TEST REPORT

No. I16Z40886-GTE02

for

TCL Communication Ltd.

LTE / UMTS / GSM mobile phone

Model Name: VFD501

FCC ID: 2ACCJH050

with

Hardware Version: PIO

Software Version: v8F27

Issued Date: 2016-05-04

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
I16Z40886-GTE02	Rev.0	1st edition	2016-05-04

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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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2. Client Information

2.1. Applicant Information

Company Name:	TCL Communication Ltd.
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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
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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	VFD501
FCC ID	2ACCJH050
Antenna	Integrated
Output power	21.96dBm maximum EIRP measured for Band II
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

The EUT is a variant model of VFD500.All the result is coming from the initial model.

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version
\	\	\	\

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

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery
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

WCDMA Band II

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	24.232(c)	P
2	Emission Limit	24.238, 2.1051	P
3	Frequency Stability	24.235, 2.1055	P
4	Occupied Bandwidth	2.1049(h)(i)	P
5	Emission Bandwidth	24.238(b)	P
6	Band Edge Compliance	24.238(b)	P
7	Conducted Spurious Emission	24.238, 2.1057	P
8	Peak-to-Average Power Ratio	24.232(d)	P

WCDMA Band V

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	§2.1046(a), 22.913(a)	P
2	Emission Limit	22.917, 2.1051	P
3	Frequency Stability	22.235, 2.1055	P
4	Occupied Bandwidth	2.1049(h)(i)	P
5	Emission Bandwidth	22.917(b)	P
6	Band Edge Compliance	22.917(b)	P
7	Conducted Spurious Emission	22.917, 2.1057	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 peak 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, 1852.4 MHz, 1880.0MHz and 1907.6MHz for WCDMA Band II;826.4MHz, 836.6MHz and 846.6MHz for WCDMA Band V (bottom, middle and top of operational frequency range).

Limit

According to FCC§2.1046.

WCDMA Band II

Measurement result-QPSK

	CH	Frequency(MHz)	output power(dBm)
WCDMA (Band II)	9262	1852.4	22.68
	9400	1880.0	22.78
	9538	1907.6	22.94

Measurement result-16QAM

	CH	Frequency(MHz)	output power(dBm)
WCDMA (Band II)	9262	1852.4	21.52
	9400	1880.0	21.48
	9538	1907.6	21.55

WCDMA Band V

Measurement result-QPSK

	CH	Frequency(MHz)	output power(dBm)
WCDMA (Band V)	4132	826.4	22.75
	4183	836.6	22.82
	4233	846.6	22.77

Measurement result-16QAM

	CH	Frequency(MHz)	output power(dBm)
WCDMA (Band II)	4132	826.4	21.12
	4183	836.6	21.21
	4233	846.6	21.01

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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.

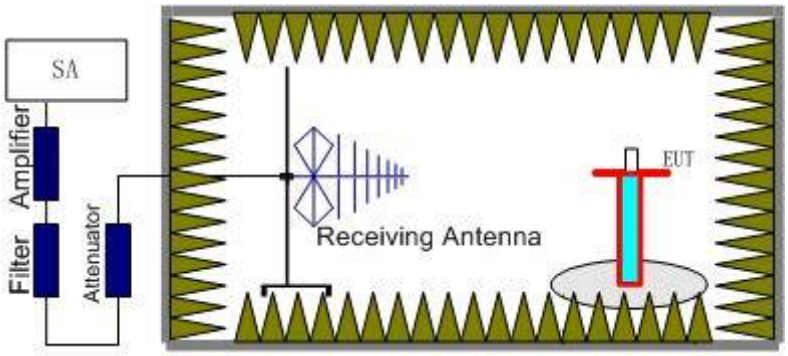
Rule Part 24.232(b) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

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

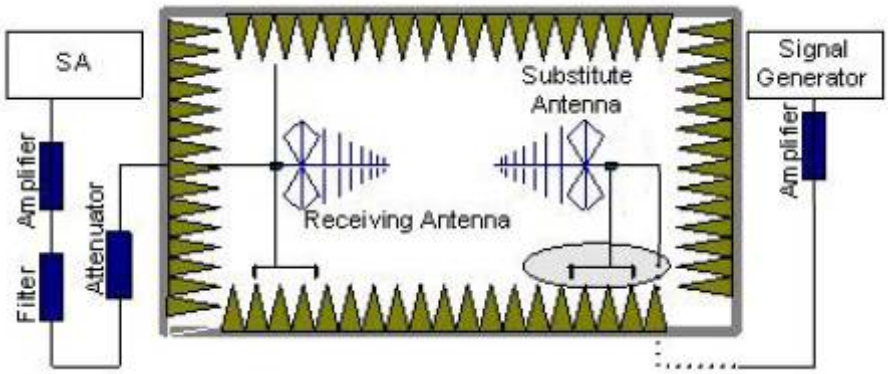
A.1.3.2 Method of Measurement

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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WCDMA Band II-EIRP

Limits

	Burst Peak EIRP (dBm)
WCDMA Band II	≤33dBm (2W)

Measurement result-QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1852.40	-25.06	2.84	-43.75	-4.87	20.72	33.00	12.28	H
1880.00	-24.22	2.85	-43.75	-4.82	21.50	33.00	11.50	H
1907.60	-23.70	2.88	-43.77	-4.77	**21.96**	33.00	11.04	H

Measurement result-16QAM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	G_a Antenna Gain(dB)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1852.40	-25.44	2.84	-43.75	-4.87	20.34	33.00	12.66	H
1880.00	-24.46	2.85	-43.75	-4.82	21.26	33.00	11.74	H
1907.60	-23.80	2.88	-43.77	-4.77	**21.86**	33.00	11.14	H

Frequency: 1907.60MHz

Peak EIRP(dBm)= P_{Mea}(-23.70)- P_{cl}(2.88dB)- P_{Ag}(-43.77dB)-G_a(-4.77dB) =21.96dBm

ANALYZER SETTINGS: RBW = VBW = 5MHz

WCDMA Band V-ERP

Limits

	Burst Peak ERP (dBm)
WCDMA Band V	≤38.45dBm

Measurement result

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
826.40	-23.75	2.25	-45.76	-0.93	2.15	18.54	38.45	19.91	H
836.60	-21.84	2.26	-45.66	-0.82	2.15	**20.23**	38.45	18.22	H
846.60	-23.31	2.26	-45.56	-0.81	2.15	18.65	38.45	19.80	H

Measurement result-16QAM

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
826.40	-24.07	2.25	-45.76	-0.93	2.15	18.22	38.45	20.23	H
836.60	-23.52	2.26	-45.66	-0.82	2.15	**18.55**	38.45	19.90	H
846.60	-23.92	2.26	-45.56	-0.81	2.15	18.04	38.45	20.41	H

Frequency: 836.60MHz

Peak ERP(dBm)= P_{Mea}(-21.84dBm)- P_{cl}(2.26dB)- P_{Ag}(-45.66dB)-G_a (-0.82dB)-2.15dB=20.23dBm

ANALYZER SETTINGS: RBW = VBW = 5MHz

Note: The EUT is tested in vertical polarization mode

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A.2 EMISSION LIMIT

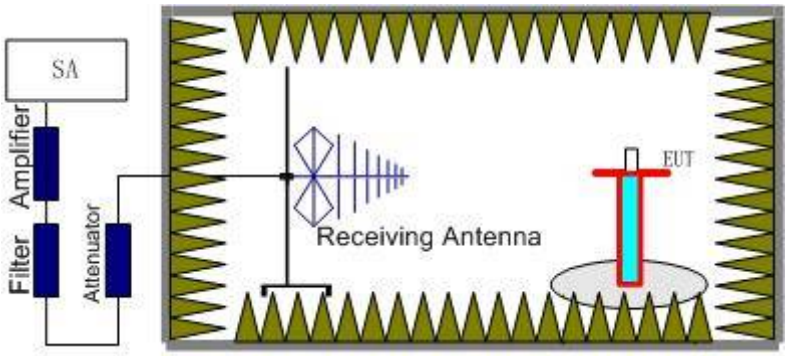
A.2.1 Measurement Method

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

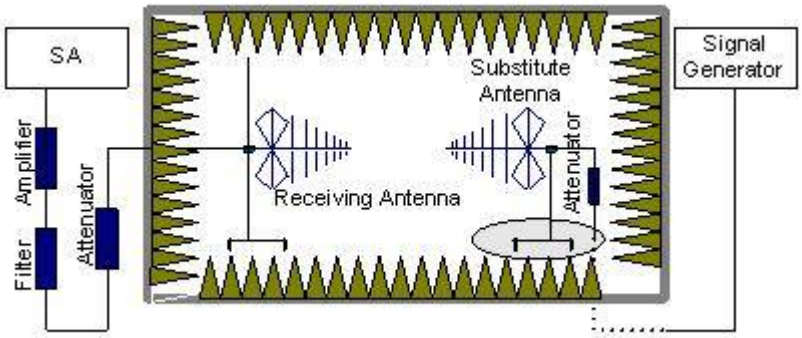
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment. The resolution bandwidth is set as outlined in Part 24.238, Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and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

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 , Part 22.917 specify that the powerof any emission outside of the authorizedoperating frequency ranges mustbe attenuated below the transmittingpower (P) by a factor of at least 43 + 10log(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 WCDMA Band II (1852.4 MHz, 1880.0MHz and 1907.6MHz),WCDMA Band V(826.4MHz, 836.6MHz and 846.6MHz). 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 WCDMA Band II,WCDMA Band Vinto 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
WCDMA Band V	Low	30MHz-10GHz	Pass
	Middle	30MHz-10GHz	Pass
	High	30MHz-10GHz	Pass
WCDMA Band II	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)
WCDMA Band V	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
WCDMA Band II	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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WCDMA BAND II Mode Channel 9262/1852.4MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
3703.40	-53.80	5.35	-8.48	-50.67	-13.00	37.67	H
5832.12	-58.64	6.58	-10.53	-54.69	-13.00	41.69	H
7507.98	-57.53	7.56	-12.21	-52.88	-13.00	39.88	H
9846.69	-55.91	8.45	-13.05	-51.31	-13.00	38.31	H
11474.36	-52.65	8.90	-13.11	-48.44	-13.00	35.44	V
13797.52	-49.73	9.93	-14.38	-45.28	-13.00	32.28	V

WCDMA BAND II Mode Channel 9400/1880MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
3783.99	-59.41	5.03	-8.60	-55.84	-13.00	42.84	H
5733.08	-59.13	6.77	-10.55	-55.35	-13.00	42.35	H
7623.31	-55.74	7.45	-12.30	-50.89	-13.00	37.89	V
9596.00	-56.03	8.39	-13.30	-51.12	-13.00	38.12	V
11297.71	-54.12	9.08	-13.14	-50.06	-13.00	37.06	H
13580.17	-49.81	9.89	-14.25	-45.45	-13.00	32.45	H

WCDMA BAND II Mode Channel 9538/1907.6MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit （dBm）	Margin(dB)	Polarization
3734.44	-58.73	5.23	-8.53	-55.43	-13.00	42.43	H
5612.78	-58.68	6.81	-10.58	-54.91	-13.00	41.91	V
7653.20	-56.20	7.58	-12.32	-51.46	-13.00	38.46	H
9561.56	-55.64	8.17	-13.34	-50.47	-13.00	37.47	V
11404.45	-51.65	9.21	-13.12	-47.74	-13.00	34.74	H
13621.91	-48.74	10.25	-14.27	-44.72	-13.00	31.72	V

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WCDMA BAND V Mode Channel 4132/826.4MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1655.13	-49.90	3.42	-5.22	2.15	-50.25	-13.00	37.25	H
2596.75	-55.87	4.59	-6.27	2.15	-56.34	-13.00	43.34	V
3190.22	-57.50	5.34	-7.46	2.15	-57.53	-13.00	44.53	V
4074.34	-59.52	5.60	-8.97	2.15	-58.30	-13.00	45.30	V
4921.07	-58.49	6.33	-9.82	2.15	-57.15	-13.00	44.15	H
5899.40	-57.78	6.89	-10.52	2.15	-56.30	-13.00	43.30	V

WCDMA BAND V Mode Channel 4183/836.6MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1670.52	-58.24	3.51	-5.19	2.15	-58.71	-13.00	45.71	H
2614.20	-56.86	4.55	-6.31	2.15	-57.25	-13.00	44.25	V
3252.98	-59.77	5.13	-7.61	2.15	-59.44	-13.00	46.44	H
4054.14	-58.15	5.61	-8.95	2.15	-56.96	-13.00	43.96	V
4915.91	-59.42	6.31	-9.82	2.15	-58.06	-13.00	45.06	V
5687.65	-57.69	6.68	-10.56	2.15	-55.96	-13.00	42.96	H

WCDMA BAND V Mode Channel 4233/846.6MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit （dBm）	Margin(dB)	Polarization
1690.65	-53.72	3.46	-5.16	2.15	-54.17	-13.00	41.17	H
2614.28	-56.76	4.55	-6.31	2.15	-57.15	-13.00	44.15	V
3111.37	-59.74	5.19	-7.27	2.15	-59.81	-13.00	46.81	H
4125.54	-59.67	5.79	-9.03	2.15	-58.58	-13.00	45.58	V
5087.07	-58.03	6.44	-10.02	2.15	-56.60	-13.00	43.60	H
5710.10	-57.92	6.70	-10.56	2.15	-56.21	-13.00	43.21	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 WCDMA Band II and WCDMA Band V, 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

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2.1055(d)(1) applies.

A.3.3 Measurement results

WCDMA Band II

Frequency Error vs Voltage-QPSK

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.5	-8	0.004
3.8	8	0.004
4.2	11	0.006

Frequency Error vs Temperature-QPSK

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	6	0.003
-20	4	0.002
-10	6	0.003
0	6	0.003
10	4	0.002
20	7	0.004
30	5	0.002
40	6	0.003
50	-7	0.004

Frequency Error vs Voltage-16QAM

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.5	-4	0.002
3.8	3	0.002
4.2	3	0.002

Frequency Error vs Temperature-16QAM

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	-3	0.002
-20	4	0.002
-10	3	0.002
0	1	0.001
10	5	0.003
20	3	0.002
30	-2	0.001
40	-7	0.004
50	-5	0.003

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WCDMA Band V

Frequency Error vs Voltage-QPSK

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.5	5	0.006
3.8	4	0.005
4.2	-4	0.004

Frequency Error vs Temperature-QPSK

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	-6	0.007
-20	-4	0.004
-10	-5	0.006
0	4	0.005
10	-4	0.005
20	-12	0.014
30	-3	0.003
40	2	0.003
50	-5	0.006

Frequency Error vs Voltage-16QAM

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.5	3	0.004
3.8	1	0.001
4.2	-1	0.001

Frequency Error vs Temperature-16QAM

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	-2	0.002
-20	1	0.001
-10	3	0.004
0	-1	0.001
10	-1	0.001
20	3	0.004
30	1	0.001
40	-2	0.002
50	-2	0.002

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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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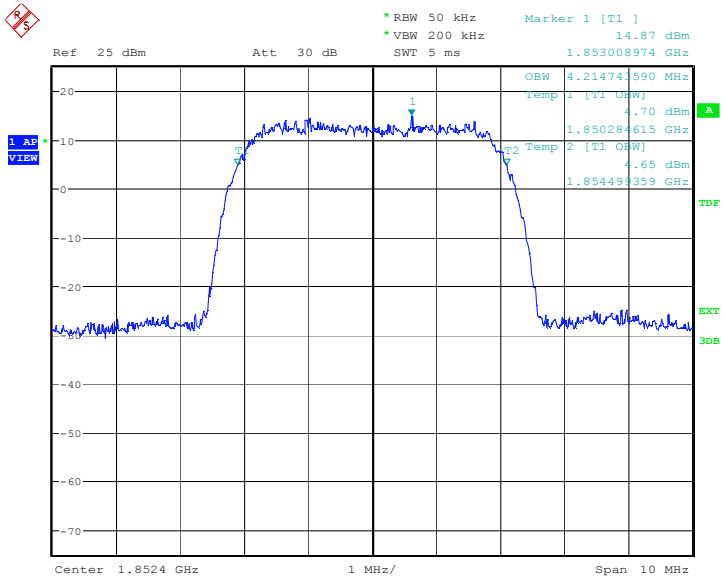
WCDMA Band II (99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(MHz)
1852.4	4.215
1880.0	4.215
1907.6	4.231

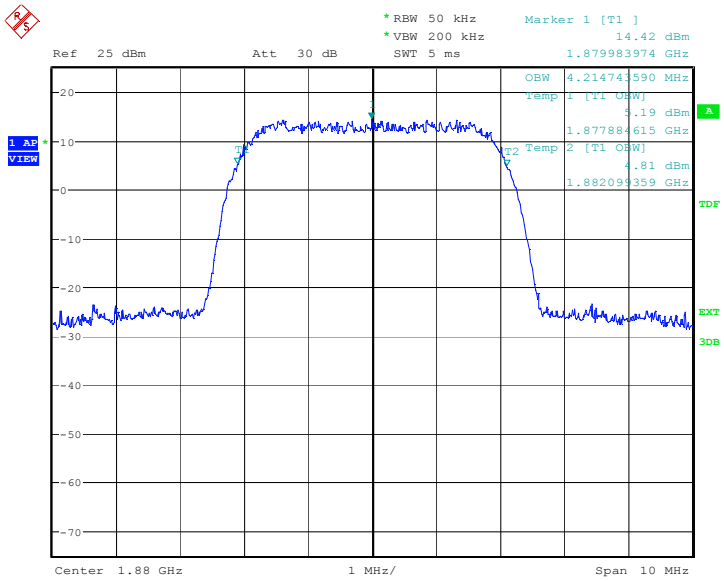
WCDMA Band Ⅱ

Channel 9262-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 05:49:22

Channel 9400-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 05:49:57

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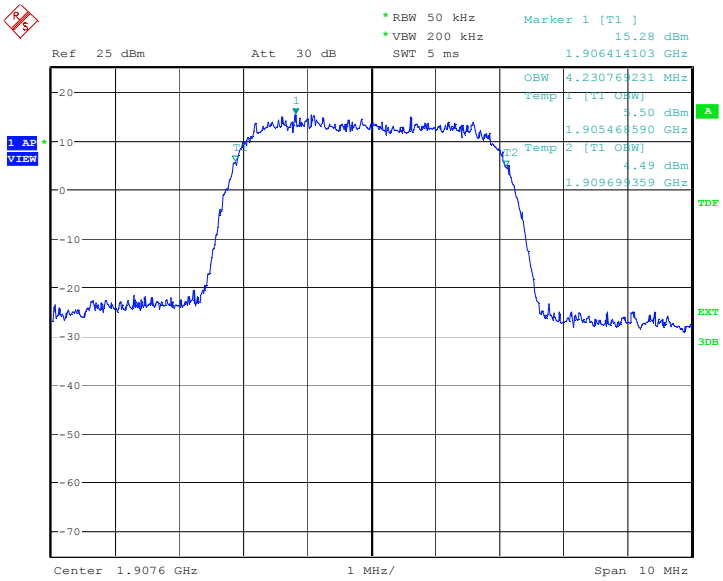
Channel 9538-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 05:50:32

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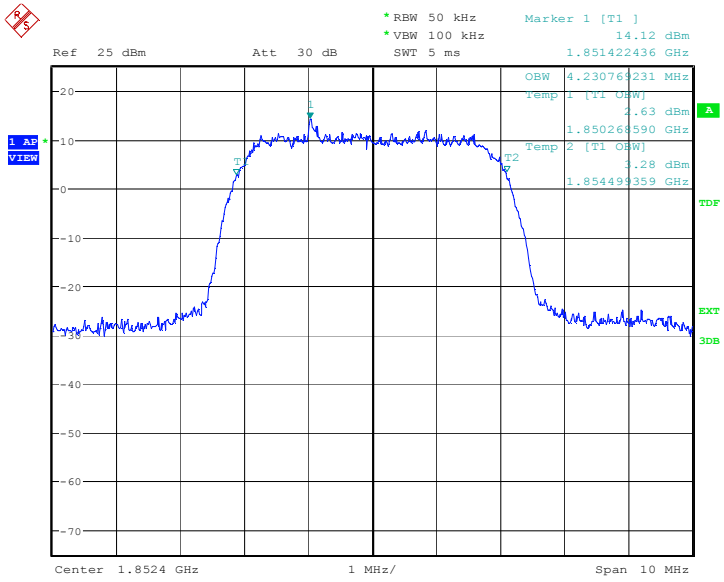
WCDMA Band II (99% BW)-16QAM

Frequency(MHz)	Occupied Bandwidth (99% BW)(MHz)
1852.4	4.231
1880.0	4.215
1907.6	4.215

WCDMA Band Ⅱ

Channel 9262-Occupied Bandwidth (99% BW)



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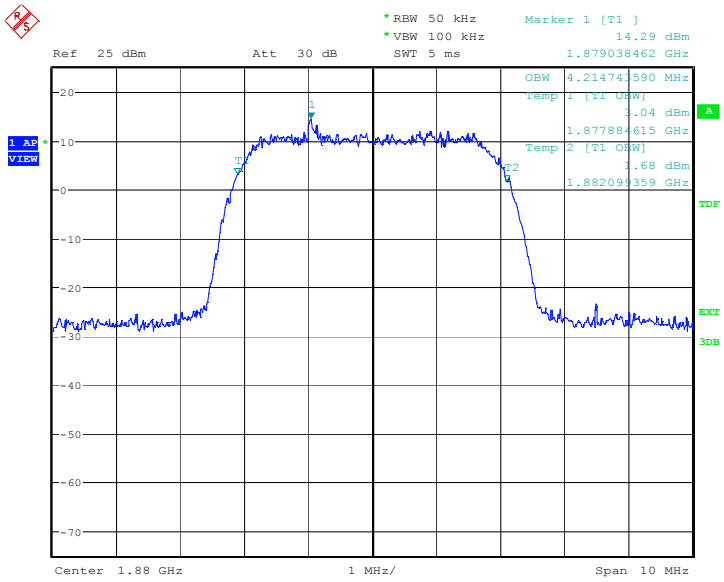
Channel 9400-Occupied Bandwidth (99% BW)



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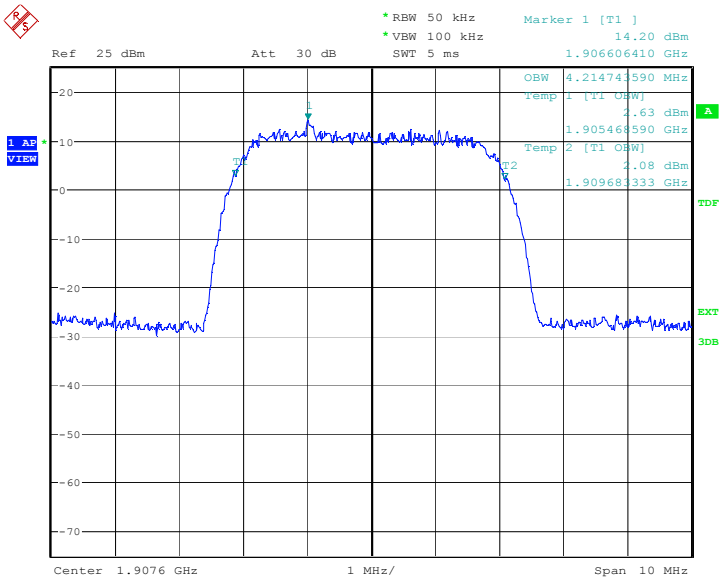
Channel 9538-Occupied Bandwidth (99% BW)



Date: 26.APR.2016 06:08:03

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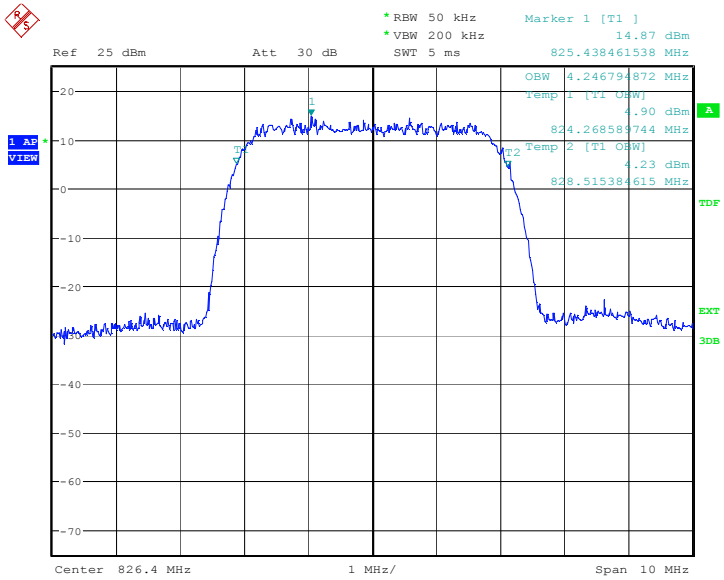
WCDMA Band V(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(MHz)
826.4	4.247
836.6	4.247
846.6	4.231

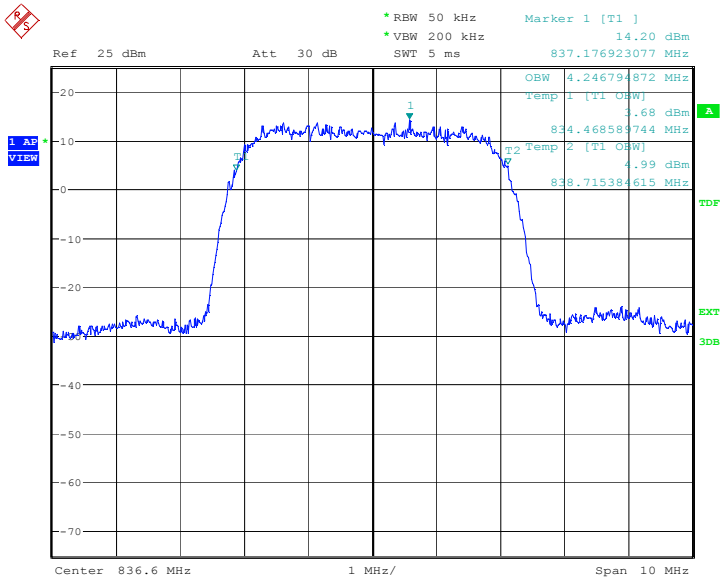
WCDMA Band V

Channel 4132-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 06:14:29

Channel 4183-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 06:15:04

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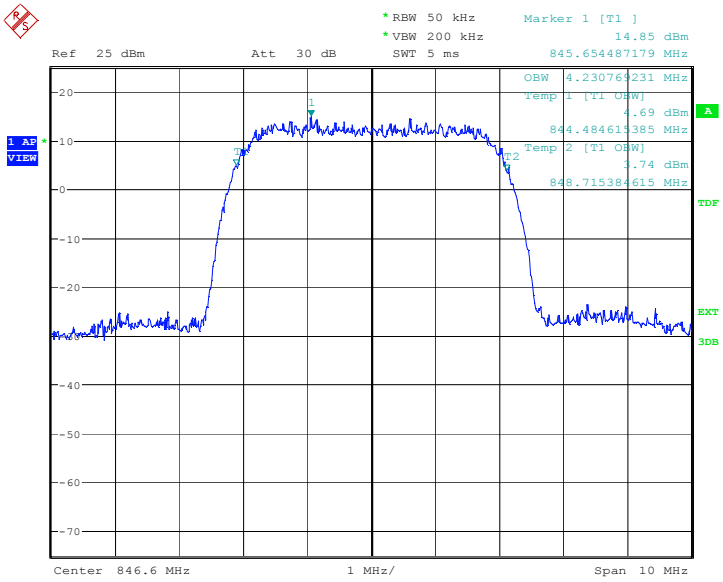
Channel 4233-Occupied Bandwidth (99% BW)



Date: 23.APR.2016 06:15:39

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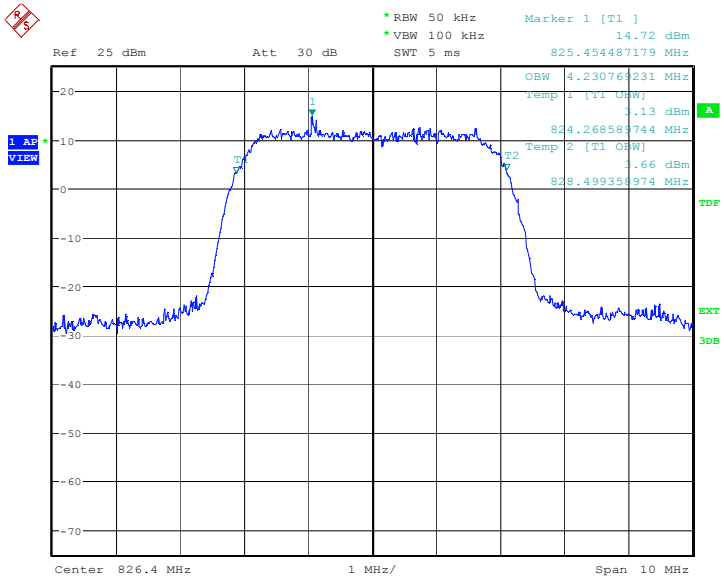
WCDMA Band V(99% BW)-16QAM

Frequency(MHz)	Occupied Bandwidth (99% BW)(MHz)
826.4	4.231
836.6	4.231
846.6	4.231

WCDMA Band V

Channel 4132-Occupied Bandwidth (99% BW)



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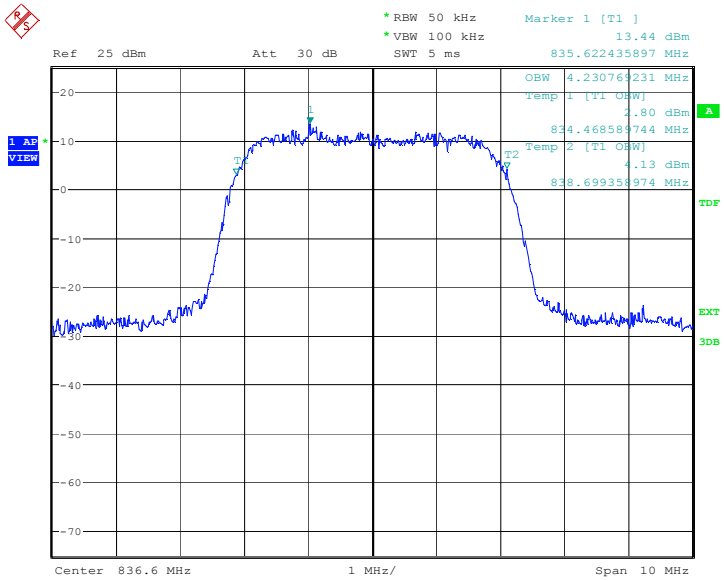
Channel 4183-Occupied Bandwidth (99% BW)



Date: 26.APR.2016 06:29:27

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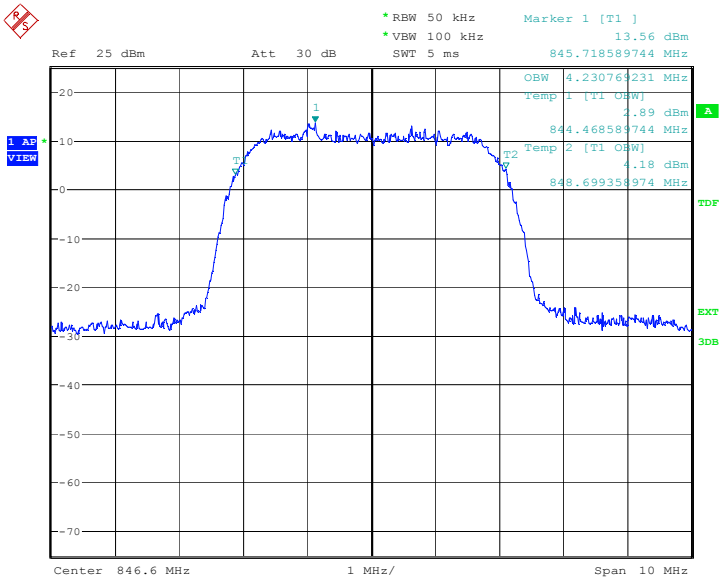
Channel 4233-Occupied Bandwidth (99% BW)



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A.5 EMISSION BANDWIDTH

Reference

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

A.5.1Emission Bandwidth Results

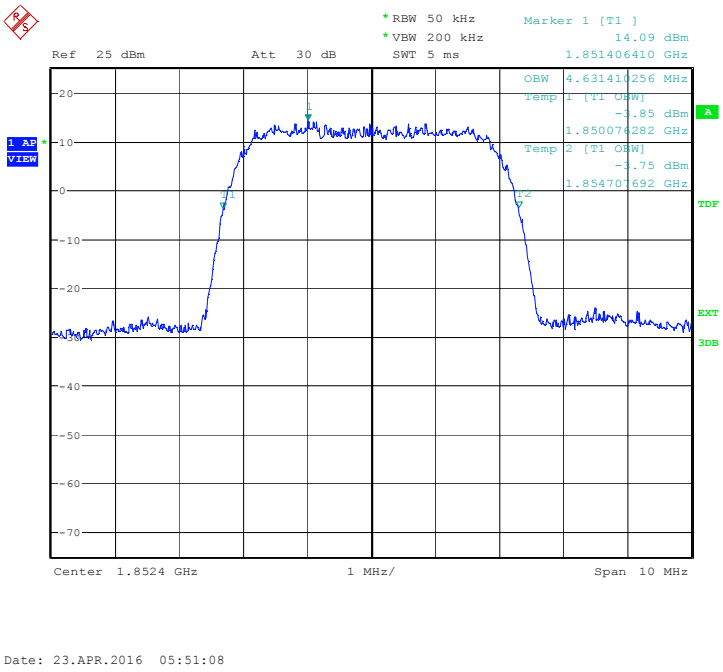
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

WCDMA Band II -QPSK

Frequency(MHz)	Emission Bandwidth (100% BW)(MHz)
1852.4	4.631
1880.0	4.647
1907.6	4.647

WCDMA Band II

Channel 9262-Emission Bandwidth (100% BW)



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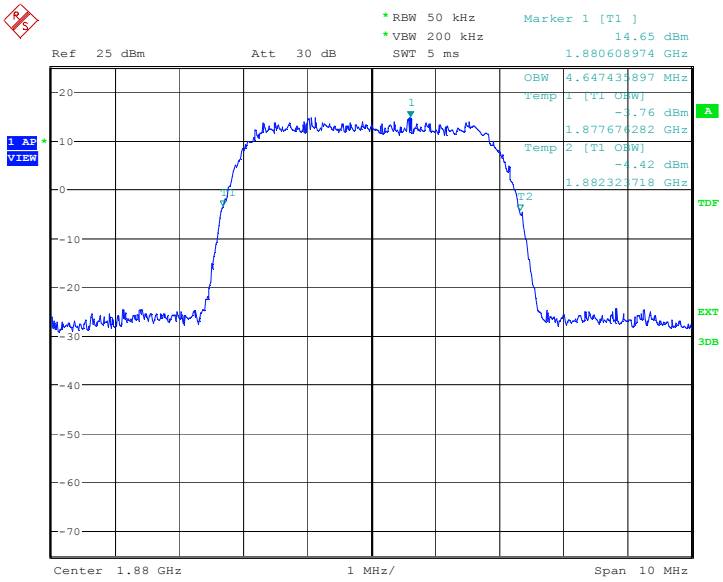
Channel 9400-Emission Bandwidth (100% BW)



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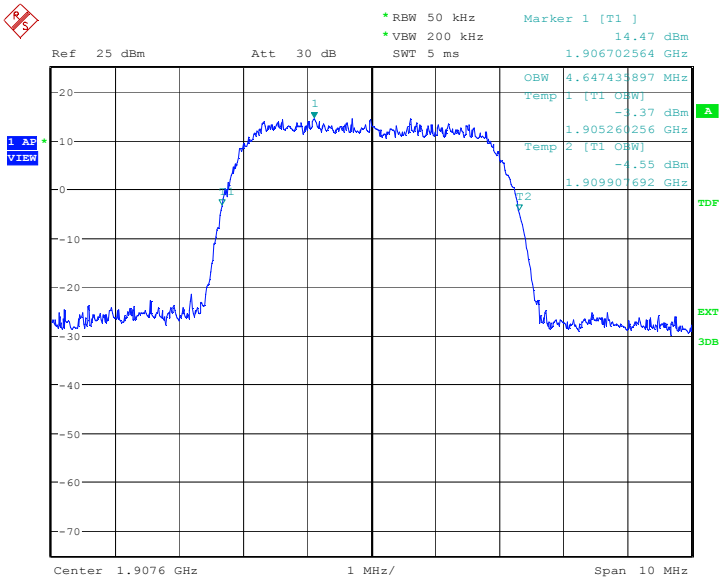
Channel 9538-Emission Bandwidth (100% BW)



Date: 23.APR.2016 05:52:17

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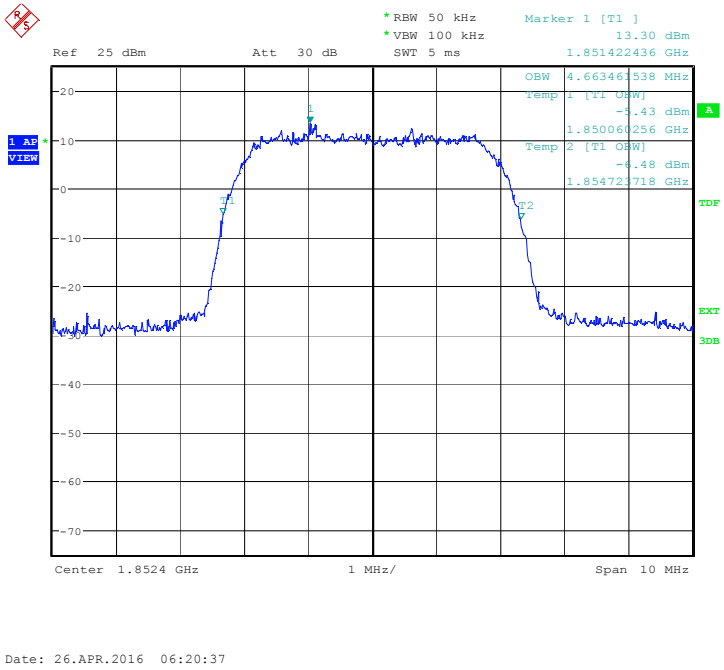
WCDMA Band II -16QAM

Frequency(MHz)	Emission Bandwidth (100% BW)(MHz)
1852.4	4.663
1880.0	4.663
1907.6	4.647

WCDMA Band II

Channel 9262-Emission Bandwidth (100% BW)



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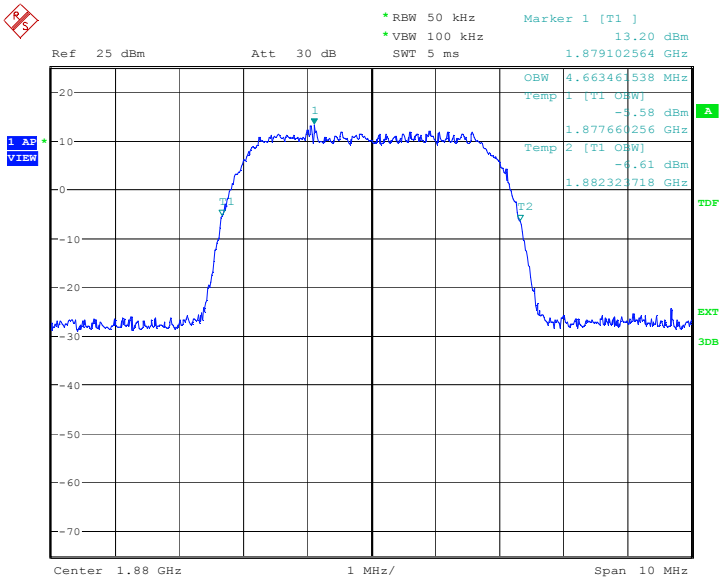
Channel 9400-Emission Bandwidth (100% BW)



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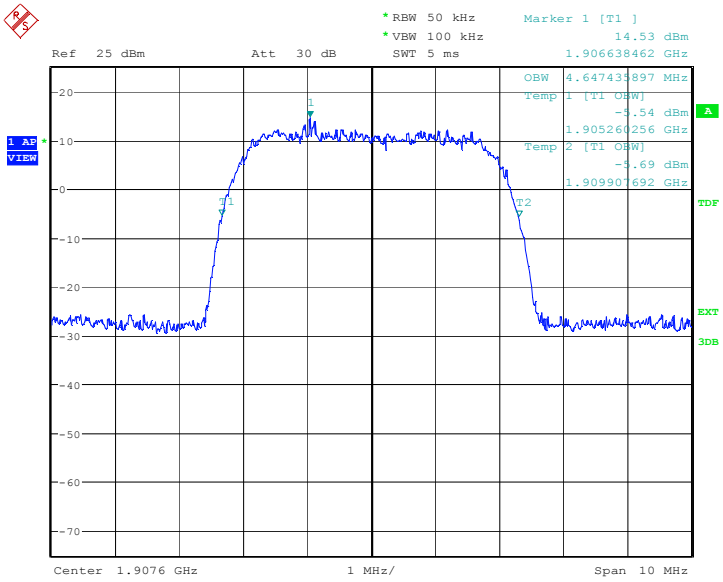
Channel 9538-Emission Bandwidth (100% BW)



Date: 26.APR.2016 06:22:53

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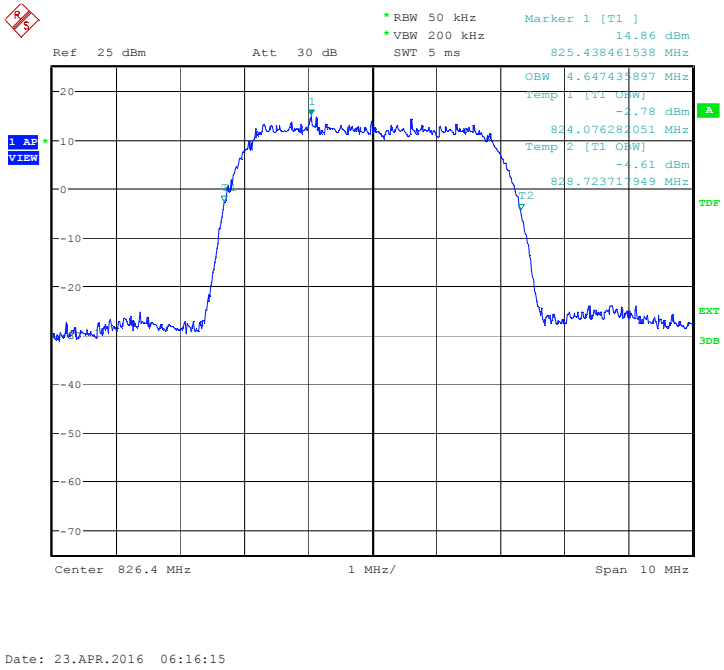
WCDMA Band V-QPSK

Frequency(MHz)	Emission Bandwidth (100% BW)(MHz)
826.40	4.647
836.60	4.647
846.60	4.615

WCDMA Band V

Channel 4132-Emission Bandwidth (100% BW)



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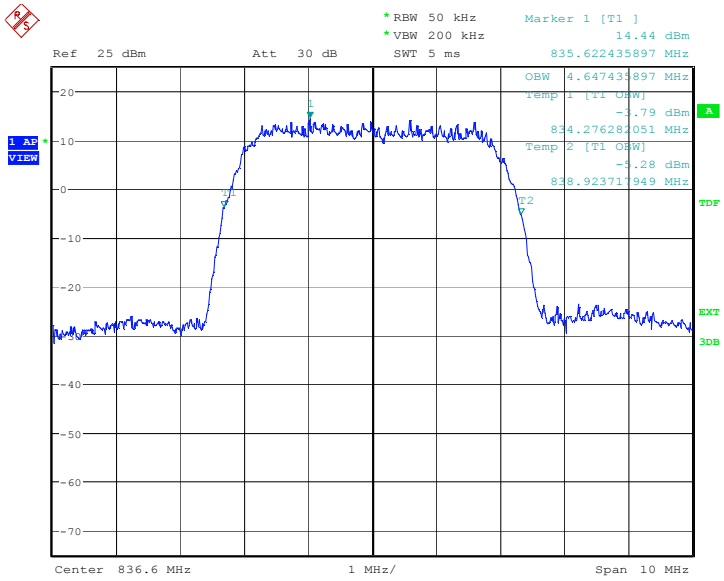
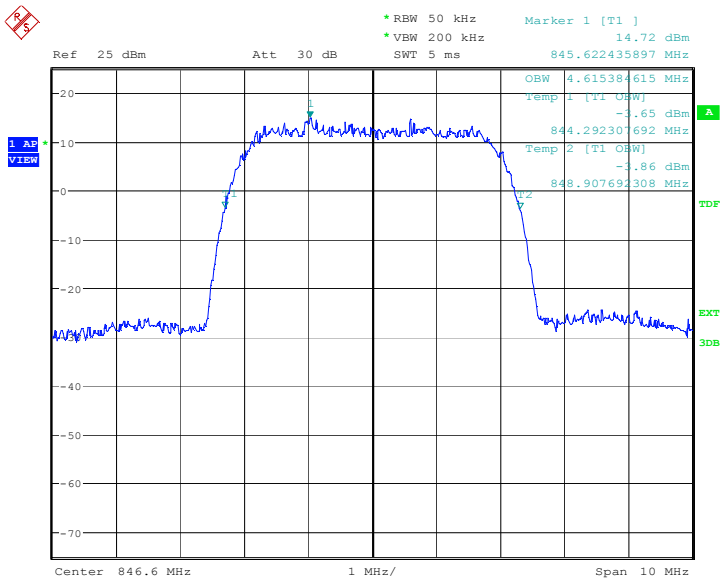
Channel 4183-Emission Bandwidth (100% BW)



Date: 23.APR.2016 06:16:49

Channel 4233-Emission Bandwidth (100% BW)



Date: 23.APR.2016 06:17:24

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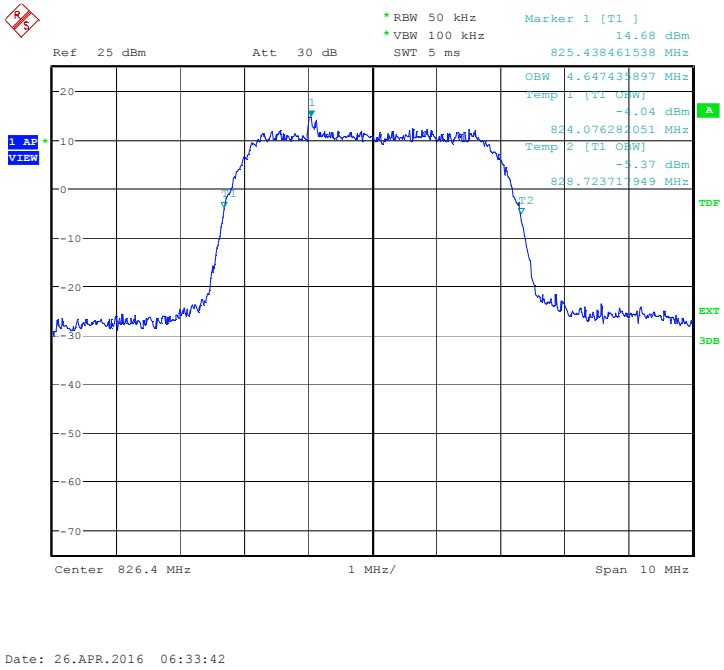
WCDMA Band V-16QAM

Frequency(MHz)	Emission Bandwidth (100% BW)(MHz)
826.40	4.647
836.60	4.663
846.60	4.647

WCDMA Band V

Channel 4132-Emission Bandwidth (100% BW)



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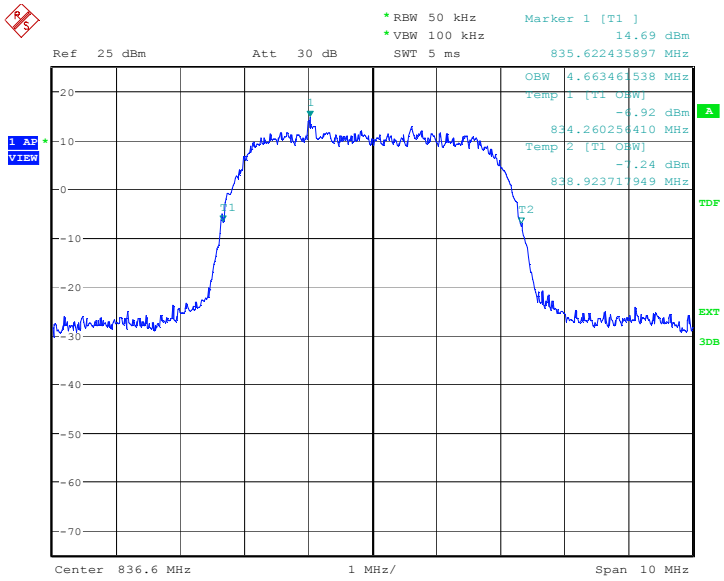
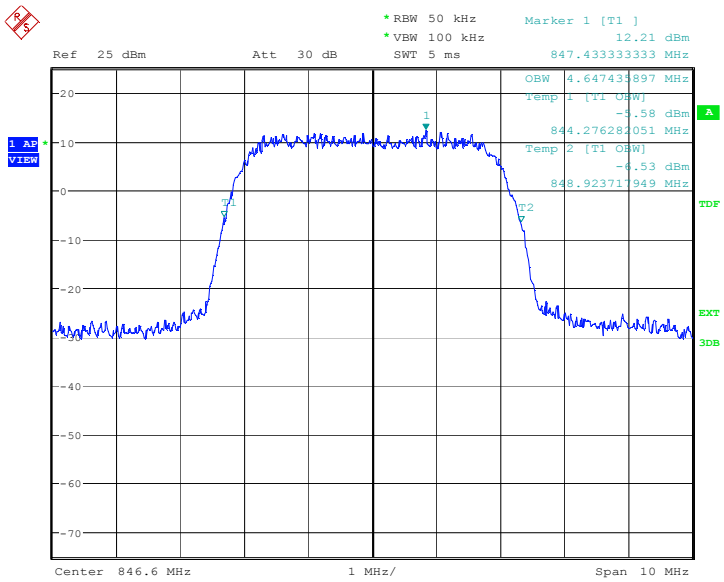
Channel 4183-Emission Bandwidth (100% BW)



Date: 26.APR.2016 06:34:25

Channel 4233-Emission Bandwidth (100% BW)



Date: 26.APR.2016 06:35:13

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A.6 BAND EDGE COMPLIANCE

Reference

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

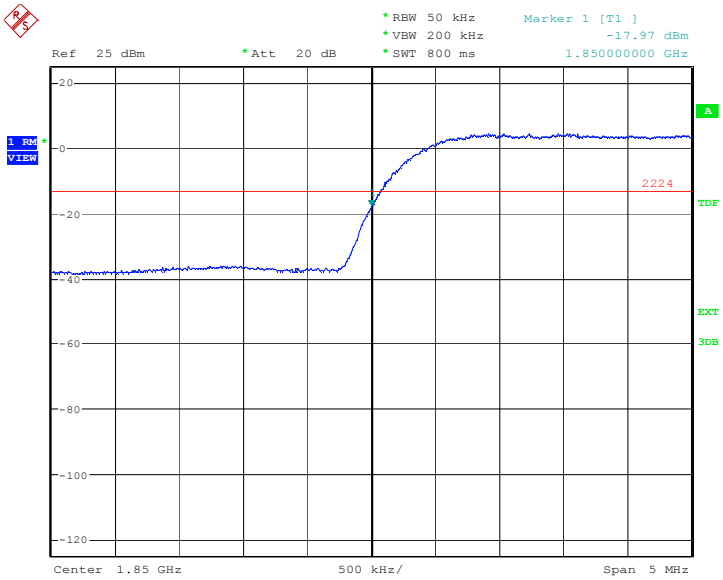
A.6.1 Measurement limit

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.

A.6.2 Measurement result

WCDMA Band Ⅱ-QPSK

LOW BAND EDGE BLOCK-A (WCDMA Band Ⅱ)-Channel 9262



Date: 23.APR.2016 05:55:59

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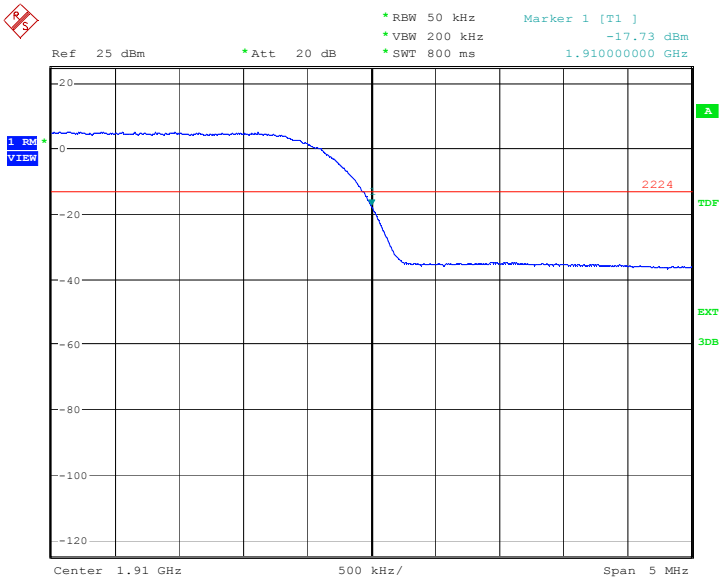
HIGH BAND EDGE BLOCK-C (WCDMA Band Ⅱ) –Channel 9538



Date: 23.APR.2016 05:58:05

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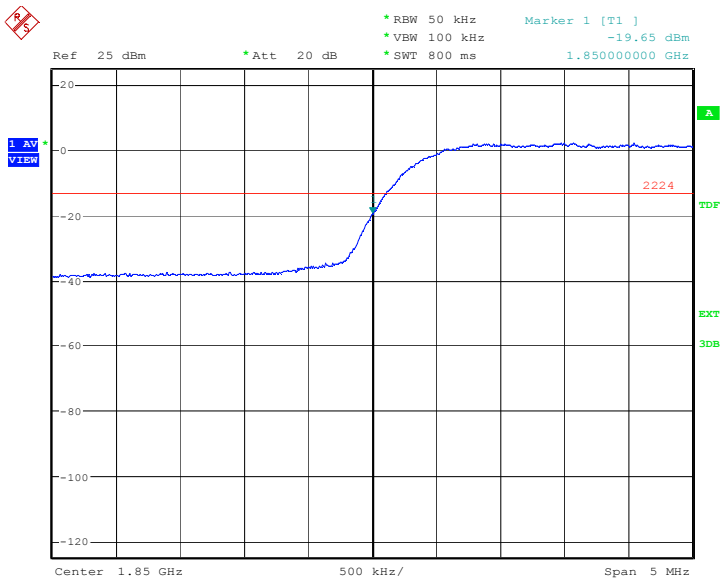
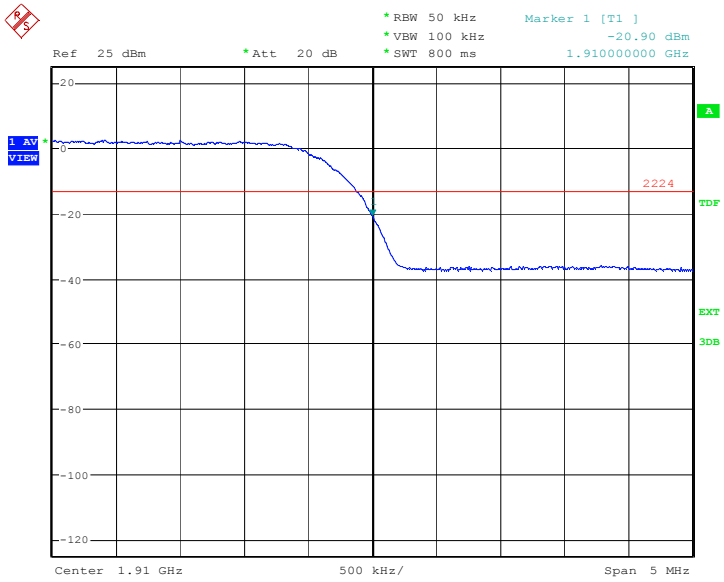
WCDMA Band Ⅱ-16QAM

LOW BAND EDGE BLOCK-A (WCDMA Band Ⅱ)-Channel 9262



Date: 26.APR.2016 06:19:06

HIGH BAND EDGE BLOCK-C (WCDMA Band Ⅱ) –Channel 9538



Date: 26.APR.2016 06:19:32

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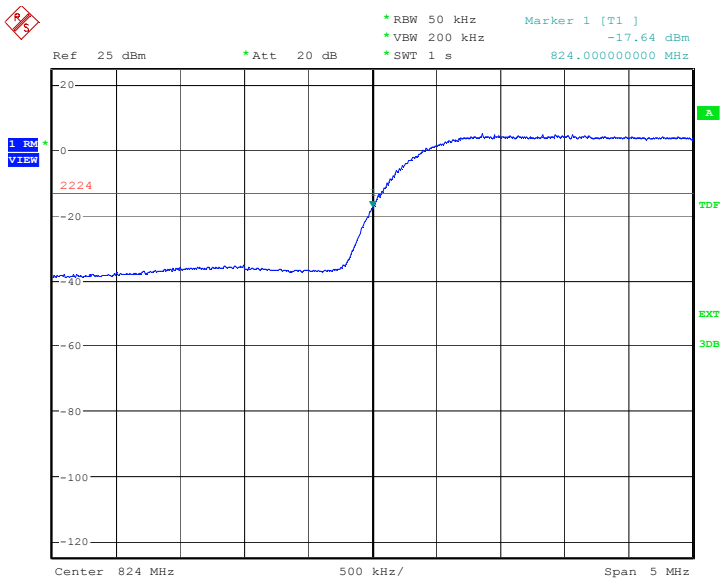
WCDMA Band Ⅴ-QPSK

LOW BAND EDGE BLOCK-A (WCDMA Band Ⅴ)-Channel 4132



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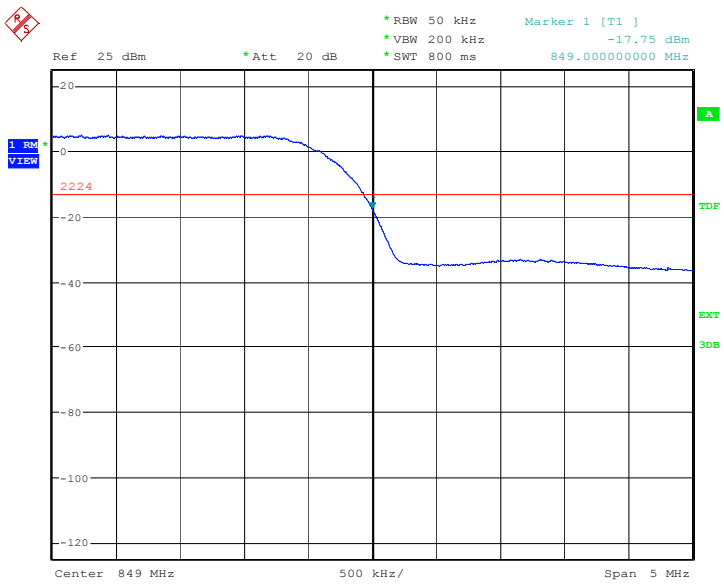
HIGH BAND EDGE BLOCK-C (WCDMA Band Ⅴ) –Channel 4233



Date: 23.APR.2016 06:23:12

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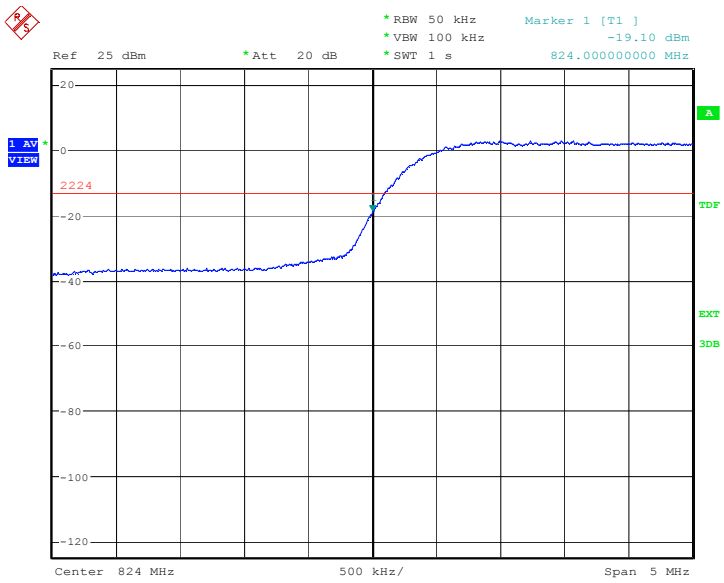
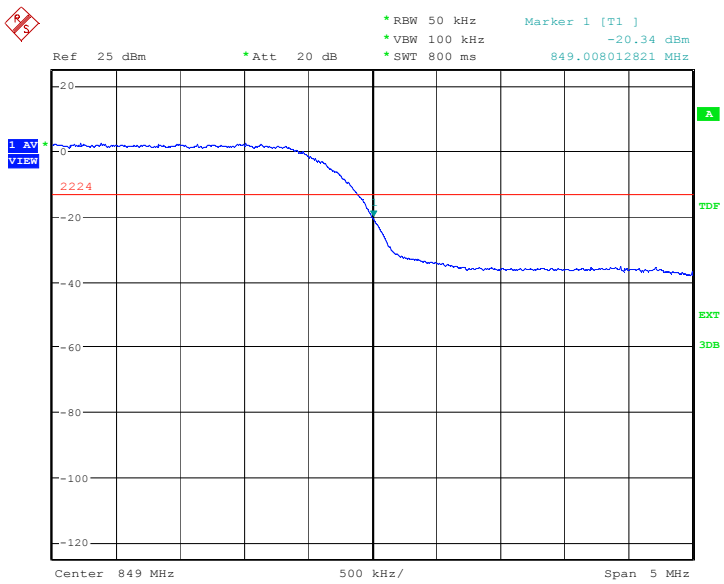
WCDMA Band Ⅴ-16QAM

LOW BAND EDGE BLOCK-A (WCDMA Band Ⅴ)-Channel 4132



Date: 26.APR.2016 06:40:16

HIGH BAND EDGE BLOCK-C (WCDMA Band Ⅴ) –Channel 4233



Date: 26.APR.2016 06:40:39

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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)

WCDMA Band Ⅱ Transmitter

Channel	Frequency (MHz)
9262	1852.40
9400	1880.00
9538	1907.60

WCDMA Band Ⅴ Transmitter

Channel	Frequency (MHz)
4132	826.40
4183	836.60
4233	846.60

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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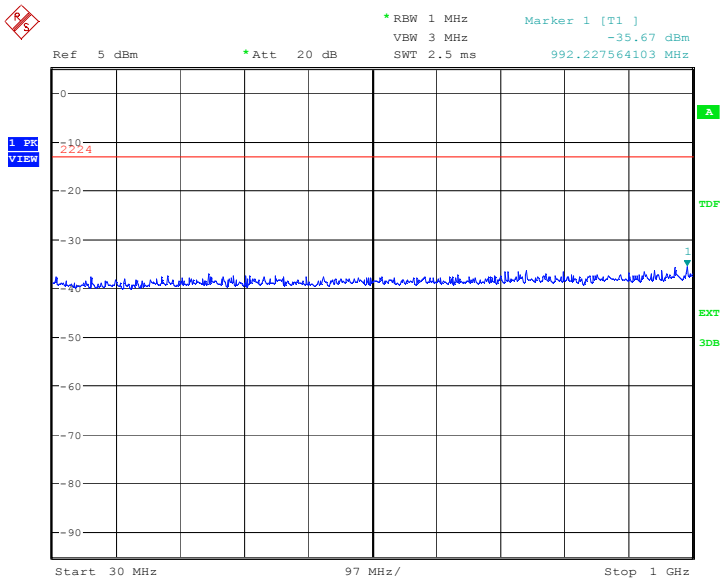
A.7.3 Measurement result

WCDMA Band Ⅱ

Channel 9262: 30MHz –1GHz

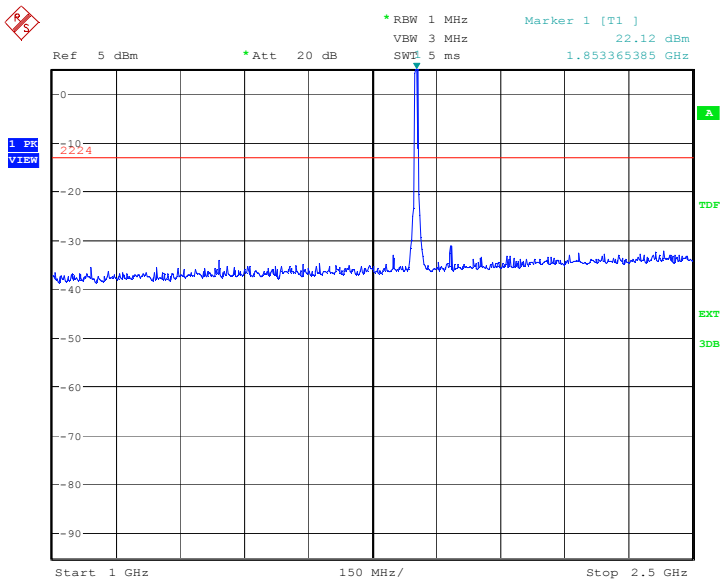
Spurious emission limit –13dBm.



Channel 9262: 1GHz –2.5GHz

Spurious emission limit –13dBm.

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



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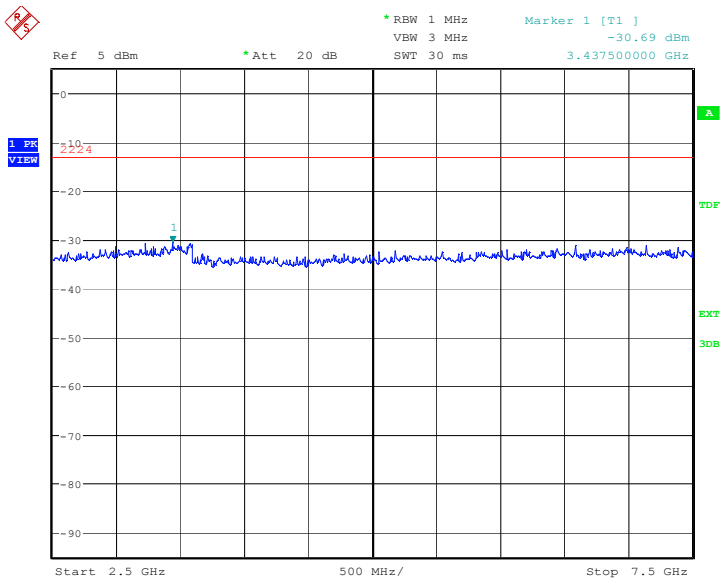
Channel 9262: 2.5GHz –7.5GHz

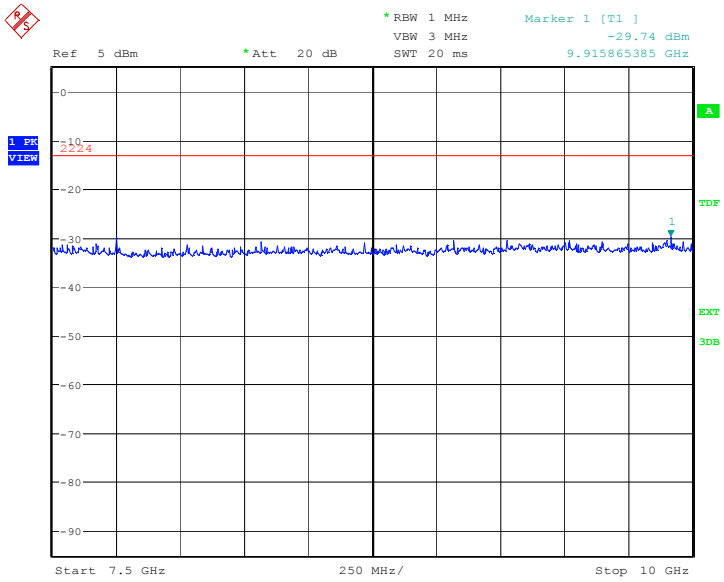
Spurious emission limit –13dBm.



Date: 23.APR.2016 06:01:43

Channel 9262: 7.5GHz –10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:02:11

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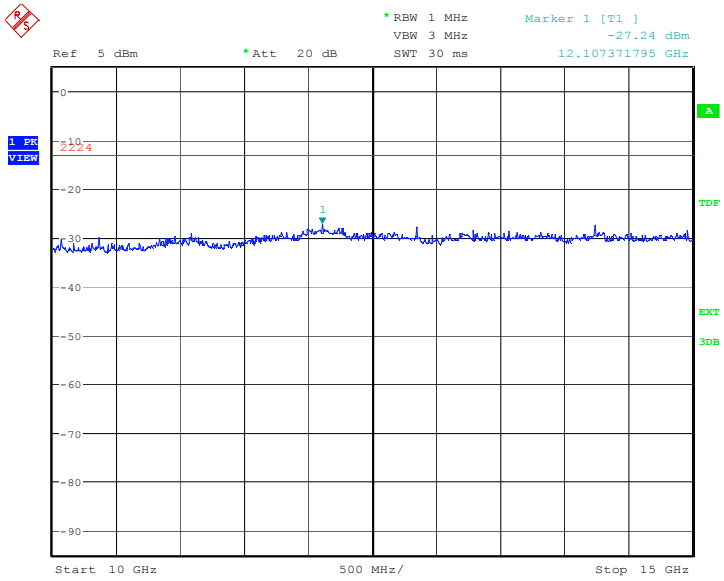
Channel 9262: 10GHz –15GHz

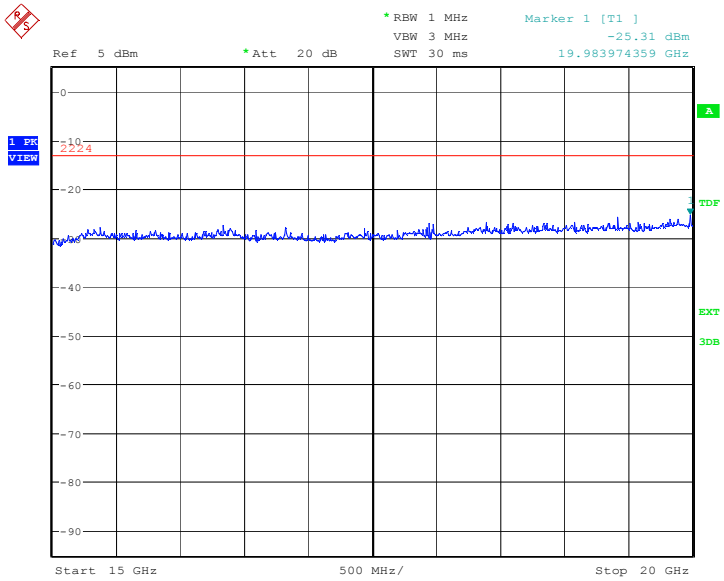
Spurious emission limit –13dBm.



Date: 23.APR.2016 06:02:39

Channel 9262: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:03:07

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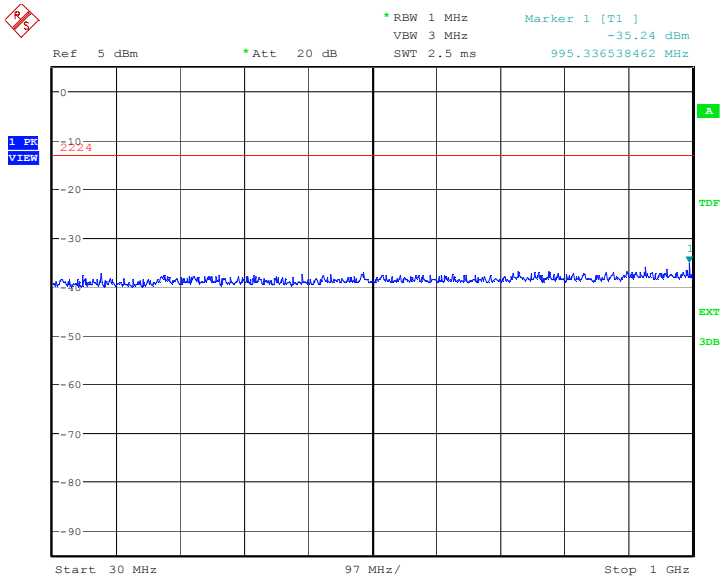
Channel 9400: 30MHz –1GHz

Spurious emission limit –13dBm.

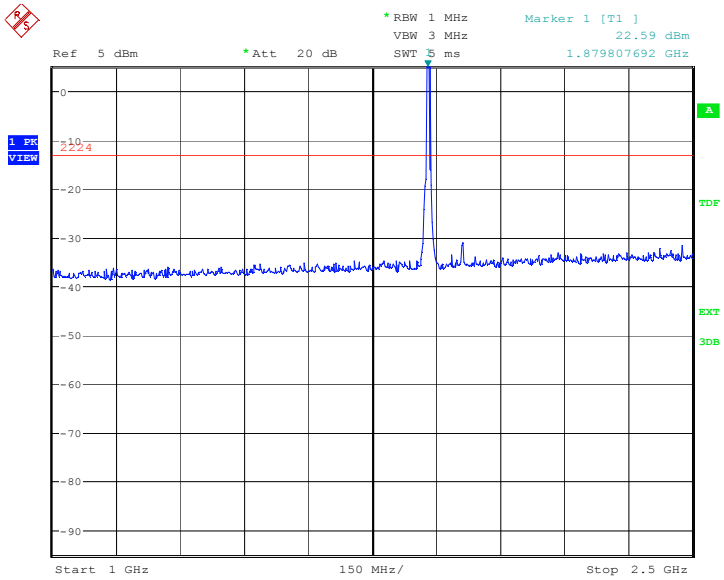


Date: 23.APR.2016 06:03:38

Channel 9400: 1GHz –2.5GHz

Spurious emission limit –13dBm.

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



Date: 23.APR.2016 06:04:07

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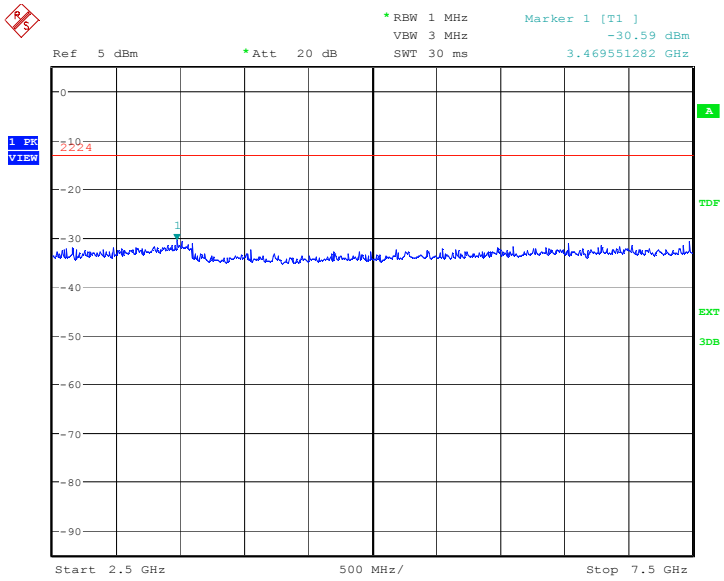
Channel 9400: 2.5GHz –7.5GHz

Spurious emission limit –13dBm.



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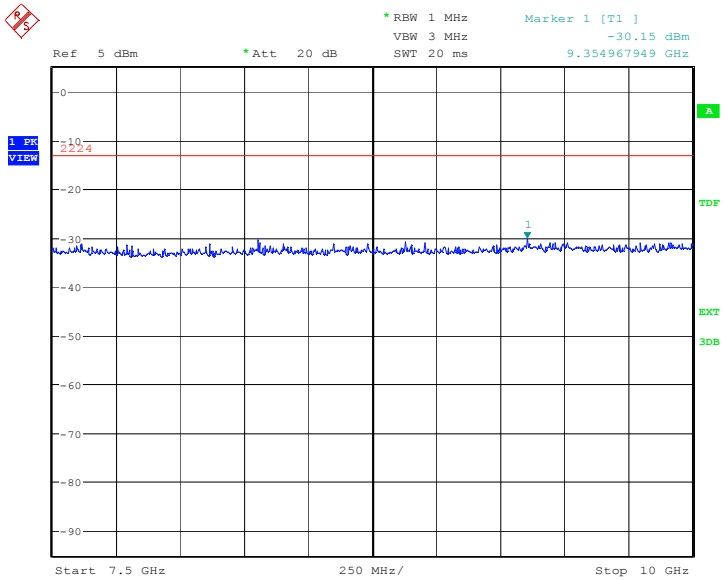
Channel 9400: 7.5GHz –10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:05:03

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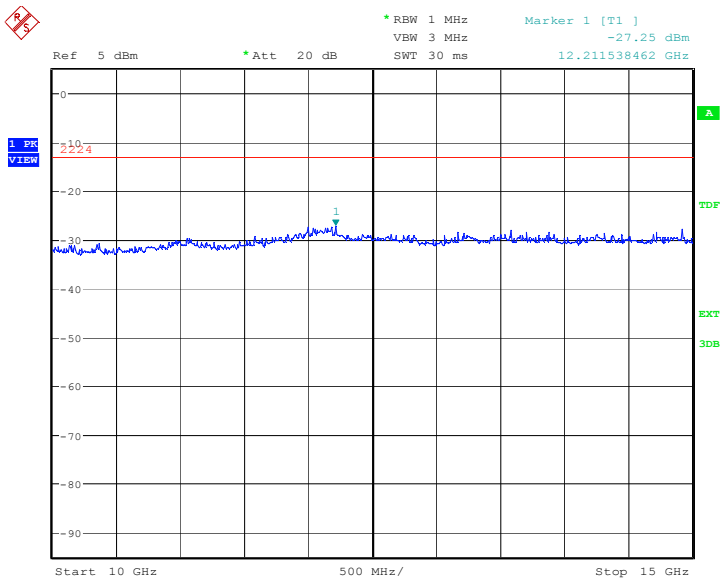
Channel 9400: 10GHz –15GHz

Spurious emission limit –13dBm.



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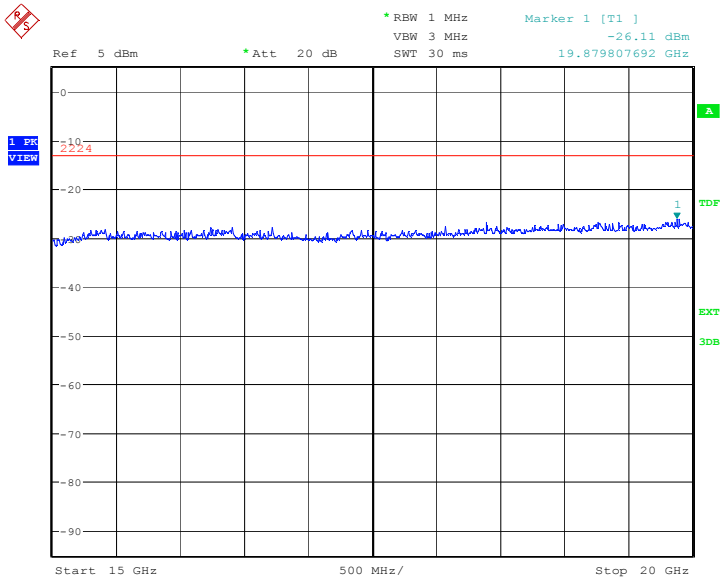
Channel 9400: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:05:59

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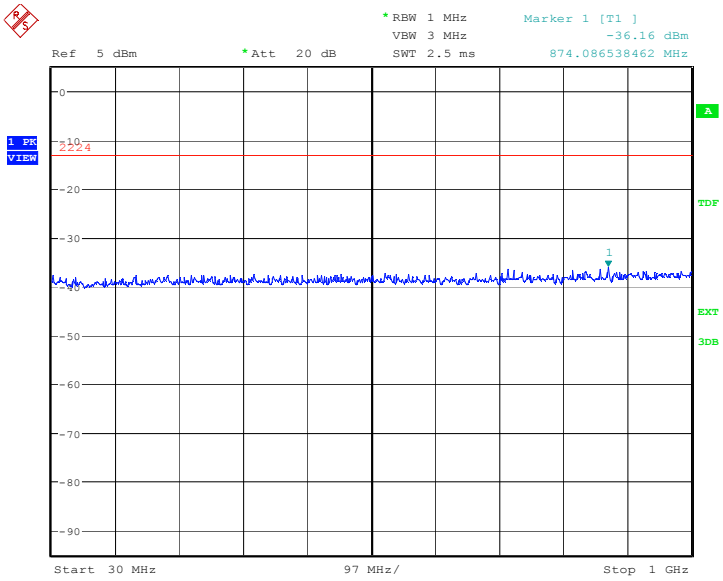
Channel 9538: 30MHz –1GHz

Spurious emission limit –13dBm.



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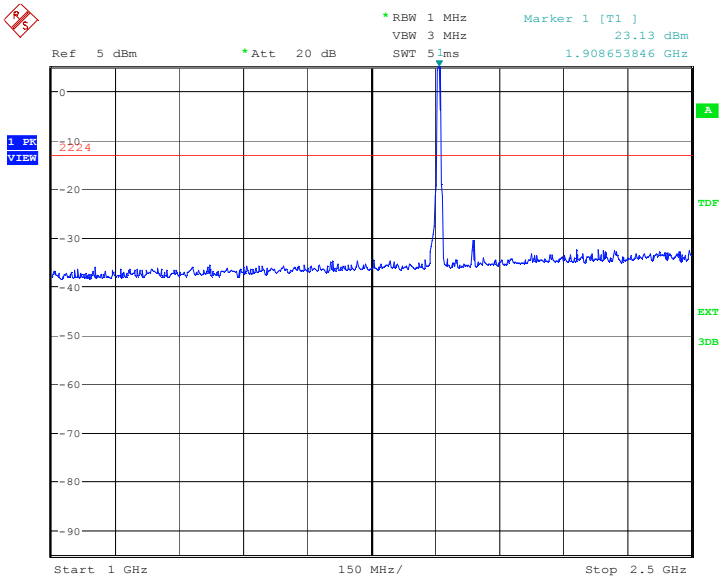
Channel 9538: 1GHz –2.5GHz

Spurious emission limit –13dBm.

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



Date: 23.APR.2016 06:06:58

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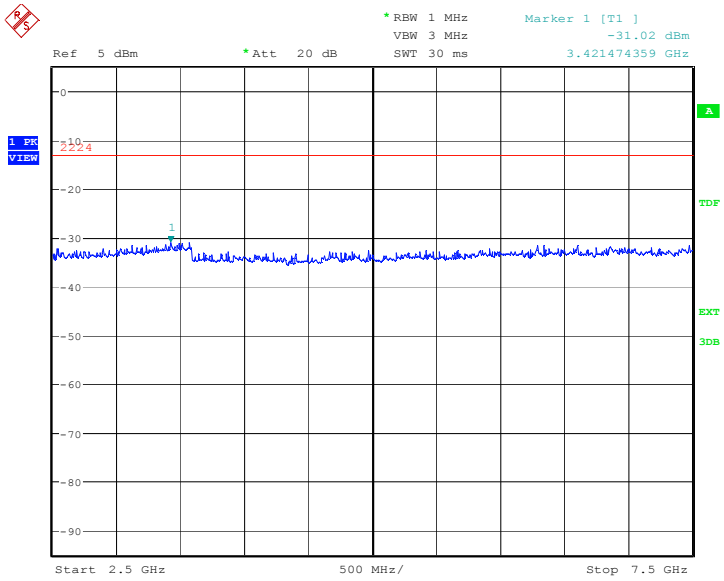
Channel 9538: 2.5GHz –7.5GHz

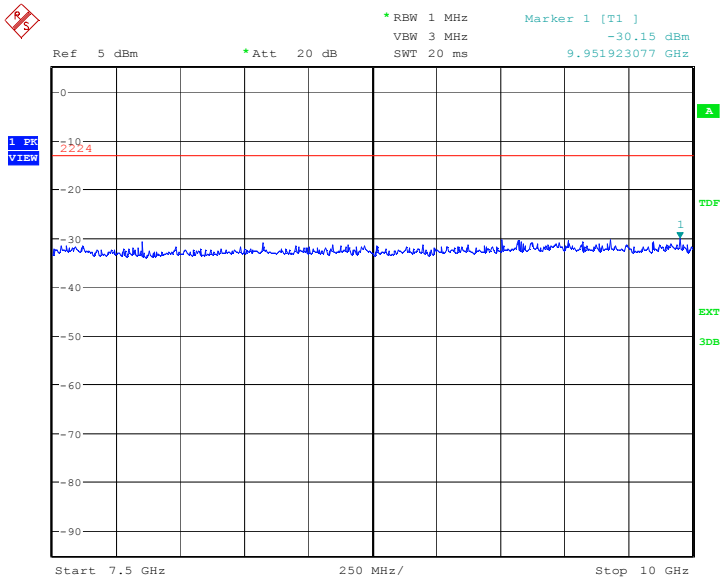
Spurious emission limit –13dBm.



Date: 23.APR.2016 06:07:27

Channel 9538: 7.5GHz –10GHz

Spurious emission limit –13dBm.



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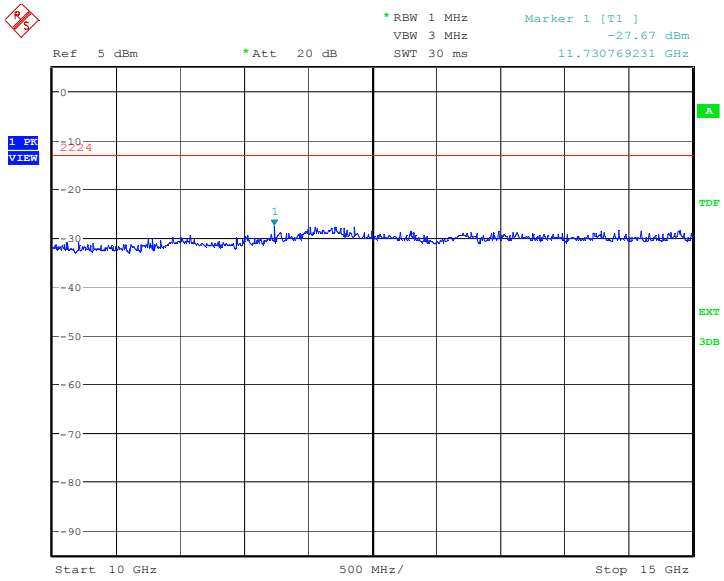
Channel 9538: 10GHz –15GHz

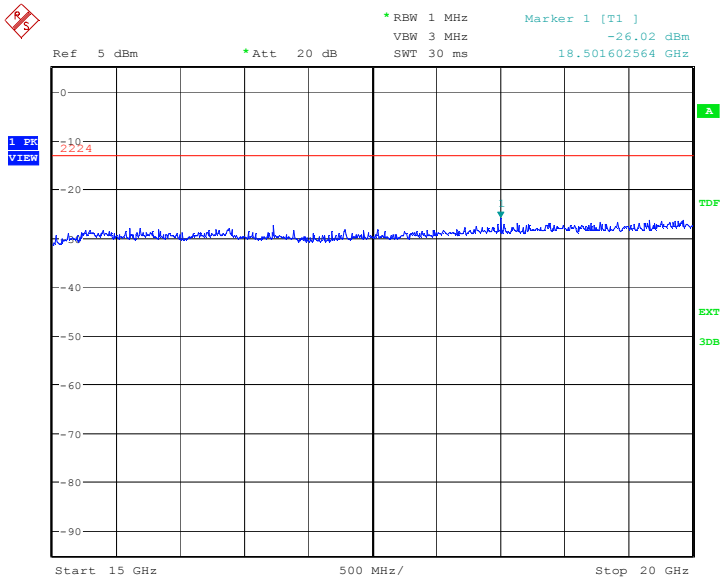
Spurious emission limit –13dBm.



Date: 23.APR.2016 06:08:23

Channel 9538: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:08:51

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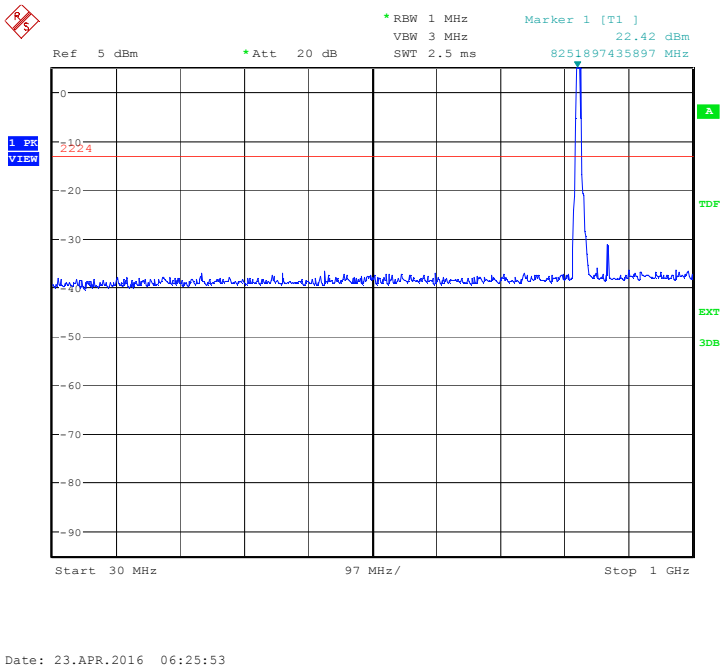
WCDMA Band Ⅴ

Channel 4132: 30MHz –1GHz

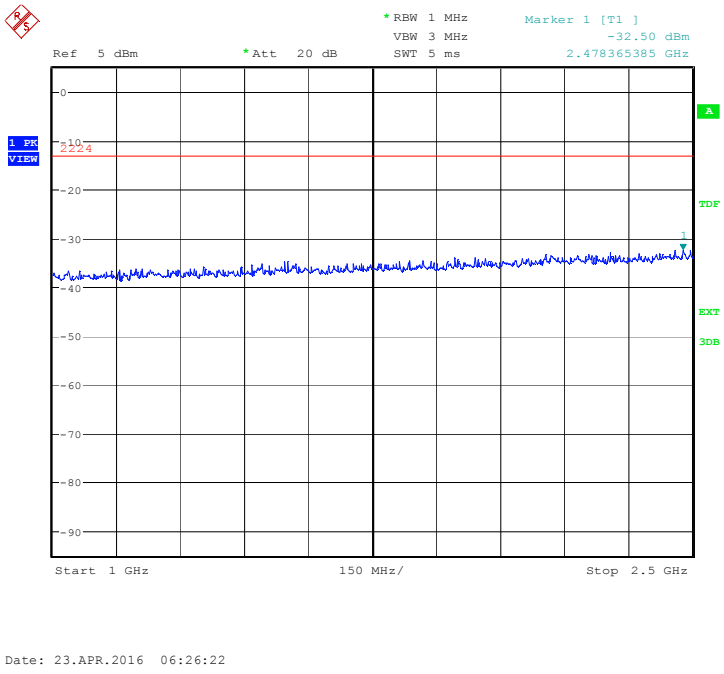
Spurious emission limit –13dBm.

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



Channel 4132: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



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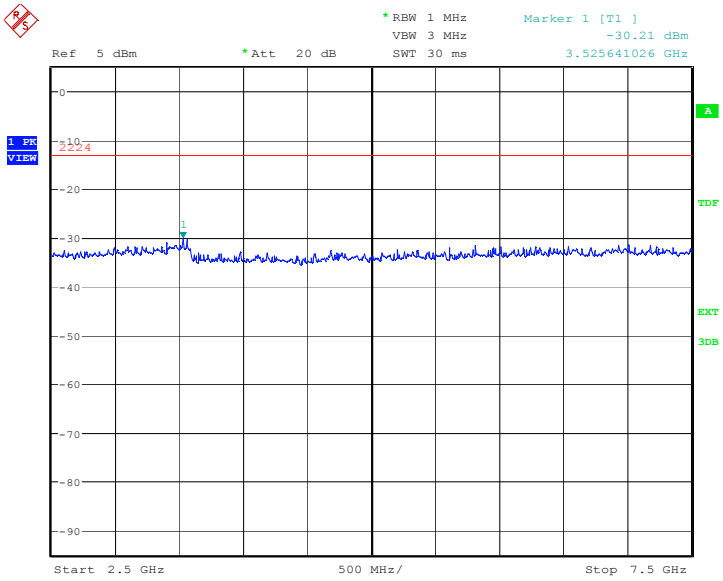
Channel 4132: 2.5GHz –7.5GHz

Spurious emission limit –13dBm.



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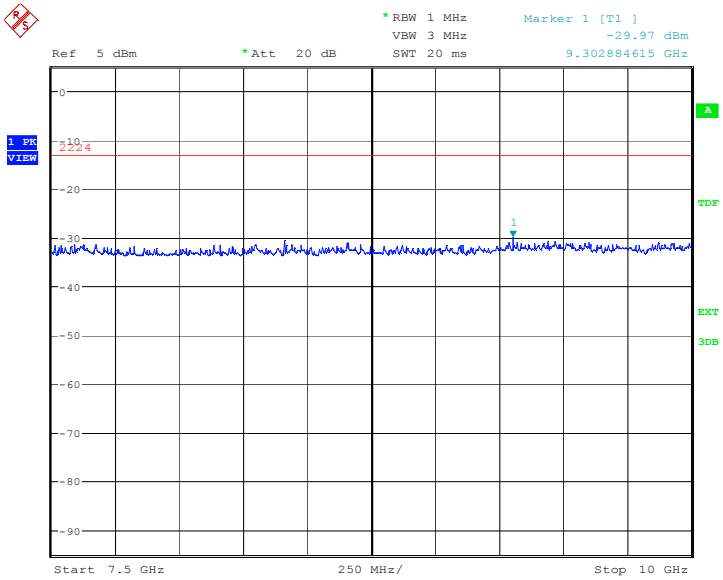
Channel 4132: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



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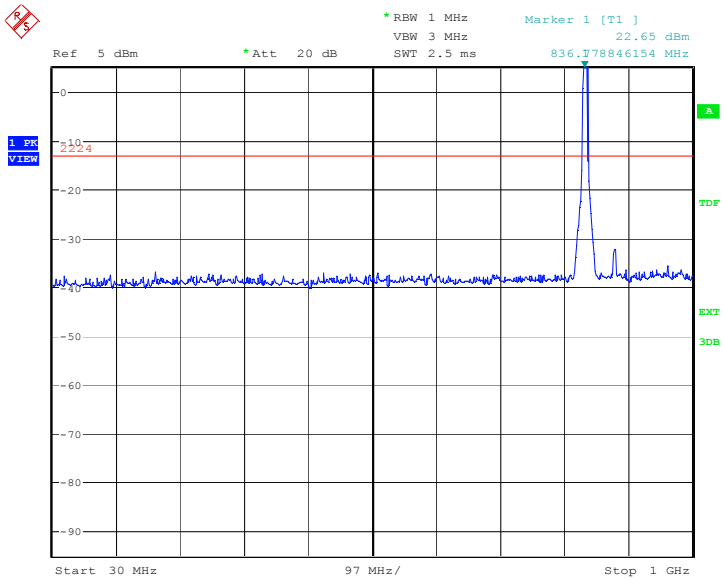
Channel 4183: 30MHz –1GHz

Spurious emission limit –13dBm.

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



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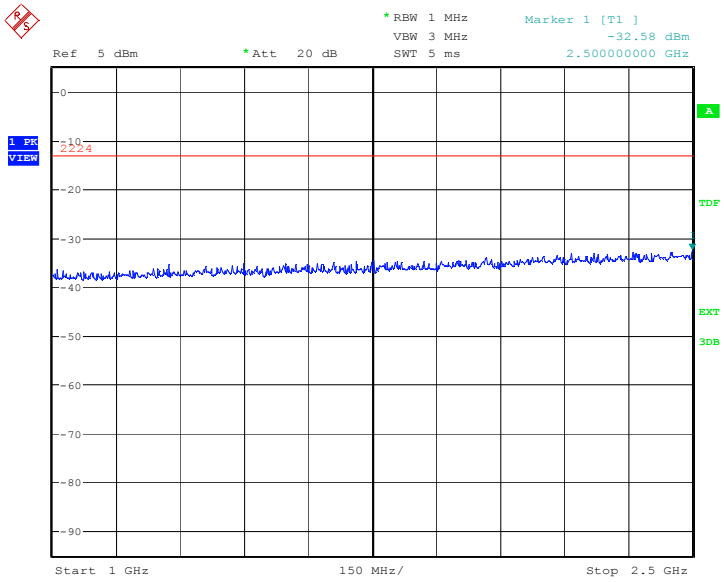
Channel 4183: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:28:17

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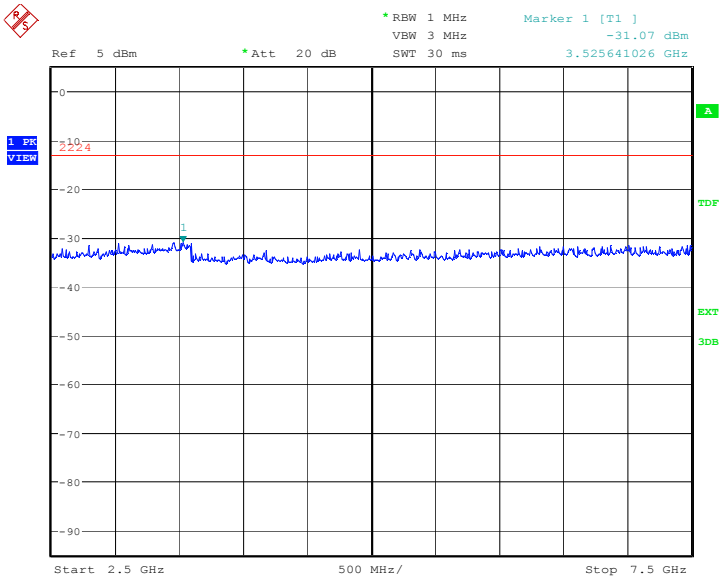
Channel 4183: 2.5GHz –7.5GHz

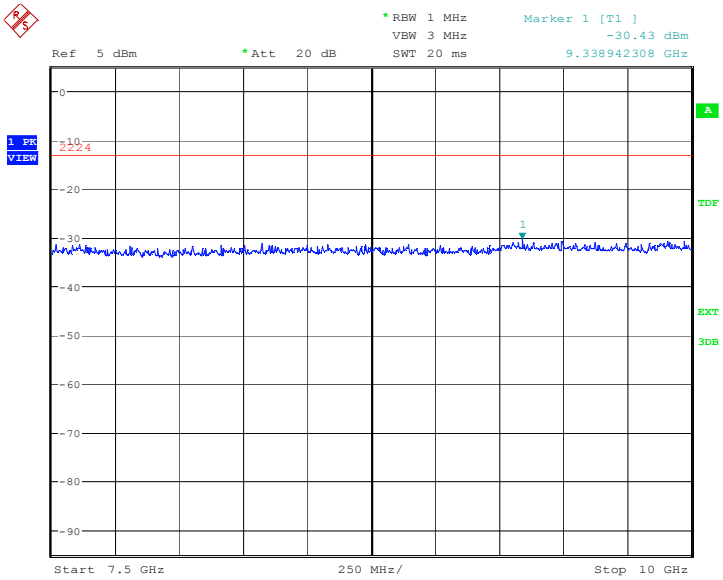
Spurious emission limit –13dBm.



Date: 23.APR.2016 06:28:45

Channel 4183: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:29:13

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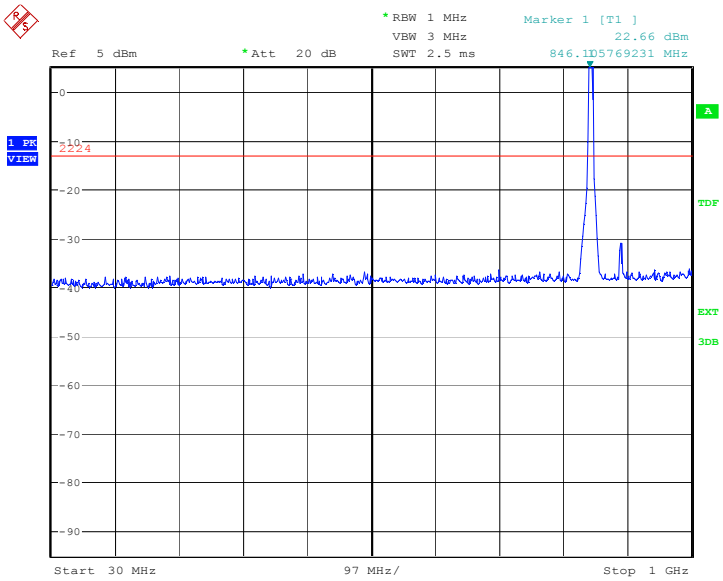
Channel 4233: 30MHz –1GHz

Spurious emission limit –13dBm.

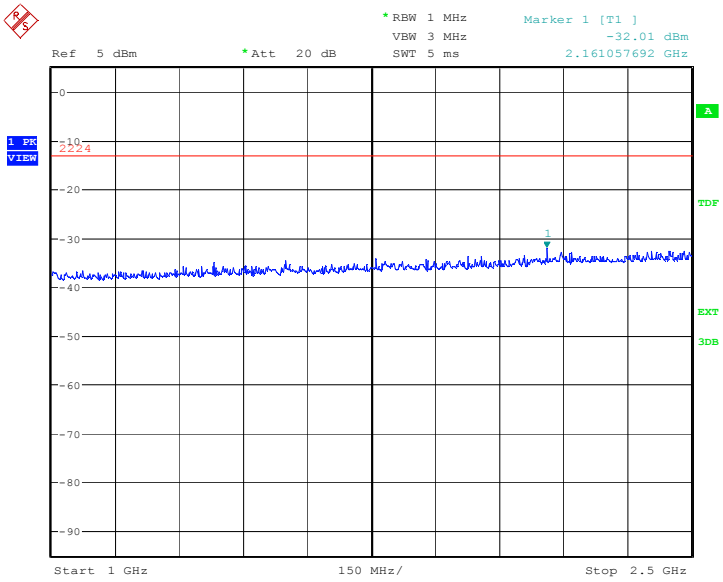
NOTE: peak above the limit line is the carrier frequency.



Date: 23.APR.2016 06:29:45

Channel 4233: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:30:13

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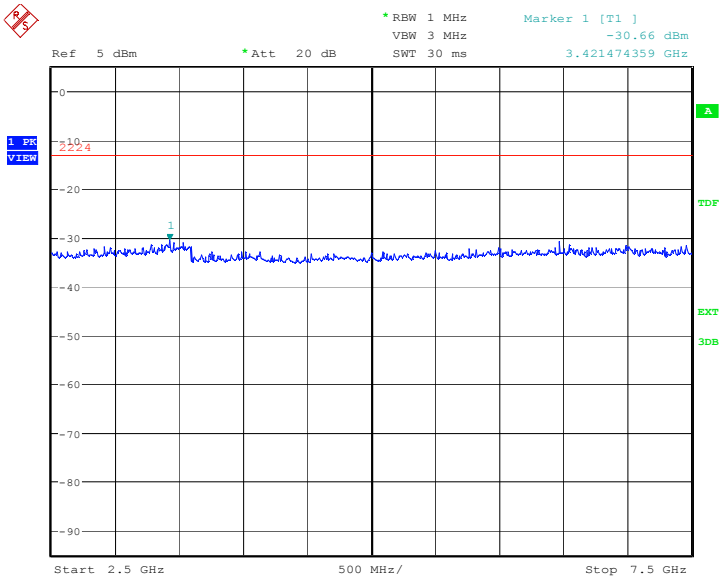
Channel 4233: 2.5GHz –7.5GHz

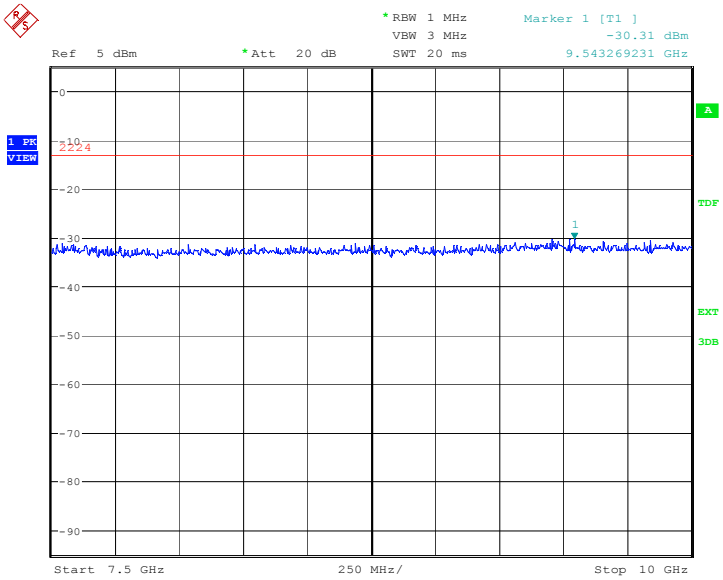
Spurious emission limit –13dBm.



Date: 23.APR.2016 06:30:41

Channel 4233: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



Date: 23.APR.2016 06:31:09

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A.8 PEAK-TO-AVERAGE POWER RATIO

Reference

FCC: CFR Part 24.232 (d)

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

According to KDB 971168:

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

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

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

d) Set the measurement interval to 1 ms

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

A.8.1 Measurement limit

not exceed 13 dB

A.8.2 Measurement results

WCDMA Band II-QPSK

Measurement result

	CH	Frequency(MHz)	PAPR(dB)
WCDMA (Band II)	9400	1880.0	3.65

WCDMA Band II-16QAM

Measurement result

	CH	Frequency(MHz)	PAPR(dB)
WCDMA (Band II)	9400	1880.0	4.71

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

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