

# **FCC CFR47 PART 22H, 24E, 27 CERTIFICATION TEST REPORT FCC ID: 2AWR4EELR-P-02**

**Product:** Ellume.lab

**Trade Mark:** N/A

**Model Number:** E-ELR-P-02

**Family Model:** N/A

**Report No.:** S19122601207005

## **Prepared for**

Ellume Ltd

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## **Prepared by**

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TEST RESULT CERTIFICATION

Applicant's name : Ellume Ltd
Address : 57 Didsbury Street, East Brisbane, Queensland 4169, Australia
Manufacturer's Name : Hatch International Limited
Address : 14D, JiaFu Ge CaiFu building, Caitian road, Futian District, Shenzhen, China
Product name : Ellume.lab
Model and/or type reference : E-ELR-P-02
Family Model: N/A
Standards : FCC CFR 47 Part 22H, Part 24E, Part 27
Test procedure : ANSI C63.26:2015
ANSI/TIA-603-E-2016

This device described above has been tested by NTEK, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test
Date (s) of performance of tests : 26 Dec. 2019 ~ 16 Apr. 2020
Date of Issue : 16 Apr. 2020
Test Result : Pass

Testing Engineer : Mary Hu (Mary Hu)
Technical Manager : Jason Chen (Jason Chen)
Authorized Signatory : Sam Chen (Sam Chen)

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# 1. GENERAL INFORMATION

## 1.1 PRODUCT DESCRIPTION

A major technical description of EUT is described as following:

Product Designation:	Ellume.lab
Trade Mark	N/A
Model Name	E-ELR-P-02
Family Model	N/A
Model Difference	N/A
FCC ID:	2AWR4EELR-P-02
Frequency Bands:	U.S. Bands: <input checked="" type="checkbox"/> LTE FDD Band 2,5,7
Frequency Range:	LTE FDD Band 2 Uplink: 1850MHz-1910MHz, Downlink: 1930MHz-1990MHz; LTE FDD Band 5 Uplink: 824MHz-849MHz, Downlink: 869MHz-894MHz; LTE-FDD Band 7 Uplink: 2500MHz-2570MHz, Downlink: 2620MHz-2690MHz;
Type of Modulation:	QPSK/16QAM
SIM Card	SIM 1 and SIM 2 is a chipset unit and tested as a single chipset. The SIM 1 is chosen for test.
Antenna:	FPC Antenna
Antenna gain:	1.2dBi
Power Supply:	<input checked="" type="checkbox"/> DC supply: DC3.8V/5000mAh from Battery or DC 5V from Type-C port.
Adapter:	<input checked="" type="checkbox"/> Adapter supply: Model:TEKA012-0502000UK Input:100-240V~50/60Hz 0.35A Output: 5.0V $\overline{\text{---}}$ 2000mA
Extreme Vol. Limits:	DC 3.2V to DC 4.4V (Nominal DC3.8V) (Note 1)
HW Version	H308_MB_V2
SW Version	MOLY.LR12A.R2.MP.V54
** Note1: The High Voltage DC 4.4V and Low Voltage 3.2V was declared by manufacturer, The EUT couldn't be operate normally with higher or lower voltage.	

**1.2 RELATED SUBMITTAL(S) / GRANT (S)**

This submittal(s) (test report) is intended for **FCC ID: 2AWR4EELR-P-02** filing to comply with the FCC Part 22H&24E &27.

**1.3 TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI/TIA-603-E-2016, FCC CFR 47 Part 2, Part 22, Part 24, Part 27, ANSI C63.26:2015.

**1.4 TEST FACILITY**

The test site used to collect the radiated data is located at:

ShenZhen NTEK Testing Technology Co., Ltd.

1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street, Bao'an District, Shenzhen 518126 P.R.China.

The test site is constructed and calibrated to meet the FCC requirements in documents ANSI C63.26:2015& ANSI C63.4: 2014.

FCC Registration No.:463705

IC Registration No.:9270A-1,

CNAS Registration No.:L5516

**MEASUREMENT UNCERTAINTY**

The reported uncertainty of measurement, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.5dB

**1.5 SPECIAL ACCESSORIES**

The battery and the charger, earphone supplied by the applicant were used as accessories and being tested with EUT intended for FCC grant together.

**1.6 WORST-CASE CONFIGURATION AND MODE**

The worst-case scenario for all measurements is based on the investigation results.

The device has LTE Bands of: Band 2, Band 5, Band 7.

The RB Size was selected to measure for peak or average ERP and EIRP, which was based on the conducted power verification baseline data.

For the fundamental investigation of radiated emissions, the EUT is investigated for vertical and horizontal antenna orientations and X Y and Z orientations of the EUT alone. After the investigations the worst case was determined to be at X orientation for all LTE bands.

## 2. SYSTEM TEST CONFIGURATION

### 2.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 2.2 EUT EXERCISE

The Transmitter was operated in the maximum output power mode through Communication Tester. The TX frequency was fixed which was for the purpose of the measurements.

### 2.3 CONFIGURATION OF EUT SYSTEM

Table 2-1 Equipment Used in EUT System

Item	Equipment	Model No.	ID or Specification	Note
1	Ellume.lab	E-ELR-P-02	FCC ID: 2AWR4EELR-P-02	EUT

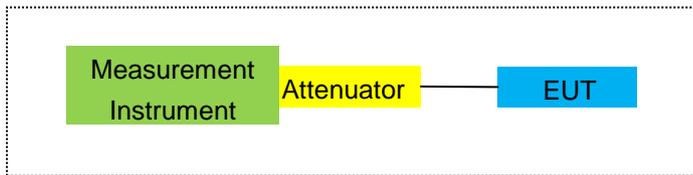
*Note: All the accessories have been used during the test.  
the following "EUT" in setup diagram means EUT system.*

**2.4 TEST SETUP**

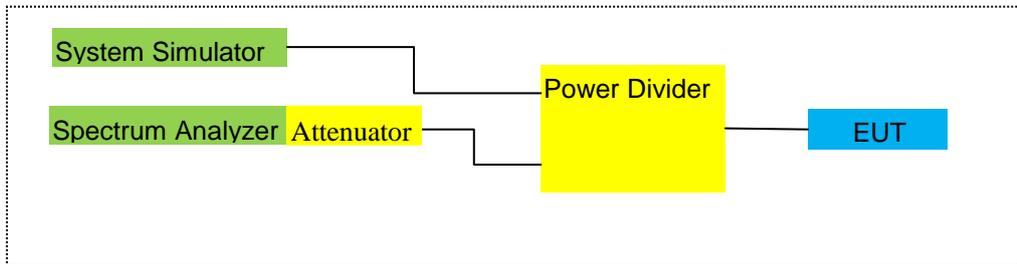
For Radiated Test Cases



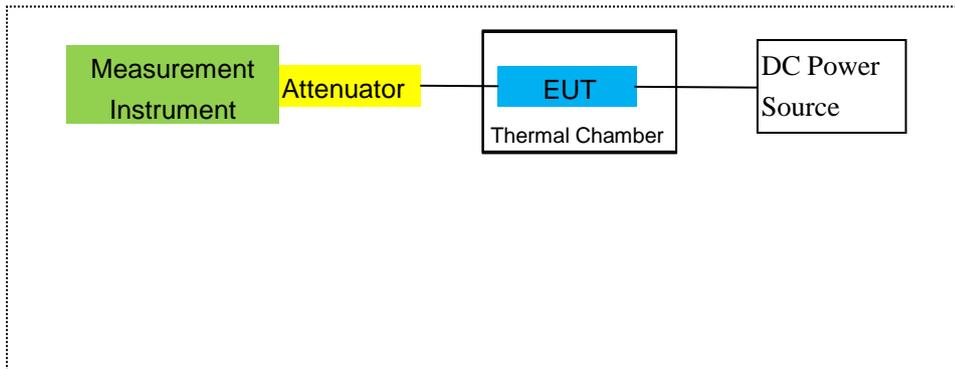
For Conducted Output Power



For Peak-to Average Ratio, Occupied Bandwidth, Conducted Band edge and Conducted Spurious Emission



For Frequency Stability



Note: EUT built-in battery-powered, the battery is fully-charged.

### 3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

NAME OF EQUIPMENT	MANUFACTURER	MODEL	SERIAL NUMBER	NEXT CAL. DATE
SPECTRUM ANALYZER	AGILENT	N9020A	MY49100060	2020.08.27
TEST RECEIVER	R&S	ESCI	A0304218	2020.05.12
COMMUNICATION TESTER	R&S	CMU200	117858	2020.05.12
COMMUNICATION TESTER	R&S	CMW500	148500	2020.05.12
TEST RECEIVER	R&S	ESPI	101318	2020.05.12
LISN	SCHWARZBECK	NSLK8127	A0304233	2020.05.12
CLIMATE CHAMBER	ALBATROSS	--	--	2020.05.12
Loop Antenna	ARA	PLA-1030/B	1029	2020.05.12
Biological Antenna	TESEQ	CBL6111D	31216	2020.05.12
Horn Antenna	EM	EM-AH-10180	2011071402	2020.05.12
DC Power Source	N/A	PS-6005D	20170402923	2020.05.12

## 4. OUTPUT POWER

### 4.1 OUTPUT POWER MEASUREMENT

#### LTE Measurement Procedure:

All LTE bands conducted power peak and average are obtained from the CMW500 telecommunication test set. The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS36.101 specification.

UE Power Class: 3 (23 +/- 2dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101.

**Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3**

Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS36.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of "NS\_01".3

**Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)**

Network Signalling value	Requirements (sub-clause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks ( $N_{RB}$ )	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	NA
NS_03	6.6.2.2.1	2, 4, 10, 23, 25, 35, 36	3	>5	$\leq 1$
			5	>6	$\leq 1$
			10	>6	$\leq 1$
			15	>8	$\leq 1$
			20	>10	$\leq 1$
NS_04	6.6.2.2.2	41	5	>6	$\leq 1$
			10, 15, 20	See Table 6.2.4-4	
NS_05	6.6.3.3.1	1	10, 15, 20	$\geq 50$	$\leq 1$
NS_06	6.6.2.2.3	12, 13, 14, 17	1.4, 3, 5, 10	Table 5.6-1	n/a
NS_07	6.6.2.2.3	13	10	Table 6.2.4-2	Table 6.2.4-2
	6.6.3.3.2				
NS_08	6.6.3.3.3	19	10, 15	> 44	$\leq 3$
NS_09	6.6.3.3.4	21	10, 15	> 40	$\leq 1$
				> 55	$\leq 2$
NS_10		20	15, 20	Table 6.2.4-3	Table 6.2.4-3
NS_11	6.6.2.2.1	23 <sup>1</sup>	1.4, 3, 5, 10	Table 6.2.4-5	Table 6.2.4-5
..					
NS_32	-	-	-	-	-

Note 1: Applies to the lower block of Band 23, i.e. a carrier placed in the 2000-2010 MHz region.

Test data reference attachment.

## 5. OCCUPIED BANDWIDTH

### RULE PART(S)

FCC: §2.1049

### LIMITS

For reporting purposes only

### TEST PROCEDURE

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at the low, middle and high channel in each band. The -26dB bandwidth was also measured and recorded.

### MODES TESTED

LTE Band 2

LTE Band 5

LTE Band 7

### RESULTS

**PASS**

Test data reference attachment.

## 6. BANDEDGE AND EMISSION MASK

### RULE PART(S)

FCC: §2.1051, §22.901, §22.917, §24.238, §27.53

FCC: §22.359

### LIMITS

FCC: §22.359, §24.238, §27.53

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.

(m)(4) 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. Show citation box.

(c)(4) 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;

**TEST PROCEDURE**

The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

For each band edge measurement:

Set the spectrum analyzer span to include the block edge frequency (704, 716, 824, 849, 1710 and 1755, 1850 and 1910MHz)

Set a marker to point the corresponding band edge frequency in each test case.

Set resolution bandwidth to at least 1% of emission bandwidth.

**MODES TESTED**

- LTE Band 2
- LTE Band 5
- LTE Band 7

**RESULTS**

Test data reference attachment.

Note: Both QPSK and 16QAM has been tested, the worst case is QPSK mode, the report just reported the worst case.

## 7. OUT OF BAND EMISSIONS

### RULE PART(S)

FCC: §2.1051, §22.901, §22.917, §24.238 and §27.53

### LIMITS

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.

### TEST PROCEDURE

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band Emissions, if any, up to 10th harmonic. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were caught.

For each out of band emissions measurement:

- 
- Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz.

### **MODES TESTED**

LTE Band 2  
LTE Band 5  
LTE Band 7

### **7.1 MEASUREMENT METHOD**

The test set up and general procedure is similar to conducted peak output power test. Only different for setting the measurement configuration of the measuring instrument of Spectrum Analyzer.

Test data reference attachment.

Note: Both QPSK and 16QAM has been tested, the worst case is QPSK mode, the report just reported the worst case.

## 8. RADIATED MEASUREMENT

### 8.1. RADIATED POWER (ERP & EIRP)

#### RULE PART(S)

FCC: §2.1046, §22.913, §24.232 and §27.50

#### LIMITS:

22.913(a) - The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.  
27.50 (c) (10) the following power and antenna height requirements apply to stations transmitting in the 698–746 MHz band, the portable stations (hand-held devices) are limited to 3 watts ERP.  
27.50 (b)(10) Portable stations (hand-held devices) transmitting in the 746–757 MHz, 758–763 MHz, 776–793 MHz, and 805–806 MHz bands are limited to 3 watts ERP.  
27.50 (d)(4) The following power and antenna height requirements apply to stations transmitting in the 1710–1755 MHz and 2110–2155 MHz bands: Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band are limited to 1 watt EIRP.  
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.

#### TEST PROCEDURE

ANSI/TIA-603-E Clause 2.2.17

KDB 971168 v02r01 RF power output using broadband peak and average power meter method.

KDB 971168 D01 Power Meas License Digital Systems v02r01, "Measurement Guidance for Certification of Licensed Digital Transmitters"

#### MODES TESTED

LTE Band 2  
LTE Band 5  
LTE Band 7

#### RESULTS

Pass

8.2 LTE BAND 2

Radiated Power (EIRP) for Band 2									
Mode	RB/RB position	Frequency	Result					Polarization Of Max. ERP	Conclusion
			SG Level (dBm)	Cable Loss (dBm)	Antenna Gain (dB)	Max. EIRP Average (dBm)	Max. EIRP Average (mW)		
1.4MHz Band QPSK	6/0	1850.7	-0.63	3.76	28.24	23.85	242.66	Horizontal	Pass
		1880	0.05	3.91	28.22	24.36	272.90	Horizontal	Pass
		1909.3	-0.71	3.93	28.20	23.56	226.99	Horizontal	Pass
3.0MHz Band QPSK	15/0	1851.5	-0.27	3.77	28.23	24.19	262.42	Horizontal	Pass
		1880	-0.67	3.91	28.24	23.66	232.14	Horizontal	Pass
		1908.5	-0.15	3.94	28.25	24.16	260.62	Horizontal	Pass
5.0MHz Band QPSK	25/0	1852.5	-0.60	3.77	28.31	23.94	247.74	Horizontal	Pass
		1880	-0.35	3.91	28.22	23.96	248.89	Horizontal	Pass
		1907.5	-0.27	3.94	28.20	23.99	250.61	Horizontal	Pass
10.0MHz Band QPSK	50/0	1855	-0.43	3.79	28.33	24.11	257.63	Horizontal	Pass
		1880	0.99	3.95	28.22	25.26	335.74	Horizontal	Pass
		1905	0.21	3.97	28.19	24.43	277.33	Horizontal	Pass
15.0MHz Band QPSK	75/0	1857.5	-0.26	3.79	28.34	24.29	268.53	Horizontal	Pass
		1880	-0.24	3.95	28.22	24.03	252.93	Horizontal	Pass
		1902.5	0.16	3.97	28.18	24.37	273.53	Horizontal	Pass
20.0MHz Band QPSK	100/0	1860	-0.81	3.81	28.35	23.73	236.05	Horizontal	Pass
		1880	0.03	3.96	28.22	24.29	268.53	Horizontal	Pass
		1900	-0.24	4.00	28.16	23.92	246.60	Horizontal	Pass
1.4MHz Band QPSK	6/0	1850.7	-0.79	3.76	28.24	23.69	233.88	Vertical	Pass
		1880	-0.23	3.91	28.22	24.08	255.86	Vertical	Pass
		1909.3	0.62	3.93	28.20	24.89	308.32	Vertical	Pass
3.0MHz Band QPSK	15/0	1851.5	0.63	3.77	28.23	25.09	322.85	Vertical	Pass
		1880	0.47	3.91	28.24	24.80	302.00	Vertical	Pass
		1908.5	0.48	3.94	28.25	24.79	301.30	Vertical	Pass
5.0MHz Band QPSK	25/0	1852.5	0.52	3.77	28.31	25.06	320.63	Vertical	Pass
		1880	1.07	3.91	28.22	25.38	345.14	Vertical	Pass
		1907.5	-0.02	3.94	28.20	24.24	265.46	Vertical	Pass
10.0MHz Band	50/0	1855	0.16	3.79	28.33	24.70	295.12	Vertical	Pass
		1880	-0.42	3.95	28.22	23.85	242.66	Vertical	Pass

QPSK		1905	0.10	3.97	28.19	24.32	270.40	Vertical	Pass
15.0MHz z Band QPSK	75/0	1857.5	-0.72	3.79	28.34	23.83	241.55	Vertical	Pass
		1880	0.07	3.95	28.22	24.34	271.64	Vertical	Pass
		1902.5	0.59	3.97	28.18	24.80	302.00	Vertical	Pass
20.0MHz z Band QPSK	100/0	1860	-0.78	3.81	28.35	23.76	237.68	Vertical	Pass
		1880	1.15	3.96	28.22	25.41	347.54	Vertical	Pass
		1900	1.15	4.00	28.16	25.31	339.63	Vertical	Pass

Note:

SG Level= Signal generator output

Max. EIRP Average (dBm)= Antenna Gain(dB)+ SG Level (dBm)- Cable Loss(dBm)

Radiated Power (EIRP) for Band 2									
Mode	RB/RB position	Frequency	Result						Conclusion
			SG Level (dBm)	Cable Loss (dBm)	Antenna Gain (dB)	Max. EIRP Average (dBm)	Max. EIRP Average (mW)	Polarization Of Max. ERP	
1.4MHz Band 16 QAM	6/0	1850.7	0.10	3.76	28.24	24.58	287.08	Horizontal	Pass
		1880	0.75	3.91	28.22	25.06	320.63	Horizontal	Pass
		1909.3	0.32	3.93	28.20	24.59	287.74	Horizontal	Pass
3.0MHz Band 16 QAM	15/0	1851.5	0.12	3.77	28.23	24.58	287.08	Horizontal	Pass
		1880	-0.16	3.91	28.24	24.17	261.22	Horizontal	Pass
		1908.5	-0.19	3.94	28.25	24.12	258.23	Horizontal	Pass
5.0MHz Band 16 QAM	25/0	1852.5	0.00	3.77	28.31	24.54	284.45	Horizontal	Pass
		1880	-0.57	3.91	28.22	23.74	236.59	Horizontal	Pass
		1907.5	-0.24	3.94	28.20	24.02	252.35	Horizontal	Pass
10.0MHz Band 16 QAM	50/0	1855	-0.89	3.79	28.33	23.65	231.74	Horizontal	Pass
		1880	-0.28	3.95	28.22	23.99	250.61	Horizontal	Pass
		1905	0.54	3.97	28.19	24.76	299.23	Horizontal	Pass
15.0MHz Band 16 QAM	75/0	1857.5	-0.86	3.79	28.34	23.69	233.88	Horizontal	Pass
		1880	-0.54	3.95	28.22	23.73	236.05	Horizontal	Pass
		1902.5	0.01	3.97	28.18	24.22	264.24	Horizontal	Pass
20.0MHz Band 16 QAM	100/0	1860	-1.65	3.81	28.35	22.89	194.54	Horizontal	Pass
		1880	0.33	3.96	28.22	24.59	287.74	Horizontal	Pass
		1900	-0.71	4.00	28.16	23.45	221.31	Horizontal	Pass
1.4MHz Band 16 QAM	6/0	1850.7	-1.08	3.76	28.24	23.40	218.78	Vertical	Pass
		1880	0.16	3.91	28.22	24.47	279.90	Vertical	Pass
		1909.3	0.78	3.93	28.20	25.05	319.89	Vertical	Pass
3.0MHz Band 16 QAM	15/0	1851.5	-0.01	3.77	28.23	24.45	278.61	Vertical	Pass
		1880	0.66	3.91	28.24	24.99	315.50	Vertical	Pass
		1908.5	-0.01	3.94	28.25	24.30	269.15	Vertical	Pass
5.0MHz Band 16 QAM	25/0	1852.5	-0.40	3.77	28.31	24.14	259.42	Vertical	Pass
		1880	-0.30	3.91	28.22	24.01	251.77	Vertical	Pass
		1907.5	0.24	3.94	28.20	24.50	281.84	Vertical	Pass
10.0MHz Band 16 QAM	50/0	1855	-0.08	3.79	28.33	24.46	279.04	Vertical	Pass
		1880	-0.53	3.95	28.22	23.74	236.59	Vertical	Pass
		1905	0.17	3.97	28.19	24.39	274.79	Vertical	Pass
15.0MHz Band	75/0	1857.5	-1.41	3.79	28.34	23.14	206.06	Vertical	Pass
		1880	0.27	3.95	28.22	24.54	284.45	Vertical	Pass

16 QAM		1902.5	0.94	3.97	28.18	25.15	327.34	Vertical	Pass
20.0MH	100/0	1860	-1.47	3.81	28.35	23.07	202.77	Vertical	Pass
z Band		1880	1.11	3.96	28.22	25.37	344.35	Vertical	Pass
16 QAM		1900	0.13	4.00	28.16	24.29	268.53	Vertical	Pass

Note:

SG Level= Signal generator output

Max. EIRP Average (dBm)= Antenna Gain(dB)+ SG Level (dBm)- Cable Loss(dBm)

8.3 LTE BAND 5

Radiated Power (ERP) for Band 5											
Mode	RB/RB position	Frequency	Result							Polarization Of Max. ERP	Conclusion
			SG Level (dBm)	Cable Loss (dBm)	Antenna Gain (dB)	Correction (dB)	Max. ERP Average (dBm)	Max. ERP Average (mW)			
1.4MHz Band QPSK	6/0	824.7	8.39	2.01	19.68	2.15	23.91	246.04	Horizontal	Pass	
		836.5	7.38	2.01	19.77	2.15	22.99	199.07	Horizontal	Pass	
		848.3	7.64	2.02	19.82	2.15	23.29	213.30	Horizontal	Pass	
3.0MHz Band QPSK	15/0	825.5	6.89	2.01	19.70	2.15	22.43	174.98	Horizontal	Pass	
		836.5	6.75	2.01	19.77	2.15	22.36	172.19	Horizontal	Pass	
		847.5	7.58	2.02	19.81	2.15	23.22	209.89	Horizontal	Pass	
5.0MHz Band QPSK	25/0	826.5	7.73	2.01	19.71	2.15	23.28	212.81	Horizontal	Pass	
		836.5	6.62	2.01	19.77	2.15	22.23	167.11	Horizontal	Pass	
		846.5	7.34	2.02	19.79	2.15	22.96	197.70	Horizontal	Pass	
10.0MHz Band QPSK	50/0	829	7.32	2.01	19.73	2.15	22.89	194.54	Horizontal	Pass	
		836.5	7.73	2.01	19.77	2.15	23.34	215.77	Horizontal	Pass	
		844	7.63	2.02	19.78	2.15	23.24	210.86	Horizontal	Pass	
1.4MHz Band QPSK	6/0	824.7	7.92	2.01	19.68	2.15	23.44	220.80	Vertical	Pass	
		836.5	8.19	2.01	19.77	2.15	23.80	239.88	Vertical	Pass	
		848.3	7.97	2.02	19.82	2.15	23.62	230.14	Vertical	Pass	
3.0MHz Band QPSK	15/0	825.5	8.24	2.01	19.70	2.15	23.78	238.78	Vertical	Pass	
		836.5	8.41	2.01	19.77	2.15	24.02	252.35	Vertical	Pass	
		847.5	7.83	2.02	19.81	2.15	23.47	222.33	Vertical	Pass	
5.0MHz Band QPSK	25/0	826.5	7.31	2.01	19.71	2.15	22.86	193.20	Vertical	Pass	
		836.5	8.04	2.01	19.77	2.15	23.65	231.74	Vertical	Pass	
		846.5	7.75	2.02	19.79	2.15	23.37	217.27	Vertical	Pass	
10.0MHz Band QPSK	50/0	829	7.03	2.01	19.73	2.15	22.60	181.97	Vertical	Pass	
		836.5	8.19	2.01	19.77	2.15	23.80	239.88	Vertical	Pass	
		844	8.48	2.02	19.78	2.15	24.09	256.45	Vertical	Pass	

Note:

ERP=EIRP-2.15

SG Level= Signal generator output

Max. EIRP Average (dBm)= Antenna Gain(dB)+ SG Level (dBm)- Cable Loss(dBm)

Radiated Power (ERP) for Band 5											
Mode	RB/RB position	Frequency	Result							Polarization Of Max. ERP	Conclusion
			SG Level (dBm)	Cable Loss (dBm)	Antenna Gain (dB)	Correction (dB)	Max. ERP Average (dBm)	Max. ERP Average (mW)			
1.4MHz Band 16 QAM	6/0	824.7	7.96	2.01	19.68	2.15	23.48	222.84	Horizontal	Pass	
		836.5	6.50	2.01	19.77	2.15	22.11	162.55	Horizontal	Pass	
		848.3	7.15	2.02	19.82	2.15	22.80	190.55	Horizontal	Pass	
3.0MHz Band 16 QAM	15/0	825.5	6.67	2.01	19.70	2.15	22.21	166.34	Horizontal	Pass	
		836.5	6.97	2.01	19.77	2.15	22.58	181.13	Horizontal	Pass	
		847.5	6.52	2.02	19.81	2.15	22.16	164.44	Horizontal	Pass	
5.0MHz Band 16 QAM	25/0	826.5	7.16	2.01	19.71	2.15	22.71	186.64	Horizontal	Pass	
		836.5	7.32	2.01	19.77	2.15	22.93	196.34	Horizontal	Pass	
		846.5	7.15	2.02	19.79	2.15	22.77	189.23	Horizontal	Pass	
10.0MHz Band 16 QAM	50/0	829	6.62	2.01	19.73	2.15	22.19	165.58	Horizontal	Pass	
		836.5	7.18	2.01	19.77	2.15	22.79	190.11	Horizontal	Pass	
		844	6.67	2.02	19.78	2.15	22.28	169.04	Horizontal	Pass	
1.4MHz Band 16 QAM	6/0	824.7	7.34	2.01	19.68	2.15	22.86	193.20	Vertical	Pass	
		836.5	7.31	2.01	19.77	2.15	22.92	195.88	Vertical	Pass	
		848.3	7.22	2.02	19.82	2.15	22.87	193.64	Vertical	Pass	
3.0MHz Band 16 QAM	15/0	825.5	6.68	2.01	19.70	2.15	22.22	166.72	Vertical	Pass	
		836.5	6.55	2.01	19.77	2.15	22.16	164.44	Vertical	Pass	
		847.5	7.94	2.02	19.81	2.15	23.58	228.03	Vertical	Pass	
5.0MHz Band 16 QAM	25/0	826.5	7.97	2.01	19.71	2.15	23.52	224.91	Vertical	Pass	
		836.5	5.92	2.01	19.77	2.15	21.53	142.23	Vertical	Pass	
		846.5	7.83	2.02	19.79	2.15	23.45	221.31	Vertical	Pass	
10.0MHz Band 16 QAM	50/0	829	8.21	2.01	19.73	2.15	23.78	238.78	Vertical	Pass	
		836.5	7.32	2.01	19.77	2.15	22.93	196.34	Vertical	Pass	
		844	7.15	2.02	19.78	2.15	22.76	188.80	Vertical	Pass	

Note:

ERP=EIRP-2.15

SG Level= Signal generator output

Max. EIRP Average (dBm)= Antenna Gain(dB)+ SG Level (dBm)- Cable Loss(dBm)

8.4 LTE BAND 7

Radiated Power (EIRP) for Band 7										
Mode	RB/ RB position	Frequency	Result						Polarizati on Of Max. ERP	Conclusion
			SG Level	Cabl e	Antenn a Gain	Max. EIRP	Max. EIRP	Averag e		
			(dBm )	Loss (dBm )	(dB)	Averag e	Averag e			
			(dBm)	(mW)						
5.0MHz Band QPSK	25/0	2502.5	1.02	4.54	27.75	24.23	264.85	Horizontal	Pass	
		2535	1.41	4.69	27.72	24.44	277.97	Horizontal	Pass	
		2567.5	0.77	4.71	27.71	23.77	238.23	Horizontal	Pass	
10.0MH z Band QPSK	25/0	2502.5	1.80	4.55	27.76	25.01	316.96	Horizontal	Pass	
		2535	0.92	4.69	27.72	23.95	248.31	Horizontal	Pass	
		2567.5	0.90	4.72	27.70	23.88	244.34	Horizontal	Pass	
15.0MH z Band 16 QAM	50/0	2505	0.53	4.55	27.77	23.75	237.14	Horizontal	Pass	
		2535	0.79	4.69	27.72	23.82	240.99	Horizontal	Pass	
		2565	0.10	4.72	27.69	23.07	202.77	Horizontal	Pass	
20.0MH z Band 16 QAM	50/0	2505	2.04	4.57	27.78	25.25	334.97	Horizontal	Pass	
		2535	1.75	4.73	27.72	24.74	297.85	Horizontal	Pass	
		2565	1.13	4.75	27.68	24.06	254.68	Horizontal	Pass	
5.0MHz Band QPSK	75/0	2507.5	0.40	4.54	27.75	23.61	229.84	Vertical	Pass	
		2535	1.13	4.69	27.72	24.16	260.62	Vertical	Pass	
		2562.5	1.01	4.71	27.71	24.01	251.77	Vertical	Pass	
10.0MH z Band QPSK	75/0	2507.5	1.70	4.55	27.76	24.91	309.74	Vertical	Pass	
		2535	1.90	4.69	27.72	24.93	311.17	Vertical	Pass	
		2562.5	1.93	4.72	27.70	24.91	309.74	Vertical	Pass	
15.0MH z Band 16 QAM	100/ 0	2510	0.71	4.55	27.77	23.93	247.17	Vertical	Pass	
		2535	1.38	4.69	27.72	24.41	276.06	Vertical	Pass	
		2560	1.68	4.72	27.69	24.65	291.74	Vertical	Pass	
20.0MH z Band 16 QAM	100/ 0	2510	2.16	4.57	27.78	25.37	344.35	Vertical	Pass	
		2535	1.34	4.73	27.72	24.33	271.02	Vertical	Pass	
		2560	1.88	4.75	27.68	24.81	302.83	Vertical	Pass	

Note:

SG Level= Signal generator output

Max. EIRP Average (dBm)= Antenna Gain(dB)+ SG Level (dBm)- Cable Loss(dBm)

Radiated Power (EIRP) for Band 7									
Mode	RB/RB position	Frequency	Result						Conclusion
			SG Level (dBm)	Cable Loss (dBm)	Antenna Gain (dB)	Max. EIRP	Max. EIRP	Polarization Of Max. ERP	
						Average (dBm)	Average (mW)		
5.0MHz Band 16 QAM	25/0	2502.5	0.16	4.54	27.75	23.37	217.27	Horizontal	Pass
		2535	-0.21	4.69	27.72	22.82	191.43	Horizontal	Pass
		2567.5	0.21	4.71	27.71	23.21	209.41	Horizontal	Pass
10.0MHz Band 16 QAM	25/0	2502.5	-0.30	4.55	27.76	22.91	195.43	Horizontal	Pass
		2535	0.51	4.69	27.72	23.54	225.94	Horizontal	Pass
		2567.5	0.31	4.72	27.70	23.29	213.30	Horizontal	Pass
15.0MHz Band 16 QAM	50/0	2505	0.03	4.55	27.77	23.25	211.35	Horizontal	Pass
		2535	0.08	4.69	27.72	23.11	204.64	Horizontal	Pass
		2565	0.13	4.72	27.69	23.10	204.17	Horizontal	Pass
20.0MHz Band 16 QAM	50/0	2505	-0.05	4.57	27.78	23.16	207.01	Horizontal	Pass
		2535	0.48	4.73	27.72	23.47	222.33	Horizontal	Pass
		2565	0.57	4.75	27.68	23.50	223.87	Horizontal	Pass
5.0MHz Band 16 QAM	75/0	2507.5	0.19	4.54	27.75	23.40	218.94	Vertical	Pass
		2535	-0.80	4.69	27.72	22.23	167.11	Vertical	Pass
		2562.5	-0.53	4.71	27.71	22.47	176.60	Vertical	Pass
10.0MHz Band 16 QAM	75/0	2507.5	0.06	4.55	27.76	23.27	212.32	Vertical	Pass
		2535	0.87	4.69	27.72	23.90	245.47	Vertical	Pass
		2562.5	0.12	4.72	27.70	23.10	204.17	Vertical	Pass
15.0MHz Band 16 QAM	100/0	2510	1.05	4.55	27.77	24.27	267.30	Vertical	Pass
		2535	0.68	4.69	27.72	23.71	234.96	Vertical	Pass
		2560	0.35	4.72	27.69	23.32	214.78	Vertical	Pass
20.0MHz Band 16 QAM	100/0	2510	1.68	4.57	27.78	24.89	308.32	Vertical	Pass
		2535	1.76	4.73	27.72	24.75	298.54	Vertical	Pass
		2560	1.05	4.75	27.68	23.98	250.03	Vertical	Pass

Note:

SG Level= Signal generator output

Max. EIRP Average (dBm)= Antenna Gain(dB)+ SG Level (dBm)- Cable Loss(dBm)

## 9. SPURIOUS RADIATION EMISSION

### RULE PART(S)

FCC: §2.1053, §22.917, §24.238 and §27.53

### LIMIT

§22.917 (e) and §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.

§27.53 (g) For operations in 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.

§27.53 (h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log_{10}(P)$  dB.

### TEST PROCEDURE

For Cellular equipment - Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. 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. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

For PCS equipment - Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth ( i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth in the 1 MHz band immediately outside and adjacent to the channel edge of the equipment. Beyond the 1 MHz band immediately outside the channel edge of the equipment, a resolution bandwidth of 1 MHz shall be employed. A narrower resolution bandwidth is allowed to be used provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz or 1% of the occupied bandwidth as applicable.

The power of any unwanted emissions measured from the channel edge of the equipment shall be attenuated below the transmitter power, P (dBW), as follows:

- a. for base station and subscriber equipment, other than mobile subscriber equipment, the attenuation shall not be less than  $43 + 10 \text{ Log}_{10}(p)$ , dB; and
- b. for mobile subscriber equipment, the attenuation shall not be less than  $43 + 10 \text{ Log}_{10}(p)$ , dB at the channel edges and  $55 + 10 \text{ Log}_{10}(p)$  at 5.5 MHz away and beyond the channel edges where p in (a) and (b) is the transmitter power measured in watts.

**MODES TESTED**

- LTE Band 2
- LTE Band 5
- LTE Band 7

**RESULTS**

PASS

9.1 LTE BAND 2

**QPSK EIRP POWER FOR LTE BAND 2 (1.4MHZ BANDWIDTH)**

Test Results for Low Channel 1850.7MHz							
Frequency(MHz)	SG Level(dBm)	Cable Loss(dB)	Antenna Gain(dB)	Absolute Level(dBm)	Limit (dBm)	Margin(dBm)	Polarity
3701.4	-52.58	4.04	33.51	-23.11	-13	-10.11	Horizontal
3701.4	-54.07	4.04	33.51	-24.60	-13	-11.60	Vertical
5552.1	-56.78	5.24	35.84	-26.18	-13	-13.18	Vertical
5552.1	-66.89	5.24	35.84	-36.29	-13	-23.29	Horizontal
Test Results for Mid Channel 1880MHz							
3760.0	-54.16	4.04	33.56	-24.64	-13	-11.64	Horizontal
3760.0	-54.48	4.04	33.56	-24.96	-13	-11.96	Vertical
5640.0	-54.42	5.24	35.91	-23.75	-13	-10.75	Vertical
5640.0	-55.96	5.24	35.91	-25.29	-13	-12.29	Horizontal
Test Results for High Channel 1909.3MHz							
3818.6	-53.56	4.04	34.00	-23.60	-13	-10.60	Horizontal
3818.6	-55.50	4.04	34.00	-25.54	-13	-12.54	Vertical
5727.9	-58.32	5.24	36.04	-27.52	-13	-14.52	Vertical
5727.9	-57.52	5.24	36.04	-26.72	-13	-13.72	Horizontal

**QPSK EIRP POWER FOR LTE BAND 2 (20.0MHZ BANDWIDTH)**

<b>Test Results for Low Channel 1860MHz</b>							
Frequency(MHz)	SG Level(dBm)	Cable Loss(dB)	Antenna Gain(dB)	Absolute Level(dBm)	Limit (dBm)	Margin(dBm)	Polarity
3720.0	-57.04	4.07	33.54	-27.57	-13	-14.57	Horizontal
3720.0	-52.11	4.07	33.54	-22.64	-13	-9.64	Vertical
5580.0	-58.44	5.28	35.86	-27.86	-13	-14.86	Vertical
5580.0	-60.41	5.28	35.86	-29.83	-13	-16.83	Horizontal
<b>Test Results for Mid Channel 1880MHz</b>							
3760.0	-56.52	4.04	33.56	-27.00	-13	-14.00	Horizontal
3760.0	-53.49	4.04	33.56	-23.97	-13	-10.97	Vertical
5640.0	-58.01	5.24	35.91	-27.34	-13	-14.34	Vertical
5640.0	-58.83	5.24	35.91	-28.16	-13	-15.16	Horizontal
<b>Test Results for High Channel 1900MHz</b>							
3800.0	-55.83	4.04	34.00	-25.87	-13	-12.87	Horizontal
3800.0	-57.12	4.04	34.00	-27.16	-13	-14.16	Vertical
5700.0	-57.74	5.24	36.04	-26.94	-13	-13.94	Vertical
5700.0	-57.04	5.24	36.04	-26.24	-13	-13.24	Horizontal

Note:  $P_{Mea}(dBm) = Power(dBm) + AR_{pl}(dBm)$

. Over Limit = :  $P_{Mea}(dBm) - Limit(dBm)$

. Both QPSK and 16QAM has been tested, the worst case is QPSK mode, the report just reported the worst case.

9.3 LTE BAND 5

**QPSK EIRP POWER FOR LTE BAND 5 (1.4MHZ BANDWIDTH)**

Test Results for Low Channel 824.7MHz							
Frequency(MHz)	SG Level(dBm)	Cable Loss(dB)	Antenna Gain(dB)	Absolute Level(dBm)	Limit (dBm)	Margin(dBm)	Polarity
1649.4	-50.34	2.78	27.50	-25.62	-13	-12.62	Horizontal
1649.4	-55.71	2.78	27.50	-30.99	-13	-17.99	Vertical
2474.1	-55.06	2.90	27.80	-30.16	-13	-17.16	Vertical
2474.1	-53.07	2.90	27.80	-28.17	-13	-15.17	Horizontal
Test Results For Mid Channel 836.5MHz							
1673.0	-52.32	2.78	27.48	-27.62	-13	-14.62	Horizontal
1673.0	-49.86	2.78	27.48	-25.16	-13	-12.16	Vertical
2509.5	-52.11	2.91	27.70	-27.32	-13	-14.32	Vertical
2509.5	-52.70	2.91	27.70	-27.91	-13	-14.91	Horizontal
Test Results for High Channel 848.3MHz							
1696.6	-52.50	2.78	27.43	-27.85	-13	-14.85	Horizontal
1696.6	-54.07	2.78	27.43	-29.42	-13	-16.42	Vertical
2544.9	-51.39	2.92	27.74	-26.57	-13	-13.57	Vertical
2544.9	-52.35	2.92	27.74	-27.53	-13	-14.53	Horizontal

**QPSK EIRP POWER FOR LTE BAND 5 (10MHZ BANDWIDTH)**

Test Results for Low Channel 829MHz							
Frequency(MHz)	SG Level(dBm)	Cable Loss(dB)	Antenna Gain(dB)	Absolute Level(dBm)	Limit (dBm)	Margin(dBm)	Polarity
1658.0	-53.57	2.78	27.50	-28.85	-13	-15.85	Horizontal
1658.0	-50.73	2.78	27.50	-26.01	-13	-13.01	Vertical
2487.0	-55.31	2.90	27.80	-30.41	-13	-17.41	Vertical
2487.0	-52.59	2.90	27.80	-27.69	-13	-14.69	Horizontal
Test Results For Mid Channel 836.5MHz							
1673.0	-52.85	2.78	27.48	-28.15	-13	-15.15	Horizontal
1673.0	-51.97	2.78	27.48	-27.27	-13	-14.27	Vertical
2509.5	-56.53	2.91	27.70	-31.74	-13	-18.74	Vertical
2509.5	-53.94	2.91	27.70	-29.15	-13	-16.15	Horizontal
Test Results for High Channel 844MHz							
1688.0	-55.93	2.78	27.43	-31.28	-13	-18.28	Horizontal
1688.0	-49.41	2.78	27.43	-24.76	-13	-11.76	Vertical
2532.0	-50.13	2.92	27.74	-25.31	-13	-12.31	Vertical
2532.0	-51.86	2.92	27.74	-27.04	-13	-14.04	Horizontal

Note: P<sub>Mea</sub>(dBm)= Power(dBm)+ AR<sub>pl</sub> (dBm)

. Over Limit= : P<sub>Mea</sub>(dBm)-Limit(dBm)

. Both QPSK and 16QAM has been tested, the worst case is QPSK mode, the report just reported the worst case.

9.4 LTE BAND 7

**QPSK EIRP POWER FOR LTE BAND 7 (5.0MHZ BANDWIDTH)**

<b>Test Results for Low Channel 2502.5MHz</b>							
Frequency(MHz)	SG Level(dBm)	Cable Loss(dB)	Antenna Gain(dB)	Absolute Level(dBm)	Limit (dBm)	Margin(dBm)	Polarity
5005.0	-66.75	5.23	35.81	-36.17	-25	-11.17	Horizontal
5005.0	-65.83	5.23	35.81	-35.25	-25	-10.25	Vertical
7507.5	-67.46	5.67	36.85	-36.28	-25	-11.28	Vertical
7507.5	-65.41	5.67	36.85	-34.23	-25	-9.23	Horizontal
<b>Test Results for Mid Channel 2535MHz</b>							
5070.0	-65.54	5.23	35.82	-34.95	-25	-9.95	Horizontal
5070.0	-63.91	5.23	35.82	-33.32	-25	-8.32	Vertical
7605.0	-67.64	5.67	36.85	-36.46	-25	-11.46	Vertical
7605.0	-67.95	5.67	36.85	-36.77	-25	-11.77	Horizontal
<b>Test Results for High Channel 2567.5MHz</b>							
5135.0	-63.64	5.24	35.83	-33.05	-25	-8.05	Horizontal
5135.0	-67.25	5.24	35.83	-36.66	-25	-11.66	Vertical
7702.5	-67.01	5.68	36.87	-35.82	-25	-10.82	Vertical
7702.5	-67.61	5.68	36.87	-36.42	-25	-11.42	Horizontal

**QPSK EIRP POWER FOR LTE BAND 7 (20.0MHZ BANDWIDTH)**

Test Results for Low Channel 2510MHz							
Frequency(MHz)	SG Level(dBm)	Cable Loss(dB)	Antenna Gain(dB)	Absolute Level(dBm)	Limit (dBm)	Margin(dBm)	Polarity
5020.0	-66.00	5.23	35.82	-35.41	-25	-10.41	Horizontal
5020.0	-64.50	5.23	35.82	-33.91	-25	-8.91	Vertical
7530.0	-66.72	5.67	36.86	-35.53	-25	-10.53	Vertical
7530.0	-64.09	5.67	36.86	-32.90	-25	-7.90	Horizontal
Test Results for Mid Channel 2535MHz							
5070.0	-64.63	5.23	35.82	-34.04	-25	-9.04	Horizontal
5070.0	-63.79	5.23	35.82	-33.20	-25	-8.20	Vertical
7605.0	-67.58	5.67	36.85	-36.40	-25	-11.40	Vertical
7605.0	-67.27	5.67	36.85	-36.09	-25	-11.09	Horizontal
Test Results for High Channel 2560MHz							
5120.0	-63.54	5.24	35.83	-32.95	-25	-7.95	Horizontal
5120.0	-66.68	5.24	35.83	-36.09	-25	-11.09	Vertical
7680.0	-66.79	5.70	36.88	-35.61	-25	-10.61	Vertical
7680.0	-67.41	5.70	36.88	-36.23	-25	-11.23	Horizontal

Note: P<sub>Mea</sub>(dBm)= Power(dBm)+ AR<sub>pl</sub> (dBm)

. Over Limit= : P<sub>Mea</sub>(dBm)-Limit(dBm)

. Both QPSK and 16QAM has been tested, the worst case is QPSK mode, the report just reported the worst case.

## 10. FREQUENCY STABILITY

### RULE PART(S)

FCC: §2.1055, §22.355, §24.235, §27.54

### LIMITS

§22.355 - The carrier frequency shall not depart from the reference frequency in excess of  $\pm 2.5$  ppm for mobile stations.

§24.235 - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

### TEST PROCEDURE

Use CMW 500 with Frequency Error measurement capability.

- Temp. =  $-30^{\circ}$  to  $+50^{\circ}\text{C}$
- Voltage = low voltage, DC 3.2V, Normal, DC 3.8V and High voltage, DC 4.4V.

### Frequency Stability vs Temperature:

The EUT is placed inside a temperature chamber. The temperature is set to  $-30^{\circ}\text{C}$  and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is increased by 10 degrees, allowed to stabilize and soak, and then the measurement is repeated. This is repeated until  $+50^{\circ}\text{C}$  is reached.

### Frequency Stability vs Voltage:

The peak frequency error is recorded (worst-case).

### MODES TESTED

LTE Band 2  
LTE Band 5  
LTE Band 7

### RESULTS

See the following pages.

10.1 LTE BAND 2

QPSK, (20MHz BANDWIDTH)

**Frequency error vs. Voltage**

Voltage [Vdc]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 2 QPSK, (CH 18900 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
3.2	1880	7.7	0.00410	2.5
3.8	1880	7.6	0.00406	2.5
4.4	1880	9.1	0.00483	2.5

**Frequency error vs. Temperature**

Temperature [°C]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 2 QPSK, (CH 18900 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
Normal (25C)	1880	7.6	0.00402	2.5
Extreme (50C)	1880	9.0	0.00480	2.5
Extreme (40C)	1880	8.8	0.00466	2.5
Extreme (30C)	1880	7.1	0.00377	2.5
Extreme (10C)	1880	8.5	0.00450	2.5
Extreme (0C)	1880	8.3	0.00441	2.5
Extreme (-10C)	1880	9.3	0.00495	2.5
Extreme (-20C)	1880	8.0	0.00427	2.5
Extreme (-30C)	1880	8.0	0.00427	2.5

**16QAM, (20MHz BANDWIDTH)**

**Frequency error vs. Voltage**

Voltage [Vdc]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 2 16QAM, (CH 18900 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
3.2	1880	9.5	0.00506	2.5
3.8	1880	8.9	0.00475	2.5
4.4	1880	8.1	0.00430	2.5

**Frequency error vs. Temperature**

Temperature [°C]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 2 16QAM, (CH 18900 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
Normal (25C)	1880	9.9	0.00529	2.5
Extreme (50C)	1880	8.6	0.00459	2.5
Extreme (40C)	1880	8.1	0.00430	2.5
Extreme (30C)	1880	9.5	0.00503	2.5
Extreme (10C)	1880	9.1	0.00483	2.5
Extreme (0C)	1880	8.3	0.00441	2.5
Extreme (-10C)	1880	9.4	0.00502	2.5
Extreme (-20C)	1880	8.7	0.00464	2.5
Extreme (-30C)	1880	8.3	0.00441	2.5

**\*Note:** Frequency error measurements were made by using the build-in capability of the Wireless Communication Test Set.

10.2 LTE BAND 5

QPSK, (20MHz BANDWIDTH)

**Frequency error vs. Voltage**

Voltage [Vdc]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 QPSK, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
3.2	836.5	5.8	0.00689	2.5
3.8	836.5	6.4	0.00760	2.5
4.4	836.5	5.0	0.00596	2.5

**Frequency error vs. Temperature**

Temperature [°C]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 QPSK, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
Normal (25C)	836.5	6.4	0.00760	2.5
Extreme (50C)	836.5	5.8	0.00689	2.5
Extreme (40C)	836.5	5.8	0.00689	2.5
Extreme (30C)	836.5	6.1	0.00725	2.5
Extreme (10C)	836.5	5.4	0.00648	2.5
Extreme (0C)	836.5	4.9	0.00583	2.5
Extreme (-10C)	836.5	5.2	0.00624	2.5
Extreme (-20C)	836.5	6.5	0.00777	2.5
Extreme (-30C)	836.5	5.9	0.00706	2.5

**16QAM, (20MHz BANDWIDTH)**

**Frequency error vs. Voltage**

Voltage [Vdc]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 16QAM, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
3.2	836.5	6.1	0.00725	2.5
3.8	836.5	6.5	0.00777	2.5
4.4	836.5	5.2	0.00624	2.5

**Frequency error vs. Temperature**

Temperature [°C]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 16QAM, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
Normal (25C)	836.5	6.4	0.00760	2.5
Extreme (50C)	836.5	5.6	0.00668	2.5
Extreme (40C)	836.5	6.2	0.00736	2.5
Extreme (30C)	836.5	6.0	0.00720	2.5
Extreme (10C)	836.5	5.2	0.00624	2.5
Extreme (0C)	836.5	5.8	0.00689	2.5
Extreme (-10C)	836.5	5.5	0.00654	2.5
Extreme (-20C)	836.5	6.4	0.00760	2.5
Extreme (-30C)	836.5	6.0	0.00720	2.5

**\*Note:** Frequency error measurements were made by using the build-in capability of the Wireless Communication Test Set.

10.3 LTE BAND 7

QPSK, (20MHz BANDWIDTH)

**Frequency error vs. Voltage**

Voltage [Vdc]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 QPSK, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
3.2	2535	9.5	0.00375	2.5
3.8	2535	8.4	0.00331	2.5
4.4	2535	7.9	0.00312	2.5

**Frequency error vs. Temperature**

Temperature [°C]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 QPSK, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
Normal (25C)	2535	8.9	0.00351	2.5
Extreme (50C)	2535	8.4	0.00331	2.5
Extreme (40C)	2535	7.9	0.00312	2.5
Extreme (30C)	2535	8.4	0.00331	2.5
Extreme (10C)	2535	7.6	0.00300	2.5
Extreme (0C)	2535	7.9	0.00312	2.5
Extreme (-10C)	2535	8.9	0.00351	2.5
Extreme (-20C)	2535	8.4	0.00331	2.5
Extreme (-30C)	2535	7.9	0.00312	2.5

**16QAM, (20MHz BANDWIDTH)**

**Frequency error vs. Voltage**

Voltage [Vdc]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 16QAM, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
3.2	2535	9.2	0.00363	2.5
3.8	2535	8.9	0.00351	2.5
4.4	2535	8.2	0.00323	2.5

**Frequency error vs. Temperature**

Temperature [°C]	Frequency [MHz]	Frequency* Error[Hz]	Frequency Error[ppm]	Limit [ppm]
<b>BAND 7 16QAM, (CH 21100 RB size 100 RB Offset 0 20MHz BANDWIDTH)</b>				
Normal (25C)	2535	9.2	0.00363	2.5
Extreme (50C)	2535	7.1	0.00280	2.5
Extreme (40C)	2535	8.9	0.00351	2.5
Extreme (30C)	2535	7.2	0.00284	2.5
Extreme (10C)	2535	8.2	0.00323	2.5
Extreme (0C)	2535	8.6	0.00339	2.5
Extreme (-10C)	2535	7.7	0.00304	2.5
Extreme (-20C)	2535	9.4	0.00371	2.5
Extreme (-30C)	2535	9.2	0.00363	2.5

**\*Note:** Frequency error measurements were made by using the build-in capability of the Wireless Communication Test Set.

## 11. Peak-to-Average Ratio

### 11.1 Description of the PAR Measurement

The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

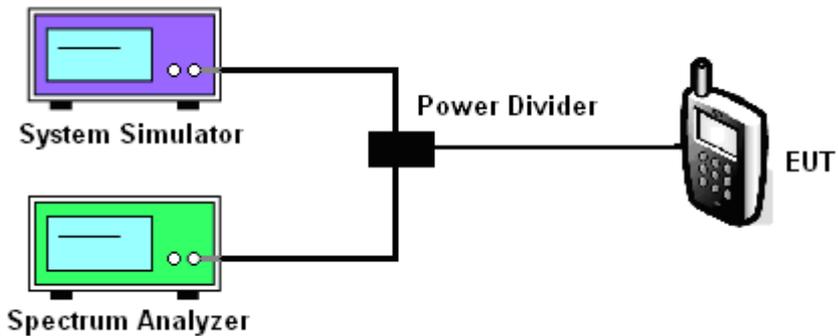
### 11.2 Measuring Instruments

See list of measuring instruments of this test report.

### 11.3 Test Procedures

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. For GSM/EGPRS operating modes:
  - a. Set the RBW = 1MHz, VBW = 1MHz, Peak detector in spectrum analyzer.
  - b. Set EUT in maximum power output, and triggered the burst signal.
  - c. Measured respectively the Peak level and Mean level, and the deviation was recorded as Peak to Average Ratio.
4. For UMTS operating modes:
  - a. Set the CCDF (Complementary Cumulative Distribution Function) option in spectrum analyzer.
  - b. The highest RF powers were measured and recorded the maximum PAPR level associated with a probability of 0.1 %.

11.4 Test Setup



**MODES TESTED**

- LTE Band 2
- LTE Band 5
- LTE Band 7

Test data reference attachment.

----END OF REPORT----