

## Industrial Internet Innovation Center (Shanghai) Co.,Ltd.

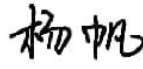
## RF TEST REPORT

PRODUCT	LTE CAT-M1 Data Module
BRAND	u-blox
MODEL	SARA-R510M8S
APPLICANT	u-blox AG
FCC ID	XPYUBX19KM01
ISSUE DATE	June 25, 2024
STANDARD(S)	FCC Part 2, FCC Part 22H, FCC Part 24E, FCC Part 27

Prepared by: Fan Yuhang



Reviewed by: Yang Fan



Approved by: Zhang Min

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## 1. Summary of Test Report

### 1.1 Test Standard (s)

No.	Test Standard	Title	Version
1	FCC Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS	-
2	FCC Part 22H	CELLULAR RADIOTELEPHONE SERVICE	-
3	FCC Part 24E	BROADBAND PCS	-
4	FCC Part 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES	-

Note: FCC Part 2 have not been accredited by A2LA.

### 1.2 Reference Documents

No.	Test Standard	Title	Version
1	ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2016
2	ANSI C63.26	American National Standard of Procedures for Compliance Testing of Licensed Transmitters Used in Licensed Radio	2015
3	KDB 971168 D01	Measurement Guidance for Certification of Licensed Digital Transmitters	v03r01

Note: KDB 971168 D01 have not been accredited by A2LA.

### 1.3 Summary of Test Results

#### LTE CAT-M Band 2

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	2.1046/24.232(c)	Pass(Note3)
2	Emission Limit	2.1053/24.238(a)	Pass
3	Frequency Stability	2.1055/24.235	Pass(Note2)
4	Occupied Bandwidth	2.1049	Pass(Note2)
5	Emission Bandwidth	2.1049	Pass(Note2)
6	Band Edge Compliance	2.1051/24.238(a)	Pass(Note2)
7	Conducted Spurious Emission	2.1051/24.238(a)	Pass(Note2)
8	Peak to Average Power Ratio	24.232 (d)	Pass(Note2)

## LTE CAT-M Band 4

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	2.1046/27.50(d)(4)	Pass(Note3)
2	Emission Limit	2.1053/27.53(h)	Pass
3	Frequency Stability	2.1055/27.54	Pass(Note2)
4	Occupied Bandwidth	2.1049	Pass(Note2)
5	Emission Bandwidth	2.1049	Pass(Note2)
6	Band Edge Compliance	2.1051/27.53(h)	Pass(Note2)
7	Conducted Spurious Emission	2.1051/27.53(h)	Pass(Note2)
8	Peak to Average Power Ratio	27.50(d)(5)	Pass(Note2)

## LTE CAT-M Band 5

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	2.1046/22.913(a)	Pass(Note3)
2	Emission Limit	2.1053/22.917(a)	Pass
3	Frequency Stability	2.1055/22.355	Pass(Note2)
4	Occupied Bandwidth	2.1049	Pass(Note2)
5	Emission Bandwidth	2.1049	Pass(Note2)
6	Band Edge Compliance	2.1051/22.917(a)	Pass(Note2)
7	Conducted Spurious Emission	2.1051/22.917(a)	Pass(Note2)
8	Peak to Average Power Ratio	N/A	Pass(Note2)

## LTE CAT-M Band 12

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	2.1046/27.50(c)(10)	Pass(Note3)
2	Emission Limit	2.1053/27.53(g)	Pass
3	Frequency Stability	27.54, 2.1055	Pass(Note2)
4	Occupied Bandwidth	2.1049	Pass(Note2)
5	Emission Bandwidth	2.1049	Pass(Note2)
6	Band Edge Compliance	27.53(g)	Pass(Note2)
7	Conducted Spurious Emission	27.53(g), 2.1057	Pass(Note2)

## LTE CAT-M Band 13

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	2.1046/27.50(b)(10)	Pass(Note3)
2	Emission Limit	2.1053/27.53(c) (2)	Pass
3	Frequency Stability	27.54, 2.1055	Pass(Note2)



4	Occupied Bandwidth	2.1049	Pass(Note2)
5	Emission Bandwidth	2.1049	Pass(Note2)
6	Band Edge Compliance	27.53(c) (2)	Pass(Note2)
7	Conducted Spurious Emission	27.53(c) (2),2.1057	Pass(Note2)

**LTE CAT-M Band 66**

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	27.50(d)(4)	Pass(Note3)
2	Emission Limit	2.1053/27.53(h)	Pass
3	Frequency Stability	27.54, 2.1055	Pass(Note2)
4	Occupied Bandwidth	2.1049	Pass(Note2)
5	Emission Bandwidth	2.1049	Pass(Note2)
6	Band Edge Compliance	27.53(h)	Pass(Note2)
7	Conducted Spurious Emission	27.53(h), 2.1057	Pass(Note2)
8	Peak to Average Power Ratio	27.50(d)(5)	Pass(Note2)

**LTE CAT-M Band 71**

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	27.50(c)(10)	Pass(Note3)
2	Emission Limit	2.1053/27.53(g)	Pass
3	Frequency Stability	27.54, 2.1055	Pass(Note2)
4	Occupied Bandwidth	2.1049	Pass(Note2)
5	Emission Bandwidth	2.1049	Pass(Note2)
6	Band Edge Compliance	27.53(g)	Pass(Note2)
7	Conducted Spurious Emission	27.53(g),2.1057	Pass(Note2)

**Note1:**

The LootPaw GPS Tracker, manufactured by u-blox AG is a variant product for testing.

This project is a variant project based on the MDE\_UBLOX\_2105\_FCC\_01. Verify worst mode power. Retest the RSE in the all mode, and the test data was recorded in this report.

Industrial Internet Innovation Center (Shanghai) Co., Ltd. only performed test cases which identified with Pass/Fail/Inc result in section 1.3.

Industrial Internet Innovation Center (Shanghai) Co., Ltd. has verified that the compliance of the tested device specified in section 4 of this test report is successfully evaluated according to the procedure and test methods as defined in type certification requirement listed in section 1 of this test report.

**Note2:**

The test verdict of this item come form the original report.

**Note3:**

This test item verifies only the worst mode.

#### 1.4 Data Provided by Applicant

No.	Item(s)	Data
1	LTE CAT-M band 2	-3.42
2	LTE CAT-M band 4	-3.15
3	LTE CAT-M band 5	-10.68
4	LTE CAT-M band 12	-11.25
5	LTE CAT-M band 13	-4.34
6	LTE CAT-M band 66	-3.15
7	LTE CAT-M band 71	-12.54

Note: The data of antenna gain is provided by Antenna specification may affect the validity of the test results in this report, and the impact and consequences of this shall be undertaken by the customer.



## 2. General Information of The Laboratory

### 2.1 Testing Laboratory

Lab Name	Industrial Internet Innovation Center (Shanghai) Co.,Ltd.
Address	Building 4, No. 766, Jingang Road, Pudong, Shanghai, China
Telephone	021-68866880
FCC Registration No.	708870
FCC Designation No.	CN1364

### 2.2 Laboratory Environmental Requirements

Temperature	15°C~35°C
Relative Humidity	25%RH~75%RH
Atmospheric Pressure	86kPa~106kPa

### 2.3 Project Information

Project Manager	Zhang Heng
Test Date	February 06, 2024 to March 26,2024

### 3. General Information of The Customer

#### 3.1 Applicant

Company	u-blox AG
Address	Zürcherstrasse 68 Thalwil CH-8800 Switzerland
Telephone	+41 44 722 7462

#### 3.2 Manufacturer

Company	u-blox AG
Address	Zürcherstrasse 68 Thalwil CH-8800 Switzerland
Telephone	+41 44 722 7462



## 4. General Information of The Product

### 4.1 Product Description for Equipment under Test (EUT)

Product	LTE CAT-M1 Data Module
Model	SARA-R510M8S
Date of Receipt	S03aa: February 04, 2024 S04aa: February 04, 2024
EUT ID*	S03aa/S04aa
SN/IMEI	S03aa:352709570799593 S04aa: N/A
Supported Radio Technology and Bands	LTE CAT-M Band 2/4/5/12/13/66/71 BT 5.3 BLE WLAN 802.11b/g/n GPS/GLONASS/Galileo
Hardware Version	v1
Software Version	v1
FCC ID	XPYUBX19KM01
Power Rating	30.5mm*47mm*18mm
NOTE1: EUT ID is the internal identification code of the laboratory. NOTE2: Samples in the test report are provided by the customer. The test results are only applicable to the samples received by the laboratory.	

### 4.2 Description for Auxiliary Equipment (AE)

AE ID*	Description	Model	SN/Remark
AE1	RF Cable	N/A	N/A
NOTE1: AE ID is the internal identification code of the laboratory.			

### 4.3 Additional Information

Modulation:

Type of modulation	QPSK
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Band Frequency Range:

Band	Frequency Range
Band 2	1850 - 1910 MHz
Band 4	1710 - 1755 MHz
Band 5	824 - 849 MHz
Band 12	699-716 MHz
Band 13	777-787 MHz
Band 66	1710-1780 MHz

Band 71	663-698 MHz
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Band List:

Band	BW (MHz)	Low Channel	Low Freq. (MHz)	Mid Channel	Mid Freq. (MHz)	High Channel	High Freq. (MHz)
Band 2	1.4	18607	1850.7	18900	1880	19193	1909.3
	3	18615	1851.5	18900	1880	19185	1908.5
	5	18625	1852.5	18900	1880	19175	1907.5
	10	18650	1855	18900	1880	19150	1905
	15	18675	1857.5	18900	1880	19125	1902.5
	20	18700	1860	18900	1880	19100	1900
Band 4	1.4	19957	1710.7	20175	1732.5	20393	1754.3
	3	19965	1711.5	20175	1732.5	20385	1753.5
	5	19975	1712.5	20175	1732.5	20375	1752.5
	10	20000	1715	20175	1732.5	20350	1750
	15	20025	1717.5	20175	1732.5	20325	1747.5
	20	20050	1720	20175	1732.5	20300	1745
Band 5	1.4	20407	824.7	20525	836.5	20643	848.3
	3	20415	825.5	20525	836.5	20635	847.5
	5	20425	826.5	20525	836.5	20625	846.5
	10	20450	829	20525	836.5	20600	844
Band 12	1.4	23017	699.7	23095	707.5	23173	715.3
	3	23025	700.5	23095	707.5	23165	714.5
	5	23035	701.5	23095	707.5	23155	713.5
	10	23060	704	23095	707.5	23130	711
Band 13	5	23205	779.5	23230	782	23255	784.5
	10	23230	782	23230	782	23230	782
Band 66	1.4	131979	1710.7	132322	1745	132665	1779.3
	3	131987	1711.5	132322	1745	132657	1778.5
	5	131997	1712.5	132322	1745	132647	1777.5
	10	132022	1715	132322	1745	132622	1775
	15	132047	1717.5	132322	1745	132597	1772.5
	20	132072	1720	132322	1745	132572	1770
Band 71	5	133147	665.5	133297	680.5	133447	695.5
	10	133172	668	133297	680.5	133422	693
	15	133197	670.5	133297	680.5	133397	690.5
	20	133222	673	133297	680.5	133372	688



## 5. Test Configuration Information

### 5.1 Laboratory Environmental Conditions

#### 5.1.1 Permanent Facilities

Relative Humidity	Min. = 45%, Max. = 55%		
Atmospheric Pressure	101kPa		
Temperature	Normal	Minimum	Maximum
	25°C	-10°C	45°C
Working Voltage of EUT	Normal	Minimum	Maximum
	3.7V	3.0V	4.2 V

### 5.2 Test Equipments Utilized

#### Conduction test system

No.	Name	Model	S/N	SW Version	HW Version	Manufacturer	Cal. Date	Cal. Interval
1	Software	Eagle V3.3	N/A	V3.3	N/A	3IN	N/A	N/A
2	Frequency spectrum analyzer	FSQ	101091	V4.75	V11.00	R&S	2023-07-26	1 Year
3	Frequency spectrum analyzer	FSW43	101943	1.12	00	R&S	2023-08-31	1 Year
4	Wideband Radio Communication Tester	CMW 500	148874	V3.5.136	N/A	R&S	2023-07-27	1 Year
5	Temperature Chamber	B-TF-107C	201804107	N/A	N/A	BoYi	2023-06-28	1 Year
6	Programmable power supply	Keithley 2303	4039070	N/A	N/A	Keithley	2023-06-23	1 Year
7	RF Test Automation Box	RF 2021B	2001	V3.3	N/A	RANATEC	N/A	N/A

#### Radiated emission test system

No.	Name	Model	S/N	SW Version	HW Version	Manufacturer	Cal. Date	Cal. Interval
1	Universal Radio Communication Tester	CMU200	123126	V5.2.1	B12	R&S	2023-10-16	1 Year
2	Universal Radio Communication Tester	CMW500	104178	V3.7.20	1206.0600.00	R&S	2023-10-16	1 Year
3	EMI Test Receiver	ESU40	100307	V5.1-24-3	01	R&S	2023-12-19	1 Year
4	TRILOG Broadband Antenna	VULB9163	01345	N/A	N/A	Schwarzbeck	2023-03-23	1 Year

5	Double- ridged Waveguide Antenna	ETS-3117	00135890	N/A	N/A	ETS	2023-07-28	1 Years
6	EMI Test Software	EMC32 V10.35.02	N/A	N/A	N/A	R&S	N/A	N/A
7	Preamplifier	SCU08F1	8320024	N/A	N/A	R&S	2023-10-16	1 year
8	Preamplifier	SCU18	10155	N/A	N/A	R&S	2023-10-16	1 year
9	Antenna	SWB-VUBA 9117	9117-266	N/A	N/A	Schwar zbeck	2023-9-8	1 year
10	Antenna	BBHA9120 D	02112	N/A	N/A	Schwar zbeck	2023-7-28	1 year
11	Signal Generator	SMF100A	102314	3.20.390.24	05.10	R&S	2023-10-16	1 year

Note:After 2024-3-22, the TRILOG Broadband Antenna is not used for radiation testing.

### 5.3 Measurement Uncertainty

#### Measurement Uncertainty of Radiation test

Frequency Range	Uncertainty(dB)
$30\text{MHz} \leq f \leq 1\text{GHz}$	$\pm 5.10$
$1\text{GHz} \leq f \leq 18\text{GHz}$	$\pm 5.66$
$18\text{GHz} \leq f \leq 40\text{GHz}$	$\pm 5.22$

#### Measurement Uncertainty of Conduction test

No	Item	Extended uncertainty (k=2)	
1	Frequency Tolerance	23Hz	
2	RF Output Power	0.7dB	
3	conducted spurious	9kHz~3.6GHz	1.5dB
		3.6GHz~8.4GHz	2.8dB
		8.4GHz~12.75GHz	3.4dB
4	EVM	2.1%	
5	Occupied Bandwidth	Bandwidth 1.4MHz	0.03MHz
		Bandwidth 3MHz	0.03MHz
		Bandwidth 5MHz	0.03MHz
		Bandwidth 10MHz	0.05MHz
		Bandwidth 15MHz	0.06MHz
		Bandwidth 20MHz	0.08MHz
6	Emission intermodulation	Adjacent channel	1.4dB
		Alternate channel	1.4dB
7	Range of frequency	0.08MHz	



## 6. Test Results

### 6.1 Output Power

#### 6.1.1 Measurement Limit

FCC §22.913(a) (5) The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

FCC §24.232(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

FCC §27.50(a) 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. ( $EIRP \leq 24dBm/5MHz$ )

FCC §27.50(b) (10) Portable stations (hand-held devices) transmitting in the 746–757 MHz, 776–788 MHz, and 805–806 MHz bands are limited to 3 watts ERP.

FCC §27.50(c) (10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698–746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

FCC §27.50(d) (4) Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band is limited to 1 watt EIRP.

FCC §27.50(h): Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

#### 6.1.2 Method of Measurements

Method of measurements please refer to KDB971168 D01 v03 clause 5.

The EUT was set up for the max output power with pseudo random data modulation.

The power was measured with Rhode & Schwarz base station CMW500.

These measurements were done at 3 frequencies.(bottom, middle and top of operational frequency range).

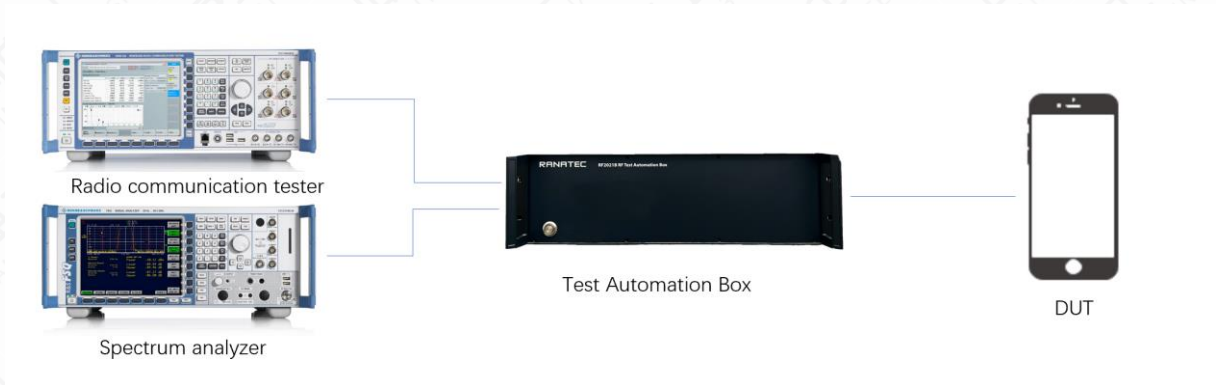
1. The transmitter output port was connected to base station.
2. Set the EUT at maximum power through base station.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure and record maximum average power for other modulation signal.
5. During the process of testing, the EUT was controlled Rhode & Schwarz Digital Radio.
6. Communication tester to ensure max power transmission and proper modulation.
7. This result contains output power and EIRP measurements for the EUT. In all cases, output power is within the specified limits.

$EIRP = \text{Conducted power} + \text{Gain}$ ,  $ERP = EIRP - 2.15dB$ .

#### 6.1.3 Test procedures

The transmitter output power was connected to calibrated attenuator, the other end of which was connected to signal analyzer. Transmitter output power was read off the power in dBm. The power outputs at the transmitter antenna port was determined by adding the value of attenuator to the base station reading.

### 6.1.4 Test Setup



### 6.1.5 Output Power Measurement result

LTE CatM	Mode	Origina data(dBm)	Verified power(dBm)
Band2	QPSK	23.12	22.35
Band 4	QPSK	23.56	20.37
Band 5	QPSK	22.63	22.55
Band 12	QPSK	23	22.99
Band 13	QPSK	22.83	22.79
Band 66	QPSK	23.79	20.63
Band 71	QPSK	22.89	21.71

Note1: The power of the worst part is verified to meet the requirements.



## 6.2 Emission Limit

### 6.2.1 Measurement Limit

According to KDB 971168, a relaxation of the reference bandwidth is often provided for measurements within a specified frequency range at the edge of the authorized frequency block/band. This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth.

FCC §22.917(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

FCC §24.238(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

FCC §27.53(a) For mobile and portable stations operating in the 2305–2315 MHz and 2350–2360 MHz bands:

- (i) By a factor of not less than:  $43 + 10 \log(P)$  dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, not less than  $55 + 10 \log(P)$  dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2341 and 2345 MHz, not less than  $61 + 10 \log(P)$  dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341 MHz, and not less than  $67 + 10 \log(P)$  dB on all frequencies between 2328 and 2337 MHz;
- (ii) By a factor of not less than  $43 + 10 \log(P)$  dB on all frequencies between 2300 and 2305 MHz,  $55 + 10 \log(P)$  dB on all frequencies between 2296 and 2300 MHz,  $61 + 10 \log(P)$  dB on all frequencies between 2292 and 2296 MHz,  $67 + 10 \log(P)$  dB on all frequencies between 2288 and 2292 MHz, and  $70 + 10 \log(P)$  dB below 2288 MHz;
- (iii) By a factor of not less than  $43 + 10 \log(P)$  dB on all frequencies between 2360 and 2365 MHz, and not less than  $70 + 10 \log(P)$  dB above 2365 MHz.

FCC §27.53(h) (1) General protection levels. Except as otherwise specified below, for operations in the 1695–1710 MHz, 1710–1755 MHz, 1755–1780 MHz, 1915–1920 MHz, 1995–2000 MHz, 2000–2020 MHz, 2110–2155 MHz, 2155–2180 MHz, and 2180–2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10}(P)$  dB.

FCC §27.53(c) (2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least  $43 + 10 \log(P)$  dB;

FCC §27.53(g) For operations in the 600 MHz band and the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least  $43 + 10 \log(P)$  dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. 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.

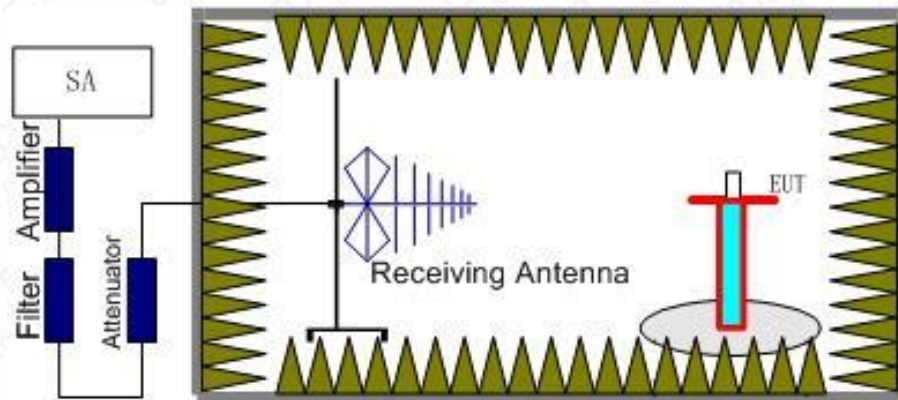
### 6.2.2 Method of Measurement

The measurements procedures in TIA-603E-2016 are used. This measurement is carried out in fully-anechoic chamber FAC-3.

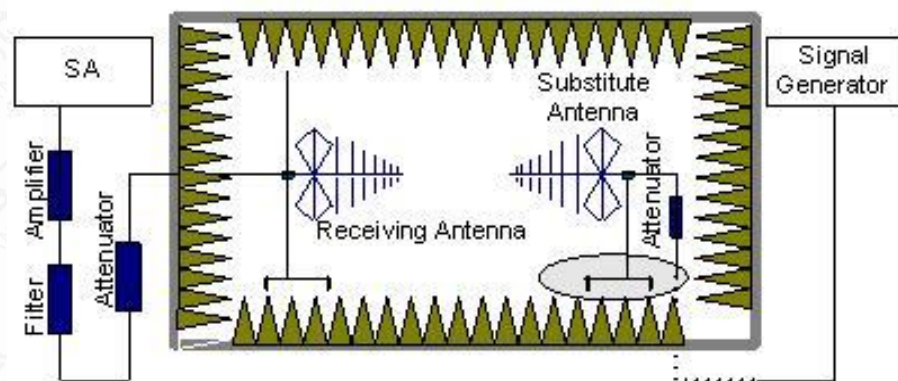
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz as outlined in Part 22.917(a)/24.238(a)/27.53(g)/27.53(h)/27.53(m)(4). The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the LTE Bands 2/4/5/7/26/38/40/41.

**The procedure of radiated spurious emissions is as follows:**

1. Below 1 GHz, EUT was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna. Above 1 GHz, EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all non-harmonic and harmonics of the transmit frequency through the 10th harmonic were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



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. Adjust the level of the signal generator output until the value of the receiver reaches 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.

4.The Path loss (Pcl) between the Signal Source with the Substitution Antenna and the Substitution Antenna Gain (Ga) should be recorded after test.

An amplifier should be connected in for the test.

The Path loss (Pcl) is the summation of the cable loss and the gain of the amplifier.

The measurement results are obtained as described below:

Power (EIRP) =PMea- Pcl + Ga

5.This value is EIRP since the measurement is calibrated using an antenna of known gain (unit: dBi) and known input power.

6.ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dBi.

### 6.2.3 Measurement Results

Radiated emissions measurements were made at the upper, middle, and lower carrier frequencies of the LTE Bands.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 the LTE Bands. Into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this. The evaluated frequency range is from 30MHz to ten times the main frequency signal. The final data result takes the worst pattern data and places it in the report.

Band	BW (MHz)	Low Freq. (MHz)	Mid Freq. (MHz)	High Freq. (MHz)	Result
Band 2	1.4	1850.7	1880	1909.3	PASS
	3	1851.5	1880	1908.5	PASS
	5	1852.5	1880	1907.5	PASS
	10	1855	1880	1905	PASS
	15	1857.5	1880	1902.5	PASS
	20	1860	1880	1900	PASS
Band 4	1.4	1710.7	1732.5	1754.3	PASS
	3	1711.5	1732.5	1753.5	PASS
	5	1712.5	1732.5	1752.5	PASS
	10	1715	1732.5	1750	PASS
	15	1717.5	1732.5	1747.5	PASS
	20	1720	1732.5	1745	PASS
Band 5	1.4	824.7	836.5	848.3	PASS
	3	825.5	836.5	847.5	PASS
	5	826.5	836.5	846.5	PASS
	10	829	836.5	844	PASS
Band 12	1.4	699.7	707.5	715.3	PASS
	3	700.5	707.5	714.5	PASS
	5	701.5	707.5	713.5	PASS
	10	704	707.5	711	PASS
Band 13	5	779.5	782	784.5	PASS
	10	782	782	782	PASS
Band 66	1.4	1710.7	1745	1779.3	PASS

Band	BW (MHz)	Low Freq. (MHz)	Mid Freq. (MHz)	High Freq. (MHz)	Result
	3	1711.5	1745	1778.5	PASS
	5	1712.5	1745	1777.5	PASS
	10	1715	1745	1775	PASS
	15	1717.5	1745	1772.5	PASS
	20	1720	1745	1770	PASS
Band 71	5	665.5	680.5	695.5	PASS
	10	668	680.5	693	PASS
	15	670.5	680.5	690.5	PASS
	20	673	680.5	688	PASS

Only the worst mode data is provided

#### RSE-CATM2-L

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3701.2	-22.28	6.6	7.9	-20.98	-13	7.98	H
4275.6	-40.92	7.1	8.9	-39.12	-13	26.12	H
5552.4	-35.3	8.2	9.8	-33.7	-13	20.70	H
7402.4	-44.79	9.7	11.6	-42.89	-13	29.89	H
9254.0	-46.77	10.7	12.7	-44.77	-13	31.77	V
12954.4	-34.64	13.2	12.3	-35.54	-13	22.54	V

#### RSE-CATM2-M

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3211.6	-46.03	6.1	6.9	-45.23	-13	32.23	H
3760.0	-25.61	6.6	7.9	-24.31	-13	11.31	V
4360.0	-45.41	7.2	8.9	-43.71	-13	30.71	V
5640.8	-44.71	8.3	10.2	-42.81	-13	29.81	V
7519.6	-41.29	9.7	11.6	-39.39	-13	26.39	V
13158.8	-36.58	13.0	12.3	-37.28	-13	24.28	V

#### RSE-CATM2-H

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3051.6	-40.45	6.0	6.7	-39.75	-13	26.75	V



3819.6	-25.46	6.7	7.9	-24.26	-13	11.26	H
4310.0	-45.36	7.1	8.9	-43.56	-13	30.56	H
5728.0	-36.87	8.5	10.2	-35.17	-13	22.17	V
7637.2	-42.52	9.7	11.8	-40.42	-13	27.42	V
13364.6	-34.94	13.7	12.3	-36.34	-13	23.34	V

**RSE-CATM4-L**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3421.6	-28.32	6.3	7.8	-26.82	-13	13.82	V
4100.0	-54.81	7.0	8.6	-53.21	-13	40.21	H
5132.4	-41.07	7.9	9.4	-39.57	-13	26.57	H
6843.2	-47.31	9.2	10.9	-45.61	-13	32.61	V
8553.6	-46.78	10.3	12.6	-44.48	-13	31.48	H
13685.2	-38.94	13.9	12.3	-40.54	-13	27.54	V

**RSE-CATM4-M**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3464.8	-28.27	6.4	7.8	-26.87	-13	13.87	V
5197.2	-39.73	8.0	9.4	-38.33	-13	25.33	V
6930.4	-48.71	9.3	11.1	-46.91	-13	33.91	V
8662.4	-50.86	10.3	12.7	-48.46	-13	35.46	V
12127.0	-41.11	12.6	12.3	-41.41	-13	28.41	V
13860.2	-38.89	13.5	12.3	-40.09	-13	27.09	H

**RSE-CATM4-H**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3509.2	-29.35	6.4	7.8	-27.95	-13	14.95	V
5262.0	-40.73	8.0	9.4	-39.33	-13	26.33	V
7206.8	-48.53	9.5	11.4	-46.63	-13	33.63	V

9549.2	-49.87	10.7	12.7	-47.87	-13	34.87	H
12279.6	-43.01	12.7	12.3	-43.41	-13	30.41	V
16705.0	-36.23	15.1	12.3	-39.03	-13	26.03	H

**RSE-CATM5-L**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1649.3	-40.56	4.2	4.7	-40.06	-13	27.06	V
2475.4	-45.61	5.4	5.6	-45.41	-13	32.41	V
3334.4	-53.77	6.2	6.9	-53.07	-13	40.07	V
4297.6	-53.09	7.1	8.9	-51.29	-13	38.29	H
5875.6	-53.01	8.5	10.2	-51.31	-13	38.31	H
8013.4	-53.25	9.9	12.2	-50.95	-13	37.95	V

**RSE-CATM5-M**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1672.9	-42.55	4.5	4.7	-42.35	-13	29.35	V
2514.6	-43.08	5.4	5.6	-42.88	-13	29.88	H
3345.2	-51.5	6.2	6.9	-50.8	-13	37.80	V
4183.2	-54.13	7.0	8.9	-52.23	-13	39.23	H
5239.6	-51.11	8.0	9.4	-49.71	-13	36.71	H
6621.2	-51.13	9.1	10.6	-49.63	-13	36.63	V

**RSE-CATM5-H**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1697.5	-44.2	4.5	4.7	-44	-13	31.00	V
2530.0	-43.49	5.4	5.6	-43.29	-13	30.29	H
3393.6	-50.79	6.3	7.8	-49.29	-13	36.29	V
4242.8	-53.74	7.1	8.9	-51.94	-13	38.94	H
5028.8	-52.59	7.8	9.6	-50.79	-13	37.79	H



7441.3	-49.34	9.7	11.6	-47.44	-13	34.44	V
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**RSE-CATM12-L**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1399.1	-48.9	4.0	5.3	-47.6	-13	34.60	V
2099.2	-45.9	4.9	4.5	-46.3	-13	33.30	V
2782.7	-41.35	5.7	6.1	-40.95	-13	27.95	H
3498.4	-49.98	6.4	7.8	-48.58	-13	35.58	V
4292.8	-53.32	7.1	8.9	-51.52	-13	38.52	H
7439.5	-48.27	9.7	11.6	-46.37	-13	33.37	H

**RSE-CATM12-M**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1414.0	-49.24	4.0	5.3	-47.94	-13	34.94	V
2122.7	-43.84	4.9	4.5	-44.24	-13	31.24	V
2811.2	-41.66	5.7	6.1	-41.26	-13	28.26	H
3537.2	-47.25	6.4	7.8	-45.85	-13	32.85	V
4852.0	-51.18	7.6	9.0	-49.78	-13	36.78	H
7277.5	-47.56	9.6	11.4	-45.76	-13	32.76	V

**RSE-CATM12-H**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1431.3	-50.06	4.1	5.3	-48.86	-13	35.87	V
2145.8	-44.36	5.0	5.1	-44.26	-13	31.26	H
2816.9	-42.23	5.7	6.1	-41.83	-13	28.83	V
3576.4	-46.5	6.5	7.8	-45.2	-13	32.20	V
4291.2	-52.33	7.1	8.9	-50.53	-13	37.53	H
5090.8	-52.02	7.9	9.6	-50.32	-13	37.32	H

**RSE-CATM13-L**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1555.9	-46.34	4.2	5.3	-45.24	-13	32.24	V
3111.2	-50.03	6.0	6.7	-49.33	-13	36.33	H
3888.8	-48.74	6.8	8.6	-46.94	-13	33.94	V
4960.4	-51.36	7.7	9.6	-49.46	-13	36.46	V
6307.2	-52.18	8.8	10.3	-50.68	-13	37.68	V
7946.5	-52.85	9.8	12.2	-50.45	-13	37.45	V

**RSE-CATM13-M**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1563.8	-46.91	4.2	5.3	-45.81	-13	32.81	V
2318.5	-45.35	5.1	5.1	-45.35	-13	32.35	V
3182.8	-47.5	6.1	6.9	-46.7	-13	33.70	H
3910.0	-53.33	6.8	8.6	-51.53	-13	38.53	V
4543.6	-52.92	7.4	8.7	-51.62	-13	38.62	H
5312.4	-52.87	8.0	9.4	-51.47	-13	38.47	H

**RSE-CATM13-H**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1569.7	-51.44	4.2	5.3	-50.34	-13	37.34	H
3210.4	-49.33	6.1	6.9	-48.53	-13	35.53	H
3922.0	-52.96	6.8	8.6	-51.16	-13	38.16	H
4852.4	-51.53	7.6	9.0	-50.13	-13	37.13	H
6246.0	-50.65	8.8	10.3	-49.15	-13	36.15	V
7278.7	-47.4	9.6	11.4	-45.6	-13	32.60	H

**RSE-CATM66-L**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
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3421.2	-25.64	6.3	7.8	-24.14	-13	11.14	V
5131.6	-41.53	7.9	9.4	-40.03	-13	27.03	V
6842.8	-49.3	9.2	10.9	-47.6	-13	34.60	V
8552.8	-47.98	10.3	12.6	-45.68	-13	32.68	H
11974.4	-37.32	12.6	12.3	-37.62	-13	24.62	V
13689.4	-38.83	13.9	12.3	-40.43	-13	27.43	V

**RSE-CATM66-M**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3489.2	-28.95	6.4	7.8	-27.55	-13	14.55	V
5235.6	-39.03	8.0	9.4	-37.63	-13	24.63	H
7277.2	-48.36	9.6	11.4	-46.56	-13	33.56	H
8725.2	-48.92	10.4	12.7	-46.62	-13	33.62	H
12215.2	-36.48	12.6	12.3	-36.78	-13	23.78	V
13959.6	-39.34	13.7	12.3	-40.74	-13	27.74	H

**RSE-CATM66-H**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
3559.2	-29.72	6.4	7.8	-28.32	-13	15.32	V
4180.8	-45.2	7.0	8.9	-43.3	-13	30.30	H
5338.0	-33.7	8.1	9.4	-32.4	-13	19.40	H
7439.2	-48.74	9.7	11.6	-46.84	-13	33.84	V
12454.6	-36.27	12.7	12.3	-36.67	-13	23.67	V
14236.8	-39.63	13.7	12.3	-41.03	-13	28.03	V

**RSE-CATM71-L**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1327.8	-44.82	3.9	3.0	-45.72	-13	32.72	H
1995.8	-48.98	4.8	4.5	-49.28	-13	36.29	H

2601.5	-43.76	5.5	5.6	-43.66	-13	30.66	H
3318.8	-48.17	6.2	6.9	-47.47	-13	34.47	V
3981.6	-51.13	6.9	8.6	-49.43	-13	36.43	V
5046.0	-53.28	7.8	9.6	-51.48	-13	38.48	V

**RSE-CATM71-M**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1357.5	-44.89	3.9	3.0	-45.79	-13	32.79	H
2041.5	-48.3	4.8	4.5	-48.6	-13	35.60	V
2714.6	-42.47	5.6	6.1	-41.97	-13	28.97	H
3393.6	-44.14	6.3	7.8	-42.64	-13	29.64	V
4072.8	-53.14	6.9	8.6	-51.44	-13	38.44	H
7277.8	-46.96	9.6	11.4	-45.16	-13	32.16	H

**RSE-CATM71-H**

Frequency (MHz)	PMea (dBm)	Pcl (dBm)	Ga (dBd)	Test Result (dBm)	Limit (dBm)	Margin(dBm)	Polarization
1387.7	-48.82	4.0	5.3	-47.52	-13	34.52	H
2081.5	-47.67	4.9	4.5	-48.07	-13	35.07	H
2780.4	-42.39	5.7	6.1	-41.99	-13	28.99	V
3470.0	-50.2	6.4	7.8	-48.8	-13	35.80	V
4162.4	-53	7.0	8.9	-51.1	-13	38.10	H
5203.2	-51.8	8.0	9.4	-50.4	-13	37.40	H



**Annex A: Revised History**

Version	Revised Content
V0	Initial

Annex B: Accreditation Certificate



The image shows an accreditation certificate from A2LA. At the top, there are logos for ILAC-MRA and A2LA. The main title is "Accredited Laboratory". Below that, it states "A2LA has accredited" followed by "INDUSTRIAL INTERNET INNOVATION CENTER (SHANGHAI) CO., LTD." and "Shanghai, People's Republic of China". The field of accreditation is "Electrical Testing". A paragraph explains that the laboratory is accredited to ISO/IEC 17025:2017. A gold seal on the left says "CORPORATE SEAL 1978" and "A2LA". A signature and name "Mr. Trace McInturff" are on the right, along with the certificate number "3682.01" and validity date "February 28, 2025". A footer note refers to the laboratory's Electrical Scope of Accreditation.

**Accredited Laboratory**

A2LA has accredited

**INDUSTRIAL INTERNET INNOVATION CENTER  
(SHANGHAI) CO., LTD.**  
Shanghai, People's Republic of China

for technical competence in the field of  
**Electrical Testing**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

Presented this 20<sup>th</sup> day of September 2023.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 3682.01  
Valid to February 28, 2025

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

END OF REPORT