FCC Test Report

(PART 27)

Report No.:	RF171218C01
FCC ID:	XPY2AGQN4NNN
Test Model:	SARA-R410M-02B
Received Date:	Dec. 18, 2017
Test Date:	Dec. 26, 2017 ~ Jan. 08, 2018
Issued Date:	Jan. 16, 2018
Applicant:	u-blox AG
Address:	Zuercherstrasse 68, 8800 , Thalwil, Switzerland
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:	No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei Shan Hsiang, Taoyuan Hsien 333, Taiwan, R.O.C.
FCC Registration / Designation Number:	788550 / TW0003

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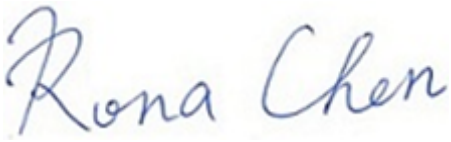
Release Control Record

Issue No.	Description	Date Issued
RF171218C01	Original Release	Jan. 16, 2018

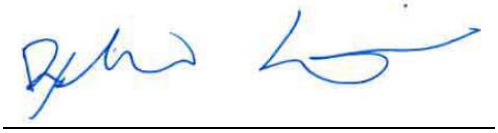
1 Certificate of Conformity

Product:	CAT M1 and Narrowband-IOT Module
Brand:	u-blox AG
Test Model:	SARA-R410M-02B
Sample Status:	Identical Prototype
Applicant:	u-blox AG
Test Date:	Dec. 26, 2017 ~ Jan. 08, 2018
Standards:	FCC Part 27, Subpart C, L

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:** Jan. 16, 2018

Rona Chen / Specialist

Approved by :  , **Date:** Jan. 16, 2018

Dylan Chiou / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 27 & Part 2 (LTE 4)			
FCC Clause	**Test Item**	**Result**	**Remarks**
2.1046 27.50(d)(4)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
2.1055 27.54	Frequency Stability	Pass	Meet the requirement of limit.
2.1049 27.53(h)	Occupied Bandwidth	Pass	Meet the requirement of limit.
27.50(d)(5)	Peak to Average Ratio	Pass	Meet the requirement of limit.
27.53(h)	Band Edge Measurements	Pass	Meet the requirement of limit.
2.1051 27.53(h)	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 27.53(h)	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -21.24 dB at 43.58 MHz.

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	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Test Site and Instruments

Description & Manaufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Feb. 17, 2017	Feb. 16, 2018
Spectrum Analyzer Agilent	N9010A	MY52220314	Nov. 24, 2017	Nov. 23, 2018
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	100115	Nov. 23, 2017	Nov. 22, 2018
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Dec. 06, 2017	Dec. 05, 2018
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-969	Dec. 12, 2017	Dec. 11, 2018
Double Ridge Guide Horn Antenna EMCO	3115	5619	Nov. 30, 2017	Nov. 29, 2018
BILOG Antenna SCHWARZBECK	VULB 9168	9168-153	Dec. 06, 2017	Dec. 05, 2018
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 17, 2017	Apr. 16, 2018
MXG Vector signal generator Agilent	N5182B	MY53050430	Oct. 24, 2017	Oct. 23, 2018
Preamplifier EMCI	EMC 012645	980115	Oct. 20, 2017	Oct. 19, 2018
Preamplifier EMCI	EMC 184045	980116	Oct. 20, 2017	Oct. 19, 2018
Preamplifier EMCI	EMC 330H	980112	Oct. 13, 2017	Oct. 12, 2018
Power Meter Anritsu	ML2495A	1012010	Aug. 15, 2017	Aug. 14, 2018
Power Sensor Anritsu	MA2411B	1315050	Aug. 15, 2017	Aug. 14, 2018
RF Coaxial Cable HUBER+SUHNNER	EMC104-SM-SM-8000&3000	140811+170717	Oct. 20, 2017	Oct. 19, 2018
RF Coaxial Cable HUBER+SUHNNER	SUCOFLEX 104	EMC104-SM-SM-1000(140807)	Oct. 20, 2017	Oct. 19, 2018
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 20, 2017	Oct. 19, 2018
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower &Turn Table Controller MF	MF-7802	NA	NA	NA
Radio Communication Analyzer	MT8820C	6201300640	Aug. 16, 2017	Aug. 15, 2019
Temperature & Humidity Chamber	GTH-120-40-CP-AR	MAA1306-019	Sep. 08, 2017	Sep. 07, 2018
DC Power Supply Topward	33010D	807748	Oct. 25, 2016	Oct. 24, 2018
Digital Multimeter Fluke	87-III	70360742	Jun. 30, 2017	Jun. 29, 2018

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 HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The IC Site Registration No. is IC7450F-10.

3 General Information

3.1 General Description of EUT

Product	CAT M1 and Narrowband-IOT Module	
Brand	u-blox AG	
Test Model	SARA-R410M-02B	
Status of EUT	Identical Prototype	
Power Supply Rating	5.0 Vdc (adapter or host equipment)	
Modulation Type	BPSK, QPSK	
NB-IoT Category	NB1	
Deployment	Stand-alone, Guard-band, In-band	
Sub-carrier Spacing	3.75 kHz, 15 kHz	
N_{tones}	Single tone, Multi tone	
Frequency Range	LTE Band 4	1710.1 ~ 1754.9 MHz
Emission Designator	LTE Band 4 (BPSK)	78K68F9W
	LTE Band 4 (QPSK)	196K47F9W
Max. EIRP Power	LTE Band 4 (BPSK)	188.36 mW
	LTE Band 4 (QPSK)	190.99 mW
Antenna Type	External Antenna	
Accessory Device	Refer to Note as below	
Data Cable Supplied	Refer to Note as below	

Note:

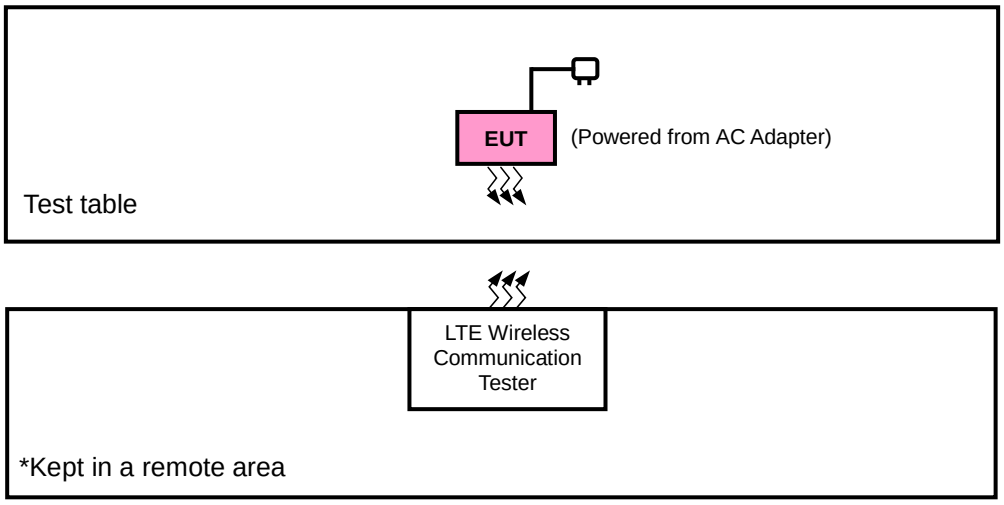
1. The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter	UNIFIVE	UUX324-1215	I/P: 100-240 Vac, 50/60 Hz, 0.6 A O/P: 12 Vdc, 1.5 A 1.55m cable w/o core

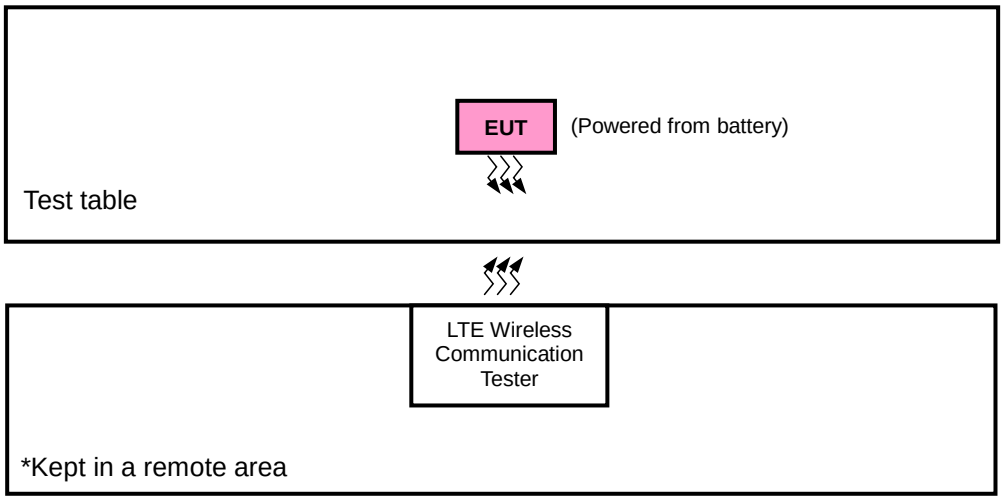
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Configuration of System under Test

<Radiated Emission Test>



< E.I.R.P. Test>



3.2.1 Description of Support Units

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

No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	LTE Wireless Communication Test Set	Keysight	E7515A	MY56030229	--

No.	Signal Cable Description Of The Above Support Units
1.	N/A

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items 1 acted as communication partners to transfer data.

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 / EIRP	Radiated Emission
LTE Band 4	Z-plane	Z-axis

EUT Configure Mode	Test Item	Available Channel	Tested Channel	Sub-carrier Spacing (kHz)	Modulation	N_{tones}
-	EIRP	19951 to 20399	19951	3.75	BPSK	1@0
				15	QPSK	3@3
			20175, 20399	3.75	BPSK	1@47
				15	QPSK	3@3
-	Frequency Stability	19957 to 20393	19951, 20399	15	QPSK	1@47
						3@3
-	Occupied Bandwidth	19951 to 20399	19957	3.75	BPSK	1@0
				15	QPSK	1@0
						3@3
						12@0
			20175	3.75	BPSK	1@0
				15	QPSK	1@0
						3@3
						12@0
			20393	3.75	BPSK	1@47
				15	QPSK	1@11
						3@3
						12@0
-	Peak to Average Ratio	19951 to 20399	20175	3.75	BPSK	1@0
				15	QPSK	1@0
						3@3
-	Band Edge	19951 to 20399	19951	3.75	BPSK	1@0
				15	QPSK	1@0
						3@3
						12@0
			20399	3.75	BPSK	1@47
				15	QPSK	1@11
						3@3
						12@0
-	Conducted Emission	19951 to 20399	19951, 20175, 20399	15	QPSK	3@3
-	Radiated Emission	19951 to 20399	19951, 20175, 20399	15	QPSK	3@3

Note: Above test items were sent based on the maximum Conducted Output Power. This device was tested under all debloyment, Ntones and modulations. The worst case was found in QPSK modulation of Stand-alone mode.

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP / EIRP	25 deg. C, 65 % RH	120 Vac, 60 Hz	Wayne Lin
Frequency Stability	25 deg. C, 65 % RH	120 Vac, 60 Hz	Wayne Lin
Occupied Bandwidth	25 deg. C, 65 % RH	120 Vac, 60 Hz	Wayne Lin
Band Edge	25 deg. C, 65 % RH	120 Vac, 60 Hz	Wayne Lin
Peak to Average Ratio	25 deg. C, 65 % RH	120 Vac, 60 Hz	Wayne Lin
Conducted Emission	25 deg. C, 65 % RH	120 Vac, 60 Hz	Wayne Lin
Radiated Emission	25 deg. C, 65 % RH	120 Vac, 60 Hz	Getaz Yang

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 27
KDB 971168 D01 Power Meas License Digital Systems v02r02
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

Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band are limited to 1 watt EIRP.

4.1.2 Test Procedures

EIRP / ERP Measurement:

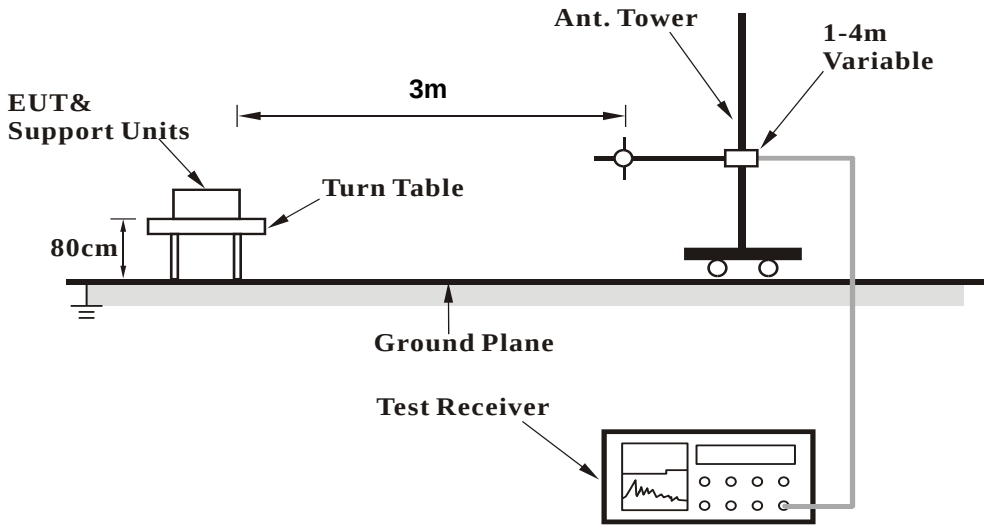
a. All measurements were done at low, middle and high operational frequency range. RBW and VBW is 5 MHz for WCDMA and 10 MHz for LTE mode.
b. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m (below or equal 1 GHz) and/or 1.5 m (above 1 GHz) height 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 dBi.

Conducted Power Measurement:

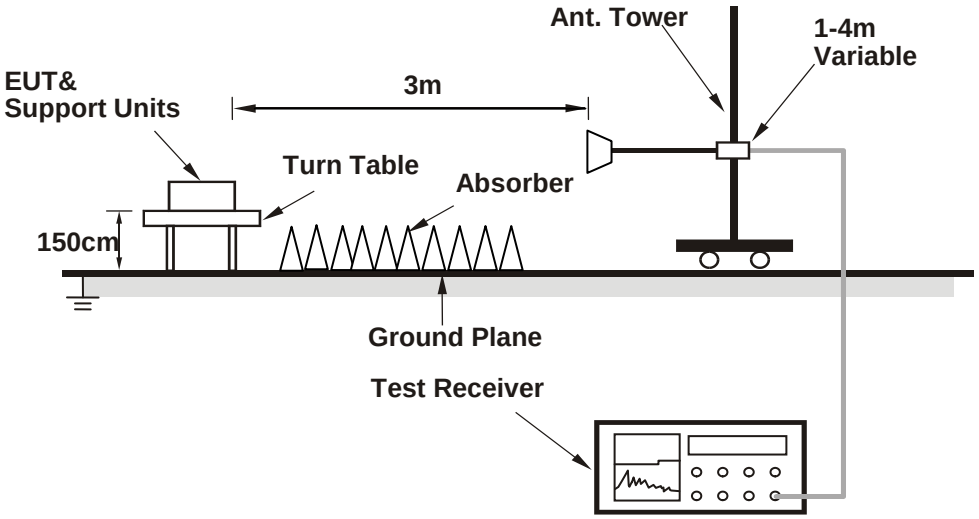
a. The EUT was set up for the maximum power with LTE link data modulation and link up with simulator.
b. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

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)

Stand-alone

Channel	Frequency of Uplink (MHz)	Modulation	N_{tones}	Sub-carrier Spacing (kHz)	Power (dBm)
19951	1710.1	BPSK	1@0	3.75	22.07
		QPSK	1@0	15	22.48
		QPSK	3@3	15	**23.21**
		QPSK	12@0	15	21.39
20175	1732.5	BPSK	1@0	3.75	21.86
		BPSK	1@47	3.75	21.88
		QPSK	1@0	15	22.13
		QPSK	1@11	15	22.03
		QPSK	3@3	15	22.93
		QPSK	12@0	15	21.04
20399	1754.9	BPSK	1@47	3.75	21.98
		QPSK	1@11	15	22.13
		QPSK	3@3	15	23.02
		QPSK	12@0	15	20.89

Guard-band

Channel	Frequency of Uplink (MHz)	Modulation	N_{tones}	Sub-carrier Spacing (kHz)	Power (dBm)
19951	1710.1	BPSK	1@0	3.75	22.12
		QPSK	1@0	15	22.29
		QPSK	3@3	15	23.10
		QPSK	12@0	15	21.14
20151	1730.1	BPSK	1@0	3.75	22.04
		BPSK	1@47	3.75	22.09
		QPSK	1@0	15	22.13
		QPSK	1@11	15	22.09
		QPSK	3@3	15	22.94
		QPSK	12@0	15	20.91
20399	1754.9	BPSK	1@47	3.75	21.90
		QPSK	1@11	15	21.89
		QPSK	3@3	15	23.01
		QPSK	12@0	15	20.81

In-band

Channel	Frequency of Uplink (MHz)	Modulation	N_{tones}	Sub-carrier Spacing (kHz)	Power (dBm)
20010	1715.99	BPSK	1@0	3.75	22.34
		QPSK	1@0	15	22.55
		QPSK	3@3	15	23.16
		QPSK	12@0	15	21.24
20185	1733.49	BPSK	1@0	3.75	21.99
		BPSK	1@47	3.75	21.99
		QPSK	1@0	15	22.10
		QPSK	1@11	15	22.03
		QPSK	3@3	15	23.10
		QPSK	12@0	15	20.85
20360	1750.99	BPSK	1@47	3.75	21.96
		QPSK	1@11	15	21.93
		QPSK	3@3	15	23.07
		QPSK	12@0	15	20.96

EIRP Power (dBm)

Stand-alone

LTE Band 4							
Modulation: BPSK							
Plane	**Channel**	**Frequency (MHz)**	**LVL (dBm)**	**Correction Factor (dB)**	**EIRP (dBm)**	**EIRP (mW)**	**Polarization (H/V)**
Z	19951	1710.1	-13.70	36.45	22.75	**188.36**	H
	20175	1732.5	-14.42	36.80	22.38	172.94	
	20399	1754.9	-14.91	36.94	22.03	159.70	
	19951	1710.1	-19.31	37.28	17.97	62.62	V
	20175	1732.5	-20.30	37.63	17.33	54.08	
	20399	1754.9	-20.63	37.64	17.01	50.23	
Modulation: QPSK							
Z	19951	1710.1	-13.64	36.45	22.81	**190.99**	H
	20175	1732.5	-14.37	36.80	22.43	174.94	
	20399	1754.9	-14.88	36.94	22.06	160.81	
	19951	1710.1	-19.24	37.28	18.04	63.64	V
	20175	1732.5	-20.22	37.63	17.41	55.08	
	20399	1754.9	-20.54	37.64	17.10	51.29	

4.2 Frequency Stability Measurement

4.2.1 Limits of Frequency Stabiliity Measurement

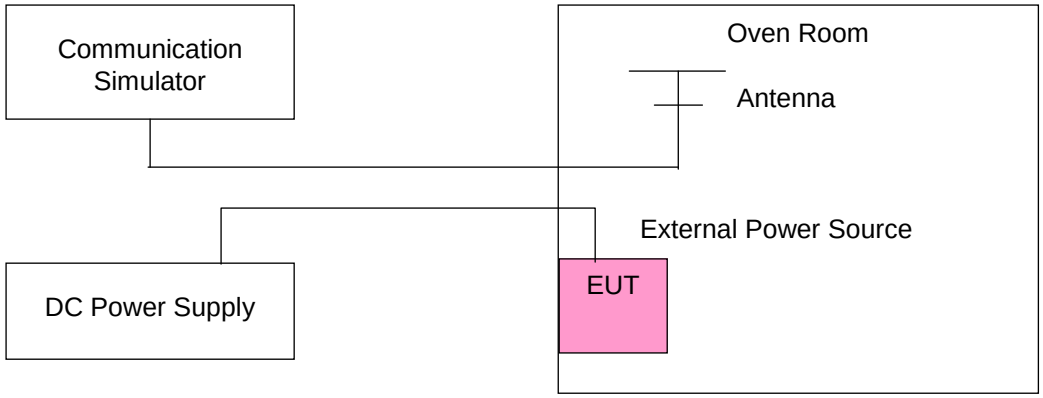
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

4.2.2 Test Procedure

a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.
b. EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.
c. The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ±0.5 ℃ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

Note: The frequency error was recorded frequency error from the communication simulator.

4.2.3 Test Setup



4.2.4 Test Results

Stand-alone

Frequency Error vs. Voltage

Voltage (Volts)	LTE Band 4				Limit (ppm)
	Modulation: QPSK				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
120	1732.499999	-0.001	1754.900002	0.001	2.5
102	1732.499998	-0.001	1754.899998	-0.001	2.5
138	1732.500002	0.001	1754.899999	-0.001	2.5

Note: The applicant defined the normal working voltage of the battery is from 102 Vac to 138 Vac.

Frequency Error vs. Temperature

Temp. (℃)	LTE Band 4				Limit (ppm)
	Modulation: QPSK				
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
-30	1732.500001	0.001	1754.900003	0.002	2.5
-20	1732.500003	0.002	1754.900002	0.001	2.5
-10	1732.500002	0.001	1754.900003	0.001	2.5
0	1732.499999	-0.001	1754.899998	-0.001	2.5
10	1732.499997	-0.002	1754.899996	-0.002	2.5
20	1732.499997	-0.002	1754.899998	-0.001	2.5
30	1732.499999	-0.001	1754.899999	-0.001	2.5
40	1732.500001	0.001	1754.900001	0.000	2.5
50	1732.500002	0.001	1754.900003	0.002	2.5
60	1732.500003	0.001	1754.900003	0.001	2.5

4.3 Occupied Bandwidth Measurement

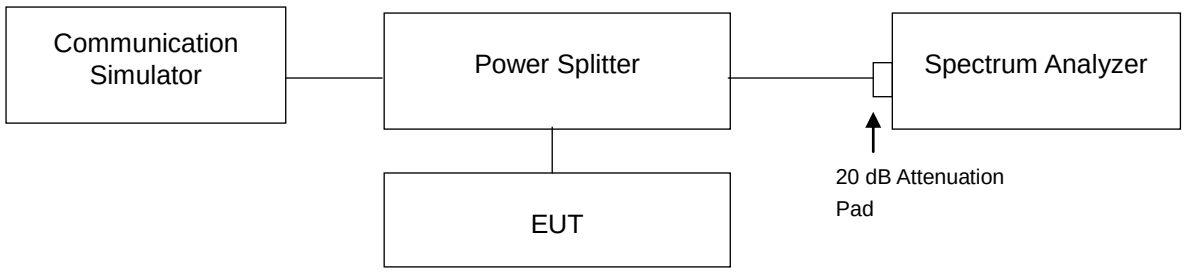
4.3.1 Limits of Occupied Bandwidth Measurement

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.

4.3.2 Test Procedure

a. The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
b. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

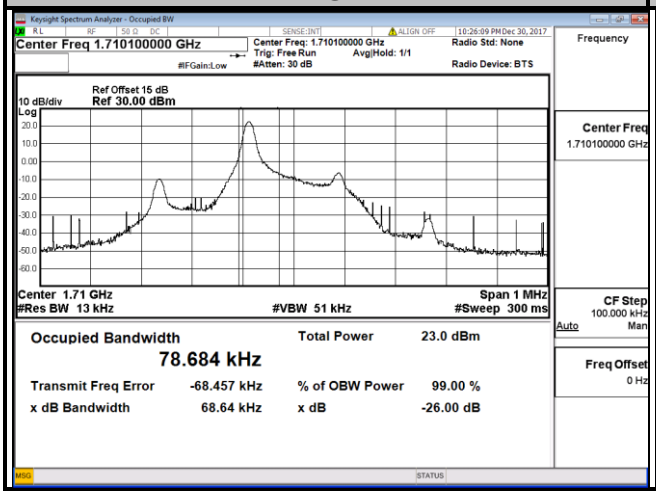
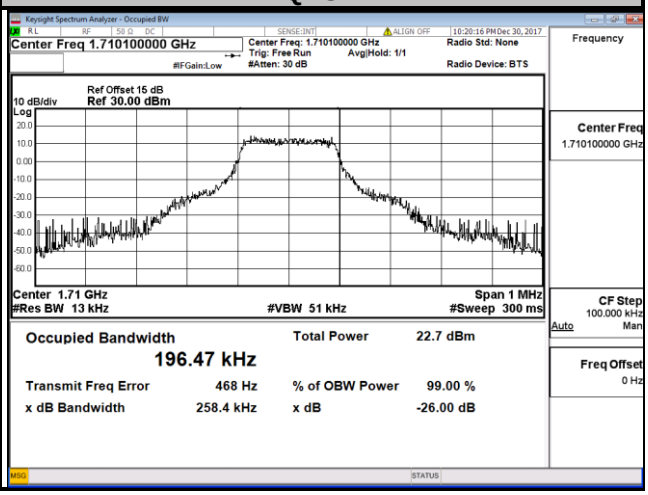
4.3.3 Test Setup



4.3.4 Test Result

Stand-alone

LTE Band 4					
Channel	**Frequency (MHz)**	**Modulation**	**N_{tones}**	**Sub-carrier Spacing (kHz)**	**99 % Occupied Bandwidth (MHz)**
19951	1710.1	BPSK	1@0	3.75	78.68
		QPSK	1@0	15	156.55
		QPSK	3@3	15	138.40
		QPSK	12@0	15	196.47
20175	1732.5	BPSK	1@0	3.75	77.23
		BPSK	1@47	3.75	--
		QPSK	1@0	15	155.17
		QPSK	1@11	15	--
		QPSK	3@3	15	138.25
		QPSK	12@0	15	195.82
20399	1754.9	BPSK	1@47	3.75	74.19
		QPSK	1@11	15	149.12
		QPSK	3@3	15	137.22
		QPSK	12@0	15	195.05

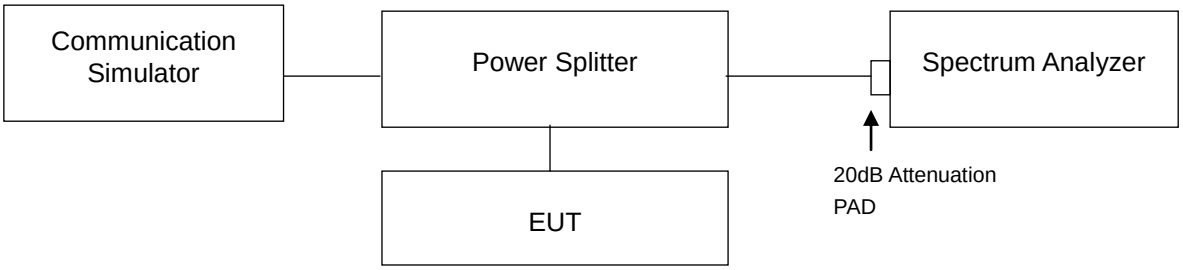
Spectrum Plot of Worst Value	
BPSK	**QPSK**
	

4.4 Band Edge Measurement

4.4.1 Limits of Band Edge Measurement

For operations in the 1710–1755 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10(P) dB.

4.4.2 Test Setup

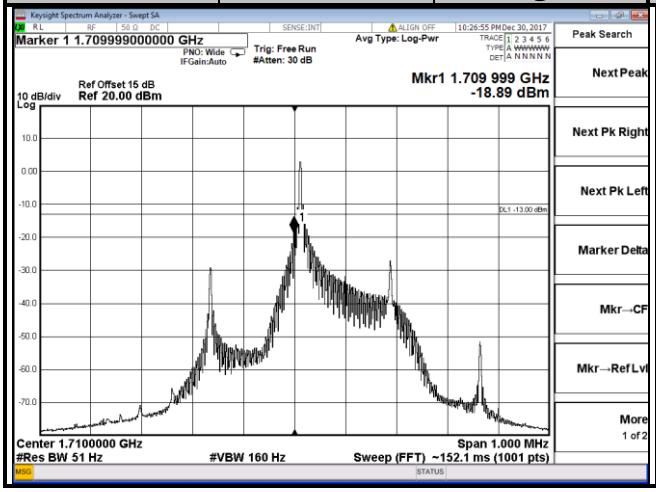
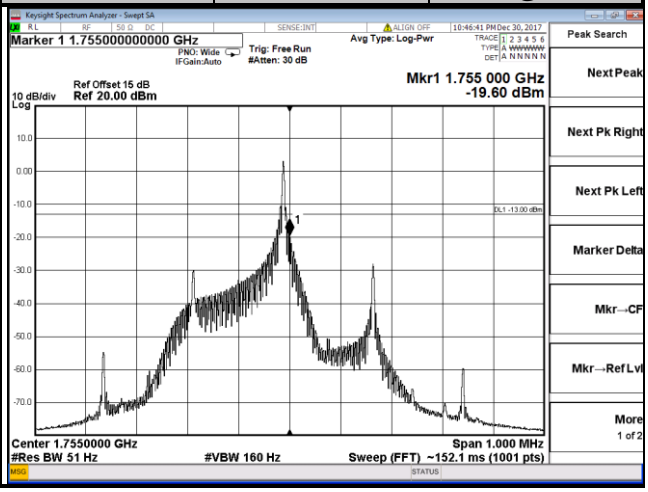


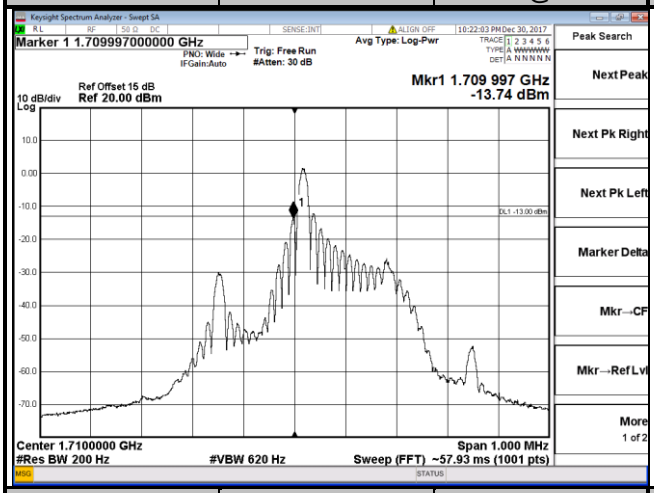
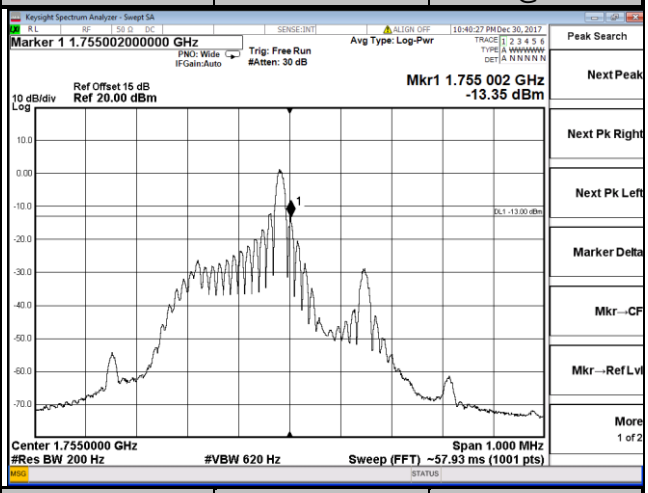
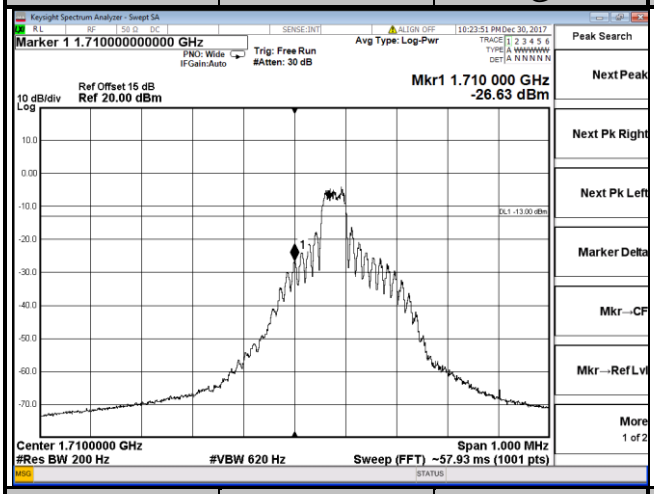
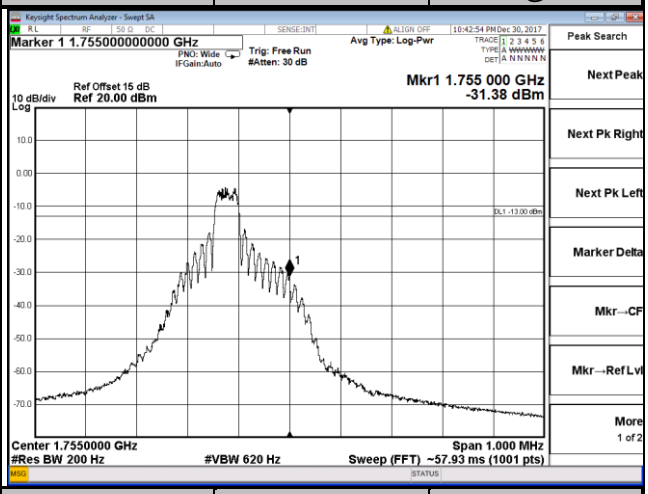
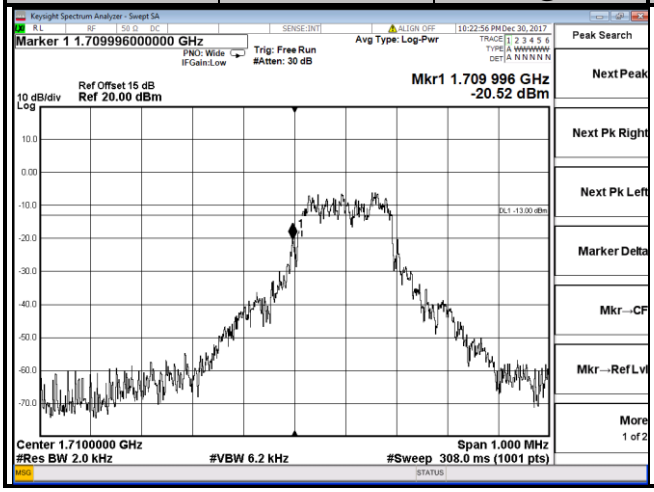
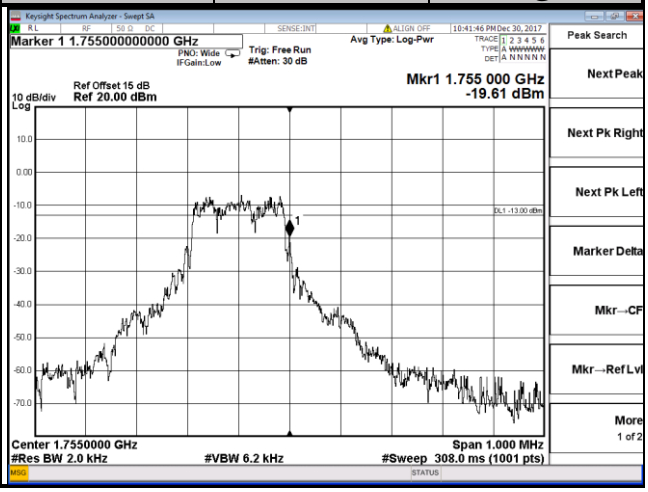
4.4.3 Test Procedures

a. All measurements were done at low and high operational frequency range.
b. Record the max. trace plot into the test report.

4.4.4 Test Results

Stand-alone

LTE Band 4					
Modulation: BPSK					
Channel	19951	1@0	Channel	20399	1@47
					

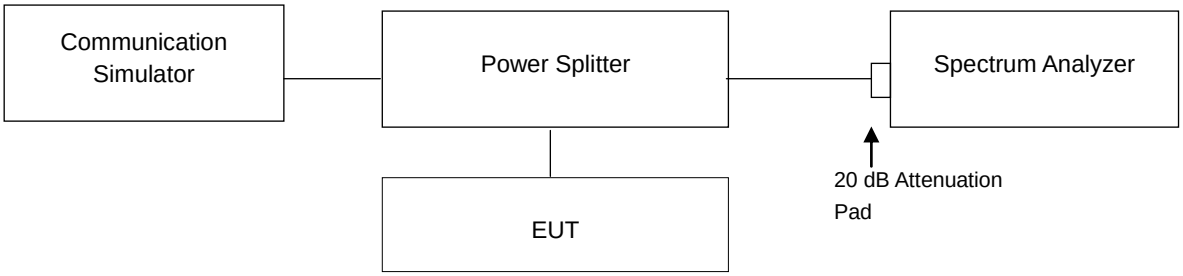
LTE Band 4					
Modulation: QPSK					
Channel	19951	1@0	Channel	20399	1@11
					
Channel	19951	3@3	Channel	20399	3@3
					
Channel	19951	12@0	Channel	20399	12@0
					

4.5 Peak to Average Ratio

4.5.1 Limits of Peak to Average Ratio Measurement

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

4.5.2 Test Setup



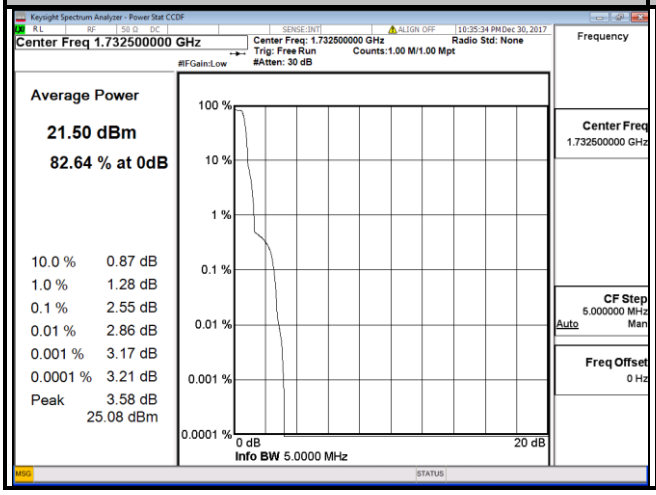
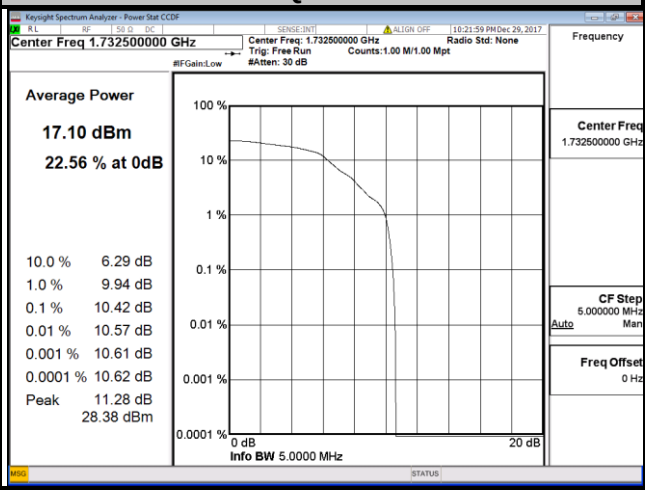
4.5.3 Test Procedures

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

4.5.4 Test Results

Stand-alone

LTE Band 4					
Channel	**Frequency (MHz)**	**Modulation**	**N_{tones}**	**Sub-carrier Spacing (kHz)**	**Peak to Average Ratio (dB)**
20175	1732.5	BPSK	1@0	3.75	2.55
20175	1732.5	QPSK	1@0	15	4.17
20175	1732.5	QPSK	3@3	15	10.42

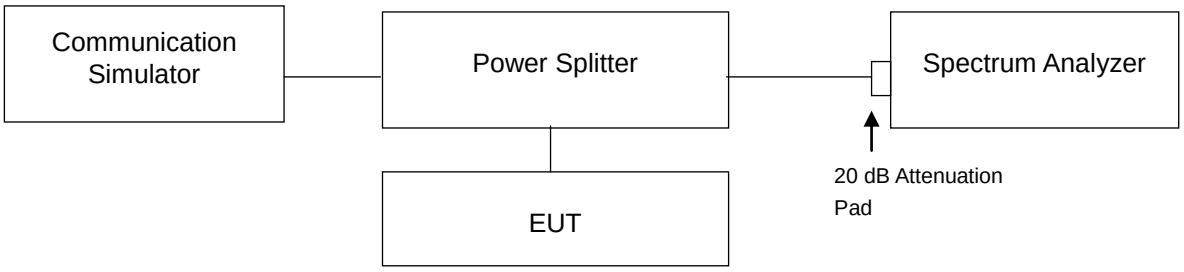
Spectrum Plot of Worst Value	
BPSK	**QPSK**
	

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 log10(P) dB. The limit of emission is equal to -13 dBm.

4.6.2 Test Setup

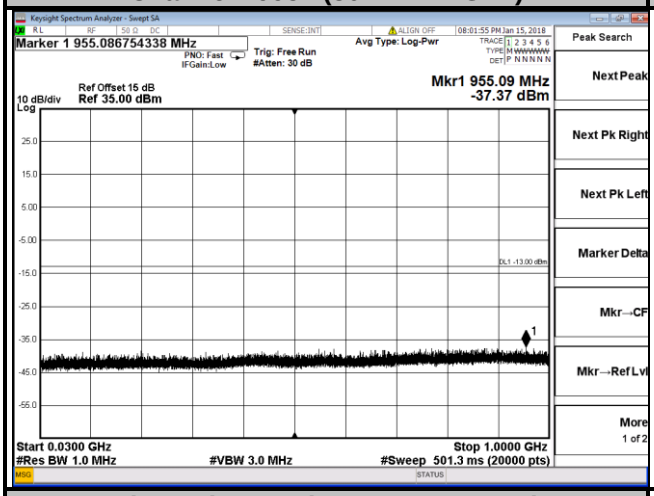
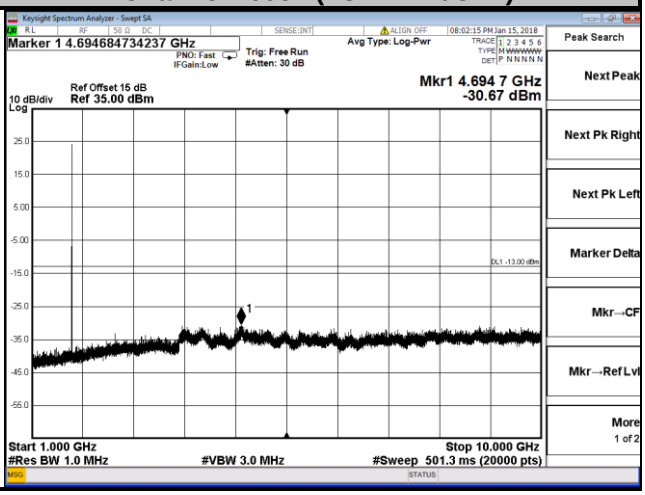
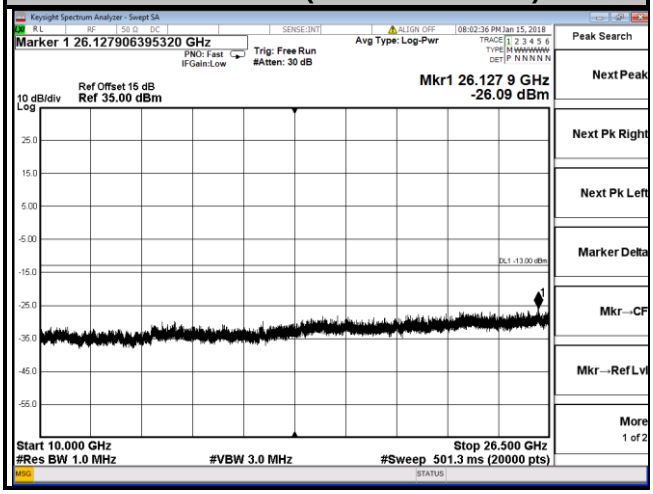


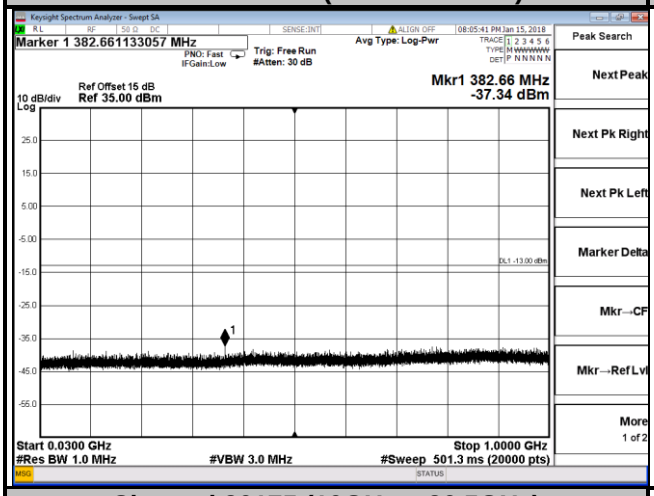
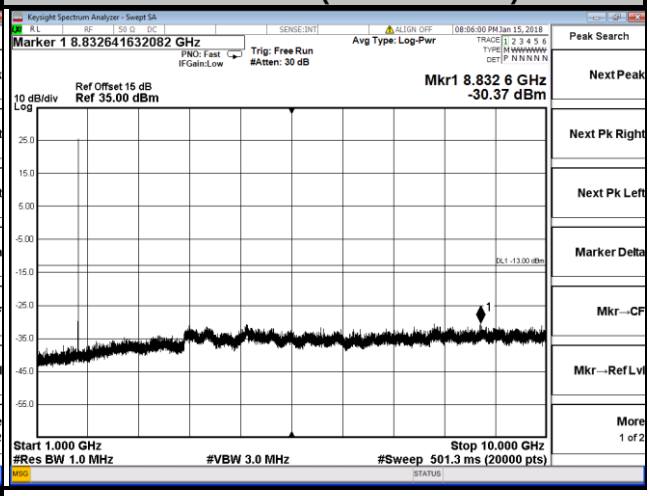
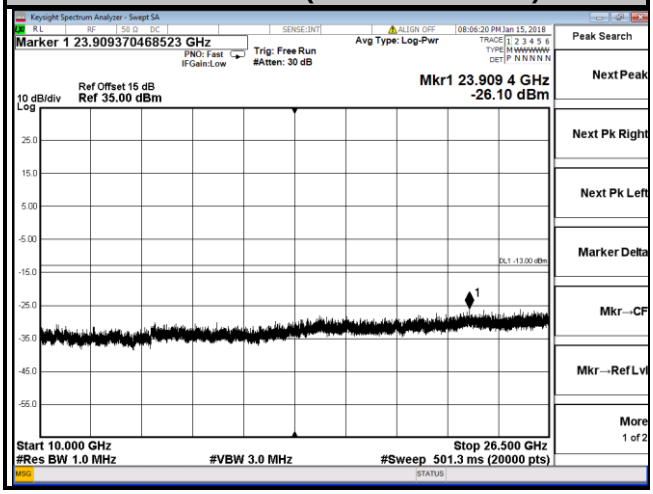
4.6.3 Test Procedure

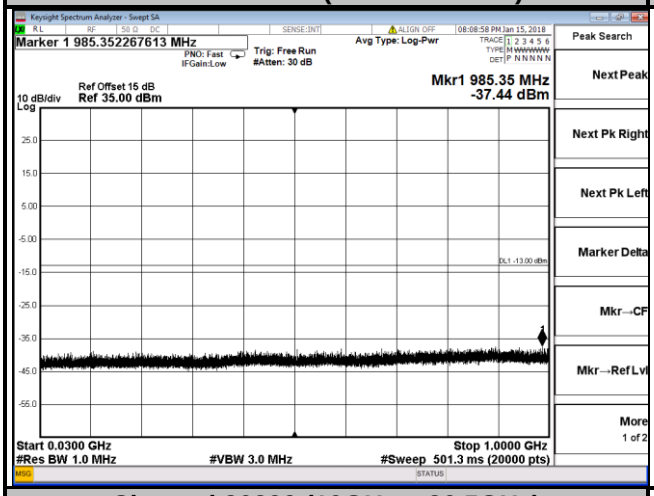
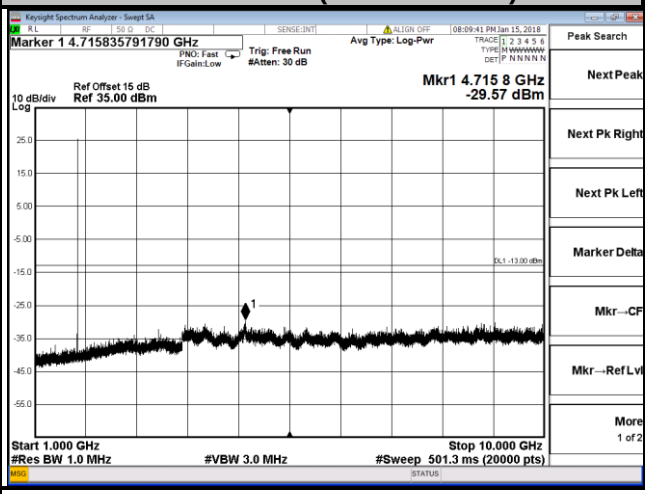
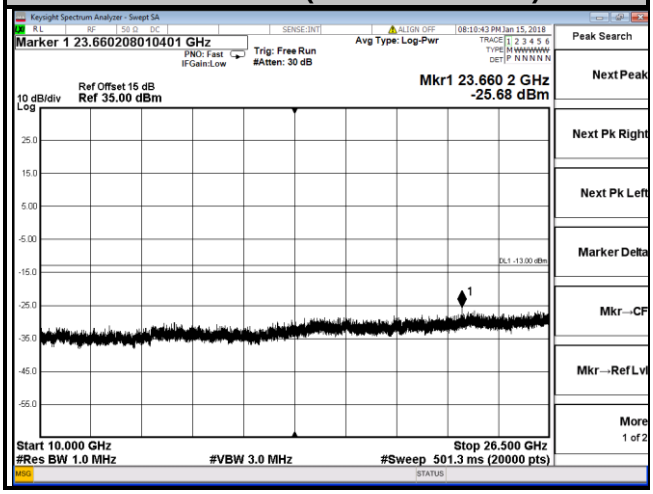
a. The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.
b. Measuring frequency range is from from 30 MHz to 18 GHz for LTE Band 4. 10 dB attenuation pad is connected with spectrum. RBW = 100 kHz and VBW = 300 kHz are used for conducted emission measurement.

4.6.4 Test Results

Stand-alone

LTE Band 4	
Modulation: QPSK	
Channel 19951 (30MHz ~ 1GHz)	Channel 19951 (1GHz ~ 10GHz)
	
Channel 19951 (10GHz ~ 26.5GHz)	
	

LTE Band 4	
Modulation: QPSK	
Channel 20175 (30MHz ~ 1GHz)	Channel 20175 (1GHz ~ 10GHz)
	
Channel 20175 (10GHz ~ 26.5GHz)	
	

LTE Band 4	
Modulation: QPSK	
Channel 20399 (30MHz ~ 1GHz)	Channel 20399 (1GHz ~ 10GHz)
	
Channel 20399 (10GHz ~ 26.5GHz)	
	

4.7 Radiated Emission Measurement

4.7.1 Limits of Radiated Emission Measurement

a. The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 +10 log10(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 dBi.

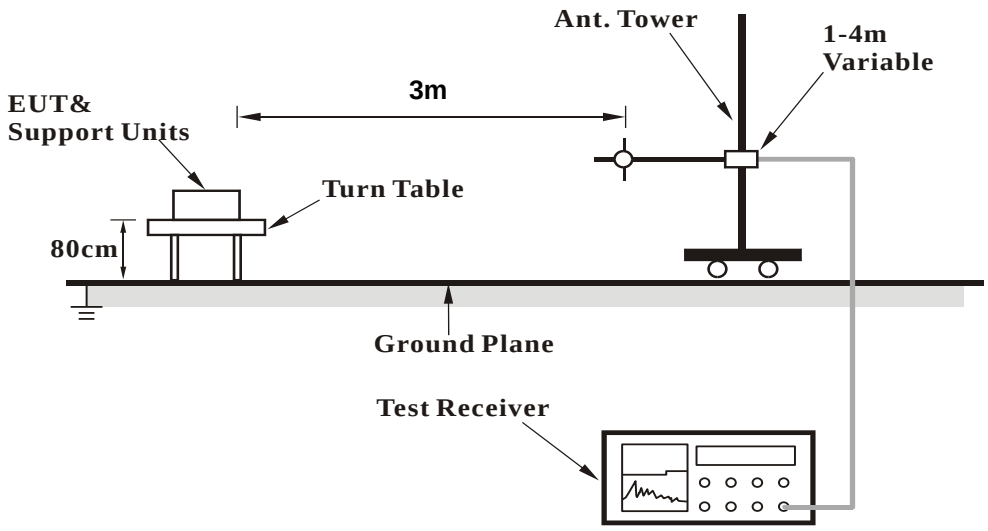
Note: The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

4.7.3 Deviation from Test Standard

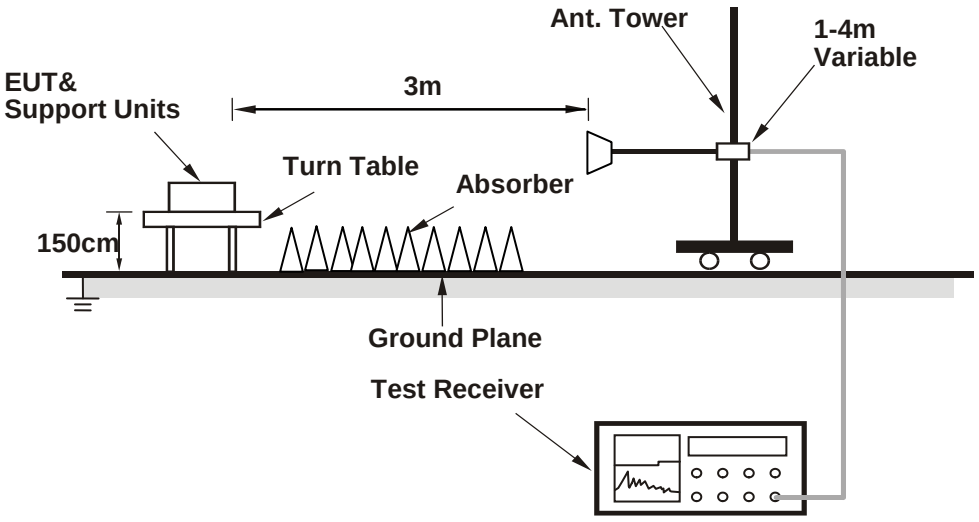
No deviation.

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

Stand-alone

LTE Band 4

Modulation: QPSK

Low Channel

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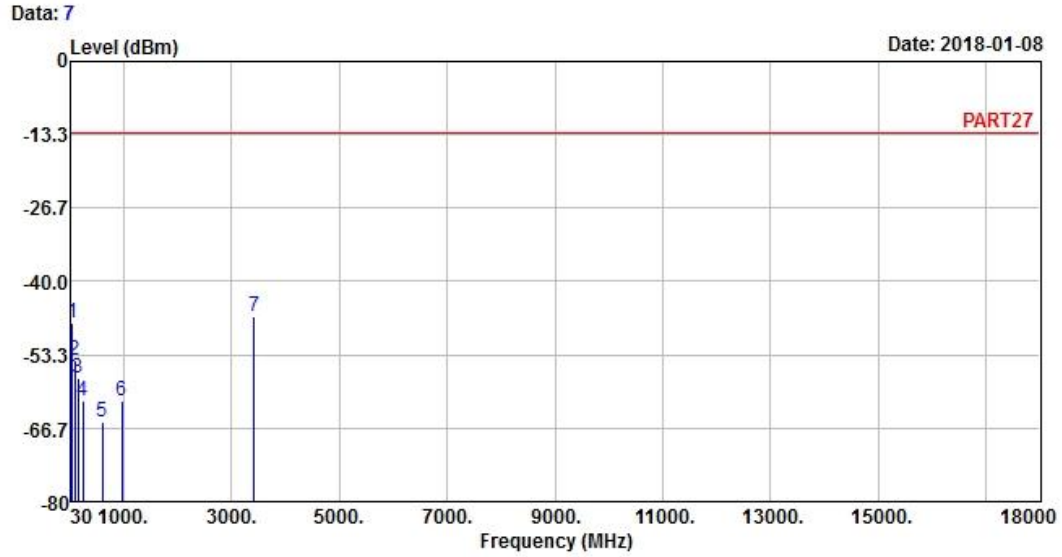
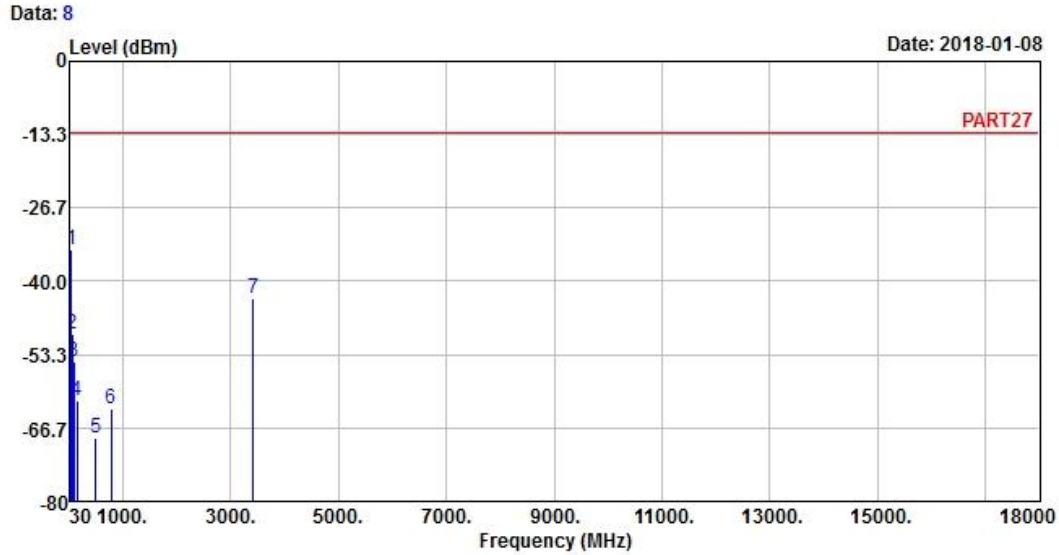
A D T



Site : 966 Chamber 5
Condition: PART27 HORIZONTAL
Remark : NB-IoT Band 4 QPSK_Link-L-CH
Tested by: Getaz Yang

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1	44.55	-47.61	-45.62	-13.00	-34.61	-1.99	Peak
2	93.05	-54.17	-43.22	-13.00	-41.17	-10.95	Peak
3	151.25	-57.44	-50.14	-13.00	-44.44	-7.30	Peak
4	241.46	-61.84	-55.50	-13.00	-48.84	-6.34	Peak
5	600.36	-65.41	-64.66	-13.00	-52.41	-0.75	Peak
6	972.84	-61.72	-64.34	-13.00	-48.72	2.62	Peak
7 pp	3420.20	-46.38	-37.20	-13.00	-33.38	-9.18	Peak

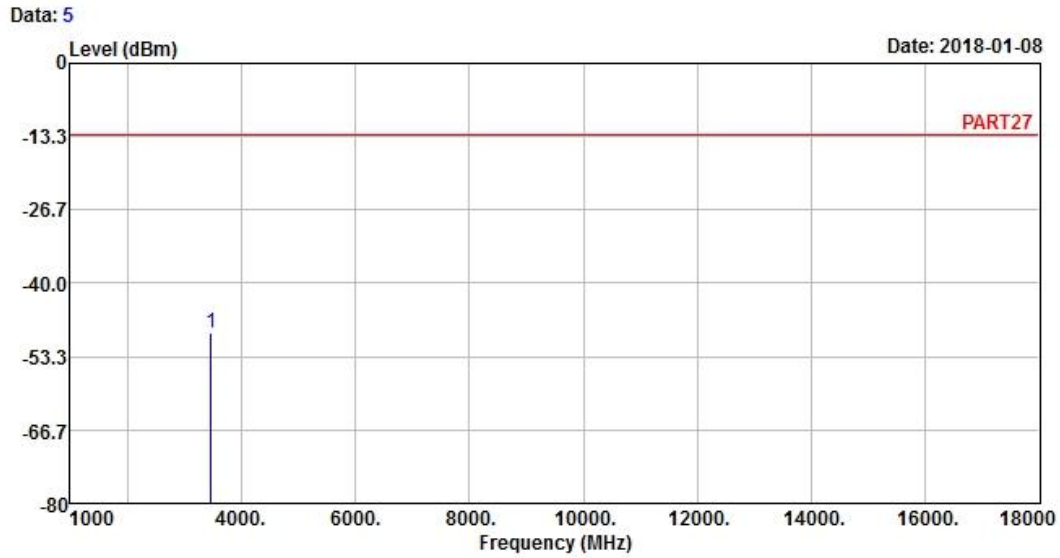


Site : 966 Chamber 5
Condition: PART27 VERTICAL
Remark : NB-IoT Band 4 QPSK_Link-L-CH
Tested by: Getaz Yang

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1 pp	43.58	-34.24	-32.77	-13.00	-21.24	-1.47	Peak
2	62.01	-49.62	-41.81	-13.00	-36.62	-7.81	Peak
3	93.05	-54.62	-43.67	-13.00	-41.62	-10.95	Peak
4	148.34	-61.62	-53.85	-13.00	-48.62	-7.77	Peak
5	503.36	-68.63	-64.12	-13.00	-55.63	-4.51	Peak
6	787.57	-63.12	-63.89	-13.00	-50.12	0.77	Peak
7	3420.20	-43.04	-33.86	-13.00	-30.04	-9.18	Peak

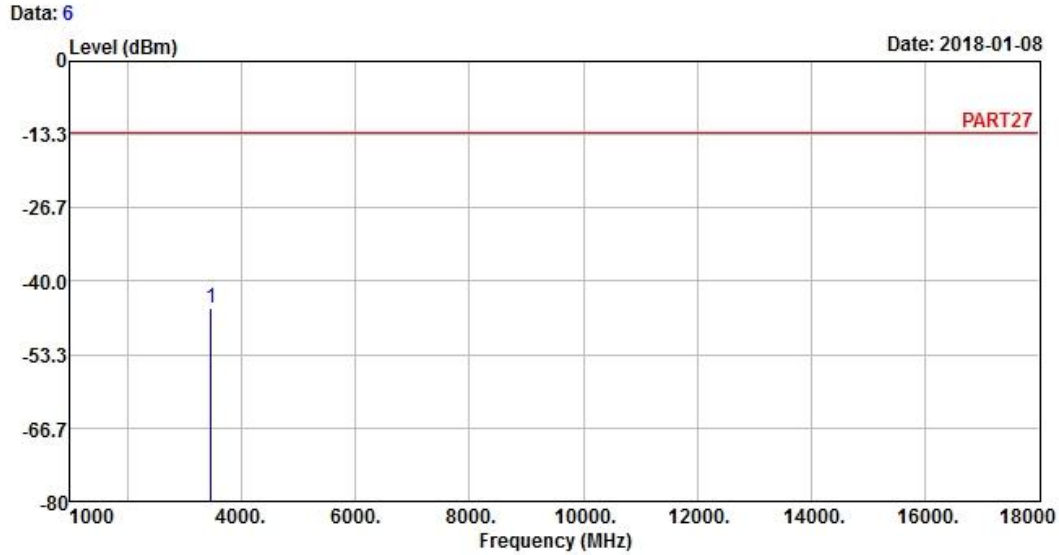
Middle Channel

Bureau Veritas Consumer Products Services Ltd.,Taoyuan Branch



Site : 966 Chamber 5
Condition: PART27 HORIZONTAL
Remark : NB-IoT Band 4 QPSK_Link-M-CH
Tested by: Getaz Yang

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1 pp	3465.00	-49.11	-40.20	-13.00	-36.11	-8.91	Peak



Site : 966 Chamber 5
Condition: PART27 VERTICAL
Remark : NB-IoT Band 4 QPSK_Link-M-CH
Tested by: Getaz Yang

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1 pp	3465.00	-44.93	-36.02	-13.00	-31.93	-8.91	Peak

High Channel

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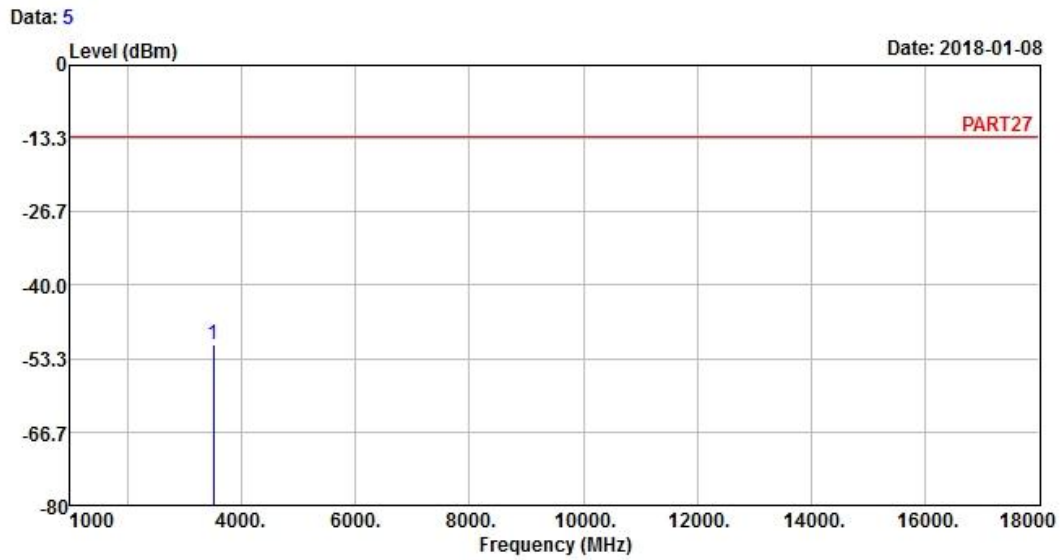
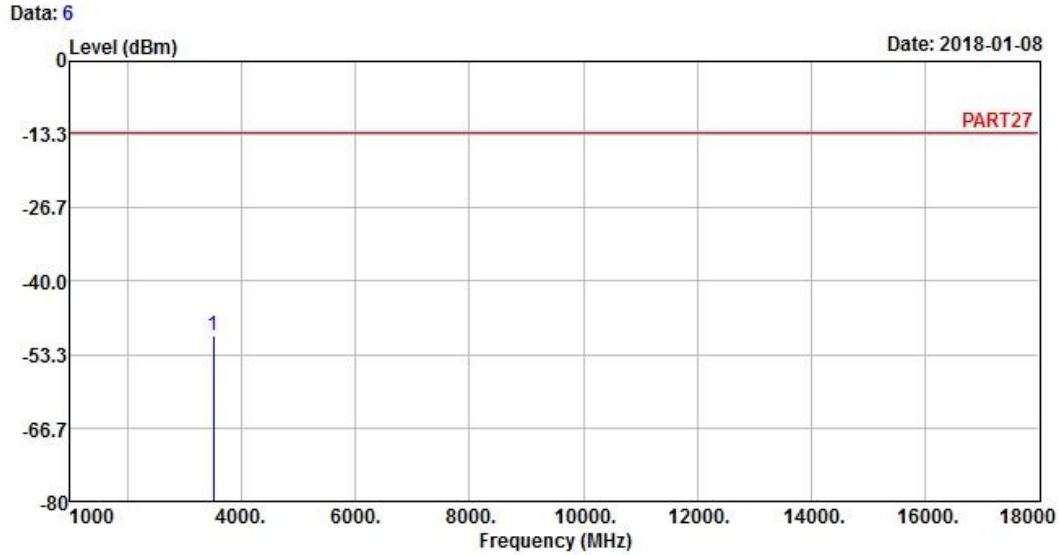


Site : 966 Chamber 5
Condition: PART27 HORIZONTAL
Remark : NB-IoT Band 4 QPSK_Link-H-CH
Tested by: Getaz Yang

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1 pp	3509.80	-50.88	-42.77	-13.00	-37.88	-8.11	Peak



Site : 966 Chamber 5
Condition: PART27 VERTICAL
Remark : NB-IoT Band 4 QPSK_Link-H-CH
Tested by: Getaz Yang

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1 pp	3509.80	-49.97	-41.86	-13.00	-36.97	-8.11	Peak

5 Pictures of Test Arrangements

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

Appendix – Information on 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:

Linko EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

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

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