



Test report No. : 4789004574-US-R3-V0
Page : 1 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

RADIO TEST REPORT

Product : SYNCUP PETS
Model Name : TMUS-SUP-1
FCC ID : 2ASXC-TMO-NBT-01
Test Regulation : FCC 47 CFR Part 27, Subpart C, L
Received Date : May 2, 2019
Test Date : May 6, 2019 ~ May 31, 2019
Issued Date : Aug. 26, 2019

Applicant : T-mobile Usa, Inc.
12920 Se 38th Street, Bellevue, Washington, United States,
98006

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building B and Building E, No. 372-7, Sec. 4, Zhongxing
Rd., Zhudong Township, Hsinchu County, Taiwan



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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 2 of 69
Issued date : Aug. 26, 2019
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REVISION HISTORY

Original Test Report No.: 4789004574-US-R3-V0

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Table Of Contents

1. Attestation of Test Results.....	4
2. Summary of Test Results	5
3. Test Methodology and Procedures.....	6
4. Facilities and Accreditation.....	6
5. Measurement Uncertainty.....	7
6. Equipment under Test.....	8
6.1. Description of EUT	8
6.2. Technical Information	9
6.3. Emission Designator	9
6.4. Test Condition	10
6.5. Description Of Available Antennas	10
6.6. Test Mode Applicability and Tested Channel Detail.....	10
7. Test Equipment	14
8. Description of Test Setup	16
9. Test Results	17
9.1. RF Output Power	17
9.2. Peak to Average Power Ratio	21
9.3. Occupied Bandwidth.....	31
9.4. Frequency Stability	38
9.5. Band Edge Measurements	42
9.6. Spurious Emissions at Antenna Terminal	52
9.7. Radiated Spurious Emission.....	59

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Page : 4 of 69
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1. Attestation of Test Results

APPLICANT: T-mobile Usa, Inc.
12920 Se 38th Street, Bellevue, Washington, United States, 98006

MANUFACTURER CyberTAN Technology Inc.
No. 99, Park Avenue III Science-based Industrial Park Hsinchu
Taiwan 308

EUT DESCRIPTION: SYNCUP PETS

BRAND: T-Mobile

MODEL: TMUS-SUP-1

SAMPLE STAGE: Engineering sample

DATE of TESTED: May 6, 2019 ~ May 31, 2019

APPLICABLE STANDARDS

STANDARD	Test Results
FCC 47 CFR PART 27	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Evelyn Lee Date : Aug. 26, 2019
Project Handler

Approved and Authorized By:

Stanley Wu Date : Aug. 26, 2019
Senior Project Engineer

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2. Summary of Test Results

LTE 4 and LTE 66		
FCC Clause	Test Items	Result
§ 2.1046 § 27.50 (d)(4)	RF Output Power	PASS
§ 27.50 (d)(5)	Peak-to-Average Power Ratio	PASS
§ 2.1049	Occupied Bandwidth	PASS
§ 2.1055 § 27.54	Frequency Stability	PASS
§ 27.53 (h)	Band Edge Measurements	PASS
§ 2.1051 § 27.53 (h)	Spurious Emissions at Antenna Terminal	PASS
§ 2.1053 § 27.53 (h)	Radiated Spurious Emission	PASS

LTE 12		
FCC Clause	Test Items	Result
§ 2.1046 § 27.50 (c)(10)	RF Output Power	PASS
§ 27.50 (d)(5)	Peak-to-Average Power Ratio	PASS
§ 2.1049	Occupied Bandwidth	PASS
§ 2.1055 § 27.54	Frequency Stability	PASS
§ 27.53 (g)	Band Edge Measurements	PASS
§ 2.1051 § 27.53 (g)	Spurious Emissions at Antenna Terminal	PASS
§ 2.1053 § 27.53 (g)	Radiated Spurious Emission	PASS

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3. Test Methodology and Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB 971168 D01 Power Meas License Digital Systems v03r01, ANSI C63.26-2015 and ANSI/TIA-603-E.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. The full scope of accreditation can be viewed at http://accreditation.taftw.org.tw/taf/public/basic/viewApplyItems.action?unitNo=3398

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5. Measurement Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Test Item	Measurement Frequency Range	K	U(dB)
RF Output Power	30MHz ~ 40GHz	2	0.7dB
Effective Radiated Power	30MHz ~ 1GHz	2	5.6dB
Equivalent Isotropic Radiated Power	1GHz ~ 18GHz	2	4.2dB
Peak-to-Average Power Ratio	30MHz ~ 40GHz	2	3.10%
Occupied Bandwidth	30MHz ~ 40GHz	2	3.10%
Spurious Emissions at Antenna Terminal	30MHz ~ 40GHz	2	1.1dB
Frequency Stability	30MHz ~ 40GHz	2	299Hz
Radiated Spurious Emission	30MHz ~ 1GHz	2	5.6dB
	1GHz ~ 18GHz	2	4.2dB
	18GHz ~ 40GHz	2	4.4dB

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6. Equipment under Test

6.1. Description of EUT

Product	SYNCUP PETS
Brand Name	T-Mobile
Model Name	TMUS-SUP-1
Normal Voltage	5Vdc (adapter or host equipment) 3.7Vdc for battery
Voltage Operation Range	3.33~4.07Vdc
Hardware Version	V01
Software Version	0.31.10.14

Note :

1. The EUT contains following accessory devices.

Product	Brand	Model	Description
PSU Adapter	PHIHONG	AN05A-050E	I/P: 100-240Vac, 50-60Hz, 0.2A O/P: 5.0 Vdc, 1.0A
Battery	Joules Miles	GWB001-A1	3.7 Vdc, 430 mAh
Charging Dock	CyberTAN	N/A	N/A
Collar mount	CyberTAN	N/A	N/A
USB Cable	N/A	N/A	1 meter shielded cable without core
Bands	CyberTAN	N/A	N/A

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

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Doc No: 17-EM-F0916 / 4.0



6.2. Technical Information

Frequency Bands	■ LTE Band 4	1710 MHz to 1755 MHz (Uplink) 2110 MHz to 2155 MHz (Downlink)
	■ LTE Band 12	699 MHz to 716 MHz (Uplink) 729 MHz to 746 MHz (Downlink)
	■ LTE Band 66	1710 MHz to 1780 MHz (Uplink) 2110 MHz to 2200 MHz (Downlink)
Sub-carrier spacing	15 kHz / 3.75 kHz	
Modulation Mode	QPSK / BPSK	

Note 1: Accordance with manufacturer description, the product support both single tone and multi tone carrier for spacing 15 kHz , but just only support single tone carrier for 3.75 kHz spacing.

6.3. Emission Designator

Frequency Bands	■ LTE Band 4	Sub-carrier spacing 15 kHz	238KG7D
	■ LTE Band 12	Sub-carrier spacing 15 kHz	238KG7D
	■ LTE Band 66	Sub-carrier spacing 15 kHz	238KG7D

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Doc No: 17-EM-F0916 / 4.0



6.4. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	22~25°C / 65~69%RH	120Vac / 60 Hz	May 6, 2019 ~ May 31, 2019	Howard Kao
Radiated Spurious Emission	966-2	23~25°C / 66~68%RH	120Vac / 60 Hz	May 6, 2019 ~ May 24, 2019	Will Chen

FCC Test Firm Registration Number: 498077

6.5. Description Of Available Antennas

Band	Antenna Type	Antenna Gain(dBi)
LTE Band 4	Internal	-1.9
LTE Band 12	Internal	-1.5
LTE Band 66	Internal	-1.8

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

6.6. Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all mode and data rates and positions and carrier tone size and modulations were investigated. Subsequently, only the worst case are reported .

The following testing in NB-IOT is set based on the maximum RF Output Power.

Radiated measurements are performed by rotating the EUT in two different orthogonal (XZ axis) test planes, the worst case was found when positioned as the table below.

Band	Axis
LTE Band 4	X-plane
LTE Band 12	X-plane
LTE Band 66	X-plane

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Following channel(s) was (were) selected for the final test as listed below

LTE Band 4

Test item	Sub-carrier Spacing (kHz)		Modulation		Test Channel			Tone	
	3.75	15	QPSK	BPSK	L	M	H	1	100%
RF Output Power (Note 3)	V	V	V	V	V	V	V	V	V
Frequency Stability	-	V	V	-	V	-	V	-	V
Emission Bandwidth (Note 4)	-	V	V	-	V	V	V	-	V
Band Edge (Note 3)	V	V	V	V	V	-	V	V	V
Peak to Average Ratio	V	V	V	V	V	V	V	V	-
Spurious Emissions at Antenna Terminal	V	V	V	V	V	V	V	V	-
Radiated Spurious Emissions	V	-	V	-	V	V	V	V	-

Note:

1. The mark "V" means that this configuration is chosen for testing.
2. The mark "-" means that this configuration is not testing.
3. Accordance with manufacturer description, the product support multi tone carrier and single tone carrier when operating in spacing 15 kHz, but only support single tone carrier when operating in 3.75 kHz spacing.
4. Since only when operating in QPSK of spacing 15 kHz could use with full Tone carrier, therefore, for emission bandwidth test only with operating in QPSK of spacing 15 kHz.

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Doc No: 17-EM-F0916 / 4.0



LTE Band 12

Test item	Sub-carrier Spacing (kHz)		Modulation		Test Channel			Tone	
	3.75	15	QPSK	BPSK	L	M	H	1	100%
RF Output Power (Note 3)	V	V	V	V	V	V	V	V	V
Frequency Stability	-	V	V	-	V	-	V	-	V
Emission Bandwidth (Note 4)	-	V	V	-	V	V	V	-	V
Band Edge (Note 3)	V	V	V	V	V	-	V	V	V
Peak to Average Ratio	V	V	V	V	V	V	V	V	-
Spurious Emissions at Antenna Terminal	V	V	V	V	V	V	V	V	-
Radiated Spurious Emissions	V	-	V	-	V	V	V	V	-

Note:

1. The mark "V" means that this configuration is chosen for testing.
2. The mark "-" means that this configuration is not testing.
3. Accordance with manufacturer description, the product support multi tone carrier and single tone carrier when operating in spacing 15 kHz, but only support single tone carrier when operating in 3.75 kHz spacing.
4. Since only when operating in QPSK of spacing 15 kHz could use with full Tone carrier, therefore, for emission bandwidth test only with operating in QPSK of spacing 15 kHz.

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LTE Band 66

Test item	Sub-carrier Spacing (kHz)		Modulation		Test Channel			Tone	
	3.75	15	QPSK	BPSK	L	M	H	1	100%
RF Output Power (Note 3)	V	V	V	V	V	V	V	V	V
Frequency Stability	-	V	V	-	V	-	V	-	V
Emission Bandwidth (Note 4)	-	V	V	-	V	V	V	-	V
Band Edge (Note 3)	V	V	V	V	V	-	V	V	V
Peak to Average Ratio	V	V	V	V	V	V	V	V	-
Spurious Emissions at Antenna Terminal	V	V	V	V	V	V	V	V	-
Radiated Spurious Emissions	V	-	V	-	V	V	V	V	-

Note:

1. The mark "V" means that this configuration is chosen for testing.
2. The mark "-" means that this configuration is not testing.
3. Accordance with manufacturer description, the product support multi tone carrier and single tone carrier when operating in spacing 15 kHz, but only support single tone carrier when operating in 3.75 kHz spacing.
4. Since only when operating in QPSK of spacing 15 kHz could use with full Tone carrier, therefore, for emission bandwidth test only with operating in QPSK of spacing 15 kHz.

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7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Spectrum Analyzer	Keysight	N9010A	MY56070827	Nov. 8, 2018	1 year
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	Nov. 8, 2018	1 year
Loop Antenna	ETS lindgren	6502	00213440	Dec. 11, 2018	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck	VULB 9168 & N-6-05	774 & AT-N0538	Jan. 14, 2019	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck	VULB 9168 & N-6-05	773 & AT-N0539	Jan. 14, 2019	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	Jan. 25, 2019	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01686	Jan. 16, 2019	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	Jan.16, 2019	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	759	Nov. 13, 2018	1 year
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	Jan. 30, 2019	1 year
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	Jan. 29, 2019	1 year
Preamplifier (18-40GHz)	EMCI	EMC184040SE E	980426	May. 8, 2019	1 year
Signal Generator	Keysight	N5173B	MY53271122	Jan. 14,2019	1 year
RF Cable (9 KHz~18 GHz)	UltraPhase & EMC Instrument	A1K50-UP0358-A1K50-1500&EMC106-NM-SM-2500/7000	170111-4&170219/170102	Jan. 29, 2019	1 year
RF Cable (18 GHz~40 GHz)	UltraPhase	K1K50-UP0264-K1K50-2500/2500/600	170214-2/170214-6/170111-1	Jan. 29, 2019	1 year

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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 15 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Spectrum Analyzer	Keysight	N9010A	MY56070834	Nov. 8, 2018	1 year
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	161254	Dec. 5, 2018	1 year
Temperature & Humidity Test Chamber	GIANT FORCE	GTH-150-40-CP-AR	MAA1701-010	Apr. 3, 2019	1 year

UL Software		
Description	Name	Version
Radiated measurement	AUDIX_E3	9.0

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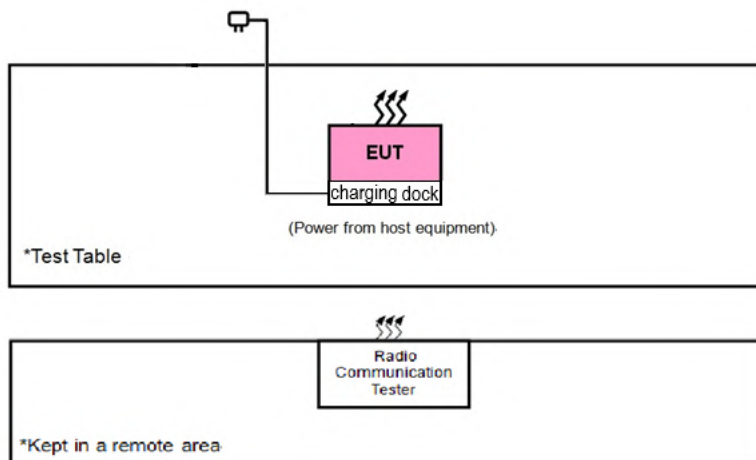


8. Description of Test Setup

Support Equipment

Item	Equipment	Brand Name	Model Name	S/N
N/A	N/A	N/A	N/A	N/A

Setup Diagram for Test



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Doc No: 17-EM-F0916 / 4.0



9. Test Results

9.1. RF Output Power

Requirements

Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP.

Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

Test procedure

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

The relevant equation for determining the ERP or EIRP from the conducted RF output power measured using the guidance provided above is:

$$\text{ERP or EIRP} = P_{\text{Meas}} + G_T - L_C$$

where:

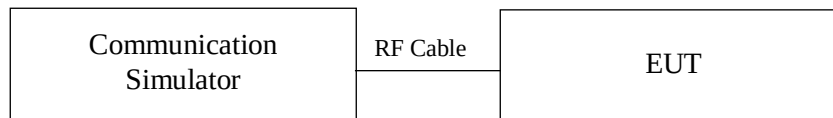
ERP or EIRP = effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas} , typically dBW or dBm);

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);

L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

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Test Results

Conducted Output Power (dBm)

Band	Sub-carrier Spacing	Ntones	Tone@	QPSK			BPSK		
				Low Ch 19951	Mid Ch 20175	High Ch 20399	Low Ch 19951	Mid Ch 20175	High Ch 20399
				1710.1 MHz	1732.5 MHz	1754.9 MHz	1710.1 MHz	1732.5 MHz	1754.9 MHz
4	15 kHz	1	0	22.53	22.80	22.93	21.87	22.73	22.88
		1	11	22.59	22.79	22.84	21.90	22.67	22.83
		12	0	20.30	20.61	20.62			
	3.75 kHz	1	0	22.66	22.87	22.59	22.70	22.88	22.41
		1	47	22.70	22.88	22.59	22.71	22.91	22.50

Band	Sub-carrier Spacing	Ntones	Tone@	QPSK			BPSK		
				Low Ch 23011	Mid Ch 23095	High Ch 23179	Low Ch 23011	Mid Ch 23095	High Ch 23179
				699.1 MHz	707.5 MHz	715.9 MHz	699.1 MHz	707.5 MHz	715.9 MHz
12	15 kHz	1	0	23.22	23.59	23.57	23.16	23.61	23.49
		1	11	23.19	23.56	23.56	23.18	23.59	23.56
		12	0	20.71	21.36	21.24			
	3.75 kHz	1	0	23.20	23.49	23.87	23.18	23.44	23.86
		1	47	23.19	23.48	23.99	23.16	23.42	23.93

Band	Sub-carrier Spacing	Ntones	Tone@	QPSK			BPSK		
				Low Ch 131973	Mid Ch 132322	High Ch 132671	Low Ch 131973	Mid Ch 132322	High Ch 132671
				1710.1 MHz	1745.0 MHz	1779.9 MHz	1710.1 MHz	1745.0 MHz	1779.9 MHz
66	15 kHz	1	0	21.34	21.91	21.72	21.35	21.96	22.02
		1	11	21.34	21.92	21.84	21.39	21.90	22.01
		12	0	19.10	19.74	19.70			
	3.75 kHz	1	0	22.44	22.73	22.59	22.42	22.75	22.60
		1	47	22.42	22.80	22.71	22.42	22.77	22.65

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E.I.R.P (dBm)

Band	Mode	QPSK			BPSK		
	Channel	Low CH	Mid CH	High CH	Low CH	Mid CH	High CH
		19951	20175	20399	19951	20175	20399
	Frequency	1710.1 MHz	1732.5 MHz	1754.9 MHz	1710.1 MHz	1732.5 MHz	1754.9 MHz
4	Conducted power(dBm)	22.7	22.88	22.93	22.71	22.91	22.88
	Conducted power (Watts)	0.19	0.19	0.20	0.19	0.20	0.19
	E.I.R.P (dBm)	20.8	20.98	21.03	20.81	21.01	20.98
	E.I.R.P (Watts)	0.12	0.13	0.13	0.12	0.13	0.13

Band	Mode	QPSK			BPSK		
	Channel	Low CH	Mid CH	High CH	Low CH	Mid CH	High CH
		131973	132322	132671	131973	132322	132671
	Frequency	1710.1 MHz	1745 MHz	1779.9 MHz	1710.1 MHz	1745 MHz	1779.9 MHz
66	Conducted power(dBm)	22.44	22.8	22.71	22.42	22.77	22.65
	Conducted power (Watts)	0.18	0.19	0.19	0.17	0.19	0.18
	E.I.R.P (dBm)	20.64	21	20.91	20.62	20.97	20.85
	E.I.R.P (Watts)	0.12	0.13	0.12	0.12	0.13	0.12

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E.R.P (dBm)

Band	Mode	QPSK			BPSK		
	Channel	Low CH	Mid CH	High CH	Low CH	Mid CH	High CH
		23011	23095	23179	23011	23095	23179
	Frequency	699.1 MHz	707.5 MHz	715.9 MHz	699.1 MHz	707.5 MHz	715.9 MHz
12	Conducted power(dBm)	23.22	23.59	23.99	23.18	23.61	23.93
	Conducted power (Watts)	0.21	0.23	0.25	0.21	0.23	0.25
	E.R.P (dBm)	19.57	19.94	20.34	19.53	19.96	20.28
	E.R.P (Watts)	0.09	0.10	0.11	0.09	0.10	0.11

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9.2. Peak to Average Power Ratio

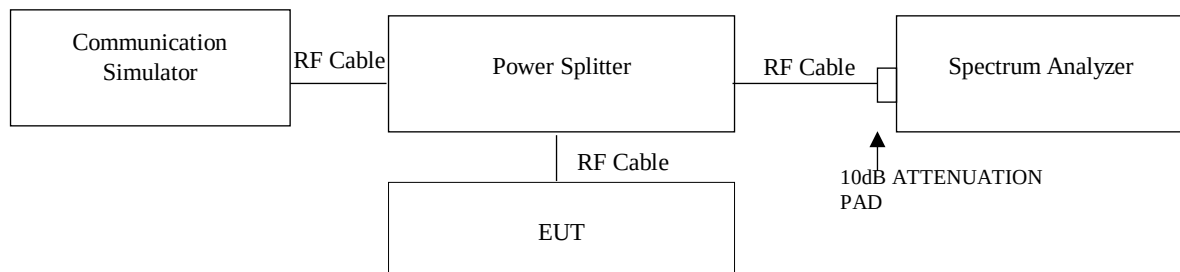
Requirements

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.

Test procedure

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 %.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 22 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

Test Results

LTE Band 4

Sub-carrier spacing	Channel	Peak to Average Ratio (dB)		Sub-carrier spacing	Channel	Peak to Average Ratio (dB)	
		QPSK	BPSK			QPSK	BPSK
15 kHz	19951	1.84	1.98	3.75kHz	19951	1.94	2.25
	20175	1.81	1.94		20175	1.88	2.22
	20399	1.77	1.90		20399	1.77	2.18

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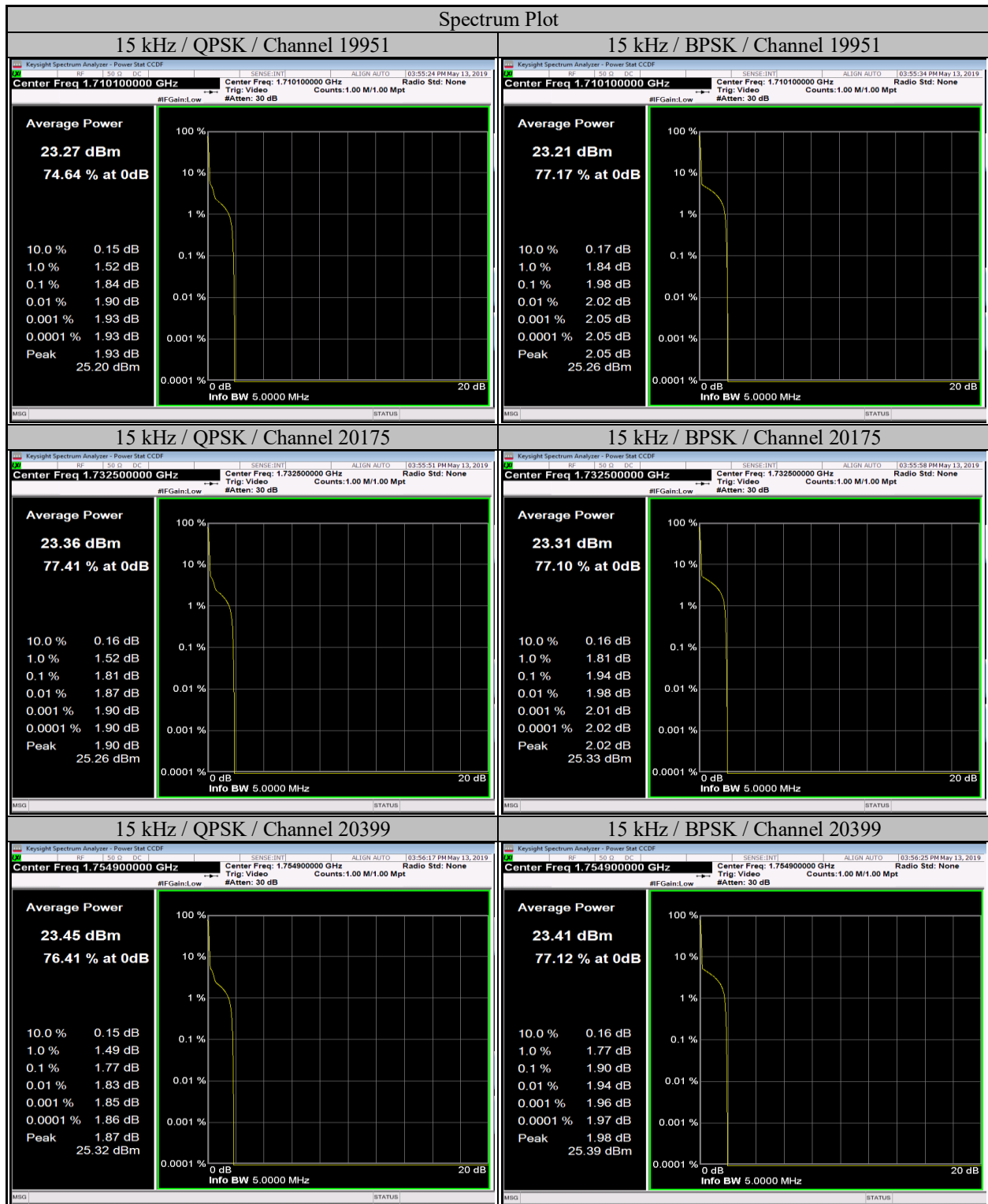
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Test report No. : 4789004574-US-R3-V0
Page : 23 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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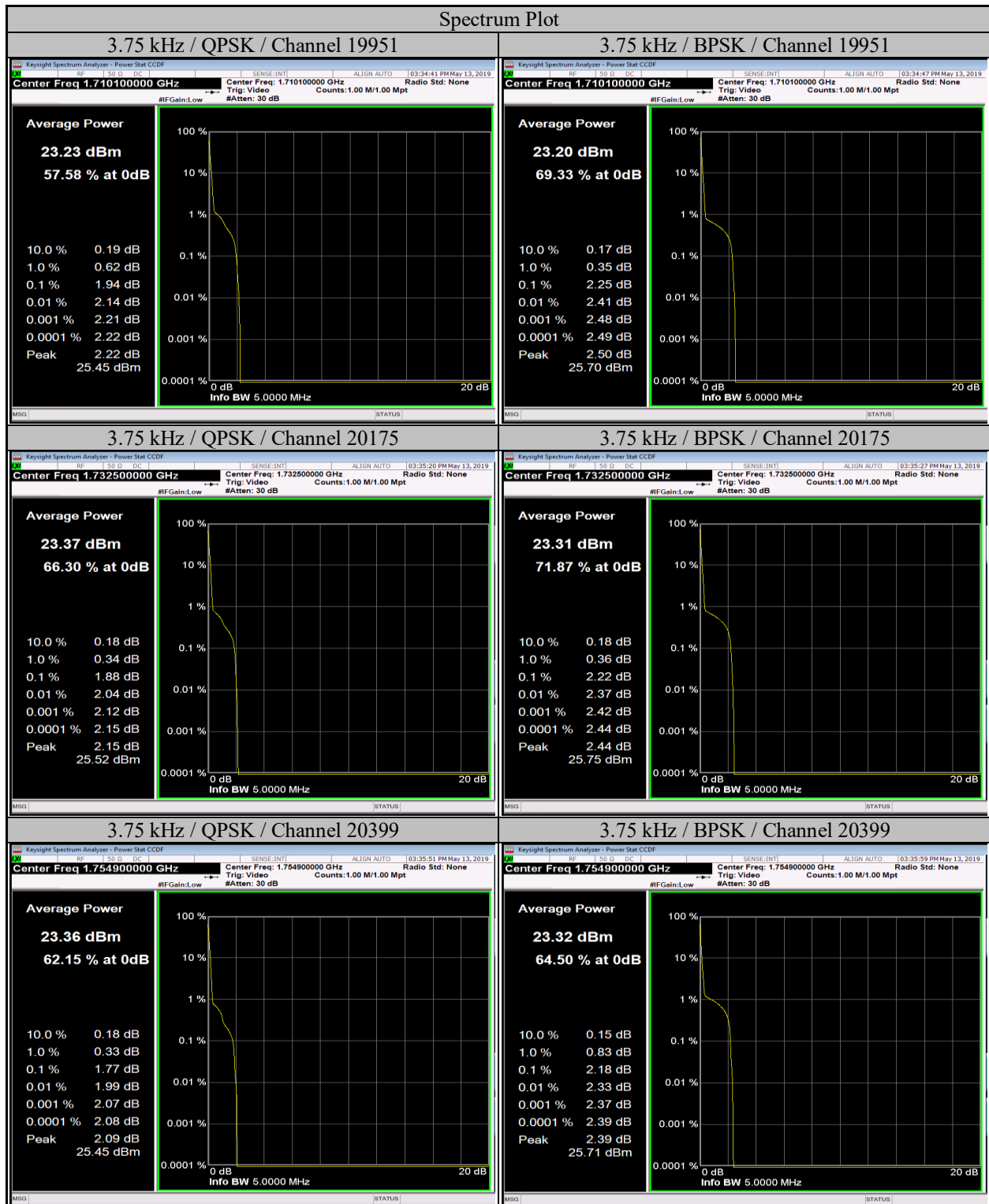
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Test report No. : 4789004574-US-R3-V0
Page : 24 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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LTE Band 12

Sub-carrier spacing	Channel	Peak to Average Ratio (dB)		Sub-carrier spacing	Channel	Peak to Average Ratio (dB)	
		QPSK	BPSK			QPSK	BPSK
15 kHz	23011	1.84	1.96	3.75kHz	23011	2.15	1.86
	23095	1.81	1.95		23095	2.12	1.83
	23179	1.79	1.92		23179	1.81	2.10

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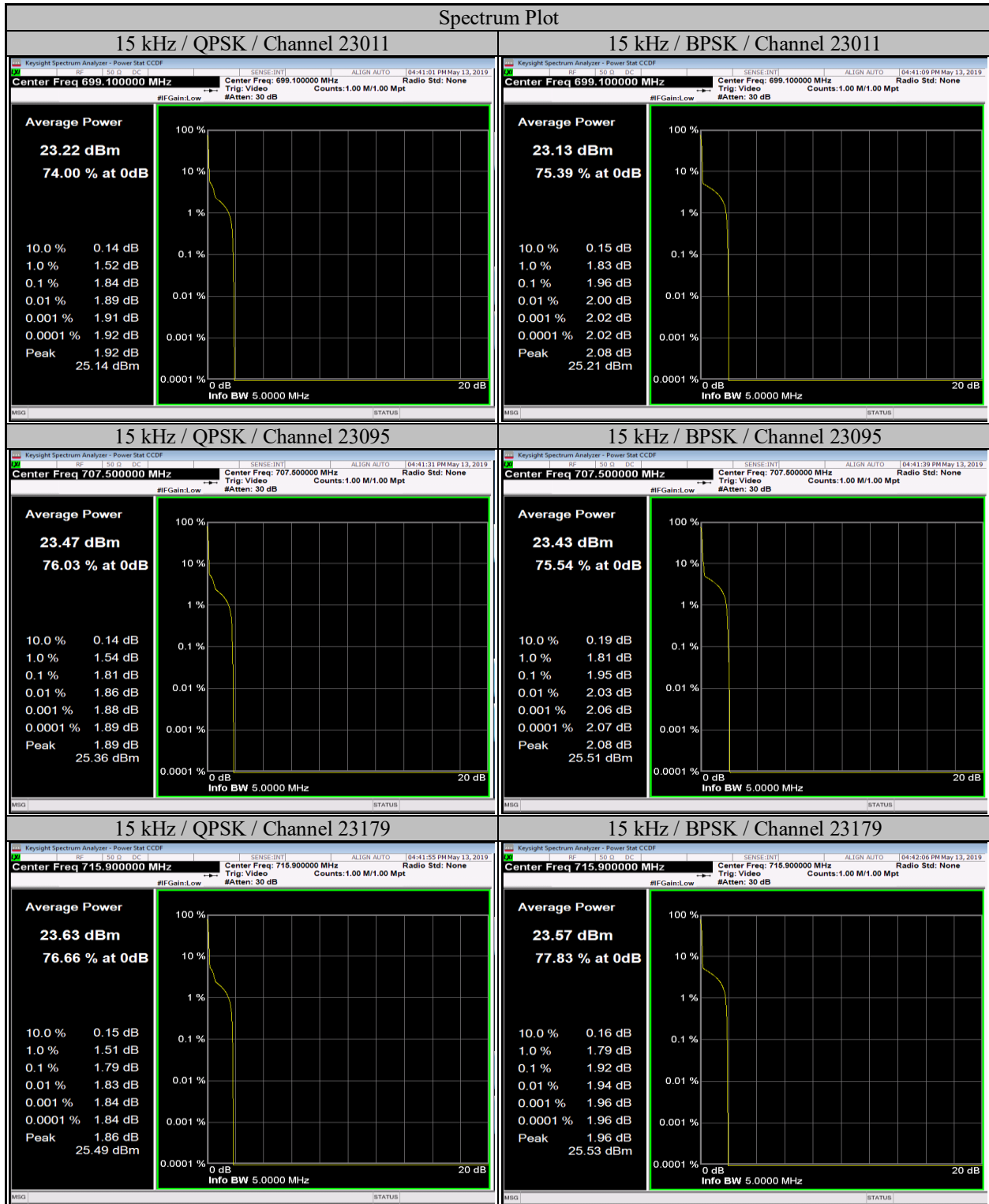
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Test report No. : 4789004574-US-R3-V0
Page : 26 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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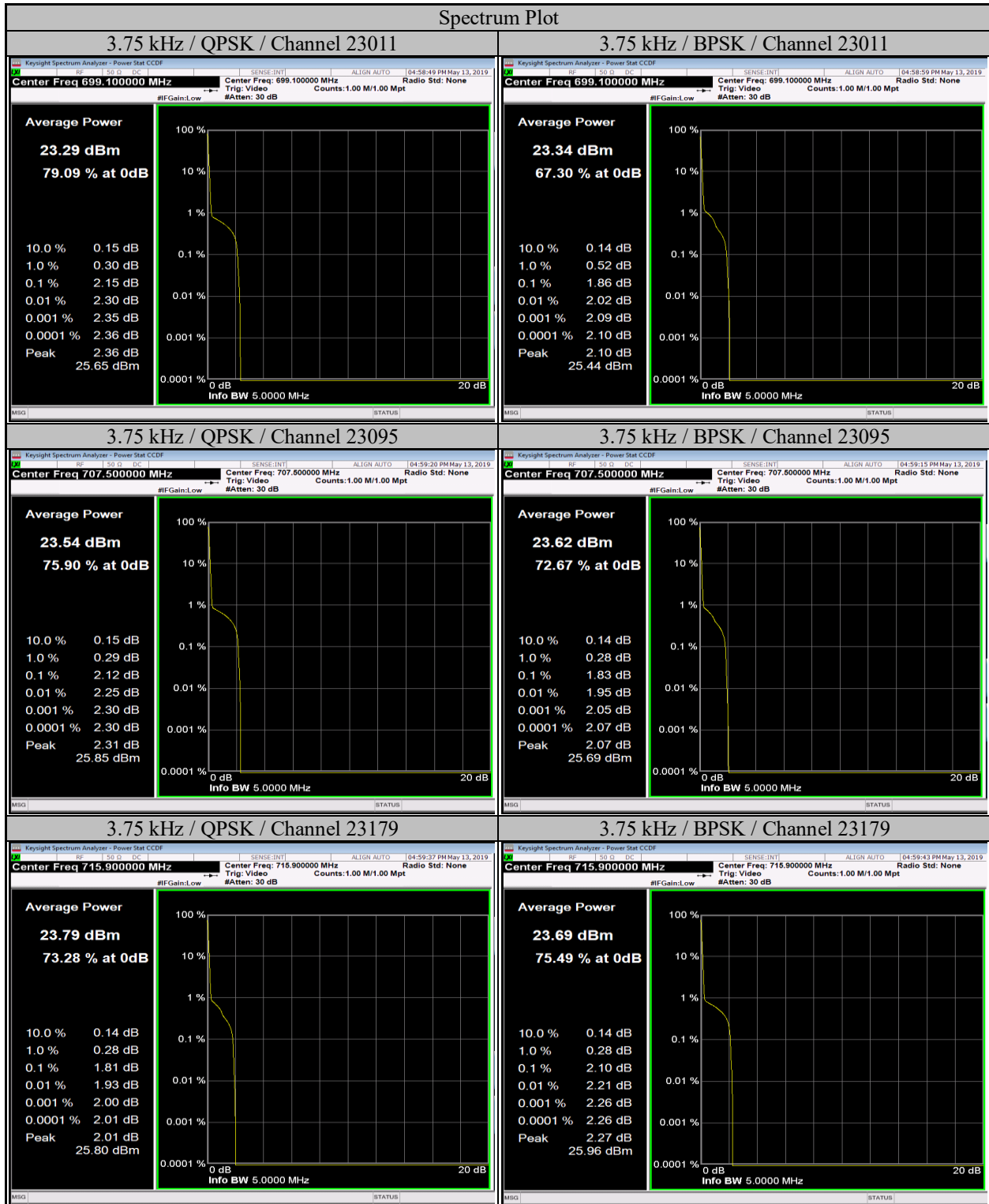
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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 27 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 28 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

LTE Band 66

Sub-carrier spacing	Channel	Peak to Average Ratio (dB)		Sub-carrier spacing	Channel	Peak to Average Ratio (dB)	
		QPSK	BPSK			QPSK	BPSK
15 kHz	131973	1.85	2.00	3.75kHz	131973	1.92	2.26
	132322	1.79	1.95		132322	1.86	2.19
	132671	1.76	1.86		132671	1.79	2.10

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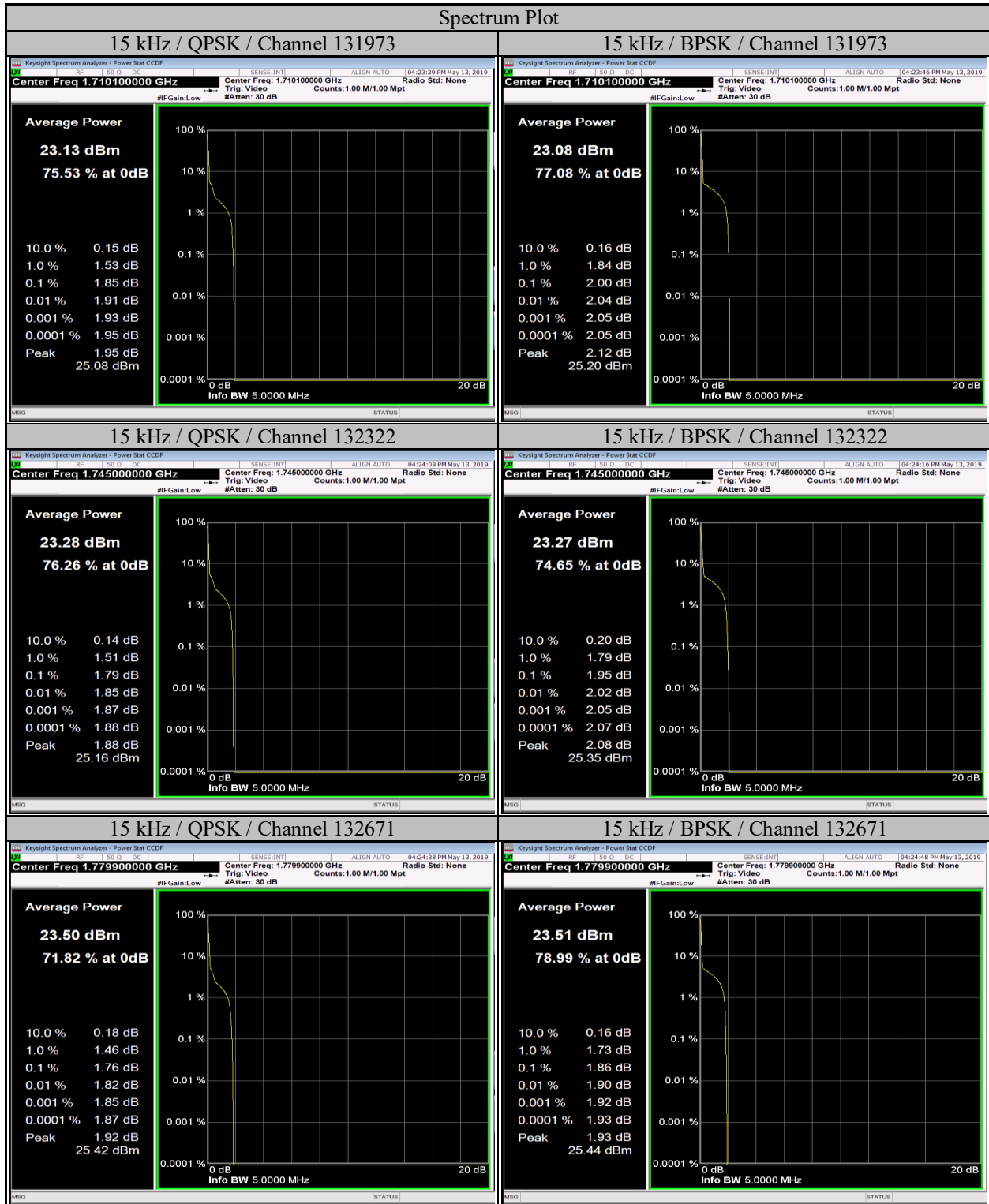
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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 29 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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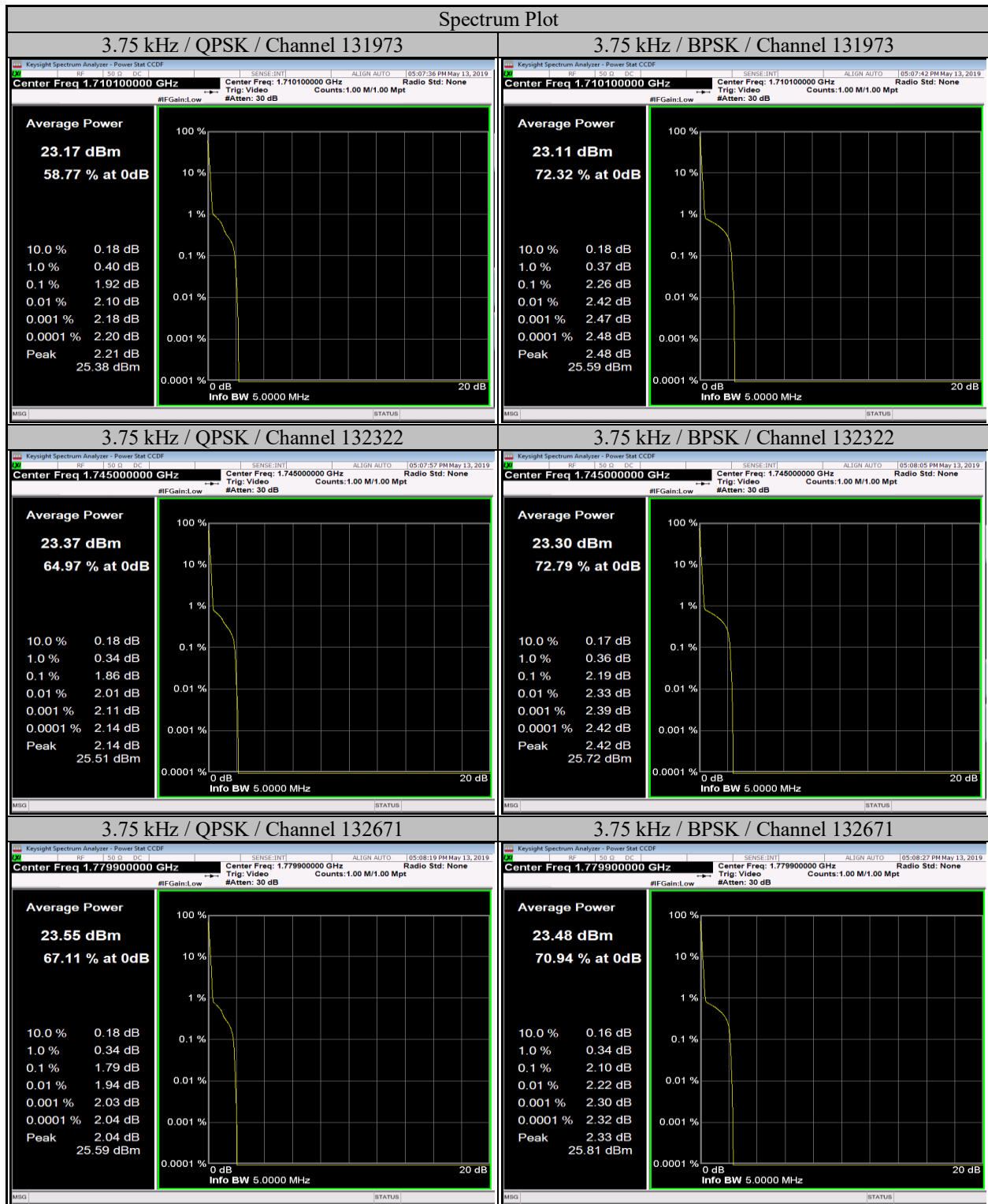
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Test report No. : 4789004574-US-R3-V0
Page : 30 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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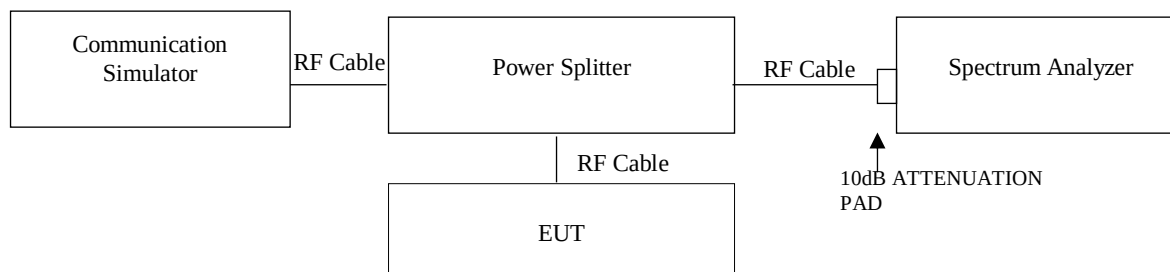


9.3. Occupied Bandwidth

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. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

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Test Results

LTE Band 4

Sub-Carrier Spacing	Channel	99 % Occupied Bandwidth (MHz)	Sub-Carrier Spacing	Channel	26dB Bandwidth (MHz)
		QPSK			QPSK
15 kHz	19951	178.54	15 kHz	19951	238.20
	20175	178.96		20175	235.70
	20399	179.96		20399	233.90

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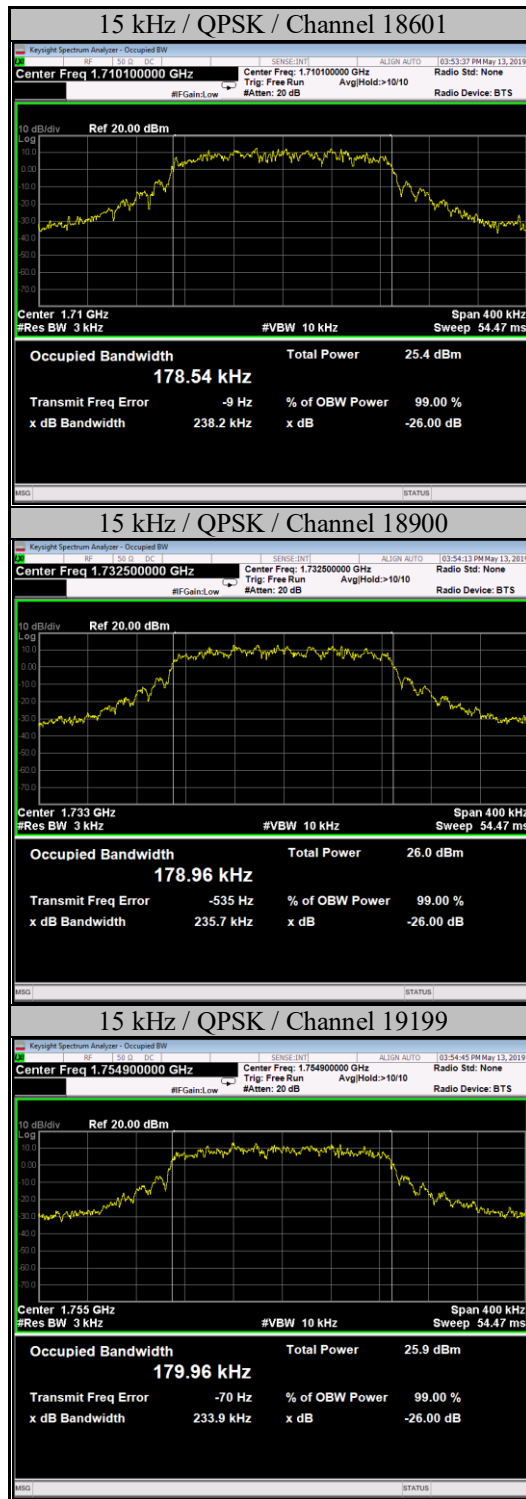
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Test report No. : 4789004574-US-R3-V0
Page : 33 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 34 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

LTE Band 12

Sub-Carrier Spacing	Channel	99 % Occupied Bandwidth (MHz)	Sub-Carrier Spacing	Channel	26dB Bandwidth (MHz)
		QPSK			QPSK
15 kHz	23011	179.58	15 kHz	23011	237.70
	23095	178.75		23095	235.50
	23179	179.43		23179	237.30

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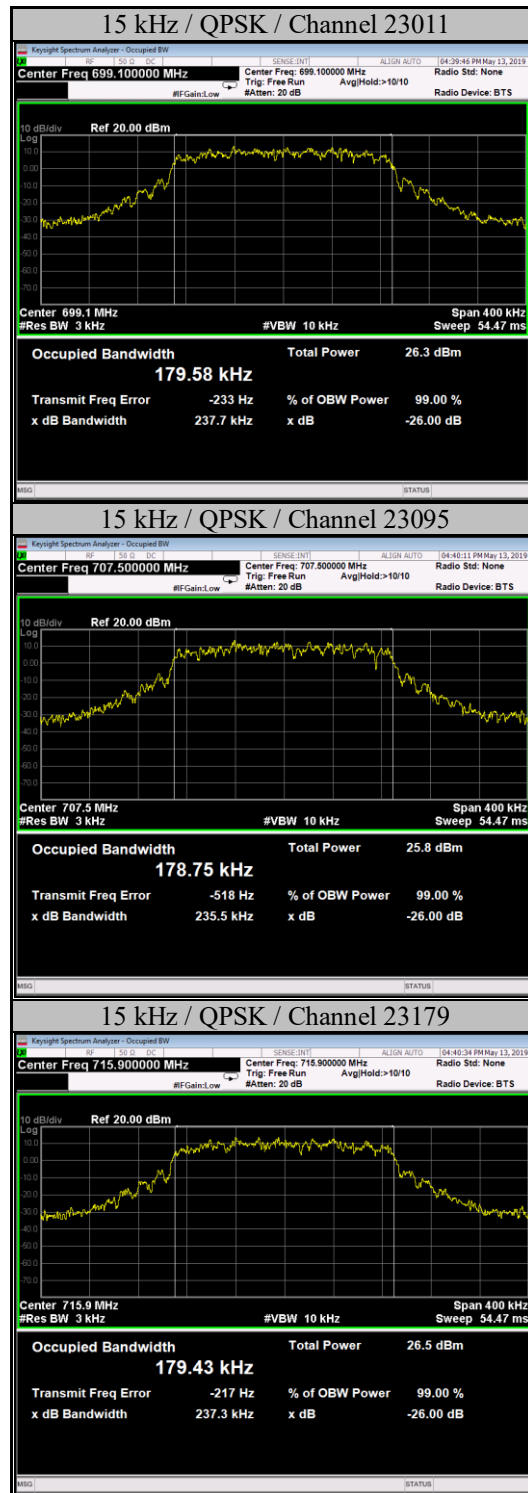
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Test report No. : 4789004574-US-R3-V0
Page : 35 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 36 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

LTE Band 66

Sub-Carrier Spacing	Channel	99 % Occupied Bandwidth (MHz)	Sub-Carrier Spacing	Channel	26dB Bandwidth (MHz)
		QPSK			QPSK
15 kHz	131973	178.17	15 kHz	131973	238.00
	132322	179.13		132322	235.70
	132671	179.63		132671	234.20

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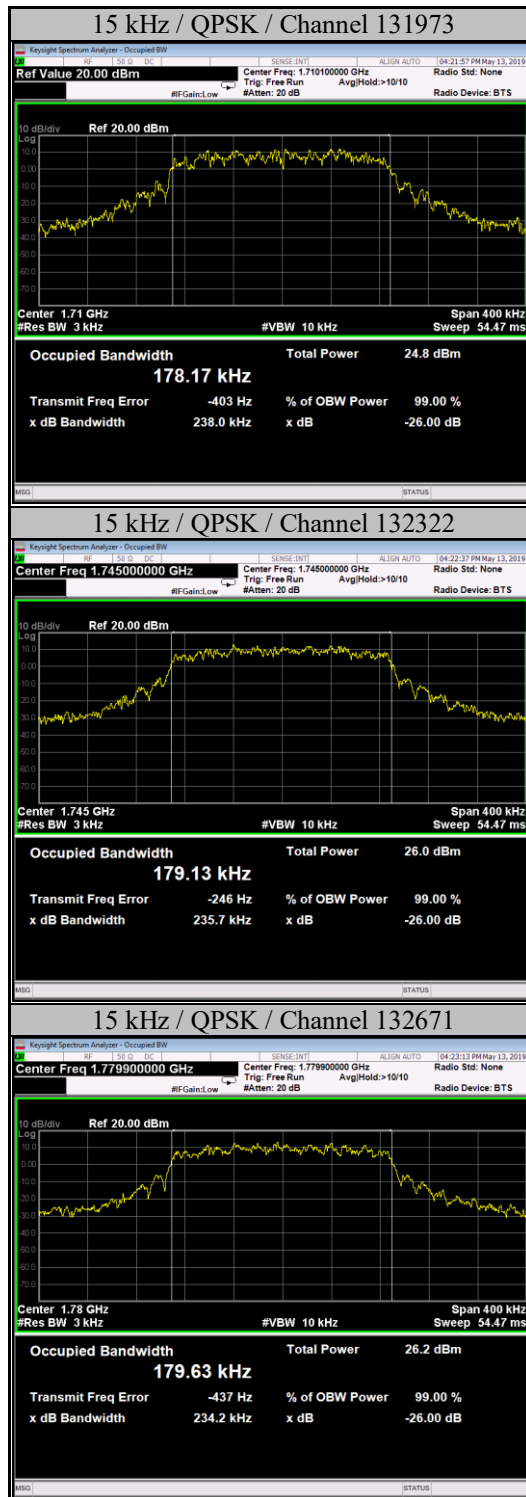
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Test report No. : 4789004574-US-R3-V0
Page : 37 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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9.4. Frequency Stability

Requirements

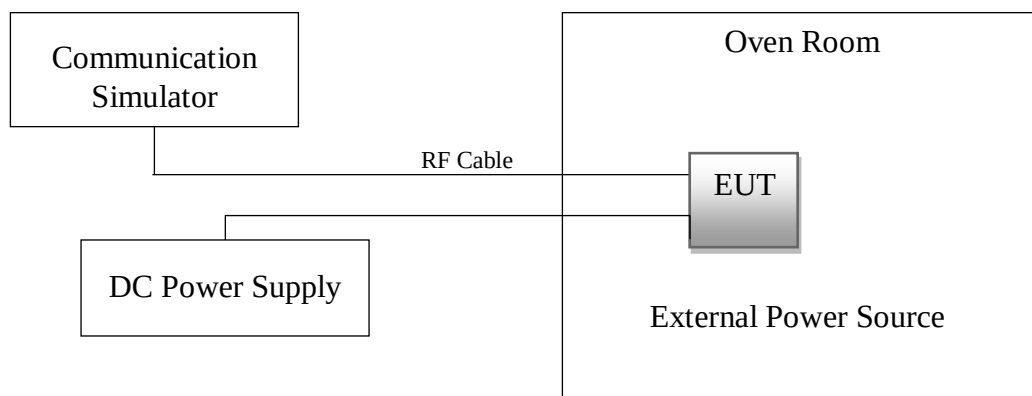
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test procedure

1. 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.
2. 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.
3. 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.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

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Test Results

LTE Band 4

Sub-carrier spacing: 15 kHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V _{nom}	T _{nom}	1710.100012	0.007	1754.900015	0.008
V _{min}		1710.100012	0.007	1754.900015	0.008
V _{max}		1710.100013	0.008	1754.900014	0.008

Sub-carrier spacing: 15 kHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	-30	1710.100018	0.010	1754.900013	0.008
	-20	1710.100016	0.010	1754.900013	0.007
	-10	1710.100018	0.011	1754.900012	0.007
	0	1710.100019	0.011	1754.900014	0.008
	10	1710.100014	0.008	1754.900015	0.009
	20	1710.100012	0.007	1754.900015	0.008
	30	1710.100018	0.011	1754.900012	0.007
	40	1710.100012	0.007	1754.900012	0.007
	50	1710.100017	0.010	1754.900014	0.008

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LTE Band 12

Sub-carrier spacing: 15 kHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V _{nom}	T _{nom}	699.100005	0.007	715.900008	0.011
V _{min}		699.100004	0.005	715.900006	0.008
V _{max}		699.100003	0.005	715.900008	0.010

Sub-carrier spacing: 15 kHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	-30	699.100009	0.014	715.900005	0.007
	-20	699.100008	0.012	715.900005	0.007
	-10	699.100006	0.009	715.900004	0.006
	0	699.100009	0.012	715.900003	0.004
	10	699.100008	0.012	715.900005	0.008
	20	699.100004	0.005	715.900006	0.008
	30	699.100005	0.007	715.899996	-0.005
	40	699.100009	0.012	715.900003	0.005
	50	699.100006	0.009	715.900006	0.008

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Doc No: 17-EM-F0916 / 4.0



LTE Band 66

Sub-carrier spacing: 15 kHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
V _{nom}	T _{nom}	1710.100018	0.010	1779.900018	0.010
V _{min}		1710.100017	0.010	1779.900019	0.011
V _{max}		1710.100017	0.010	1779.900018	0.010

Sub-carrier spacing: 15 kHz					
Voltage (V)	Temp. (°C)	Low Channel		High Channel	
		Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)
	-30	1710.100017	0.010	1779.900018	0.010
	-20	1710.100017	0.010	1779.900019	0.011
	-10	1710.100019	0.011	1779.900020	0.011
	0	1710.100018	0.010	1779.900022	0.012
	10	1710.100019	0.011	1779.900016	0.009
	20	1710.100017	0.010	1779.900019	0.011
	30	1710.100019	0.011	1779.900013	0.008
	40	1710.100019	0.011	1779.900012	0.006
	50	1710.100019	0.011	1779.900020	0.011

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9.5. Band Edge Measurements

Requirements

For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

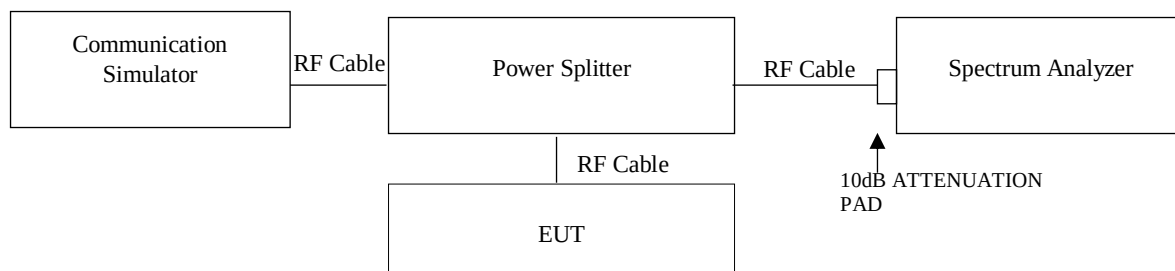
For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts by at least $43 + 10 \log (P)$ dB. On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log (P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;

For operations in the 1710-1755 MHz and 1755-1780 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log (P)$ dB.

Test procedure

1. All measurements were done at low and high operational frequency range.
2. For full tone sub-carrier, the center frequency of spectrum is the band edge frequency and span is 1 MHz, RBW of the spectrum is 2 kHz and VBW of the spectrum is 10 kHz.
3. For 1 tone sub-carrier, the center frequency of spectrum is the band edge frequency and span is 1 MHz, RBW of the spectrum is 200 Hz and VBW of the spectrum is 1 kHz.
(1 tone bandwidth = Full tones bandwidth / 12 is about $180 \text{ kHz} / 12 = 15 \text{ kHz}$, and since RBW should be use greater than or equal to 1% of OBW, using 200 Hz is enough to cover 1% of demand in this case.)
4. Record the max trace plot into the test report.

Test Setup



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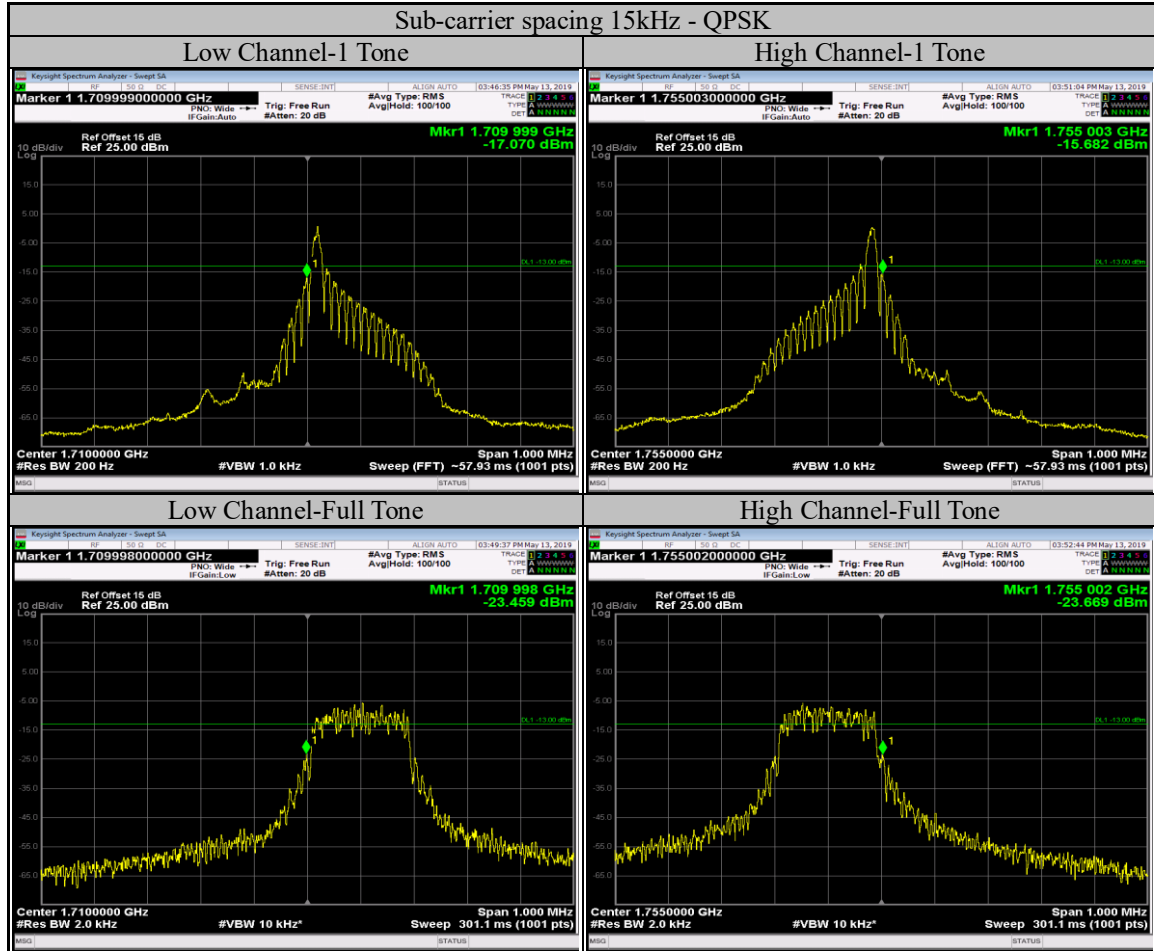
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The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Test Results

LTE Band 4



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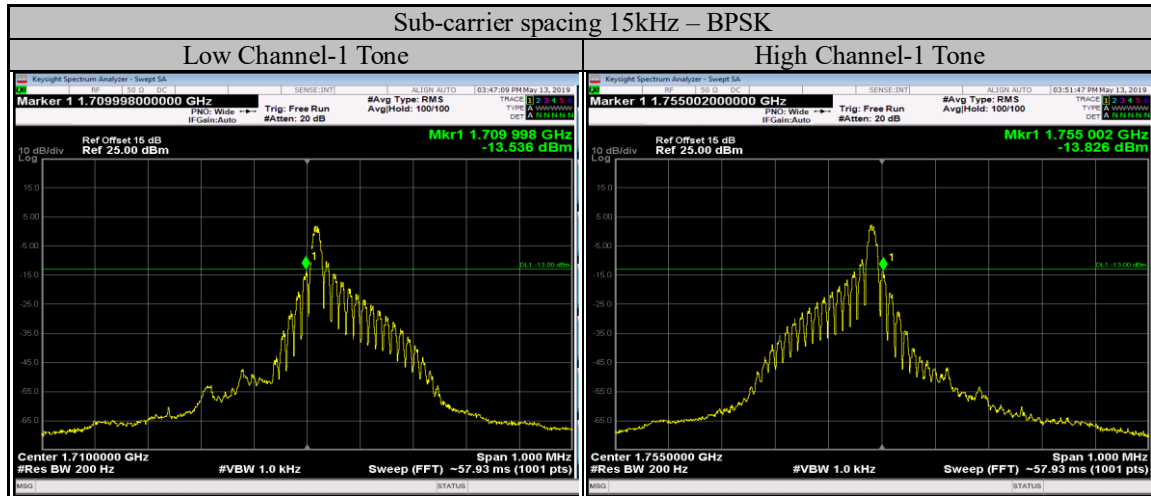
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Test report No. : 4789004574-US-R3-V0
Page : 44 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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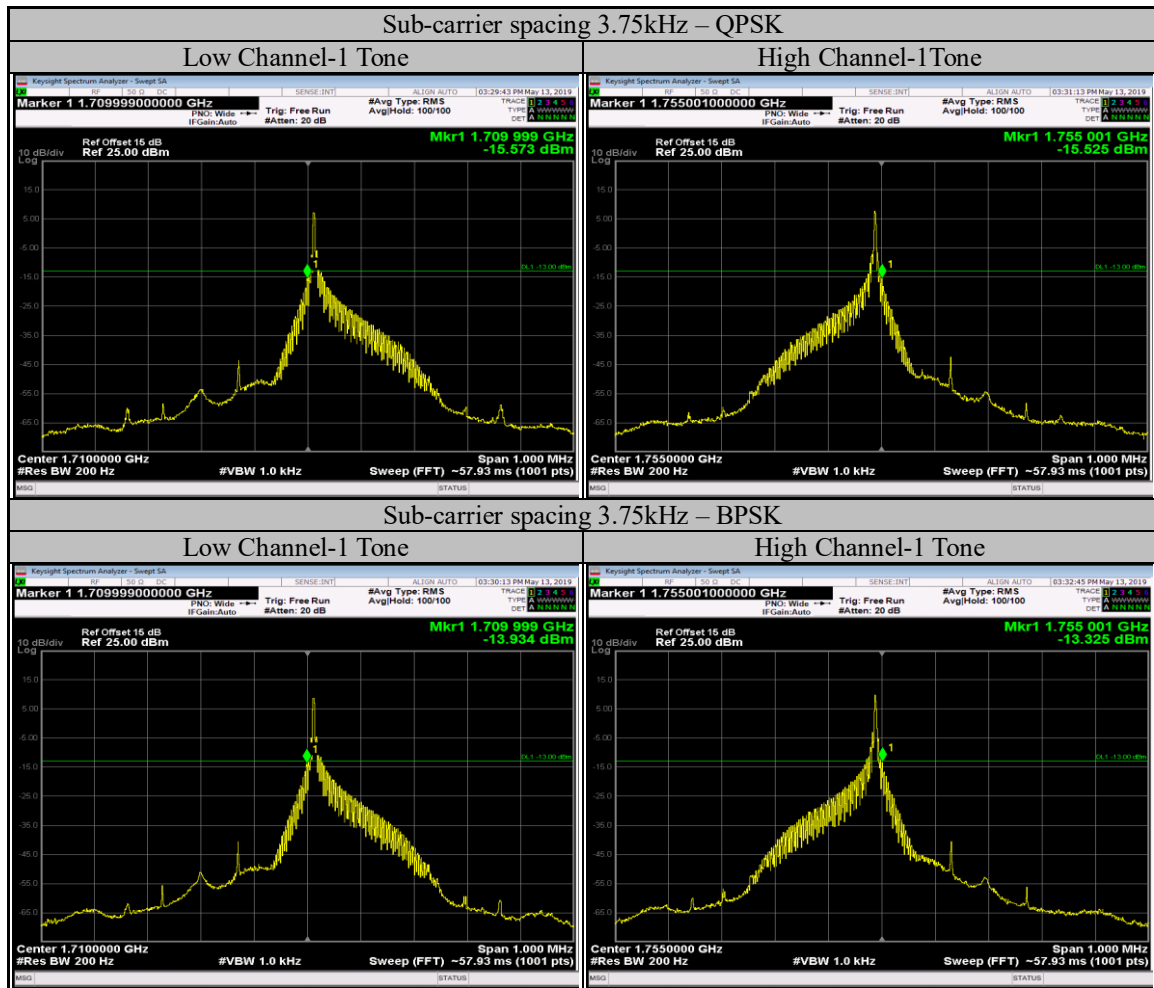
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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 45 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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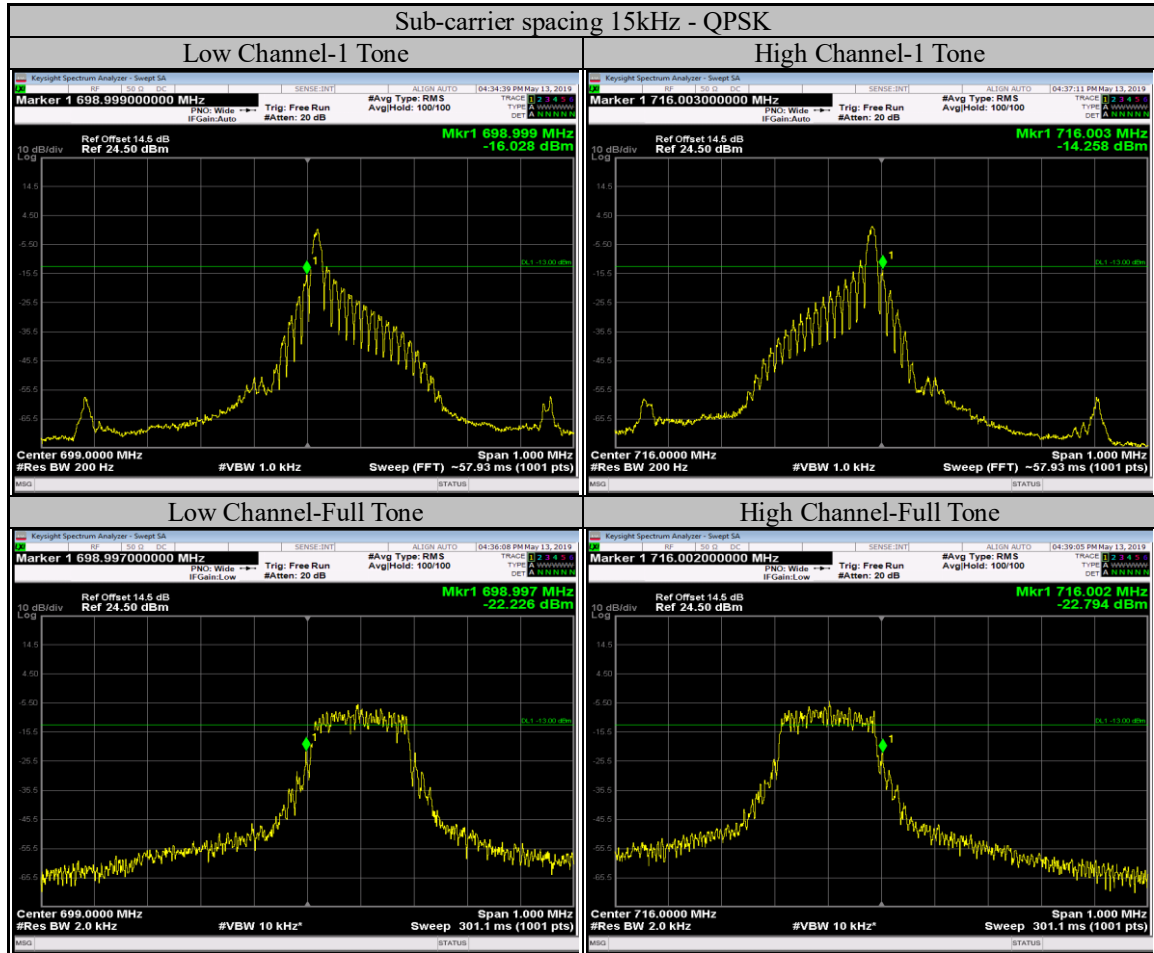
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LTE Band 12



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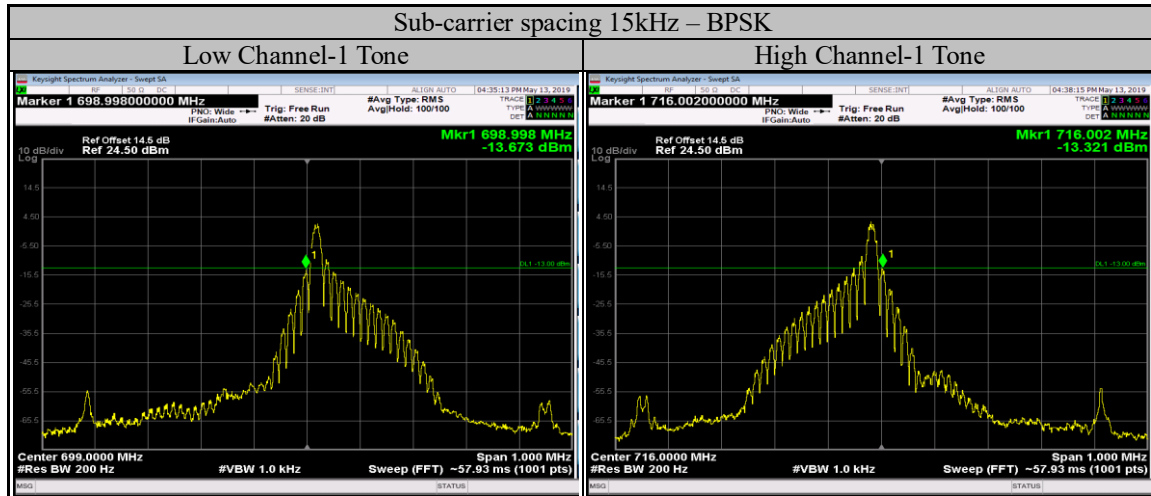
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Test report No. : 4789004574-US-R3-V0
Page : 47 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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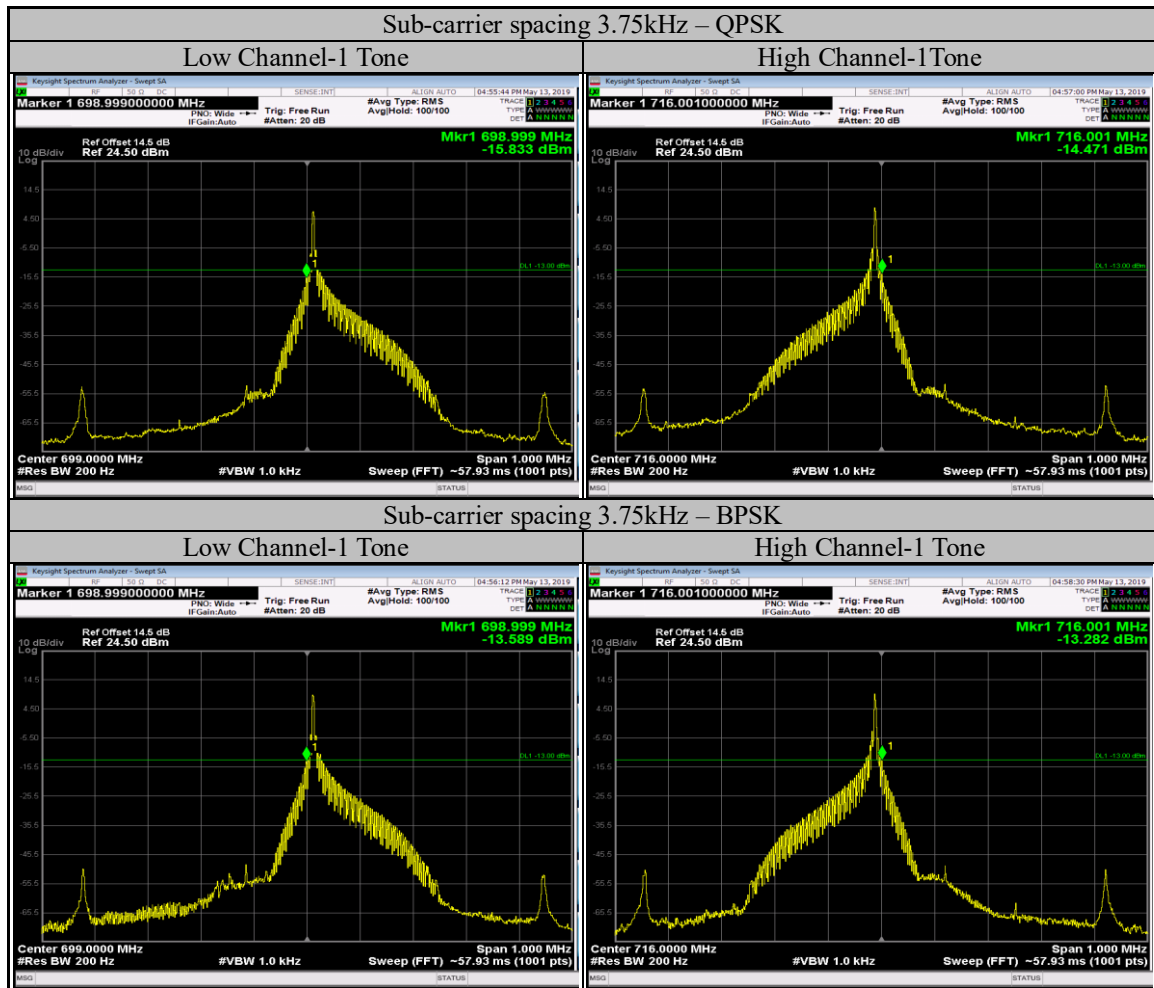
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Test report No. : 4789004574-US-R3-V0
Page : 48 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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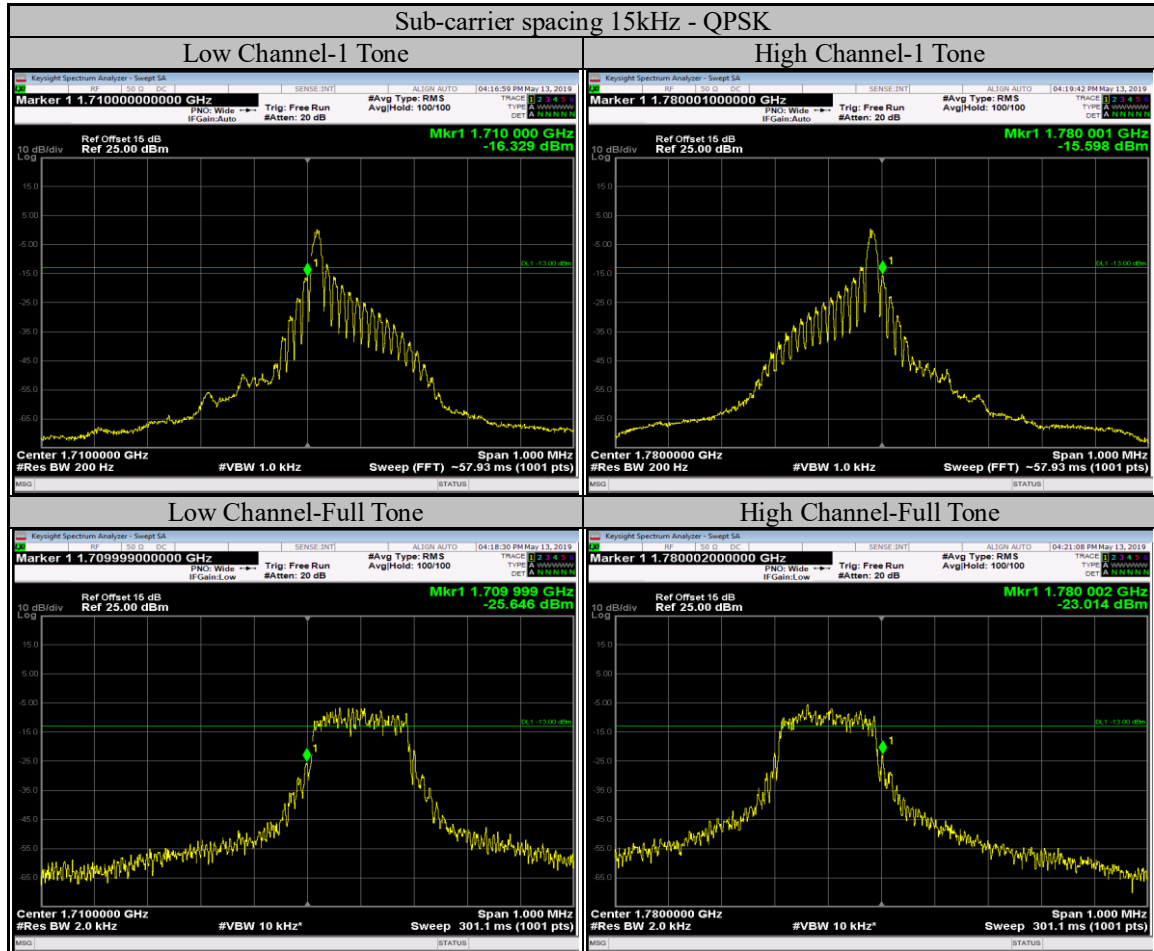
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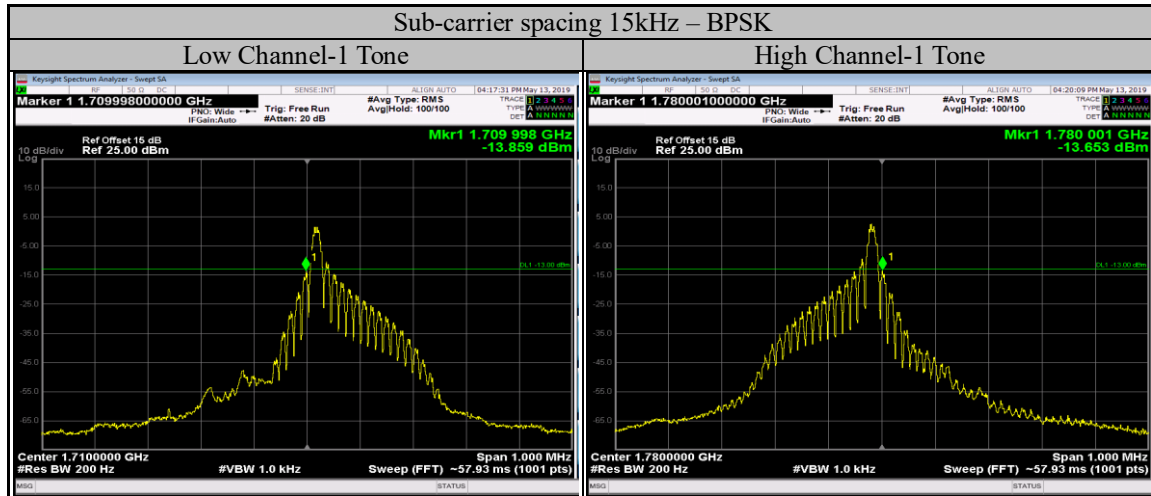


LTE Band 66





Test report No. : 4789004574-US-R3-V0
Page : 50 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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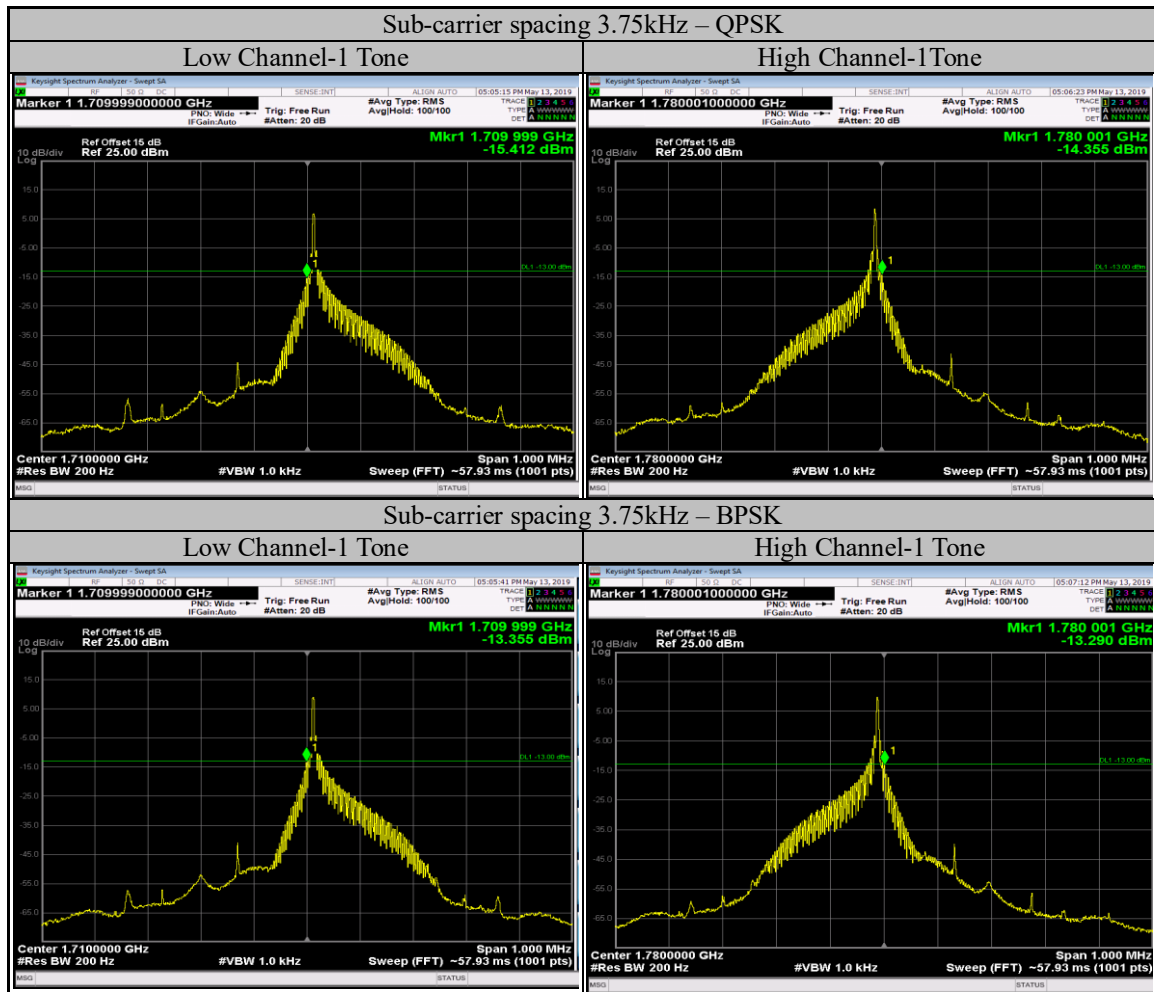
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Test report No. : 4789004574-US-R3-V0
Page : 51 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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9.6. Spurious Emissions at Antenna Terminal

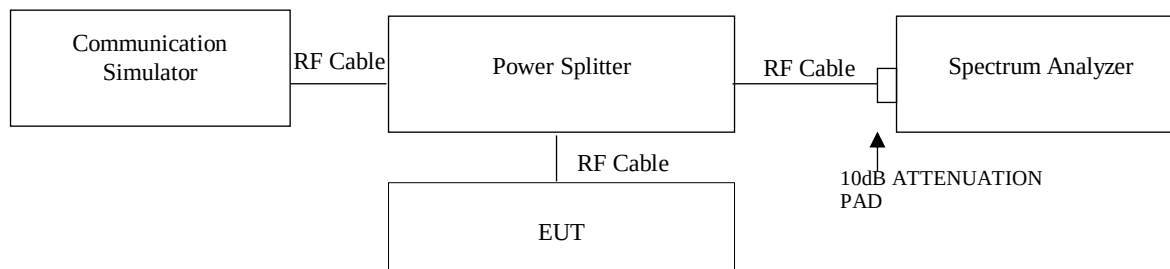
Requirements

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 -13 dBm.

Test procedure

1. The EUT was connected to Spectrum Analyzer and Communication Simulator via power Splitter. All measurements were done at low, middle and high operational frequency range. The measurement is carried out using a spectrum analyzer.
2. Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier. 10 dB attenuation pad is connected with spectrum. RBW = 1 MHz and VBW = 3 MHz is used for conducted emission measurement.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

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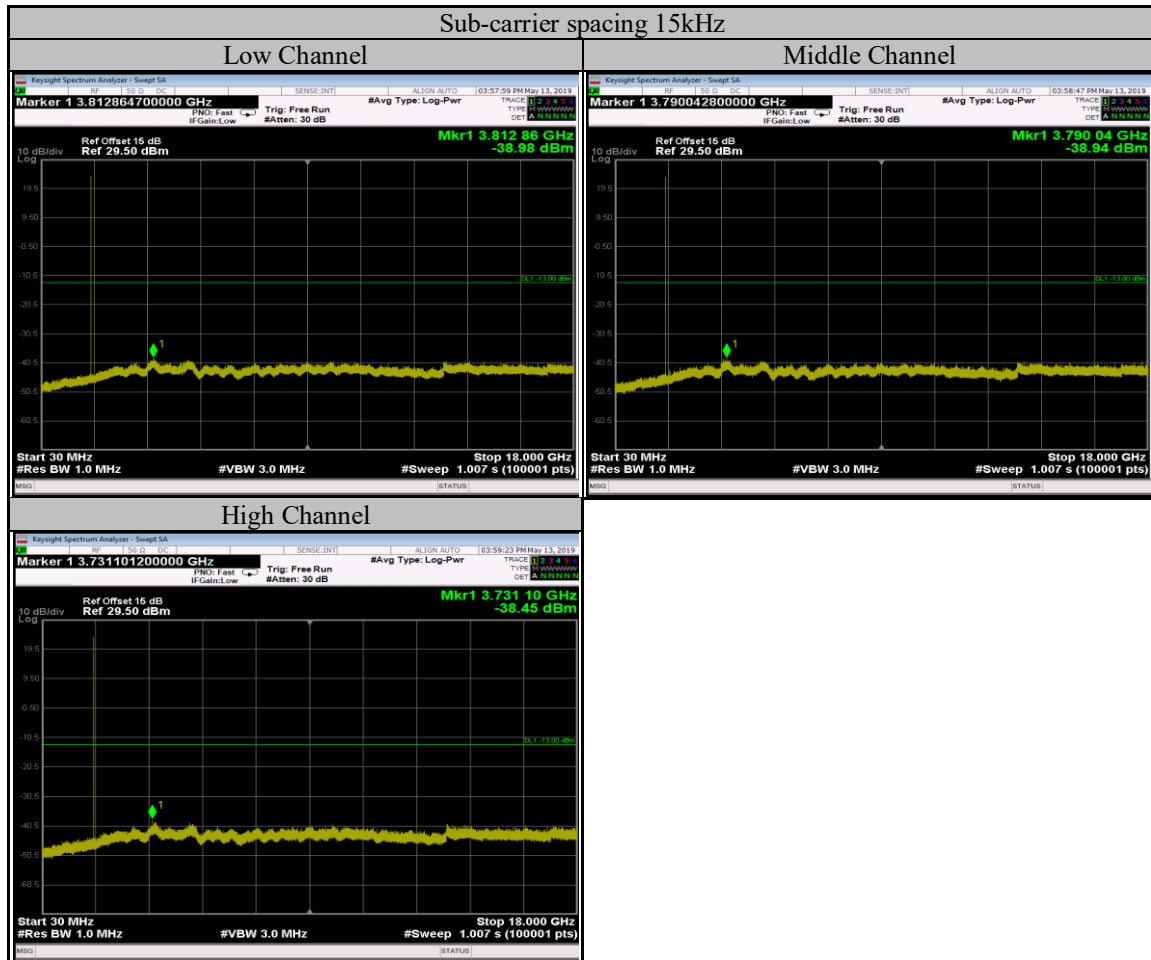
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Test report No. : 4789004574-US-R3-V0
Page : 53 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

Test Results

LTE Band 4



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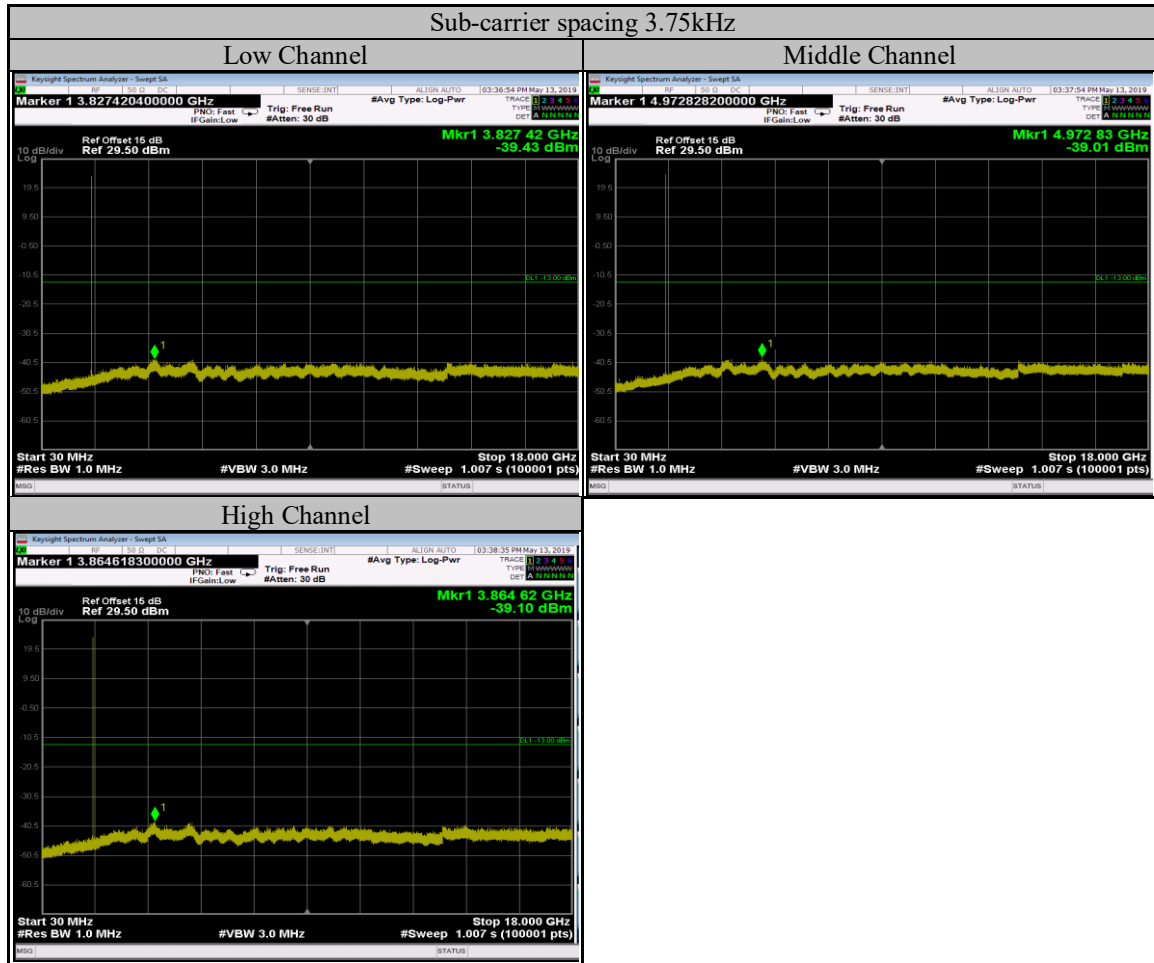
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Test report No. : 4789004574-US-R3-V0
Page : 54 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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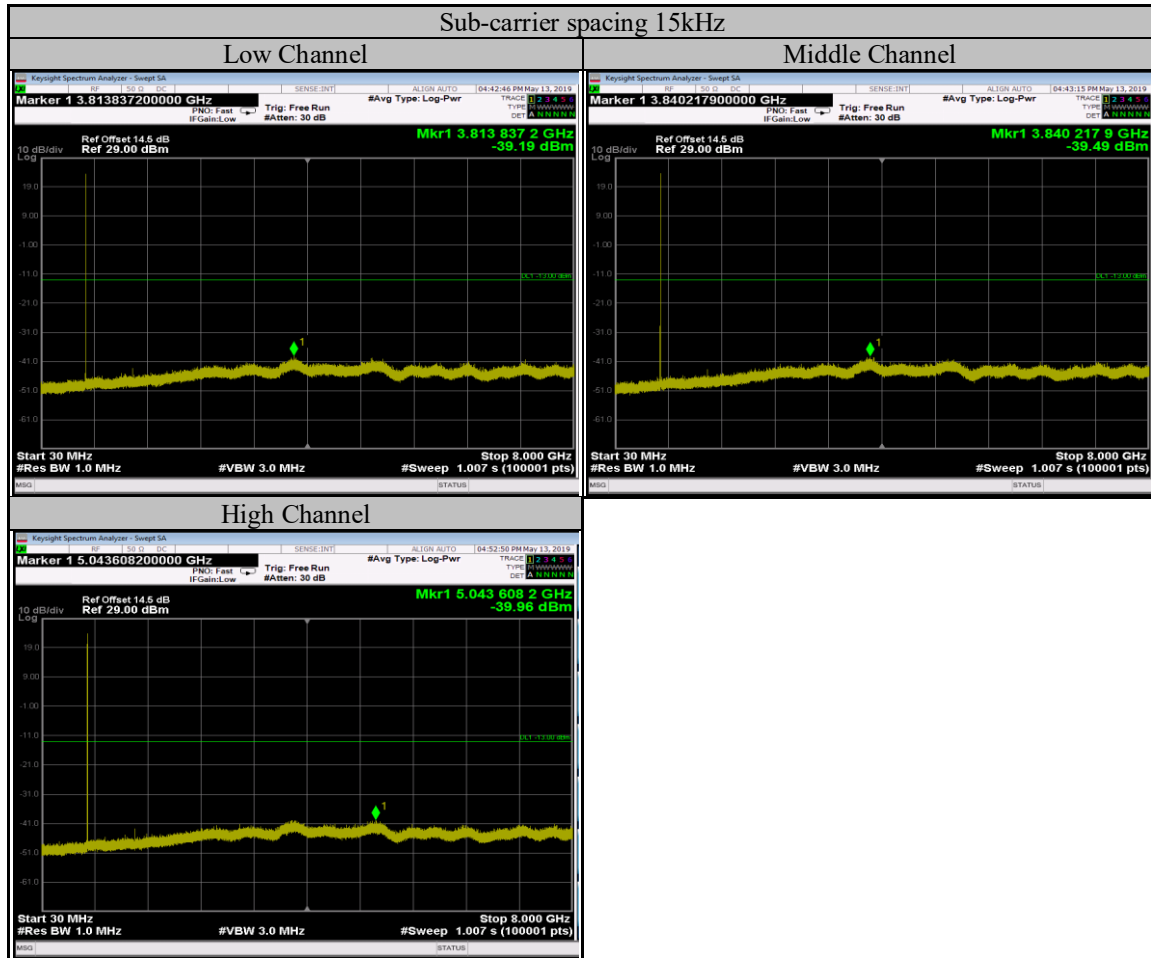
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Test report No. : 4789004574-US-R3-V0
Page : 55 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

LTE Band 12



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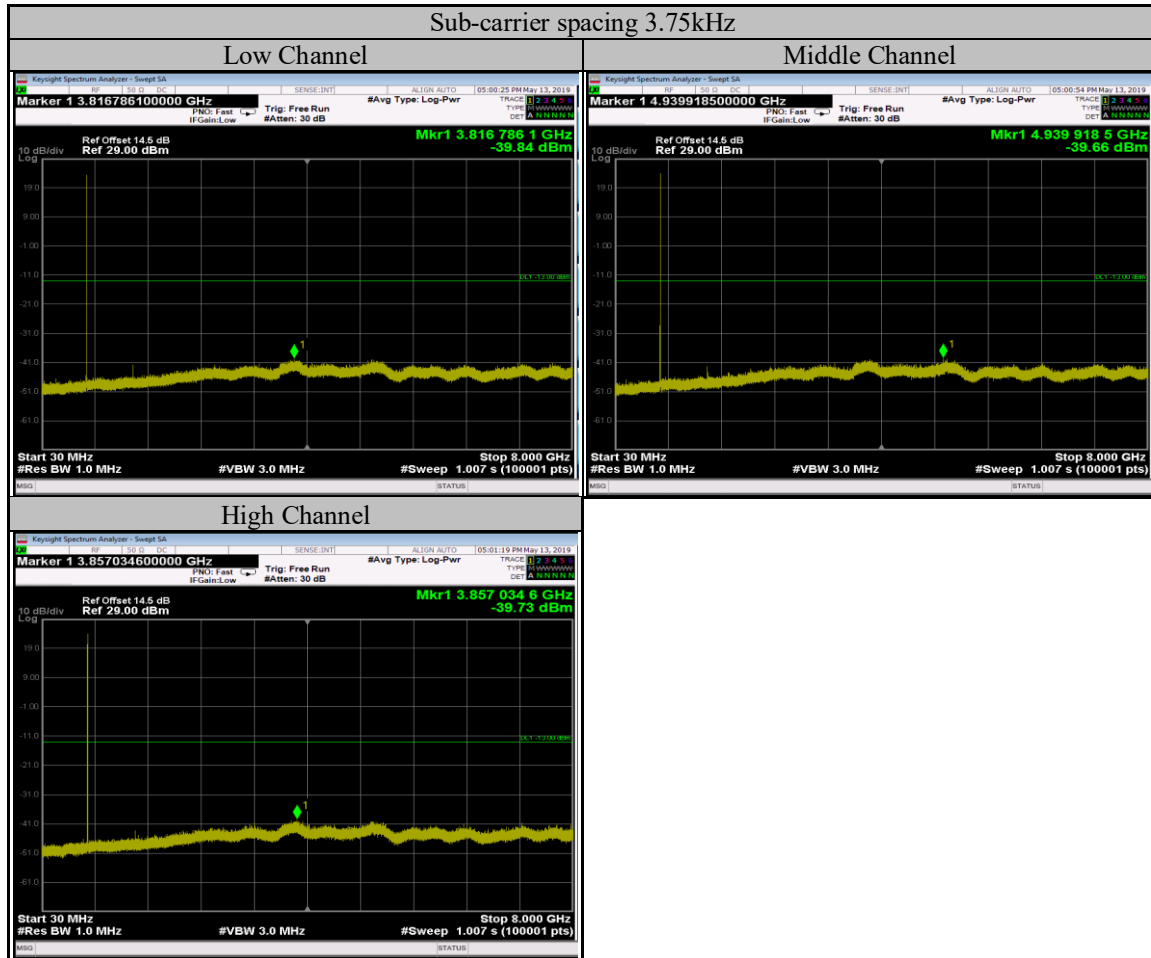
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Test report No. : 4789004574-US-R3-V0
Page : 56 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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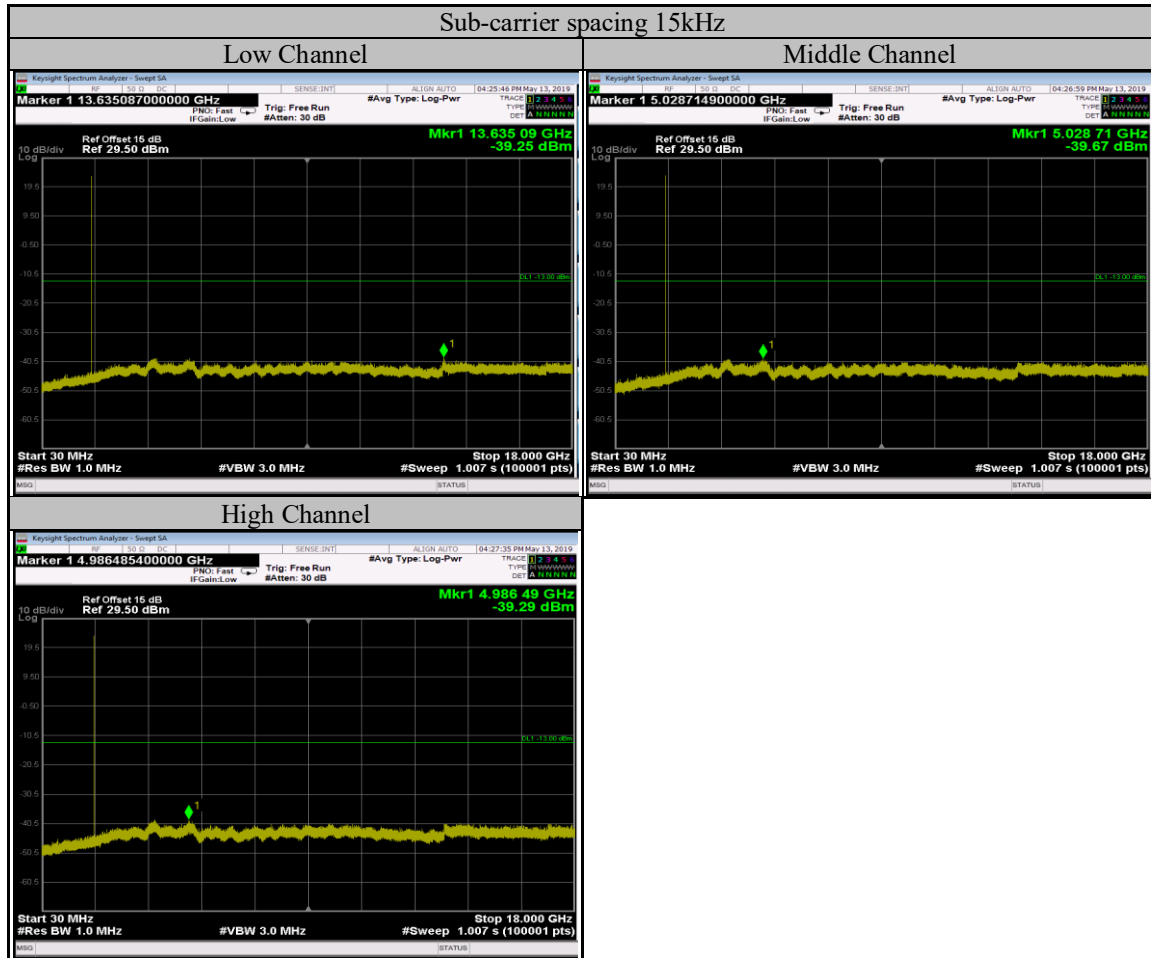
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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 57 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

LTE Band 66



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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 58 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01



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Doc No: 17-EM-F0916 / 4.0



9.7. Radiated Spurious Emission

Requirements

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 is equal to -13 dBm.

Test procedure

1. 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.
2. 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.

$EIRP = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution horn.}$

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.P.R power - 2.15 dBi.

Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz/3 MHz.

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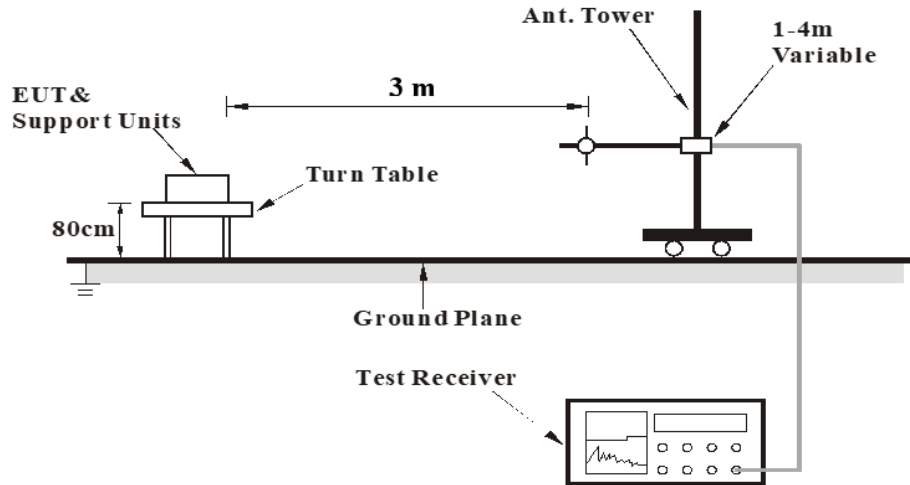
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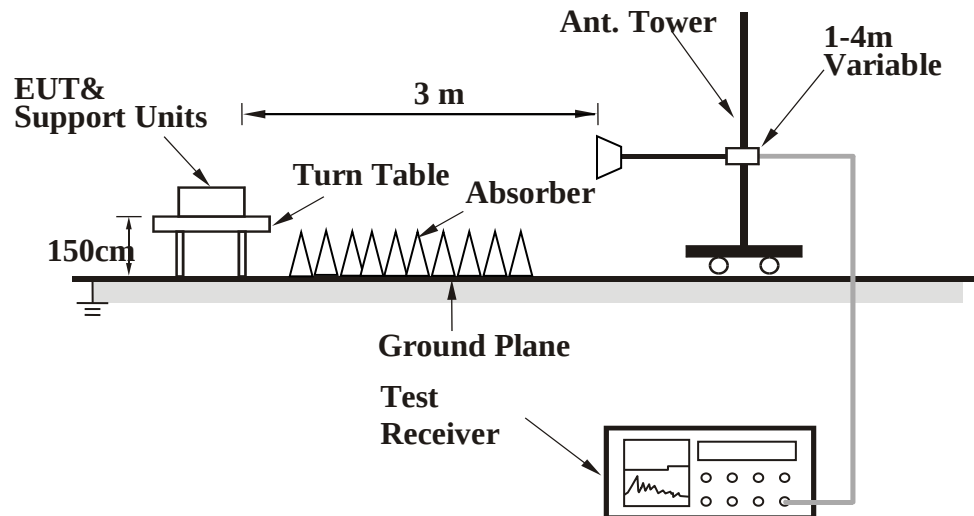


Test Setup

<Frequency Range 30 MHz ~ 1 GHz >



<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

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Doc No: 17-EM-F0916 / 4.0



Test Results

LTE Band 4

- Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier.
- The spurious emissions within 30-1000MHz were found more than 20dB below the permissible value is not required to be report.

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	Low Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3420.2	-32.97	-13	-19.97	-37.18	-43.64	10.67	H
5130.3	-38.17	-13	-25.17	-46.35	-48.63	10.46	H
6840.4	-46.66	-13	-33.66	-58.40	-56.50	9.84	H
3420.2	-37.29	-13	-24.29	-41.26	-47.96	10.67	V
5130.3	-43.23	-13	-30.23	-51.38	-53.69	10.46	V
6840.4	-40.53	-13	-27.53	-52.96	-50.37	9.84	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 62 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	Middle Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3465	-37.11	-13	-24.11	-41.35	-47.64	10.53	H
5197.5	-44.07	-13	-31.07	-52.23	-54.77	10.70	H
6930	-45.05	-13	-32.05	-57.05	-54.86	9.81	H
3465	-37.66	-13	-24.66	-41.66	-48.19	10.53	V
5197.5	-42.76	-13	-29.76	-50.91	-53.46	10.70	V
6930	-42.03	-13	-29.03	-54.73	-51.84	9.81	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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Test report No. : 4789004574-US-R3-V0
Page : 63 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	High Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3509.8	-38.28	-13	-25.28	-42.57	-48.57	10.30	H
5264.7	-40.71	-13	-27.71	-48.86	-51.66	10.95	H
7019.6	-41.58	-13	-28.58	-53.80	-51.02	9.44	H
3509.8	-29.21	-13	-16.21	-33.27	-39.50	10.30	V
5264.7	-40.27	-13	-27.27	-48.42	-51.22	10.95	V
7019.6	-38.29	-13	-25.29	-51.22	-47.73	9.44	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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LTE Band 12

- Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier.
- The spurious emissions within 30-1000MHz were found more than 20dB below the permissible value is not required to be report.

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	Low Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
1398.4	-13.52	-13	-0.52	-13.21	-19.02	5.50	H
2097.3	-40.87	-13	-27.87	-41.28	-48.65	7.78	H
2796.4	-47.94	-13	-34.94	-51.20	-57.33	9.40	H
1398.4	-14.15	-13	-1.15	-13.52	-19.65	5.50	V
2097.3	-40.40	-13	-27.40	-40.74	-48.18	7.78	V
2796.4	-43.65	-13	-30.65	-46.70	-53.04	9.40	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G. Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 65 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	Middle Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
1415	-14.18	-13	-1.18	-13.88	-19.76	5.58	H
2122.5	-42.17	-13	-29.17	-42.70	-49.90	7.73	H
2830	-47.74	-13	-34.74	-51.11	-57.22	9.48	H
1415	-13.98	-13	-0.98	-13.38	-19.56	5.58	V
2122.5	-44.05	-13	-31.05	-44.51	-51.78	7.73	V
2830	-51.57	-13	-38.57	-54.71	-61.05	9.48	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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Doc No: 17-EM-F0916 / 4.0



Test report No. : 4789004574-US-R3-V0
Page : 66 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	High Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
1431.8	-15.47	-13	-2.47	-15.18	-21.13	5.66	H
2147.7	-50.48	-13	-37.48	-51.13	-58.18	7.70	H
2863.6	-48.84	-13	-35.84	-52.32	-58.44	9.60	H
1431.8	-18.16	-13	-5.16	-17.59	-23.82	5.66	V
2147.7	-48.16	-13	-35.16	-48.73	-55.86	7.70	V
2863.6	-54.90	-13	-41.90	-58.14	-64.50	9.60	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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LTE Band 66

- Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier.
- The spurious emissions within 30-1000MHz were found more than 20dB below the permissible value is not required to be report.

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	Low Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3420.2	-39.61	-13	-26.61	-43.82	-50.21	10.60	H
5130.3	-51.76	-13	-38.76	-59.94	-62.08	10.32	H
6840.4	-50.34	-13	-37.34	-62.08	-60.02	9.69	H
3420.2	-37.89	-13	-24.89	-41.86	-48.49	10.60	V
5130.3	-50.05	-13	-37.05	-58.20	-60.37	10.32	V
6840.4	-51.09	-13	-38.09	-63.52	-60.77	9.69	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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Test report No. : 4789004574-US-R3-V0
Page : 68 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	Middle Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3490	-36.38	-13	-23.38	-40.64	-46.65	10.27	H
5235	-45.34	-13	-32.34	-53.50	-56.21	10.87	H
6980	-45.60	-13	-32.60	-57.74	-54.91	9.31	H
3490	-37.24	-13	-24.24	-41.26	-47.51	10.27	V
5235	-45.14	-13	-32.14	-53.29	-56.01	10.87	V
6980	-44.90	-13	-31.90	-57.76	-54.21	9.31	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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Test report No. : 4789004574-US-R3-V0
Page : 69 of 69
Issued date : Aug. 26, 2019
FCC ID : 2ASXC-TMO-NBT-01

EUT Test Condition		Measurement Detail	
Sub-carrier spacing	3.75 kHz	Frequency Range	Above 1 GHz
Channel	High Channel		

Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA. Reading (dBm)	S.G. Value (dBm)	Correction Factor (dB)	Polarization (H/V)
3559.8	-39.24	-13	-26.24	-43.67	-49.40	10.16	H
5339.7	-38.00	-13	-25.00	-46.13	-49.06	11.06	H
7119.6	-44.49	-13	-31.49	-56.80	-53.38	8.89	H
3559.8	-38.49	-13	-25.49	-42.72	-48.65	10.16	V
5339.7	-37.48	-13	-24.48	-45.63	-48.54	11.06	V
7119.6	-38.05	-13	-25.05	-51.03	-46.94	8.89	V

Remarks:

1. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).
2. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
3. The other emission levels were very low against the limit.

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