Prüfbericht - Nr.: *Test Report No.:*	**16030063 001**	**Seite 1 von 66** *Page 1 of 66*

Auftraggeber: *Client:*	**Comba Telecom Ltd.** **15th Floor, Delta House,** **No.3 On Yiu Street, Shatin,** **Hongkong**
Gegenstand der Prüfung: *Test item:*	**Master Unit of Tri-band Distributed Antenna System**

Bezeichnung: *Identification:*	**RA-5700-D**	**FCC ID:** *FCC ID*	**PX8RA-5700-D**
Wareneingangs-Nr.: *Receipt No.:*	**173056815**	**Eingangsdatum:** *Date of receipt:*	**20.10.2010**

Prüfort: *Testing location:*	**TÜV Rheinland (Guangdong) Ltd. EMC Laboratory** **Guangzhou Auto Market, Yuan Gang Section of Guangshan Road, Guangzhou 510650** **P. R. China**	**Listed test laboratory according to FCC rules section 2.948 for measuring devices**
Prüfgrundlage: *Test specification:*	**TIA/EIA-603-C-2004** **FCC "Rules and Regulations":** **Part 22, subpart H, 2009** **Part 24, subpart E, 2009** **Part 27, 2009** **Part 2, 2009**	
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).*	
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland (Guangdong) Ltd.**	

geprüft / *tested by:* | **kontrolliert**/ *reviewed by:*

Datum *Date*	Name/Stellung *Name/Position*	Unterschrift *Signature*	Datum *Date*	Name/Stellung *Name/Position*	Unterschrift *Signature*
Apr. 25, 2011	Ken Kuang Project Engineer		25. Apr. 2011	Liangdong Xie Project Manager	

Sonstiges/ Other Aspects:

Abkürzungen:				*Abbreviations:*			
P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*	
F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*	
N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*	
N/T	=	*nicht getestet*		*N/T*	=	*not tested*	

TEST SUMMARY

EUT: RA-5700-D		
Mode	**Test items**	**Result**
Transmitter Requirements		
LTE	RF power Output	Pass
	Occupied Bandwidth, Input/Output Comparison	Pass
	Spurious Emissions at antenna terminal	Pass
	Field Strength of Spurious Radiation	Pass
	Frequency Stability	Pass
	Error Vector Magnitude (EVM)	No limit
CDMA	RF Power Output	Pass
	Occupied Bandwidth, Input/Output Comparison	Pass
	Out-of-Band Emissions at antenna terminal	Pass
	Intermodulation Test	Pass
	Field Strength of Spurious Radiation	Pass
	Out of Band Rejection	Pass
	Frequency Stability	Pass
	Error Vector Magnitude (EVM)	No limit

Note: as the DUT is only RF amplifier without phase modulation function, the Error Vector Magnitude (EVM) is not necessary for FCC application, it is only client's additional request for verification.

Contents

1 General Remarks

1.1 Complementary Materials

No attached documents in this report.

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Guangdong) Ltd. EMC Laboratory

Guangzhou Auto Market, Yuan Gang Section of Guangshan Road
Guangzhou 510650

P. R. China

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Equipment	Manufacturer	Type	Serial No.	Calibrated until
TÜV Rheinland (Guangdong) Ltd.				
EMI Test Receiver	Rohde & Schwarz	ESCI-3	100216	16.Mar.2011
Spectrum Analyzer	Rohde & Schwarz	FSP30	100286	16.Mar.2011
Trilog-Broadband Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9168	209	16.Mar.2011
Trilog-Broadband Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9168	210	16.Mar.2011
Double-Ridged Waveguide Horn Antenna	Rohde & Schwarz	HF906	100385	16.Mar.2011
Double-Ridged Waveguide Horn Antenna	Rohde & Schwarz	HF906	100407	16.Mar.2011
Pre-amplifier	MITEQ	AFS42-00101800-25-S-42	1101599	16.Mar.2011
Band Reject Filter	Micro-Tronics	BRM50702	023	16.Mar.2011
Standard Gain Horn Antenna	EMCO	3160-09	21642	16.Mar.2011
Standard Gain Horn Antenna	EMCO	3160-09	21645	16.Mar.2011
Pre-amplifier	MITEQ	AFS33-18002650-30-8P-44	1108282	16.Mar.2011
3m Anechoic Chamber	Albatross Project GmbH	N/A	N/A	16.Mar.2011
Climatic Chamber	ESPEC	EL-04 KA	6107116	16.Mar.2011
Audio analyzer	KENWOOD	10087290	VA-2230A	16.Mar.2011
RF communication test set	HP	8920A	3417A04617	16.Mar.2011
Signal generator	Rohde & Schwarz	SMU200A	101904	13.Aug.2011
Spectrum analyzer	Agilent	N9020A	MY49060014	06.May.2011
Spectrum analyzer	Agilent	N9020A	MY50200776	10.Jun.2011
Attenuator	SHX manufacturer	30dB/50W	080820	10.Jun.2011

2.3 Trace ability

All measurement equipment calibrations are traceable to NIST or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

Uncertainty for radiated emissions measurements is ± 4.94dB (30MHz-1GHz), ± 4.88dB (>1GHz).

The reported expanded uncertainty is based on a standard uncertainty multiply by a coverage factor k=2, providing a level of confidence of approximately 95%.

2.6 Location of original data

The original copies of all test data taken during actual testing were attached at Appendix 1 of this report and delivered to the applicant.
A copy has been retained in the TUV Rheinland (Guangzhou) file for certification follow-up purposes.

2.7 Status of facility used for testing

TÜV Rheinland (Guangdong) Ltd. EMC Laboratory; Guangzhou Auto Market, Yuan Gang Section of Guangshan Road, Guangzhou 510650, P. R. China is listed on the US Federal Communications Commission list of facilities approved to perform measurements, the register no. 833845.

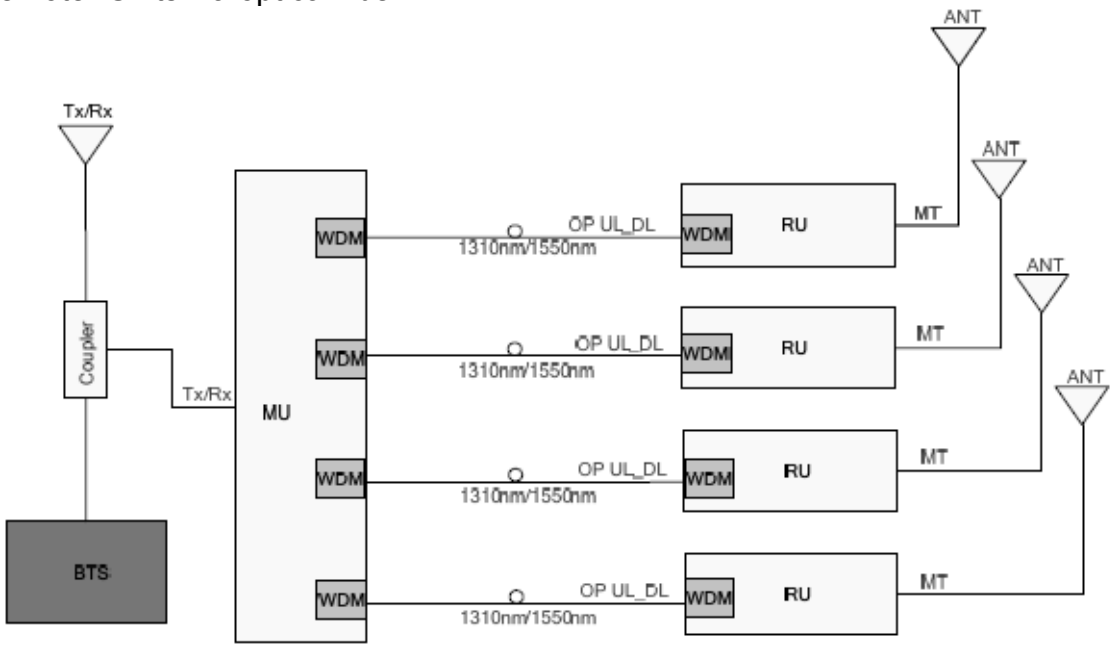
3 General Product Information

The submitted sample RA-5700-D is Master Unit (RU) of Multi-band In-band Distributed Antenna system RA-5700. The EUT supports three systems, which are LTE 700, CDMA 850 and CDMA 1900.

On the UL, the signals transmitted by the mobile are converted into optical signals, and then via the UL optical fiber. The signals are transmitted to MU, which converts the optical signals to RF signals, and then the RF signal is fed to BTS.

On the DL, combined signals as 700MHz, 850MHz and 1900MHz from the BTSs converted into optical signals after amplification in the MU. Then the optical signals are transmitted to the RU via optical fiber.

The Master Unit can provide four optical I/O ports and can connect four identical Remoter Units via optical fiber.



For details, refer to technical document and the user manual.

3.1 Product Function and Intended Use

For details, refer to technical document and the user manual.

3.2 Ratings and System Details

Model name	:	RA-5700-D
Supporting system	:	LTE 700, CDMA 850, CDMA 1900
Frequency range	:	LTE 700 band 1: Downlink: 728 – 746 MHz Uplink: 698 – 716 MHz LTE 700 band 2: Downlink: 746 – 756 MHz Uplink: 777 – 787 MHz CDMA 850: Downlink: 869 – 894 MHz Uplink: 824 – 849 MHz CDMA 1900: Downlink: 1930 – 1995 MHz Uplink: 1850 – 1915 MHz
Uplink RF output power	:	- 20dBm (LTE 700 band 1 and band 2) - 20dBm (CDMA 850) - 20dBm (CDMA 1900)
Type Modulation	:	LTE (for LTE 700) CDMA (for 850 and 1900)
Emission Designators	:	F9W
Type of antenna	:	External antenna
Operating temperature	:	-30°C to 50°C
Nominal power input		120VAC / 60Hz
Power supply operating range	:	85-264 VAC / 47-63 Hz
Rated power input	:	160W
Protection Class	:	I

3.3 Independent Operation Modes

The EUT was powered by 120VAC. The EUT was configured for maximum gain, 30dB. Signal generator was used to provide the input signals to the EUT. Tests were performed with CDMA signal input and LTE signal input. The input power was the maximum declared by the manufacturer.

For further information refer to User Manual

3.4 Submitted Documents

Application form
Block Diagram
Circuit Diagram
Components List
PCB layout
FCC label
User Manual
Photo document

4 Test Set-up and Operation Mode

4.1 Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Refer to Test set-up in chapter 5.

4.3 Special Accessories and Auxiliary Equipment

The RA-5700-R is Remote Unit (RU) of Multi-band In-band Distributed Antenna system RA-5700. The R-5700-R is connected with RA-5700-D for test.

4.4 Countermeasures to achieve EMC Compliance

The test sample, which has been tested, contained the noise suppression parts as described in the technical document. No additional measures were employed to achieve compliance.

4.5 Test set-up

Diagram 1 of Measurement Equipment Configuration for Testing Radiated Emission

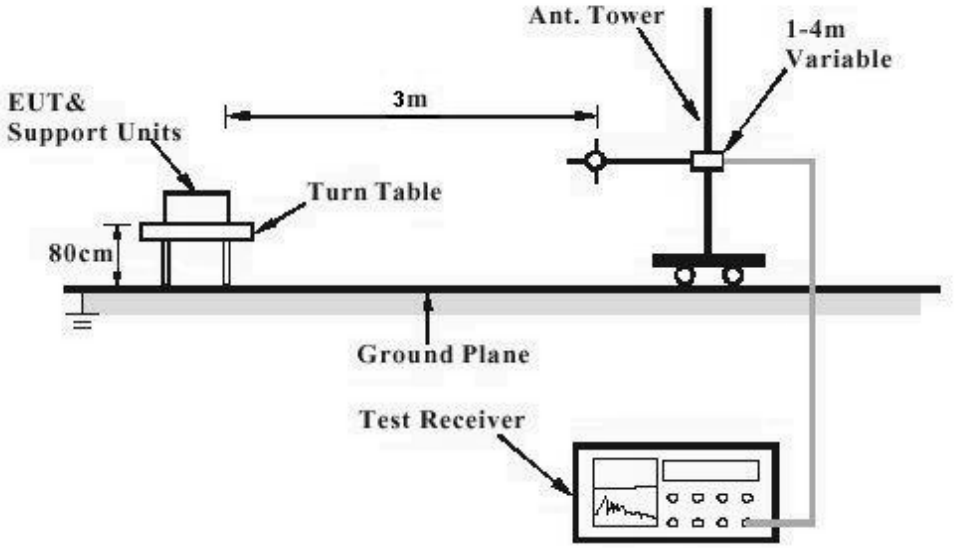


Diagram 2 of Measurement Equipment Configuration for Substitution Method

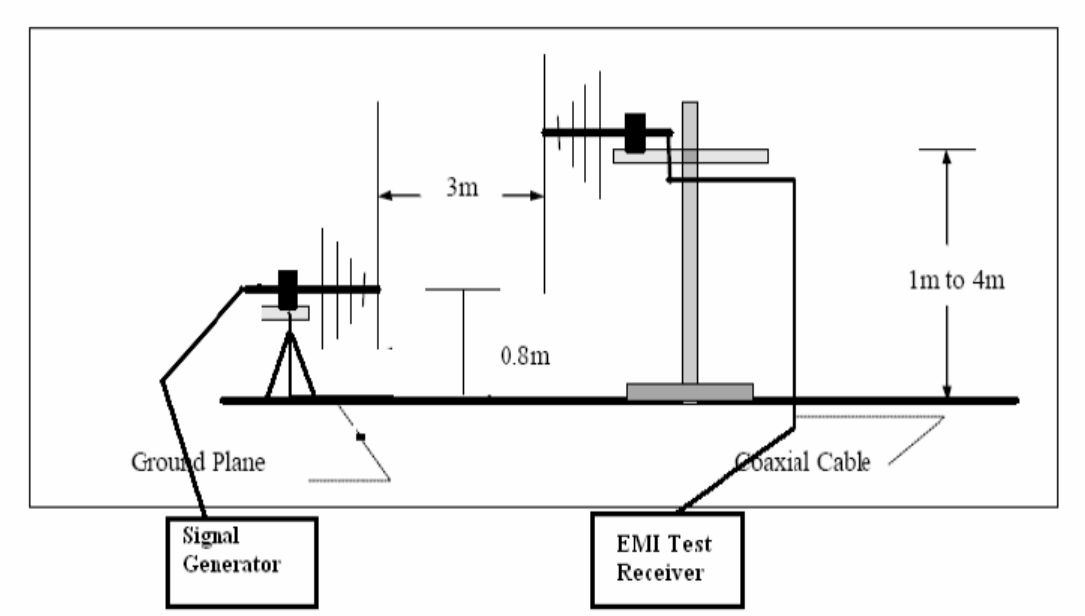


Diagram 3 of Measurement Equipment Configuration for RF power output, Occupied Bandwidth, Spurious Emissions at antenna terminal, Intermodulation Test, Out-of-Band Rejection

4.6 Test frequency selection

Mode	Tested frequency (MHz)
LTE 700 Band 1_DL	733.0
	737.0
	741.0
LTE 700 Band 1_UL	703.0
	707.0
	711.0
LTE 700 Band 2_DL	751.0
LTE 700 Band 2_UL	782.0
CDMA 850_DL	869.62
	881.18
	893.38
CDMA 850_UL	824.62
	836.18
	848.38
CDMA 1900_DL	1930.62
	1960.18
	1989.38
CDMA 1900_UL	1850.62
	1880.18
	1909.38

5 Test Results

5 . 1 Test result of LTE 700MHz band 1 and Band 2

5.1.1 RF power Output

RESULT: **Pass**

Date of testing	:	28.Sep.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1046(a)
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.1
Operation mode	:	Transmitting with maximum RF power output

Limits:

For operating frequency band 698–746 MHz:

FCC Part 27.50 (c) (3)
Fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

For operating frequency band 746 -787 MHz:

FCC Part 27.50 (b) (4)
Fixed and base stations transmitting a signal in the 746–757 MHz, 758–763 MHz, 776–787 MHz, and 788–793 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

Measurement procedure:

1. The RF output of EUT was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. A spectrum analyzer was setup to measure peak power.
4. Measurements were performed at three frequencies (low, middle, and high channels) with modulation.

Test Results:

For operating frequency band 698–746 MHz:

Downlink: 728 – 746 MHz, Uplink: 698 – 716 MHz

The input signal level is – 50dBm.

Table 2: Output power at low, middle and high channel, LTE 700 Band 1_UL

Channel	Direction	Freq. (MHz)	RF power ouput (dBm)	RF power output (W)	Limit (W)
Low	UL	703.0	-21.32	0.0000074	1000
Middle	UL	707.0	-20.99	0.0000080	1000
High	UL	711.0	-21.32	0.0000074	1000

For operating frequency band 746 -787 MHz:

Downlink: 746 – 756 MHz, Uplink: 777 – 787 MHz

The input signal level is – 50dBm.

Table 3: Output power at one channel, LTE 700 Band 2_UL

Channel	Direction	Freq. (MHz)	RF power ouput (dBm)	RF power output (W)	Limit (W)
One	UL	782.0	-21.09	0.0000078	1000

5.1.2 Occupied bandwidth, Input/output Comparison

RESULT: **Pass**

Date of testing	:	29.Sep.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1049
Test method	:	ANSI/TIA-603-C-2004
Operation mode	:	Transmitting with maximum RF power output
Limits	:	N/A

Measurement procedure:

1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. The spectrum analyzer was setup to measure the Occupied Bandwidth (defined as the 99% Power Bandwidth).
4. The Occupied Bandwidth was measured at the input and output ports of the EUT at low, middle and high channel of each type of modulation.

Test Results:

Table 4: 99% Occupied Bandwidth – LTE 700 Band 1_UL

Channel	Direction	Freq. (MHz)	99% Occupied bandwidth (MHz)
Lowest	UL	703.0	8.91
Middle	UL	707.0	8.93
High	UL	711.0	8.94

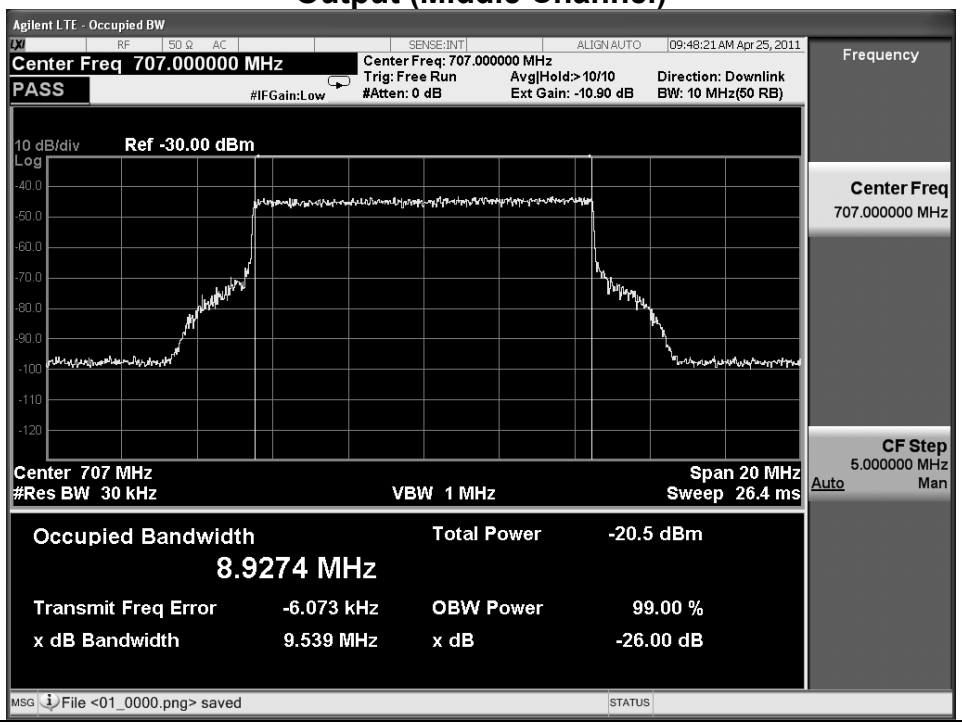
Table 5: 99% Occupied Bandwidth – LTE 700 Band 2_UL

Channel	Direction	Freq. (MHz)	99% Occupied bandwidth (MHz)
One	UL	782.0	8.93

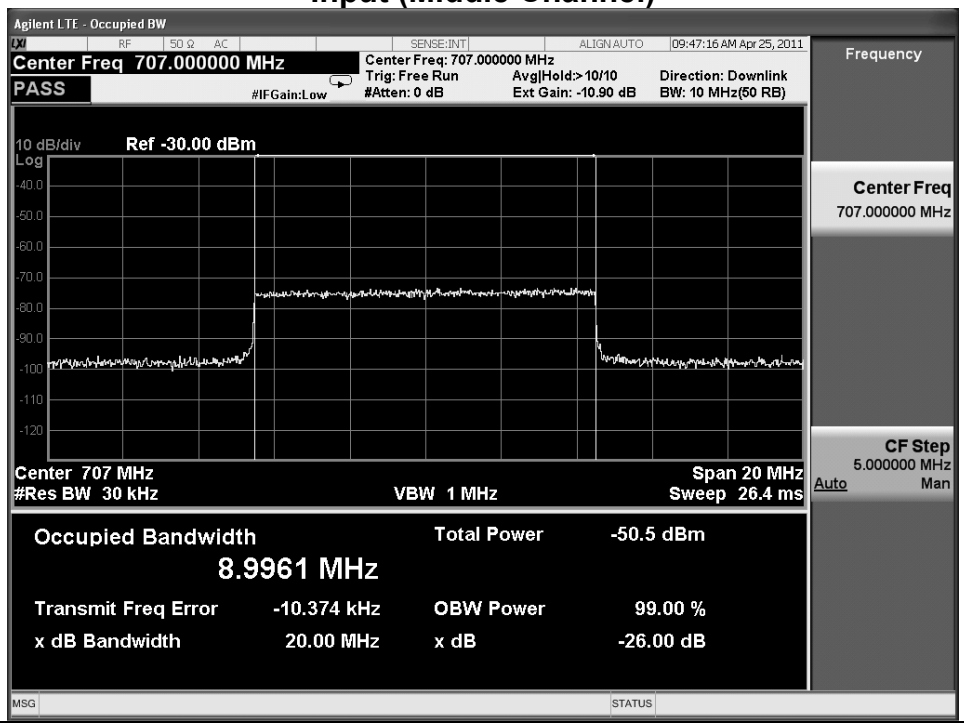
Note: only middle channel of comparison of input/output is list in the following pages.

Input/output Bandwidth Comparison – LTE 700 Band 1_UL

Output (Middle Channel)

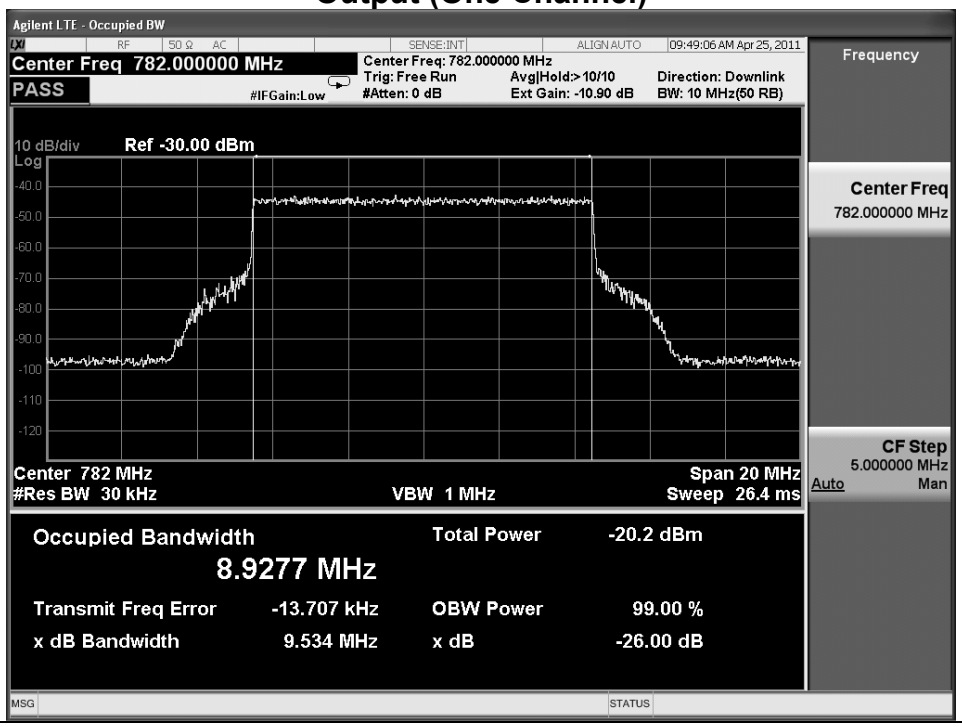


Input (Middle Channel)

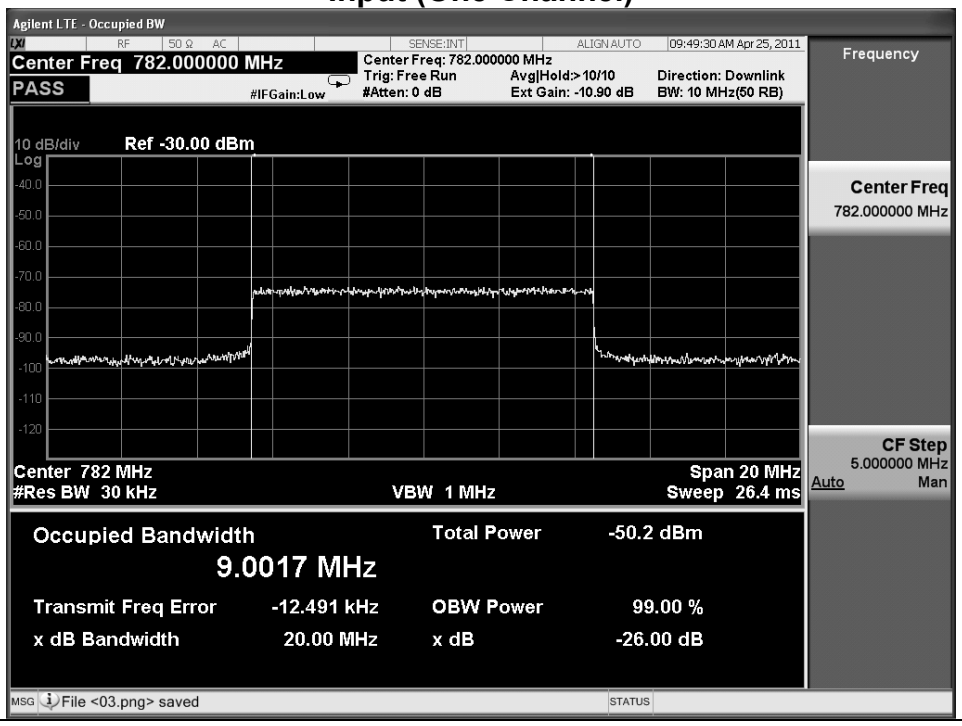


Input/output Bandwidth Comparison – LTE 700 Band 2_UL

Output (One Channel)



Input (One Channel)



5.1.3 Spurious Radiation at antenna terminal

RESULT: **Pass**

Date of testing	:	29.Sep.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1051
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.13
Operation mode	:	Transmitting with maximum RF power output

Limits:

For operating frequency band 698–746 MHz:

Refer to FCC Part 27.53 (g).

Operations in the 698–746 MHz band.
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. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

The following method was used to determine the Limit for Spurious Emissions:

Maximum output power in watts: P (W).

The emission must be reduced by 43+10Log(P) dB

Therefore, the Emission Limit equals:

10Log(P) dBW + 30dB – (43+10Log(P) dB) = – 13 dBm

For operating frequency band 746 -787 MHz:

Refer to FCC Part 27.53 (c) and 27.53(f).

For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the 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, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed.

The emission must be reduced by 76+10Log(P) dB at 6.25 kHz

Therefore, the Emission Limit equals:

10Log(P) dBW + 30dB – (43+10Log(P) dB) = – 13 dBm

The emission must be reduced by 76+10Log(P) dB at 6.25 kHz

Therefore, the Emission Limit equals:

10Log(P) dBW + 30dB – (76+10Log(P) dB) + 10Log (10/6.25) = – 45 dBm

Refer to FCC Part 27.53(f).

For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to - 70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and – 80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

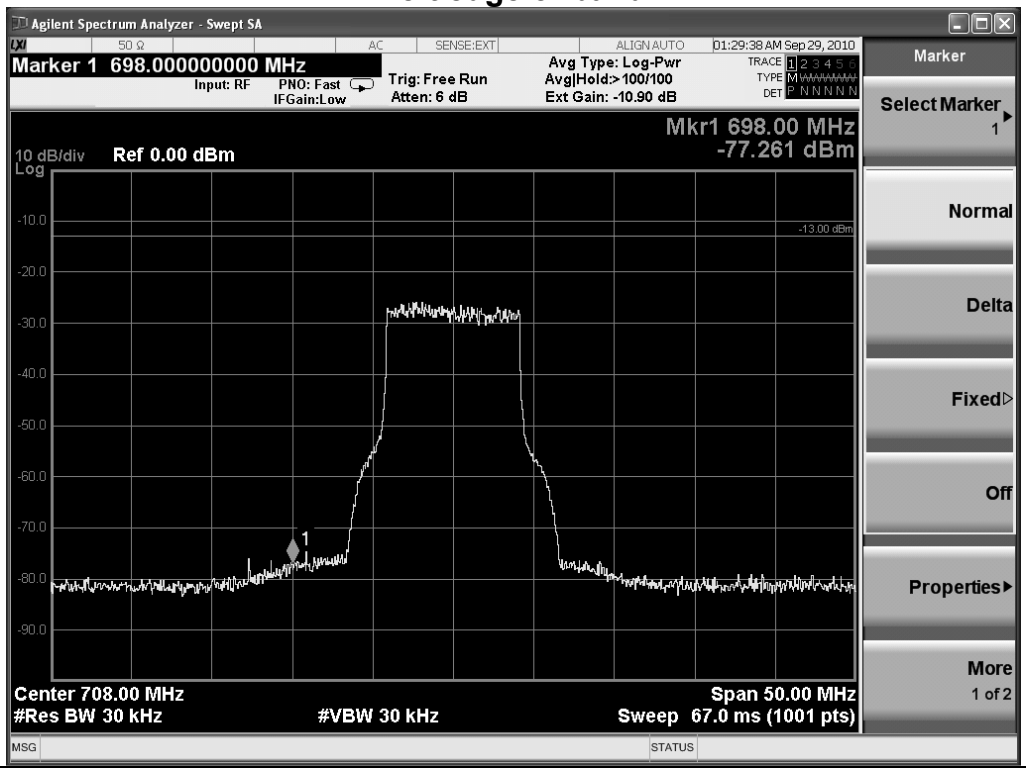
Measurement procedure:

1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. The spurious emissions at antenna were measured at the RF output port of the EUT at middle channel of each type of modulation.

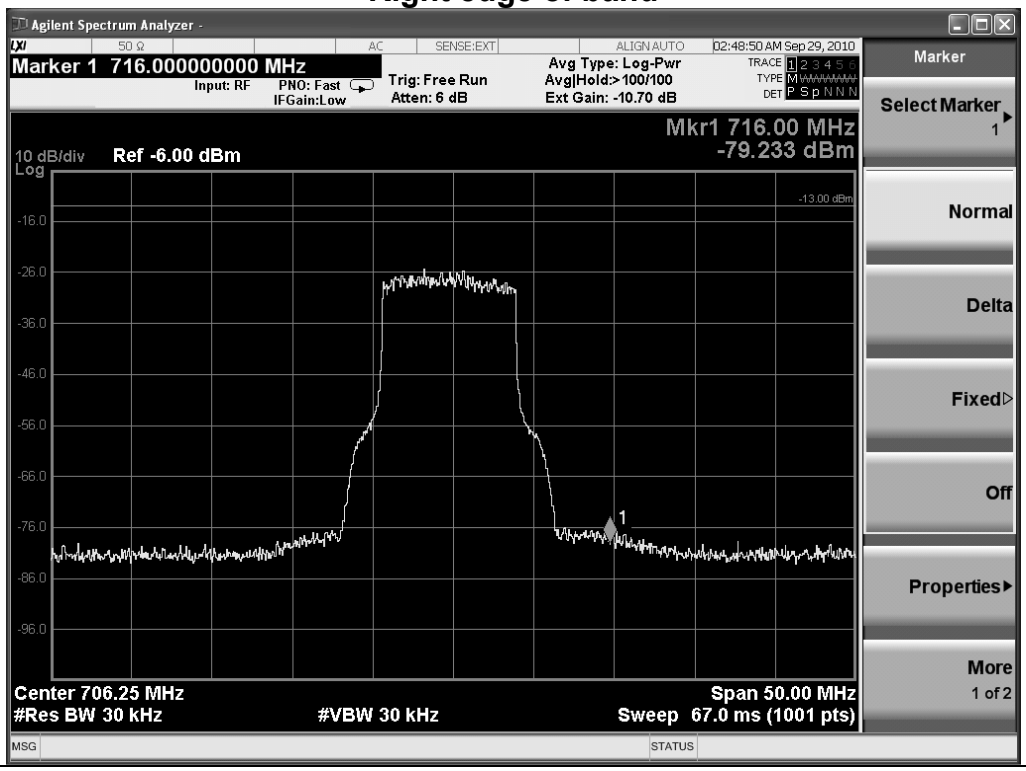
Test Results:

Antenna Terminal Spurious Emissions – Band Edge Emissions, LTE 700 Band 1_UL

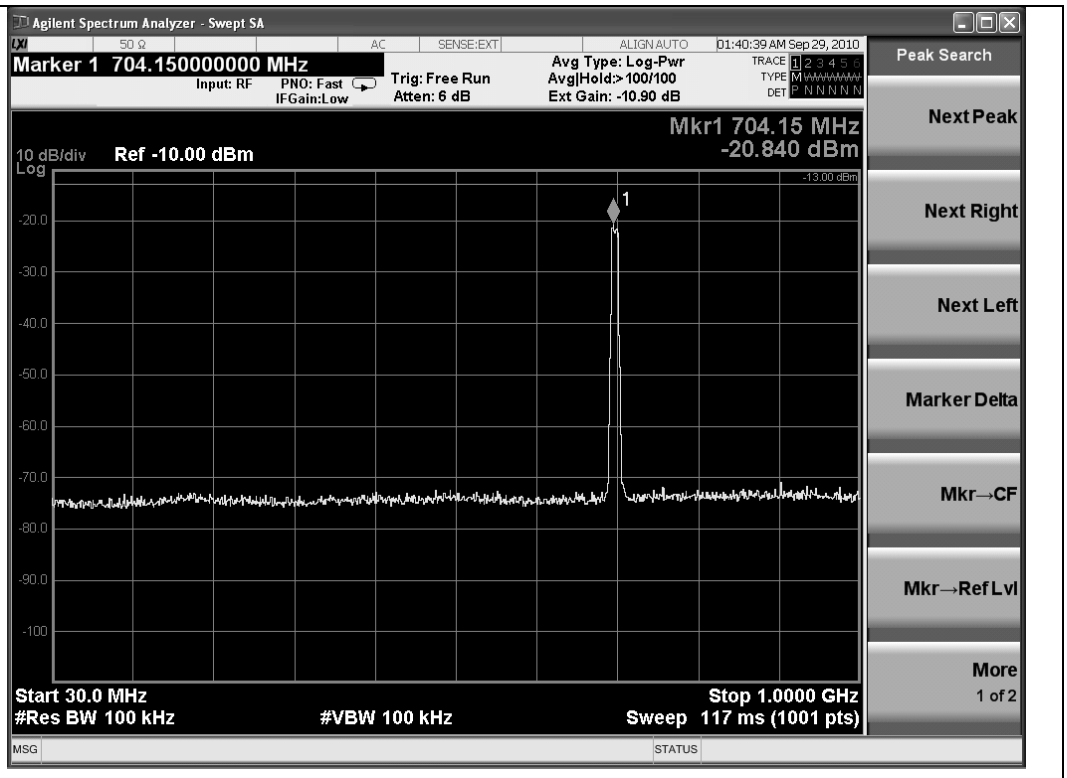
Left edge of band



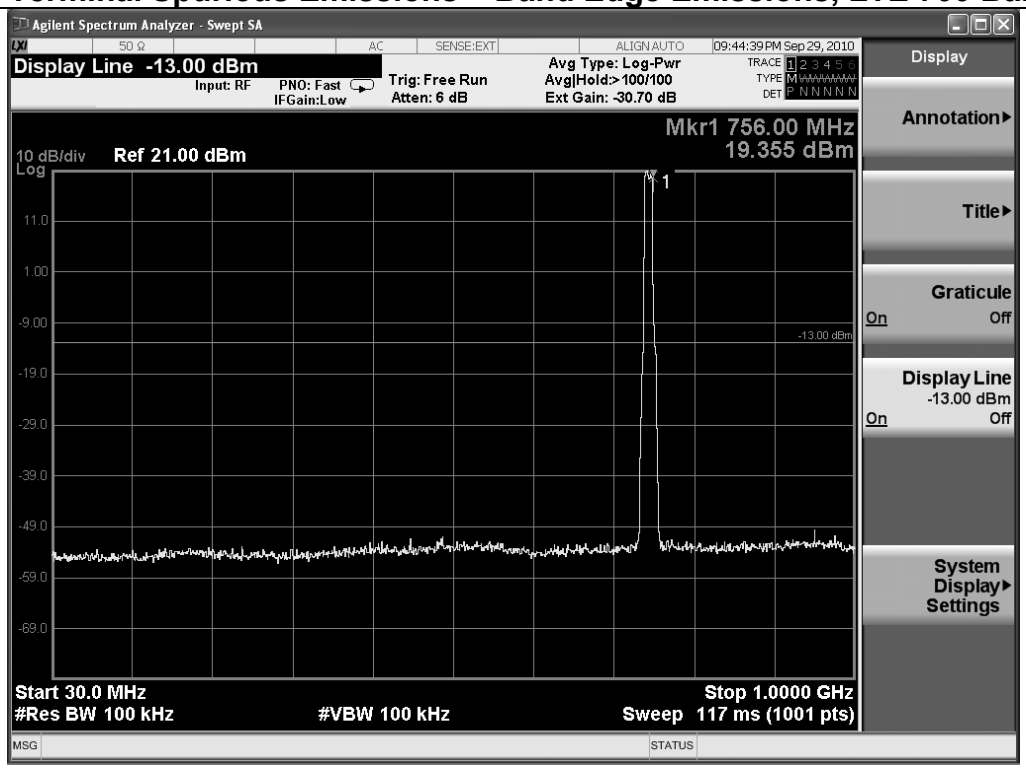
Right edge of band



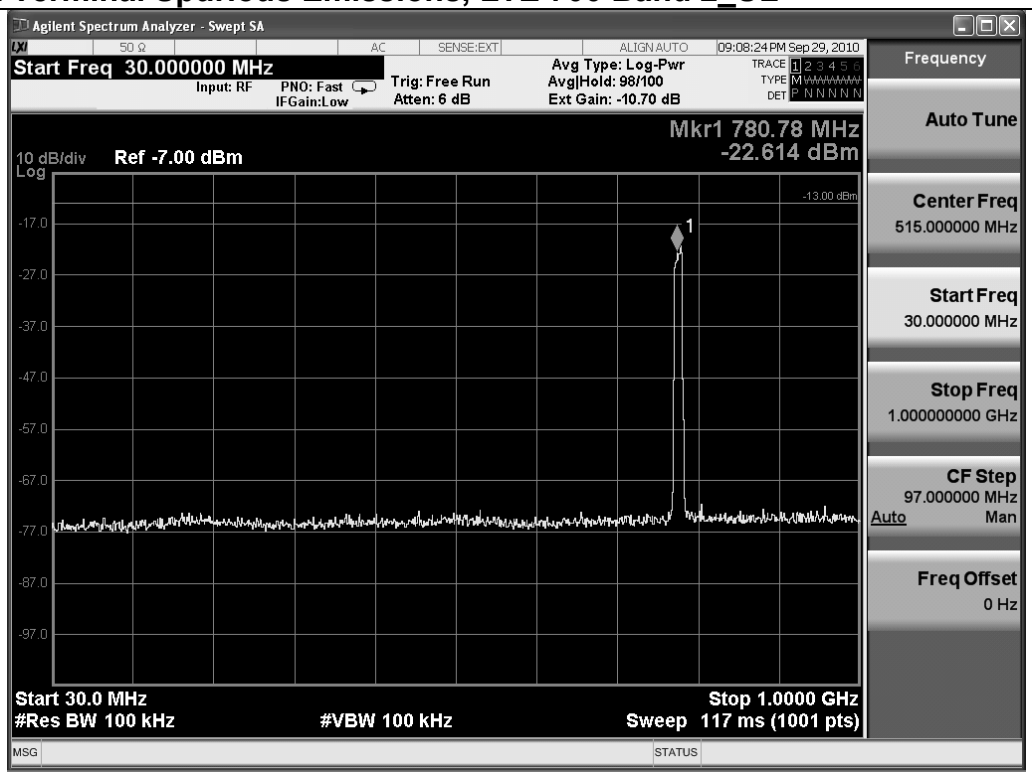
Antenna Terminal Spurious Emissions, LTE 700 Band 1_UL



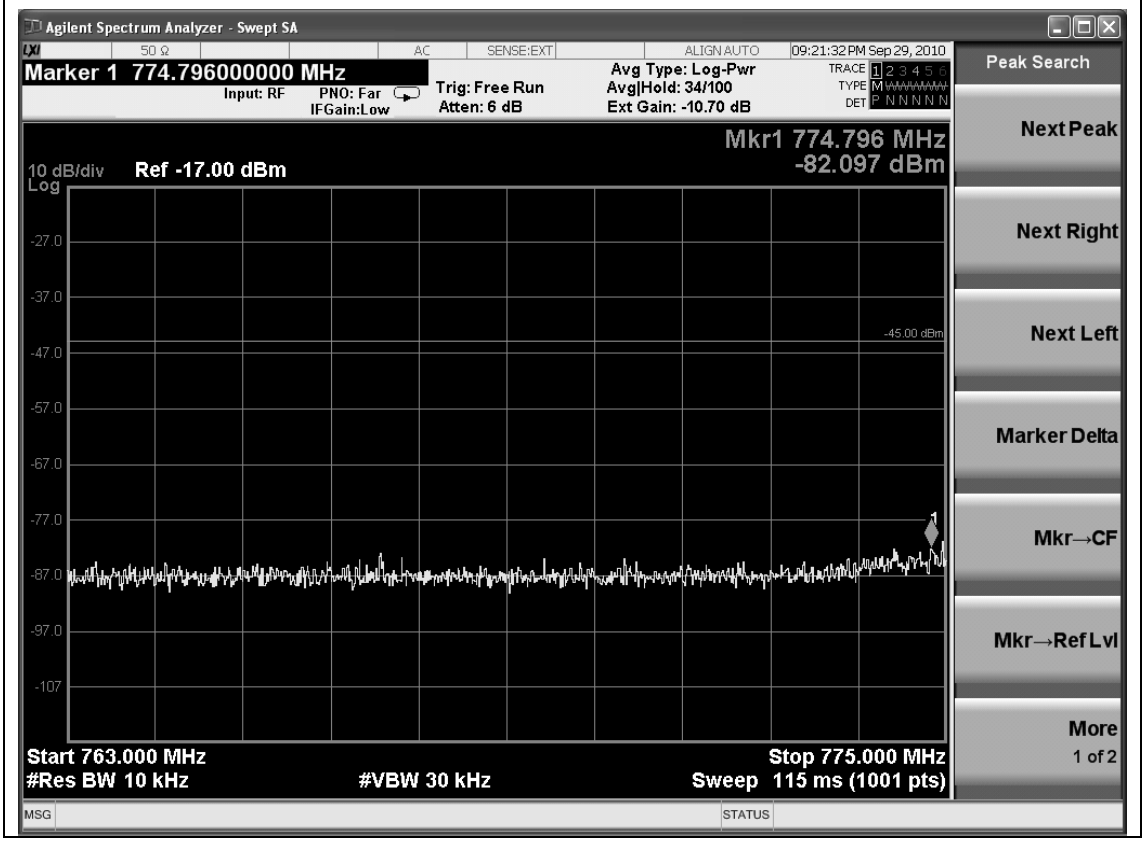
Antenna Terminal Spurious Emissions – Band Edge Emissions, LTE 700 Band 2_UL



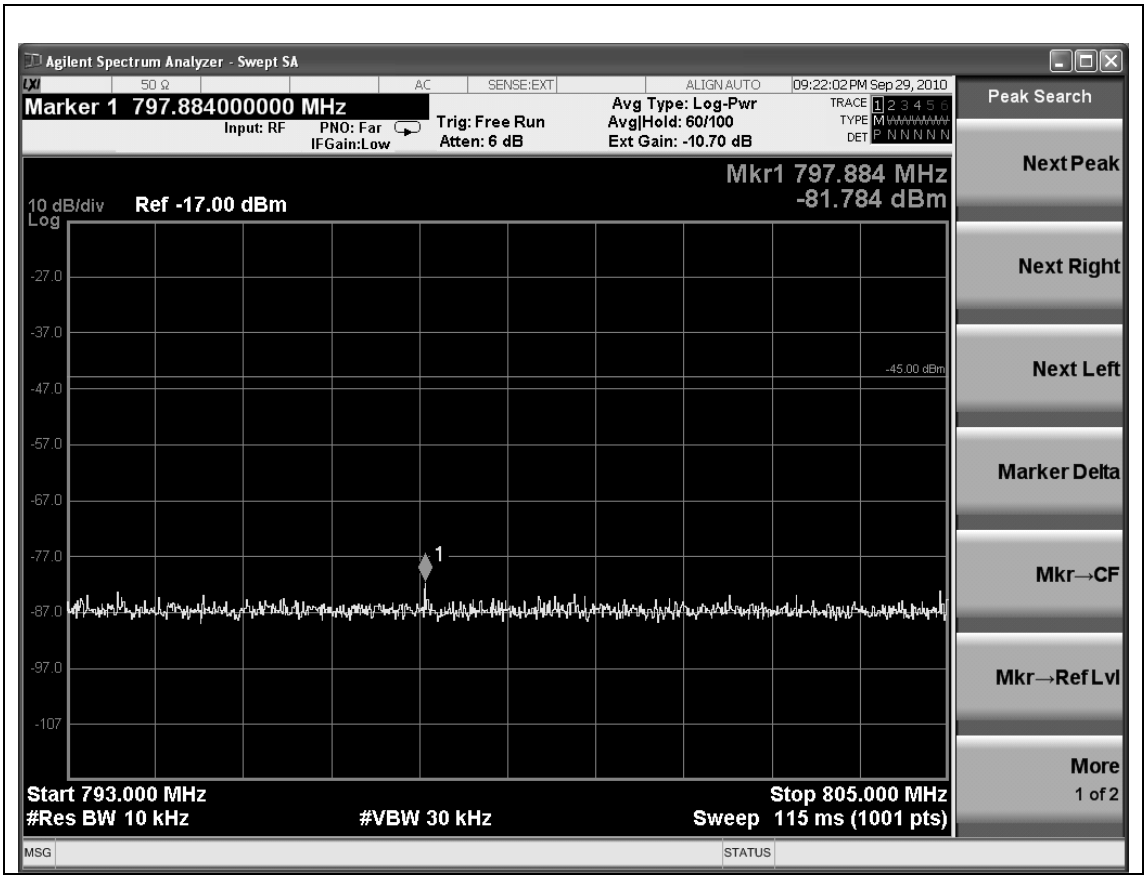
Antenna Terminal Spurious Emissions, LTE 700 Band 2_UL



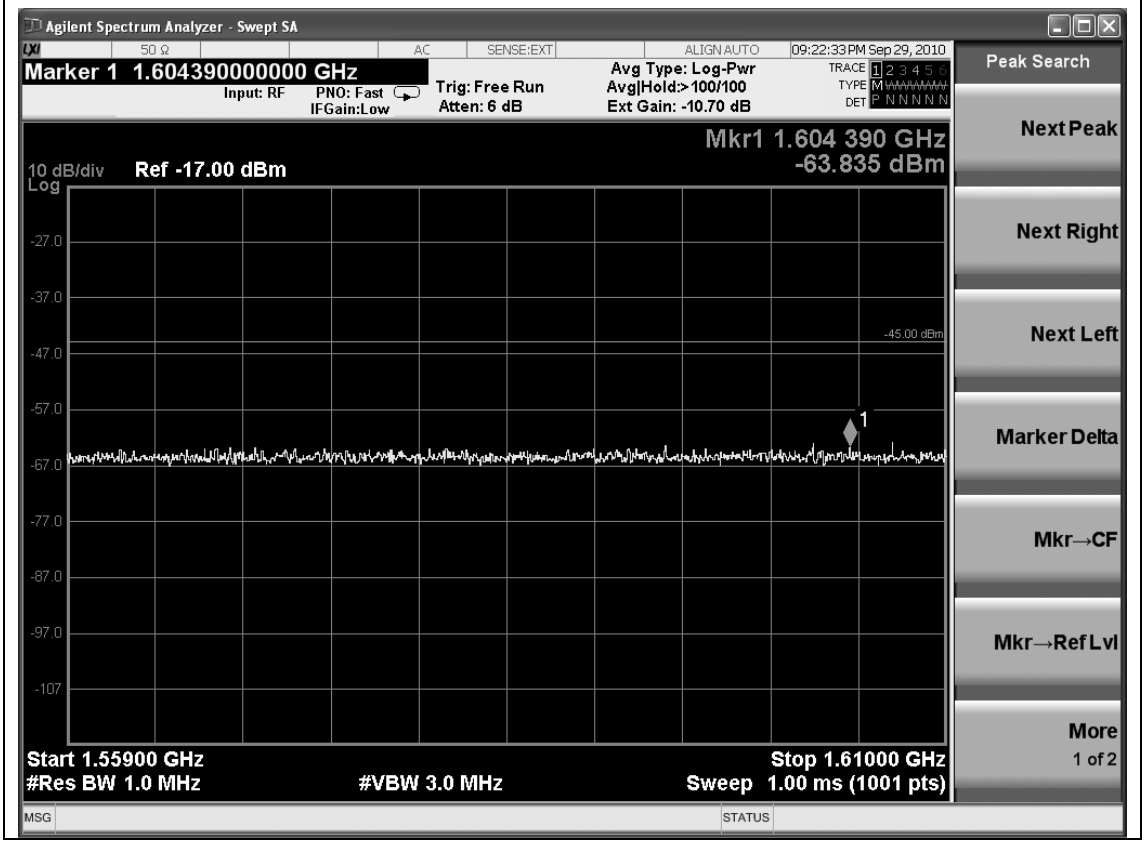
Antenna Terminal Spurious Emissions within 763 – 775 MHz, LTE 700 Band 2_UL



Antenna Terminal Spurious Emissions within 793 – 805 MHz, LTE 700 Band 2_UL



Antenna Terminal Spurious Emissions within 1559 – 1610 MHz, additional requirement 27.53(f), limit: - 70dBW/MHz, LTE 700 Band 2_UL



5.1.4 Field Strength of Spurious Emissions

RESULT: **Pass**

Date of testing	:	13.Jan.2011
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1053
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.12
Operation mode	:	Transmitting with maximum RF power output

Limits:

For operating frequency band 698–746 MHz:

Refer to FCC Part 27.53 (g).

Operations in the 698–746 MHz band.
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. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

For operating frequency band 746–787 MHz:

Refer to FCC Part 27.53 (c).

For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the 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, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

Measurement procedure:

1. The EUT RF output port was connected to 50 ohm RF load.

2. The EUT input port was connected to signal generator and was setup to transmit maximum power.

3. The measurement antenna was placed at a distance of 3 meters from the EUT.

4. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from EUT.

5. The frequency range up to 10-th harmonic of each of the three fundamental frequencies (low, middle and high channels) was investigated. The worst case of emissions was reported.

6. For spurious emissions attenuation, the substitution method was used.

7. The EUT was substituted by a reference antenna (half-wave dipole – below 1 GHz, or Horn antenna – above 1 GHz), connected to a signal generator.

8. The signal generator output level was adjusted to obtain the same reading as from EUT. The EIRP at the spurious emissions frequency was calculated as follows:

EIRP(dBm) = Reading (SG) + Cable loss(dB) + G(dBi)

According the limit specified in 27.53(c) and 27.53(g) :

The following method was used to determine the Limit for Spurious Emissions:

Maximum output power in watts: P (W).

The emission must be reduced by 43+10Log(P) dB

Therefore, the Emission Limit equals:

10Log(P) dBW + 30dB – (43+10Log(P) dB) = – 13 dBm

Test Results:

There were no emissions detected above the noise floor, which was at least 20 dB below the specification limit.

Table 6: Transmitter Spurious Radiated Emissions - LTE 700 band 1_UL

Freq. (MHz)	Polarization (V/H)	Reading (SG) (dBm)	Cable loss (dB)	Antenna Gain(dBi)	Transmit power (dBm)	Limit (dBm)
1414	H	-57.15	7.4	5.25	-59.3	-13
2121	H	-35.55	8.7	6.75	-37.5	-13
2828	H	-50.25	10.2	6.95	-53.5	-13
3535	H	-61.75	11.2	8.25	-64.7	-13
4242	H	-65.95	12.5	8.65	-69.8	-13
4949	H	-64.85	14.6	8.25	-71.2	-13
1414	V	-57.05	7.4	5.25	-59.2	-13
2121	V	-72.35	8.7	6.75	-74.3	-13
2828	V	-68.85	10.2	6.95	-72.1	-13
3535	V	-34.65	11.2	8.25	-37.6	-13
4242	V	-41.25	12.5	8.65	-45.1	-13
4949	V	-63.85	14.6	8.25	-70.2	-13
Note: All other emissions not reported are more than 20 dB below the limit.						

Table 7: Transmitter Spurious Radiated Emissions - LTE 700 band 2_UL

Freq. (MHz)	Polarization (V/H)	Reading (SG) (dBm)	Cable loss (dB)	Antenna Gain(dBi)	Transmit power (dBm)	Limit (dBm)
1502	H	-55.15	7.4	5.35	-57.3	-13
2253	H	-34.85	8.7	6.84	-36.8	-13
3004	H	-48.25	10.2	7.12	-51.5	-13
3755	H	-59.35	11.2	8.25	-62.3	-13
4506	H	-61.55	12.5	8.65	-65.4	-13
5257	H	-64.25	14.6	8.43	-70.6	-13
1502	V	-56.05	7.4	5.35	-58.2	-13
2253	V	-71.35	8.7	6.84	-73.3	-13
3004	V	-67.85	10.2	7.12	-71.1	-13
3755	V	-33.65	11.2	8.25	-36.6	-13
4506	V	-40.25	12.5	8.65	-44.1	-13
5257	V	-61.85	14.6	8.43	-68.2	-13
Note: All other emissions not reported are more than 20 dB below the limit.						

5.1.5 Frequency Stability

RESULT: **Pass**

Date of testing	:	29.Sep.2010
Temperature	:	-30°C to 50°C
Humidity	:	50%
Basic standard	:	FCC Part 2 Per Section 2.1055
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.2
Operation mode	:	Transmitting with maximum RF power output
Limits:		

Refer to FCC Part 27.54

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized of operation.

Measurement procedure:

1. The EUT was placed inside the temperature chamber.
2. The RF output port was connected to a spectrum analyzer.
3. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
4. After the temperature stabilized for approximately 20 min, the transmitting frequency was measured by the spectrum analyzer and recorded.
5. At room temperature, the frequency was measured when EUT was powered with the nominal voltage and with 85% and 115% of the nominal voltage.

Test Results:

Table 8: Frequency stability - LTE 700_UL

Operating frequency : 707.000000 MHz
Channel : Middle
Reference Voltage : 120 VAC

Voltage with nominal Voltage	Power (VAC)	Temp (ºC)	Measured Freq (MHz)	Deviation (ppm)	Limit (ppm)
100%	120	+20(Ref)	737.000000	Ref	1.5
100%		-30	736.999996	- 0.005	
100%		-20	736.999997	- 0.004	
100%		-10	736.999997	- 0.004	
100%		0	736.999998	- 0.003	
100%		+10	736.999998	- 0.003	
100%		+20	737.000002	+ 0.003	
100%		+30	737.000004	+ 0.004	
100%		+40	737.000006	+ 0.008	
100%		+50	737.000008	+ 0.010	
85%	102	+20	737.000002	+ 0.003	
115%	138	+20	737.000001	+ 0.002	

5.1.6 Error Vector Magnitude (EVM)

RESULT: **No Limit**

Date of testing	:	04.Mar.2011
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	---
Test method	:	ANSI/TIA-603-C-2004
Operation mode	:	Transmitting with maximum RF power output
Limits	:	N/A

Measurement procedure:

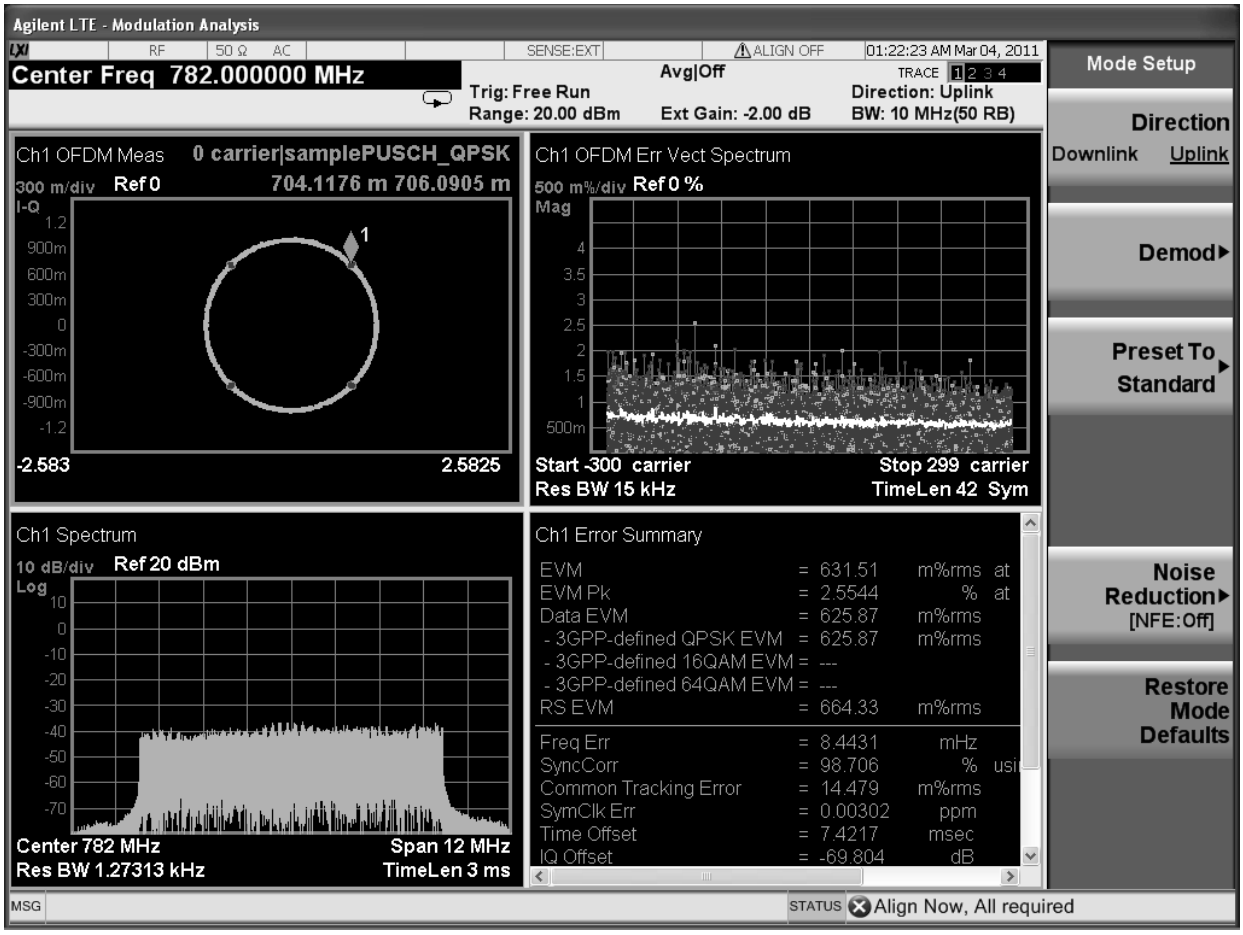
1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. The spectrum analyzer was setup to measure the Error Vector Magnitude (EVM) of output signal.

The EVM was measured at the output port of the EUT at the middle channel of each type of modulation.

Test result:

Table 9: EVM, LTE 700_UL

Channel	Direction	Freq. (MHz)	EVM Pk (%)	EVM RMS (%)
One	UL	782.0	2.55	0.63



5.2 Test result of CDMA 850 and CDMA 1900

5.2.1 RF power Output

RESULT: **Pass**

Date of testing	:	28.Sep.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1046(a)
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.1
Operation mode	:	Transmitting with maximum RF power output

Limits:

For CDMA 850:

FCC Part 22.931 (a)
The effective radiated power (ERP) of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(a) *Maximum ERP*. In general, the effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

For CDMA 1900:

FCC Part 24.232 (b) (4)
Base stations are limited to 1640 watts peak equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT. Base station antenna heights may exceed 300 meters with a corresponding reduction in power; see Table 1 of this section.

Measurement procedure:

1. The RF output of EUT was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. A spectrum analyzer was setup to measure peak power.
4. Measurements were performed at three frequencies (low, middle, and high channels) with modulation.

Test Results:

For CDMA 850:

Downlink: 869 – 894 MHz, Uplink: 824 – 849 MHz

The input signal level is – 50dBm.

Table 10: Output power at low, middle and high channel, CDMA 850_UL

Channel	Direction	Freq. (MHz)	RF power ouput (dBm)	RF power output (W)	Limit (W)
Low	UL	824.62MHz	-20.14	0.00001	500
Middle	UL	836.18MHz	-20.21	0.00001	500
High	UL	848.38MHz	-20.78	0.000008	500

For CDMA 1900:

Downlink: 1930 – 1995 MHz, Uplink: 1850 – 1915 MHz

The input signal level is – 50dBm.

Table 11: Output power at low, middle and high channel, CDMA 1900_UL

Channel	Direction	Freq. (MHz)	RF power ouput (dBm)	RF power output (W)	Limit (W)
Low	UL	1850.62	-21.36	0.000007	500
Middle	UL	1880.18	-20.61	0.000009	500
High	UL	1909.38	-21.01	0.000008	500

5.2.2 Occupied bandwidth, Input/output Comparison

RESULT: **Pass**

Date of testing	:	28.Sep.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1049
Test method	:	ANSI/TIA-603-C-2004
Operation mode	:	Transmitting with maximum RF power output
Limits	:	N/A

Measurement procedure:

1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. The spectrum analyzer was setup to measure the Occupied Bandwidth (defined as the 99% Power Bandwidth).
4. The Occupied Bandwidth was measured at the input and output ports of the EUT at low, middle and high channel of each type of modulation.

Test Results:

CDMA 850:

Table 12: 99% Occupied Bandwidth – CDMA 850_UL

Channel	Direction	Freq. (MHz)	99% Occupied bandwidth (MHz)
Lowest	UL	824.62	1.2725
Middle	UL	836.18	1.2739
High	UL	848.38	1.2714

CDMA 1900:

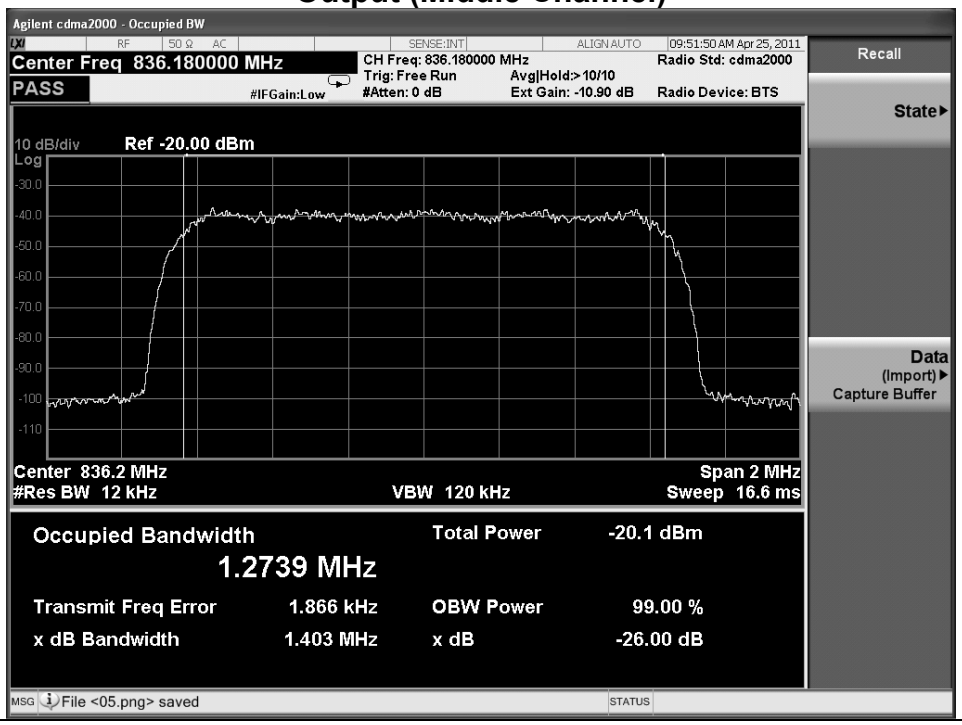
Table 13: 99% Occupied Bandwidth – CDMA 1900_UL

Channel	Direction	Freq. (MHz)	99% Occupied bandwidth (MHz)
Lowest	UL	1850.62	1.2646
Middle	UL	1880.18	1.2694
High	UL	1909.38	1.2695

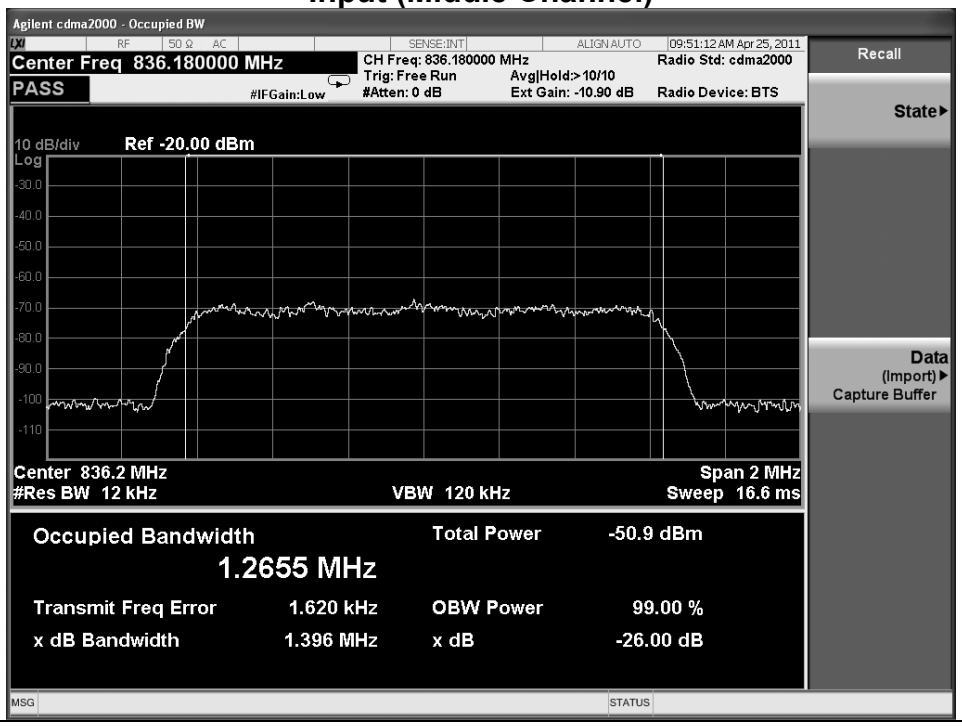
Note: only middle channel of comparison of input/output is list in the following pages.

Input/output Bandwidth Comparison – CDMA 850_UL

Output (Middle Channel)



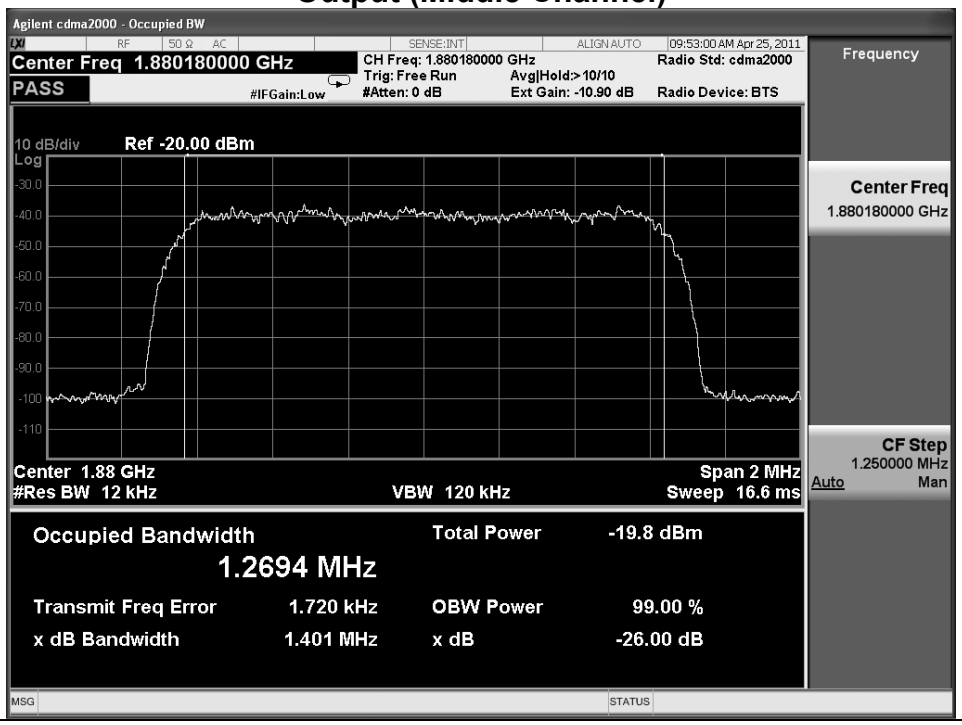
Input (Middle Channel)



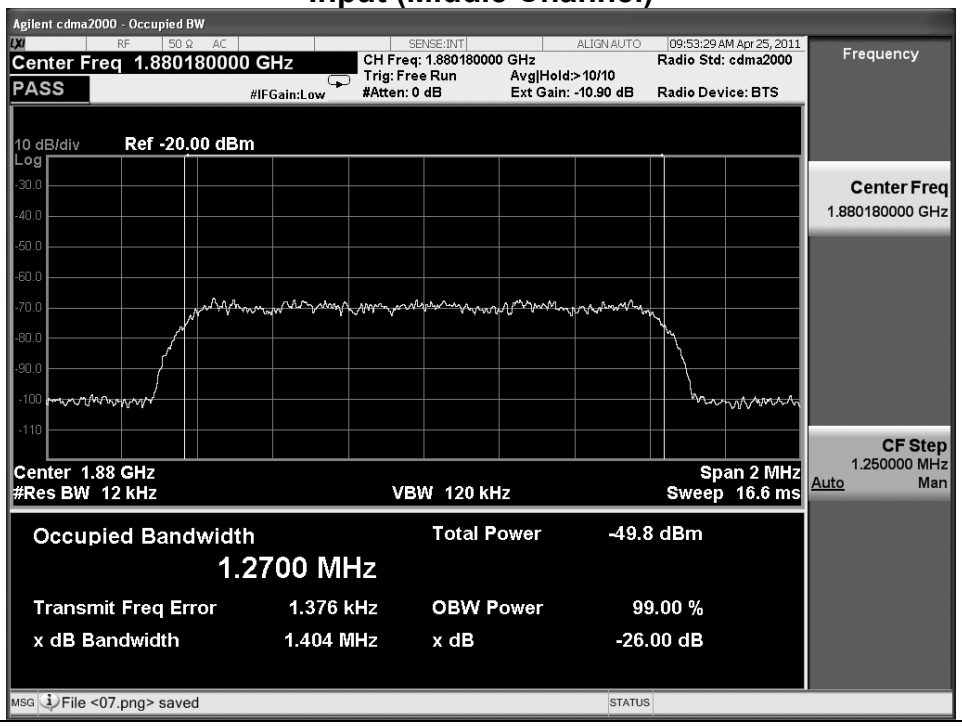
Note: only middle channel of comparison of input/output is list in the following pages.

Input/output Bandwidth Comparison – CDMA 1900_UL

Output (Middle Channel)



Input (Middle Channel)



5.2.3 Out-of-Band Emissions at antenna terminal

RESULT: **Pass**

Date of testing	:	29.Sep.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1051
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.13
Operation mode	:	Transmitting with maximum RF power output

Limits :

Refer to FCC Part 22.917(a) for CDMA 850.

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.

Refer to FCC Part 24.238(a) for CDMA 1900.

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.

The following method was used to determine the Limit for Spurious Emissions:

Maximum output power in watts: P (W).

The emission must be reduced by 43+10Log(P) dB

Therefore, the Emission Limit equals:

10Log(P) dBW + 30dB – (43+10Log(P) dB) = – 13 dBm

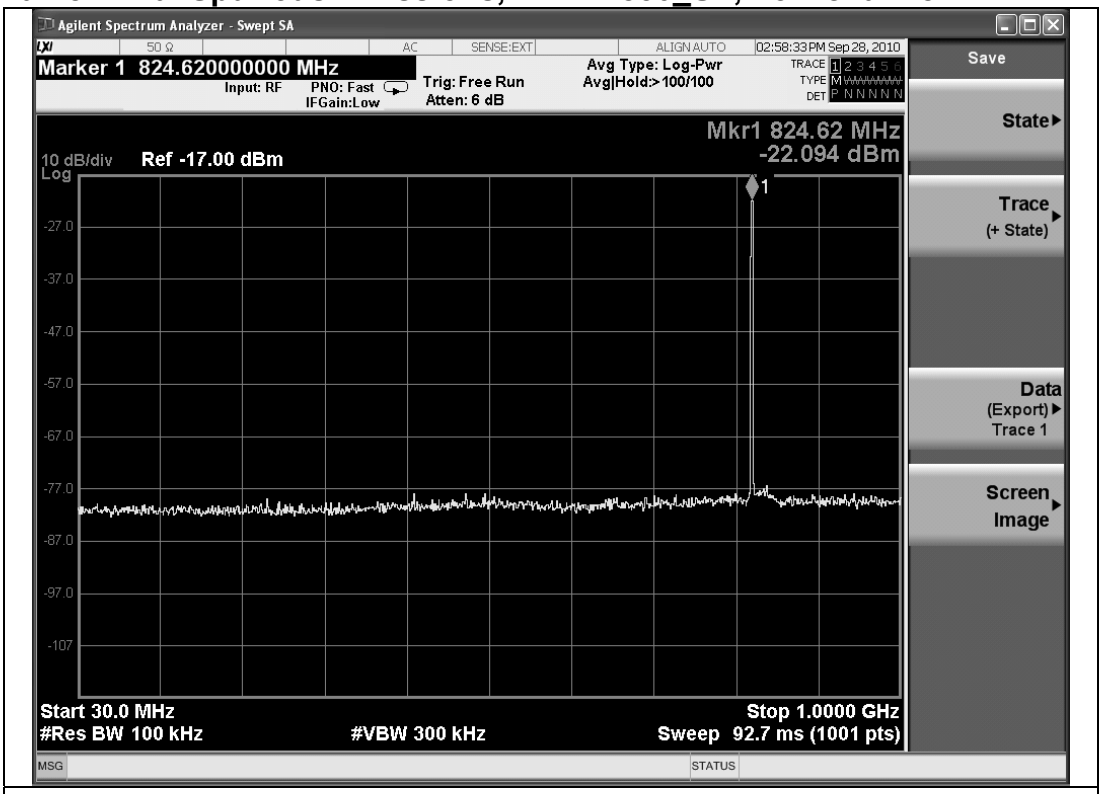
Measurement procedure:

1. The EUT RF output port was connected to spectrum analyzer.
2. The EUT was setup to transmit maximum power output.
3. The spurious emissions at antenna were measured at the RF output port of the EUT at low, middle and high channel of each type of modulation.
4. The spectrum analyzer resolution bandwidth (RBW) was set to 1 MHz for above 1 GHz and 100 kHz for the cell band.

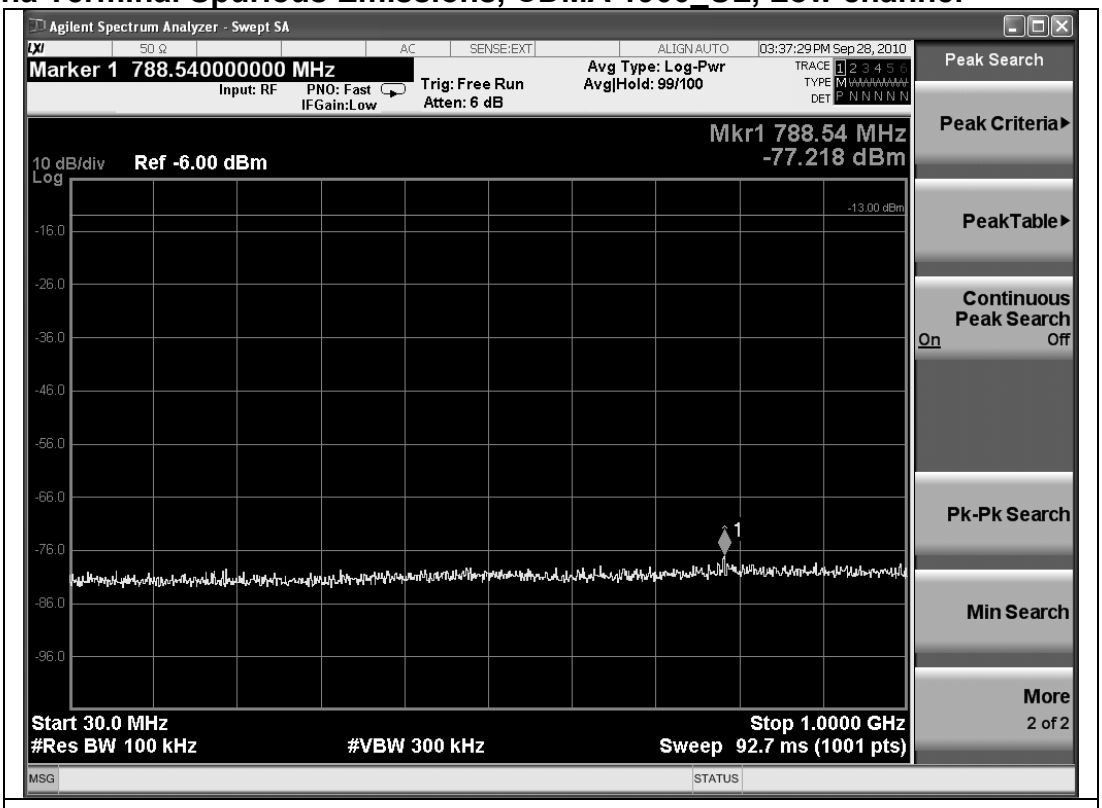
Test Results:

The low channel caused the worst emissions and list in the following page.

Antenna Terminal Spurious Emissions, CDMA 850_UL, Low channel

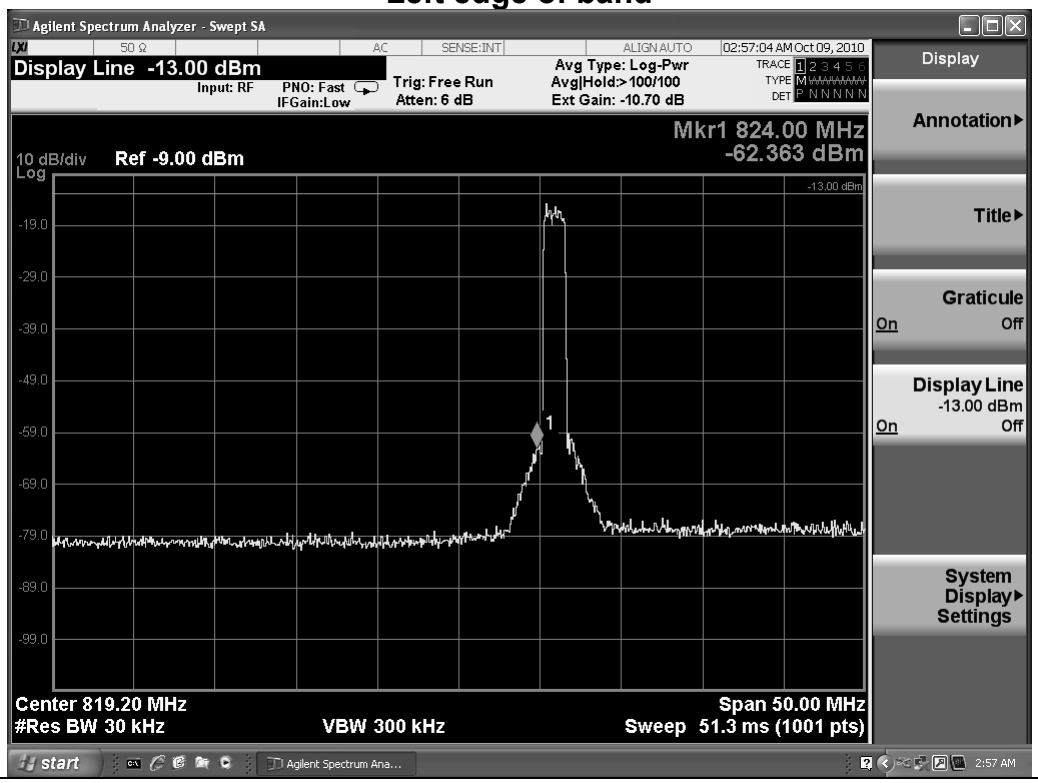


Antenna Terminal Spurious Emissions, CDMA 1900_UL, Low channel

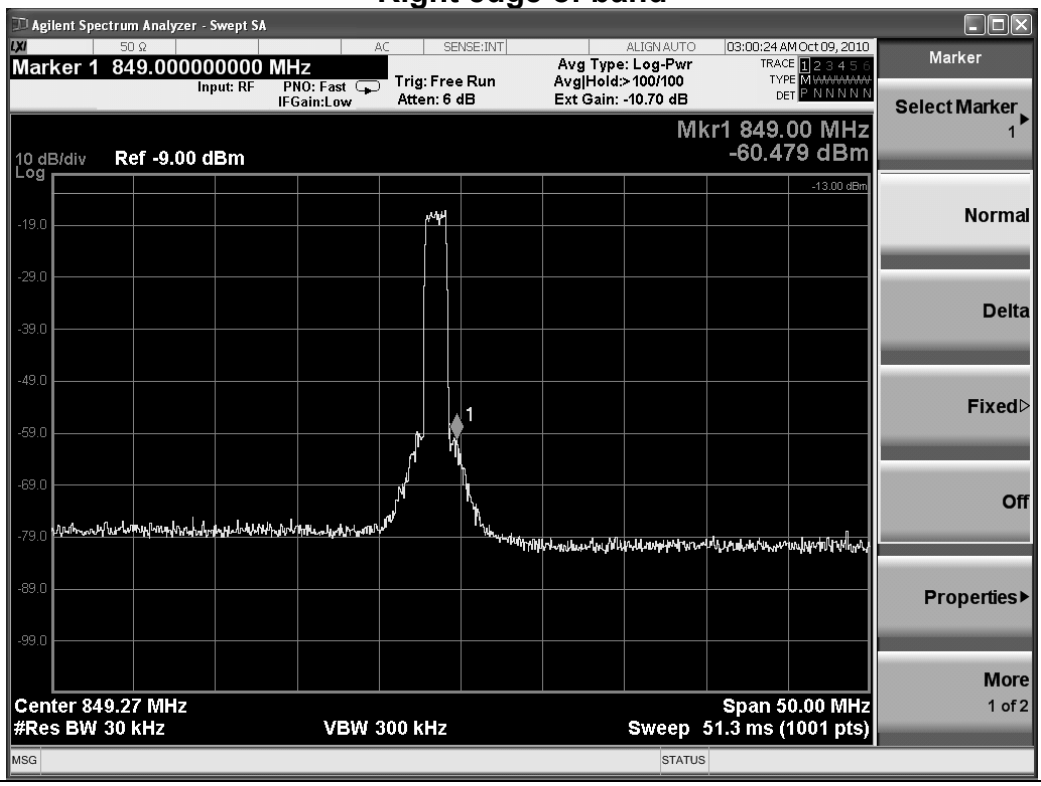


Antenna Terminal Spurious Emissions – Band Edge Emissions, CDMA 850_UL

Left edge of band

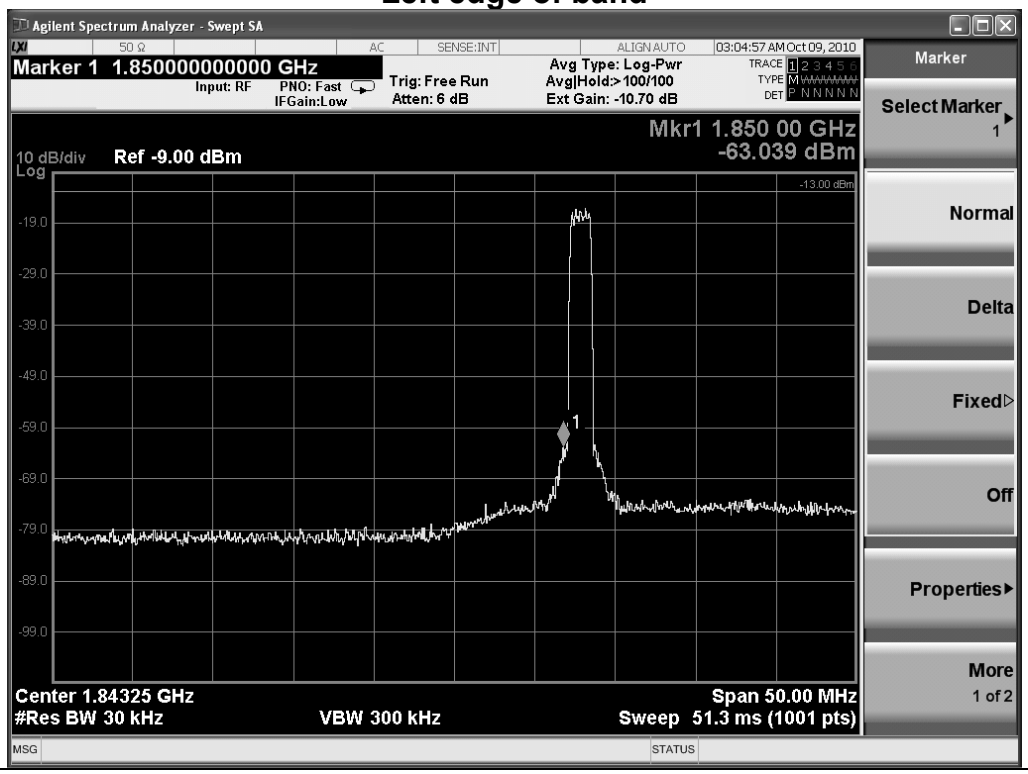


Right edge of band

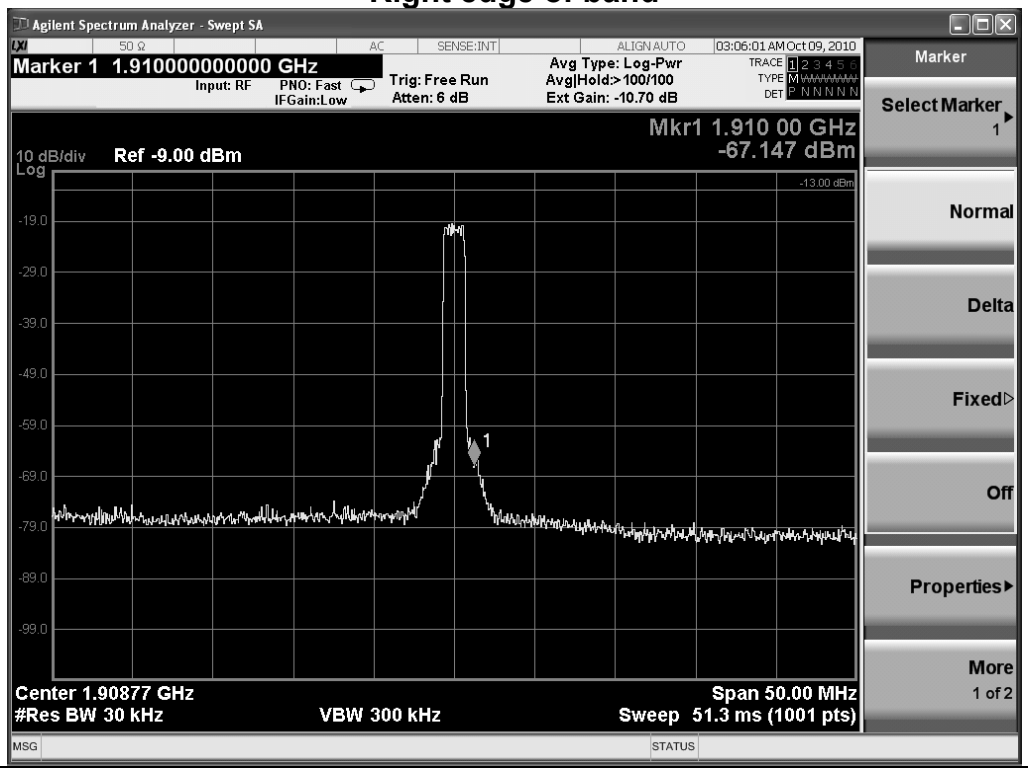


Antenna Terminal Spurious Emissions – Band Edge Emissions, CDMA 1900_UL

Left edge of band



Right edge of band



5.2.4 Intermodulation

RESULT: **Pass**

Date of testing	:	09.Oct.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1051
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.13
Operation mode	:	Transmitting with maximum RF power output

Limits :

Refer to FCC Part 22.917(a) for CDMA 850.

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.

Refer to FCC Part 24.238(a) for CDMA 1900.

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.

The emission must be reduced by 43+10Log(P) dB.

Therefore, the Emission Limit equals:

10Log(P) dBW + 30dB – (43+10Log(P) dB) = – 13 dBm

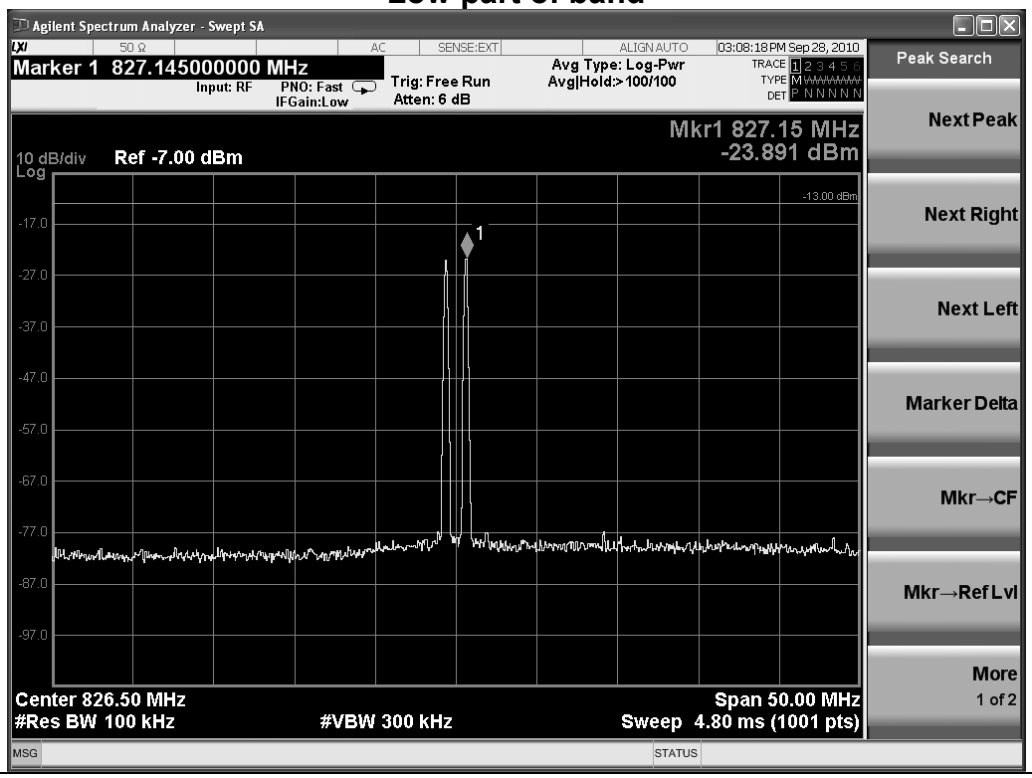
Measurement procedure:

1. The EUT RF output port was connected to spectrum analyzer.
2. Two RF signal was input to EUT's input port.
3. The frequencies of both two RF signals shall be within the repeater's operating band. The spacing between two RF signals shall be the minimum possible spacing applied in a network. The level shall be increased till the maximum rated output power per channel, as declared by the manufacturer, is achieved.
4. The spurious emissions at antenna were measured at the RF output port of the EUT.
5. The spectrum analyzer resolution bandwidth (RBW) was set to 100 kHz for the cell band.

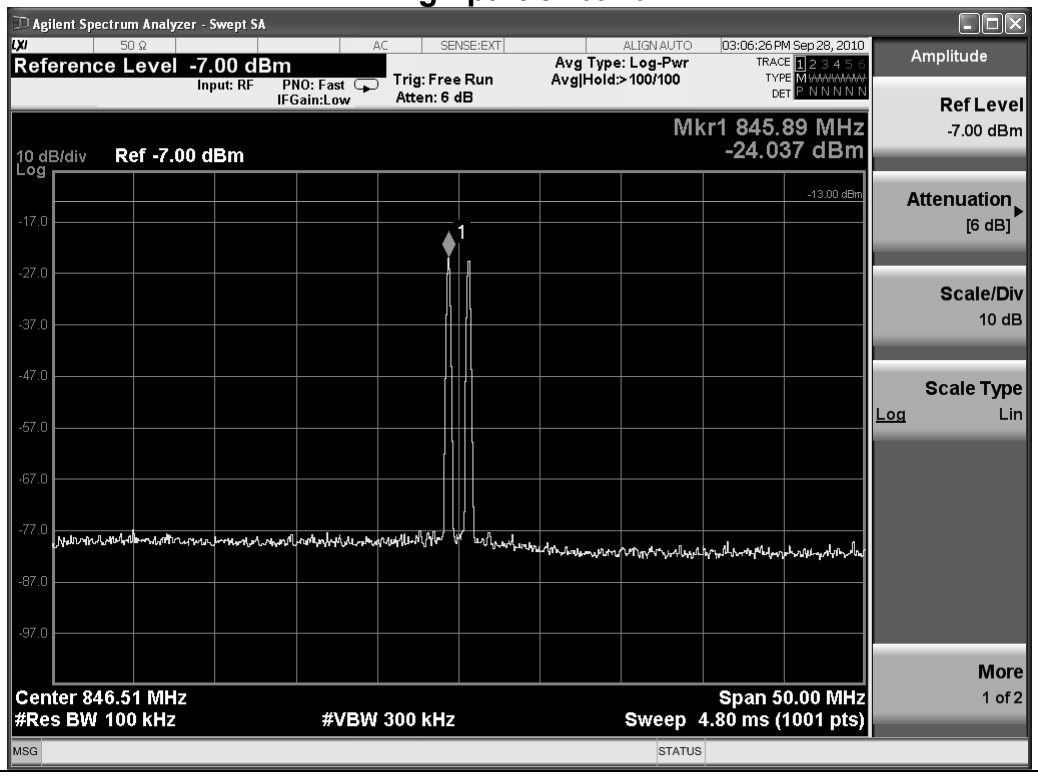
Test Results:

Intermodulation, CDMA 850_UL

Low part of band

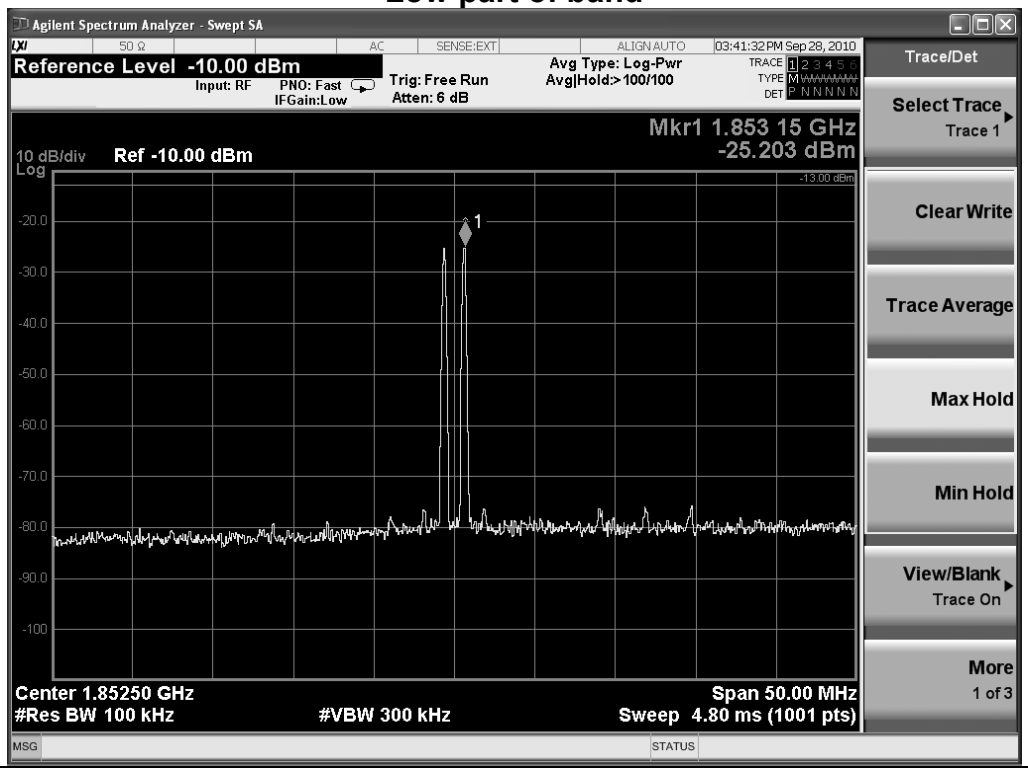


High part of band

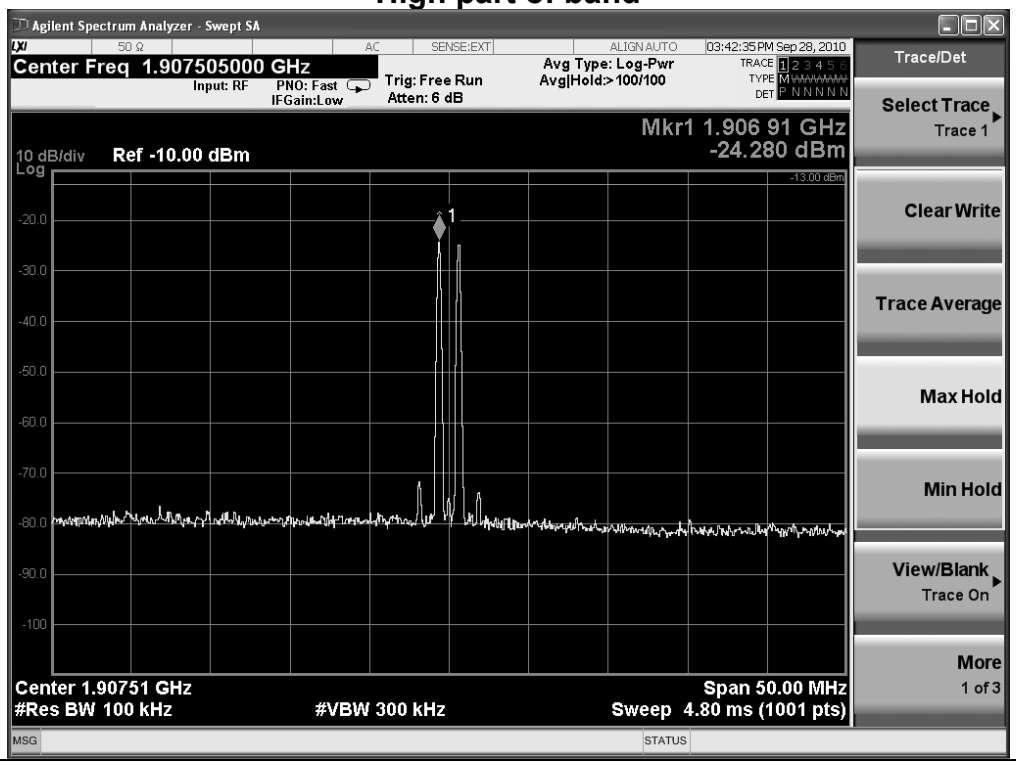


Intermodulation, CDMA 1900_UL

Low part of band



High part of band



5.2.5 Field Strength of Spurious Emissions

RESULT: **Pass**

Date of testing	:	13.Jan.2011
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	FCC Part 2.1053
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.12
Operation mode	:	Transmitting with maximum RF power output

Limits:

Refer to FCC Part 22.917(a) for CDMA 850.
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.

Refer to FCC Part 24.238(a) for CDMA 1900.

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.

The emission must be reduced by 43+10Log(P) dB.

Therefore, the Emission Limit equals:

10Log(P) dBW + 30dB – (43+10Log(P) dB) = – 13 dBm

Measurement procedure:

1. The EUT RF output port was connected to 50 ohm RF load.

2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.

3. The measurement antenna was placed at a distance of 3 meters from the EUT.

4. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from EUT.

5. The frequency range up to 10-th harmonic of each of the three fundamental frequencies (low, middle and high channels) was investigated. The worst case of emissions was reported.

5. For spurious emissions attenuation, the substitution method was used.

6. The EUT was substituted by a reference antenna (half-wave dipole – below 1 GHz, or Horn antenna – above 1 GHz), connected to a signal generator.

7. The signal generator output level was adjusted to obtain the same reading as from EUT. The EIRP at the spurious emissions frequency was calculated as follows:

EIRP(dBm) = Reading (SG) + Cable loss(dB) + G(dBi)

According the limit specified in 27.53(c) and 27.53(g) :

The following method was used to determine the Limit for Spurious Emissions:

Maximum output power in watts: P (W).

The emission must be reduced by 43+10Log(P) dB

Therefore, the Emission Limit equals:
10Log(P) dBW + 30dB – (43+10Log(P) dB) = – 13 dBm

Test Results:

There were no emissions detected above the noise floor, which was at least 20 dB below the specification limit.

Table 14: Transmitter Spurious Radiated Emissions – CDMA 850_UL

Freq. (MHz)	Polarization (V/H)	Reading (SG) (dBm)	Cable loss (dB)	Antenna Gain(dBi)	Transmit power (dBm)	Limit (dBm)
1648	H	-52.65	7.4	5.25	-54.8	-13
2472	H	-62.75	8.7	6.75	-64.7	-13
3296	H	-35.15	10.2	6.95	-38.4	-13
4120	H	-53.95	11.2	8.25	-56.9	-13
4944	H	-62.35	12.5	8.65	-66.2	-13
5768	H	-57.45	14.6	8.25	-63.8	-13
1648	V	-55.15	7.4	5.25	-57.3	-13
2472	V	-63.35	8.7	6.75	-65.3	-13
3296	V	-65.05	10.2	6.95	-68.3	-13
4120	V	-34.35	11.2	8.25	-37.3	-13
4944	V	-40.25	12.5	8.65	-44.1	-13
5768	V	-58.25	14.6	8.25	-64.6	-13
Note: All other emissions not reported are more than 20 dB below the limit.						

Table 15: Transmitter Spurious Radiated Emissions – CDMA 1900_UL

Freq. (MHz)	Polarization (V/H)	Reading (SG) (dBm)	Cable loss (dB)	Antenna Gain(dBi)	Transmit power (dBm)	Limit (dBm)
3700	H	-44.85	10.4	6.95	-48.3	-13
5550	H	-45.95	13.5	8.65	-50.8	-13
7400	H	-61.72	16.3	10.82	-67.2	-13
9250	H	-56.32	19.5	12.02	-63.8	-13
11100	H	-47.51	22.3	13.41	-56.4	-13
12950	H	-40.43	25.1	14.23	-51.3	-13
3700	V	-37.35	10.4	6.95	-40.8	-13
5550	V	-36.15	13.5	8.65	-41.0	-13
7400	V	-61.72	16.3	10.82	-67.2	-13
9250	V	-58.32	19.5	12.02	-65.8	-13
11100	V	-40.31	22.3	13.41	-49.2	-13
12950	V	-37.43	25.1	14.23	-48.3	-13
Note: All other emissions not reported are more than 20 dB below the limit.						

5.2.6 Out-of-Band Rejection

RESULT: **Pass**

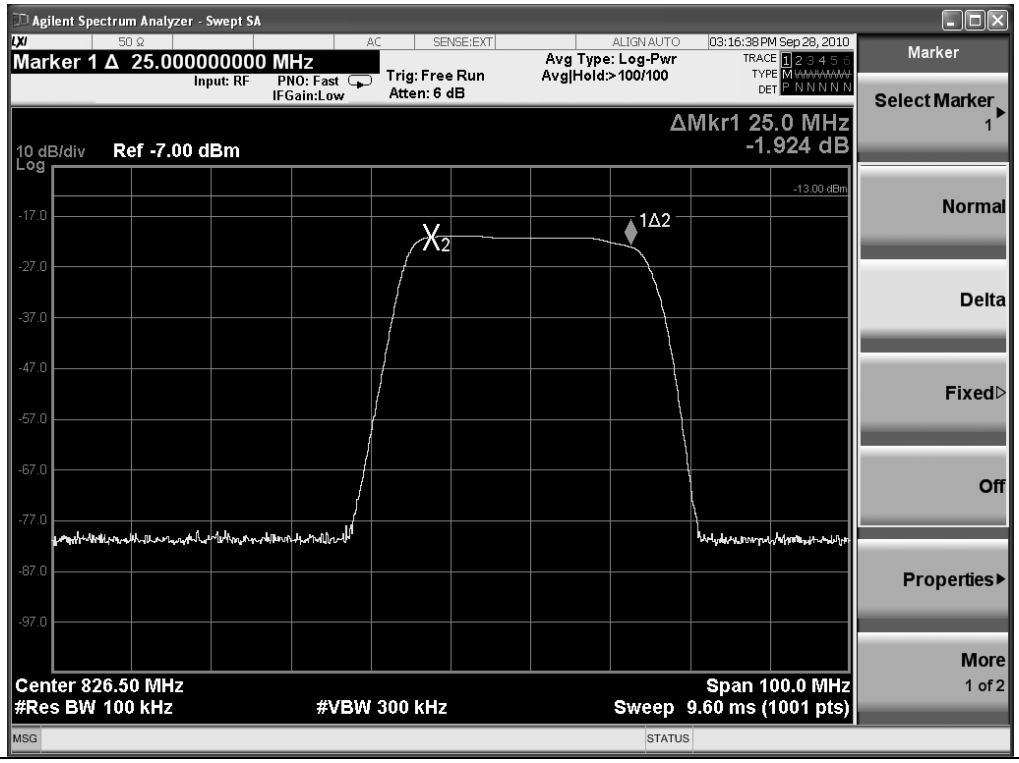
Date of testing	:	28.Sep.2010
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	---
Test method	:	ANSI/TIA-603-C-2004
Operation mode	:	Transmitting with maximum RF power output
Limits	:	N/A

Measurement procedure:

1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. A continuous sinusoidal RF signal shall be fed successively at frequency offsets 100 MHz from the edges of the relevant MS or BTS transmit frequency band into the relevant input port of the repeater.
4. The RF output curve was recorded by spectrum analyzer.

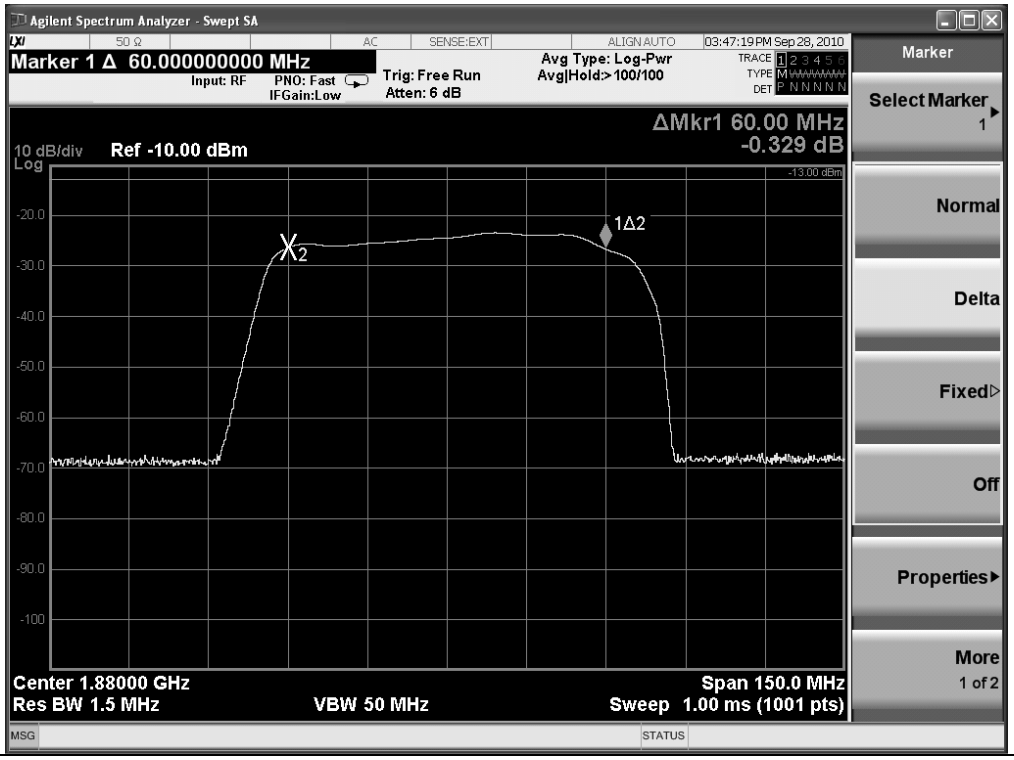
Test Results:

Out-of-Band Rejection, CDMA 850_UL



Test Results:

Out-of-Band Rejection, CDMA 1900_UL



5.2.7 Frequency Stability

RESULT: **Pass**

Date of testing	:	30.Sep.2010
Temperature	:	-30°C to 50°C
Humidity	:	50%
Basic standard	:	FCC Part 2 Per Section 2.1055
Test method	:	ANSI/TIA-603-C-2004, clause 2.2.2
Operation mode	:	Transmitting with maximum RF power output
Limits:		

Refer to FCC part 22.355

For base station, the frequency tolerance shall be within 1.5 ppm.

Refer to FCC part 24.235

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized of operation.

Measurement procedure:

1. The EUT was placed inside the temperature chamber.
2. The RF output port was connected to a spectrum analyzer.
3. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
4. After the temperature stabilized for approximately 20 min, the transmitting frequency was measured by the spectrum analyzer and recorded.
5. At room temperature, the frequency was measured when EUT was powered with the nominal voltage and with 85% and 115% of the nominal voltage.

Table 16: Frequency stability – CDMA 850_UL

Operating frequency : 836.180000 MHz
Channel : Middle
Reference Voltage : 120 VAC

Voltage with nominal Voltage	Power (VAC)	Temp (ºC)	Measured Freq (MHz)	Deviation (ppm)	Limit (ppm)
100%	120	+20(Ref)	836.180002	Ref	1.5
100%		-30	836.179979	- 0.025	
100%		-20	836.179984	- 0.019	
100%		-10	836.179983	- 0.020	
100%		0	836.179991	- 0.010	
100%		+10	836.180090	- 0.012	
100%		+20	836.180002	+ 0.001	
100%		+30	836.180010	+ 0.012	
100%		+40	836.180016	+ 0.019	
100%		+50	836.180018	+ 0.021	
85%	102	+20	836.179979	- 0.038	
115%	138	+20	836.179984	- 0.027	

Table 17: Frequency stability – CDMA 1900_UL

Operating frequency : 1880.000000 MHz
Channel : Middle
Reference Voltage : 120 VAC

Voltage with nominal Voltage	Power (VAC)	Temp (ºC)	Measured Freq (MHz)	Deviation (ppm)	Limit (ppm)
100%	120	+20(Ref)	1880.000001	Ref	1.5
100%		-30	1879.999997	- 0.002	
100%		-20	1879.999998	- 0.002	
100%		-10	1880.000001	- 0.001	
100%		0	1880.000000	0.000	
100%		+10	1880.000001	+ 0.001	
100%		+20	1880.000001	+ 0.001	
100%		+30	1880.000002	+ 0.002	
100%		+40	1880.000002	+ 0.002	
100%		+50	1880.000003	+ 0.002	
85%	102	+20	1880.000003	+ 0.002	
115%	138	+20	1880.000003	+ 0.002	

5.2.8 Error Vector Magnitude (EVM)

RESULT: **No Limit**

Date of testing	:	03.Mar.2011
Temperature	:	22°C
Humidity	:	50%
Basic standard	:	---
Test method	:	ANSI/TIA-603-C-2004
Operation mode	:	Transmitting with maximum RF power output
Limits	:	N/A

Measurement procedure:

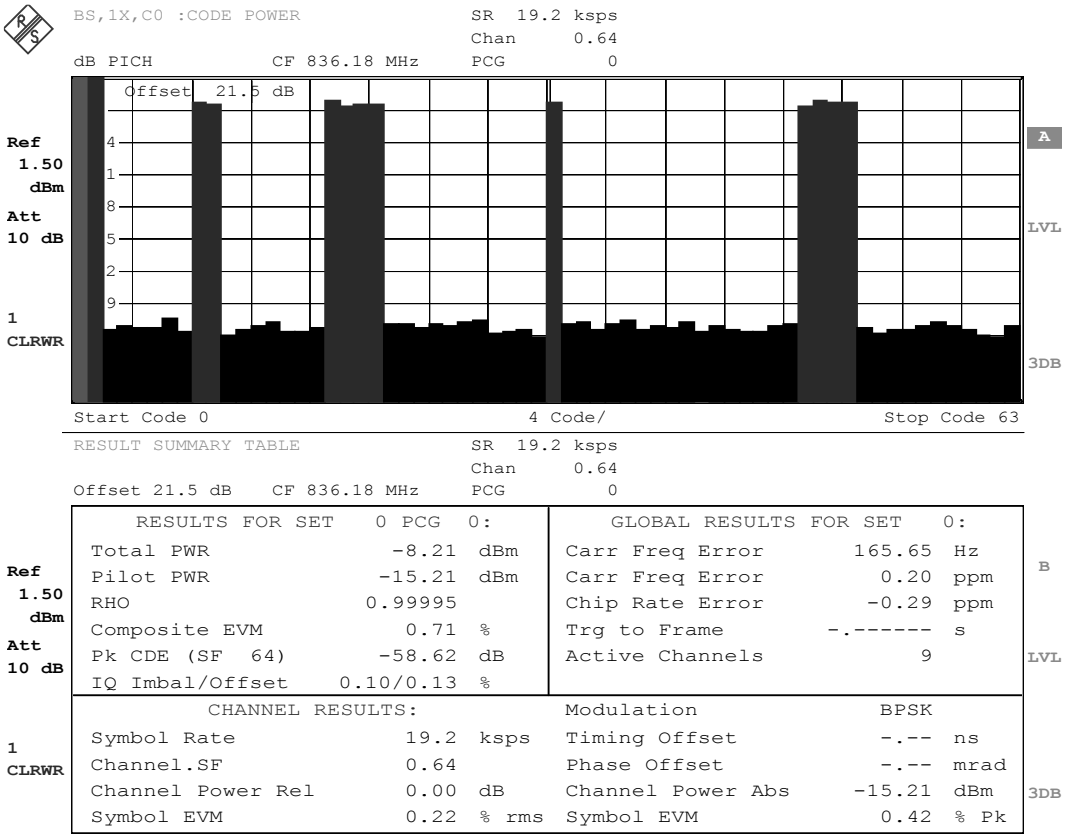
1. The EUT RF output port was connected to spectrum analyzer.
2. The level of RF input signal shall be increased, until the maximum output power per channel, declared by client, is reached.
3. The spectrum analyzer was setup to measure the Error Vector Magnitude (EVM) of output signal.

The EVM was measured at the output port of the EUT at the middle channel of each type of modulation.

Test result:

Table 18: EVM, CDMA 850_UL

Channel	Direction	Freq. (MHz)	EVM Pk (%)	EVM RMS (%)
Middle	UL	836.18	0.42	0.22



Date: 3.MAR.2011 04:59:39

Table 19: EVM, CDMA 1900_UL

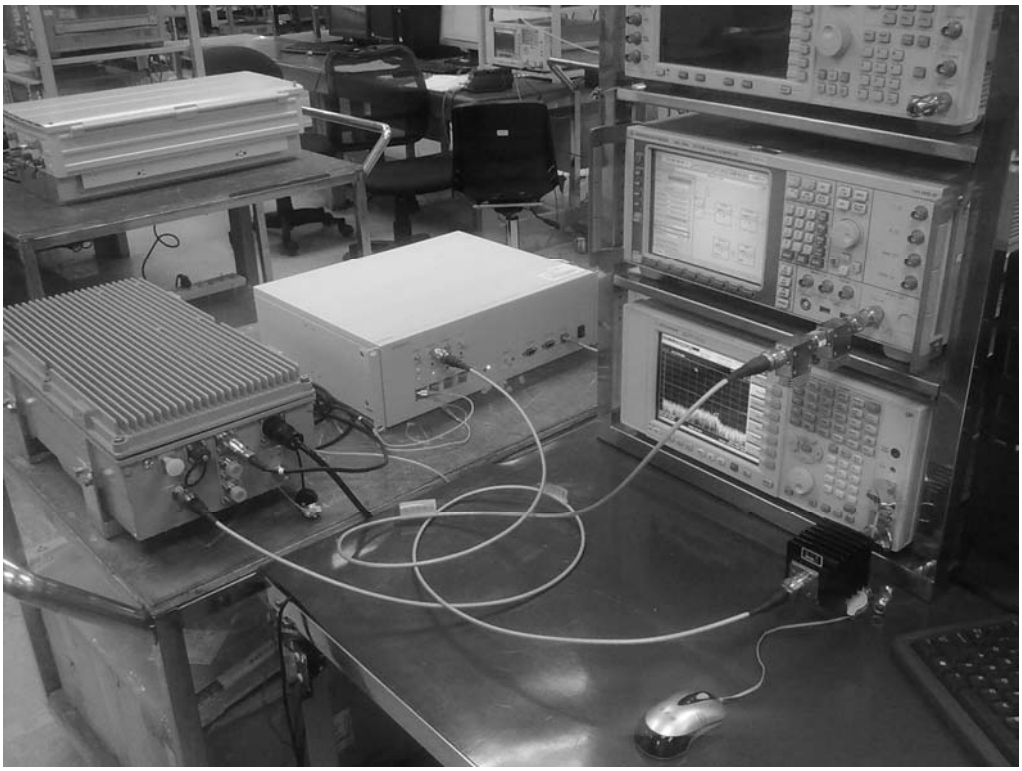
Channel	Direction	Freq. (MHz)	EVM Pk (%)	EVM RMS (%)
Middle	UL	1880.18	0.77	0.42

RESULTS FOR SET 0 PCG 0:			GLOBAL RESULTS FOR SET 0:		
Total PWR	-8.75	dBm	Carr Freq Error	377.19	Hz
Pilot PWR	-15.74	dBm	Carr Freq Error	0.20	ppm
RHO	0.99992		Chip Rate Error	-0.24	ppm
Composite EVM	0.88	%	Trg to Frame	-.------	s
Pk CDE (SF 64)	-57.16	dB	Active Channels	9	
IQ Imbal/Offset	0.07/0.06	%			
CHANNEL RESULTS:			Modulation	BPSK	
Symbol Rate	19.2	ksps	Timing Offset	-.--	ns
Channel.SF	0.64		Phase Offset	-.--	mrad
Channel Power Rel	0.00	dB	Channel Power Abs	-15.74	dBm
Symbol EVM	0.28	% rms	Symbol EVM	0.59	% Pk

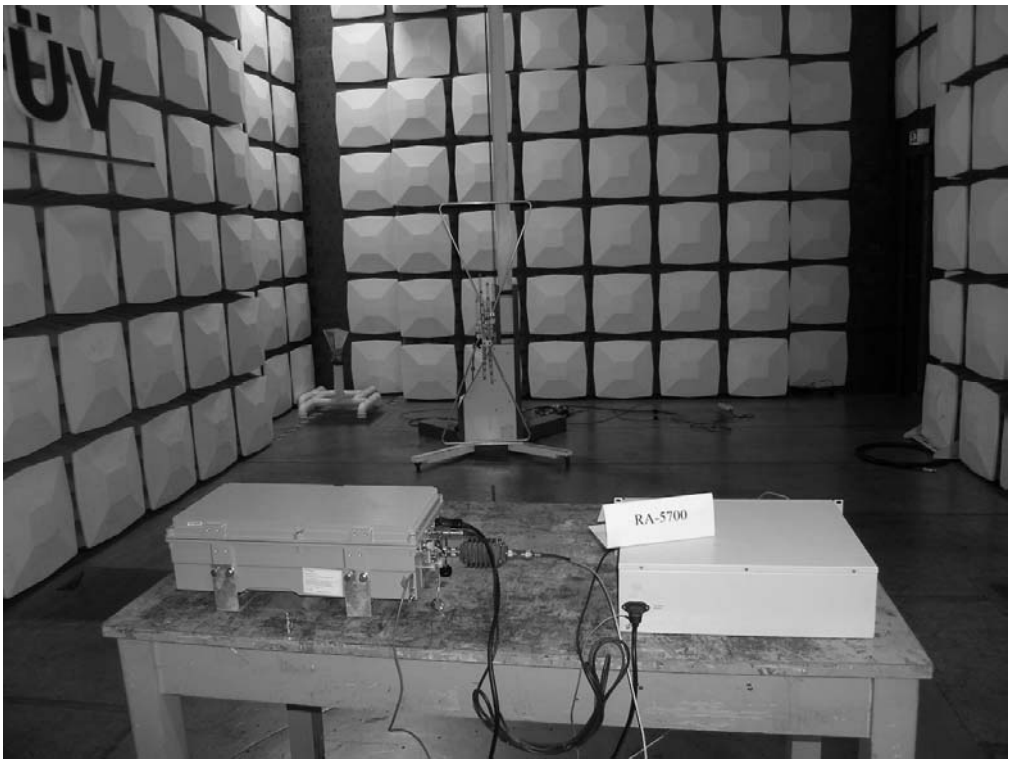
Date: 3.MAR.2011 05:25:21

6 Photographs of the Test Set-Up

Photograph 1: Set-up for RF power, Occupied Bandwidth, Out-of-Band emissions, Intermodulation test, Spurious Emissions at antenna terminal, EVM

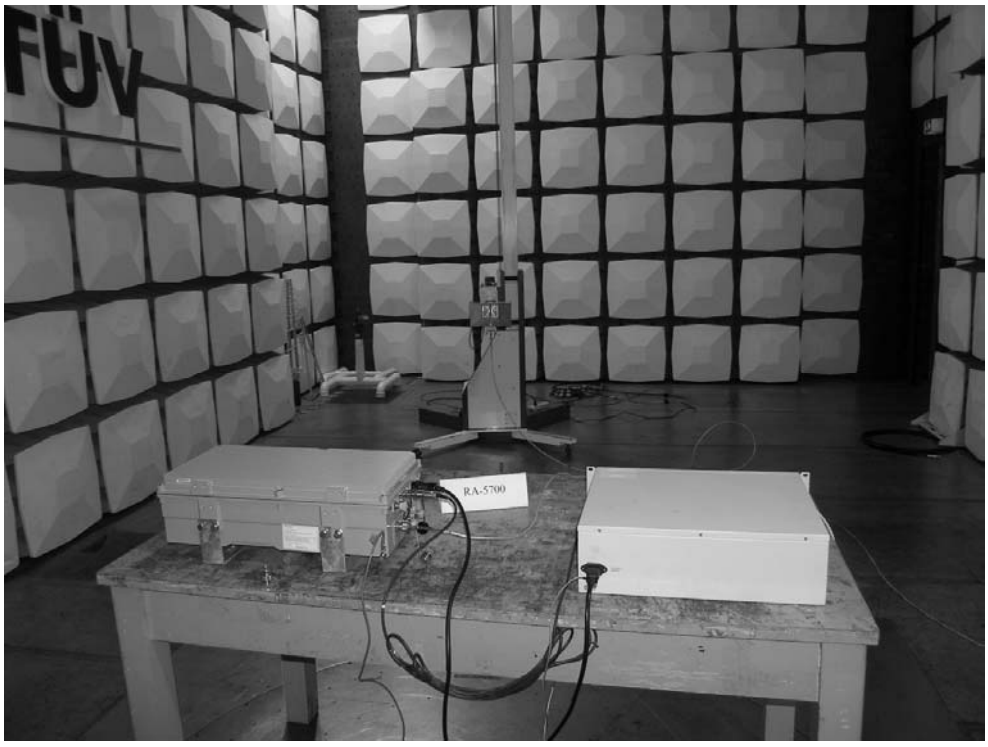


Photograph 2: Set-up for Radiation Measurement Below 1GHz

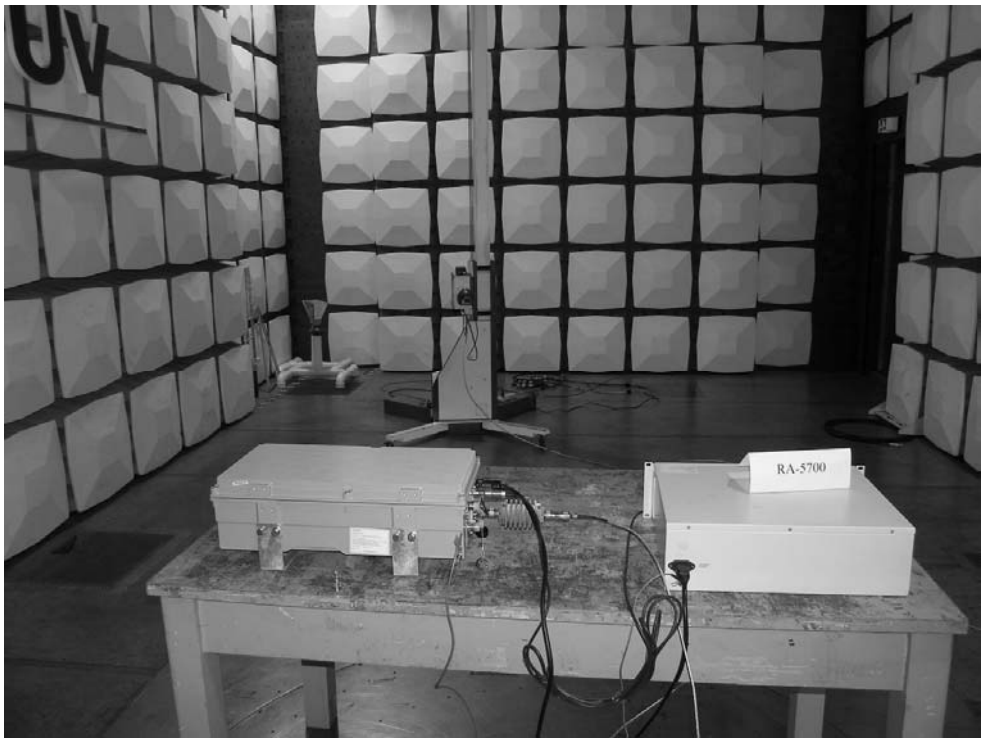


Photograph 3: Set-up for Radiation Measurement above 1GHz

1 GHz to 18 GHz



18 GHz to 20 GHz



7 List of Tables

8 List of Photographs