RADIO TEST REPORT

Report No.:STS2106071W03

Issued for

Shenzhen Coban Electronics Co.,Ltd

5/F, Block 22, Wisdomland Business Park, Guankou 2nd Road, Nantou, Nanshan District ,Shenzhen, Guangdong, China.518052

Product Name:	Pet GPS Tracker
Brand Name:	BAANOOL, DI QIU TU XING
Model Name:	GPS-201
Series Model:	BN-201
FCC ID:	2ATUK-BN-201
Test Standard:	47 CFR Part 2, 22

Shenzhen STS Test Services Co., Ltd.
A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China
TEL: +86-755 3688 6288 FAX: +86-755 3688 6277 E-mail:sts@stsapp.com

TEST RESULT CERTIFICATION

Applicant's Name.....:	Shenzhen Coban Electronics Co.,Ltd
Address .....:	5/F, Block 22, Wisdomland Business Park, Guankou 2nd Road, Nantou, Nanshan District ,Shenzhen, Guangdong, China.518052
Manufacturer's Name.....:	Shenzhen Coban Electronics Co.,Ltd
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Product description

Product Name .....:	Pet GPS Tracker
Brand Name .....:	BAANOOL, DI QIU TU XING
Model Name.....:	GPS-201
Series Model .....:	BN-201
Test Standards.....:	47 CFR Part 2, 22
Test Procedure .....:	KDB 971168 D01 v03r01, ANSI C63.26 2015

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Date of Test.....:	
Date of receipt of test item.....:	09 June. 2021
Date (s) of performance of tests .:	09 June. 2021 ~ 24 Jan. 2022
Date of Issue ..... :	24 Jan. 2022
Test Result .....:	Pass

Testing Engineer : (Chris Chen)

Technical Manager : (Sean she)

Authorized Signatory : (Vita Li)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	24 Jan. 2022	STS2106071W03	ALL	Initial Issue

1. TEST FACTORY & MEASUREMENT UNCERTAINTY

1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD
Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China
FCC test Firm Registration Number: 625569
IC test Firm Registration Number: 12108A
A2LA Certificate No.: 4338.01

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.87dB
2	Unwanted Emissions, conducted	±2.895dB
3	All emissions, radiated 9K-30MHz	±3.80dB
4	All emissions, radiated 30M-1GHz	±4.09dB
5	All emissions, radiated 1G-6GHz	±4.92dB
6	All emissions, radiated>6G	±5.49dB
7	Conducted Emission (9KHz-30MHz)	±2.73dB

2. GENERAL INFORMATION

2.1 TECHNICAL SPECIFICATIONS AND REGULATIONS

2.1.1 PRODUCT DESCRIPTION

A major technical description of EUT is described as following:

Product Name	Pet GPS Tracker
Trade Name	BAANOOL, DI QIU TU XING 
Model Name	GPS-201
Series Model	BN-201
Model Difference	Only different in appearance and color.
Frequency Bands	U.S. Bands: FDD Band 5
SIM Card	Only support single SIM Card.
Antenna	PIFA
Antenna gain	0dBi
Battery parameter	Rated Voltage:3.7V Charge Limit Voltage:4.2V Capacity: 450mAh
Rating	Input: DC 5V 300mA
Extreme Vol. Limits	3.33V to 4.07V (Nominal 3.7V)
Extreme Temp. Tolerance	-20℃ to +55℃
Hardware version number	201-V1.03
Software version number	201_V1.03_220120

Note: The antenna information refer the manufacturer provide report, applicable only to the tested sa-mple identified in the report.

2.1.2 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Product Specification Subjective To This Standard	
Tx Frequency	Band 5: 824~849MHz
Rx Frequency	Band 5:869~894MHz
Deployment	Stand-alone
Ntones	Single, multi-tone
Sub-carrier spacing	3.75KHz, 15KHz
Maximum Output Power Limit	Band 5: 27.28 dBm
Type of Modulation	BPSK /QPSK

RF Function	Band	Mode	Modulation	Power Class	Ant Gain(dBi)	Ant Type	SIM Card
NB-IoT	FDD:5	NB1	BPSK,QPSK	3	0	PIFA	1 SIM 1 is used to tested.

2.1.4 TEST CONFIGURATION OF EQUIPMENT UNDER TEST

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 v03r01 and ANSI C63.26 2015 Power Meas. License Digital Systems with maximum output power. Radiated measurements are performed by rotating the EUT in three different orthogonal test planes tofind the maximum emission.

Remark:

1. The mark ‘v’means that this configuration is chosen for testing
2. The mark ‘-’means that this bandwidth is not supported.
3. The device is investigated from 30MHz to 10 times of fundamental signal for radiated

ITEMS	Band	Subcarrier Spacing (KHz)		Modulation		Test Channel		
		3.75	15	BPSK	QPSK	L	M	H
Max. Output Power	5	v	v	v	v	v	v	v
Peak&Avera Ratio	5	v	v	v	v	v	v	v
26dB&99% Bandwidth	5	v	v	v	v	v	v	v
Conducted Band Edge	5	v	v	v	v	v		v
Conducted Spurious Emission	5	v	v	v	v	v	v	v
Frequency Stability	5	v	v		v		v	
E.R.P.& E.I.R.P.	5	v	v	v	v	v	v	v
Radiated Spurious Emission	5	v	v	v	v	v	v	v

2.1.5 RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for filing to comply with the 47 CFR Part 2, 22.

2.1.6 SPECIAL ACCESSORIES

The battery and the charger, earphone supplied by the applicant were used as accessories and being tested with eut intended for fcc grant together.

2.1.7 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commission’s requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.1.8 EUT EXERCISE

The Transmitter was operated in the maximum output power mode through Communication Tester. The TX frequency was fixed which was for the purpose of the measurements.

2.1.9 CONFIGURATION OF EUT SYSTEM

The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

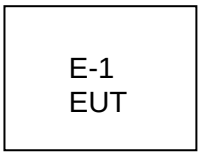


Table 2-1 Equipment Used in EUT System

Item	Equipment	Model No.	Length	Note
N/A	N/A	N/A	N/A	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in『Length』column.

2.1.10 MEASUREMENT INSTRUMENTS

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2021.09.30	2022.09.29
Signal Analyzer	R&S	FSV 40-N	101823	2021.09.30	2022.09.29
Signal Generator	Agilent	83752A	3610A02740	2021.09.30	2022.09.29
Wireless Communications Test Set	R&S	CMW 500	133884	2021.03.04	2022.03.03
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2021.10.11	2023.10.10
Bilog Antenna	TESEQ	CBL6111D	45873	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1343	2020.10.12	2022.10.11
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2021.10.08	2022.10.07
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2021.09.30	2022.09.29
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2021.09.28	2022.09.27
Turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08
Test SW	BULUN	BL410-E/18.905			

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Universal Radio communication tester	R&S	CMU200	119907	2021.09.29	2022.09.28
Wireless Communications Test Set	R&S	CMW 500	133884	2021.03.04	2022.03.03
Signal Analyzer	Agilent	N9020A	MY52440124	2021.03.04	2022.03.03
Temperature& Humidity test chamber	Safety test	AG80L	171200018	2021.03.04	2022.03.03
Programmable power supply	Agilent	E3642A	MY40002025	2021.10.08	2022.10.07
Temperature & Humidity	SW-108	SuWei	N/A	2021.03.04	2022.03.03
Universal Radio communication tester	R&S	CMU200	119907	2021.09.29	2022.09.28
Test SW	FARAD	LZ-RF /LzRf-3A3			

2.1.11 MEASUREMENT RESULTS EXPLANATION EXAMPLE

For all conducted test items:
The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factorbetween EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF Cable Loss + Attenuator Factor.

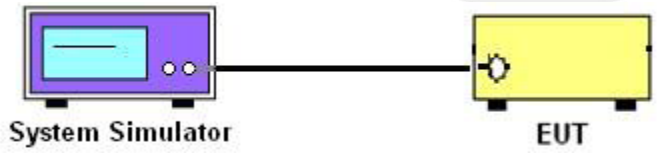
3. CONDUCTED OUTPUT POWER&RADIATED POWER AND EFFECTIVE ISOTROPIC RADIATED POWER

3.1 DESCRIPTION OF THE CONDUCTED OUTPUT POWER MEASUREMENT

3.1.1 MEASUREMENT METHOD

CONDUCTED OUTPUT POWER:
A system simulator was used to establish communication with the eut. Its parameters were set to force the eut transmitting at maximum output power. The measured power in the radio frequency on the transmitter output terminals shall be reported.
Configuration follows KDB 971168 D01 v03r01.
C63.26 2015 Section 5.2.5.5.
In many cases, RF output power limits are specified in terms of the ERP or the EIRP. Typically, ERP is specified when the operating frequency is less than or equal to 1 GHz and EIRP is specified when the operating frequency is greater than 1 GHz. Both are defined as the product of the power supplied to the antenna and its gain (relative to a dipole antenna in the case of ERP, and relative to an isotropic antenna in the case of EIRP); however, when working in decibels (i.e., logarithmic scale), the ERP and EIRP represent the sum of the transmit antenna gain (in dBd or dBi, respectively) and the conducted RF output power (expressed in dB relative to watts or milliwatts).
The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation (1) as follows:
(1) ERP or EIRP = PMeas + GT
ERP= EIRP-2.15
where
ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as PMeas, e.g., dBm or dBW)
PMeas measured transmitter output power or PSD, in dBm or dBW
GT gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)
For devices utilizing multiple antennas, see 6.4 for guidance with respect to determining the effective array transmit antenna gain term to be used in the above equation.
The following equations demonstrate the mathematical relationship between ERP and EIRP:
a) ERP = EIRP − 2.15, where ERP and EIRP are expressed in consistent units.
b) EIRP = ERP + 2.15, where ERP and EIRP are expressed in consistent units.

3.1.2 TEST SETUP



3.1.3 TEST PROCEDURES

1. The transmitter output port was connected to system simulator.

2. Set EUT at maximum power through the system simulator.

3. Select lowest/middle/highest channels for each band and different modulation.

4. Measure and record the power level from the system simulator.

3.1.4 TEST RESULTS

NB-IoT Band 5 Maximum Average Power [dBm]										
Mode	UL Channel	Modulation	Subcarrier Space (KHz)	RB Configure	Conduction AVG Power(dBm)	Ant Gain(dBi)	ERP (dBm)	ERP (W)	ERP Limit(W)	Verdict
Band 5 Standalone	Lowest	BPSK	3.75	1#0	27.12	0.00	24.97	0.31	7.00	PASS
				1#47	26.87	0.00	24.72	0.30	7.00	PASS
			15	1#0	26.58	0.00	24.43	0.28	7.00	PASS
				1#11	26.29	0.00	24.14	0.26	7.00	PASS
		QPSK	3.75	1#0	26.09	0.00	23.94	0.25	7.00	PASS
				1#47	25.80	0.00	23.65	0.23	7.00	PASS
			15	1#0	25.60	0.00	23.45	0.22	7.00	PASS
				1#11	26.86	0.00	24.71	0.30	7.00	PASS
				12#0	26.59	0.00	24.44	0.28	7.00	PASS
	Middle	BPSK	3.75	1#0	27.23	0.00	25.08	0.32	7.00	PASS
				1#47	26.99	0.00	24.84	0.30	7.00	PASS
			15	1#0	26.70	0.00	24.55	0.29	7.00	PASS
				1#11	26.50	0.00	24.35	0.27	7.00	PASS
		QPSK	3.75	1#0	26.24	0.00	24.09	0.26	7.00	PASS
				1#47	25.95	0.00	23.80	0.24	7.00	PASS
			15	1#0	25.72	0.00	23.57	0.23	7.00	PASS
				1#11	27.02	0.00	24.87	0.31	7.00	PASS
				12#0	26.79	0.00	24.64	0.29	7.00	PASS
	Highest	BPSK	3.75	1#0	27.28	0.00	25.13	0.33	7.00	PASS
				1#47	27.02	0.00	24.87	0.31	7.00	PASS
			15	1#0	26.74	0.00	24.59	0.29	7.00	PASS
				1#11	26.47	0.00	24.32	0.27	7.00	PASS
		QPSK	3.75	1#0	26.18	0.00	24.03	0.25	7.00	PASS
				1#47	25.91	0.00	23.76	0.24	7.00	PASS
			15	1#0	25.67	0.00	23.52	0.22	7.00	PASS
				1#11	27.07	0.00	24.92	0.31	7.00	PASS
				12#0	26.79	0.00	24.64	0.29	7.00	PASS

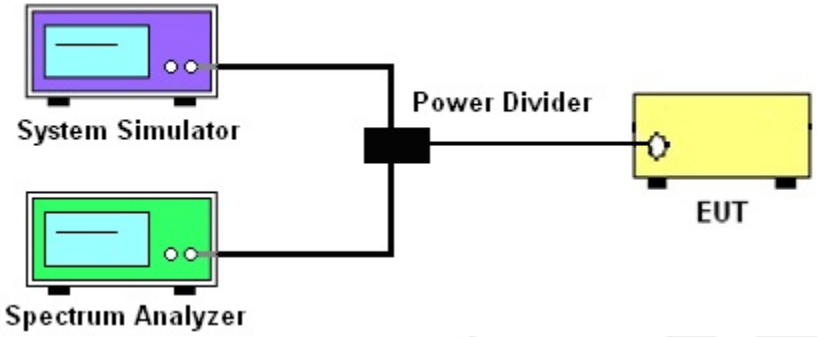
4. PEAK-TO-AVERAGE RATIO

4.1 DESCRIPTION OF THE CONDUCTED OUTPUT POWER MEASUREMENT

4.1.1 MEASUREMENT METHOD

Use one of the procedures presented in 4.1.3 to measure the total peak power and record as PPk. Use one of the applicable procedures presented 4.1.3 to 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).

4.1.2 TEST SETUP



4.1.3 TEST PROCEDURES

1. The testing follows FCC KDB 971168 D01 v03r01 Section 5.7 and ANSI C63.26 2015 Section 5.2.6.

2. The EUT was connected to spectrum and system simulator via a power divider

3. Select lowest, middle, and highest channels for each band and different modulation.

4. Set the test probe and measure the peak and average power of the spectrum analyzer

5. Record the deviation as Peak to Average Ratio.

	LTE	
LTE BW	3.75K	15K
Span	1MHz	1MHz
RBW	30kHz	30kHz
VBW	100kHz	100kHz
Detector	PK/AVG	PK/AVG
Trace	Max	Max
Sweep Count	Auto	Auto

4.1.4 TEST RESULTS

NB-IoT Band 5 PAR [dBm]						
Mode	Modulation	Subcarrier Space (KHz)	RB Configure	Lowest	Middle	Highest
				P-A	P-A	P-A
Band 5 Standalone	BPSK	3.75	1#0	0.44	0.4	0.38
		15	1#0	2.47	2.39	2.17
	QPSK	3.75	1#0	0.42	0.4	0.37
		15	1#0	0.44	0.42	0.39
		15	12#0	0.43	0.39	0.37
Limit				≤13dB		

Note: Test chart See Appendix D

5. OCCUPIED BANDWIDTH

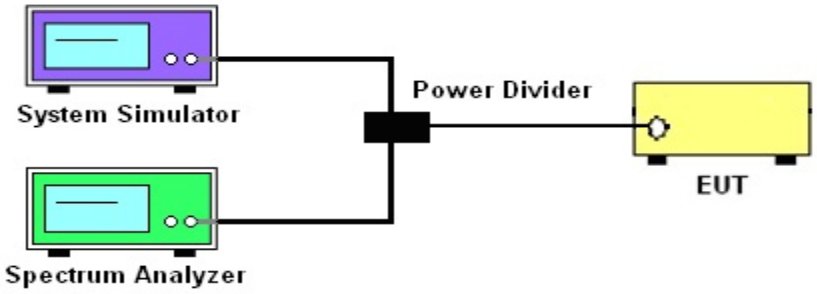
5.1 DESCRIPTION OF OCCUPIED BANDWIDTH MEASUREMENT

5.1.1 MEASUREMENT METHOD

1.The occupied bandwidth is 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 transmitted power.

2.The 26 db emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 26 db below the maximum in-band spectral density of the modulated signal. spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.

5.1.2 TEST SETUP



5.1.3 TEST PROCEDURES

1. The testing follows FCC KDB 971168 D01 v03r01 Section 4.2 and 4.3.

2. The EUT was connected to spectrum and system simulator via a power divider

3. Select lowest, middle, and highest channels for each band and different modulation.

4. Set the test probe and measure the Occupied Bandwidth of the spectrum analyzer

5. Measure and record the Occupied Bandwidth from the Spectrum Analyzer.

	LTE	
LTE BW	3.75K	15K
Span	1MHz	1MHz
RBW	2kHz	2kHz
VBW	6.2kHz	6.2kHz
Detector	PK	PK
Trace	Max	Max
Sweep Count	Auto	Auto

5.1.4 MEASUREMENT RESULT

NB-IoT Band 5 Bandwidth [KHz]/Standalone								
Modulation	Subcarrier Space (KHz)	RB Configure	Lowest		Middle		Highest	
			99% BW	26dB BW	99% BW	26dB BW	99% BW	26dB BW
BPSK	3.75	1#0	102.17	112.9	112.21	130.2	110.48	113.8
	15	1#0	107.42	119.5	100.57	102	118.78	127.4
QPSK	3.75	1#0	99.655	115	103.84	114.9	103.53	128.3
	15	1#0	100.04	115	105.61	141.4	101.98	128.1
	15	12#0	181.84	232.1	181.83	232	180.93	245.4

Note: Test chart See Appendix A

6. CONDUCTED BAND EDGE

6.1 DESCRIPTION OF CONDUCTED BAND EDGE MEASUREMENT

6.1.1 MEASUREMENT METHOD

1. §22.917(a)
For operations in the 824 – 849 MHz band, the FCC limit is 43 + 10log10(P[Watts]) dB below the transmitter power P(Watts) in a 100kHz bandwidth. However, in the 1MHz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

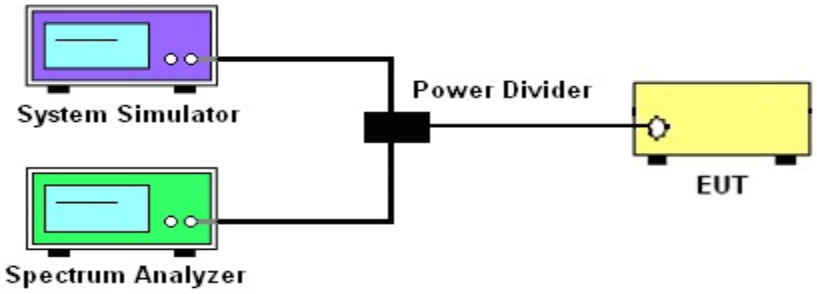
2. §24.238 (a)
For operations in the 1850-1910 and 1930-1990 MHz band, the FCC limit is 43 + 10log10(P[Watts]) dB below the transmitter power P(Watts) in a 1MHz bandwidth. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed

3. §27.53 (h)
For operations in the 1710 – 1755 MHz band, the FCC limit is 43 + 10log10(P[Watts]) dB below the transmitter power P(Watts) in a 1 MHz bandwidth. However, in the 1MHz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

4. §27.53(m)(4)
For operations in the 2500 MHz ~ 2570 MHz band this section, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHzand 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licenseesoperating on frequencies below 2495 MHz may also submit a documented interference complaintagainst BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

5. §27.53 (g)
For operations in the 698 -746 MHz band, the FCC limit is 43 + 10log10(P[Watts]) dB below the transmitter power P(Watts) in a 100 kHz bandwidth. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

6.1.2 TEST SETUP



6.1.3 TEST PROCEDURES

1. The testing FCC KDB 971168 D01 v03r01 Section 6.0 and ANSI C63.26 2015 Section 5.7.

2. The EUT was connected to spectrum analyzer and system simulator via a power divider.

3. The band edges of low and high channels for the highest RF powers were measured. Set RBW >= 1% EBW in the 1MHz band immediately outside and adjacent to the band edge.

4. Set spectrum analyzer with RMS/AVG detector.

5. The RF fundamental frequency should be excluded against the limit line in the operating frquency band.

6.The limit line is derived from 43 + 10log(P)dB below the transmitter power P(Watts)
= P(W)- [43 + 10log(P)] (dB)
= [30 + 10log(P)] (dBm) - [43 + 10log(P)] (dB)
= -13dBm.

Band 7:
= P(W)- [55 + 10log(P)] (dB)
= [30 + 10log(P)] (dBm) - [55 + 10log(P)] (dB)
= -25dBm.

	LTE	
LTE BW	3.75K	15K
Span	1MHz	1MHz
RBW	200Hz	200Hz
VBW	1kHz	1kHz
Detector	AVG	AVG
Trace	Max	Max
Sweep Count	Auto	Auto

6.1.4 MEASUREMENT RESULT

Note: Test chart See Appendix B

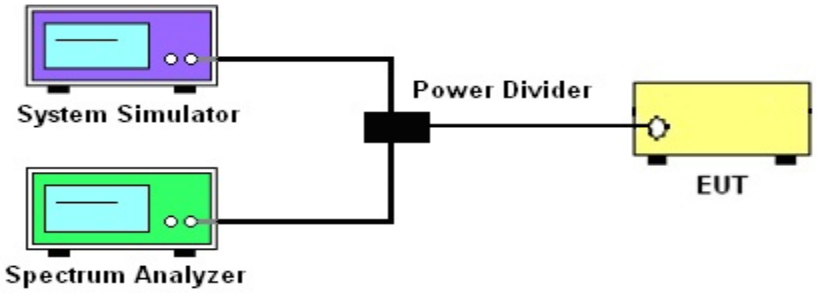
7. CONDUCTED SPURIOUS EMISSION

7.1 DESCRIPTION OF CONDUCTED SPURIOUS EMISSION MEASUREMENT

7.1.1 MEASUREMENT METHOD

The power of any emission outside of the authorized operating frequency ranges must be lower than the transmitter power (P) by a factor of at least 43 + 10 log (P) dB.
For Band 7:
The power of any emission outside of the authorized operating frequency ranges must be lower than the transmitter power (P) by a factor of at least 55 + 10 log (P) dB.
It is measured by means of a calibrated spectrum analyzer and scanned from 30 MHz up to a frequency including its 10th harmonic.

7.1.2 TEST SETUP



7.1.3 TEST PROCEDURES

1.The testing FCC KDB 971168 D01 v03r01 Section 6.0 and ANSI C63.26 2015 Section 5.7.

2. The EUT was connected to spectrum analyzer and system simulator via a power divider.

3. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement
4. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
5. The RF fundamental frequency should be excluded against the limit line in the operating frquency band.
6.The limit line is derived from 43 + 10log(P)dB below the transmitter power P(Watts)
= P(W)- [43 + 10log(P)] (dB) = [30 + 10log(P)] (dBm) - [43 + 10log(P)] (dB)
= -13dBm.
For Band 7: P(W)- [43 + 10log(P)] (dB) =-25dBm

	LTE	
LTE BW	3.75K	15K
Span	Auto	Auto
RBW	1000kHz	1000kHz
VBW	3000kHz	3000kHz
Detector	PK	PK
Trace	Max	Max

7.1.4 TEST RESULTS

Note: Test chart See Appendix C

8. RADIATED SPURIOUS EMISSION

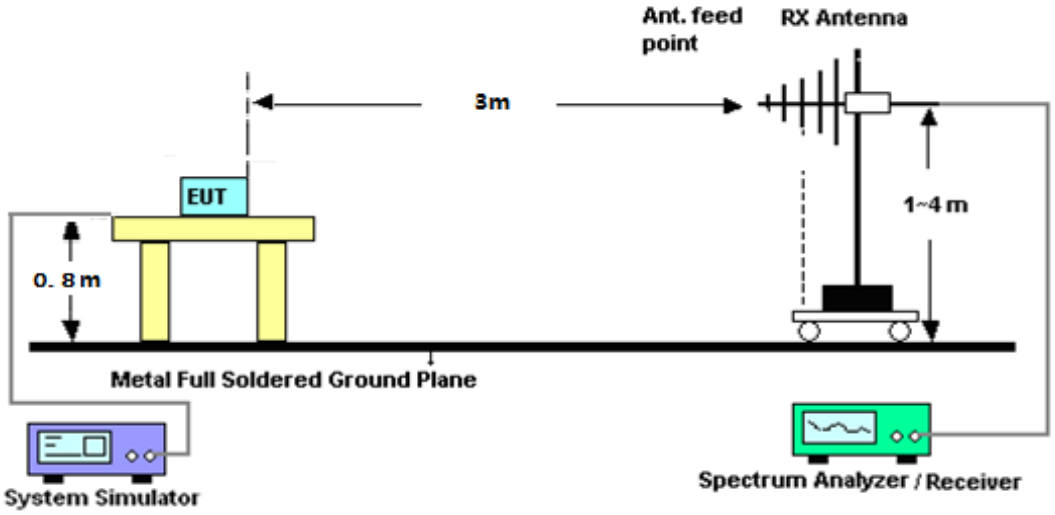
8.1 DESCRIPTION OF RADIATED SPURIOUS EMISSION

8.1.1 MEASUREMENT METHOD

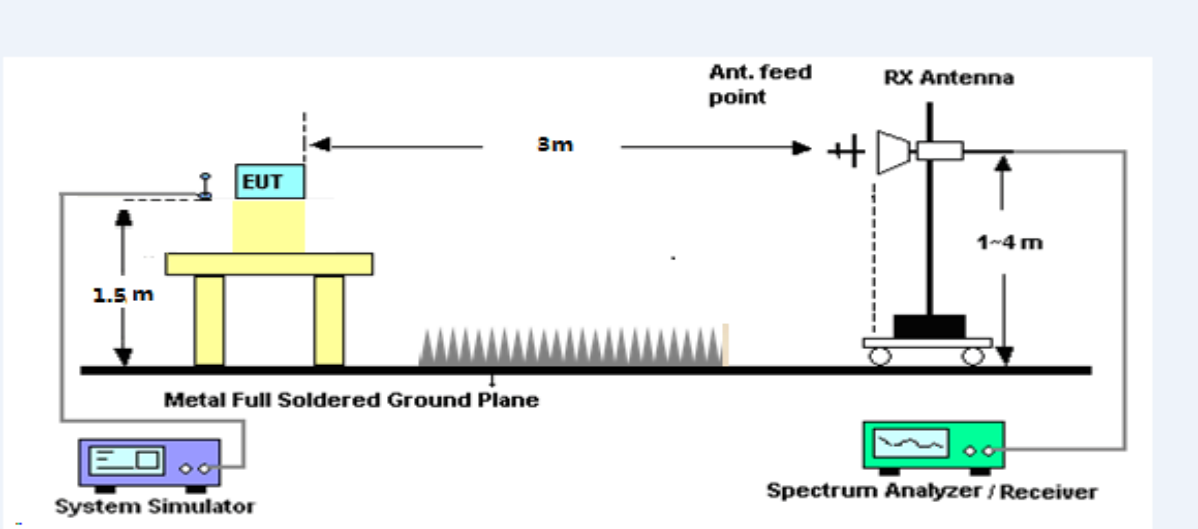
The radiated spurious emission was measured by substitution method according to ANSI C63.26 2015. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least 43 + 10 log (P) dB.
For Band 7 The power of any emission outside of the authorized operating frequency ranges must attenuated below the transmitter power (P) by a factor of at least 55 + 10 log (P) dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

8.1.2 TEST SETUP

The procedure of radiated spurious emissions is as follows:
a) Pre-calibration With pre-calibration method, the Radiated Spurious Emissions(RSE) is calculated as, RSE=Rx（dBuV）+CL（dB）+SA（dB）+Gain（dBi）-107（dBuV to dBm）The SA is calibrated using following setup.
b) EUT was placed on 1.5 m non-conductive stand at a 3 m test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 m from the test item for emission measurements. The height of receiving antenna is 0.8m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the test item and adjusting the receiving antenna polarization. The radiated emission measurements of all non-harmonic and harmonics of the transmit frequency through the 10th harmonic measured with peak detector and 1MHz bandwidth.
Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of any band into any of the other blocks.
The substitution method is used. Substitution values at each frequency are measured before and saved to the test software. A "reference path loss" is established and the ARpl is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss and the air loss. The measurement results are obtained as described below:
Power=PMea+ARpl
For radiated test from 30MHz to 1GHz



For radiated test from above 1GHz



8.1.3 TEST PROCEDURES

1. The testing FCC KDB 971168 D01 Section 7 and ANSI C63.26 2015 Section 5.5.

2. The EUT was placed on a rotatable wooden table with 1.5 meter above ground.

3. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.

4. The table was rotated 360 degrees to determine the position of the highest spurious emission.

5. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations

6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.

7. A horn antenna was substituted in place of the EUT and was driven by a signal generator.

8. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.

9. Taking the record of output power at antenna port.

10. Repeat step 7 to step 8 for another polarization.

11. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
The limit line is derived from 43 + 10log(P)dB below the transmitter power P(Watts)
= P(W)- [43 + 10log(P)] (dB)
= [30 + 10log(P)] (dBm) - [43 + 10log(P)] (dB)
= -13dBm
.
For Band 7:
The limit line is derived from 55 + 10log(P)dB below the transmitter power P(Watts)
= [30 + 10log(P)] (dBm) - [55 + 10log(P)] (dB)
= -25dBm
EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain
ERP (dBm) = EIRP - 2.15

8.1.4 TEST RESULTS

NB-IoT Band 5 / QPSK / 3.75KHz /1#0/ The Worst Test Results for Lowest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1648.34	-34.59	9.56	9.72	-34.75	-13.00	-21.75	H
2471.83	-34.96	10.50	10.86	-35.32	-13.00	-22.32	H
3296.45	-33.25	12.78	11.57	-32.04	-13.00	-19.04	H
1648.34	-35.52	9.56	9.72	-35.68	-13.00	-22.68	V
2471.83	-35.10	10.50	10.86	-35.46	-13.00	-22.46	V
3296.45	-33.18	12.78	11.57	-31.97	-13.00	-18.97	V
NB-IoT Band 5 / QPSK / 3.75KHz /1#0/ The Worst Test Results for Middle							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1672.87	-34.05	9.56	9.72	-34.21	-13.00	-21.21	H
2509.60	-35.00	10.50	10.86	-35.36	-13.00	-22.36	H
3346.03	-32.85	12.78	11.57	-31.64	-13.00	-18.64	H
1672.87	-34.76	9.56	9.72	-34.92	-13.00	-21.92	V
2509.60	-34.96	10.50	10.86	-35.32	-13.00	-22.32	V
3346.03	-32.24	12.78	11.57	-31.03	-13.00	-18.03	V
NB-IoT Band 5 / QPSK / 3.75KHz /1#0/ The Worst Test Results for Highest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1697.54	-34.80	9.56	9.72	-34.96	-13.00	-21.96	H
2546.72	-35.18	10.50	10.86	-35.54	-13.00	-22.54	H
3395.36	-32.78	12.78	11.57	-31.57	-13.00	-18.57	H
1697.54	-35.18	9.56	9.72	-35.34	-13.00	-22.34	V
2546.72	-34.69	10.50	10.86	-35.05	-13.00	-22.05	V
3395.36	-32.61	12.78	11.57	-31.40	-13.00	-18.40	V

NB-IoT Band 5 / BPSK / 3.75KHz /1#0/ The Worst Test Results for Lowest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1648.10	-34.17	9.56	9.72	-34.33	-13.00	-21.33	H
2472.01	-35.38	10.50	10.86	-35.74	-13.00	-22.74	H
3296.61	-32.88	12.78	11.57	-31.67	-13.00	-18.67	H
1648.10	-35.30	9.56	9.72	-35.46	-13.00	-22.46	V
2472.01	-34.51	10.50	10.86	-34.87	-13.00	-21.87	V
3296.61	-32.72	12.78	11.57	-31.51	-13.00	-18.51	V
NB-IoT Band 5 / BPSK / 3.75KHz /1#0/ The Worst Test Results for Middle							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1672.86	-33.60	9.56	9.72	-33.76	-13.00	-20.76	H
2509.46	-35.41	10.50	10.86	-35.77	-13.00	-22.77	H
3346.24	-32.66	12.78	11.57	-31.45	-13.00	-18.45	H
1672.86	-34.72	9.56	9.72	-34.88	-13.00	-21.88	V
2509.46	-33.83	10.50	10.86	-34.19	-13.00	-21.19	V
3346.24	-32.42	12.78	11.57	-31.21	-13.00	-18.21	V
NB-IoT Band 5 / BPSK / 3.75KHz /1#0/ The Worst Test Results for Highest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1697.61	-33.72	9.56	9.72	-33.88	-13.00	-20.88	H
2546.48	-35.37	10.50	10.86	-35.73	-13.00	-22.73	H
3395.81	-32.97	12.78	11.57	-31.76	-13.00	-18.76	H
1697.61	-34.86	9.56	9.72	-35.02	-13.00	-22.02	V
2546.48	-34.55	10.50	10.86	-34.91	-13.00	-21.91	V
3395.81	-32.67	12.78	11.57	-31.46	-13.00	-18.46	V

NB-IoT Band 5 / QPSK / 15KHz /1#0/ The Worst Test Results for Lowest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1648.06	-33.70	9.56	9.72	-33.86	-13.00	-20.86	H
2472.01	-34.59	10.50	10.86	-34.95	-13.00	-21.95	H
3296.45	-33.01	12.78	11.57	-31.80	-13.00	-18.80	H
1648.06	-34.69	9.56	9.72	-34.85	-13.00	-21.85	V
2472.01	-33.84	10.50	10.86	-34.20	-13.00	-21.20	V
3296.45	-32.32	12.78	11.57	-31.11	-13.00	-18.11	V
NB-IoT Band 5 / QPSK / 15KHz /1#0/ The Worst Test Results for Middle							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1673.14	-34.82	12.90	12.56	-34.48	-13.00	-21.48	H
2509.42	-34.93	13.10	16.32	-38.15	-13.00	-25.15	H
3346.26	-32.33	12.33	21.13	-41.13	-13.00	-28.13	H
1673.14	-35.07	12.90	12.56	-34.73	-13.00	-21.73	V
2509.42	-35.23	13.10	16.32	-38.45	-13.00	-25.45	V
3346.26	-32.74	12.33	21.13	-41.54	-13.00	-28.54	V
NB-IoT Band 5 / QPSK / 15KHz /1#0/ The Worst Test Results for Highest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1697.96	-34.46	9.56	9.72	-34.62	-13.00	-21.62	H
2546.43	-34.60	10.50	10.86	-34.96	-13.00	-21.96	H
3395.74	-32.76	12.78	11.57	-31.55	-13.00	-18.55	H
1697.96	-34.56	9.56	9.72	-34.72	-13.00	-21.72	V
2546.43	-33.98	10.50	10.86	-34.34	-13.00	-21.34	V
3395.74	-32.40	12.78	11.57	-31.19	-13.00	-18.19	V

NB-IoT Band 5 / BPSK / 15KHz /1#0/ The Worst Test Results for Lowest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1648.29	-34.79	9.56	9.72	-34.95	-13.00	-21.95	H
2472.29	-34.61	10.50	10.86	-34.97	-13.00	-21.97	H
3296.63	-32.54	12.78	11.57	-31.33	-13.00	-18.33	H
1648.29	-34.63	9.56	9.72	-34.79	-13.00	-21.79	V
2472.29	-34.10	10.50	10.86	-34.46	-13.00	-21.46	V
3296.63	-31.75	12.78	11.57	-30.54	-13.00	-17.54	V
NB-IoT Band 5 / BPSK / 15KHz /1#0/ The Worst Test Results for Middle							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1672.91	-33.60	9.56	9.72	-33.76	-13.00	-20.76	H
2509.59	-34.94	10.50	10.86	-35.30	-13.00	-22.30	H
3346.07	-33.25	12.78	11.57	-32.04	-13.00	-19.04	H
1672.91	-35.96	9.56	9.72	-36.12	-13.00	-23.12	V
2509.59	-34.18	10.50	10.86	-34.54	-13.00	-21.54	V
3346.07	-33.01	12.78	11.57	-31.80	-13.00	-18.80	V
NB-IoT Band 5 / BPSK / 15KHz /1#0/ The Worst Test Results for Highest							
Frequency(MHz)	S G.Lev (dBm)	Ant(dBi)	Loss	PMea (dBm)	Limit （dBm）	Margin (dBm)	Polarity
1697.94	-34.58	9.56	9.72	-34.74	-13.00	-21.74	H
2546.91	-35.11	10.50	10.86	-35.47	-13.00	-22.47	H
3395.71	-32.34	12.78	11.57	-31.13	-13.00	-18.13	H
1697.94	-35.24	9.56	9.72	-35.40	-13.00	-22.40	V
2546.91	-34.90	10.50	10.86	-35.26	-13.00	-22.26	V
3395.71	-32.82	12.78	11.57	-31.61	-13.00	-18.61	V

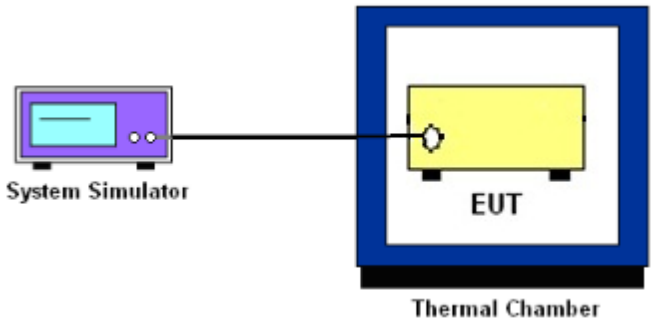
9. FREQUENCY STABILITY

9.1 DESCRIPTION OF FREQUENCY STABILITY MEASUREMENT

9.1.1 MEASUREMENT METHOD

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5ppm) of the center frequency.

9.1.2 TEST SETUP



9.1.3 TEST PROCEDURES FOR TEMPERATURE VARIATION

1. The EUT was set up in the thermal chamber and connected with the system simulator.

2. With power OFF, the temperature was decreased to -30°C and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute.
3. With power OFF, the temperature was raised in 10°C step up to 50°C. The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.

9.1.4 TEST PROCEDURES FOR VOLTAGE VARIATION

1. The testing follows FCC KDB 971168 D01v01r03 Section 9.

2. The EUT was placed in a temperature chamber at 25±5° C and connected with the system simlator.

3. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value measured at the input to the EUT.

4. The variation in frequency was measured for the worst case.

9.1.5 TEST RESULTS

NB-IoT Band 5 (QPSK) / 836.5MHz / 3.75KHz/1#0					
Temperature (°C)	Voltage	Freq. Dev.	Freq. Dev.	Limit	Result
	(Volt)	(Hz)	(ppm)		
50	Normal Voltage	23.84	0.013	2.5ppm	PASS
40		23.40	0.012		
30		16.13	0.009		
20		12.85	0.007		
10		30.09	0.016		
0		34.13	0.018		
-10		26.85	0.014		
-20		34.49	0.018		
-30		33.50	0.018		
20	Maximum Voltage	15.66	0.008		
20	BEP	33.99	0.018		

NB-IoT Band 5 (QPSK) / 836.5MHz /15KHz/1#0					
Temperature (°C)	Voltage	Freq. Dev.	Freq. Dev.	Limit	Result
	(Volt)	(Hz)	(ppm)		
50	Normal Voltage	17.25	0.009	2.5ppm	PASS
40		28.86	0.015		
30		12.88	0.007		
20		13.76	0.007		
10		25.26	0.013		
0		20.25	0.011		
-10		14.77	0.008		
-20		34.88	0.019		
-30		12.13	0.006		
20	Maximum Voltage	34.08	0.018		
20	BEP	35.10	0.019		

APPENDIX-PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※