TEST REPORT

No. I22Z61849-WMD01

for

HMD Global Oy

Smart Phone

Model Name: TA-1515

FCC ID: 2AJOTTA-1515

with

Hardware Version: V1.0

Software Version: 00US_0_060

Issued Date: 2022-12-13

Note:

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

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S.Government.

Test Laboratory:

CTTL, Telecommunication Technology Labs, CAICT

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I22Z61849-WMD01	Rev.0	1st edition	2022-12-13

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

CONTENTS

1. Test Laboratory

1.1. Introduction & Accreditation

Telecommunication Technology Labs, CAICT is an ISO/IEC 17025:2017 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 (BDA)

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

1.3. Testing Environment

Normal Temperature: 15-35℃

Relative Humidity: 20-75%

1.4. Project Data

Testing Start Date: 2022-09-25

Testing End Date: 2022-12-07

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)

2. Client Information

2.1. Applicant Information

Company Name:	HMD Global Oy
Address /Post:	Bertel Jungin aukio 9, 02600 Espoo, Finland
Contact:	Reza Serafat
Email:	reza.serafat@hmdglobal.com
Telephone:	+491735287964

2.2. Manufacturer Information

Company Name:	HMD Global Oy
Address /Post:	Bertel Jungin aukio 9, 02600 Espoo, Finland
Contact:	Reza Serafat
Email:	reza.serafat@hmdglobal.com
Telephone:	+491735287964

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

3.1. About EUT

Description	Smart Phone
Model Name	TA-1515
FCC ID	2AJOTTA-1515
Antenna	Embedded
Output power	30.33dBm maximum EIRP measured for PCS1900
Extreme vol. Limits	3.6VDC to 4.4VDC (nominal: 3.85VDC)
Extreme temp. Tolerance	0°C to +45°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	357433970004299	V1.0	00US_0_060	2022-09-22
UT25a	357433970006013	V1.0	00US_0_060	2022-11-15
UT23a	357433970006641	V1.0	00US_0_060	2022-11-15

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

UT25a is first source, and UT23a is second source.

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery
AE2	Battery

AE1

Model	TN-BP4000N2
Manufacturer	Guangdong Fenghua new energy co.,ltd.
Capacitance	3900mAh

AE2

Model	TN-BP4000N2
Manufacturer	Dongguan Ganfeng Electronics Co., Ltd
Capacitance	3900mAh

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

4. Reference Documents

4.1. Documents supplied by applicant

EUT parameters are supplied by the customer, which are the bases of testing. CAICT is not responsible for the accuracy of customer supplied technical information that may affect the test results (for example, antenna gain and loss of customer supplied cable).

4.2. Reference Documents for testing

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

Reference	Title	Version
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-21 Edition
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-21 Edition
ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	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

5. Laboratory Environment

Fully-anechoic chamber 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	< 4Ω
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

Shielded room did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz - 1MHz, >60dB; 1MHz - 1000MHz, >90dB.
Electrical insulation	> 2 MΩ
Ground system resistance	< 4Ω

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

First source

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

Second source

Items	List	Clause in FCC rules	Verdict
2	Emission Limit	2.1051/24.238	P

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.

All the test results are based on normal power.

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.

7. Test Equipments Utilized

Description	Type	Series Number	Manufacture	Cal Due Date	Calibration Interval
Universal Radio Communication Tester	CMU200	108646	R&S	2023-01-17	25 months
Spectrum Analyzer	FSU	200030	R&S	2023-05-25	1 year
Climate chamber	SH-242	93008556	ESPEC	2023-12-23	3 years
EMI Antenna	VULB9163	9163-235	Schwarzbeck	2023-04-19	1 year
EMI Antenna	3115	00146404	ETS-Lindgren	2023-02-23	1 year
EMI Antenna	LB-7180-NF	J203001300005	A-INFO	2023-02-23	1 year
Signal Generator	SMF100A	101295	R&S	2022-12-23	1 year
Test Receiver	E4440A	MY48250642	Agilent	2023-03-10	1 year
Universal Radio Communication Tester	CMW500	143008	R&S	2023-04-01	1 year

Annex A: Measurement Results

A.1 Output Power

A.1.1 Summary

During the process of testing, the EUT was controlled via communication tester 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 (bottom, middle and top of operational frequency range) for each bandwidth.

The results below include a correction factor for cable loss that is provided by the customer.

A.1.2.2 Measurement Result

GSM850

GSM(GMSK)

Frequency (MHz)	Power Step	Output power (dBm)
824.2	5	32.90
836.6	5	32.96
848.8	5	32.37

GPRS(GMSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
824.2	3	32.79
836.6	3	32.89
848.8	3	32.91

EGPRS(8PSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
824.2	6	26.98
836.6	6	26.87
848.8	6	26.76

PCS1900

GSM(GMSK)

Frequency (MHz)	Power Step	Output power (dBm)
1850.2	0	29.93
1880.0	0	29.84
1909.8	0	29.66

GPRS(GMSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
1850.2	3	29.91
1880.0	3	29.78
1909.8	3	29.59

EGPRS(8PSK,1Slot)

Frequency (MHz)	Power Step	Output power (dBm)
1850.2	5	25.89
1880.0	5	25.80
1909.8	5	25.56

A.1.3 Radiated

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

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

Part 24.232(c) specifies "Mobile and portable stations are limited to 2 watts EIRP".

A.1.3.2 Method of Measurement

ANSI C63.26 chapter 5.2.5.5: when working in decibels (i.e., logarithmic scale), the ERP and EIRP represent the sum of the transmit antenna gain (in dBd or dBi, respectively) and the conducted RF output power (expressed in dB relative to watts or milliwatts).

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation (1) as follows:

$$ERP \text{ or } EIRP = P_{Mea} + G_T$$

Where

ERP or EIRP	effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Mea} , e.g., dBm or dBW)
P_{Mea}	measured transmitter output power or PSD, in dBm or dBW
G_T	gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

The antenna gain provided by the client may affect the validity of the measurement results in this report, and the client shall bear the impact and consequences arising therefrom.

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)

PCS1900-EIRP

Limits

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

Measurement result

GSM850

GSM(GMSK)

Frequency (MHz)	Conducted output power (dBm)	Radiated output power (dBm) G_T = -2.53dBi
824.2	32.90	28.22
836.6	32.96	28.28
848.8	32.37	27.69

GPRS(GMSK,1Slot)

Frequency (MHz)	Conducted output power (dBm)	Radiated output power (dBm) G_T = -2.53dBi
824.2	32.79	28.11
836.6	32.89	28.21
848.8	32.91	28.23

EGPRS(8PSK,1Slot)

Frequency (MHz)	Conducted output power (dBm)	Radiated output power (dBm) G_T = -2.53dBi
824.2	26.98	22.30
836.6	26.87	22.19
848.8	26.76	22.08

PCS1900

GSM(GMSK)

Frequency (MHz)	Conducted output power (dBm)	Radiated output power (dBm) G_T = 0.4dBi
1850.2	29.93	30.33
1880.0	29.84	30.24
1909.8	29.66	30.06

GPRS(GMSK,1Slot)

Frequency (MHz)	Conducted output power (dBm)	Radiated output power (dBm) G_T = 0.4dBi
1850.2	29.91	30.31
1880.0	29.78	30.18
1909.8	29.59	29.99

EGPRS(8PSK,1Slot)

Frequency (MHz)	Conducted output power (dBm)	Radiated output power (dBm) G_T = 0.4dBi
1850.2	25.89	26.29
1880.0	25.80	26.20
1909.8	25.56	25.96

Note: Expanded measurement uncertainty is U = 0.578 dB, k = 2.

A.2 Emission Limit

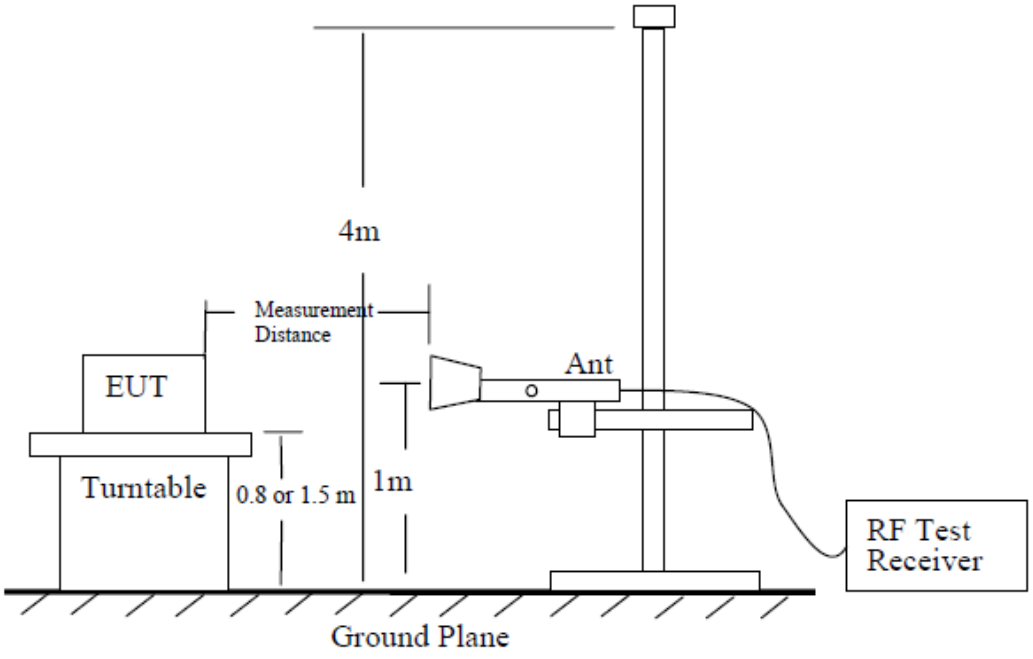
A.2.1 Measurement Method

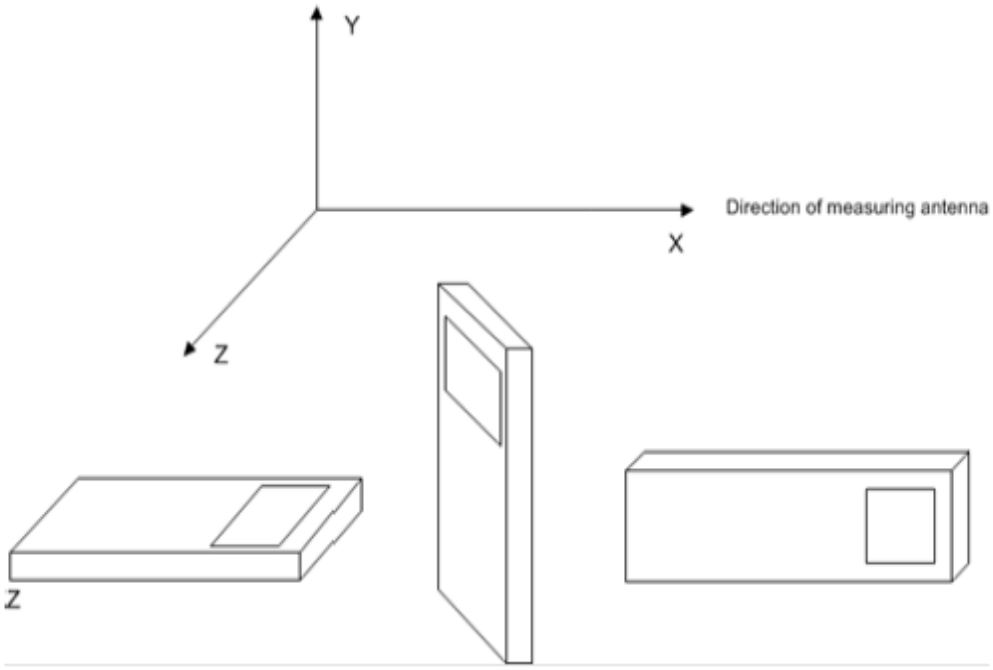
The measurements procedures in C63.26 are used.

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:

Using the test configuration as follow, measure the radiated emissions directly from the EUT and convert the measured field strength or received power to ERP or EIRP, as required, for comparison to the applicable limits.





The emission characteristics of the EUT can be identified from the pre-scan measurement information.

Exploratory radiated measurements (pre-scans) may be performed to determine the general EUT radiated emissions characteristics and, when necessary, the EUT-to-measurement antenna orientation that produces the maximum emission amplitude. Pre-scans shall only be used to determine the emission frequencies (i.e., not amplitude levels). The information garnered from a pre-scan can then be used to perform final compliance measurements using either the substitution or direct field strength method.

For radiated emissions measurements performed at frequencies less than or equal to 1 GHz, the EUT shall be placed on a RF-transparent table or support at a nominal height of 80 cm above the reference ground plane. Radiated measurements shall be made with the measurement antenna positioned in both horizontal and vertical polarization. The measurement antenna shall be varied from 1 m to 4 m in height above the reference ground in a search for the relative positioning that produces the maximum radiated signal level (i.e., field strength or received power). When orienting the measurement antenna in vertical polarization, the minimum height of the lowest element of the antenna shall clear the site reference ground plane by at least 25 cm.

The radiated emission measurements of all non-harmonic and harmonics of the transmit frequency through the 10th harmonic were measured with peak detector.

For radiated measurements performed at frequencies above 1 GHz, the EUT shall be placed on an RF transparent table or support at a nominal height of 1.5 m above the ground plane. When maximizing the emissions from the EUT for measurement, the EUT and its transmitting antenna(s) shall be rotated through 360°. For each mode of operation to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

Final measurements shall be performed for the worst case combination(s) of variable technical parameters that result in the maximum measured emission amplitude, record the frequency and amplitude of the highest fundamental emission (if applicable), and the frequency and amplitude data for the six highest-amplitude spurious emissions.

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.

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

Measurement Results:

GSM 850MHz

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	-48.08	3.56	5.23	2.15	-48.56	-13.00	35.60	H
2484.00	-48.54	4.61	6.05	2.15	-49.25	-13.00	36.20	H
3285.02	-62.06	5.28	7.68	2.15	-61.81	-13.00	48.80	H
4130.02	-56.48	6.05	9.03	2.15	-55.65	-13.00	42.70	V
4939.01	-57.26	6.71	9.84	2.15	-56.28	-13.00	43.30	V
5758.01	-56.98	7.25	10.55	2.15	-55.83	-13.00	42.80	H

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
1686.01	-55.21	3.59	5.17	2.15	-55.78	-13.00	42.80	H
2510.00	-38.34	4.63	6.12	2.15	-39.00	-13.00	26.00	H
3347.02	-59.90	5.32	7.83	2.15	-59.54	-13.00	46.50	V
4176.02	-57.89	6.15	9.08	2.15	-57.11	-13.00	44.10	H
5031.01	-57.38	6.58	9.94	2.15	-56.17	-13.00	43.20	H
5874.01	-56.38	7.31	10.53	2.15	-55.31	-13.00	42.30	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	-48.89	3.60	5.14	2.15	-49.50	-13.00	36.50	V
2546.00	-44.44	4.66	6.18	2.15	-45.07	-13.00	32.10	H
3415.02	-60.99	5.38	8.00	2.15	-60.52	-13.00	47.50	V
4254.02	-57.58	6.24	9.15	2.15	-56.82	-13.00	43.80	V
5094.01	-56.80	6.76	10.03	2.15	-55.68	-13.00	42.70	V
5955.01	-56.47	7.47	10.51	2.15	-55.58	-13.00	42.60	V

GSM 1900MHz

First source

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	-56.27	6.42	8.48	-54.21	-13.00	41.21	V
5550.02	-52.67	7.18	10.59	-49.26	-13.00	36.26	V
7406.01	-54.60	8.13	12.09	-50.64	-13.00	37.64	V
9244.01	-53.05	9.03	13.25	-48.83	-13.00	35.83	V
11101.01	-50.77	9.83	13.18	-47.42	-13.00	34.42	V
12942.01	-48.69	10.49	13.47	-45.71	-13.00	32.71	V

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	-52.08	6.26	8.56	-49.78	-13.00	36.78	H
5640.02	-50.26	7.27	10.57	-46.96	-13.00	33.96	V
7520.01	-53.75	8.31	12.22	-49.84	-13.00	36.84	V
9397.01	-53.84	9.04	13.34	-49.54	-13.00	36.54	V
11284.01	-50.38	9.90	13.14	-47.14	-13.00	34.14	V
13146.01	-44.74	10.73	13.70	-41.77	-13.00	28.77	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	-53.40	6.08	8.65	-50.83	-13.00	37.83	V
5730.02	-48.20	7.29	10.55	-44.94	-13.00	31.94	H
7640.01	-50.37	8.15	12.31	-46.21	-13.00	33.21	H
9548.01	-54.12	9.37	13.35	-50.14	-13.00	37.14	V
11455.01	-50.14	9.93	13.11	-46.96	-13.00	33.96	V
13371.01	-43.70	10.57	14.02	-40.25	-13.00	27.25	H

GSM 1900MHz

Second source

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	-56.27	6.26	8.56	-53.97	-13.00	40.97	V
5641.02	-54.24	7.27	10.57	-50.94	-13.00	37.94	V
7521.01	-52.57	8.31	12.22	-48.66	-13.00	35.66	V
9411.01	-53.60	9.09	13.35	-49.34	-13.00	36.34	V
11276.01	-49.83	9.85	13.14	-46.54	-13.00	33.54	V
13151.01	-42.99	10.71	13.71	-39.99	-13.00	26.99	V

Sample：3760.02MHz

Power (EIRP) = P_{Mea} - P_{pl} + G_a

Power (-53.97dBm) = P_{Mea} (-56.27dBm)- P_{pl} (6.26dB)+ Ga(8.56dBi)

Note: Expanded measurement uncertainty

Frequency range	Expanded measurement uncertainty
30MHz-1GHz	5.76dB, k=2
1GHz-18GHz	4.69dB, k=2
18GHz-40GHz	3.37dB, k=2

Note: The measurement results showed here are worst cases

A.3 Frequency Stability

A.3.1 Method of Measurement

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage. Two reference points are established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation shall be identified as F_L and F_H respectively.

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 CMU200.

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 each band, 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 1.5 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 1.5 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℃ decrements from +50℃ to -30℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

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 the lower, higher and nominal voltage. 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.

A.3.2 Measurement results

GSM 850

Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20	3.85	824.029	848.971		
50				-2.39	0.0029
40				0.06	0.0001
30				-2.59	0.0031
10				-3.42	0.0041
0				-1.49	0.0018
-10				-1.87	0.0022
-20				-5.04	0.0060
-30				-2.00	0.0024

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.6	20	824.029	848.971	-1.81	0.0022
4.4				-1.49	0.0018

PCS 1900

Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20	3.85	1850.034	1909.962		
50				1.87	0.0010
40				2.90	0.0015
30				0.19	0.0001
10				1.03	0.0005
0				-0.52	0.0003
-10				0.39	0.0002
-20				0.06	0.0000
-30				2.58	0.0014

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.6	20	1850.034	1909.962	4.13	0.0022
4.4				0.97	0.0005

Note: Expanded measurement uncertainty is U = 0.01 PPM, k = 2.

A.4 Occupied Bandwidth

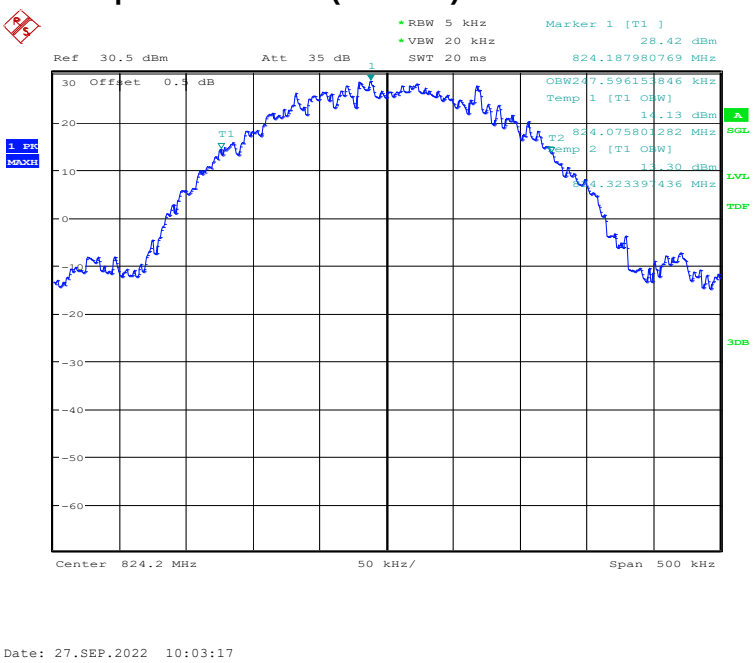
Occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequency. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the following pages.
The measurement method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

GSM 850 (99%)

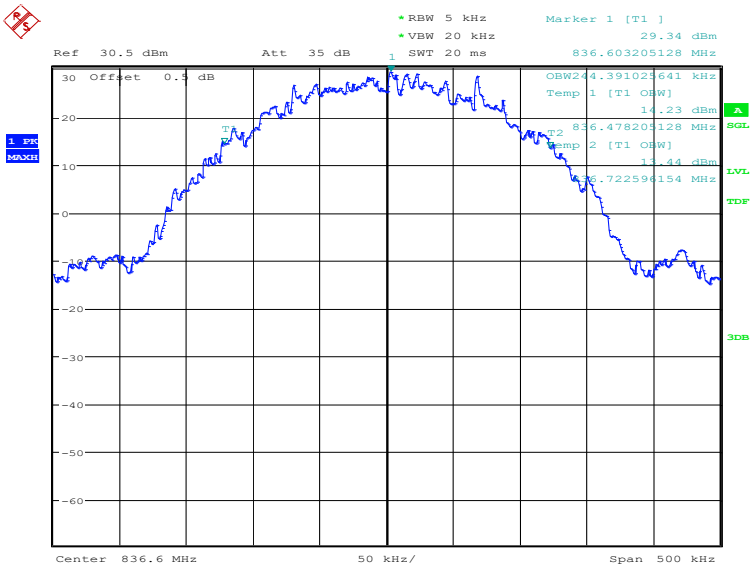
Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
824.2	247.60
836.6	244.39
848.8	247.60

GSM 850 (99%)

Channel 128-Occupied Bandwidth (99% BW)

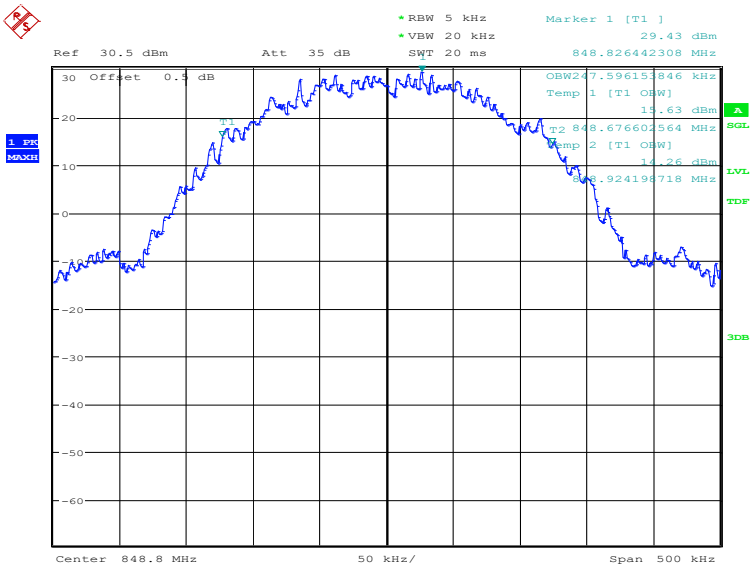


Channel 190-Occupied Bandwidth (99% BW)



Date: 27.SEP.2022 10:03:44

Channel 251-Occupied Bandwidth (99% BW)



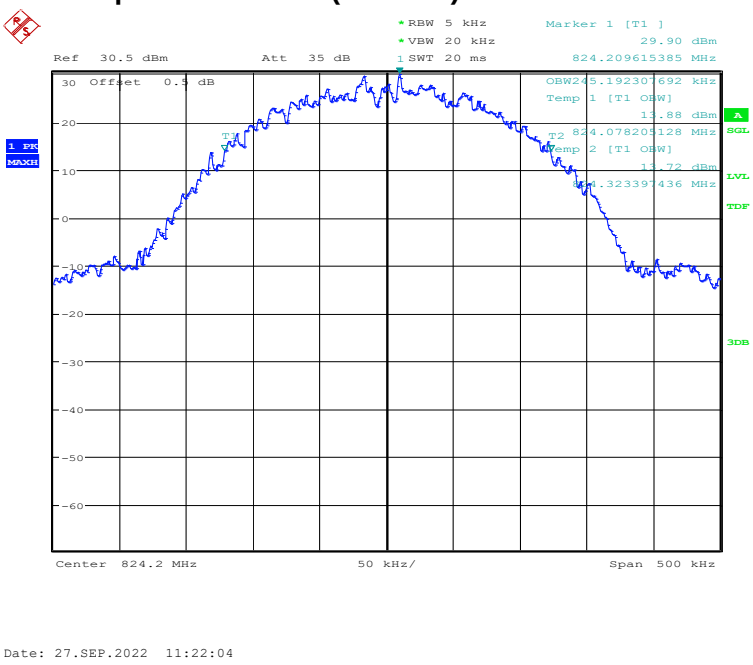
Date: 27.SEP.2022 10:04:12

GPRS 850 (99%)

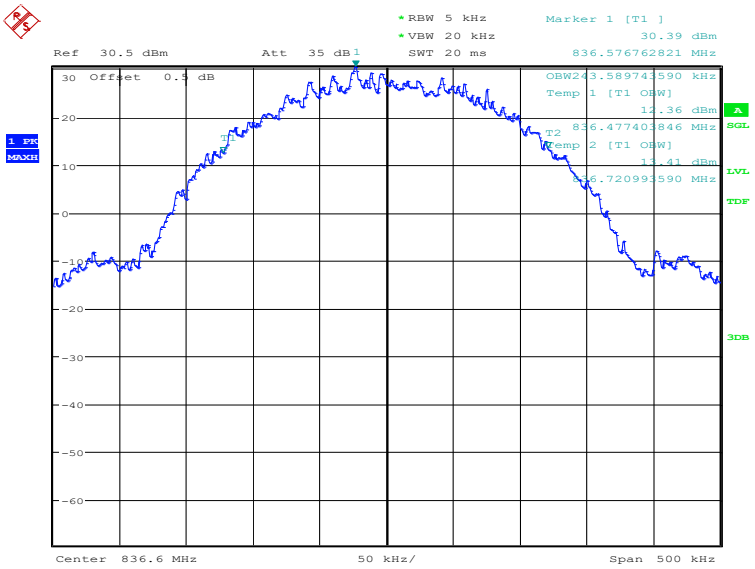
Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
824.2	245.19
836.6	243.59
848.8	242.79

GPRS 850 (99%)

Channel 128-Occupied Bandwidth (99% BW)

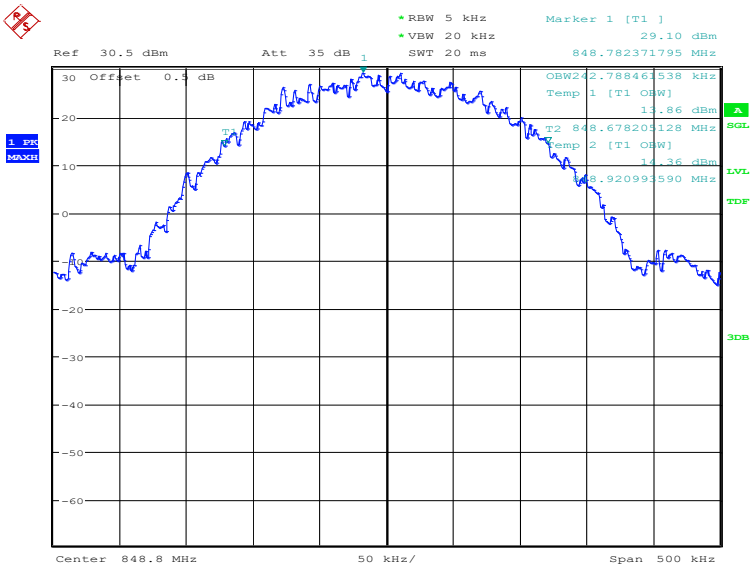


Channel 190-Occupied Bandwidth (99% BW)



Date: 27.SEP.2022 11:22:32

Channel 251-Occupied Bandwidth (99% BW)



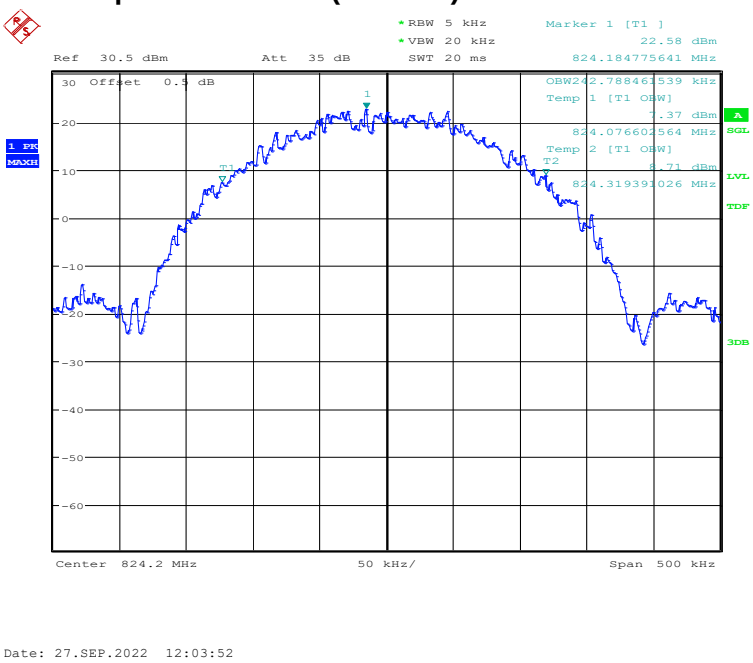
Date: 27.SEP.2022 11:22:59

EGPRS 850-8PSK (99%)

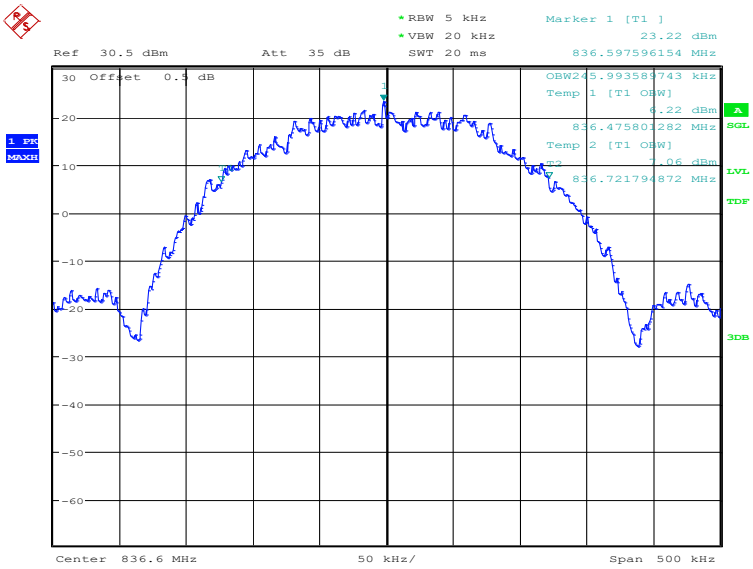
Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
824.2	242.79
836.6	245.99
848.8	241.99

EGPRS 850-8PSK (99%)

Channel 128-Occupied Bandwidth (99% BW)

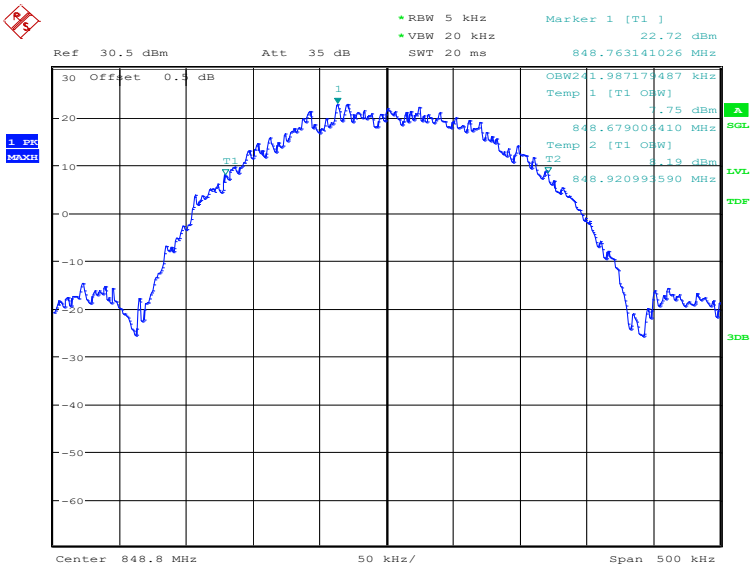


Channel 190-Occupied Bandwidth (99% BW)



Date: 27.SEP.2022 12:04:20

Channel 251-Occupied Bandwidth (99% BW)



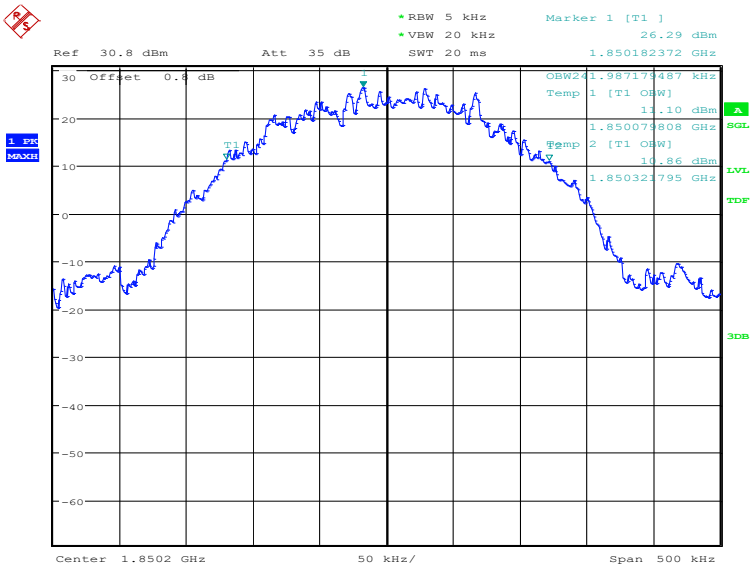
Date: 27.SEP.2022 12:04:47

PCS 1900 (99%)

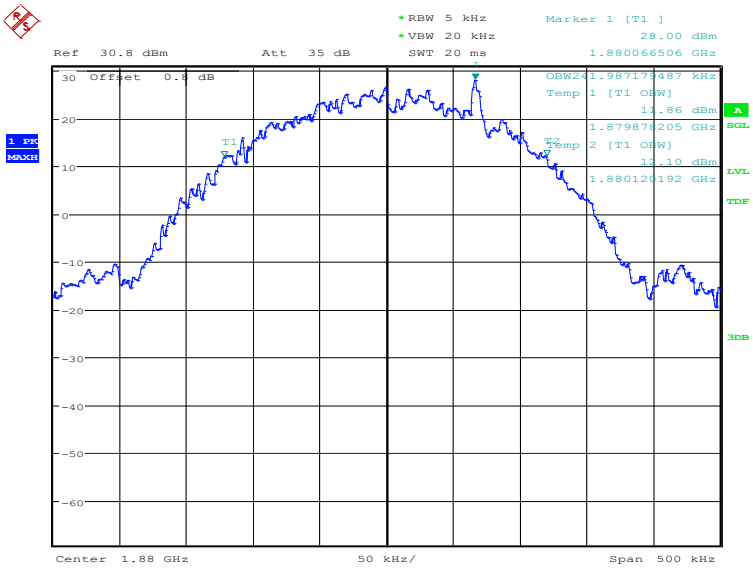
Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
1850.2	241.99
1880.0	241.99
1909.8	246.79

PCS 1900 (99%)

Channel 512-Occupied Bandwidth (99% BW)

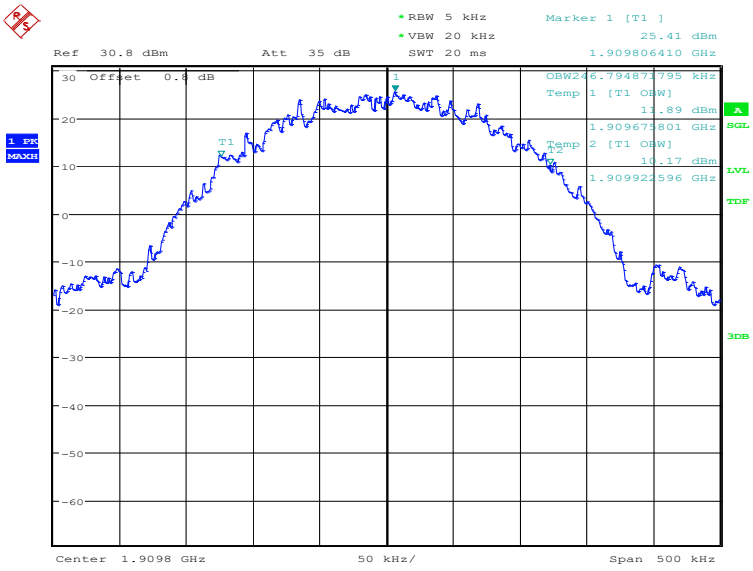


Channel 661-Occupied Bandwidth (99% BW)



Date: 27.SEP.2022 10:05:49

Channel 810-Occupied Bandwidth (99% BW)



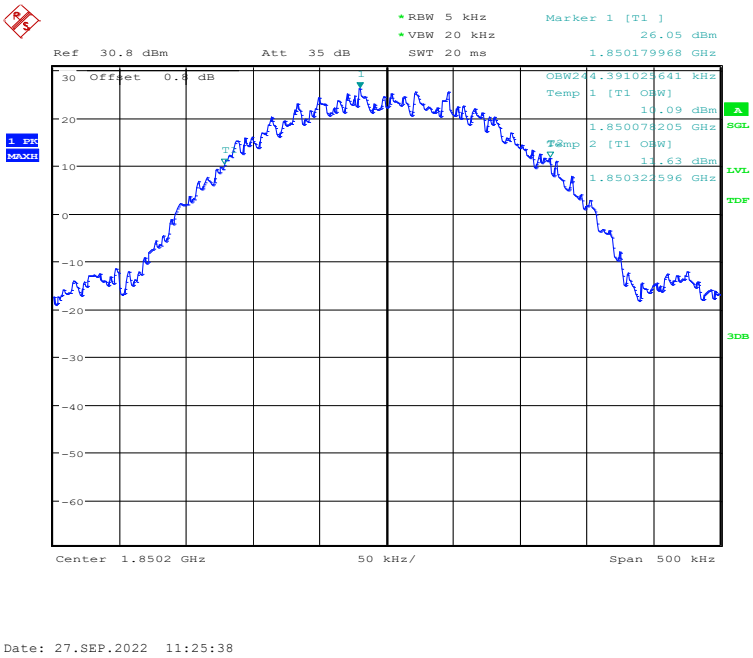
Date: 27.SEP.2022 10:06:17

GPRS 1900 (99%)

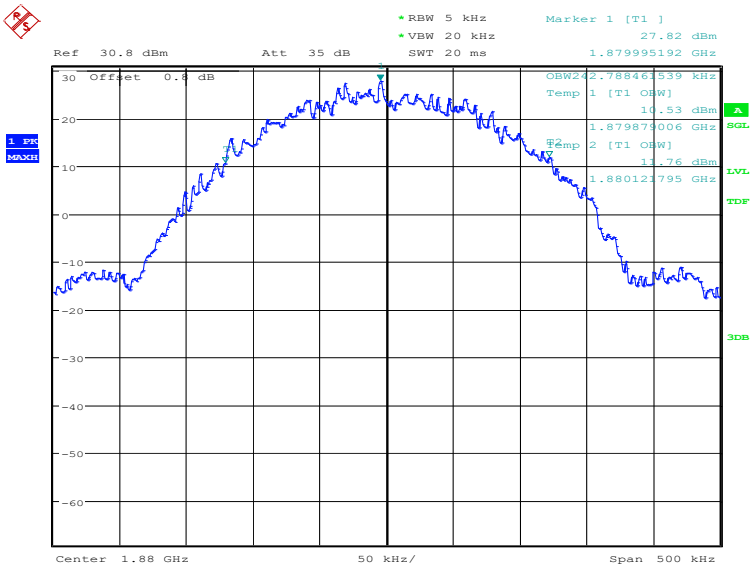
Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
1850.2	244.39
1880.0	242.79
1909.8	243.59

GPRS 1900 (99%)

Channel 512-Occupied Bandwidth (99% BW)

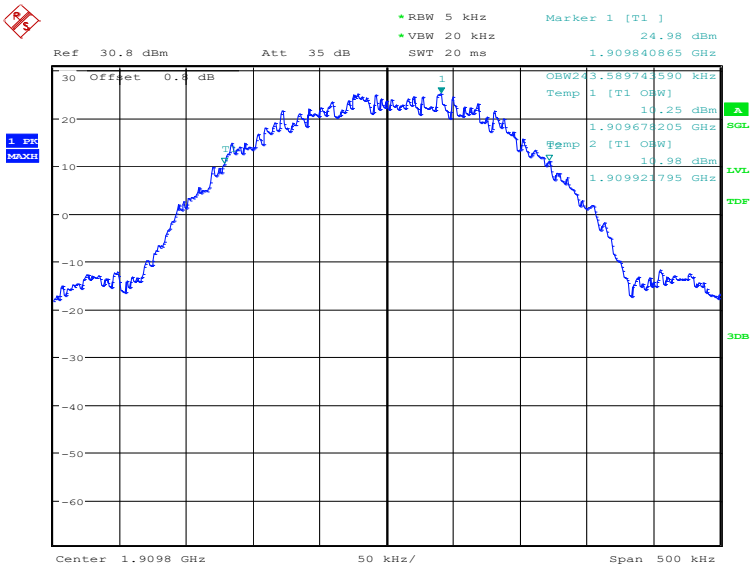


Channel 661-Occupied Bandwidth (99% BW)



Date: 27.SEP.2022 11:26:05

Channel 810-Occupied Bandwidth (99% BW)



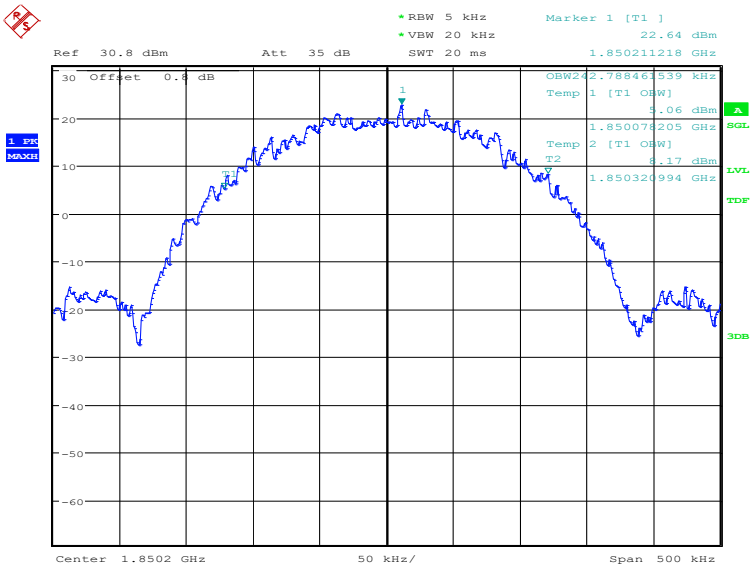
Date: 27.SEP.2022 11:26:33

EGPRS 1900-8PSK (99%)

Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
1850.2	242.79
1880.0	245.19
1909.8	245.99

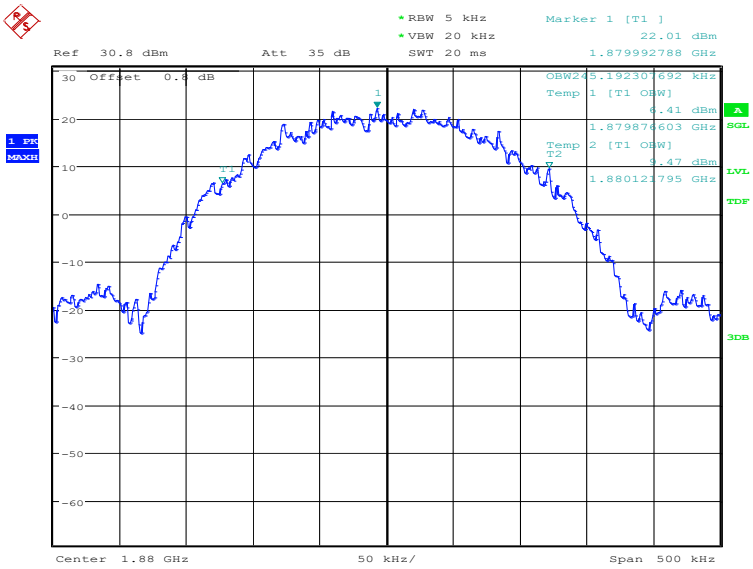
EGPRS 1900-8PSK (99%)

Channel 512-Occupied Bandwidth (99% BW)



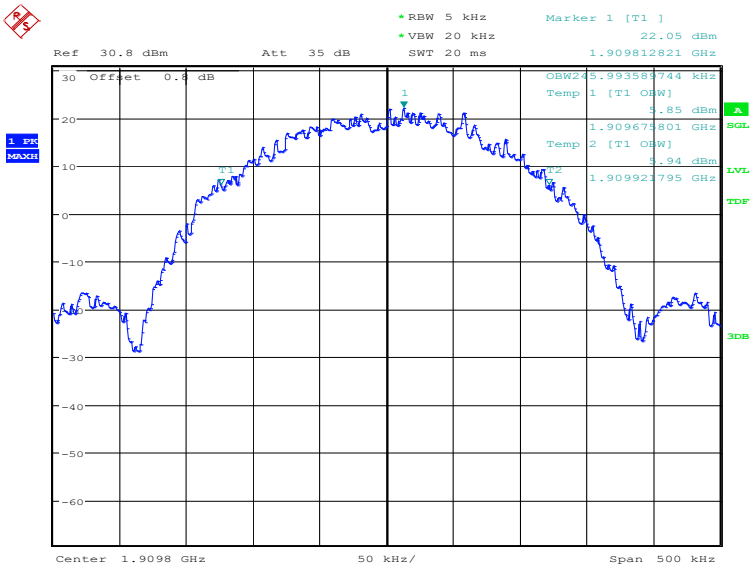
Date: 27.SEP.2022 12:05:54

Channel 661-Occupied Bandwidth (99% BW)



Date: 27.SEP.2022 12:06:21

Channel 810-Occupied Bandwidth (99% BW)



Date: 27.SEP.2022 12:06:49

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

A.5 Emission Bandwidth

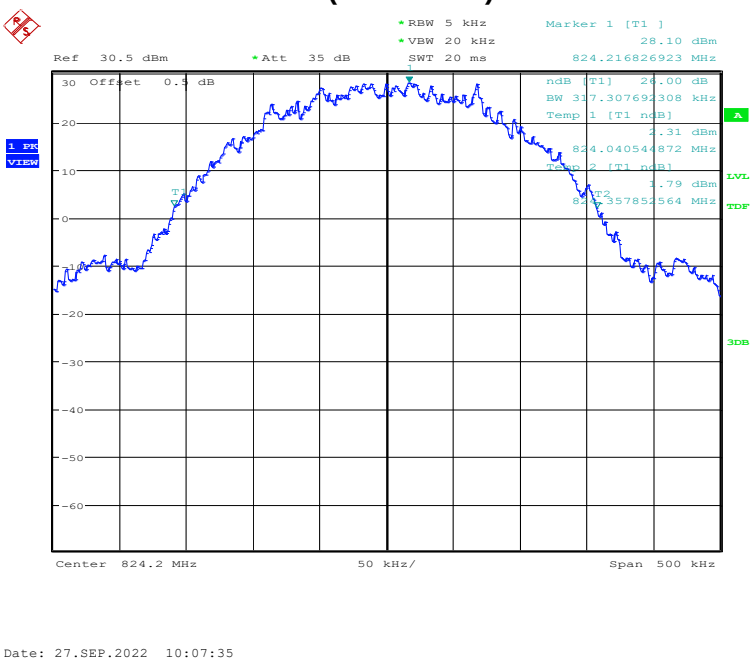
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
The measurement method is from ANSI C63.26:
a) 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.

GSM 850 (-26dBc)

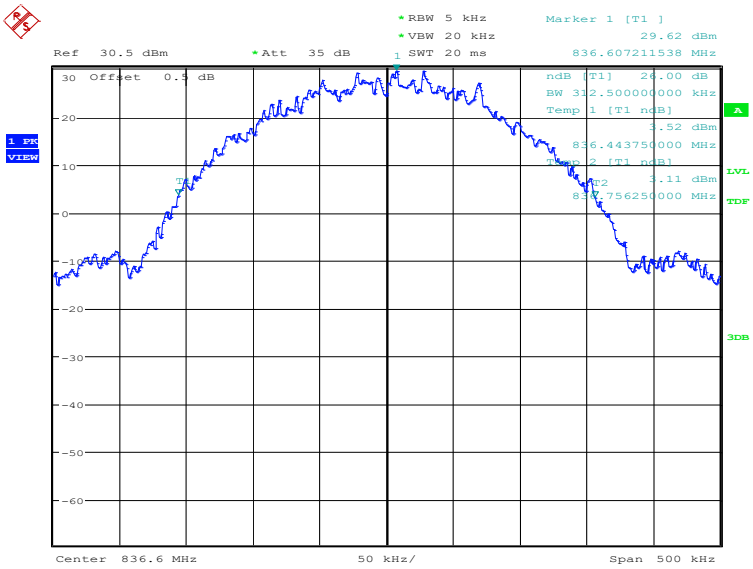
Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
824.2	317.31
836.6	312.50
848.8	304.49

GSM 850 (-26dBc)

Channel 128-Emission Bandwidth (-26dBc BW)

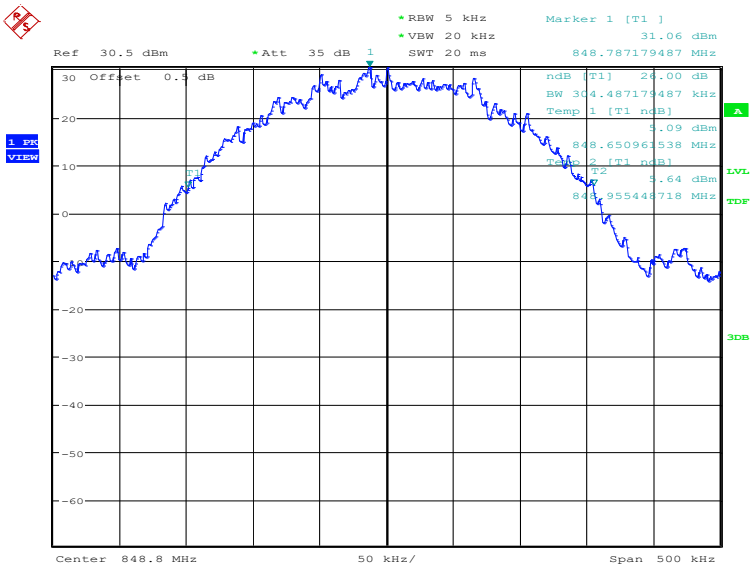


Channel 190-Emission Bandwidth (-26dBc BW)



Date: 27.SEP.2022 10:08:02

Channel 251-Emission Bandwidth (-26dBc BW)



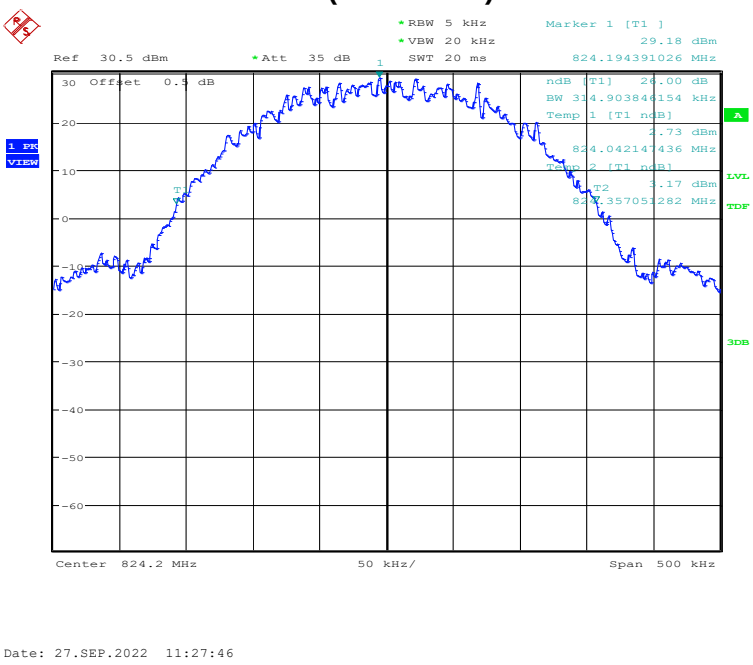
Date: 27.SEP.2022 10:08:30

GPRS 850 (-26dBc)

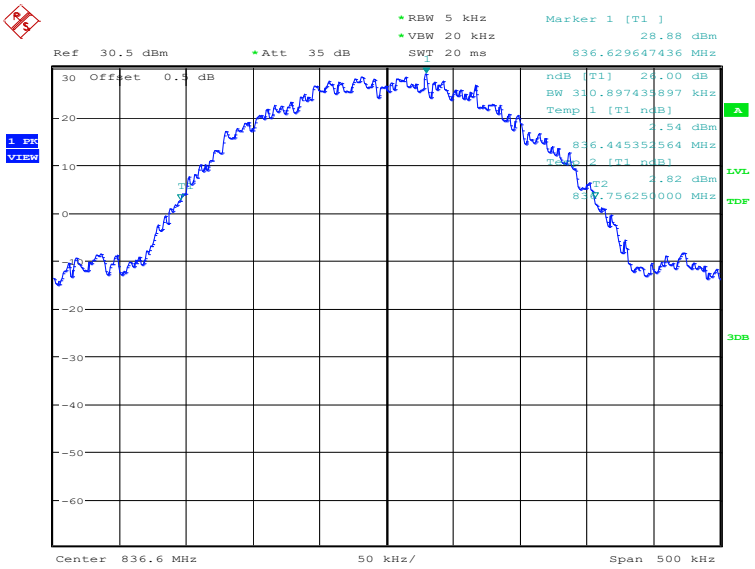
Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
824.2	314.90
836.6	310.90
848.8	314.10

GPRS 850 (-26dBc)

Channel 128-Emission Bandwidth (-26dBc BW)

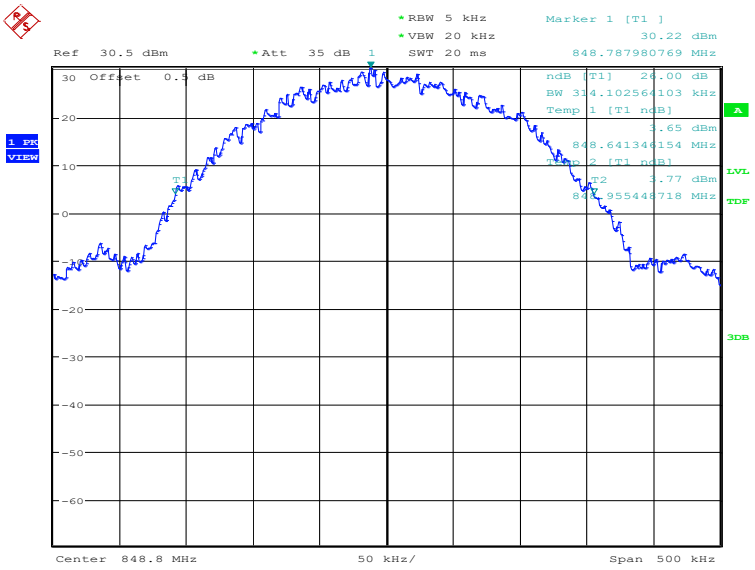


Channel 190-Emission Bandwidth (-26dBc BW)



Date: 27.SEP.2022 11:28:14

Channel 251-Emission Bandwidth (-26dBc BW)



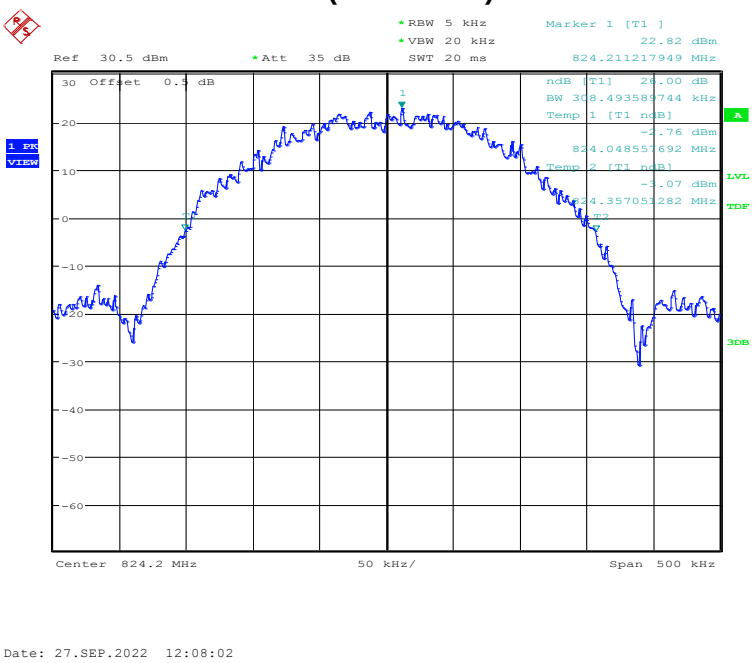
Date: 27.SEP.2022 11:28:41

EGPRS 850-8PSK (-26dBc)

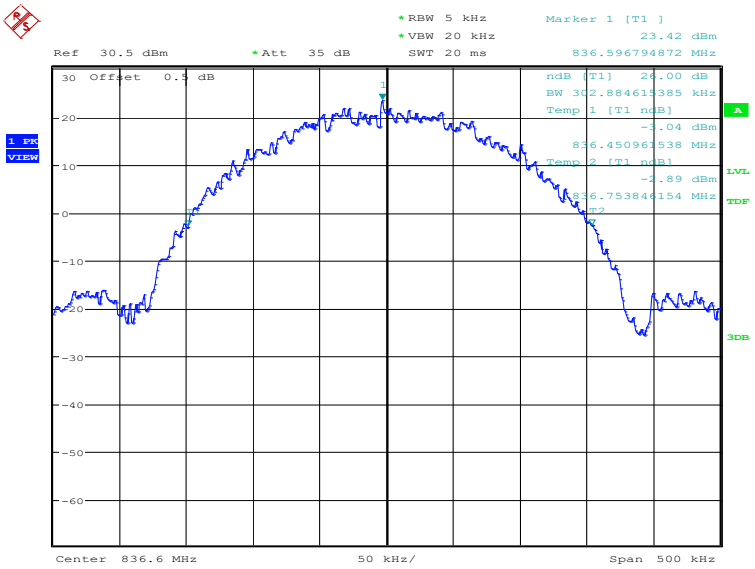
Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
824.2	308.49
836.6	302.88
848.8	300.48

EGPRS 850-8PSK (-26dBc)

Channel 128-Emission Bandwidth (-26dBc BW)

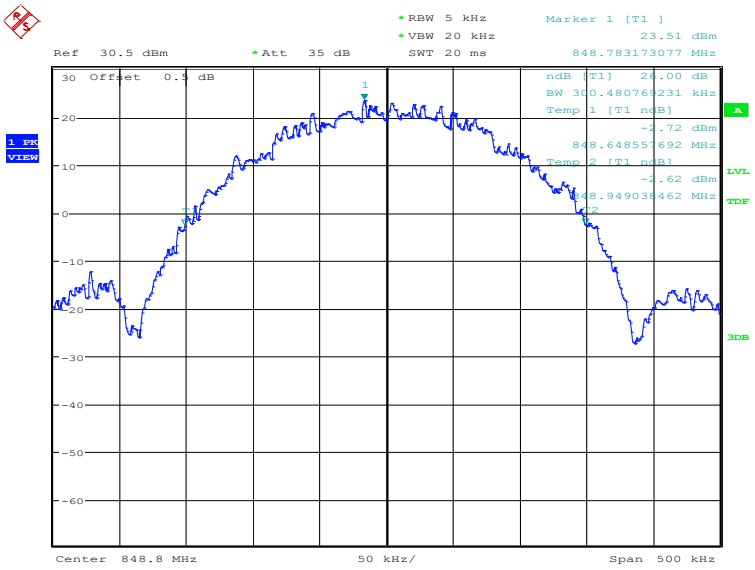


Channel 190-Emission Bandwidth (-26dBc BW)



Date: 27.SEP.2022 12:08:30

Channel 251-Emission Bandwidth (-26dBc BW)



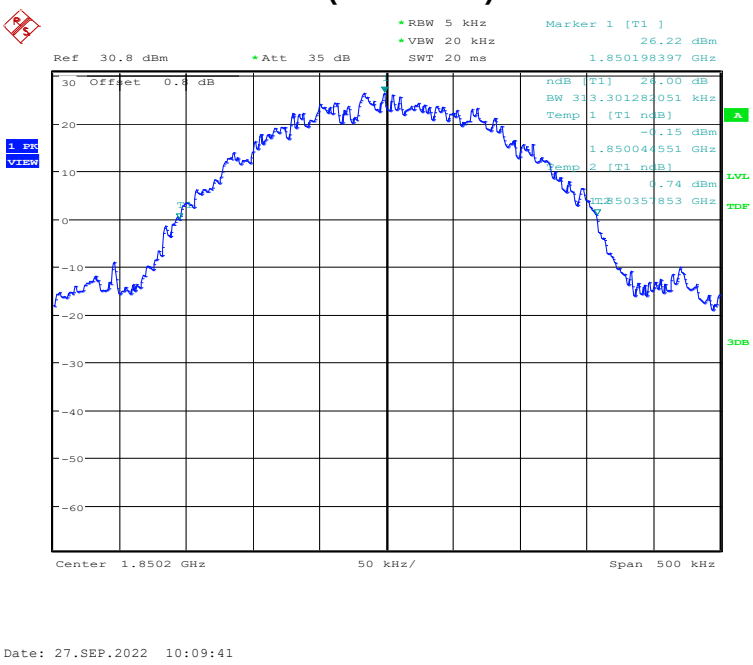
Date: 27.SEP.2022 12:08:58

PCS 1900 (-26dBc)

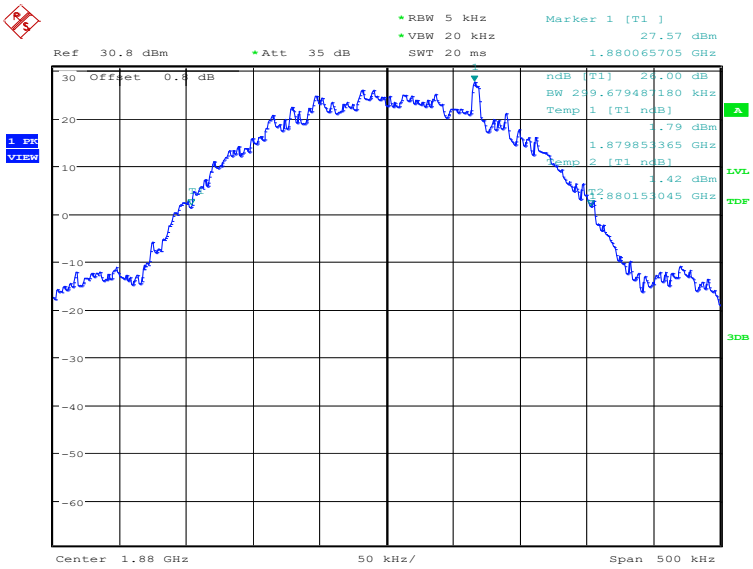
Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
1850.2	313.30
1880.0	299.68
1909.8	311.70

PCS 1900 (-26dBc)

Channel 512-Emission Bandwidth (-26dBc BW)

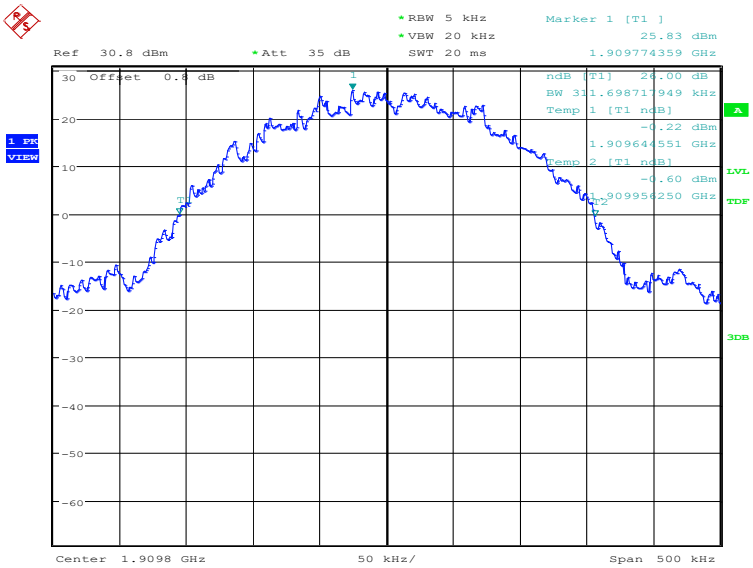


Channel 661-Emission Bandwidth (-26dBc BW)



Date: 27.SEP.2022 10:10:08

Channel 810-Emission Bandwidth (-26dBc BW)



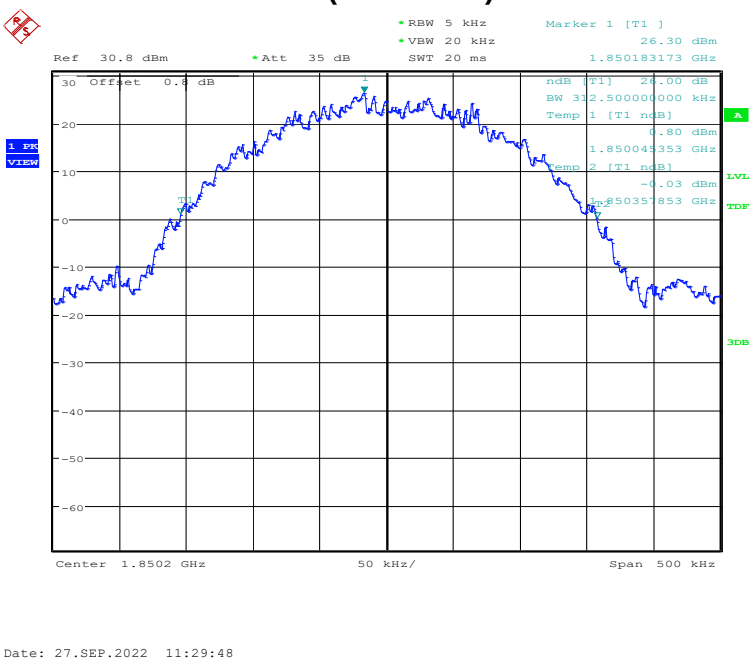
Date: 27.SEP.2022 10:10:36

GPRS 1900 (-26dBc)

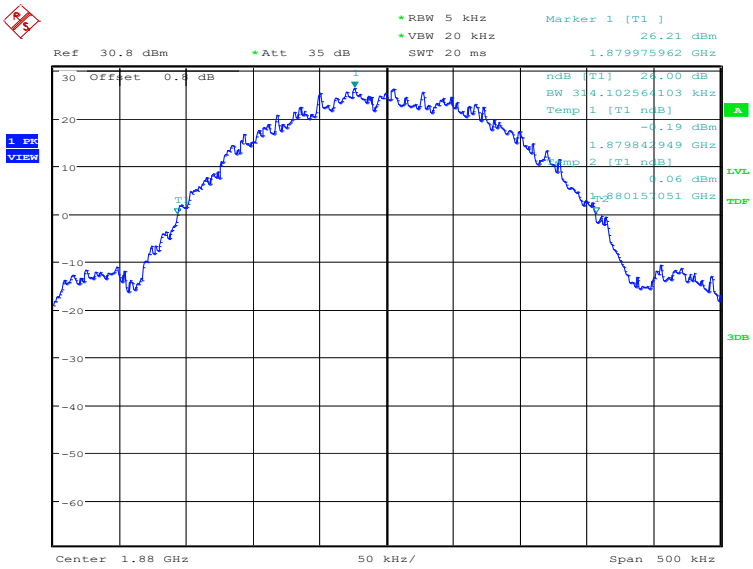
Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
1850.2	312.50
1880.0	314.10
1909.8	315.71

GPRS 1900 (-26dBc)

Channel 512-Emission Bandwidth (-26dBc BW)

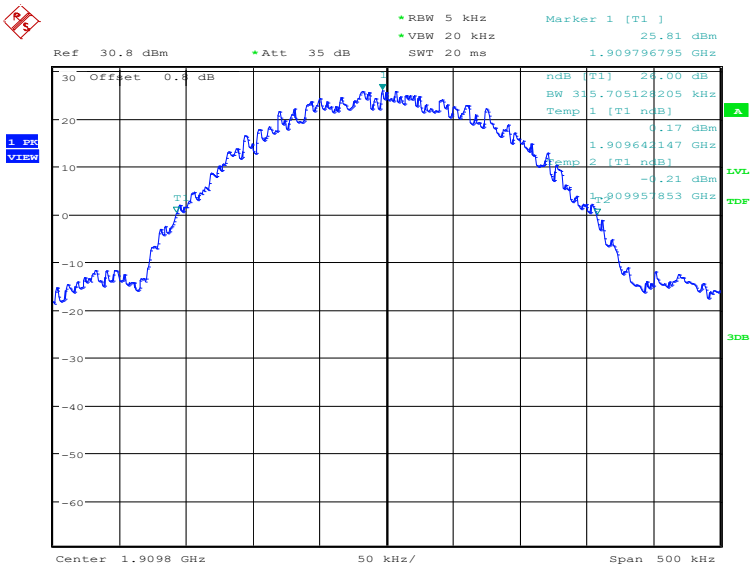


Channel 661-Emission Bandwidth (-26dBc BW)



Date: 27.SEP.2022 11:30:16

Channel 810-Emission Bandwidth (-26dBc BW)



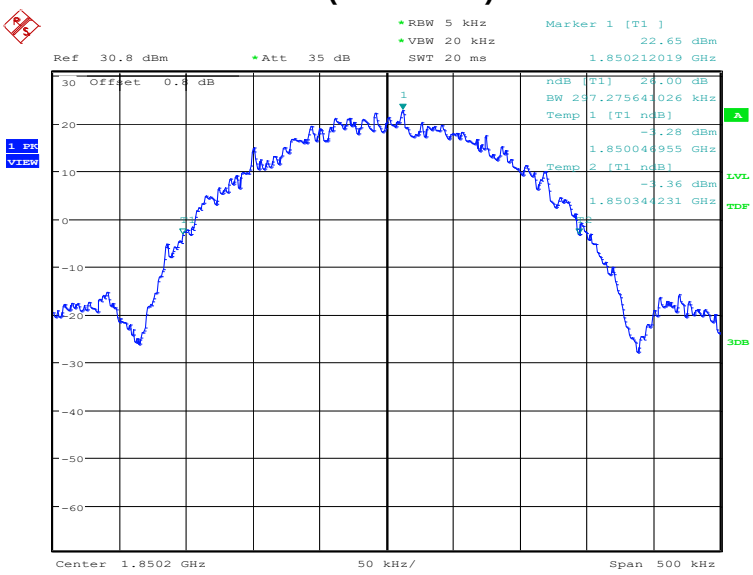
Date: 27.SEP.2022 11:30:43

EGPRS 1900-8PSK (-26dBc)

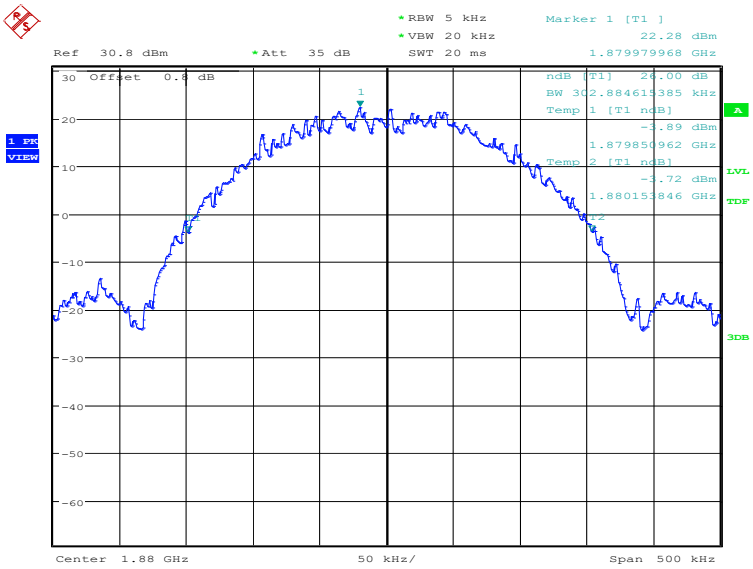
Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
1850.2	297.28
1880.0	302.88
1909.8	310.10

EGPRS 1900-8PSK (-26dBc)

Channel 512-Emission Bandwidth (-26dBc BW)

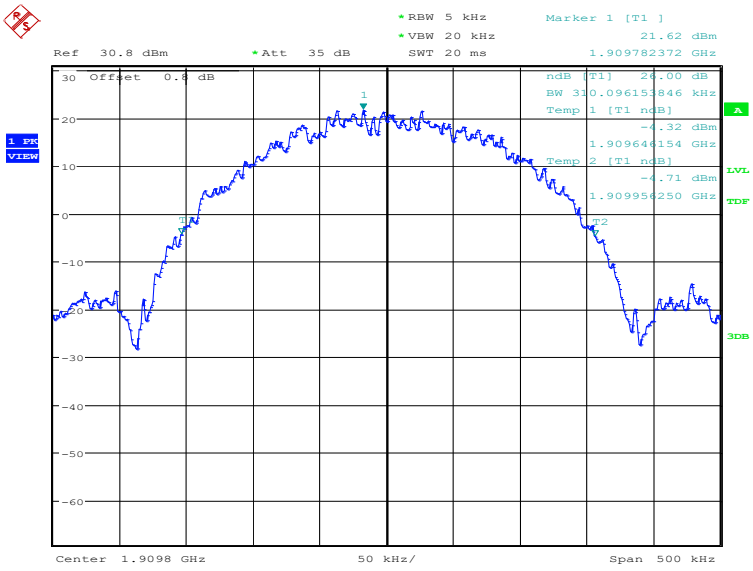


Channel 661-Emission Bandwidth (-26dBc BW)



Date: 27.SEP.2022 12:10:32

Channel 810-Emission Bandwidth (-26dBc BW)



Date: 27.SEP.2022 12:11:00

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

A.6 Band Edge Compliance

A.6.1 Measurement limit

Part 22.917 and Part 24.238 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.

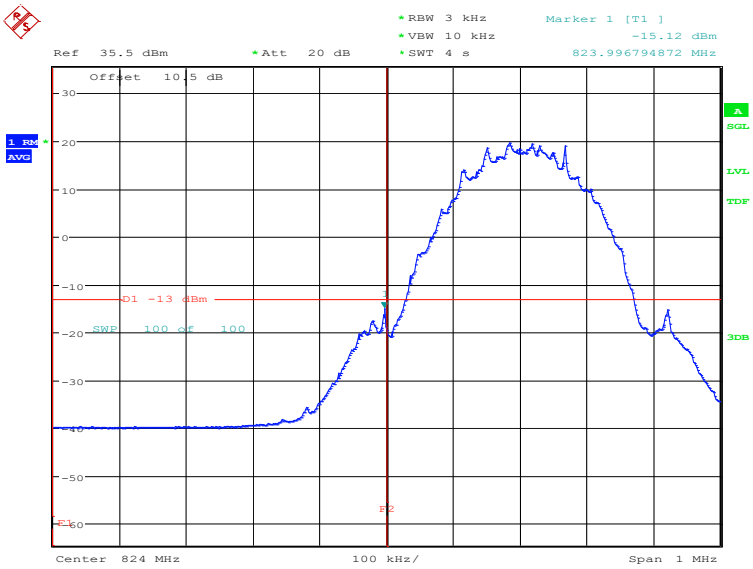
According to KDB 971168, a relaxation of the reference bandwidth is often provided for measurements within a specified frequency range at the edge of the authorized frequency block/band. This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth.

The spectrum analyzer readings are corrected by [10 log (1/duty cycle)] for the non-continuous transmitting scenario.

A.6.2 Measurement result

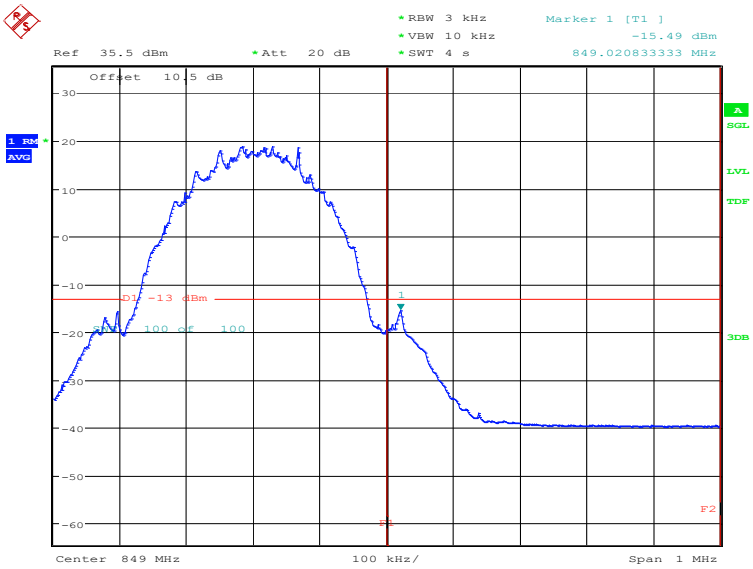
GSM 850

Channel 128



Date: 27.SEP.2022 10:18:36

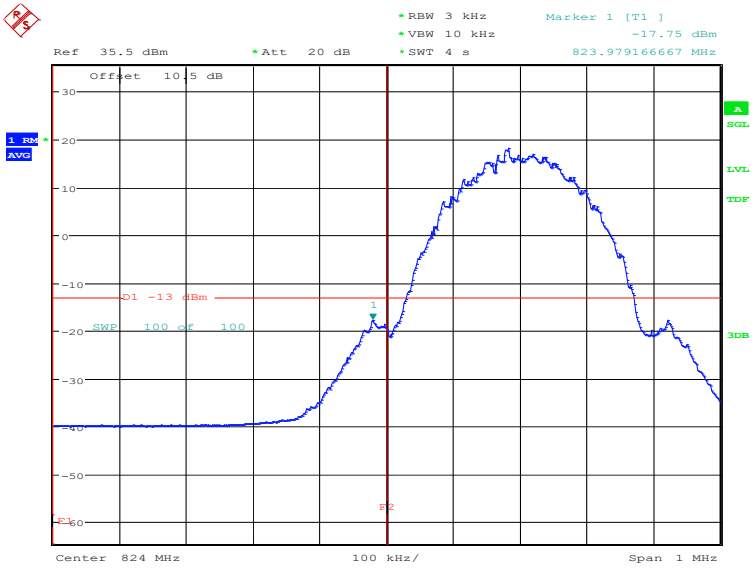
Channel 251



Date: 27.SEP.2022 10:35:46

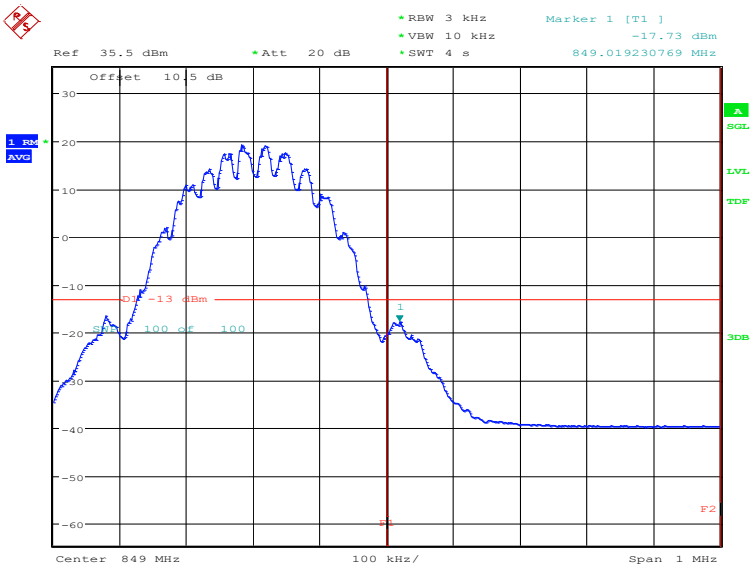
GPRS 850

Channel 128



Date: 27.SEP.2022 11:38:40

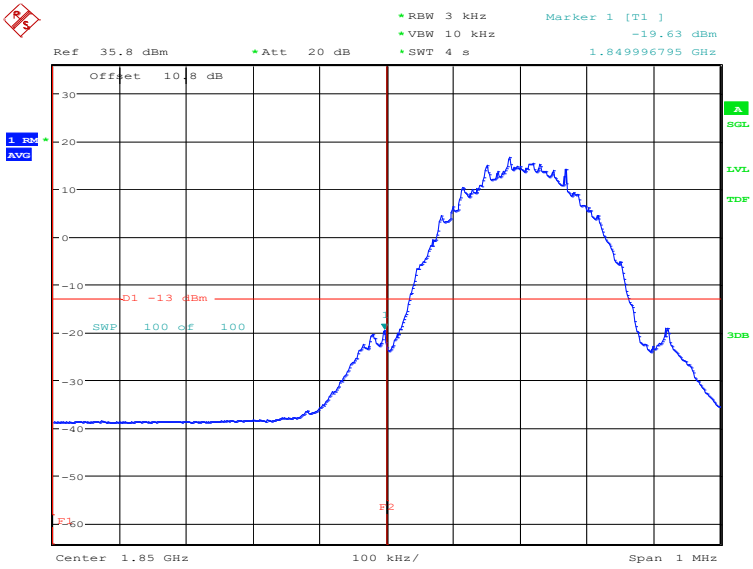
Channel 251



Date: 27.SEP.2022 11:45:50

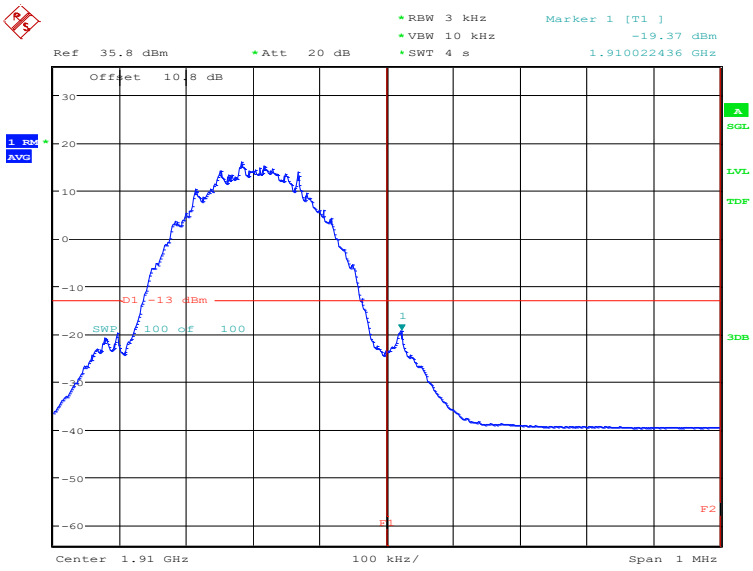
PCS 1900

Channel 512



Date: 27.SEP.2022 10:51:29

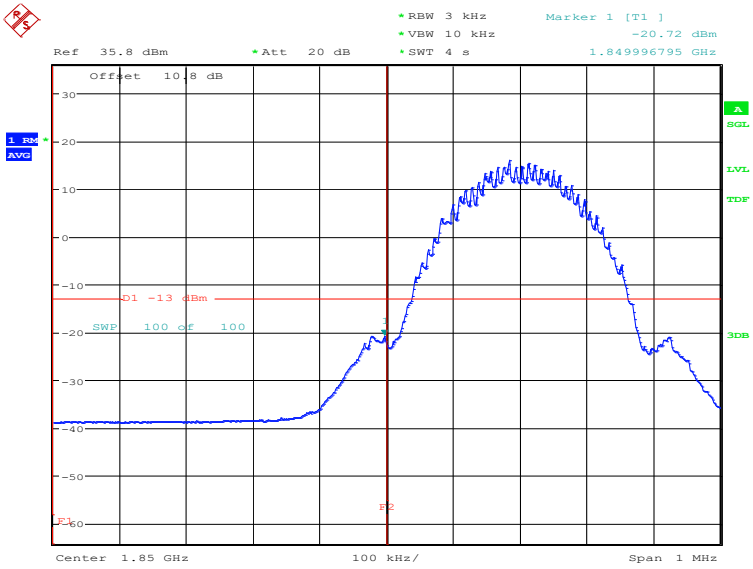
Channel 810



Date: 27.SEP.2022 11:06:27

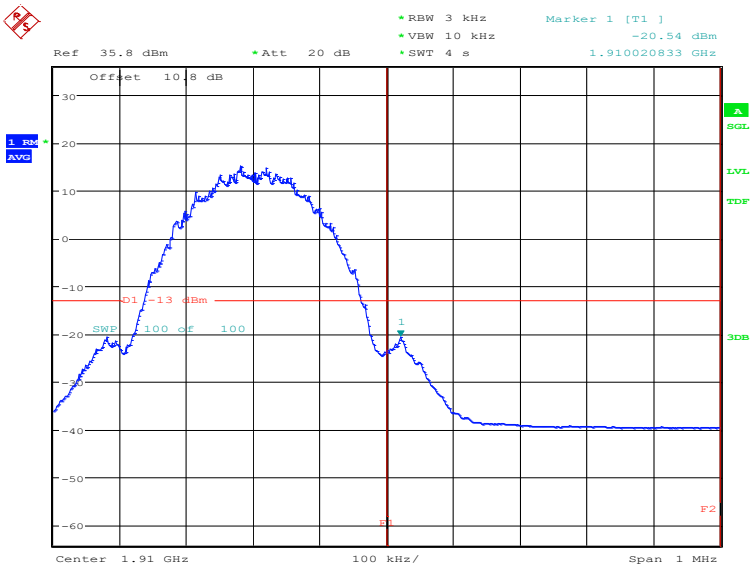
GPRS 1900

Channel 512



Date: 27.SEP.2022 11:53:39

Channel 810



Date: 27.SEP.2022 12:00:50

Note: Expanded measurement uncertainty is U = 0.622 dB, k = 2.

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. The number of sweep points of spectrum analyzer is greater than 2×span/RBW.

A. 7.2 Measurement Limit

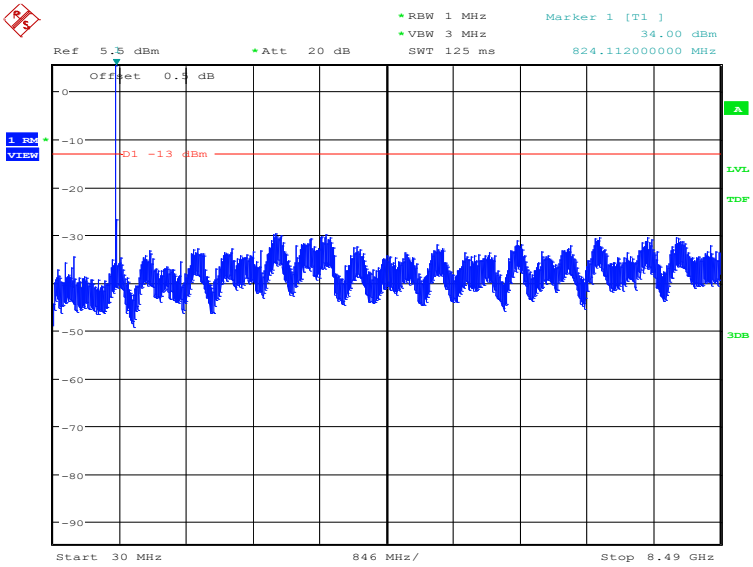
Part 22.917 and Part 24.238 specify that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

A.7.3 Measurement result

GSM850

Channel 128: 30MHz – 8.49GHz

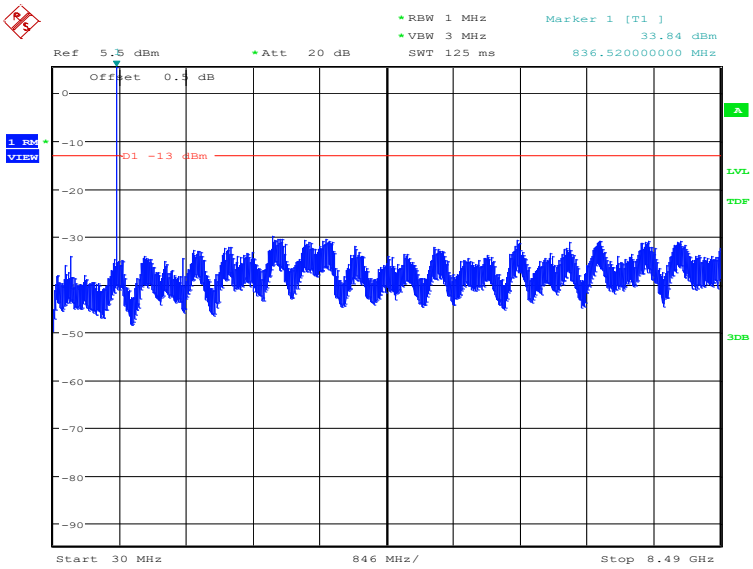
NOTE: peak above the limit line is the carrier frequency.



Date: 27.SEP.2022 11:15:36

Channel 190: 30MHz – 8.49GHz

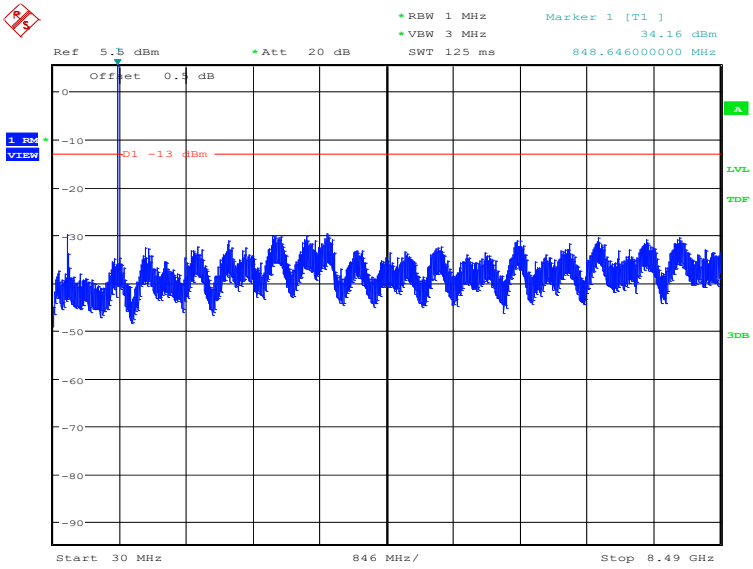
NOTE: peak above the limit line is the carrier frequency.



Date: 27.SEP.2022 11:16:07

Channel 251: 30MHz – 8.49GMHz

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

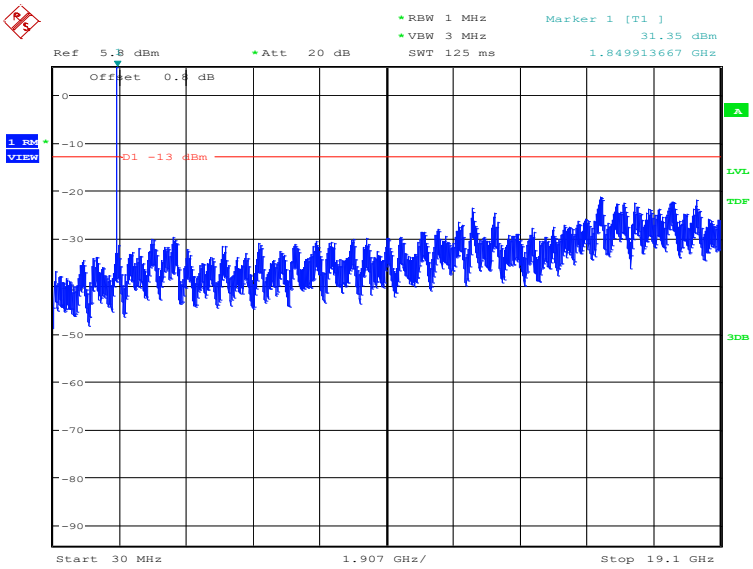


Date: 27.SEP.2022 11:16:38

PCS1900

Channel 512: 30MHz – 19.10GHz

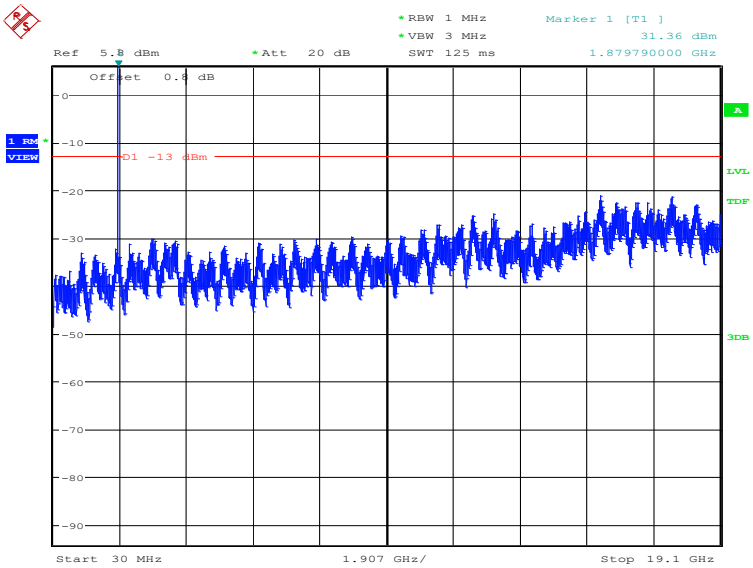
NOTE: peak above the limit line is the carrier frequency.



Date: 27.SEP.2022 11:17:52

Channel 661: 30MHz – 19.10GHz

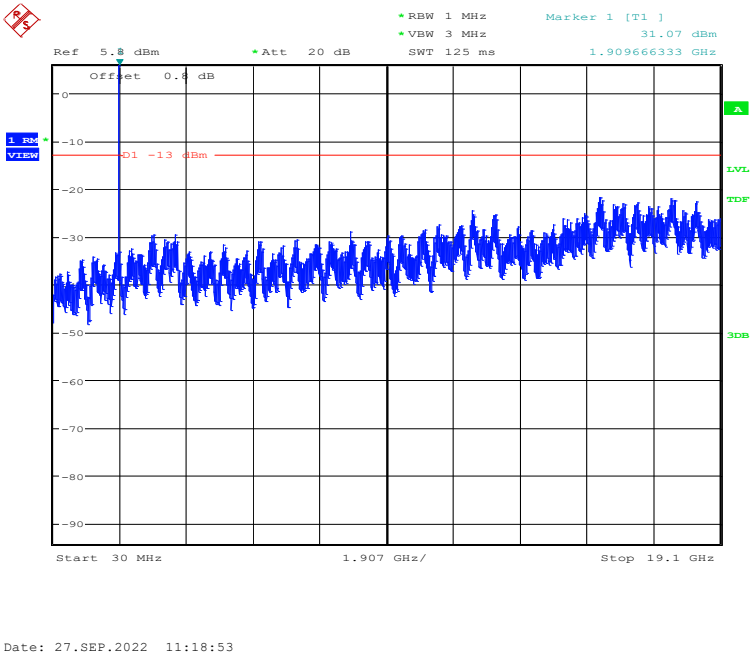
NOTE: peak above the limit line is the carrier frequency.



Date: 27.SEP.2022 11:18:22

Channel 810: 30MHz – 19.10GHz

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



Note: Expanded measurement uncertainty is U = 0.622 dB, k = 2.

A.8 Peak-to-Average Power Ratio

The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB
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) Record the maximum PAPR level associated with a probability of 0.1%.

Measurement results

	Frequency (MHz)	PAPR (dB)
PCS1900	1880.0	7.72
GPRS1900	1880.0	7.72
EGPRS1900(8PSK)	1880.0	10.51

Note: Expanded measurement uncertainty is U = 0.578 dB, k = 2.

Annex B: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP® ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

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 17025:2017. 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).

2022-10-01 through 2023-09-30
Effective Dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program

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