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-R4
Issue Date	May 8, 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 22H (2019)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Peng Tao

Performed by: Peng Tao

Kai Xu

Approved by: Kai Xu

TA Technology (Shanghai) Co., Ltd.

No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China

TEL: +86-021-50791141/2/3

FAX: +86-021-50791141/2/3-8000

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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 22.913(a)(5)	PASS
2	Occupied Bandwidth	2.1049	PASS
3	Band Edge Compliance	2.1051 / 22.917(a)	PASS
4	Peak-to-Average Power Ratio	22.913(d)/ KDB 971168 D01(5.7)	PASS
5	Frequency Stability	2.1055 / 22.355	PASS
6	Spurious Emissions at Antenna Terminals	2.1051 / 22.917(a)	PASS
7	Radiates Spurious Emission	2.1053 / 22.917 (a)	PASS
Date of Testing: December 13, 2019 ~January 14, 2020			
Note: 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-R4).All test values duplicated from the BG77 report (Report No. : R1909A0576-R5). 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
Country:	P. R. China
Contact:	Xu Kai
Telephone:	+86-021-50791141/2/3
Fax:	+86-021-50791141/2/3-8000
Website:	http://www.ta-shanghai.com
E-mail:	xukai@ta-shanghai.com

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	2.29dBi		
Test Mode(s)	LTE Band 5/26;		
Test Modulation	(LTE)QPSK 16QAM;		
LTE Category	M1		
Maximum E.R.P.	LTE Band 5:	21.43dBm	
	LTE Band 26:	21.52dBm	
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 5	824 ~ 849	869 ~ 894
	LTE Band 26	824 ~ 849	869 ~ 894
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 22H (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.

mode and data rates and positions 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 as the worst case configuration below for LTE Band 5/26

Test items	Modes	Bandwidth (MHz)					Modulation		RB			Test Channel		
		1.4	3	5	10	15	QPSK	16QAM	1	50%	100%	L	M	H
RF power output and Effective Isotropic Radiated power	LTE 5	O	O	O	O	-	O	O	O	O	O	O	O	O
	LTE 26	O	O	O	O	O	O	O	O	O	O	O	O	O
Occupied Bandwidth	LTE 5	O	O	O	O	-	O	O	-	-	O	O	O	O
	LTE 26	O	O	O	O	O	O	O	-	-	O	O	O	O
Band Edge Compliance	LTE 5	O	O	O	O	-	O	O	O	-	O	O	-	O
	LTE 26	O	O	O	O	O	O	O	O	-	O	O	-	O
Peak-to-Average Power Ratio	LTE 5	O	O	O	O	-	O	O	-	-	O	O	O	O
	LTE 26	O	O	O	O	O	O	O	-	-	O	O	O	O
Frequency Stability	LTE 5	O	O	O	O	-	O	O	O	O	O	O	O	O
	LTE 26	O	O	O	O	O	O	O	O	O	O	O	O	O
Spurious Emissions at Antenna Terminals	LTE 5	O	O	O	O	-	O	-	O	-	-	O	O	O
	LTE 26	O	O	O	O	O	O	-	O	-	-	O	O	O
Radiates Spurious Emission	LTE 5	O	-	O	O	-	O	-	O	-	-	-	O	-
	LTE 26	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

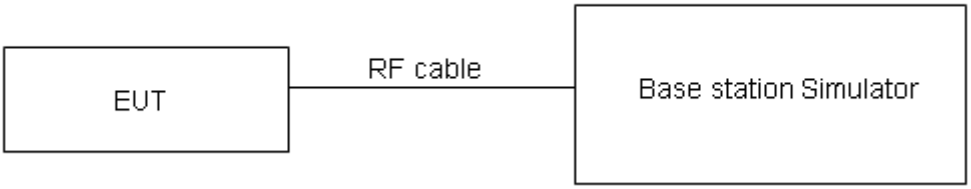
Methods of Measurement

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

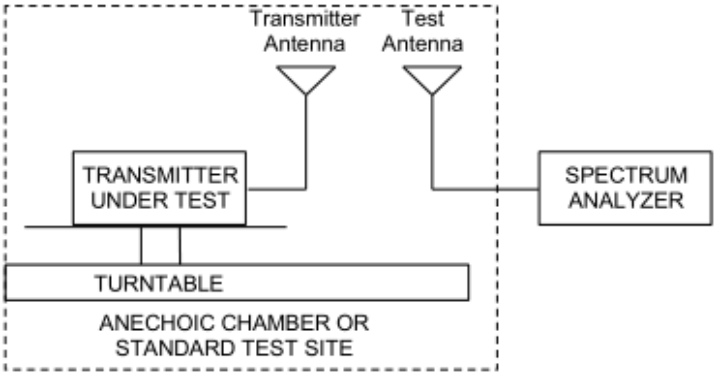
The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI C63.26 (2015).
a) Connect the equipment as illustrated. Mount the equipment with the manufacturer specified antenna in a vertical orientation on a manufacturer specified mounting surface located on a non-conducting rotating platform of a 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 = Generator Output Power (dBm) – 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 (dBm) = LVL (dBm) + 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 (dBm) = Output Power (dBm) - Losses (dB) + Antenna Gain (dBi)
where:dBd refers to gain relative to an ideal dipole.
EIRP (dBm) = ERP (dBm) + 2.15 (dB.)

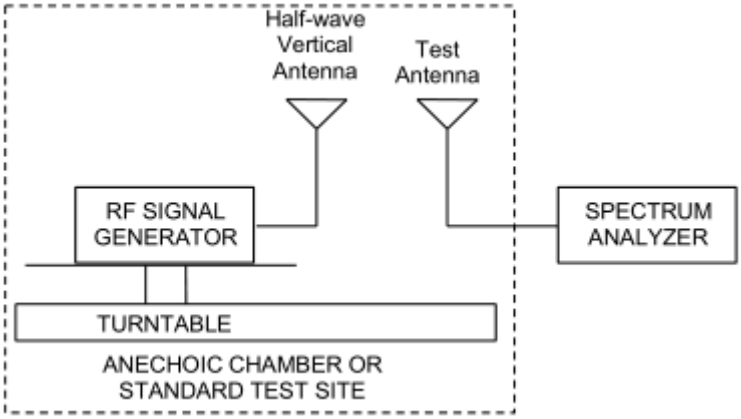
The RB allocation refers to section 5.1, using the maximum output power configuration.

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 22.913(a)(5) specifies that "Mobile/portable stations are limited to 7 watts ERP".

Limit	≤ 7 W (38.45 dBm)

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 ERP .

Test Results

LTE Band 5	Channel/ Frequency(MHz)	Index	RB# RBstart	Conducted Power (dBm)		ERP(dBm)	
				QPSK	16QAM	QPSK	16QAM
1.4MHz	20407/824.7	0	1#0	20.58	20.22	20.56	20.20
		0	6#0	19.03	18.89	19.01	18.87
	20525/836.5	0	1#0	21.20	19.57	21.18	19.55
		0	6#0	18.96	19.61	18.94	19.59
	20643/848.3	0	1#5	20.92	19.55	20.90	19.53
		0	6#0	18.91	19.55	18.89	19.53
3MHz	20415/825.5	0	1#0	20.80	20.47	20.78	20.45
		0	6#0	18.90	18.81	18.88	18.79
	20525/836.5	0	1#0	21.03	19.78	21.01	19.76
		0	6#0	19.03	19.33	19.01	19.31
	20635/847.5	1	1#5	20.84	18.93	20.82	18.91
		1	6#0	18.95	19.28	18.93	19.26
5MHz	20425/826.5	0	1#0	20.86	20.43	20.84	20.41
		0	6#0	20.00	20.23	19.98	20.21
	20525/836.5	0	1#0	20.88	20.47	20.86	20.45
		0	6#0	20.03	20.20	20.01	20.18
	20625/846.5	3	1#5	20.68	20.17	20.66	20.15
		3	6#0	19.94	20.07	19.92	20.05
10MHz	20450/829	0	1#0	20.95	20.49	20.93	20.47
		0	4#0	20.96	21.45	20.94	21.43
	20525/836.5	0	1#0	20.74	21.20	20.72	21.18
		0	4#0	20.92	21.18	20.90	21.16
	20600/844	7	1#5	20.78	20.28	20.76	20.26
		7	4#2	20.91	21.36	20.89	21.34

LTE Band26	Channel/ Frequency(MHz)	Index	RB# RBstart	Conducted Power (dBm)		ERP(dBm)	
				QPSK	16QAM	QPSK	16QAM
1.4MHz	26797/824.7	0	1#0	21.38	19.53	21.36	19.51
		0	6#0	18.92	19.66	18.90	19.64
	26915/836.5	0	1#0	21.21	20.02	21.19	20.00
		0	6#0	19.06	19.24	19.04	19.22
	27033/848.3	0	1#5	21.26	19.60	21.24	19.58
		0	6#0	18.90	19.59	18.88	19.57
3MHz	26805/825.5	0	1#0	21.24	19.71	21.22	19.69
		0	6#0	18.92	19.35	18.90	19.33
	26915/836.5	0	1#0	21.17	19.83	21.15	19.81
		0	6#0	18.96	19.27	18.94	19.25
	27025/847.5	1	1#5	21.18	19.77	21.16	19.75
		1	6#0	18.93	19.24	18.91	19.22
5MHz	26815/826.5	3	1#0	21.08	20.68	21.06	20.66
		0	6#0	20.04	20.27	20.02	20.25
	26915/836.5	0	1#0	21.05	20.63	21.03	20.61
		0	6#0	20.08	20.24	20.06	20.22
	27015/846.5	0	1#5	20.91	20.57	20.89	20.55
		3	6#0	19.88	20.06	19.86	20.04
10MHz	26840/829	3	1#0	21.11	20.57	21.09	20.55
		0	4#0	20.07	21.17	20.05	21.15
	26915/836.5	0	1#0	21.11	20.67	21.09	20.65
		0	4#0	20.04	21.26	20.02	21.24
	26990/844	4	1#5	21.07	20.60	21.05	20.58
		7	4#2	20.98	21.54	20.96	21.52
15MHz	26865/831.5	3	1#0	21.07	20.73	21.05	20.71
		0	6#0	20.93	21.17	20.91	21.15
	26915/836.5	0	1#0	21.04	20.59	21.02	20.57
		0	6#0	20.95	21.19	20.93	21.17
	26965/841.5	8	1#5	21.06	20.72	21.04	20.70
		11	6#0	20.99	21.12	20.97	21.10

5.4. Occupied Bandwidth

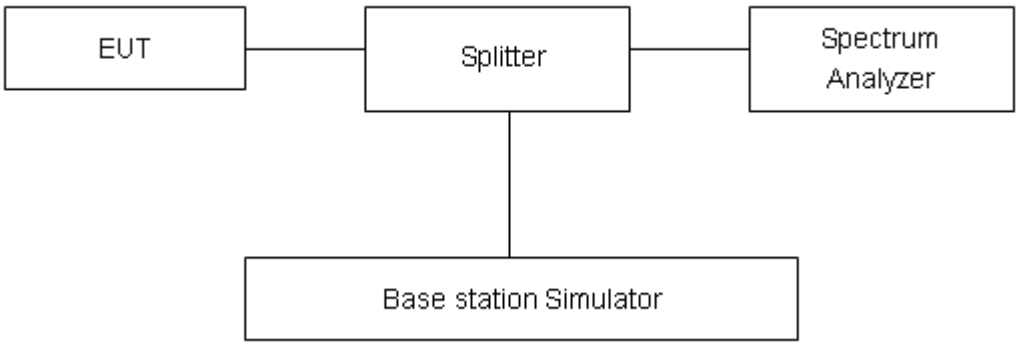
Ambient condition

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 5/26
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

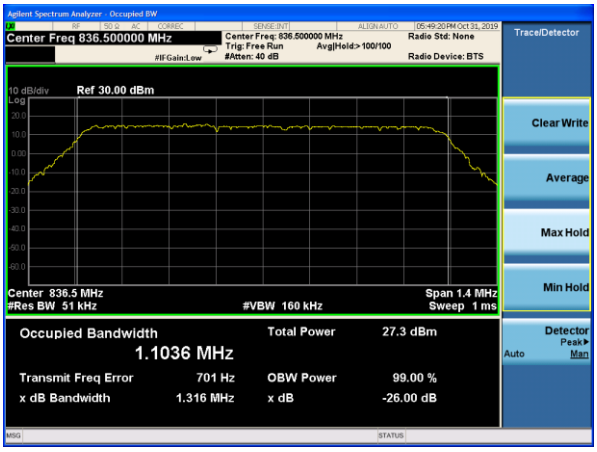
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 624Hz.

Test Result

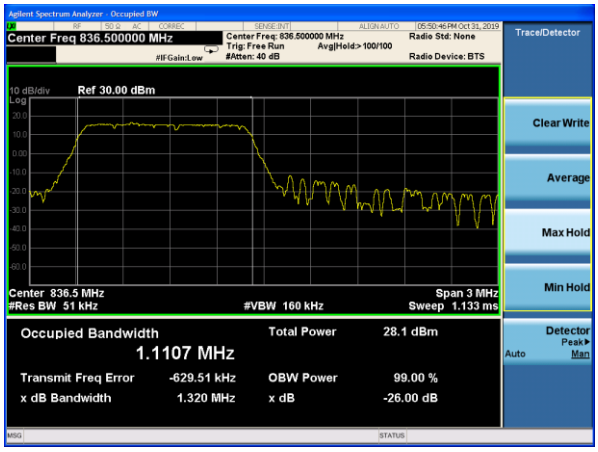
Mode	Bandwidth	Modulation	Channel/ Frequency(MHz)	RB	Index	Bandwidth(MHz)	
						99% Power	-26dBc
LTE Band 5	1.4MHz	QPSK	20525/836.5	6#0	0	1.1036	1.316
		16QAM	20525/836.5	6#0	0	0.9448	1.195
	3MHz	QPSK	20525/836.5	6#0	0	1.1107	1.320
		16QAM	20525/836.5	6#0	0	0.9508	1.181
	5MHz	QPSK	20525/836.5	6#0	0	1.1072	1.318
		16QAM	20525/836.5	6#0	0	0.9490	1.229
	10MHz	QPSK	20525/836.5	6#0	0	1.1126	1.341
		16QAM	20525/836.5	6#0	0	0.9579	1.161

Mode	Bandwidth	Modulation	Channel/ Frequency(MHz)	RB	Index	Bandwidth(MHz)	
						99% Power	-26dBc
LTE Band 26	1.4MHz	QPSK	26915/836.5	6#0	0	1.1068	1.364
		16QAM	26915/836.5	6#0	0	0.9429	1.162
	3MHz	QPSK	26915/836.5	6#0	0	1.1083	1.331
		16QAM	26915/836.5	6#0	0	0.9509	1.211
	5MHz	QPSK	26915/836.5	6#0	0	1.1023	1.391
		16QAM	26915/836.5	6#0	0	0.9585	1.177
	10MHz	QPSK	26915/836.5	6#0	0	1.1100	1.328
		16QAM	26915/836.5	6#0	0	0.9644	1.309
	15MHz	QPSK	26915/836.5	6#0	0	1.1249	1.375
		16QAM	26915/836.5	6#0	0	0.9634	1.439

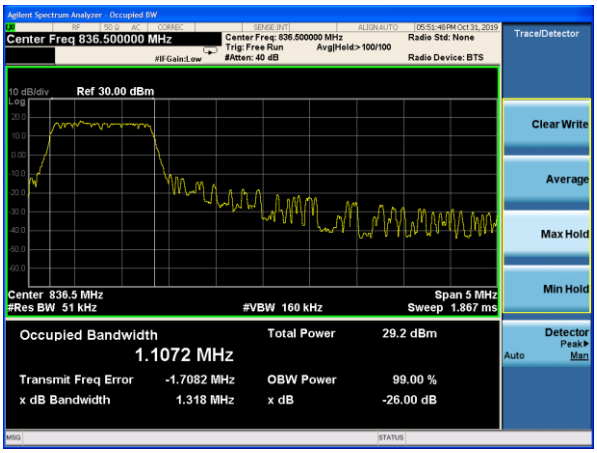
LTE Band 5 QPSK 1.4MHz CH-Middle



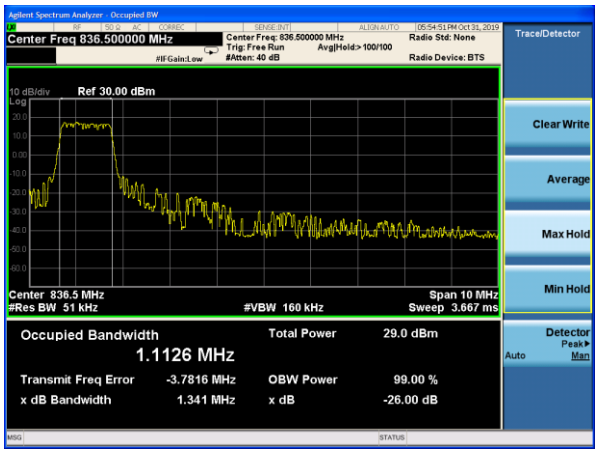
LTE Band 5 QPSK 3MHz CH-Middle



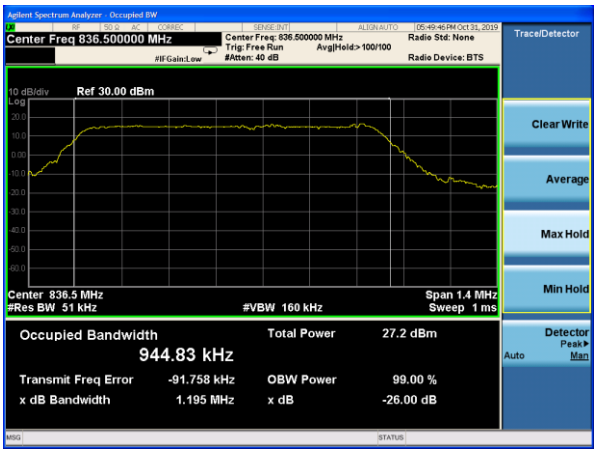
LTE Band 5 QPSK 5MHz CH-Middle



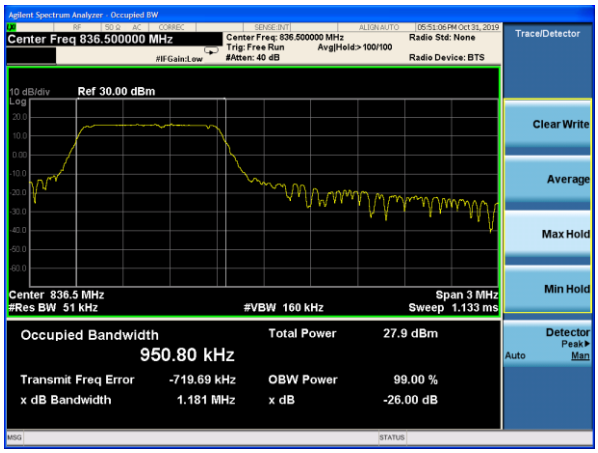
LTE Band 5 QPSK 10MHz CH-Middle



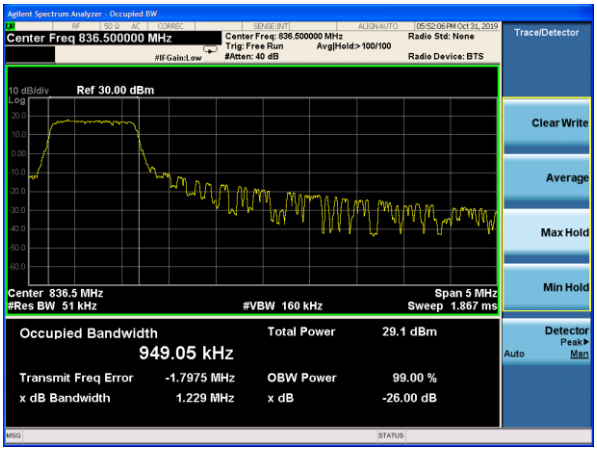
LTE Band 5 16QAM 1.4MHz CH-Middle



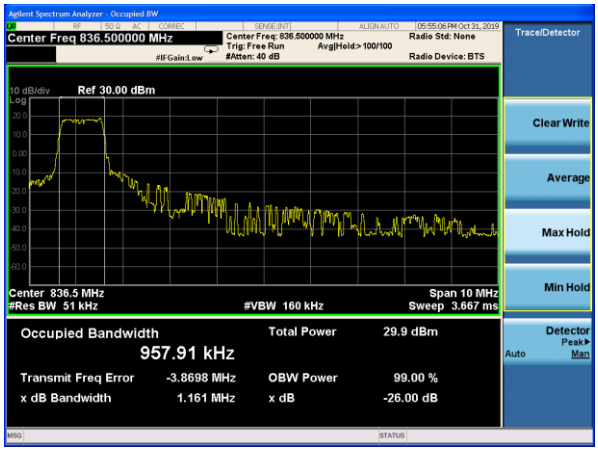
LTE Band 5 16QAM 3MHz CH-Middle



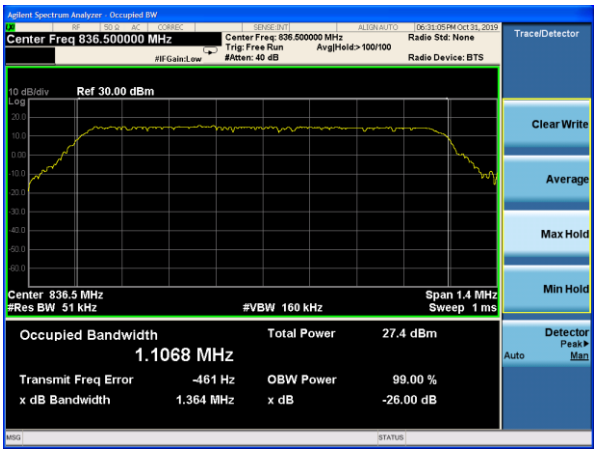
LTE Band 5 16QAM 5MHz CH-Middle



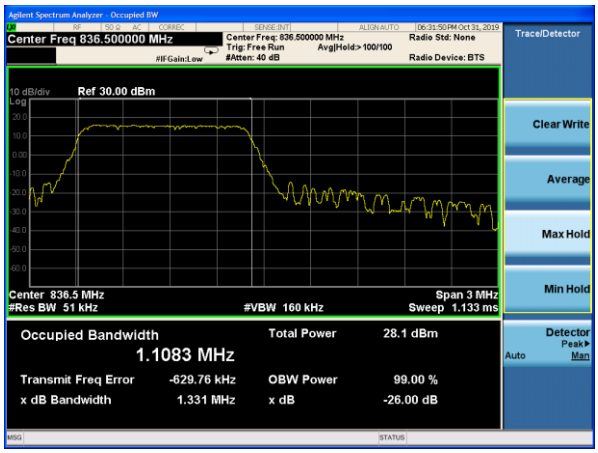
LTE Band 5 16QAM 10MHz CH-Middle



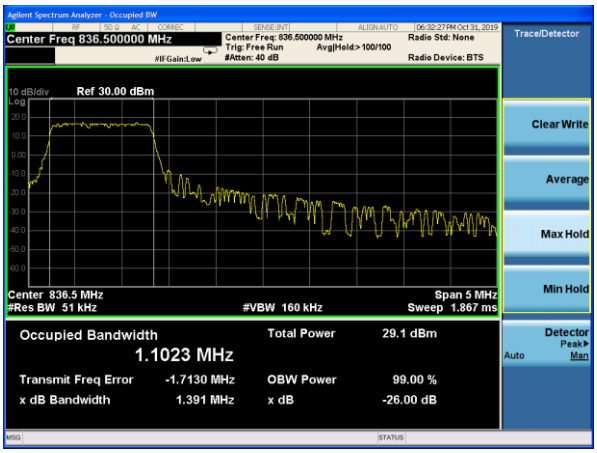
LTE Band 26 QPSK 1.4MHz CH-Middle



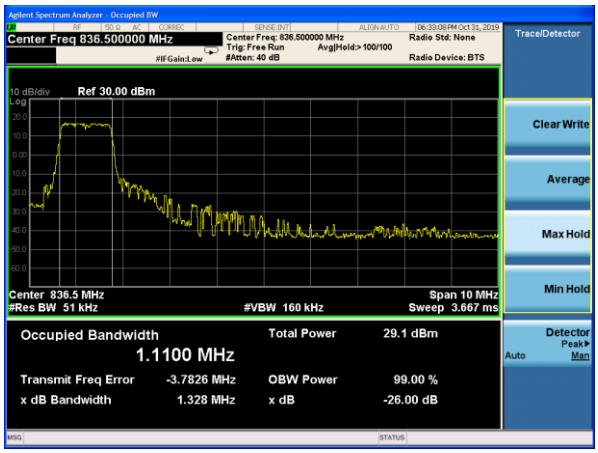
LTE Band 5 QPSK 3MHz CH-Middle



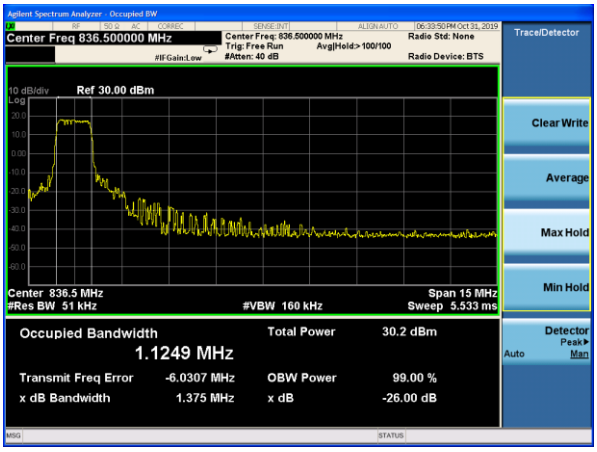
LTE Band 26 QPSK 5MHz CH-Middle



LTE Band 5 QPSK 10MHz CH-Middle

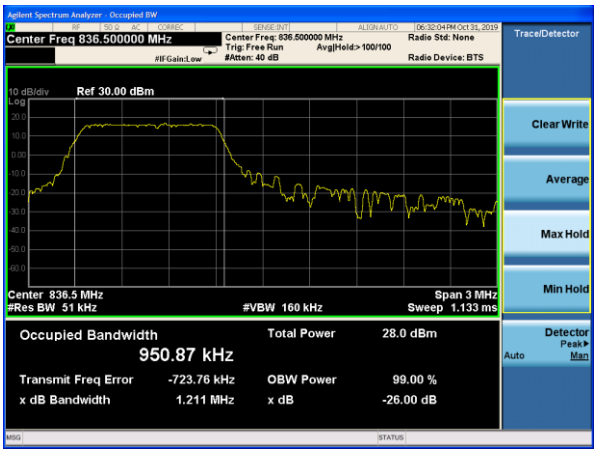


LTE Band 26 QPSK 15MHz CH-Middle

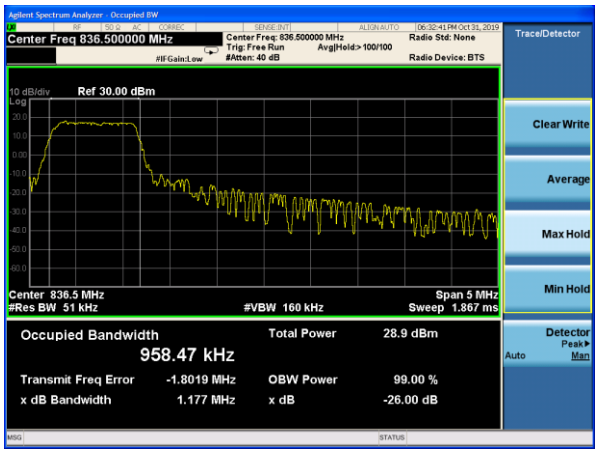


LTE Band 26 16QAM 1.4MHz CH-Middle

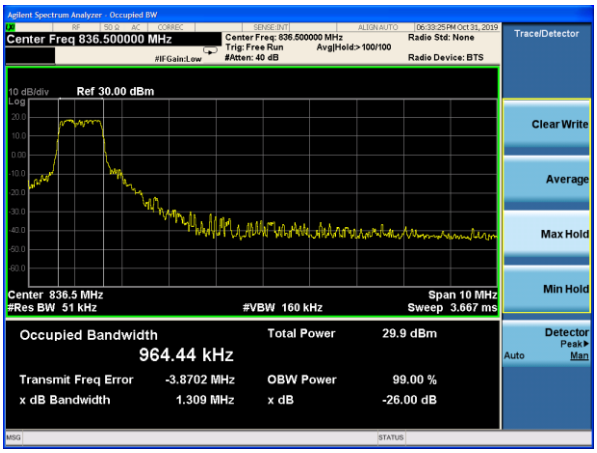
LTE Band 26 16QAM 3MHz CH-Middle



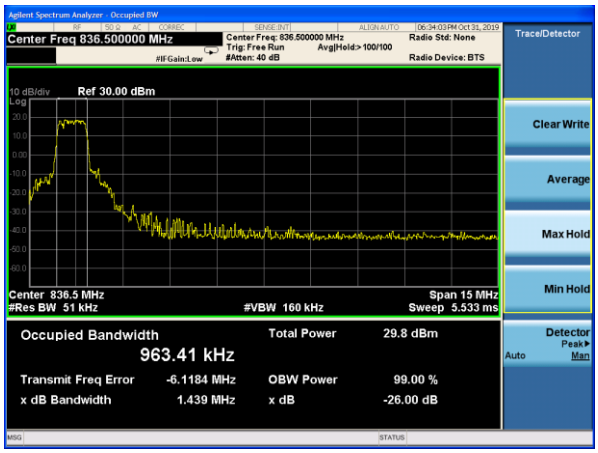
LTE Band 26 16QAM 5MHz CH-Middle



LTE Band 26 16QAM 10MHz CH-Middle



LTE Band 26 16QAM 15MHz CH-Middle



5.5. Band Edge Compliance

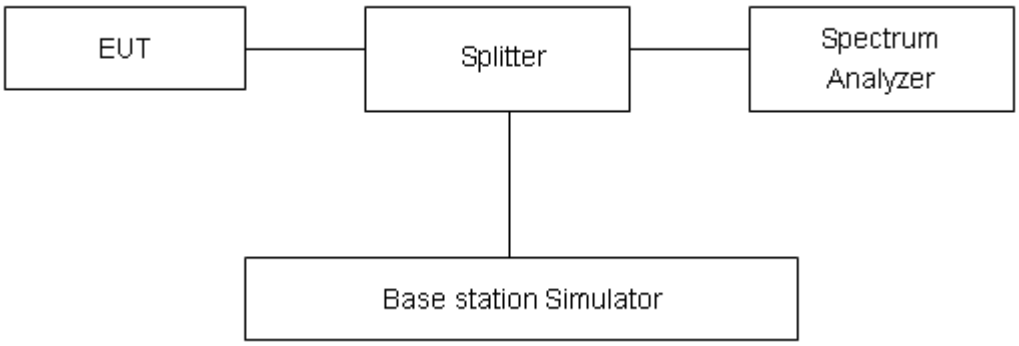
Ambient condition

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.
RBW is set to 51kHz, VBW is set to 160kHz for LTE Band 5 (1.4MHz/3MHz/5MHz/10MHz),
RBW is set to 51kHz,VBW is set to 160kHz for LTE Band 26 (1.4MHz/3MHz/5MHz/10MHz/15MHz),
Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

Rule Part 22.917(a) specifies that “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.”

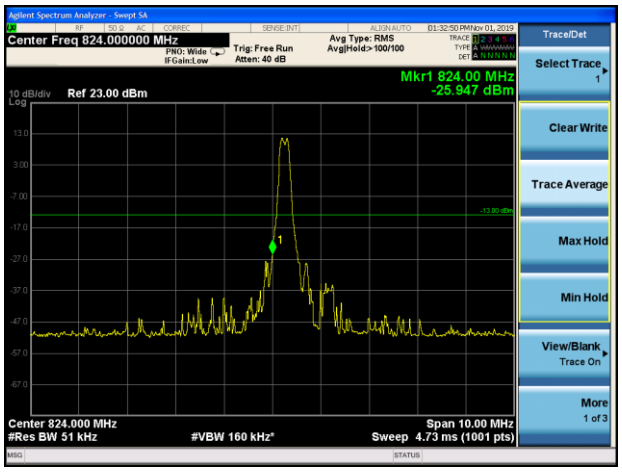
Limit	-13 dBm

Measurement Uncertainty

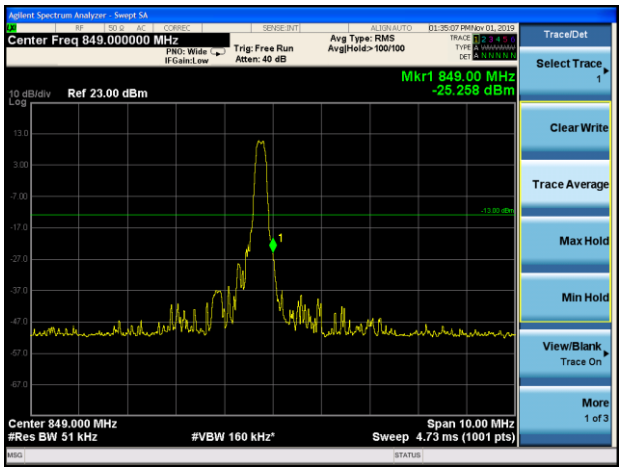
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96, U=0.684dB.

Test Result:

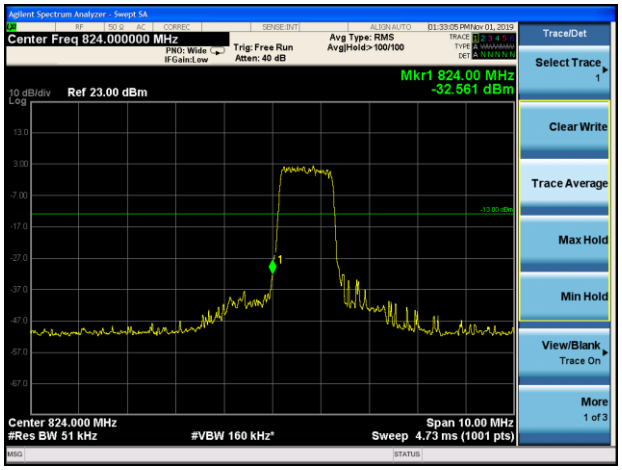
LTE Band 5 QPSK 1.4MHz CH-Low 1RB



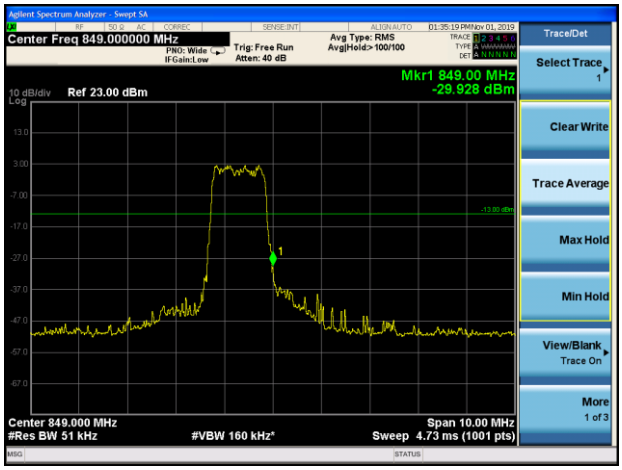
LTE Band 5 QPSK 1.4MHz CH-High 1RB



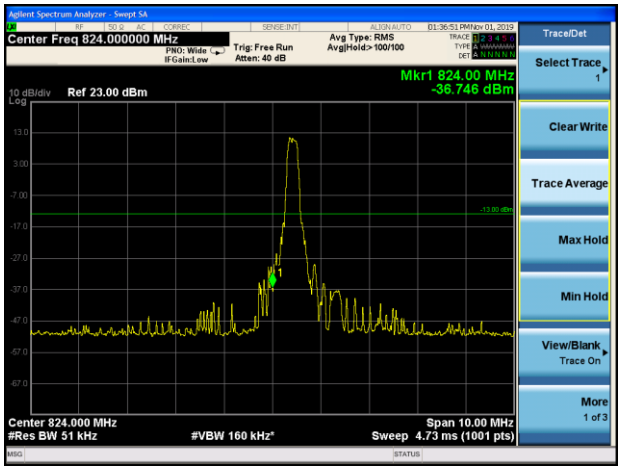
LTE Band 5 QPSK 1.4MHz CH-Low 100%RB



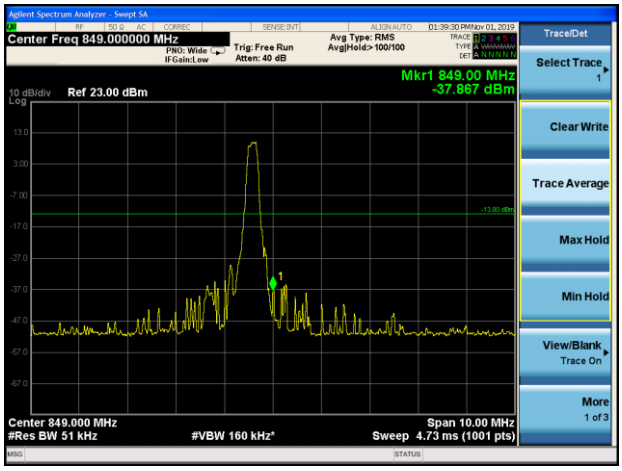
LTE Band 5 QPSK 1.4MHz CH-High 100%RB



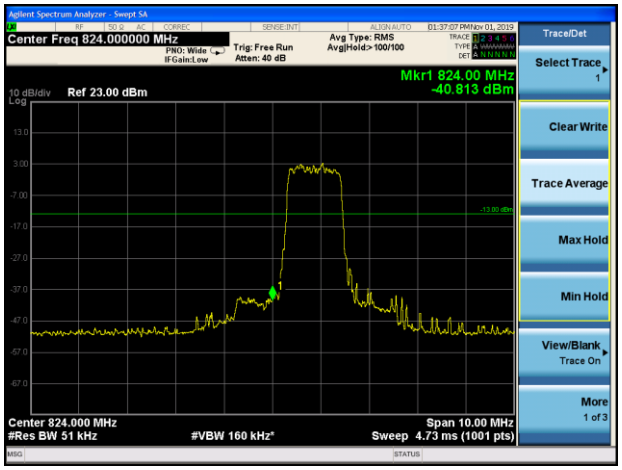
LTE Band 5 QPSK 3MHz CH-Low 1RB



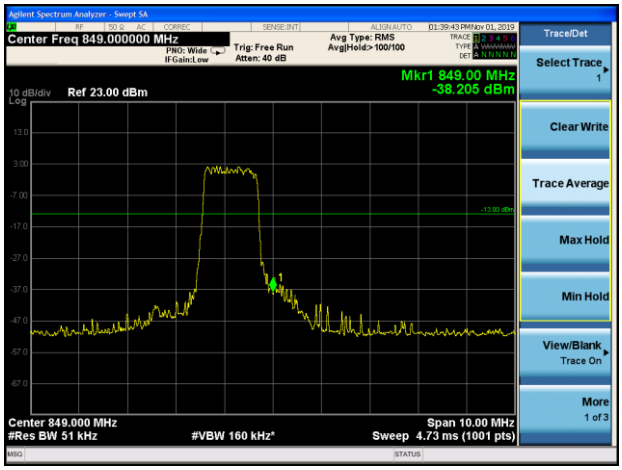
LTE Band 5 QPSK 3MHz CH-High 1RB



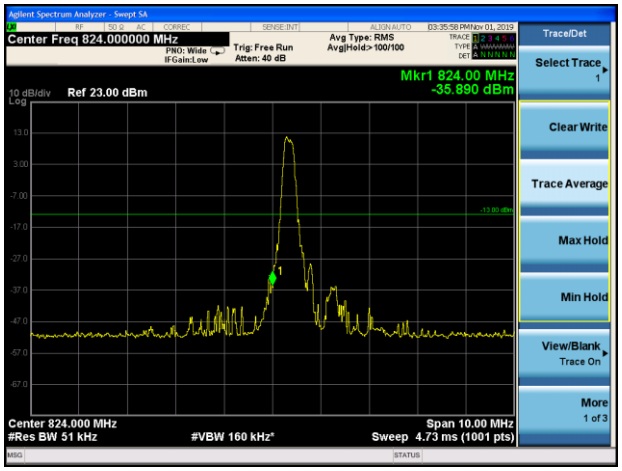
LTE Band 5 QPSK 3MHz CH-Low 100%RB



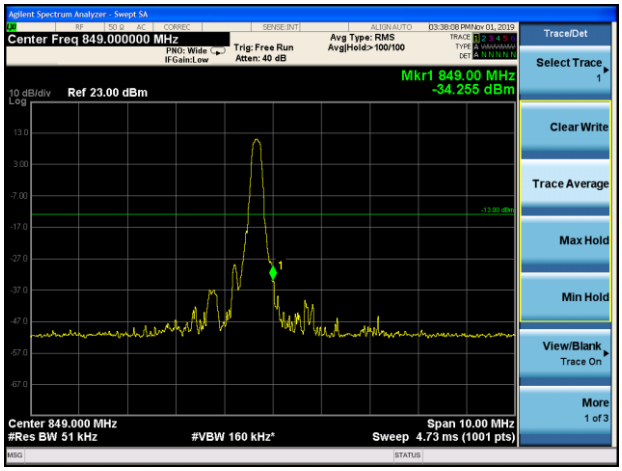
LTE Band 5 QPSK 3MHz CH-High 100%RB



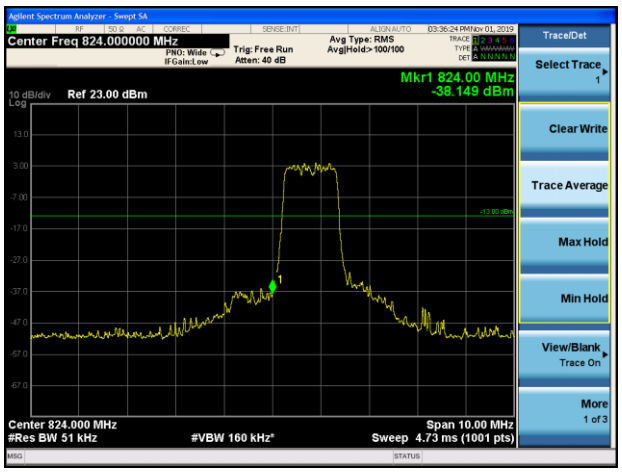
LTE Band 5 QPSK 5MHz CH-Low 1RB



LTE Band 5 QPSK 5MHz CH-High 1RB

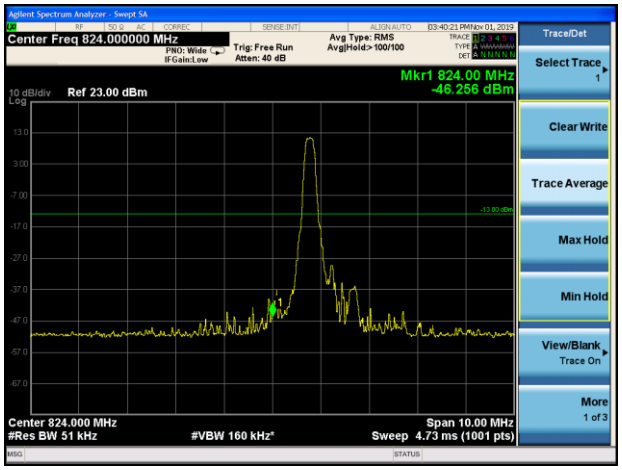


LTE Band 5 QPSK 5MHz CH-Low 100%RB

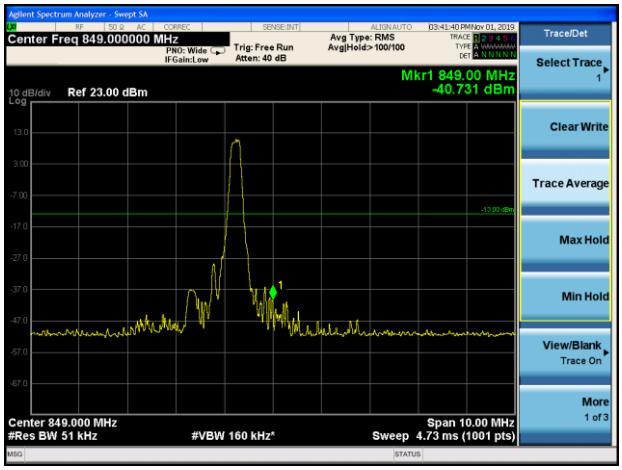


LTE Band 5 QPSK 5MHz CH-High 100%RB

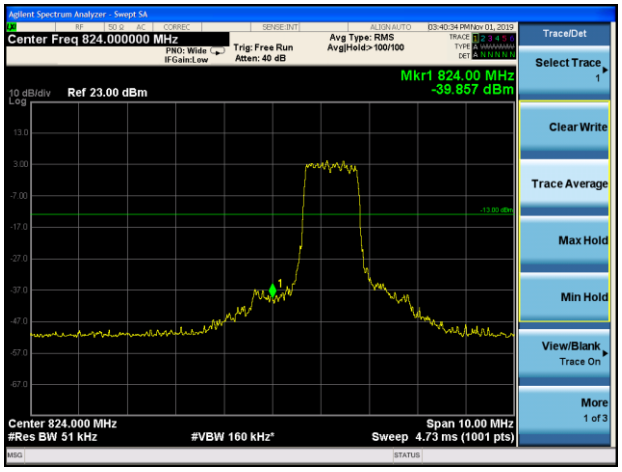
LTE Band 5 QPSK 10MHz CH-Low 1RB



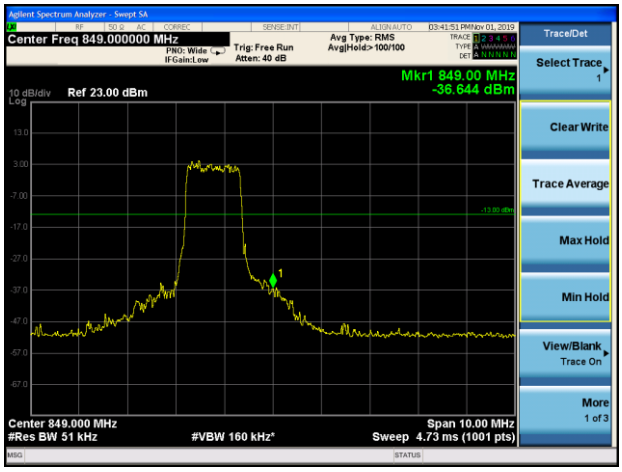
LTE Band 5 QPSK 10MHz CH-High 1RB



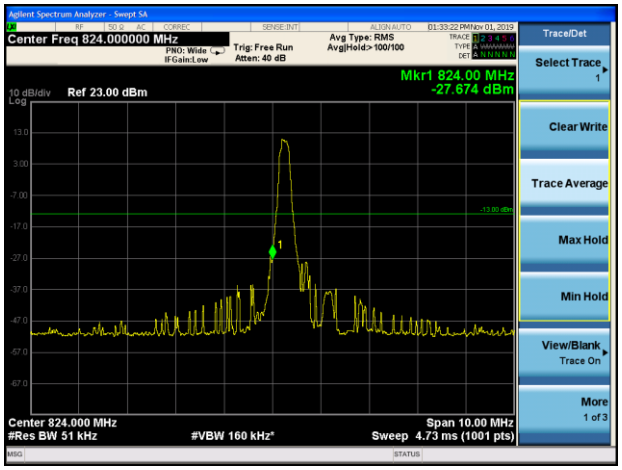
LTE Band 5 QPSK 10MHz CH-Low 100%RB



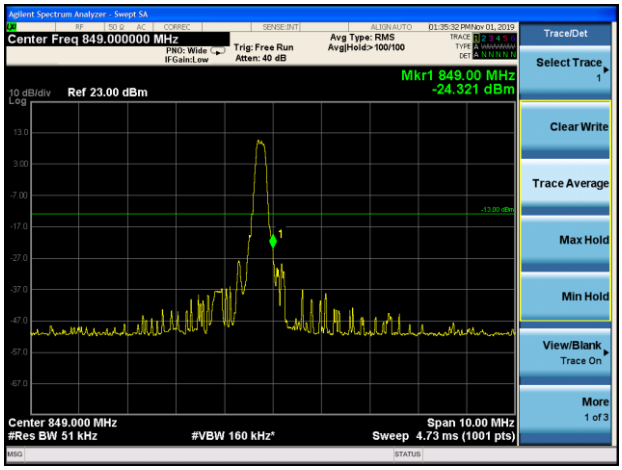
LTE Band 5 QPSK 10MHz CH-High 100%RB



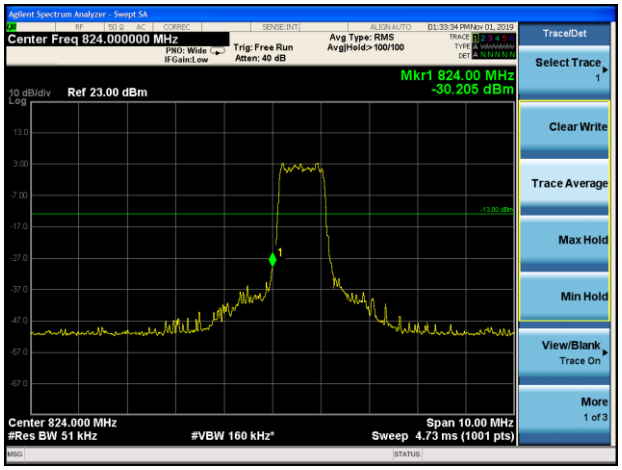
LTE Band 5 16QAM 1.4MHz CH-Low 1RB



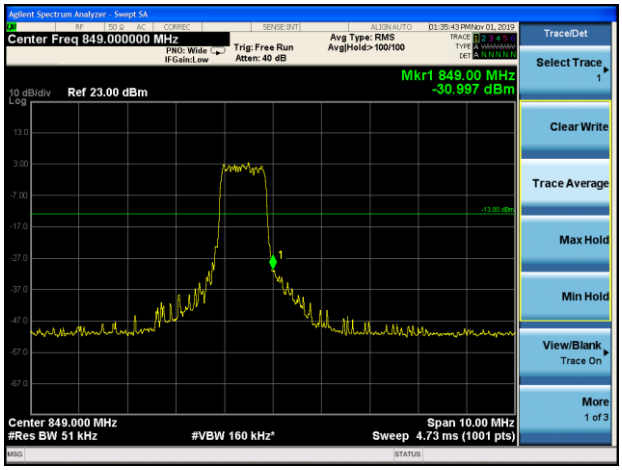
LTE Band 5 16QAM 1.4MHz CH-High 1RB



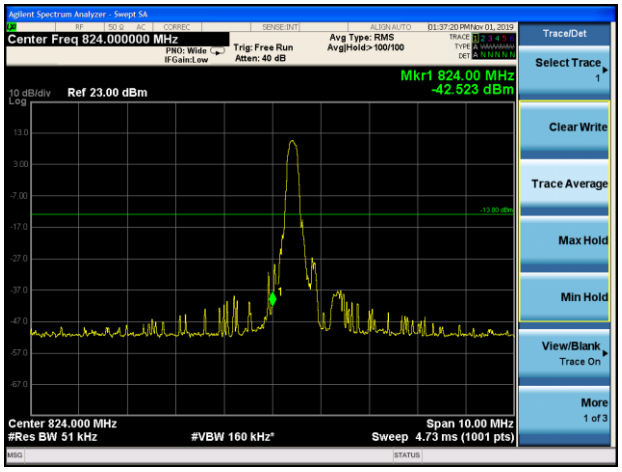
LTE Band 5 16QAM 1.4MHz CH-Low 100%RB



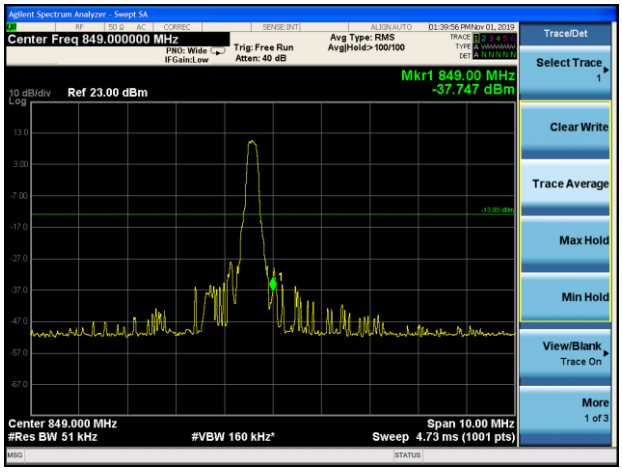
LTE Band 5 16QAM 1.4MHz CH-High 100%RB



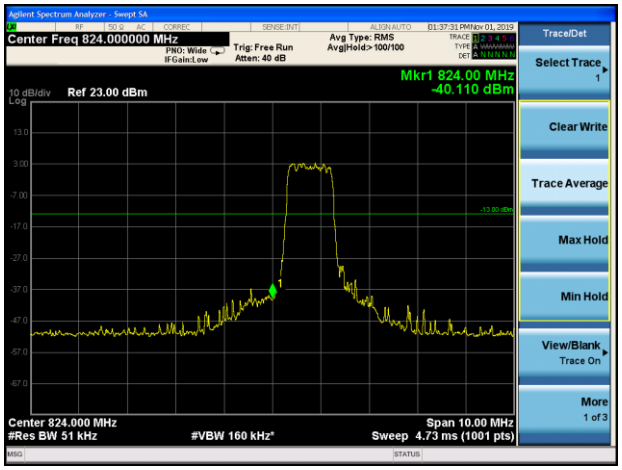
LTE Band 5 16QAM 3MHz CH-Low 1RB



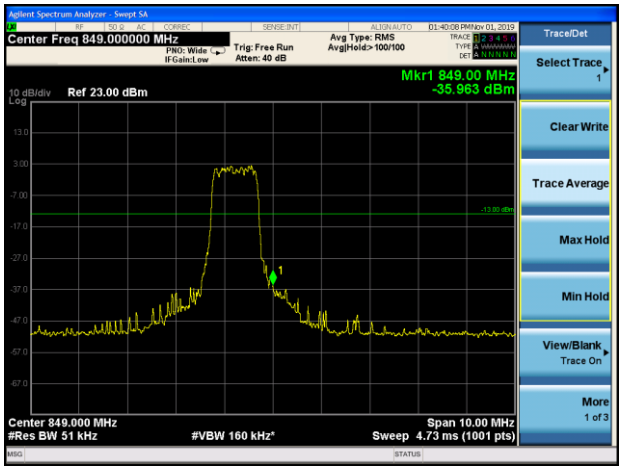
LTE Band 5 16QAM 3MHz CH-High 1RB



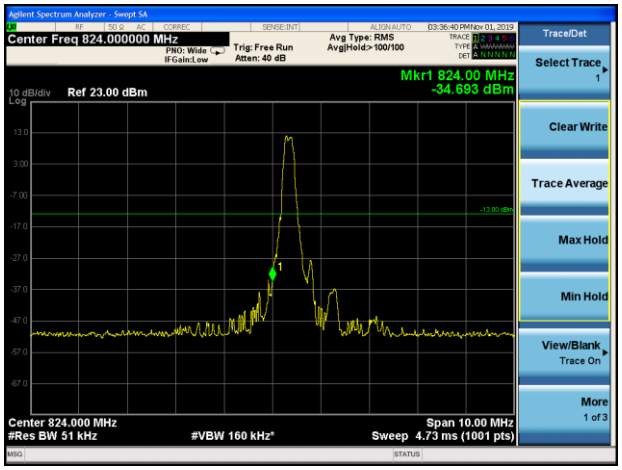
LTE Band 5 16QAM 3MHz CH-Low 100%RB



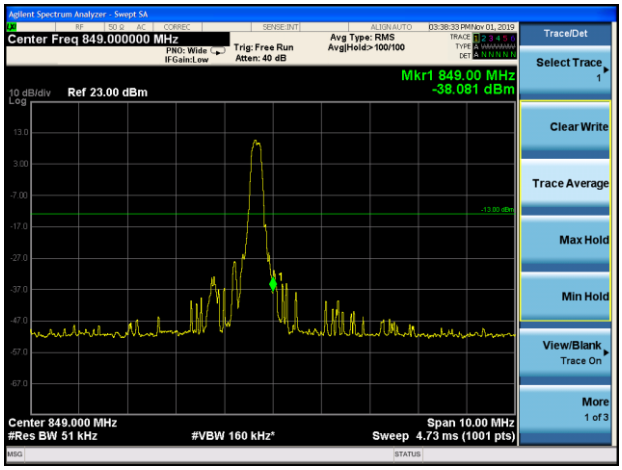
LTE Band 5 16QAM 3MHz CH-High 100%RB



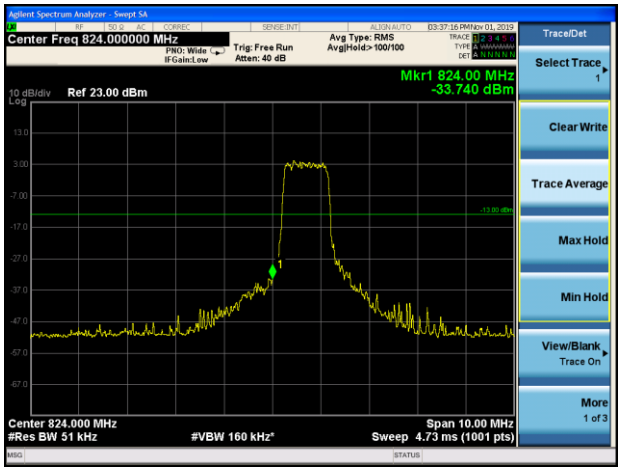
LTE Band 5 16QAM 5MHz CH-Low 1RB



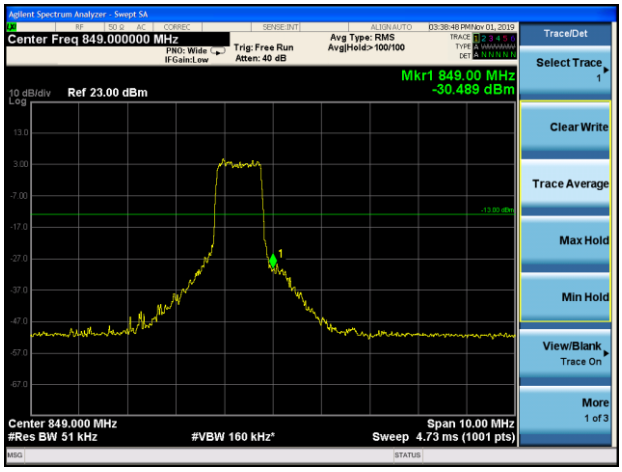
LTE Band 5 16QAM 5MHz CH-High 1RB



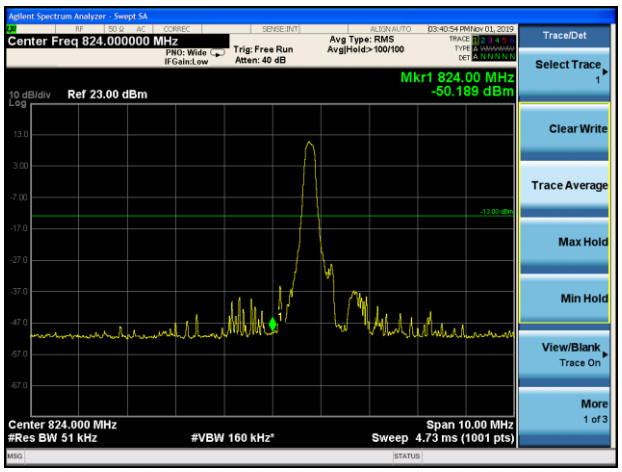
LTE Band 5 16QAM 5MHz CH-Low 100%RB



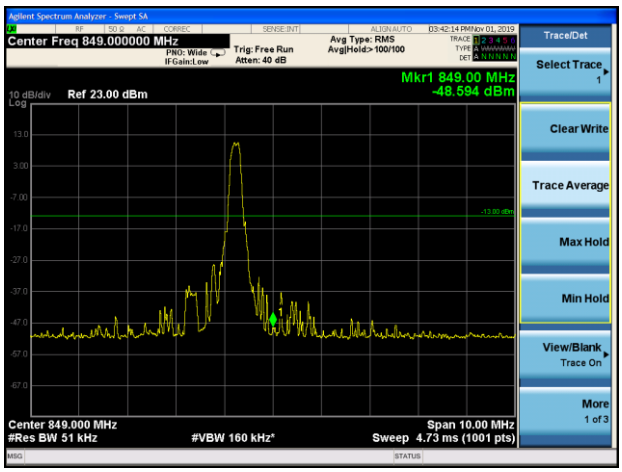
LTE Band 5 16QAM 5MHz CH-High 100%RB



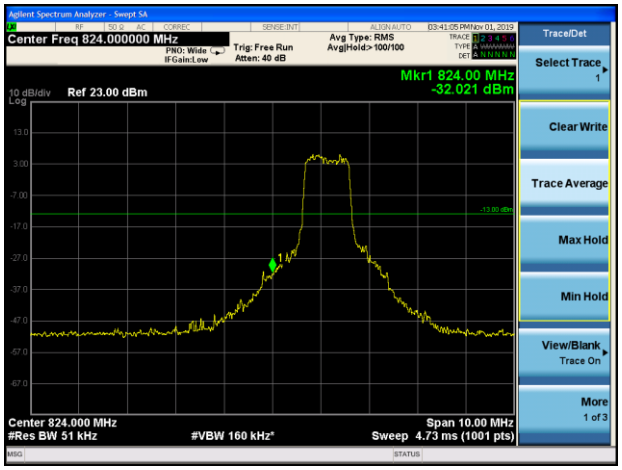
LTE Band 5 16QAM 10MHz CH-Low 1RB



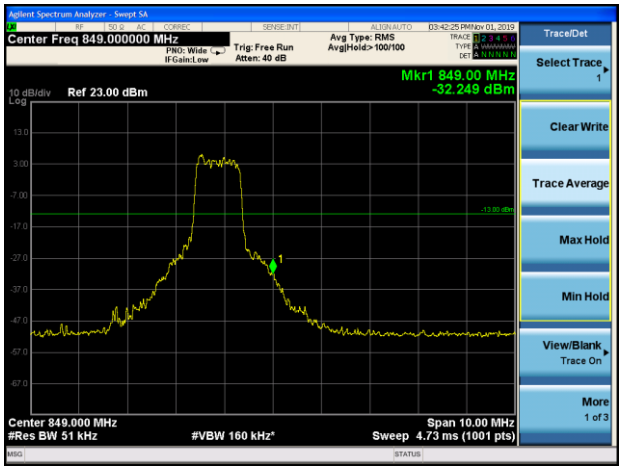
LTE Band 5 16QAM 10MHz CH-High 1RB



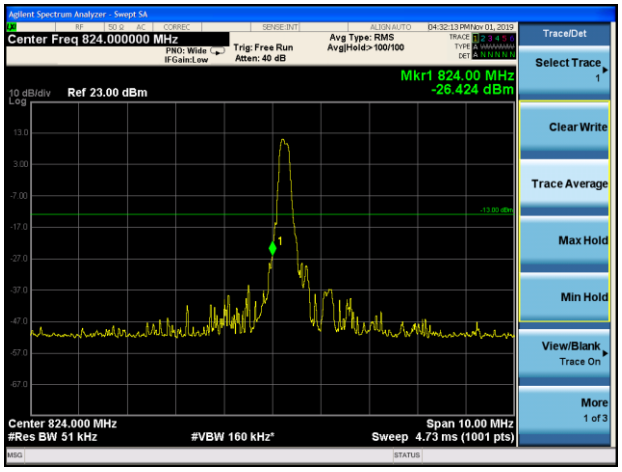
LTE Band 5 16QAM 10MHz CH-Low 100%RB



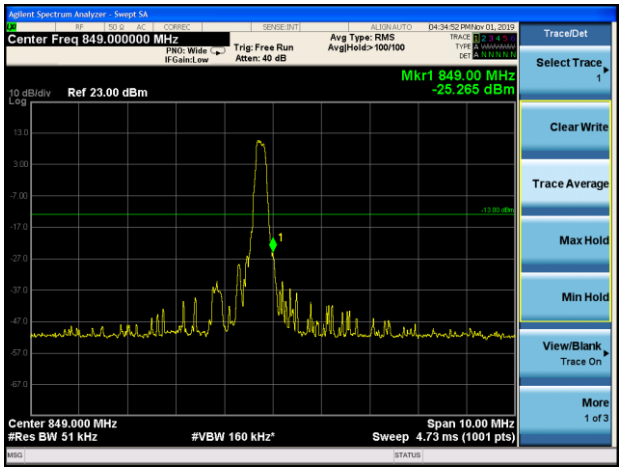
LTE Band 5 16QAM 10MHz CH-High 100%RB



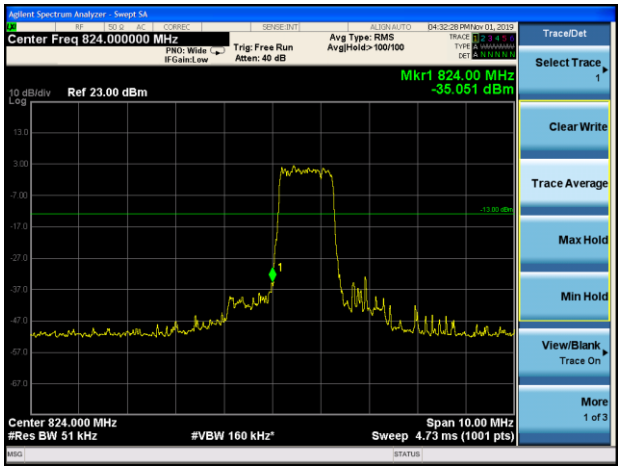
LTE Band 26 QPSK 1.4MHz CH-Low 1RB



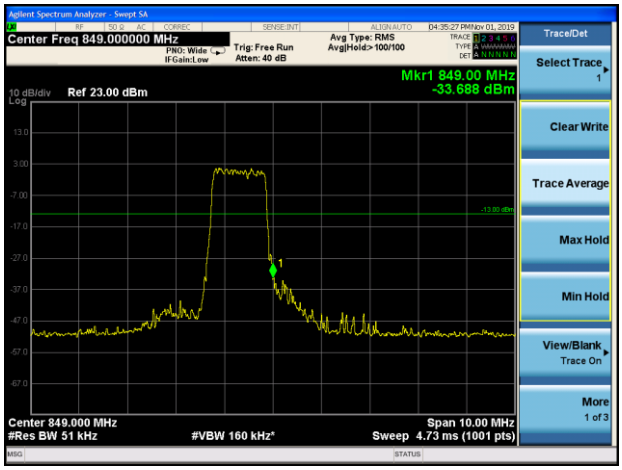
LTE Band 26 QPSK 1.4MHz CH-High 1RB



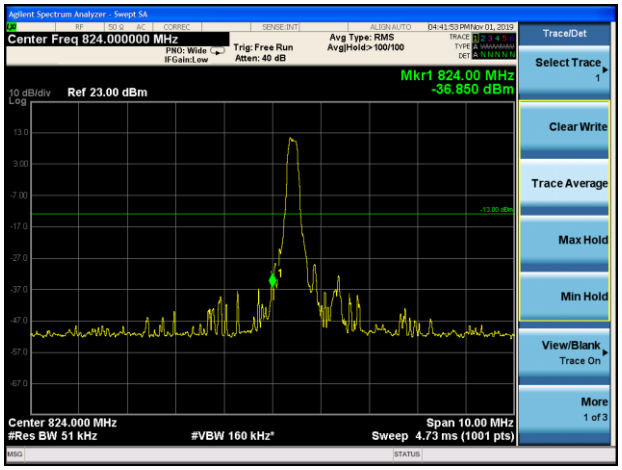
LTE Band 26 QPSK 1.4MHz CH-Low 100%RB



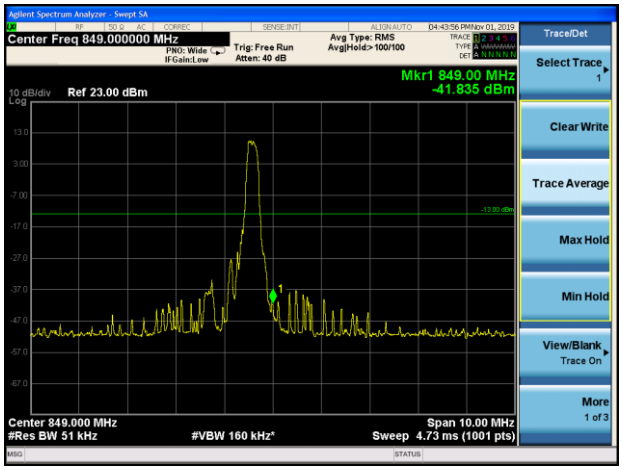
LTE Band 26 QPSK 1.4MHz CH-High 100%RB



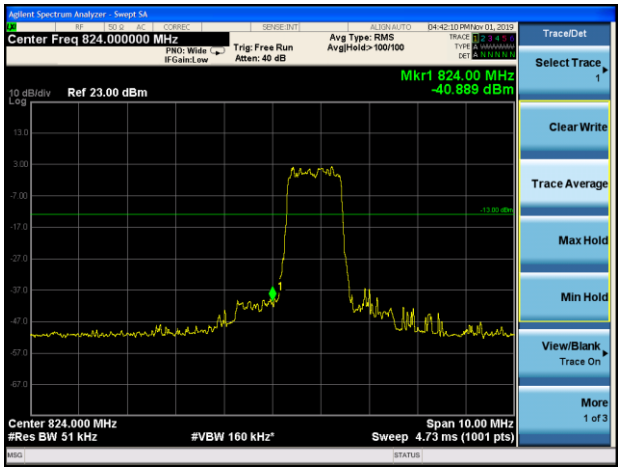
LTE Band 26 QPSK 3MHz CH-Low 1RB



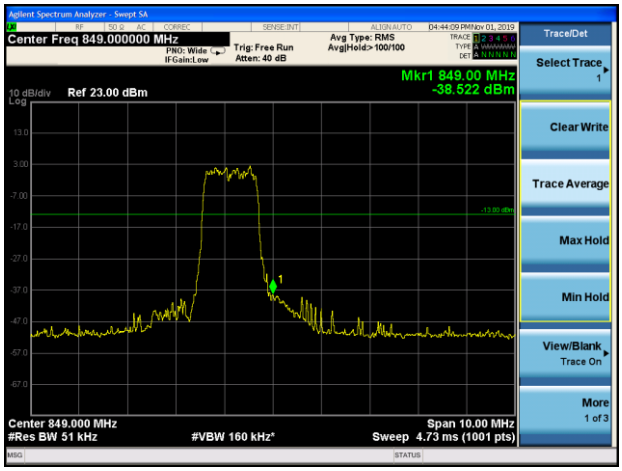
LTE Band 26 QPSK 3MHz CH-High 1RB



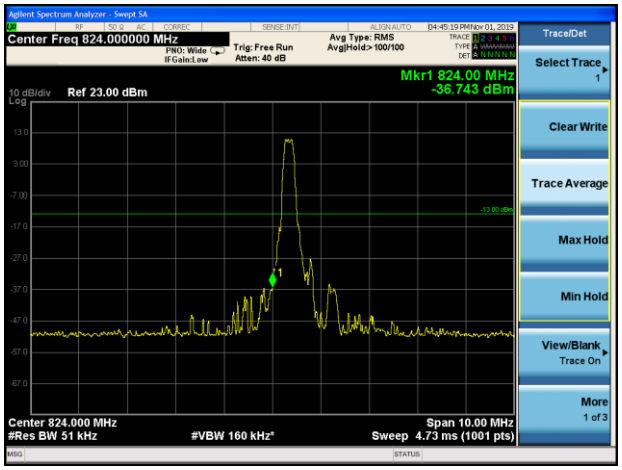
LTE Band 26 QPSK 3MHz CH-Low 100%RB



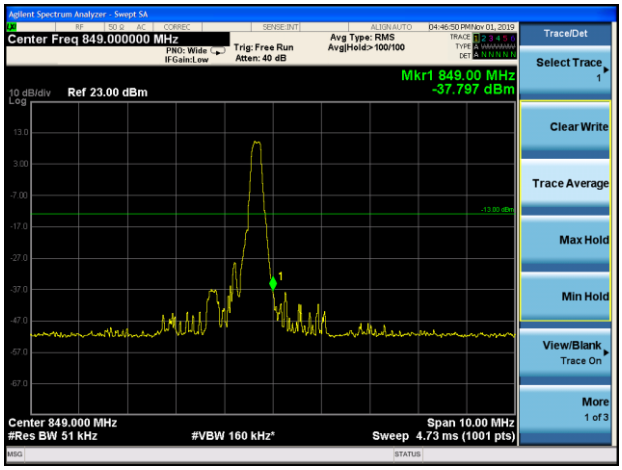
LTE Band 26 QPSK 3MHz CH-High 100%RB



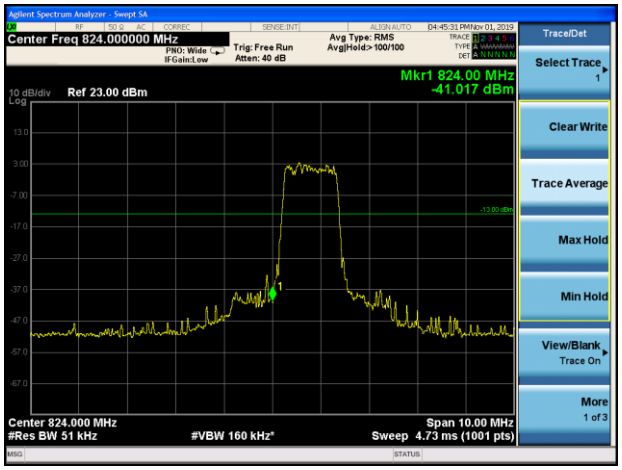
LTE Band 26 QPSK 5MHz CH-Low 1RB



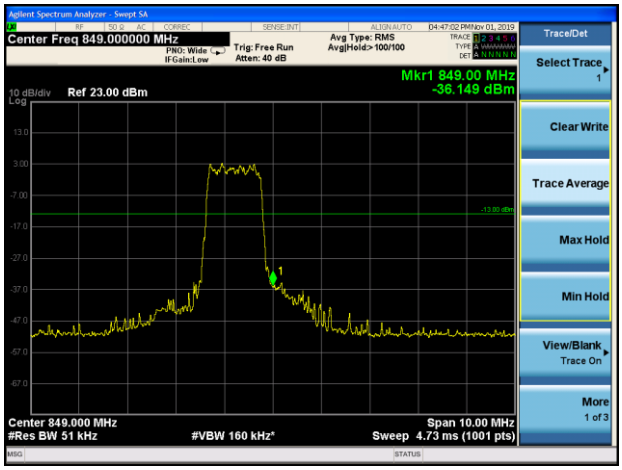
LTE Band 26 QPSK 5MHz CH-High 1RB



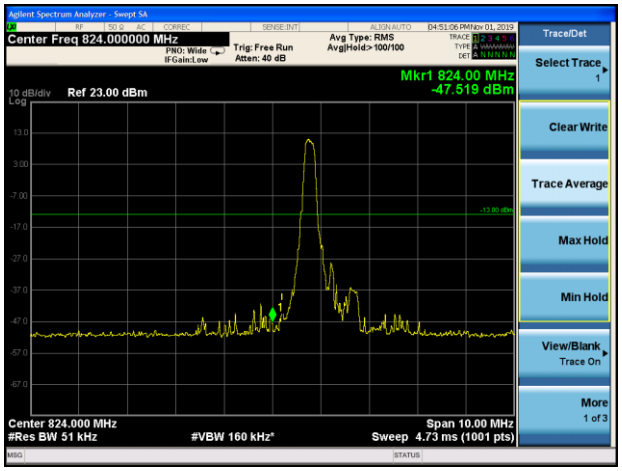
LTE Band 26 QPSK 5MHz CH-Low 100%RB



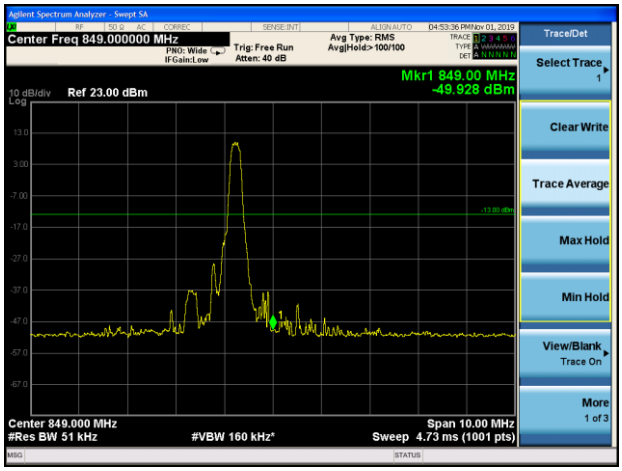
LTE Band 26 QPSK 5MHz CH-High 100%RB



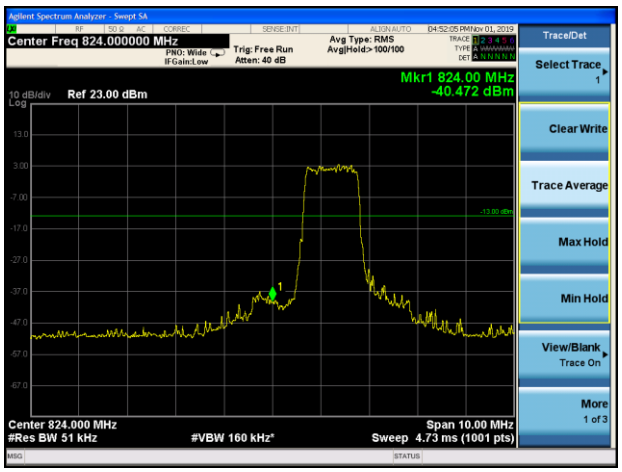
LTE Band 26 QPSK 10MHz CH-Low 1RB



LTE Band 26 QPSK 10MHz CH-High 1RB



LTE Band 26 QPSK 10MHz CH-Low 100%RB



LTE Band 26 QPSK 10MHz CH-High 100%RB