



RF TEST REPORT

Applicant Quectel Wireless Solutions Co., Ltd
FCC ID XMR201606EC21A
Product LTE Module
Brand Quectel
Model EC21-A, EC21-A MINIPCIE
Report No. R1805A0226-R1V3
Issue Date June 12, 2018

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 2 (2017)/ FCC CFR 47 Part 22H (2017)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Performed by: Jiangpeng Lan

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Summary of measurement results

No.	Test Type	Clause in FCC rules	Verdict
1	RF power output	2.1046	PASS
2	Effective Radiated Power	22.913(a)(2)	PASS
3	Radiates Spurious Emission	2.1053 / 22.917 (a)	PASS
Date of Testing: May 24, 2018~ June 3, 2018			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard.			



1. Test Laboratory

1.1. Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein .Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test facility

CNAS (accreditation number: L2264)

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

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

IC (recognition number is 8510A)

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

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

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

A2LA (Certificate Number: 3857.01)

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



1.3. Testing Location

Company: TA Technology (Shanghai) Co., Ltd.
Address: No.145, Jintang Rd, Tangzhen Industry Park, Pudong
City: Shanghai
Post code: 201201
Country: P. R. China
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E-mail: xukai@ta-shanghai.com

2. General Description of Equipment under Test

Client Information

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

General Information

EUT Description			
Model	EC21-A, EC21-A MINIPCIE		
IMEI	861108037284717		
Hardware Version	R1.1		
Software Version	EC21AGBR05A05M4G		
Power Supply	External Power Supply		
Antenna Type	External Antenna (The EUT don't have standard Antenna. The Antenna used for testing in this report is the after-market accessory.)		
Test Mode(s)	WCDMA Band V		
Test Modulation	QPSK		
HSDPA UE Category	24		
HSUPA UE Category	6		
DC-HSDPA UE Category	24		
HSPA+ Uplink Category	6		
Maximum E.R.P.	WCDMA Band V:	18.38dBm	
Rated Power Supply Voltage	3.8V		
Extreme Voltage	Minimum: 3.3V Maximum: 4.3V		
Extreme Temperature	Lowest: -30°C Highest: +50°C		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WCDMA Band V	824 ~ 849	869 ~ 894
Note: The information of the EUT is declared by the manufacturer.			

EC21-A, EC21-A MINIPCIE (Report No: R1805A0226-R1V3) is a variant model of EC21-A, EC21-A MINIPCIE (Report No: RTWK160719001-00). Only RF Power Output, Effective Radiated power and Radiates Spurious Emission are tested for variant in this report. Other test items refer to the original report. The detailed product change description please refers to the ANNEX B.



3. Applied Standards

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

FCC CFR47 Part 2 (2017)

FCC CFR 47 Part 22H (2017)

ANSI/TIA-603-E (2016)

KDB 971168 D01 Power Meas License Digital Systems v03r01

4. Test Configuration

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes. EUT stand-up position (Z axis), lie-down position (X, Y axis). Receiver antenna polarization (horizontal and vertical), the worst emission was found in position (Z axis, horizontal polarization) and the worst case was recorded.

All mode and data rates and positions were investigated. Subsequently, only the worst case emissions are reported.

The following testing in WCDMA is set based on the maximum RF Output Power.

Test modes are chosen to be reported as the worst case configuration below:

Test items	Modes/Modulation
	WCDMA Band V
RF power output	RMC HSDPA/HSUPA DC-HSDPA
Effective Radiated Power	RMC
Radiates Spurious Emission	RMC

5. Test Case Results

5.1. RF Power Output

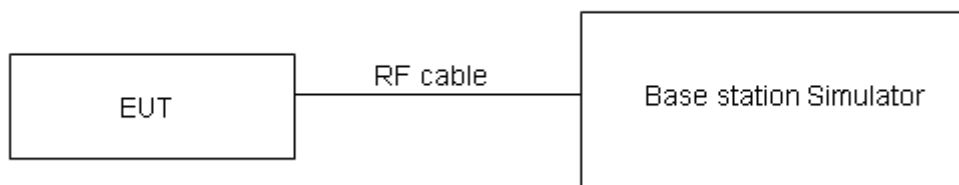
Ambient condition

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

Methods of Measurement

During the process of the testing, The EUT is controlled by the Base Station Simulator to ensure max power transmission and proper modulation.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Limits

No specific RF power output requirements in part 2.1046.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.4$ dB.

Test Results

WCDMA Band V		Conducted Power(dBm)		
		Channel 4132	Channel 4183	Channel 4233
		826.4(MHz)	836.6(MHz)	846.6(MHz)
RMC		23.35	23.37	23.35
HSDPA	Sub - Test 1	22.38	22.37	22.34
	Sub - Test 2	22.43	22.48	22.41
	Sub - Test 3	21.86	21.81	21.85
	Sub - Test 4	21.94	21.97	21.94
HSUPA	Sub - Test 1	22.31	22.26	22.40
	Sub - Test 2	21.88	21.86	21.94
	Sub - Test 3	22.32	22.30	22.42
	Sub - Test 4	22.39	22.49	22.48
	Sub - Test 5	22.36	22.39	22.34
DC-HSDPA	Sub - Test 1	23.22	23.24	23.22
	Sub - Test 2	23.20	23.23	23.21
	Sub - Test 3	22.69	22.72	22.70
	Sub - Test 4	22.68	22.71	22.69

5.2. Effective Radiated Power

Ambient condition

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

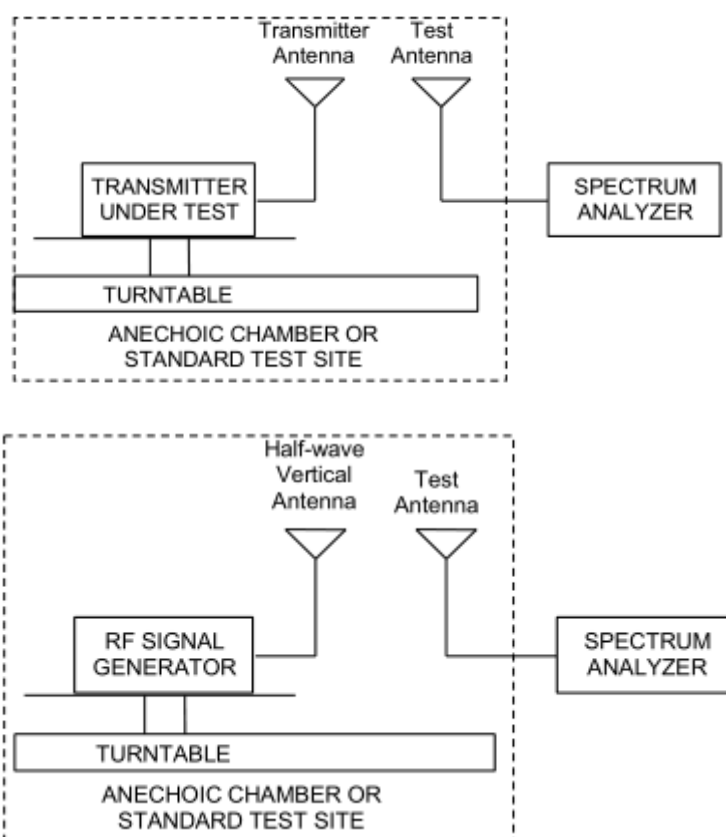
Methods of Measurement

The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI/TIA-603-E (2016).

- Connect the equipment as illustrated. Mount the equipment with the manufacturer specified antenna in a vertical orientation on a manufacturer specified mounting surface located on a non-conducting rotating platform of a RF anechoic chamber (preferred) or a standard radiation site.
- Key the transmitter, then rotate the EUT 360° azimuthally and record spectrum analyzer power level (LVL) measurements at angular increments that are sufficiently small to permit resolution of all peaks. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading at each angular increment. (Note: several batteries may be needed to offset the effect of battery voltage droop, which should not exceed 5% of the manufactured specified battery voltage during transmission).
- Replace the transmitter under test with a vertically polarized half-wave dipole (or an antenna whose gain is known relative to an ideal half-wave dipole). The center of the antenna should be at the same location as the center of the antenna under test.
- Connect the antenna to a signal generator with a known output power and record the path loss (in dB) as LOSS. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading. $LOSS = \text{Generator Output Power (dBm)} - \text{Analyzer reading (dBm)}$
- Determine the effective radiated output power at each angular position from the readings in steps b) and d) using the following equation: $ERP \text{ (dBm)} = LVL \text{ (dBm)} + LOSS \text{ (dB)}$
- The maximum ERP is the maximum value determined in the preceding step.
- When calculating ERP, in addition to knowing the antenna radiation and matching characteristics, it is necessary to know the loss values of all elements (e.g. transmission line attenuation, mismatches, filters, combiners) interposed between the point where transmitter output power is measured, and the point where power is applied to the antenna. ERP can then be calculated as follows:
 $ERP \text{ (dBm)} = \text{Output Power (dBm)} - \text{Losses (dB)} + \text{Antenna Gain (dBd)}$
 where: dBd refers to gain relative to an ideal dipole.
 $EIRP \text{ (dBm)} = ERP \text{ (dBm)} + 2.15 \text{ (dB.)}$

The RB allocation refers to section 5.1, using the maximum output power configuration.

Test setup



Limits

Rule Part 22.913(a) specifies that "Mobile/portable stations are limited to 7 watts ERP".

Limit	$\leq 7 \text{ W}$ (38.45 dBm)
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Measurement Uncertainty

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

**Test Results:**

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

Mode	Channel	Frequency (MHz)	Polarization	ERP (dBm)	Limit (dBm)	Conclusion
WCDMA Band V	Low	826.4	Horizontal	18.38	38.45	Pass
	Mid	836.6	Horizontal	18.04	38.45	Pass
	High	846.6	Horizontal	17.72	38.45	Pass

5.3. Radiates Spurious Emission

Ambient condition

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

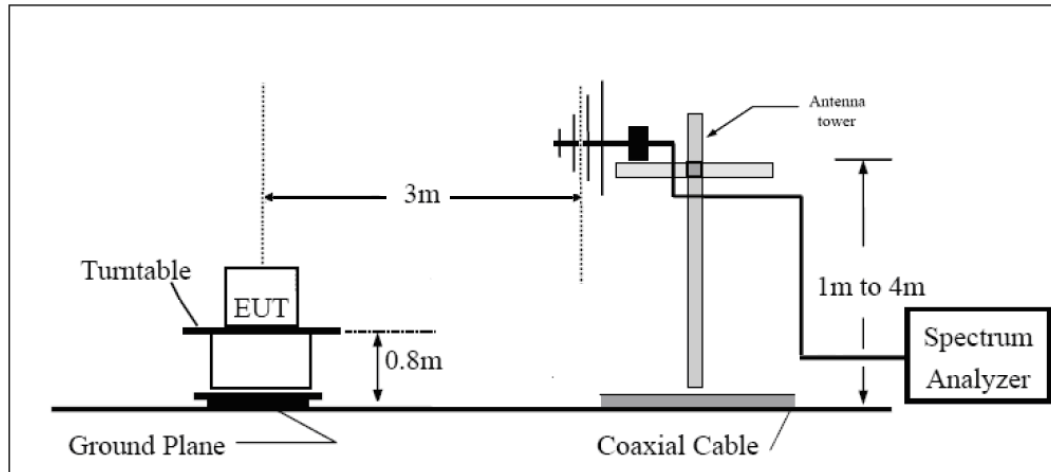
Method of Measurement

1. The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI/TIA-603-E (2016).
2. The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).
3. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
4. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz for above 1GHz and RBW=100kHz, VBW=300kHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (Pr).
5. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
6. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl), the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
7. The measurement results are obtained as described below:
$$\text{Power(EIRP)} = \text{PMea} - \text{PAg} - \text{Pcl} + \text{Ga}$$

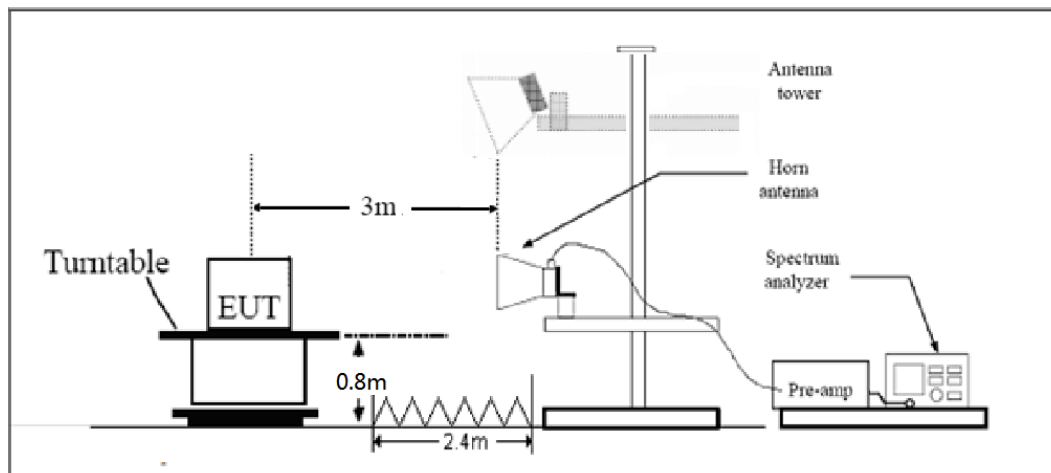
The measurement results are amend as described below:
$$\text{Power(EIRP)} = \text{PMea} - \text{Pcl} + \text{Ga}$$
8. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power. ERP can be calculated from EIRP by subtracting the gain of the dipole, $\text{ERP} = \text{EIRP} - 2.15\text{dBi}$.
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

Test setup

30MHz~1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

Limits

Rule Part 22.917(a) specifies that “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.”

Limit	-13 dBm
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U = 3.55$ dB.

**Test Result**

Sweep the whole frequency band through the range from 30MHz to the 10th harmonic of the carrier, from 30MHz to 1GHz are all noise floor will not be recorded in the report.

WCDMA Band V CH-Low

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1652.8	-69.26	2	10.15	Horizontal	-63.26	-13.00	50.26	180
3	2479.2	-63.07	2.51	11.35	Horizontal	-56.38	-13.00	43.38	135
4	3305.6	-68.84	4.2	10.85	Horizontal	-64.34	-13.00	51.34	315
5	4132.0	-65.29	5.2	11.35	Horizontal	-61.29	-13.00	48.29	315
6	4958.4	-64.72	5.5	11.95	Horizontal	-60.42	-13.00	47.42	270
7	5784.8	-63.21	5.7	13.55	Horizontal	-57.51	-13.00	44.51	45
8	6611.2	-61.43	6.3	13.75	Horizontal	-56.13	-13.00	43.13	90
9	7437.6	-61.84	6.8	13.85	Horizontal	-56.94	-13.00	43.94	315
10	8264.0	-62.19	6.9	14.25	Horizontal	-56.99	-13.00	43.99	270

Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor.
2.The worst emission was found in the antenna is Horizontal position.

WCDMA Band V CH-Middle

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1673.2	-68.43	2	10.75	Horizontal	-61.83	-13.00	48.83	90
3	2509.8	-62.68	2.51	11.05	Horizontal	-56.29	-13.00	43.29	135
4	3346.4	-68.18	4.2	11.15	Horizontal	-63.38	-13.00	50.38	225
5	4183.0	-63.38	5.2	11.15	Horizontal	-59.58	-13.00	46.58	45
6	5019.6	-65.11	5.5	11.95	Horizontal	-60.81	-13.00	47.81	90
7	5856.2	-63.49	5.7	13.55	Horizontal	-57.79	-13.00	44.79	180
8	6692.8	-62.05	6.3	13.75	Horizontal	-56.75	-13.00	43.75	315
9	7529.4	-61.78	6.8	13.85	Horizontal	-56.88	-13.00	43.88	90
10	8366.0	-62.52	6.9	14.25	Horizontal	-57.32	-13.00	44.32	270

Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor.
2.The worst emission was found in the antenna is Horizontal position.



WCDMA Band V CH-High

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1693.2	-67.08	2	10.15	Horizontal	-61.08	-13.00	48.08	225
3	2539.8	-63.88	2.51	11.05	Horizontal	-57.49	-13.00	44.49	270
4	3386.4	-68.83	4.2	11.15	Horizontal	-64.03	-13.00	51.03	180
5	4233.0	-63.45	5.2	11.15	Horizontal	-59.65	-13.00	46.65	135
6	5079.6	-54.35	5.5	11.95	Horizontal	-50.05	-13.00	37.05	90
7	5926.2	-62.64	5.7	13.55	Horizontal	-56.94	-13.00	43.94	45
8	6772.8	-62.53	6.3	13.75	Horizontal	-57.23	-13.00	44.23	180
9	7619.4	-62.26	6.8	13.85	Horizontal	-57.36	-13.00	44.36	135
10	8466.0	-61.21	6.9	14.25	Horizontal	-56.01	-13.00	43.01	90
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2.The worst emission was found in the antenna is Horizontal position.									

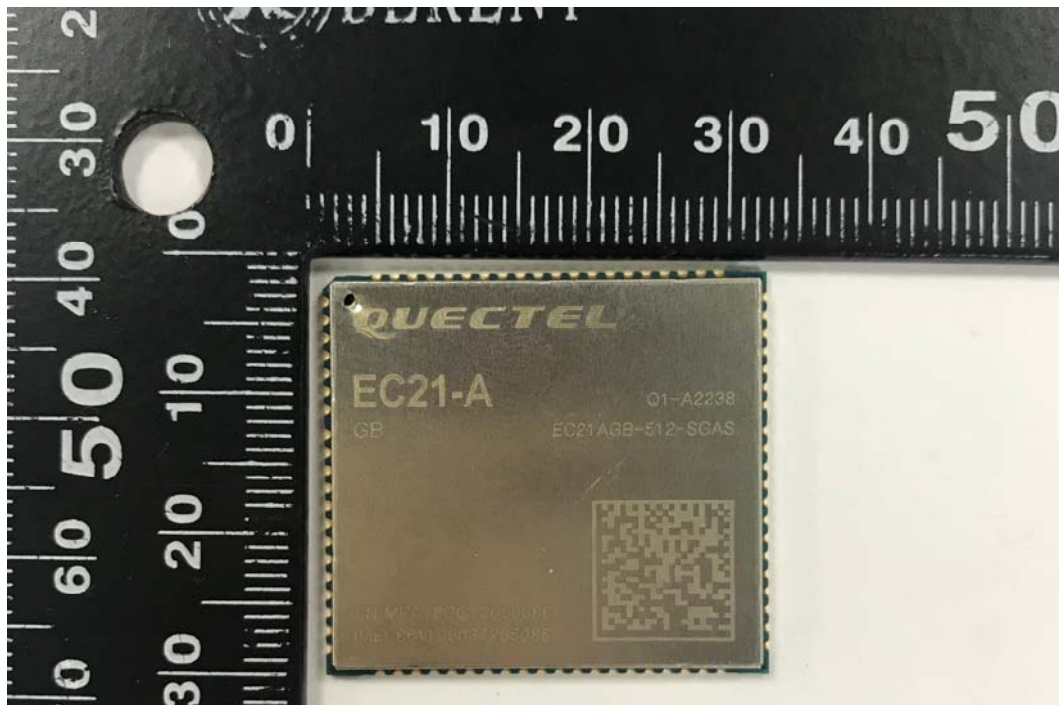
6. Main Test Instruments

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
Power Splitter	Hua Xiang	SHX-GF2-2-13	10120101	NA	NA
Spectrum Analyzer	Agilent	N9010A	MY47191109	2018-05-20	2019-05-19
Universal Radio Communication Tester	Agilent	E5515C	MY48367192	2018-05-20	2019-05-19
Signal Analyzer	R&S	FSV30	100815	2017-12-17	2018-12-16
EMI Test Receiver	R&S	ESCI	100948	2018-05-20	2019-05-19
Signal generator	R&S	SMB 100A	102594	2018-05-13	2019-05-12
Loop Antenna	SCHWARZBECK	FMZB1519	1519-047	2014-12-06	2019-12-05
Trilog Antenna	SCHWARZBECK	VUBL 9163	9163-201	2017-11-18	2020-11-17
Horn Antenna	R&S	HF907	100126	2014-12-06	2019-12-05
Horn Antenna	ETS-Lindgren	3160-09	00102644	2015-01-30	2020-01-29
Climatic Chamber	Re Ce	PT-30B	20101891	2015-07-18	2018-07-17
RF Cable	Agilent	SMA 15cm	0001	2018-02-03	2018-08-02
Preamplifier	R&S	SCU18	102327	2017-06-18	2018-06-17
Software	R&S	EMC32	V 8.52.0	NA	NA
MOB COMMS DC SUPPLY	Keysight	66319D	MY43004105	2018-05-07	2019-05-06

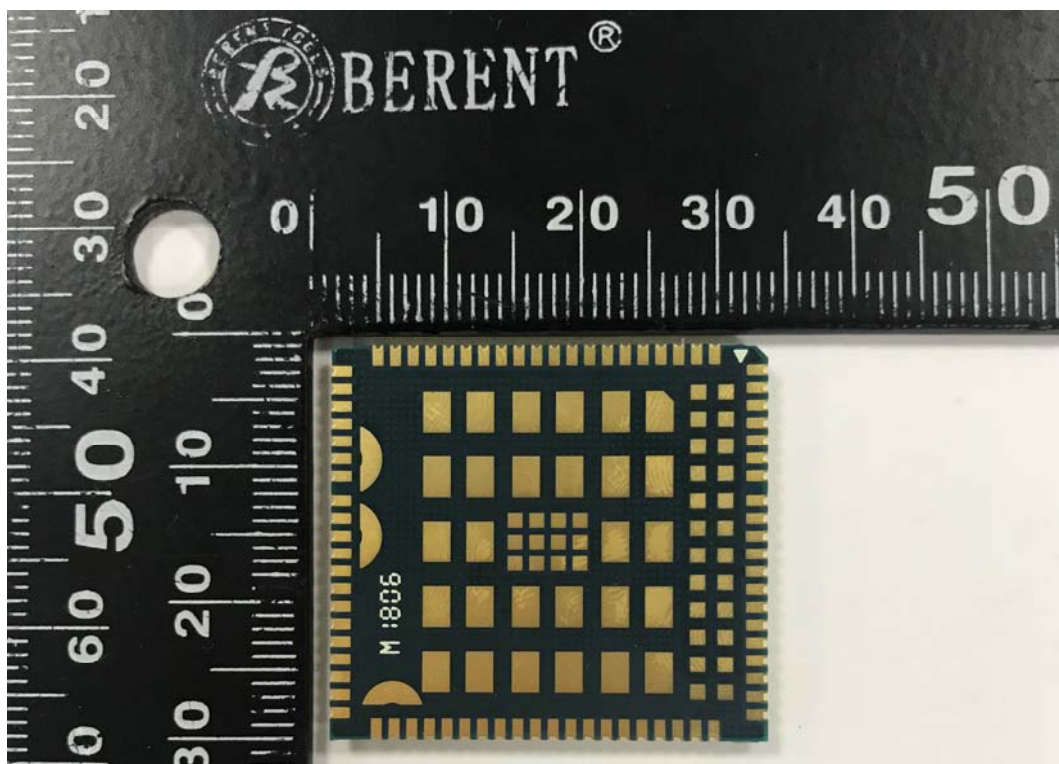
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ANNEX A: EUT Appearance and Test Setup

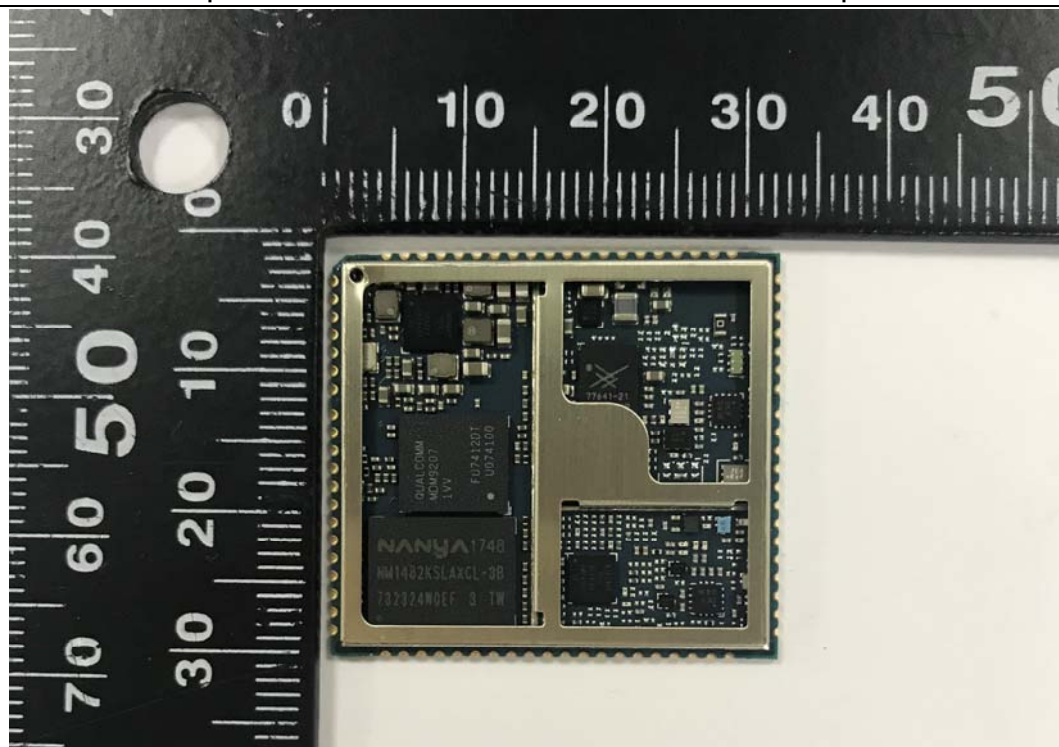
A.1 EUT Appearance



Front Side



Back Side



No sheilding

a: EUT

Picture 1 EUT and Accessory

A.2 Test Setup



Picture 2: Radiated Spurious Emissions Test setup

ANNEX B: Product Change Description

We Quectel Wireless Solutions Co., Ltd declare the following models.

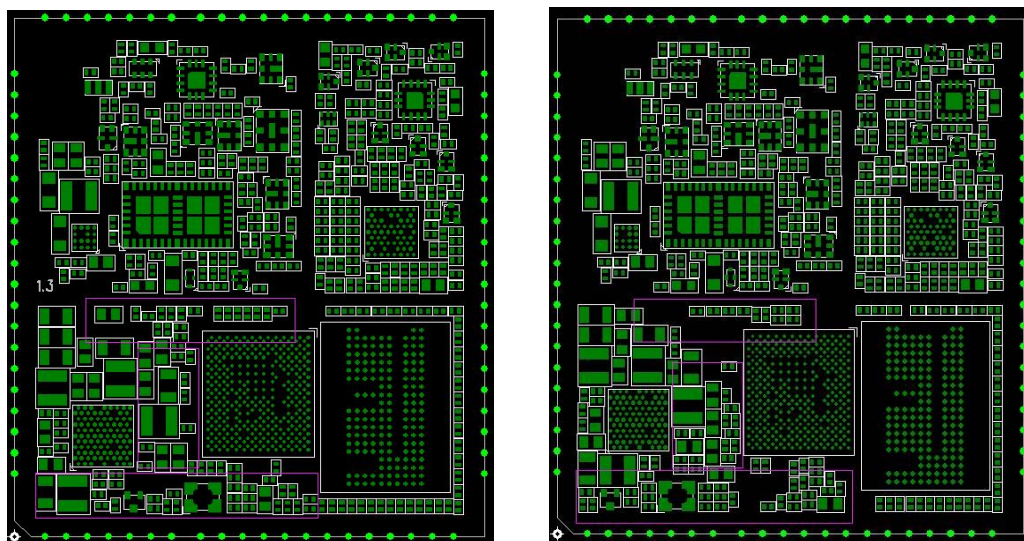
Product Name: LTE Module

Model Number: EC21-A, EC21-A MINIPCIE,
EC21-V, EC21-V MINIPCIE,

Hardware version: Refer to below table

Model	Certified HW Version A	New HW Version B
EC21-A, EC21-A MINIPCIE	R1.0	R1.1
EC21-V, EC21-V MINIPCIE	R1.0	R1.1

All above series models share the same hardware and software design. Here we need to update the hardware to improve power supply. There are some differences between **Certified HW Version A** and **New HW Version B** on PCB design which are some capacitors and resistors' location which used for BB. The details are shown as following pictures and table.



Designator	R1.0 Position (mm, mm)	R1.1 Position (mm, mm)
C0301	(5.8, 13.7)	(9.7,6.89)
C0306	(7.475, 13.75)	(10.84,7.81)
C0310	-	(8.707, 13.847)
C0307	(10.85, 11.1)	-
C0328	(8.85, 12.78)	-
C0227	(8.085, 11.15)	-
R0501	(16.35, 13.9)	(19.08, 13.91)
C0340	-	(9.23, 1.7)



C0402	-	(12.37, 4.25)
C0227	(8.085, 11.15)	(4.45, 13.58)
C0330	(9.1, 11.375)	(9.66, 5.12)
C0211	(2.575, 11.03)	(2.42, 12.35)
L0201	(2.35, 9.15)	(2.32, 10.45)
L0202	(8.925, 7.1)	(8.15, 7.94)
C0214	(1.91, 2.73)	(1.89, 4.05)
L0204	(3.62, 2.64)	(3.78, 3.97)
Y0101	(11.61, 2.45)	(7.45, 2.39)
Q0101	(7.36, 2.125)	(3.32, 2.12)
C0317	(15.46, 2.3)	(17.01, 1.87)

We hereby state that there is no any other internal difference between them and the change is layout part of power supply BB which won't affect the RF portions and the original RF data can be re-used.

Your assistance on this matter is highly appreciated.

Sincerely,

Name: Jean Hu

Title: Certification Section