CERTIFICATION TEST REPORT

Report Number: 11981177-E1V6

Applicant	:	SAMSUNG ELECTRONICS CO., LTD. 129, Samsung-ro, Yeongtong-gu, Suwon-si Gyeonggi-do, 16677, Rep. of Korea
FCC ID	:	A3LSOL230-48D
EUT Description	:	SMALL CELL (SOL230)
Test Standard(s)	:	FCC CFR47 PART 96 SUBPART E

Date Of Issue:

March 25, 2019

Prepared by:
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NVLAP Lab code: 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	10/30/17	Initial Issue	Kiya Kedida
V2	11/14/17	Updated: Section 7.1,7.1.1,7.1.2,7.4	Kiya Kedida
V3	11/16/17	Updated: Section 7.1.1 & 7.1.2	Kiya Kedida
V4	11/20/17	Updated: Section 5.3.1 & 5.3.2 (Changed ERP to EIRP)	Kiya Kedida
V5	11/27/17	Updated: Section 5.3.1	Kiya Kedida
V6	03/25/19	Updated page 9 Conducted Power, EIRP levels for 20 MHz BW port (Changed CD to AB)	Kiya Kedida

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: SMALL CELL (SOL230)

MODEL: SOL230-48D

SERIAL NUMBER: SLS-BP00SV01CH,SLS-BP00SV02CH

DATE TESTED: OCTOBER 19-28, 2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC CFR 47 PART 96 SUBPART E	PASS

UL Verification Services Inc. 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 UL Verification Services Inc. 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 UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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.

Approved & Released For
UL Verification Services Inc. By:

DAN CORONIA
CONSUMER TECHNOLOGY DIVISION
OPERATIONS LEADER
UL VERIFICATION SERVICES INC

Prepared By:

KIYA KEDIDA
CONSUMER TECHNOLOGY DIVISION
PROJECT ENGINEER
UL VERIFICATION SERVICES INC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA-603-D, FCC CFR 47 Part 96, FCC KDB 940660 D01 and ANSI C63.26.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A (ISED: 2324B-1)	☐ Chamber D (ISED: 22541-1)
☒ Chamber B (ISED: 2324B-2)	☐ Chamber E (ISED: 22541-2)
☒ Chamber C (ISED: 2324B-3)	☐ Chamber F (ISED: 22541-3)
	☐ Chamber G (ISED: 22541-4)
	☐ Chamber H (ISED: 22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.
UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.
Chambers A through C are covered under ISED company address code 2324B with site numbers 2324B - 1 through 2324B-3, respectively. Chambers D through H are covered under ISED address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

EIRP = PSA reading with EUT worst orientation (dBm) + Path loss (dB) – cable loss(between the SG and substitution antenna) + Substitution Antenna Factor (dBi)

ERP = PSA reading with EUT worst orientation (dBm) + Path loss (dB) – cable loss(between the SG and substitution antenna)

(Path loss = Signal generator output – PSA reading with substitution antenna)

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Occupied Channel Bandwidth	±1.1 %
RF output power, conducted	±0.35 dB
Power Spectral Density, conducted	±0.39 dB
Unwanted Emissions, conducted	±2.9 dB
All emissions, radiated	±5.36 dB
Temperature	±0.9 °C
Humidity	±2.26% RH
Supply Voltages	±0.45 %
Time	±0.2 %

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is small cell base station.

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an Omni and Directional antenna for the [List the bands supported] with a maximum peak gain as follow:

Frequency (MHz)	Peak Gain (dBi)
LTE Band 48, 3550~3700MHz (OMNI)	3
LTE Band 48, 3550~3700MHz DIRECTIONAL	7

5.3. MAXIMUM OUTPUT POWER

5.3.1. MAXIMUM OUTPUT POWER FOR OMNI ANTENNA

The transmitter has a maximum peak conducted and EIRP output powers as follows:

10 MHz BW Port AB Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	10MHz	QPSK	29.33	35.34
			16QAM	29.00	35.01
			64QAM	28.43	34.44

10 MHz BW Port CD Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	10MHz	QPSK	29.60	35.61
			16QAM	29.21	35.22
			64QAM	28.76	34.77

20 MHz BW Port AB Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	20MHz	QPSK	28.74	34.75
			16QAM	28.61	34.62
			64QAM	28.59	34.60

20 MHz BW Port CD Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	20MHz	QPSK	29.03	35.04
			16QAM	28.52	34.53
			64QAM	28.18	34.19

5.3.2. MAXIMUM OUTPUT POWER FOR DIRECTIONAL ANTENNA

The transmitter has a maximum peak conducted and EIRP output powers as follows:

10 MHz BW Port AB Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	10MHz	QPSK	24.63	34.64
			16QAM	24.91	34.92
			64QAM	24.63	34.64

10 MHz BW Port CD Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	10MHz	QPSK	25.28	35.29
			16QAM	25.27	35.28
			64QAM	24.33	34.34

20 MHz BW Port AB Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	20MHz	QPSK	25.85	35.86
			16QAM	25.62	35.63
			64QAM	25.44	35.45

20 MHz BW Port CD Conducted Power & EIRP

FCC Part 96					
Band	Frequency Range(MHz)	BandWidth (MHz)	Modulation	Conducted	Radiated
				Total Avg Power dBm	Total EIRP dBm
LTE48	3550~3700	20MHz	QPSK	26.16	36.17
			16QAM	25.73	35.74
			64QAM	25.84	35.85

5.4. DESCRIPTION OF TEST SETUP

I/O CABLES (CONDUCTED SETUP)

I/O Cable List						
Cable No	**Port**	**# of Identical ports**	**Connector Type**	**Serial Type**	**Cable Length (m)**	**Remarks**
1	RJ-45	2	RJ-45	Unshielded	1m	NA
2	AC	1	2 Prong	Shielded	1m	NA
3	RF Out	1	Spectrum Analyzer	Shielded	0.5m	NA

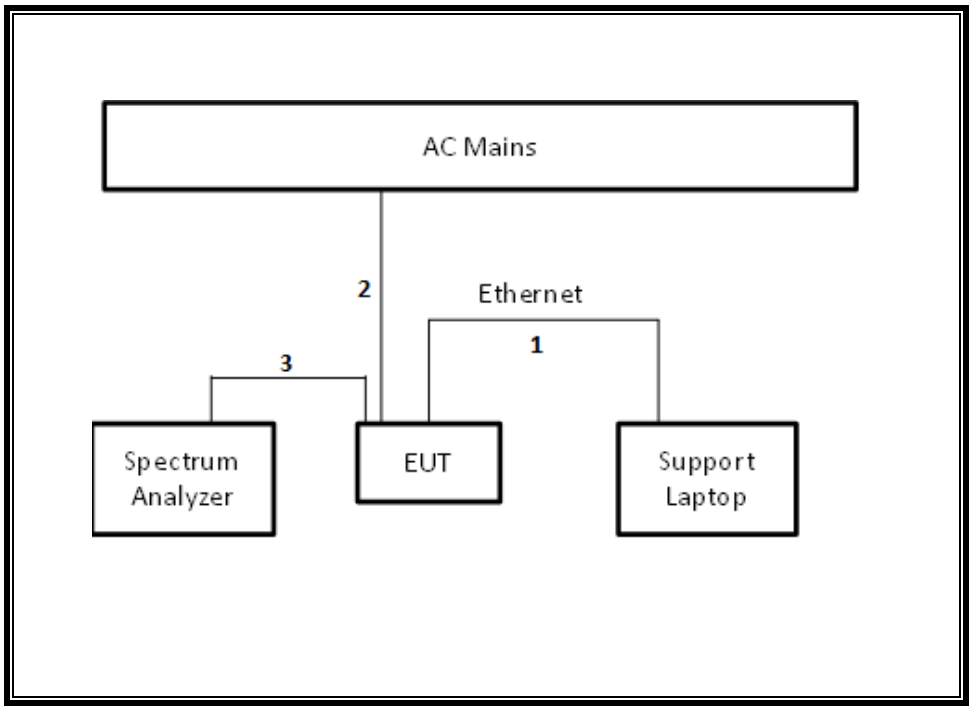
I/O CABLES (RADIATED SETUP)

I/O Cable List						
Cable No	**Port**	**# of Identical ports**	**Connector Type**	**Serial Type**	**Cable Length (m)**	**Remarks**
1	Ethernet	1	2 Prong	Shielded	2m	NA
2	AC	1	Spectrum Analyzer	Shielded	10m	NA

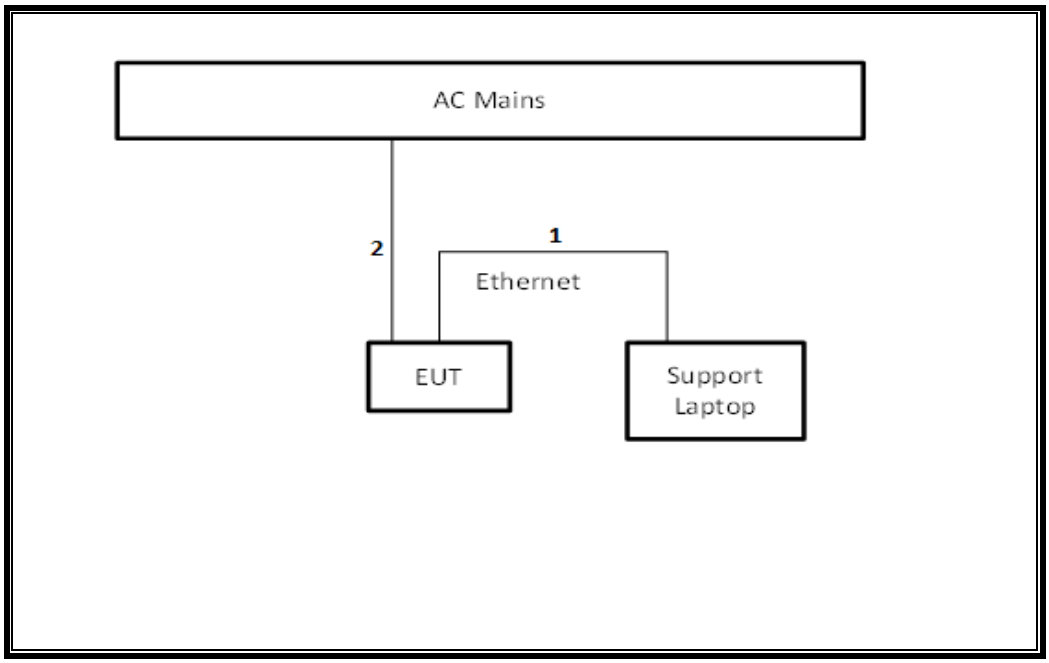
TEST SETUP

The EUT is set to continuously transmit via support laptop software.

SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	**Manufacturer**	**Model**	**T Number**	**Cal Date**	**Cal Due**
Amplifier, 1 to 18 GHz	Miteq	AFS43-00101800-25-S-42	913	06/21/17	06/21/18
Amplifier, 1 to 8 GHz	Miteq	AMF-4D-01000800-30-29P	1156	02/15/17	02/15/18
Amplifier, 10KHz to 1GHz, 32dB	Keysight	8447D	15	08/14/17	08/14/18
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	408	11/10/16	11/10/17
Horn Antenna	ETS-Lindgren	3117	T712	01/30/17	01/30/18
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	907	01/23/17	01/23/18
Highpass Filter, 6 GHz	Micro-Circuits	HPS17542	T895	09/22/17	09/22/18
3400-3800 MHz Band Reject filter	Micro-Circuits	BRM50711-02	T1792	05/16/17	05/16/18
PXA, Signal Analyzer	Agilent Technologies	N9030A	T1931	06/06/17	06/06/18
DC power supply, 60V	Lambda	SCPV53298	None	CNR	None
Antenna, Tuned Dipole 400~1000 MHz	ETS	3121C DB4	T273	06/08/17	06/08/18

Test Equipment List			
Description	**Manufacturer**	**Model**	**T Number**
Antenna Port Software	UL	UL RF	Ver 3.7, Nov 12, 2015

7. ANTENNA PORT TEST RESULTS

SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
2.1049	Occupied Bandwidth (99%)	N/A	Conducted	Pass
96.41 (e) (2)	Conducted Spurious Emission	-40dBm		Pass
2.1046	Conducted output power	N/A		Pass
96.41 (e) (2)	Emission Mask	Please refer to limit under section 7.5		Pass
90.213	Frequency Stability	N/A		Pass
96.41 (b)	Equivalent Isotropic Radiated Power	47dBm/10MHz		Pass
96.41 (b)	Maximum Power Spectral Density	37dBm/MHz		Pass
96.41 (e) (2)	Radiated Spurious Emission	-40dBm	Radiated	Pass

7.1. RF OUTPUT POWER

TEST PROCEDURE

ANSI C63.26:2015/ TIA / EIA 603-E
KDB 940660 Section 2.b.1

ERP/EIRP = PMeas + GT − LC

where: ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as PMeas, typically dBW or dBm);
PMeas = measured transmitter output power or PSD, in dBm or dBW;
GT = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);
LC = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

For devices utilizing multiple antennas, KDB 662911 provides guidance for determining the effective array transmit antenna gain term to be used in the above equation.

LIMITS

b) Power limits. Unless otherwise specified in this section, the maximum effective isotropic radiated power (EIRP) and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the table below.

Device	Maximum EIRP (dBm/10 megahertz)	Maximum PSD (dBm/MHz)
End User Device	23	n/a
Category A CBSD	30	20
Category B CBSD[1]	47	37

MODES TESTED

LTE Band 48

- QPSK
- 16QAM
- 64QAM

The TX chains are correlated and the antenna gain is the same for each chain. The directional gain is:

OMNI ANTENNA AB

Antenna Gain (dBi)	10 * Log (2 chains) (dB)	Correlated Chains Directional Gain (dBi)
3.00	3.01	6.01

OMNI ANTENNA CD

Antenna Gain (dBi)	10 * Log (2 chains) (dB)	Correlated Chains Directional Gain (dBi)
3.00	3.01	6.01

DIRECTIONAL ANTENNA AB

Antenna Gain (dBi)	10 * Log (2 chains) (dB)	Correlated Chains Directional Gain (dBi)
7.00	3.01	10.01

DIRECTIONAL ANTENNA CD

Antenna Gain (dBi)	10 * Log (2 chains) (dB)	Correlated Chains Directional Gain (dBi)
7.00	3.01	10.01

NOTE: Due to limited modulation bandwidth and limited display capabilities of spectrum analyzer (Maximum up to 8MHz RBW) an alternative procedure was used as shown below to calculate RF output power based on PSD (Section 7.4) results to comply with dBm/10MHz power limit:

- PSD + 10log(10)= RF output power

Note: Total power was only aggregated across on each individual MIMO transmitter A+B or C+D per 10MHz bandwidth.

7.1.1. LTE OUTPUT POWER RESULT FOR OMNI ANTENNA

The transmitter has a maximum Average conducted power and EIRP output power per 10MHz as follows:

Tested By	Jose Martinez
Date	October 19-23, 2017

LTE Band 48

10 MHz BW Port AB Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port A dBm/10MHz	Port B dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	10MHz	3555	QPSK	24.7	25.7	28.27	34.28	47.00	-12.72
			16QAM	25.8	24.7	28.28	34.29	47.00	-12.71
			64QAM	24.8	24.6	27.73	33.74	47.00	-13.26
		3625	QPSK	25.6	25.5	28.59	34.60	47.00	-12.40
			16QAM	25.9	26.1	29.00	35.01	47.00	-11.99
			64QAM	24.5	24.8	27.67	33.68	47.00	-13.32
		3695	QPSK	26.3	26.3	29.33	35.34	47.00	-11.66
			16QAM	26.1	25.9	28.98	34.99	47.00	-12.01
			64QAM	25.8	25.0	28.43	34.44	47.00	-12.56

10 MHz BW Port CD Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port C dBm/10MHz	Port D dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	10MHz	3555	QPSK	26.1	25.1	28.64	34.65	47.00	-12.35
			16QAM	25.8	25.5	28.65	34.66	47.00	-12.34
			64QAM	24.9	24.4	27.70	33.71	47.00	-13.29
		3625	QPSK	26.3	25.9	29.10	35.11	47.00	-11.89
			16QAM	26.3	25.7	29.01	35.02	47.00	-11.98
			64QAM	25.2	25.0	28.13	34.14	47.00	-12.86
		3695	QPSK	26.4	26.8	29.60	35.61	47.00	-11.39
			16QAM	26.4	26.0	29.21	35.22	47.00	-11.78
			64QAM	25.8	25.7	28.76	34.77	47.00	-12.23

20 MHz BW Port AB Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port A dBm/10MHz	Port B dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	20MHz	3560	QPSK	24.6	24.6	27.57	33.58	47.00	-13.42
			16QAM	25.6	25.4	28.51	34.52	47.00	-12.48
			64QAM	24.9	24.4	27.71	33.72	47.00	-13.28
		3615	QPSK	25.3	25.0	28.20	34.21	47.00	-12.79
			16QAM	25.1	25.0	28.06	34.07	47.00	-12.93
			64QAM	24.3	24.7	27.54	33.55	47.00	-13.45
		3670	QPSK	25.9	25.6	28.74	34.75	47.00	-12.25
			16QAM	25.4	25.8	28.61	34.62	47.00	-12.38
			64QAM	25.3	25.8	28.59	34.60	47.00	-12.40

20 MHz BW Port CD Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port C dBm/10MHz	Port D dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	20MHz	3580	QPSK	25.6	25.3	28.44	34.45	47.00	-12.55
			16QAM	24.7	25.1	27.93	33.94	47.00	-13.06
			64QAM	25.7	24.2	28.01	34.02	47.00	-12.98
		3635	QPSK	25.6	26.0	28.79	34.80	47.00	-12.20
			16QAM	25.7	25.2	28.43	34.44	47.00	-12.56
			64QAM	25.2	25.1	28.18	34.19	47.00	-12.81
		3690	QPSK	26.3	25.7	29.03	35.04	47.00	-11.96
			16QAM	25.5	25.5	28.52	34.53	47.00	-12.47
			64QAM	25.3	24.8	28.09	34.10	47.00	-12.90

7.1.2. LTE OUTPUT POWER RESULT FOR DIRECTIONAL ANTENNA

The transmitter has a maximum Average conducted power and EIRP output power per 10MHz as follows:

LTE Band 48

10 MHz BW Port AB Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port A dBm/10MHz	Port B dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	10MHz	3555	QPSK	21.0	21.7	24.36	34.37	47.00	-12.63
			16QAM	21.8	21.6	24.71	34.72	47.00	-12.28
			64QAM	20.4	20.8	23.62	33.63	47.00	-13.37
		3625	QPSK	21.4	20.9	24.20	34.21	47.00	-12.79
			16QAM	21.5	21.9	24.69	34.70	47.00	-12.30
			64QAM	20.7	20.2	23.47	33.48	47.00	-13.52
		3695	QPSK	21.9	21.3	24.63	34.64	47.00	-12.36
			16QAM	21.5	22.3	24.91	34.92	47.00	-12.08
			64QAM	21.2	21.3	24.28	34.29	47.00	-12.71

10 MHz BW Port CD Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port C dBm/10MHz	Port D dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	10MHz	3555	QPSK	22.0	21.4	24.72	34.73	47.00	-12.27
			16QAM	21.9	21.9	24.87	34.88	47.00	-12.12
			64QAM	21.0	20.5	23.77	33.78	47.00	-13.22
		3625	QPSK	21.5	22.2	24.91	34.92	47.00	-12.08
			16QAM	21.5	22.3	24.93	34.94	47.00	-12.06
			64QAM	21.4	21.2	24.33	34.34	47.00	-12.66
		3695	QPSK	22.6	21.9	25.28	35.29	47.00	-11.71
			16QAM	22.4	22.2	25.27	35.28	47.00	-11.72
			64QAM	21.4	21.2	24.32	34.33	47.00	-12.67

20 MHz BW Port AB Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port A dBm/10MHz	Port B dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	20MHz	3560	QPSK	23.3	22.3	25.85	35.86	47.00	-11.14
			16QAM	22.8	22.4	25.62	35.63	47.00	-11.37
			64QAM	22.5	21.5	25.04	35.05	47.00	-11.95
		3615	QPSK	22.4	21.9	25.16	35.17	47.00	-11.83
			16QAM	22.1	21.9	24.99	35.00	47.00	-12.00
			64QAM	21.9	21.9	24.90	34.91	47.00	-12.09
		3670	QPSK	22.1	22.6	25.36	35.37	47.00	-11.63
			16QAM	21.7	22.4	25.04	35.05	47.00	-11.95
			64QAM	22.4	22.5	25.44	35.45	47.00	-11.55

20 MHz BW Port CD Conducted Power

FCC Part 96									
Band	BandWidth (MHz)	Frequency Range(MHz)	Modulation	Conducted Output power (Avg)			EIRP Output power (Avg)		
				Port C dBm/10MHz	Port D dBm/10MHz	Total Avg Power dBm/10MHz	Total EIRP dBm/10MHz	EIRP Limit dBm/10MHz	Margin dBm
LTE48	20MHz	3580	QPSK	22.7	22.4	25.57	35.58	47.00	-11.42
			16QAM	22.5	22.1	25.32	35.33	47.00	-11.67
			64QAM	22.4	21.9	25.18	35.19	47.00	-11.81
		3635	QPSK	23.3	23.0	26.16	36.17	47.00	-10.83
			16QAM	22.3	22.7	25.53	35.54	47.00	-11.46
			64QAM	22.6	22.6	25.58	35.59	47.00	-11.41
		3690	QPSK	23.1	22.6	25.84	35.85	47.00	-11.15
			16QAM	22.9	22.6	25.73	35.74	47.00	-11.26
			64QAM	22.8	21.9	25.38	35.39	47.00	-11.61

7.2. PEAK TO AVERAGE RATIO

TEST PROCEDURE

Per KDB 940660 D0R1

TEST SPEC

Some regulatory requirements specify a PAPR limit when the output power limits are specified in terms of average power. If it becomes necessary to provide measurement data to demonstrate compliance to a PAPR limit, then the appropriate procedure from those provided in 5.2.3 shall be utilized to determine the peak power (or peak PSD) and the appropriate procedure from those provided in 5.2.4 shall be used to determine the average power (or average PSD). The data from these measurements is then used in Equation (2) to determine the PAPR of a narrowband CW-like signal. See 5.2.3.4 for guidance on determining the PAPR of a broadband noise-like signal.

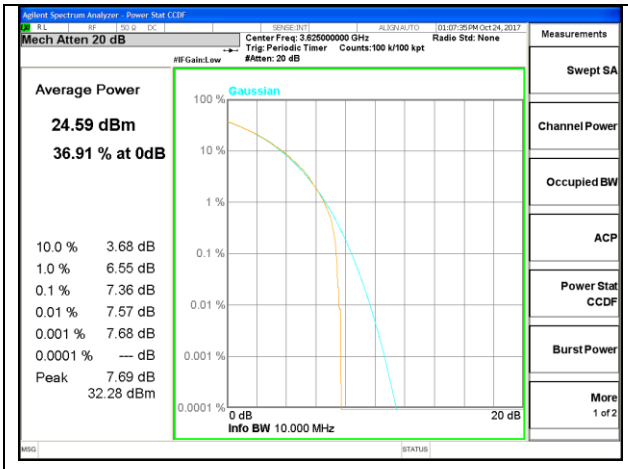
$$PAPR\ (dB) = P_{Pk}\ (dBm\ or\ dBW) - P_{Avg}\ (dBm\ or\ dBW) \quad (2)$$

where

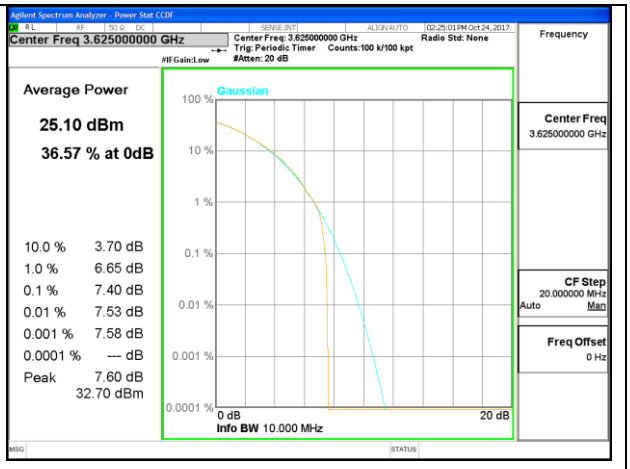
PAPR	peak-to-average power ratio, in dB
P_{Pk}	measured peak power or peak PSD level, in dBm or dBW
P_{Avg}	measured average power or average PSD level, in dBm or dBW

CONDUCTED PEAK TO AVERAGE PLOT FOR OMNI ANTENNA

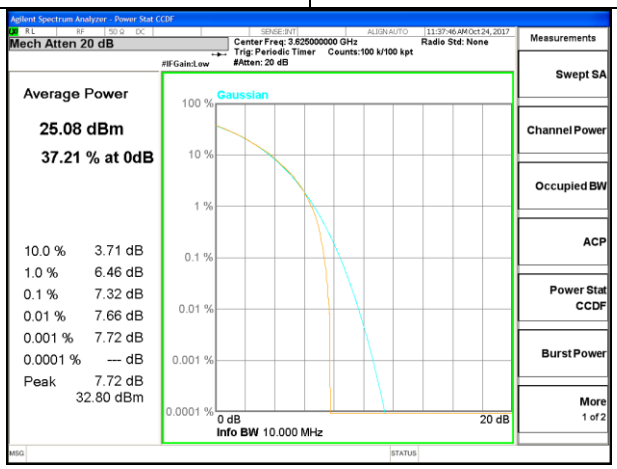
Antenna Port A 10MHz



LTE B48 10MHz QPSK Middle Channel

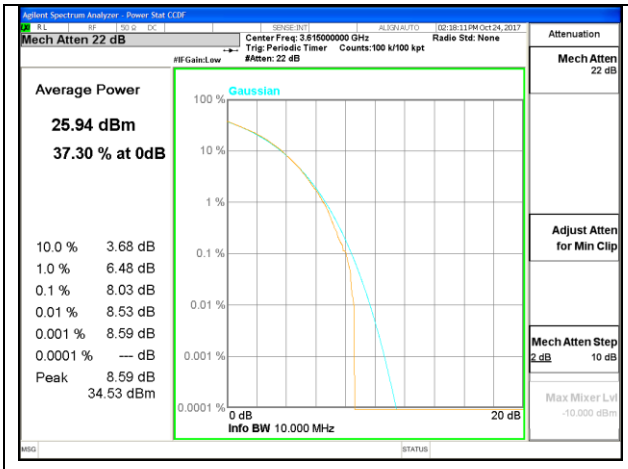


LTE B48 10MHz 16QAM Middle Channel

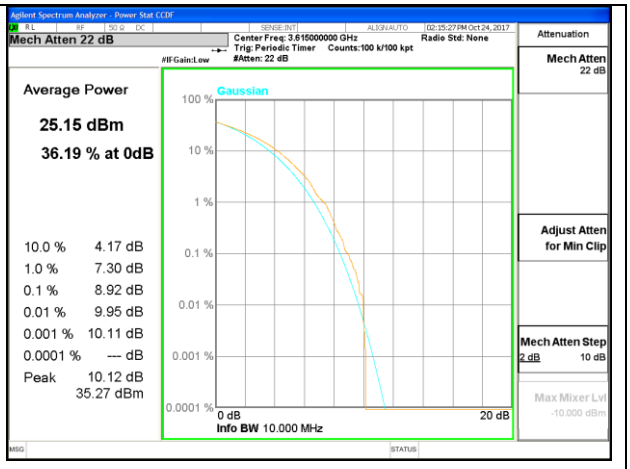


LTE B48 10MHz 64QAM Middle Channel

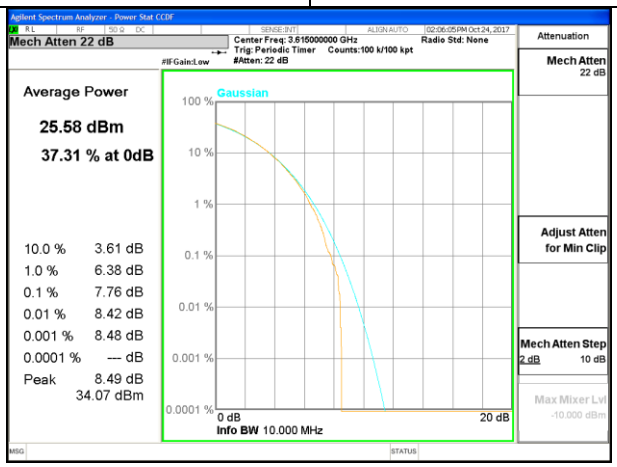
Antenna Port A 20MHz



LTE B48 20MHz QPSK Middle Channel

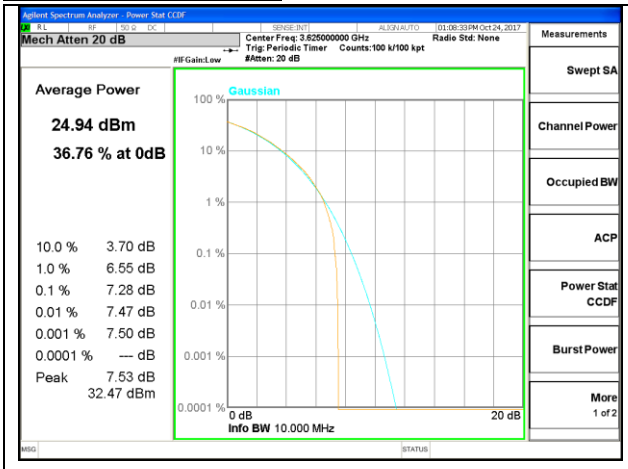


LTE B48 20MHz 16QAM Middle Channel

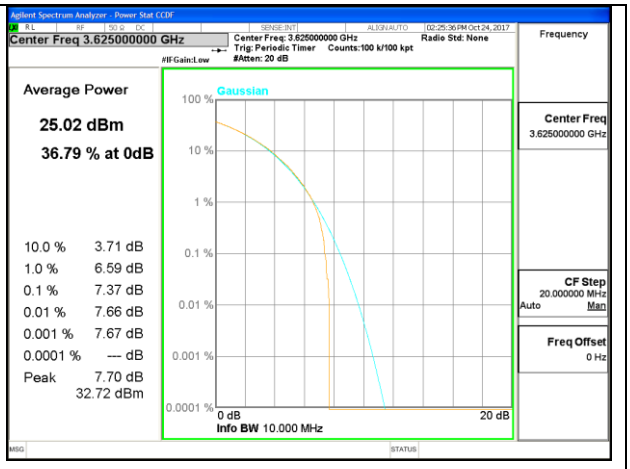


LTE B48 20MHz 64QAM Middle Channel

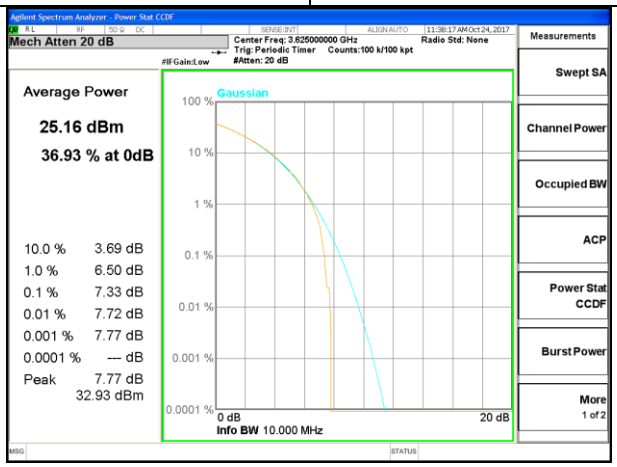
Antenna Port B 10MHz



LTE B48 10MHz QPSK Middle Channel

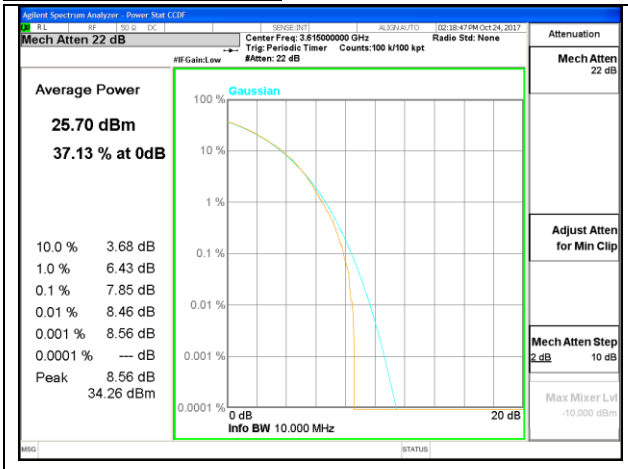


LTE B48 10MHz 16QAM Middle Channel

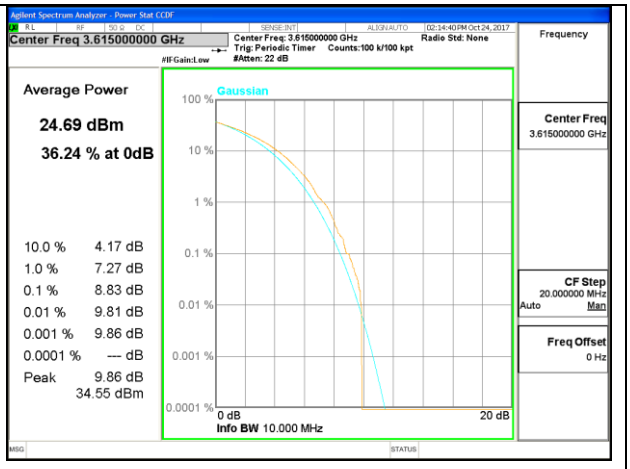


LTE B48 10MHz 64QAM Middle Channel

Antenna Port B 20MHz



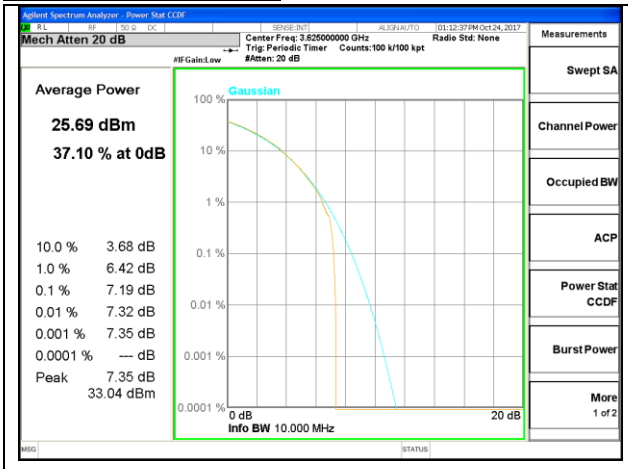
LTE B48 20MHz QPSK Middle Channel



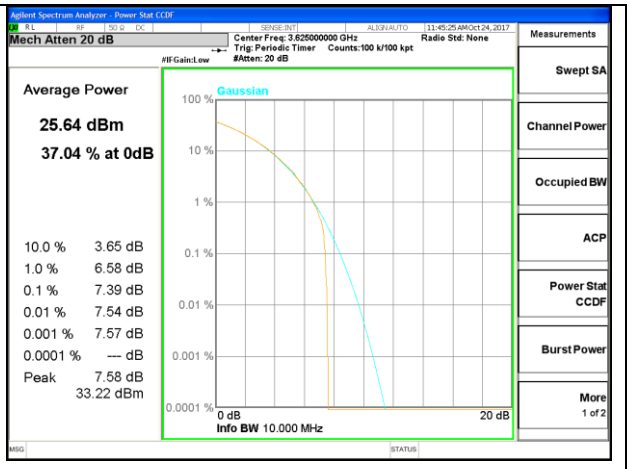
LTE B48 20MHz 16QAM Middle Channel

LTE B48 20MHz 64QAM Middle Channel

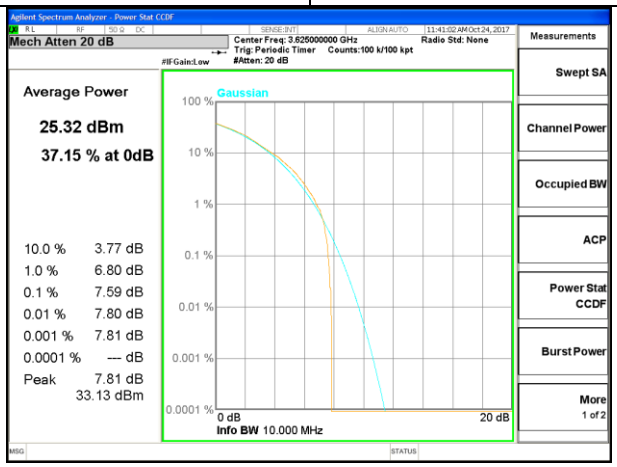
Antenna Port C 10MHz



LTE B48 10MHz QPSK Middle Channel

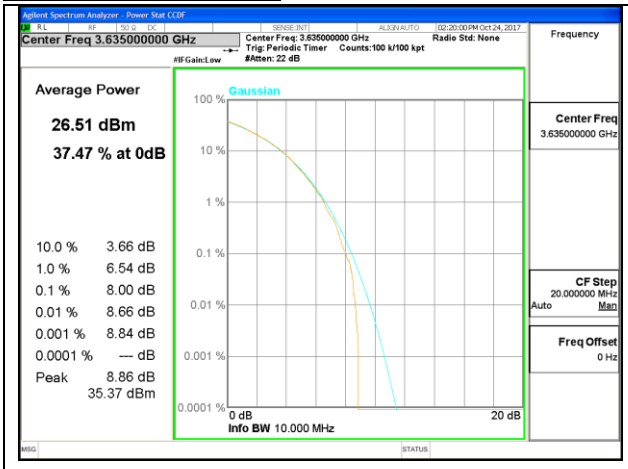


LTE B48 10MHz 16QAM Middle Channel

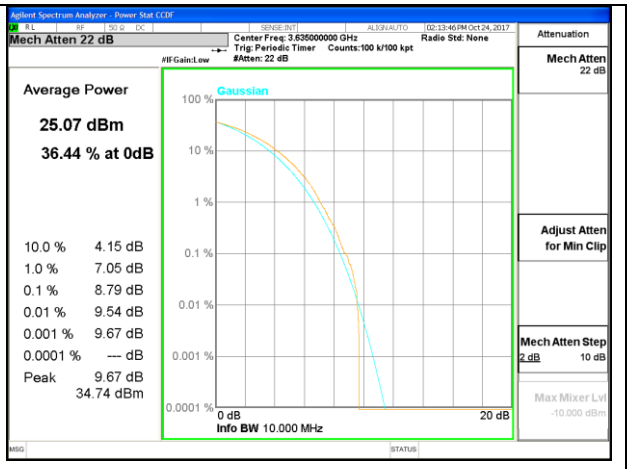


LTE B48 10MHz 64QAM Middle Channel

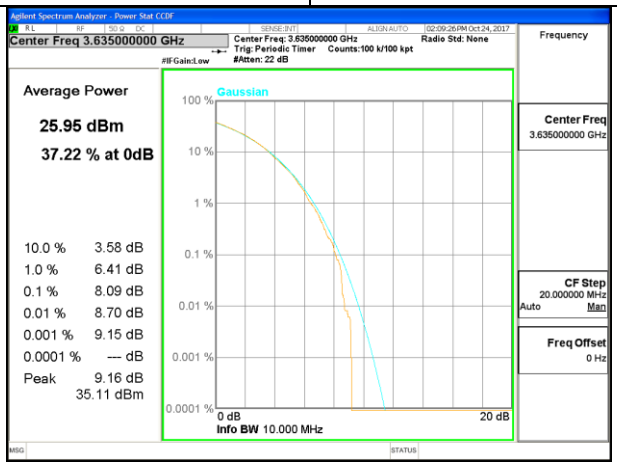
Antenna Port C 20MHz



LTE B48 20MHz QPSK Middle Channel

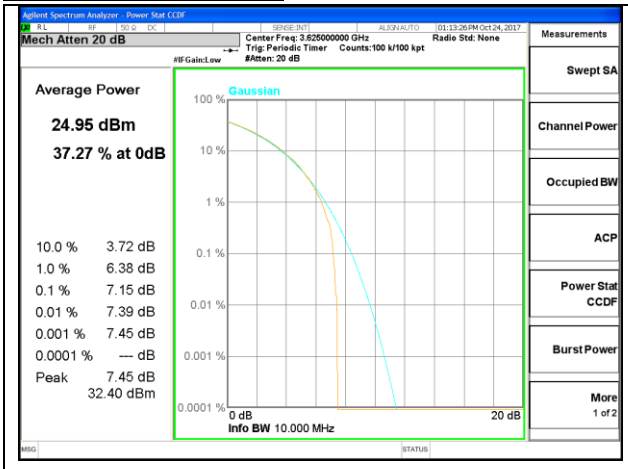


LTE B48 20MHz 16QAM Middle Channel

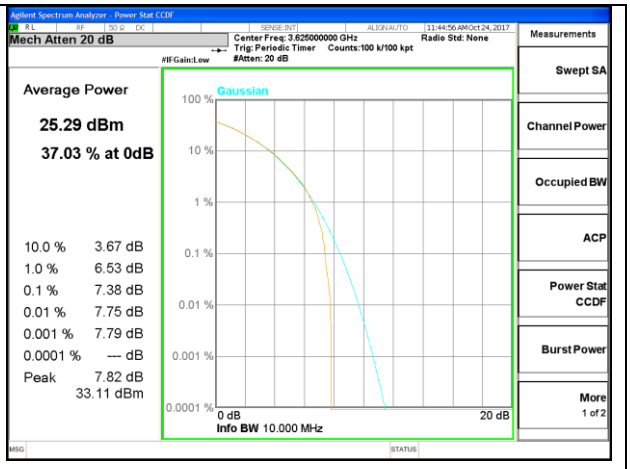


LTE B48 20MHz 64QAM Middle Channel

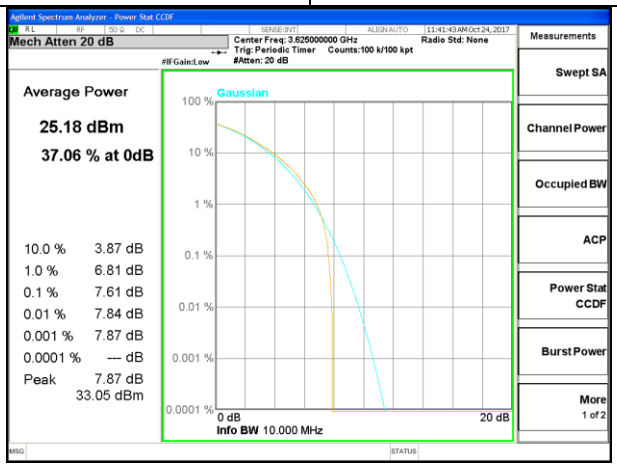
Antenna Port D 10MHz



LTE B48 10MHz QPSK Middle Channel

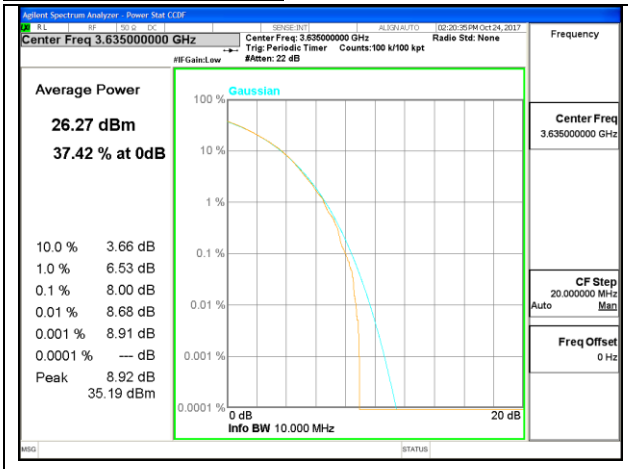


LTE B48 10MHz 16QAM Middle Channel

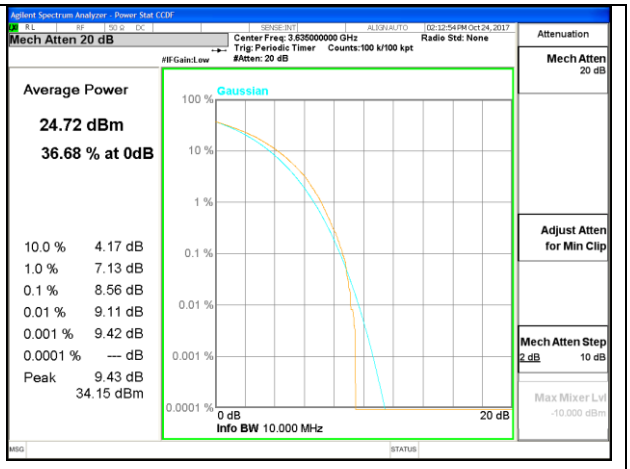


LTE B48 10MHz 64QAM Middle Channel

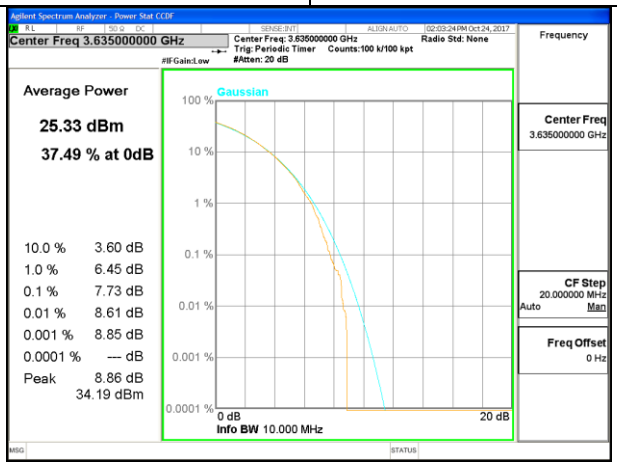
Antenna Port D 20MHz



LTE B48 20MHz QPSK Middle Channel



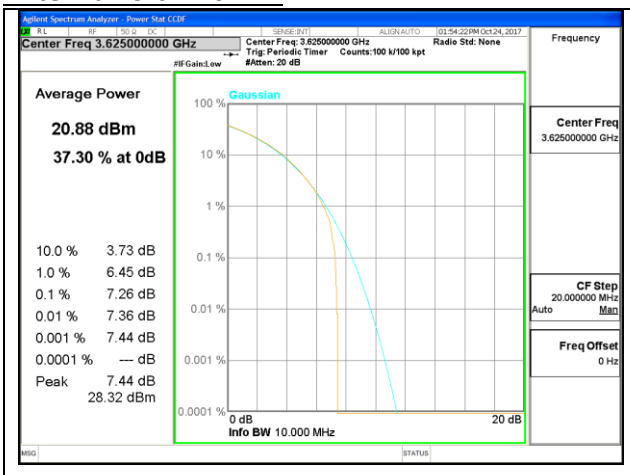
LTE B48 20MHz 16QAM Middle Channel



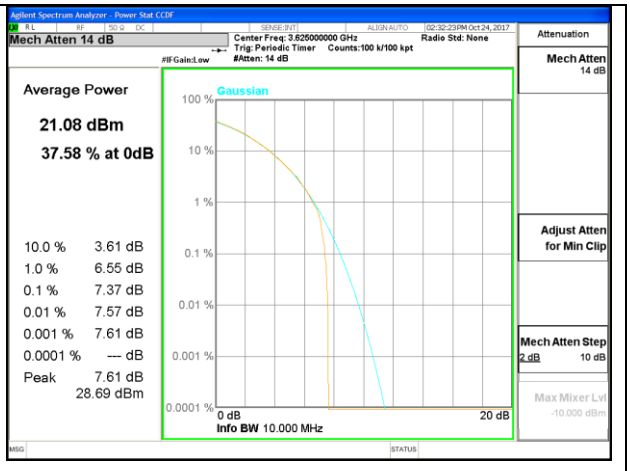
LTE B48 20MHz 64QAM Middle Channel

CONDUCTED PEAK TO AVERAGE RESULT DIRECTIONAL ANTENNA

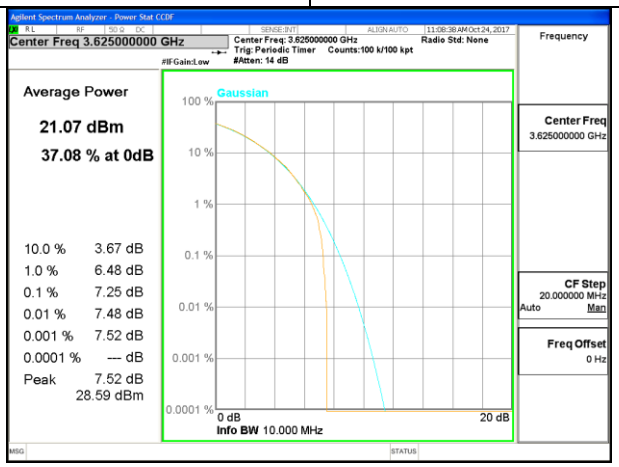
Antenna Port A 10MHz



LTE B48 10MHz QPSK Middle Channel

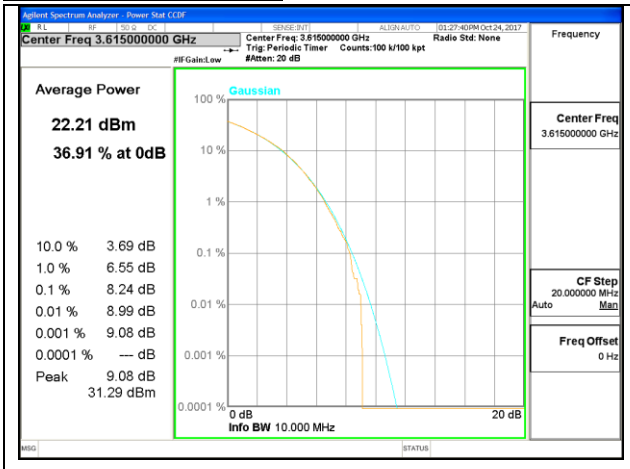


LTE B48 10MHz 16QAM Middle Channel

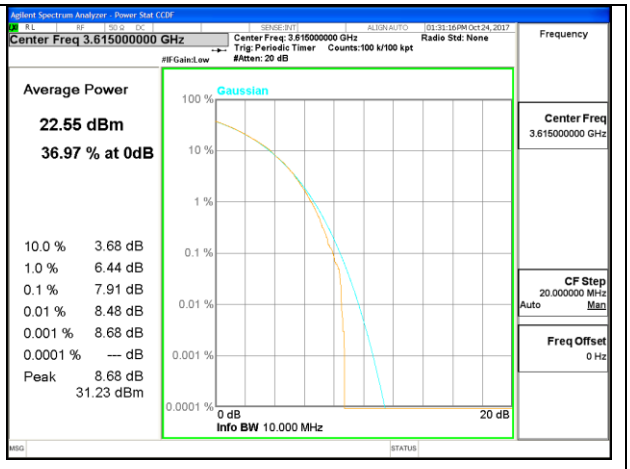


LTE B48 10MHz 64QAM Middle Channel

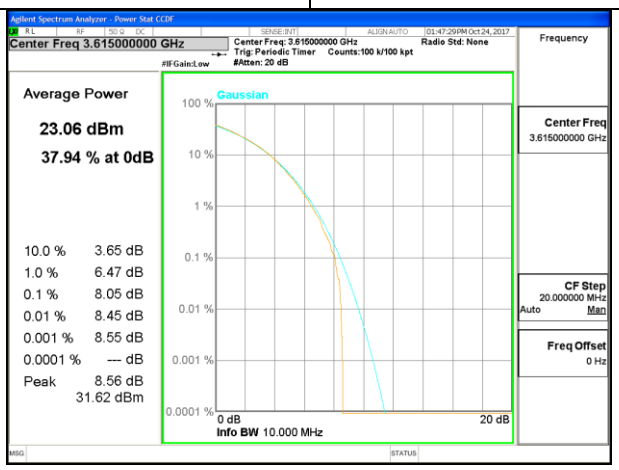
Antenna Port A 20MHz



LTE B48 20MHz QPSK Middle Channel

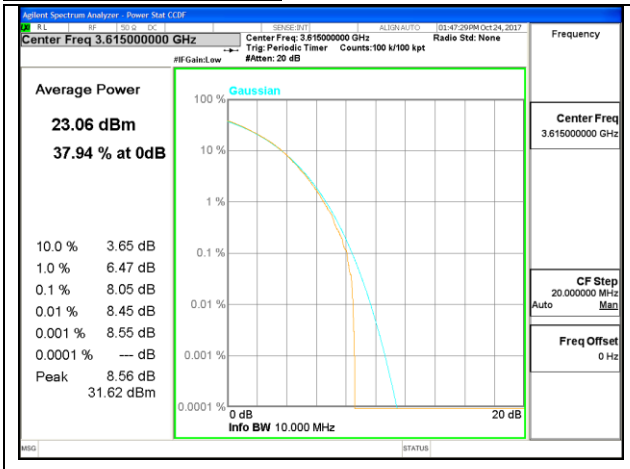


LTE B48 20MHz 16QAM Middle Channel

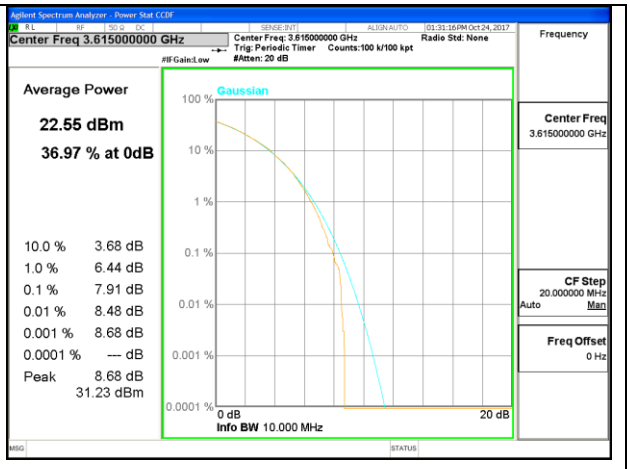


LTE B48 20MHz 64QAM Middle Channel

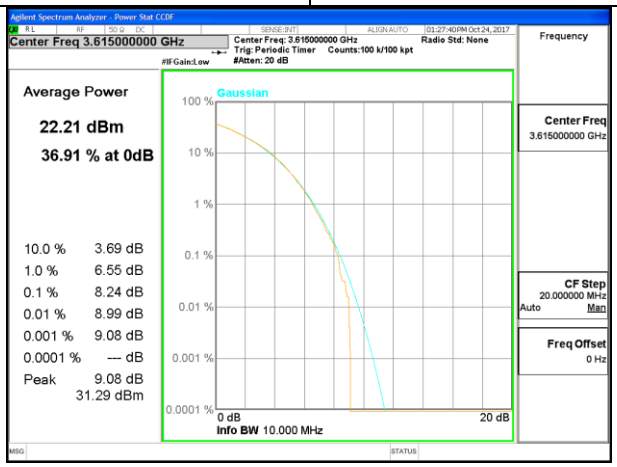
Antenna Port B 10MHz



LTE B48 10MHz QPSK Middle Channel

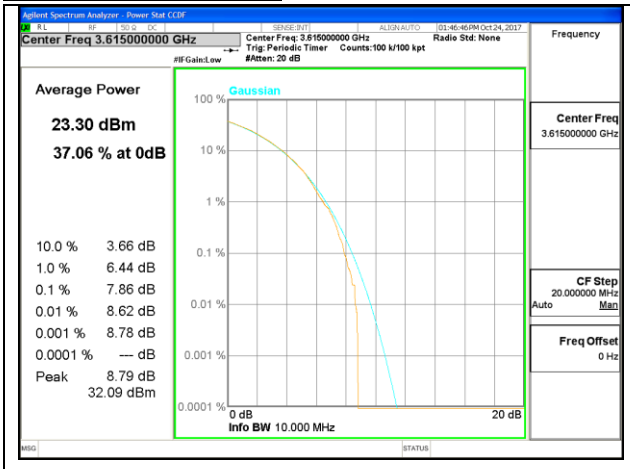


LTE B48 10MHz 16QAM Middle Channel

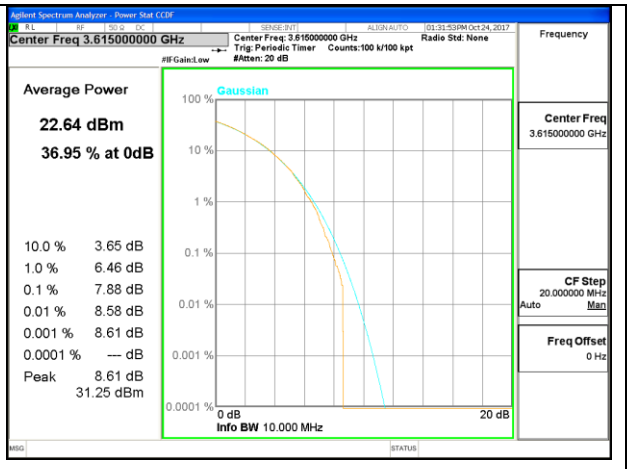


LTE B48 10MHz 64QAM Middle Channel

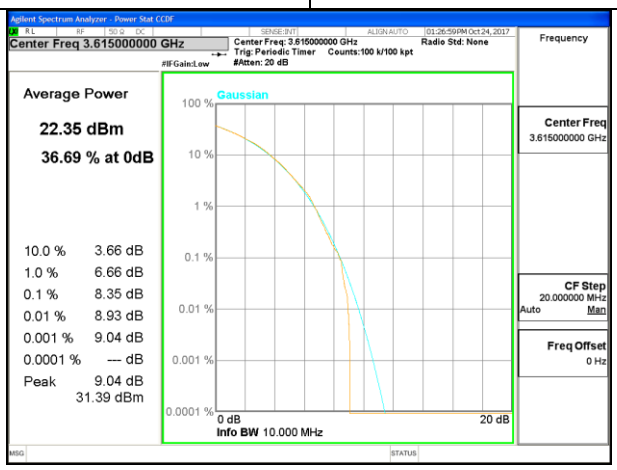
Antenna Port B 20MHz



LTE B48 20MHz QPSK Middle Channel

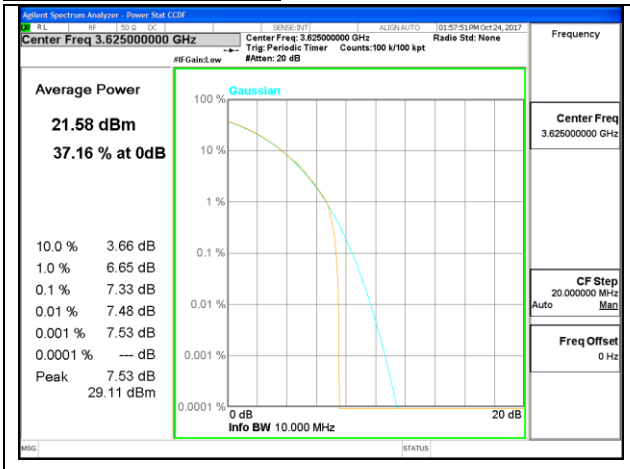


LTE B48 20MHz 16QAM Middle Channel

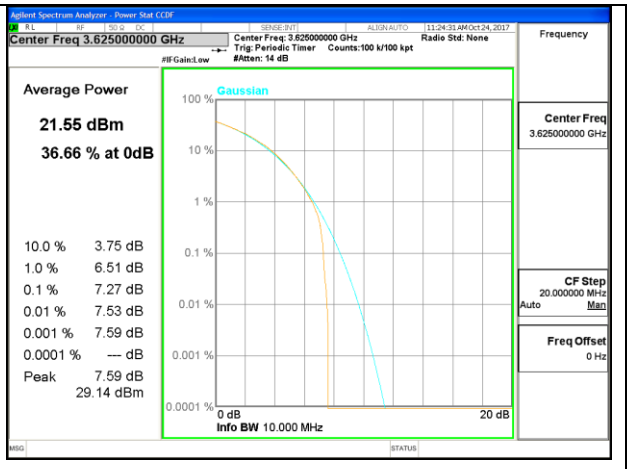


LTE B48 20MHz 64QAM Middle Channel

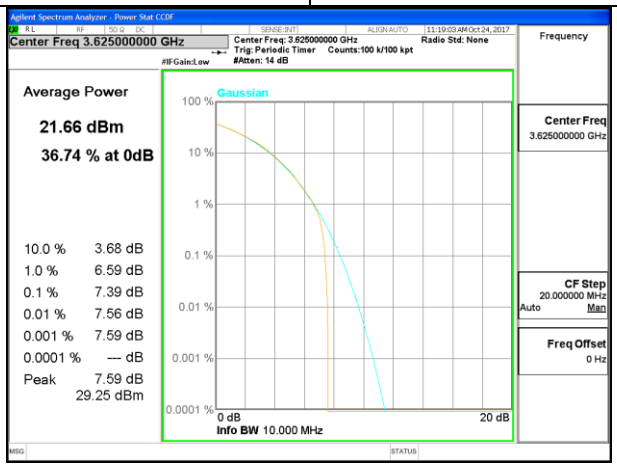
Antenna Port C 10MHz



LTE B48 10MHz QPSK Middle Channel

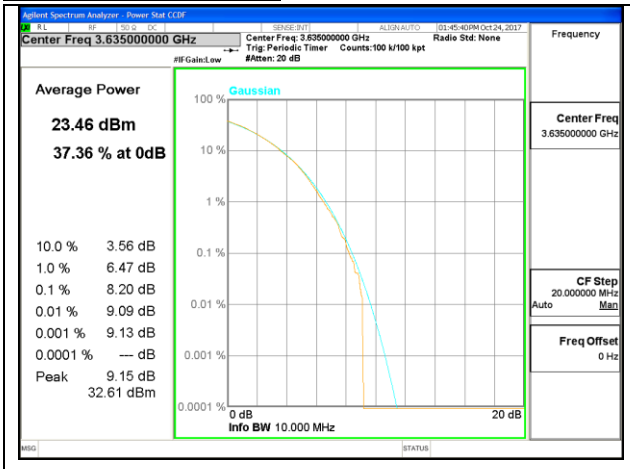


LTE B48 10MHz 16QAM Middle Channel

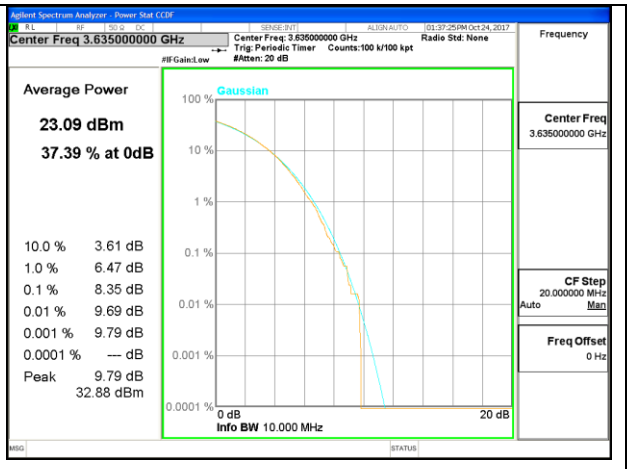


LTE B48 10MHz 64QAM Middle Channel

Antenna Port C 20MHz



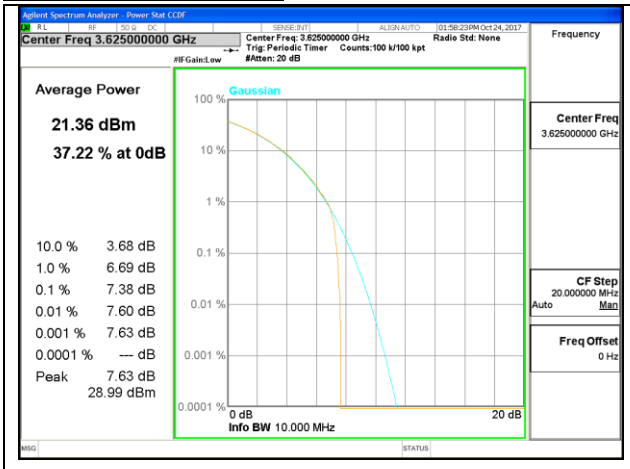
LTE B48 20MHz QPSK Middle Channel



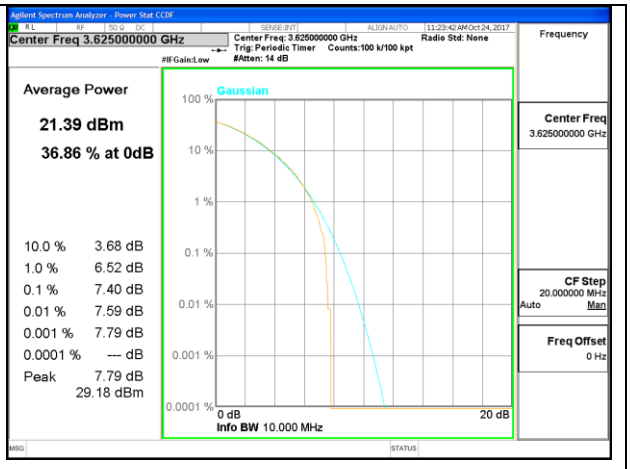
LTE B48 20MHz 16QAM Middle Channel

LTE B48 20MHz 64QAM Middle Channel

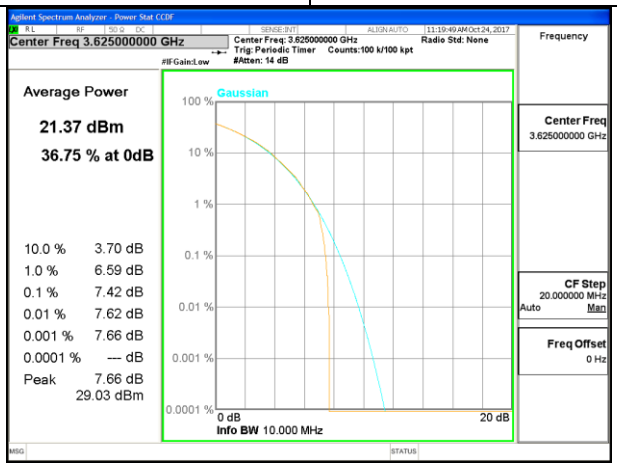
Antenna Port D 10MHz



LTE B48 10MHz QPSK Middle Channel

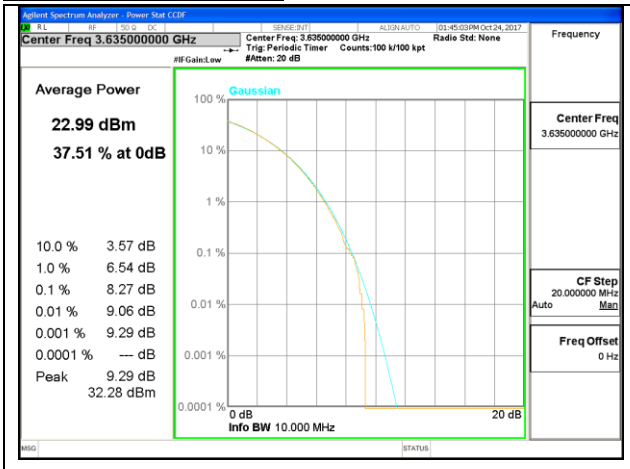


LTE B48 10MHz 16QAM Middle Channel

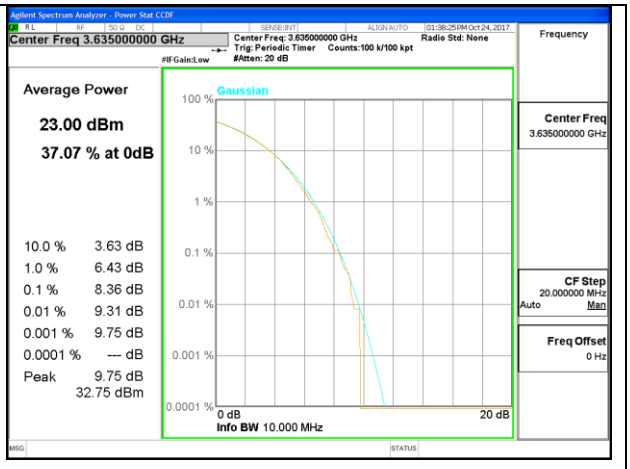


LTE B48 10MHz 64QAM Middle Channel

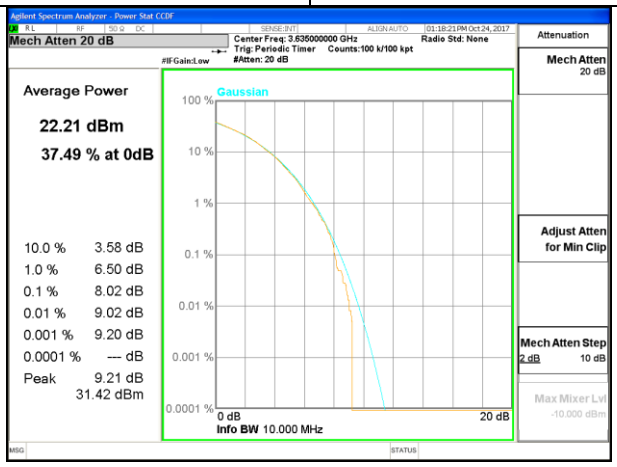
Antenna Port D 20MHz



LTE B48 20MHz QPSK Middle Channel



LTE B48 20MHz 16QAM Middle Channel



LTE B48 20MHz 64QAM Middle Channel

7.3. OCCUPIED BANDWIDTH

RULE PART(S)

FCC: §2.1049

LIMITS

For reporting purposes only

TEST PROCEDURE

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at the low, middle and high channel in each band. The -26dB bandwidth was also measured and recorded.

OCCUPIED BANDWIDTH RESULTS FOR OMNI ANTENNA

Antenna Port A

Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9411	9.485
			50/0	3625	8.9192	9.459
			50/0	3695	8.9354	9.423
		16QAM	50/0	3555	8.9305	9.530
			50/0	3625	8.8898	8.889
			50/0	3695	8.9358	9.397
		64QAM	50/0	3555	8.9351	9.650
			50/0	3625	8.9294	9.528
			50/0	3695	8.9431	9.485
	20	QPSK	100/0	3560	17.810	18.50
			100/0	3615	17.791	18.58
			100/0	3670	17.797	18.78
		16QAM	100/0	3560	17.803	18.73
			100/0	3615	17.832	18.62
			100/0	3670	17.819	18.71
		64QAM	100/0	3560	17.807	18.62
			100/0	3615	17.816	18.67
			100/0	3670	17.825	18.81

Antenna Port B

Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9429	9.520
			50/0	3625	8.9686	9.462
			50/0	3695	8.9591	9.382
		16QAM	50/0	3555	8.9545	9.546
			50/0	3625	8.9563	9.432
			50/0	3695	8.9300	9.402
		64QAM	50/0	3555	8.9285	9.597
			50/0	3625	8.929	9.493
			50/0	3695	8.9076	9.632
	20	QPSK	100/0	3560	17.896	18.57
			100/0	3615	17.868	18.54
			100/0	3670	17.812	18.72
		16QAM	100/0	3560	17.823	18.72
			100/0	3615	17.866	18.57
			100/0	3670	17.732	18.72
		64QAM	100/0	3560	17.829	18.56
			100/0	3615	17.864	18.76
			100/0	3670	17.830	18.73

Antenna Port C

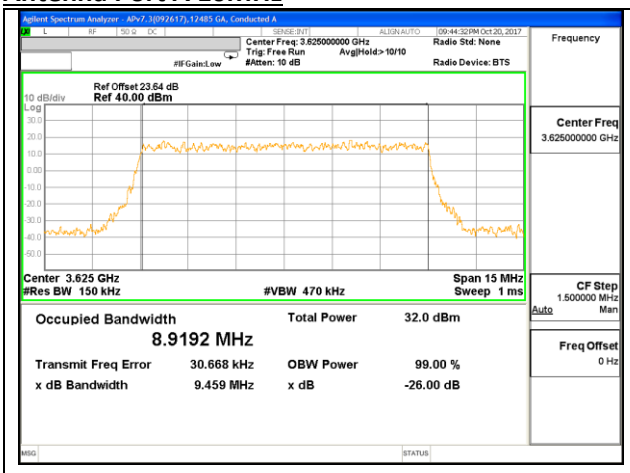
Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9426	9.535
			50/0	3625	8.9609	9.397
			50/0	3695	8.9318	9.402
		16QAM	50/0	3555	8.9287	9.496
			50/0	3625	8.893	9.441
			50/0	3695	8.911	9.467
		64QAM	50/0	3555	8.9383	9.599
			50/0	3625	8.9358	9.549
			50/0	3695	8.940	9.480
	20	QPSK	100/0	3580	17.819	18.53
			100/0	3635	17.828	18.58
			100/0	3690	17.856	18.72
		16QAM	100/0	3580	17.808	18.52
			100/0	3635	17.854	18.57
			100/0	3690	17.820	18.69
		64QAM	100/0	3580	17.799	18.61
			100/0	3635	17.824	18.65
			100/0	3690	17.822	18.68

Antenna Port D

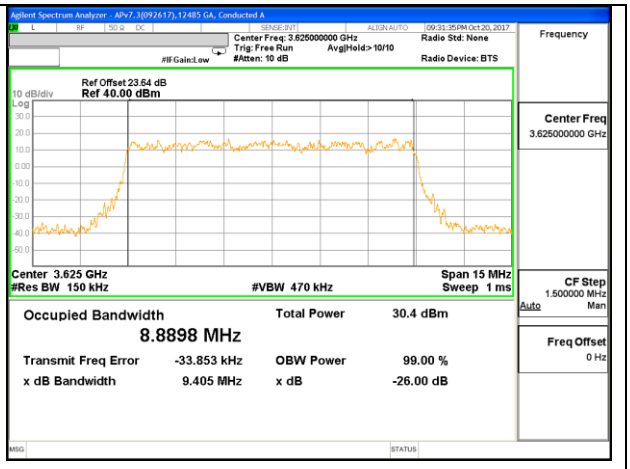
Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9345	9.553
			50/0	3625	8.9104	9.387
			50/0	3695	8.9370	9.381
		16QAM	50/0	3555	8.9455	9.540
			50/0	3625	8.9371	9.502
			50/0	3695	8.9193	9.452
		64QAM	50/0	3555	8.9461	9.607
			50/0	3625	8.9436	9.481
			50/0	3695	8.9014	9.542
	20	QPSK	100/0	3580	17.815	18.56
			100/0	3635	17.819	18.59
			100/0	3690	17.838	18.78
		16QAM	100/0	3580	17.846	18.68
			100/0	3635	17.852	18.64
			100/0	3690	17.826	18.77
		64QAM	100/0	3580	17.827	18.70
			100/0	3635	17.846	18.54
			100/0	3690	17.802	18.81

OCCUPIED BANDWIDTH PLOTS FOR OMNI ANTENNA

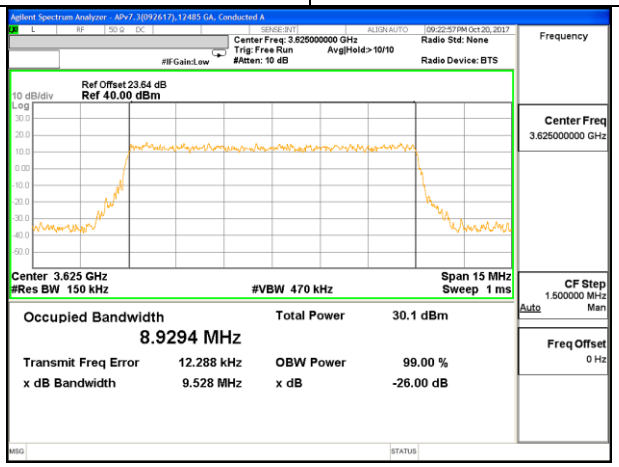
Antenna Port A 10MHz



LTE B48 10MHz QPSK Middle Channel

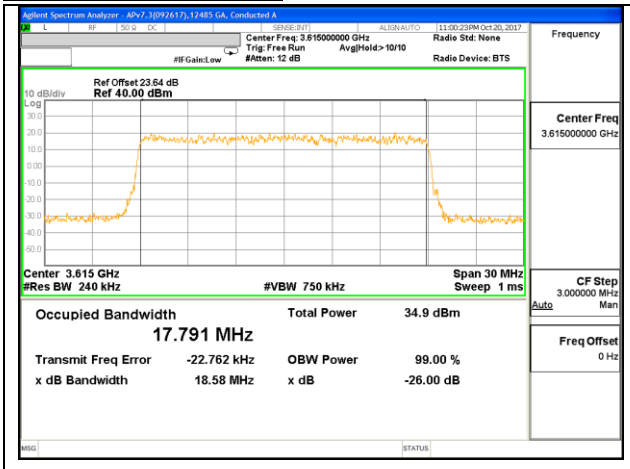


LTE B48 10MHz 16QAM Middle Channel

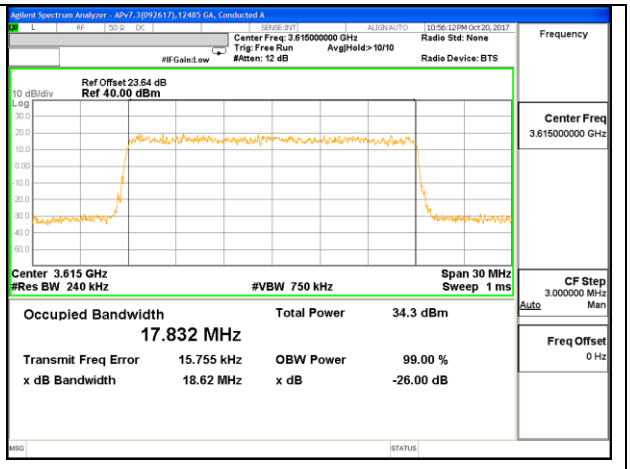


LTE B48 10MHz 64QAM Middle Channel

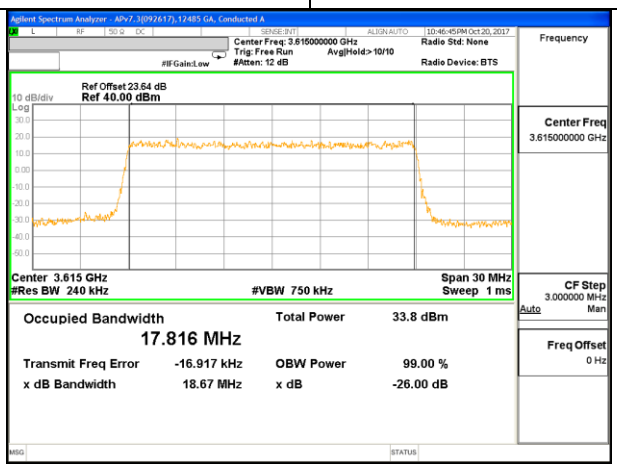
Antenna Port A 20MHz



LTE B48 20MHz QPSK Middle Channel

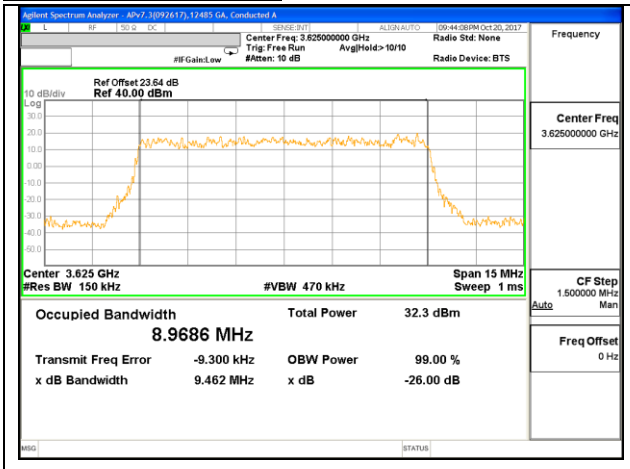


LTE B48 20MHz 16QAM Middle Channel

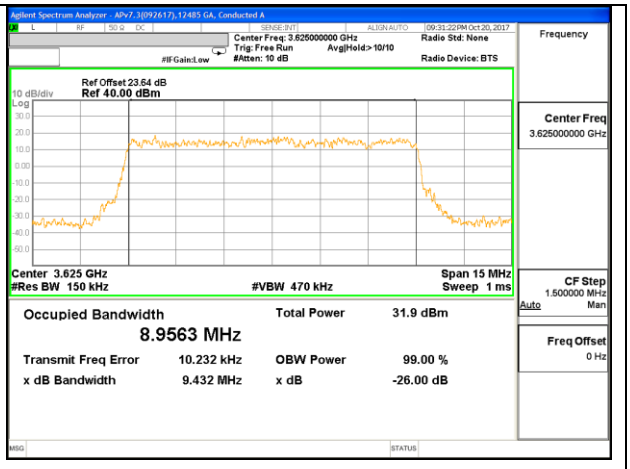


LTE B48 20MHz 64QAM Middle Channel

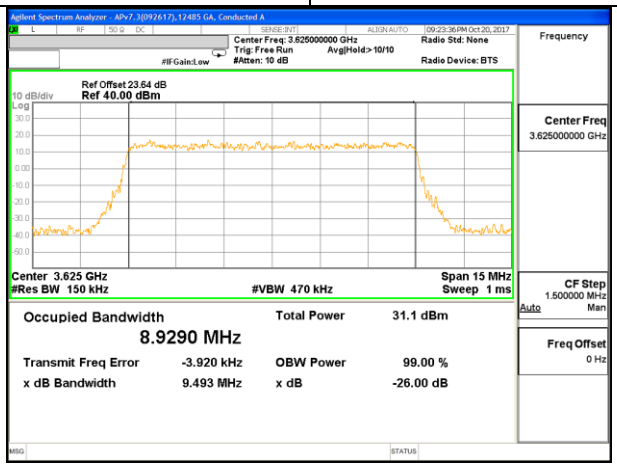
Antenna Port B 10MHz



LTE B48 10MHz QPSK Middle Channel

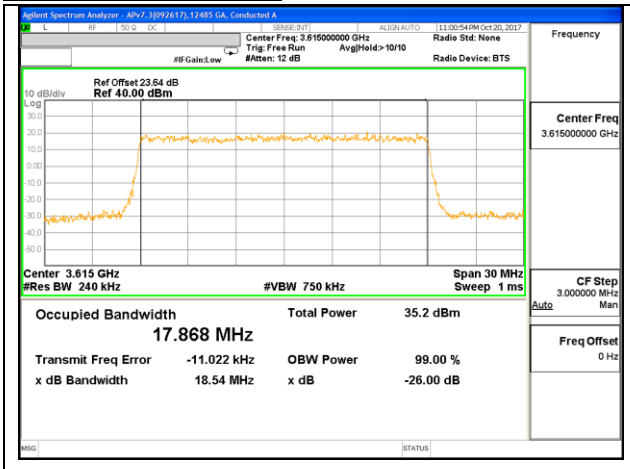


LTE B48 10MHz 16QAM Middle Channel

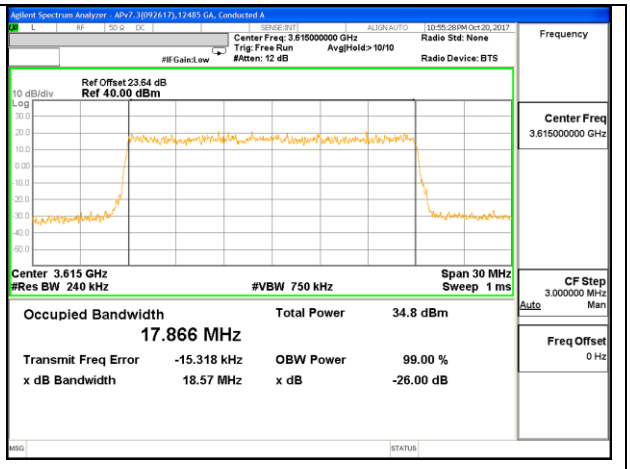


LTE B48 10MHz 64QAM Middle Channel

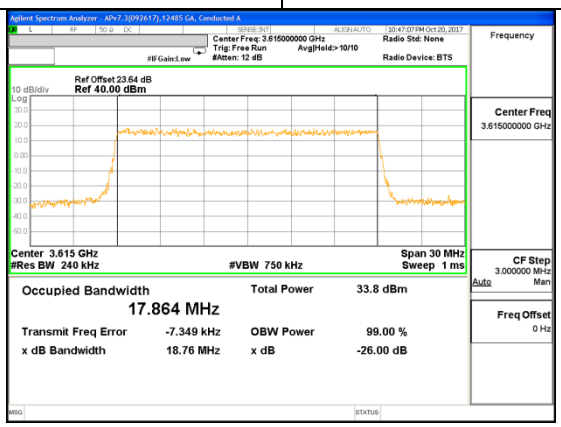
Antenna Port B 20MHz



LTE B48 20MHz QPSK Middle Channel

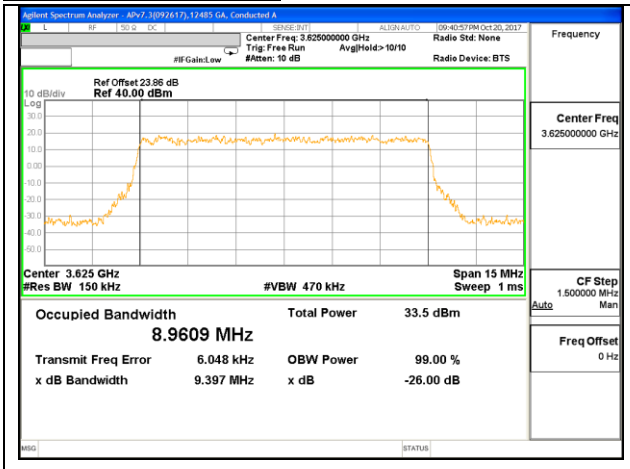


LTE B48 20MHz 16QAM Middle Channel

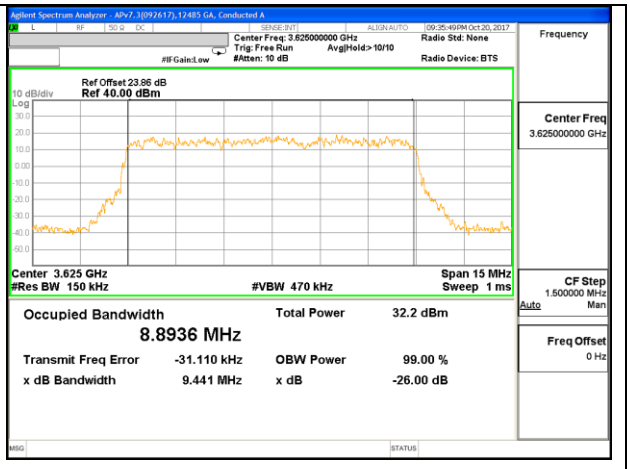


LTE B48 20MHz 64QAM Middle Channel

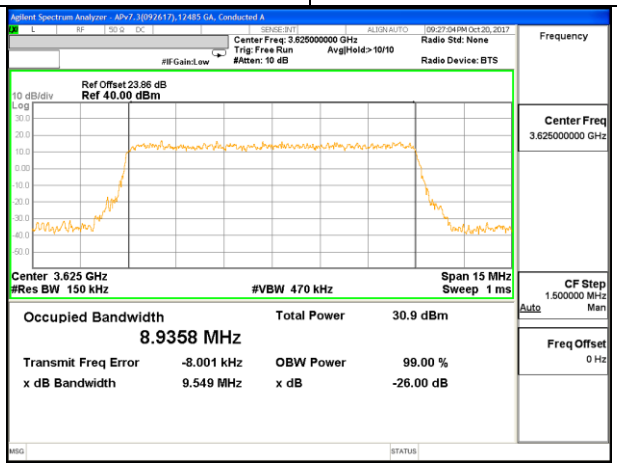
Antenna Port C 10MHz



LTE B48 10MHz QPSK Middle Channel

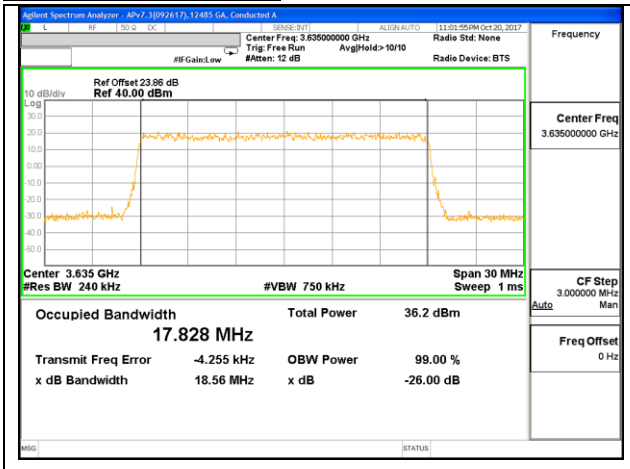


LTE B48 10MHz 16QAM Middle Channel

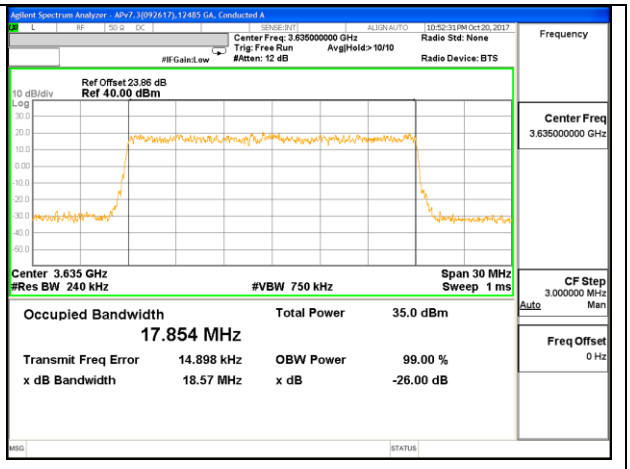


LTE B48 10MHz 64QAM Middle Channel

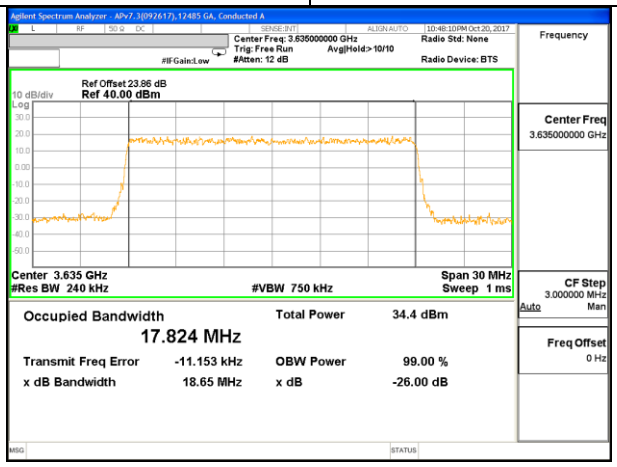
Antenna Port C 20MHz



LTE B48 20MHz QPSK Middle Channel

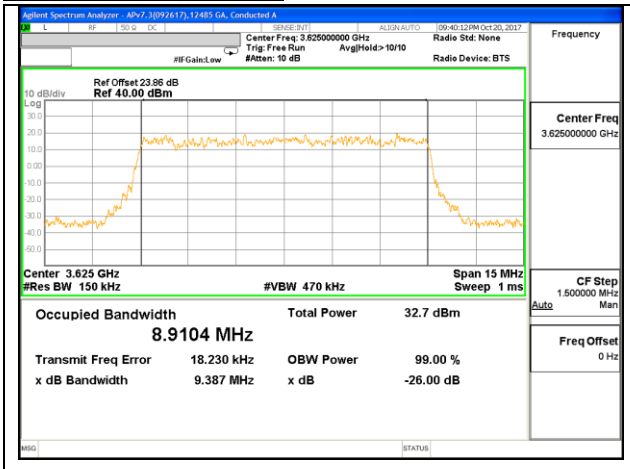


LTE B48 20MHz 16QAM Middle Channel

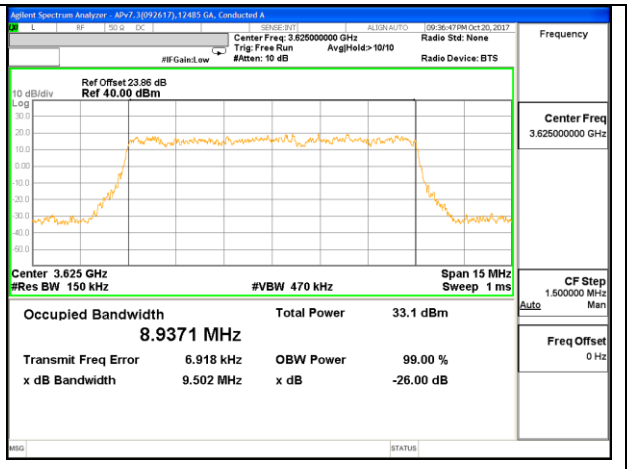


LTE B48 20MHz 64QAM Middle Channel

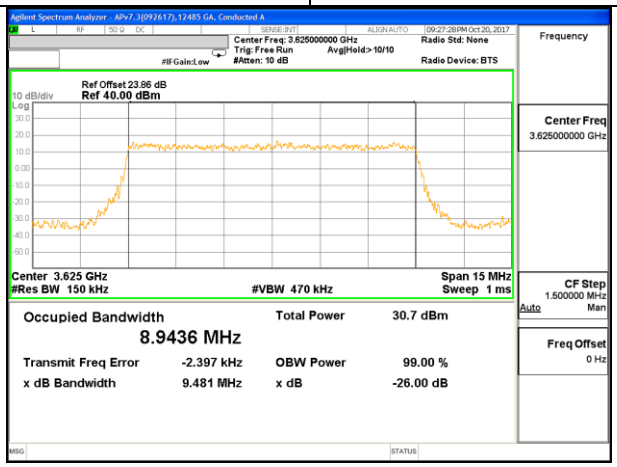
Antenna Port D 10MHz



LTE B48 10MHz QPSK Middle Channel

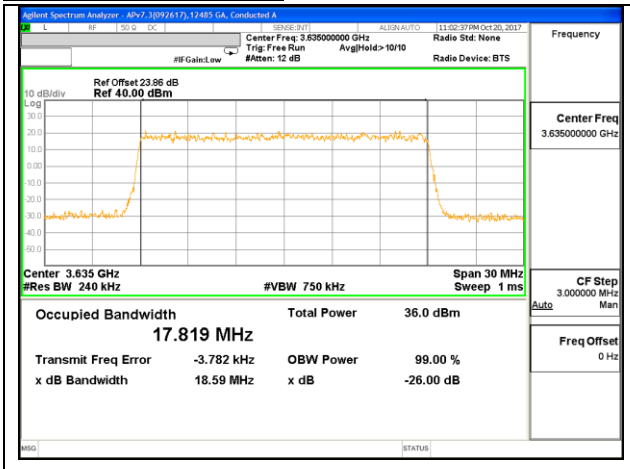


LTE B48 10MHz 16QAM Middle Channel

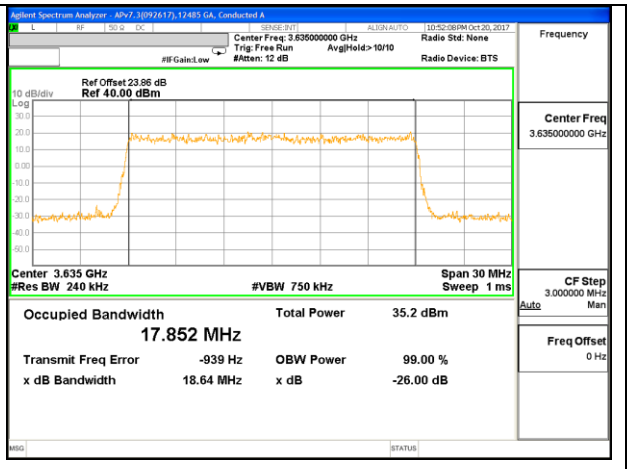


LTE B48 10MHz 64QAM Middle Channel

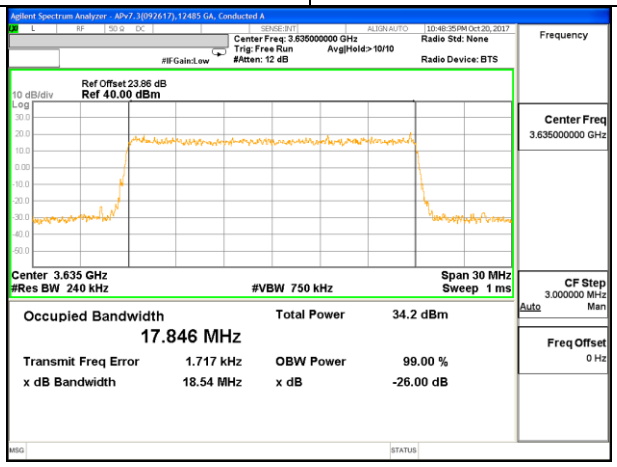
Antenna Port D 20MHz



LTE B48 20MHz QPSK Middle Channel



LTE B48 20MHz 16QAM Middle Channel



LTE B48 20MHz 64QAM Middle Channel

OCCUPIED BANDWIDTH RESULTS FOR DIRECTIONAL ANTENNA

Antenna Port A

Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9420	9.602
			50/0	3625	8.9366	9.551
			50/0	3695	8.9952	9.479
		16QAM	50/0	3555	8.9414	9.588
			50/0	3625	8.9498	9.493
			50/0	3695	8.9488	9.464
		64QAM	50/0	3555	8.9456	9.658l
			50/0	3625	8.9398	9.554
			50/0	3695	8.9239	9.514
	20	QPSK	100/0	3560	17.834	18.79
			100/0	3615	17.862	18.63
			100/0	3670	17.804	18.66
		16QAM	100/0	3560	17.807	18.80
			100/0	3615	17.832	18.64
			100/0	3670	17.778	18.59
		64QAM	100/0	3560	17.857	18.79
			100/0	3615	17.833	18.71
			100/0	3670	17.812	18.56

Antenna Port B

Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9435	9.592
			50/0	3625	8.9399	9.417
			50/0	3695	8.9433	9.527
		16QAM	50/0	3555	8.9474	9.598
			50/0	3625	8.9548	9.434
			50/0	3695	8.8959	9.480
		64QAM	50/0	3555	8.9393	9.648
			50/0	3625	8.9399	9.534
			50/0	3695	8.9415	9.584
	20	QPSK	100/0	3560	17.832	18.79
			100/0	3615	17.881	18.62
			100/0	3670	17.831	18.56
		16QAM	100/0	3560	17.820	18.78
			100/0	3615	17.846	18.69
			100/0	3670	17.798	18.60
		64QAM	100/0	3560	17.831	18.85
			100/0	3615	17.846	18.66
			100/0	3670	17.851	18.66

Antenna Port C

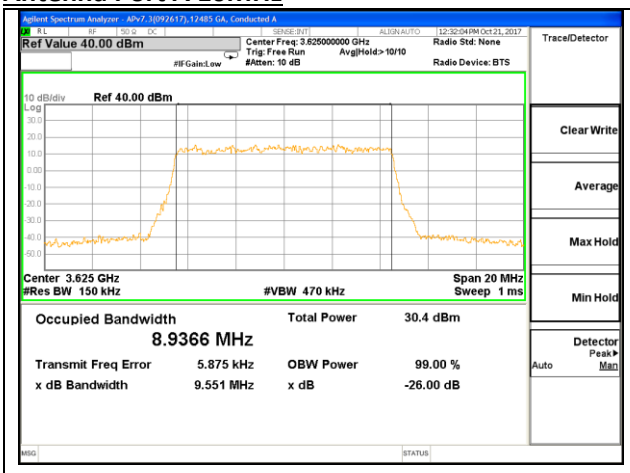
Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9514	9.667
			50/0	3625	8.9212	9.388
			50/0	3695	8.9185	9.439
		16QAM	50/0	3555	8.9390	9.550
			50/0	3625	8.9309	9.413
			50/0	3695	8.9108	9.546
		64QAM	50/0	3555	8.9514	9.667
			50/0	3625	8.9212	9.388
			50/0	3695	8.9185	9.439
	20	QPSK	100/0	3580	17.840	18.80
			100/0	3635	17.803	18.62
			100/0	3690	17.827	18.53
		16QAM	100/0	3580	17.842	18.76
			100/0	3635	17.878	18.60
			100/0	3690	17.897	18.55
		64QAM	100/0	3580	17.824	18.58
			100/0	3635	17.780	18.77
			100/0	3690	17.795	18.68

Antenna Port D

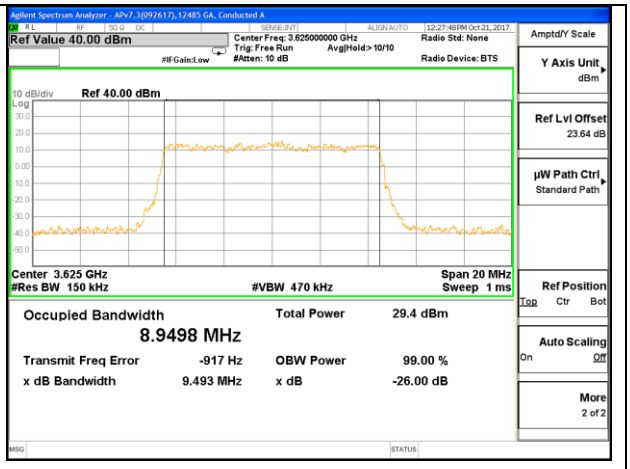
Band	BW(MHz)	Mode	RB/RB Size	f (MHz)	99% BW (MHz)	-26dB BW (MHz)
LTE 48	10	QPSK	50/0	3555	8.9508	9.552
			50/0	3625	8.9555	9.378
			50/0	3695	8.9609	9.507
		16QAM	50/0	3555	8.9440	9.553
			50/0	3625	8.9448	9.506
			50/0	3695	8.9309	9.470
		64QAM	50/0	3555	8.9292	9.633
			50/0	3625	8.9517	9.431
			50/0	3695	8.9599	9.575
	20	QPSK	100/0	3580	17.839	18.82
			100/0	3635	17.809	18.66
			100/0	3690	17.798	18.67
		16QAM	100/0	3580	17.851	18.76
			100/0	3635	17.851	18.68
			100/0	3690	17.801	18.56
		64QAM	100/0	3580	17.835	18.84
			100/0	3635	17.830	18.70
			100/0	3690	17.825	18.62

OCCUPIED BANDWIDTH PLOTS FOR DIRECTIONAL ANTENNA

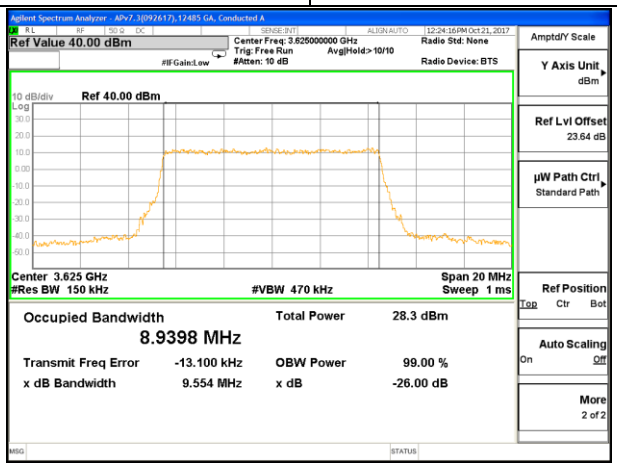
Antenna Port A 10MHz



LTE B48 10MHz QPSK Middle Channel

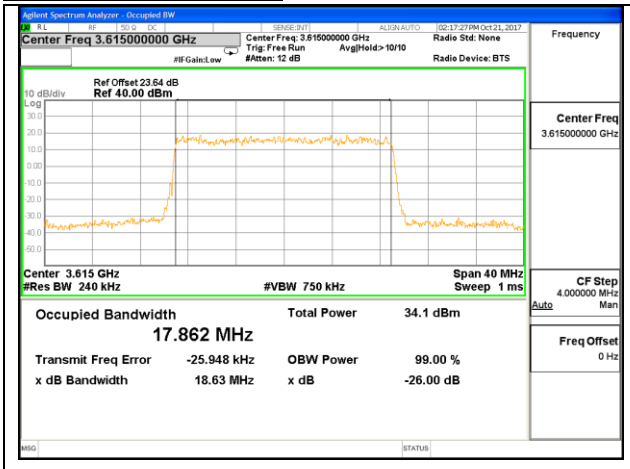


LTE B48 10MHz 16QAM Middle Channel

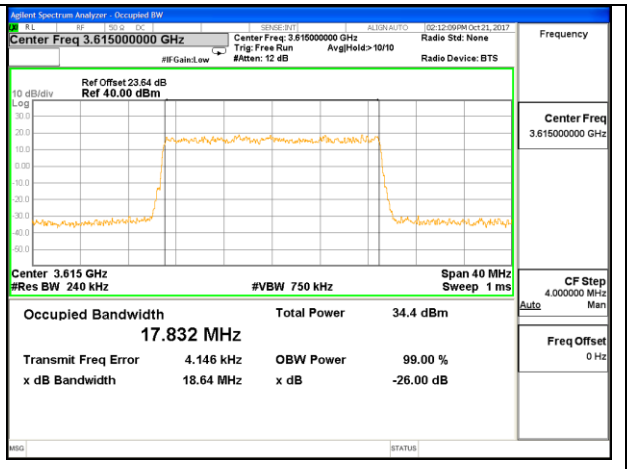


LTE B48 10MHz 64QAM Middle Channel

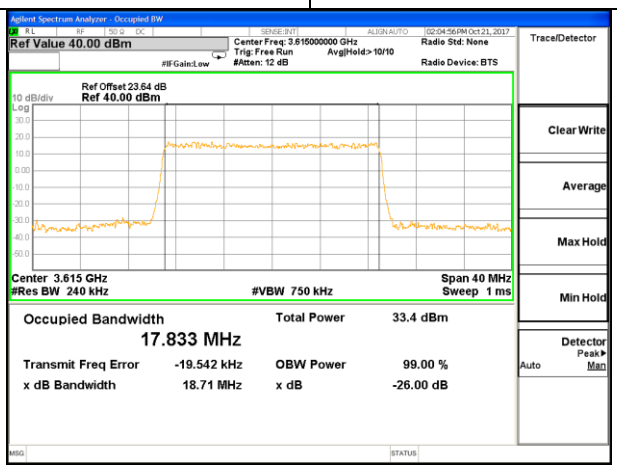
Antenna Port A 20MHz



LTE B48 20MHz QPSK Middle Channel

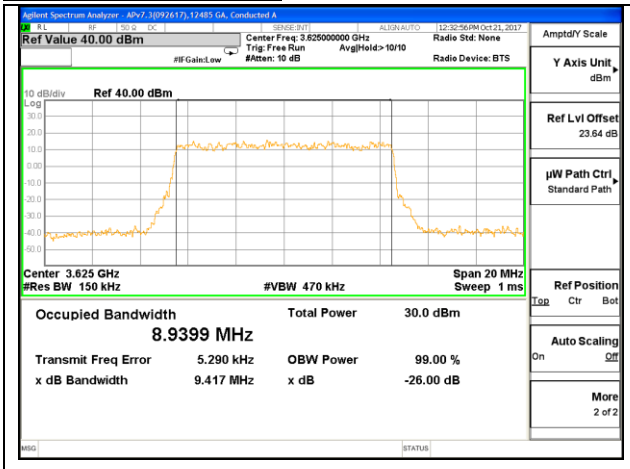


LTE B48 20MHz 16QAM Middle Channel

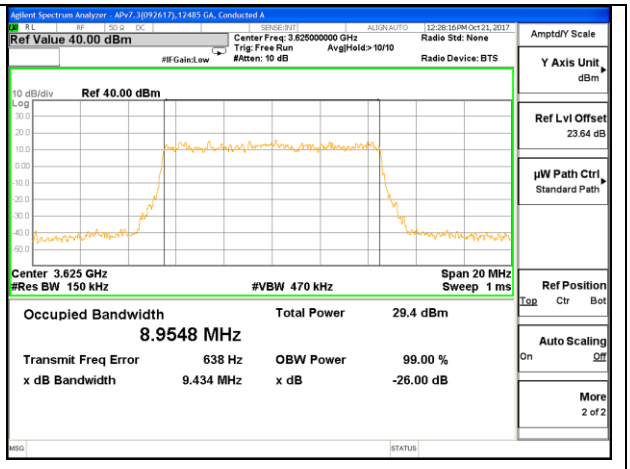


LTE B48 20MHz 64QAM Middle Channel

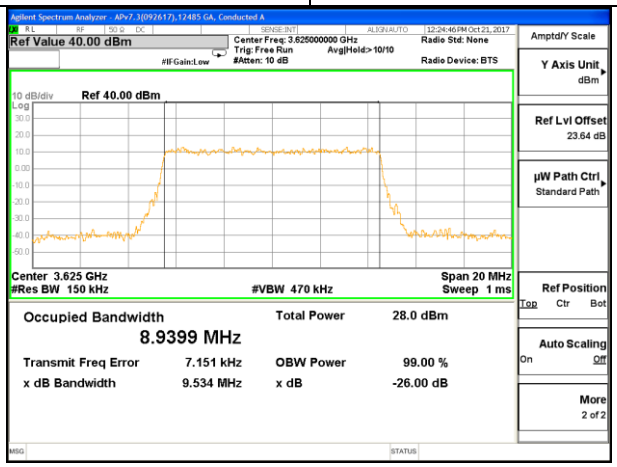
Antenna Port B 10MHz



LTE B48 10MHz QPSK Middle Channel

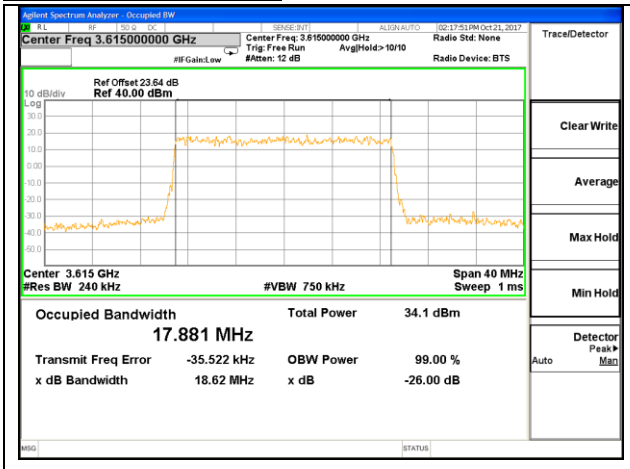


LTE B48 10MHz 16QAM Middle Channel

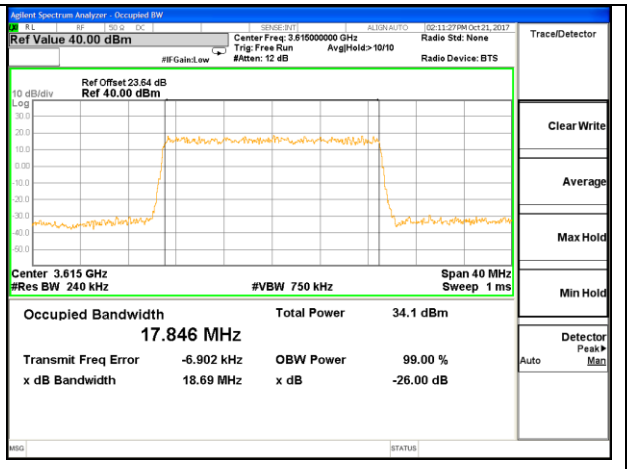


LTE B48 10MHz 64QAM Middle Channel

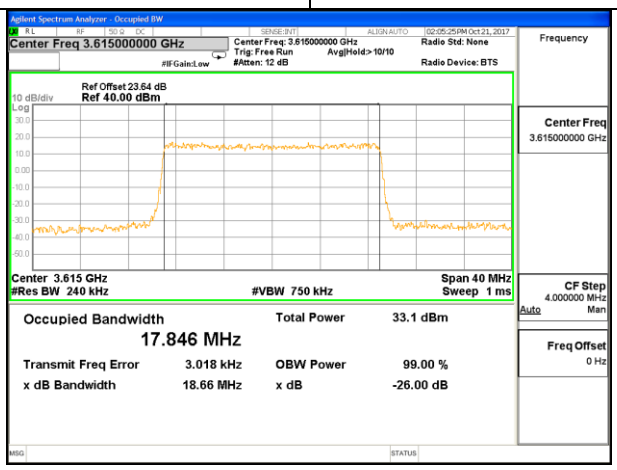
Antenna Port B 20MHz



LTE B48 20MHz QPSK Middle Channel



LTE B48 20MHz 16QAM Middle Channel



LTE B48 20MHz 64QAM Middle Channel