



Electromagnetic Emission

FCC MEASUREMENT REPORT

VERIFICATION OF COMPLIANCE FCC PART15 CERTIFICATION

PRODUCT : FM Transmitter
MODEL/TYPE NO : NFM-40T
FCC ID : RA6NFM-40T
TRADE NAME : D.B.LOGIC
APPLICANT : D.B.LOGIC Co.,Ltd.
2F., 900-5, Hogye-2dong, Dongan-Gu,
Anyang-Si, Kyunggi-Do, Korea
Attn. : Boung Sub, Kim / Director
FCC CLASSIFICATION : DXX - Low Power Communication Device Transmitter
FCC RULE PART(S) : FCC Part 15 Subpart C
FCC PROCEDURE : Certification
DATES OF TEST : July 7, 2003
DATES OF ISSUE : July 8, 2003
TEST REPORT No. : BWS-03-EF-0032
TEST LAB. : BWS Tech., Inc. (Registration No. : 553281)

This Low power FM Transmitter has been tested in accordance with the measurement procedures specified in ANSI C63.4-2000 at the BWS TECH/EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart B Section15.109

I attest to the accuracy of data. All measurement herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

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FCC TEST REPORT

Scope – *Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)*

1. General Information

Applicant

Company Name : D.B.LOGIC Co.,Ltd.
Company Address : 2F., 900-5, Hoggie-2dong, Dongan-Gu,
Anyang-Si, Kyunggi-Do, Korea
Phone/Fax : Phone : +82 31 429 7012 Fax : +82 31 429 5998

Manufacturer

Company Name : D.B.LOGIC Co.,Ltd.
Company Address : 2F., 900-5, Hoggie-2dong, Dongan-Gu,
Anyang-Si, Kyunggi-Do, Korea
Phone/Fax : Phone : +82 31 429 7012 Fax : +82 31 429 5998

- **EUT Type** : FM Transmitter
- **Model Number** : NFM-40T
- **FCC Identifier** : RA6NFM-40T
- **S/N** : Prototype
- **Freq. Range** : 88.0 MHz ~ 92.0 MHz (40ch)
- **FCC Rule Part(s)** : Part 15 Subpart C Section 15.239
- **Test Procedure** : ANSI C63.4-2000
- **FCC Classification** : DXX - Low Power Communication Device Transmitter
- **Dates of Tests** : July 7, 2003
- **Place of Tests** : BWS TECH Inc.
EMC Testing Lab (FCC Registration Number : 553281)
294-9, Jungdae-Dong, Kwangju-Si,
Kyunggi-Do, 464-080, Korea
TEL: +82 31 762 0124 FAX: +82 31 762 0126
- **Test Report No.** : BWS-03-EF-0032

2. Description of Test Facility

The measurement test for radiated and conducted emission test were conducted at the open area test site of BWS TECH Inc. facility located at 294-9, Jungdae-Dong, Kwangju-Si, Kyunggi-Do, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-2000 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission with the FCC for 3 and 10 meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-1992 and registered to the Federal Communications Commission(Registration Number : 553281).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2000) was used in determining radiated and conducted emissions from the D.B.LOGIC Co.,Ltd. FM Transmitter Model : NFM-40T.

3. Product Information

3.1 Equipment Description

The Equipment Under Test(EUT) is the D.B.LOGIC Co., Ltd. FM stereo Transmitter model :NFM-40T(FCC ID : NFM-40T). This low power transmitter is powered by car battery(12VDC). This FM transmitter is a kind of modulator which converting the audio signal from the external audio source to FM signal for car.use only.

3.2 General Specification

- Chassis Type	Metal enclosure
- List of Each OSC. Or X-Tal. Freq.(≥ 1 MHz)	X1:7.6MHz,
- IC PLL :	BH1417F-SOP22,ROHM
- RF Frequency Out	88.0 MHz~ 92.0 MHz (40CH)
- Modulation method	FM
- Audio Frequency Response	50Hz ~ 10kHz(3dB)
- RF Impedance	50 Ω
- I/O Cable(s)	Unshielded
- Power Requirement	DC 10.5V ~ 16.5V
- Audio separation	Min. 20dB

4. Description of Tests

4.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2000. The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50 /50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within an bandwidth of 10KHz or for "quasi-peak" within a bandwidth of 9KHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1m x 1.5m x 0.8m wooden table which is placed 40cm away from the vertical wall and 1.5m away from the side wall of the chamber room. Two LISNs are bonded to the shielded room. The EUT is powered from the PMM LISN and the support equipment is powered from the another Koritsu LISN. Power to the LISNs is filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the EMCO LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling (serpentine fashion) to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the R3261A Spectrum Analyzer to determine the frequency producing the max. emission from the EUT. The frequency producing the max. level was reexamined using the detector function set to the CISPR Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.45 to 30MHz. The bandwidth of the Spectrum Analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by switching power lines, varying the mode of operation or resolution, clock or data exchange speed, if applicable, whichever determined the worst-case emission. Each emission reported was calibrated using self-calibrating mode.

Photographs of the worst-case emission can be seen in photographs of conducted emission test setup.

4.2 Radiated Emission Measurement

Preliminary measurements were made at indoors 3 meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the emission frequencies producing the maximum EME.

Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using biconilog antenna and above 1000MHz, linearly polarized double ridge horn antennas were used. Above 1GHz, linearly polarized double ridge horn antennas were used. The measurements were performed with three frequencies which were selected as bottom, middle and top frequency in the operating band. Emission level from the EUT with various configurations were examined on the spectrum analyzer connected with the RF amplifier and plotted graphically.

Final measurements were made outdoors open site at 3-meter test range using biconical and logperiodic antenna. The output from the antenna was connected, via a preselector or a preamplifier, to the input of the EMI Measuring Receiver and Spectrum analyzer(for above 1GHz). The detector function was set to the quasi-peak or peak mode as appropriate. The measurement bandwidth on the Field strength receiver was set to at least 120kHz (1MHz for measurement above 1GHz), with all post-detector filtering no less than 10 times the measurement bandwidth. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during preliminary measurement was examined and investigated as the same set up and configuration which produced the maximum emission The EUT , support equipment and interconnecting cables were configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1m x 1.5 meter table. The turntable containing the system was rotated and the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission.

Each emission was maximized by varying the mode of operating frequencies of the EUT. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor(20dB/decade) as per section 15.31(f).

Photographs of the worst-case emission test setup can be seen in Appendix A.

4.3 Emission Bandwidth Measurement

Emissions from the intentional radiator shall be confined within a band 200 kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the frequency range of operating ranges. Position the EUT as shown in the radiated emission measurement and set it to any one measured frequency within its operating range and make sure the measuring instrument is operated in its linear range. Set both RBW and VBW of the spectrum analyzer to 10 kHz and 30 kHz respectively with a convenient frequency span including 200kHz bandwidth of the emission.

The bandwidth of emission shall be no wider than of 200kHz of the carrier center frequency for EUT operating range. The bandwidth is determined at the point 26dB down from the modulated carrier. Plot the graph on spectrum analyzer.

5. Test Condition

5.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the EUT and the supported equipments were installed to meet FCC requirement and operated in a manner which tends to maximize its emission level in a typical application.

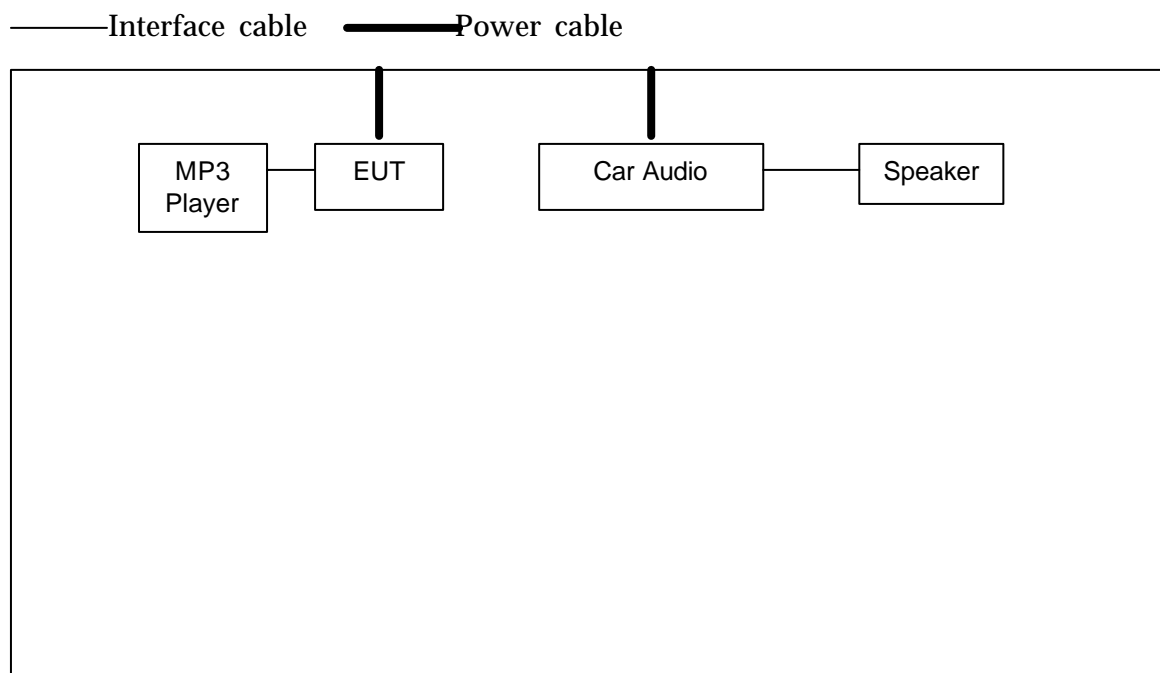
Radiated Emission Test

Preliminary radiated emission tests were conducted using the procedure in ANSI C63.4/2000 Clause 8.3.1.1 to determine the worst operating condition. Final radiated emission tests were conducted at 3 meter open field test site. To complete the test configuration required by the FCC, the EUT was tested in all three orthogonal planes. All testing was performed at 12VDC via external DC power supply.

5.2 EUT operation

The EUT was set to the normal audio transmitting mode in a FM band with external music sound source during all the testing in a manner similar to a typical use. For the EUT operation, the MP3 audio player and DC power supply source were used.

5.3 Test System layout on EUT and peripherals



5.4 Peripherals / Support Equipment Used

Following peripheral devices and interface cables were connected during the measurement:

Type of Peripheral Equipment Used:

Description	Model Name	Serial No.	Manufacturer	FCC ID
EUT	NFM-40T	N/A	D.B.LOGIC	RA6NFM-40T
Car Audio	A01001A	N/A	BONTECH CO.,LTD.	-
Speaker	-	N/A	Kwang Tung	-
MP3 Player	MP GIO	N/A	KASCOM	-

Type of Cables Used:

Device from	Device to	Type of Cable	Length	Type of shield
Car Audio	Power Supply	Power cable	1.2m	Unshielded
EUT	Power Supply	Power cable	1.2m	Unshielded
EUT	MP3 Player	RCA cable	2.6m	Unshielded

6. TEST RESULTS

6.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

FCC Rule Parts	Measurement Required	Result
15.207	Conducted Emission	N/A
15.239(b)	Radiated Emissions of RF Carrier frequency	Passed by – 14.97 dB
15.239(c)	Out-of-band Radiated Emissions	Passed by – 6.6 dB
15.239(a)	Emission Bandwidth Measurement	Passed

The data collected shows that the **D.B.LOGIC Co., Ltd. FM Transmitter NFM-40T** complies with technical requirements of the Part 15.239 of the FCC Rules.

This equipment is car battery only operated device. The Conducted emission measurement according to the section 15.207 is not applicable to this equipment,

Note : Modification to EUT

The device tested is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

5.2 Radiated Emissions of RF Carrier frequency

EUT : FM Transmitter NFM-40T (SN:Prototype)
Limit apply to : FCC Part15 Subpart C Section 15.239(b)
Test Date : July 7, 2003
Operating Condition : RF transmit with ext. audio source
Environment Condition : Humidity Level : 30 %RH, Temperature : 12
Result : Passed by -14.97dB

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.

Detector mode : Peak mode

Measurement Distance : 3 meters

Frequency [MHz]	Reading [dB μ V]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Emission Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
88.10	32.00	V	7.97	1.77	41.74	68.00	26.26
90.10	31.50	H	8.34	1.80	41.64	68.00	26.36
91.90	42.70	V	8.52	1.81	53.03	68.00	14.97

Detector mode : Average mode

Measurement Distance : 3 meters

Frequency [MHz]	Reading [dB μ V]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Emission Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
88.10	28.80	V	7.97	1.77	38.54	68.00	29.46
90.10	29.90	H	8.34	1.80	40.04	68.00	27.96
91.90	35.80	V	8.52	1.81	46.13	68.00	21.87

NOTES :

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Emission Level = Reading + Antenna factor + Cable loss
3. Margin value = Limit - Emission Level
4. Measurement was made at three channel operating frequencies as of Low Mid and High channel.
5. The EUT was tested in all the three orthogonal planes and the worst case emissions was vertical axes.

Tested by Min Seup, Lee

5.3 Out-of-band Radiated Emissions

EUT : FM Transmitter NFM-40T (SN:Prototype)
Limit apply to : FCC Part15 Subpart C Section 15.239(b)
Test Date : July 7, 2003
Operating Condition : RF transmit with ext. audio source
Environment Condition : Humidity Level : 30 %RH, Temperature : 12
Result : Passed by -6.6dB

Radiated Emission Test Data

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.

Detector mode : CISPR Quasi-Peak mode (6dB Bandwidth : 120 kHz)

Measurement Distance : 3 meters

Frequency [MHz]	Reading [dB μ V]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Emission Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
176.20	10.70	V	15.51	2.76	28.97	43.50	14.53
197.60	17.90	V	16.04	2.98	36.92	43.50	6.58
201.58	15.50	V	16.14	3.04	34.68	43.50	8.82
205.19	17.40	V	16.27	3.05	36.72	43.50	6.78
395.20	14.70	V	15.23	4.25	34.18	46.00	11.82
403.21	8.10	V	15.34	4.29	27.73	46.00	18.27
410.19	19.10	V	15.50	4.33	38.93	46.00	7.07

NOTES :

- * H : Horizontal polarization , ** V : Vertical polarization*
- Emission Level = Reading + Antenna factor + Cable loss*
- Margin value = Limit - Emission Level*
- All other emissions not reported were more than 25dB below the permitted limit.*
- The EUT was tested in all the three orthogonal planes and the worst case emissions was vertical axes.*

Tested by Min Seup. Lee

5.4 Emission Bandwidth Measurement

EUT : FM Transmitter NFM-40T (SN:Prototype)
Limit apply to : FCC Part15 Subpart C Section 15.239(b)
Test Date : July 7, 2003
Operating Condition : RF transmit with ext. audio source
Environment Condition : Humidity Level : 30 %RH, Temperature : 12
Result : Passed

Measurement Data

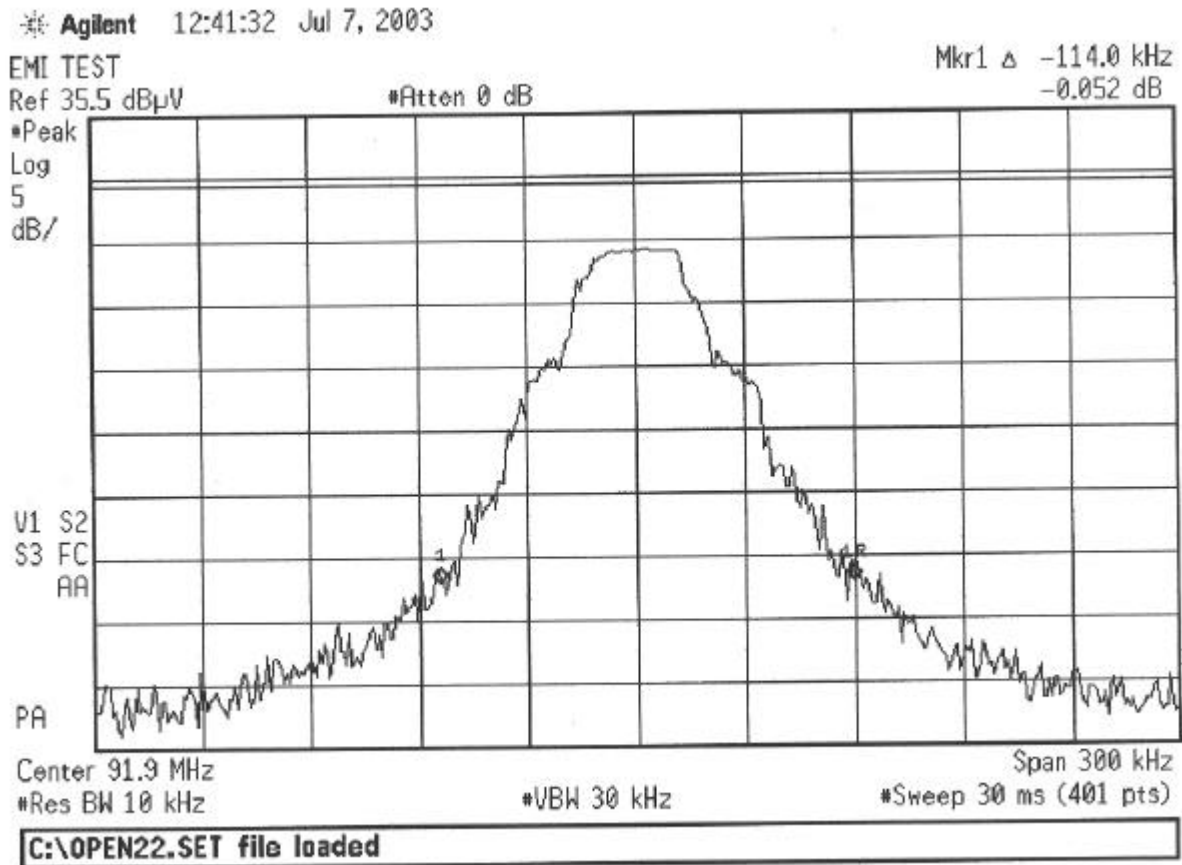
Emission Frequency [MHz]	Emission Bandwidth [kHz]	Limit [kHz]	Remark
92.0	114	200	

NOTES :

1. Please see the measured bandwidth plot in next page.
2. The emission bandwidth shall be no wider than 200kHz of the center frequency of the equipment operating channel. The bandwidth is determined at the points 26dB down from the modulated carrier.
3. Spectrum analyzer settings
Resolution bandwidth : 10 kHz
Video bandwidth : 30 kHz
Frequency span : 300 kHz

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Plot of Bandwidth



7. ANTENNA REQUIREMENT

7.1 Antenna Requirement

According to the section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to be complied.

-. Complied to the requirement

This device does not use a detachable antenna. The 10cm insulated wire is used as an antenna and the feeding side of the wire antenna is permanently attached to the transmitter by soldering and the other side is terminated without any additional terminal connector.

8. Sample Calculation and Other Information

8.1 Sample Calculations

$$\text{dB}\mu\text{V} = 20 \log_{10} (\mu\text{V}/\text{m})$$

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)}$$

EX. 1.

@ 29.74 MHz Class B limit = $250 \mu\text{V} = 48 \text{ dB}\mu\text{V}$

Reading = $26.40 \text{ dB}\mu\text{V}$ (calibrated level)

$$10^{(26.40/20)} = \mu\text{V}$$

$$\text{Margin} = 26.40 - 48 = -21.60$$

21.60 dB ; below limit

EX. 2.

@ 929.49 MHz Class B limit = $200 \mu\text{V}/\text{m} = 46.00 \text{ dB}\mu\text{V}/\text{m}$

Reading = $12.10 \text{ dB}\mu\text{V}$ (calibrated level)

Antenna factor + Cable Loss = 31.07 dB

Total = $43.17 \text{ dB}\mu\text{V}/\text{m}$

$$10^{(43.17/20)} = \mu\text{V}/\text{m}$$

$$\text{Margin} = 43.17 - 46.00 = -2.83 \text{ dB}$$

2.83 dB ; below limit

8.2. Measurement Uncertainty

Measurement uncertainty of RFI Voltage Measurement test was estimated at $\pm 3.51 \text{ dB}$ (k=2)

Measurement uncertainty of RFI Field Strength Measurement test was estimated at $\pm 4.34 \text{ dB}$ (k=2)

9. TEST EQUIPMENTS LIST

The listing below denotes the test equipments utilized for the test(s).

<u>Test Equipment</u>	<u>Manufacture Model Number</u>	<u>Serial Number</u>	<u>Calibration Due date</u>
Signal Analyzer	PMM PMM9000	3100570602	08/16/03
EMC Analyzer	HP E7403A	US39150108	02/19/03
Spectrum Analyzer	ADVANTEST E7403A	61720002	08/22/03
Amplifier (0.1MHz-1.3GHz)	HP 8447E	2945A02712	08/19/03
Biconical Antenna	SWALZBECK BBA9106	N/A	09/12/03
Log Periodic Antenna	SCHAFFNER UPA6109	N/A	09/12/03
Plotter	HP 7475A	007475A	N/A
Shield Room 7m x 4m x 4m	SEMITECH	000815	N/A
Turn Table	JAEMC JAC-2	N/A	N/A
Antenna Mast	Dae-il EMC JAC-1	N/A	N/A
Artificial Mains Network	PMM L3-25	1110K70403	10/02/03
Artificial Mains Network	KYORITSU KNW-242C	8-920-20	08/31/03
Antenna Turntable Controller	JAEMC JAC-2	N/A	N/A