FCC TEST REPORT

(PART 22)

Applicant:	Particle Industries, Inc
Address:	126 Post St,4th floor, San Francisco, CA 94108 USA

Manufacturer or Supplier:	Particle Industries, Inc
Address:	126 Post St,4th floor, San Francisco, CA 94108 USA
Product:	Electron
Brand Name:	Particle
Model Name:	ELC402, ELC404
FCC ID:	XPY2AGQN4NNN
Date of tests:	Oct. 17, 2019 ~ Nov. 28, 2019

The tests have been carried out according to the requirements of the following standard:

☒ **FCC PART 22, Subpart H** ☒ **FCC Part 2**
☒ **ANSI/TIA/EIA-603-D** ☒ **ANSI C63.26-2015**
☒ **ANSI/TIA/EIA-603-E**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Remark：This test report is for internal customer use only, not as a final certification test report.

Prepared by Alex Chen Engineer / Mobile Department	Approved by Luke Lu Manager / Mobile Department
Alex Date: Dec. 23, 2020	Luke Lu Date: Dec. 23, 2020

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF191017W004-1	Original release, This test report is for internal customer use only, not as a final certification test report.	Nov. 29, 2019
RFP20120029-1	Based on the original product add one model name, changed product name. In this report, All test data is copied from the original test report RF191017W004-1.	Dec. 23, 2020

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 22 & Part 2		
STANDARD SECTION	**TEST TYPE**	**RESULT**
2.1046 22.913 (a)	Effective Radiated Power	Compliance
2.1055 22.355	Frequency Stability	Compliance
2.1049 22.917 (b)	Occupied Bandwidth	Compliance
22.913 (d)	Peak to average ratio*	Compliance
22.917	Band Edge Measurements	Compliance
2.1051 22.917	Conducted Spurious Emissions	Compliance
2.1053 22.917	Radiated Spurious Emissions	Compliance

* Refer to KDB 971168 D01 Power Meas License Digital Systems v03r01.

1.1 MEASUREMENT UNCERTAINTY

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

MEASUREMENT	UNCERTAINTY
Maximum Peak Output Power	±2.06dB
Frequency Stability	±76.97Hz
Radiated emissions (30MHz~1GMHz)	±4.98dB
Radiated emissions (1GMHz ~6GMHz)	±4.70dB
Radiated emissions (6GMHz ~18GMHz)	±4.60dB
Radiated emissions (18GMHz ~40GMHz)	±4.12dB
Conducted emissions	±4.01dB
Occupied Channel Bandwidth	±43.58KHz
Band Edge Measurements	±4.70dB
Peak to average ratio	±0.76dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.2 TEST SITE AND INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Feb. 26,19	Feb. 25,20
EXA Signal Analyzer	KEYSIGHT	N9010A-526	MY54510322	Feb. 26,19	Feb. 25,20
Bilog Antenna	ETS-LINDGREN	3143B	00161965	Feb. 26,19	Feb. 25,20
Horn Antenna (1GHz-18GHz)	ETS-LINDGREN	3117	00168692	Nov. 24, 19	Nov. 23, 20
Horn Antenna (18GHz-40GHz)	N/A	QWH-SL-18-40-K-SG/QMS-00361	15433	Nov. 24, 19	Nov. 23, 20
Radio Communication Analyzer	ANRITSU	MT8820C	6201465426	Feb. 26,19	Feb. 25,20
Signal Pre-Amplifier	EMSI	EMC 9135	980249	Jul. 08,19	Jul. 09,20
Signal Pre-Amplifier	EMSI	EMC 012645B	980257	Jul. 08,19	Jul. 09,20
Signal Pre-Amplifier	EMSI	EMC 184045B	980259	Jul. 08,19	Jul. 09,20
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-CT0001143-1216	Feb. 26,19	Feb. 25,20
Test Software	E3	V 9.160323	N/A	N/A	N/A
Test Software	ADT	ADT_Radiated_V7.6.15.9.2	N/A	N/A	N/A
10dB Attenuator	JFW/USA	50HF-010-SMA	1505	Jul. 08,19	Jul. 09,20
Power Meter	Anritsu	ML2495A	1506002	Feb. 26,19	Feb. 25,20
Power Sensor	Anritsu	MA2411B	1339352	Feb. 26,19	Feb. 25,20
Humid & Temp Programmable Tester	Juyi	ITH-120-45-CP-AR	IAA1504-001	Jul. 08,19	Jul. 09,20
MXG Analog Microvave Signal Generator	KEYSIGHT	N5183A	MY50143024	Feb. 26,19	Feb. 25,20
Power Divider	MCLI/USA	PS2-15	24880	Jul. 09,19	Jul. 08,20

NOTE: 1. The calibration interval of the above test instruments is 12 months or 24 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

2. The test was performed in 3m Semi-anechoic Chamber and RF Oven Room.

3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.

4. The FCC Site Registration No. is 525120; The Designation No. is CN1171.

2 GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

EUT	Electron	
BRAND NAME	Particle	
MODEL NAME	ELC402, ELC404	
POWER SUPPLY	DC 5V from Host Uint or DC3.7V from Li-ion battery Vnor=3.7V,Vmin=3.145V,Vmax=4.255V	
MODULATION TYPE	**LTE:** QPSK	
LTE CATEGORY	**M1**	
FREQUENCY RANGE	**LTE Band 5 (Channel Bandwidth: 1.4MHz)**	824.7MHz ~ 848.3MHz
	LTE Band 5 (Channel Bandwidth: 3MHz)	825.5MHz ~ 847.5MHz
	LTE Band 5 (Channel Bandwidth: 5MHz)	826.5MHz ~ 846.5MHz
	LTE Band 5 (Channel Bandwidth: 10MHz)	829MHz ~ 844MHz
MAX. ERP POWER	**LTE Band 5 (Channel Bandwidth: 1.4MHz)**	168mW
	LTE Band 5 (Channel Bandwidth: 3MHz)	170mW
	LTE Band 5 (Channel Bandwidth: 5MHz)	172mW
	LTE Band 5 (Channel Bandwidth: 10MHz)	173mW
EMISSION DESIGNATOR	**LTE Band 5 (Channel Bandwidth: 1.4MHz)**	QPSK: 1M11G7D
	LTE Band 5 (Channel Bandwidth: 3MHz)	QPSK: 1M27G7D
	LTE Band 5 (Channel Bandwidth: 5MHz)	QPSK: 1M09G7D
	LTE Band 5 (Channel Bandwidth: 10MHz)	QPSK: 1M09G7D
ANTENNA TYPE	Fixed External Antenna with 1.42dBi gain	
HW VERSION	V007	
SW VERSION	V1.4.0	
I/O PORTS	Refer to user's manual	

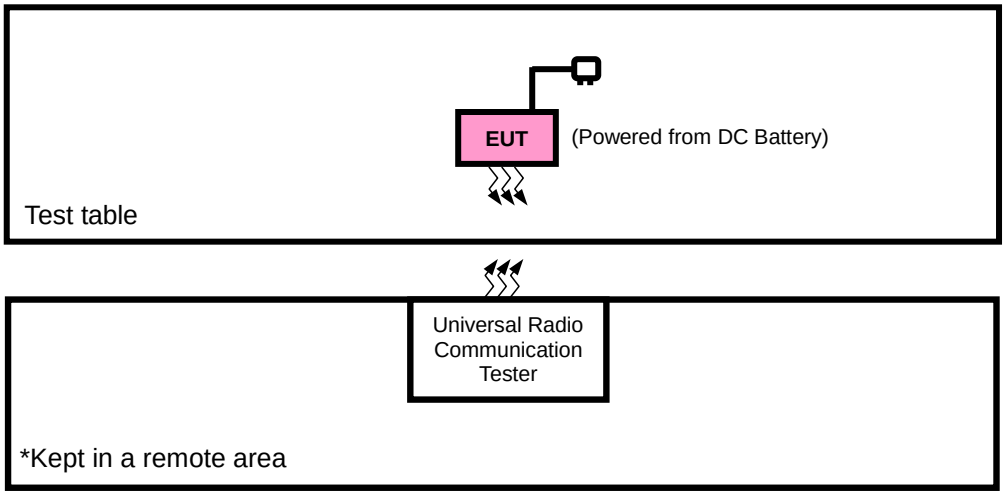
NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. The schematic and PCB of the ELC404 is completely the same with ELC402, and these two models of HW&SW is the same. Because changing the MVNO's E-SIM card（embedded SIM card）provider from Kore to Twilio, so we plan to use different model name to sell it in market. The differences are as follows:ELC402 uses eSIM of Kore.ELC404 uses eSIM of Twilio.
3. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
4. The EUT incorporates a SISO function. Physically, the EUT provides one completed transmitter and one receiver.

MODULATION MODE	TX FUNCTION
LTE	1TX/1RX

2.2 CONFIGURATION OF SYSTEM UNDER TEST

FOR RADIATION EMISSION



2.3 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.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Battery	N/A	N/A	N/A	N/A
2	DC source	LONG WEI	PS-6403D	010934269	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A
2	DC Line: Unshielded, Detachable 1.0m

2.4 TEST ITEM AND TEST CONFIGURATION

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 in radiated emission was found when positioned on X-plane for LTE. Following channel(s) was (were) selected for the final test as listed below:

EUT CONFIGURE MODE	DESCRIPTION
-	**EUT + Battery with or LTE link**

LTE BAND 5 MODE

TEST ITEM	Available Channel	Tested Channel	Channel bandwidth	modulation	mode
ERP	20407 to 20643	20407, 20525, 20643	1.4MHz	QPSK	1 RB / 0 RB Offset
	20415 to 20635	20415, 20525, 20635	3MHz	QPSK	1 RB / 0 RB Offset
	20425 to 20625	20425, 20525, 20625	5MHz	QPSK	1 RB / 0 RB Offset
	20450 to 20600	20450, 20525, 20600	10MHz	QPSK	1 RB / 0 RB Offset
FREQUENCY STABILITY	20407 to 20643	20407, 20643	1.4MHz	QPSK	1 RB / 0 RB Offset
	20415 to 20635	20415, 20635	3MHz	QPSK	1 RB / 0 RB Offset
	20425 to 20625	20425, 20625	5MHz	QPSK	1 RB / 0 RB Offset
	20450 to 20600	20450, 20600	10MHz	QPSK	1 RB / 0 RB Offset
OCCUPIED BANDWIDTH	20407 to 20643	20407, 20525, 20643	1.4MHz	QPSK	6 RB / 0 RB Offset
	20415 to 20635	20415, 20525, 20635	3MHz	QPSK	6 RB / 0 RB Offset
	20425 to 20625	20425, 20525, 20625	5MHz	QPSK	6 RB / 0 RB Offset
	20450 to 20600	20450, 20525, 20600	10MHz	QPSK	6 RB / 0 RB Offset
BAND EDGE	20407 to 20643	20407	1.4 MHz	QPSK	1 RB / 0 RB Offset
					6 RB / 0 RB Offset
	20407 to 20643	20643	1.4 MHz	QPSK	1 RB / 5 RB Offset
					6 RB / 0 RB Offset
	20415 to 20635	20415	3 MHz	QPSK	1 RB / 0 RB Offset
					6 RB / 0 RB Offset
	20415 to 20635	20635	3 MHz	QPSK	1 RB / 5 RB Offset
					6 RB / 0 RB Offset
	20425 to 20625	20425	5MHz	QPSK	1 RB / 0 RB Offset
					6 RB / 0 RB Offset
	20425 to 20625	20625	5MHz	QPSK	1 RB / 5 RB Offset
					6 RB / 0 RB Offset
	20450 to 20600	20450	10MHz	QPSK	1 RB / 0 RB Offset
					6 RB / 0 RB Offset
	20450 to 20600	20600	10MHz	QPSK	1 RB / 5 RB Offset
					6 RB / 0 RB Offset

CONDCUDETED EMISSION	20407 to 20643	20407, 20525, 20643	1.4MHz	QPSK	1 RB / 0 RB Offset
	20415 to 20635	20415, 20525, 20635	3MHz	QPSK	1 RB / 0 RB Offset
	20425 to 20625	20425, 20525, 20625	5MHz	QPSK	1 RB / 0 RB Offset
	20450 to 20600	20450, 20525, 20600	10MHz	QPSK	1 RB / 0 RB Offset
RADIATED EMISSION	20407 to 20643	20407, 20525, 20643	1.4MHz	QPSK	1 RB / 0 RB Offset
	20415 to 20635	20525	3MHz	QPSK	1 RB / 0 RB Offset
	20425 to 20625	20525	5MHz	QPSK	1 RB / 0 RB Offset
	20450 to 20600	20525	10MHz	QPSK	1 RB / 0 RB Offset
PEAK TO AVERAGE RATIO	20407 to 20643	20407, 20525, 20643	1.4MHz	QPSK	1 RB / 0 RB Offset
	20415 to 20635	20415, 20525, 20635	3MHz	QPSK	1 RB / 0 RB Offset
	20425 to 20625	20425, 20525, 20625	5MHz	QPSK	1 RB / 0 RB Offset
	20450 to 20600	20450, 20525, 20600	10MHz	QPSK	1 RB / 0 RB Offset

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

TEST ITEM	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
ERP	23deg. C, 70%RH	DC 3.7V by battery	Allen
FREQUENCY STABILITY	23deg. C, 70%RH	DC 3.7V/3.145/4.255 by DC source	Big Wang
OCCUPIED BANDWIDTH	23deg. C, 70%RH	DC 3.7V by battery	Big Wang
BAND EDGE	23deg. C, 70%RH	DC 3.7V by battery	Big Wang
CONDCUDETED EMISSION	23deg. C, 70%RH	DC 3.7V by battery	Big Wang
RADIATED EMISSION	23deg. C, 70%RH	DC 3.7V by battery	Allen
PEAK TO AVERAGE RATIO	23deg. C, 70%RH	DC 3.7V by battery	Big Wang

2.5 EUT OPERATING CONDITIONS

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

2.6 GENERAL DESCRIPTION OF APPLIED STANDARDS

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

FCC 47 CFR Part 2

FCC 47 CFR Part 22

KDB 971168 D01 Power Meas License Digital Systems v03r01

ANSI/TIA/EIA-603-D

ANSI/TIA/EIA-603-E

ANSI C63.26-2015

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

3 TEST TYPES AND RESULTS

3.1 OUTPUT POWER MEASUREMENT

3.1.1 LIMITS OF OUTPUT POWER MEASUREMENT

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

3.1.2 TEST PROCEDURES

EIRP / ERP MEASUREMENT:

Per KDB 971168 D01 Power Meas License Digital Systems v03r01 or subclause 5.2.5.5 of ANSI C63.26-2015, the relevant equation for determing the ERP or EIRP from the conducted RF output power measured using the guidance provided above is:

ERP or EIRP = $P_{Meas} + G_T – L_C$

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.

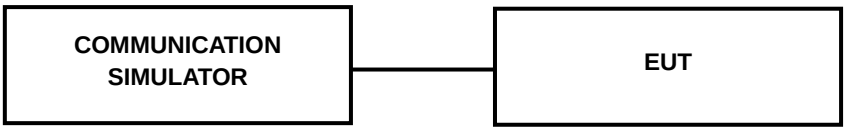
ERP=EIRP-2.15

CONDUCTED POWER MEASUREMENT:

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

3.1.3 TEST SETUP

CONDUCTED POWER MEASUREMENT:



3.1.4 TEST RESULTS

CONDUCTED OUTPUT POWER (dBm)

LTE Band 5

Band/BW	Modulation	RB Size	RB Offset	Low CH 20407	Mid CH 20525	High CH 20643	3GPP MPR (dB)
				Frequency 824.7 MHz	Frequency 836.5 MHz	Frequency 848.3 MHz	
5/1.4	QPSK	1	0	22.90	22.93	22.80	0
		1	5	22.93	22.89	22.88	0
		3	0	22.88	22.99	22.91	0
		3	3	22.88	22.91	22.78	0
		6	0	22.91	22.87	22.86	0

Band/BW	Modulation	RB Size	RB Offset	Low CH 20415	Mid CH 20525	High CH 20635	3GPP MPR (dB)
				Frequency 825.5 MHz	Frequency 836.5 MHz	Frequency 847.5 MHz	
5/3	QPSK	1	0	22.94	22.97	22.84	0
		1	5	22.97	22.93	22.92	0
		3	0	22.92	23.03	22.95	0
		3	3	22.97	22.96	22.99	1
		6	0	22.63	22.69	22.66	1

Band/BW	Modulation	RB Size	RB Offset	Low CH 20425	Mid CH 20525	High CH 20625	3GPP MPR (dB)
				Frequency 826.5 MHz	Frequency 836.5 MHz	Frequency 846.5 MHz	
5/5	QPSK	1	0	23.00	23.03	22.90	0
		1	5	23.03	22.99	22.98	0
		3	0	22.98	23.09	23.01	0
		3	3	23.03	23.02	23.05	1
		6	0	22.69	22.75	22.72	1

Band/BW	Modulation	RB Size	RB Offset	Low CH 20450	Mid CH 20525	High CH 20600	3GPP MPR (dB)
				Frequency 829 MHz	Frequency 836.5 MHz	Frequency 844 MHz	
5/10	QPSK	1	0	23.03	23.06	22.93	0
		1	5	23.06	23.02	23.01	0
		3	0	23.01	**23.12**	23.04	0
		3	3	23.06	23.05	23.08	1
		6	0	22.72	22.78	22.75	1

ERP POWER (dBm)

LTE BAND 5

CHANNEL BANDWIDTH: 1.4MHz QPSK

Channel	Frequency (MHz)	Conducted Power (dBm)	G_T-L_C (dB)	ERP (dBm)	ERP (mW)	Limit (W)
20407	824.7	22.93	1.42	22.20	165.96	7
20525	836.5	22.99	1.42	22.26	**168.27**	7
20643	848.3	22.91	1.42	22.18	165.20	7

CHANNEL BANDWIDTH: 3MHz QPSK

Channel	Frequency (MHz)	Conducted Power (dBm)	G_T-L_C (dB)	ERP (dBm)	ERP (mW)	Limit (W)
20415	825.5	22.97	1.42	22.24	167.49	7
20525	836.5	23.03	1.42	22.30	**169.82**	7
20635	847.5	22.99	1.42	22.26	168.27	7

CHANNEL BANDWIDTH: 5MHz QPSK

Channel	Frequency (MHz)	Conducted Power (dBm)	G_T-L_C (dB)	ERP (dBm)	ERP (mW)	Limit (W)
20425	826.5	23.03	1.42	22.30	169.82	7
20525	836.5	23.09	1.42	22.36	**172.19**	7
20625	846.5	23.05	1.42	22.32	170.61	7

CHANNEL BANDWIDTH: 10MHz QPSK

Channel	Frequency (MHz)	Conducted Power (dBm)	G_T-L_C (dB)	ERP (dBm)	ERP (mW)	Limit (W)
20450	829.0	23.06	1.42	22.33	171.00	7
20525	836.5	23.12	1.42	22.39	**173.38**	7
20600	844.0	23.08	1.42	22.35	171.79	7

REMARKS: ERP Output Power (dBm) = EIRP (dBm) -2.15(dB).

3.2 FREQUENCY STABILITY MEASUREMENT

3.2.1 LIMITS OF FREQUENCY STABILIITY MEASUREMENT

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

3.2.2 TEST PROCEDURE

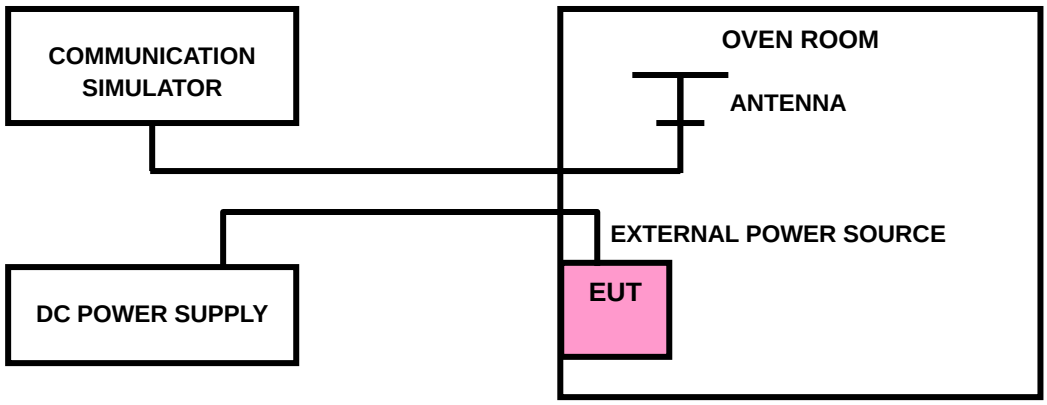
a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

b. EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.

c. The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ±0.5℃ 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.

3.2.3 TEST SETUP



3.2.4 TEST RESULTS

LTE Band 5

FREQUENCY ERROR VS. VOLTAGE

VOLTAGE (Volts)	1.4MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
V_{nor}	0.0022	0.0025	2.5
V_{min}	-0.0031	-0.0030	2.5
V_{max}	0.0021	0.0021	2.5

NOTE: The applicant defined the normal working voltage of the battery is V_{min} to V_{max}.

FREQUENCY ERROR vs. TEMPERATURE.

TEMP. (℃)	1.4MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
-30	-0.0113	-0.0111	2.5
-20	-0.0102	-0.0109	2.5
-10	-0.0084	-0.0079	2.5
0	-0.0074	-0.0072	2.5
10	-0.0047	-0.0044	2.5
20	-0.0040	-0.0042	2.5
30	-0.0033	-0.0026	2.5
40	-0.0021	-0.0021	2.5
50	-0.0002	-0.0002	2.5

FREQUENCY ERROR VS. VOLTAGE

VOLTAGE (Volts)	3MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
V_{nor}	0.0022	0.0021	2.5
V_{min}	-0.0021	-0.0025	2.5
V_{max}	0.0018	0.0017	2.5

NOTE: The applicant defined the normal working voltage of the battery is V_{min} to V_{max}.

FREQUENCY ERROR vs. TEMPERATURE.

TEMP. (℃)	3MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
-30	-0.0123	-0.0116	2.5
-20	-0.0112	-0.0098	2.5
-10	-0.0083	-0.0083	2.5
0	-0.0074	-0.0076	2.5
10	-0.0045	-0.0052	2.5
20	-0.0040	-0.0042	2.5
30	-0.0027	-0.0026	2.5
40	-0.0021	-0.0022	2.5
50	-0.0005	-0.0003	2.5

FREQUENCY ERROR VS. VOLTAGE

VOLTAGE (Volts)	5MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
V_{nor}	0.0021	0.0024	2.5
V_{min}	-0.0023	-0.0030	2.5
V_{max}	0.0021	0.0020	2.5

NOTE: The applicant defined the normal working voltage of the battery is from V_{min} to V_{max}.

FREQUENCY ERROR vs. TEMPERATURE.

TEMP. (℃)	5MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
-30	-0.0113	-0.0120	2.5
-20	-0.0100	-0.0098	2.5
-10	-0.0083	-0.0079	2.5
0	-0.0076	-0.0072	2.5
10	-0.0055	-0.0052	2.5
20	-0.0039	-0.0038	2.5
30	-0.0029	-0.0026	2.5
40	-0.0018	-0.0014	2.5
50	-0.0004	-0.0005	2.5

FREQUENCY ERROR VS. VOLTAGE

VOLTAGE (Volts)	10MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
V_{nor}	0.0024	0.0026	2.5
V_{min}	-0.0030	-0.0031	2.5
V_{max}	0.0025	0.0026	2.5

NOTE: The applicant defined the normal working voltage of the battery is from V_{min} to V_{max}.

FREQUENCY ERROR vs. TEMPERATURE.

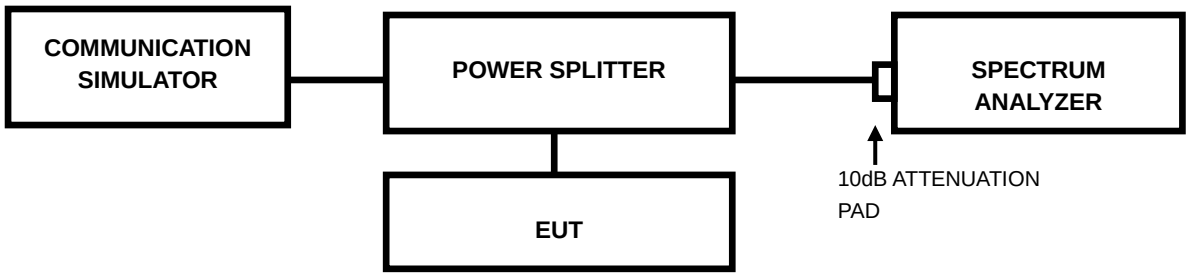
TEMP. (℃)	10MHz		LIMIT (ppm)
	FREQUENCY ERROR (ppm)		
	Low Channel	High Channel	
-30	-0.0114	-0.0114	2.5
-20	-0.0106	-0.0110	2.5
-10	-0.0086	-0.0079	2.5
0	-0.0077	-0.0074	2.5
10	-0.0055	-0.0045	2.5
20	-0.0039	-0.0043	2.5
30	-0.0037	-0.0035	2.5
40	-0.0021	-0.0017	2.5
50	-0.0002	-0.0002	2.5

3.3 OCCUPIED BANDWIDTH MEASUREMENT

3.3.1 TEST PROCEDURES

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.

3.3.2 TEST SETUP



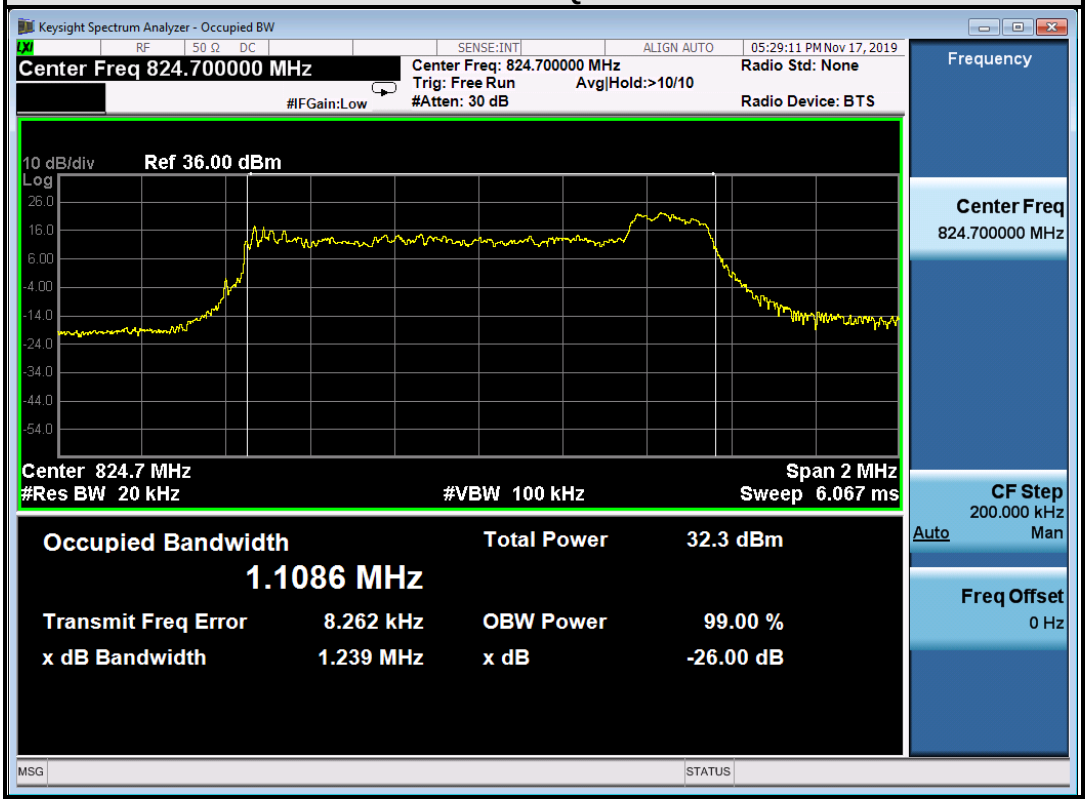
3.3.3 TEST RESULTS

LTE BAND 5

CHANNEL BANDWIDTH:1.4MHz			
CHANNEL	Frequency (MHz)	99% OCCUPIED Bandwidth (MHz)	26 dB bandwidth (MHz)
		QPSK	QPSK
20407	824.7	1.11	1.24
20525	836.5	1.09	1.21
20643	848.3	1.10	1.20

SPECTRUM PLOT OF WORST VALUE of 99% Occupied Bandwidth/ 26 dB Occupied Bandwidth

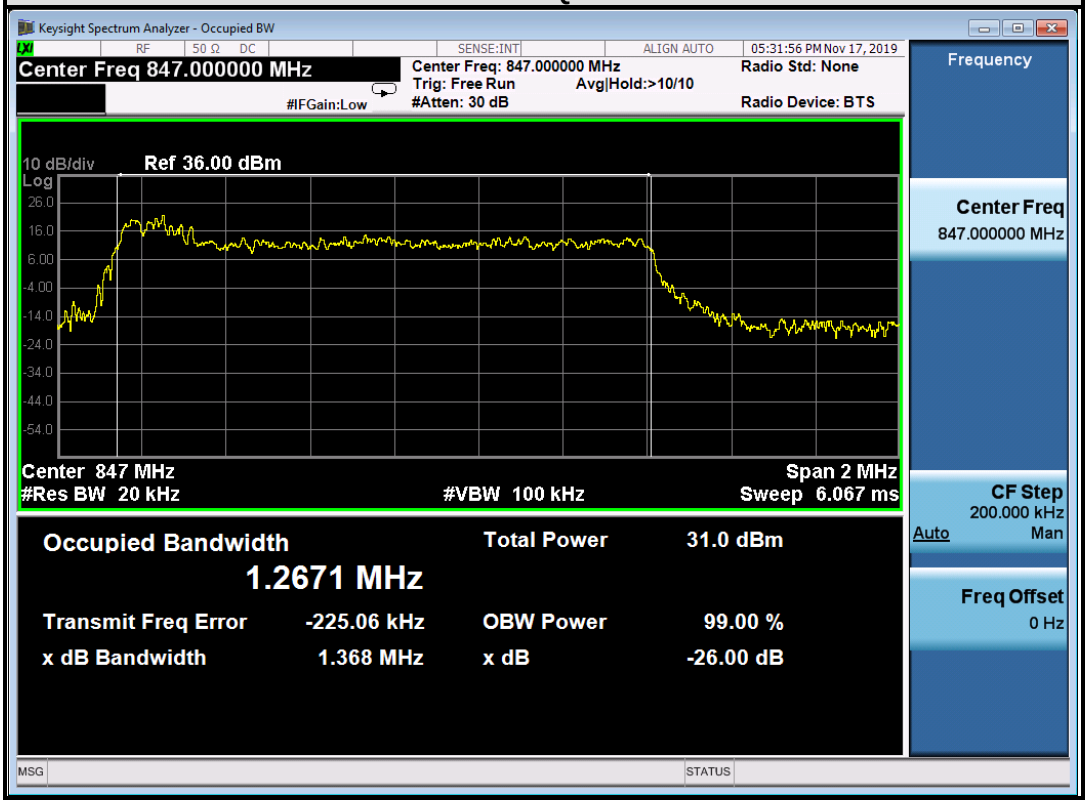
1.4MHz / QPSK



CHANNEL BANDWIDTH:3MHz			
CHANNEL	Frequency (MHz)	99% OCCUPIED Bandwidth (MHz)	26 dB bandwidth (MHz)
		QPSK	QPSK
20415	825.5	1.26	1.37
20525	836.5	1.26	1.38
20635	847.5	1.27	1.37

SPECTRUM PLOT OF WORST VALUE of 99% Occupied Bandwidth/ 26 dB Occupied Bandwidth

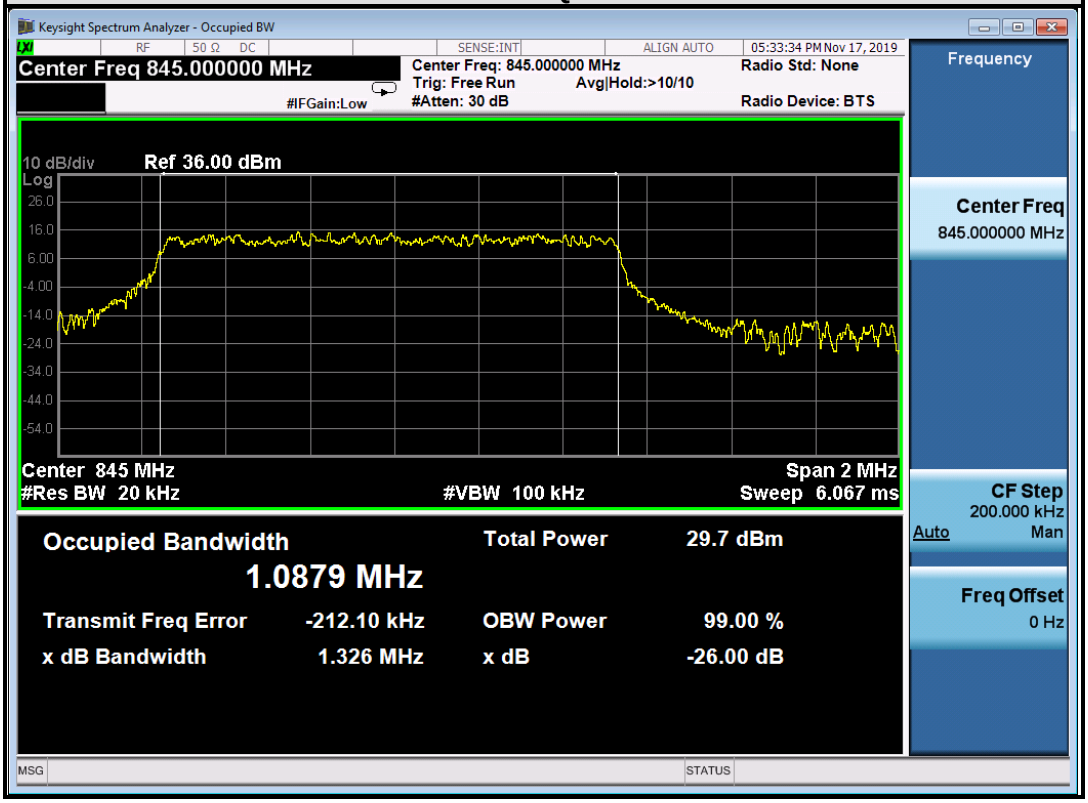
3MHz / QPSK



CHANNEL BANDWIDTH:5MHz			
CHANNEL	Frequency (MHz)	99% OCCUPIED Bandwidth (MHz)	26 dB bandwidth (MHz)
		QPSK	QPSK
20425	826.5	1.08	1.34
20525	836.5	1.08	1.52
20625	846.5	1.09	1.33

SPECTRUM PLOT OF WORST VALUE of 99% Occupied Bandwidth/ 26 dB Occupied Bandwidth

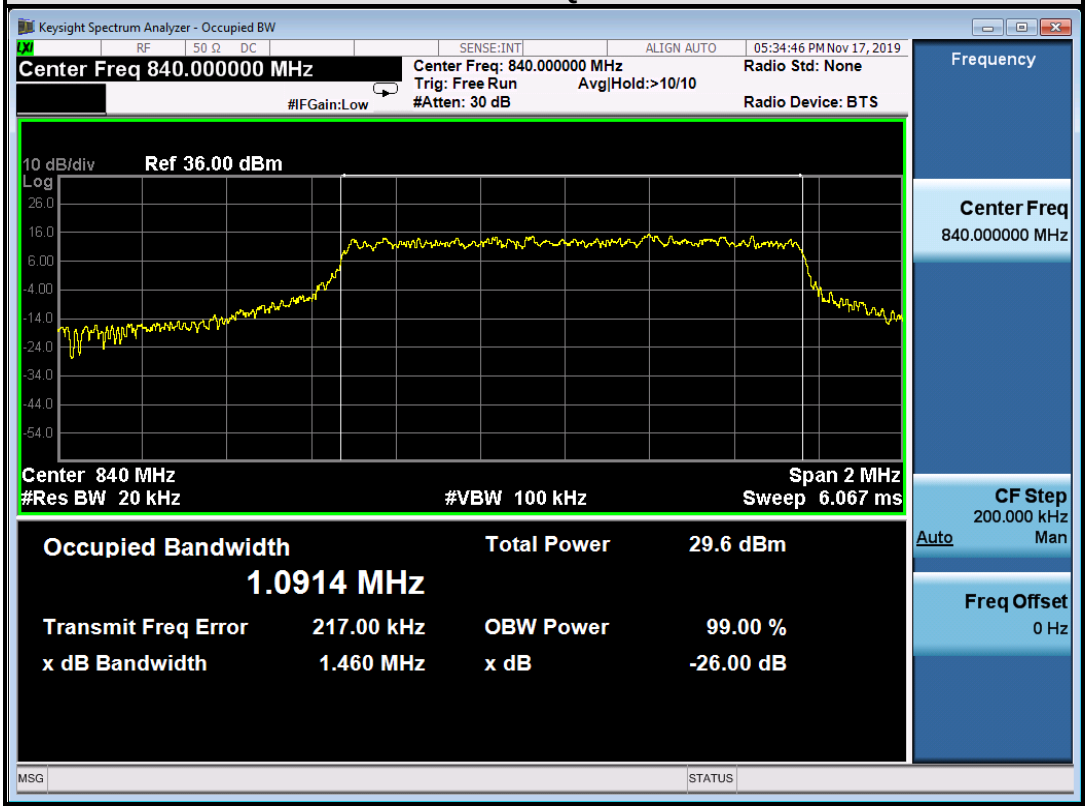
5MHz / QPSK



CHANNEL BANDWIDTH: 10MHz			
CHANNEL	Frequency (MHz)	99% OCCUPIED Bandwidth (MHz)	26 dB bandwidth (MHz)
		QPSK	QPSK
20450	829	1.09	1.41
20525	836.5	1.08	1.43
20600	844	1.09	1.46

SPECTRUM PLOT OF WORST VALUE of 99% Occupied Bandwidth/ 26 dB Occupied Bandwidth

10MHz / QPSK

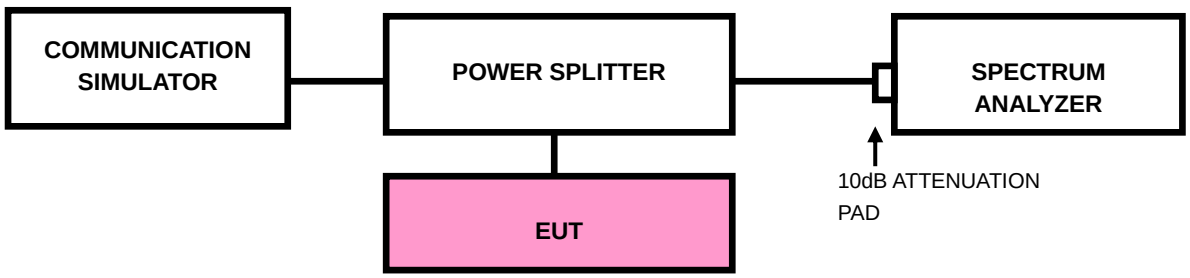


3.4 BAND EDGE MEASUREMENT

3.4.1 LIMITS OF BAND EDGE MEASUREMENT

Power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

3.4.2 TEST SETUP



3.4.3 TEST PROCEDURES

a. All measurements were done at low and high operational frequency range.

b. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 20kHz and VBW of the spectrum is 100 kHz. (LTE bandwidth 1.4MHz).

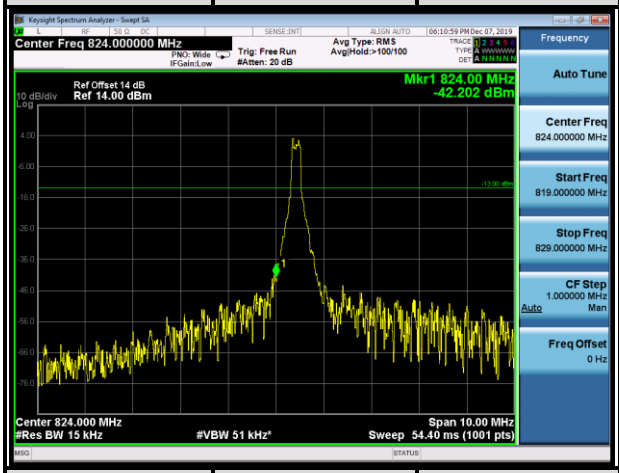
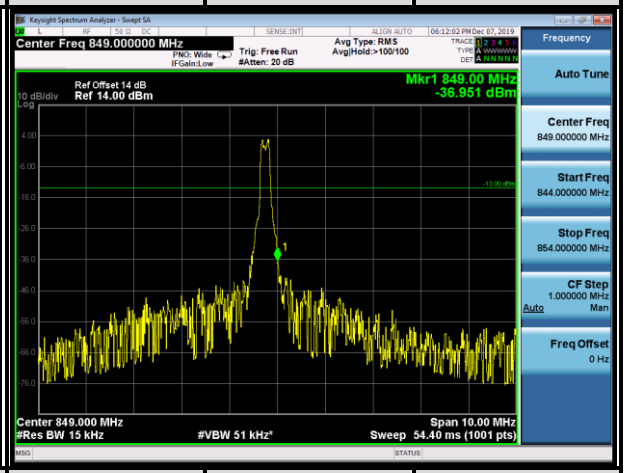
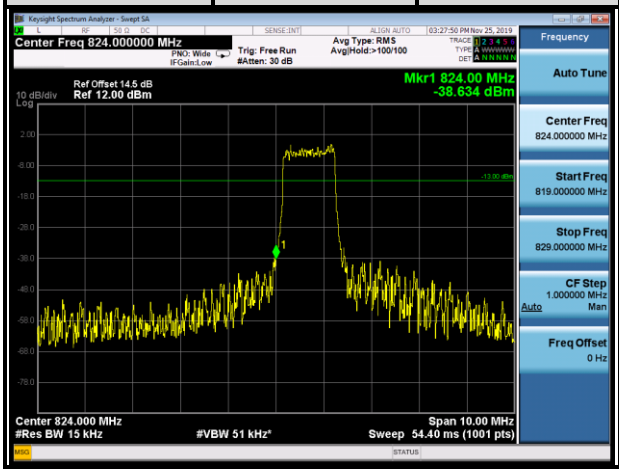
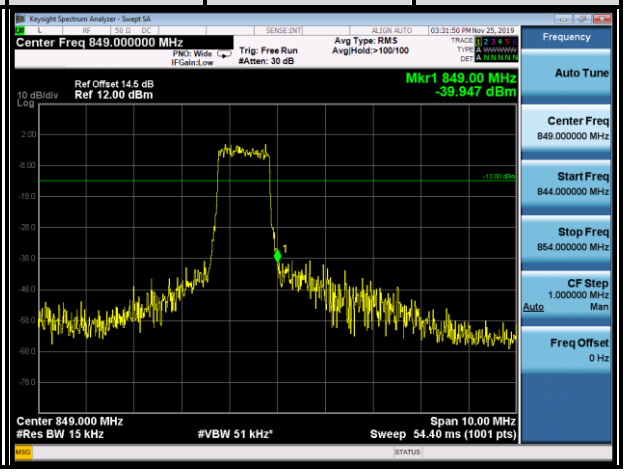
c. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 30kHz and VBW of the spectrum is 100kHz. (LTE bandwidth 3MHz)

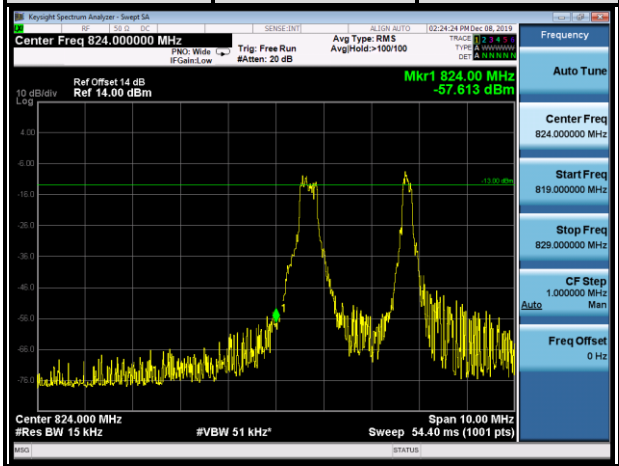
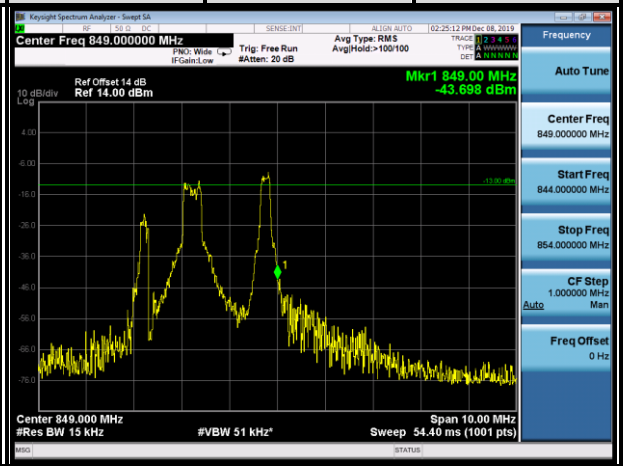
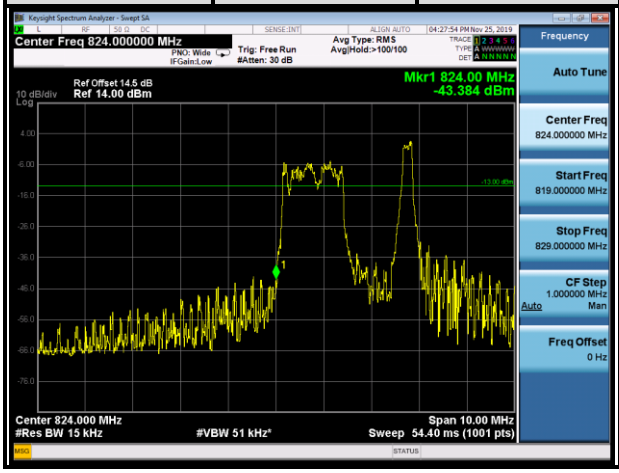
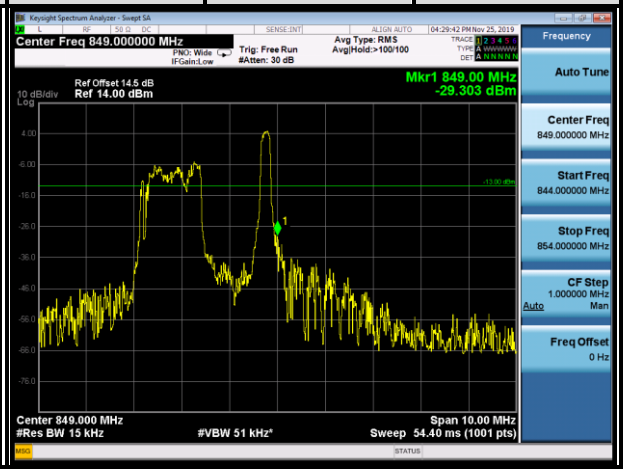
d. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 50kHz and VBW of the spectrum is 200kHz. (LTE bandwidth 5MHz)

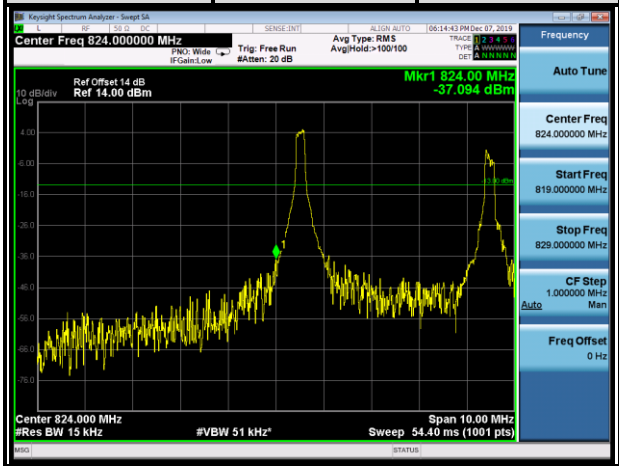
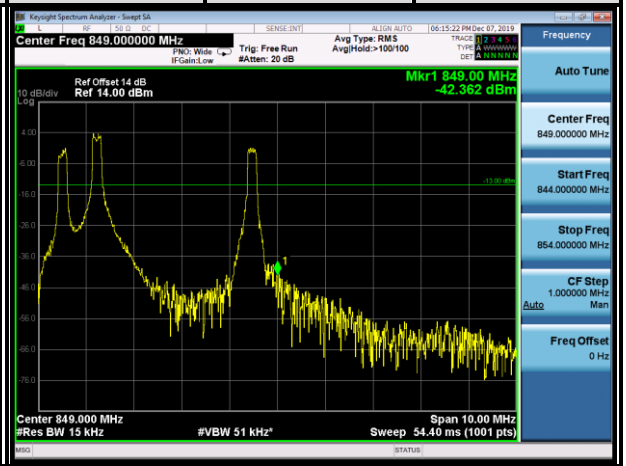
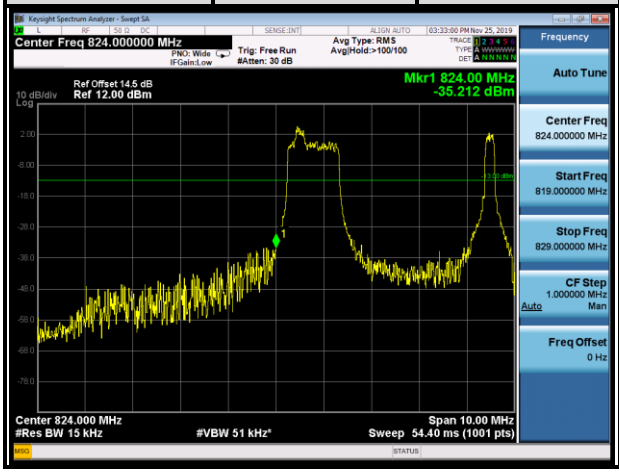
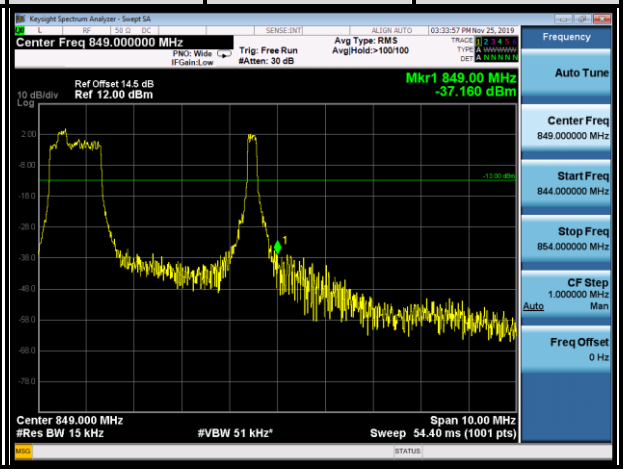
e. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 100kHz and VBW of the spectrum is 300kHz. (LTE bandwidth 10MHz)

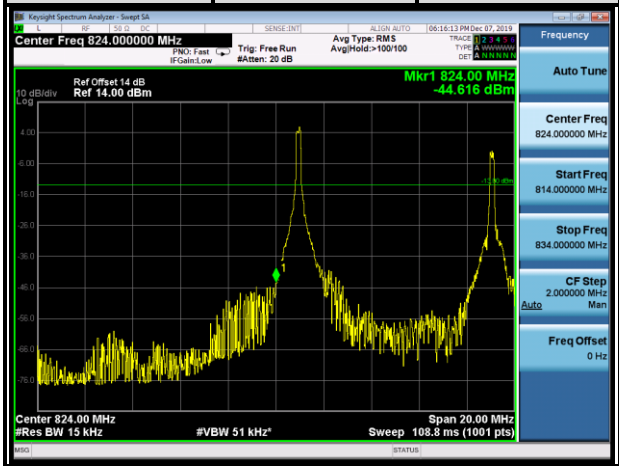
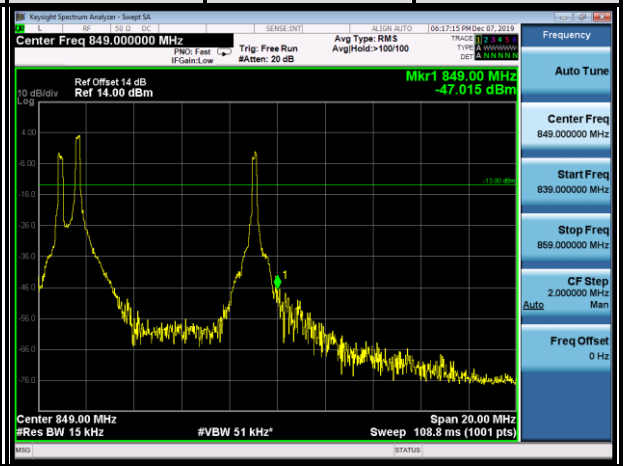
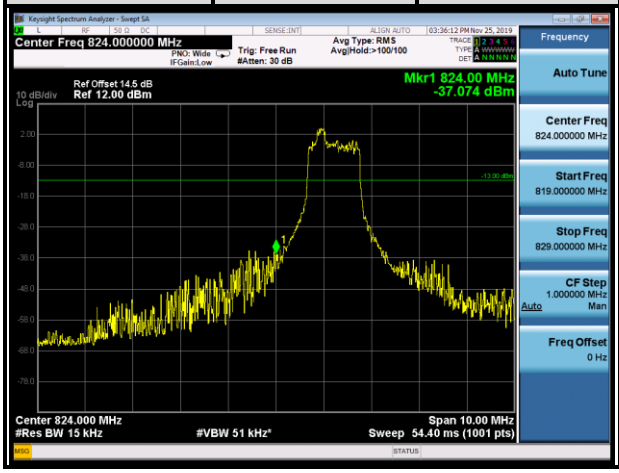
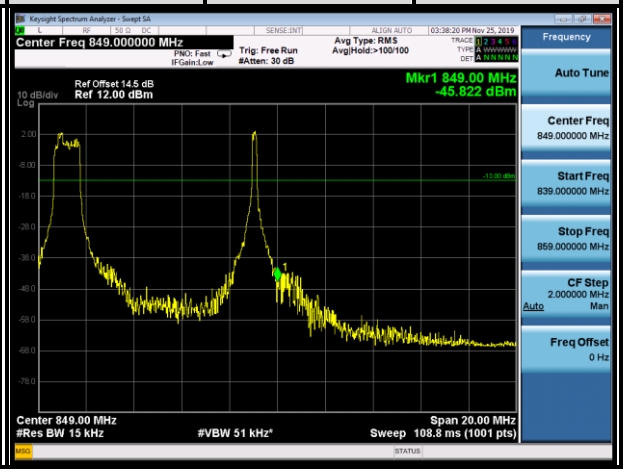
f. Record the max trace plot into the test report.

3.4.4 TEST RESULTS

LTE Band5					
Channel Bandwidth: 1.4MHz QPSK					
CHANNEL	20407	1 RB	CHANNEL	20643	1 RB
					
CHANNEL	20407	Full RB	CHANNEL	20643	Full RB
					

LTE Band5					
Channel Bandwidth: 3MHz QPSK					
CHANNEL	20415	1 RB	CHANNEL	20635	1 RB
					
CHANNEL	20415	Full RB	CHANNEL	20635	Full RB
					

LTE Band5					
Channel Bandwidth: 5MHz QPSK					
CHANNEL	20425	1 RB	CHANNEL	20625	1 RB
					
CHANNEL	20425	Full RB	CHANNEL	20625	Full RB
					

LTE Band5					
Channel Bandwidth: 10MHz QPSK					
CHANNEL	20450	1 RB	CHANNEL	20600	1 RB
					
CHANNEL	20450	Full RB	CHANNEL	20600	Full RB
					

3.5 CONDUCTED SPURIOUS EMISSIONS

3.5.1 LIMITS OF CONDUCTED SPURIOUS EMISSIONS MEASUREMENT

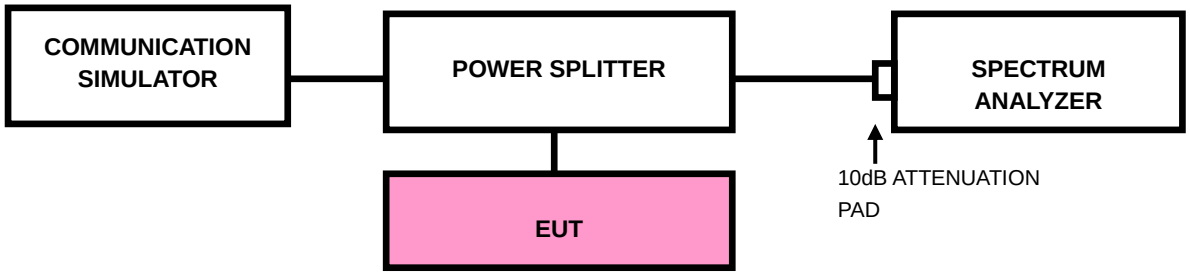
The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. The emission limit equal to –13dBm.

3.5.2 TEST PROCEDURE

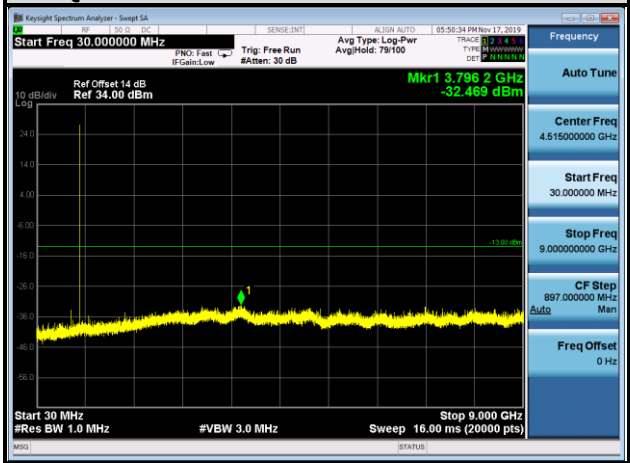
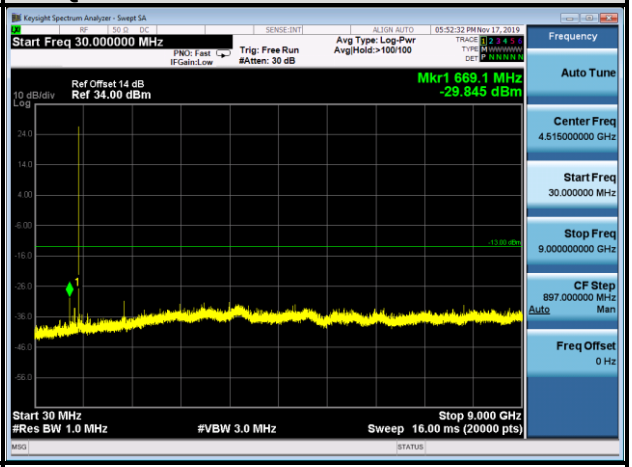
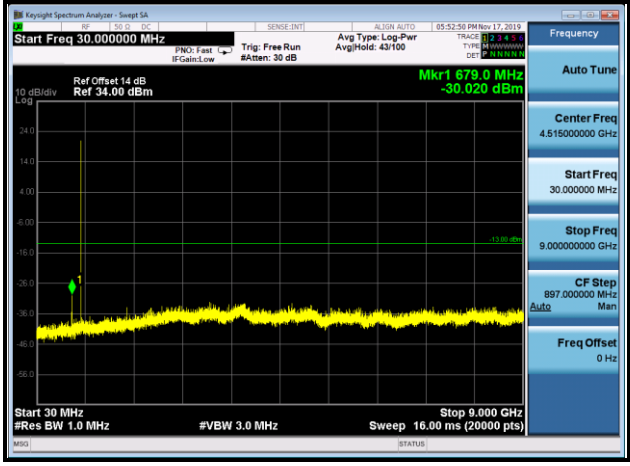
a. The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.

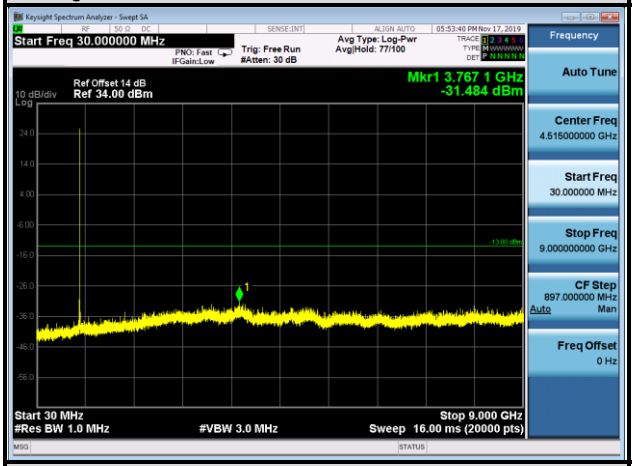
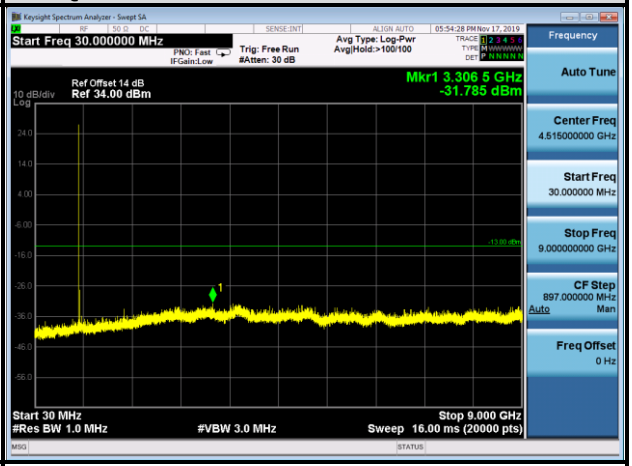
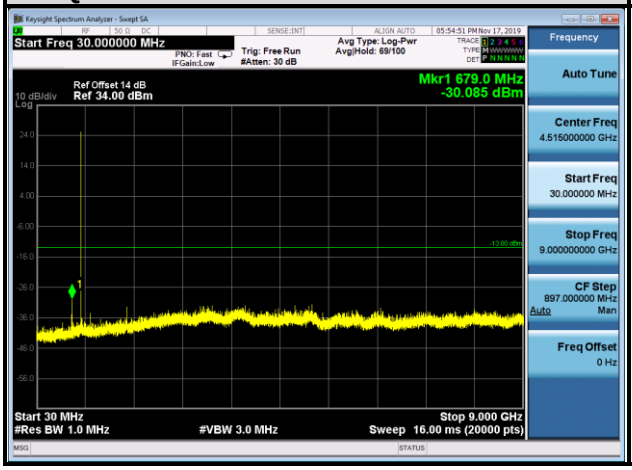
b. Measuring frequency range is from 9 kHz to 9GHz. 10dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz is used for conducted emission measurement.

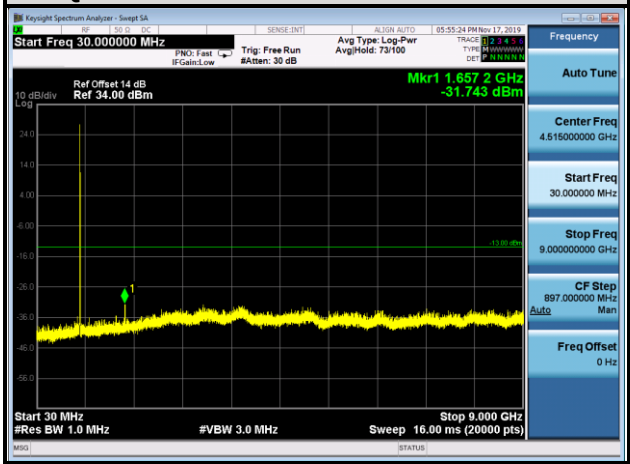
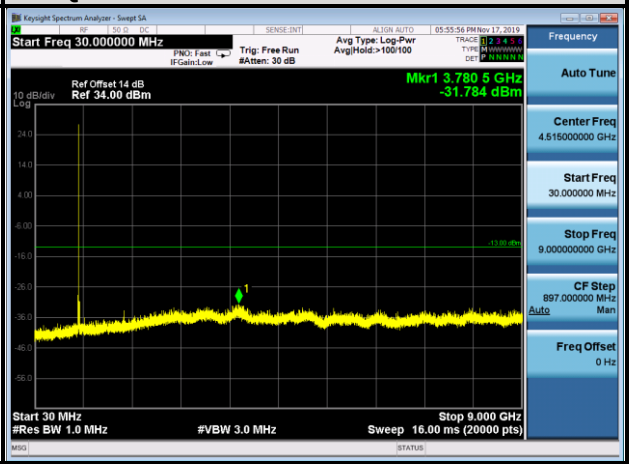
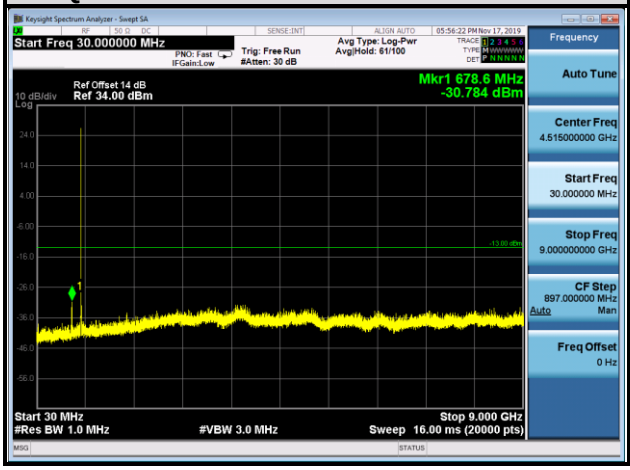
3.5.3 TEST SETUP

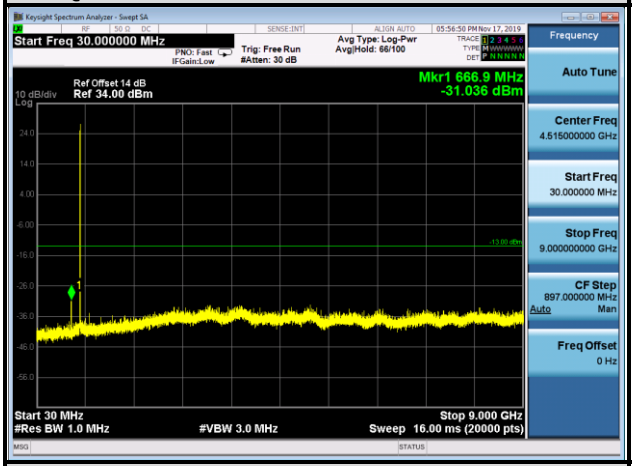
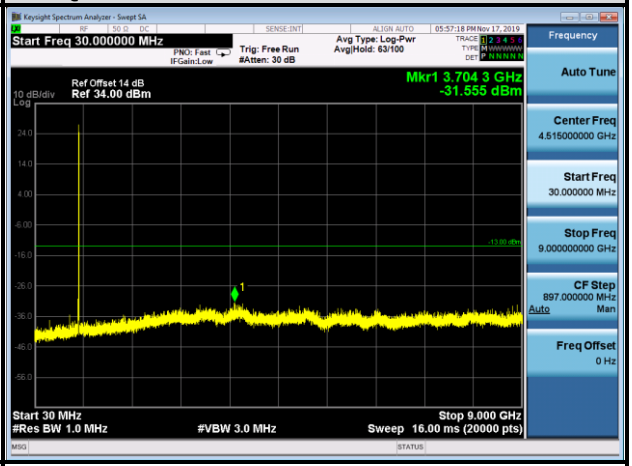
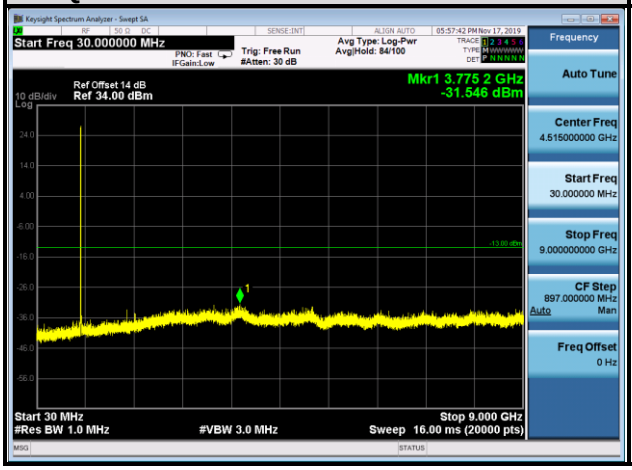


3.5.4 TEST RESULTS

LTE Band 5(Channel Bandwidth: 1.4MHz)	
CHANNEL 20407	CHANNEL 20525
FREQUENCY RANGE : 30MHz~9.0GHz	FREQUENCY RANGE : 30MHz~9.0GHz
	
CHANNEL 20643	
FREQUENCY RANGE : 30MHz~9.0GHz	
	

LTE Band 5 (Channel Bandwidth: 3MHz)	
CHANNEL 20415	CHANNEL 20525
FREQUENCY RANGE : 30MHz~9.0GHz	FREQUENCY RANGE : 30MHz~9.0GHz
	
CHANNEL 20635	
FREQUENCY RANGE : 30MHz~9.0GHz	
	

LTE Band 5 (Channel Bandwidth: 5MHz)	
CHANNEL 20425	CHANNEL 20525
FREQUENCY RANGE : 30MHz~9.0GHz	FREQUENCY RANGE : 30MHz~9.0GHz
	
CHANNEL 20625	
FREQUENCY RANGE : 30MHz~9.0GHz	
	

LTE Band 5 (Channel Bandwidth: 10MHz)	
CHANNEL 20450	CHANNEL 20525
FREQUENCY RANGE : 30MHz~9.0GHz	FREQUENCY RANGE : 30MHz~9.0GHz
	
CHANNEL 20600	
FREQUENCY RANGE : 30MHz~9.0GHz	
	

3.6 RADIATED EMISSION MEASUREMENT

3.6.1 LIMITS OF RADIATED EMISSION MEASUREMENT

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. The emission limit equal to –13dBm.

3.6.2 TEST PROCEDURES

a. 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.

b. The substitution horn antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to “Read Value “ of step a. Record the power level of S.G

c. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.

d. E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, E.R.P power = E.I.P.R power - 2.15dBi.

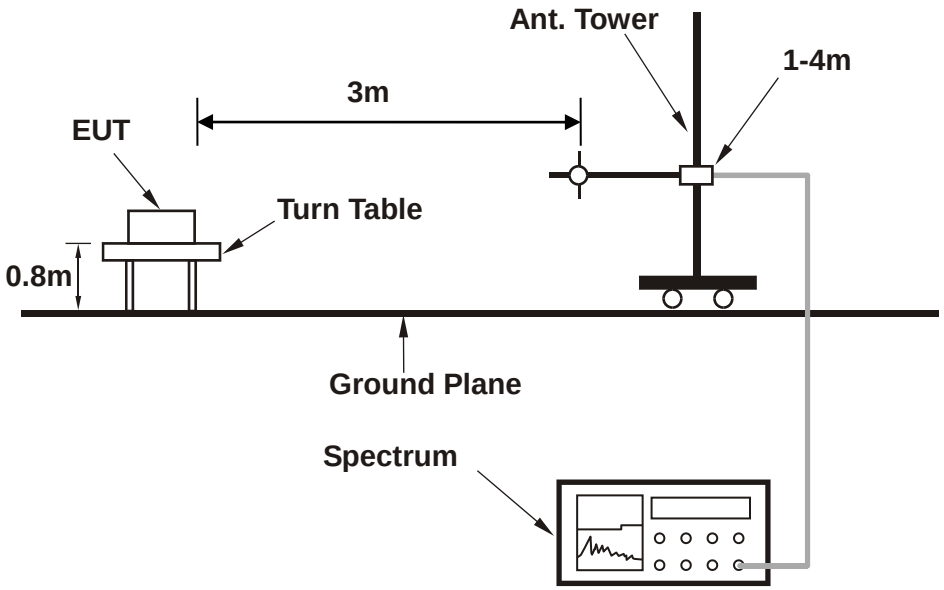
NOTE: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

3.6.3 DEVIATION FROM TEST STANDARD

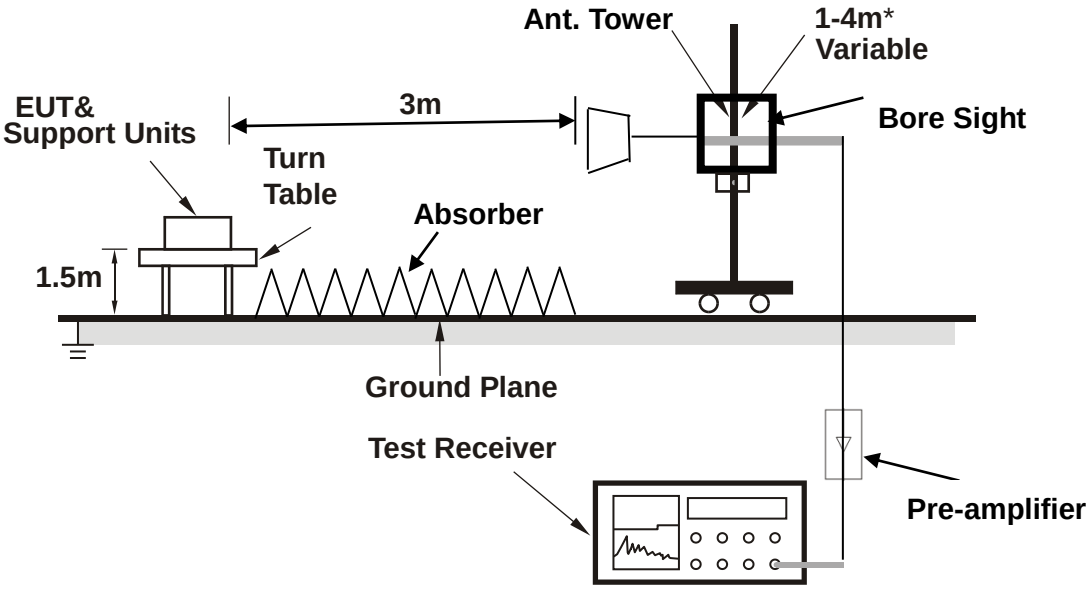
No deviation

3.6.4 TEST SETUP

< Frequency Range 30MHz~1GHz >



<Frequency Range above 1GHz>



Note: Above 1G is a directional antenna

Depends on the EUT height and the antenna 3dB beamwidth both, refer to section 7.3 of CISPR 16-2-3.

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

3.6.5 TEST RESULTS

BELOW 1GHz WORST-CASE DATA

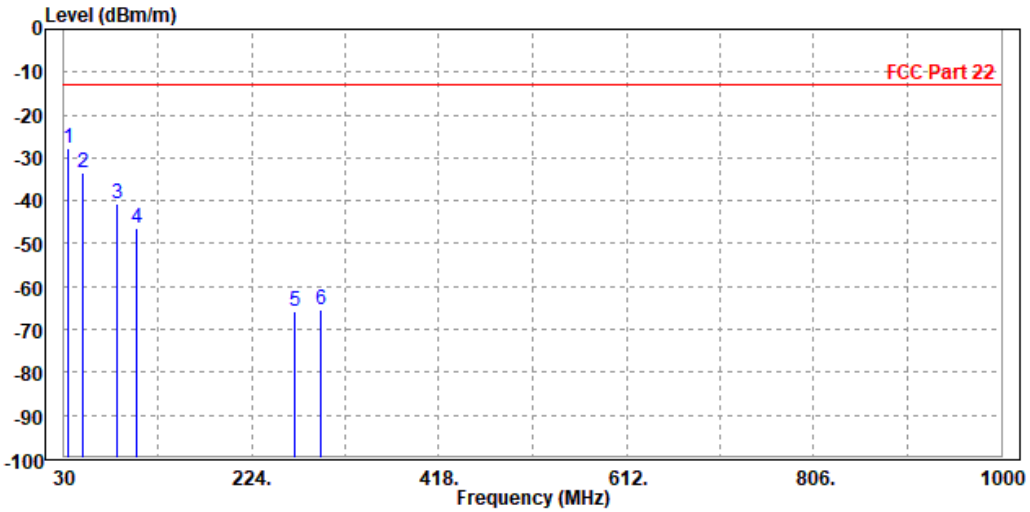
30 MHz – 1GHz data:

LTE Band 5

CHANNEL BANDWIDTH: 1.4MHz / QPSK

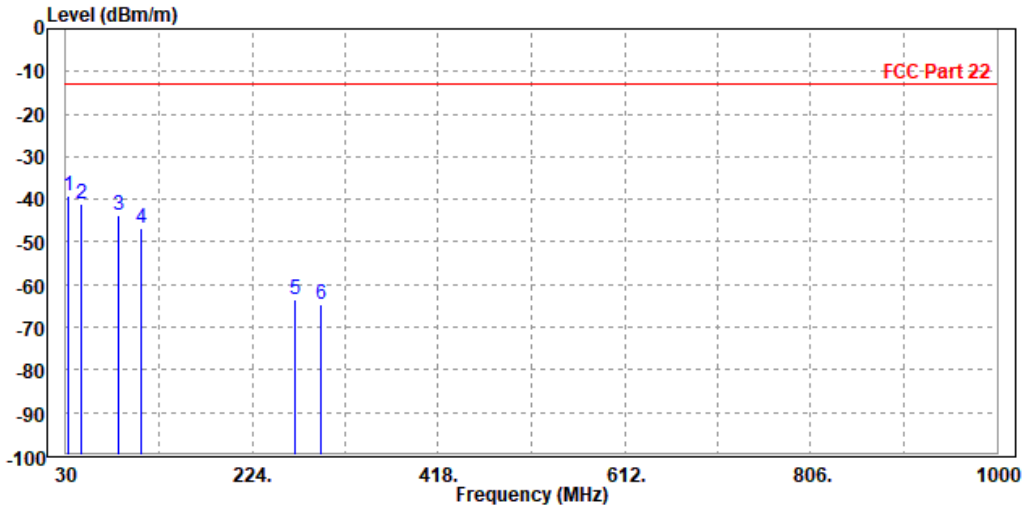
MODE	TX channel 20525	FREQUENCY RANGE	Below 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1 PP	34.258	-27.62	-41.11	-13.00	-14.62	13.49	Peak	Horizontal
2	49.265	-33.37	-37.16	-13.00	-20.37	3.79	Peak	Horizontal
3	85.260	-40.53	-32.15	-13.00	-27.53	-8.38	Peak	Horizontal
4	105.260	-46.37	-34.12	-13.00	-33.37	-12.25	Peak	Horizontal
5	268.260	-65.60	-50.22	-13.00	-52.60	-15.38	Peak	Horizontal
6	295.350	-65.30	-51.26	-13.00	-52.30	-14.04	Peak	Horizontal



MODE	TX channel 20525	FREQUENCY RANGE	Below 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1 PP	33.170	-39.06	-40.17	-13.00	-26.06	1.11	Peak	Vertical
2	46.178	-41.20	-37.65	-13.00	-28.20	-3.55	Peak	Vertical
3	84.190	-43.66	-33.29	-13.00	-30.66	-10.37	Peak	Vertical
4	108.165	-46.93	-35.18	-13.00	-33.93	-11.75	Peak	Vertical
5	269.250	-63.61	-52.18	-13.00	-50.61	-11.43	Peak	Vertical
6	295.174	-64.53	-53.21	-13.00	-51.53	-11.32	Peak	Vertical



ABOVE 1GHz DATA

Note: For higher frequency, the emission is too low to be detected.

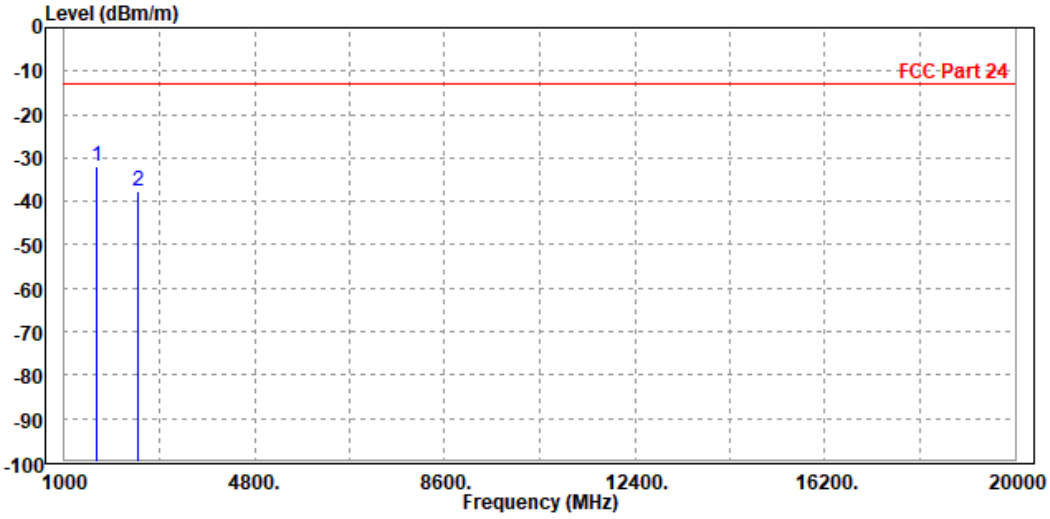
LTE Band 5

CHANNEL BANDWIDTH: 1.4MHz / QPSK

CH20407

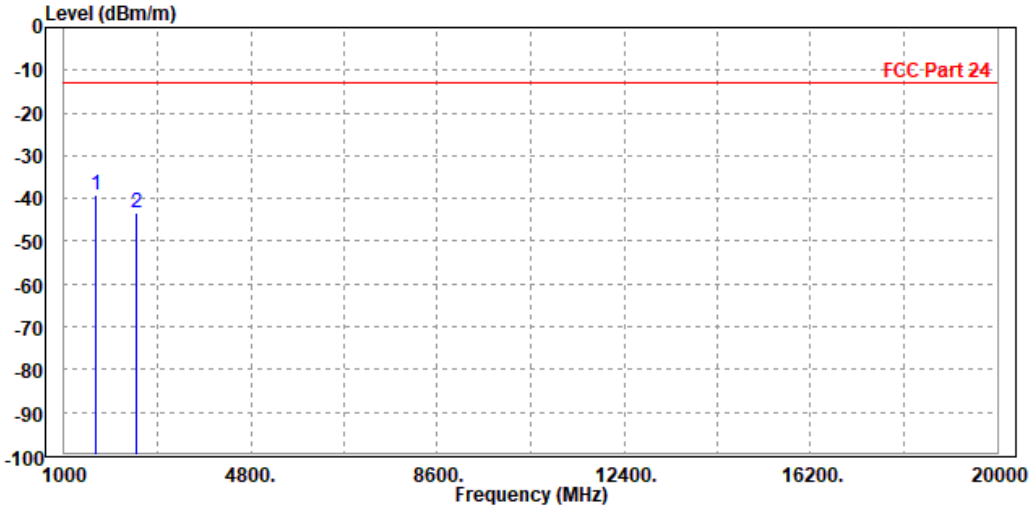
MODE	TX channel 20407	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1 PP	1646.000	-31.99	-35.22	-13.00	-18.99	3.23	Peak	Horizontal
2	2474.100	-37.75	-45.77	-13.00	-24.75	8.02	Peak	Horizontal



MODE	TX channel 20407	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M			

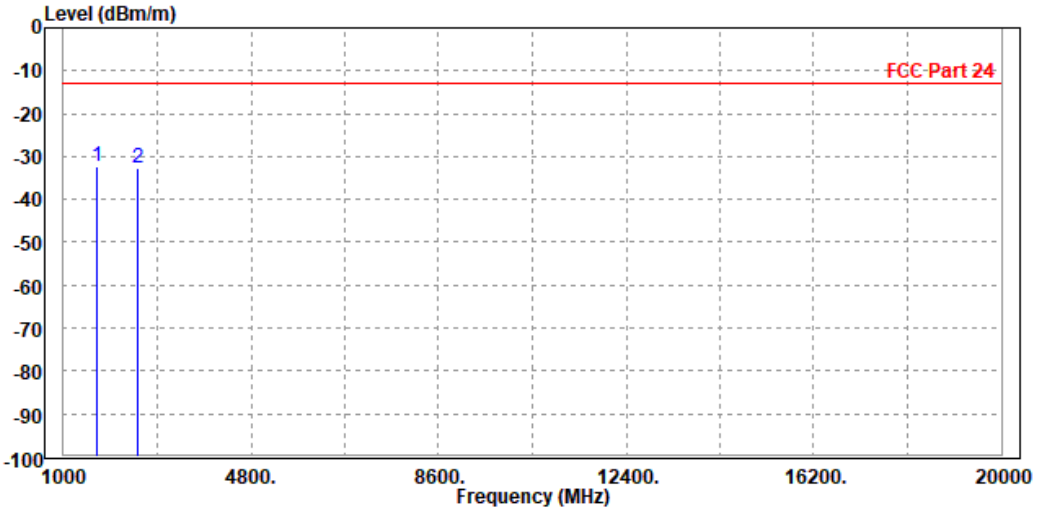
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1 PP	1646.000	-39.31	-42.67	-13.00	-26.31	3.36	Peak	Vertical
2	2474.100	-43.49	-50.53	-13.00	-30.49	7.04	Peak	Vertical



CH20525

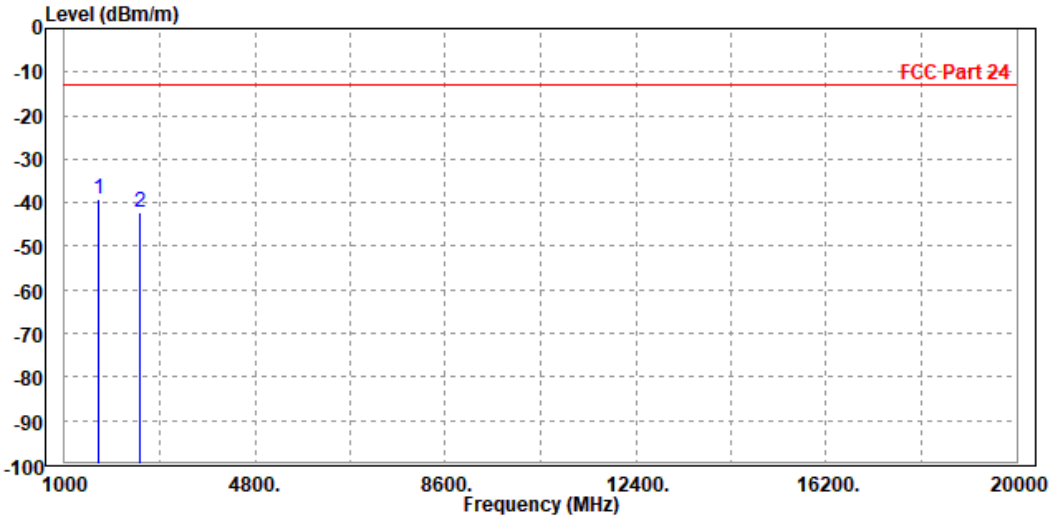
MODE	TX channel 20525	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	PP 1665.000	-32.22	-35.68	-13.00	-19.22	3.46	Peak	Horizontal
2	2509.500	-32.65	-40.71	-13.00	-19.65	8.06	Peak	Horizontal



MODE	TX channel 20525	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M			

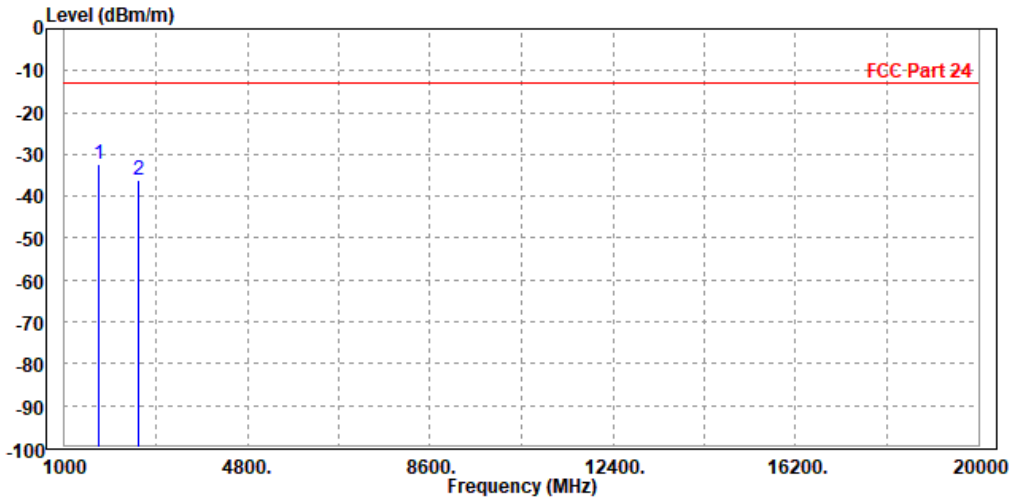
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	PP 1665.000	-39.18	-42.72	-13.00	-26.18	3.54	Peak	Vertical
2	2509.500	-42.38	-49.48	-13.00	-29.38	7.10	Peak	Vertical



CH20643

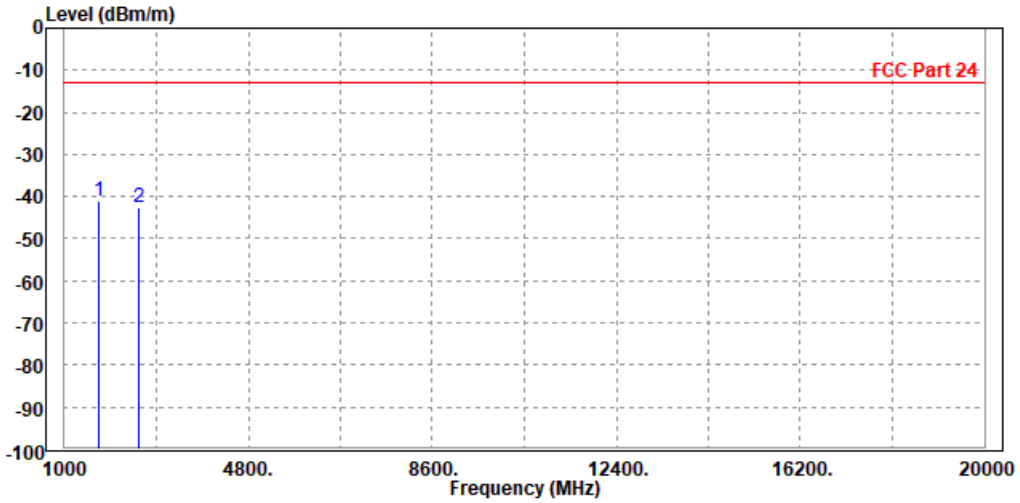
MODE	TX channel 20643	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	PP 1703.000	-32.31	-36.23	-13.00	-19.31	3.92	Peak	Horizontal
2	2544.900	-36.26	-44.37	-13.00	-23.26	8.11	Peak	Horizontal



MODE	TX channel 20643	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M			

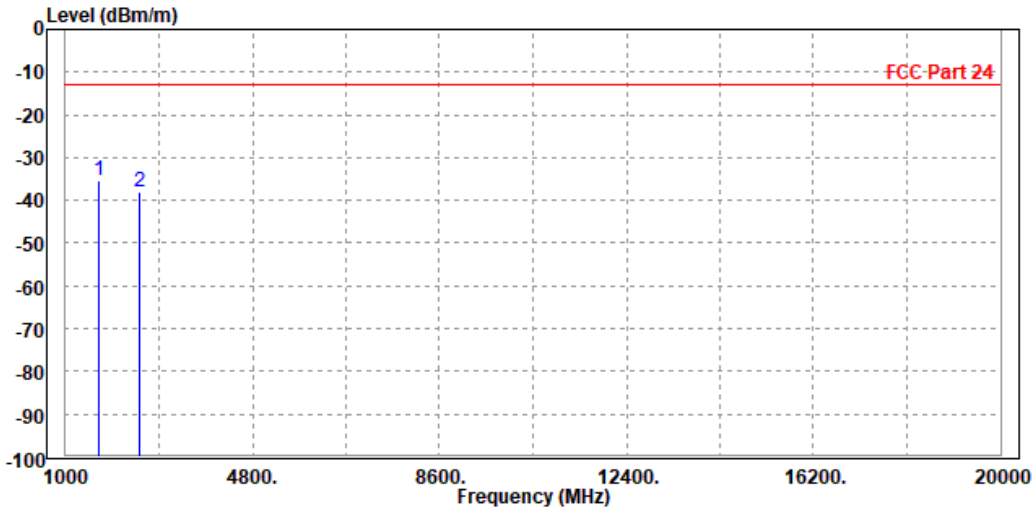
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	PP 1703.000	-41.02	-44.90	-13.00	-28.02	3.88	Peak	Vertical
2	2544.900	-42.59	-49.80	-13.00	-29.59	7.21	Peak	Vertical



CHANNEL BANDWIDTH: 3MHz / QPSK

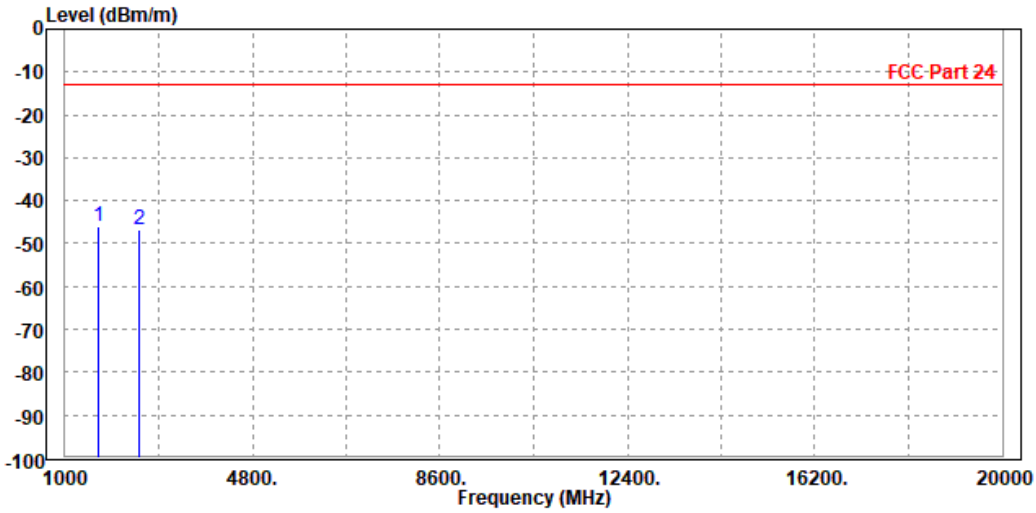
MODE	TX channel 20525	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M			

		Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
		MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	PP	1665.000	-35.50	-38.96	-13.00	-22.50	3.46	Peak	Horizontal
2		2509.500	-37.96	-46.02	-13.00	-24.96	8.06	Peak	Horizontal



MODE	TX channel 20525	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M			

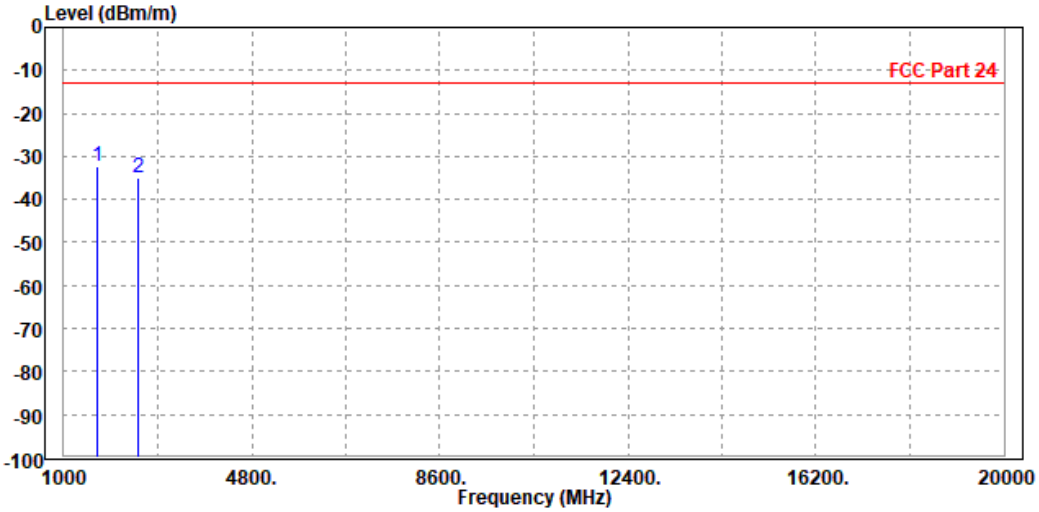
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	PP 1665.000	-46.08	-49.62	-13.00	-33.08	3.54	Peak	Vertical
2	2509.500	-46.89	-53.99	-13.00	-33.89	7.10	Peak	Vertical



CHANNEL BANDWIDTH: 5MHz / QPSK

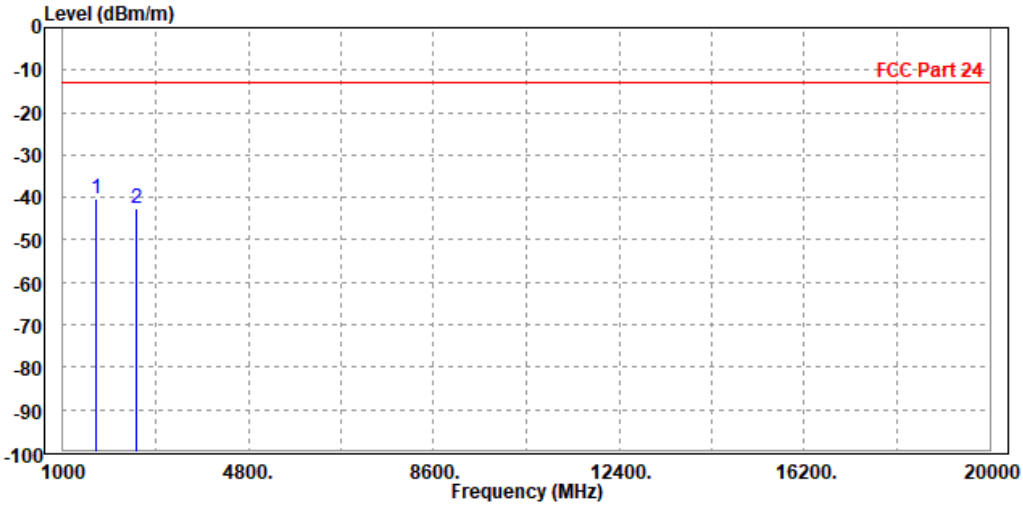
MODE	TX channel 20525	**FREQUENCY RANGE**	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	**INPUT POWER**	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1 PP	1665.000	-32.27	-35.73	-13.00	-19.27	3.46	Peak	Horizontal
2	2509.500	-35.17	-43.23	-13.00	-22.17	8.06	Peak	Horizontal



MODE	TX channel 20525	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M			

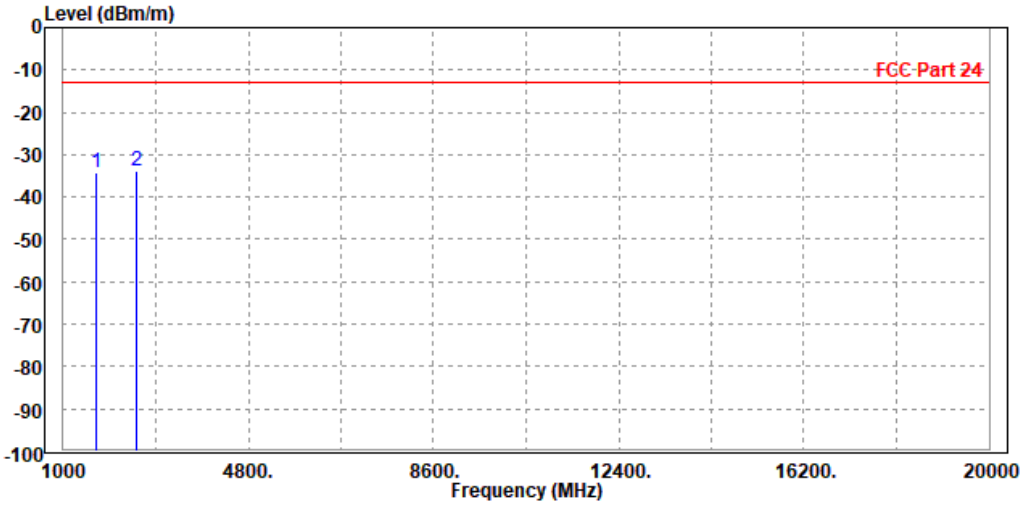
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1 PP	1665.000	-40.12	-43.66	-13.00	-27.12	3.54	Peak	Vertical
2	2509.500	-42.57	-49.67	-13.00	-29.57	7.10	Peak	Vertical



CHANNEL BANDWIDTH: 10MHz / QPSK

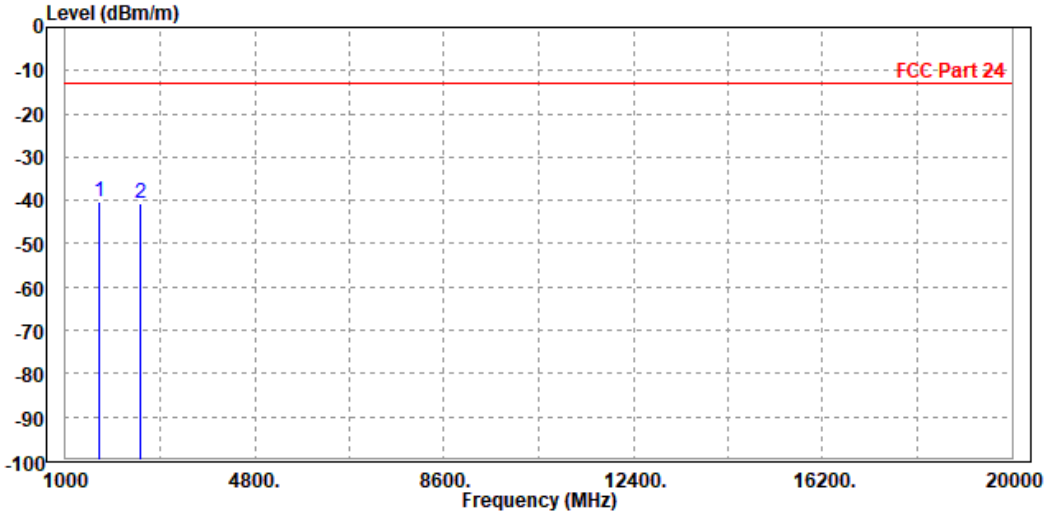
MODE	TX channel 20525	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	1665.000	-34.10	-37.56	-13.00	-21.10	3.46	Peak	Horizontal
2 PP	2509.500	-33.92	-41.98	-13.00	-20.92	8.06	Peak	Horizontal



MODE	TX channel 20525	FREQUENCY RANGE	Above 1000MHz
ENVIRONMENTAL CONDITIONS	23deg. C, 70%RH	INPUT POWER	DC 3.7V by battery
TESTED BY	Allen		
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M			

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBm/m	dBm	dBm/m	dB	dB/m		
1	PP 1665.000	-40.28	-43.82	-13.00	-27.28	3.54	Peak	Vertical
2	2509.500	-40.78	-47.88	-13.00	-27.78	7.10	Peak	Vertical

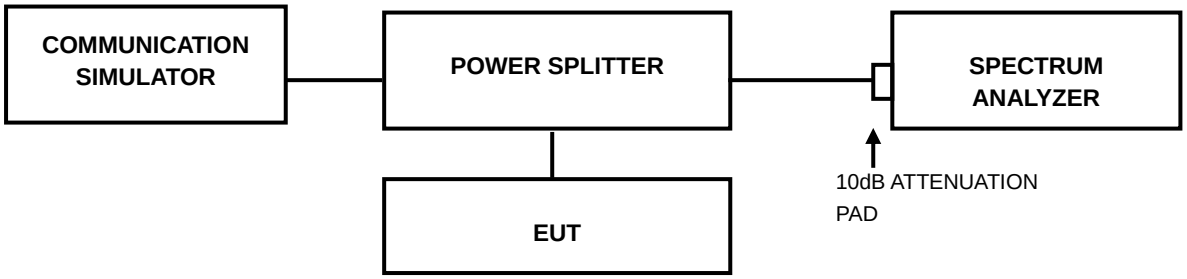


3.7 PEAK TO AVERAGE RATIO

3.7.1 LIMITS OF PEAK TO AVERAGE RATIO MEASUREMENT

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

3.7.2 TEST SETUP



3.7.3 TEST PROCEDURES

1. Set resolution/measurement bandwidth ≥ 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%.

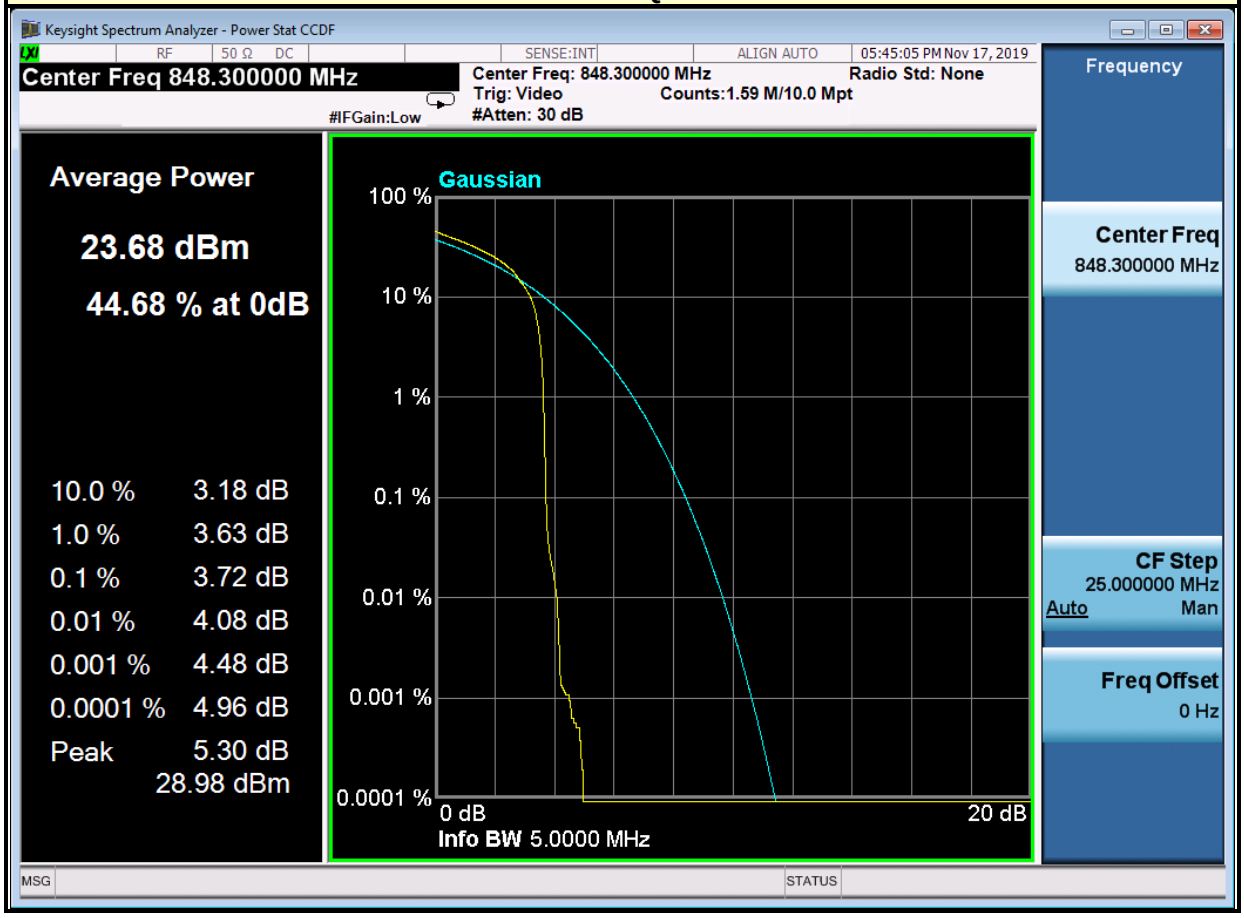
3.7.4 TEST RESULTS

LTE BAND 5

CHANNEL BANDWIDTH: 1.4MHz		
CHANNEL	Frequency (MHz)	PEAK TO AVERAGE RATIO (dB)
		QPSK
20407	824.7	3.71
20525	836.5	3.70
20643	848.3	3.72

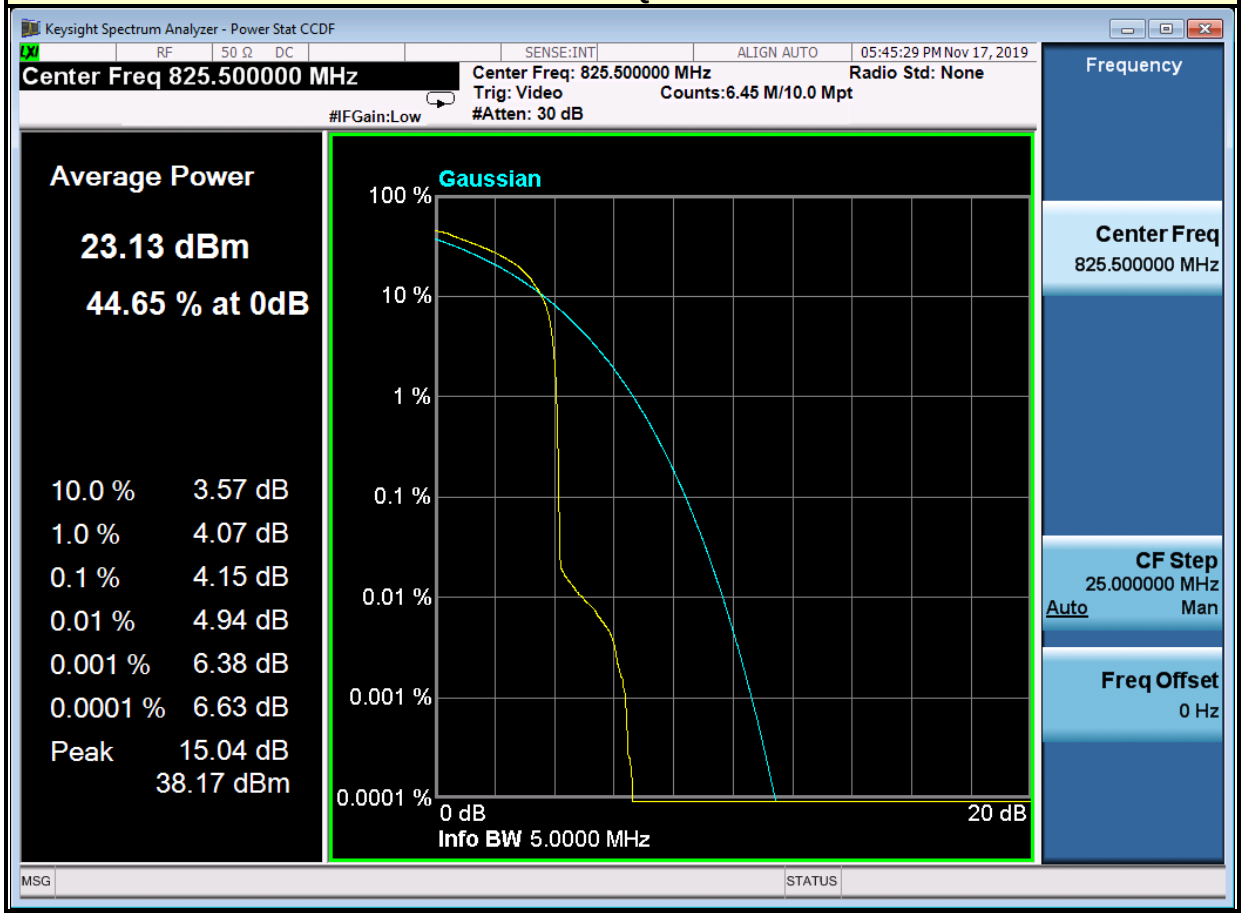
SPECTRUM PLOT OF WORST VALUE

1.4MHz / QPSK



CHANNEL BANDWIDTH: 3MHz		
CHANNEL	Frequency (MHz)	PEAK TO AVERAGE RATIO (dB)
		QPSK
20415	825.5	4.15
20525	836.5	3.45
20635	847.5	3.94

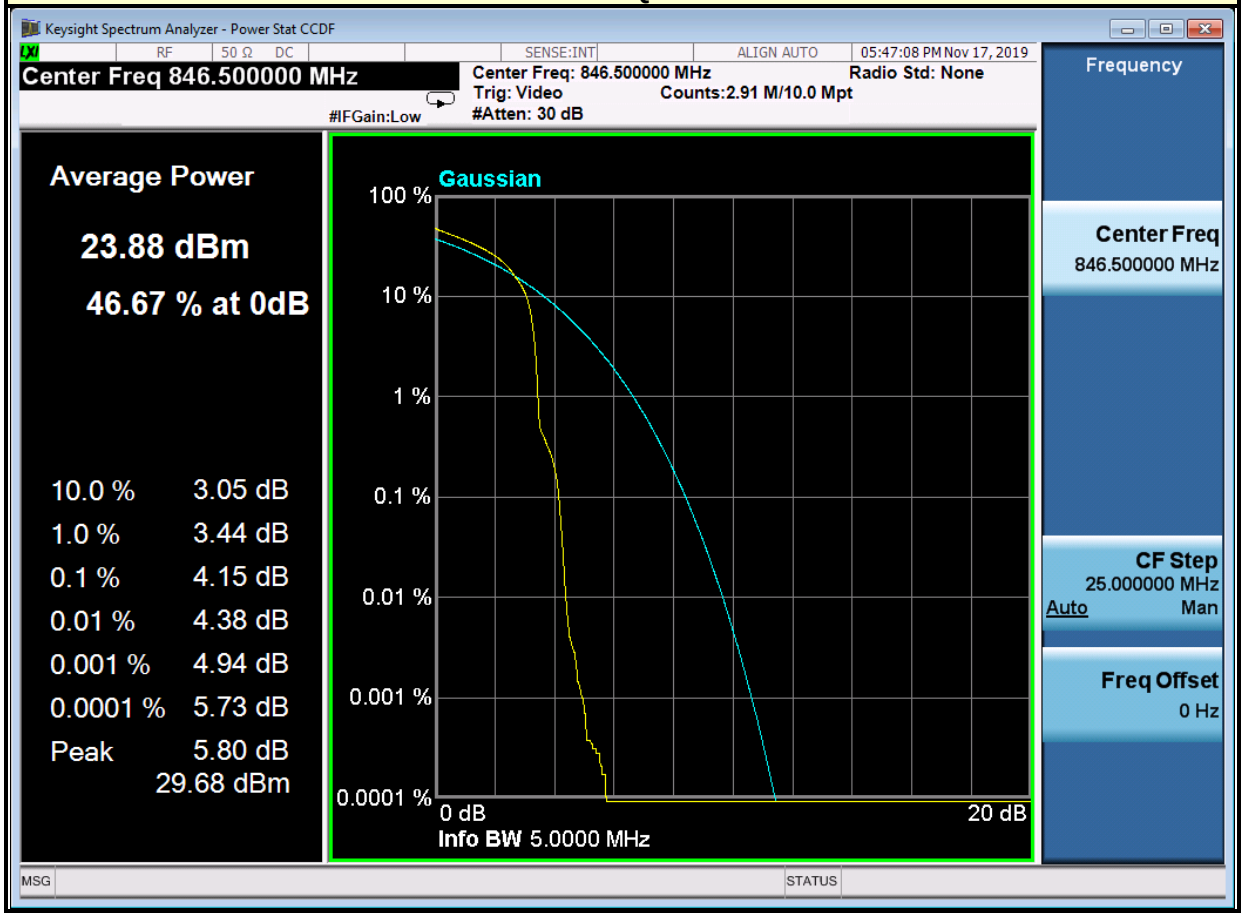
SPECTRUM PLOT OF WORST VALUE
3MHz / QPSK



CHANNEL BANDWIDTH: 5MHz		
CHANNEL	Frequency (MHz)	PEAK TO AVERAGE RATIO (dB)
		QPSK
20425	826.5	4.02
20525	836.5	4.03
20625	846.5	4.15

SPECTRUM PLOT OF WORST VALUE

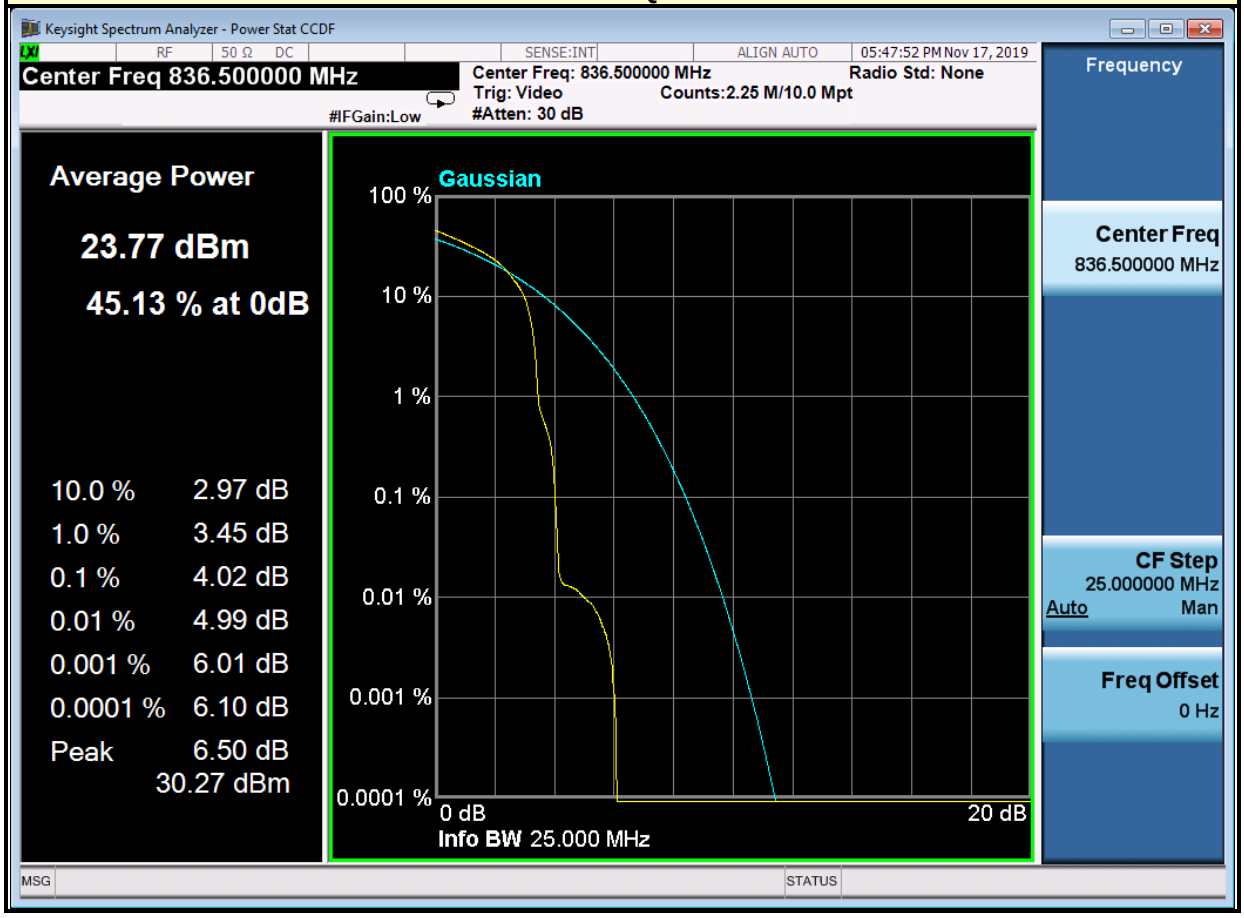
5MHz / QPSK



CHANNEL BANDWIDTH: 10MHz		
CHANNEL	Frequency (MHz)	PEAK TO AVERAGE RATIO (dB)
		QPSK
20450	829	3.80
20525	836.5	4.02
20600	844	3.96

SPECTRUM PLOT OF WORST VALUE

10MHz / QPSK



4 PHOTOGRAPHS OF THE TEST CONFIGURATION

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

5 INFORMATION ON THE TESTING LABORATORIES

We, BV 7LAYERS COMMUNICATIONS TECHNOLOGY (SHENZHEN) CO. LTD., were founded in 2015 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

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

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Email: customerservice.dg@cn.bureauveritas.com
Web Site: www.adt.com.tw

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

6 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---