TEST REPORT

No. I19N00846-RF-GSM

for

Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd

smartphone

Model Name: cp3648A

FCC ID: R38YLCP3648A

with

Hardware Version: P1

Software Version: 9.0.002.P1.190609.cp3648A

Issued Date: 2019-07-02

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of SAICT.

Test Laboratory:

Designation Number: CN1210

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I19N00846-RF-GSM	Rev.0	1st edition	2019-07-02

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1. TEST LABORATORY

1.1. Testing Location

Company Name:	Shenzhen Academy of Information and Communications Technology
Address:	Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, P. R. China
Postal Code:	518026
Telephone:	+86(0)755-33322000
Fax:	+86(0)755-33322001

1.2. Testing Environment

Normal Temperature:	15-35℃
Relative Humidity:	20-75%

1.3. Project data

Testing Start Date:	2019-05-31
Testing End Date:	2019-07-01

1.4. Signature

Lai Minghua
(Prepared this test report)

Huang Qiuqin
(Reviewed this test report)

Zhang Hao
(Approved this test report)

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2. CLIENT INFORMATION

2.1. Applicant Information

Company Name:	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
Address /Post:	Building B, Boton Science Park, Chaguang Road, Xili Town, Nanshan District, Shenzhen
Contact Person:	Yentl Chen
Contact Email	chenyanting@yulong.com
Telephone:	+86 15927320221
Fax:	/

2.2. Manufacturer Information

Company Name:	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
Address /Post:	Building B, Boton Science Park, Chaguang Road, Xili Town, Nanshan District, Shenzhen
Contact Person:	Yentl Chen
Contact Email	chenyanting@yulong.com
Telephone:	+86 15927320221
Fax:	/

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3. EQUIPMENT UNDER TEST (EUT) AND ANCILLARY EQUIPMENT (AE)

3.1. About EUT

Description	smartphone
Model Name	cp3648A
FCC ID	R38YLCP3648A
Frequency Bands	GSM850;GSM1900
Antenna	Integrated
Extreme vol. Limits	3.7VDC to 4.4VDC (nominal: 3.85VDC)
Extreme temp. Tolerance	-15°C to +55°C
Condition of EUT as received	No abnormality in appearance

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Sample Arrival Date
UT10aa	990013500007302	P1	9.0.002.P1.190609.cp3648A	2019-05-30
UT03aa	990013500007211	P1	9.0.002.P1.190609.cp3648A	2019-05-30

*EUT ID: is used to identify the test sample in the lab internally.

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery1
AE2	Battery2
AE3	Charger1
AE4	Charger2

AE1

Model	Li-ion Polymer
Manufacturer	Tianjin Lishen
Capacitance	2450mAh

AE2

Model	Li-ion Polymer
Manufacturer	Zhuhai Coslight
Capacitance	2450mAh

AE3

Model	RD0501000-USBA-18MG
Manufacturer	Shenzhen Ruide

AE4

Model	618045
Manufacturer	Shenzhen Kosun

*AE ID: is used to identify the test sample in the lab internally.

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3.4. General Description

The Equipment Under Test (EUT) is a model of TD-LTE mobile phone with integrated antenna. It consists of normal options: lithium battery, charger. Manual and specifications of the EUT were provided to fulfil the test.

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4. REFERENCE DOCUMENTS

4.1. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-17 Edition
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-17 Edition
FCC Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS	10-1-17 Edition
ANSI C63.26	American National Standard of Procedures for Compliance Testing of Licensed Transmitters Used in Licensed Radio Service	2015

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5. LABORATORY ENVIRONMENT

Control room / conducted chamber did not exceed following limits along the RF testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. =20 %, Max. = 80 %
Shielding effectiveness	> 110 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 0.5 Ω

Fully-anechoic chamber did not exceed following limits along the EMC testing

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 15 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	> 2MΩ
Ground system resistance	< 4 Ω
Voltage Standing Wave Ratio （VSWR）	≤ 6 dB, from 1 to 18 GHz，3 m distance
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

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6. SUMMARY OF TEST RESULTS

Abbreviations used in this clause:		
Verdict Column	P	Pass
	F	Fail
	NA	Not applicable
	NM	Not measured
Location Column	A/B/C/D	The test is performed in test location A, B, C or D which are described in section 1.1 of this report

GSM850

Items	List	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/22.913	A.1	P
2	Field Strength of Spurious Radiation	2.1053/22.917	A.2	P
3	Frequency Stability	2.1055/22.355	A.3	P
4	Occupied Bandwidth	2.1049/22.917	A.4	P
5	Emission Bandwidth	2.1049/22.917	A.5	P
6	Band Edge Compliance	2.1051/22.917	A.6	P
7	Conducted Spurious Emission	2.1051/22.917	A.7	P

PCS1900

Items	List	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/24.232	A.1	P
2	Field Strength of Spurious Radiation	2.1053/24.238	A.2	P
3	Frequency Stability	2.1055/24.235	A.3	P
4	Occupied Bandwidth	2.1049/24.238	A.4	P
5	Emission Bandwidth	2.1049/24.238	A.5	P
6	Band Edge Compliance	2.1051/24.238	A.6	P
7	Conducted Spurious Emission	2.1051/24.238	A.7	P
8	PEAK-TO-AVERAGE POWER RATIO	24.232	A.8	P

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7. STATEMENT

Since the information of samples in this report is provided by the client, the laboratory is not respo nsible for the authenticity of sample information.
This report takes measured values as criterion of test conclusion. The test conlusion meets the li mit requirements.

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8. TEST EQUIPMENTS UTILIZED

NO.	Description	TYPE	Manufacture	series number	CAL DUE DATE
1	Test Receiver	ESR7	R&S	101676	2019-11-28
2	BiLog Antenna	3142E	ETS	00224831	2021-05-17
3	Horn Antenna	3117	ETS-lindgren	00066577	2022-04-02
4	Horn Antenna	QSH-SL-18 -26-S-20	Q-par	17013	2020-01-15
5	Antenna	BBHA 9120D	Schwarzbeck	1593	2019-12-11
6	Antenna	VUBA 9117	Schwarzbeck	207	2020-07-16
7	Antenna	QWH-SL-18 -40-K-SG	Q-par	15979	2020-01-16
8	preamplifier	83017A	Agilent	MY39501110	/
9	Signal Generator	SMB100A	R&S	179725	2019-11-28
10	Fully Anechoic Chamber	FACT3-2.0	ETS-Lindgren	1285	2020-07-20
11	Spectrum Analyzer	FSV40	R&S	101192	2020-05-20
12	Universal Radio Communication Tester	CMU200	R&S	114545	2020-05-16
13	Universal Radio Communication Tester	CMU200	R&S	123210	2019-12-13
14	Spectrum Analyzer	FSU	R&S	101506	2019-12-13
15	Temperature Chamber	SH-241	ESPECs	92007516	2019-11-13
16	DC Power Supply	U3606A	Agilent Technologies	MY50450012	2019-11-13

Test software

Item	Name	Vesion
Radiated	EMC32	Version 10.01.00

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ANNEX A: MEASUREMENT RESULTS

A.1 OUTPUT POWER

Reference

FCC: CFR Part 2.1046, 22.913, 24.232.

A.1.1 Summary

During the process of testing, the EUT was controlled via Rhode & Schwarz Digital Radio Communication tester (CMU-200) to ensure max power transmission and proper modulation.

This result contains max output power and EIRP measurements for the EUT. In all cases, output power is within the specified limits.

A.1.2 Conducted

A.1.2.1 Method of Measurements

The EUT was set up for the max output power with pseudo random data modulation.

These measurements were done at 3 frequencies, 1850.2 MHz, 1880.0MHz and 1909.8MHz for PCS1900 band; 824.2MHz, 836.6MHz and 848.8MHz for GSM850 band. (bottom, middle and top of operational frequency range).

GSM850

	Power step	Nominal Peak output power (dBm)
GSM	5	33dBm(2W)
GPRS	3	33dBm(2W)
EGPRS	6	27dBm(0.5W)

Measurement result

GSM(GMSK)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	5	33.56
836.6	5	33.83
848.8	5	33.64

GPRS(GMSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	3	33.54
836.6	3	33.81
848.8	3	33.63

EGPRS(8PSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	6	26.75
836.6	6	26.71
848.8	6	26.81

Note: Expanded measurement uncertainty is U = 0.488dB, k = 1.96

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PCS1900

	Power step	Nominal Peak output power (dBm)
GSM	0	30dBm(1W)
GPRS	3	30dBm(1W)
EGPRS	5	26dBm(0.4W)

Measurement result

GSM(GMSK)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	0	30.96
1880.0	0	30.82
1909.8	0	30.45

GPRS(GMSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	3	30.95
1880.0	3	30.81
1909.8	3	30.42

EGPRS(8PSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	5	26.45
1880.0	5	26.49
1909.8	5	26.15

Note: Expanded measurement uncertainty is U = 0.488dB, k = 1.96

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A.1.3 Radiated

A.1.3.1 Description

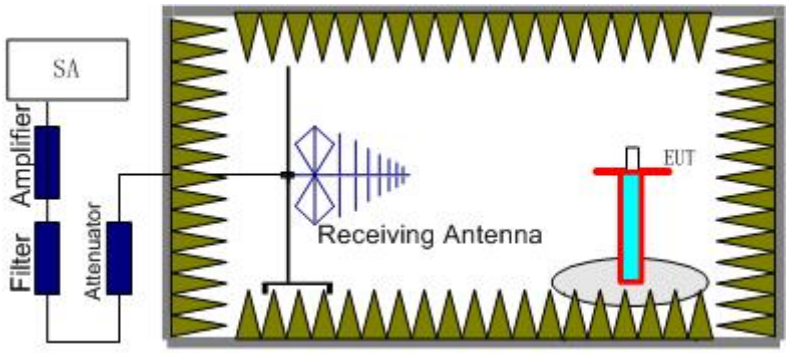
This is the test for the maximum radiated power from the EUT.

Rule Part 24.232(c) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

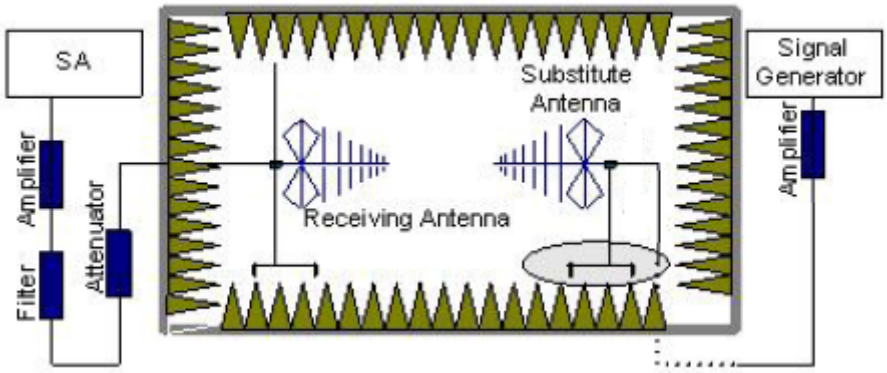
Rule Part 22.913(a) specifies " The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts."

A.1.3.2 Method of Measurement

1. For radiated emissions measurements performed at frequencies less than or equal to 1 GHz, EUT was placed on a 80 cm high non-conductive stand at a 3 meter test distance from the receive antenna. For radiated measurements performed at frequencies above 1 GHz, EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. Receiving antenna was placed on the antenna mast 3 meters from the EUT. For emission measurements. The receiving antenna shall be varied from 1 m to 4 m in height above the reference ground in a search for the relative positioning that produces the maximum radiated signal level. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three channels (High, Middle, Low) were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, an substitution antenna for the frequency band of interest is placed at the

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reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjusts the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna.
   The cable loss (P_{cl}) ,the Substitution Antenna Gain(dBi) (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test.
   The measurement results are obtained as described below:
   Power(EIRP)=P_{Mea}- P_{Ag} - P_{cl} + G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dB.

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GSM 850-ERP 22.913(a)

Limits

	Power Step	Burst Peak ERP (dBm)
GSM	5	≤38.45dBm (7W)
GPRS	3	≤38.45dBm (7W)
EGPRS	6	≤38.45dBm (7W)

Measurement result

GSM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
824.20	**-2.56**	**-33.60**	**-0.30**	**2.15**	**28.59**	**38.45**	**H**
836.60	-2.98	-33.50	-0.30	2.15	28.07	38.45	H
848.80	-2.80	-33.50	-0.30	2.15	28.25	38.45	H

GPRS

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
824.20	-5.81	-33.60	-0.30	2.15	25.34	38.45	H
836.60	-5.85	-33.50	-0.30	2.15	25.20	38.45	H
848.80	-5.91	-33.50	-0.30	2.15	25.14	38.45	H

EGPRS-8PSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
824.20	-6.76	-33.60	-0.30	2.15	24.39	38.45	H
836.60	-6.55	-33.50	-0.30	2.15	24.50	38.45	H
848.80	-6.77	-33.50	-0.30	2.15	24.28	38.45	H

Frequency: 824.20MHz

Peak ERP(dBm)=PMea(-2.56dBm)-(Pcl+PAg)(-33.60dB)+Ga(-0.30dB)-2.15dB=28.59dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

Note: Both of Vertical and Horizontal polarizations are evaluated, but only the worst case is recorded in this report.

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PCS1900-EIRP 24.232(c)

Limits

	Power Step	Burst Peak EIRP (dBm)
GSM	0	≤33dBm (2W)
GPRS	3	≤33dBm (2W)
EGPRS	5	≤33dBm (2W)

Measurement result

GSM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.20	-13.66	-29.30	10.00	25.64	33.00	H
1880.00	-15.55	-29.40	10.00	23.85	33.00	H
1909.80	-16.94	-29.30	10.00	22.36	33.00	H

GPRS

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.20	-13.85	-29.40	10.00	25.55	33.00	H
1880.00	**-13.45**	**-29.30**	**10.00**	**25.85**	**33.00**	**H**
1909.80	-16.88	-29.30	10.00	22.42	33.00	H

EGPRS-8PSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.20	-13.73	-29.40	10.00	25.67	33.00	H
1880.00	**-13.45**	**-29.30**	**10.00**	**25.85**	**33.00**	**H**
1909.80	-15.69	-29.30	10.00	23.61	33.00	H

Frequency**:** 1880.00MHz

Peak EIRP(dBm)= PMea(-13.45dBm) –(Pcl+PAg)(-29.30dB)+Ga (10dB) =25.85dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

Note: Both of Vertical and Horizontal polarizations are evaluated, but only the worst case is recorded in this report.

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A.2 FIELD STRENGTH OF SPURIOUS RADIATION

Reference

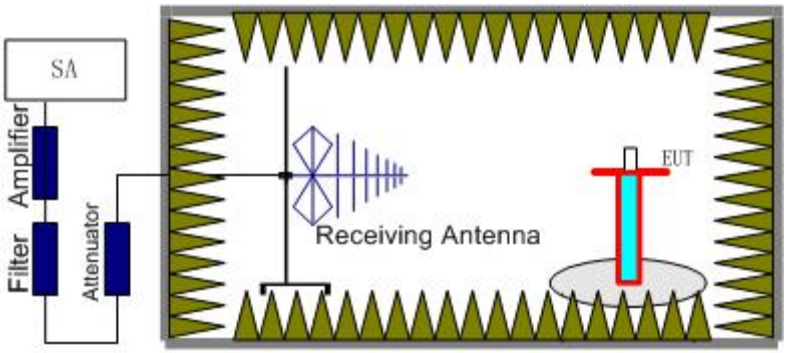
FCC: CFR 2.1053, 22.917, 24.238.

A.2.1 Measurement Method

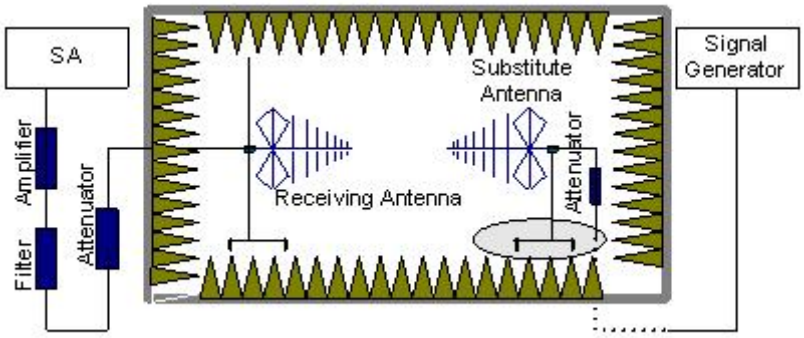
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1910 MHz. The resolution bandwidth is set 1MHz as outlined in Part 24.238 and Part 22.917. The spectrum is scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of PCS1900 and GSM850.

The procedure of radiated spurious emissions is as follows:

1. For radiated emissions measurements performed at frequencies less than or equal to 1 GHz, EUT was placed on a 80 cm high non-conductive stand at a 3 meter test distance from the receive antenna. For radiated measurements performed at frequencies above 1 GHz, EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. Receiving antenna was placed on the antenna mast 3 meters from the EUT. For emission measurements. The receiving antenna shall be varied from 1 m to 4 m in height above the reference ground in a search for the relative positioning that produces the maximum radiated signal level. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three channels (High, Middle, Low) were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



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In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjusts the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. The Path loss (P_{pl}) between the Signal Source with the Substitution Antenna and the Substitution Antenna Gain(dBi) (G_a) should be recorded after test.
   A amplifier should be connected in for the test.
   The Path loss (P_{pl}) is the summation of the cable loss and the gain of the amplifier.
   The measurement results are obtained as described below:
   Power(EIRP)=P_{Mea} - P_{pl} + G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dB.

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A.2.2 Measurement Limit

Part 24.238 and Part 22.917 specify that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

A.2.3 Measurement Results

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of the PCS1900 band (1850.2 MHz, 1880 MHz and 1909.8 MHz) and GSM850 band (824.2MHz, 836.6MHz, 848.8MHz) . It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the PCS1900 ,GSM850 into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

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A.2.4 Measurement Results Table

Frequency	Channel	Frequency Range	Result
GSM 850MHz	Low	30MHz-10GHz	Pass
	Middle	30MHz-10GHz	Pass
	High	30MHz-10GHz	Pass
GSM 1900MHz	Low	30MHz-20GHz	Pass
	Middle	30MHz-20GHz	Pass
	High	30MHz-20GHz	Pass

A.2.5 Sweep Table

Working Frequency	Subrange (GHz)	RBW	VBW	Sweep time (s)
850MHz	0.03~1	100KHz	300KHz	10
	1-2	1 MHz	3 MHz	2
	2~5	1 MHz	3 MHz	3
	5~8	1 MHz	3 MHz	3
	8~10	1 MHz	3 MHz	3
1900MHz	0.03~1	100KHz	300KHz	10
	1-2	1 MHz	3 MHz	2
	2~5	1 MHz	3 MHz	3
	5~8	1 MHz	3 MHz	3
	8~11	1 MHz	3 MHz	3
	11~14	1 MHz	3 MHz	3
	14~18	1 MHz	3 MHz	3
	18~20	1 MHz	3 MHz	2

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GSM Mode Channel 128/824.2MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2901.60	-40.73	1.00	11.40	-32.48	-13.00	H
3539.00	-65.04	1.20	12.30	-56.09	-13.00	V
4467.00	-66.07	1.20	12.70	-56.72	-13.00	H
5286.00	-66.17	1.60	13.20	-56.72	-13.00	V
6168.50	-64.94	1.60	13.40	-55.29	-13.00	V
7426.00	-62.82	1.90	11.50	-55.37	-13.00	H

GSM Mode Channel 190/836.6MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2901.87	-41.39	1.00	11.40	-33.14	-13.00	H
3346.00	-62.31	1.10	12.30	-53.26	-13.00	V
4451.50	-66.90	1.20	12.70	-57.55	-13.00	V
5533.50	-67.15	1.40	13.20	-57.50	-13.00	V
6506.00	-65.26	1.70	12.80	-56.31	-13.00	V
7446.00	-63.45	1.90	11.50	-56.00	-13.00	V

GSM Mode Channel 251/848.8MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit(dBm)	Polarization
2526.93	-42.05	1.00	10.80	-34.40	-13.00	V
3503.00	-65.77	1.20	12.30	-56.82	-13.00	H
4331.00	-67.37	1.30	12.70	-58.12	-13.00	H
5059.50	-66.21	1.20	12.60	-56.96	-13.00	H
6314.50	-65.16	1.60	12.80	-56.11	-13.00	V
7306.50	-63.36	1.70	11.50	-55.71	-13.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

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GSM Mode Channel 512/1850.2MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2909.33	-41.38	1.00	11.40	-30.98	-13.00	H
3143.00	-64.72	1.00	11.40	-54.32	-13.00	V
4376.50	-65.67	1.30	12.70	-54.27	-13.00	V
5550.50	-61.45	1.40	13.20	-49.65	-13.00	V
6408.50	-64.35	1.60	12.80	-53.15	-13.00	V
7352.00	-62.04	1.70	11.50	-52.24	-13.00	H

GSM Mode Channel 661/1880.0MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2946.93	-41.89	1.00	11.40	-31.49	-13.00	V
3164.00	-64.69	1.00	11.40	-54.29	-13.00	V
4594.50	-65.63	1.30	12.70	-54.23	-13.00	V
5640.00	-63.55	1.30	13.20	-51.65	-13.00	V
6572.00	-63.82	1.70	12.80	-52.72	-13.00	H
7500.50	-62.52	1.80	11.50	-52.82	-13.00	V

GSM Mode Channel 810/1909.8MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit(dBm)	Polarization
2908.53	-41.57	1.00	11.40	-31.17	-13.00	V
3185.50	-64.28	1.10	11.40	-53.98	-13.00	V
4604.50	-66.59	1.30	12.70	-55.19	-13.00	V
5267.00	-66.63	1.60	13.20	-55.03	-13.00	H
6409.00	-65.44	1.60	12.80	-54.24	-13.00	V
7371.00	-63.71	1.70	11.50	-53.91	-13.00	V

Note: The maximum value of expanded measurement uncertainty for this test item is U = 3.34dB(30MHz-3GHz)/4.06dB(3GHz-18GHz)/4.56dB(18GHz-40GHz), k = 2

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A.3 FREQUENCY STABILITY

Reference

FCC: CFR Part 2.1055, 22.355, 24.235.

A.3.1 Method of Measurement

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of R&S CMU200 DIGITAL RADIO COMMUNICATION TESTER.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -15℃.
3. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on mid channel of PCS 1900 and GSM850, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10℃ increments from -15℃ to +55℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments remeasuring carrier frequency at each voltage. Pause at nominal voltage for 1 1/2 hours unpowered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +55℃.
7. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10℃ increments from +55℃ to -15℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

A.3.2 Measurement Limit

A.3.2.1 For Hand carried battery powered equipment

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.7VDC and 4.4VDC, with a nominal voltage of 3.85VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. These voltages represent a tolerance of -10 % and +12.5 %. For the purposes of measuring frequency stability these voltage limits are to be used.

A.3.2.2 For equipment powered by primary supply voltage

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec.

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24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. For this EUT section 2.1055(d)(1) applies. This requires varying primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

A.3.3 Measurement results

GSM 850

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.7	9	0.010
3.85	-7	0.008
4.4	6	0.008

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-15	-8	0.010
-5	-30	0.036
5	15	0.017
15	11	0.013
25	6	0.007
35	18	0.021
45	-10	0.012
55	7	0.009

EGPRS 850 - 8PSK

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.7	-58	0.069
3.85	-52	0.062
4.4	-47	0.056

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-15	-47	0.057
-5	-46	0.055
5	-49	0.059
15	-50	0.059
25	-50	0.059
35	-50	0.060
45	-49	0.059
55	-49	0.059

Expanded measurement uncertainty is 10Hz, k = 2

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PCS 1900

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.7	28	0.015
3.85	24	0.013
4.4	22	0.012

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-15	21	0.011
-5	20	0.011
5	20	0.011
15	23	0.012
25	25	0.013
35	17	0.009
45	27	0.014
55	15	0.008

EGPRS 1900 - 8PSK

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.7	-44	0.023
3.85	-39	0.021
4.4	-40	0.021

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-15	-42	0.022
-5	-43	0.023
5	-40	0.021
15	-46	0.024
25	-42	0.022
35	-38	0.020
45	-40	0.021
55	-41	0.022

Expanded measurement uncertainty is 10Hz, k = 2

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A.4 OCCUPIED BANDWIDTH

Reference

FCC: CFR Part 2.1049, 22.917, 24.238.

A.4.1 Occupied Bandwidth Results

Occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the US Cellular/PCS frequency bands. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the following pages.

The EUT was set up for the max output power with pseudo random data modulation. Use the Occupied Bandwidth function of SA to measure the 99% bandwidth.

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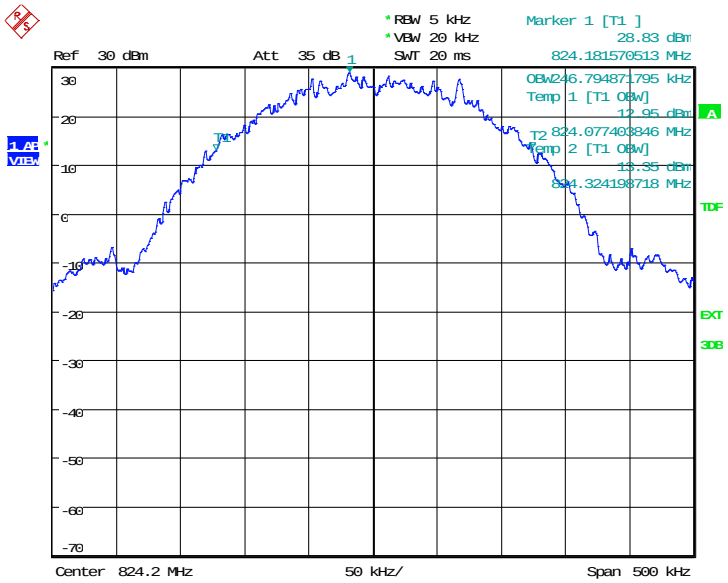
GSM 850(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	246.79
836.6	245.99
848.8	249.20

GSM 850

Channel 128-Occupied Bandwidth (99% BW)



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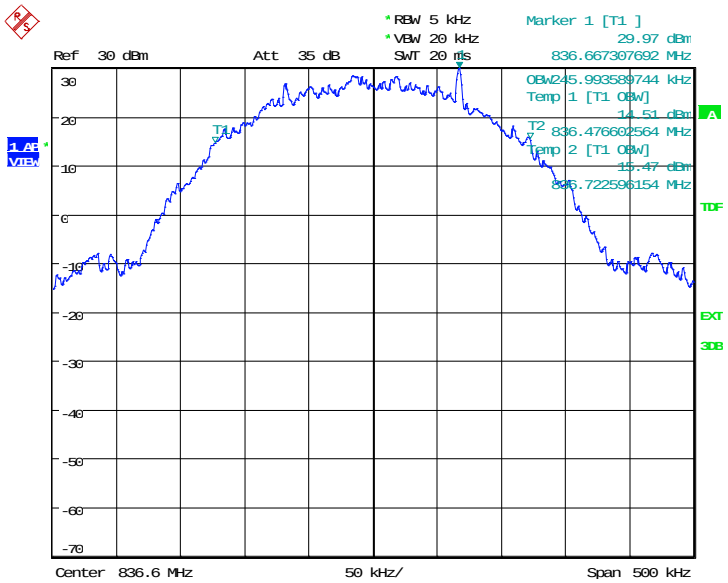
Channel 190-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 06:36:23

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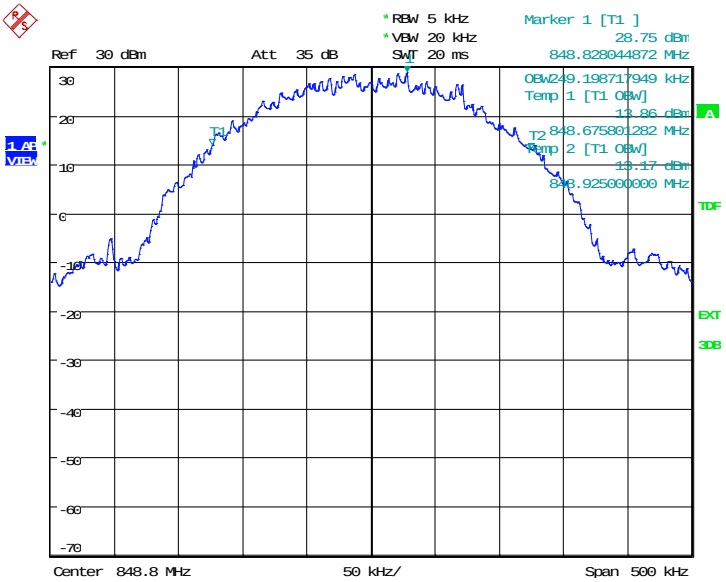
Channel 251-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 06:36:54

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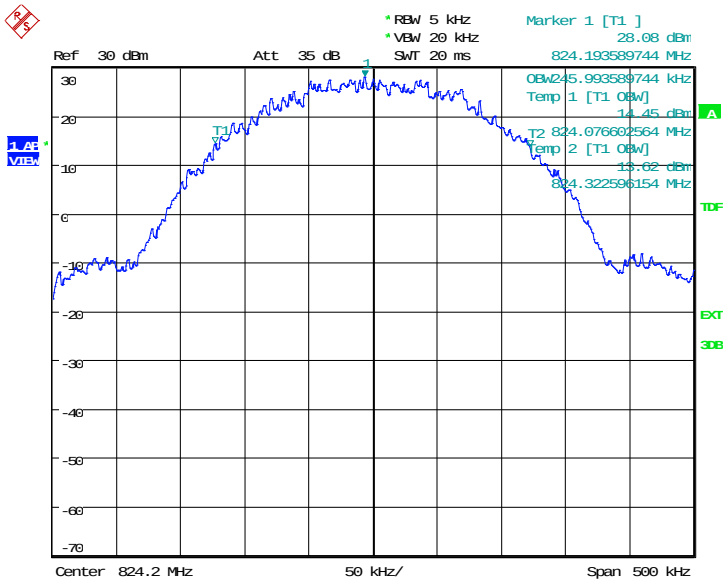
GPRS 850(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	245.99
836.6	248.40
848.8	243.59

GPRS 850

Channel 128-Occupied Bandwidth (99% BW)



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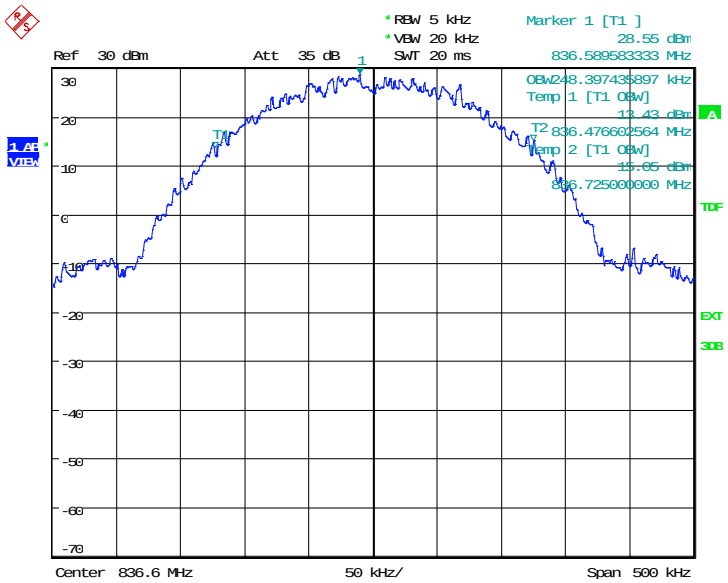
Channel 190-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 11:58:53

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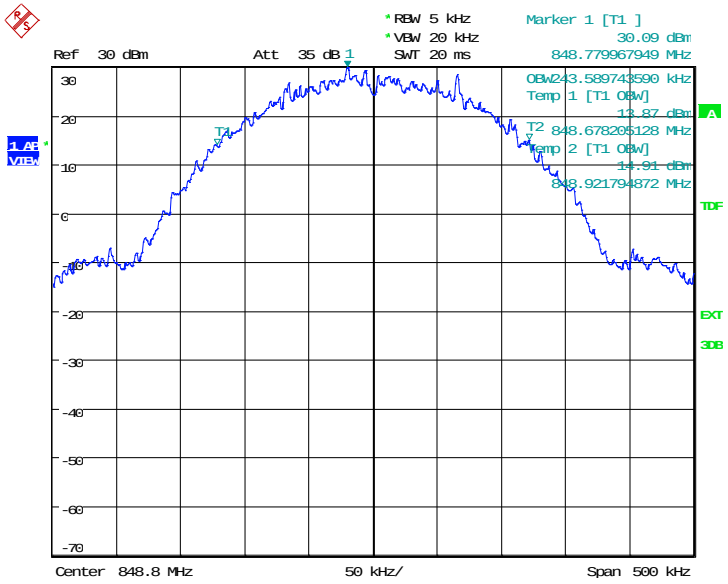
Channel 251-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 11:59:24

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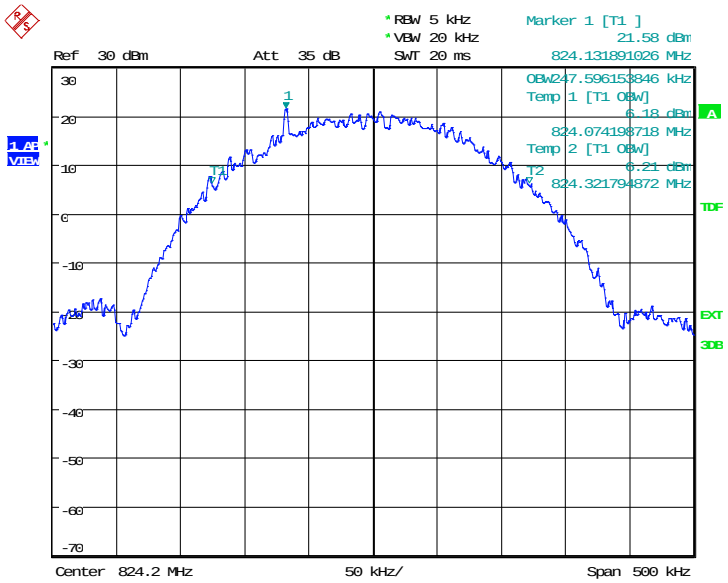
EGPRS 850-8PSK(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	247.60
836.6	245.19
848.8	245.99

EGPRS 850-8PSK

Channel 128-Occupied Bandwidth (99% BW)



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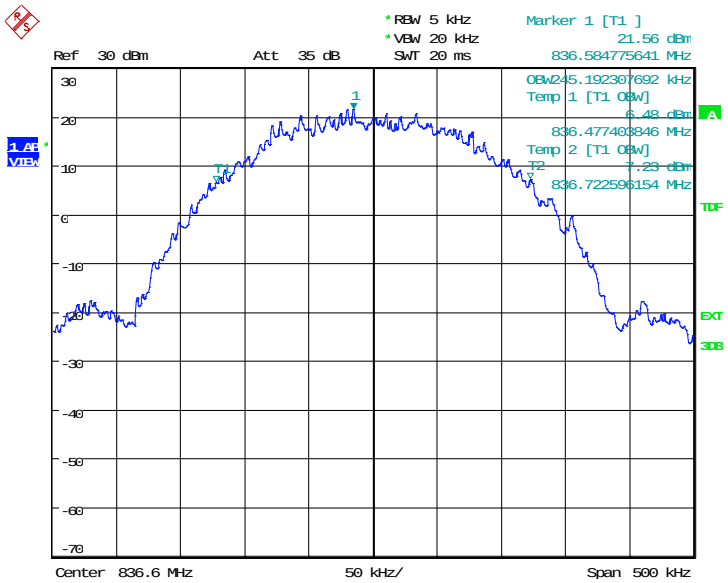
Channel 190-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 11:37:49

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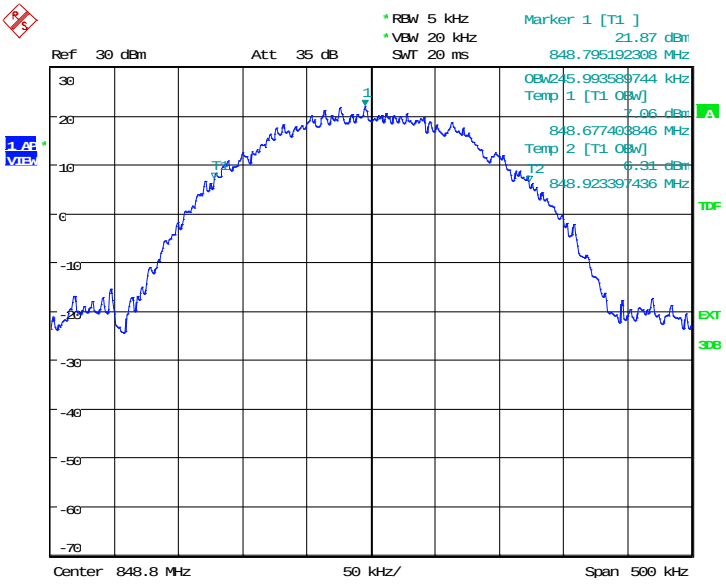
Channel 251-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 11:38:20

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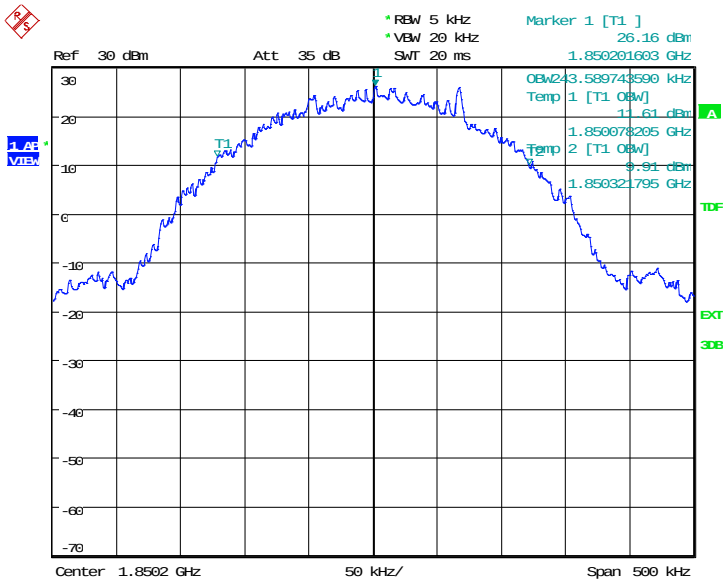
PCS 1900(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	243.59
1880.0	243.59
1909.8	245.19

PCS 1900

Channel 512-Occupied Bandwidth (99% BW)



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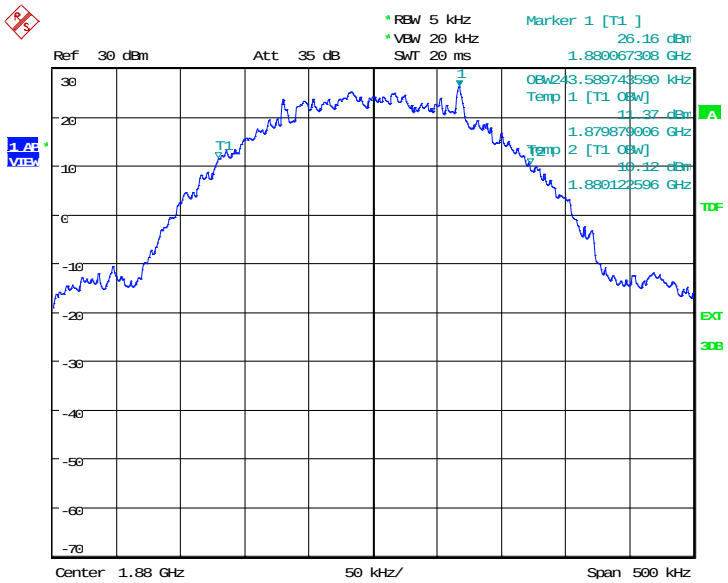
Channel 661-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 07:31:07

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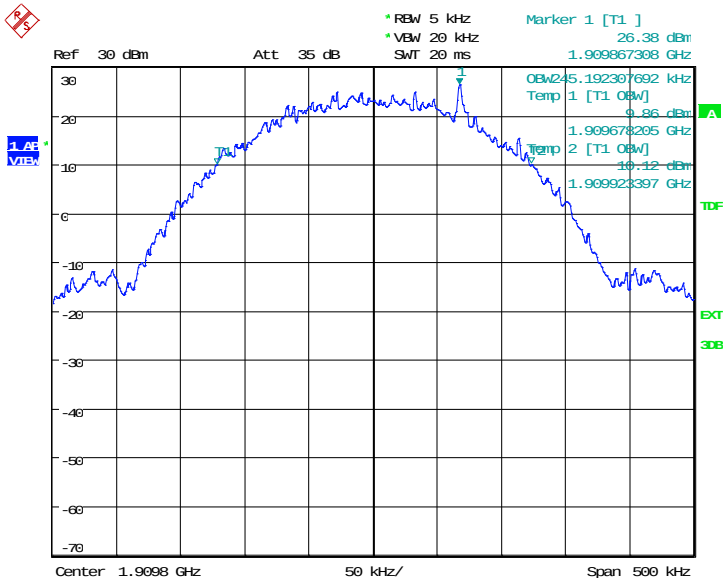
Channel 810-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 07:31:39

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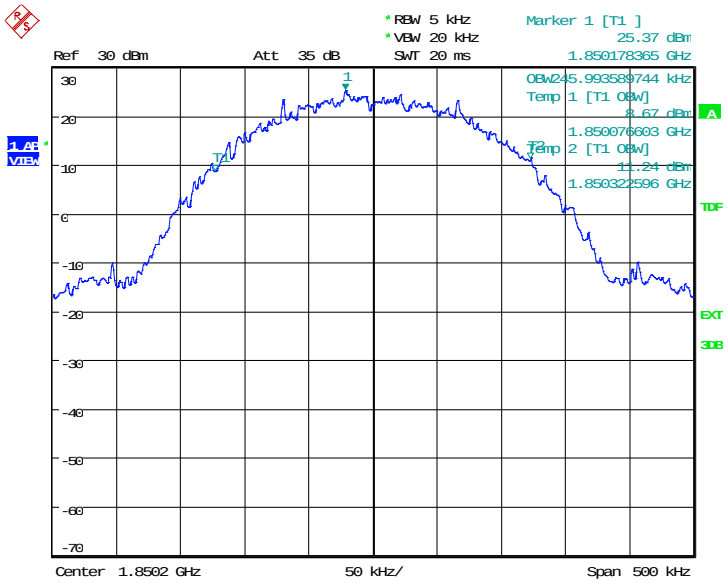
GPRS 1900(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	245.99
1880.0	243.59
1909.8	248.40

GPRS 1900

Channel 512-Occupied Bandwidth (99% BW)



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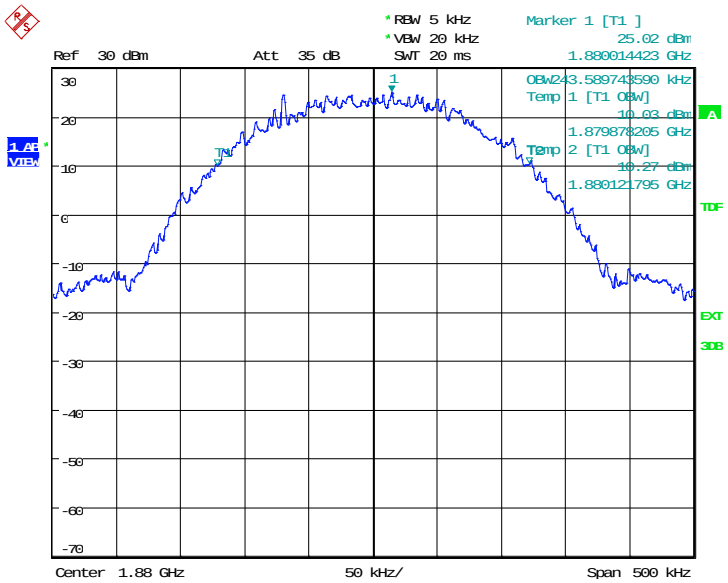
Channel 661-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 11:48:03

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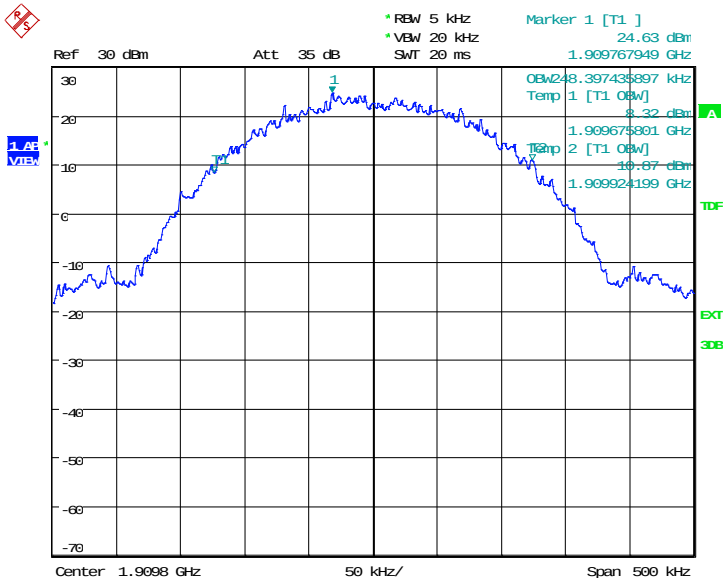
Channel 810-Occupied Bandwidth (99% BW)



Date: 31.MAY.2019 11:48:34

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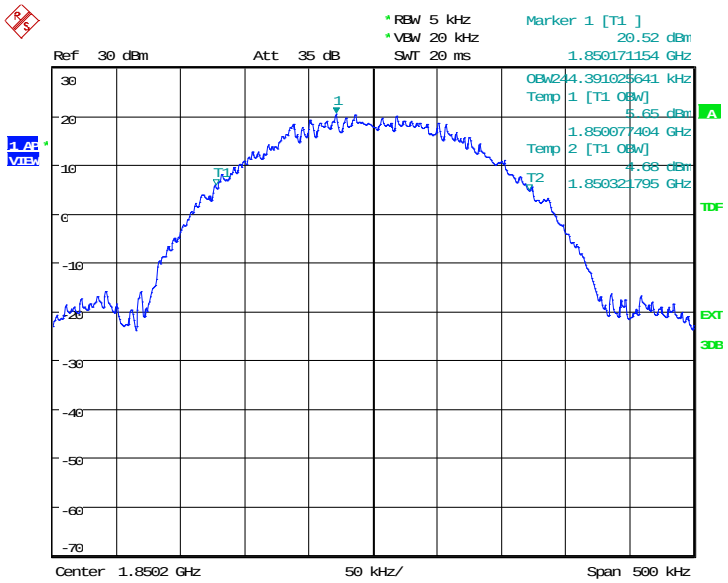
EGPRS 1900-8PSK(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	244.39
1880.0	242.79
1909.8	246.79

EGPRS 1900-8PSK

Channel 512-Occupied Bandwidth (99% BW)



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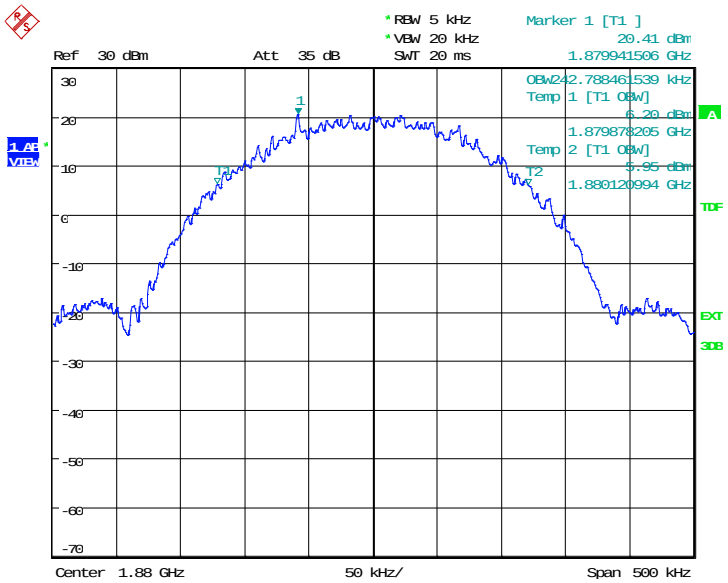
Channel 661-Occupied Bandwidth (99% BW)



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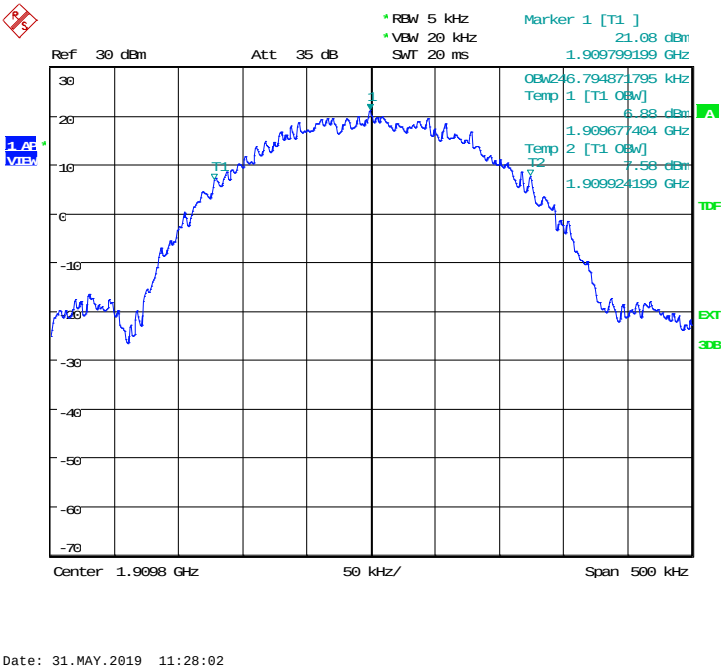
Channel 810-Occupied Bandwidth (99% BW)



Note: Expanded measurement uncertainty is U = 3428Hz, k = 2

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A.5 EMISSION BANDWIDTH

Reference

FCC: CFR Part 2.1049, 22.917, 24.238

A.5.1Emission Bandwidth Results

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Similar to conducted emissions; Emission bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of PCS1900 band and GSM850 band. Table below lists the measured -26dBc BW. Spectrum analyzer plots are included on the following pages.

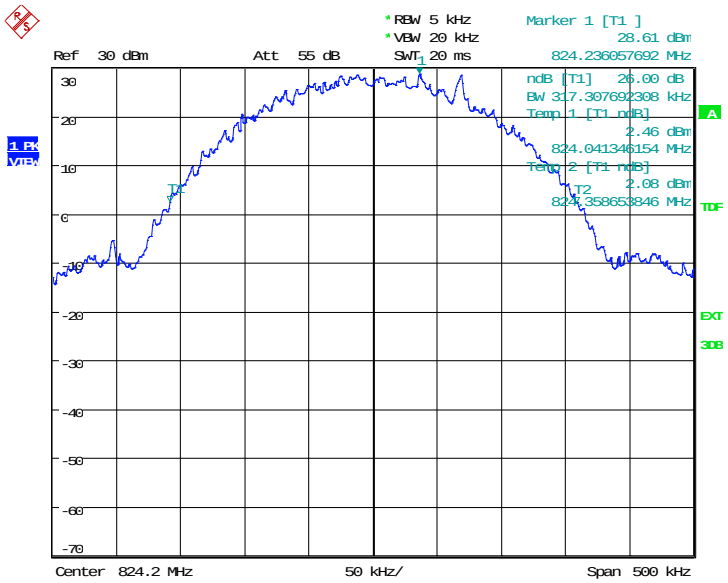
The EUT was set up for the max output power with pseudo random data modulation. Use the Occupied Bandwidth function of SA to measure the 26dBc bandwidth.

GSM 850(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
824.2	317.31
836.6	313.30
848.8	314.90

GSM 850

Channel 128-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 06:38:02

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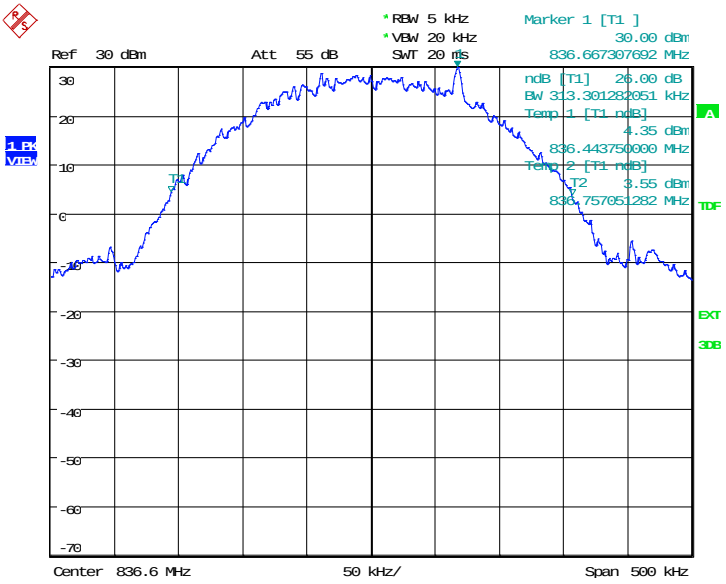
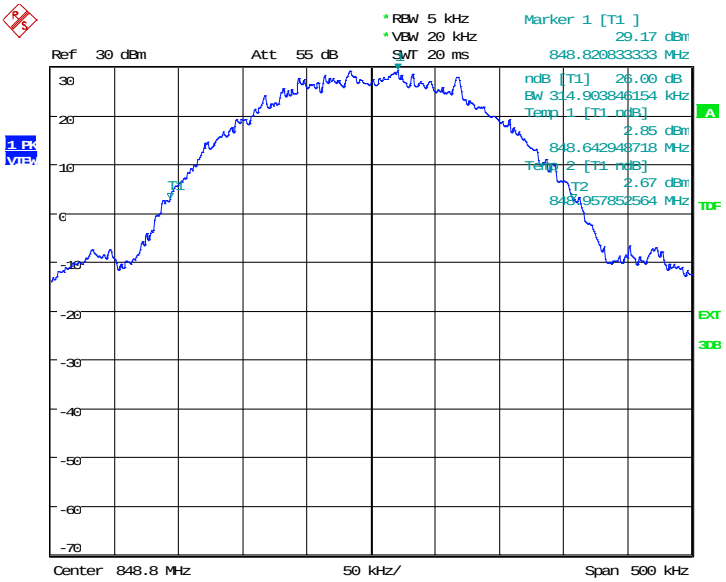
Channel 190-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 06:39:09

Channel 251-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 06:40:15

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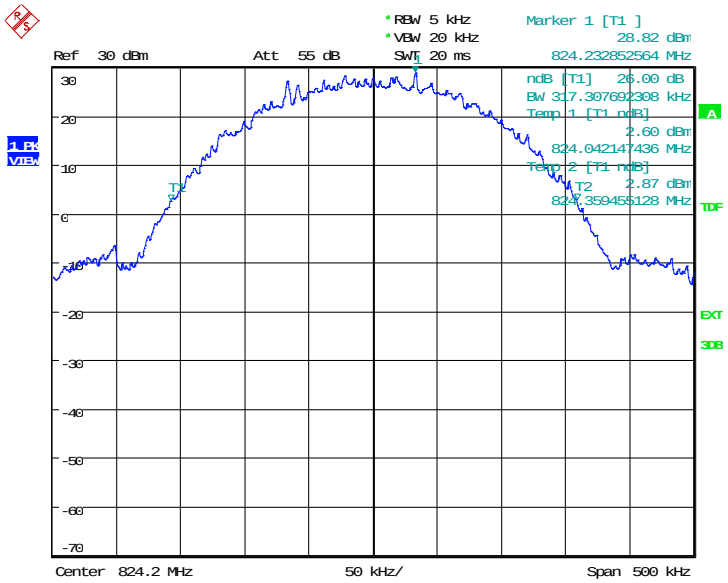
GPRS 850(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
824.2	317.31
836.6	314.90
848.8	314.90

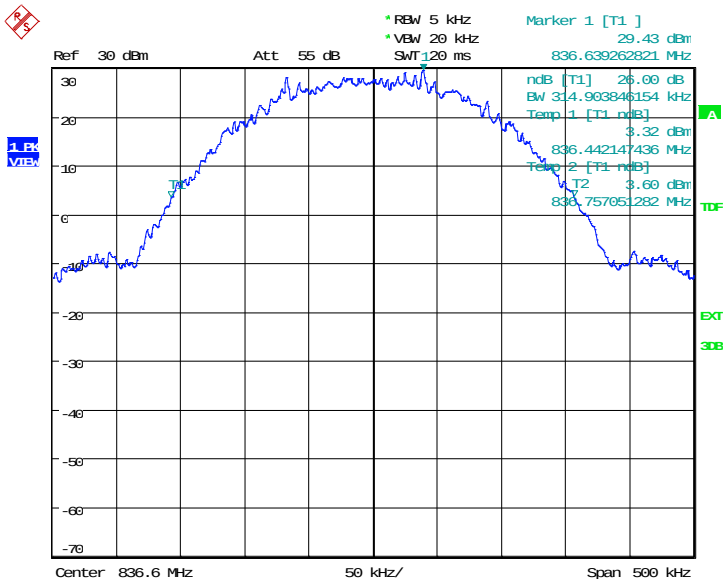
GPRS 850

Channel 128-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 12:00:32

Channel 190-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 12:01:39

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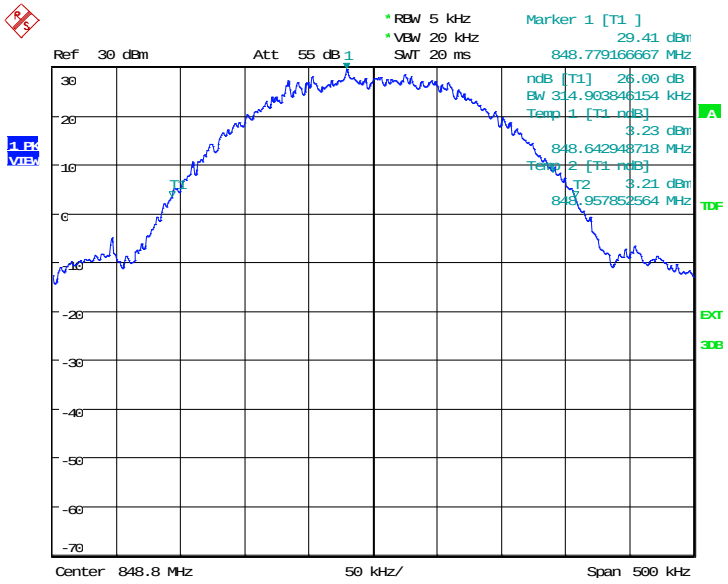
Channel 251-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 12:02:45

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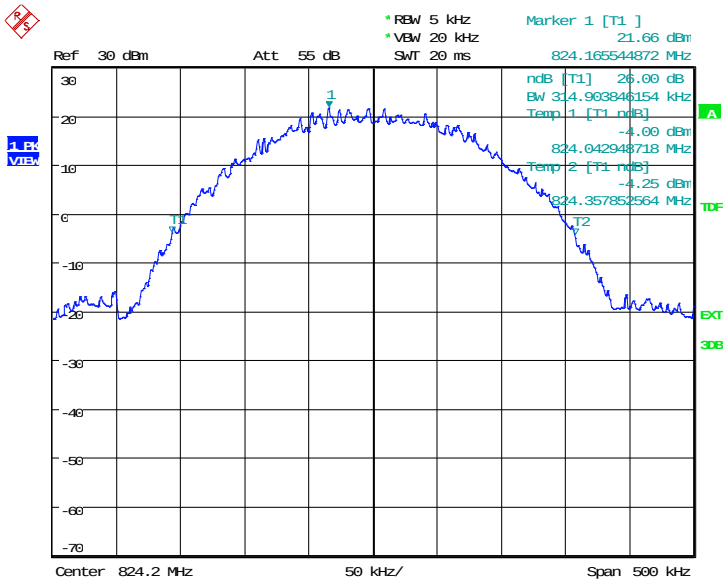
EGPRS 850-8PSK(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
824.2	314.90
836.6	313.30
848.8	314.10

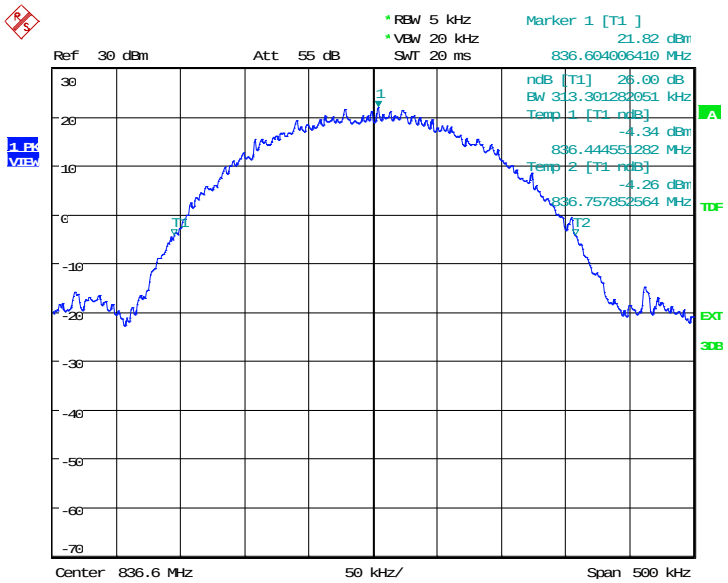
EGPRS 850-8PSK

Channel 128-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:39:28

Channel 190-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:40:35

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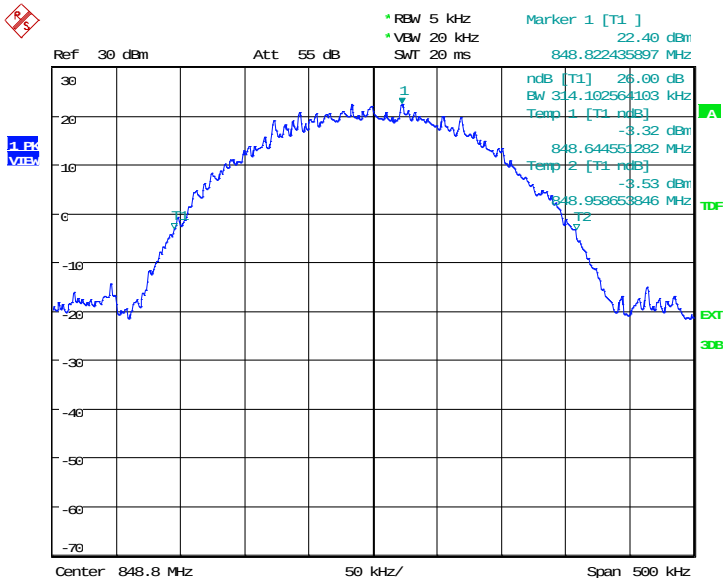
Channel 251-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:41:42

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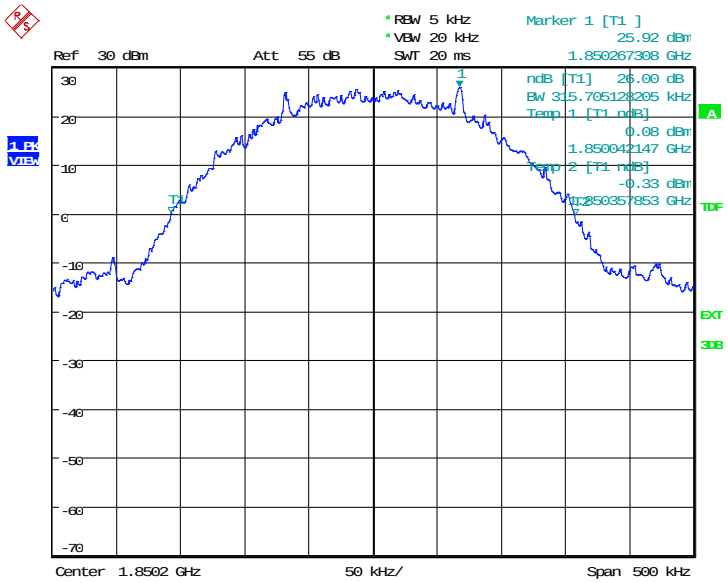
PCS 1900(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
1850.2	315.71
1880.0	314.10
1909.8	311.70

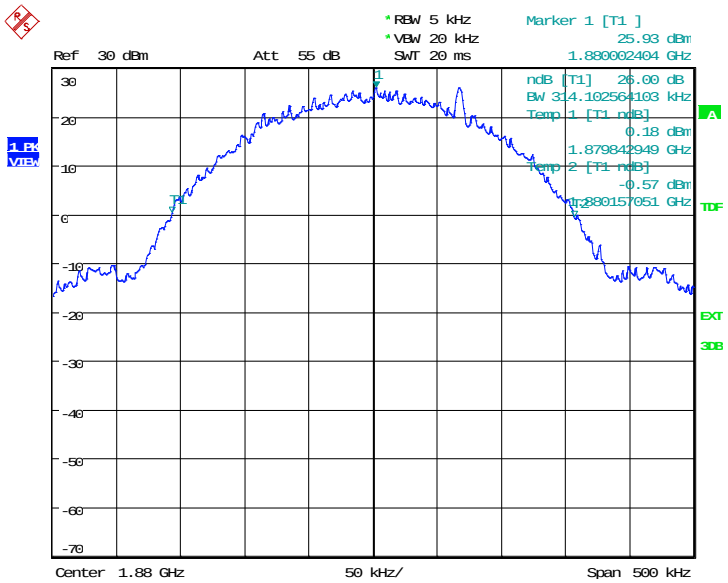
PCS 1900

Channel 512-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 07:32:46

Channel 661-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 07:33:53

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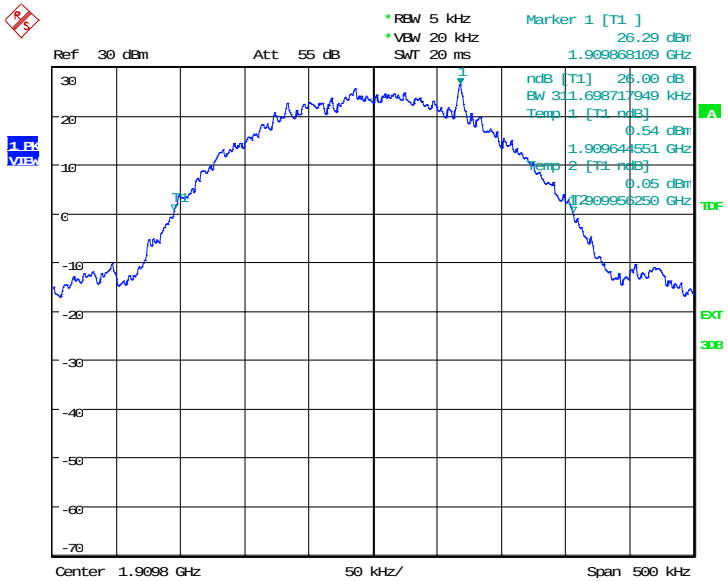
Channel 810-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 07:34:59

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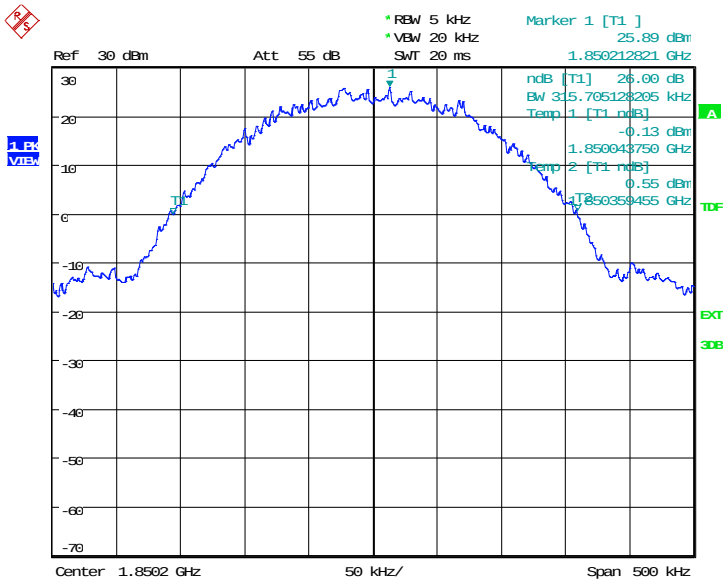
GPRS 1900(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
1850.2	315.71
1880.0	315.71
1909.8	314.90

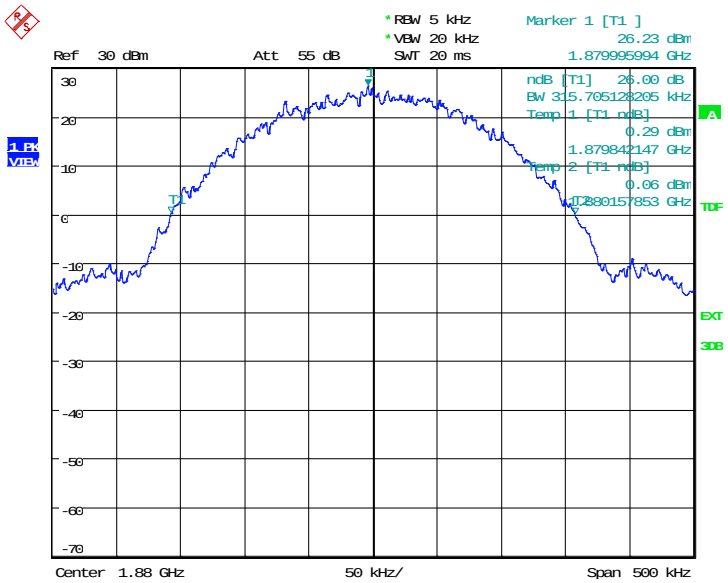
GPRS 1900

Channel 512-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:49:42

Channel 661-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:50:49

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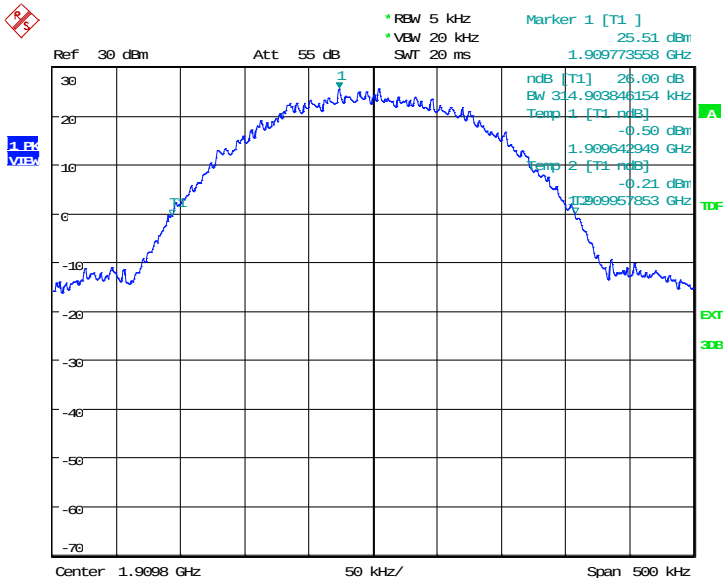
Channel 810-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:51:56

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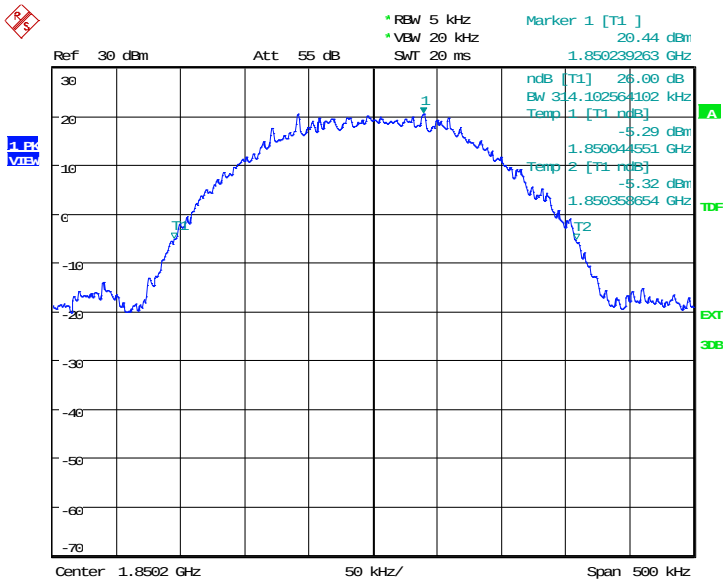
EGPRS 1900-8PSK(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
1850.2	314.10
1880.0	306.09
1909.8	314.10

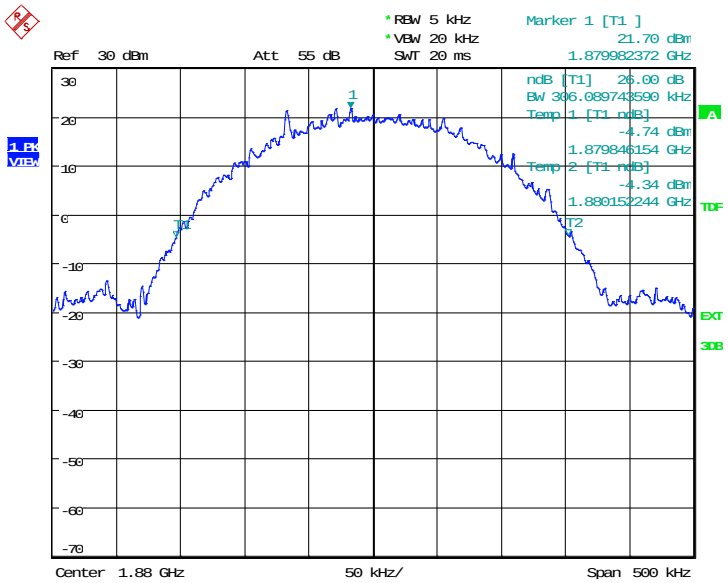
EGPRS 1900-8PSK

Channel 512-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:29:10

Channel 661-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:30:17

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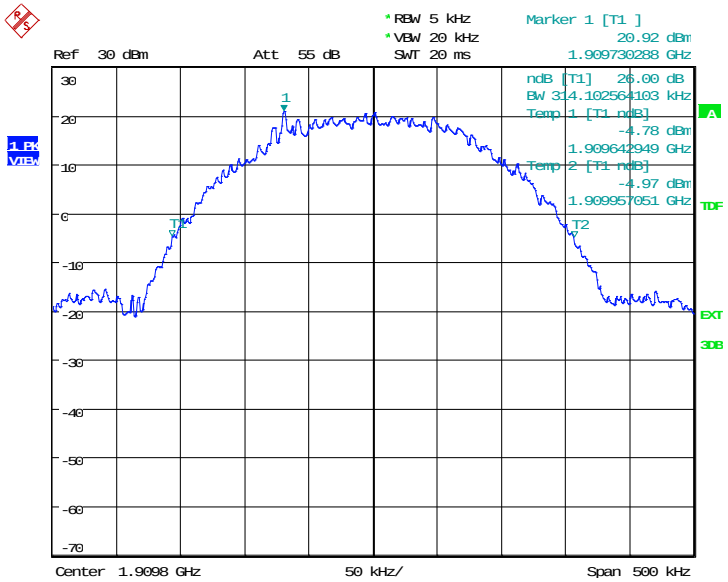
Channel 810-Emission Bandwidth (-26dBc BW)



Date: 31.MAY.2019 11:31:23

Note: Expanded measurement uncertainty is U = 3428Hz, k = 2

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A.6 BAND EDGE COMPLIANCE

Reference

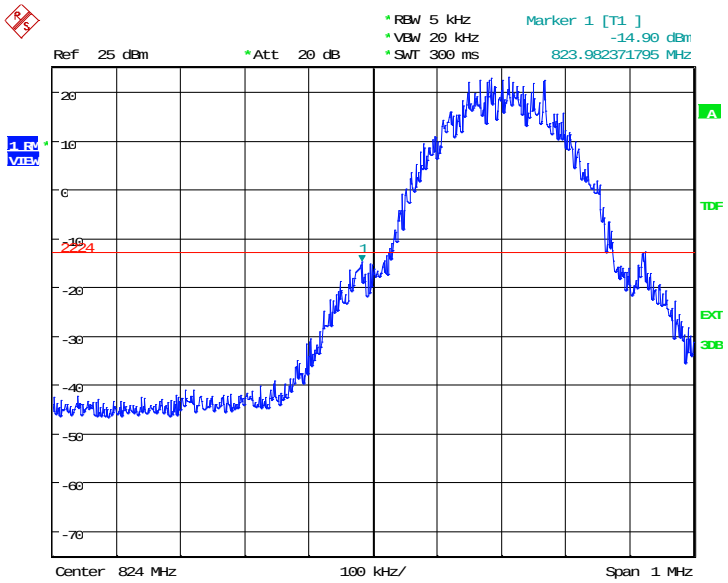
FCC: CFR Part 2.1051, 22.917, 24.238

Measurement limit

On any frequency outside frequency band of the US Cellular/PCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log (P) dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm. A relaxation of the reference bandwidth is often provided for measurements within a specified frequency range at the edge of the authorized frequency block/band. This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth.

GSM 850

LOW BAND EDGE BLOCK-A (GSM850)-Channel 128



Date: 31.MAY.2019 06:40:23

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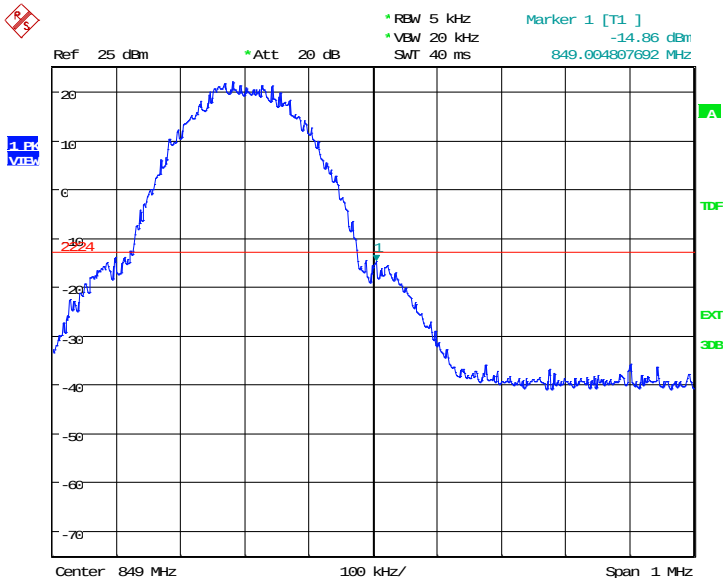
HIGH BAND EDGE BLOCK-C (GSM850) –Channel 251



Date: 31.MAY.2019 12:11:00

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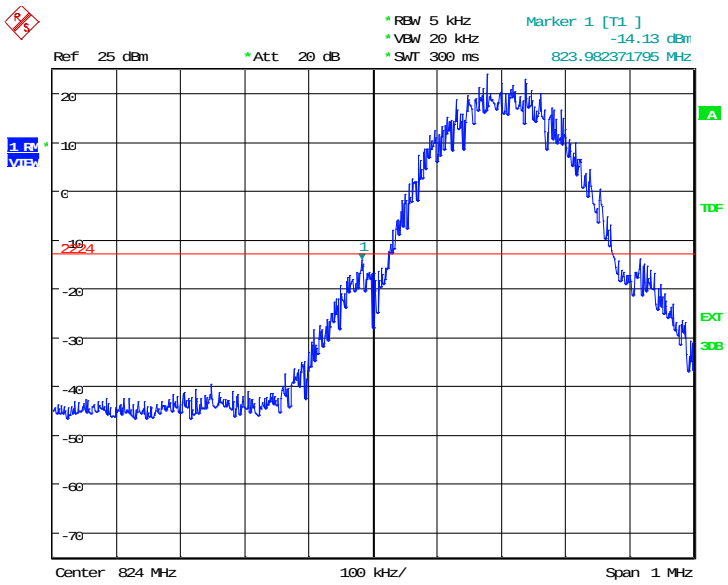
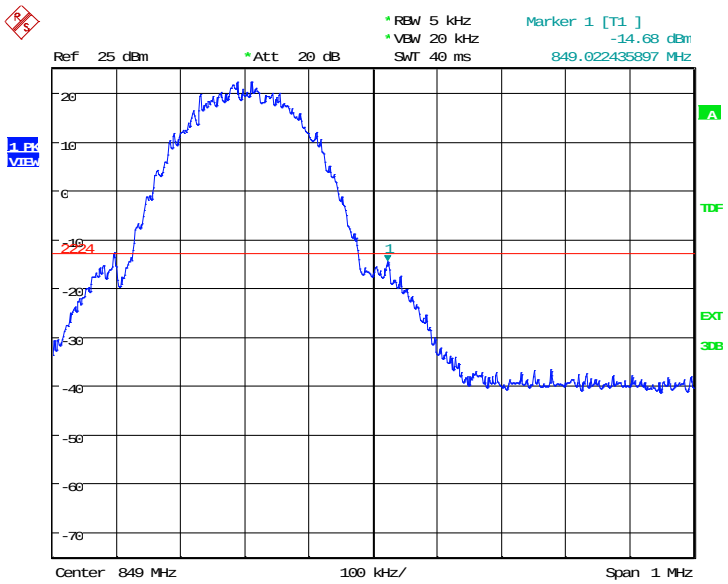
GPRS 850

LOW BAND EDGE BLOCK-A (GSM850)-Channel 128



Date: 31.MAY.2019 12:02:53

HIGH BAND EDGE BLOCK-C (GSM850) –Channel 251



Date: 31.MAY.2019 12:09:55

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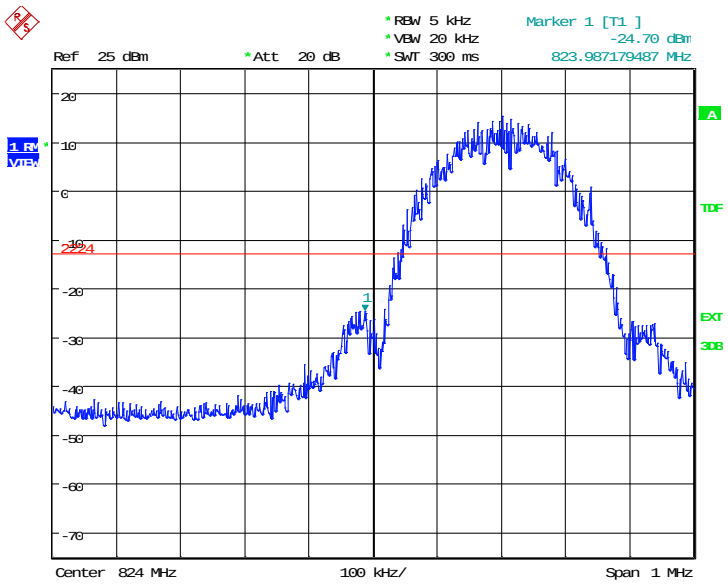
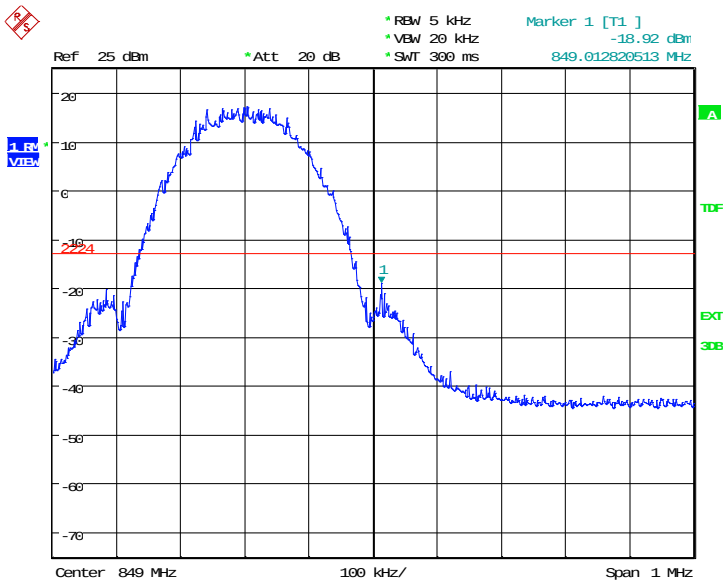
EGPRS 850-8PSK

LOW BAND EDGE BLOCK-A (GSM850)-Channel 128



Date: 31.MAY.2019 11:41:50

HIGH BAND EDGE BLOCK-C (GSM850) –Channel 251



Date: 31.MAY.2019 11:43:53

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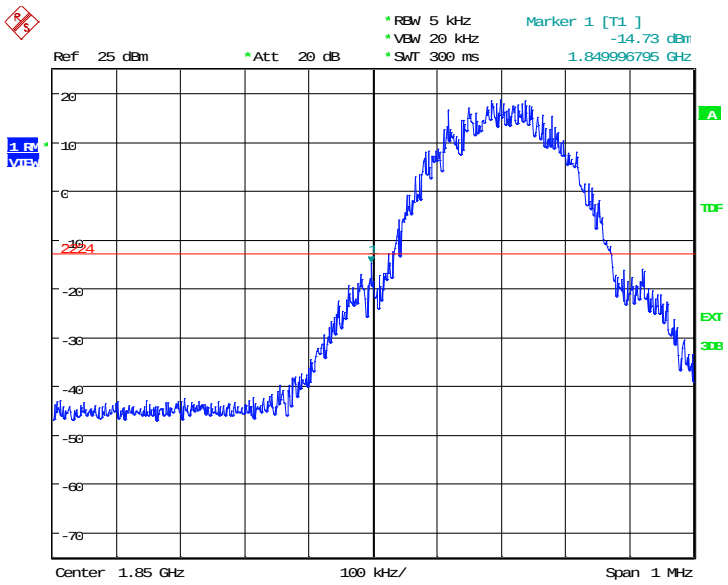
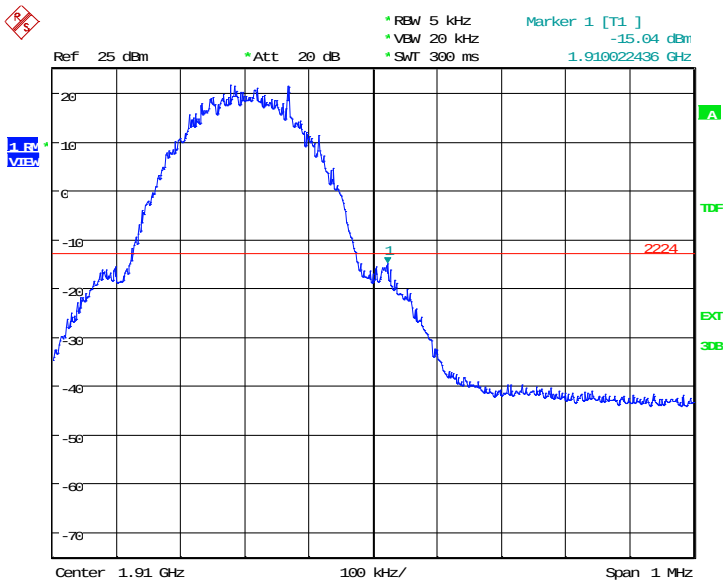
PCS 1900

LOW BAND EDGE BLOCK-A (PCS-1900)-Channel 512



Date: 31.MAY.2019 07:35:07

HIGH BAND EDGE BLOCK-C (PCS-1900) –Channel 810



Date: 31.MAY.2019 07:37:10

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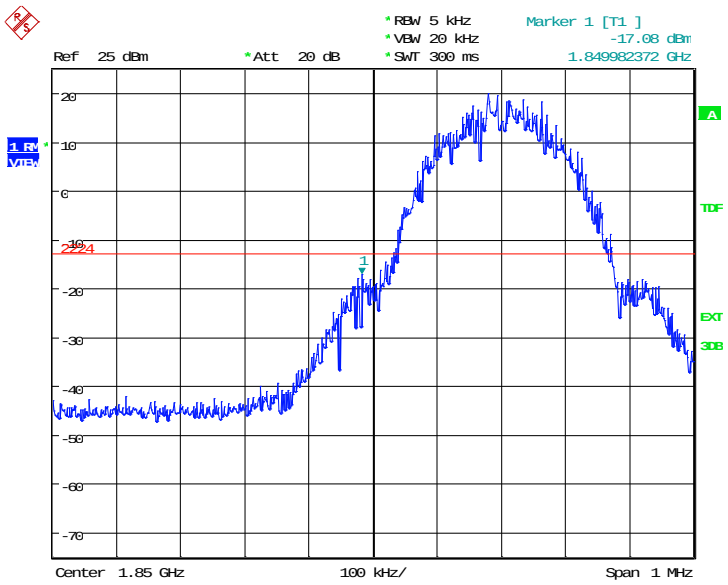
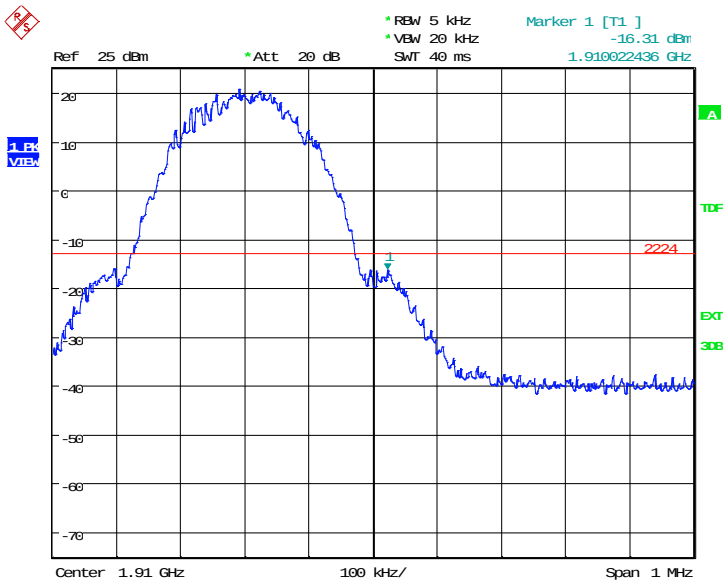
GPRS 1900

LOW BAND EDGE BLOCK-A (PCS-1900)-Channel 512



Date: 31.MAY.2019 11:52:03

HIGH BAND EDGE BLOCK-C (PCS-1900) –Channel 810



Date: 24.JUN.2019 12:51:52

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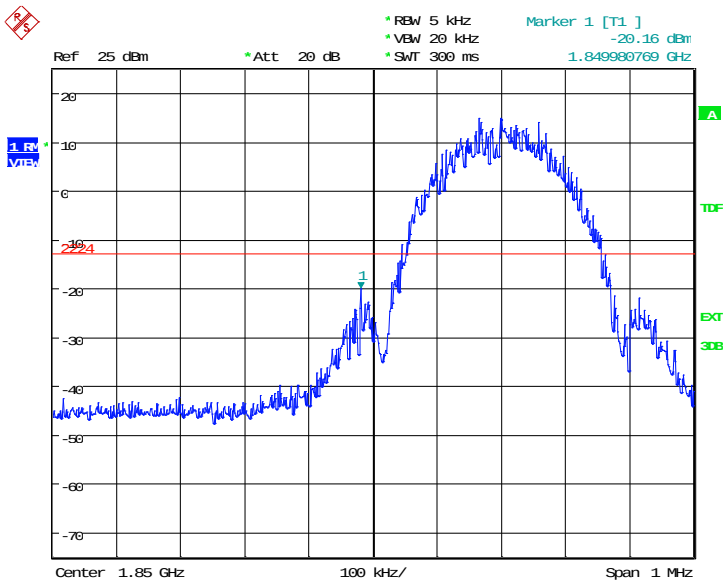
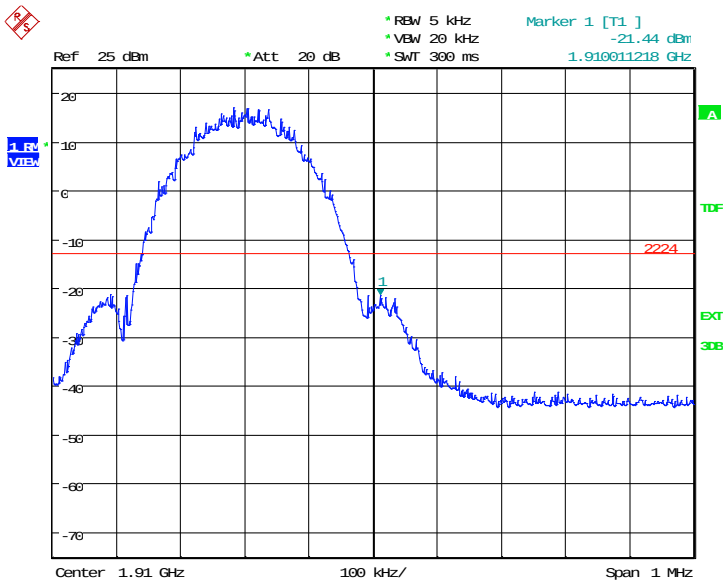
EGPRS 1900-8PSK

LOW BAND EDGE BLOCK-A (PCS-1900)-Channel 512



Date: 31.MAY.2019 11:31:32

HIGH BAND EDGE BLOCK-C (PCS-1900) –Channel 810



Date: 31.MAY.2019 11:33:34

Note: Expanded measurement uncertainty is U = 0.488dB(100KHz-2GHz)/1.211dB(2GHz-26.5GHz), k = 1.96

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A.7 CONDUCTED SPURIOUS EMISSION

Reference

FCC: CFR Part 2.1051, 22.917, 24.238

A.7.1 Measurement Method

The following steps outline the procedure used to measure the conducted emissions from the EUT.

1. Determine frequency range for measurements: From CFR 2.1051 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 9 GHz, data taken from 10 MHz to 25 GHz.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

GSM850 Transmitter

Channel	Frequency (MHz)
128	824.2
190	836.6
251	848.8

PCS1900 Transmitter

Channel	Frequency (MHz)
512	1850.2
661	1880.0
810	1909.8

A. 7.2 Measurement Limit

Part 24.238 and Part 22.917 specify that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

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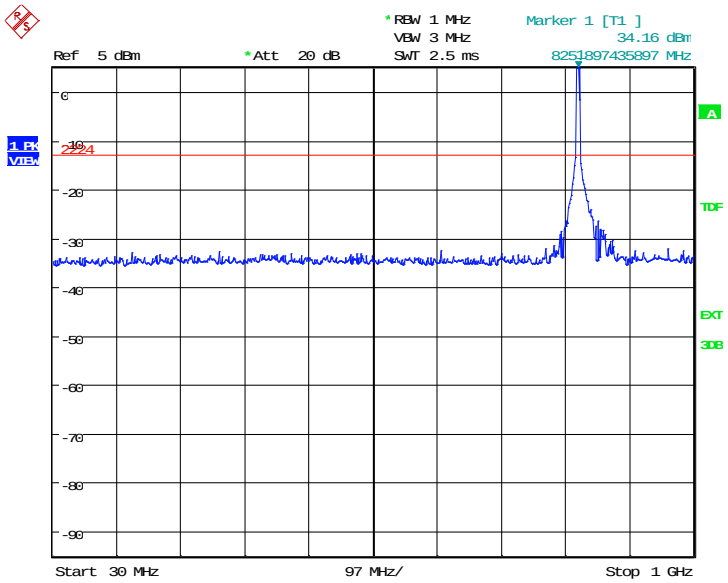
A.7.3 Measurement result

GSM850

Channel 128: 30MHz – 1GHz

Spurious emission limit –13dBm.

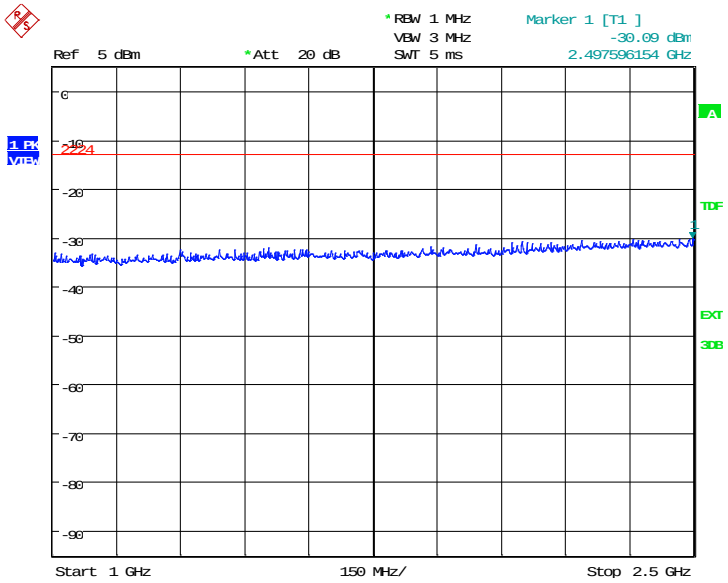
NOTE: peak above the limit line is the carrier frequency.



Date: 31.MAY.2019 06:43:09

Channel 128: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 06:43:36

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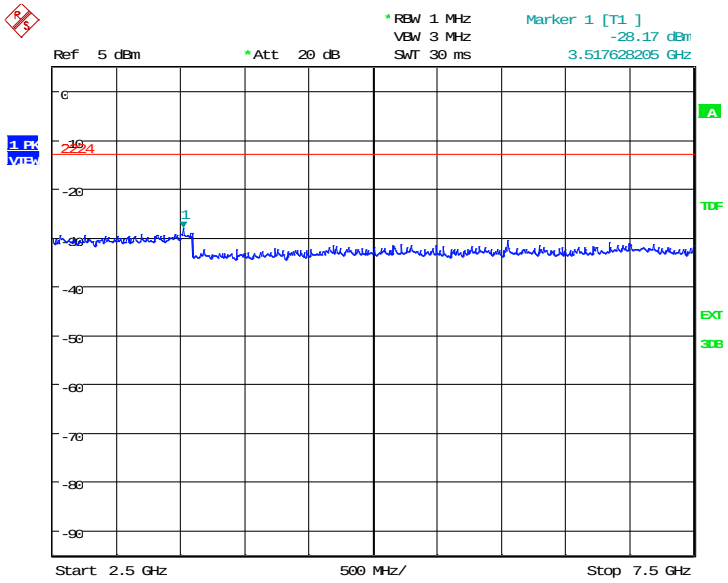
Channel 128: 2.5GHz – 7.5GHz

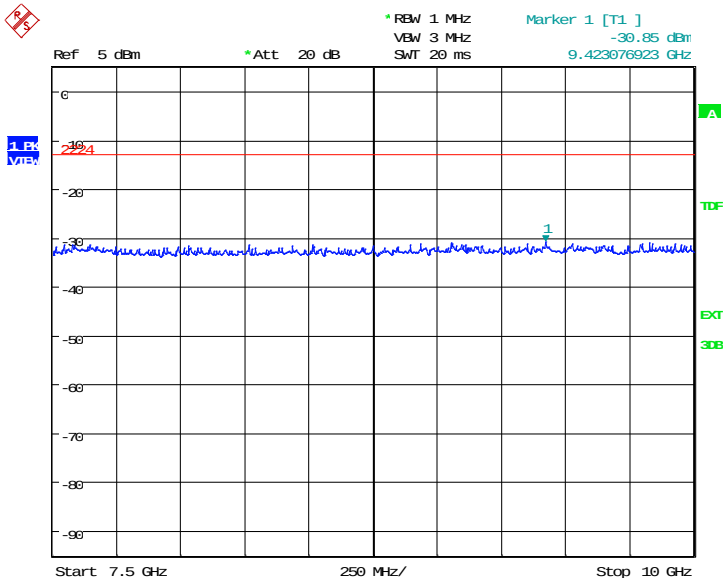
Spurious emission limit –13dBm.



Date: 31.MAY.2019 06:44:03

Channel 128: 7.5GHz –10GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 06:44:30

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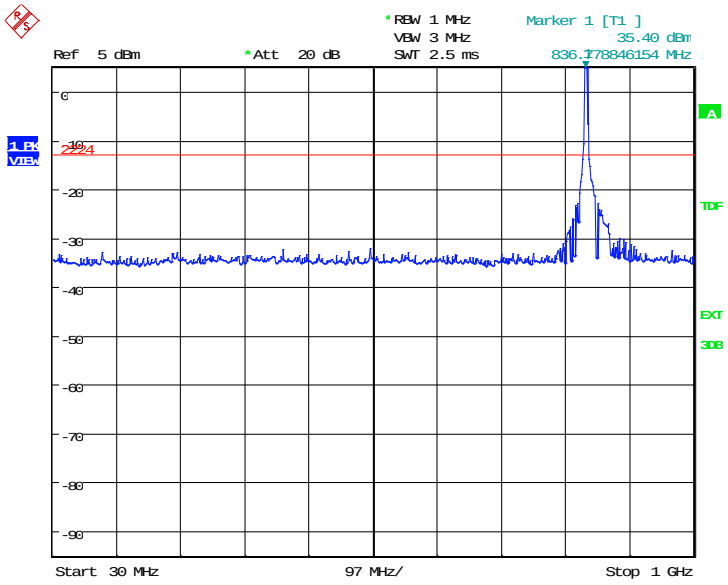
Channel 190: 30MHz – 1GHz

Spurious emission limit –13dBm

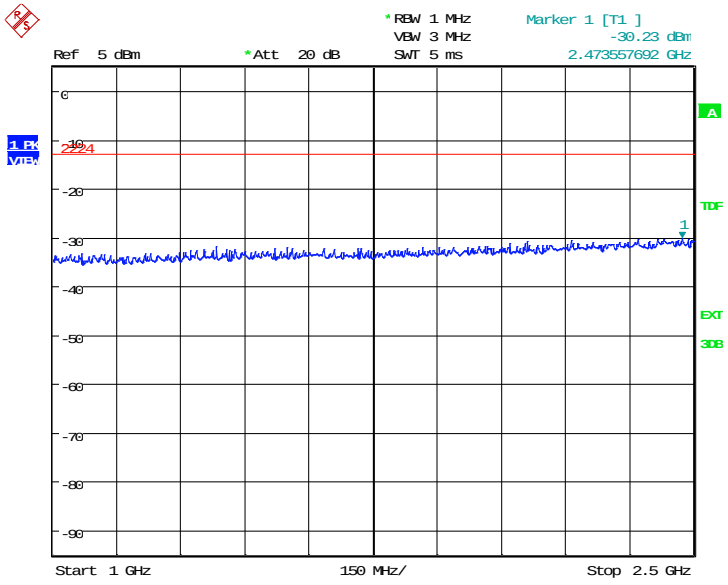
NOTE: peak above the limit line is the carrier frequency.



Date: 31.MAY.2019 06:44:57

Channel 190: 1GHz –2.5GHz

Spurious emission limit –13dBm



Date: 31.MAY.2019 06:45:24

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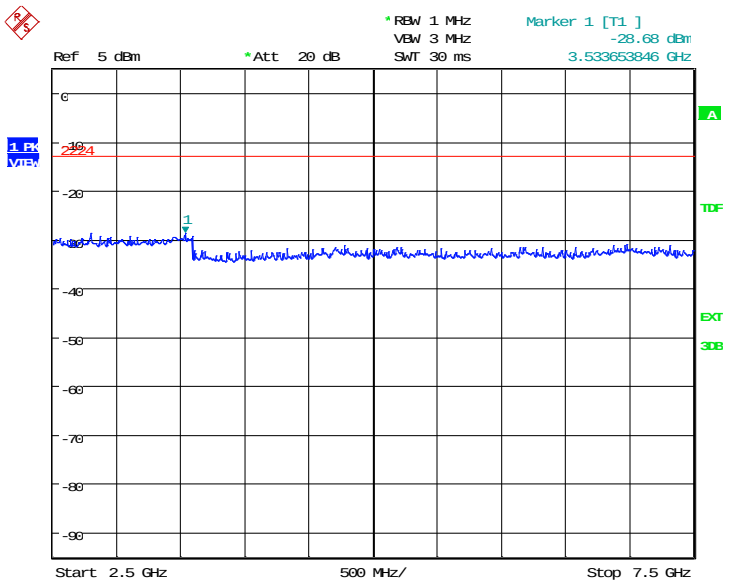
Channel 190: 2.5GHz –7.5GHz

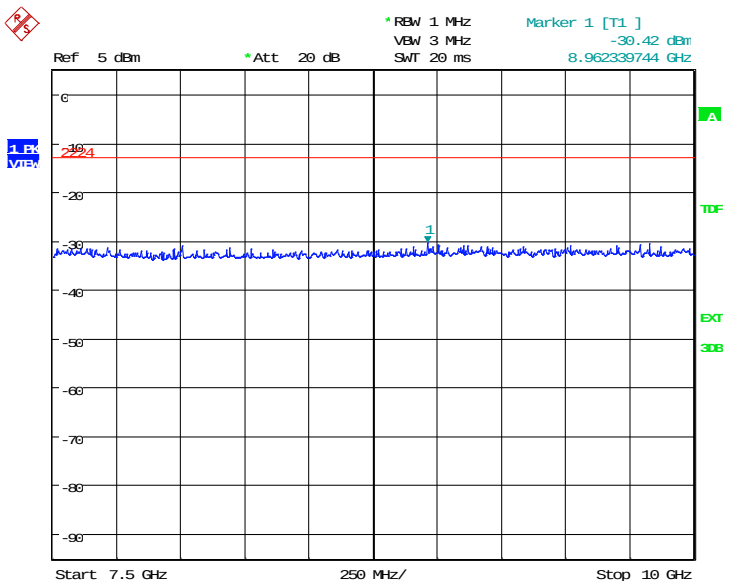
Spurious emission limit –13dBm



Date: 31.MAY.2019 06:45:51

Channel 190: 7.5GHz –10GHz

Spurious emission limit –13dBm



Date: 31.MAY.2019 06:46:17

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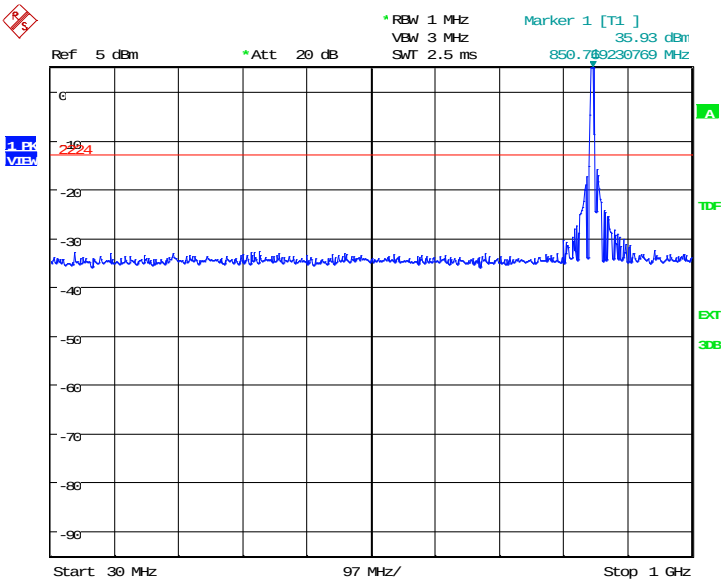
Channel 251: 30MHz – 1GHz

Spurious emission limit –13dBm.

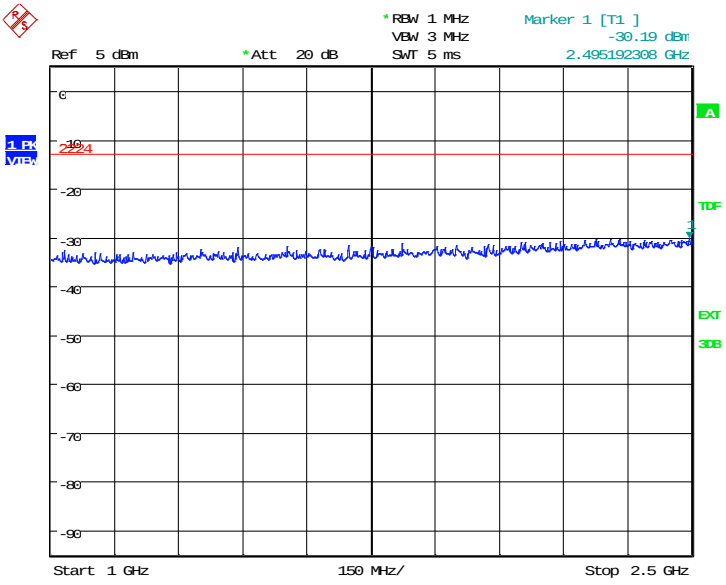
NOTE: peak above the limit line is the carrier frequency.



Date: 31.MAY.2019 06:46:45

Channel 251: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 06:47:12

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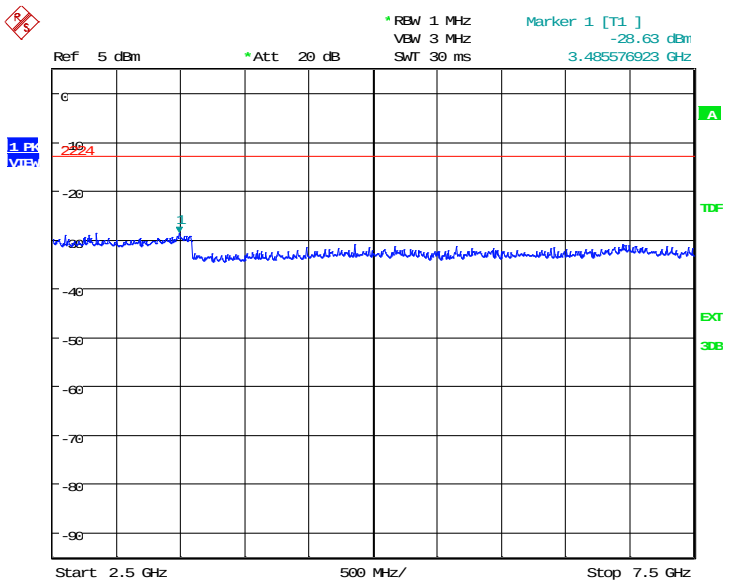
Channel 251:2.5GHz – 7.5GHz

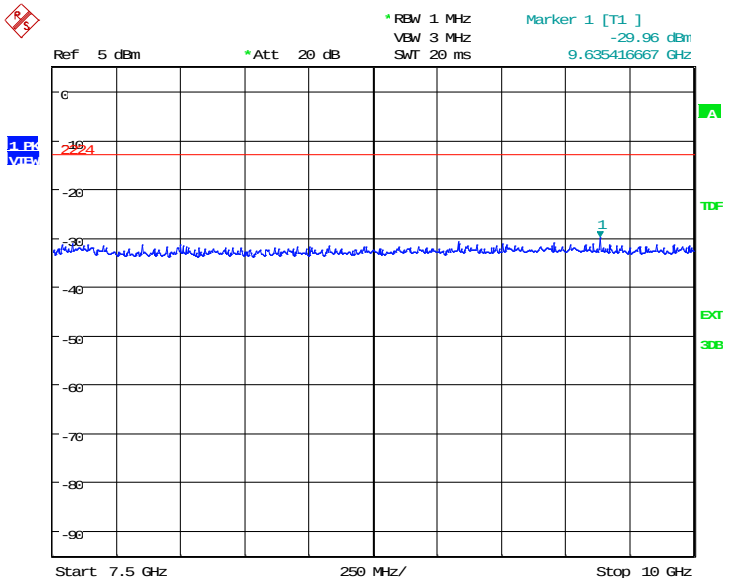
Spurious emission limit –13dBm.



Date: 31.MAY.2019 06:47:39

Channel 251: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 06:48:05

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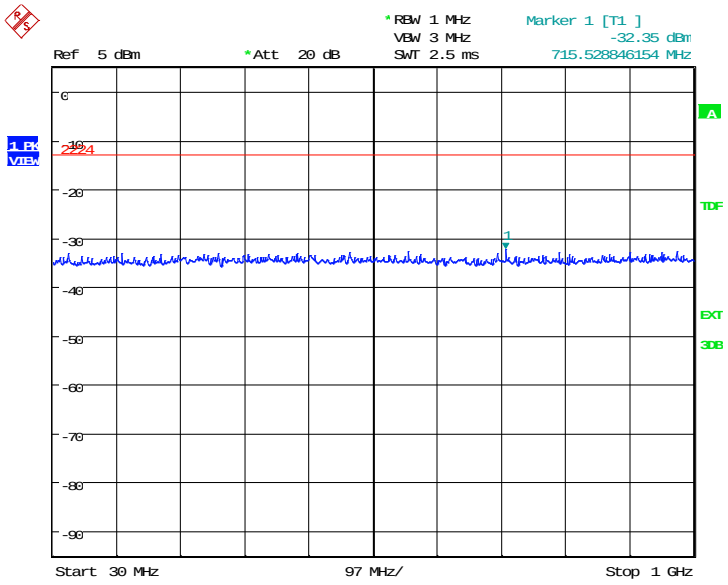
PCS1900

Channel 512: 30MHz – 1GHz

Spurious emission limit –13dBm.

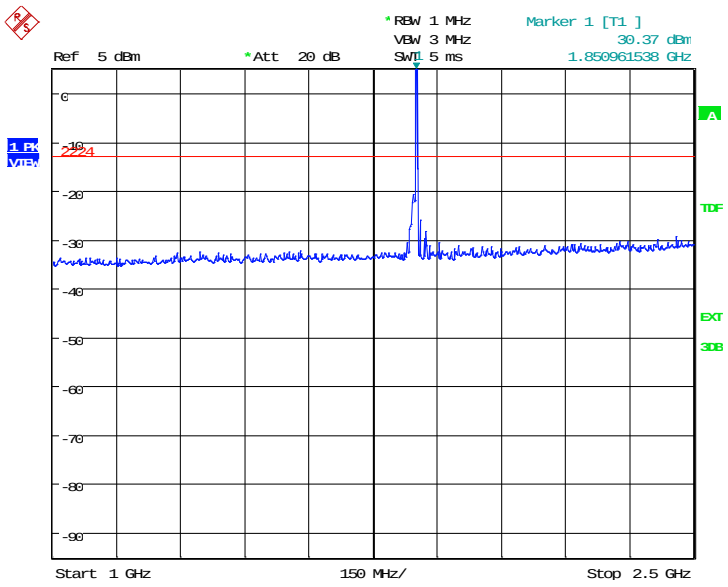


Date: 31.MAY.2019 07:37:53

Channel 512: 1GHz – 2.5GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.



Date: 31.MAY.2019 07:38:20

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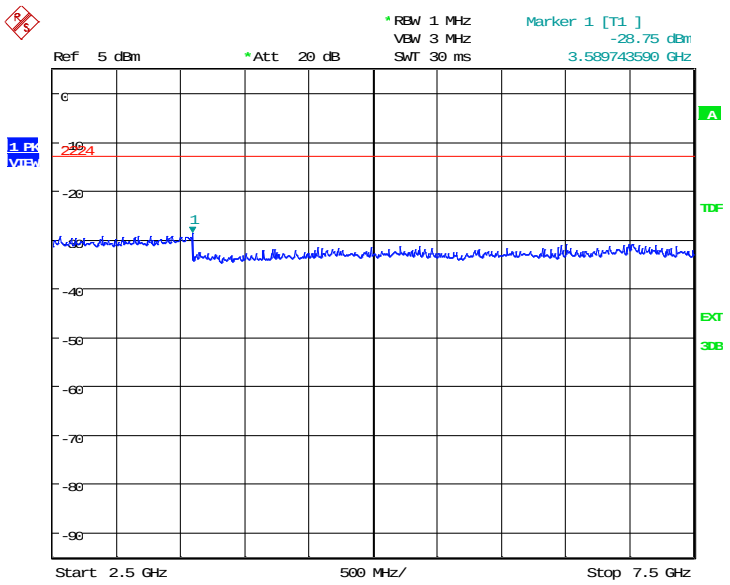
Channel 512: 2.5GHz – 7.5GHz

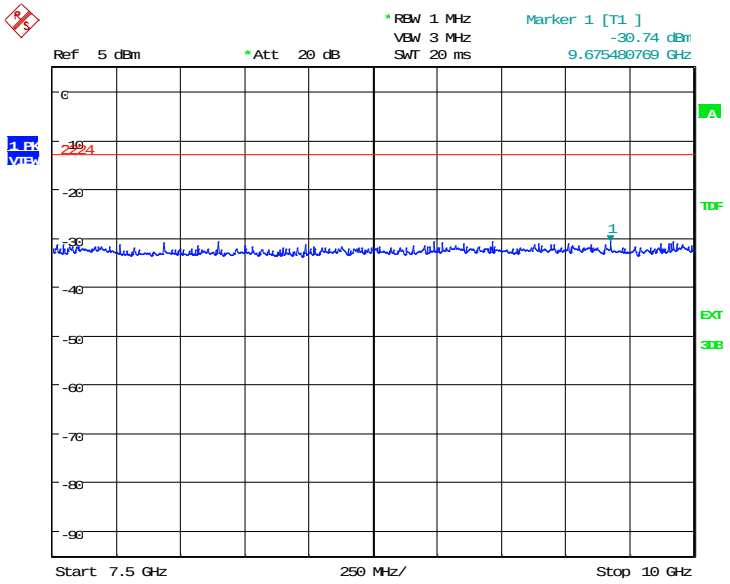
Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:38:47

Channel 512: 7.5GHz –10GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:39:13

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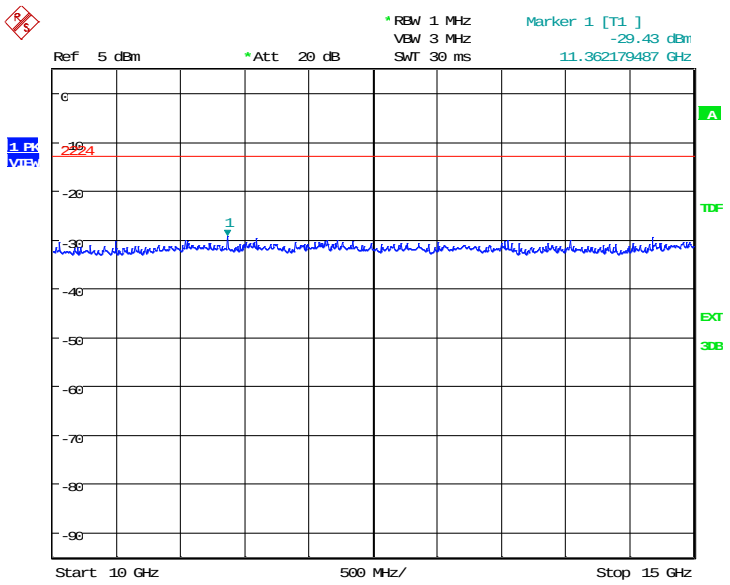
Channel 512: 10GHz –15GHz

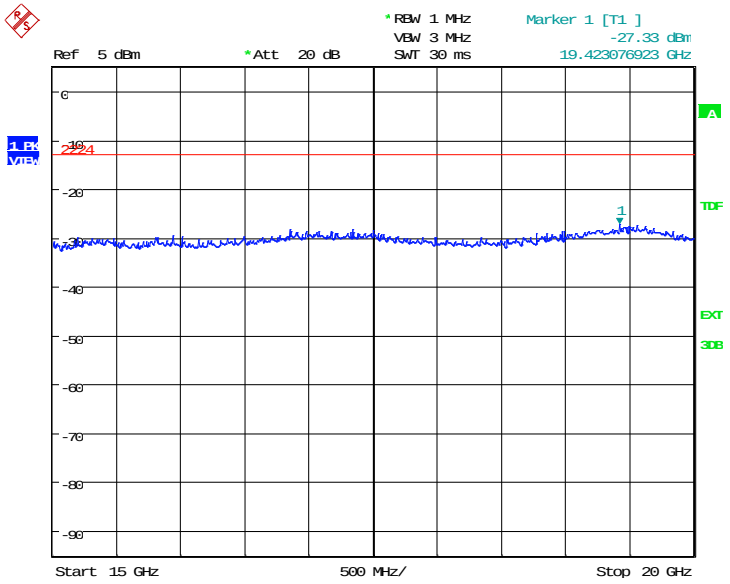
Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:39:40

Channel 512: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:40:07

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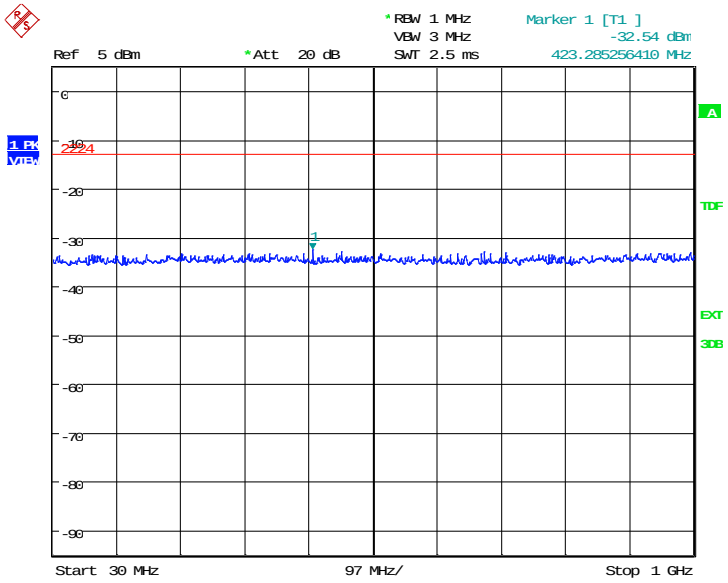
Channel 661: 30MHz – 1GHz

Spurious emission limit –13dBm

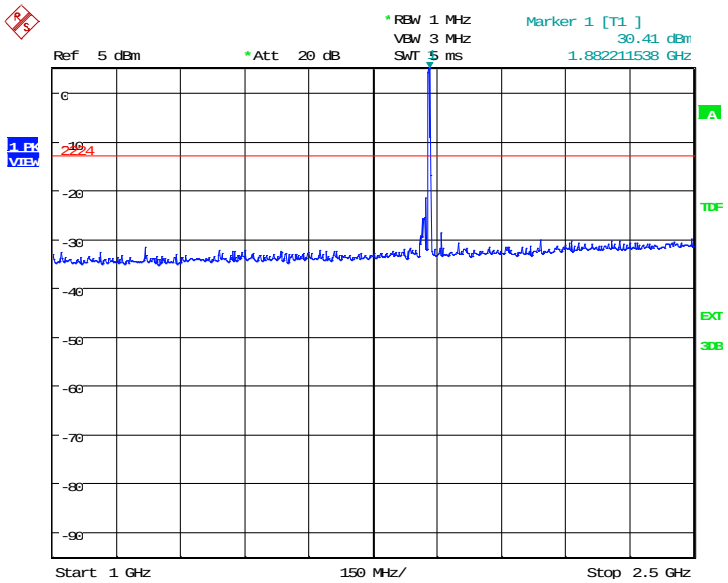


Date: 31.MAY.2019 07:40:35

Channel 661: 1GHz –2.5GHz

Spurious emission limit –13dBm

NOTE: peak above the limit line is the carrier frequency.



Date: 31.MAY.2019 07:41:02

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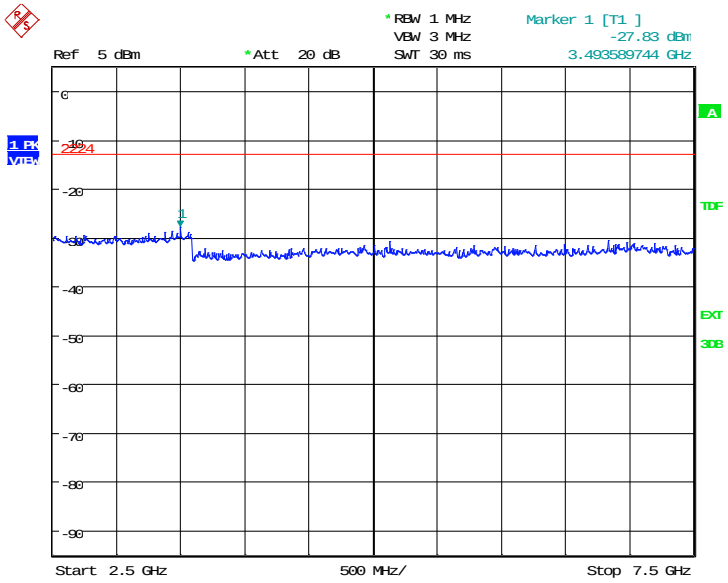
Channel 661: 2.5GHz –7.5GHz

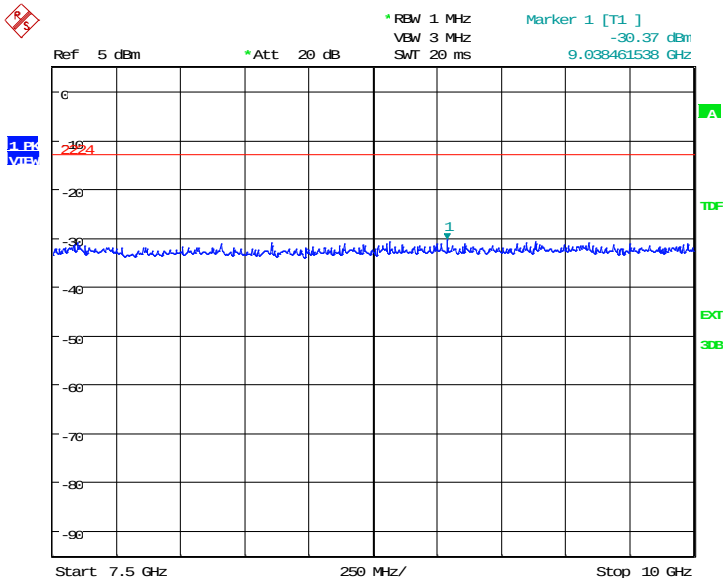
Spurious emission limit –13dBm



Date: 31.MAY.2019 07:41:28

Channel 661: 7.5GHz –10GHz

Spurious emission limit –13dBm



Date: 31.MAY.2019 07:41:55

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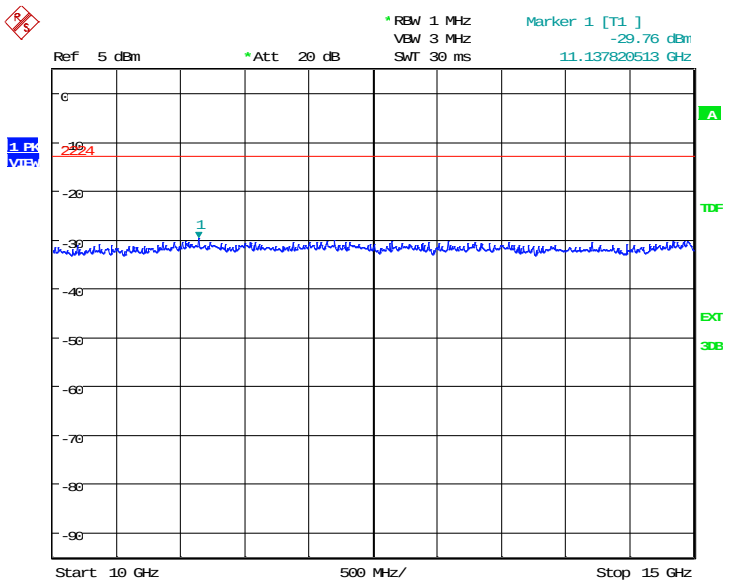
Channel 661: 10GHz –15GHz

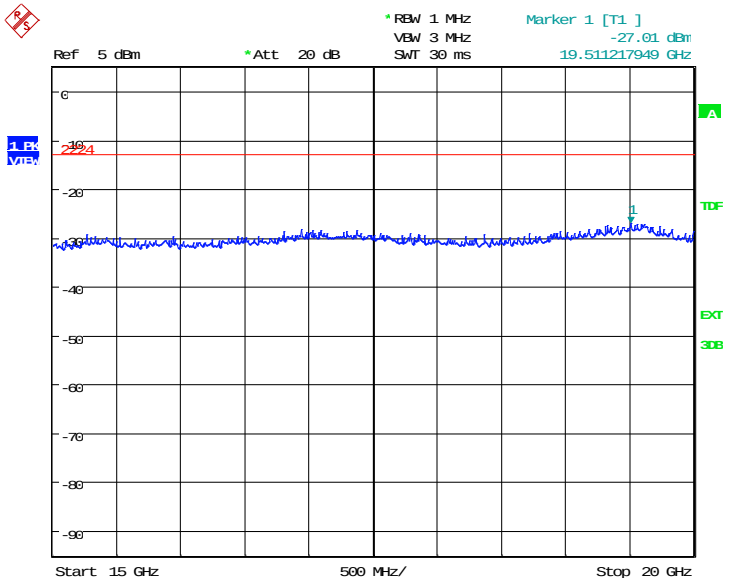
Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:42:22

Channel 661: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:42:49

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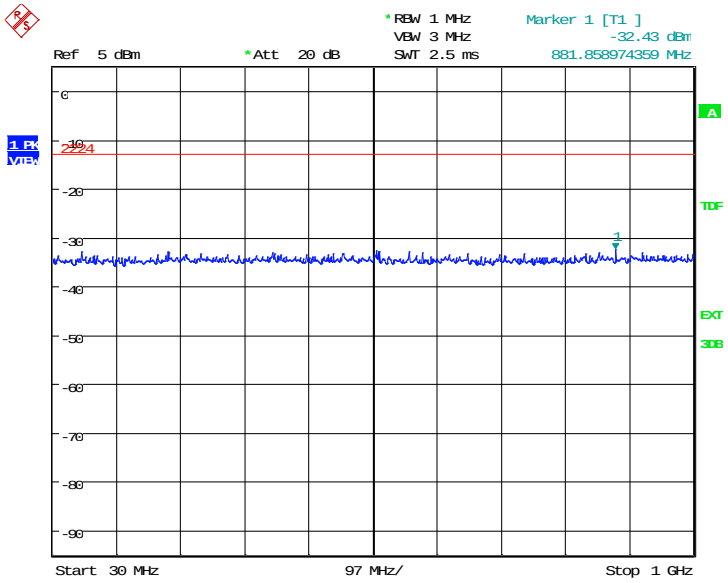
Channel 810: 30MHz – 1GHz

Spurious emission limit –13dBm.

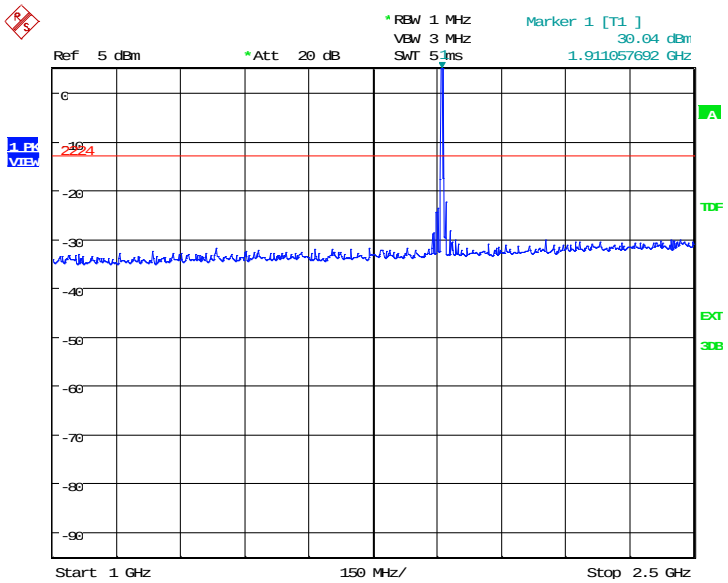


Date: 31.MAY.2019 07:43:16

Channel 810: 1GHz – 2.5GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.



Date: 31.MAY.2019 07:43:43

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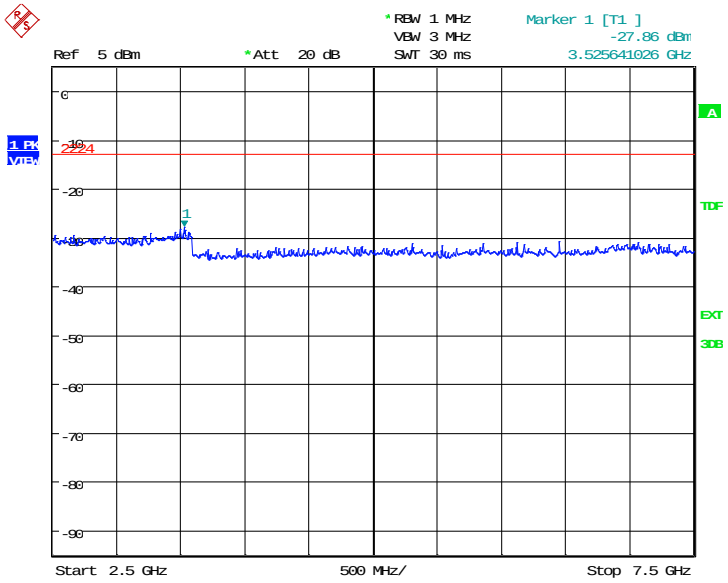
Channel 810:2.5GHz – 7.5GHz

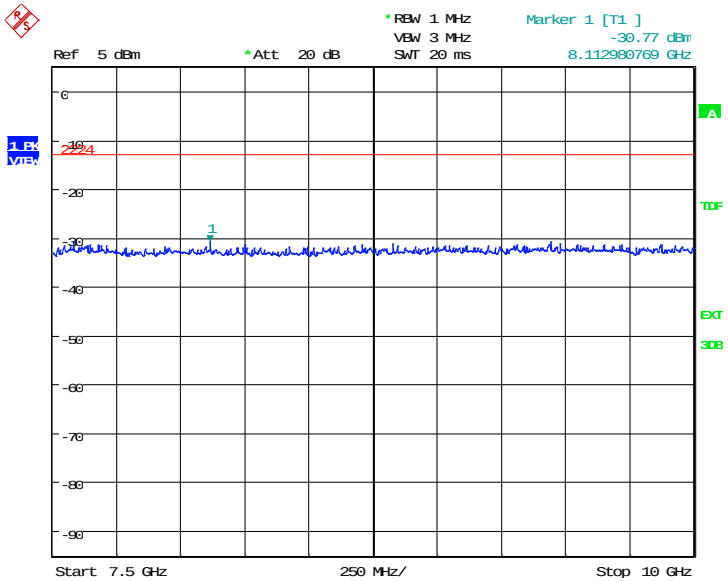
Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:44:10

Channel 810: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:44:37

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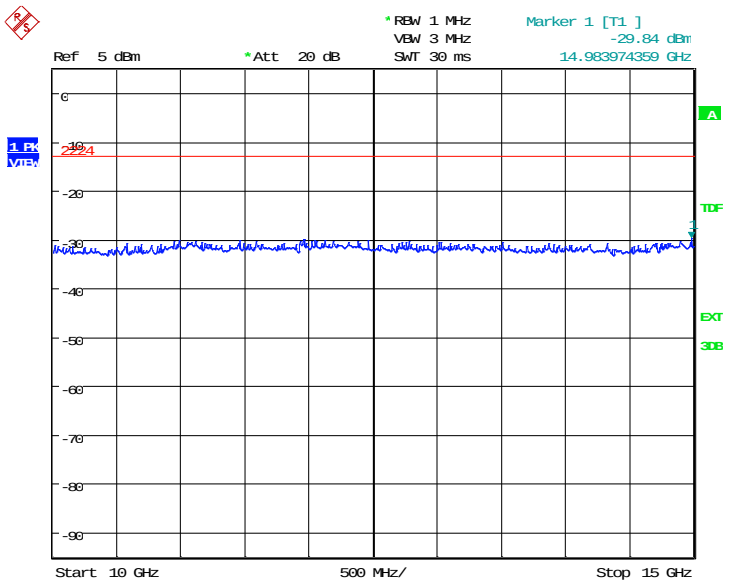
Channel 810: 10GHz –15GHz

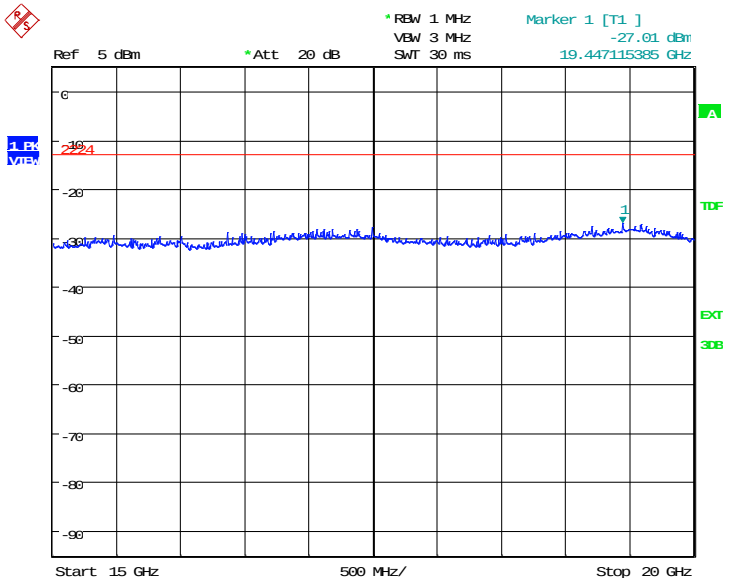
Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:45:04

Channel 810: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 31.MAY.2019 07:45:31

Note: Expanded measurement uncertainty is U = 0.488dB(100KHz-2GHz)/1.211dB(2GHz-26.5GHz), k = 1.96

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A.8 PEAK-TO-AVERAGE POWER RATIO

Reference

FCC: CFR Part 24.232

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

a)Refer to instrument's analyzer instruction manual for details on how to use the power statistics/CCDF function;

b) Set resolution/measurement bandwidth ⩾ signal' s occupied bandwidth;

c) Set the number of counts to a value that stabilizes the measured CCDF curve;

d) Set the measurement interval to 1 ms

e)Record the maximum PAPR level associated with a probability of 0.1%

A.8.1 Measurement limit

not exceed 13 dB

A.8.2 Measurement results

GSM1900

	Frequency(MHz)	PAPR(dB)
PCS1900	1880.0	7.63
GPRS1900	1880.0	7.63
EGPRS1900(8PSK)	1880.0	10.74

Note: Expanded measurement uncertainty is U = 0.483, k = 2

*****END OF REPORT*****

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