Kyocera Wireless Corp.
KWC 7135

SPECIFIC ABSORPTION RATE (SAR)

REPORT

CONTENT

1 INTRODUCTION

This test report describes an environmental evaluation measurement of specific absorption rate (SAR) distribution in simulated human head tissues exposed to radio frequency (RF) radiation from a wireless portable device manufactured by Kyocera Wireless Corp. (KWC). These measurements were performed for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC). The testing was performed in June 2002 in the KWC SAR Test Facility. The wireless device is described as follows;

EUT Type:	*Trimode, CDMA(PCS), CDMA and Analog (Cellular) Phone*
Trade Name:	*Kyocera Wireless Corp.*
Model:	*KWC-7135*
Tx Frequency :	*824.04 – 848.97 and 1851.25 – 1908.75 MHz*
Modulation:	*CDMA and Analog*
Antenna:	*Retracting whip w/ helix*
FCC Classification:	*Non-Broadcast Transmitter Held to Ear*
Application Type:	*Certification*
Serial Number :	*3G-X-00Z659*
FCC ID:	*OVFKWC-7135*
Place of Test:	*KWC, 10300 Campus Point Drive, Lab AA-136, San Diego, CA, USA*
Date of Test:	*June 2002*
FCC Rule Part:	*47 CFR 2.1093; OET Bulletin 65, Sup. C; 47 CFR 22; 47 CFR 24*

Testing has been carried out in accordance with:
IEEE P1528-200X Draft 6.4

2 SAR TEST RESULT SUMMARY

This device has been tested for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1 ~ 1992 and has been tested in accordance with the measurement procedures specified in IEEE P1528-200X Draft 6.4. Normal antenna operating positions were incorporated, with the device transmitting at frequencies consistent with normal usage of the device. The device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE std. C95.1-1992

2.1 Maximum Results Found during SAR Evaluation

The equipment is deemed to fulfill the requirements if the measured values are less than or equal to the limit.

2.1.1 Head Configuration

Mode/Ch/f(MHz)	Conducted Power	Antenna Position	Device Position	Limit (mW/g)	Measured (mW/g)	Result
FM/799/848.97	26.13 dBm	Retracted	Right Cheek	1.6	0.776	**PASSED**

Mode/Ch/f(MHz)	Conducted Power	Antenna Position	Device Position	Limit (mW/g)	Measured (mW/g)	Result
PCS/600/1880	23.70 dBm	Extended	Right Cheek	1.6	0.888	**PASSED**

2.1.2 Body Worn Configuration (with KWC body worn accessories)

Mode/Ch/f(MHz)	Conducted Power	Antenna Position	Device Position	Limit (mW/g)	Measured (mW/g)	Result
FM/799/848.97	26.16 dBm	Retracted	Waist level	1.6	0.344	**PASSED**

2.1.3 Measurement Uncertainty

Combined Uncertainty (Assessment & Source)	**± 10.32 %**
Extended Uncertainty (k=2)	**± 20.6 %**

3 DESCRIPTION OF TESTED DEVICE

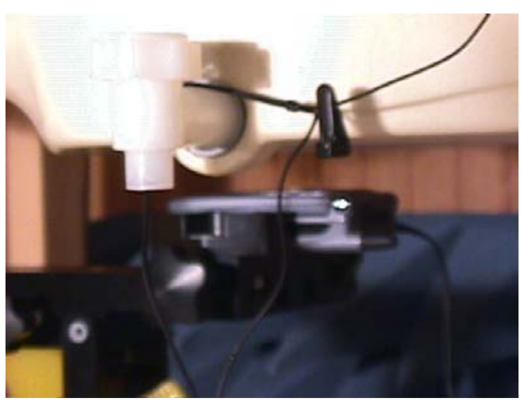
The test sample consisted of a KWC 7135. This model will operate in CDMA PCS, CDMA and analog cellular mode. The CDMA PCS mode is designed to transmit in the 1851.25 – 1908.75 MHz band. The cellular FM AMPS mode is designed to transmit in the 824.04 – 848.97 MHz. The cellular CDMA mode is designed to transmit in the 824.04 – 848.97 MHz band.

The KWC-7135 is a tri-mode and dual band cellular/PCS phone. The antenna is a telescoping retracting whip antenna tuned for dual frequency, with a helix antenna that is at the top of the whip which gets activated when the whip is retracted. See pictures below. Since either position is possible during use, both retracted and extended were tested, at the low, mid, and high frequencies of each band.

There is only one battery option available to operate KWC-7155. All measurements were done with production batteries.

The KWC-7135 has provision for headset to allow hands-free operation. The following body worn accessories are available for KWC-7135. SAR measurements for hands-free operating condition were done at the low, mid, and high frequencies of each band.

The SAR levels were also tested with 22.5mm air space in all modes for the hands-free application with other body-worn holster that contains no metal and provides at least 22.5mm separation from the closest point of the handset (antenna side of phone away from body) to the body.



22.5mm

4 TEST CONDITIONS

4.1 Ambient Conditions

All tests were performed under the following environmental conditions:

Ambient Temperature:	22 ± 1 Degrees C
Tissue simulating liquid temperature:	22 ± 1 Degrees C
Humidity:	38 %
Pressure:	1015 mB

4.2 RF characteristics of the test site

All KWC dosimetry equipment is operated within a shielded screen room manufactured by Lindgren RF Enclosures to provide isolation from external EM fields.

The E-field probes of the DASY 3 system are capable of detecting signals as low as 5µW/g in the liquid dielectric, and so external fields are minimised by the screen room, leaving the phone as the dominate radiation source. The floor of the screen room is reflective, so 2 two-foot square ferrite panels are placed beneath the phantom area of the DASY system to minimise reflected energy that would otherwise re-enter the phantom and combine constructively or destructively with the desired fields. These ferrite panels provide roughly 12 to 13 dB of attenuation in the frequency range of 900 MHz, and 7 to 8 dB of attenuation in the frequency range of 1.9 GHz.

4.3 Test Signal, Frequencies and Output Power

The device was controlled by using Kyocera Wireless Phone Support Toolkit, Test Code Controller.

In all operating bands, the measurements were performed on low, mid and high channels.

The phone was set to nominal maximum power level during all tests and at the beginning of the each test the battery was fully charged. Radiated power output was measured in KWC antenna range, fully an-echoic chamber from the same unit that was used in SAR testing.

DASY3 system measures power drift during SAR testing by comparing E-field in the same location at the beginning and at the end of measurement. These records were used to monitor stability of power output.

5 DESCRIPTION OF THE TEST EQUIPMENT

The measurements were performed with an automated near-field scanning system, DASY3, manufactured by Schmid & Partner Engineering AG (SPEAG) of Zurich, Switzerland.

Test Equipment	Serial Number	Due date
DASY3 DAE3 Version 1	493	01-20-03
E-field Probe ET3DV6	1618	02-21-03
Dipole Validation kit, D835V2	454	02-11-04
Dipole Validation kit, D1900V2	5D003	02-20-04

The calibration records of E-field probe are attached in Appendix C.

Additional equipment needed in validation

Test Equipment	Due date
Signal Generator, HP E4421B	04-12-03
Power meter, Giga-tronics 8541C	02-27-03
Power Sensor, Giga-tronics	02-10-03
Network Analyzer, HP 8753C	08-30-02
HP 85070B Dielectric Probe	--
Thermometer	--

5.1 System Validation

The probes are calibrated annually by the manufacturer. Dielectric parameters of the stimulating liquids are measured with an automated Hewlett Packard 85070B dielectric probe in conjunction with an HP 8753C network analyzer.

The SAR measurements of the device were done within 24 hours of system accuracy verification, which was done using the dipole validation kit. Power level of 10dBm was supplied to a dipole antenna placed under the flat section of SAM phantom. The validation results are in the table below and printouts of the validation test are attached in Appendix A. All the measured parameters were within the specification.
Note since the validation reference in muscle liquid is not available, the system validation with head tissues was done for the device testing in muscle. Based on OET 65 Supplement C EAB Part 22/24 SAR review Reminder Sheet 01/2002, this is a valid test.

Tissue	F (MHz)	Description	Validation SAR (mW/g), 1g	Dielectric Parameters		Temp (°C)	Test date	Comments Validation testing -
				ε_r	σ (S/m)			
Head	**835**	Measured	0.101	41.5	0.89	22	05-30-02	for device testing in head liquid
		Measured	0.100	41.5	0.89	22	05-31-02	for continuing testing in head liquid
		Measured	0.100	41.3	0.89	22	06-03-02	for continuing testing in head liquid
		Measured	.0915	41.5	.89	22	06-05-02	for continuing testing in head liquid and muscle testing
		SPEAG Reference	0.104	41.9	0.89	--	02-11-02	
		FCC Reference	--	**41.5**	**0.90**	20-26	--	
Head	**1900**	Measured	0.430	39.8	1.47	22	05-29-02	for device testing in head liquid
		Measured	0.464	40.0	1.50	22	06-04-02	for continuing testing in head
		Measured	0.456	40.0	1.46	22	06-05-02	for device testing in muscle
		SPEAG Reference	0.456	39.1	1.47	--	02-20-02	
		FCC Reference	--	**40.0**	**1.40**	20-26	--	
Muscle	**835**	Measured	--	56.7	0.91	22	06-06-02	for device testing in muscle
		FCC Reference	--	**55.2**	**0.97**	--	--	
Muscle	**1900**	Measured	--	54.9	1.50	22	04-23-02	for device testing n muscle
		FCC Reference	--	**53.3**	**1.52**	20-26	--	

FCC reference values are adopted from OET Bulletin 65 (97-01) Supplement C (01-01).

5.2 Tissue Stimulants

All dielectric parameters of tissue stimulants were measured within 24 hours of SAR measurements. The depth of the tissue stimulant in the ear reference point and flat reference point of the phantom were at least 15cm during all the tests.

5.2.1 Head Tissue Stimulant

The composition of the head tissue simulating liquid for 835MHz is

51.07%	Water
0.23%	Cellulose
47.31%	Sugar
0.24%	Preventol
1.15%	Salt

and for 1900MHz is

54%	Water
44.91%	Glycol monobutyl
0.21%	Salt

The ingredients above are adopted from Application Note: Recipes for Head Tissue Simulating Liquid by SPEAG.

5.2.2 Muscle Tissue Stimulant

The composition of the muscle tissue simulating liquid for 835MHz is

65.45%	Water
34.31%	Sugar
0.1%	Preventol
0.62%	Salt

and for 1900MHz is

69.91%	Water
29.96%	Glycol monobutyl
0.13%	Salt

The ingredients above are adopted from Application Note: Recipes for Muscle Tissue Simulating Liquid by SPEAG.

5.3 Phantoms

SAM v4.0 phantom, manufactured by SPEAG, was used during the measurement. It has fiberglass shell integrated in a wooden table. The shape of the shell corresponds to the phantom defined by IEEE SCC34-SC2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. Reference markings on the phantom allow the complete set-up of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

The thickness of phantom shell is 2mm except for the ear, where an integrated ear spacer provides a 6mm spacing from the tissue boundary. Manufacturer reports tolerance in shell thickness to be $\pm$ **0.1mm.**

5.4 Isotropic E-Field Probe ET3DV6

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycol)
Calibration	Calibration certificate in Appendix C
Frequency	10MHz to 3GHz (dosimetry); Linearity: $\pm$ 0.2dB (30MHz to 3GHz)
Optical Surface	$\pm$ 0.2mm repeatability in air and clear liquid over diffuse reflecting
Detection	surface
Directivity	$\pm$ 0.2dB in HSL (rotation around probe axis) $\pm$ 0.4dB in HSL (rotation normal to probe axis)
Dynamic Range	5 uW/g to > 100 mW/g; Linearity: $\pm$ 0.2dB
Dimensions	Overall length: 330mm Tip length: 16mm Body diameter: 12mm Tip diameter: 6.8mm Distance from probe tip to dipole centers: 2.7mm

Application	General dosimetry up to 3GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms.

6 DESCRIPTION OF THE TEST PROCEDURE

6.1 Test Positions

The device was placed in the holder so that the ear reference point of the phone, aligns with the ear reference of the SAM phantom. See picture.

Device holder was provided by SPEAG together with DASY3.

6.1.1 Against Phantom Head

Measurements were made on both left hand side and right hand side of the phantom.

The device was position against phantom according to OET Bulletin 65 (97-01) Supplement C (01-01). Definitions of terms used in aligning the device to a head phantom are available in IEEE Draft Standard P1528-2001 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

6.1.1.1 Initial Ear Position

The device was initially positioned with the earpiece region pressed against the ear spacer of a head phantom parallel to the "Neck-Front" line defined along the base of the ear spacer that contains the "ear reference point". The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane". With the phone in this initial position, the measurement system was not able to capture the peak SAR location in several test modes. The system software from SPEAG that will enable the measurement probe to tilt is currently not available. In order to measure the peak SAR, the phone was positioned 0.5 inches pass the initial ear position described above. This was a worst case position and the different tests modes in which it was used are described in the test results. Additional tests were performed to show the SAR results in the normal position (initial ear position described above) and the 0.5 inch modified position. The normal initial ear position and the 0.5 inch modified ear position are shown below.

0.5 inch

Normal Initial Ear Position

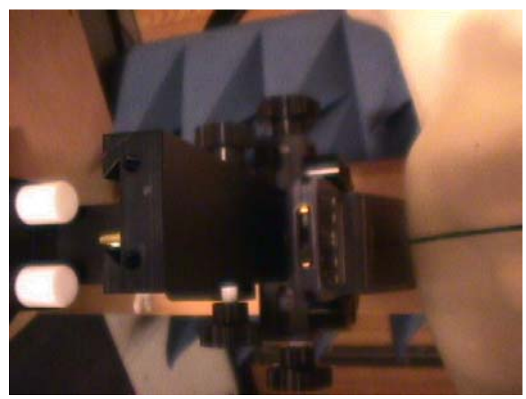
Modified 0.5 Inch Initial Ear Position

6.1.1.2 Cheek Position

"Initial ear position" alignments are maintained and the device is brought toward the mouth of the head phantom by pivoting along the "Neck-Front" line until any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom or when any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

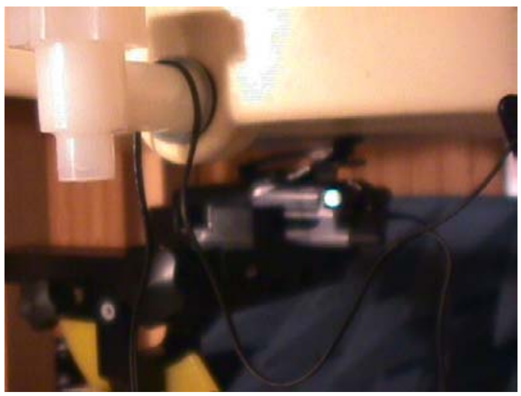
6.1.1.3 Tilt Position

In the "cheek position", if the earpiece of the device is not in full contact with the phantom's ear spacer and the peak SAR location for the "cheek position" is located at the ear spacer region or corresponds to the earpiece region of the handset, the device is returned to the "initial ear position" by rotating it away from the mouth until the earpiece is in full contact with the ear spacer. Otherwise, the device is moved away from the cheek perpendicular to the line passes through both "ear reference points" for approximate 2-3cm. While it is in this position, the device is tilted away from the mouth with respect to the "test device reference point" by 15^o. After the tilt, it is then moved back toward the head perpendicular to the line passes through both "ear reference point" until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process is repeated with a tilt angle less than 15^o so that the device and its antenna would touch the phantom simultaneously.



6.1.2 Body Worn Configuration

KWC body worn accessories were tested for the FCC RF exposure compliance. The phone was positioned into the holester and placed below the flat phantom. Headset was connected during measurements.



The SAR levels were also measured with 22.5mm air space for the hands-free application, which allow user can use other body-worn holster that contains no metal and provides at least 22.5mm separation from the closest point of the handset to the body. The handset needs to be in the clamshell shut and antenna oriented away from the body position.

6.2 Scan Procedures

First coarse scans are used for quick determination of the field distribution. Next a cube scan, 7x7x7 points; spacing between each point 5x5x5mm, is performed around the highest E-field value to determine the averaged SAR-distribution over 1g.

6.3 SAR Averaging Methods

The maximum SAR value is average over its volume using interpolation and extrapolation.

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot" –condition [W. Gander, Computermathematik, p. 141-150] (x, y and z – directions) [numerical Recipes in C, Second Edition, p 123].

The extrapolation is based on least square algorithm [W. Gander, Computermathematik, p. 168-180]. Through the points in the first 30mm in all z-axis, polynomials of order four are calculated. This polynomial is then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1mm from one another.

7 MEASUREMENT UNCERTAINTY

Description of individual measurement uncertainty

Uncert. description	Uncert. Value %	Probability distribution	Divisor	C_i[1] 1g	Stand. Uncert (1g) %	V_i[2] or V_{eff}
Measurement system						
Probe calibration	± 4.4	normal	1	1	± 4.4	∞
Axial isotropy of the probe	± 4.7	rectangular	√3	$(1-C_p)^{1/2}$	± 1.9	∞
Sph. Isotropy of the probe	± 9.6	rectangular	√3	$(C_p)^{1/2}$	± 3.9	∞
Spatial resolution	± 0.0	rectangular	√3	1	± 0.0	∞
Boundary effects	± 5.5	rectangular	√3	1	± 3.2	∞
Probe linearity	± 4.7	rectangular	√3	1	± 2.7	∞
Detection limit	± 1.0	rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	normal	1	1	± 1.0	∞
Response time	± 0.8	rectangular	√3	1	± 0.5	∞
Integration time	± 1.4	rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 3.0	rectangular	√3	1	± 1.7	∞
Mech. Constrains of robot	± 0.4	rectangular	√3	1	± 0.2	∞
Probe positioning	± 2.9	rectangular	√3	1	± 1.7	∞
Extrap. and integration	± 3.9	rectangular	√3	1	± 2.3	∞
Test Sample Related						
Device positioning	± 3.0	normal	√3	1	± 1.7	∞
Power drift	± 5.0	normal	√3	1	± 2.9	∞
Phantom and setup						
Phantom uncertainty	± 4.0	rectangular	1	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	rectangular	√3	0.6	± 1.7	∞
Liquid conductivity (meas.)	± 10.0	rectangular	√3	0.6	± 3.5	∞
Liquid permittivity (target)	± 5.0	rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (meas.)	± 5.0	rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					± 10.32	
Extended Standard Uncertainty (k=2)					± 20.6	

8 TEST DATA

For each mode, corresponding SAR distribution printouts of maximum results in every device position (Cheek or Tilt), every antenna position (Extended or Retracted) are shown in Appendix B. Included in the test results for the following modes: Left Cheek FM, Right Cheek FM, Left Cheek CDMA 800, Right Cheek CDMA 800, Left Cheek CDMA PCS are the SAR plots for both the normal initial ear position and the 0.5 inch modified initial ear position. For these modes the data in the tables below are for the 0.5 inch modified initial ear position because that is the position in which the peak SAR was able to be measured. For the Right Cheek CDMA PCS mode, the peak SAR was captured with the phone in the normal initial ear position.

8.1 Head SAR Test Results

The Appendix B includes the SAR distribution plots for all data shown in the following tables.

Left Head SAR

Mode	Channel # / Frequency (MHz)	Conducted Power (dBm)	SAR, Average over 1g (mW/g)			
			Cheek Position		Tilted Position	
			Antenna Retracted	Antenna Extended	Antenna Retracted	Antenna Extended
FM 835	991/824.04	26.18	0.299	0.552	0.145	0.256
	383/836.49	26.14	0.237	0.455	0.141	0.265
	799/848.97	26.10	0.568	0.600	0.159	0.322
Cellular CDMA 835	1013/824.70	25.06	0.531	0.475	0.116	0.204
	383/836.49	25.15	0.367	0.399	0.112	0.215
	777/848.31	25.12	0.521	0.533	0.134	0.262
PCS CDMA 1900	25/1851.25	23.64	0.362	0.305	0.075	0.028
	600/1880	23.65	0.376	0.428	0.008	0.113
	1175/1908.75	23.64	0.094	0.350	0.005	0.083

Right Head SAR

Mode	Channel # / Frequency (MHz)	Conducted Power (dBm)	SAR, Average over 1g (mW/g)			
			Cheek Position		Tilted Position	
			Antenna Retracted	Antenna Extended	Antenna Retracted	Antenna Extended
FM 835	991/824.04	26.21	0.744	0.755	0.149	0.224
	383/836.49	26.15	0.566	0.675	0.152	0.275
	799/848.97	26.16	0.776	0.712	0.150	0.286
Cellular CDMA 835	1013/824.70	25.04	0.763	0.634	0.121	0.236
	383/836.49	25.14	0.531	0.607	0.146	0.196
	777/848.31	25.06	0.598	0.687	0.133	0.298
PCS CDMA 1900	25/1851.25	23.64	0.319	0595	0.021	0.088
	600/1880	23.66	0.256	0.888	0.014	0.114
	1175/1908.75	23.56	0.105	0.622	0.006	0.032

The highest measured SAR (at head) in the cellular band is 0.776mW/g. The highest measured SAR (at head) in PCS band is 0.888 mW/g.

8.2 Body Worn SAR Test Result

The Appendix B includes the SAR distribution plots for all data shown in the following tables.

Waist Level SAR with KWC Body Worn Accessories

Mode	Channel # / Frequency (MHz)	Conducted Power Before Test (dBm)	SAR, Average over 1g (mW/g)	
			Antenna Retracted	Antenna Extended
FM 835	991/824.04	26.14	0.310	0.318
	383/836.49	26.15	0.203	0.294
	799/848.97	26.16	0.344	0.314
Cellular CDMA 835	1013/824.70	25.19	0.272	0.257
	383/836.49	25.20	0.227	0.258
	777/848.31	25.18	0.337	0.258
PCS CDMA 1900	25/1851.25	23.74	0.061	0.123
	600/1880	23.79	0.082	0.148
	1175/1908.75	23.60	0.043	0.107

Waist Level SAR with 22.5mm Air Separation

Mode	Channel # / Frequency (MHz)	Conducted Power Before Test (dBm)	SAR, Average over 1g (mW/g)	
			Antenna Retracted	Antenna Extended
FM 835	991/824.04	26.15	0.353	0.311
	383/836.49	26.16	0.277	0.316
	799/848.97	26.12	0.380	0.298
Cellular CDMA 835	1013/824.70	25.08	0.271	0.240
	383/836.49	25.20	0.227	0.258
	777/848.31	25.16	0.292	0.255
PCS CDMA 1900	25/1851.25	23.60	0.061	0.142
	600/1880	23.65	0.089	0.188
	1175/1908.75	23.68	0.048	0.126

With KWC body worn accessories, the highest measured SAR in the cellular band is 0.344mW/g, in PCS band is 0.148 mW/g.

9 TEST SYSTEM PHOTOS

DASY 3 System

SAM Phantom