Licensed Non-Broadcasting Transceiver

RF MEASUREMENT REPORT

VERIFICATION OF COMPLIANCE

PRODUCT	:	**PCS 1.9G Pico Repeater**
MODEL/TYPE NO	:	**SHPR19-F1**
FCC ID	:	**R3ISHPR19-F1**
TRADE NAME	:	**Seohwa Telecom**
APPLICANT	:	**Seohwa Telecom Co., Ltd. #678 Gasan-dong, Gumchen-gu, Seoul, Korea**
FCC RULE PART(S)	:	**FCC Part 24 & Part 2**
FCC PROCEDURE	:	**Certification**
FCC CLASSIFICATION	:	**Licensed Non-Broadcast Station Transmitter (TNB)**
EMISSION DESIGNATOR	:	**F9W(CDMA), DXW(NADC), GXW(GSM)**
FREQUENCY RANGE	:	**FWD : 1930 MHz ~ 1990 MHz RVS : 1850 MHz ~ 1910 MHz**
RF OUTPUT POWER	:	**BWS-04-RF-011**
DATES OF TEST	:	**April 09, 2004**
DATES OF ISSUE	:	**April 20, 2004**
TEST REPORT No.	:	**BWS-04-RF-011**
TEST LAB.		**BWS Tech., Inc. (Registration No. : 553281)**

This RF Reapter Model SHPR19-F1 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.

Kang, Bong Chul
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 Gasna-dong, Gumchen-gu, Seoul, Korea
Phone/Fax	:	Phone : +82 2 838 5511 Fax : +82 2 838 5313

Other Information

● **EUT Type**	:	RF Broad Band Repeater
● **Model Name**	:	SHPR19-F1
● **FCC Identifier**	:	R3ISHPR19-F1
● **Brand Name**	:	Seohwa Telecom
● **S/N**	:	Prototype
● **Freq. Range**	:	FWD : 1930 MHz ~ 1990 MHz RVS : 1850 MHz ~ 1910 MHz
● **Max. Power Output**	:	10 mWatts (10 dBm) CDMA – Single Channel NADC – Composite Multiple Channel GSM - Composite Multiple Channel
● **Emission Designator**	:	F9W(CDMA), DXW(NADC), GXW(GSM)
● **FCC Classfication**	:	Licensed Non-Broadcast Station Transmitter (TNB)
● **Rule Part(s)**	:	FCC Part 24 & Part 2
● **Test Procedure**	:	Certification
● **Dates of Tests**	:	April 09, 2004
● **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-04-RF-011

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. Operational Instruction
-. Explanation of operational instruction for circuit is shown.

Appendix 8. Part List / Tune up Procedure
-. 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 RF Broad Band repeater is a device to cover signal blind, which are generated in the wave shadow area where the signal reception is not clear, as amplifying and emitting the frequency of radio waves received from the nearby station. This repeater is located on the path between CDMA Base station and a mobile terminal. It amplifies the signal between a station and a terminal, and provides the radio channel.

4.2 Technical Specification

- Chassis Type	Metal enclosure
- Frequency Range	FWD : 1930 MHz ~ 1990 MHz RVS : 1850 MHz ~ 1910 MHz
- Channel Spacing	1.23 MHz
- RF Output Power	10 mWatts (10 dBm) CDMA – Single Channel NADC – Composite Multiple Channel GSM - Composite Multiple Channel
- Input Power Range	-120 dBm ~ -40 dBm
- Shut Down	14 ~ 16 dBm / Total
- Communication	Tx/Rx
- ALC Range	30 dB/1dB Step
- Operating Temperature	-25℃ ~ +55℃
- Dimension	180(W) x 120(H) x 50(D)
- Power Supply	7Vdc / 115Vac

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.

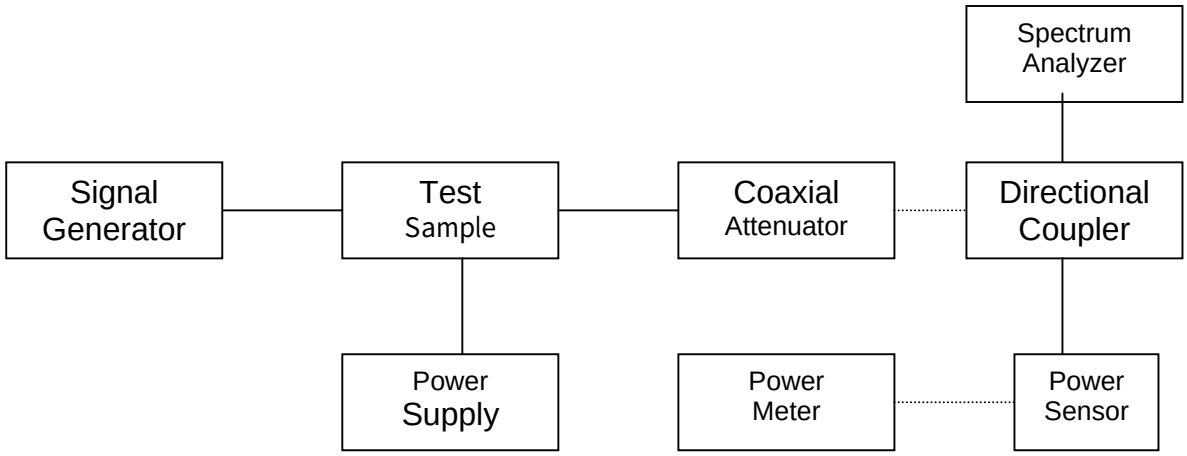
5. DESCRIPTION OF TESTS

5.1 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.



5.2 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

5.3 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})

5.4 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.

5.5 Modulation Limiting - §2.1047(b) & §22.915(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.

5.6 Occupied Bandwidth : §2.1049 & §22.913

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.

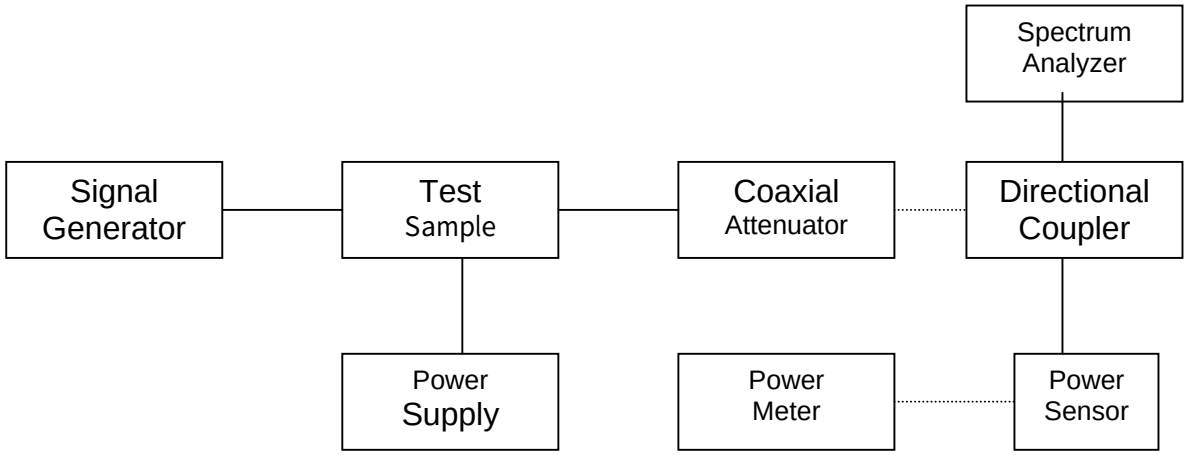
The antenna output terminal of the EUT was connected to the input of a 50ohm spectrum analyzer through a matched 30dB attenuator. The radio transmitter was modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established 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.

5.7 Spurious and Harmonic Emissions at Antenna Terminal : §2.1051

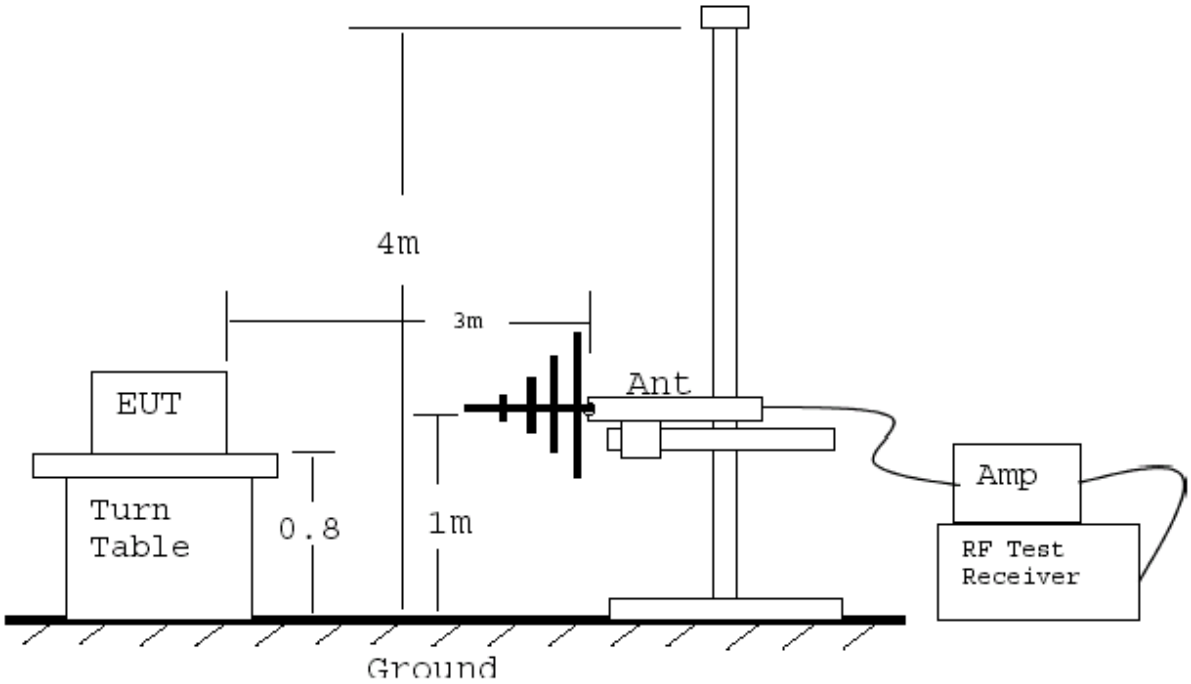
The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to 10 GHz. The transmitter is modulated with a 2500Hz tone at a level of 16dB greater 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.

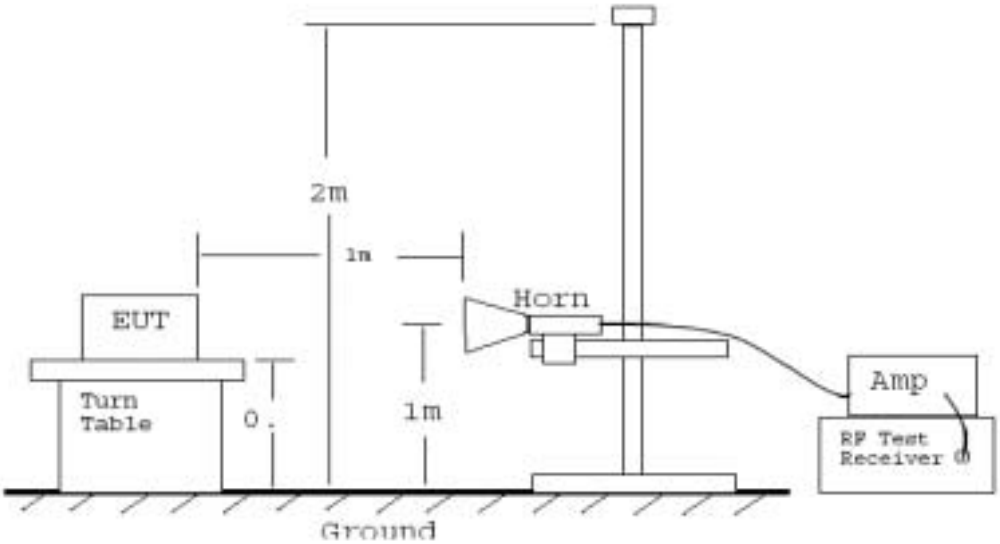


5.8 Radiated Spurious and Harmonic Emissions : §2.1053

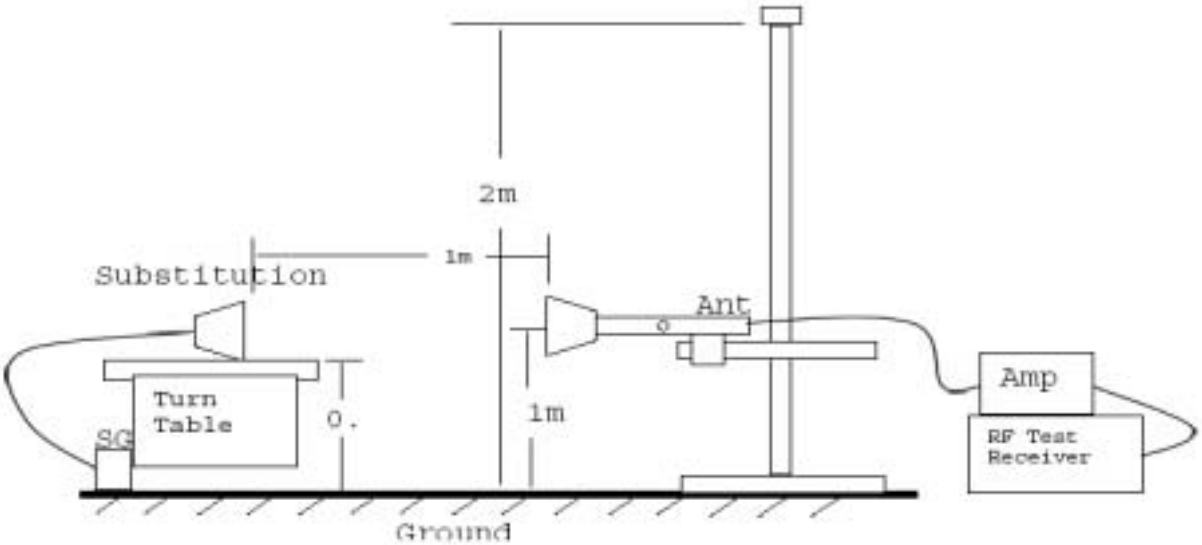
Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet,
control circuits, power leads, or inter-mediate circuit elements under normal conditions of installation and operation.
Radiation and harmonic emissions above 1 GHz is measured outdoors at our 3-meter 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

5.9 Frequency Stability / Temperature Variation - §2.1055(b) & §22.335

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 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
Part 2.1055	RF Power Output	☒ Pass ☐ Fail

The data collected shows that the **Seohwa Telecom Co., Ltd. PCS Repeater SHPR19-F1** complies with technical requirements of the FCC Rule Part 2.947 and Part 22 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 RF Power Output Measurement

Test Standard	:	FCC Part 24.232 & 2.1046
Operating Frequency	:	Forward 1930 - 1990 MHz Reverse 1850 - 1910 MHz
Channel	:	Low / Mid/ High
RF Power Output	:	10 mW CDMA - Single Channel NADC - Composite Multiple Channel GSM - Composite Multiple Channel

Down Link(Forward)

Test Conditon	Measured Output Power (mW)		
	Low	Mid	High
CDMA	4.2	6.1	5.9
NADC	4.4	6.2	6.5
GSM	5.2	7.4	6.2

Up Link(Reverse)

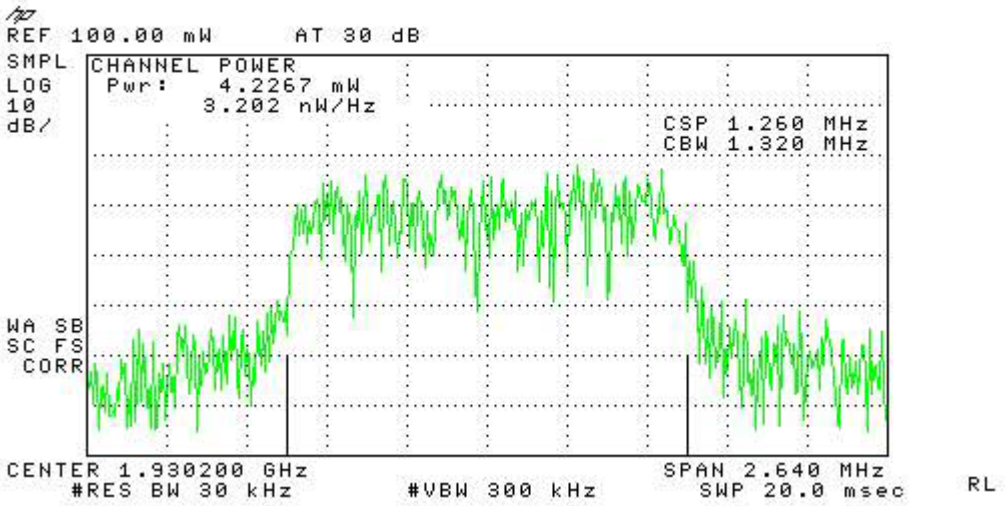
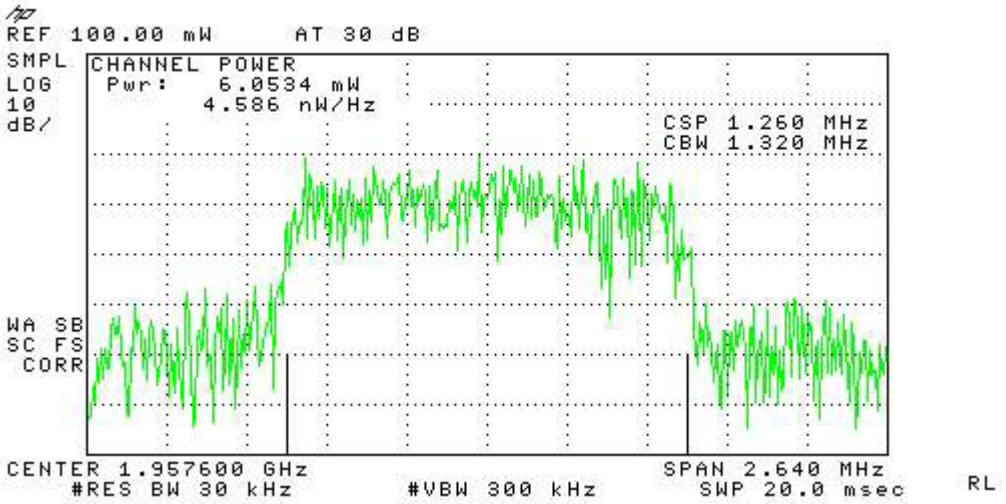
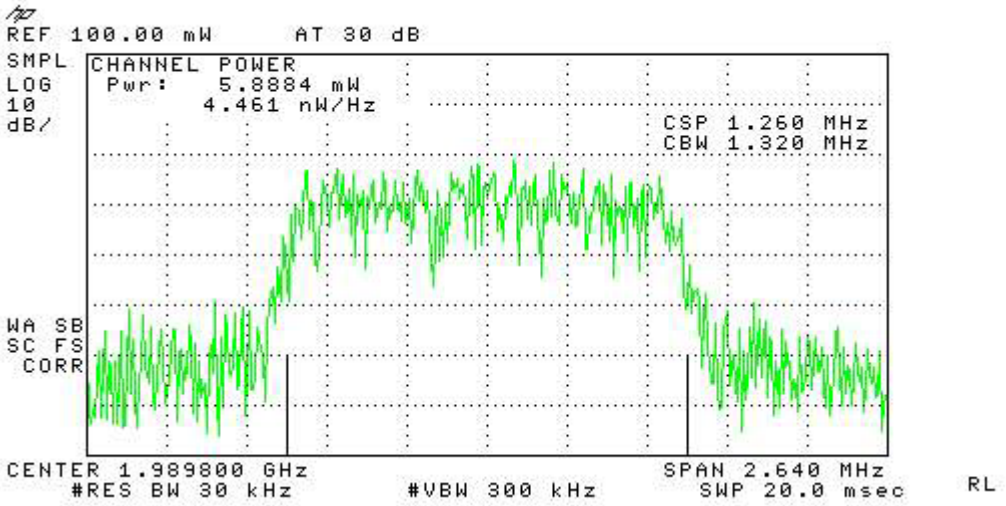
Test Conditon	Measured Output Power (mW)		
	Low	Mid	High
CDMA	12.1	9.9	7.2
NADC	12.8	7.2	5.8
GSM	13.0	8.4	5.6

Note :

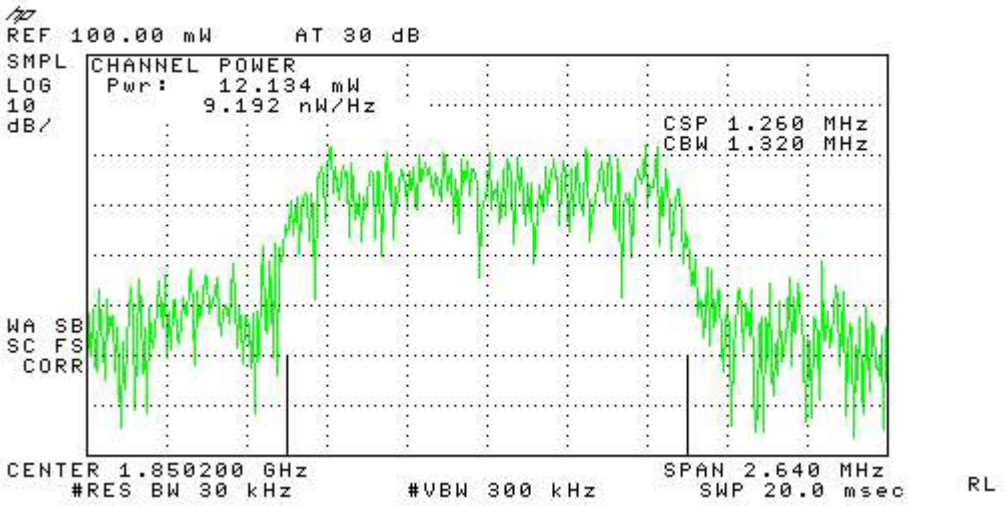
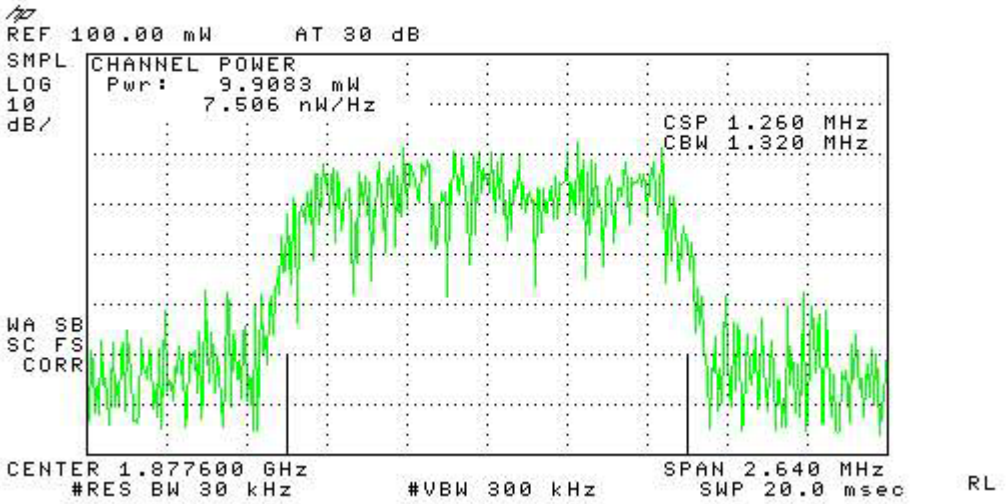
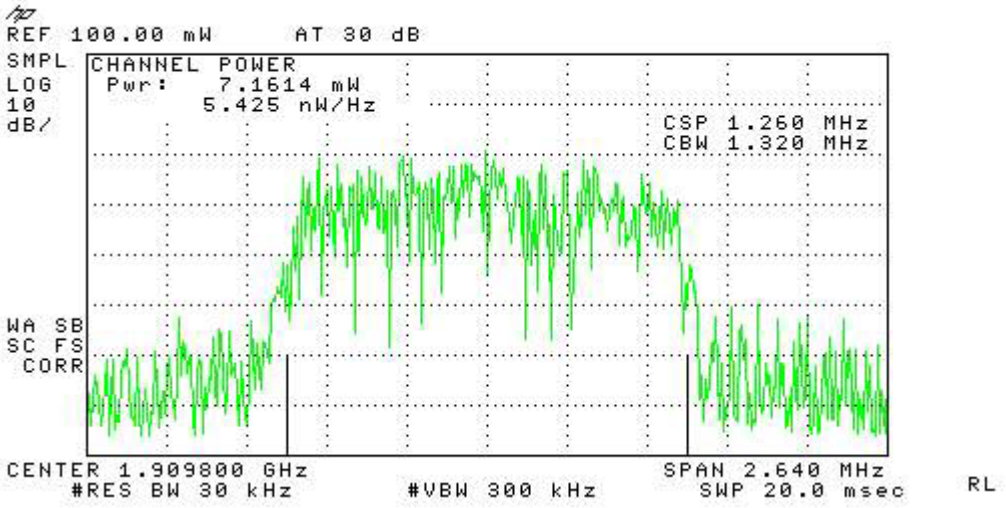
1. *The input to the amplifier is tuned such that the output power is set to its maximum rated power*
2. *The RF output ports were properly attenuated by the RF attenuator and were connected to the RF Power Meter and Spectrum Analyzer.*
3. *The measurements were performed at the shielded room.with environmental conditions of 23.9℃, 55%RH*
4. *Frequency Table*

Channel	*Down Link (Forward)*	*Up Link (Reverse)*
Low Channel	*1930.2 MHz*	*1850.2 MHz*
Middle Channel	*1957.6 MHz*	*1877.6 MHz*
High Channel	*1989.8 MHz*	*1909.8 MHz*

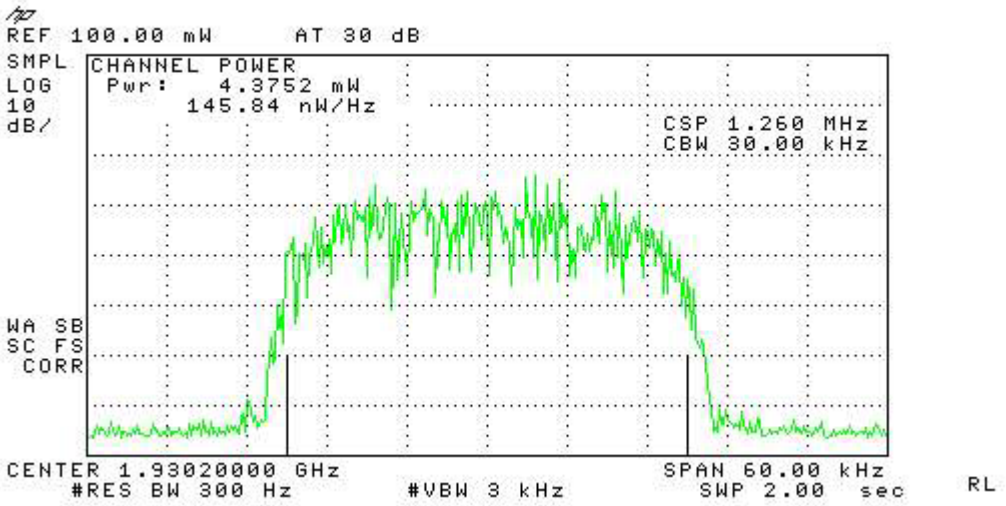
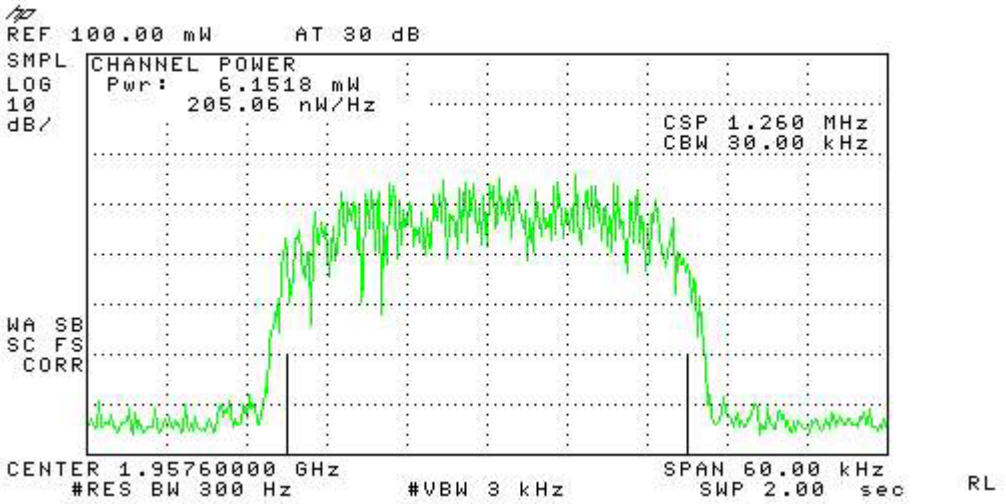
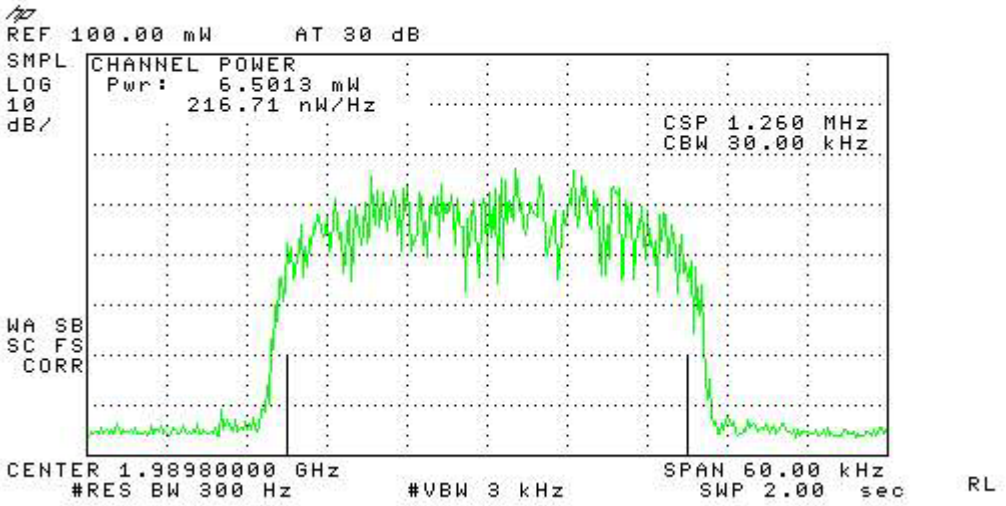
CDMA Forward Plot

Low Channel 1930.2 MHz 4.2 mW	
Middle Channel 1957.6 MHz 6.1 mW	
High Channel 1989.8 MHz 5.9 mW	

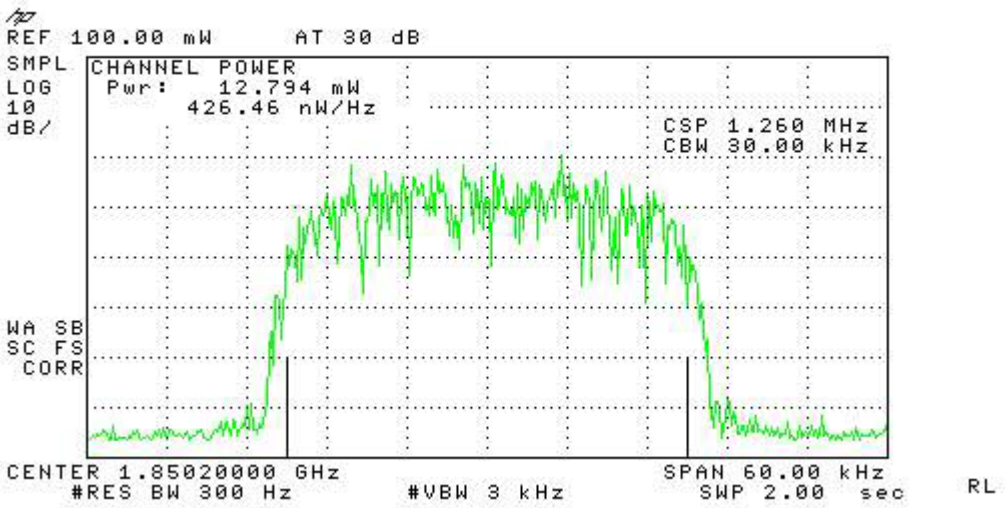
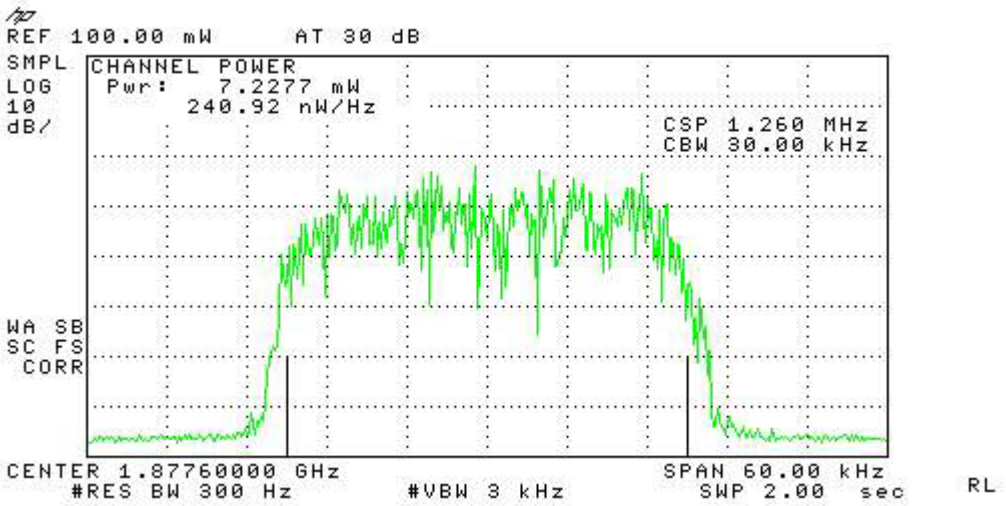
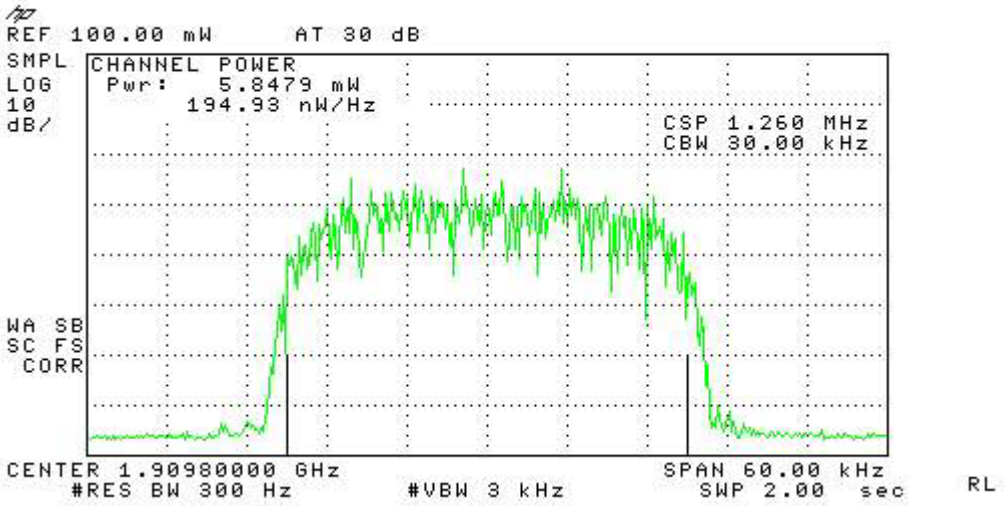
CDMA Reverse Plot

Low Channel 1850.2 MHz 12.1 mW	
Middle Channel 1877.6 MHz 9.9 mW	
High Channel 1909.8 MHz 7.2 mW	

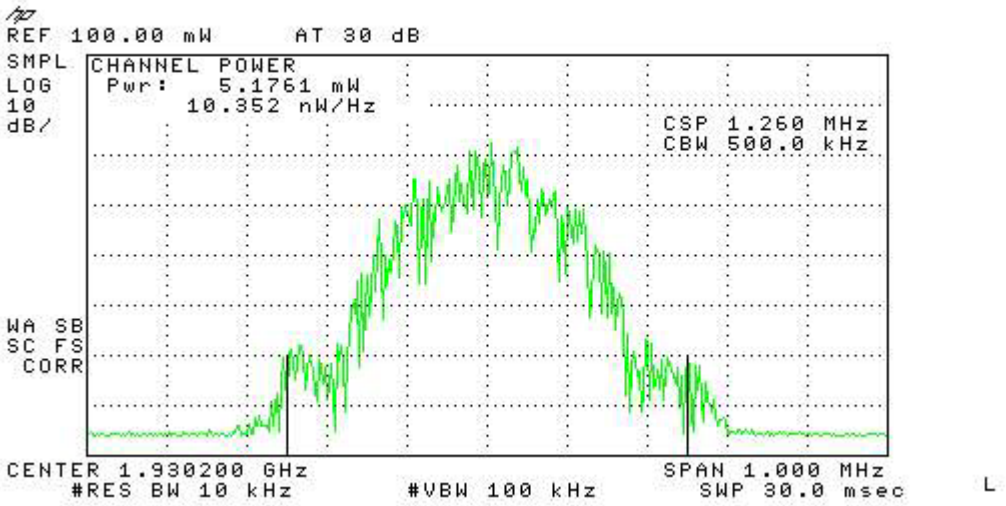
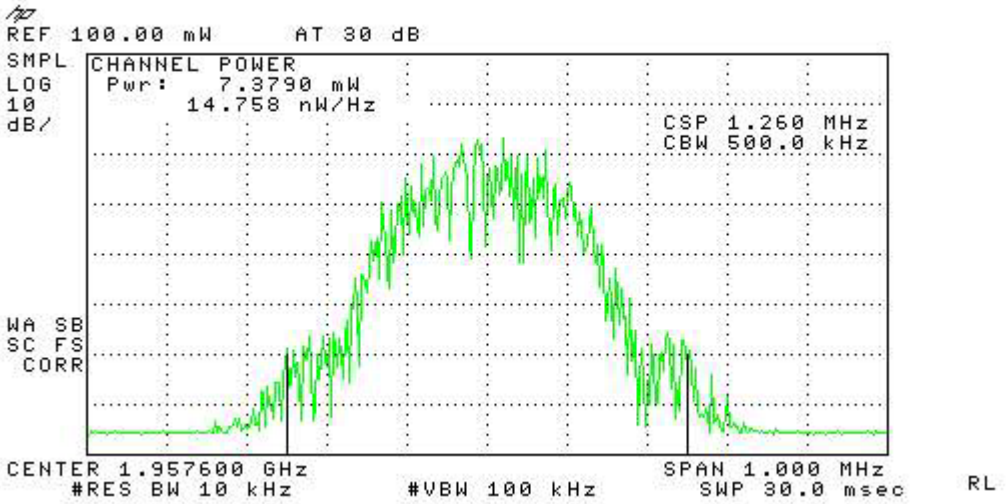
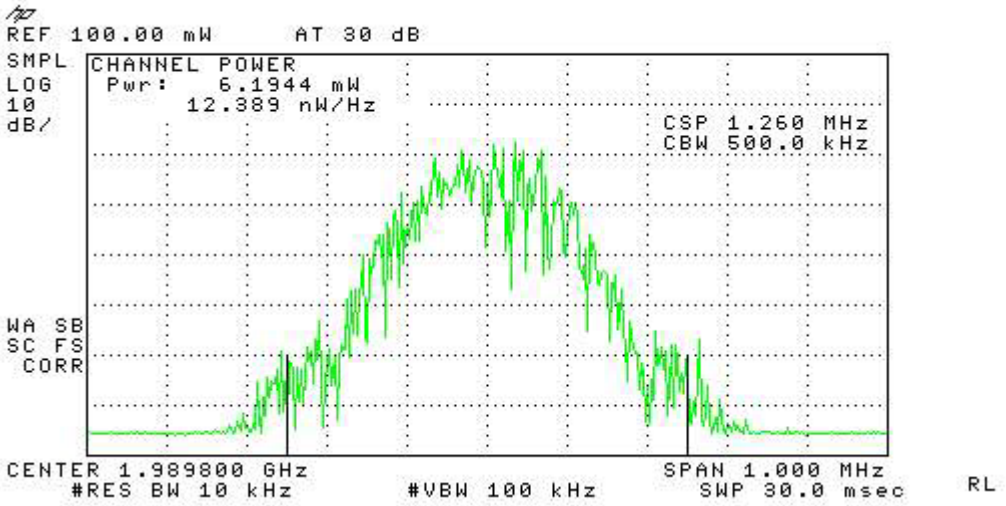
NADC Forward Plot

Low Channel 1930.2 MHz 4.4 mW	
Middle Channel 1957.6 MHz 6.2 mW	
High Channel 1989.8 MHz 6.5 mW	

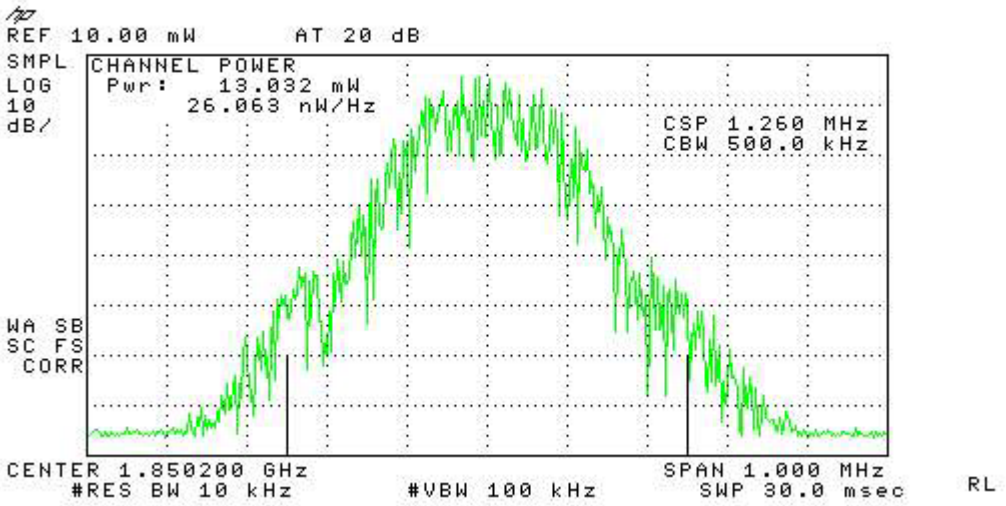
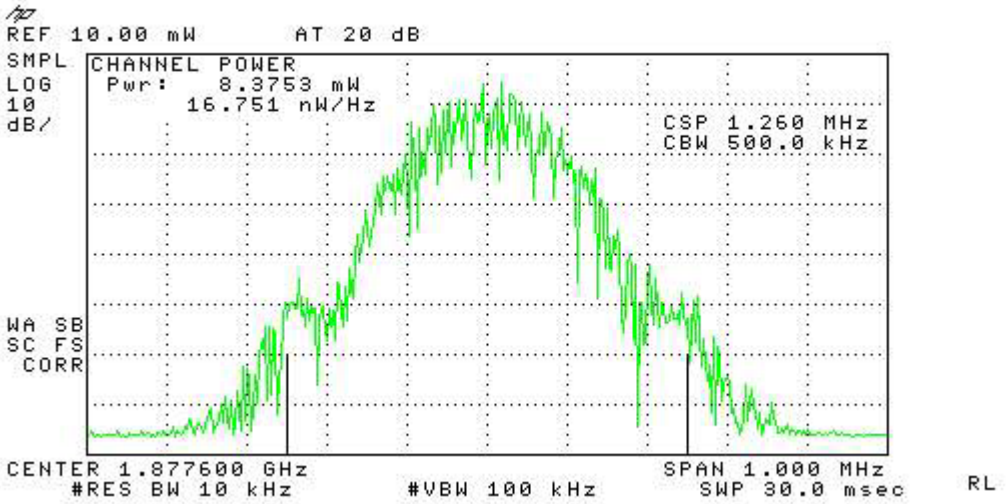
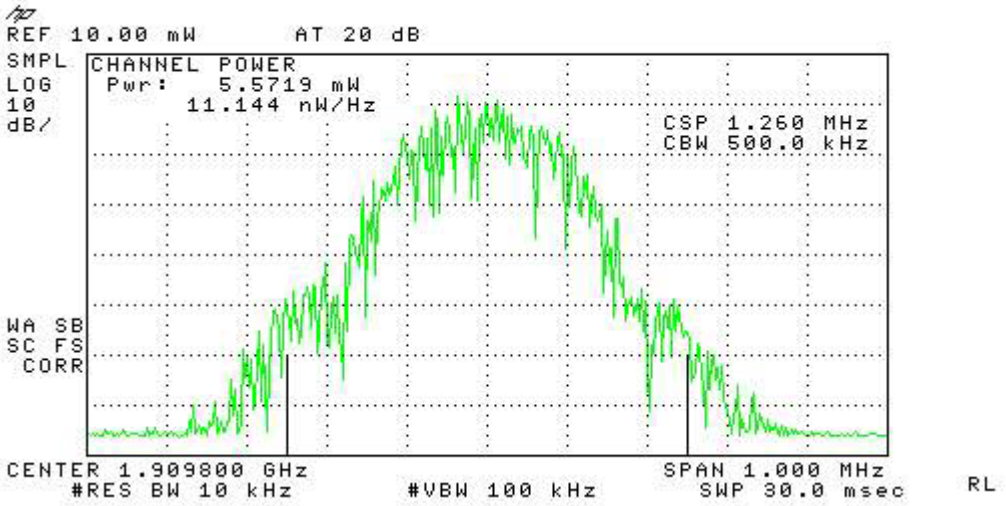
NADC Reverse Plot

Low Channel 1850.2 MHz 12.8 mW	
Middle Channel 1877.6 MHz 7.2 mW	
High Channel 1989.8 MHz 5.8 mW	

GSM Forward Plot

Low Channel 1930.2 MHz 5.2 mW	
Middle Channel 1957.6 MHz 7.4 mW	
High Channel 1989.8 MHz 6.2 mW	

GSM Reverse Plot

Low Channel 1850.2 MHz 13.0 mW	
Middle Channel 1877.6 MHz 8.4 mW	
High Channel 1989.8 MHz 5.6 mW	

7.2 Occupied Bandwidth

Test Standard	:	FCC Part 24.238 & 2.1049
Operating Frequency	:	Forward 1930 - 1990 MHz Reverse 1850 - 1910 MHz
Channel	:	Low / Mid/ High
RF Power Output	:	10 mW CDMA - Single Channel NADC - Composite Multiple Channel GSM - Composite Multiple Channel

Down Link(Forward)

Test Conditon	Measured Occupied Bandwidth (kHz)		
	Low	Mid	High
CDMA	1390	1375	1390
NADC	32.8	32.5	32.5
GSM	283	290	285

Up Link(Reverse)

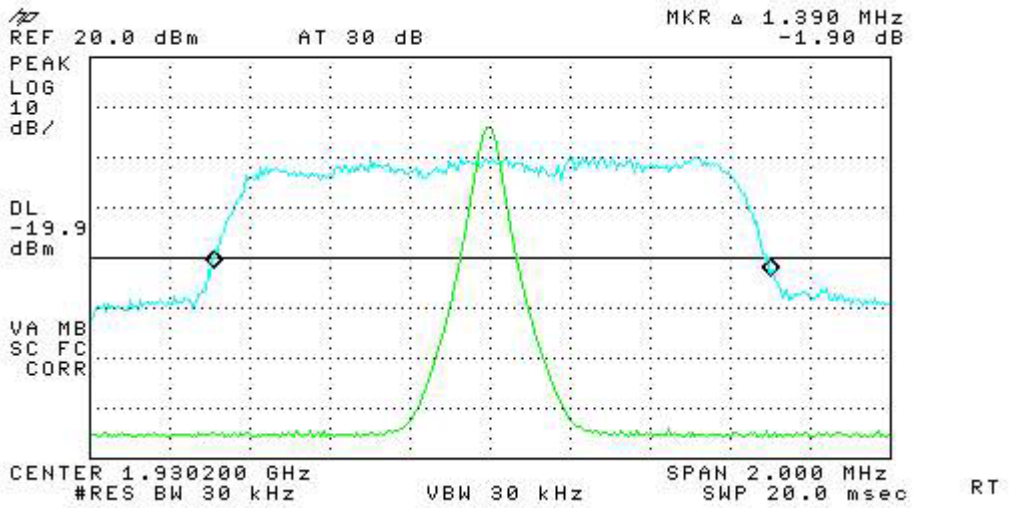
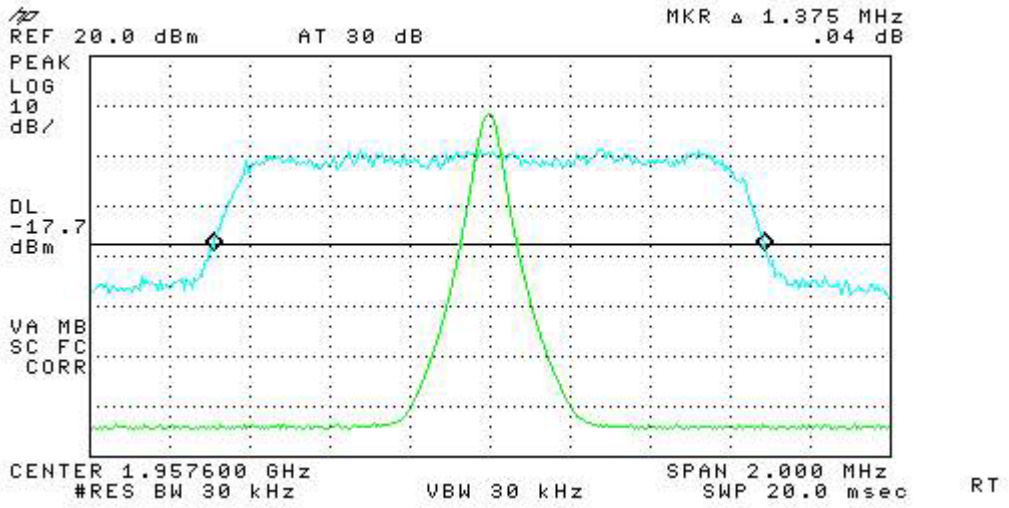
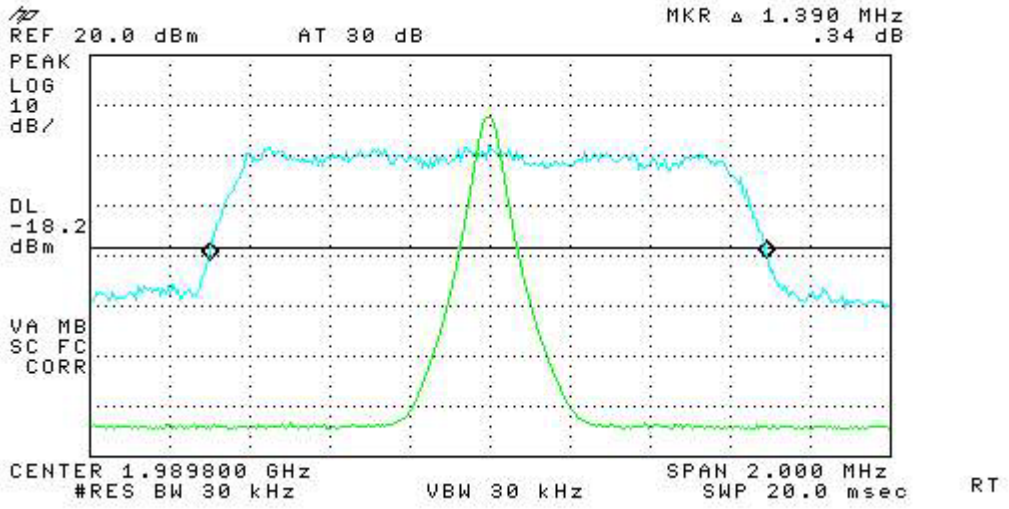
Test Conditon	Measured Occupied Bandwidth (kHz)		
	Low	Mid	High
CDMA	1385	1400	1390
NADC	32.5	33.0	32.0
GSM	290	280	283

Note :

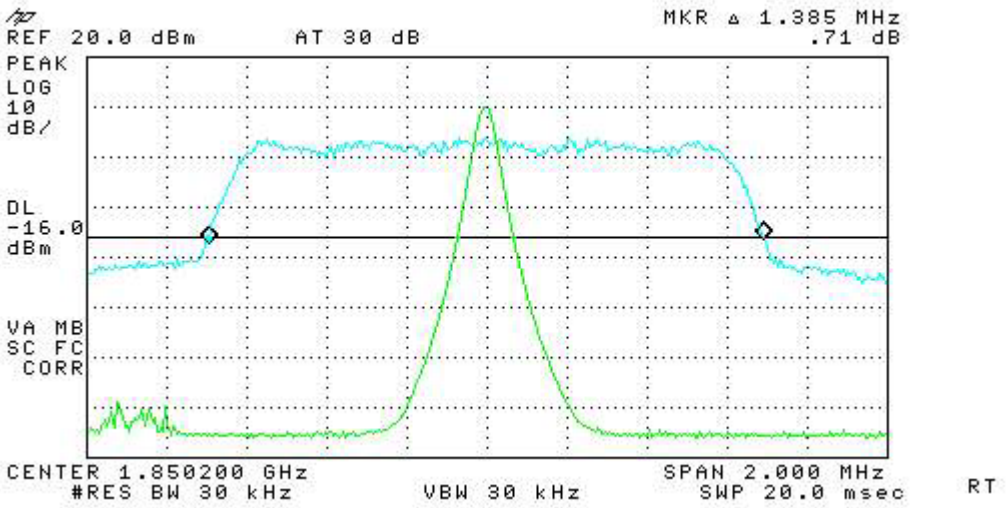
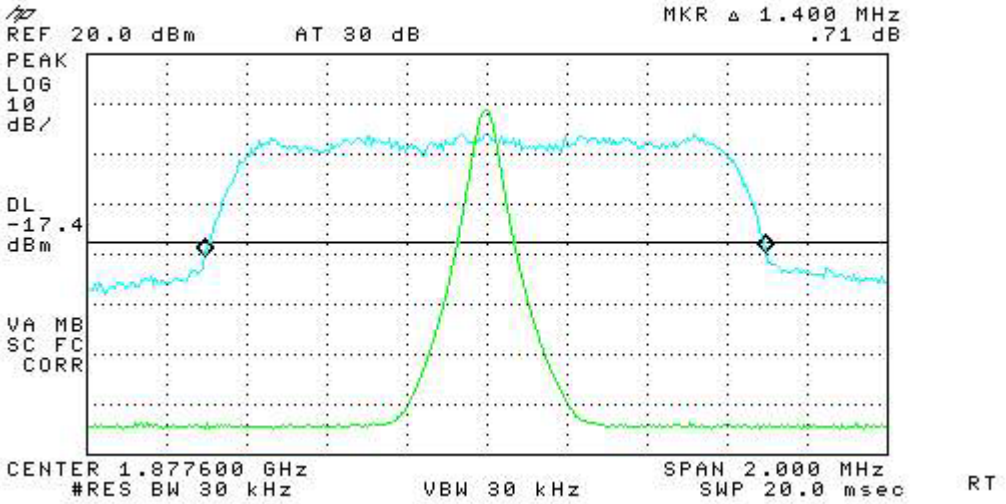
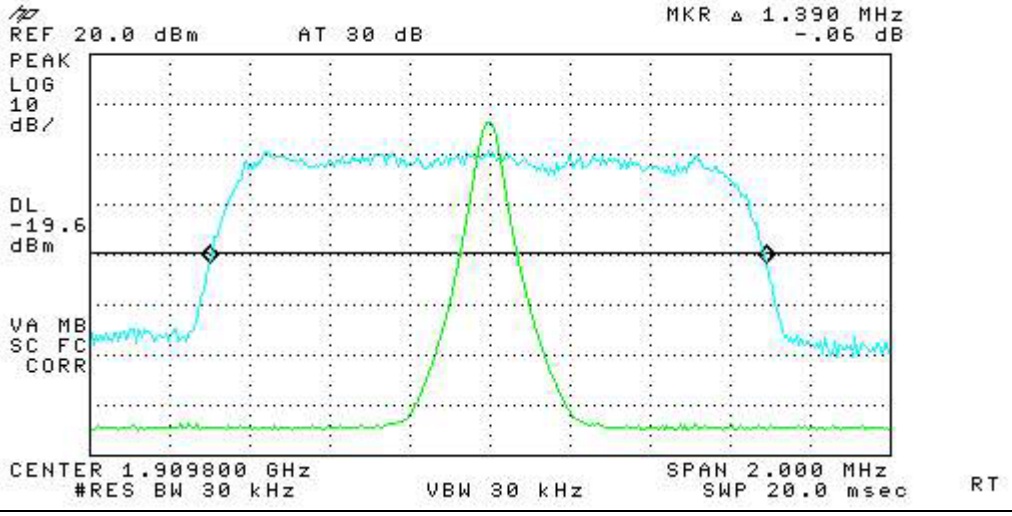
1. *The input to the amplifier is tuned such that the output power is set to its maximum rated power*
2. *The spectrum analyzer for this measurement was set with RBW and VBW, as recorded in the plots.*
3. *The frequency band measurements were performed at the rated supply voltage and ±10% of the rated supply voltage.*
4. *The measurements were performed at the shielded room.with environmental conditions of 23.9℃, 55%RH*
5. *Frequency Table*

Channel	Down Link (Forward)	Up Link (Reverse)
Low Channel	1930.2 MHz	1850.2 MHz
Middle Channel	1957.6 MHz	1877.6 MHz
High Channel	1989.8 MHz	1909.8 MHz

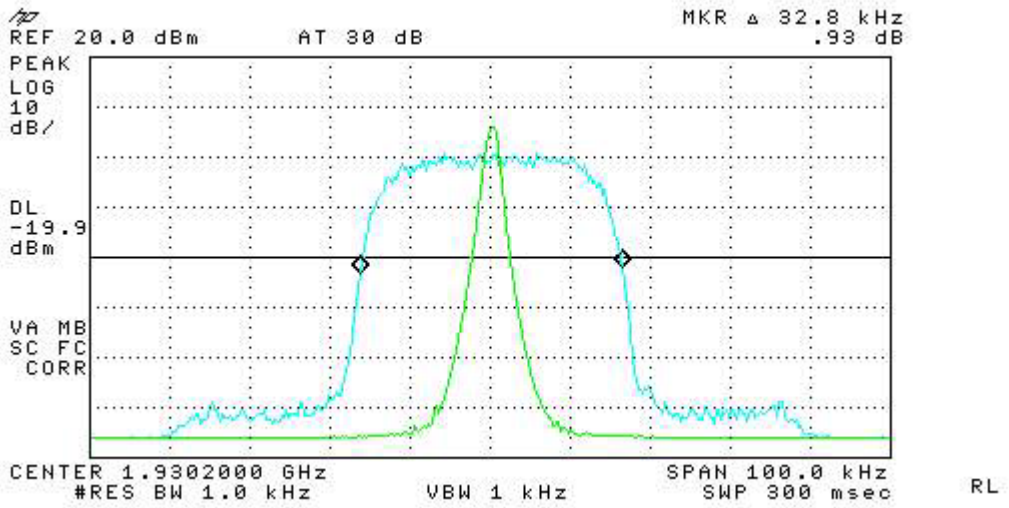
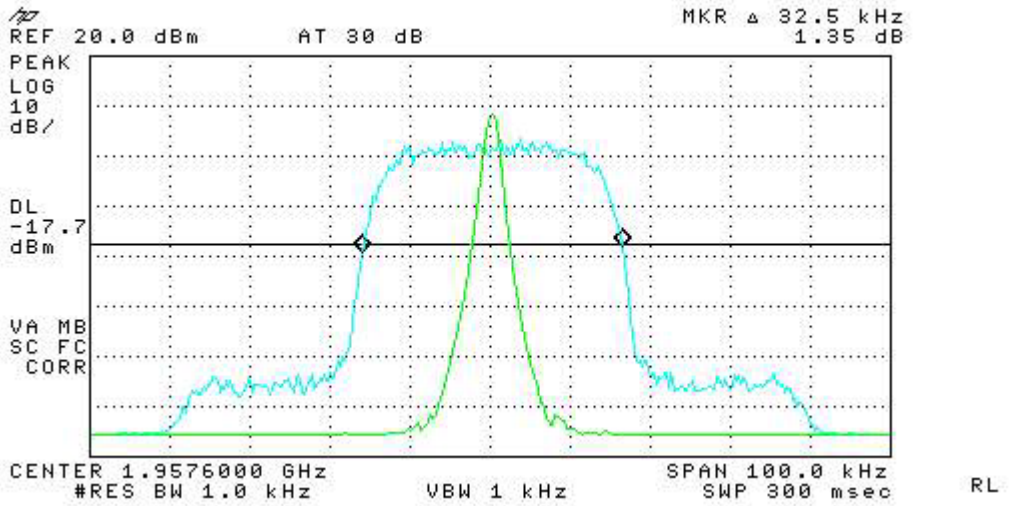
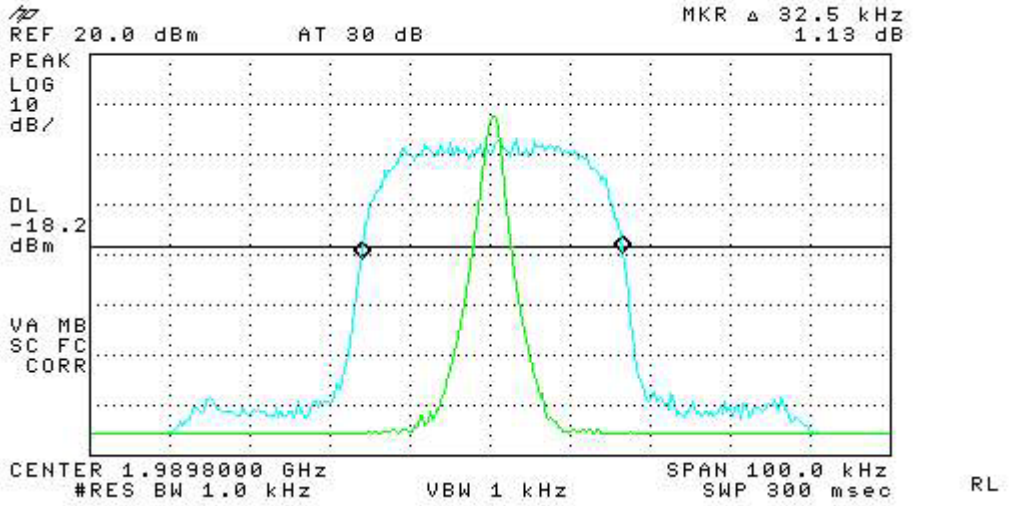
CDMA Forward Plot

Low Channel 1930.2 MHz 1.390 MHz	
Middle Channel 1957.6 MHz 1.375 MHz	
High Channel 1989.8 MHz 1.390 MHz	

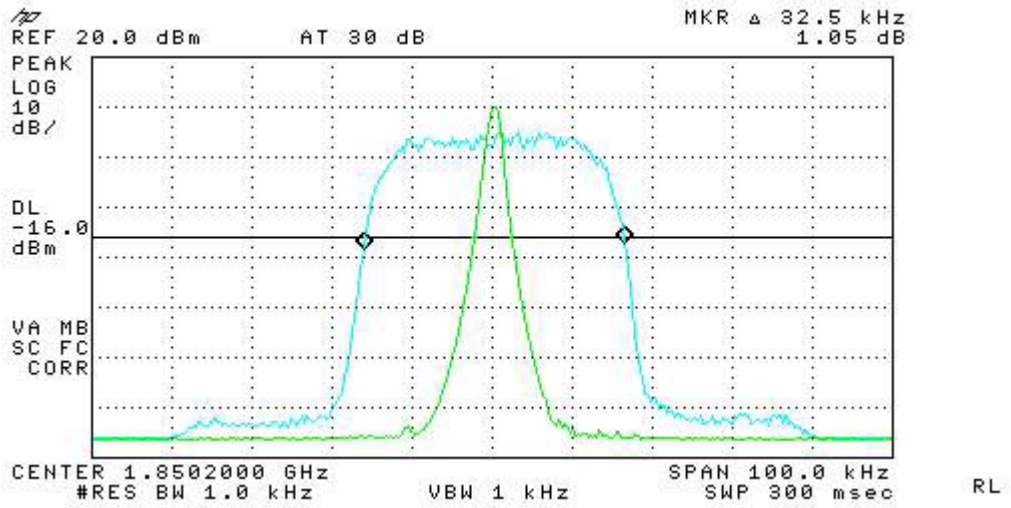
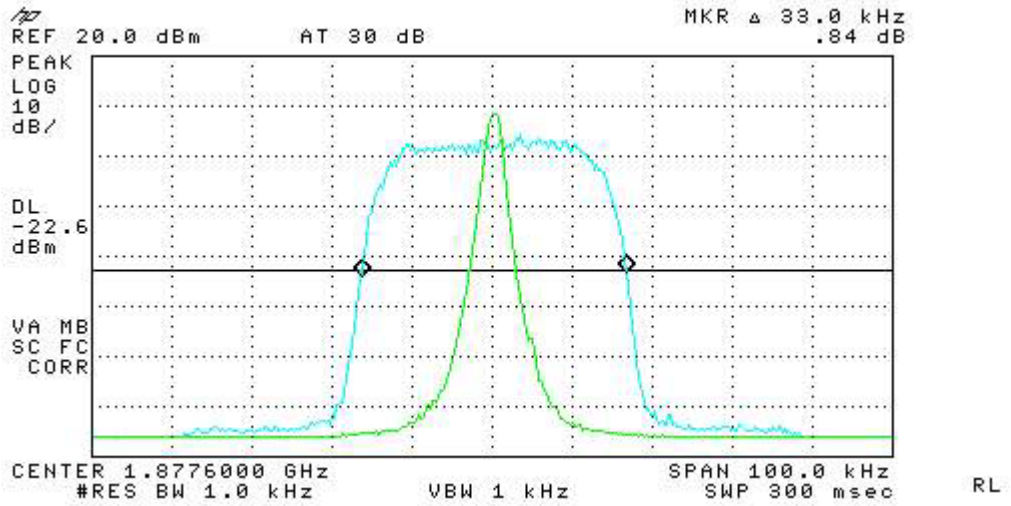
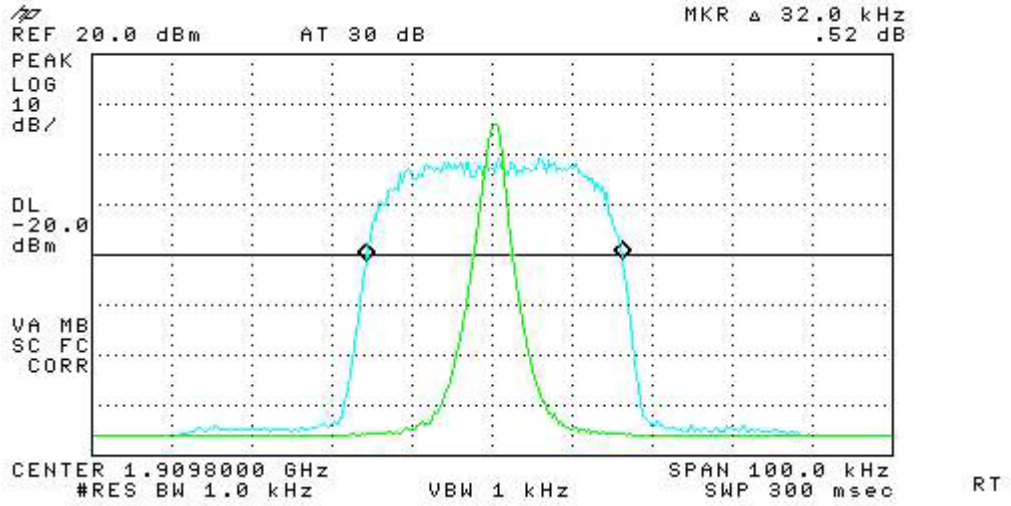
CDMA Reverse Plot

Low Channel 1850.2 MHz 1.385 MHz	
Middle Channel 1877.6 MHz 1.400 MHz	
High Channel 1909.8 MHz 1.390 MHz	

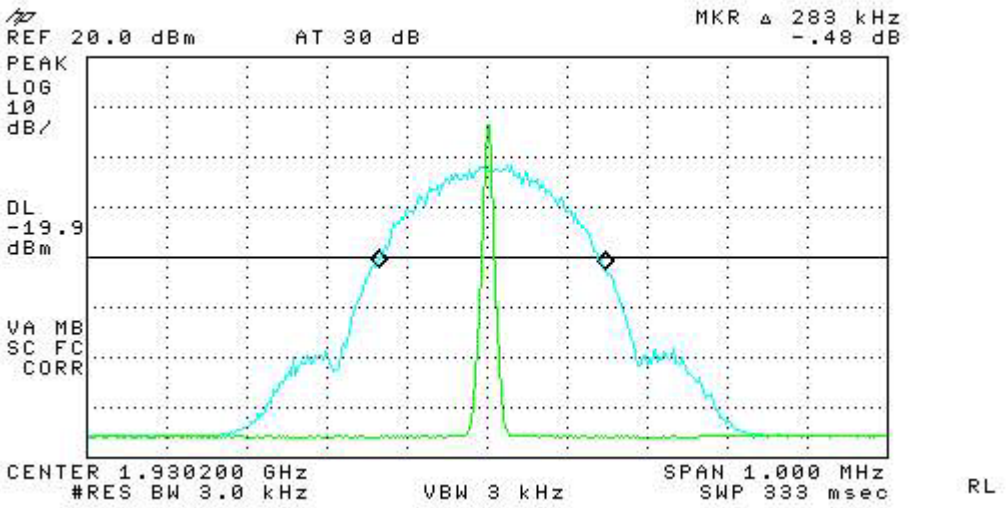
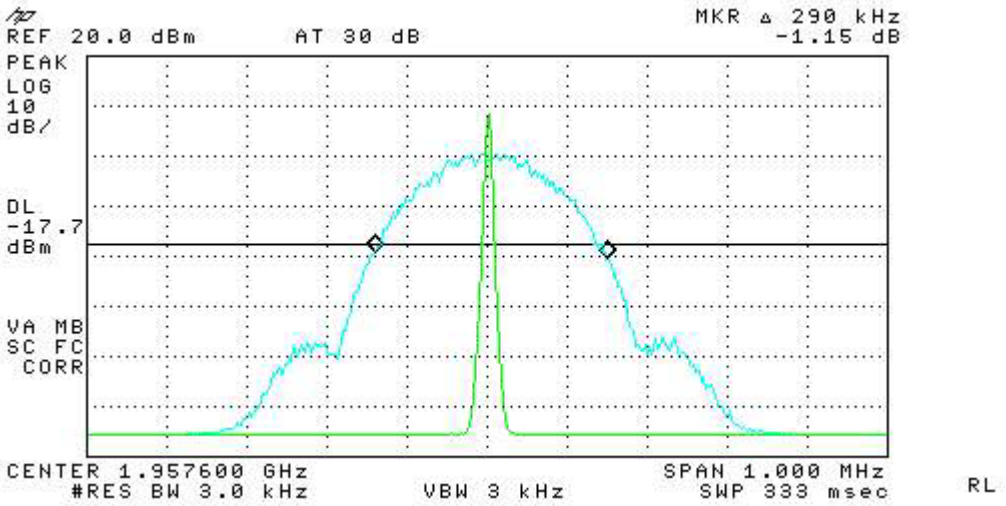
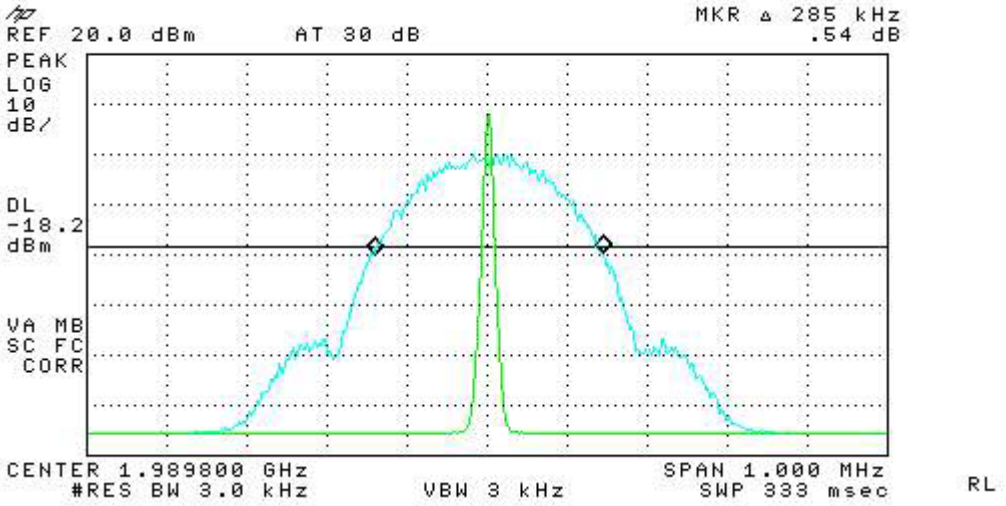
NADC Forward Plot

Low Channel 1930.2 MHz 32.8 kHz	
Middle Channel 1957.6 MHz 32.5 kHz	
High Channel 1989.8 MHz 32.5 kHz	

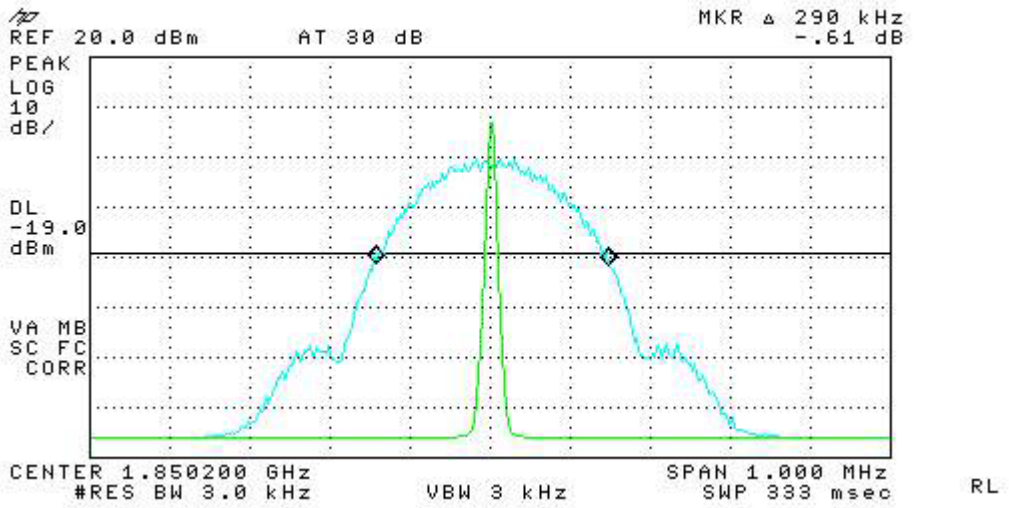
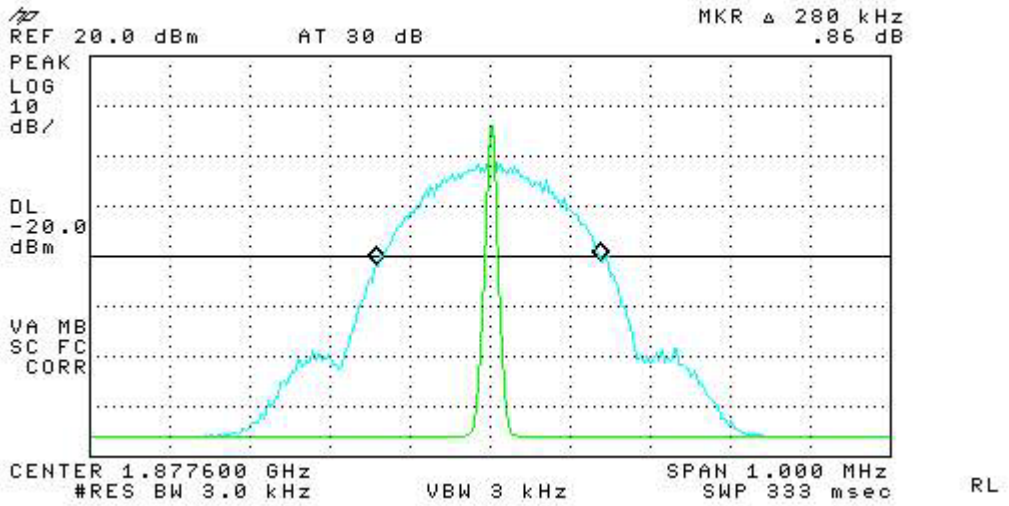
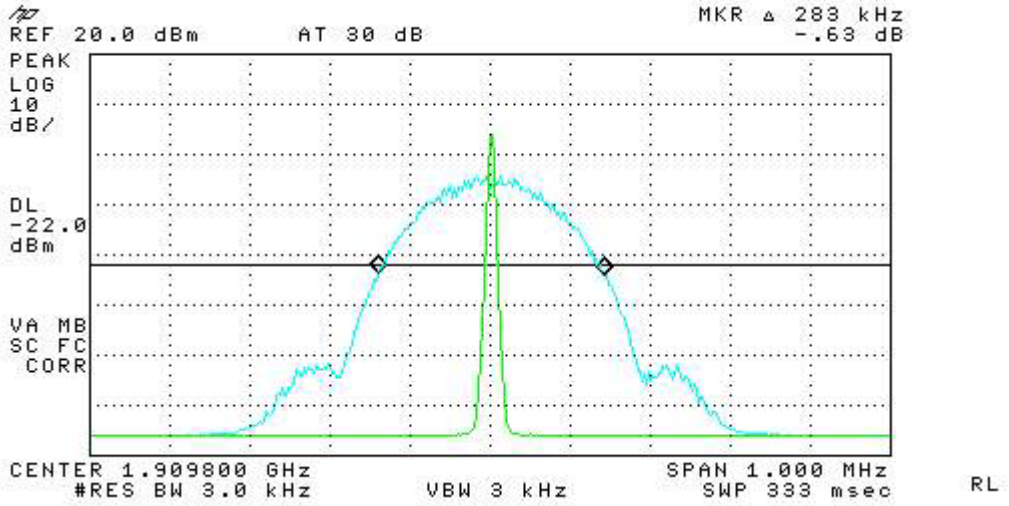
NADC Reverse Plot

Low Channel 1850.2 MHz 32.5 kHz	
Middle Channel 1877.6 MHz 33.0 kHz	
High Channel 1989.8 MHz 32.0 kHz	

GSM Forward Plot

Low Channel 1930.2 MHz 283 kHz	
Middle Channel 1957.6 MHz 290 kHz	
High Channel 1989.8 MHz 285 kHz	

GSM Reverse Plot

Low Channel 1850.2 MHz 290 kHz	
Middle Channel 1877.6 MHz 280 kHz	
High Channel 1989.8 MHz 283 kHz