TEST REPORT

Ref. Report No.
99-341-024

This test report only responds to the tested sample and shall not be reproduced except in full without written approval of the the Korea Testing Laboratory.

Name and address of the applicant

Utel Co., Ltd.
1662-13, Daechang B/D 2F, Bongchun 7-dong, Kwamak-ku,
Seoul, Korea 151-057

Standard / Test regulation

FCC Part 15, Subpart C

Test result

Pass

Incoming date : April 23, 1999

Test date : June 3, 1999

Test item(s) ;

Low Power Wireless Transmitter

Model/type ref. ;

TIU-200A

Manufacturer ;

Utel Co., Ltd.

Additional information ;

-Required Authorization :Certification
-FCC ID. : N6YUT-2006

Issue date : June 14, 1999

Tested and reported by

S.K, Seol

Soun-Kweon Seol , Senior Engineer

Reviewed by

S. J. Kim

Seok-Jin Kim , EMC Team Leader

KOREA TESTING LABORATORY

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□. GENERAL INFORMATION

1. Grantee Name and : Utel Co., Ltd.
   Mailing Address 1662-13, Daechang B/D 2F, Bongchun 7-dong, Kwamak-ku, Seoul, Korea 151-057

2. Manufacturer's Name and : Utel Co., Ltd
   Mailing Address 1662-13, Daechang B/D 2F, Bongchun 7-dong, Kwamak-ku, Seoul, Korea 151-057

3. Equipment Descriptions

   3.1 Operating Frequency : 2411.0 MHz ~ 2473.0 MHz
   3.2 Type of Emission :
   3.3 Power Supply : DC 12V (AC Adapter)
   3.4 Additional Information ;
   - Oscillator used : VCO Transistor(BFG540/X, 2411~2473MHz), Crystal(4MHz) PLL IC(SP5055S)

4. Rules and Regulations : FCC Part 15, Subpart C

5. Measuring Procedure : ANSI C63.4-1992

6. Place of Measurement : Absorber-lined room(3-Meter) of KAITECH

7. Date of Measurement

   6.1 Line Conducted : May 28, 1999
   6.2 Radiated Emission : June 3, 1999

□. GENERAL REQUIREMENTS OF THE EUT

1. Labelling Requirement (Section 15.19)

This device complies with Part 15 of the FCC Rules. Operation is subject to following two condition : this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

1.1 Location on Enclosure : Bottom side
1.2 How Applied : By Ink-printing on Adhesive Label

2. Information to User (Section 15.21)

The following or similar statements were provided in the manual for user instruction.
Please refer page 2 of the attached manual for details.

CAUTION : Any changes or modifications in construction of this device which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3. Special Accessories (Section 15.27)

3.1 Were the special Accessories provided? [ ] yes, [x] no

3.2 If yes, details for the special accessories are as follows :

3.3 If yes, were the appropriate instructions provided on the first page of the text concerned with the device?
[ ] yes, [ ] no

3.4 Are these accessories provided of the type which can be readily obtained from multiple retail outlets ?
[ ] yes, [ ] no

And therefore does the manual specify what additional components or accessories are required to used in order to comply with the Rules?
[ ] yes, [ ] no

□. CONDUCTED EMISSION MEASUREMENT (Section 15.107)

1. Test Procedure

This transmitter(EUT) is designed to operate in the frequency band 2411.0 to 2473.0 MHz. But, Testing was performed with test-sample which is fixed to 4 channels(2434.0MHz,2453.0MHz,2473.0MHz,2411.0MHz) in operating frequency ranges 2411.0~2473.0MHz. Therefore measurements were performed with the equipment operating on three frequencies, which were the top, middle(second), and bottom in the band, as per Section 15.31(m).

Conducted emission measurements on the EUT were performed by "AC Power Line Conducted Emissions Testing" procedure as per ANSI C63.4. The EUT was set up on a wooden table 0.8 meters height, 1.0 by 1.5 meters in size, placed in the shielded enclosed with a side of wall of which constituted a vertical conducting surface of 2.2m X 3.1m in size to maintain 40Cm from the rear of EUT

2. LISN's(Line Impedance Stabilization Network, EMCO, 3825/2, 50ohm/50uH) were installed and electrically boned to the conducting ground plane. The EUT was connected to one LISN.

One of two 50ohm output terminals of the LISN was connected to the Spectrum Analyzer(HP, 8566B, 10kHz to 22GHz) with the Quasi-Peak Adapter (HP, 85650A, 10kHz to 1.0GHz) and the other was terminated in 50 ohms. Measurements were again performed after interchanging such a connection oppositely.

The frequency range from 450kHz to 30MHz was examined and the peak values that are within 6dB of the limit would be compared to quasi-peak values using the Quasi-Peak instrument (ROHDE & SCHWARZ, ESH3, 9kHz to 30MHz : Detector Function CISPR Quasi-Peak) or HP Quasi-Peak adapter(85650A, 10kHz to 1.0GHz)

The voltage developed across the 50ohms port in LISN was measured by the Spectrum Analyzer and graphed by the Plotter(HP, 7470A). The 6dB bandwidth of the Spectrum Analyzer and Quasi-Peak Adapter was set to 9kHz with no post detector video filter.

The position of connecting cables was changed to find the worst case configuration during measurements. 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 (□) as shown in following sample calculation.

For example :

	Measured Value at	0.64MHz	25.1 dB□
+	Cable Losses *		0.0 dB
=	Conducted Emission		25.1dB□/m
			(= 18.0 □/m)

* In case of RG214/ RF cable 15Ft, the loss is about 0.17dB at the frequency of 30MHz which is negligible.

4. Measurement Data

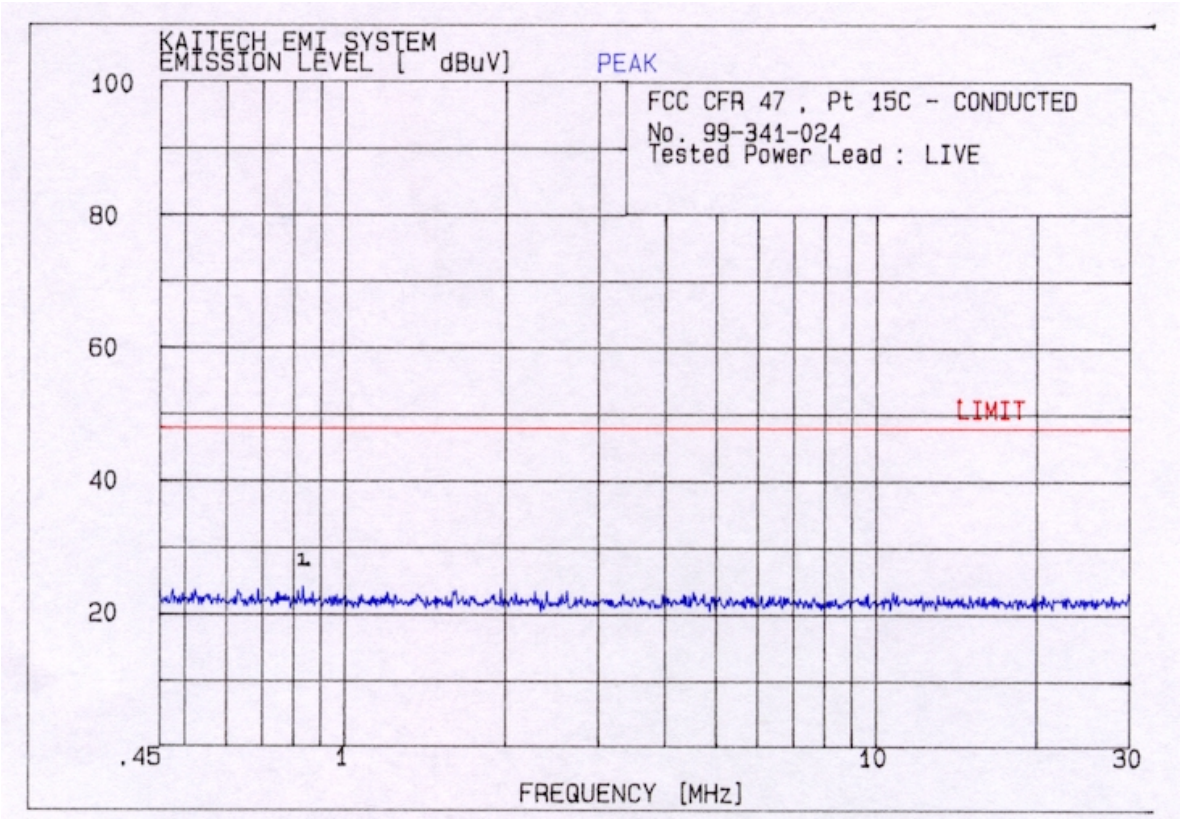
- Resolution Bandwidth : x Peak (6dB Bandwidth : 9kHz)
  ____ CISPR Quasi-Peak (6dB Bandwidth : 9kHz)

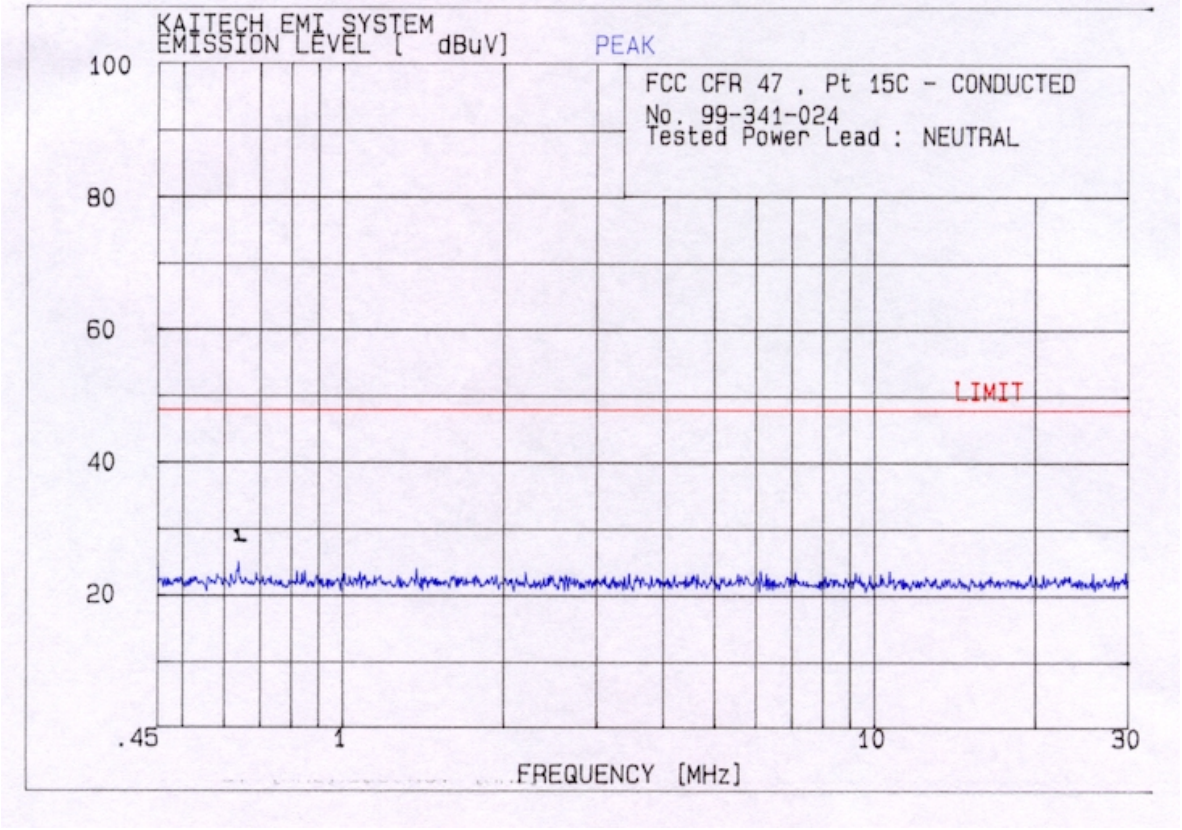
- Measurement channel : CH3 (2473.0 MHz Tuning)

Power Lead Tested	Frequency (MHz)	Measured Value		Emission Level		Limit (□)	(*) Margin (dB)
		Peak (dB□)	Q-Peak (dB□)	(dB□)	(□)		
Live to Ground	0.84	24.3	-	24.3	16.4	250	-23.6
	-	-	-	-	-	-	-
Neutral to Ground	0.64	25.1	-	25.1	18.0	250	-22.8
	-	-	-	-	-	-	-

Note : The noise floor level of the spectrum analyzer was observed in 22dB□.
The highest emission level was reported .
And refer to measured graphs on next page.

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


KAITECH EMI SYSTEM
EMISSION LEVEL [dBuV]
PEAK
FCC CFR 47 , Pt 15C - CONDUCTED
No. 99-341-024
Tested Power Lead : LIVE
LIMIT
100
80
60
40
20
1
.45
1
10
30
FREQUENCY [MHz]


KAITECH EMI SYSTEM
EMISSION LEVEL [dBuV]
PEAK
FCC CFR 47 , Pt 15C - CONDUCTED
No. 99-341-024
Tested Power Lead : NEUTRAL
LIMIT
100
80
60
40
20
1
.45
1
10
30
FREQUENCY [MHz]

□. RADIATED EMISSION MEASUREMENT (Section 15.249)

1. Test Procedure

1.1 Preliminary Testing for Reference

This transmitter(EUT) is designed to operate in the frequency band 2411.0 to 2473.0 MHz. But, Testing was performed with test-sample which is fixed to 4 channels(2434.0MHz,2453.0MHz,2473.0MHz,2411.0 MHz) in operating frequency ranges 2411.0~2473.0MHz. Therefore measurements were performed with the equipment operating on three frequencies, which were the top, middle(second), and bottom in the band, as per Section 15.31(m).

Preliminary testing was performed in a KAITECH 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 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 KAITECH Absorber-Lined Room that was listed up at FCC according to the "Radiated Emissions Testing" procedure specified by ANSI C63.4.

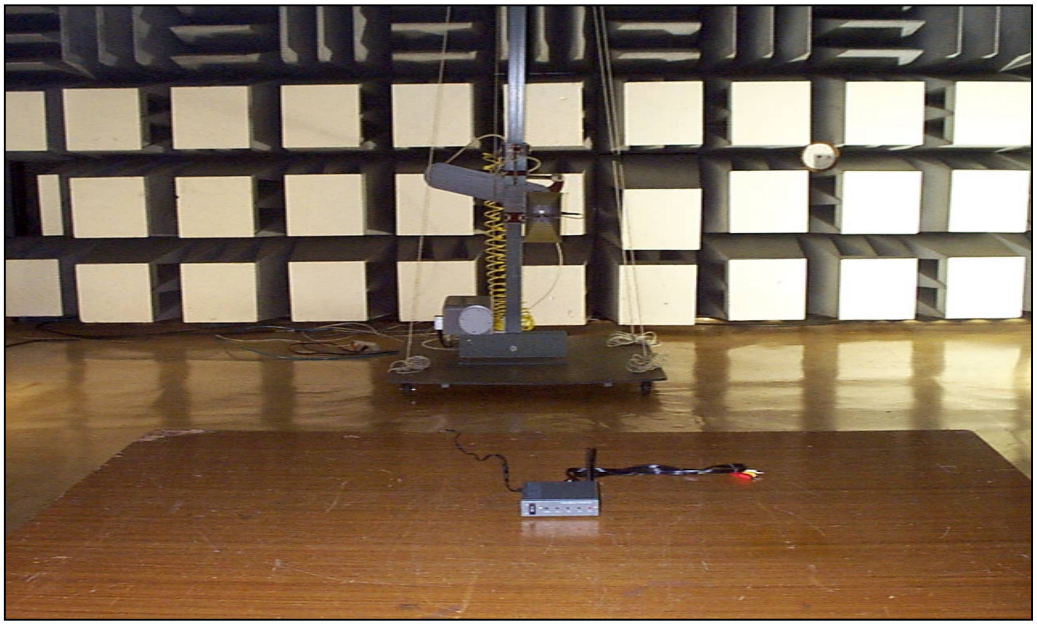
Based on the test results in preliminary test, measurement was made in same test set up and configuration which produced maximum emission level. Receiving antenna was installed at 3-meter distance from the EUT, and was connected to an EMI receiver or spectrum analyzer(for above 1GHz) with a RF amplifier.

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 2411.0MHz	88.5 dB□
+	Antenna Factor	28.6 dB
+	Cable Loss	2.9 dB
-	Preamplifier	35.0 dB
-	Distance Correction Factor *	0.0 dB
=	Radiated Emission	85.0 dB□/m
		(=17782.8.0□/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 : 2411.0MHz Tuning, CH4)

- 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)
2411.0	P	V	88.5	31.5	-35.0	-	85.0	17782.5	50000	-9.0
*** 4822.0	P	H	57.9	37.8	-35.0	-9.5	51.2	363.1	500	-2.8
*** 7233.0	P	H	53.3	42.0	-35.0	-9.5	50.8	346.7	500	-3.2
*** 9644.0	P	V/H	**** <40.0	43.5	-35.0	-9.5	<39.0	<89.1	500	<-15.0

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 : 2453.0MHz Tuning, CH2)

- 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)
2453.0	P	V	86.2	31.5	-35.0	-	82.7.3	13645.8	50000	-11.3
*** 4906.0	P	H	58.5	38.0	-35.0	-9.5	52.0	398.1	500	-2.0
*** 7359.0	P	H	51.7	42.6	-35.0	-9.5	49.8	309.0	500	-4.2
*** 9812.0	p	V/H	**** <40.0	43.8	-35	-9.5	<39.3	<92.3	500	<-14.7

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 : 2473.0MHz Tuning, CH3)

- 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)
2473.0	P	V	86.8	31.6	-35.0	-	83.4	14791.1	50000	-10.6
*** 4946.0	P	H	58.0	38.1	-35.0	-9.5	51.6	380.2	500	-2.4
*** 7419.0	P	H	53.2	42.8	-35.0	-9.5	51.5	375.8	500	-2.5
*** 9892.0	P	V/H	**** <40.0	43.9	-35.0	-9.5	<39.4	<93.3	500	<-14.6

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 ;

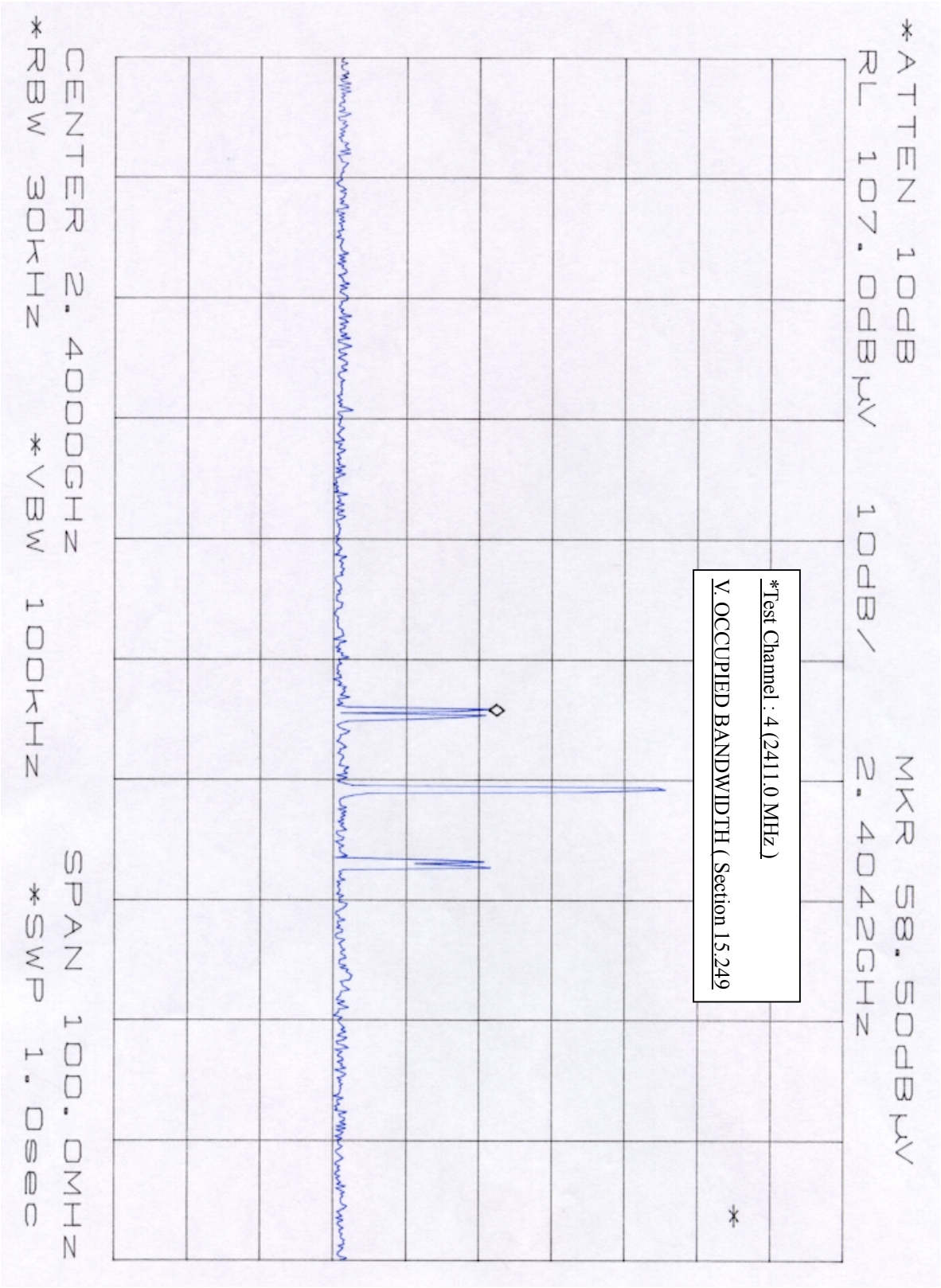
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.1775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	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			

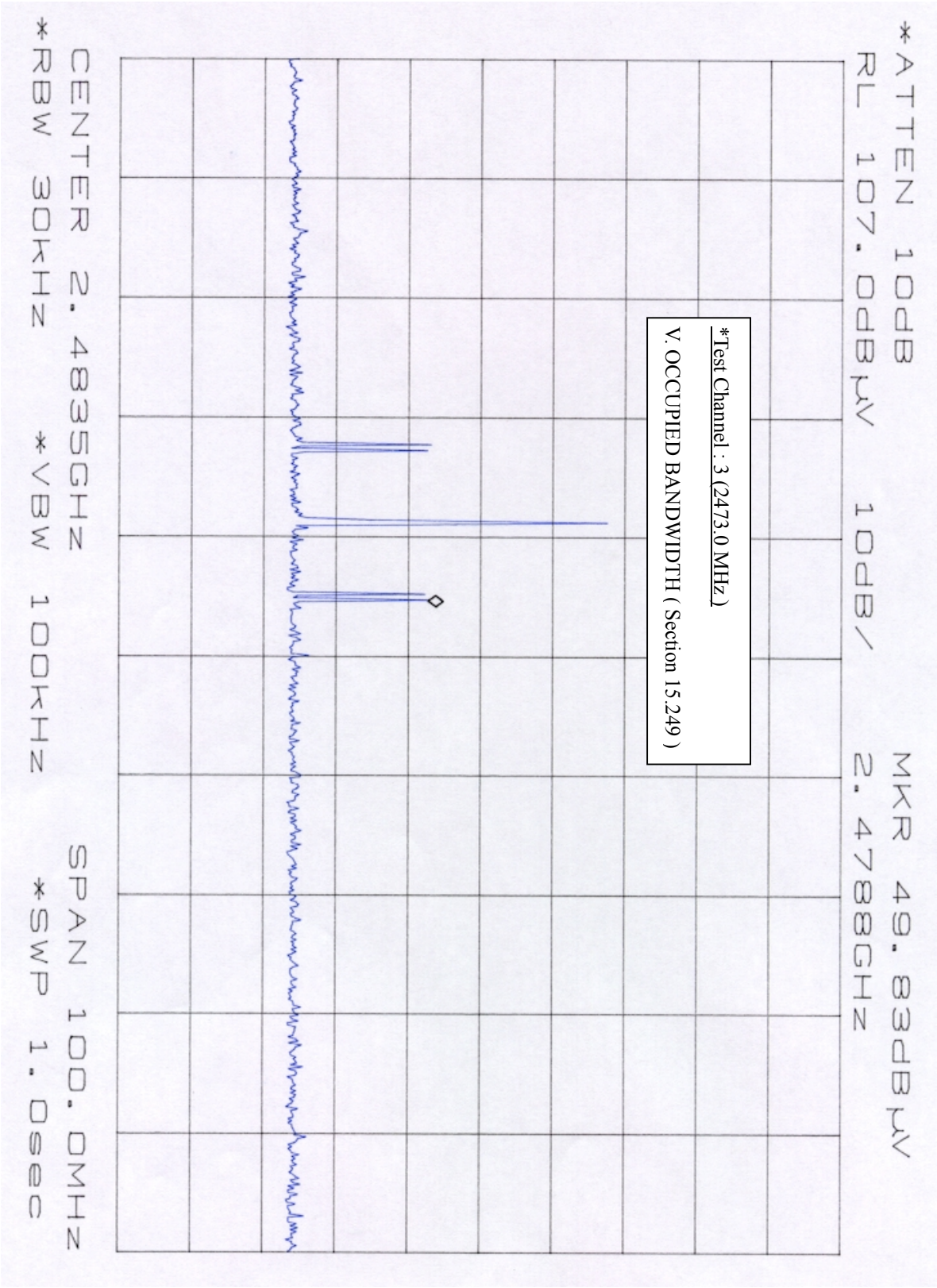
The field strength of emissions appearing within above frequency bands did not exceed the limits shown in section 15.209. At frequency equal to or less than 1000MHz, compliance with the limits section 15.209 was demonstrated using measurement employing a CISPR quasi-peak detector. Above 1000 MHz, demonstrated 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 18GHz. And all other emissions not reported on data were more than 15 dB below the permitted level.


*ATTEN 10dB
MKR 58.50dBμV
RL 107.0dBμV 10dB/ 2.4042GHz
*Test Channel : 4 (2411.0 MHz)
V. OCCUPIED BANDWIDTH (Section 15.249
CENTER 2.4000GHz
SPAN 100.0MHz
*RBW 30kHz *VBW 100kHz *SWP 1.0sec



*Test Channel : 3 (2473.0 MHz)

V. OCCUPIED BANDWIDTH (Section 15.249)

□. TEST EQUIPMENT USED FOR MEASUREMENTS

Equipment	Model No.	Manufacturer	Serial No.	Effective Cal. Duration
[ ] EMI Receiver (20MHz-1GHz)	ESVS30	R & S	830516/002	06/29/98-06/29/99
[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	06/29/98-06/29/99
[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	06/29/98-06/29/99
[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	-
[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).