TEST REPORT

No. I16Z40666-GTE01

for

TCL Communication Ltd.

LTE / UMTS / GSM mobile phone

Model Name: VFD500

FCC ID: 2ACCJH049

with

Hardware Version: PIO

Software Version: v8F27

Issued Date: 2016-04-27

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.

Test Laboratory:

FCC 2.948 Listed: No. 525429

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I16Z40666-GTE01	Rev.0	1st edition	2016-04-27

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1. Test Laboratory

1.1. Testing Location

Company Name:	CTTL,Telecommunication Technology Labs, Academy of Telecommunication Research, MIIT
Address:	No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China
Postal Code:	100191
Telephone:	00861062304633
Fax:	00861062304793

1.2. Testing Environment

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

1.3. Project data

Testing Start Date:	2016-04-06
Testing End Date:	2016-04-26

1.4. Signature

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(Prepared this test report)

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(Reviewed this test report)

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Deputy Director of the laboratory

(Approved this test report)

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2. Client Information

2.1. Applicant Information

Company Name:	TCL Communication Ltd.
Address /Post:	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
Contact Person:	Gong Zhizhou
Contact Email	zhizhou.gong@tcl.com
Telephone:	0086-21-31363544
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2.2. Manufacturer Information

Company Name:	TCL Communication Ltd.
Address /Post:	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
Contact Person:	Gong Zhizhou
Contact Email	zhizhou.gong@tcl.com
Telephone:	0086-21-31363544
Fax:	0086-21-61460602

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

3.1. About EUT

Description	LTE / UMTS / GSM mobile phone
Model Name	VFD500
FCC ID	2ACCJH049
Antenna	Integrated
Output power	30.19dBm maximum ERP measured for GSM850
Extreme vol. Limits	3.5VDC to 4.2VDC (nominal: 3.8VDC)
Extreme temp. Tolerance	-30°C to +50°C

Note: Components list, please refer to documents of the manufacturer; it is also included in the original test record of CTTL, Telecommunication Technology Labs, Academy of Telecommunication Research, MIIT

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version
UT15a	357911070006934	PIO	v8F27
UT34a	357911070006850	PIO	v8F27

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery
AE2	Battery
AE3	Travel charger
AE4	Travel charger
AE5	Travel charger
AE6	Travel charger
AE7	Travel charger
AE8	Travel charger

AE1

Model	CAB2000047C1
Manufacturer	BYD
Capacitance	2000mAh

AE2

Model	CAB2000013C2
Manufacturer	SCUD
Capacitance	2000mAh

AE3

Model	CBA0066AA4C1
Manufacturer	BYD

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AE4

Model	CBA0066AB4C1
Manufacturer	BYD

AE5

Model	CBA3068AB1C1
Manufacturer	BYD

AE6

Model	CBA0077AA1C1
Manufacturer	BYD

AE7

Model	CBA0066AA1C5
Manufacturer	PUAN

AE8

Model	CBA3068AA1C4
Manufacturer	Aohai

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

3.4. General Description

The Equipment Under Test (EUT) is a model of LTE / UMTS / GSM mobile phone with integrated 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 24	PERSONAL COMMUNICATIONS SERVICES	10-1-15 Edition
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-15 Edition
ANSI/TIA-603-D	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2015
ANSI C63.4	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	2014
KDB 971168 D01	Measurement Guidance for Certification of Licensed Digital Transmitters	v02r02

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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

Semi-anechoic chamber 2 / Fully-anechoic chamber 3 (10 meters×6.7 meters×6.15 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	> 100 dB
Electrical insulation	> 2 MΩ
Ground system resistance	< 0.5 Ω
Normalised site attenuation (NSA)	< ±3.5 dB, 3 m distance
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 3000 MHz

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6. SUMMARY OF TEST RESULTS

Items	List	Clause in FCC rules	Verdict
1	Output Power	22.913(a)/24.232(c)	P
2	Emission Limit	2.1051/22.917/24.238	P
3	Frequency Stability	2.1055/24.235	P
4	Occupied Bandwidth	2.1049(h)(i)	P
5	Emission Bandwidth	22.917(b)/24.238(b)	P
6	Band Edge Compliance	22.917(b)/24.238(b)	P
7	Conducted Spurious Emission	2.1057/22.917/24.238	P

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7. Test Equipments Utilized

NO.	Description	TYPE	series number	MANUFACTURE	CAL DUE DATE	Calibration interval
1	Test Receiver	ESU26	100235	R&S	2017-03-02	1 year
2	Test Receiver	ESU26	100376	R&S	2016-10-29	1 year
3	EMI Antenna	VULB 9163	302	Schwarzbeck	2017-01-03	3 year
4	EMI Antenna	3117	00119024	ETS-Lindgren	2017-01-20	3 year
5	LISN	ENV216	101200	R&S	2016-07-07	1 year
6	Universal Radio Communication Tester	CMU200	108646	R&S	2016-10-27	1 year
7	Universal Radio Communication Tester	E5515C	MY48361083	Agilent	2016-07-06	1 year
8	Spectrum Analyzer	E4440A	MY48250642	Agilent	2017-03-02	1 year
9	EMI Antenna	9117	177	Schwarzbeck	2017-06-25	3 year
10	EMI Antenna	VULB9163	9163-234	Schwarzbeck	2016-09-15	3 year
11	Signal Generator	N5183A	MY49060052	Agilent	2017-03-07	1 year
12	Climate chamber	SH-241	92007454	ESPEC	2017-12-14	2 year
13	Loop Antenna	HFH2-Z2	829324/007	R&S	2017-12-10	3 year

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

A.1.2 Conducted

A.1.2.1 Method of Measurements

The EUT was set up for the max output power with pseudo random data modulation.
These measurements were done at 3 frequencies, 1850.2 MHz, 1880.0MHz and 1909.8MHz for PCS1900 band; 824.2MHz, 836.6MHz and 848.8MHz for GSM850 band. (bottom, middle and top of operational frequency range).

GSM850

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

Measurement result

GSM(GMSK)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	5	31.95
836.6	5	31.88
848.8	5	31.75

GPRS(GMSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	3	32.01
836.6	3	31.90
848.8	3	31.78

EGPRS(8PSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	6	27.07
836.6	6	27.09
848.8	6	27.04

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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	29.60
1880.0	0	29.48
1909.8	0	29.35

GPRS(GMSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	3	29.61
1880.0	3	29.49
1909.8	3	29.36

EGPRS(8PSK,1Slot)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	5	26.61
1880.0	5	26.54
1909.8	5	26.48

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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.

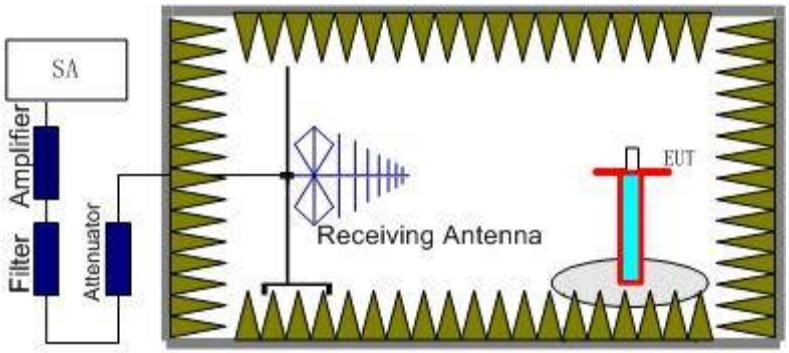
Rule Part 24.232(c) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

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

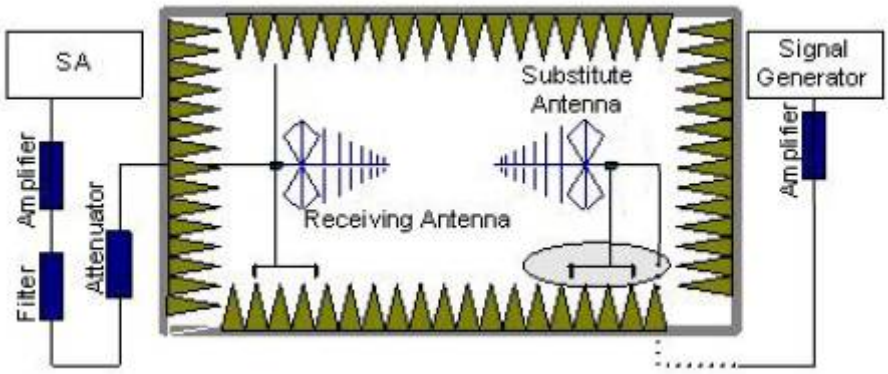
A.1.3.2 Method of Measurement

The measurements procedures in TIA-603D-2015 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 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

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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 connect 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 22.913(a)

Limits

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

Measurement result

GSM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.20	-13.09	2.26	-45.79	-0.96	2.15	29.25	38.45	9.20	H
836.60	-11.94	2.26	-45.66	-0.82	2.15	**30.13**	38.45	8.32	H
848.80	-13.11	2.28	-45.54	-0.79	2.15	28.79	38.45	9.66	H

GPRS

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.20	-13.04	2.26	-45.79	-0.96	2.15	29.30	38.45	9.15	H
836.60	-11.88	2.26	-45.66	-0.82	2.15	**30.19**	38.45	8.26	H
848.80	-12.85	2.28	-45.54	-0.79	2.15	29.05	38.45	9.40	V

EGPRS-8PSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
824.20	-15.75	2.26	-45.79	-0.96	2.15	**26.59**	38.45	11.86	H
836.60	-15.90	2.26	-45.66	-0.82	2.15	26.17	38.45	12.28	H
848.80	-17.80	2.28	-45.54	-0.79	2.15	24.10	38.45	14.35	V

Frequency: 836.60MHz

Peak ERP(dBm)=P_{Mea}(-11.88dBm)-P_{cl}(2.26dB)-P_{Ag}(-45.66dB)-G_a (-0.82dB)-2.15dB=30.19dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

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PCS1900-EIRP 24.232(c)

Limits

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

Measurement result

GSM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1850.20	-16.72	2.93	-43.75	-4.87	28.97	33.00	4.03	H
1880.00	-15.98	2.85	-43.75	-4.82	**29.74**	33.00	3.26	H
1909.80	-17.17	2.89	-43.77	-4.76	28.47	33.00	4.53	H

GPRS

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1850.20	-16.49	2.93	-43.75	-4.87	29.20	33.00	3.80	H
1880.00	-16.00	2.85	-43.75	-4.82	**29.72**	33.00	3.28	H
1909.80	-17.15	2.89	-43.77	-4.76	28.49	33.00	4.51	H

EGPRS-8PSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1850.20	-19.69	2.93	-43.75	-4.87	**26.00**	33.00	7.00	H
1880.00	-20.14	2.85	-43.75	-4.82	25.58	33.00	7.42	H
1909.80	-21.64	2.89	-43.77	-4.76	24.00	33.00	9.00	H

Frequency: 1880.00 MHz

Peak EIRP(dBm)= P_{Mea}(-15.98dBm) - P_{cl}(2.85dB) - P_{Ag}(-43.75dB) - G_a (-4.82dB) =29.74dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

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A.2 EMISSION LIMIT

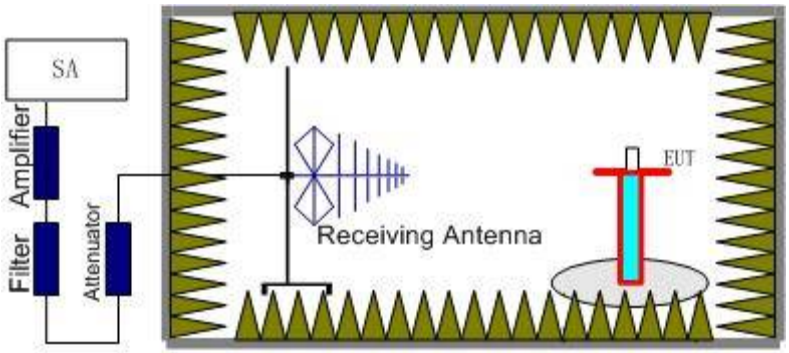
A.2.1 Measurement Method

The measurement procedures in TIA-603D-2015 are used.

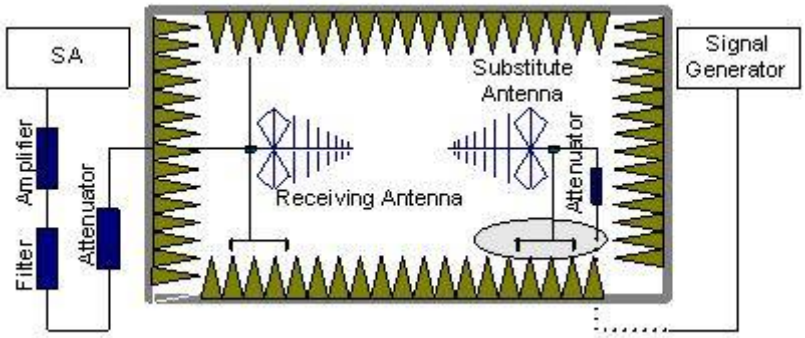
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1910 MHz. The resolution bandwidth is set as outlined in Part 24.238 and Part 22.917. The spectrum is scanned with the mobile station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

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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. 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	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1648.48	-45.80	3.41	-5.23	2.15	-46.13	-13.00	33.13	V
3226.38	-58.69	5.23	-7.54	2.15	-58.53	-13.00	45.53	V
4374.87	-59.52	6.21	-9.27	2.15	-58.61	-13.00	45.61	V
5129.65	-59.31	6.44	-10.08	2.15	-57.82	-13.00	44.82	H
6215.08	-56.88	6.84	-10.72	2.15	-55.15	-13.00	42.15	H
7766.96	-58.25	7.30	-12.41	2.15	-55.29	-13.00	42.29	H

GSM Mode Channel 190/836.6MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1673.28	-46.57	3.54	-5.19	2.15	-47.07	-13.00	34.07	V
3399.12	-59.54	5.53	-7.96	2.15	-59.26	-13.00	46.26	H
4187.42	-60.47	5.87	-9.09	2.15	-59.40	-13.00	46.40	H
4965.51	-58.68	6.33	-9.87	2.15	-57.29	-13.00	44.29	V
5686.02	-58.20	6.68	-10.56	2.15	-56.47	-13.00	43.47	V
7094.05	-58.66	7.48	-11.71	2.15	-56.58	-13.00	43.58	V

GSM Mode Channel 251/848.8MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1697.44	-46.70	3.45	-5.14	2.15	-47.16	-13.00	34.16	V
3346.86	-59.89	5.22	-7.83	2.15	-59.43	-13.00	46.43	V
4010.45	-60.23	5.74	-8.91	2.15	-59.21	-13.00	46.21	H
4718.05	-57.65	6.15	-9.62	2.15	-56.33	-13.00	43.33	H
6049.32	-57.75	6.89	-10.55	2.15	-56.24	-13.00	43.24	H
7130.71	-57.90	7.15	-11.76	2.15	-55.44	-13.00	42.44	H

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GSM Mode Channel 512/1850.2MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
3497.03	-60.37	5.42	-8.19	-57.60	-13.00	44.60	V
4544.12	-59.08	5.97	-9.44	-55.61	-13.00	42.61	V
6996.53	-57.75	7.19	-11.60	-53.34	-13.00	40.34	H
8793.02	-58.16	8.01	-13.06	-53.11	-13.00	40.11	H
9861.86	-57.32	8.42	-13.04	-52.70	-13.00	39.70	V
13319.20	-50.44	9.77	-13.95	-46.26	-13.00	33.26	H

GSM Mode Channel 661/1880.0MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
3572.22	-60.27	5.48	-8.30	-57.45	-13.00	44.45	V
5612.46	-58.75	6.81	-10.58	-54.98	-13.00	41.98	H
6738.96	-58.33	7.11	-11.29	-54.15	-13.00	41.15	V
8988.99	-58.32	8.07	-13.10	-53.29	-13.00	40.29	H
10435.54	-54.42	8.78	-13.07	-50.13	-13.00	37.13	H
13622.68	-48.67	10.26	-14.27	-44.66	-13.00	31.66	H

GSM Mode Channel 810/1909.8MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
3122.52	-59.72	5.23	-7.29	-57.66	-13.00	44.66	V
4308.91	-60.91	5.95	-9.21	-57.65	-13.00	44.65	H
6993.71	-57.72	7.18	-11.59	-53.31	-13.00	40.31	V
8324.72	-57.13	7.96	-12.86	-52.23	-13.00	39.23	V
13646.15	-48.85	10.48	-14.29	-45.04	-13.00	32.04	H
14365.84	-48.57	10.16	-14.43	-44.30	-13.00	31.30	V

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A.3 FREQUENCY STABILITY

A.3.1 Method of Measurement

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

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30℃.
3. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on mid channel of PCS 1900 and GSM850, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10℃ increments from -30℃ to +50℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments remeasuring carrier frequency at each voltage. Pause at nominal voltage for 1 1/2 hours unpowered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +50℃.
7. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10 C decrements from +50℃ to -30℃. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

A.3.2 Measurement Limit

A.3.2.1 For Hand carried battery powered equipment

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.5VDC and 4.2VDC, with a nominal voltage of 3.8VDC. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress.

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)
3.5	9	0.010
3.8	-19	0.022
4.2	9	0.010

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	10	0.012
-20	9	0.011
-10	12	0.014
0	5	0.006
10	10	0.012
20	8	0.010
30	12	0.015
40	11	0.013
50	10	0.012

EGPRS 850 - 8PSK

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.5	-59	0.070
3.8	-64	0.077
4.2	-57	0.068

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	-55	0.065
-20	-52	0.062
-10	-55	0.066
0	-53	0.063
10	-57	0.068
20	-53	0.063
30	-59	0.070
40	-53	0.063
50	-57	0.068

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PCS 1900

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.5	-20	0.011
3.8	14	0.008
4.2	9	0.005

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	11	0.006
-20	36	0.019
-10	18	0.009
0	13	0.007
10	15	0.008
20	12	0.006
30	17	0.009
40	17	0.009
50	20	0.011

EGPRS 1900 - 8PSK

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.5	-49	0.026
3.8	-47	0.025
4.2	-54	0.029

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	-52	0.028
-20	-49	0.026
-10	-52	0.028
0	-45	0.024
10	-57	0.030
20	-46	0.024
30	-48	0.025
40	-53	0.028
50	-39	0.021

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A.4 OCCUPIED BANDWIDTH

Reference

FCC: CFR Part 2.1049(h)(i)

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.

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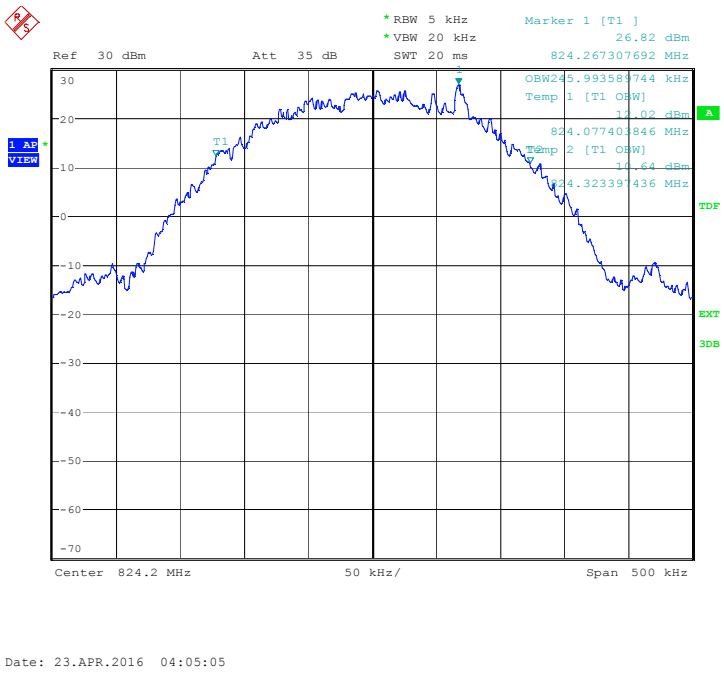
GSM 850(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	245.994
836.6	245.192
848.8	245.192

GSM 850

Channel 128-Occupied Bandwidth (99% BW)



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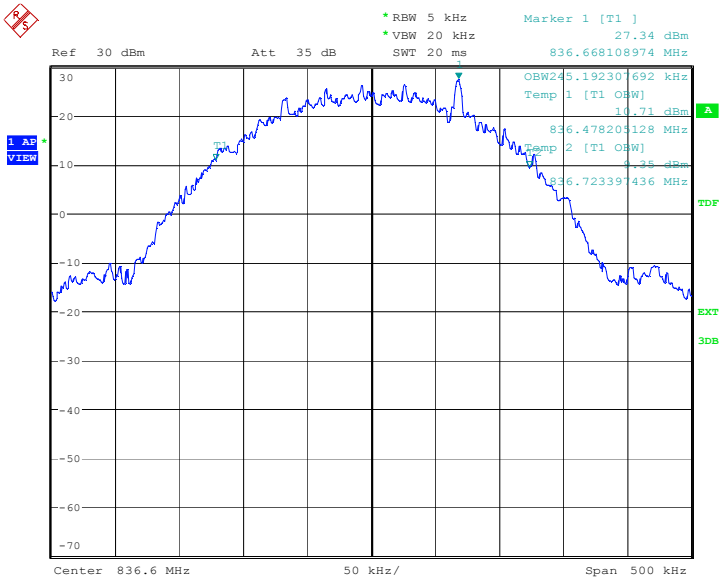
Channel 190-Occupied Bandwidth (99% BW)



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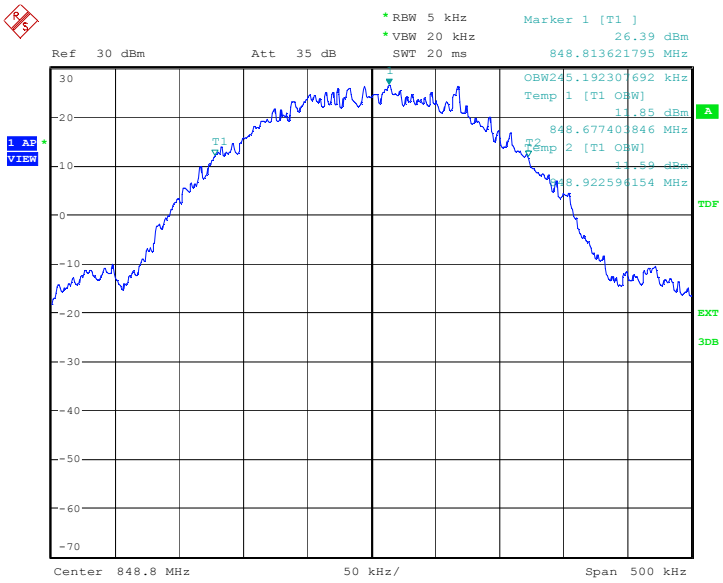
Channel 251-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 04:06:09

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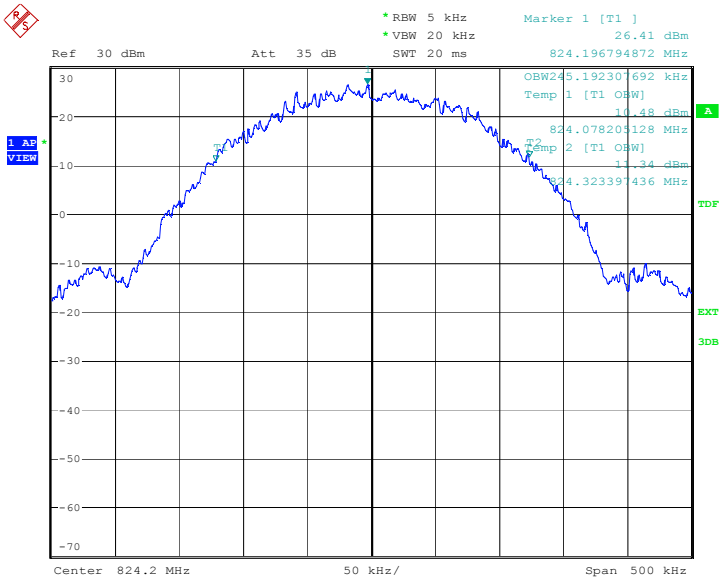
GPRS 850(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	245.192
836.6	244.391
848.8	245.994

GPRS 850

Channel 128-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 04:51:34

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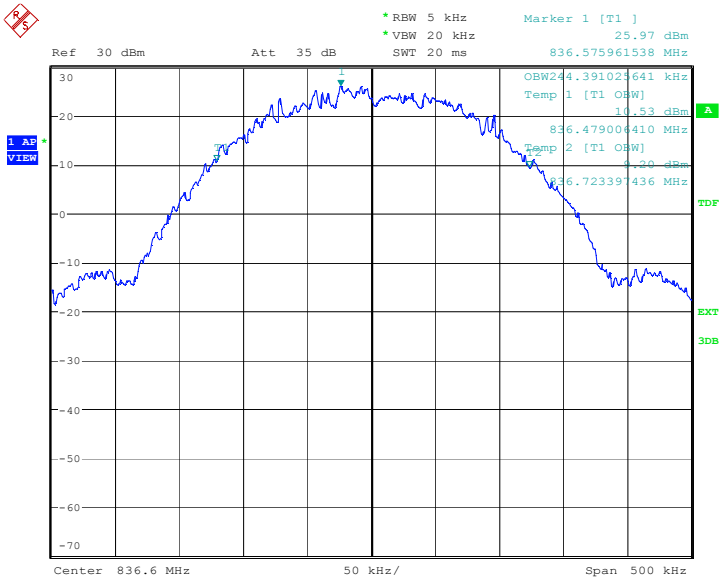
Channel 190-Occupied Bandwidth (99% BW)



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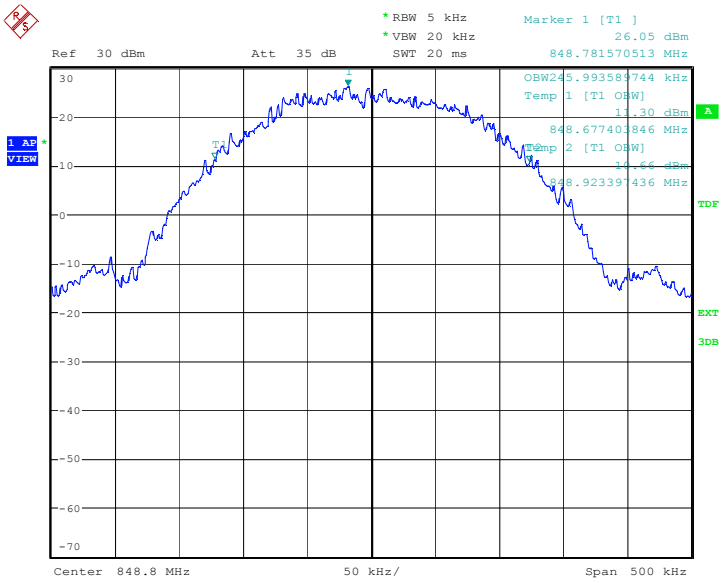
Channel 251-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 04:52:38

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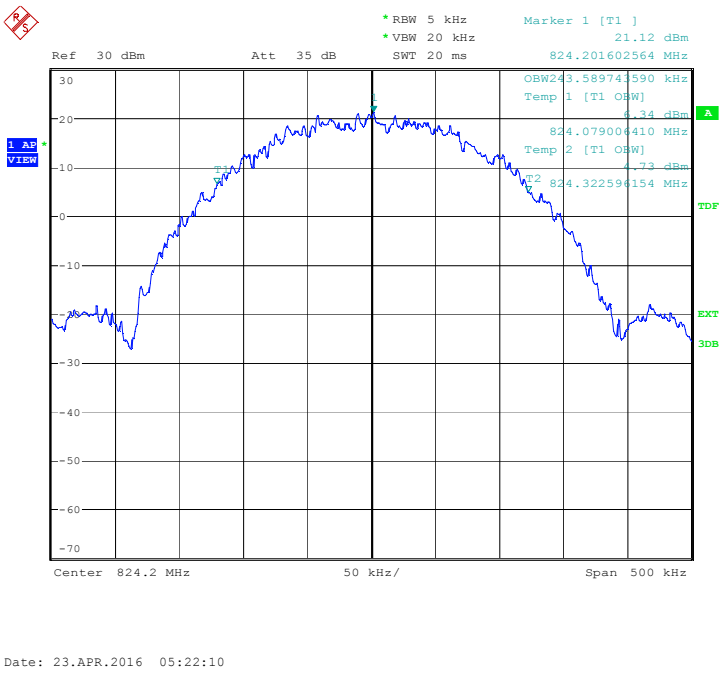
EGPRS 850-8PSK(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	243.590
836.6	247.596
848.8	244.391

EGPRS 850-8PSK

Channel 128-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 05:22:10

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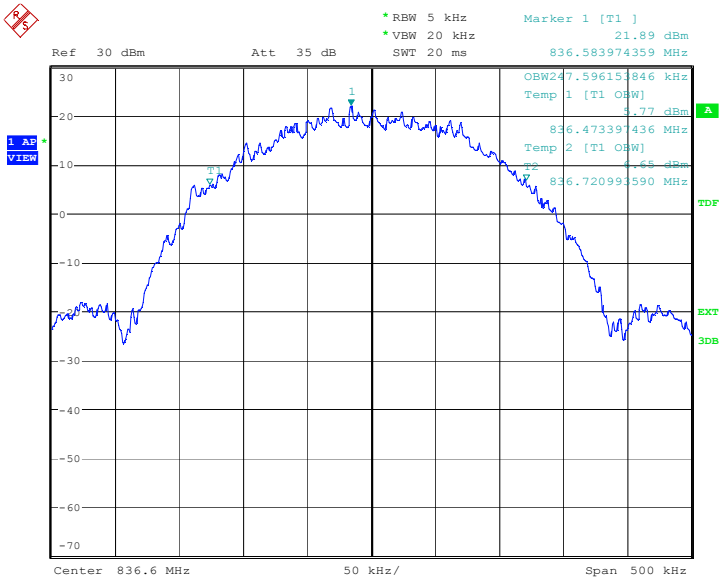
Channel 190-Occupied Bandwidth (99% BW)



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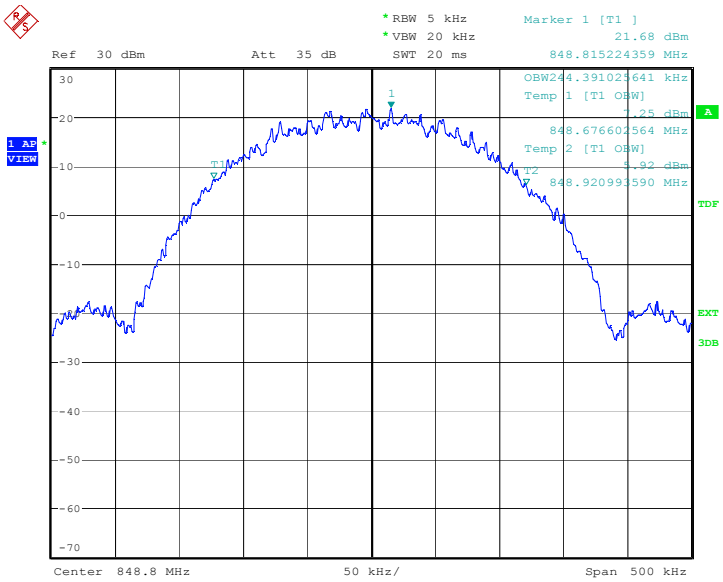
Channel 251-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 05:23:14

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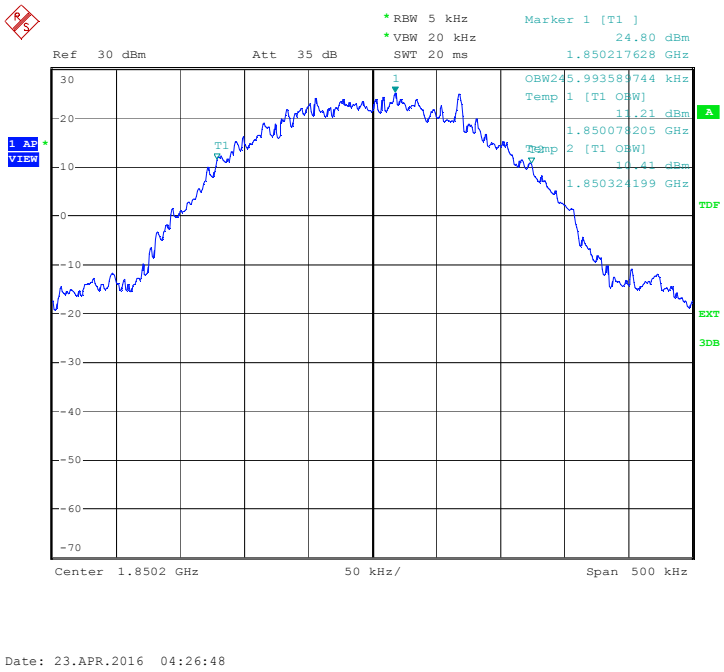
PCS 1900(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	245.994
1880.0	242.788
1909.8	245.192

PCS 1900

Channel 512-Occupied Bandwidth (99% BW)



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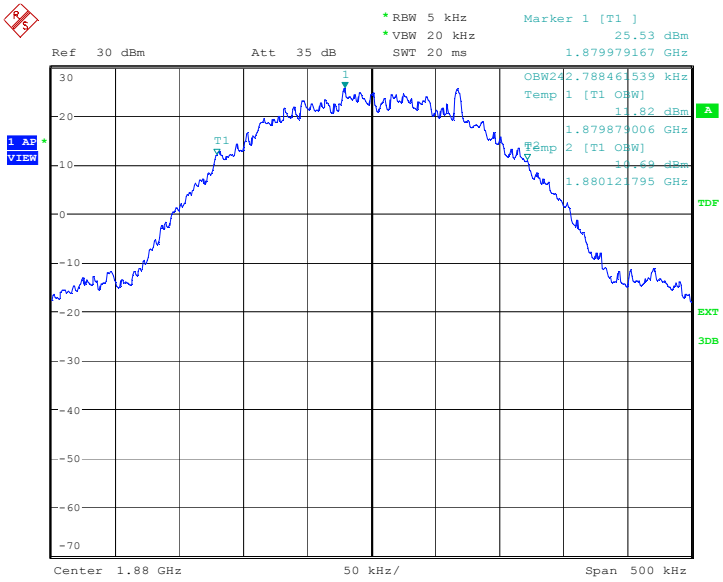
Channel 661-Occupied Bandwidth (99% BW)



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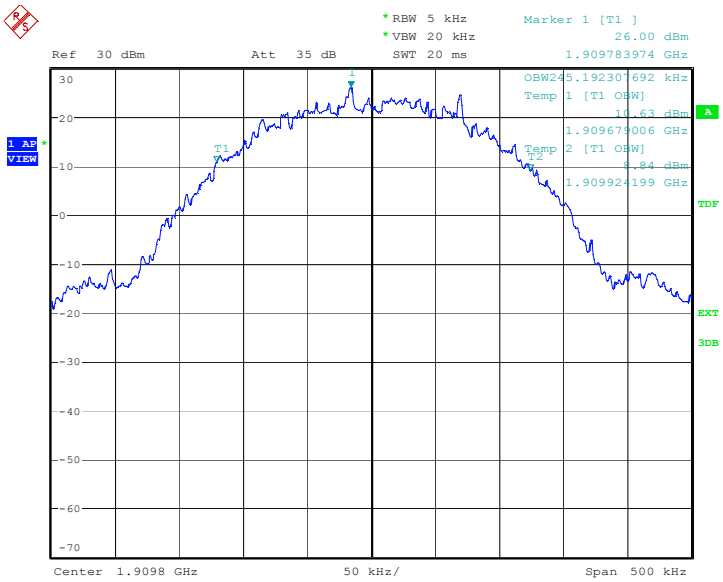
Channel 810-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 04:27:53

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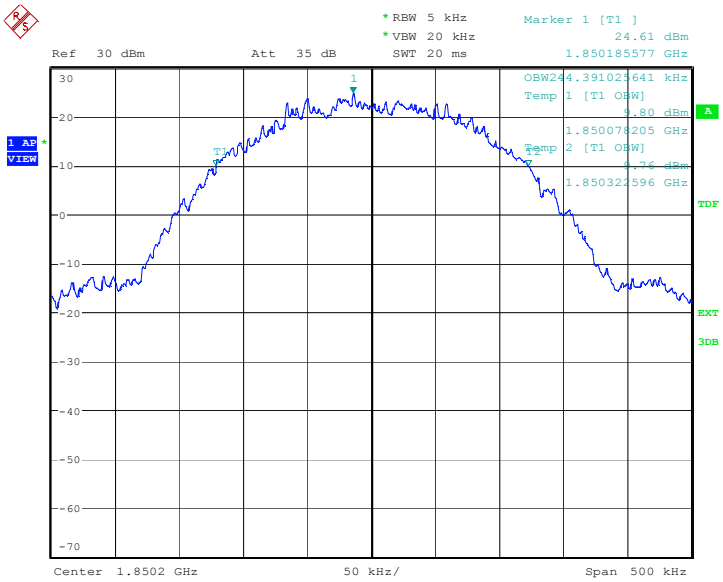
GPRS 1900(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	244.391
1880.0	241.987
1909.8	245.192

GPRS 1900

Channel 512-Occupied Bandwidth (99% BW)



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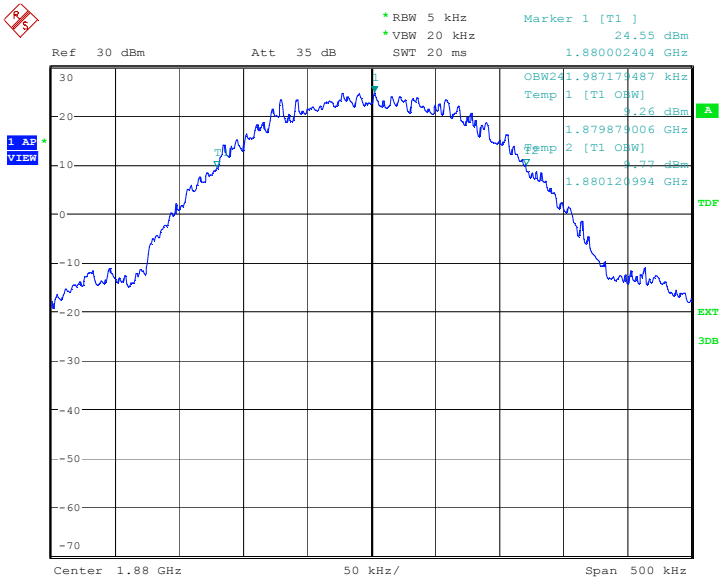
Channel 661-Occupied Bandwidth (99% BW)



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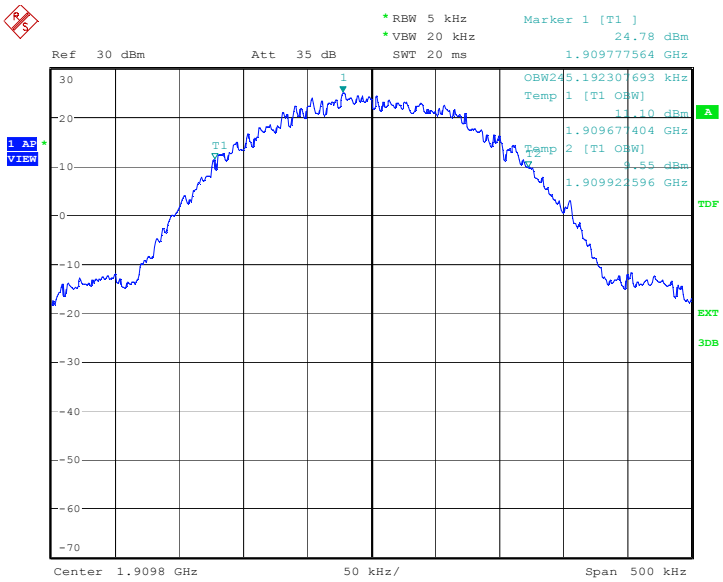
Channel 810-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 05:11:51

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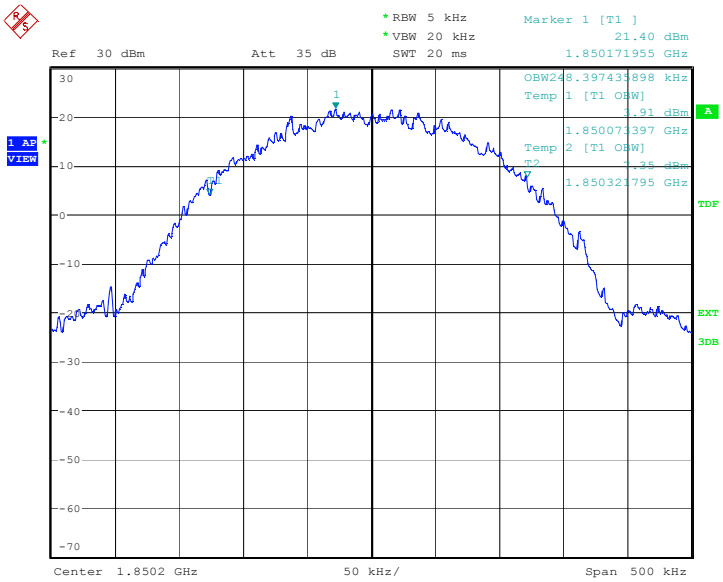
EGPRS 1900-8PSK(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	248.397
1880.0	249.199
1909.8	250.000

EGPRS 1900-8PSK

Channel 512-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 05:35:38

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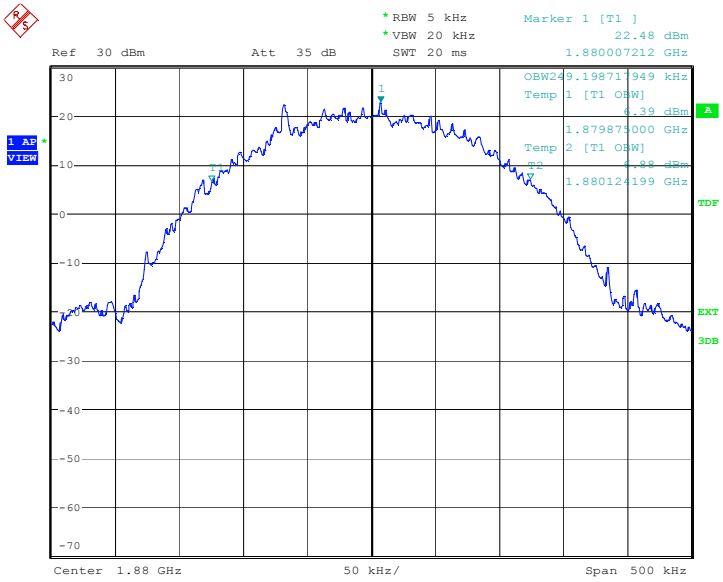
Channel 661-Occupied Bandwidth (99% BW)



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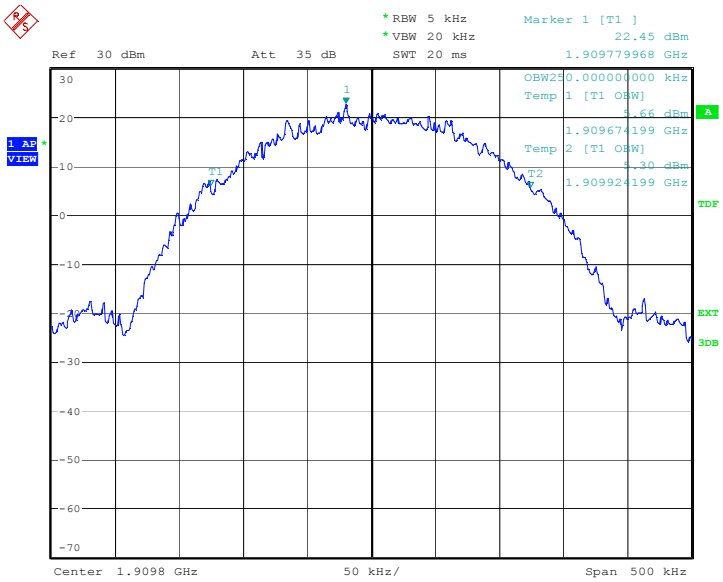
Channel 810-Occupied Bandwidth (99% BW)



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A.5 EMISSION BANDWIDTH

Reference

FCC: CFR Part 22.917(b), 24.238(a)

A.5.1Emission Bandwidth Results

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

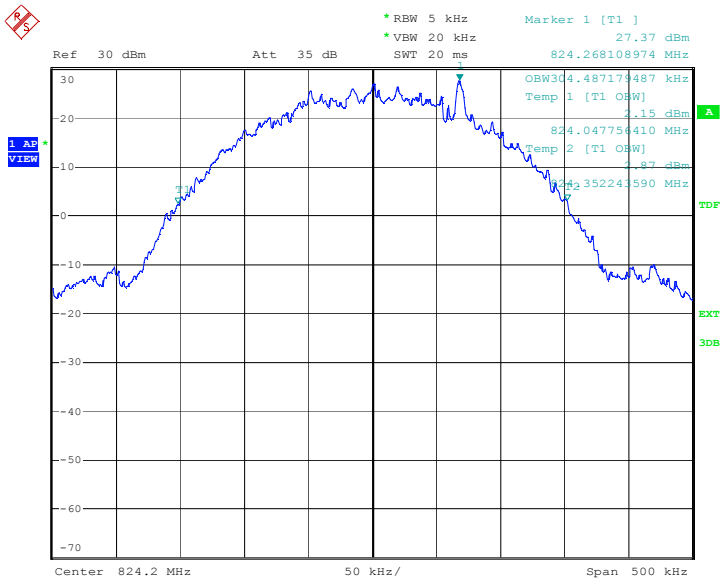
Similar to conducted emissions; Emission bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of PCS1900 band and GSM850 band. Table below lists the measured 100% BW. Spectrum analyzer plots are included on the following pages.

GSM 850(100% BW)

Frequency(MHz)	Emission Bandwidth (100% BW)(kHz)
824.2	304.487
836.6	306.090
848.8	306.891

GSM 850

Channel 128-Emission Bandwidth (100% BW)



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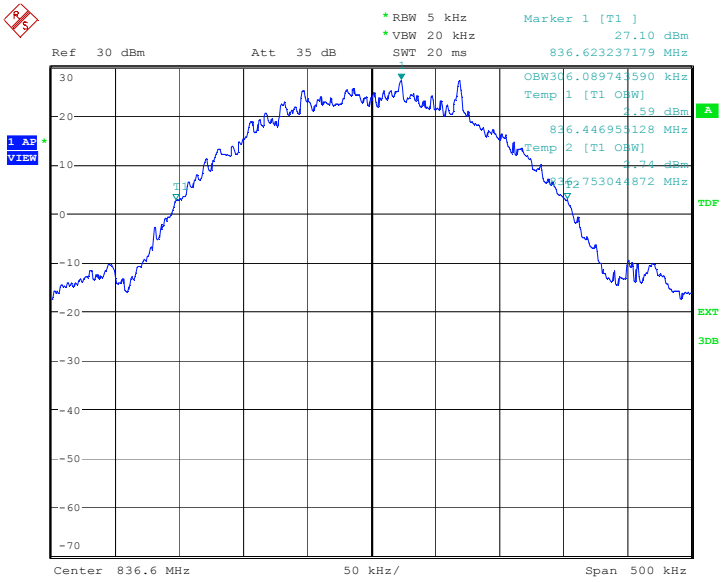
Channel 190-Emission Bandwidth (100% BW)



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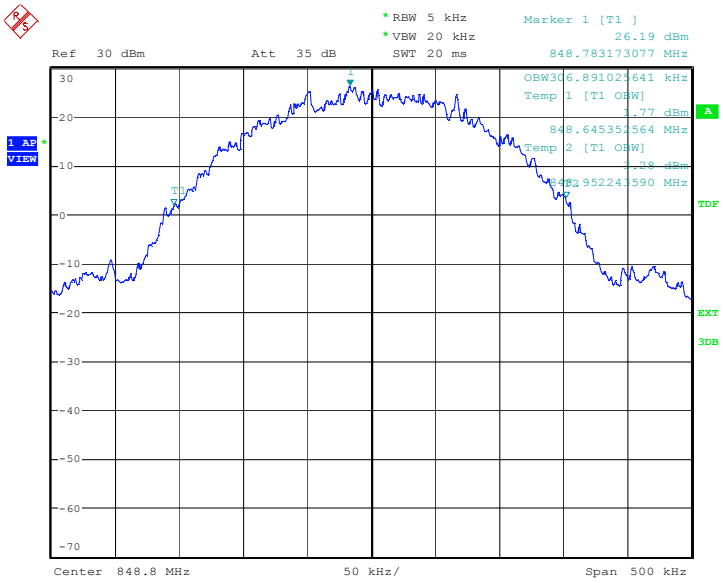
Channel 251-Emission Bandwidth (100% BW)



Date: 23.APR.2016 04:07:47

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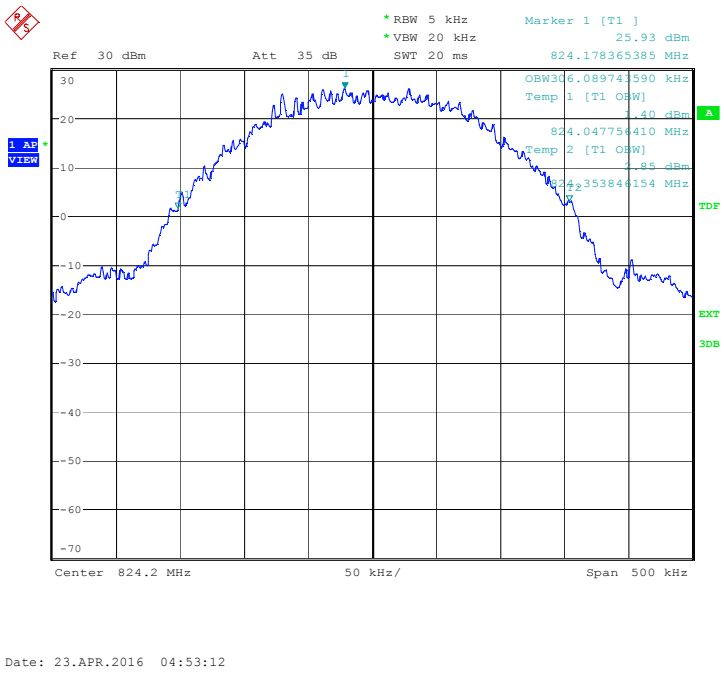
GPRS 850(100% BW)

Frequency(MHz)	Emission Bandwidth (100% BW)(kHz)
824.2	306.090
836.6	306.891
848.8	307.692

GPRS 850

Channel 128-Emission Bandwidth (100% BW)



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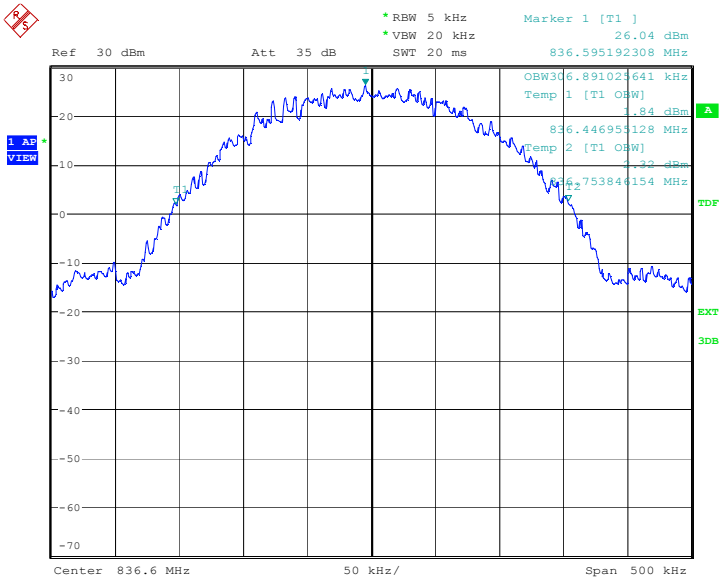
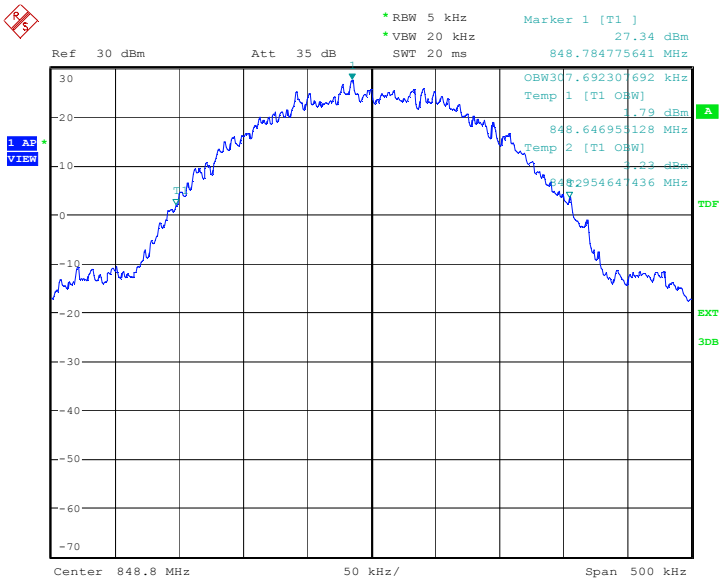
Channel 190-Emission Bandwidth (100% BW)



Date: 23.APR.2016 04:53:44

Channel 251-Emission Bandwidth (100% BW)



Date: 23.APR.2016 04:54:16

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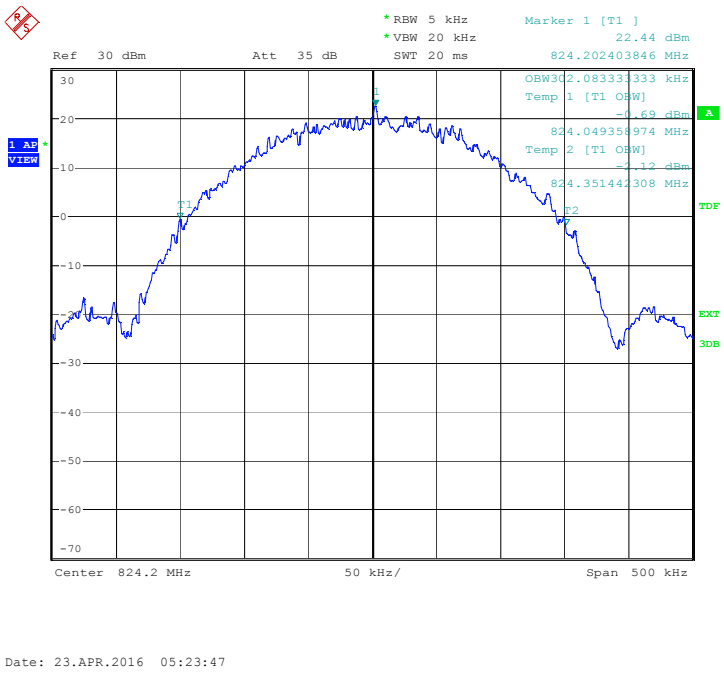
EGPRS 850-8PSK(100% BW)

Frequency(MHz)	Emission Bandwidth (100% BW)(kHz)
824.2	302.083
836.6	303.686
848.8	300.481

EGPRS 850-8PSK

Channel 128-Emission Bandwidth (100% BW)



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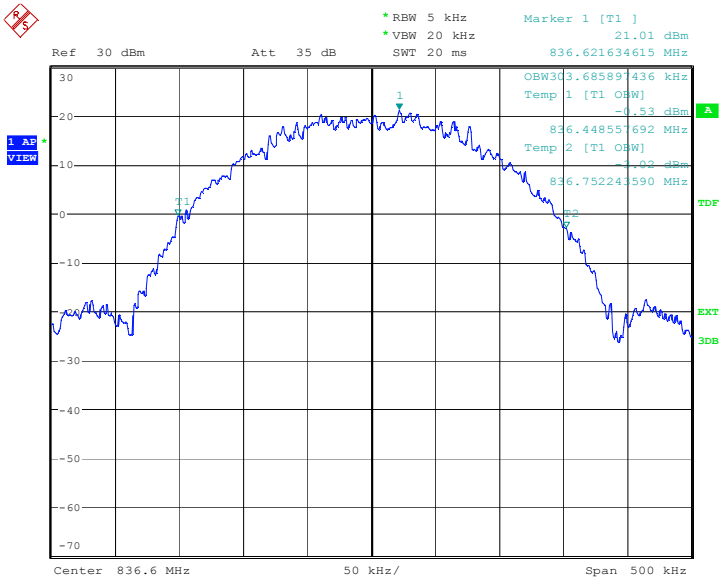
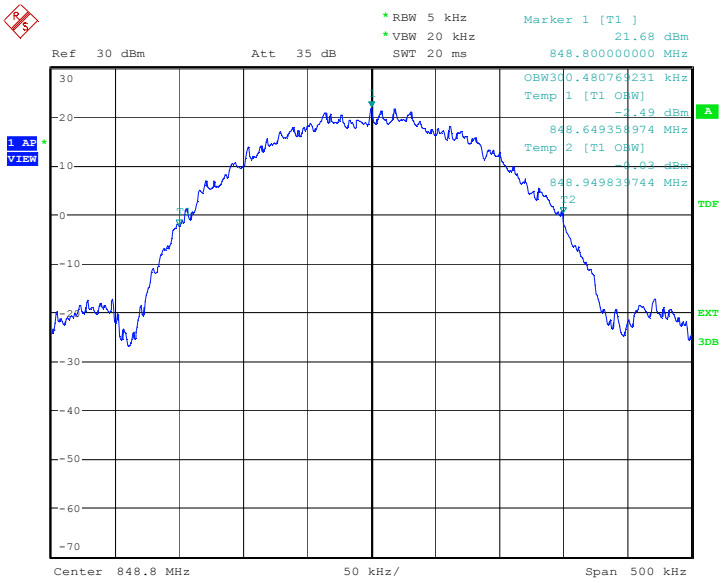
Channel 190-Emission Bandwidth (100% BW)



Date: 23.APR.2016 05:24:20

Channel 251-Emission Bandwidth (100% BW)



Date: 23.APR.2016 05:24:52

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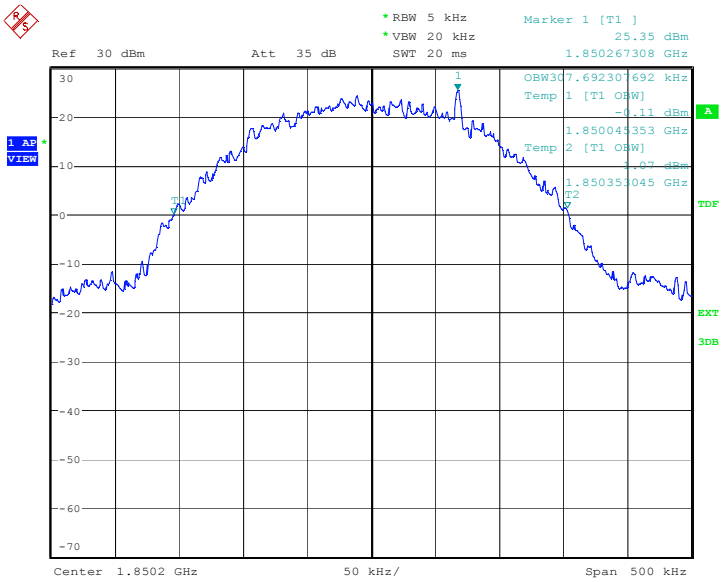
PCS 1900(100% BW)

Frequency(MHz)	Emission Bandwidth (100% BW)(kHz)
1850.2	307.692
1880.0	308.494
1909.8	309.295

PCS 1900

Channel 512-Emission Bandwidth (100% BW)



Date: 23.APR.2016 04:28:26

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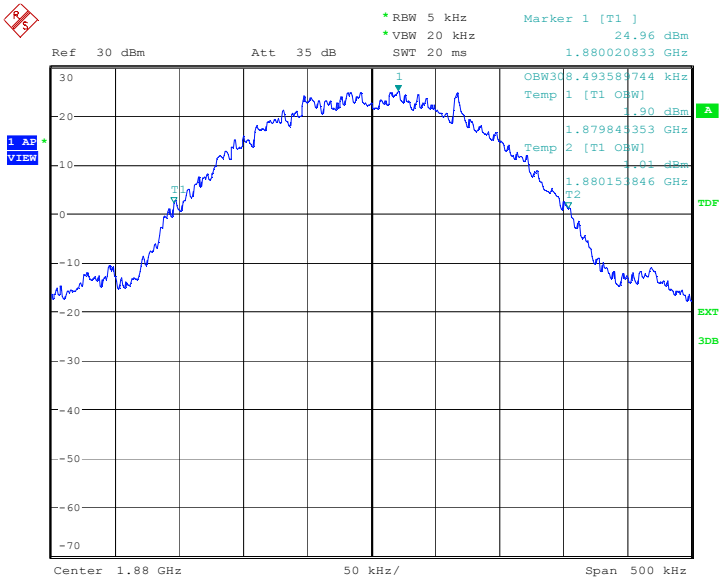
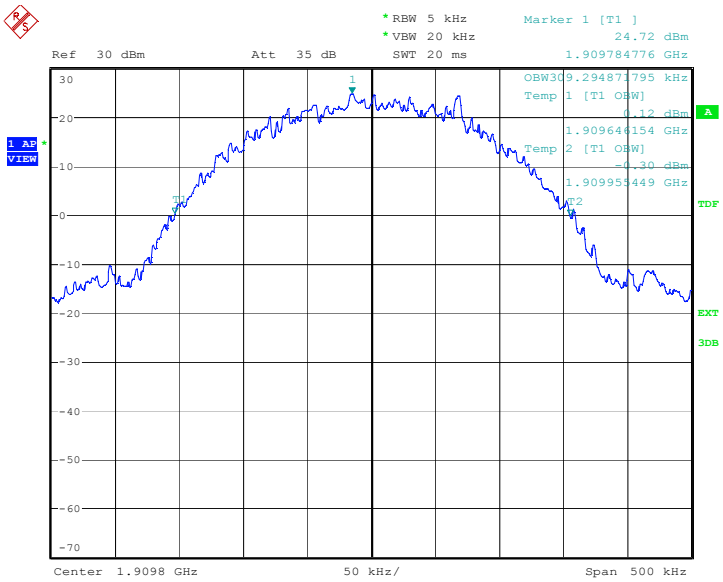
Channel 661-Emission Bandwidth (100% BW)



Date: 23.APR.2016 04:28:58

Channel 810-Emission Bandwidth (100% BW)



Date: 23.APR.2016 04:29:30

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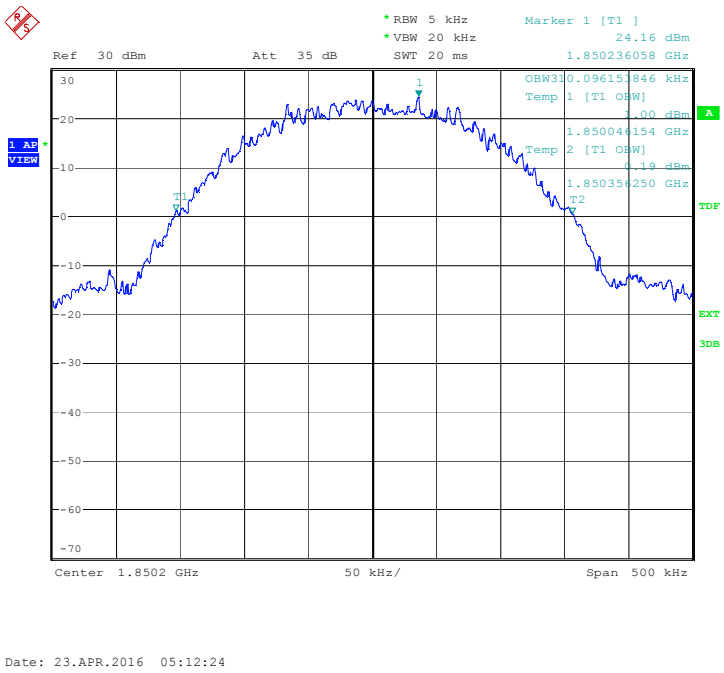
GPRS 1900(100% BW)

Frequency(MHz)	Emission Bandwidth (100% BW)(kHz)
1850.2	310.096
1880.0	307.692
1909.8	306.090

GPRS 1900

Channel 512-Emission Bandwidth (100% BW)



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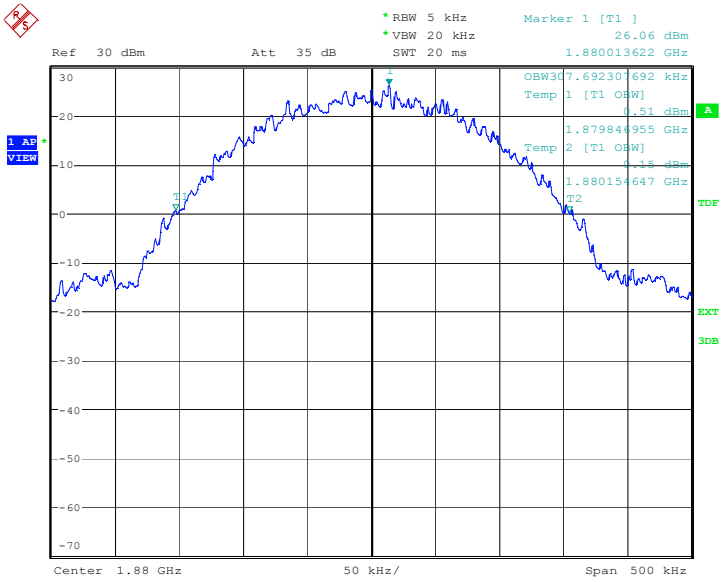
Channel 661-Emission Bandwidth (100% BW)



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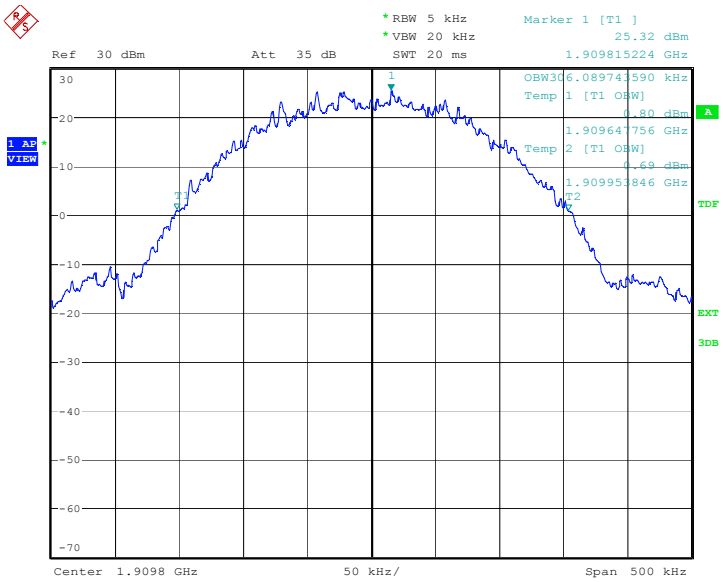
Channel 810-Emission Bandwidth (100% BW)



Date: 23.APR.2016 05:13:28

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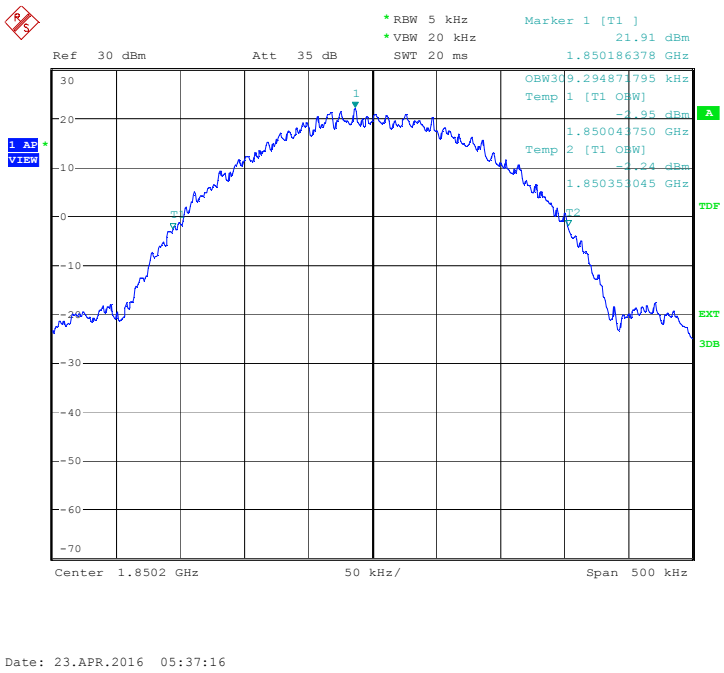
EGPRS 1900-8PSK(100% BW)

Frequency(MHz)	Emission Bandwidth (100% BW)(kHz)
1850.2	309.295
1880.0	306.891
1909.8	306.891

EGPRS 1900-8PSK

Channel 512-Emission Bandwidth (100% BW)



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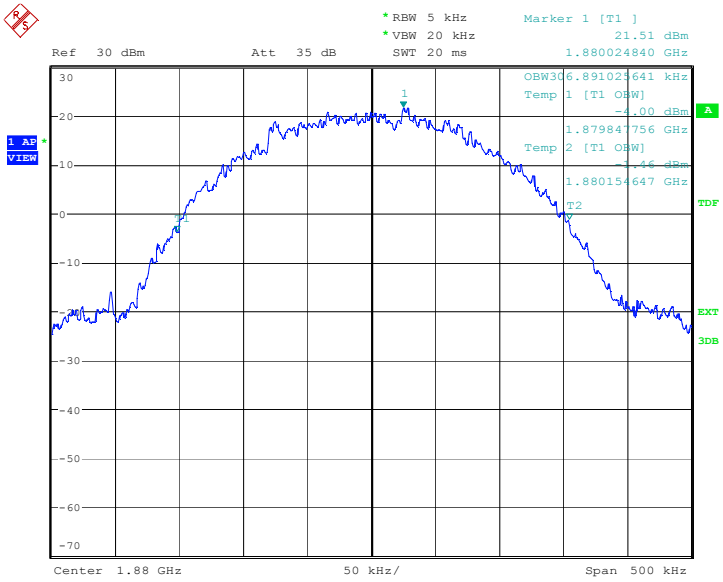
Channel 661-Emission Bandwidth (100% BW)



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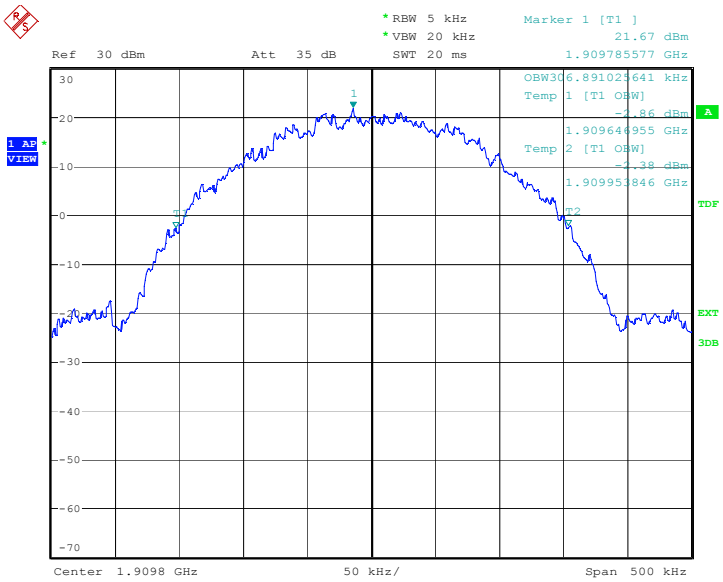
Channel 810-Emission Bandwidth (100% BW)



Date: 23.APR.2016 05:38:20

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A.6 BAND EDGE COMPLIANCE

Reference

FCC: CFR Part 22.917(b), 24.238(a)

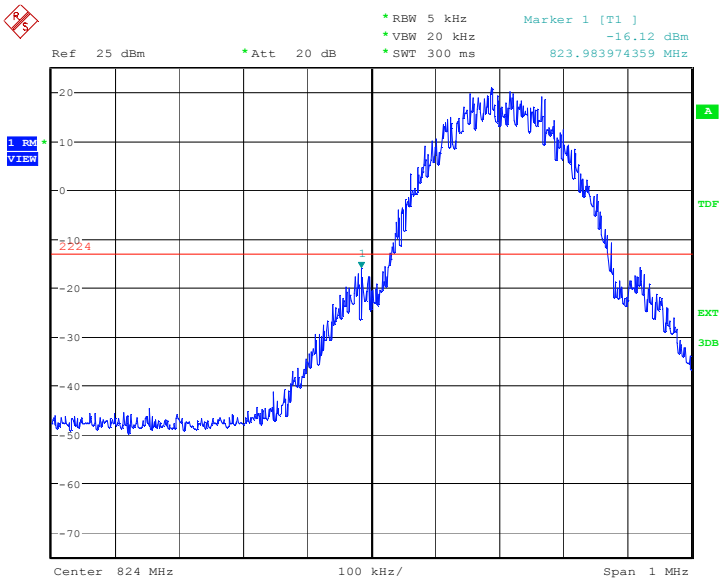
Measurement limit

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

GSM 850

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



Date: 26.APR.2016 05:08:44

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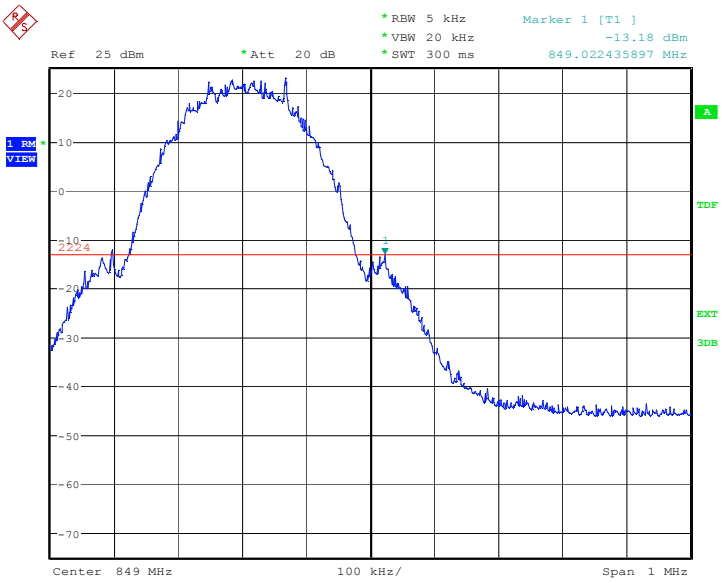
HIGH BAND EDGE BLOCK-C (GSM850) –Channel 251



Date: 26.APR.2016 05:13:47

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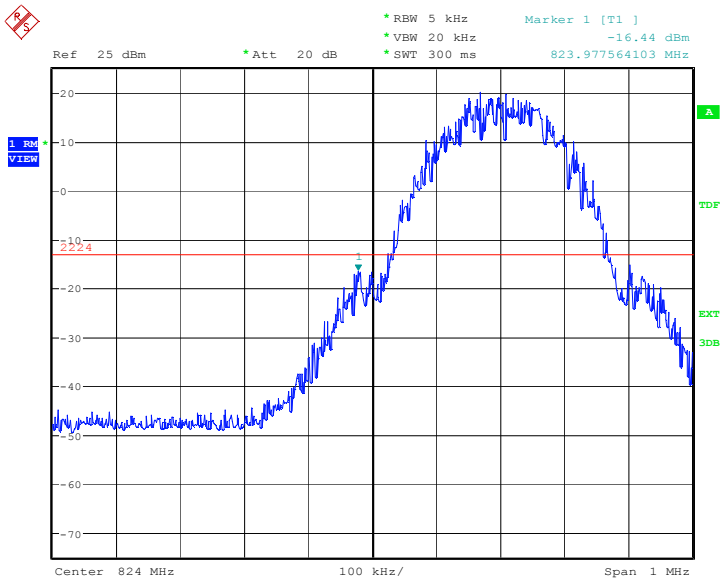
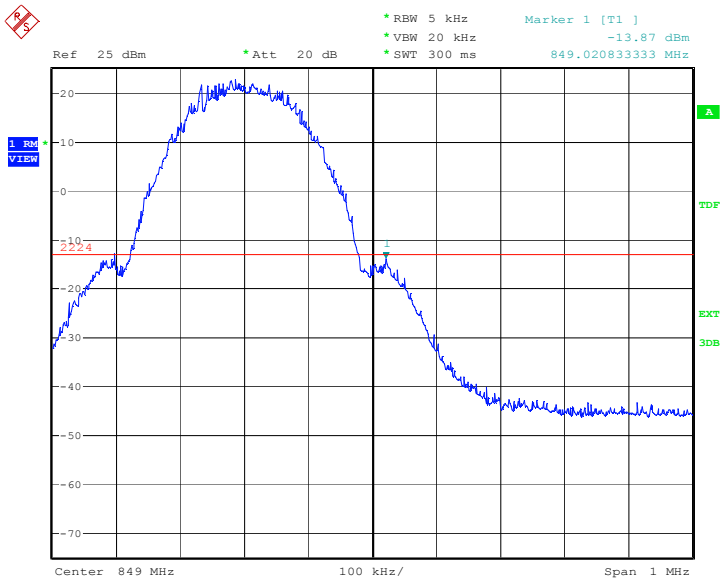
GPRS 850

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



Date: 26.APR.2016 05:18:17

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



Date: 26.APR.2016 05:23:21

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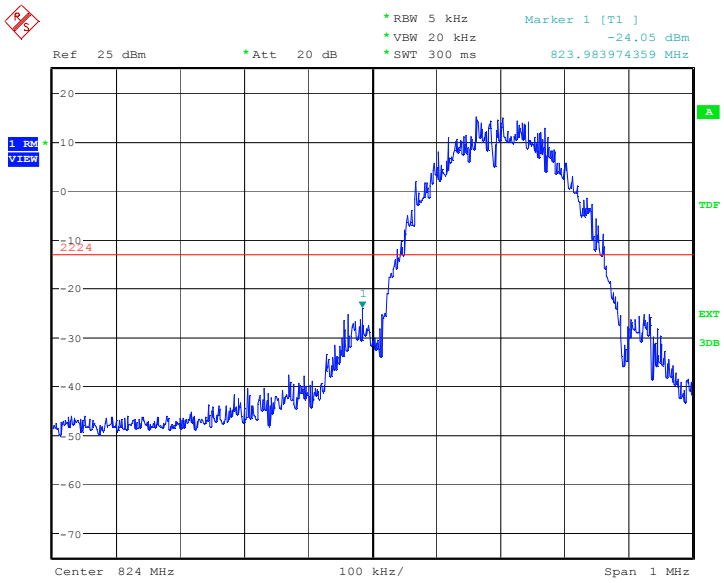
EGPRS 850-8PSK

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



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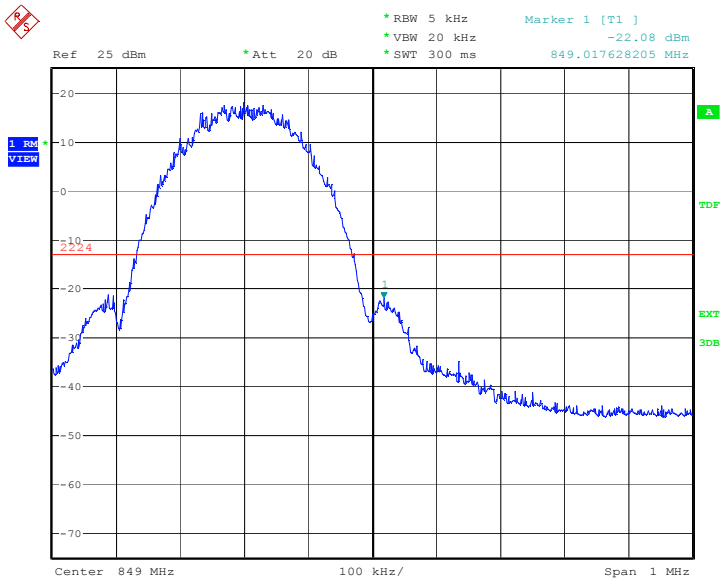
HIGH BAND EDGE BLOCK-C (GSM850) –Channel 251



Date: 26.APR.2016 05:35:26

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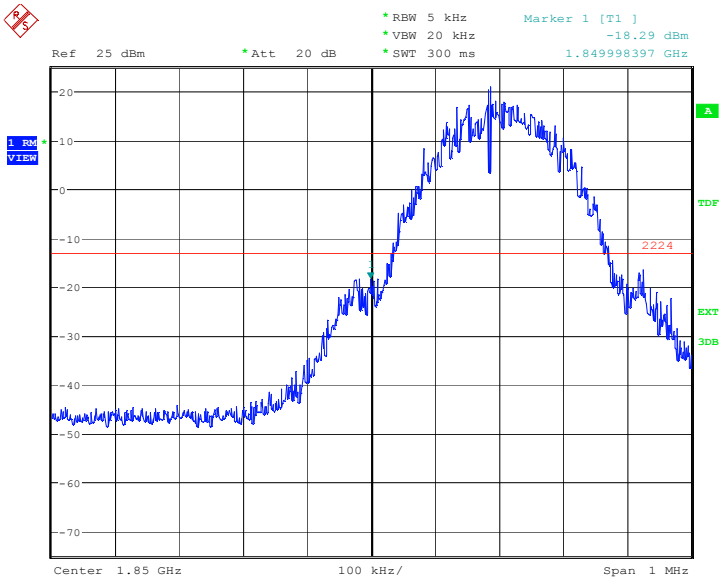
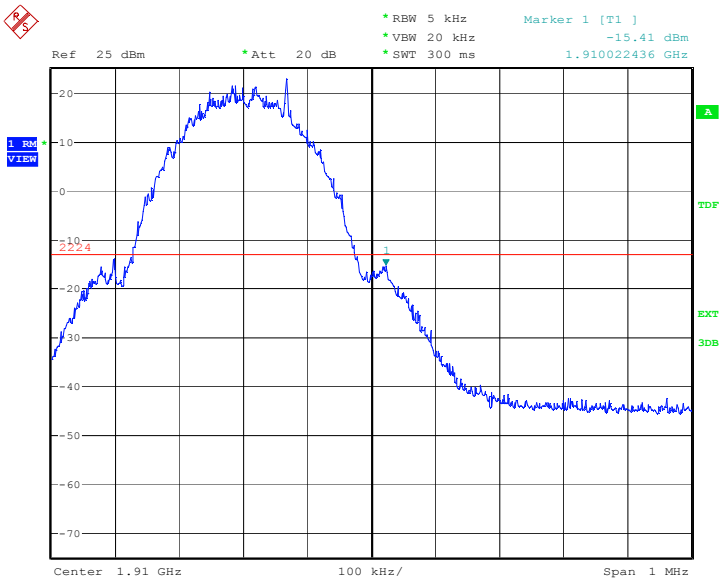
PCS 1900

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



Date: 23.APR.2016 04:33:03

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



Date: 23.APR.2016 04:35:07

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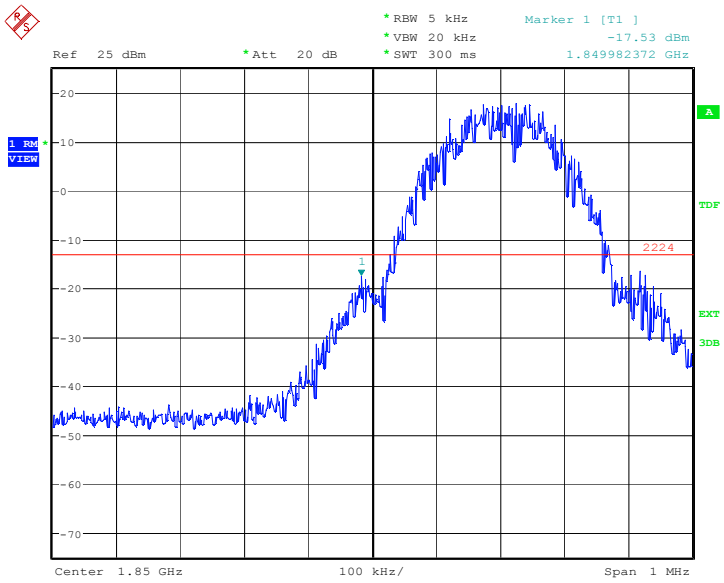
GPRS 1900

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



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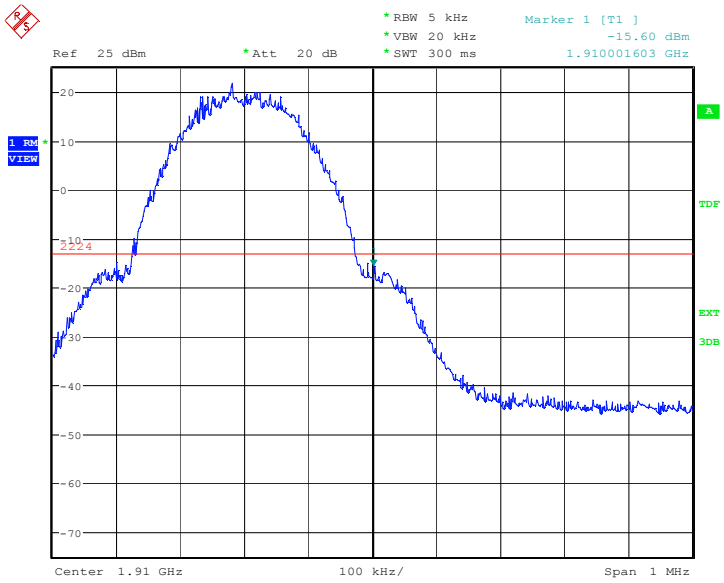
HIGH BAND EDGE BLOCK-C (PCS-1900) –Channel 810



Date: 23.APR.2016 05:19:03

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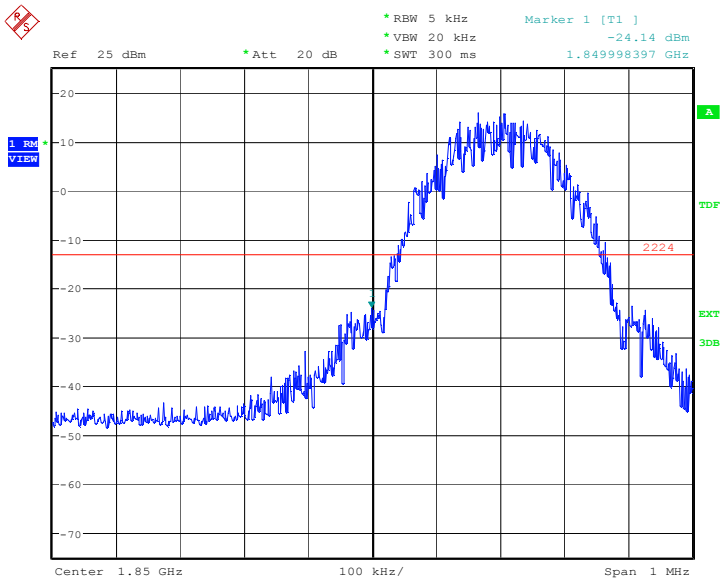
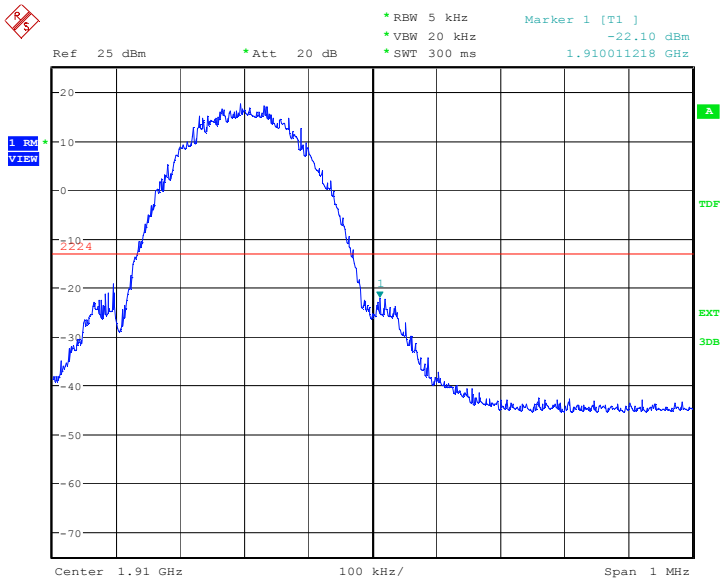
EGPRS 1900-8PSK

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



Date: 23.APR.2016 05:41:53

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



Date: 23.APR.2016 05:43:56

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A.7 CONDUCTED SPURIOUS EMISSION

Reference

FCC: CFR Part 2.1057, 22.917, 24.238.

A.7.1 Measurement Method

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

1. Determine frequency range for measurements: From CFR 2.1057 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, 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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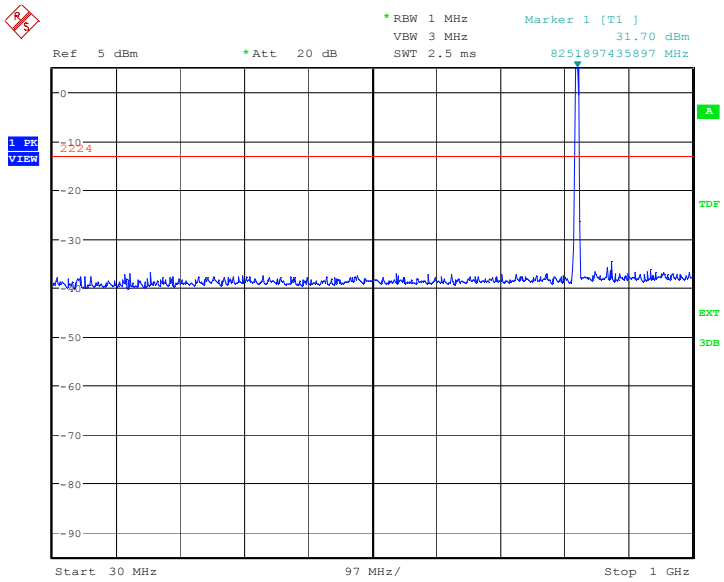
A.7.3 Measurement result

GSM850

Channel 128: 30MHz – 1GHz

Spurious emission limit –13dBm.

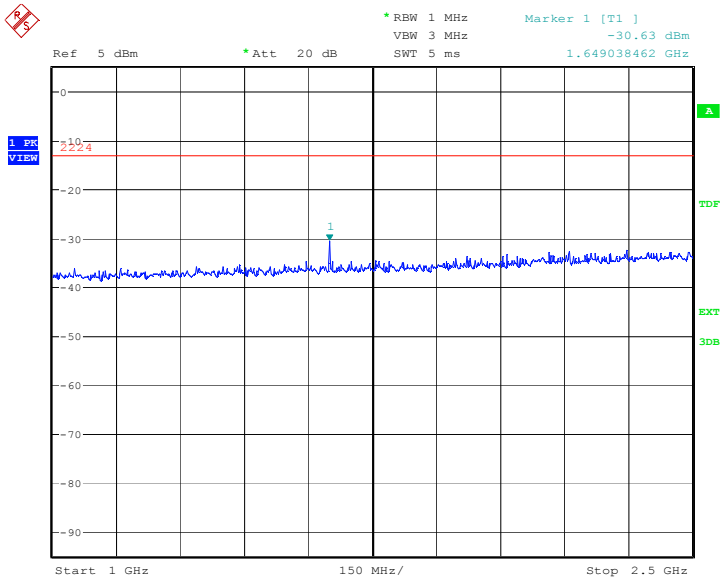
NOTE: peak above the limit line is the carrier frequency.



Date: 23.APR.2016 04:15:51

Channel 128: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:16:19

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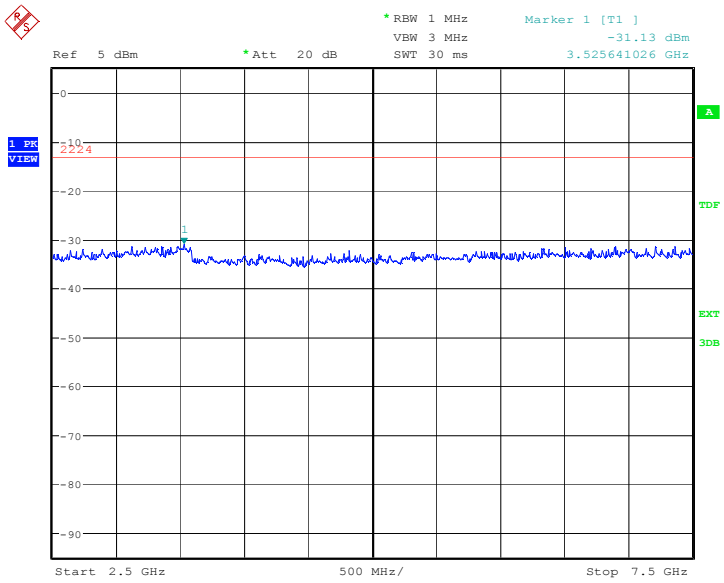
Channel 128: 2.5GHz – 7.5GHz

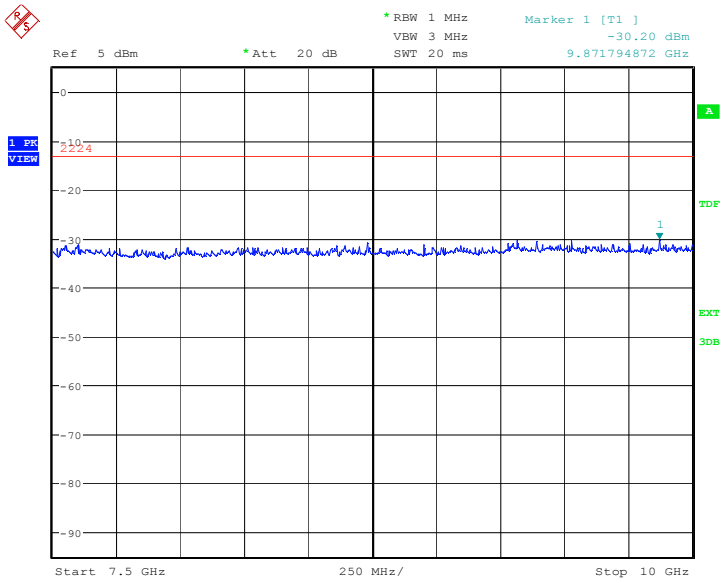
Spurious emission limit –13dBm.



Date: 23.APR.2016 04:16:47

Channel 128: 7.5GHz –10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:17:15

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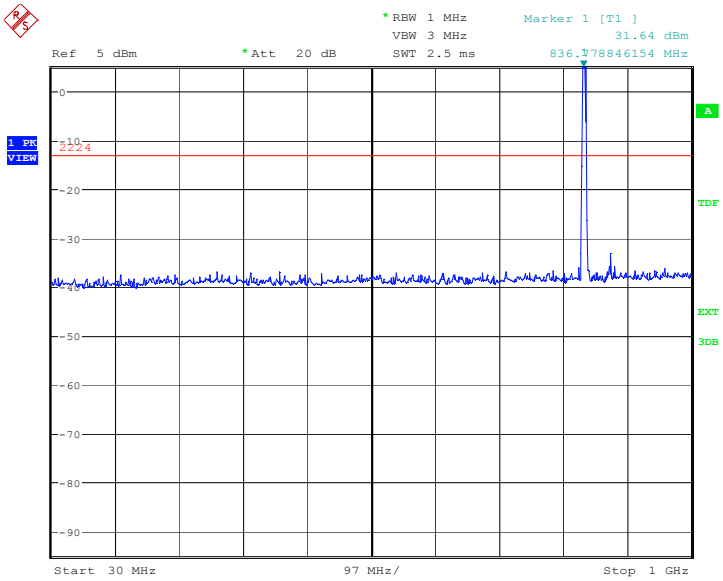
Channel 190: 30MHz – 1GHz

Spurious emission limit –13dBm

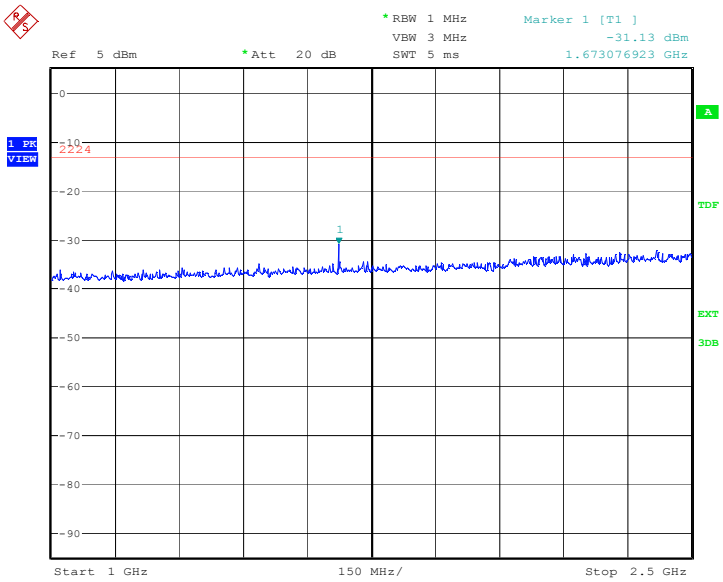
NOTE: peak above the limit line is the carrier frequency.



Date: 23.APR.2016 04:17:44

Channel 190: 1GHz –2.5GHz

Spurious emission limit –13dBm



Date: 23.APR.2016 04:18:12

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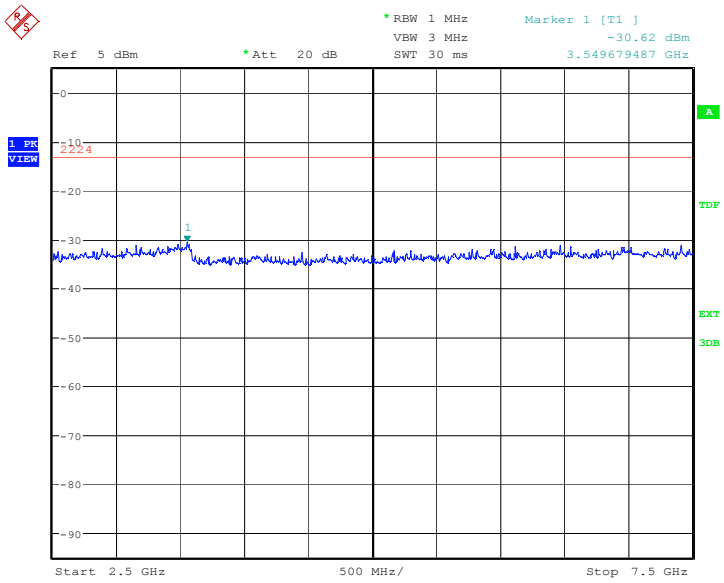
Channel 190: 2.5GHz –7.5GHz

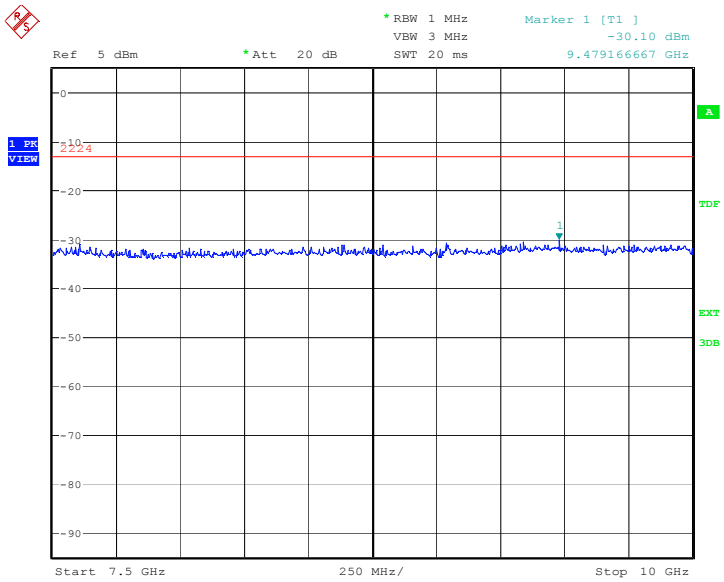
Spurious emission limit –13dBm



Date: 23.APR.2016 04:18:40

Channel 190: 7.5GHz –10GHz

Spurious emission limit –13dBm



Date: 23.APR.2016 04:19:08

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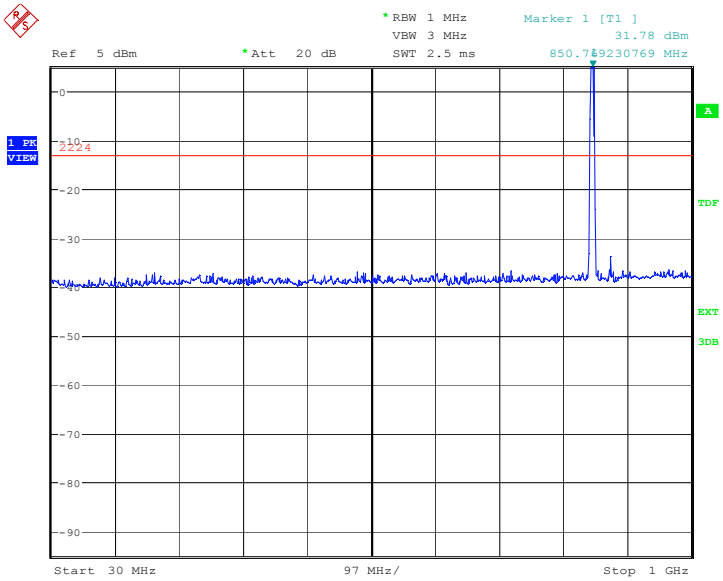
Channel 251: 30MHz – 1GHz

Spurious emission limit –13dBm.

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



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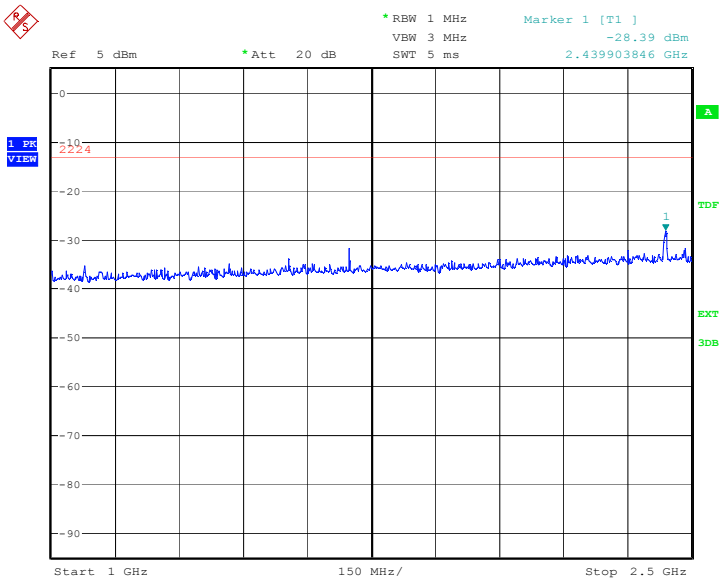
Channel 251: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:20:05

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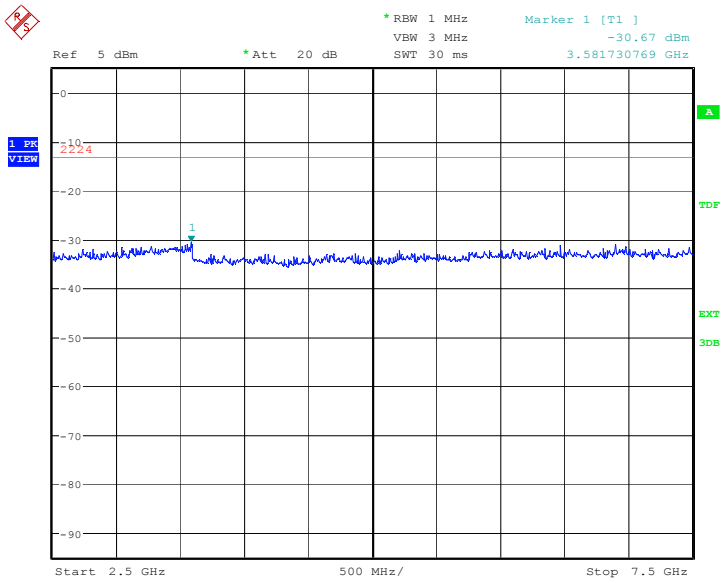
Channel 251:2.5GHz – 7.5GHz

Spurious emission limit –13dBm.



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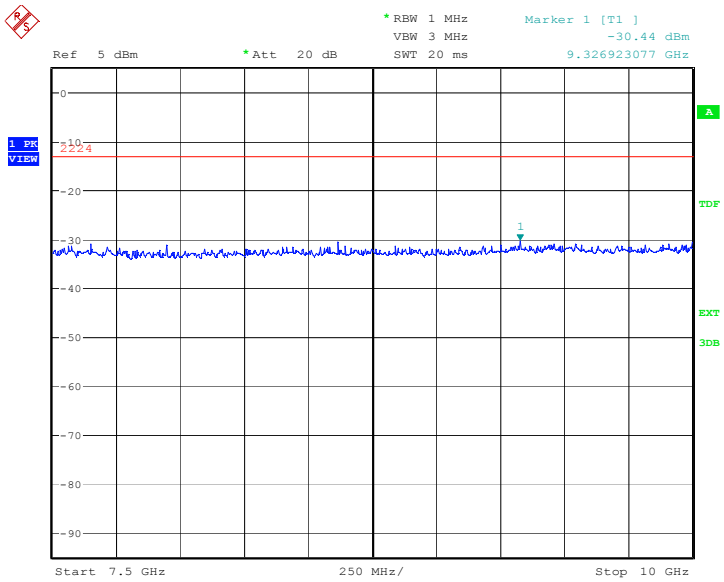
Channel 251: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:21:01

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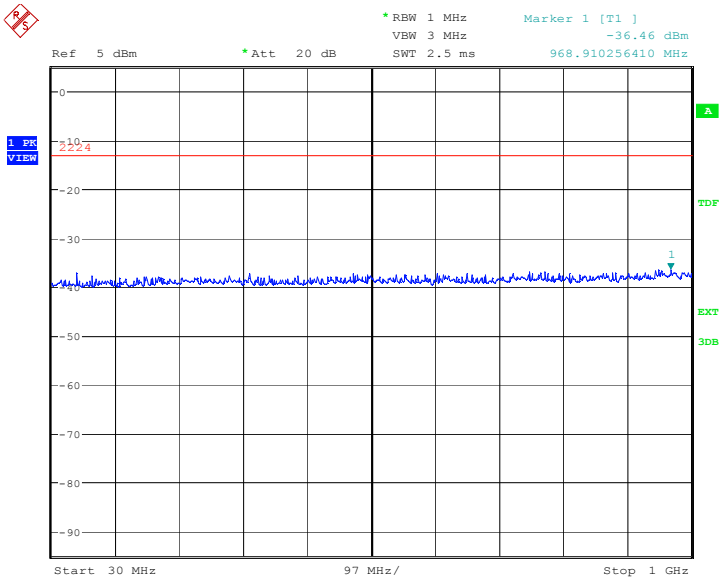
PCS1900

Channel 512: 30MHz – 1GHz

Spurious emission limit –13dBm.

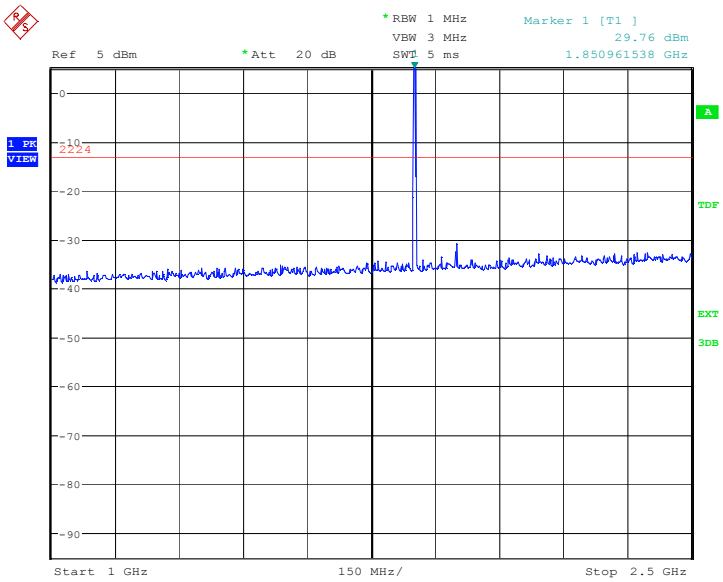


Date: 23.APR.2016 04:37:34

Channel 512: 1GHz – 2.5GHz

Spurious emission limit –13dBm.

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



Date: 23.APR.2016 04:38:02

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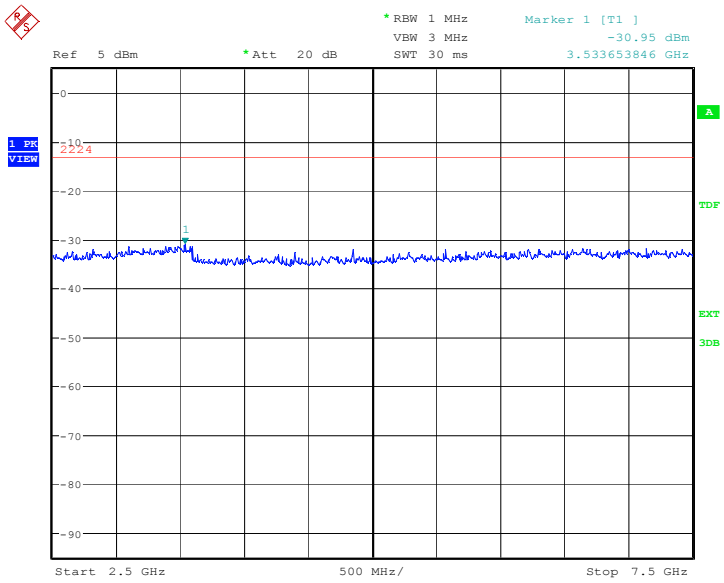
Channel 512: 2.5GHz – 7.5GHz

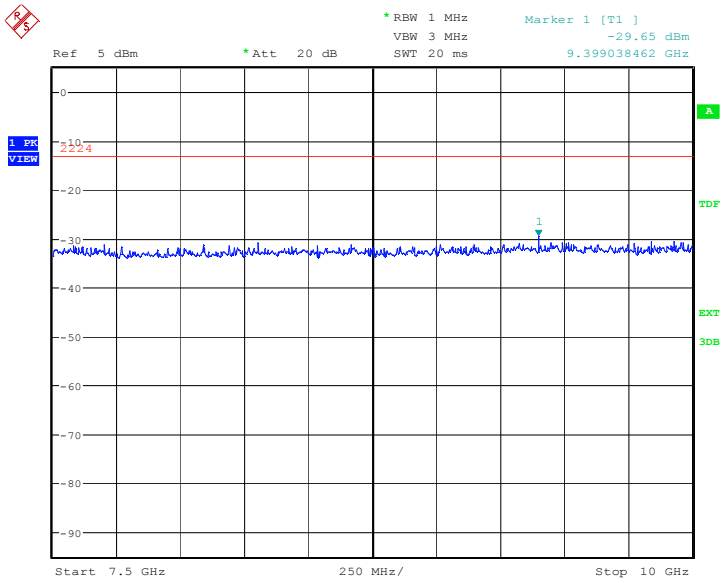
Spurious emission limit –13dBm.



Date: 23.APR.2016 04:38:30

Channel 512: 7.5GHz –10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:38:58

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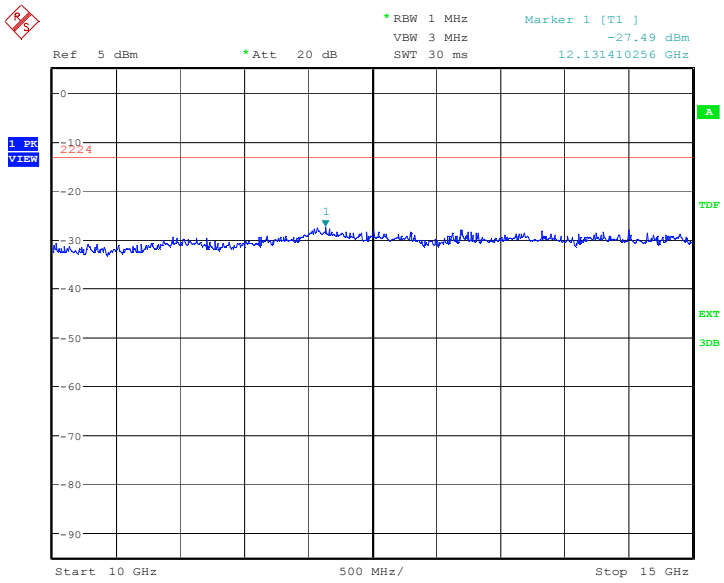
Channel 512: 10GHz –15GHz

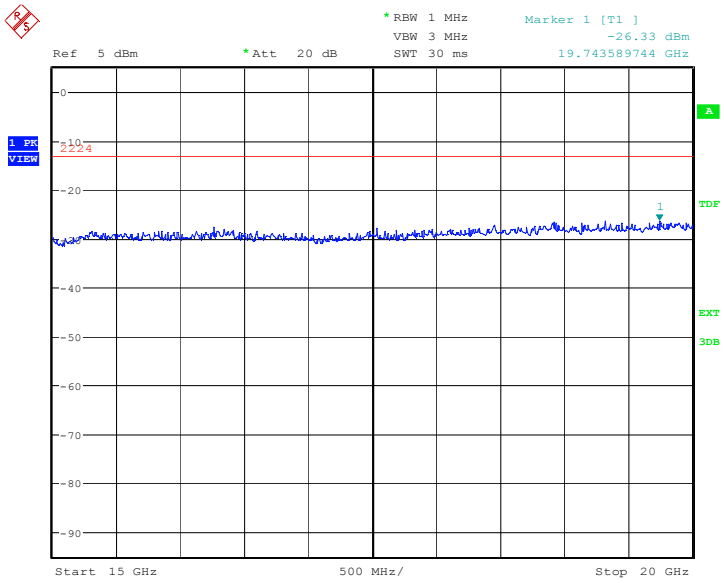
Spurious emission limit –13dBm.



Date: 23.APR.2016 04:39:26

Channel 512: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:39:54

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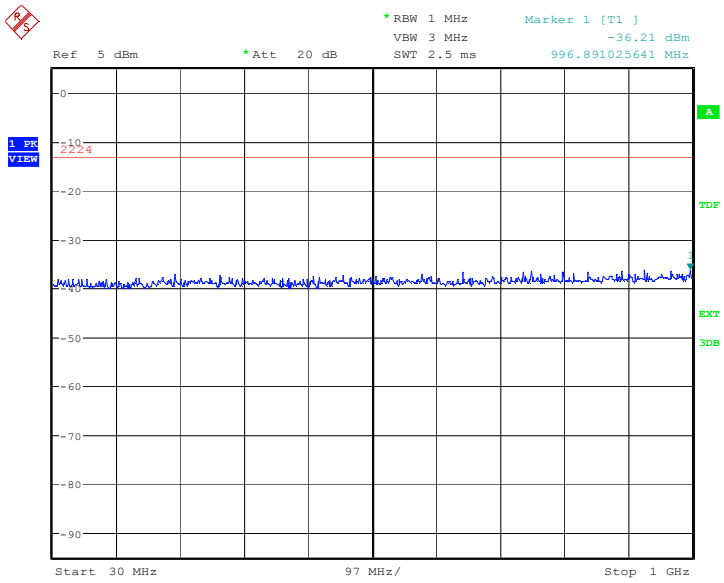
Channel 661: 30MHz – 1GHz

Spurious emission limit –13dBm

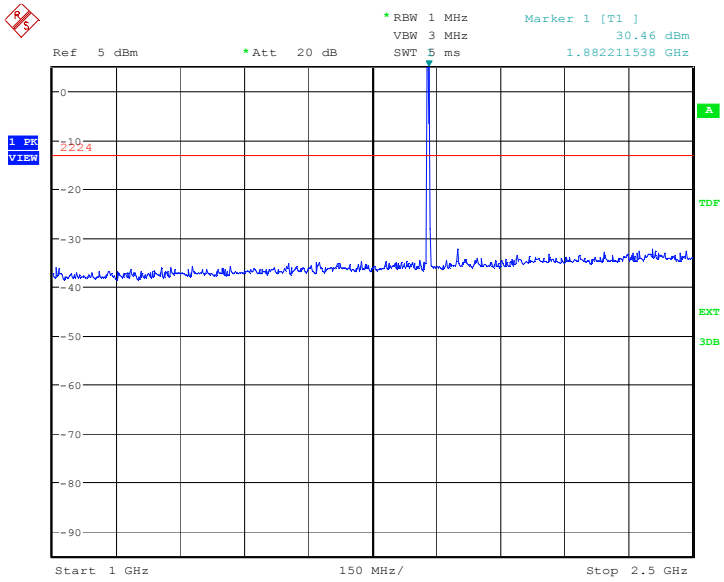


Date: 23.APR.2016 04:40:23

Channel 661: 1GHz –2.5GHz

Spurious emission limit –13dBm

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



Date: 23.APR.2016 04:40:51

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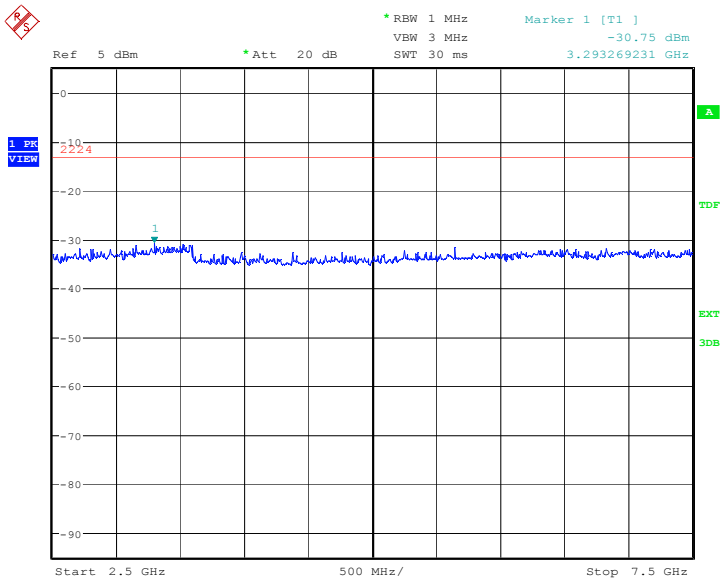
Channel 661: 2.5GHz –7.5GHz

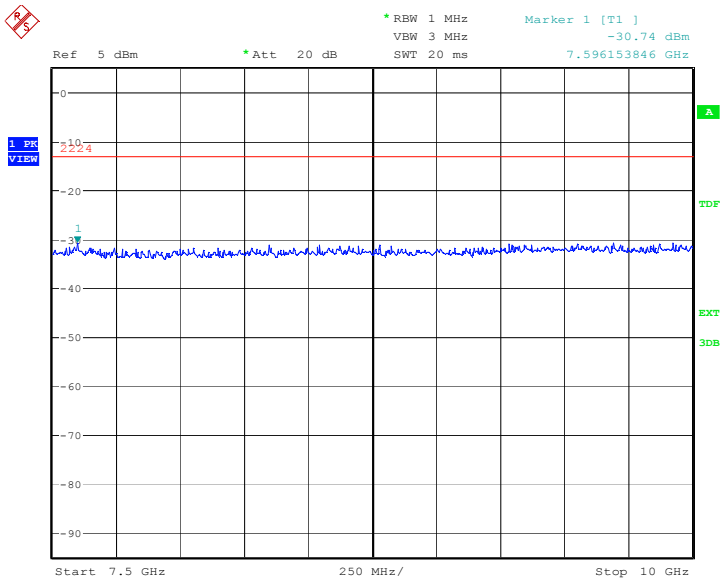
Spurious emission limit –13dBm



Date: 23.APR.2016 04:41:19

Channel 661: 7.5GHz –10GHz

Spurious emission limit –13dBm



Date: 23.APR.2016 04:41:47

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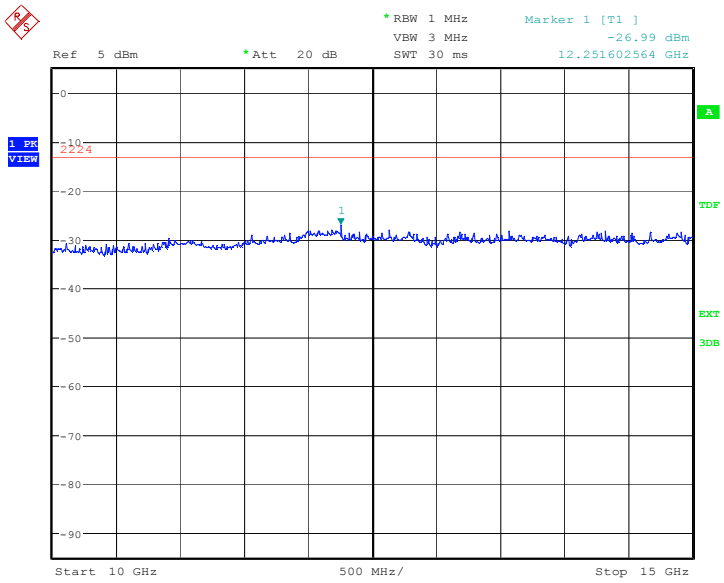
Channel 661: 10GHz –15GHz

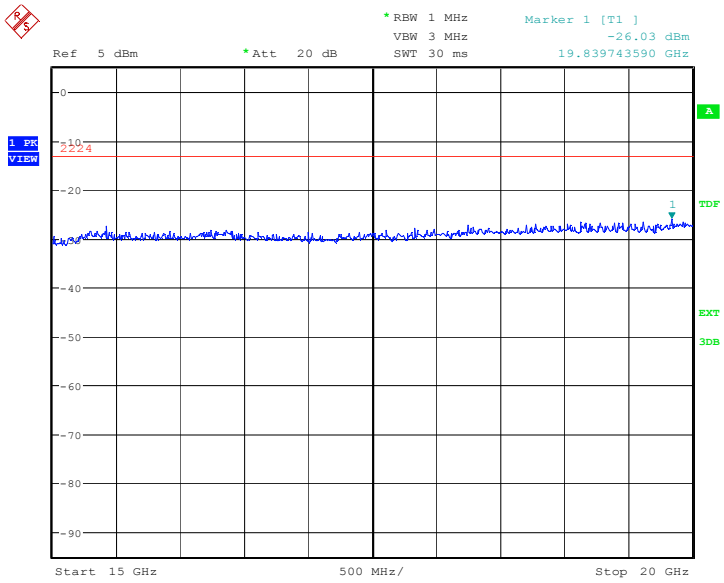
Spurious emission limit –13dBm.



Date: 23.APR.2016 04:42:16

Channel 661: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:42:44

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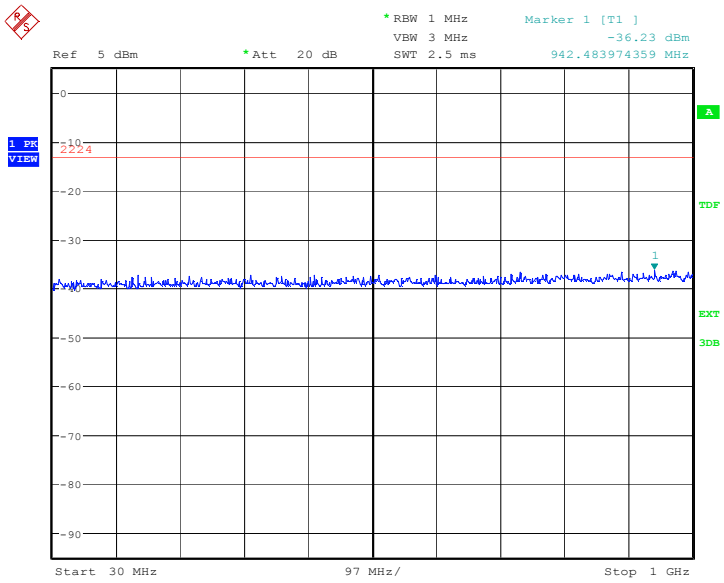
Channel 810: 30MHz – 1GHz

Spurious emission limit –13dBm.

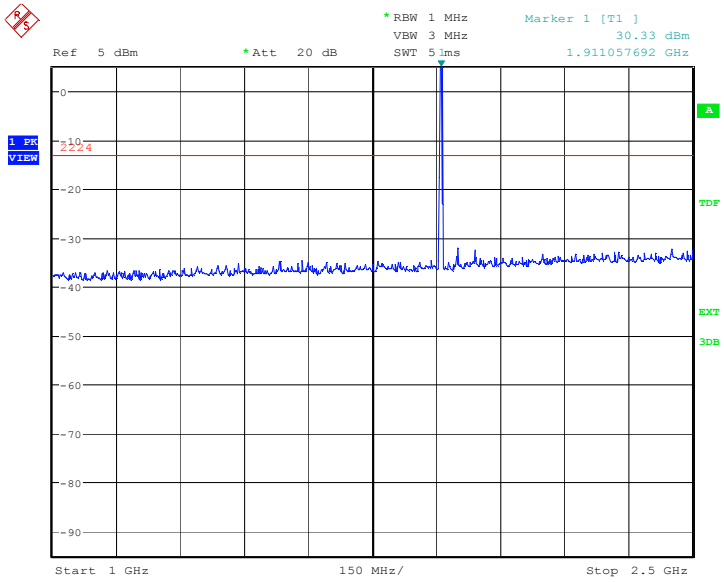


Date: 23.APR.2016 04:43:12

Channel 810: 1GHz – 2.5GHz

Spurious emission limit –13dBm.

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



Date: 23.APR.2016 04:43:40

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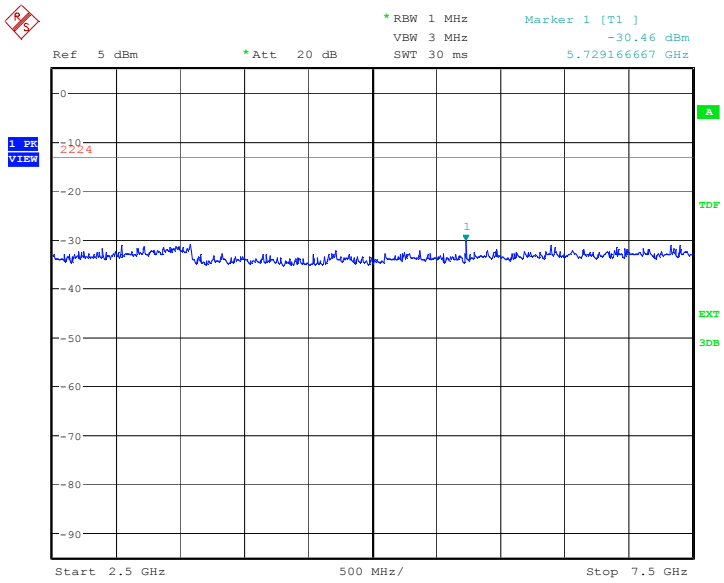
Channel 810:2.5GHz – 7.5GHz

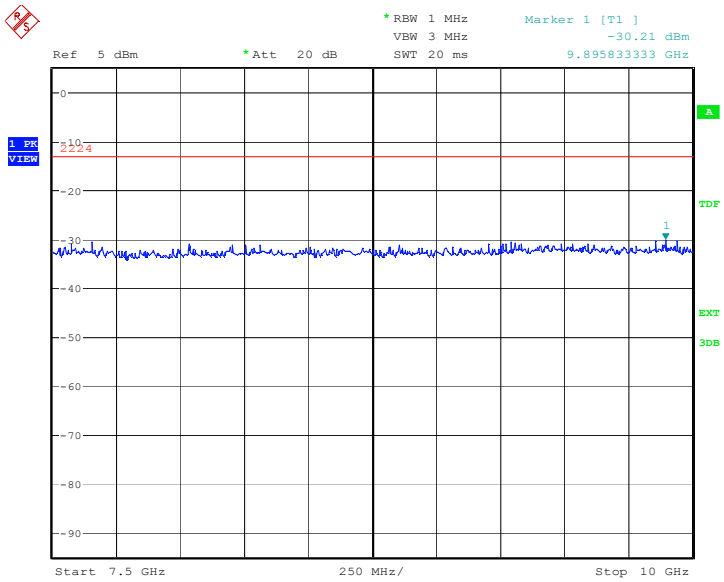
Spurious emission limit –13dBm.



Date: 23.APR.2016 04:44:09

Channel 810: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:44:37

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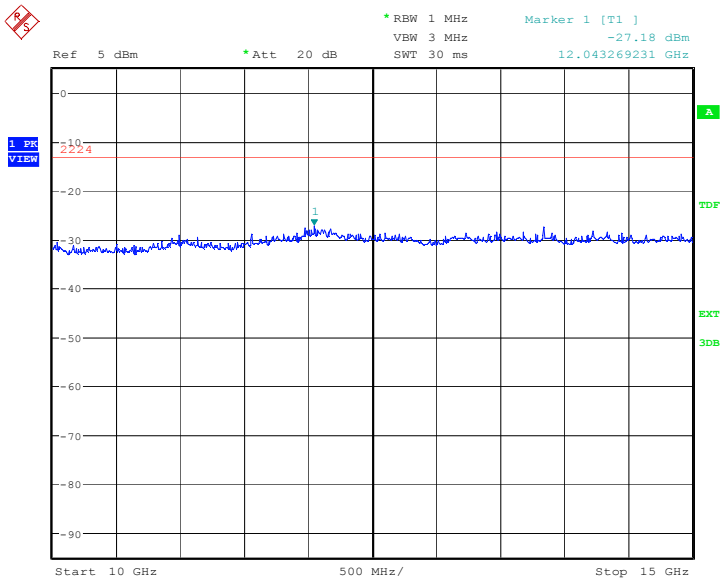
Channel 810: 10GHz –15GHz

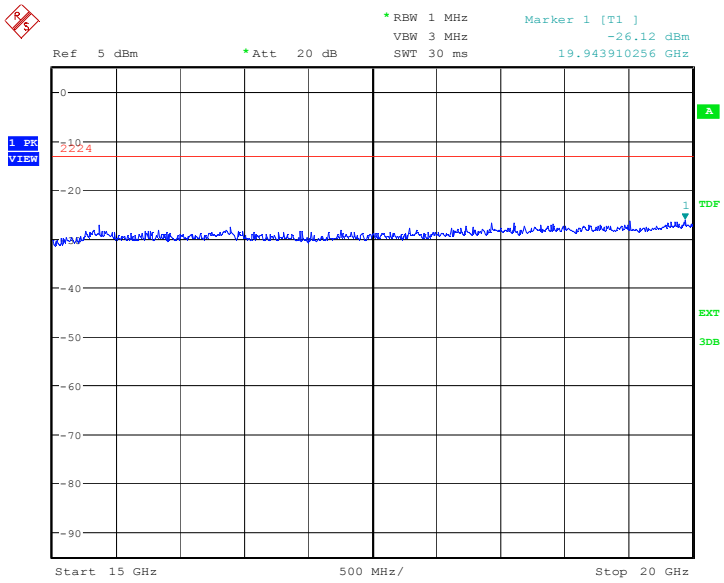
Spurious emission limit –13dBm.



Date: 23.APR.2016 04:45:05

Channel 810: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 04:45:33

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