FCC Test Report

FCC Part 24E & 27 F&L

Product Name : TKG-1MU
Model No. : TKG-1MU
FCC ID : BXTTKG1MU

Applicant : Kaga Electronics Co.,Ltd.
Address : 20 Kandamatsunagacho,Chiyoda-ku
Tokyo 101-8628,Japan

Date of Receipt : Aug. 13, 2018
Test Date : Aug. 14, 2018~ Sep. 05, 2018
Issued Date : Sep. 21, 2018
Report No. : 1882083R-HP-US-P07V01
Report Version : V1.1

Test Report Certification

Issued Date : Sep. 21, 2018
Report No. :1882083R-HP-US-P07V01

Product Name	:	TKG-1MU
Applicant	:	Kaga Electronics Co.,Ltd.
Address	:	20 Kandamatsunagacho,Chiyoda-ku Tokyo 101-8628,Japan
Manufacturer	:	eSky wireless Inc
Address	:	22-303,#328 xinghu street ,suzhou ,China
Model No.	:	TKG-1MU
FCC ID	:	BXTTKG1MU
EUT Voltage	:	DC 9-16V
Test Voltage		AC 120V/60Hz
Brand Name		Kaga
Applicable Standard	:	FCC CFR Title 47 Part 2, FCC Part 24 Subpart E FCC Part 27 Subpart L&F TIA/EIA 603-D KDB971168 ANSI 63.26: 2015
Test Result	:	Complied
Performed Location	:	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 FCC Designation Number: CN1199

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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
1882083R-HP-US-P07V01	V1.0	Initial Issued Report	Sep. 14, 2018
1882083R-HP-US-P07V01	V1.1	Page 13, Add channel list	Sep. 21, 2018

1. General Information

1.1. EUT Description

Product Name	TKG-1MU
Model No.	TKG-1MU
EUT Voltage	DC 9-16V
4G	
Support Band	LTE Band 2/4/12
Uplink	Band 2: 1850-1910MHz Band 4: 1710~1755MHz Band 12: 699~716MHz
Downlink	Band 2: 1930-1990MHz Band 4: 2110~2155MHz Band 12:729~746MHz
Type of modulation	QPSK, 16QAM
Antenna Type	Dipole
Antenna Gain	Band 2: 3.13dBi Band 4: 3.52dBi Band 12: 2.23dBi

1.2. Mode of Operation

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1 :LTE Band 2 Link
Mode 2 :LTE Band 4 Link
Mode 3 : LTE Band 12 Link
Note 1: Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report. For the LTE band, we also evaluate the each channel of bandwidth, RB offset and modulation, we will choose the worst case shown on this report.

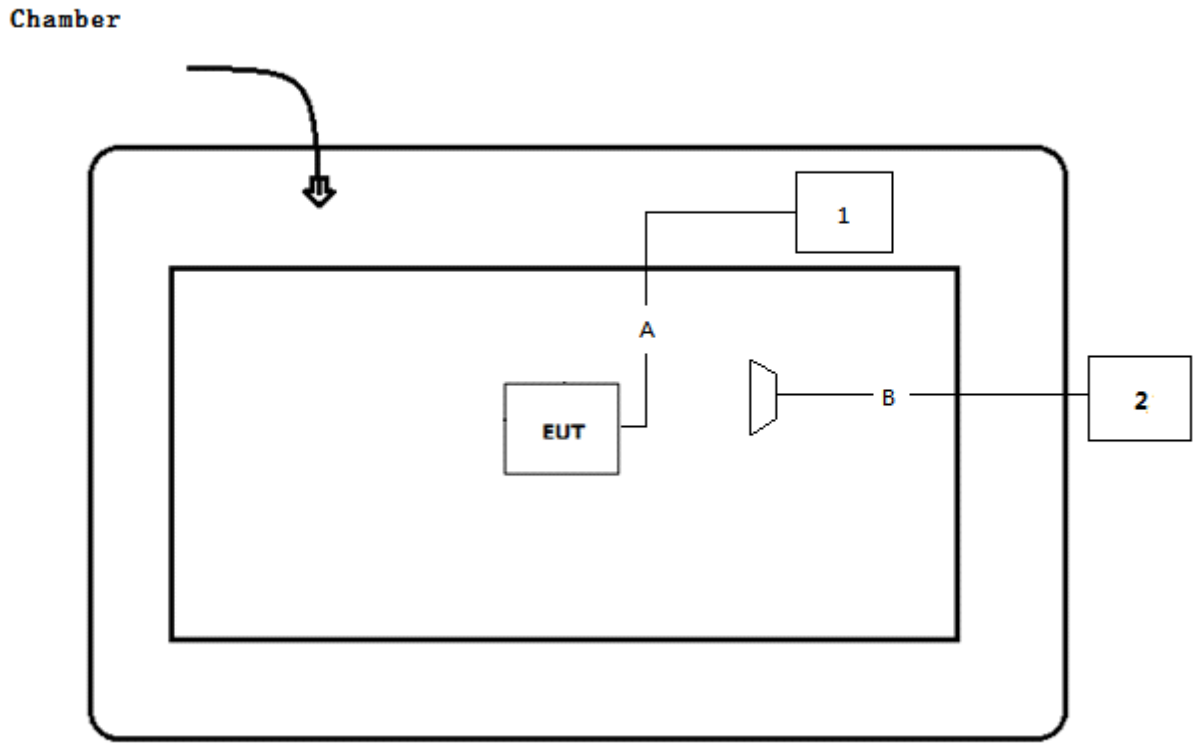
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	DC Power Supply	IDRC	CD-035-020PR	977272	non-shielded 1.8m
2	Radio Communication Tester	Anritsu	MT8820C	6201181503	non-shielded 1.8m

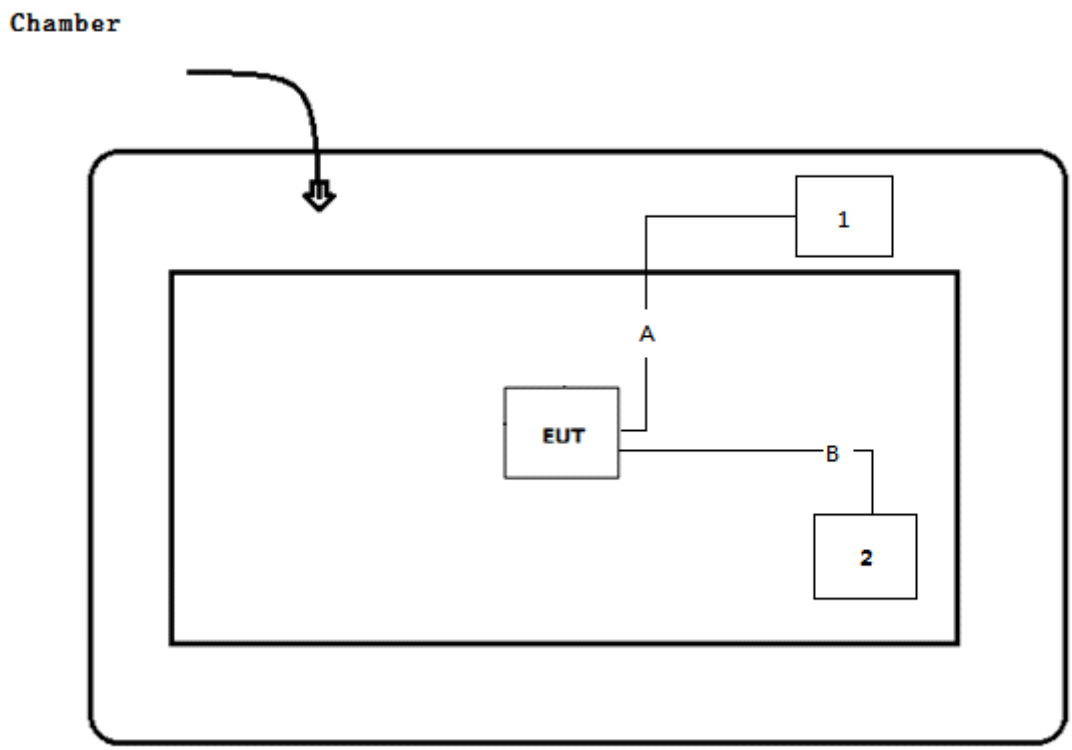
1.4. Configuration of Tested System

RadiatedConnection Diagram



Signal Cable Type		Signal cable Description
A	Control Cable	Non-Shielded,2m
B	Coaxial Cable	Shielded,>5m

Conducted Connection Diagram



Signal Cable Type		Signal cable Description
A	Control Cable	Non-Shielded,2m
B	Coaxial Cable	Shielded,>5m

1.5. EUT Exercise Software

1	Setup the EUT and simulators as shown on above.
2	Turn on the power of all equipment.
3	EUT Communicate with MT8820C, then select channel to test.

2. Summary Technical Test

2.1. Limit and Test Result

LTE Band 2			
FCC Part 24 Subpart E			
Industry Canada RSS-133, Issue 6, Industry Canada RSS-GEN			
Test Item	FCC Reference section	FCC Limit	Result
Maximum Output Power	§2.1033 §2.1046 §24.232	< 2 Watts	Pass
Equivalent Isotropic Radiated Power	§24.232	< 2 Watts	Pass
Peak-to-average power ratio	§24.232	< 13dB	Pass
Occupied Bandwidth	§2.1049	N/A	Pass
Conducted Band EdgeEmissions	§27.238	<-13dBm	Pass
Spurious Radiation	§2.1053 §24.238	<-13dBm	Pass
Frequency Stability Under Temperature & Voltage Variations	§2.1055 §24.235	< 2.5 ppm	Pass

LTE Band 4			
FCC Part 27 Subpart L			
Industry Canada RSS-139, Issue 3, Industry Canada RSS-GEN			
Test Item	FCC Reference section	FCC Limit	Result
Maximum Output Power	§2.1033 §2.1046 §27.50	<1 Watts	Pass
Equivalent Isotropic Radiated Power	§27.50	<1 Watts	Pass
Peak-to-average power ratio	§27.50	< 13dB	Pass
Occupied Bandwidth	§2.1049	N/A	Pass
Conducted Band EdgeEmissions	§27.53	<-13dBm	Pass
Spurious Radiation	§2.1053 §27.53	<-13dBm	Pass
Frequency Stability Under Temperature & Voltage Variations	§2.1055 §27.54	<2.5 ppm	Pass

LTE Band 12			
FCC Part 27 Subpart F			
Industry Canada RSS-130,Issue 1,Industry Canada RSS-GEN			
Test Item	FCC Reference section	FCC Limit	Result
Maximum Output Power	§2.1033 §2.1046 §27.50	<3 Watts	Pass
Equivalent Isotropic Radiated Power	§27.50	<3 Watts	Pass
Occupied Bandwidth	§2.1049	N/A	Pass
Conducted Band EdgeEmissions	§27.53	<-13dBm	Pass
Spurious Radiation	§2.1053 §27.53	<-13dBm	Pass
Frequency Stability Under Temperature & Voltage Variations	§2.1055 §27.54	< 2.5 ppm	Pass

2.2. Channel list

LTE Band 2

BW [MHz]	RB Offset	Low Ch. / Freq.	Mid Ch. / Freq.	High Ch. / Freq.
20	Channel	18700	18900	19100
20	Frequency	1860	1880	1900
15	Channel	18675	18900	19125
15	Frequency	1857.5	1880	1902.5
10	Channel	18650	18900	19150
10	Frequency	1855	1880	1905
5	Channel	18625	18900	19175
5	Frequency	1852.5	1880	1907.5

LTE Band 4

BW [MHz]	RB Offset	Low Ch. / Freq.	Mid Ch. / Freq.	High Ch. / Freq.
20	Channel	20050	20175	20300
20	Frequency	1720	1732.5	1745
15	Channel	20025	20175	20325
15	Frequency	1717.5	1732.5	1747.5
10	Channel	20000	20175	20350
10	Frequency	1715	1732.5	1750
5	Channel	19975	20175	20375
5	Frequency	1712.5	1732.5	1752.5

LTE Band 12

BW [MHz]	RB Offset	Low Ch. / Freq.	Mid Ch. / Freq.	High Ch. / Freq.
10	Channel	23060	23095	23130
10	Frequency	704	707.5	711
5	Channel	23035	23095	23155
5	Frequency	701.5	707.5	713.5

2.3. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	23
Humidity (%RH)	25-75	52
Barometric pressure (mbar)	860-1060	950-1000

2.4. Measurement Uncertainty

Items	Uncertainty
Maximum Output Power	±1.2 dB
Equivalent Isotropic Radiated Power	±3.2 dB
Occupied Bandwidth	±10 Hz
Conducted Band Edge Emissions	±1.2 dB
Field Strength of Spurious Radiation	±3.2 dB
Frequency Stability Under Temperature & Voltage Variations	±10 Hz

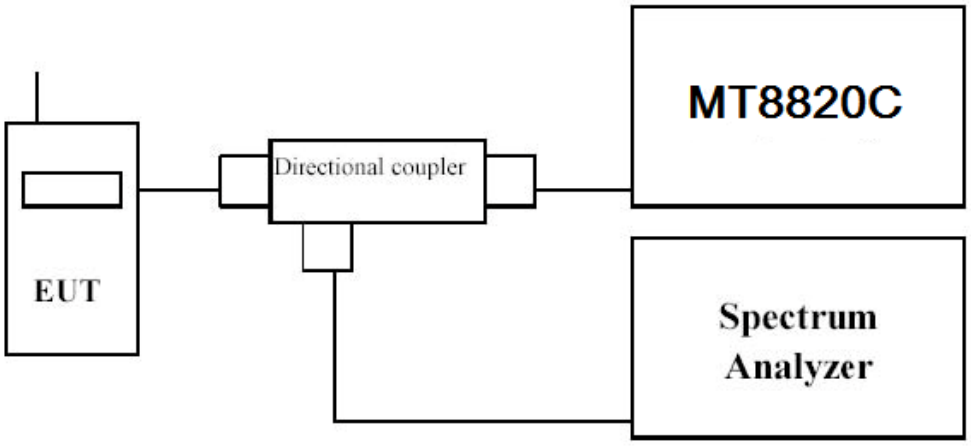
3. Maximum Output Power and Effective Isotropic Radiated Power Measurement

3.1. Test Equipment

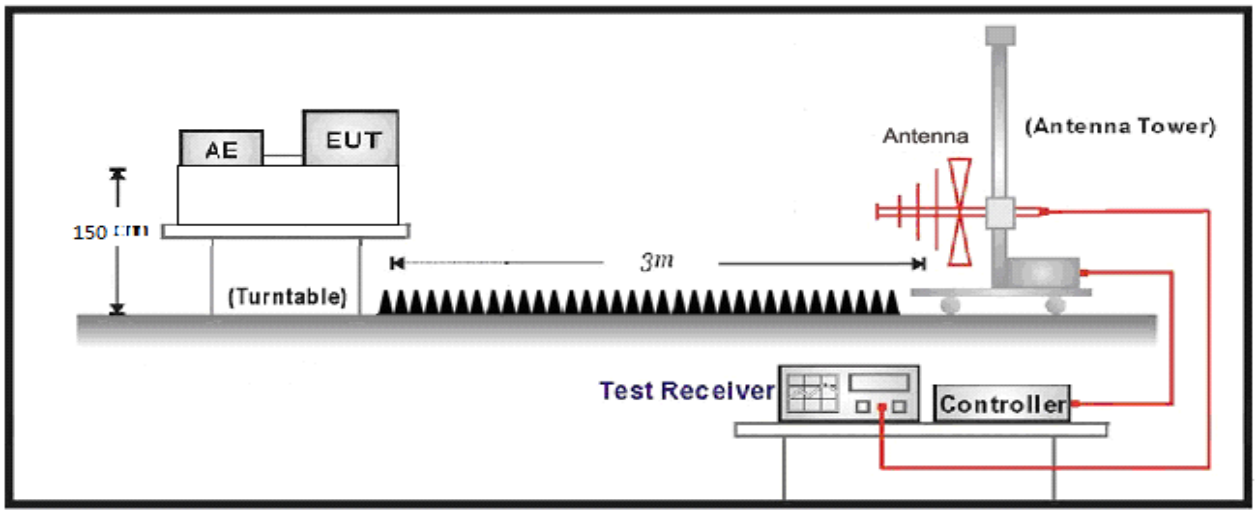
Maximum Output Power and Effective Isotropic Radiated Power Measurement / AC-5				
Instrument	Manufacturer	Type No.	Serial No	Cali. Due Date
PSA Series Spectrum Analyzer	Agilent	E4440A	MY49420184	2019.02.04
Radio Communication Tester	Anritsu	MT8820C	6201181503	2018.09.16
Dual Directional Coupler	Agilent	778D	20160	2019.02.04
10dB Coaxial Coupler	Agilent	87300C	MY44300299	2019.03.28
PSG Analog Signal Generator	Agilent	E8257D	MY44321116	2019.02.04
Preamplifier	QuieTek	AP-025C	CHM-0503006	2019.04.11
Preamplifier	Miteq	NSP1800-25	1364185	2019.05.03
Bilog Antenna	Teseq GmbH	CBL6112D	27612	2019.01.23
Half Wave Tuned Dipole Antenna	COM-POWER	AD-100	40137	2019.02.26
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	737	2019.03.06
DRG Horn	ETS-Lindgren	3117	00167055	2019.07.23
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC5-TH	2019.01.05

3.2. Test Setup

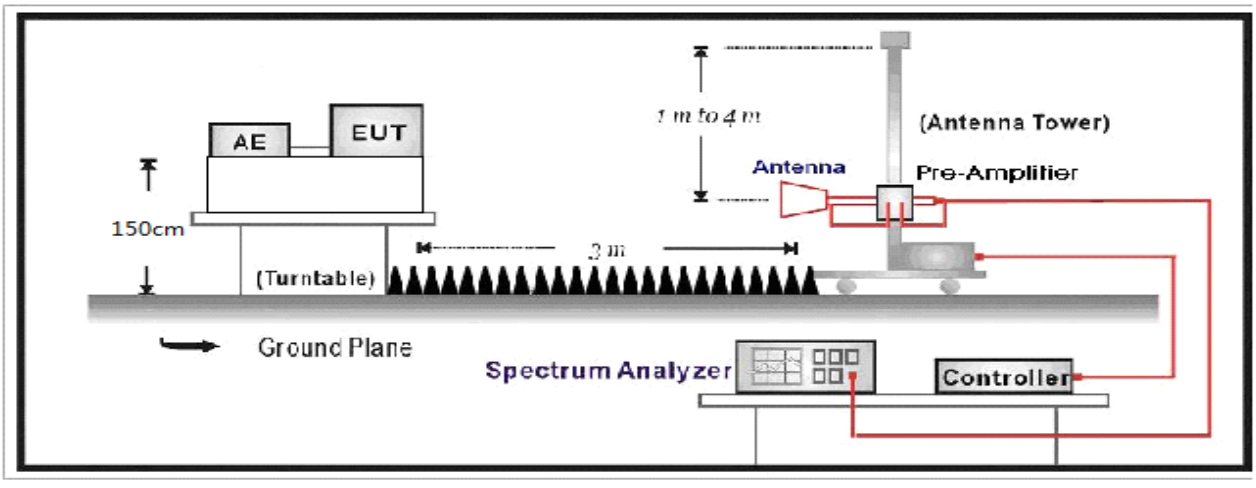
Conducted Power Measurement:



Radiated Power Measurement (Below 1G):



Radiated Power Measurement (Above 1G):



3.3. Test Procedure

Test Method for conducted power
a) The RF output of the transmitter was connected to base station simulator.
b) The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
c) Set EUT at maximum average power by base station simulator.
d) Measure lowest, middle, and highest channels for each bandwidth and different modulation.
Test For Effective Isotropic Radiated Power Measurement:
a) The EUT was placed on a turntable with 1.5 meter height in a fully anechoic chamber.
b) The EUT was set at 3 meters from the receiving antenna, which was mounted on the antenna tower
c) LTE operating modes: use channel power function to test
d) The table was rotated 360 degrees to determine the position of the highest radiated power.
e) The height of the receiving antenna is adjusted to look for the maximum EIRP.
f) The maximum EIRP shall be record.
g) A dipole antenna was substituted in place of the EUT and was driven by a signal generator.
h) The conducted power at the terminal of the dipole antenna is measured.
i) Repeat step c) to step h) to get the maximum EIRP of the substitution antenna.
j) EIRP = Ps + Et －Es + Gs = Ps + Rt－Rs + Gs.
k) Ps (dBm)：Input power to substitution antenna
l) Gs (dBi or dBd)：Substitution antenna Gain.
m) Et = Rt + AF
n) Es = Rs + AF
o) AF (dB/m)：Receive antenna factor
p) Rt：The highest received signal in spectrum analyzer for EUT.
q) Rs：The highest received signal in spectrum analyzer for substitution antenna.

3.4. Test Result

Note: Appendix 1

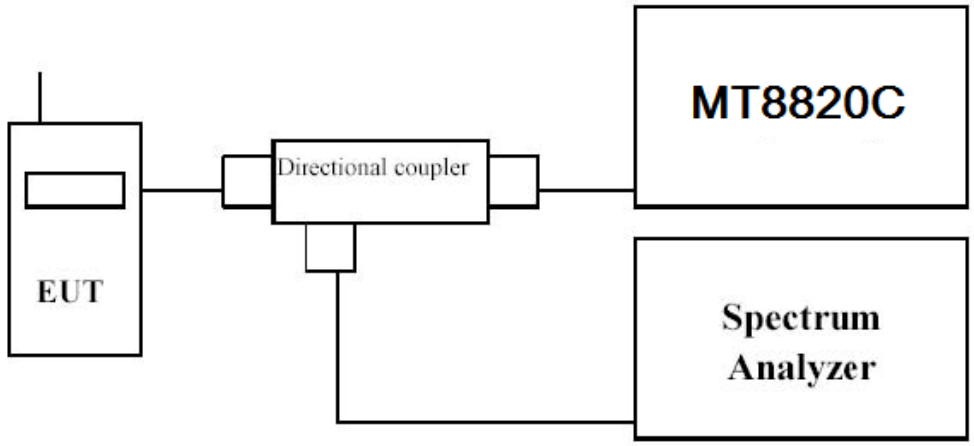
4. Occupied Bandwidth

4.1. Test Equipment

Occupied Bandwidth / TR-8				
Instrument	Manufacturer	Type No.	Serial No	Cali. Due Date
PSA Series Spectrum Analyzer	Agilent	E4440A	MY49420184	2019.02.04
Radio Communication Tester	Anritsu	MT8820C	6201181503	2018.09.16
Dual Directional Coupler	Agilent	778D	20160	2019.02.04
10dB Coaxial Coupler	Agilent	87300C	MY44300299	2019.03.28
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC6-TH	2019.01.05

4.2. Test Setup

Conducted Power Measurement:



4.3. Test Procedure

Test Method for conducted test

1. The EUT was connected to Spectrum Analyzer and Base Station via power divider.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. The 99% occupied bandwidth and 26 dB bandwidth of themiddle channel for the highest RF powers were measured.

4.4. Test Result

Note: Appendix 1

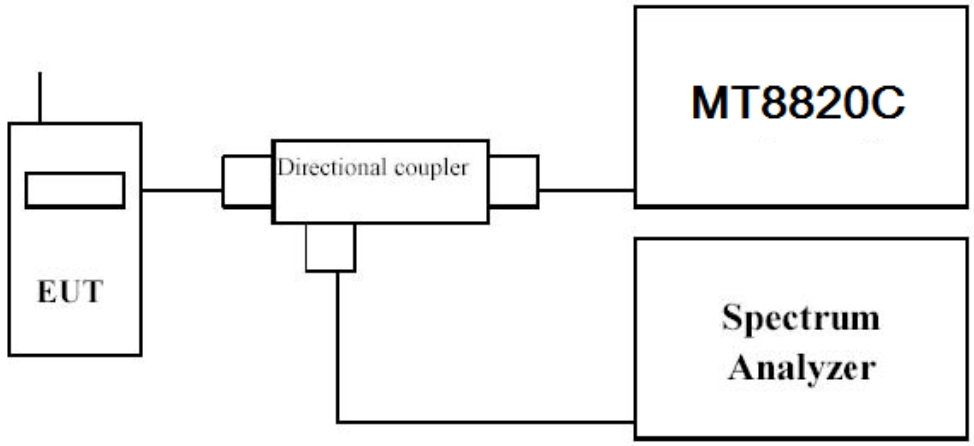
Mode	Bandwidth (MHz)
LTE2	5
	10
	15
	20
LTE4	5
	10
	15
	20
LTE12	5
	10

5. Conducted Band Edge

5.1. Test Equipment

Conducted Band Edge / TR-8				
Instrument	Manufacturer	Type No.	Serial No	Cali. Due Date
PSA Series Spectrum Analyzer	Agilent	E4440A	MY49420184	2019.02.04
Radio Communication Tester	Anritsu	MT8820C	6201181503	2018.09.16
Dual Directional Coupler	Agilent	778D	20160	2019.02.04
10dB Coaxial Coupler	Agilent	87300C	MY44300299	2019.03.28
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC6-TH	2019.01.05

Conducted Power Measurement:



5.2. Test Procedure

Test Method for conducted test

1. The EUT was connected to spectrum analyzer and System Simulator via power divider.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. The conducted spurious emission for the whole frequency range was taken.

5.3. Test Result

Note: Appendix 1

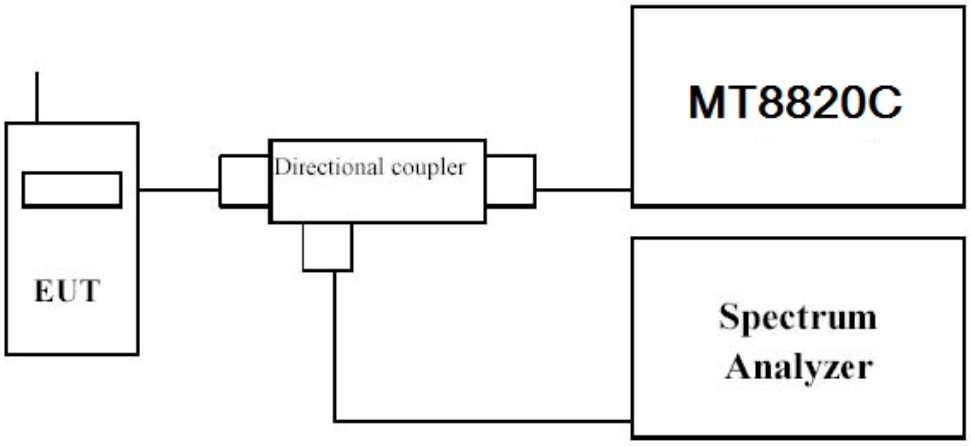
6. Spurious Emission

6.1. Test Equipment

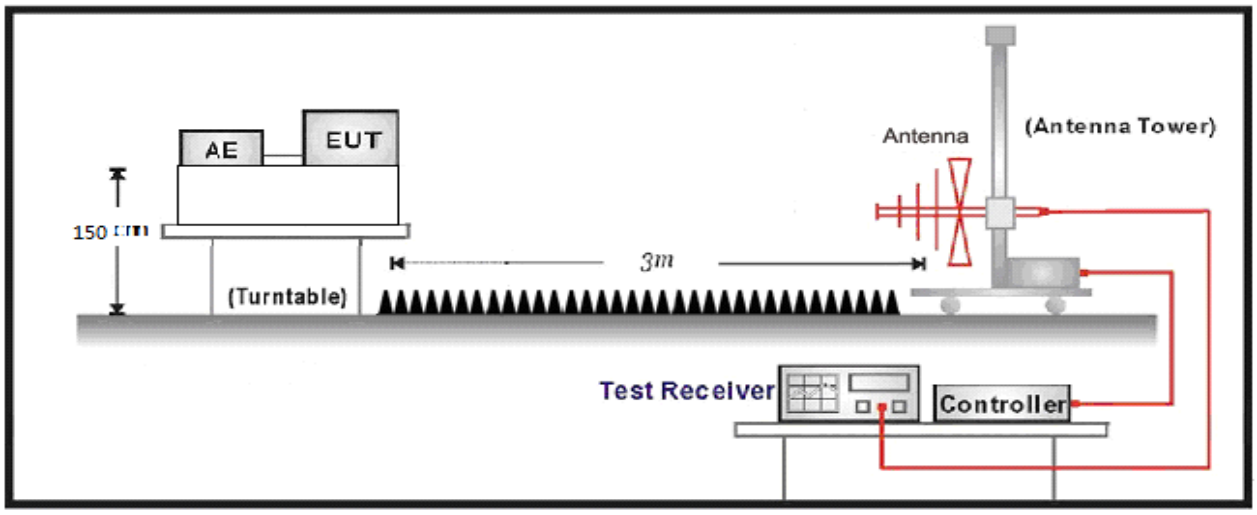
Spurious Emission / AC-5				
Instrument	Manufacturer	Type No.	Serial No	Cali. Due Date
PSA Series Spectrum Analyzer	Agilent	E4440A	MY49420184	2019.02.04
Radio Communication Tester	Anritsu	MT8820C	6201181503	2018.09.16
Dual Directional Coupler	Agilent	778D	20160	2019.02.04
10dB Coaxial Coupler	Agilent	87300C	MY44300299	2019.03.28
PSG Analog Signal Generator	Agilent	E8257D	MY44321116	2019.02.04
Preamplifier	QuieTek	AP-025C	CHM-0503006	2019.04.11
Preamplifier	Miteq	NSP1800-25	1364185	2019.05.03
Bilog Antenna	Teseq GmbH	CBL6112D	27612	2019.01.23
Half Wave Tuned Dipole Antenna	COM-POWER	AD-100	40137	2019.02.26
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	737	2019.03.06
DRG Horn	ETS-Lindgren	3117	00167055	2019.07.23
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC5-TH	2019.01.05

6.2. Test Setup

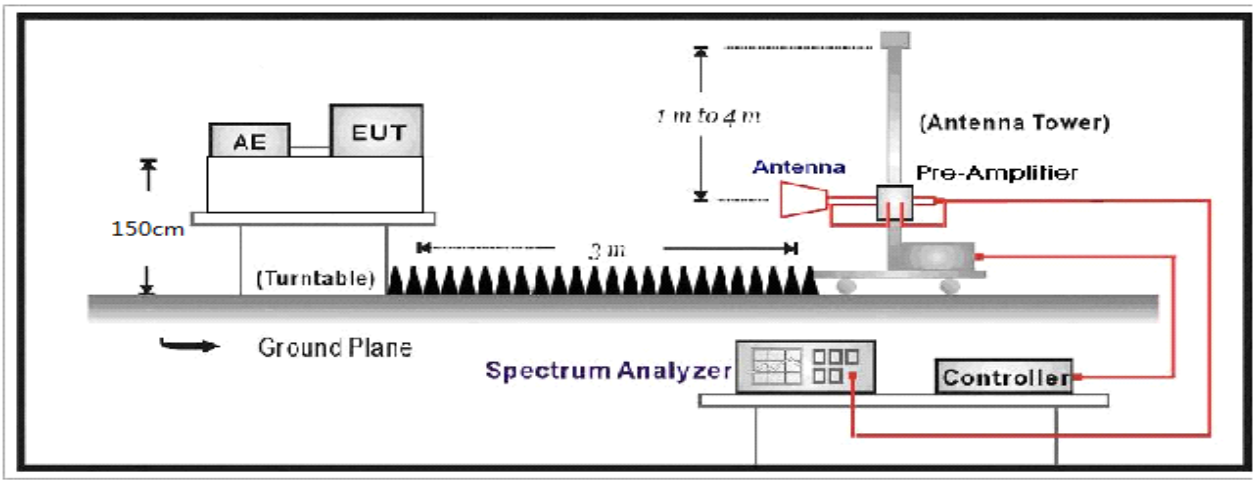
Conducted Power Measurement:



Radiated Power Measurement (Below 1G):



Radiated Power Measurement (Above 1G):



6.3. Test Procedure

Test Method for conducted power
a) The RF output of the transmitter was connected to base station simulator. b) The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. c) Set EUT at maximum average power by base station simulator. d) Measure lowest, middle, and highest channels for each bandwidth and different modulation.
Test For Effective Isotropic Radiated Power Measurement:
a) The EUT was placed on a turntable with 1.5 meter height in a fully anechoic chamber. b) The EUT was set at 3 meters from the receiving antenna, which was mounted on the antenna tower c) LTE operating modes: use channel power function to test d) The table was rotated 360 degrees to determine the position of the highest radiated power. e) The height of the receiving antenna is adjusted to look for the maximum EIRP. f) The maximum EIRP shall be record. g) A dipole antenna was substituted in place of the EUT and was driven by a signal generator. h) The conducted power at the terminal of the dipole antenna is measured. i) Repeat step c) to step h) to get the maximum EIRP of the substitution antenna. j) EIRP = Ps + Et – Es + Gs = Ps + Rt – Rs + Gs. k) Ps (dBm)：Input power to substitution antenna l) Gs (dBi or dBd)：Substitution antenna Gain. m) Et = Rt + AF n) Es = Rs + AF o) AF (dB/m)：Receive antenna factor p) Rt：The highest received signal in spectrum analyzer for EUT. q) Rs：The highest received signal in spectrum analyzer for substitution antenna.

6.4. Test Result

Product	TKG-1MU		
Test Item	Radiated Spurious Emission		
Test Mode	Mode 1: LTE Band 2 Link QPSK/16QAM 5MHz		
Date of Test	2018/08/20	Test Site	AC5

Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)
Low Channel 18625 (1852.5MHz) BW5MHz 1RB0								
3705.00	-59.487	V	-55.449	4.76	12.73	-47.479	-13.00	-34.479
5557.50	-66.551	V	-58.261	4.81	13.20	-49.871	-13.00	-36.871
3705.00	-51.467	H	-47.711	4.83	12.73	-39.811	-13.00	-26.811
5557.50	-66.048	H	-57.927	4.87	13.18	-49.617	-13.00	-36.617
Note 1: We have evaluated all bandwidth and channels by modulation of QPSK and 16QAM, shown in the report are worst data. Note 2: We also evaluate frequency range 30MHz-1GHz, but the test trace is same as the ambient noise, therefor no data appear in the report.								

Product	TKG-1MU		
Test Item	Radiated Spurious Emission		
Test Mode	Mode 2: LTE Band 4 Link QPSK/16QAM 5MHz		
Date of Test	2018/08/20	Test Site	AC-5

Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)
Mid Channel 19975 (1732.50MHz) BW5MHz 1RB0								
3465.00	-60.254	V	-56.481	4.78	12.81	-48.451	-13.00	-35.451
5197.50	-61.841	V	-54.114	4.79	12.83	-46.074	-13.00	-33.074
3465.00	-59.754	H	-56.300	4.80	12.84	-48.260	-13.00	-35.260
5197.50	-62.213	H	-54.697	4.80	12.82	-46.677	-13.00	-33.677
Note 1: We have evaluated all bandwidth and channels by modulation of QPSK and 16QAM, shown in the report are worst data. Note 2: We also evaluate frequency range 30MHz-1GHz, but the test trace is same as the ambient noise, therefor no data appear in the report.								

Product	TKG-1MU		
Test Item	Radiated Spurious Emission		
Test Mode	Mode 3: LTE Band 12 Link QPSK/16QAM 15MHz		
Date of Test	2018/08/20	Test Site	AC-5

Frequency (MHz)	SA Reading (dBm)	Ant.Pol. (H/V)	SG Reading (dBm)	Cable Loss (dB)	Gain (dBi)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)
Low Channel 23035 (701.50MHz) BW5MHz 1RB0								
1425.000	-58.180	V	-63.922	2.69	12.67	-53.942	-13.00	-40.942
2105.000	-58.791	V	-58.681	3.26	11.27	-50.671	-13.00	-37.671
1425.000	-54.595	H	-60.123	2.69	12.67	-50.143	-13.00	-37.143
2105.000	-55.175	H	-54.994	3.26	11.27	-46.984	-13.00	-33.984

Note 1: We have evaluated all bandwidth and channels by modulation of QPSK and 16QAM, shown in the report are worst data.

Note 2: We also evaluate frequency range 30MHz-1GHz, but the test trace is same as the ambient noise, therefor no data appear in the report.

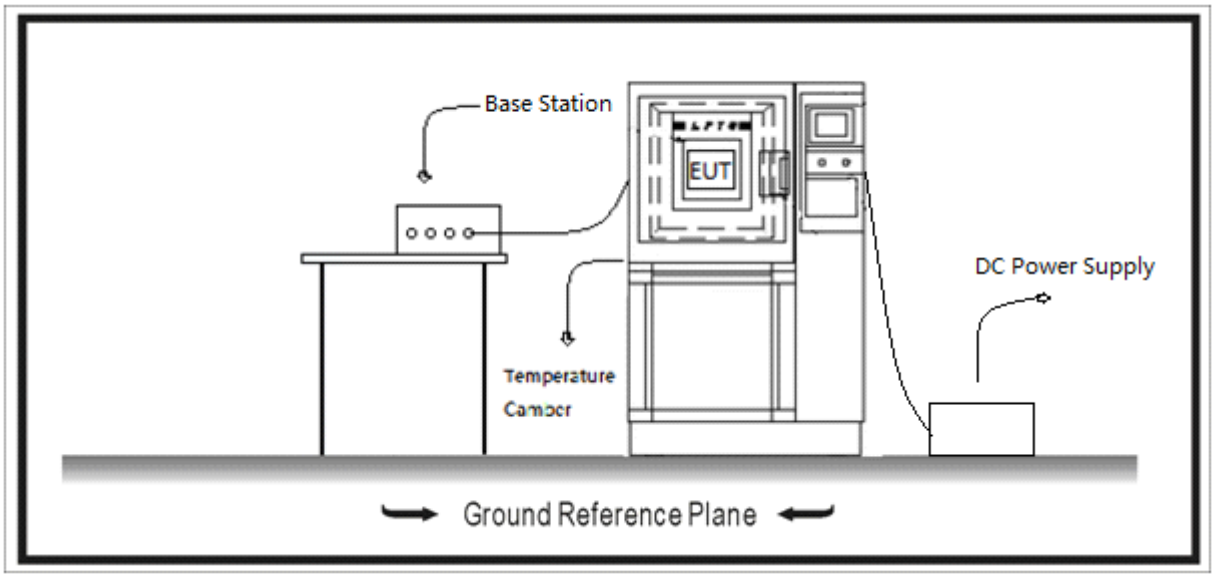
7. Frequency Stability Under Temperature & Voltage Variations

7.1. Test Equipment

Frequency Stability Under Temperature & Voltage Variations/TR-7				
Instrument	Manufacturer	Type No.	Serial No	Cali. Due Date
PSA Series Spectrum Analyzer	Agilent	E4440A	MY49420184	2019.02.04
Radio Communication Tester	Anritsu	MT8820C	6201181503	2018.09.16
Dual Directional Coupler	Agilent	778D	20160	2019.02.04
10dB Coaxial Coupler	Agilent	87300C	MY44300299	2019.03.28
DC Power Supply	IDRC	CD-035-020PR	977272	2018.09.16
Temperature & Humidity Chamber	Gaoyu	TH-1P-B	WIT-05121302	2019.01.04
Temperature/Humidity Meter	Zhicheng	ZC1-2	AC6-TH	2019.01.05

7.2. Test Setup

For Conducted Measurement



7.3. Test Procedure

Frequency Stability Under Temperature Variations:
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20℃ operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30℃. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10℃ increased per stage until the highest temperature of +50℃ reached.
Frequency Stability Under Voltage Variations:
Set chamber temperature to 20℃. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency. Reduce the input voltage to specify extreme voltage variation (±15%) and endpoint, record the maximum frequency change.

7.4. Test Result

Note: Appendix 1

The End