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FCC Part 24(E) Test Report
for
Hyundai Electronics Industries Co., Ltd.
on the
Single Band PCS
Model: HGP-230

Test Report: J99006681a
Date of Report: April 5, 1999

NVLAP Laboratory Code 200201-0
Accredited for testing to FCC Parts 15

Tested by:	Xi-ming Yang	
Reviewer:	C. K. Li	

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1 JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of

Company: Hyundai Electronics Industrial Co., Ltd/
San 136-1, Amiri, Bubal-Eub,
Ichon-Si
Kyungki-Do, Korea

Name of contact: M.K. Kim
Telephone: (619) 613-6000
Fax: (619) 613-6005

1.2 Equipment under test (EUT)

Equipment type: Single Band PCS CDMA Phone

Equipment class: Licensed Portable Transmitter (Held to ear)

Model number(s): HGP-230

FCC ID: CKLHGP-230

Manufacturer: SAME as above.

Use of Product : Voice communications

Production is planned: [X] Yes, [ ] No

Technical Specifications:

Type of Emission	1M25F9W
Modulation	CDMA
Range of RF Output	0.5 W (Peak EIRP)
Means for variation of operating power	Continuously variable
The dc voltage applied to and current into the several elements of the final RF amplifying device	*Collector Voltage:* 3.6 Vdc *Collector Current:* 400 mA
Frequency Range	1851.25 to 1908.75 MHz
Max. number of Channels	1200
Antenna	¼ 8 Helical over ¼ 8 whip
Detachable antenna ?	No
External input	Audio

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Frequency Tolerance	0.4 ppm

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EUT receive date: 4/1/99

EUT received condition: Good condition prototype

Test start date: 4/2/99

Test end date: 4/5/99

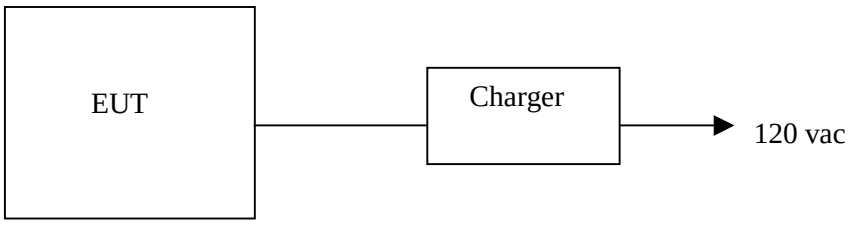
1.3 Test plan reference

FCC Part 2.1033, FCC Part 24 (E)

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details the placement of the equipment under test on the turntable.



S:	Shielded	**U:**	Unshield	**F:**	With Ferrite Core

Support equipment					
Equp. #	**Equipment**	**Manufacturer**	**Model #**	**S/N #**	**FCC ID**
1	Battery charger	Hyunda1	NA	NA	NA
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1.4.2 Justification

The system was configured for testing in a typical manner in accordance with ANSI C63.4 standard.

1.4.3 Mode(s) of operation

The EUT was powered from fully charged batteries. During tests, EUT was operating at continuous transmitting mode.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

2 TEST SUMMARY

FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
Transmitter Section			
2.1046 24.232(b)	RF Power Output (Effective Isotropic Radiated Power)	0.5 W (Peak)	7
2.1047	Modulation Characteristics	N/A	8
2.1049	Occupied Bandwidth	1 MHz	9
2.1051	Field Strength of Spurious Radiation	Passes	10
2.1053 24.236	Field Strength of Spurious Radiation	Worst case Freq.: 7520 MHz Margin: 19.1 dB	11
2.1055 24.235	Frequency Stability Vs. Temperature Vs. Voltage	 0.4 ppm 0.0 ppm	15
15.107	Line Conducted Emissions	N/A	N/A
Digital Section			
15.109(a)	Radiated Emissions	Worst case Freq.: 279.9 MHz Margin: -9.2 dB	13

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3 EFFECTIVE RADIATED POWER

3.1 Test Description

Parameter:	FCC § 2.1046
Requirement:	FCC § 24.232(b)
Effective Isotropic Radiated Power (EIRP):	< 2 watts peak

3.2 Test Procedure

The EUT was positioned on a non-conductive turntable, 0.8m above the ground plane on an open test site.

The radiated emission at the fundamental frequency was measured at 3m distance with a test antenna and spectrum analyzer. During the measurement, the resolution and video bandwidth of the spectrum analyzer were set to 1 MHz. To maximize emissions, the system was rotated through 360°, the antenna height was varied from 1m to 4m, and the antenna polarization was changed.

The ERP was calculated using equation:

Where E = Field Strength (V/m), D = Distance between two antennae(m)

$$E = \frac{\sqrt{30 \cdot P \cdot G}}{D}$$

G = Numeric Gain of Antenna (1 for isotropic antenna), P = ERP (W) = EIRP (G=1)

3.3 Test Results

Test Conditions:		*Antenna Gain ,G = 1.0*			*Distance, D = 3*	
Frequency MHz	Reading dB(μV)	Antenna Factor dB(1/m)	Preamp Gain dB	Cable Loss dB	Field Strength dB(μV/m)	EIRP W
1851.2	93.7	26.2	0	2.3	122.20	0.498
1880.0	92.7	26.2	0	2.3	121.20	0.395
1908.8	91.4	26.2	0	2.3	119.90	0.293

Note: Field Strength = Reading + Antenna Factor – preamp + Cable loss

3.4 Modifications made during testing

None

3.5 Test Instrumentation

[x] Hewlett Packard HP8566B Spectrum Analyzer (S.A.)

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[x] EMCO 3115 Horn Antenna
[ ] HP Pre-amp

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4 MODULATION CHARACTERISTICS

4.1 Test Description

Parameter:	FCC § 2.1047
Requirement:	Not Applicable

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5 OCCUPIED BANDWIDTH

5.1 Test description

Parameter:	FCC §2.1049
Requirement:	FCC § 24.238
Emission Bandwidth Limits:	At least 26 dB below the transmitter Power

5.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation. The resolution bandwidth (RBW) of the spectrum analyzer was set up to at least 1 MHz inside the frequency block. In the 1 MHz bands immediately outside and adjacent to the frequency block, the RBW may be reduced to at least 1% of emission bandwidth of the fundamental emission.

5.3 Test Results

Please see Exhibit 9 for the occupied bandwidth plots:

Plot Number	Description
9-1-1 9-1-2	Low Channel, 6 dB Bandwidth Low Channel, 20 dB Bandwidth
9-2-1 9-2-2	Mid Channel, 6 dB Bandwidth Mid Channel, 20 dB Bandwidth
9-3-1 9-3-2	High Channel, 6 dB Bandwidth High Channel, 20 dB Bandwidth

5.4 Modifications made during testing

None

5.5 Test instrumentation

[X] Leader LFG-1300S Function Generator
[X] HP 8566B Spectrum Analyzer
[X] HP 7470A Plotter

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6 SPURIOUS EMISSION AT ANTENNA TERMINALS

6.1 Test description

Parameter:	FCC §2.1051
Requirement:	FCC §
Emission Limits:	43 + 10log (P) dB

6.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation.

6.3 Test Results

Please see Exhibit 10 for the antenna conducted spurious emission plots:

Plot Number	Description
10-1(X)	1-100 MHz
10-2(X)	100-1000 MHz
10-3(X)	1-1.85 GHz
10-4(X)	1.85 GHz band edge or 1.91 GHz band edge
10-5(X)	1.85-1.91 GHz
10-6(X)	1.91-2.5 GHz
10-7(X)	2.5 GHz –20 GHz

X=L: low channel, M: Mid channel, H: High channel

6.4 Modifications made during testing

None

6.5 Test instrumentation

[X] Leader LFG-1300S Function Generator
[X] HP 8566B Spectrum Analyzer
[X] HP 7470A Plotter

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7 RADIATED SPURIOUS EMISSIONS

7.1 Test description

Parameter:	FCC §2.1053
Requirement:	FCC § 24.236, § 24.238
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7.2 Test Procedure

The transmitter was placed on a wooden turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3 orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated, with measurement equipment RBW setting at 1 MHz.

The spurious harmonic attenuation was calculated as the difference between E in dB(uV/m) at the fundamental frequency and at the spurious emission frequency.

Spurious attenuation in dB = $43 + 10\text{Log}_{10}$(power out in Watts)

7.3 Test Results

Please see the following pages for

[X] Spurious harmonic attenuation
[X] FCC Part 15.109 Radiated Emission

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SPURIOUS HARMONIC ATTENUATION

Company:	Hyundai Electronics
Project #:	J99006681
Model:	HGP 230
Engineer:	Xi-Ming Yang
Date of test:	April 2, 1999

Test Condition:	continue transmitting

Frequency	Antenna Pol	Reading Factor	Antenna	Cable Loss	PreAmp	Distance Factor	Field Strength	Spurious Attenuation	Margin
MHz	H/V	dB(uV)	dB(1/m)	dB	dB	dB(uV/m)	dB	dB	dB
Fundamental Frequency =1851.25 MHz, Field Strength =118.5 dBuV/m									
3703.4	H	21.4	32.0	2.8	0.0	0.0	56.2	62.3	25.4
5553.8	H	48.0	34.4	3.7	-28.3	0.0	57.8	60.7	23.8
7404.9	H	46.0	37.5	4.6	-28.0	0.0	60.1	58.4	21.5
9256.2	H	37.0	37.9	5.1	-27.0	0.0	53.0	65.5	28.6
11107.0	H	46.0	38.4	5.9	-39.9	0.0	50.4	68.1	31.2
12958.5	H	37.0	40.2	6.1	-39.2	0.0	44.1	74.4	37.5
14810.3	H	34.0	39.0	6.7	-37.4	0.0	42.3	76.2	39.3
16661.4	H	35.0	39.5	7.0	-39.4	0.0	42.1	76.4	39.5
18512.6	H	38.0	40.2	7.5	-23.3	-9.5	52.9	65.6	28.7
Fundamental Frequency =1880.0 MHz, Field Strength =117.8 dBuV/m									
3760.1	H	20.0	32.0	2.8	0.0	0.0	54.8	63.0	26.8
5640.0	H	45.3	34.4	3.7	-28.3	0.0	55.1	62.7	26.5
7520.0	H	48.4	37.5	4.6	-28.0	0.0	62.5	55.3	19.1
9400.0	H	40.8	37.9	5.1	-27.0	0.0	56.8	61.0	24.8
11280.0	H	46.0	38.4	5.9	-39.9	0.0	50.4	67.4	31.2
13160.0	H	35.0	40.2	6.1	-39.2	0.0	42.1	75.7	39.5
15040.0	H	35.6	39.0	6.7	-37.4	0.0	43.9	73.9	37.7
16920.0	H	35.0	39.5	7.0	-39.4	0.0	42.1	75.7	39.5
18800.0	H	38.0	40.2	7.5	-23.3	-9.5	52.9	64.9	28.7
Fundamental Frequency =1908.75 MHz, Field Strength =117.3 dBuV/m									
3817.5	H	20.1	32.0	2.8	0.0	0.0	54.9	62.4	26.2
5736.3	H	44.9	34.4	3.7	-28.3	0.0	54.7	62.6	26.4
7635.1	H	47.2	37.5	4.6	-28.0	0.0	61.3	56.0	19.8
9543.9	H	37.0	37.9	5.1	-27.0	0.0	53.0	64.3	28.1
11452.5	H	44.4	38.4	5.9	-39.9	0.0	48.8	68.5	32.3
13361.3	H	36.0	40.2	6.1	-39.2	0.0	43.1	74.2	38.0
15270.0	H	35.0	39.0	6.7	-37.4	0.0	43.3	74.0	37.8
17178.8	H	34.0	39.5	7.0	-39.4	0.0	41.1	76.2	40.0
19087.5	H	37.0	40.2	7.5	-23.3	-9.5	51.9	65.4	29.2

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Note: 1. All measurement were made at 3 meters unless otherwise specified in the “Distance Factor , 9.5dB = 1m)
2. All readings are average readings.

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FCC PART 15.109 RADIATED EMISSION

Test Condition: Receiving mode
Frequency range investigated: 30 to 1000 MHz.

Frequency	**Antenna Polarity**	**Reading**	**Antenna Factor**	**Cable Loss**	**Pre-amp**	**Corrected Reading**	**Limit**	**Margin**
MHz	H/V	dB(uV)	dB(1/m)	dB	dB	dB(uV/m)	dB(uV/m)	dB
108.0	V	13.0	11.9	0.0	0.0	24.9	43.5	-18.6
135.0	H	16.9	11.6	0.0	0.0	28.5	43.5	-15.0
279.9	H	13.0	23.8	0.0	0.0	36.8	46.0	-9.2
422.0	V	14.0	22.6	0.0	0.0	36.6	46.0	-9.4
486.0	H	10.0	22.3	0.0	0.0	32.3	46.0	-13.7
594.0	H	10.0	23.9	0.0	0.0	33.9	46.0	-12.1

Note: 1. All measurement were made at 3 meters
2. Negative signs (-) in the margin column signify levels below the limit.

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7.4 Modifications made during testing

None

7.5 Test instrumentation

[X] CDI B100/200/300 Biconical Antennas
[X] EMCO Bi-logcon Antenna
[X] EMCO 3115 Horn Antenna
[X] HP 8566B Spectrum Analyzer
[X] Preamplifiers

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8 FREQUENCY STABILITY

8.1 Test description

Parameter:	FCC §2.1055
Requirement:	FCC § 24.235
Frequency Tolerance:	Sufficient to ensure that the fundamental emission stays within the authorized frequency block

8.2 Test Procedure

The ppm frequency error of the transmitter was calculated by:

$$ppm\ error = \left(\frac{MCF}{ACF} - 1 \right) \cdot 10^6$$

Where MCF is the Measured Carrier Frequency in MHz
ACF is the Assigned Carrier Frequency in MHz

8.2.1 Frequency Stability vs. Temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.
After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

8.2.2 Frequency Stability vs. Voltage

At room temperature (25 ±5 ^{o}C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

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8.3 Test Results

Frequency Stability vs Temperature		
ACF (MHz): 1880.000056		
Temperature, C	MCF (MHz)	PPM Error
50	1880.00051	0.241489355
40	1880.00036	0.161702123
30	1879.99991	-0.077659572
20	1879.99996	-0.051063828
10	1880.00026	0.108510635
0	1880.0006	0.289361693
-10	1880.00068	0.331914884
-20	1880.0005	0.236170206
-30	1880.0008	0.395744669

Frequency Stability vs Voltage			
ACF (MHz): 1880.000056			
%	Voltage	MCF (MHz)	PPM Error
115	4.20	1880.000056	0.00
100	3.60	1880.000056	0.00
Battery Endpoint	3.20	1880.000056	0.00

8.4 Modifications made during testing

None

8.5 Test instrumentation

[X] Data provided by applicant

[ ] Temperature Chamber, -50C to +100C
[ ] Hewlett Packard 5383A Frequency Counter
[ ] Tektronix 2784 Spectrum Analyzer
[ ] Goldstar DC Power Supply, GR303

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9 AC LINE CONDUCTED EMISSIONS

9.1 Test description

Parameter:	ANSI C63.4
Requirement:	FCC § 15.107

9.2 Test Procedure

The EUT was connected to the DC power supply, that was connected to the AC line through the LISNs.

Both HOT and NEUTRAL leads were tested.

9.3 Test Results

[X] Passed. The test result is attached in Exhibit 12.

9.4 Modifications made during testing

None

9.5 Test instrumentation

[ ] HP 8566B Spectrum Analyzer
[ ] LISN

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10 LIST OF EXHIBITS

The following exhibits are listed as reference only and are submitted as separate attachments:

Exhibit 1	**ID Label Format, ID Label Location**
Exhibit 2a	**Equipment Photographs (External)**
Exhibit 2b	**Equipment Photographs (Internal)**
Exhibit 3	**Block Diagram**
Exhibit 4	**Circuit Diagram**
Exhibit 5	**Theory of Operation. Description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power.**
Exhibit 6	**Tune up Procedure over the power range**
Exhibit 7	**Test Setup Photos**
Exhibit 8	**Instruction Manual**
Exhibit 9	**RF Power Output Plots**
Exhibit 10	**Bandwidth Plots**
Exhibit 11	**Spurious Emission at Antenna Terminals**
Exhibit 12	**SAR Report**
Exhibit 13	**AC Conducted Emission Test Data**