

Electromagnetic Emission

FCC MEASUREMENT REPORT

CERTIFICATION OF COMPLIANCE

FCC Part 15 Certification Measurement

PRODUCT : Radar Detector
MODEL/TYPE NO : MRD-1000
FCC ID : QTIMRD-1000
APPLICANT : MICROLINE Co., Ltd.
#801 Shinnae Techno-Town 485, Sangbong-Dong,
Jungnang-Gu, Seoul, Korea
Attn. : Kyung-Tae Lee / Engineer of R&D Planning Team
FCC CLASSIFICATION : Part 15 Subpart B Unintentional Radiators
Radar Detector – CRD
FCC RULE PART(S) : FCC Part 15 Subpart B
FCC PROCEDURE : Certification
TRADE NAME : M&C
TEST REPORT No. : E03.0103.FCC.009N
DATES OF TEST : January 1 ~ 3, 2003
DATES OF ISSUE : January 3, 2003
TEST LABORATORY : ETL Inc (FCC Registration Number : 95422)
#584 Sangwhal-ri, Kanam-myon, Yaju-kun, Kyunggi-do,
469-885, Korea
Tel : +82-31- 885-0072, 0073 Fax : +82-2-885-0074

This MICROLINE Co., Ltd., Model MRD-1000 has been tested in accordance with the measurement procedures specified in ANSI C63.4-1992 at the ETL/EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart B : Unintentional Radiators. 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.

Yo han, Park

Name : Yo han, park

Title : Chief Engineer & Lab. Manager

E-RAE Testing Laboratory Inc.

#584 Sangwhal-ri, Kanam-myon, Yaju-kun,
Kyunggi-do, 469-885, Korea



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FCC MEASUREMENT 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)

General Information

Applicant Name : MICROLINE Co., Ltd.

Address : #801 Shinnae Techo-Town 485, Sangbong-Dong,
Jungnang-Gu, Seoul, Korea

Attention : Kyung-Tae Lee / Engineer of R&D Planning Team

~~ETL~~ **EUT Type** : Radar Detector
~~ETL~~ **Model Number** : MRD-1000
~~ETL~~ **FCC Identifier** : QTIMRD-1000
~~ETL~~ **S/N** : N/A
~~ETL~~ **Modulation** : N/A
~~ETL~~ **FCC Rule Part(s)** : Part 15 Subpart B Unintentional Radiators
~~ETL~~ **Test Procedure** : ANSI C63.4-1992
~~ETL~~ **FCC Classification** : Part 15 Unintentional Radiators
~~ETL~~ Radar Detector (CRD)
~~ETL~~ **Dates of Tests** : January 1 ~ 3, 2003
~~ETL~~ **Place of Tests** : ETL Inc
EMC Testing Lab (FCC Registration Number : 95422)
584, Sangwhal-Ri, Kanam-Myun, Yoju-Kun,
Kyounggi-Do, Korea
Tel : +82-31- 885-0072, 0073 Fax : +82-31-885-0074
~~ETL~~ **Test Report No.** : E03.0103.FCC.009N

1. INTRODUCTION

The measurement test for radiated and conducted emission test were conducted at the open area test site of E-RAE Testing Laboratory Inc. facility located at 584, Sangwhal-ri, Ganam-myun, Youju-kun, Kyounggi-do, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-1992 and CISPR Publication 16. The ETL has site descriptions on file 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 : 95422).

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.63.4-1992) was used in determining radiated and conducted emissions from the MICROLINE Co., Ltd., Model: MRD-1000

2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the MICROLINE Co., Ltd. / Radar Detector / MRD-1000
Please refer to Users manual

2.2 General Specification

✍ Chassis Type	: Plastic Cover
✍ List of Each OSC. Or X-Tal. Freq. ($\geq 1\text{MHz}$)	: X-TAL – 8.0MHz
✍ Chipset Brand & Part No.	: PIC16C72A-20/SO – MICROCHIP, OP-AMP – NATIONAL : 93LC46A – MICROCHIP, LP2951 – NATIONAL, NE592D – PHILIPS : SN74HC595DR – TI, SN74HC10DR – TI, SN74HC02DR/SO – TI
✍ Number of Layers	: Main board – 2Layers, IF Board – 2Layers, RF Board – 2Layers
✍ Frequency of Operation	: X Band – $10.525\text{GHz} \pm 25\text{MHz}$: K Band – $24.150\text{GHz} \pm 100\text{MHz}$: Ka Band – $34.7\text{GHz} \pm 1300\text{MHz}$
✍ Laser Spectral Response	: 800 ~ 1,100nm
✍ Operating Temperature	: -4 to 176°F (-20 to 80°C)
✍ Power condition	: 12 ~ 16V, 260mA
✍ Dimension (HWL)	: 1.3 X 2.8 X 4 Inches (33 X 71 X 103mm)
✍ Weight	: 4.23 oz (120g)

3. DESCRIPTION OF TESTS

3.1 Radiated Emission Measurement

Radiated emission measurements were in accordance with § 12.2 in ANSI C63.4-1992 "Measurement of Information Technology Equipment ". The measurements were performed over the frequency range of 30MHz to 1GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Quasi-peak" within a bandwidth of 120KHz.

- Procedure of Test

Preliminary measurements were made at 3 meter using broadband antennas, and spectrum analyzer to determined the frequency producing the max. Emission in shielded room. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using SchwarzBeck Log-Bicon antenna. Above 1GHz, linearly polarized double Schwarz Beck Broad-band horn antennas were used. Final measurements were made open site at 3meters. A search was made of spectrum from 30 to 1000MHz and from 11.7 to 12.2 GHz the measurements indicate that the unit DOES meet the FCC requirements. Measurements in the 11.7 to 12.2GHz band were made with a Standard Gain Horn. The measurements in the 11.7 to 12.2GHz band represent the ambient noise levels. The attached plots were made with peak detector with the analyzer in a maximum hold for 2 minutes. The test equipment was placed on a wooden turn-table. 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 pre-scan measurements was re-examined by manual. The detector function was set to CISPR Quasi-peak mode and the bandwidth of the receiver was set to 120kHz or 1MHz depending on the frequency of type of signal. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the max. Emission for the frequency and were placed on top of a 0.8-meter high nonmetallic 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the max. emission. Each emission was maximized by: varying the mode of operation to the EUT and/or support equipment and changing the polarity of the antenna, whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in Photographs of the worst-case emission test setup can be seen in Appendix B.

4. TEST CONDITION

4.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

4.2 EUT operation

The EUT was connected as user's guide. And during the test executed EUT is operating on the following Bands: 10.525GHz(X-Band), 24.150GHz(K-Band), 34.70GHz(Ka-Band)

Operating Mode	Worst case
Stand by	X
10.525GHz(X-Band),	O
24.150GHz(K-Band),	X
34.70GHz(Ka-Band)	X

O: Worst case investigated during the Test

4.3 Support Equipment Used

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

EUT – Radar Detector (MICROLINE Co., Ltd.)

FCC ID : QTIMRD-1000
Model Name : MRD-1000
Serial No. : N/A
Manufacturer : MICROLINE Co., Ltd.
Power Supply Type : Power supply from DC 12V of Light jack of in the car
Power Cord : Non-shielded, Detachable: 0.5m of Light Jack
Data Cable : N/A

Support Unit 1 – DC Power Supply (HANYOUNG)

FCC ID : N/A
Model Name : HYP-3030
Serial No. : N/A
Manufacturer : HANYOUNG
Power Supply Type : Linear
Power Cord : Non-Shielded, Detachable, 1.2m
Data cable : N/A

5. TEST RESULTS

5.1 Summary of Test Results

This equipment is Power Supply system from DC Power supply of DC 12V
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.

Test Rule Parts	Measurement Required	Result
15.109(e)	Radiated Emissions Measurement	Passed By – 19.87dB
15.109(h)	Radiated Emissions Measurement	No Signal Detected

The data collected shows that the MICROLINE Co., Ltd., Radar Detector, MRD-1000 complies with technical requirements of above rules part 15.109(e) and 15.109(h).

The equipment 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. TEST RESULTS

5.1 Radiated Emissions Measurement of 30 ~ 1000MHz

EUT	Radar Detector / MRD-1000 (SN:N/A)
Limit apply to	15.109(e) : CISPR Pub.22(1997)
Test Date	January 2, 2003:
Operating Condition	Operating on the following Bands 10.525GHz(X-Band), 24.150GHz(K-Band), 34.70GHz(Ka-Band)
Environment Condition	Humidity Level : 40 %RH, Temperature : 20°C
Result	Passed by – 19.87dBμV

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 [dBμV]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
80.0	9.33	V	7.22	2.20	18.75	40.0	21.25
240.0	10.13	V	10.89	4.10	25.12	47.0	21.88
320.0	8.87	H	13.08	4.68	26.54		20.46
400.0	6.69	H	15.04	5.40	27.13		19.87

NOTES :

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Emission Level = Reading + Antenna factor + Cable loss
3. Margin value = Limit - Emission Level
4. The measurement was performed for the frequency range 30MHz ~ 1000MHz according to the CISPR 22 Class B



Test Engineer : C. S. Kim

5. TEST RESULTS

5.2 Radiated Emissions Measurement of 11.7 ~ 12.2GHz

EUT	Radar Detector / MRD-1000 (SN:N/A)
Limit apply to	15.109(h)
Test Date	January 2, 2003
Operating Condition	Operating on the following Bands
	10.525GHz(X-Band), 24.150GHz(K-Band), 34.70GHz(Ka-Band)
Environment Condition	Humidity Level : 40 %RH, Temperature : 19°C
Result	No signal detected

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 : 1 MHz)

Measurement Distance : 3 meters

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]

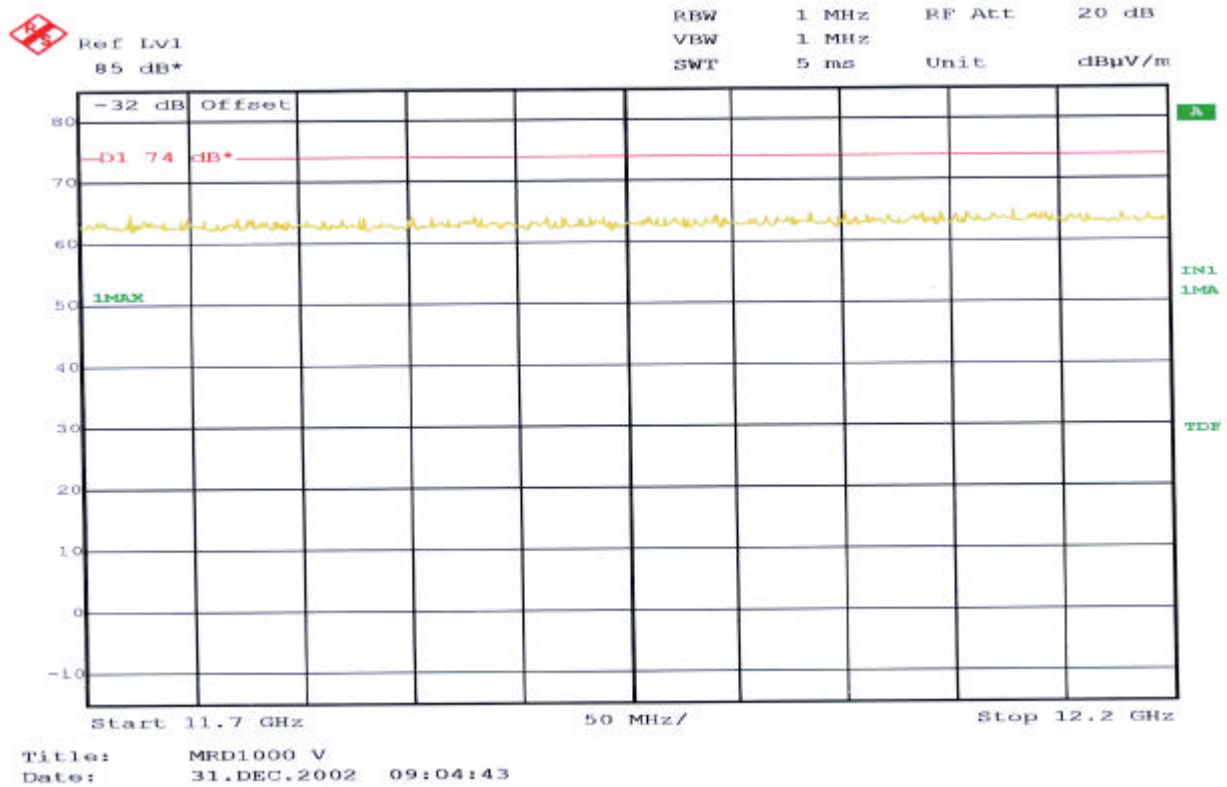
NOTES :

- * H : Horizontal polarization , ** V : Vertical polarization
- Emission Level = Reading + Antenna factor + Cable loss
- Margin value = Limit - Emission Level
- The measurement was performed for the frequency range 11.7GHz ~ 12.2GHz according to the FCC Part 15.109 (h)
- No signal detected of 11.7GHz ~ 12.2GHz, No Test data result.

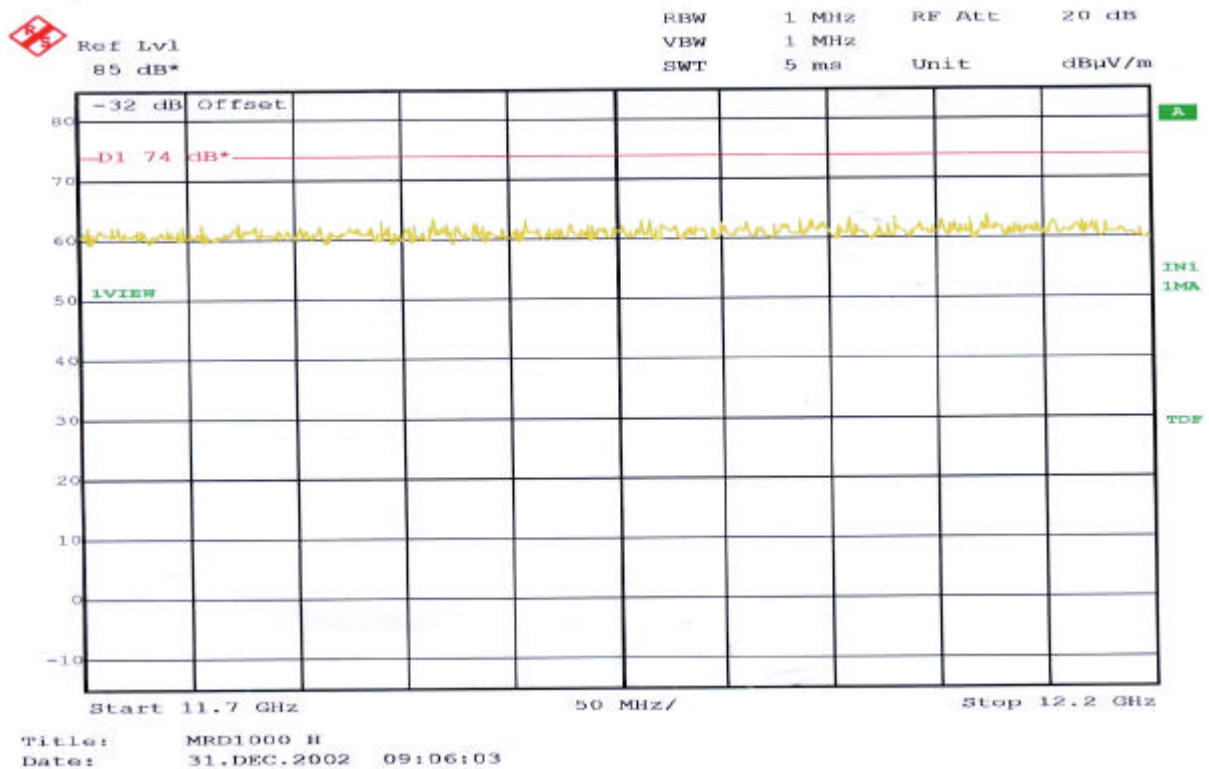


Test Engineer : C. S. Kim

Horizontal polarization



Vertical polarization



6. SAMPLE CALCULATION

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Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.
The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF$$

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

$$dB(\mu V/m) = 20 \log_{10} (\mu V / m) : \text{Equation 1}$$

$$dB\mu V = dBm + 107 : \text{Equation 2}$$

Example 2 : @ 400.0 MHz

Class B Limit	=	223.87 μV	=	47.0 dB $\mu V/m$
Reading	=	6.69 dB μV		
Antenna Factor + Cable Loss	=	20.44 dB		
Total	=	27.13 dB $\mu V/m$		
Margin	=	27.13 - 47.0	=	-19.87
	=	-19.87 dB below Limit		

7. TEST EQUIPMENT LIST

List of Test Equipments Used for Measurements

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Test Equipment	Model	Mfg.	Serial No.	Cal. Date
☒ Spectrum Analyzer	R3261A	Advantest	21720033	02-10-25
☒ Receiver	ESVS 10	R & S	835165/001	02-03-21
☒ Receiver	ESI40	R & S	8315647003	02-11-16
☒ Receiver	ESHS30	R & S	84190/002	02-01-24
☒ Spectrum Analyzer	E7402A	HP	US39110107	03-05-21
☒ LISN	3825/2	EMCO	9208-1995	02-12-27
☒ LISN	3825/2	EMCO	9006-1669	02-12-28
☒ Preamplifier	HP8447D	HP	2944A07626	02-01-10
☒ Preamplifier	AMF-4D-001180-26-CP	MIDEQ	67009	02-11-25
☐ Preamplifier	HP 8347A	HP	2834A00544	02-05-23
☒ TriLog Antenna	VULB9160	Schwarz Beck	3082	02-06-19
☐ LogBicon	VULB9165	Schwarz Beck	2023	02-05-28
☒ Dipole Antenna	VHAP	Schwarz Beck	964	02-05-04
☐ Dipole Antenna	VHAP	Schwarz Beck	965	02-05-04
☒ Dipole Antenna	UHAP	Schwarz Beck	949	02-05-04
☐ Dipole Antenna	UHAP	Schwarz Beck	950	02-05-04
☒ Broad-band Horn Antenna	BBHA 9120D	Schwarz Beck	227	02-03-15
☐ Magnetic Loop Antenna	6502	EMCO	9810-2111	02-12-11
☒ Turn-Table	DETT-03	Daeil EMC	-	N/A
☒ Antenna Master	DEAM-03	Daeil EMC	-	N/A
☒ Plotter	7440A	H.P	2725A 75722	N/A
☒ Chamber	DTEC01	DAETONG	-	N/A
☒ Thermo Hygrograph	3-3122	ISUZU	3312201	02-01-10
☒ BaroMeter	-	Regulus	-	-