



# TEST REPORT

## No. I21Z70555-WMD02

for

**Samsung Electronics Co., Ltd.**

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

**Model Name: SM-A032F/DS, SM-A032F**

**FCC ID: ZCasma032F**

with

**Hardware Version: REV1.0**

**Software Version: A032F.001**

**Issued Date: 2021-11-26**

**Note:**

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

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

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## **REPORT HISTORY**

<b>Report Number</b>	<b>Revision</b>	<b>Description</b>	<b>Issue Date</b>
I21Z70555-WMD02	Rev.0	1 <sup>st</sup> edition	2021-11-26

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



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## **1. Test Laboratory**

### **1.1. Introduction & Accreditation**

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

### **1.2. Testing Location**

Location 1: CTTL (huayuan North Road)

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

Location 2: CTTL(Shouxiang)

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

### 1.3. Testing Environment

Normal Temperature: 15-35°C  
Relative Humidity: 20-75%

### 1.4. Project Data

Testing Start Date: 2021-08-23  
Testing End Date: 2021-11-25

### 1.5. Signature



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Dong Yuan  
(Prepared this test report)



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Zhou Yu  
(Reviewed this test report)



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



## **2. Client Information**

### **2.1. Applicant Information**

Company Name: Samsung Electronics Co., Ltd.  
Address /Post: 19 Chapin Rd., Building D Pine Brook, NJ 07058  
Contact: Jenni Chun  
Email: j1.chun@samsung.com  
Telephone: +1-201-937-4203

### **2.2. Manufacturer Information**

Company Name: Samsung Electronics Co., Ltd.  
Address /Post: Samsung R5, Maetan dong 129, Samsung ro  
Youngtong gu, Suwon city 443 742, Korea  
Contact: Sunghoon Cho  
Email: ggobi.cho@samsung.com  
Telephone: +82-10-2722-4159

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

#### **3.1. About EUT**

Description	Multi-band GSM/WCDMA/LTE phone with Bluetooth, WLAN
Model Name	SM-A032F/DS, SM-A032F
FCC ID	ZCASMA032F
Antenna	Embedded
Output power	18.39dBm maximum ERP measured for WCDMA Band V
Extreme vol. Limits	3.65VDC to 4.4VDC (nominal: 3.85VDC)
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**

<b>EUT ID*</b>	<b>SN</b>	<b>HW Version</b>	<b>SW Version</b>	<b>Date of receipt</b>
UT14a	I2170555UT14a	REV1.0	A032F.001	2021-08-20

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

#### **3.3. Internal Identification of AE used during the test**

<b>AE ID*</b>	<b>Description</b>
AE1	Battery
AE1	
Model	Secondary Li-ion Battery
Manufacturer	Ningde Amperex Technology Limited
Capacitance	4900mAh/5000mAh

\*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.

<b>Reference</b>	<b>Title</b>	<b>Version</b>
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-20 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

**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

**Semi-anechoic chamber SAC-1** (23 meters×17meters×10meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. = 15 %, Max. = 75 %
Shielding effectiveness	0.014MHz - 1MHz, >60dB; 1MHz - 1000MHz, >90dB.
Electrical insulation	> 2 MΩ
Ground system resistance	< 4Ω
Normalised site attenuation (NSA)	< ± 4 dB, 3m/10m distance, from 30 to 1000 MHz
Site voltage standing-wave ratio ( $S_{VSWR}$ )	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

**Fully-anechoic chamber FAC-3** (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 6000 MHz

## 6. Summary Of Test Result

### WCDMA Band V

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	22.913	P
2	Emission Limit	2.1051/22.917	P
3	Frequency Stability	2.1055	BR
4	Occupied Bandwidth	2.1049	BR
5	Emission Bandwidth	22.917	BR
6	Band Edge Compliance	22.917	BR
7	Conducted Spurious Emission	22.917	BR

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. Output power was measured on QPSK and 16QAM modulations. It was found that QPSK was the worst case. All testing was performed using QPSK modulations to represent the worst case unless otherwise stated. The test results shown in the following sections represent the worst case emission.

The Equipment Under Test (EUT) model SM-A032F/DS, SM-A032F (FCC ID: ZCASMA032F) is a variant product of SM-A032M/DS, SM-A032M (FCC ID: ZCASMA032M), according to the declaration of changes provided by the applicant and FCC KDB publication 484596 D01, spot check measurements were performed on this device, all the test results are derived from test report No.I21Z70411-WMD02. Please refer Annex A for detail spot check verification data and reference data. The spot check test results are consistent with basic model.

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

## 7. Test Equipment Utilized

Description	Type	Series Number	Manufacture	Cal Due Date	Calibration Interval
Universal Radio Communication Tester	CMU200	108646	R&S	2021-12-17	1 year
Spectrum Analyzer	FSU	200030	R&S	2022-06-02	1 year
Climate chamber	SH-242	93008556	ESPEC	2023-12-23	3 years
Wireless Communication Test Set	E5515E	MY53211012	Agilent	2022-08-01	1 year
EMI Antenna	3117	00119021	ETS-Lindgren	2022-02-02	1 year
EMI Antenna	9117	167	Schwarzbeck	2022-08-19	1 year
EMI Antenna	3117	00058888	ETS-Lindgren	2021-11-30	1 year
EMI Antenna	3117	00119021	ETS-Lindgren	2022-02-02	1 year
Test Receiver	E4440A	MY48250642	Agilent	2022-03-04	1 year
Universal Radio Communication Tester	CMW500	143008	R&S	2021-12-01	1 year
EMI Antenna	VULB9163	9163-235	Schwarzbeck	2022-04-07	1 year
Signal Generator	N5183A	MY49060052	Agilent	2022-07-11	1 year
Power Amplifier	5S1G4	0341863	AR	/	/

## **Annex A: Measurement Results**

### **A.1 Output Power**

#### **A.1.1 Summary**

During the process of testing, the EUT was controlled via communication tester to ensure max power transmission and proper modulation.

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

#### **A.1.2 Conducted**

##### **A.1.2.1 Method of Measurements**

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

These measurements were done at 3 frequencies (bottom, middle and top of operational frequency range) for each bandwidth.

##### **A.1.2.2 Measurement Result**

#### **WCDMA Band V**

##### **QPSK**

	CH	Frequency (MHz)	output power (dBm)
WCDMA (Band V)	4132	826.4	23.29
	4183	836.6	23.31
	4233	846.6	23.37

##### **16QAM**

	CH	Frequency (MHz)	output power (dBm)
WCDMA (Band V)	4132	826.4	23.15
	4183	836.6	22.93
	4233	846.6	22.80

### A.1.3 Radiated

#### A.1.3.1 Description

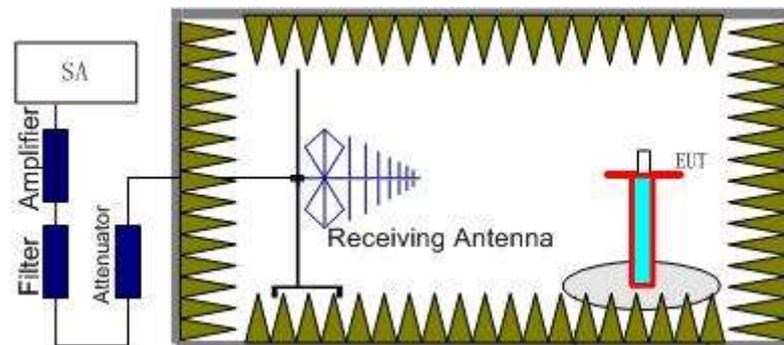
This is the test for the maximum radiated power from the EUT.

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

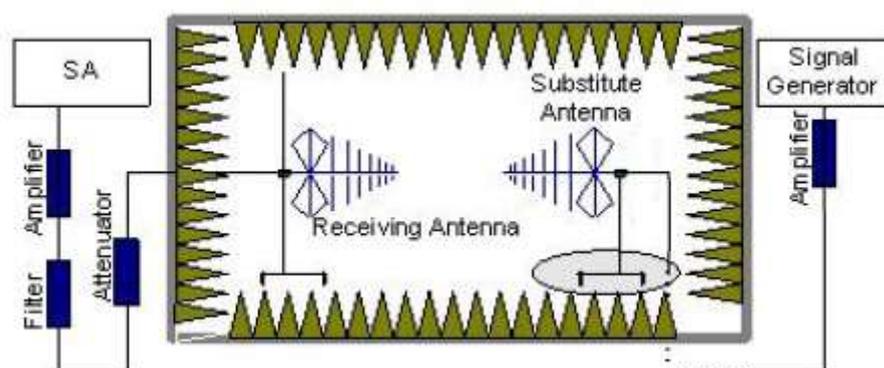
#### A.1.3.2 Method of Measurement

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 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 rms 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 ( $P_r$ ).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, a 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 substitution antenna and adjusts 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. An amplifier should be connected to the Signal Source output port. And the cable should be connected 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,  $ERP = EIRP - 2.15\text{dBi}$ .

**Spot Check Measurement Results:**
**WCDMA Band V-ERP**
**Limits**

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

**Measurement result-QPSK**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
826.40	-24.37	2.25	45.76	0.93	2.15	17.92	38.45	20.53	H
836.60	-23.83	2.26	45.66	0.82	2.15	18.24	38.45	20.21	H
846.60	-24.38	2.26	45.56	0.81	2.15	17.58	38.45	20.87	H

**Measurement result-16QAM**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
826.40	-24.36	2.25	45.76	0.93	2.15	17.93	38.45	20.52	H
836.60	-23.83	2.26	45.66	0.82	2.15	18.24	38.45	20.21	H
846.60	-24.35	2.26	45.56	0.81	2.15	17.61	38.45	20.84	H

**Reference Measurement Results from basic model:**

**WCDMA Band V-ERP**

**Limits**

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

**Measurement result**

**QPSK**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
826.40	-24.38	2.25	45.76	0.93	2.15	17.91	38.45	20.54	H
836.60	-23.72	2.26	45.66	0.82	2.15	18.35	38.45	20.10	H
846.60	-24.04	2.26	45.56	0.81	2.15	17.92	38.45	20.53	H

**16QAM**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	P <sub>cl</sub> (dB)	P <sub>Ag</sub> (dB)	G <sub>a</sub> (dBi)	Correction (dB)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
826.40	-24.35	2.25	45.76	0.93	2.15	17.94	38.45	20.51	H
836.60	-23.68	2.26	45.66	0.82	2.15	18.39	38.45	20.06	H
846.60	-24.06	2.26	45.56	0.81	2.15	17.90	38.45	20.55	H

Frequency: 836.60MHz

$$\text{Peak EIRP (dBm)} = P_{\text{Mea}}(-23.68) - P_{\text{cl}}(2.26\text{dB}) + P_{\text{Ag}}(45.66\text{dB}) + G_{\text{a}}(0.82\text{dB}) = 18.39\text{dBm}$$

## A.2 Emission Limit

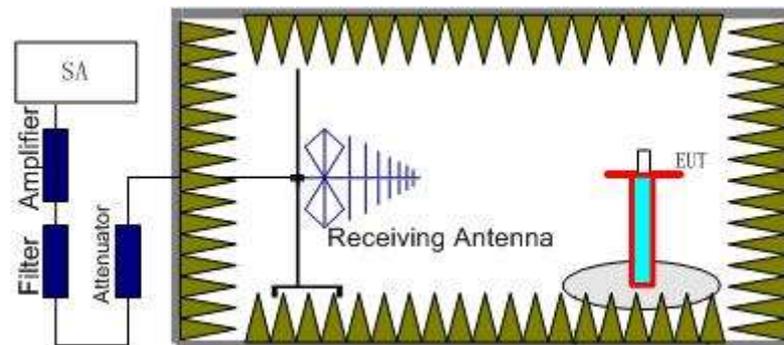
### **A.2.1 Measurement Method**

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

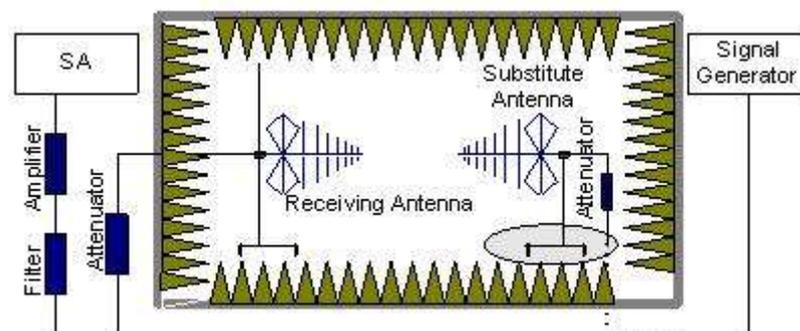
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of WCDMA Band 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 ( $P_r$ ).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, a 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

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:

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

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,  $ERP = EIRP - 2.15\text{dBi}$ .

### **A.2.2 Measurement Limit**

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

### **A.2.3 Measurement Results**

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of 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 V 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.

All mode of operation were investigated and the worst case configuration results are reported in this section. The range of evaluated frequency is from 9 kHz to 20GHz. Measurement value show only up to 6 maximum emissions noted.

#### A.2.4 Measurement Results Table

Frequency	Channel	Frequency Range	Result
WCDMA Band V	Low	9KHz -10GHz	Pass
	Middle	9KHz -10GHz	Pass
	High	9KHz -10GHz	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

**Spot Check Measurement Results:**
**WCDMA BAND V Mode Channel 4132/826.4MHz**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1629.01	-58.90	3.55	5.27	2.15	-59.33	-13.00	46.33	V
2476.00	-52.46	4.60	6.03	2.15	-53.18	-13.00	40.18	V
3285.02	-54.93	5.28	7.68	2.15	-54.68	-13.00	41.68	V
4138.02	-50.12	6.07	9.04	2.15	-49.30	-13.00	36.30	H
4959.01	-54.37	6.67	9.86	2.15	-53.33	-13.00	40.33	H
5787.01	-53.35	7.21	10.54	2.15	-52.17	-13.00	39.17	V

**WCDMA BAND V Mode Channel 4183/836.6MHz**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1683.01	-59.67	3.59	5.17	2.15	-60.24	-13.00	47.24	V
2508.00	-53.33	4.63	6.11	2.15	-54.00	-13.00	41.00	V
3356.02	-53.62	5.32	7.85	2.15	-53.24	-13.00	40.24	H
4180.02	-49.67	6.16	9.08	2.15	-48.90	-13.00	35.90	H
5018.01	-54.23	6.57	9.93	2.15	-53.02	-13.00	40.02	V
5853.01	-53.00	7.24	10.53	2.15	-51.86	-13.00	38.86	V

**WCDMA BAND V Mode Channel 4233/846.6MHz**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1692.01	-56.42	3.59	5.15	2.15	-57.01	-13.00	44.01	H
2536.00	-51.45	4.66	6.16	2.15	-52.10	-13.00	39.10	H
3385.02	-53.31	5.35	7.92	2.15	-52.89	-13.00	39.89	H
4237.02	-49.89	6.25	9.14	2.15	-49.15	-13.00	36.15	H
5100.01	-53.91	6.77	10.04	2.15	-52.79	-13.00	39.79	V
5957.01	-53.03	7.47	10.51	2.15	-52.14	-13.00	39.14	H

**Reference Measurement Results from basic model:**
**WCDMA BAND V Mode Channel 4132/826.4MHz**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1648.01	-59.52	3.56	5.23	2.15	-60.00	-13.00	47.00	V
2461.00	-54.01	4.58	5.98	2.15	-54.76	-13.00	41.76	V
3313.02	-54.76	5.29	7.75	2.15	-54.45	-13.00	41.45	V
4133.02	-52.44	6.05	9.03	2.15	-51.61	-13.00	38.61	H
4933.01	-54.65	6.72	9.83	2.15	-53.69	-13.00	40.69	H
5774.01	-53.68	7.23	10.55	2.15	-52.51	-13.00	39.51	H

**WCDMA BAND V Mode Channel 4183/836.6MHz**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1684.01	-59.39	3.59	5.17	2.15	-59.96	-13.00	46.96	V
2522.00	-48.72	4.65	6.14	2.15	-49.38	-13.00	36.38	H
3340.02	-54.61	5.31	7.82	2.15	-54.25	-13.00	41.25	H
4180.02	-50.61	6.16	9.08	2.15	-49.84	-13.00	36.84	V
5006.01	-53.57	6.59	9.91	2.15	-52.40	-13.00	39.40	V
5852.01	-53.69	7.24	10.53	2.15	-52.55	-13.00	39.55	V

**WCDMA BAND V Mode Channel 4233/846.6MHz**

Frequency (MHz)	P <sub>Mea</sub> (dBm)	Path Loss(dB)	Antenna Gain(dBi)	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polarization
1695.01	-58.99	3.60	5.15	2.15	-59.59	-13.00	46.59	H
2527.00	-49.56	4.65	6.15	2.15	-50.21	-13.00	37.21	H
3409.02	-55.22	5.37	7.98	2.15	-54.76	-13.00	41.76	H
4242.02	-52.27	6.25	9.14	2.15	-51.53	-13.00	38.53	H
5084.01	-53.24	6.73	10.02	2.15	-52.10	-13.00	39.10	V
5922.01	-52.52	7.46	10.52	2.15	-51.61	-13.00	38.61	H

Note: Expanded measurement uncertainty is U = 5.16 dB, k = 2.

## **A.3 Frequency Stability**

### **A.3.1 Method of Measurement**

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

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a "call mode". This is accomplished with the use of CMU200.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30°C.
3. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on mid channel of each band, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments remeasuring carrier frequency at each voltage. Pause at nominal voltage for 1.5 hours unpowered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +50°C.
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 +50°C to -30°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

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

### A.3.2 Measurement results

#### WCDMA Band V QPSK

#### Frequency Error vs Temperature

Temperature(°C)	Voltage(V)	F <sub>L</sub> (MHz)	F <sub>H</sub> (MHz)	Offset(Hz)	Frequency error(ppm)
20	3.85	824.136	848.880		
50				10.36	0.0124
40				2.33	0.0028
30				-2.20	0.0026
10				10.04	0.0120
0				-0.21	0.0003
-10				15.06	0.0180
-20				14.01	0.0167
-30				14.01	0.0167

#### Frequency Error vs Voltage

Voltage(V)	Temperature(°C)	F <sub>L</sub> (MHz)	F <sub>H</sub> (MHz)	Offset(Hz)	Frequency error(ppm)
3.65	20	824.136	848.880	15.96	0.0191
4.40				13.87	0.0166

#### **A.4 Occupied Bandwidth**

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

The measurement method is from ANSI C63.26:

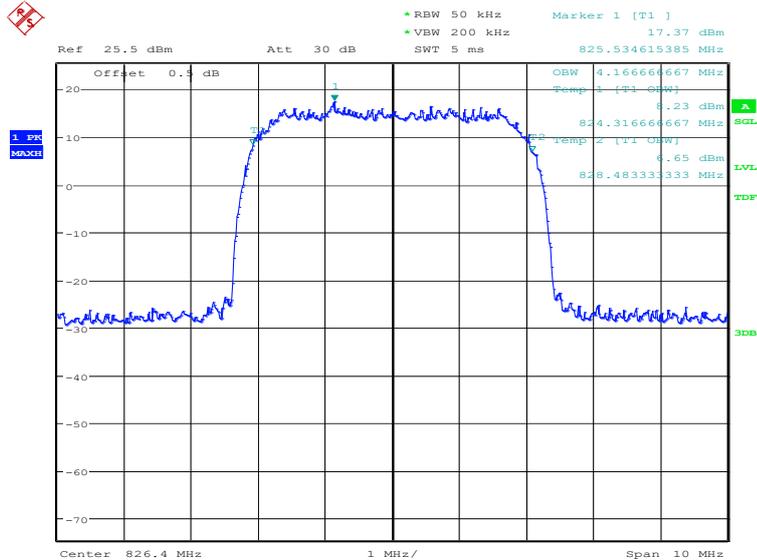
- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts.
- b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set  $\geq 3 \times$  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.

### WCDMA Band V (99%)-QPSK

Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
826.4	4166.67
836.6	4182.69
846.6	4166.67

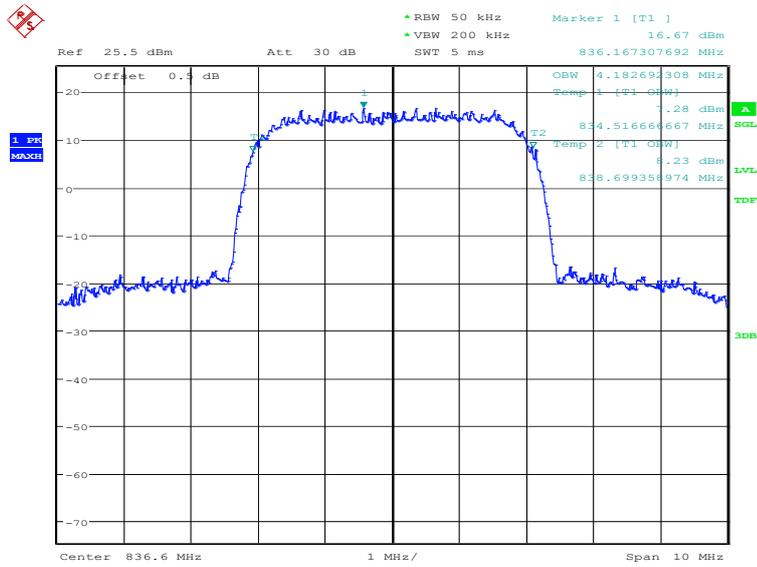
### WCDMA Band V (99%)

#### Channel 4132-Occupied Bandwidth (99% BW)



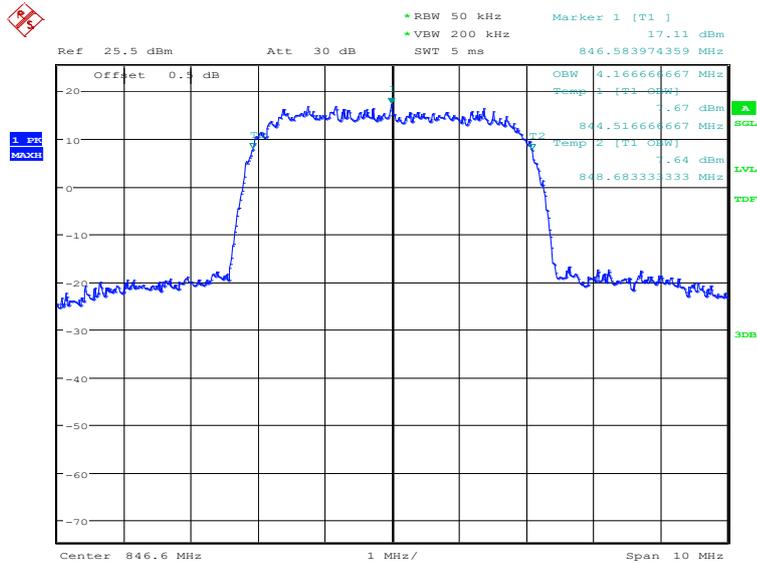
Date: 23.AUG.2021 17:59:46

### Channel 4183-Occupied Bandwidth (99% BW)



Date: 23.AUG.2021 18:00:13

### Channel 4233-Occupied Bandwidth (99% BW)



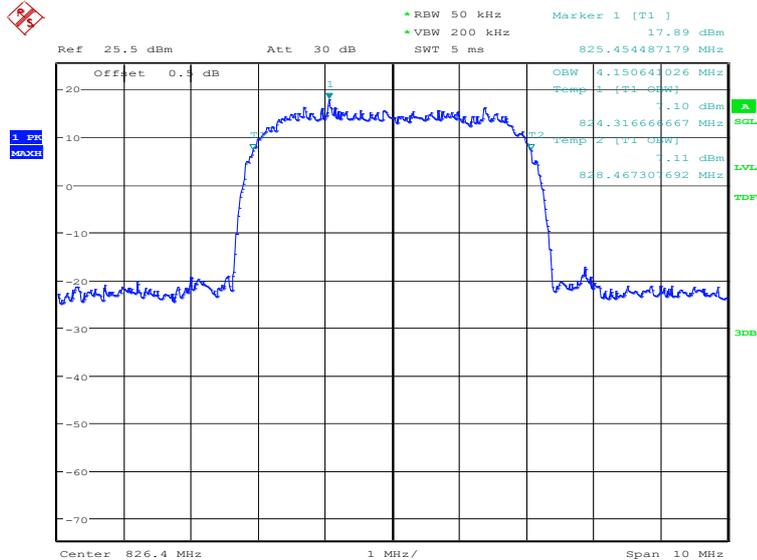
Date: 23.AUG.2021 18:00:40

### WCDMA Band V (99%)-16QAM

Frequency (MHz)	Occupied Bandwidth (99%)(kHz)
826.4	4150.64
836.6	4166.67
846.6	4166.67

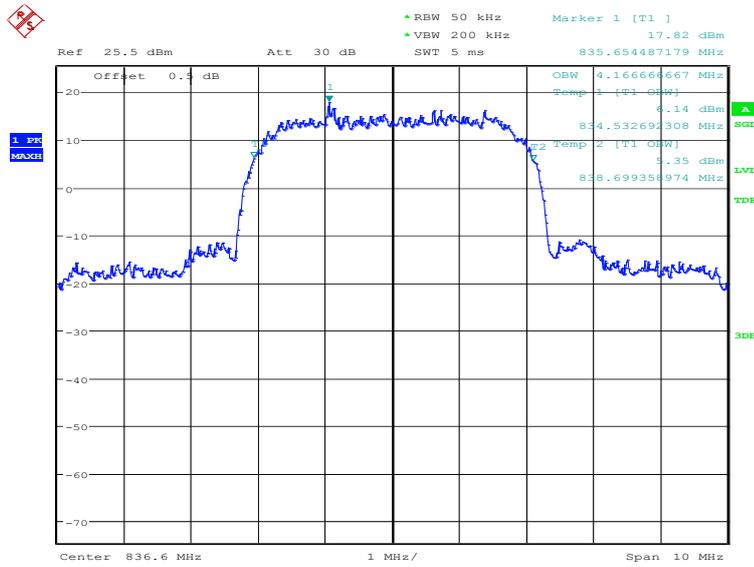
### WCDMA Band V (99%)

#### Channel 4132-Occupied Bandwidth (99% BW)



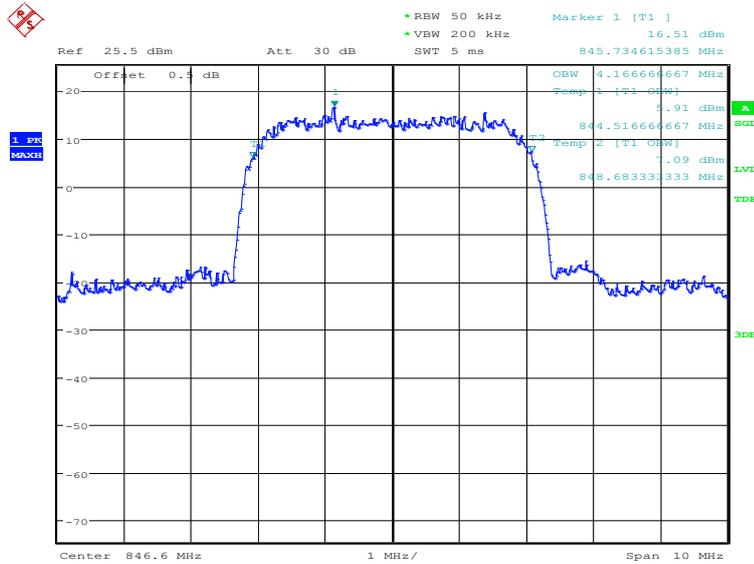
Date: 15.SEP.2021 10:35:49

### Channel 4183-Occupied Bandwidth (99% BW)



Date: 15.SEP.2021 10:36:16

### Channel 4233-Occupied Bandwidth (99% BW)



Date: 15.SEP.2021 10:36:43

## **A.5 Emission Bandwidth**

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

The measurement method is from ANSI C63.26:

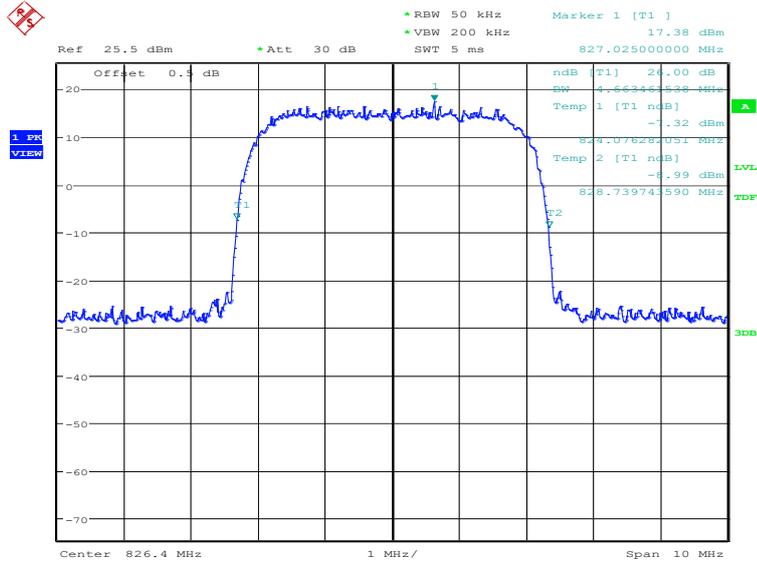
- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.
- b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set  $\geq 3 \times$  RBW.
- c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.
- d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target “-X dB” requirement, i.e., if the requirement calls for measuring the -26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.
- e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

### WCDMA Band V-QPSK (-26dBc)

Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
826.40	4663.46
836.60	4695.51
846.60	4711.54

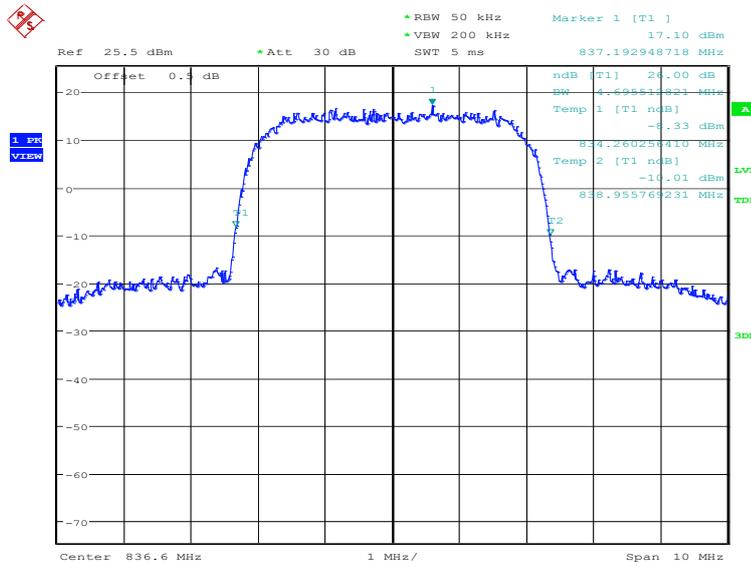
### WCDMA Band V (-26dBc)

#### Channel 4132-Emission Bandwidth (-26dBc BW)



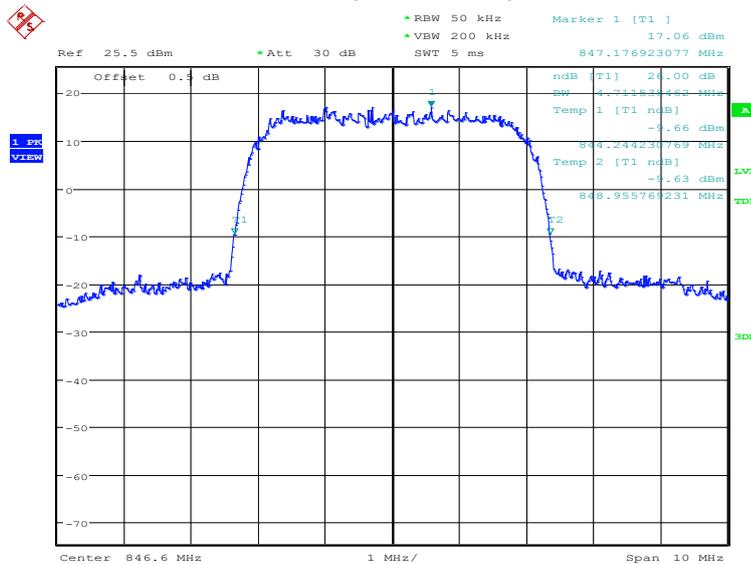
Date: 23.AUG.2021 18:05:56

### Channel 4183-Emission Bandwidth (-26dBc BW)



Date: 23.AUG.2021 18:06:23

### Channel 4233-Emission Bandwidth (-26dBc BW)



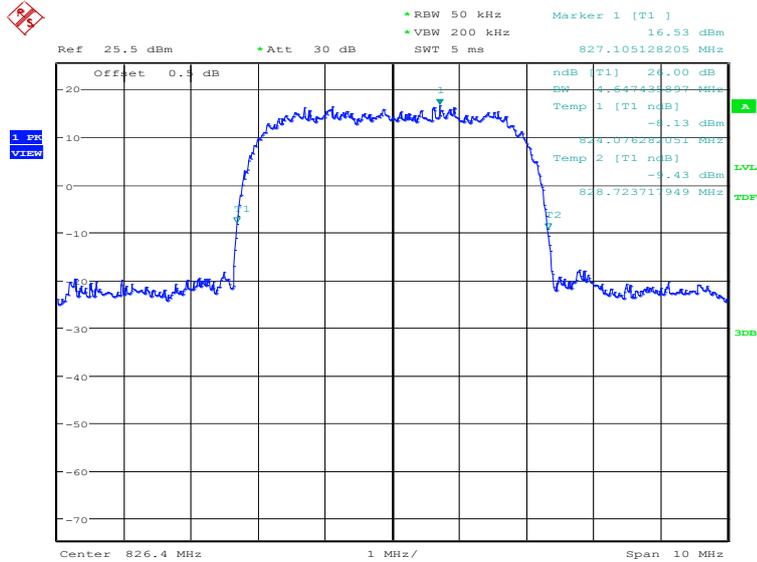
Date: 23.AUG.2021 18:06:50

### WCDMA Band V-16QAM (-26dBc)

Frequency (MHz)	Emission Bandwidth (-26dBc)(kHz)
826.40	4647.44
836.60	4663.46
846.60	4631.41

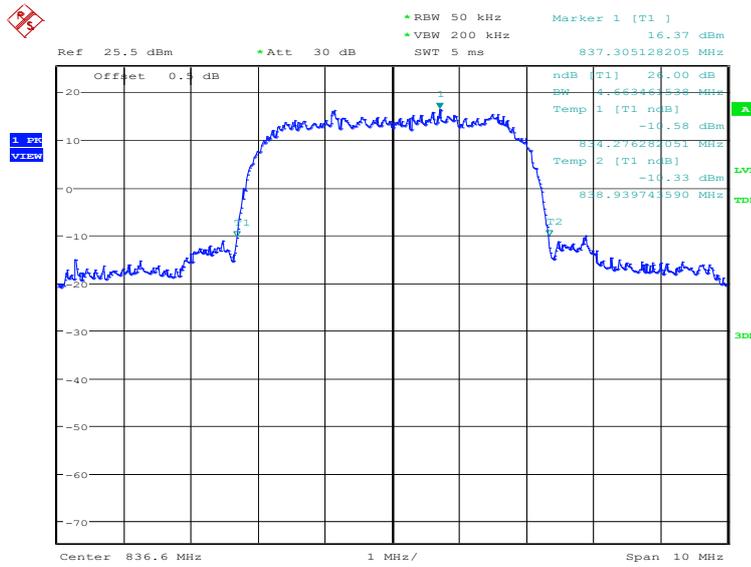
### WCDMA Band V (-26dBc)

#### Channel 4132-Emission Bandwidth (-26dBc BW)



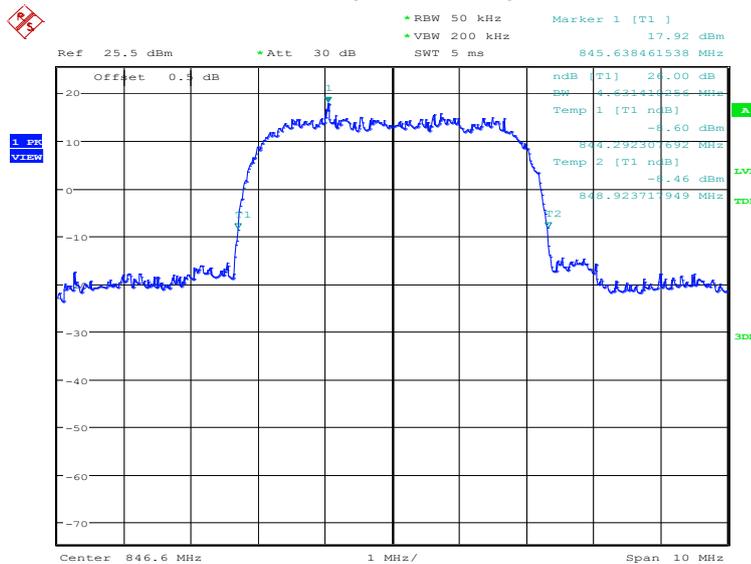
Date: 15.SEP.2021 10:42:43

### Channel 4183-Emission Bandwidth (-26dBc BW)



Date: 15.SEP.2021 10:43:10

### Channel 4233-Emission Bandwidth (-26dBc BW)



Date: 15.SEP.2021 10:43:37

## **A.6 Band Edge Compliance**

### **A.6.1 Measurement limit**

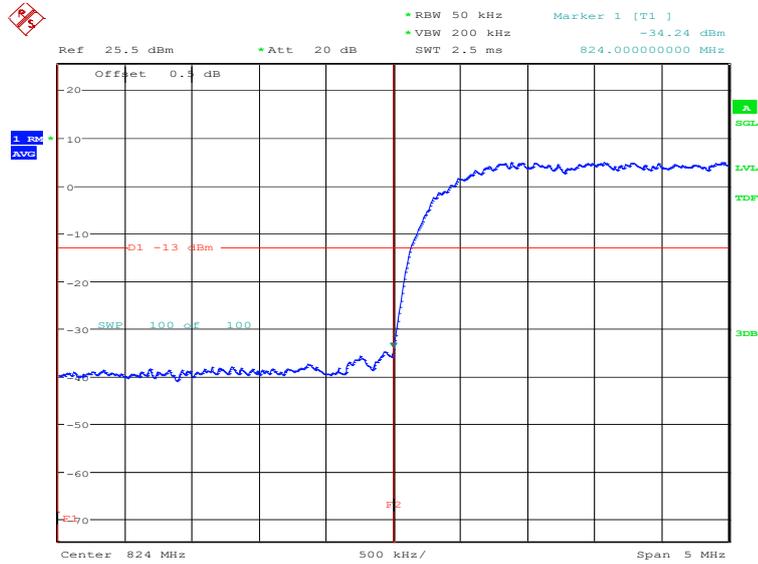
Part 22.917 specifies that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

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

### A.6.2 Measurement result

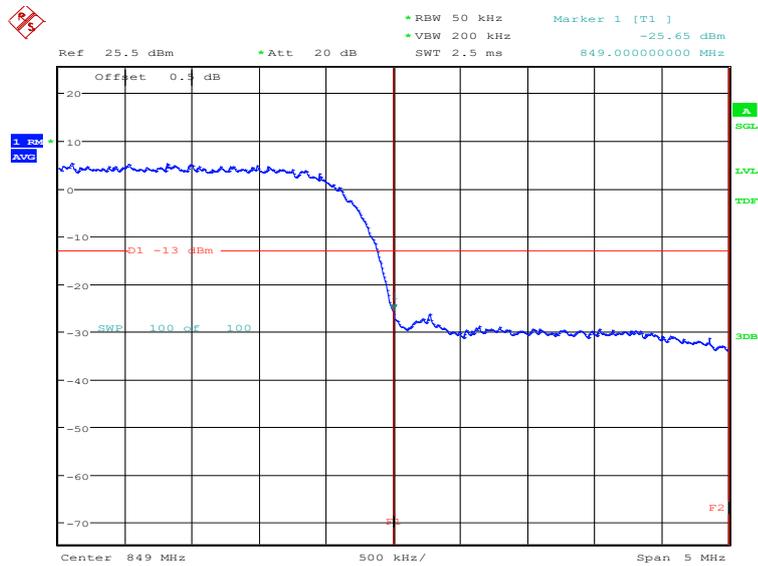
#### WCDMA Band V-QPSK

#### Channel 4132



Date: 23.AUG.2021 18:14:11

#### Channel 4233



Date: 23.AUG.2021 18:15:25

## **A.7 Conducted Spurious Emission**

### **A.7.1 Measurement Method**

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

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

### **A. 7.2 Measurement Limit**

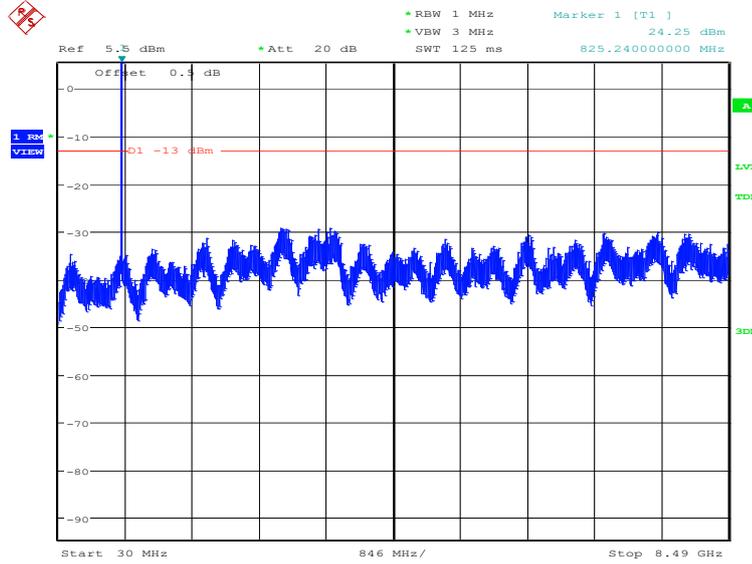
Part 22.917 specifies that the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

### A.7.3 Measurement result

#### WCDMA Band V

#### Channel 4132: 30MHz –8.49GHz

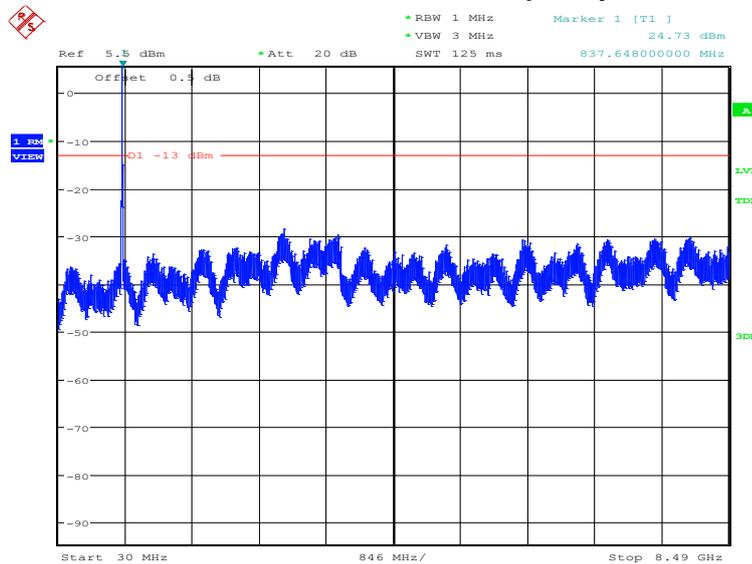
NOTE: peak above the limit line is the carrier frequency.



Date: 23.AUG.2021 18:21:54

#### Channel 4183: 30MHz –8.49GHz

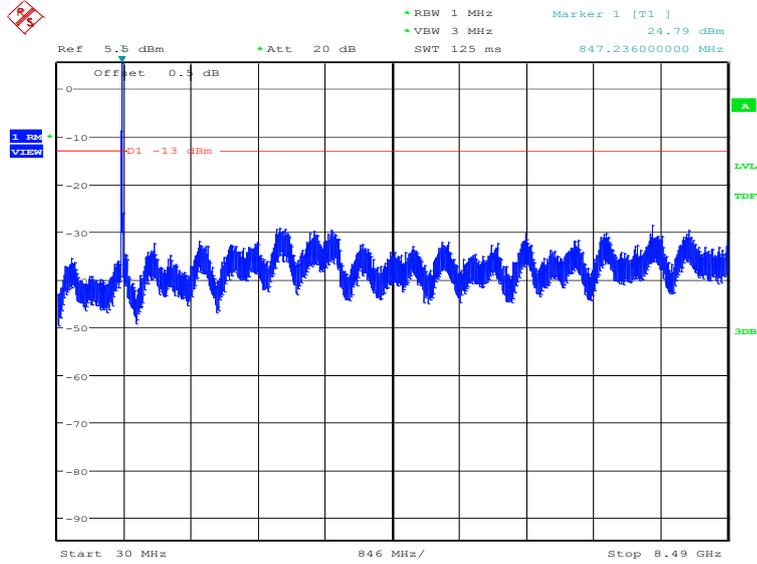
NOTE: peak above the limit line is the carrier frequency.



Date: 23.AUG.2021 18:22:24

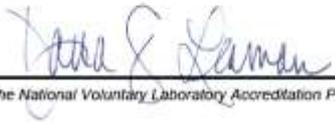
### Channel 4233: 30MHz –8.49GHz

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



Date: 23.AUG.2021 18:22:54

## Annex B: Accreditation Certificate

<p>United States Department of Commerce National Institute of Standards and Technology</p>  	
<hr/> <b>Certificate of Accreditation to ISO/IEC 17025:2017</b> <hr/>	
NVLAP LAB CODE: 600118-0	
<b>Telecommunication Technology Labs, CAICT</b> Beijing China	
<i>is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:</i>	
<b>Electromagnetic Compatibility &amp; Telecommunications</b>	
<i>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).</i>	
2021-09-29 through 2022-09-30 Effective Dates	  For the National Voluntary Laboratory Accreditation Program

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