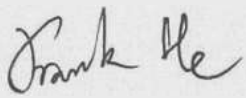
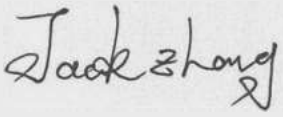
DEKRA Testing and Certification (Suzhou) Co., Ltd.
No.99 Hongye Rd., Suzhou Industrial Park, Suzhou, 215006, Jiangsu, China
TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098

Test report No:
2050503R-RF-US-P40V01

FCC TEST REPORT

Product Name	GPS Tracker
Trademark	KAGA
FCC ID	BXTHKS1MU
Model and /or type reference	HKL-1MU,HKS-1MU,HKO-1MU
Applicant´s name / address	KAGA Electronics Co. ,Ltd. 20 Kandamatsunagacho,Chiyoda-ku, Tokyo
Test method requested, standard	FCC CFR Title 47 Part 22 & 24 & 27 & 90 ANSI C63.26: 2015 KDB971168 D01 v03r01, KDB971168 D02 v02r01 ANSI/TIA-603-E: 2016
Verdict Summary	IN COMPLIANCE
Documented by (name / position & signature)	Kitty Li/Project Assistant 
Reviewed by (name / position & signature)	Frank He/Technical Supervisor 
Approved by (name / position & signature)	Jack Zhang/Supervisor 
Date of issue	2020-07-17
Report template No	Template_FCC Part 22&24&27&90-RF-V1.0

INDEX

page

COMPETENCES AND GUARANTEES

DEKRA is a testing laboratory competent to carry out the tests described in this report.
In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

GENERAL CONDITIONS

Test Location	No. 99, Hongye Road, Suzhou Industrial Park Suzhou, 215006, P.R. China
Date(receive sample)	May. 21, 2020
Date (start test)	May. 23, 2020
Date (finish test)	Jul. 11, 2020

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or Competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA.

ENVIRONMENTAL CONDITIONS

The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment. The climatic conditions during the tests were within the following limits:

Ambient temperature	15 °C – 35 °C
Relative Humidity air	30% - 60%

If explicitly required in the basic standard or applied product / product family standard the climatic values are recorded and documented separately in this test report.

POSSIBLE TEST CASE VERDICTS

Test case does not apply to test object	N/A
Test object does meet requirement	P (Pass) / PASS
Test object does not meet requirement	F (Fail) / FAIL
Not measured	N/M

ABBREVIATIONS

For the purposes of the present document, the following abbreviations apply:

EUT : Equipment Under Test
QP : Quasi-Peak
CAV : CISPR Average
AV : Average
CDN : Coupling Decoupling Network
SAC : Semi-Anechoic Chamber
OATS : Open Area Test Site
BW : Bandwidth
AM : Amplitude Modulation
PM : Pulse Modulation
HCP : Horizontal Coupling Plane
VCP : Vertical Coupling Plane
U_N : Nominal voltage
*T*x : Transmitter
*R*x : Receiver
N/A : Not Applicable
N/M : Not Measured

DOCUMENT HISTORY

Report No.	Version	Description	Issued Date
2050503R-RF-US-P40V01	V1.0	Initial issue of report.	2020-04-30
2050503R-RF-US-P40V01	V1.1	1) Remove the model of HKM-1MU 2) Update the models differences	2020-07-31

REMARKS AND COMMENTS

1. The equipment under test (EUT) does meet the essential requirements of the stated standard(s)/test(s).
2. These test results on a sample of the device are for the purpose of demonstrating Compliance with FCC Part 22, 24, 27, 90.
3. The measurement result is considered in conformance with the requirement if it is within the prescribed limit, It is not necessary to account the uncertainty associated with the measurement result, unless the specification, standard or customer have special requirements.
4. The test results presented in this report relate only to the object tested.
5. The test results relate only to the samples tested.
6. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification (Suzhou) Co., Ltd.
7. This report will not be used for social proof function in China market.

USED EQUIPMENT

RF Output Power/Frequency Stability/Occupied Bandwidth/Spurious Emissions at antenna terminals/Spurious Emissons at antenna terminals at Block Edges / TR7

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A	MY48030494	2019.09.28	2020.09.27
Signal analyzer	R&S	FSV	104212	2019.12.28	2020.12.27
Wideband Radio Communication Tester	R&S	CMW 500	1201.0002K50-158243-jb	2019.08.30	2020.08.29
Directional Coupler	Midwest Microwave	CPL-5231-16-001	-	2019.08.31	2020.08.30
Dual Directional Coupler	Agilent	778D	20160	2019.09.28	2020.09.27
Temperature & Humidity Chamber	Gaoyu	TH-1P-B	WIT-05121302	2019.09.30	2020.09.29
Temperature/Humidity Meter	Zhichen	ZC1-2	TR7-TH	2019.08.21	2020.08.20

Radiated Emission(30MHz-1GHz) / AC3(Chamber details)

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
EMI Test Receiver	R&S	ESCI	100573	2020.03.03	2021.03.02
Bilog Antenna	Teseq GmbH	CBL6112D	27611	2019.09.23	2020.09.22
Temperature/Humidity Meter	RTS	RTS-8S	AC2-TH	2019.09.02	2020.09.01
Coaxial Cable	Huber+Suhner	RG 214	AC2-C	2020.04.13	2021.04.12
DEKRA test software	N/A	N/A	N/A	N/A	N/A

Radiated Emissions (1GHz-40GHz)/ AC5

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Signal analyzer	R&S	FSV	104212	2019.12.28	2020.12.27
Wideband Radio Communication Tester	R&S	CMW 500	1201.0002K50-158243-jb	2019.08.30	2020.08.29
ESG Vector Signal Generator	Agilent	E4438C	MY49070163	2019.09.30	2020.09.29
low Noise Amplifier	BXT	NA2651D	LNA17040209	2020.04.12	2021.04.11
Pre-Amplifier	Chengyi	EMC184045SE	980263	2020.06.13	2021.06.12
Half Wave Tuned Dipole Antenna	COM-POWER	AD-100	40137	2020.03.08	2021.03.07
Bilog Antenna	Schaffner	Schaffner	2932	2019.11.16	2020.11.15
DRG Horn	ETS-Lindgren	3117	00167055	2020.05.24	2021.05.23
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	294	2020.03.23	2021.03.22
Coaxial Cable	Huber+Suhner	SUCOFLEX 106	AC5-C2	2020.04.12	2021.04.11
Coaxial Cable	ROSENBERGER	LA1-C011-2000/3000	AC5-40G	2020.04.18	2021.04.17
Temperature/Humidity Meter	Riters	RTS-8S	AC5-TH	2019.09.02	2020.09.01
Dekra test software	Dekra	-	-	-	-

UNCERTAINTY

Uncertainties have been calculated according to the DEKRA internal document. The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Test item	Uncertainty
RF Output Power	± 1.13 dB
Frequency Stability	± 279 Hz
Occupied Bandwidth	± 279 Hz
Spurious Emissions at antenna terminals	± 1.13 dB
Spurious Emissions at antenna terminals at Block Edges	± 1.13 dB
Radiated Emission(30MHz~1GHz)	Horizontal: 30MHz~200MHz: 4.60 dB 200MHz~1GHz: 4.10 dB Vertical: 30MHz~200MHz: 4.80 dB 200MHz~1GHz: 4.10 dB
Radiated Emission(1GHz~26.5GHz)	Horizontal: 1GHz~18GHz: 5.00 dB Vertical: 1GHz~18GHz: 4.80 dB Horizontal: 18GHz~40GHz: 4.70 dB Vertical: 18GHz~40GHz: 4.60 dB

1 GENERAL INFORMATION

1.1 General Description of the Item(s)

Product Name..... :	GPS Tracker
Model No. ..... :	HKL-1MU,HKS-1MU,HKO-1MU
Trademark ..... :	KAGA
Software Version..... :	N/A
Manufacturer..... :	eSky wireless Inc
Manufacturer Address..... :	22-303,#328 xinghu street ,suzhou ,China

Wireless specifiction..... :	WCDMA
Support Band(s)	2/5
Uplink Frequency	Band 2: 1850-1910 MHz Band 5: 824-849 MHz
Downlink Frequency	Band 2: 1930-1990 MHz Band 5: 869-894 MHz
Type of Modulation..... :	BPSK, QPSK

Wireless specifiction..... :	LTE
Support Band(s)	2/4/5/7/12/13/25/26/41
Uplink Frequency	Band 2: 1850-1910 MHz Band 4: 1710-1755 MHz Band 5: 824-849 MHz Band 7: 2500-2570 MHz Band 12: 699-716 MHz Band 13: 777-787 MHz Band 25: 1850-1915 MHz Band 26: 814-849 MHz Band 41: 2496-2690 MHz
Downlink Frequency	Band 2: 1930-1990 MHz Band 4: 2110-2155 MHz Band 5: 869-894 MHz Band 7: 2620-2690 MHz Band 12: 729-746 MHz Band 13: 746-756 MHz Band 25: 1930-1995 MHz Band 26: 859-894 MHz Band 41: 2496-2690 MHz
Type of Modulation..... :	QPSK, 16QAM

Rated power supply .....:	Voltage and Frequency	
	☐	AC: 220 – 240 V, 50/60 Hz
	☐	AC: 100 – 120 V, 50/60 Hz
	☒	DC: 12 Vdc
	☐	Battery: 3.7V
Mounting position.....:	☐	Table top equipment
	☐	Wall/Ceiling mounted equipment
	☐	Floor standing equipment
	☐	Hand-held equipment
	☒	Other: Module

.

Note: All the product information is provided by the client.

1.2 Antenna Information

Antenna model / type number ..... :	LTE Antenna			
Antenna serial number ..... :	7O120C-36			
Antenna Delivery ..... :	☒	1TX + 1RX		
	☐	2TX + 2RX		
Antenna technology ..... :	☒	SISO		
	☐	MIMO	☐	CDD
			☐	Beam-forming
Antenna Type ..... :	☐	External	☐	Dipole
			☐	Sectorized
	☒	Internal	☐	PIFA
			☒	PCB
			☐	Ceramic Chip
			☐	Others……..
WCDMA Antenna Gain ..... :	Band 2: 2.67 dBi Band 5: -1.22 dBi			
LTE Antenna Gain ..... :	Band 2: 2.67 dBi Band 4: 1.32 dBi Band 5: -1.22 dBi Band 7: -1.28 dBi Band 12: -2.89 dBi Band 13: -2.89 dBi Band 25: 2.67 dBi Band 26: 0.02 dBi Band 41: -1.28 dBi			

Note: All the product information is provided by the client.

1.3 Model difference description

The difference among the three models are that CAN-BUS and Interface (connector), others part are the same(include the RF module)

	TCU		
	TCU-CAN(L) HKL-1MU	**TCU-STD HKS-1MU**	**TCU-OBD HKO-1MU**
Cellular Module	EG25-G (Quectel)		
Cellular Function	Packet, SMS		
GNSS	GPS/QZSS, Galileo, GLONASS, BeiDou （1.5m CEP-50）		
MCU	32 bit MCU （ARM Cortex-M3 Flash128KB+SRAM64KB）		
LED Indicator	Power, Cellular, GNSS		
Switch	Reboot		
Sensor	Accelerometer	Accelerometer, Pulse (Hall Effect)	Accelerometer
Cellular Antenna	Internal FPC Antenna		
GPS Antenna	Internal Ceramic Passive Antenna		
CAN-BUS	CAN 500K/250K	N/A	CAN 500K/250K Rx only (ES1: remove)
Terminal Resistance	N/A	N/A	N/A
SIM	4FF SIM Card		
Interface (connector)	Sumitomo 6187-4441, HM waterproof, 4pin, Male		OBDⅡ
	VIN, GND, CAN_H, CAN_L	VIN, GND, (CANL, CANH)	VIN, GND, CAN_H, CAN_L
Internal Battery	Li Battery 750 mAh		
Bluetooth	Bluetooth LE (Bluetooth 4.2)		

Note: All the information are from the client.

2 DESCRIPTION OF TEST SETUP

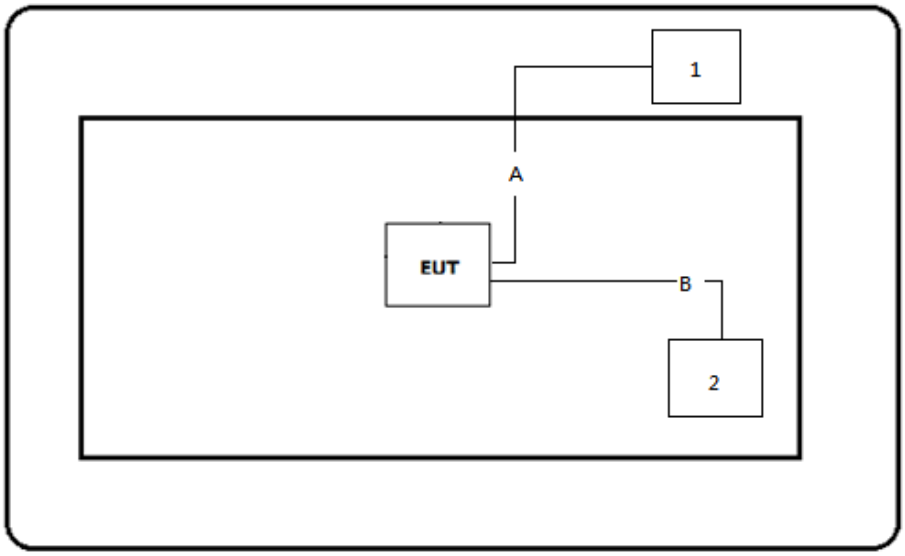
2.1 Auxiliary equipment / Test software for the EUT

No.	Auxiliary equipment	Model No.	Manufacturer	Supplied by
1	DC Power Supply	CD-035-020PR	IDRC	N/A
2	Wideband Radio Communication Tester	CMW 500	R&S	N/A

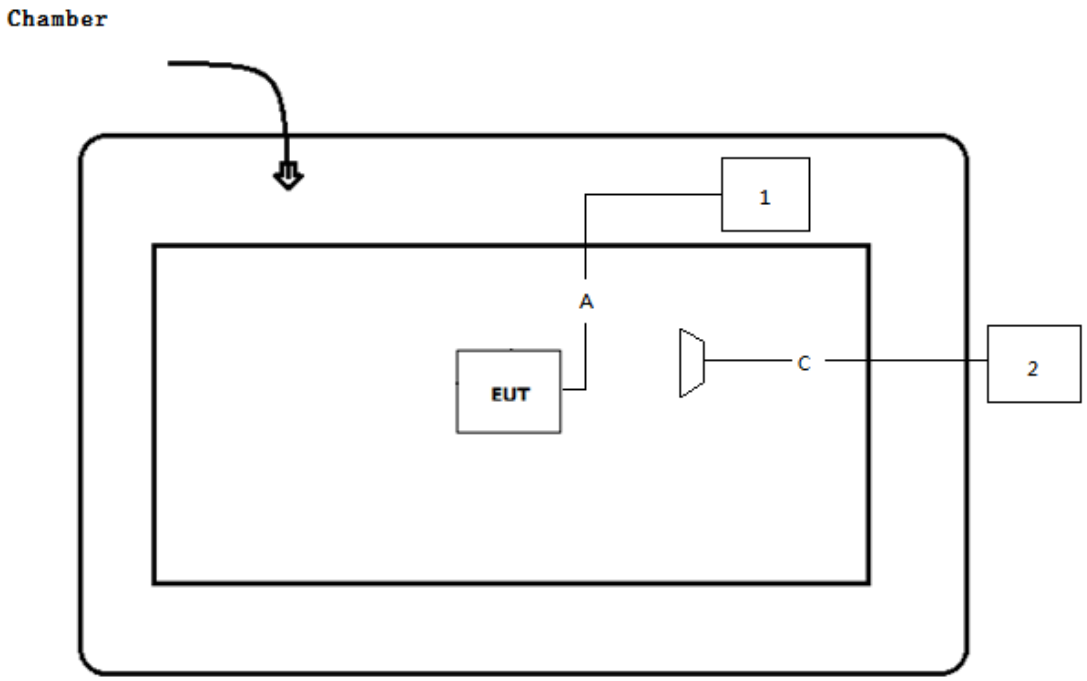
No.	Signal Cable Type	Signal Cable Description
A	Control Cable	Non-Shielded, 2m
B	Coaxial Cable	Shielded, 1.5m
C	Coaxial Cable	Shielded, 10m

2.2 Test Configuration / Block diagram used for tests

Conducted Connection Diagram



Radiated Connection Diagram



2.3 Testing process

1	Setup the EUT and simulators as shown on above.
2	Turn on the power of all equipment.
3	EUT Communicate with CMW 500, then select channel to test.

3 VERDICT SUMMARY SECTION

This chapter presents an overview of standards and results. Refer to the next chapters for details of measured test results and applied test levels.

3.1 Standards

Standard	Year	Description
FCC CFR Title 47 Part 2	2020	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
FCC CFR Title 47 Part 22	2020	PUBLIC MOBILE SERVICES
FCC CFR Title 47 Part 24	2020	PERSONAL COMMUNICATIONS SERVICES
FCC CFR Title 47 Part 27	2020	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES
FCC CFR Title 47 Part 90	2020	PRIVATE LAND MOBILE RADIO SERVICES

3.2 Deviation(s) from the Standard(s) / Test Specification(s)

The following deviation(s) was / were made from the published requirements of the listed standards: N/A.

3.3 Overview of results

FCC Part 22			
Requirement – Test case	**Basic standard(s)**	**Verdict**	**Remark**
RF Output Power	Section 22.913	PASS	
Frequency Stability	Section 22.355	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 22.917	PASS	
Radiated Emissions	Section 22.917	PASS	

FCC Part 90			
Requirement – Test case	**Basic standard(s)**	**Verdict**	**Remark**
RF Output Power	Section 90.635(b)	PASS	
Frequency Stability	Section 90.213	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 90.691	PASS	
Radiated Emissions	Section 90.691	PASS	

FCC Part 24			
Requirement – Test case	**Basic standard(s)**	**Verdict**	**Remark**
RF Output Power	Section 24.232	PASS	
Frequency Stability	Section 24.235	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 24.238	PASS	
Radiated Emissions	Section 24.238	PASS	

FCC Part 27			
Requirement – Test case	**Basic standard(s)**	**Verdict**	**Remark**
RF Output Power	Section 27.50	PASS	
Frequency Stability	Section 27.54	PASS	
Occupied Bandwidth	Section 2.1049	PASS	
Spurious Emissions at antenna terminals	Section 27.53	PASS	
Radiated Emissions	Section 27.53	PASS	

3.4 Test Facility

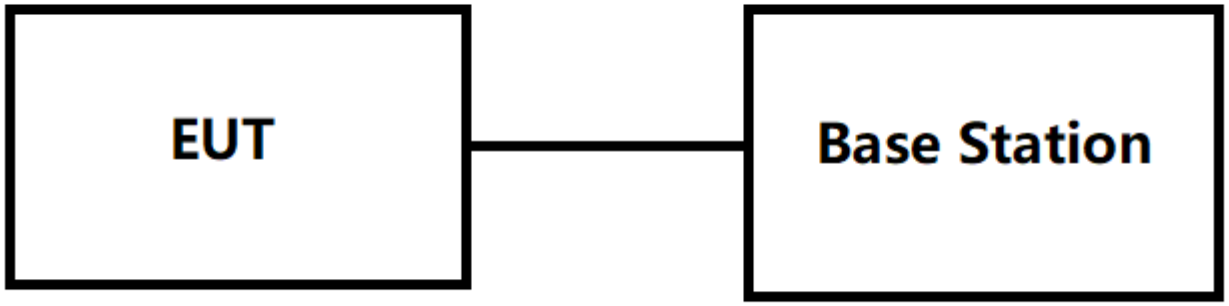
USA	**:**	**FCC Designation Number: CN1199**
CA	**:**	**ISED CAB identifier: CN0040**

4 TEST RESULTS

4.1 RF Output Power	VERDICT: PASS

4.1.1 Limit	
LTE Band	**Standard**
2/25	FCC §2.1046 and §24.232: Mobile and portable stations are limited to 2 watts EIRP. The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.
4/66	FCC §27.50(d)(4): Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.
5/26	FCC §2.1046 and §22.913: The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.
	FCC §90.635: The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).
7/41	FCC §27.50(h)(2): 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.
12/13/17/71/85	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(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.

4.1.2 Test Setup



4.1.3 Test Procedure

	References Rule	Chapter	Item
☒	ANSI C63.26-2015	5.2	RF output power measurement procedures

The conducted RF Output Power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMW500, selecting maximum transmission power of the EUT and different modes of modulation.
Peak to average ratio(PAPR) is used equation PAPR(dB)=PPK(dBm)-PAVG(dBm), where PPK is measured peak power, and PAVG is measured average power.
The maximum equivalent isotropically radiated power(e.i.r.p.) is calculated by adding the declared maximum antenna gain(dBi).
The maximum effective radiated power e.r.p. is calculated form the maximum equivalent isotropically radiated power(e.i.r.p.) by subtracting 2.15 dB: E.R.P = E.I.R.P. – 2.15 dB

4.1.4 Test Data

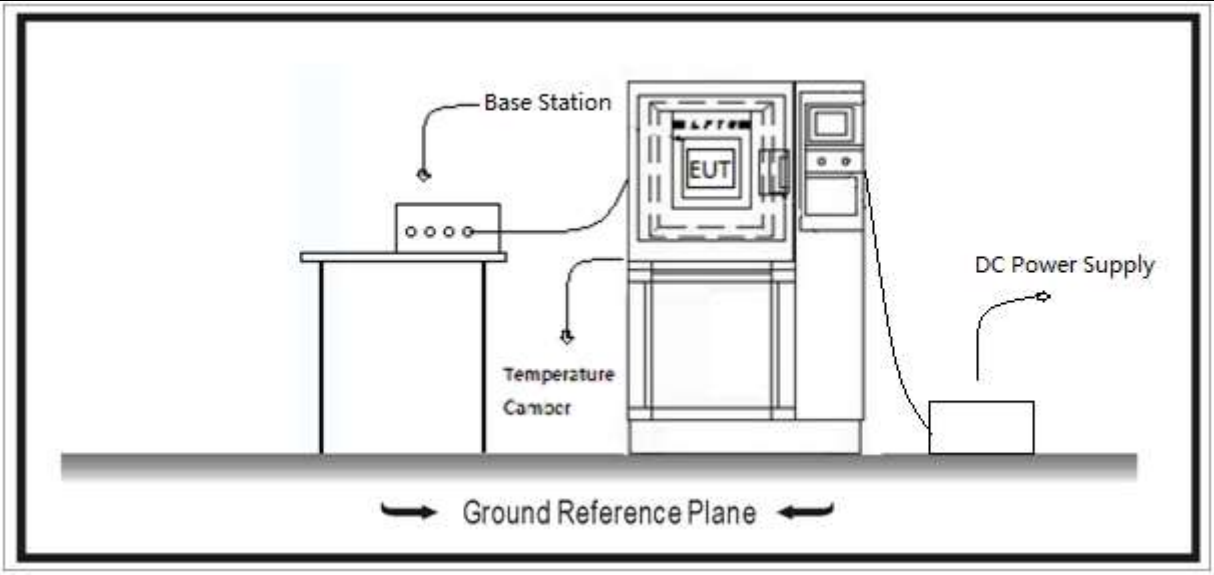
Please refer to Appendix A for EIRP data and Appendix B for CCDF

4.2 Frequency Stability — VERDICT: PASS

4.2.1 Limit

LTE Band	Standard
2/25	FCC §2.1055 and §24.235: The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.
4/66	FCC §2.1055 and §27.54: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.
5/26	FCC §2.1055 and §22.355: ±2.5 ppm for mobile stations operating in the range 821 to 896 MHz.
	FCC §2.1055 and §90.213: ±2.5 ppm for mobile stations operating in the range 809 to 824 MHz.
7/41	FCC §2.1055 and §27.54: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.
12/13/17/71/85	FCC §2.1055 and §27.54: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

4.2.2 Test Setup



4.2.3 Test Procedure

	References Rule	Chapter	Description
☒	ANSI C63.26	5.6	Frequency stability testing

The frequency tolerance measurements over temperature variations were made voer temperature range of -30℃ to +50℃. The EUT was placed inside a environmental temperature chamber and the temperature was lowered hourly in 10℃ steps from +50℃ to -30℃.

The supply voltage was varied between 85% and 115% of nominal voltage.

The EUT was set in “Radio Resource Control (RRC) mode” in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter. The worst case LTE mode for conducted power was used for the test.

In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation. a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation are identified as fL and fH respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.

The reference point measurements were made at the RF output terminals of the EUT using directional coupler and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

4.2.4 Test Data

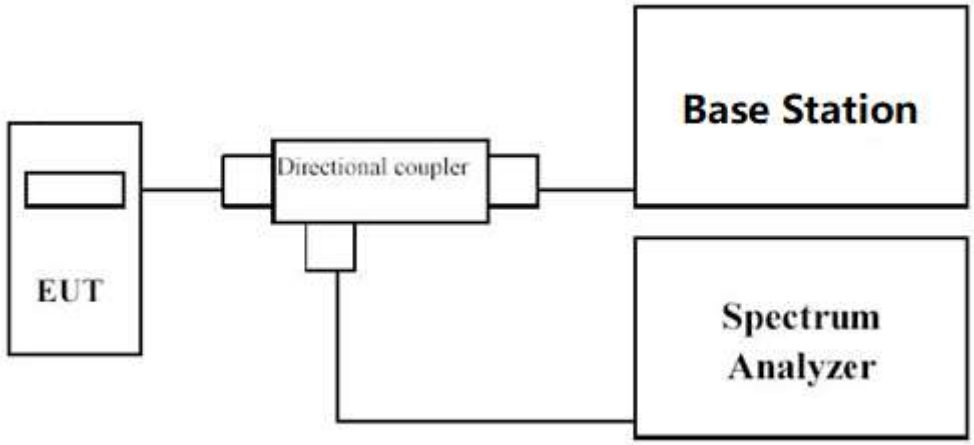
Please refer to Appendix F for test data

4.3 Occupied Bandwidth	VERDICT: PASS

4.3.1 Limit

LTE Band	Standard
2/4/5/7/12/13/17 /25/26/41/66/71/85	FCC §2.1049: 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.

4.3.2 Test Setup



4.3.3 Test Procedure

References Rule		Chapter	Description
☒	ANSI C63.26	5.4	Occupied bandwidth

The occupied bandwidth measurement was performed at the output terminals of the EUT using directional coupler and spectrum analyser. The EUT was controller via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

4.3.4 Test Data

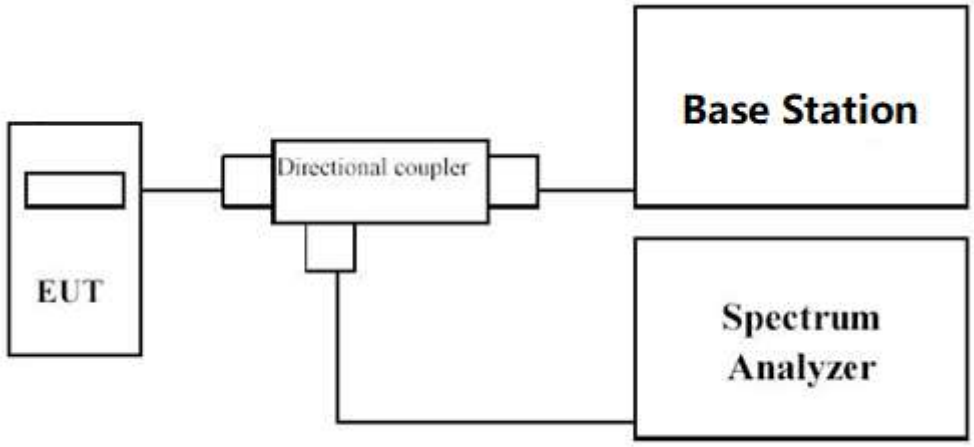
Please refer to Appendix C for test data

4.4 Spurious Emissions at antenna terminals	VERDICT: PASS

4.4.1 Limit

LTE Band	Standard
2/25	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §24.238: 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.
4/66	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §27.53(h): 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 log10 (P) dB.
5/26	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §22.917: 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 §90.691: For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.
7/41	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §27.53(h): 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 log10 (P) dB.
12/13/17/71/85	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	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.
	FCC §27.53(c): 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. On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

4.4.2 Test Setup



4.4.3 Test Procedure

References Rule		Chapter	Description
☒	ANSI C63.26	5.7	Unwanted (out-of-band and spurious) conducted emissions measurement procedures (conducted test at antenna port)

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using directional coupler.
The spectrum was investigated from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment.
The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least X + 10 log (P) dB. P in watts. The specification can be interpreted as an absolute limit when the specified attenuation is actually subtracted from the maximum permissible transmitter power [i.e., 10 log P – {X + 10 log P}], resulting in an absolute level of -X dBW [or (-X + 30) dBm].
The configuration of tones and modulation which is the worst case for conducted power was used.

4.4.4 Test Data

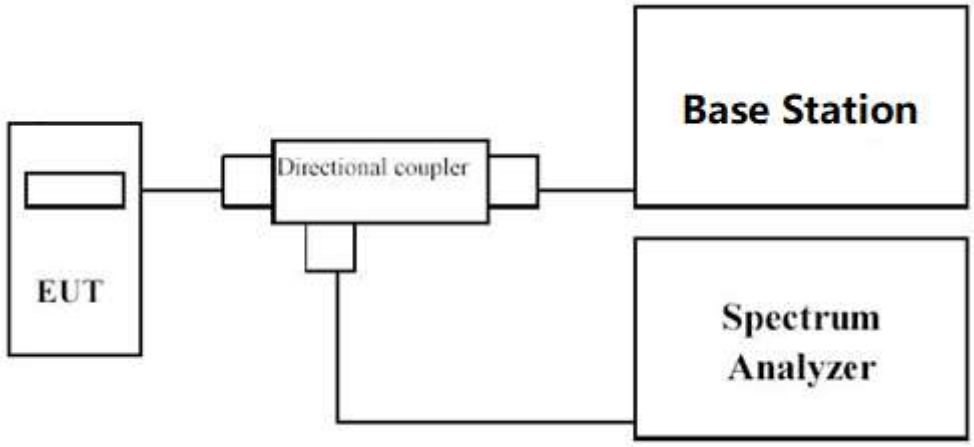
Please refer to Appendix E for test data

4.5 Spurious Emissons at antenna terminals at Block Edges	VERDICT: PASS

4.5.1 Limit

LTE Band	Standard
2/25	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §24.238: 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.
4/66	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §27.53(h): 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 log10 (P) dB.
5/26	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §22.917: 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 §90.691: For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.
7/41	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §27.53(h): 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 log10 (P) dB.
12/13/17 /71/85	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	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.
	FCC §27.53(c): 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. On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

4.5.2 Test Setup



4.5.3 Test Procedure

	References Rule	Chapter	Description
☒	ANSI C63.26	5.7	Unwanted (out-of-band and spurious) conducted emissions measurement procedures (conducted test at antenna port)

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using directional coupler.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

For LTE Band 2/25: 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.

For LTE Band 4/66: In the 1 megahertz 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.

For LTE Band 5/26: For §22, in the 1 MHz bands immediately outside and adjacent to the frequency block or band, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. For §90, use RBW = 300 Hz for offsets less than 37.5 kHz from a channel edge; RBW = 100 kHz for offsets greater than 37.5 kHz is allowed.

For LTE Band 7/41: For mobile digital stations, 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 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

For LTE Band 12/17/71/85: 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.
For LTE Band 13: On any frequency outside the 746-758 MHz band and 776-788 MHz band, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed; on all frequencies between 763-775 MHz and 793-805 MHz, any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25KHz segment.
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least X + 10 log (P) dB. P in watts. The specification can be interpreted as an absolute limit when the specified attenuation is actually subtracted from the maximum permissible transmitter power [i.e., 10 log P – {X + 10 log P}], resulting in an absolute level of -X dBW [or (-X + 30) dBm].

4.5.4 Test Data

Please refer to Appendix D for test data

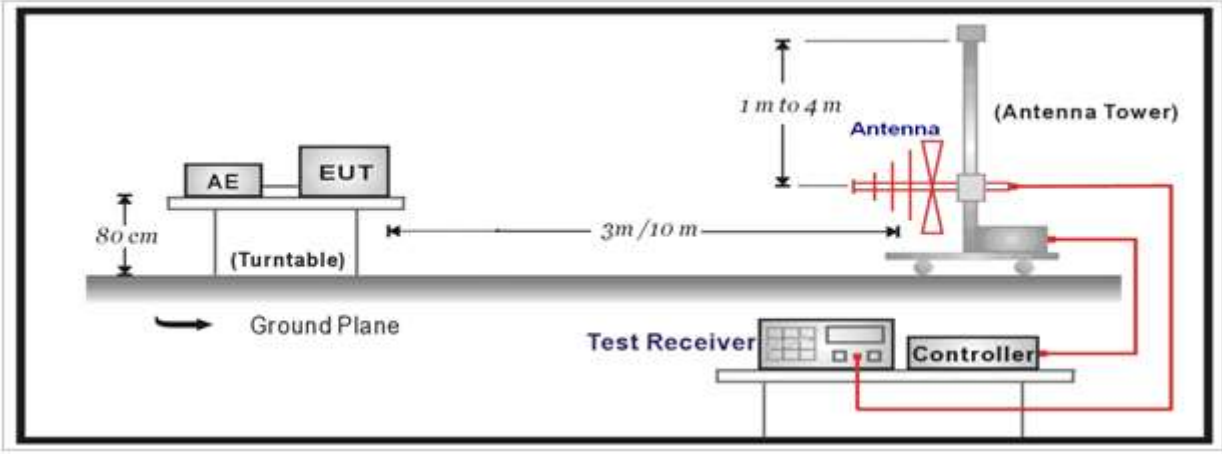
4.6 Radiated Emissions — VERDICT: PASS

4.6.1 Limit

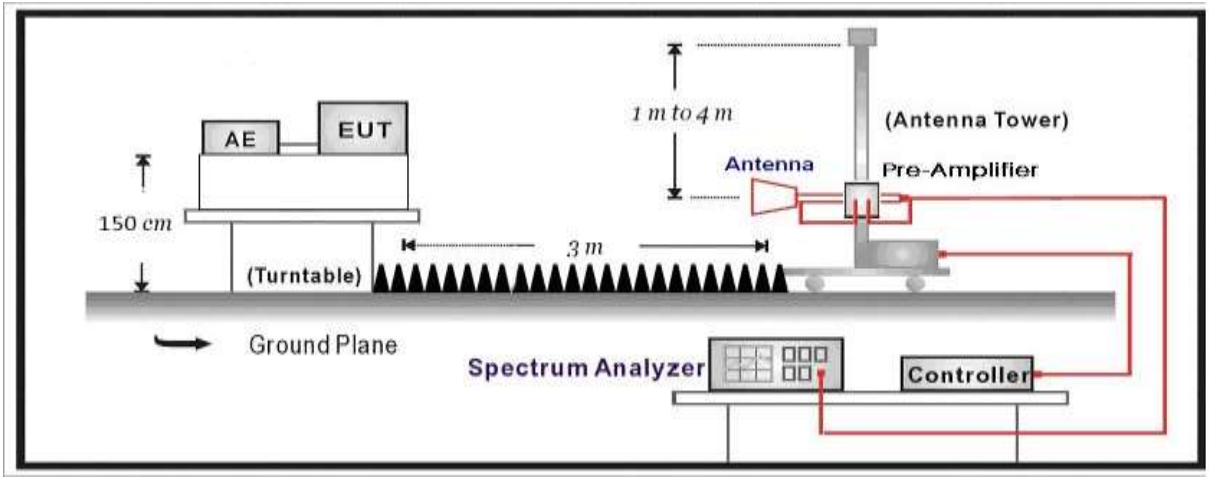
LTE Band	Standard
2/25	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §24.238: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.
4/66	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §27.53(h): 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 log10 (P) dB.
5/26	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §22.917: 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 §90.691: For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.
7/41	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	FCC §27.53(h): 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 log10 (P) dB.
12/13/17 /71/85	FCC §2.1051: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.
	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.
	FCC §27.53(c): 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. On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

4.6.2 Test Setup

30MHz-1GHz Test Setup:



Above 1GHz Test Setup:



4.6.3 Test Procedure

	Reference Rule	Chapter	Description
☒	ANSI C63.26	5.5	Radiated emissions testing

The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment.
Emissions below 18 GHz were measured at a 3 meter test distance.
The EUT was tested in three orthogonal axes and in all possible test configurations and poisoning when measurement antenna is orented n both horizontal and vertical polarization, the worst case emissions was showed in the report.
Radiated emissions were used the substitution method descried in ANSI/TIA-603-E-2016.
Radiated emissions were measured with 100kHz RBW below 1GHz and 1MHz RBW above 1GHz.
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least X + 10 log (P) dB. P in watts. The specification can be interpreted as an absolute limit when the specified attenuation is actually subtracted from the maximum permissible transmitter power [i.e., 10 log P – {X + 10 log P}], resulting in an absolute level of -X dBW [or (-X + 30) dBm].

4.6.4 Test Data

WCDMA Band 2

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
Middle channel				
3760.000	H	-54.597	-13	-41.597
5640.000	H	-55.142	-13	-42.142
3760.000	V	-52.916	-13	-39.916
5640.000	V	-53.905	-13	-40.905

WCDMA Band 5

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
Middle channel				
1672.800	H	-59.449	-13	-46.449
2509.200	H	-55.239	-13	-42.239
1672.800	V	-59.318	-13	-46.318
2509.200	V	-53.444	-13	-40.444

LTE Band 2

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
20MHz Middle channel				
3760.000	H	-54.449	-13	-41.449
5640.000	H	-52.738	-13	-39.738
3760.000	V	-52.791	-13	-39.791
5640.000	V	-52.197	-13	-39.197
15MHz Middle channel				
3760.000	H	-52.791	-13	-39.791
5640.000	H	-52.197	-13	-39.197
3760.000	V	-54.147	-13	-41.147
5640.000	V	-52.637	-13	-39.637
10MHz Middle channel				
3760.000	H	-54.115	-13	-41.115
5640.000	H	-52.847	-13	-39.847
3760.000	V	-54.007	-13	-41.007
5640.000	V	-52.658	-13	-39.658
5MHz Middle channel				
3760.000	H	-54.595	-13	-41.595
5640.000	H	-52.640	-13	-39.640
3760.000	V	-51.592	-13	-38.592
5640.000	V	-49.833	-13	-36.833
3MHz Middle channel				
3760.000	H	-54.844	-13	-41.844
5640.000	H	-52.943	-13	-39.943
3760.000	V	-53.730	-13	-40.730
5640.000	V	-52.173	-13	-39.173
1.4MHz Middle channel				
3760.000	H	-54.228	-13	-41.228
5640.000	H	-53.094	-13	-40.094
3760.000	V	-54.156	-13	-41.156
5640.000	V	-53.159	-13	-40.159

LTE Band 4

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
20MHz Lowest channel				
3444.000	H	-48.175	-13	-35.175
5160.000	H	-53.991	-13	-40.991
3444.000	V	-48.288	-13	-35.288
5160.000	V	-54.339	-13	-41.339
15MHz Middle channel				
3465.000	H	-48.288	-13	-35.288
5197.500	H	-54.831	-13	-41.831
3465.000	V	-45.878	-13	-32.878
5197.500	V	-54.053	-13	-41.053
10MHz Middle channel				
3465.000	H	-46.708	-13	-33.708
5197.500	H	-54.051	-13	-41.051
3465.000	V	-46.232	-13	-33.232
5197.500	V	-53.942	-13	-40.942
5MHz Middle channel				
3465.000	H	-47.591	-13	-34.591
5197.500	H	-54.805	-13	-41.805
3465.000	V	-45.232	-13	-32.232
5197.500	V	-53.864	-13	-40.864
3MHz Middle channel				
3465.000	H	-46.278	-13	-33.278
5197.500	H	-54.508	-13	-41.508
3465.000	V	-45.579	-13	-32.579
5197.500	V	-53.847	-13	-40.847
1.4MHz Middle channel				
3465.000	H	-45.579	-13	-32.579
5197.500	H	-54.079	-13	-41.079
3465.000	V	-47.497	-13	-34.497
5197.500	V	-54.172	-13	-41.172

LTE Band 5

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
10MHz Middle channel				
1673.000	H	-57.141	-13	-44.141
2480.500	H	-46.806	-13	-33.806
1673.000	V	-58.686	-13	-45.686
2480.500	V	-48.022	-13	-35.022
5MHz Middle channel				
1673.000	H	-58.784	-13	-45.784
2480.500	H	-47.042	-13	-34.042
1673.000	V	-58.816	-13	-45.816
2480.500	V	-47.193	-13	-34.193
3MHz Middle channel				
1673.000	H	-57.798	-13	-44.798
2480.500	H	-46.573	-13	-33.573
1673.000	V	-57.582	-13	-44.582
2480.500	V	-47.019	-13	-34.019
1.4MHz Middle channel				
1649.400	H	-54.466	-13	-41.466
2474.100	H	-46.461	-13	-33.461
1649.400	V	-58.488	-13	-45.488
2474.100	V	-46.461	-13	-33.461

LTE Band 7

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
20MHz Lowest channel				
5020.000	H	-51.621	-13	-38.621
7530.000	H	-48.030	-13	-35.030
5020.000	V	-52.948	-13	-39.948
7530.000	V	-48.824	-13	-35.824
15MHz Middle channel				
5070.000	H	-53.282	-13	-40.282
7605.000	H	-49.539	-13	-36.539
5070.000	V	-52.567	-13	-39.567
7605.000	V	-49.549	-13	-36.549
10MHz Middle channel				
5070.000	H	-53.241	-13	-40.241
7605.000	H	-48.806	-13	-35.806
5070.000	V	-52.927	-13	-39.927
7605.000	V	-48.153	-13	-35.153
5MHz Middle channel				
5070.000	H	-52.954	-13	-39.954
7605.000	H	-48.694	-13	-35.694
5070.000	V	-52.283	-13	-39.283
7605.000	V	-48.885	-13	-35.885

LTE Band 12

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
10MHz Middle channel				
1415.000	H	-56.536	-13	-43.536
2122.500	H	-54.843	-13	-41.843
1415.000	V	-58.050	-13	-45.050
2122.500	V	-55.168	-13	-42.168
5MHz Middle channel				
1415.000	H	-58.431	-13	-45.431
2122.500	H	-55.713	-13	-42.713
1415.000	V	-57.329	-13	-44.329
2122.500	V	-56.331	-13	-43.331
3MHz Middle channel				
1415.000	H	-58.810	-13	-45.810
2122.500	H	-56.168	-13	-43.168
1415.000	V	-58.901	-13	-45.901
2122.500	V	-55.619	-13	-42.619
1.4MHz Middle channel				
1415.000	H	-58.589	-13	-45.589
2122.500	H	-55.412	-13	-42.412
1415.000	V	-58.654	-13	-45.654
2122.500	V	-56.164	-13	-43.164

LTE Band 13

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
10MHz				
1564.000	H	-58.318	-13	-45.318
2410.000	H	-51.143	-13	-38.143
1564.000	V	-57.834	-13	-44.834
2410.000	V	-50.184	-13	-37.184
5MHz				
1564.000	H	-57.179	-13	-44.179
2410.000	H	-51.511	-13	-38.511
1564.000	V	-57.419	-13	-44.419
2410.000	V	-50.630	-13	-37.630

LTE Band 25

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
20MHz Middle channel				
3760.000	H	-53.787	-13	-40.787
5640.000	H	-52.910	-13	-39.910
3760.000	V	-55.138	-13	-42.138
5640.000	V	-53.679	-13	-40.679
15MHz Middle channel				
3760.000	H	-53.990	-13	-40.990
5640.000	H	-54.365	-13	-41.365
3760.000	V	-54.392	-13	-41.392
5640.000	V	-53.358	-13	-40.358
10MHz Middle channel				
3760.000	H	-54.631	-13	-41.631
5640.000	H	-53.324	-13	-40.324
3760.000	V	-54.433	-13	-41.433
5640.000	V	-54.145	-13	-41.145
5MHz Middle channel				
3760.000	H	-54.770	-13	-41.770
5640.000	H	-54.554	-13	-41.554
3760.000	V	-55.342	-13	-42.342
5640.000	V	-53.903	-13	-40.903
3MHz Middle channel				
3760.000	H	-53.571	-13	-40.571
5640.000	H	-54.641	-13	-41.641
3760.000	V	-53.543	-13	-40.543
5640.000	V	-54.286	-13	-41.286
1.4MHz Middle channel				
3760.000	H	-54.934	-13	-41.934
5640.000	H	-54.482	-13	-41.482
3760.000	V	-54.360	-13	-41.360
5640.000	V	-53.566	-13	-40.566

LTE Band 26

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
15MHz Middle channel				
1663.000	H	-58.561	-13	-45.561
2494.500	H	-55.805	-13	-42.805
1663.000	V	-59.004	-13	-46.004
2494.500	V	-55.554	-13	-42.554
10MHz Middle channel				
1663.000	H	-59.827	-13	-46.827
2494.500	H	-55.673	-13	-42.673
1663.000	V	-58.579	-13	-45.579
2494.500	V	-56.941	-13	-43.941
5MHz Middle channel				
1663.000	H	-59.808	-13	-46.808
2494.500	H	-56.230	-13	-43.230
1663.000	V	-59.478	-13	-46.478
2494.500	V	-55.840	-13	-42.840
3MHz Middle channel				
1663.000	H	-59.712	-13	-46.712
2494.500	H	-56.577	-13	-43.577
1663.000	V	-58.344	-13	-45.344
2494.500	V	-56.028	-13	-43.028
1.4MHz Middle channel				
1663.000	H	-59.276	-13	-46.276
2494.500	H	-56.123	-13	-43.123
1663.000	V	-58.763	-13	-45.763
2494.500	V	-56.195	-13	-43.195

LTE Band 41 2490-2690MHz

Frequency (MHz)	Ant.Pol. (H/V)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
20MHz Middle channel				
5186.000	H	-51.908	-13	-38.908
7744.500	H	-40.944	-13	-27.944
5186.000	V	-51.848	-13	-38.848
7744.500	V	-47.184	-13	-34.184
15MHz Middle channel				
5186.000	H	-52.095	-13	-39.095
7744.500	H	-46.847	-13	-33.847
5186.000	V	-51.747	-13	-38.747
7744.500	V	-47.645	-13	-34.645
10MHz Middle channel				
5186.000	H	-52.189	-13	-39.189
7744.500	H	-47.844	-13	-34.844
5186.000	V	-51.865	-13	-38.865
7744.500	V	-40.272	-13	-27.272
5MHz Middle channel				
5186.000	H	-51.742	-13	-38.742
7744.500	H	-46.612	-13	-33.612
5186.000	V	-51.422	-13	-38.422
7744.500	V	-47.039	-13	-34.039

Note 1: Spurious emissions level = Signal Generator Reading(dBm) – Cable loss(dB) + substitute antenna gain(dBi)
Note 2: We evaluated and tested all modes, and only the worst value of each bandwidth in each band is shown in the report

4.7 Test setup photo and EUT Photo	VERDICT: PASS

Remark: The test setup photo and EUT Photo please see appendix.

The End