

FCC Radio Test Report

FCC ID: 2AO38-AP1000-41

This report concerns (check one): ☒ Original Grant ☐ Class I Change ☐ Class II Change

Project No. : 1812C016
Equipment : Apex Lifestyle Small Cell
Test Model : AP1000-41
Series Model : N/A
Applicant : Casa Systems, Inc.
Address : 100 Old River Road Suite 100 Andover,
Massachusetts 01810 United States

Date of Receipt : Dec. 04, 2018
Date of Test : Dec. 04, 2018 ~ Dec. 19, 2018
Issued Date : Jan. 31, 2019
Tested by : BTL Inc.

Technical Engineer : David Mao
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Certificate #5123.02

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The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

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REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	Original Issue.	Jan. 03, 2019
R01	Modified the comments of TCB.	Jan. 31, 2019

1. GENERAL SUMMARY

Equipment : Apex Lifestyle Small Cell
Brand Name : N/A
Test Model : AP1000-41
Series Model : N/A
Applicant : Casa Systems, Inc.
Manufacturer : Casa Systems, Inc.
Address : 100 Old River Road Suite 100 Andover, Massachusetts 01810 United States
Date of Test : Dec. 04, 2018 ~ Dec. 19, 2018
Test Sample : Engineering Sample No.: D181211152
Standard(s) : 47 CFR FCC Part 27
47 CFR FCC Part 2
ANSI / TIA / EIA-603-E-2016
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-3-1812C016) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of A2LA according to the ISO/IEC 17025 quality assessment standard and technical standard(s).

Test results included in this report are only for the LTE Band 41 part.

2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

FCC Part 27 & Part 2			
Standard(s) Section	Test Item	Judgment	Tested By
2.1046 27.50(d)(4)	Radiated power	PASS	Paul Li
2.1046 27.50(d)(4)	Output Power	PASS	Paul Li
2.1049 27.53(h)	Occupied Bandwidth	PASS	Paul Li
2.1051 27.53(h)	Conducted Spurious Emissions	PASS	Paul Li
2.1053 27.53(h)	Radiated Spurious Emissions	PASS	Paul Li
27.53(h)	Band Edge Measurements	PASS	Paul Li
27.50	Peak To Average Ratio	PASS	Paul Li
2.1055 27.54	Frequency Stability	PASS	Paul Li

2.1 TEST FACILITY

The test facilities used to collect the test data in this report is at the location of No.3, Jinshagang 1st Road, Shixia, Dalang Town, Dongguan, Guangdong, China.

BTL's Test Firm Registration Number for FCC: 357015

BTL's Designation Number for FCC: CN1240

2.2 MEASUREMENT UNCERTAINTY

The measurement uncertainty figures shall be calculated according the methods described in the ETSI TR 100 028 and shall correspond to an expansion factor (coverage factor) $k=1.96$ or $k=2$ (which provide confidence levels of respectively 90% and 95.45% in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)). Measurement Uncertainty for a Level of Confidence of 95 %, $U=2 \times U_c(y)$.

The BTL measurement uncertainty as below table:

A. Radiated Measurement :

Test Site	Method	Measurement Frequency Range	Ant. H / V	U,(dB)
DG-CB03 (3m)	CISPR	9KHz ~ 30MHz	V	3.79
		9KHz ~ 30MHz	H	3.57
		30MHz ~ 200MHz	V	3.82
		30MHz ~ 200MHz	H	3.78
		200MHz ~ 1,000MHz	V	4.10
		200MHz ~ 1,000MHz	H	4.06

Test Site	Method	Measurement Frequency Range	Ant. H / V	U,(dB)
DG-CB03 (3m)	CISPR	1GHz ~ 18GHz	V	3.12
		1GHz ~ 18GHz	H	3.68

Test Site	Method	Measurement Frequency Range	Ant. H / V	U,(dB)
DG-CB03 (1.5m)	CISPR	18GHz ~ 40GHz	V	4.15
		18GHz ~ 40GHz	H	4.14

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	Apex Lifestyle Small Cell			
Brand Name	N/A			
Test Model	AP1000-41			
Series Model	N/A			
Model Difference	N/A			
S/N	A01B18000001			
Hardware Version	REV1.0			
Software Version	v4.2.3			
Modulation Type	LTE 41	UL: QPSK,16QAM, 64QAM DL: QPSK,16QAM, 64QAM		
Operation Frequency	LTE 41 (Channel Bandwidth: 5MHz)	2498.5 ~ 2687.5 MHz		
	LTE 41 (Channel Bandwidth: 10MHz)	2501.0 ~ 2685.0 MHz		
	LTE 41 (Channel Bandwidth: 15MHz)	2503.5 ~ 2682.5 MHz		
	LTE 41 (Channel Bandwidth: 20MHz)	2506.0 ~ 2680.0 MHz		
Max. EIRP Power	LTE 41 (Channel Bandwidth: 5MHz)	QPSK	28.58	dBm
		16QAM	28.36	dBm
		64QAM	27.28	dBm
	LTE 41 (Channel Bandwidth: 10MHz)	QPSK	27.73	dBm
		16QAM	27.20	dBm
		64QAM	25.51	dBm
	LTE 41 (Channel Bandwidth: 15MHz)	QPSK	27.83	dBm
		16QAM	27.38	dBm
		64QAM	25.63	dBm
	LTE 41 (Channel Bandwidth: 20MHz)	QPSK	27.89	dBm
		16QAM	27.27	dBm
		64QAM	25.94	dBm
Power Source	DC voltage supplied from AC/DC adapter. Model Name: S24B72-120A200-0K			
Power Rating	I/P: 100-240V ~50/60Hz Max. 0.8A O/P: 12V---2A			

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. Table for Filed Antenna:

Ant.	Brand	P/N	Antenna Type	Connector	Gain(dBi)
1	T&W	EmP102-B-I100(G)	Internal	IPEX	3.40
2	T&W	EmP102-B-I150(G)	Internal	IPEX	3.40

Note:

This EUT supports CDD, and all antennas have the same gain, so Directional gain= G_{ANT} +Array Gain. So, Array Gain= $10\log(N_{ANT}/N_{SS})$ dB, that is Directional gain= $3.40+10\log(2/1)=6.41$.

3.2 DESCRIPTION OF TEST MODES AND TEST CONDITION

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

LTE BAND 41					
Test Item	Available Channel	Tested Channel	Channel Bandwidth	Modulation	Mode
EIRP	39675 to 41565	39675, 40620, 41565	5MHz	QPSK, 16QAM, 64QAM	Full RB
	39700 to 41540	39700, 40620, 41540	10MHz	QPSK, 16QAM, 64QAM	Full RB
	39725 to 41515	39725, 40620, 41515	15MHz	QPSK, 16QAM, 64QAM	Full RB
	39750 to 41490	39750, 40620, 41490	20MHz	QPSK, 16QAM, 64QAM	Full RB
Occupied Bandwidth	39675 to 41565	39675, 40620, 41565	5MHz	QPSK, 16QAM, 64QAM	Full RB
	39700 to 41540	39700, 40620, 41540	10MHz	QPSK, 16QAM, 64QAM	Full RB
	39725 to 41515	39725, 40620, 41515	15MHz	QPSK, 16QAM, 64QAM	Full RB
	39750 to 41490	39750, 40620, 41490	20MHz	QPSK, 16QAM, 64QAM	Full RB
Conducted Spurious Emission	39675 to 41565	40620	5MHz	QPSK	Full RB
	39750 to 41490	40620	20MHz	QPSK	Full RB
Radiated Spurious Emission	39675 to 41565	40620	5MHz	QPSK	Full RB
	39750 to 41490	40620	20MHz	QPSK	Full RB
Band Edge	39675 to 41565	39675, 41565	5MHz	QPSK	Full RB
	39700 to 41540	39700, 41540	10MHz	QPSK	Full RB
	39725 to 41515	39725, 41515	15MHz	QPSK	Full RB
	39750 to 41490	39750, 41490	20MHz	QPSK	Full RB
Peak to Average Ratio	39675 to 41565	39675, 40620, 41565	5MHz	QPSK, 16QAM, 64QAM	Full RB
	39700 to 41540	39700, 40620, 41540	10MHz	QPSK, 16QAM, 64QAM	Full RB
	39725 to 41515	39725, 40620, 41515	15MHz	QPSK, 16QAM, 64QAM	Full RB
	39750 to 41490	39750, 40620, 41490	20MHz	QPSK, 16QAM, 64QAM	Full RB
Frequency Stability	39675 to 41565	40620	5MHz	QPSK	Full RB
	39700 to 41540	40620	10MHz	QPSK	Full RB
	39725 to 41515	40620	15MHz	QPSK	Full RB
	39750 to 41490	40620	20MHz	QPSK	Full RB

EUT TEST CONDITIONS:

Test Item	Environmental Conditions	Test Voltage
EIRP	22.2°C, 49.9%RH	AC 120V/60Hz
Output Power	22.2°C, 49.9%RH	AC 120V/60Hz
Occupied Bandwidth	23.4°C, 41.2%RH	AC 120V/60Hz
Conducted Spurious Emission	23.4°C, 41.2%RH	AC 120V/60Hz
Radiated Spurious Emission	25°C, 60%RH	AC 120V/60Hz
Band Edge	23.4°C, 41.2%RH	AC 120V/60Hz
Peak to Average Ratio	23.4°C, 41.2%RH	AC 120V/60Hz
Frequency Stability	Normal, Extreme	Normal, Extreme

3.3 DUTY CYCLE

If duty cycle is $\geq 98\%$, duty factor is not required.

If duty cycle is $< 98\%$, duty factor shall be considered.

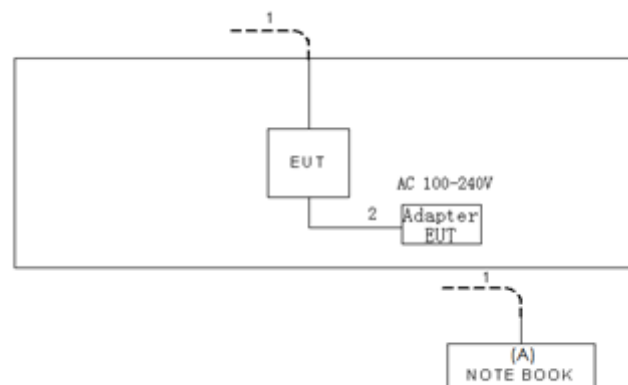


$$\text{Duty cycle} = 6.780 \text{ ms} / 10.020 \text{ ms} = 67.665 \%$$

NOTE:

Duty Factor = $10 \log(1/\text{Duty cycle}) = 1.70$, the conducted output power = measured power + duty factor.

3.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



3.4 DESCRIPTION OF SUPPORT UNITS

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

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.
A	NOTEBOOK	DELL	INSPIRON 1420	N/A	N/A

Item	Shielded Type	Ferrite Core	Length	Note
1	NO	NO	1.2m	RJ45 Cable
2	NO	NO	1.8m	DC Cable

4. TEST RESULT

4.1 OUTPUT POWER MEASUREMENT

4.1.1 LIMIT

Mobile / Portable station are limited to 2 watts e.i.r.p.

4.1.2 TEST PROCEDURE

EIRP:

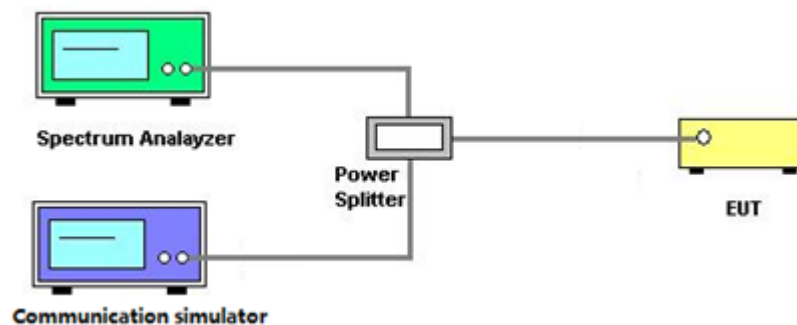
$EIRP = \text{Conducted Power} + \text{Antenan gain}$

Conducted Output Power:

1. The transmitter output port was connected to the system simulator.
2. Set EUT at maximum power through system simulator.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure and record the power level from the spectrum analyzer.

4.1.3 TESTSETUP LAYOUT

Conducted Output Power Measurement



4.1.4 TEST DEVIATION

No deviation

4.1.5 TEST RESULTS

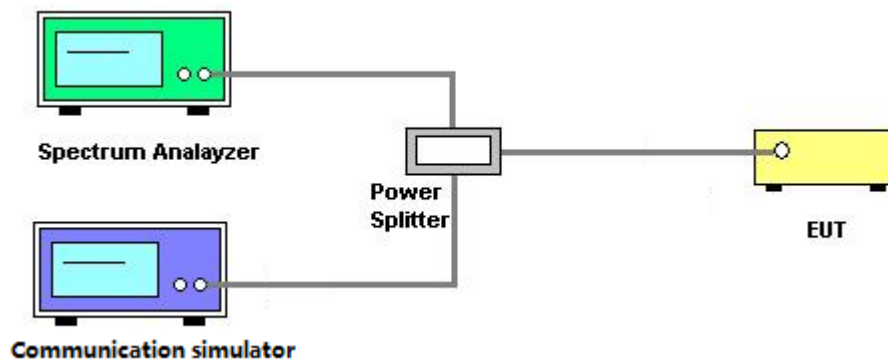
Please refer to the Appendix A.

4.2 OCCUPIED BANDWIDTH MEASUREMENT

4.2.1 TEST PROCEDURE

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

4.2.2 TEST SETUP LAYOUT



4.2.3 TEST DEVIATION

No deviation

4.2.4 TEST RESULTS

Please refer to the Appendix B.

4.3 CONDUCTED EMISSIONS MEASUREMENT

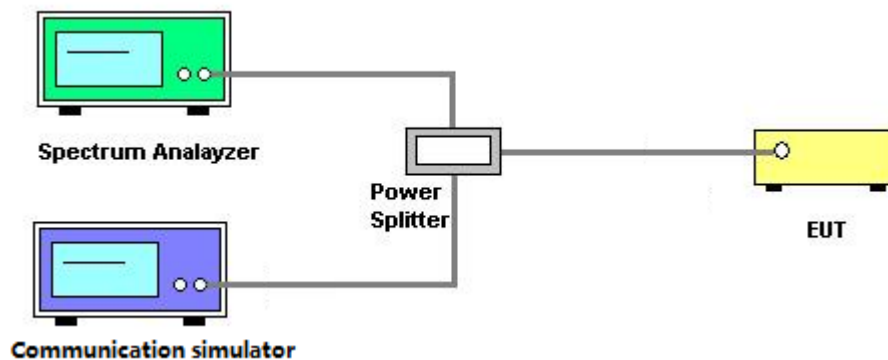
4.3.1 LIMIT

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 $55 + 10 \log(P)$ dB. The emission limit equal to -25dBm.

4.3.2 TEST PROCEDURES

1. The testing follows FCC KDB 971168 v03r01 Section 6.0.
2. The EUT was connected to spectrum analyzer and system simulator via a power divider.
3. The band edges of low and high channels for the highest RF powers were measured. Set $RBW \geq 1\%$ EBW in the 1MHz band immediately outside and adjacent to the band edge.
4. Set spectrum analyzer with RMS detector.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

4.3.3 TESTSETUP LAYOUT



4.3.4 TESTDEVIATION

No deviation

4.3.5 TEST RESULTS

Please refer to the Appendix C.

4.4 RADIATED EMISSIONS MEASUREMENT

4.4.1 LIMIT

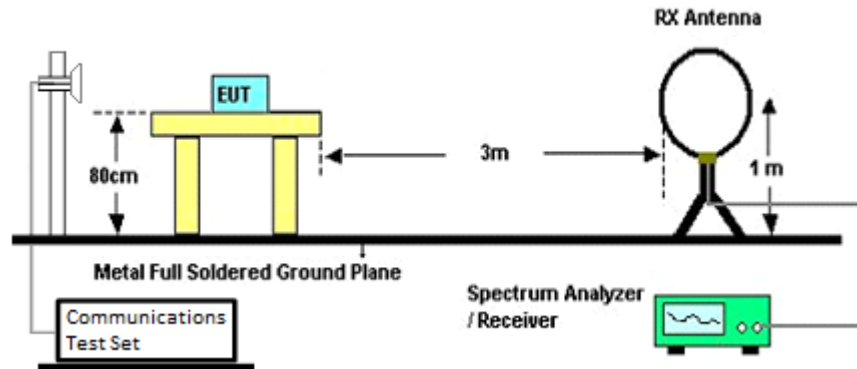
The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $55 + 10 \log(P)$ dB. The emission limit equal to -25dBm.

4.4.2 TEST PROCEDURES

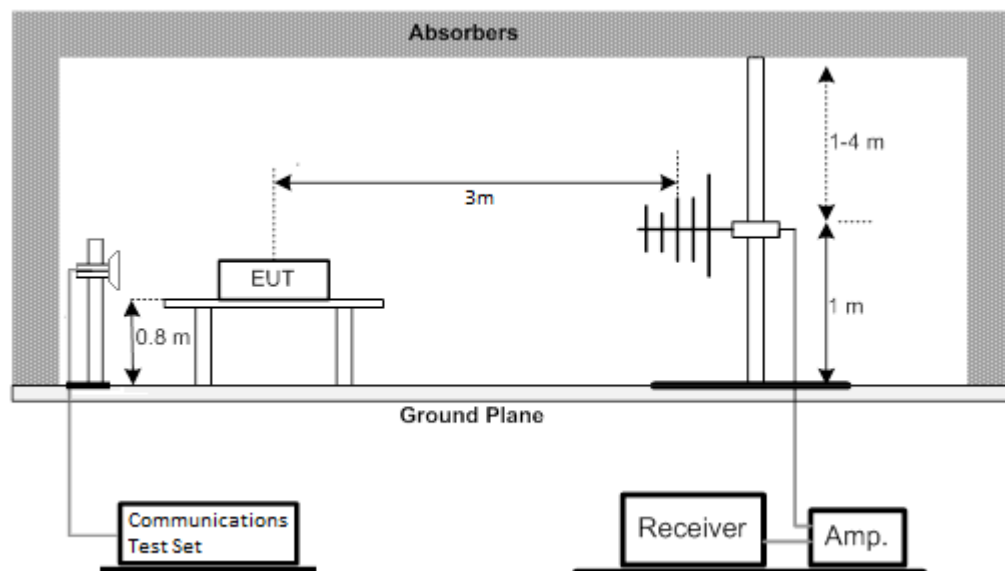
1. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m 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
3. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.
4. 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 - 2.15dBi.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

4.4.3 TESTSETUP LAYOUT

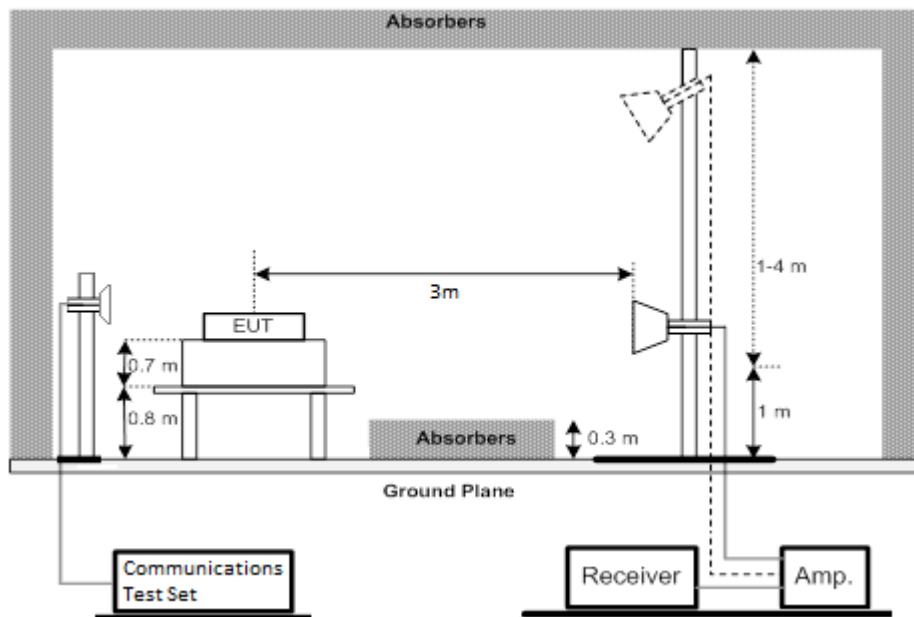
Below 30MHz



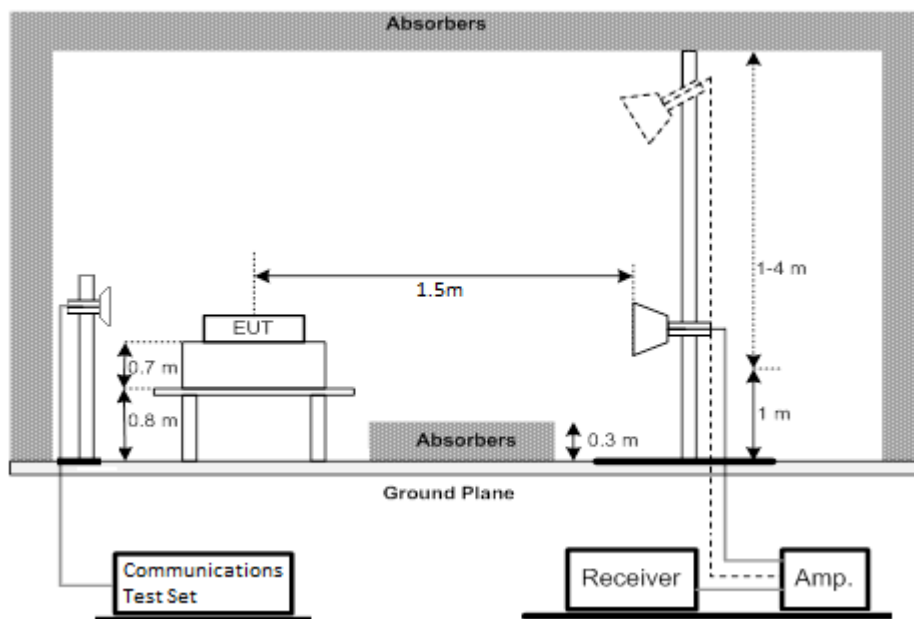
30MHz to 1GHz



1GHz to 18GHz



Above 18GHz



4.4.4 TEST DEVIATION

No deviation

4.4.5 TEST RESULTS (9KHZ TO 30MHZ)

Please refer to the Appendix D.

4.4.6 TEST RESULTS (30MHZ TO 1000MHZ)

Please refer to the Appendix E.

4.4.7 TEST RESULTS (ABOVE 1000MHZ)

Please refer to the Appendix F.

4.5 BAND EDGE MEASUREMENT

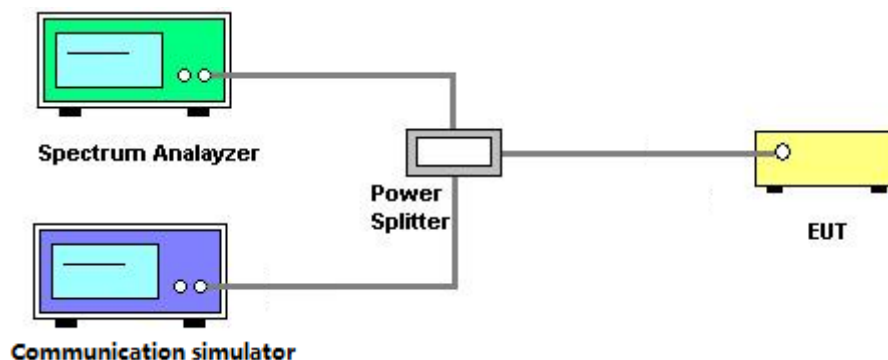
4.5.1 LIMIT

For mobile digital stations, the attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

4.5.2 TEST PROCEDURES

1. All measurements were done at low and high operational frequency range.
2. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 51kHz and VB of the spectrum is 150kHz (LTE Bandwidth 5MHz).
3. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 100kHz and VB of the spectrum is 300kHz (LTE Bandwidth 10MHz).
4. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 150kHz and VB of the spectrum is 470kHz (LTE Bandwidth 15MHz).
5. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 200kHz and VB of the spectrum is 620kHz (LTE Bandwidth 20MHz).
6. Record the max trace plot into the test report.

4.5.3 TESTSETUP LAYOUT



4.5.4 TESTDEVIATION

No deviation

4.5.5 TEST RESULTS

Please refer to the Appendix G.

4.6 PEAK TO AVERAGE RATIO MEASUREMENT

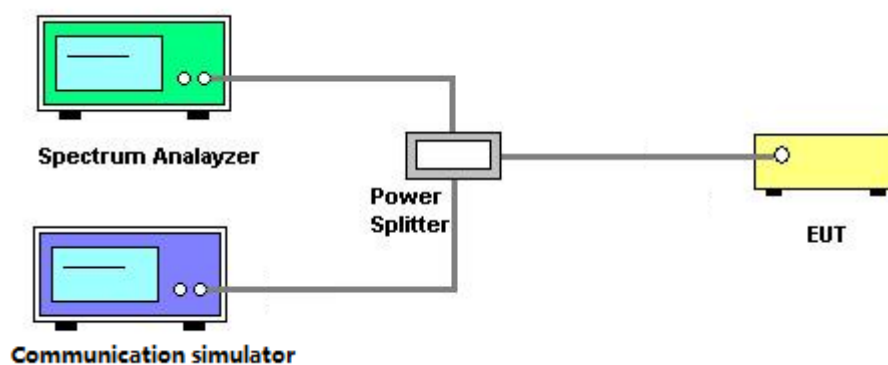
4.6.1 LIMIT

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

4.6.2 TEST PROCEDURES

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

4.6.3 TESTSETUP LAYOUT



4.6.4 TESTDEVIATION

No deviation

4.6.5 TEST RESULTS

Please refer to the Appendix H

4.7 FREQUENCY STABILITY MEASUREMENT

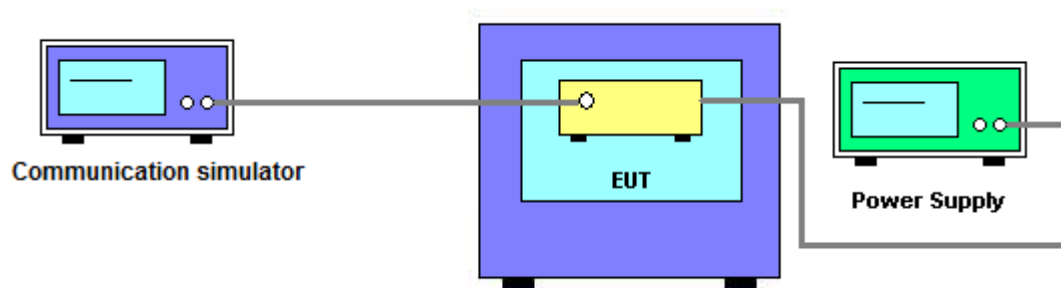
4.7.1 LIMIT

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

4.7.2 TEST PROCEDURES

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.
4. The frequency error was recorded frequency error from the communication simulator.

4.7.3 TESTSETUP LAYOUT



4.7.4 TESTDEVIATION

No deviation

4.7.5 TEST RESULTS

Please refer to the Appendix I

5. LIST OF MEASUREMENT EQUIPMENTS

Radiated Emission Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Antenna	Schwarbeck	VULB9160	9160-3232	Mar. 11, 2019
2	Amplifier	Agilent	8449B	3008A02274	Mar. 11, 2019
3	Amplifier	HP	8447D	2944A09673	Aug. 11, 2019
4	HighPass Filter	Wairwright Instruments Gmbh	WHK 1.5/15G-10ST	11	Mar. 11, 2019
5	Band Reject Filter	Wairwright Instruments Gmbh	WRCG 1710/1785-1690/180 5-60/12SS	38	Mar. 11, 2019
6	Band Reject Filter	Wairwright Instruments Gmbh	WRCG 824/849-810/863-60/ 9SS	7	Mar. 11, 2019
7	Band Reject Filter	Wairwright Instruments Gmbh	WRCG 880/915-860/935-60/ 9SS	14	Mar. 11, 2019
8	Band Reject Filter	Wairwright Instruments Gmbh	WRCG 1850/1910-1830/193 0-60/10SS	17	Mar. 11, 2019
9	HighPass Filter	Wairwright Instruments Gmbh	WHK3.1/18G-10SS	24	Mar. 11, 2019
10	Wireless Communication Test SET	Agilent	E5515C	MY48364183	Mar. 11, 2019
11	Microwave Preamplifier With Adaptor	EMC INSTRUMENT	EMC2654045	980039 & HA01	Mar. 11, 2019
12	Receiver	Agilent	N9038A	MY52130039	Aug. 11, 2019
13	wideband radio communication tester	R&S	CMW500	152372	Mar. 11, 2019
14	Cable	emci	LMR-400(30MHz-1G Hz)(8m+5m)	N/A	May 25, 2019
15	Cable	mitron	B10-01-01-12M	18072744	Jul. 30, 2019
16	Controller	ETS-Lindgren	2090	N/A	N/A
17	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A
18	Loop Antenna	EM	EM-6876-1	230	Feb. 07, 2019
19	Double Ridged Guide Antenna	ETS	3115	75789	Mar. 11, 2019
20	Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170319	Jun. 30, 2019

Conducted Emission & Band Edge & Occupied Bandwidth Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Wireless Communication Test SET	Agilent	E5515C	MY48364183	Mar. 11, 2019
2	EXA Spectrum Analyzer	Agilent	N9010A	MY50520044	Mar. 11, 2019
3	POWER SPLITTER	Mini-Circuits	ZFRSC-123-S+	331000910-1	Mar. 11, 2019
4	wideband radio communication tester	R&S	CMW500	152372	Mar. 11, 2019
5	Spectrum Analyzer	R&S	FSP40	100185	Aug. 11, 2019

Frequency Stability Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Wireless Communication Test SET	Agilent	E5515C	MY48364183	Mar. 11, 2019
2*	Multi-output DC Power Supply	GW Instek	GPC-3030DN	EK880675	Sep. 26, 2020
3	POWER SPLITTER	Mini-Circuits	ZFRSC-123-S+	331000910-1	Mar. 11, 2019
4	wideband radio communication tester	R&S	CMW500	152372	Mar. 11, 2019

Remark: "N/A" denotes no model name, serial no. or calibration specified.

All calibration period of equipment list is one year.

*All calibration period of equipment list is three year.

6. EUT TEST PHOTO

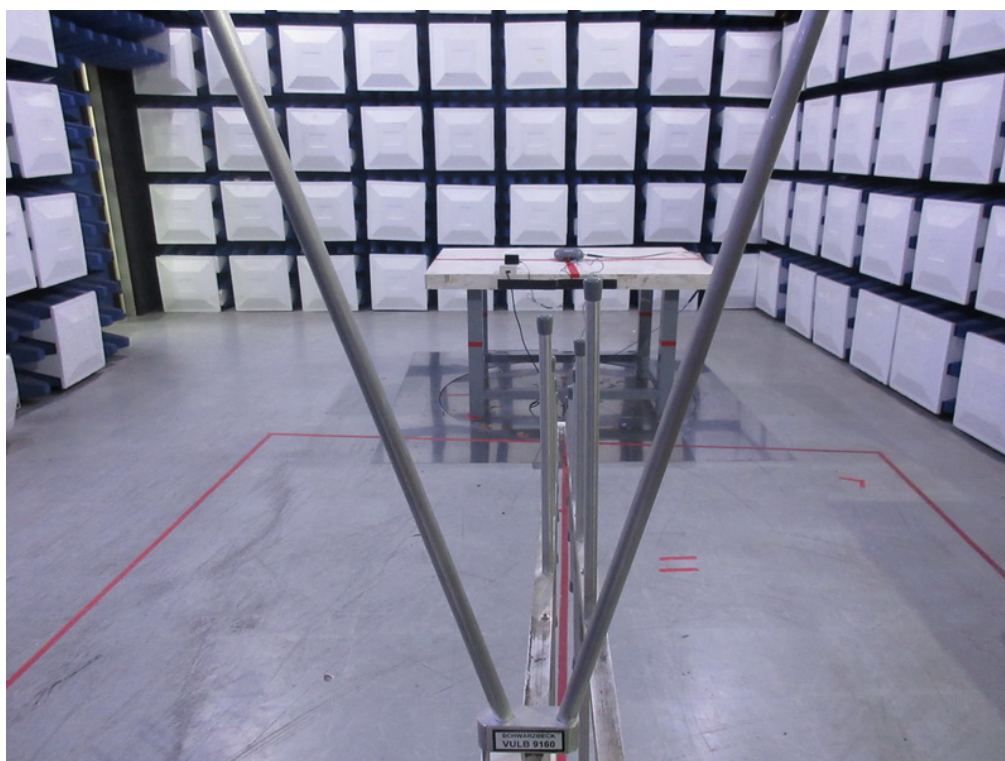
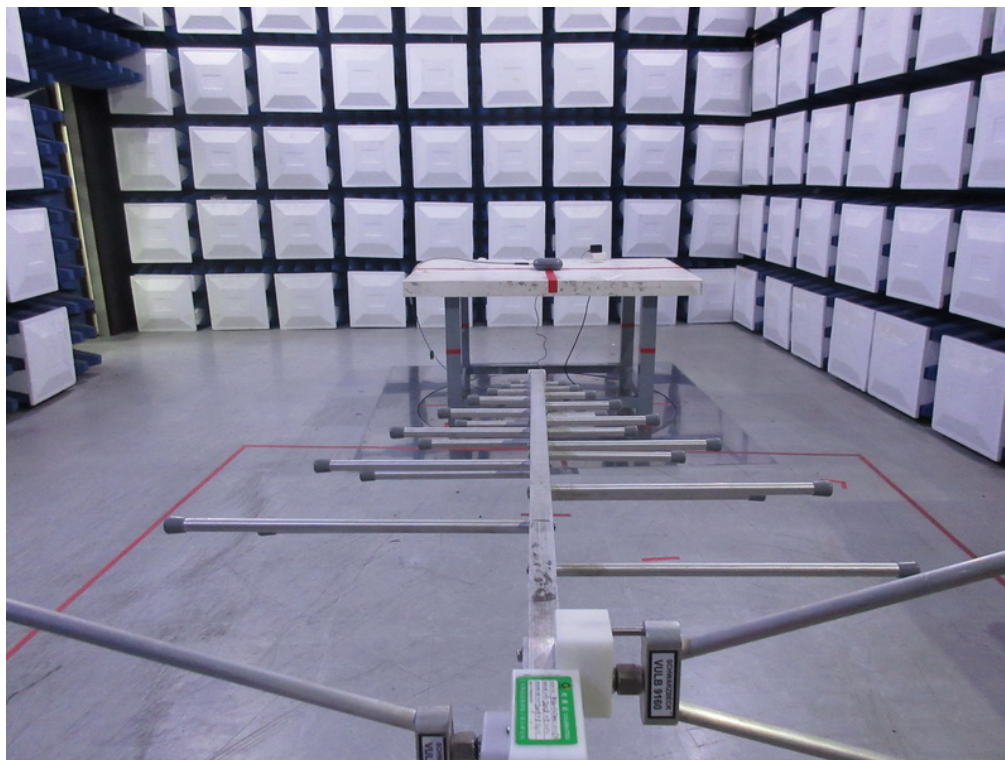
Radiated Measurement Photos

9KHz to 30MHz



Radiated Measurement Photos

30MHz to 1000MHz



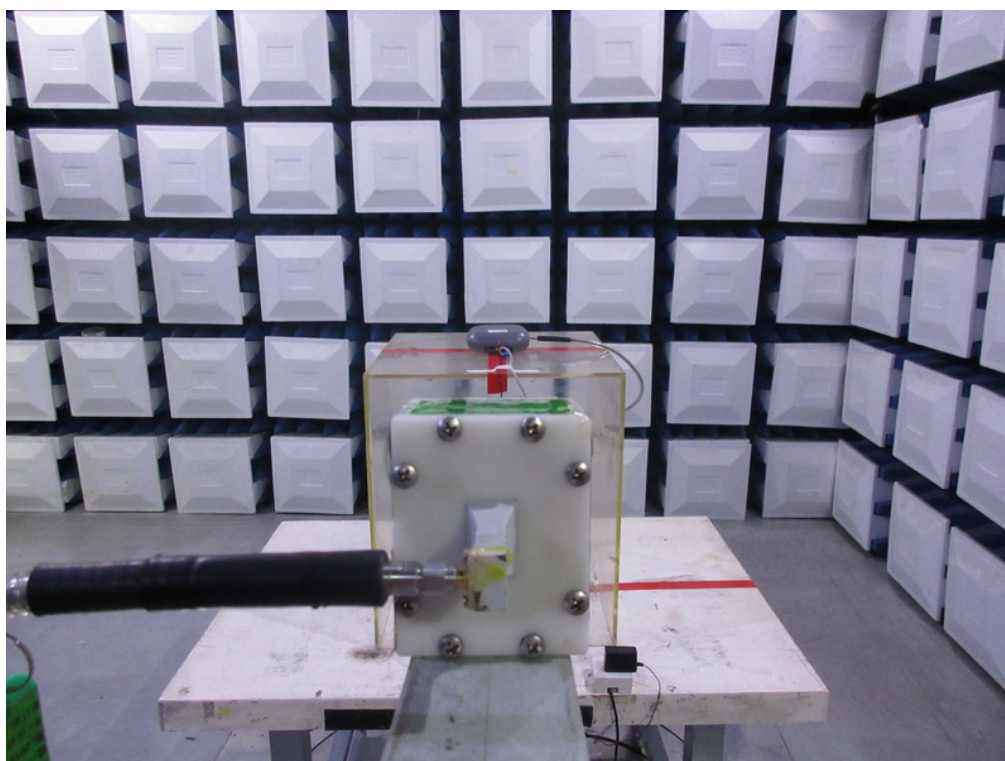
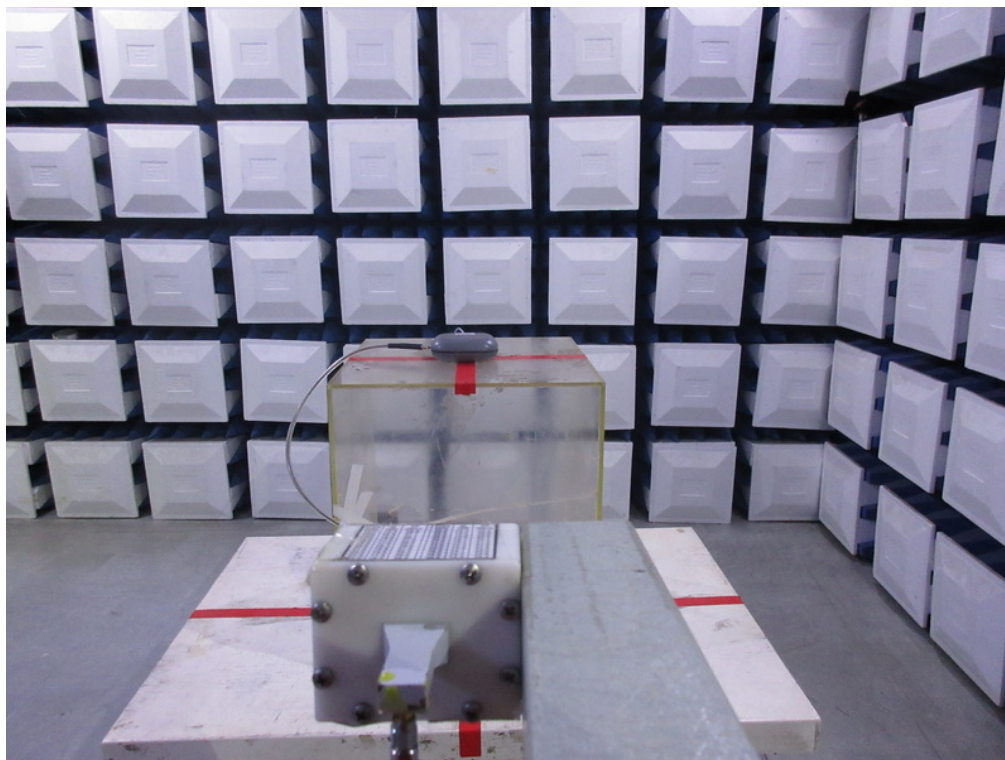
Radiated Measurement Photos

1GHz to 18GHz



Radiated Measurement Photos

Above 18GHz



APPENDIX A - OUTPUT POWER

Conducted Output Power: For ANT 1

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39675 CH	40620 CH	41565 CH
			2498.5MHz	2593.0MHz	2687.5MHz
41 / 5M	QPSK	Full RB	17.47	17.04	17.24
	16QAM	Full RB	16.46	16.84	16.73
	64QAM	Full RB	15.88	15.39	15.53

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39675 CH	40620 CH	41565 CH
			2498.5MHz	2593.0MHz	2687.5MHz
41 / 5M	QPSK	Full RB	17.42	17.84	17.10
	16QAM	Full RB	16.97	16.57	17.71
	64QAM	Full RB	16.42	16.23	16.48

For ANT 1+ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39675 CH	40620 CH	41565 CH
			2498.5MHz	2593.0MHz	2687.5MHz
41 / 5M	QPSK	Full RB	22.15	22.17	21.88
	16QAM	Full RB	21.43	21.41	21.95
	64QAM	Full RB	20.87	20.54	20.74

For ANT 1

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39700 CH	40620 CH	41540 CH
			2501.0MHz	2593.0MHz	2685.0MHz
41 / 10M	QPSK	Full RB	16.41	17.14	16.00
	16QAM	Full RB	15.74	15.85	15.86
	64QAM	Full RB	14.22	14.24	14.32

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39700 CH	40620 CH	41540 CH
			2501.0MHz	2593.0MHz	2685.0MHz
41 / 10M	QPSK	Full RB	16.12	16.02	16.31
	16QAM	Full RB	16.12	16.31	16.08
	64QAM	Full RB	14.32	14.41	14.46

For ANT 1+ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39700 CH	40620 CH	41540 CH
			2501.0MHz	2593.0MHz	2685.0MHz
41 / 10M	QPSK	Full RB	20.97	21.32	20.86
	16QAM	Full RB	20.64	20.79	20.68
	64QAM	Full RB	18.98	19.03	19.10

For ANT 1

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39725 CH	40620 CH	41515 CH
			2503.5MHz	2593.0MHz	2682.5MHz
41 / 15M	QPSK	Full RB	16.64	16.13	16.58
	16QAM	Full RB	16.43	16.31	16.17
	64QAM	Full RB	14.16	14.21	14.26

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39725 CH	40620 CH	41515 CH
			2503.5MHz	2593.0MHz	2682.5MHz
41 / 15M	QPSK	Full RB	16.79	16.63	16.80
	16QAM	Full RB	15.78	16.01	16.36
	64QAM	Full RB	14.49	14.49	14.49

For ANT 1+ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39725 CH	40620 CH	41515 CH
			2503.5MHz	2593.0MHz	2682.5MHz
41 / 15M	QPSK	Full RB	21.42	21.09	21.40
	16QAM	Full RB	20.82	20.87	20.97
	64QAM	Full RB	19.22	19.13	19.08

For ANT 1

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39750 CH	40620 CH	41490 CH
			2506.0MHz	2593.0MHz	2680.0MHz
41 / 20M	QPSK	Full RB	16.60	16.02	16.60
	16QAM	Full RB	15.64	16.05	16.26
	64QAM	Full RB	14.35	14.84	14.33

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39750 CH	40620 CH	41490 CH
			2506.0MHz	2593.0MHz	2680.0MHz
41 / 20M	QPSK	Full RB	16.91	16.60	16.94
	16QAM	Full RB	15.78	15.98	16.05
	64QAM	Full RB	14.82	14.81	14.70

For ANT 1+ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39750 CH	40620 CH	41490 CH
			2506.0MHz	2593.0MHz	2680.0MHz
41 / 20M	QPSK	Full RB	21.46	21.03	21.48
	16QAM	Full RB	20.42	20.72	20.86
	64QAM	Full RB	19.30	19.53	19.23

**EIRP Power:
For ANT 1**

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39675 CH	40620 CH	41565 CH
			2498.5MHz	2593.0MHz	2687.5MHz
41 / 5M	QPSK	Full RB	23.88	23.45	23.65
	16QAM	Full RB	22.87	23.25	23.14
	64QAM	Full RB	22.29	21.80	21.94

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39675 CH	40620 CH	41565 CH
			2498.5MHz	2593.0MHz	2687.5MHz
41 / 5M	QPSK	Full RB	23.83	24.25	23.51
	16QAM	Full RB	23.38	22.98	24.12
	64QAM	Full RB	22.83	22.64	22.89

For ANT 1+ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39675 CH	40620 CH	41565 CH
			2498.5MHz	2593.0MHz	2687.5MHz
41 / 5M	QPSK	Full RB	28.56	28.58	28.29
	16QAM	Full RB	27.84	27.82	28.36
	64QAM	Full RB	27.28	26.95	27.15

For ANT 1

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39700 CH	40620 CH	41540 CH
			2501.0MHz	2593.0MHz	2685.0MHz
41 / 10M	QPSK	Full RB	22.82	23.55	22.41
	16QAM	Full RB	22.15	22.26	22.27
	64QAM	Full RB	20.63	20.65	20.73

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39700 CH	40620 CH	41540 CH
			2501.0MHz	2593.0MHz	2685.0MHz
41 / 10M	QPSK	Full RB	22.53	22.43	22.72
	16QAM	Full RB	22.53	22.72	22.49
	64QAM	Full RB	20.73	20.82	20.87

For ANT 1+ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39700 CH	40620 CH	41540 CH
			2501.0MHz	2593.0MHz	2685.0MHz
41 / 10M	QPSK	Full RB	27.38	27.73	27.27
	16QAM	Full RB	27.05	27.20	27.09
	64QAM	Full RB	25.39	25.44	25.51

For ANT 1

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39725 CH	40620 CH	41515 CH
			2503.5MHz	2593.0MHz	2682.5MHz
41 / 15M	QPSK	Full RB	23.05	22.54	22.99
	16QAM	Full RB	22.84	22.72	22.58
	64QAM	Full RB	20.57	20.62	20.67

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39725 CH	40620 CH	41515 CH
			2503.5MHz	2593.0MHz	2682.5MHz
41 / 15M	QPSK	Full RB	23.20	23.04	23.21
	16QAM	Full RB	22.19	22.42	22.77
	64QAM	Full RB	21.25	21.03	20.90

For ANT 1+ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39725 CH	40620 CH	41515 CH
			2503.5MHz	2593.0MHz	2682.5MHz
41 / 15M	QPSK	Full RB	27.83	27.50	27.81
	16QAM	Full RB	27.23	27.28	27.38
	64QAM	Full RB	25.63	25.54	25.49

For ANT 1

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39750 CH	40620 CH	41490 CH
			2506.0MHz	2593.0MHz	2680.0MHz
41 / 20M	QPSK	Full RB	23.01	22.43	23.01
	16QAM	Full RB	22.05	22.46	22.67
	64QAM	Full RB	20.76	21.25	20.74

For ANT 2

LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39750 CH	40620 CH	41490 CH
			2506.0MHz	2593.0MHz	2680.0MHz
41 / 20M	QPSK	Full RB	23.32	23.01	23.35
	16QAM	Full RB	22.19	22.39	22.46
	64QAM	Full RB	21.23	21.22	21.11

For ANT 1+ANT 2

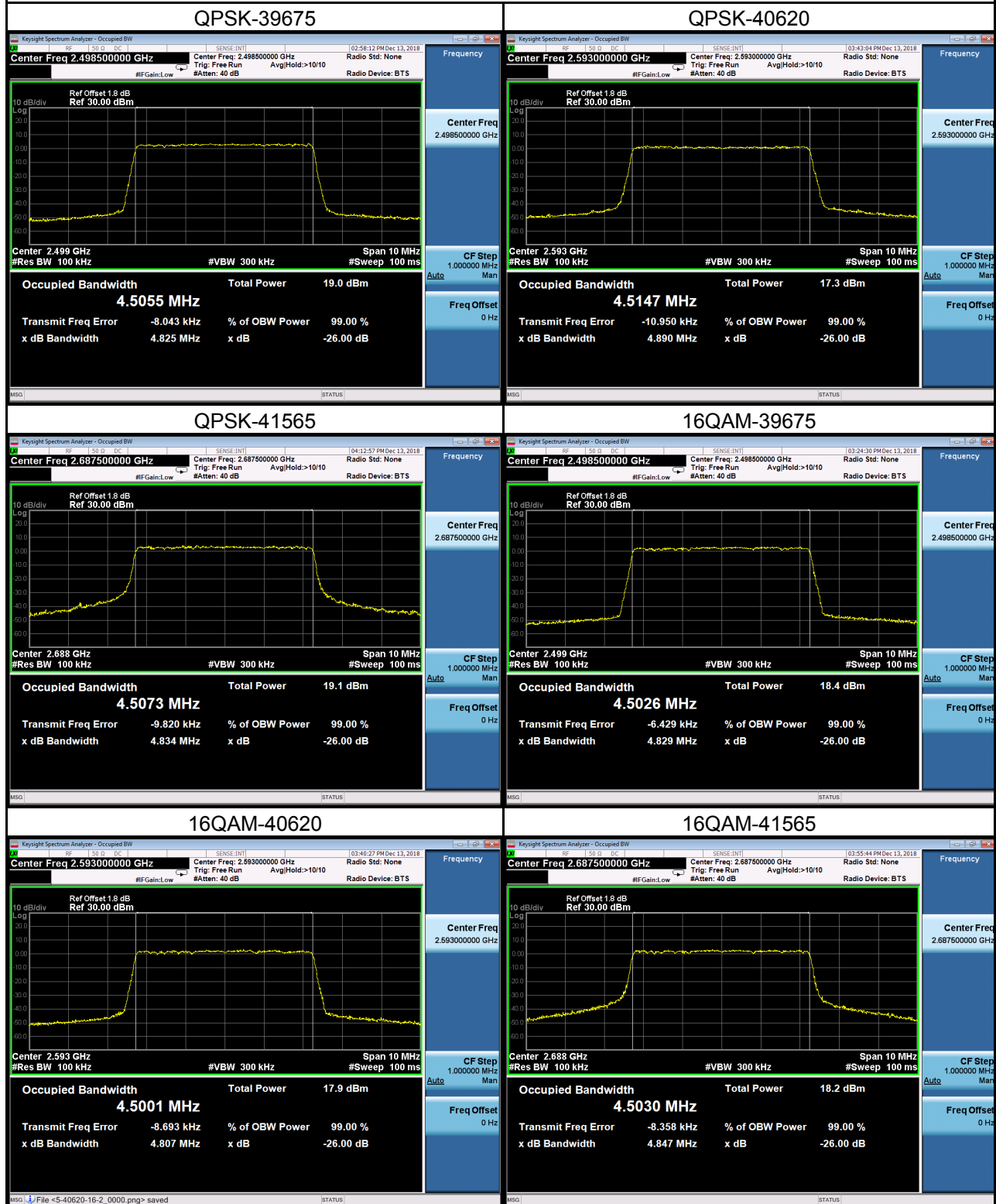
LTE Band / BW	Modulation	RB Size	Low CH	Mid CH	High CH
			39750 CH	40620 CH	41490 CH
			2506.0MHz	2593.0MHz	2680.0MHz
41 / 20M	QPSK	Full RB	27.87	27.44	27.89
	16QAM	Full RB	26.83	27.13	27.27
	64QAM	Full RB	25.71	25.94	25.64

APPENDIX B - OCCUPIED BANDWIDTH

For ANT 1

LTE Band 41_5M								
QPSK			16QAM			64QAM		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
39675	2498.5	4.5055	39675	2498.5	4.5026	39675	2498.5	4.5183
40620	2593.0	4.5147	40620	2593.0	4.5001	40620	2593.0	4.5123
41565	2687.5	4.5073	41565	2687.5	4.5030	41565	2687.5	4.5197
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
39675	2498.5	4.825	39675	2498.5	4.829	39675	2498.5	4.889
40620	2593.0	4.890	40620	2593.0	4.807	40620	2593.0	4.881
41565	2687.5	4.834	41565	2687.5	4.847	41565	2687.5	4.904

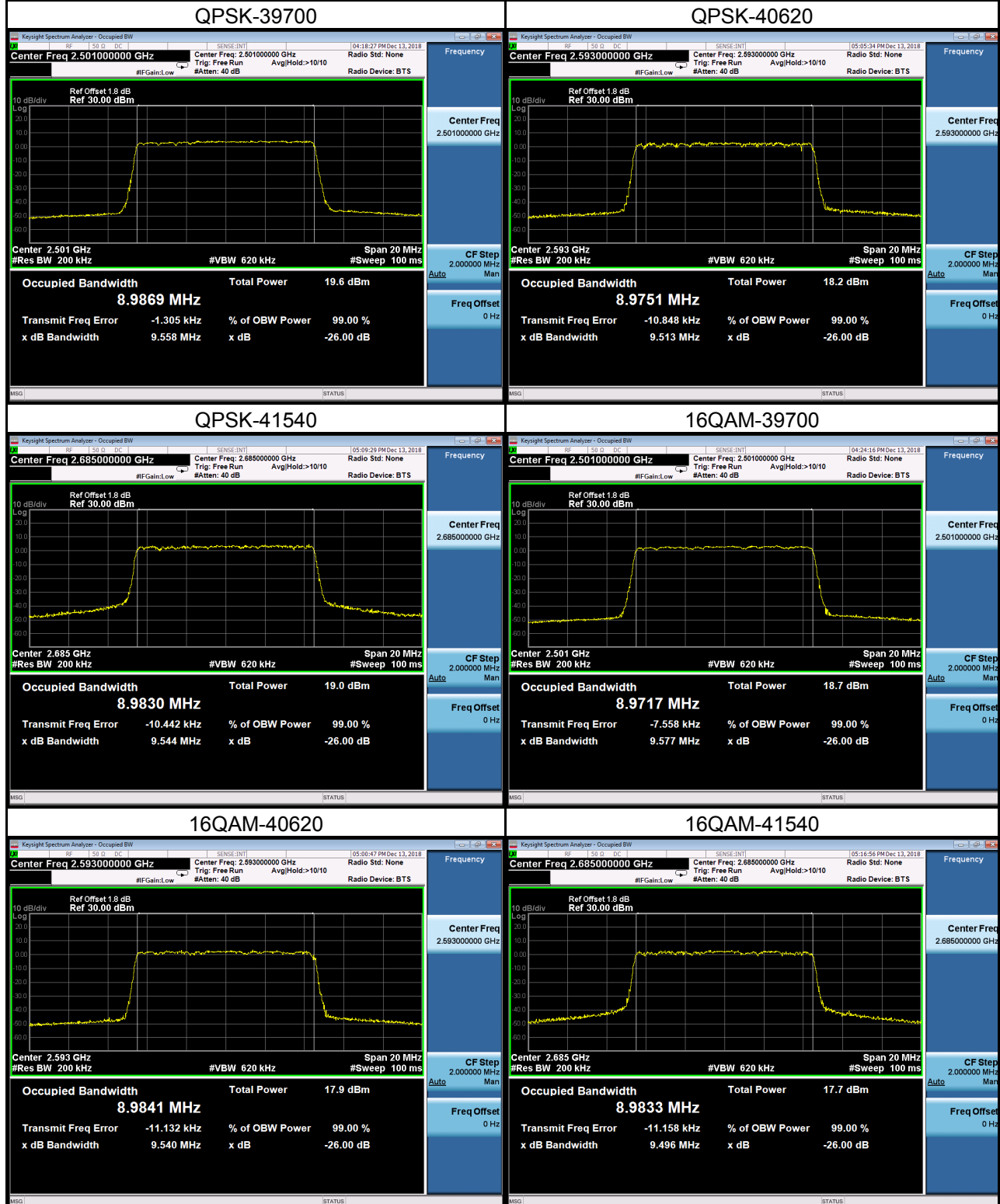
Spectrum Plot





LTE Band 41_10M								
QPSK			16QAM			64QAM		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
39700	2501.0	8.9869	39700	2501.0	8.9717	39700	2501.0	8.9773
40620	2593.0	8.9751	40620	2593.0	8.9841	40620	2593.0	8.9799
41540	2685.0	8.9830	41540	2685.0	8.9833	41540	2685.0	8.9839
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
39700	2501.0	9.558	39700	2501.0	9.577	39700	2501.0	9.658
40620	2593.0	9.513	40620	2593.0	9.540	40620	2593.0	9.616
41540	2685.0	9.544	41540	2685.0	9.496	41540	2685.0	9.685

Spectrum Plot

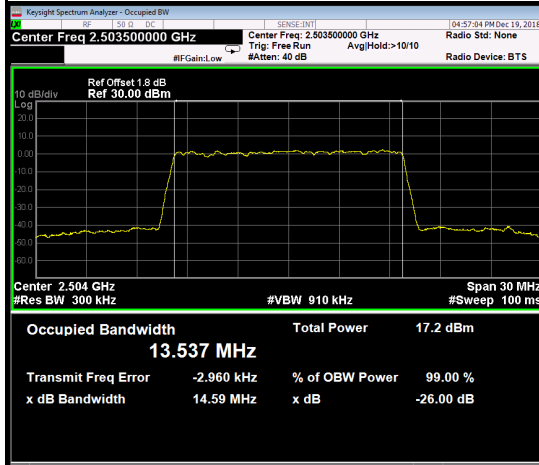




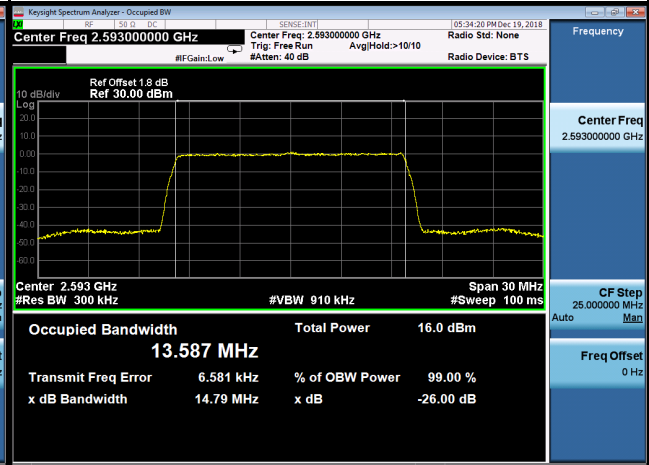
LTE Band 41_15M								
QPSK			16QAM			64QAM		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
39725	2503.5	13.537	39725	2503.5	13.520	39725	2503.5	13.562
40620	2593.0	13.587	40620	2593.0	13.526	40620	2593.0	13.574
41515	2682.5	13.532	41515	2682.5	13.528	41515	2682.5	13.582
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
39725	2503.5	14.59	39725	2503.5	14.63	39725	2503.5	14.78
40620	2593.0	14.79	40620	2593.0	14.67	40620	2593.0	14.78
41515	2682.5	14.54	41515	2682.5	14.67	41515	2682.5	14.81

Spectrum Plot

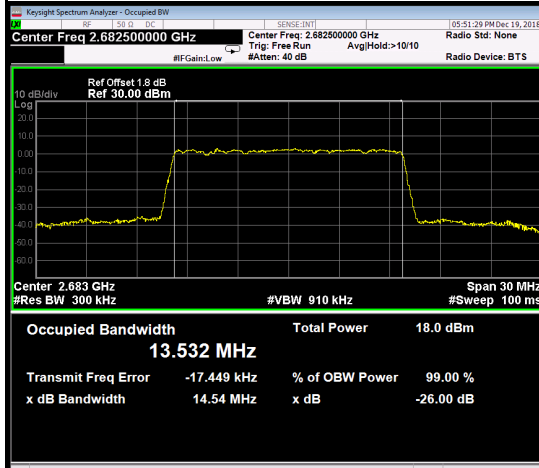
QPSK-39725



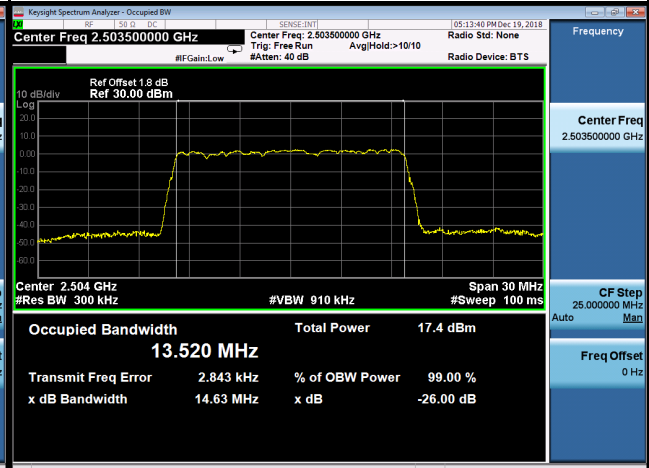
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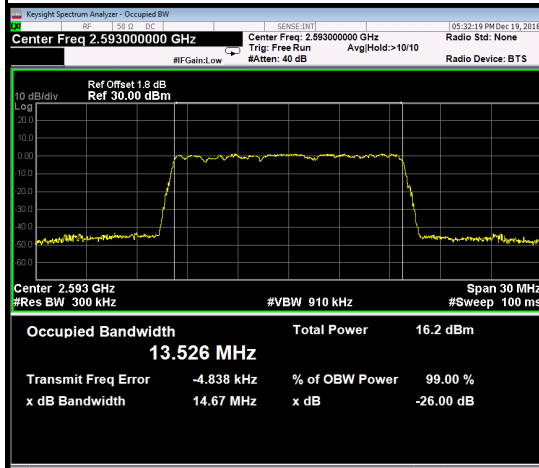
QPSK-41515



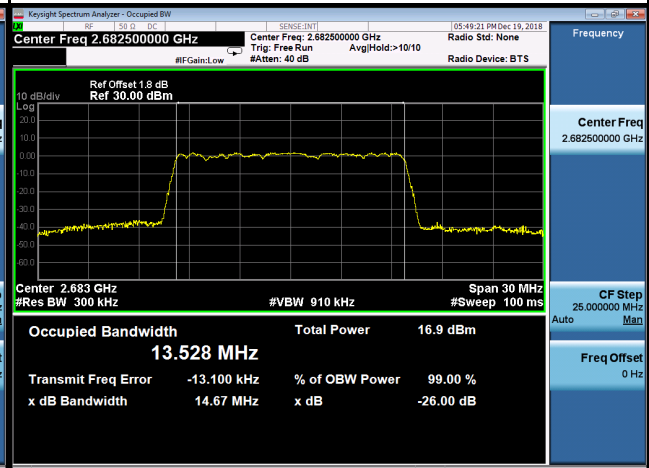
16QAM-39725

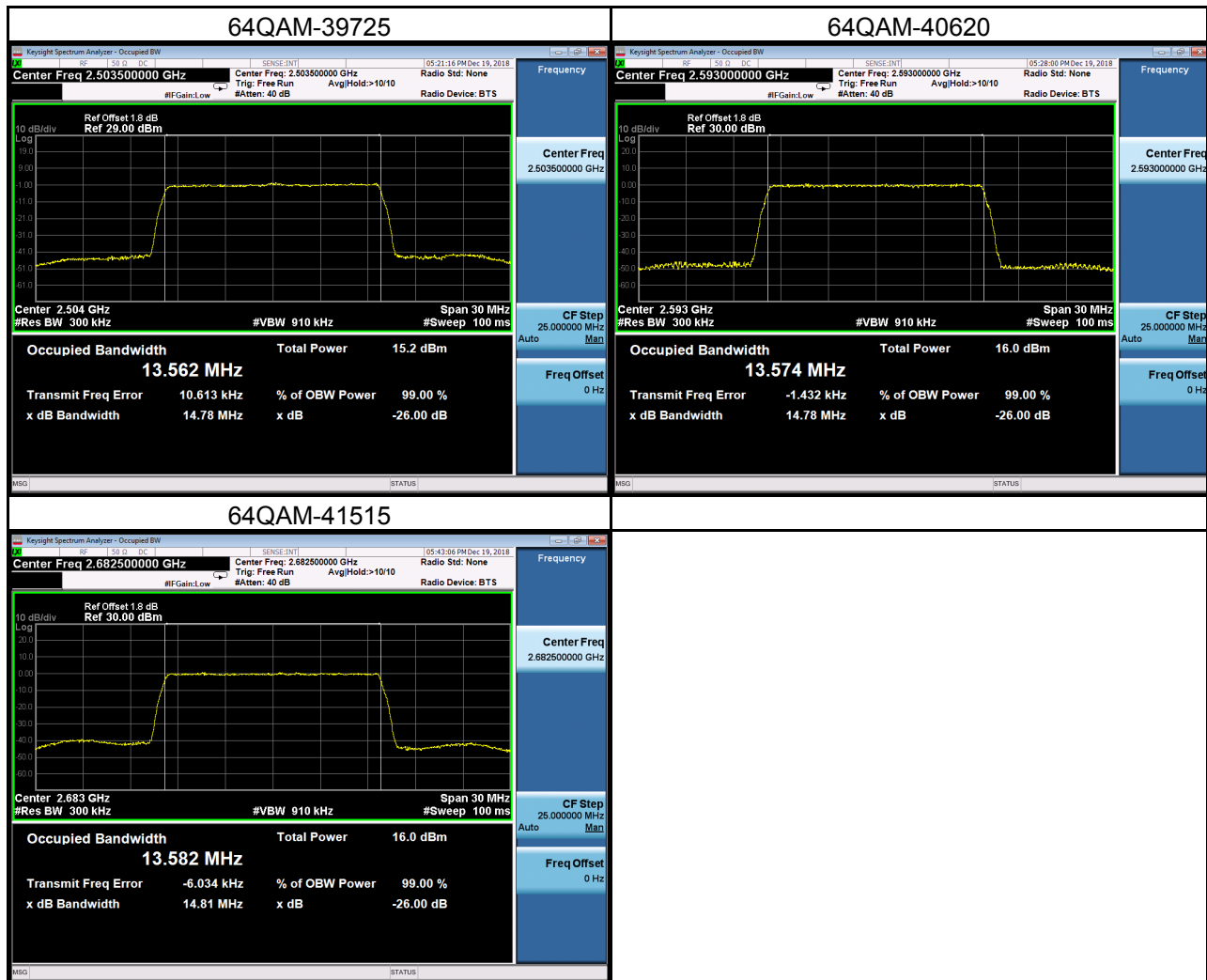


16QAM-40620



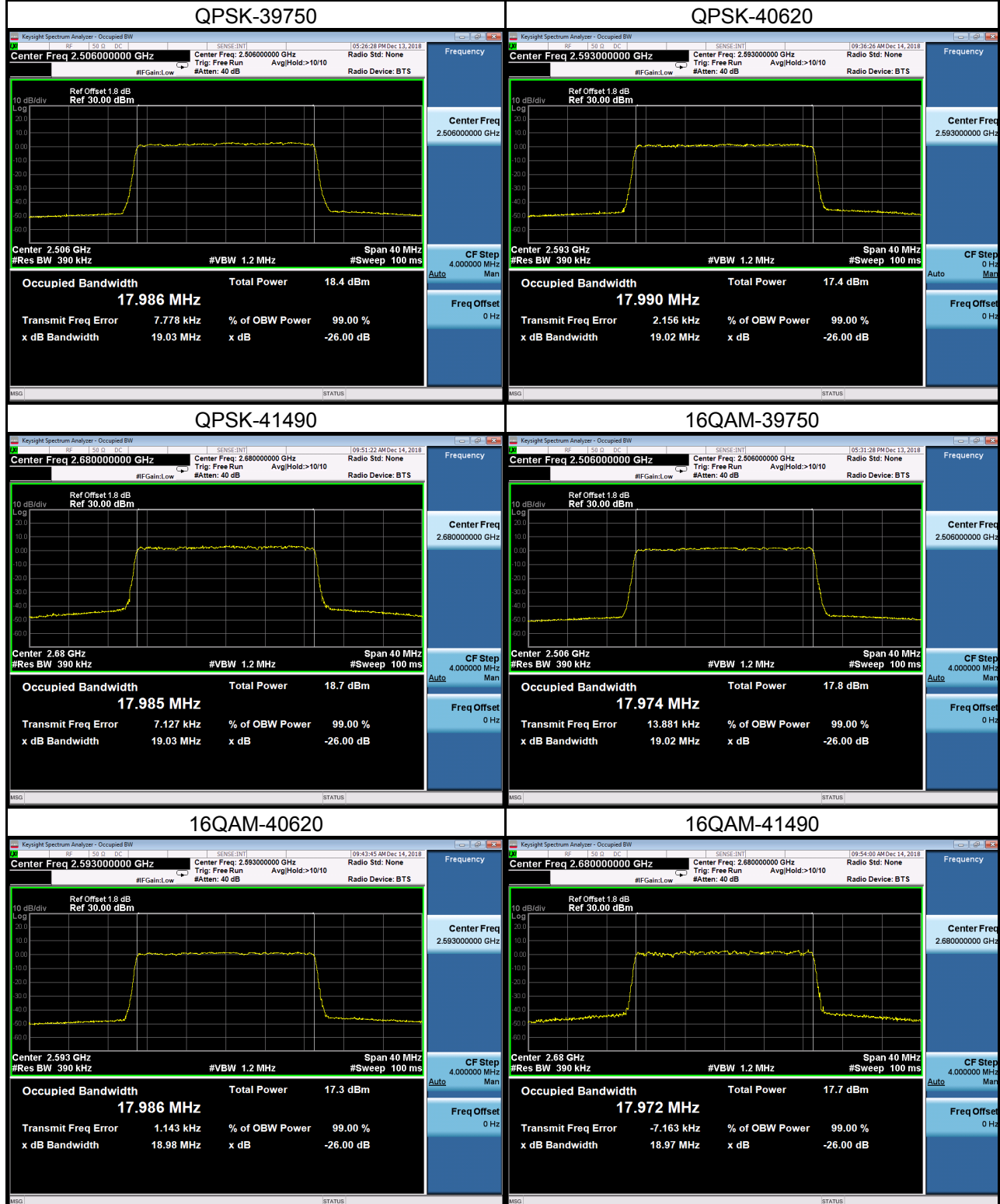
16QAM-41515





LTE Band 41_20M								
QPSK			16QAM			64QAM		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
39750	2506.0	17.986	39750	2506.0	17.974	39750	2506.0	17.946
40620	2593.0	17.990	40620	2593.0	17.986	40620	2593.0	17.956
41490	2680.0	17.985	41490	2680.0	17.972	41490	2680.0	17.952
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
39750	2506.0	19.03	39750	2506.0	19.02	39750	2506.0	19.07
40620	2593.0	19.02	40620	2593.0	18.98	40620	2593.0	19.14
41490	2680.0	19.03	41490	2680.0	18.97	41490	2680.0	19.16

Spectrum Plot



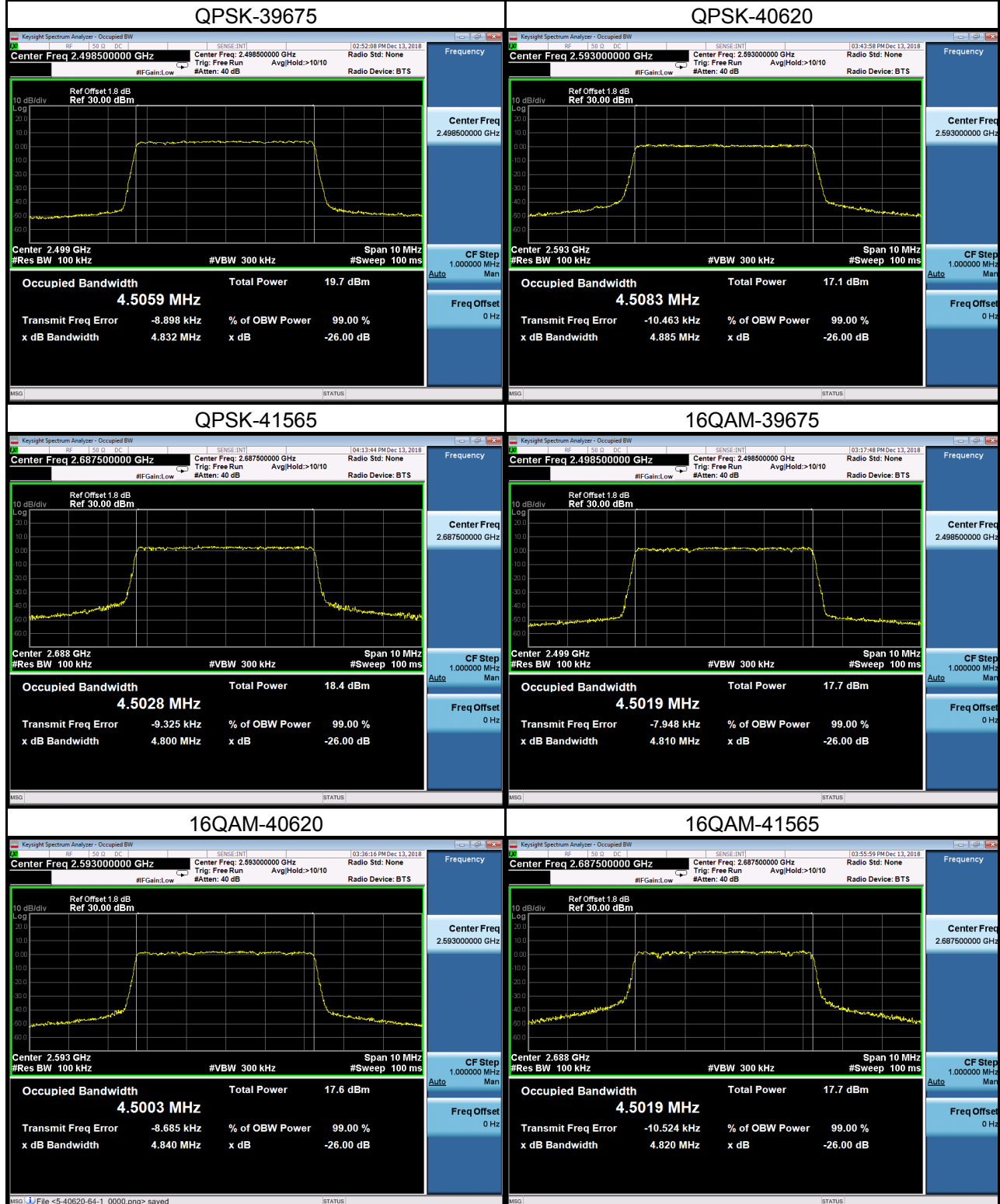


For ANT 2

LTE Band 41_5M

QPSK			16QAM			64QAM		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
39675	2498.5	4.5059	39675	2498.5	4.5019	39675	2498.5	4.5109
40620	2593.0	4.5083	40620	2593.0	4.5003	40620	2593.0	4.5037
41565	2687.5	4.5028	41565	2687.5	4.5019	41565	2687.5	4.5105
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
39675	2498.5	4.832	39675	2498.5	4.810	39675	2498.5	4.868
40620	2593.0	4.885	40620	2593.0	4.840	40620	2593.0	4.844
41565	2687.5	4.800	41565	2687.5	4.820	41565	2687.5	4.878

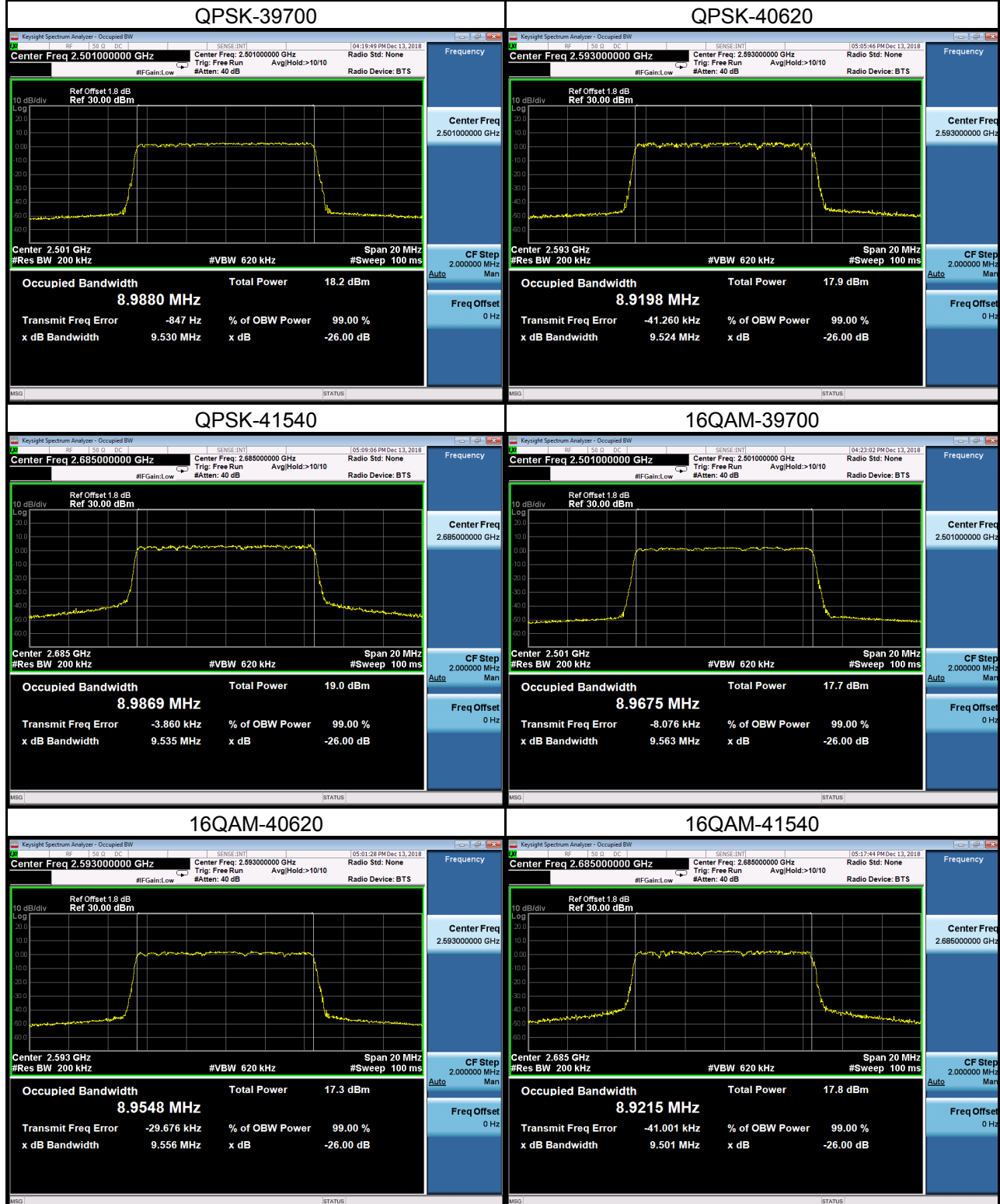
Spectrum Plot

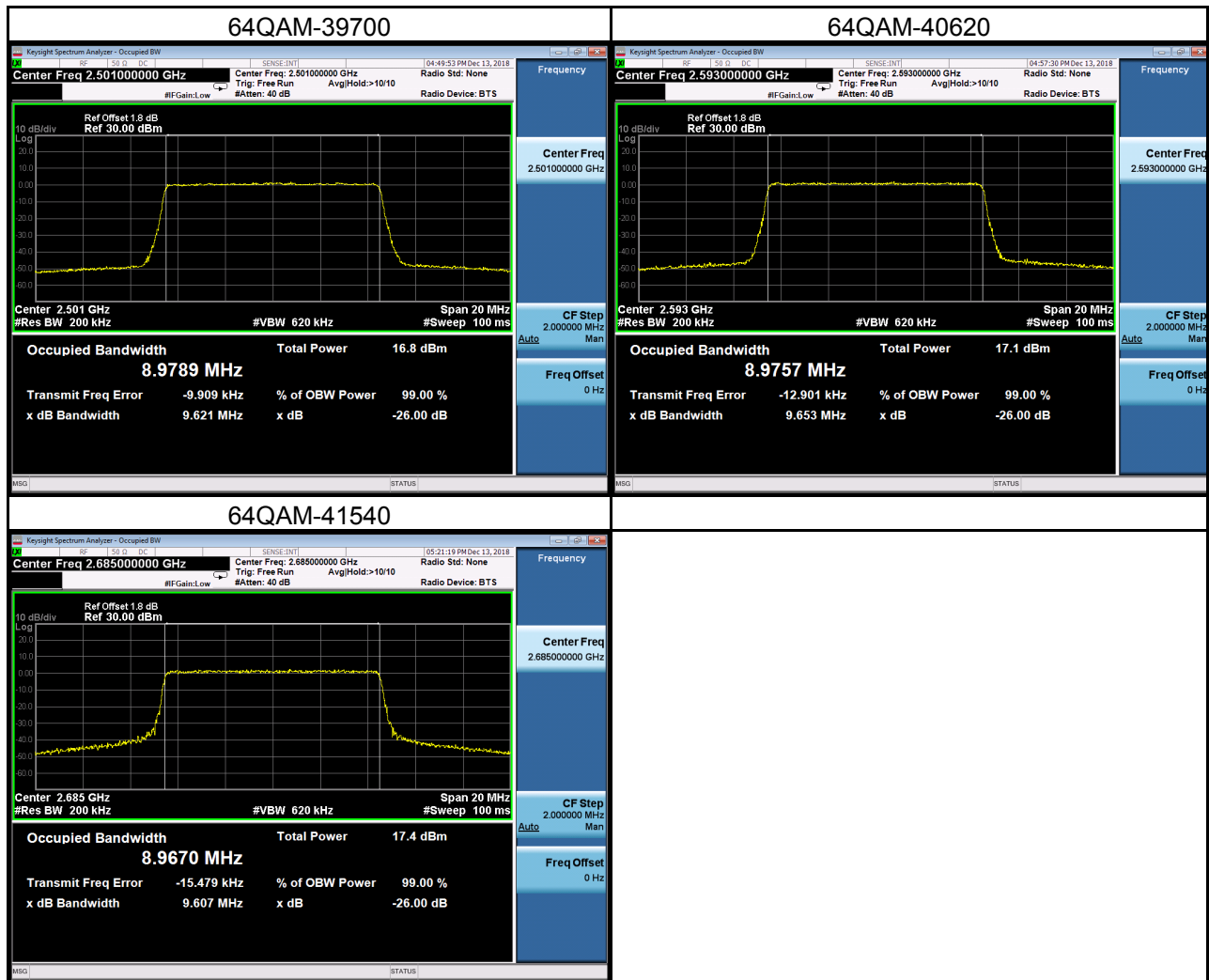




LTE Band 41_10M								
QPSK			16QAM			64QAM		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
39700	2501.0	8.9880	39700	2501.0	8.9675	39700	2501.0	8.9789
40620	2593.0	8.9198	40620	2593.0	8.9548	40620	2593.0	8.9757
41540	2685.0	8.9869	41540	2685.0	8.9215	41540	2685.0	8.9670
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
39700	2501.0	9.530	39700	2501.0	9.563	39700	2501.0	9.621
40620	2593.0	9.524	40620	2593.0	9.556	40620	2593.0	9.653
41540	2685.0	9.535	41540	2685.0	9.501	41540	2685.0	9.607

Spectrum Plot





LTE Band 41_15M								
QPSK			16QAM			64QAM		
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)	Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
39725	2503.5	13.534	39725	2503.5	13.526	39725	2503.5	13.582
40620	2593.0	13.581	40620	2593.0	13.520	40620	2593.0	13.593
41515	2682.5	13.530	41515	2682.5	13.533	41515	2682.5	13.581
Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
39725	2503.5	14.59	39725	2503.5	14.62	39725	2503.5	14.79
40620	2593.0	14.58	40620	2593.0	14.67	40620	2593.0	14.81
41515	2682.5	14.57	41515	2682.5	14.63	41515	2682.5	14.80