Licensed Non-Broadcasting Transceiver

RF MEASUREMENT REPORT

VERIFICATION OF COMPLIANCE

PRODUCT	:	**RF Repeater System**
MODEL/TYPE NO	:	**SHHR05-U1**
FCC ID	:	**R31SHHR05-U1**
TRADE NAME	:	**Seohwa Telecom Co., Ltd.**
APPLICANT	:	**Seohwa Telecom Co., Ltd.**
FCC RULE PART(S)	:	**FCC Part 24 & Part 2**
FCC PROCEDURE	:	**Certification**
FCC CLASSIFICATION	:	**PCS Licensed Transmitter(PCB)**
EMISSION DESIGNATOR	:	**F9W(CDMA), DXW(NADC), GXW(GSM)**
FREQUENCY RANGE	:	**1850 MHz ~ 1910 MHz (Up Link), 1930 MHz ~ 1990 MHz (Down Link)**
RF OUTPUT POWER	:	**10 mW (Up Link), 5 mW (Down Link)**
DATES OF TEST	:	**March 7, 2005**
DATES OF ISSUE	:	**February 21, 2005**
TEST REPORT No.	:	**BWS-05-RF-002**
TEST LAB.		**BWS Tech., Inc. (Registration No. : 553281)**

This RF Repeater Model SHHR05-U1 has been tested in accordance with the measurement procedures specified CFR 47 Part 2.947 and ANSI C63.4-2000 at the BWS TECH/RF Test Laboratory and has been shown to be complied with the FCC Technical Specification described above.
I attest to the accuracy of data. All measurement herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

TaeHyun Nam
Chief of Laboratory Division
BWS TECH Inc.

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This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the BWS TECH,Inc.

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RF TEST REPORT

Scope – *Measurement and determination of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of relevant international standard*

1. General Information

Applicant Information

Company Name	:	Seohwa Telecom Co., Ltd.
Company Address	:	678, Gasan-dong, Gumcheon-gu, Seoul,Korea
Phone/Fax	:	Phone : 82-2-838-5511 Fax : 82-2-838-5313

Other Information

● **EUT Type**	:	RF Repeater System
● **Model Name**	:	SHHR05-U1
● **FCC Identifier**	:	R31SHHR05-U1
● **Brand Name**	:	Seohwa Telecom Co., Ltd.
● **S/N**	:	ProtoType
● **Freq. Range**	:	1850 MHz ~ 1910 MHz (Up Link) 1930 MHz ~ 1990 MHz (Down Link)
● **Max. Power Output**	:	10 mW (Up Link) 5 mW (Down Link)
● **Emission Designator**	:	F9W(CDMA), DXW(NADC), GXW(GSM)
● **FCC Classfication**	:	PCS Licensed Transmitter(PCB)
● **Rule Part(s)**	:	FCC Part 24 & Part 2
● **Test Procedure**	:	Certification
● **Dates of Tests**	:	March 7, 2005
● **Place of Tests**	:	BWS TECH Inc. 294-9, Jungdae-Dong, Kwangju-Si, Kyunggi-Do 464-080, Korea EMC Testing Laboratory (FCC Registration Number : 553281) TEL: +82 31 762 0124 FAX: +82 31 762 0126
● **Test Report No.**	:	BWS-05-RF-002

2. DESCRIPTION OF ATTACHMENTS

Appendix 1. FCC ID Label and Location
-. Sample FCC ID Label and location information is shown

Appendix 2. Test Setup Photos
-. Radiated Emission Test setup photos are shown

Appendix 3. External Photos
-. External photos are shown

Appendix 4. Internal Photos
-. Internal photos are shown

Appendix 5. Block Diagram
-. The block diagram is shown

Appendix 6. Schematics
-. The circuit diagrams are shown

Appendix 7. Layout
-. The layouts are shown.

Appendix 8. Part List
-. The part lists are shown.

Appendix 9. User Manual
-. The alignment procedure are shown.

Appendix 10. RF Exposure statement
-. The user operating manual is shown.

3. INTRODUCTION

The measurement tests were conducted at the open area test site of BWS TECH Inc. facility located at 294-9, Jungdae-Dong, Kwangju-Si, Kyunggi-Do, Korea. The measurement facilities were constructed in conformance with the requirements of the ANSI C63.4-2000 and CISPR Publication 16. The BWS has site descriptions on file with the FCC for 3 and 10 meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-2000 and registered to the Federal Communications Commission(Registration Number : 553281).

All measurements contained in this application were conducted in accordance with FCC Rules and regulations CFR 47and American National Standard Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2000).

Measurement Procedure

The radiated and spurious measurements were made outdoors at a 3-meter test range (see Figure2).
The equipment under testing was placed on a wooden turntable, 3-meters from the receive antenna. The receive antenna height and turntable rotations was adjusted for the highest reading on the receive spectrum analyzer. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. This level was recorded.
For readings above 1 GHZ, the above procedure would be repeated using horn antennas and the difference between the gain of the horn and an isotropic antenna are taken into consideration.

4. PRODUCT INFORMATION

4.1 Equipment Description

This product is designed to cover blank spots of small offices, hotel rooms, small parking lots, garages or small buildings. It helps to improve PCS communications signal and coverage by extending the coverage of a base station.

Outdoor antenna receives signal from a PCS base station, then HR1900P repeater amplifies the signal. After amplification, the signal is passed through to the indoor antennas. Conversely, signals from handsets are amplified and retransmitted to the base station.

4.2 Technical Specification

General System Electrical Specification

Characteristic	Specification
Frequency	Up Link : 1850 ~ 1910 MHz Down Link : 1930 ~ 1990 MHz
Characteristic Impedance	50 ohm

Up / Down Link Specification

Gain	50dB ±2dB/Fc
Maximum Output Power	+10dBm /11FA (Up Link) +7dBm /11FA (Down Link)
VSWR	≤ 1.7 : 1.0
Noise Figure	≤ 7dB
Operating Temperature	-20℃ ~ +50℃

Mechanical Specification

Input Connector	SMA -Type (Female)
Power	7 Vdc
Dimensions(W*H*D)	68 mm x 100 mm x 37 mm
Weight	≤ 460 g

4.3 Variations covered by this report

Model Difference : N/A

Technical Deviation : N/A

4.4 Additional information related to Testing

☑ **Note.**

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☑ **Note.**

Please refer to the duties and responsibilities of the Responsible Party attached.

5. DESCRIPTION OF TESTS

5.1 Power Line Conducted Emission Measurement §15.207

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2000. The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50Ω/50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 10KHz or for "quasi-peak" within a bandwidth of 9KHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1m x 1.5m x 0.8m wooden table, which is placed 40cm away from the vertical wall, and 1.5m away from the sidewall of the chamber room. Two LISNs are bonded to the shielded room. The EUT is powered from the PMM LISN and the support equipment is powered from the LISN. Power to the LISNs is filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling (serpentine fashion) to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the Spectrum Analyzer to determine the frequency producing the max. Emission from the EUT. The frequency producing the max. Level was reexamined using the detector function set to the CISPR Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.45 to 30MHz. The bandwidth of the Spectrum Analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by switching power lines, varying the mode of operation or resolution, clock or data exchange speed, if applicable, whichever determined the worst-case emission. Each emission reported was calibrated using self-calibrating mode.

Photographs of the worst-case emission can be seen in photographs of conducted emission test setup.

5.2 Radiated Emission Measurement §15.207

Preliminary measurements were made at indoors 3-meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the emission frequencies producing the maximum EME.

Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configurations, mode of operation, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using bi-log antenna and above 1000MHz, linearly polarized double ridge horn antennas were used. Above 1GHz, linearly polarized double ridge horn antennas were used. The measurements were performed with three frequencies, which were selected as bottom, middle, and top frequency in the operating band. Emission level from the EUT with various configurations was examined on the spectrum analyzer connected with the RF amplifier and plotted graphically.

Final measurements were made outdoors open site at 3-meter test range using biconical and log periodic, Horn antenna. The output from the antenna was connected, via a preselector or a preamplifier, to the input of the EMI Measuring Receiver and Spectrum analyzer (for above 25GHz). The detector function was set to the quasi-peak or peak mode as appropriate. The measurement bandwidth on the Field strength receiver was set to at least 120kHz (1MHz for measurement above 1GHz), with all post-detector filtering no less than 10 times the measurement bandwidth. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during preliminary measurement was examined and investigated as the same set up and configuration which produced the maximum emission The EUT, support equipment and interconnecting cables were configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1m x 1.5 meter table. The turntable containing the system was rotated and the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission.

Varying the mode of operating frequencies of the EUT maximized each emission. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst-case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor (20dB/decade) as per section 15.31(f).

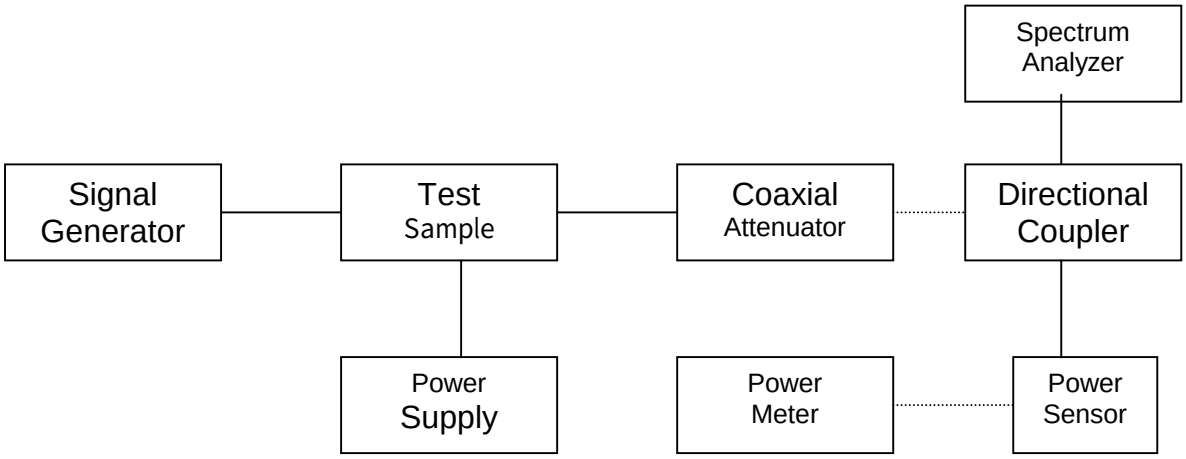
Photographs of the worst-case emission test setup can be seen in Appendix A.

5.3 RF Power Output - Conducted Power Output - §2.1046

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.1

The EUT was connected to a resistive coaxial attenuator having a 50 ohm load impedance, and the unmodulated RF output power(carrier) was measured by means of an R. F. Spectrum Analyzer.

The EUT was aligned for transmitter operation on three frequencies(Fo) at full rated power per the tune-up procedure outlined in the Product Specification. This represents frequencies at the low, middle and high end of the EUT operating frequency band.



5.4 RF Power Output – ERP Measurement by Substitution Method - §2.1046

The EUT was setup at an antenna to EUT distance of 3 meters on an open area test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane.
The physical arrangement of the EUT and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels.
Measurements were taken using both horizontal and vertical antenna polarizations. The worst-case, maximum radiated emission was recorded and used as reference for the ERP measurement. The EUT was then replaced by an ½ wave dipole antenna and polarized in accordance with the EUT's antenna polarization. The ½ wave dipole antenna was connected to a RF signal generator with a coaxial cable.
The search antenna height, and search antenna polarity was set to levels that produced the maximum reading obtained above. The signal generator was adjusted to a level that produced the radiated emission level obtained in the above.
The signal generator level was recorded and corrected by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal ½ wave dipole antenna. The signal generator corrected level is the ERP level

5.5 Transmitter Audio Frequency Response - §2.1047(a)

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.6

The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic. The frequency response of the audio modulating circuit over the frequency range 100 – 5000 Hz is measured. The audio signal generator is connected to the audio input circuit/microphone of the EUT. The audio signal input is adjusted to obtain 20% modulation at 1kHz and this point is taken as the 0dB reference level. With the input held constant and below the limit at all frequencies, the audio signal generator is varied from 100 Hz to 50 kHz. The deviation in kHz was recorded using a modulation analyzer. The response in dB relative to 1 kHz was calculated as follows:

Audio Frequency Response = 20 LOG (DEV_{freq}/DEV_{ref})

5.6 Audio Low Pass Filter Frequency Response - §2.1047(a)

Test Procedure : ANSI/TIA/EIA-603-1992, Section 2.2.15

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz. The response in dB relative to 1kHz is measured using the HP8901 Modulation Analyzer. For the frequency response of the audio low-pass filter, The EUT and test equipment were set up such that the audio input is connected at the input to the modulation limiter and the modulated stage. The audio output is connected at the output of the modulated stage.

5.7 Modulation Limiting - §2.1047(b)

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.3

The audio signal generator is connected to the audio input circuit/microphone of the EUT.

The transmitter is adjusted its full rating. The modulation response is measured for each of the three modulating frequencies, one of them is the frequency of maximum response(300Hz, 1000 Hz, and 3000Hz), and the input signal voltage is varied from 30% modulation to at least 20dB higher than the saturation point. The system maximum deviation was recorded at each test condition.

Measurements of modulation and test plots are attached. Measurements were performed for both negative and positive modulation and respective results were recorded.

5.8 Occupied Bandwidth : §2.1049

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.

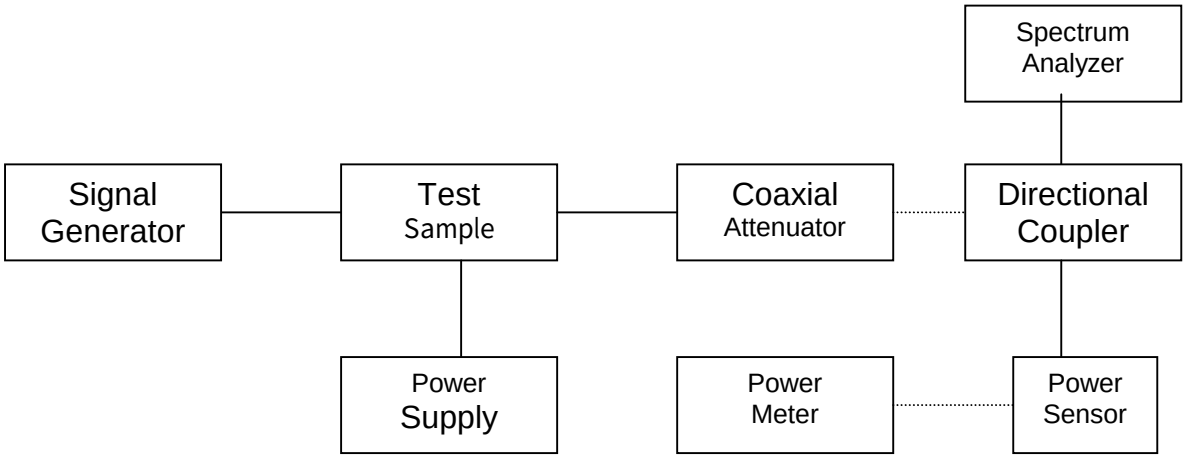
The antenna output terminal of the EUT was connected to the input of a 50ohm spectrum analyzer through a matched 30dB attenuator. The radio transmitter was modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit. The occupied bandwidth data is obtained for 25kHz and 12.5 kHz channel bandwidth. The results are shown on the attached graphs.
.

Specified Limits:
(a) On any frequency removed from the assigned carrier frequency by more than 20kHz, up to and including 45kHz, the sideband is at least 26dB below the carrier.
(b) On any frequency removed from the assigned carrier frequency by more than 45kHz, up to and including 90kHz, the sideband is at least 45dB below the carrier.
(c) On any frequency removed from the assigned carrier frequency by more than 90kHz, up to the first multiple of the carrier frequency, the sideband is at least 60dB below the carrier of 40 + log10 (mean power output in Watts) dB, whichever is the smaller attenuation.

5.9 Spurious and Harmonic Emissions at Antenna Terminal : §2.1051

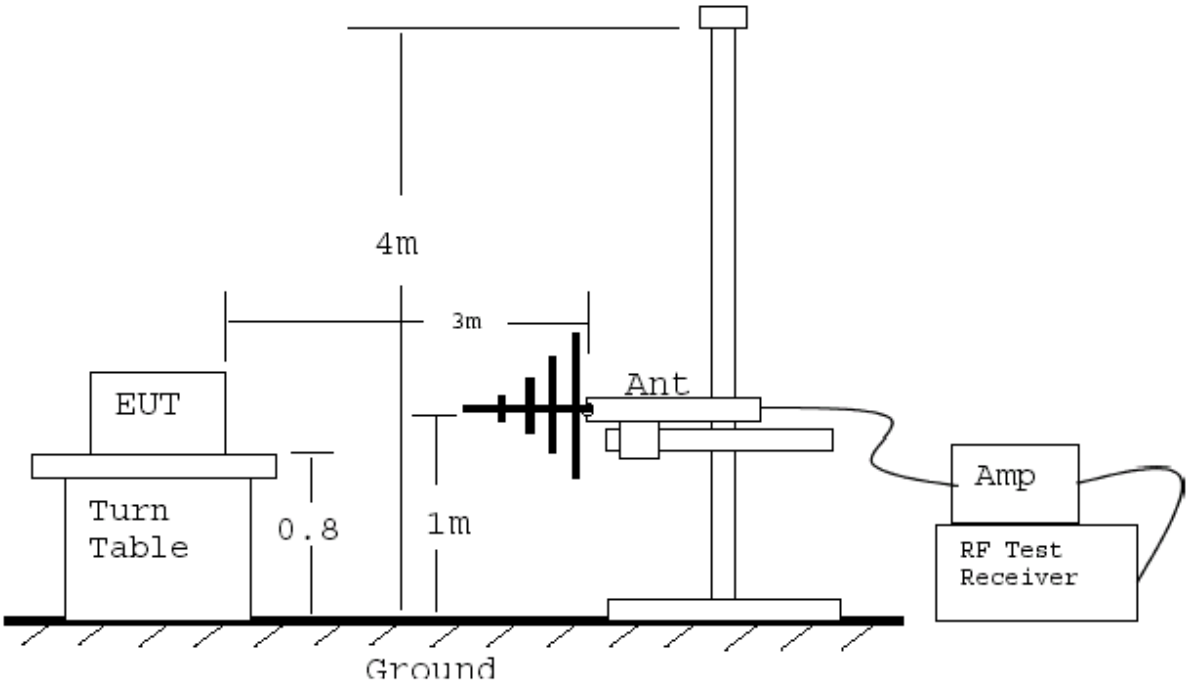
The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to 10 GHz. The transmitter is modulated with a 2500Hz tone at a level of 16dB greater than that required to provide 50% modulation of the rated system deviation at 1000 Hz.

The antenna output terminal of the EUT was connected to the input of 50 ohm spectrum analyzer through a matched 30dB RF attenuator and coaxial cable. The transmitter was operating at maximum power with modulation.

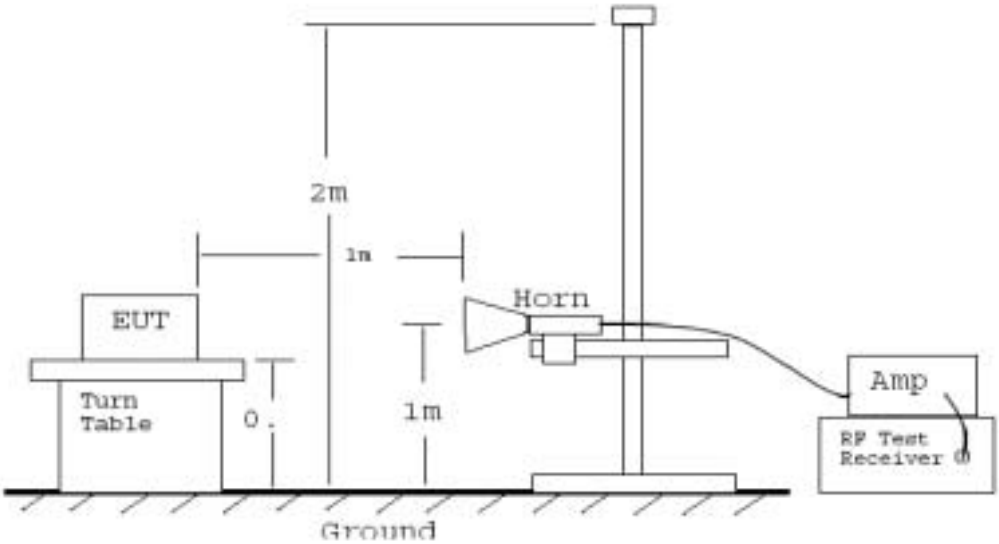


5.10 Radiated Spurious and Harmonic Emissions : §2.1053

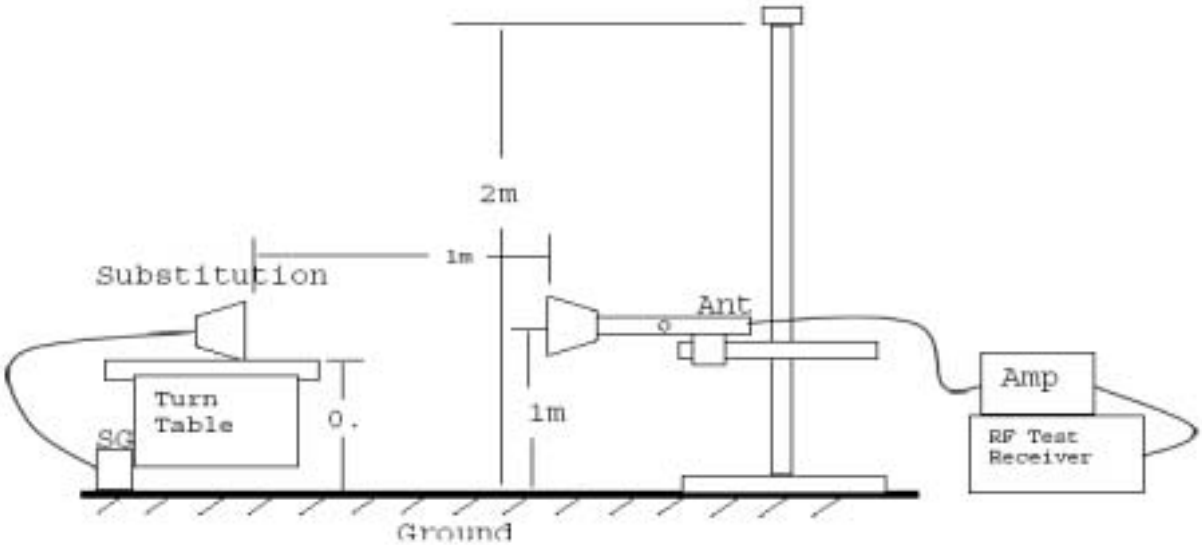
Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet,
control circuits, power leads, or inter-mediate circuit elements under normal conditions of installation and operation.
Radiation and harmonic emissions above 1 GHz is measured outdoors at our 3-meter test range. The equipment under test is placed on a wooden turn-table 3-meters from the receive antenna. The receive antenna height and turntable rotations were adjusted for the highest reading on the receive spectrum analyzer. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer reading. This level is recorded. For readings above 1GHz, the above procedure is repeated using horn antennas and the difference between the gain of the horn and an isotropic antenna are taken into consideration.



Radiated Emission Test 30 – 1000 MHz (Bilog)



Radiated Emission Test 1 – 9 GHz (Horn)



Substitution Method above1 GHz

5.11 Frequency Stability / Temperature Variation - §2.1055(b)

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The frequency stability of the transmitter is measured by:
a) **Temperature:** The temperature is varied from -30°C to +50°C using an environmental chamber.
b) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the voltage
normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification **-** The minimum frequency stability shall be +/- 1.5ppm for base station or Fixed station at any time during normal operation.

Time Period and Procedure:
1. The carrier frequency of the transmitter and the individual oscillators is measured at room temperature
(25°C to 27°C to provide a reference).
2. The equipment is subjected to an overnight "soak" at -30~°C without any power applied.
3. After the overnight "soak" at -30~°C (usually 14-16 hours), the equipment is turned on in a "standby"
condition for one minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter and the individual oscillators is made within a three minute interval after applying power to the transmitter.
4. Frequency measurements is made at 1~°C interval up to room temperature. At least a period of one and one half hour is provided to allow stabilization of the equipment at each temperature level.
5. Again the transmitter carrier frequency and the individual oscillators is measured at room temperature
to begin measurement of the upper temperature levels.
6. Frequency were made at 10 intervals starting at -30~°C up to +50~°C allowing at least two hours at each
temperature for stabilization. In all measurements the frequency is measured within three minutes after
applying power to the transmitter.
7. The artificial load is mounted external to the temperature chamber.

Note: The EUT is tested down to the battery endpoint for battery operated equipment.

6. TEST RESULTS

6.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this
report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

FCC Rules Section	Description	Test Result
Part 15.207	Power Line Conducted Spurious	☒ **Pass** ☐ Fail
Part 15.209	Radiated Emission	☒ **Pass** ☐ Fail
Part 2.1046	RF Power Output	☒ **Pass** ☐ Fail
Part 2.1049	Occupied Bandwidth	☒ **Pass** ☐ Fail
Part 2.1051	Spurious Emission at Antenna Terminal	☒ **Pass** ☐ Fail
Part 2.1053	Field Strength of Spurious Emission	☒ **Pass** ☐ Fail
Part 2.1055	Frequency Stability	☒ **Pass** ☐ Fail

The data collected shows that the **Seohwa Telecom Co., Ltd. Repeater SHHR05-U1** complies with technical requirements of the FCC Rule Part 2.947 and Part 24 related technical specification.

6.2 Modification to EUT

The device tested is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

7. TEST DATA

7.1 Power Line Conducted Emission

7.1.1 Up Link

Test Standard	: FCC Part 15.207
Operating Frequency	: 1880 MHz
RF Power Output	: 10 mW

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Power Line Conducted Emission Test Data

Detector Mode ; CISPR Quasi Peak mode (6dB Bandwidth : 9kHz)

Freq [MHz]	Correcton		Phase [H/N]	Peak Mode		
	AMN	C.L		Limit [dBuV]	Reading [dBuV]	Emission Level [dBuV]
0.195	0.06	0.03	H	64.70	49.90	49.99
0.263	0.07	0.16	H	62.90	41.30	41.53
0.329	0.08	0.22	H	61.00	41.10	41.40
0.393	0.08	0.24	H	59.10	41.20	41.52
0.459	0.07	0.28	H	57.30	36.60	36.95
1.505	0.03	0.48	H	56.00	44.90	45.41
1.571	0.03	0.48	H		45.20	45.71
1.638	0.03	0.49	H		43.80	44.32
1.965	0.03	0.54	H		44.00	44.57
2.031	0.03	0.55	H		44.20	44.78
2.096	0.03	0.55	H		43.10	43.68
4.903	0.05	0.86	N	60.00	37.10	38.01
5.370	0.05	0.88	H		33.80	34.73
5.500	0.05	0.88	H		34.00	34.93
6.160	0.06	0.91	H		33.50	34.47
24.970	0.10	1.48	N		34.50	36.08

NOTES :

1. *H : Hot Line , N :Neutral Line*
2. *Emission Level = Reading + Correction Factor*
3. *Measurements were performed at the AC Power Inlet of the host PC with the EUT plugged in the frequency band of 150kHz ~ 30MHz*
4. *The measurements were performed at the shielded room with environmental conditions of 26℃, 41%RH*

7.1.2 Down Link

Test Standard	: FCC Part 15.207
Operating Frequency	: 1960 MHz
RF Power Output	: 5 mW

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Power Line Conducted Emission Test Data

Detector Mode ; CISPR Quasi Peak mode (6dB Bandwidth : 9kHz)

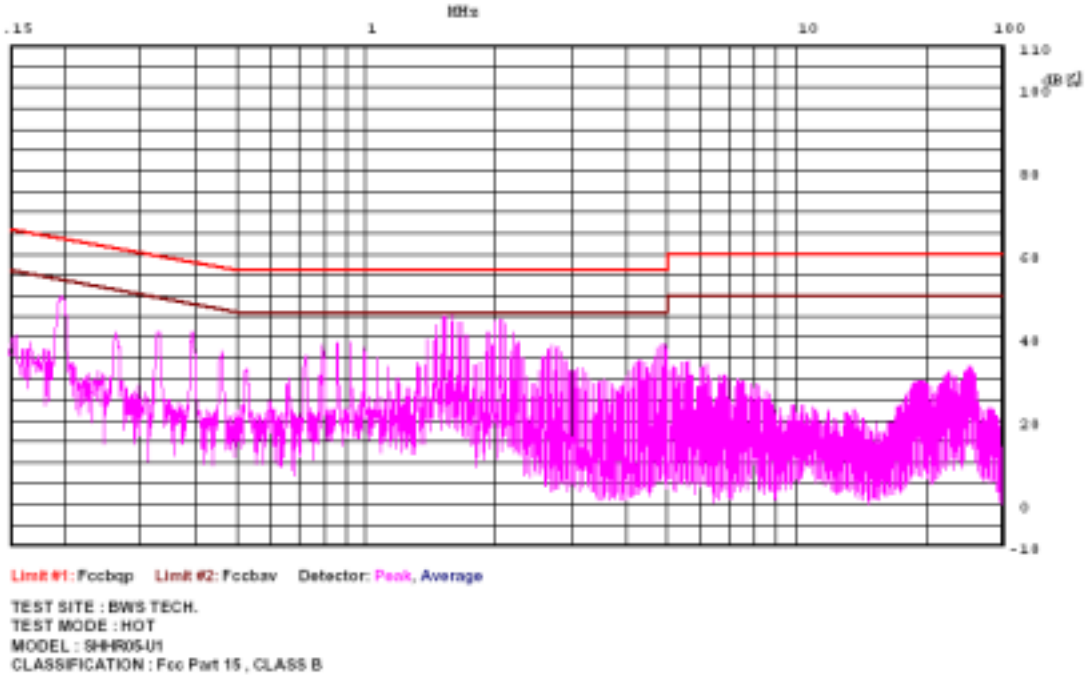
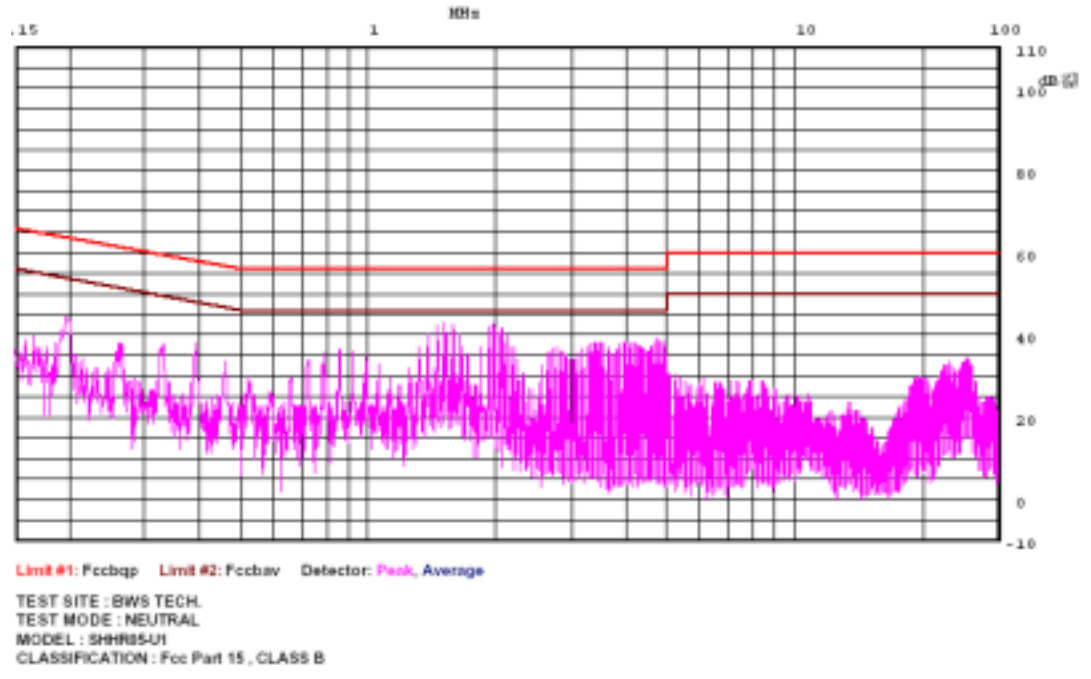
Freq [MHz]	Correcton		Phase [H/N]	Peak Mode		
	AMN	C.L		Limit	Reading	Emission Level
				[dBuV]	[dBuV]	[dBuV]
0.153	0.06	0.03	N	66.00	39.70	39.79
0.192	0.06	0.03	H	64.90	47.20	47.29
0.197	0.06	0.03	H	64.70	49.10	49.19
0.263	0.07	0.16	H	62.90	41.20	41.43
0.328	0.08	0.22	H	61.00	39.80	40.10
0.393	0.08	0.24	H	59.10	40.30	40.62
1.437	0.03	0.46	H	56.00	43.80	44.29
1.501	0.03	0.48	H		45.30	45.81
1.567	0.03	0.48	H		45.30	45.81
1.896	0.03	0.53	H		43.30	43.86
1.959	0.03	0.54	H		45.00	45.57
2.026	0.03	0.55	H		44.60	45.18
4.900	0.05	0.86	H	60.00	36.00	36.91
4.965	0.05	0.86	H		34.80	35.71
5.490	0.05	0.88	H		34.70	35.63
25.030	0.10	1.48	N		34.60	36.18

NOTES :

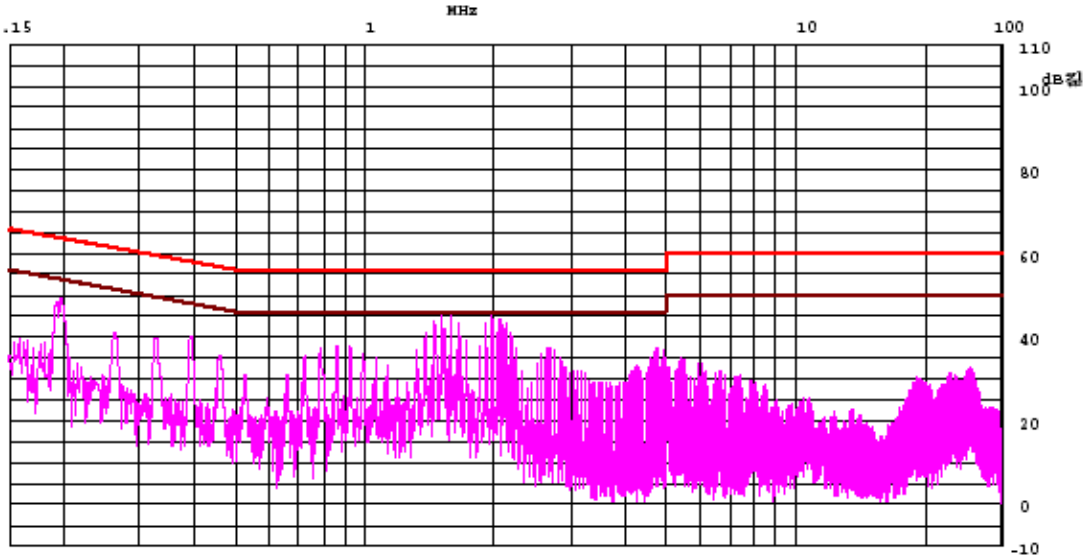
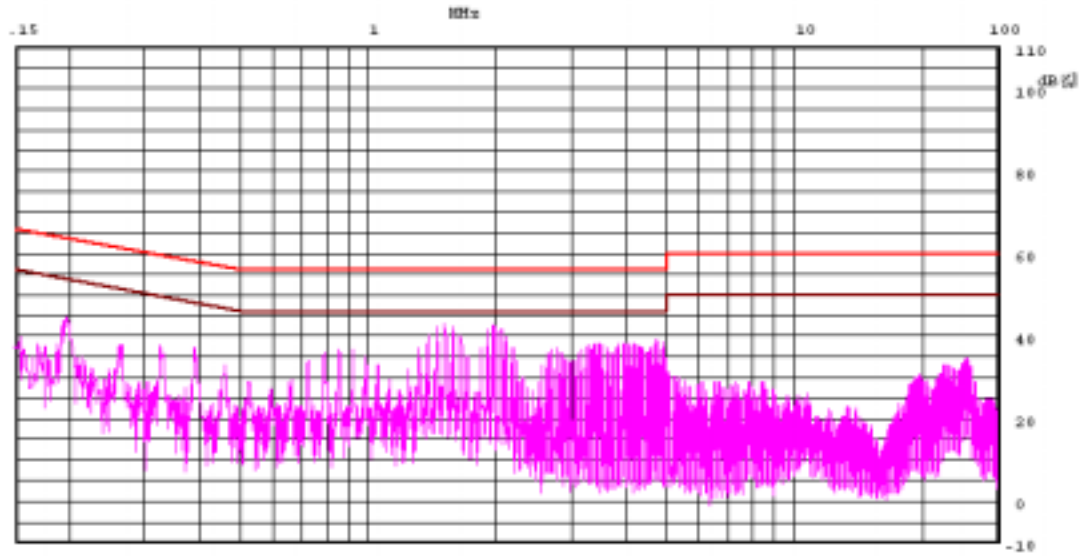
1. *H : Hot Line , N :Neutral Line*
2. *Emission Level = Reading + Correction Factor*
3. *Measurements were performed at the AC Power Inlet of the host PC with the EUT plugged in the frequency band of 150kHz ~ 30MHz*
4. *The measurements were performed at the shielded room with environmental conditions of 29℃, 49%RH*

Tested by ***Yang, Eun Jung***

Plots of Power Line Conducted Emission

Mode	Plot (Up Link)
Hot	
Neutral	

Plots of Power Line Conducted Emission

Mode	Plot (Down Link)
Hot	 Limit #1: Fccbqp Limit #2: Fccbav Detector: Peak, Average TEST SITE: BWS TECH. TEST MODE : HOT MODEL : SHHR05-U1 CLASSIFICATION: Fcc Part 15 , CLASS B
Neutral	 Limit #1: Fccbqp Limit #2: Fccbav Detector: Peak, Average TEST SITE : BWS TECH. TEST MODE : NEUTRAL MODEL : SHHR05-U1 CLASSIFICATION : Fcc Part 15 , CLASS B

7.2 Radiated Emission

Test Standard	: FCC Part 15.209
Operating Frequency	: Up Link : 1880 MHz Down Link : 1960 MHz
RF Power Output	: 10 mW (Up Link) 5 mW (Down Link)

Radiated Emission Test Data

All emission not reported were found to be more than 30dB below the limit.

NOTES :

1. *All modes of operation were investigated and the worst-case emissions are reported.*
2. *The measurements were performed at the open-site with environmental conditions of 35℃, 24%RH.*

Tested by ***Yang, Eun Jung***

7.3 RF Power Output Measurement

Test Standard	: FCC Part 24.232 & 2.1046
Operating Frequency	: Up Link : 1850 MHz ~ 1910 MHz Down Link : 1930 MHz ~ 1990 MHz
Channel	: Low / Mid/ High
RF Power Output	: 10 mW (Up Link) 5 mW (Down Link)

Test Conditon	Measured Output Power (mW)					
	Up Link			Down Link		
	Low	Mid	High	Low	Mid	High
CDMA	6.6	8.2	2.7	1.7	4.3	1.7
NADC	7.2	8.6	2.8	1.7	4.6	2.1
GSM	6.5	7.8	2.9	1.9	4.1	1.6

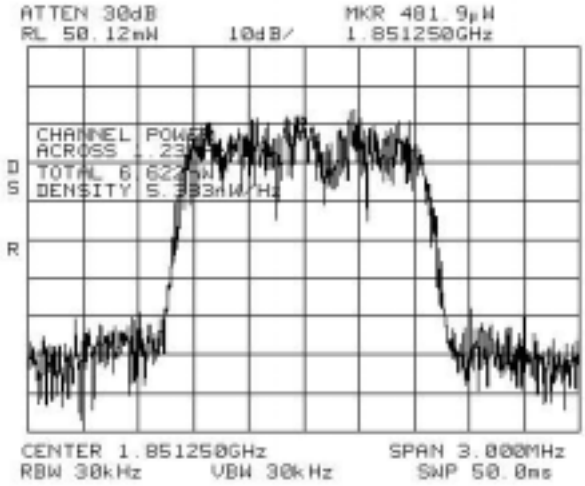
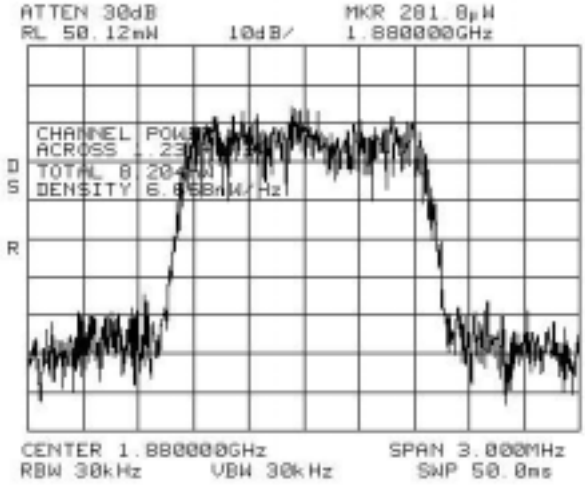
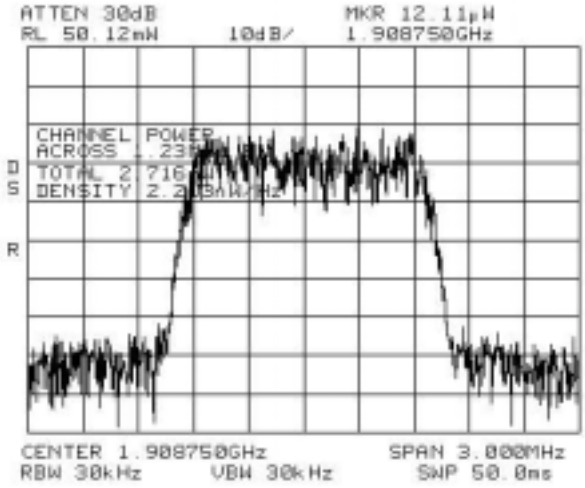
Note :

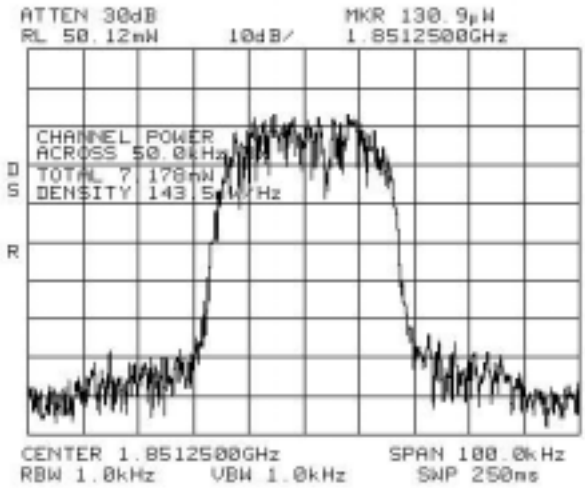
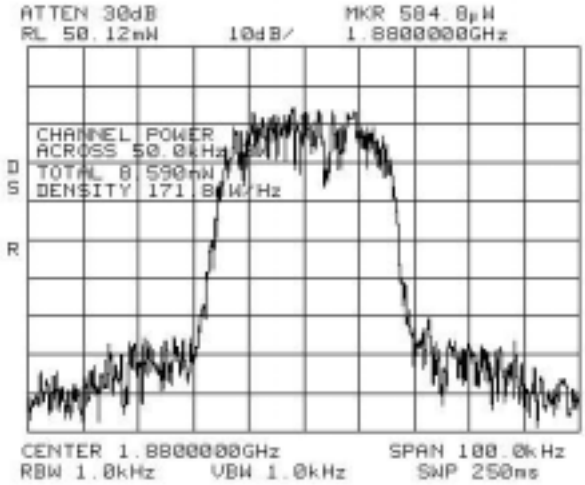
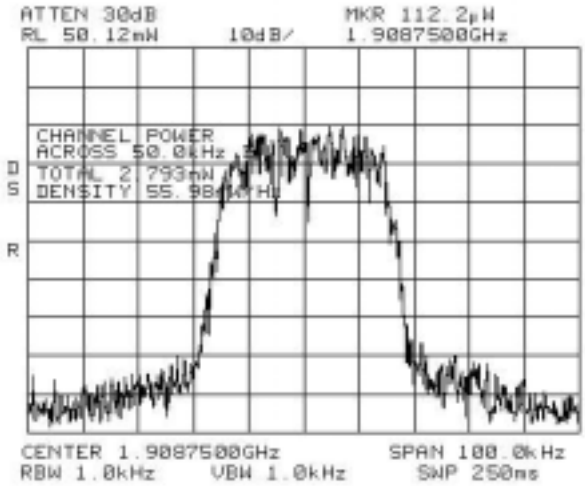
1. *The input to the amplifier is tuned such that the output power is set to its maximum rated power*
2. *The RF output ports were properly attenuated by the RF attenuator and were connected to the RF Power Meter and Spectrum Analyzer.*
3. *The measurements were performed at the shielded room.with environmental conditions of 27℃, 50%RH*
4. *Frequency Table*

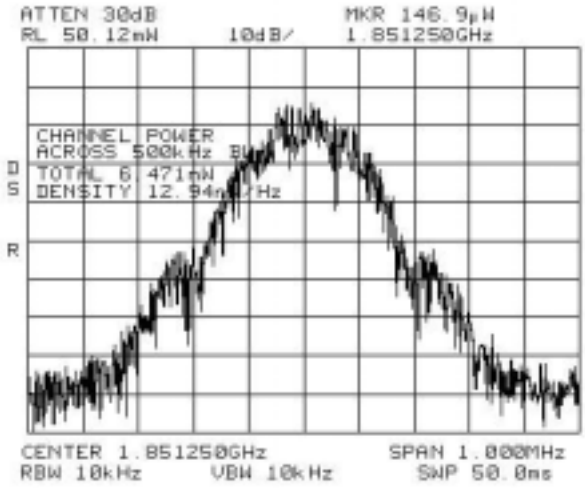
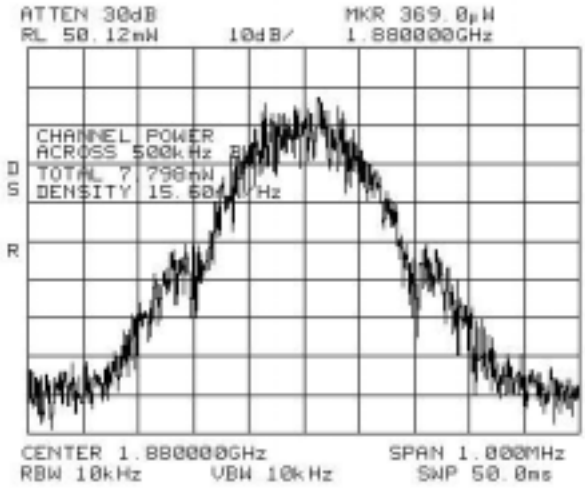
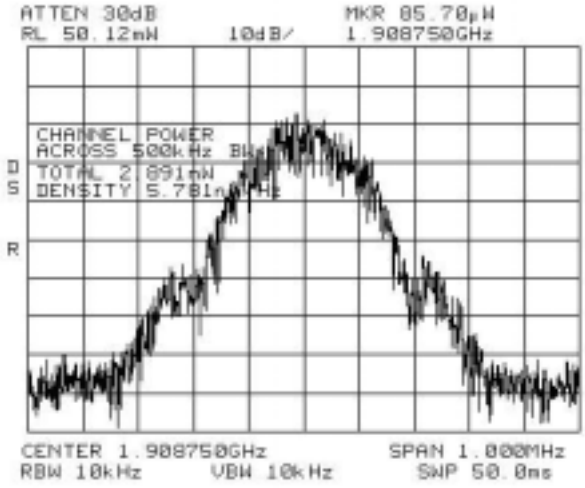
Channel		Frequency	
		Up Link	Down Link
CDMA	Low Channel	1851.25 MHz	1931.25 MHz
NADC	Middle Channel	1880.00 MHz	1960.00 MHz
GSM	High Channel	1908.75 MHz	1988.75 MHz

*Tested by **Yang, Eun Jung***

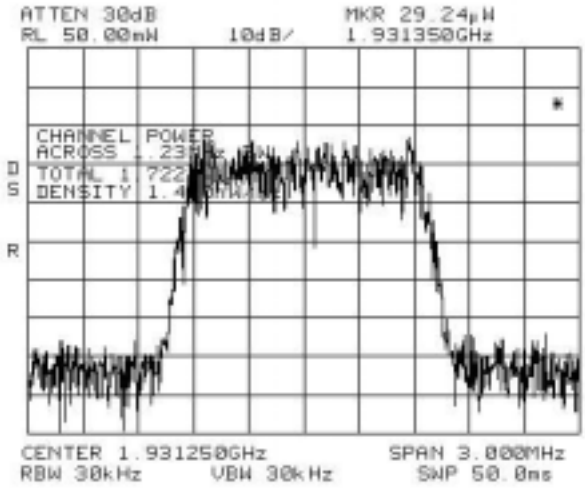
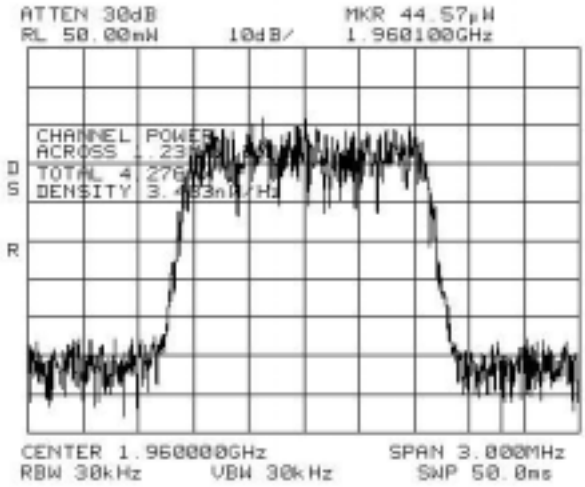
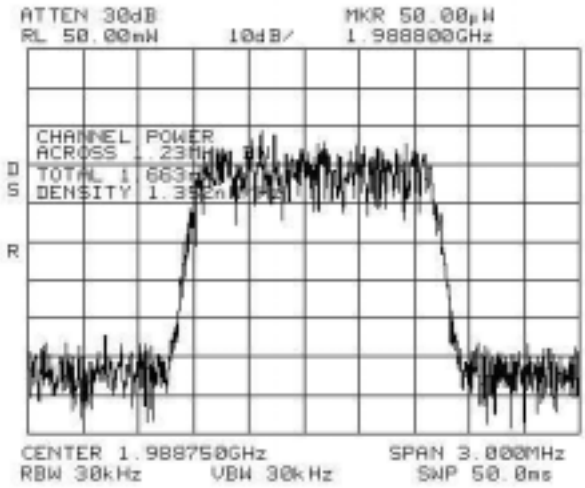
1. Up Link

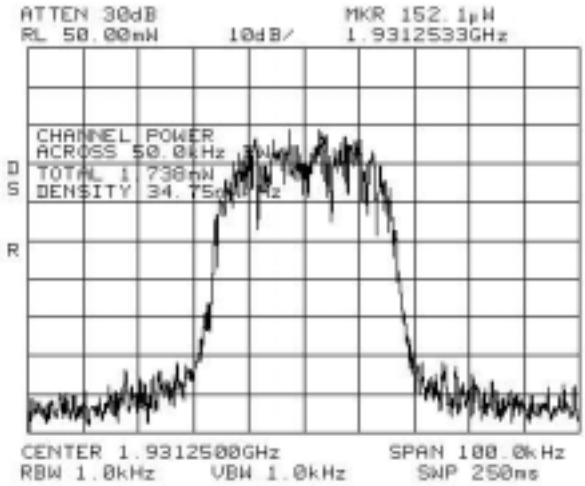
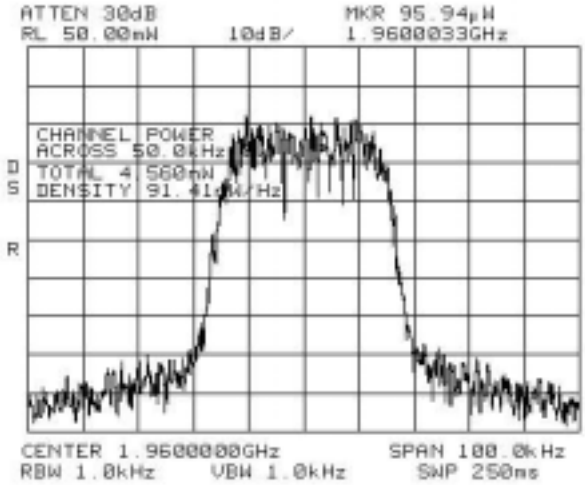
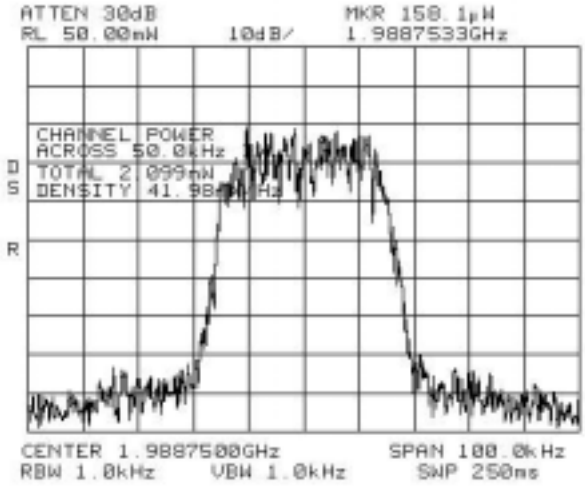
CDMA	
Low Channel 6.6 mW	
Middle Channel 8.2 mW	
High Channel 2.7 mW	

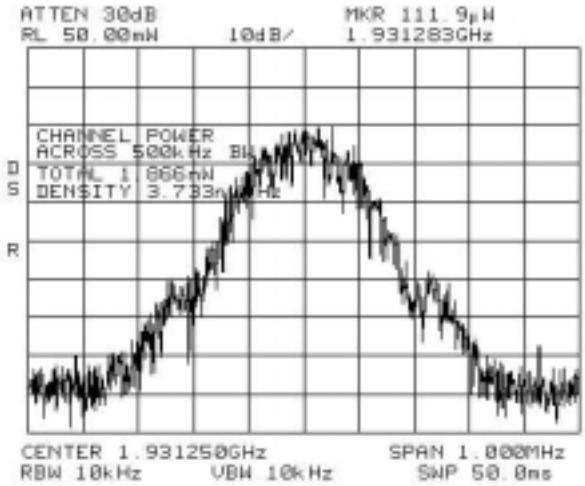
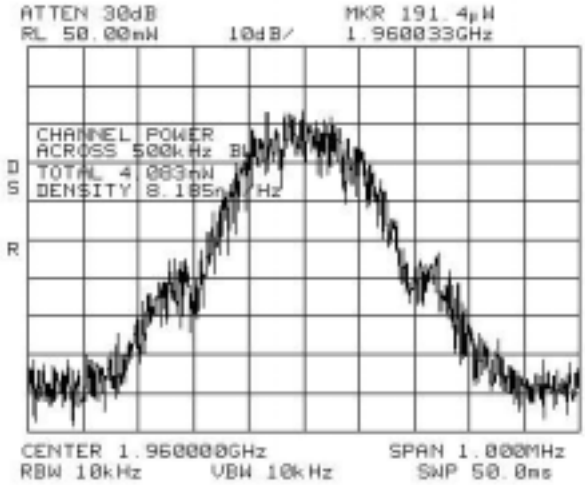
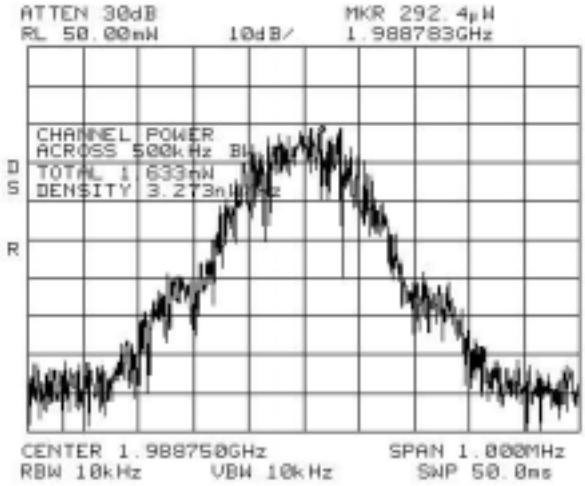
NADC	
Low Channel 7.2 mW	
Middle Channel 8.6 mW	
High Channel 2.8 mW	

GSM	
Low Channel 6.5 mW	
Middle Channel 7.8 mW	
High Channel 2.9 mW	

2. Down Link

CDMA	
Low Channel 1.7 mW	
Middle Channel 4.3 mW	
High Channel 1.7 mW	

NADC	
Low Channel 1.7 mW	
Middle Channel 4.6 mW	
High Channel 2.1 mW	

GSM	
Low Channel 1.9 mW	
Middle Channel 4.1 mW	
High Channel 1.6 mW	

7.4 Occupied Bandwidth

Test Standard	: FCC Part 24.238 & 2.1049
Operating Frequency	: Up Link : 1850 MHz ~ 1910 MHz Down Link : 1930 MHz ~ 1990 MHz
Channel	: Low / Mid/ High
RF Power Output	: 10 mW (Up Link) 5 mW (Down Link)

Test Conditon	Measured Occupied Bandwidth (kHz)					
	Up Link			Down Link		
	Low	Mid	High	Low	Mid	High
CDMA	1380.0	1380.0	1385.0	1380.0	1405.0	1385.0
NADC	32.0	32.0	32.0	32.2	32.0	32.2
GSM	300.0	303.0	302.0	307.0	305.0	307.0

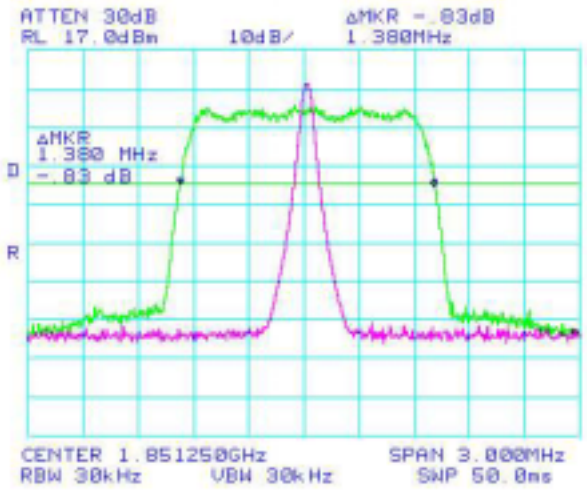
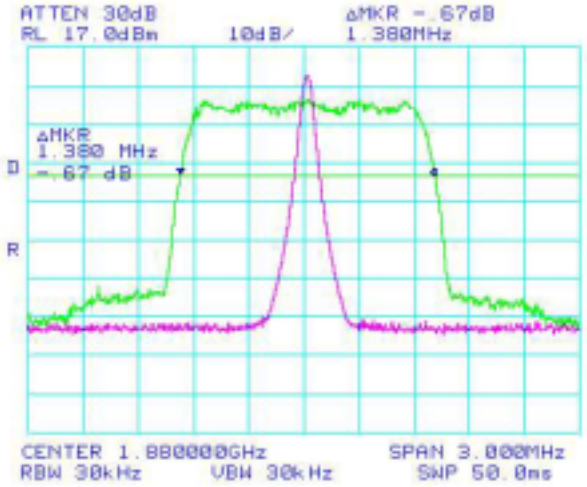
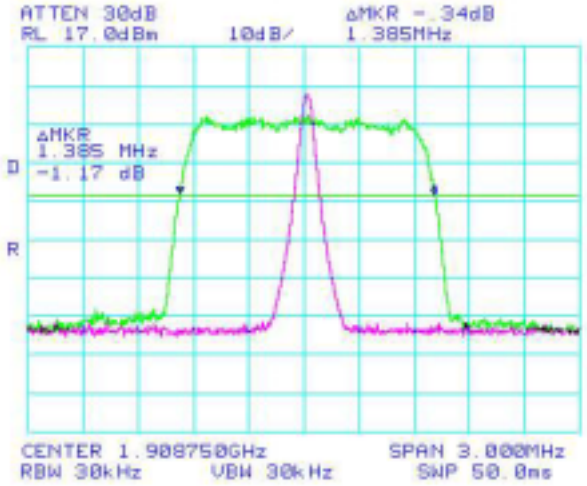
Note :
1. *The input to the amplifier is tuned such that the output power is set to its maximum rated power*
2. *The spectrum analyzer for this measurement was set with RBW and VBW, as recorded in the plots.*
3. *The frequency band measurements were performed at the rated supply voltage and ±10% of the rated supply voltage.*
4. *The measurements were performed at the shielded room with environmental conditions of 27℃, 50%RH*
5. *Frequency Table*

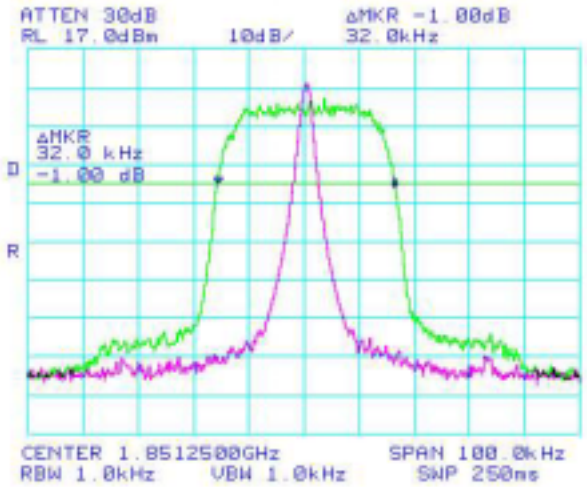
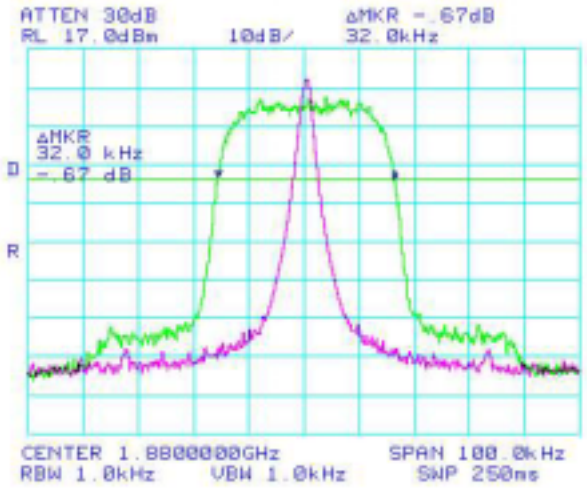
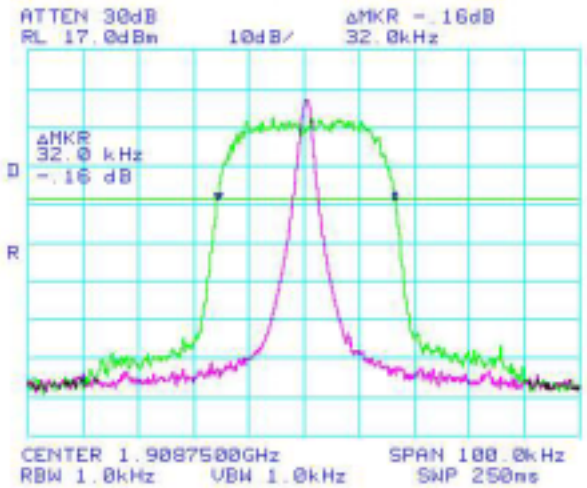
Channel		Frequency	
		Up Link	Down Link
CDMA	Low Channel	1851.25 MHz	1931.25 MHz
NADC	Middle Channel	1880.00 MHz	1960.00 MHz
GSM	High Channel	1908.75 MHz	1988.75 MHz

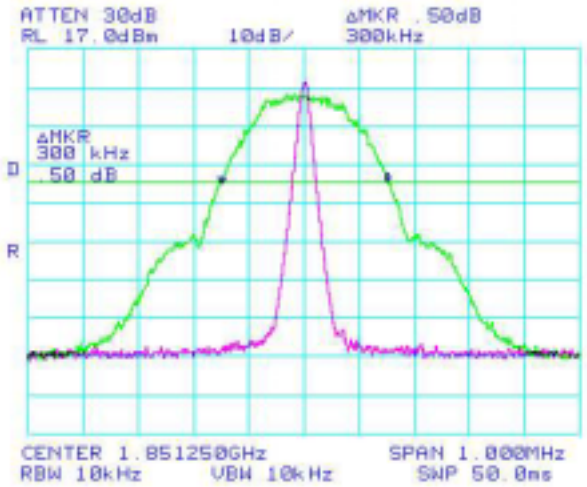
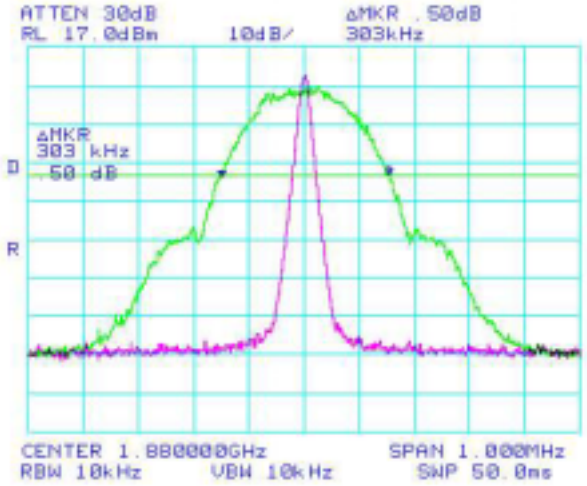
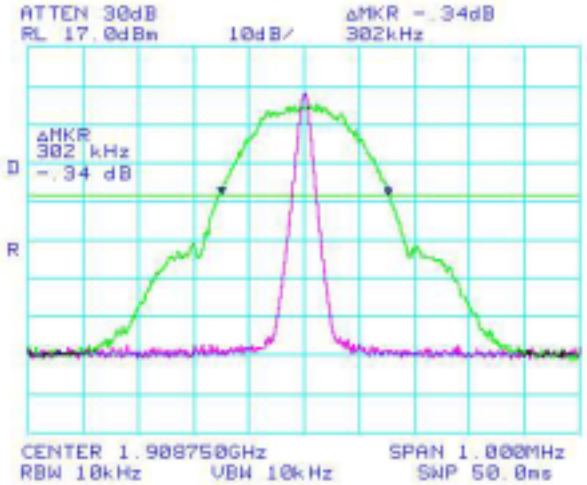
Tested by **Yang, Eun Jung**

BWS TECH Inc .
294-9 Jungdae-Dong,
Kwanggu-Si,Kyunggi-Do,
464-800, Korea

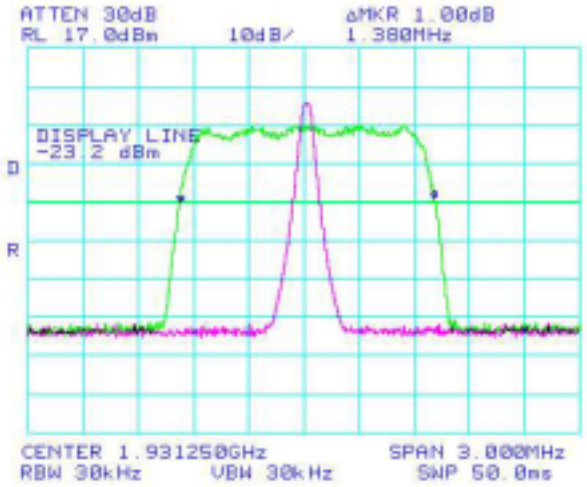
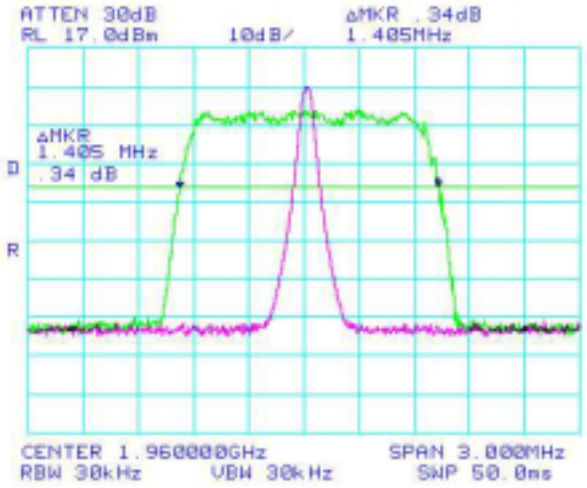
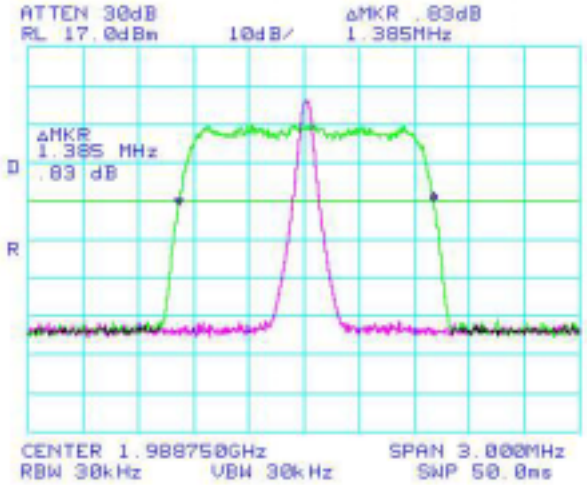
1. Up Link

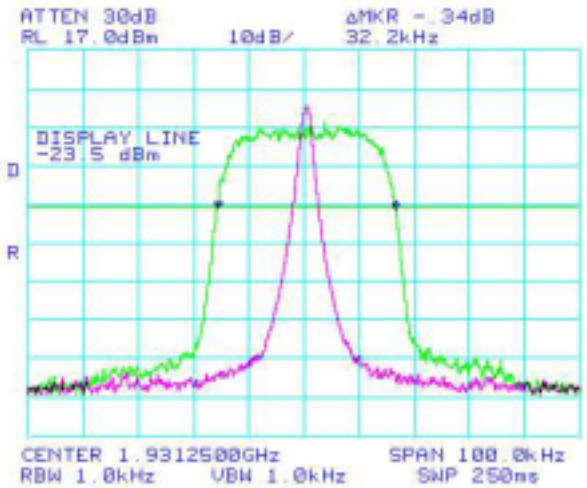
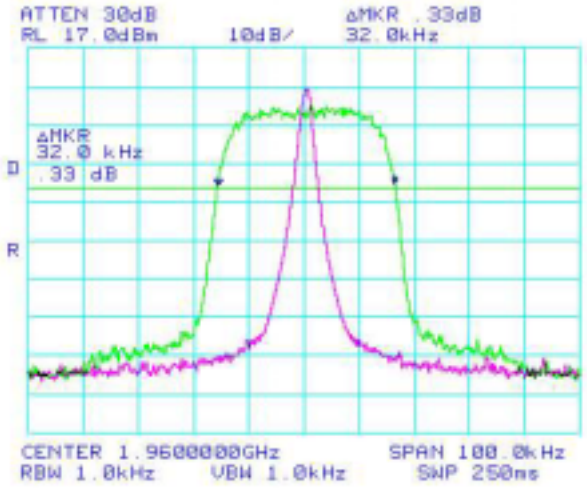
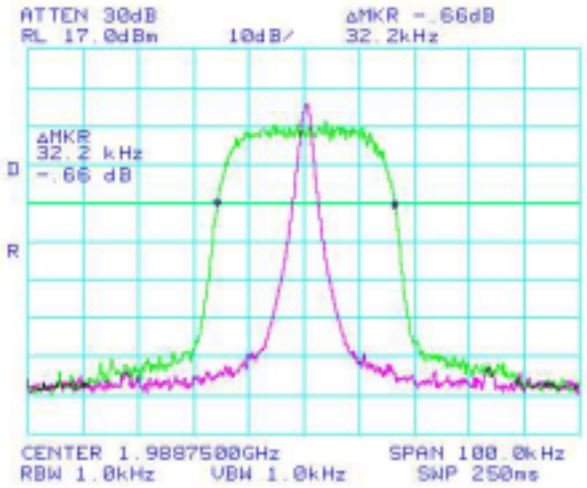
CDMA	
Low Channel 1380 kHz	
Middle Channel 1380 kHz	
High Channel 1385 kHz	

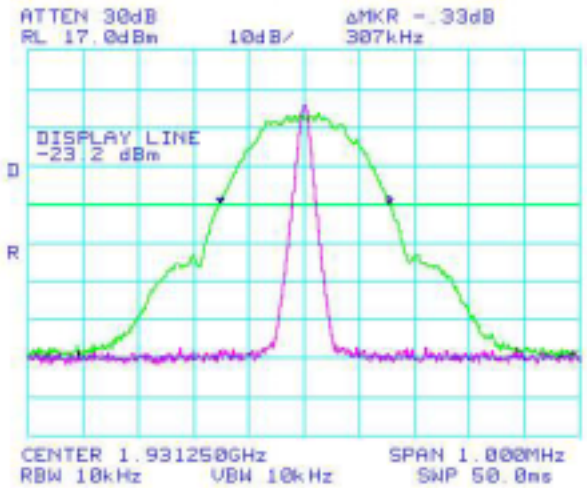
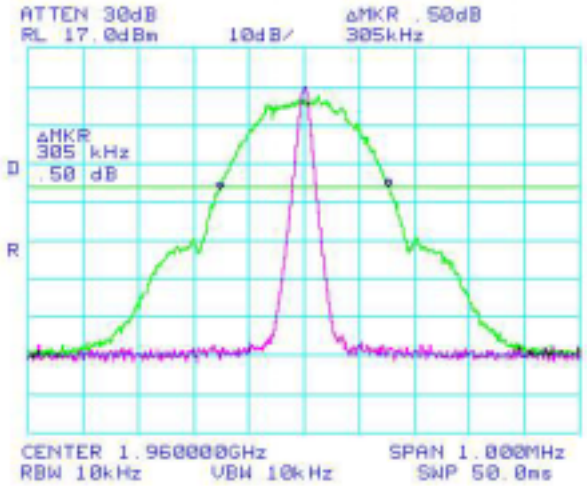
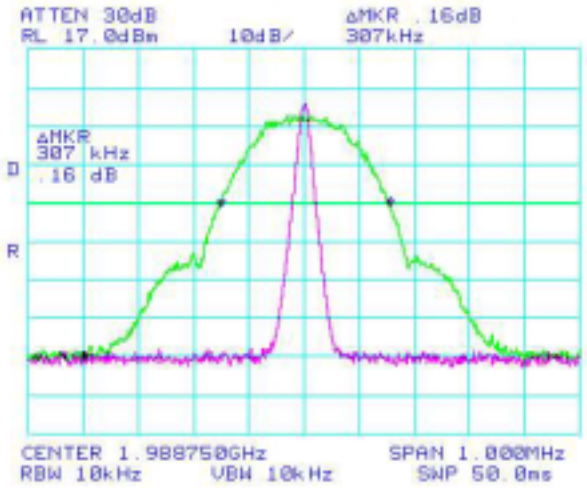
NADC	
Low Channel 32.0 kHz	
Middle Channel 32.0 kHz	
High Channel 32.0 kHz	

GSM	
Low Channel 300 kHz	
Middle Channel 303 kHz	
High Channel 302 kHz	

2. Down Link

CDMA	
Low Channel 1380 kHz	
Middle Channel 1405 kHz	
High Channel 1385 kHz	

NADC	
Low Channel 32.2 kHz	
Middle Channel 32.0 kHz	
High Channel 32.2 kHz	

GSM	
Low Channel 307 kHz	
Middle Channel 305 kHz	
High Channel 307 kHz	

7.5 Spurious Emission at Antenna Terminal

Test Standard	: FCC Part 24.238 & 2.1051
Operating Frequency	: Up Link : 1850 MHz ~ 1910 MHz Down Link : 1930 MHz ~ 1990 MHz
Channel	: Low / Mid/ High
RF Power Output	: 10 mW (Up Link) 5 mW (Down Link)

Data Table

Test Condition	Frequency Range	Limit (dBm)	Measured Emission Level (dBm)					
			Up Link			Down Link		
			Low	Mid	High	Low	Mid	High
CDMA	30MHz < f_0 < 1GHz	-13.00	-	-	-	-	-	-
	1GHz< f_0 <20GHz	-13.00	-47.83	-	-	-	-40.83	-
	Intermodulation	-13.00	-42.33			-		
NADC	30MHz < f_0 < 1GHz	-13.00	-	-	-	-	-	-
	1GHz< f_0 <20GHz	-13.00	-	-	-	-	-53.00	-
	Intermodulation	-13.00	-49.83			-61.00		
GSM	30MHz < f_0 < 1GHz	-13.00	-	-	-	-	-	-
	1GHz< f_0 <20GHz	-13.00	-	-	-	-	-	-
	Intermodulation	-13.00	-50.17			-52.17		

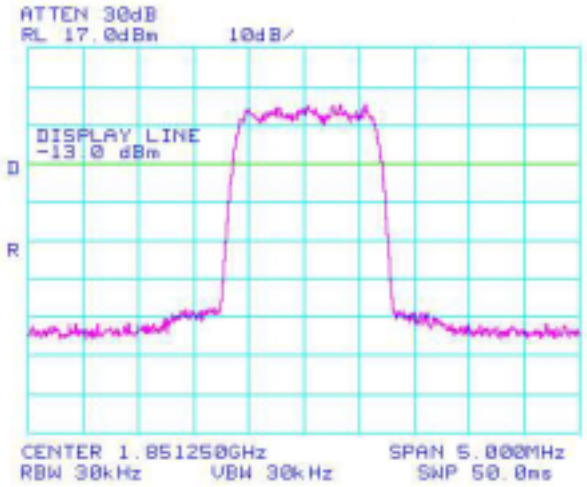
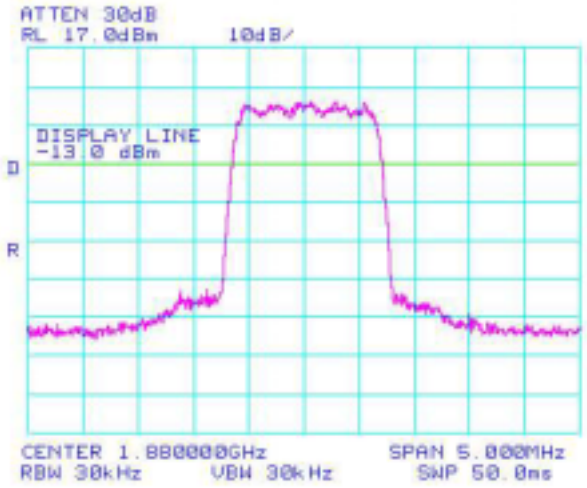
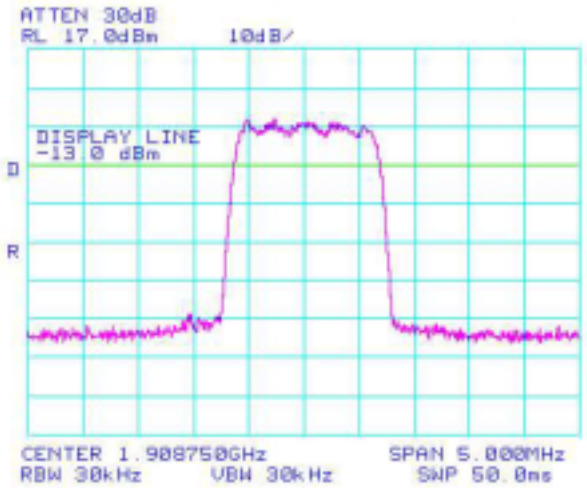
Note :

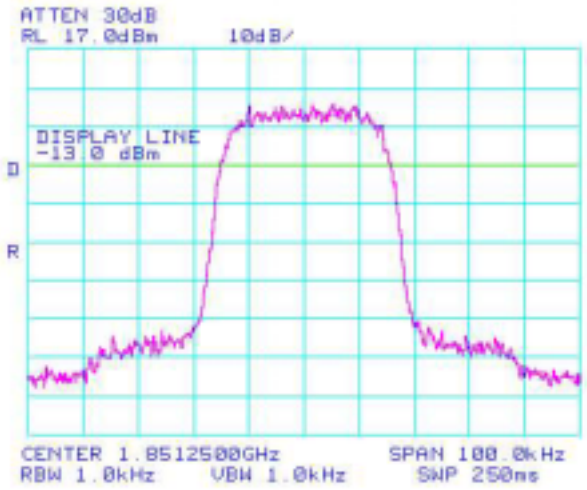
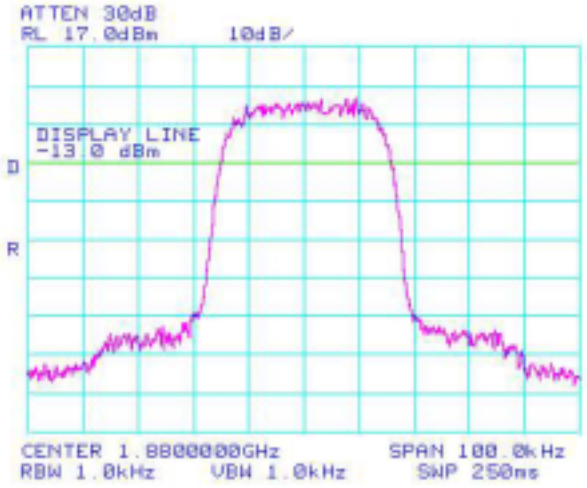
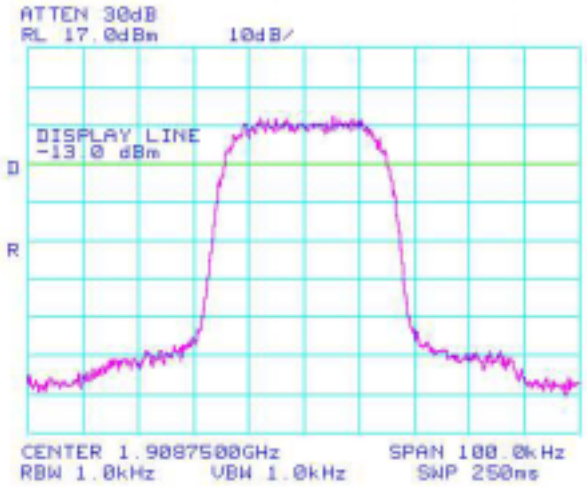
1. *The input to the amplifier is CDMA, NADC, GSM modulated signal tuned such that the output power is set to its maximum rated output power.*
2. *The RF output ports were properly terminated by the RF load and were connected to the RF Power Meter and Spectrum analyzer through the directional coupler.*
3. *The spectrum analyzer for this measurement was set with the RBW 100kHz in the range of 30MHz ~1GHz, and RBW 1MHz in the range of 1GHz~26.5GHz, as recorded in the plots. The VBW was set the same as RBW.*
4. *The measurements were performed at the shielded room.with environmental conditions of 27℃, 50%RH*
5. *Plots were taken with single input at low, mid, and high of the band. Plots were taken of the out-of-band emissions from 30MHz to the 10th harmonic of the carrier frequency.*
6. *For measuring emissions above 0.9 GHz, a high-pass filter was used to eliminate the fundamental transmit frequency to prevent possible saturation effects on the front end of the spectrum analyzer.*
7. *The emissions shall not be more than 43 + 10 log (P) dBc below the mean power output, which is equivalent to –13 dBm.*
8. *Frequency Table*

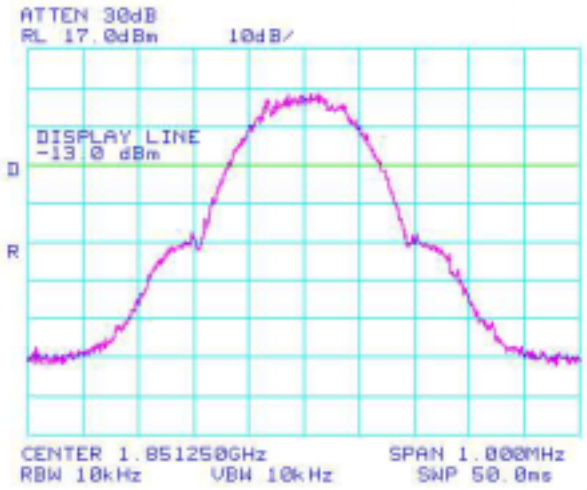
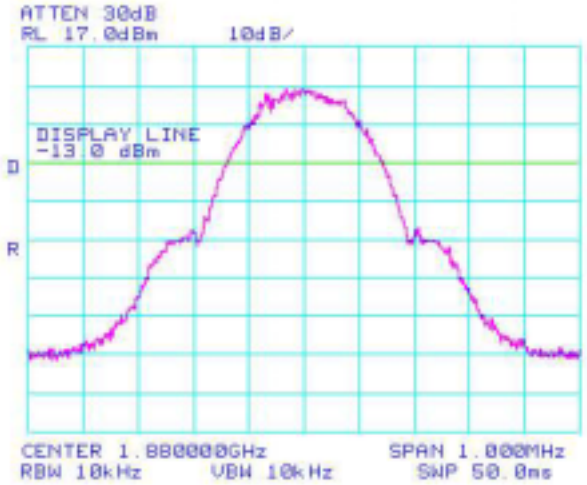
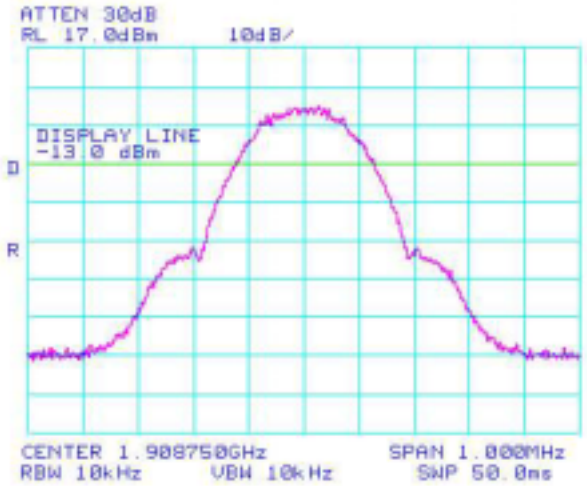
Channel		Frequency	
		Up Link	Down Link
CDMA	Low Channel	1851.25 MHz	1931.25 MHz
NADC	Middle Channel	1880.00 MHz	1960.00 MHz
GSM	High Channel	1908.75 MHz	1988.75 MHz

Tested by **Yang, Eun Jung**

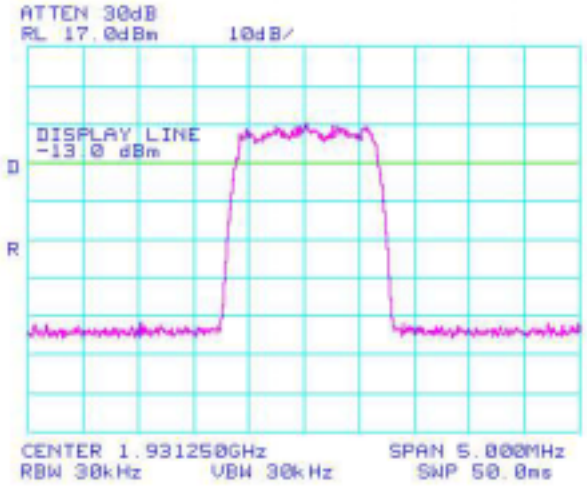
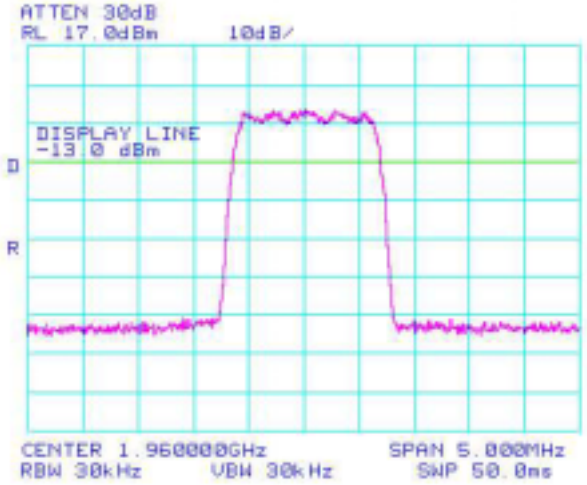
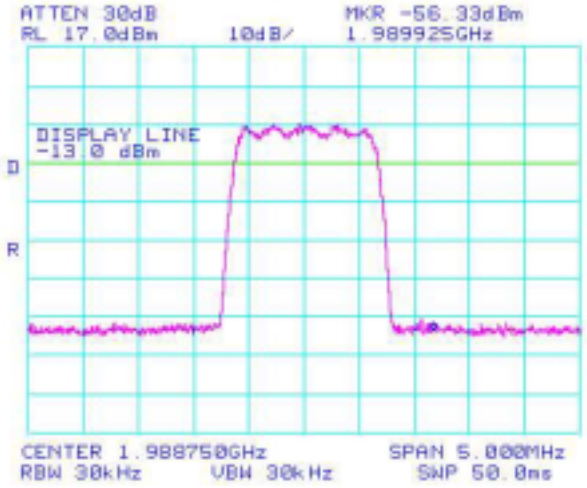
1. Up Link

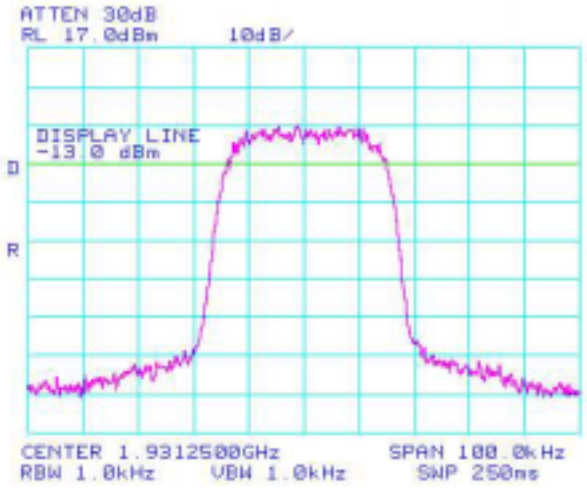
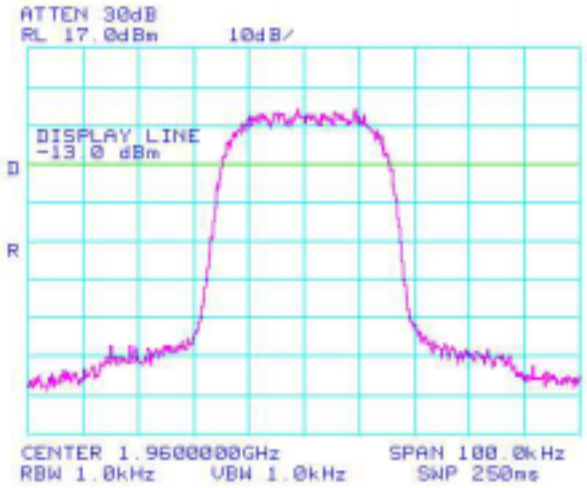
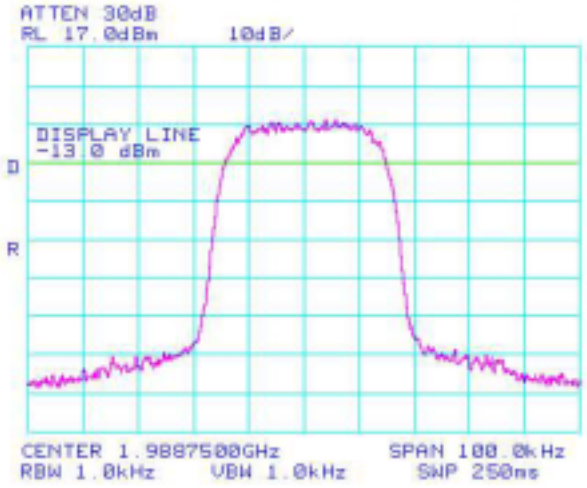
CDMA	
Low Channel In-band Nothing	
Middle Channel In-band Nothing	
High Channel In-band Nothing	

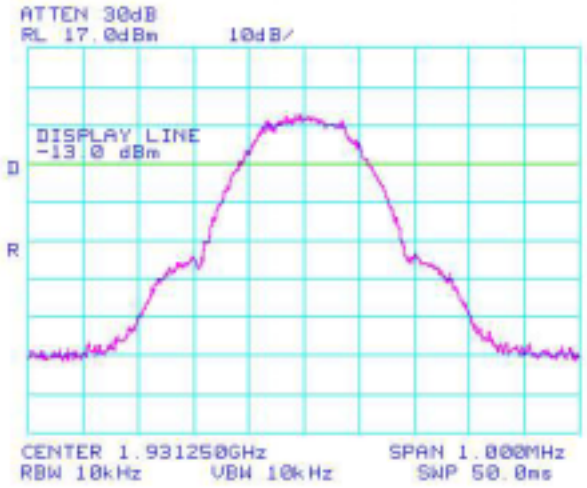
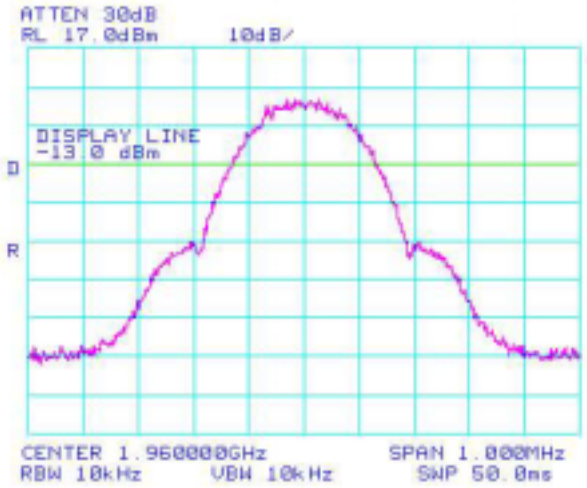
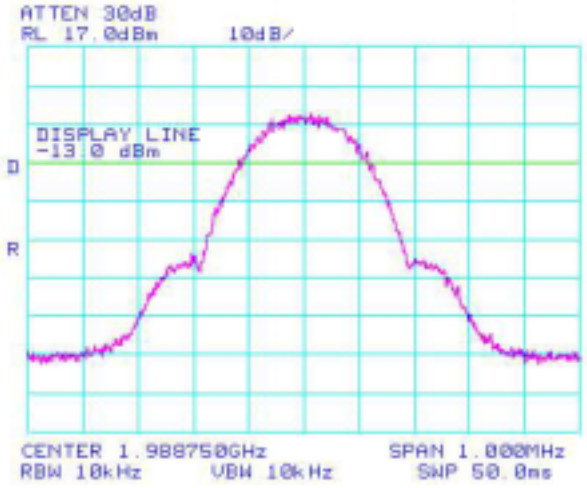
NADC	
Low Channel In-band Nothing	
Middle Channel In-band Nothing	
High Channel In-band Nothing	

GSM	
Low Channel In-band Nothing	
Middle Channel In-band Nothing	
High Channel In-band Nothing	

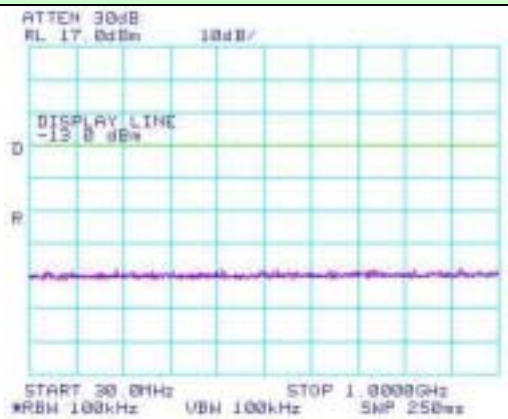
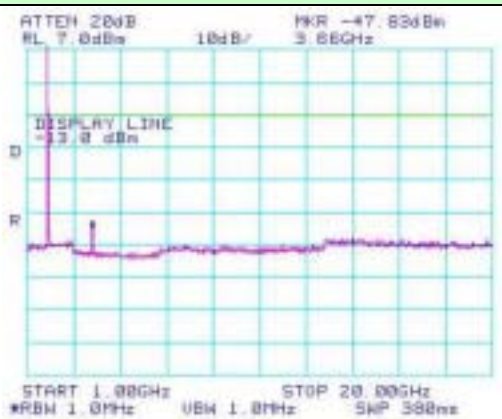
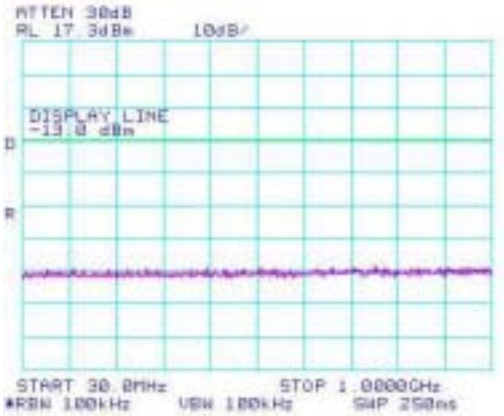
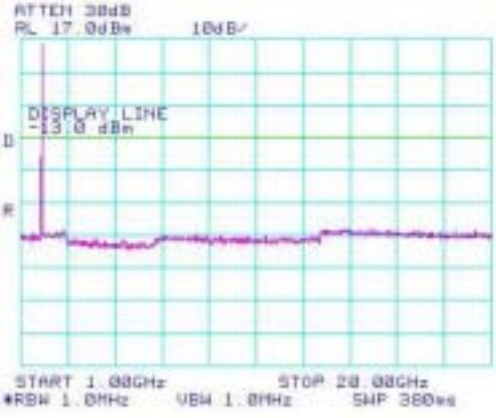
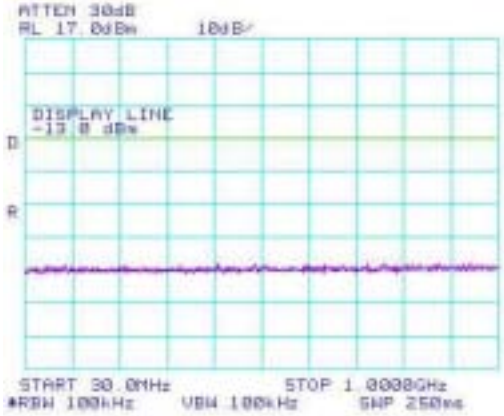
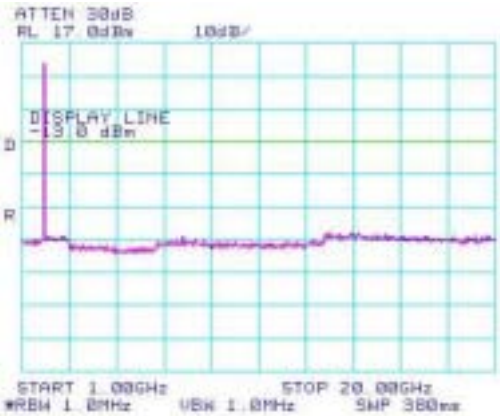
2. Down Link

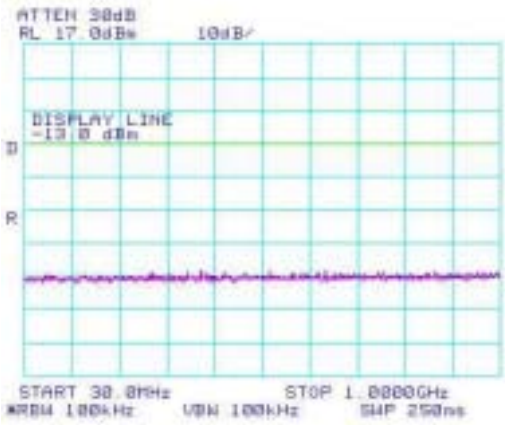
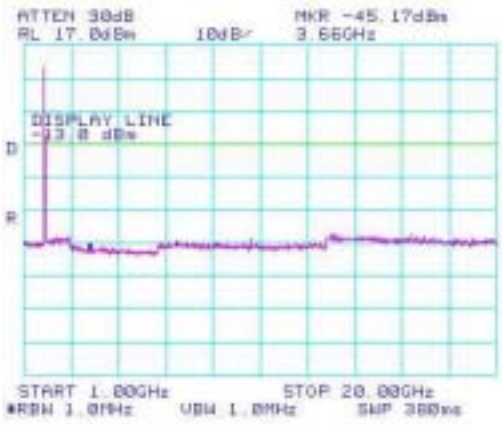
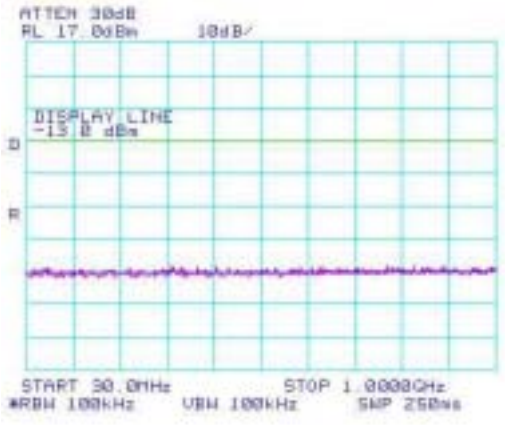
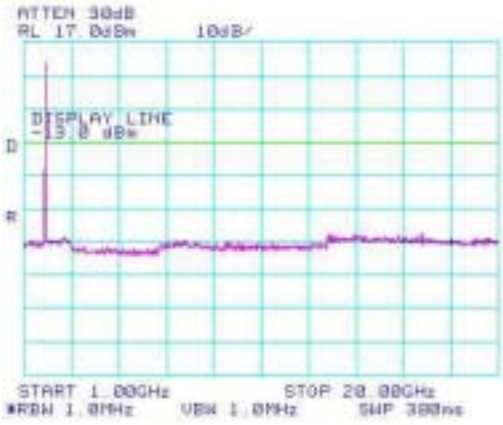
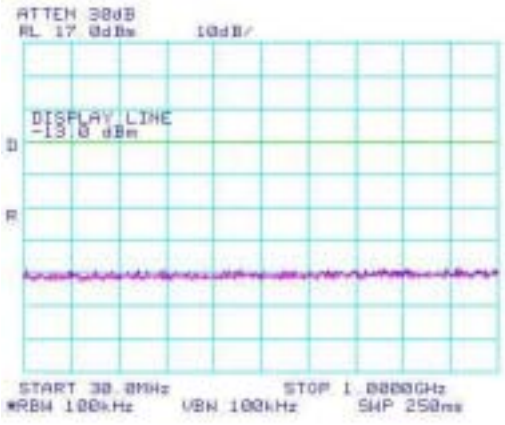
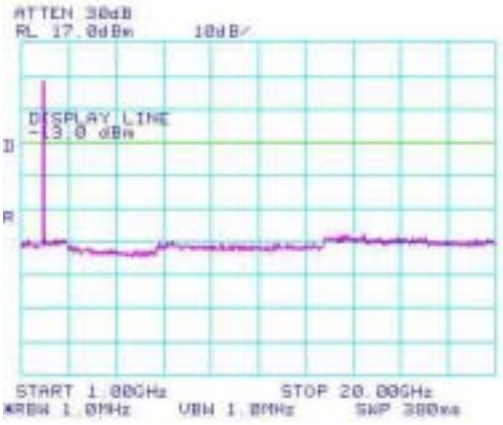
CDMA	
Low Channel In-band Nothing	
Middle Channel In-band Nothing	
High Channel In-band Nothing	

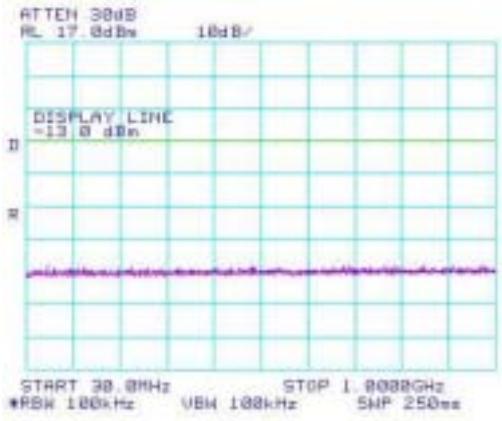
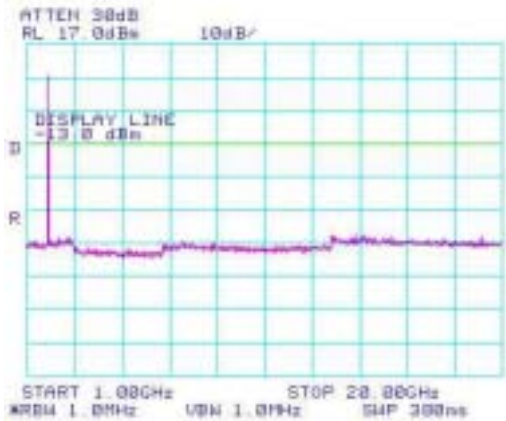
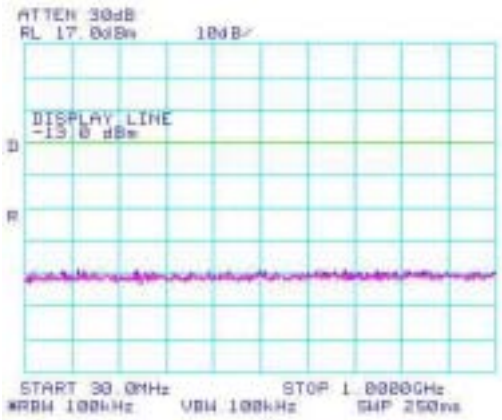
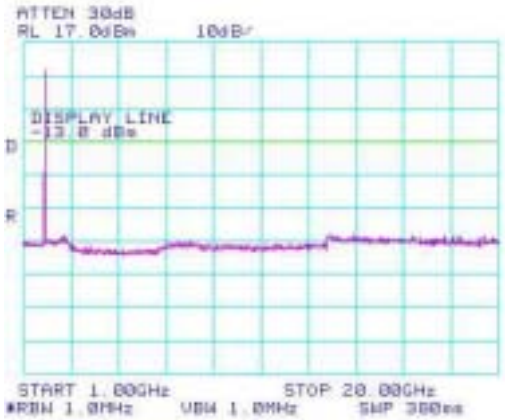
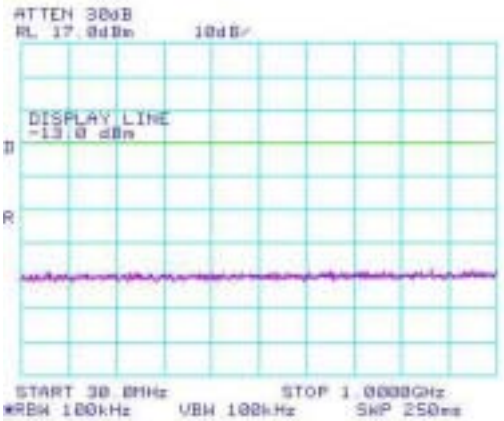
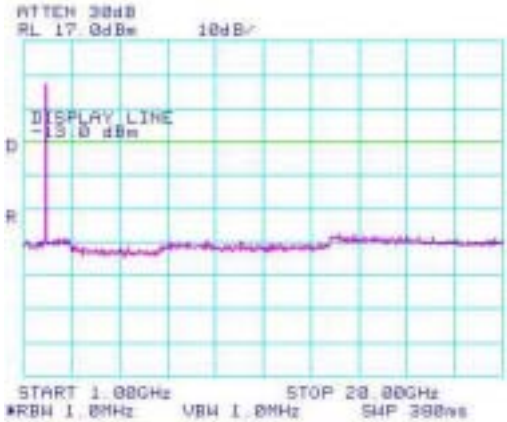
NADC	
Low Channel In-band Nothing	
Middle Channel In-band Nothing	
High Channel In-band Nothing	

GSM	
Low Channel In-band Nothing	
Middle Channel In-band Nothing	
High Channel In-band Nothing	

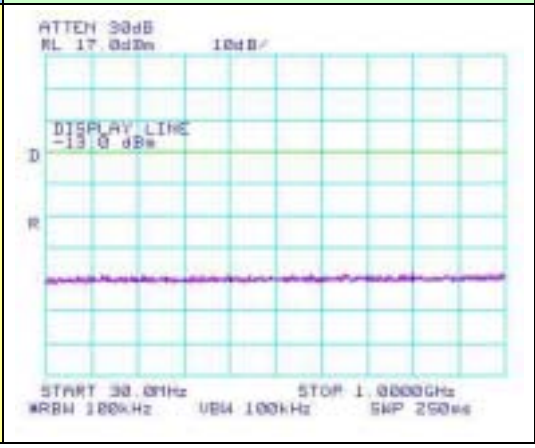
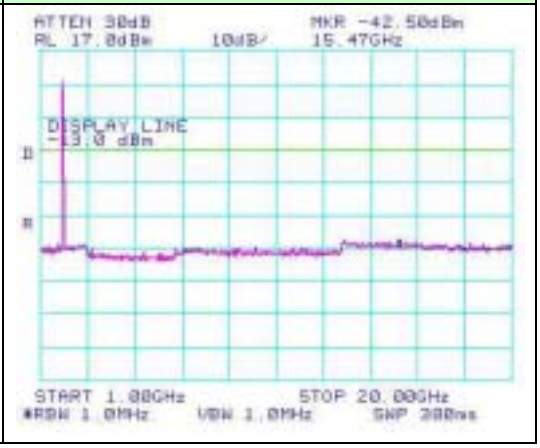
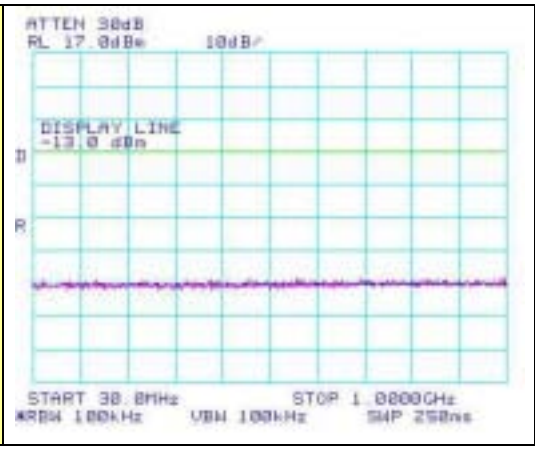
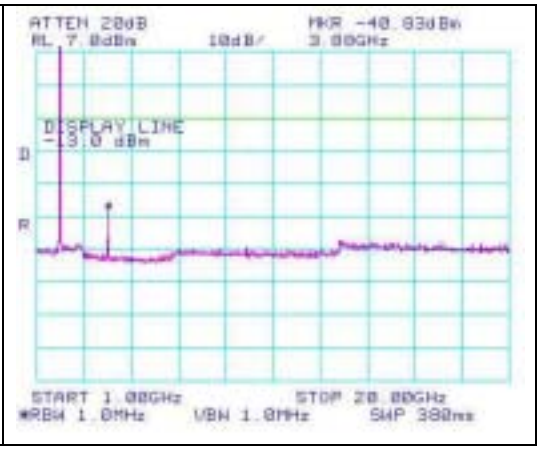
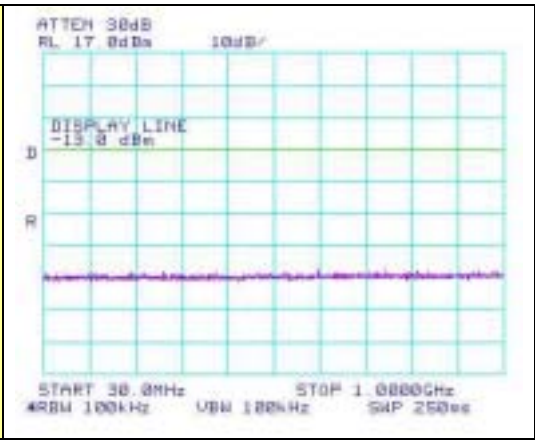
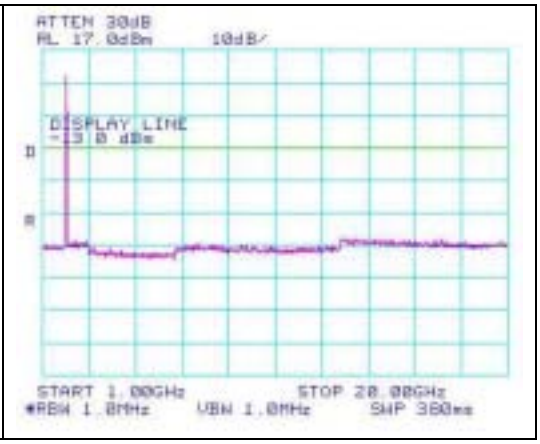
3. Up Link

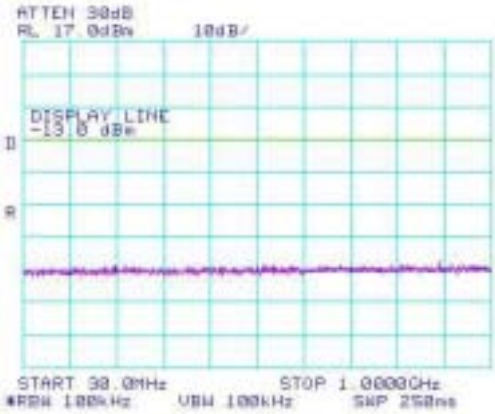
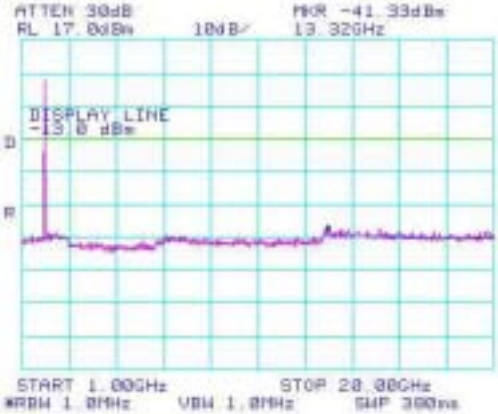
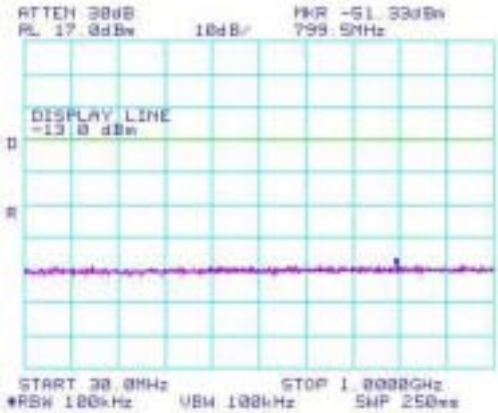
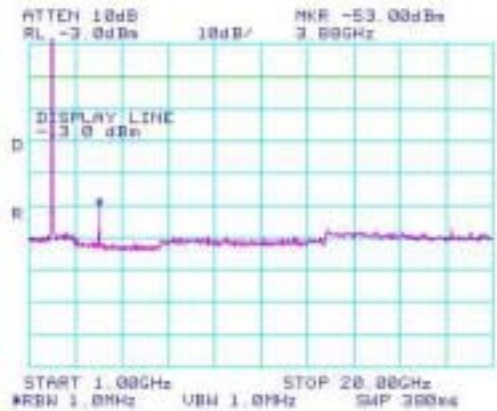
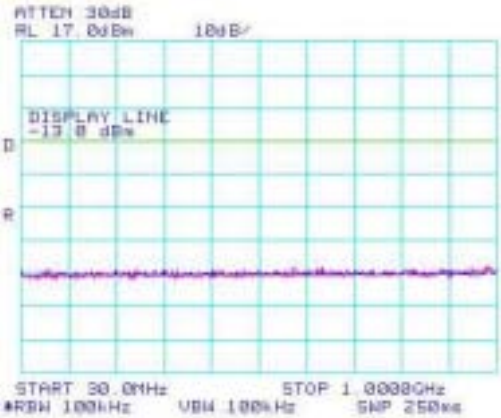
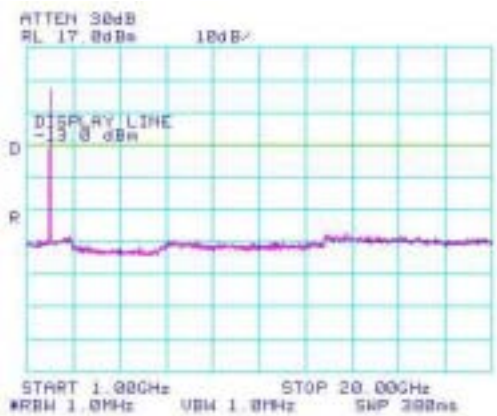
Frequency	30 MHz ~ 1 GHz	1 GHz ~ 20 GHz
CDMA Low Frequency -47.83 dBm		
CDMA Middle Frequency Nothing		
CDMA High Frequency Nothing		

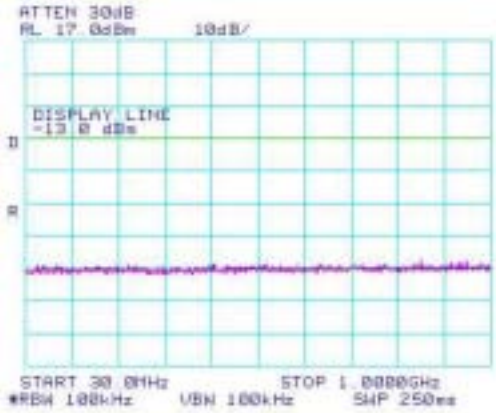
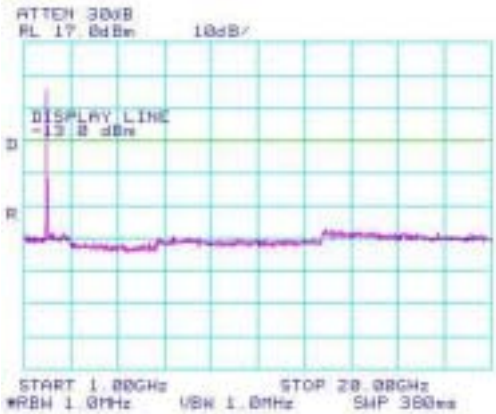
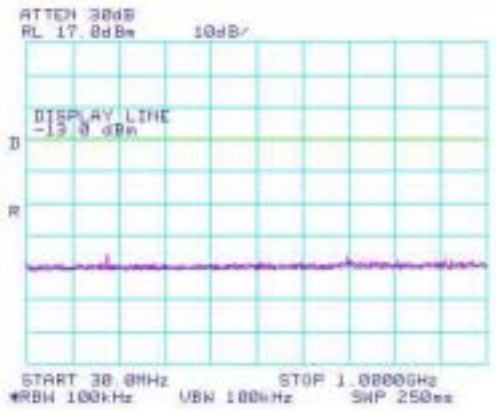
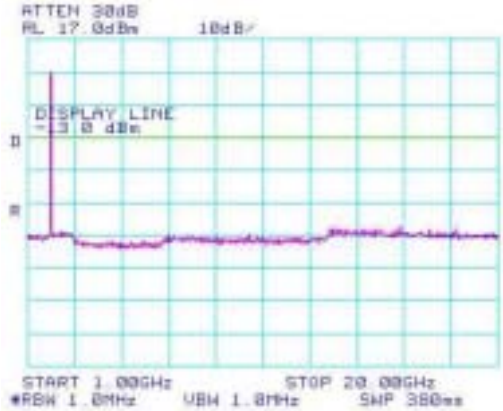
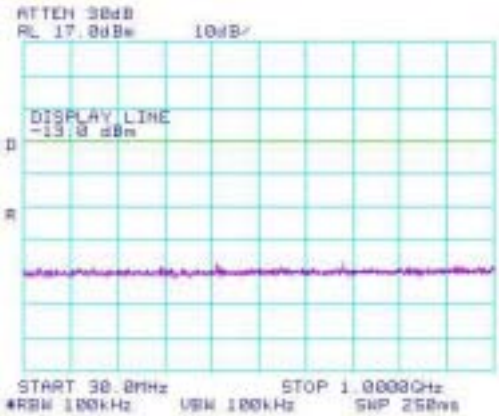
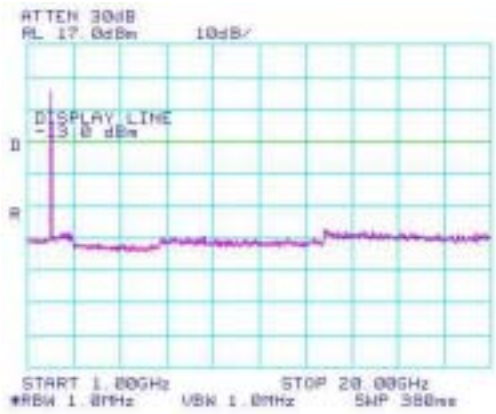
Frequency	30 MHz ~ 1 GHz	1 GHz ~ 20 GHz
NADC Low Frequency Nothing		
NADC Middle Frequency Nothing		
NADC High Frequency Nothing		

Frequency	30 MHz ~ 1 GHz	1 GHz ~ 20 GHz
GSM Low Frequency Nothing		
GSM Middle Frequency Nothing		
GSM High Frequency Nothing		

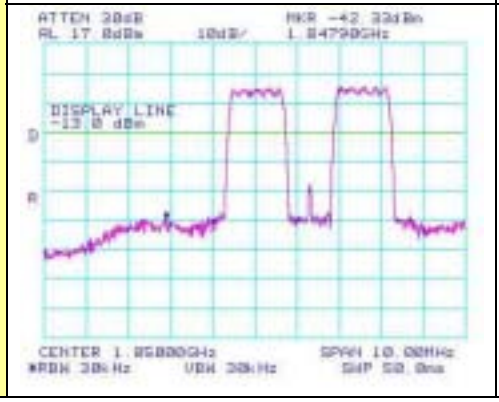
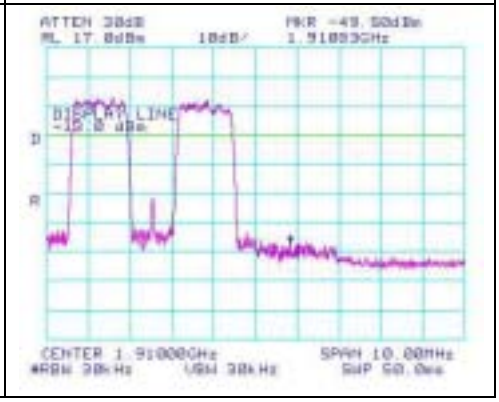
4. Down Link

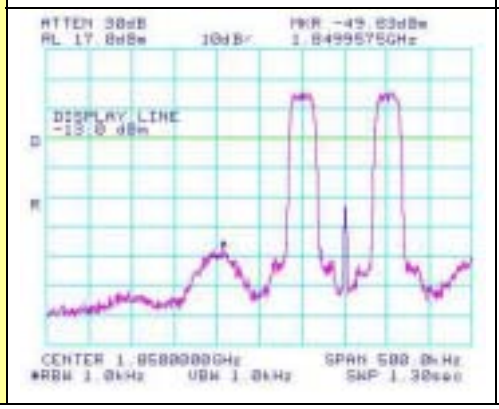
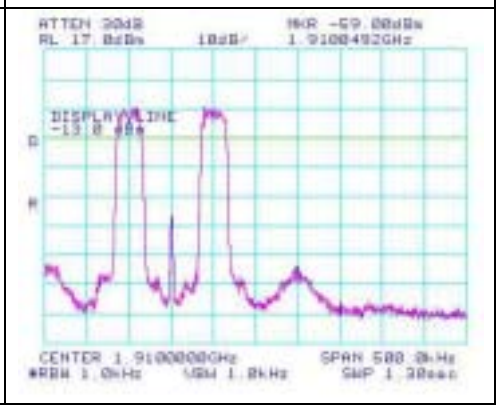
Frequency	30 MHz ~ 1 GHz	1 GHz ~ 20 GHz
CDMA Low Frequency Nothing		
CDMA Middle Frequency -40.83 dBm		
CDMA High Frequency Nothing		

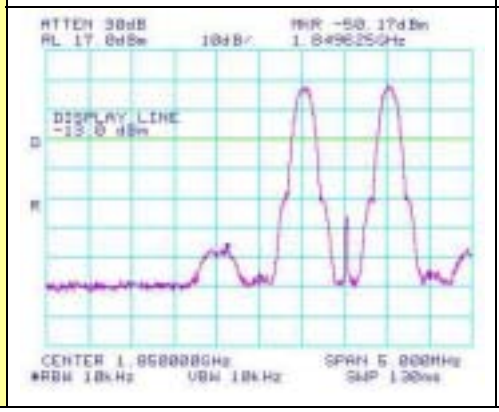
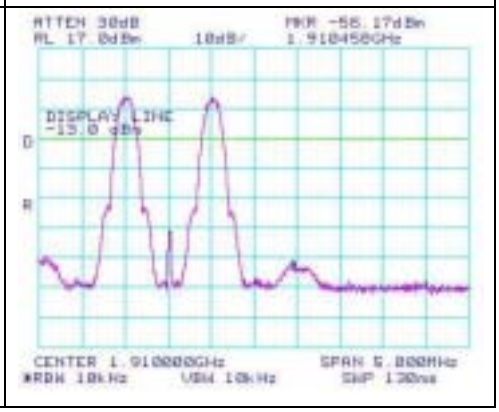
Frequency	30 MHz ~ 1 GHz	1 GHz ~ 20 GHz
NADC Low Frequency Nothing		
NADC Middle Frequency -53.00 dBm		
NADC High Frequency Nothing		

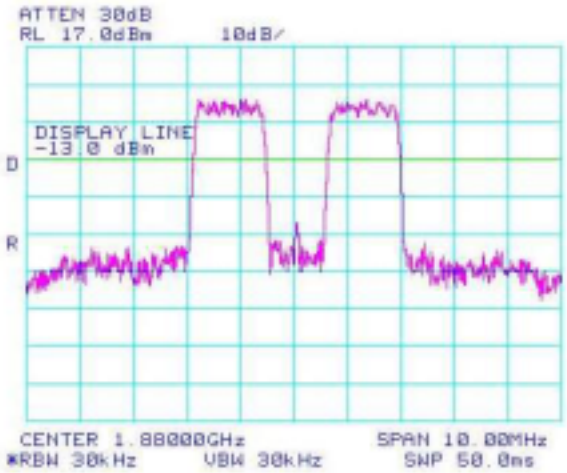
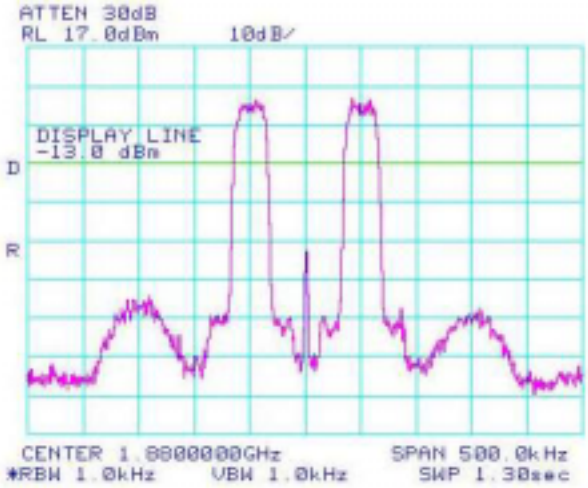
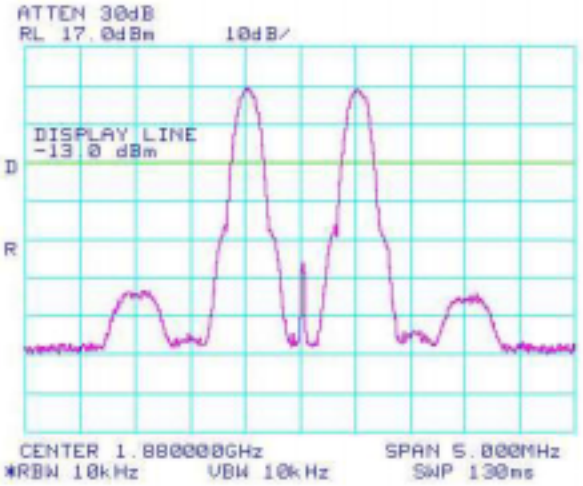
Frequency	30 MHz ~ 1 GHz	1 GHz ~ 20 GHz
GSM Low Frequency Nothing		
GSM Middle Frequency Nothing		
GSM High Frequency Nothing		

5. Up Link

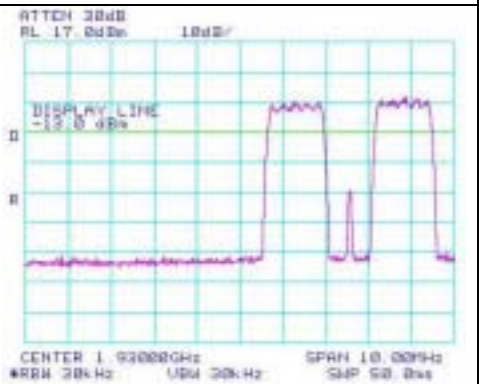
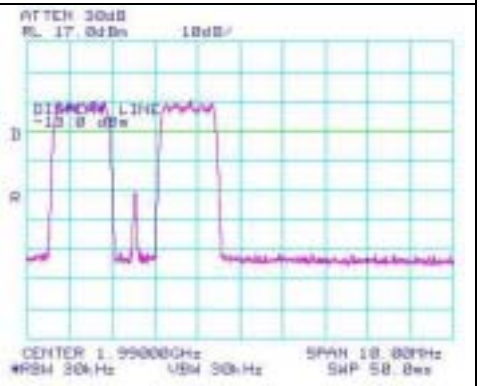
Intermodulation (1)		
	Lower Edge	Upper Edge
CDMA -42.33 dBm		

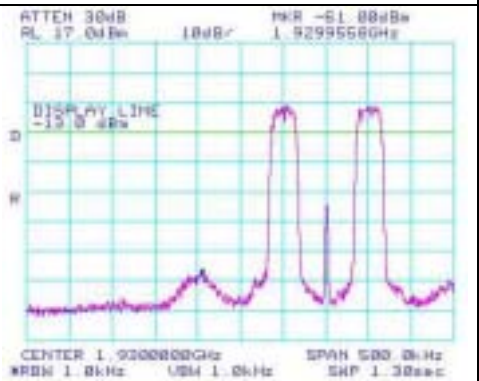
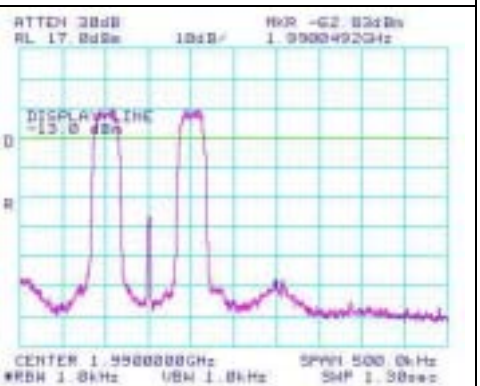
	Lower Edge	Upper Edge
NADC -49.83 dBm		

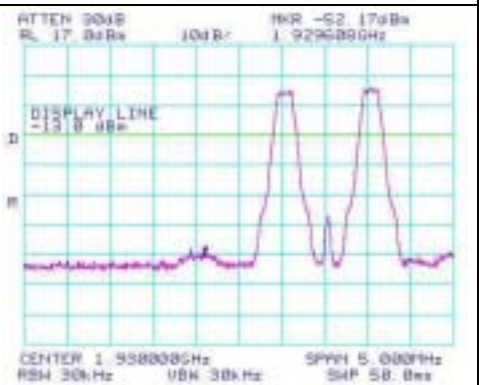
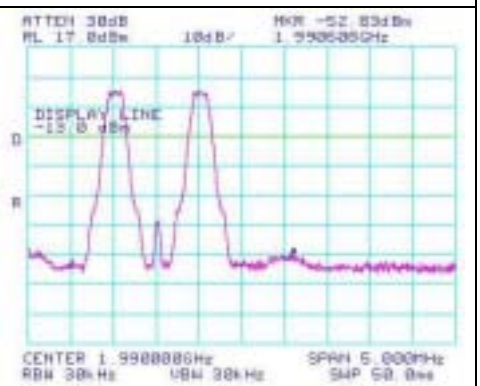
	Lower Edge	Upper Edge
GSM -50.17 dBm		

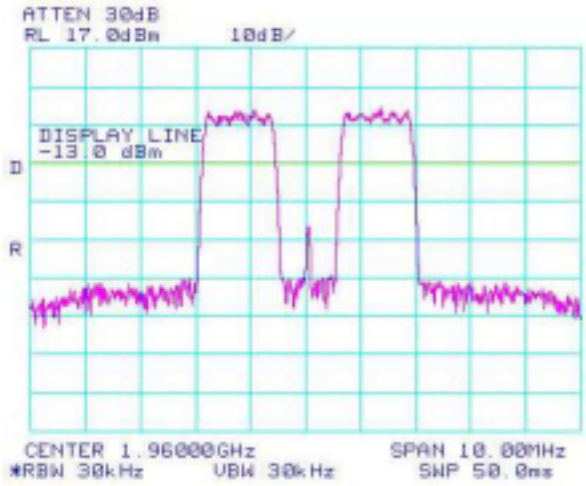
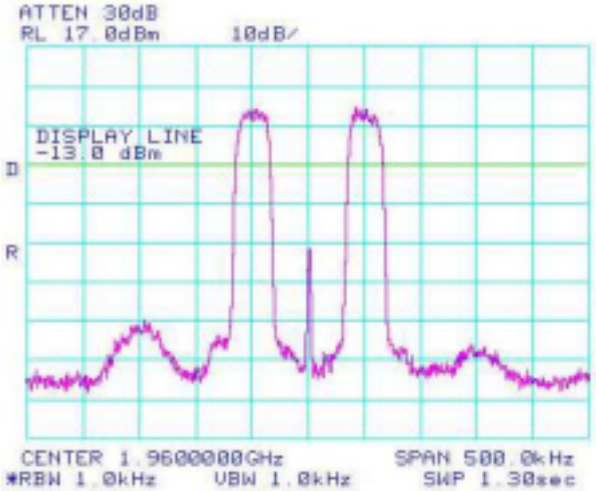
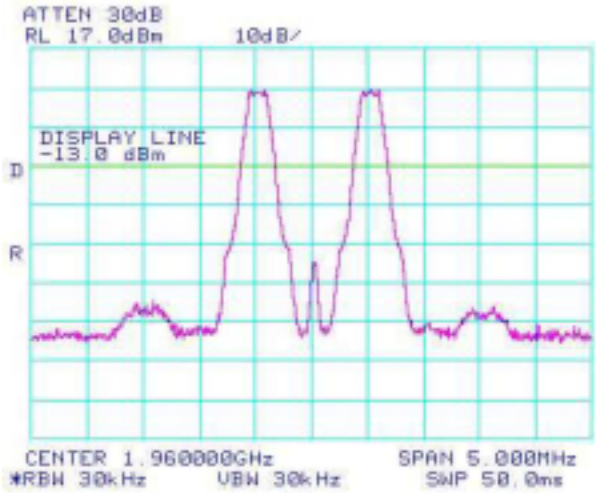
Intermodulation(2)	
CDMA 1880.00 MHz ±1.25 MHz << -13dBm	
NADC 1880.00 MHz ±50 kHz << -13dBm	
GSM 1880.00 MHz ±500 kHz << -13dBm	

6. Down Link

Intermodulation (1)		
	Lower Edge	Upper Edge
CDMA Nothing		

	Lower Edge	Upper Edge
NADC -61.00 dBm		

	Lower Edge	Upper Edge
GSM -52.17 dBm		

Intermodulation(2)	
CDMA 1960.00 MHz ±1.25 MHz << -13dBm	
NADC 1960.00 MHz ±50 kHz -13dBm	
GSM 1960.00 MHz ±500 kHz -13dBm	

7.6 Field Strength of Spurious Radiation

Test Standard	: FCC Part 24.238 & 2.1053
Operating Frequency	: Up Link : 1850 MHz ~ 1910 MHz Down Link : 1930 MHz ~ 1990 MHz
Channel	: Low / Middle / High
RF Power Output	: 10 mW (Up Link) 5 mW (Down Link)
Distance	: 3 meters

Harmonic	Antenna Polarization (V/H)	ERP (dBm)	Limit (dBm)	Margin (dB)
2nd	-	<< ambient level	-13.0	-
3rd	-	<< ambient level	-13.0	-
4th	-	-	-	-
5th	-	-	-	-
6th	-	-	-	-
7th	-	-	-	-
8th	-	-	-	-
9th	-	-	-	-
10th	-	-	-	-

Note :

1. *The spectrum bandwidth was set to RBW 100 kHz (freq. up to 1GHz) and RBW 1 MHz(freq above 1GHz).*
2. *Transmitter was set to the rated power output(5 mW) condition.*
3. *The spectrum was checked from 30 MHz up to the 10th harmonic of the carrier frequency.*
4. *All emission not reported were found to be more than 30dB below the limit.*
5. *The EUT was positioned through 3 orthogonal axis and worst-case are reported.*
6. *ERP measurements were performed using the rated supply voltage condition(DC 7V).*
7. *The limit was applied according to the 43 +10log(P)dBc.*
8. *The measurements were performed at the open-site with environmental conditions of 35℃, 24%RH.*

Tested by ***Yang, Eun Jung***

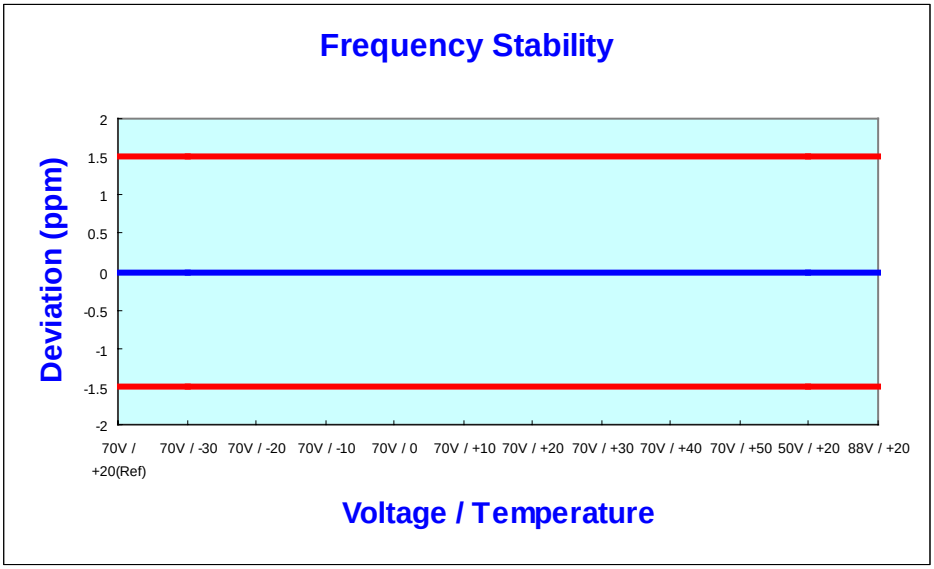
8.7 Frequency Stability

Test Standard	: FCC Part 24.235 & 2.1055
Operating Frequency	: Up Link : 1880.0 MHz Down Link : 1960.0 MHz
Channel	: Middle
RF Power Output	: 10 mW (Up Link: Non-Modulation Signal) 5 mW (Down Link: Non-Modulation Signal)

8.7.1 Up Link

Voltage (%)	Power Supply (Vdc)	Temperature (°C)	Frequency (Hz)	Deviation (ppm)
100 %	7	+20(Ref)	1880000000Hz	0
100 %	7	-20	1880000000Hz	0
100 %	7	-10	1880000000Hz	0
100 %	7	0	1880000000Hz	0
100 %	7	+10	1880000000Hz	0
100 %	7	+20	1880000000Hz	0
100 %	7	+30	1880000000Hz	0
100 %	7	+40	1880000000Hz	0
100 %	7	+50	1880000000Hz	0
85 %	5.95	+20	1880000000Hz	0
115 %	8.05	+20	1880000000Hz	0

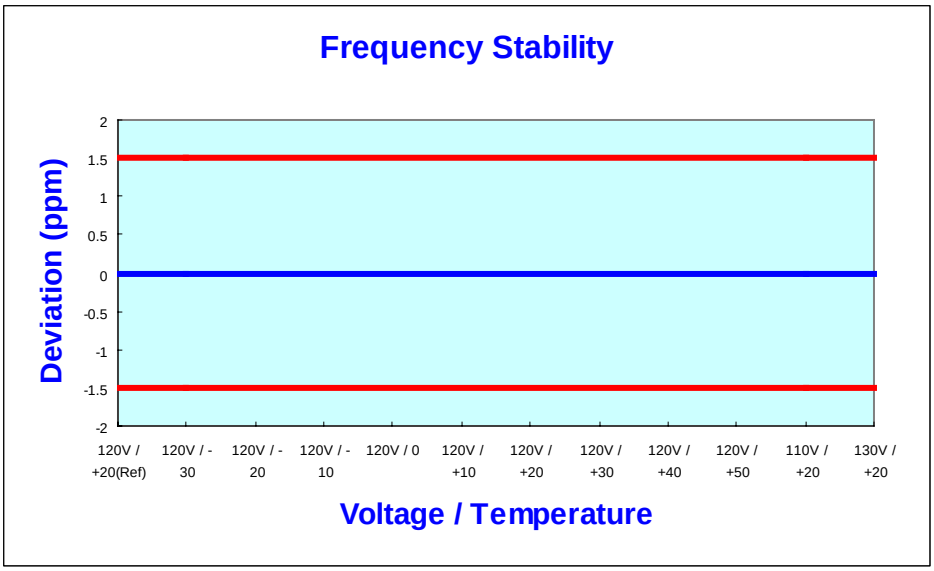
Note :
1. The worst-case temperature & voltage deviation was recorded.
2. Frequency drift of this unit dose not happen.



8.7.2 Down Link

Voltage (%)	Power Supply (Vac)	Temperature (°C)	Frequency (Hz)	Deviation (ppm)
100 %	7	+20(Ref)	1960000000Hz	0
100 %	7	-20	1960000000Hz	0
100 %	7	-10	1960000000Hz	0
100 %	7	0	1960000000Hz	0
100 %	7	+10	1960000000Hz	0
100 %	7	+20	1960000000Hz	0
100 %	7	+30	1960000000Hz	0
100 %	7	+40	1960000000Hz	0
100 %	5.95	+50	1960000000Hz	0
85 %	8.05	+20	1960000000Hz	0
115 %	7	+20	1960000000Hz	0

Note :
1. *The worst-case temperature & voltage deviation was recorded.*
2. *Frequency drift of this system dose not happen.*



Tested by ***Yang, Eun Jung***

8. TEST EQUIPMENT LIST

List of Test Equipments Used for Measurements

Test Equipment	Model	Mfg.	Serial No.	Cal. Due Date
Spectrum Analyzer	8594E	H.P.	3911A08040	05-12-28
Spectrum Analyzer	E7403A	ADVANTEST	61720002	05-05-18
Receiver	ESH3	R & S	892580/014	05-08-30
Signal Generator	E4432B	H.P.	US40053157	06-03-10
Signal Generator	GT9000	GIGATRONICS	9604010	06-03-10
Power Meter	E4418A	H.P.	GB38272621	06-03-10
Power Sensor	8481A	H.P.	3318A92101	06-03-10
Audio Analyzer	8903B	H.P.	3011A09344	06-03-10
Modulation Analyzer	8901B	H.P.	3028A03124	06-03-10
Function Generator	FG-2002C	GOLD STAR	207095	06-01-13
Broadband Power Amplifier	100W 10000M 11	Amplifier Research	18649	05-12-29
Broadband Power Amplifier	75A220	Amplifier Research	15326	05-12-29
Preamplifier	8447E	H.P.	2945A02712	05-08-30
Horn Antenna	BBHA 9120 D	Schwarz Beck	234	07-02-07
Horn Antenna	BBHA 9170	Schwarz Beck	157	07-02-07
Dipole Antenna	VDA6106A / UHA9105	Schaffner-chase	1277	05-09-12
Biconical Antenna	VHA9103	Schwarzbeck	-	06-02-04
Log Periodic Antenna	UPA6109	SCHAFFNER	1076	06-02-04
Attenuator	8325	BIRD	4572	06-03-10
Attenuator	RFA500NMF30	RFA500NMF30	9522	05-12-28
Termination	8173	BIRD	2501	-
Dual directional coupler	772D	H.P.	2839A00395	05-12-28
Dual directional coupler	778D	H.P.	1144A08477	05-10-15
LISN	L3-25	PMM	1110KT0403	05-04-06
LISN	LI-115	COM-POWER	8-920-20	05-10-27
Digital Oscilloscope	TDS3032	Tektronix	B081558	05-12-28
Turn-Table	JAC-2	JAEMC	-	-
Antenna Master	JAC-1	Daeil EMC	-	-
Plotter	7550A	H.P	2725A 75529	-
EMC Anechoic Chamber	-	SEMITECH	000815	
Temp/Humidity Chamber	-	Seo jin	-	05-09-03
Thermo Hygrograph	PC-5000TRH-II	SATO	-	자체교정
BaroMeter	KEIRYOKI	SATO	564021	05-09-15
Slidacs	DeaKyong Slidacs	DeaKyong	-	-