. RADIATED EMISSION MEASUREMENT (Section 15.249)

1. Test Procedure

1.1 Preliminary Testing for Reference

The base station(EUT) is designed to transmit on one of 40 channels in the band 902.800 to 904.750MHz. Therefore measurements were performed with the equipment operating on three frequencies, which were the top(CH40), middle(CH20), and bottom(CH1) in the band, as per Section 15.31(m).

Preliminary testing was performed in a KTL absorber-lined room to determine the emission characteristics of the EUT. The EUT was placed on the wooden table which has dimensions of 0.8 meters in height, 1 meter in length and 1.5 meters in width. Receiving antenna(Biconical antenna : 30 to 300MHz, Log-periodic antenna : 200 to 1000MHz or Horn Antenna : 1 to 18GHz) was placed at the distance of 1 meter from the EUT.

An attempt was made to maximize the emission level with the various configurations of the EUT. The position of connecting cables and antenna of the EUT was changed to find the worst case configuration that produces maximum emission level from the EUT while rotating the table and varying antenna height.

Emissions level from the EUT with various configurations were examined on a Spectrum Analyzer connected with a RF amplifier and graphed by a plotter.

1.2 Final Radiated Emission Test at a Absorber-Lined Room

The final measurement of radiated field strength was carried out in a KTL Absorber-Lined Room that was listed up at FCC according to the "Radiated Emissions Testing" procedure specified by ANSI C63.4.

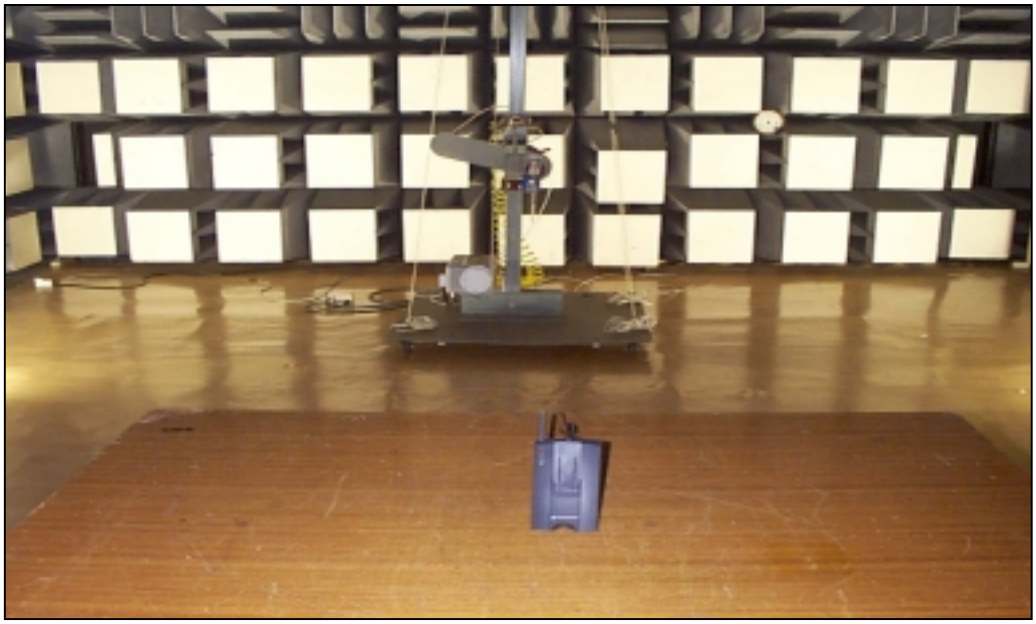
Based on the test results in preliminary test, measurement was made in same test set up and configuration which produced maximum emission level. Receiving antenna was installed at 3-meter distance from the EUT, and was connected to an EMI receiver or spectrum analyzer(for above 1GHz) with a RF amplifier.

Turntable was rotated through 360 degrees and receiving antenna height was varied from 1 to 4 meters above the ground plane to read maximum emission level.

If necessary, the radiated emission measurements could be performed at a closer distance than specified distance to ensure higher accuracy and their results were extrapolated to the specified distance using an inverse linear distance extrapolation factor(20dB/decade) as per Section 15.31(f).

The maximum emission level from the EUT occurred in such configuration as shown in the following photograph.

2. Photograph for the worst case configuration



3. Sample Calculation

The emission level measured in decibels above one microvolt (dB) was converted into microvolt per meter (/m) as shown in following sample calculation.

For example :

	Measured Value at 902.800MHz	84.5 dB	
+	Antenna Factor		29.0 dB
+	Cable Loss		5.7 dB
-	Preamplifier		30.0 dB
-	Distance Correction Factor *		0.0 dB
=	Radiated Emission	89.2 dB /m	
		(=28840.3 /m)	

* Extrapolated from the measured distance(1.0m) to the specified distance(3m) by an inverse linear distance extrapolation.

4. Measurement Data

4.1 Operating Frequency (Bottom : 902.800MHz , CH1)

- Resolution Bandwidth : x CISPR Quasi-Peak (6dB Bandwidth : 120kHz for 1GHz below)
  x Peak (3dB Bandwidth : 1MHz for 1GHz above)
- Measurement Distance : 3 Meter

Frequency (MHz)	* D.M.	* A.P.	Measured Value (dB)	* A.F. + C.L (dB)	* A.G. (dB)	* D.C.F. (dB)	Emission Level (dB /m)	Emission Level (/m)	Limit (/m)	** Margin (dB)
451.40	Q	V	42.5	25.8	-30.0	-	38.3	82.2	200	-7.7
902.80	Q	V	84.5	34.7	-30.0	-	89.2	28840.3	50000	-4.8
*** 1354.20	P	H	47.2	32.2	-35.0	-9.5	34.9	55.6	500	-19.1
*** 1805.60	P	V	47.5	35.3	-35.0	-9.5	38.3	82.2	500	-15.7
*** 2257.00	P	H/V	**** <40.0	39.3	-35.0	-9.5	<34.8	<55.0	500	<-19.2
*** 2708.40	P	H/V	**** <40.0	40.7	-35.0	-9.5	<36.2	<64.6	500	<-17.8

Note

* D.M. : Detect Mode (P : Peak, Q : Quasi-Peak, A : Average)
A.P. : Antenna Polarization (H : Horizontal, V : Vertical)
A.F. : Antenna Factor
C.L. : Cable Loss
A.G. : Amplifier Gain
D.C.F. : Distance Correction Factor

** Margin (dB) = Emission Level (dB) - Limit (dB)

*** In the case of these frequencies, the EUT was measured at 1.0m distance for sufficent sensitivity of measurement system.

**** < means less than. The observed spectrum analyzer nois floor level with RF preamplifier was 40.0 dBuV

4.2 Operating Frequency (Middle : 903.750MHz , CH20)

- Resolution Bandwidth : x CISPR Quasi-Peak (6dB Bandwidth : 120kHz for 1GHz below)
  x Peak (3dB Bandwidth : 1MHz for 1GHz above)
- Measurement Distance : 3 Meter

Frequency (MHz)	* D.M.	* A.P.	Measured Value (dB)	* A.F. + C.L (dB)	* A.G. (dB)	* D.C.F. (dB)	Emission Level (dB /m)	Emission Level (/m)	Limit (/m)	** Margin (dB)
451.88	Q	V	40.8	25.8	-30.0	-	36.6	67.6	200	-9.4
903.750	Q	V	85.1	34.7	-30.0	-	89.8	30903.0	50000	-4.2
*** 1355.63	P	H	44.4	32.2	-35.0	-9.5	32.1	40.3	500	-21.9
*** 1807.50	P	V	46.0	35.3	-35.0	-9.5	36.8	69.2	500	-17.2
*** 2259.23	P	V/H	**** <40.0	39.3	-35.0	-9.5	<34.8	<55.0	500	<-19.2
*** 2711.25	P	V/H	**** <40.0	40.7	-35.0	-9.5	<36.2	<64.6	500	<-17.8

Note

* D.M. : Detect Mode (P : Peak, Q : Quasi-Peak, A : Average)
A.P. : Antenna Polarization (H : Horizontal, V : Vertical)
A.F. : Antenna Factor
C.L. : Cable Loss
A.G. : Amplifier Gain
D.C.F. : Distance Correction Factor

** Margin (dB) = Emission Level (dB) - Limit (dB)

*** In the case of these frequencies, the EUT was measured at 1.0m distance for sufficent sensitivity of measurement system.

**** < means less than. The observed spectrum analyzer nois floor level with RF preamplifier was 40.0 dBuV

4.3 Operating Frequency (Top : 904.750MHz , CH40)

- Resolution Bandwidth : x CISPR Quasi-Peak (6dB Bandwidth : 120kHz for 1GHz below)
  x Peak (3dB Bandwidth : 1MHz for 1GHz above)
- Measurement Distance : 3 Meter

Frequency (MHz)	* D.M.	* A.P.	Measured Value (dB)	* A.F. + C.L (dB)	* A.G. (dB)	* D.C.F. (dB)	Emission Level (dB /m)	Emission Level (/m)	Limit (/m)	** Margin (dB)
452.38	Q	V	42.2	25.8	-30.0	-	38.0	79.4	200	-8.0
904.75	Q	V	85.0	34.7	-30.0	-	89.7	30549.2	50000	-4.3
*** 1357.13	P	H	45.0	32.2	-35.0	-9.5	32.7	43.2	500	-21.3
*** 1809.50	P	V	45.0	35.3	-35.0	-9.5	35.8	61.7	500	-18.2
*** 2261.88	P	V/H	**** <40.0	39.3	-35.0	-9.5	<34.8	<55.0	500	<-19.2
*** 2714.25	P	V/H	**** <40.0	40.7	-35.0	-9.5	<36.2	<64.6	500	<-17.8

Note

* D.M. : Detect Mode (P : Peak, Q : Quasi-Peak, A : Average)
A.P. : Antenna Polarization (H : Horizontal, V : Vertical)
A.F. : Antenna Factor
C.L. : Cable Loss
A.G. : Amplifier Gain
D.C.F. : Distance Correction Factor

** Margin (dB) = Emission Level (dB) - Limit (dB)

*** In the case of these frequencies, the EUT was measured at 1.0m distance for sufficent sensitivity of measurement system.

**** < means less than. The observed spectrum analyzer nois floor level with RF preamplifier was 40.0 dBuV

Note ;

(1) Fundamental emissions from the intentional radiators were not located within any of frequency bands described in section 15.205(a) listed below ;

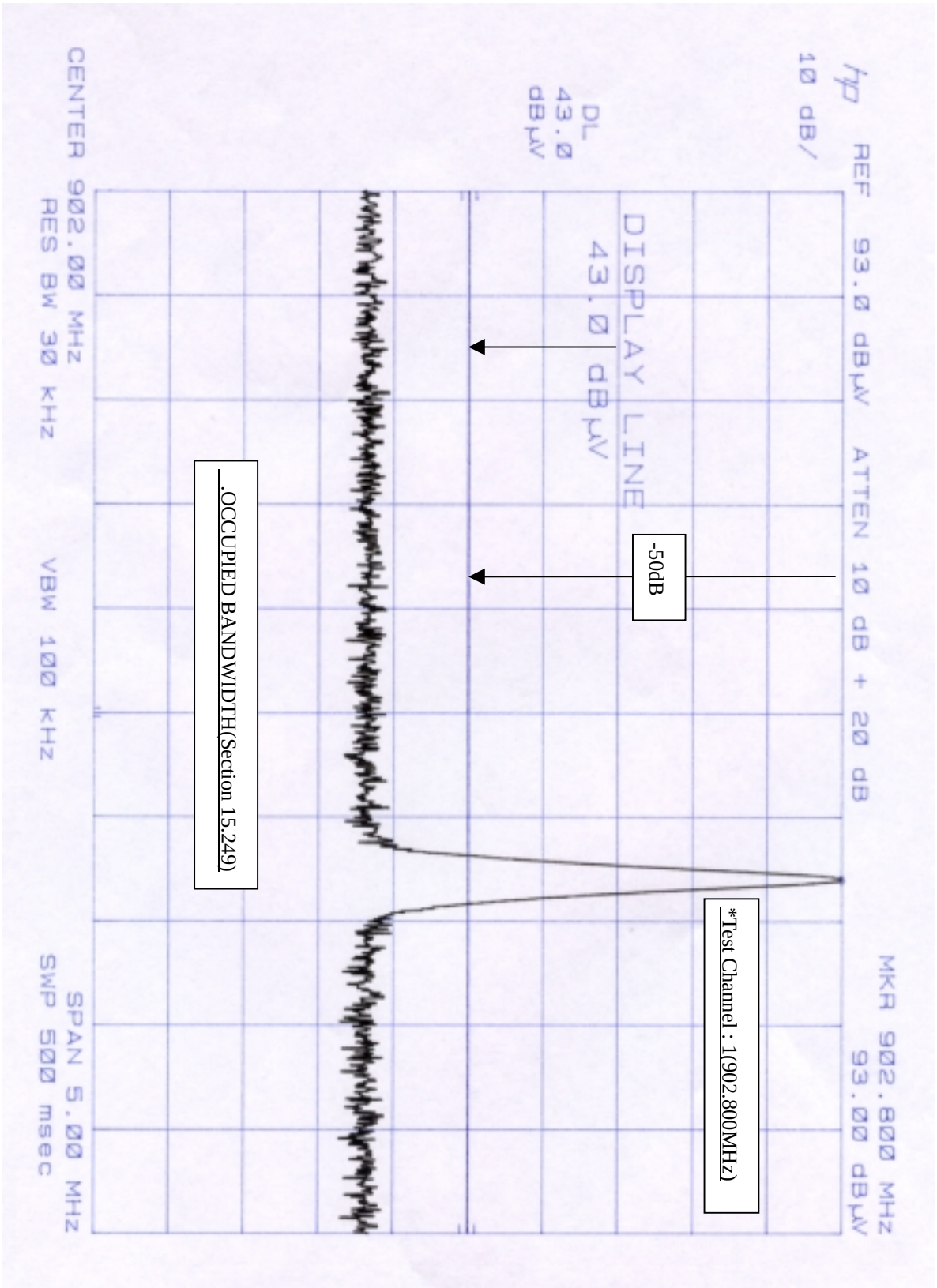
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.1775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	
13.36-13.41			

The field strength of emissions appearing within above frequency bands did not exceed the limits shown in section 15.209. At frequency equal to or less than 1000MHz, compliance with the limits section 15.209 was demonstrated using measurement employing a CISPR quasi-peak detector. Above 1000 MHz, demonstrated based on the average value of the measured emissions.

(2) If the intentional radiator was operated under the radiated emission limits of the general requirements of section 15.209, it's fundamental emissions were not located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-860MHz.

(3) The level of any unwanted emissions from an intentional radiator did not exceed the level of the fundamental emission.

(4) Radiated and spurious emissions were checked from 30MHz to 10GHz. And all other emissions not reported on data were more than 20 dB below the permitted level.


hp
REF 93.0 dBµV ATTEN 10 dB + 20 dB
10 dB/
DL
43.0
dBµV
DISPLAY LINE
43.0 dBµV
-50dB
*Test Channel : 1(902.800MHz)
MKR 902.800 MHz
93.00 dBµV
CENTER 902.00 MHz
RES BW 30 kHz
VBW 100 kHz
SPAN 5.00 MHz
SWP 500 msec
.OCCUPIED BANDWIDTH(Section 15.249)

. TEST EQUIPMENT USED FOR MEASUREMENTS

Equipment	Model No.	Manufacturer	Serial No.	Effective Cal. Duration
[x] EMI Receiver (20MHz-1GHz)	ESVS30	R & S	830516/002	06/29/99-06/29/00
[x] Spectrum Analyzer (9kHz-26.5GHz)	8563A	H. P.	3222A02069	02/10/99-02/10/00
[x] Spectrum Analyzer (100Hz-22GHz)	8566B	H. P.	3014A07057	05/29/99-05/29/00
[x] Quasi-Peak Adapter (10kHz-1GHz)	85650A	H. P.	3107A01511	05/29/99-05/29/00
[x] RF-Preselector (20Hz-2GHz)	85685A	H. P.	3010A01181	05/29/99-05/29/00
[x] Test Receiver (9kHz-30MHz)	ESH3	R & S	860905/001	06/29/99-06/29/00
[x] Pre-Amplifier (0.1-3000MHz, 30dB)	8347A	H. P.	2834A00543	05/29/99-05/29/00
[x] Pre-Amplifier (1-26.5GHz, 35dB)	8449B	H. P.	3008A00302	06/29/99-06/29/00
[x] LISN(50 , 50 H) (10kHz-100MHz)	3825/2	EMCO	9010-1710	-
[x] LISN(50 , 50 H) (10kHz-100MHz)	3825/2	EMCO	9011-1720	-
[x] Plotter	7470A	H. P.	3104A21292	-
[x] Tuned Dipole Ant. (30MHz-300MHz)	VHA 9103	Schwarzbeck	-	*
[x] Tuned Dipole Ant. (300MHz-1GHz)	UHA 9105	Schwarzbeck	-	*
[x] Biconical Ant. (30MHz-300MHz)	BBA 9106	Schwarzbeck	-	*
[x] Log Periodic Ant. (200MHz-1GHz)	3146	EMCO	-	*
[x] Horn Ant. (1GHz-18GHz)	3115	EMCO	-	*
[ ] DC Power Supply	6260B	H.P.	1145A04822	-
[ ] Audio Generator	LAV-190	LEADER	5020297	06/29/99-06/29/00
[ ] Volt Meter	3438A	H.P.	1717A-00613	06/16/99-06/16/00
[x] Shielded Room (5.0m x 4.5m)	-	SIN-MYUNG	-	-

* Each set of antennas has been calibrated to ensure correlation with ANSI C63.5 standard. The calibration of antennas is traceable to Korea Standard Research Institute(KSRI).