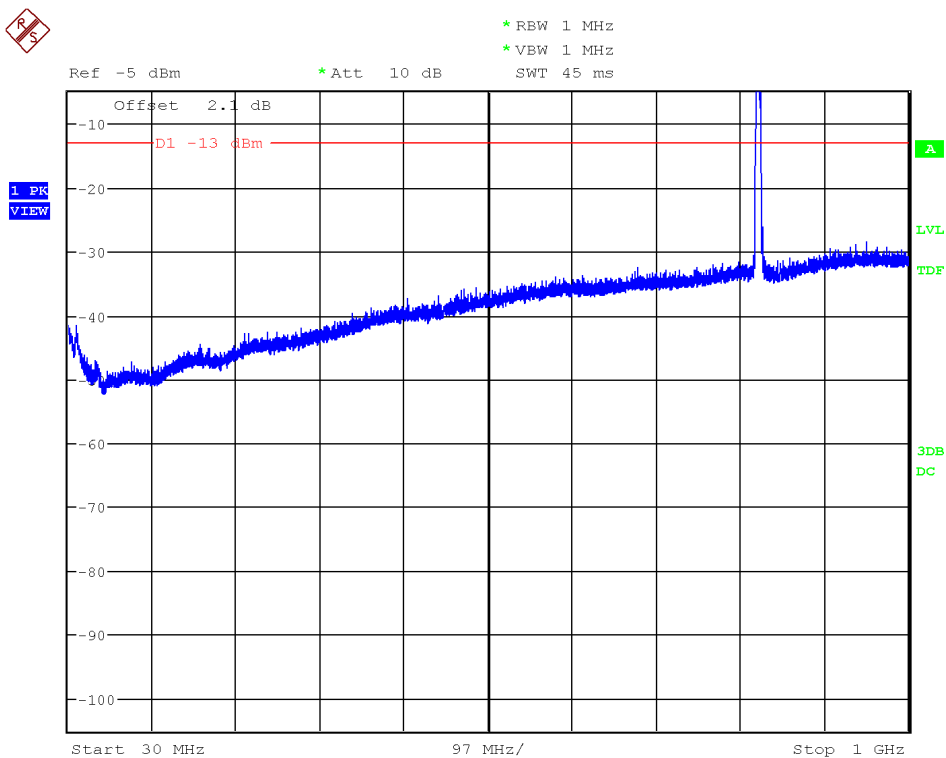
CHANNEL: HIGHEST



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

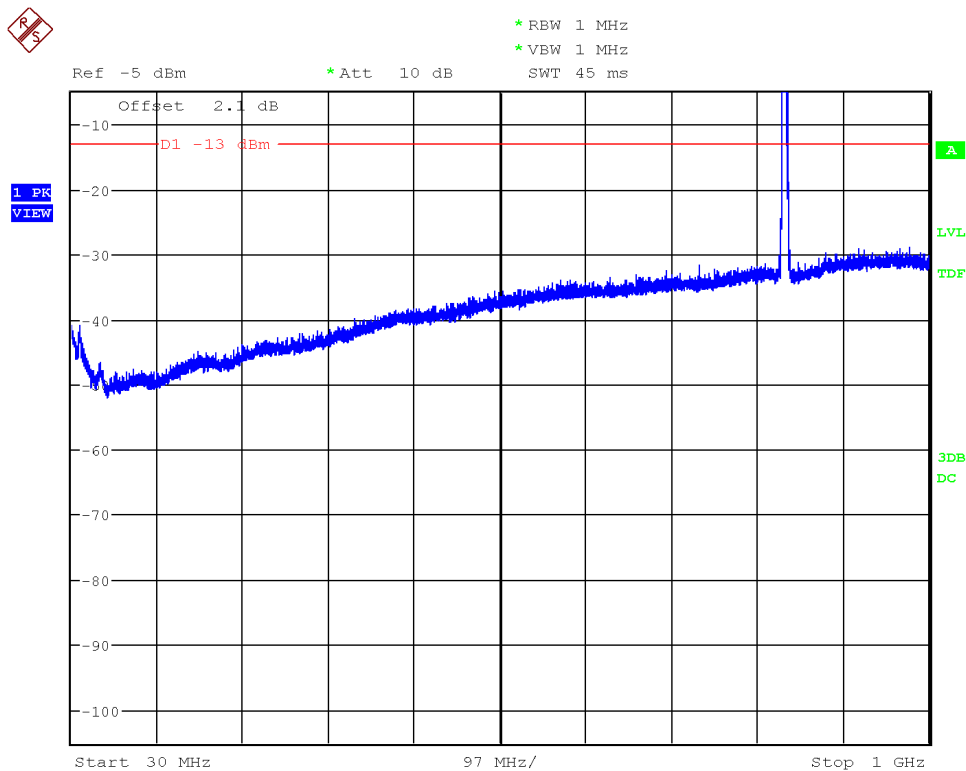
WCDMA MODULATION

CHANNEL: LOWEST



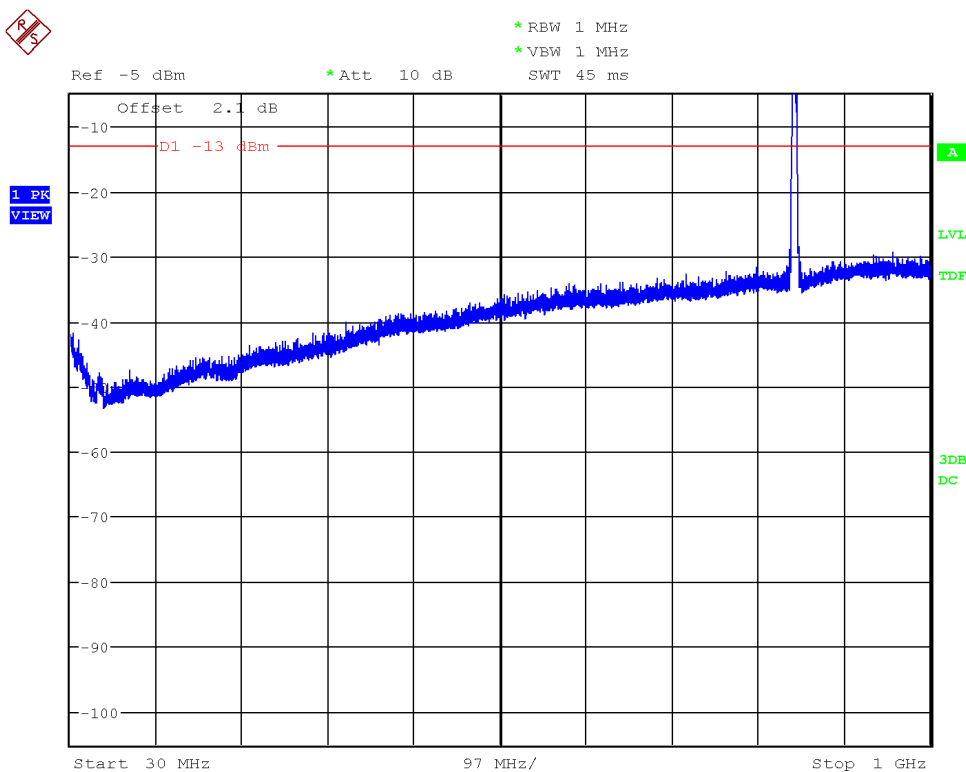
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

CHANNEL: HIGHEST

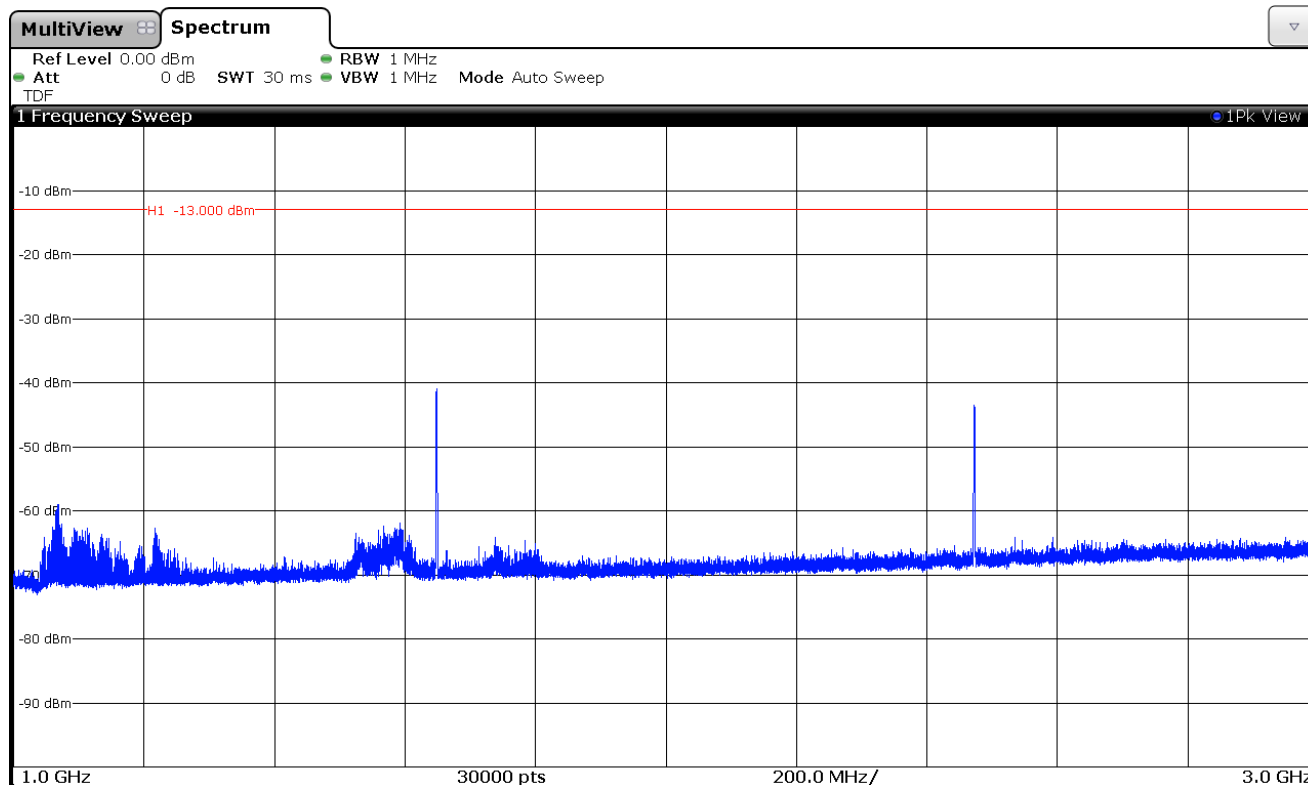


Note: The peak above the limit is the carrier frequency.

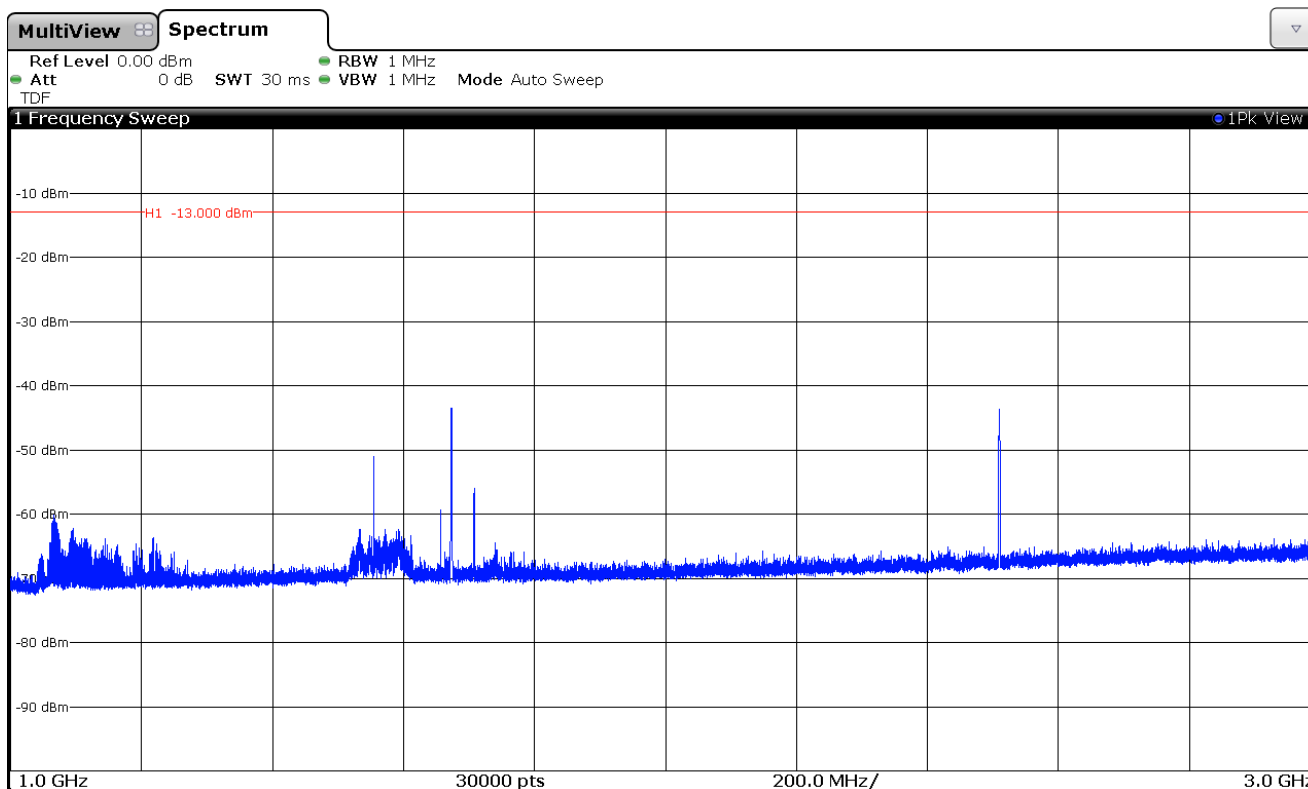
FREQUENCY RANGE 1 GHz to 3 GHz.

GPRS MODULATION

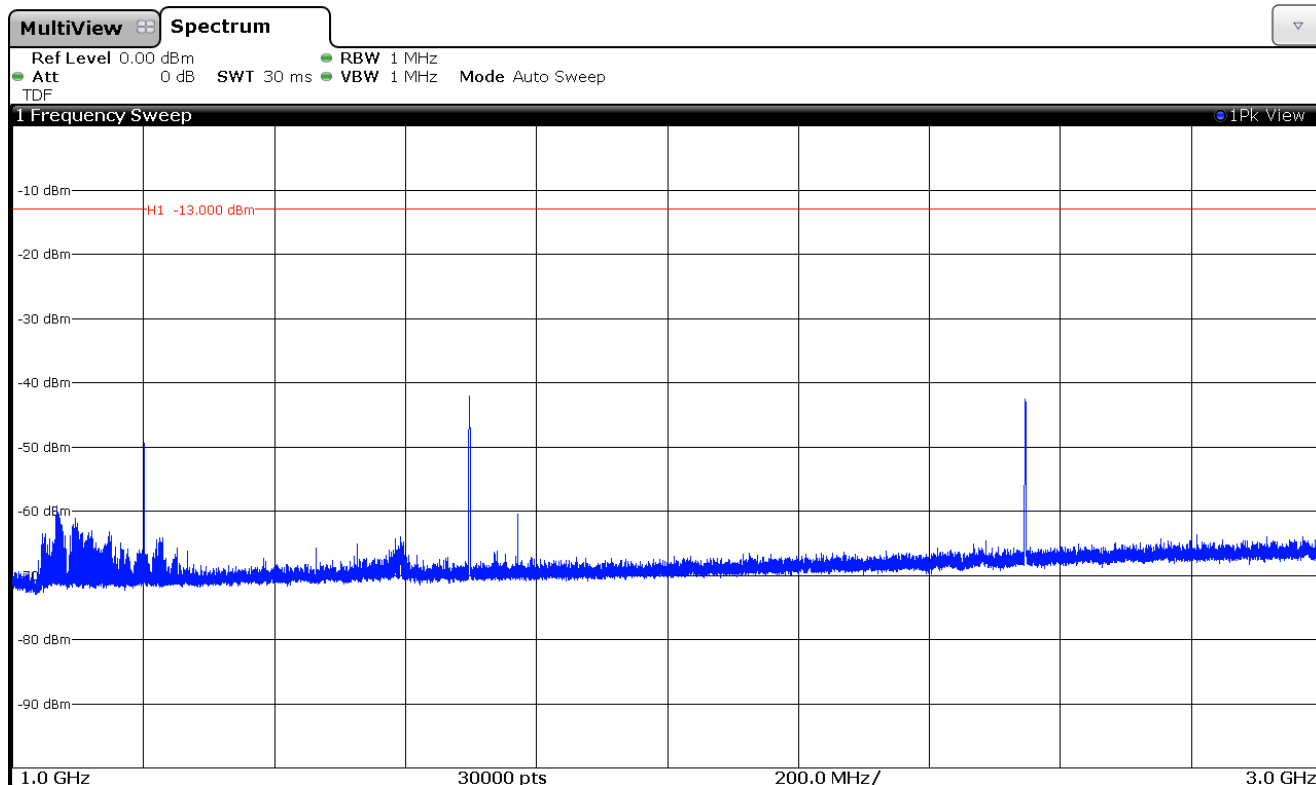
CHANNEL: LOWEST



CHANNEL: MIDDLE

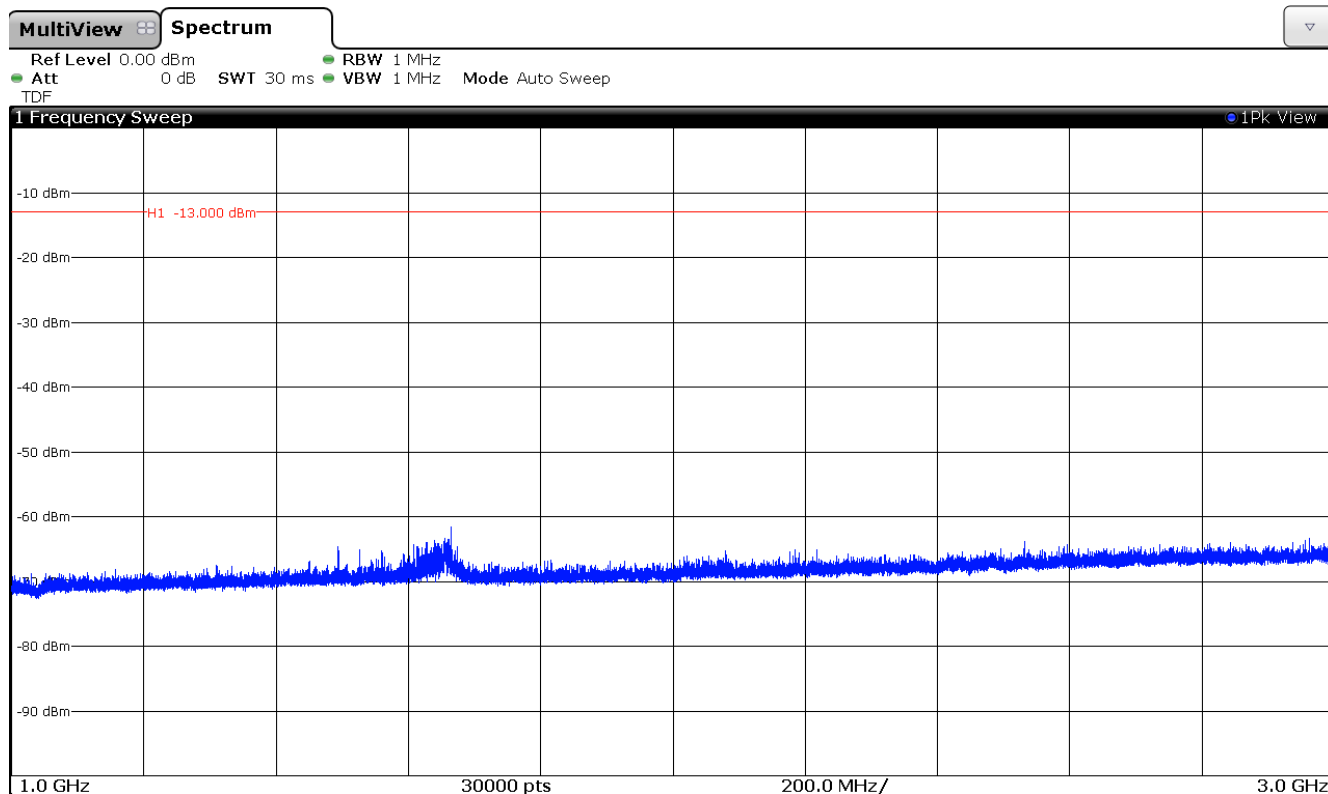


CHANNEL: HIGHEST

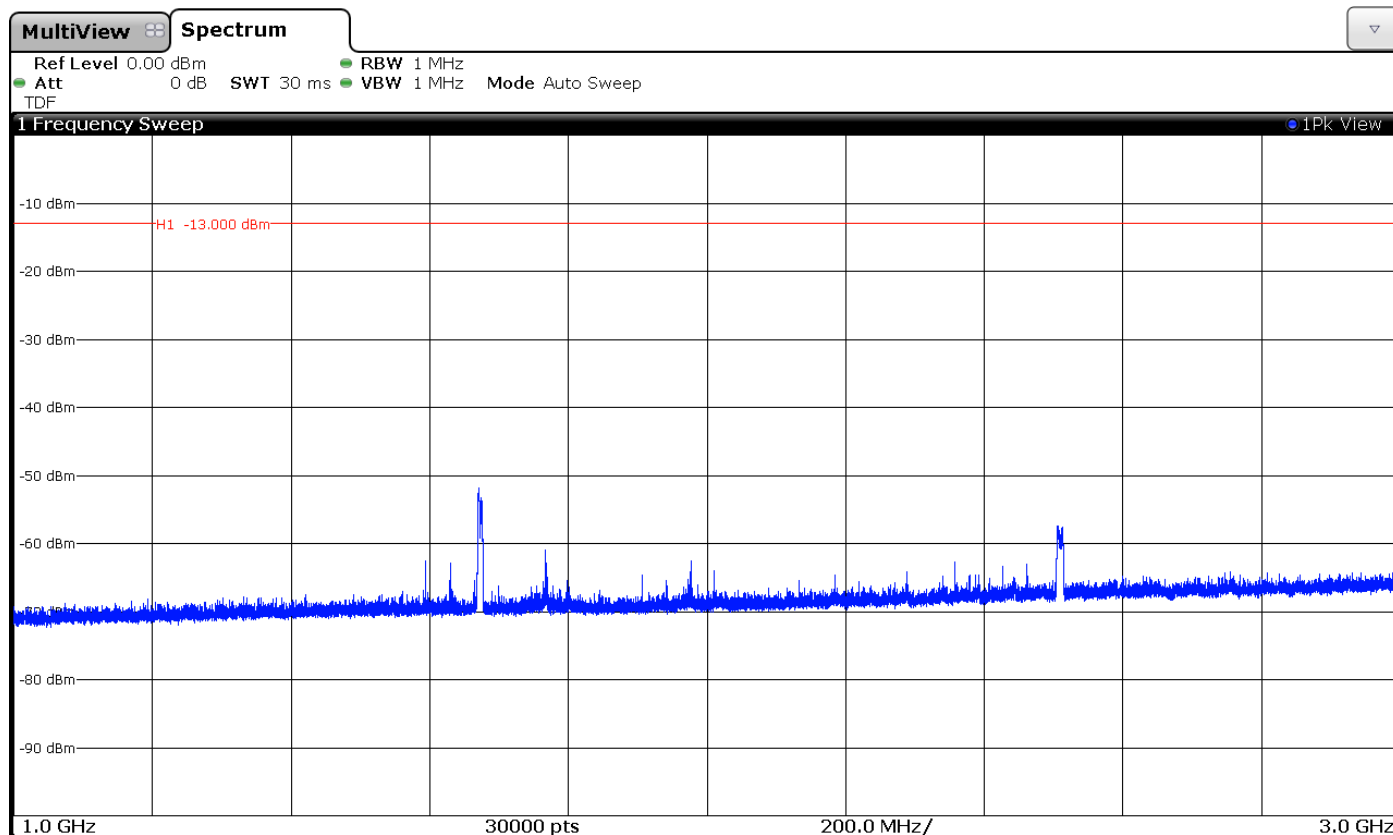


WCDMA MODULATION

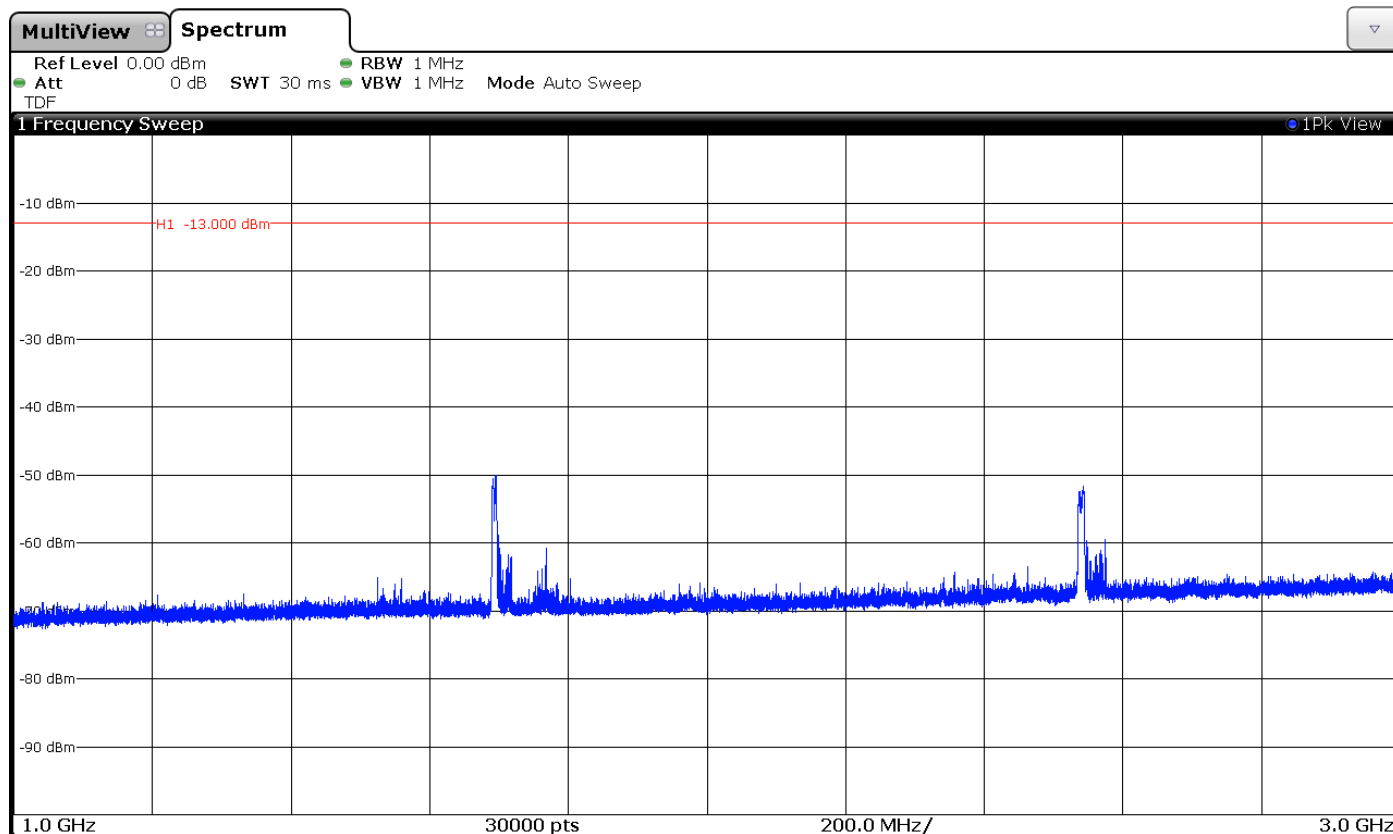
CHANNEL: LOWEST



CHANNEL: MIDDLE



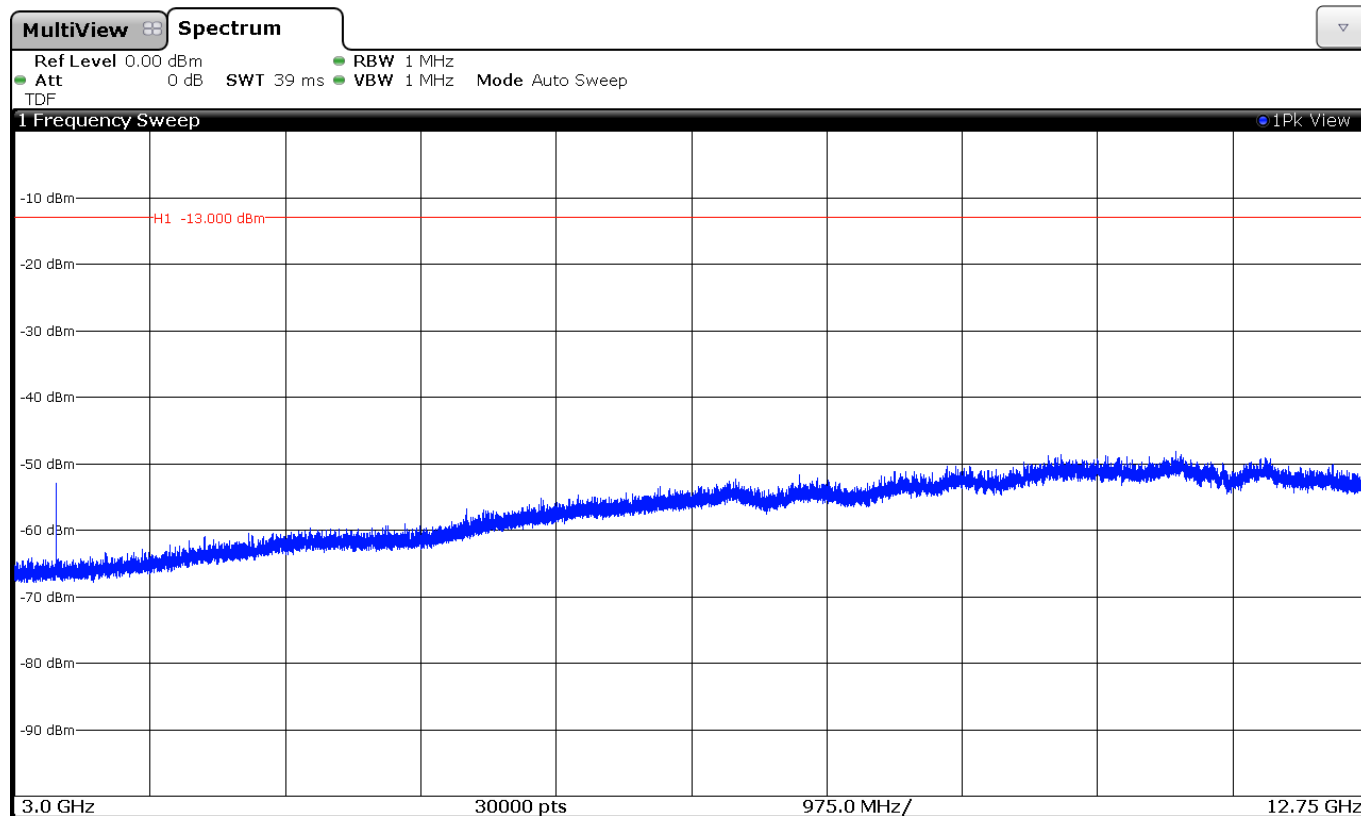
CHANNEL: HIGHEST



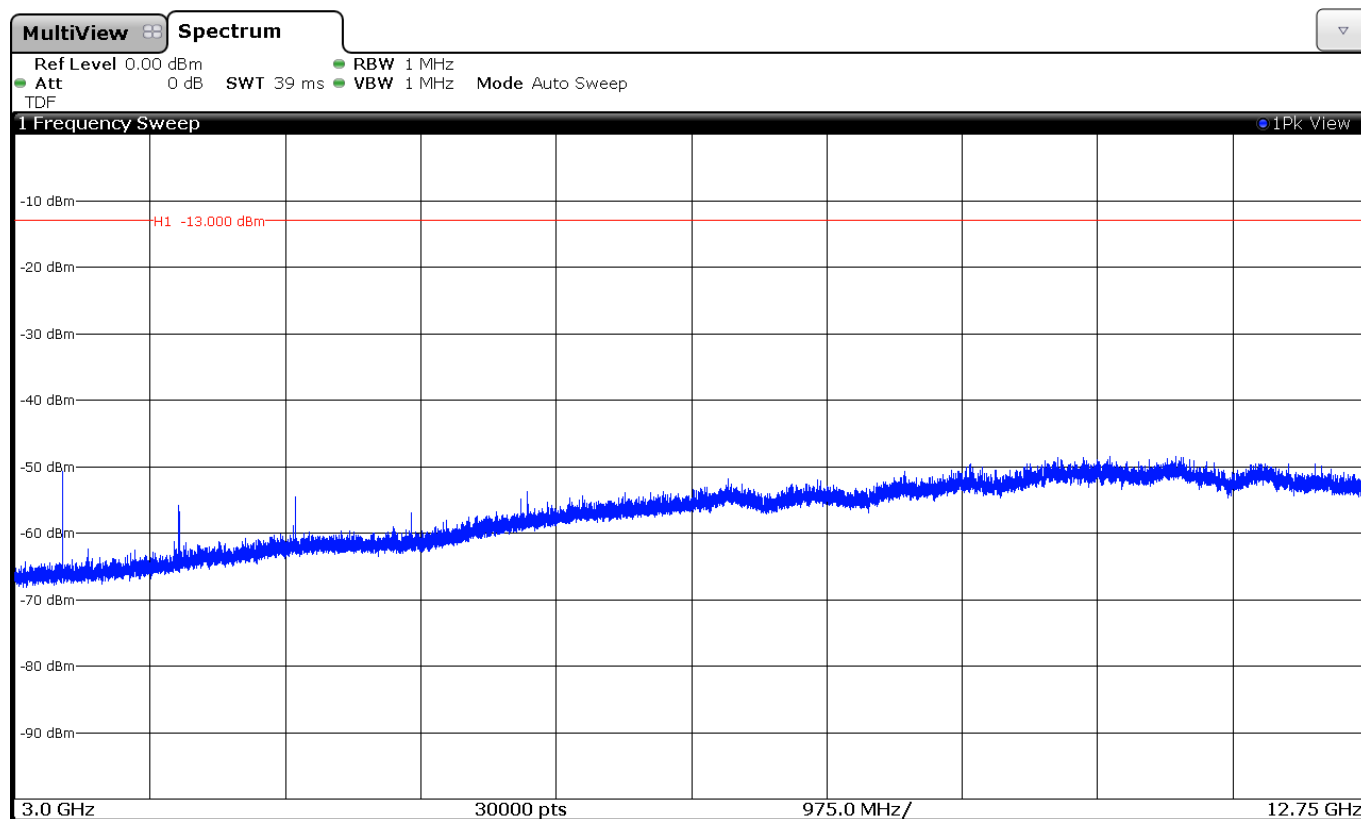
FREQUENCY RANGE 3 GHz to 12.75 GHz.

GPRS MODULATION

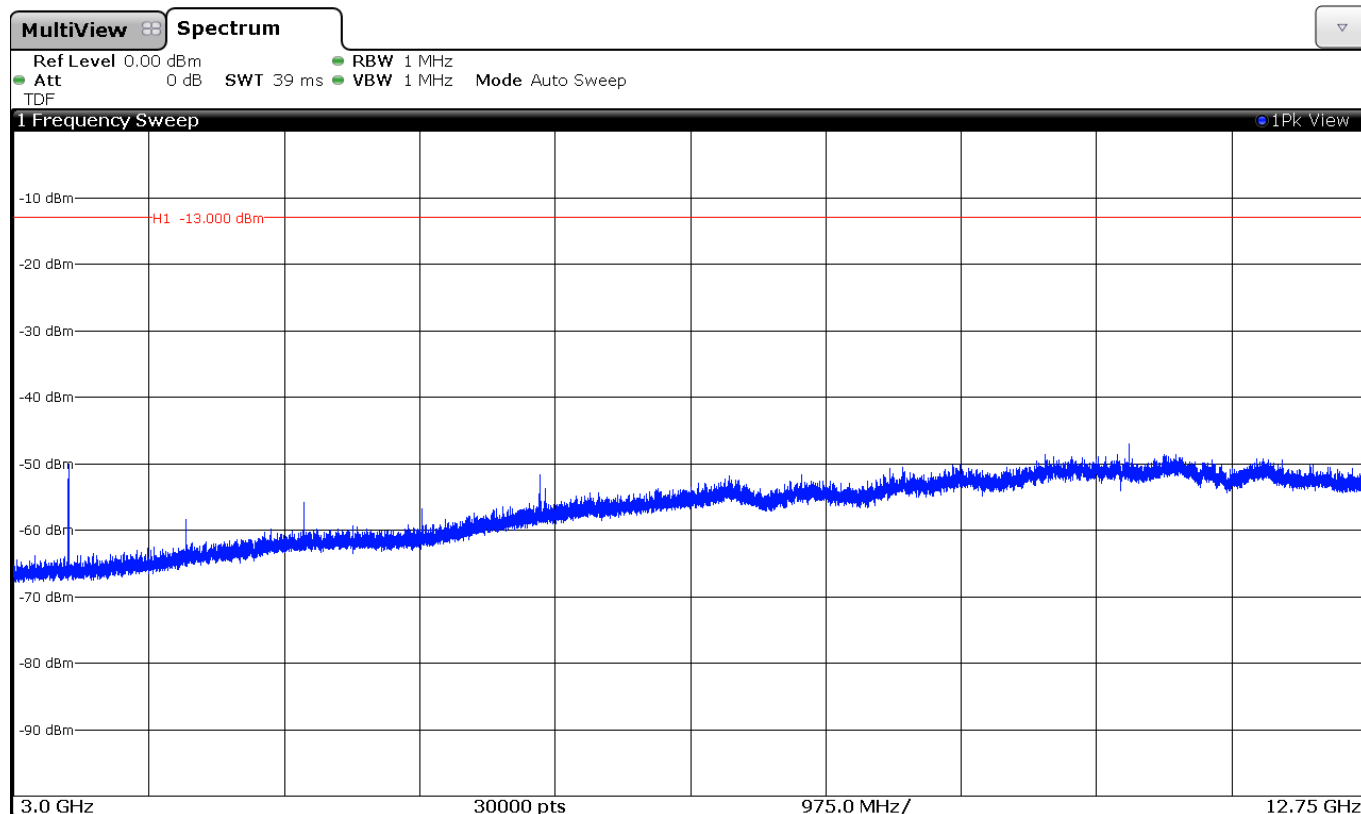
CHANNEL: LOWEST



CHANNEL: MIDDLE

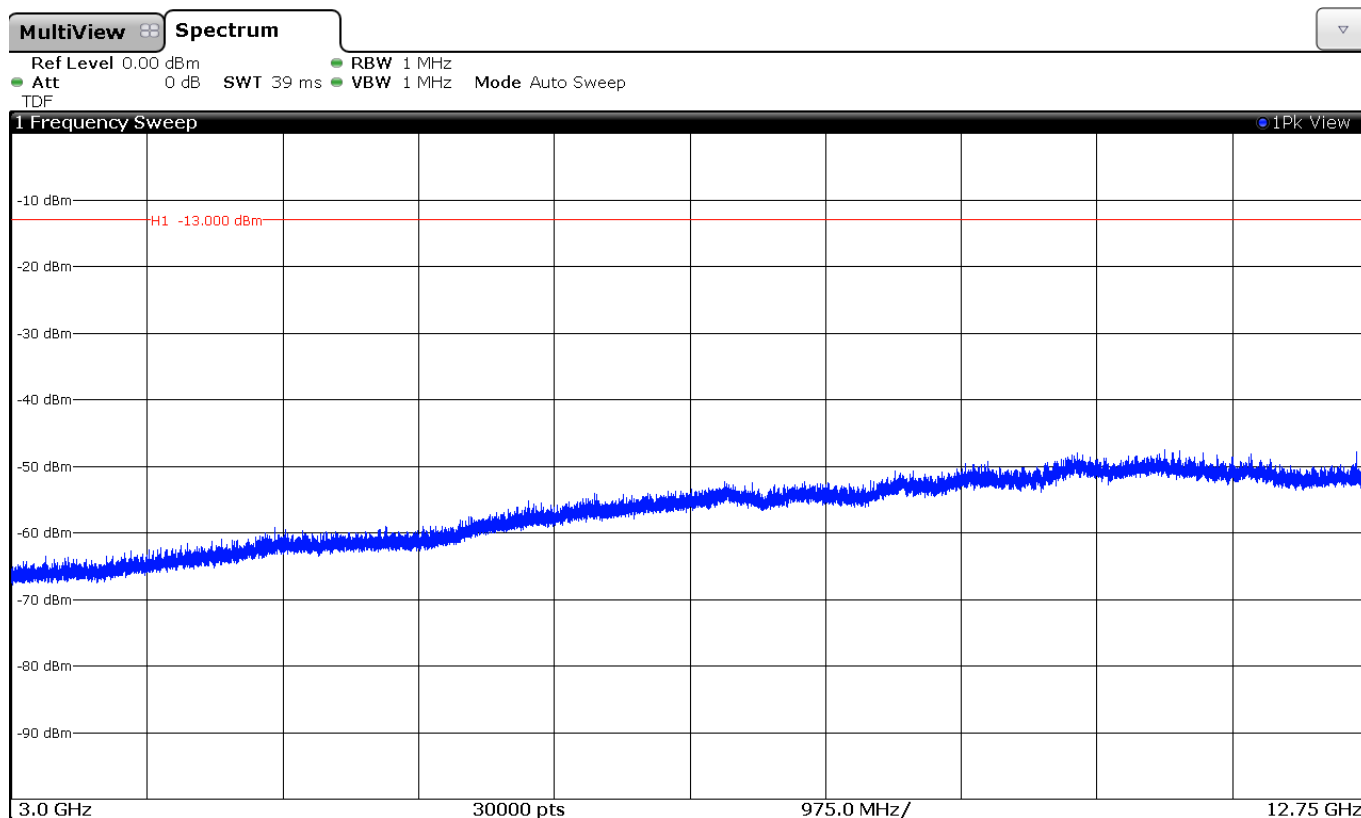


CHANNEL: HIGHEST

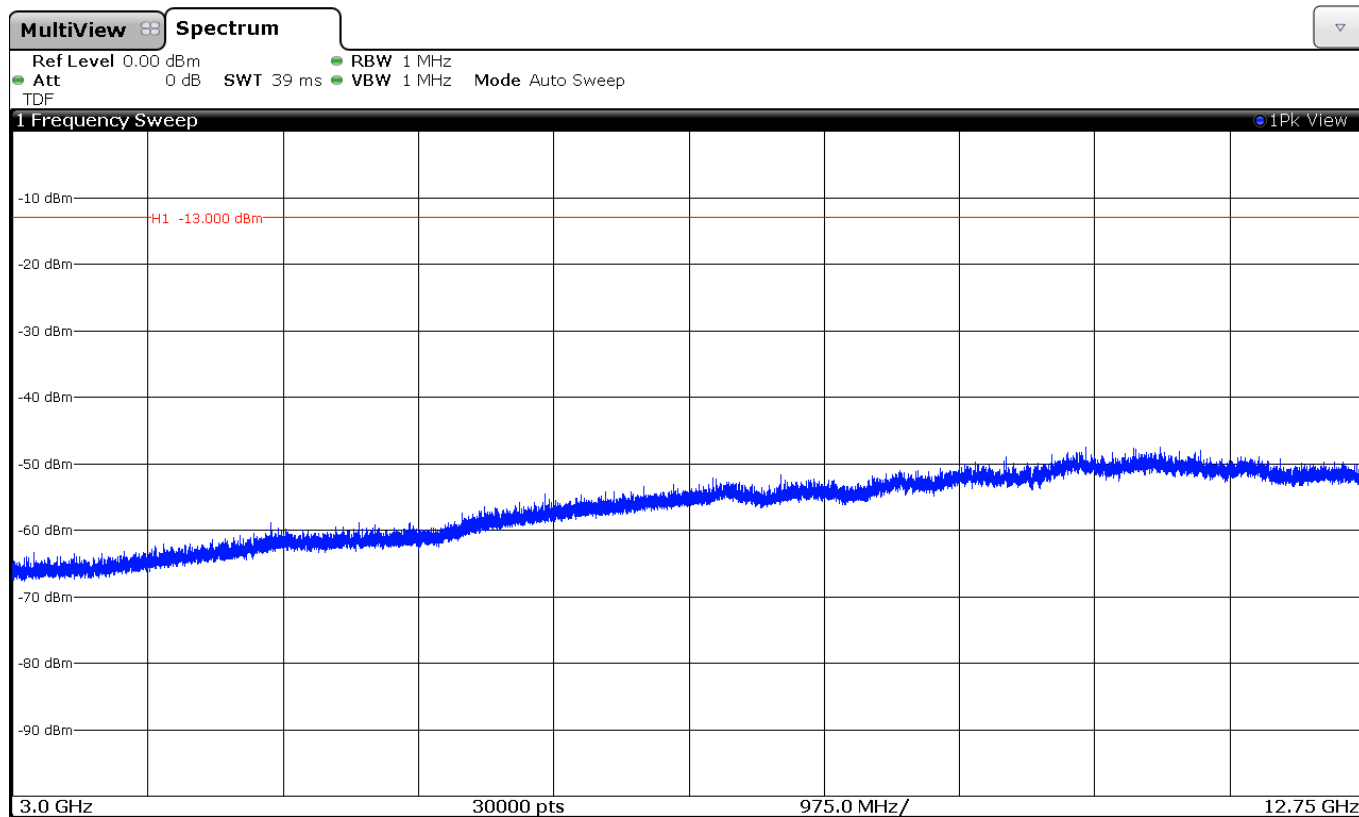


WCDMA MODULATION

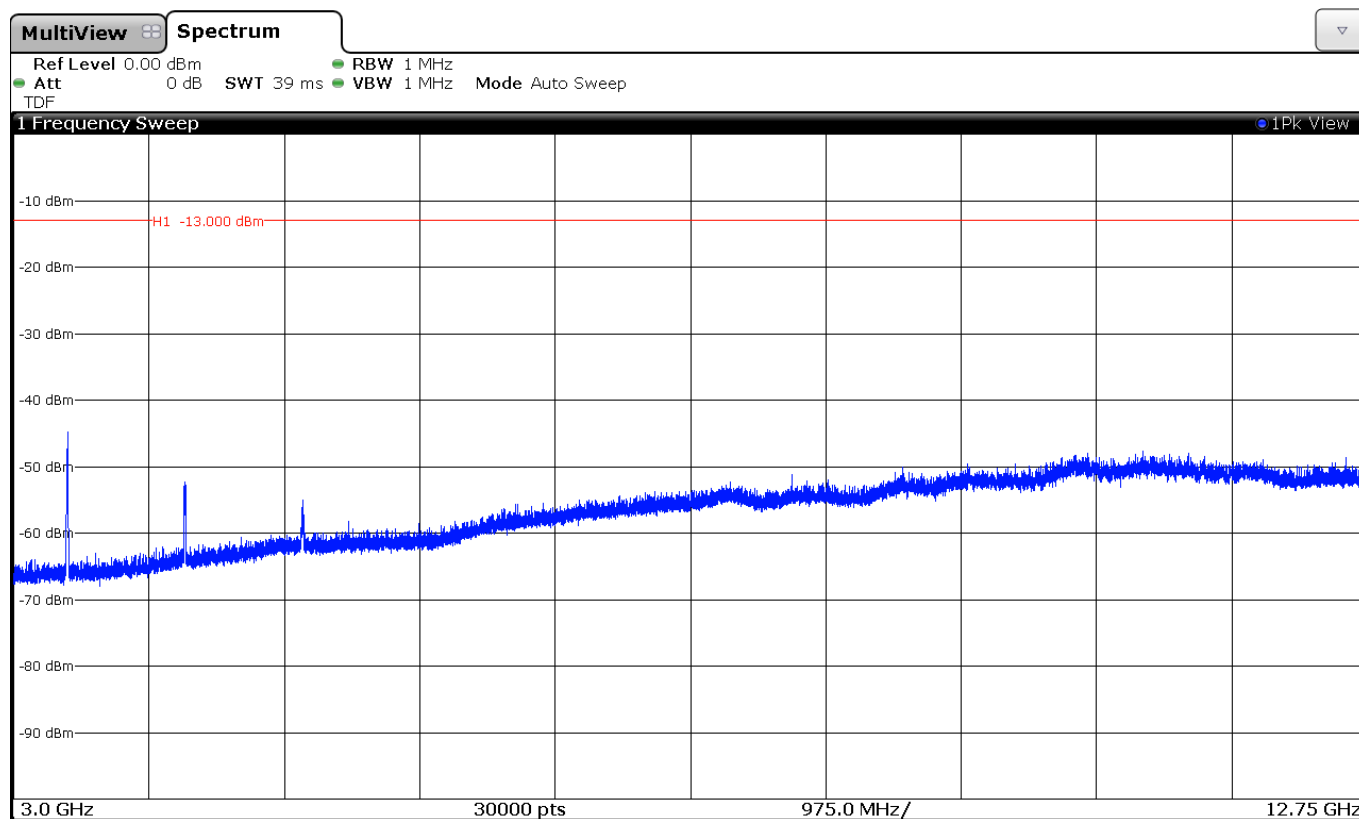
CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST



TEST RESULTS FOR FCC PART 24

TEST CONDITIONS

Power supply (V):

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

$$V_{\text{max}} = 3.3 \text{ Vdc (*)}$$

$$V_{\text{min}} = 4.2 \text{ Vdc (*)}$$

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

Type of power supply = DC Voltage from external power supply

Type of antenna = External attachable antenna

(*): Declared by the applicant.

TEST FREQUENCIES:

GPRS AND EDGE MODULATION

Lowest channel (512): 1850.2 MHz

Middle channel (662): 1880.2 MHz

Highest channel (810): 1909.8 MHz

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

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.).

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

TEST SETUP



RESULTS

MAXIMUM OUTPUT POWER (CONDUCTED).

GPRS MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	-0.40	-0.40	-0.40
Measured maximum peak power (dBm) at antenna port	29.50	29.00	29.30
Maximum effective isotropic radiated peak power E.I.R.P. (dBm)	29.10	28.60	28.90
Measured maximum average power (dBm) at antenna port	29.37	28.89	29.21
Maximum effective isotropic radiated average power E.I.R.P. (dBm)	28.97	28.49	28.81
Peak-to-average ratio (PAR) (dB)	0.13	0.11	0.09
Measurement uncertainty (dB)	±0.5		

EDGE MODULATION

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	-0.40	-0.40	-0.40
Measured maximum peak power (dBm) at antenna port	29.20	29.20	29.10
Maximum effective isotropic radiated peak power E.I.R.P. (dBm)	28.80	28.80	28.70
Measured maximum average power (dBm) at antenna port	26.32	26.38	26.24
Maximum effective isotropic radiated average power E.I.R.P. (dBm)	25.92	25.98	25.84
Peak-to-average ratio (PAR) (dB)	2.88	2.82	2.86
Measurement uncertainty (dB)	±0.5		

Verdict: PASS

Modulation Characteristics

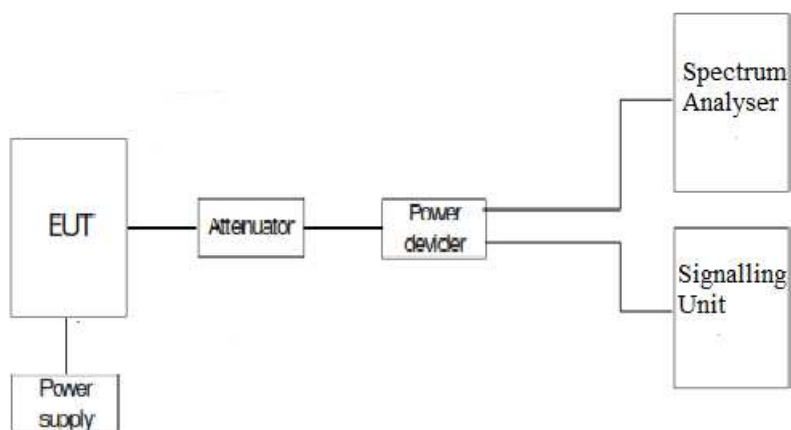
SPECIFICATION

FCC §2.1047

METHOD

For 2G, the EUT operates with GPRS (GMSK) and EDGE (8-PSK) modes, in which the information is digitised and coded into a bit stream.

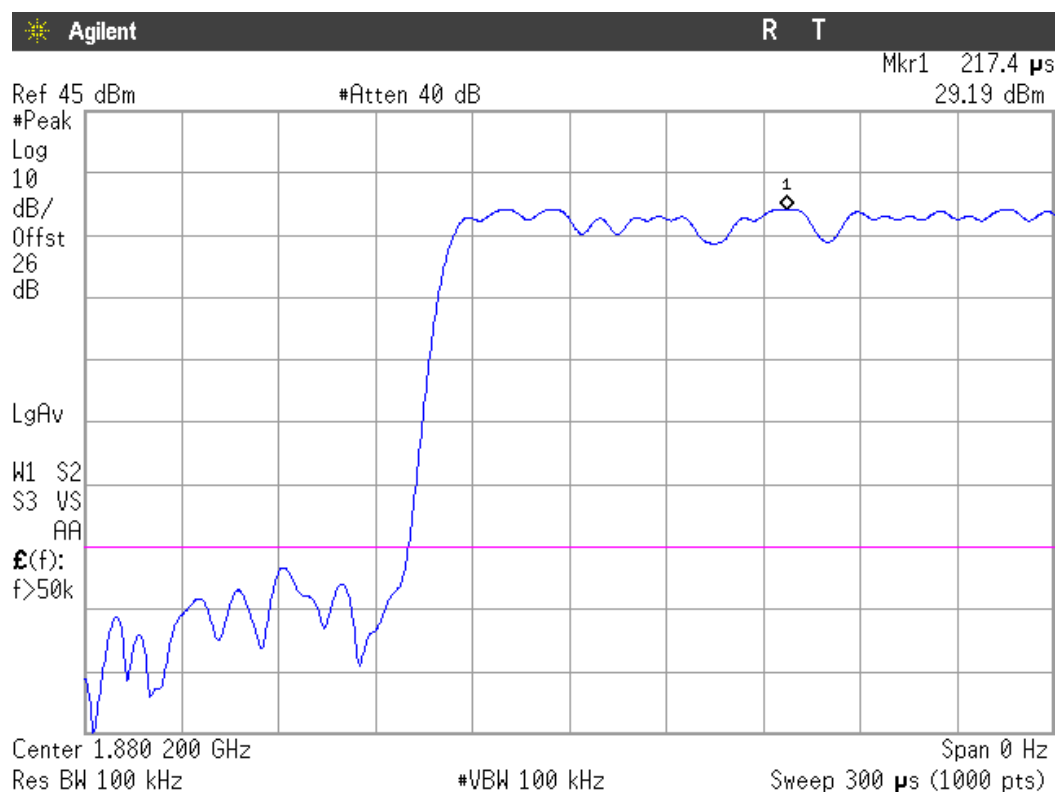
TEST SETUP



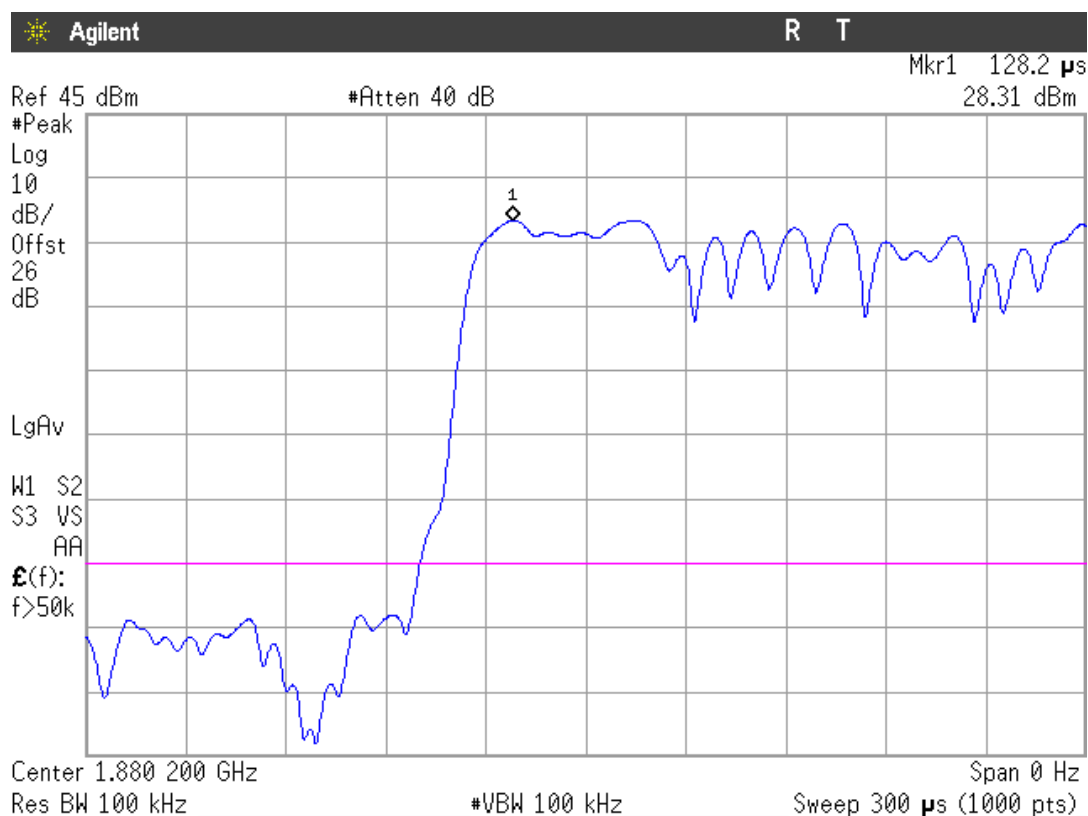
RESULTS

The following plot shows the modulation schemes in the EUT.

GPRS MODULATION



EDGE MODULATION



Frequency Stability

SPECIFICATION

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

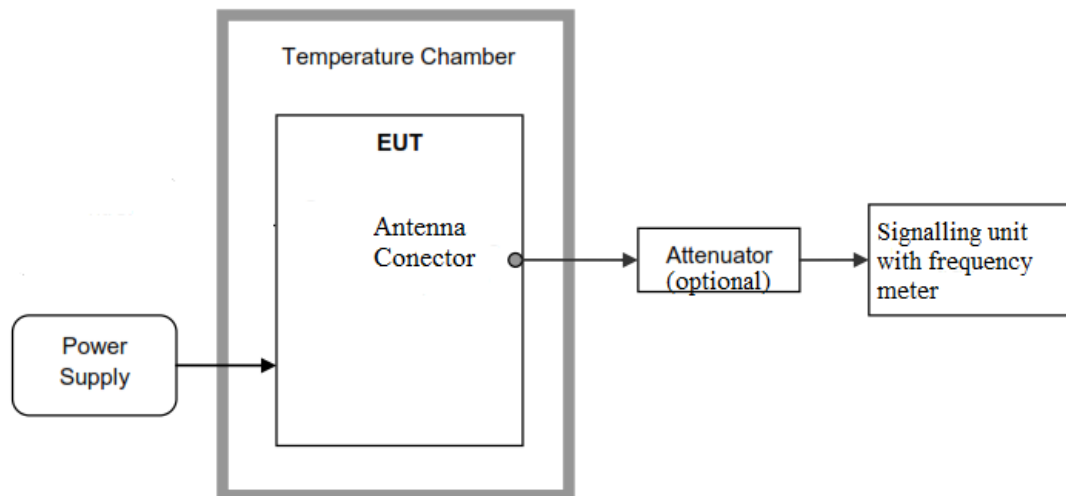
METHOD

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

The supply voltage was varied between the extreme voltages indicated by the applicant.

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

TEST SETUP



RESULTS

Frequency stability over temperature variations.

GPRS AND EDGE MODULATION

Temperature (°C)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
+50	-30	-0.0160	-0.00000160
+40	-19	-0.0101	-0.00000101
+30	-23	-0.0122	-0.00000122
+20	17	0.0090	0.00000090
+10	-32	-0.0170	-0.00000170
0	-26	-0.0138	-0.00000138
-10	-27	-0.0144	-0.00000144
-20	-31	-0.0165	-0.00000165
-30	-24	-0.0128	-0.00000128

Frequency stability over voltage variations.

GPRS AND EDGE MODULATION

DC Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)	Frequency Error (%)
Vmax	4.2	18	0.0096	0.00000096
Vmin	3.3	-30	-0.0160	-0.00000160

Occupied Bandwidth

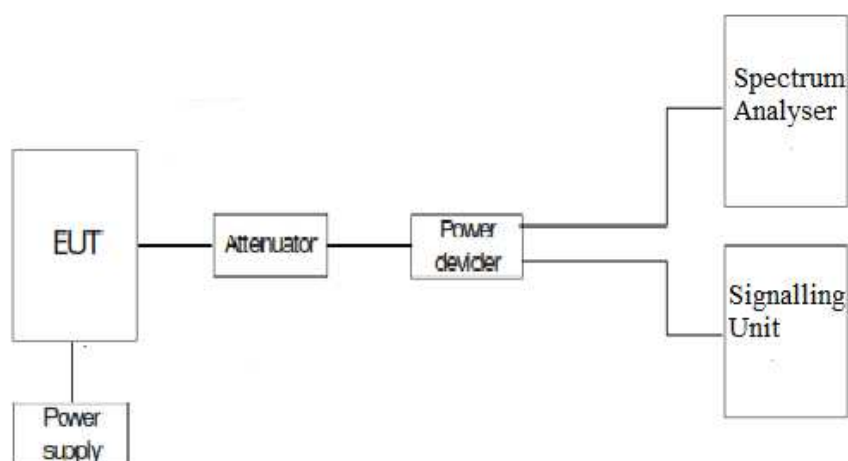
SPECIFICATION

FCC §2.1049

METHOD

The EUT was configured to transmit a modulated carrier signal with different possible modulations and nominal bandwidths, where applicable. The 99% occupied bandwidth and the -26 dBc bandwidth were measured with the spectrum analyser.

TEST SETUP



RESULTS

GPRS MODULATION

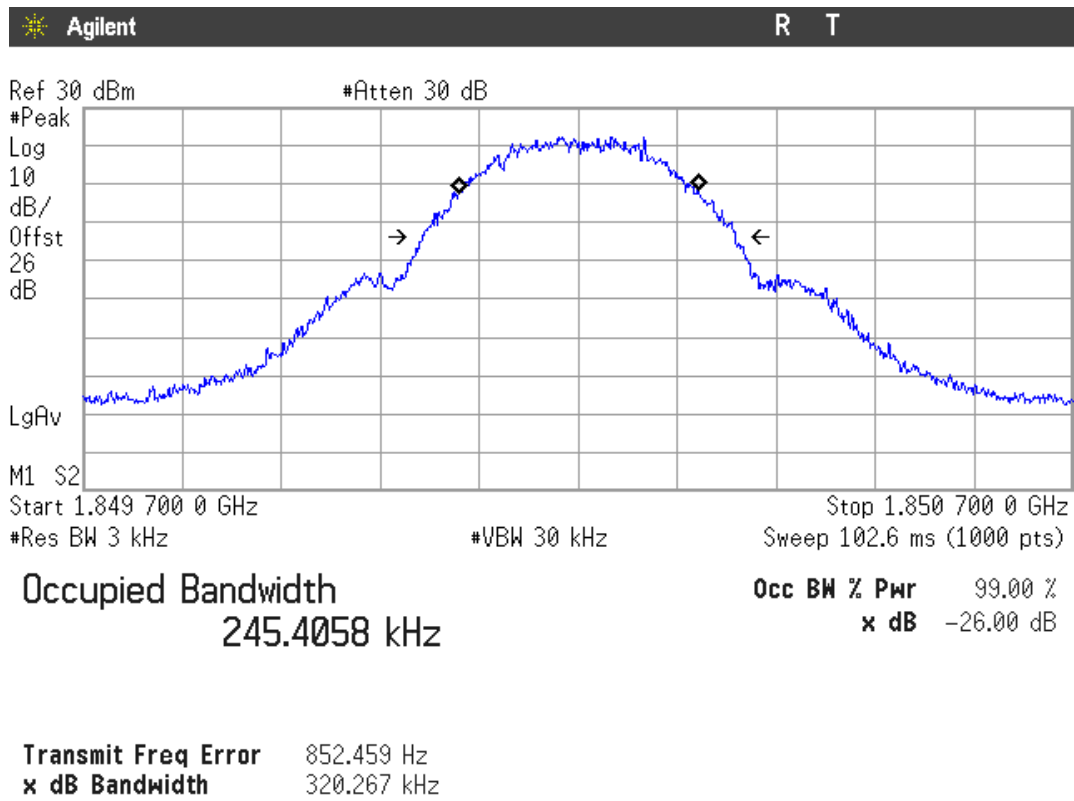
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	245.41	243.41	243.21
-26 dBc bandwidth (kHz)	320.27	311.35	314.06
Measurement uncertainty (kHz)	<±3.15		

EDGE MODULATION

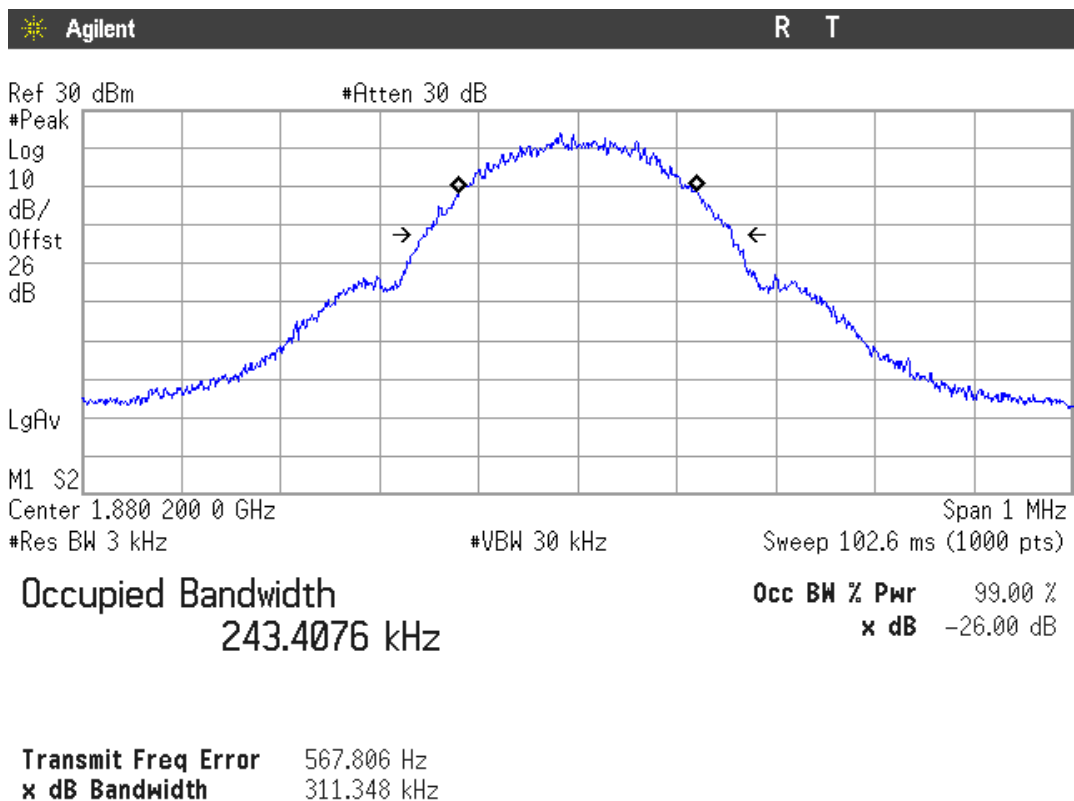
Channel	Lowest	Middle	Highest
99% Occupied bandwidth (kHz)	249.80	245.46	247.94
-26 dBc bandwidth (kHz)	309.65	309.51	308.95
Measurement uncertainty (kHz)	<±3.15		

GPRS MODULATION

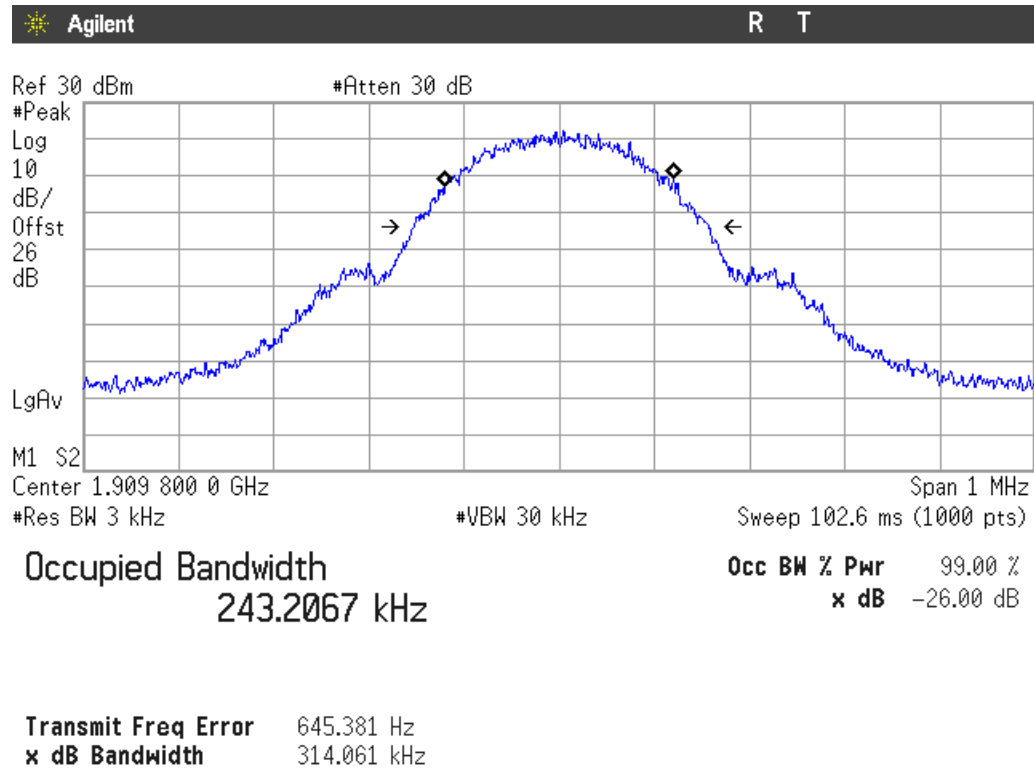
Lowest Channel



Middle Channel

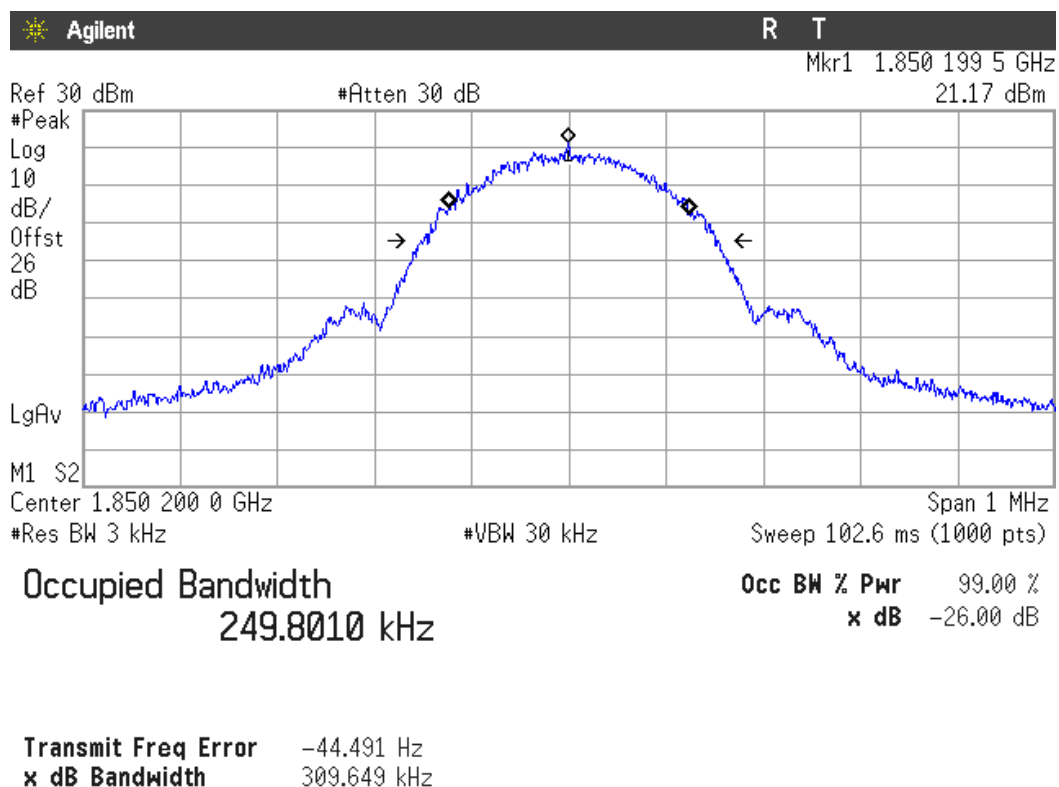


Highest Channel

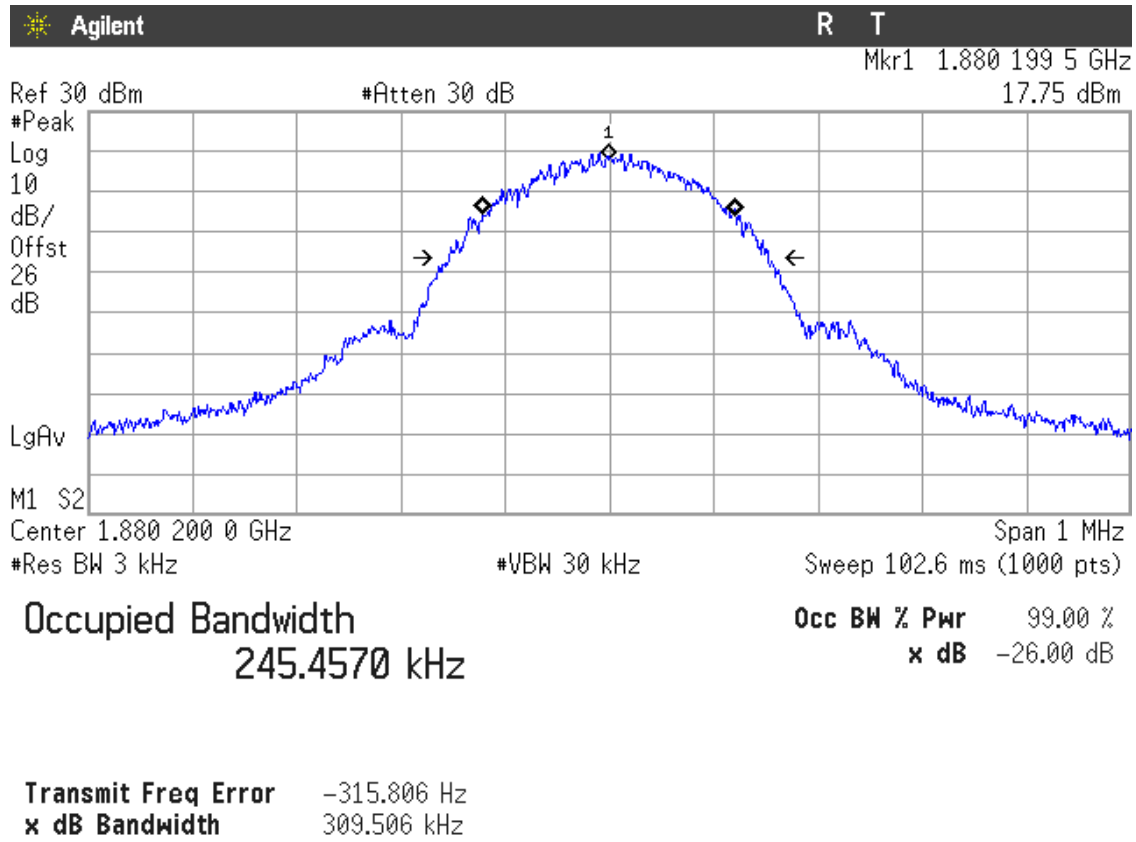


EDGE MODULATION

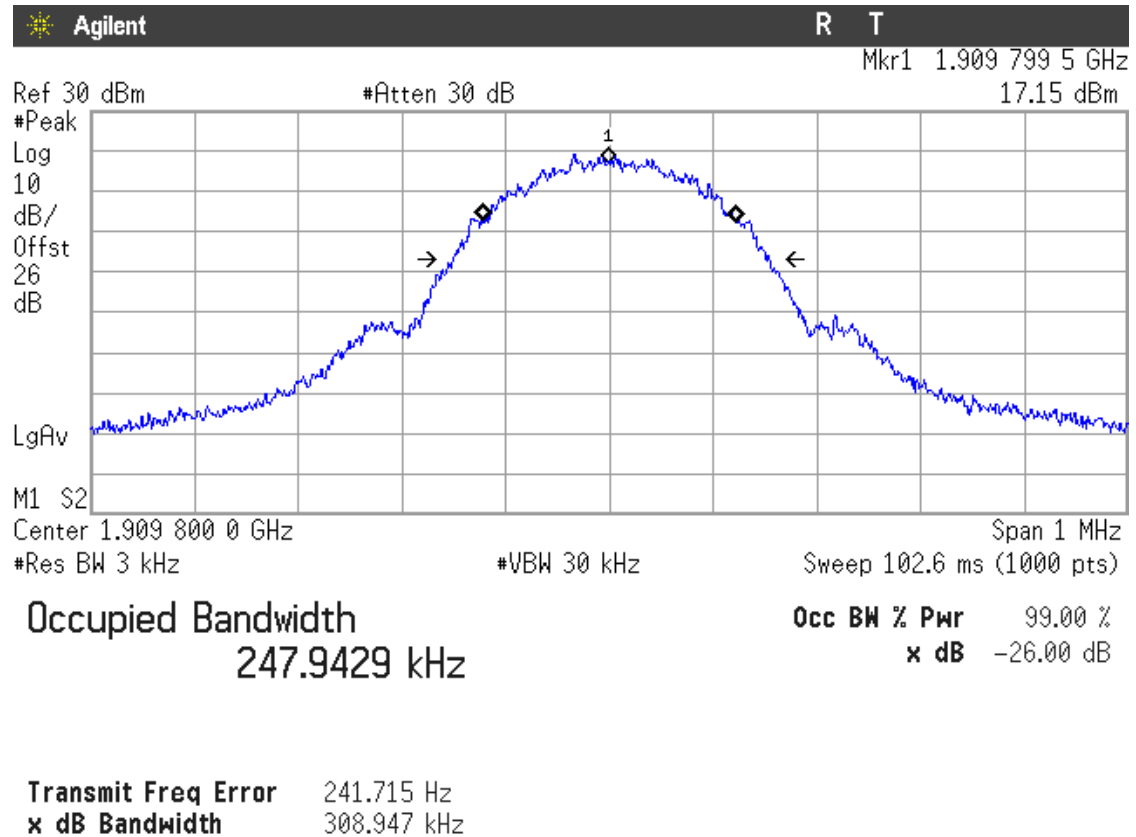
Lowest Channel



Middle Channel



Highest Channel



Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051 and §24.238

METHOD

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

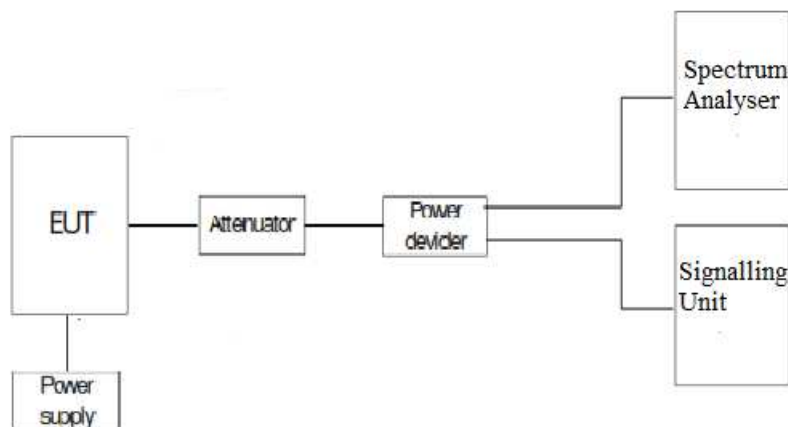
Measurement Limit:

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.

2. CHANNEL: MIDDLE

No spurious signals were found.

3. CHANNEL: HIGHEST

No spurious signals were found.

EDGE MODULATION

1. CHANNEL: LOWEST

No spurious signals were found.

2. CHANNEL: MIDDLE

No spurious signals were found.

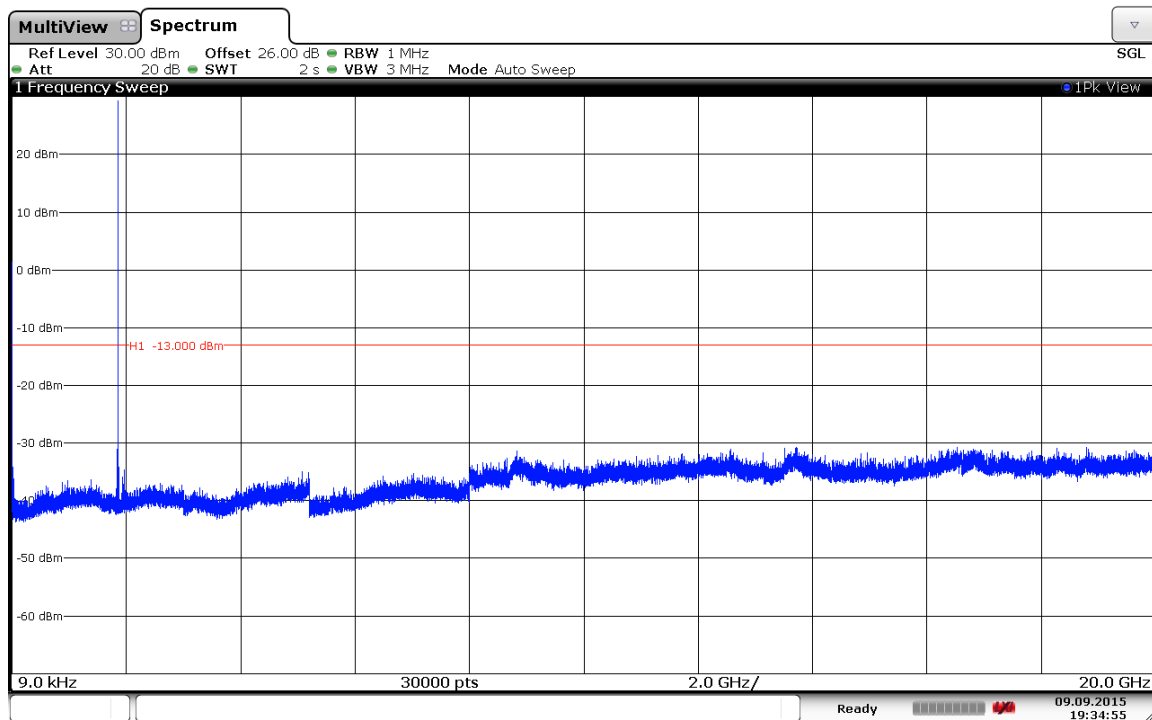
3. CHANNEL: HIGHEST

No spurious signals were found.

Verdict: PASS

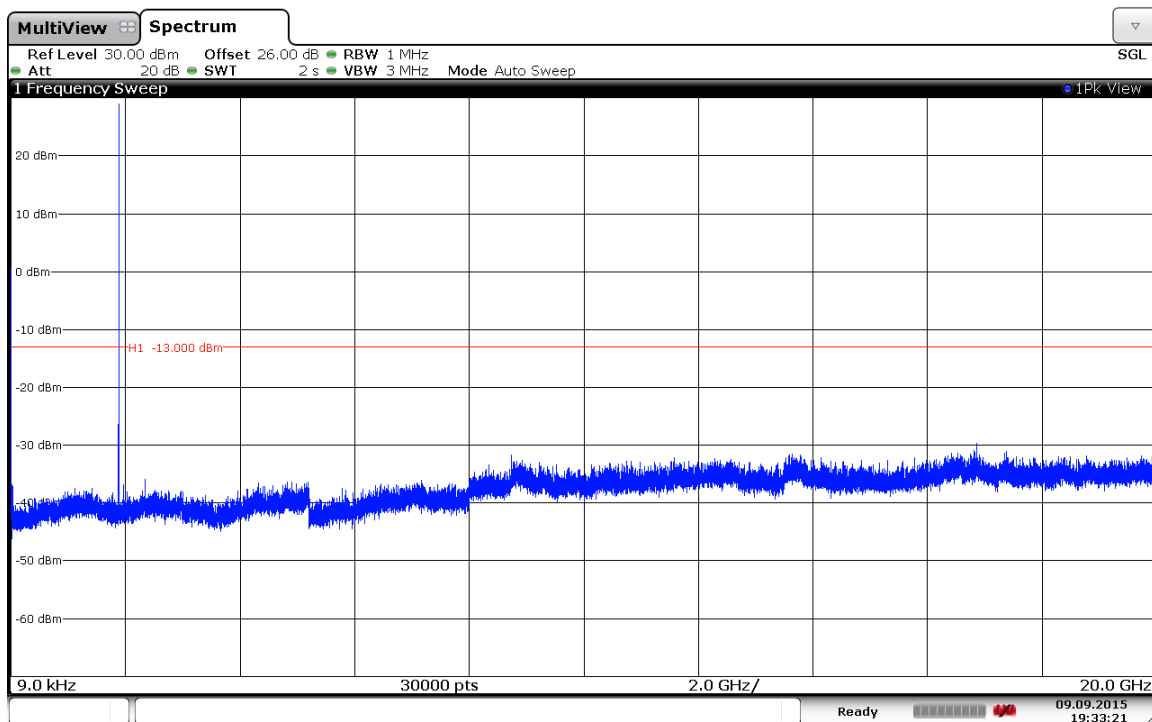
GPRS MODULATION

1. CHANNEL: LOWEST



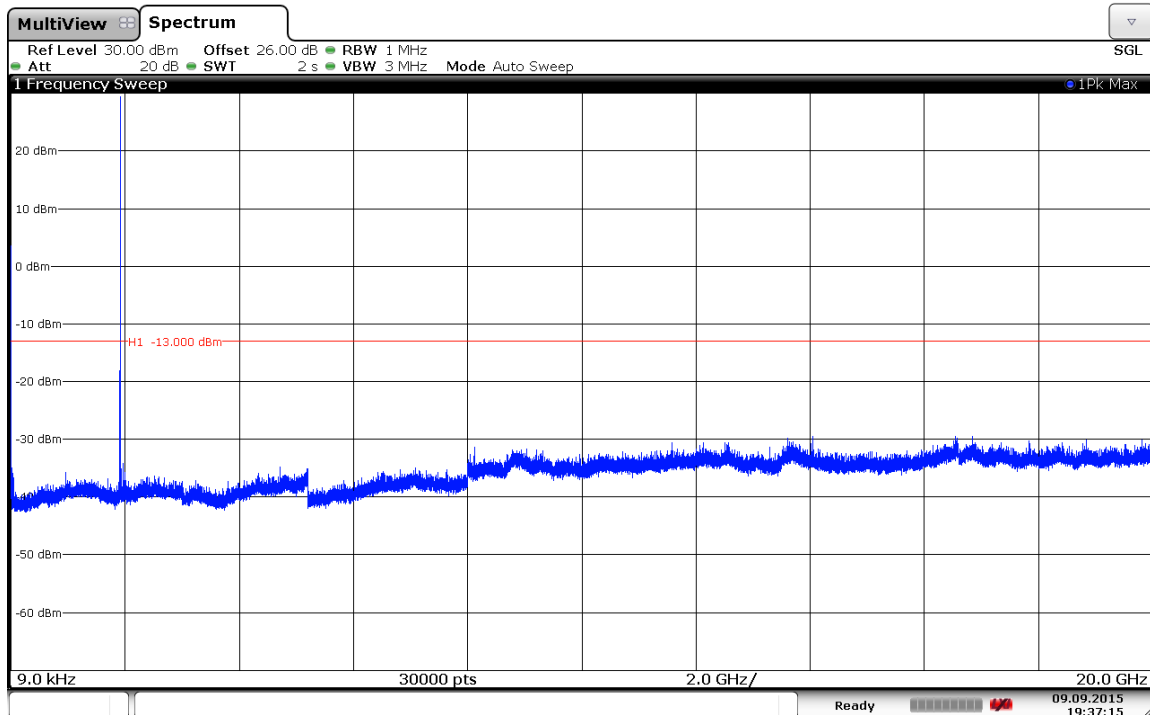
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

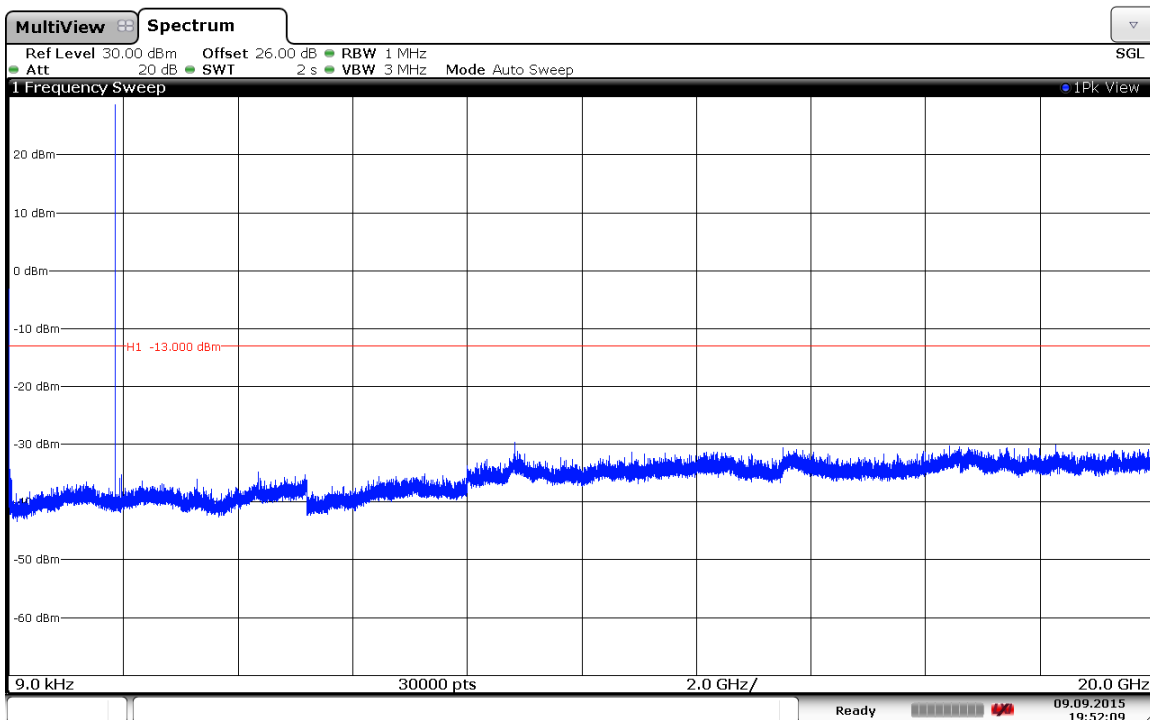
3. CHANNEL: HIGHEST



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

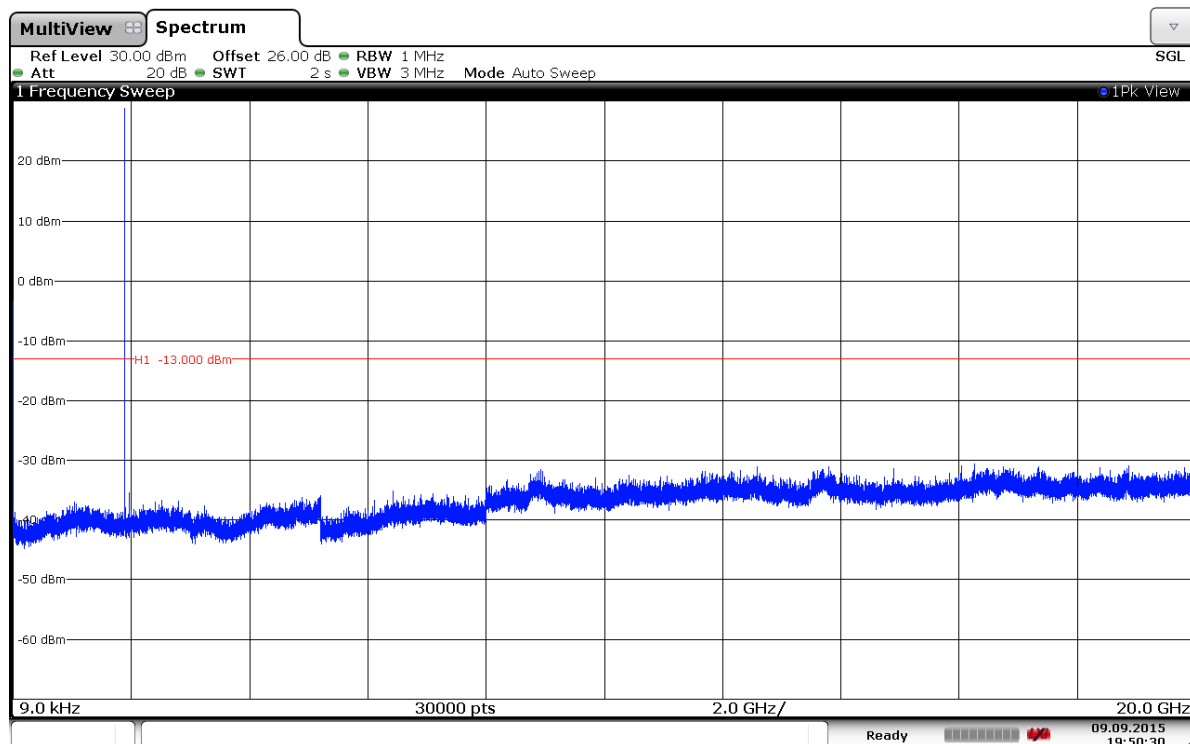
EDGE MODULATION

1. CHANNEL: LOWEST



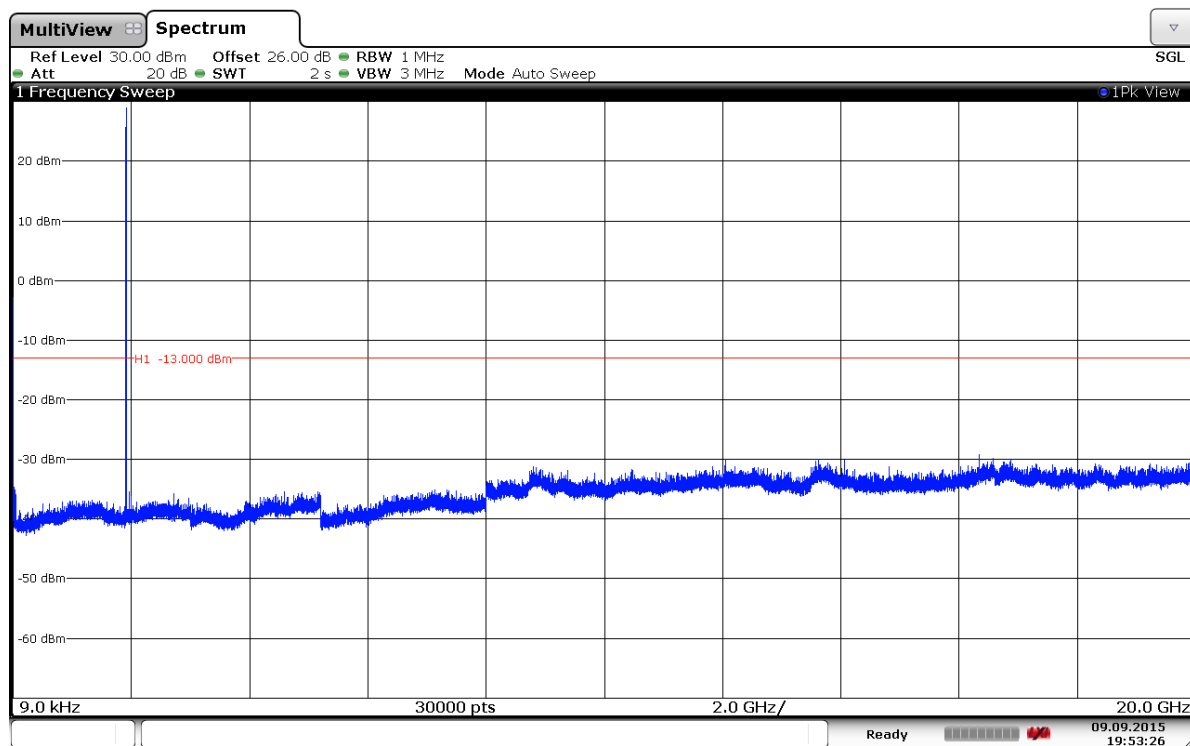
Note: The peak above the limit is the carrier frequency.

2. CHANNEL: MIDDLE



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

3. CHANNEL: HIGHEST



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

Spurious emissions at antenna terminals at Block Edges

SPECIFICATION

FCC §2.1051 and §24.238

METHOD

As indicated in FCC part 24. in the 1 MHz bands immediately outside and adjacent to the frequency block or band a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

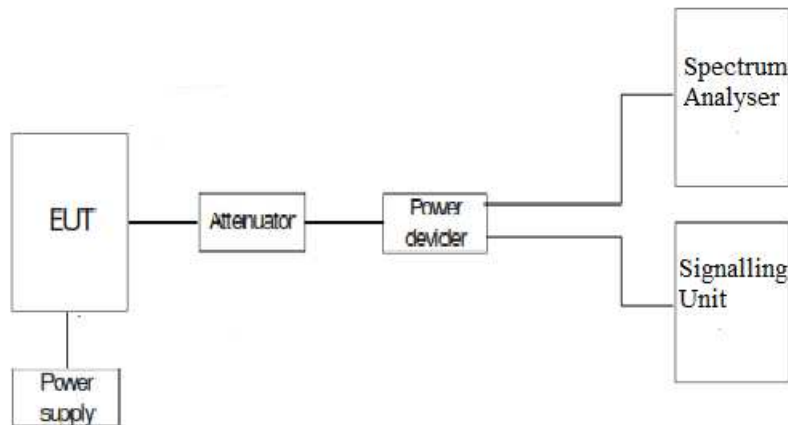
Measurement Limit:

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

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

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

TEST SETUP



RESULTS (see plots in next pages)

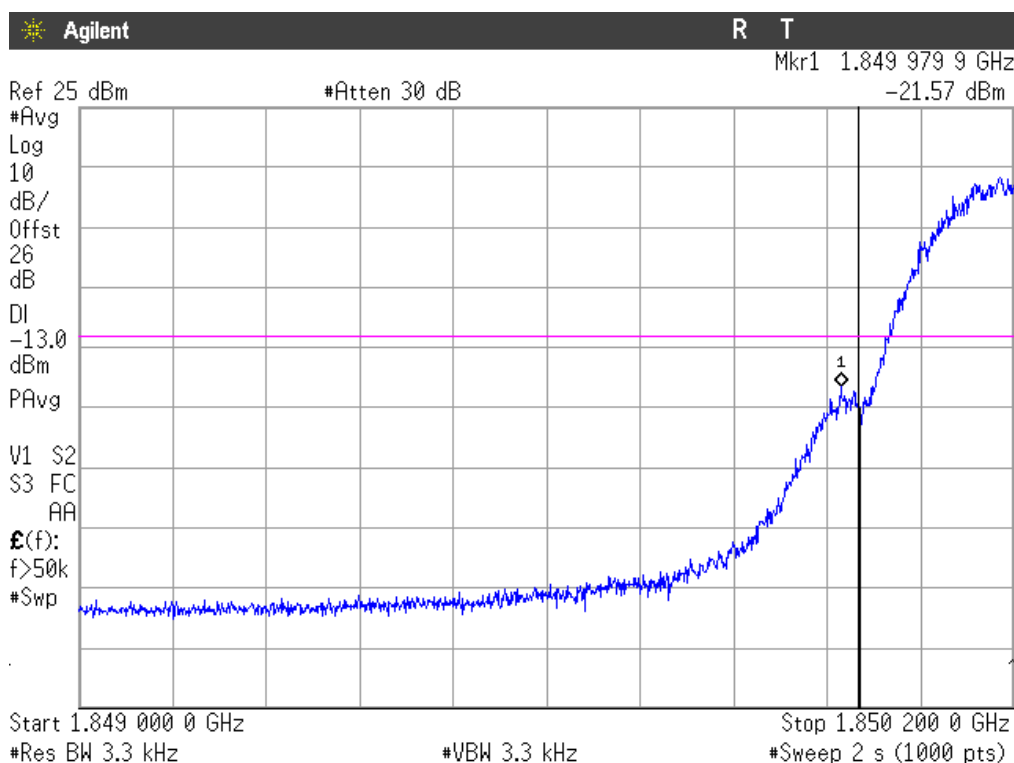
MODULATION:	GPRS	EDGE
Maximum measured level at lowest Block Edge at antenna port (dBm)	-21.57	-30.67

MODULATION:	GPRS	EDGE
Maximum measured level at highest Block Edge at antenna port (dBm)	-22.96	-30.66

Measurement uncertainty = ± 1.57 dB.

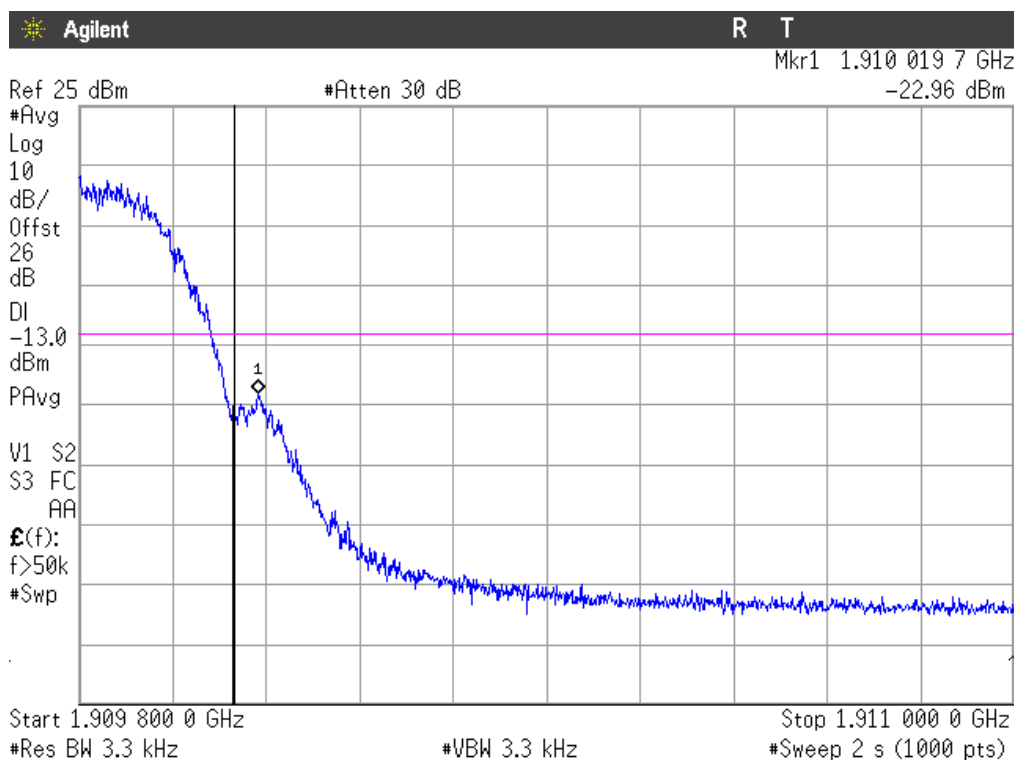
GPRS MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST

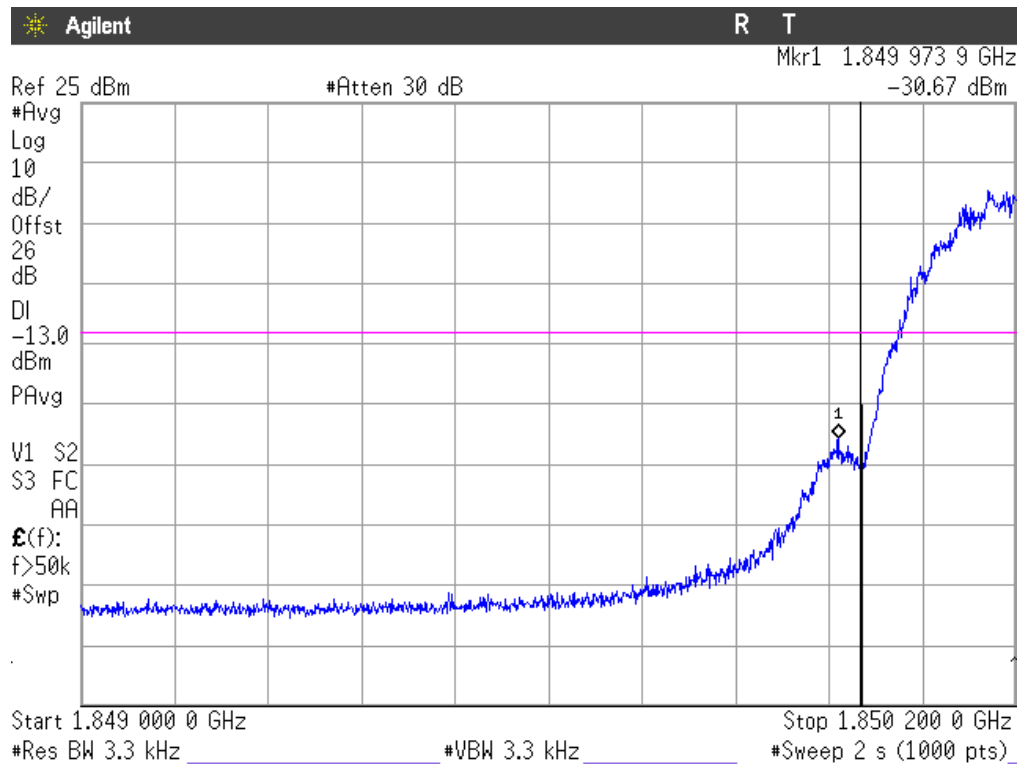


NOTE: The equipment transmits at the maximum output power

Verdict: PASS

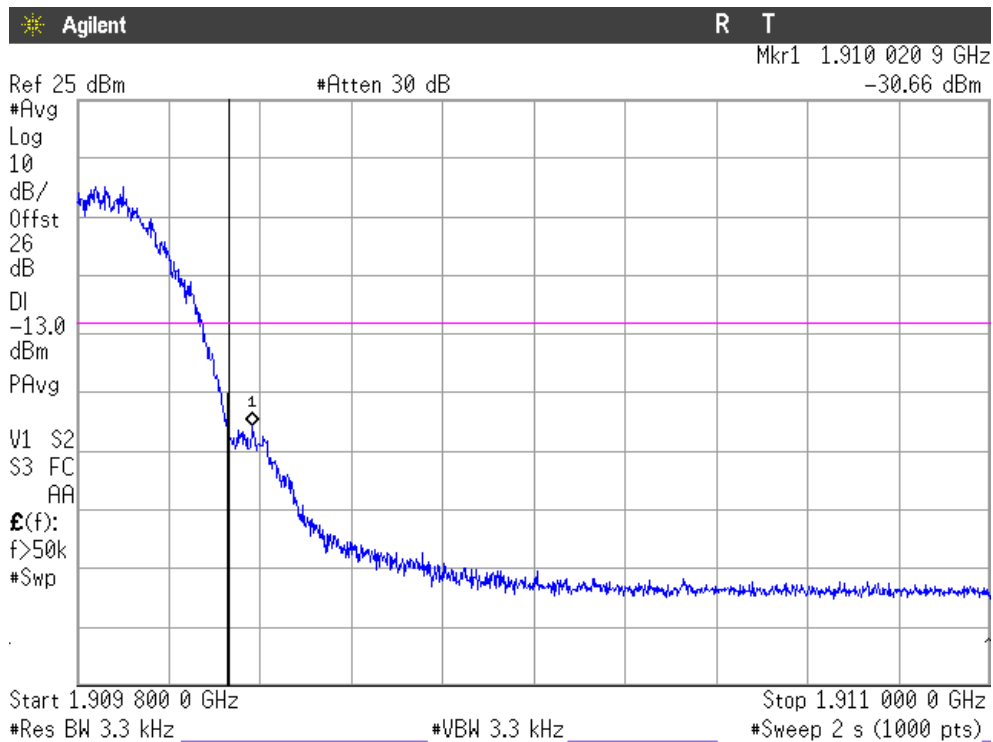
EDGE MODULATION

CHANNEL LOWEST



NOTE: The equipment transmits at the maximum output power

CHANNEL HIGHEST



NOTE: The equipment transmits at the maximum output power

Verdict: PASS

Radiated emissions

SPECIFICATION

FCC § 24.238

METHOD

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

The EUT was placed on a 1 meter high 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 were substituted by the Substitution method, in accordance with the ANSI/TIA/EIA-603-C: 2004.

Measurement Limit:

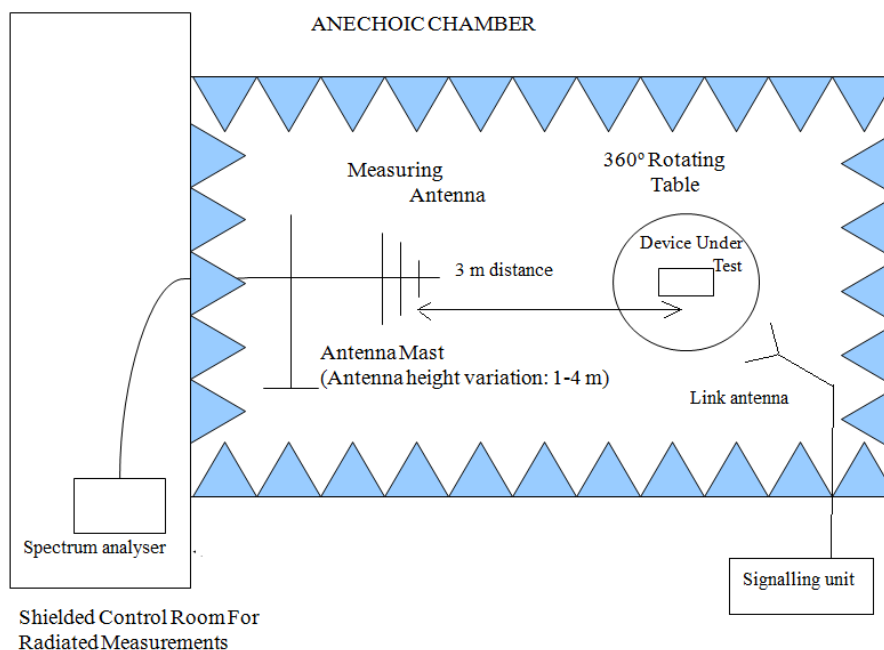
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. P in watts.

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

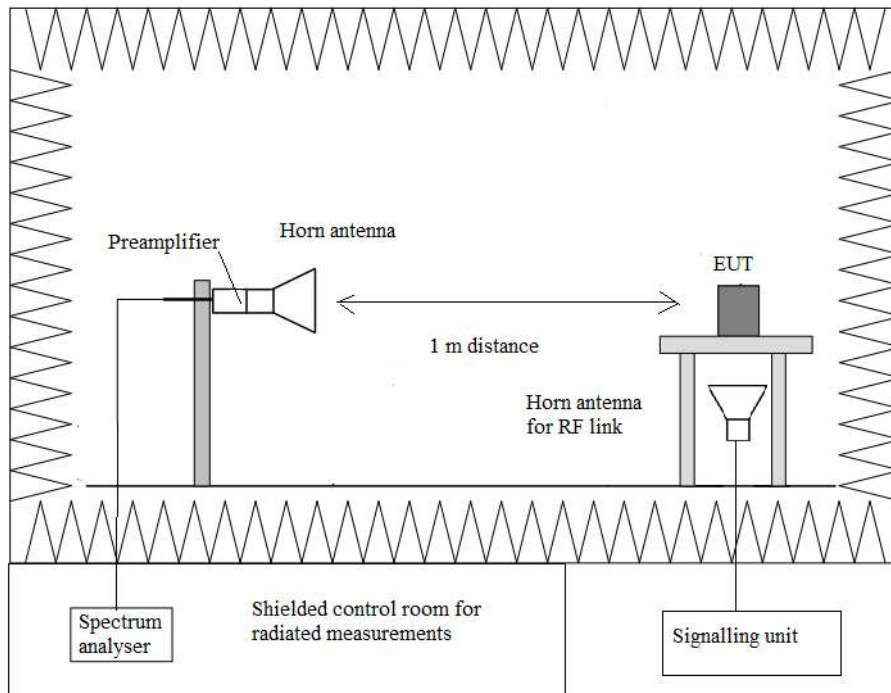
$$P_o \text{ (dBm)} - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS

GPRS AND EDGE MODULATION

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

1. CHANNEL: LOWEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 GHz.

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)
11101.75	-49.38	Vertical	-33.10	9.02	10.70	-31.42

2. CHANNEL: MIDDLE

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

Frequency range 1 GHz-20 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)
11280.75	-50.91	Vertical	-34.63	9.02	10.70	-32.95

3. CHANNEL: HIGHEST

Frequency range 30 MHz-1000 MHz.

No spurious signals were found in all the range.

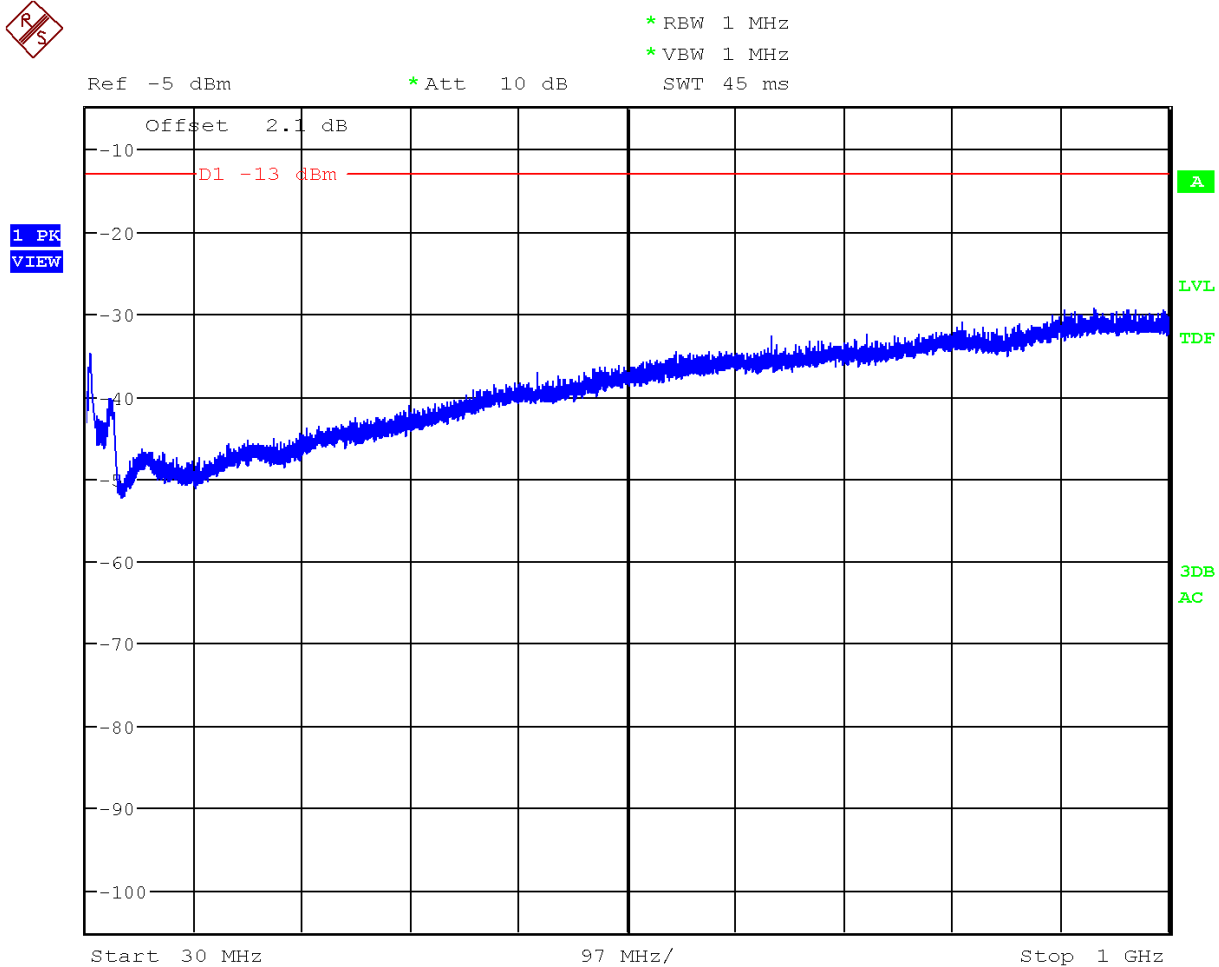
Frequency range 1 GHz-20 GHz.

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

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

GPRS MODULATION

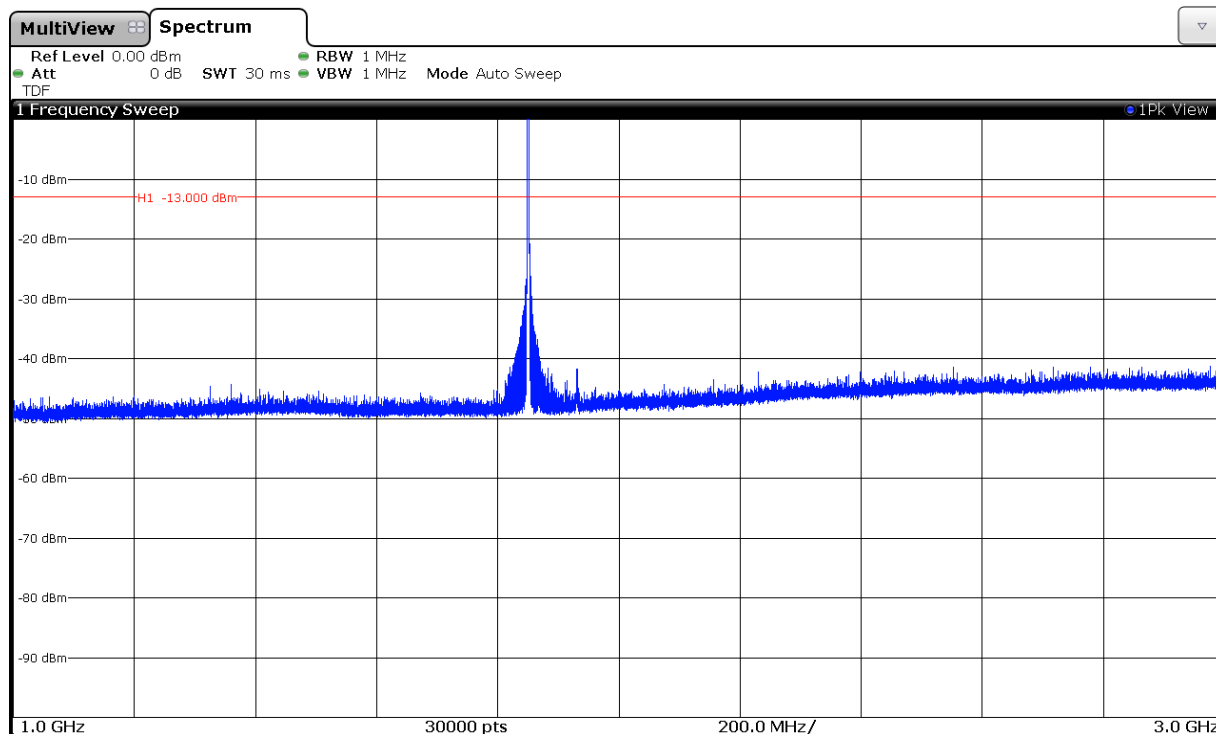


(This plot is valid for all three channels)

FREQUENCY RANGE 1 GHz to 3 GHz.

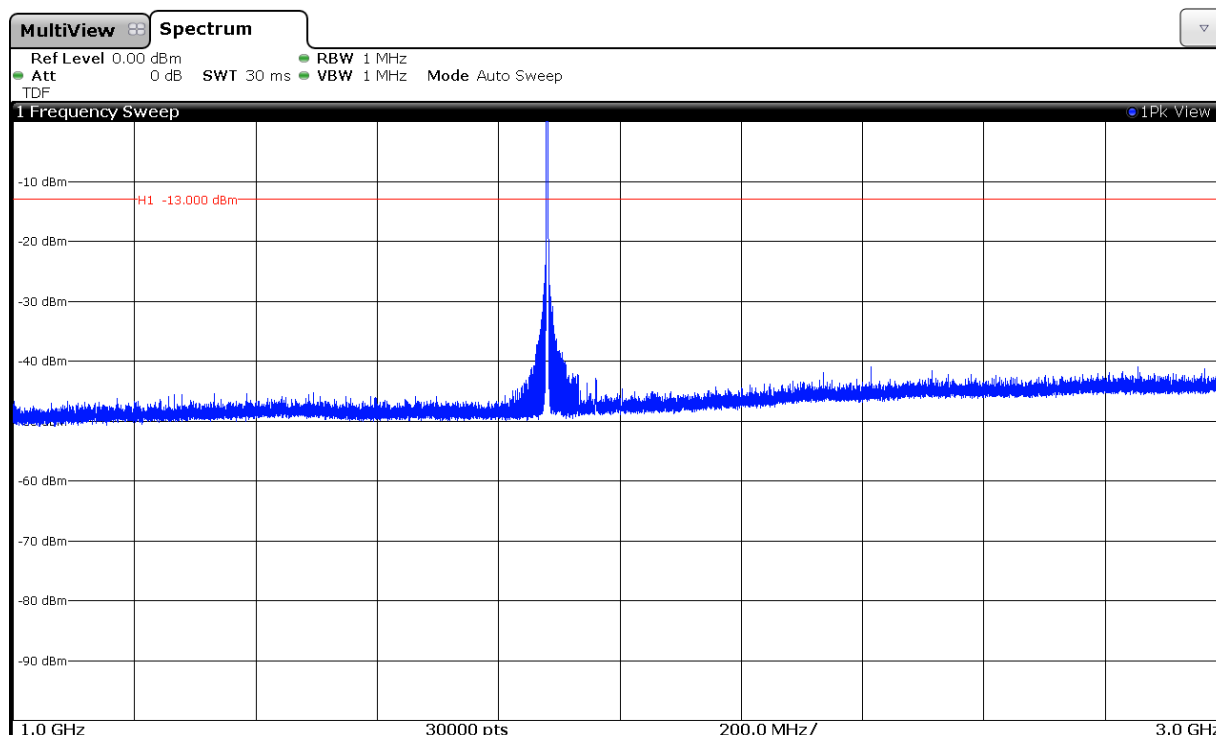
GPRS MODULATION

CHANNEL: LOWEST



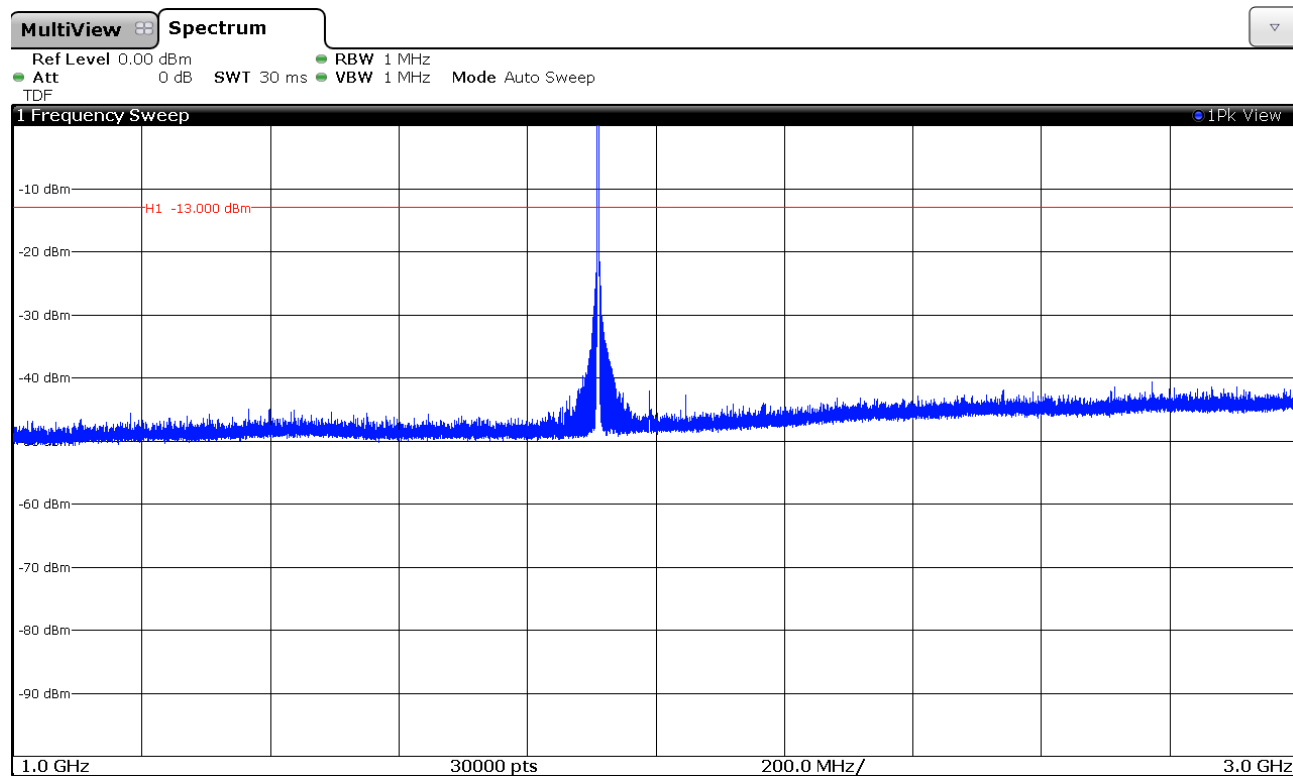
Note: The peak above the limit is the carrier frequency.

CHANNEL: MIDDLE



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

CHANNEL: HIGHEST

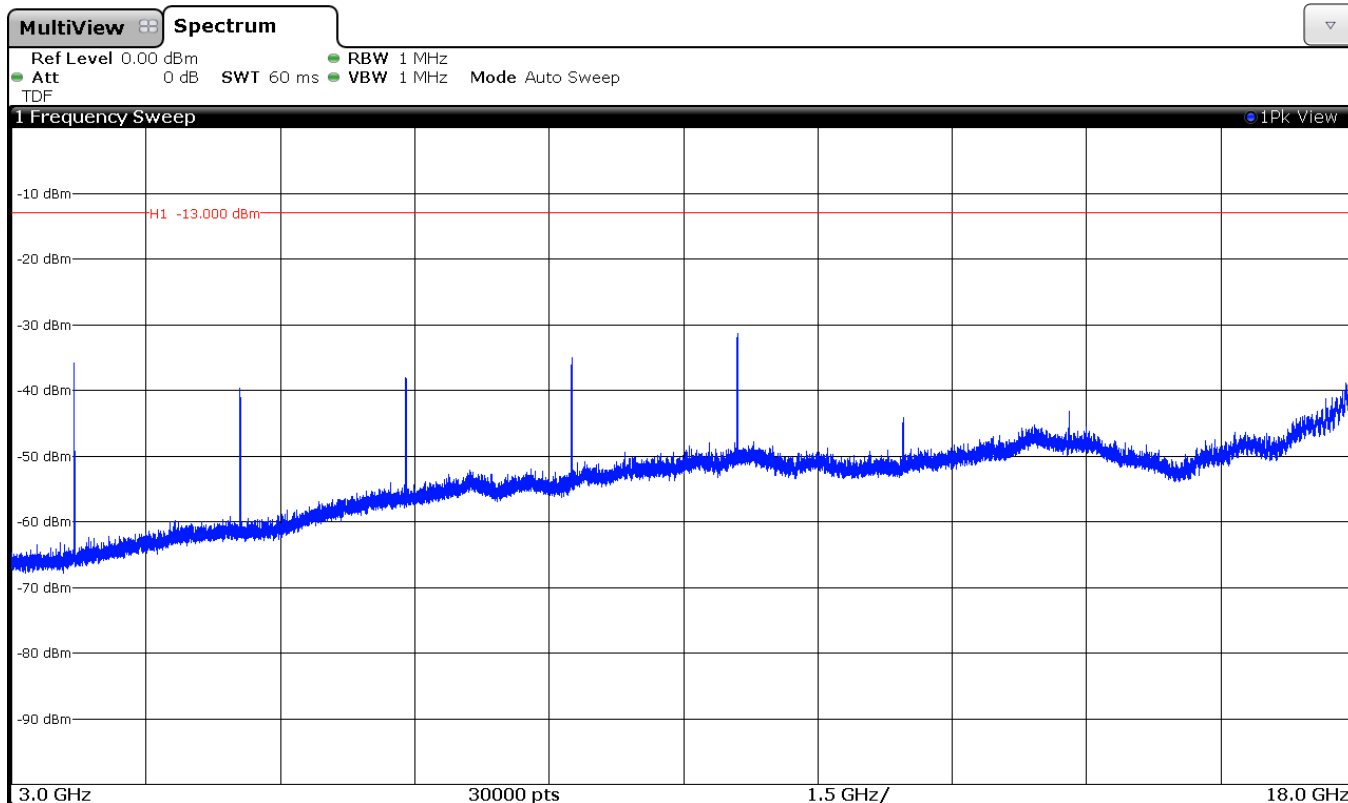


Note: The peak above the limit is the carrier frequency.

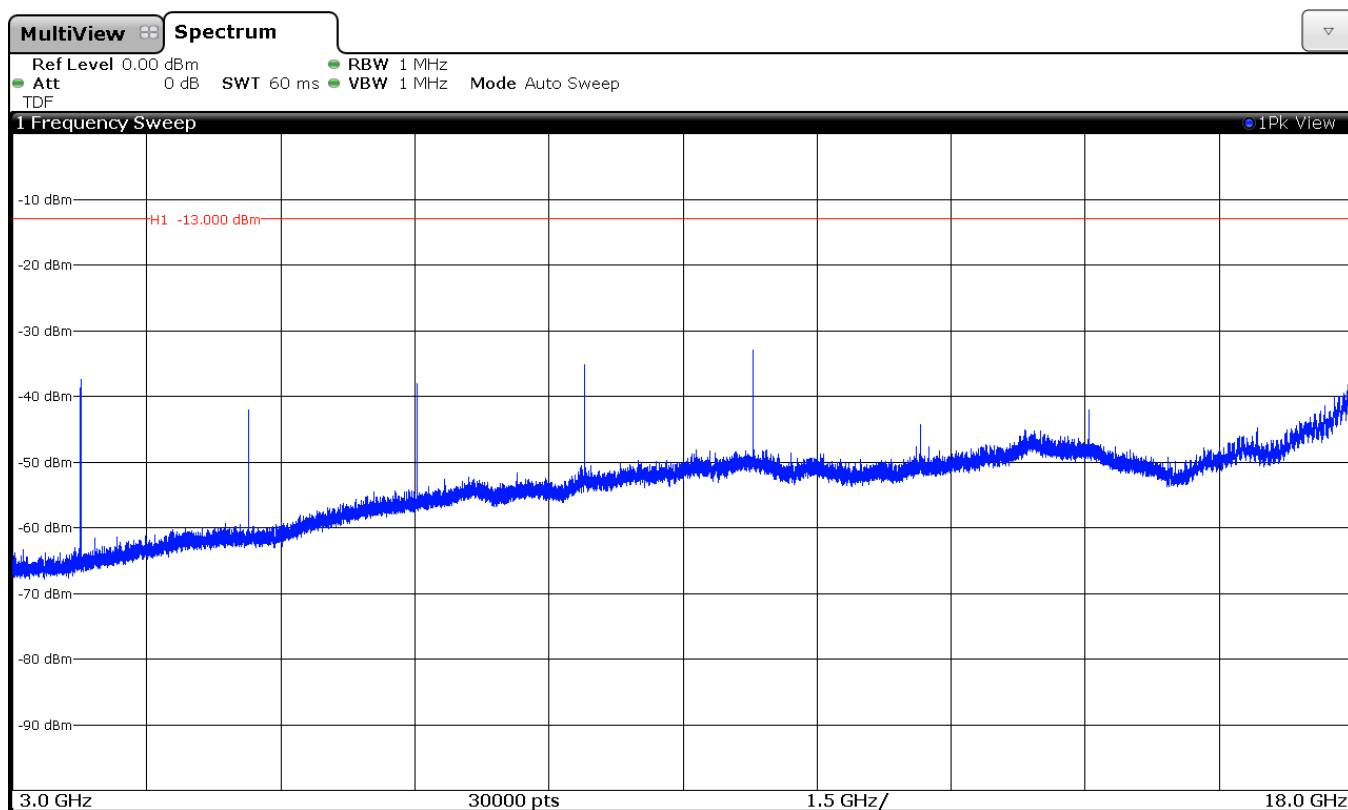
FREQUENCY RANGE 3 GHz to 18 GHz.

GPRS MODULATION

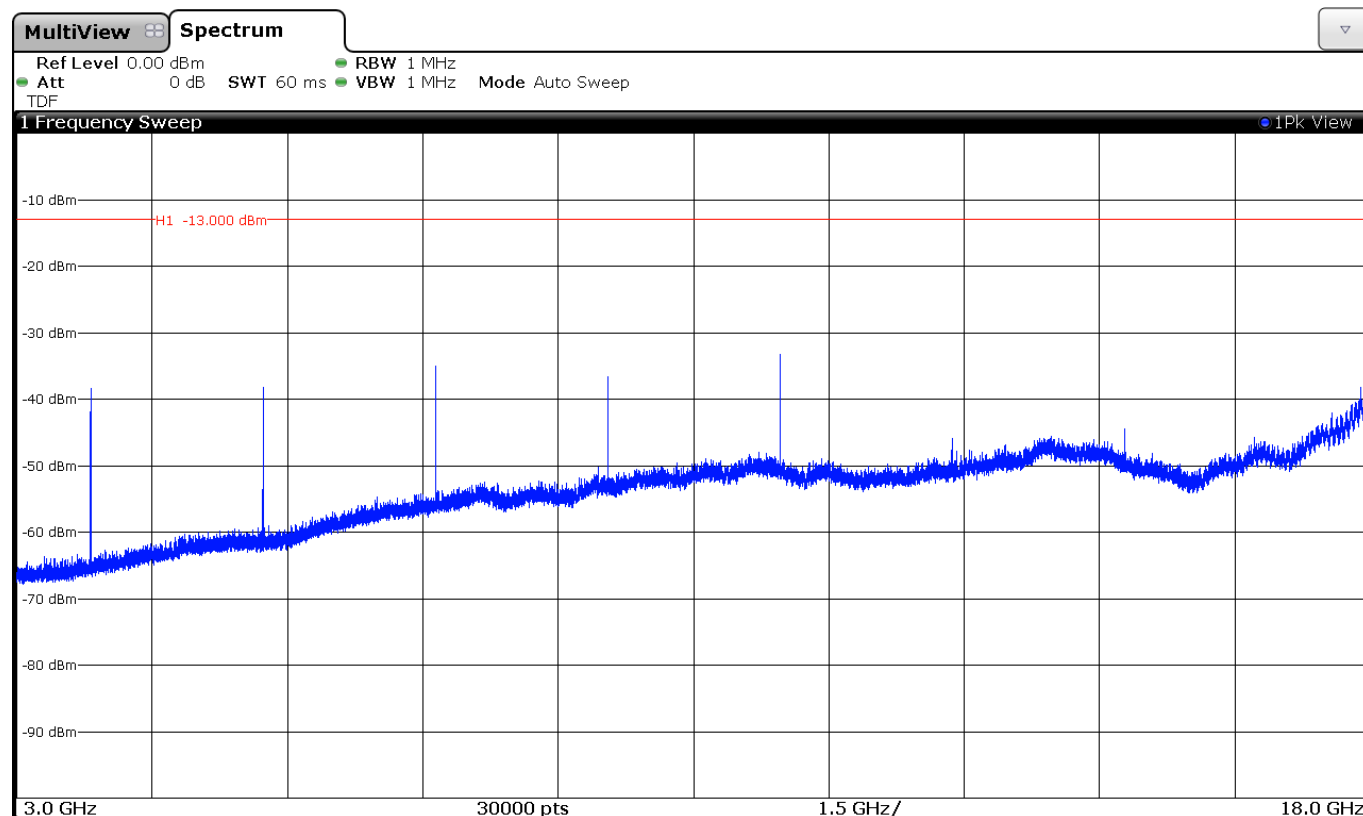
CHANNEL: LOWEST



CHANNEL: MIDDLE



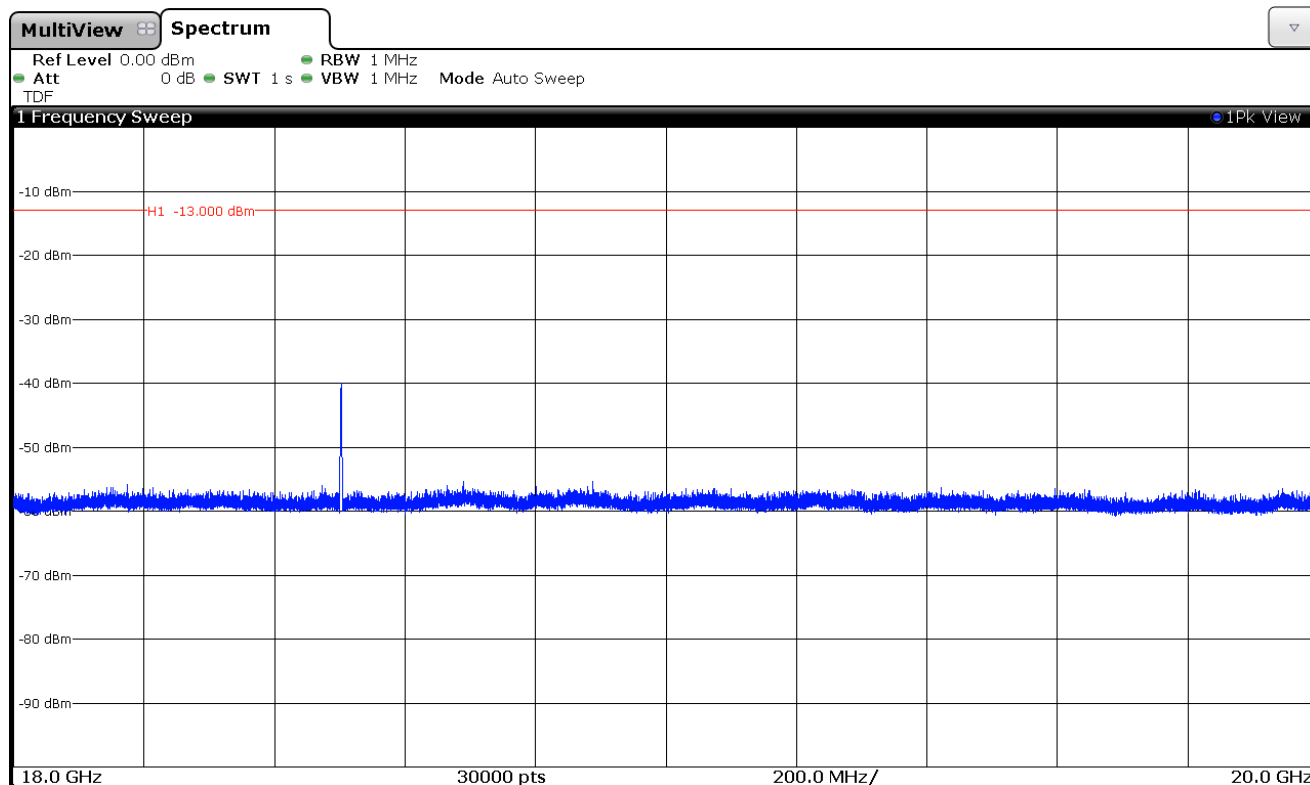
CHANNEL: HIGHEST



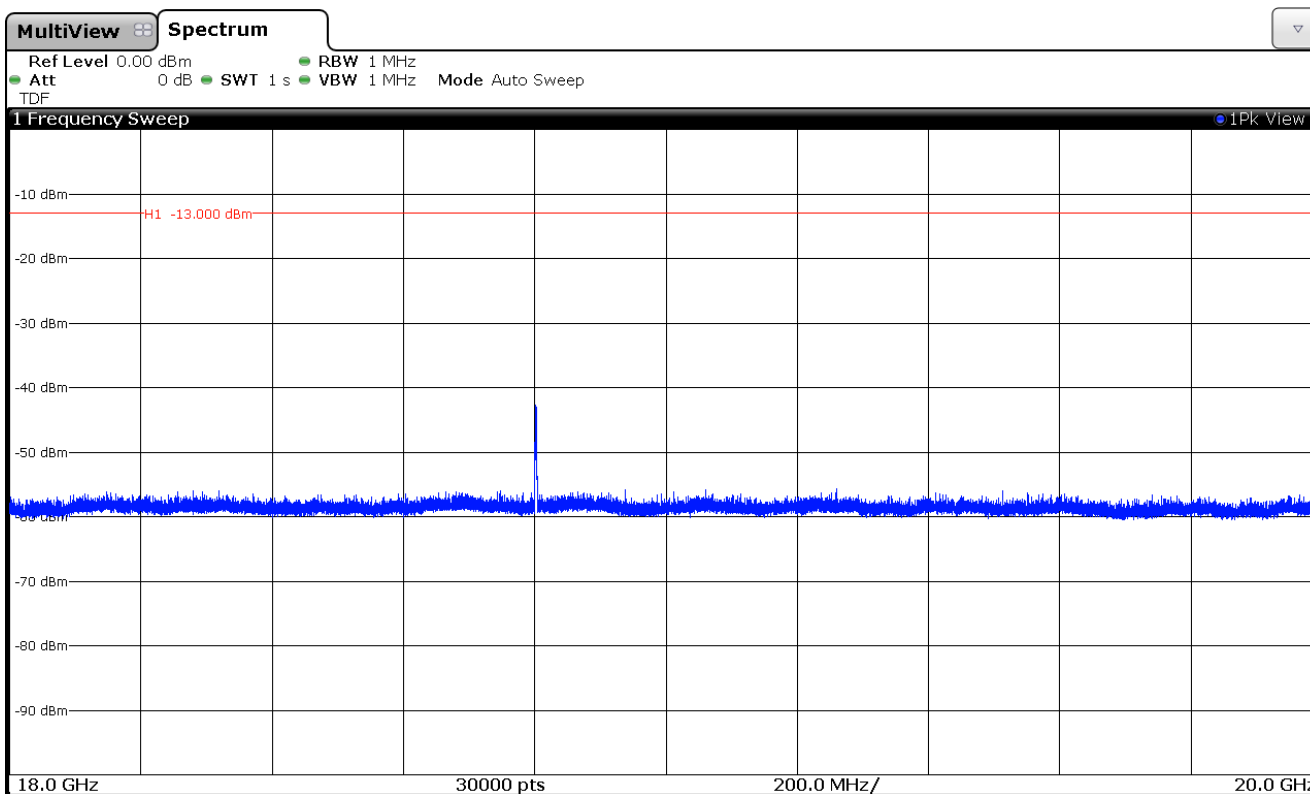
FREQUENCY RANGE 18 GHz TO 20 GHz.

GPRS MODULATION

CHANNEL: LOWEST



CHANNEL: MIDDLE



CHANNEL: HIGHEST

