RF TEST REPORT

Applicant	Quectel Wireless Solutions Co., Ltd
FCC ID	XMR201808BC66
Product	NB_IoT Module
Brand	Quectel
Model	BC66
Report No.	R1809A0442-R2
Issue Date	November 16, 2018

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 2 (2018)/ FCC CFR 47 Part 24E (2018)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Performed by: Jiangpeng Lan	*Approved by: Kai Xu*

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Summary of measurement results

No.	Test Case	Clause in FCC rules	Verdict
1	RF power output	2.1046	PASS
2	Effective Isotropic Radiated power	24.232(c)	PASS
3	Occupied Bandwidth	2.1049	PASS
4	Band Edge Compliance	2.1051 /24.238(a)	PASS
5	Peak-to-Average Power Ratio	24.232/KDB 971168 D01(5.7)	PASS
6	Frequency Stability	2.1055 / 24.235	PASS
7	Spurious Emissions at Antenna Terminals	2.1051 / 24.238(a)	PASS
8	Radiates Spurious Emission	2.1053 / 24.238(a)	PASS
Date of Testing: October 29, 2018 ~ November 12, 2018			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard.			

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

CNAS (accreditation number: L2264)

TA Technology (Shanghai) Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

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.

IC (recognition number is 8510A)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Canada to perform electromagnetic emission measurement.

VCCI (recognition number is C-4595, T-2154, R-4113, G-10766)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Japan to perform electromagnetic emission measurement.

A2LA (Certificate Number: 3857.01)

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

1.3. Testing Location

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

Client Information

Applicant	Quectel Wireless Solutions Co., Ltd
Applicant address	7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China
Manufacturer	Quectel Wireless Solutions Co., Ltd
Manufacturer address	7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China

General information

EUT Description			
Model	BC66		
IMEI	867997030054273		
Hardware Version	R1.0		
Software Version	BC66NBR01A06		
Power Supply	External Power Supply		
Antenna Type	The EUT don't have standard Adapter and Antenna. The adapter and Antenna used for testing in this report is the after-market accessory.		
Antenna Gain	4dBi		
Test Mode(s)	NB-IOT Band 2/ NB-IOT Band 25;		
Test Modulation:	BPSK, QPSK		
Category	NB1		
Deployment:	stand-alone		
Sub-carrier spacing:	3.75KHz, 15KHz		
Ntones:	single, multi-tone		
Maximum E.I.R.P	NB-IOT Band 2:	24.98dBm	
	NB-IOT Band 25:	25.13dBm	
Rated Power Supply Voltage	3.3V		
Extreme Voltage	Minimum: 2.1V Maximum: 3.63V		
Extreme Temperature	Lowest:-40°C Highest: +85°C		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	NB-IOT Band 2	1850 ~ 1910	1930 ~ 1990
	NB-IOT Band 25	1850 ~ 1915	1930 ~ 1995
Note: The information of the EUT is declared by the manufacturer.			

Accessory equipment	
Evaluation Board	RF Cable
RS232-to-USB Cable	Antenna: Dipole Antenna
DC 5V Adaptor	/

3. Applied Standards

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

FCC CFR47 Part 2 (2018)

FCC CFR 47 Part 24E (2018)

ANSI C63.26 (2015)

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 (Z axis, horizontal polarization) and the worst case was recorded.

All mode and data rates and positions and RB size and modulations were investigated.
Subsequently, only the worst case emissions are reported.
The following testing in NB-IOT is set based on the maximum RF Output Power.

All modes as Subcarrier Spacing, modulations, Channel were investigated.
Subsequently, only the worst case emissions are reported.
The following testing in NB-IOT is set based on the maximum RF Output Power.
The following testing in different mode is set to detailin the following table:

Test modes are chosen to be reported as the worst case configuration below for NB-IOT Band 2/25

Test items	Mode	Deployment mode	Subcarrier Spacing (kHz)		Modulation		Test Channel		
		Stand-alone	3.75	15	BPSK	QPSK	L	M	H
RF power output	NB-IOT B2	O	O	O	O	O	O	O	O
	NB-IOT B25	O	O	O	O	O	O	O	O
Effective Isotropic Radiated power	NB-IOT B2	O	O	O	O	O	O	O	O
	NB-IOT B25	O	O	O	O	O	O	O	O
Occupied Bandwidth	NB-IOT B2	O	O	O	O	O	O	O	O
	NB-IOT B25	O	O	O	O	O	O	O	O
Band Edge Compliance	NB-IOT B2	O	O	O	O	O	O	-	O
	NB-IOT B25	O	O	O	O	O	O	-	O
Peak-to-Average Power Ratio	NB-IOT B2	O	O	O	O	O	O	O	O
	NB-IOT B25	O	O	O	O	O	O	O	O
Frequency Stability	NB-IOT B2	O	O	O	O	O	O	O	O
	NB-IOT B25	O	O	O	O	O	O	O	O
Conducted Spurious Emissions	NB-IOT B2	O	-	O	-	O	O	O	O
	NB-IOT B25	O	-	O	-	O	O	O	O
Radiates Spurious Emission	NB-IOT B2	O	-	O	-	O	O	O	O
	NB-IOT B25	O	-	O	-	O	O	O	O

Note1. 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

5.1. RF Power Output

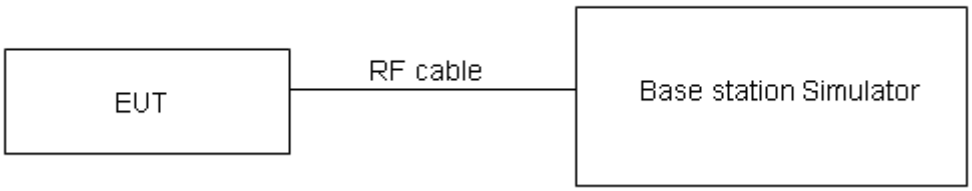
Ambient condition

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.

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.

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.

Test Results

Mode	Modulation	Sub-carrier spacing (KHz)	Ntones	Output Power (dBm) for low/mid/high channel		
				18601/1850.1	18900/1880.0	19199/1909.9
Band 2 Standalone	BPSK	3.75	1@0	23.38	23.26	23.34
			1@47	23.36	23.21	23.33
		15	1@0	23.26	23.18	23.26
			1@11	23.23	23.12	23.21
	QPSK	3.75	1@0	23.35	23.29	23.31
			1@47	23.40	23.25	23.32
		15	1@0	23.25	23.11	23.19
			1@11	23.14	23.01	23.13
		15	12@0	21.02	21.97	21.13

Mode	Modulation	Sub-carrier spacing (KHz)	Ntones	Output Power (dBm) for low/mid/high channel		
				26041/1850.1	26341/1880.1	26689/1914.9
Band 25 Standalone	BPSK	3.75	1@0	24.17	24.21	23.95
			1@47	24.06	24.17	23.90
		15	1@0	23.95	24.09	23.79
			1@11	23.97	24.05	23.92
	QPSK	3.75	1@0	24.12	24.08	23.93
			1@47	24.13	24.19	23.84
		15	1@0	23.99	24.10	23.80
			1@11	23.94	24.01	23.77
		15	12@0	21.82	22.08	21.62

5.2. Effective Isotropic Radiated Power

Ambient condition

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

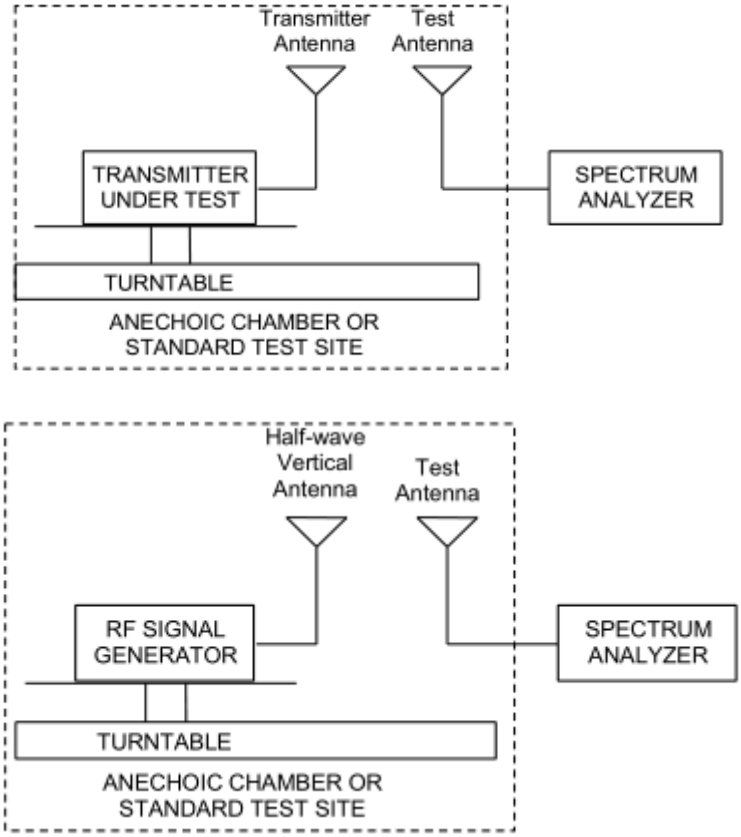
Methods of Measurement

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 (dBd)
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



Limits

Rule Part 24.232(c) Mobile and portable stations are limited to 2 watts EIRP.
Rule Part 24.232(e) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

Limit	≤ 2 W (33 dBm)

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 1.19 dB

Test Results:

The measurement is performed for both of horizontal and vertical antenna Polarization, and only the data of worst mode is recorded in this report.

Mode	Channel	Frequency (MHz)	Modulation	Polarization	Sub-carrier spacing (KHz)	Ntones	EIRP (dBm)	Limit (dBm)	Conclusion
Band2 Standalone	18601	1850.1	BPSK	H	3.75	1@0	24.54	33	Pass
			QPSK	H	3.75	1@0	24.34	33	Pass
			BPSK	H	15	1@0	24.47	33	Pass
			QPSK	H	15	1@0	24.27	33	Pass
	18900	1880	BPSK	H	3.75	1@0	24.98	33	Pass
			QPSK	H	3.75	1@0	24.54	33	Pass
			BPSK	H	15	1@0	24.67	33	Pass
			QPSK	H	15	1@0	24.13	33	Pass
	19199	1909.9	BPSK	H	3.75	1@0	24.62	33	Pass
			QPSK	H	3.75	1@0	24.37	33	Pass
			BPSK	H	15	1@0	24.31	33	Pass
			QPSK	H	15	1@0	24.39	33	Pass

Mode	Channel	Frequency (MHz)	Modulation	Polarization	Sub-carrier spacing (KHz)	Ntones	EIRP (dBm)	Limit (dBm)	Conclusion
Band25 Standalone	26041	1850.1	BPSK	H	3.75	1@0	25.13	33	Pass
			QPSK	H	3.75	1@0	25.01	33	Pass
			BPSK	H	15	1@0	24.84	33	Pass
			QPSK	H	15	1@0	24.61	33	Pass
	26341	1880.1	BPSK	H	3.75	1@0	24.89	33	Pass
			QPSK	H	3.75	1@0	24.37	33	Pass
			BPSK	H	15	1@0	24.69	33	Pass
			QPSK	H	15	1@0	24.51	33	Pass
	26689	1914.9	BPSK	H	3.75	1@0	24.96	33	Pass
			QPSK	H	3.75	1@0	24.76	33	Pass
			BPSK	H	15	1@0	24.36	33	Pass
			QPSK	H	15	1@0	24.66	33	Pass

5.3. Occupied Bandwidth

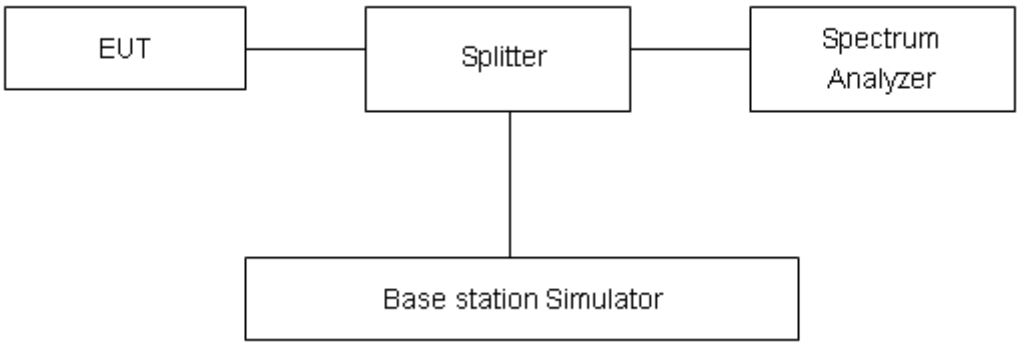
Ambient condition

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 2kHz, VBW is set to 6.2kHz for NB-IOT Band 2/25.
99% power and -26dBc occupied bandwidths are recorded. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

No specific occupied bandwidth requirements in part 2.1049.

Measurement Uncertainty

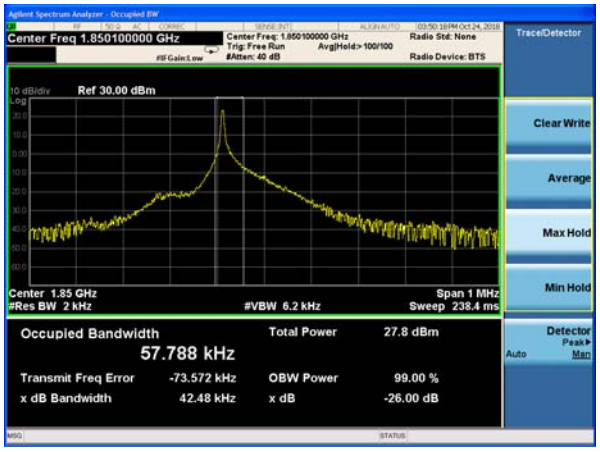
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 624Hz.

Test Result

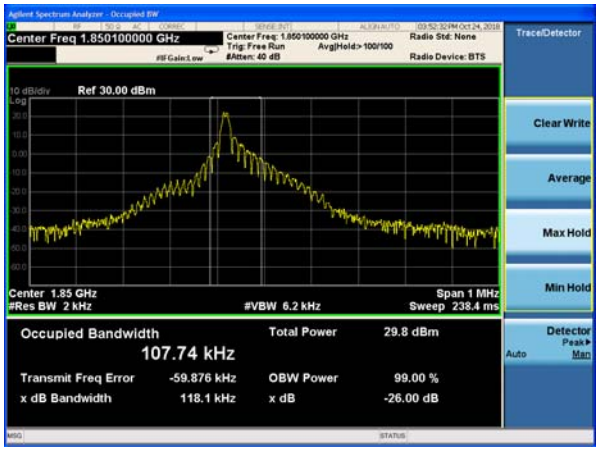
Mode	Modulation	Sub-carrier spacing (KHz)	Ntones	Bandwidth(KHz) for low/mid/high channel					
				18601/1850.1		18900/1880.0		19199/1909.9	
				99% Power	-26dBc	99% Power	-26dBc	99% Power	-26dBc
Band 2 Standalone	BPSK	3.75	1@0	57.79	42.48	58.70	42.29	59.36	42.81
	QPSK	3.75	1@0	65.16	45.08	64.48	44.88	66.56	46.15
	BPSK	15	1@0	107.74	118.10	107.38	116.50	103.10	114.80
	QPSK	15	1@0	104.93	128.60	109.79	130.60	105.41	129.80
	QPSK	15	12@0	179.79	234.70	181.08	238.20	180.34	235.00

Mode	Modulation	Sub-carrier spacing (KHz)	Ntones	Bandwidth(KHz) for low/mid/high channel					
				26041/1850.1		26341/1880.1		26689/1914.9	
				99% Power	-26dBc	99% Power	-26dBc	99% Power	-26dBc
Band 25 Standalone	BPSK	3.75	1@0	58.24	42.18	58.29	42.71	58.13	41.89
	QPSK	3.75	1@0	65.13	45.05	65.07	46.24	63.60	45.27
	BPSK	15	1@0	107.66	116.30	102.83	113.40	105.00	112.80
	QPSK	15	1@0	104.40	129.30	104.27	130.00	107.25	131.00
	QPSK	15	12@0	179.55	238.10	180.39	238.00	181.20	239.50

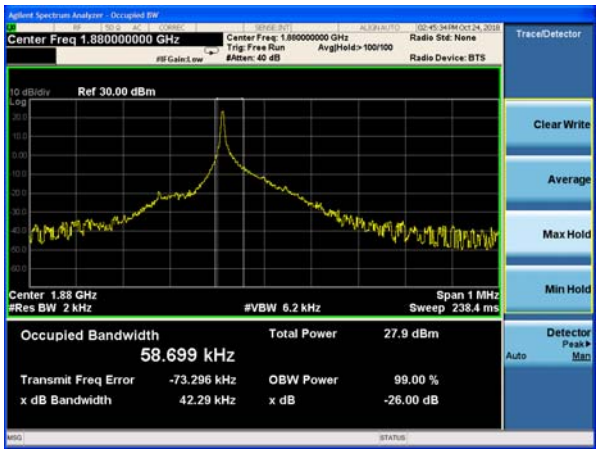
NB-IOT Band 2 BPSK 3.75kHz 1@0 CH-Low



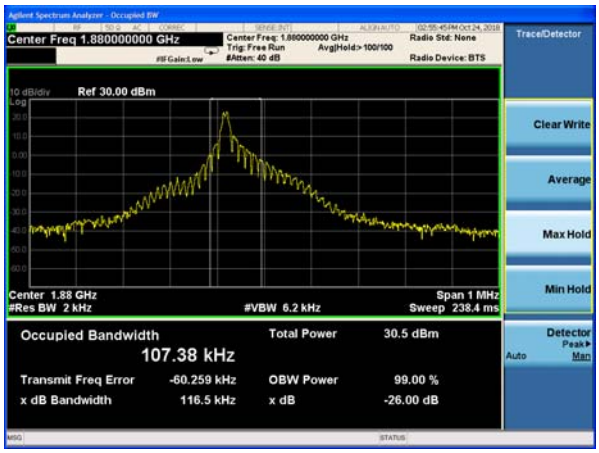
NB-IOT Band 2 BPSK 15kHz 1@0 CH-Low



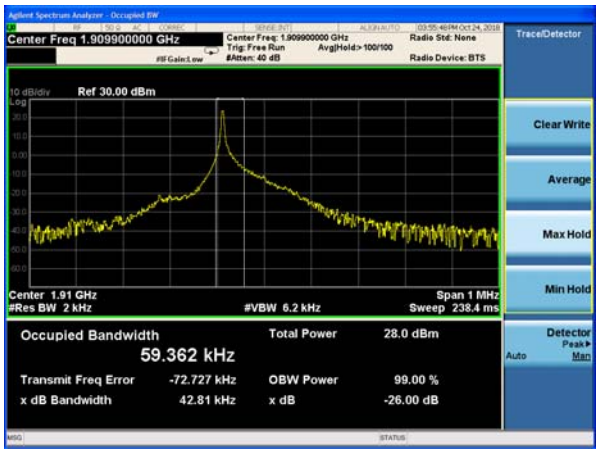
NB-IOT Band 2 BPSK 3.75kHz 1@0 CH-Middle



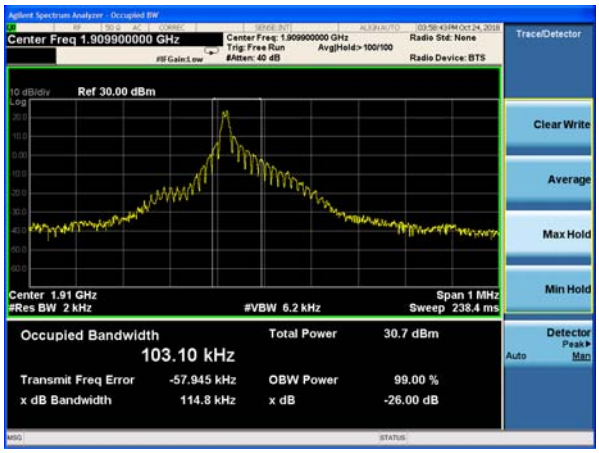
NB-IOT Band 2 BPSK 15kHz 1@0 CH-Middle



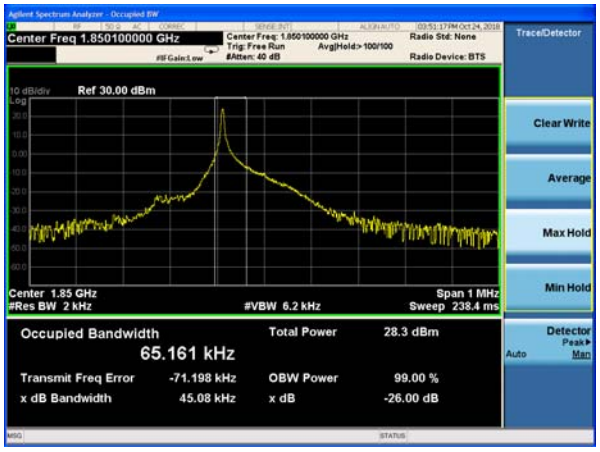
NB-IOT Band 2 BPSK 3.75kHz 1@0 CH-High



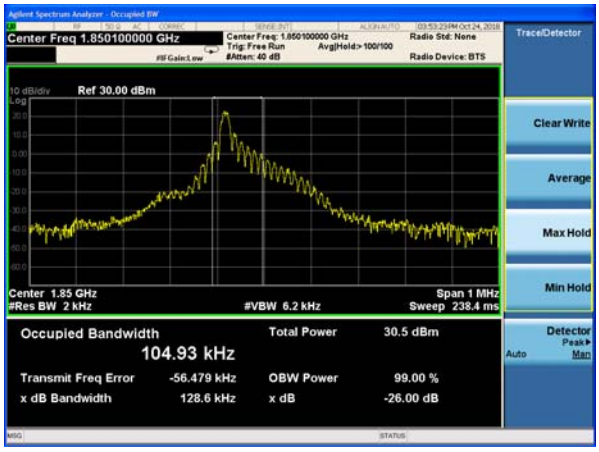
NB-IOT Band 2 BPSK 15kHz 1@0 CH-High



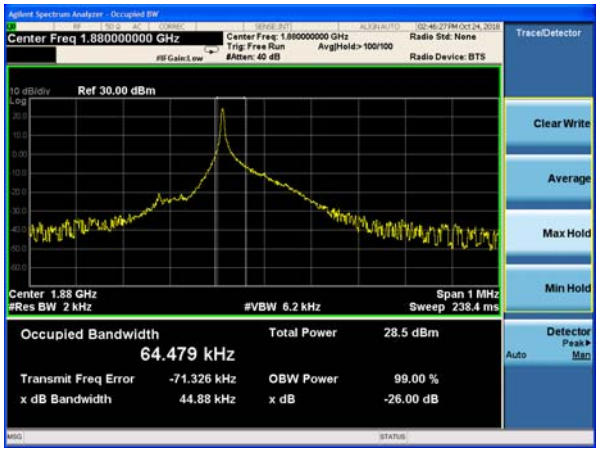
NB-IOT Band 2 QPSK 3.75kHz 1@0 CH-Low



NB-IOT Band 2 QPSK 15kHz 1@0 CH-Low

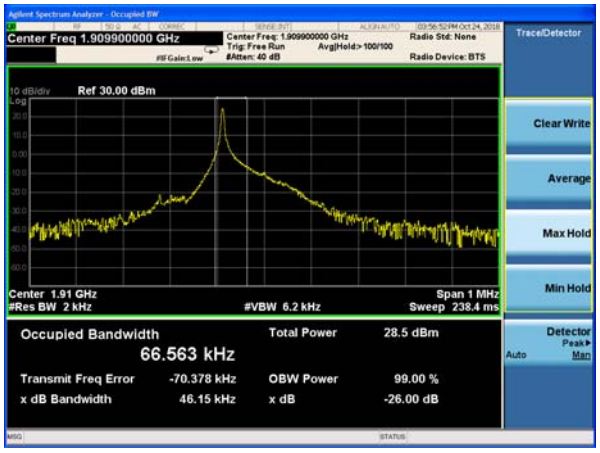


NB-IOT Band 2 QPSK 3.75kHz 1@0 CH-Middle

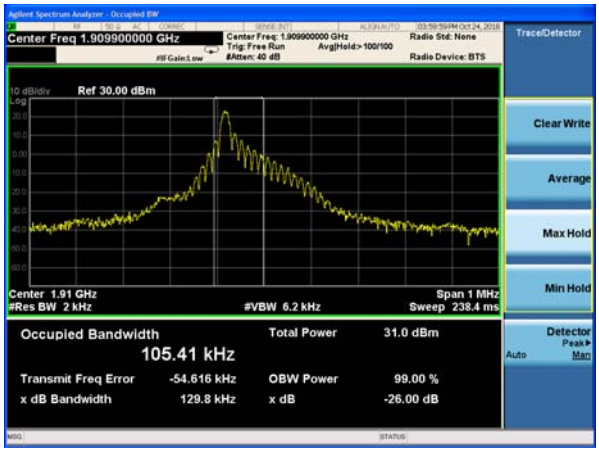


NB-IOT Band 2 QPSK 15kHz 1@0 CH-Middle

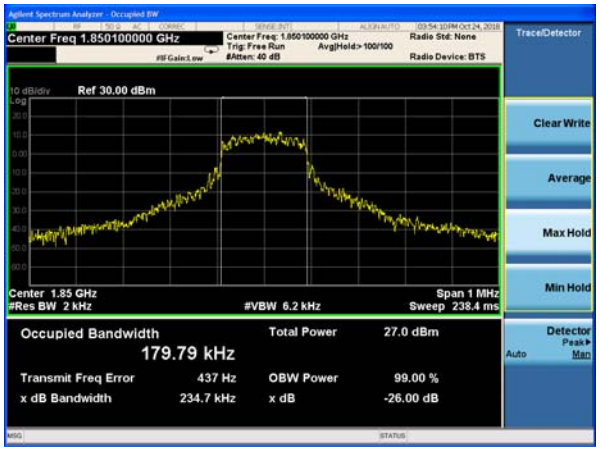
NB-IOT Band 2 QPSK 3.75kHz 1@0 CH-High



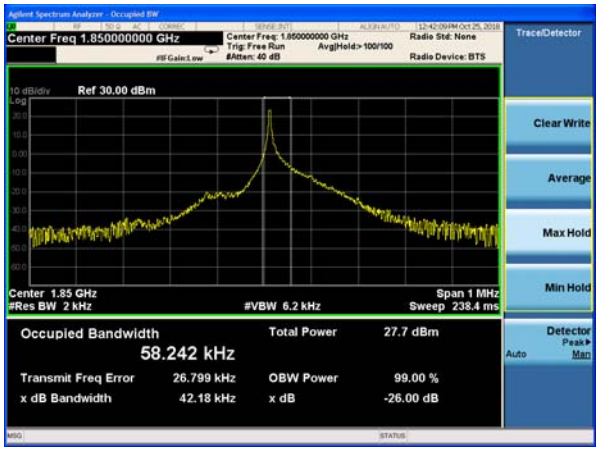
NB-IOT Band 2 QPSK 15kHz 1@0 CH-High



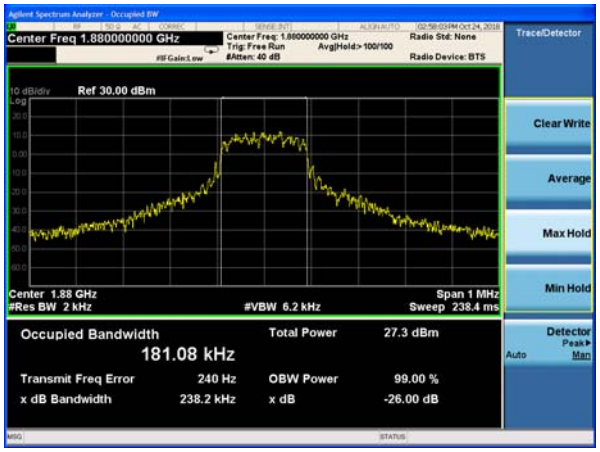
NB-IOT Band 2 QPSK 15kHz 12@0 CH-Low



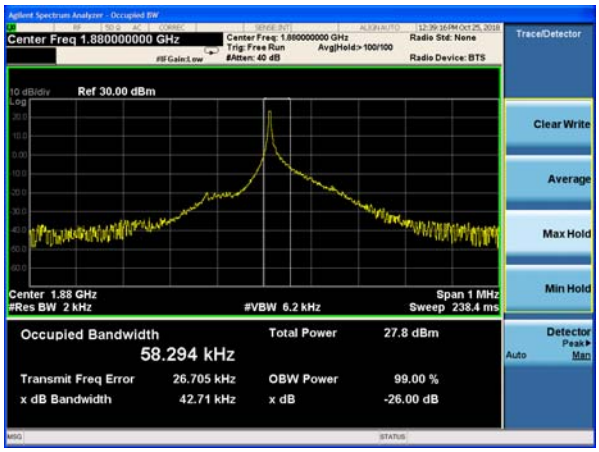
NB-IOT Band 25 BPSK 3.75kHz 1@0 CH-Low



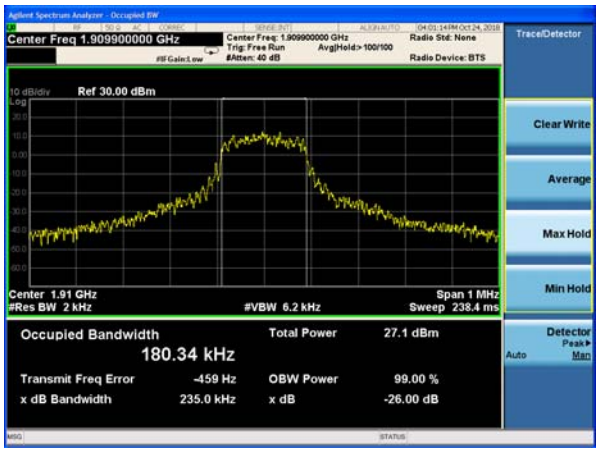
NB-IOT Band 2 QPSK 15kHz 12@0 CH-Middle



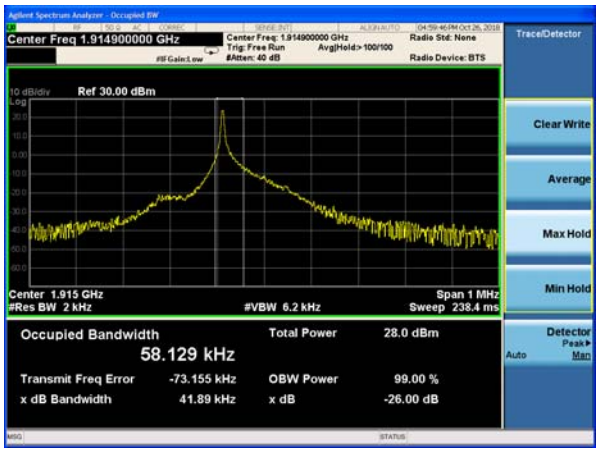
NB-IOT Band 25 BPSK 3.75kHz 1@0 CH-Middle



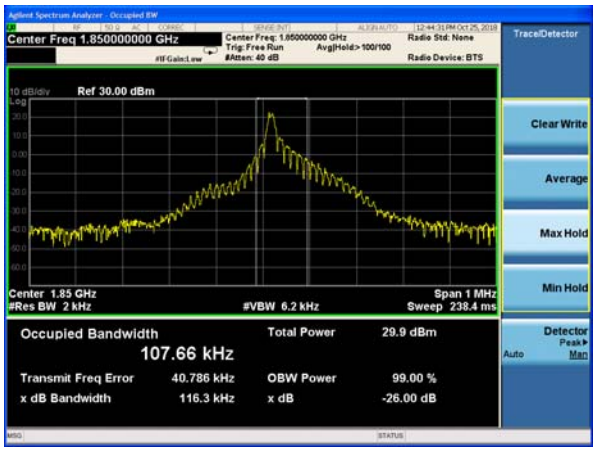
NB-IOT Band 2 QPSK 15kHz 12@0 CH-High



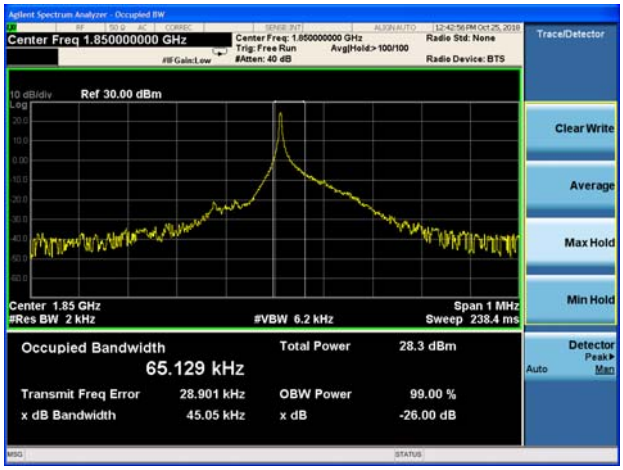
NB-IOT Band 25 BPSK 3.75kHz 1@0 CH-High



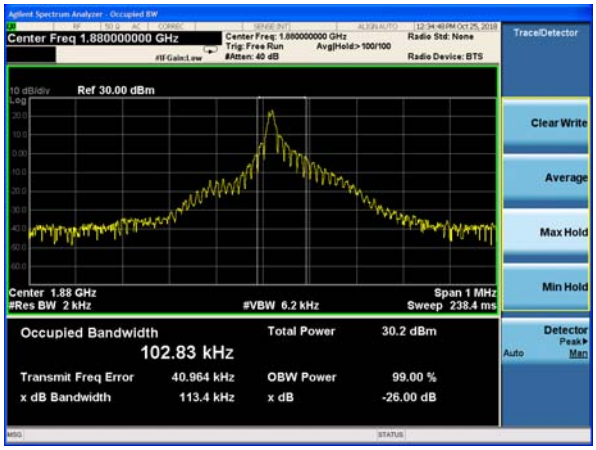
NB-IOT Band 25 BPSK 15kHz 1@0 CH-Low



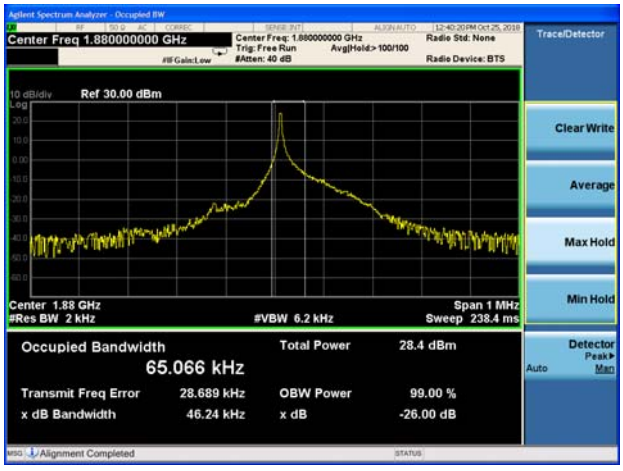
NB-IOT Band 25 QPSK 3.75kHz 1@0 CH-Low



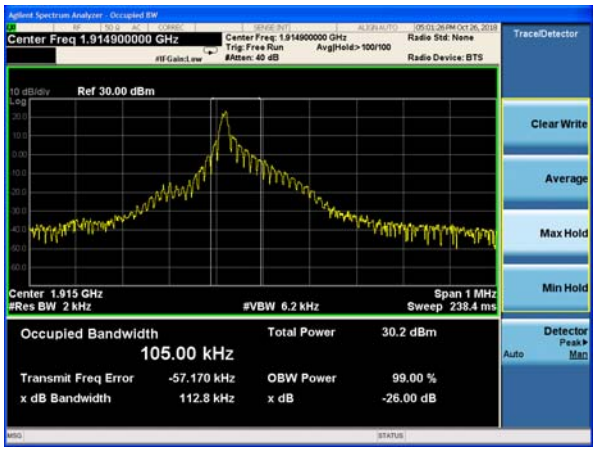
NB-IOT Band 25 BPSK 15kHz 1@0 CH-Middle



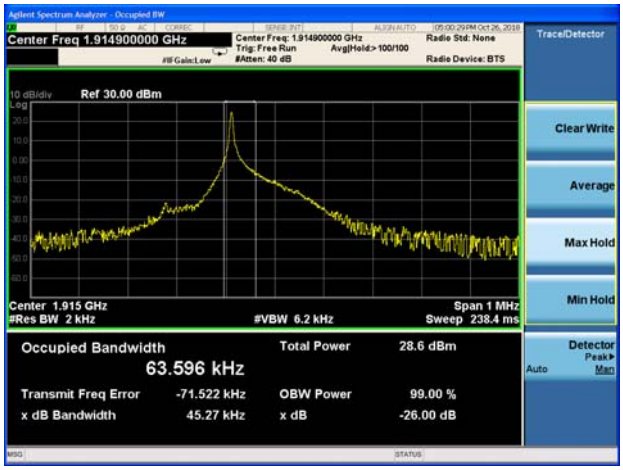
NB-IOT Band 25 QPSK 3.75kHz 1@0 CH-Middle



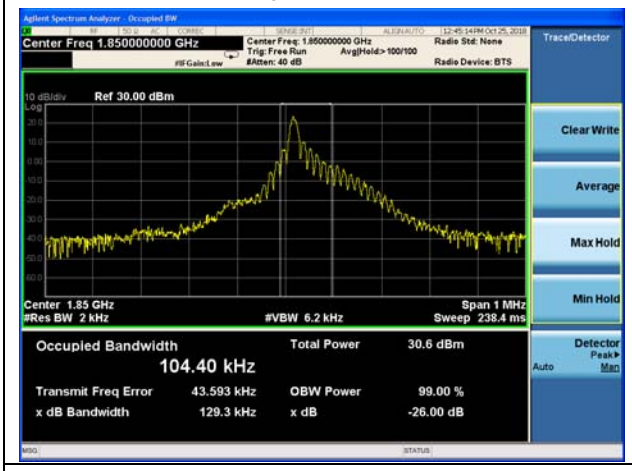
NB-IOT Band 25 BPSK 15kHz 1@0 CH-High



NB-IOT Band 25 QPSK 3.75kHz 1@0 CH-High

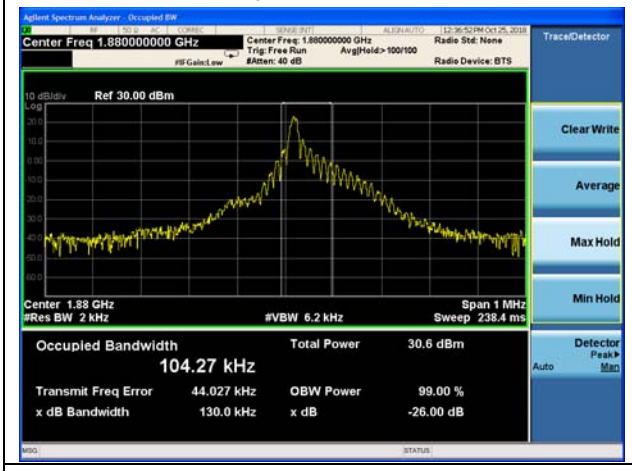


NB-IOT Band 25 QPSK 15kHz 1@0 CH-Low

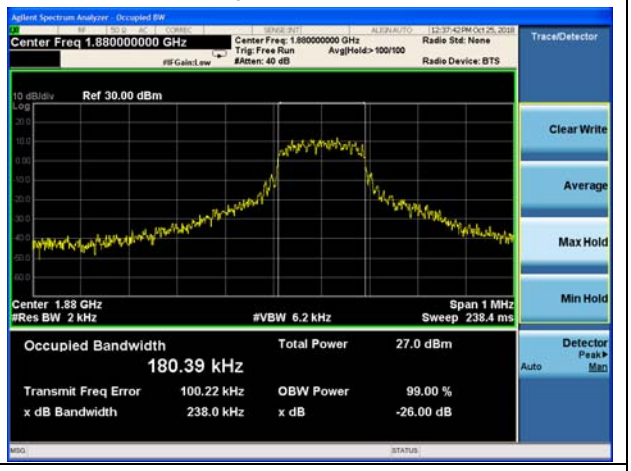


NB-IOT Band 25 QPSK 15kHz 12@0 CH-Low

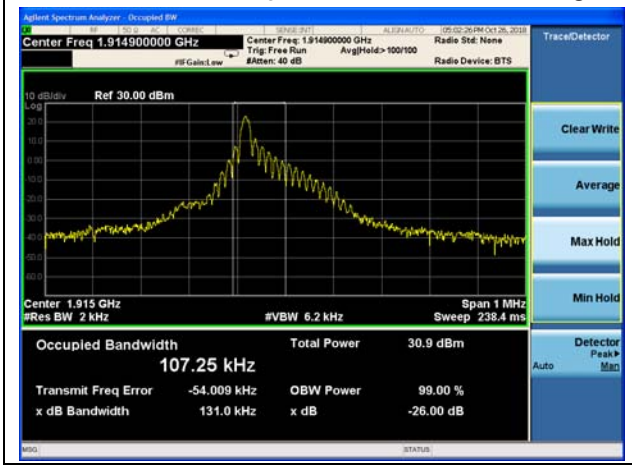
NB-IOT Band 25 QPSK 15kHz 1@0 CH-Middle



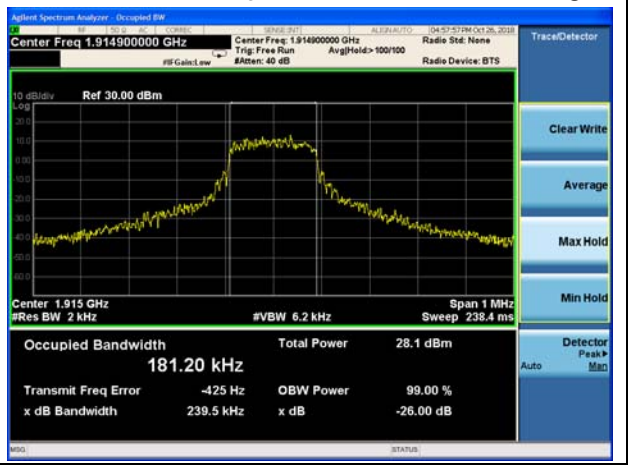
NB-IOT Band 25 QPSK 15kHz 12@0 CH-Middle



NB-IOT Band 25 QPSK 15kHz 1@0 CH-High



NB-IOT Band 25 QPSK 15kHz 12@0 CH-High



5.4. Band Edge Compliance

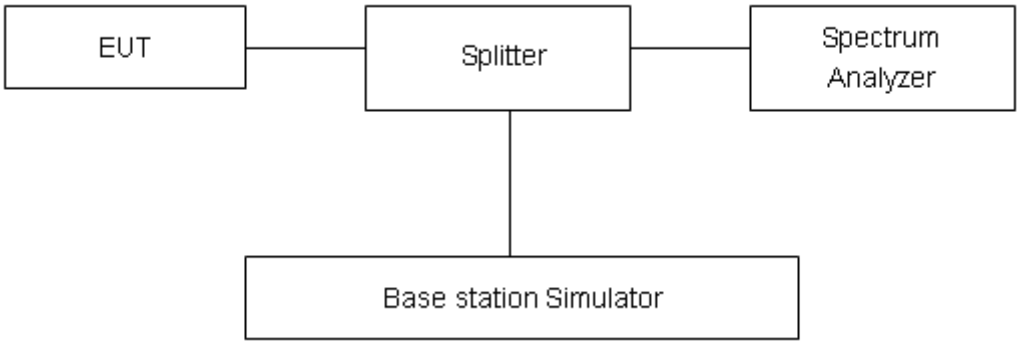
Ambient condition

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

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The band edge of the lowest and highest channels were measured. The Average detector is used and RBW is set to 51Hz, VBW is set to 160Hz for 3.75KHz single carrier,
RBW is set to 200Hz, VBW is set to 620Hz for 15KHz single carrier,
RBW is set to 2kHz, VBW is set to 6.2KHz for 15KHz full carrier.
Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

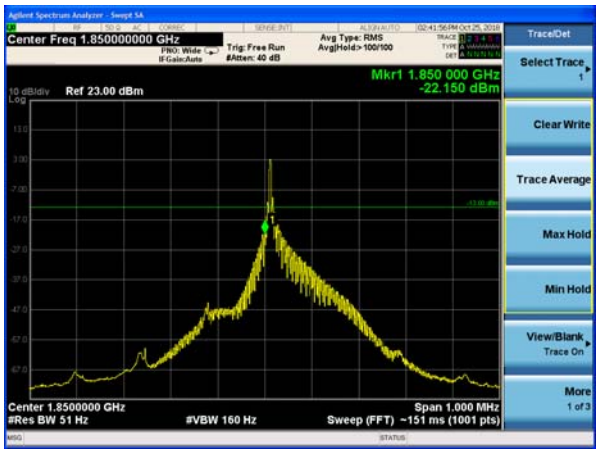
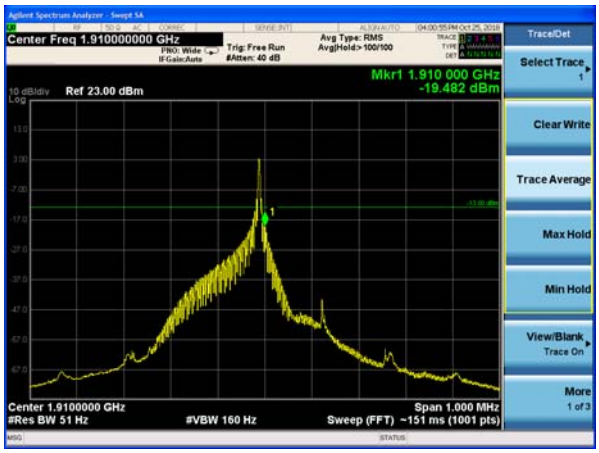
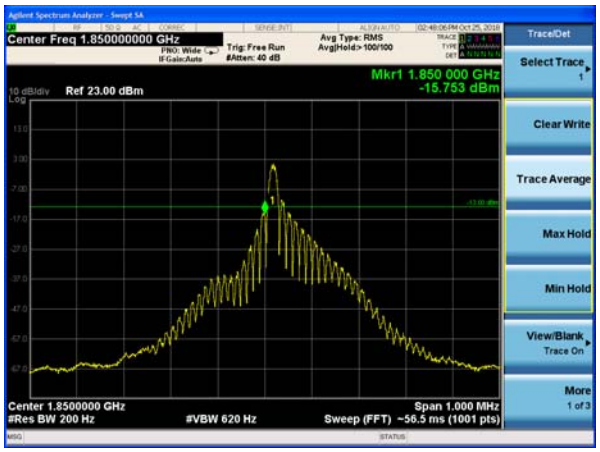
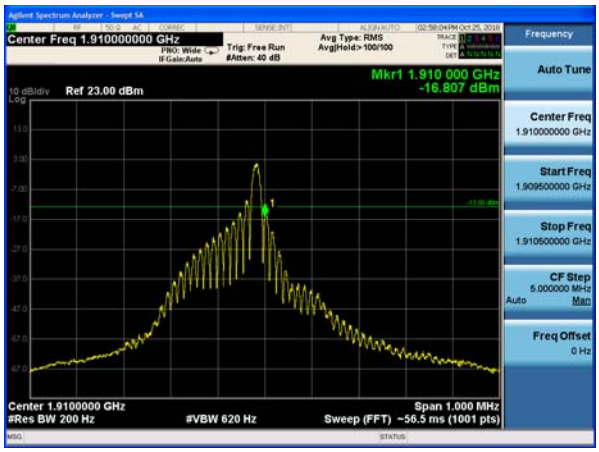
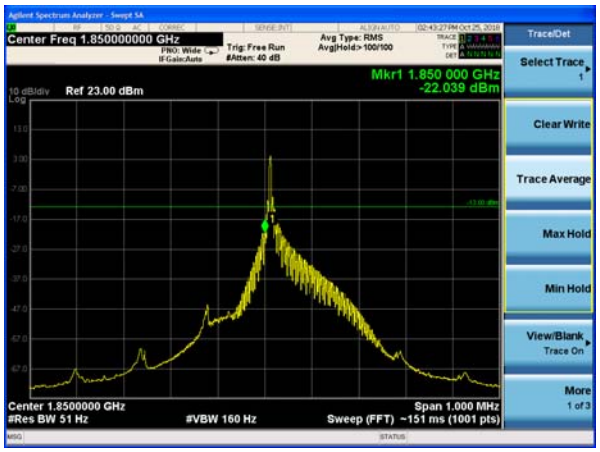
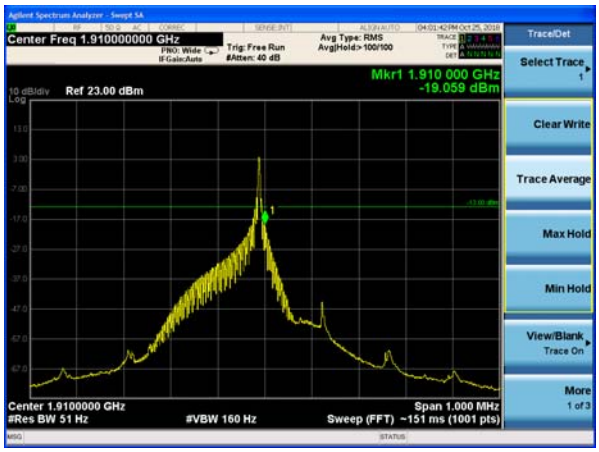
Rule Part 24.238(a) specifies that “on any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log10 (P) dB.”

Limit	-13 dBm

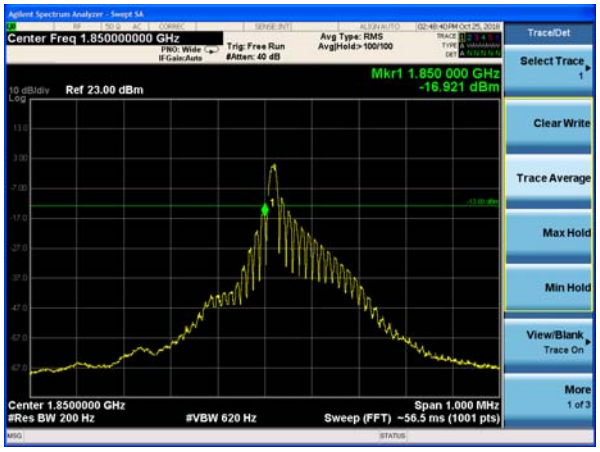
Measurement Uncertainty

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

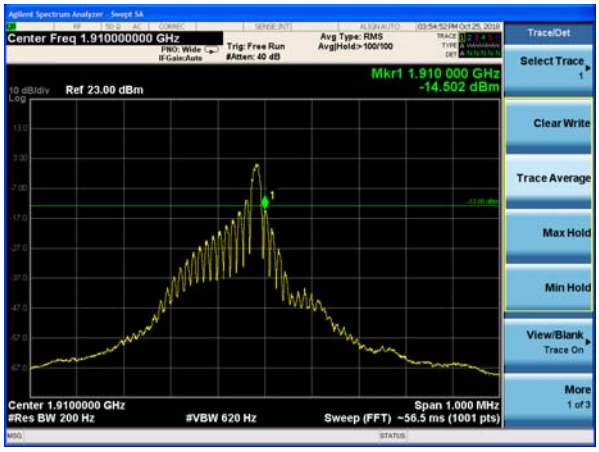
Test Result:

NB-IOT Band 2 BPSK 3.75kHz 1@0 CH-Low	NB-IOT Band 2 BPSK 3.75kHz 1@47 CH-High
	
NB-IOT Band 2 BPSK 15kHz 1@0 CH-Low	NB-IOT Band 2 BPSK 15kHz 1@11 CH-High
	
NB-IOT Band 2 QPSK 3.75kHz 1@0 CH-Low	NB-IOT Band 2 QPSK 3.75kHz 1@47 CH-High
	

NB-IOT Band 2 QPSK 15kHz 1@0 CH-Low

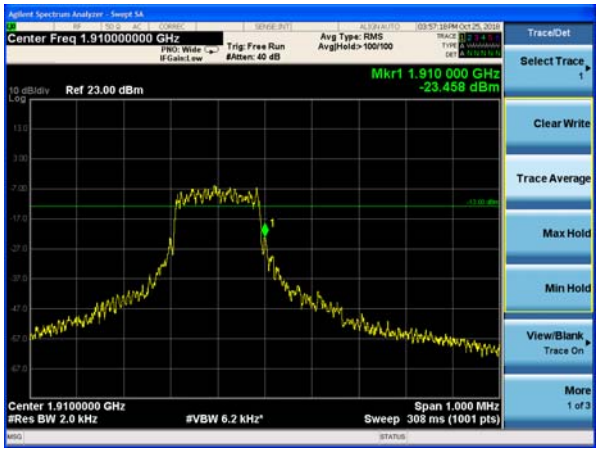


NB-IOT Band 2 QPSK 15kHz 1@11 CH-High

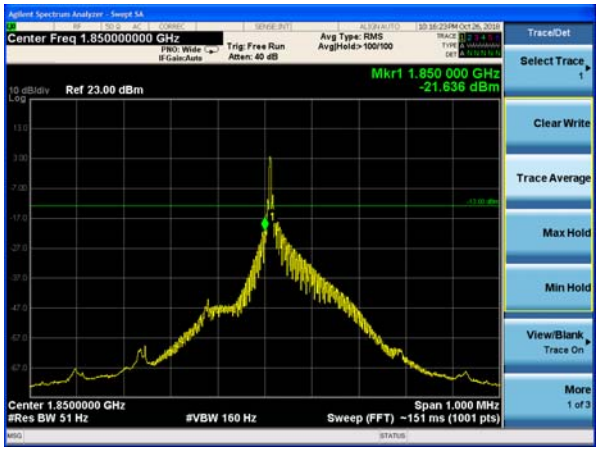


NB-IOT Band 2 QPSK 15kHz 12@0 CH-Low

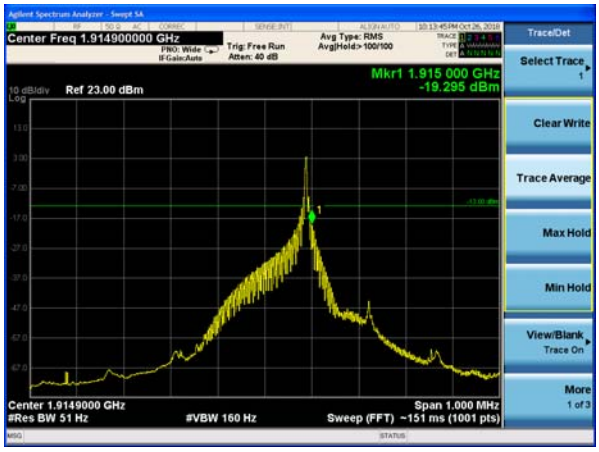
NB-IOT Band 2 QPSK 15kHz 12@0 CH-High



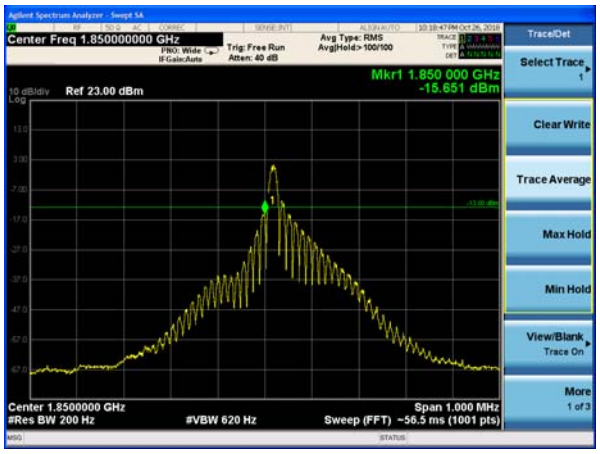
NB-IOT Band 25 BPSK 3.75kHz 1@0 CH-Low



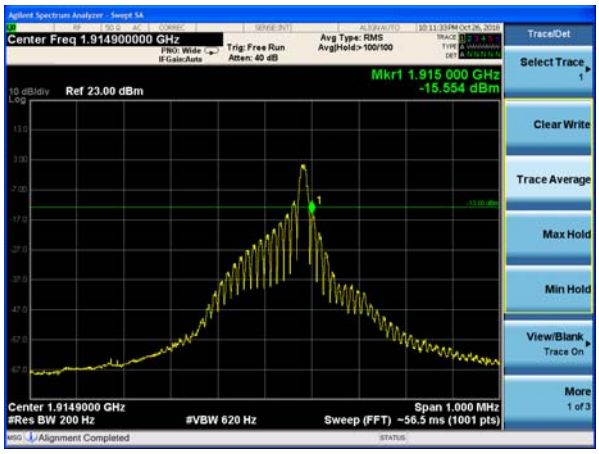
NB-IOT Band 25 BPSK 3.75kHz 1@47 CH-High



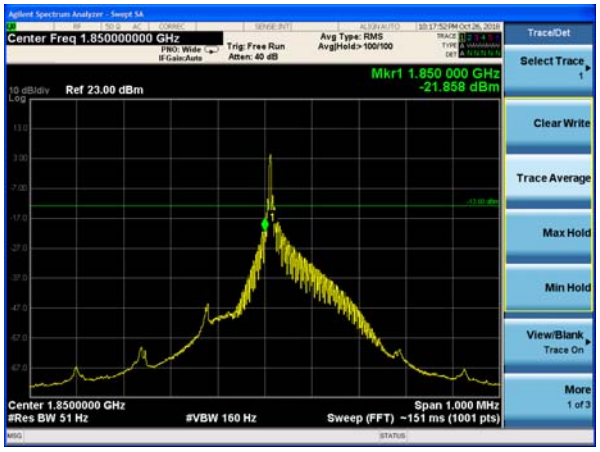
NB-IOT Band 25 BPSK 15kHz 1@0 CH-Low



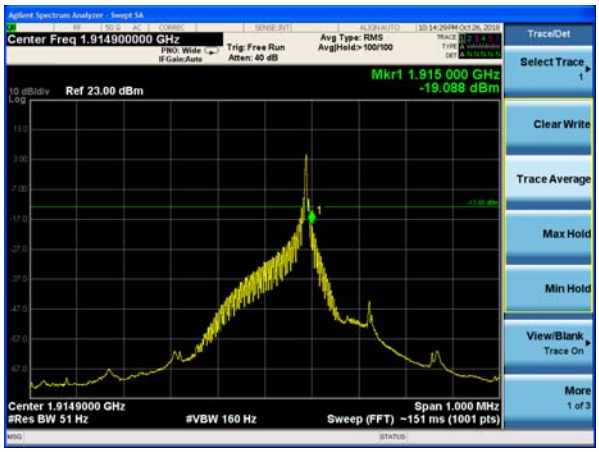
NB-IOT Band 25 BPSK 15kHz 1@11 CH-High



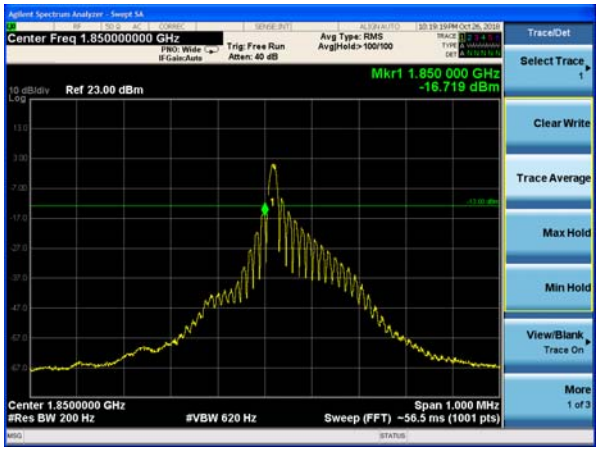
NB-IOT Band 25 QPSK 3.75kHz 1@0 CH-Low



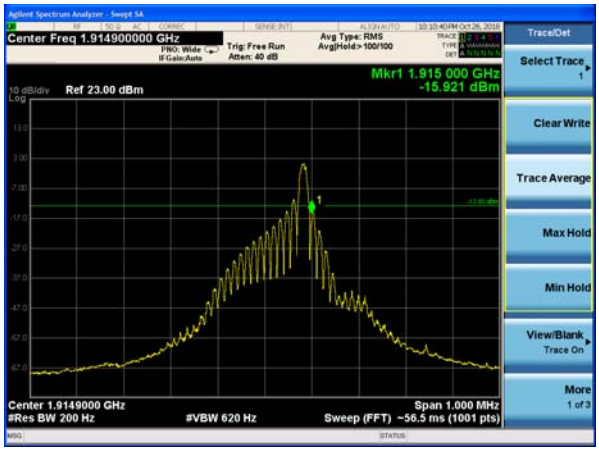
NB-IOT Band 25 QPSK 3.75kHz 1@47 CH-High



NB-IOT Band 25 QPSK 15kHz 1@0 CH-Low



NB-IOT Band 25 QPSK 15kHz 1@11 CH-High



NB-IOT Band 25 QPSK 15kHz 12@0 CH-Low

NB-IOT Band 25 QPSK 15kHz 12@0 CH-High

5.5. Peak-to-Average Power Ratio (PAPR)

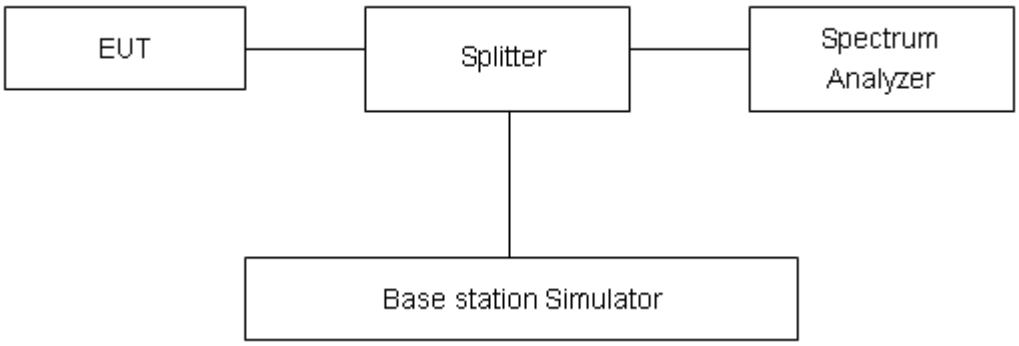
Ambient condition

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

Methods of Measurement

Measure the total peak power and record as PPk. And measure the total average power and record as PAvg. Both the peak and average power levels must be expressed in the same logarithmic units (*e.g.*, dBm). Determine the PAPR from:
PAPR (dB) = PPk (dBm) - PAvg (dBm).

Test Setup



Limits

In measuring transmissions in this band using an average power technique, the peakto-average ratio (PAR) of the transmission may not exceed 13 dB in 24.232(d).

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.

Test Results

Mode	Modulation	Sub-carrier spacing (KHz)	Channel/ Frequency(MHz)	Peak-to-Average Power Ratio (PAPR)		
				Peak(dBm)	Avg(dBm)	PAPR(dB)
Band 2 Standalone	BPSK	3.75	18900/1880.0	26.22	22.15	4.07
	QPSK	3.75	18900/1880.0	25.73	22.13	3.60
	BPSK	15	18900/1880.0	25.90	19.13	6.77
	QPSK	15	18900/1880.0	25.68	19.14	6.54

Mode	Modulation	Sub-carrier spacing (KHz)	Channel/ Frequency(MHz)	Peak-to-Average Power Ratio (PAPR)		
				Peak(dBm)	Avg(dBm)	PAPR(dB)
Band 25 Standalone	BPSK	3.75	26341/1880.1	26.25	22.16	4.09
	QPSK	3.75	26341/1880.1	25.75	22.18	3.57
	BPSK	15	26341/1880.1	25.93	19.25	6.68
	QPSK	15	26341/1880.1	25.66	19.06	6.60

5.6. Frequency Stability

Ambient condition

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

Method of Measurement

Frequency Stability (Temperature Variation)

The temperature inside the climate chamber is varied from -40°C to +85°C in 10°C step size,

(1) With all power removed, the temperature was decreased to 0°C and permitted to stabilize for three hours.

(2) Measure the carrier frequency with the test equipment in a “call mode”. These measurements should be made within 1 minute of powering up the mobile station, to prevent significant self warming.

(3) Repeat the above measurements at 10°C increments from -40°C to +85°C. Allow at least 1.5 hours at each temperature, un-powered, before making measurements.

Frequency Stability (Voltage Variation)

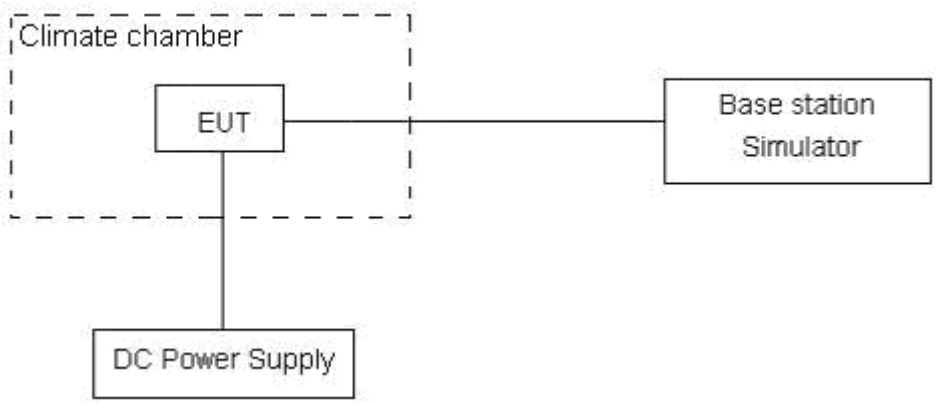
The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery-operating end point which shall be specified by the manufacturer.

This transceiver is specified to operate with an input voltage of between 2.1 V and 3.63 V, with a nominal voltage of 3.3V.

Test setup



Limits

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block

Measurement Uncertainty

The assessed measurement uncertainty to ensure 99.75％ confidence level for the normal distribution is with the coverage factor *k* = 3, U= 0.01ppm.

Test Result

NB-IOT Band 2					
BPSK,(15KHz)					
Condition		1850	1910	Delta (Hz)	Frequency Stability(ppm)
Temperature	Voltage	F low@-13dBm(MHz)	F high@-13dBm(MHz)		
Normal（25°C）	Normal	1850.0622	1909.8789	6.38	0.00339
Extreme（85°C）		1850.0649	1909.8762	3.82	0.00203
Extreme（80°C）		1850.0615	1909.8796	9.17	0.00488
Extreme（70°C）		1850.0649	1909.8762	17.50	0.00931
Extreme（60°C）		1850.0639	1909.8772	12.33	0.00656
Extreme（50°C）		1850.0681	1909.8734	2.16	0.00115
Extreme（40°C）		1850.0614	1909.8797	9.74	0.00518
Extreme（30°C）		1850.0642	1909.8769	6.03	0.00321
Extreme（20°C）		1850.0661	1909.8751	4.15	0.00221
Extreme（10C）		1850.0669	1909.8742	6.75	0.00359
Extreme（0°C）		1850.0601	1909.8813	8.19	0.00436
Extreme（-10°C）		1850.0653	1909.8758	16.34	0.00869
Extreme（-20°C）		1850.0614	1909.8797	17.42	0.00927
Extreme（-30°C）		1850.0606	1909.8805	4.32	0.00230
Extreme（-40°C）		1850.0683	1909.8728	9.25	0.00492
25°C	LV	1850.0613	1909.8801	3.21	0.00171
	HV	1850.0654	1909.8757	6.57	0.00349
QPSK,(15KHZ)					
Condition		1850	1910	Delta (Hz)	Frequency Stability(ppm)
Temperature	Voltage	F low@-13dBm(MHz)	F high@-13dBm(MHz)		
Normal（25°C）	Normal	1850.0554	1909.8792	3.83	0.00204
Extreme（85°C）		1850.0527	1909.8763	4.68	0.00249
Extreme（80°C）		1850.0561	1909.8797	7.69	0.00409
Extreme（70°C）		1850.0527	1909.8763	2.18	0.00116
Extreme（60°C）		1850.0537	1909.8773	3.06	0.00163
Extreme（50°C）		1850.0495	1909.8731	17.94	0.00954
Extreme（40°C）		1850.0562	1909.8798	5.42	0.00288
Extreme（30°C）		1850.0534	1909.8771	12.31	0.00655
Extreme（20°C）		1850.0515	1909.8751	7.06	0.00376
Extreme（10C）		1850.0507	1909.8743	11.50	0.00612
Extreme（0°C）		1850.0575	1909.8811	7.57	0.00403
Extreme（-10°C）		1850.0523	1909.8759	6.92	0.00368
Extreme（-20°C）		1850.0562	1909.8798	5.42	0.00288
Extreme（-30°C）		1850.0572	1909.8806	7.55	0.00402

Extreme（-40°C）		1850.0493	1909.8729	11.14	0.00593
25°C	LV	1850.0566	1909.8802	15.29	0.00813
	HV	1850.0522	1909.8758	11.02	0.00586

NB-IOT Band 25					
BPSK,(15KHz)					
Condition		1850	1915	Delta (Hz)	Frequency Stability(ppm)
Temperature	Voltage	F low@-13dBm(MHz)	F high@-13dBm(MHz)		
Normal（25°C）	Normal	1850.6271	1914.6583	12.85	0.01816
Extreme（85°C）		1850.6284	1914.6526	16.46	0.02327
Extreme（80°C）		1850.6241	1914.6547	16.21	0.02291
Extreme（70°C）		1850.6248	1914.6564	19.68	0.02782
Extreme（60°C）		1850.6250	1914.6526	25.93	0.03665
Extreme（50°C）		1850.6285	1914.6537	20.17	0.02851
Extreme（40°C）		1850.6247	1914.6592	15.49	0.02189
Extreme（30°C）		1850.6285	1914.6575	14.54	0.02055
Extreme（20°C）		1850.6259	1914.6547	13.61	0.01924
Extreme（10C）		1850.6264	1914.6525	16.47	0.02328
Extreme（0°C）		1850.6268	1914.6571	13.86	0.01959
Extreme（-10°C）		1850.6275	1914.6558	19.03	0.02690
Extreme（-20°C）		1850.6273	1914.659	12.33	0.01743
Extreme（-30°C）		1850.6295	1914.6542	20.48	0.02895
Extreme（-40°C）		1850.6281	1914.6576	15.64	0.02211
25°C	LV	1850.6296	1914.6584	13.20	0.01866
	HV	1850.6248	1914.6561	12.18	0.01722
QPSK,(15KHZ)					
Condition		1850	1915	Delta (Hz)	Frequency Stability(ppm)
Temperature	Voltage	F low@-13dBm(MHz)	F high@-13dBm(MHz)		
Normal（25°C）	Normal	1850.6264	1914.6529	10.84	0.01532
Extreme（85°C）		1850.6297	1914.6584	11.45	0.01618
Extreme（80°C）		1850.6254	1914.6546	21.34	0.03016
Extreme（70°C）		1850.6265	1914.6573	23.56	0.03330
Extreme（60°C）		1850.6920	1914.6557	15.67	0.02215
Extreme（50°C）		1850.6246	1914.6541	15.91	0.02249
Extreme（40°C）		1850.6282	1914.6527	17.68	0.02499
Extreme（30°C）		1850.6259	1914.6584	19.35	0.02735
Extreme（20°C）		1850.6245	1914.6598	22.57	0.03190
Extreme（10C）		1850.6272	1914.6554	24.65	0.03484
Extreme（0°C）		1850.6291	1914.6582	14.72	0.02081

Extreme（-10°C）		1850.6228	1914.6569	9.85	0.01392
Extreme（-20°C）		1850.6237	1914.6545	16.59	0.02345
Extreme（-30°C）		1850.6259	1914.6538	17.26	0.02440
Extreme（-40°C）		1850.6265	1914.6562	20.14	0.02847
25°C	LV	1850.6268	1914.6587	18.28	0.02584
	HV	1850.6254	1914.6569	13.21	0.01867

5.7. Spurious Emissions at Antenna Terminals

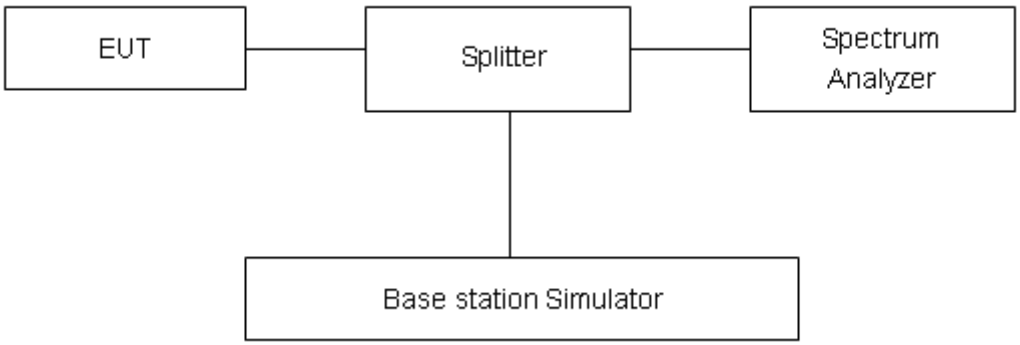
Ambient condition

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 measurement is carried out using a spectrum analyzer. The spectrum analyzer scans from 9kHz to the 10th harmonic of the carrier. The peak detector is used.
RBW is set to 100kHz, VBW is set to 300kHz for 30MHz~1GHz
RBW is set to 1MHz, VBW is set to 3MHz for above 1GHz, Sweep is set to ATUO.
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

Test setup



Limits

Rule Part 24.238(a) specifies that “on any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log10 (P) dB.”

Limit	-13 dBm

Measurement Uncertainty

The assessed measurement uncertainty to ensure 99.75% confidence level for the normal distribution is with the coverage factor *k* = 1.96.

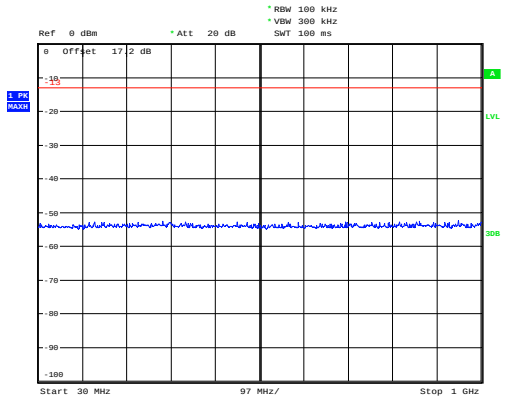
Frequency	Uncertainty
9kHz-1GHz	0.684 dB
1GHz-20GHz	1.407 dB

Test Result

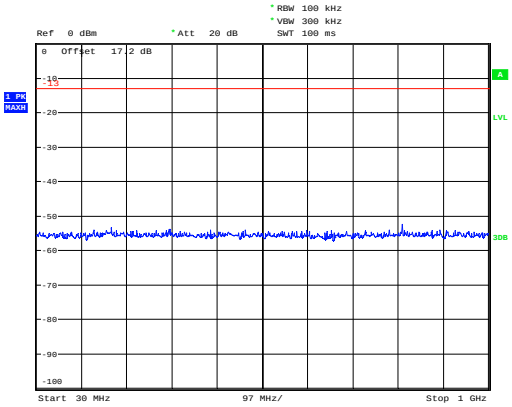
Sweep the whole frequency band through the range from 9kHz to the 10th harmonic of the carrier, the emissions more than 20 dB below the limit are not reported.

The signal beyond the limit is carrier.

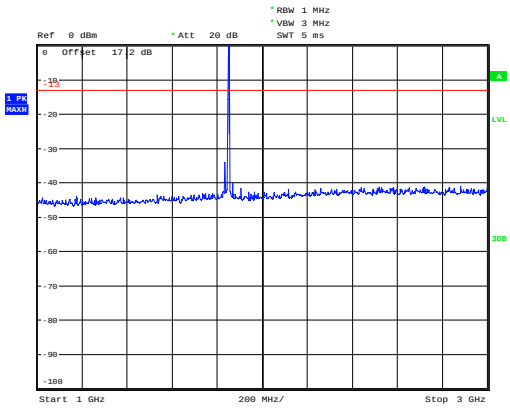
NB-IOT Band 2 CH-Low 30MHz~1GHz



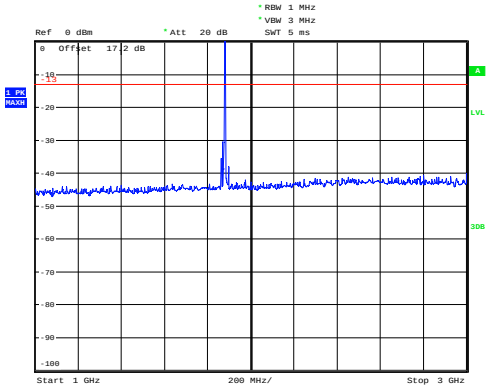
NB-IOT Band 2 CH-Middle 30MHz~1GHz



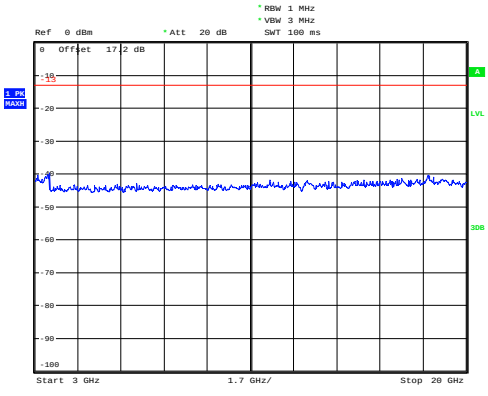
NB-IOT Band 2 CH-Low 1GHz~3GHz



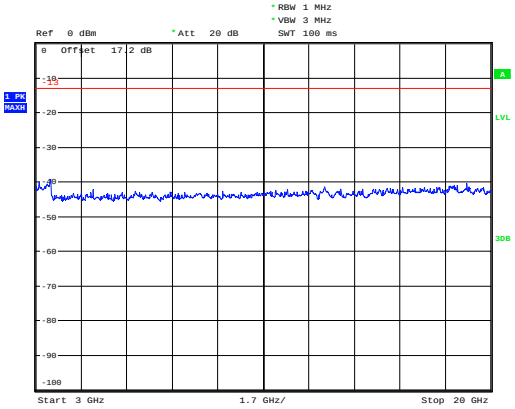
NB-IOT Band 2 CH-Middle 1GHz~3GHz



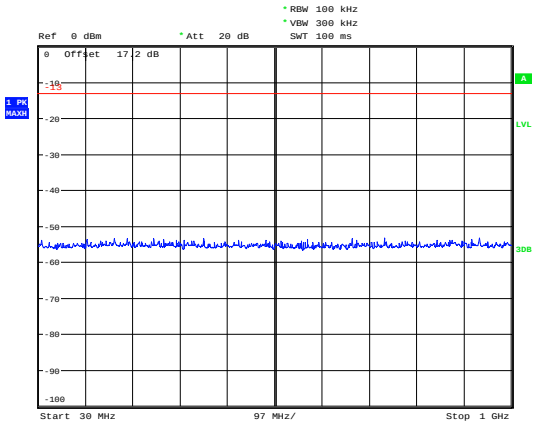
NB-IOT Band 2 CH-Low 3GHz~20GHz



NB-IOT Band 2 CH-Middle 3GHz~20GHz

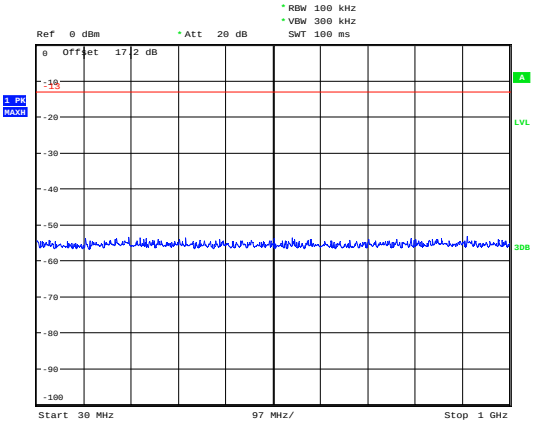


NB-IOT Band 2 CH-High 30MHz~1GHz



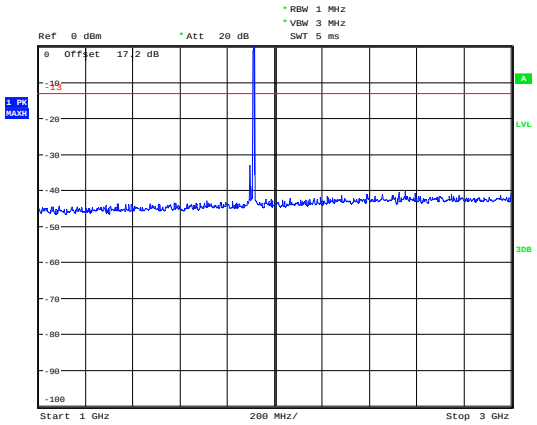
Date: 29.OCT.2018 11:00:31

NB-IOT Band 25 CH-Low 30MHz~1GHz



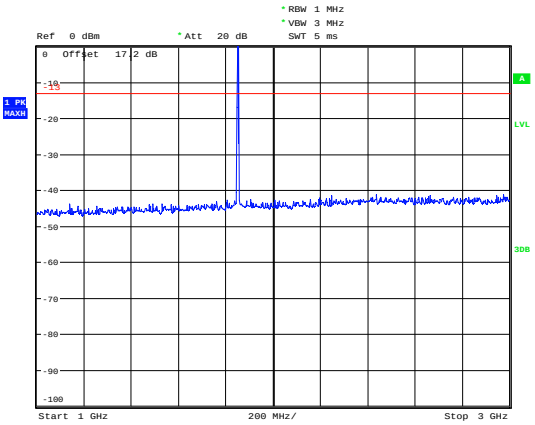
Date: 29.OCT.2018 12:11:37

NB-IOT Band 2 CH-High 1GHz~3GHz



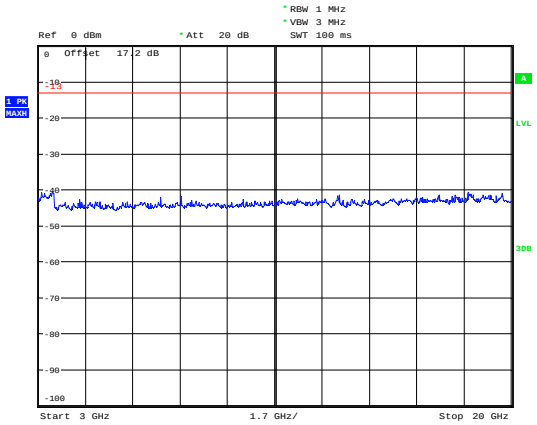
Date: 29.OCT.2018 11:01:20

NB-IOT Band 25 CH-Low 1GHz~3GHz



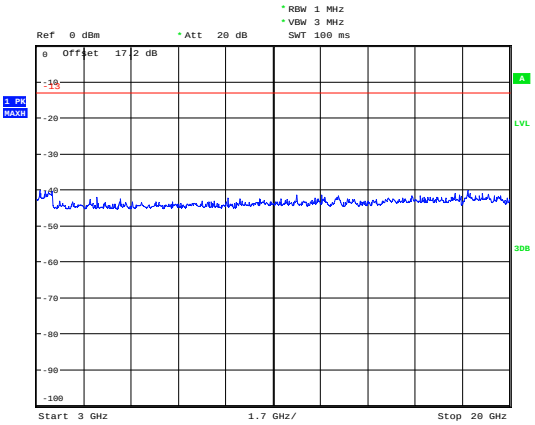
Date: 29.OCT.2018 12:12:05

NB-IOT Band 2 CH-High 3GHz~20GHz



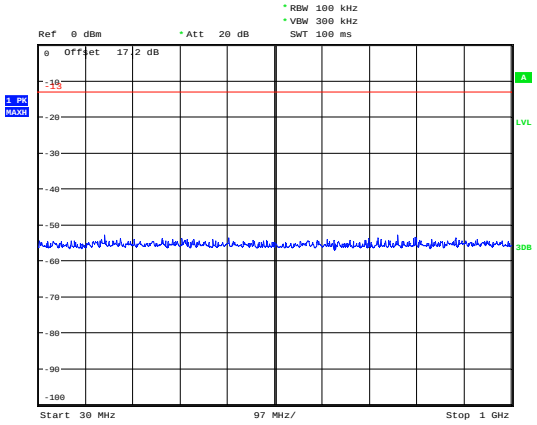
Date: 29.OCT.2018 11:02:13

NB-IOT Band 25 CH-Low 3GHz~20GHz



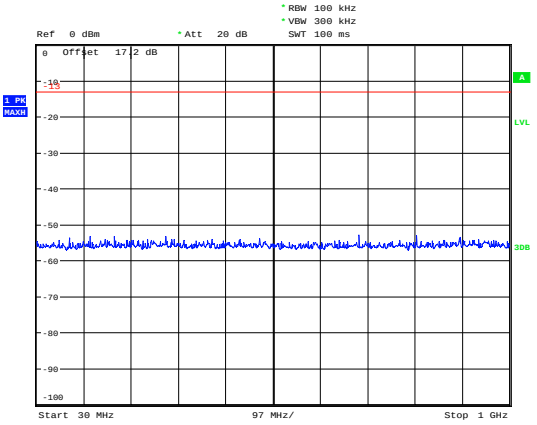
Date: 29.OCT.2018 12:12:38

NB-IOT Band 25 CH- Middle 30MHz~1GHz



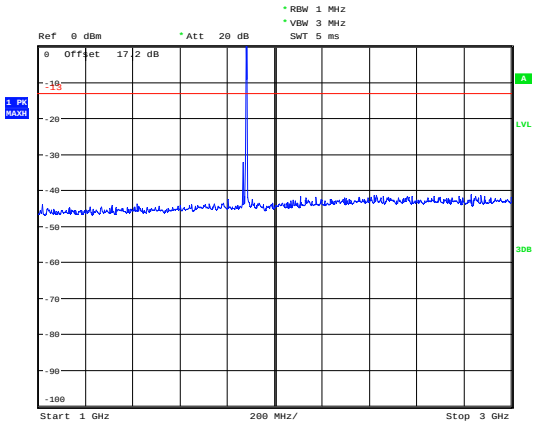
Date: 29.OCT.2018 13:25:58

NB-IOT Band 25 CH- High 30MHz~1GHz



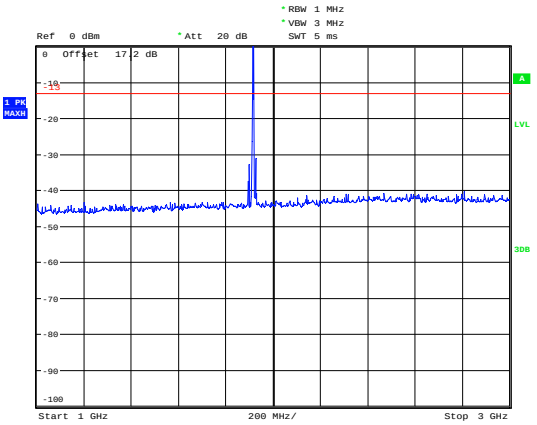
Date: 29.OCT.2018 13:28:02

NB-IOT Band 25 CH-Middle 1GHz~3GHz



Date: 29.OCT.2018 13:25:25

NB-IOT Band 25 CH-High 1GHz~3GHz



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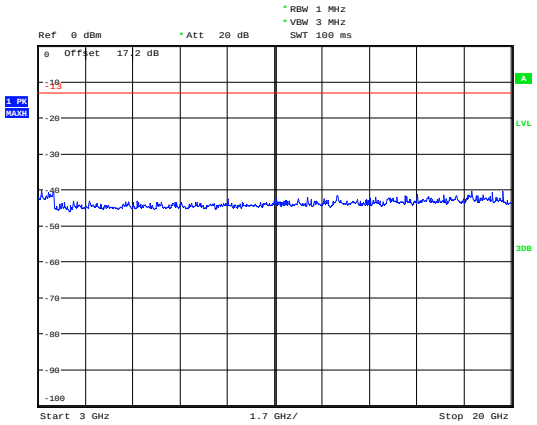
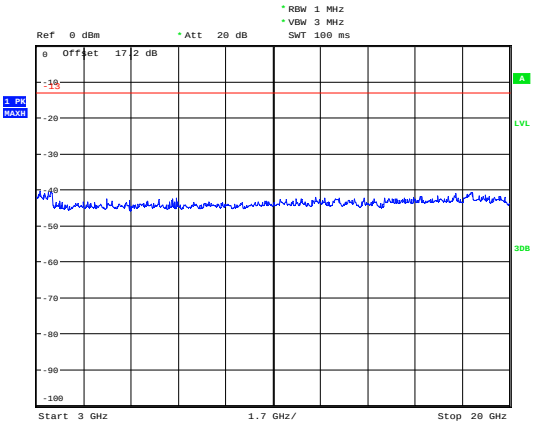
NB-IOT Band 25 CH-Middle 3GHz~20GHz



Date: 29.OCT.2018 13:25:02

NB-IOT Band 25 CH-High 3GHz~20GHz



Date: 29.OCT.2018 13:29:26

5.8. Radiates Spurious Emission

Ambient condition

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

Method of Measurement

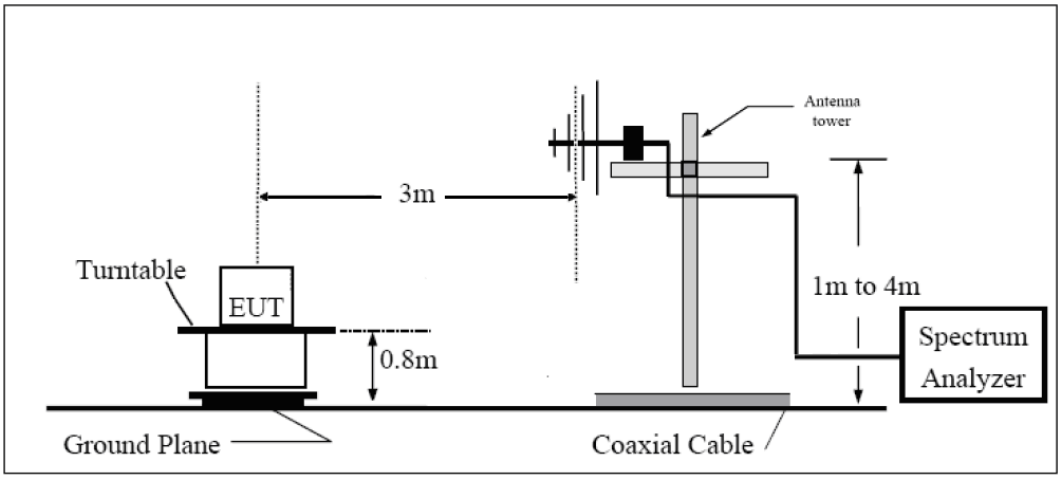
1. The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI C63.26 (2015).
2. Above 30MHz: The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H). Above 1GHz: (Note: the FCC's permission to use 1.5m as an alternative per TCBC Conf call of Dec. 2, 2014.) The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).
3. A log-periodic antenna or horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
4. The EUT is then put into continuously transmitting mode at its maximum power level during the test.Set Test Receiver or Spectrum RBW=1MHz,VBW=3MHz for above 1GHz and RBW=100kHz,VBW=300kHz for 30MHz to 1GHz,, And the maximum value of the receiver should be recorded as (Pr).
5. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
6. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
7. The measurement results are obtained as described below:
Power(EIRP)=PMea- PAg - Pcl + Ga
The measurement results are amend as described below:
Power(EIRP)=PMea- Pcl + Ga
8. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi)

and known input power. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.

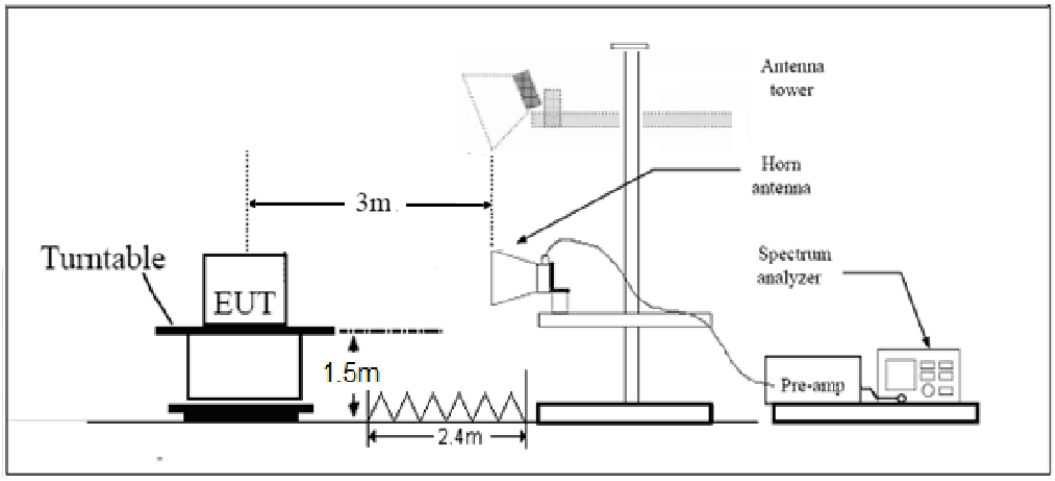
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

Test setup

30MHz~~~ 1GHz



Above 1GHz



Note: Area side: 2.4mX3.6m

Limits

Rule Part 24.238(a) specifies that “on any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log10 (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= 3.55 dB.

Test Result

Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier, the emissions below the noise floor will not be recorded in the report.

NB-IOT Band 2 CH-Low

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	3700.5	-58.27	5.10	11.05	Horizontal	-52.32	-13.00	39.32	225
3	5550.8	-58.25	5.42	12.65	Horizontal	-51.02	-13.00	38.02	180
4	7402.8	-56.18	6.70	13.85	Horizontal	-49.03	-13.00	36.03	180
5	9253.5	-54.26	7.01	14.75	Horizontal	-46.52	-13.00	33.52	90
6	11104.2	-53.10	7.48	15.95	Horizontal	-44.63	-13.00	31.63	45
7	12954.9	-53.16	7.51	16.55	Horizontal	-44.12	-13.00	31.12	90
8	14805.6	-52.43	8.24	15.35	Horizontal	-45.32	-13.00	32.32	135
9	16656.3	-50.16	8.41	14.95	Horizontal	-43.62	-13.00	30.62	180
10	18507.0	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

NB-IOT Band 2 CH-Middle

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	3759.0	-56.32	5.10	11.05	Horizontal	-50.37	-13.00	37.37	315
3	5638.9	-58.92	5.42	12.65	Horizontal	-51.69	-13.00	38.69	135
4	7520.0	-56.59	6.70	13.85	Horizontal	-49.44	-13.00	36.44	225
5	9400.0	-54.28	7.01	14.75	Horizontal	-46.54	-13.00	33.54	90
6	11280.0	-53.15	7.48	15.95	Horizontal	-44.68	-13.00	31.68	90
7	13160.0	-53.48	7.51	16.55	Horizontal	-44.44	-13.00	31.44	45
8	15040.0	-52.11	8.24	15.35	Horizontal	-45.00	-13.00	32.00	270
9	16920.0	-49.65	8.41	14.95	Horizontal	-43.11	-13.00	30.11	315
10	18800.0	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

NB-IOT Band 2 CH-High

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	3817.5	-55.39	5.10	11.05	Horizontal	-49.44	-13.00	36.44	180
3	5726.6	-56.35	5.42	12.65	Horizontal	-49.12	-13.00	36.12	180
4	7637.2	-56.76	6.70	13.85	Horizontal	-49.61	-13.00	36.61	90
5	9546.5	-54.89	7.01	14.75	Horizontal	-47.15	-13.00	34.15	45
6	11455.8	-52.95	7.48	15.95	Horizontal	-44.48	-13.00	31.48	90
7	13365.1	-53.12	7.51	16.55	Horizontal	-44.08	-13.00	31.08	135
8	15274.4	-53.44	8.24	15.35	Horizontal	-46.33	-13.00	33.33	180
9	17183.7	-50.10	8.41	14.95	Horizontal	-43.56	-13.00	30.56	45
10	19093.0	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

NB-IOT Band 25 CH-Low

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	3700.13	-61.41	5.10	11.05	Horizontal	-55.46	-13.00	42.46	180
3	5550.38	-61.63	5.42	12.65	Horizontal	-54.40	-13.00	41.40	90
4	7230.00	-57.19	6.70	13.85	Horizontal	-50.04	-13.00	37.04	45
5	9255.38	-57.57	7.01	14.75	Horizontal	-49.83	-13.00	36.83	90
6	11109.37	-55.10	7.48	15.95	Horizontal	-46.63	-13.00	33.63	135
7	12942.0	-54.37	7.51	16.55	Horizontal	-45.33	-13.00	32.21	180
8	14831.63	-52.32	8.24	15.35	Horizontal	-45.21	-13.00	32.29	90
9	16666.50	-51.83	8.41	14.95	Horizontal	-45.29	-13.00	32.29	45
10	-	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

NB-IOT Band 25 CH-Middle

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	3764.63	-60.85	5.10	11.05	Horizontal	-54.90	-13.00	41.90	180
3	5647.50	-60.54	5.42	12.65	Horizontal	-53.31	-13.00	40.31	90
4	7444.88	-56.19	6.70	13.85	Horizontal	-49.04	-13.00	36.04	45
5	9459.75	-54.91	7.01	14.75	Horizontal	-47.17	-13.00	34.17	90
6	11296.50	-53.01	7.48	15.95	Horizontal	-44.54	-13.00	31.54	135
7	13294.50	-53.75	7.51	16.55	Horizontal	-44.71	-13.00	31.71	180
8	14991.38	-51.55	8.24	15.35	Horizontal	-44.44	-13.00	31.44	90
9	16900.80	-50.08	8.41	14.95	Horizontal	-43.54	-13.00	30.54	45
10	-	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

NB-IOT Band 25 CH-High

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	EIRP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	3829.50	-58.92	5.10	11.05	Horizontal	-52.97	-13.00	39.97	180
3	5743.88	-61.06	5.42	12.65	Horizontal	-53.83	-13.00	40.83	315
4	9570.75	-55.88	6.70	13.85	Horizontal	-48.73	-13.00	35.73	135
5	11503.13	-54.16	7.01	14.75	Horizontal	-46.42	-13.00	33.42	225
6	13398.30	-54.34	7.48	15.95	Horizontal	-45.87	-13.00	32.87	90
7	15316.50	-56.54	7.51	16.55	Horizontal	-47.50	-13.00	34.50	135
8	17247.30	-52.35	8.24	15.35	Horizontal	-45.24	-13.00	32.24	45
9	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

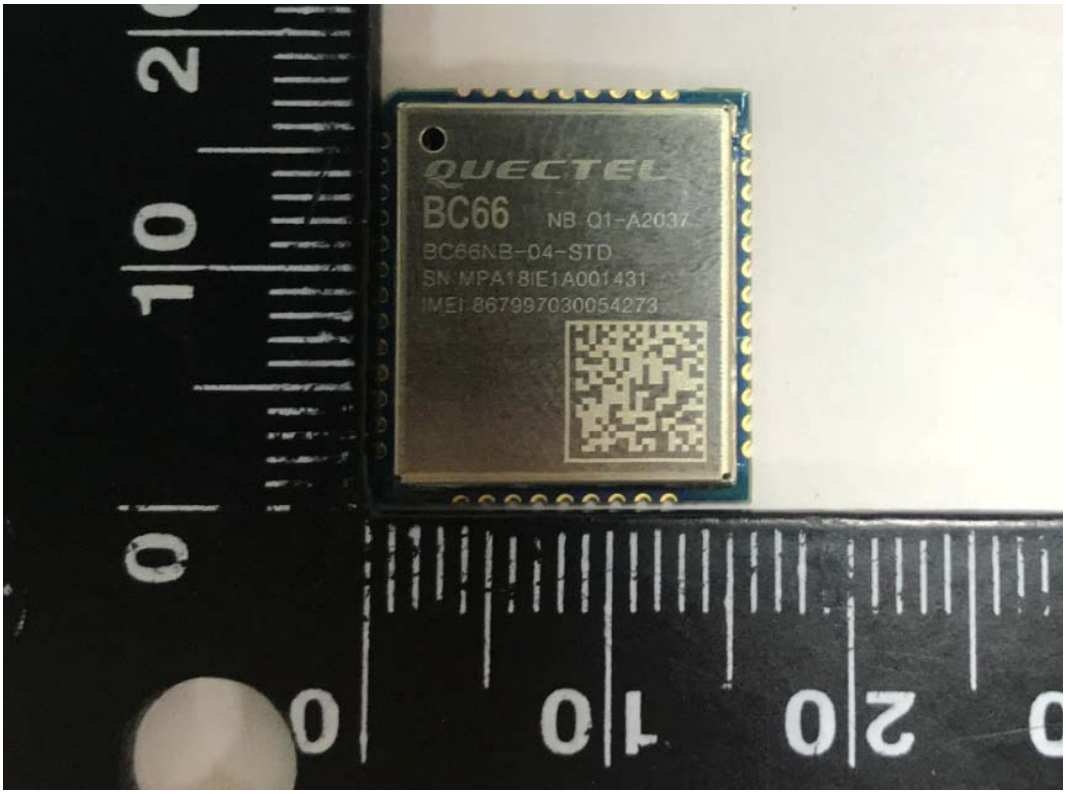
6. Main Test Instruments

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
Base Station Simulator	R&S	CMU200	118133	2018-05-13	2019-05-12
Base Station Simulator	R&S	CMW500	113824	2018-05-20	2019-05-19
Power Splitter	Hua Xiang	SHX-GF2-2-13	10120101	/	/
Spectrum Analyzer	Agilent	N9010A	MY50210259	2018-05-20	2019-05-19
Universal Radio Communication Tester	Agilent	E5515C	MY48367192	2018-05-20	2019-05-19
Signal Analyzer	R&S	FSV30	100815	2017-12-17	2018-12-16
EMI Test Receiver	R&S	ESCI	100948	2018-05-20	2019-05-19
Loop Antenna	SCHWARZBECK	FMZB1519	1519-047	2017-09-26	2019-09-25
Trilog Antenna	SCHWARZBECK	VUBL 9163	9163-201	2017-11-18	2019-11-17
Horn Antenna	R&S	HF907	100126	2018-07-07	2020-07-06
Horn Antenna	ETS-Lindgren	3160-09	00102643	2018-06-20	2020-06-19
Signal generator	R&S	SMB 100A	102594	2018-05-20	2019-05-19
Climatic Chamber	ESPEC	SU-242	93000506	2017-12-17	2020-12-16
Preampflier	R&S	SCU18	102327	2018-05-20	2019-05-19
MOB COMMS DC SUPPLY	Keysight	66319D	MY43004105	2018-05-07	2019-05-06
RF Cable	Agilent	SMA 15cm	0001	/	/
Software	R&S	EMC32	9.26.0	/	/

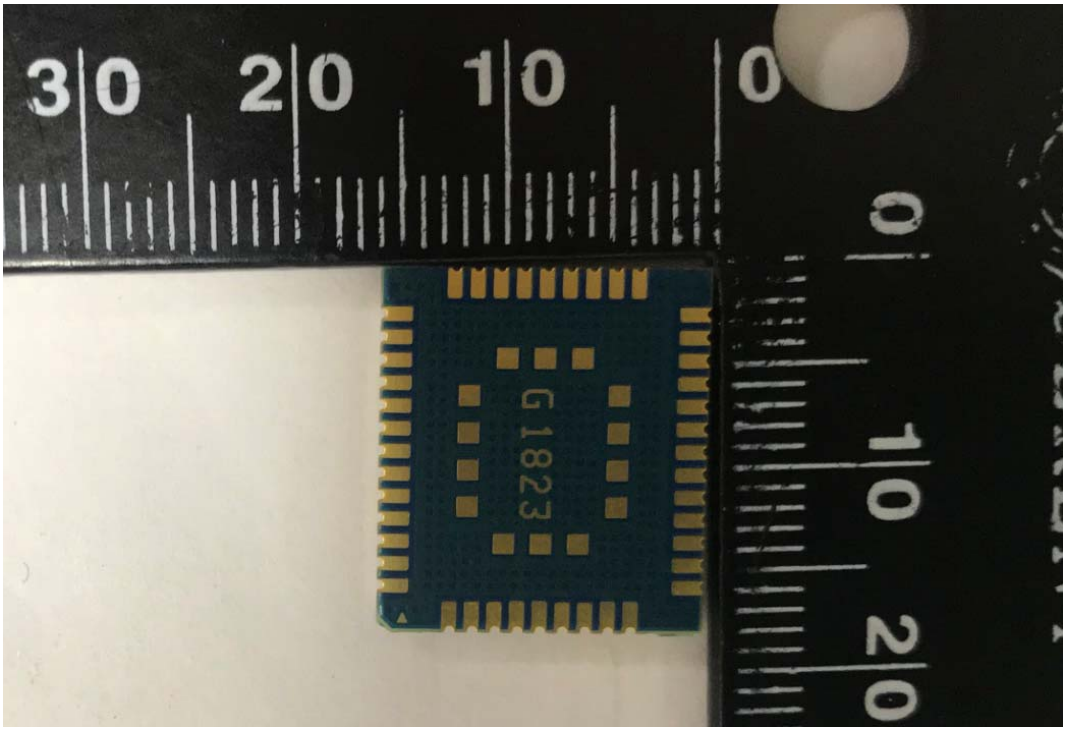
*******END OF REPORT *******

ANNEX A: EUT Appearance and Test Setup

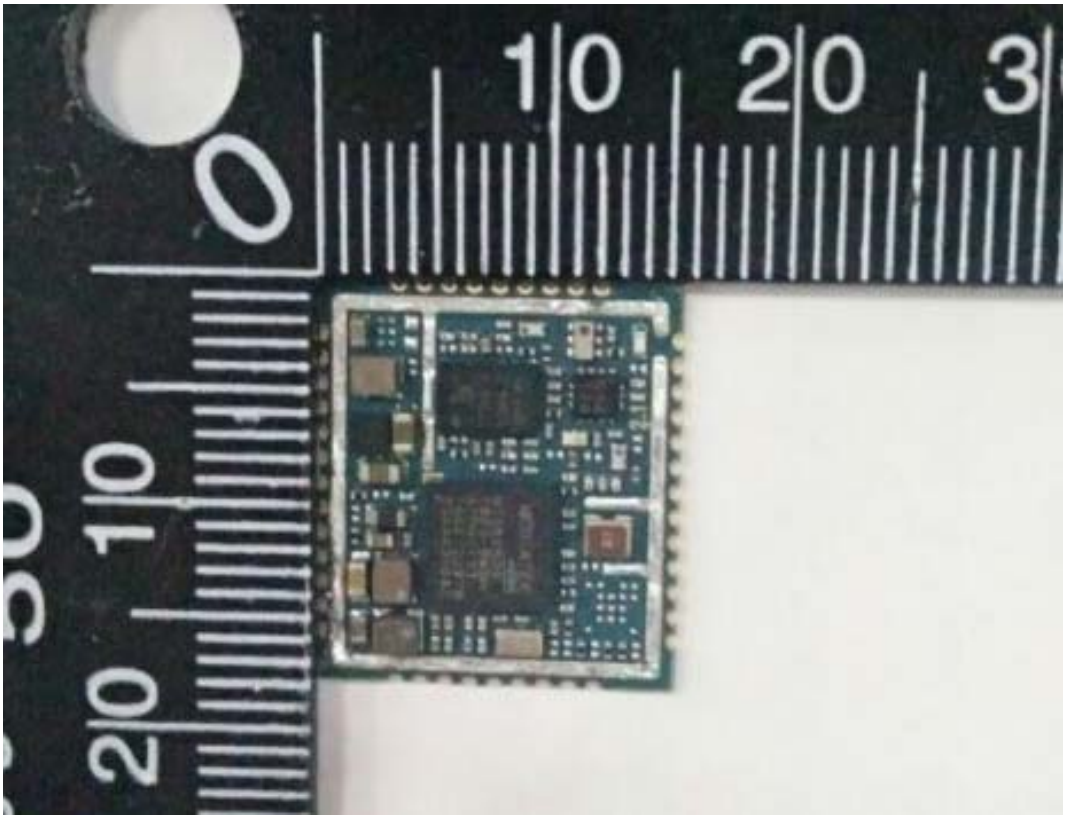
A.1 EUT Appearance



Front Side



Back Side



Unshielded

a: EUT

Picture 1 EUT and Accessory

A.2 Test Setup

Picture 2: Radiated Spurious Emissions Test setup