Lab Code: 200167-0

# FCC PART 27

# TEST AND MEASUREMENT REPORT

For

## Beijing Telestone Technology Co., Ltd.

6F, Saiou Scientific Building, No. 5 Haiying Road,

Fengtai Science Park, Beijing, China, 100070

## FCC ID: U5TWFDS-RUB

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Remote Unit Wireless Network System |

| | |
|---|---|
| **Test Engineer:** | Victor Zhang |
| **Report Number:** | R0908188-27 |
| **Report Date:** | 2009-09-24 |
| **Reviewed By:** | Boni Baniqued<br>Senior RF Engineer |
| **Prepared By: (11)** | Bay Area Compliance Laboratories Corp.<br>1274 Anvilwood Ave<br>Sunnyvale, CA 94089, USA<br>Tel: (408) 732-9162<br>Fax: (408) 732 9164 |

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## DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|---|---|---|---|
| 0 | R0908188-27 | Original Report | 2009-09-24 |

# 1 GENERAL INFORMATION

## 1.1 Product Description for Equipment under Test (EUT)

The *Beijing Telestone Technology Co., Ltd.* FCC ID: U5TWFDS-RUB, Model: WFDS-RUB or the "EUT" as referred to in this report is a Remote Unit (RUB) for Wireless Fiber Distribution System. The RUB is a Single band remote unit with UL 1700 MHz and DL 2100 MHz consists of optical transceiver, RF PCB and power panel. On the down link, the optical signals from Main Unit (MU)/Expansion Unit (EU) are converted to the RF signals and simultaneously the RF signals are amplified; and on the up link, the RF signals received are converted to the optical signals and the optical signals are transmitted to Main Unit (MU)/Expansion Unit (EU).

## 1.2 Mechanical Description

*Model: WFDS-RUB* measures approximately 290 mm **(L)** x 180 mm **(W)** x 58 mm **(H)**, and weighs approximately 1.98 kg.

**The test data gathered are from production sample, serial number: 09080703 provided by the manufacturer.*

## 1.3 EUT Photo


*Please refer to Exhibit C for more EUT photographs.*

## 1.4 Objective

This type approval report is prepared on behalf of Beijing Telestone Technology Co., Ltd. in accordance with Part 2, Subpart J, Part 27, Subpart L, of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for RF output power, modulation characteristic, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation, frequency stability, band edge, and conducted and radiated margin.

## 1.5 Related Submittal(s)/Grant(s)

No Related Submittals

## 1.6 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 27 Subpart L - Miscellaneous Wireless Communications Services

Applicable Standards: IA/EIA603-C, ANSI C63.4-2003.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## 1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values ranging from +2.0 dB for Conducted Emissions tests and +4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

Detailed instrumentation measurement uncertainties can be found in BACL Corp. report QAP-018.

## 1.8 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on FebRUBry 11 and

December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

# 2 SYSTEM TEST CONFIGURATION

## 2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-C.

The final qualification test was performed with the EUT operating at normal mode.

## 2.2 EUT Exercise Software

NA, signal was sent through EUT using a signal generator, device was set to normal operating mode.

## 2.3 Equipment Modifications

No modifications were made to the EUT.

## 2.4 Support Equipment List

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| Beijing Telestone Technology Co., Ltd. | Expansion Unit | WFDS-EU | 09080629 |
| Beijing Telestone Technology Co., Ltd. | Main Unit | WFDS-MU | 09080123 |

## 2.5 Local Support Equipment and Software List and Details

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| Agilent | Signal Generator | E4438C | MY45094317 |
| Agilent | Signal Studio for 3GPP WCDMA | N7600B | - |

## 2.6 Internal Configurations of EUT

RUB:

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| Beijing Telestone Technology Co., Ltd. | RF Board (1) | TS7.820.0410a | FC09-0683 |
| Beijing Telestone Technology Co., Ltd. | Power Board | TS7.820.0415a | - |
| Beijing Telestone Technology Co., Ltd. | RF-Optical Transceiver | CTR8270-12 | 0807023235 |

EU:

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| Beijing Telestone Technology Co., Ltd. | RF Board (1) | TS7.820.0352b | - |
| Beijing Telestone Technology Co., Ltd. | RF Board (2) | TS7.820.0350c | - |
| Beijing Telestone Technology Co., Ltd. | LED Board | TS7.820.0344b | - |
| Beijing Telestone Technology Co., Ltd. | AC/DC Power Supply | RS-25-48 | RA89244260 |
| Beijing Telestone Technology Co., Ltd. | 1in 8 out Splitter | SWBC-1x8-131 | 3080614043 |
| Beijing Telestone Technology Co., Ltd. | RF-Optical Transceiver | CTR8270-12 | 0807023722 |

MU:

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| Beijing Telestone Technology Co., Ltd. | RF Board (1) | TS7.820.0352b | - |
| Beijing Telestone Technology Co., Ltd. | RF Board (2) | TS7.820.0350c | - |
| Beijing Telestone Technology Co., Ltd. | LED Board | TS7.820.0344b | - |
| Beijing Telestone Technology Co., Ltd. | AC/DC Power Supply | RS-25-48 | RA89244258 |
| Beijing Telestone Technology Co., Ltd. | 1in 8 out Splitter | SWBC-1x8-131 | 3080614144 |
| Beijing Telestone Technology Co., Ltd. | RF-Optical Transceiver | CTR8270-12 | 0807013137 |

## 2.7 Interface Ports and Cables

| Cable Description | Length (m) | To | From |
|---|---|---|---|
| Shielded Cable (Fiber Optic) | 1.5 | MU | Expansion Hub |
| Shielded Cable (Fiber Optic) | 1.5 | EU | RUB |
| RF Cable | < 1 | Main Hub/RUB | Spectrum Analyzer |
| RF Cable | < 1 | Main Hub/RUB | Signal Generator |

# 3 SUMMARY OF TEST RESULTS

| FCC Rules | Description of Tests | Results |
|---|---|---|
| § 2.1046, § 27.50 (i) | RF Output Power | Compliant |
| § 2.1047 | Modulation Characteristics | N/A |
| § 2.1049 (h),§ 27.53 (c) | Occupied Bandwidth | Compliant |
| § 2.1053, § 27.53 (c) | Spurious Radiated Emissions | Compliant |
| § 2.1051, § 27.53 (c) | Spurious Emissions at Antenna Terminals | Compliant |
| § 27.53 (c) | Band Edge | Compliant |
| § 27.54 | Frequency Stability | NA |
| §27.52, §2.1091 | RF Exposure | Compliant |

# 4 FCC §2.1046 & §27.50 – RF OUTPUT POWER

## 4.1 Applicable Standard

According to §27.50, the maximum effective radiated power (ERP) of fixed and base station must not exceed 1000 Watts.

## 4.2 Test Procedure

*Conducted:*

The RF output of the transmitter was connected to the signal generator and the spectrum analyzer through sufficient attenuation.

## 4.3 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21-24°C |
| **Relative Humidity:** | 40-43 % |
| **ATM Pressure:** | 101-103 kPa |

** The testing was performed by Victor Zhang on from 2009-09-08 to 2009-09-18 in RF Site.*

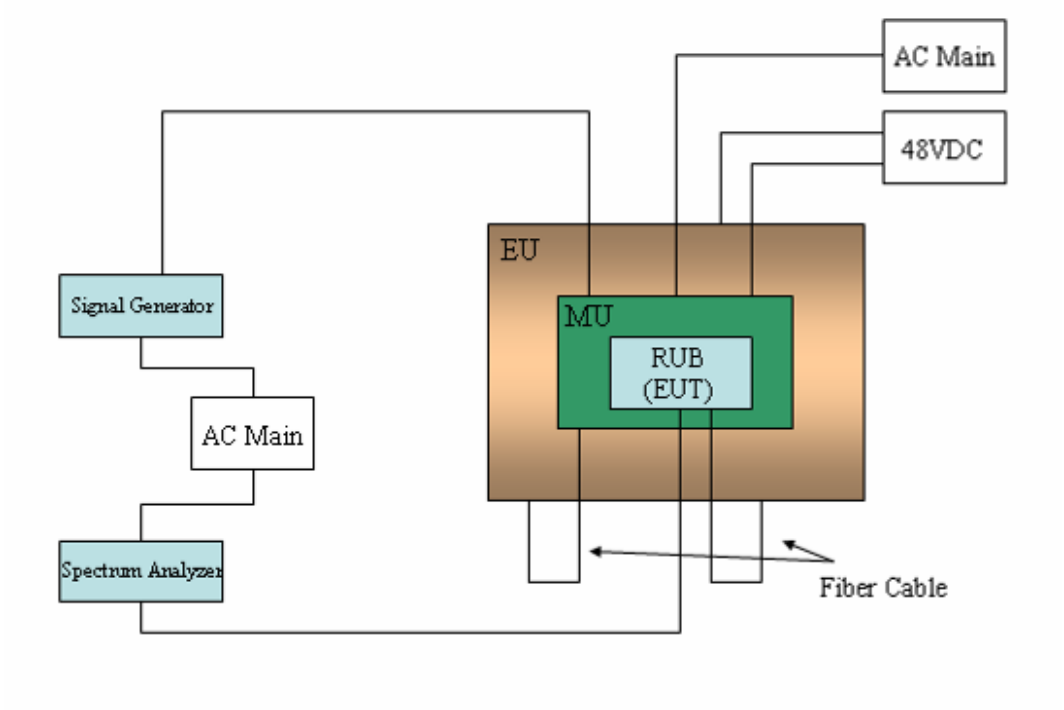
## 4.4 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4440A | MY44303352 | 2009-04-27 |
| Agilent | Signal Generator | E4438C | MY45094317 | 2009-09-01 |

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## 4.5 Test Setup Block Diagram

Bench Testing:



## 4.6 Summary of Test Results

**Maximum Output Power**

WCDMA, Rel 99:

| Channel | Frequency (MHz) | Output Power (dBm) |
|---|---|---|
| Low | 2112.4 | 22.77 |
| Middle | 2132.4 | 22.86 |
| High | 2152.6 | 21.62 |

HSUPA:

| Channel | Frequency (MHz) | Output Power (dBm) | | | | |
|---|---|---|---|---|---|---|
| | | Subtest 1 | Subtest 2 | Subtest 3 | Subtest 4 | Subtest 5 |
| Low | 2112.4 | 22.63 | 22.74 | 22.77 | 22.68 | 22.52 |
| Middle | 2132.4 | 22.58 | 22.82 | 22.69 | 22.61 | 22.43 |
| High | 2152.6 | 21.55 | 21.56 | 21.23 | 21.45 | 21.40 |

HSDPA:

| Channel | Frequency (MHz) | Output Power (dBm) | | | | |
|---|---|---|---|---|---|---|
| | | Subtest 1 | Subtest 2 | Subtest 3 | Subtest 4 | Subtest 5 |
| Low | 2112.4 | 22.67 | 22.64 | 22.80 | 22.79 | 22.74 |
| Middle | 2132.4 | 22.58 | 22.73 | 22.76 | 22.84 | 22.81 |
| High | 2152.6 | 21.49 | 21.48 | 21.61 | 21.55 | 21.58 |

# 5 FCC §2.1047 - MODULATION CHARACTERISTIC

## 5.1 Applicable Standard

According to FCC § 2.1047(d) and part 25, there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

## 5.2 Test Result

N/A

# 6 FCC §2.1049 & §27.53 - OCCUPIED BANDWIDTH

## 6.1 Applicable Standard

Requirements: CFR 47, Section 2.1049 and Section 27.53.

## 6.2 Test Procedure

The RF output of the transmitter was connected to the simulator and the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 100 kHz and the 26 dB & 99% bandwidth was recorded.

## 6.3 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21-24°C |
| **Relative Humidity:** | 40-43 % |
| **ATM Pressure:** | 101-103 kPa |

** The testing was performed by Victor Zhang on from 2009-09-08 to 2009-09-18 in RF Site.*

## 6.4 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4440A | MY44303352 | 2009-04-27 |
| Agilent | Signal Generator | E4438C | MY45094317 | 2009-09-01 |

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

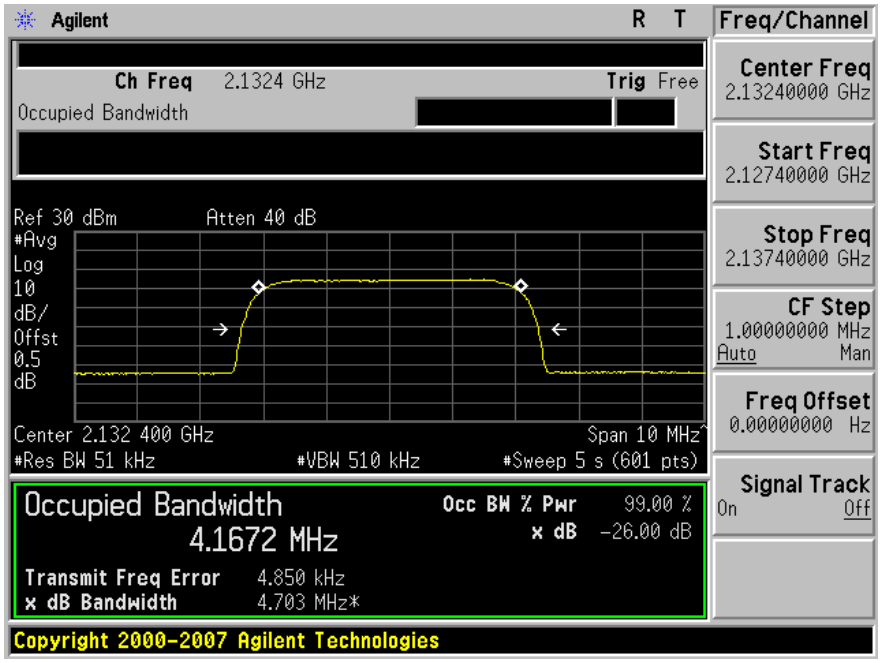
## 6.5 Summary of Test Results

Occupied Bandwidth – WCDMA Rel 99

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) | 26 dB Bandwidth (MHz) |
|---|---|---|---|
| Middle | 2132.4 | 4.1672 | 4.703 |

Please refer to the following plot for details.

Occupied Bandwidth



# 7 FCC §2.1053 & §27.53 - SPURIOUS RADIATED EMISSIONS

## 7.1 Applicable Standard

Requirements: CFR 47, § 2.1053, § 27.53.

## 7.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. 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 the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.
Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 log (TX Power in Watts/0.001) – the absolute level
Spurious attenuation limit in dB = 43 + 10 $Log_{10}$ (power out in Watts)

## 7.3 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21-24 °C |
| **Relative Humidity:** | 42-44 % |
| **ATM Pressure:** | 101-103 kPa |

** The testing was performed by Victor Zhang from 2009-09-14 to 2009-09-16 in 5 Meter Chamber #3.*

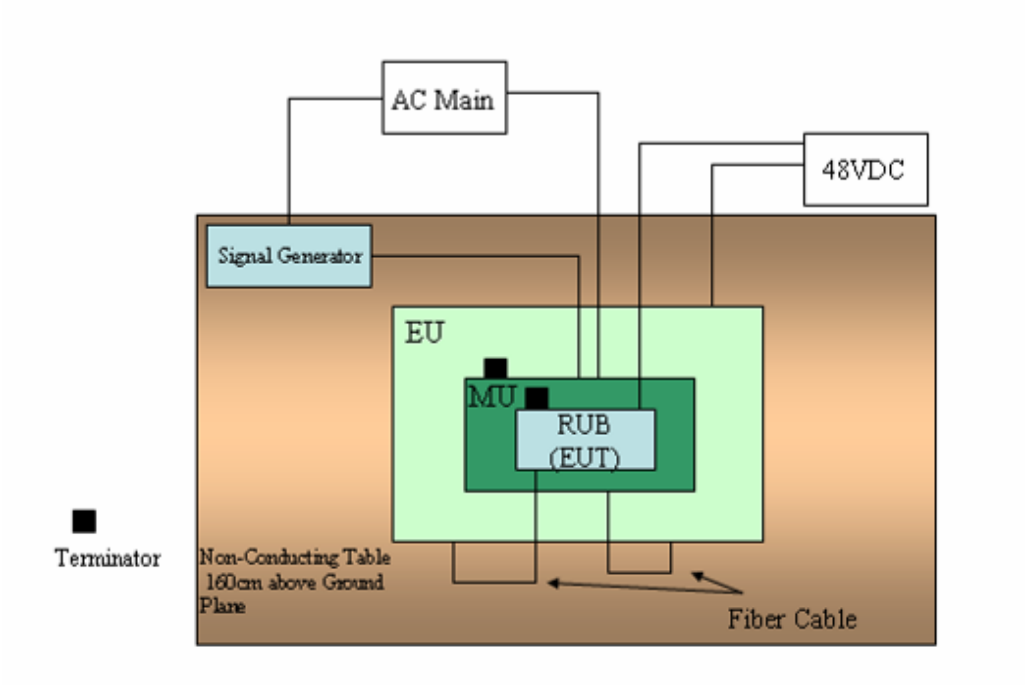
## 7.4 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4440A | US45303156 | 2009-07-23 |
| Sunol Sciences | Antenna | JB1 | A020106-1 | 2009-04-17 |
| A.R.A | Horn Antenna | DRG-118/A | 1132 | 2009-07-28 |
| Agilent | Signal Generator | E4438C | MY45094317 | 2009-09-01 |
| Ducommun | Amplifier | ALN-09173030-01 | 988251-03R | 2009-03-04 |
| HP | Pre-Amplifier | 8447D | 2944A06639 | 2009-06-05 |

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## 7.5 Test Setup Block Diagram

Radiated Emission



## 7.6 Summary of Test Results

The worst case reading as follows:

| Mode: WCDMA Rel 99, Frequency: 2132.4 MHz | | | |
|---|---|---|---|
| **Margin (dB)** | **Frequency (MHz)** | **Polarization (Horizontal/Vertical)** | **Frequency Range** |
| -27.84 | 4264.8 | Horizontal | 30 MHz – 25 GHz |

## 7.7 Test Results

Modulation: WCDMA Rel 99, Frequency: 2132.4 MHz

| **Indicated** | | **Azimuth (degree)** | **Test Antenna** | | **Substituted** | | | | | **Limit (dBm)** | **Margin (dB)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Frequency (MHz)** | **S.A. Amp. (dBuV)** | | **Height (m)** | **Polarity (H/V)** | **Frequency (MHz)** | **Level (dBm)** | **Ant. Gain Cord. (dB)** | **Cable Loss (dB)** | **Absolute Level (dBm)** | | |
| 4264.80 | 54.82 | 197 | 1.31 | V | 4264.80 | -51.12 | 10.90 | 0.62 | -40.84 | -13.00 | -27.84 |
| 4264.80 | 46.87 | 158 | 1.18 | H | 4264.80 | -59.07 | 10.90 | 0.62 | -48.79 | -13.00 | -35.79 |
| 6397.20 | 40.85 | 180 | 1.00 | V | 6397.20 | -61.45 | 11.50 | 0.80 | -50.75 | -13.00 | -37.75 |
| 6397.20 | 39.77 | 180 | 1.00 | H | 6397.20 | -62.53 | 11.50 | 0.80 | -51.83 | -13.00 | -38.83 |
| 881.000 | 49.59 | 161 | 1.35 | V | 881.000 | -62.43 | 0.00 | 0.23 | -62.66 | -13.00 | -49.66 |
| 881.000 | 46.56 | 232 | 1.51 | H | 881.000 | -65.46 | 0.00 | 0.23 | -65.69 | -13.00 | -52.69 |

# 8 FCC §2.1051 & §22.917 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

## 8.1 Applicable Standard

Requirements: CFR 47, § 2.1051. § 27.53.

The spectrum shall be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1057.

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

## 8.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10$^{th}$ harmonic.

## 8.3 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21-24°C |
| **Relative Humidity:** | 40-43 % |
| **ATM Pressure:** | 101-103 kPa |

** The testing was performed by Victor Zhang on from 2009-09-08 to 2009-09-18 in RF Site.*

## 8.4 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4440A | MY44303352 | 2009-04-27 |
| Agilent | Signal Generator | E4438C | MY45094317 | 2009-09-01 |

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

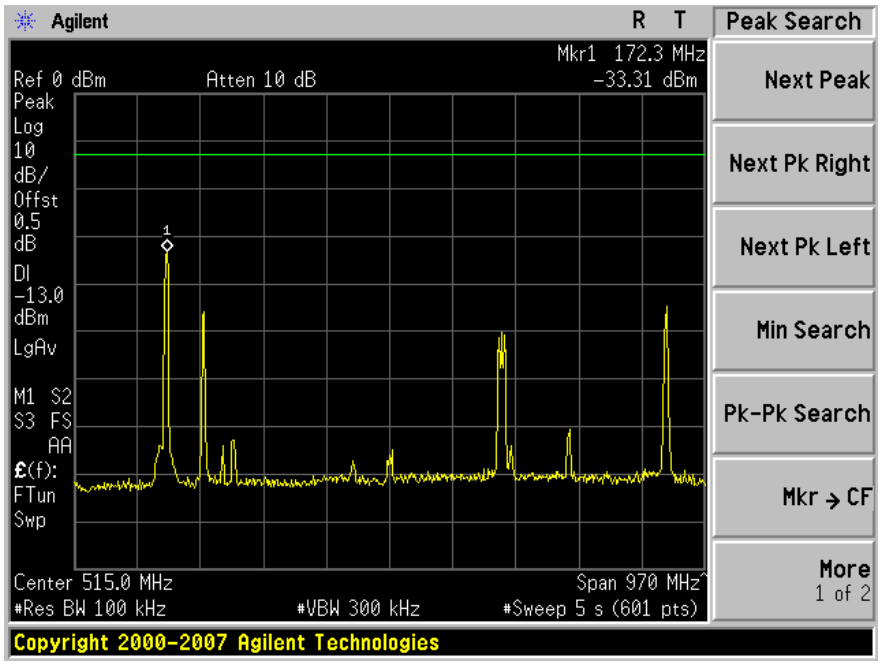
## 8.5 Test Results

Please refer to the following plots.

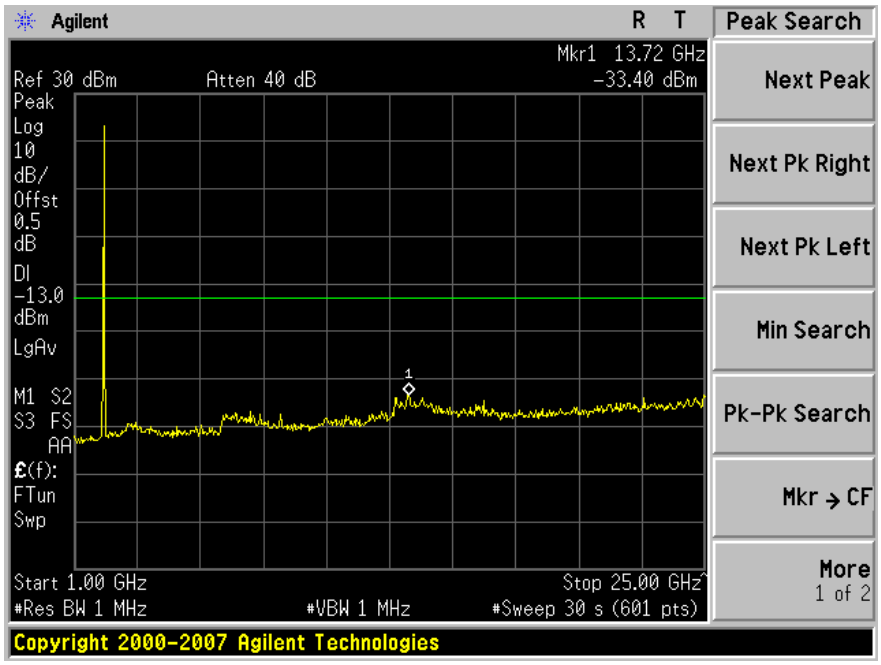
Worst Case: WCDMA Rel 99

Modulation: WCDMA Middle Channel

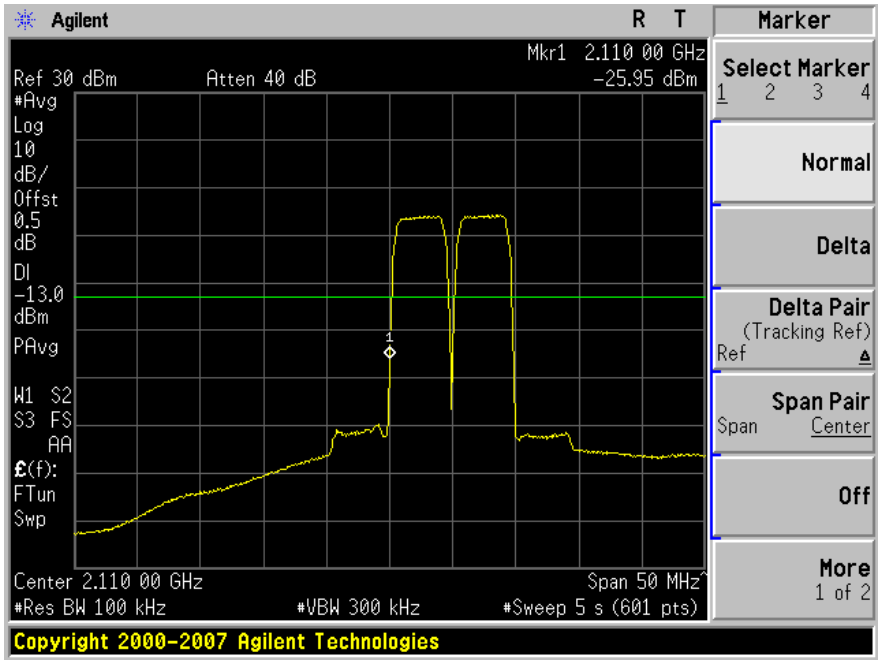
Plot 1: 30 MHz to 1 GHz



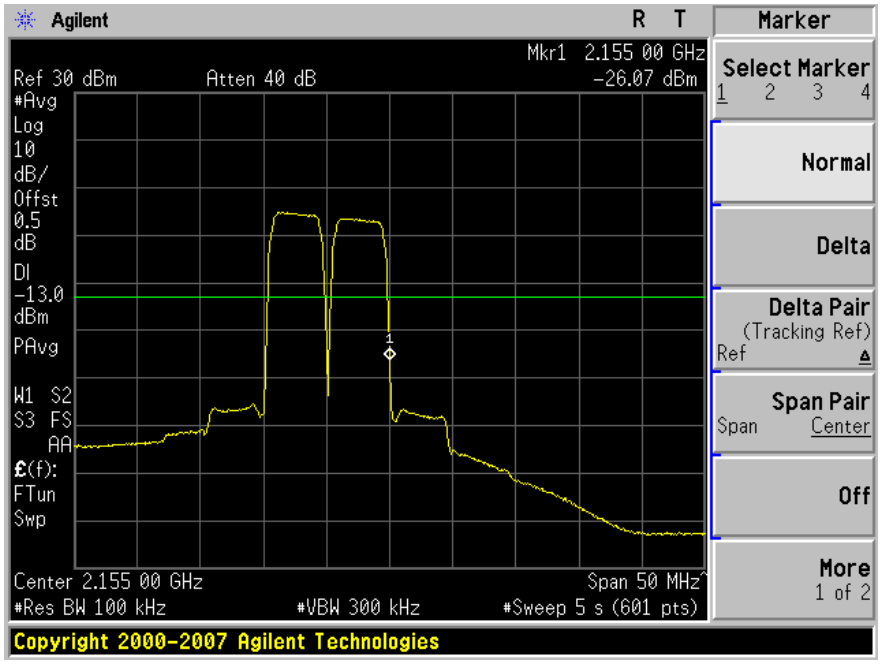

Plot 2: Above 1 GHz



Inter-Modulation: Lowest Channel:




Inter-Modulation: Highest Channel:



# 9 FCC §27.53 – BAND EDGE

## 9.1 Applicable Standard

According to § 27.53, the power of any emissions 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.

## 9.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The center of the spectrum analyzer was set to block edge frequency.

## 9.3 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 21-24°C |
| **Relative Humidity:** | 40-43 % |
| **ATM Pressure:** | 101-103 kPa |

** The testing was performed by Victor Zhang on from 2009-09-08 to 2009-09-18 in RF Site.*

## 9.4 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4440A | MY44303352 | 2009-04-27 |
| Agilent | Signal Generator | E4438C | MY45094317 | 2009-09-01 |

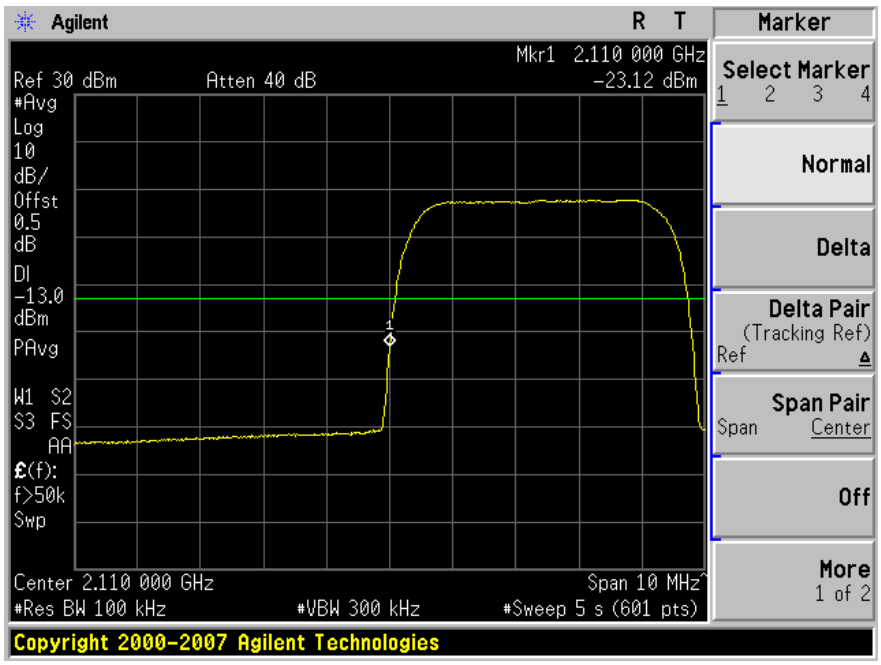
*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## 9.5 Test Results

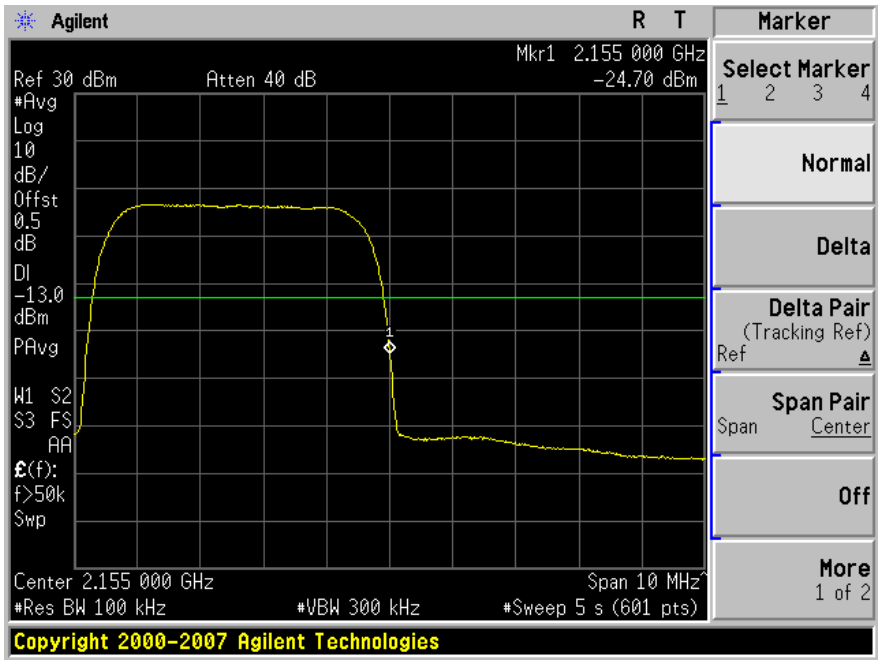
Please refer to the following plots.

Worst Case: WCDMA Rel 99

Plot 1: Lowest Edge




Plot 2: Highest Edge



# 10 FCC §2.1055 & §27.54 – Frequency Stability

## 10.1 Applicable Standard

According to § 27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

## 10.2 Test Result

N/A

# 11 FCC §1.1307(b), §27.52 & §2.1091 - RF EXPOSURE

## 11.1 Applicable Standard

According to §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density ($mW/cm^2$) | Averaging Time (minute) |
|---|---|---|---|---|
| **Limits for General Population/Uncontrolled Exposure** | | | | |
| 0.3-1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34-30 | 824/f | 2.19/f | *($180/f^2$) | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | / | / | f/1500 | 30 |
| 1500-100,000 | / | / | 1.0 | 30 |

f = frequency in MHz
* = Plane-wave equivalent power density

## 11.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

| | |
|---|---|
| Maximum peak output power at antenna input terminal (dBm): | 22.86 |
| Maximum peak output power at antenna input terminal (mW): | 193.20 |
| Prediction distance (cm): | 30 |
| Prediction frequency (MHz): | 2132.4 |
| Antenna Gain, typical (dBi): | 5.0 |
| Maximum Antenna Gain (numeric): | 3.16 |
| Power density at predication frequency and distance ($mW/cm^2$): | 0.05398 |
| MPE limit for uncontrolled exposure at predication frequency ($mW/cm^2$): | 1.0 |

**Test Result**

The highest power density level at 30 cm is 0.05398 $mW/cm^2$, which is below the uncontrolled exposure limit of 1 $mW/cm^2$ at 2132.4 MHz.

*This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 30cm between the radiation and your body.*