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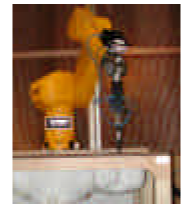

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

APPLICANT NAME & ADDRESS:
Symbol Technologies, Inc.
30 Plan Way
Holtsville, NY 11742-1300

DATE & LOCATION OF TESTING:
Dates of Tests: December 3-4, 2003
Test Report S/N: SAR.231203598.H9P
Test Site: PCTEST Lab, Columbia, MD USA

FCC ID:	**H9PLA3021-500P**
APPLICANT:	**SYMBOL TECHNOLOGIES, INC.**

EUT Type:	**Wireless Wall Scanner**
Tx/Rx Frequency:	**2402 – 2480 MHz (DSS)**
Max. RF Output Power:	**0.331 W (25.19 dBm) Conducted**
Max. SAR Measurement:	**1.43 W/kg (Body - Front Side)**
	0.119 W/kg (Body - Back Side)
	0.679 W/kg (Body - Topside)
Trade Name/Model(s):	**MK2042-1210-US**
FCC Classification:	**Part 15 Spread Spectrum Transmitter (DSS)**
FCC Rule Part(s):	**§2.1093; FCC/OET Bulletin 65 Supplement C [July 2001]**
Application Type:	**Certification**
Test Device Serial No.:	***identical* prototype [S/N: #MXA31137]**

This wireless portable 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 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. P1528 D1.2 (April 2003).

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.

Grant Conditions: Power output is conducted. This device has been tested for SAR compliance for typical body touch use. This device must not be co-located or operating with another transmitter/antenna. End-users must be informed of the body-worn operating configurations to satisfy RF exposure compliance.

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. 862.

Alfred Cirwithian
Vice President Engineering

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1. INTRODUCTION / SAR DEFINITION

The 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 and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.[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) 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 due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR 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.[6] 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.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (r). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1).

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{r\,dv}\right)$$

Figure 1.1
SAR Mathematical Equation

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = s\,E^2 / r$$

where:

s = conductivity of the tissue-simulant material (S/m)

r = mass density of the tissue-simulant material (kg/m^3)

E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

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2. SAR MEASUREMENT SETUP

Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 2.1).

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Gateway Pentium 4 2.53 GHz computer with Windows XP system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

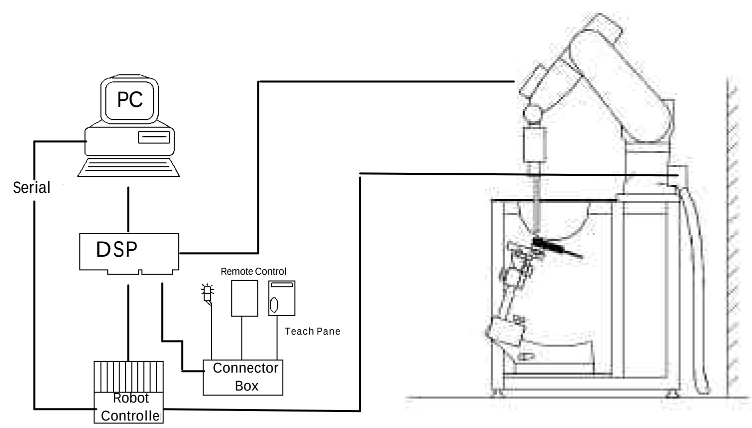

Figure 2.1 SAR Measurement System Setup

System Electronics

The DAE3 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [7].

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3. DASY4 E-FIELD PROBE SYSTEM

Probe Measurement System

Figure 3.1 DAE System

The SAR measurements were conducted with the dosimetric probe ET3DV6, designed in the classical triangular configuration [7] (see Fig. 3.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip (see Fig. 3.3). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.3.1). The approach is stopped at reaching the maximum.

Probe Specifications

Calibration:	In air from 10 MHz to 6 GHz
	In brain and muscle simulating tissue at
	Frequencies of 150 MHz, 450 MHz, 835 MHz, 900 MHz, 1900MHz, 2450MHz, 5300MHz, & 5800MHz
Frequency:	10 MHz to > 6 GHz; Linearity: ± 0.2 dB
	(30 MHz to 6 GHz)
Directivity:	± 0.2 dB in HSL (rotation around probe axis)
	± 0.4 dB in HSL (rotation normal probe axis)
Dynamic:	5 :W/g to > 100 mW/g;
Range:	Linearity: ± 0.2 dB
Dimensions:	Overall length: 330 mm
	Tip length: 16 mm
	Body diameter: 12 mm
	Tip diameter: 3 mm
	Distance from probe tip to dipole centers: 2 mm
Application:	General dosimetry up to 6 GHz
	Compliance tests of mobile phones
	Fast automatic scanning in arbitrary phantoms

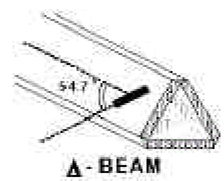

Figure 3.1 Triangular Probe Configuration

Figure 3.2 Probe Thick-Film Technique

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4. Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in [8] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [9] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz (see Fig. 4.1), and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe (see Fig. 4.2).

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

SAR is proportional to $\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

$$\text{SAR} = \frac{|E|^2 \cdot s}{r}$$

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

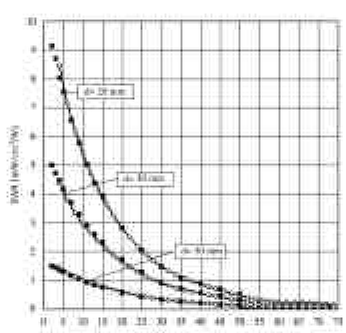

Figure 4.1 E-Field and Temperature measurements at 900MHz [7]

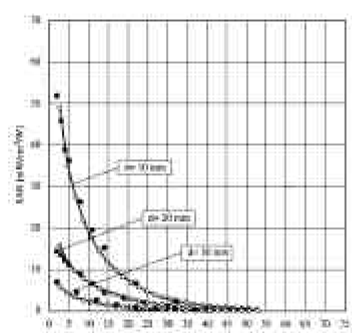

Figure 4.2 E-Field and temperature measurements at 1.9GHz [7]

******NOTE: The temperature calibration was not performed by PCTEST. For information use only.*

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5. PHANTOM & EQUIVALENT TISSUES

SAM Phantom

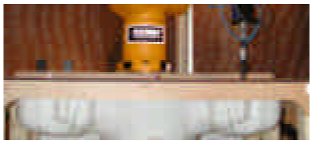

Figure 5.1 SAM Twin Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [11][12]. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 5.1)

Brain & Muscle Simulating Mixture Characterization

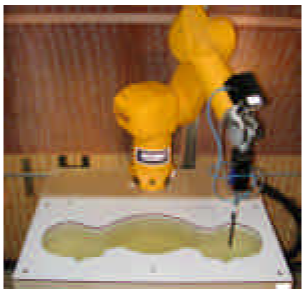

Figure 5.2 Simulated Tissue

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellullose (HEC) gelling agent and saline solution (see Table 6.1). Preservation with a bacteriacide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table. Other head and body tissue parameters that have not bee specified in P1528 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove [13].(see Fig. 5.2)

Table 5.1 Composition of the Brain & Muscle Tissue Equivalent Matter

INGREDIENTS		SIMULATING TISSUE	
		2450MHz Brain	2450MHz Muscle
Mixture Percentage			
WATER		58.55	73.20
DGBE		6.96	26.70
SUGAR		0.00	0.00
SALT		0.11	0.04
BACTERIACIDE		0.00	0.00
HEC		0.00	0.00
TRITON X-100		35.38	0.00
Dielectric Constant	Target	38.50	52.50
Conductivity (S/m)	Target	1.87	1.78

Device Holder for Transmitters

Figure 5.2 Mounting Device

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 5.2) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

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6. TEST SYSTEM SPECIFICATIONS

Automated Test System Specifications

Positioner

Robot: Stäubli Unimation Corp. Robot Model: RX60L
Repeatability: 0.02 mm
No. of axis: 6

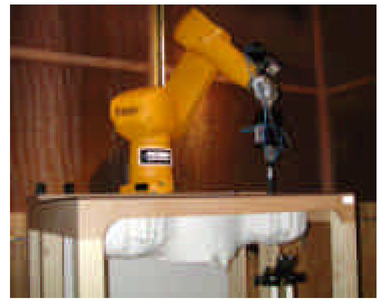

Figure 6.1 DASY4 Test System

Data Acquisition Electronic (DAE) System

Cell Controller

Processor: Pentium 4
Clock Speed: 2.53 GHz
Operating System: Windows XP Professional

Data Converter

Features: Signal Amplifier, multiplexer, A/D converter, & control logic
Software: DASY4 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

PC Interface Card

Function: 24 bit (64 MHz) DSP for real time processing
Link to DAE3
16 bit A/D converter for surface detection system
serial link to robot
direct emergency stop output for robot

E-Field Probes

Model: ES3DV2 S/N: 3022
Construction: Triangular core
Frequency: 10 MHz to 6 GHz
Linearity: ± 0.2 dB (30 MHz to 6 GHz)

Phantom

Phantom: SAM Twin Phantom (V4.0)
Shell Material: VIVAC Composite
Thickness: 2.0 ± 0.2 mm

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7. DOSIMETRIC ASSESSMENT & PHANTOM SPECS

Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm x 15mm.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 34mm (fine resolution volume scan, zoom scan) was assessed by measuring 7 x 7 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see Fig. 7.1):
   a. The data at the surface was extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm [15]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.
   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions) [15][16]. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.
   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as procedure #1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.

Figure 7.1 Sample SAR Area Scan

Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. 7.2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

Figure 7.2 SAM Twin Phantom shell

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8. TEST CONFIGURATION POSITIONS

Body-worn operating configurations are tested with the terminal positioned touching against a flat phantom (lap) in a normal use configuration (see Figure 8.1). Body dielectric parameters are used.

In addition to the typical lap (back side) position test configuration, the front and top sides (See Figure 8.1) were also evaluated for SAR compliance. All sides of the terminal were tested in the touch position.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and a caution statement must be included in the user's manual.

Figure 8.1 Body SAR Configurations

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9. ANSI/IEEE C95.1 - 1992 RF EXPOSURE LIMITS

Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 10.1. Safety Limits for Partial Body Exposure [2]

	HUMAN EXPOSURE LIMITS	
	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)
SPATIAL PEAK SAR [1] Brain	1.60	8.00
SPATIAL AVERAGE SAR [2] Whole Body	0.08	0.40
SPATIAL PEAK SAR [3] Hands, Feet, Ankles, Wrists	4.00	20.00

1 The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2 The Spatial Average value of the SAR averaged over the whole body.
3 The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

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10. MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = cxf/e	i = cxg/e	k
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1 - g)**	**c_i (10 - g)**	**1 - g u_i (± %)**	**10 - g u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E1.1	4.8	N	1	1	1	4.8	4.8	∞
Axial Isotropy	E1.2	4.7	R	√3	0.7	0.7	1.9	1.9	∞
Hemishperical Isotropy	E1.2	9.6	R	√3	0.7	0.7	3.9	3.9	∞
Boundary Effect	E1.3	1.0	R	√3	1	1	0.6	0.6	∞
Linearity	E1.4	4.7	R	√3	1	1	2.7	2.7	∞
System Detection Limits	E1.5	1.0	R	√3	1	1	0.6	0.6	∞
Readout Electronics	E1.6	1.0	N	1	1	1	1.0	1.0	∞
Response Time	E1.7	0.8	R	√3	1	1	0.5	0.5	∞
Integration Time	E1.8	2.6	R	√3	1	1	1.5	1.5	∞
RF Ambient Conditions	E5.1	3.0	R	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E5.2	0.4	R	√3	1	1	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E5.3	2.9	R	√3	1	1	1.7	1.7	∞
Extrapolation, Interpolation & Integration Algorithms for Max. SAR Evaluation	E4.2	1.0	R	√3	1	1	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E3.2.1	2.9	N	1	1	1	2.9	2.9	145
Device Holder Uncertainty	E3.1.1	3.6	N	1	1	1	3.6	3.6	5
Output Power Variation - SAR drift measurement	5.6.2	5.0	R	√3	1	1	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E2.1	4.0	R	√3	1	1	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E2.2	5.0	R	√3	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E2.2	2.5	N	1	0.64	0.43	1.6	1.1	∞
Liquid Permittivity - deviation from target values	E2.2	5.0	R	√3	0.6	0.5	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E2.2	2.5	N	1	0.6	0.5	1.5	1.2	∞
Combined Standard Uncertainty (k=1)			RSS				10.3	10.0	
Expanded Uncertainty (k=2) (95% CONFIDENCE LEVEL)							20.6	20.1	

The above measurement uncertainties are according to IEEE Std. 1528-200x (Jan. 2002)

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11. SYSTEM VERIFICATION

Tissue Verification

Table 12.1 Simulated Tissue Verification [5]

MEASURED TISSUE PARAMETERS					
Date(s)	12/03/03	2450MHz Brain		2450MHz Muscle	
Liquid Temperature (°C)	20.8	Target	Measured	Target	Measured
Dielectric Constant: ε		39.20	40.30	52.70	53.24
Conductivity: σ		1.80	1.85	1.95	1.91

Prior to assessment, the system is verified to the ±10% of the specifications at 2450MHz by using the system validation kit(s). (Graphic Plots Attached)

Table 12.2 System Validation [5]

System Verification TARGET & MEASURED							
Date	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Tissue	Targeted SAR 1_g (mW/g)	Measured SAR 1_g (mW/g)	Deviation (%)
12/03/03	22.3	20.4	**0.250**	**2450 MHz Brain**	**13.10**	12.80	- 2.3

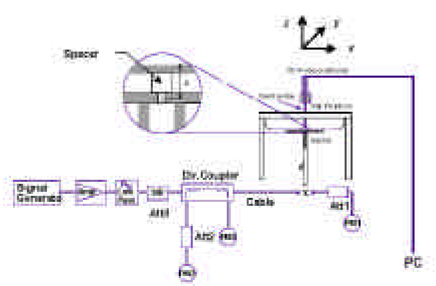

Figure 12.1 Dipole Validation Test Setup

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12. SAR TEST DATA SUMMARY

See Measurement Result Data Pages

Procedures Used To Establish Test Signal

The EUT was placed into continuous transmit mode using the manufacturer's software. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR [4].

Device Test Conditions

The transmitting EUT is powered through the AC adapter. In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a power deviation of more than 5% occurred, the test was repeated.

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SAR DATA SUMMARY

Mixture Type: 2450MHz Muscle

13.1 MEASUREMENT RESULTS (Body SAR – Front Side)

FREQUENCY		Modulation	Begin / End POWER‡ (dBm)		Separation Distance (cm)‡‡	Antenna Position	SAR (W/kg)
MHz	Ch.						
2402.0	01	FHSS	25.16	25.13	Touch	Fixed	**0.748**
2440.0	40	FHSS	25.18	25.15	Touch	Fixed	**1.340**
2480.0	79	FHSS	25.19	25.17	Touch	Fixed	**1.430**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					**Muscle 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTES:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings. Standard Batteries are the only options.
   ‡Power Measured ☒ Conducted ☐ ERP ☐ EIRP
4. SAR Measurement System ☒ DASY4 ☐ IDX
   Phantom Configuration ☐ Left Head ☒ Flat Phantom ☐ Right Head
5. SAR Configuration ☐ Head ☒ Body ☐ Hand
6. Test Signal Call Mode ☒ Manu. Test Codes ☐ Base Station Simulator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Both sides of the phone were tested and the worst-case side is reported.
9. Liquid tissue depth is 15.1 cm. ± 0.1

Alfred Cirwithian
Vice President Engineering

Figure 13.1 Body SAR Test Setup

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SAR DATA SUMMARY

Mixture Type: 2450MHz Muscle

13.2 MEASUREMENT RESULTS (Body SAR – Back Side)							
FREQUENCY		Modulation	Begin / End POWER‡ (dBm)		Separation Distance (cm)‡‡	Antenna Position	SAR (W/kg)
MHz	Ch.						
2402.0	01	FHSS	24.94	24.93	Touch	Fixed	**0.050**
2440.0	40	FHSS	24.96	24.94	Touch	Fixed	**0.103**
2480.0	79	FHSS	24.98	24.95	Touch	Fixed	**0.119**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					**Muscle 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTES:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings. Standard Batteries are the only options.

	‡Power Measured	☒ Conducted	☐ ERP	☐ EIRP
4.	SAR Measurement System	☒ DASY4	☐ IDX	
	Phantom Configuration	☐ Left Head	☒ Flat Phantom	☐ Right Head
5.	SAR Configuration	☐ Head	☒ Body	☐ Hand
6.	Test Signal Call Mode	☒ Manu. Test Codes	☐ Base Station Simulator	

7. Tissue parameters and temperatures are listed on the SAR plots.
8. Both sides of the phone were tested and the worst-case side is reported.
9. Liquid tissue depth is 15.1 cm. ± 0.1

Alfred Cirwithian
Vice President Engineering

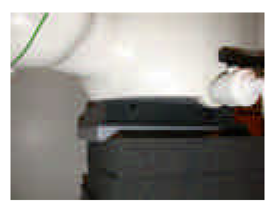

Figure 13.2 Body SAR Test Setup

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SAR DATA SUMMARY

Mixture Type: 2450MHz Muscle

13.3 MEASUREMENT RESULTS (Body SAR – Top Side)

FREQUENCY		Modulation	Begin / End POWER‡ (dBm)		Separation Distance (cm)‡‡	Antenna Position	SAR (W/kg)
MHz	Ch.						
2402.0	01	FHSS	25.04	25.01	Touch	Fixed	**0.269**
2440.0	40	FHSS	25.07	25.06	Touch	Fixed	**0.505**
2480.0	79	FHSS	25.08	25.05	Touch	Fixed	**0.679**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					**Muscle 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTES:

1. The test data reported are the worst-case SAR value with the antenna-head position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings. Standard Batteries are the only options.
   ‡Power Measured ☒ Conducted ☐ ERP ☐ EIRP
4. SAR Measurement System ☒ DASY4 ☐ IDX
   Phantom Configuration ☐ Left Head ☒ Flat Phantom ☐ Right Head
5. SAR Configuration ☐ Head ☒ Body ☐ Hand
6. Test Signal Call Mode ☒ Manu. Test Codes ☐ Base Station Simulator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Both sides of the phone were tested and the worst-case side is reported.
9. Liquid tissue depth is 15.1 cm. ± 0.1

Alfred Cirwithian
Vice President Engineering

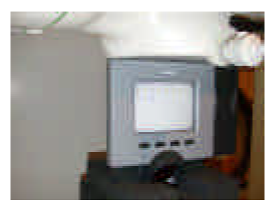

Figure 13.3 Body SAR Test Setup

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14. SAR TEST EQUIPMENT

Equipment Calibration

Table 15.1 Test Equipment Calibration

EQUIPMENT SPECIFICATIONS			
Type		**Calibration Date**	**Serial Number**
Stäubli Robot RX60L		February 2003	599131-01
Stäubli Robot Controller		February 2003	PCT592
Stäubli Teach Pendant (Joystick)		February 2003	3323-00161
Micron Computer, 450 MHz Pentium III, Windows NT		February 2003	PCT577
SPEAG EDC3		February 2003	321
SPEAG DAE3		February 2003	330
SPEAG E-Field Probe ES3DV2		September 2003	3022
SPEAG Dummy Probe		February 2003	PCT583
SPEAG SAM Twin Phantom V4.0		February 2003	PCT666
SPEAG Light Alignment Sensor		February 2003	205
PCTEST Validation Dipole D300V2		September 2003	PCT301
SPEAG Validation Dipole D835V2		February 2003	PCT512
SPEAG Validation Dipole D1900V2		February 2003	PCT613
SPEAG Validation Dipole D2450V2		February 2003	PCT614
Brain Equivalent Matter (300MHz)		December 2003	PCTBEM601
Brain Equivalent Matter (835MHz)		December 2003	PCTBEM101
Brain Equivalent Matter (1900MHz)		December 2003	PCTBEM301
Brain Equivalent Matter (2450MHz)		December 2003	PCTBEM801
Muscle Equivalent Matter (300MHz)		December 2003	PCTMEM701
Muscle Equivalent Matter (835MHz)		December 2003	PCTMEM201
Muscle Equivalent Matter (1900MHz)		December 2003	PCTMEM401
Muscle Equivalent Matter (2450MHz)		December 2003	PCTMEM901
Microwave Amp. Model: 5S1G4, (800MHz - 4.2GHz)		January 2003	22332
Gigatronics 8651A Power Meter		January 2003	1835299
HP-8648D (9kHz ~ 4GHz) Signal Generator		January 2003	PCT530
Amplifier Research 5S1G4 Power Amp		January 2003	PCT540
HP-8753E (30kHz ~ 3GHz) Network Analyzer		January 2003	PCT552
HP85070B Dielectric Probe Kit		January 2003	PCT501
Ambient Noise/Reflection, etc.	<12mW/kg/<3%of SAR	January 2003	Anechoic Room PCT01

NOTE:

The E-field probe was calibrated by SPEAG, by waveguide technique procedure. Dipole Validation measurement is performed by PCTEST Lab. before each test. The brain simulating material is calibrated by PCTEST using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

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15. CONCLUSION

Measurement Conclusion

The SAR 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. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

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]

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16. REFERENCES

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EXHIBIT A – Test Results

Radiated Measurements

§15.247(b) / §15.205 & §15.209

Transfer Rate:	2 Mbps
Distance of Measurements:	3 Meters
Channel:	01

Frequency (MHz)	Level (dBm)	Peak/ Average	AFCL (dB)	POL (H/V)	F/S (dBmV/m)	F/S (mV/m)	Margin (dB)
4804	- 99.2	Peak	40.39	V	48.19	256.7	- 5.8
7206	- 105.0	Peak	47.42	V	49.42	295.8	- 4.6
9608	- 123.0	Peak	50.30	V	34.30	51.9	- 19.7
12010	- 135.0						

Table A-1. Radiated Measurements @ 3 meters

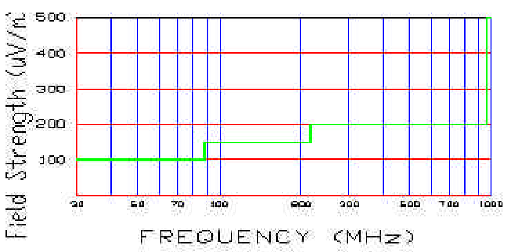

Figure A-1. Radiated limits at 3 meters.

NOTES:

1. All harmonics in the restricted bands specified in §15.205 are below the limit shown in Table G-1. (Note: * = Restricted Band measured frequency)

2. All harmonics/spurs are at least 20 dB below the highest emission in the authorized band using RBW = 100kHz

3. Average Measurements > 1GHz using RBW = 1 MHz VBW = 10 Hz

4. The peak emissions above 1 GHz are not more than 20 dB above the average limit.

5. The antenna is manipulated through typical positions, polarity and length during the tests.

6. The EUT is supplied with nominal AC voltage or/and a new/fully-recharged battery.

7. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.

8. < - 135 are below the analyzer floor level.

9. Above 1 GHz, the limit is 500 μV/m (54dBμ/m) at 3 meters radiated.

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EXHIBIT A – Test Results (Cont.)

Radiated Measurements

§15.247(b) / §15.205 & §15.209

Transfer Rate:	2 Mbps
Distance of Measurements:	3 Meters
Channel:	40

Frequency (MHz)	Level (dBm)	Peak/ Average	AFCL (dB)	POL (H/V)	F/S (dBmV/m)	F/S (mV/m)	Margin (dB)
4880	- 99.4	Peak	40.50	V	48.10	254.1	- 5.9
7320	- 106.0	Peak	48.00	V	49.00	281.8	- 5.0
9760	- 125.8	Peak	50.30	V	31.50	37.6	- 22.5
12200	- 135.0						

Table A-2. Radiated Measurements @ 3 meters

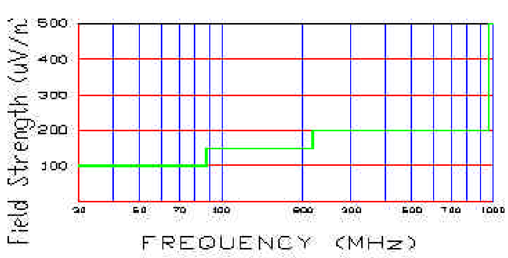

Figure A-2. Radiated limits at 3 meters.

NOTES:

1. All harmonics in the restricted bands specified in §15.205 are below the limit shown in Table G-1. (Note: * = Restricted Band measured frequency)
2. All harmonics/spurs are at least 20 dB below the highest emission in the authorized band using RBW = 100kHz
3. Average Measurements > 1GHz using RBW = 1 MHz VBW = 10 Hz
4. The peak emissions above 1 GHz are not more than 20 dB above the average limit.
5. The antenna is manipulated through typical positions, polarity and length during the tests.
6. The EUT is supplied with nominal AC voltage or/and a new/fully-recharged battery.
7. The spectrum is measured from 9kHz to the 10^{th} harmonic and the worst-case emissions are reported.
8. < - 135 are below the analyzer floor level.
9. Above 1 GHz, the limit is 500 µV/m (54dBµ/m) at 3 meters radiated.

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EXHIBIT A – Test Results (Cont.)

Radiated Measurements

§15.247(b) / §15.205 & §15.209

Transfer Rate:	2 Mbps
Distance of Measurements:	3 Meters
Channel:	79

Frequency (MHz)	Level (dBm)	Peak/ Average	AFCL (dB)	POL (H/V)	F/S (dBmV/m)	F/S (mV/m)	Margin (dB)
4960	- 99.8	Peak	40.70	V	47.90	248.3	- 6.1
7440	- 105.3	Peak	48.20	V	49.90	281.8312.6	- 4.1
9920	- 126.4	Peak	50.40	V	31.00	37.635.5	- 23.0
12400	- 135.0						

Table A-3. Radiated Measurements @ 3 meters

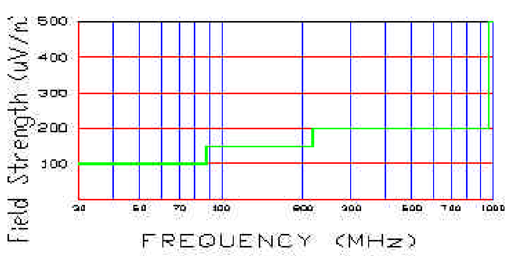

Figure A-3. Radiated limits at 3 meters.

NOTES:

1. All harmonics in the restricted bands specified in §15.205 are below the limit shown in Table G-1. (Note: * = Restricted Band measured frequency)
2. All harmonics/spurs are at least 20 dB below the highest emission in the authorized band using RBW = 100kHz
3. Average Measurements > 1GHz using RBW = 1 MHz VBW = 10 Hz
4. The peak emissions above 1 GHz are not more than 20 dB above the average limit.
5. The antenna is manipulated through typical positions, polarity and length during the tests.
6. The EUT is supplied with nominal AC voltage or/and a new/fully-recharged battery.
7. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.
8. < - 135 are below the analyzer floor level.
9. Above 1 GHz, the limit is 500 µV/m (54dBµ/m) at 3 meters radiated.

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EXHIBIT A – Test Results (Cont.)

Radiated Restricted Band Measurements

§15.205 / §15.209

Special attention is made for the EUT's harmonic and spurious radiated emission in the restricted bands of operations. The EUT was tested from 9kHz and up to the tenth harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHZ. Above 1 GHz, average measurement was used, using RBW 1MHz – VBW 10Hz and linearly polarized horn antennas. All harmonics/spurs are at least 20dB below the highest emission in the authorized band using RBW = 100kHz. In addition, peak measurements were taken to ensure that the peak levels are not more than 20dB above the average limit. All out of band emissions, other than those created by the spreading sequence, data sequence, and the carrier modulation must not exceed the limits show in Table G-1 per Section 15.209.

Frequency	F/S (mV/m)	Measured Distance (Meters)
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table A-4. Restricted Band Limits

TEST MEASUREMENT EQUIPMENT

HP 8562A	Spectrum Analyzer 50GHz
HP 8566B	Spectrum Analyzer 100Hz – 22GHz
HP 83017A	Microwave Analyzer 40dB Gain (0.5 – 26.5GHz)
HP 3784A	Digital Transmission Analyzer
EMCO 3115	Horn Antenna (1 – 18GHz)
HP 8495A	20dB Attenuator (DC-40GHz) 0 –70dB
HP 8493B	10dB Attenuator
MicroCoax Cables	Low Loss Microwave Cables (1 – 26.5GHz)
CDI Dipoles	Dipole Antennas (30 – 1000MHz)
EMCO 3116	Horn Antenna (18 – 40GHz)

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EXHIBIT A. TEST RESULTS (CONTINUED)

EXHIBIT A – Test Results (Cont.)

Radiated Restricted Band Measurements (Cont.)

§15.205 /§15.209

Operating Frequency: 2480 MHz

Distance of Measurements: 3 Meters

FREQ (MHz)	Level (dBm)	AFCL (dB/m)	POL (H/V)	F/S (dBμV/m)	F/S (uV/M)	Margin (dB)
2483.9	-100.3	33.0	V	39.7	96.6	-14.3
2484.5	-104.5	33.0	V	35.5	59.6	-18.5
2484.4	-100.2	33.1	V	39.9	98.9	-14.1
2485.1	-93.6	33.1	V	46.5	211.3	-7.5
2493.0	-102.0	33.2	V	38.2	81.3	-15.8
2496.0	-110.0	33.2	V	30.2	32.4	-23.8

Table A-5. Radiated Restricted Band Measurements at 3-meters

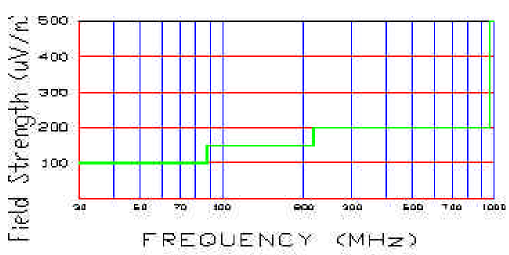

Figure A-4. Limits at 3 meters

NOTES:

1. The antenna is manipulated through typical positions, polarity and length during the testing.

2. The EUT is supplied with the minimal AC voltage or/and a new/fully re-charged battery.

3. The spectrum is measured from 9kHz up to the 10^{th} harmonic and the worst-case emissions are reported.

4. The conducted limits are shown on Figure A-4. Above 1 GHz the limit is 500μV/m.

5. < -135dBm is below the analyzer measurement floor level.

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EXHIBIT B. TEST RESULTS (CONTINUED)

EXHIBIT B – Test Data (Cont.)

Summary of Test Results

Test Date(s): December 04, 2003

Test Engineer:

Table B-1. Summary of Test Results

FCC Part 15 Section	Description	Result
15.107	Conducted Emissions	PASS
15.109	Radiated Spurious Emissions	PASS

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EXHIBIT B – Test Data (Cont.)

Radiated Test Data/Plots

FREQ (MHz)	Level (dBm)	AFCL (dB/m)	POL (H/V)	Height (m)	Azimuth (° angle)	F/S (uV/M)	Margin (dB)
76.34	-82.76	7.06	H	2.5	135	36.78	-8.7
127.23	-84.40	12.01	H	2.3	225	53.75	-8.9
165.44	-85.72	14.63	H	2.2	90	62.42	-7.6
191.38	-85.76	16.07	H	1.9	180	73.33	-6.2
211.30	-88.31	17.02	V	1.7	180	61.00	-7.8
236.82	-86.69	18.19	V	1.6	200	84.19	-7.5

Table B-2. Radiated Measurements at 3-meters

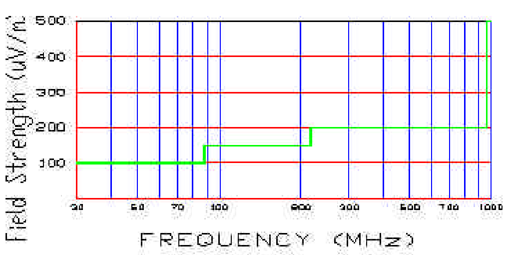

Figure B-1. Limits at 3 meters

NOTES:

1. All modes of operation were investigated and the worst-case emissions are reported.

2. The radiated limits are shown on Figure A-1. Above 1 GHz the limit is 500µV/m.

---

1 All readings are calibrated by HP8640B signal generator with accuracy traceable to the National Institute of Standards and Technology (NIST).

2 AFCL = Antenna Factor (Roberts dipole) and Cable Loss (30 ft. RG58C/U).

3 Measurements using CISPR quasi-peak mode. Above 1GHz, peak detector function mode is used with a resolution bandwidth of 1MHz and a video bandwidth of 1MHz. The peak level complies with the average limit. Peak mode is used with linearly polarized horn antenna and low-loss microwave cable.

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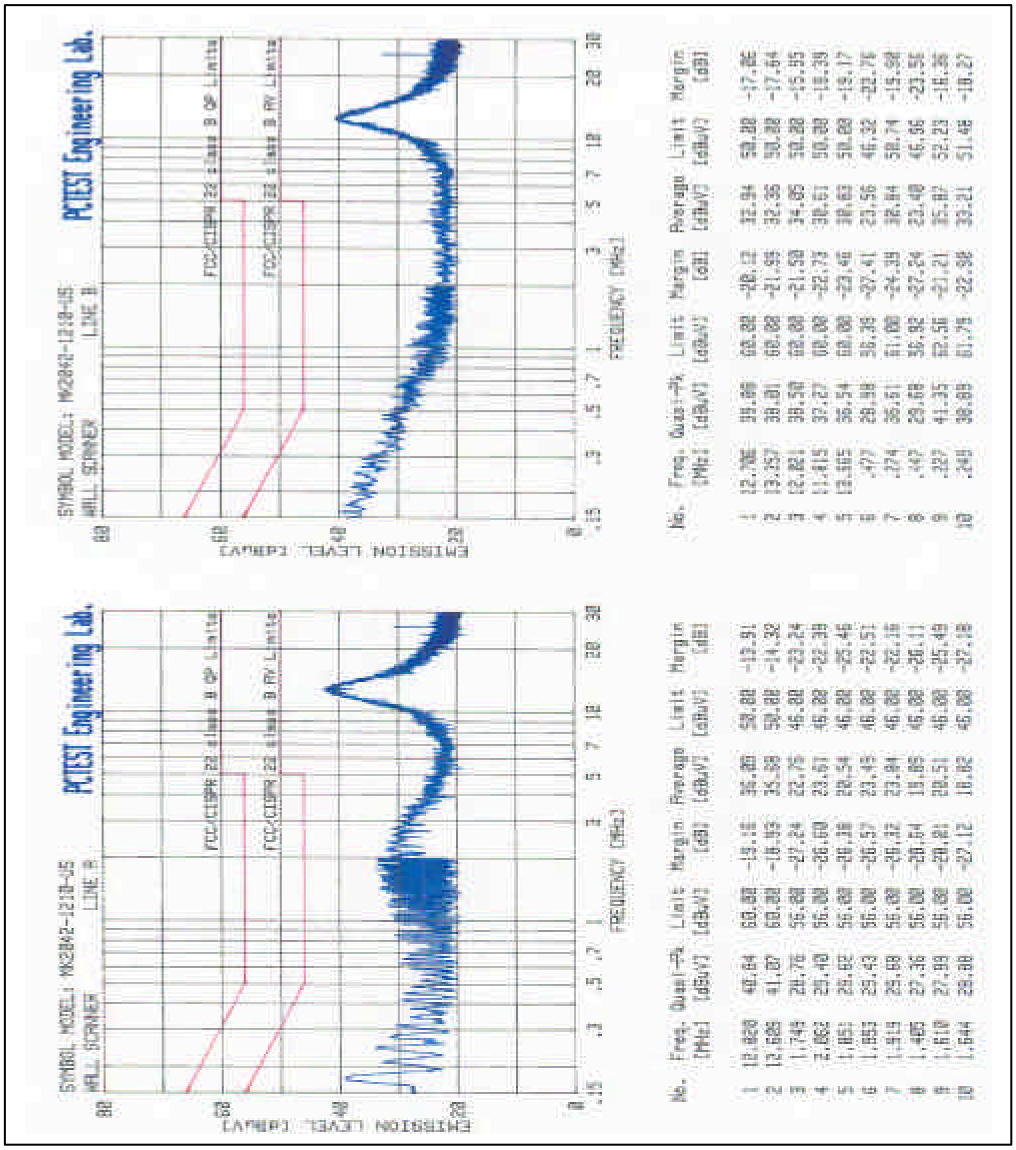
EXHIBIT B. TEST RESULTS (CONTINUED)

EXHIBIT B – Test Data (Cont.)

Line-Conducted Test Data

Plot B-1. Line-Conducted Test Plot



Notes:

1. All Modes of operation were investigated and the worst-case emissions are reported.
2. The limit for Class B device(s) from 150kHz to 30MHz are specified in EN55022.
3. Line A = Phase; Line B = Neutral
4. Deviations to the Specifications: *None*.

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