



# RF TEST REPORT

**Applicant**      Quectel Wireless Solutions Co., Ltd  
**FCC ID**          XMR201912BG77  
**Product**        LTE Cat M1 & Cat NB2 Module  
**Brand**            Quectel  
**Model**            BG77  
**Marketing**      Quectel BG77  
**Report No.**      R2004A0248-R5  
**Issue Date**     July 1, 2020

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 2 (2019)/ FCC CFR 47 Part 24E (2019)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Performed by: Peng Tao

Approved by: Kai Xu

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### Summary of measurement results

No.	Test Case	Clause in FCC rules	Verdict
1	RF power output and Effective Radiated Power	2.1046 24.232(c)	PASS
2	Occupied Bandwidth	2.1049	PASS
3	Band Edge Compliance	2.1051 /24.238(a)	PASS
4	Peak-to-Average Power Ratio	24.232/KDB 971168 D01(5.7)	PASS
5	Frequency Stability	2.1055 / 24.235	PASS
6	Spurious Emissions at Antenna Terminals	2.1051 / 24.238(a)	PASS
7	Radiates Spurious Emission	2.1053 / 24.238(a)	PASS

Date of Testing: December 13, 2019 ~January 14, 2020

Note: PASS: The EUT complies with the essential requirements in the standard.

FAIL: The EUT does not comply with the essential requirements in the standard.

All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.

**There is no test for BG77 in this report(Report No.: R2004A0248-R5).All test values duplicated from the BG77 report (Report No. : R1909A0576-R6). The detailed product change description please refers to the *Statement letter*.**

## 1. Test Laboratory

### 1.1. Notes of the test report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

### 1.2. Test facility

#### **FCC (Designation number: CN1179, Test Firm Registration Number: 446626)**

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

#### **A2LA (Certificate Number: 3857.01)**

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

### 1.3. Testing Location

Company: TA Technology (Shanghai) Co., Ltd.  
Address: No.145, Jintang Rd, Tangzhen Industry Park, Pudong  
City: Shanghai  
Post code: 201201  
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## 2. General Description of Equipment under Test

### 2.3. Applicant and Manufacturer Information

Applicant	Quectel Wireless Solutions Co., Ltd
Applicant address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Manufacturer	Quectel Wireless Solutions Co., Ltd
Manufacturer address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

### 2.4. General information

EUT Description			
Model	BG77		
IMEI	866349040016200		
Hardware Version	R1.2		
Software Version	BG77LAR02A04		
Power Supply	External Power Supply		
Antenna Type	The EUT don't have standard Antenna, The Antenna used for testing in this report is the after-market accessory (Dipole Antenna)		
Antenna Gain	1.59dBi		
Test Mode(s)	LTE Band 2/25		
Test Modulation	(LTE)QPSK,16QAM		
LTE Category	M1		
Maximum E.I.R.P	LTE Band 2:	22.89dBm	
	LTE Band 25:	23.01dBm	
Rated Power Supply Voltage	3.3V		
Extreme Voltage	Minimum: 2.6V    Maximum: 4.8V		
Extreme Temperature	Lowest: -40°C    Highest: +85°C		
Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	LTE Band 2	1850 ~ 1910	1930 ~ 1990
	LTE Band 25	1850 ~ 1915	1930 ~ 1995
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.			

### 3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**Test standards:**

**FCC CFR 47 Part 24E (2019)**

**ANSI C63.26 (2015)**

**Reference standard:**

**FCC CFR47 Part 2 (2019)**

**KDB 971168 D01 Power Meas License Digital Systems v03r01**

## 4. Test Configuration

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes. EUT stand-up position (Z axis), lie-down position (X, Y axis). Receiver antenna polarization (horizontal and vertical), the worst emission was found in position (X axis, horizontal polarization) and the worst case was recorded.

All mode and data rates and positions and RB size and modulations were investigated.

Subsequently, only the worst case emissions are reported.

The following testing in LTE is set based on the maximum RF Output Power.

Test modes are chosen to be reported as the worst case configuration below for LTE Band 2/25:

Test items	Bandwidth (MHz)						Modulation		RB			Test Channel		
	1.4	3	5	10	15	20	QPSK	16QAM	1	50%	100%	L	M	H
RF power output	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Effective Isotropic Radiated power	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Occupied Bandwidth	O	O	O	O	O	O	O	O	-	-	O	O	O	O
Band Edge Compliance	O	O	O	O	O	O	O	O	O	-	O	O	-	O
Peak-to-Average Power Ratio	O	O	O	O	O	O	O	O	-	-	O	O	O	O
Frequency Stability	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Conducted Spurious Emissions	O	O	O	O	O	O	O	-	O	-	-	O	O	O
Radiates Spurious Emission	O	-	O	-	-	O	O	-	O	-	-	-	O	-
Note	1. The mark "O" means that this configuration is chosen for testing. 2. The mark "-" means that this configuration is not testing.													

## 5. Test Case Results

### 5.3.RF Power Output and Effective Radiated Power

#### Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

#### Methods of Measurement

During the process of the testing, The EUT is controlled by the Base Station Simulator to ensure max power transmission and proper modulation.

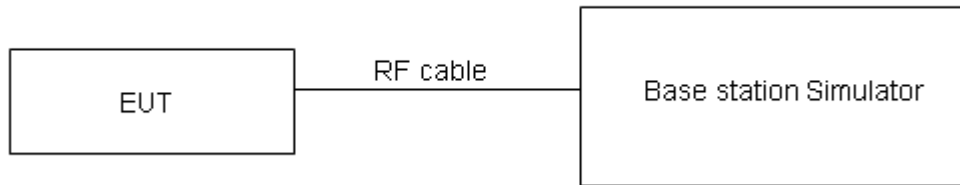
The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI C63.26 (2015).

- a) Connect the equipment as illustrated. Mount the equipment with the manufacturer specified antenna in a vertical orientation on a manufacturer specified mounting surface located on a non-conducting rotating platform of a RF anechoic chamber (preferred) or a standard radiation site.
- b) Key the transmitter, then rotate the EUT 360° azimuthally and record spectrum analyzer power level (LVL) measurements at angular increments that are sufficiently small to permit resolution of all peaks. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading at each angular increment. (Note: several batteries may be needed to offset the effect of battery voltage droop, which should not exceed 5% of the manufactured specified battery voltage during transmission).
- c) Replace the transmitter under test with a vertically polarized half-wave dipole (or an antenna whose gain is known relative to an ideal half-wave dipole). The center of the antenna should be at the same location as the center of the antenna under test.
- d) Connect the antenna to a signal generator with a known output power and record the path loss (in dB) as LOSS. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading.  $LOSS = \text{Generator Output Power (dBm)} - \text{Analyzer reading (dBm)}$
- e) Determine the effective radiated output power at each angular position from the readings in steps b) and d) using the following equation:  $ERP \text{ (dBm)} = \text{LVL (dBm)} + \text{LOSS (dB)}$
- f) The maximum ERP is the maximum value determined in the preceding step.
- g) When calculating ERP, in addition to knowing the antenna radiation and matching characteristics, it is necessary to know the loss values of all elements (e.g.transmission line attenuation, mismatches, filters, combiners) interposed between the point where transmitter output power is measured, and the point where power is applied to the antenna. ERP can then be calculated as follows:  
 $EIRP \text{ (dBm)} = \text{Output Power (dBm)} - \text{Losses (dB)} + \text{Antenna Gain (dBi)}$   
where:dBd refers to gain relative to an ideal dipole.  
 $EIRP \text{ (dBm)} = \text{ERP (dBm)} + 2.15 \text{ (dB.)}$

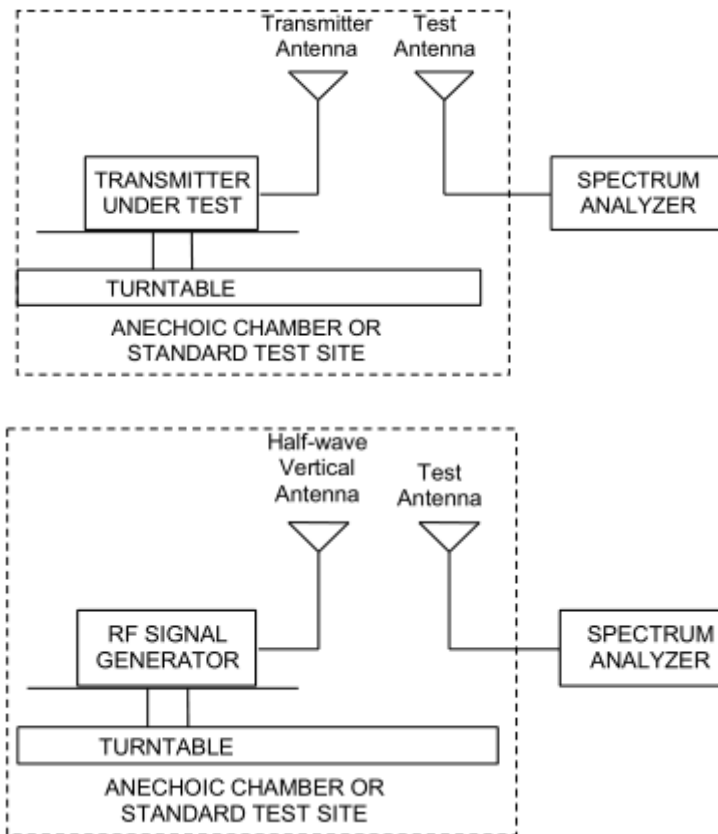


The RB allocation refers to section 5.1, using the maximum output power configuration.

**Test Setup**



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



**Limits**

No specific RF power output requirements in part 2.1046.

Rule Part 24.232(c) Mobile and portable stations are limited to 2 watts EIRP.

Rule Part 24.232(e) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

Limit	$\leq 2\text{ W}$ (33 dBm)
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**Measurement Uncertainty**

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor  $k = 2$ ,  $U = 0.4$  dB for RF power output,  $k = 2$ ,  $U = 1.19$  dB for EIRP.

**Test Results**

LTE Band2	Channel/ Frequency(MHz)	Index	RB# RBstart	Conducted Power (dBm)		EIRP (dBm)	
				QPSK	16QAM	QPSK	16QAM
1.4MHz	18607/1850.7	0	1#0	21.49	20.79	22.87	22.17
		0	6#0	19.39	19.38	20.77	20.76
	18900/1880	0	1#0	21.13	20.40	22.51	21.78
		0	6#0	19.26	19.20	20.64	20.58
	19193/1909.3	0	1#5	21.33	20.60	22.71	21.98
		0	6#0	19.50	19.42	20.88	20.80
3MHz	18615/1851.5	0	1#0	21.51	20.70	22.89	22.08
		0	6#0	19.43	19.45	20.81	20.83
	18900/1880	0	1#0	21.33	20.46	22.71	21.84
		0	6#0	19.16	19.20	20.54	20.58
	19185/1908.5	1	1#5	21.29	20.75	22.67	22.13
		1	6#0	19.20	19.19	20.58	20.57
5MHz	18625/1852.5	0	1#0	21.51	21.50	22.89	22.88
		0	6#0	20.40	20.50	21.78	21.88
	18900/1880	0	1#0	21.22	20.85	22.60	22.23
		0	6#0	20.25	20.17	21.63	21.55
	19175/1907.5	0	1#5	21.32	21.48	22.70	22.86
		3	6#0	20.42	20.70	21.80	22.08
10MHz	18650/1855	3	1#0	21.33	21.50	22.71	22.88
		0	4#0	20.44	20.43	21.82	21.81
	18900/1880	0	1#0	21.28	21.40	22.66	22.78
		0	4#0	21.35	21.17	22.73	22.55
	19150/1905	4	1#5	21.34	21.48	22.72	22.86
		7	4#2	21.37	21.33	22.75	22.71
15MHz	18675/1857.5	3	1#0	21.36	21.25	22.74	22.63
		0	6#0	21.49	21.47	22.87	22.85
	18900/1880	0	1#0	21.33	21.44	22.71	22.82
		0	6#0	21.30	21.26	22.68	22.64
	19125/1902.5	8	1#5	21.34	21.49	22.72	22.87
		11	6#0	21.42	21.23	22.80	22.61
20MHz	18700/1860	3	1#0	21.39	21.47	22.77	22.85
		0	6#0	21.48	21.25	22.86	22.63
	18900/1880	0	1#0	21.25	21.31	22.63	22.69
		0	6#0	21.29	21.41	22.67	22.79
	19100/1900	12	1#5	21.31	21.39	22.69	22.77
		15	6#0	21.43	21.20	22.81	22.58



LTE Band25	Channel/ Frequency(MHz)	Index	RB# RBstart	Conducted Power (dBm)		EIRP (dBm)	
				QPSK	16QAM	QPSK	16QAM
1.4MHz	26047/1850.7	0	1#0	21.63	20.04	23.01	21.42
		0	6#0	19.05	19.45	20.43	20.83
	26365/1882.5	0	1#0	21.32	19.80	22.70	21.18
		0	6#0	18.85	19.20	20.23	20.58
	26683/1914.3	0	1#5	20.94	19.49	22.32	20.87
		0	6#0	18.77	19.79	20.15	21.17
3MHz	26055/1851.5	0	1#0	21.25	19.92	22.63	21.30
		0	6#0	19.06	19.34	20.44	20.72
	26365/1882.5	0	1#0	21.01	19.85	22.39	21.23
		0	6#0	18.89	19.14	20.27	20.52
	26675/1913.5	1	1#5	20.91	19.66	22.29	21.04
		1	6#0	18.64	18.99	20.02	20.37
5MHz	26065/1852.5	0	1#0	21.02	20.75	22.40	22.13
		0	6#0	19.97	20.13	21.35	21.51
	26365/1882.5	0	1#0	20.80	21.03	22.18	22.41
		0	6#0	19.82	19.92	21.20	21.30
	26665/1912.5	0	1#5	20.81	20.47	22.19	21.85
		3	6#0	19.72	19.84	21.10	21.22
10MHz	26090/1855	3	1#0	21.03	20.76	22.41	22.14
		0	4#0	20.95	21.24	22.33	22.62
	26365/1882.5	0	1#0	20.80	21.07	22.18	22.45
		0	4#0	20.64	20.91	22.02	22.29
	26640/1910	4	1#5	20.61	20.30	21.99	21.68
		7	4#2	20.62	20.81	22.00	22.19
15MHz	26115/1857.5	3	1#0	21.03	20.76	22.41	22.14
		0	6#0	20.85	20.96	22.23	22.34
	26365/1882.5	0	1#0	20.77	21.07	22.15	22.45
		0	6#0	20.74	20.79	22.12	22.17
	26615/1907.5	8	1#5	20.59	20.31	21.97	21.69
		11	6#0	20.60	20.75	21.98	22.13
20MHz	26140/1860	3	1#0	21.01	20.71	22.39	22.09
		0	6#0	20.82	20.95	22.20	22.33
	26365/1882.5	0	1#0	20.89	20.06	22.27	21.44
		0	6#0	20.74	20.87	22.12	22.25
	26590/1905	12	1#5	20.51	20.29	21.89	21.67
		15	6#0	20.56	20.92	21.94	22.30

### 5.4. Occupied Bandwidth

#### Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

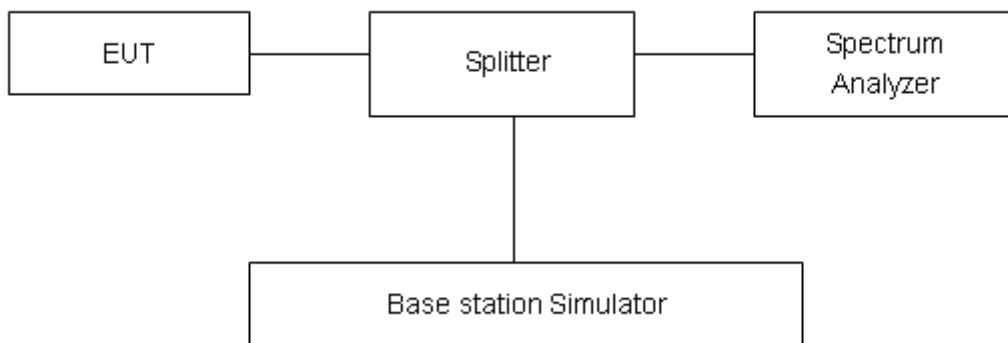
#### Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The occupied bandwidth is measured using spectrum analyzer.

RBW is set to 51kHz, VBW is set to 160kHz for LTE Band 2/25

99% power and -26dBc occupied bandwidths are recorded. Spectrum analyzer plots are included on the following pages.

#### Test Setup



#### Limits

No specific occupied bandwidth requirements in part 2.1049.

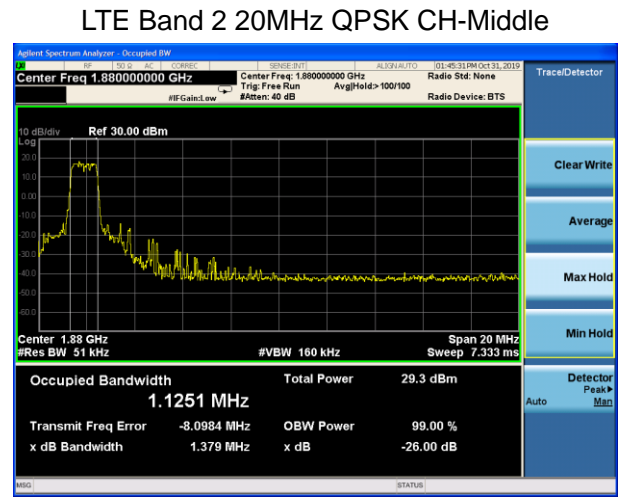
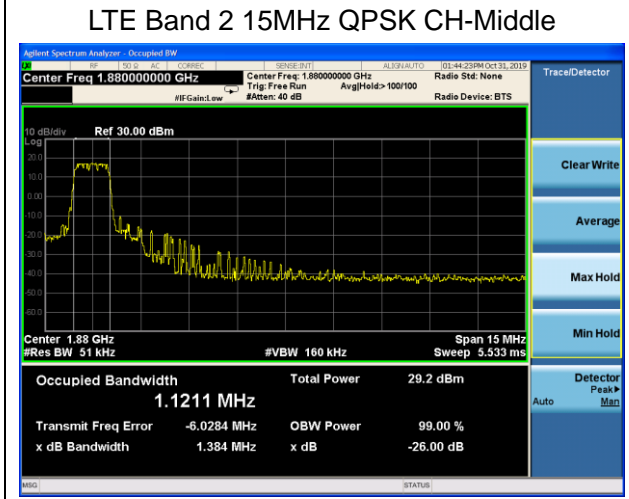
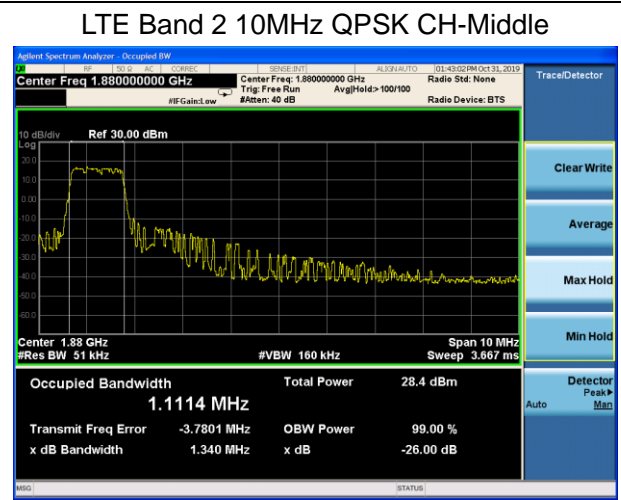
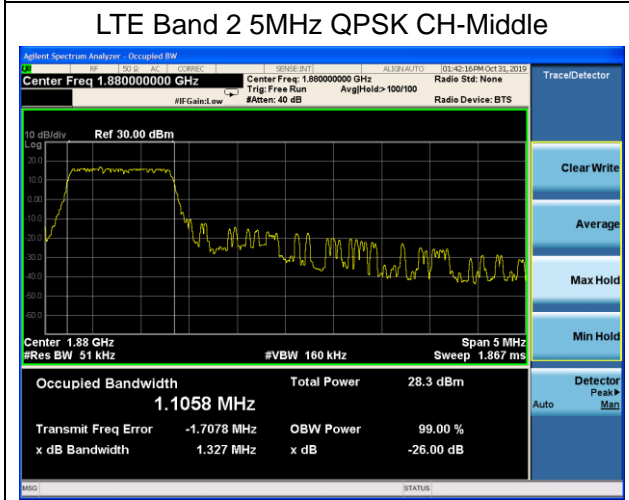
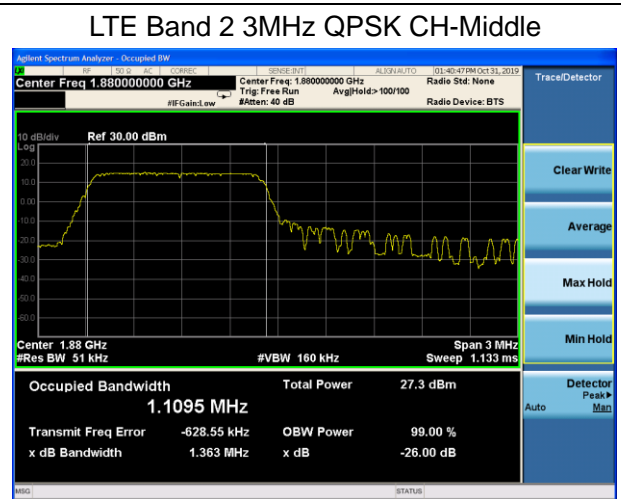
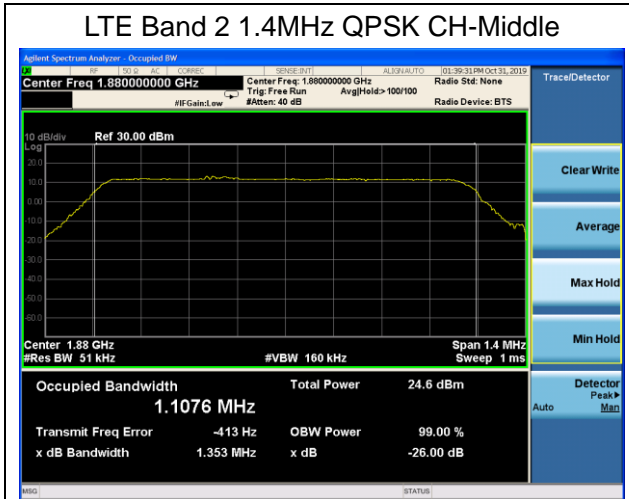
#### Measurement Uncertainty

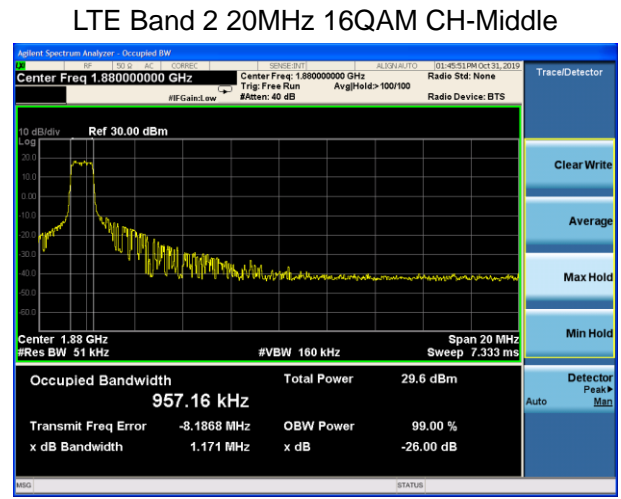
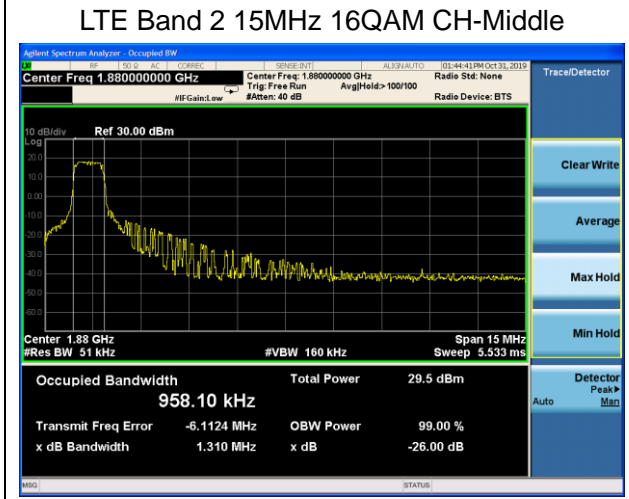
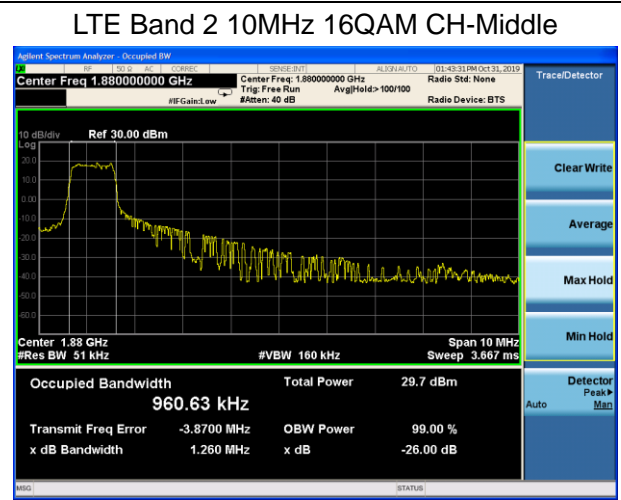
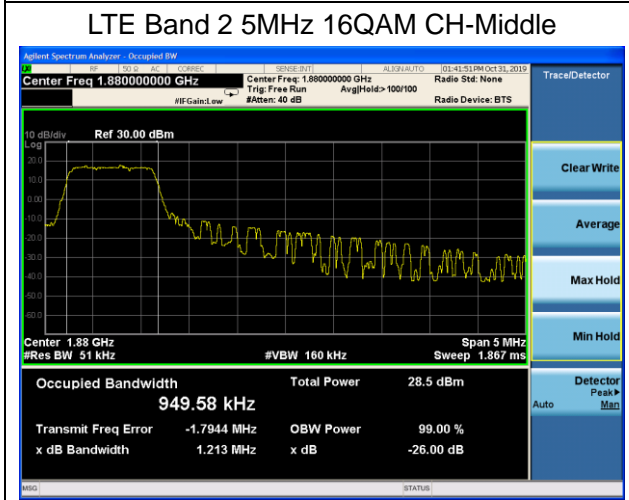
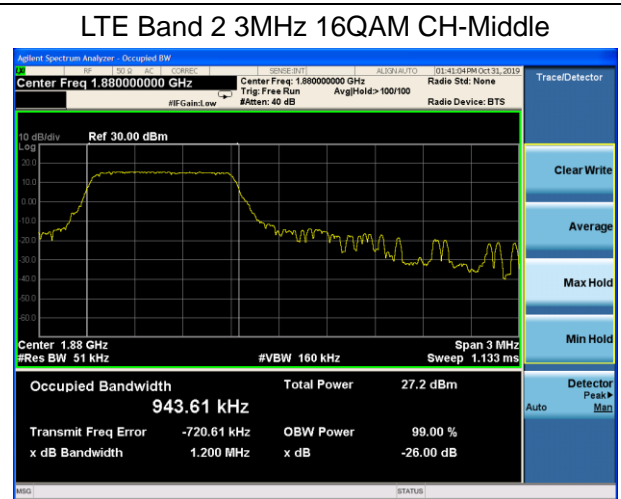
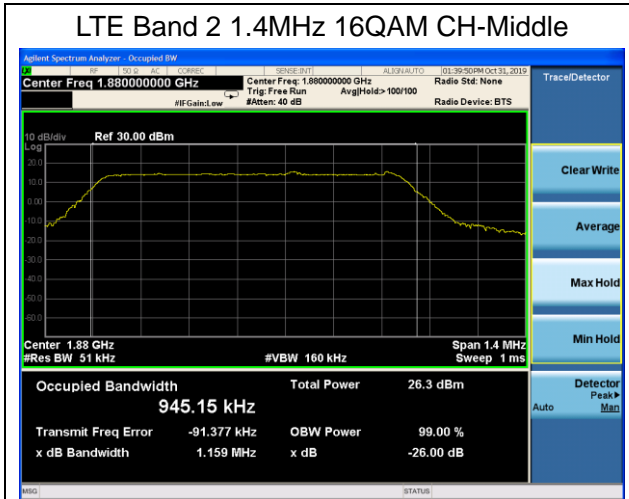
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor  $k = 2$ ,  $U = 624\text{Hz}$ .

**Test Result**

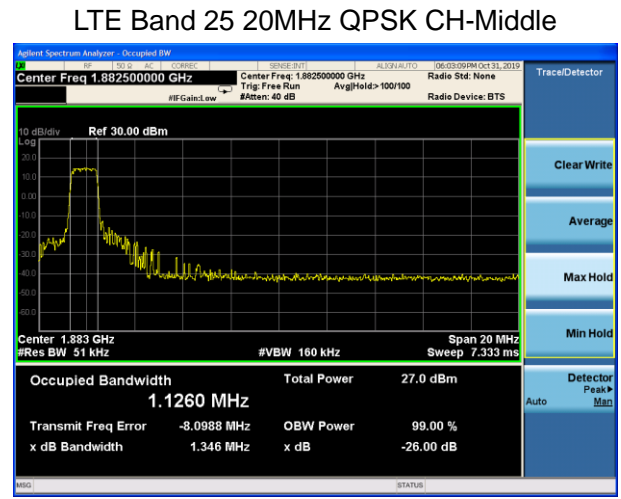
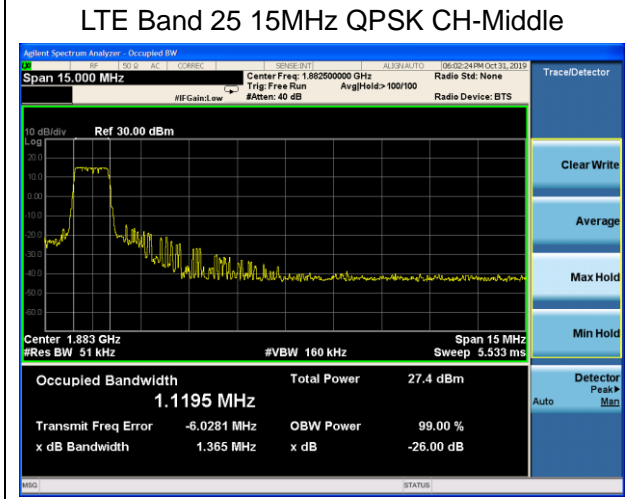
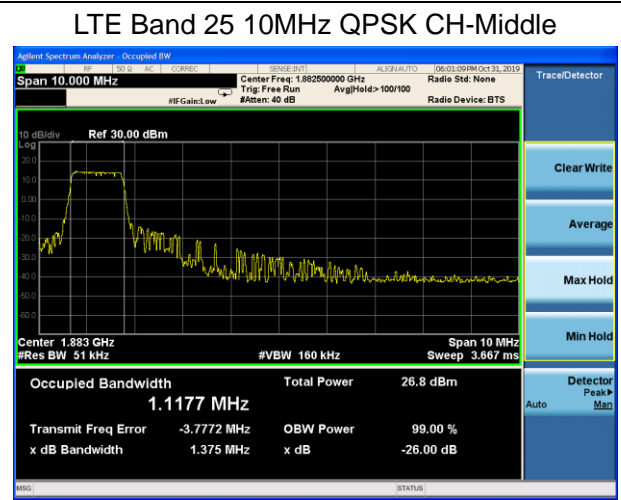
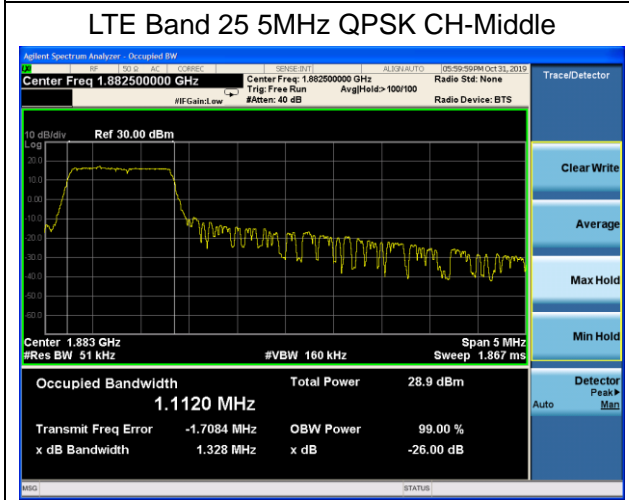
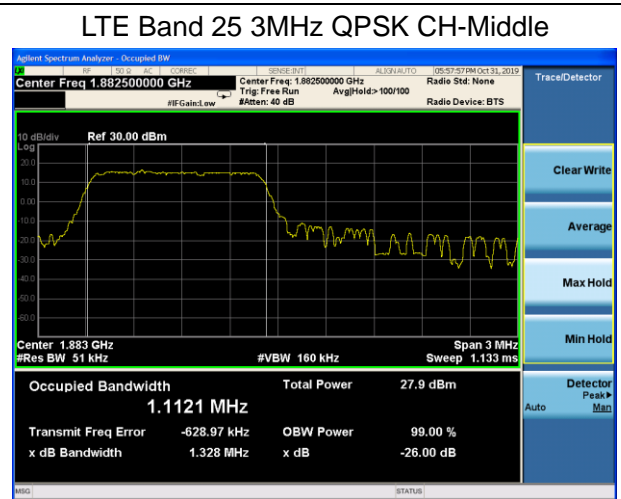
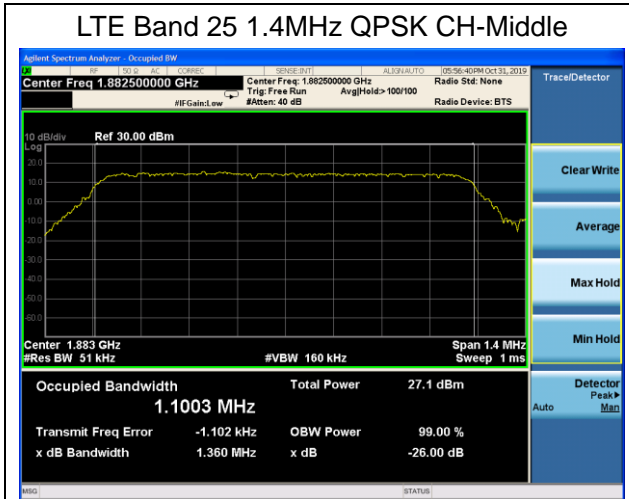
Mode	Bandwidth	Modulation	Channel/ Frequency(MHz)	RB	Index	Bandwidth(MHz)	
						99% Power	-26dBc
Band2	1.4MHz	QPSK	18900/1880	6#0	0	1.1076	1.353
		16QAM	18900/1880	6#0	0	0.9452	1.159
	3MHz	QPSK	18900/1880	6#0	0	1.1095	1.363
		16QAM	18900/1880	6#0	0	0.9436	1.200
	5MHz	QPSK	18900/1880	6#0	0	1.1058	1.327
		16QAM	18900/1880	6#0	0	0.9496	1.213
	10MHz	QPSK	18900/1880	6#0	0	1.1114	1.340
		16QAM	18900/1880	6#0	0	0.9606	1.260
	15MHz	QPSK	18900/1880	6#0	0	1.1211	1.384
		16QAM	18900/1880	6#0	0	0.9581	1.310
	20MHz	QPSK	18900/1880	6#0	0	1.1251	1.379
		16QAM	18900/1880	6#0	0	0.9572	1.171

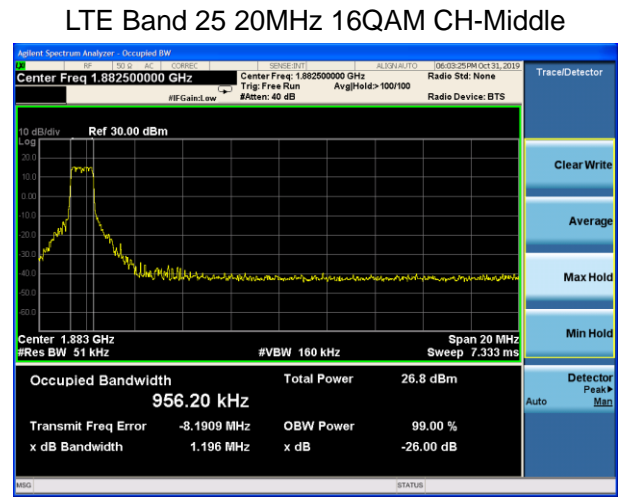
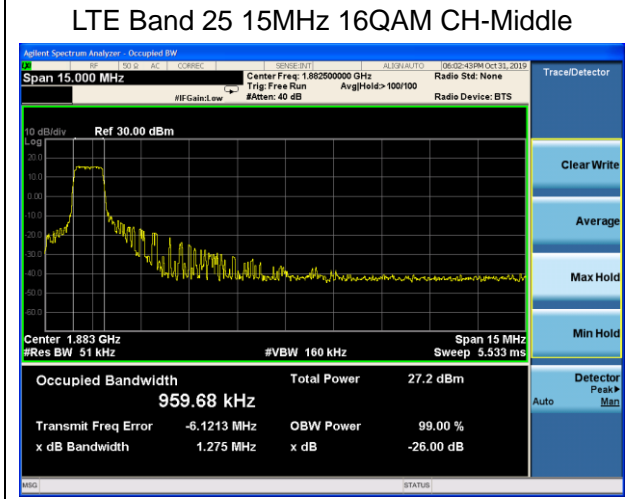
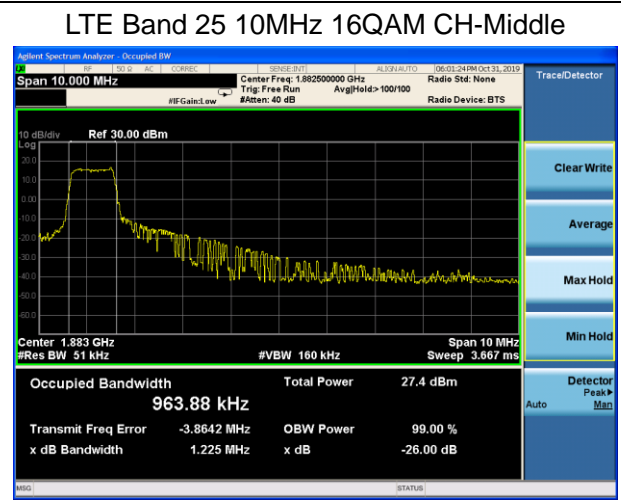
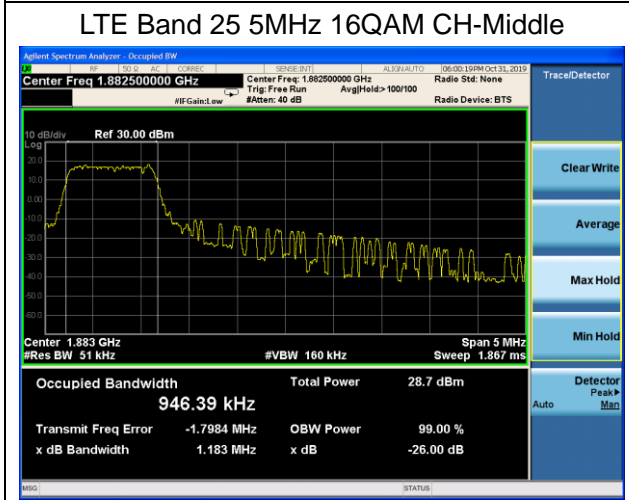
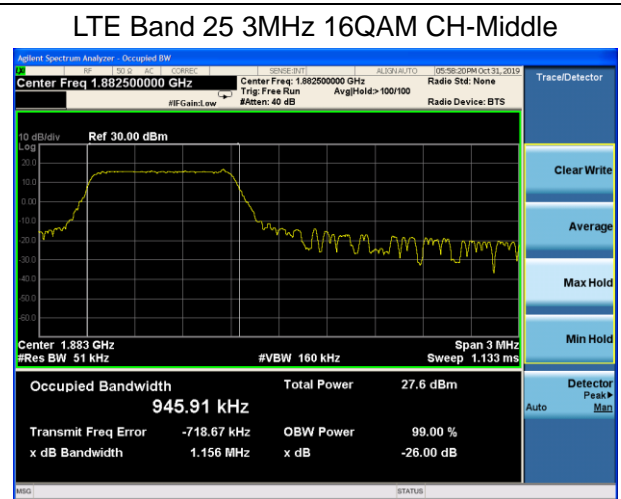
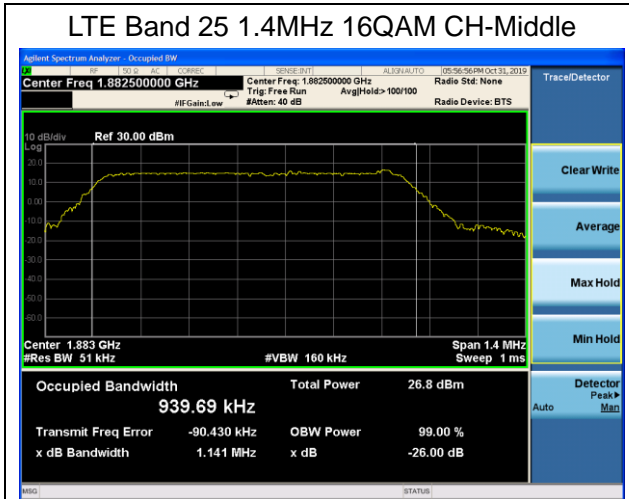
Mode	Bandwidth	Modulation	Channel/ Frequency(MHz)	RB	Index	Bandwidth(MHz)	
						99% Power	-26dBc
Band25	1.4MHz	QPSK	26365/1882.5	6#0	0	1.1003	1.360
		16QAM	26365/1882.5	6#0	0	0.9397	1.141
	3MHz	QPSK	26365/1882.5	6#0	0	1.1121	1.328
		16QAM	26365/1882.5	6#0	0	0.9459	1.156
	5MHz	QPSK	26365/1882.5	6#0	0	1.1120	1.328
		16QAM	26365/1882.5	6#0	0	0.9464	1.183
	10MHz	QPSK	26365/1882.5	6#0	0	1.1177	1.375
		16QAM	26365/1882.5	6#0	0	0.9639	1.225
	15MHz	QPSK	26365/1882.5	6#0	0	1.1195	1.365
		16QAM	26365/1882.5	6#0	0	0.9597	1.275
	20MHz	QPSK	26365/1882.5	6#0	0	1.1260	1.346
		16QAM	26365/1882.5	6#0	0	0.9562	1.196











### 5.5. Band Edge Compliance

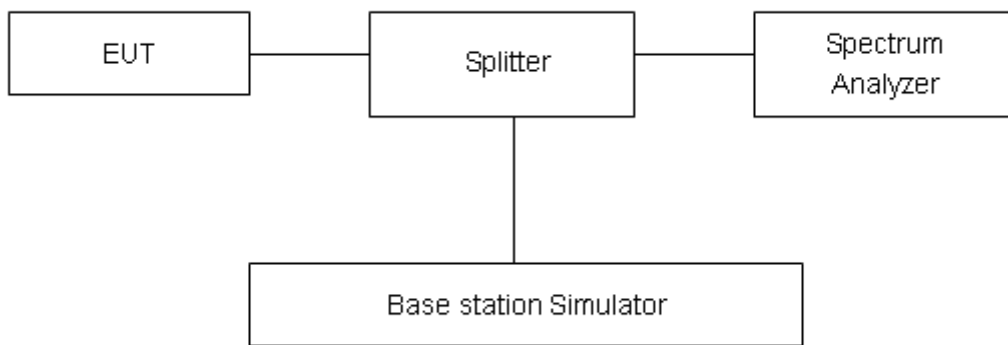
#### Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

#### Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The band edge of the lowest and highest channels were measured. The Average detector is used and RBW is set to 51kHz, VBW is set to 160kHz for LTE Band 2/5 (1.4/3/5/10/15/20MHz), Spectrum analyzer plots are included on the following pages.

#### Test Setup



#### Limits

Rule Part 24.238(a) specifies that “on any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log_{10} (P)$  dB.”

Limit	-13 dBm
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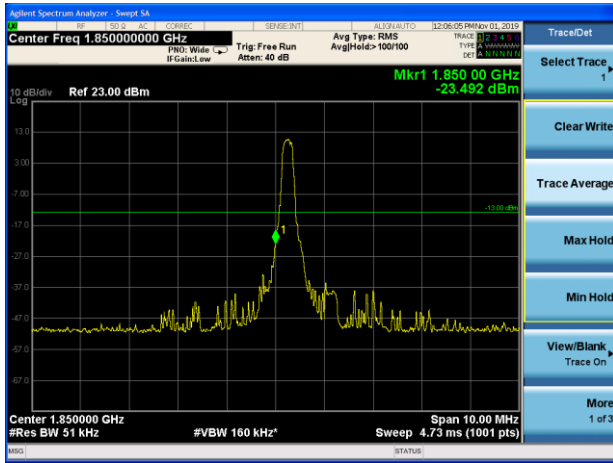
#### Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor  $k = 1.96$ ,  $U=0.684$ dB.

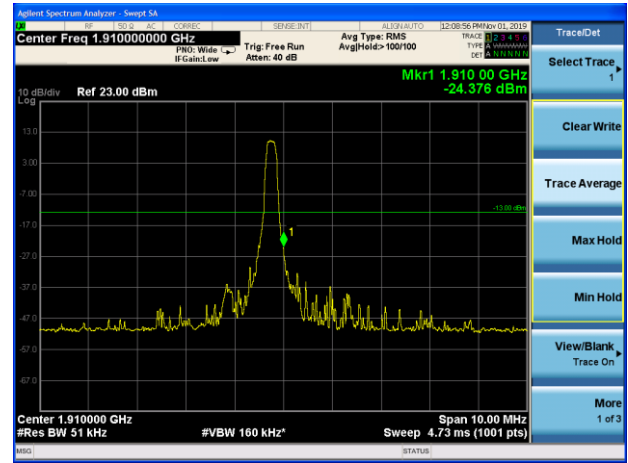


Test Result:

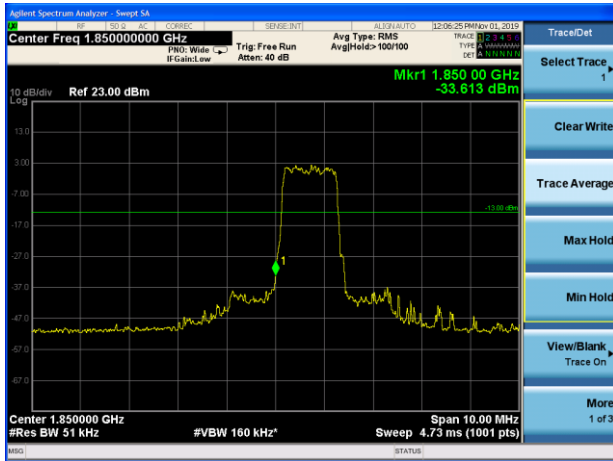
LTE Band 2 1.4MHz QPSK 1RB CH-Low



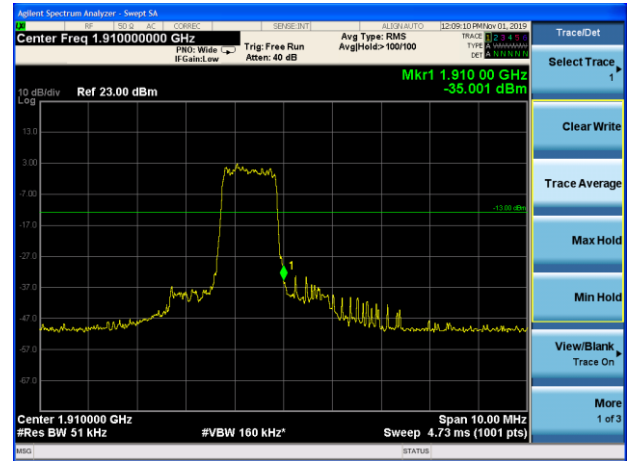
LTE Band 2 1.4MHz QPSK 1RB CH-High



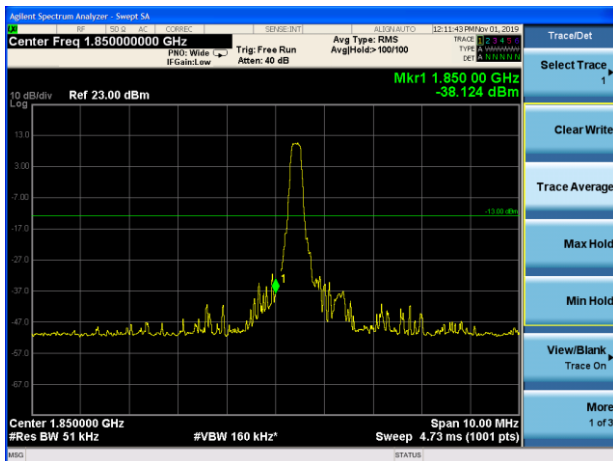
LTE Band 2 1.4MHz QPSK 100%RB CH-Low



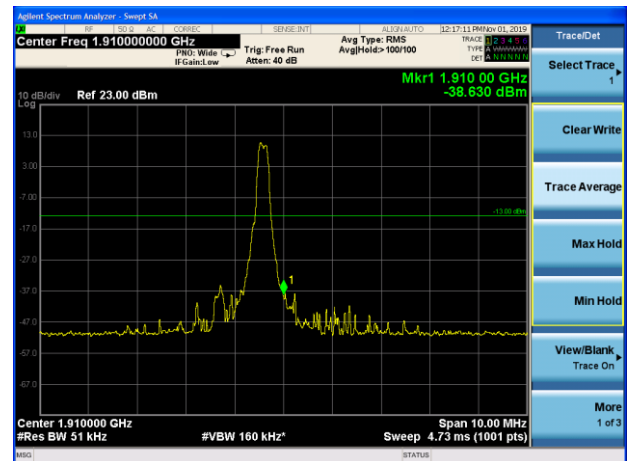
LTE Band 2 1.4MHz QPSK 100%RB CH-High



LTE Band 2 3MHz QPSK 1RB CH-Low

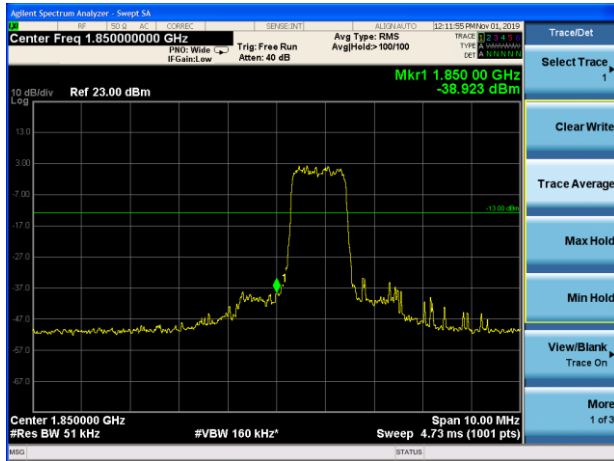


LTE Band 2 3MHz QPSK 1RB CH-High

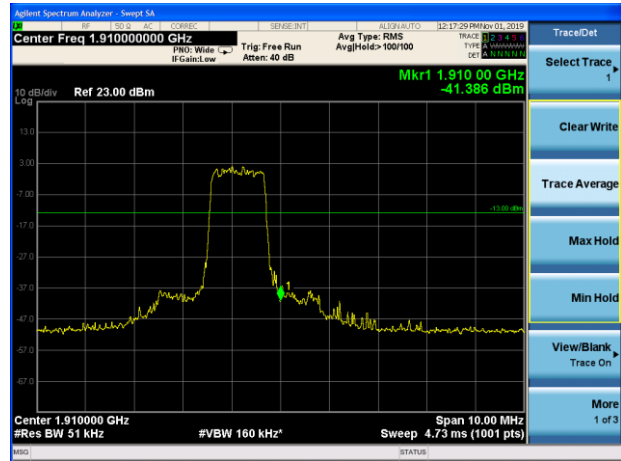




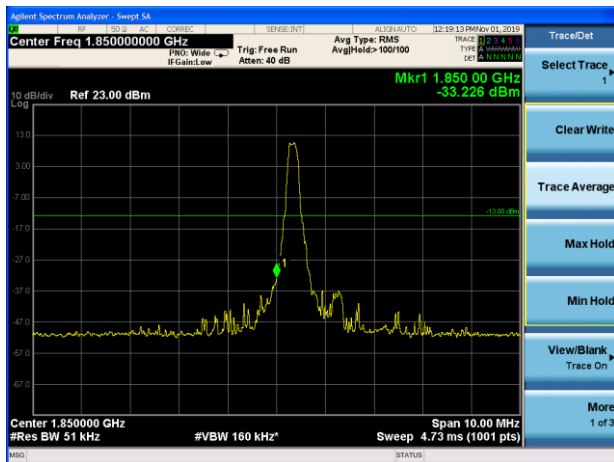
LTE Band 2 3MHz QPSK 100%RB CH-Low



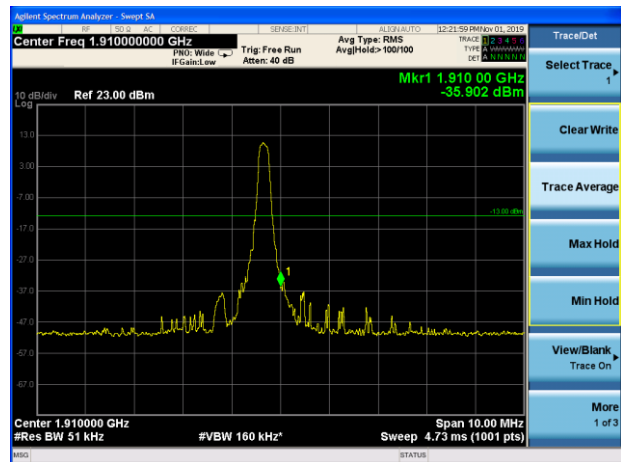
LTE Band 2 3MHz QPSK 100%RB CH-High



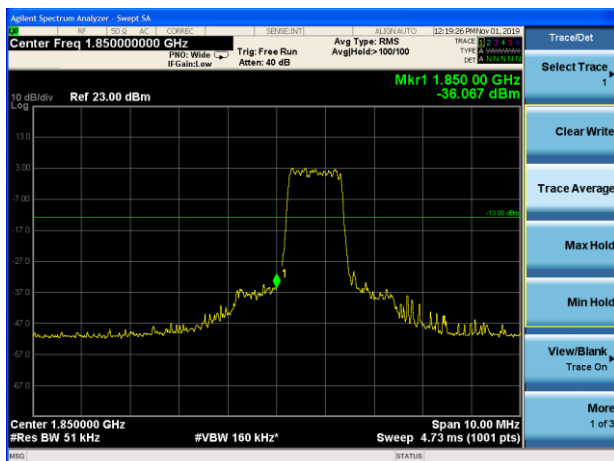
LTE Band 2 5MHz QPSK 1RB CH-Low



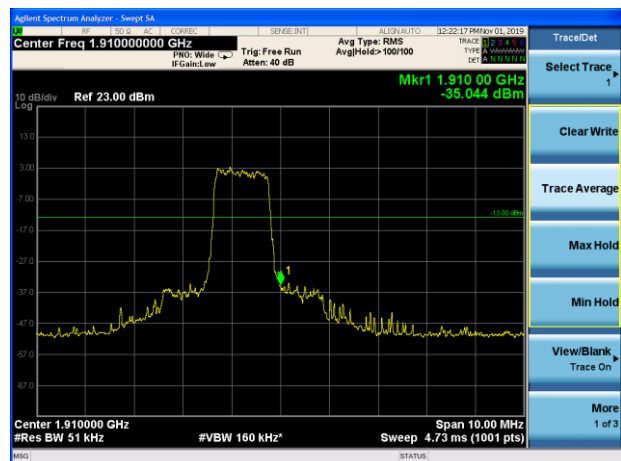
LTE Band 2 5MHz QPSK 1RB CH-High



LTE Band 2 5MHz QPSK 100%RB CH-Low

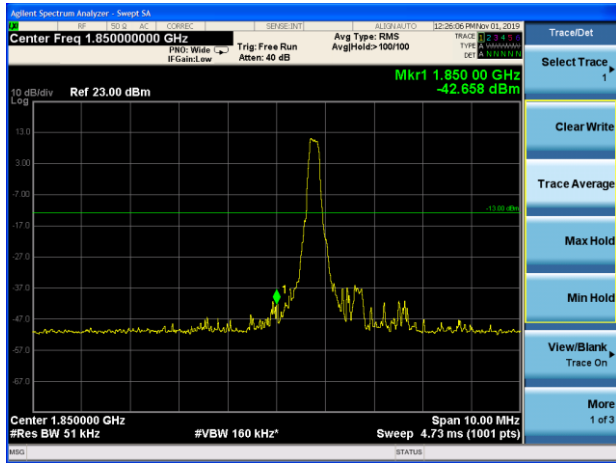


LTE Band 2 5MHz QPSK 100%RB CH-High

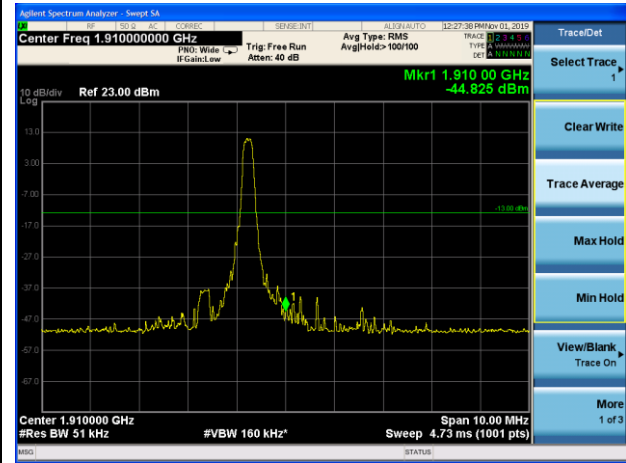




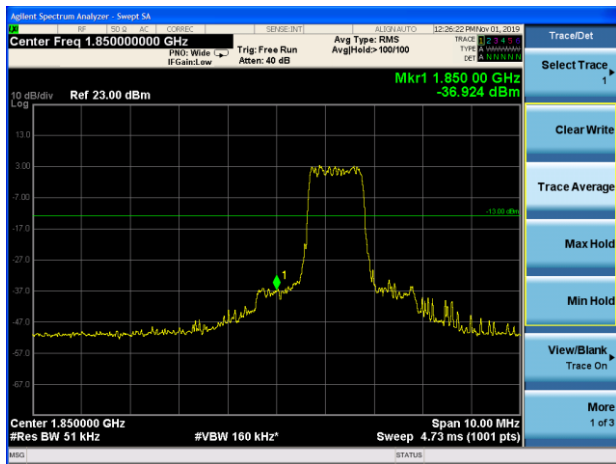
LTE Band 2 10MHz QPSK 1RB CH-Low



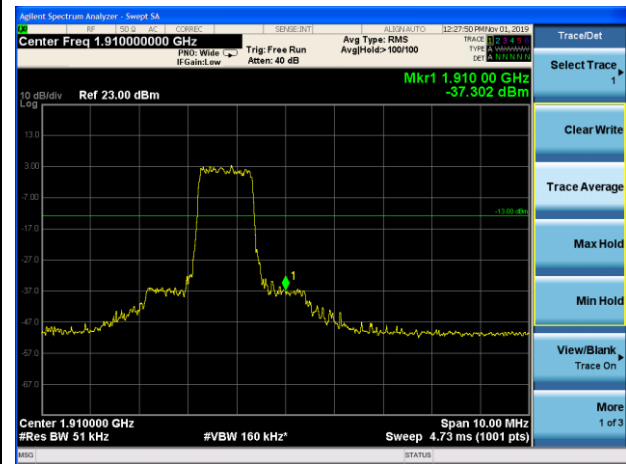
LTE Band 2 10MHz QPSK 1RB CH-High



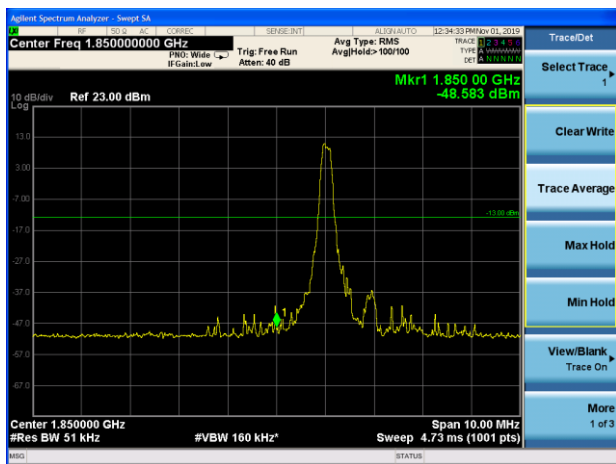
LTE Band 2 10MHz QPSK 100%RB CH-Low



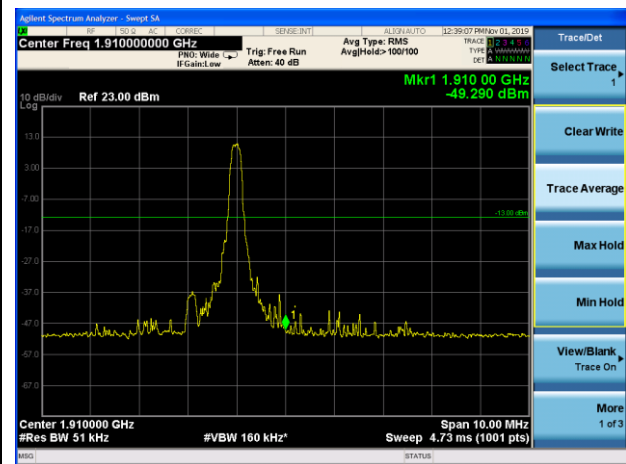
LTE Band 2 10MHz QPSK 100%RB CH-High



LTE Band 2 15MHz QPSK 1RB CH-Low

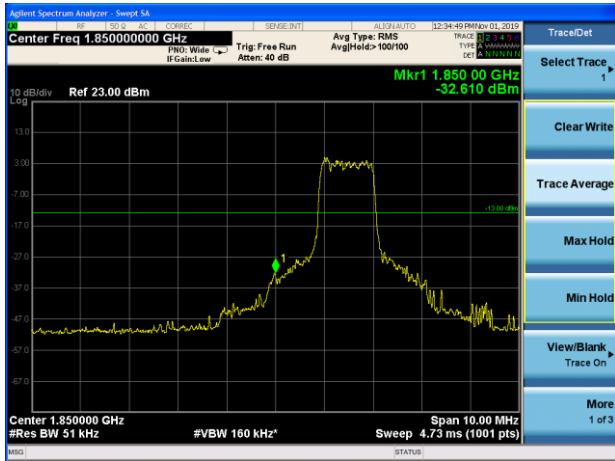


LTE Band 2 15MHz QPSK 1RB CH-High

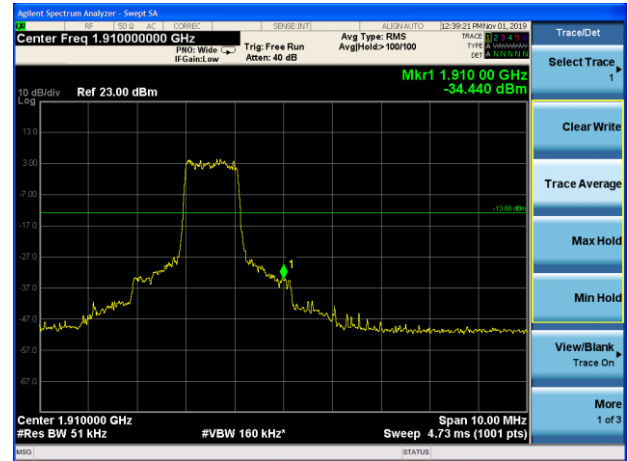




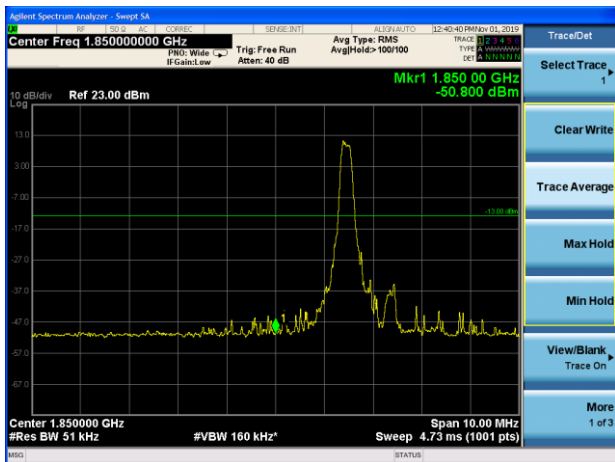
LTE Band 2 15MHz QPSK 100%RB CH-Low



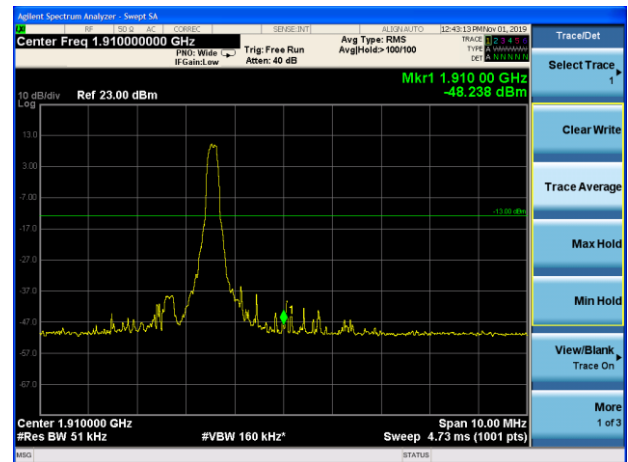
LTE Band 2 15MHz QPSK 100%RB CH-High



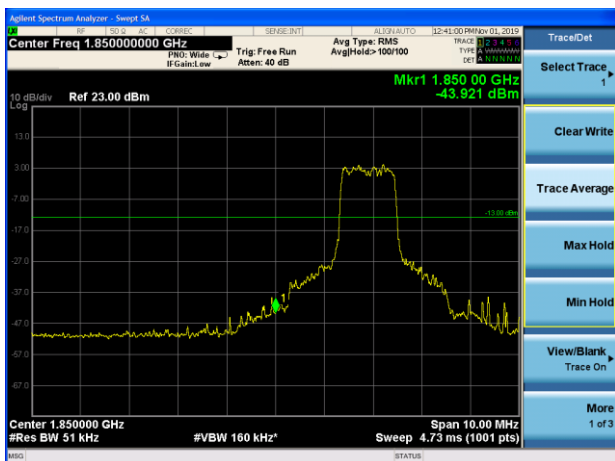
LTE Band 2 20MHz QPSK 1RB CH-Low



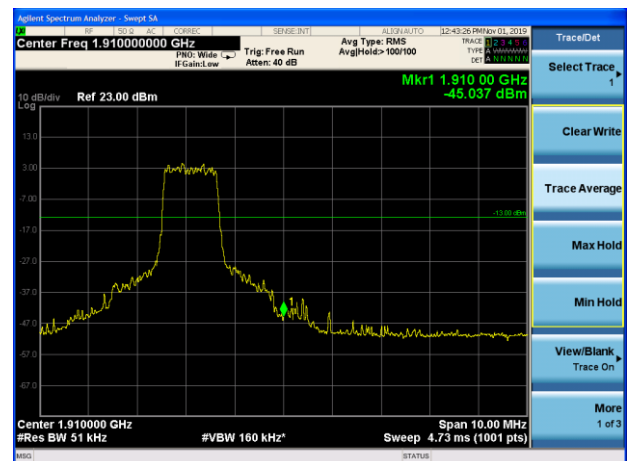
LTE Band 2 20MHz QPSK 1RB CH-High



LTE Band 2 20MHz QPSK 100%RB CH-Low

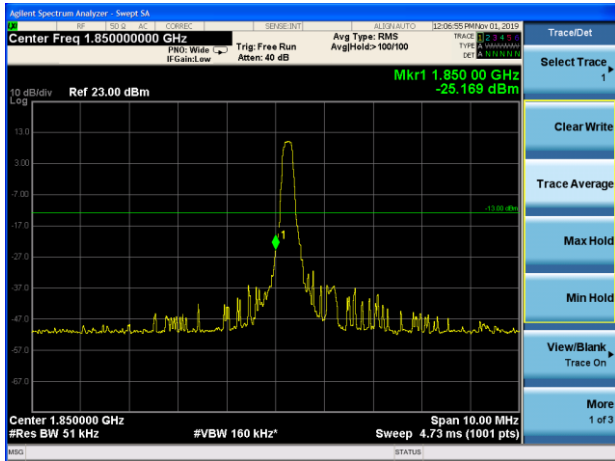


LTE Band 2 20MHz QPSK 100%RB CH-High

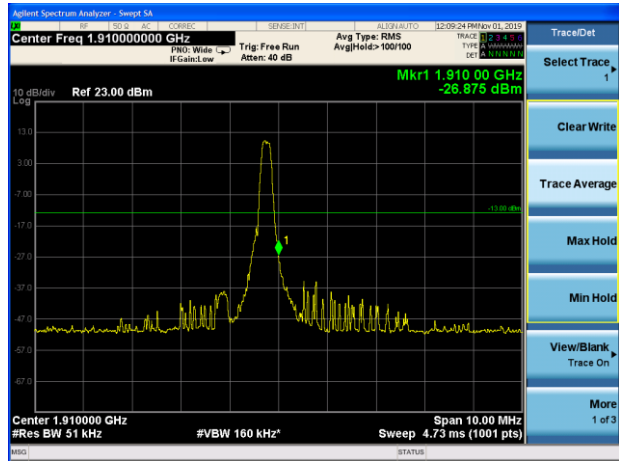




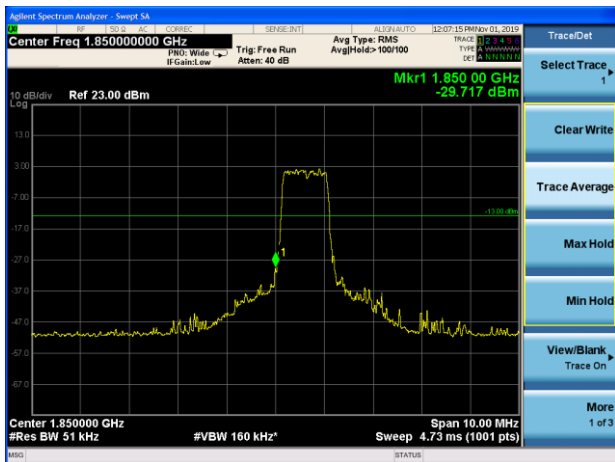
### LTE Band 2 1.4MHz 16QAM 1RB CH-Low



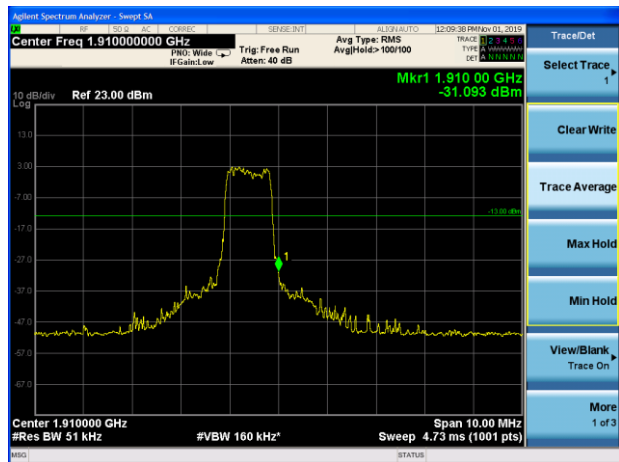
### LTE Band 2 1.4MHz 16QAM 1RB CH-High



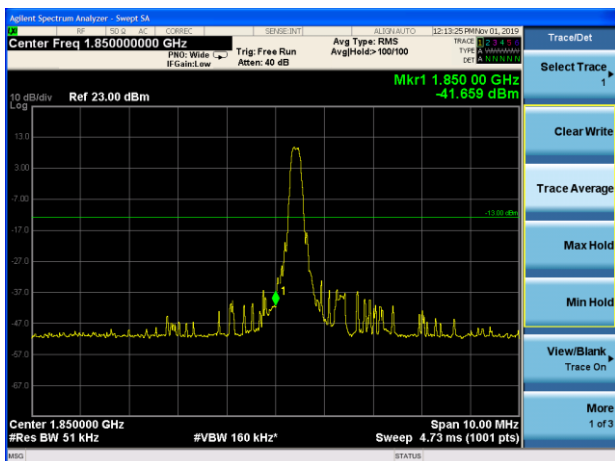
### LTE Band 2 1.4MHz 16QAM 100%RB CH-Low



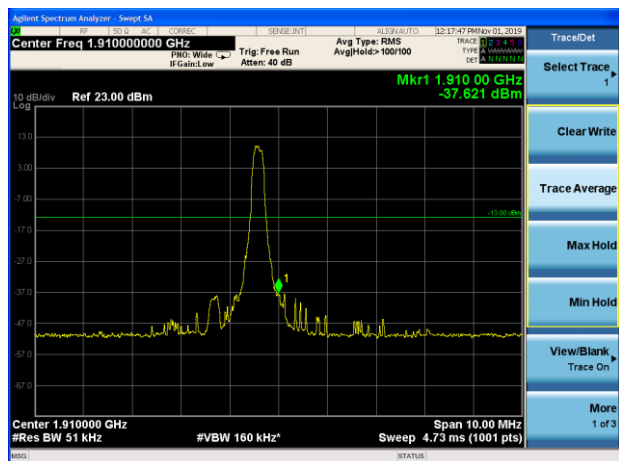
### LTE Band 2 1.4MHz 16QAM 100%RB CH-High



### LTE Band 2 3MHz 16QAM 1RB CH-Low



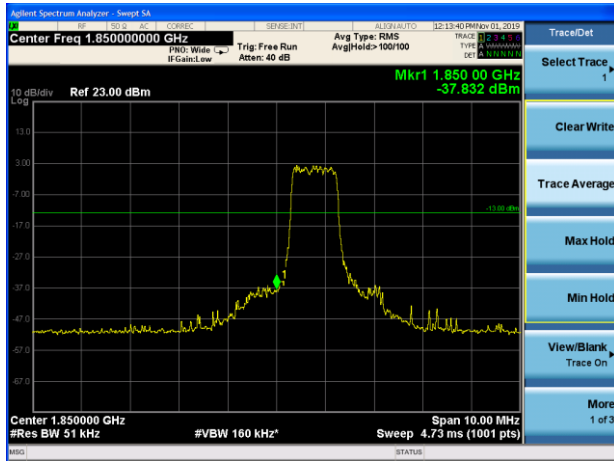
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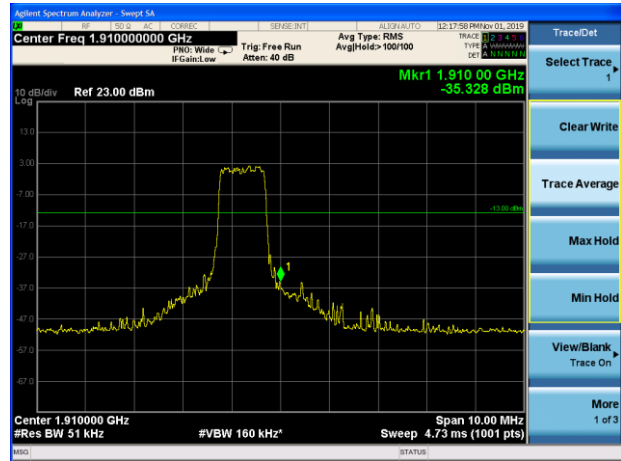




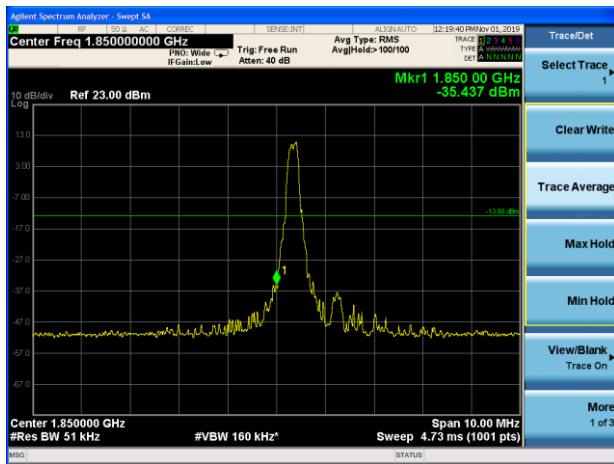
### LTE Band 2 3MHz 16QAM 100%RB CH-Low



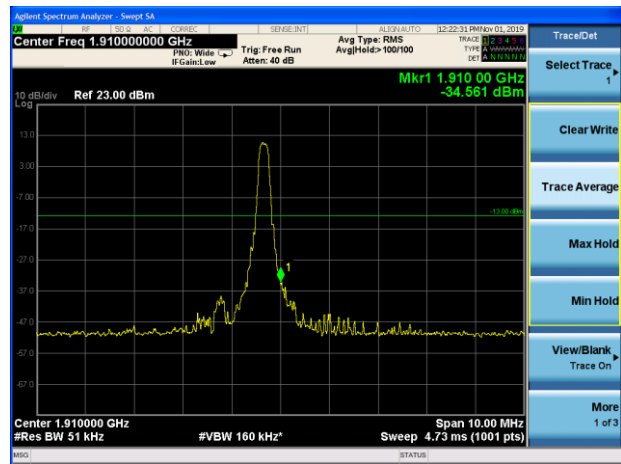
### LTE Band 2 3MHz 16QAM 100%RB CH-High



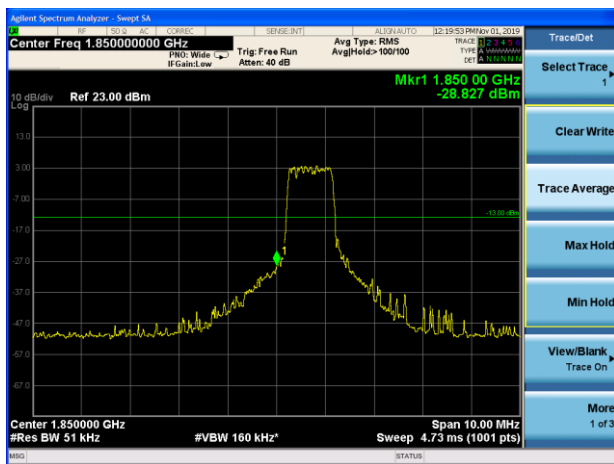
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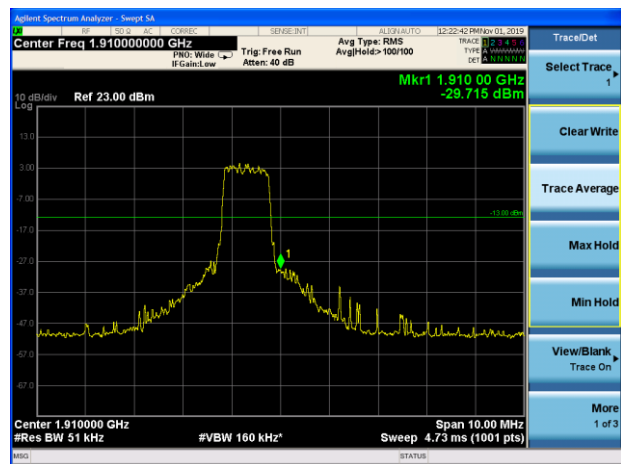
### LTE Band 2 5MHz 16QAM 1RB CH-High



### LTE Band 2 5MHz 16QAM 100%RB CH-Low

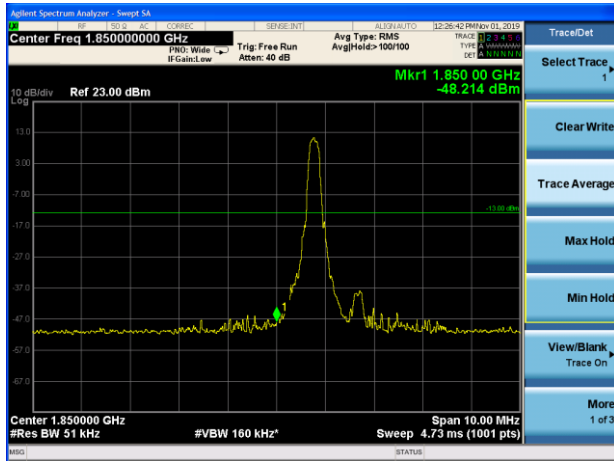


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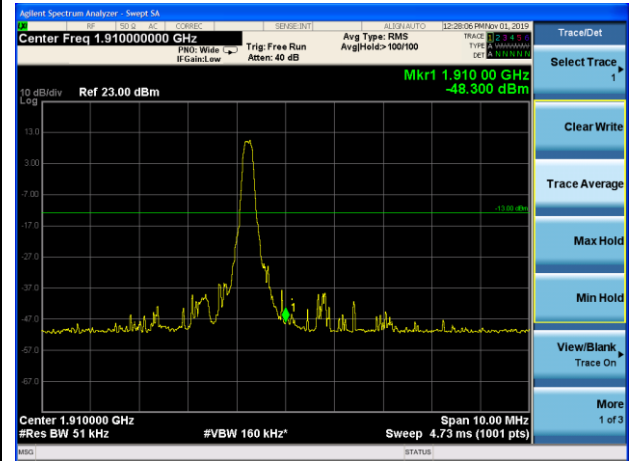




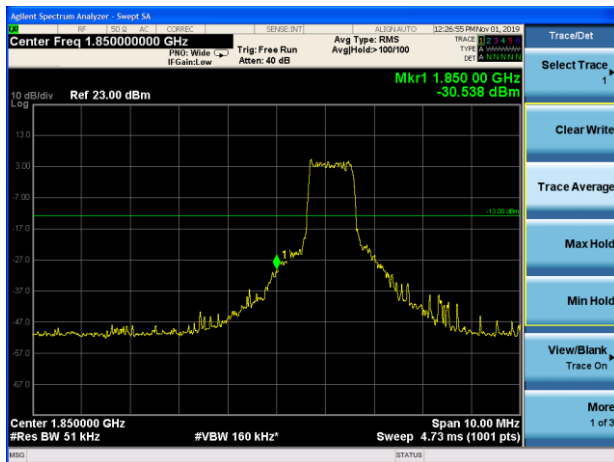
### LTE Band 2 10MHz 16QAM 1RB CH-Low



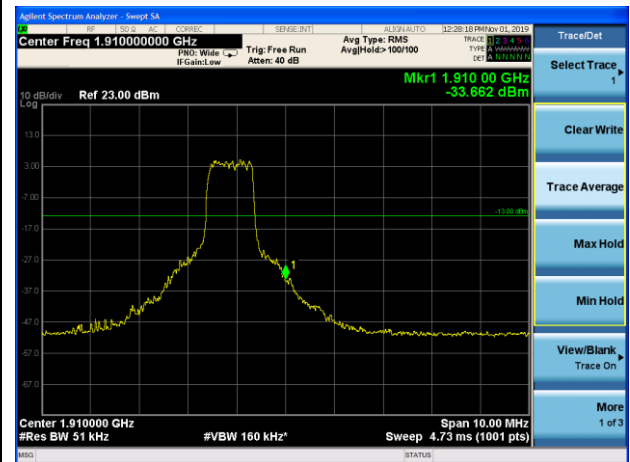
### LTE Band 2 10MHz 16QAM 1RB CH-High



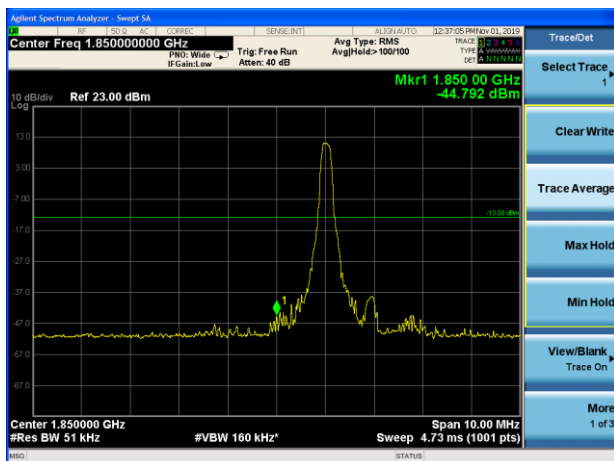
### LTE Band 2 10MHz 16QAM 100%RB CH-Low



### LTE Band 2 10MHz 16QAM 100%RB CH-High



### LTE Band 2 15MHz 16QAM 1RB CH-Low



### LTE Band 2 15MHz 16QAM 1RB CH-High

