Electromagnetic Emission
FCC MEASUREMENT REPORT
FCC PART 15 SUBPART C
FOR LOW POEWR TRANSMITTER

PRODUCT	:	**CAR MP3 Player**
MODEL/TYPE NO	:	**CAR MP3 AC-100**
FCC ID	:	**PM8AC-100**
TRADE NAME	:	**AL Tech. Inc.**
APPLICANT	:	**AL Tech. Inc. Haesung Bldg.1F 747-2, Yoksam-Dong, Kangnam-Gu, Seoul, Korea, 153-080 Attn. : Jung Woo, Kim / Engineer**
FCC CLASSIFICATION	:	**DXX- Part 15 Low Power Communication Device Transmitter**
FCC RULE PART(S)	:	**FCC Part 15 Subpart C Section 15.239**
FCC PROCEDURE	:	**Certification**
DATES OF TEST	:	**June 28, 2004**
DATES OF ISSUE	:	**July 05, 2004**
TEST REPORT No.	:	**BWS-04-RF-0015**
TEST LAB.	:	**BWS Tech., Inc. (Registration No. : 553281)**

This Car MP3 Player 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 C Section15.239 I attest to the accuracy of data. All measurement herein was 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 vouc h 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.

TaeHyun Nam
Chief of Laboratory Division
BWS TECH Inc.

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TABLE OF CONTENTS

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	:	AL Tech. Inc.
Company Address	:	Haesung Bldg.1F 747-2, Yoksam-Dong, Kangnam-Gu, Seoul, Korea, 153-080
Phone/Fax	:	Phone : +82-2-566-5093 Fax : +82-2-566-6186

Manufacturer

Company Name	:	AL Tech. Inc.
Company Address	:	Haesung Bldg.1F 747-2, Yoksam-Dong, Kangnam-Gu, Seoul, Korea, 153-080
Phone/Fax	:	Phone : +82-2-566-5093 Fax : +82-2-566-6186

● **EUT Type**	:	CAR MP3 Player
● **Model Number**	:	CAR MP3 AC-100
● **FCC Identifier**	:	MP8-AC100
● **S/N**	:	Prototype
● **Freq. Range**	:	88.1 MHz to 88.9 MHz & 106.7 MHz to 107.9 MHz
● **Channel**	:	12 Ch.
● **Modulation Method**	:	FSK
● **FCC Rule Part(s)**	:	Part 15 Subpart C Section 15.239
● **Test Procedure**	:	ANSI C63.4-2000
● **Dates of Tests**	:	July 05, 2004
● **Place of Tests**	:	BWS TECH Inc. EMC Testing Lab (FCC Registration Number : 553281) 294-7, Jungdae-Dong, Kwangju-Si, Kyunggi-Do, 464-080, Korea TEL: +82 31 764 0125 FAX: +82 31 764 0126
● **Test Report No.**	:	BWS-04-RF-0015

2. Description of Test Facility

The measurement for radiated emission test were practiced at the open area test site of BWS TECH Inc. Measurement for conducted emission test were practiced at the semi EMC Anechoic Chamber 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 C63.4-2000 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 emissions from the AL Tech. Inc. CAR MP3 Player Model : CAR MP3 AC-100.

3. Product Information

3.1 Equipment Description

The Equipment Under Test (EUT) is RF transmitter by the AL Tech. Inc. CAR MP3 Player model: CAR MP3 AC-100 (FCC ID: PM8AC-100).
This product allows to play mp3 file in a Removable USB memory like AnyDrive. In addition, it transmits mp3 music by FM frequency to FM Radio.

3.2 General Specification

3.2.1 General Specifications

- Current Dissipation	35mA Max
- Supply Voltage	12Vdc
- Dimension	(H)4mm X (W)30mm X(D)30mm
- Environment	Storage Temperature :-30℃ +80℃ Operating Temperature : -10℃ +60℃
- Antenna	Gain : 3dBi Length : 50Cm Impedance : 50 Ω
- Power Requirement	12VDC

3.2.2 Electrical Specification(Transmitter)

- Carrier Frequency	88.1 MHz to 88.9 MHz & 106.7 MHz to 107.9 MHz
- Number of Channel	12 Channel
- Channel Space	200 kHz
- Frequency Deviation	±75 kHz
- Oscillation Method	PLL VCO
- Modulation method	FSK
- Type of Emission	F3E
- Duplex	Only Transmit
- RF Output Level	250 uV/m at 3m
- Frequency Stability	±5 PPM
- Frequency Drift	±100 Hz (after 30min)
- Audio Input Frequency Range	6dB/oct 20 Hz ~ 15 kHz
- Pre-Emphasis	75 us
- Spurious	-65 dBc
- Total Harmonic Distortion	0.1% Typical
- RF out matching impedance	50Ω
- Function	RF Oscillator & Audio Frequency

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 50Ω/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 a 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 sidewall 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 configurations, 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 was 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 log periodic, Horn 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 25GHz). 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.

Varying the mode of operating frequencies of the EUT maximized each emission. 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.

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.

Conducted Emission Test

It needs not to test requirement, because the EUT supplies from a DC battery.

Radiated Emission Test

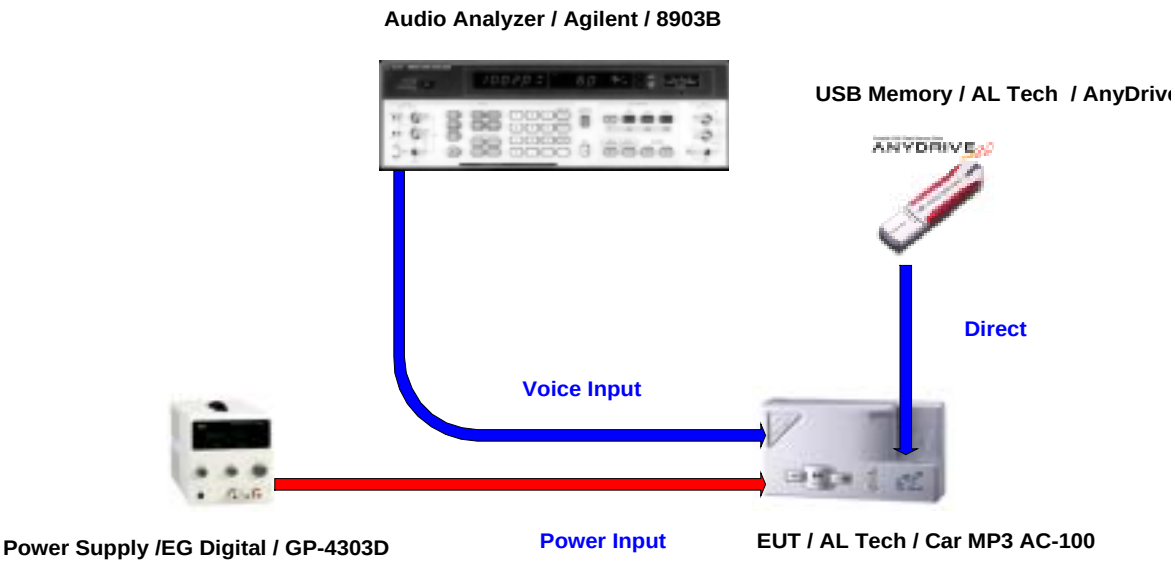
Preliminary radiated emission tests were conducted using the procedure in ANSI C63.4/2000 Clause 8.3.1.1 to determine the worst operating condition. Final radiated emission tests were measured at 3-meter open field test site. To complete the test configuration required by the FCC, the EUT was tested in all three orthogonal planes.

5.2 EUT operation

EUT was tested according to the following operation modes provided by the specifications given by the manufacturer, and reported the worst emissions

5.3 Peripherals / Support Equipment Used

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



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	Limit	Result
15.239(a)	Frequency Band / 20dB Bandwidth	88 MHz ~ 108 MHz / 200kHz	Pass
15.239(b)	Field Strength of Radiation (< 200kHz)	250 μV/m	Pass
15.239(c)	Field Strength of Radiation (> 200kHz)	15.209 & 15.205	Pass
15.239(c)	Field Strength of Spurious Radiation	15.209 & 15.205	Pass

The data collected shows that the AL Tech. Inc., Ltd. CAR MP3 Player CAR MP3 AC-100 complies with technical requirements of the Part 15.239 of the FCC Rules.

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.

6.2 Frequency Band / 20dB Bandwidth [§15.239(a)]

Test Date : June 28, 2004

Environment Condition : Humidity Level : 55 %RH, Temperature : 23℃

Tested by : 

Chang Young, Choi

Test Method:

The sample was placed 0.8m above the ground plane on the open filed test site. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis(X,Y,Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations.

Limits of Field Strength of Radiation

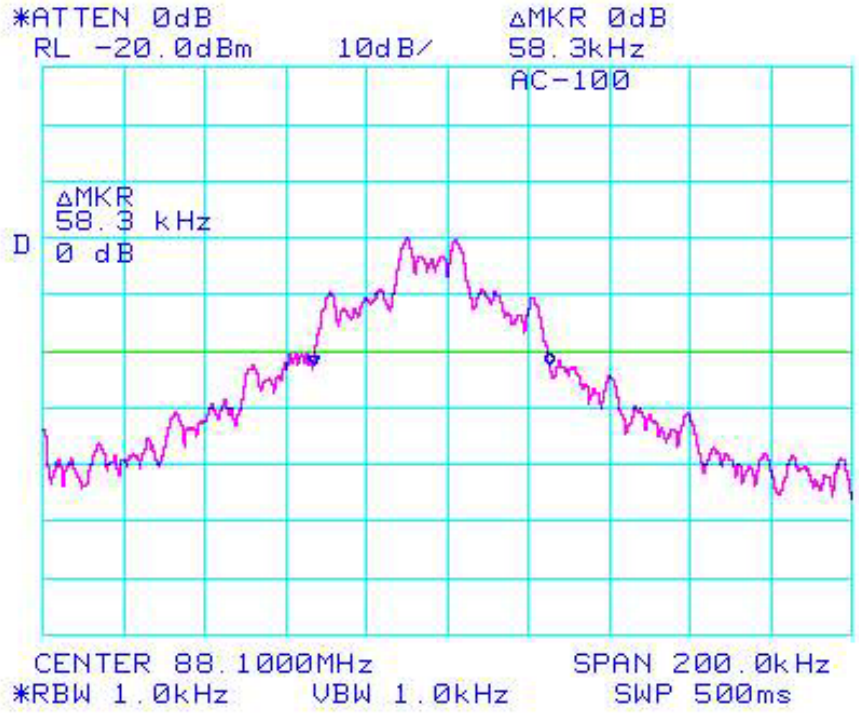
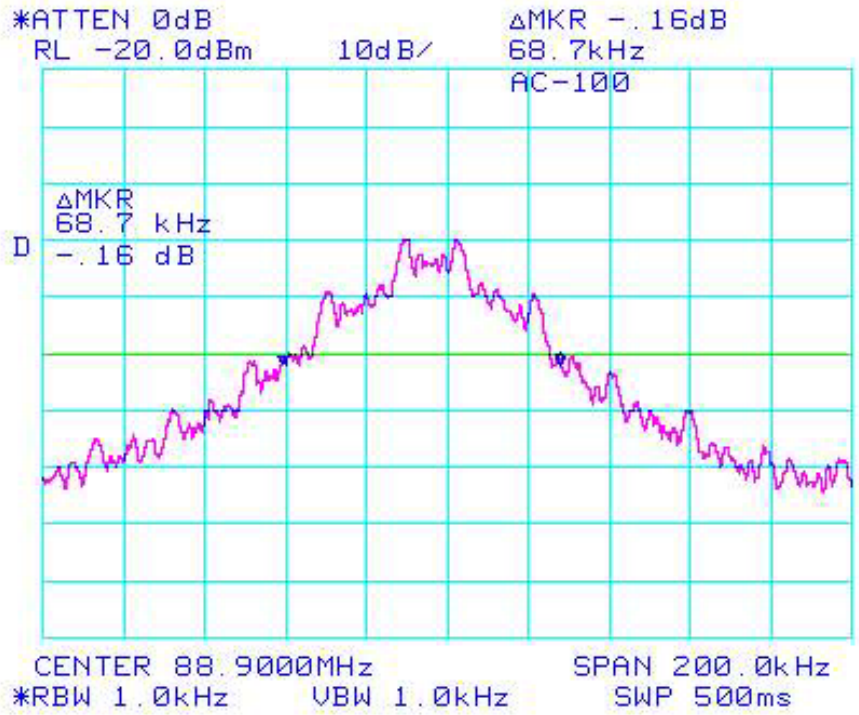
(1) Emissions from the intentional radiator shall be confined within a band 200 kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the frequency range of 88-108 MHz.

Tabulated Bandwidth Test Data

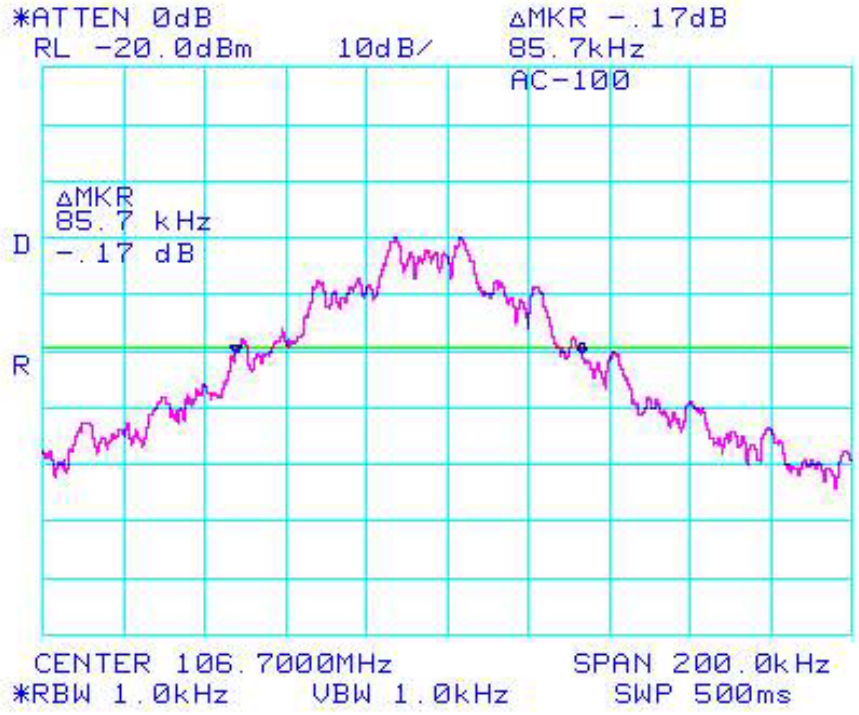
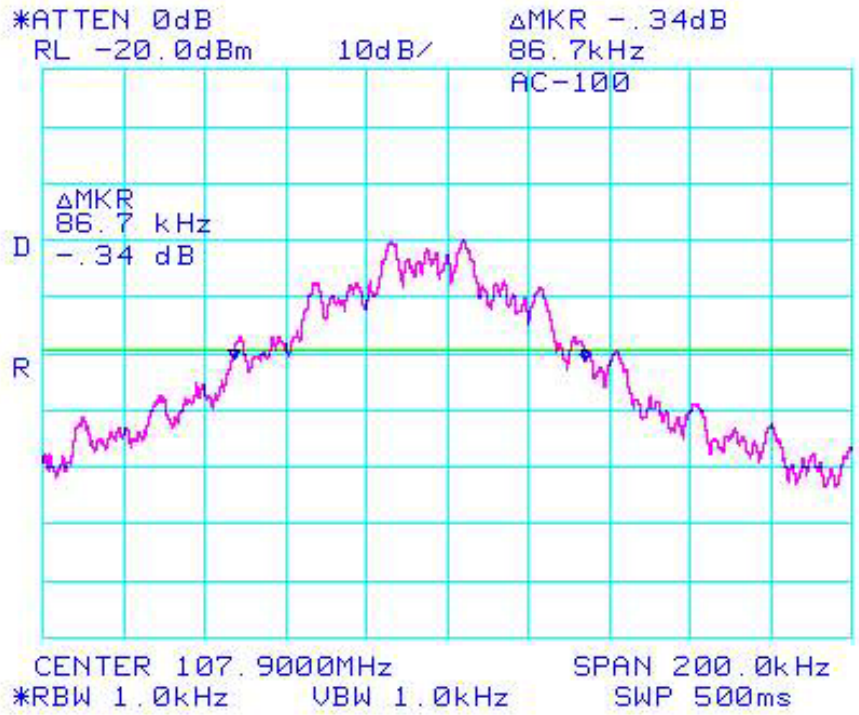
Frequency (MHz)	20dB Bandwidth (kHz)
88.10	58.30
88.90	68.70
106.70	85.70
107.90	86.70

The plot of test result is attached as below.

Test Plot 1

Channel 1 88.1 MHz	
Channel 5 88.9 MHz	

Test Plot 2

Channel 6 106.7 MHz	
Channel 12 107.9 MHz	

6.3 Field Strength of Radiation [§15.239(b),(c)]

Test Date : June 28, 2004

Environment Condition : Humidity Level : 55 %RH, Temperature : 23℃

Tested by : Chang Young, Choi

Test Method:

The sample was placed 0.8m above the ground plane on the open filed test site. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis(X,Y,Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations.

Limits of Field Strength of Radiation

(2) The field strength of any emissions within the permitted 200 kHz band shall not exceed 250 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in Sec. 15.35 for limiting peak emissions apply.

(3) The field strength of any emissions radiated on any frequency outside of the specified 200 kHz band shall not exceed the general radiated emission limits in Sec. 15.209.

Tabulated field strength of radiation Test Data

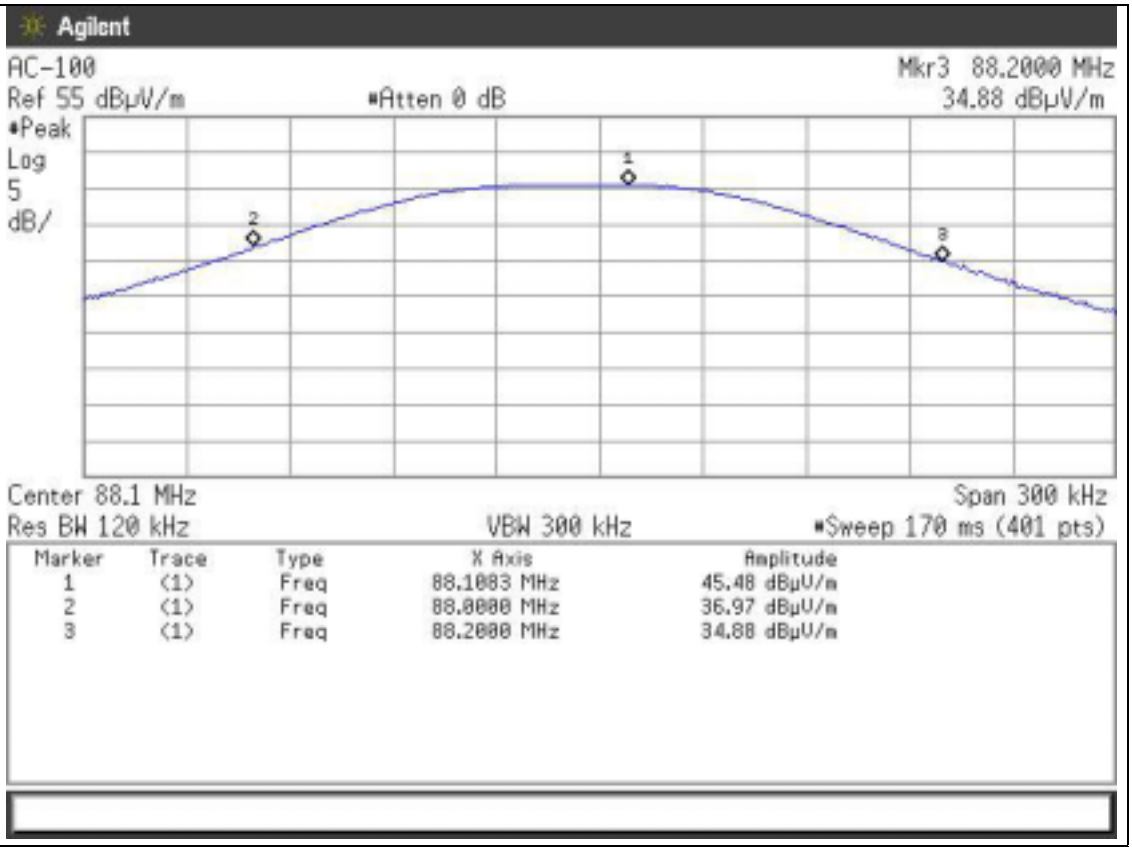
Frequency (MHz)	Detector Mode	Level (dBuV)	Antenna Pplarity (H/V)	Factor & Loss (dB)	Level (dBuV/m)	Level (uV/m)	Limit (uV/m)	Limit (dBuV/m)	Margin (dB)
88.00	Peak	27.22	H	9.75	36.97	70.55	100.00	40.00	3.03
88.10	Peak	35.73	H	9.75	45.48	187.93	250.00	47.96	2.48
88.20	Peak	25.13	H	9.75	34.88	55.46	150.00	43.52	8.64
88.80	Peak	25.94	H	9.65	35.59	60.19	150.00	43.52	7.93
88.90	Peak	35.00	H	9.65	44.65	170.80	250.00	47.96	3.31
89.00	Peak	24.41	H	9.65	34.06	50.47	150.00	43.52	9.46
106.60	Peak	28.07	H	11.84	39.91	98.97	150.00	43.52	3.61
106.70	Peak	35.76	H	11.84	47.60	239.88	250.00	47.96	0.36
106.80	Peak	25.74	H	11.84	37.58	75.68	150.00	43.52	5.94
107.80	Peak	28.20	H	11.98	40.18	102.09	150.00	43.52	3.34
107.90	Peak	35.83	H	11.98	47.81	245.75	250.00	47.96	0.15
108.00	Peak	25.97	H	11.98	37.95	78.98	150.00	43.52	5.57

The plot of test result is attached as below.

Test Plot 1

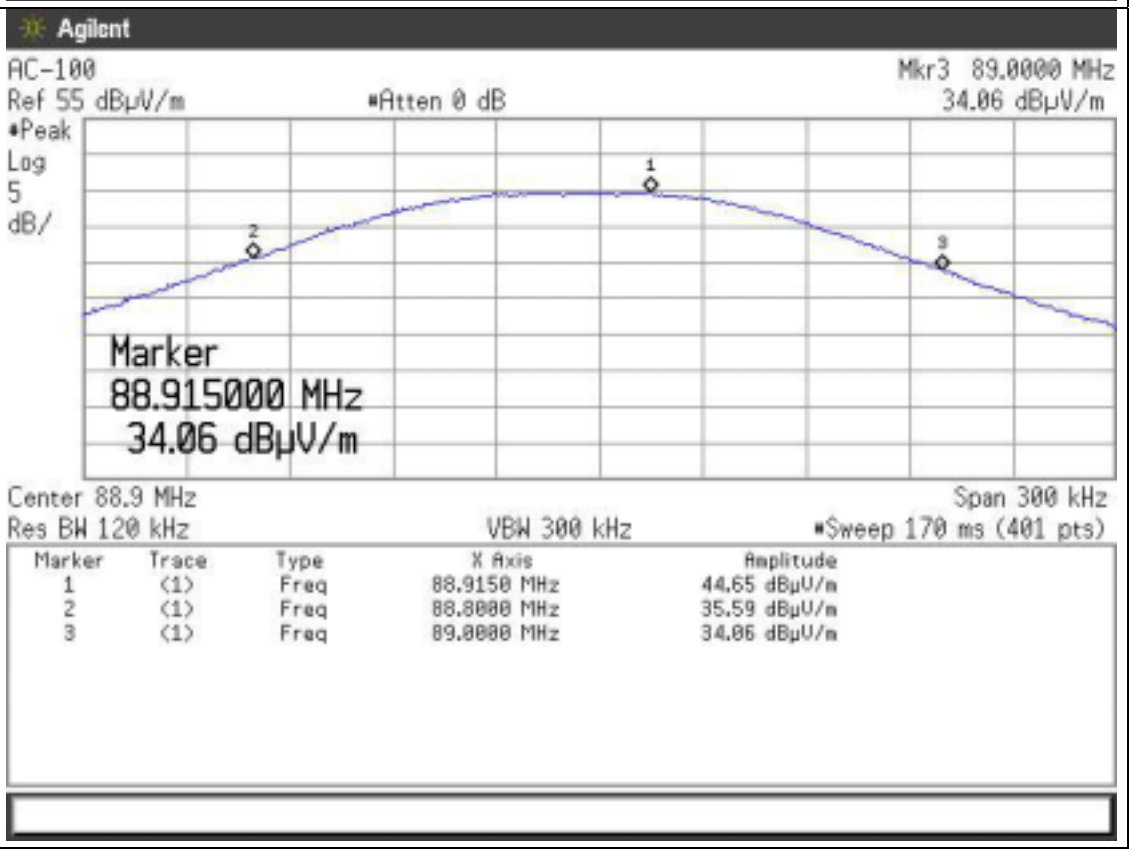
Channel 1

88.1 MHz

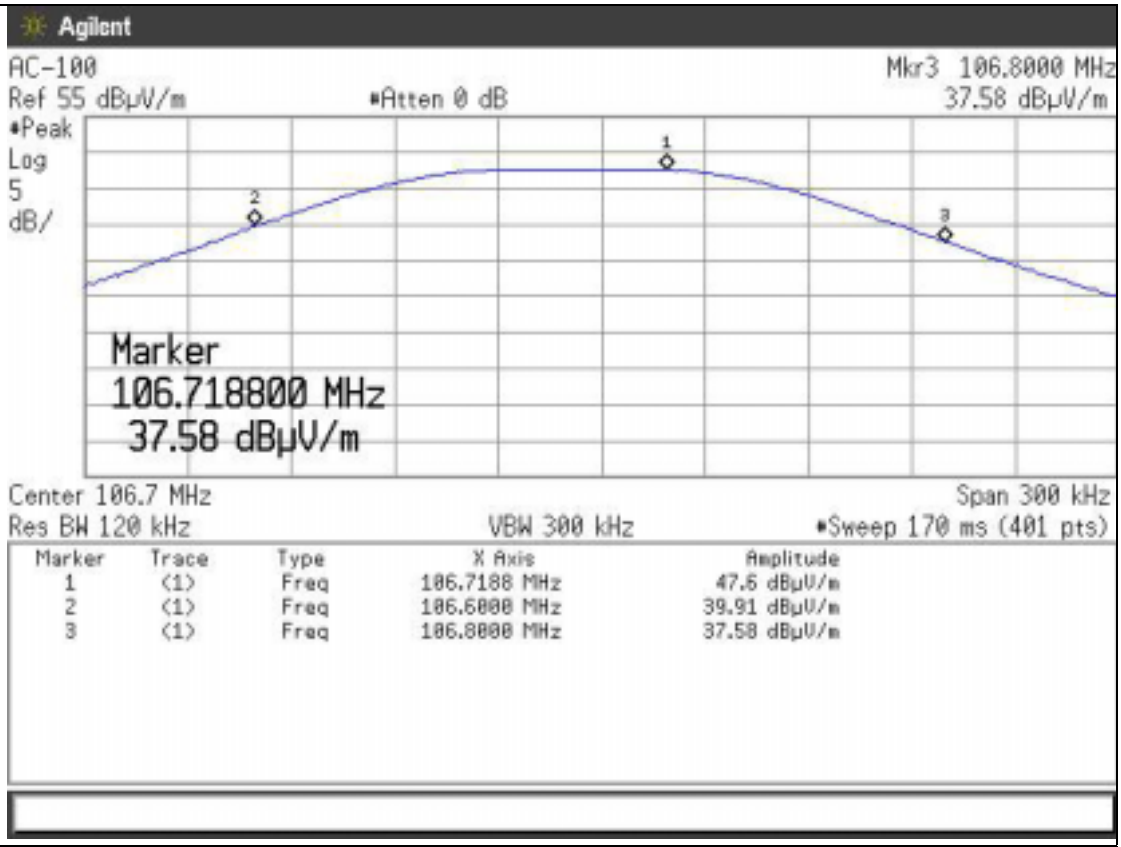
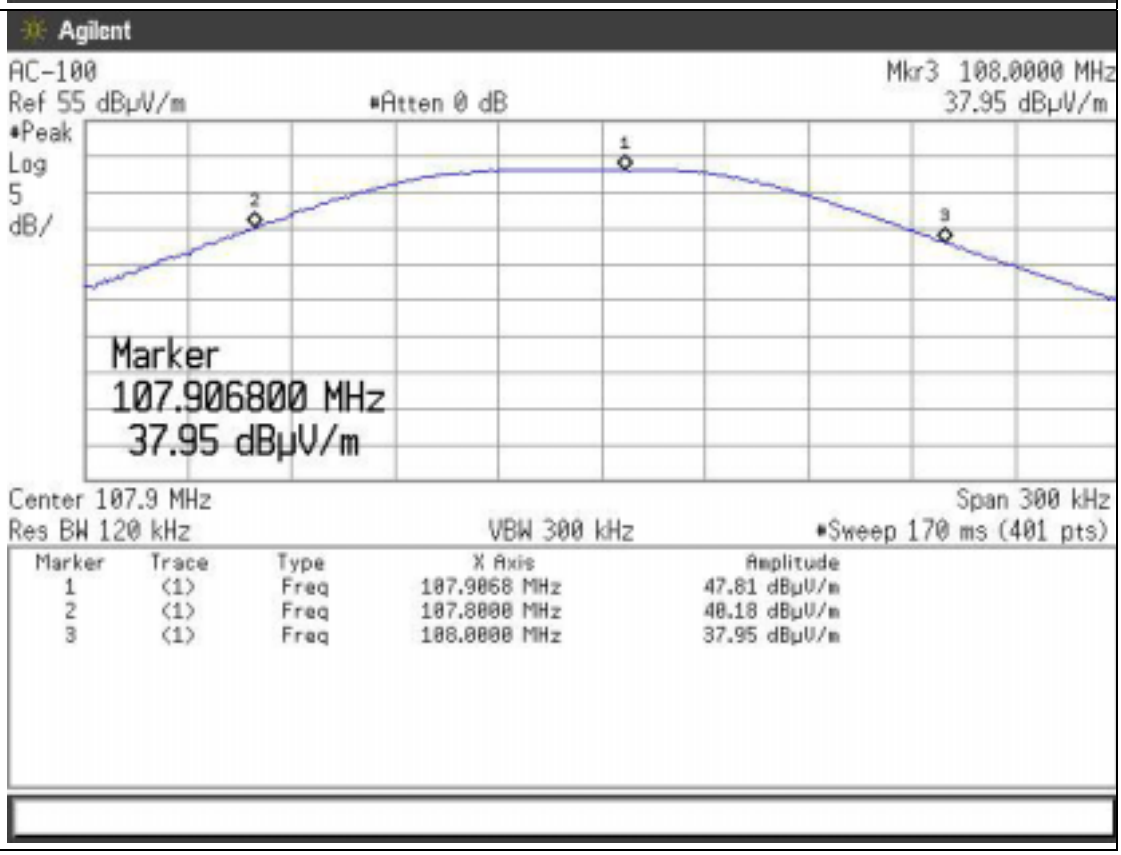


Channel 5

88.9 MHz



Test Plot 2

Channel 6 106.7 MHz	
Channel 12 107.9 MHz	

6.4 Field Strength of Radiation [§15.239(c), §15.209]

Test Date : June 28, 2004

Environment Condition : Humidity Level : 55 %RH, Temperature : 23℃

Tested by : 

Chang Young, Choi

Test Method:

The sample was placed 0.8m above the ground plane on the open filed test site. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis(X,Y,Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations.

Limits of Field Strength of Radiation

(1) The field strength of any emissions radiated on any frequency outside of the specified 200 kHz band shall not exceed the general radiated emission limits in Sec. 15.209.

Tabulated field strength of radiation Test Data

a) Field strength of radiation 1

Frequency (MHz)	Detector Mode	Level (dBuV)	Antenna Pplarity (H/V)	Factor & Loss (dB)	Level (dBuV/m)	Level (uV/m)	Limit (uV/m)	Limit (dBuV/m)	Margin (dB)
42.95	Q-Peak	15.48	H	11.85	27.33	23.25	100.00	40.00	12.67
43.84	Q-Peak	14.75	H	11.73	26.48	21.09	100.00	40.00	13.52
109.59	Q-Peak	23.42	H	12.28	35.70	60.95	150.00	43.52	7.82
131.51	Q-Peak	16.51	H	16.87	33.38	46.67	150.00	43.52	10.14
142.71	Q-Peak	12.00	H	17.00	29.00	28.18	150.00	43.52	14.52
143.18	Q-Peak	8.81	H	17.00	25.81	19.52	150.00	43.52	17.71
171.82	Q-Peak	4.91	H	16.17	21.08	11.32	150.00	43.52	22.44
329.31	Q-Peak	18.79	V	18.49	37.28	73.11	200.00	46.02	8.74
372.61	Q-Peak	24.71	V	19.46	44.17	161.62	200.00	46.02	1.85
416.45	Q-Peak	19.26	V	20.48	39.74	97.05	200.00	46.02	6.28
460.29	Q-Peak	18.59	V	21.82	40.41	104.83	200.00	46.02	5.61
644.31	Q-Peak	14.09	V	26.43	40.52	106.17	200.00	46.02	5.50
706.84	Q-Peak	11.02	V	27.61	38.63	85.41	200.00	46.02	7.39

b) Field strength of radiation 2

Frequency (MHz)	Detector Mode	Level (dBuV)	Antenna Pplarity (H/V)	Factor & Loss (dB)	Level (dBuV/m)	Level (uV/m)	Limit (uV/m)	Limit (dBuV/m)	Margin (dB)
176.20	Peak	11.62	H	16.11	27.73	24.35	150.00	43.52	15.79
264.30	Peak	13.34	H	16.04	29.38	29.44	200.00	46.02	16.64
352.40	Peak	6.48	H	19.06	25.54	18.92	200.00	46.02	20.48
177.80	Peak	12.33	H	16.10	28.43	26.39	150.00	43.52	15.09
266.70	Peak	13.16	H	16.14	29.30	29.17	200.00	46.02	16.72
355.60	Peak	6.51	H	19.12	25.63	19.12	200.00	46.02	20.39
213.40	Peak	15.06	H	14.05	29.11	28.54	150.00	43.52	14.41
320.10	Peak	10.48	H	18.26	28.74	27.35	200.00	46.02	17.28
426.80	Peak	4.29	H	20.81	25.10	17.99	200.00	46.02	20.92
215.80	Peak	15.16	H	14.13	29.29	29.14	150.00	43.52	14.23
323.70	Peak	10.69	H	18.37	29.06	28.38	200.00	46.02	16.96
431.60	Peak	5.01	H	20.97	25.98	19.91	200.00	46.02	20.04

7. Sample Calculation and Other Information

7.1 Sample Calculations

$$dB\mu V = 20 \log 10 (\mu V/m)$$

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

EX. 1.

@ 88.1 MHz Radiated Emissions limit = 47.96 dBμV

Reading = 35.73 dBμV(Peak level)
Antenna factor + Cable Loss = 9.75 dB
Total = 45.48 dBμV/m
$10^{(45.48/20)}$ = 187.93 μV/m
Margin = 47.96 – 45.48 = -2.48
12.47dB ; below limit

7.2. Measurement Uncertainty

Measurement uncertainty of RFI Voltage Measurement test was estimated at ±3.51 dB(k=2)
Measurement uncertainty of RFI Field Strength Measurement test was estimated at ±4.34dB (k=2)

8. TEST EQUIPMENTS LIST

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

Test Equipment	Manufacture Model Number	Serial Number	Calibration Due date
Signal Analyzer	PMM PMM9000	3100570602	09/09/04
EMC Analyzer	HP E7403A	US39150108	05/18/05
Spectrum Analyzer	ADVANTEST R3261C	61720002	08/14/04
Audio Analyzer	HP 8903B	3011A09344	04/29/05
Power Supply	EG Digital GP-4303D	1080181	04/29/05
Amplifier (0.1MHz-1.3GHz)	HP 8447E	2945A02712	08/14/04
Biconical Antenna	PMM BC01	0020J70501	01/16/05
Log Periodic Antenna	PMM LC01	0020J70501	01/16/05
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	10/02/04
Artificial Mains Network	FCC FCC-LISN-50-50-2-02	03074	10/07/04
Antenna Turntable Controller	JAEMC JAC-2	N/A	N/A