FCC Test Report

(PART 90S)

Report No.:	RF190614C23-10
FCC ID:	B32CM5PA
Test Model:	CM5P
Received Date:	Jun. 14, 2019
Test Date:	Jul. 03 ~ Jul. 07, 2019
Issued Date:	Jul. 17, 2019
Applicant:	Verifone, Inc.
Address:	1400 West Stanford Ranch Road Suite 200 Rocklin CA 95765 USA
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan (R.O.C)
Test Location (1):	No. 19, Hwa Ya 2nd Rd, Wen Hwa Vil, Kwei Shan Dist., Taoyuan City 33383, Taiwan (R.O.C)
Test Location (2):	B2F., No.215, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City 231, Taiwan, R.O.C
FCC Registration / Designation Number:	427177 / TW0011

Testing Laboratory
2021

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Release Control Record

Issue No.	Description	Date Issued
RF190614C23-10	Original Release	Jul. 17, 2019

1 Certificate of Conformity

Product:	Point of Sale Terminal
Brand:	Verifone
Test Model:	CM5P
Sample Status:	Identical Prototype
Applicant:	Verifone, Inc.
Test Date:	Jul. 03 ~ Jul. 07, 2019
Standards:	FCC Part 90, Subpart I, S FCC Part 2

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** Jul. 17, 2019

Ivonne Wu / Supervisor

Approved by : _____ , **Date:** Jul. 17, 2019

Dylan Chiou / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 90 & Part 2 (LTE 26)			
FCC Clause	**Test Item**	**Result**	**Remarks**
2.1046 90.635 (b)	Effective Radiated Power	Pass	Meet the requirement of limit.
2.1047	Modulation Characteristics	Pass	Meet the requirement.
2.1055 90.213	Frequency Stability	Pass	Meet the requirement of limit.
2.1049 90.209	Occupied Bandwidth	Pass	Meet the requirement of limit.
2.1051 90.210	Emission Masks	Pass	Meet the requirement of limit.
2.1051 90.691	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 90.691	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -33.91 dB at 222.51 MHz.

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 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	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.0400 dB
	30 MHz ~ 200 MHz	2.0153 dB
	200 MHz ~ 1000 MHz	2.0224 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	1.0121 dB
	18 GHz ~ 40 GHz	1.1508 dB

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent Technologies	N9038A	MY52260177	Aug. 20, 2018	Aug. 19, 2019
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 15, 2019	Apr. 14, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSW26	102023	Oct. 11, 2018	Oct. 10, 2019
HORN Antenna ETS-Lindgren	3117	00143293	Nov. 25, 2018	Nov. 24, 2019
BILOG Antenna SCHWARZBECK	VULB 9168	9168-616	Nov. 27, 2018	Nov. 26, 2019
BILOG Antenna SCHWARZBECK	VULB 9168	9168-631	Nov. 26, 2018	Nov. 25, 2019
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 25, 2018	Nov. 24, 2019
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 15, 2019	Apr. 14, 2020
MXG Vector signal generator Agilent	N5182B	MY53050430	Nov. 19, 2018	Nov. 18, 2019
Preamplifier Agilent	310N	187226	Jun. 18, 2019	Jun. 17, 2020
Preamplifier Agilent	83017A	MY39501357	Jun. 18, 2019	Jun. 17, 2020
RF signal cable ETS-LINDGREN	5D-FB	Cable-CH1-01(RFC-SMS-100-SMS-120+RFC-SMS-100-SMS-400)	Jun. 18, 2019	Jun. 17, 2020
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(RFC-SMS-100-SMS-24)	Jun. 18, 2019	Jun. 17, 2020
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 8.130425b	NA	NA	NA
Antenna Tower MF	NA	NA	NA	NA
Turn Table MF	NA	NA	NA	NA
Antenna Tower &Turn Table Controller MF	MF-7802	NA	NA	NA
Radio Communication Analyzer Anritsu	MT8820C	6201300640	Aug. 16, 2017	Aug. 15, 2019
Temperature & Humidity Chamber	GTH-120-40-CP-AR	MAA1306-019	Sep. 05, 2018	Sep. 04, 2019
DC Power Supply Topward	33010D	807748	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HsinTien Chamber 1.

3 General Information

3.1 General Description of EUT

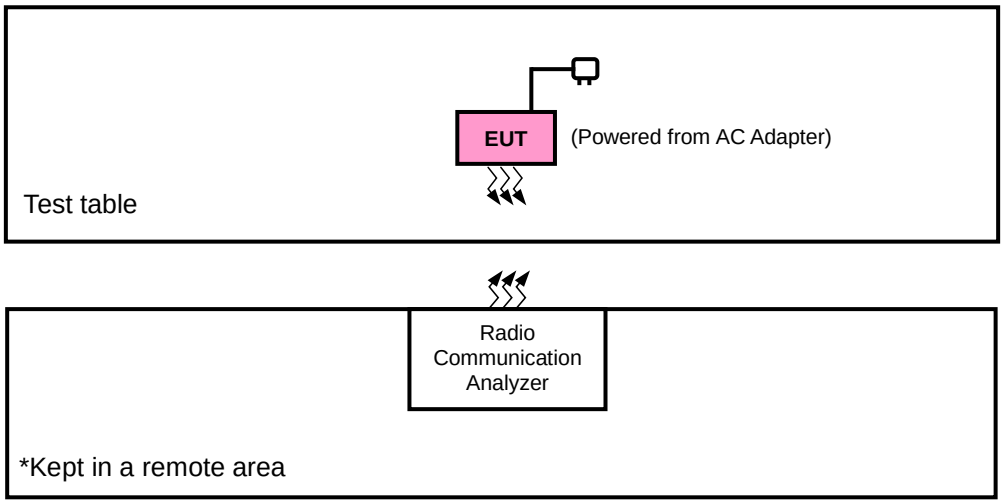
Product	Point of Sale Terminal	
Brand	Verifone	
Test Model	CM5P	
Status of EUT	Identical Prototype	
Power Supply Rating	5.0 Vdc (adapter or host equipment) 3.7 Vdc (Li-ion battery)	
Modulation Type	LTE	QPSK, 16QAM
Frequency Range	LTE Band 26 (Channel Bandwidth: 1.4 MHz)	814.7 ~ 823.3 MHz
	LTE Band 26 (Channel Bandwidth: 3 MHz)	815.5 ~ 822.5 MHz
	LTE Band 26 (Channel Bandwidth: 5 MHz)	816.5 ~ 821.5 MHz
	LTE Band 26 (Channel Bandwidth: 10 MHz)	819 MHz
Emission Designator	LTE Band 26 (Channel Bandwidth: 1.4 MHz)	1M09D7W
	LTE Band 26 (Channel Bandwidth: 3 MHz)	2M70G7D
	LTE Band 26 (Channel Bandwidth: 5 MHz)	4M50D7W
	LTE Band 26 (Channel Bandwidth: 10 MHz)	8M96D7W
Max. ERP Power	LTE Band 26 (Channel Bandwidth: 1.4 MHz)	71.45 mW
	LTE Band 26 (Channel Bandwidth: 3 MHz)	71.94 mW
	LTE Band 26 (Channel Bandwidth: 5 MHz)	72.61 mW
	LTE Band 26 (Channel Bandwidth: 10 MHz)	73.28 mW
Antenna Type	Fixed Internal Antenna with -1.8 dBi gain	
Accessory Device	Refer to Note as below	
Data Cable Supplied	Refer to Note as below	

Note:

1. The EUT's accessories list refers to Ext. Pho.
2. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.

3.2 Configuration of System under Test

<Radiated Emission Test>



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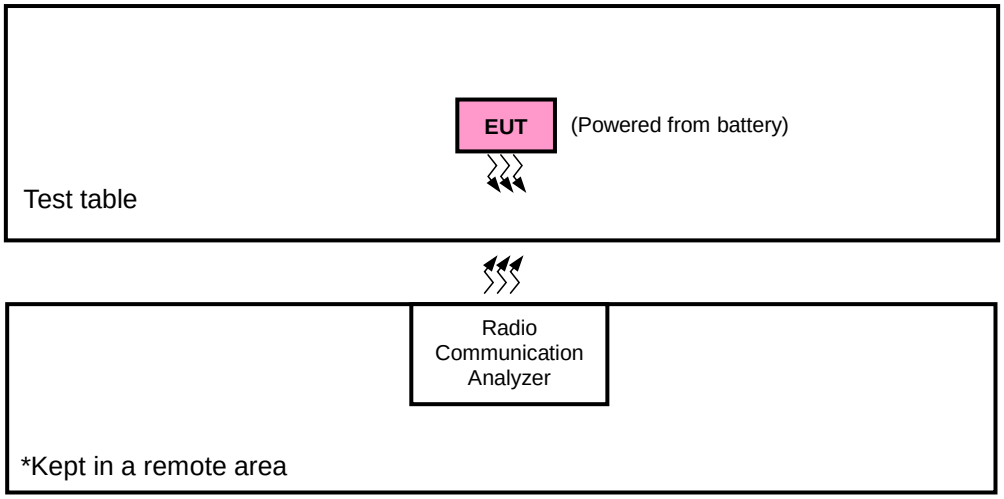


3.2.1 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.3 Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis, and antenna ports

The worst case was found when positioned as the table below. Following channel(s) was (were) selected for the final test as listed below:

Band	ERP	Radiated Emission
LTE Band 26	X-plane	X-axis

LTE Band 26

EUT Configure Mode	Test Item	Available Channel	Tested Channel	Channel Bandwidth	Modulation	Mode
-	ERP	26697 to 26783	26697, 26740, 26783	1.4 MHz	QPSK, 16QAM	3 RB / 0 RB Offset
		26705 to 26775	26705, 26740, 26775	3 MHz	QPSK, 16QAM	1 RB / 0 RB Offset
		26715 to 26765	26715, 26740, 26765	5 MHz	QPSK, 16QAM	1 RB / 0 RB Offset
		26740	26740	10 MHz	QPSK, 16QAM	1 RB / 0 RB Offset
-	Modulation Characteristics	26740	26740	10 MHz	QPSK, 16QAM	50 RB / 0 RB Offset
-	Frequency Stability	26697 to 26783	26697, 26783	1.4 MHz	QPSK	1 RB / 0 RB Offset
		26705 to 26775	26705, 26775	3 MHz	QPSK	1 RB / 0 RB Offset
		26715 to 26765	26715, 26765	5 MHz	QPSK	1 RB / 0 RB Offset
		26740	26740	10 MHz	QPSK	1 RB / 0 RB Offset
-	Occupied Bandwidth	26697 to 26783	26697, 26740, 26783	1.4 MHz	QPSK, 16QAM	6 RB / 0 RB Offset
		26705 to 26775	26705, 26740, 26775	3 MHz	QPSK, 16QAM	15 RB / 0 RB Offset
		26715 to 26765	26715, 26740, 26765	5 MHz	QPSK, 16QAM	25 RB / 0 RB Offset
		26740	26740	10 MHz	QPSK, 16QAM	50 RB / 0 RB Offset
-	Emission Mask	26697 to 26783	26697, 26740, 26783	1.4 MHz	QPSK, 16QAM	6 RB / 0 RB Offset
		26705 to 26775	26705, 26740, 26775	3 MHz	QPSK, 16QAM	15 RB / 0 RB Offset
		26715 to 26765	26715, 26740, 26765	5 MHz	QPSK, 16QAM	25 RB / 0 RB Offset
		26740	26740	10 MHz	QPSK, 16QAM	50 RB / 0 RB Offset
-	Conducted Emission	26697 to 26783	26697, 26740, 26783	1.4 MHz	QPSK	3 RB / 0 RB Offset
		26705 to 26775	26705, 26740, 26775	3 MHz	QPSK	1 RB / 0 RB Offset
		26715 to 26765	26715, 26740, 26765	5 MHz	QPSK	1 RB / 0 RB Offset
		26740	26740	10 MHz	QPSK	1 RB / 0 RB Offset
-	Radiated Emission	26697 to 26783	26697, 26740, 26783	1.4 MHz	QPSK	3 RB / 0 RB Offset
		26715 to 26765	26715, 26740, 26765	5 MHz	QPSK	1 RB / 0 RB Offset
		26740	26740	10 MHz	QPSK	1 RB / 0 RB Offset

Note:

1. This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.
2. For radiated emission above 1 GHz, according to 3GPP 36.521 Section 6.6.3.1.4, choose the lowest, 5 MHz & highest channel bandwidth for final test.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	25 deg. C, 65 % RH	3.7 Vdc	Karl Lee
Frequency Stability	25 deg. C, 65 % RH	3.7 Vdc	Gavin Wu
Occupied Bandwidth	25 deg. C, 65 % RH	3.7 Vdc	Gavin Wu
Peak to Average Ratio	25 deg. C, 65 % RH	3.7 Vdc	Gavin Wu
Emission Mask	25 deg. C, 65 % RH	3.7 Vdc	Gavin Wu
Band Edge	25 deg. C, 65 % RH	3.7 Vdc	Gavin Wu
Conducted Emission	25 deg. C, 65 % RH	3.7 Vdc	Gavin Wu
Radiated Emission	25 deg. C, 65 % RH	120 Vac, 60 Hz	Karl Lee

3.4 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

3.5 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 90
KDB 971168 D01 Power Meas License Digital Systems v03r01
KDB 971168 D02 Misc Rev Approv License Devices v02r01
ANSI/TIA/EIA-603-E 2016
ANSI 63.26-2015

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

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw) ERP.

4.1.2 Test Procedures

EIRP / ERP Measurement:

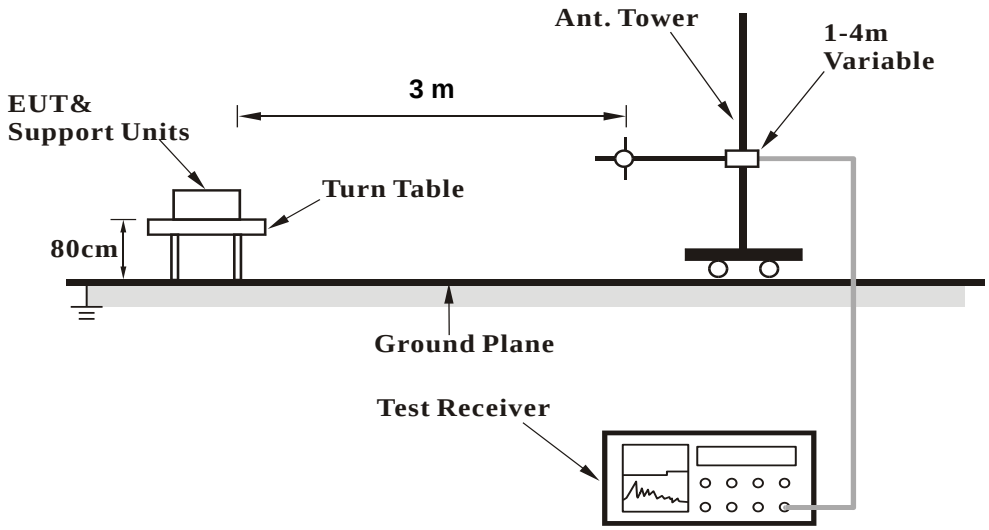
a. All measurements were done at low, middle and high operational frequency range. RBW and VBW is 10 MHz for LTE mode.
b. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m (below or equal 1 GHz) and/or 1.5 m (above 1 GHz) height of Turn Table, 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 1 m to 4 m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.
c. 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 b. Record the power level of S.G.
d. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn. 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 - 2.15 dB.

Conducted Power Measurement:

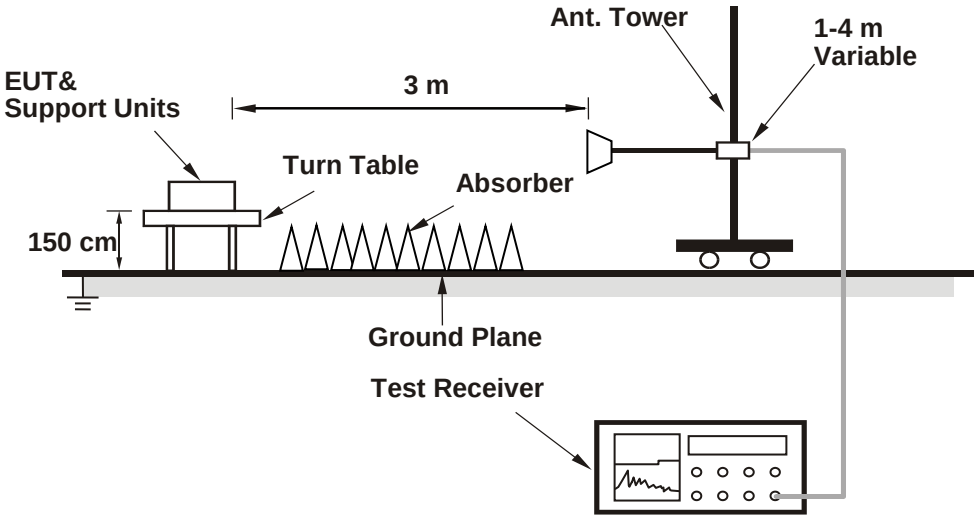
a. The EUT was set up for the maximum power with LTE link data modulation and link up with simulator.
b. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

4.1.3 Test Setup

EIRP / ERP Measurement:
<Radiated Emission below or equal 1 GHz>



<Radiated Emission above 1 GHz>



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

Conducted Power Measurement:

4.1.4 Test Results

Conducted Output Power (dBm)

LTE Band 26																	
BW	MCS Index	RB Size	RB Offset		Mid		3GPP MPR (dB)	BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP MPR (dB)
		Channel			26740					Channel		26715	26740	26765	
		Frequency (MHz)			819.0					Frequency (MHz)		816.5	819.0	821.5	
10M	QPSK	1	0		22.96		0	5M	QPSK	1	0	23.06	22.96	23.10	0
		1	24		22.78		0			1	12	22.72	22.78	22.91	0
		1	49		22.86		0			1	24	22.79	22.86	22.90	0
		25	0		21.94		1			12	0	21.86	21.94	22.05	1
		25	12		21.79		1			12	6	21.73	21.79	21.81	1
		25	25		21.73		1			12	13	21.81	21.73	21.88	1
		50	0		21.85		1			25	0	21.79	21.85	21.98	1
	16QAM	1	0		21.87		1		16QAM	1	0	21.94	21.87	22.06	1
		1	24		21.77		1			1	12	21.76	21.77	21.83	1
		1	49		21.75		1			1	24	21.72	21.75	21.85	1
		25	0		20.99		2			12	0	20.92	20.99	21.04	2
		25	12		20.76		2			12	6	20.75	20.76	20.72	2
		25	25		20.72		2			12	13	20.73	20.72	20.86	2
		50	0		20.86		2			25	0	20.84	20.86	20.89	2
BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP MPR (dB)	BW	MCS Index	RB Size	RB Offset	Low	Mid	High	3GPP MPR (dB)
		Channel		26705	26740	26775				Channel		26697	26740	26783	
		Frequency (MHz)		815.5	819.0	822.5				Frequency (MHz)		814.7	819.0	823.3	
3M	QPSK	1	0	23.06	22.92	23.03	0	1.4M	QPSK	1	0	22.97	22.93	23.02	0
		1	7	22.76	22.75	22.79	0			1	2	22.79	22.67	22.79	0
		1	14	22.85	22.82	22.85	0			1	5	22.72	22.75	22.88	0
		8	0	21.81	21.94	22.04	1			3	0	23.05	22.88	23.05	0
		8	3	21.74	21.69	21.70	1			3	1	22.78	22.64	22.79	0
		8	7	21.77	21.62	21.81	1			3	3	22.76	22.68	22.78	0
		15	0	21.86	21.76	21.98	1			6	0	21.83	21.81	21.90	1
	16QAM	1	0	21.90	21.74	21.96	1		16QAM	1	0	22.00	21.79	21.92	1
		1	7	21.71	21.72	21.75	1			1	2	21.71	21.74	21.69	1
		1	14	21.84	21.67	21.80	1			1	5	21.79	21.70	21.74	1
		8	0	20.87	20.95	20.89	2			3	0	21.96	21.89	21.95	1
		8	3	20.74	20.64	20.66	2			3	1	21.73	21.63	21.70	1
		8	7	20.81	20.72	20.72	2			3	3	21.76	21.70	21.73	1
		15	0	20.74	20.78	20.88	2			6	0	20.89	20.83	20.84	2

ERP Power (dBm)

LTE Band 26							
Channel Bandwidth: 1.4 MHz / QPSK							
Plane	**Channel**	**Frequency (MHz)**	**Reading (dBm)**	**Correction Factor (dB)**	**ERP (dBm)**	**ERP (mW)**	**Polarization (H/V)**
X	26697	814.7	-10.74	31.208	18.32	67.89	H
	26740	819.0	-10.61	31.3	18.54	71.45	
	26783	823.3	-10.64	31.222	18.43	69.69	
	26697	814.7	-16.08	31.504	13.27	21.25	V
	26740	819.0	-15.48	31.117	13.49	22.32	
	26783	823.3	-16.36	31.922	13.41	21.94	
Channel Bandwidth: 1.4 MHz / 16QAM							
X	26697	814.7	-11.75	31.208	17.31	53.80	H
	26740	819.0	-11.61	31.3	17.54	56.75	
	26783	823.3	-11.65	31.222	17.42	55.23	
	26697	814.7	-17.09	31.504	12.26	16.84	V
	26740	819.0	-16.49	31.117	12.48	17.69	
	26783	823.3	-17.36	31.922	12.41	17.43	

Note: ERP (dBm) = Reading (dBm) + Correction Factor (dB) – 2.15

LTE Band 26							
Channel Bandwidth: 3 MHz / QPSK							
Plane	**Channel**	**Frequency (MHz)**	**Reading (dBm)**	**Correction Factor (dB)**	**ERP (dBm)**	**ERP (mW)**	**Polarization (H/V)**
X	26705	815.5	-10.70	31.208	18.36	68.52	H
	26740	819.0	-10.58	31.3	18.57	71.94	
	26775	822.5	-10.60	31.222	18.47	70.34	
	26705	815.5	-16.04	31.504	13.31	21.45	V
	26740	819.0	-15.44	31.117	13.53	22.53	
	26775	822.5	-16.33	31.922	13.44	22.09	
Channel Bandwidth: 3 MHz / 16QAM							
X	26705	815.5	-11.71	31.208	17.35	54.30	H
	26740	819.0	-11.58	31.3	17.57	57.15	
	26775	822.5	-11.60	31.222	17.47	55.87	
	26705	815.5	-17.05	31.504	12.30	17.00	V
	26740	819.0	-16.45	31.117	12.52	17.85	
	26775	822.5	-17.33	31.922	12.44	17.55	

Note: ERP (dBm) = Reading (dBm) + Correction Factor (dB) – 2.15

LTE Band 26							
Channel Bandwidth: 5 MHz / QPSK							
Plane	Channel	Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	ERP (dBm)	ERP (mW)	Polarization (H/V)
X	26715	816.5	-10.67	31.208	18.39	68.99	H
	26740	819.0	-10.54	31.3	18.61	72.61	
	26765	821.5	-10.56	31.222	18.51	70.99	
	26715	816.5	-16.00	31.504	13.35	21.65	V
	26740	819.0	-15.40	31.117	13.57	22.74	
	26765	821.5	-16.29	31.922	13.48	22.29	
Channel Bandwidth: 5 MHz / 16QAM							
X	26715	816.5	-11.67	31.208	17.39	54.80	H
	26740	819.0	-11.54	31.3	17.61	57.68	
	26765	821.5	-11.56	31.222	17.51	56.39	
	26715	816.5	-17.01	31.504	12.34	17.16	V
	26740	819.0	-16.40	31.117	12.57	18.06	
	26765	821.5	-17.29	31.922	12.48	17.71	

Note: ERP (dBm) = Reading (dBm) + Correction Factor (dB) – 2.15

LTE Band 26							
Channel Bandwidth: 10 MHz / QPSK							
Plane	Channel	Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	ERP (dBm)	ERP (mW)	Polarization (H/V)
X	26740	819.0	-10.50	31.3	18.65	73.28	H
	26740	819.0	-15.36	31.117	13.61	22.95	V
Channel Bandwidth: 10 MHz / 16QAM							
X	26740	819.0	-11.51	31.3	17.64	58.08	H
	26740	819.0	-16.36	31.117	12.61	18.23	V

Note: ERP (dBm) = Reading (dBm) + Correction Factor (dB) – 2.15

4.2 Modulation Characteristics Measurement

4.2.1 Limits of Modulation Characteristics

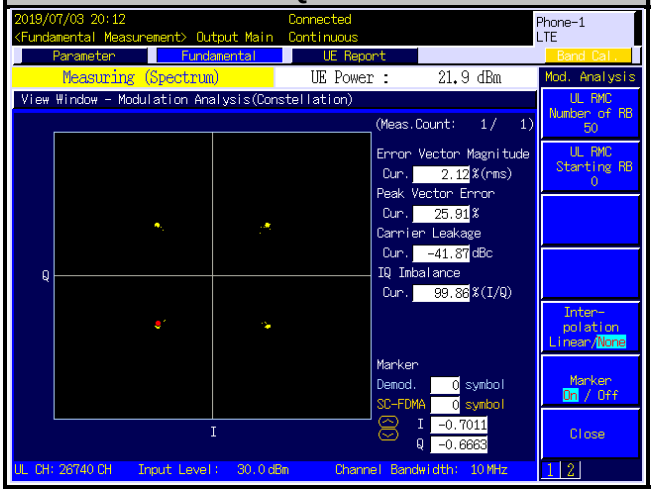
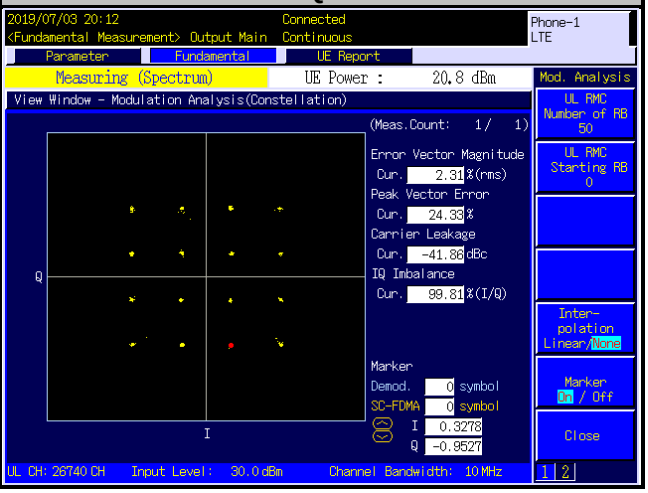
N/A

4.2.2 Test Setup

4.2.3 Test Procedure

Connect the EUT to Communication Simulator via the antenna connector. The frequency band is set as EUT supported Modulation and Channels, the EUT output is matched with 50 ohm load, the waveform quality and constellation of the EUT was tested.

4.2.4 Test Results

Spectrum Plot of Measurement	
LTE Band 26	
Channel 26740	
QPSK	16QAM
	

4.3 Frequency Stability Measurement

4.3.1 Limits of Frequency Stability Measurement

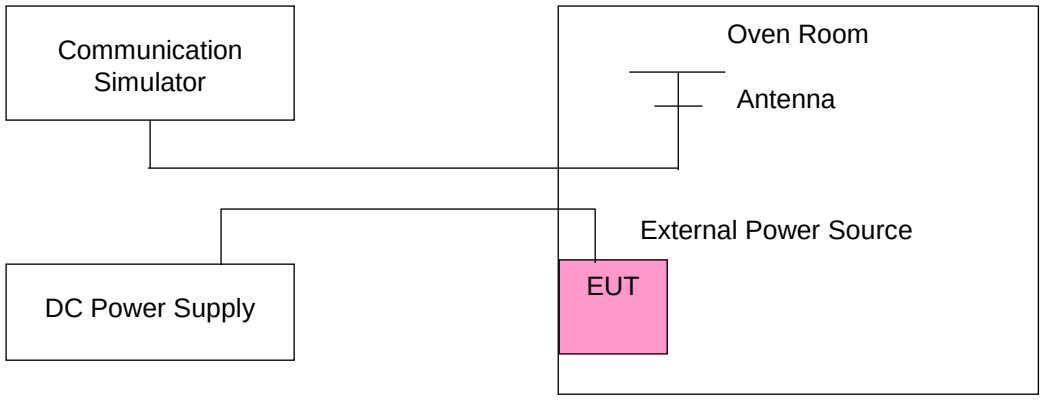
1.5 ppm is for base and fixed station. 2.5 ppm is for mobile station.

4.3.2 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.

4.3.3 Test Setup



4.3.4 Test Results

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 26				Limit (ppm)
	Channel Bandwidth: 1.4 MHz				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
3.7	814.700004	0.004	823.300000	0.002	2.5
3.145	814.700003	0.004	823.300000	0.004	2.5
4.255	814.700001	0.002	823.300000	0.004	2.5

Note: The applicant defined the normal working voltage of the battery is from 3.145 Vdc to 4.255 Vdc.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 26				Limit (ppm)
	Channel Bandwidth: 1.4 MHz				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
-30	814.700002	0.003	823.300000	0.003	2.5
-20	814.700002	0.002	823.300000	0.003	2.5
-10	814.700002	0.002	823.300000	0.003	2.5
0	814.700002	0.003	823.300000	0.003	2.5
10	814.700002	0.002	823.300000	0.004	2.5
20	814.699996	-0.004	823.300000	-0.002	2.5
30	814.699997	-0.004	823.300000	-0.004	2.5
40	814.699997	-0.003	823.300000	-0.004	2.5
50	814.699998	-0.002	823.300000	-0.004	2.5

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 26				Limit (ppm)
	Channel Bandwidth: 3 MHz				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
3.7	815.500002	0.003	822.500000	0.004	2.5
3.145	815.500003	0.004	822.500000	0.004	2.5
4.255	815.500001	0.002	822.500000	0.003	2.5

Note: The applicant defined the normal working voltage of the battery is from 3.145 Vdc to 4.255 Vdc.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 26				Limit (ppm)
	Channel Bandwidth: 3 MHz				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
-30	815.500003	0.004	822.500000	0.004	2.5
-20	815.500002	0.002	822.500000	0.003	2.5
-10	815.500002	0.002	822.500000	0.003	2.5
0	815.500001	0.002	822.500000	0.001	2.5
10	815.500002	0.003	822.500000	0.004	2.5
20	815.499997	-0.003	822.500000	-0.005	2.5
30	815.499999	-0.001	822.500000	-0.002	2.5
40	815.499996	-0.005	822.500000	-0.005	2.5
50	815.499997	-0.004	822.500000	-0.005	2.5

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 26				Limit (ppm)
	Channel Bandwidth: 5 MHz				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
3.7	816.500003	0.003	821.500000	0.003	2.5
3.145	816.500004	0.005	821.500000	0.002	2.5
4.255	816.500002	0.002	821.500000	0.005	2.5

Note: The applicant defined the normal working voltage of the battery is from 3.145 Vdc to 4.255 Vdc.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 26				Limit (ppm)
	Channel Bandwidth: 5 MHz				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
-30	816.500002	0.003	821.500000	0.004	2.5
-20	816.500003	0.003	821.500000	0.003	2.5
-10	816.500003	0.004	821.500000	0.002	2.5
0	816.500003	0.004	821.500000	0.004	2.5
10	816.500001	0.001	821.500000	0.002	2.5
20	816.499997	-0.004	821.500000	-0.003	2.5
30	816.499996	-0.004	821.500000	-0.004	2.5
40	816.499997	-0.004	821.500000	-0.001	2.5
50	816.499997	-0.004	821.500000	-0.003	2.5

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 26		Limit (ppm)
	Channel Bandwidth: 10 MHz		
	Frequency (MHz)	Frequency Error (ppm)	
3.7	819.000001	0.002	2.5
3.145	819.000002	0.002	2.5
4.255	819.000001	0.001	2.5

Note: The applicant defined the normal working voltage of the battery is from 3.145 Vdc to 4.255 Vdc.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 26		Limit (ppm)
	Channel Bandwidth: 10 MHz		
	Frequency (MHz)	Frequency Error (ppm)	
-30	819.000002	0.003	2.5
-20	819.000003	0.003	2.5
-10	819.000002	0.002	2.5
0	819.000003	0.003	2.5
10	819.000004	0.005	2.5
20	818.999998	-0.002	2.5
30	818.999997	-0.003	2.5
40	818.999999	-0.002	2.5
50	818.999997	-0.004	2.5

4.4 Occupied Bandwidth Measurement

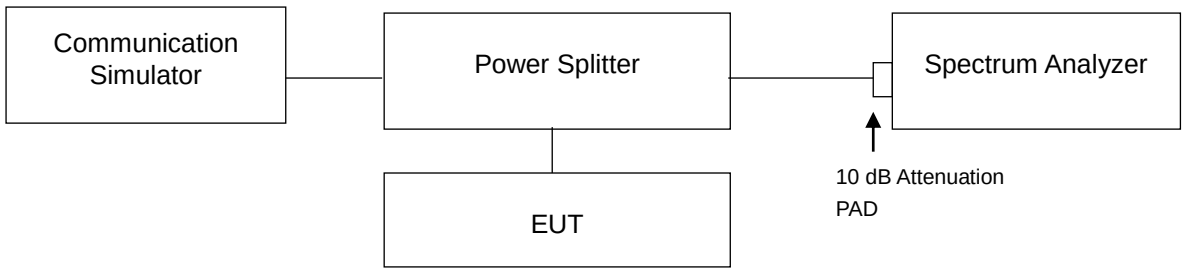
4.4.1 Limits of Occupied Bandwidth Measurement

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

4.4.2 Test Procedure

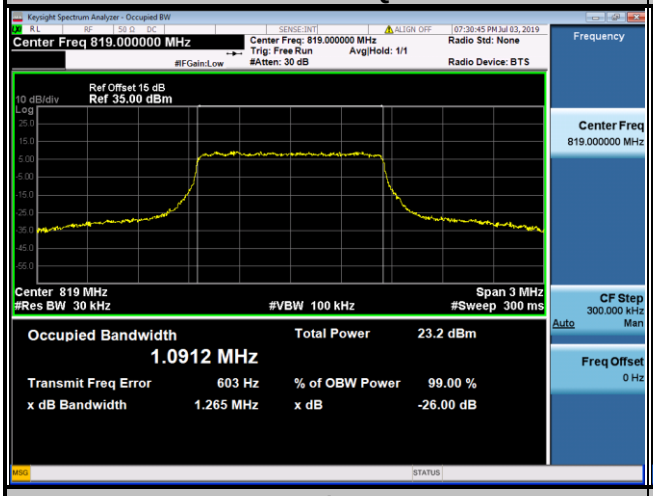
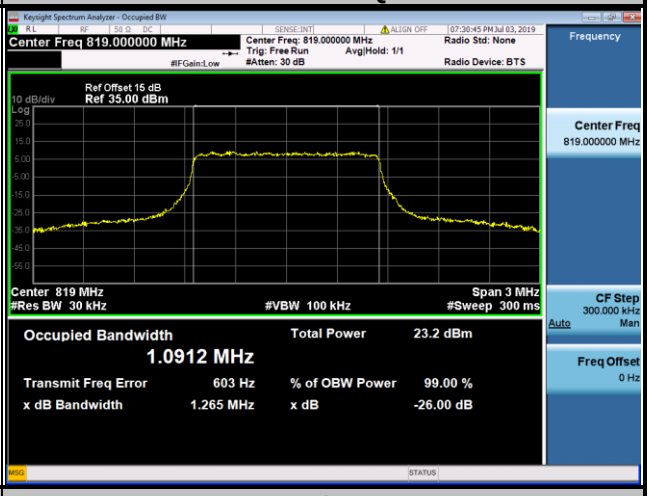
The EUT makes a call to the communication simulator. All measurements were done at low, middle and high operational frequency range. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function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

4.4.3 Test Setup



4.4.4 Test Results

LTE Band 26					
Channel Bandwidth: 1.4 MHz					
Channel	Frequency (MHz)	99 % Occupied Bandwidth (MHz)		26 dB Bandwidth (MHz)	
		QPSK	16QAM	QPSK	16QAM
26697	814.7	1.0885	1.0872	1.246	1.248
26740	819.0	1.0879	1.0912	1.253	1.265
26783	823.3	1.0881	1.0897	1.253	1.262
Channel Bandwidth: 3 MHz					
Channel	Frequency (MHz)	99 % Occupied Bandwidth (MHz)		26 dB Bandwidth (MHz)	
		QPSK	16QAM	QPSK	16QAM
26705	815.5	2.7022	2.6979	2.922	2.919
26740	819.0	2.7023	2.6972	2.925	2.923
26775	822.5	2.7014	2.6995	2.934	2.933

Spectrum Plot of Worst Value	
99 % Occupied Bandwidth	26 dB Bandwidth
1.4 MHz / 16QAM	1.4 MHz / 16QAM
	
3 MHz / QPSK	3 MHz / QPSK
	

LTE Band 26					
Channel Bandwidth: 5 MHz					
Channel	**Frequency (MHz)**	**99 % Occupied Bandwidth (MHz)**		**26 dB Bandwidth (MHz)**	
		QPSK	**16QAM**	**QPSK**	**16QAM**
26715	816.5	4.4927	4.4963	4.822	4.816
26740	819.0	4.4938	4.4966	4.843	4.835
26765	821.5	4.4935	4.4949	4.826	4.834
Channel Bandwidth: 10 MHz					
Channel	**Frequency (MHz)**	**99 % Occupied Bandwidth (MHz)**		**26 dB Bandwidth (MHz)**	
		QPSK	**16QAM**	**QPSK**	**16QAM**
26740	819.0	8.9551	8.9591	9.519	9.510

Spectrum Plot of Worst Value	
99 % Occupied Bandwidth	**26 dB Bandwidth**
5 MHz / 16QAM	**5 MHz / QPSK**
	
10 MHz / 16QAM	**10 MHz / QPSK**
	

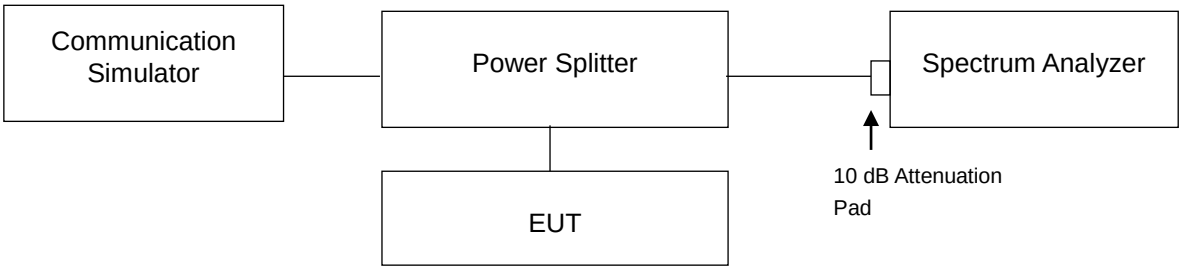
4.5 Emission Mask Measurement

4.5.1 Limits of Emission Mask Measurement

According to FCC part 90.691 shall be tested the emission mask. For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log_{10}(f/6.1) decibels or 50 + 10Log_{10}(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.
For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log_{10}(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

For §90.691(a), RBW=300 Hz for offset less than 37.5 kHz from channel edge and RBW=100 kHz for offsets greater than 37.5 kHz is allowed.

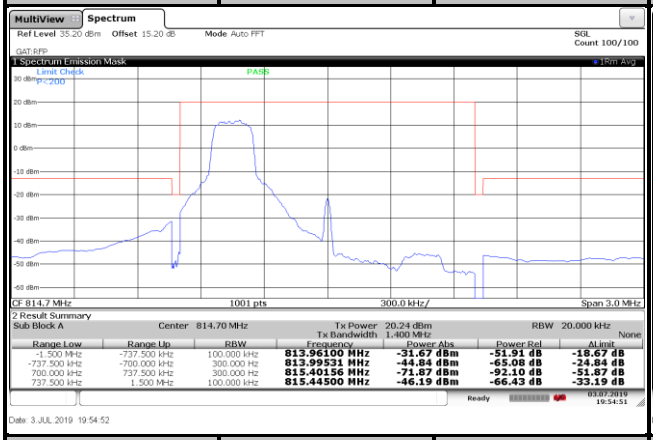
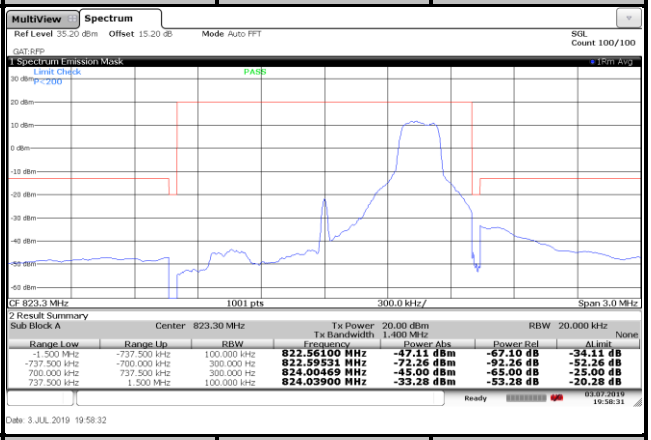
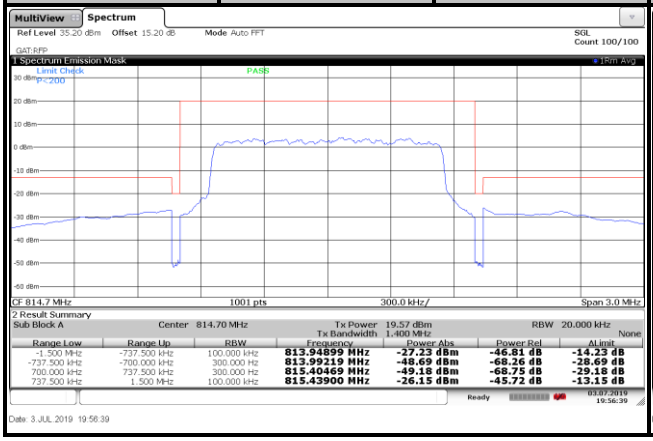
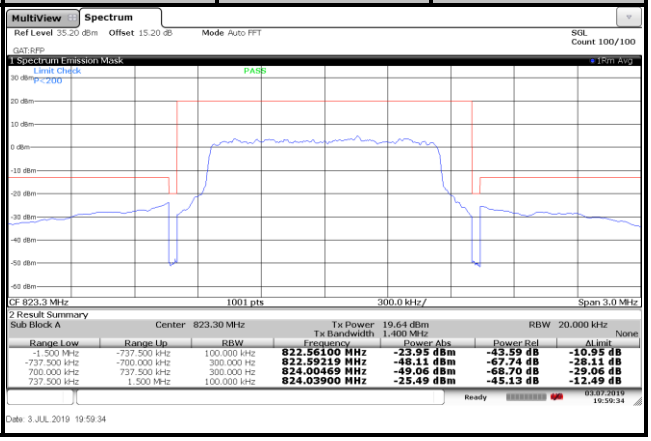
4.5.2 Test Setup

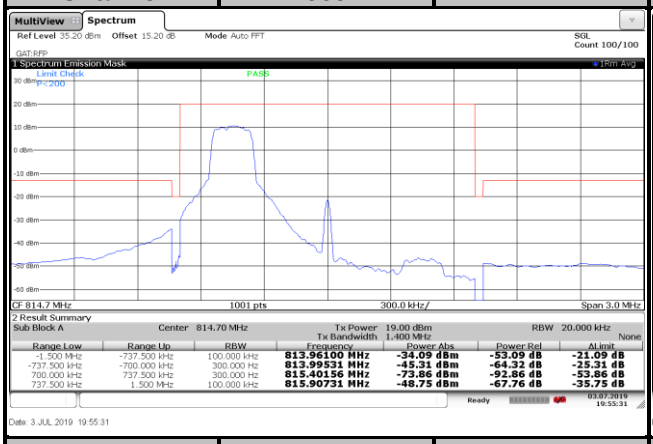
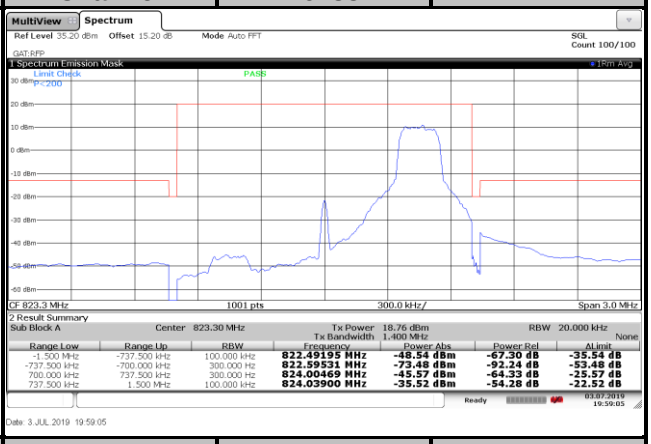
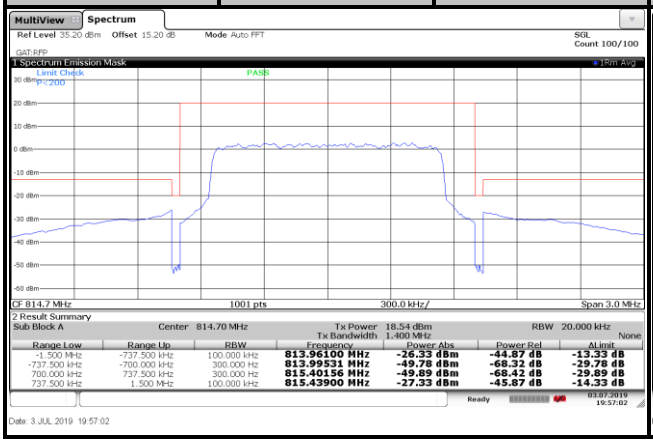
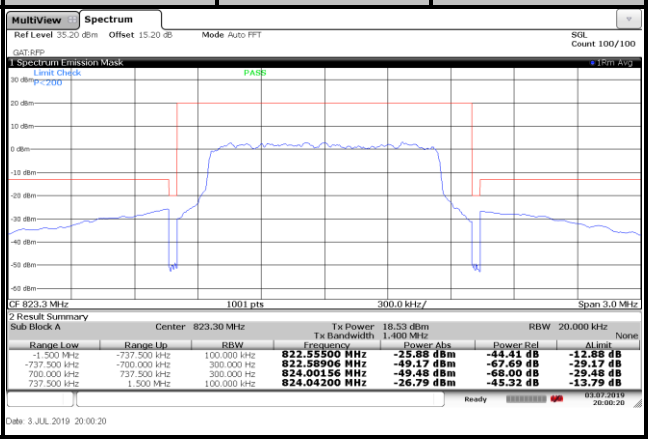


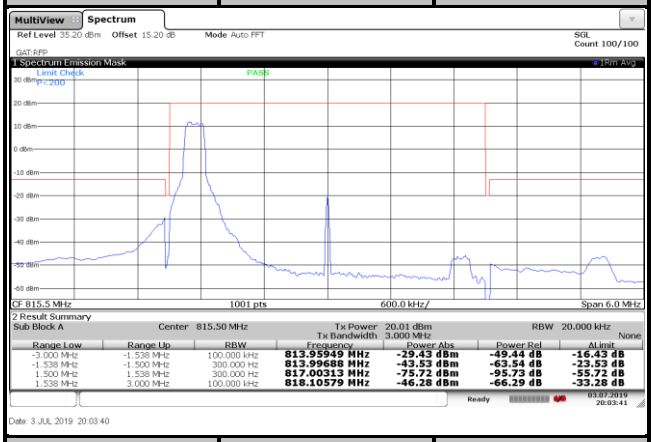
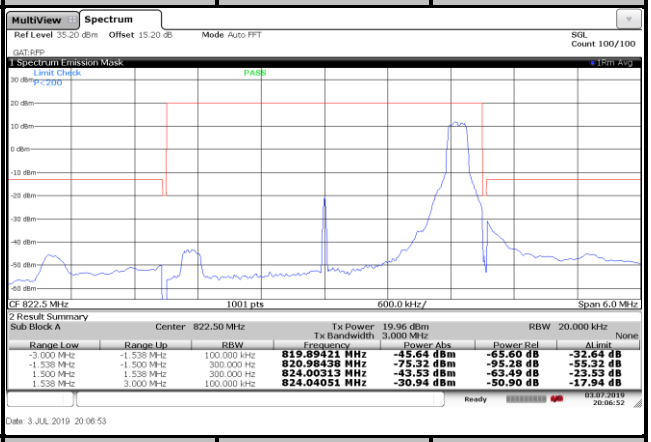
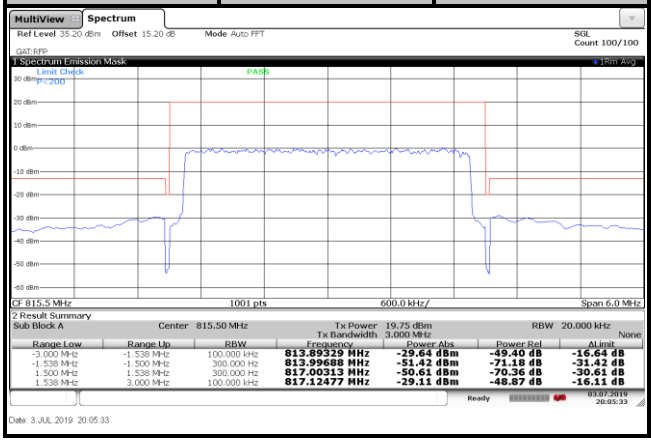
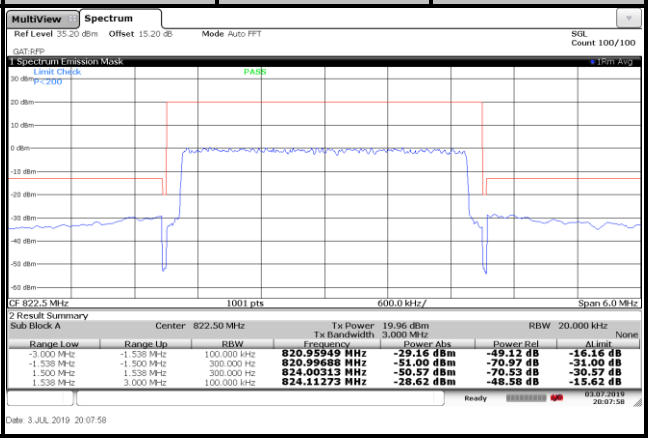
4.5.3 Test Procedures

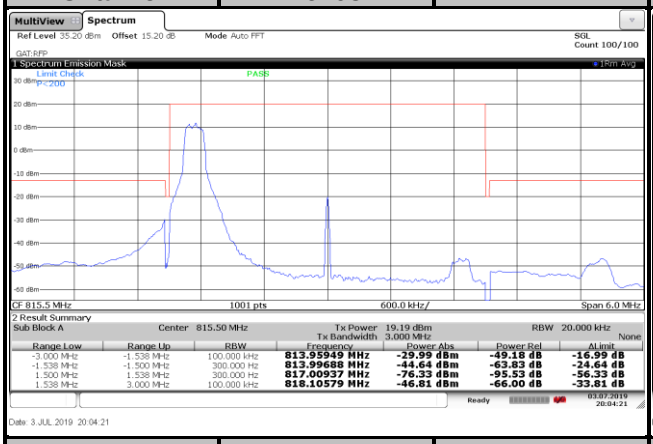
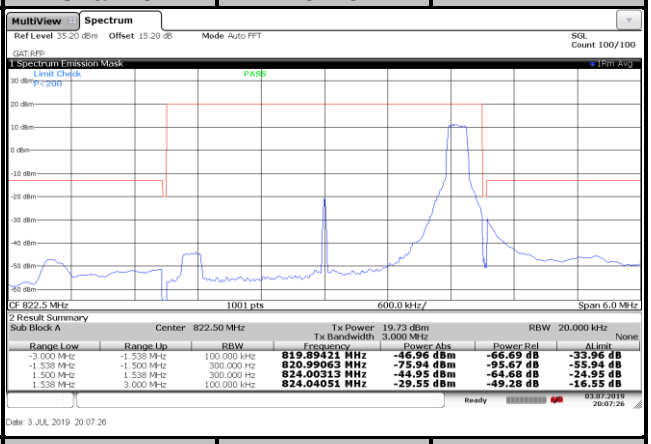
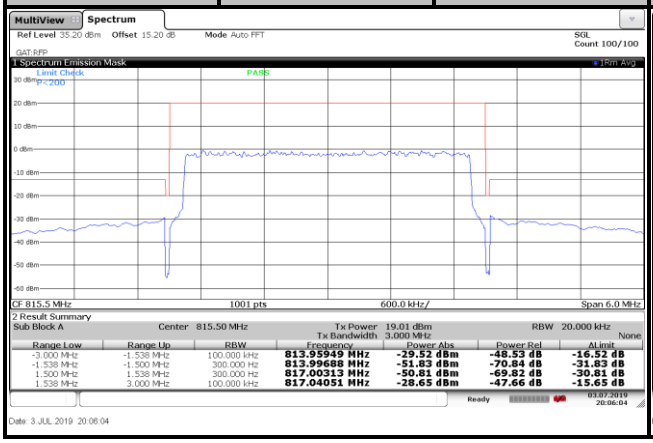
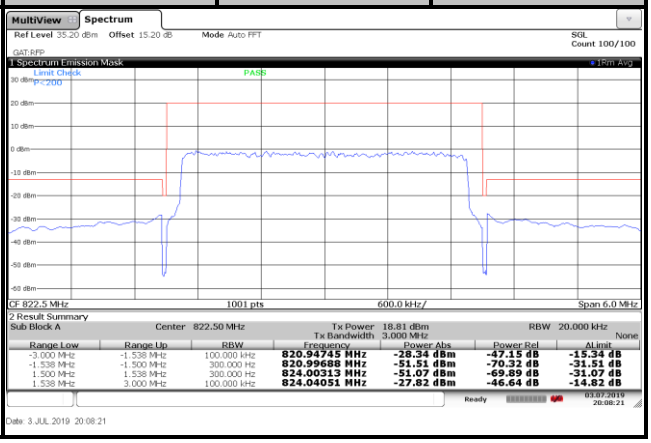
a. The measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
b. Record the test plot.

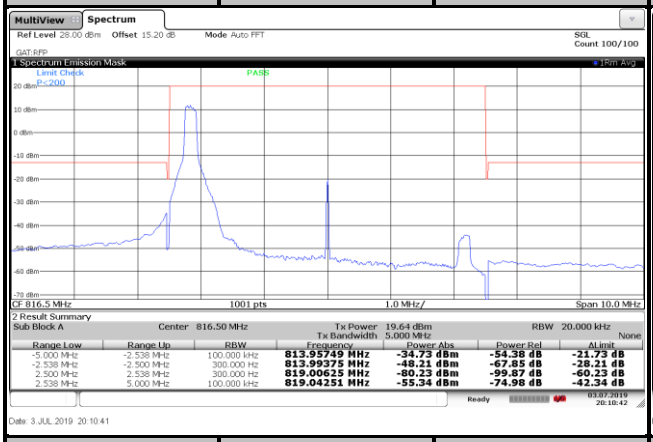
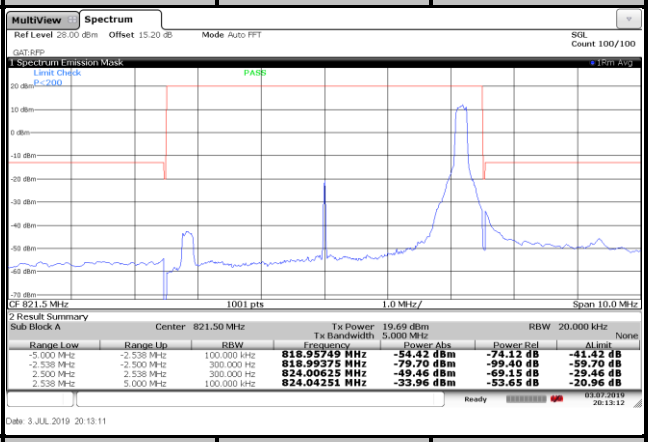
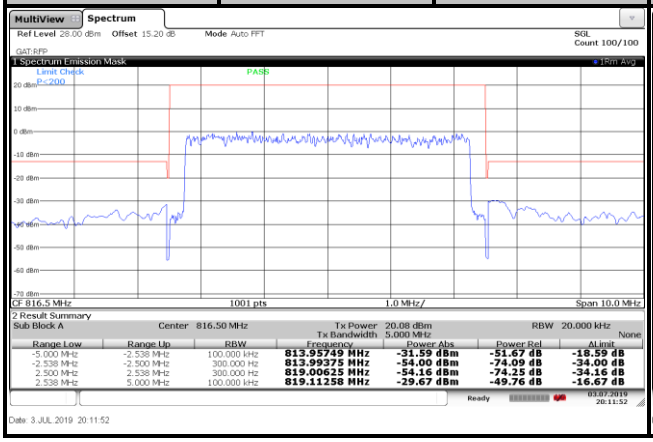
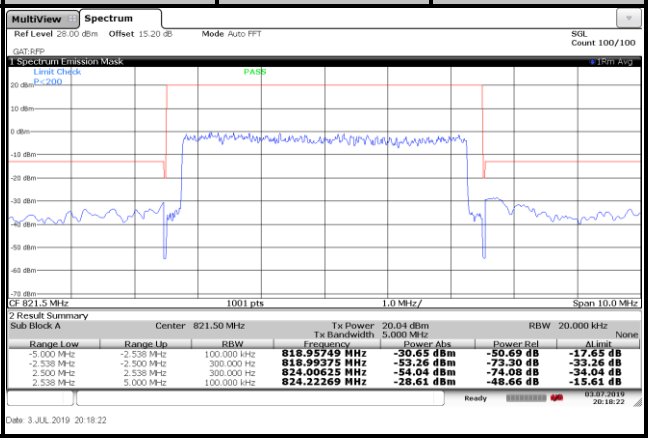
4.5.4 Test Results

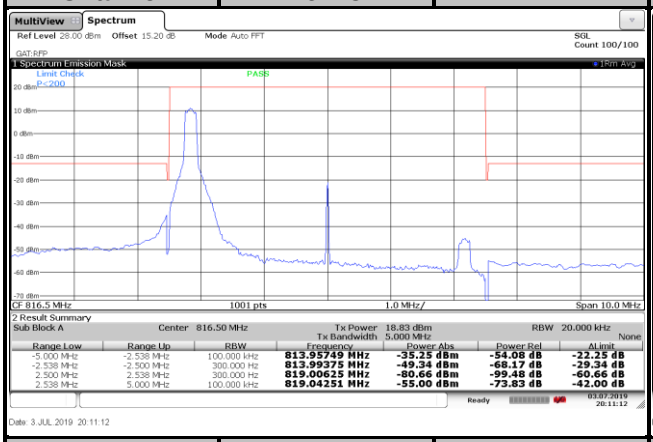
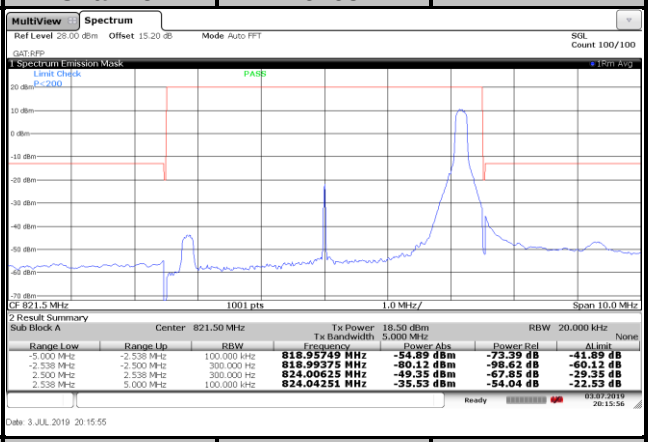
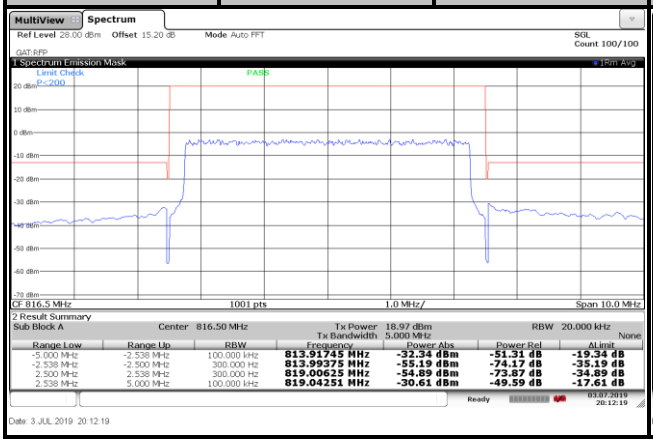
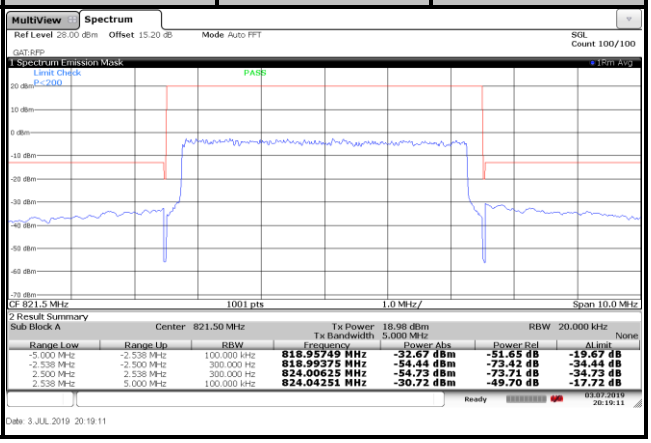
LTE Band 26					
Channel Bandwidth: 1.4 MHz / QPSK					
Channel	26697	1 RB	Channel	26783	1 RB
					
Channel	26697	6 RB	Channel	26783	6 RB
					

LTE Band 26					
Channel Bandwidth: 1.4 MHz / 16QAM					
Channel	26697	1 RB	Channel	26783	1 RB
					
Channel	26697	6 RB	Channel	26783	6 RB
					

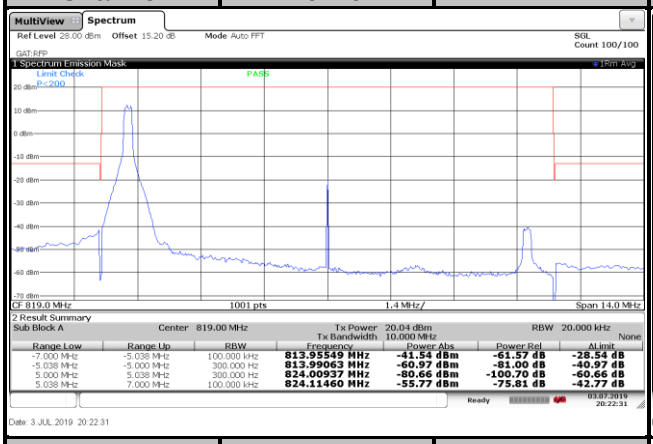
LTE Band 26					
Channel Bandwidth: 3 MHz / QPSK					
Channel	26705	1 RB	Channel	26775	1 RB
					
Channel	26705	15 RB	Channel	26775	15 RB
					

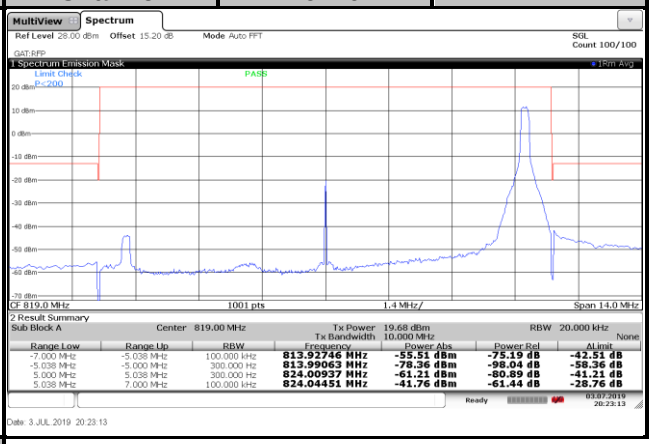
LTE Band 26					
Channel Bandwidth: 3 MHz / 16QAM					
Channel	26705	1 RB	Channel	26775	1 RB
					
Channel	26705	15 RB	Channel	26775	15 RB
					

LTE Band 26					
Channel Bandwidth: 5 MHz / QPSK					
Channel	26715	1 RB	Channel	26765	1 RB
					
Channel	26715	25 RB	Channel	26765	25 RB
					

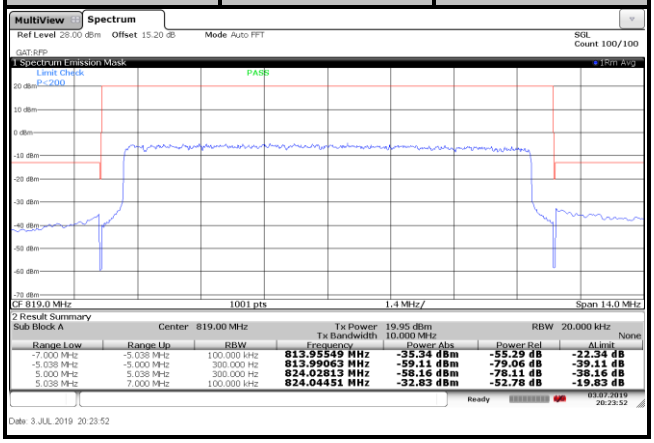
LTE Band 26					
Channel Bandwidth: 5 MHz / 16QAM					
Channel	26715	1 RB	Channel	26765	1 RB
					
Channel	26715	25 RB	Channel	26765	25 RB
					

LTE Band 26					
Channel Bandwidth: 10 MHz / QPSK					
Channel	26740	1 RB	Channel	26740	1 RB

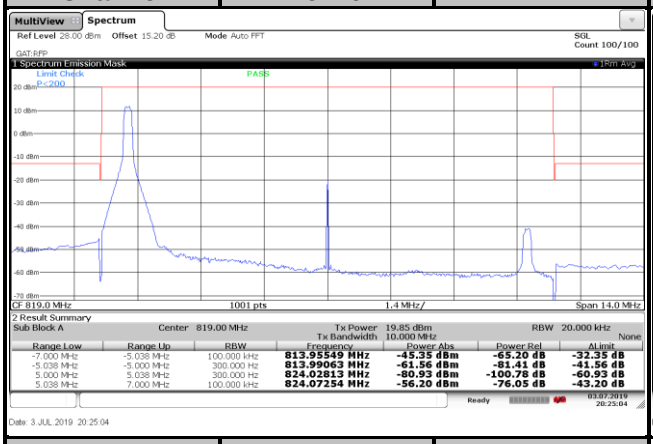


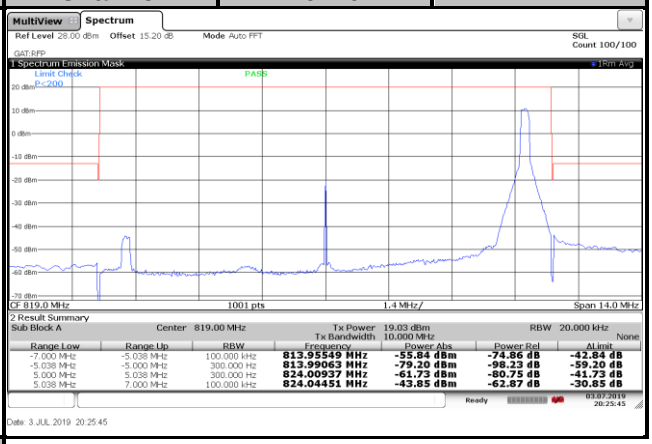


Channel	26740	50 RB

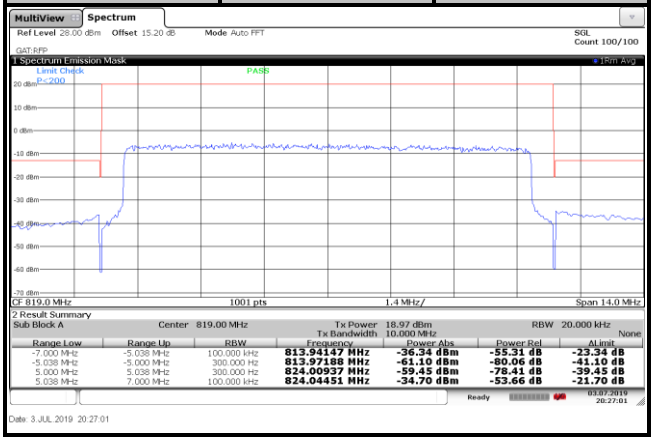


LTE Band 26					
Channel Bandwidth: 10 MHz / 16QAM					
Channel	26740	1 RB	Channel	26740	1 RB





Channel	26740	50 RB

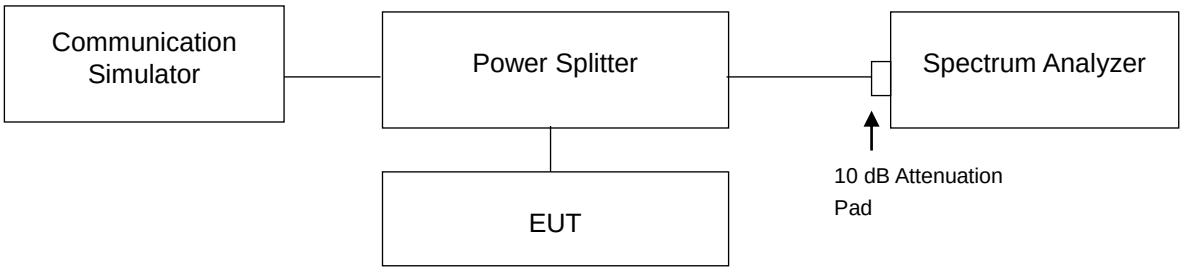


4.6 Conducted Spurious Emissions

4.6.1 Limits of Conducted Spurious Emissions Measurement

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 +10 $\log_{10}$(P) dB. The limit of emission is equal to -13 dBm.

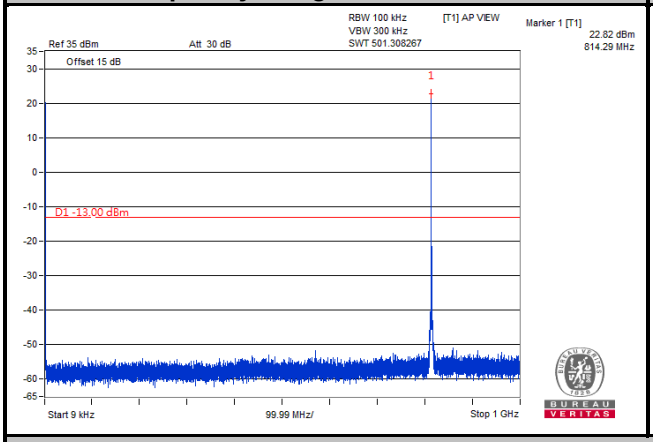
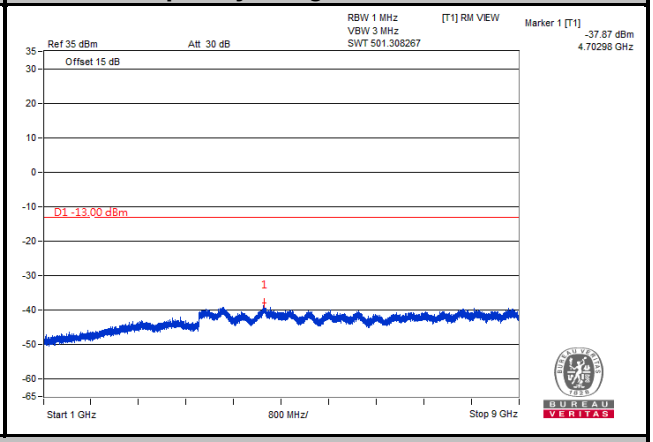
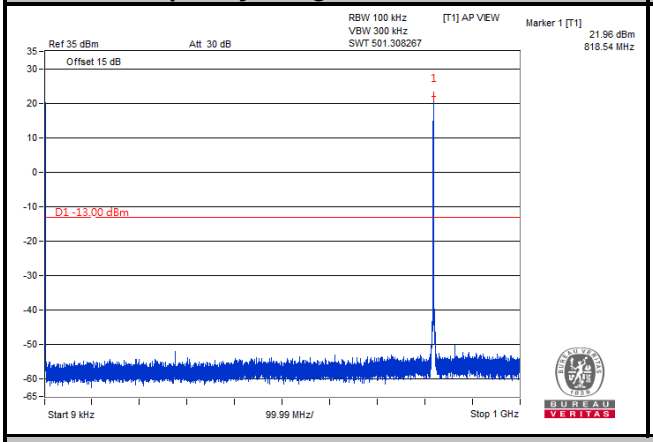
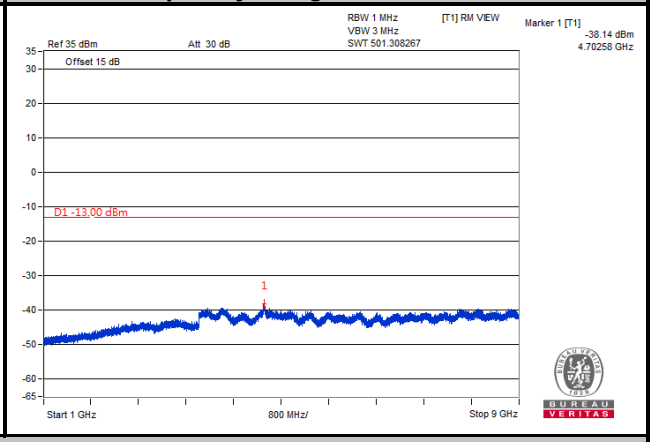
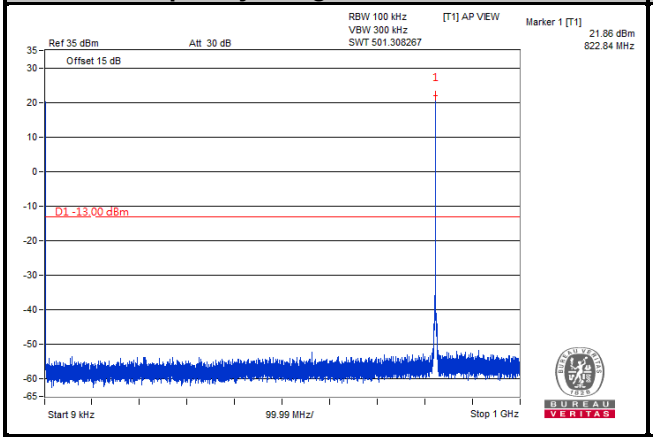
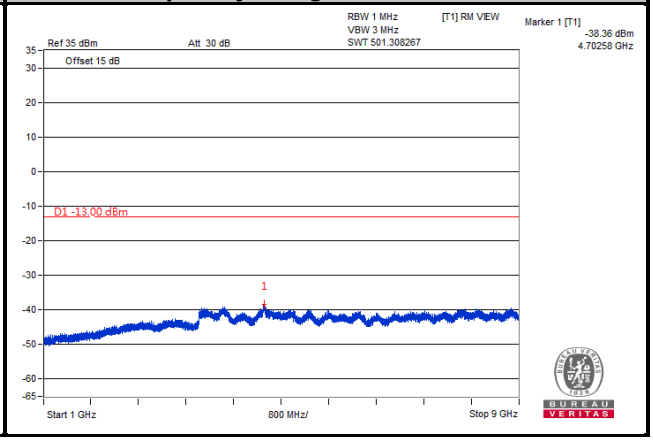
4.6.2 Test Setup



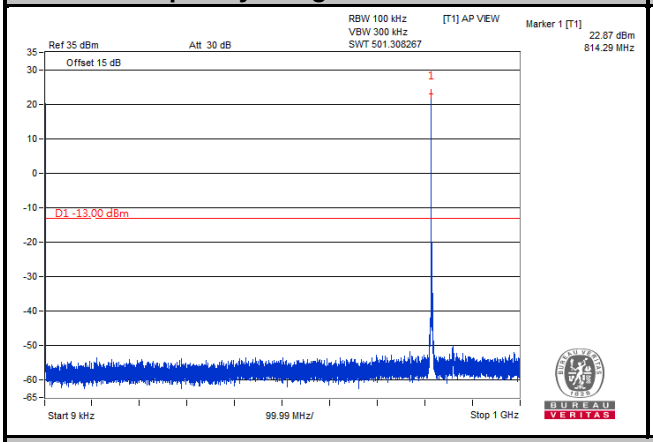
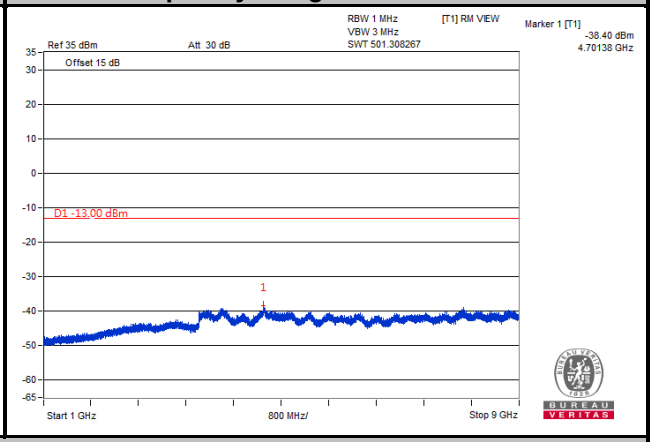
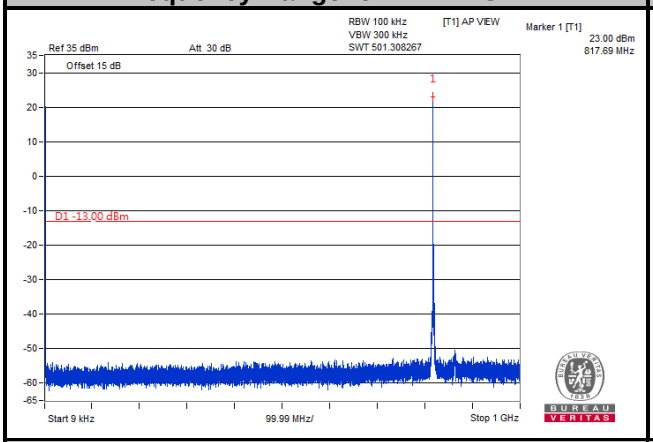
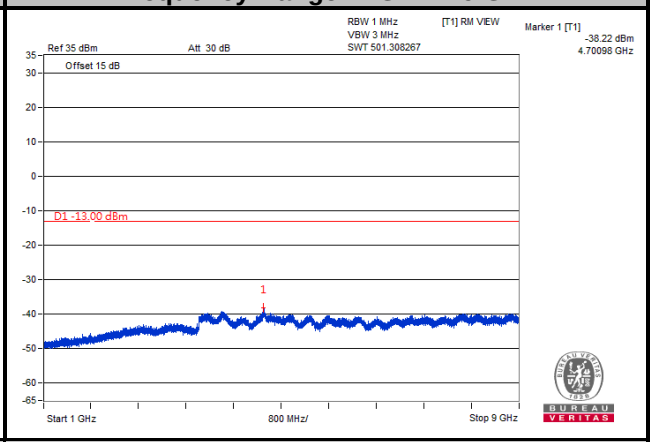
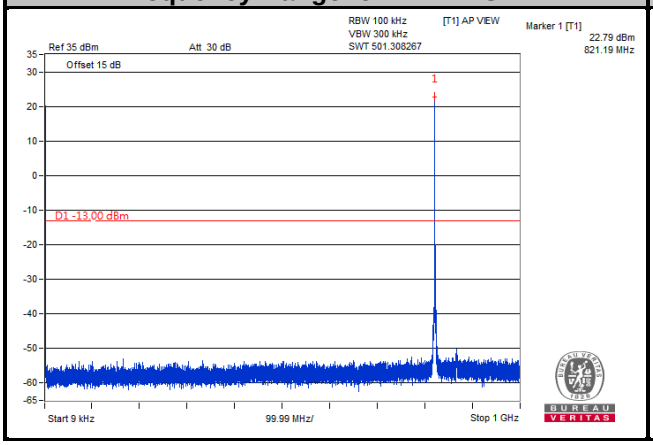
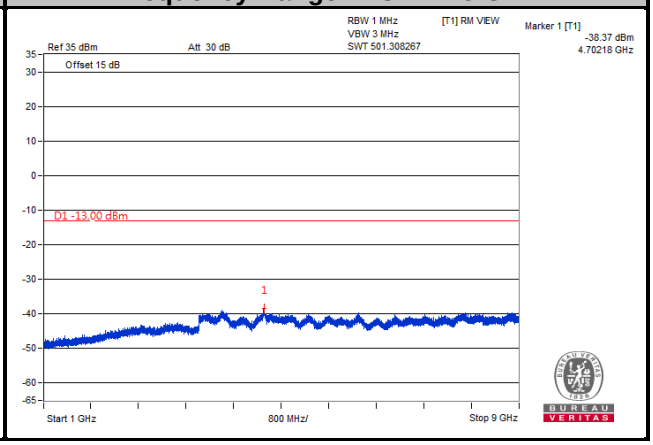
4.6.3 Test Procedure

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 1 GHz. 10 dB attenuation pad is connected with spectrum. RBW = 100 kHz and VBW = 300 kHz are used for conducted emission measurement.
c. Measuring frequency range is from 1 GHz to 9 GHz. 10 dB attenuation pad is connected with spectrum. RBW = 1 MHz and VBW = 3 MHz are used for conducted emission measurement.

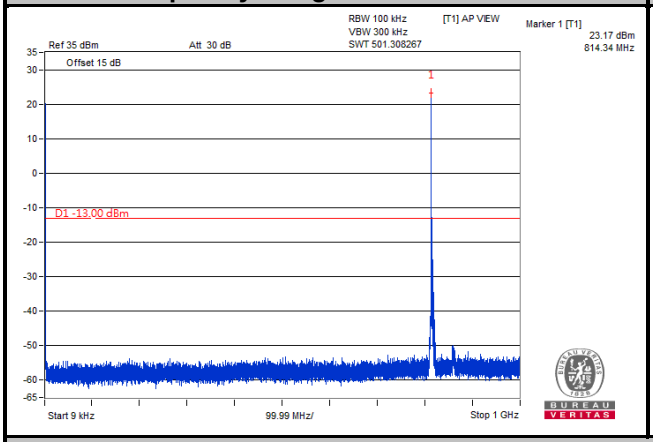
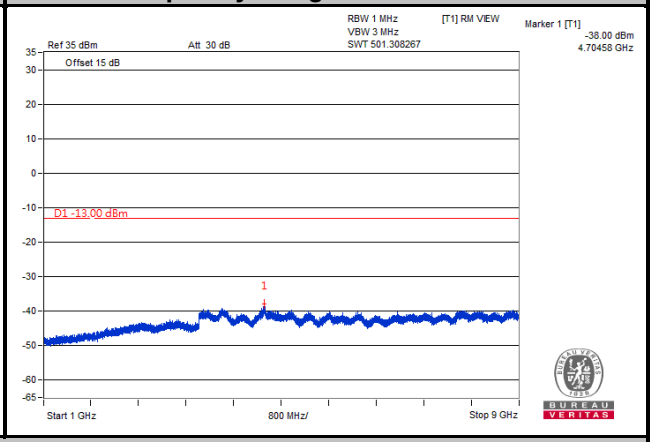
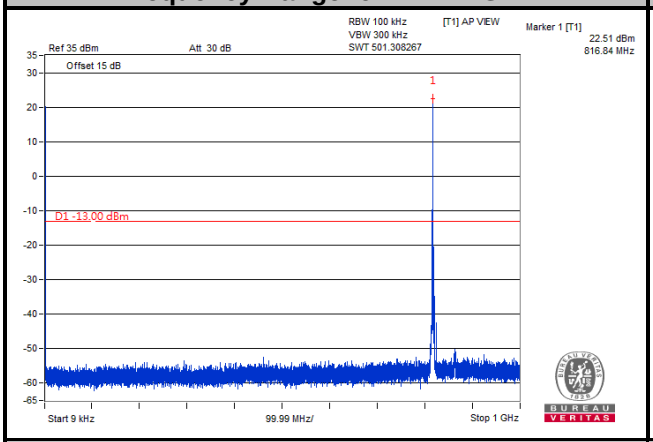
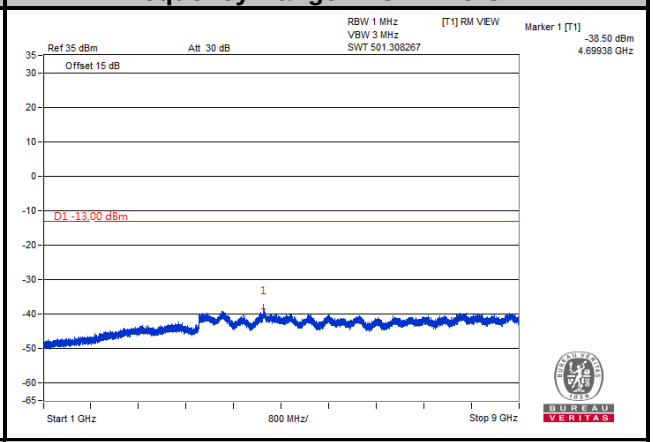
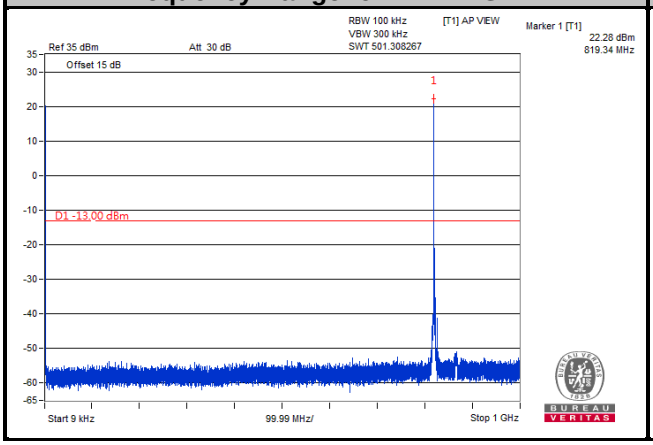
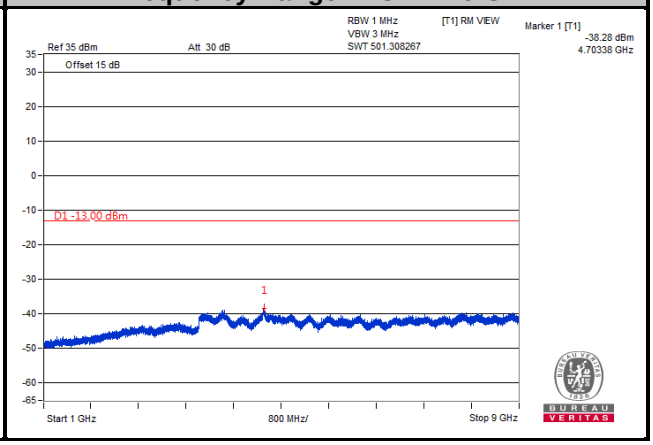
4.6.4 Test Results

LTE Band 26	
Channel Bandwidth: 1.4 MHz	
Channel 26697	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	
Channel 26740	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	
Channel 26783	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	

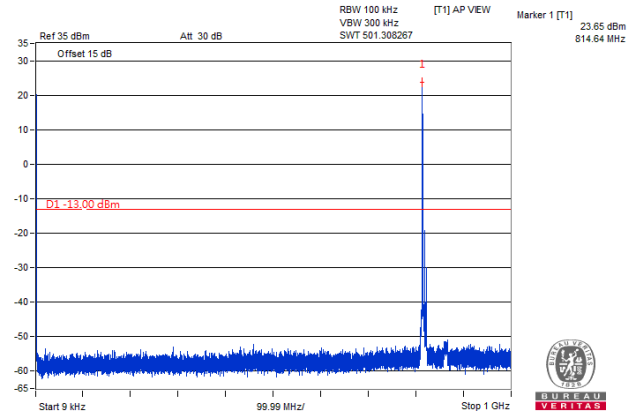
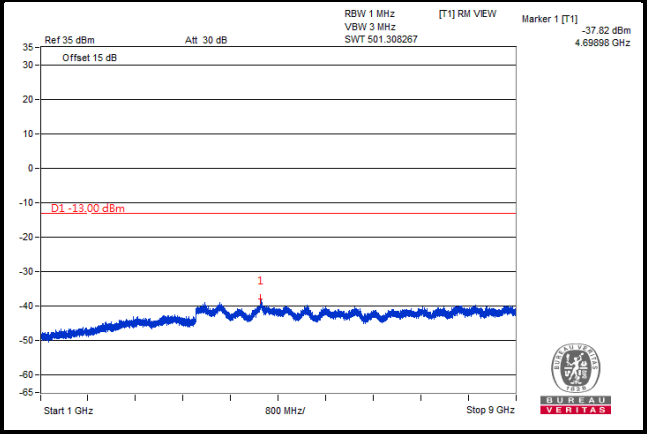
Note: The signal over the limit in 9 kHz is from spectrum analyzer.

LTE Band 26	
Channel Bandwidth: 3 MHz	
Channel 26705	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	
Channel 26740	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	
Channel 26775	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	

Note: The signal over the limit in 9 kHz is from spectrum analyzer.

LTE Band 26	
Channel Bandwidth: 5 MHz	
Channel 26715	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	
Channel 26740	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	
Channel 26765	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	

Note: The signal over the limit in 9 kHz is from spectrum analyzer.

LTE Band 26	
Channel Bandwidth: 10 MHz	
Channel 26740	
Frequency Range: 9 kHz ~ 1 GHz	Frequency Range: 1 GHz ~ 9 GHz
	

Note: The signal over the limit in 9 kHz is from spectrum analyzer.

4.7 Radiated Emission Measurement

4.7.1 Limits of Radiated Emission Measurement

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 +10 log (P) dB. The limit of emission is equal to -13 dBm.

4.7.2 Test Procedure

a. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m (below or equal 1 GHz) and/or 1.5 m (above 1 GHz) 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 1 m to 4 m 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 - 2.15 dB.

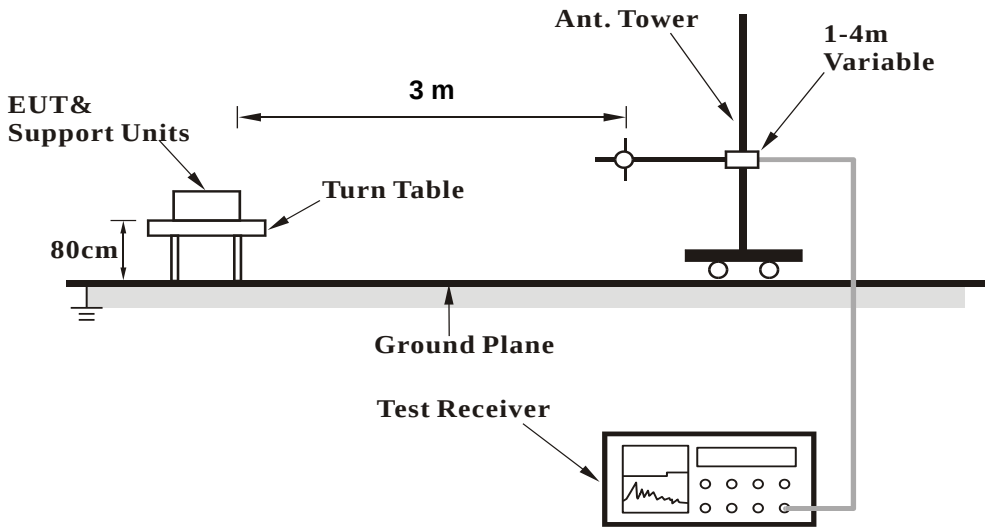
Note: The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

4.7.3 Deviation from Test Standard

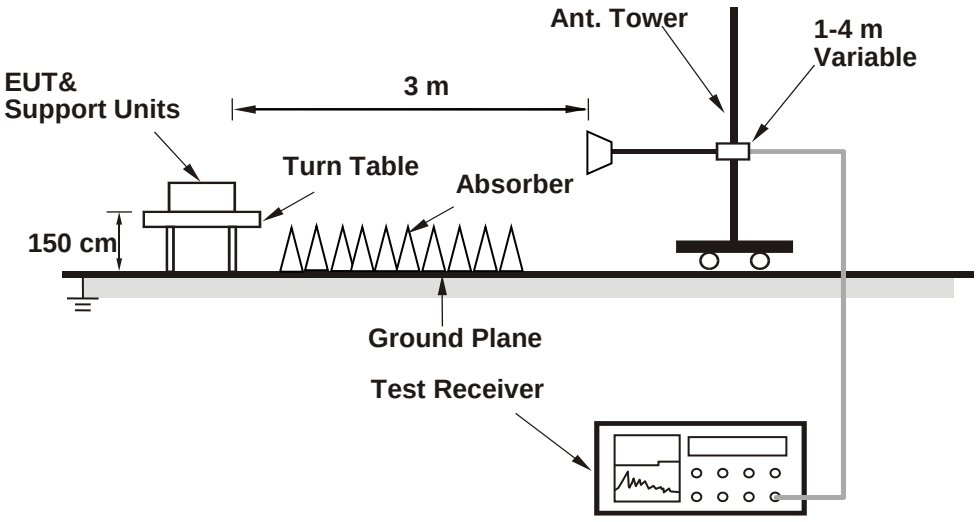
No deviation.

4.7.4 Test Setup

<Radiated Emission below or equal 1 GHz>



<Radiated Emission above 1 GHz>



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

4.7.5 Test Results

LTE Band 26

Channel Bandwidth: 1.4 MHz / QPSK

Low Channel

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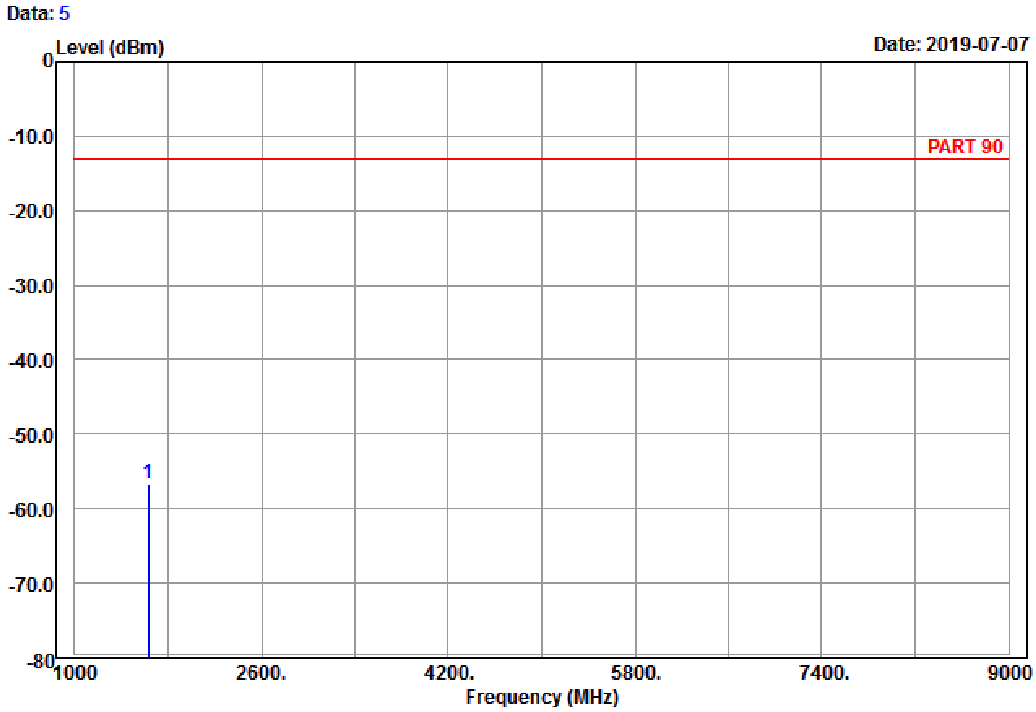
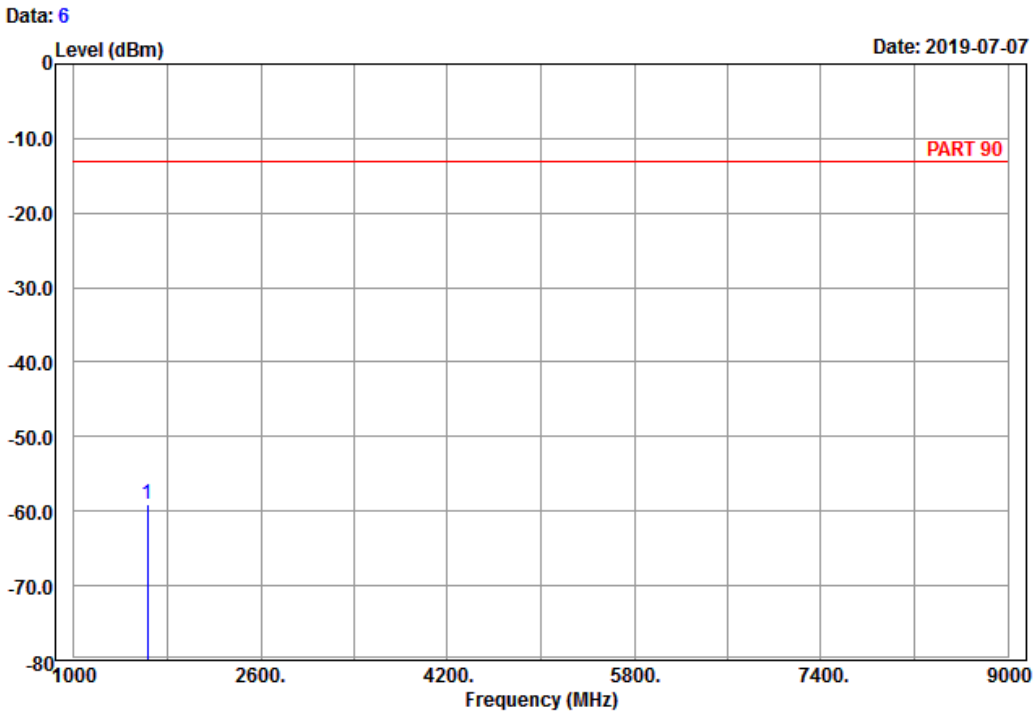


Site : 966 chamber 1
Condition: PART 90 Horizontal
Remark : LTE_Band 26_Link_CH26697
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1629.40	-56.66	-64.22	7.56	-13.00	-43.66	Peak



Site : 966 chamber 1
Condition: PART 90 Vertical
Remark : LTE_Band 26_Link_CH26697
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1629.40	-59.15	-66.71	7.56	-13.00	-46.15	Peak

Middle Channel

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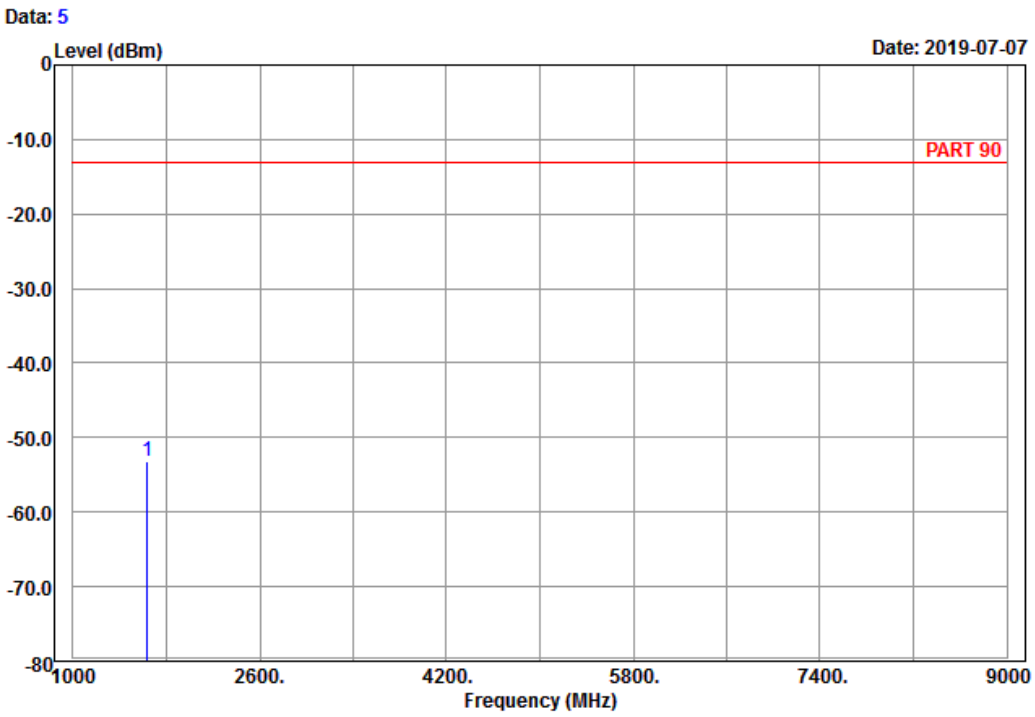
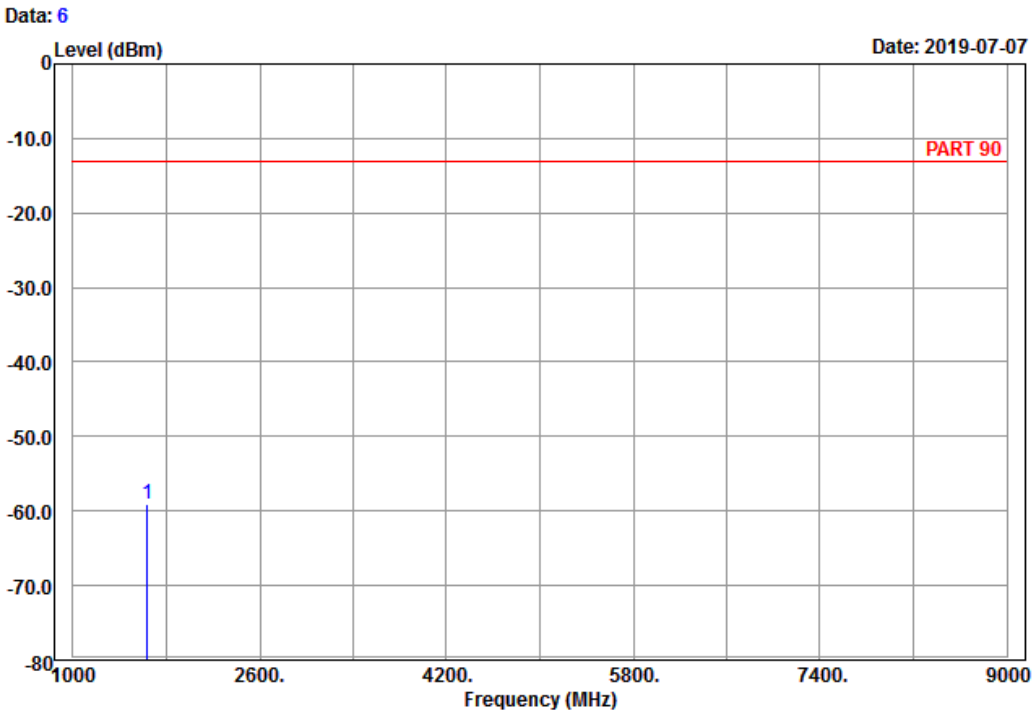


Site : 966 chamber 1
Condition: PART 90 Horizontal
Remark : LTE_Band 26_Link_CH26740
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1638.00	-53.17	-60.73	7.56	-13.00	-40.17	Peak

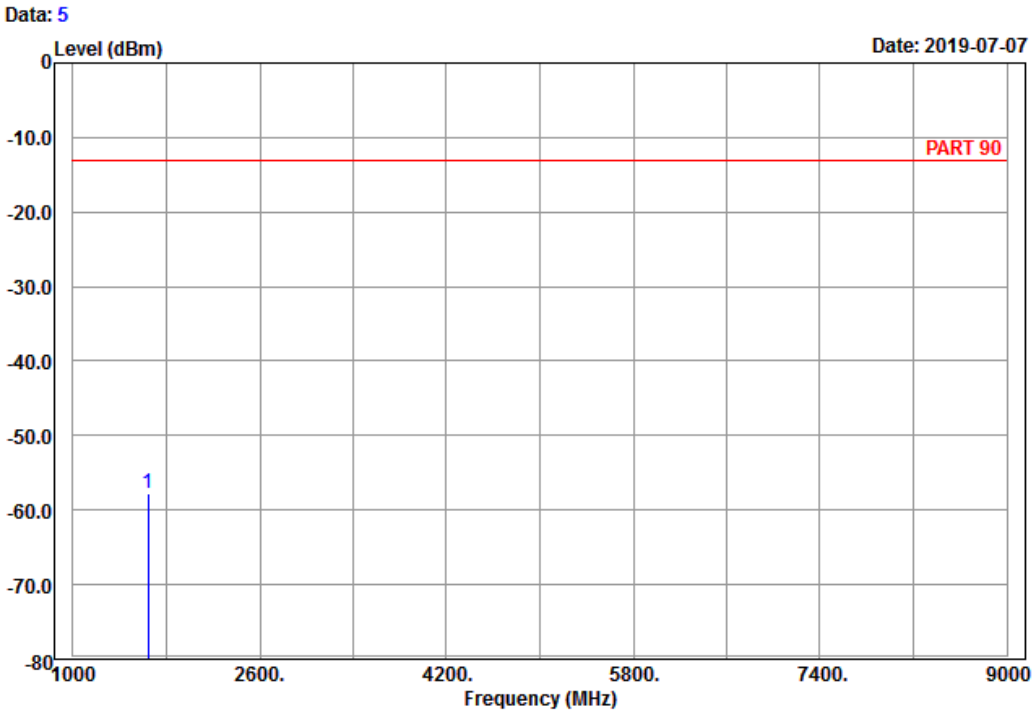


Site : 966 chamber 1
Condition: PART 90 Vertical
Remark : LTE_Band 26_Link_CH26740
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1638.00	-58.99	-66.55	7.56	-13.00	-45.99	Peak

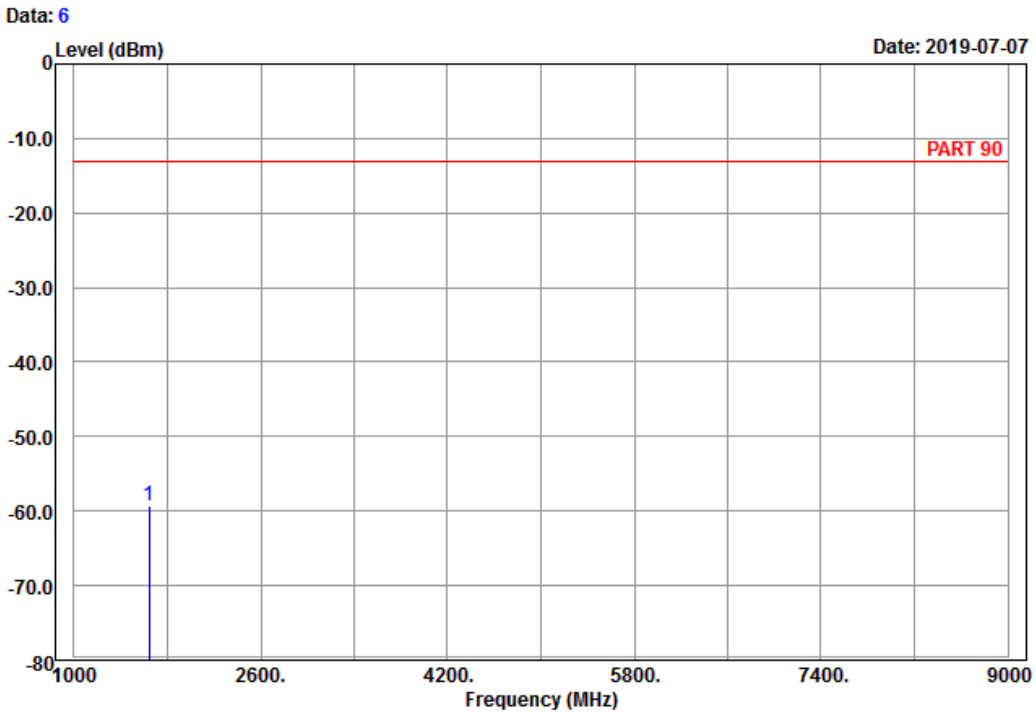
High Channel

Bureau Veritas Consumer Products Services Ltd.,Taoyuan Branch



Site : 966 chamber 1
Condition: PART 90 Horizontal
Remark : LTE_Band 26_Link_CH26783
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1646.60	-57.85	-65.58	7.73	-13.00	-44.85	Peak

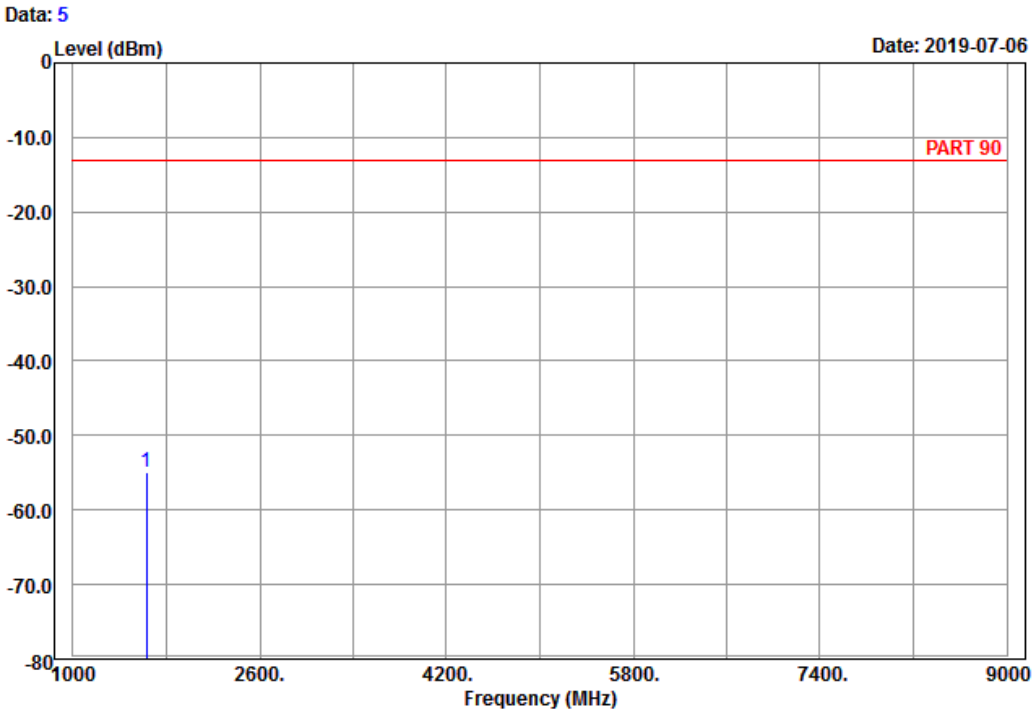


Site : 966 chamber 1
Condition: PART 90 Vertical
Remark : LTE_Band 26_Link_CH26783
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1646.60	-59.40	-67.13	7.73	-13.00	-46.40	Peak

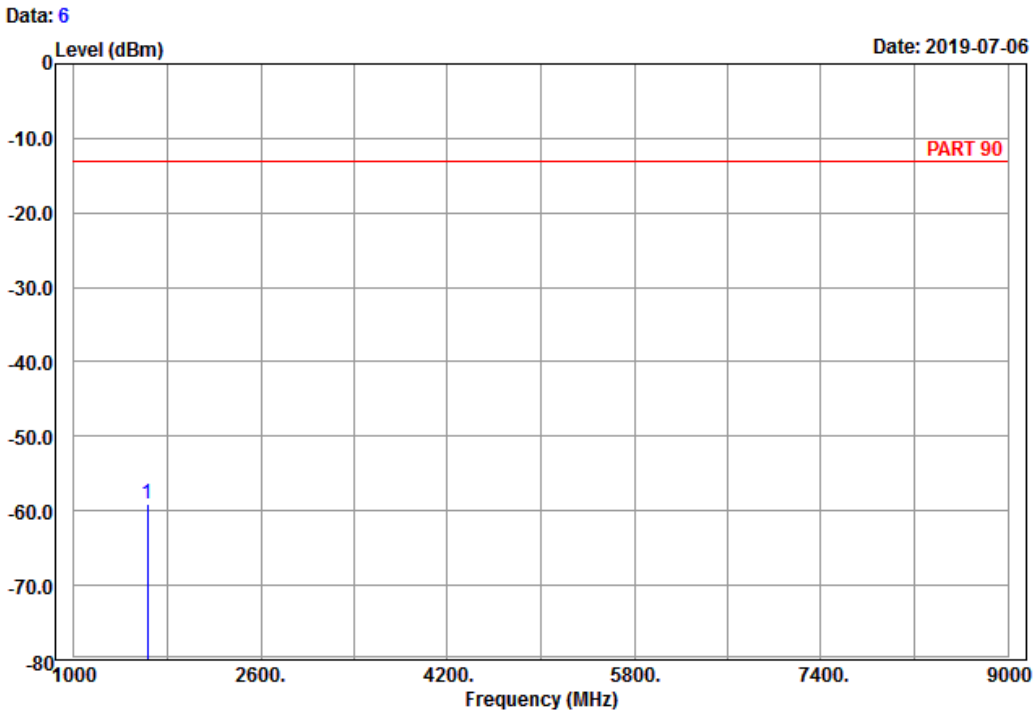
Channel Bandwidth: 5 MHz / QPSK
Low Channel

Bureau Veritas Consumer Products Services Ltd.,Taoyuan Branch



Site : 966 chamber 1
Condition: PART 90 Horizontal
Remark : LTE_Band 26_Link_CH26715
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1633.00	-55.00	-62.56	7.56	-13.00	-42.00	Peak

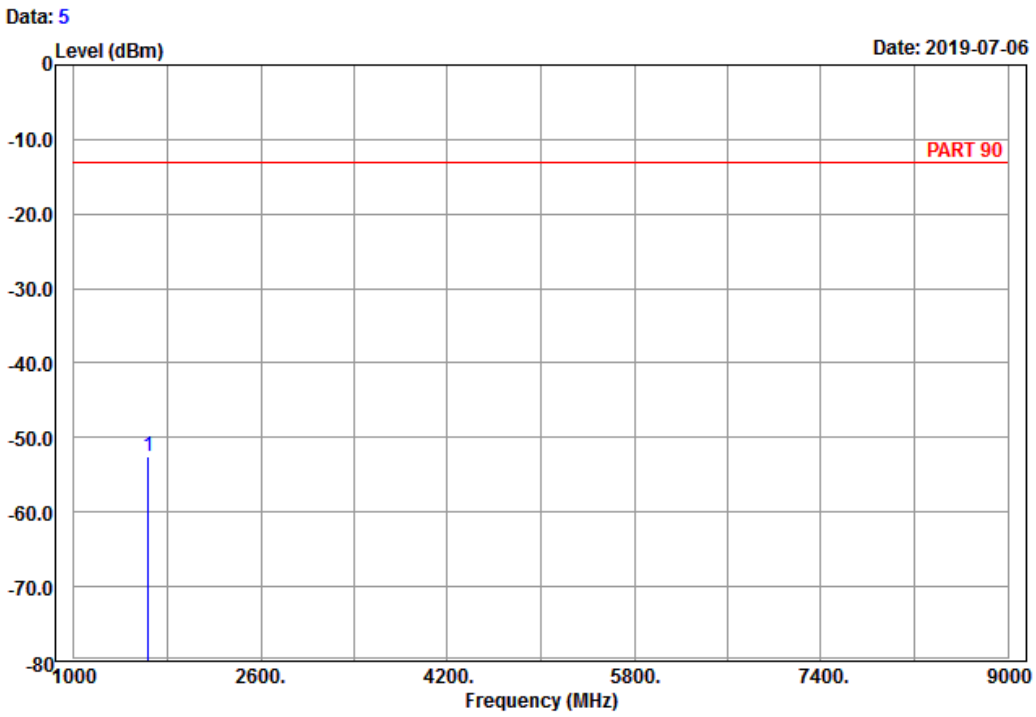


Site : 966 chamber 1
Condition: PART 90 Vertical
Remark : LTE_Band 26_Link_CH26715
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1633.00	-59.00	-66.56	7.56	-13.00	-46.00	Peak

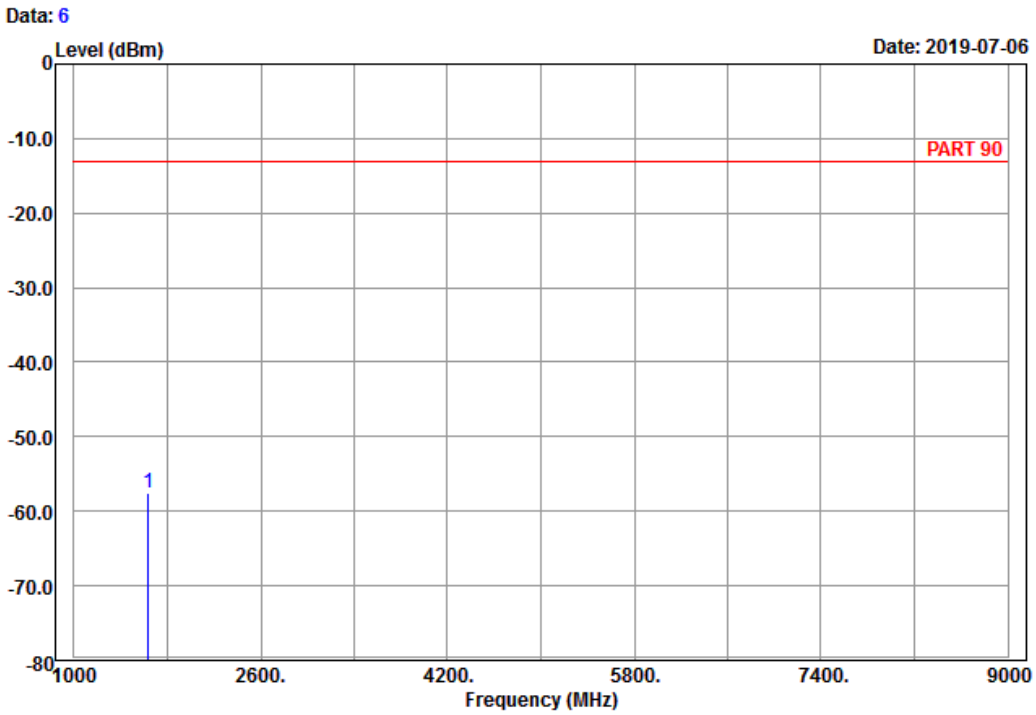
Middle Channel

Bureau Veritas Consumer Products Services Ltd.,Taoyuan Branch



Site : 966 chamber 1
Condition: PART 90 Horizontal
Remark : LTE_Band 26_Link_CH26740
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1638.00	-52.63	-60.19	7.56	-13.00	-39.63	Peak

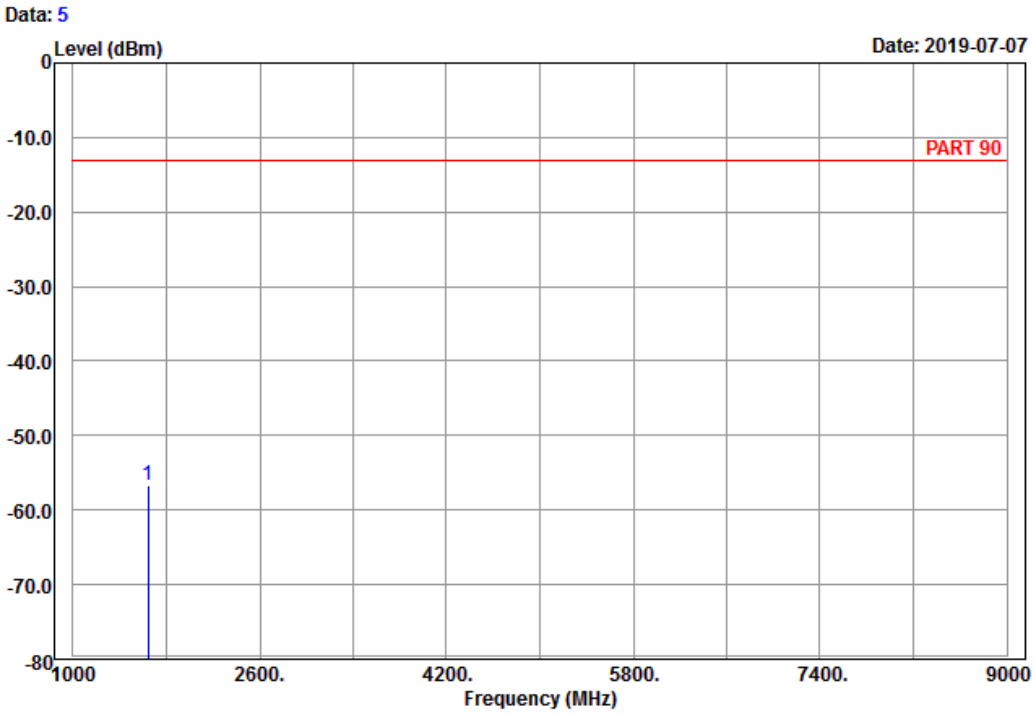


Site : 966 chamber 1
Condition: PART 90 Vertical
Remark : LTE_Band 26_Link_CH26740
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1638.00	-57.55	-65.11	7.56	-13.00	-44.55	Peak

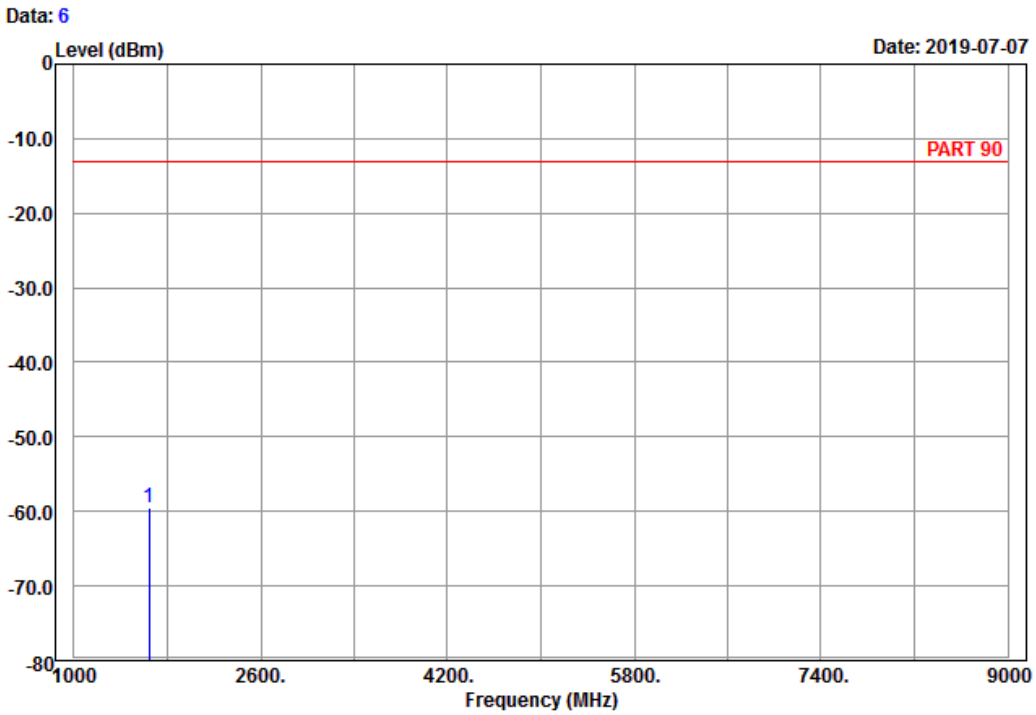
High Channel

Bureau Veritas Consumer Products Services Ltd.,Taoyuan Branch



Site : 966 chamber 1
Condition: PART 90 Horizontal
Remark : LTE_Band 26_Link_CH26765
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1643.00	-56.65	-64.38	7.73	-13.00	-43.65	Peak

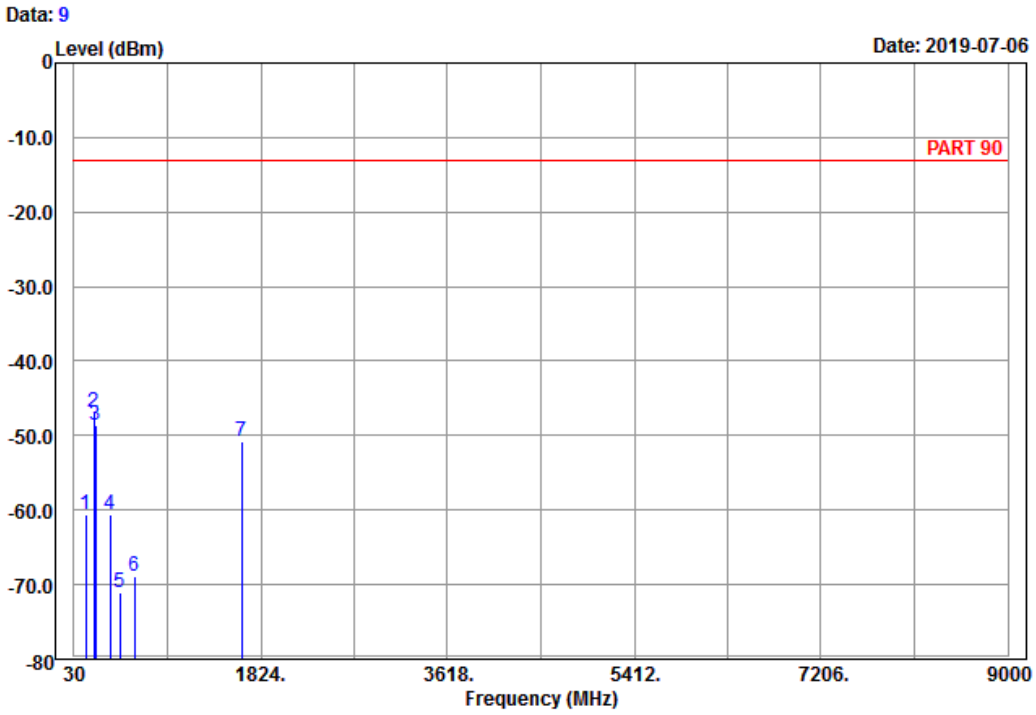


Site : 966 chamber 1
Condition: PART 90 Vertical
Remark : LTE_Band 26_Link_CH26765
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	1643.00	-59.49	-67.22	7.73	-13.00	-46.49	Peak

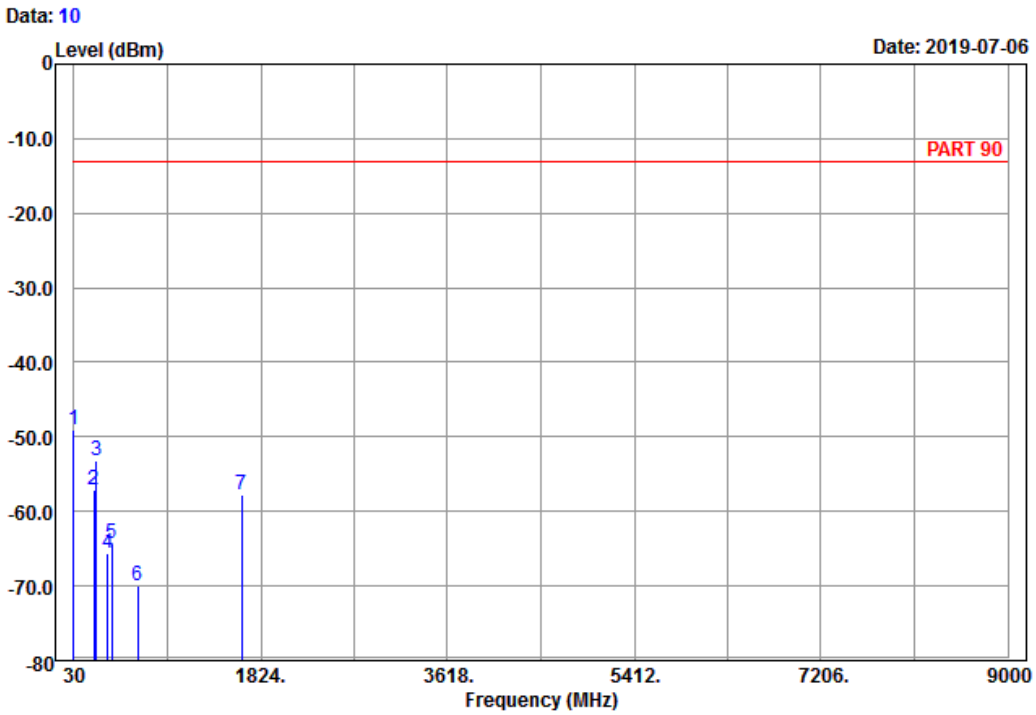
Channel Bandwidth: 10 MHz / QPSK

Bureau Veritas Consumer Products Services Ltd.,Taoyuan Branch



Site : 966 chamber 1
Condition: PART 90 Horizontal
Remark : LTE_Band 26_Link_CH26740
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1	146.64	-60.65	-52.79	-7.86	-13.00	-47.65	Peak
2 pp	222.51	-46.91	-41.03	-5.88	-13.00	-33.91	Peak
3	238.17	-48.67	-43.01	-5.66	-13.00	-35.67	Peak
4	377.00	-60.69	-56.76	-3.93	-13.00	-47.69	Peak
5	471.50	-71.12	-66.67	-4.45	-13.00	-58.12	Peak
6	613.60	-68.95	-69.22	0.27	-13.00	-55.95	Peak
7	1638.00	-50.87	-58.43	7.56	-13.00	-37.87	Peak



Site : 966 chamber 1
Condition: PART 90 Vertical
Remark : LTE_Band 26_Link_CH26740
Tested by: Karl Lee

	Freq	Level	Read Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBm	dBm	dB	dBm	dB	
1 pp	30.00	-49.04	-38.50	-10.54	-13.00	-36.04	Peak
2	217.38	-57.03	-51.08	-5.95	-13.00	-44.03	Peak
3	244.92	-53.28	-47.71	-5.57	-13.00	-40.28	Peak
4	350.40	-65.70	-60.32	-5.38	-13.00	-52.70	Peak
5	390.30	-64.21	-60.95	-3.26	-13.00	-51.21	Peak
6	639.50	-70.03	-70.02	-0.01	-13.00	-57.03	Peak
7	1638.00	-57.67	-65.23	7.56	-13.00	-44.67	Peak

5 Pictures of Test Arrangements

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

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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

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

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