PCTEST Engineering Laboratory, Inc.

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CERTIFICATE OF COMPLIANCE (MPE EVALUATION)

HYUNDAI Electronics Industries Co., Ltd.
San 136-1, Ami-Ri, Bubal-Eub
Ichon-Si, Kyoungki-Do, KOREA 467-701
Attn: Mr. Ki-Soo Kim, Section Chief, QA Office

Dates of Tests: July 06-09, 1999
Test Report S/N: MPE.990625409.CKL
Test Site: PCTEST Lab, Columbia MD

FCC ID **CKLHD-MIC1900**

APPLICANT **HYUNDAI Electronics Industries Co., Ltd.**

EUT Type:	**Base Station Transceiver Subsystem (Micro-BTS System)**
Tx Frequency:	**1965.625 – 1969.375 MHz**
Rx Frequency:	**1885.625 – 1889.375 MHz**
Frequency Block(s):	**Block E**
Max. Output Power:	**10.0 Watts**
Trade Name/Model(s):	***HYUNDAI HD-MIC 1900***
FCC Classification:	**Licensed Base Station for Part 24 (PCB)**
Application Type:	**Certification**
Serial Number:	**n/a (pre production)**
FCC Rule Part(s):	**§ 24.52; ET Docket 96.326**

This wireless device has been shown to be capable of compliance for localized maximum permissible exposure (MPE) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and was tested in accordance with the measurement procedures specified in ANSI/IEEE Std. C95.3-1992. (See Test Report).

I attest to the accuracy of data. All measurements reported 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.

NVLAP accreditation does not constitute any product endorsement by NVLAP or any agency of the United States Government.

PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a)

Randy Ortanez
President & Chief Engineer

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MPE MEASUREMENT REPORT

Scope - Environmental evaluation measurements of Maximum Permissible Exposure (MPE) exposed to radiofrequency (RF) radiation from transmitter for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).[1]

Company Name:	**HYUNDAI Electronics Industries Co., Ltd.**
ADDRESS :	**San 136-1, Ami-Ri, Bubal-Eub**
	Ichon-Si, Kyoungki-Do, KOREA 467-701
Attention :	**Mr. Ki-Soo Kim, Section Chief, QA Office**

- EUT Type: Base Station Transceiver Subsystem (Micro-BTS System)
- Trade Name: ***HYUNDAI***
- FCC IDENTIFIER: **CKLHD-MIC1900**
- Model: ***HD-MIC 1900***
- Tx Frequency Range: 1965.625 – 1969.375 MHz
- Rx Frequency Range: 1885.625 – 1889.375 MHz
- Application Type: Certification
- FCC Classification: Licensed Base Station for Part 24 (PCB)
- FCC Rule Part(s): § 24(E); Docket 96-326
- Max. Power Rating: 10.0 W
- Channel(s): 725, 750, 775
- Frequency Block(s): Block E
- Modulation: CDMA
- Dates of Test(s): July 06-09, 1999
- Place of Test(s): PCTEST Engineering Lab. Columbia, MD, U.S.A.
- Test Report S/N: MPE.990625409.CKL

NVLAP® Lab Code 100431-0

[1] *IEEE/ANSI Std. C95.1-1992 limits are used to determine compliance with FCC ET-Docket 93-62.*

1.1 INTRODUCTION

The Federal Communications Commissions (FCC) has adopted the guidelines for evaluating the environmental effects of radiofrequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public from the potential hazards of RF emissions.[1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) and maximum permissible exposure (MPE) in *IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*. (c) 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.[2] The measurement procedure described in *IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave*[3] is used for guidance in measuring SAR/MPE due to the RF radiation exposure from the Equipment Under Test (EUT). The new guidelines incorporate limits for Maximum Permissible Exposure (MPE) in terms of electric and magnetic field strength and power density for transmitters operating at frequencies between 300 kHz and 100 GHz. These criteria for SAR/MPE evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,"* NCRP Report No. 86 (c) NCRP, 1986, Bethesda, MD 20814.[4] SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. MPE is the rms and peak electric and magnetic strength, their squares, or the plane-wave equivalent power densities associated with these fields to which a person may be exposed without harmful effect and with an acceptable safety factor.

1.2 Section 24.52 RF Hazards

> *Licensees and manufacturers are subject to the radiofrequency radiation exposure requirements specified in §1.1307(b), §2.1091 and §2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis of this statement must be submitted to the Commission upon request.*

This equipment is designed to generate and radiate radio frequency (RF) energy. It should be installed and maintained only by trained technicians. Licensees of the Federal Communications Commission (FCC) using this equipment are responsible for insuring that its installation and operation comply with FCC regulations designed to limit human exposure to RF radiation in accordance with the American National Standards Institute IEEE Standard C95.1-1991, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.*

This standard establishes two sets of "maximum permitted exposure" (MPE) limits, one for "controlled" environments and another, that allows less exposure, for "uncontrolled" environments. These terms are defined by the standard:

> **Uncontrolled Environment / General Population.** Uncontrolled environments are locations where there is exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces where there are no expectations that the exposure levels may exceed those shown [in a table of exposure ceilings].
>
> **Controlled Environment / Occupational.** Controlled environments are locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, by other cognizant persons, or as the incidental result of transient passage through areas where exposure levels may be above the general population/uncontrolled limits.

2.1 DEFINITION

2.2 Maximum Permissible Exposure (MPE)

The maximum permitted exposures (MPE) prescribed by the standard are set in terms of different parameters of effects, depending on the frequency generated by the equipment in question. At the frequency range of this Personal Communication System Base Transmitter equipment, 1930-1990 MHz, the maximum permitted exposure levels are set in terms of "power density", whose definition and relationship to electric field and magnetic field strengths are described by the following equation:

$$S(mW/cm^2) = \frac{E^2}{3770} = 37.7H^2$$

where:

S = Power density (mW/cm^2).
Power per unit area normal to the direction of propagation, usually expressed in units of watts per square meter (W/m^2) or for convenience, units such as milliwatts per square centimeter. For plane waves, power density, electric field strength (E) and magnetic field strength (H) are related by the impedance of free space (377 ohms).

E = electric field strength (V/m)

H = magnetic field strength (A/m)

Whether a given installation meets the maximum permitted exposure ceilings depends, in part, upon antenna type, antenna placement and the output power to which this equipment is adjusted.

3.1 MAXIMUM PERMISSIBLE EXPOSURE LIMITS

3.2 RadioFrequency Guides (ANSI/IEEE C95.1-1992)

Frequency Range (f)	Electric Field Strength (E^2)	Magnetic Field Strength (H^2)	Power Density E-field; H-field (S)	Averaging Time $\|E\|^2$; $\|H\|^2$; S
(MHz)	(V^2/m^2)	(A^2/m^2)	(mW/cm^2)	(minutes)
0.3 - 3.0	400,000	2.5	100.0	6
3.0 - 30	4,000 ($900/f^2$)	0.025 ($900/f^2$)	$900/f^2$	6
30 - 300	4,000	0.025	1.0	6
300 - 1500	4,000 (f/300)	0.025 (f/300)	f/300	6
1500 - 100,000	20,000	0.125	5.0	6

Table 1. Occupational Exposure (Controlled Environment)

Frequency Range (f)	Electric Field Strength (E^2)	Magnetic Field Strength (H^2)	Power Density E-field; H-field (S)	Averaging Time $\|E\|^2$; $\|H\|^2$; S
(MHz)	(V^2/m^2)	(A^2/m^2)	(mW/cm^2)	(minutes)
0.3 - 1.342	400,000	2.5	100.0	30
1.342 - 30	4,000 ($180/f^2$)	0.025	$180/f^2$	30
30 - 300	800	0.005	0.2	30
300 - 1500	4,000 (f/1500)	0.025 (f/1500)	f/1500	30
1500 - 100,000	4,000	0.025	1.0	30

Table 2. General Public Exposure (Uncontrolled Environment)

NOTES:

f = Frequency in Megahertz (MHz)
E^2 = Electric Field Strength squared
H^2 = Magnetic Field Strength squared
V^2/m^2 = Volts squared per meter squared
A^2/m^2 = Amperes squared per meter squared
mw/cm^2 = Milliwatts per centimeter squared

4.1 FCC LIMITS FOR MPE

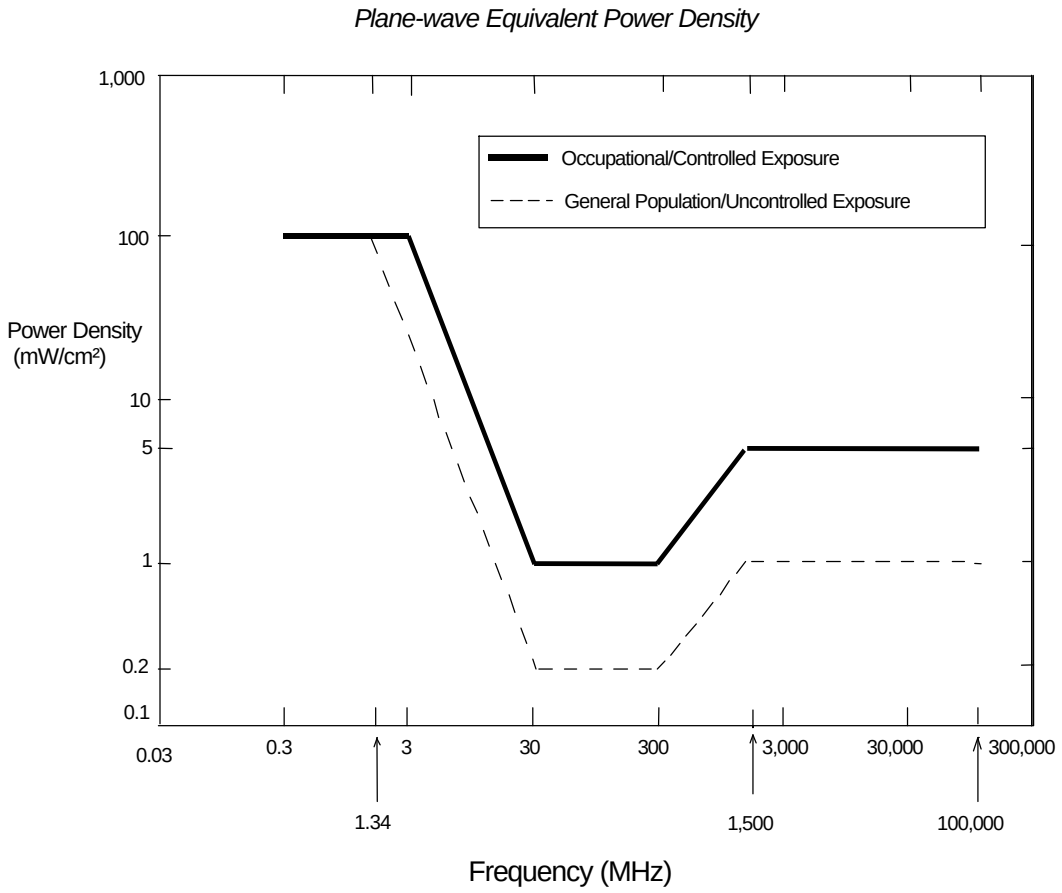

Figure 1. FCC Limits for Maximum Permissible Exposure (MPE)

5.1 RF Human Exposure Data and Measurement Procedure

This exhibit contains an outline of the measurement procedure and the data used to support the statement of compliance with FCC 47 CFR §24.52 and hence ANSI/IEEE C95.1-1992 IEEE *Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.*

4.2 Measurement Procedure:

Measurements were made at PCTEST Engineering Laboratory, Inc. test facility in Columbia, Maryland. The following steps were followed when measuring the equipment for RF radiation (also see 'Notes' below):

1. Power up equipment and configure transmitters
2. Measure near front face of the frame with Wandel & Goltermann (W & G) EM Radiation Meter, Model number EMR-20.
3. Measure near left face of the frame with W&G EM Radiation Meter.
4 Measure near right face of the frame with W&G EM Radiation Meter.
5 Measure near back face of the frame with W&G EM Radiation Meter.
6 Measure near top face of the frame with W&G EM Radiation Meter.
7. Record measurement.

Notes:

1. Care was taken to ensure that the operator did not interfere with the probe.
2. A minimum separation distance of 20 cm was maintained.

6.1 TEST DATA SUMMARY

6.2 Measured Data:

Ambient TEMPERATURE (°C) 22.0
Relative HUMIDITY (%) 55.0
Atmospheric PRESSURE (kPa) 99.0

MODEL: HD-MIC 1900
FREQUENCY (MHz): 1967.5
CHANNEL: 750
POWER: +40.0 dBm (10.0 Watts)

Measurement Results

FREQUENCY			POWER		POWER
MHz	Channel	Modulation	(dBm)	POSITION	DENSITY (mW/cm^2)
1967.5	750	CDMA	+ 40.0	FRONT	0.0020
1967.5	750	CDMA	+ 40.0	BACK	0.0036
1967.5	750	CDMA	+ 40.0	LEFT	0.0018
1967.5	750	CDMA	+ 40.0	RIGHT *	0.0027
1967.5	750	CDMA	+ 40.0	TOP	0.0014
MPE SAFETY LIMIT Uncontrolled Environment/General Public				**1.0 mW/cm^2**	
MPE SAFETY LIMIT Controlled Environment/Occupational				**5.0 mW/cm^2**	

NOTES:
1. All modes of operation were investigated and the worst-case are reported.
2. Power Density as measured with W&G EMR-20 Meter

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7.1 SPECIFICATIONS

Applies to the EMR-20 EM Radiation Meter together with the Calibration Option BN 2244/90.40.

EMR-20

Type ..... electrical field
Frequency range ..... 100 kHz to 3 GHz
Measurement method ..... true triaxial
H/V directional characteristic ..... isotropic, triaxial

Isotropic deviation

Sensor ..... ±0.5 dB at f > 1 MHz
Complete instrument typically ..... ±1 dB at f > 1 MHz
Measurement range ..... 0.8 to 800 V/m

Linearity

±1 dB ..... 2 to 800 V/m
± 3 dB ..... 0.8 to 2 V/m

Overload protection

CW ..... 0.7 W/cm^2
Pulse ..... 70 W/cm^2
Frequency response ..... typically ± 2 dB
Suppression of magnetic field components ..... 20 dB
Settling time ..... typically 1 s (0 to 90% of measured value)
Display refresh rate ..... typically 400 ms
Temperature range ..... 0 to 50 ºC

Power Supply

Rechargeable batteries ..... 2 x Mignon (AA) 1.2 V
Battery capacity ..... 600 mAh
Dry batteries ..... 2 x Mignon (AA) 1.5 V

Display and warning indicators

Display type ..... device-specific LCD
Visual warning ..... bright red LED's in foil keypad
Audible warning .. built-in piezoelectric generator; tone sequence (depends on measured value)
Range selection ..... single continuous range

Measurement functions

Units ..... V/m, A/m, mW/cm^2, W/m^2
Detection type ..... quasi-r.m.s.
Analog display ..... instantaneous value; shown on logarithmic scale
Digital display ..... instantaneous or average value or maximum thereof since switching on
Averaging ..... instantaneous value or average over 6 minutes
Alarm functions ..... on/off, variable threshold setting
Calibration ..... variable probe calibration factor setting

Calibration

Recommended calibration interval ..... 2 years
Calibration Due Date.....11/08/98

Interfaces

Transfer Interface ..... bi-directional/optical

Dimensions and Weight

Dimensions (incl. sensor & impact protection) .....approx. 95 x 50 x 450 mm (3.7" x 2.0" x 17.8")
Weight (incl. batteries) ..... approx. 450 g

7.1 CONCLUSION

The SAR/MPE measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.[3]

Whether a given installation meets ANSI standards for human exposure to radio frequency radiation may depend not only on this equipment but also on whether the "environments" being assessed are being affected by radio frequency fields from other equipment, the effects of which may add to the level of exposure. Accordingly, the overall exposure may be affected by radio frequency generating facilities that exist at the time the licensee's equipment is being installed or even by equipment installed later. Therefore, the effects of any such facilities must be considered in site selection and in determining whether a particular installation meets the FCC requirements.

REFERENCES:

[1] Federal Communications Commission, ET Docket 93-62, *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation,* Aug. 1996.

[2] ANSI/IEEE C95.1 - 1991, *American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300kHz to 100GHz*, New York: IEEE, Aug. 1992

[3] ANSI/IEEE C95.3 - 1991, *IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave*, New York: IEEE, 1992.

[4] NCRP, National Council on Radiation Protection and Measurements, *Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields*, NCRP Report No. 86, 1986. Reprinted Feb. 1995.