



## FCC TEST REPORT

**Application No.:** DNT240214R0346-1102

**Applicant:** Hangzhou Qianwan Technology Co., Ltd.

**Address of Applicant:** Room 603 - 604, Building 16, Lefu Haibang Park, Xiangwang Road, Cangqian Street, Hangzhou City, China

**EUT Description:** DBDD GPS Tracker

**Model No.:** D1

**FCC ID:** 2BE4R-D1

**Power supply** DC 3.7V From Battery; DC 5V From Adapter Input AC 100-240V, 50/60Hz

**Standards:** 47 CFR Part 2  
47 CFR Part 24 subpart E  
47 CFR Part 27 subpart C

**Trade Mark:** N/A

**Date of Receipt:** 2024/3/4

**Date of Test:** 2024/3/4 to 2024/3/14

**Date of Issue:** 2024/3/15

**Test Result:** **PASS \***

**Prepared By:** Wayne Lin (Testing Engineer)

**Reviewed By:** Pencils Chen (Project Engineer)

**Approved By:** Wick Peng (Manager)



Note: If there is any objection to the results in this report, please submit a written inquiry to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp, and is issued by the company in accordance with the requirements of the "Conditions of Issuance of Test Reports" printed in the attached page. Unless otherwise stated, the results presented in this report only apply to the samples tested this time. Partial reproduction of this report is not allowed unless approved by the company in writing.



Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Mar. 15, 2024	Valid	Original Report



## Contents

1 Test Summary .....	4
1.1 LTE Band 2 .....	4
1.2 LTE Band 4 .....	5
1.3 LTE Band 12 .....	6
1.4 LTE Band 17 .....	7
2 General Information .....	8
2.1 Test Location .....	8
2.2 General Description of EUT .....	9
2.3 Test Mode .....	10
2.4 Test Environment .....	10
2.5 Technical Specification .....	11
2.6 Test Frequencies .....	12
3 Description of Tests .....	15
3.1 Conducted Output Power .....	15
3.2 Effective (Isotropic) Radiated Power of Transmitter .....	15
3.3 EIRP Power Density .....	16
3.4 Occupied Bandwidth .....	16
3.5 Band Edge at Antenna Terminals .....	18
3.6 Spurious And Harmonic Emissions at Antenna Terminal .....	19
3.7 Peak-Average Ratio .....	20
3.8 Field Strength of Spurious Radiation .....	21
3.9 Frequency Stability / Temperature Variation .....	22
3.10 Test Setups .....	23
3.10.1 Test Setup 1 .....	23
3.10.2 Test Setup 2 .....	23
3.10.3 Test Setup 3 .....	24
3.11 Test Conditions .....	25
4 Main Test Instruments .....	27
5 Measurement Uncertainty .....	29
6 Appendixes .....	30



# 1 Test Summary

## 1.1 LTE Band 2

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §24.232	$EIRP \leq 2\text{ W}$	Section 1 of Appendix B.1	Pass
Peak-Average Ratio	§2.1046, §24.232	Limit $\leq 13\text{ dB}$	Section 2 of Appendix B.1	Pass
Modulation Characteristics	§2.1047	Digital modulation	Section 3 of Appendix B.1	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Section 4 of Appendix B.1	Pass
Band Edges Compliance	§2.1051, §24.238	$\leq -13\text{ dBm}/1\%*EBW$ , in 1 MHz bands immediately outside and adjacent to the frequency block.	Section 5 of Appendix B.1	Pass
Spurious Emission at Antenna Terminals	§2.1051, §24.238	$\leq -13\text{ dBm}/1\text{ MHz}$ , from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Section 6 of Appendix B.1	Pass
Field Strength of Spurious Radiation	§2.1053, §24.238	$\leq -13\text{ dBm}/1\text{ MHz}$ .	Section 7 of Appendix B.1	Pass
Frequency Stability	§2.1055, §24.235	$\leq \pm 2.5\text{ ppm}$ .	Section 8 of Appendix B.1	Pass



## 1.2 LTE Band 4

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(d)	$EIRP \leq 1\text{ W}$	Section 1 of Appendix B.2	Pass
Peak-Average Ratio	§2.1046, §27.50(d)	Limit $\leq 13\text{ dB}$	Section 2 of Appendix B.2	Pass
Modulation Characteristics	§2.1047	Digital modulation	Section 3 of Appendix B.2	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Section 4 of Appendix B.2	Pass
Band Edges Compliance	§2.1051, §27.53(h)	$\leq -13\text{ dBm}/1\% \cdot \text{EBW}$ , in 1 MHz bands immediately outside and adjacent to the frequency block.	Section 5 of Appendix B.2	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(h)	$\leq -13\text{ dBm}/1\text{ MHz}$ , from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Section 6 of Appendix B.2	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(h)	$\leq -13\text{ dBm}/1\text{ MHz}$ .	Section 7 of Appendix B.2	Pass
Frequency Stability	§2.1055, §27.54	$\leq \pm 2.5\text{ ppm}$ .	Section 8 of Appendix B.2	Pass



### 1.3 LTE Band 12

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§27.50(c)	FCC: ERP $\leq$ 3 W.	Section 1 of Appendix B.3	Pass
Peak-Average Ratio	§2.1046, §27.50(c)	Limit $\leq$ 13 dB	Section 2 of Appendix B.3	Pass
Modulation Characteristics	§2.1047	Digital modulation	Section 3 of Appendix B.3	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Section 4 of Appendix B.3	Pass
Band Edges Compliance	§2.1051, §27.53(g)	$\leq$ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Section 5 of Appendix B.3	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(g)	FCC: $\leq$ -13 dBm/100 kHz, from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Section 6 of Appendix B.3	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(g)	FCC: $\leq$ -13 dBm/100 kHz.	Section 7 of Appendix B.3	Pass
Frequency Stability	§2.1055, §27.54	$\leq$ $\pm$ 2.5ppm.	Section 8 of Appendix B.3	Pass



## 1.4 LTE Band 17

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§27.50(c)	FCC: ERP $\leq$ 3 W.	Section 1 of Appendix B.4	Pass
Peak-Average Ratio	§2.1046, §27.50(c)	Limit $\leq$ 13 dB	Section 2 of Appendix B.4	Pass
Modulation Characteristics	§2.1047	Digital modulation	Section 3 of Appendix B.4	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Section 4 of Appendix B.4	Pass
Band Edges Compliance	§2.1051, §27.53(g)	$\leq$ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Section 5 of Appendix B.4	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(g)	FCC: $\leq$ -13 dBm/100 kHz, from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Section 6 of Appendix B.4	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(g)	FCC: $\leq$ -13 dBm/100 kHz.	Section 7 of Appendix B.4	Pass
Frequency Stability	§2.1055, §27.54	$\leq \pm 2.5$ ppm.	Section 8 of Appendix B.4	Pass





## 2 General Information

### 2.1 Test Location

Company:	Dongguan DN Testing Co., Ltd
Address:	No. 1, West Fourth Street, South Xinfu Road, Wusha Liwu, Chang ' an Town, Dongguan City, Guangdong P.R.China
Test engineer:	Wayne Lin

### 2.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

**Lab A:**

• **FCC, USA**

Designation Number: CN1348

• **A2LA (Certificate No. 7050.01)**

DONGGUAN DN TESTING CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 7050.01.

• **Innovation, Science and Economic Development Canada**

DONGGUAN DN TESTING CO., LTD. EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

IC#: 31026.





## 2.3 General Description of EUT

Manufacturer:	Shenzhen Jutai Electronic Technology Co., Ltd.
Address of Manufacturer:	304, Building 1, Sanyu Industrial Park, Xinzhuang Community, Matian Street, Guangming District, Shenzhen City
EUT Description::	DBDD GPS Tracker
Model No.:	D1
Additional Model(s):	N/A
Chip Type:	ASR3603C
Serial Number	PR240214R0346
Power Supply	DC 3.7V From Battery; DC 5V From Adapter Input AC 100-240V,50/60Hz
Trade Mark:	DBDD
Hardware Version:	V1.0
Software Version:	V1.0
Sample Type:	<input type="checkbox"/> Portable Device, <input type="checkbox"/> Module, <input checked="" type="checkbox"/> Mobile Device
Antenna Type:	<input type="checkbox"/> External, <input checked="" type="checkbox"/> Integrated
Antenna Gain*:	<input checked="" type="checkbox"/> Provided by applicant
	LTE Band 2: 4dBi; LTE Band 4: 4dBi; LTE Band 12: 3dBi; LTE Band 17: 3dBi;
RF Cable*:	<input checked="" type="checkbox"/> Provided by applicant
	0.5dB(0.6~1GHz); 0.8dB(1.4~2GHz); 1.0dB(2.1~2.7GHz); 1.5dB(3~4GHz); 1.8dB(4.4~6GHz);

### Remark:

\*Since the above data and/or information is provided by the applicant relevant results or conclusions of this report are only made for these data and/or information , DNT is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.



## 2.4 Test Mode

Test Mode	Test Modes Description
LTE/TM1	LTE system, QPSK modulation
LTE/TM2	LTE system, 16QAM modulation

Remark: The test mode(s) are selected according to relevant radio technology specifications.

## 2.5 Test Environment

Operating Environment:		
Humidity:	45~56 % RH	
Atmospheric Pressure:	101.0~101.30 KPa	
Temperature	NT	20~25 °C
Voltage:	LV	3.1V
	NV	3.7V
	HV	4.3V

Remark: LV= lower extreme test voltage; NV= nominal voltage

HV= upper extreme test voltage; NT= normal temperature



## 2.6 Technical Specification

Characteristics	Description		
Radio System Type	<input checked="" type="checkbox"/> LTE		
Supported Frequency Range	Band	TX	RX
	LTE Band 2	1850 to 1910 MHz	1930 to 1990 MHz
	LTE Band 4	1710 to 1755 MHz	2110 to 2155 MHz
	LTE Band 12	699 to 716 MHz	729 to 746 MHz
	LTE Band 17	704 to 716 MHz	734 to 746 MHz
Supported Channel Bandwidth	LTE Band 2	<input checked="" type="checkbox"/> 1.4 MHz; <input checked="" type="checkbox"/> 3 MHz; <input checked="" type="checkbox"/> 5 MHz; <input checked="" type="checkbox"/> 10 MHz; <input checked="" type="checkbox"/> 15 MHz, <input checked="" type="checkbox"/> 20 MHz	
	LTE Band 4	<input checked="" type="checkbox"/> 1.4 MHz; <input checked="" type="checkbox"/> 3 MHz; <input checked="" type="checkbox"/> 5 MHz; <input checked="" type="checkbox"/> 10 MHz; <input checked="" type="checkbox"/> 15 MHz, <input checked="" type="checkbox"/> 20 MHz	
	LTE Band 12	<input checked="" type="checkbox"/> 1.4 MHz; <input checked="" type="checkbox"/> 3 MHz; <input checked="" type="checkbox"/> 5 MHz; <input checked="" type="checkbox"/> 10 MHz	
	LTE Band 17	<input checked="" type="checkbox"/> 5 MHz; <input checked="" type="checkbox"/> 10 MHz	
Characteristics	Description		
Designation of Emissions (Remark: the necessary bandwidth of which is the worst value from the measured occupied bandwidths for each type of channel bandwidth configuration.)	LTE Band 2	1M09G7D;1M09W7D; 1M09W7D 2M69G7D;2M70W7D; 2M70W7D 4M50G7D;4M50W7D; 4M49W7D 8M97G7D;8M97W7D; 8M97W7D 13M4G7D;13M5W7D; 13M4W7D 17M9G7D;17M9W7D; 17M9W7D	
	LTE Band 4	1M10G7D;1M09W7D; 1M10W7D 2M70G7D;2M70W7D; 2M70W7D 4M50G7D;4M50W7D; 4M50W7D 8M97G7D;8M97W7D; 8M97W7D 13M4G7D;13M5W7D; 13M4W7D 17M9G7D;17M9W7D; 17M9W7D	
	LTE Band 12	1M09G7D;1M09W7D; 1M09W7D 2M69G7D;2M70W7D; 2M70W7D 4M50G7D;4M50W7D; 4M50W7D 8M97G7D;8M98W7D; 8M97W7D	
	LTE Band 17	4M50G7D;4M50W7D; 4M50W7D 8M97G7D;8M95W7D; 8M95W7D	



## 2.7 Test Frequencies

Test Mode	Bandwidth	TX / RX	RF Channel		
			Low (L)	Middle (M)	High (H)
LTE Band 2	1.4MHz	TX	Channel 18607	Channel 18900	Channel 19193
			1850.7 MHz	1880 MHz	1909.3 MHz
		RX	Channel 607	Channel 900	Channel 1193
			1930.7 MHz	1960 MHz	1989.3 MHz
	3MHz	TX	Channel 18615	Channel 18900	Channel 19185
			1851.5 MHz	1880 MHz	1908.5 MHz
		RX	Channel 615	Channel 900	Channel 1185
			1931.5 MHz	1960 MHz	1988.5 MHz
	5MHz	TX	Channel 18625	Channel 18900	Channel 19175
			1852.5 MHz	1880 MHz	1907.5 MHz
		RX	Channel 625	Channel 900	Channel 1175
			1932.5 MHz	1960 MHz	1987.5 MHz
	10MHz	TX	Channel 18650	Channel 18900	Channel 19150
			1855 MHz	1880 MHz	1905 MHz
		RX	Channel 650	Channel 900	Channel 1150
			1935 MHz	1960 MHz	1985 MHz
	15MHz	TX	Channel 18675	Channel 18900	Channel 19125
			1857.5 MHz	1880 MHz	1902.5 MHz
		RX	Channel 675	Channel 900	Channel 1125
			1937.5 MHz	1960 MHz	1982.5 MHz
	20MHz	TX	Channel 18700	Channel 18900	Channel 19100
			1860 MHz	1880 MHz	1900 MHz
		RX	Channel 700	Channel 900	Channel 1100
			1940 MHz	1960 MHz	1980 MHz



Test Mode	Bandwidth	TX / RX	RF Channel		
			Low (L)	Middle (M)	High (H)
LTE Band 4	1.4MHz	TX	Channel 19957 1710.7 MHz	Channel 20175 1732.5 MHz	Channel 20393 1754.3 MHz
		RX	Channel 1975 2112.5 MHz	Channel 2175 2132.5MHz	Channel 2375 2152.5 MHz
	3MHz	TX	Channel 19965 1711.5 MHz	Channel 20175 1732.5 MHz	Channel 20385 1753.5 MHz
		RX	Channel 2000 2115 MHz	Channel 2175 2132.5MHz	Channel 2350 2150 MHz
	5MHz	TX	Channel 19975 1712.5 MHz	Channel 20175 1732.5 MHz	Channel 20375 1752.5 MHz
		RX	Channel 1975 2112.5 MHz	Channel 2175 2132.5MHz	Channel 2375 2152.5 MHz
	10MHz	TX	Channel 20000 1715 MHz	Channel 20175 1732.5 MHz	Channel 20350 1750 MHz
		RX	Channel 2000 2115 MHz	Channel 2175 2132.5MHz	Channel 2350 2150 MHz
	15MHz	TX	Channel 20025 1717.5 MHz	Channel 20175 1732.5 MHz	Channel 20325 1747.5 MHz
		RX	Channel 2025 2117.5 MHz	Channel 2175 2132.5MHz	Channel 2325 2147.5 MHz
	20MHz	TX	Channel 20050 1720 MHz	Channel 20175 1732.5 MHz	Channel 20300 1745 MHz
		RX	Channel 2050 2120 MHz	Channel 2175 2132.5MHz	Channel 2300 2145 MHz

Test Mode	Bandwidth	TX / RX	RF Channel		
			Low (L)	Middle (M)	High (H)
LTE Band 12	1.4MHz	TX	Channel 23017 699.7 MHz	Channel 23095 707.5 MHz	Channel 23173 715.3 MHz
		RX	Channel 5017 729.7 MHz	Channel 5095 737.5 MHz	Channel 5173 745.3 MHz
	3MHz	TX	Channel 23025 700.5 MHz	Channel 23095 707.5 MHz	Channel 23165 714.5 MHz
		RX	Channel 5025 730.5 MHz	Channel 5095 737.5 MHz	Channel 5165 744.5 MHz
	5MHz	TX	Channel 23035 701.5 MHz	Channel 23095 707.5 MHz	Channel 23155 713.5 MHz
		RX	Channel 5035 731.5 MHz	Channel 5095 737.5 MHz	Channel 5155 743.5 MHz
	10MHz	TX	Channel 23060 704 MHz	Channel 23095 707.5 MHz	Channel 23130 711 MHz
		RX	Channel 5060 734 MHz	Channel 5095 737.5 MHz	Channel 5130 741 MHz



Test Mode	Bandwidth	TX / RX	RF Channel		
			Low (L)	Middle (M)	High (H)
LTE Band 17	5MHz	TX	Channel 23755	Channel 23790	Channel 23825
			706.5 MHz	710 MHz	713.5 MHz
	5MHz	RX	Channel 5755	Channel 5790	Channel 5825
			736.5 MHz	740 MHz	743.5 MHz
	10MHz	TX	Channel 23780	Channel 23790	Channel 23800
			709 MHz	710 MHz	711 MHz
	10MHz	RX	Channel 5780	Channel 5790	Channel 5800
			739 MHz	740 MHz	741 MHz





### 3 Description of Tests

#### 3.1 Conducted Output Power

Measurement Procedure: FCC KDB 971168 D01 V03r01

The transmitter output was connected to a calibrated coaxial cable, attenuator and power meter, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The power output at the transmitter antenna port was determined by adding the value of the cable insertion loss to the power reading. The tests were performed at three frequencies (low channel, middle channel and high channel) and on the highest power levels, which can be setup on the transmitters.

**Remark: Reference test setup 1**

#### 3.2 Effective (Isotropic) Radiated Power of Transmitter

Measurement Procedure: FCC KDB 971168 D01 V03r01 ; C63.26 (2015)

Calculate power in dBm by the following formula:

ERP (dBm) = Conducted Power (dBm) + antenna gain (dBd)

EIRP(dBm) = Conducted Power (dBm) + antenna gain (dBi)

EIRP=ERP+2.15Db

Measurement Procedure: FCC KDB 971168 D01 V03r01 ; ANSI/C63.26 (2015)

**Below 1GHz test procedure as below:**

- 1). The EUT was powered ON and placed on a 0.8m high table in the chamber. The antenna of the transmitter was extended to its maximum length.
- 2). The disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 3). Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 4). The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 5). A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.
- 6). The output power into the substitution antenna was then measured.
- 7). Steps 5) and 6) were repeated with both antennas polarized.
- 8). Calculate power in dBm by the following formula:

ERP (dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd)

Where:

Pg is the generator output power into the substitution antenna.

**Above 1GHz test procedure as below:**

- 1). Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber
- 2). Calculate power in dBm by the following formula:  
EIRP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBi)  
EIRP=ERP+2.15dB





Where:

Pg is the generator output power into the substitution antenna.

- 3). Test the EUT in the lowest channel, the middle channel the Highest channel
- 4). The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, Only the test worst case mode is recorded in the report.
- 5). Repeat above procedures until all frequencies measured was complete.

**Remark: Reference test setup 2**

### 3.3 EIRP Power Density

For mobile and portable stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band, the average EIRP must not exceed 50 milliwatts within any 1 megahertz of authorized bandwidth, *except that* for mobile and portable stations compliant with 3GPP LTE standards or another advanced mobile broadband protocol that avoids concentrating energy at the edge of the operating band the average EIRP must not exceed 250 milliwatts within any 5 megahertz of authorized bandwidth but may exceed 50 milliwatts within any 1 megahertz of authorized bandwidth. For mobile and portable stations using time division duplexing (TDD) technology, the duty cycle must not exceed 38 percent in the 2305-2315 MHz and 2350-2360 MHz bands. Mobile and portable stations using FDD technology are restricted to transmitting in the 2305-2315 MHz band. Power averaging shall not include intervals in which the transmitter is off.

#### Test Settings

1. Set instrument center frequency to OBW center frequency.
2. Set span to at least 1.5 times the OBW.
3. Set the RBW to the specified reference bandwidth (often 1 MHz).
4. Set VBW  $\geq 3 \times$  RBW.
5. Detector = RMS (power averaging).
6. Ensure that the number of measurement points in the sweep  $\geq 2 \times$  span/RBW.
7. Sweep time = auto couple.
8. Employ trace averaging (RMS) mode over a minimum of 100 traces.
9. Use the peak marker function to determine the maximum amplitude level within the reference bandwidth (PSD).

### 3.4 Occupied Bandwidth

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 4.2

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. The transmitter output was connected to a calibrated coaxial cable, attenuator and Spectrum analyser, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The tests were performed at three frequencies (low channel, middle channel and high channel). The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual. The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest



frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

**Remark: Reference test setup 1**

**Test Settings**

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW  $\geq 3 \times$  RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7



### 3.5 Band Edge at Antenna Terminals

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 6.0

The transmitter output was connected to a calibrated coaxial cable, attenuator and Spectrum analyser, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The tests were performed at two frequencies (low channel and high channel) in the 1MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of 100kHz or 1% of the emission bandwidth of the fundamental emission of the transmitter may be employed. The EUT emission bandwidth is measured as the width of the signal between two points, outside of which all emission are attenuated at least 26dB below the transmitter power. The video bandwidth of the spectrum analyzer was set at thrice the resolution bandwidth. Detector Mode was set to rms.

#### Remark: Reference test setup 1

##### Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3.  $RBW \geq 1\%$  of the emission bandwidth
4.  $VBW \geq 3 \times RBW$
5. Detector = RMS
6. Number of sweep points  $\geq 2 \times \text{Span}/RBW$
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize



### 3.6 Spurious And Harmonic Emissions at Antenna Terminal

Measurement Procedure: FCC KDB 971168 D01 V03r01

The transmitter output was connected to a calibrated coaxial cable, attenuator and Spectrum analyzer, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The tests were performed at three frequencies (low channel and high channel). The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. 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  $43 + 10 \log(P)$  dB. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. 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. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

**Remark: Reference test setup 1**

#### Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to at least  $10 \times$  the fundamental frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings





### 3.7 Peak-Average Ratio

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 5.7.1

A peak to average ratio measurement is performed at the conducted port of the EUT. For WCDMA signals, the spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level. For GSM signals, an average and a peak trace are used on a spectrum analyzer to determine the largest deviation between the average and the peak power of the EUT in a bandwidth greater than the emission bandwidth. The traces are generated with the spectrum analyzer set to zero span mode.

#### Remark: Reference test setup 1

##### Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power



### 3.8 Field Strength of Spurious Radiation

Measurement Procedure: FCC KDB 971168 D01 V03r01

#### Below 1GHz test procedure as below:

- 1). The EUT was powered ON and placed on a 80cm high table in the chamber. The antenna of the transmitter was extended to its maximum length.
- 2). The disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 3). Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 4). The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 5). A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 2) is obtained for this set of conditions.
- 6). The output power into the substitution antenna was then measured.
- 7). Steps 5) and 6) were repeated with both antennas polarized.
- 8) Calculate power in dBm by the following formula:

$$\text{ERP(dBm)} = \text{Pg(dBm)} - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$

Where:

Pd is the dipole equivalent power, Pg is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to Pg [dBm] – cable loss [dB]. The calculated Pd levels are then compared to the absolute spurious emission limit of -13dBm which is equivalent to the required minimum attenuation of  $43 + 10\log_{10}(\text{Power [Watts]})$ .

#### Above 1GHz test procedure as below:

- 1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber
- 2) Calculate power in dBm by the following formula:

$$\text{EIRP(dBm)} = \text{Pg(dBm)} - \text{cable loss (dB)} + \text{antenna gain (dBi)}$$

$$\text{EIRP} = \text{ERP} + 2.15\text{dB}$$

Where:

Pg is the generator output power into the substitution antenna.

3. Test the EUT in the lowest channel, the middle channel the Highest channel
4. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, Only the test worst case mode is recorded in the report.
5. Repeat above procedures until all frequencies measured was complete

Remark1: Reference test setup 2

Remark2: The emission below 18G were measured at a 3m test distance, while emissions above 18GHz were measured at a 1m test distance.

#### Test Settings:

1. RBW=100kHz for emission below 1GHz and 1MHz for emission above 1GHz
2. VBW  $\geq 3 \times$  RBW
3. Number of sweep point  $\geq 2 \times$  span/RBW
4. Detector=RMS
5. Trace mode=Average (Max Hold for pulsed emissions)



6. The trace was allowed to stabilize

### 3.9 Frequency Stability / Temperature Variation

#### Measurement Procedure:

Frequency stability testing is performed in accordance with the guidelines of FCC KDB 971168 D01 V03r01; ANSI/C63.26 (2015)

. The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Specification – The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within  $\pm 0.00025\%$  ( $\pm 2.5$  ppm ) of the center frequency.

#### Time Period and Procedure:

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

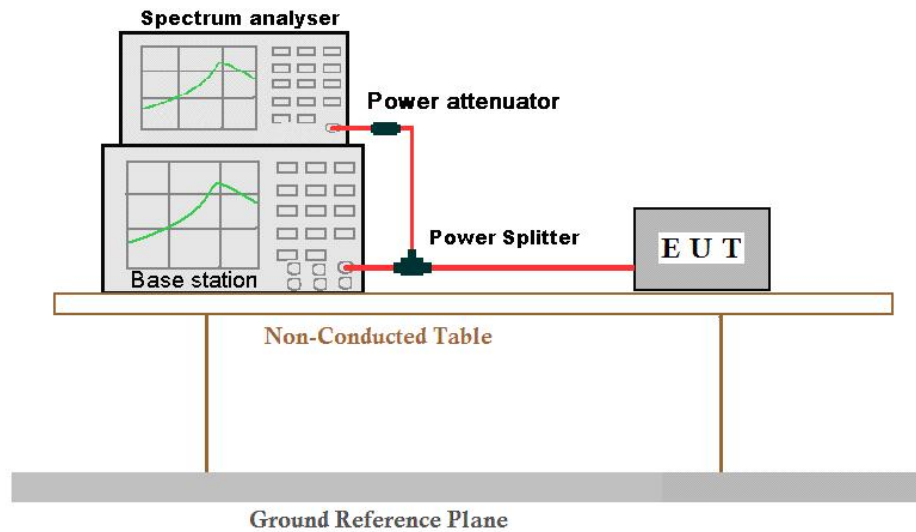
**Remark: Reference test setup 3**





### 3.10 Test Setups

#### 3.10.1 Test Setup 1



#### 3.10.2 Test Setup 2

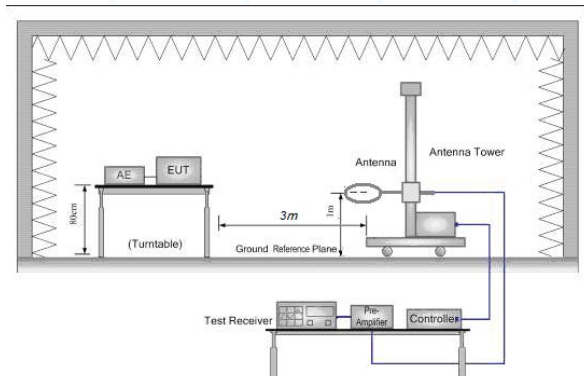


Figure 1. Below 30MHz

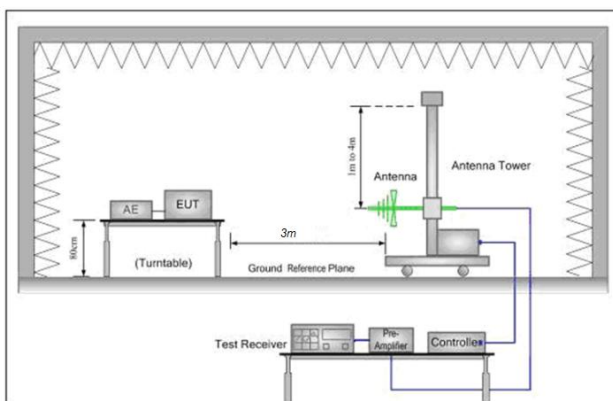


Figure 2. 30MHz to 1GHz

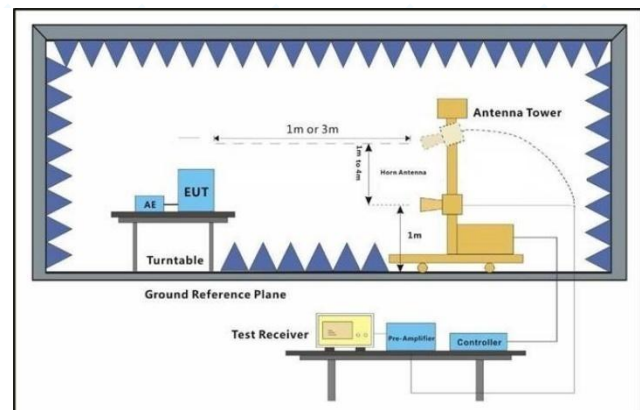
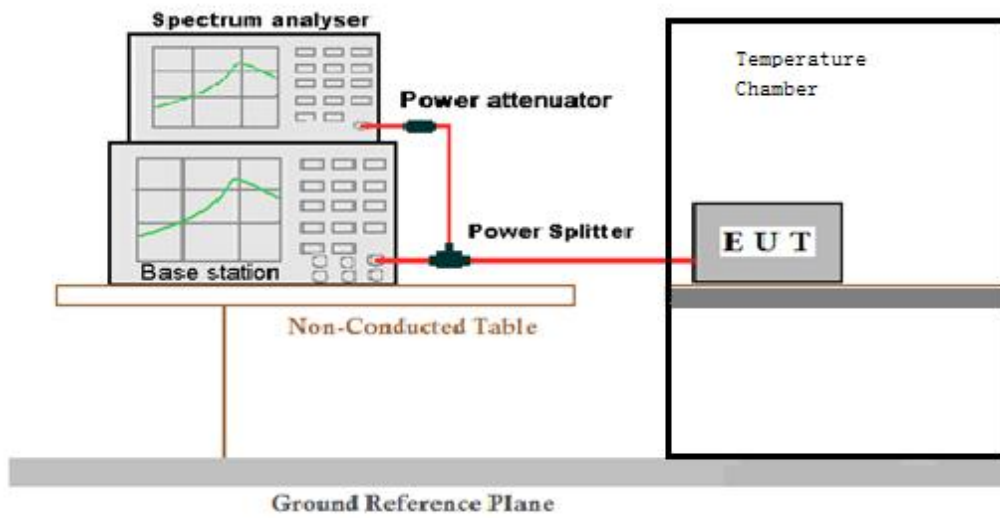


Figure 3. above 1GHz



### 3.10.3 Test Setup 3





### 3.11 Test Conditions

Test Case		Test Conditions	
Transmit Output Power Data	Average Power, Total	Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel )
		Test Mode	LTE/TM1;LTE/TM2
	Average Power, Spectral Density (if required )	Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel )
		Test Mode	LTE/TM1;LTE/TM2
Peak-to-Average Ratio (if required)		Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel )
		Test Mode	LTE/TM1;LTE/TM2
Modulation Characteristics		Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	M (M= middle channel )
		Test Mode	LTE/TM1;LTE/TM2
Bandwidth	Occupied Bandwidth	Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel )



	Emission Bandwidth (if required )	Test Mode	LTE/TM1;LTE/TM2
		Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel )
		Test Mode	LTE/TM1;LTE/TM2
Band Edges Compliance		Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	L, H (L= low channel, H= high channel )
		Test Mode	LTE/TM1;LTE/TM2
Spurious Emission at Antenna Terminals		Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 1
		RF Channels (TX)	L,M, H (L= low channel, M= middle channel, H= high channel )
		Test Mode	GSM/TM1;UMTS/TM1;CDMA/TM1;EVDO/TM1; LTE/TM1;
Field Strength of Spurious Radiation		Test Environment	Ambient Climate & Rated Voltage
		Test Setup	Test Setup 2
		Test Mode	LTE/TM1;LTE/TM2 Remark: If applicable, the EUT conf. that has maximum power density (based on the equivalent power level) is selected.
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel )
Frequency Stability		Test Environment	(1) -30 °C to +50 °C with step 10 °C at Rated Voltage; (2) VL, VN and VH of Rated Voltage at Ambient Climate.
		Test Setup	Test Setup 3
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel )



	Test Mode	LTE/TM1;LTE/TM2
--	-----------	-----------------

## 4 Main Test Instruments

For Connect EUT Antenna Terminal Test					
Description	Manufacturer	Model	Serial Number	Cal date	Due date
Radio Communication Tester	R&S	CMW500	123933	2023/10/25	2024/10/24
Spectrum Analyzer	Agilent	N9020A	MY51281254	2023/10/25	2024/10/24
RF Test Software	Tonscend	V3.1.46	NA	NA	NA
power supply	Keysight	E3640A	ZB2022628	2023/10/25	2024/10/24
filter bank	Tonscend	JS0806-F	NA	2023/10/25	2024/10/24
RF Control Unit	Tonscend	JS0806-1	21K8060502	2023/10/25	2024/10/24

Test Equipment for Radiated Emission(30MHz-1000MHz)					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Receiver	R&S	ESR7	102497	2023-10-24	2024-10-23
Test Software	ETS-LINDGREN	TiLE-FULL	NA	NA	NA
RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	NA	2023-10-24	2024-10-23
Log periodic antenna	ETS-LINDGREN	VULB 9168	01475	2023-10-24	2024-10-23
Pre-amplifier	Schwarzbeck	BBV9743B	00423	2023-10-24	2024-10-23
Radio Communication Tester	R&S	CMW500	123933	2023/10/25	2024/10/24



Test Equipment for Radiated Emission(Above 1000MHz)					
Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Frequency analyser	Keysight	N9010A	MY52221458	2023-10-24	2024-10-23
RF Cable	ETS-LINDGREN	RFC-NMS-100- NMS-350-IN	NA	2023-10-24	2024-10-23
Horn Antenna	ETS-LINDGREN	3117	00252567	2023-10-24	2024-10-23
Double ridged waveguide antenna	ETS-LINDGREN	3116C	00251780	2023-10-24	2024-10-23
Test Software	ETS-LINDGREN	TiLE-FULL	NA	NA	NA
Pre-amplifier	ETS-LINDGREN	3117-PA	252567	2023-10-24	2024-10-23
Pre-amplifier	ETS-LINDGREN	3116C-PA	251780	2023-10-24	2024-10-23
Radio Communication Tester	R&S	CMW500	123933	2023/10/25	2024/10/24



## 5 Measurement Uncertainty

For a 95% confidence level ( $k = 2$ ), the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 as following:

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	$\pm 0.41\text{dB}$
2	RF power density, conducted	$\pm 1.96\text{dB}$
3	Spurious emissions, conducted	$\pm 0.41\text{dB}$
4	Radio Frequency	$\pm 7.10 \times 10^{-8}$
5	Duty Cycle	$\pm 0.49\%$
6	Occupied Bandwidth	$\pm 0.2\%$

No.	Item	Measurement Uncertainty
1	Radiated Emission	$\pm 4.8\text{dB}$ (Below 1GHz)
		$\pm 4.8\text{dB}$ (1GHz to 6GHz)
		$\pm 4.5\text{dB}$ (6GHz to 18GHz)
		$\pm 5.02\text{dB}$ (Above 18GHz)





## 6 Appendixes

Appendix B.1	LTE Band 2
Appendix B.2	LTE Band 4
Appendix B.3	LTE Band 12
Appendix B.4	LTE Band 17

---

The End