TEST REPORT

of

FCC Part 22 Subpart H and Part 24 Subpart E

FCC ID: TQ8-TS310B1AX

Equipment Under Test	:	Premium Gen 2.0 I-BOX
Model Name	:	TS310B1AX
Serial No.	:	N/A
Applicant	:	HYUNDAI MOBIS CO., LTD.
Manufacturer	:	HYUNDAI MOBIS CO., LTD.
Date of Test(s)	:	2013.01.17 ~ 2013.02.01
Date of Issue	:	2013.03.08

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

Tested By:	**Logan Lee**	**Date:**	**2013.03.08**
Approved By:	**Denny Ham**	**Date:**	**2013.03.08**

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1. General information

1.1. Testing laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- Wireless Div. 3FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

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1.2. Details of applicant

Applicant : HYUNDAI MOBIS CO., LTD.
Address : 80-9, Mabook-Dong, Giheung-Gu, Yongin-shi, Gyunggi-Do, 446-912, South Korea
Contact Person : Kim, Jong-Tae
Phone No. : +82 31 260 0092

1.3. Description of EUT

Kind of Product	Premium Gen 2.0 I-BOX
Model Name	TS310B1AX
Serial Number	N/A
Power Supply	DC 14.4 V (Vehicle Battery)
Rated Power	CDMA800: 24 ㏈m CDMA1 900: 24 ㏈m
Frequency Range	CDMA800: 824.70 ㎒ ~ 848.31 ㎒ CDMA1900: 1 851.25 ㎒ ~ 1 908.75 ㎒
Antenna Gain	CDMA800: 1.34 ㏈i CDMA1 900: 4.02 ㏈i
Support Mode	1xRTT, 1xEV-DO
Emission Designator	CDMA800 (1xRTT): 1M27F9W CDMA1 900 (1xRTT): 1M28F9W CDMA800 (1xEV-DO): 1M27F9W CDMA1 900 (1xEV-DO): 1M27F9W

1.4. Description of test mode

The transmitter has a maximum average output power as follows:

1xRTT

Cellular Band

Frequency (㎒)	Service Option (SO)	Channel	Average Output Power (㏈m)
824.70	RC3 55 (Loopback)	1 013	23.53
836.52		384	23.88
848.31		777	24.02

PCS Band

Frequency (㎒)	Service Option (SO)	Channel	Average Output Power (㏈m)
1 851.25	RC1 55 (Loopback)	25	23.33
1 880.00		600	23.56
1 908.75		1 175	23.35

1xEV-DO Release 0

Cellular Band - RTAP

Frequency (㎒)	RTAP Rate	Channel	Average Output Power (㏈m)
824.70	38.4	1 013	23.57
836.52		384	23.90
848.31		777	23.78

PCS Band - RTAP

Frequency (㎒)	RTAP Rate	Channel	Average Output Power (㏈m)
1 851.25	38.4	25	23.72
1 880.00		600	23.88
1 908.75		1 175	23.75

CDMA (800 / 1 900)
We found out the test mode with the highest power level after we investigated average output power of all the modulations and (or) data rates for each mode. So we chose below test mode as a representative of worst case.

- CDMA (800) 1xRTT : RC3 / 55 (Loopback), 1xEV-DO Rel0 : RTAP / 38.4
- CDMA (1 900) 1xRTT : RC1 / 55 (Loopback), 1xEV-DO Rel0 : RTAP / 38.4

1.5. Sample calculation for offset

Where relevant, the following sample calculation is provided:

1.5.1. Conducted test

Offset value (dB) = Directional Coupler (dB) + Attenuator (dB) + Cable loss (dB)

1.5.2. Radiation test

E.R.P. & E.I.R.P. = [S.G level + Amp.](dB m) - Cable loss(dB) + Ant. gain (dB d/dB i)

1.6. Test equipment list

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due.
Signal Generator	R&S	SMBV100A	255834	Jul. 02, 2012	Annual	Jul. 02, 2013
Signal Generator	R&S	SMR40	100272	Aug. 23, 2012	Annual	Aug. 23, 2013
Spectrum Analyzer	Agilent	E4440A	MY43362142	Mar. 29, 2012	Annual	Mar. 29, 2013
Spectrum Analyzer	R&S	FSV30	100768	Mar. 29, 2012	Annual	Mar. 29, 2013
Mobile Test Unit	Agilent	E5515C	GB43345198	Mar. 29, 2012	Annual	Mar. 29, 2013
Directional Coupler	KRYTAR	152613	140972	Jul. 19, 2012	Annual	Jul. 19, 2013
Attenuator	Agilent	8495B	MY42140907	Mar. 31, 2012	Annual	Mar. 31, 2013
Attenuator	Mini-Circuits	BW-N20W5+	9050-1	Mar. 30, 2012	Annual	Mar. 30, 2013
Low Pass Filter	Mini-Circuits	NLP-1200+	V8979400903-1	Jul. 12, 2012	Annual	Jul. 12, 2013
High Pass Filter	Wainwright	WHK3.0/18G-10SS	344	Jul. 12, 2012	Annual	Jul. 12, 2013
High Pass Filter	Wainwright	WHKX1.5/15G-6SS	4	Mar. 30, 2012	Annual	Mar. 30, 2013
DC Power Supply	Agilent	U8002A	MY50020026	Mar. 29, 2012	Annual	Mar. 29, 2013
Preamplifier	H.P.	8447F	2944A03909	Jul. 03, 2012	Annual	Jul. 03, 2013
Preamplifier	R&S	SCU 18	10117	Jan. 14, 2013	Annual	Jan. 14, 2014
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	Jul. 12, 2012	Annual	Jul. 12, 2013
Test Receiver	R&S	ESU26	100109	Feb. 21, 2012	Annual	Feb. 21, 2013
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	396	May 12, 2011	Biennial	May 12, 2013
Horn Antenna	R&S	HF906	100326	Nov. 23, 2011	Biennial	Nov. 23, 2013
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	BBHA9170	BBHA9170431	Aug. 24, 2012	Biennial	Aug. 24, 2014
Dipole Antenna	SCHWARZBECK MESSELEKTRONIK	VHA/UHA	9103/9105	May 24, 2011	Biennial	May 24, 2013
Antenna Master	INNCO	MM4000	N/A	N.C.R.	N/A	N.C.R.
Turn Table	INNCO	DS 1200S	N/A	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.4 m)	N/A	N.C.R.	N/A	N.C.R.

1.7. Summary of test results

The EUT has been tested according to the following specifications:

APPLIED STANDARD : FCC Part 22 Subpart H, Part 24 Subpart E		
Section in FCC part	**Test Item**	**Result**
§2.1046 §22.913(a) §24.232(c)	RF Radiated Output Power	Complied
§2.1053 §22.917(a) §24.238(a)	Spurious Radiated Emission	Complied
§2.1046	Conducted Output Power	Complied
§2.1049	Occupied Bandwidth	Complied
§24.232(d)	Peak-Average Ratio	Complied
§2.1051 §22.917(a) §24.238(a)	Spurious Emission at Antenna Terminal	Complied
§2.1055 §22.355 §24.235	Frequency Stability	Complied
§22.917(a) §24.238(a)	Band Edge	Complied
§1.1307 §2.1091	RF Exposure Evaluation	Complied

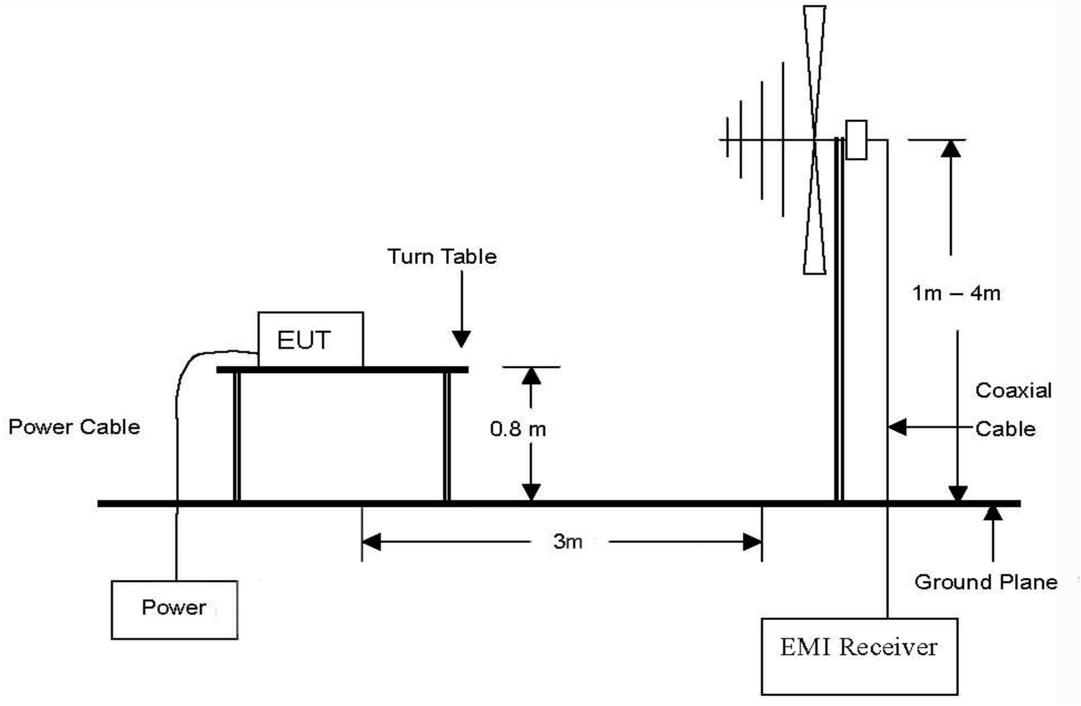
1.8. Test report revision

Revision	Report number	Description
0	F690501/RF-RTL006252	Initial
1	F690501/RF-RTL006252-1	Added Details of EUT setup & MPE data of maximum tune up tolerance
2	F690501/RF-RTL006252-2	Separated Details of EUT setup from the report

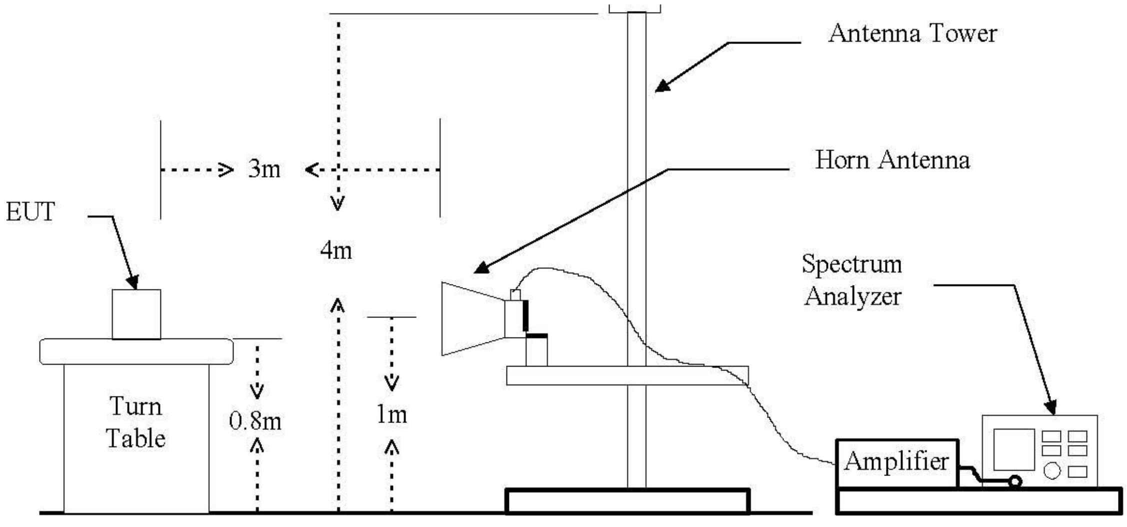
2. RF radiated output power & spurious radiated emission

2.1. Test setup

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



The diagram below shows the test setup that is utilized to make the measurements for emission .The spurious emissions were investigated form 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



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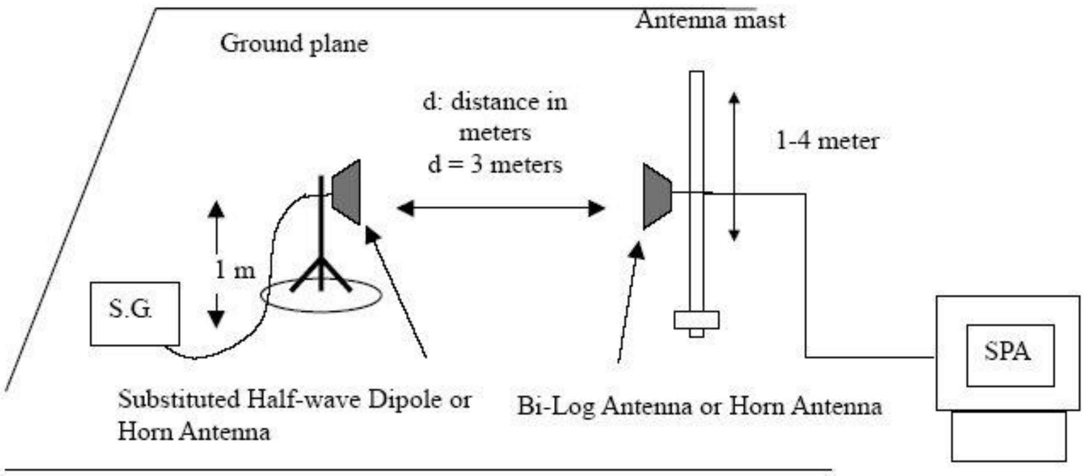
The diagram below shows the test setup for substituted method



2.2. Limit

2.2.1. RF radiated output power

FCC §22.913(a), The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.FCC §24.232(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

2.2.2. Spurious Radiated emission

§ 22.917(a) and §24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency must be attenuated below the transmitting (P) by a factor of at least 43+10log(P)㏈.

2.3. Test procedure : Based on ANSI/TIA 603C: 2004

1. On a test site, the EUT shall be placed at 80cm height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to correspond to the fundamental 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. During the measurement of the EUT, the resolution bandwidth was to 3 ㎒ and the video bandwidth was set to 3 ㎒.
5. The transmitter shall be switched on, the measuring receiver shall be tuned to the frequency of the transmitter under test.
6. The test antenna shall be raised and lowered through the specified range of height until the maximum signal level is detected by the measuring receiver.
7. The transmitter shall be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.
8. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
9. The maximum signal level detected by the measuring receiver shall be noted.
10. The EUT was replaced by half-wave dipole (824 ~ 849 ㎒) or horn antenna (1 850 ~ 1 910 ㎒) connected to a signal generator.
11. In necessary, the input attenuator setting on the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.
12. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
13. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring received, 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.
14. The input level to the substitution antenna shall be recorded as power level in ㏈m, corrected for any change of input attenuator setting of the measuring receiver.
15. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

2.4. Test result for RF radiated output power

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

CDMA800 1xRTT mode

Frequency (㎒)	Ant. Pol. (H/V)	S.G level + Amp. (dB m)	Cable loss (dB)	Ant. gain (dB d)	E.R.P.	
					(dB m)	(㎽)
824.70	V	30.27	3.42	-3.44	23.41	219.28
824.70	H	32.89	3.42	-3.44	26.03	400.87
836.52	V	29.99	3.38	-3.45	23.16	207.01
836.52	H	30.66	3.38	-3.45	23.83	241.55
848.31	V	29.62	3.34	-3.42	22.86	193.20
848.31	H	30.41	3.34	-3.42	23.65	231.74

CDMA1 900 1xRTT mode

Frequency (㎒)	Ant. Pol. (H/V)	S.G level + Amp. (dB m)	Cable loss (dB)	Ant. gain (dB i)	E.I.R.P.	
					(dB m)	(㎽)
1 851.25	V	24.11	4.87	7.56	26.80	478.63
1 851.25	H	20.71	4.87	7.56	23.40	218.78
1 880.00	V	21.25	4.91	7.63	23.97	249.46
1 880.00	H	19.23	4.91	7.63	21.95	156.68
1 908.75	V	24.76	4.94	7.70	27.52	564.94
1 908.75	H	19.54	4.94	7.70	22.30	169.82

Remark:
1. E.R.P. & E.I.R.P. = S.G level (dB m) - Cable loss (dB) + Ant. gain (dB d/dB i)

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CDMA800 1xEV-DO mode

Frequency (㎒)	Ant. Pol. (H/V)	S.G level + Amp. (dB m)	Cable loss (dB)	Ant. gain (dB d)	E.R.P.	
					(dB m)	(㎽)
824.70	V	30.26	3.42	-3.44	23.40	218.78
824.70	H	31.87	3.42	-3.44	25.01	316.96
836.52	V	30.04	3.38	-3.45	23.21	209.41
836.52	H	30.38	3.38	-3.45	23.55	226.46
848.31	V	29.91	3.34	-3.42	23.15	206.54
848.31	H	30.53	3.34	-3.42	23.77	238.23

CDMA1 900 1xEV-DO mode

Frequency (㎒)	Ant. Pol. (H/V)	S.G level + Amp. (dB m)	Cable loss (dB)	Ant. gain (dB i)	E.I.R.P.	
					(dB m)	(㎽)
1 851.25	V	24.14	4.87	7.56	26.83	481.95
1 851.25	H	20.73	4.87	7.56	23.42	219.79
1 880.00	V	21.22	4.91	7.63	23.94	247.74
1 880.00	H	19.38	4.91	7.63	22.10	162.18
1 908.75	V	24.79	4.94	7.70	27.55	568.85
1 908.75	H	19.79	4.94	7.70	22.55	179.89

Remark:
1. E.R.P. & E.I.R.P. = S.G level (dB m) - Cable loss (dB) + Ant. gain (dB d/dB i)

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2.5. Spurious radiated emission

- Measured output Power: 26.03 ㏈m = 0.400 9 W
- Modulation Signal: CDMA800 1xRTT
- Distance: 3 meters
- Limit: -(43 + $10\log_{10}$(W)) = 39.03 ㏈c

Frequency (㎒)	Ant. Pol. (H/V)	S.G level + Amp. (㏈m)	Cable loss (㏈)	Ant. gain (㏈d)	E.R.P. (㏈m)	㏈c	Margin (㏈)
Low Channel (824.70 ㎒)							
1 650.42	V	-35.08	4.54	6.45	-33.17	-59.20	20.17
1 648.95	H	-42.31	4.54	6.44	-40.41	-66.44	27.41
2 474.43	V	-40.14	5.68	7.98	-37.84	-63.87	24.84
2 474.32	H	-40.12	5.68	7.98	-37.82	-63.85	24.82
Middle Channel (836.52 ㎒)							
1 673.20	V	-32.01	4.58	6.51	-30.08	-56.11	17.08
1 672.23	H	-42.63	4.57	6.50	-40.70	-66.73	27.70
2 511.33	V	-40.98	5.72	8.02	-38.68	-64.71	25.68
2 512.10	H	-39.44	5.72	8.03	-37.13	-63.16	24.13
High Channel (848.31 ㎒)							
1 695.34	V	-32.13	4.61	6.56	-30.18	-56.21	17.18
1 695.26	H	-42.27	4.61	6.56	-40.32	-66.35	27.32
2 543.42	V	-40.21	5.75	8.07	-37.89	-63.92	24.89
2 543.21	H	-39.75	5.75	8.07	-37.43	-63.46	24.43

Remark:
1. E.R.P. & E.I.R.P. = S.G level (㏈m) - Cable loss (㏈) + Ant. gain (㏈d/㏈i)
2. No more harmonic above 3rd harmonic for all channel.

- Measured output Power : 27.52 dBm = 0.564 9 W
- Modulation Signal : CDMA1 900 1xRTT
- Distance : 3 meters
- Limit : $-(43 + 10\log_{10}(W)) = 40.52$ dBc

Frequency (MHz)	Ant. Pol. (H/V)	S.G level + Amp. (dBm)	Cable loss (dB)	Ant. gain (dBi)	E.I.R.P. (dBm)	dBc	Margin (dB)
Low Channel(1 851.25 MHz)							
3 702.74	V	-40.63	7.13	11.85	-35.91	-63.43	22.91
3 702.45	H	-42.56	7.13	11.85	-37.84	-65.36	24.84
5 553.41	V	-24.95	9.24	12.12	-22.07	-49.59	9.07
5 553.10	H	-31.27	9.24	12.12	-28.39	-55.91	15.39
Middle Channel(1 880.00 MHz)							
3 760.71	V	-39.45	7.23	11.85	-34.83	-62.35	21.83
3 761.32	H	-44.43	7.23	11.85	-39.81	-67.33	26.81
5 640.08	V	-25.42	9.36	12.08	-22.70	-50.22	9.70
5 641.11	H	-32.01	9.36	12.08	-29.29	-56.81	16.29
High Channel(1 908.75 MHz)							
3 817.51	V	-37.71	7.33	11.84	-33.20	-60.72	20.20
3 817.15	H	-45.08	7.33	11.84	-40.57	-68.09	27.57
5 726.45	V	-24.95	9.46	12.04	-22.37	-49.89	9.37
5 726.84	H	-31.79	9.46	12.04	-29.21	-56.73	16.21

Remark:
1. E.R.P. & E.I.R.P. = S.G level (dBm) - Cable loss (dB) + Ant. gain (dBd/dBi)
2. No more harmonic above 3rd harmonic for all channel.

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- Measured output Power: 25.01 ㏈m = 0.317 0 W
- Modulation Signal: CDMA800 1xEV-DO
- Distance: 3 meters
- Limit: $-(43 + 10\log_{10}(W))$ = 38.01 ㏈c

Frequency (㎒)	Ant. Pol. (H/V)	S.G level + Amp. (㏈m)	Cable loss (㏈)	Ant. gain (㏈d)	E.R.P. (㏈m)	㏈c	Margin (㏈)
Low Channel (824.70 ㎒)							
1 650.50	V	-35.04	4.54	6.45	-33.13	-58.14	20.13
1 648.94	H	-42.21	4.54	6.44	-40.31	-65.32	27.31
2 474.43	V	-39.54	5.68	7.98	-37.24	-62.25	24.24
2 474.50	H	-40.24	5.68	7.98	-37.94	-62.95	24.94
Middle Channel (836.52 ㎒)							
1 673.20	V	-32.07	4.58	6.51	-30.14	-55.15	17.14
1 671.23	H	-42.33	4.57	6.50	-40.40	-65.41	27.40
2 511.33	V	-41.09	5.72	8.02	-38.79	-63.80	25.79
2 512.60	H	-39.42	5.72	8.03	-37.11	-62.12	24.11
High Channel (848.31 ㎒)							
1 695.40	V	-33.42	4.61	6.56	-31.47	-56.48	18.47
1 695.26	H	-41.82	4.61	6.56	-39.87	-64.88	26.87
2 543.42	V	-40.25	5.75	8.07	-37.93	-62.94	24.93
2 543.30	H	-39.93	5.75	8.07	-37.61	-62.62	24.61

Remark:
1. E.R.P. & E.I.R.P. = S.G level (㏈m) - Cable loss (㏈) + Ant. gain (㏈d/㏈i)
2. No more harmonic above 3rd harmonic for all channel.

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- Measured output Power : 27.55 dBm = 0.568 9 W
- Modulation Signal : CDMA1 900 1xEV-DO
- Distance : 3 meters
- Limit : -(43 + $10\log_{10}$(W)) = 40.55 dBc

Frequency (MHz)	Ant. Pol. (H/V)	S.G level + Amp. (dBm)	Cable loss (dB)	Ant. gain (dBi)	E.I.R.P. (dBm)	dBc	Margin (dB)
Low Channel(1 851.25 MHz)							
3 702.80	V	-40.60	7.13	11.85	-35.88	-63.43	22.88
3 702.30	H	-42.58	7.13	11.85	-37.86	-65.41	24.86
5 553.41	V	-24.84	9.24	12.12	-21.96	-49.51	8.96
5 553.30	H	-31.33	9.24	12.12	-28.45	-56.00	15.45
Middle Channel(1 880.00 MHz)							
3 760.60	V	-39.41	7.23	11.85	-34.79	-62.34	21.79
3 761.40	H	-44.64	7.23	11.85	-40.02	-67.57	27.02
5 640.20	V	-25.29	9.36	12.08	-22.57	-50.12	9.57
5 641.20	H	-31.98	9.36	12.08	-29.26	-56.81	16.26
High Channel(1 908.75 MHz)							
3 817.51	V	-37.50	7.33	11.84	-32.99	-60.54	19.99
3 817.30	H	-45.09	7.33	11.84	-40.58	-68.13	27.58
5 726.60	V	-24.91	9.46	12.04	-22.33	-49.88	9.33
5 726.70	H	-31.75	9.46	12.04	-29.17	-56.72	16.17

Remark:
1. E.R.P. & E.I.R.P. = S.G level (dBm) - Cable loss (dB) + Ant. gain (dBd/dBi)
2. No more harmonic above 3rd harmonic for all channel.

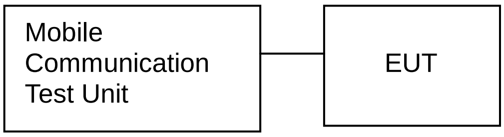
3. Conducted Output Power

3.1. Limit

Requirements: CFR 47, Section §2.1046

3.2. Test Procedure

1. The RF output of the transmitter was connected to the input of the Mobile Communication Test Unit through sufficient attenuation.
2. The EUT was set up for the max. output power with pseudo random data modulation.
3. The power was measured with Mobile Communication Test unit.



3.3.Test Settings

- CDMA2000 1xRTT

- Protocol Rev > 6 (IS-2000-0)
- System ID: 14655; NID:1; Reg. Ch. #. 384(Cell) & 600(PCS)
- Radio Config (RC) > Please see following table for details
- FCH Service Option (SO) Setup > Please see following table for details
- Traffic Data Rate > Full
- TDSO SCH info > F-SCH parameters > F-SCH Data Rate > 153.6kbps
  > R-SCH Parameters > R-SCH Data Rate > 153.6kbps
- RVS Power Ctrl > All Up bits (Maximum TxPout)

- CDMA2000 1xEV-DO

FTAP

- Protocol Rev > 0 (1xEVDO)
- Application Config > Enhanced Test Application Protocol > FTAP
- FTAP Rate > 307.2 kbps (2 slot, QPSK)
- Access Network Info > Termination Parameters > Sector ID > 00000000 > Subnet Mask > 0
- Generator Info > Termination Parameters > Max Forward Packet Duration > 16 slots
- RVS Power Ctrl > All Up bits (Maximum TxPout)

RTAP

- Protocol Rev > 0 (1xEVDO)
- Application Config > Enhanced Test Application Protocol > RTAP
- RTAP Rate > 153.6 kbps
- Access Network Info > Termination Parameters > Sector ID > 00000000 > Subnet Mask > 0
- Generator Info > Termination Parameters > Max Forward Packet Duration > 16 slots
- RVS Power Ctrl > All Up bits (Maximum TxPout)

3.4. Test Result

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

CDMA2000 1xRTT

- Cellular Band (Preliminary Measurement Results @ Middle channel)

Radio Configuration (RC)	Service Option (SO)	Average Output Power (dBm)		
		Ch. 1 013 / 824.70 MHz	Ch. 384 / 836.52 MHz	Ch. 777 / 848.31 MHz
RC1 (Fwd1, Rvs1)	1 (Voice)			
	2 (Loopback)	-	23.82	-
	3 (Voice)			
	6 (SMS)			
	55 (Loopback)	-	23.86	-
	68 (Voice)			
	70 (Voice)			
RC2 (Fwd2, Rvs2)	9 (Loopback)	-	23.76	-
	14 (SMS)			
	17 (Voice)			
	55 (Loopback)	-	23.87	-
	32768 (Voice)			
RC3 (Fwd3, Rvs3)	1 (Voice)			
	2 (Loopback)	23.57	23.82	24.01
	3 (Voice)			
	6 (SMS)			
	55 (Loopback)	23.53	23.88	24.02
	32 (+F-SCH)	23.56	23.84	24.01
	32 (+SCH)	23.63	23.86	23.82
	68 (Voice)			
	70 (Voice)			
RC4 (Fwd4, Rvs3)	1 (Voice)			
	2 (Loopback)	-	23.82	-
	3 (Voice)			
	6 (SMS)			
	55 (Loopback)	-	23.85	-
	32 (+F-SCH)	-	23.81	-
	32 (+SCH)	-	23.85	-
	68 (Voice)			
	70 (Voice)			
RC5 (Fwd5, Rvs4)	9 (Loopback)	-	23.80	-
	14 (SMS)			
	17 (Voice)			
	55 (Loopback)	-	23.83	-
	32768 (Voice)			

- The measurement is average output power for Low, Middle and High channel in worst case.
- The service option 55 of RC3 of worst case is bigger than other power compared with each service option.

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- PCS Band (Preliminary Measurement Results @ Middle channel)

Radio Configuration (RC)	Service Option (SO)	Average Output Power (㏈m)		
		Ch. 25 / 1 851.25 ㎒	Ch. 600 / 1 880.00 ㎒	Ch. 1 175 / 1 908.75 ㎒
RC1 (Fwd1, Rvs1)	1 (Voice)			
	2 (Loopback)	23.35	23.48	23.29
	3 (Voice)			
	6 (SMS)			
	55 (Loopback)	23.33	23.56	23.35
	68 (Voice)			
	70 (Voice)			
RC2 (Fwd2, Rvs2)	9 (Loopback)	-	23.45	-
	14 (SMS)			
	17 (Voice)			
	55 (Loopback)	-	23.53	-
	32768 (Voice)			
RC3 (Fwd3, Rvs3)	1 (Voice)			
	2 (Loopback)	-	23.43	-
	3 (Voice)			
	6 (SMS)			
	55 (Loopback)	-	23.48	-
	32 (+F-SCH)	-	23.54	-
	32 (+SCH)	-	23.51	-
	68 (Voice)			
	70 (Voice)			
RC4 (Fwd4, Rvs3)	1 (Voice)			
	2 (Loopback)	-	23.45	-
	3 (Voice)			
	6 (SMS)			
	55 (Loopback)	-	23.47	-
	32 (+F-SCH)	-	23.42	-
	32 (+SCH)	-	23.47	-
	68 (Voice)			
	70 (Voice)			
RC5 (Fwd5, Rvs4)	9 (Loopback)	-	23.42	-
	14 (SMS)			
	17 (Voice)			
	55 (Loopback)	-	23.50	-
	32768 (Voice)			

- The measurement is average output power for Low, Middle and High channel in worst case.
- The service option 55 of RC1 of worst case is bigger than other power compared with each service option.

CDMA2000 1xEV-DO Release 0 (Rel 0)

- Cellular Band (Preliminary Measurement Results @ Middle channel)

Application Protocol	Rate	Average Output Power (㏈m)		
		Ch. 1 013 / 824.70 ㎒	Ch. 384 / 836.52 ㎒	Ch. 777 / 848.31 ㎒
RTAP	9.6	-	23.84	-
	19.2	-	23.82	-
	38.4	23.75	23.90	23.78
	76.8	-	23.87	-
	153.6	-	23.75	-
FTAP	307.2 kbps (2 slot, QPSK)	23.59	23.87	23.88

- The measurement is average output power for Low, Middle and High channel in worst case.
- The rate 38.4 of RTAP of worst case is bigger than other power compared with each rate.

- PCS Band (Preliminary Measurement Results @ Middle channel)

Application Protocol	Rate	Average Output Power (㏈m)		
		Ch. 25 / 1 851.25 ㎒	Ch. 600 / 1 880.00 ㎒	Ch. 1 175 / 1 908.75 ㎒
RTAP	9.6	-	23.84	-
	19.2	-	23.75	-
	38.4	23.72	23.88	23.75
	76.8	-	23.82	-
	153.6	-	23.76	-
FTAP	307.2 kbps (2 slot, QPSK)	23.69	23.84	23.74

- The measurement is average output power for Low, Middle and High channel in worst case.
- The rate 38.4 of RTAP of worst case is bigger than other power compared with each rate.

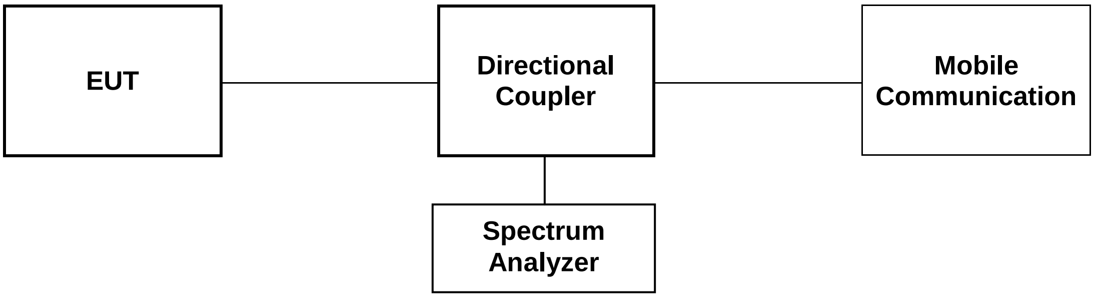
4. Occupied Bandwidth 99 %

4.1. Limit

Requirements: CFR 47, Section §2.1049.

4.2. Test Procedure

1. The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.
2. The resolution bandwidth of the spectrum analyzer was set.
3. OBW was measured with Mobile Communication Test unit for each channel.



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4.3 Test Results

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

Band	Mode	Frequency (㎒)	Occupied Bandwidth (㎒)
CDMA800	1xRTT RC3 55 (Loopback)	824.70	1.268
		836.52	1.266
		848.31	1.271
CDMA1 900	1xRTT RC1 55 (Loopback)	1 851.25	1.282
		1 880.00	1.273
		1 908.75	1.271

Band	Mode	Frequency (㎒)	Occupied Bandwidth (㎒)
CDMA800	1xEV-DO(Rel0) RTAP 38.4	824.70	1.267
		836.52	1.267
		848.31	1.271
CDMA1 900	1xEV-DO(Rel0) RTAP 38.4	1 851.25	1.271
		1 880.00	1.270
		1 908.75	1.273

Please refer to the following plots.

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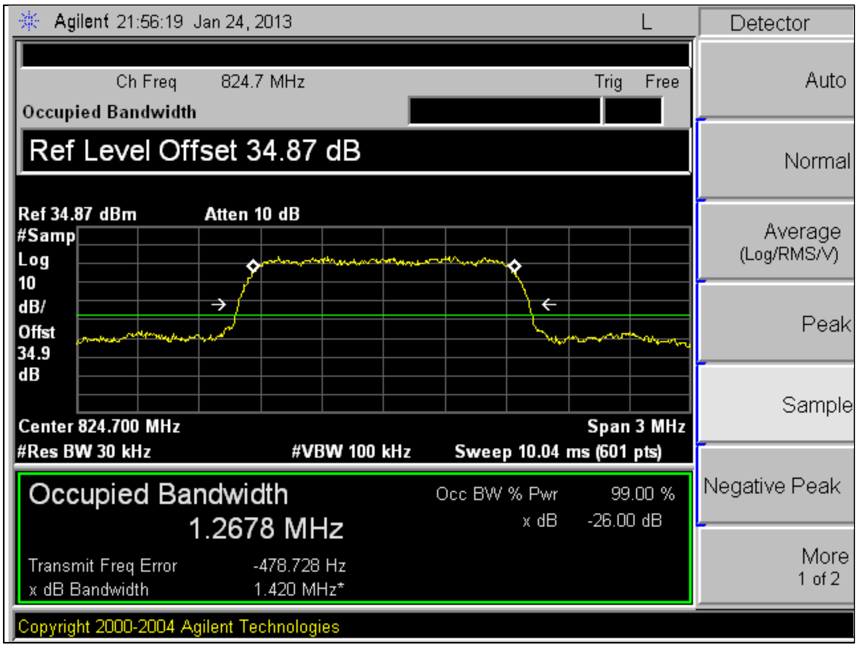
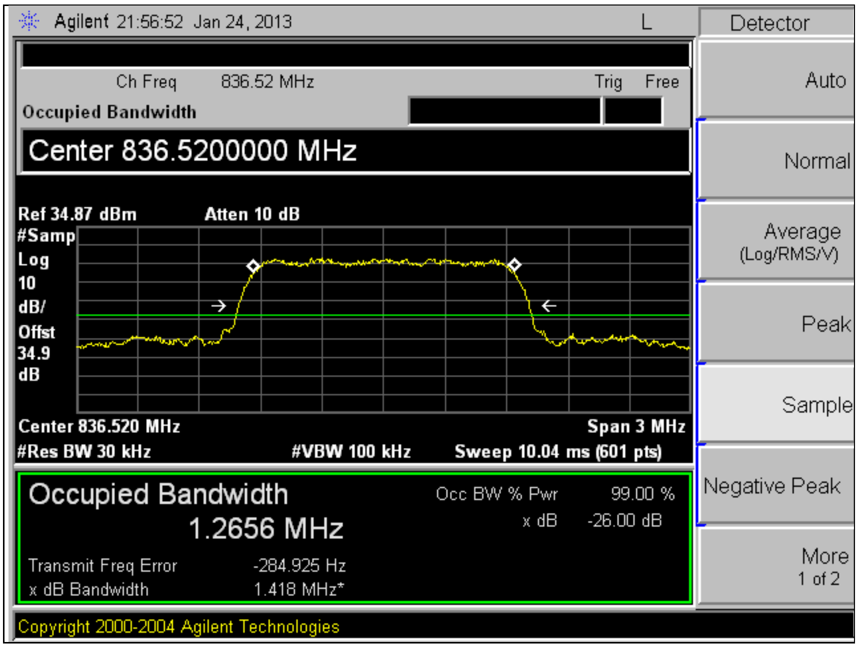
CDMA800

1xRTT

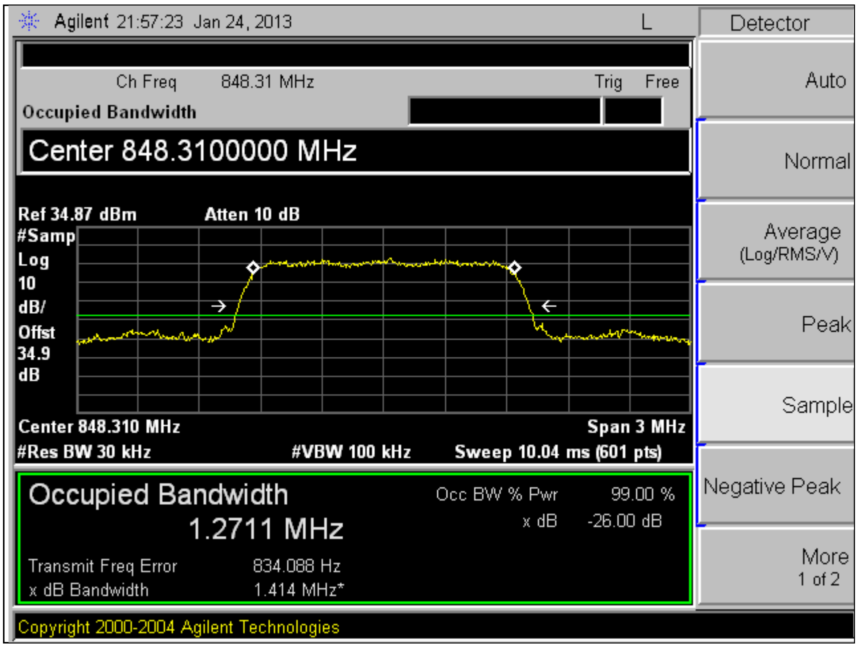
Low Channel



Middle Channel



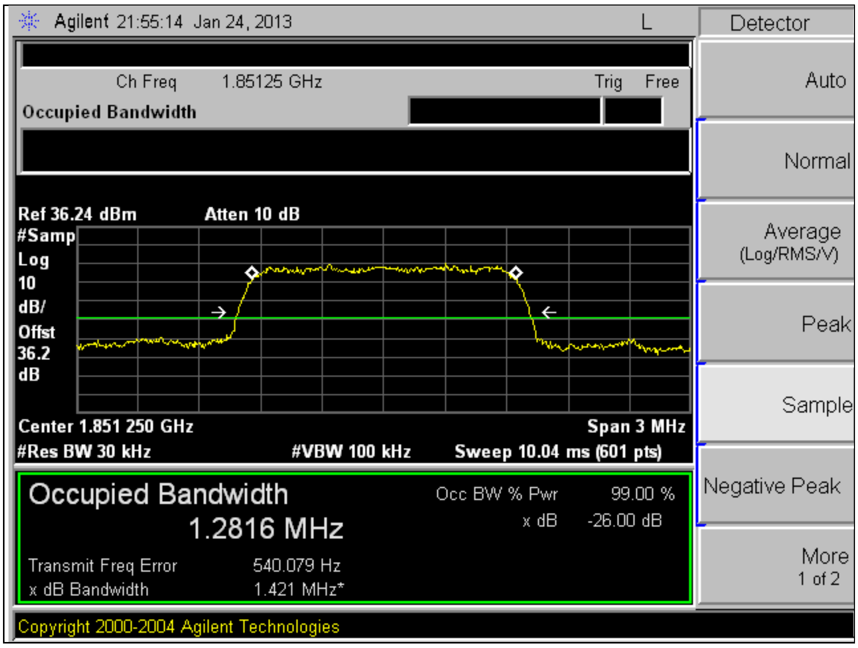
High Channel



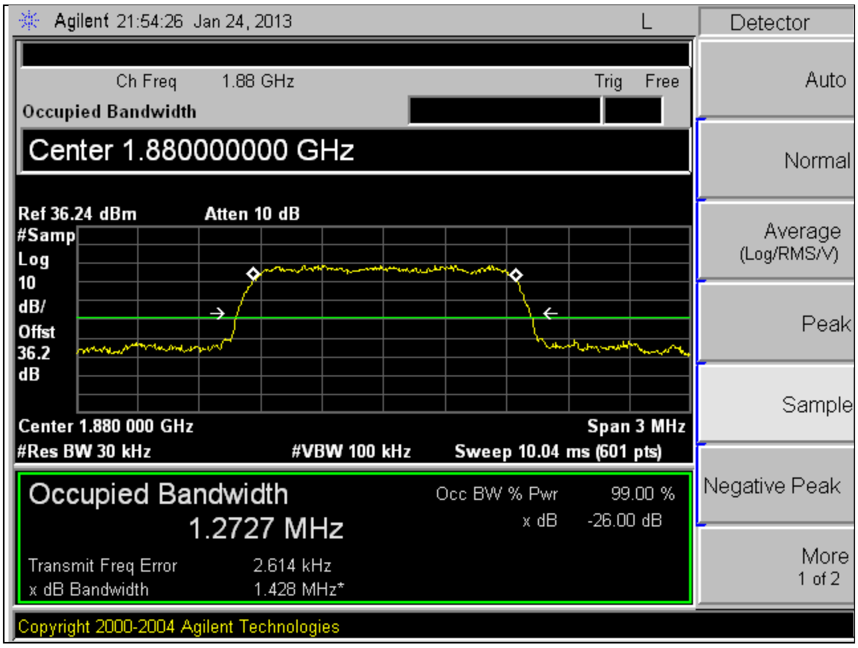
CDMA1 900

1xRTT

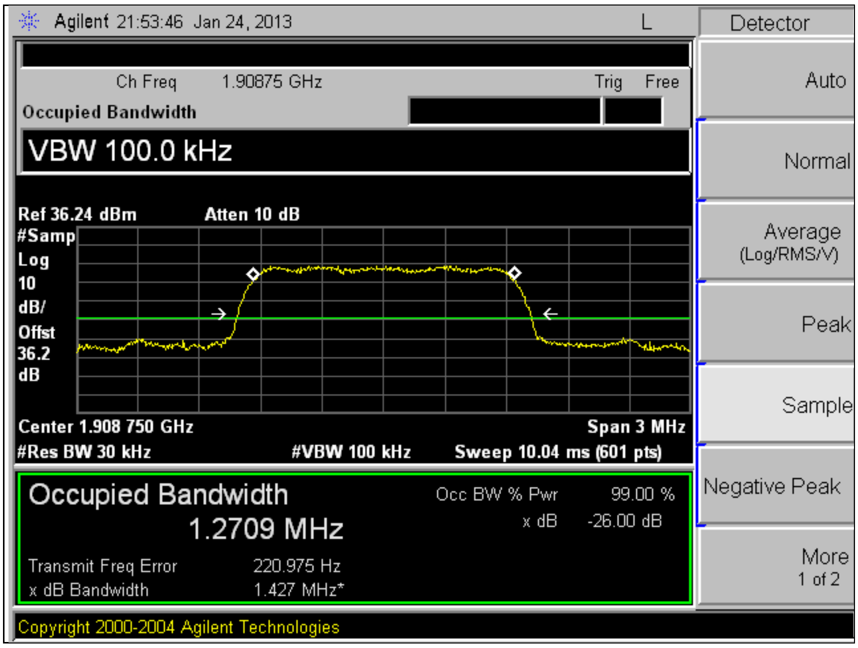
Low Channel



Middle Channel



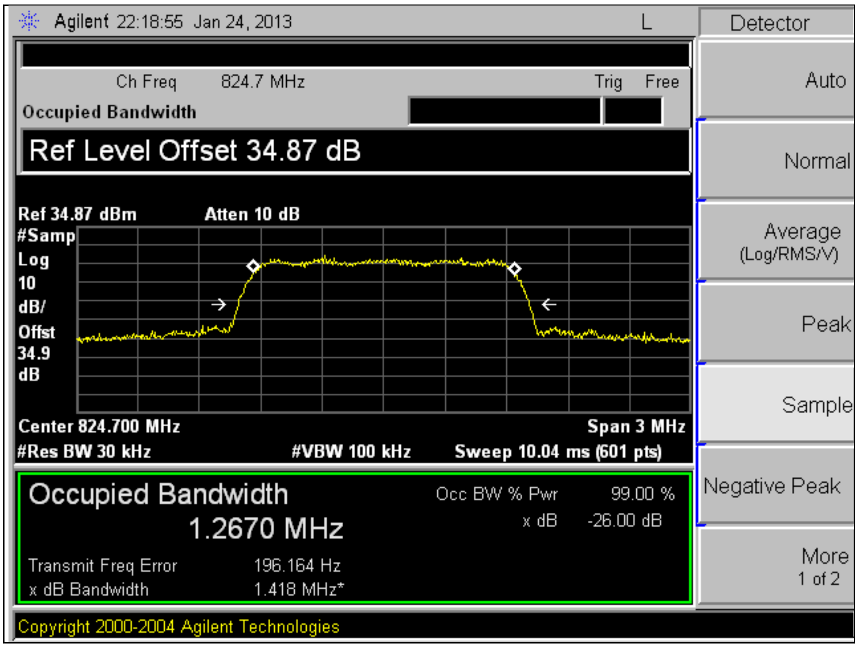
High Channel



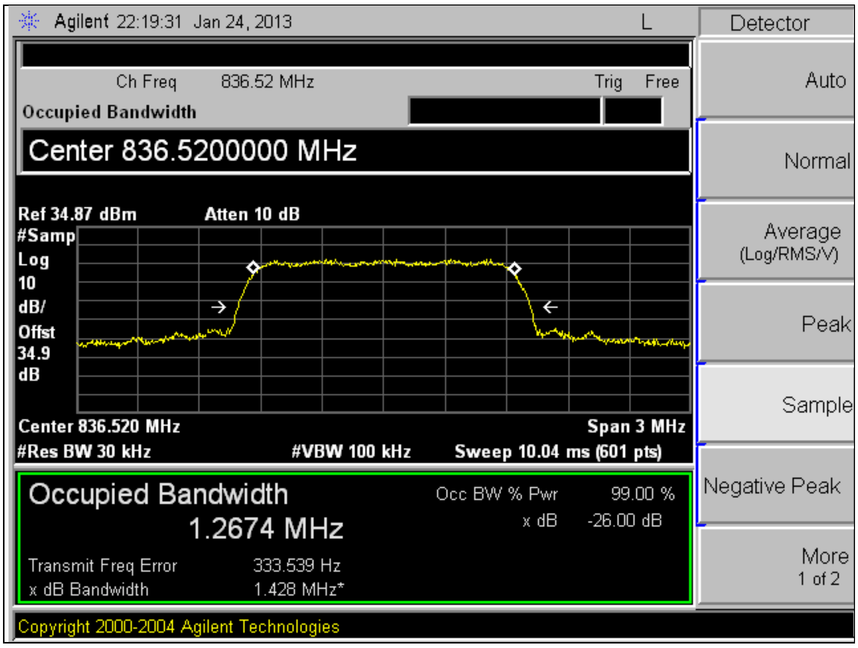
CDMA800

1xEV-DO

Low Channel



Middle Channel



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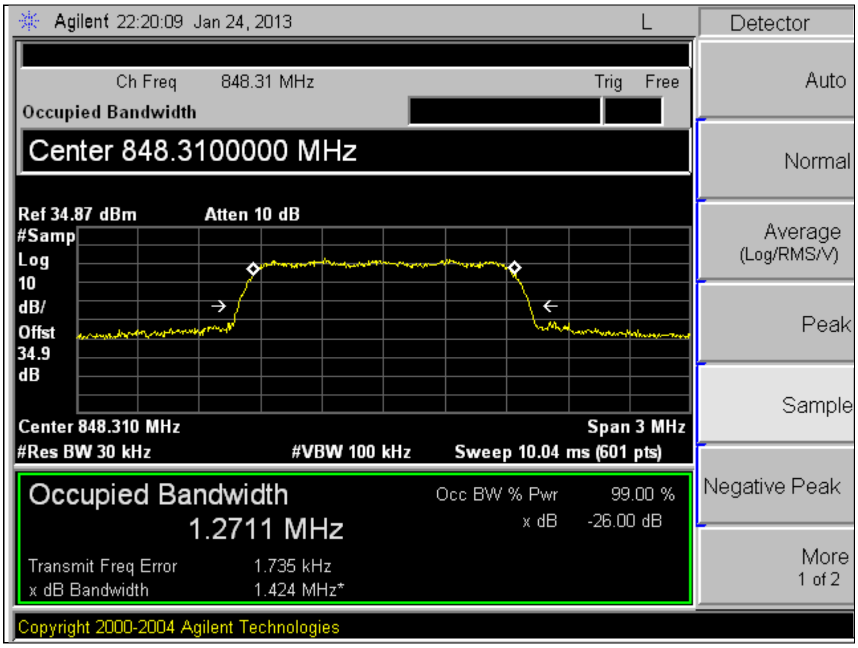
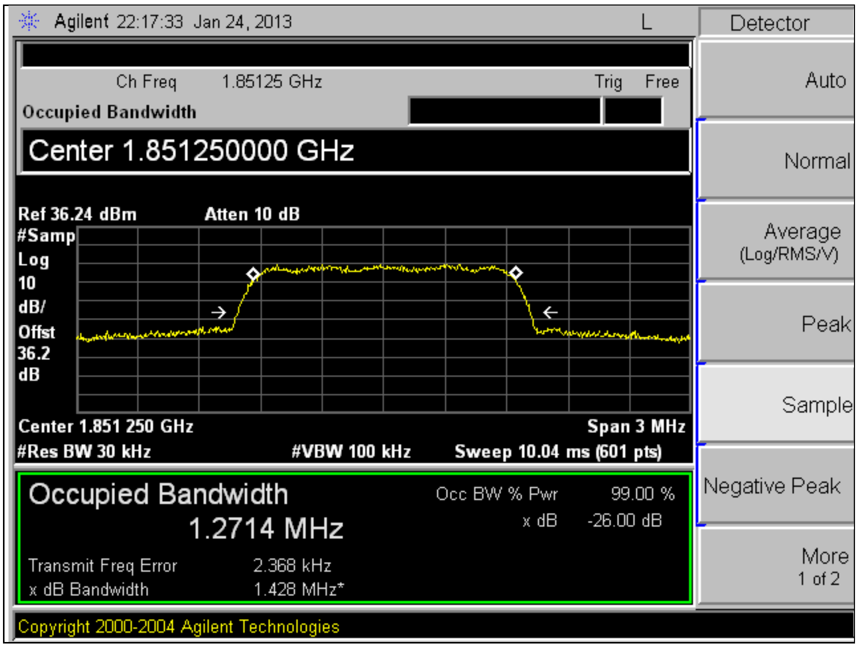
High Channel



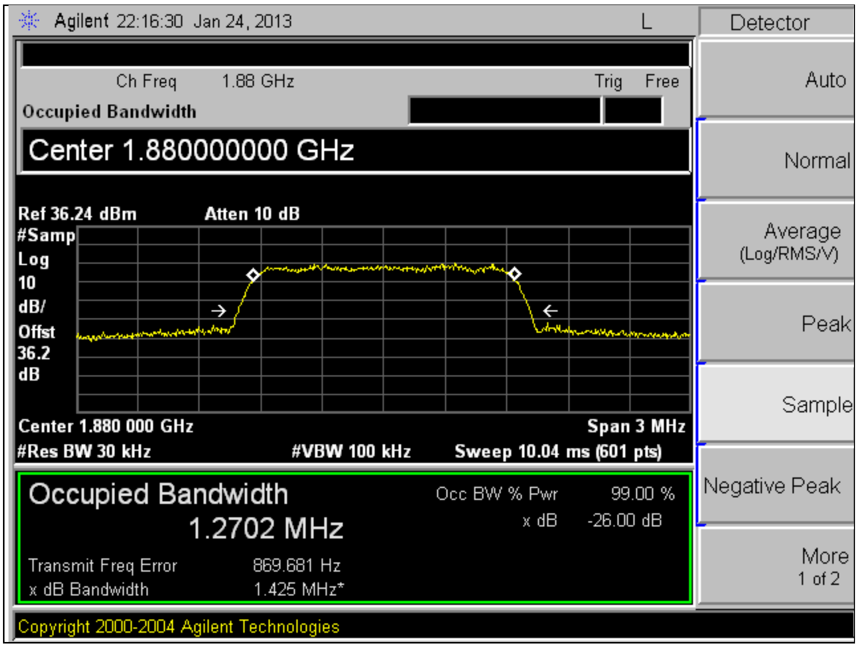
CDMA1 900

1xEV-DO

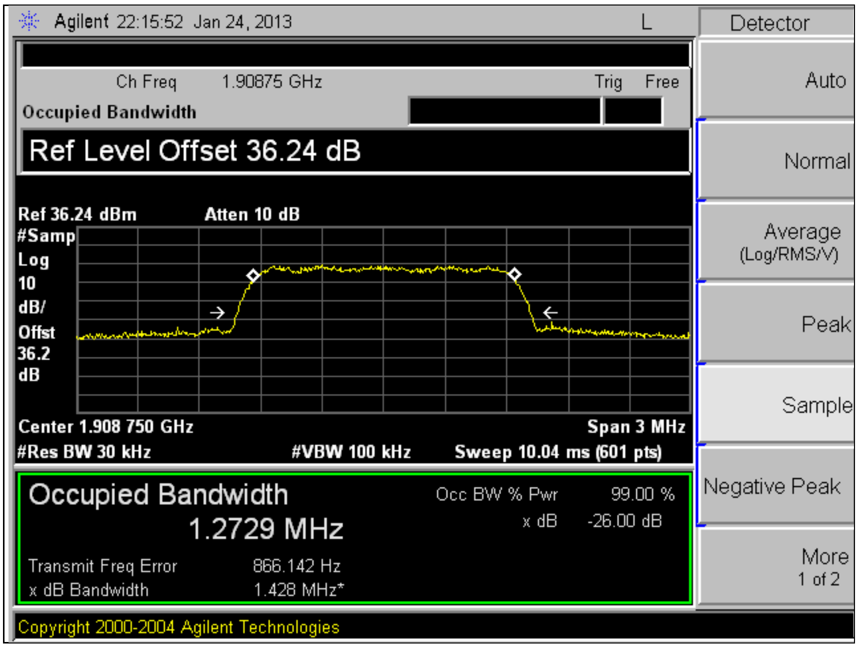
Low Channel



Middle Channel



High Channel



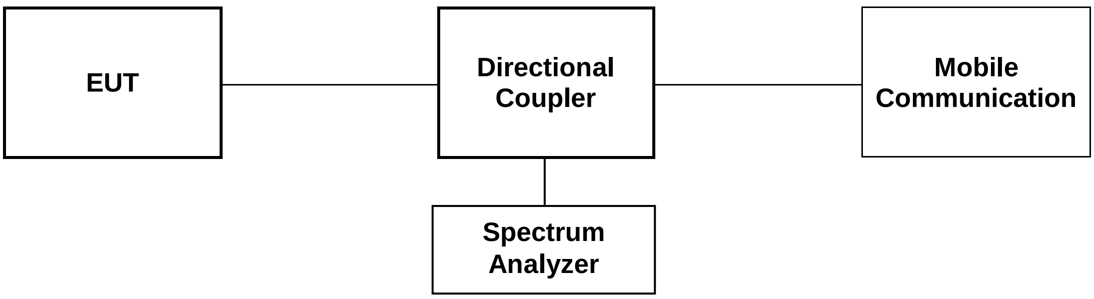
5. Peak-Average Ratio

5.1. Limit

§24.232(d) Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

5.2. Test Procedure

1. The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.
2. The CCDF function of the spectrum analyzer was set.
3. PAR was measured with spectrum analyzer for each channel.



4.3 Test Results

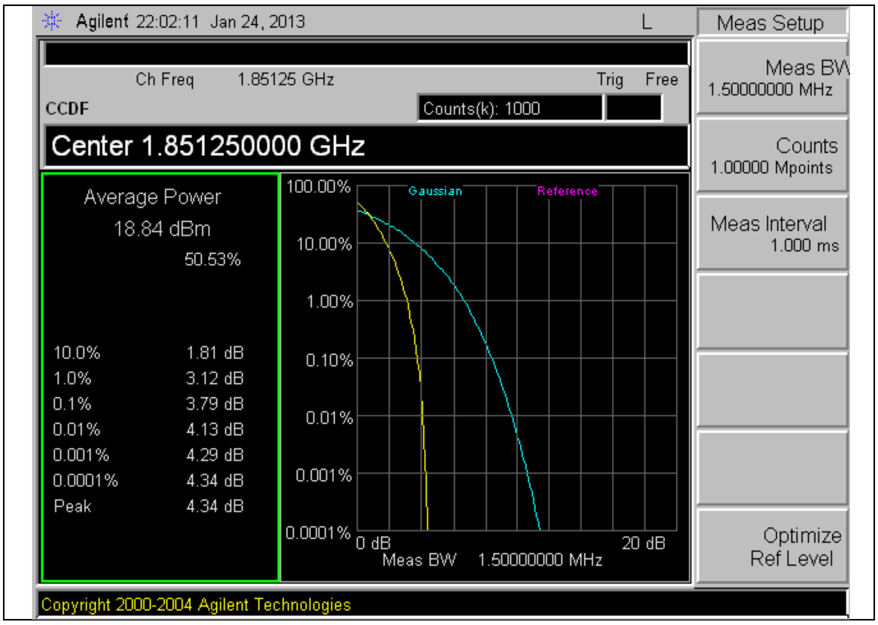
Ambient temperature	:	(24 ± 2) ℃
Relative humidity	:	47 % R.H.

Please refer to the following plots.

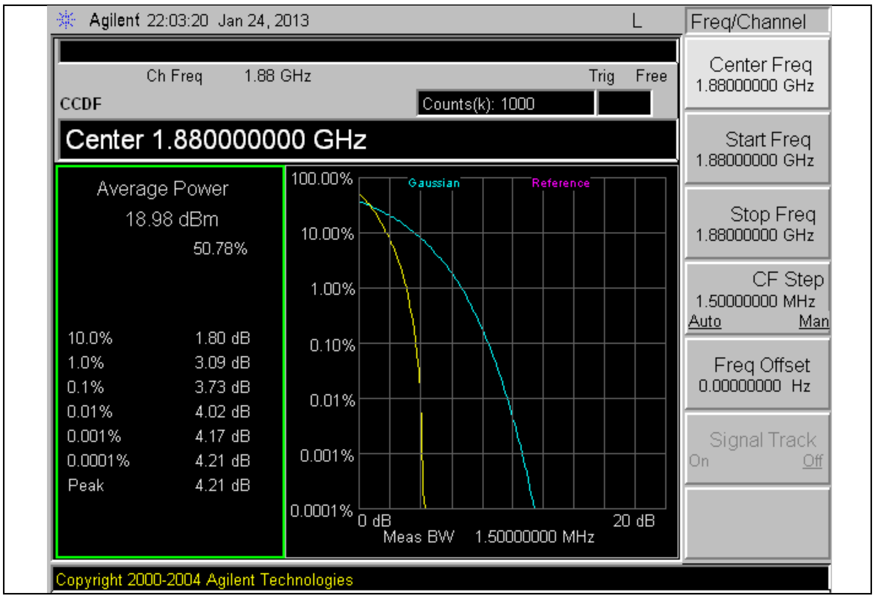
CDMA1 900

1xRTT

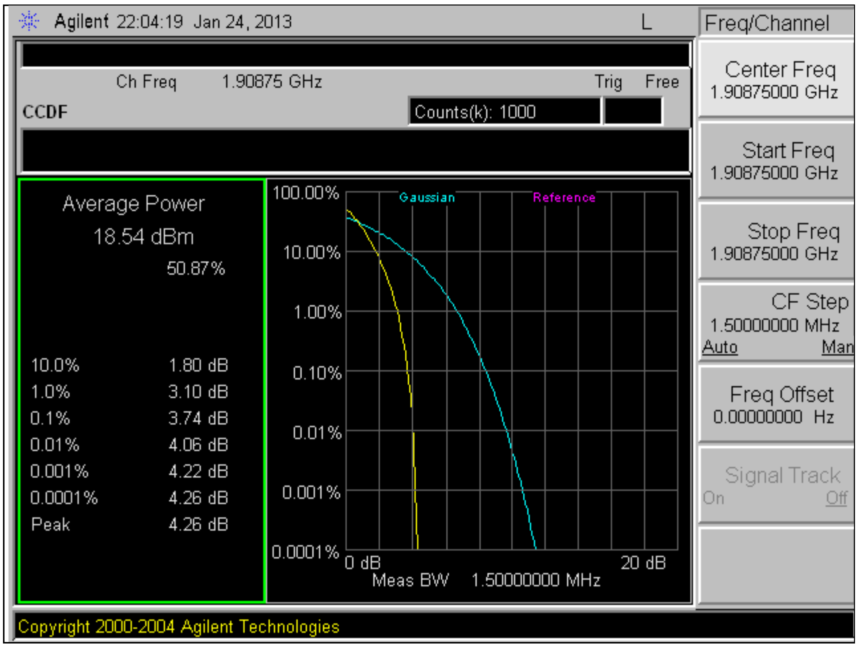
Low Channel



Middle Channel



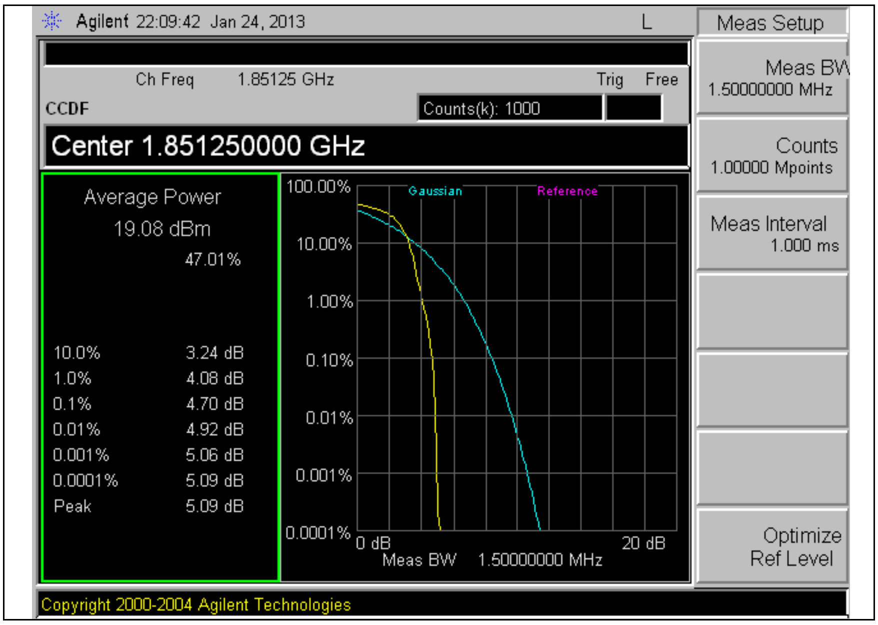
High Channel



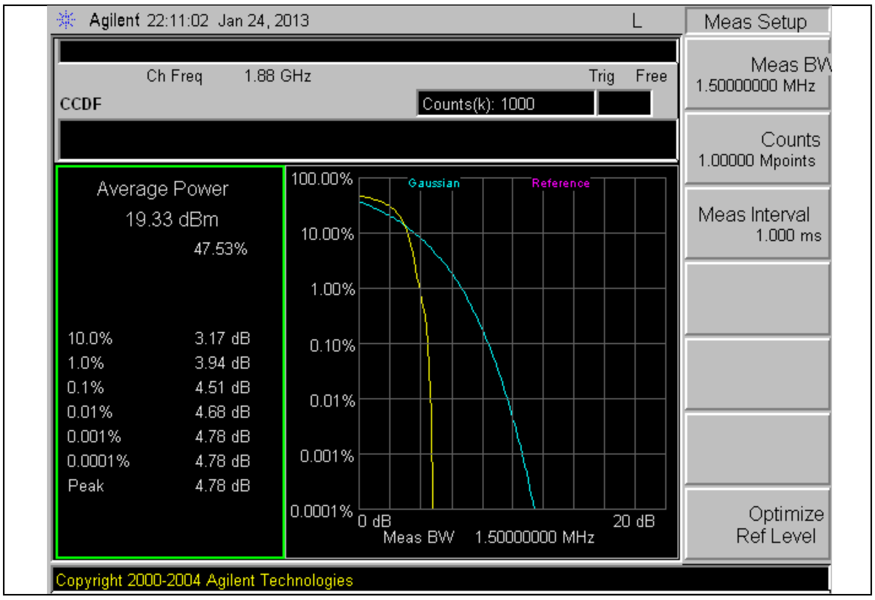
CDMA1 900

1xEV-DO

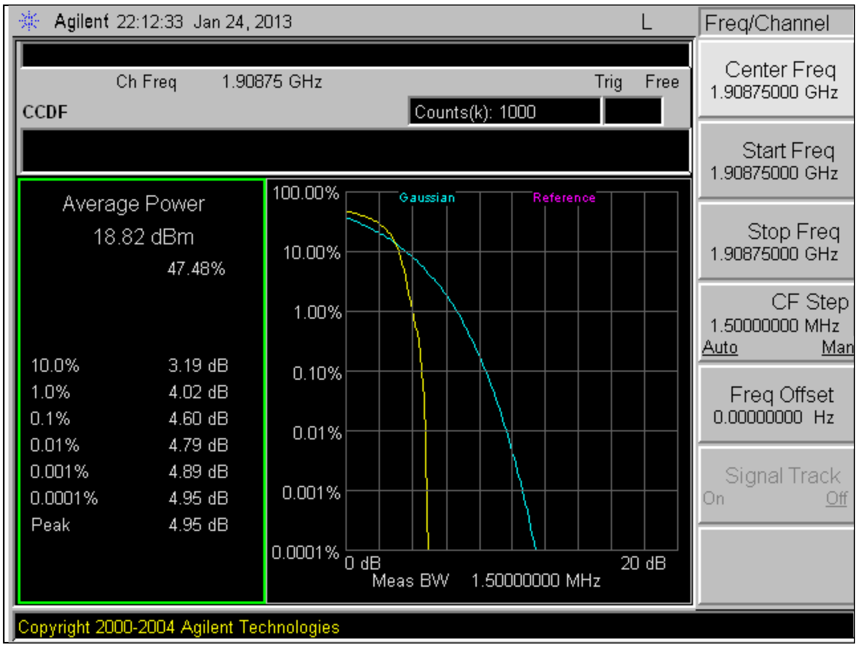
Low Channel



Middle Channel



High Channel



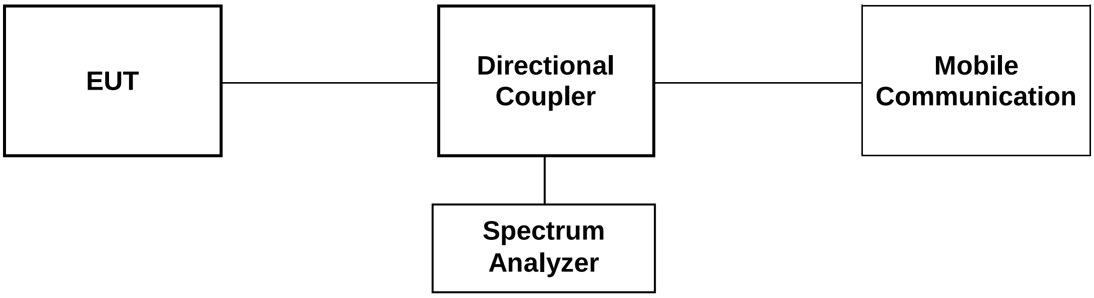
6. Spurious Emissions at Antenna Terminal

6.1. Limit

§22.917(a) and §24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency must be attenuated below the transmitting (P) by a factor of at least 43 + 10log(P)㏈.

6.2. Test Procedure

1. The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation.
2. The resolution bandwidth of the spectrum analyzer was set at 1 ㎒. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



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6.3. Test Results

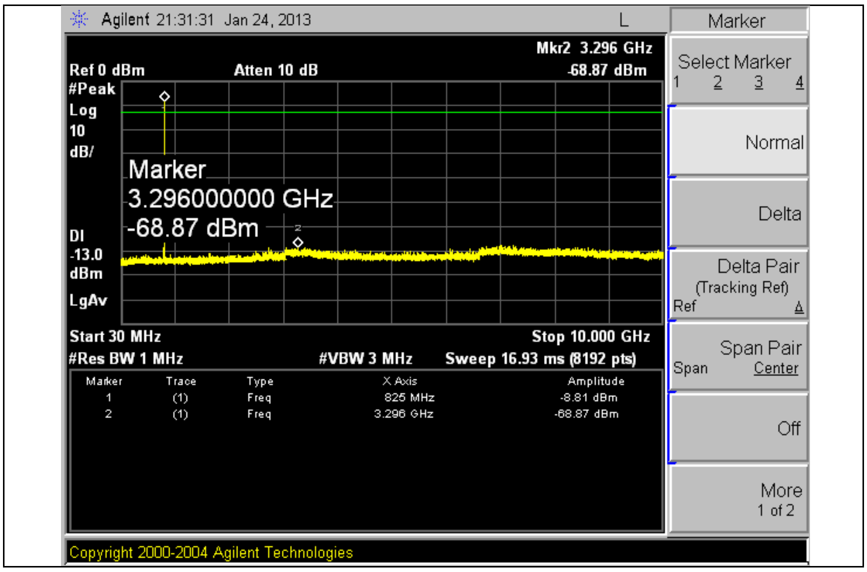
Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

Please refer to the following plots.

CDMA800

1xRTT

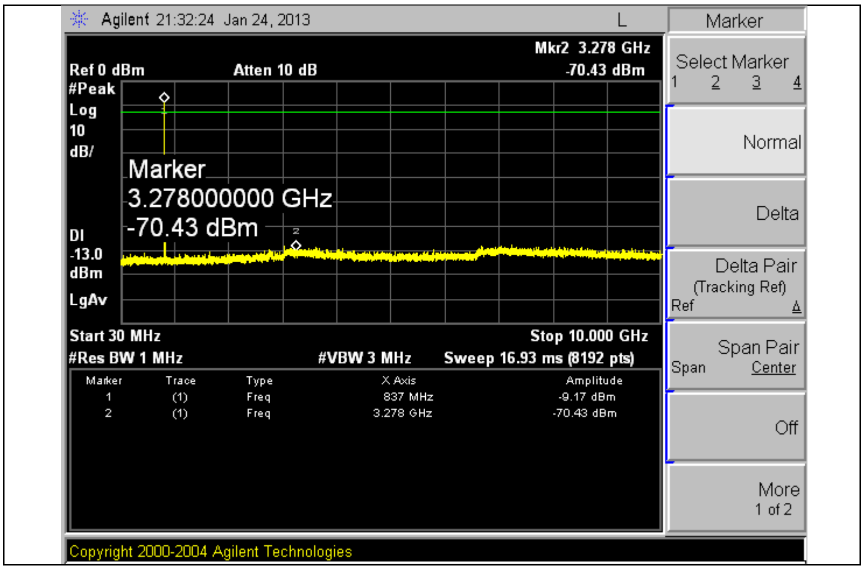
Low Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
3 296.00	-	Noise level	-

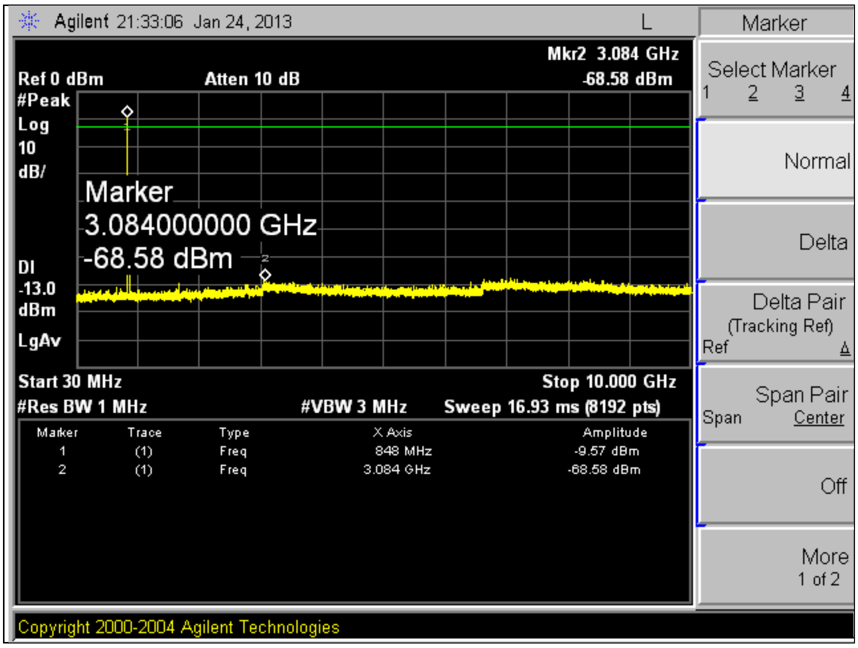
Middle Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
3 278.00	-	Noise level	-

High Channel



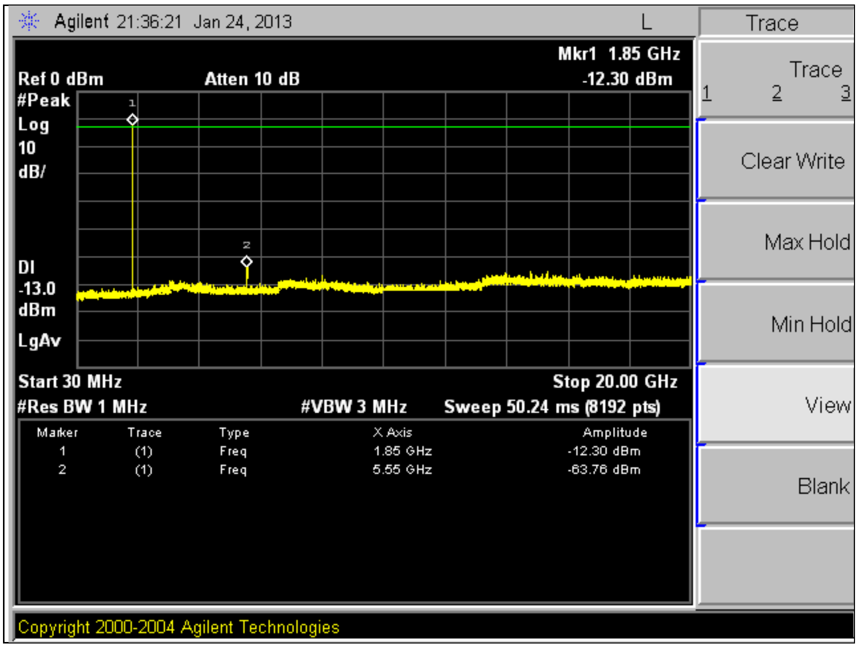
Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
3 084.00	-	Noise level	-

CDMA1 900

1xRTT

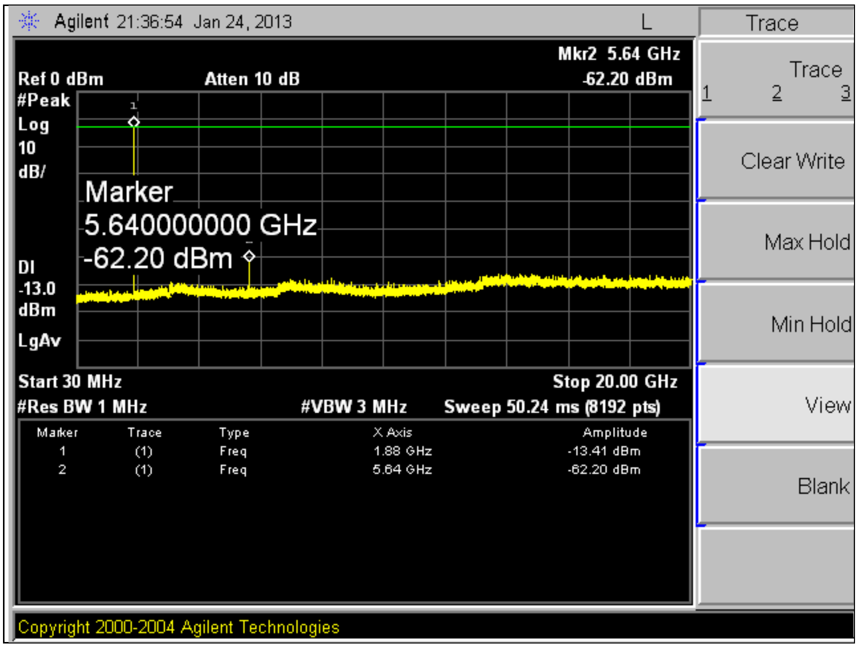
Low Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
5 550.00	37.35	-63.76	--26.41

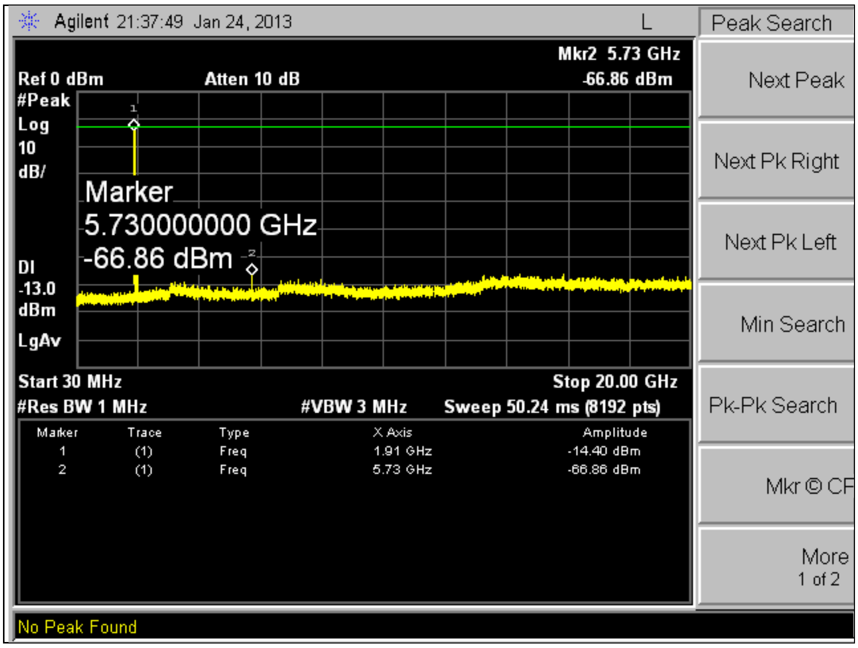
Middle Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
5 640.00	37.38	-62.20	-24.82

High Channel



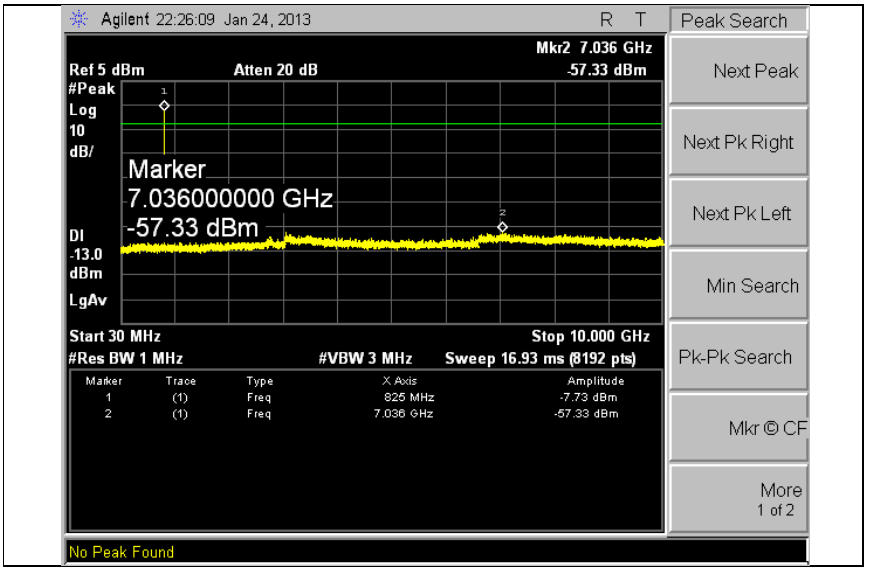
Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
5 730.00	37.42	-66.86	-29.44

CDMA800

1xEV-DO

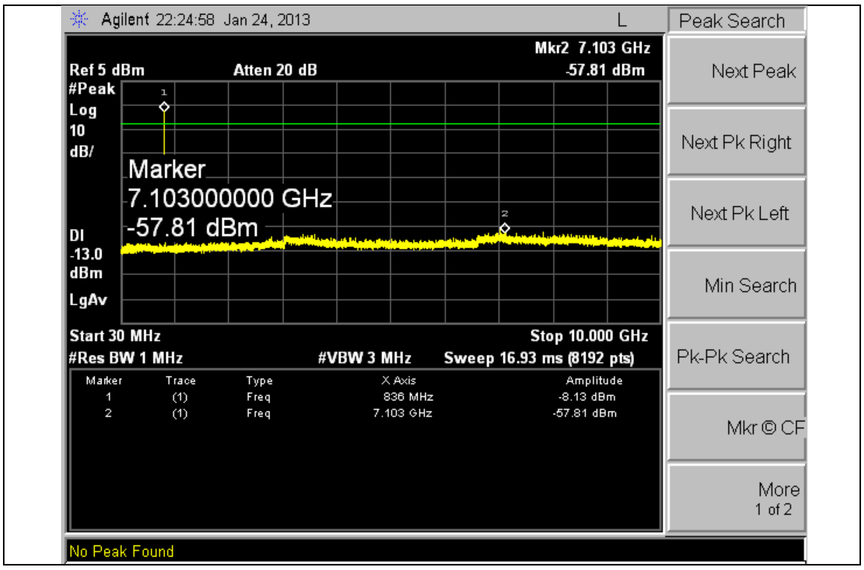
Low Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
7 036.00	-	Noise level	-

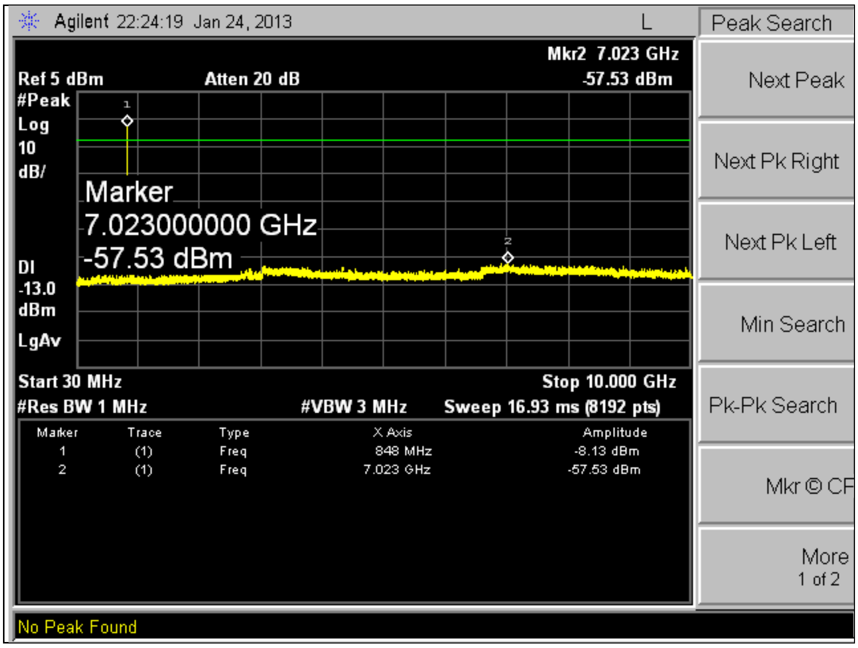
Middle Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
7 103.00	-	Noise level	-

High Channel



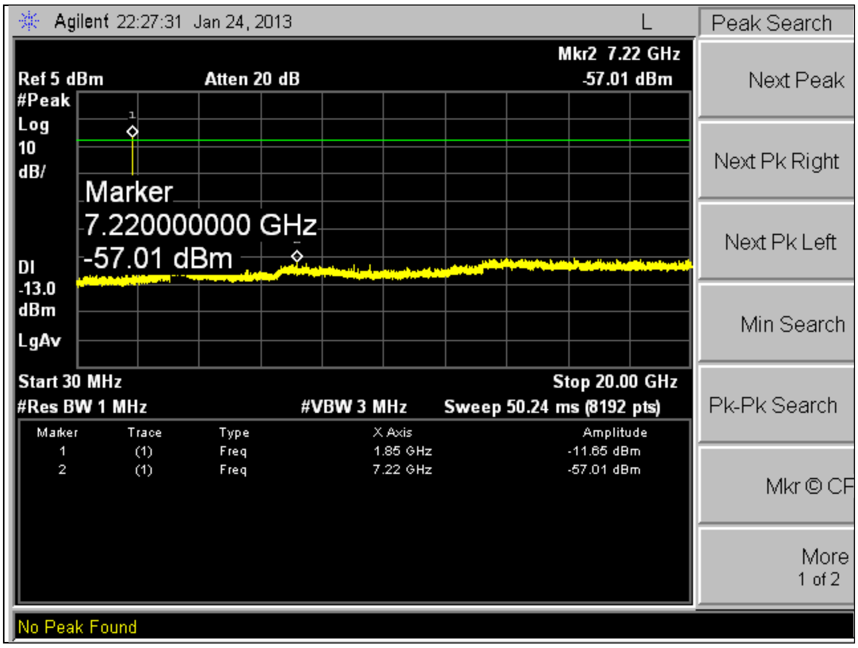
Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
7 023.00	-	Noise level	-

CDMA1 900

1xEV-DO

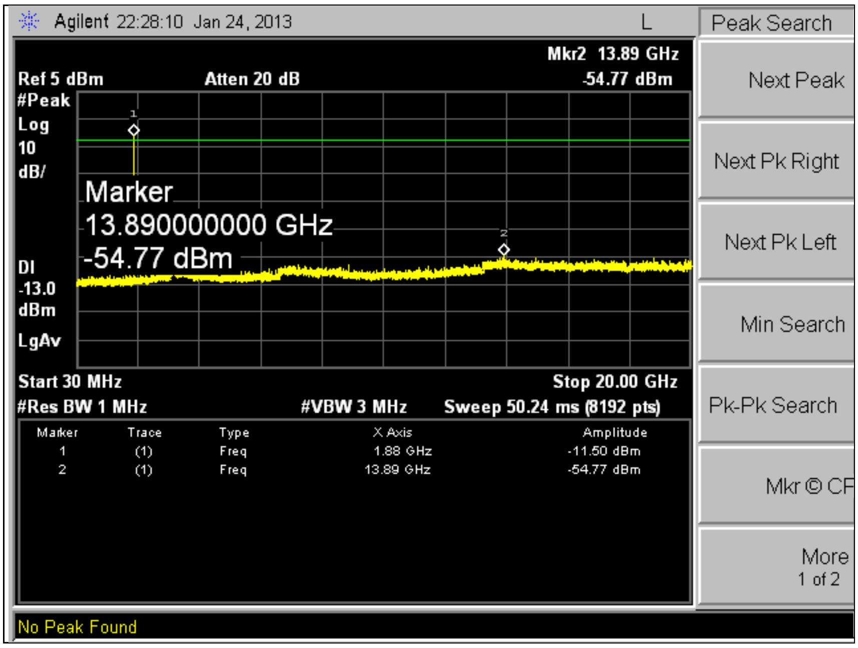
Low Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
7 220.00	38.12	-57.01	-18.89

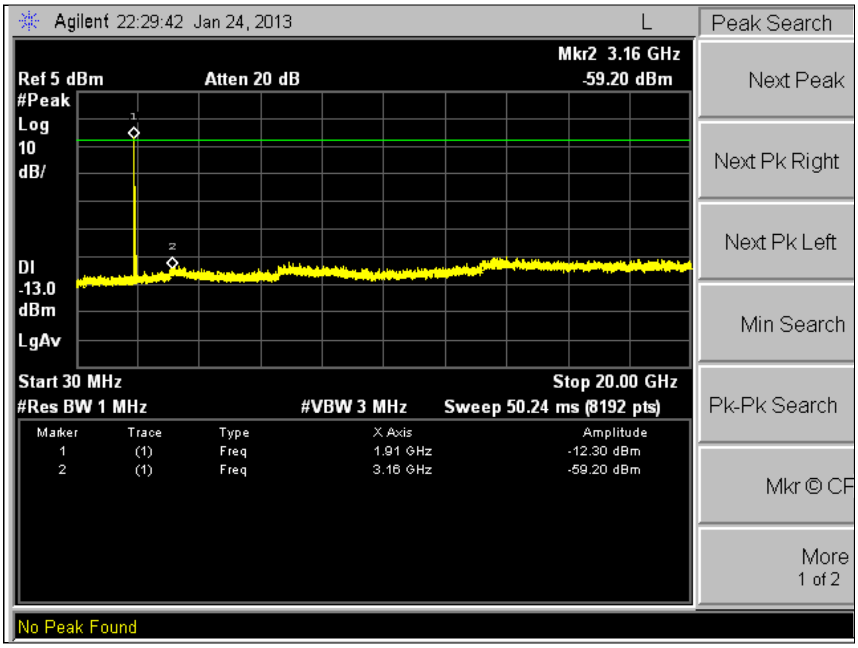
Middle Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
13 890.00	-	Noise level	-

High Channel



Note:
Offset (dB) = Directional Coupler (dB) + Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
3 160.00	-	Noise level	-

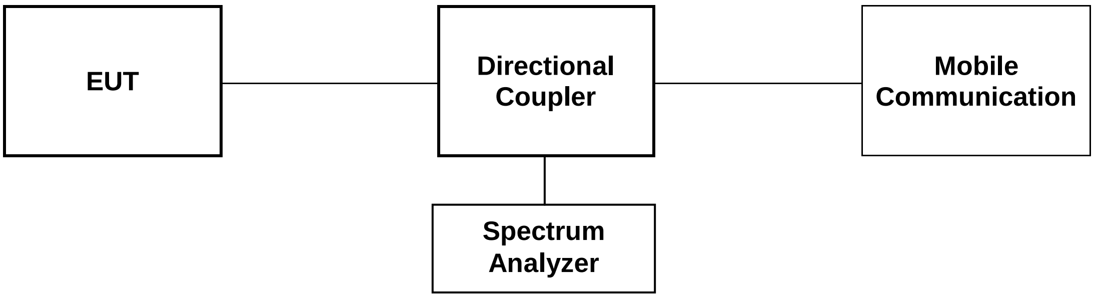
7. Band Edge

7.1. Limit

§22.917(a) and §24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency must be attenuated below the transmitting (P) by a factor of at least 43+10log(P)dB.

7.2. Test Procedure

1. The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.
2. The center of the spectrum analyzer was set to block edge frequency.



7.3. Test Results

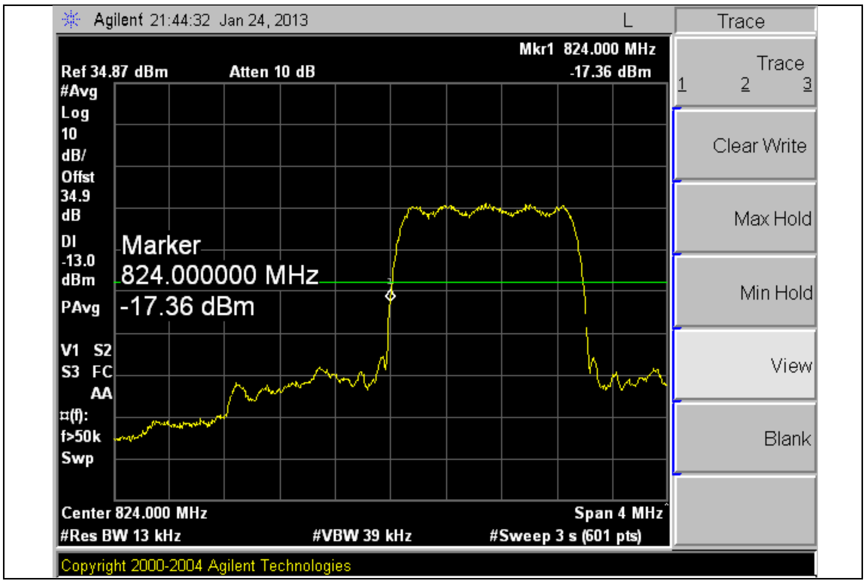
Ambient temperature	:	(24 ± 2) ℃
Relative humidity	:	47 % R.H.

Please refer to the following plots.

CDMA800 (band edge)

1xRTT

Low Channel

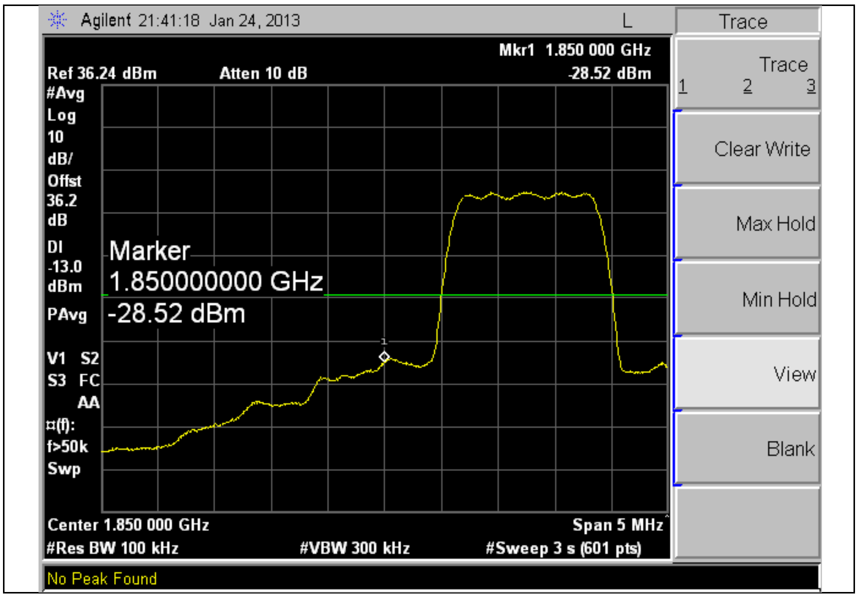


High Channel

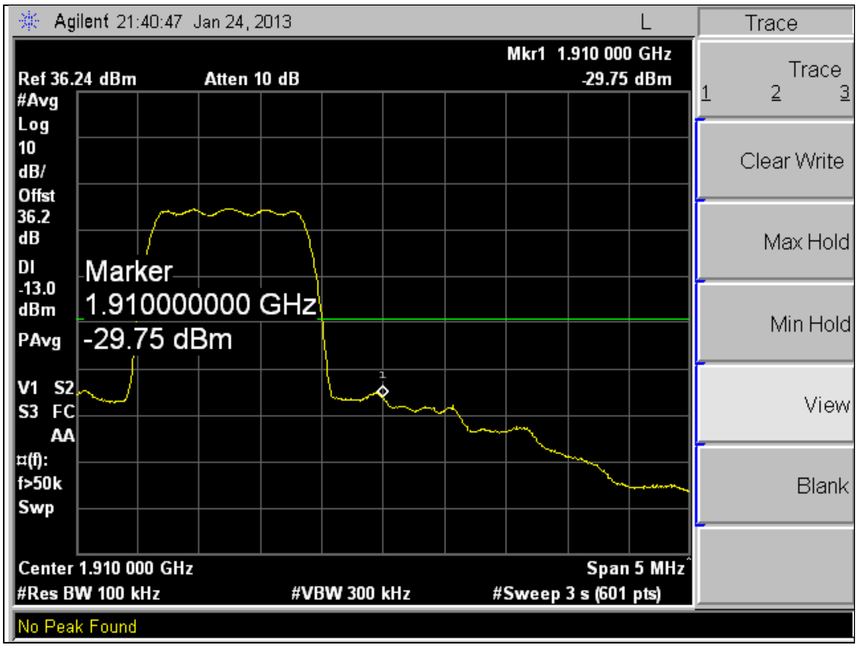
CDMA1 900 (Band edge)

1xRTT

Low Channel



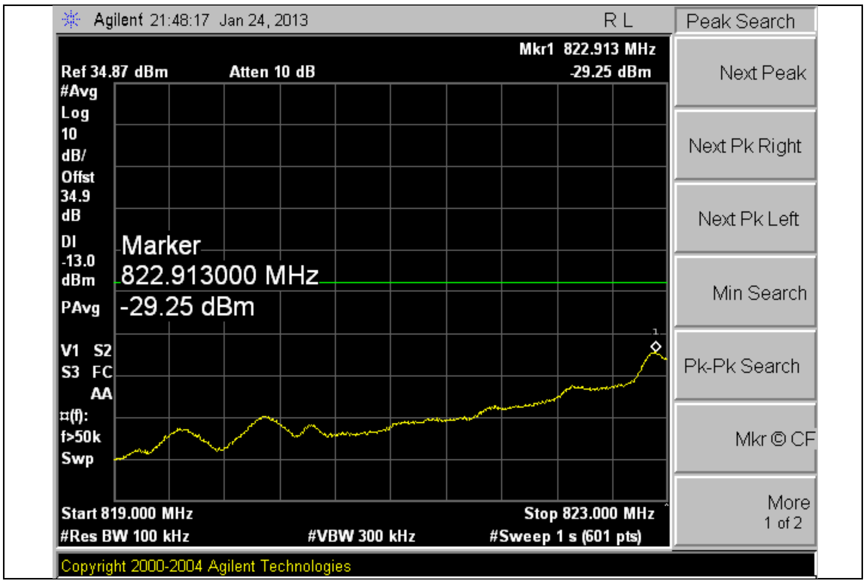
High Channel



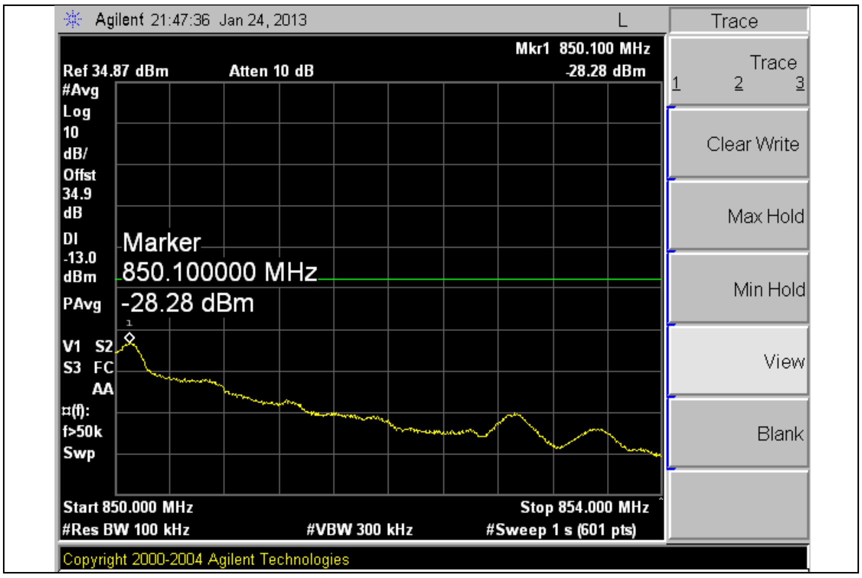
CDMA800 (4 ㎒ SPAN)

1xRTT

Low Channel



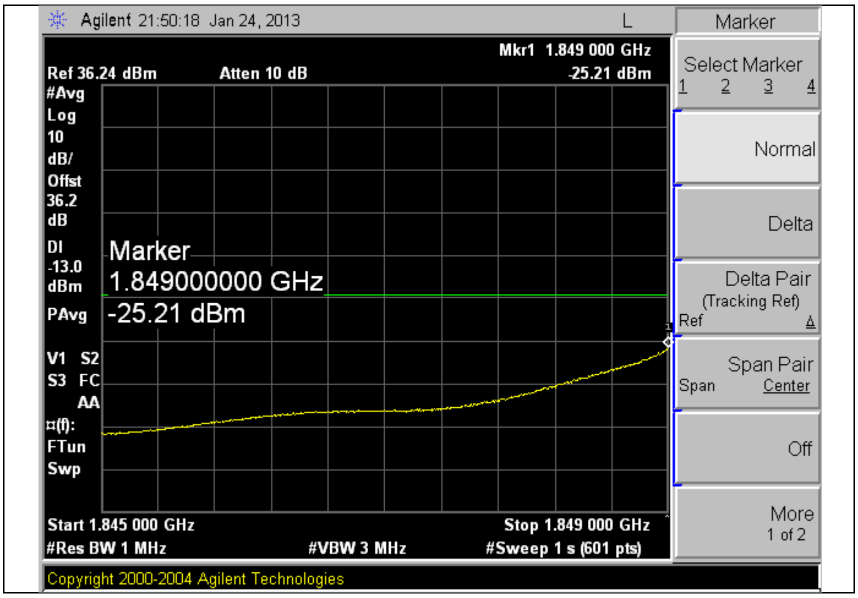
High Channel



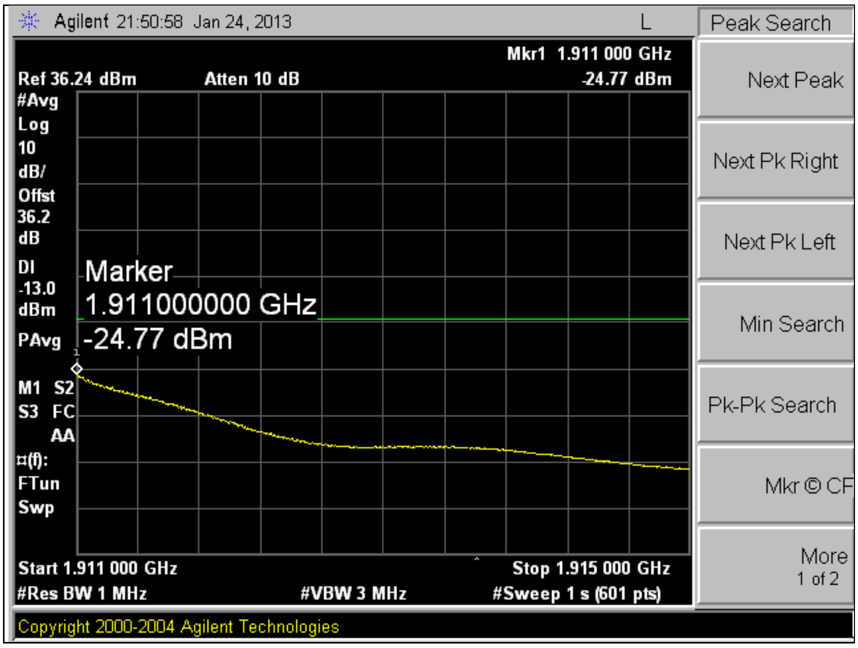
CDMA1 900 (4 ㎒ SPAN)

1xRTT

Low Channel



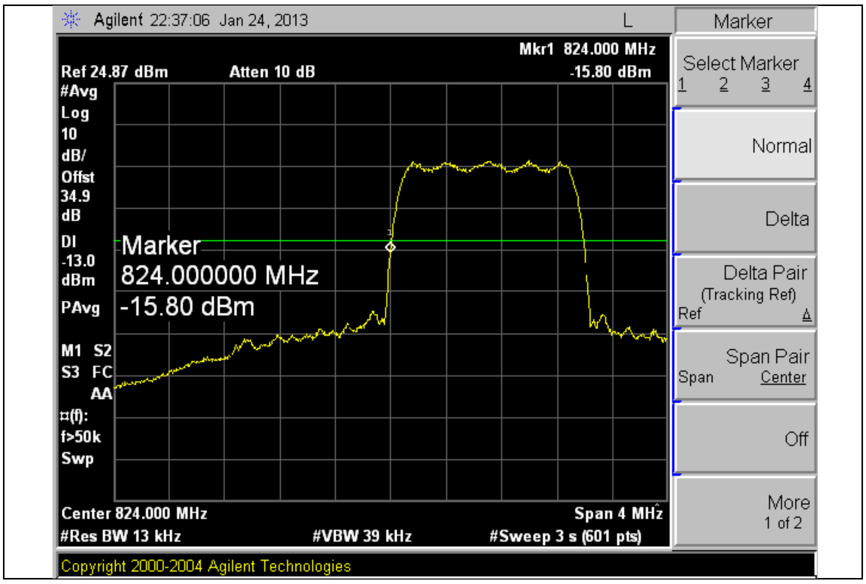
High Channel



CDMA800 (band edge)

1xEV-DO

Low Channel

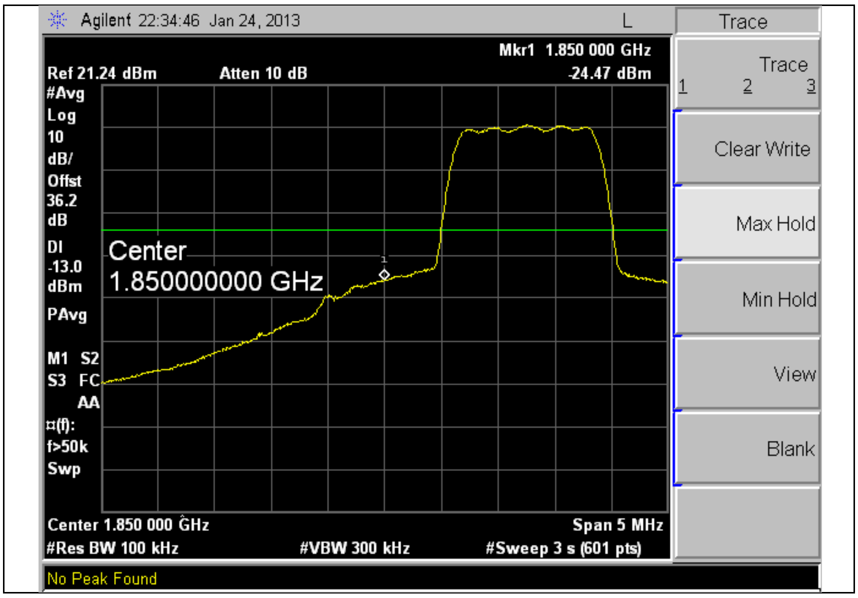


High Channel

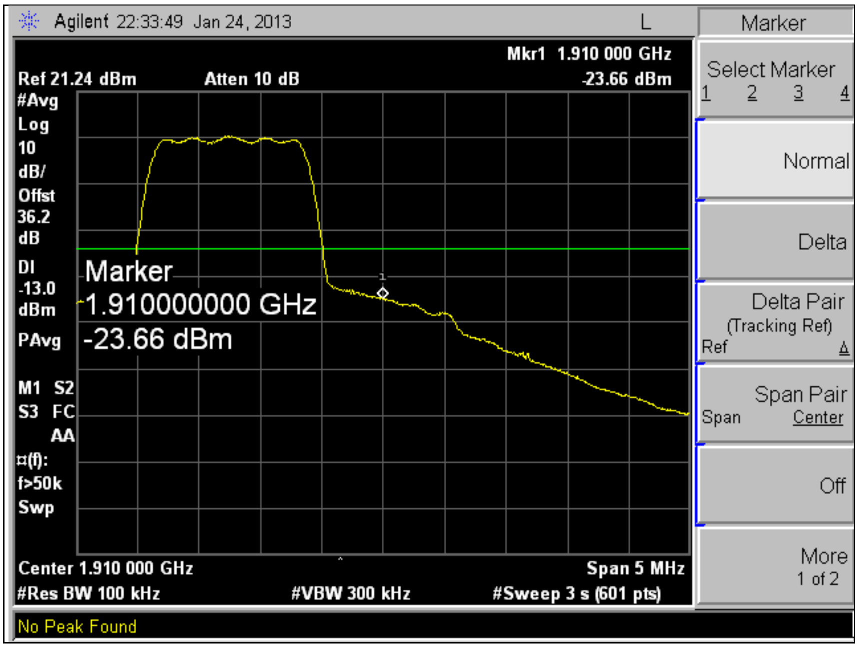
CDMA1 900 (Band edge)

1xEV-DO

Low Channel



High Channel



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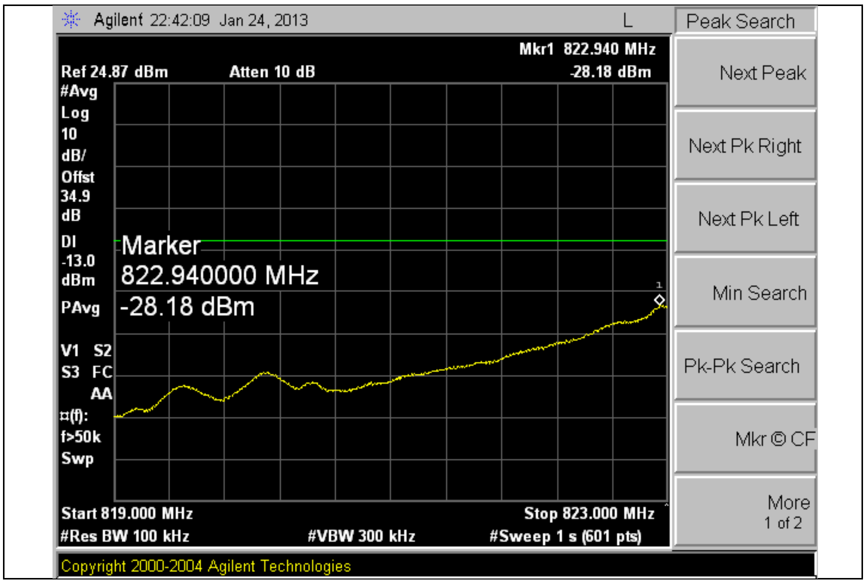
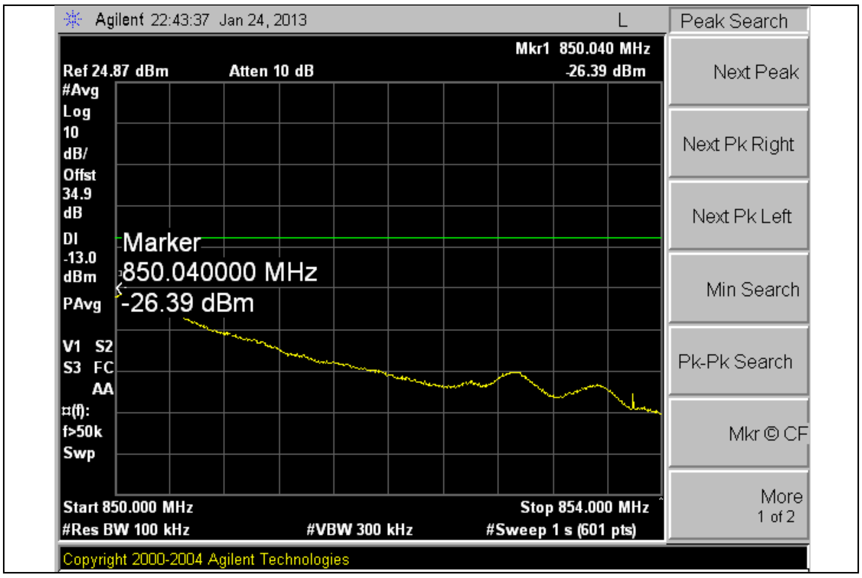
CDMA800 (4 ㎒ SPAN)

1xEV-DO

Low Channel



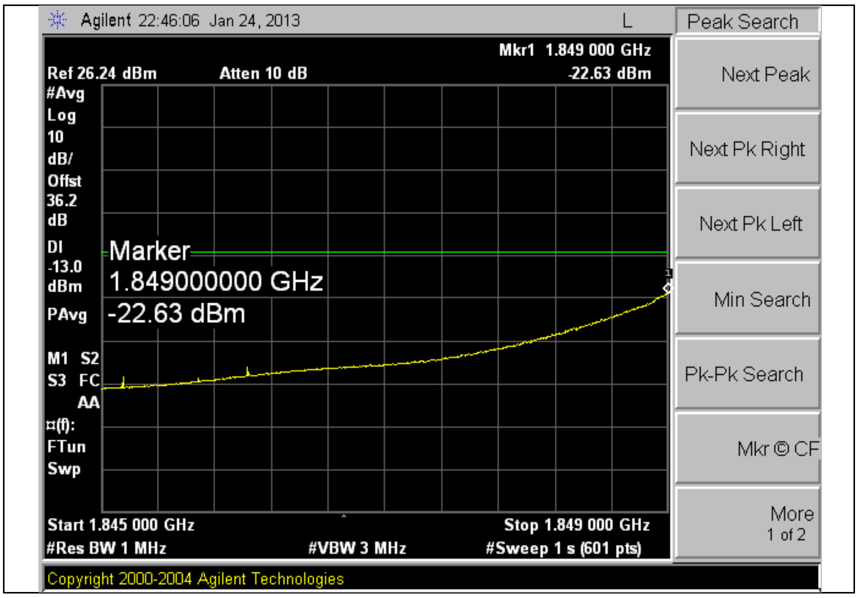
High Channel



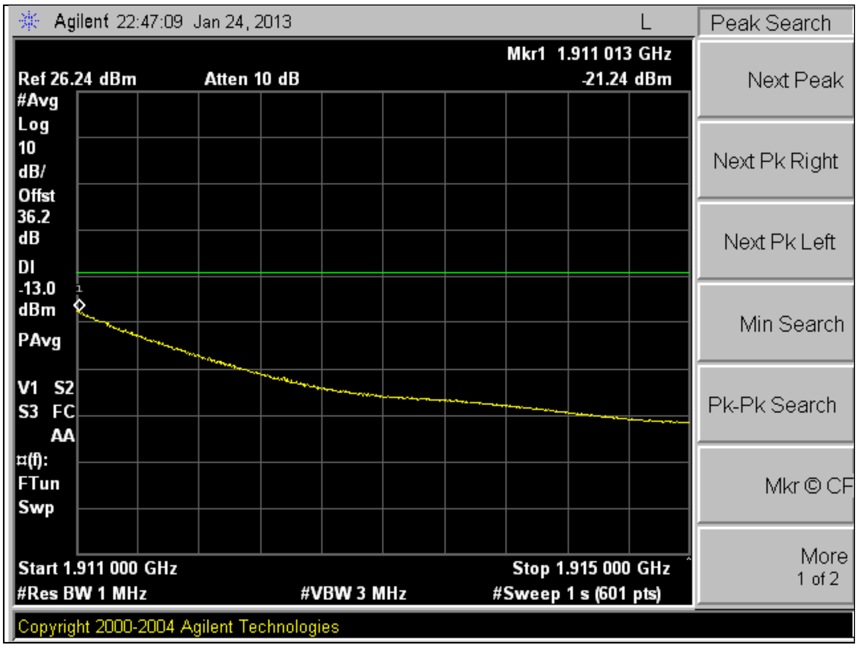
CDMA1 900 (4 ㎒ SPAN)

1xEV-DO

Low Channel



High Channel



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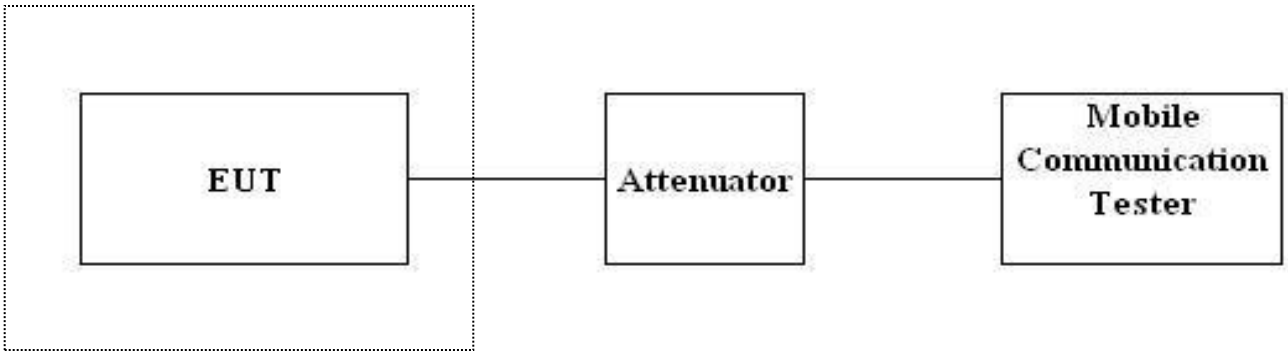
8. Frequency Stability

8.1. Limit

Requirements: FCC § 2.1055 (a), § 2.1055 (d) & following:
According to §22.355, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table of this section.
For Mobile devices operating in the 824 to 849 ㎒ band at a power level less than or equal to 3 Watts, the limit specified in Table C-1 is +/- 2.5 ppm.
§24.235 the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

8.2. Test Procedure

1. Frequency Stability vs. Temperature: The equipment under test was connected to an external DC 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.
3. After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.



Temperature Chamber

8.3. Test Results

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

CDMA800 1xRTT mode at middle channel

Reference Frequency: 836.52 ㎒, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
-30	14.4	4	0.002 391
-20		4	0.002 391
-10		3	0.001 195
0		2	0.000 000
10		2	0.000 000
20		2	**Ref**
30		3	0.001 195
40		3	0.001 195
50		4	0.002 391
Frequency Stability versus power Supply			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
24	(+15 %)	2	0.000 000
	(-15 %)	2	0.000 000

CDMA1 900 1xRTT mode at middle channel

Reference Frequency: 1 880.0 ㎒, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
-30	14.4	5	0.001 596
-20		3	0.000 532
-10		4	0.001 064
0		2	0.000 000
10		1	-0.000 532
20		2	**Ref**
30		3	0.000 532
40		4	0.001 064
50		4	0.001 064
Frequency Stability versus power Supply			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**Ppm**
24	(+15 %)	2	0.000 000
	(-15 %)	3	0.000 532

CDMA800 1xEV-DO mode at middle channel

Reference Frequency: 836.52 ㎒, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
-30	14.4	5	0.003 586
-20		4	0.002 391
-10		3	0.001 195
0		2	0.000 000
10		2	0.000 000
20		2	**Ref**
30		3	0.001 195
40		4	0.002 391
50		5	0.003 586
Frequency Stability versus power Supply			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
24	(+15 %)	3	0.001 195
	(-15 %)	3	0.001 195

CDMA1 900 1xEV-DO mode at middle channel

Reference Frequency: 1 880.0 ㎒, Limit: 2.5 ppm			
Frequency Stability versus Temperature			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
-30	14.4	5	0.001 596
-20		4	0.001 064
-10		3	0.000 532
0		2	0.000 000
10		2	0.000 000
20		2	**Ref**
30		4	0.001 064
40		5	0.001 596
50		6	0.002 128
Frequency Stability versus power Supply			
Environment Temperature (℃)	**Power Supplied (Vdc)**	**Frequency Measure with Time Elapse**	
		Frequency Error (㎐)	**ppm**
24	(+15 %)	2	0.000 000
	(-15 %)	3	0.000 532

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9. RF Exposure Evaluation

9.1 Environmental evaluation and exposure limit according to FCC CFR 47 part 1, 1.1307(b), 1.1310

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 (㎒)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (㎽/㎠)	Average Time
(A) Limits for Occupational /Control Exposures				
300 – 1 500	--	--	F/300	6
1 500 – 100 000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1 500	**--**	**--**	**F/1 500**	**30**
1 500 – 100 000	**--**	**--**	**1**	**30**

9.1.1. Friis transmission formula: Pd = (Pout*G)/(4*pi*R^2)

Where Pd = power density in ㎽/㎠

Pout = output power to antenna in ㎽

G = gain of antenna in linear scale

Pi = 3.1416

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

Pd the limit of MPE, 1 ㎽/㎠. 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.

9.1.2. Test Result of RF Exposure Evaluation

Test Item : RF Exposure Evaluation Data
Test Mode : Normal Operation

9.1.3. Output Power into Antenna & RF Exposure Evaluation Distance

Mode: CDMA800 1xRTT

Channel	Channel Frequency (㎒)	Measured E.R.P. (dB m)	Duty Cycle (%)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Low	824.70	26.03	100	0.079 750	0.549 80
Middle	836.52	23.83	100	0.048 054	0.557 68
High	848.31	23.65	100	0.046 103	0.565 54

Mode	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Maximum tune up tolerance	824.70	25.50	1.34	0.096 101	0.549 80

Mode: CDMA1 900 1xRTT

Channel	Channel Frequency (㎒)	Measured E.I.R.P. (dB m)	Duty Cycle (%)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Low	1 851.25	26.80	100	0.156 217	1
Middle	1 880.00	23.97	100	0.081 420	1
High	1 908.75	27.52	100	0.184 389	1

Mode	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Maximum tune up tolerance	1 908.75	25.50	4.02	0.178 127	1

Note :
1. The power density Pd (5th column) at a distance of 20 ㎝ calculated from the friis transmission formula is far below the limit .

Mode: CDMA800 1xEV-DO

Channel	Channel Frequency (㎒)	Measured E.R.P. (dB m)	Duty Cycle (%)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Low	824.70	25.01	100	0.063 056	0.549 80
Middle	836.52	23.55	100	0.045 054	0.557 68
High	848.31	23.77	100	0.047 395	0.565 54

Mode	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Maximum tune up tolerance	824.70	25.50	1.34	0.096 101	0.549 80

Mode: CDMA1900 1xEV-DO

Channel	Channel Frequency (㎒)	Measured E.I.R.P. (dB m)	Duty Cycle (%)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Low	1 851.25	26.83	100	0.157 300	1
Middle	1 880.00	23.94	100	0.080 859	1
High	1 908.75	27.55	100	0.185 665	1

Mode	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	LIMITS (㎽/㎠)
Maximum tune up tolerance	1 908.75	25.50	4.02	0.178 127	1

Note :
1. The power density Pd (5th column) at a distance of 20 ㎝ calculated from the friis transmission formula is far below the limit .

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