TEST REPORT

No. I18Z62361-WMD05

for

HMD Global OY

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

GSM850,900,1800,1900 WCDMA:1,2,4, 5, 8

LTE:1,2,3,4,5,7,8,12/17,28,38,66 mobile phone,

Bluetooth4.2,WIFI802.11 b/g/n

Model Name: TA-1149

FCC ID: 2AJOTTA-1149

with

Hardware Version: 89571_1_12

Software Version: 00XX_1_XXX

Issued Date: 2019-01-28

TESTING
NVLAP LAB CODE 600118-0

Note:

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

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I18Z62361-WMD05	Rev.0	1st edition	2019-01-28

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1. Test Laboratory

1.1. Testing Location

Location 1: CTTL(huayuan North Road)

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

Location 2: CTTL(Shouxiang)

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

1.2. Testing Environment

Normal Temperature: 15-35℃

Relative Humidity: 20-75%

1.3. Project data

Testing Start Date: 2019-01-02

Testing End Date: 2019-01-22

1.4. Signature

Dong Yuan

(Prepared this test report)

Zhou Yu

(Reviewed this test report)

Zhao Hui Lin

Deputy Director of the laboratory

(Approved this test report)

2. Client Information

2.1. Applicant Information

Company Name:	HMD Global OY
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2.2. Manufacturer Information

Company Name:	HMD Global OY
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3. Equipment UnderTest (EUT) and Ancillary Equipment (AE)

3.1. About EUT

Description	Multi-band GSM/WCDMA/LTE phone with Bluetooth,WLAN GSM850,900,1800,1900WCDMA:1,2,4,5,8LTE:1,2,3,4,5,7,8,12/17,28,38,66 mobile phone, Bluetooth4.2,WIFI802.11 b/g/n
Model Name	TA-1149
FCC ID	2AJOTTA-1149
Antenna	Embedded
Output power	22.58dBm maximum EIRP measured for WCDMA Band IV
Extreme vol. Limits	3.6VDC to 4.4VDC (nominal: 3.9VDC)
Extreme temp. Tolerance	-10°C to +55°C

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

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Date of receipt
UT28a	352901100008443/ 352901100008450	89571_1_12	00XX_1_XXX	2018-12-25
UT53a	352901100004681/ 352901100004699	89571_1_12	00XX_1_XXX	2019-01-03

*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

AE1

Model	WT330
Manufacturer	Jiade Energy Technology(Zhuhai) Co.,Ltd.
Capacitance	3000mAh(rated)
Nominal Voltage	3.85V

AE2

Model	WT330
Manufacturer	Sunwoda Electronic Co.,Ltd
Capacitance	3000mAh(rated)
Nominal Voltage	3.85V

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

3.4. Normal Accessory setting

Fully charged battery was used during the test.

3.5. General Description

The Equipment Under Test (EUT) is a model of Multi-band GSM/WCDMA/LTE phone with Bluetooth,WLANGSM850,900,1800,1900WCDMA:1,2,4,5,8LTE:1,2,3,4,5,7,8,12/17,28,38,66 mobile phone, Bluetooth4.2,WIFI802.11 b/g/n with embedded antenna. Manual and specifications of the EUT were provided to fulfil the test.

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	10-1-18 Edition
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-18 Edition
FCC Part 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES	10-1-18 Edition
ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2016
TIA-102.CAAA-E	DIGITAL C4FMCQPSK TRANSCEIVER MEASUREMENT METHODS	2016
ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services	2015
KDB 971168 D01	MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS	v03r01

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

6. SUMMARY OF TEST RESULTS

WCDMA Band II

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

WCDMA Band V

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	§2.1046(a), 22.913(a)	BR
2	Emission Limit	22.917, 2.1051	BR
3	Frequency Stability	22.235, 2.1055	BR
4	Occupied Bandwidth	2.1049(h)(i)	BR
5	Emission Bandwidth	22.917(b)	BR
6	Band Edge Compliance	22.917(b)	BR
7	Conducted Spurious Emission	22.917, 2.1057	BR

WCDMA Band IV

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	27.50(d)(4)	BR
2	Emission Limit	27.53(h), 2.1051	BR
3	Frequency Stability	27.54, 2.1055	BR
4	Occupied Bandwidth	2.1049(h)(i)	BR
5	Emission Bandwidth	27.53(h)	BR
6	Band Edge Compliance	27.53(h)	BR
7	Conducted Spurious Emission	27.53(h), 2.1057	BR
8	Peak-to-Average Power Ratio	27.50(a)	BR

Terms used in Verdict column

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

6.1. Explanation of re-use of test data

The Equipment Under Test (EUT) model TA-1149 (FCC ID: 2AJOTTA-1149) is a variant product of TA-1133 (FCC ID: 2AJOTTA-1133), according to the declaration of changes provided by the applicant and FCC KDB publication 484596 D01. All the test results are derived from test report No.I18Z62361-WMD02.

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

This EUT is a Single SIM card slot product and the report of original sample is dual SIM card slot. We share the test results of original sample and do spot check.

7. TestEquipments Utilized

NO.	Description	TYPE	series number	MANUFACTURE	CAL DUE DATE	Calibration interval
1	Test Receiver	ESU26	100235	R&S	2019-03-31	1 year
2	Test Receiver	ESU26	100376	R&S	2019-12-27	1 year
3	EMI Antenna	3117	00058889	ETS-Lindgren	2020-05-27	3 year
4	Universal Radio Communication Tester	CMU200	108646	R&S	2020-01-03	1 year
5	Spectrum Analyzer	FSU26	200030	R&S	2019-06-04	1 year
6	EMI Antenna	VULB9163	9163-235	Schwarzbeck	2019-05-10	3 year
7	Signal Generator	SMF100A	101295	R&S	2019-12-27	1 year
8	Climate chamber	SH-242	93008556	ESPEC	2019-12-21	2 year
9	Loop Antenna	HFH2-Z2	829324/007	R&S	2020-01-03	1 year

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).

WCDMA Band II

Measurement result-QPSK

	CH	Frequency(MHz)	output power(dBm)
WCDMA (Band II)	9262	1852.4	24.33
	9400	1880.0	24.26
	9538	1907.6	24.40

WCDMA Band V

Measurement result-QPSK

	CH	Frequency(MHz)	output power(dBm)
WCDMA (Band V)	4132	826.4	24.18
	4183	836.6	24.05
	4233	846.6	24.11

WCDMA Band IV

Measurement result-QPSK

	CH	Frequency(MHz)	output power(dBm)
WCDMA (Band IV)	1312	1712.4	24.31
	1450	1740.0	24.42
	1513	1752.6	24.38

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."

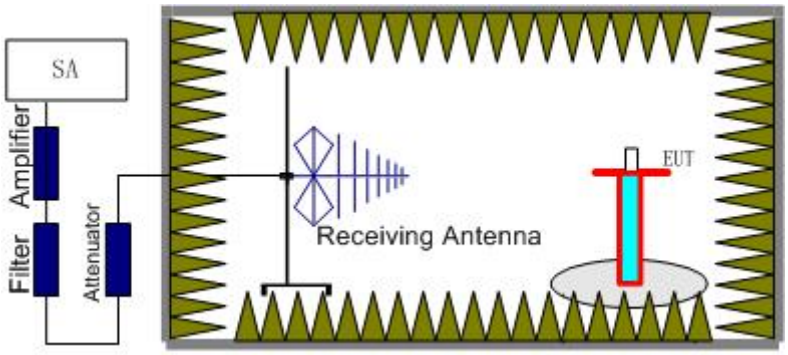
Rule Part 22.913(a) specifies ” The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.”

Rule Part 27.50(d)(2) specifies, "Fixed, mobile, and portable (handheld)stations operating in the 1710–1755MHz band are limited to a peak EIRP of 1 watt.”

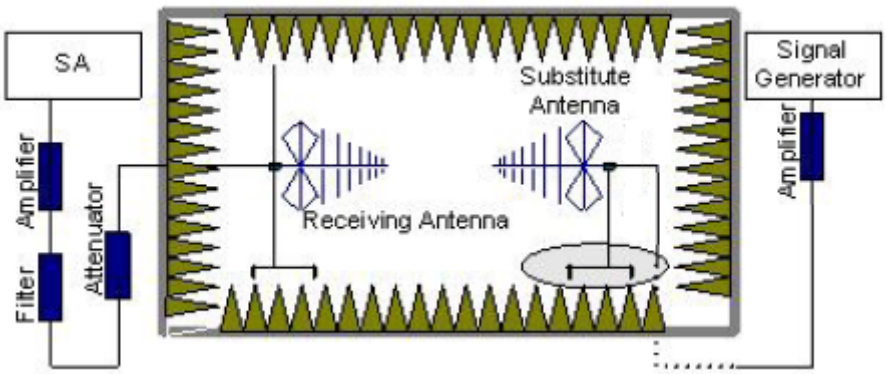
A.1.3.2 Method of Measurement

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

1. EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUTthrough 360°and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequenciesin 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, ansubstitution antenna for the frequency band of interest is placed at the

reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjust the level of thesignal generator output until the value of the receiver reach thepreviously 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.

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)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1852.40	-24.72	2.84	43.75	4.87	21.06	33.00	11.94	H
1880.00	-24.28	2.85	43.75	4.82	21.44	33.00	11.56	H
1907.60	-23.41	2.88	43.77	4.77	22.25	33.00	10.75	H

ANALYZER SETTINGS: RBW = VBW = 5MHz

Frequency: 1907.60MHz

Peak EIRP(dBm)=P_{Mea}(-23.41dBm)-P_{cl}(2.88dB)-P_{Ag}(-43.77dB)-G_a (-4.77dB)= 22.25dBm

WCDMA Band V-ERP

Limits

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

Measurement result-QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Margin(dB)	Polarization
826.40	-21.67	2.25	45.76	0.93	2.15	20.62	38.45	17.83	H
836.60	-21.28	2.26	45.66	0.82	2.15	20.79	38.45	17.66	H
846.60	-21.29	2.26	45.56	0.81	2.15	20.67	38.45	17.78	H

ANALYZER SETTINGS: RBW = VBW = 5MHz

Frequency: 836.60MHz

Peak ERP(dBm)=P_{Mea}(-21.28dBm)-P_{cl}(2.26dB)-P_{Ag}(-45.66dB)-G_a (-0.82dB)-2.15dB= 20.79dBm

WCDMA Band IV-EIRP

Limits

	Burst Peak EIRP (dBm)
WCDMA Band IV	30dBm (1W)

Measurement result-QPSK

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)	P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Margin(dB)	Polarization
1712.40	-25.06	3.66	44.10	5.12	20.50	30.00	9.50	H
1740.00	-23.21	4.36	44.15	5.07	21.65	30.00	8.35	H
1752.60	-22.76	3.85	44.14	5.05	22.58	30.00	7.42	H

ANALYZER SETTINGS: RBW = VBW = 5MHz

Frequency: 1907.60MHz

Peak EIRP(dBm)=P_{Mea}(-22.76dBm)-P_{cl}(3.85dB)-P_{Ag}(-44.14dB)-G_a (-5.05dB)= 22.58dBm

Note: The EUT is tested in vertical polarization mode

A.2 EMISSION LIMIT

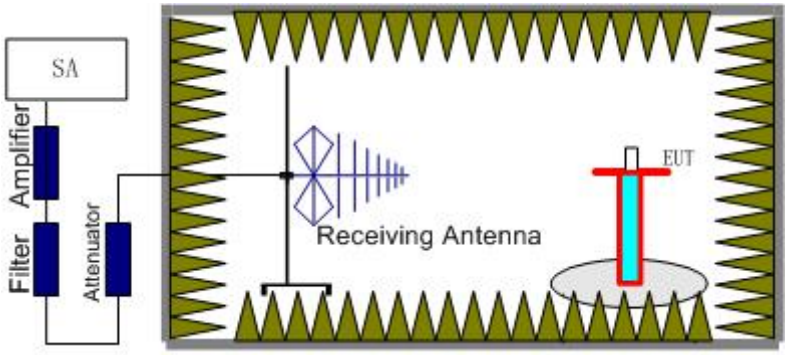
A.2.1 Measurement Method

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

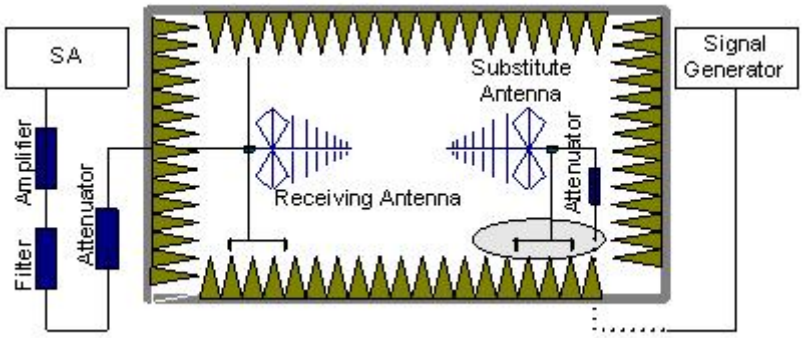
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment. The resolution bandwidth is set as outlined in Part 24.238, Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and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

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 EUTthrough 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, ansubstitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the

substitution antenna, and adjust the level of thesignal generator output until the value of the receiver reach thepreviously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. The Path loss (P_{pl}) between the Signal Source with the Substitution Antenna and the Substitution Antenna Gain (G_a) should be recorded after test.
   A amplifier should be connected in for the test.
   The Path loss (P_{pl}) is the summation of the cable loss and the gain of the amplifier.
   The measurement results are obtained as described below:
   Power(EIRP)=P_{Mea}-P_{pl}-G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dBi.

A.2.2 Measurement Limit

Part 24.238 , Part 22.917 and Part 27.53 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)and WCDMA Band IV(1712.4MHz, 1740MHz and 1752.6MHz). 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 V and WCDMA Band IV into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

A.2.4 Measurement Results Table

Frequency	Channel	Frequency Range	Result
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
WCDMA Band IV	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
WCDMA Band IV	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

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
7411.01	-54.29	8.15	12.09	-50.35	-13.00	37.35	V
9239.01	-54.97	9.02	13.24	-50.75	-13.00	37.75	V
11128.01	-52.12	9.71	13.17	-48.66	-13.00	35.66	H
12967.01	-49.68	10.48	13.48	-46.68	-13.00	33.68	V
14844.00	-46.22	11.15	14.12	-43.25	-13.00	30.25	H
16687.00	-42.99	11.77	13.67	-41.09	-13.00	28.09	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
7512.01	-54.83	8.34	12.21	-50.96	-13.00	37.96	H
9418.01	-55.12	9.13	13.35	-50.90	-13.00	37.90	H
11262.01	-52.24	9.77	13.15	-48.86	-13.00	35.86	V
13167.01	-48.23	10.64	13.73	-45.14	-13.00	32.14	V
15032.00	-45.70	11.26	13.98	-42.98	-13.00	29.98	H
16934.00	-42.93	12.12	13.77	-41.28	-13.00	28.28	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
7615.01	-55.04	8.04	12.29	-50.79	-13.00	37.79	V
9563.01	-54.65	9.31	13.34	-50.62	-13.00	37.62	H
11483.01	-51.24	9.85	13.10	-47.99	-13.00	34.99	H
13370.01	-48.68	10.57	14.02	-45.23	-13.00	32.23	H
15298.00	-45.60	11.28	13.82	-43.06	-13.00	30.06	V
17197.00	-42.91	12.36	14.23	-41.04	-13.00	28.04	H

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
1654.01	-56.82	3.57	5.22	2.15	-57.32	-13.00	44.32	H
2476.00	-52.20	4.60	6.03	2.15	-52.92	-13.00	39.92	V
3316.02	-54.74	5.29	7.76	2.15	-54.42	-13.00	41.42	H
4131.02	-55.04	6.05	9.03	2.15	-54.21	-13.00	41.21	H
4938.01	-54.79	6.71	9.84	2.15	-53.81	-13.00	40.81	H
5759.01	-54.75	7.25	10.55	2.15	-53.60	-13.00	40.60	H

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
1658.01	-59.27	3.57	5.22	2.15	-59.77	-13.00	46.77	H
2512.00	-45.85	4.64	6.12	2.15	-46.52	-13.00	33.52	V
3341.02	-55.03	5.31	7.82	2.15	-54.67	-13.00	41.67	H
4186.02	-55.05	6.17	9.09	2.15	-54.28	-13.00	41.28	V
5022.01	-54.86	6.57	9.93	2.15	-53.65	-13.00	40.65	H
5843.01	-53.96	7.21	10.53	2.15	-52.79	-13.00	39.79	V

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
1704.01	-59.06	3.60	5.13	2.15	-59.68	-13.00	46.68	H
2537.00	-52.70	4.66	6.17	2.15	-53.34	-13.00	40.34	V
3394.02	-55.80	5.36	7.95	2.15	-55.36	-13.00	42.36	V
4235.02	-55.12	6.25	9.14	2.15	-54.38	-13.00	41.38	H
5097.01	-54.80	6.76	10.04	2.15	-53.67	-13.00	40.67	V
5938.01	-52.93	7.47	10.51	2.15	-52.04	-13.00	39.04	H

WCDMA BAND IV Mode Channel 1312/1712.4MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
3422.02	-37.44	5.38	8.01	-34.81	-13.00	21.81	V
10294.01	-51.97	9.62	13.02	-48.57	-13.00	35.57	V
11990.01	-49.59	10.10	13.00	-46.69	-13.00	33.69	H
13708.01	-48.53	10.60	14.32	-44.81	-13.00	31.81	V
15416.00	-46.17	11.42	13.75	-43.84	-13.00	30.84	H
17141.00	-42.86	12.54	14.11	-41.29	-13.00	28.29	V

WCDMA BAND IV Mode Channel 1450/1740MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
3478.02	-39.89	5.48	8.15	-37.22	-13.00	24.22	H
10452.01	-51.93	9.72	13.08	-48.57	-13.00	35.57	H
12185.01	-49.95	10.10	13.07	-46.98	-13.00	33.98	H
13908.01	-47.40	10.81	14.44	-43.77	-13.00	30.77	H
15642.00	-45.49	11.54	13.70	-43.33	-13.00	30.33	H
17396.00	-43.15	12.49	14.67	-40.97	-13.00	27.97	H

WCDMA BAND IV Mode Channel 1513/1752.6MHz

Frequency(MHz)	P_{Mea}(dBm)	Path Loss	Antenna Gain	Peak EIRP(dBm)	Limit（dBm）	Margin(dB)	Polarization
3504.02	-43.05	5.53	8.21	-40.37	-13.00	27.37	H
10512.01	-52.25	9.61	13.10	-48.76	-13.00	35.76	H
12256.01	-49.70	10.02	13.10	-46.62	-13.00	33.62	V
14009.01	-47.48	10.87	14.50	-43.85	-13.00	30.85	H
15769.00	-45.99	11.64	13.70	-43.93	-13.00	30.93	H
17526.00	-43.96	12.82	14.94	-41.84	-13.00	28.84	H

A.3 FREQUENCY STABILITY

A.3.1 Method of Measurement

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

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -10℃.
3. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on mid channel of 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 -10℃ to +55℃. 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 +55℃.
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 increments from -10℃ to +55℃. 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 3.6VDC and 4.4VDC, with a nominal voltage of 3.9VDC. 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.

A.3.3 Measurement results

WCDMA Band II

Frequency Error vs Voltage-QPSK

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.6	-3.60	0.0019
3.9	-2.17	0.0012
4.4	-3.34	0.0018

Frequency Error vs Temperature-QPSK

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-10	-6.74	0.0036
0	-4.01	0.0021
10	-4.17	0.0022
20	-4.43	0.0024
30	-3.97	0.0021
40	4.29	0.0023
50	-3.78	0.0020

WCDMA Band V

Frequency Error vs Voltage-QPSK

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.6	-4.79	0.0057
3.9	-6.39	0.0076
4.4	7.00	0.0084

Frequency Error vs Temperature-QPSK

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-10	-5.71	0.0068
0	-5.45	0.0065
10	-4.65	0.0056
20	-5.52	0.0066
30	-3.48	0.0042
40	-4.56	0.0055
50	-5.95	0.0071

WCDMA Band IV

Frequency Error vs Voltage-QPSK

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.6	-5.16	0.0030
3.9	-4.24	0.0024
4.4	-3.60	0.0021

Frequency Error vs Temperature-QPSK

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-10	-2.14	0.0012
0	-4.52	0.0026
10	-4.33	0.0025
20	-6.00	0.0034
30	-5.08	0.0029
40	-7.31	0.0042
50	-6.93	0.0040

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 4.2:

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.

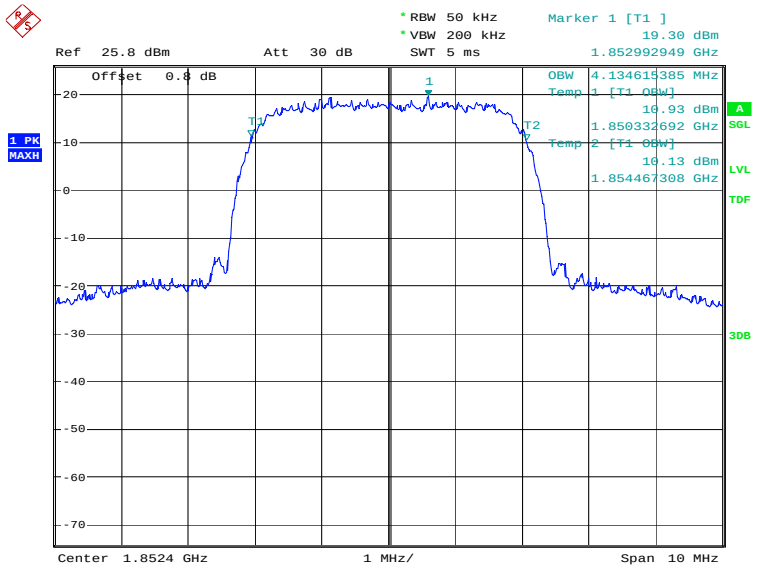
e) Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

WCDMA Band II (99% BW)-QPSK

Frequency(MHz)	Occupied Bandwidth (99% BW)(KHz)
1852.4	4134.62
1880.0	4134.62
1907.6	4166.67

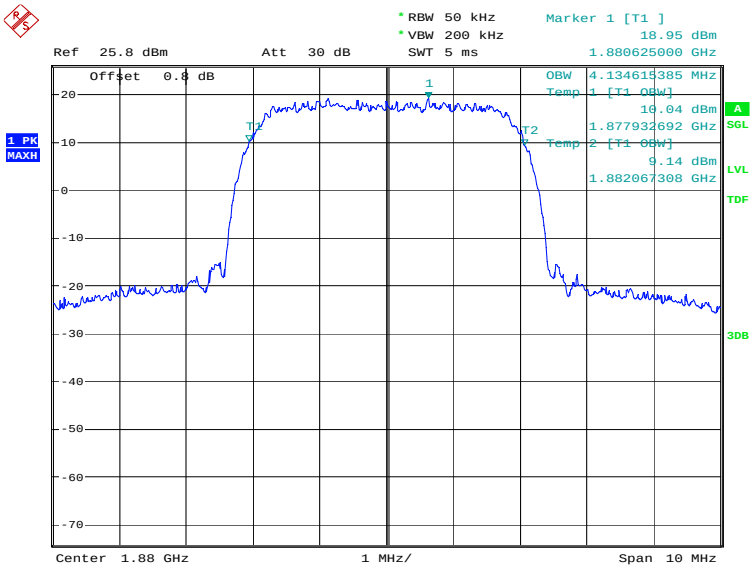
WCDMA Band II

Channel 9262-Occupied Bandwidth (99% BW)



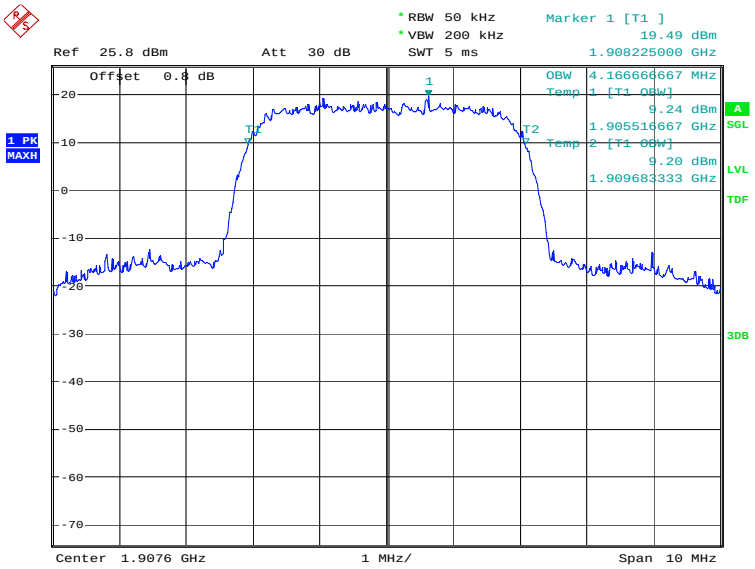
Date: 14.JAN.2019 10:08:22

Channel 9400-Occupied Bandwidth (99% BW)



Date: 14.JAN.2019 10:09:33

Channel 9538-Occupied Bandwidth (99% BW)



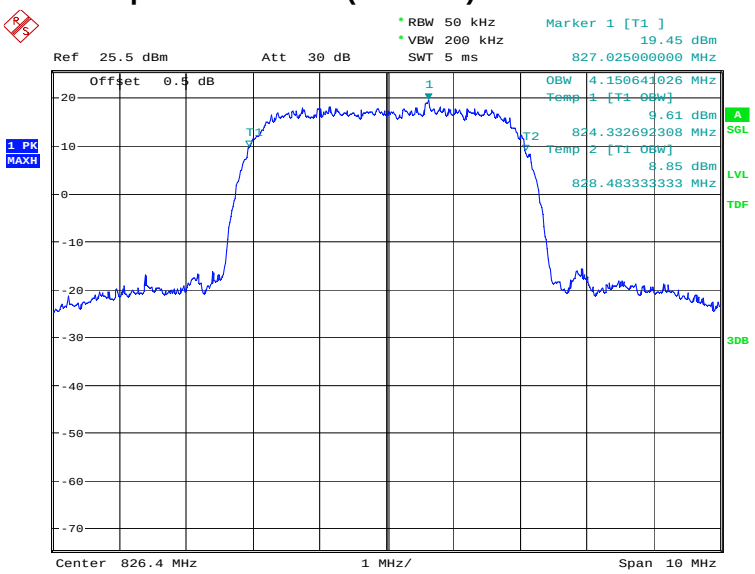
Date: 14.JAN.2019 10:10:45

WCDMA Band V(99% BW)-QPSK

Frequency(MHz)	Occupied Bandwidth (99% BW)(KHz)
826.4	4150.64
836.6	4134.62
846.6	4134.62

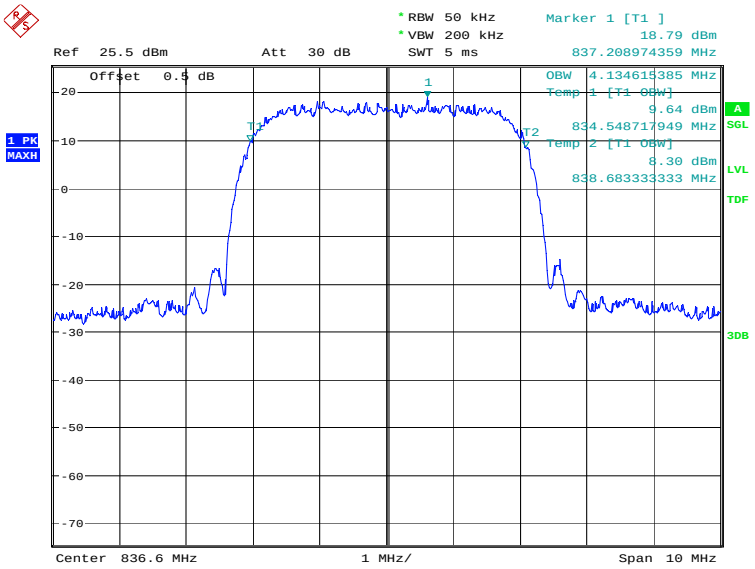
WCDMA Band V

Channel 4132-Occupied Bandwidth (99% BW)



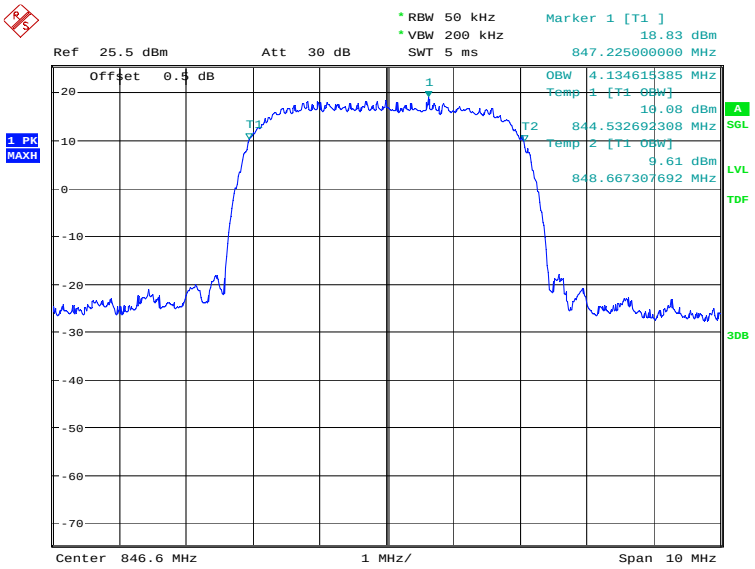
Date: 8.JAN.2019 16:30:39

Channel 4183-Occupied Bandwidth (99% BW)



Date: 8.JAN.2019 16:31:51

Channel 4233-Occupied Bandwidth (99% BW)



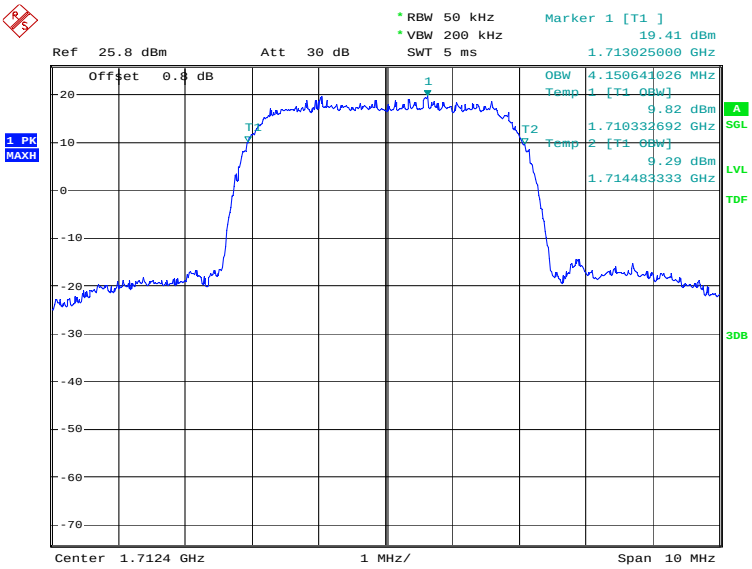
Date: 8.JAN.2019 16:33:03

WCDMA Band IV(99% BW)-QPSK

Frequency(MHz)	Occupied Bandwidth (99% BW)(KHz)
1712.4	4150.64
1740.0	4118.59
1752.6	4150.64

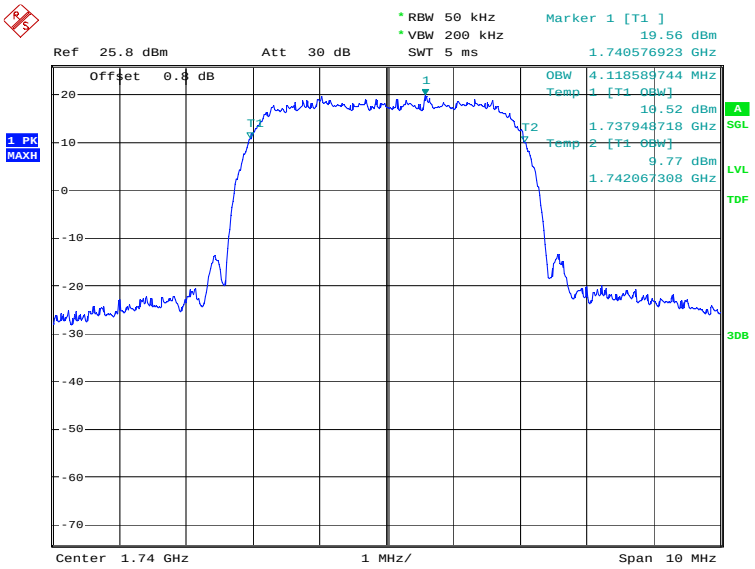
WCDMA Band IV

Channel 1312-Occupied Bandwidth (99% BW)



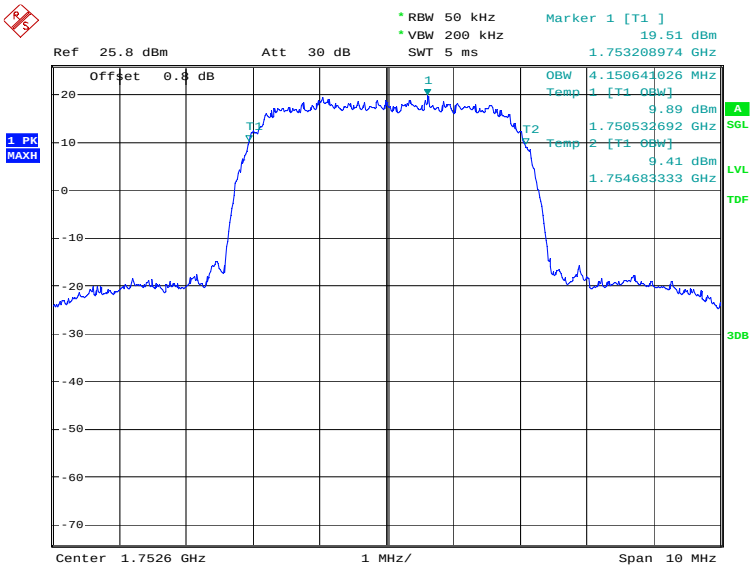
Date: 14.JAN.2019 10:12:47

Channel 1450-Occupied Bandwidth (99% BW)



Date: 14.JAN.2019 10:13:59

Channel 1513-Occupied Bandwidth (99% BW)



Date: 14.JAN.2019 10:15:10

A.5 EMISSION BANDWIDTH

Reference

FCC: CFR Part 22.917(b), 24.238(a), 27.53(h)

A.5.1Emission Bandwidth Results

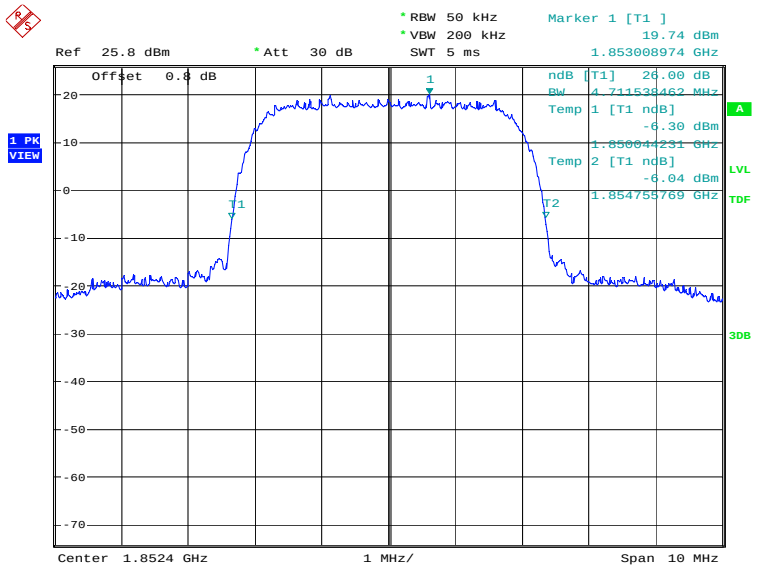
The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

WCDMA Band II-QPSK

Frequency(MHz)	Emission Bandwidth (KHz)
1852.4	4711.54
1880.0	4727.56
1907.6	4759.62

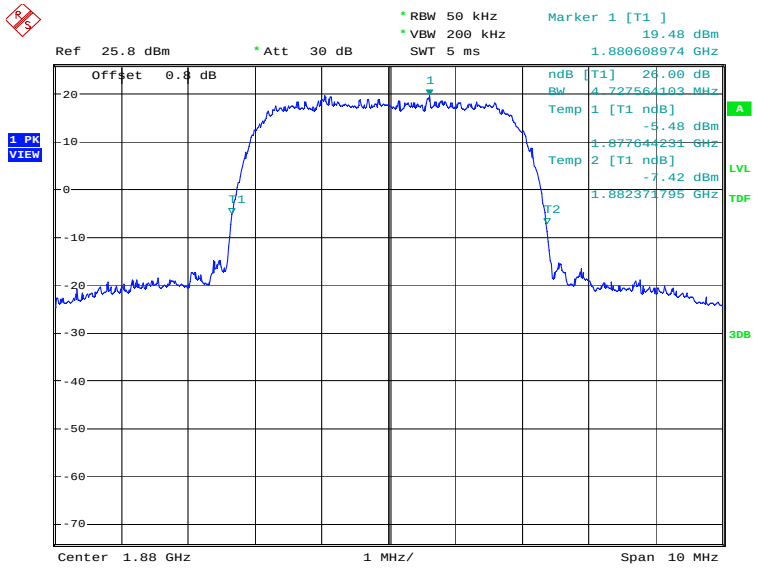
WCDMA Band II

Channel 9262-Emission Bandwidth



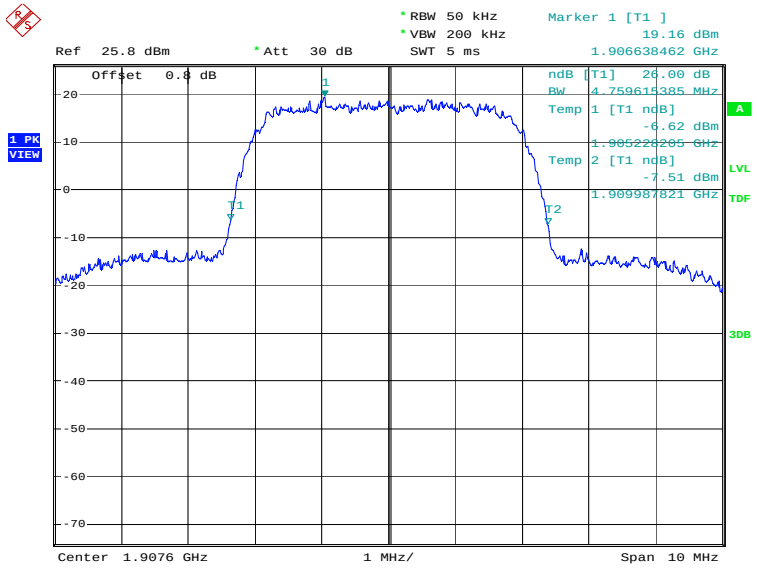
Date: 14.JAN.2019 10:17:09

Channel 9400-Emission Bandwidth



Date: 14.JAN.2019 10:18:21

Channel 9538-Emission Bandwidth



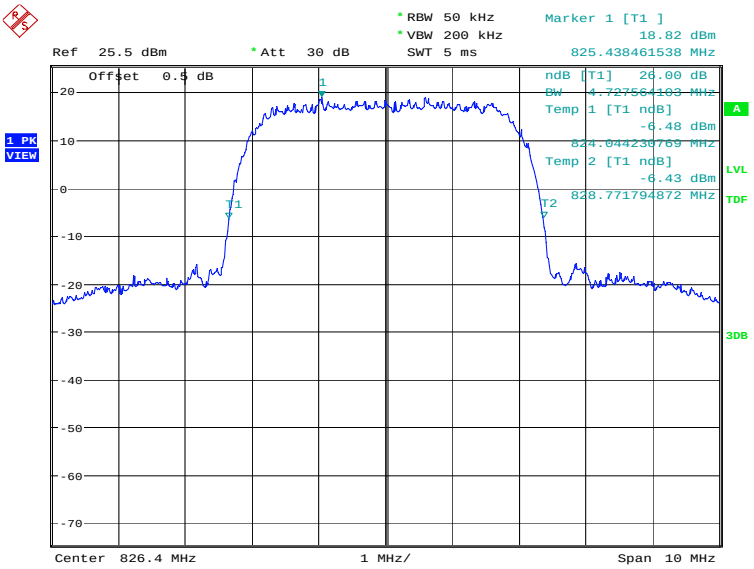
Date: 14.JAN.2019 10:19:32

WCDMA Band V-QPSK

Frequency(MHz)	Emission Bandwidth (KHz)
826.40	4727.56
836.60	4711.54
846.60	4711.54

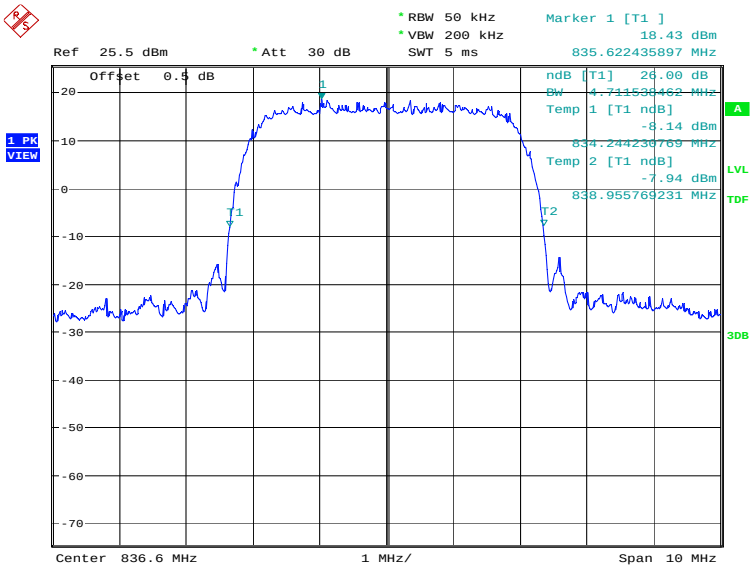
WCDMA Band V

Channel 4132-Emission Bandwidth



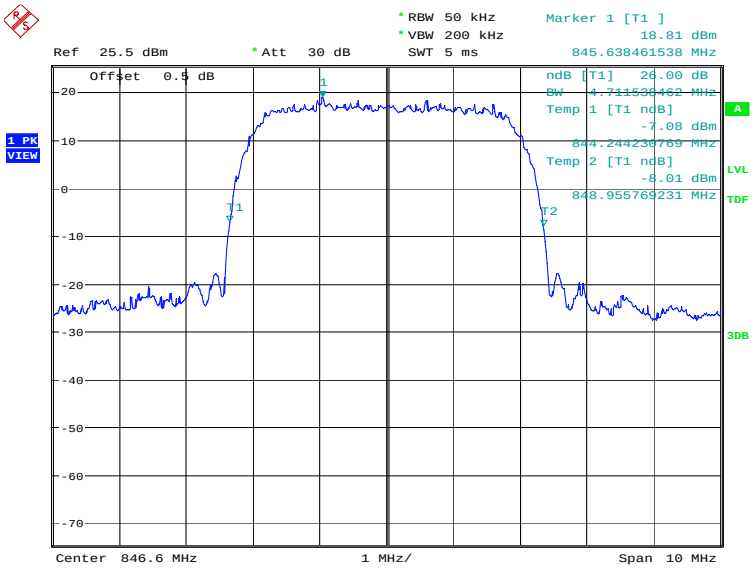
Date: 8.JAN.2019 16:38:28

Channel 4183-Emission Bandwidth



Date: 8.JAN.2019 16:39:40

Channel 4233-Emission Bandwidth



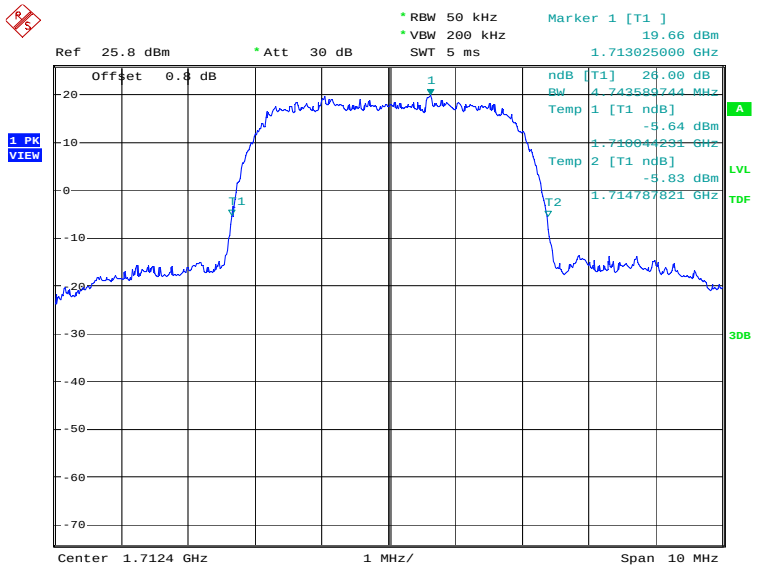
Date: 8.JAN.2019 16:40:52

WCDMA Band IV-QPSK

Frequency(MHz)	Emission Bandwidth (KHz)
1712.4	4743.59
1740.0	4711.54
1752.6	4727.56

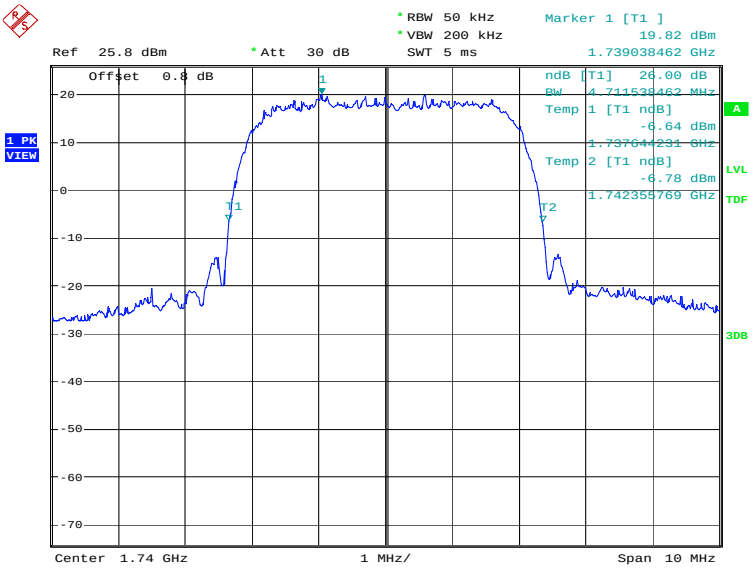
WCDMA Band IV

Channel 1312-Emission Bandwidth



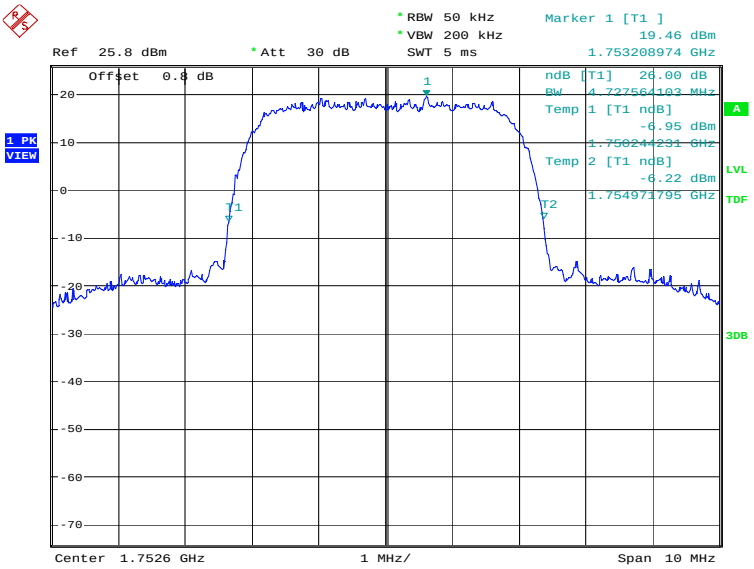
Date: 14.JAN.2019 10:21:32

Channel 1450-Emission Bandwidth



Date: 14.JAN.2019 10:22:43

Channel 1513-Emission Bandwidth



Date: 14.JAN.2019 10:23:55

A.6 BAND EDGE COMPLIANCE

Reference

FCC: CFR Part 22.917(b), 24.238(a), 27.53(h).

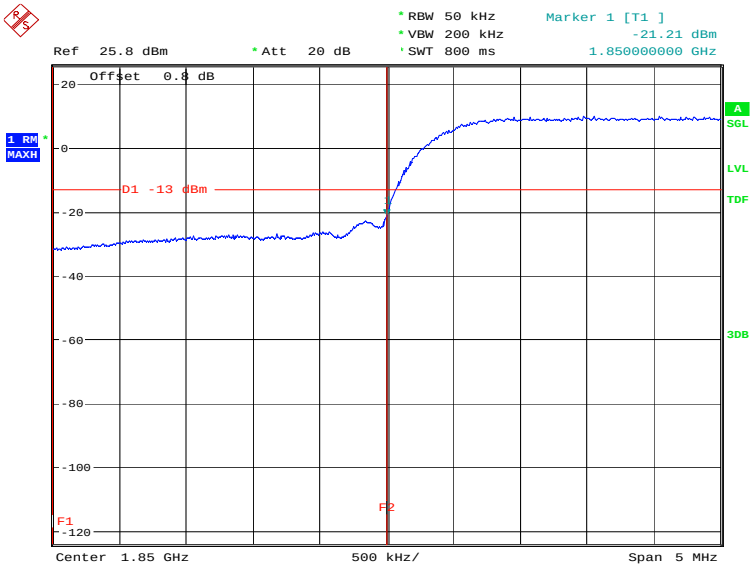
A.6.1 Measurement limit

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

A.6.2 Measurement result

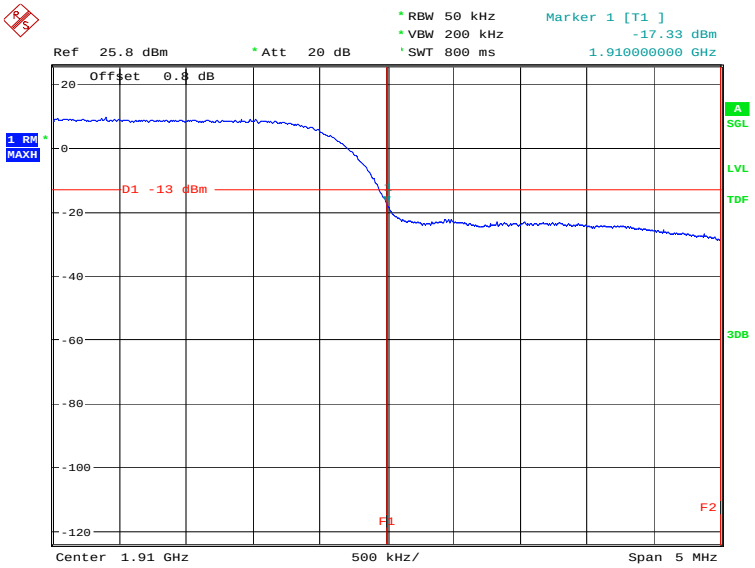
WCDMA Band II-QPSK

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



Date: 14.JAN.2019 10:25:01

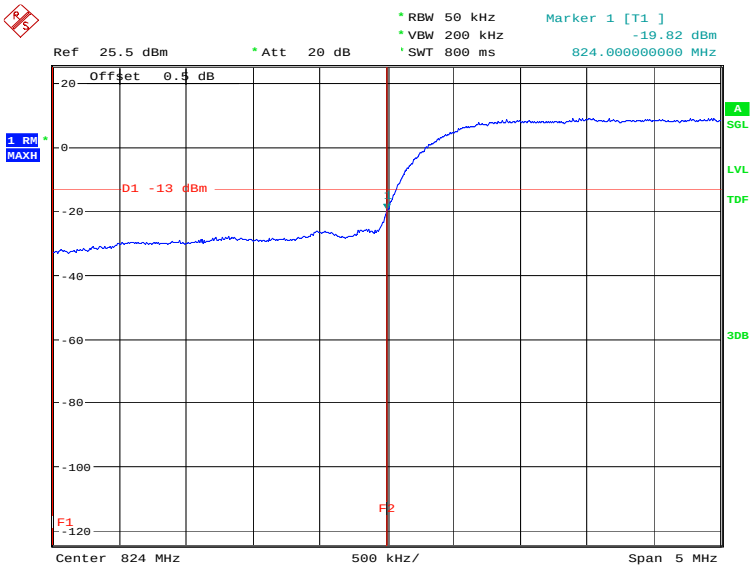
HIGH BAND EDGE BLOCK-C (WCDMA Band Ⅱ) –Channel 9538



Date: 14.JAN.2019 10:25:21

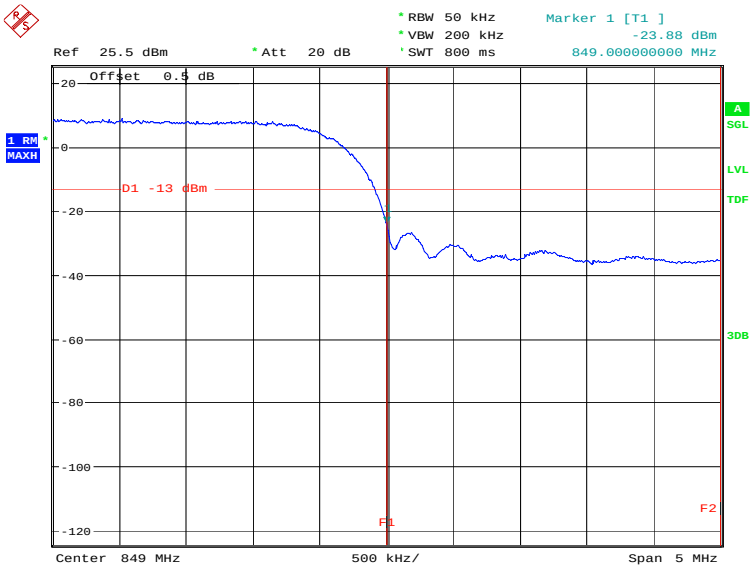
WCDMA Band Ⅴ-QPSK

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



Date: 8.JAN.2019 16:42:35

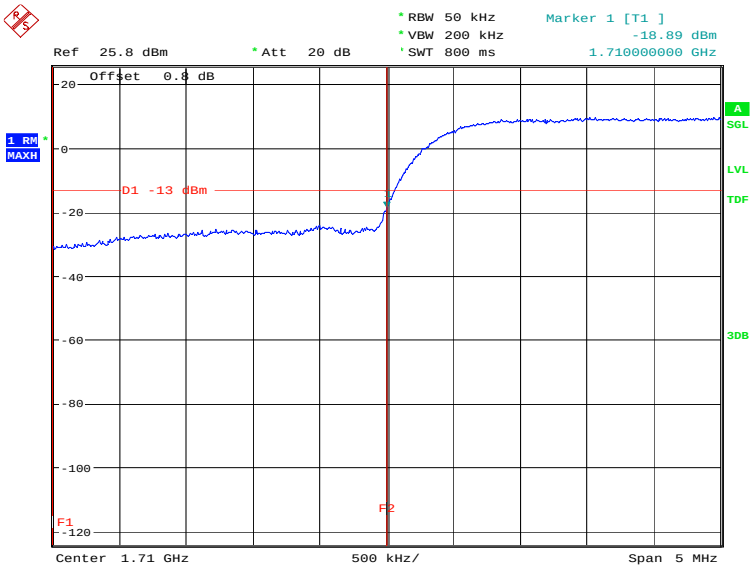
HIGH BAND EDGE BLOCK-C (WCDMA Band Ⅴ) –Channel 4233



Date: 8.JAN.2019 16:42:54

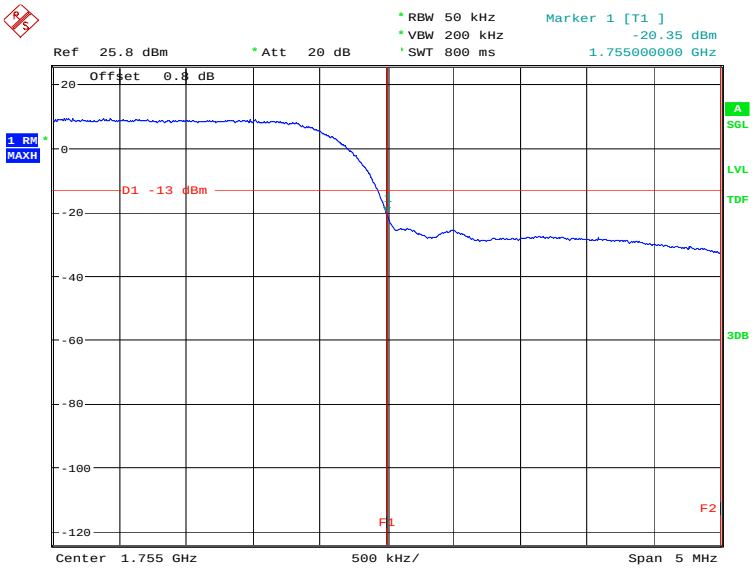
WCDMA Band IV-QPSK

LOW BAND EDGE BLOCK-A (WCDMA Band IV)-Channel 1312



Date: 14.JAN.2019 10:26:07

HIGH BAND EDGE BLOCK-C (WCDMA Band IV) –Channel 1513



Date: 14.JAN.2019 10:26:27

A.7 CONDUCTED SPURIOUS EMISSION

Reference

FCC: CFR Part 2.1057, 22.917, 24.238, 27.53(h).

A.7.1 Measurement Method

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

1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 9 GHz, data taken from 10 MHz to 25 GHz.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.
3. According to KDB 971168 6.0, the applicable rule part specifies the reference bandwidth for measuring unwanted emission levels (typically, 100 kHz if the authorized frequency band/block is at or below 1 GHz and 1 MHz if the authorized frequency band/block is above 1 GHz)

WCDMA Band Ⅱ Transmitter

Channel	Frequency (MHz)
9262	1852.40
9400	1880.00
9538	1907.60

WCDMA Band IV Transmitter

Channel	Frequency (MHz)
1312	1712.40
1450	1740.00
1513	1752.60

WCDMA Band Ⅴ Transmitter

Channel	Frequency (MHz)
4132	826.40
4183	836.60
4233	846.60

A. 7.2 Measurement Limit

Part 24.238, Part 22.917 and Part 27.53(h) 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.

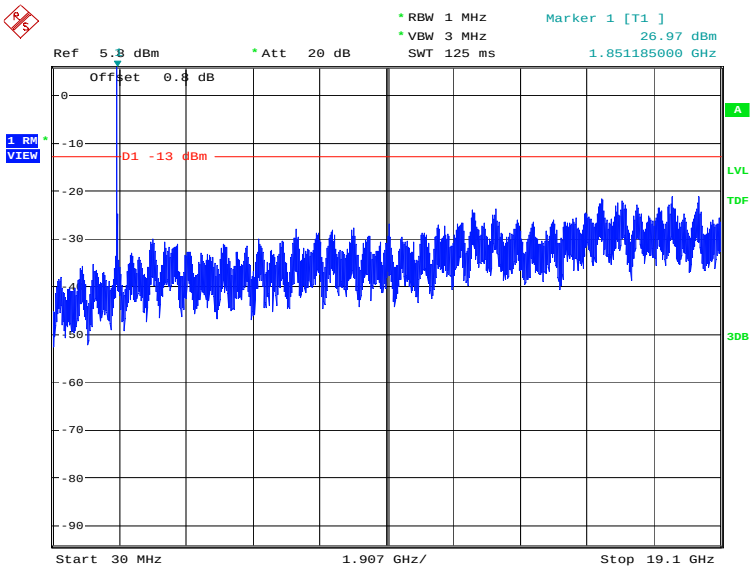
The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. 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.7.3 Measurement result

WCDMA Band Ⅱ

Channel 9262: 30MHz – 19.1GHz

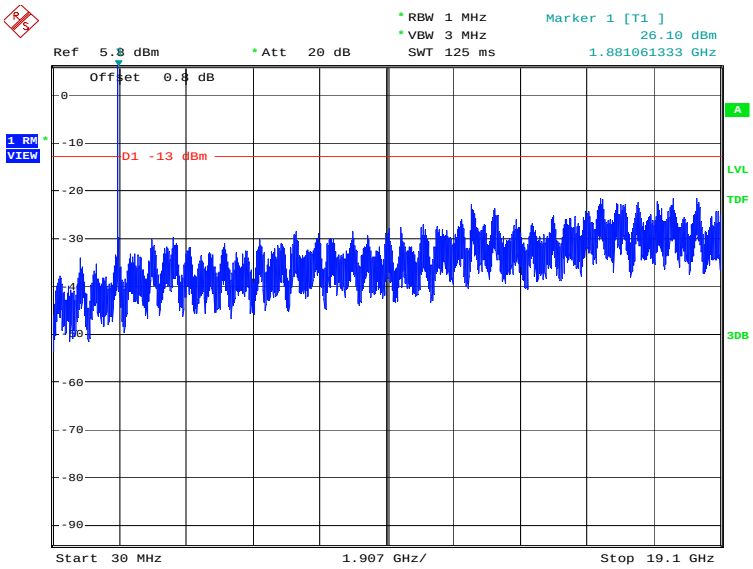
Spurious emission limit –13dBm.



Date: 14.JAN.2019 10:28:13

Channel 9400: 30MHz – 19.1GHz

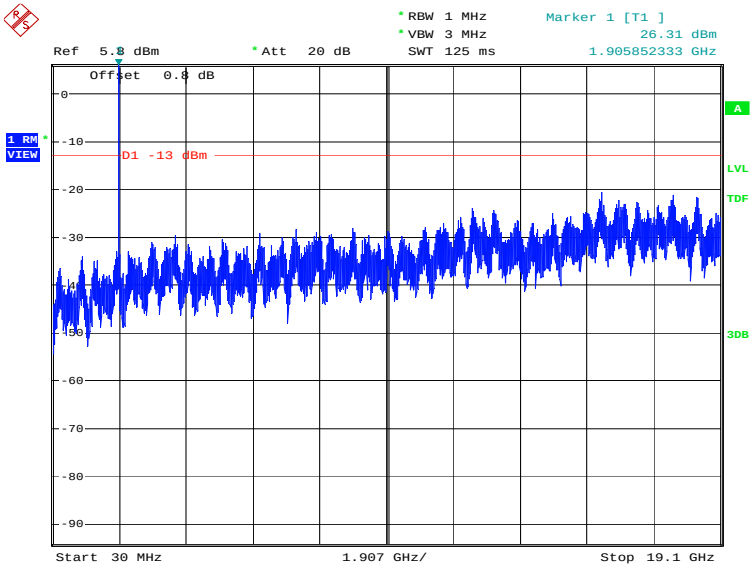
Spurious emission limit –13dBm.



Date: 14.JAN.2019 10:28:29

Channel 9538: 30MHz –19.1GHz

Spurious emission limit –13dBm.

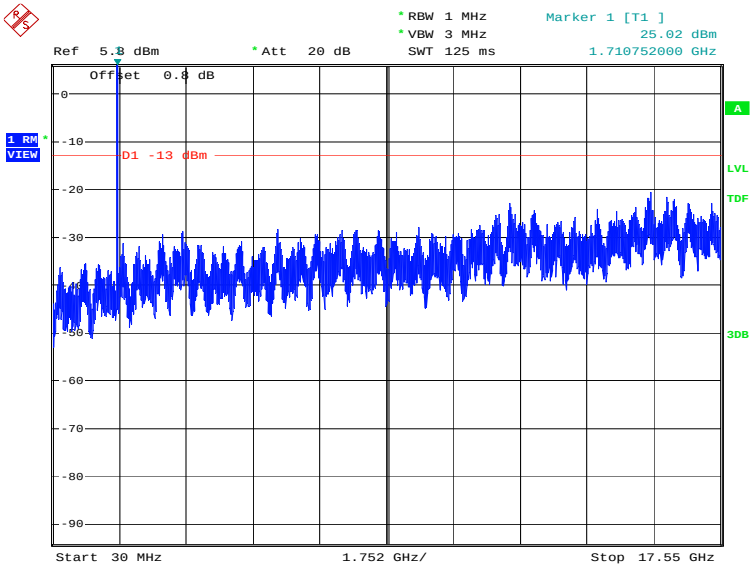


Date: 14.JAN.2019 10:28:44

WCDMA Band IV

Channel 1312: 30MHz –17.55GHz

Spurious emission limit –13dBm.

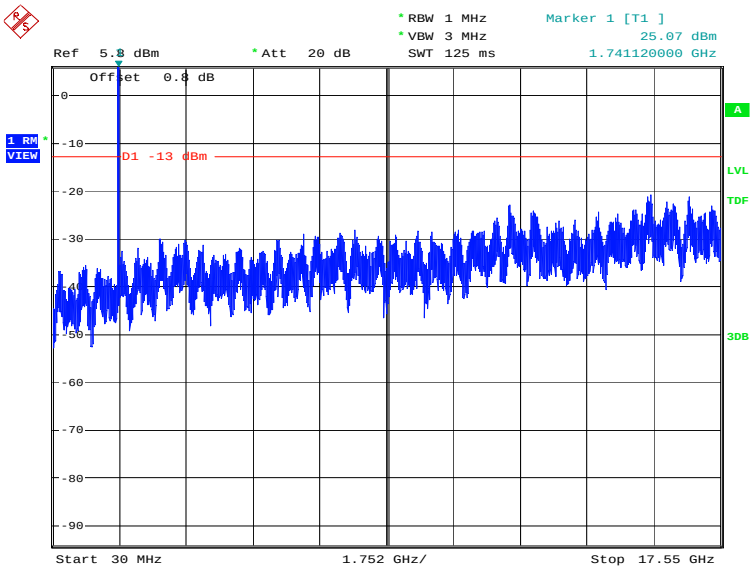


Date: 14.JAN.2019 10:32:08

WCDMA Band IV

Channel 1450: 30MHz –17.55GHz

Spurious emission limit –13dBm.

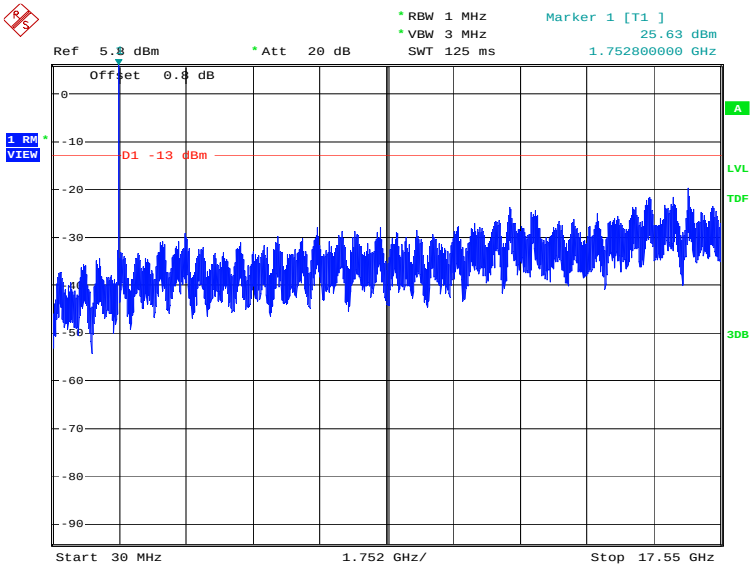


Date: 14.JAN.2019 10:32:23

WCDMA Band IV

Channel 1513: 30MHz –17.55GHz

Spurious emission limit –13dBm.



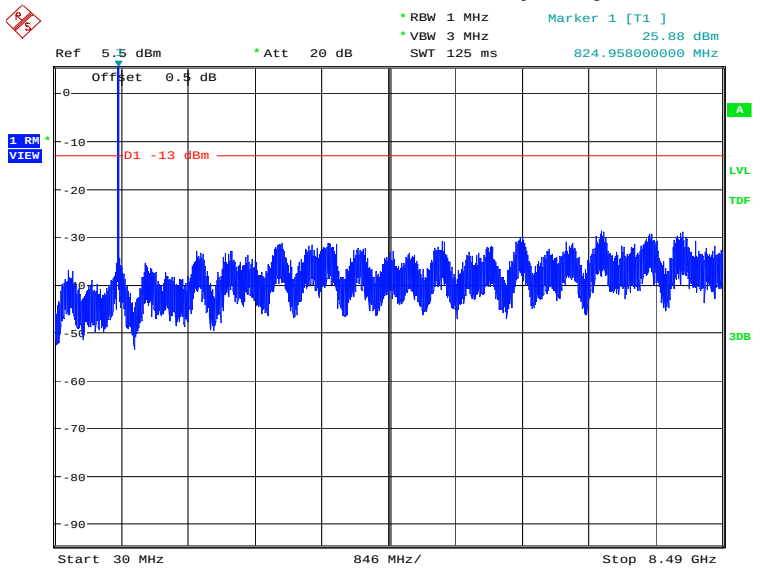
Date: 14.JAN.2019 10:32:39

WCDMA Band Ⅴ

Channel 4132: 30MHz –8.49GHz

Spurious emission limit –13dBm.

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

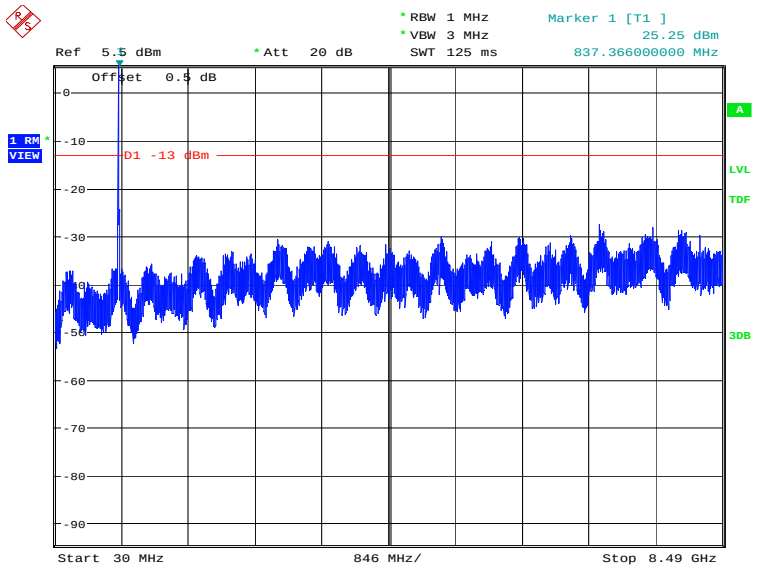


Date: 8.JAN.2019 16:45:31

Channel 4183: 30MHz –8.49GHz

Spurious emission limit –13dBm.

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

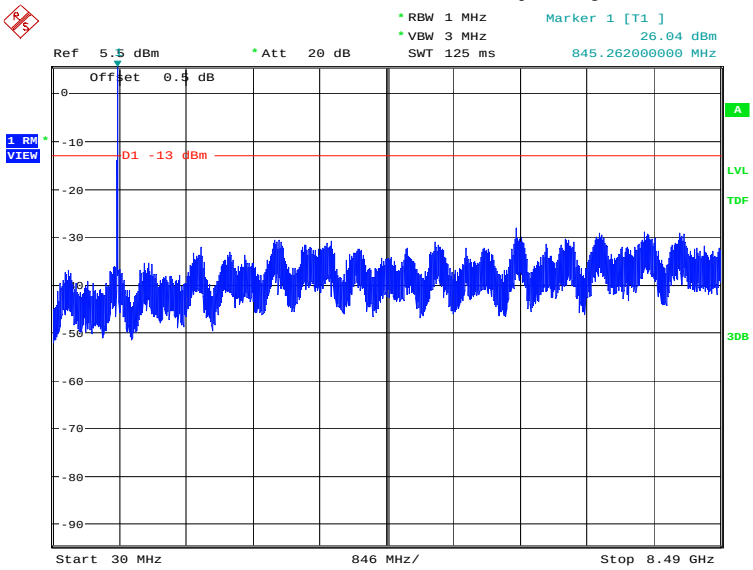


Date: 8.JAN.2019 16:45:47

Channel 4233: 30MHz –8.49GHz

Spurious emission limit –13dBm.

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



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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

WCDMA (Band II)	CH	Frequency(MHz)	PAPR(dB)
	9400	1880.0	3.56

WCDMA Band IV-QPSK

Measurement result

WCDMA (Band IV)	CH	Frequency(MHz)	PAPR(dB)
	1450	1740.0	3.33

ANNEX B: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT
Beijing
China

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

Electromagnetic Compatibility & Telecommunications

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

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

For the National Voluntary Laboratory Accreditation Program

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