TEST REPORT

No. I19Z62374-WMD16

for

SAMSUNG Electronics Co., Ltd.

Multi-band GSM/WCDMA/LTE phone with Bluetooth, WLAN

Model Name: SM-A215U1

FCC ID: ZCASMA215U

with

Hardware Version: REV1.0

Software Version: A215U1.001

Issued Date: 2020-04-17

Note:

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I19Z62374-WMD16	Rev.0	1st edition	2020-03-23
I19Z62374-WMD16	Rev.1	Changed the Client Information and EUT Software version	2020-04-17

Note: the latest revision of the test report supersedes all previous version.

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1. Test Laboratory

1.1. Introduction & Accreditation

Telecommunication Technology Labs, CAICT is an ISO/IEC 17025:2005 accredited test laboratory under NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP) with lab code 600118-0 and is also an FCC accredited test laboratory (CN5017), and ISED accredited test laboratory (CN0066). The detail accreditation scope can be found on NVLAP website.

1.2. Testing Location

Location 1: CTTL (huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China 100191

Location 2: CTTL(Shouxiang)

Address: No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China 100191

Location 3: CTTL (BDA)

Address: No.18A, Kangding Street, Beijing Economic-Technology Development Area, Beijing, P. R. China 100176

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1.3. Testing Environment

Normal Temperature: 15-35℃

Relative Humidity: 20-75%

1.4. Project data

Testing Start Date: 2020-01-10

Testing End Date: 2020-03-17

1.5. Signature

Dong Yuan

(Prepared this test report)

Zhou Yu

(Reviewed this test report)

Zhao Hui Lin

Deputy Director of the laboratory

(Approved this test report)

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2. Client Information

2.1. Applicant Information

Company Name:	SAMSUNG Electronics Co., Ltd.
Address /Post:	19 Chapin Road, Building D, Pine Brook New Jersey United States, 07058
Contact:	Jenni Chun
Email:	j1.chun@samsung.com
Telephone:	1-973-808-6375
Fax:	NA

2.2. Manufacturer Information

Company Name:	SAMSUNG Electronics Co., Ltd.
Address /Post:	Samsung R5, Maetan dong 129, Samsung ro Youngtong gu, Suwon city 443 742, Korea
Contact:	JP KIM
Email:	jp426.kim@samsung.com
Telephone:	NA
Fax:	NA

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3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1. About EUT

Description	Multi-band GSM/WCDMA/LTE phone with Bluetooth, WLAN
Model Name	SM-A215U1
FCC ID	ZCASMA215U
Antenna	Embedded
Output power	29.67dBm maximum ERP measured for GSM850
Extreme vol. Limits	3.5VDC to 4.4VDC (nominal: 3.8VDC)
Extreme temp. Tolerance	-10°C to +55°C

Note: Components list, please refer to documents of the manufacturer; it is also included in the original test record of CTTL.

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Date of receipt
UT07a	354230110026502	REV1.0	A215U1.001	2019-12-27
UT19a	354230110009631	REV1.0	A215U1.001	2020-01-13

*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	Battery

AE1

Model	NVT-WT-N6
Manufacturer	Dongguan NVT Technology Co., Ltd.
Capacitance	3900mAh

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

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4. Reference Documents

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

Reference	Title	Version
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-19 Edition
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-19 Edition
ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2016
ANSI/TIA-102.CAAA-E	DIGITAL C4FMCQPSK TRANSCEIVER MEASUREMENT METHODS	2016
ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services	2015
KDB 971168 D01	MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS	v03r01

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5. LABORATORY ENVIRONMENT

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

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

Fully-anechoic chamber 2 (8.6 meters×6.1 meters×3.85 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ˚C, Max. = 30 ˚C
Relative humidity	Min. = 35 %, Max. = 60 %
Shielding effectiveness	> 110 dB
Electrical insulation	> 2 MΩ
Ground system resistance	< 1 Ω
Site voltage standing-wave ratio (S_{VSWR})	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

Fully-anechoic chamber FAC-3 (9 meters×6.5 meters×4 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. = 15 %, Max. = 75 %
Shielding effectiveness	0.014MHz - 1MHz, >60dB; 1MHz - 1000MHz, >90dB.
Electrical insulation	> 2 MΩ
Ground system resistance	< 4 Ω
Site voltage standing-wave ratio (S_{VSWR})	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

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6. SUMMARY OF TEST RESULT

6.1. Summary of test results

GSM850

Items	List	Clause in FCC rules	Verdict
1	Output Power	22.913	BR
2	Emission Limit	2.1051/22.917	BR
3	Frequency Stability	2.1055	BR
4	Occupied Bandwidth	2.1049	BR
5	Emission Bandwidth	22.917	BR
6	Band Edge Compliance	22.917	BR
7	Conducted Spurious Emission	22.917	BR

PCS1900

Items	List	Clause in FCC rules	Verdict
1	Output Power	24.232	BR
2	Emission Limit	2.1051/24.238	BR
3	Frequency Stability	2.1055	BR
4	Occupied Bandwidth	2.1049	BR
5	Emission Bandwidth	24.238	BR
6	Band Edge Compliance	24.238	BR
7	Conducted Spurious Emission	24.238	BR
8	peak-to-average power ratio	24.232	BR

Terms used in Verdict column

P	Pass. The EUT complies with the essential requirements in the standard.
NP	Not Performed. The test was not performed by CTTL.
NA	Not Applicable. The test was not applicable.
BR	Re-use test data from basic model report.
F	Fail. The EUT does not comply with the essential requirements in the standard.

Explanation of worst-case configuration

The worst-case scenario for all measurements is based on the conducted output power measurement investigation results unless otherwise stated. The test results shown in the following sections represent the worst case emission.

6.2. Explanation of re-use of test data

The Equipment Under Test (EUT) model SM-A215U1 (FCC ID: ZCASMA215U) is a variant product of SM-A215U (ZCASMA215U). According to the declaration of changes provided by the applicant and FCC KDB publication 484596 D01, all the test results are derived from test report No. I19Z62374-WMD01.

For detail differences between two models please refer the Declaration of Changes document.

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7. Test Equipments Utilized

	Description	Type	Series Number	Manufacture	Cal Due Date	Calibration Interval
1	Universal Radio Communication Tester	CMU200	108646	R&S	2020-12-24	1 year
2	Spectrum Analyzer	FSU26	200030	R&S	2020-06-03	1 year
3	Climate chamber	SH-242	93008556	ESPEC	2020-12-21	3 years
4	EMI Antenna	VULB9163	9163-483	Schwarzbeck	2020-09-16	1 year
5	EMI Antenna	3117	00058889	ETS-Lindgren	2020-11-18	1 year
6	EMI Antenna	3117	00139065	ETS-Lindgren	2020-10-15	1 year
7	EMI Antenna	9117	167	Schwarzbeck	2020-05-27	1 year
8	Signal Generator	N5183A	MY49060052	R&S	2020-06-24	1 year
9	Test Receiver	E4440A	MY48250642	Agilent	2020-03-18	1 year
10	Universal Radio Communication Tester	CMW500	143008	R&S	2020-11-26	1 year
11	Power Amplifier	5S1G4	0341863	AR	/	

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ANNEX A: MEASUREMENT RESULTS

A.1 OUTPUT POWER

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.
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
Limit：38.45dBm (7W)

Measurement result
GSM(GMSK)

Frequency (MHz)	Power Step	Output power (dBm)
824.2	5	32.52
836.6	5	32.50
848.8	5	32.50

GPRS(GMSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
824.2	3	32.54
836.6	3	32.52
848.8	3	32.54

EGPRS(8PSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
824.2	6	26.76
836.6	6	26.92
848.8	6	26.97

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PCS1900

Limit：33dBm (2W)

Measurement result

GSM(GMSK)

Frequency (MHz)	Power Step	Output power (dBm)
1850.2	0	29.51
1880.0	0	29.53
1909.8	0	29.51

GPRS(GMSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
1850.2	3	29.51
1880.0	3	29.53
1909.8	3	29.54

EGPRS(8PSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
1850.2	5	26.19
1880.0	5	26.12
1909.8	5	26.15

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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.

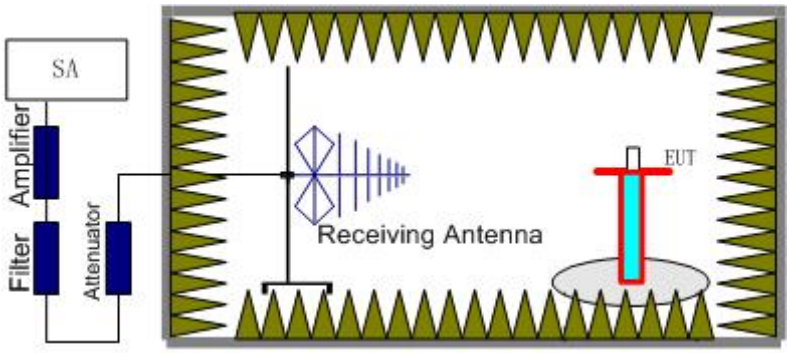
Rule Part 24.232(c) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

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

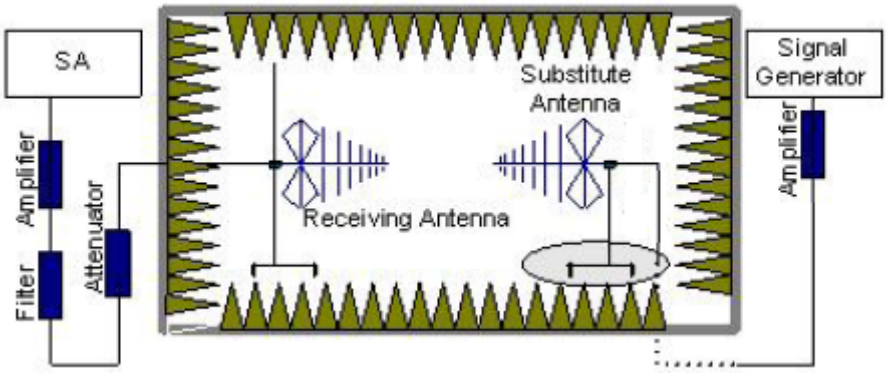
A.1.3.2 Method of Measurement

The measurements procedures in TIA-603E-2016 are used.

1. EUT was placed on a 1.5-meter-high non-conductive stand at a 3-meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. 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 rms 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, a 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

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with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna and adjust 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. An amplifier should be connected to the Signal Source output port. And the cable should be connected between the Amplifier and the Substitution Antenna.
   The cable loss (P_{cl}), the Substitution Antenna Gain (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 -2.15dBi.

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GSM 850-ERP

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)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
824.20	-12.74	2.26	45.79	0.96	2.15	29.60	38.45	8.85	H
836.60	-12.41	2.26	45.66	0.82	2.15	29.66	38.45	8.79	H
848.80	-13.02	2.28	45.54	0.79	2.15	28.88	38.45	9.57	H

GPRS

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
824.20	-12.73	2.26	45.79	0.96	2.15	29.61	38.45	8.84	H
836.60	-12.40	2.26	45.66	0.82	2.15	29.67	38.45	8.78	H
848.80	-13.01	2.28	45.54	0.79	2.15	28.89	38.45	9.56	H

EGPRS-8PSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
824.20	-20.46	2.26	45.79	0.96	2.15	21.88	38.45	16.57	H
836.60	-19.26	2.26	45.66	0.82	2.15	22.81	38.45	15.64	H
848.80	-19.31	2.28	45.54	0.79	2.15	22.59	38.45	15.86	H

Frequency: 836.60MHz

Peak ERP (dBm)=P_{Mea}(-12.40dBm)-P_{cl}(2.26dB)+P_{Ag}(45.66dB)+G_a (0.82dB)-2.15dB=29.67dBm

Note: Expanded measurement uncertainty is U = 2.84 dB, k = 2.

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PCS1900-EIRP

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)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1850.20	-21.90	2.93	43.75	4.87	23.79	33.00	9.21	H
1880.00	-20.86	2.85	43.75	4.82	24.86	33.00	8.14	H
1909.80	-20.99	2.89	43.77	4.76	24.65	33.00	8.35	H

GPRS

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1850.20	-21.99	2.93	43.75	4.87	23.70	33.00	9.30	H
1880.00	-20.92	2.85	43.75	4.82	24.80	33.00	8.20	H
1909.80	-21.08	2.89	43.77	4.76	24.56	33.00	8.44	H

EGPRS-8PSK

Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	P_{Ag} (dB)	G_a (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1850.20	-26.19	2.93	43.75	4.87	19.50	33.00	13.50	H
1880.00	-26.20	2.85	43.75	4.82	19.52	33.00	13.48	H
1909.80	-25.75	2.89	43.77	4.76	19.89	33.00	13.11	H

Frequency**:** 1880.00MHz

Peak EIRP (dBm)= P_{Mea}(-20.86dBm) - P_{cl}(2.85dB) + P_{Ag}(43.75dB)+G_a (4.82dB) = 24.86dBm

Note: Expanded measurement uncertainty is U = 2.84 dB, k = 2.

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A.2 EMISSION LIMIT

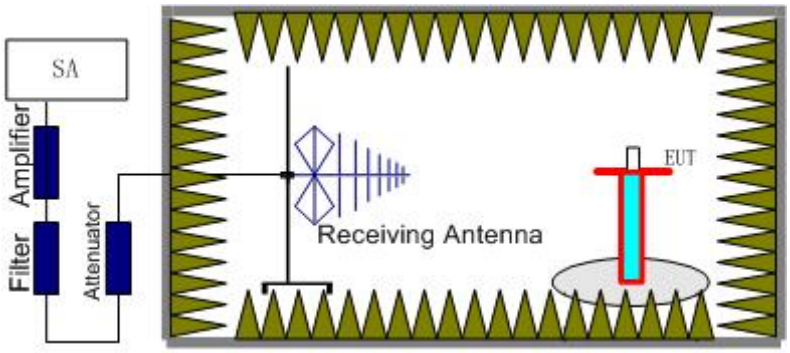
A.2.1 Measurement Method

The measurement procedures in TIA-603E-2016 are used.

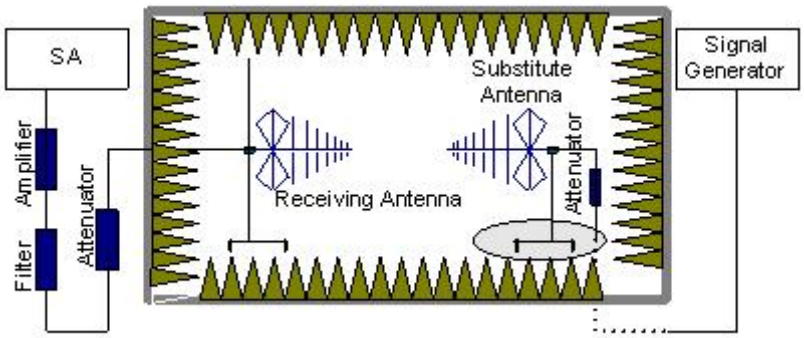
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment. The resolution bandwidth is set as outlined in Part 24.238 and Part 22.917. The spectrum is scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and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

The procedure of radiated spurious emissions is as follows:

1. EUT was placed on a 1.5-meter-high non-conductive stand at a 3-meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. 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 non-harmonic and harmonics of the transmit frequency through the 10th harmonic 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, a 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

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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 (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 -2.15dBi.

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(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1648.01	-50.36	3.56	5.23	2.15	-50.84	-13.00	37.80	H
2462.00	-53.13	4.58	5.99	2.15	-53.87	-13.00	40.90	V
3297.02	-54.15	5.29	7.71	2.15	-53.88	-13.00	40.90	V
4115.02	-55.47	6.04	9.02	2.15	-54.64	-13.00	41.60	H
4940.01	-55.22	6.71	9.84	2.15	-54.24	-13.00	41.20	H
5770.01	-53.93	7.23	10.55	2.15	-52.76	-13.00	39.80	V

GSM Mode Channel 190/836.6MHz

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1674.01	-54.25	3.58	5.19	2.15	-54.79	-13.00	41.80	H
2510.00	-49.92	4.63	6.12	2.15	-50.58	-13.00	37.60	H
3347.02	-53.57	5.32	7.83	2.15	-53.21	-13.00	40.20	V
4172.02	-54.90	6.14	9.07	2.15	-54.12	-13.00	41.10	V
5019.01	-55.48	6.57	9.93	2.15	-54.27	-13.00	41.30	H
5844.01	-53.57	7.22	10.53	2.15	-52.41	-13.00	39.40	H

GSM Mode Channel 251/848.8MHz

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1698.01	-50.23	3.60	5.14	2.15	-50.84	-13.00	37.80	H
2546.00	-45.45	4.66	6.18	2.15	-46.08	-13.00	33.10	H
3395.02	-53.74	5.36	7.95	2.15	-53.30	-13.00	40.30	H
4251.02	-55.99	6.24	9.15	2.15	-55.23	-13.00	42.20	H
5112.01	-55.09	6.81	10.06	2.15	-53.99	-13.00	41.00	V
5941.01	-52.99	7.47	10.51	2.15	-52.10	-13.00	39.10	V

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GSM Mode Channel 512/1850.2MHz

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3698.02	-57.19	6.43	8.48	-55.14	-13.00	42.14	V
7401.01	-55.60	8.12	12.08	-51.64	-13.00	38.64	V
11109.01	-52.95	9.80	13.18	-49.57	-13.00	36.57	H
12960.01	-49.81	10.48	13.48	-46.81	-13.00	33.81	V
14808.00	-46.21	11.13	14.15	-43.19	-13.00	30.19	V
16661.00	-43.67	11.84	13.66	-41.85	-13.00	28.85	H

GSM Mode Channel 661/1880.0MHz

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3748.02	-57.24	6.30	8.55	-54.99	-13.00	41.99	V
5649.02	-56.86	7.27	10.57	-53.56	-13.00	40.56	V
7511.01	-54.51	8.35	12.21	-50.65	-13.00	37.65	H
9409.01	-55.00	9.08	13.35	-50.73	-13.00	37.73	H
11283.01	-51.85	9.89	13.14	-48.60	-13.00	35.60	H
13171.01	-48.53	10.62	13.74	-45.41	-13.00	32.41	H

GSM Mode Channel 810/1909.8MHz

Frequency (MHz)	P_{Mea} (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarization
3819.02	-57.18	6.08	8.65	-54.61	-13.00	41.61	H
5723.02	-56.72	7.30	10.56	-53.46	-13.00	40.46	V
7635.01	-55.23	8.13	12.31	-51.05	-13.00	38.05	H
9556.01	-54.96	9.34	13.34	-50.96	-13.00	37.96	H
11460.01	-51.52	9.91	13.11	-48.32	-13.00	35.32	H
13378.01	-48.87	10.57	14.03	-45.41	-13.00	32.41	H

Note: Expanded measurement uncertainty is U = 5.16 dB, k = 2.

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A.3 FREQUENCY STABILITY

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 -30℃.
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 -30℃ to +50℃. 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 +50℃.
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 -30℃ to +50℃. 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 3.5VDC and 4.4VDC, with a nominal voltage of 3.8VDC. 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. 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. 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.

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A.3.3 Measurement results

GSM 850

Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20	3.8	824.024	848.976		
50				-15.04	0.0180
40				-24.15	0.0289
30				-25.96	0.0310
10				-22.79	0.0272
0				-24.67	0.0295
-10				-24.28	0.0290
-20				-23.89	0.0286
-30				-23.89	0.0286

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.5	20	824.024	848.976	-23.37	0.0279
4.4				-21.44	0.0256

PCS 1900

Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20	3.8	1850.034	1909.965		
50				-1.61	0.0009
40				3.42	0.0018
30				1.61	0.0009
10				-23.83	0.0127
0				-28.41	0.0151
-10				11.24	0.0060
-20				-27.44	0.0146
-30				-22.66	0.0121

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.5	20	1850.034	1909.965	-25.38	0.0135
4.4				-29.70	0.0158

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A.4 OCCUPIED BANDWIDTH

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 f frequency. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the following pages. The measurement method is from ANSI C63.26:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts.

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

d) Set the detection mode to peak, and the trace mode to max-hold.

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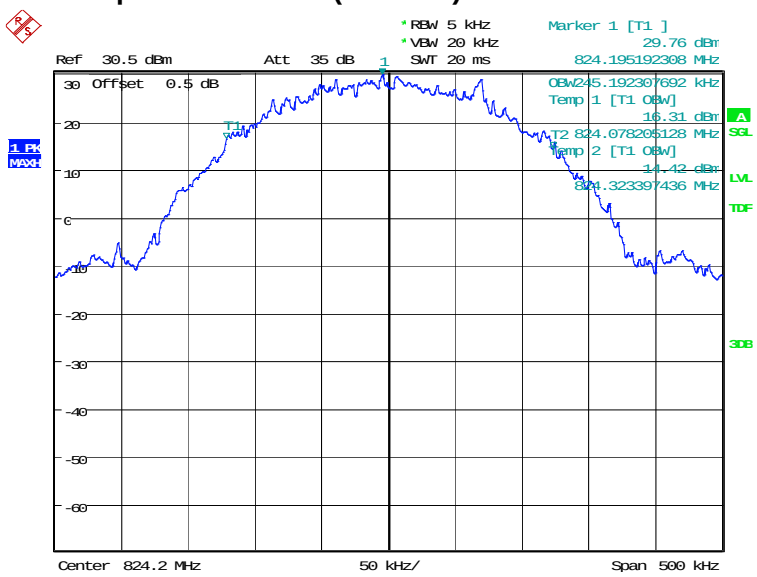
GSM 850(99% BW)

Frequency (MHz)	Occupied Bandwidth (99% BW) (kHz)
824.2	245.19
836.6	243.59
848.8	245.99

GSM 850

Channel 128-Occupied Bandwidth (99% BW)



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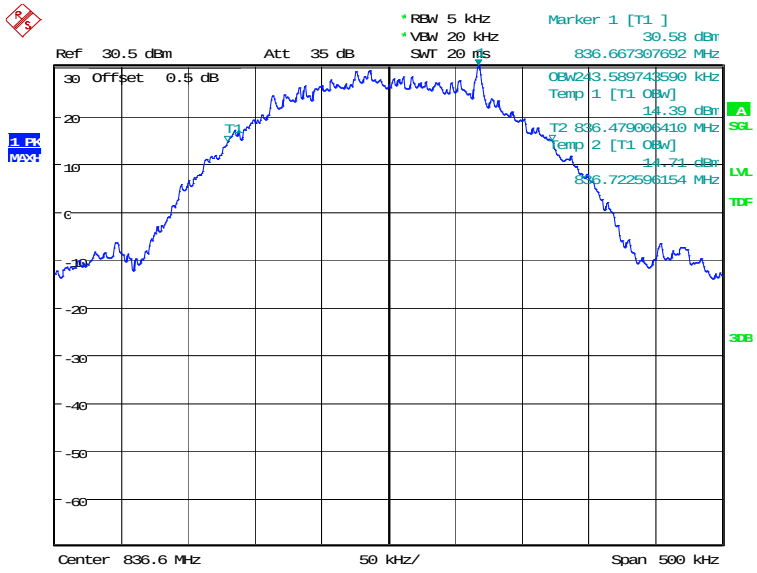
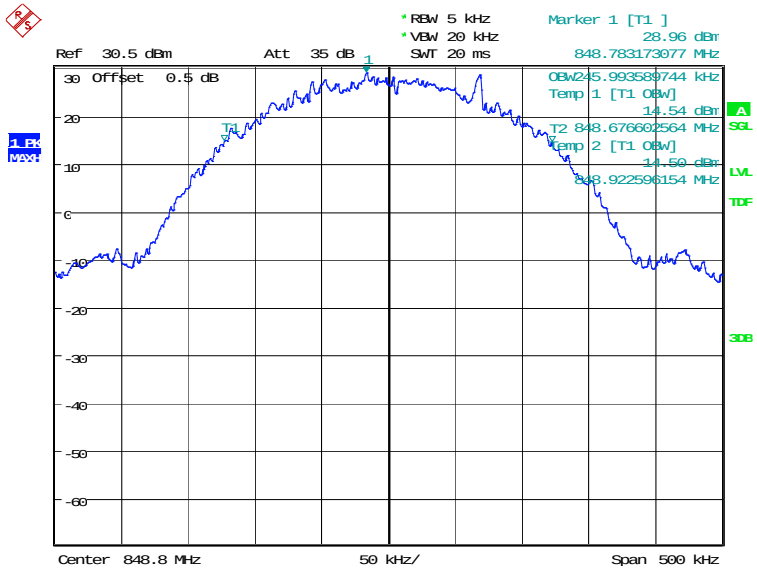
Channel 190-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 08:32:46

Channel 251-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 08:33:59

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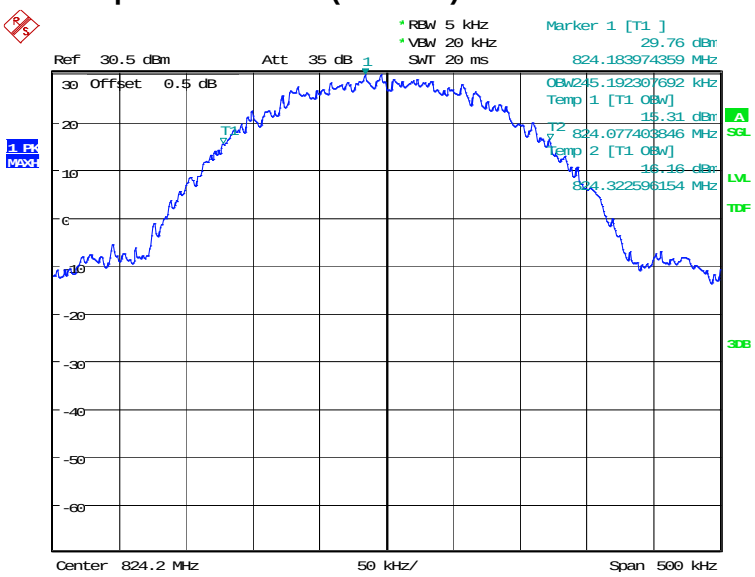
GPRS 850(99% BW)

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

GPRS 850

Channel 128-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 09:47:14

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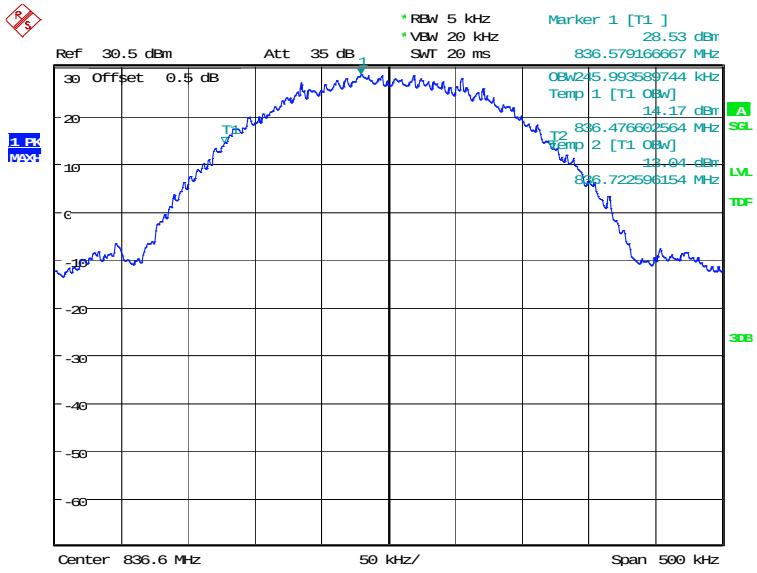
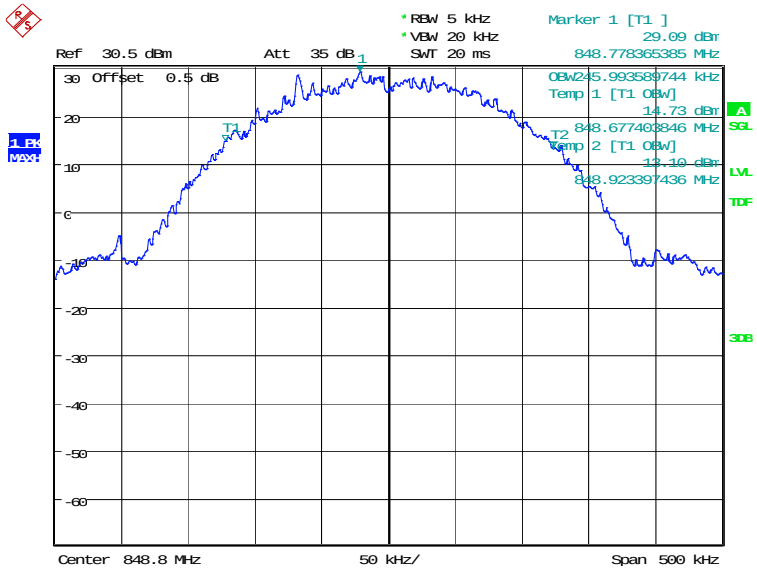
Channel 190-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 09:48:26

Channel 251-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 09:49:38

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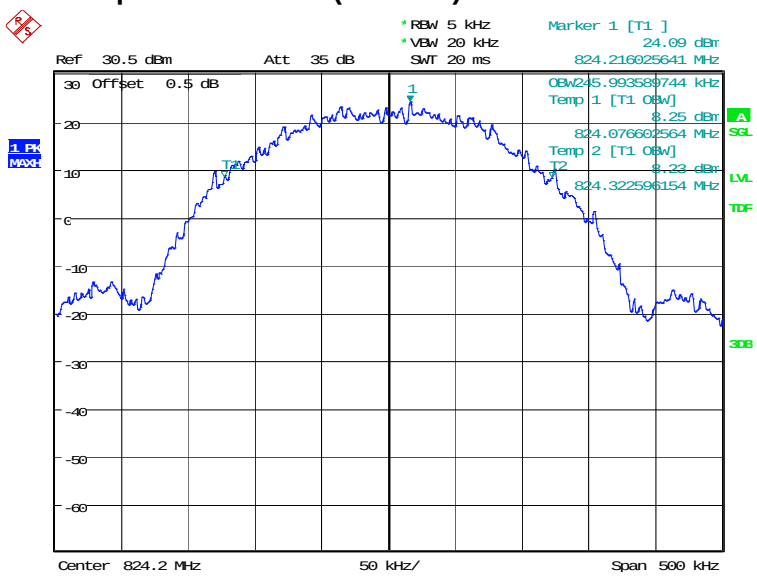
EGPRS 850-8PSK (99% BW)

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

EGPRS 850-8PSK

Channel 128-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 13:03:46

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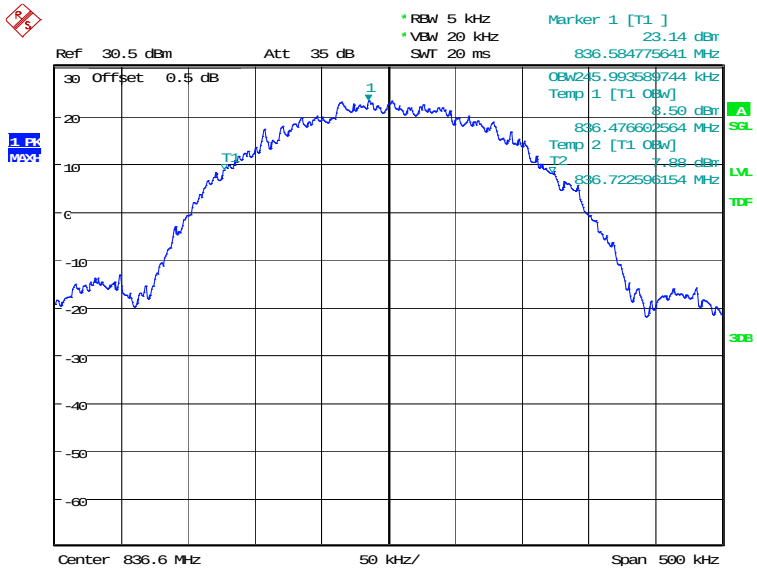
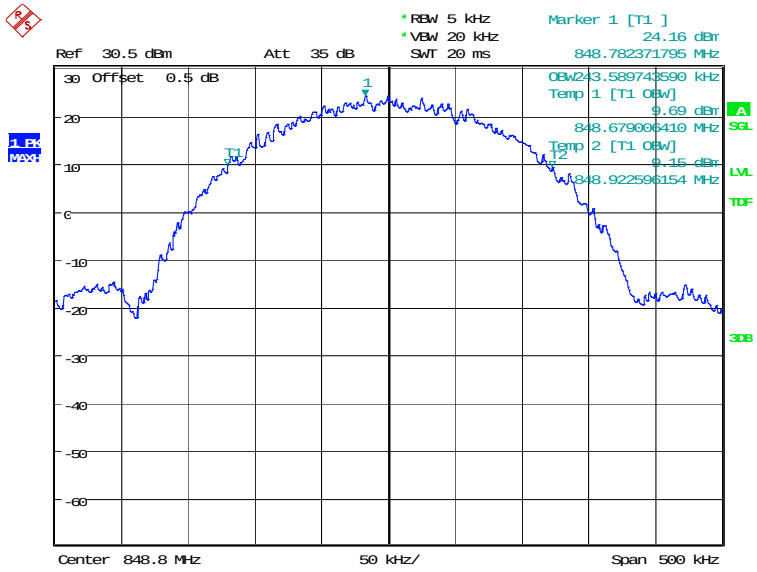
Channel 190-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 13:04:58

Channel 251-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 13:06:10

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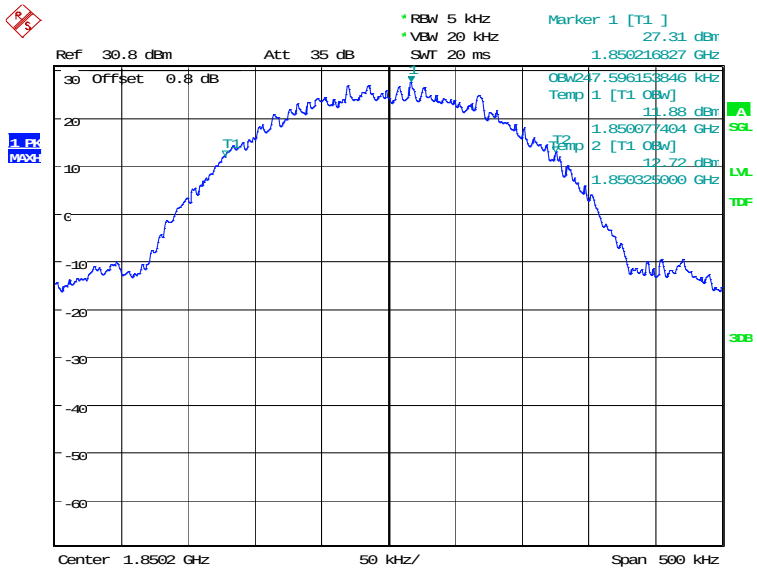
PCS 1900 (99% BW)

Frequency (MHz)	Occupied Bandwidth (99% BW) (kHz)
1850.2	247.60
1880.0	244.39
1909.8	243.59

PCS 1900

Channel 512-Occupied Bandwidth (99% BW)



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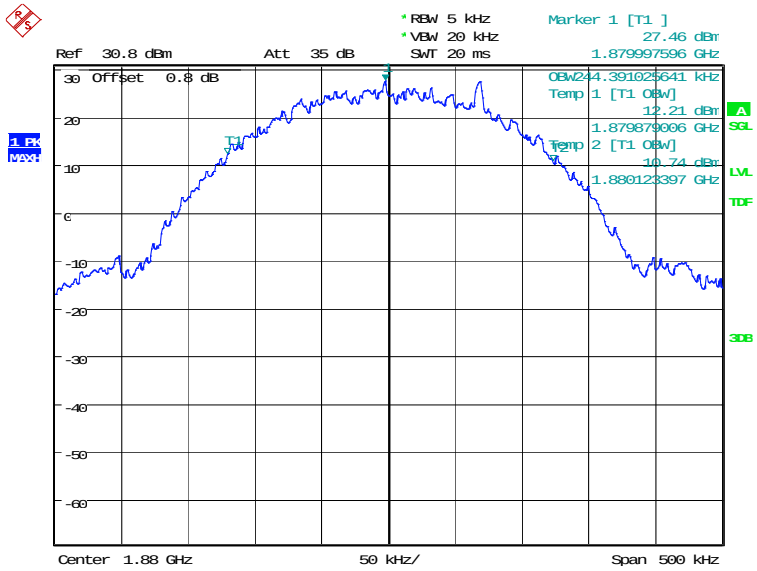
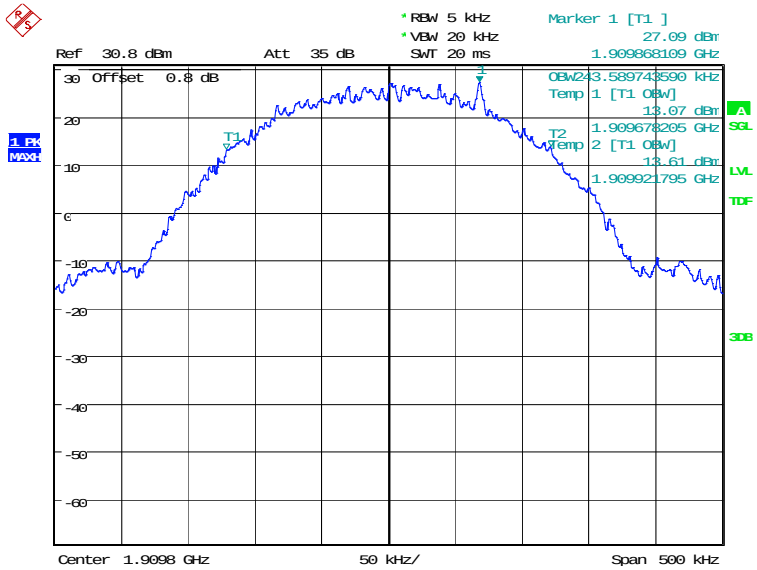
Channel 661-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 08:37:04

Channel 810-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 08:38:17

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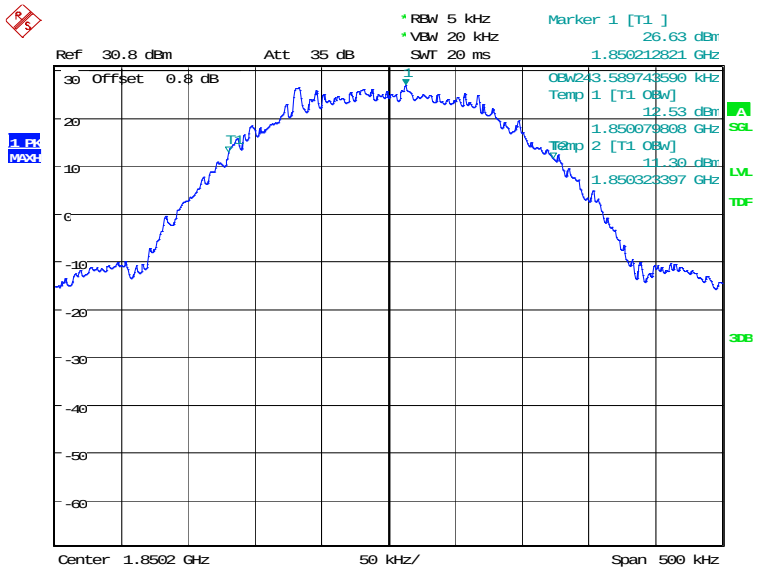
GPRS 1900(99% BW)

Frequency (MHz)	Occupied Bandwidth (99% BW) (kHz)
1850.2	243.59
1880.0	244.39
1909.8	248.40

GPRS 1900

Channel 512-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 10:03:17

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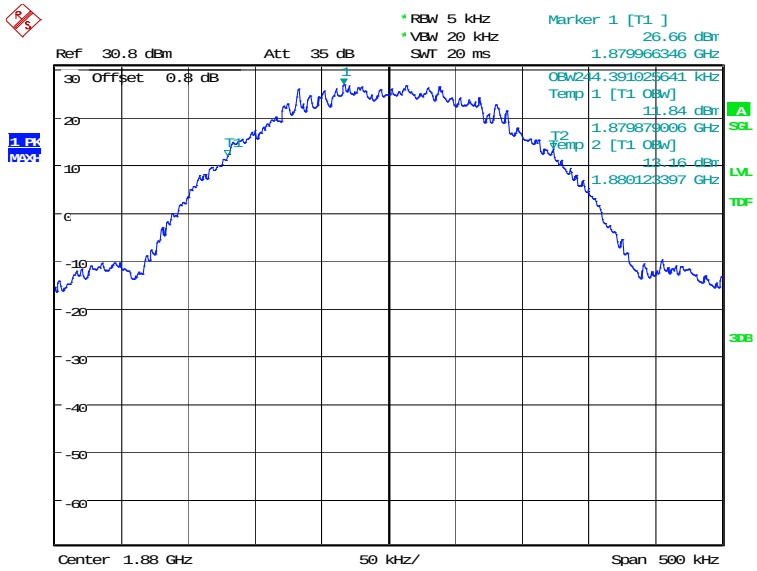
Channel 661-Occupied Bandwidth (99% BW)



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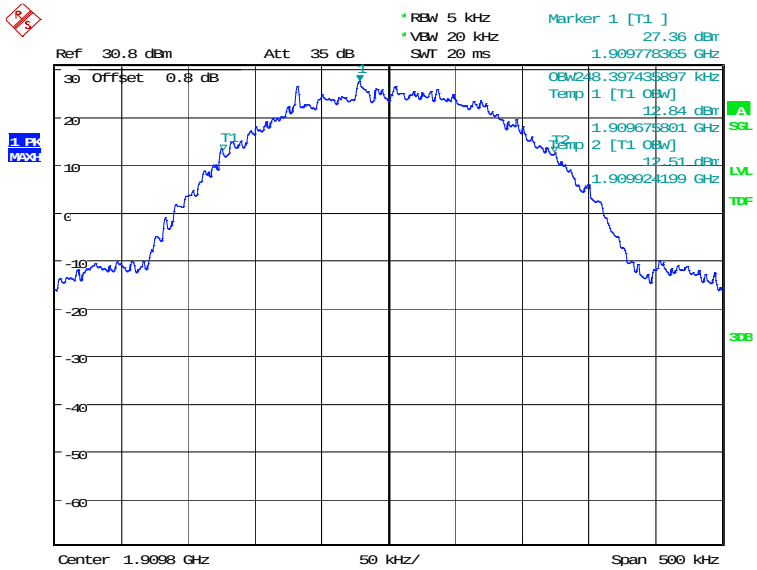
Channel 810-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 10:05:41

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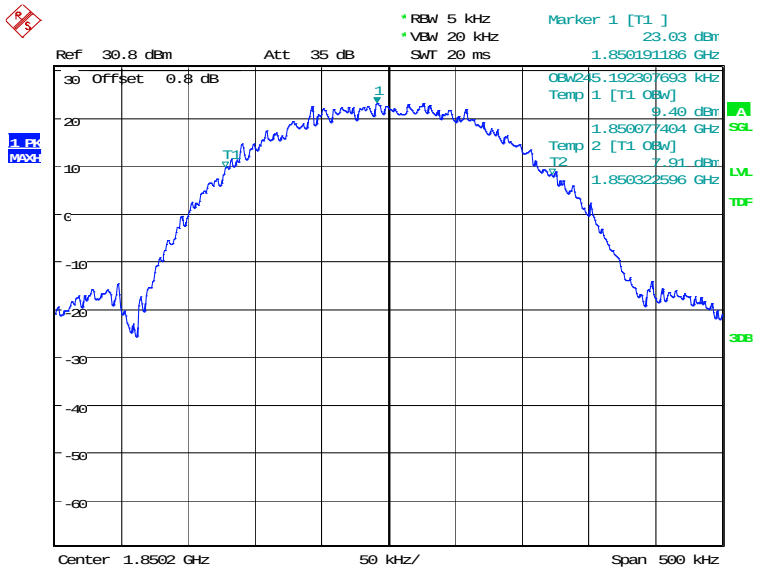
EGPRS 1900-8PSK (99% BW)

Frequency (MHz)	Occupied Bandwidth (99% BW) (kHz)
1850.2	245.19
1880.0	244.39
1909.8	246.79

EGPRS 1900-8PSK

Channel 512-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 13:07:51

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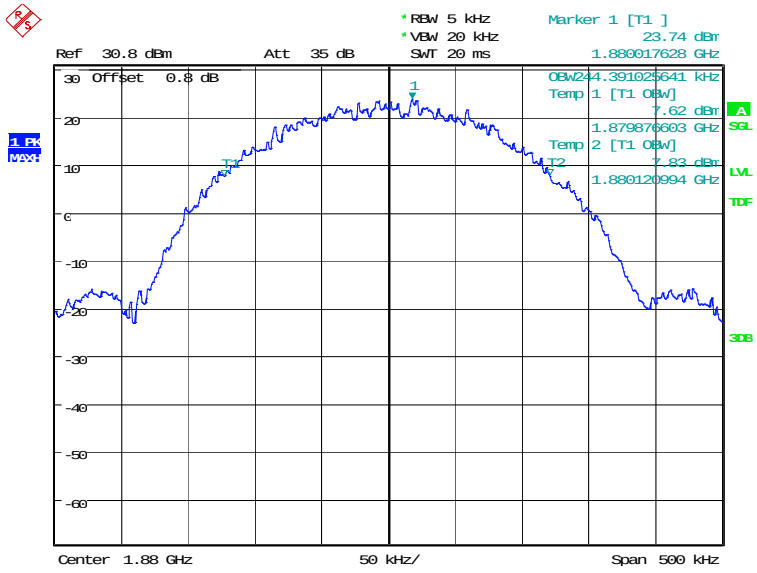
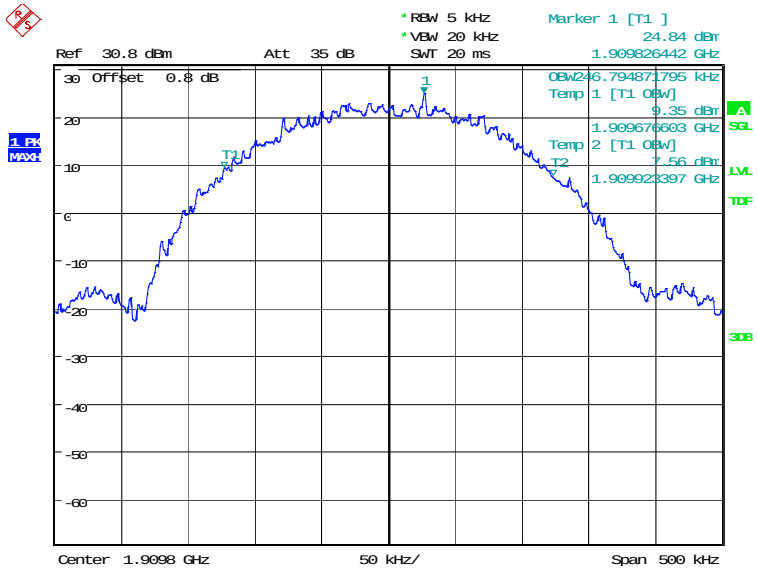
Channel 661-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 13:09:03

Channel 810-Occupied Bandwidth (99% BW)



Date: 17.JAN.2020 13:10:15

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A.5 EMISSION BANDWIDTH

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.

The measurement method is from ANSI C63.26:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.

b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target "−X dB" requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.

e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

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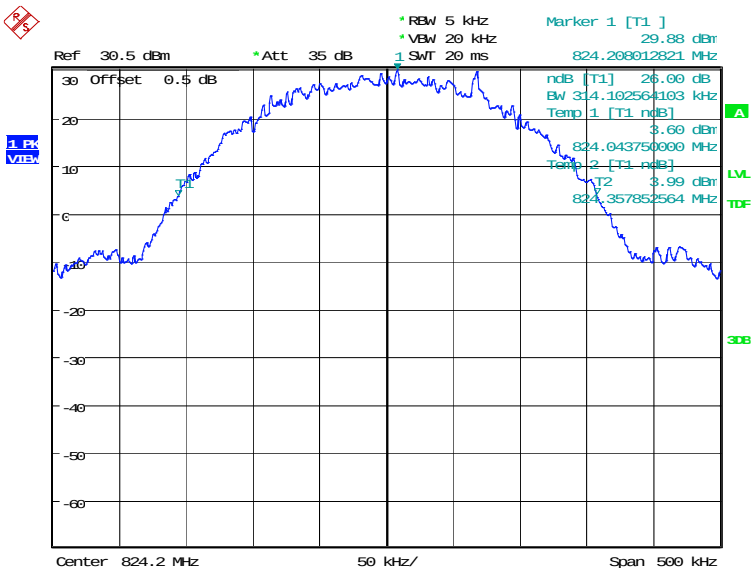
GSM 850

Frequency (MHz)	Emission Bandwidth (kHz)
824.2	314.10
836.6	314.10
848.8	315.71

GSM 850

Channel 128-Emission Bandwidth



Date: 17.JAN.2020 08:40:40

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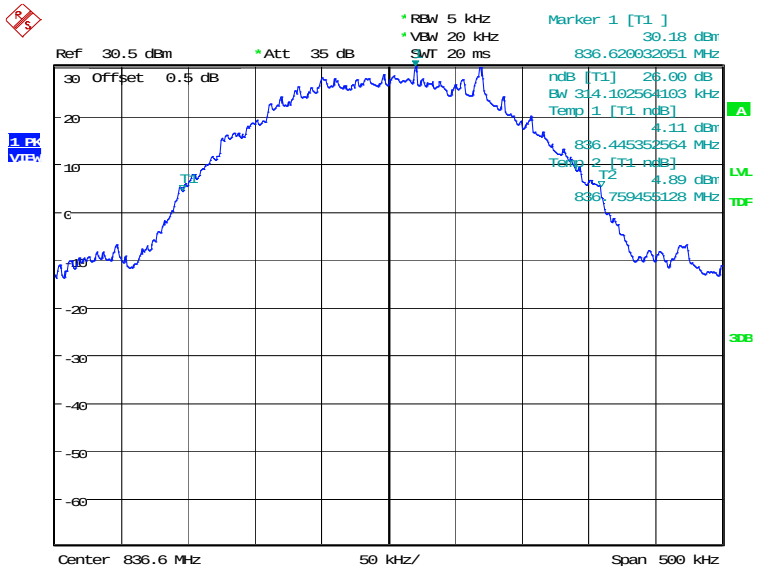
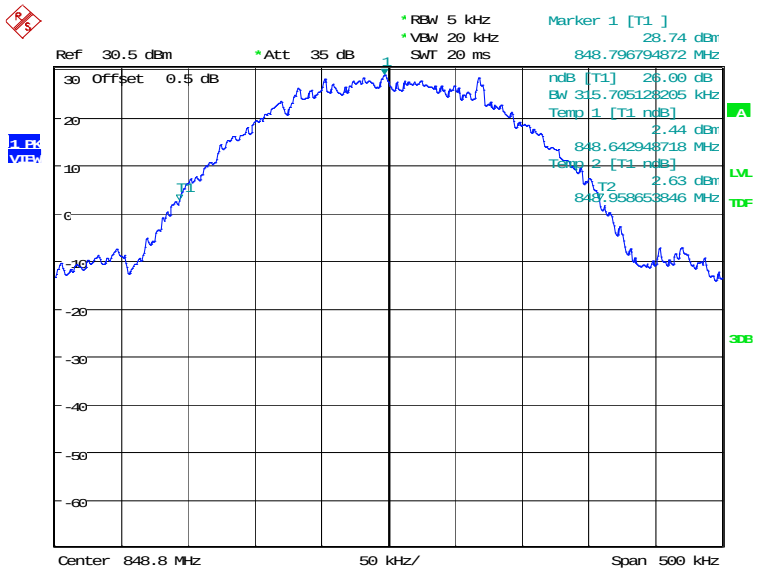
Channel 190-Emission Bandwidth



Date: 17.JAN.2020 08:41:53

Channel 251-Emission Bandwidth



Date: 17.JAN.2020 08:43:08

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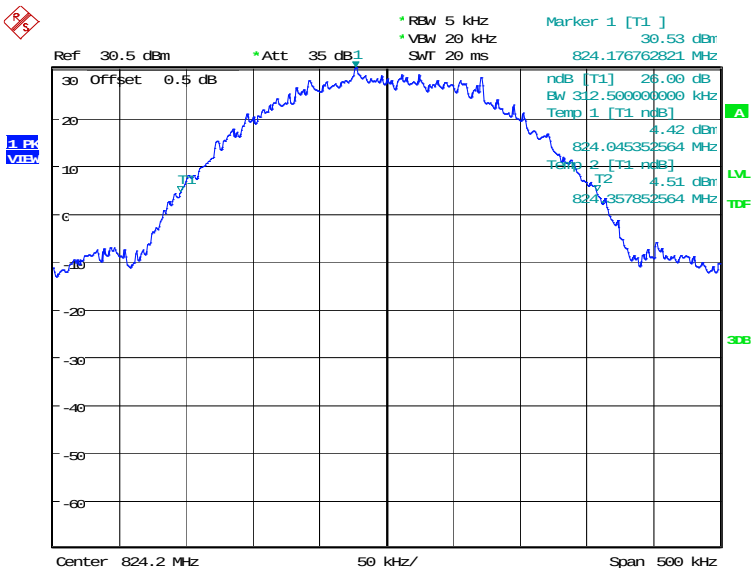
GPRS 850

Frequency (MHz)	Emission Bandwidth (kHz)
824.2	312.50
836.6	314.10
848.8	313.30

GPRS 850

Channel 128-Emission Bandwidth



Date: 17.JAN.2020 10:08:26

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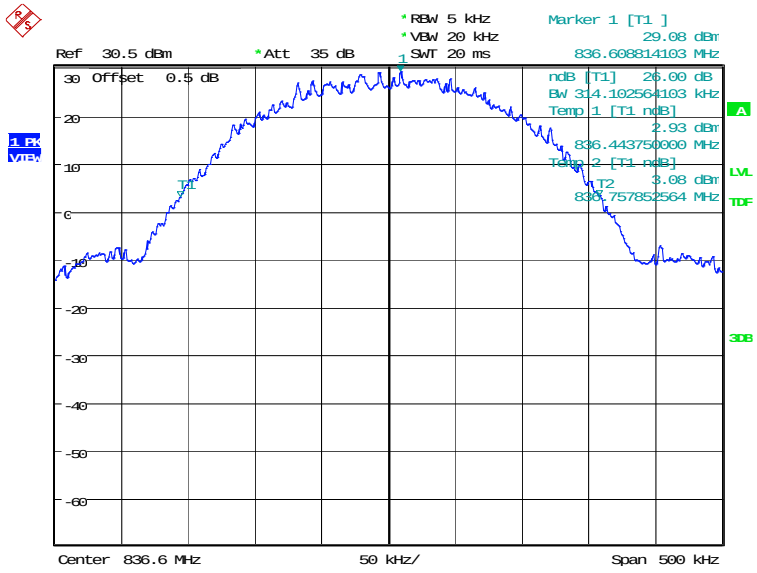
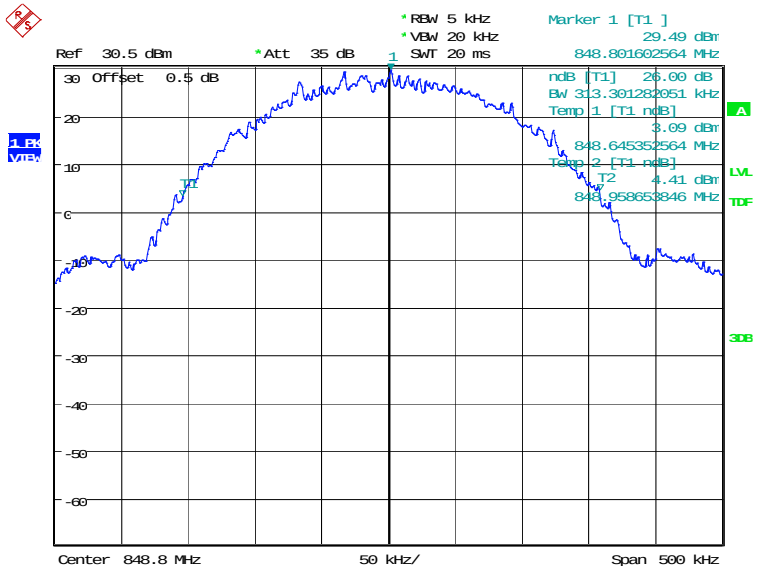
Channel 190-Emission Bandwidth



Date: 17.JAN.2020 10:09:38

Channel 251-Emission Bandwidth



Date: 17.JAN.2020 10:10:50

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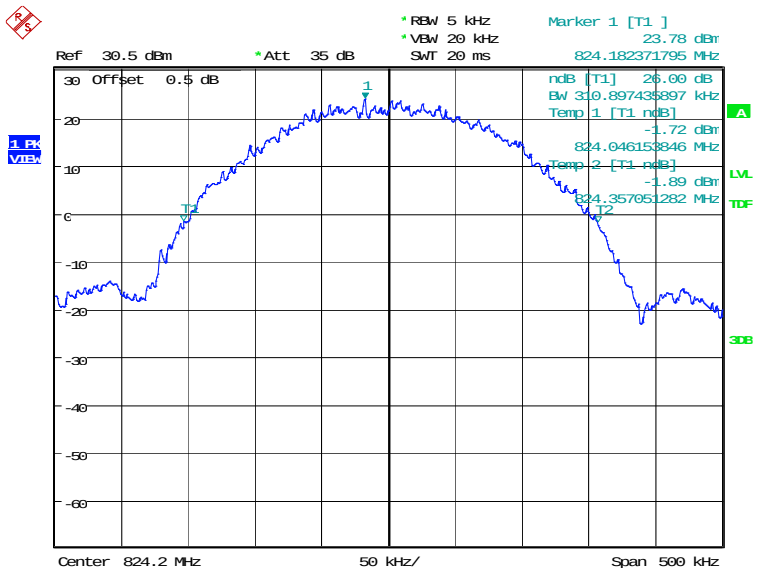
EGPRS 850-8PSK

Frequency (MHz)	Emission Bandwidth (kHz)
824.2	310.90
836.6	310.90
848.8	314.10

EGPRS 850-8PSK

Channel 128-Emission Bandwidth



Date: 17.JAN.2020 13:12:35

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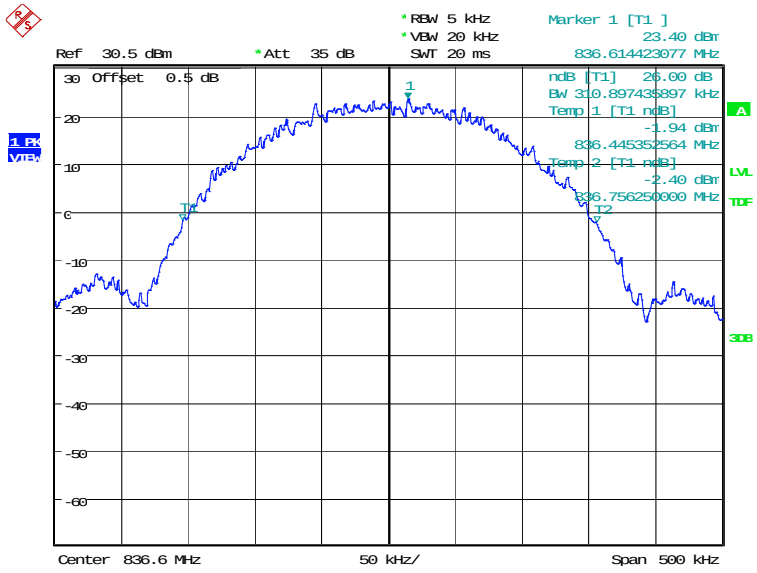
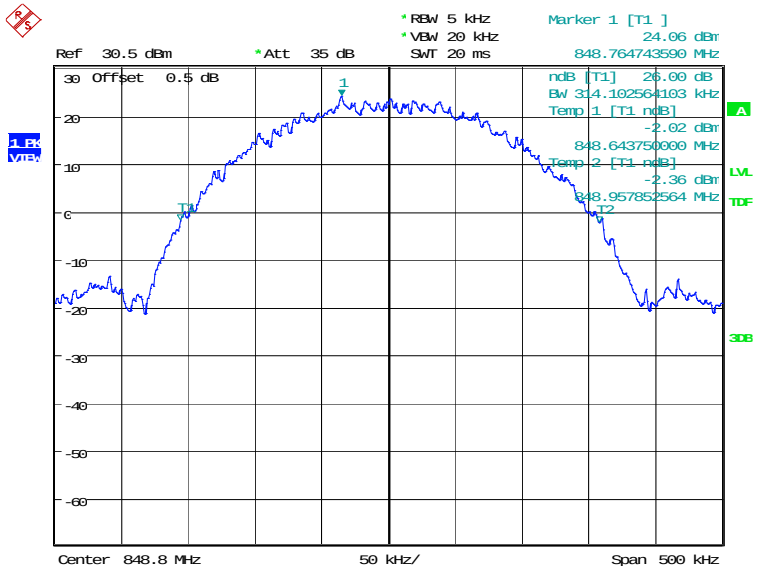
Channel 190-Emission Bandwidth



Date: 17.JAN.2020 13:13:47

Channel 251-Emission Bandwidth



Date: 17.JAN.2020 13:14:59

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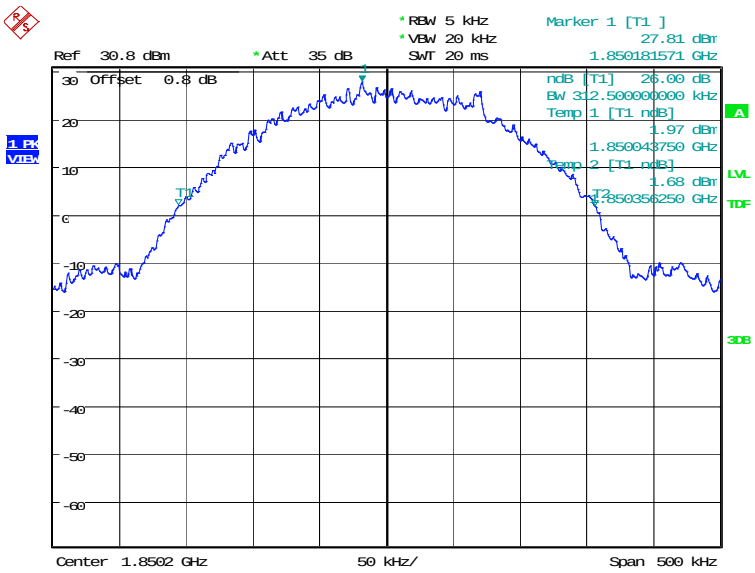
PCS 1900

Frequency (MHz)	Emission Bandwidth (kHz)
1850.2	312.50
1880.0	316.51
1909.8	314.90

PCS 1900

Channel 512-Emission Bandwidth



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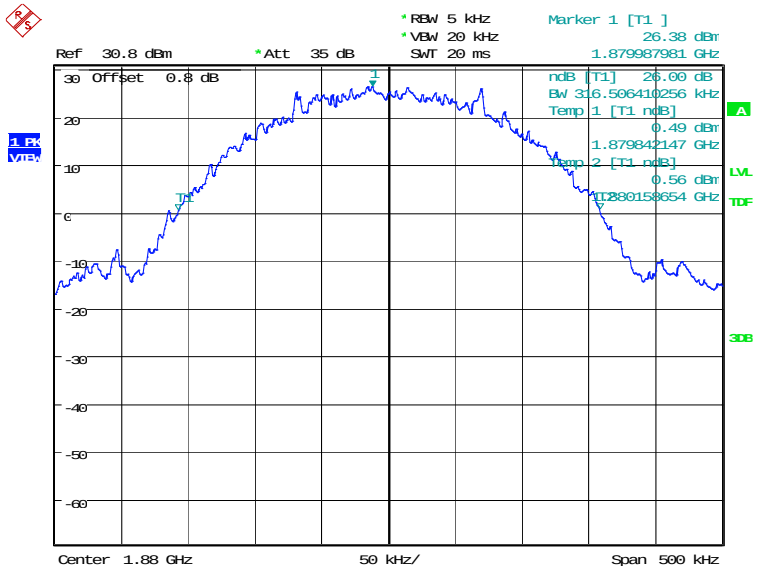
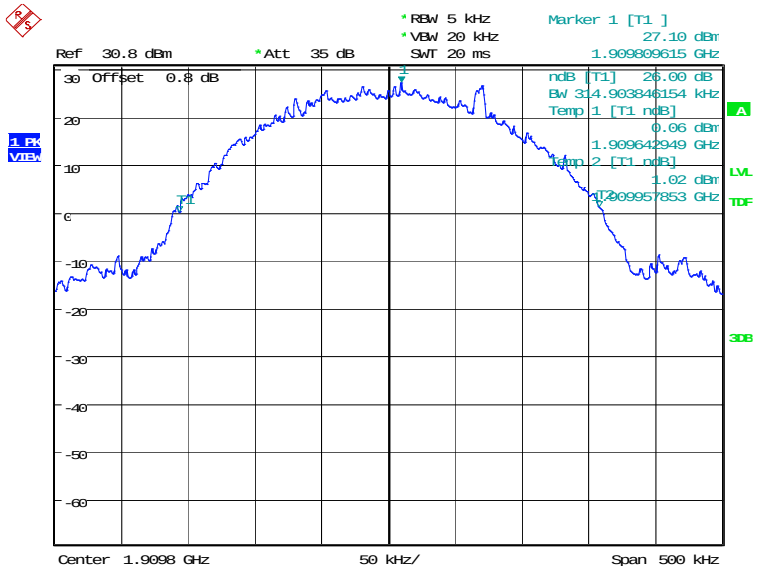
Channel 661-Emission Bandwidth



Date: 17.JAN.2020 08:47:06

Channel 810-Emission Bandwidth



Date: 17.JAN.2020 08:48:20

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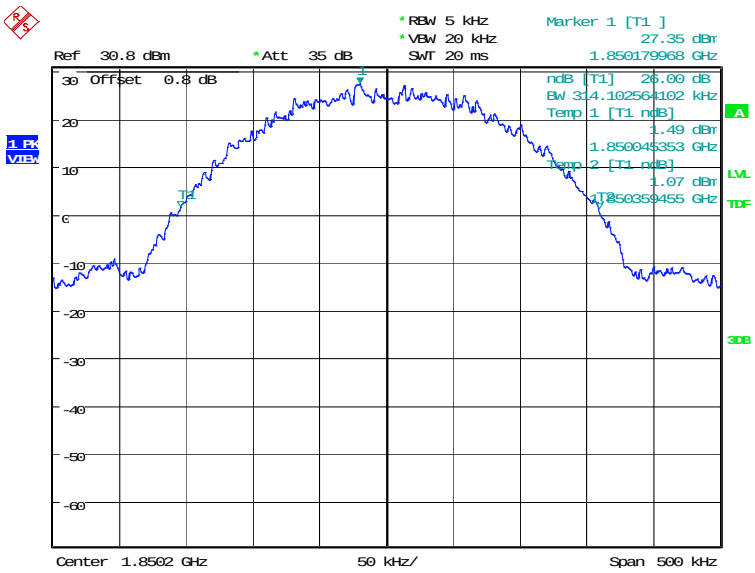
GPRS 1900

Frequency (MHz)	Emission Bandwidth (kHz)
1850.2	314.10
1880.0	318.11
1909.8	314.90

GPRS 1900

Channel 512-Emission Bandwidth



Date: 17.JAN.2020 10:13:47

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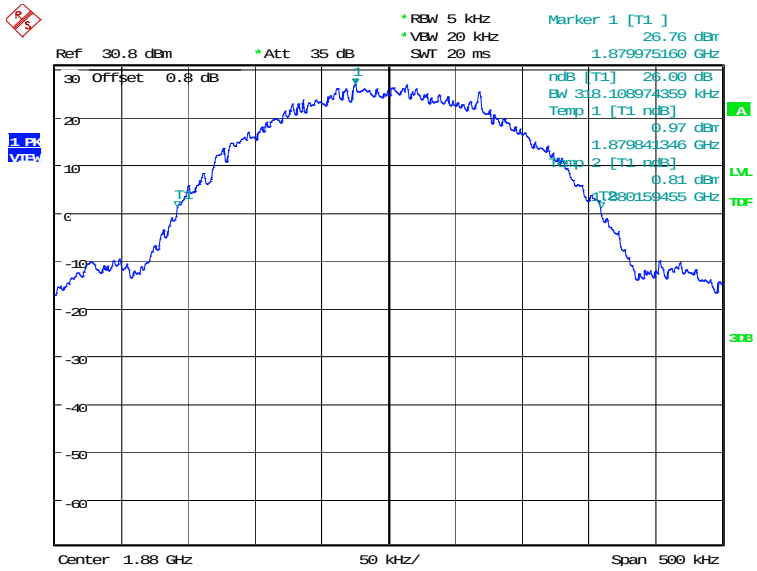
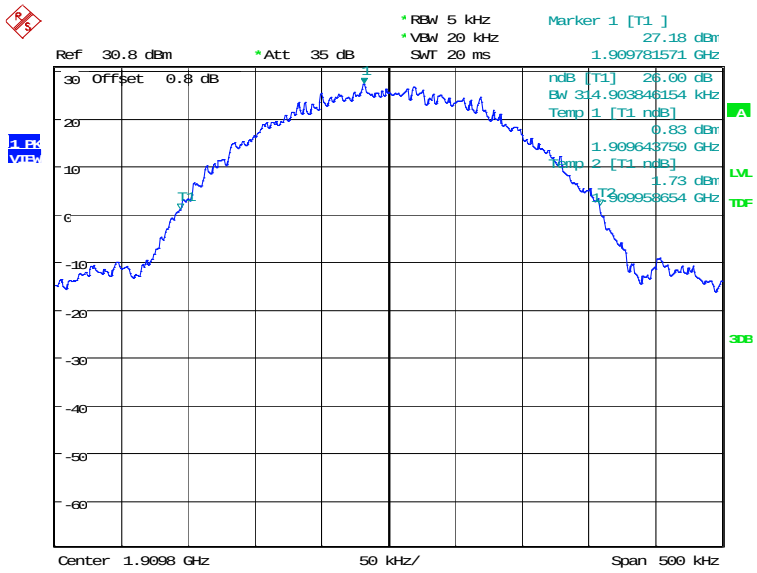
Channel 661-Emission Bandwidth



Date: 17.JAN.2020 10:14:59

Channel 810-Emission Bandwidth



Date: 17.JAN.2020 10:16:11

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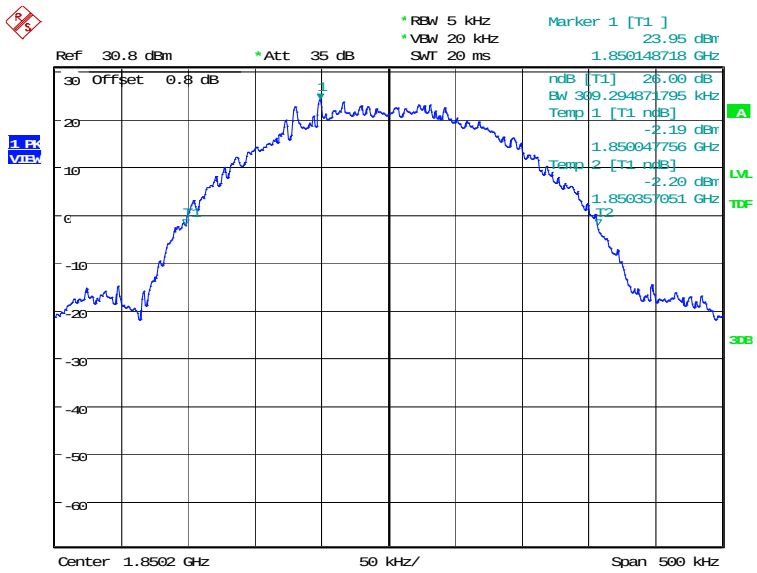
EGPRS 1900-8PSK

Frequency (MHz)	Emission Bandwidth (kHz)
1850.2	309.29
1880.0	315.71
1909.8	310.90

EGPRS 1900-8PSK

Channel 512-Emission Bandwidth



Date: 17.JAN.2020 13:17:45

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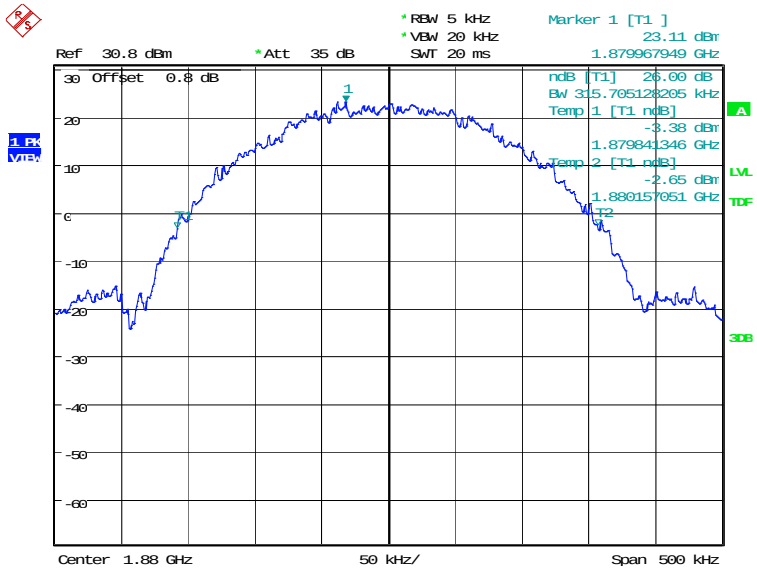
Channel 661-Emission Bandwidth



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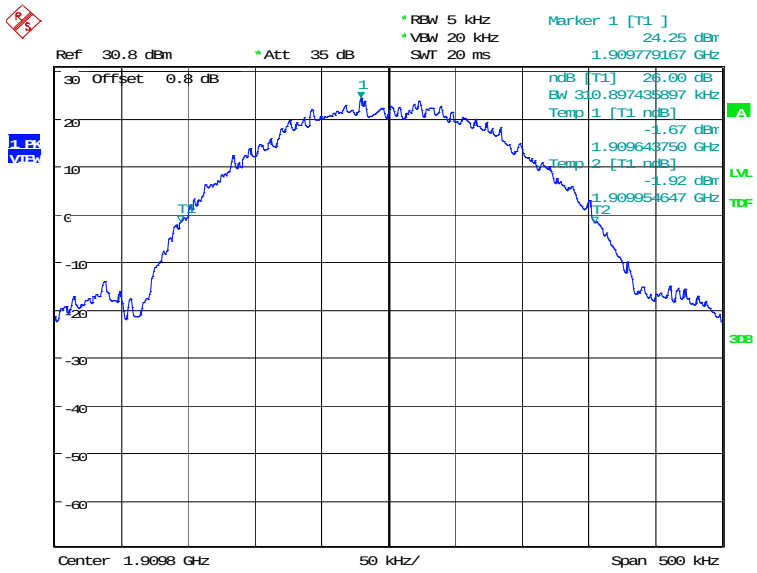
Channel 810-Emission Bandwidth



Date: 17.JAN.2020 13:20:10

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A.6 BAND EDGE COMPLIANCE

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. According to KDB 971168 6.0, 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.

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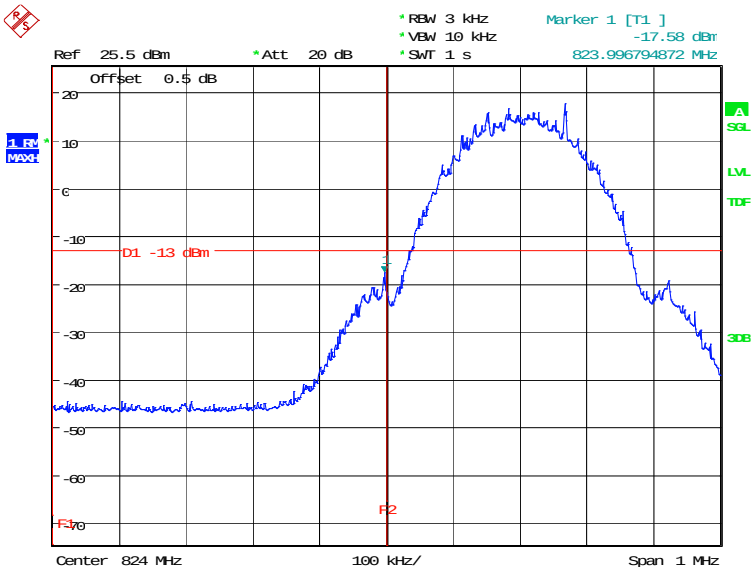
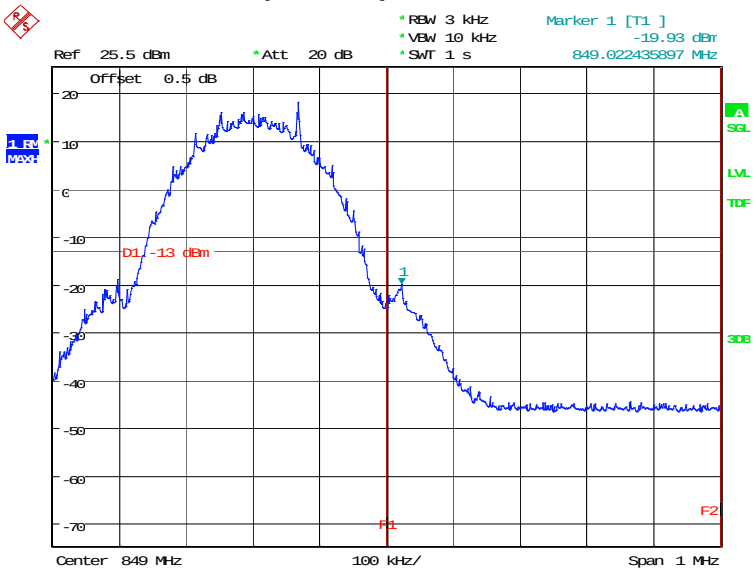
GSM 850

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



Date: 17.JAN.2020 08:54:36

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



Date: 17.JAN.2020 08:59:54

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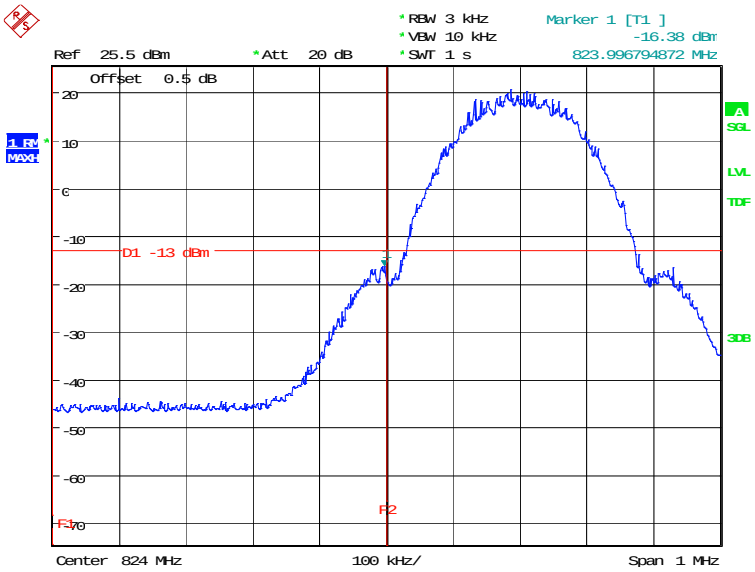
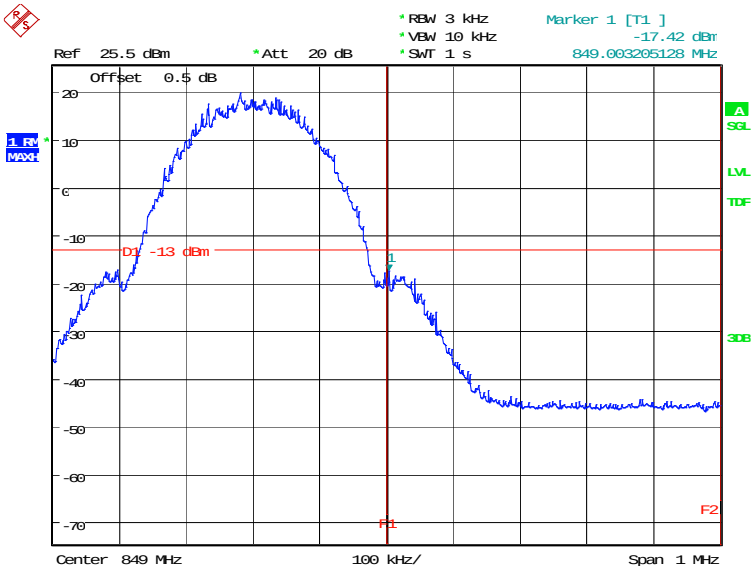
GPRS 850

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



Date: 17.JAN.2020 10:23:04

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



Date: 17.JAN.2020 10:28:21

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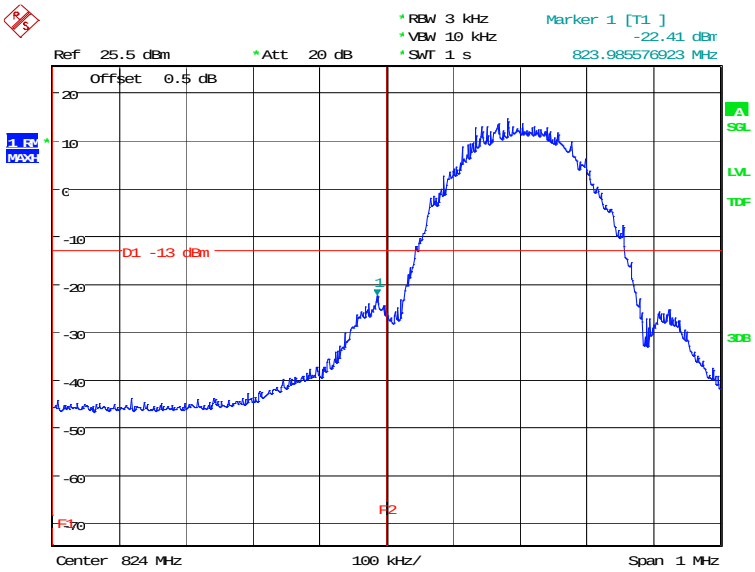
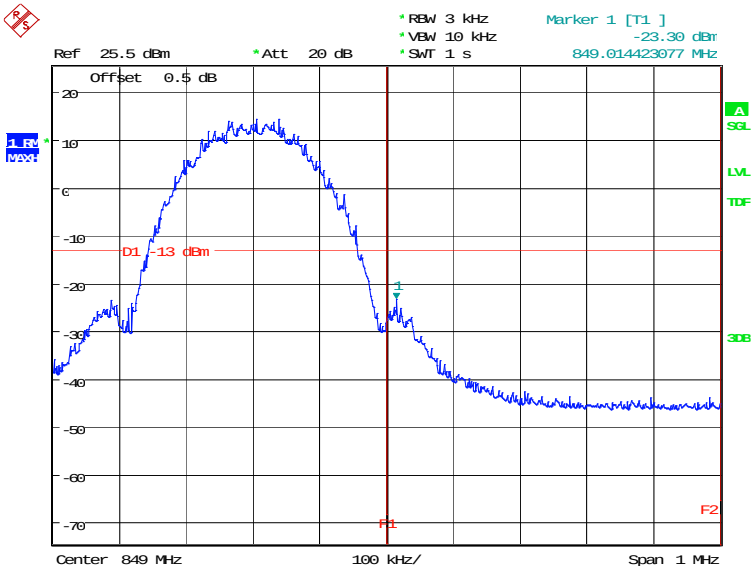
EGPRS 850-8PSK

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



Date: 17.JAN.2020 13:26:31

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



Date: 17.JAN.2020 13:31:49

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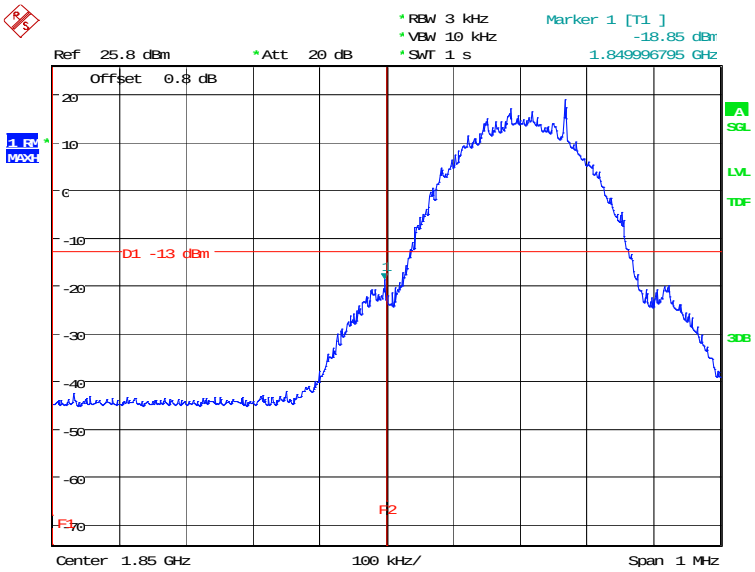
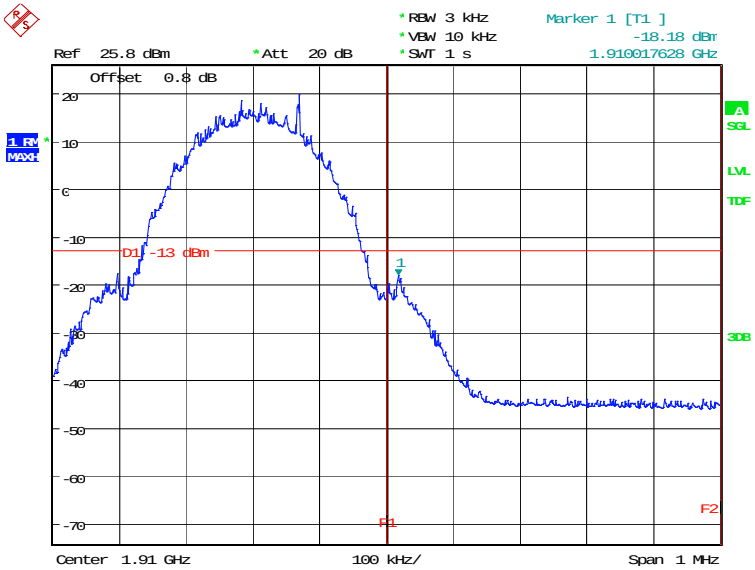
PCS 1900

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



Date: 17.JAN.2020 09:06:06

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



Date: 17.JAN.2020 09:11:25

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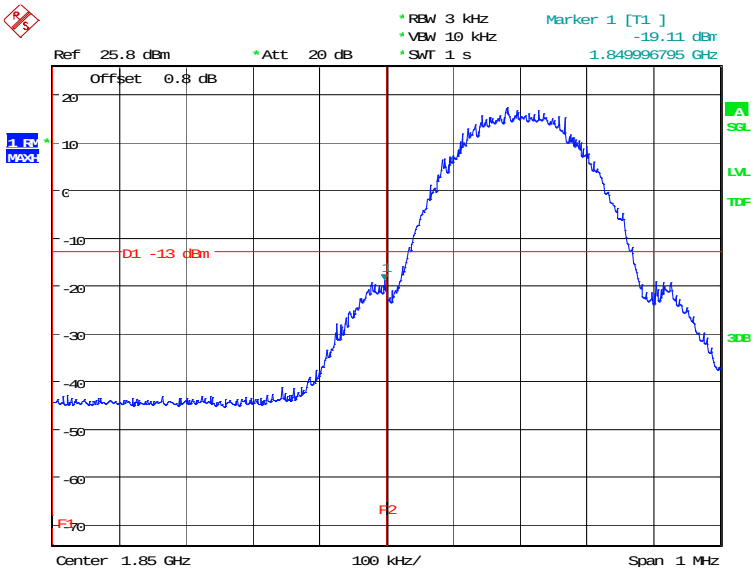
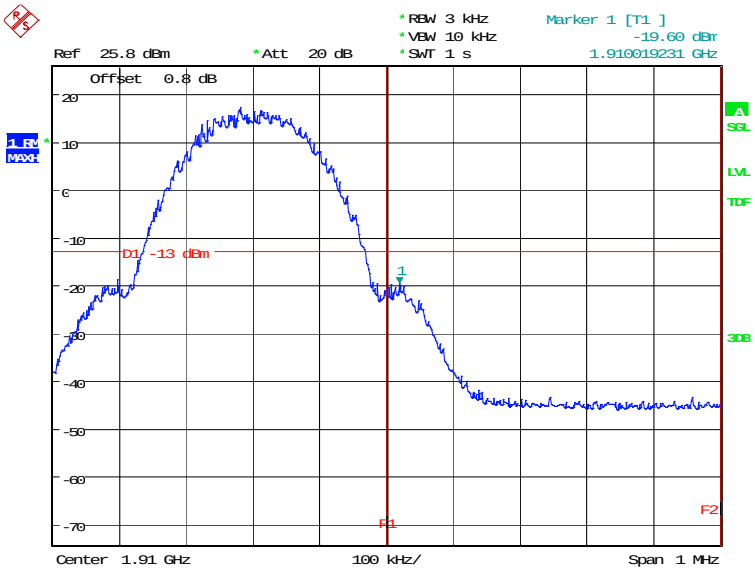
GPRS 1900

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



Date: 17.JAN.2020 10:34:35

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



Date: 17.JAN.2020 10:39:52

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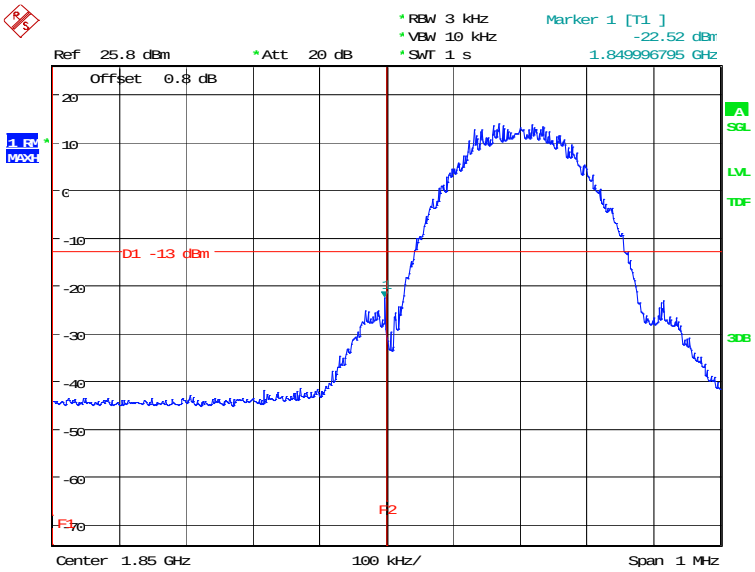
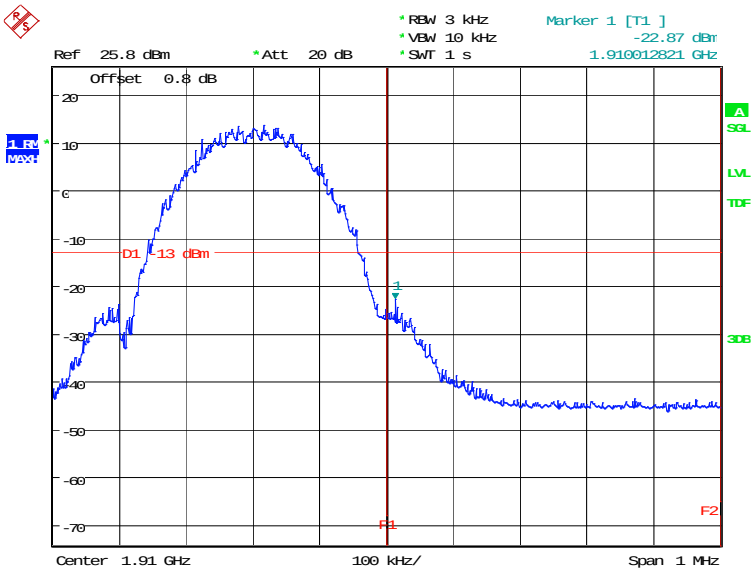
EGPRS 1900-8PSK

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



Date: 17.JAN.2020 13:39:09

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



Date: 17.JAN.2020 13:44:26

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A.7 CONDUCTED SPURIOUS EMISSION

A.7.1 Measurement Method

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

1. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:
   (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
   (b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.
3. According to KDB 971168, the applicable rule part specifies the reference bandwidth for measuring unwanted emission levels (typically, 100 kHz if the authorized frequency band/block is at or below 1 GHz and 1 MHz if the authorized frequency band/block is above 1 GHz).

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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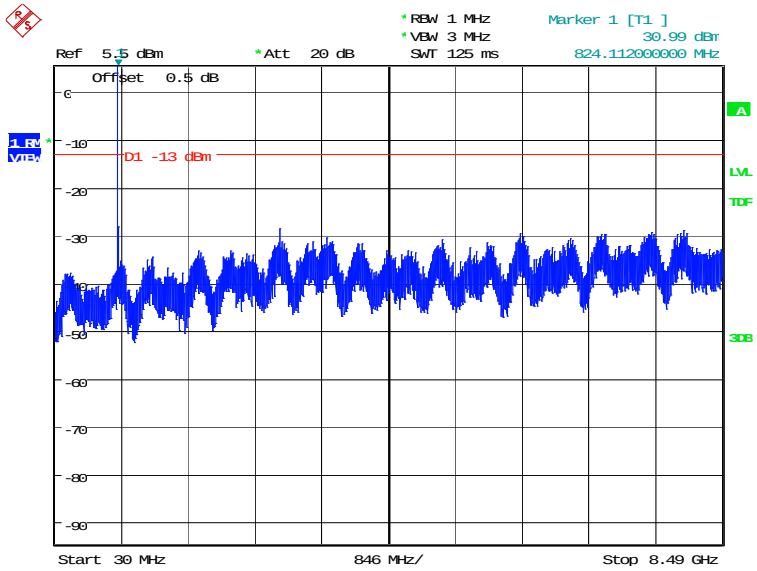
A.7.3 Measurement result

GSM850

Channel 128: 30MHz – 8.49GHz

Spurious emission limit –13dBm.

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

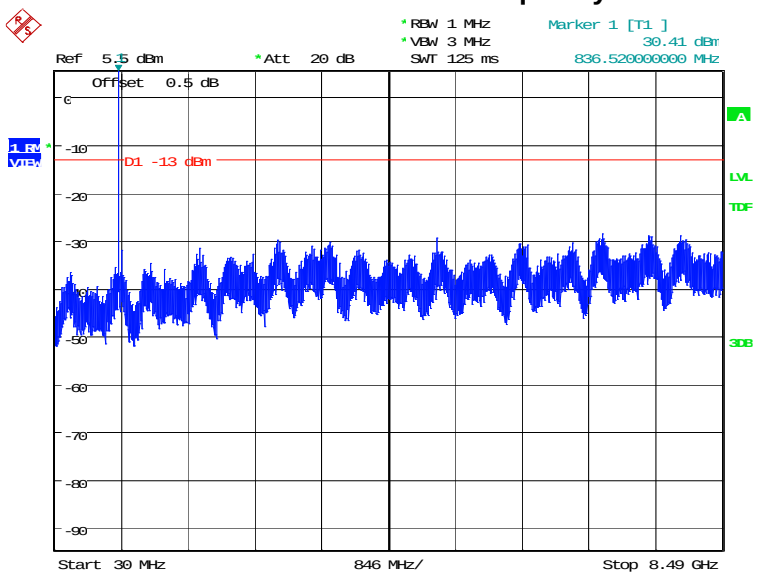


Date: 17.JAN.2020 09:25:59

Channel 190: 30MHz – 8.49GHz

Spurious emission limit –13dBm

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



Date: 17.JAN.2020 09:26:18

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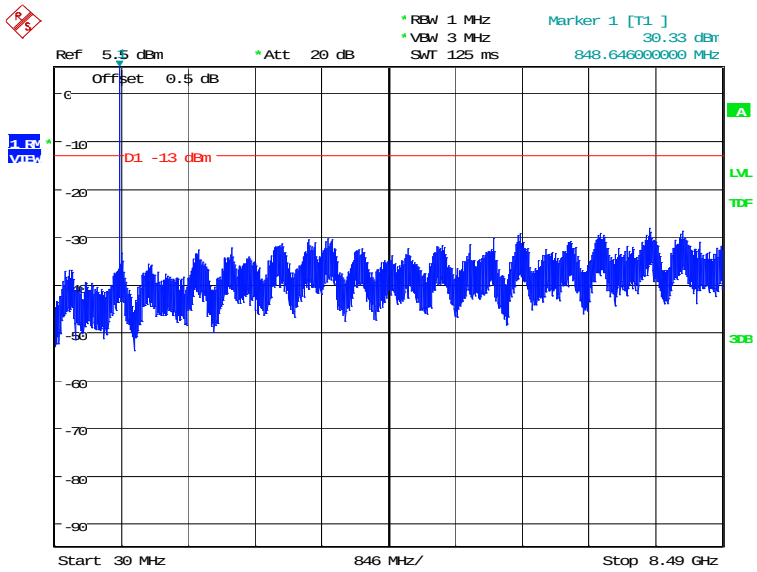
Channel 251: 30MHz – 8.49GMHz

Spurious emission limit –13dBm.

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



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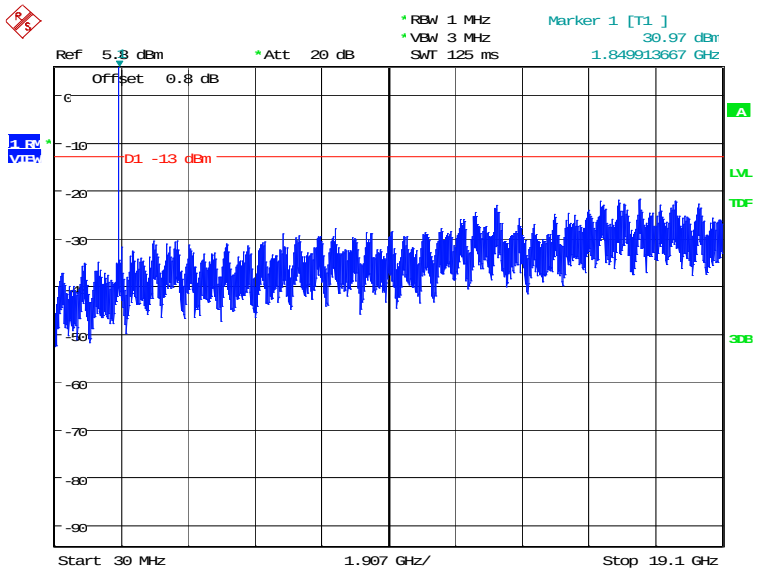
PCS1900

Channel 512: 30MHz – 19.10GHz

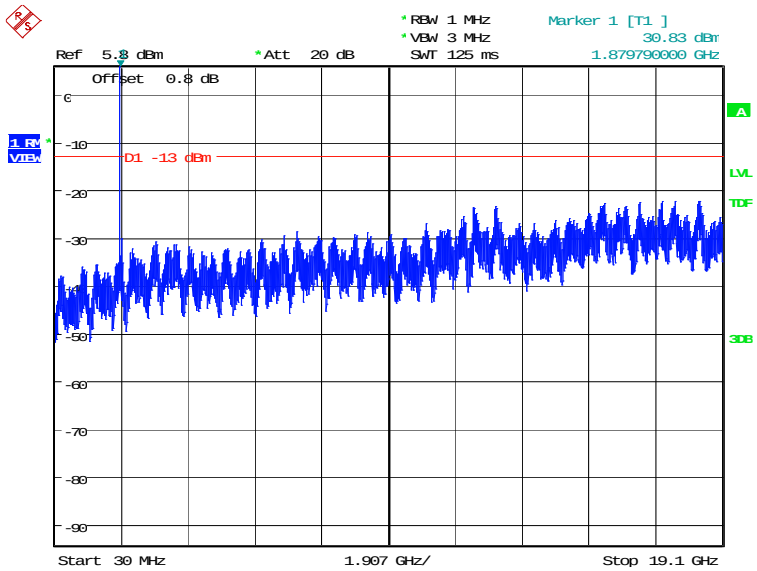
Spurious emission limit –13dBm.



Date: 17.JAN.2020 09:27:22

Channel 661: 30MHz – 19.10GHz

Spurious emission limit –13dBm



Date: 17.JAN.2020 09:27:38

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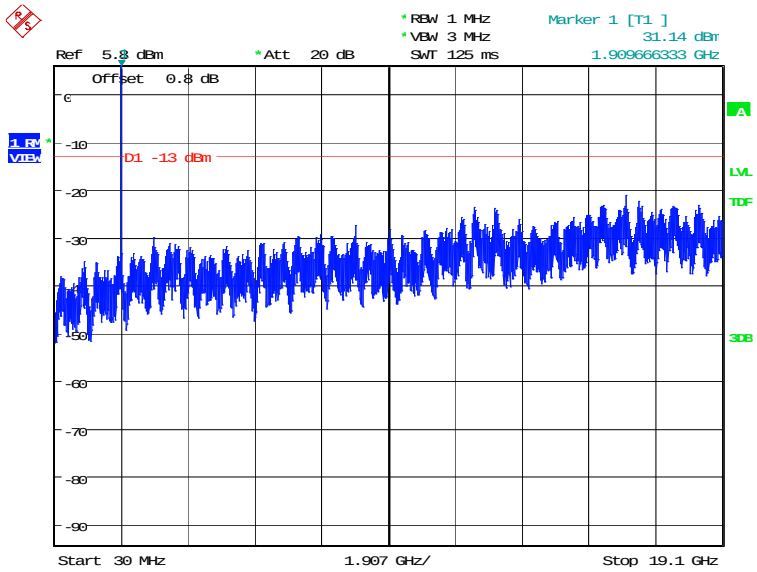
Channel 810: 30MHz – 19.10GHz

Spurious emission limit –13dBm



Date: 17.JAN.2020 09:27:54

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A.8 PEAK-TO-AVERAGE POWER RATIO

According to 24.232(d), the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

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 1ms;

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

	Frequency (MHz)	PAPR (dB)
PCS1900	1880.0	7.69
GPRS1900	1880.0	7.72
EGPRS1900(8PSK)	1880.0	10.29

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ANNEX B: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT
Beijing
China

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2019-09-26 through 2020-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

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

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