

TEST REPORT

of

FCC Part 2, 27
FCC ID : STE-QUADCOMM-2100

Equipment Under Test : RV-Quadcomm
Model Name : Quadcomm-2100
Serial No. : N/A
Applicant : R-tron Inc.
Manufacturer : R-tron Inc.
Date of Test(s) : 2010-07-14 ~ 2010-08-02
Date of Issue : 2010-08-03

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Date

2010-08-17

Feel Jeong

Approved By



Date

2010-08-17

Charles Kim

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1. General information

1.1. Testing laboratory

SGS Testing Korea Co., Ltd.

- 705, Dongchun-Dong Sooji-Gu, Yongin-Shi, Kyungki-Do, South Korea.
- Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

www.electrolab.kr.sgs.com

Telephone : +82 +31 428 5700

FAX : +82 +31 427 2371

1.2. Details of applicant

Applicant : R-tron Inc.
Address : Jisan IT Venture Center 3F, 1004-9 Doksna-Dong, Gumchon-Gu, Seoul, Korea
Contact Person : You-Sik, Choi
Phone No. : 82-2-6343-1023

1.3. Description of EUT

Kind of Product	RV-Quadcomm
Model Name	Quadcomm-2100
Serial Number	N/A
Power Supply	110 ~ 220 Vac
Rated Power	30 dBm (Uplink, Downlink)
Frequency Range	1 710.00 MHz ~ 1 755.00 MHz(Uplink), 2 110.00 MHz ~ 2 155.00 MHz(Downlink)
Antenna Gain	9 dB i(Yagi_Uplink), 4.5 dB i(Patch_Downlink)

1.4. Description of test mode

Uplink mode

Test mode	Channel	Channel No.	Frequency (MHz)	Measured Channel Power	
				dB m	mW
CDMA2000	Low	25	1 711.25	30.54	1 132
	Mid	450	1 732.50	30.31	1 074
	High	875	1 753.75	30.09	1 021
EV-DO	Low	25	1 711.25	30.41	1 099

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Downlink mode

Test mode	Channel	Channel No.	Frequency (MHz)	Measured Channel Power	
				dB m	mW
CDMA2000	Low	25	2 111.25	30.57	1 140
	Mid	450	2 132.50	30.77	1 194
	High	875	2 153.75	30.08	1 019
EV-DO	Mid	450	2 132.50	30.62	1 153

We found out the test mode with the highest power level after we analyze. So we chose CDMA2000 (worst case) as a representative.

1.4. Test equipment list

Equipment	Manufacturer	Model	Cal Due.
Signal Generator	Agilent	E4438C	Mar. 31, 2011
Signal Generator	Rohde & Schwarz	SMR40	Sep. 25, 2010
Spectrum Analyzer	Agilent	E4440A	Mar. 31, 2011
Power Divider	Agilent	87302C	Jan. 07, 2011
Attenuator	Agilent	8498A	Apr. 01, 2011
High Pass Filter	Wainwright	WHK3.0/18G-10SS	Sep. 29, 2010
Band Reject Filter	Wainwright	WRCG824/849-814/85 960/10SS	Apr. 01, 2011
AC power Supply	Deakwang	Slidas	Sep. 25, 2010
Preamplifier	H.P.	8447F	Jun. 05, 2011
Preamplifier	Empower RF Systems,Inc	2002-BBSC4AEL	Mar. 31, 2011
Test Receiver	R & S	ESU26	Apr. 15, 2011
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	Jun. 22, 2011
Horn Antenna	Rohde & Schwarz	HF 906	Oct. 08, 2011
Horn Antenna	SCHWARZBECK	BBH 9120D	Nov. 09, 2011
Dipole Antenna	VHAP/UHAP	975/958	Oct. 10, 2011
Antenna Master	EMCO	1050	N.C.R
Turn Table	Daeil EMC	DI-1500	N.C.R
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	Jan. 27, 2011

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1.6. Summary of Test Results

APPLIED STANDARD : FCC Part 27		
Section in FCC part	Test Item	Result
§2.1046 §27.50	Maximum Channel Power	Complied
§27.53(g)	Field Strength of Spurious Radiation	Complied
§2.1049	Occupied Bandwidth 26dB	Complied
§27.53(g)	Spurious Emission at Antenna Terminal	Complied
§27.54(g)	Frequency Stability	Complied
§27.53(g)	Band Edge	Complied
§1.1307(b)(1)	Maximum Permissible Exposure (Exposure of Humans to RF Fields)	Complied

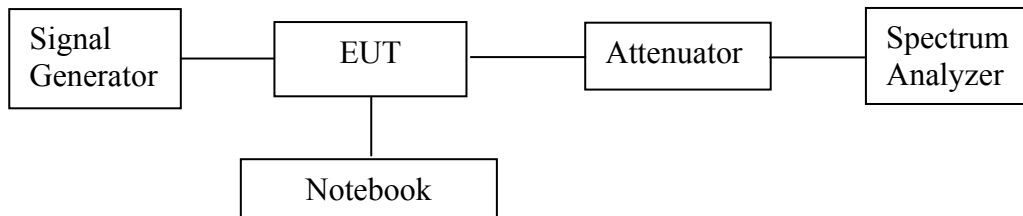
1.7. Test Report Revision

Revision	Report number	Description
0	F690501/RF-RTL004068	Initial
1	F690501/RF-RTL004068-1	Revised FCC ID

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2. Maximum Channel Power

2.1. Set up



2.2. Limit

According to 47 CFR Part 2 section § 2.1046 and Part 27 section § 27.50(h)(1), the maximum EIRP of a base station shall not exceed $33 \text{ dBW} + 10 \lg (X/Y) \text{ dBW}$, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition.

As to the limit, the X is 10 MHz and Y is 5.5 MHz for the EUT, so the limit is calculated to be $33 \text{ dBW} (63 \text{ dBm}) + 10 \lg (1.25 \text{ MHz} / 5.5 \text{ MHz}) = 59.57 \text{ dBm}$.

2.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. RF power output was measured with an RF input level at the point just before the compression point of the amplifier.
4. This is the point of maximum RF output power. If the RF input level is increased beyond this point, the amplifier gain (and consequently output power) is automatically reduced.

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2.4. Test Results

Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

AWS band

Uplink mode

Test mode	Channel No.	Frequency (MHz)	Measured Channel Power	
			dB m	mW
Low	25	1 711.25	30.54	1 132
Mid	450	1 732.50	30.31	1 074
High	875	1 753.75	30.09	1 021

Downlink mode

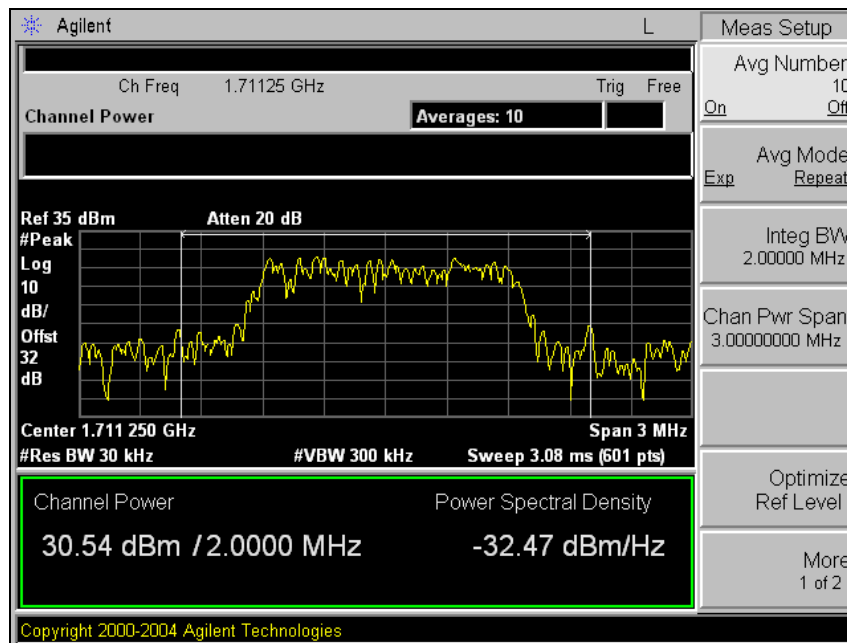
Test mode	Channel No.	Frequency (MHz)	Measured Channel Power	
			dB m	mW
Low	25	2 111.25	30.57	1 140
Mid	450	2 132.50	30.77	1 194
High	875	2 153.75	30.08	1 019

Please refer to the following plots.

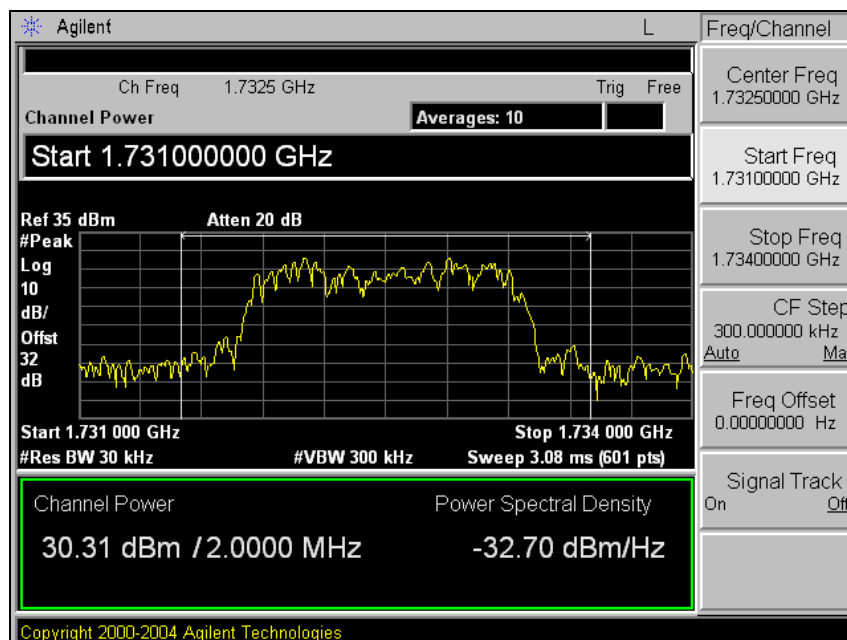
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AWS(Uplink)

Low Channel

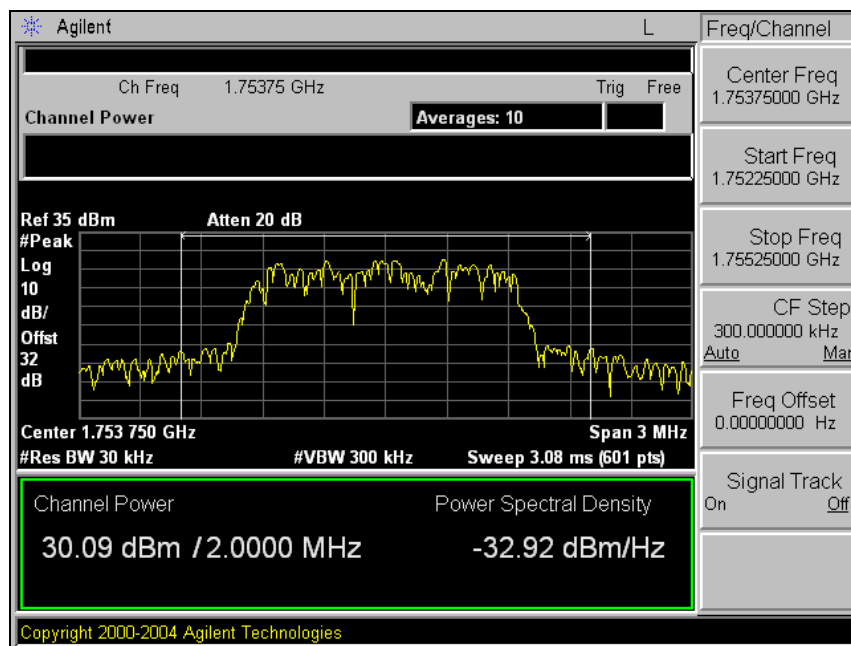


Middle Channel



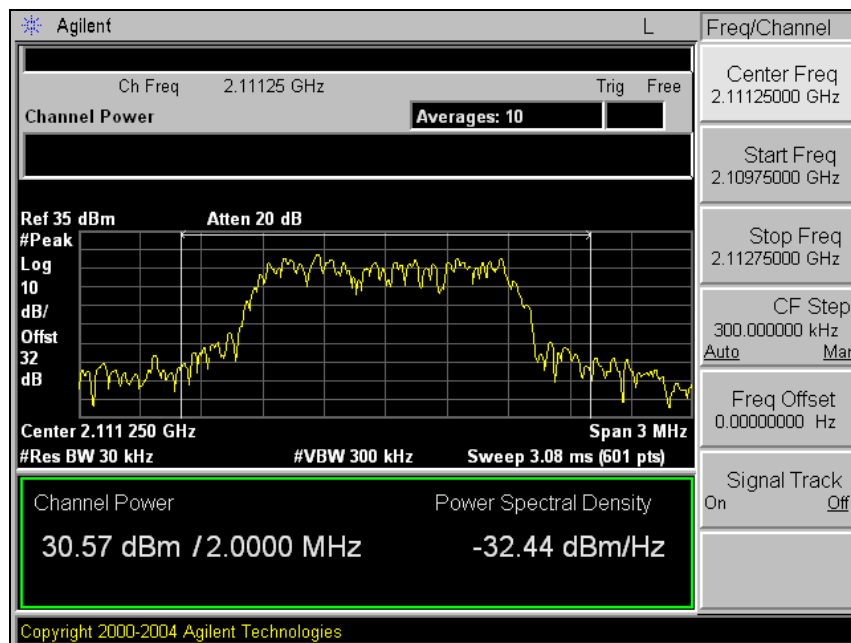
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High Channel



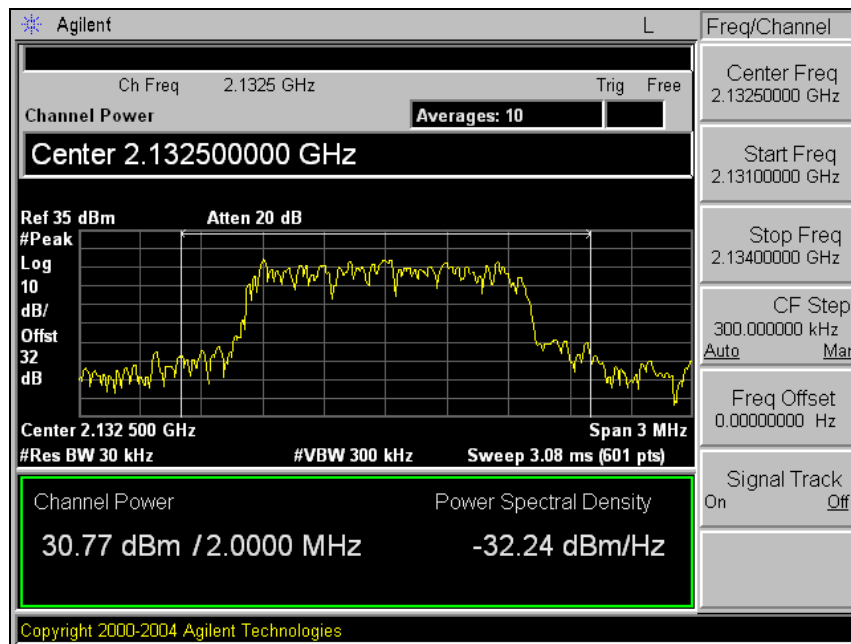
AWS(Downlink)

Low Channel

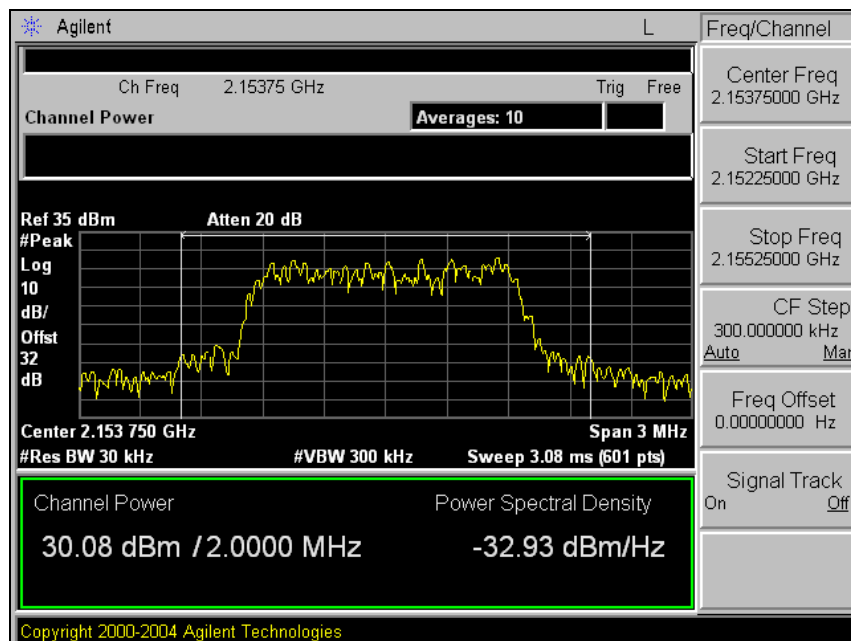


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Middle Channel



High Channel

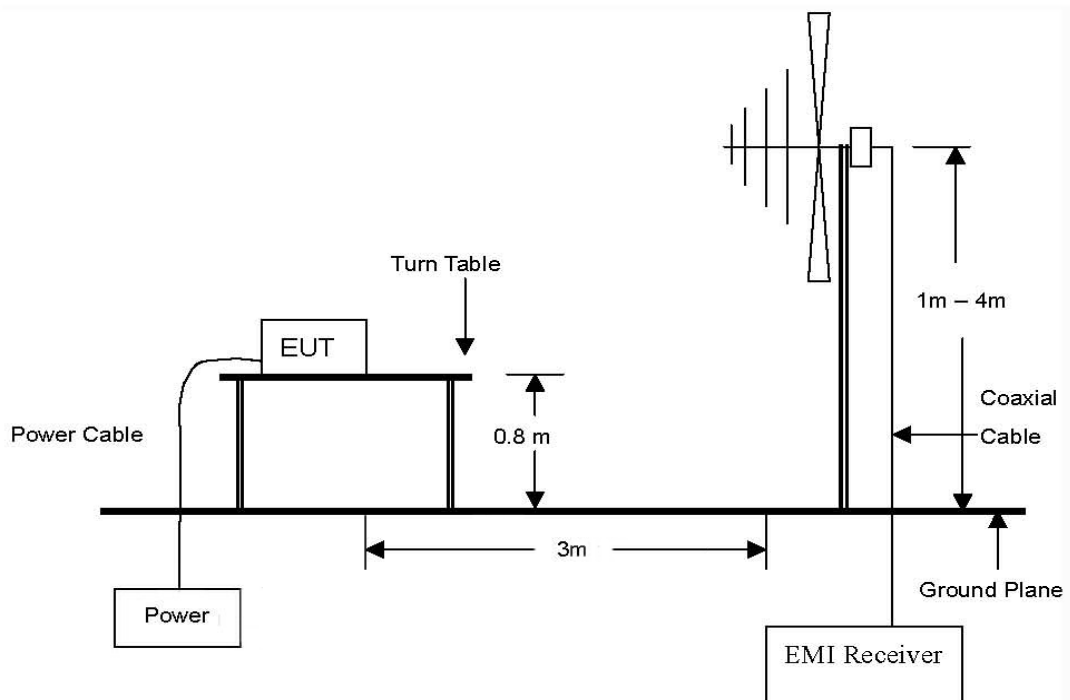


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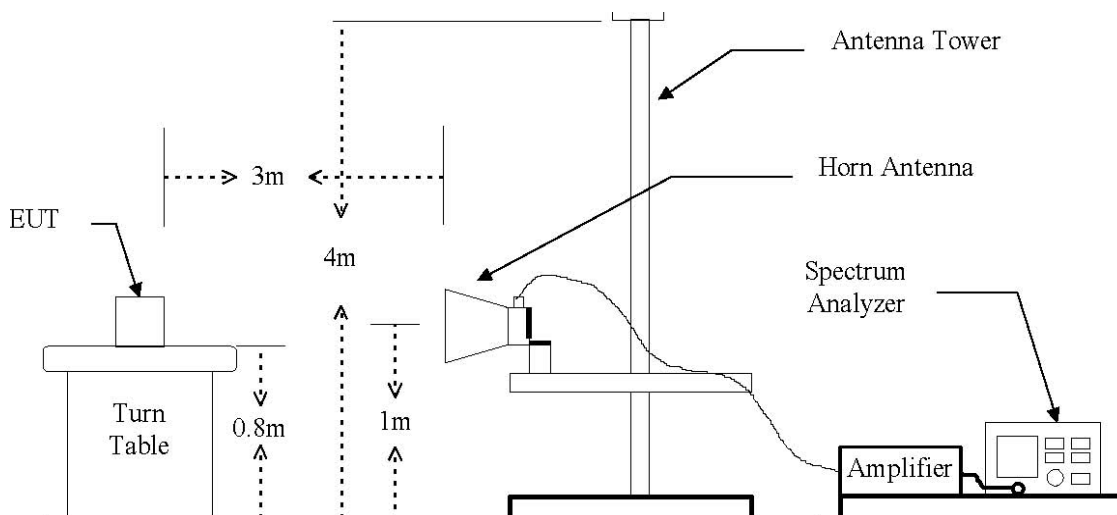
3. Field Strength of Spurious Radiation

3.1. Set up

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 40 GHz Emissions.



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3.2. Limit

§ 27.53(g) For operation in the 1 710 ~ 1 755 MHz and 2 110 ~ 2 155 MHz bands, the power of any emission outside a license's block shall be attenuated below the transmitting (P) by a factor of at least $43+10\log(P)$ dB.

3.3. Test Procedure

1. On a test site, the EUT shall be placed at 0.8cm height on a turn table, and in the position closest to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3m from EUT to correspond to the frequency of the transmitter.
3. The output of the test antenna shall be connected to the measuring receiver and the peak detector is used for the measurement.
4. The transmitter shall be switched on, the measuring receiver shall be tuned to the frequency of the transmitter under test.
5. The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the measuring receiver.
6. The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
7. The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the measuring receiver.
8. The maximum signal level detected by the measuring receiver shall be noted.
9. The transmitter shall be replaced by a horn (substitution antenna).
10. The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.
11. The substitution antenna shall be connected to a calibrated signal generator.
12. In necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
13. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
14. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, which is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.
15. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.
16. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.
17. The measure of the effective radiated power is the large of the two levels recorded, at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary

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3.4. Test Result

Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

AWS(Uplink)

Frequency (MHz)	Ant. Pol. (H/V)	S.G level (dB m)	Cable loss (dB)	Ant. gain (dB i)	E.I.R.P. (dB m)	Margin (dB)
Low Channel (1 711.25 MHz)						
89.413	H	-50.28	0.96	-7.94	-59.18	46.18
103.558	H	-49.74	1.01	-7.85	-58.60	45.60
750.056	H	-49.20	3.16	-8.05	-60.41	47.41
Middle Channel (1 732.50 MHz)						
89.413	H	-50.29	0.96	-7.94	-59.19	46.19
103.558	H	-50.17	1.01	-7.85	-59.03	46.03
750.063	H	-49.53	3.16	-8.05	-60.74	47.74
High Channel (1 753.75 MHz)						
89.415	H	-50.32	0.96	-7.94	-59.22	46.22
103.556	H	-50.33	1.01	-7.85	-59.19	46.19
750.055	H	-49.31	3.16	-8.05	-60.52	47.52

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AWS(Downlink)

Frequency (MHz)	Ant. Pol. (H/V)	S.G level (dB m)	Cable loss (dB)	Ant. gain (dB i)	E.I.R.P. (dB m)	Margin (dB)
Low Channel (2 111.25 MHz)						
89.414	H	-50.65	0.96	-7.94	-59.55	46.55
103.558	H	-49.63	1.01	-7.85	-58.49	45.49
750.060	H	-49.15	3.16	-8.05	-60.36	47.36
Middle Channel (2 132.50 MHz)						
89.416	H	-50.64	0.96	-7.94	-59.54	46.54
103.559	H	-49.73	1.01	-7.85	-58.59	45.59
750.036	H	-49.11	3.16	-8.05	-60.32	47.32
High Channel (2 153.75 MHz)						
89.415	H	-50.58	0.96	-7.94	-59.48	46.48
103.553	H	-49.74	1.01	-7.85	-58.60	45.60
750.052	H	-49.62	3.16	-8.05	-60.83	47.83

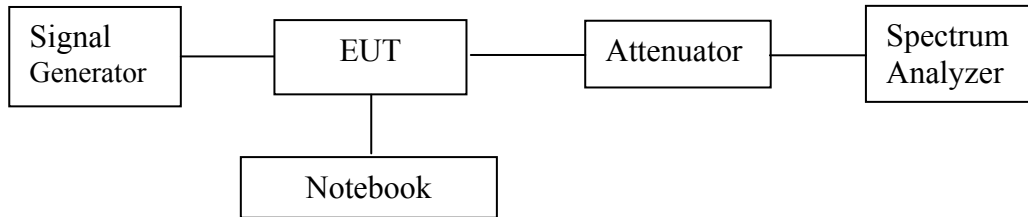
Remark:

1. $E.R.P. \ \& \ E.I.R.P = S.G \ level \ (dB \ m) - Cable \ loss \ (dB) + Ant. \ gain \ (dB \ d/dB \ i)$
2. No more spurious emissions above MHz for all channel.

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4. Occupied Bandwidth 26 dB

4.1. Set up



4.2. Limit

47 CFR Part 2 section § 2.1049 and Part 27, no specific modulation characteristics requirement limits is applicable.

The occupied bandwidth is defined in section § 2.1049: the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. The occupied bandwidth is normally called 99% bandwidth.

According to section § 27.53(l)(6), the emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. The emission bandwidth is normally called 26 dB bandwidth.

4.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. The resolution bandwidth of the spectrum analyzer was set at 30 kHz.

4.4 Test Results

Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

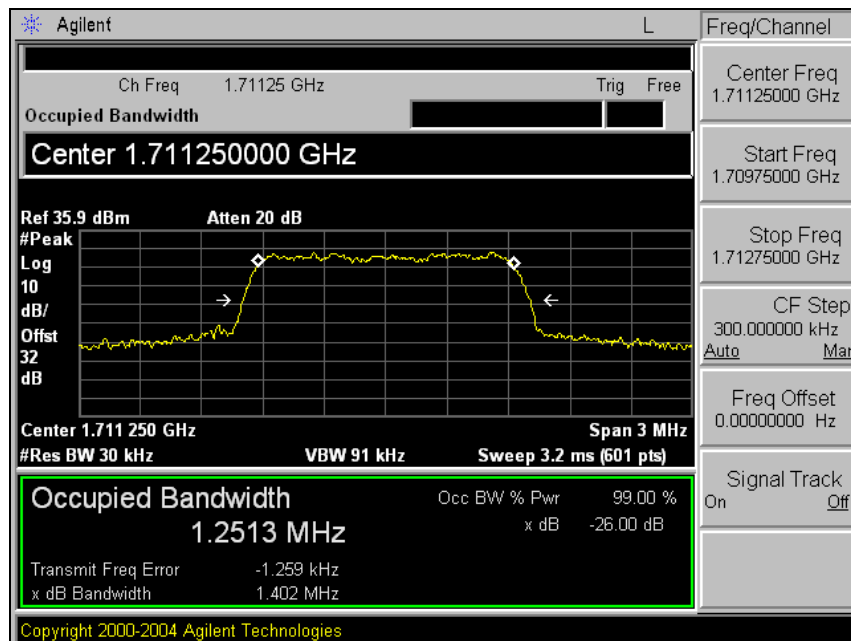
Please refer to the following plots.

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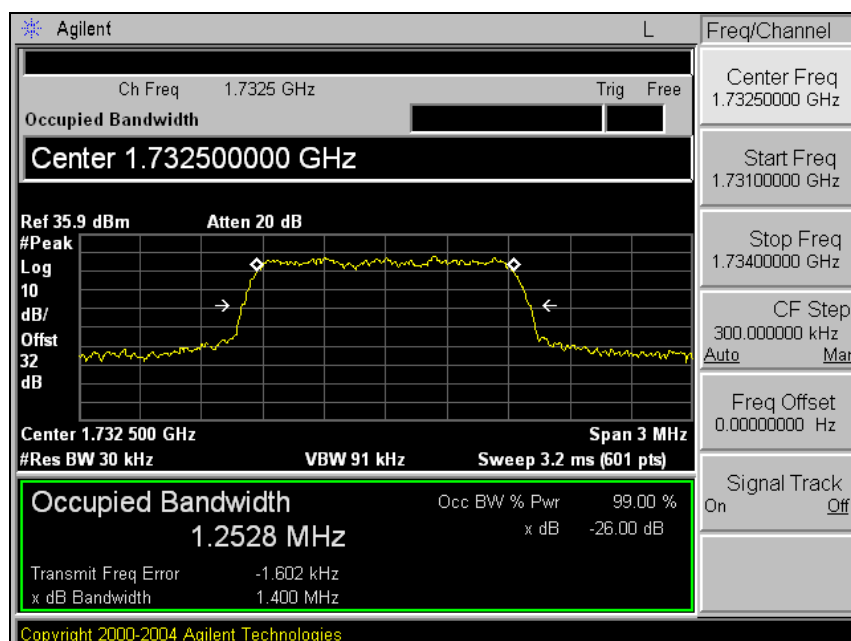
Output 26 dB Occupied Bandwidth

AWS(Uplink)

Low Channel

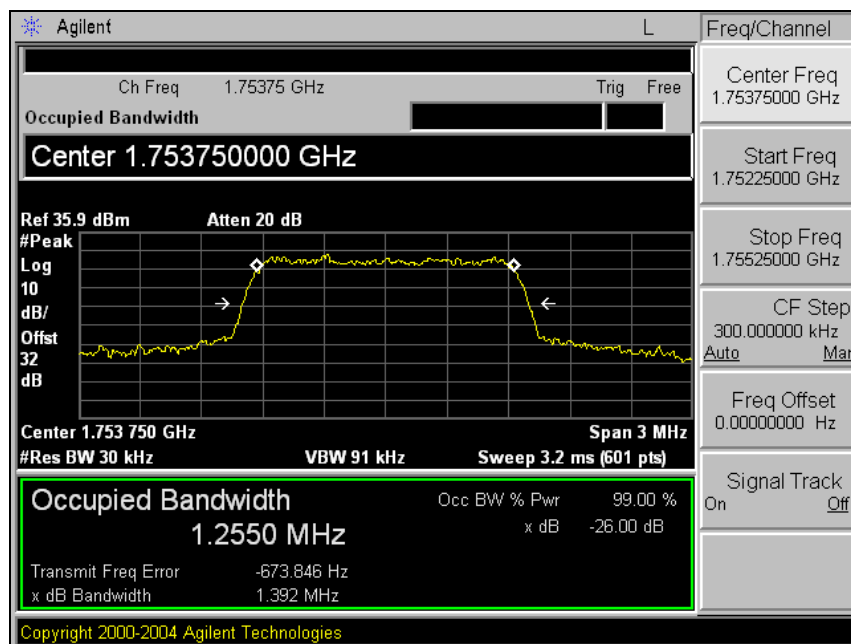


Middle Channel



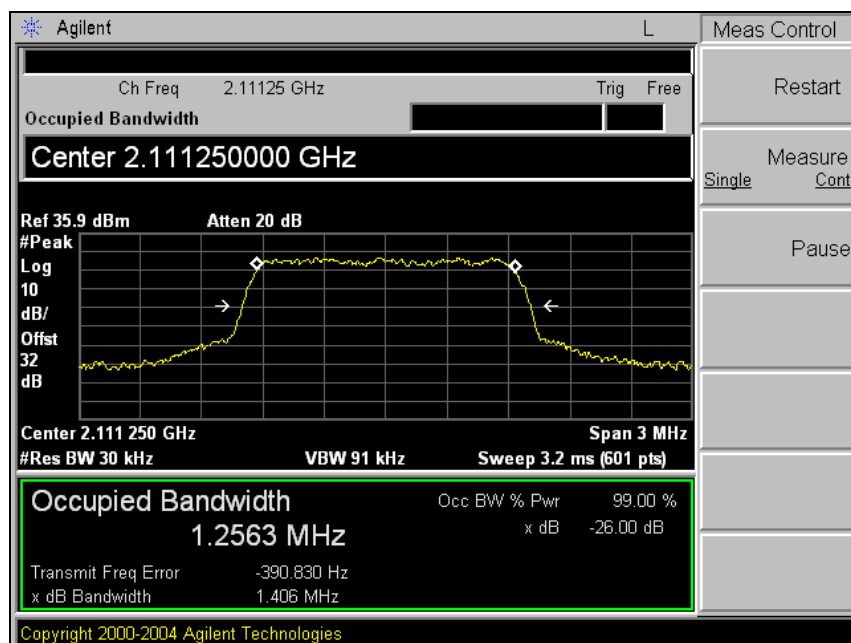
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High Channel



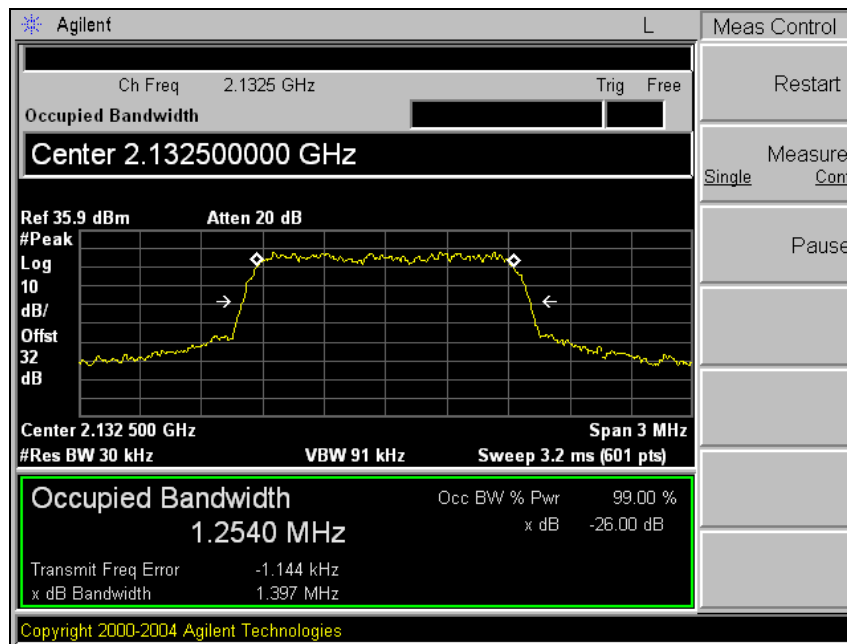
AWS(Downlink)

Low Channel

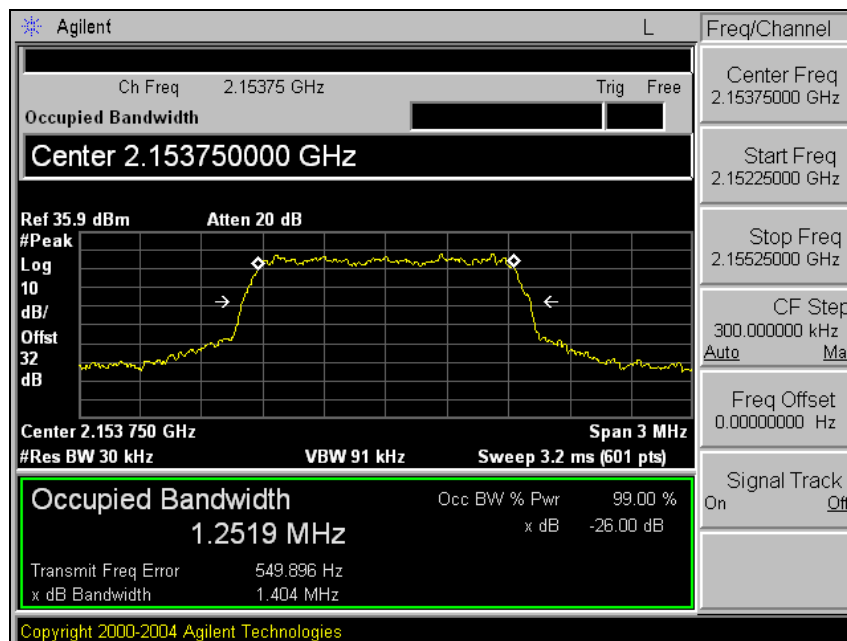


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Middle Channel



High Channel

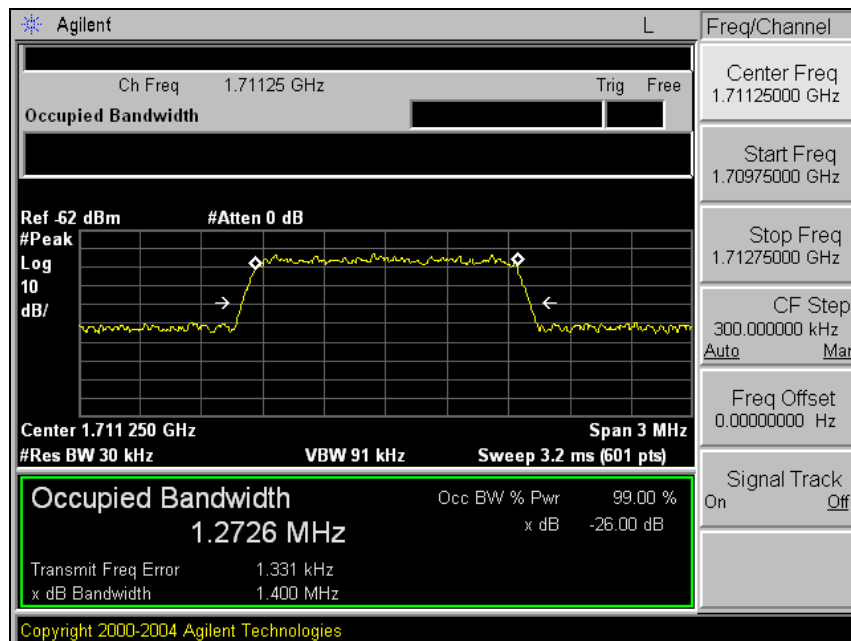


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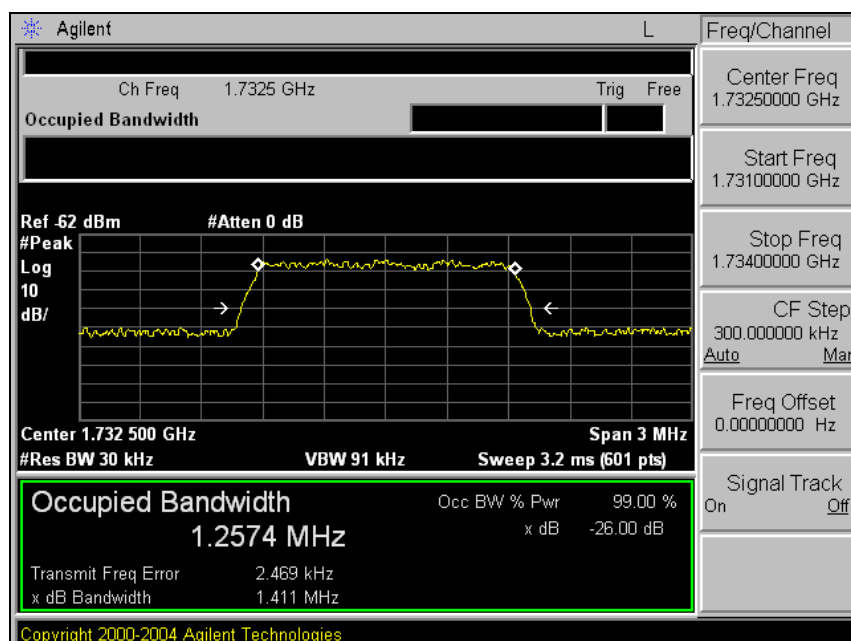
Input 26 dB Occupied Bandwidth

AWS(Uplink)

Low Channel

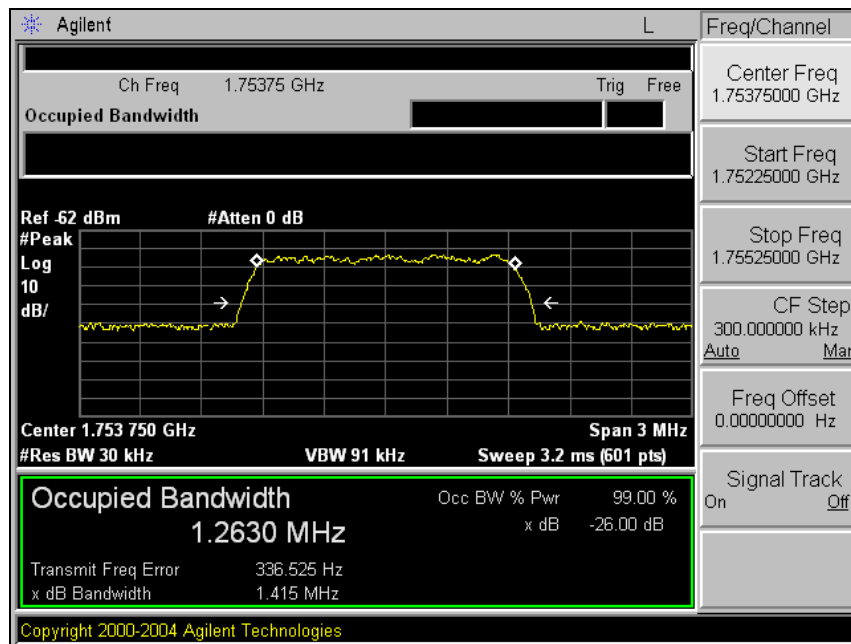


Middle Channel



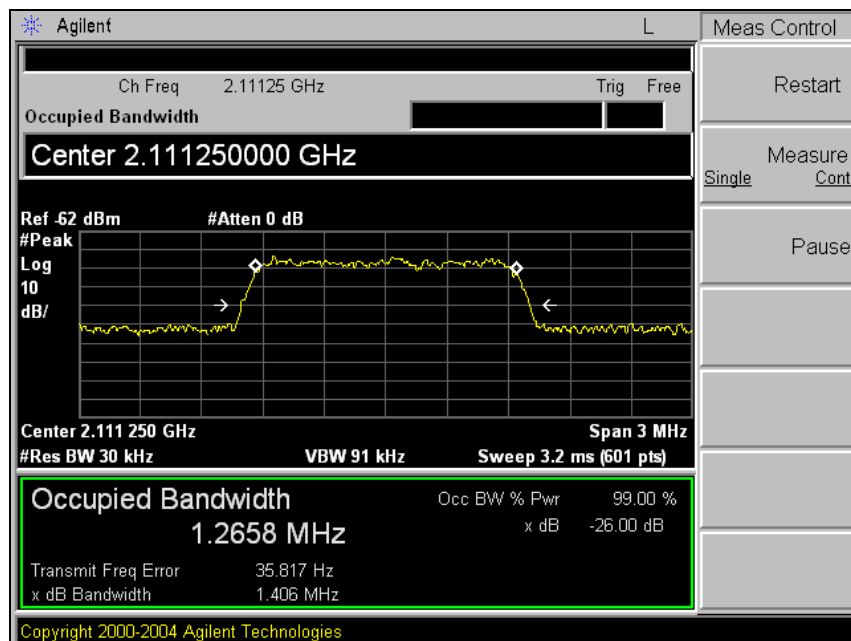
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High Channel



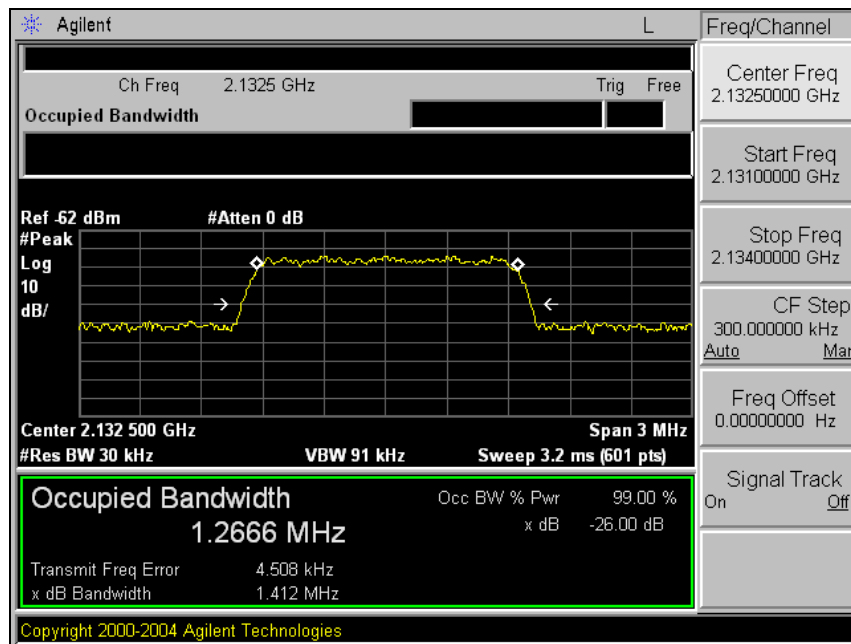
AWS(Downlink)

Low Channel

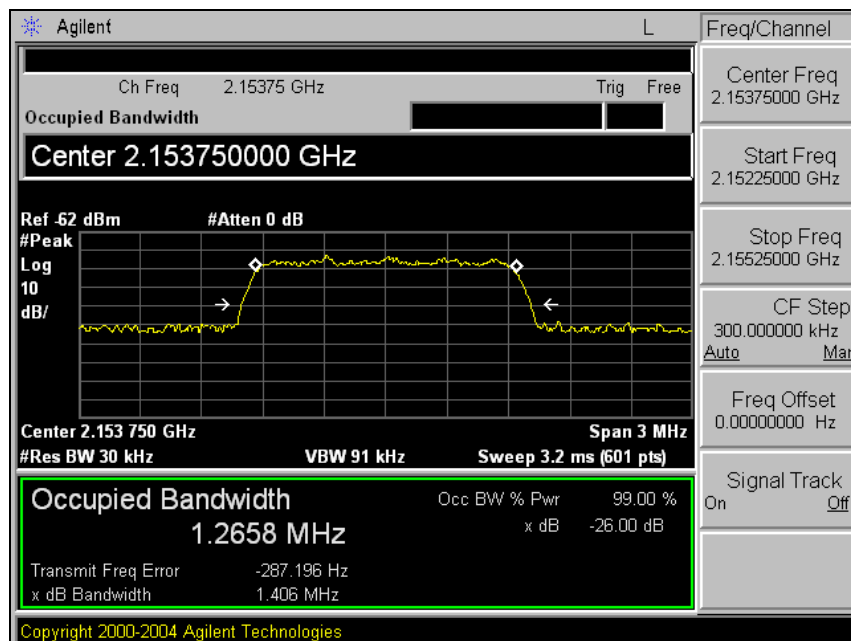


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Middle Channel



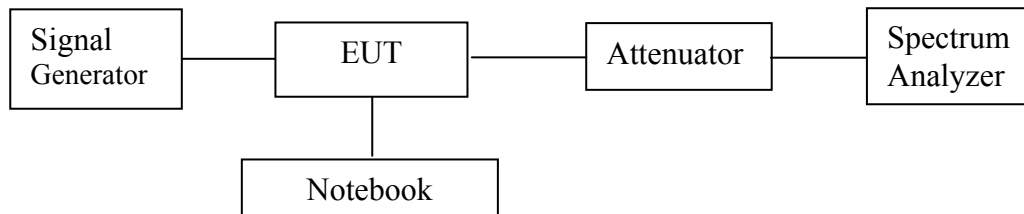
High Channel



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5. Spurious Emissions at Antenna Terminal

5.1. Set up



5.2. Limit

§ 27.53(g) For operation in the 1 710 ~ 1 755 MHz and 2 110 ~ 2 155 MHz bands, the power of any emission outside a license's block shall be attenuated below the transmitting (P) by a factor of at least $43+10\log(P)\text{dB}$.

5.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. The resolution bandwidth of the spectrum analyzer was set at 1 MHz.

5.4. Test Results

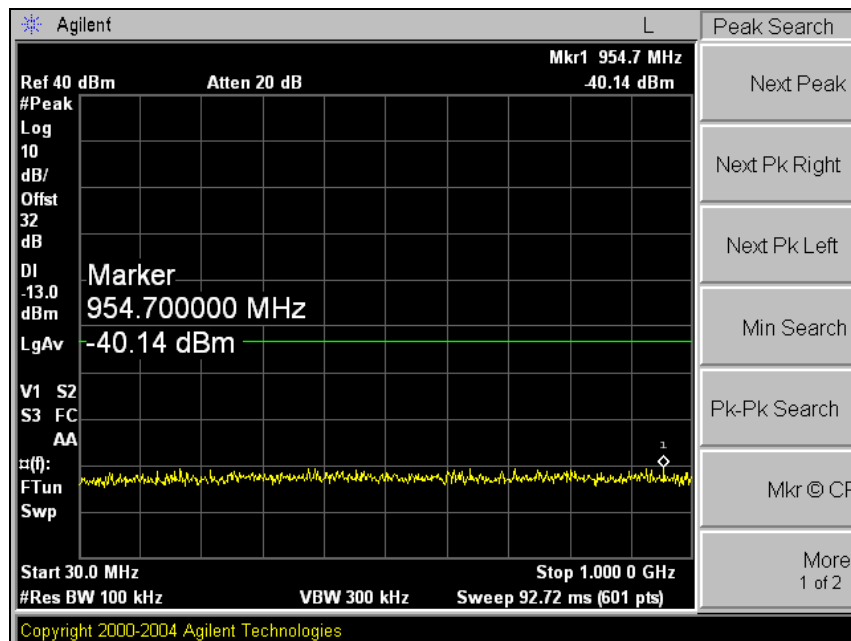
Ambient temperature : $(24 \pm 2) ^\circ\text{C}$
 Relative humidity : 47 % R.H.

Please refer to the following plots.

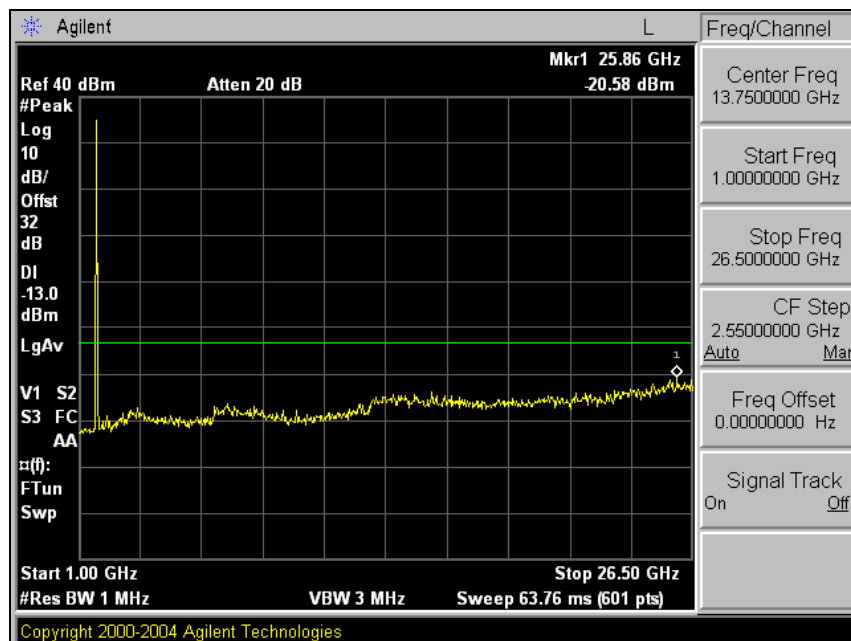
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AWS(Uplink)

Low Channel

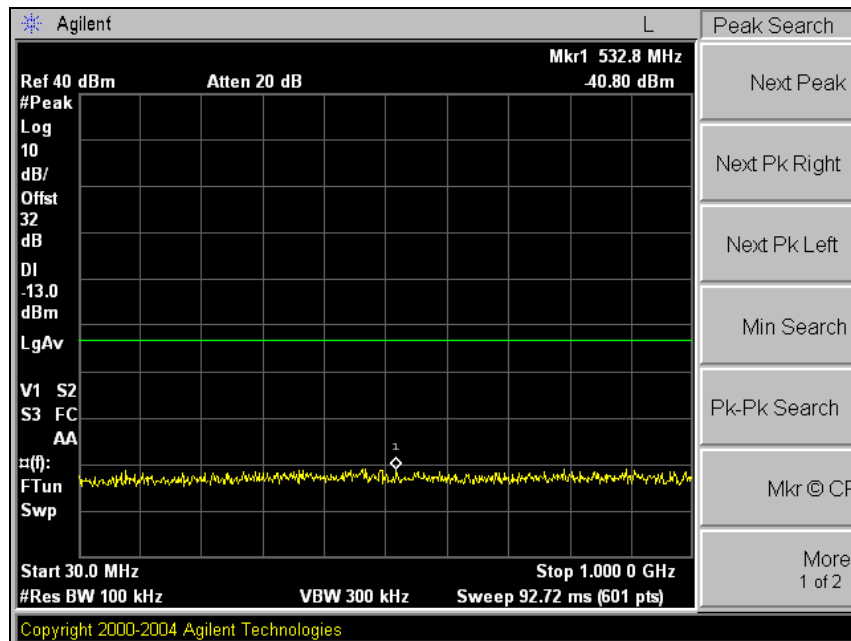


Low Channel

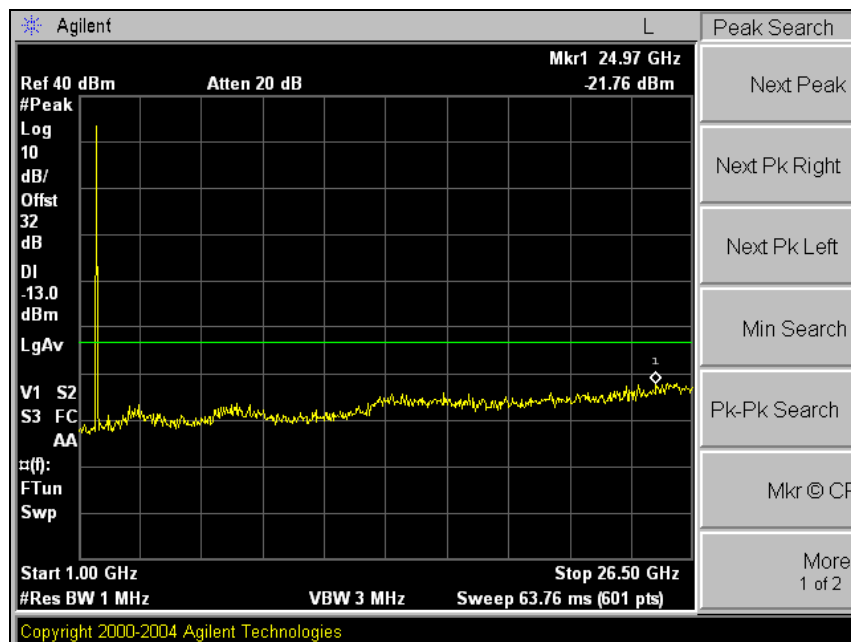


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Middle Channel

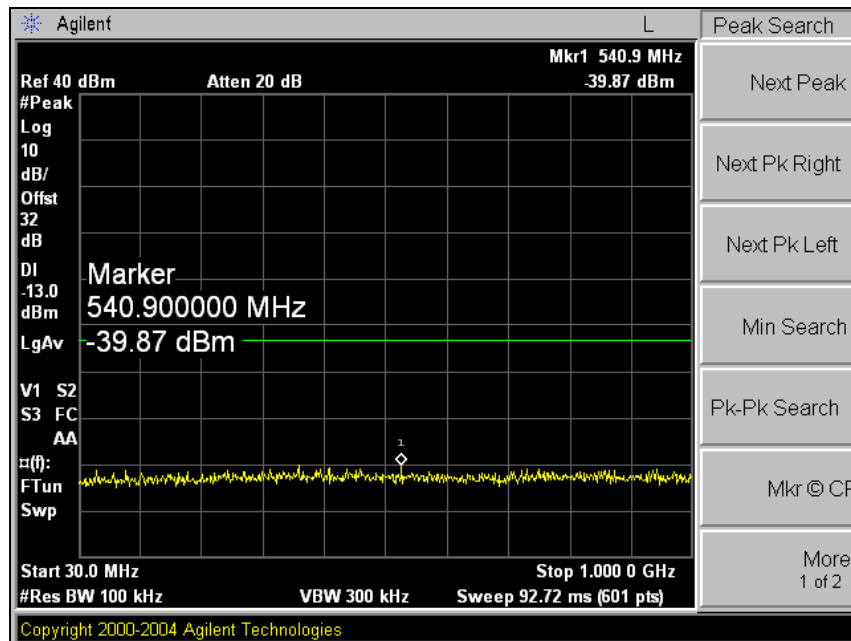


Middle Channel

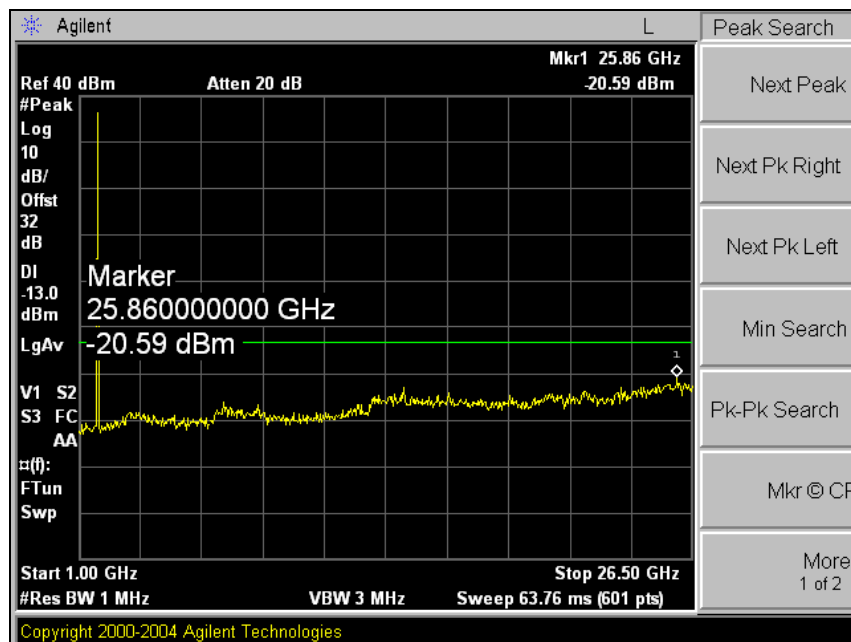


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High Channel



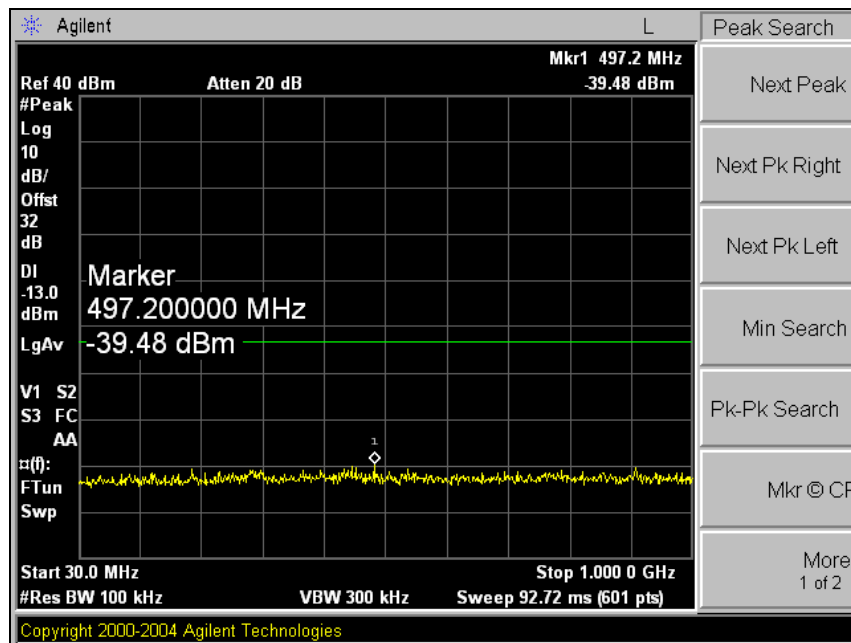
High Channel



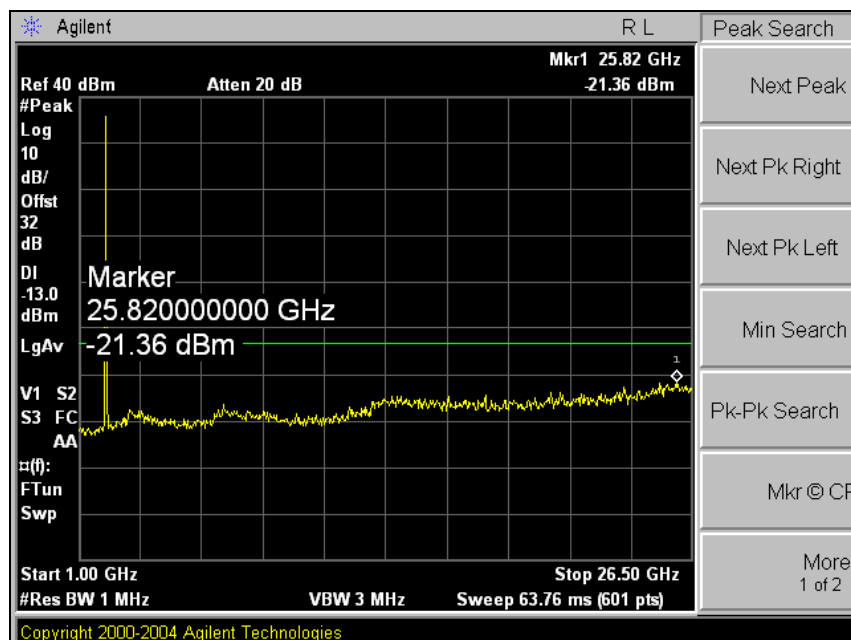
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AWS(Downlink)

Low Channel

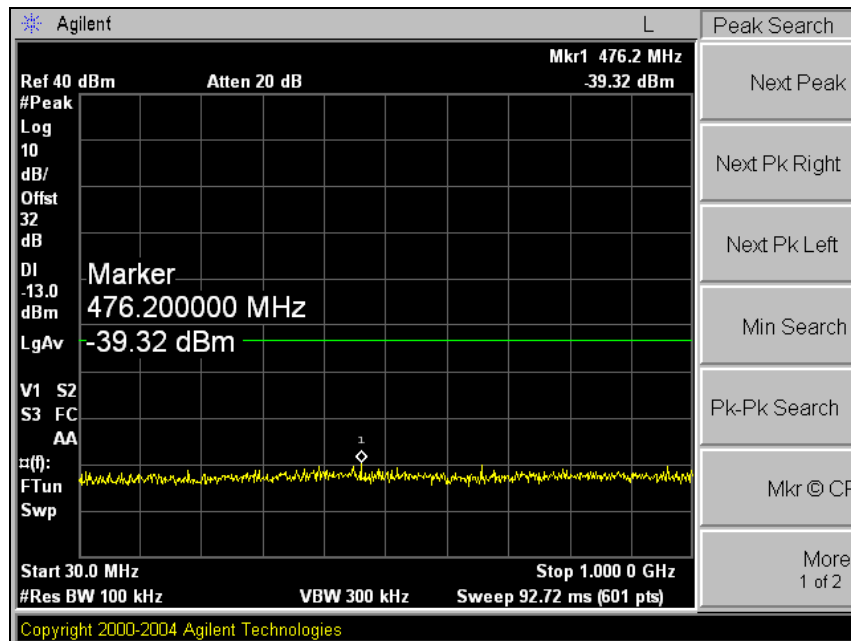


Low Channel

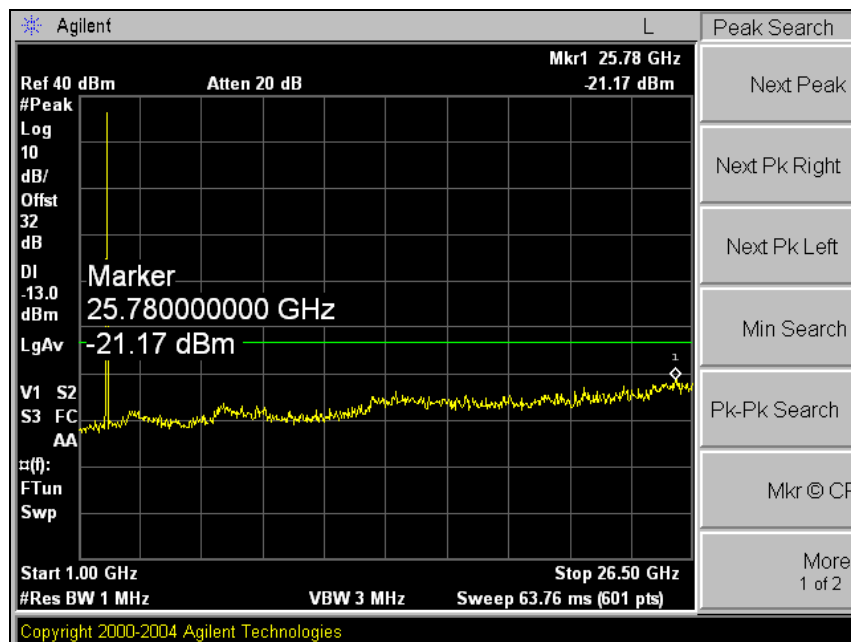


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Middle Channel

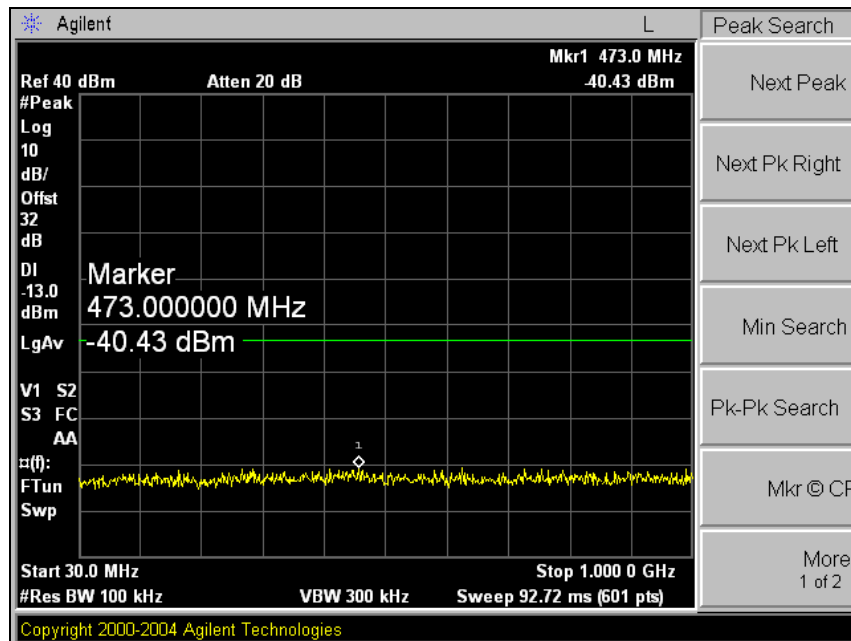


Middle Channel

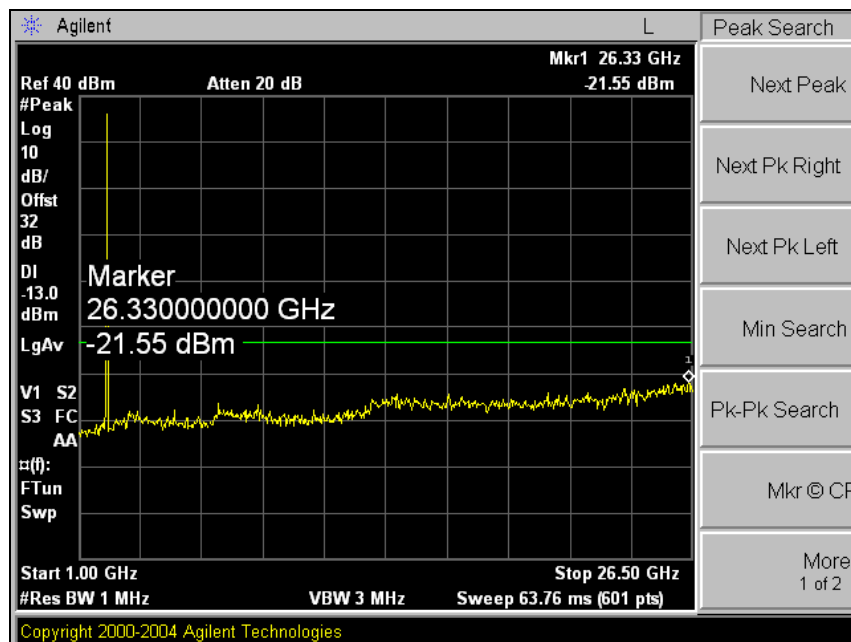


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High Channel



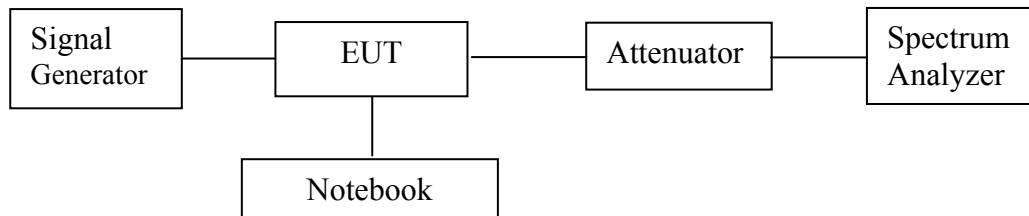
High Channel



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6. Band Edge

6.1. Set up



6.2. Limit

§ 27.53(g) For operation in the 1 710 ~ 1 755 MHz and 2 110 ~ 2 155 MHz bands, the power of any emission outside a license's block shall be attenuated below the transmitting (P) by a factor of at least $43+10\log(P)$ dB.

6.3. Test Procedure

1. The transmitter was tested while in a continuous transmit mode.
2. The EUT was tuned to a low, middle, and high channel in both the downlink (base to mobile) and uplink (mobile to base) directions.
3. The resolution bandwidth of the spectrum analyzer was set at 30 kHz.

6.4. Test Results

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

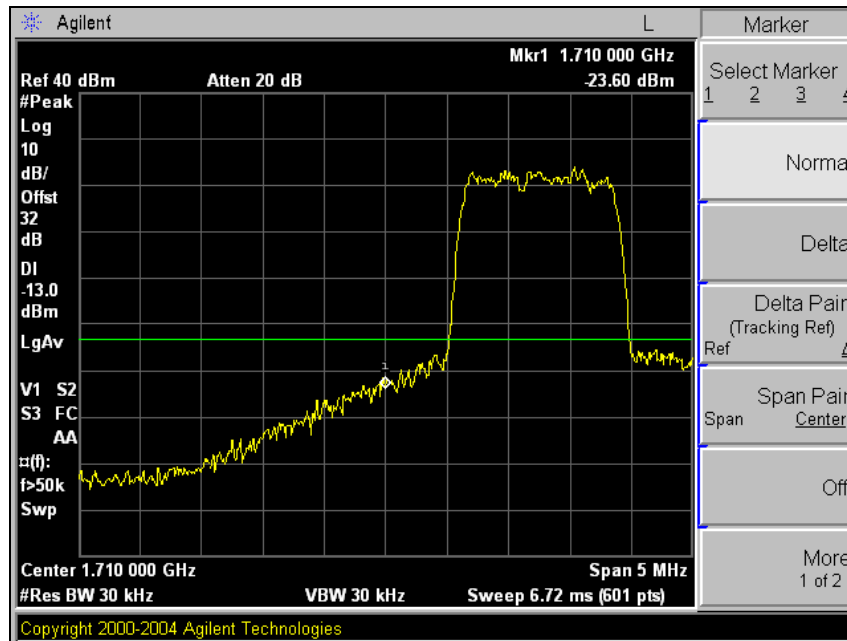
Please refer to the following plots.

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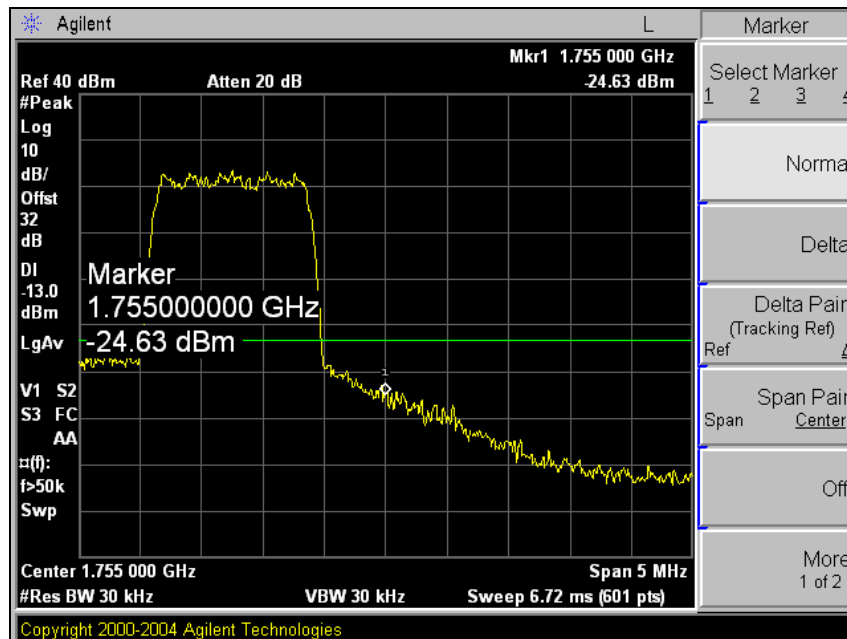
Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

AWS(Uplink)

Low Channel



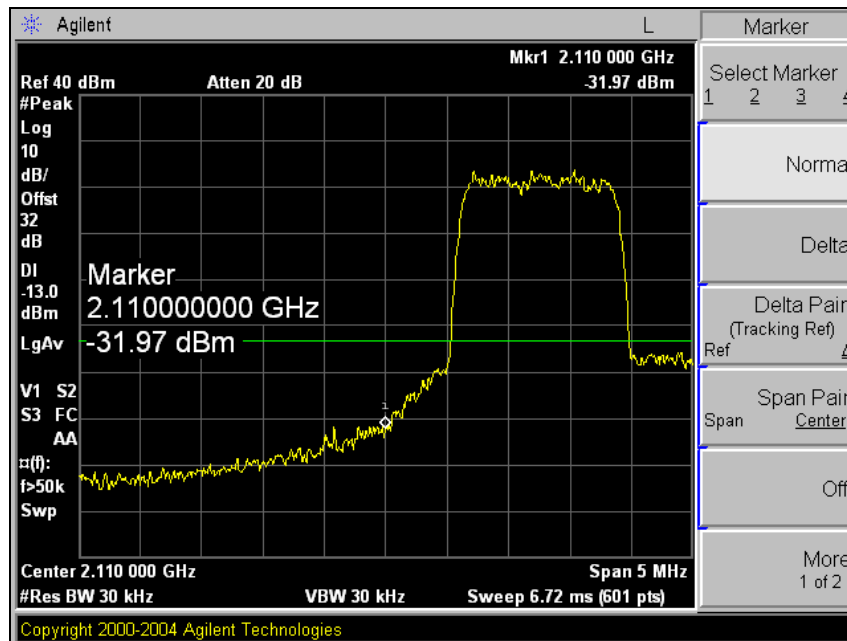
High Channel



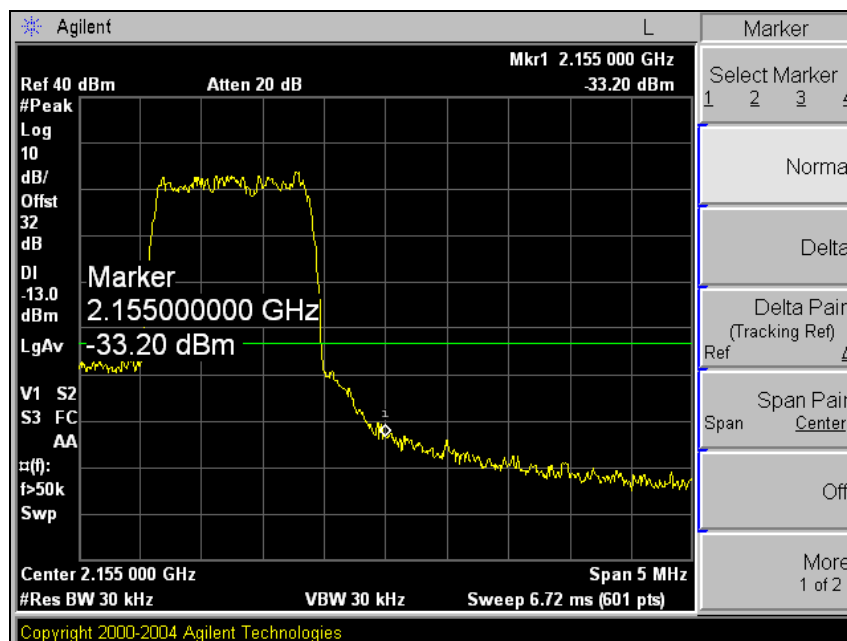
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

AWS(Downlink)

Low Channel



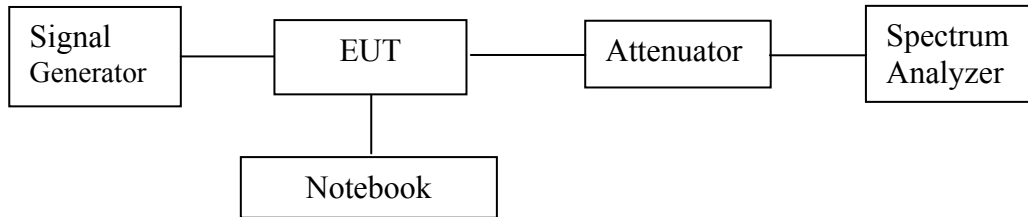
High Channel



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7. Frequency Stability

7.1. Set up



7.2. Limit

According to 47 CFR Part 2 section § 2.1055 and Part 27 section § 27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

7.3. Test Procedure

1. Frequency Stability vs. Temperature: The equipment under test was connected to an external AC power supply and the RF output was connected to a frequency counter via feed-through attenuators.
2. The EUT was placed inside the temperature chamber. The AC leads and RF output cable exited the chamber through an opening made for the purpose.
3. After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.
4. Frequency Stability vs. Voltage: An external variable AC power supply was connected to the battery terminals of the equipment under test. The voltage was set to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the AC end point. The output frequency was recorded for each AC.

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7.4. Test Results

Ambient temperature : (24 ± 2) °C
Relative humidity : 47 % R.H.

AWS(Uplink) mode at middle channel

Reference Frequency: 1 732.50 MHz, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
50	110	-20	-0.012
40		-18	-0.010
30		-11	-0.006
24		-3	-0.002
10		4	0.002
0		7	0.004
-10		11	0.006
-20		13	0.008
-30		19	0.011
Frequency Stability versus power Supply			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
24	126.5	-3	-0.002
	93.5	-4	-0.002
	85(End point)	-4	-0.002

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AWS(Downlink) mode at middle channel

Reference Frequency: 2 132.50 MHz, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
50	110	-21	-0.010
40		-18	-0.008
30		-10	-0.005
24		-3	-0.001
10		6	0.003
0		11	0.005
-10		17	0.008
-20		20	0.009
-30		25	0.012
Frequency Stability versus power Supply			
Environment Temperature (℃)	Power Supplied (Vac)	Frequency Measure with Time Elapse	
		Frequency Error (Hz)	ppm
24	126.5	-3	-0.001
	93.5	-2	-0.001
	85(End point)	-3	-0.001

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8. RF Exposure Evaluation

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in § 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time
(A) Limits for Occupational /Control Exposures				
300 – 1500	--	--	F/300	6
1500 - 100000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1500	--	--	F/1500	6
<u>1500 - 100000</u>	<u>--</u>	<u>--</u>	<u>1</u>	<u>30</u>

8.1 Friis transmission formula : $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot R^2)$

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

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8.2 Test Result of RF Exposure Evaluation

Test Item : RF Exposure Evaluation Data

Test Mode : Normal Operation

8.2.1 Output Power into Antenna & RF Exposure Evaluation Distance

AWS band

Uplink mode

Channel	Frequency (MHz)	Output Power to Antenna (dB m)	Antenna Gain (dB i)	R (cm)
Low	1 711.25	30.54	9	26.761
Mid	1 732.50	30.31	9	26.062
High	1 753.75	30.09	9	25.410

Downlink mode

Channel	Frequency (MHz)	Output Power to Antenna (dB m)	Antenna Gain (dB i)	R (cm)
Low	2 111.00	30.57	4.5	15.996
Mid	2 130.00	30.77	4.5	16.368
High	2 153.75	30.08	4.5	15.118

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