

FCC Test Report

(PART 27)

Report No.: RF170713C17-3

FCC ID: XHG-R910

Test Model: FRKR910KIT

Received Date: Jul. 13, 2017

Test Date: Jul. 28, 2017 ~ Aug. 02, 2017

Issued Date: Aug. 18, 2017

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Release Control Record

Issue No.	Description	Date Issued
RF170713C17-3	Original Release	Aug. 18, 2017

1 Certificate of Conformity

Product: Mobile Hotspot

Brand: Franklin Wireless

Test Model: FRKR910KIT

Sample Status: Production Unit

Applicant: Franklin Technology Inc.

Test Date: Jul. 28, 2017 ~ Aug. 02, 2017

Standards: FCC Part 27, Subpart C, M

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 EMC characteristics under the conditions specified in this report.

Prepared by : Gina Liu, **Date:** Aug. 18, 2017

Gina Liu / Specialist

Approved by : David Huang, **Date:** Aug. 18, 2017

David Huang / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 27 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 27.50(h)	Equivalent Isotropic Radiated Power	Pass	Meet the requirement of limit.
2.1055 27.54	Frequency Stability	Pass	Meet the requirement of limit.
2.1049	Occupied Bandwidth	Pass	Meet the requirement of limit.
--	Peak to Average Ratio	Pass	Meet the requirement of limit.
2.1051 27.53(l)	Band Edge Measurements	Pass	Meet the requirement of limit.
2.1051 27.53(m)	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 27.53(m)	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -3.96 dB at 5012.00 MHz.

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:

Measurement	Frequency	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Feb. 17, 2017	Feb. 16, 2018
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 16, 2016	Dec. 15, 2017
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 13, 2016	Dec. 12, 2017
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Dec. 26, 2016	Dec. 27, 2017
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-969	Dec. 12, 2016	Dec. 13, 2017
Double Ridge Guide Horn Antenna EMCO	3115	5619	Dec. 26, 2016	Dec. 27, 2017
BILOG Antenna SCHWARZBECK	VULB 9168	9168-153	Dec. 12, 2016	Dec. 13, 2017
Agilent Communications Tester-Wireless	8960 Series 10	MY53201073	Jun. 28, 2017	Jun. 27, 2018
Preamplifier EMCI	EMC 012645	980115	Oct. 21, 2016	Oct. 20, 2017
Preamplifier EMCI	EMC 184045	980116	Oct. 21, 2016	Oct. 20, 2017
Preamplifier EMCI	EMC 330H	980112	Oct. 21, 2016	Oct. 20, 2017
Power Meter Anritsu	ML2495A	1232002	Sep. 08, 2016	Sep. 07, 2017
Power Sensor Anritsu	MA2411B	1207325	Sep. 08, 2016	Sep. 07, 2017
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	309219/4 2950114	Oct. 21, 2016	Oct. 20, 2017
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	250130/4	Oct. 21, 2016	Oct. 20, 2017
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 21, 2016	Oct. 20, 2017
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
Radio Communication Analyzer	MT8820C	6201300640	Aug. 10, 2015	Aug. 09, 2017
Temperature & Humidity Chamber	GTH-120-40-CP-AR	MAA1306-019	Sep. 02, 2016	Sep. 01, 2017
DC Power Supply Topward	33010D	807748	Oct. 25, 2016	Oct. 24, 2018
Digital Multimeter Fluke	87-III	70360742	Jul. 30, 2017	Jul. 29, 2018

Note:

1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The IC Site Registration No. is IC7450F-10.

3 General Information

3.1 General Description of EUT

Product	Mobile Hotspot				
Brand	Franklin Wireless				
Test Model	FRKR910KIT				
Status of EUT	Production Unit				
Power Supply Rating	3.8 Vdc (Battery) 5 Vdc (Adapter)				
Modulation Type	QPSK, 16QAM				
Frequency Range	LTE Band 41 (Channel Bandwidth: 5 MHz)	2498.5 ~ 2687.5 MHz			
	LTE Band 41 (Channel Bandwidth: 10 MHz)	2501.0 ~ 2685.0 MHz			
	LTE Band 41 (Channel Bandwidth: 15 MHz)	2503.5 ~ 2682.5 MHz			
	LTE Band 41 (Channel Bandwidth: 20 MHz)	2506.0 ~ 2680.0 MHz			
Max. EIRP Power	LTE Band 41 (Channel Bandwidth: 5 MHz)	97.95 mW			
	LTE Band 41 (Channel Bandwidth: 10 MHz)	103.04 mW			
	LTE Band 41 (Channel Bandwidth: 15 MHz)	110.15 mW			
	LTE Band 41 (Channel Bandwidth: 20 MHz)	112.72 mW			
Emission Designator	LTE Band 41 (Channel Bandwidth: 5 MHz)	4M50G7D			
	LTE Band 41 (Channel Bandwidth: 10 MHz)	8M99W7D			
	LTE Band 41 (Channel Bandwidth: 15 MHz)	13M4G7D			
	LTE Band 41 (Channel Bandwidth: 20 MHz)	17M9W7D			
Antenna Type	PCB Antenna				
Accessory Device	Refer to Note as below				
Data Cable Supplied	Refer to Note as below				

Note:

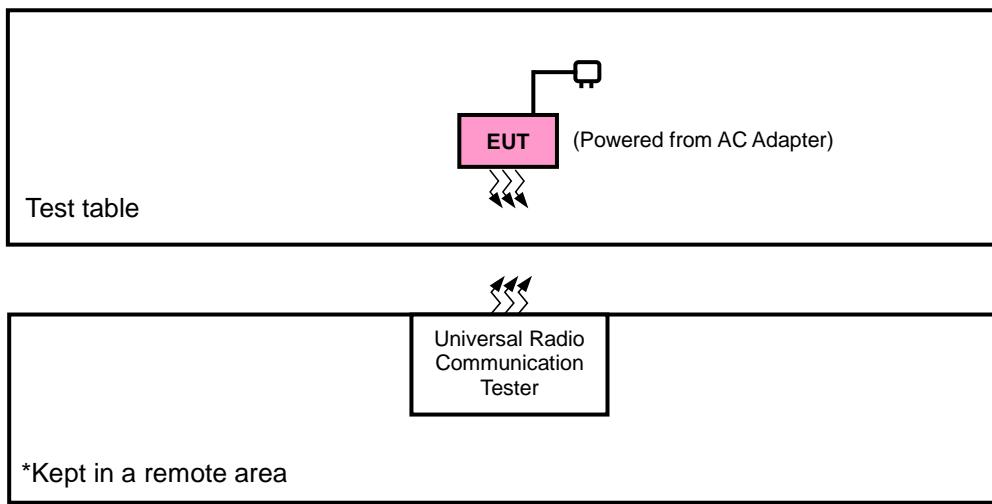
1. The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter	JIANGSU CHENYANG ELECTRON	CYSE12-050200U	I/P: 100-240 Vac, 50/60 Hz, 0.35 mA O/P: 5 Vdc, 2000 mA
Battery	BAK	R910	3.8 Vdc, 3000 mAh
Main Board	BOMIN	R910	--
BT/WLAN Module	Qualcomm Atheros	QCA-6174A-1	--

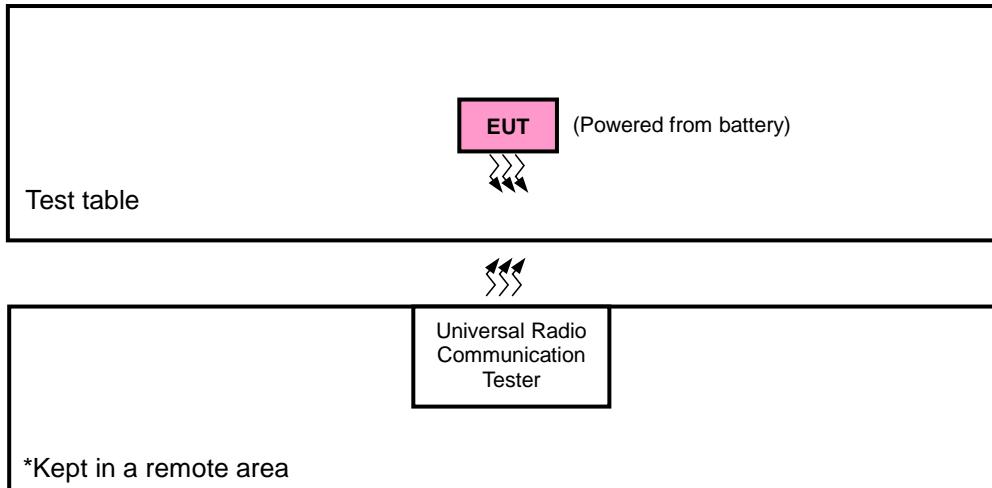
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Configuration of System under Test

<Radiated Emission Test>



<E.I.R.P. Test>



3.2.1 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

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	EIRP	Radiated Emission
LTE Band 41	Y-plane	Z-axis

LTE Band 41

EUT Configure Mode	Test Item	Available Channel	Tested Channel	Channel Bandwidth	Modulation	Mode
-	EIRP	39675 to 41565	39675, 40620, 41565	5 MHz	QPSK, 16QAM	1 RB / 12 RB Offset
		39700 to 41540	39700, 40620, 41540	10 MHz	QPSK, 16QAM	1 RB / 24 RB Offset
		39725 to 41515	39725, 40620, 41515	15 MHz	QPSK, 16QAM	1 RB / 37 RB Offset
		39750 to 41490	39750, 40620, 41490	20 MHz	QPSK, 16QAM	1 RB / 50 RB Offset
-	Frequency Stability	39675 to 41565	39675, 41565	5 MHz	QPSK	1 RB / 12 RB Offset
		39700 to 41540	39700, 41540	10 MHz	QPSK	1 RB / 24 RB Offset
		39725 to 41515	39725, 41515	15 MHz	QPSK	1 RB / 37 RB Offset
		39750 to 41490	39750, 41490	20 MHz	QPSK	1 RB / 50 RB Offset
-	Occupied Bandwidth	39675 to 41565	39675, 40620, 41565	5 MHz	QPSK, 16QAM	25 RB / 0 RB Offset
		39700 to 41540	39700, 40620, 41540	10 MHz	QPSK, 16QAM	50 RB / 0 RB Offset
		39725 to 41515	39725, 40620, 41515	15 MHz	QPSK, 16QAM	75 RB / 0 RB Offset
		39750 to 41490	39750, 40620, 41490	20 MHz	QPSK, 16QAM	100 RB / 0 RB Offset
-	Peak to Average Ratio	39675 to 41565	39675, 40620, 41565	5 MHz	QPSK, 16QAM	25 RB / 0 RB Offset
		39700 to 41540	39700, 40620, 41540	10 MHz	QPSK, 16QAM	1 RB / 0 RB Offset
		39725 to 41515	39725, 40620, 41515	15 MHz	QPSK, 16QAM	1 RB / 0 RB Offset
		39750 to 41490	39750, 40620, 41490	20 MHz	QPSK, 16QAM	1 RB / 0 RB Offset
-	Band Edge	39675 to 41565	39675, 41565	5 MHz	QPSK, 16QAM	25 RB / 0 RB Offset
		39700 to 41540	39700, 41540	10 MHz	QPSK, 16QAM	50 RB / 0 RB Offset
		39725 to 41515	39725, 41515	15 MHz	QPSK, 16QAM	75 RB / 0 RB Offset
		39750 to 41490	39750, 41490	20 MHz	QPSK, 16QAM	100 RB / 0 RB Offset
-	Conducted Emission	39675 to 41565	39675, 40620, 41565	5 MHz	QPSK	1 RB / 12 RB Offset
		39700 to 41540	39700, 40620, 41540	10 MHz	QPSK	1 RB / 24 RB Offset
		39725 to 41515	39725, 40620, 41515	15 MHz	QPSK	1 RB / 37 RB Offset
		39750 to 41490	39750, 40620, 41490	20 MHz	QPSK	1 RB / 50 RB Offset
-	Radiated Emission	39750 to 41490	39750, 40620, 41490	20 MHz	QPSK	1 RB / 50 RB Offset

Note: This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
EIRP	25 deg. C, 65 % RH	3.8 Vdc	Gavin Wu
Frequency Stability	25 deg. C, 65 % RH	3.8 Vdc	Carlos Chen
Occupied Bandwidth	25 deg. C, 65 % RH	3.8 Vdc	Carlos Chen
Band Edge	25 deg. C, 65 % RH	3.8 Vdc	Carlos Chen
Peak to Average Ratio	25 deg. C, 65 % RH	3.8 Vdc	Carlos Chen
Conducted Emission	25 deg. C, 65 % RH	3.8 Vdc	Carlos Chen
Radiated Emission	25 deg. C, 65 % RH	120 Vac, 60 Hz	Gavin Wu

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

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

FCC 47 CFR Part 2

FCC 47 CFR Part 27

KDB 971168 D01 Power Meas License Digital Systems v02r02

ANSI/TIA/EIA-603-D 2010

Note: 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

The radiated peak output power shall be according to the specific rule Part 27.50(h)(2) that “User stations are limited to 2 watts” and 27.50(i) specific that “Peak transmit power must be measure over any interval of continuous transmission using instrumentation calibration in terms of rms-equivalent voltage.”

4.1.2 Test Procedures

EIRP Measurement:

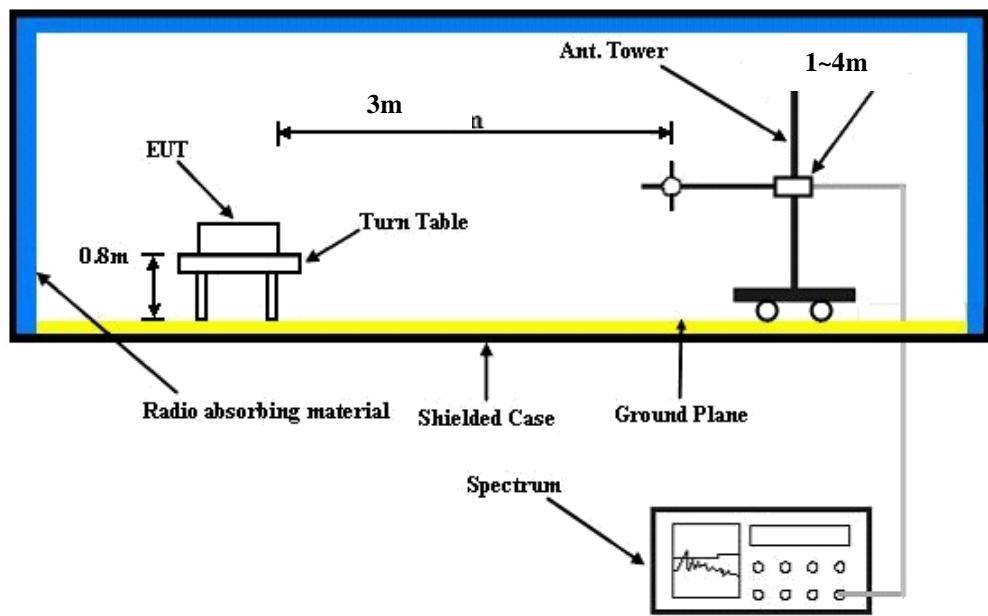
- a. All measurements were done at low, middle and high operational frequency range. RBW and VBW is 10 MHz for LTE mode.
- b. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.
- c. The substitution horn antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a tx cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to “Read Value” of step b. Record the power level of S.G.
- d. $EIRP = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution horn.}$

Conducted Power Measurement:

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

4.1.3 Test Setup

EIRP / ERP Measurement:



For the actual test configuration, please refer to the attached file (Test Setup Photo).

Conducted Power Measurement:



4.1.4 Test Results

Conducted Output Power (dBm)

Band / BW	RB Size	RB Offset	QPSK			3GPP MPR (dB)	16QAM			3GPP MPR (dB)
			Low Ch 39675	Mid Ch 40620	High Ch 41565		Low Ch 39675	Mid Ch 40620	High Ch 41565	
			2498.5 MHz	2593.0 MHz	2687.5 MHz		2498.5 MHz	2593.0 MHz	2687.5 MHz	
41 / 5M	1	0	23.1	22.7	23.1	0	22.1	21.8	21.6	1
	1	12	23.1	22.8	22.5	0	22.3	21.8	21.4	1
	1	24	23.3	22.7	22.3	0	22.4	21.8	21.2	1
	12	0	22.4	21.8	21.7	1	21.4	20.8	20.7	2
	12	6	22.4	21.9	21.7	1	21.3	20.9	20.7	2
	12	13	22.4	21.9	21.5	1	21.4	20.8	20.5	2
	25	0	22.3	21.9	21.6	1	21.4	20.9	20.6	2
41 / 10M	1	0	23.3	22.8	23.2	0	22.5	22.1	22.1	1
	1	24	23.2	22.6	22.5	0	22.4	21.9	21.6	1
	1	49	23.2	22.6	22.3	0	22.5	21.8	21.3	1
	25	0	22.4	21.9	21.9	1	21.5	21.0	21.0	2
	25	12	22.5	21.9	21.7	1	21.6	21.0	20.8	2
	25	25	22.5	21.9	21.6	1	21.6	20.9	20.7	2
	50	0	22.5	21.9	21.7	1	21.6	21.0	20.8	2
41 / 15M	1	0	23.6	23.1	23.3	0	22.9	22.3	22.4	1
	1	37	23.4	22.8	22.8	0	22.2	21.6	21.5	1
	1	74	23.6	22.9	22.2	0	22.7	22.0	21.4	1
	36	0	22.7	22.1	22.2	1	21.7	21.1	21.2	2
	36	19	22.6	22.0	21.9	1	21.6	20.9	20.9	2
	36	39	22.6	22.0	21.6	1	21.6	20.9	20.7	2
	75	0	22.6	22.1	22.0	1	21.7	21.0	21.0	2
41 / 20M	1	0	24.01	23.55	23.79	0	23.2	22.7	22.8	1
	1	50	23.31	22.58	22.76	0	22.4	21.8	21.8	1
	1	99	23.74	23.08	22.63	0	22.9	22.2	21.6	1
	50	0	22.74	22.17	22.33	1	21.8	21.2	21.4	2
	50	25	22.56	21.98	22.03	1	21.7	21.0	21.1	2
	50	50	22.73	22.06	21.85	1	21.9	21.1	20.9	2
	100	0	22.71	22.15	22.16	1	21.8	21.2	21.2	2

LTE Band 41								
Channel Bandwidth: 5 MHz / QPSK								
Plane	Channel	Frequency (MHz)	LVL (dBm)	Correction Factor (dB)	EIRP (dBm)	EIRP (mW)	Polarization (H/V)	
Y	39675	2498.5	-23.49	38.99	15.50	35.48	H	
	40620	2593.0	-22.22	38.17	15.95	39.36		
	41565	2687.5	-23.47	38.55	15.08	32.21		
	39675	2498.5	-19.55	39.27	19.72	93.69	V	
	40620	2593.0	-18.77	38.68	19.91	97.95		
	41565	2687.5	-19.47	38.55	19.08	80.91		
Channel Bandwidth: 5 MHz / 16QAM								
Y	39675	2498.5	-24.39	38.99	14.60	28.84	H	
	40620	2593.0	-23.12	38.17	15.05	31.99		
	41565	2687.5	-24.37	38.55	14.18	26.18		
	39675	2498.5	-20.45	39.27	18.82	76.16	V	
	40620	2593.0	-19.67	38.68	19.01	79.62		
	41565	2687.5	-20.37	38.55	18.18	65.77		
LTE Band 41								
Channel Bandwidth: 10 MHz / QPSK								
Plane	Channel	Frequency (MHz)	LVL (dBm)	Correction Factor (dB)	EIRP (dBm)	EIRP (mW)	Polarization (H/V)	
Y	39700	2501.0	-23.03	38.98	15.95	39.36	H	
	40620	2593.0	-22.09	38.17	16.08	40.55		
	41540	2685.0	-22.66	38.45	15.79	37.93		
	39700	2501.0	-19.22	39.04	19.82	95.94	V	
	40620	2593.0	-18.55	38.68	20.13	103.04		
	41540	2685.0	-18.98	38.60	19.62	91.62		
Channel Bandwidth: 10 MHz / 16QAM								
Y	39700	2501.0	-23.94	38.98	15.04	31.92	H	
	40620	2593.0	-23.00	38.17	15.17	32.89		
	41540	2685.0	-23.57	38.45	14.88	30.76		
	39700	2501.0	-20.13	39.04	18.91	77.80	V	
	40620	2593.0	-19.46	38.68	19.22	83.56		
	41540	2685.0	-19.89	38.60	18.71	74.30		

LTE Band 41								
Channel Bandwidth: 15 MHz / QPSK								
Plane	Channel	Frequency (MHz)	LVL (dBm)	Correction Factor (dB)	EIRP (dBm)	EIRP (mW)	Polarization (H/V)	
Y	39725	2503.5	-23.01	39.09	16.08	40.55	H	
	40620	2593.0	-21.85	38.17	16.32	42.85		
	41515	2682.5	-22.55	38.52	15.97	39.54		
	39725	2503.5	-19.14	39.04	19.90	97.72	V	
	40620	2593.0	-18.26	38.68	20.42	110.15		
	41515	2682.5	-18.66	38.66	20.00	100.00		
Channel Bandwidth: 15 MHz / 16QAM								
Y	39725	2503.5	-23.90	39.09	15.19	33.04	H	
	40620	2593.0	-22.74	38.17	15.43	34.91		
	41515	2682.5	-23.44	38.52	15.08	32.21		
	39725	2503.5	-20.03	39.04	19.01	79.62	V	
	40620	2593.0	-19.15	38.68	19.53	89.74		
	41515	2682.5	-19.55	38.66	19.11	81.47		
LTE Band 41								
Channel Bandwidth: 20 MHz / QPSK								
Plane	Channel	Frequency (MHz)	LVL (dBm)	Correction Factor (dB)	EIRP (dBm)	EIRP (mW)	Polarization (H/V)	
Y	39750	2506.0	-22.92	39.26	16.34	43.05	H	
	40620	2593.0	-21.62	38.17	16.55	45.19		
	41490	2680.0	-22.69	38.71	16.02	39.99		
	39750	2506.0	-19.25	39.33	20.08	101.86	V	
	40620	2593.0	-18.16	38.68	20.52	112.72		
	41490	2680.0	-18.54	38.76	20.22	105.20		
Channel Bandwidth: 20 MHz / 16QAM								
Y	39750	2506.0	-23.83	39.26	15.43	34.91	H	
	40620	2593.0	-22.53	38.17	15.64	36.64		
	41490	2680.0	-23.60	38.71	15.11	32.43		
	39750	2506.0	-20.16	39.33	19.17	82.60	V	
	40620	2593.0	-19.07	38.68	19.61	91.41		
	41490	2680.0	-19.45	38.76	19.31	85.31		

4.2 Frequency Stability Measurement

4.2.1 Limits of Frequency Stability Measurement

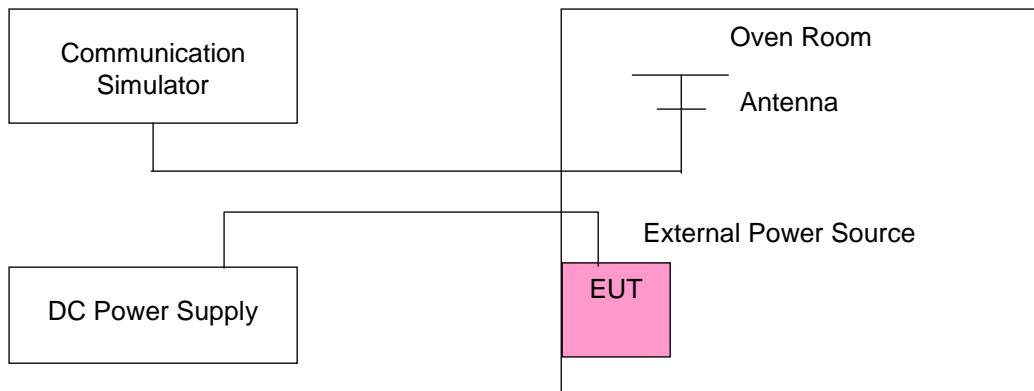
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

4.2.2 Test Procedure

- a. 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.
- b. 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.
- c. 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.

4.2.3 Test Setup



4.2.4 Test Results

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 5 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
3.8	2498.500002	0.001	2687.500001	0.000	2.5	
3.6	2498.500001	0.000	2687.500004	0.001	2.5	
4.35	2498.500002	0.001	2687.500002	0.001	2.5	

Note: The applicant defined the normal working voltage of the battery is from 3.6 Vdc to 4.35 Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 5 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
-30	2498.500002	0.001	2687.500002	0.001	2.5	
-20	2498.500003	0.001	2687.500002	0.001	2.5	
-10	2498.500003	0.001	2687.500001	0.000	2.5	
0	2498.500004	0.002	2687.500003	0.001	2.5	
10	2498.500001	0.001	2687.500003	0.001	2.5	
20	2498.499997	-0.001	2687.499997	-0.001	2.5	
30	2498.499997	-0.001	2687.499998	-0.001	2.5	
40	2498.499997	-0.001	2687.499999	-0.001	2.5	
50	2498.499998	-0.001	2687.499997	-0.001	2.5	
60	2498.499998	-0.001	2687.499997	-0.001	2.5	

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 10 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
3.8	2501.000003	0.001	2685.000003	0.001	2.5	
3.6	2501.000003	0.001	2685.000004	0.001	2.5	
4.35	2501.000003	0.001	2685.000003	0.001	2.5	

Note: The applicant defined the normal working voltage of the battery is from 3.6 Vdc to 4.35 Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 10 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
-30	2501.000003	0.001	2685.000003	0.001	2.5	
-20	2501.000003	0.001	2685.000004	0.001	2.5	
-10	2501.000001	0.001	2685.000001	0.000	2.5	
0	2501.000002	0.001	2685.000001	0.001	2.5	
10	2501.000001	0.000	2685.000004	0.001	2.5	
20	2500.999998	-0.001	2684.999996	-0.001	2.5	
30	2500.999998	-0.001	2684.999998	-0.001	2.5	
40	2500.999997	-0.001	2684.999997	-0.001	2.5	
50	2500.999997	-0.001	2684.999998	-0.001	2.5	
60	2500.999997	-0.001	2684.999999	0.000	2.5	

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 15 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
3.8	2503.500003	0.001	2682.500002	0.001	2.5	
3.6	2503.500003	0.001	2682.500003	0.001	2.5	
4.35	2503.500004	0.002	2682.500003	0.001	2.5	

Note: The applicant defined the normal working voltage of the battery is from 3.6 Vdc to 4.35 Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 15 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
-30	2503.500004	0.001	2682.500003	0.001	2.5	
-20	2503.500001	0.001	2682.500003	0.001	2.5	
-10	2503.500002	0.001	2682.500004	0.001	2.5	
0	2503.500003	0.001	2682.500003	0.001	2.5	
10	2503.500003	0.001	2682.500003	0.001	2.5	
20	2503.499997	-0.001	2682.499997	-0.001	2.5	
30	2503.499997	-0.001	2682.499999	-0.001	2.5	
40	2503.499996	-0.002	2682.499998	-0.001	2.5	
50	2503.499996	-0.002	2682.499997	-0.001	2.5	
60	2503.499998	-0.001	2682.499998	-0.001	2.5	

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 20 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
3.8	2506.000002	0.001	2680.000002	0.001	2.5	
3.6	2506.000003	0.001	2680.000004	0.001	2.5	
4.35	2506.000004	0.001	2680.000003	0.001	2.5	

Note: The applicant defined the normal working voltage of the battery is from 3.6 Vdc to 4.35 Vdc.

Frequency Error vs. Temperature

Temp. (°C)	LTE Band 41				Limit (ppm)	
	Channel Bandwidth: 20 MHz					
	Low Channel		High Channel			
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)		
-30	2506.000002	0.001	2680.000002	0.001	2.5	
-20	2506.000003	0.001	2680.000002	0.001	2.5	
-10	2506.000002	0.001	2680.000003	0.001	2.5	
0	2506.000002	0.001	2680.000004	0.001	2.5	
10	2506.000004	0.001	2680.000002	0.001	2.5	
20	2505.999998	-0.001	2679.999998	-0.001	2.5	
30	2505.999999	0.000	2679.999999	0.000	2.5	
40	2505.999996	-0.002	2679.999996	-0.001	2.5	
50	2505.999997	-0.001	2679.999996	-0.001	2.5	
60	2505.999998	-0.001	2679.999997	-0.001	2.5	

4.3 Occupied Bandwidth Measurement

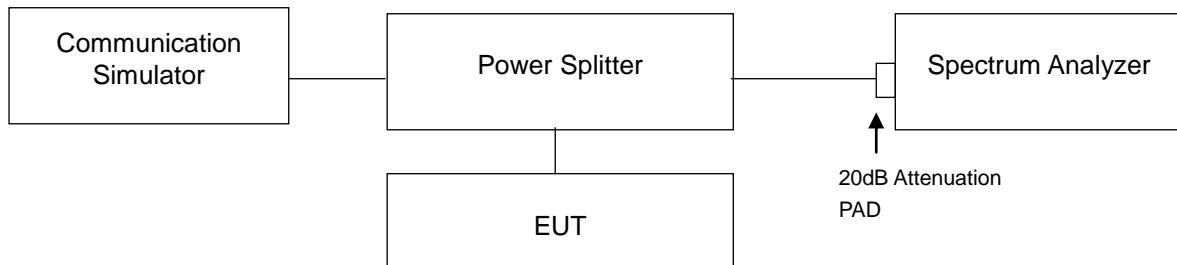
4.3.1 Limits of Occupied Bandwidth Measurement

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

4.3.2 Test Procedure

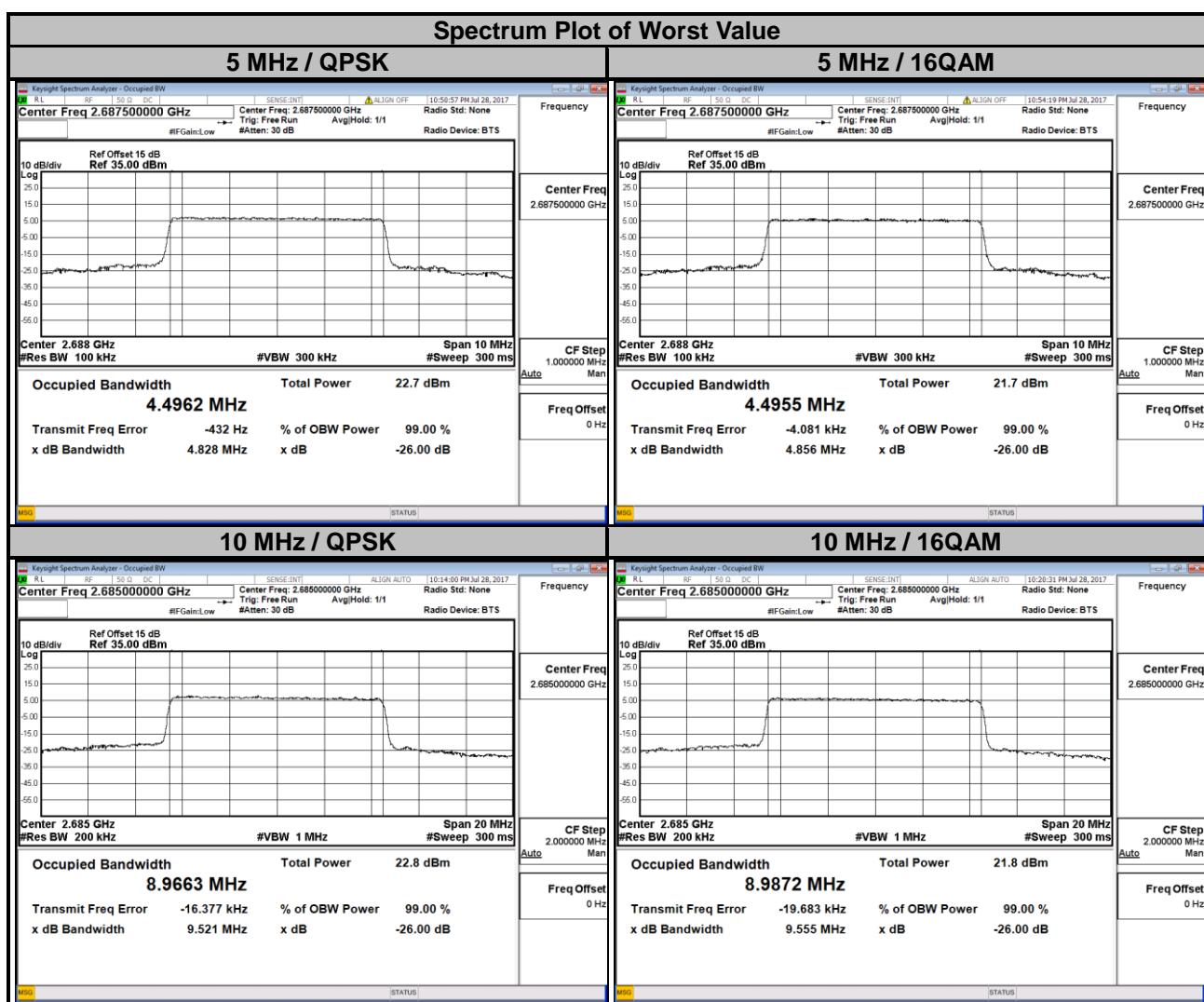
- The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

4.3.3 Test Setup

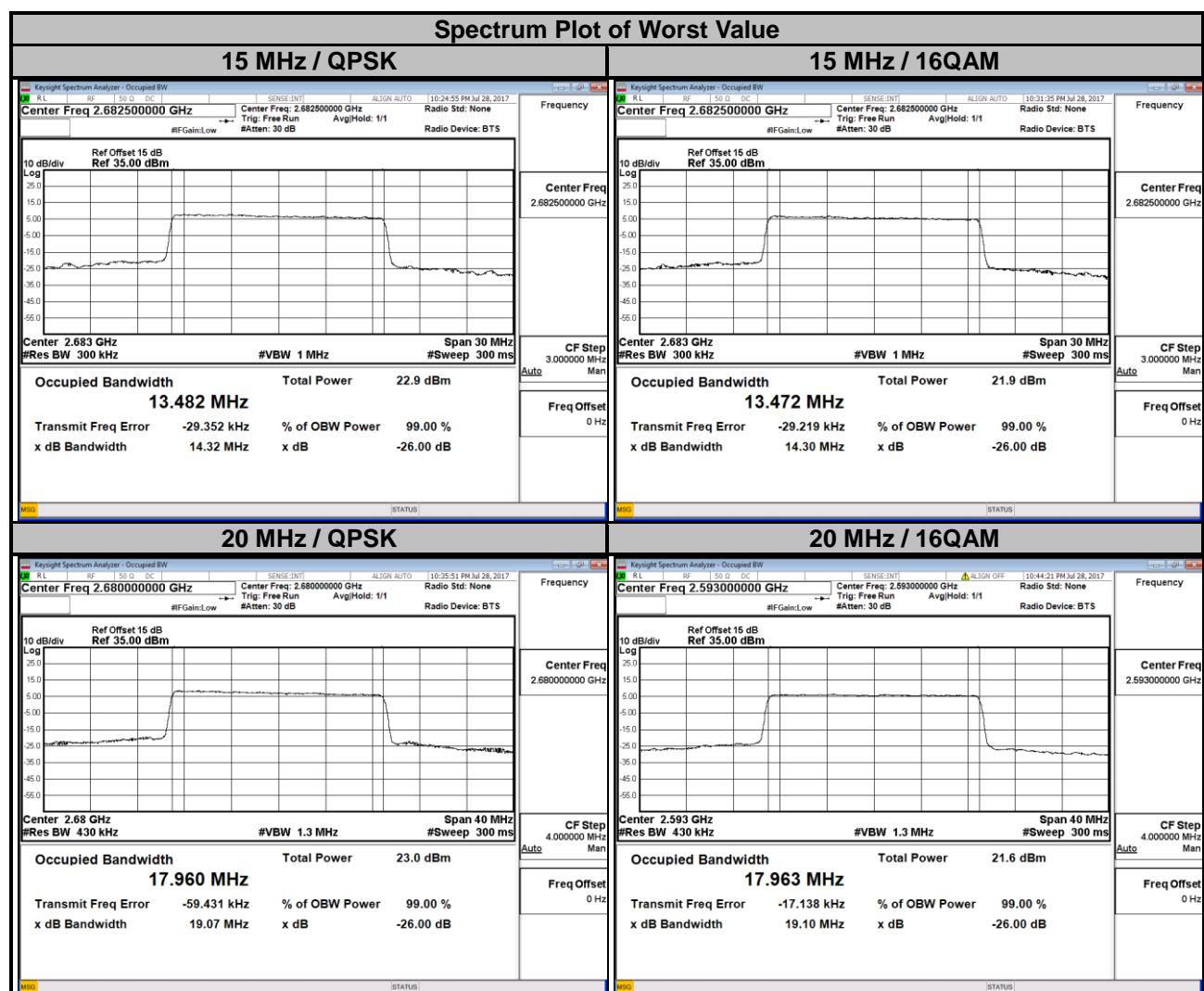


4.3.4 Test Result

LTE Band 41							
Channel Bandwidth: 5 MHz				Channel Bandwidth: 10 MHz			
Channel	Frequency (MHz)	99 % Occupied Bandwidth (MHz)		Channel	Frequency (MHz)	99 % Occupied Bandwidth (MHz)	
		QPSK	16QAM			QPSK	16QAM
39675	2498.5	4.49	4.49	39700	2501.0	8.97	8.97
40620	2593.0	4.50	4.49	40620	2593.0	8.96	8.97
41565	2687.5	4.50	4.50	41540	2685.0	8.97	8.99



LTE Band 41							
Channel Bandwidth: 15 MHz				Channel Bandwidth: 20 MHz			
Channel	Frequency (MHz)	99 % Occupied Bandwidth (MHz)		Channel	Frequency (MHz)	99 % Occupied Bandwidth (MHz)	
		QPSK	16QAM			QPSK	16QAM
39725	2503.5	13.48	13.46	39750	2506.0	17.94	17.95
40620	2593.0	13.47	13.47	40620	2593.0	17.96	17.96
41515	2682.5	13.48	13.47	41490	2680.0	17.96	17.96

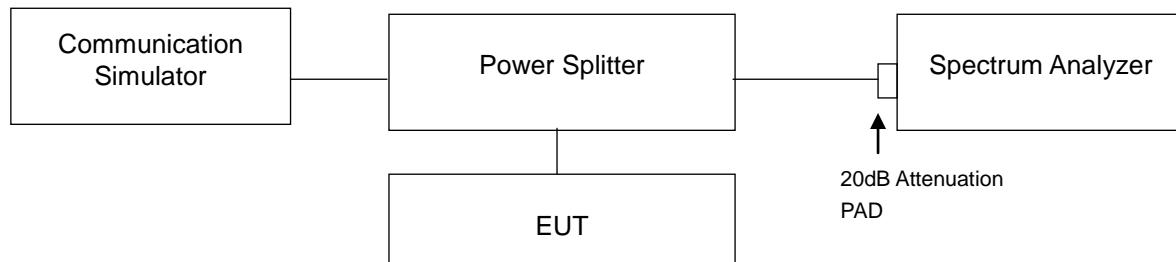


4.4 Band Edge Measurement

4.4.1 Limits of Band Edge Measurement

According to FCC 27.53(l)(4) specified that power of any emission outside of the channel edge must be attenuated below the transmitting power (P) by a factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth. In addition, the attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least two percent may be employed, except when the 1 megahertz band is 2495-2496 MHz, in which case a resolution bandwidth of at least one percent may be employed.

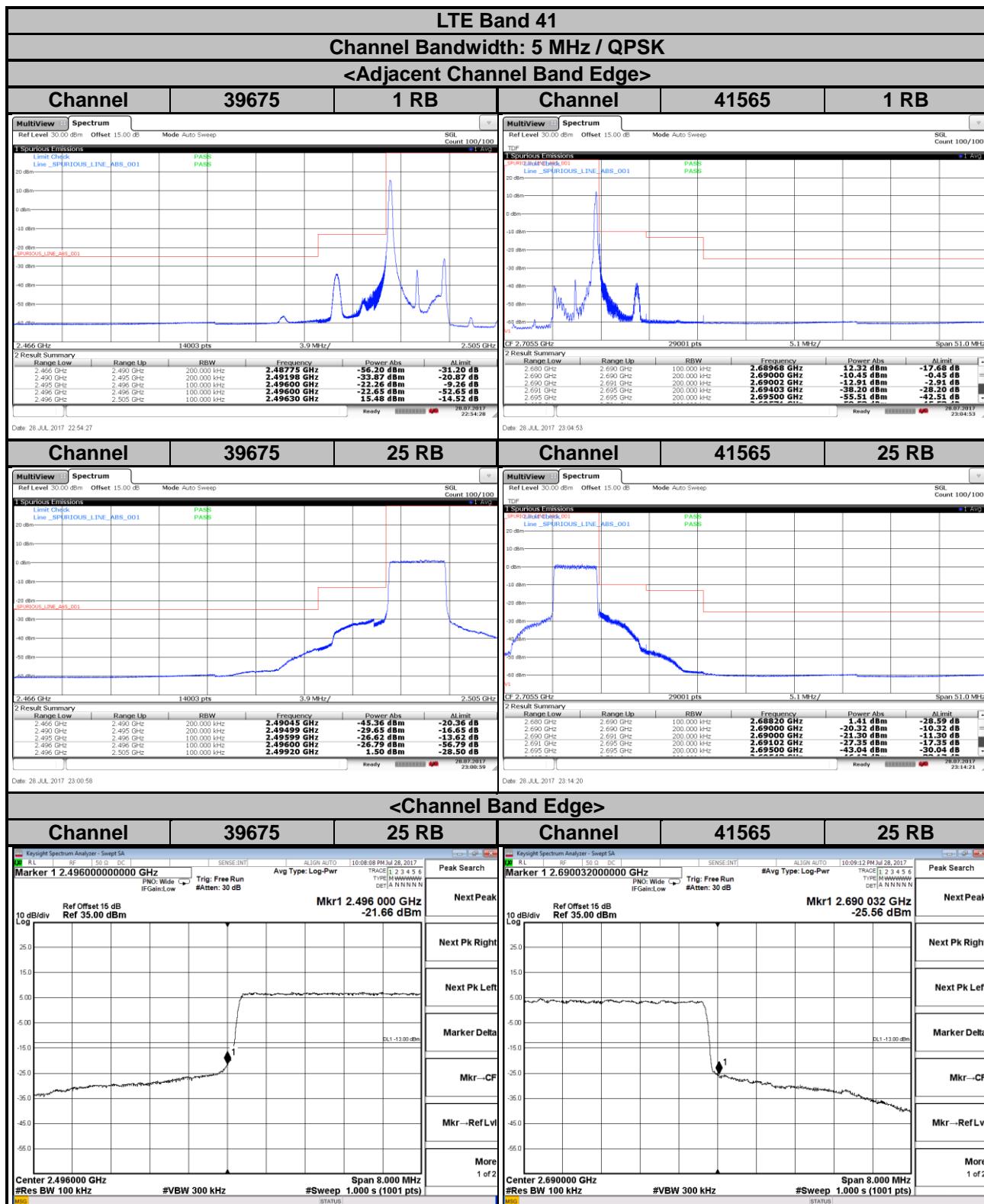
4.4.2 Test Setup



4.4.3 Test Procedures

- The EUT was set up for the maximum peak power with LTE link data modulation. The power was measured with R&S Spectrum Analyzer. All measurements were done at 2 channels (low and high operational frequency range.).
- The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- The center frequency of spectrum is the band edge frequency and span is 20 MHz. RB of the spectrum is 100 kHz and VB of the spectrum is 300 kHz (Channel bandwidth 5 MHz).
- The center frequency of spectrum is the band edge frequency and span is 40 MHz. RB of the spectrum is 100 kHz and VB of the spectrum is 300 kHz (Channel bandwidth 10 MHz).
- The center frequency of spectrum is the band edge frequency and span is 60 MHz. RB of the spectrum is 200 kHz and VB of the spectrum is 1 MHz (Channel bandwidth 15 MHz).
- The center frequency of spectrum is the band edge frequency and span is 80 MHz. RB of the spectrum is 200 kHz and VB of the spectrum is 1 MHz (Channel bandwidth 20 MHz).
- Record the max trace plot into the test report.

4.4.4 Test Results



LTE Band 41

Channel Bandwidth: 5 MHz / 16QAM

<Adjacent Channel Band Edge>

Channel

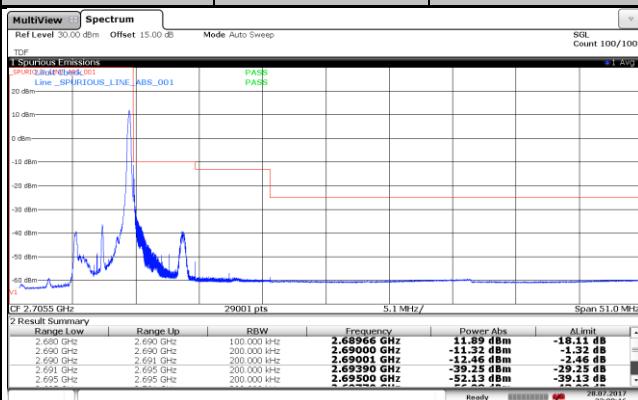
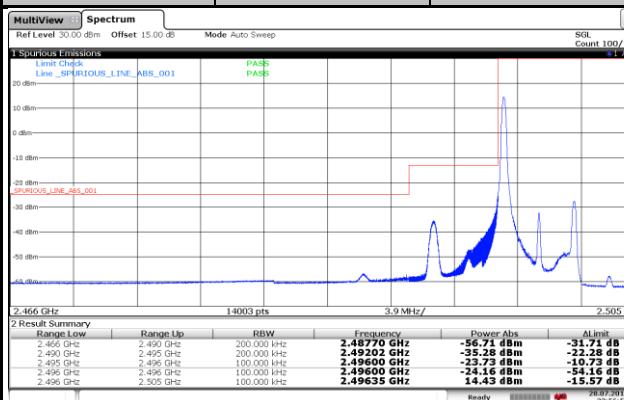
39675

1 RB

Channel

41565

1 RB



Date: 28 JUL 2017 22:56:51

Channel

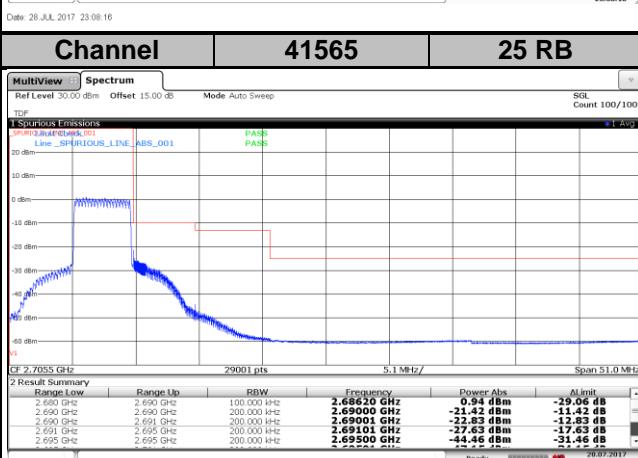
39675

25 RB

Date: 28 JUL 2017 23:08:16



Date: 28 JUL 2017 22:58:54



Date: 28 JUL 2017 23:11:13

<Channel Band Edge>

Channel

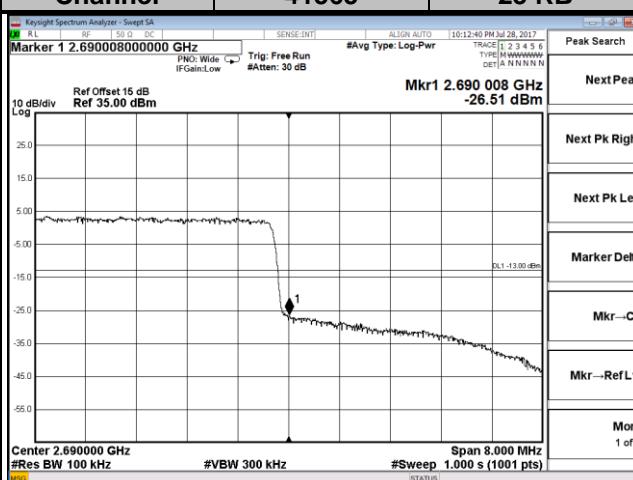
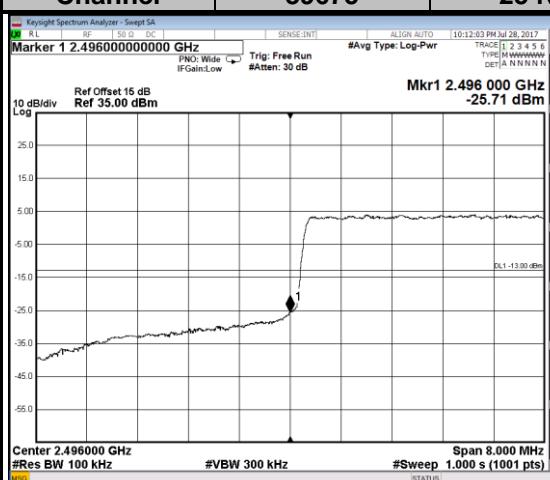
39675

25 RB

Channel

41565

25 RB



LTE Band 41

Channel Bandwidth: 10 MHz / QPSK
 <Adjacent Channel Band Edge>

Channel

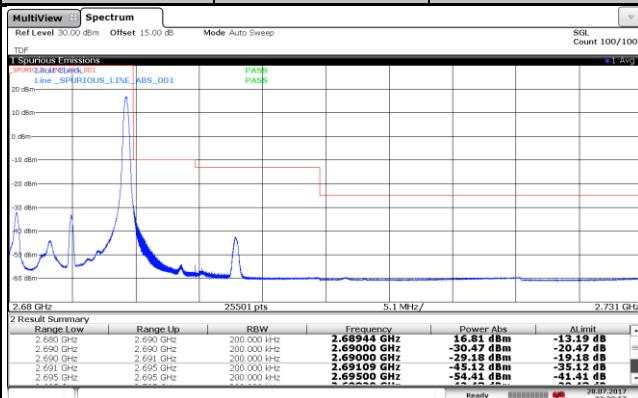
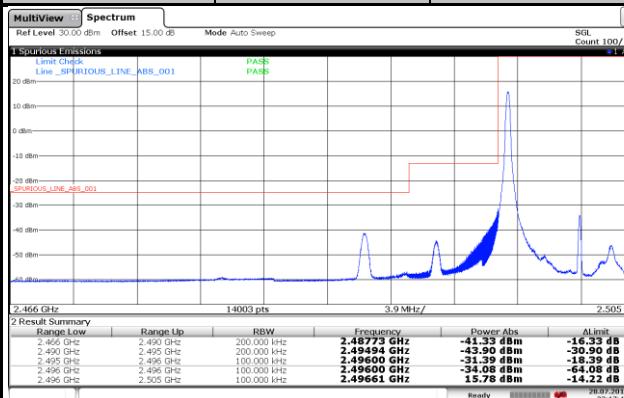
39700

1 RB

Channel

41540

1 RB



Date: 28.JUL.2017 23:17:45

Channel

39700

50 RB

Date: 28.JUL.2017 23:33:56

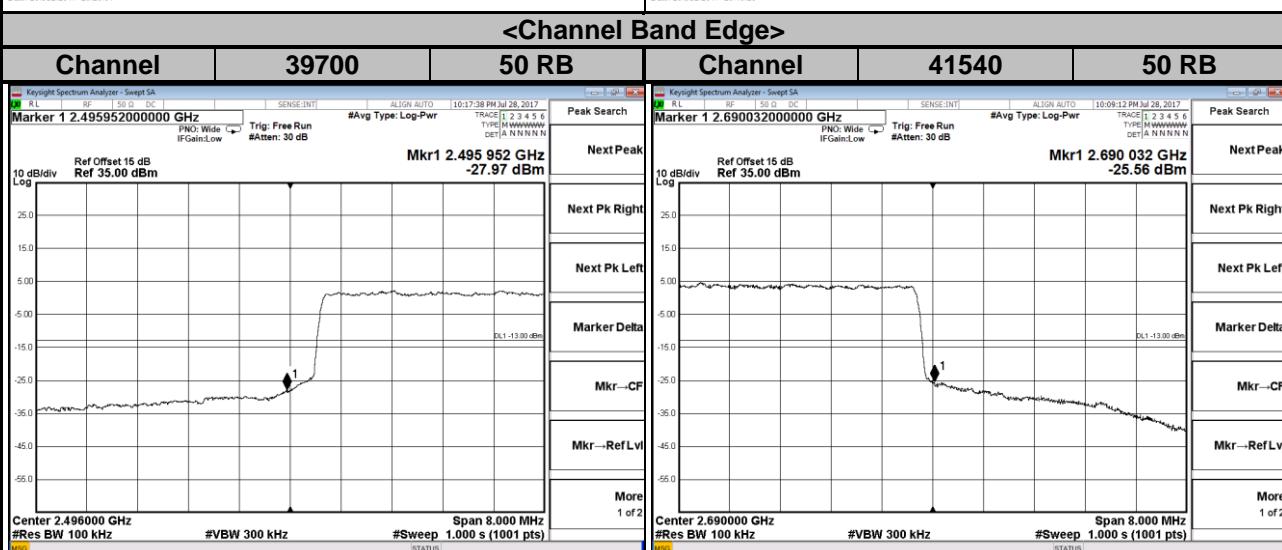
Channel

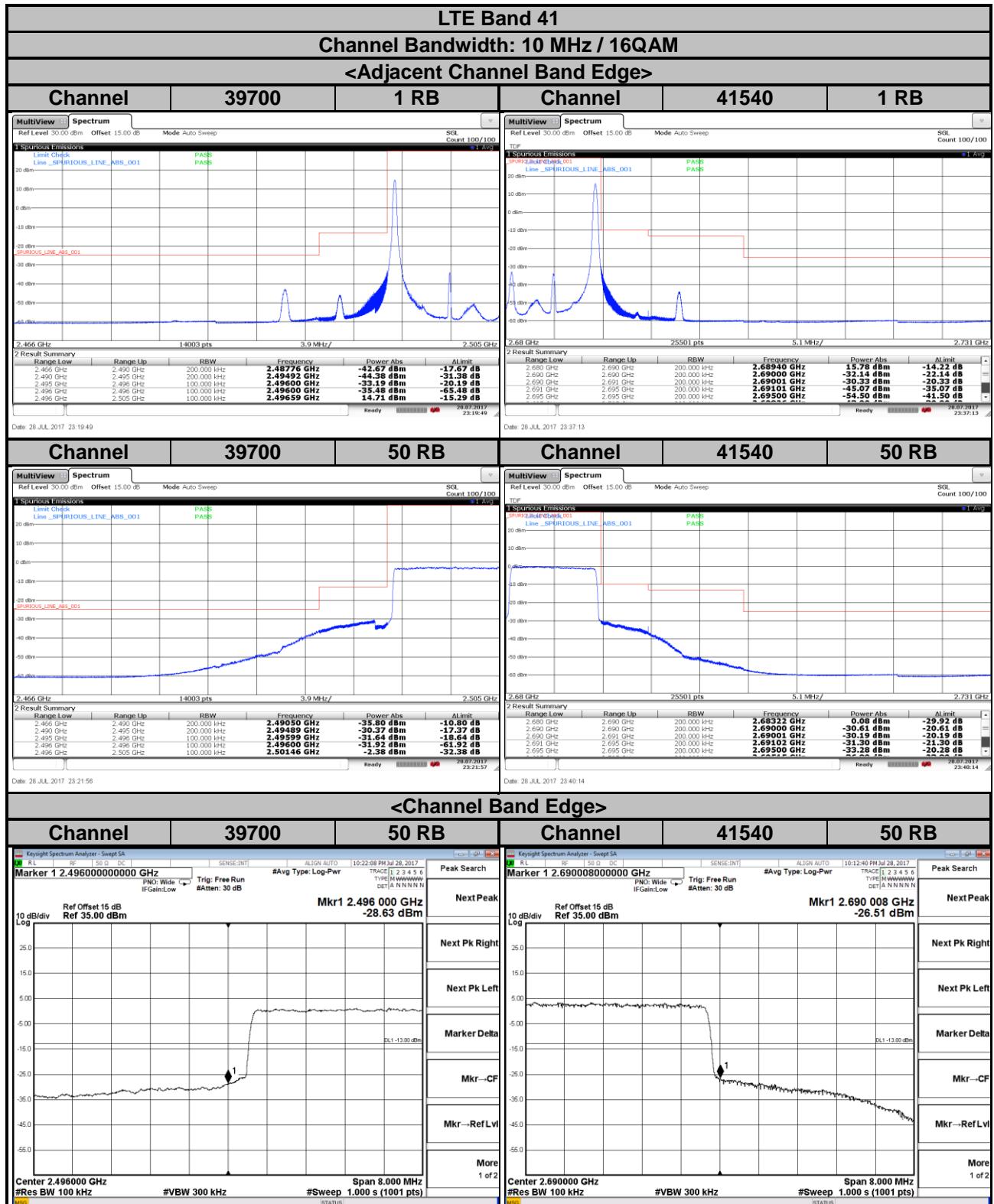
41540

50 RB



Date: 28.JUL.2017 23:23:54





LTE Band 41

Channel Bandwidth: 15 MHz / QPSK

<Adjacent Channel Band Edge>

Channel

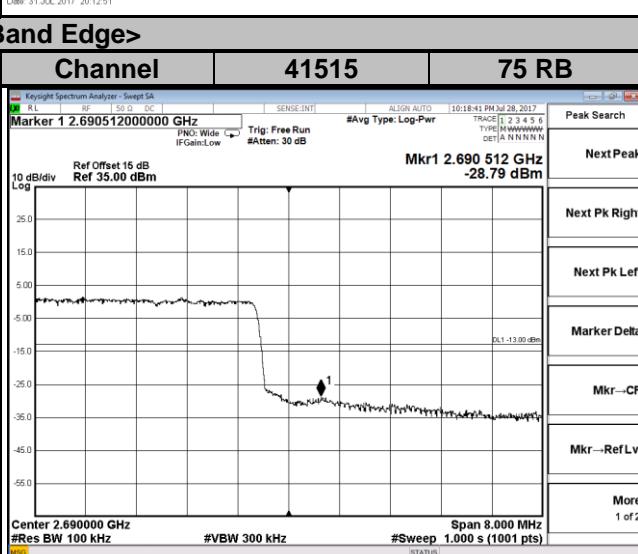
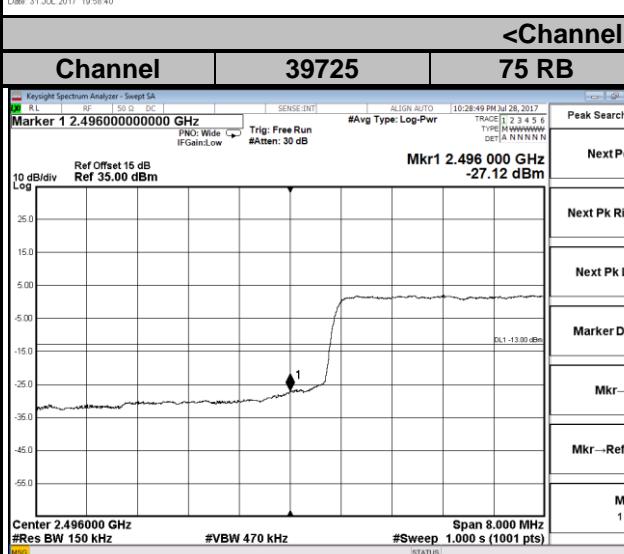
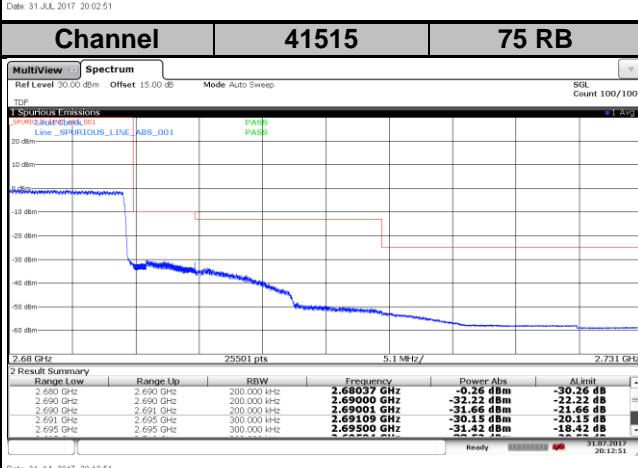
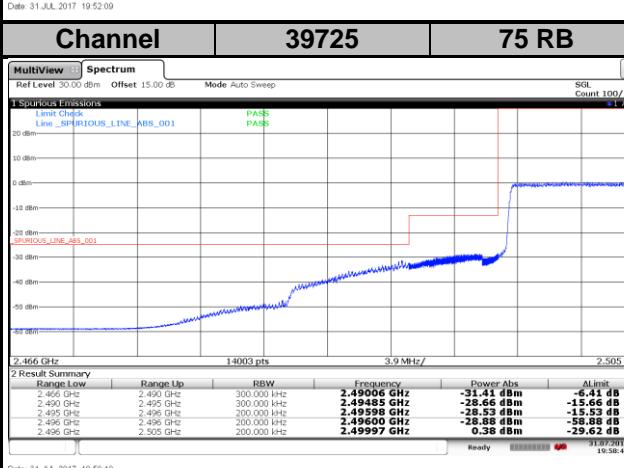
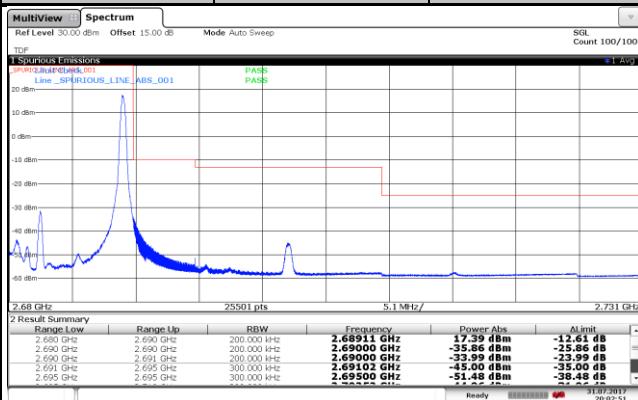
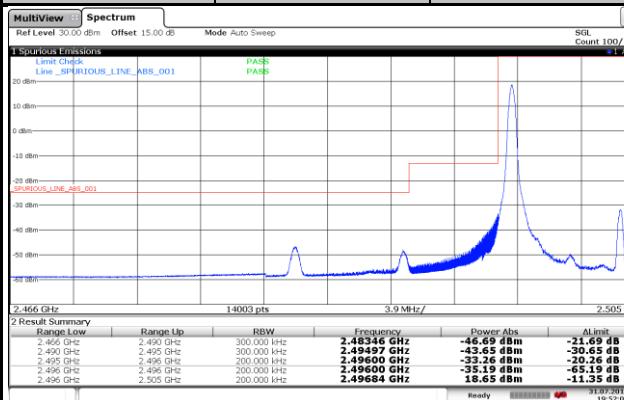
39725

1 RB

Channel

41515

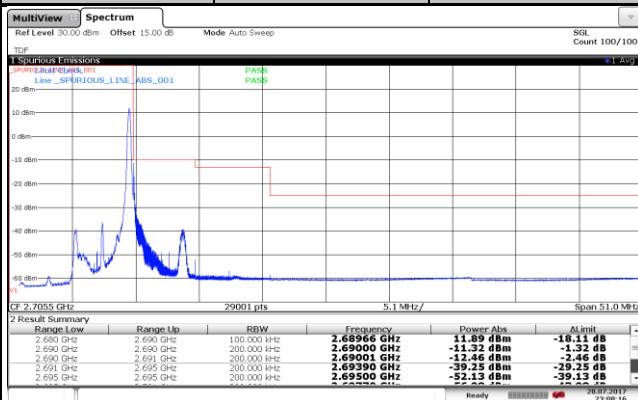
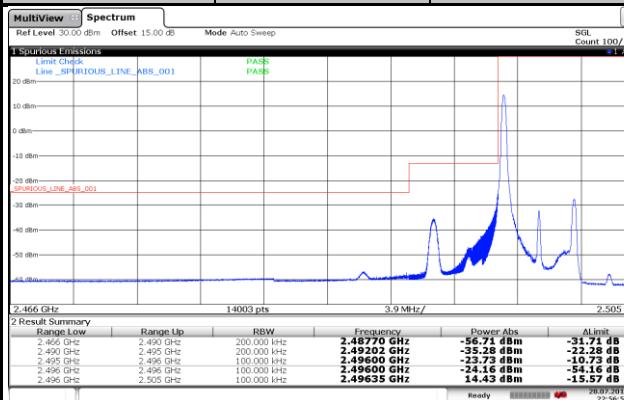
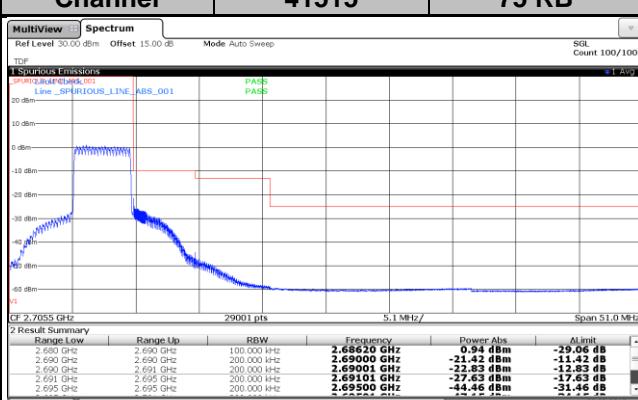
1 RB



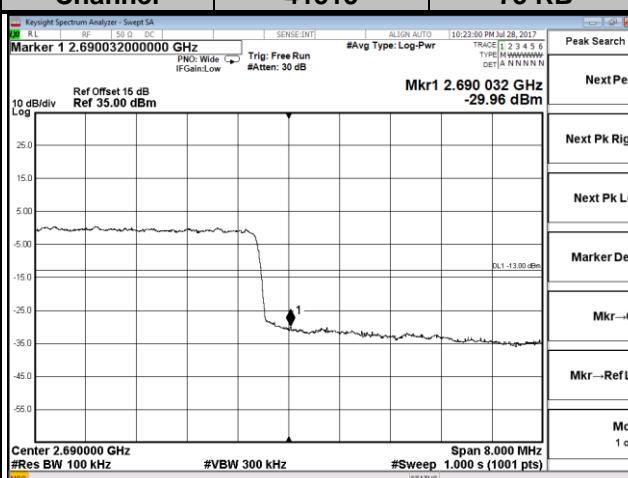
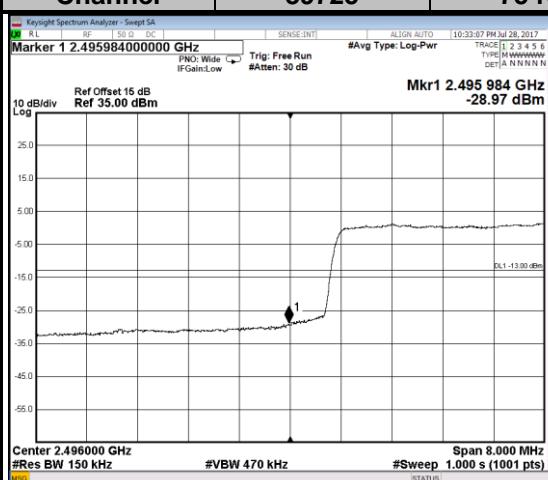
LTE Band 41

Channel Bandwidth: 15 MHz / 16QAM

<Adjacent Channel Band Edge>

Channel **39725**
1 RB
Channel
41515
1 RB

Channel **39725**
75 RB
Channel
41515
75 RB


<Channel Band Edge>

Channel **39725**
75 RB
Channel
41515
75 RB


LTE Band 41

Channel Bandwidth: 20 MHz / QPSK

<Adjacent Channel Band Edge>

Channel

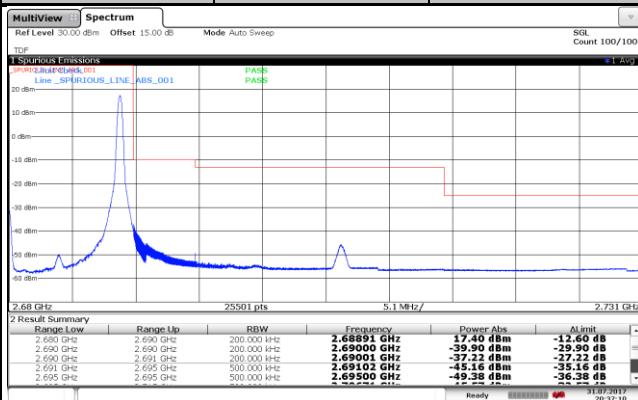
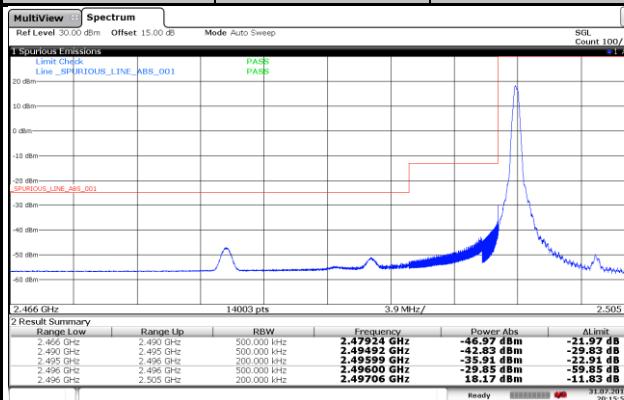
39750

1 RB

Channel

41490

1 RB



Date: 31.JUL.2017 20:15:55

Channel

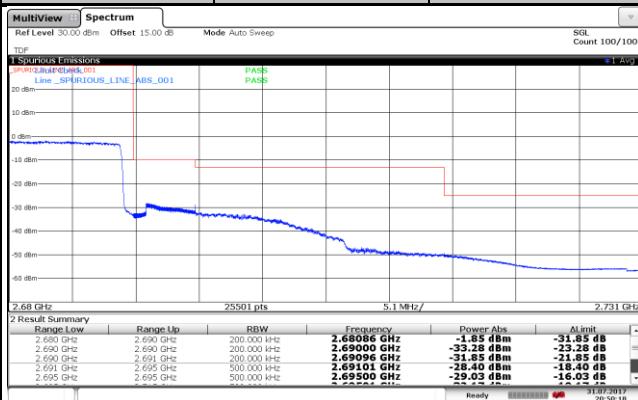
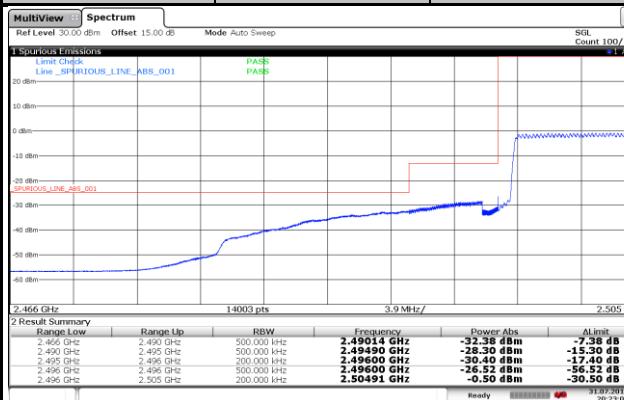
39750

100 RB

Channel

41490

100 RB



Date: 31.JUL.2017 20:23:06

Date: 31.JUL.2017 20:50:18

<Channel Band Edge>

Channel

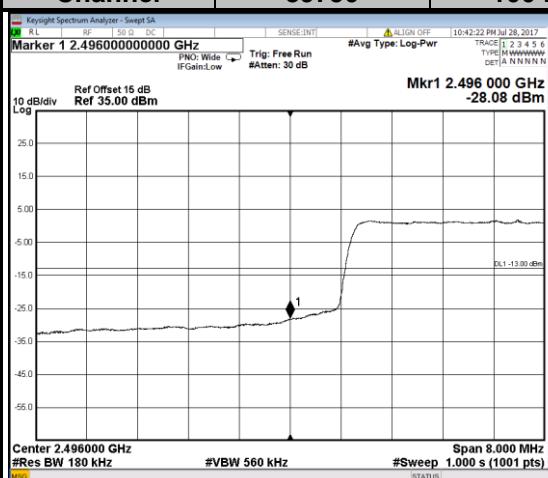
39750

100 RB

Channel

41490

100 RB



LTE Band 41

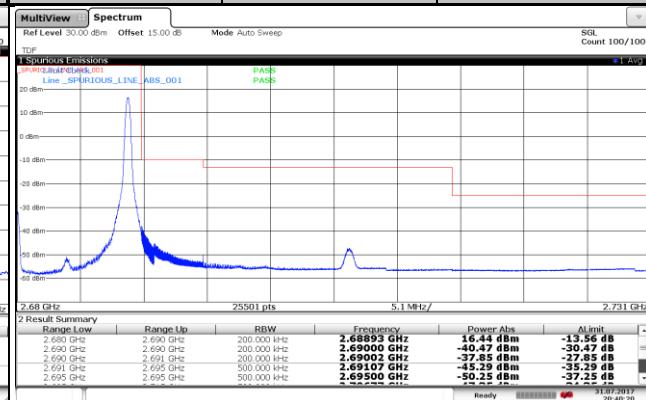
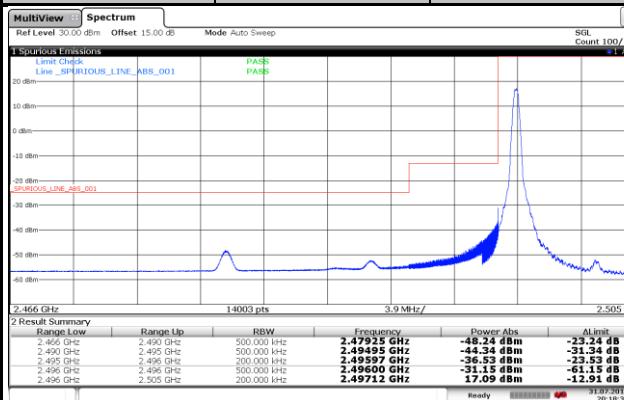
Channel Bandwidth: 20 MHz / 16QAM
<Adjacent Channel Band Edge>

Channel 39750

1 RB

Channel 41490

1 RB

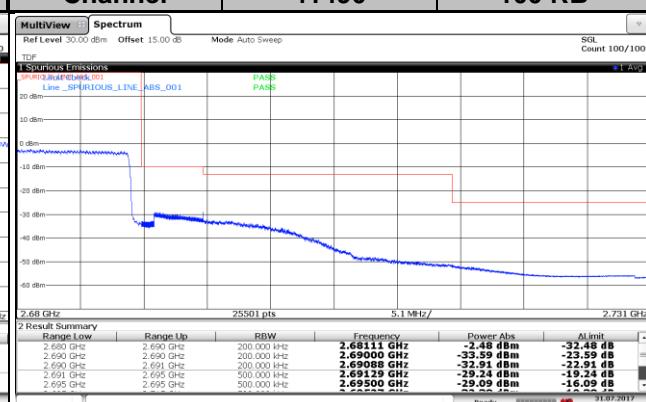
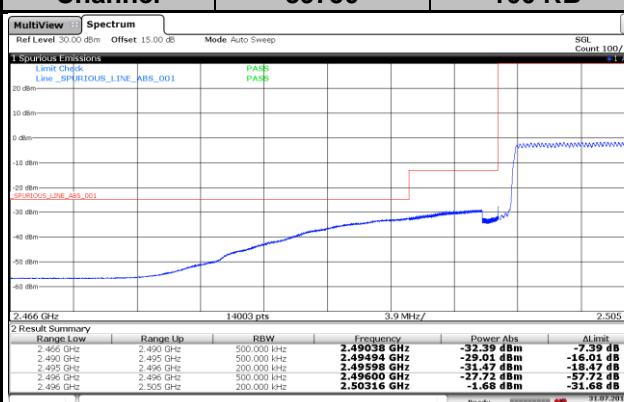


Channel 39750

100 RB

Channel 41490

100 RB



Date: 31.JUL.2017 20:20:48

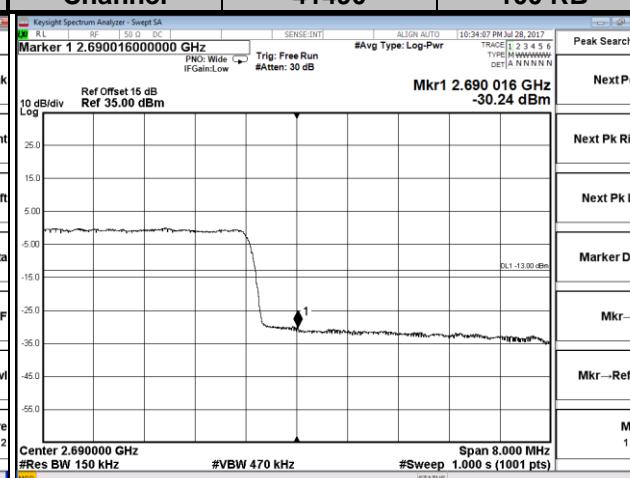
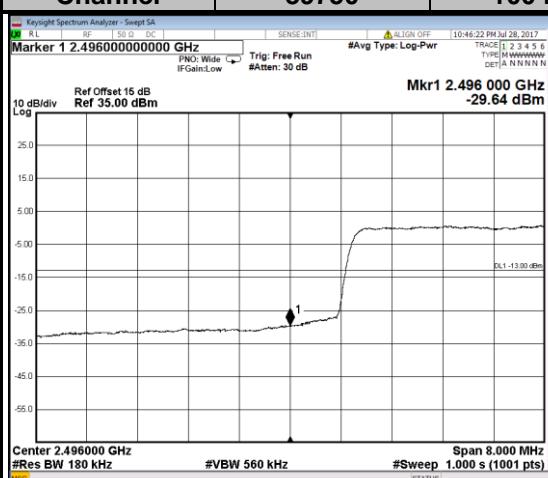
<Channel Band Edge>

Channel 39750

100 RB

Channel 41490

100 RB

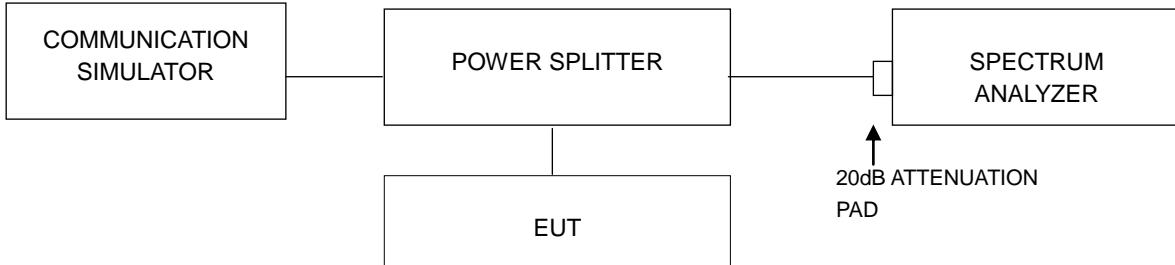


4.5 Peak to Average Ratio

4.5.1 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.

4.5.2 Test Setup

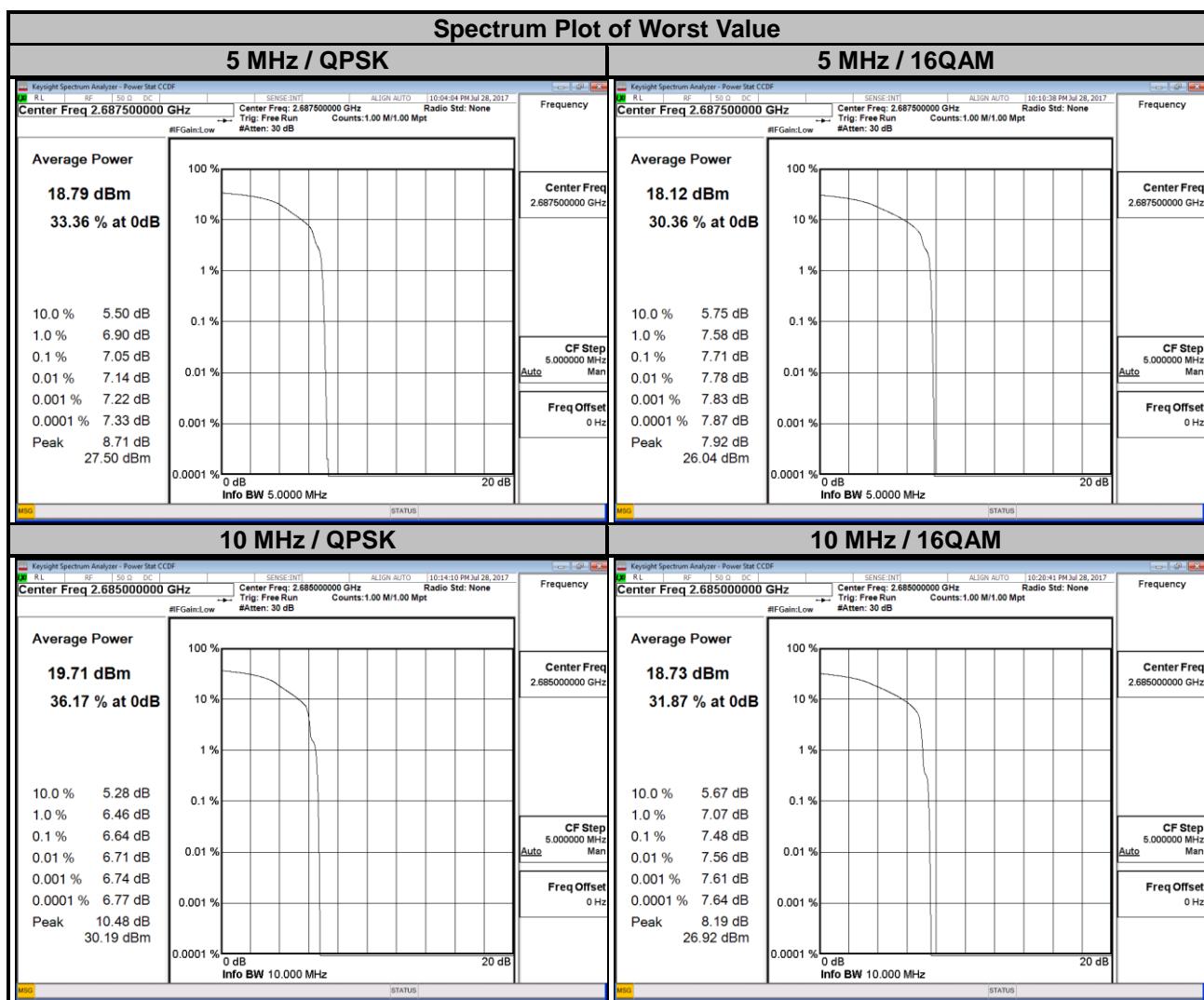


4.5.3 Test Procedures

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

4.5.4 Test Results

LTE Band 41							
Channel Bandwidth: 5 MHz				Channel Bandwidth: 10 MHz			
Channel	Frequency (MHz)	Peak to Average Ratio (dB)		Channel	Frequency (MHz)	Peak to Average Ratio (dB)	
		QPSK	16QAM			QPSK	16QAM
39675	2498.5	6.39	7.31	39700	2501.0	6.53	6.91
40620	2593.0	6.32	7.32	40620	2593.0	6.34	7.10
41565	2687.5	7.05	7.71	41540	2685.0	6.64	7.48

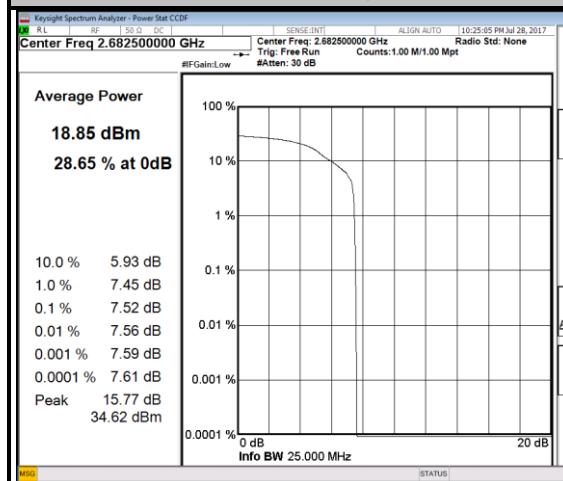


LTE Band 41

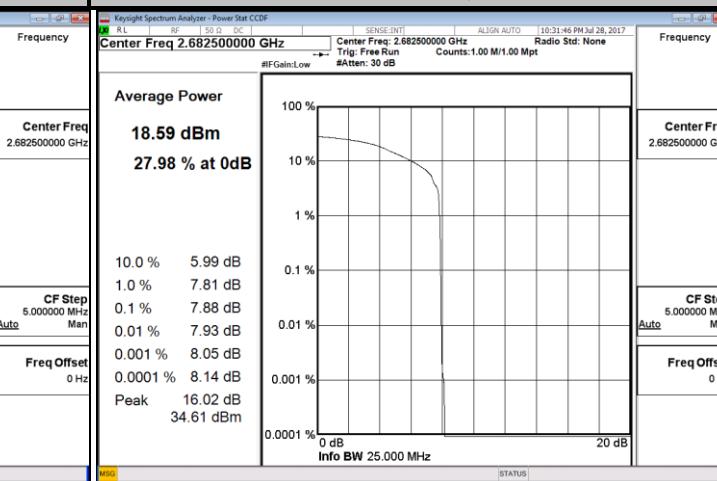
Channel Bandwidth: 15 MHz				Channel Bandwidth: 20 MHz			
Channel	Frequency (MHz)	Peak to Average Ratio (dB)		Channel	Frequency (MHz)	Peak to Average Ratio (dB)	
		QPSK	16QAM			QPSK	16QAM
39725	2503.5	5.81	7.17	39750	2506.0	7.19	7.30
40620	2593.0	5.81	7.13	40620	2593.0	7.39	7.27
41515	2682.5	7.52	7.88	41490	2680.0	5.90	7.58

Spectrum Plot of Worst Value

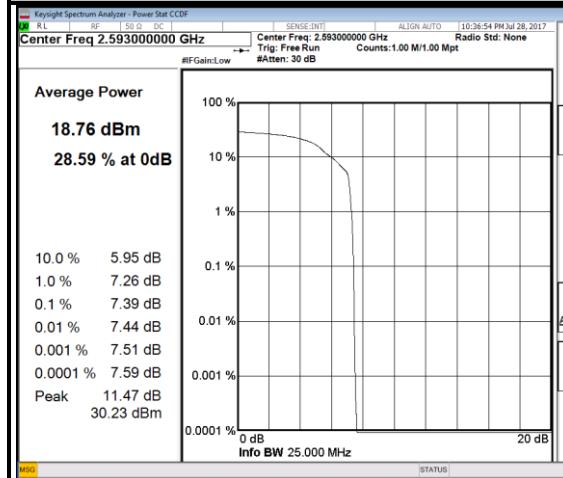
15 MHz / QPSK



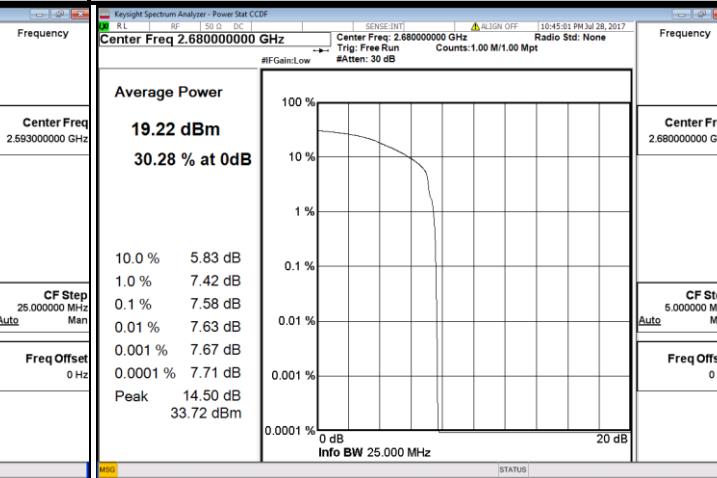
15 MHz / 16QAM



20 MHz / QPSK



20 MHz / 16QAM

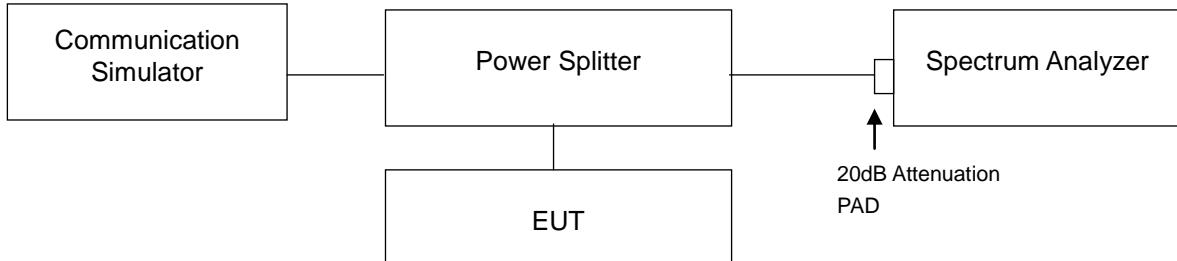


4.6 Conducted Spurious Emissions

4.6.1 Limits of Conducted Spurious Emissions Measurement

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $55 + 10 \log_{10}(P)$ dB. The limit of emission is equal to -25 dBm.

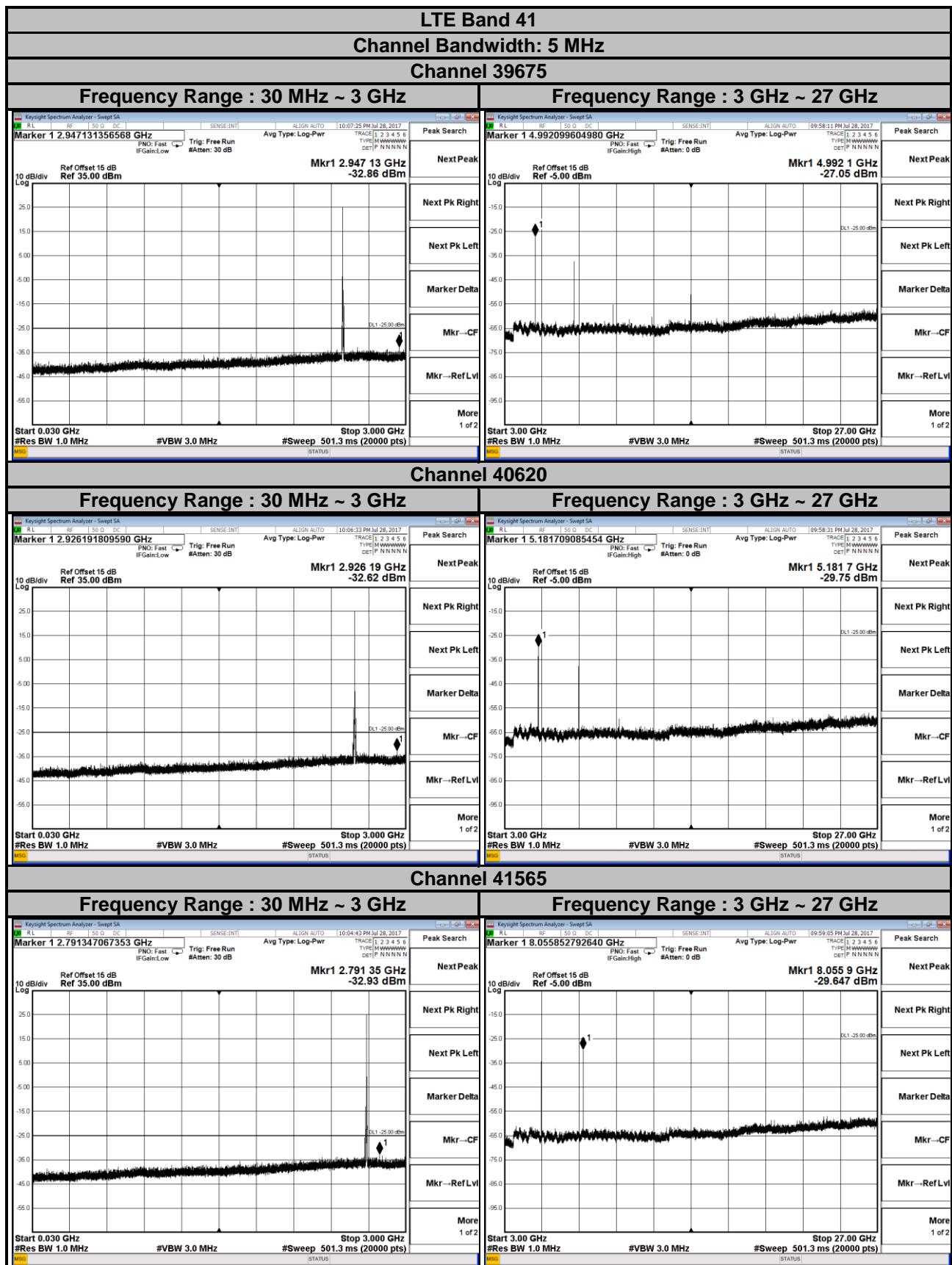
4.6.2 Test Setup

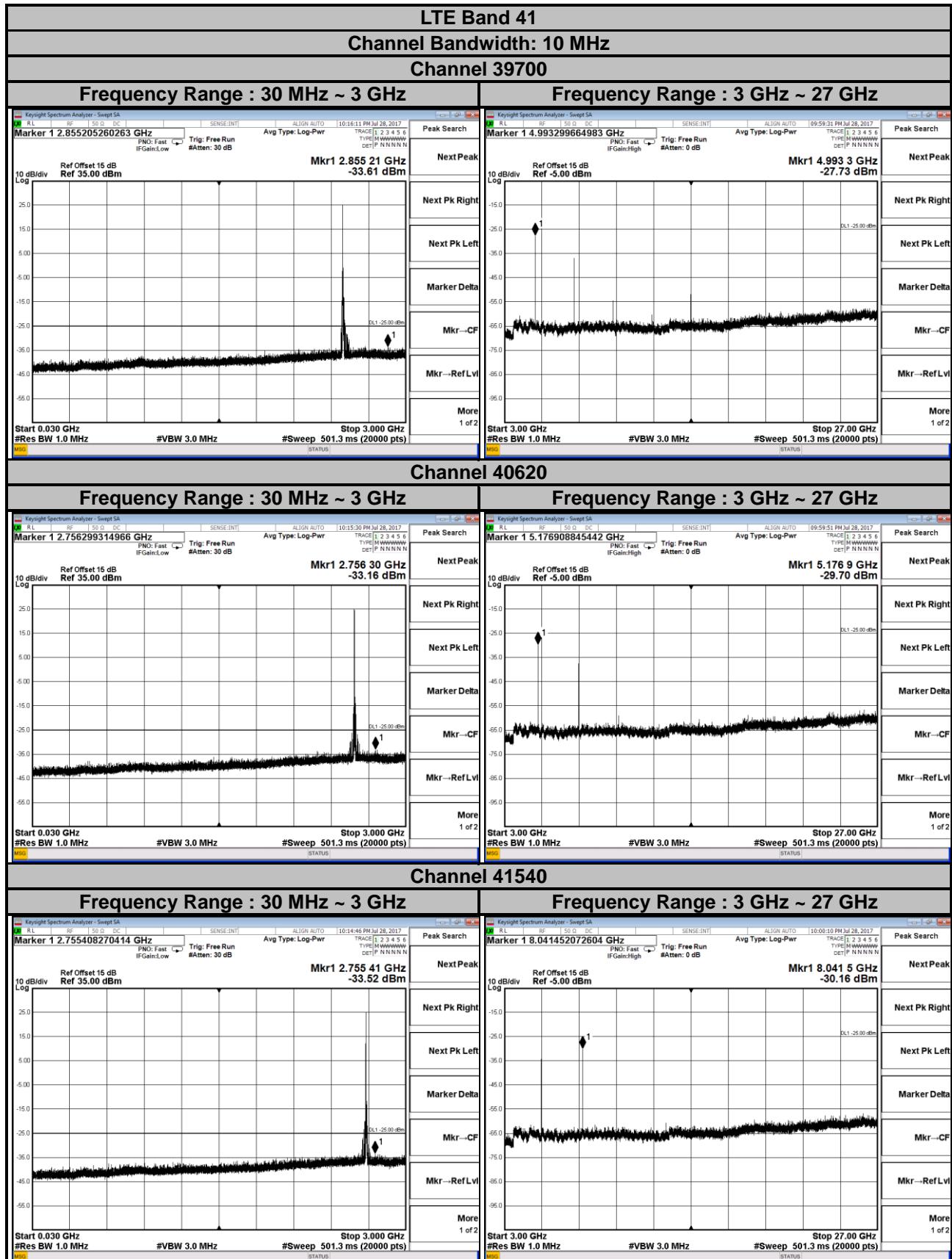


4.6.3 Test Procedure

- 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 30 MHz to 27 GHz for LTE Band 41. 10dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz are used for conducted emission measurement.

4.6.4 Test Results



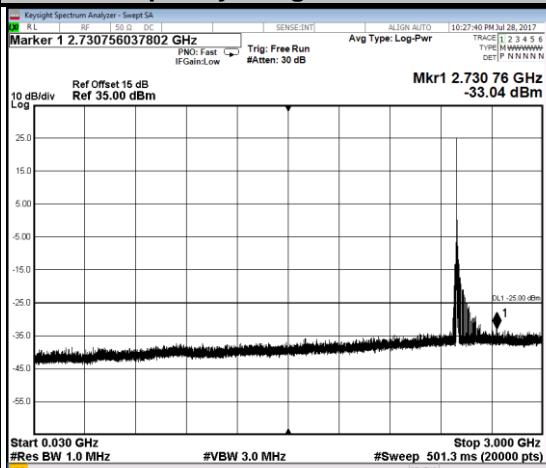


LTE Band 41

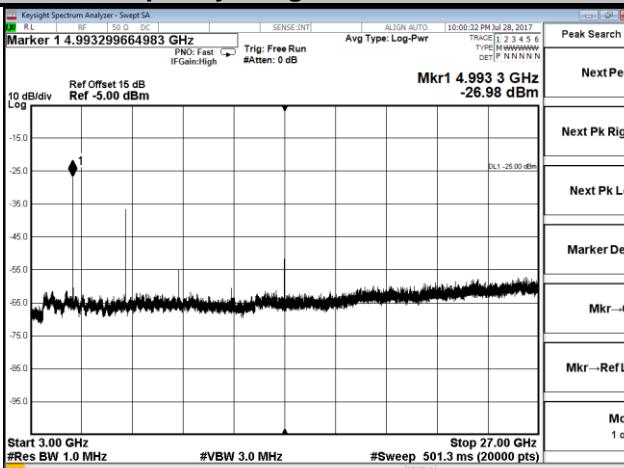
Channel Bandwidth: 15 MHz

Channel 39725

Frequency Range : 30 MHz ~ 3 GHz

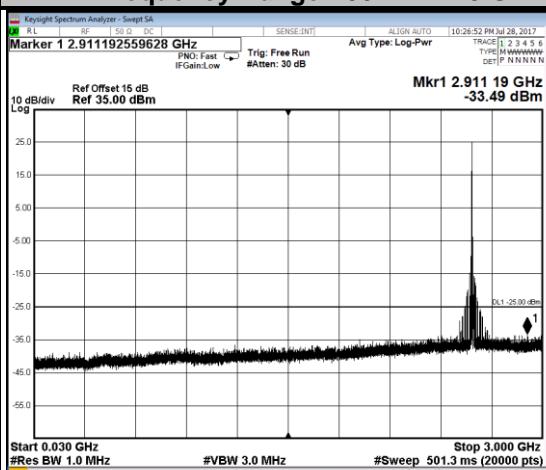


Frequency Range : 3 GHz ~ 27 GHz

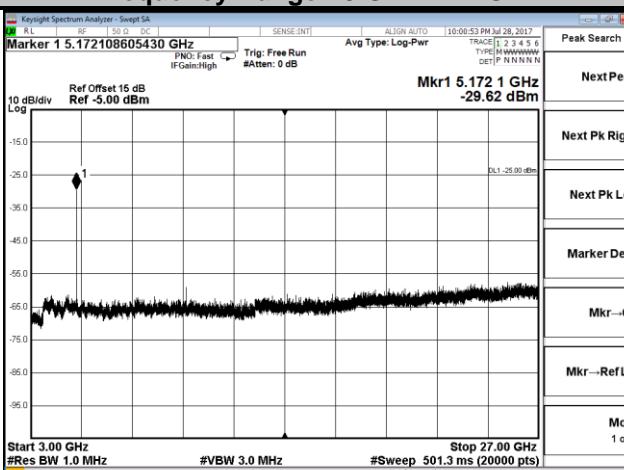


Channel 40620

Frequency Range : 30 MHz ~ 3 GHz

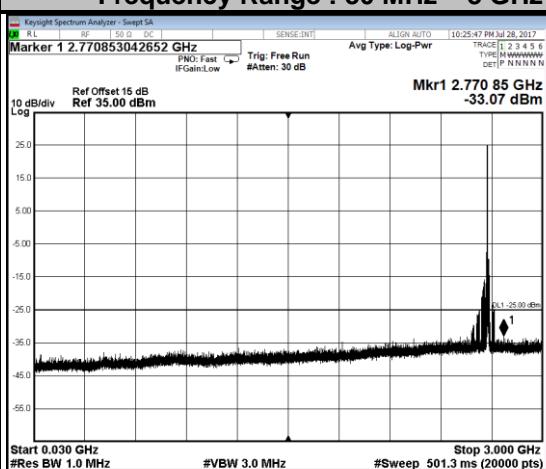


Frequency Range : 3 GHz ~ 27 GHz

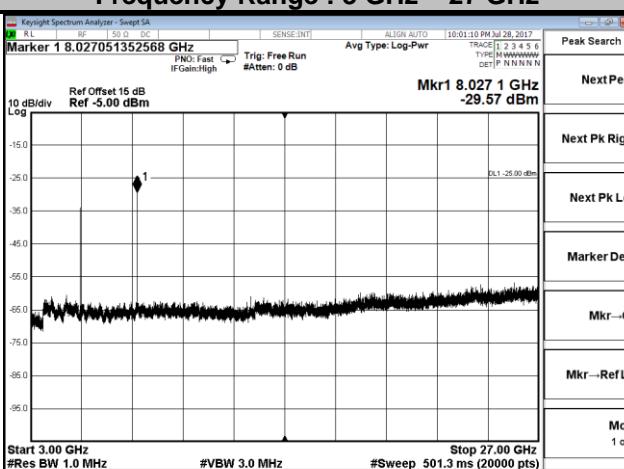


Channel 41515

Frequency Range : 30 MHz ~ 3 GHz



Frequency Range : 3 GHz ~ 27 GHz

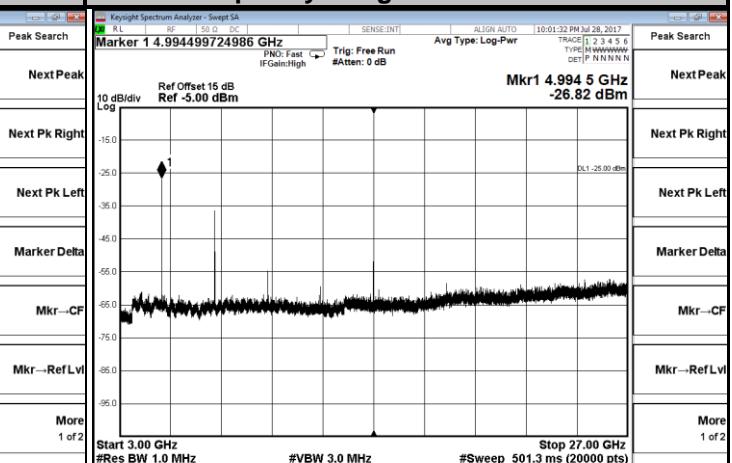
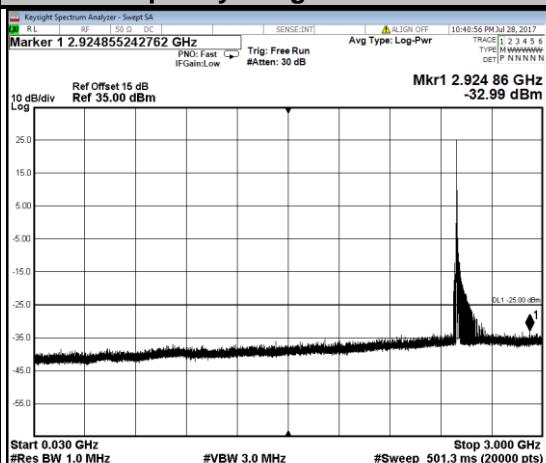


LTE Band 41

Channel Bandwidth: 20 MHz

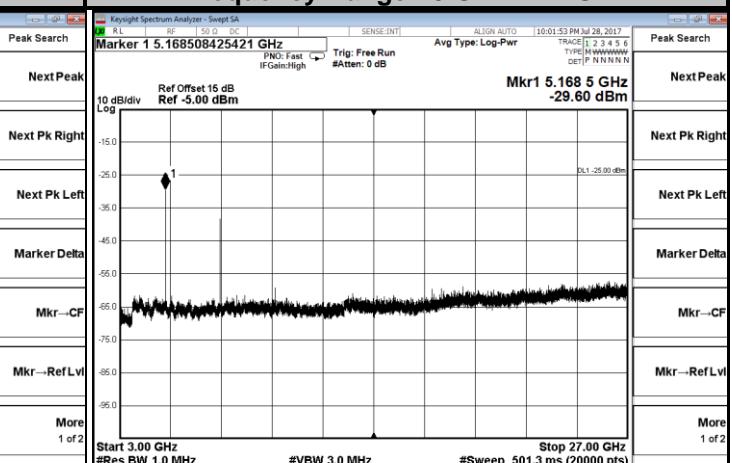
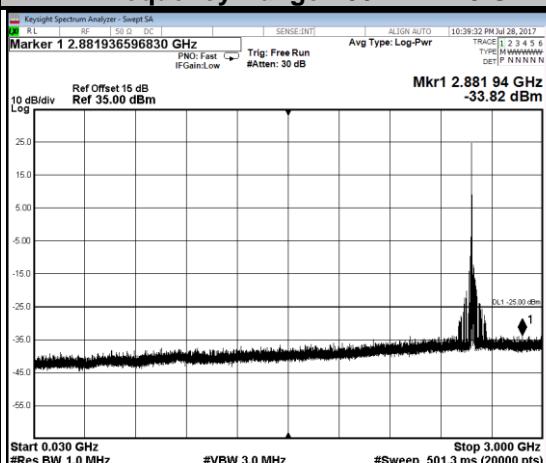
Channel 39750

Frequency Range : 30 MHz ~ 3 GHz



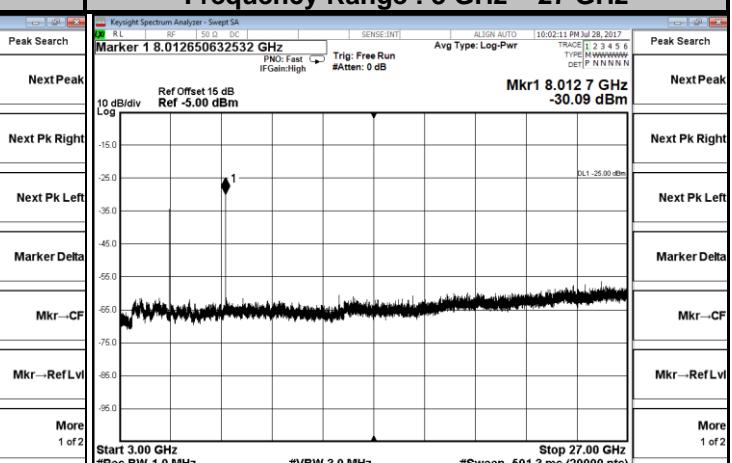
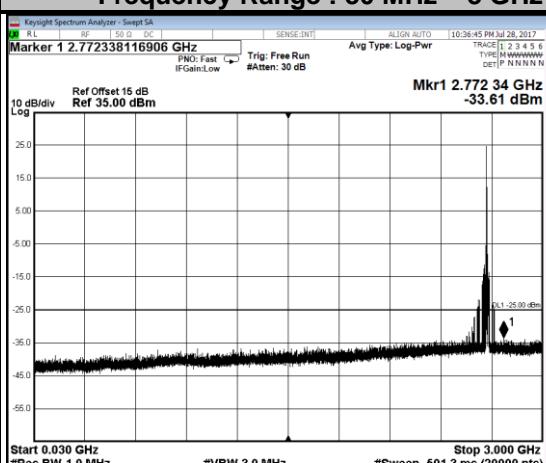
Channel 40620

Frequency Range : 30 MHz ~ 3 GHz



Channel 41490

Frequency Range : 30 MHz ~ 3 GHz



4.7 Radiated Emission Measurement

4.7.1 Limits of Radiated Emission Measurement

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $55 + 10 \log_{10}(P)$ dB. The limit of emission is equal to -25 dBm.

4.7.2 Test Procedure

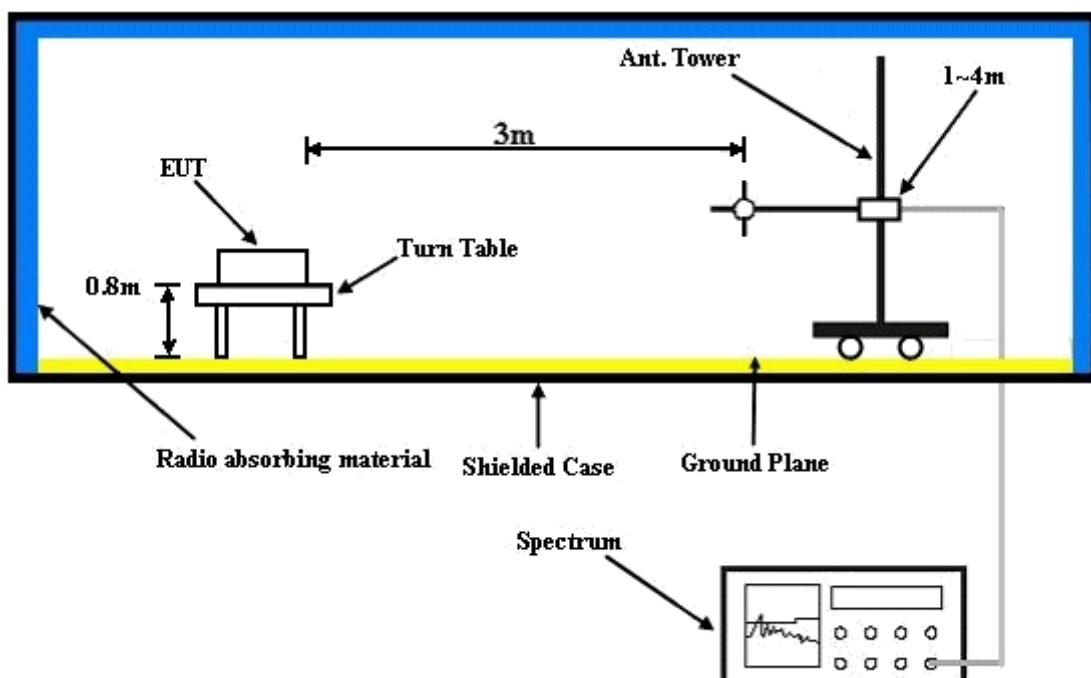
- a. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- b. The substitution horn antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to "Read Value" of step a. Record the power level of S.G.
- c. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.
- d. E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, E.R.P power = E.I.R.P power - 2.15 dBi.

NOTE: The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

4.7.3 Deviation from Test Standard

No deviation.

4.7.4 Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.7.5 Test Results

LTE Band 41

Channel Bandwidth: 20 MHz / QPSK

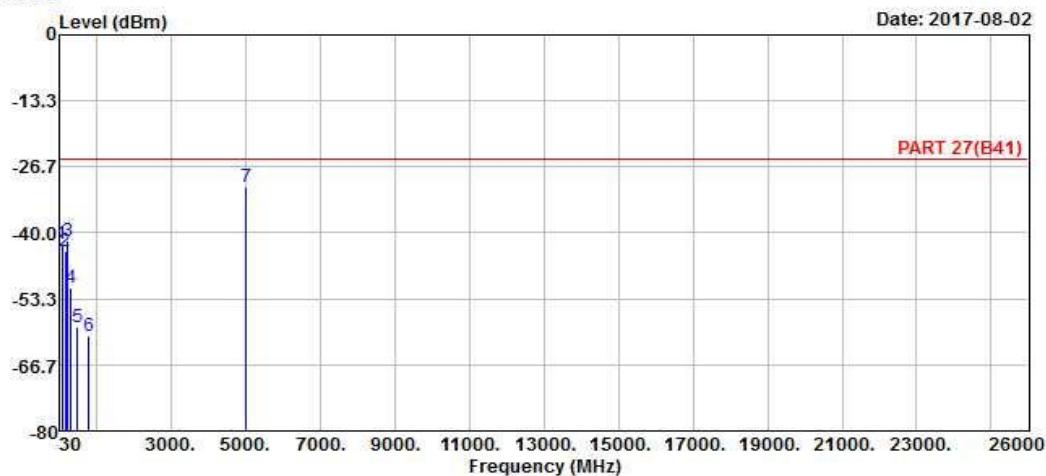
Low Channel



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 5



Site : 966 Chamber 5

Condition: PART 27(B41) HORIZONTAL

Remak : LTE Band 41_QPSK_20M_L-CH

Tested by: Gavin Wu

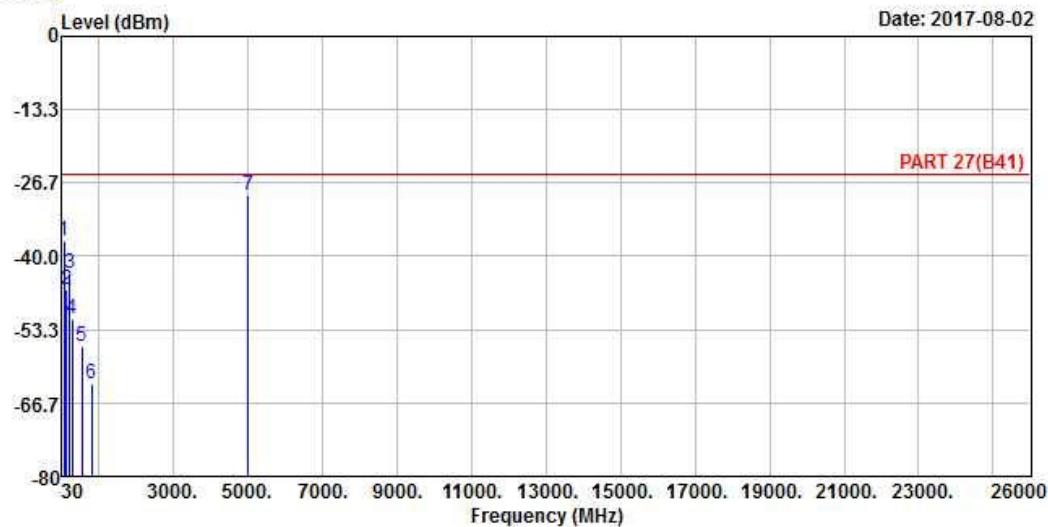
Freq	Level	Read	Limit	Over	Factor	Remark
		Freq	Level	Line		
MHz	dBm	dBm	dBm	dB	dB	
1	79.47	-42.20	-42.20	-25.00	-17.20	0.00 Peak
2	170.65	-43.74	-43.74	-25.00	-18.74	0.00 Peak
3	227.88	-41.77	-41.77	-25.00	-16.77	0.00 Peak
4	316.15	-51.02	-51.02	-25.00	-26.02	0.00 Peak
5	491.72	-59.03	-59.03	-25.00	-34.03	0.00 Peak
6	798.24	-60.84	-60.84	-25.00	-35.84	0.00 Peak
7 pp	5012.00	-30.76	-27.53	-25.00	-5.76	-3.23 Peak



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 6



Site : 966 Chamber 5

Condition: PART 27(B41) VERTICAL

Remak : LTE Band 41_QPSK_20M_L-CH

Tested by: Gavin Wu

Freq	Level	Read	Limit	Over	Factor	Remark
		Level	Line	Limit		
MHz	dBm	dBm	dBm	dB	dB	
1	78.50	-37.06	-37.06	-25.00	-12.06	0.00 Peak
2	151.25	-46.13	-46.13	-25.00	-21.13	0.00 Peak
3	225.94	-43.06	-43.06	-25.00	-18.06	0.00 Peak
4	294.81	-51.28	-51.28	-25.00	-26.28	0.00 Peak
5	556.71	-56.45	-56.45	-25.00	-31.45	0.00 Peak
6	829.28	-63.11	-63.11	-25.00	-38.11	0.00 Peak
7 pp	5012.00	-28.96	-25.73	-25.00	-3.96	-3.23 Peak

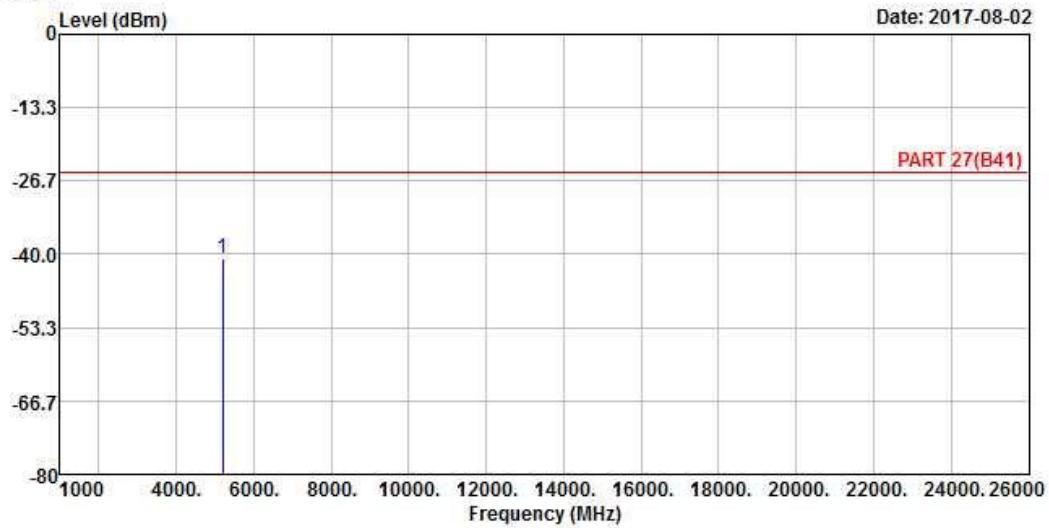
Middle Channel



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 3



Site : 966 Chamber 5

Condition: PART 27(B41) HORIZONTAL

Remak : LTE Band 41_QPSK_20M_M-CH

Tested by: Gavin Wu

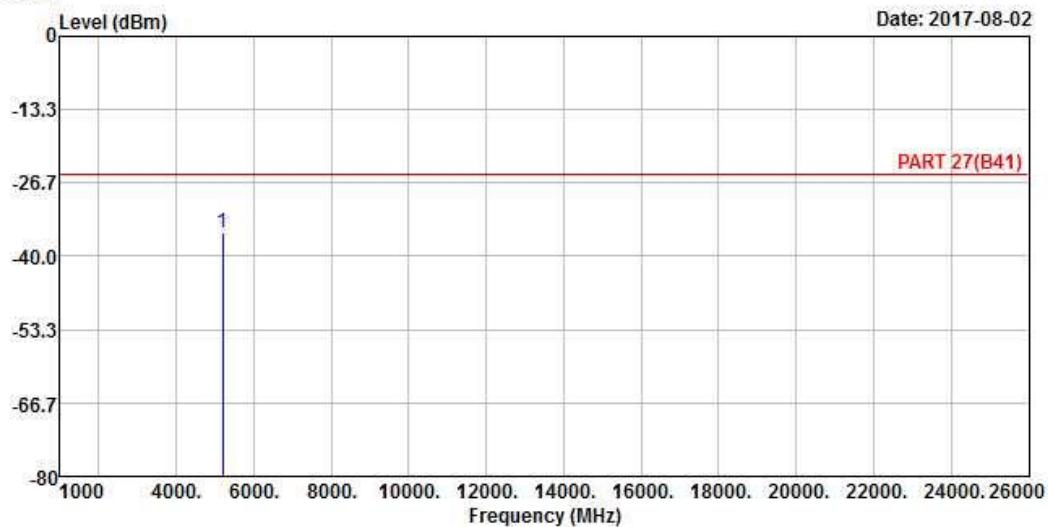
Freq	Read Level	Limit Level	Over Line	Limit Factor	Remark
MHz	dBm	dBm	dBm	dB	
1 pp	5186.00	-40.72	-37.86	-25.00	-15.72 -2.86 Peak



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 4



Site : 966 Chamber 5

Condition: PART 27(B41) VERTICAL

Remak : LTE Band 41_QPSK_20M_M-CH

Tested by: Gavin Wu

Freq	Level	Read	Limit	Over	Factor	Remark
		Level	Line	Limit		
1 pp	5186.00	-35.85	-32.99	-25.00	-10.85	-2.86 Peak

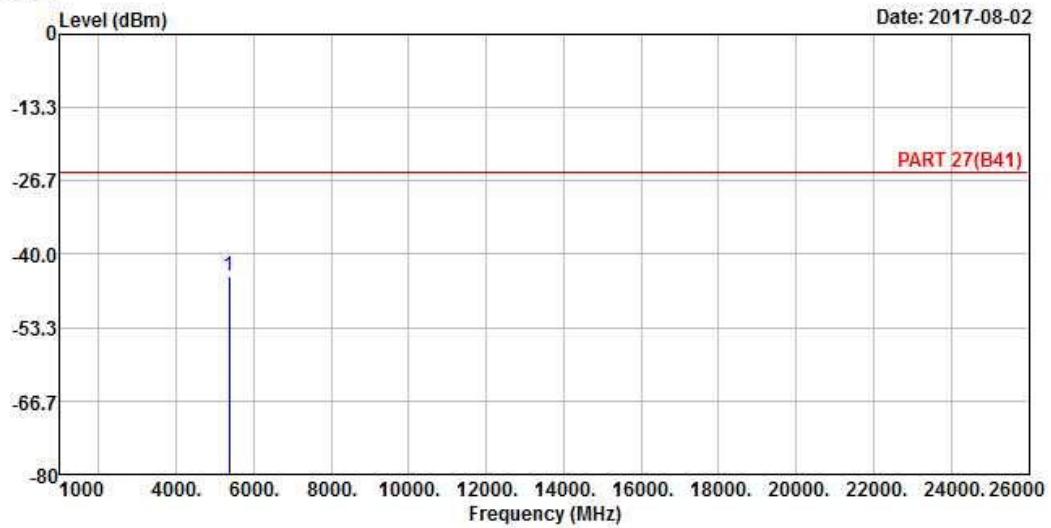
High Channel



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 3



Site : 966 Chamber 5

Condition: PART 27(B41) HORIZONTAL

Remak : LTE Band 41_QPSK_20M_H-CH

Tested by: Gavin Wu

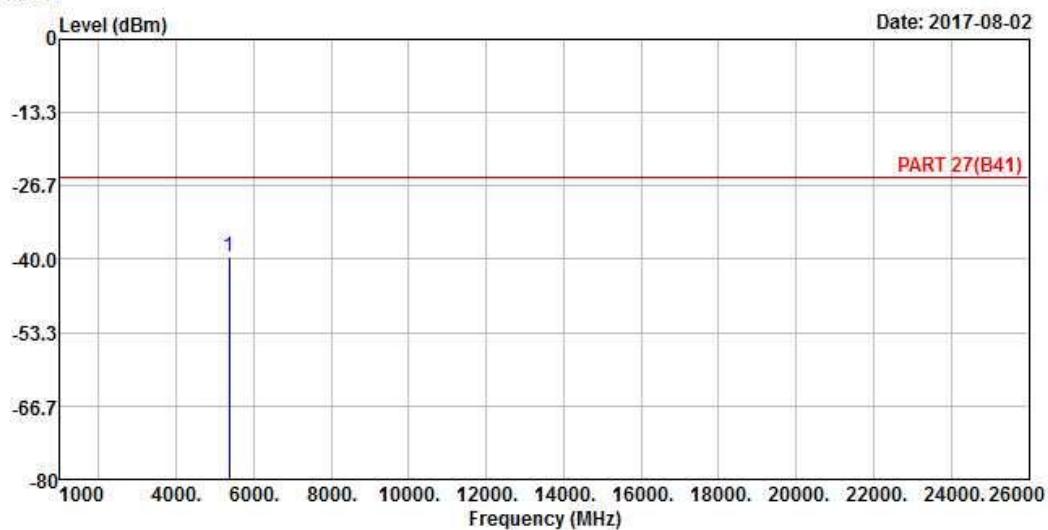
Freq	Read Level	Limit Level	Over Line	Limit Factor	Remark
MHz	dBm	dBm	dBm	dB	
1 pp	5360.00	-44.03	-42.03	-25.00	-19.03 -2.00 Peak



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 4



Site : 966 Chamber 5

Condition: PART 27(B41) VERTICAL

Remak : LTE Band 41_QPSK_20M_H-CH

Tested by: Gavin Wu

Freq	Level	Read	Limit	Over	Remark
		Level	Line	Limit Factor	
MHz	dBm	dBm	dBm	dB	
1 pp	5360.00	-39.54	-37.54	-25.00	-14.54 -2.00 Peak

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

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Tel: 886-3-3183232

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Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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