

FCC Test Report

(Part 22 – GSM, WCDMA Band 5, LTE Band 5)

Report No.: RF210105C01-5

FCC ID: PZWBHTM70QWG

Test Model: BHT-M70-QWG

Received Date: Dec. 29, 2020

Test Date: Dec. 29, 2020 ~ Sep. 02, 2021

Issued Date: Sep. 29, 2021

Applicant: DENSO WAVE INCORPORATED

Address: 1 Yoshiike Kusagi Agui-cho, Chita-gun Aichi 470-2297, Japan

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lin Kou Laboratories

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location: No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City
33383, Taiwan

**FCC Registration /
Designation Number:** 788550 / TW0003



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification.

Table of Contents

Release Control Record	4
1 Certificate of Conformity.....	5
2 Summary of Test Results	6
2.1 Measurement Uncertainty	6
2.2 Test Site and Instruments.....	7
3 General Information.....	9
3.1 General Description of EUT	9
3.2 Configuration of System under Test.....	11
3.2.1 Description of Support Units.....	12
3.3 Test Mode Applicability and Tested Channel Detail	13
3.4 EUT Operating Conditions	17
3.5 General Description of Applied Standards and References	17
4 Test Types and Results	18
4.1 Output Power Measurement	18
4.1.1 Limits of Output Power Measurement.....	18
4.1.2 Test Procedures.....	18
4.1.3 Test Setup.....	18
4.1.4 Test Results	19
4.2 Modulation Characteristics Measurement.....	25
4.2.1 Limits of Modulation Characteristics.....	25
4.2.2 Test Procedure	25
4.2.3 Test Setup.....	25
4.2.4 Test Results	26
4.3 Frequency Stability Measurement	28
4.3.1 Limits of Frequency Stability Measurement	28
4.3.2 Test Procedure	28
4.3.3 Test Instruments	28
4.3.4 Test Setup.....	28
4.3.5 Test Results	29
4.4 Occupied Bandwidth Measurement	36
4.4.1 Test Procedure	36
4.4.2 Test Setup.....	36
4.4.3 Test Result.....	37
4.5 Band Edge Measurement	45
4.5.1 Limits of Band Edge Measurement	45
4.5.2 Test Setup.....	45
4.5.3 Test Procedures.....	45
4.5.4 Test Results	46
4.6 Peak to Average Ratio	52
4.6.1 Limits of Peak to Average Ratio Measurement	52
4.6.2 Test Setup.....	52
4.6.3 Test Procedures.....	52
4.6.4 Test Results	53
4.7 Conducted Spurious Emissions	57
4.7.1 Limits of Conducted Spurious Emissions Measurement.....	57
4.7.2 Test Setup.....	57
4.7.3 Test Procedure	57
4.7.4 Test Results	58
4.8 Radiated Emission Measurement	68
4.8.1 Limits of Radiated Emission Measurement.....	68
4.8.2 Test Procedure	68
4.8.3 Deviation from Test Standard	68
4.8.4 Test Setup.....	69

4.8.5 Test Results	70
5 Pictures of Test Arrangements	112
Appendix – Information of the Testing Laboratories	113

Release Control Record

Issue No.	Description	Date Issued
RF210105C01-5	Original release	Sep. 29, 2021

1 Certificate of Conformity

Product: 2D Code Handy Terminal

Brand: DENSO

Test Model: BHT-M70-QWG

Sample Status: Engineering sample

Applicant: DENSO WAVE INCORPORATED

Test Date: Dec. 29, 2020 ~ Sep. 02, 2021

Standards: FCC Part 22, Subpart H

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Pettie Chen , **Date:** Sep. 29, 2021
Pettie Chen / Senior Specialist

Approved by : Bruce Chen , **Date:** Sep. 29, 2021
Bruce Chen / Senior Engineer

2 Summary of Test Results

Applied Standard: FCC Part 22 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 22.913 (a)	Effective radiated power	Pass	Meet the requirement of limit.
2.1047	Modulation Characteristics	Pass	Meet the requirement
22.913 (d)	Peak To Average Ratio	Pass	Meet the requirement of limit.
2.1055 22.355	Frequency Stability	Pass	Meet the requirement of limit.
2.1049	Occupied Bandwidth	Pass	Meet the requirement of limit.
22.917	Band Edge Measurements	Pass	Meet the requirement of limit.
2.1051 22.917	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 22.917	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -21.28dB at 31.94MHz.

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

HwaYa Chamber 10:

Measurement	Frequency	Expanded Uncertainty (k=2) ($\pm$)
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	2.44 dB
	30MHz ~ 200MHz	2.93 dB
	200MHz ~ 1000MHz	2.95 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.26 dB
	18GHz ~ 40GHz	1.94 dB

HwaYa Chamber 3:

Measurement	Frequency	Expanded Uncertainty (k=2) ($\pm$)
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.04 dB
	30MHz ~ 200MHz	3.86 dB
	200MHz ~ 1000MHz	3.87 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Test Site and Instruments

Test Mode A (Test Date: Dec. 29, 2020 ~ Sep. 02, 2021)

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Agilent	N9038A	MY55420137	Apr. 16, 2020	Apr. 15, 2021
			Apr. 09, 2021	Apr. 08, 2022
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 07, 2020	Dec. 06, 2021
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 16, 2020	Apr. 15, 2021
			Apr. 12, 2021	Apr. 11, 2022
Broadband Horn Antenna SCHWARZBECK	BBHA 9170	148	Nov. 22, 2020	Nov. 21, 2021
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 22, 2020	Nov. 21, 2021
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 06, 2020	Nov. 05, 2021
Fixed Attenuator WOKEN	MDCS18N-10	MDCS18N-10-01	Apr. 14, 2020	Apr. 13, 2021
			Apr. 13, 2021	Apr. 12, 2022
MXG Vector signal generator Agilent	N5182B	MY53050430	Nov. 25, 2020	Nov. 24, 2021
Bluetooth Tester	CBT	100946	Aug. 06, 2020	Aug. 05, 2022
Preamplifier EMCI	EMC 012645	980115	Oct. 07, 2020	Oct. 06, 2021
Preamplifier EMCI	EMC 184045	980116	Oct. 07, 2020	Oct. 06, 2021
Preamplifier EMCI	EMC 330H	980112	Oct. 07, 2020	Oct. 06, 2021
Power Meter Anritsu	ML2495A	1232001	Dec. 29, 2020	Dec. 28, 2021
Power Sensor Anritsu	MA2411B	1207334	Dec. 29, 2020	Dec. 28, 2021
RF Coaxial Cable EMCI	EMC104-SM-SM-8 000	171005	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable HUBER+SUHNNER	SUCOFLEX 104	EMC104-SM-SM-1000(1 40807)	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 07, 2020	Oct. 06, 2021
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in HwaYa Chamber 10.

Test Mode B (Test Date: Aug. 06, 2021)

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESR3	102579	Jul. 05, 2021	Jul. 04, 2022
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Jun. 07, 2021	Jun. 06, 2022
BILOG Antenna SCHWARZBECK	VULB9168	9168-171	Nov. 04, 2020	Nov. 03, 2021
HORN Antenna SCHWARZBECK	9120D	209	Nov. 22, 2020	Nov. 21, 2021
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 22, 2020	Nov. 21, 2021
Preamplifier Agilent (Below 1GHz)	8447D	2944A10738	Aug. 16, 2020	Aug. 15, 2021
Preamplifier Agilent (Above 1GHz)	8449B	3008A02465	Mar. 22, 2021	Mar. 21, 2022
RF Coaxial Cable WOKEN With 5dB PAD	8D-FB	Cable-CH3-01	Aug. 16, 2020	Aug. 15, 2021
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH3-03 (223653/4)	Aug. 16, 2020	Aug. 15, 2021
RF signal cable HUBER+SUHNER& EMCI	SUCOFLEX 104&EMC104-SM-S M-8000	Cable-CH3-03 (309224+170907)	Aug. 16, 2020	Aug. 15, 2021
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	013303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
Turn Table Controller BV ADT	SC100	SC93021702	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 3.

3 General Information

3.1 General Description of EUT

Product	2D Code Handy Terminal		
Brand	DENSO		
Test Model	BHT-M70-QWG		
Sample Status	Engineering sample		
Power Supply Rating	5.0 Vdc (host equipment) 5.0 / 9.0 / 12.0 Vdc (adapter) 3.6 Vdc (battery)		
Modulation Type	GSM, GPRS: GMSK EDGE: 8PSK WCDMA: BPSK, QPSK HSDPA: BPSK HSUPA: QPSK LTE: QPSK, 16QAM		
Operating Frequency	GSM/GPRS/EDGE	824.2MHz ~ 848.8MHz	
	WCDMA Band 5	826.4MHz ~ 846.6MHz	
	LTE Band 5 (Channel Bandwidth 1.4MHz)	824.7MHz ~ 848.3MHz	
	LTE Band 5 (Channel Bandwidth 3MHz)	825.5MHz ~ 847.5MHz	
	LTE Band 5 (Channel Bandwidth 5MHz)	826.5MHz ~ 846.5MHz	
	LTE Band 5 (Channel Bandwidth 10MHz)	829.0MHz ~ 844.0MHz	
Max. ERP Power	GSM	1244.515mW (30.95dBm)	
	WCDMA Band 5	174.181mW (22.41dBm)	
		QPSK	16QAM
	LTE Band 5 (Channel Bandwidth 1.4MHz)	116.950mW (20.68dBm)	99.770mW (19.99dBm)
	LTE Band 5 (Channel Bandwidth 3MHz)	118.304mW (20.73dBm)	98.175mW (19.92dBm)
	LTE Band 5 (Channel Bandwidth 5MHz)	119.399mW (20.77dBm)	100.000mW (20.00dBm)
	LTE Band 5 (Channel Bandwidth 10MHz)	120.504mW (20.81dBm)	100.925mW (20.04dBm)
Emission Designator	GSM/GPRS	247KGXW	
	EDGE	247KG7W	
	WCDMA Band 5	4M15F9W	
		QPSK	16QAM
	LTE Band 5 (Channel Bandwidth 1.4MHz)	1M09G7D	1M09D7W
	LTE Band 5 (Channel Bandwidth 3MHz)	2M70G7D	2M70D7W
	LTE Band 5 (Channel Bandwidth 5MHz)	4M49G7D	4M50D7W
	LTE Band 5 (Channel Bandwidth 10MHz)	8M97G7D	8M97D7W
Antenna Type	Refer to Note as below		
Antenna Connector	Refer to Note as below		
Accessory Device	Refer to Note as below		
Cable Supplied	Refer to Note as below		

Note:

1. The EUT contains following accessory devices.

Battery (accessory)	
Brand	DENSO
Model	BT3
Rating	3.6Vdc, 3050mAh, 10.98Wh

Adapter (Optional)	
Brand	CHANNEL WELL
Model	2ACP0183C
Input Power	100-240Vac, 0.5A, 50/60Hz
Output Power	5.0Vdc / 3.0A, 15W 9.0Vdc / 2.0A, 18.0W, 12.0Vdc / 1.5A, 18.0W

USB Cable (Optional)	
Brand	NIEN-YI
Model	NYS3892-0
Signal Line	1.45m shielded cable

QC3.0 charge single Cradle (Optional)	
Brand	DENSO
Model	CU-M70UQ

LAN Cradle with Spare battery charge (Optional)	
Brand	DENSO
Model	CU-M70L

USB Cradle with spare battery charge (Optional)	
Brand	DENSO
Model	CU-M70U

AC Adapter (CU-M70U & CU-M70L cradle use) (Optional)	
Brand	Sunny
Model	SYS1548-5012-T3
Input Power	100-240V~1.5A MAX 50-60Hz
Output Power	+12.0V / 4.16A
Power Cable	DC: 1.16m non-shielded cable with 1 core AC: 1.71m non-shielded cable without core

*After pre-testing, Cradle model: CU-M70L was the worst for the final tests.

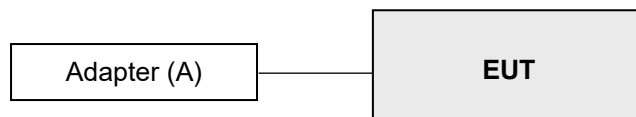
2. The following antennas were provided to the EUT.

Band	Freq. Range (MHz)	Gain (dBi)
GSM-850	824 ~ 849	0.69
WCDMA Band 5	824 ~ 849	0.69
LTE Band 5	824.7 ~ 848.3	0.69

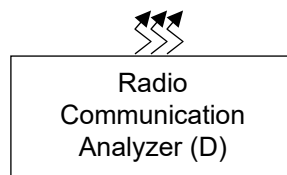
* The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

3.2 Configuration of System under Test

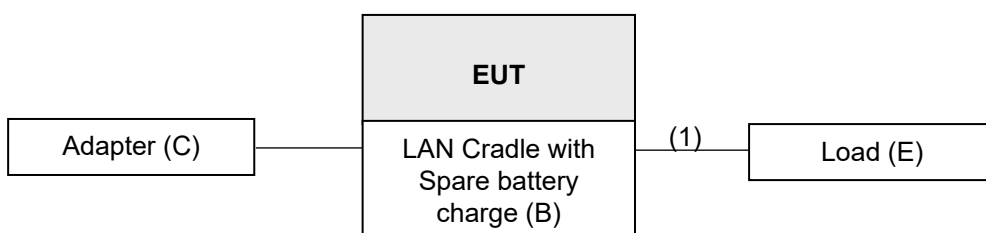
Test Mode A



Remote site



Test Mode B



Remote site



3.2.1 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Adapter	CHANNEL WELL	2ACP0183C	NA	NA	-
B	LAN Cradle with Spare battery charge	DENSO	CU-M70L	NA	NA	-
C	Adapter	Sunny	SYS1548-5012-T3	NA	NA	-
D	Radio Communication Analyzer	Anritsu	MT8821C	6261806803	NA	-
E	Load	NA	NA	NA	NA	-

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item D acted as a communication partner to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	LAN cable	1	1.5	N	0	-

3.3 Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case was found when positioned as the table below. Following channel(s) was (were) selected for the final test as listed below:

Band	Radiated Emission
GSM	Z-plane
WCDMA Band 5	Y-plane
LTE Band 5	Y-plane

Test results are presented in the report as below.

Test Mode	Test Condition
A	EUT with adapter
B	EUT with cradle model: CU-M70L

GSM Mode

EUT Configure Mode	Test Item	Available Channel	Tested Channel	Mode
A	ERP	128 to 251	128 (824.2MHz), 189 (836.4MHz), 251 (848.8MHz)	GSM, GPRS, EDGE
A	Modulation Characteristics	128 to 251	189 (836.4MHz)	GSM, GPRS, EDGE
A	Frequency Stability	128 to 251	128 (824.2MHz), 251 (848.8MHz)	GSM, EDGE
A	Occupied Bandwidth	128 to 251	128 (824.2MHz), 189 (836.4MHz), 251 (848.8MHz)	GSM, GPRS, EDGE
A	Band Edge	128 to 251	128(824.2MHz), 251(848.8MHz)	GSM, GPRS, EDGE
A	Peak To Average Ratio	128 to 251	128 (824.2MHz), 189 (836.4MHz), 251 (848.8MHz)	GSM, GPRS, EDGE
A	Conducted Emission	128 to 251	128 (824.2MHz), 189 (836.4MHz), 251 (848.8MHz)	GSM, GPRS, EDGE
A, B	Radiated Emission Below 1GHz	128 to 251	189 (836.4MHz)	GSM, EDGE
A	Radiated Emission Above 1GHz	128 to 251	128 (824.2MHz), 189 (836.4MHz), 251 (848.8MHz)	GSM, EDGE

Note: For radiated emission below 1GHz, select the worst radiated emission channel (above 1GHz) for final testing.

WCDMA Band 5

EUT Configure Mode	Test Item	Available Channel	Tested Channel	Mode
A	ERP	4132 to 4233	4132 (826.4MHz), 4182 (836.4MHz), 4233 (846.6MHz)	WCDMA, HSDPA, HSUPA
A	Modulation Characteristics	4132 to 4233	4182 (836.4MHz)	WCDMA, HSDPA, HSUPA
A	Frequency Stability	4132 to 4233	4132 (826.4MHz), 4233 (846.6MHz)	WCDMA
A	Occupied Bandwidth	4132 to 4233	4132 (826.4MHz), 4182 (836.4MHz), 4233 (846.6MHz)	WCDMA, HSDPA, HSUPA
A	Band Edge	4132 to 4233	4132 (826.4MHz), 4233 (846.6MHz)	WCDMA, HSDPA, HSUPA
A	Peak To Average Ratio	4132 to 4233	4132 (826.4MHz), 4182 (836.4MHz), 4233 (846.6MHz)	WCDMA, HSDPA, HSUPA
A	Conducted Emission	4132 to 4233	4132 (826.4MHz), 4182 (836.4MHz), 4233 (846.6MHz)	WCDMA, HSDPA, HSUPA
A, B	Radiated Emission Below 1GHz	4132 to 4233	4132 (826.4MHz)	WCDMA
A	Radiated Emission Above 1GHz	4132 to 4233	4132 (826.4MHz), 4182 (836.4MHz), 4233 (846.6MHz)	WCDMA

Note: For radiated emission below 1GHz, select the worst radiated emission channel (above 1GHz) for final testing.

LTE Band 5

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
A	ERP	20407 to 20643	20407 (824.7MHz), 20525 (836.5MHz), 20643 (848.3MHz)	1.4MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 2 RB Offset 1 RB / 5 RB Offset 3 RB / 0 RB Offset 3 RB / 1 RB Offset 3 RB / 3 RB Offset 6 RB / 0 RB Offset
		20415 to 20635	20415 (825.5MHz), 20525 (836.5MHz), 20635 (847.5MHz)	3MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 7 RB Offset 1 RB / 14 RB Offset 8 RB / 0 RB Offset 8 RB / 3 RB Offset 8 RB / 7 RB Offset 15 RB / 0 RB Offset
		20425 to 20625	20425 (826.5MHz), 20525 (836.5MHz), 20625 (846.5MHz)	5MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 12 RB Offset 1 RB / 24 RB Offset 12 RB / 0 RB Offset 12 RB / 6 RB Offset 12 RB / 13 RB Offset 25 RB / 0 RB Offset
		20450 to 20600	20450 (829.0MHz), 20525 (836.5MHz), 20600 (844.0MHz)	10MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 24 RB Offset 1 RB / 49 RB Offset 25 RB / 0 RB Offset 25 RB / 12 RB Offset 25 RB / 25 RB Offset 50 RB / 0 RB Offset
A	Modulation Characteristics	20450 to 20600	20525 (836.5MHz)	10MHz	QPSK / 16QAM	50 RB / 0 RB Offset
A	Frequency Stability	20407 to 20643	20407 (824.7MHz), 20643 (848.3MHz)	1.4MHz	QPSK	6 RB / 0 RB Offset
		20415 to 20635	20415 (825.5MHz), 20635 (847.5MHz)	3MHz	QPSK	15 RB / 0 RB Offset
		20425 to 20625	20425 (826.5MHz), 20625 (846.5MHz)	5MHz	QPSK	25 RB / 0 RB Offset
		20450 to 20600	20450 (829.0MHz), 20600 (844.0MHz)	10MHz	QPSK	50 RB / 0 RB Offset
A	Occupied Bandwidth	20407 to 20643	20407 (824.7MHz), 20525 (836.5MHz), 20643 (848.3MHz)	1.4MHz	QPSK / 16QAM	6 RB / 0RB Offset
		20415 to 20635	20415 (825.5MHz), 20525 (836.5MHz), 20635 (847.5MHz)	3MHz	QPSK / 16QAM	15 RB / 0RB Offset
		20425 to 20625	20425 (826.5MHz), 20525 (836.5MHz), 20625 (846.5MHz)	5MHz	QPSK / 16QAM	25RB / 0RB Offset
		20450 to 20600	20450 (829.0MHz), 20525 (836.5MHz), 20600 (844.0MHz)	10MHz	QPSK / 16QAM	50RB / 0RB Offset

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
A	Band Edge	20407 to 20643	20407 (824.7MHz), 20643 (848.3MHz)	1.4MHz	QPSK	1 RB / 0 RB Offset 1 RB / 5 RB Offset 6 RB / 0 RB Offset
		20415 to 20635	20415 (825.5MHz), 20635 (847.5MHz)	3MHz	QPSK	1 RB / 0 RB Offset 1 RB / 14 RB Offset 15 RB / 0 RB Offset
		20425 to 20625	20425 (826.5MHz), 20625 (846.5MHz)	5MHz	QPSK	1 RB / 0 RB Offset 1 RB / 24 RB Offset 25 RB / 0 RB Offset
		20450 to 20600	20450 (829.0MHz), 20600 (844.0MHz)	10MHz	QPSK	1 RB / 0 RB Offset 1 RB / 49 RB Offset 50 RB / 0 RB Offset
A	Peak to Average Ratio	20407 to 20643	20407 (824.7MHz), 20525 (836.5MHz), 20643 (848.3MHz)	1.4MHz	QPSK / 16QAM	3 RB / 1 RB Offset
		20415 to 20635	20415 (825.5MHz), 20525 (836.5MHz), 20635 (847.5MHz)	3MHz	QPSK / 16QAM	1 RB / 0 RB Offset
		20425 to 20625	20425 (826.5MHz), 20525 (836.5MHz), 20625 (846.5MHz)	5MHz	QPSK / 16QAM	1 RB / 0 RB Offset
		20450 to 20600	20450 (829.0MHz), 20525 (836.5MHz), 20600 (844.0MHz)	10MHz	QPSK / 16QAM	1 RB / 0 RB Offset
A	Conducted Emission	20407 to 20643	20407 (824.7MHz), 20525 (836.5MHz), 20643 (848.3MHz)	1.4MHz	QPSK	3 RB / 1 RB Offset
		20415 to 20635	20415 (825.5MHz), 20525 (836.5MHz), 20635 (847.5MHz)	3MHz	QPSK	1 RB / 0 RB Offset
		20425 to 20625	20425 (826.5MHz), 20525 (836.5MHz), 20625 (846.5MHz)	5MHz	QPSK	1 RB / 0 RB Offset
		20450 to 20600	20450 (829.0MHz), 20525 (836.5MHz), 20600 (844.0MHz)	10MHz	QPSK	1 RB / 0 RB Offset
A, B	Radiated Emission Below 1GHz	20450 to 20600	20525 (836.5MHz)	10MHz	QPSK	1 RB / 0 RB Offset
A	Radiated Emission Above 1GHz	20407 to 20643	20407 (824.7MHz), 20525 (836.5MHz), 20643 (848.3MHz)	1.4MHz	QPSK	3 RB / 1 RB Offset
		20425 to 20625	20425 (826.5MHz), 20525 (836.5MHz), 20625 (846.5MHz)	5MHz	QPSK	1 RB / 0 RB Offset
		20450 to 20600	20450 (829.0MHz), 20525 (836.5MHz), 20600 (844.0MHz)	10MHz	QPSK	1 RB / 0 RB Offset

Note:

1. For radiated emission below 1GHz, select the worst radiated emission channel (above 1GHz) for final testing.
2. For radiated emission above 1GHz, according to 3GPP 36.521 Section 6.6.3.1.4, choose the lowest, 5MHz & highest channel bandwidth for final test.
3. The measured output power for QPSK mode is higher than the measured output power for 16QAM mode. Therefore, only Modulation characteristics, occupied bandwidth and Peak to average ratio items had been tested under QPSK and 16QAM modes, the other test items were performed under QPSK mode only.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Modulation Characteristics	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Frequency Stability	25deg. C, 60%RH	3.6Vdc	James Yang
Occupied Bandwidth	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Band Edge	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Peak To Average Ratio	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Conducted Emission	25deg. C, 60%RH	120Vac, 60Hz	James Yang
Radiated Emission	22deg. C, 66%RH 22deg. C, 68%RH	120Vac, 60Hz	Tim Chen Greg Lin

3.4 EUT Operating Conditions

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency

3.5 General Description of Applied Standards and References

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test Standard:

FCC 47 CFR Part 2

FCC 47 CFR Part 22

ANSI/TIA/EIA-603-E 2016

ANSI 63.26-2015

References Test Guidance:

KDB 971168 D01 Power Meas License Digital Systems v03r01

All test items have been performed and recorded as per the above standards.

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

Mobile / Portable station are limited to 7 watts e.r.p.

4.1.2 Test Procedures

Conducted Power Measurement:

The EUT was set up for the maximum power with GSM, WCDMA, LTE link data modulation and link up with simulator. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

Maximum EIRP / ERP

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation as follows:

$$\text{EIRP} = P_{\text{Meas}} + G_T$$

$$\text{ERP} = P_{\text{Meas}} + G_T - 2.15$$

where

ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively
 (expressed in the same units as P_{Meas} , e.g., dBm or dBW)

P_{Meas} measured transmitter output power or PSD, in dBm or dBW

G_T gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

4.1.3 Test Setup

Conducted Power Measurement:



4.1.4 Test Results

Conducted Output Power (dBm)

Band	GSM850		
Channel	128	189	251
Frequency	824.2	836.4	848.8
GSM	32.41	32.26	32.27
GPRS 1Tx Slot	32.18	31.88	31.92
GPRS 2Tx Slot	30.41	30.45	30.49
GPRS 3Tx Slot	29.32	29.41	29.50
GPRS 4Tx Slot	28.15	28.41	28.45
EDGE 1Tx Slot (MCS9)	25.96	25.97	25.98
EDGE 2Tx Slot (MCS9)	24.55	24.99	24.78
EDGE 3Tx Slot (MCS9)	23.48	23.92	23.61
EDGE 4Tx Slot (MCS9)	22.55	22.96	22.67

Band	WCDMA V		
TX Channel	4132	4182	4233
Rx Channel	4357	4407	4458
Frequency	826.4	836.4	846.6
RMC 12.2K	23.82	23.87	23.85
HSDPA Subtest-1	22.76	22.75	22.82
HSDPA Subtest-2	22.79	22.82	22.82
HSDPA Subtest-3	22.33	22.36	22.37
HSDPA Subtest-4	22.31	22.31	22.36
DC-HSDPA Subtest-1	22.76	22.76	22.80
DC-HSDPA Subtest-2	22.79	22.82	22.79
DC-HSDPA Subtest-3	22.34	22.36	22.37
DC-HSDPA Subtest-4	22.31	22.30	22.36
HSUPA Subtest-1	22.79	22.81	22.83
HSUPA Subtest-2	20.82	20.78	20.84
HSUPA Subtest-3	21.72	21.79	21.81
HSUPA Subtest-4	20.75	20.76	20.84
HSUPA Subtest-5	22.80	22.90	22.80

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20450	20525	20600
		Frequency (MHz)		829	836.5	844
10M	QPSK	1	0	22.18	22.26	22.27
		1	24	22.07	22.17	22.19
		1	49	22.00	22.10	22.12
		25	0	21.12	21.22	21.24
		25	12	21.10	21.20	21.22
		25	25	21.05	21.15	21.17
		50	0	21.11	21.21	21.23
10M	16QAM	1	0	21.40	21.49	21.50
		1	24	21.38	21.48	21.49
		1	49	21.37	21.47	21.45
		25	0	20.24	20.34	20.36
		25	12	20.19	20.29	20.31
		25	25	20.16	20.26	20.28
		50	0	20.29	20.29	20.31

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20425	20525	20625
		Frequency (MHz)		826.5	836.5	846.5
5M	QPSK	1	0	22.09	22.22	22.23
		1	12	22.00	22.12	22.12
		1	24	21.94	22.05	22.08
		12	0	21.02	21.13	21.14
		12	6	21.02	21.20	21.21
		12	13	21.05	21.13	21.07
		25	0	21.08	21.18	21.18
5M	16QAM	1	0	21.37	21.46	21.40
		1	12	21.38	21.43	21.41
		1	24	21.37	21.39	21.37
		12	0	20.21	20.30	20.33
		12	6	20.16	20.29	20.23
		12	13	20.14	20.26	20.19
		25	0	20.27	20.23	20.23

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20415	20525	20635
		Frequency (MHz)		825.5	836.5	847.5
3M	QPSK	1	0	22.06	22.19	22.17
		1	7	21.99	22.09	22.12
		1	14	21.83	22.00	22.00
		8	0	20.99	21.07	21.06
		8	3	20.96	21.06	21.11
		8	7	20.93	21.01	21.06
		15	0	21.04	21.19	21.11
3M	16QAM	1	0	21.20	21.31	21.29
		1	7	21.26	21.38	21.37
		1	14	21.21	21.30	21.21
		8	0	20.22	20.30	20.21
		8	3	20.03	20.12	20.20
		8	7	20.00	20.23	20.25
		15	0	20.20	20.19	20.23

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20407	20525	20643
		Frequency (MHz)		824.7	836.5	848.3
1.4M	QPSK	1	0	22.03	22.14	22.11
		1	2	21.93	22.02	22.13
		1	5	21.89	21.99	21.99
		3	0	21.91	22.11	22.04
		3	1	21.90	22.00	22.09
		3	3	21.84	22.04	22.02
		6	0	21.09	21.20	21.16
1.4M	16QAM	1	0	21.25	21.45	21.25
		1	2	21.24	21.29	21.30
		1	5	21.23	21.44	21.30
		3	0	21.22	21.23	21.30
		3	1	21.08	21.20	21.26
		3	3	21.05	21.13	21.23
		6	0	20.19	20.18	20.24

ERP Power (dBm)

Band	GSM850		
Channel	128	189	251
Frequency	824.2	836.4	848.8
GSM	30.95	30.80	30.81
GPRS 1Tx Slot	30.72	30.42	30.46
GPRS 2Tx Slot	28.95	28.99	29.03
GPRS 3Tx Slot	27.86	27.95	28.04
GPRS 4Tx Slot	26.69	26.95	26.99
EDGE 1Tx Slot (MCS9)	24.50	24.51	24.52
EDGE 2Tx Slot (MCS9)	23.09	23.53	23.32
EDGE 3Tx Slot (MCS9)	22.02	22.46	22.15
EDGE 4Tx Slot (MCS9)	21.09	21.50	21.21

Band	WCDMA V		
TX Channel	4132	4182	4233
Rx Channel	4357	4407	4458
Frequency	826.4	836.4	846.6
RMC 12.2K	22.36	22.41	22.39
HSDPA Subtest-1	21.30	21.29	21.36
HSDPA Subtest-2	21.33	21.36	21.36
HSDPA Subtest-3	20.87	20.90	20.91
HSDPA Subtest-4	20.85	20.85	20.90
DC-HSDPA Subtest-1	21.30	21.30	21.34
DC-HSDPA Subtest-2	21.33	21.36	21.33
DC-HSDPA Subtest-3	20.88	20.90	20.91
DC-HSDPA Subtest-4	20.85	20.84	20.90
HSUPA Subtest-1	21.33	21.35	21.37
HSUPA Subtest-2	19.36	19.32	19.38
HSUPA Subtest-3	20.26	20.33	20.35
HSUPA Subtest-4	19.29	19.30	19.38
HSUPA Subtest-5	21.34	21.44	21.34

*ERP = Conducted + antenna gain (0.69dBi)-2.15

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20450	20525	20600
		Frequency (MHz)		829	836.5	844
10M	QPSK	1	0	20.72	20.80	20.81
		1	24	20.61	20.71	20.73
		1	49	20.54	20.64	20.66
		25	0	19.66	19.76	19.78
		25	12	19.64	19.74	19.76
		25	25	19.59	19.69	19.71
		50	0	19.65	19.75	19.77
10M	16QAM	1	0	19.94	20.03	20.04
		1	24	19.92	20.02	20.03
		1	49	19.91	20.01	19.99
		25	0	18.78	18.88	18.90
		25	12	18.73	18.83	18.85
		25	25	18.70	18.80	18.82
		50	0	18.83	18.83	18.85

*ERP = Conducted + antenna gain (0.69dBi)-2.15

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20425	20525	20625
		Frequency (MHz)		826.5	836.5	846.5
5M	QPSK	1	0	20.63	20.76	20.77
		1	12	20.54	20.66	20.66
		1	24	20.48	20.59	20.62
		12	0	19.56	19.67	19.68
		12	6	19.56	19.74	19.75
		12	13	19.59	19.67	19.61
		25	0	19.62	19.72	19.72
5M	16QAM	1	0	19.91	20.00	19.94
		1	12	19.92	19.97	19.95
		1	24	19.91	19.93	19.91
		12	0	18.75	18.84	18.87
		12	6	18.70	18.83	18.77
		12	13	18.68	18.80	18.73
		25	0	18.81	18.77	18.77

*ERP = Conducted + antenna gain (0.69dBi)-2.15

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20415	20525	20635
		Frequency (MHz)		825.5	836.5	847.5
3M	QPSK	1	0	20.60	20.73	20.71
		1	7	20.53	20.63	20.66
		1	14	20.37	20.54	20.54
		8	0	19.53	19.61	19.60
		8	3	19.50	19.60	19.65
		8	7	19.47	19.55	19.60
		15	0	19.58	19.73	19.65
3M	16QAM	1	0	19.74	19.85	19.83
		1	7	19.80	19.92	19.91
		1	14	19.75	19.84	19.75
		8	0	18.76	18.84	18.75
		8	3	18.57	18.66	18.74
		8	7	18.54	18.77	18.79
		15	0	18.74	18.73	18.77

*ERP = Conducted + antenna gain (0.69dBi)-2.15

LTE Band 5						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		20407	20525	20643
		Frequency (MHz)		824.7	836.5	848.3
1.4M	QPSK	1	0	20.57	20.68	20.65
		1	2	20.47	20.56	20.67
		1	5	20.43	20.53	20.53
		3	0	20.45	20.65	20.58
		3	1	20.44	20.54	20.63
		3	3	20.38	20.58	20.56
		6	0	19.63	19.74	19.70
1.4M	16QAM	1	0	19.79	19.99	19.79
		1	2	19.78	19.83	19.84
		1	5	19.77	19.98	19.84
		3	0	19.76	19.77	19.84
		3	1	19.62	19.74	19.80
		3	3	19.59	19.67	19.77
		6	0	18.73	18.72	18.78

*ERP = Conducted + antenna gain (0.69dBi)-2.15

4.2 Modulation Characteristics Measurement

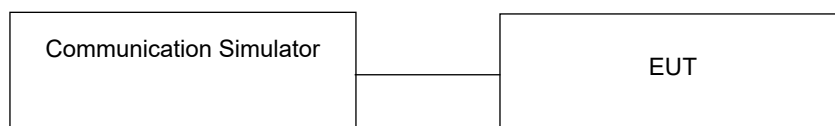
4.2.1 Limits of Modulation Characteristics

N/A

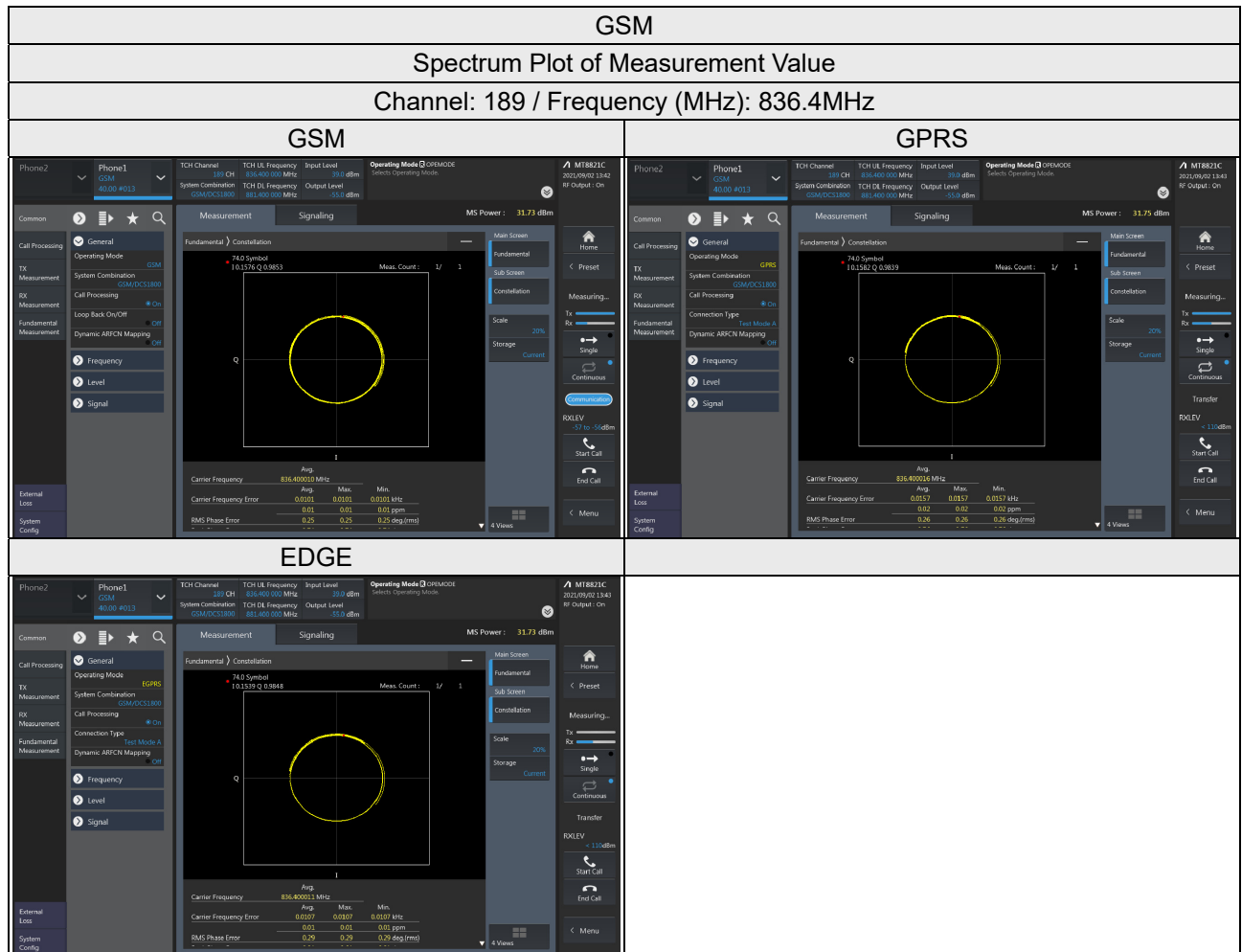
4.2.2 Test Procedure

Connect the EUT to Communication Simulator via the antenna connector, The frequency band is set as EUT supported Modulation and Channels, the EUT output is matched with 50 ohm load, the waveform quality and constellation of the EUT was tested.

4.2.3 Test Setup



4.2.4 Test Results

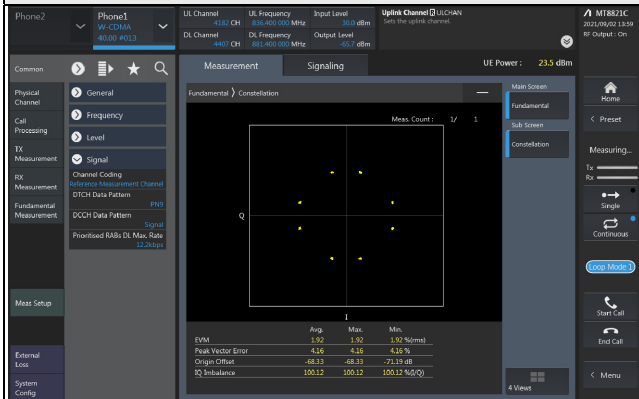


WCDMA Band 5

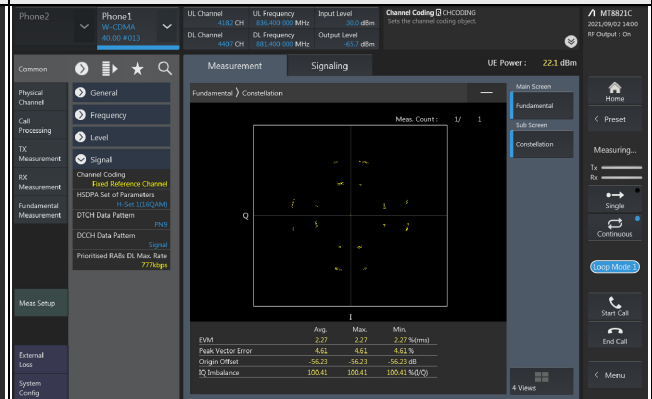
Spectrum Plot of Measurement Value

Channel: 4182 / Frequency (MHz): 836.4MHz

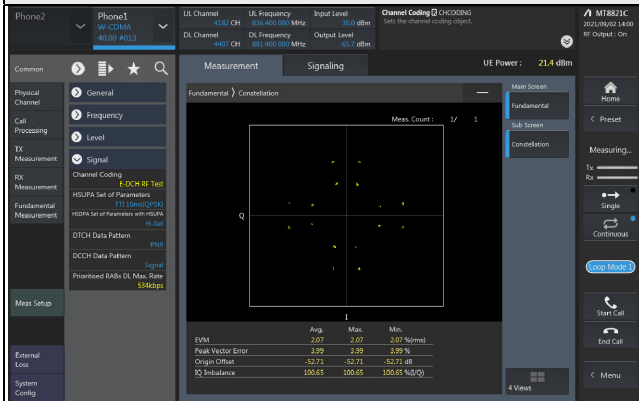
WCDMA



HSDPA



HSUPA

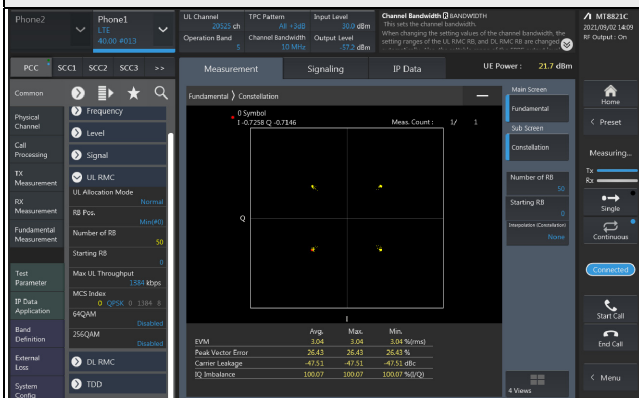


LTE Band 5

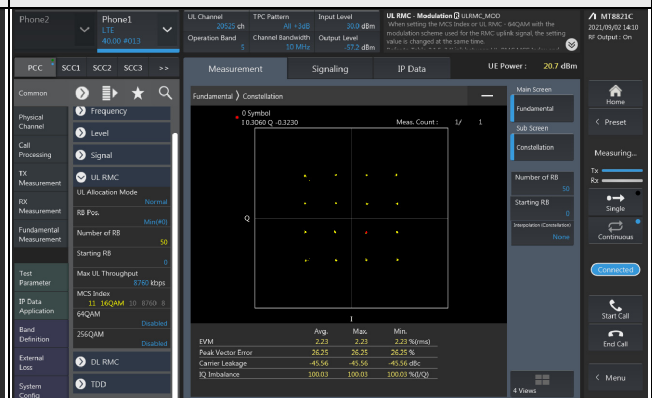
Spectrum Plot of Measurement Value

Channel: 20525 / Frequency (MHz): 836.5MHz

QPSK



16QAM



4.3 Frequency Stability Measurement

4.3.1 Limits of Frequency Stability Measurement

1.5 ppm is for base and fixed station. 2.5 ppm is for mobile station.

4.3.2 Test Procedure

- Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.
- EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.
- The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the $\pm 0.5^{\circ}\text{C}$ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

Note: The frequency error was recorded frequency error from the communication simulator.

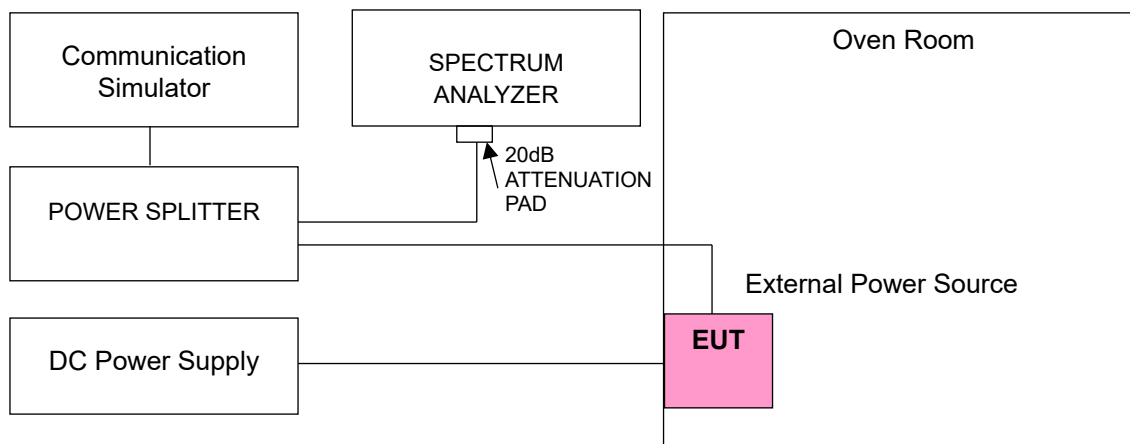
4.3.3 Test Instruments

Test Date: Sep. 02, 2021

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Radio Communication Analyzer Anritsu	MT8821C	6261806803	Jan. 22, 2021	Jan. 21, 2022
Temperature & Humidity Chamber TERCHY	HRM-120RF	931022	Dec. 24, 2020	Dec. 23, 2021
Digital Multimeter Fluke	87-III	70360742	Jun. 24, 2021	Jun. 23, 2022
DC Power Supply Topward	6306A	727263	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.3.4 Test Setup



4.3.5 Test Results

Frequency Error vs. Voltage

Voltage (Vdc)	GSM			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.6	824.200039	0.047	848.800025	0.029
3.06	824.200033	0.040	848.800012	0.014
4.14	824.200025	0.030	848.800036	0.042

Note: The applicant defined the normal working voltage is from 3.06Vdc to 4.14Vdc.

Frequency Error vs. Temperature

Temp. (°C)	GSM			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	824.200022	0.027	848.800026	0.031
-20	824.200035	0.042	848.800034	0.040
-10	824.200014	0.017	848.800034	0.040
0	824.200024	0.029	848.800021	0.025
10	824.200025	0.030	848.800032	0.038
20	824.199971	-0.035	848.799990	-0.012
30	824.199960	-0.049	848.799974	-0.031
40	824.199986	-0.017	848.799983	-0.020
50	824.199979	-0.025	848.799989	-0.013

Frequency Error vs. Voltage

Voltage (Vdc)	EDGE			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.6	824.200028	0.034	848.800024	0.028
3.06	824.200013	0.016	848.800016	0.019
4.14	824.200036	0.044	848.800039	0.046

Note: The applicant defined the normal working voltage is from 3.06Vdc to 4.14Vdc.

Frequency Error vs. Temperature

Temp. (°C)	EDGE			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	824.200037	0.045	848.800020	0.024
-20	824.200040	0.049	848.800021	0.025
-10	824.200026	0.032	848.800038	0.045
0	824.200026	0.032	848.800014	0.016
10	824.200038	0.046	848.800023	0.027
20	824.199985	-0.018	848.799977	-0.027
30	824.199965	-0.042	848.799964	-0.042
40	824.199982	-0.022	848.799965	-0.041
50	824.199977	-0.028	848.799979	-0.025

Frequency Error vs. Voltage

Voltage (Vdc)	WCDMA Band 5			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.6	826.400026	0.031	846.600013	0.015
3.06	826.400014	0.017	846.600017	0.020
4.14	826.400032	0.039	846.600035	0.041

Note: The applicant defined the normal working voltage is from 3.06Vdc to 4.14Vdc.

Frequency Error vs. Temperature

Temp. (°C)	WCDMA Band 5			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	826.400015	0.018	846.600022	0.026
-20	826.400038	0.046	846.600021	0.025
-10	826.400026	0.031	846.600020	0.024
0	826.400031	0.038	846.600017	0.020
10	826.400020	0.024	846.600039	0.046
20	826.399987	-0.016	846.599978	-0.026
30	826.399977	-0.028	846.599972	-0.033
40	826.399963	-0.045	846.599961	-0.046
50	826.399969	-0.038	846.599990	-0.012

Frequency Error vs. Voltage

Voltage (Vdc)	LTE Band 5			
	Channel Bandwidth 1.4 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.6	824.700002	0.003	848.300002	0.002
3.06	824.700003	0.003	848.300003	0.003
4.14	824.700003	0.004	848.300003	0.003

Note: The applicant defined the normal working voltage is from 3.06Vdc to 4.14Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 5			
	Channel Bandwidth 1.4 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	824.700003	0.004	848.300008	0.009
-20	824.700004	0.004	848.300004	0.004
-10	824.700003	0.004	848.300001	0.001
0	824.700003	0.004	848.300002	0.002
10	824.700004	0.005	848.300002	0.002
20	824.699997	-0.004	848.299998	-0.002
30	824.699997	-0.004	848.299998	-0.002
40	824.699998	-0.003	848.299998	-0.003
50	824.699998	-0.002	848.299999	-0.002

Frequency Error vs. Voltage

Voltage (Vdc)	LTE Band 5			
	Channel Bandwidth 3 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.6	825.500004	0.005	847.500002	0.002
3.06	825.500003	0.004	847.500004	0.004
4.14	825.500003	0.004	847.500003	0.003

Note: The applicant defined the normal working voltage is from 3.06Vdc to 4.14Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 5			
	Channel Bandwidth 3 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	825.500002	0.002	847.500007	0.008
-20	825.500003	0.004	847.500002	0.002
-10	825.500002	0.002	847.500001	0.001
0	825.500004	0.004	847.500002	0.002
10	825.500003	0.003	847.500004	0.004
20	825.499999	-0.002	847.499997	-0.004
30	825.499997	-0.004	847.499997	-0.003
40	825.499997	-0.004	847.499996	-0.005
50	825.499999	-0.001	847.499997	-0.004

Frequency Error vs. Voltage

Voltage (Vdc)	LTE Band 5			
	Channel Bandwidth 5 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.6	826.500003	0.004	846.500003	0.003
3.06	826.500003	0.004	846.500003	0.004
4.14	826.500003	0.003	846.500001	0.002

Note: The applicant defined the normal working voltage is from 3.06Vdc to 4.14Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 5			
	Channel Bandwidth 5 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	826.500006	0.007	846.500002	0.002
-20	826.500001	0.002	846.500004	0.005
-10	826.500003	0.003	846.500003	0.004
0	826.500002	0.003	846.500003	0.004
10	826.500001	0.002	846.500003	0.003
20	826.499997	-0.004	846.499997	-0.003
30	826.499997	-0.004	846.499996	-0.005
40	826.499998	-0.002	846.499996	-0.005
50	826.499998	-0.003	846.499998	-0.002

Frequency Error vs. Voltage

Voltage (Vdc)	LTE Band 5			
	Channel Bandwidth 10 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
3.6	829.000003	0.004	844.000003	0.003
3.06	829.000002	0.002	844.000003	0.003
4.14	829.000003	0.004	844.000002	0.003

Note: The applicant defined the normal working voltage is from 3.06Vdc to 4.14Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 5			
	Channel Bandwidth 10 MHz			
	Low Channel		High Channel	
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
-30	829.000003	0.004	844.000005	0.006
-20	829.000002	0.002	844.000003	0.003
-10	829.000004	0.005	844.000002	0.003
0	829.000004	0.005	844.000003	0.004
10	829.000003	0.004	844.000002	0.002
20	828.999998	-0.003	843.999997	-0.004
30	828.999997	-0.003	843.999997	-0.004
40	828.999997	-0.004	843.999998	-0.003
50	828.999997	-0.003	843.999998	-0.002

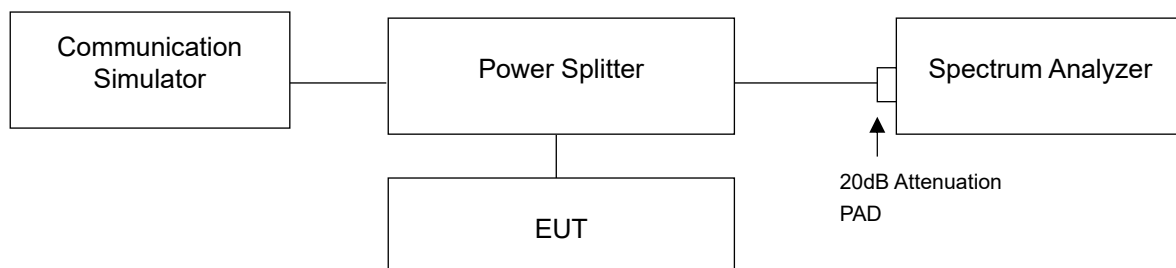
4.4 Occupied Bandwidth Measurement

4.4.1 Test Procedure

The EUT makes a call to the communication simulator. All measurements were done at low, middle and high operational frequency range. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Measurement method, please refer to section 5.4.4 of ANSI C63.26. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

For the 26dBc bandwidth measurement method, please refer to section 5.4.3 of ANSI C63.26.

4.4.2 Test Setup

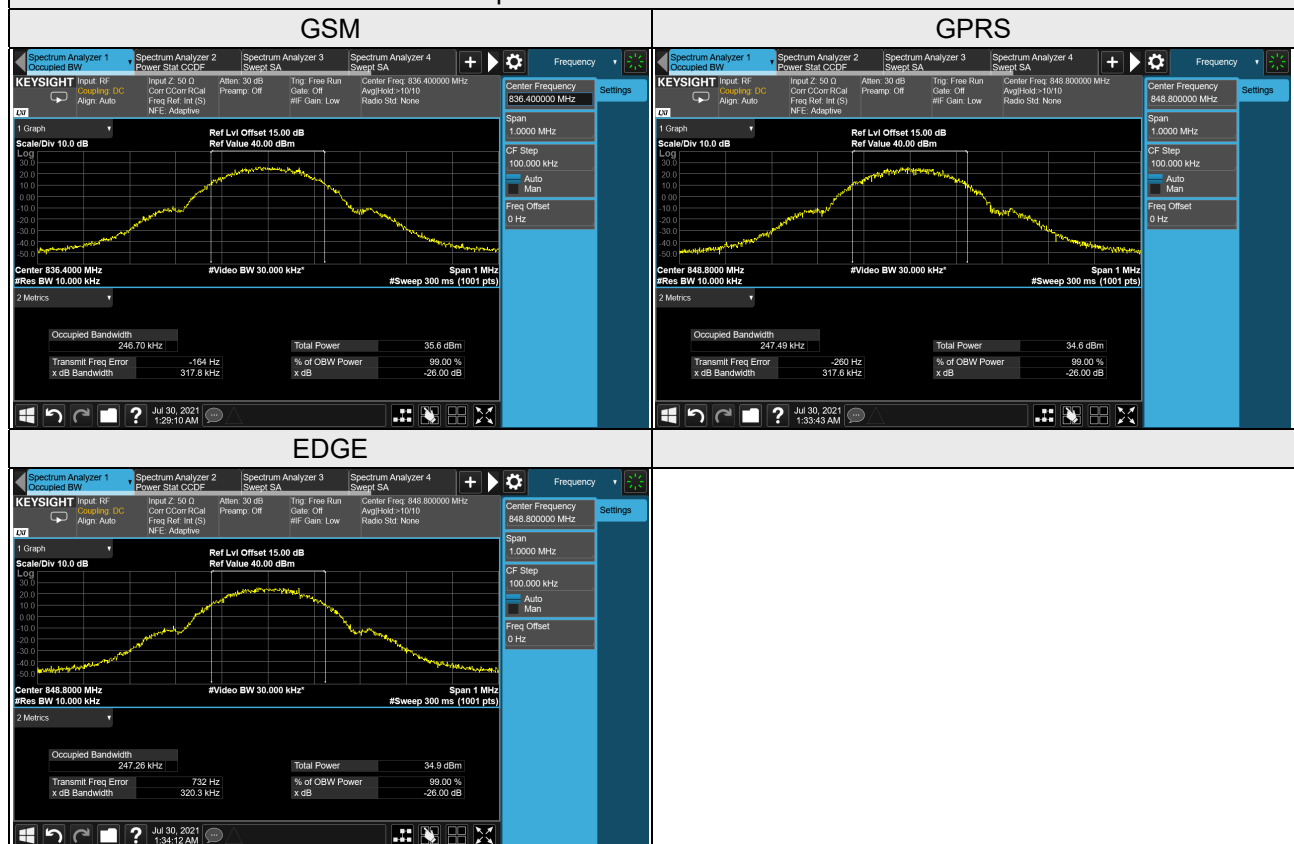


4.4.3 Test Result

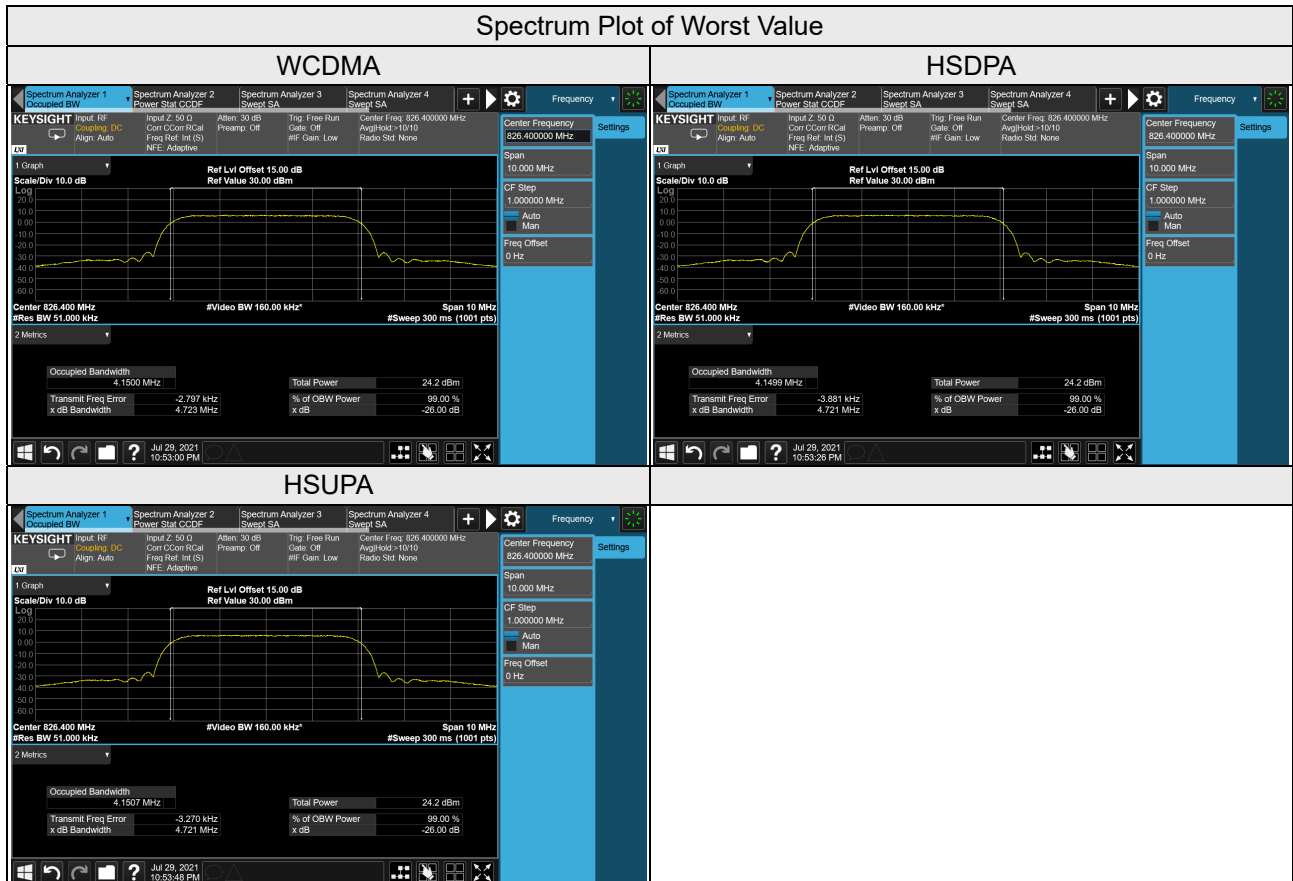
Occupied Bandwidth

Channel	Frequency (MHz)	99% Occupied Bandwidth (kHz)		
		GSM	GPRS	EDGE
128	824.2	245.89	246.06	246.41
189	836.4	246.70	245.72	246.25
251	848.8	245.21	247.49	247.26

Spectrum Plot of Worst Value



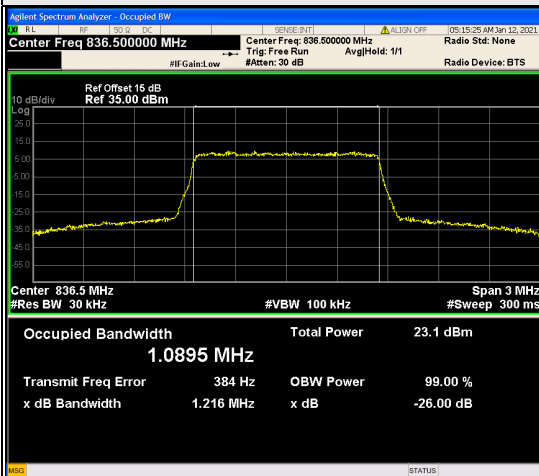
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)		
		WCDMA	HSDPA	HSUPA
4132	826.4	4.15	4.15	4.15
4182	836.4	4.15	4.14	4.14
4233	846.6	4.14	4.14	4.14



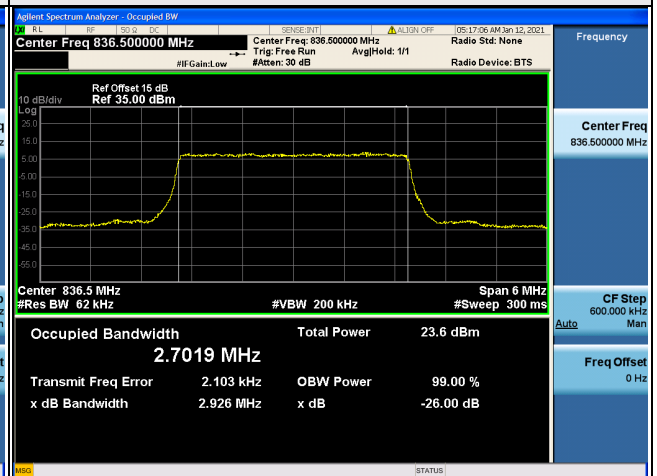
LTE Band 5, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
20407	824.7	1.09	1.09
20525	836.5	1.09	1.09
20643	848.3	1.09	1.09
LTE Band 5, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
20415	825.5	2.70	2.70
20525	836.5	2.70	2.70
20635	847.5	2.70	2.70
LTE Band 5, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
20425	826.5	4.49	4.50
20525	836.5	4.49	4.50
20625	846.5	4.49	4.49
LTE Band 5, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	
		QPSK	16QAM
20450	829.0	8.97	8.97
20525	836.5	8.97	8.97
20600	844.0	8.95	8.96

Spectrum Plot of Worst Value

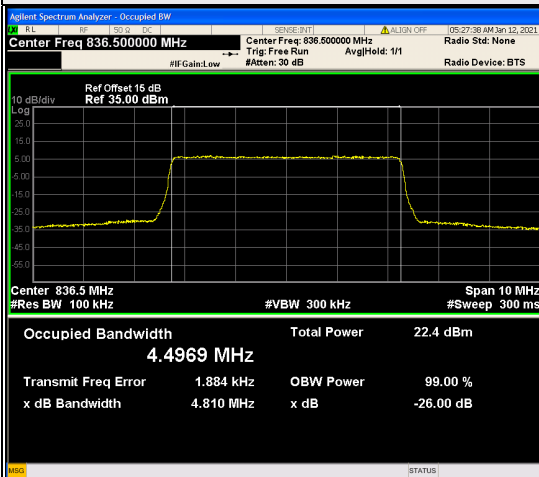
1.4MHz / 16QAM



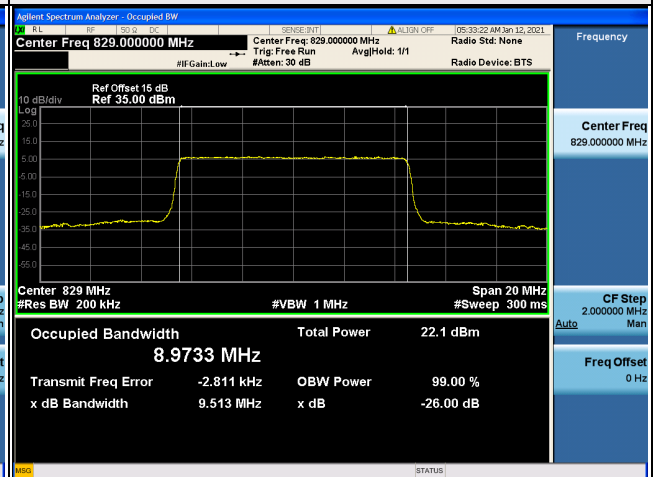
3MHz / QPSK



5MHz / 16QAM



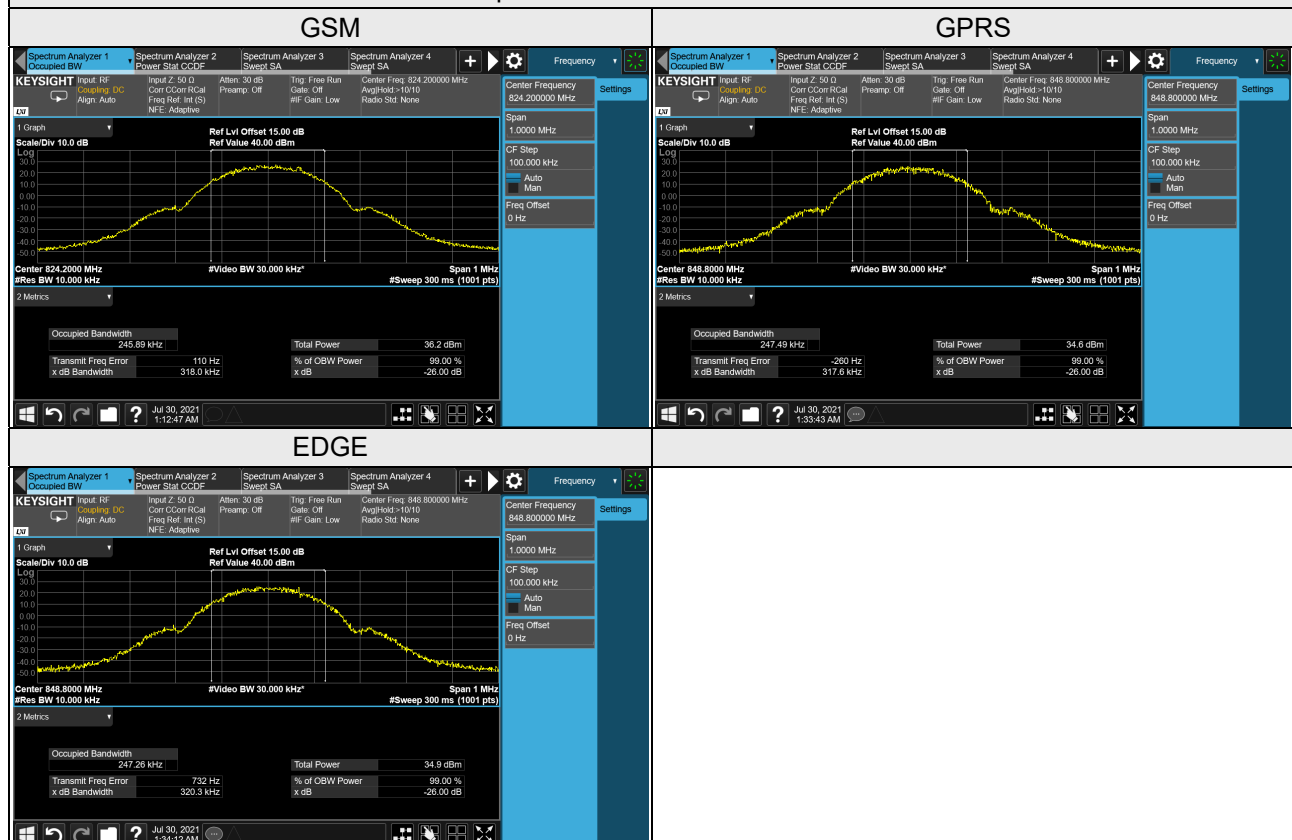
10MHz / 16QAM



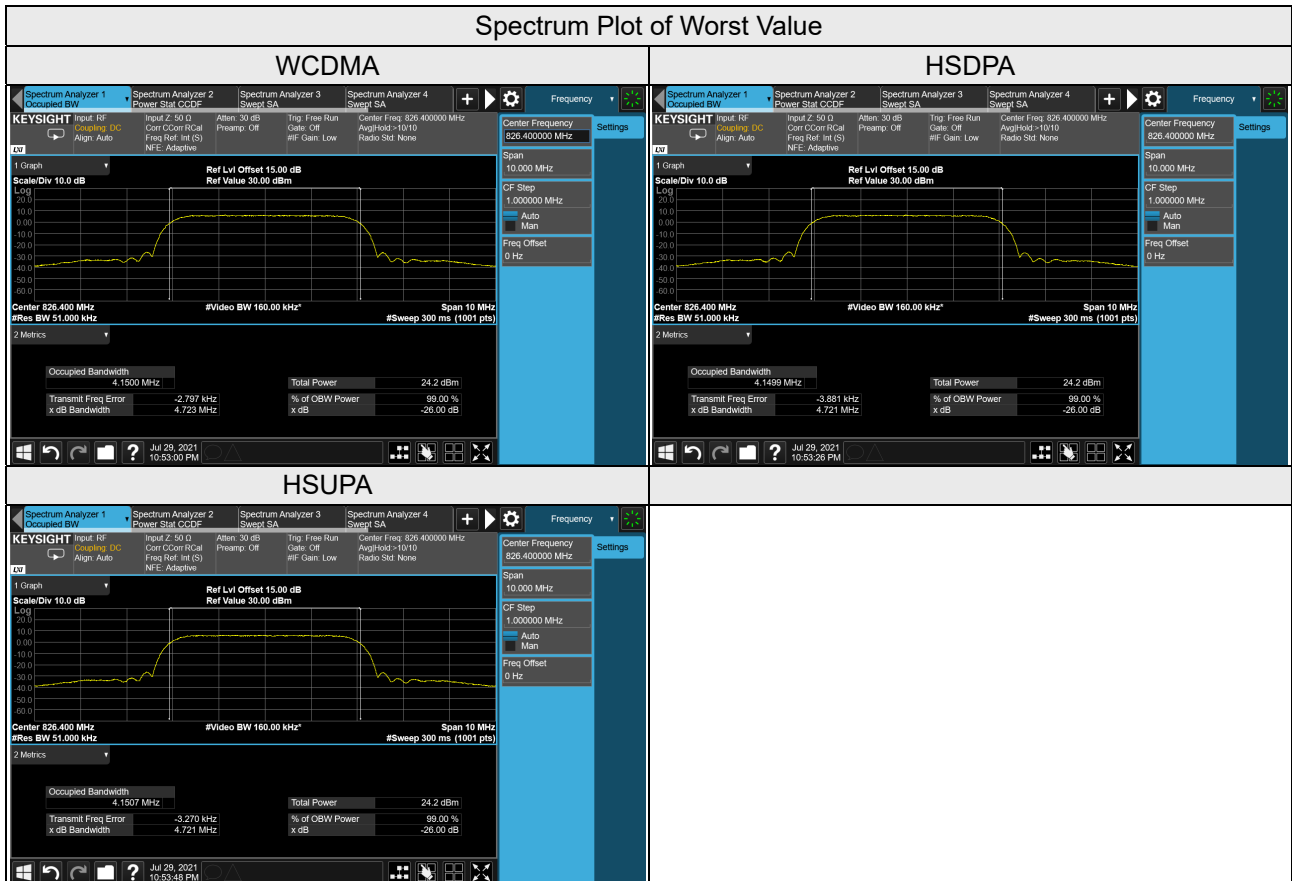
26dB Bandwidth

Channel	Frequency (MHz)	26dB Bandwidth (kHz)		
		GSM	GPRS	EDGE
128	824.2	318.00	316.60	319.40
189	836.4	317.80	316.10	315.40
251	848.8	316.30	317.60	320.30

Spectrum Plot of Worst Value



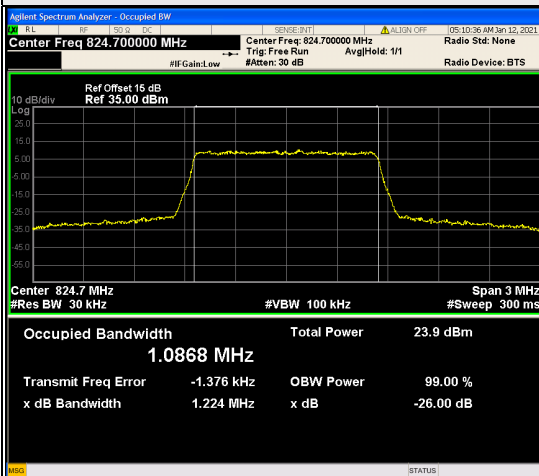
Channel	Frequency (MHz)	26dB Bandwidth (MHz)		
		WCDMA	HSDPA	HSUPA
4132	826.4	4.72	4.72	4.72
4182	836.4	4.72	4.72	4.72
4233	846.6	4.71	4.72	4.72



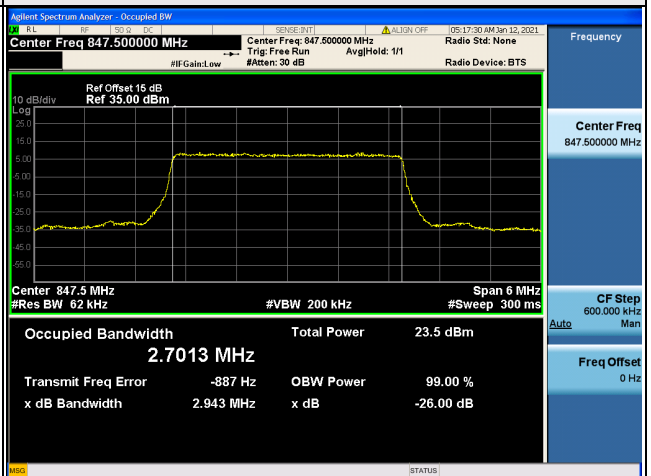
LTE Band 5, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
20407	824.7	1.22	1.22
20525	836.5	1.22	1.22
20643	848.3	1.22	1.21
LTE Band 5, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
20415	825.5	2.93	2.93
20525	836.5	2.93	2.93
20635	847.5	2.94	2.93
LTE Band 5, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
20425	826.5	4.85	4.81
20525	836.5	4.85	4.81
20625	846.5	4.81	4.80
LTE Band 5, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	
		QPSK	16QAM
20450	829.0	9.55	9.51
20525	836.5	9.53	9.52
20600	844.0	9.51	9.50

Spectrum Plot of Worst Value

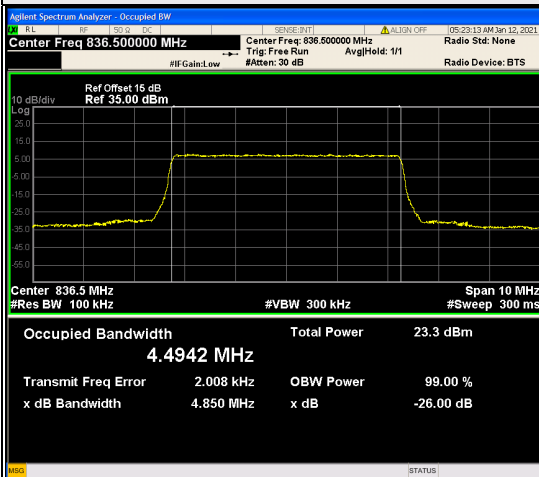
1.4MHz / QPSK



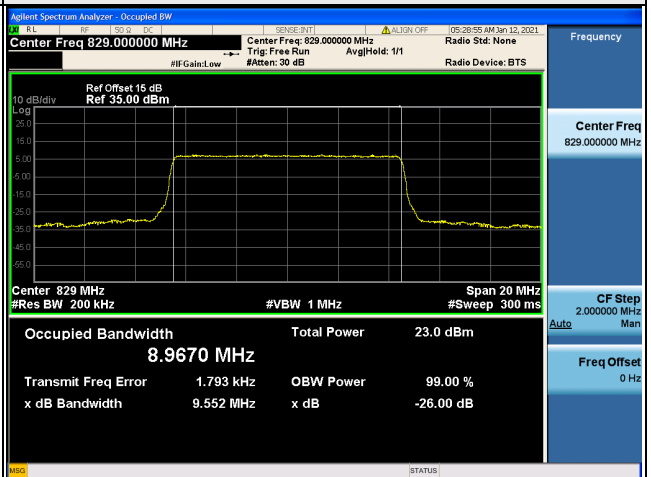
3MHz / QPSK



5MHz / QPSK



10MHz / QPSK

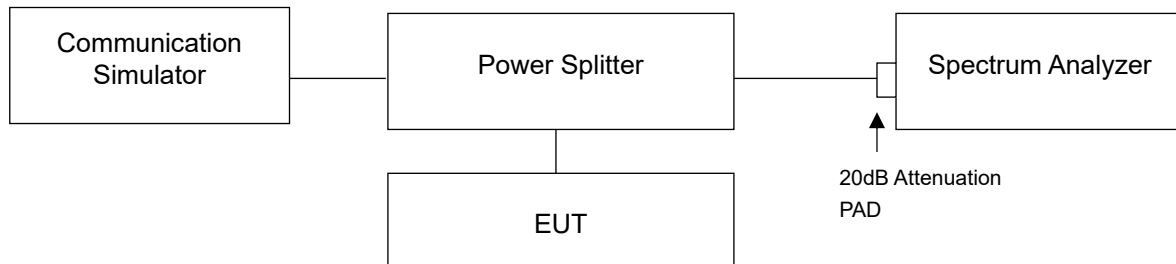


4.5 Band Edge Measurement

4.5.1 Limits of Band Edge Measurement

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. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

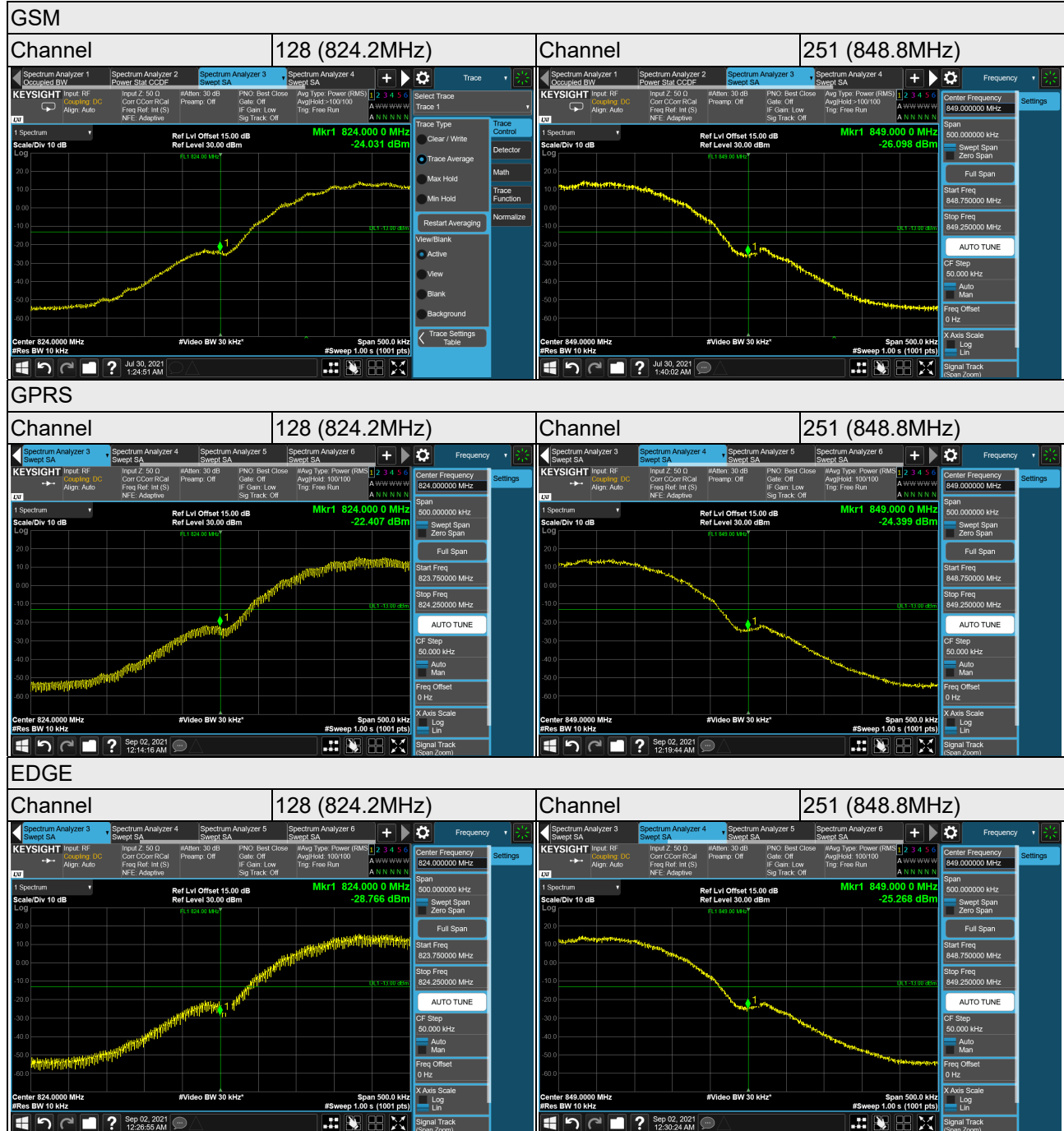
4.5.2 Test Setup



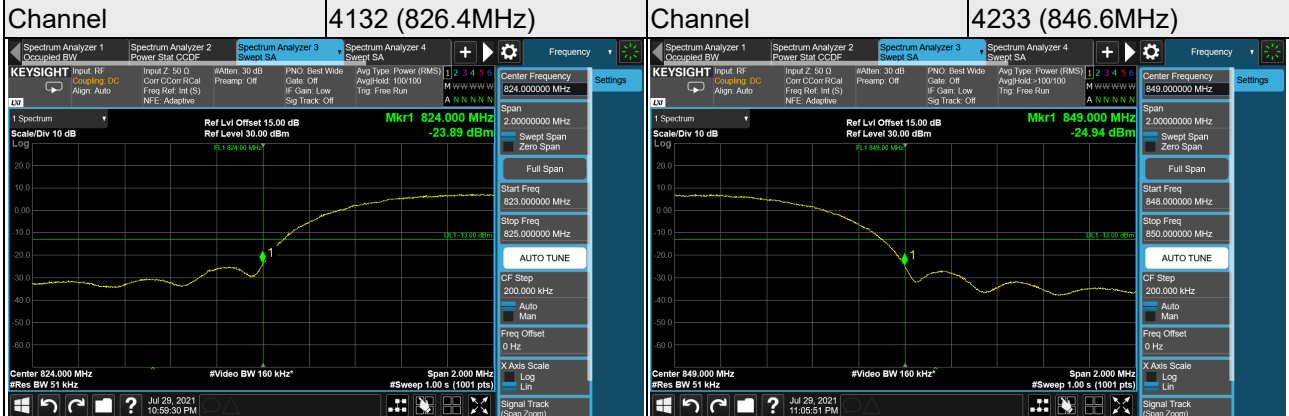
4.5.3 Test Procedures

- All measurements were done at low and high operational frequency range.
- The center frequency of spectrum is the band edge frequency and span is 500kHz. RB of the spectrum is 10kHz and VB of the spectrum is 30kHz (GSM / GPRS / EDGE).
- The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 51kHz and VB of the spectrum is 160kHz (WCDMA / HSDPA / HSUPA).
- The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 15kHz and VB of the spectrum is 51kHz (LTE Channel Bandwidth 1.4MHz).
- The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 30kHz and VB of the spectrum is 100kHz (LTE Channel Bandwidth 3MHz).
- The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 51kHz and VB of the spectrum is 160kHz (LTE Channel Bandwidth 5MHz).
- The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 100kHz and VB of the spectrum is 300kHz (LTE Channel Bandwidth 10MHz).
- Record the max trace plot into the test report.

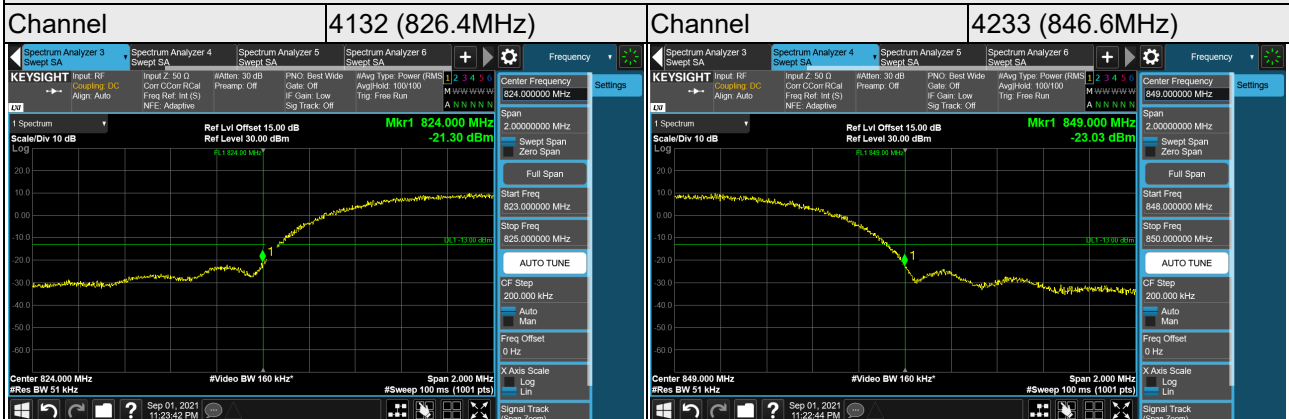
4.5.4 Test Results



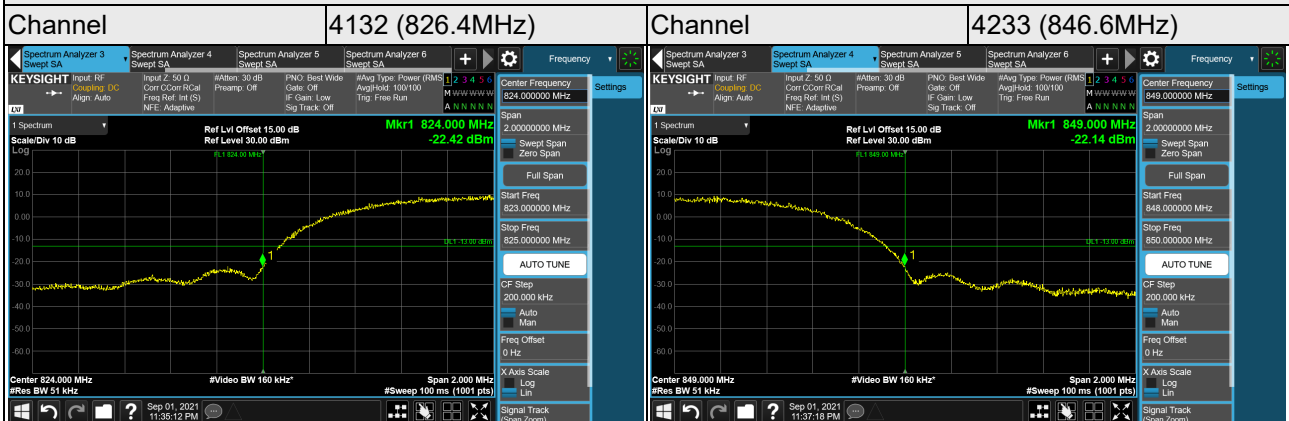
WCDMA



HSDPA



HSUPA



LTE Band 5, Channel Bandwidth 1.4MHz

Channel 20407
(824.7MHz)

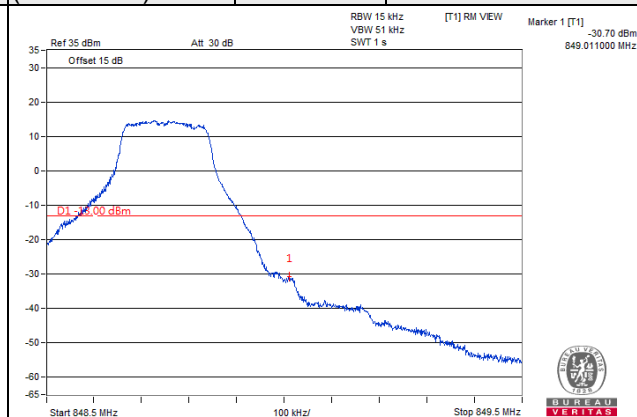
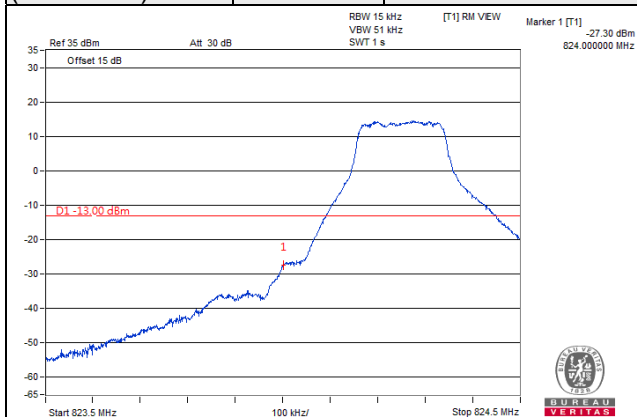
QPSK

1 RB / 0 RB Offset

Channel 20643
(848.3MHz)

QPSK

1 RB / 5 RB Offset



Channel 20407
(824.7MHz)

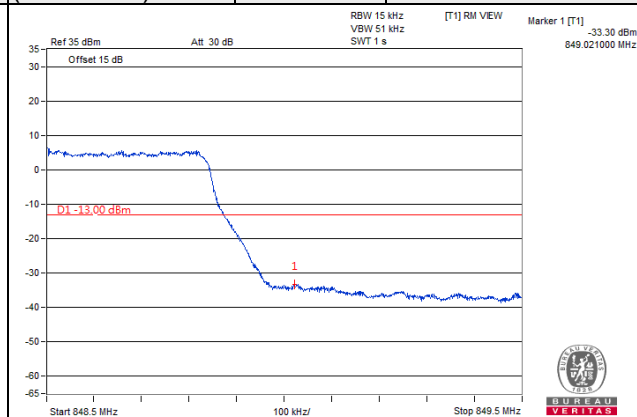
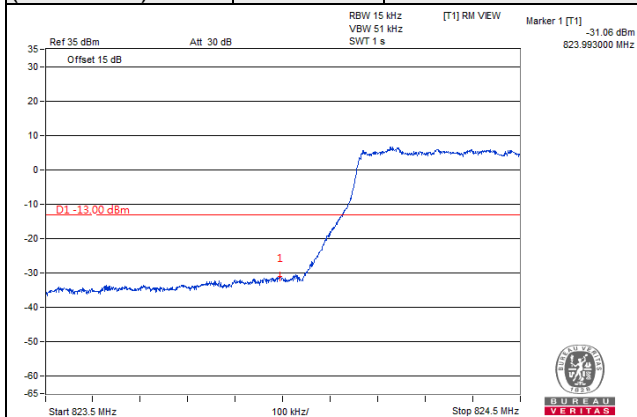
QPSK

6 RB / 0 RB Offset

Channel 20643
(848.3MHz)

QPSK

6 RB / 0 RB Offset



LTE Band 5, Channel Bandwidth 3MHz

Channel 20415
(825.5MHz)

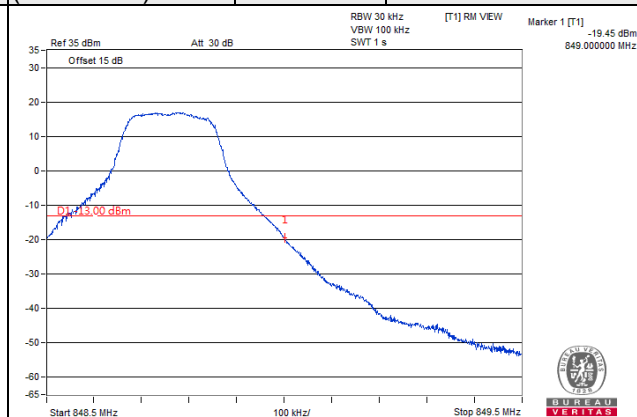
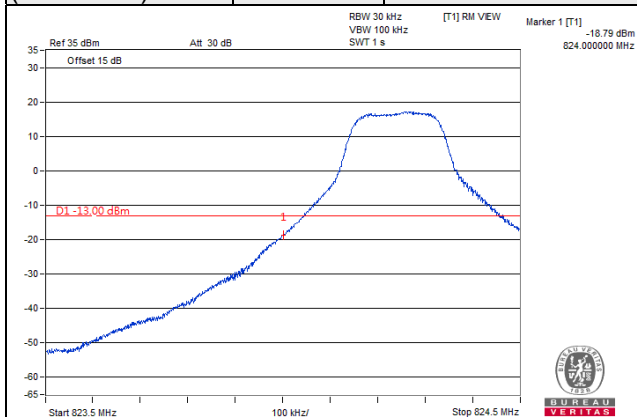
QPSK

1 RB / 0 RB Offset

Channel 20635
(847.5MHz)

QPSK

1 RB / 14 RB Offset



Channel 20415
(825.5MHz)

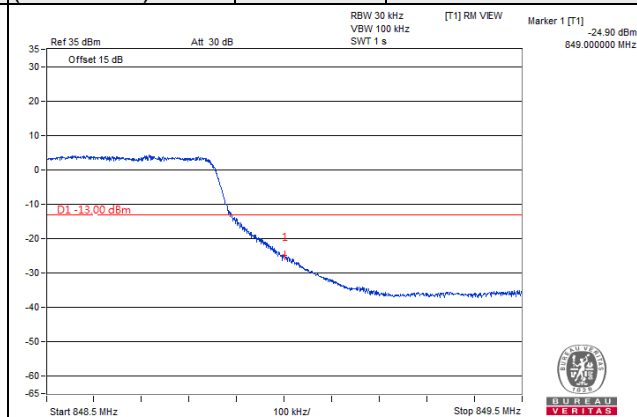
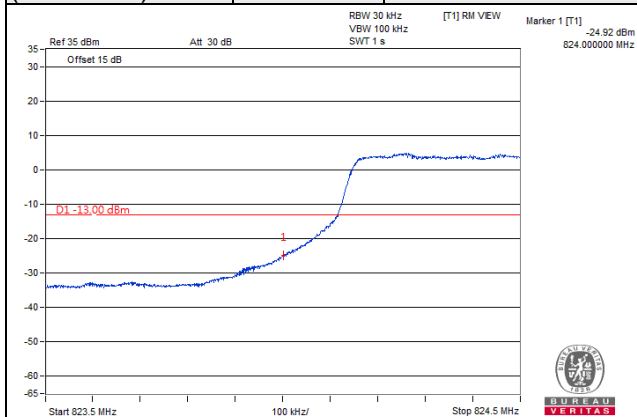
QPSK

15 RB / 0 RB Offset

Channel 20635
(847.5MHz)

QPSK

15 RB / 0 RB Offset



LTE Band 5, Channel Bandwidth 5MHz

Channel 20425
(826.5MHz)

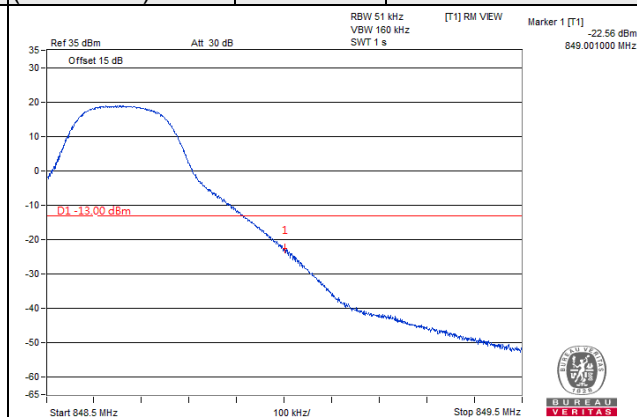
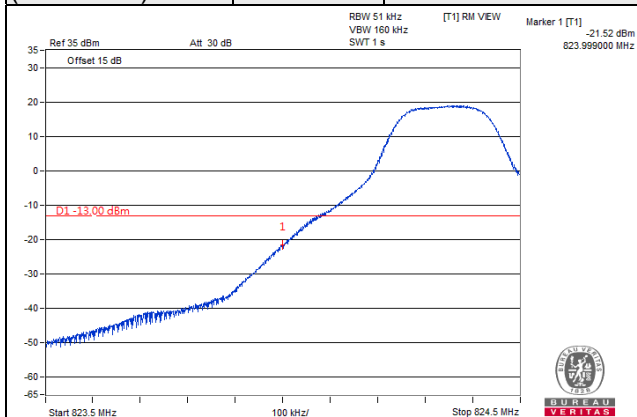
QPSK

1 RB / 0 RB Offset

Channel 20625
(846.5MHz)

QPSK

1 RB / 24 RB Offset



Channel 20425
(826.5MHz)

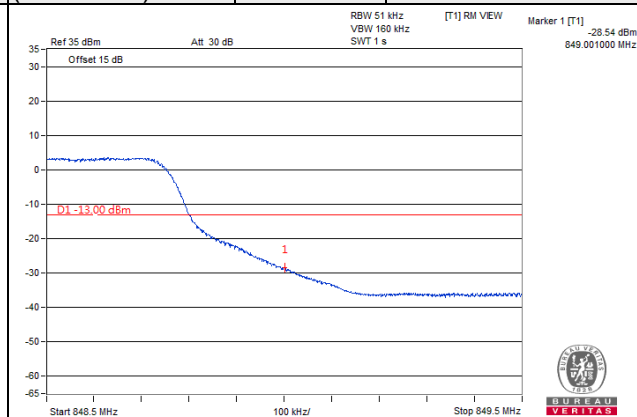
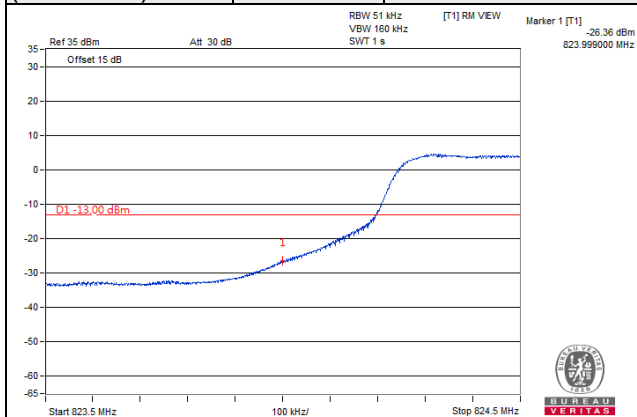
QPSK

25 RB / 0 RB Offset

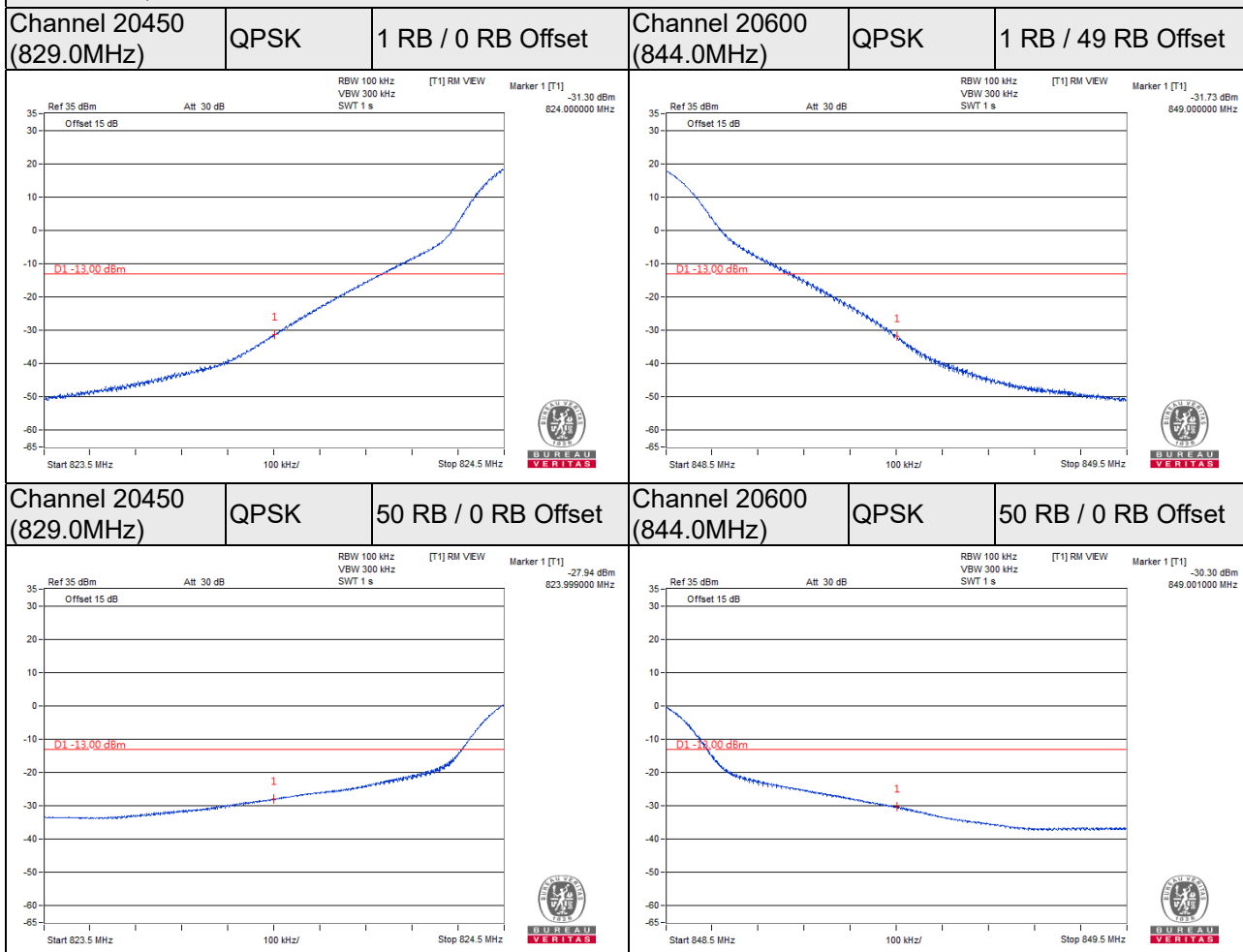
Channel 20625
(846.5MHz)

QPSK

25 RB / 0 RB Offset



LTE Band 5, Channel Bandwidth 10MHz

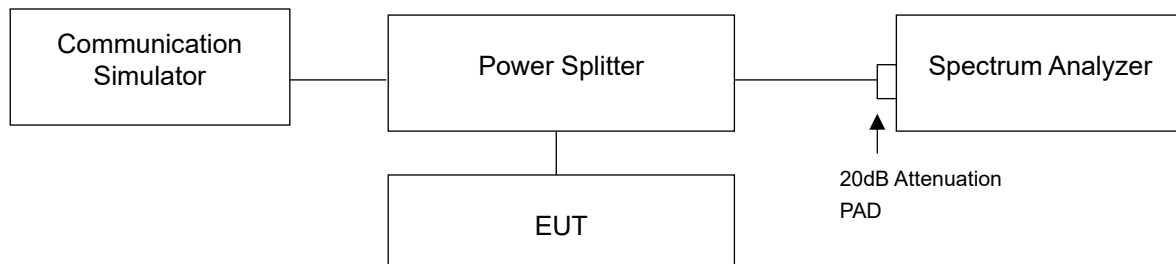


4.6 Peak to Average Ratio

4.6.1 Limits of Peak to Average Ratio Measurement

In measuring transmissions in this band using an average power technique, the peak to-average ratio (PAR) of the transmission may not exceed 13 dB

4.6.2 Test Setup

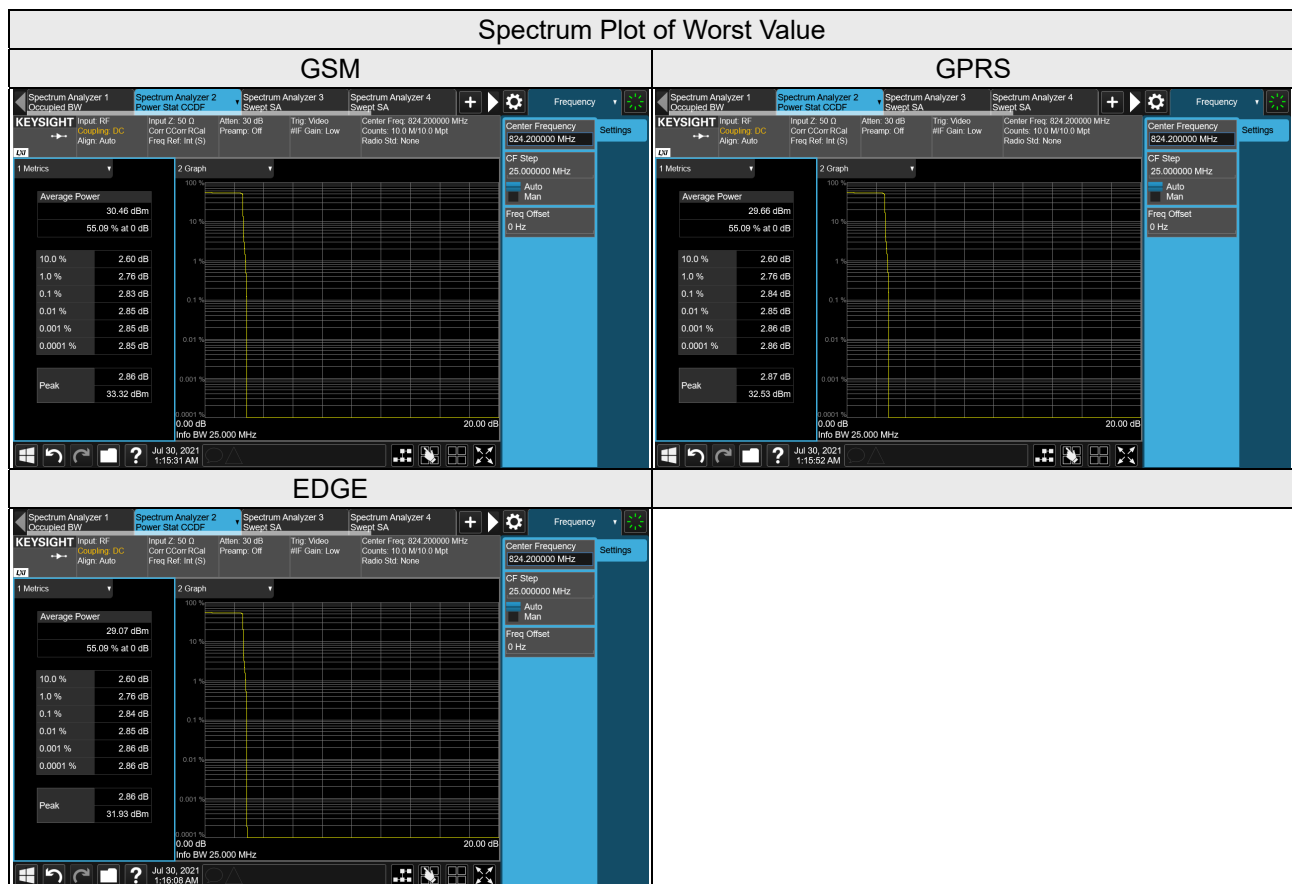


4.6.3 Test Procedures

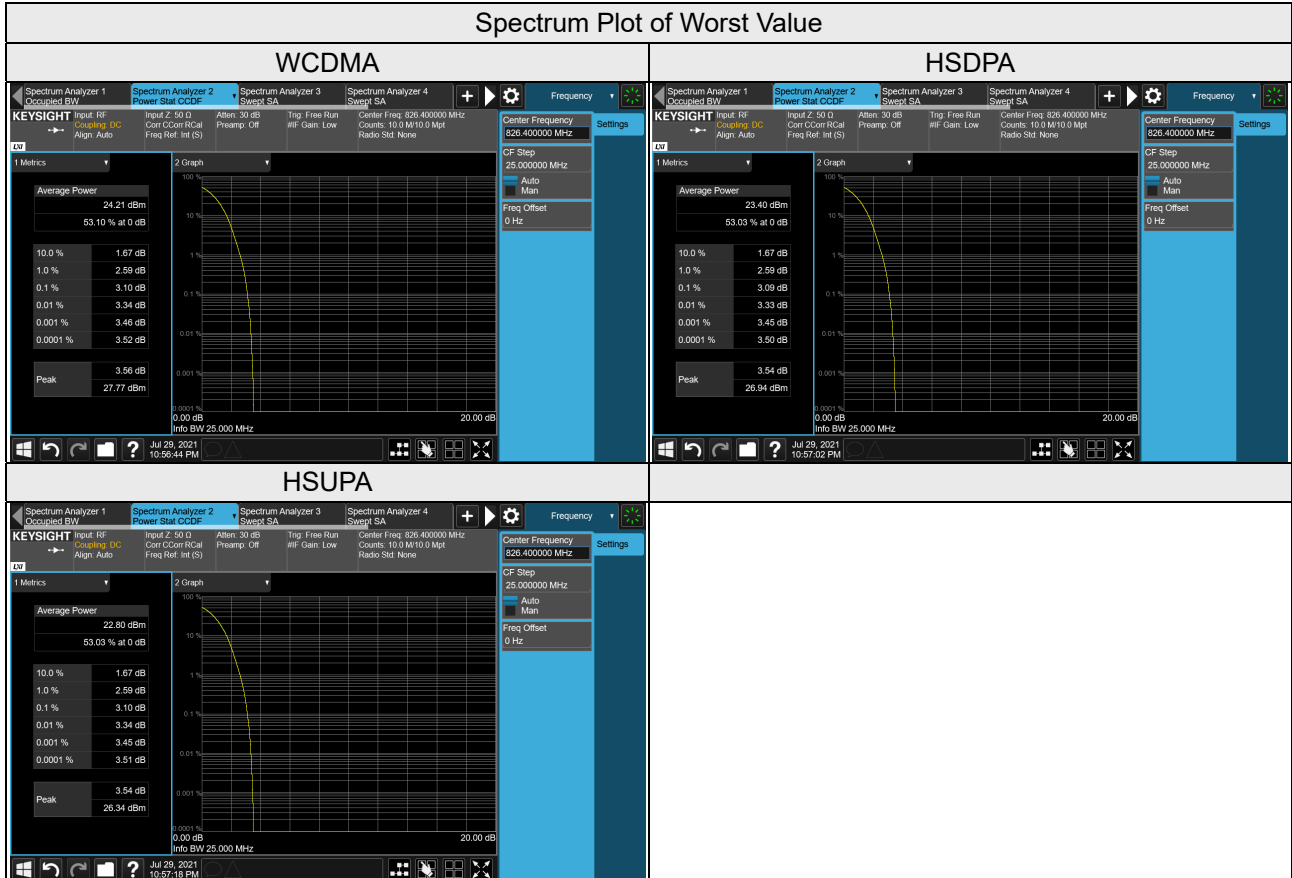
- Set resolution/measurement bandwidth $\geq$ signal's occupied bandwidth;
- Set the number of counts to a value that stabilizes the measured CCDF curve;
- Record the maximum PAPR level associated with a probability of 0.1%.

4.6.4 Test Results

Channel	Frequency (MHz)	Peak To Average Ratio (dB)		
		GSM	GPRS	EDGE
128	824.2	2.83	2.84	2.84
189	836.4	2.70	2.70	2.69
251	848.8	2.69	2.69	2.69



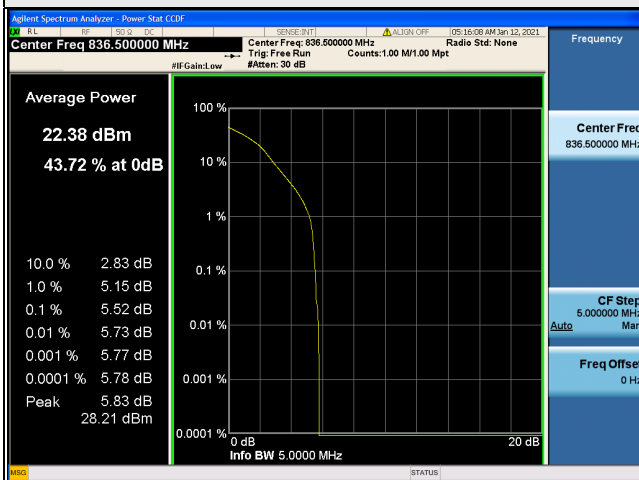
Channel	Frequency (MHz)	Peak To Average Ratio (dB)		
		WCDMA	HSDPA	HSUPA
4132	826.4	3.10	3.09	3.10
4182	836.4	3.08	3.09	3.09
4233	846.6	3.05	3.05	3.05



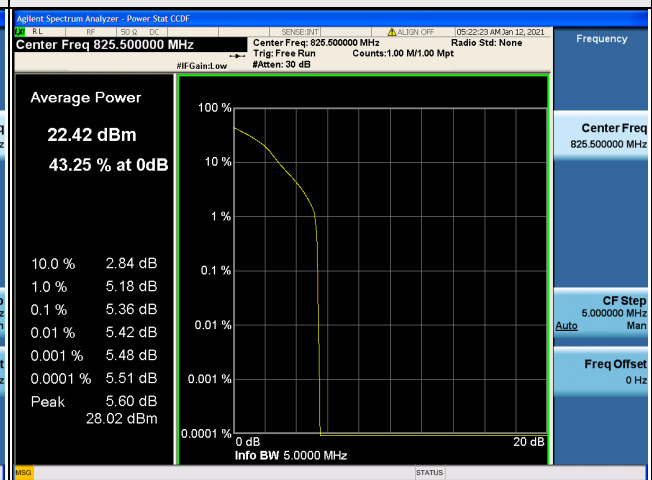
LTE Band 5, Channel Bandwidth 1.4MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
20407	824.7	3.81	5.51
20525	836.5	3.80	5.52
20643	848.3	3.79	5.36
LTE Band 5, Channel Bandwidth 3MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
20415	825.5	3.58	5.36
20525	836.5	3.58	5.33
20635	847.5	3.53	5.23
LTE Band 5, Channel Bandwidth 5MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
20425	826.5	3.56	5.29
20525	836.5	3.54	5.35
20625	846.5	3.53	5.25
LTE Band 5, Channel Bandwidth 10MHz			
Channel	Frequency (MHz)	Peak To Average Ratio (dB)	
		QPSK	16QAM
20450	829.0	3.47	5.22
20525	836.5	3.48	5.22
20600	844.0	3.49	5.23

Spectrum Plot of Worst Value

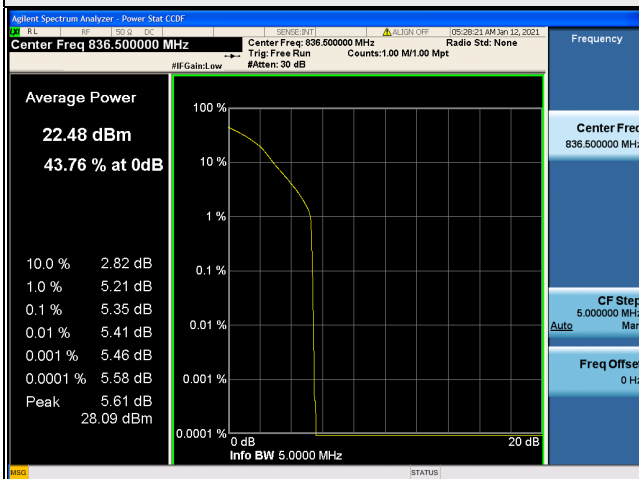
1.4MHz / 16QAM



3MHz / 16QAM



5MHz / 16QAM



10MHz / 16QAM

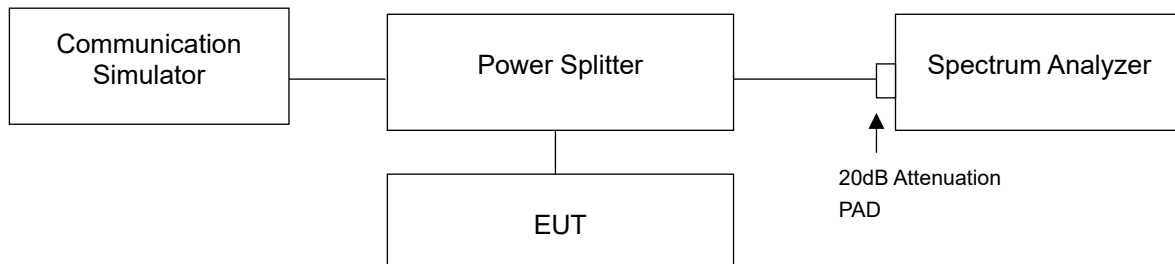


4.7 Conducted Spurious Emissions

4.7.1 Limits of Conducted Spurious Emissions Measurement

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 emission limit equal to -13dBm .

4.7.2 Test Setup



4.7.3 Test Procedure

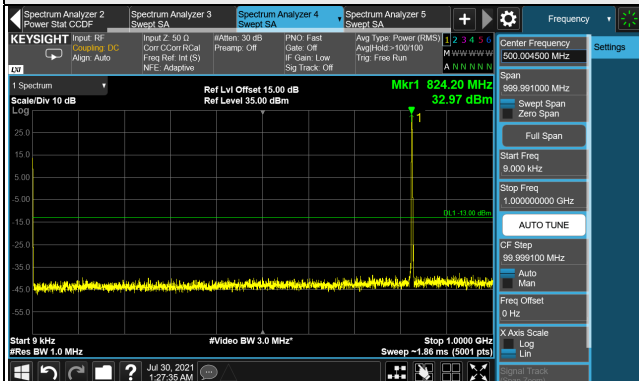
- The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.
- Measuring frequency range is from 9kHz to 10GHz. 20dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz are used for GSM and WCDMA band conducted emission measurement.
- Measuring frequency range is from 9kHz to 9GHz. 20dB attenuation pad is connected with spectrum. RBW=100kHz and VBW=300kHz for 9kHz to 1GHz and RBW=1MHz and VBW=3MHz for 1 GHz to 9GHz are used for LTE band conducted emission measurement.

4.7.4 Test Results

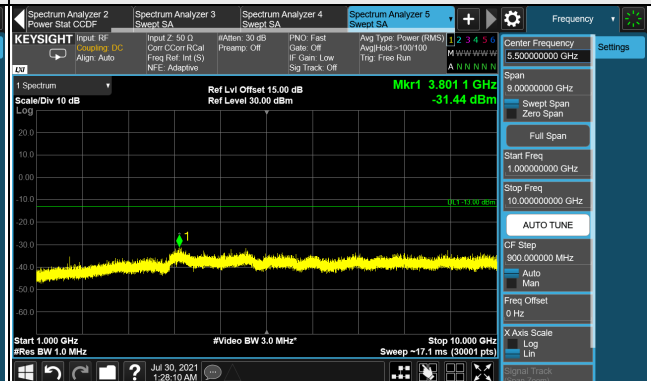
GSM

Channel 128 (824.2MHz)

Frequency Range : 9kHz ~ 1GHz

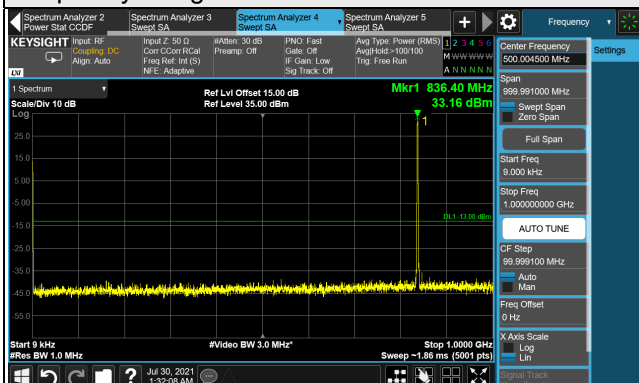


Frequency Range : 1GHz ~ 10GHz

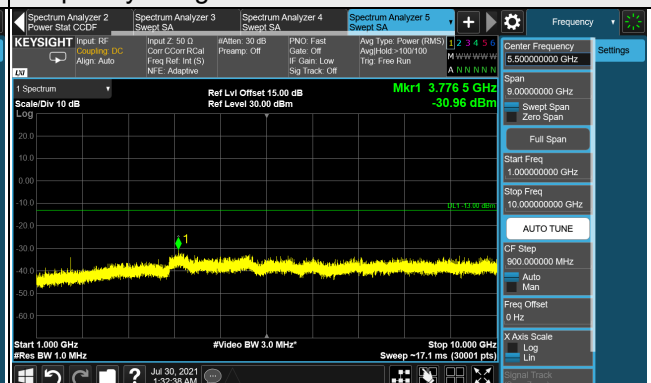


Channel 189 (836.4MHz)

Frequency Range : 9kHz ~ 1GHz

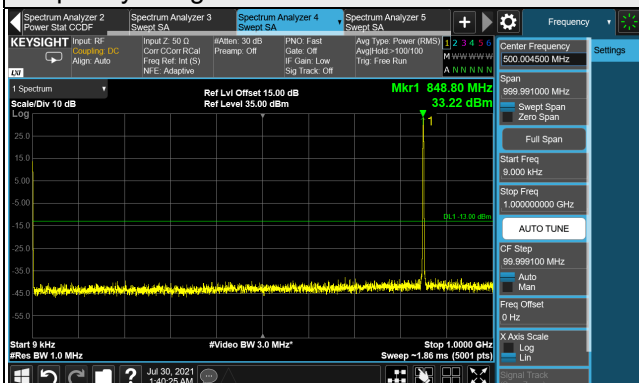


Frequency Range : 1GHz ~ 10GHz

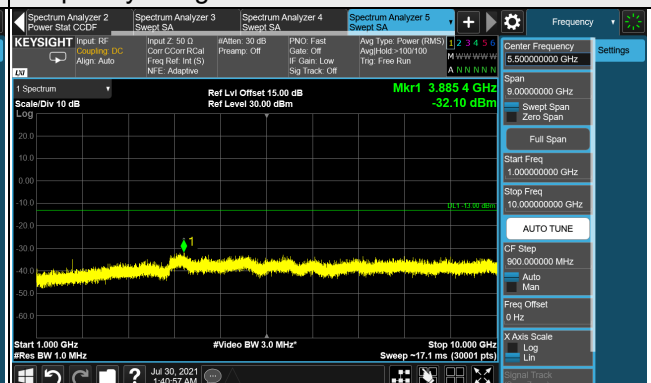


Channel 251 (848.8MHz)

Frequency Range : 9kHz ~ 1GHz



Frequency Range : 1GHz ~ 10GHz

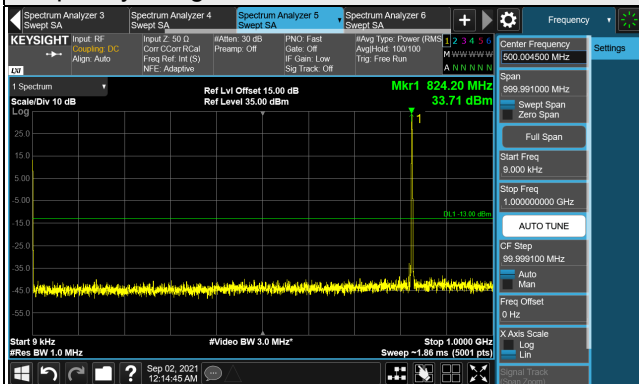


*The 9kHz signal over the limit is from Spectrum.

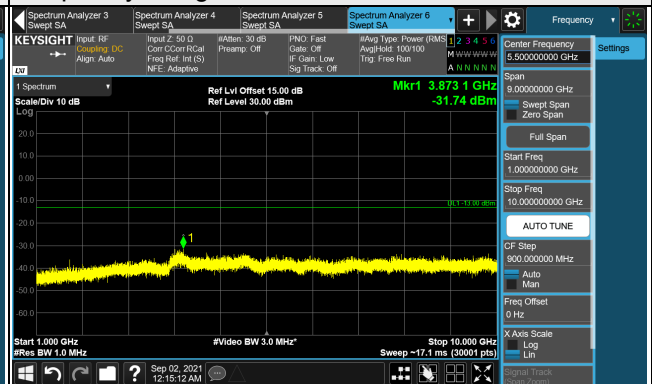
GPRS

Channel 128 (824.2MHz)

Frequency Range : 9kHz ~ 1GHz

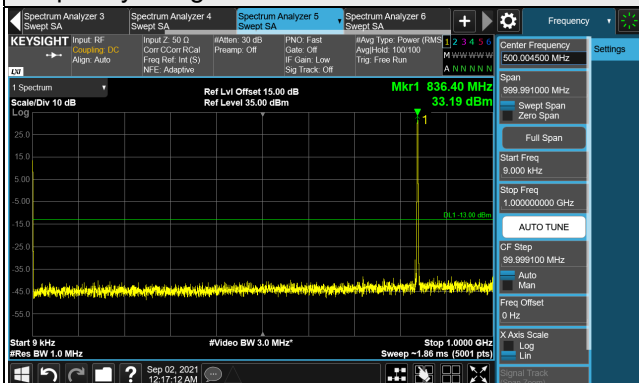


Frequency Range : 1GHz ~ 10GHz

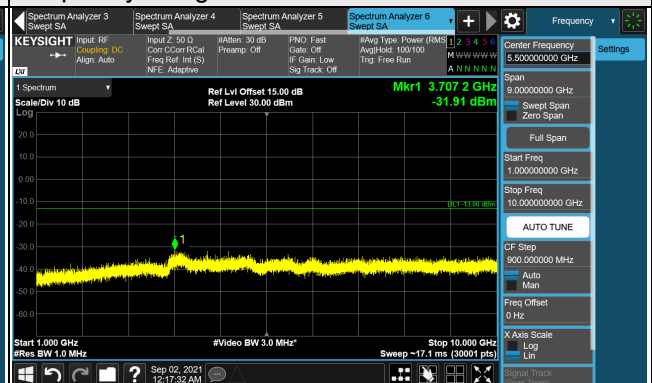


Channel 189 (836.4MHz)

Frequency Range : 9kHz ~ 1GHz

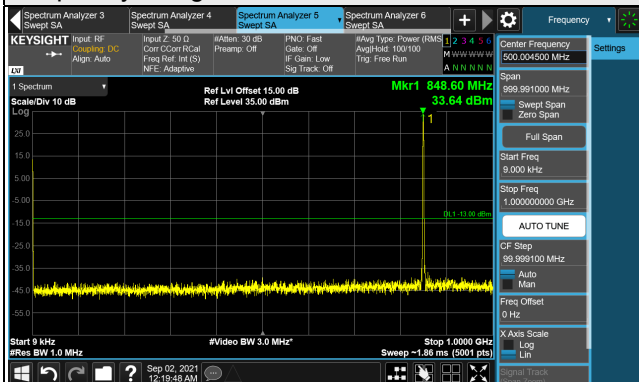


Frequency Range : 1GHz ~ 10GHz

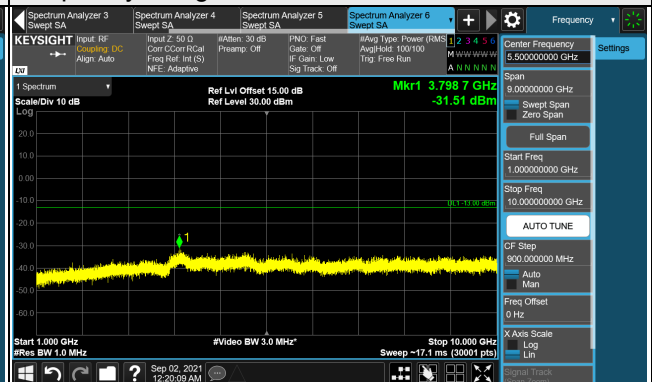


Channel 251 (848.8MHz)

Frequency Range : 9kHz ~ 1GHz



Frequency Range : 1GHz ~ 10GHz



*The 9kHz signal over the limit is from Spectrum.