TEST REPORT

No. I20Z60959-WMD04

for

OnePlus Technology (Shenzhen) Co., Ltd.

Smart Phone

Model Name: BE2028, BE2025, BE2026

FCC ID: 2ABZ2-EF170

with

Hardware Version: 16

Software Version: 10.5.5.BE88CB

Issued Date: 2020-10-29

Test Laboratory:

CTTL-Telecommunication Technology Labs, CAICT

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

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I20Z60959-WMD04	Rev.0	1st edition	2020-10-29

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

CONTENTS

1. Test Laboratory

1.1. Introduction & Accreditation

Telecommunication Technology Labs, CAICT is an ISO/IEC 17025:2017 accredited test laboratory under NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP) with lab code 600118-0, and is also an FCC accredited test laboratory (CN5017), and ISED accredited test laboratory (CN0066). The detail accreditation scope can be found on NVLAP website.

1.2. Testing Location

Location 1: CTTL(huayuan North Road)

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

1.3. Testing Environment

Normal Temperature: 15-35℃
Relative Humidity: 20-80%

1.4. Project data

Testing Start Date: 2020-07-22
Testing End Date: 2020-09-24

1.5. Signature

Dong Yuan
(Prepared this test report)

Zhang Yufeng
(Reviewed this test report)
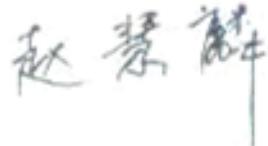
Zhao Hui Lin
Deputy Director of the laboratory
(Approved this test report)

2. Client Information

2.1. Applicant Information

Company Name:	OnePlus Technology (Shenzhen) Co., Ltd.
Address /Post:	18C02, 18C03, 18C04 and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen
Contact:	Ariel Cheng
Email:	ariel.cheng@oneplus.com
Telephone:	86 755 61898696-7023

2.2. Manufacturer Information

Company Name:	OnePlus Technology (Shenzhen) Co., Ltd.
Address /Post:	18C02, 18C03, 18C04 and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen
Contact:	Ariel Cheng
Email:	ariel.cheng@oneplus.com
Telephone:	86 755 61898696-7023

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

3.1. About EUT

Description	Smart Phone
Model	BE2028, BE2025, BE2026
FCC ID	2ABZ2-EF170
Frequency	Embedded
Antenna	Smart Phone
Extreme vol. Limits	3.45VDC to 4.45VDC (nominal: 3.87VDC)
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
UT04a	990016800072934	16	10.5.5.BE88CB	2020-07-21

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

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery

AE1

Model	BLP815
Manufacturer	Dongguan NVT Technology Co.,Ltd.
Capacity	4210mAh

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

4. Reference Documents

4.1. Documents supplied by applicant

EUT parameters, referring to Annex A for detailed information, is supplied by the client or manufacturer, which is the basis of testing.

4.2. Reference Documents for testing

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

Reference	Title	Version
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-19 Edition
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-19 Edition
ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2016
ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services	2015
KDB 971168 D01	Measurement Guidance for Certification of Licensed Digital Transmitters	v03r01

5. Laboratory Environment

Shielding chamber did not exceed following limits along the RF testing:

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. =20 %, Max. = 80 %

6. **Summary Of Test Result**

Items	List	Clause in FCC rules	Verdict
1	Output Power	22.913(a)/24.232(c)	P
2	Frequency Stability	2.1055/22.355/24.235	P
3	Occupied Bandwidth	2.1049(h)(i)	P
4	Emission Bandwidth	22.917(b)/24.238(b)	P
5	Band Edge Compliance	22.917(b)/24.238(b)	P
6	Conducted Spurious Emission	2.1057/22.917/24.238	P
7	Peak to Average Power Ratio	24.232(d)	P

Terms used in Verdict column

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

Explanation of worst-case configuration

The worst-case scenario for all measurements is based on the conducted output power measurement investigation results unless otherwise stated. The test results shown in the following sections represent the worst case emission.

7. <u>Test Equipments Utilized</u>

NO.	NAME	TYPE	SERIES NUMBER	PRODUCER	CALIBRATION INTERVAL	CAL DUE DATE
1	Spectrum Analyzer	FSV30	101576	R&S	1 Year	2021-05-07
2	Wireless Communications Test Set	8960(E5515C)	MY48360950	Agilent	1 Years	2021-09-02
3	Climatic chamber	SH-242	93008556	ESPEC	3 Years	2020-12-21

Annex A: Measurement Results

A.1 Output Power

A.1.1 Summary

During the process of testing, the EUT was controlled via Agilent Wireless Communications Test Set (8960(E5515C)) to ensure max power transmission and proper modulation.

This result is max output power conducted measurements for the EUT.

In all cases, output power is within the specified limits.

A.1.2 Method of Measurements

The EUT was set up for the max output power with pseudo random data modulation.

The power was measured with Rhode & Schwarz Spectrum Analyzer FSV30 (average).

These measurements were done at 3 frequencies, 1851.25 MHz, 1880.0 MHz and 1908.75 MHz for PCS CDMA band, 824.7MHz, 836.52MHz and 848.31MHz for CDMA 800 band (bottom, middle and top of operational frequency range) for 1x RTT and 1xEVDO .

a) Set span to at least 1.5 times the OBW.

b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.

c) Set VBW ≥ 3 × RBW.

d) Set number of points in sweep ≥ 2 × span / RBW.

e) Sweep time = auto-couple.

f) Detector = RMS (power averaging).

g) If the EUT can be configured to transmit continuously (i.e., burst duty cycle ≥ 98%), then set the trigger to free run.

h) If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98 %), then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Ensure that the sweep time is less than or equal to the transmission burst duration.

i) Trace average at least 100 traces in power averaging (i.e., RMS) mode.

j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with the band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

A1.3 Measurement results

CDMA 800

Measurement result

Channel	Frequency(MHz)	Channel power(dBm)		
		1x RTT	1xEVDO	
			Rel0	RevA
1013	824.70	24.46	24.86	24.97
384	836.52	24.49	24.96	24.95
777	848.31	24.48	24.93	24.94

CDMA 1900

Measurement result

Channel	Frequency(MHz)	Channel power(dBm)		
		1x RTT	1xEVDO	
			Rel0	RevA
25	1851.25	23.47	23.76	24.11
600	1880.00	23.98	23.80	23.90
1175	1908.75	23.90	23.89	24.27

A.2 Frequency Stability

A.2.1 Method of Measurement

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

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a "call mode". This is accomplished with the use of Agilent 8960(E5515C) Wireless Communications Test Set.

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 8960(E5515C) and in a simulated call on channel 384 for CDMA 800 and channel 600 for 1900 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 8960(E5515C) and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10℃ decrements from +50℃ to -30℃. Allow at least 1 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.

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of the lower, higher and nominal voltage. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress.

A.2.2 Measurement results

CDMA 800
Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20					
50				16.94	0.0203
40				17.73	0.0212
30				16.23	0.0194
10	3.87	824.006	848.994	16.62	0.0199
0				16.07	0.0192
-10				19.54	0.0234
-20				17.66	0.0211
-30				16.65	0.0199

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.45	20	824.006	848.994	19.17	0.0229
4.45				17.31	0.0207

CDMA 1900
Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20					
50				-4.12	0.0022
40				-5.87	0.0031
30				-6.19	0.0033
10	3.87	1850.556	1909.441	-5.53	0.0029
0				-6.48	0.0034
-10				-5.45	0.0029
-20				-9.98	0.0053
-30				-3.57	0.0019

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.45	20	1850.556	1909.441	-3.57	0.0019
4.45				-5.42	0.0029

A.3 Occupied Bandwidth

A.3.1 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 ANSI C63.26:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts.

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

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

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

CDMA 800 (99% BW)

Channel	Occupied Bandwidth (99% BW)(MHz)
1013	1.267
384	1.267
777	1.278

CDMA 800

Channel 1013-Occupied Bandwidth (99% BW)

Date: 31.JUL.2020 10:16:36
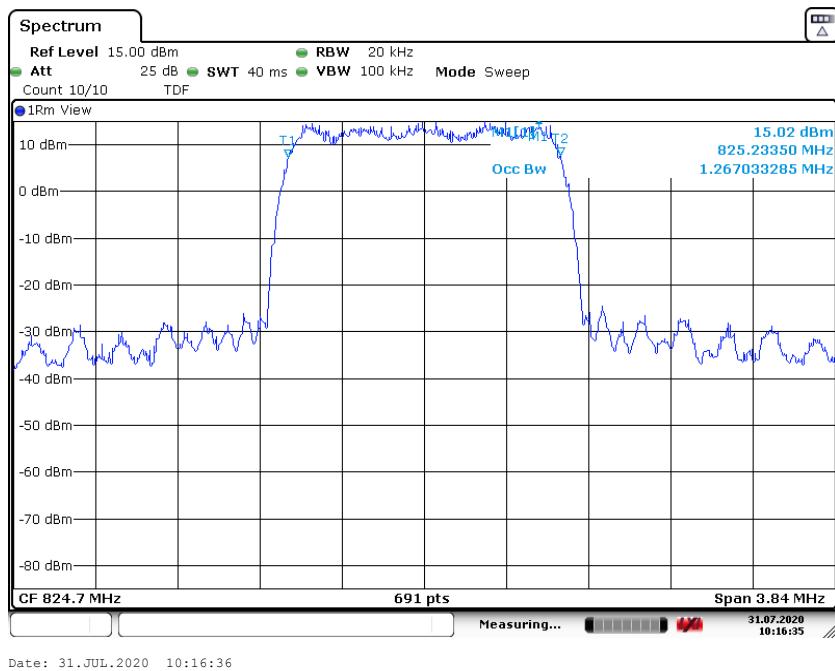
Channel 384-Occupied Bandwidth (99% BW)

Date: 31.JUL.2020 10:42:31
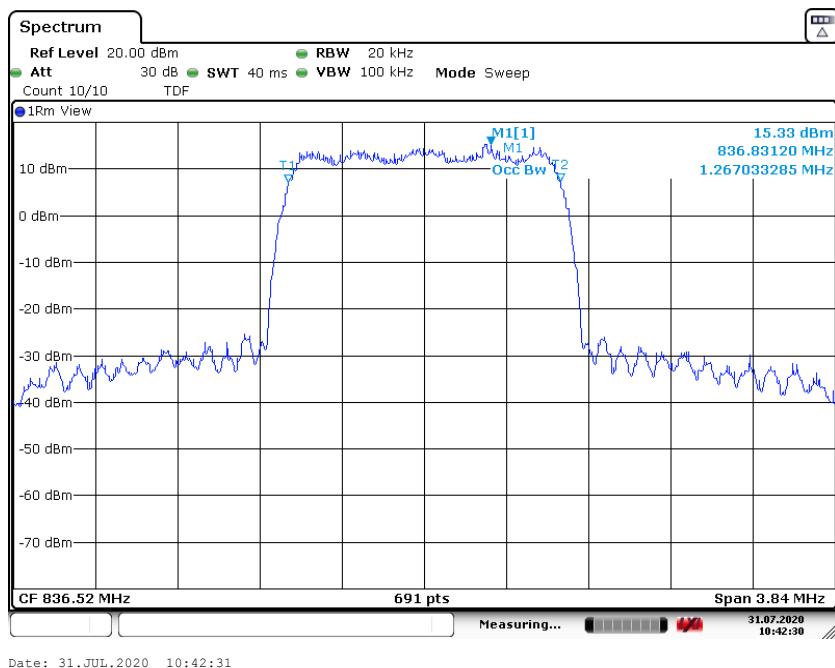
Channel 777-Occupied Bandwidth (99% BW)

Date: 31.JUL.2020 10:01:10
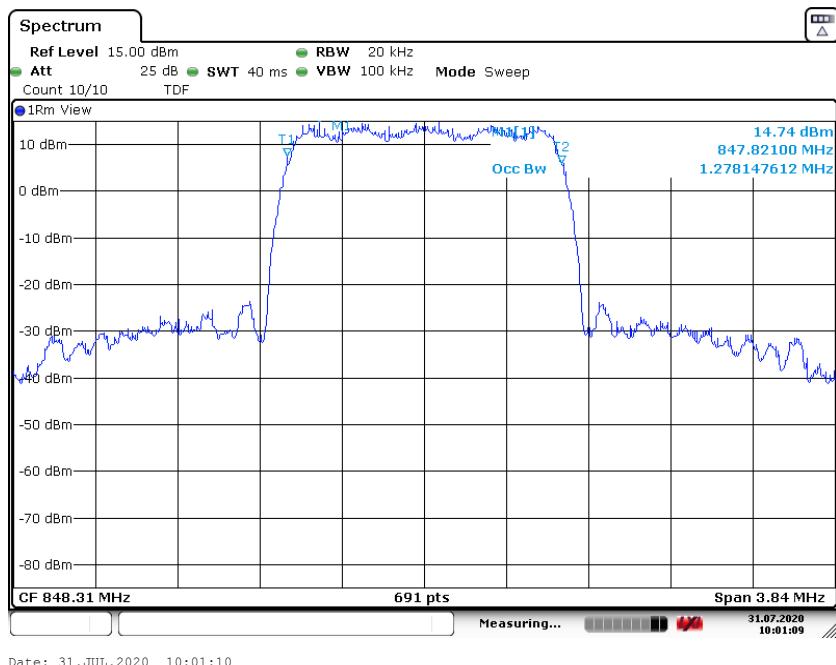
CDMA 1900 (99% BW)

Channel	Occupied Bandwidth (99% BW)(MHz)
25	1.278
600	1.273
1175	1.278

CDMA 1900

Channel 25-Occupied Bandwidth (99% BW)

Date: 31.JUL.2020 11:33:04
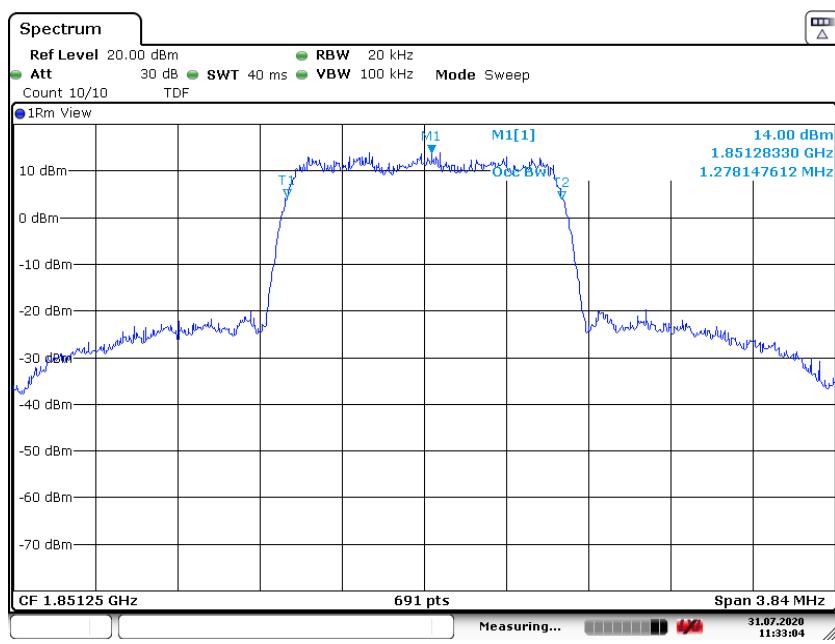
Channel 600-Occupied Bandwidth (99% BW)

Date: 31.JUL.2020 12:13:01
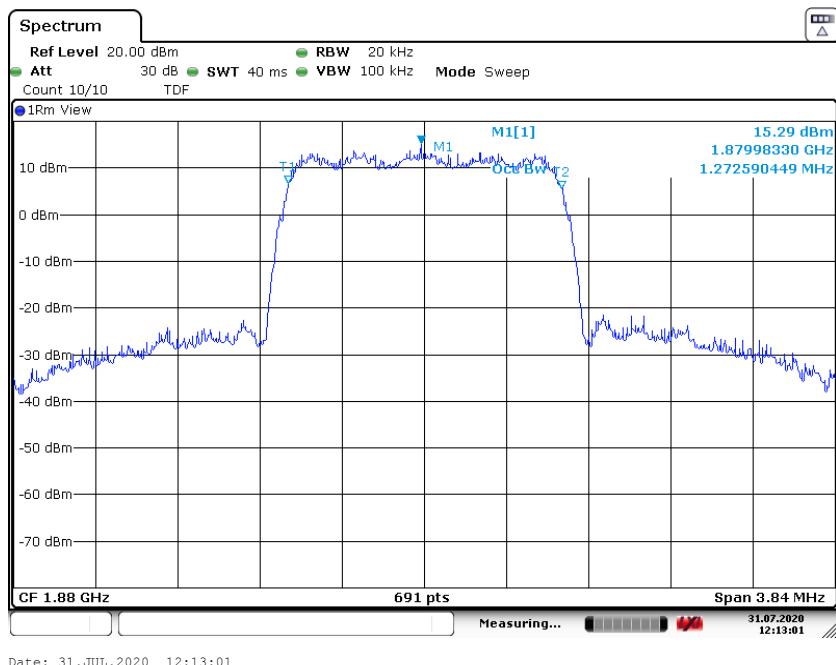
Channel 1175-Occupied Bandwidth (99% BW)

Date: 31.JUL.2020 12:02:00
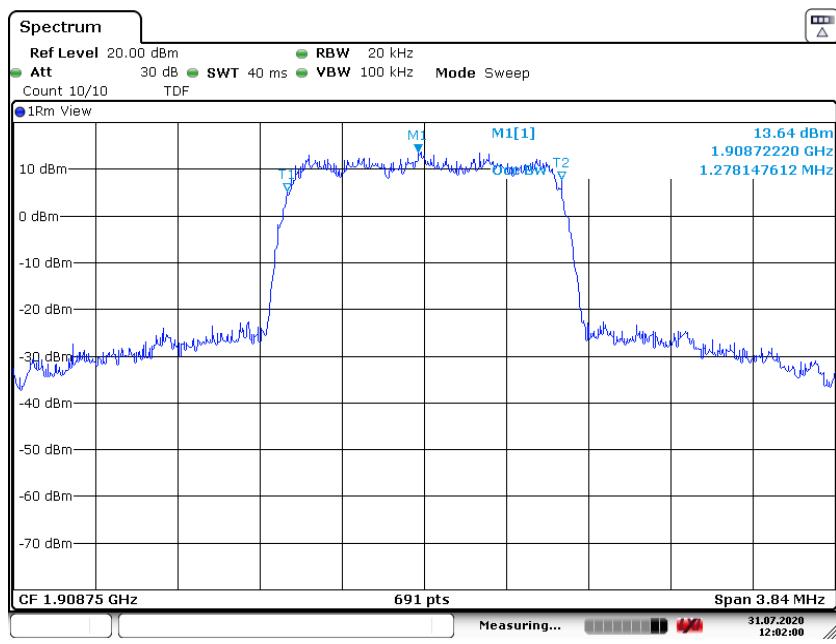
A.4 Emission Bandwidth

A.4.1Emission 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.

The measurement method is from ANSI C63.26:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts.

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

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

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

CDMA 800 (-26dBc BW)

Channel	Emission Bandwidth (-26dBc BW)(MHz)
1013	1.423
384	1.417
777	1.423

CDMA 800

Channel 1013-Emission Bandwidth (-26dBc BW)
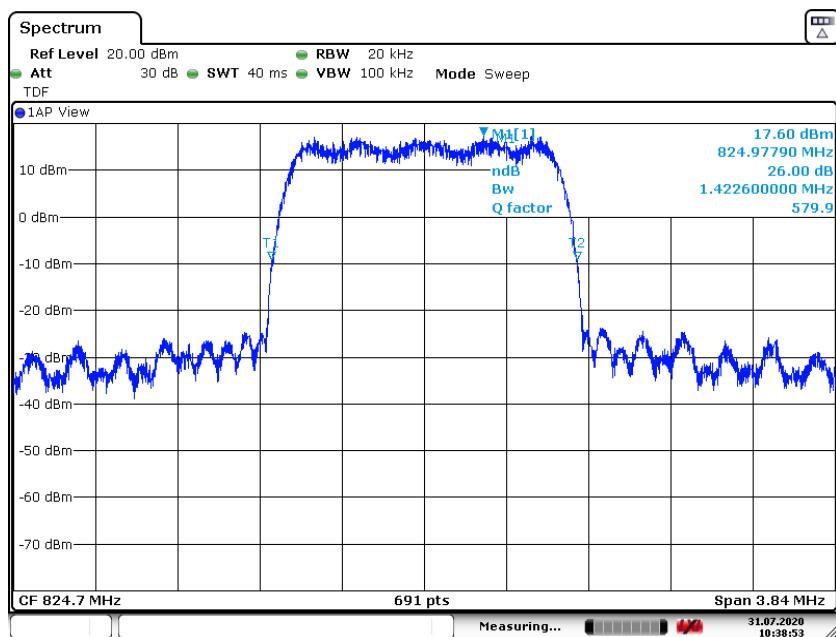
Date: 31.JUL.2020 10:38:54

Channel 384-Emission Bandwidth (-26dBc BW)

Date: 31.JUL.2020 10:40:42
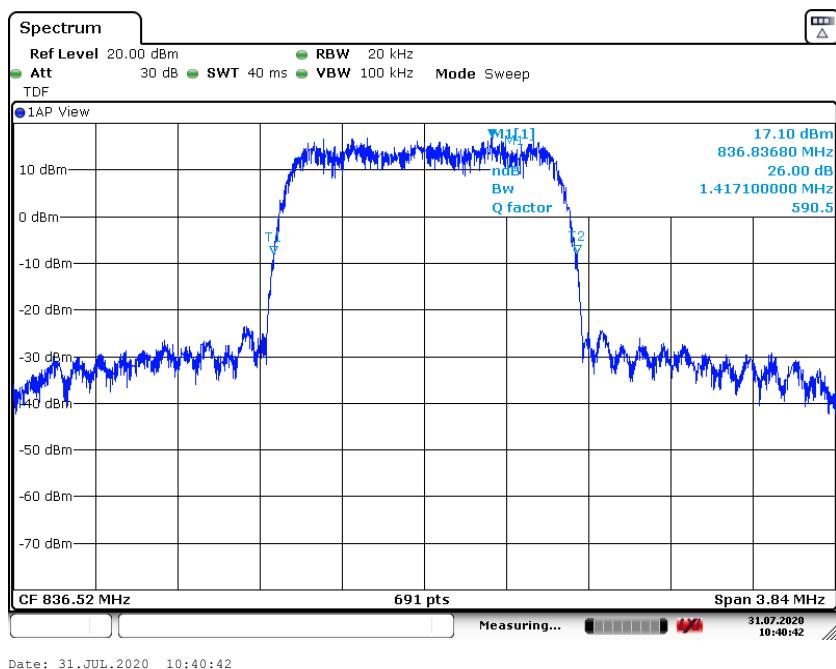
Channel 777-Emission Bandwidth (-26dBc BW)

Date: 31.JUL.2020 10:37:10
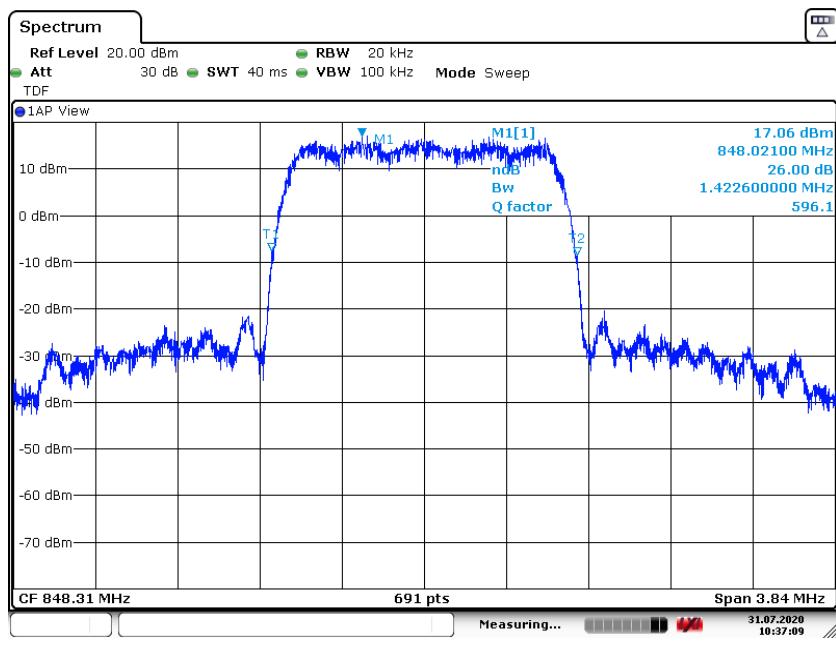
CDMA 1900 (-26dBc BW)

Channel	Emission Bandwidth (-26dBc BW)(MHz)
25	1.434
600	1.423
1175	1.423

CDMA 1900

Channel 25-Emission Bandwidth (-26dBc BW)

Date: 31.JUL.2020 11:32:11
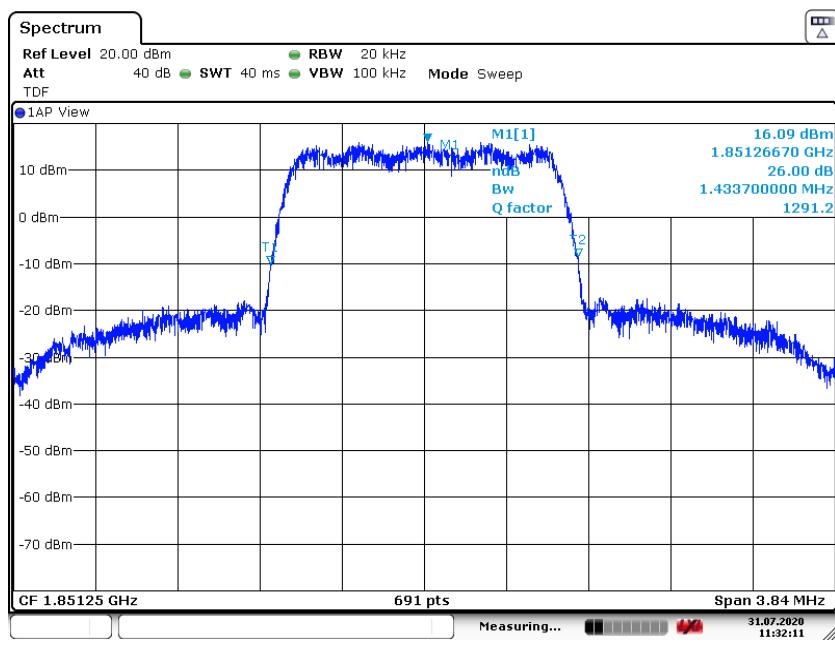
Channel 600-Emission Bandwidth (-26dBc BW)

Date: 31.JUL.2020 12:12:15
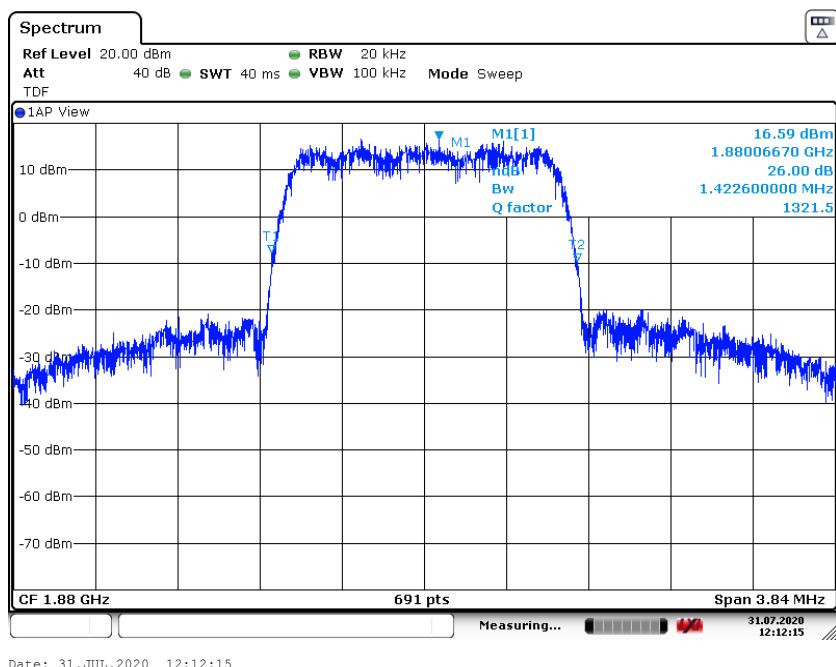
Channel 1175-Emission Bandwidth (-26dBc BW)

Date: 31.JUL.2020 12:11:13
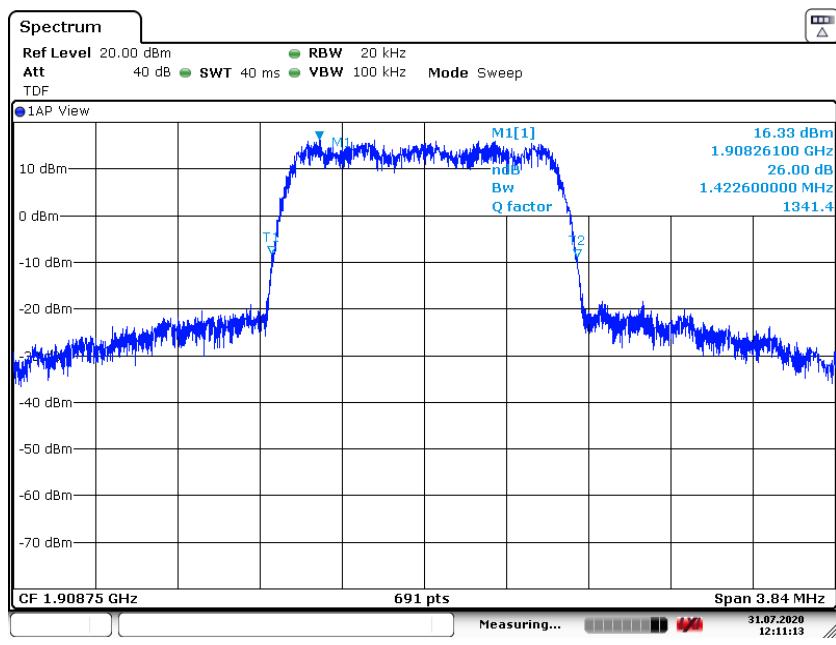
A.5 Band Edge Compliance

A.5.1 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.5.2 Measurement result

**CDMA 800**
BAND EDGE BLOCK-Channel 1013

Date: 12.AUG.2020 11:12:16
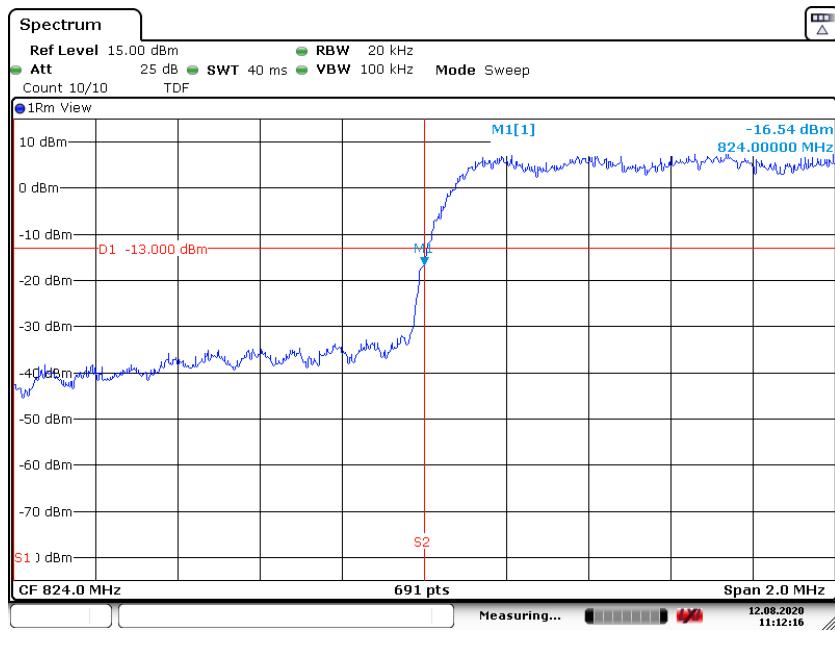
HIGH BAND EDGE BLOCK-Channel 777

Date: 31.JUL.2020 12:23:10
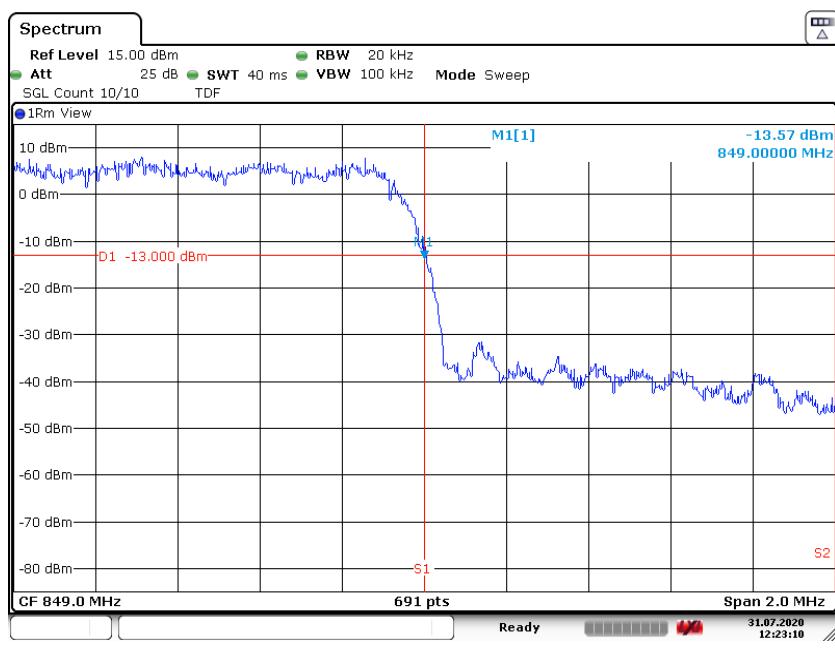
CDMA 1900
BAND EDGE BLOCK-Channel 25
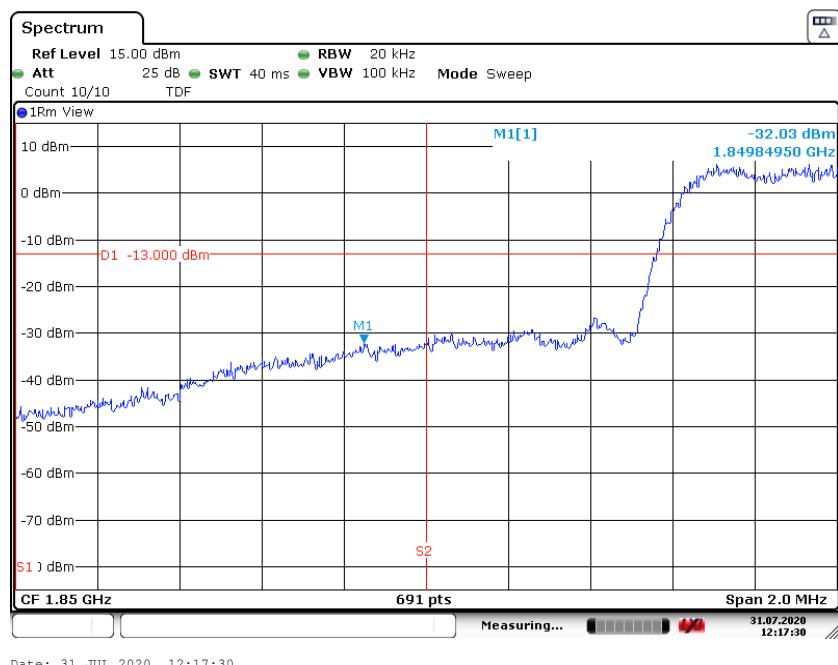
Date: 31.JUL.2020 12:17:30

HIGH BAND EDGE BLOCK-Channel 1175
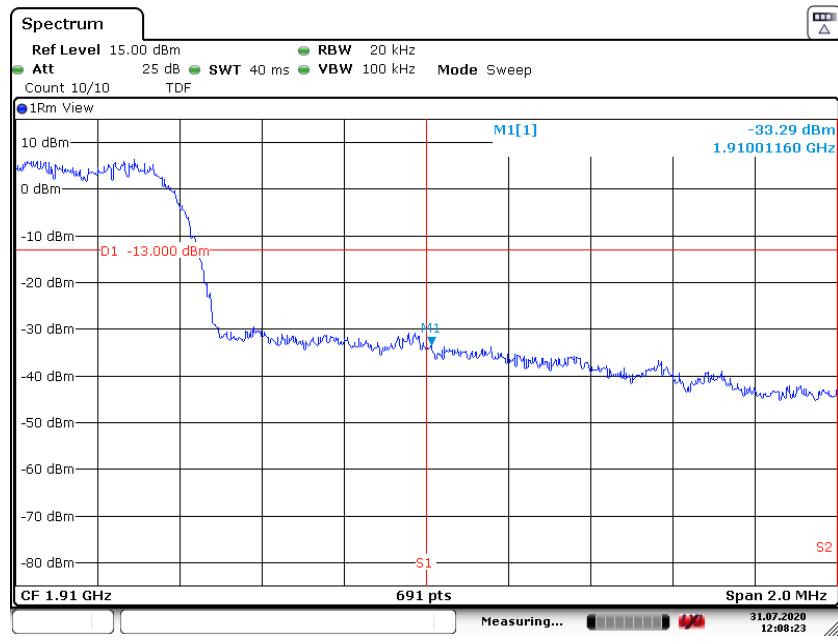
Date: 31.JUL.2020 12:08:23

A.6 Conducted Spurious Emission

A.6.1 Measurement Method

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

1. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:
   (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
   (b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.
3. The number of sweep points of spectrum analyzer is set to 30001 which is greater than span/RBW.

A.6.2 Measurement Limit

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

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

A.6.3 Measurement result

CDMA 800

**Channel 1013: 30MHz –8.49GHz**

Spurious emission limit –13dBm.

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

Date: 24.SEP.2020 17:31:07
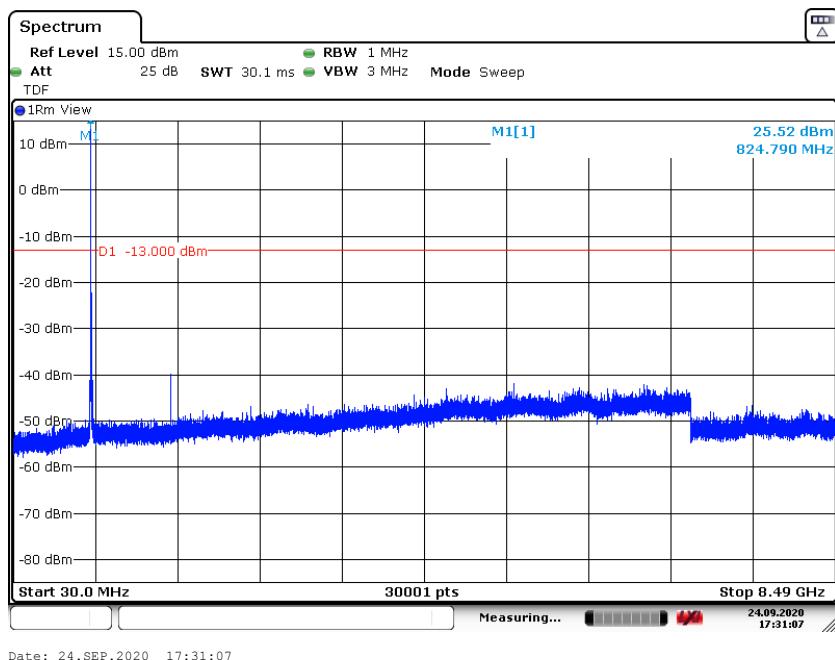
Channel 384: 30MHz –8.49GHz

Spurious emission limit –13dBm.

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

Date: 24.SEP.2020 17:27:50
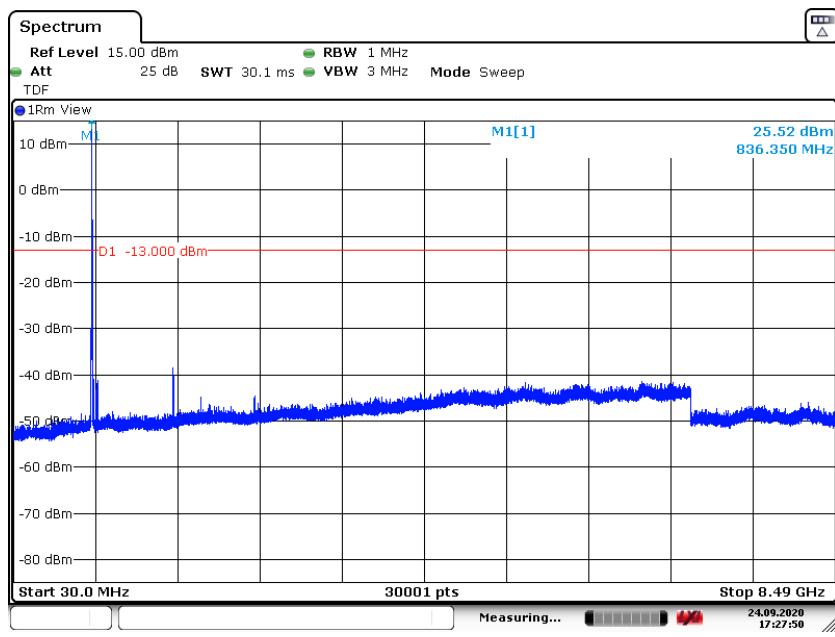
Channel 777: 30MHz –8.49GHz

Spurious emission limit –13dBm.

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

Date: 24.SEP.2020 17:29:37
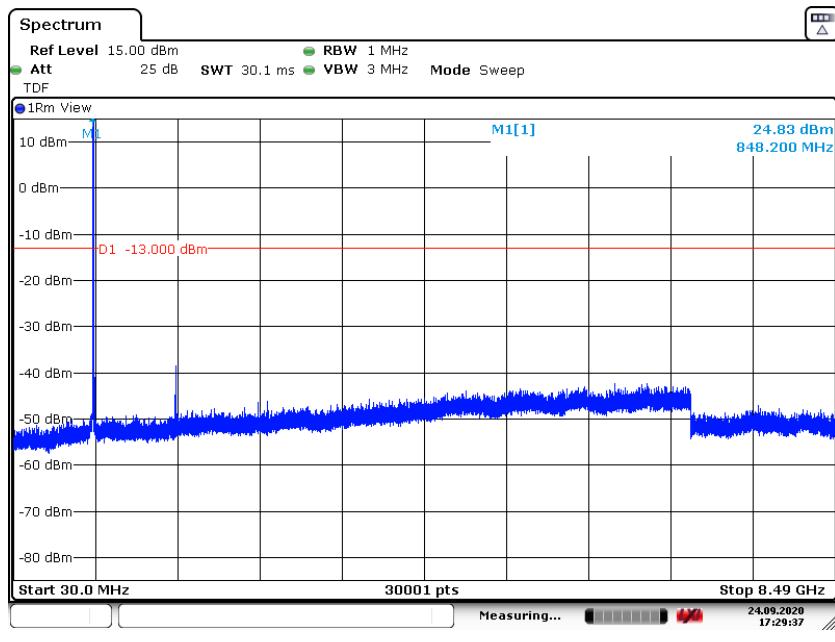
CDMA 1900

Channel 25: 30MHz –19.10GHz

Spurious emission limit –13dBm.

Date: 31.JUL.2020 11:31:07
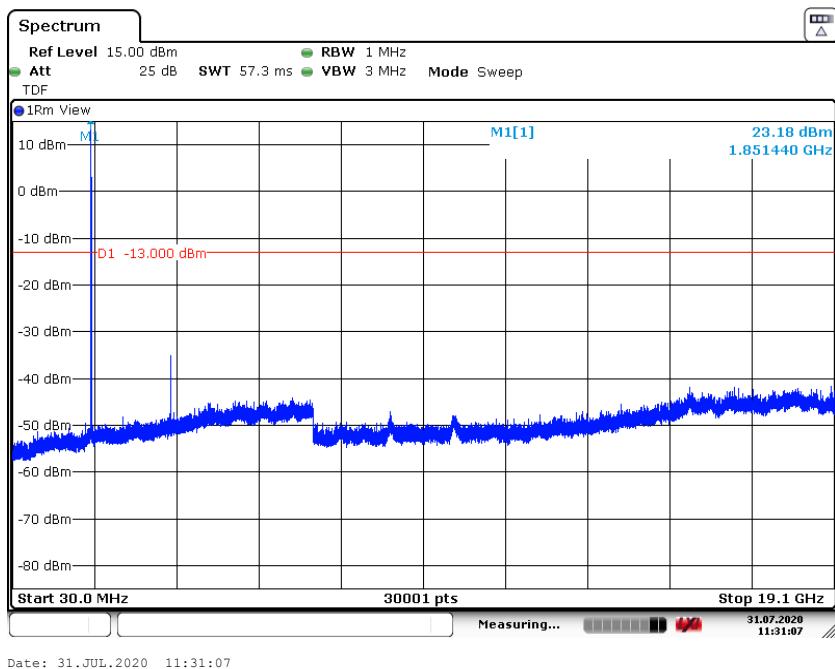
Channel 600: 30MHz –19.10GHz

Spurious emission limit –13dBm.

Date: 31.JUL.2020 12:14:19
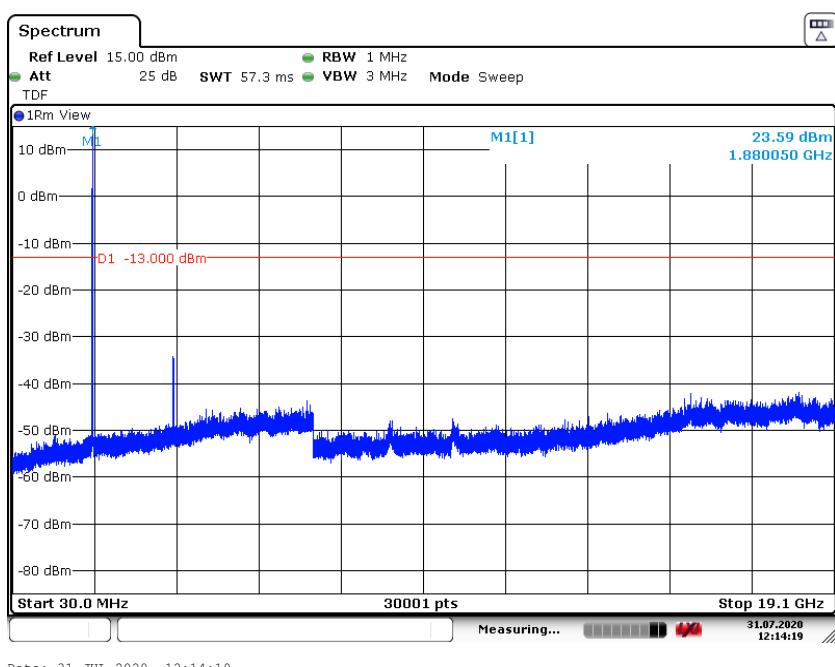
Channel 1175: 30MHz –19.10GHz

Spurious emission limit –13dBm.

Date: 31.JUL.2020 12:06:15
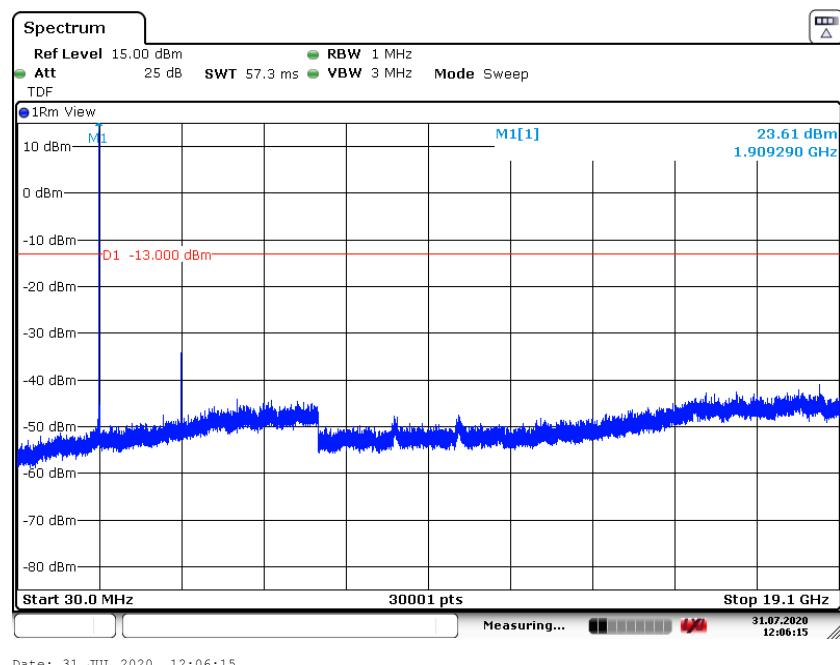
A.7 Peak-to-Average Power Ratio

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB
a)Refer to instrument's analyzer instruction manual for details on how to use the power statistics/CCDF function;
b) Set resolution/measurement bandwidth $\geq$ signal's occupied bandwidth;
c) Set the number of counts to a value that stabilizes the measured CCDF curve;
d)Record the maximum PAPR level associated with a probability of 0.1%

Measurement results
CDMA 1900
Measurement result

Channel	Frequency(MHz)	PAPR(dB)		
		1x RTT	1xEVDO	
			Rel0	RevA
600	1880.00	3.39	3.65	3.62

ANNEX B: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT
Beijing
China

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

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2020-09-29 through 2021-09-30
Effective Dates
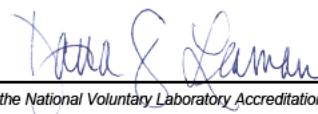
For the National Voluntary Laboratory Accreditation Program

END OF REPORT