TEST REPORT

No. I19Z60740-WMD01

for

LG Electronics USA, Inc.

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

Model Name: LM-X120BMW,LMX120BMW, X120BMW, LM-X120HM, LMX120HM, X120HM

FCC ID: ZNFX120HM

Issued Date: 2019-06-25

TESTING
NVLAP LAB CODE 600118-0

Note:

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I19Z60740-WMD01	Rev.0	1st edition	2019-06-19
I19Z60740-WMD01	Rev.1	Update the Client Information and conducted power of GSM850	2019-06-25

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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

1.3. Testing Environment

Normal Temperature: 15-35℃

Relative Humidity: 20-75%

1.4. Project data

Testing Start Date: 2019-04-23

Testing End Date: 2019-06-15

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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:	LG Electronics USA, Inc.
Address /Post:	1000 Sylvan Avenue, Englewood Cliffs NJ 07632

2.2. Manufacturer Information

Company Name:	Jiaxing Youngrui Electron Technology Co., Ltd
Address /Post:	NO.777 Yazhong Road, Daqiao Town, Nanhu District, Jiaxing City,Zhejiang

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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	LM-X120BMW,LMX120BMW, X120BMW, LM-X120HM, LMX120HM, X120HM
FCC ID	ZNFX120HM
Antenna	Embedded
Output power	32.66dBm maximum EIRP measured for PCS1900
Extreme vol. Limits	3.4VDC to 4.4VDC (nominal: 3.85VDC)
Extremetemp. 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	Date of receipt
UT01a	356250100004176/ 356250100004184	2019-04-22
UT12a	356250100012195/ 356250100012203	2019-05-17

*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	BL-O1
Manufacturer	Jiade Energy Technology(Zhuhai)Co.,Ltd
Capacitance	3000mAh(rated)
Nominal Voltage	3.85V

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

3.4. Normal Accessory setting

Fully charged battery was used during the test.

3.5. General Description

The Equipment Under Test (EUT) is a model of Multi-band Multi-band GSM/WCDMA/LTE phone with Bluetooth, WLAN with embedded antenna. 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	10-1-18 Edition
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-18 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 4000 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 4000 MHz

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6. SUMMARY OF TEST RESULT

GSM850

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

PCS1900

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

Terms used in Verdict column

P	Pass, The EUT complies with the essential requirements in the standard.
NP	Not Perform, 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

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7. Test Equipments Utilized

NO.	Description	TYPE	series number	MANUFACTURE	CAL DUE DATE	Calibration interval
1	EMI Antenna	VULB9163	9163-235	Schwarzbeck	2019-11-20	1 year
2	EMI Antenna	3117	00058889	ETS-Lindgren	2020-01-02	1 year
3	EMI Antenna	3117	00119024	ETS-Lindgren	2020-02-25	1 year
4	Universal Radio Communication Tester	CMU200	108646	R&S	2020-01-03	1 year
5	Spectrum Analyzer	FSU26	200030	R&S	2020-06-03	1 year
6	EMI Antenna	9117	177	Schwarzbeck	2019-08-22	1 year
7	Signal Generator	SMF100A	101295	R&S	2019-11-27	1 year
8	Climate chamber	SH-242	93008556	ESPEC	2019-12-21	2 year
9	Test Receiver	E4440A	MY48250642	Agilent	2020-03-18	1 year
10	Universal Radio Communication Tester	CMW500	143008	R&S	2019-11-26	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

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

Measurement result

GSM(GMSK)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	5	33.53
836.6	5	33.50
848.8	5	33.48

GPRS(GMSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	3	33.54
836.6	3	33.52
848.8	3	33.56

EGPRS(8PSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	6	27.48
836.6	6	27.46
848.8	6	27.41

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PCS1900

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

Measurement result

GSM(GMSK)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	0	30.55
1880.0	0	30.52
1909.8	0	30.54

GPRS(GMSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	3	30.54
1880.0	3	30.54
1909.8	3	30.55

EGPRS(8PSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	5	25.85
1880.0	5	25.76
1909.8	5	25.69

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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.

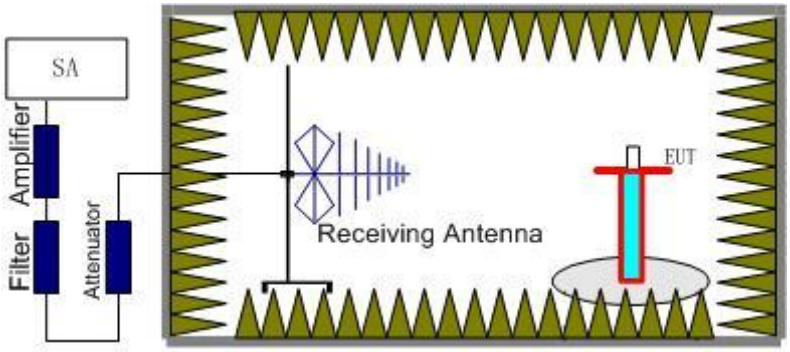
Rule Part 24.232(c) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

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

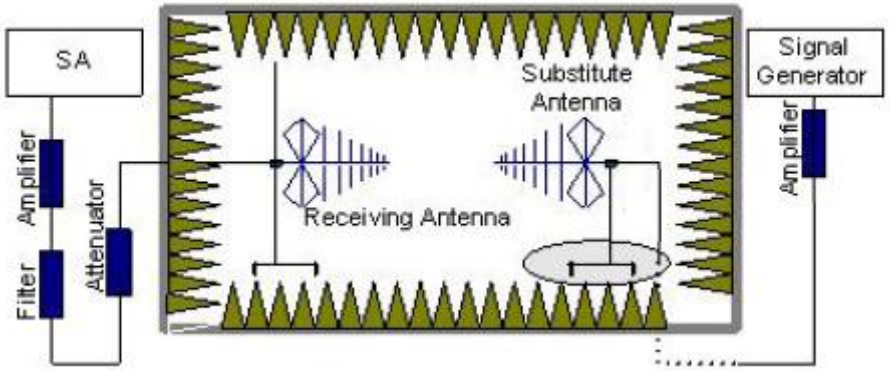
A.1.3.2 Method of Measurement

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, 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

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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. A amplifier should be connected to the Signal Source output port. And the cable should be connecting 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	-11.31	2.26	45.79	0.96	2.15	31.03	38.45	7.42	H
836.60	-11.08	2.26	45.66	0.82	2.15	30.99	38.45	7.46	H
848.80	-11.81	2.28	45.54	0.79	2.15	30.09	38.45	8.36	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	-11.30	2.26	45.79	0.96	2.15	31.04	38.45	7.41	H
836.60	-11.12	2.26	45.66	0.82	2.15	30.95	38.45	7.50	H
848.80	-11.84	2.28	45.54	0.79	2.15	30.06	38.45	8.39	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	-17.51	2.26	45.79	0.96	2.15	24.83	38.45	13.62	H
836.60	-17.78	2.26	45.66	0.82	2.15	24.29	38.45	14.16	H
848.80	-18.53	2.28	45.54	0.79	2.15	23.37	38.45	15.08	H

Frequency: 824.20MHz

Peak ERP(dBm)=P_{Mea}(-11.30dBm)-P_{cl}(2.26dB)-P_{Ag}(-45.79dB)-G_a (-0.96dB)-2.15dB=31.04dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

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	-14.76	2.93	43.75	4.87	30.93	33.00	2.07	V
1880.00	-13.09	2.85	43.75	4.82	32.63	33.00	0.37	V
1909.80	-13.66	2.89	43.77	4.76	31.98	33.00	1.02	V

GPRS

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a (dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1850.20	-14.83	2.93	43.75	4.87	30.86	33.00	2.14	V
1880.00	-13.06	2.85	43.75	4.82	32.66	33.00	0.34	V
1909.80	-13.63	2.89	43.77	4.76	32.01	33.00	0.99	V

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	-21.07	2.93	43.75	4.87	24.62	33.00	8.38	V
1880.00	-18.50	2.85	43.75	4.82	27.22	33.00	5.78	V
1909.80	-18.67	2.89	43.77	4.76	26.97	33.00	6.03	V

Frequency**:** 1880.00MHz

Peak EIRP(dBm)= P_{Mea}(-13.06dBm) - P_{cl}(2.85dB) - P_{Ag}(-43.75dB) - G_a (-4.82dB) = 32.66dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

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

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A.2 EMISSION LIMIT

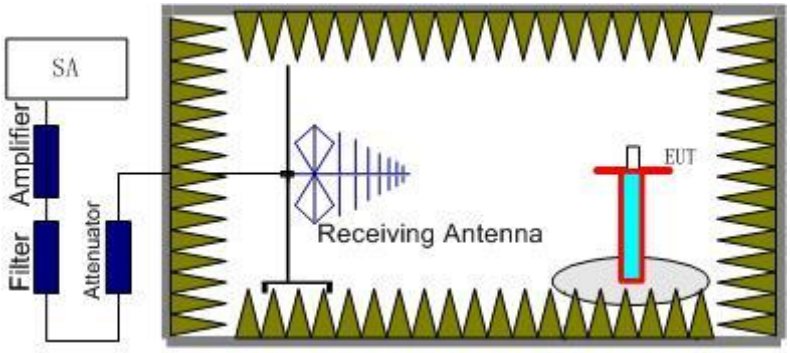
A.2.1 Measurement Method

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

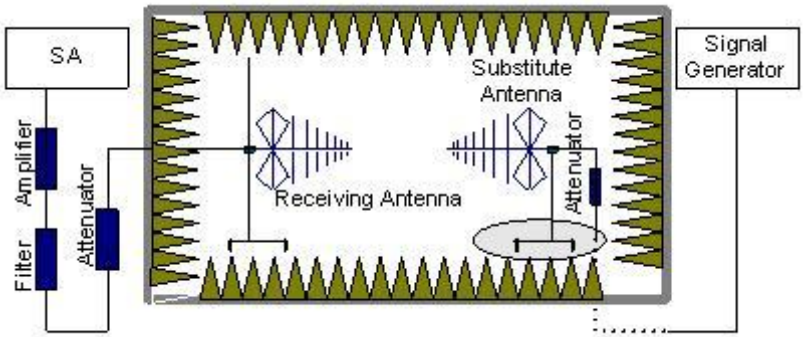
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment. The resolution bandwidth is set as outlined in Part 24.238 and Part 22.917. The spectrum is scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and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

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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.

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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(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Margin(dB)	Polarization
1648.01	-55.60	3.56	5.23	2.15	-56.08	-13.00	43.10	V
2472.00	-38.70	4.59	6.02	2.15	-39.42	-13.00	26.40	H
3296.02	-55.25	5.29	7.71	2.15	-54.98	-13.00	42.00	H
4124.02	-56.08	6.04	9.02	2.15	-55.25	-13.00	42.30	V
4953.01	-55.73	6.68	9.85	2.15	-54.71	-13.00	41.70	V
5772.01	-55.27	7.23	10.55	2.15	-54.10	-13.00	41.10	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
1672.01	-57.19	3.58	5.19	2.15	-57.73	-13.00	44.70	V
2510.00	-42.43	4.63	6.12	2.15	-43.09	-13.00	30.10	H
3337.02	-54.98	5.31	7.81	2.15	-54.63	-13.00	41.60	H
4195.02	-55.79	6.19	9.10	2.15	-55.03	-13.00	42.00	V
5006.01	-56.24	6.59	9.91	2.15	-55.07	-13.00	42.10	H
5872.01	-53.79	7.30	10.53	2.15	-52.71	-13.00	39.70	V

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	-59.72	3.60	5.14	2.15	-60.33	-13.00	47.30	V
2546.00	-40.95	4.66	6.18	2.15	-41.58	-13.00	28.60	H
3402.02	-55.74	5.36	7.96	2.15	-55.29	-13.00	42.30	V
4263.02	-55.24	6.23	9.16	2.15	-54.46	-13.00	41.50	H
5096.01	-55.33	6.76	10.03	2.15	-54.21	-13.00	41.20	H
5957.01	-53.42	7.47	10.51	2.15	-52.53	-13.00	39.50	H

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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
3701.02	-57.00	6.42	8.48	-54.94	-13.00	41.94	V
5552.02	-45.52	7.18	10.59	-42.11	-13.00	29.11	V
7395.01	-55.61	8.12	12.07	-51.66	-13.00	38.66	H
9249.01	-54.24	9.04	13.25	-50.03	-13.00	37.03	H
11101.01	-52.72	9.83	13.18	-49.37	-13.00	36.37	V
12960.01	-49.55	10.48	13.48	-46.55	-13.00	33.55	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
3760.02	-49.97	6.26	8.56	-47.67	-13.00	34.67	V
5641.02	-53.95	7.27	10.57	-50.65	-13.00	37.65	H
7531.01	-55.03	8.26	12.22	-51.07	-13.00	38.07	V
9395.01	-55.65	9.04	13.34	-51.35	-13.00	38.35	V
11276.01	-51.61	9.85	13.14	-48.32	-13.00	35.32	H
13170.01	-47.78	10.63	13.74	-44.67	-13.00	31.67	V

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
3820.02	-53.62	6.08	8.65	-51.05	-13.00	38.05	V
5733.02	-47.44	7.29	10.55	-44.18	-13.00	31.18	H
7635.01	-55.20	8.13	12.31	-51.02	-13.00	38.02	H
9546.01	-54.14	9.38	13.35	-50.17	-13.00	37.17	V
11467.01	-51.23	9.90	13.11	-48.02	-13.00	35.02	H
13364.01	-48.50	10.57	14.01	-45.06	-13.00	32.06	V

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 -10℃.
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 -10℃ 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 -10℃ 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 3.4VDC 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. 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 Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.4	9.56	0.0114
3.85	12.27	0.0147
4.4	7.36	0.0088

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-10	-13.56	0.0162
0	-15.63	0.0187
10	-15.69	0.0188
20	-14.85	0.0178
30	-12.07	0.0144
40	-19.63	0.0235
50	-17.05	0.0204

EGPRS 850 - 8PSK

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.4	-14.30	0.0171
3.85	-12.43	0.0149
4.4	-12.33	0.0147

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-10	-12.98	0.0155
0	-18.63	0.0223
10	-15.56	0.0186
20	-16.01	0.0191
30	-15.01	0.0179
40	-12.98	0.0155
50	-15.53	0.0186

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PCS 1900

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.4	33.38	0.0178
3.85	35.71	0.0190
4.4	32.54	0.0173

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-10	34.42	0.0183
0	44.17	0.0235
10	38.94	0.0207
20	29.44	0.0157
30	32.54	0.0173
40	31.38	0.0167
50	37.52	0.0200

EGPRS 1900 - 8PSK

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.4	21.28	0.0113
3.85	24.60	0.0131
4.4	27.28	0.0145

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-10	27.99	0.0149
0	19.05	0.0101
10	-16.05	0.0085
20	21.79	0.0116
30	28.51	0.0152
40	35.29	0.0188
50	31.54	0.0168

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A.4 OCCUPIED BANDWIDTH

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 measurement method is from KDB 971168:

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 (i.e., two to five times the OBW).

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

c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least 10log (OBW / RBW) below the reference level.

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

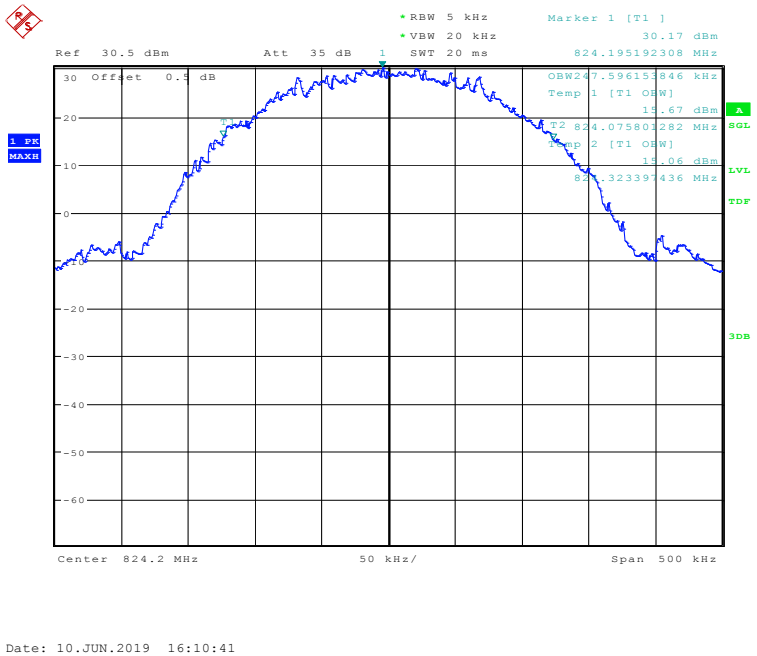
e) Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

GSM 850(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	247.60
836.6	242.79
848.8	245.99

GSM 850

Channel 128-Occupied Bandwidth (99% BW)



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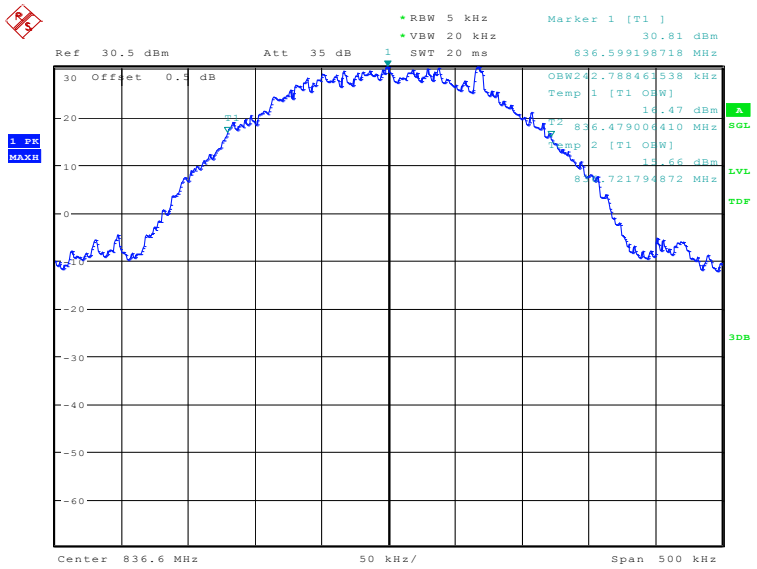
Channel 190-Occupied Bandwidth (99% BW)



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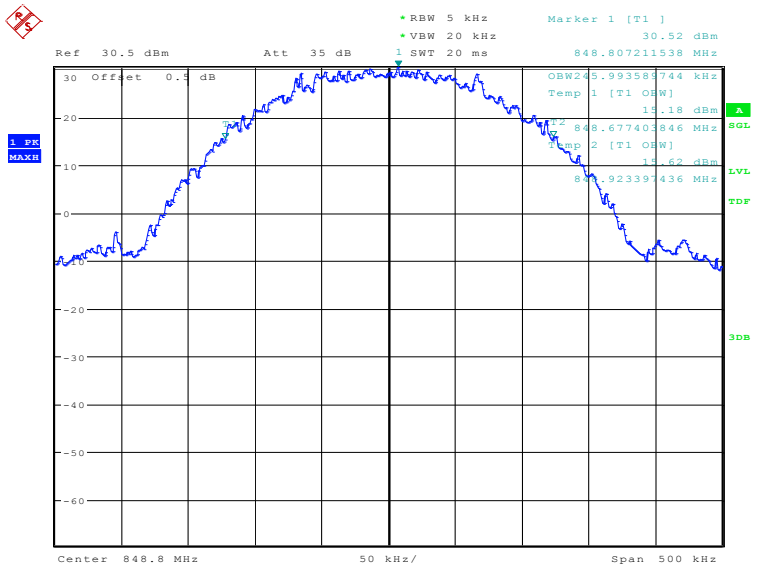
Channel 251-Occupied Bandwidth (99% BW)



Date: 10.JUN.2019 16:13:04

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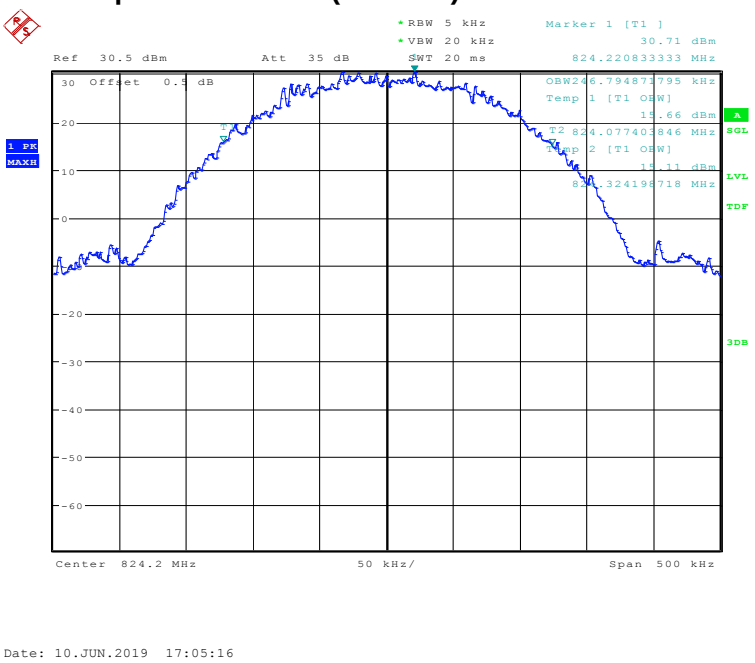
GPRS 850(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	246.79
836.6	245.99
848.8	243.59

GPRS 850

Channel 128-Occupied Bandwidth (99% BW)



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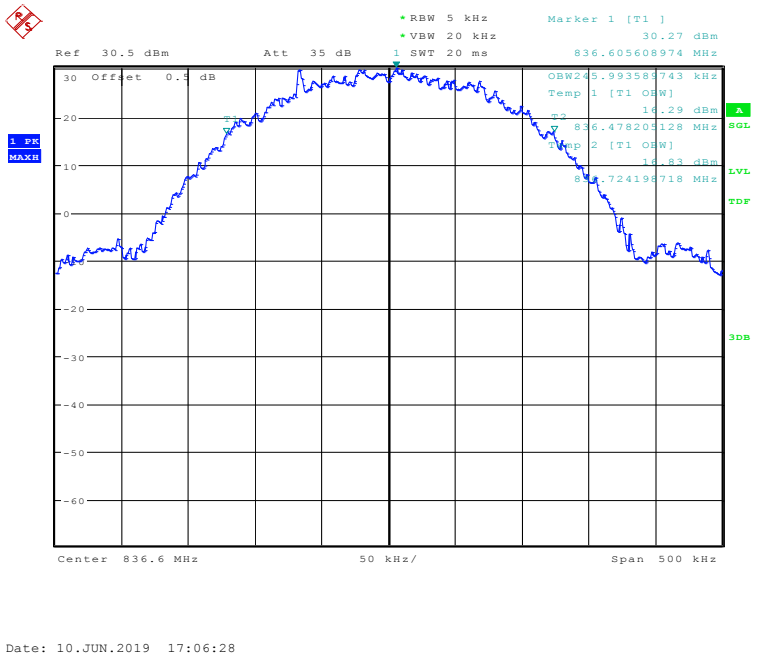
Channel 190-Occupied Bandwidth (99% BW)



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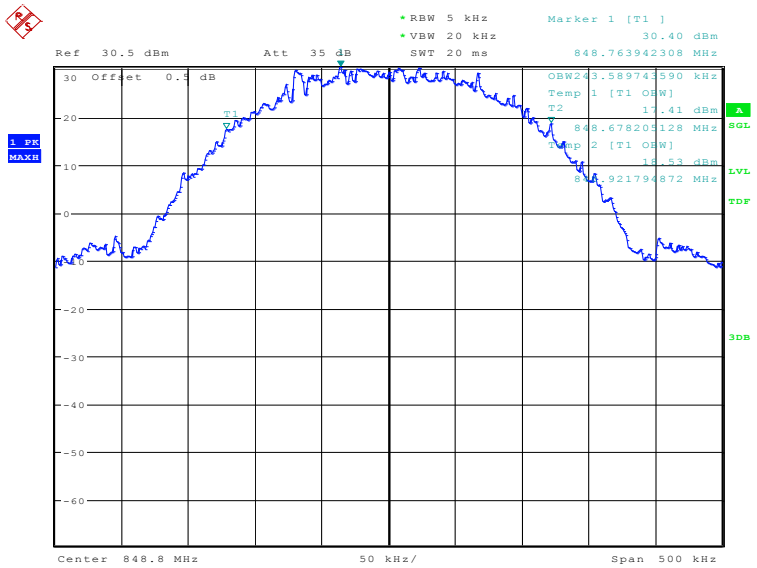
Channel 251-Occupied Bandwidth (99% BW)



Date: 10.JUN.2019 17:07:39

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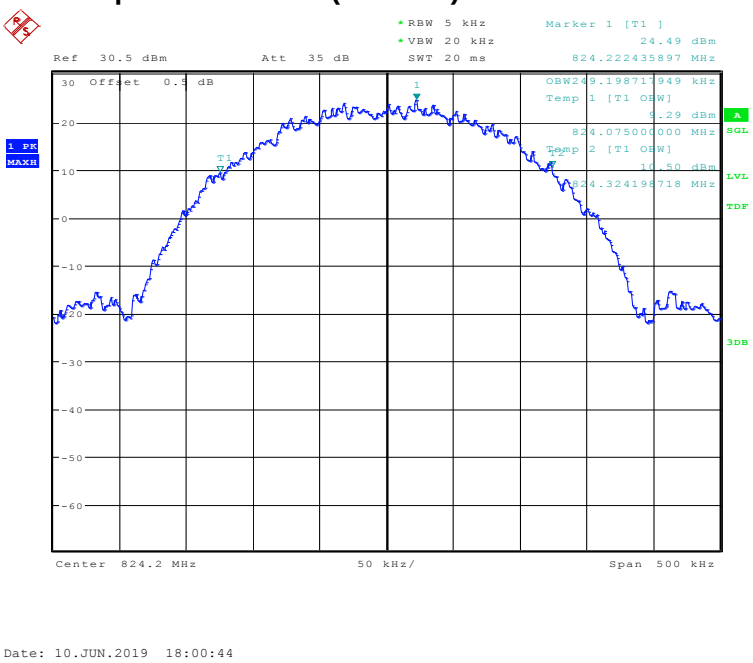
EGPRS 850-8PSK(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	249.20
836.6	248.40
848.8	248.40

EGPRS 850-8PSK

Channel 128-Occupied Bandwidth (99% BW)



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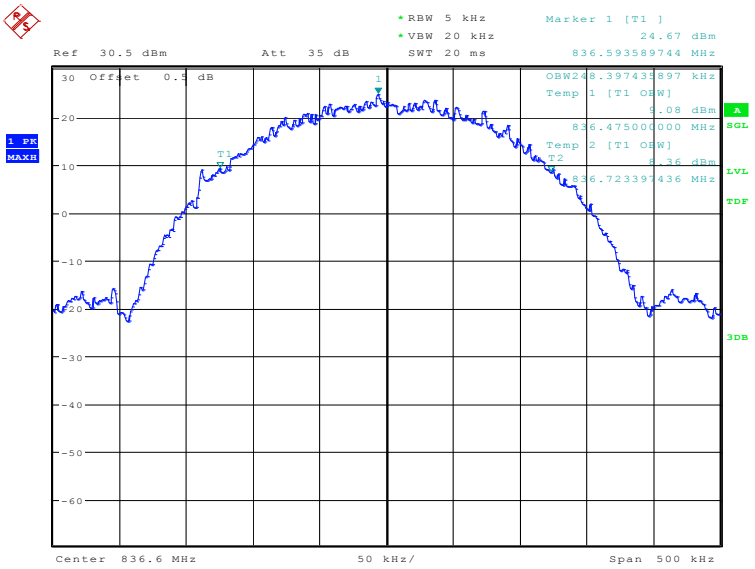
Channel 190-Occupied Bandwidth (99% BW)



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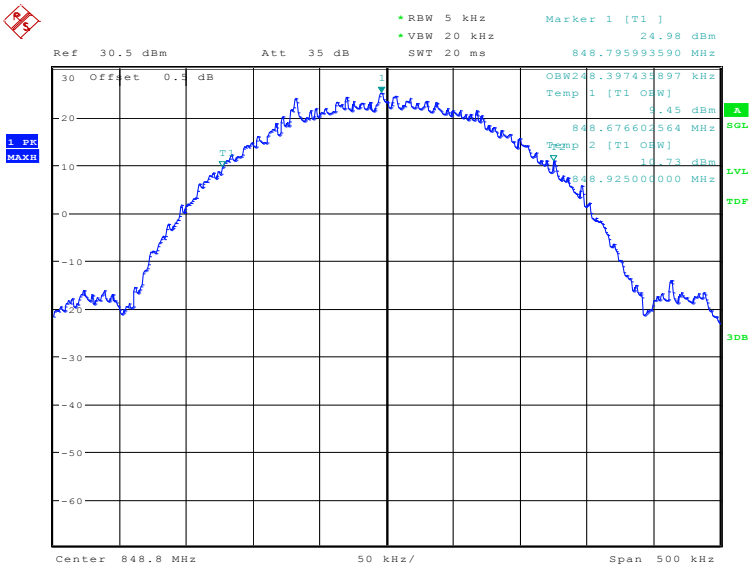
Channel 251-Occupied Bandwidth (99% BW)



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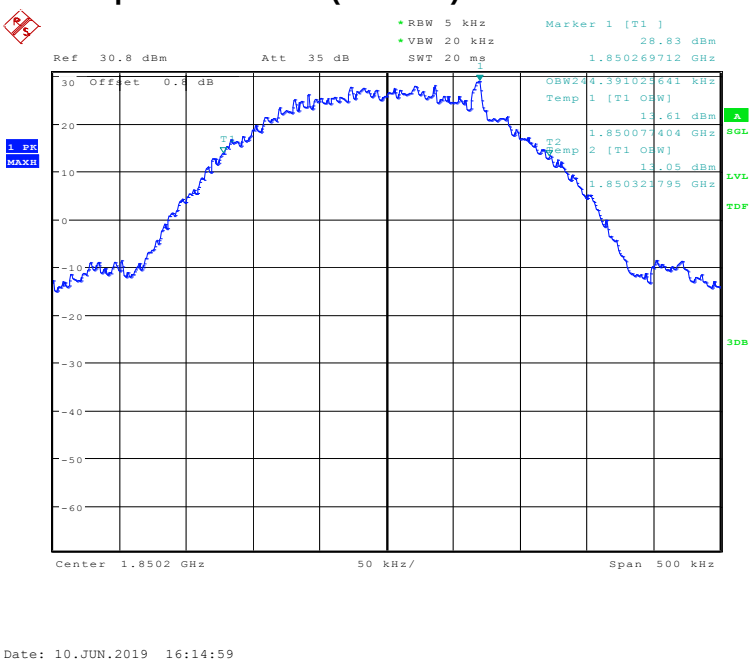
PCS 1900(99% BW)

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

PCS 1900

Channel 512-Occupied Bandwidth (99% BW)



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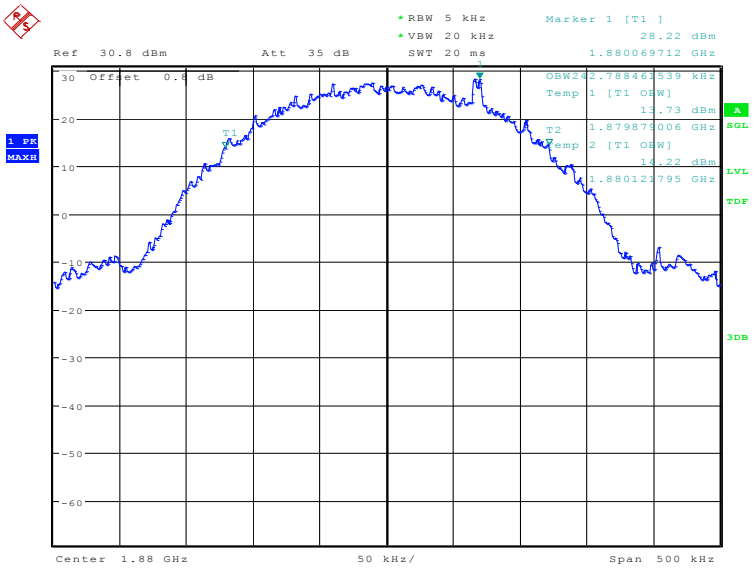
Channel 661-Occupied Bandwidth (99% BW)



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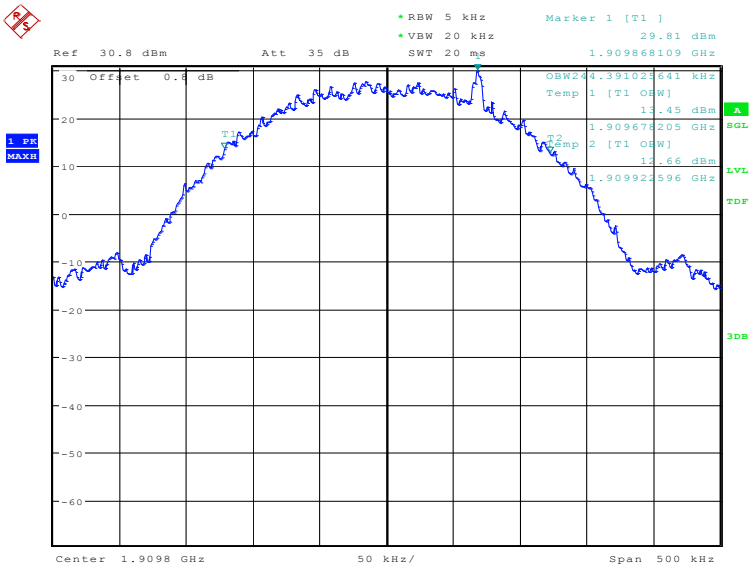
Channel 810-Occupied Bandwidth (99% BW)



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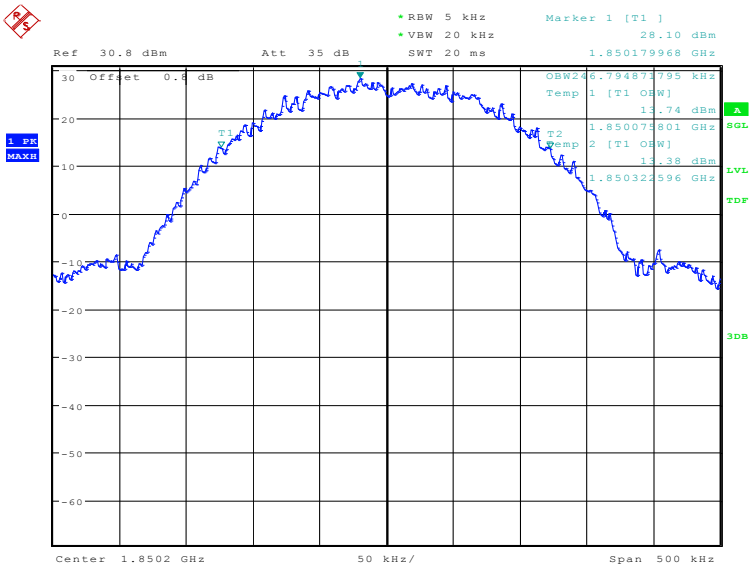
GPRS 1900(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	246.79
1880.0	241.99
1909.8	244.39

GPRS 1900

Channel 512-Occupied Bandwidth (99% BW)



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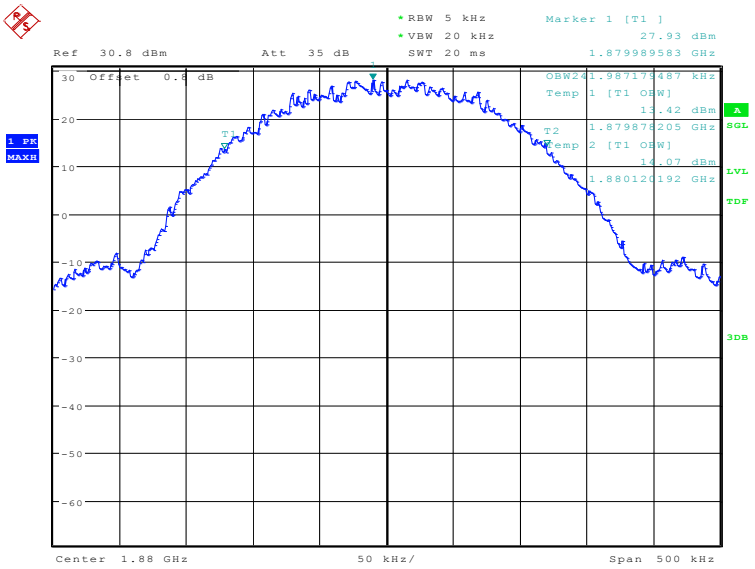
Channel 661-Occupied Bandwidth (99% BW)



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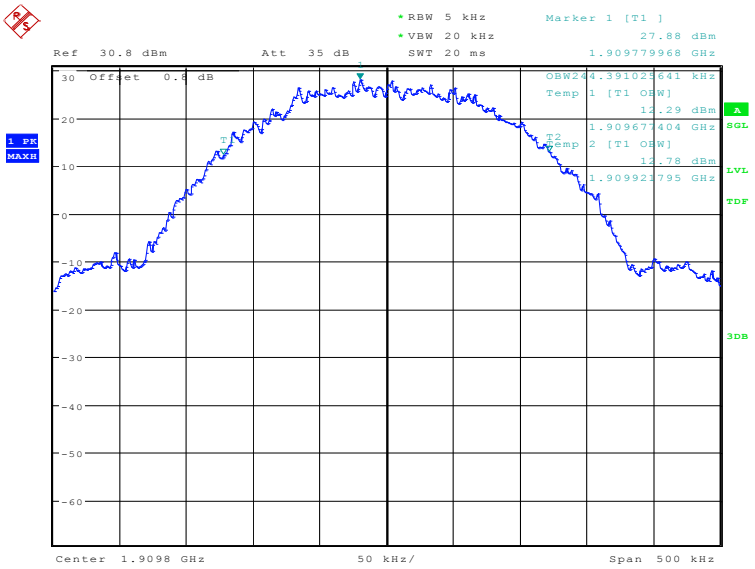
Channel 810-Occupied Bandwidth (99% BW)



Date: 10.JUN.2019 17:11:57

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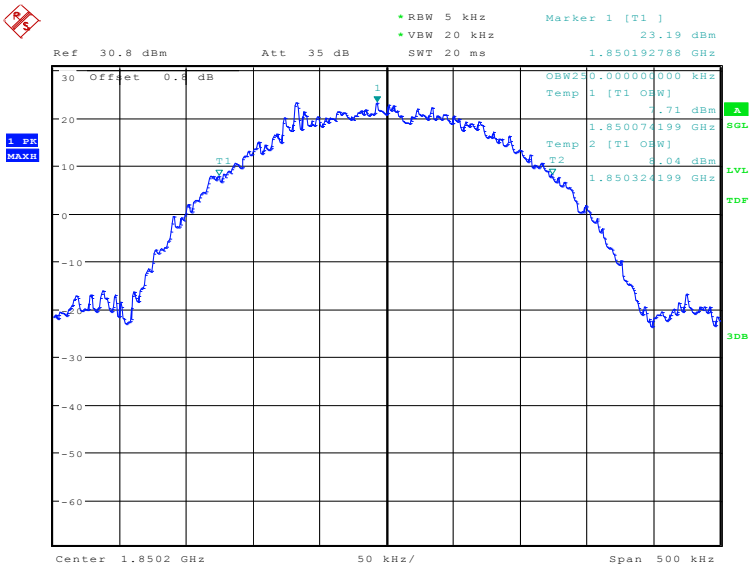
EGPRS 1900-8PSK(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	250.00
1880.0	245.19
1909.8	251.60

EGPRS 1900-8PSK

Channel 512-Occupied Bandwidth (99% BW)



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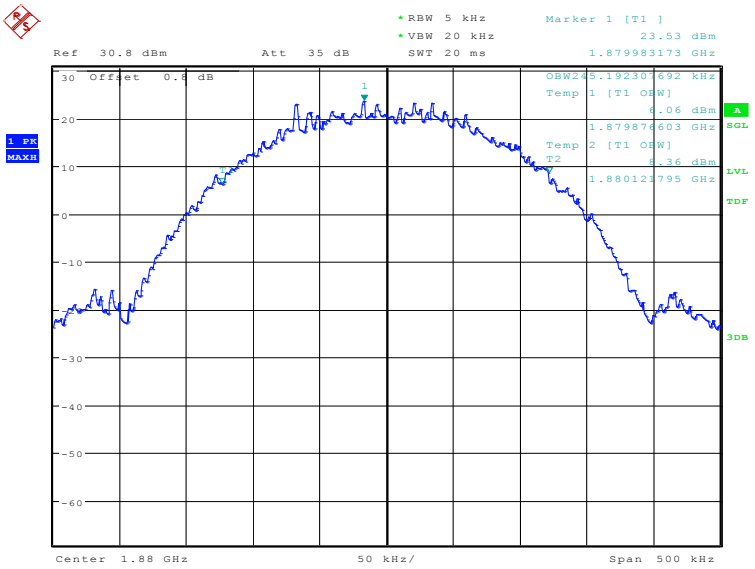
Channel 661-Occupied Bandwidth (99% BW)



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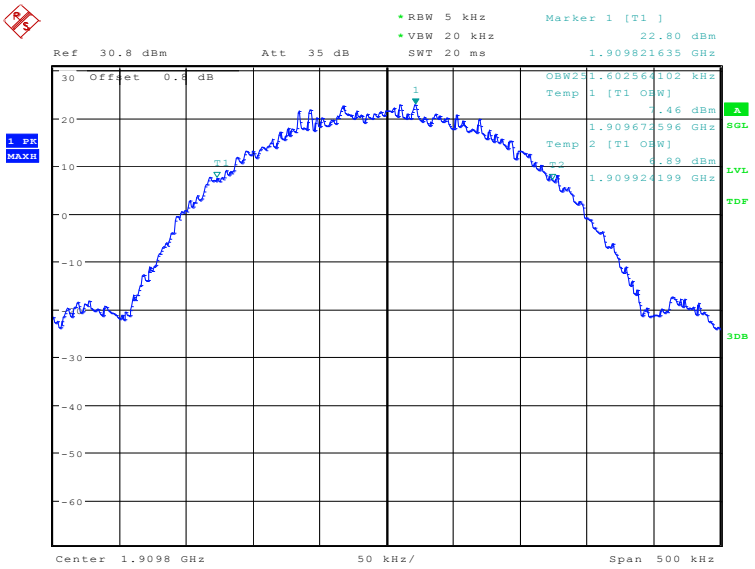
Channel 810-Occupied Bandwidth (99% BW)



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A.5 EMISSION BANDWIDTH

A.5.1Emission Bandwidth Results

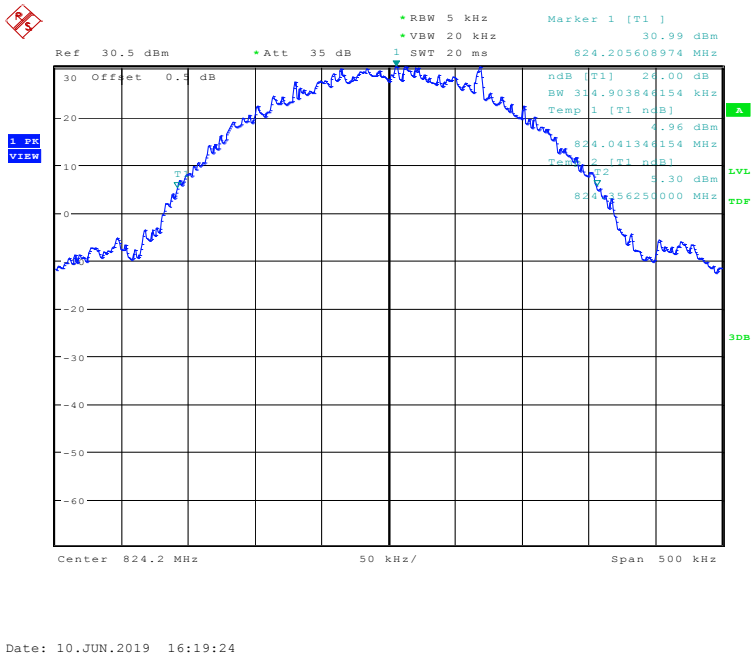
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

GSM 850

Frequency(MHz)	Emission Bandwidth (kHz)
824.2	314.90
836.6	317.31
848.8	315.71

GSM 850

Channel 128-Emission Bandwidth



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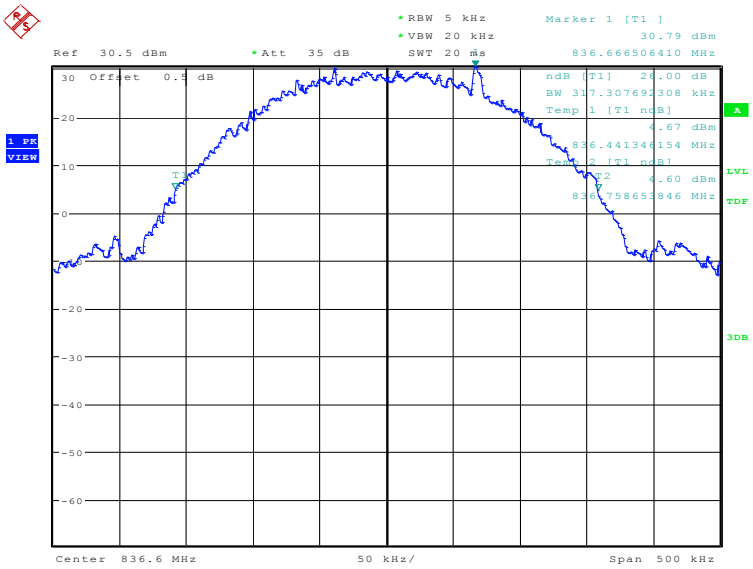
Channel 190-Emission Bandwidth



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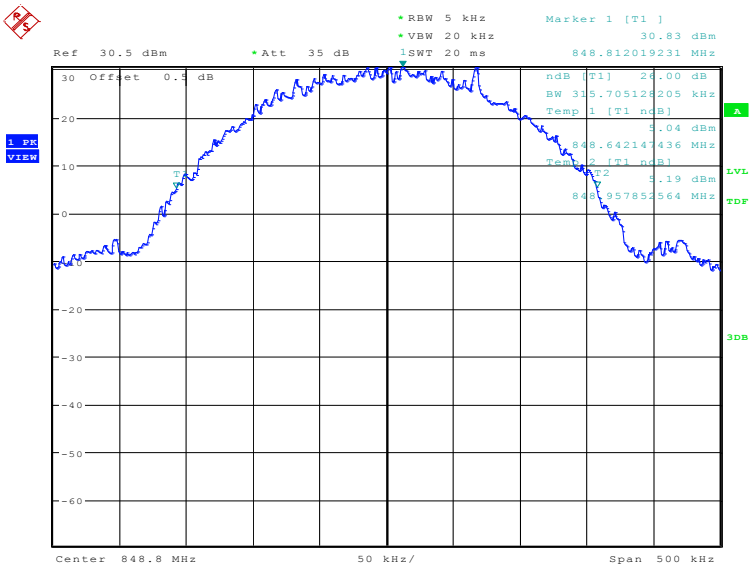
Channel 251-Emission Bandwidth



Date: 10.JUN.2019 16:21:47

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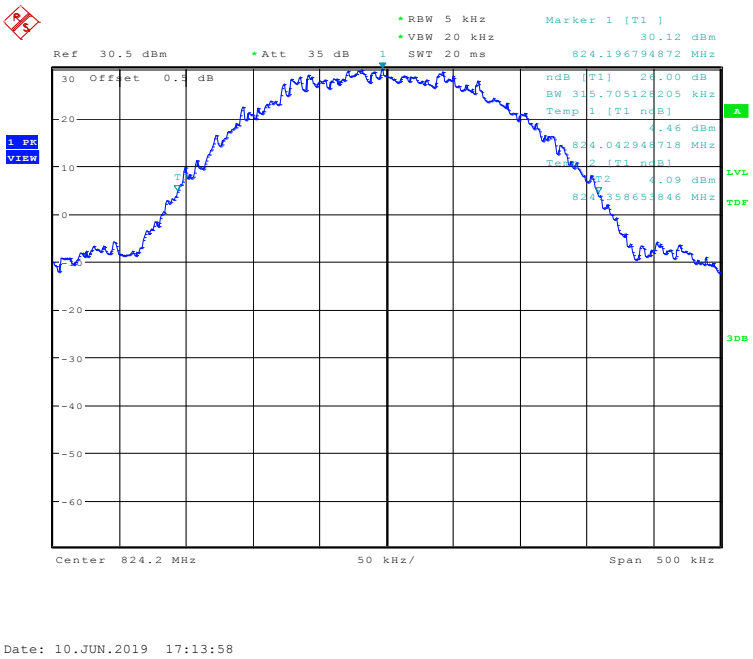
GPRS 850

Frequency(MHz)	Emission Bandwidth (kHz)
824.2	315.71
836.6	318.11
848.8	316.51

GPRS 850

Channel 128-Emission Bandwidth



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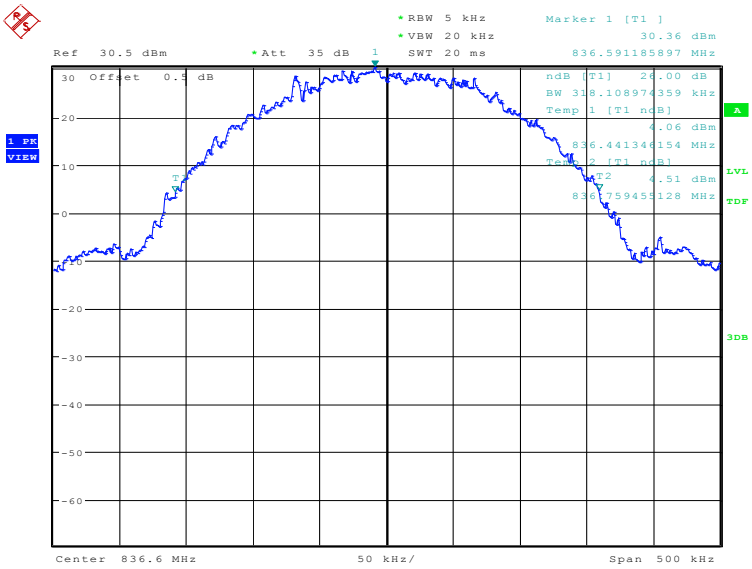
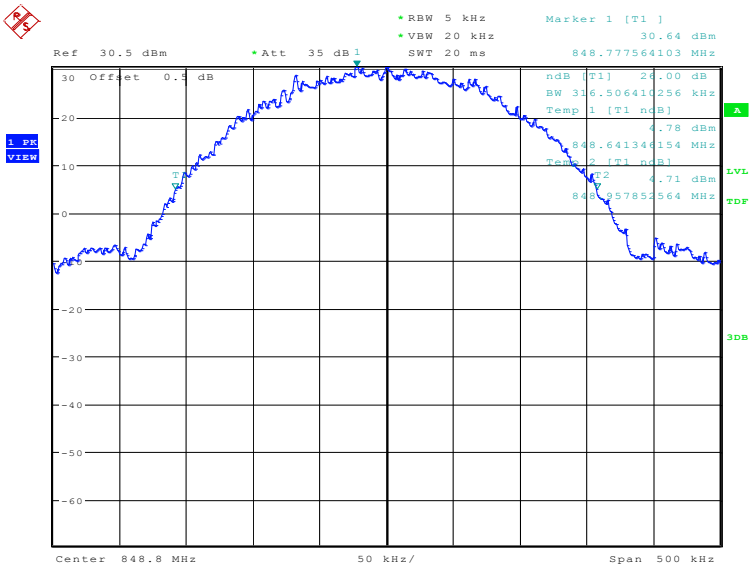
Channel 190-Emission Bandwidth



Date: 10.JUN.2019 17:15:10

Channel 251-Emission Bandwidth



Date: 10.JUN.2019 17:16:22

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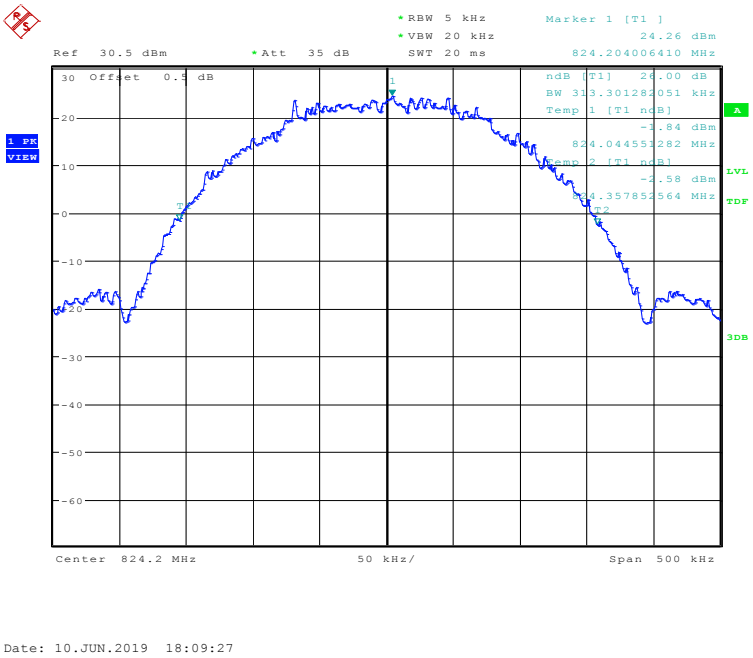
EGPRS 850-8PSK

Frequency(MHz)	Emission Bandwidth (kHz)
824.2	313.30
836.6	318.11
848.8	313.30

EGPRS 850-8PSK

Channel 128-Emission Bandwidth



Date: 10.JUN.2019 18:09:27

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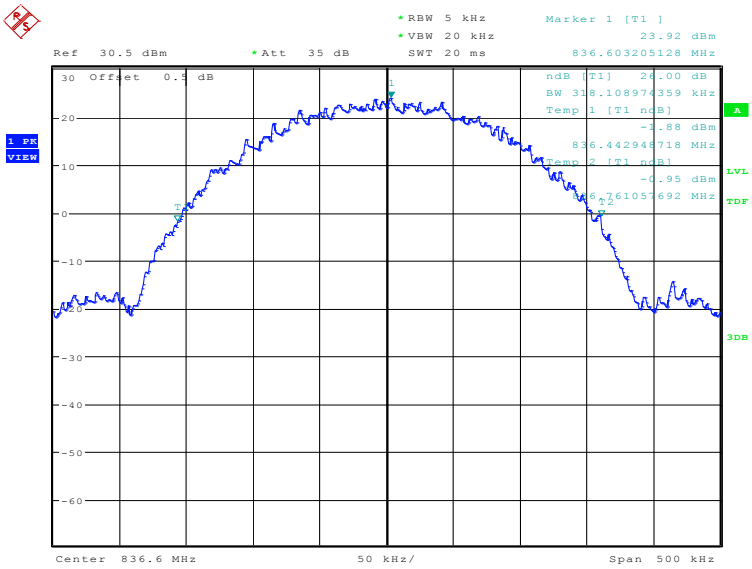
Channel 190-Emission Bandwidth



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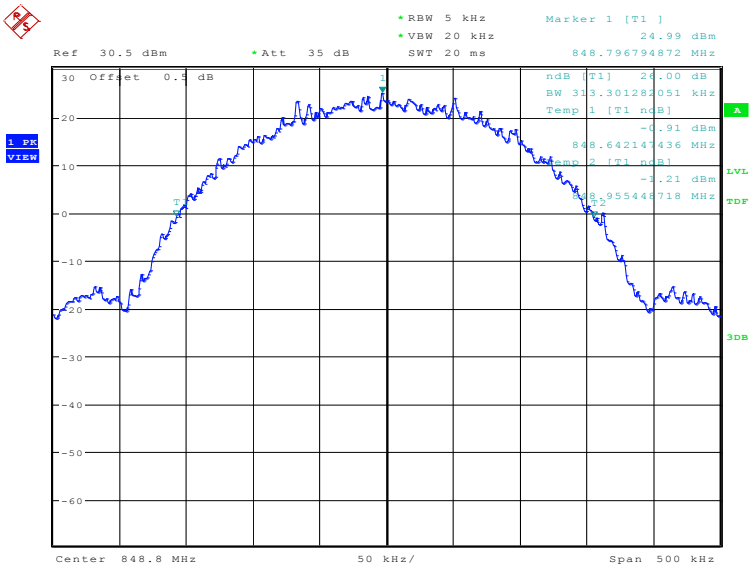
Channel 251-Emission Bandwidth



Date: 10.JUN.2019 18:11:50

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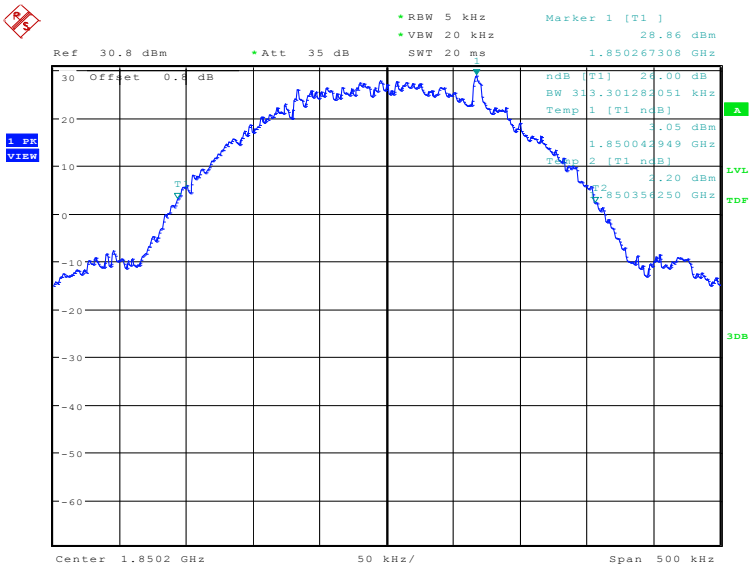
PCS 1900

Frequency(MHz)	Emission Bandwidth (kHz)
1850.2	313.30
1880.0	313.30
1909.8	309.29

PCS 1900

Channel 512-Emission Bandwidth



Date: 10.JUN.2019 16:23:42

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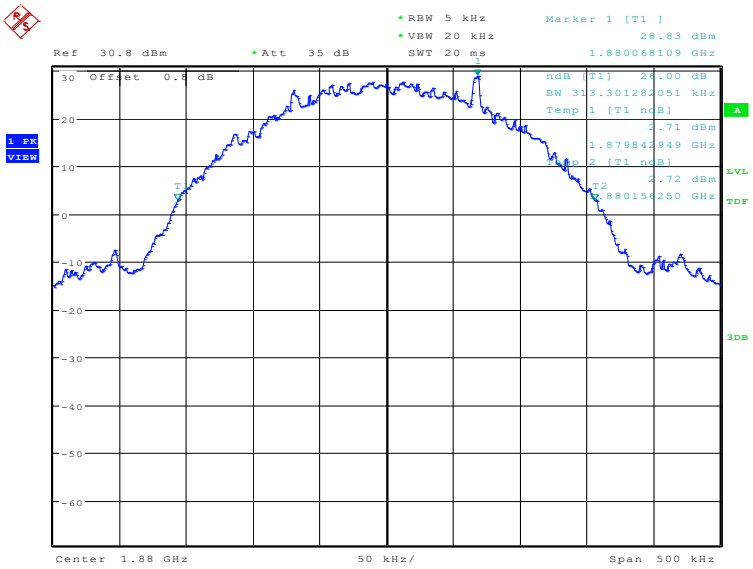
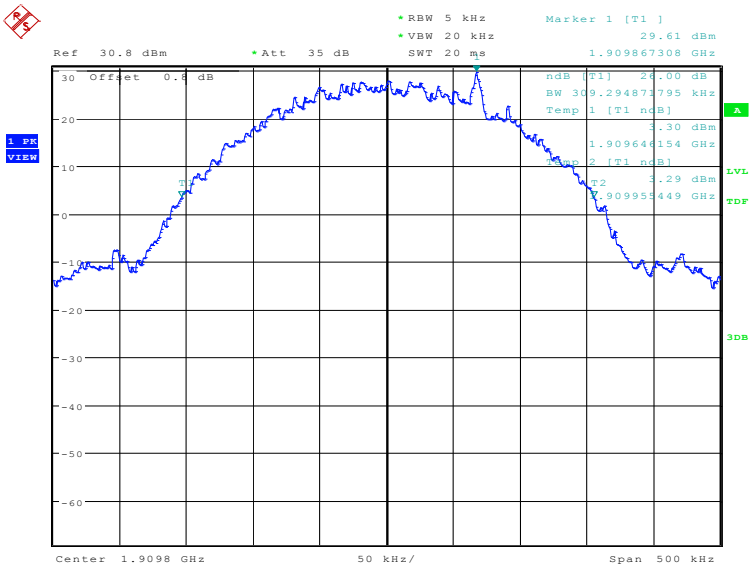
Channel 661-Emission Bandwidth



Date: 10.JUN.2019 16:24:53

Channel 810-Emission Bandwidth



Date: 10.JUN.2019 16:26:05

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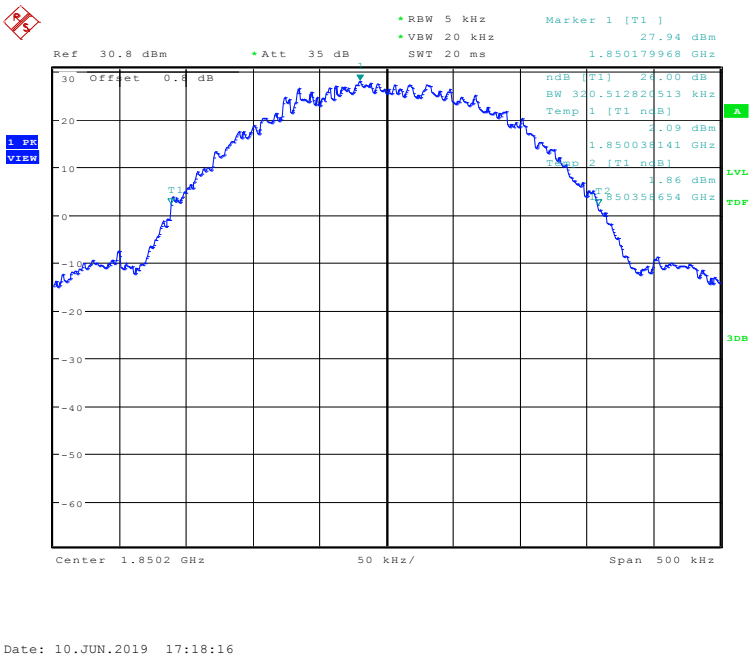
GPRS 1900

Frequency(MHz)	Emission Bandwidth (kHz)
1850.2	320.51
1880.0	310.10
1909.8	319.71

GPRS 1900

Channel 512-Emission Bandwidth



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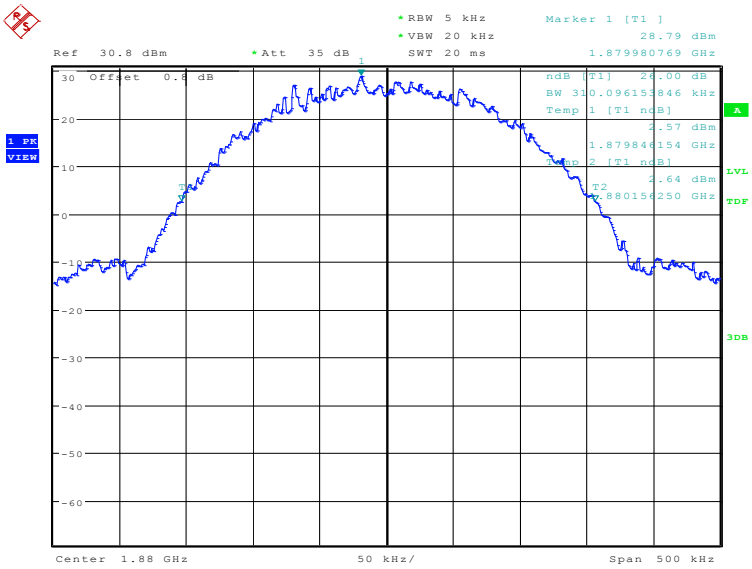
Channel 661-Emission Bandwidth



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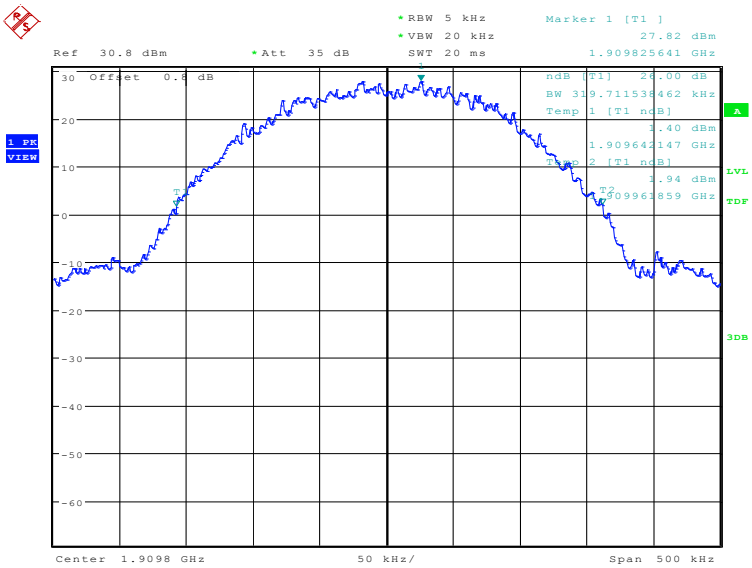
Channel 810-Emission Bandwidth



Date: 10.JUN.2019 17:20:40

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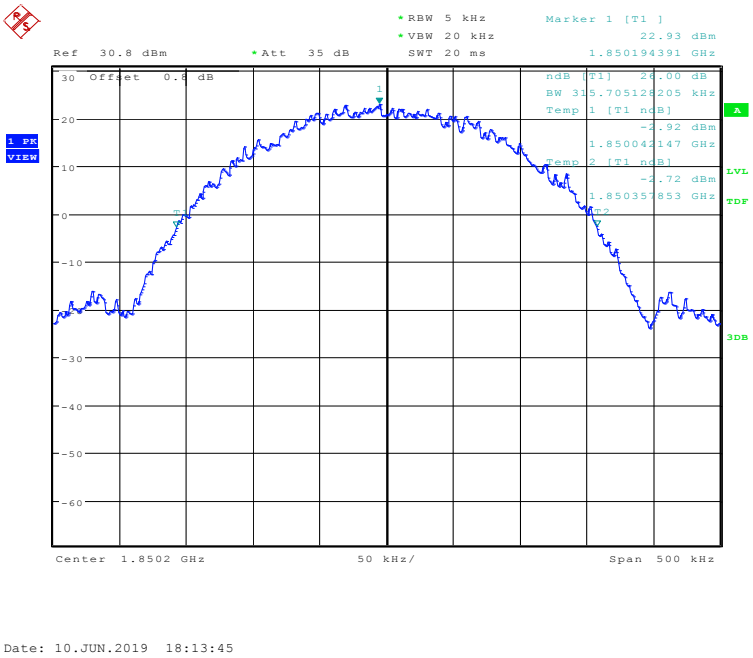
EGPRS 1900-8PSK

Frequency(MHz)	Emission Bandwidth(kHz)
1850.2	315.71
1880.0	316.51
1909.8	314.10

EGPRS 1900-8PSK

Channel 512-Emission Bandwidth



Date: 10.JUN.2019 18:13:45

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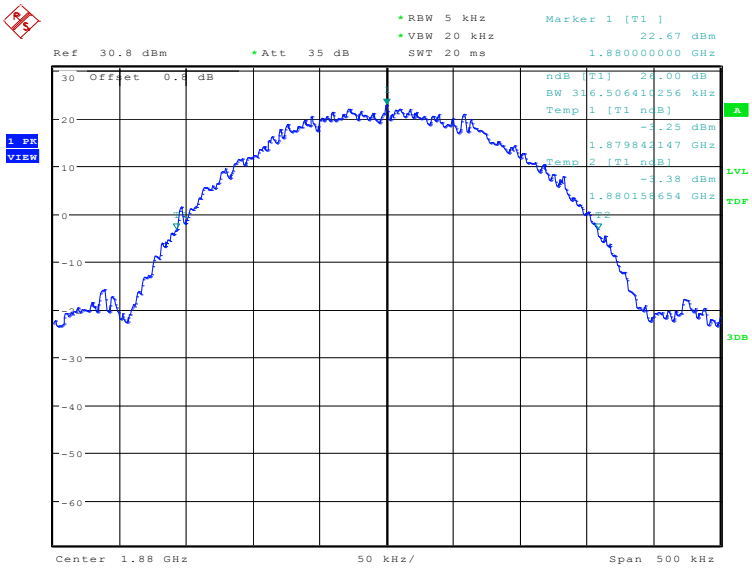
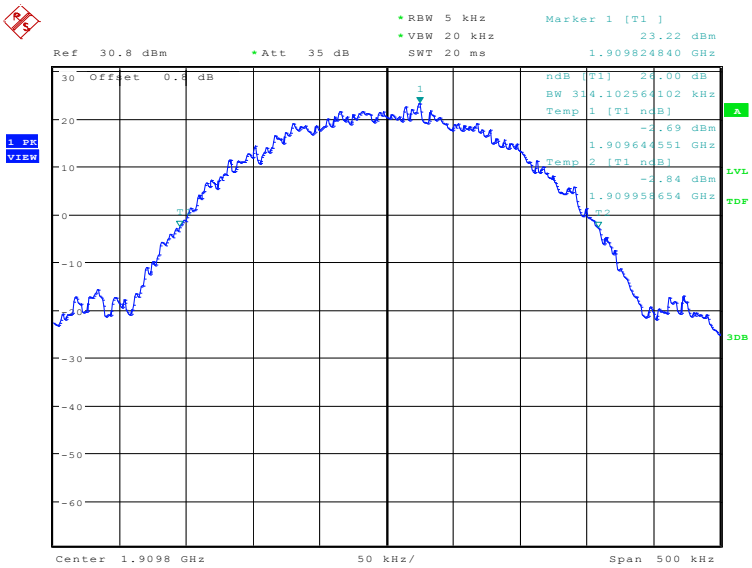
Channel 661-Emission Bandwidth



Date: 10.JUN.2019 18:14:57

Channel 810-Emission Bandwidth



Date: 10.JUN.2019 18:16:09

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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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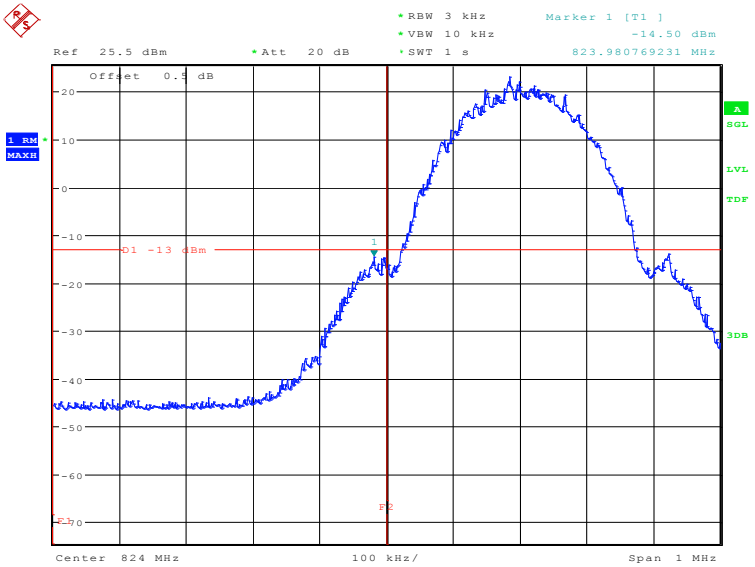
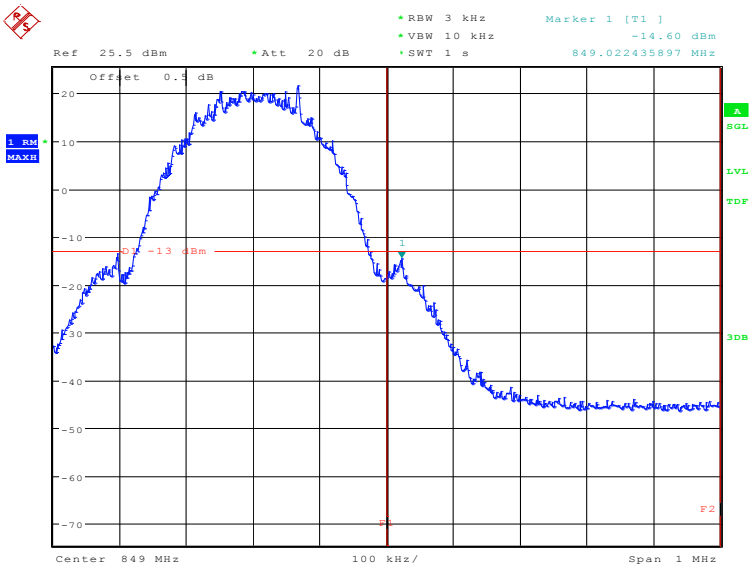
GSM 850

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



Date: 14.JUN.2019 08:44:25

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



Date: 10.JUN.2019 16:37:28

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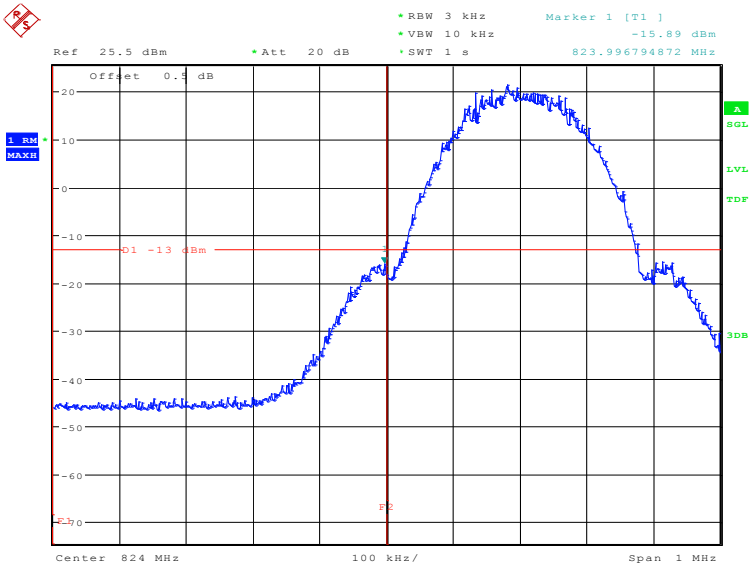
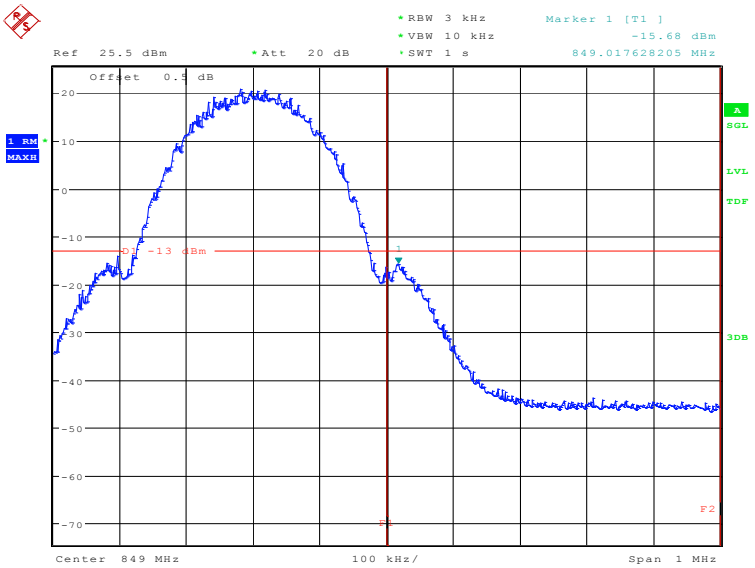
GPRS 850

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



Date: 10.JUN.2019 17:26:46

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



Date: 10.JUN.2019 17:32:03

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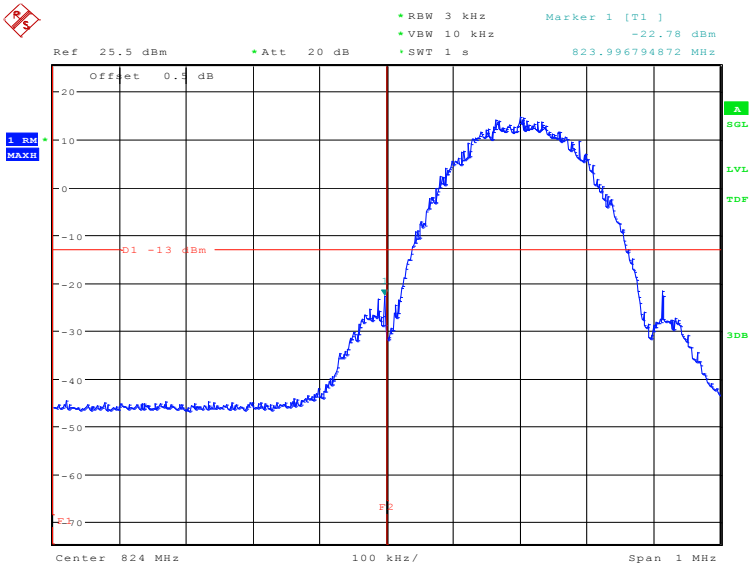
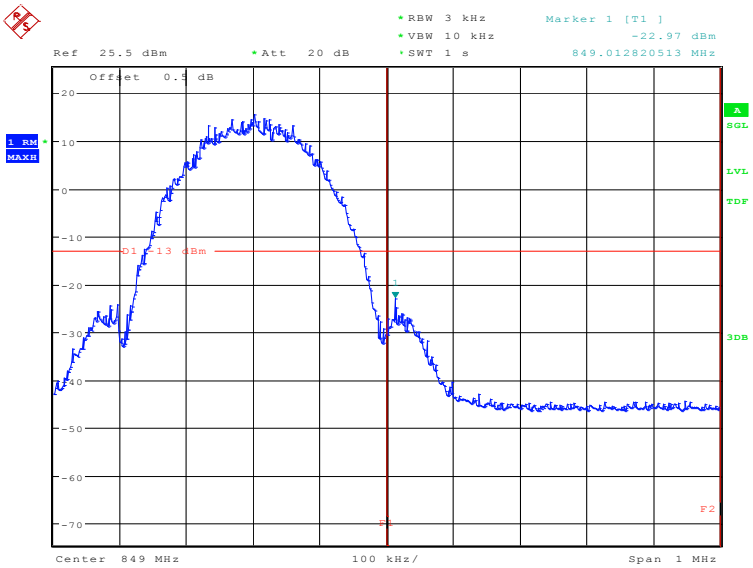
EGPRS 850-8PSK

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



Date: 10.JUN.2019 18:22:15

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



Date: 10.JUN.2019 18:27:32

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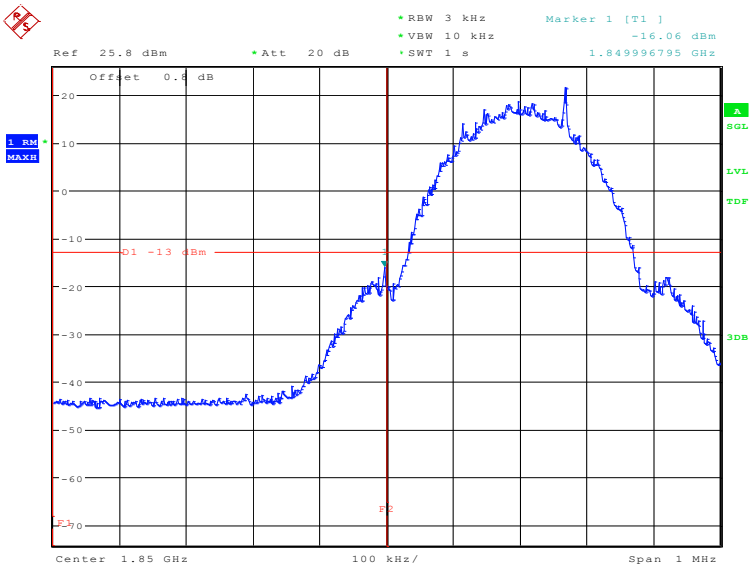
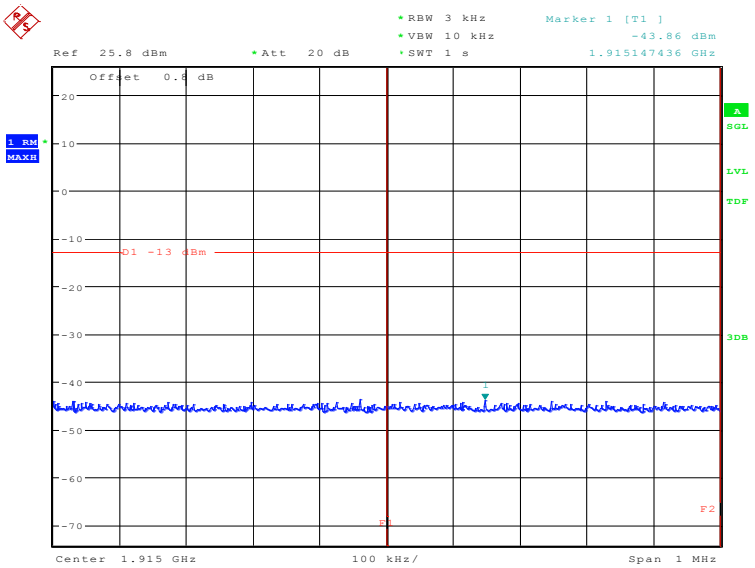
PCS 1900

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



Date: 10.JUN.2019 16:43:28

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



Date: 10.JUN.2019 16:48:44

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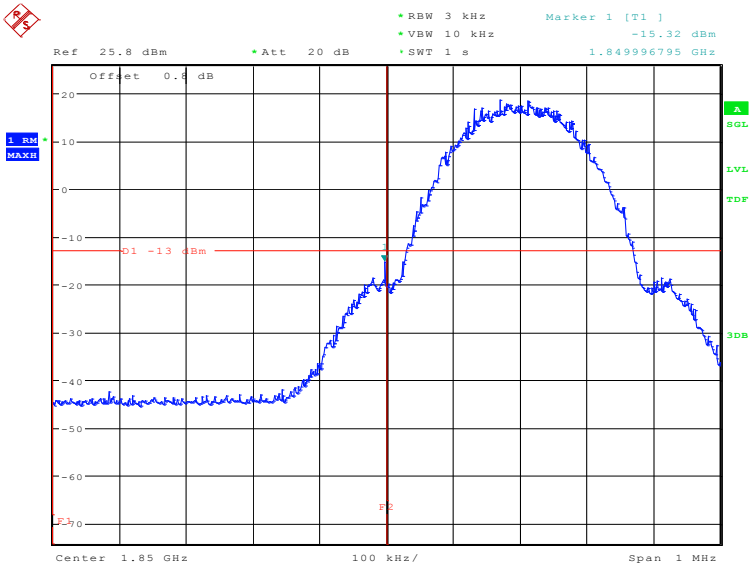
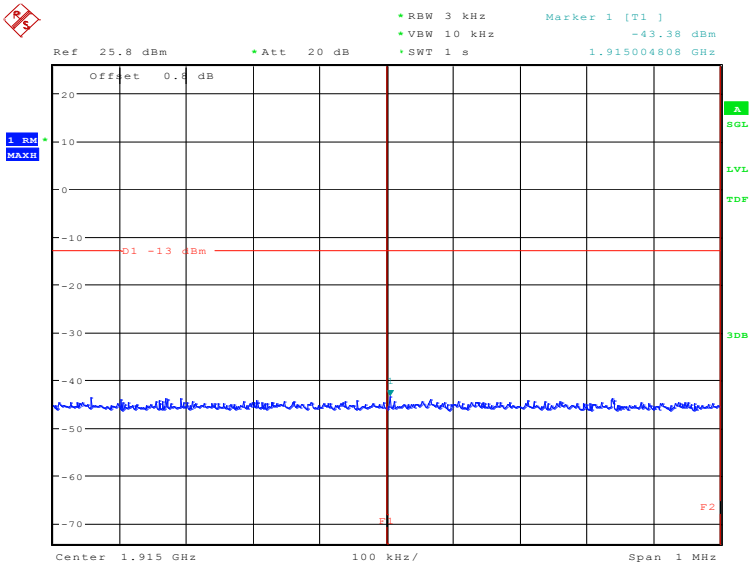
GPRS 1900

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



Date: 10.JUN.2019 17:38:02

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



Date: 10.JUN.2019 17:43:19

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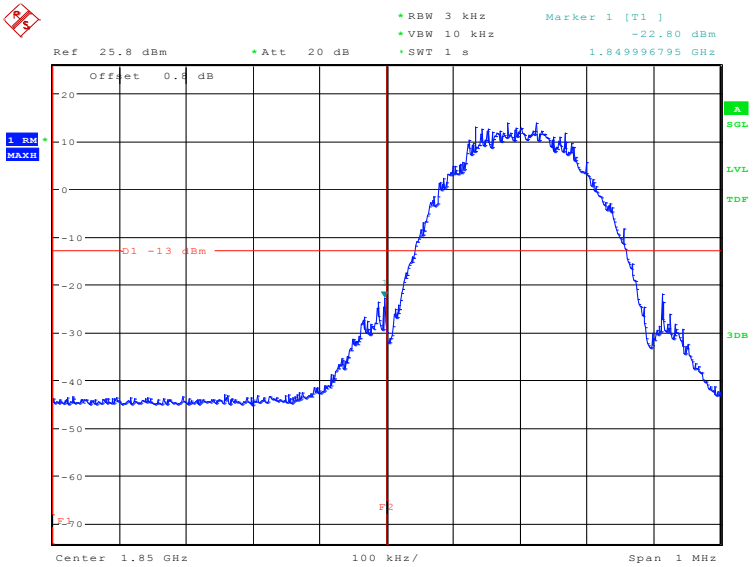
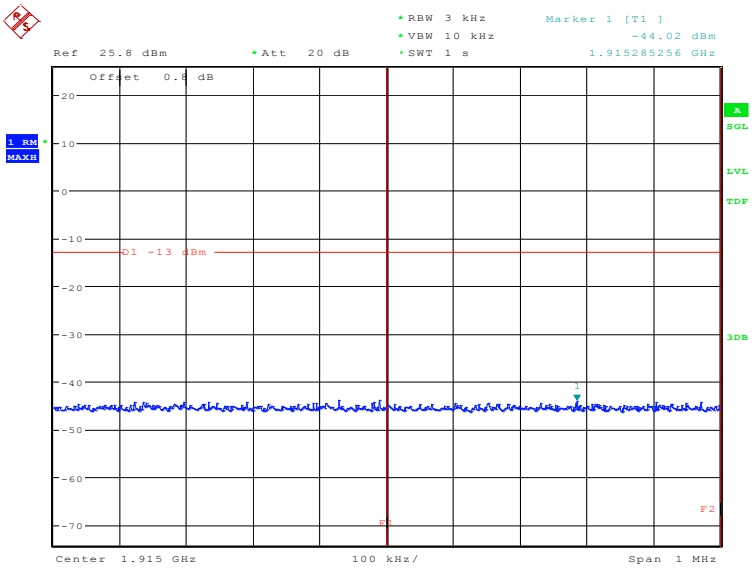
EGPRS 1900-8PSK

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



Date: 10.JUN.2019 18:33:32

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



Date: 10.JUN.2019 18:38:48

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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. Determine frequency range for measurements: From CFR 2.1057 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.
3. According to KDB 971168 6.0, 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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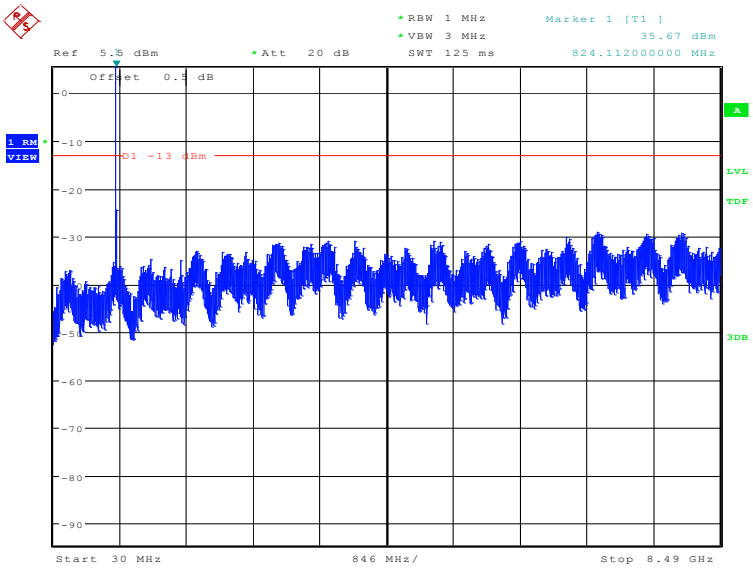
A.7.3 Measurement result

GSM850

Channel 128: 30MHz – 8.49GHz

Spurious emission limit –13dBm.

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

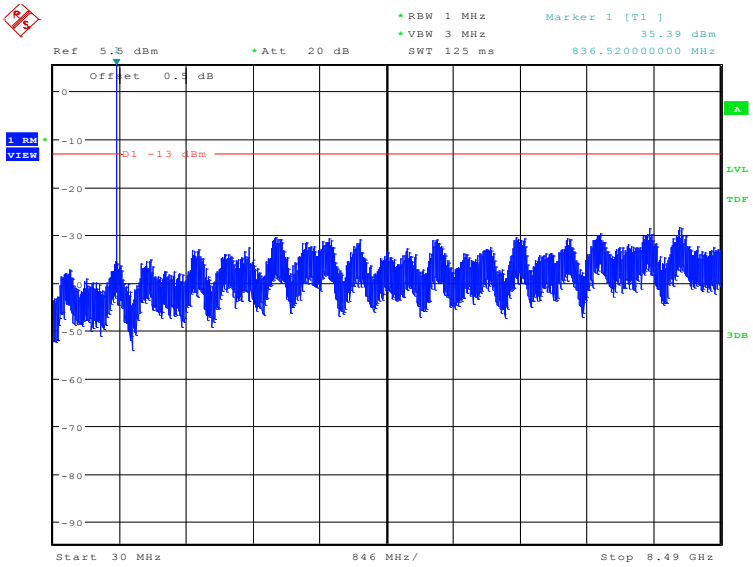


Date: 10.JUN.2019 16:49:50

Channel 190: 30MHz – 8.49GHz

Spurious emission limit –13dBm

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



Date: 10.JUN.2019 16:50:06

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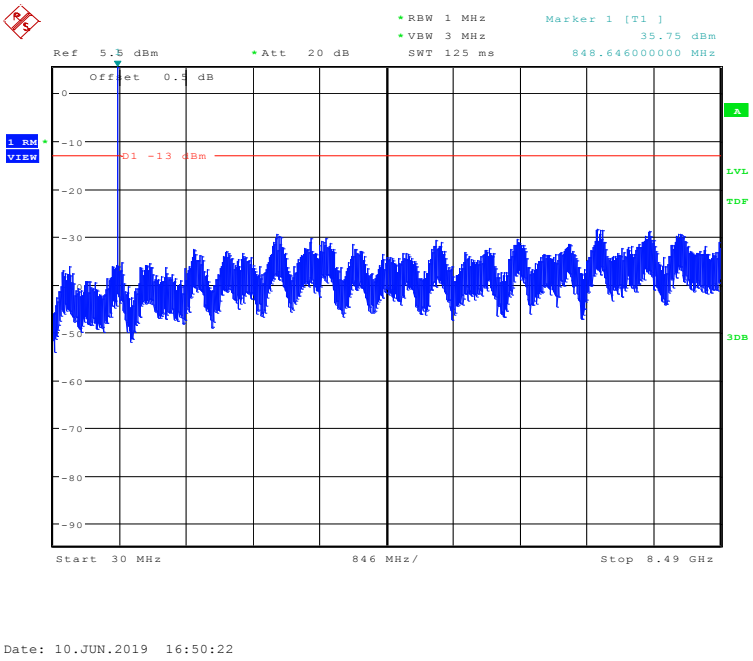
Channel 251: 30MHz – 8.49GMHz

Spurious emission limit –13dBm.

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



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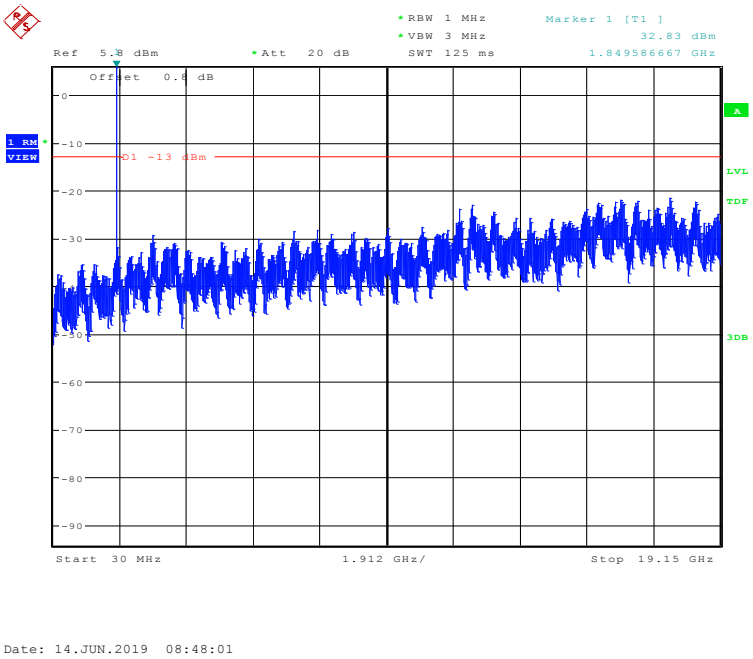
PCS1900

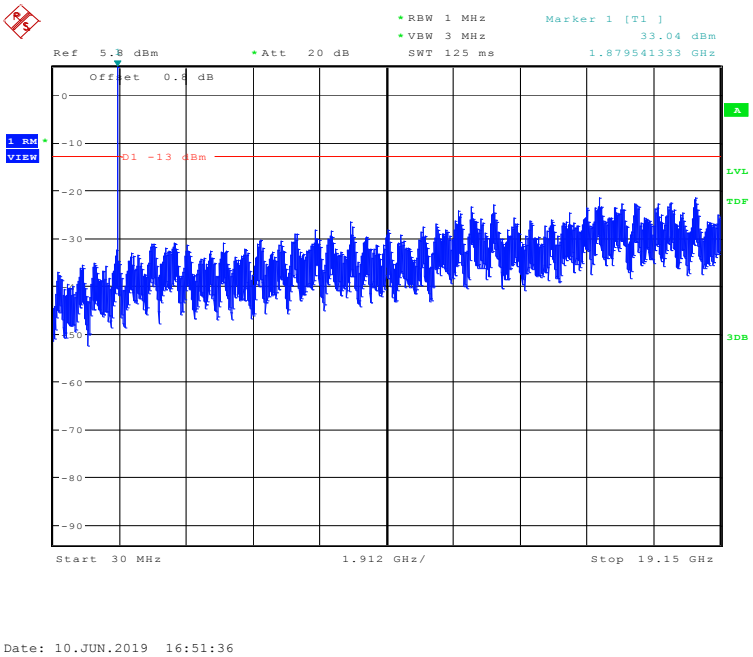
Channel 512: 30MHz – 19.15GHz

Spurious emission limit –13dBm.



Channel 661: 30MHz – 19.15GHz

Spurious emission limit –13dBm



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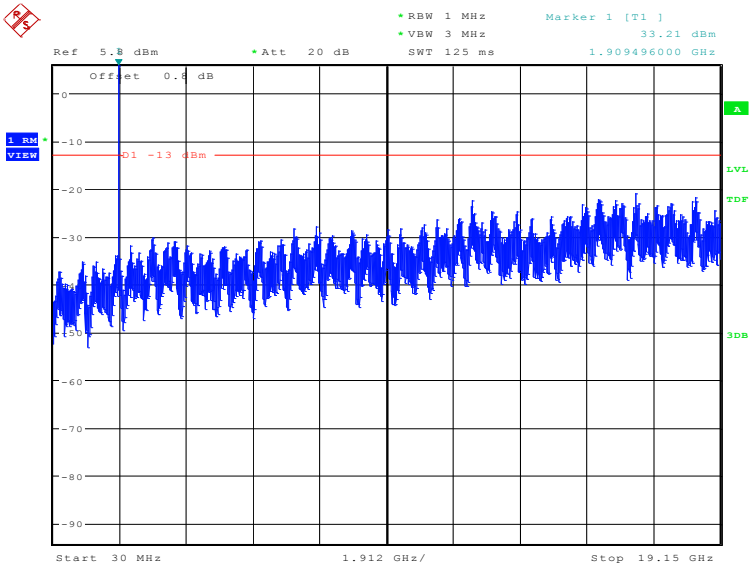
Channel 810: 30MHz – 19.15GHz

Spurious emission limit –13dBm



Date: 10.JUN.2019 16:51:52

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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.
According to KDB 971168:
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

	Frequency(MHz)	PAPR(dB)
PCS1900	1880.0	7.69
GPRS1900	1880.0	7.69
EGPRS1900(8PSK)	1880.0	10.48

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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).

2018-09-28 through 2019-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program

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

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