FCC Test Report

Product Name: CDMA Radio Frequency Unit

Model Number: CRFU-AWS

Report No: SYBH(R)005042010 EB-1

FCC ID: QISCRFU-AWS-CL

Reliability Laboratory of Huawei Technologies Co., Ltd.

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REPORT ON FCC Test of CDMA Radio Frequency Unit

Model Number : CRFU-AWS

Report No: SYBH(R) 005042010 EB-1

REGULATION **47 CFR FCC Part 2, Subpart J**
47 CFR FCC Part 27, Subpart C & L

CONCLUSION **PASSED**

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	Date (y-m-d)	Name	Signature
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1 Summary

The table below summarizes the measurements and results for the equipment of CDMA Radio Frequency Unit– CRFU-AWS. Detailed results and descriptions are shown in the following pages.

table 1. Summary of results for FCC requirements for AWS Band

47 CFR FCC Part(s) Requirements		Description	Result
Specification	Limits		
2.1046	27.50(d)	Maximum Channel Power	PASS
2.1047	-	Modulation Characteristics	PASS
2.1049	-	Occupied Bandwidth	PASS
2.1051	27.53(g)	Band Edges Compliance	PASS
2.1051	27.53(g)	Spurious Emission at Antenna Terminal	PASS
2.1053	27.53(g)	Radiated Spurious Emission	PASS
2.1055	27.54	Frequency Stability	PASS

Note1: If no limits were applied, limits for product standards may be employed in the present test report.

2 Product Description

2.1 Production Information of the Equipment under Test (EUT)

2.1.1 General Description

This describes the logical structure of the BTS. Logically, the BTS consists of the baseband system, RF system, power system, and antenna system.

Baseband System

The baseband system consists mainly of BBU3900s and performs the following functions:
Providing the physical interface for data exchange between the BTS and the BSC
Modulating and demodulating baseband data and CDMA/LTE channel signals
Providing system synchronization clock signals
Implementing resource management, operation and maintenance, and environment monitoring

RF System

The RF system consists mainly of CRFUs and performs the following functions:
On the forward links, implementing up-conversion and power amplification for modulated transmitted signals and filtering the transmitted signals to make them meet the requirements of the Um interface protocol
On the reverse link, filtering the signals received by the antenna to suppress out-band interference and performing low noise amplification, channel division, down-conversion, and channel-selective filtering

Power Supply System

The power supply system consists mainly of DCDUs and performs the following functions:
The DCDU is a DC power distribution unit and provides -48 V DC power input for the components in the cabinet.

Antenna System

The antenna system consists of the RF antenna system and satellite antenna system.
The antenna system performs the following functions:
Satellite antenna system
Through the satellite synchronization antenna, the BTS receives signals from the GPS or GLONASS system and performs wireless synchronization.
RF antenna system
The RF antenna system transmits modulated RF signals and receives the signals from the MS.

2.1.2 Support function and Service

The EUT supports the function and service as follows:

table 2. Service and Test mode List

Service Name	Characteristic	Corresponding Test Mode	Remark(Note)
CDMA 1x	Modulation: BPSK,QPSK RC1&RC3	TM1	
1x Ev-DO	Modulation: 16QAM	TM2	
LTE	QPSK	E-TM1.1/ E-TM1.2 E-TM3.2/ E-TM3.3	Only 5 MHz bandwidth

LTE	16QAM	E-TM3.2/ E-TM3.3	Only 5 MHz bandwidth
LTE	64QAM	E-TM2/E-TM3.1	Only 5 MHz bandwidth

2.2 Modification Information

For original equipment, following table is not application.

table 3. Modification Information

Model Number	Board/Module	Original Version	New Version	Modify Information

Not applicable

3 Test Site Description

The test site of:

Huawei Technologies Co. Ltd.
P.O. Box 518129
Huawei base, bantian,
Longgang District, Shenzhen, China

3.1 Testing Period

The test has been performed during the period of

Date of Start: 25. March.2010
Date of End: 07. May.2010

3.2 Applied Standards

table 4. Applied Standard

Standards Name	Standards Description
47 CFR Part 2 (10-1-08 Edition)	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
47 CFR Part 27 (10-1-08 Edition)	Miscellaneous Wireless Communications Services

table 5. Test Method

Standards Name	Standards Description
EIA/TIA-102-CAAA:1999	Digital C4FM/CQPSK Transceiver Measurement Methods (ANSI/TIA/EIA-102.CAAA-1999)
ANSI C63.4: 2003	Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ITU-R Recommendation SM.329-10 (2003)	Unwanted emissions in the spurious domain
3GPP2 C.S0010-B	Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations. Release B
3GPP2 C.S0032-0	Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access Network
3GPP2 C.S0057-B	Band Class Specification for cdma2000 Spread Spectrum Systems
3GPP TS 36.141	LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing

4 Product Description

4.1 Technical Characteristics

4.1.1 Frequency Range

table 6. Frequency Range for AWS Band of CDMA and LTE

☒ FDD ☐ TDD	Center Frequency Range	Frequency Block Range
Uplink band:	Uplink band (RX):	1710 to 1755 MHz
Downlink band:	Downlink band (TX):	2110 to 2155 MHz

4.1.2 Channel Separation/Bandwidth

table 7. Frequency Interval and Channel Separation for AWS Band of CDMA

Frequency interval:	50 kHz
Channel separation/bandwidth:	1.25 MHz

table 8. Frequency Interval and Channel Separation for AWS Band of LTE

Frequency interval:	100kHz
Channel separation/bandwidth:	5MHz

4.1.3 Type of Emission

Refer to FCC part 2.201 and 2.202..

table 9. Type of Emission of CDMA

Emission Designation:	1M25F9W

table 10. Type of Emission of LTE

Emission Designation:	5M00D9W

4.1.4 Environmental Requirements

table 11. Environmental Requirements

Minimum temperature:	-40 °C
Maximum temperature:	+52 °C
Relative Humidity:	5％ to 100％ RH

4.1.5 Power Source DC Power Source

DC voltage nominal:	⎓ -48 V
DC voltage range:	⎓ -57 V to ⎓ -38.4V
DC current maximal:	8 A

4.1.6 Tune-up Procedure

Refer to FCC 2.1033(c) (9).

Please reference the document Tune-up Procedure in TCF.

4.2 EUT Identification List

4.2.1 Component Parts Information

table 12. Component Parts Information

Model Name	Qty.	H/W Ver.	S/W Ver.	Description	Serial Number
CRFU	1	VER.C	V400R007C00	Radio Unit	210231864910A2000007
CMPT	1	VER.C	V400R007C00	Control Main Processing transmitter	0302HKL1082000185
HCPM	1	VER.B	V400R007C00	1X Channel Processing Module	21020FXD107A800058
HECM	1	VER.B	V400R007C00	EVDO Channel Processing Module	21020GBA1077800033
LMPT	1	VER.G	V100R001C01	LTE Main Processing & Transmission Unit	020HLG10A2000112
LBBP	1	VER.H	V100R001C01	HERT BBU Baseband Processing and Interface Unit	020QYB10A2000284
UBRI	1	VER.F	V400R007C00	Universal BaseBand Radio Interface Board	020AUJ10A300027

4.2.2 Adapter Technical Data

Not Applicable

4.2.3 Battery Technical Data

Not Applicable

4.2.4 FCC Identification

Grantee Code: **QIS**
Product Code: **CRFU-AWS**
FCC Identification: **QISCRFU-AWS-CL**

5 Main Test Instruments

table 13. Main Test Equipments for LTE

Equipment Description	Manufacturer	Model	Serial Number	Cal. Due
EMI Test receiver	R&S	ESU40	100144	2011-04-20
Horn Antenna	R&S	HF906	100684	2010-06-18
Broadband Antenna	SCHAFFNER	CBL6112B	2536	2010-09-21
Signal Analyzer	R&S	FSQ 40	100025	2010-10-10
Signal Analyzer	Agilent	E4445A	MY41000146	2010-10-26
Signal Analyzer	Agilent	N9020A	MY49100937	2011-01-23
Signal Generator	R&S	SMR40	100325	2011-05-11
Temperature Chamber	ESPEC	EW2465	05175005	2010-08-11

6 Transmitter Measurements

For tests in this section, typical operating frequency points (channels) were used, which include bottom/lowest channel (B), middle channel (M) and top/highest channel (T) of each frequency block as the table below. Unless otherwise stated, all tested frequency points were employed to perform tests.

table 14. Frequency points (channels) selected to perform tests for CDMA

Operating Band	Multi-Carriers	Channels No.		
		Channel B	Channel M	Channel T
AWS band:	1	No.25 2111.25MHz	No.450 2132.5MHz	No .875 2153.75MHz
AWS band:	2	No.25/50 2111.25/2112.5MHz	No.450/475 2132.5/2133.75MHz	No .875/850 2153.75/2152.5MHz
AWS band:	3	No.25/50/75 2111.25/2112.5/ 2113.75MHz	No.425/450/475 2131.25/2132.5/ 2133.75MHz	No .875/850/825 2153.75/2152.5/ 2151.25MHz
AWS band:	4	No.25/50/75/100 2111.25/2112.5/ 2113.75/2115MHz	No.400/425/450/475 2130/2131.25/ 2132.5/2133.75MHz	No .875/850/825/800 2153.75/2152.5/ 2151.25/2150MHz

table 15. Frequency points (channels) selected to perform tests for LTE

Operating Band	Multi-Carriers	Channels No.		
		Channel B	Channel M	Channel T
AWS band (5MHz bandwidth)	1	No.1975 (B) 2112.5MHz	No.2175 (M) 2132.5MHz	No.2375 (T) 2152.5MHz

6.1 Maximum Channel Power

6.1.1 Test Conditions

table 16. Test Conditions

Preconditioning:	3 hour
Measured at:	Antenna connector
Ambient temperature (+15 °C to +35 °C):	19~25 °C
Relative humidity (45 % to 85 %):	50~70 %
Air Pressure (86 kPa to 106 kPa):	101 kPa
Test Configuration/Mode:	1) CDMA AWS Band: B, M, T Multi Carriers: 1, 2, 3, 4 TM1, TM2 2) LTE AWS Band: B, M, T Single Carrier: E-TM1.1

6.1.2 Test Specifications and Limits

Compliance with FCC part 2.1046 and part 27.50(d), the power of base station transmitting in the 2110-2155 MHz band is limited to a peak EIRP of 1640 watts.

table 17. FCC Limits for AWS Band

Maximum Output Power	< 1640 Watts (=62 dBm)

6.1.3 Test Method and Setup

The EUT (CDMA Radio Frequency Unit, CRFU) was connected to the Wireless Signal Analyzer or equivalent FSQ40/N9020A via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Maximum Channel Power of the EUT by the FSQ40/N9020A.

Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an RMS equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

Before the test, (1) For CDMA2000 1X system, set the EUT/BTS to transmit a signal modulated with a combination of Pilot, Sync, Paging, and 6 traffic channels; (2) For CDMA2000 1X EV-DO system, configure the MAC channel with 14 MAC indices, i.e. the RA channel and 13 RPC channels. (3) For LTE system, configure the transmit maximum power by Console Computer

Test setup

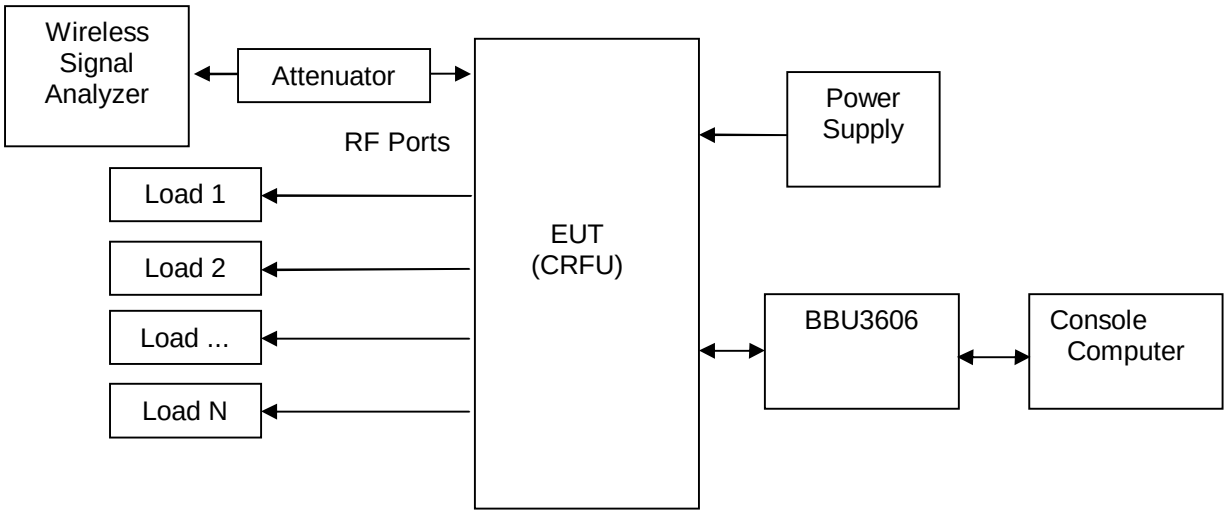

Figure 1. TEST SETUP

6.1.4 Measurement Results

6.1.4.1 Output Power

(1) TM1: CDMA 1X

(a) Single Carrier

table 18. Measurement Output Power for single carrier

Maximum Output Power (dBm)					
Channel B No.25 2111.25MHz		**Channel M** No.450 2132.5MHz		**Channel T** No .875 2153.75MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
42.74	< 62	42.85	< 62	42.68	< 62

(b)Two Carriers

table 19. Measurement Output Power for two carriers

Maximum Output Power (dBm)					
Channel B No.25/50 2111.25/2112.5MHz		**Channel M** No.450/475 2132.5/2133.75MHz		**Channel T** No .875/850 2153.75/2152.5MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
45.65	< 62	46.01	< 62	45.91	< 62

(c) Three Carriers

table 20. Measurement Output Power for three carriers

Maximum Output Power (dBm)					
Channel B No.25/50/75 2111.25/2112.5/ 2113.75MHz		**Channel M** No.425/450/475 2131.25/2132.5/ 2133.75MHz		**Channel T** No .875/850/825 2153.75/2152.5/ 2151.25MHz	
Measured	**Limit(dBm)**	**Measured**	**Limit**	**Measured**	**Limit**
47.54	< 62	47.62	< 62	47.43	< 62

(d) Four Carriers

table 21. Measurement Output Power for four carriers

Maximum Output Power (dBm)					
Channel B No.25/50/75/100 2111.25/2112.5/100 2113.75/2115MHz		**Channel M** No.400/425/450/475 2130/2131.25/2132.5/ 2133.75MHz		**Channel T** No .875/850/825/800 2153.75/2152.5/ 2151.25/2150MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
48.70	< 62	48.97	< 62	48.77	< 62

(2) TM2: CDMA 1X EV-DO

(a) Single Carrier

table 22. Measurement Output Power for single carrier

Maximum Output Power (dBm)					
Channel B No.25 2111.25MHz		**Channel M** No.450 2132.5MHz		**Channel T** No .875 2153.75MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
42.58	< 62	42.96	< 62	42.68	< 62

(b) Two Carriers

table 23. Measurement Output Power for two carriers

Maximum Output Power (dBm)					
Channel B No.25/50 2111.25/2112.5MHz		**Channel M** No.450/475 2132.5/2133.75MHz		**Channel T** No .875/850 2153.75/2152.5MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**

45.77	< 62	45.92	< 62	45.94	< 62

(c) Three Carriers

table 24. Measurement Output Power for three carriers

Maximum Output Power (dBm)					
Channel B No.25/50/75 2111.25/2112.5/ 2113.75MHz		**Channel M** No.425/450/475 2131.25/2132.5/ 2133.75MHz		**Channel T** No .875/850/825 2153.75/2152.5/ 2151.25MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
47.44	< 62	47.66	< 62	47.58	< 62

(d) Four Carriers

table 25. Measurement Output Power for four carriers

Maximum Output Power (dBm)					
Channel B No.25/50/75/100 2111.25/2112.5/100 2113.75/2115MHz		**Channel M** No.400/425/450/475 2130/2131.25/2132.5/ 2133.75MHz		**Channel T** No .875/850/825/800 2153.75/2152.5/ 2151.25/2150MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
48.88	< 62	49.08	< 62	48.86	< 62

(3) 5MHz bandwidth LTE

table 26. Measurement Results for Maximum Output Power

E-TM1.1	Maximum Output Power			Limit (dBm)
	No.1975 (B) 2112.5MHz	No.2175 (M) 2132.5MHz	No.2375 (T) 2152.5MHz	
	dBm	dBm	dBm	
Single carrier	43.78	43.73	43.92	< 62

6.1.4.2 Peak-to-Average Ratio

table 27. Measurement Results for Maximum Output Power

Test Mode	Peak-to-Average Ratio (PAR), dB			Limit (dB)
	Ch. B	Ch. M	Ch. T	
1X	5.60	5.61	5.65	< 13
EVDO	5.81	5.43	5.84	< 13
LTE-E-TM1.1	6.15	6.01	6.03	< 13

6.1.5 Conclusion

The equipment **PASSED** the requirement of this clause.

6.2 Modulation Characteristics

6.2.1 Test Conditions

table 28. Test Conditions

Preconditioning:	2 hour
Measured at:	Antenna connector
Ambient temperature (+15 °C to +35 °C):	19~25 °C
Relative humidity (45 % to 85 %):	50~70 %
Air Pressure (86 kPa to 106 kPa):	101 kPa
Test Configuration/Mode:	1) CDMA AWS Band: B, M, T Multi Carriers: 1 TM1, TM2 2) LTE AWS Band : M Single Carrier E-TM2, E-TM3.1,E-TM3.2,E-TM3.3

6.2.2 Test Specifications and Limits

No specific modulation characteristics requirement limits in FCC part 2.1047 and part 27 subpart C & L for AWS Band. In addition, limits according to the technical requirements of the EUT can be adopted as showed in the following table.

table 29. Limits According to 3GPP2 C.S0010-B and C.S0032-0

Limits for CDMA equipments:	Rho > 0.912 (for CDMA2000 1X) Rho > 0.97 (for CDMA 1X EV-DO)

table 30. Limits According to 3GPP TS 136.141

Limits for LTE equipments:	QPSK modulation (TM3.3):	EVM	< 18.5%
	16QAM modulation (TM3.2):	EVM	< 13.5%
	64QAM modulation (TM2.0, TM3.1):	EVM	< 9%

6.2.3 Test Method and Setup

The EUT (CDMA Radio Frequency Unit, CRFU) was connected to the Wireless Signal Analyzer or equivalent FSQ40/E4445A via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Modulation Characteristics of the EUT by the FSQ40/E4445A.

For the CDMA2000 1X, the measurement was made based on two Radio Configurations: RC1 and RC3. The modulation mode of RC1 is BPSK, and the modulation mode of RC3 is QPSK. For the CDMA2000 1X EV-DO, the modulation mode is 16-QAM. For LTE system, the modulation mode include QPSK, 16QAM and 64QAM.

Test setup

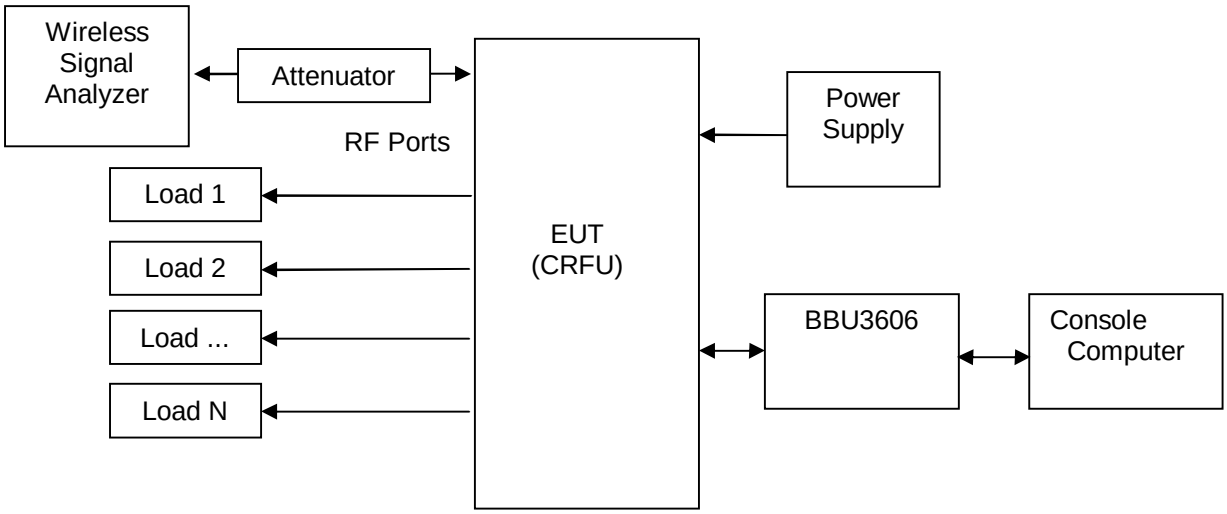

Figure 2. TEST SETUP

6.2.4 Measurement Results

(1) TM1: CDMA 1X

(a) RC1

table 31. Measurement Results for RC1

Modulation Characteristics				
Parameters Observed (Type/Mode)	**channel**	**Measured**	**Limit**	**Remark**
Rho(BPSK)	25	9.76	>0.912	See Appendix A
	450	9.80	>0.912	See Appendix A
	875	9.79	>0.912	See Appendix A

(b) RC3

table 32. Measurement Results for RC3

Parameters Observed (Type/Mode)	**channel**	**Measured**	**Limit**	**Remark**
Rho(QPSK)	25	9.89	>0.912	See Appendix A
	450	9.90	>0.912	See Appendix A
	875	9.89	>0.912	See Appendix A

2) TM2: CDMA EVDO

table 33. Measurement Results for EVDO

Modulation Characteristics				
Parameters Observed (Type/Mode)	**channel**	**Measured**	**Limit**	**Remark**
Rho(16-QAM)	25	0.996	>0.97	See Appendix A
	450	0.996	>0.97	See Appendix A

	875	0.996	>0.97	See Appendix A

3) 5MHz bandwidth LTE

table 34. Measurement Results for LTE

Test Mode	Modulation Characteristics				
	No. 2175 (M) 2132.5MHz				
	Type/Mode	Parameters	Measured	Limit	Remark
E-TM2.0	64QAM	EVM	3.106%	< 9%	See Appendix A
E-TM3.1	64QAM	EVM	7.779%	< 9%	See Appendix A
E-TM3.2	16QAM	EVM	10.906%	< 13.5%	See Appendix A
E-TM3.3	QPSK	EVM	14.941%	< 18.5%	See Appendix A

6.2.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix A.

6.3 Occupied Bandwidth

6.3.1 Test Conditions

table 35. Test Conditions

Preconditioning:	1.5 hour
Measured at:	Antenna connector
Ambient temperature (+15 °C to +35 °C):	19~25 °C
Relative humidity (45 % to 75 %):	50~70 %
Air Pressure (86 kPa to 106 kPa):	101 kPa
Test Configuration/Mode:	1)CDMA AWS Band: B, M, T Multi Carriers: 1TM1, TM2, 2) LTE AWS Band: B, M, T Single Carrier E-TM1.1

6.3.2 Test Specifications and Limits

No specific occupied bandwidth requirement in FCC part 2.1049 and part 27 subpart C & L for AWS Band. Limits according to the technical requirements of the EUT can be adopted as showed in the following table.

table 36. Limits According to EUT technical requirements of CDMA

Limits	< 1.48MHz

table 37. Limits According to EUT technical requirements of LTE

Limits	< 5 MHz

6.3.3 Test Method and Setup

The EUT (CDMA Radio Frequency Unit, CRFU) was connected to the Spectrum Analyzer or equivalent FSQ40/N9020A via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Occupied Bandwidth of the EUT by the FSQ40/N9020A.

Refer to 47CFR part2.1049 section (g) & (h).
(g) Transmitter in which the modulating base band comprises not more than three independent channels - when modulated by the full complement of signals for which the transmitter is rated. The level of modulation for each channel should be set to that prescribed in rule parts applicable to the services for which the transmitter is intended. If specific modulation levels are not set forth in the rules, the tests should provide the manufacturer's maximum rated condition.
(h) Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudorandom generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at discretion of the user.

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 (as 99% bandwidth.

Meansurement Occupied bandwidth setup for CDMA AWS band	
Measurement bandwidth (RBW):	13 kHz
Video bandwidth (VBW):	130 kHz

Meansurement Occupied bandwidth setup for 5MHz BW LTE AWS band	
Measurement bandwidth (RBW):	50 kHz
Video bandwidth (VBW):	500 kHz

Test setup

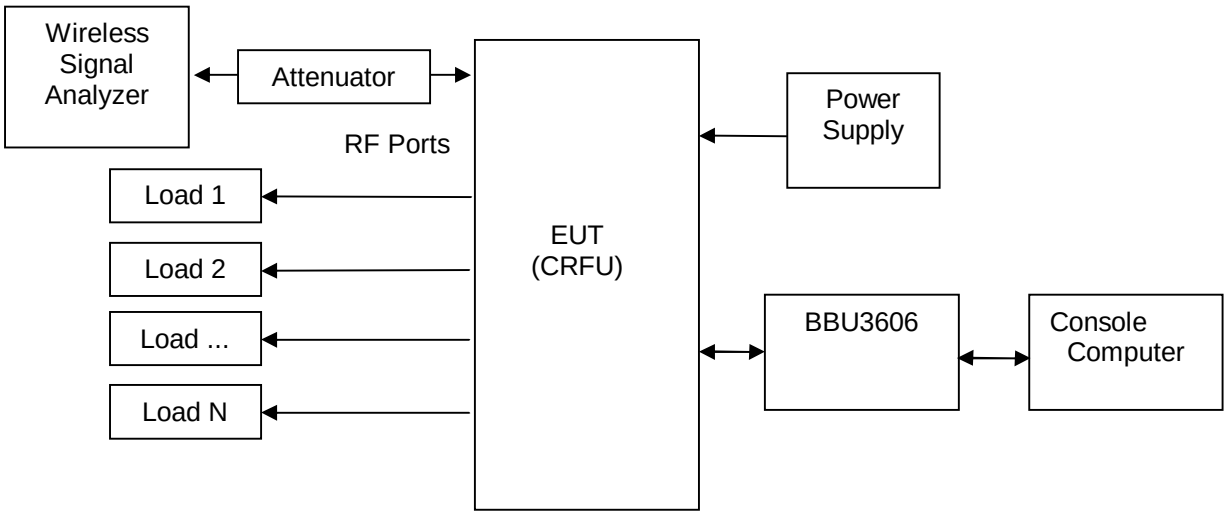

Figure 3. TEST SETUP

6.3.4 Measurement Results

(1) TM1: CDMA 1X

table 38. Measurement Results for CDMA 1X

Occupied Bandwidth (99% Bandwidth)					
Channel B No.25 2111.25MHz		**Channel M** No.450 2132.5MHz		**Channel T** No .875 2153.75MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
1.23	< 1.48	1.23	<1.48	1.23	< 1.48

(2) TM2: CDMA EVDO

table 39. Measurement Results for CDMA EVDO

Occupied Bandwidth (99% Bandwidth)

Channel B No.25 2111.25MHz		Channel M No.450 2132.5MHz		Channel T No .875 2153.75MHz	
Measured	**Limit**	**Measured**	**Limit**	**Measured**	**Limit**
1.23	< 1.48	1.23	<1.48	1.22	< 1.48

(3) 5MHz bandwidth LTE

table 40. Measurement Results for 5MHz bandwidth LTE

Test Mode	Occupied Bandwidth (99% Bandwidth)			
	No.1975 (B) 2112.5MHz	No.2175 (M) 2132.5MHz	No.2375 (T) 2152.5MHz	**Limit**
	MHz	MHz	MHz	
E-TM1.1	4.47	4.47	4.47	< 5MHz

6.3.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix B.

6.4 Band Edges Compliance

6.4.1 Test Conditions

table 41. Test Conditions

Preconditioning:	2 hour
Measured at:	Antenna connector
Ambient temperature (+15 °C to +35 °C):	19~25 °C
Relative humidity (45 % to 85 %):	50~70 %
Air Pressure (86 kPa to 106 kPa):	101 kPa
Test Configuration/Mode:	1) CDMA AWS Band: B, T Multi Carriers: 1, 4 TM1, TM2 2) LTE AWS Band: B, T Single Carrier, E-TM1.1, E-TM1.2

6.4.2 Test Specifications and Limits

Compliance with FCC part 2.1051 and part 27.53(g), 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, and the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10 (P) dB.

table 42. FCC Limits for AWS Band

Limit:	< P[Watt]-(43+10log$_{10}$P)=10log$_{10}$(1000P)-(43+10log$_{10}$P)=30-43=-13dBm

6.4.3 Test Method and Setup

The EUT (CDMA Radio Frequency Unit, CRFU) was connected to the Spectrum Analyzer or equivalent FSQ40/N9020A via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Band Edge Spurious Emissions of the EUT by the FSQ40/N9020A.

Set the Spectrum Analyzer or equivalent in power averaging mode and resolution bandwidth (RBW) as close to 1.0% of the emission bandwidth as possible. Set the sweep span to cover at least ±250% of the emission bandwidth or 2 MHz, which is larger.

Measurement bandwidth (RBW) of Spectrum Analyzer or equivalent:
for CDMA equipments 13 kHz (close to 1% of 1.25 MHz)

Measurement bandwidth (RBW) of Spectrum Analyzer or equivalent:
for LTE equipments 50 kHz (close to 1% of 5 MHz)

Test setup

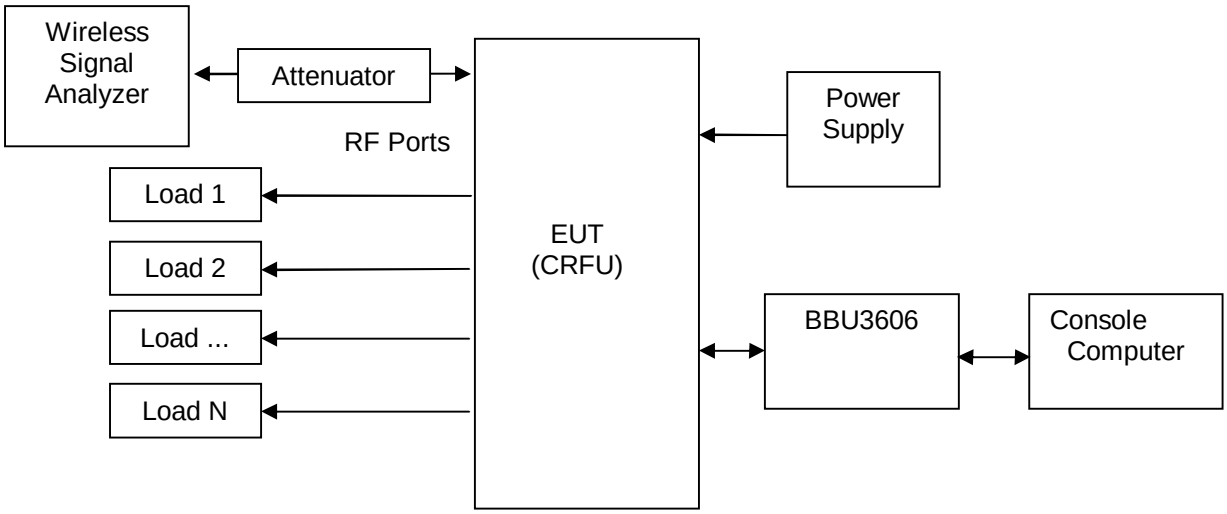

Figure 4. TEST SETUP

6.4.4 Measurement Results

(1) TM1: CDMA 1X

(a) Single Carrier

table 43. Measurement Results for 1X

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25 2111.25MHz	1	2109 to 2110	-35.19	< -13	See Appendix C
T	No 875 2153.75MHz	1	2155 to 2156	-29.87	< -13	See Appendix C

(b) Multi Carriers

table 44. Measurement Results for 1X

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25/50/75/100 2111.25/2112.5/ 2113.75/2150MHz	4	2109 to 2110	-28.02	< -13	See Appendix C
T	No.875/850/825/800 2153.75/2152.5/ 2151.25/2150MHz	4	2155 to 2156	-27.05	< -13	See Appendix C

(2) CDMA 1X EV-DO
a) Single Carrier

table 45. Measurement Results for EVDO

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25 2111.25MHz	1	2109 to 2110	-34.27	< -13	See Appendix C
T	No 875 2153.75MHz	1	2155 to 2156	-28.52	< -13	See Appendix C

(b) Multi Carriers

table 46. Measurement Results for EVDO

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25/50/75/100 2111.25/2112.5/ 2113.75/2150MHz	4	2109 to2110	-27.90	< -13	See Appendix C
T	No.875/850/825/800 2153.75/2152.5/ 2151.25/2150MHz	4	2155 to 2156	-23.93	< -13	See Appendix C

(3) 5MHz bandwidth LTE

a) E-TM1.1

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.1975(B) 2112.5MHz	1	2109 to 2110	-25.02	< -13	See Appendix C
T	No.2375 (T) 2152.5MHz	1	2155 to 2156	-25.09	< -13	See Appendix C

b) E-TM1.2

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.1975(B) 2112.5MHz	1	2109 to 2110	-23.22	< -13	See Appendix C
T	No.2375 (T) 2152.5MHz	1	2155 to 2156	-24.09	< -13	See Appendix C

6.4.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix C.

6.5 Spurious Emission at Antenna Terminal

6.5.1 Test Conditions

table 47. Test Conditions

Preconditioning:	3 hour
Measured at:	Antenna connector
Ambient temperature (+15 °C to +35 °C):	19~25 °C
Relative humidity (45 % to 85 %):	50~70 %
Air Pressure (86 kPa to 106 kPa):	101 kPa
Test Configuration/Mode:	1) CDMA Aws Band: B, M, T Multi Carriers: 1, 4 TM1, TM2 2) LTE AWS Band: B, M, T Single Carrier E-TM1.1

6.5.2 Test Specifications and Limits

Compliance with FCC part 2.1051 and part 27.53(g), based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10 (P) Db.

table 48. FCC Limits for AWS Band

Limit:	< P[Watt]-(43+10log$_{10}$P)=10log$_{10}$(1000P)-(43+10log$_{10}$P)=30-43=-13dBm (per MHz)

6.5.3 Test Method and Setup

The EUT (CDMA Radio Frequency Unit, CRFU) was connected to the Spectrum Analyzer or equivalent FSQ40 via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Out-band Spurious Emissions of the EUT by the FSQ40.

For the Out-of-block Emissions:

Frequency Search Range:

According to FCC part 2.1057, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
Measurement bandwidth (RBW) for 9 kHz to 10th harmonic included: 1MHz;

Alternatively, according to ITU SM.329-10,
Measurement bandwidth (RBW) for 9 kHz up to 150 KHz: 1 kHz;
Measurement bandwidth (RBW) for 150 kHz up to 30 MHz: 10 kHz;
Measurement bandwidth (RBW) for 30 MHz up to 22GHz harmonic included: 1 MHz;

Test setup

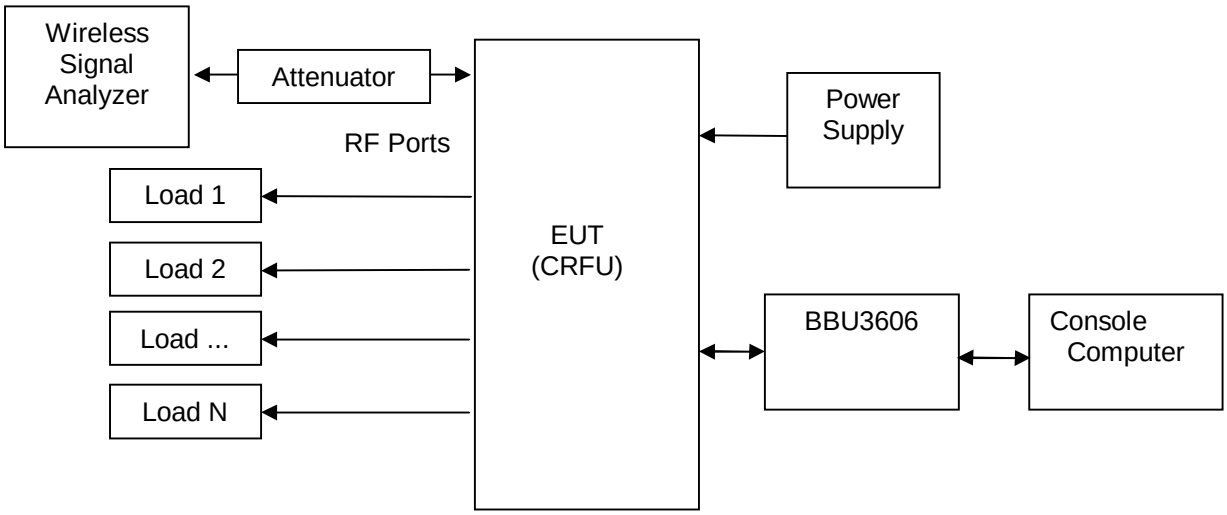

Figure 5. TEST SETUP

6.5.4 Measurement Results

6.5.4.1 Out-of-block Emissions Measurement

(1) CDMA 1X

Single Carrier

table 49. Measurement Results for CDMA 1X

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25 2111.25MHz	1	9 kHz to 22 GHz	-27.10	< -13	See Appendix D
M	No.450 2132.5MHz	1	9 kHz to 22 GHz	-27.26	< -13	See Appendix D
T	No 875 2153.75MHz	1	9 kHz to 22 GHz	-27.17	< -13	See Appendix D

(b) Multi Carriers

table 50. Measurement Results for CDMA 1X

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25/50/75/100	4	9 kHz to 22 GHz	-27.22	< -13	See

	2111.25/2112.5/ 2113.75/2150MHz					Appendix D
M	No. 400/425/450/475 2130/2131.25/ 2132.5/2133.75MHz	4	9 kHz to 22 GHz	-27.32	< -13	See Appendix D
T	No.875/850/825/800 2153.75/2152.5/ 2151.25/2150MHz	4	9 kHz to 22 GHz	-27.18	< -13	See Appendix D

(2) CDMA 1X EV-DO

(a) Single Carrier

table 51. Measurement Results for CDMA EVDO

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25 2111.25MHz	1	9 kHz to 22 GHz	-27.34	< -13	See Appendix D
M	No.450 2132.5MHz	1	9 kHz to 22 GHz	-27.15	< -13	See Appendix D
T	No 875 2153.75MHz	1	9 kHz to 22 GHz	-27.13	< -13	See Appendix D

(b) Multi Carriers

table 52. Measurement Results for CDMA EVDO

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range (MHz)	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.25/50/75/100 2111.25/2112.5/ 2113.75/2150MHz	4	9 kHz to 22 GHz	-28.19	< -13	See Appendix D
M	No. 400/425/450/475 2130/2131.25/ 2132.5/2133.75MHz	4	9 kHz to 22 GHz	-27.31	< -13	See Appendix D
T	No.875/850/825/800 2153.75/2152.5/ 2151.25/2150MHz	4	9 kHz to 22 GHz	-27.26	< -13	See Appendix D

(3) 5MHz bandwidth LTE(E-TM1.1)

table 53. Measurement Results for LTE E-TM1.1

Channel No./Operating Frequency		Multi-Carriers	Measured Frequency Range	Max. Spurious Level Measured (dBm)	Limit (dBm)	Remark
B	No.1975 2112.5MHz	1	9 kHz to 22 GHz	-26.42	< -13	See Appendix D
M	No.2175 2132.5MHz	1	9 kHz to 22 GHz	-27.10	< -13	See Appendix D
T	No 2375 2152.5MHz	1	9 kHz to 22 GHz	-27.35	< -13	See Appendix D

6.5.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix D.

6.6 Radiated Spurious Emission

6.6.1 Test Conditions

table 54. Test Conditions

Preconditioning:	3 hour
Measured at:	Enclosure
Ambient temperature (+15 °C to +35 °C):	19~25 °C
Relative humidity (45 % to 85 %):	50~70 %
Air Pressure (86 kPa to 106 kPa):	101 kPa
Test Configuration/Mode:	1)CDMA & LTE AWS Band: M Multi Carriers: 1 TM1&E-TM1.1

6.6.2 Test Specifications and Limits

Compliance with FCC part 2.1051 and part 27.53(g), based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10 (P) dB.

table 55. FCC Limits for AWS Band

Limit:	< P[Watt]-(43+10log$_{10}$P)=10log$_{10}$(1000P)-(43+10log$_{10}$P)=30-43=-13dBm (per MHz)

6.6.3 Test Method and Setup

(a) Measurements were made to detect spurious emissions radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data were supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph 2.1049(c) as appropriate. For equipment operating on frequencies below 890 MHz, an Open Field Test is normally required with the measuring instrument antenna located in the far field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurement will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections, which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with the reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.
(b) Measurements specified in paragraph (a) of this section shall be made for the following equipment:
(1) Those in which the spurious emission are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission.

The EUT (Remote RF Unit, RRU) was equipped with non-integral antenna. And it should test

according to part (b) of above section. The EUT was connected to match loads. The Console Computer controls the EUT to transmitter the maximum power which defined in specification of product. The EUT operated on a typical channel.

The test procedure

(1) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, E.R.P. shall be measured when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in FCC part 2.1033(c)(8). The EUT/RRU was connected to ancillary in order to simulate normal operating conditions with reference to the guidance given in the standard for this type of equipment.

(2) Test the radiated maximum output power by the test Receiver ESU40 received from test antenna.

(3) Use substitution method to verify the Maximum output power. The EUT is substituted by a dipole antenna. The dipole is connected to a Signal Generator. And then adjust the output level of the Signal Generator to get the same received power recorded in step (2) on the test Receiver ESU40, and record the power level of Signal Generator. Of course, the cable loss at the test frequency should be compensated.

Frequency Search Range:

According to FCC part 2.1057, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
Measurement bandwidth (RBW) for 9 kHz to 10th harmonic included: 1MHz;

Alternatively, according to ITU SM.329-10,
Measurement bandwidth (RBW) for 9 kHz up to 150 KHz: 1 kHz;
Measurement bandwidth (RBW) for 150 kHz up to 30 MHz: 10 kHz;
Measurement bandwidth (RBW) for 30 MHz up to up to 10th harmonic included: 1 MHz;

Test setup

Step 1: Pre-test

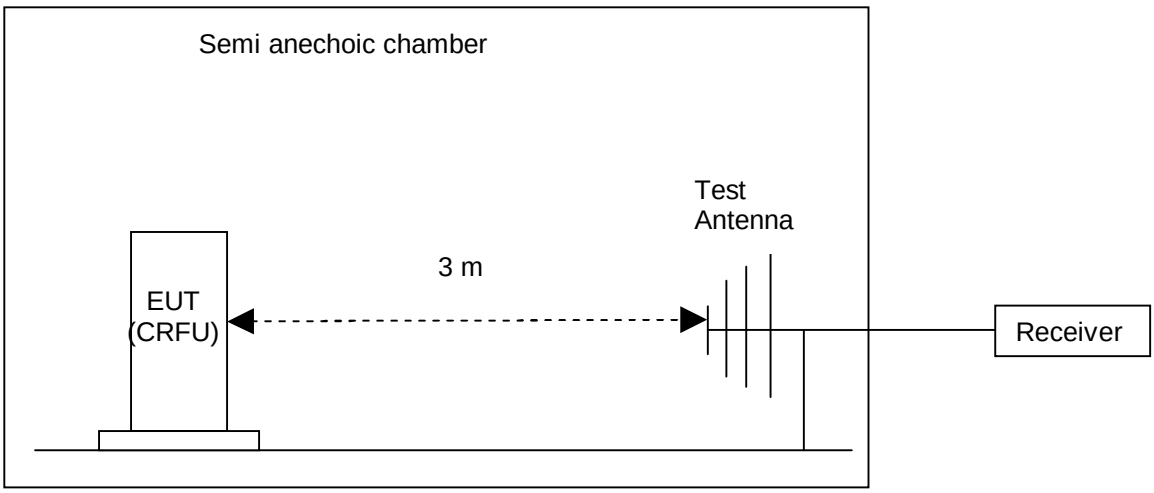

Figure 6. Test Set-up for Pre-test

Step 2: Substitution method to verify the maximum ERP

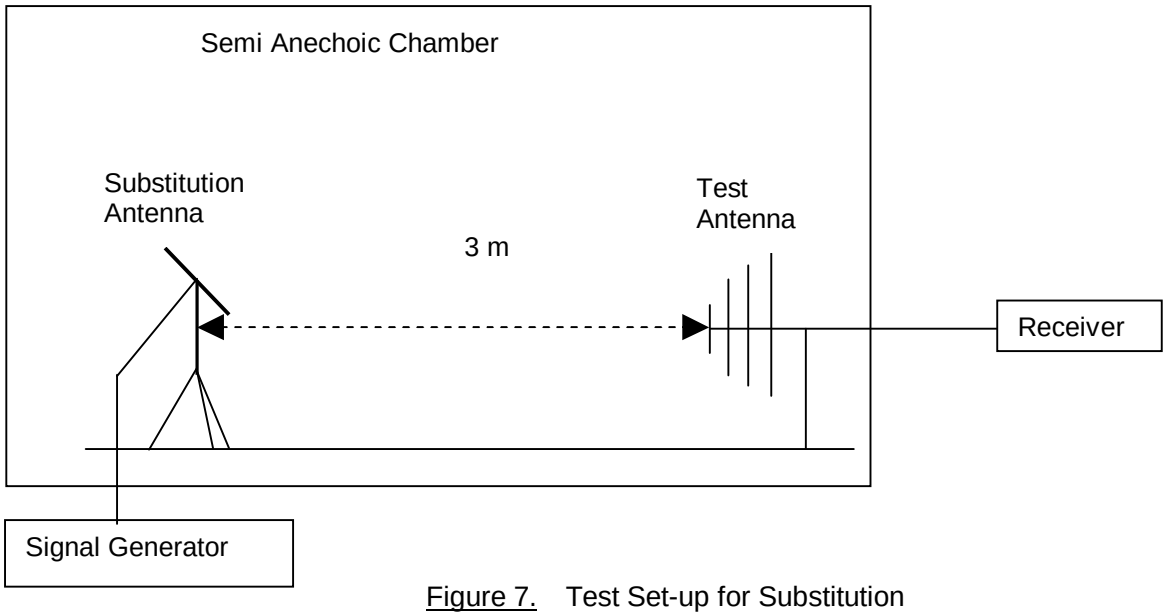

Figure 7. Test Set-up for Substitution

NOTE: Effective radiated power (ERP) refers to the radiation power output of the EUT, assuming all emissions are radiated from half-wave dipole antennas.

6.6.4 Measurement Results

6.6.4.1 Pre-test Measurement Results

table 56. Measurement Result for CDMA&LTE AWS band

Channel Number	Test Range (Frequency)	Power [dBm]	Spurious Level measured [dBm]	FCC limit	Result
Channel M 2132.5MHz	30MHz ~18GHz	43	<- 13 dBm (See appendix E)	- 13 dBm	Pass

6.6.4.2 Substitution Results

table 57. Substitution Results

Freq. [MHz]	Measurement Value [dBm]	Substitution Antenna Type	Gain [dBd]	Cable Loss [dB]	Signal Generator Level [dBm]	Substitution Level [dBm]	FCC limit [dBm]	Result
/	/	/	/	/	/	/	/	/

Note: For get the EIRP. (Efficient Radiated Power) in substitution method, the following formula should take to calculate it,

ERP [dBm] = SGP [dBm] – Cable Loss [dB] + Gain [dBd]

NOTE: SGP- Signal Generator Level

6.6.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix E.

6.7 Frequency Stability

6.7.1 Test Conditions

table 58. Test Conditions

Preconditioning:	3 hour
Measured at:	Antenna connector
Ambient temperature:	See below
Relative humidity (45 % to 85 %):	50~70 %
Air Pressure (86 kPa to 106 kPa):	101 kPa
Test Configuration/Mode:	1) CDMA AWS band at Channel M Multi Carriers: 1 TM1 2) LTE AWS band at Channel M Single Carrier E-TM2.0, E-TM3.1, E-TM3.2, E-TM3.3

6.7.2 Test Specifications and Limits

Compliance with FCC part 2.1055 and part 27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

table 59. FCC Limits for AWS Band

Limit:	(not defended)

In addition, limits according to the technical requirements of the EUT can be adopted as showed in the following table.

table 60. Limits According to EUT technical requirements

Limits for CDMA2000 equipments: (acc. to 3GPP2 C.S0010, C.S0032)	< ±0.05 ppm
for LTE equipments:	< ± (0.05 ppm+12 Hz)

6.7.3 Test Method and Setup

The frequency stability shall be measured with variation of ambient temperature from -30 °C to 50 °C. Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10 °C through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point, which shall be specified by the manufacturer.
(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

The test procedure

According to ANSI C63.4 clause 13.1.6, no modulation needs to be supplied to the intentional radiator during these tests, unless modulation is required to produce an output, e.g., single-sideband suppressed carrier transmitters.

The operating end points are: -48 VDC (normal point), -38.4 VDC (lowest point) and -57 VDC (highest point).

Test Set up

The EUT (CDMA Radio Frequency Unit, CRFU) was connected to the Spectrum Analyzer or equivalent FSQ40/E4445A via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Frequency Tolerance of the EUT by the FSQ40/E4445A
The EUT was placed inside an environmental temperature chamber.

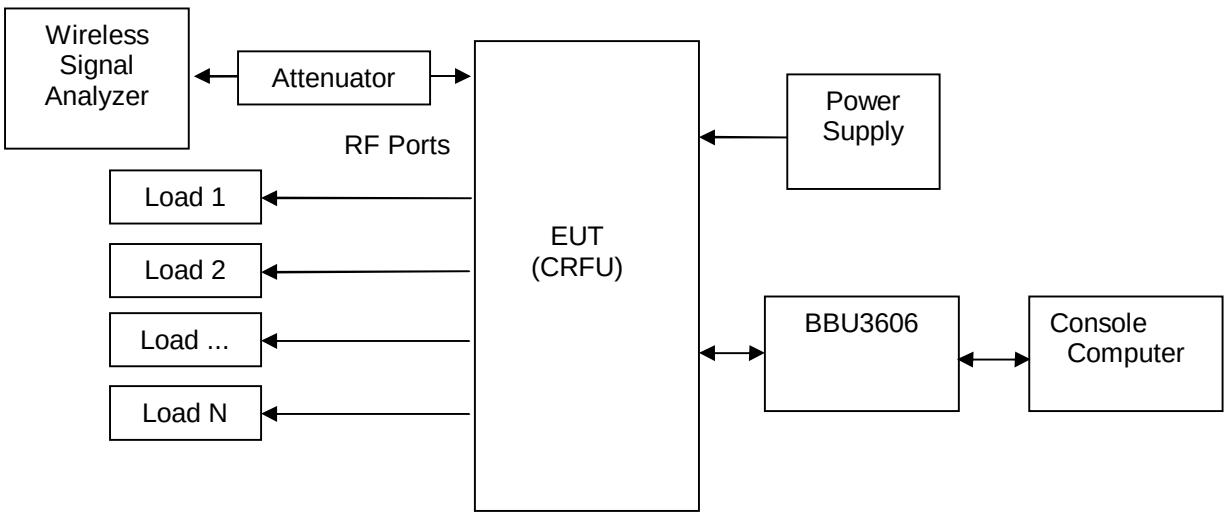

Figure 8. Test Set up

6.7.4 Measurement Results

6.7.4.1 Frequency Error vs. Temperature

table 61. Measurement Results for CDMA 1X

TEST CONDITIONS		Frequency Stability Middle Channel:450 Frequency :2132.5MHz		
		Measured Max. Frequency Error		Limit (ppm)
		Hz	ppm	
V_{nom} (-48 VDC)	-30 °C	-16.00	-0.0007	< ±0.05

	-20 °C	-18.88	-0.0008	< ±0.05
	-10 °C	-18.21	-0.0008	< ±0.05
	0 °C	-14.54	-0.0006	< ±0.05
	+10 °C	-12.79	-0.0005	< ±0.05
	+20 °C	-20.31	-0.0009	< ±0.05
	+30 °C	-18.15	-0.0008	< ±0.05
	+40 °C	-14.74	-0.0006	< ±0.05
	+50 °C	-14.97	-0.0006	< ±0.05

table 62. Measurement Results for LTE

Measured Maximum Frequency Error			
Test Environment		No.2175 (M) 2132.5MHz (TM2.0 / TM3.1 / TM3.2 / TM3.3)	
Voltage	Temperature	ppm	Limit
-48 VDC (100% rated / normal)	-30 °C	0.002/0.002/0.002/0.002	<± (0.05 ppm+12 Hz)
	-20 °C	0.002/0.002/0.001/0.001	
	-10 °C	0.002/0.002/0.001/0.001	
	0 °C	0.002/0.002/0.002/0.001	
	+10 °C	0.002/0.001/0.002/0.001	
	+20 °C	0.002/0.002/0.001/0.001	
	+30 °C	0.002/0.002/0.002/0.001	
	+40 °C	0.002/0.002/0.002/0.002	
	+50 °C	0.002/0.002/0.001/0.001	

6.7.4.2 Frequency Error vs. Voltage

table 63. Measurement Results for CDMA 1X

TEST CONDITIONS		Frequency Stability Middle Channel:450 Frequency :2132.5MHz		
		Measured Max. Frequency Error		Limit (ppm)
		Hz	ppm	
T_{nom} (23°C)	85%V_{nom} (-38.4 VDC)	-17.83	-0.007	< ±0.05
	100%V_{nom} (-48 VDC)	-17.99	-0.008	< ±0.05
	115%V_{nom} (-57 VDC)	-14.92	-0.006	< ±0.05

table 64. Measurement Results for LTE

Measured Maximum Frequency Error			
Test Environment		No.2175 (M) 2132.5MHz (TM2.0 / TM3.1 / TM3.2 / TM3.3)	
Voltage	Temperature	ppm	Limit

Measured Maximum Frequency Error			
Test Environment		No.2175 (M) 2132.5MHz (TM2.0 / TM3.1 / TM3.2 / TM3.3)	
Voltage	Temperature	ppm	Limit
-38.4 VDC (85% rated / lowest)	+20 °C	0.002/0.001/0.001/0.002	<± (0.05 ppm+12 Hz)
-48 VDC (100% rated / normal)	+20 °C	0.002/0.002/0.002/0.002	
-57 VDC (115% rated / highest)	+20 °C	0.002/0.002/0.01/0.001	

6.7.5 Conclusion

The equipment **PASSED** the requirement of this clause.

7 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 as following:

table 65. System Measurement Uncertainty

Items		Extended Uncertainty
Band Width	Magnitude (%)	U=0.2%; k=2
Band Edge Compliance	Disturbance Power (dBm)	U=2.0dB; k=2
Conducted Spurious Emission at Antenna Terminal	Disturbance Power (dBm)	U=2.0dB; k=2
Frequency Stability	Frequency Accuracy(ppm)	U=0.21ppm; k=2
Field Strength of Spurious Radiation	ERP (dBm)(30MHz~1G)	U=4.6dB; k=2
	ERP (dBm) (>1G)	U=3dB; k=2
Conducted Output Power	Power (dBm)	U=0.39dB; k=2

8 Appendices

Appendix A	Measurement Results Modulation Characteristics	14	Pages
Appendix B	Measurement Results Occupied Bandwidth	10	Pages
Appendix C	Measurement Results Band Edges	13	Pages
Appendix D	Measurement Results Spurious Emission at Antenna Terminal	46	Pages
Appendix E	Measurement Results Radiated Spurious Emission	3	Pages
Appendix F	Photos of Test Setup	3	Pages

----- END OF REPORT -----