



CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

Applicant Name:
Panasonic Corporation of North America
One Panasonic Way, 4B-8
Secaucus, NJ 07094

Date of Testing:
10/09/2006-10/10/2006
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0705140432.ACJ

FCC ID: ACJ9TGCF-191


APPLICANT: PANASONIC CORPORATION OF NORTH AMERICA

EUT Type: Toughbook Model: CF-19
Application Type: Class II Permissive Change
FCC Rule Part(s): §2.1093; FCC/OET Bulletin 65 Supplement C [July 2001]
FCC Classification: Unlicensed National Information Infrastructure (UNII)
Model(s): CF-19
Tx Frequency: 5260 - 5320MHz (UNII High Band) (OFDM)
Conducted Power: 13.12 dBm
Max. SAR Measurement: 0.509 W/kg Body SAR
Test Device Serial No.: Pre-Production [S/N: Sample #1]



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. C95.1-2005 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-2003.

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.

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.




Randy Ortanez
President



FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 1 of 20

T A B L E O F C O N T E N T S

1	INTRODUCTION	3
2	TEST SITE LOCATION	4
3	SAR MEASUREMENT SETUP	5
4	DASY E-FIELD PROBE SYSTEM	7
5	PROBE CALIBRATION PROCESS	8
6	PHANTOM AND EQUIVALENT TISSUES.....	9
7	DOSIMETRIC ASSESSMENT & PHANTOM SPECS.....	10
8	TEST CONFIGURATION POSITIONS	11
9	ANSI/IEEE C95.1-2005 RF EXPOSURE LIMITS.....	13
10	MEASUREMENT UNCERTAINTIES	14
11	SYSTEM VERIFICATION.....	15
12	SAR DATA SUMMARY	16
13	EQUIPMENT LIST	16
14	CONCLUSION.....	18
15	REFERENCES	19

FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 2 of 20

1 INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency (RF) 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 C95.1-2005 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 C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave[3] is used for guidance in measuring the Specific Absorption Rate (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 International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. 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.

1.1 SAR Definition

Specific Absorption Rate 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 (ρ). 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).

$$SAR = \frac{d}{dt} \left(\frac{dU}{dm} \right) = \frac{d}{dt} \left(\frac{dU}{\rho dV} \right)$$

Figure 1-1
SAR Mathematical Equation



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

$$SAR = \sigma E^2 / \rho$$

where:

- σ = conductivity of the tissue-simulant material (S/m)
- ρ = mass density of the tissue-simulant material (kg/m³)
- 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 relation 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]

FCC ID: ACJ9TGCF-191	 PCTEST Engineering Wireless Lab www.pctest.com	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 3 of 20

2 TEST SITE LOCATION

2.1 INTRODUCTION

The map at the right shows the location of the PCTEST LABORATORY in Columbia, Maryland. It is in proximity to the FCC Laboratory, the Baltimore-Washington International (BWI) airport, the city of Baltimore and Washington, DC (See Figure 2-1).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49' 38" W longitude. The facility is 1.5 miles north of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2003 on January 27, 2006 and Industry Canada.

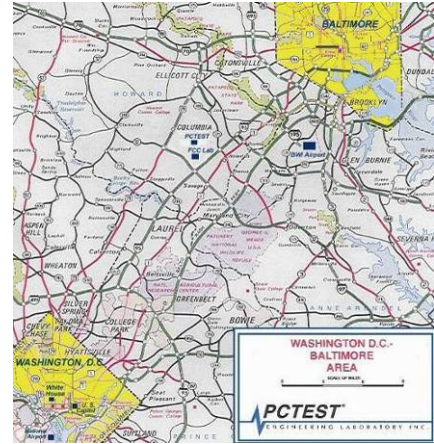
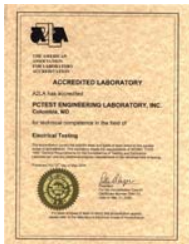




Figure 2-1
Map of the Greater Baltimore and Metropolitan Washington, D.C. area

2.2 Test Facility / A2LA Accreditation:

Measurements were performed at an independent accredited PCTEST Engineering Lab located in Columbia, MD 21045, U.S.A.



- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC 2451).
- PCTEST Lab is accredited to ISO 17025-2005 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) for Specific Absorption Rate (SAR) testing, CTIA Test Plans, FCC, Hearing-Aid Compatibility (HAC) testing, CTIA OTA and Industry Canada Rules.
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the US-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and all Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) in AMPS and CDMA mobile phones.

FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 4 of 20

3 SAR MEASUREMENT SETUP

3.1 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 4 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 Figure 3-1).

3.2 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.

3.3 System Electronics

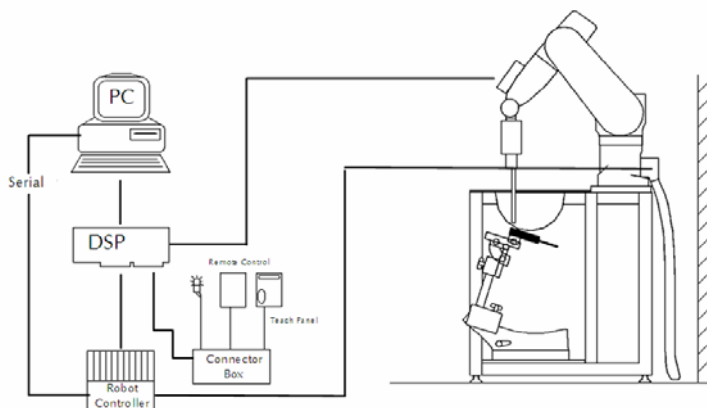




Figure 3-1
SAR Measurement System Setup

The DAE4 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].

FCC ID: ACJ9TGCF-191	 PCTEST Precision Test Equipment Ltd. www.pctest.com	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 5 of 20

3.4 Automated Test System Specifications

Positioner

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

Data Acquisition Electronic System (DAE)

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, SEMCAD software
Connecting Lines: Optical Downlink for data and status info
Optical upload for commands and clock

PC Interface Card



Function: 166MHz low power Pentium MMX 32MB chipdisk
Link to DAE
16-bit A/D converter for surface detection system
Two Serial & Ethernet link to robotics
Direct emergency stop output for robot

Phantom

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



Figure 3-2
DASY4 SAR Measurement System

FCC ID: ACJ9TGCF-191	 PCTEST Engineering Wireless Lab www.pctest.com	CERTIFICATION REPORT	 Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19	Page 6 of 20

4 DASY E-FIELD PROBE SYSTEM

4.1 Probe Measurement System



**Figure 4-1
SAR System**

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration [7] (see Fig. 4.2) 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 multi-fiber line ending at the front of the probe tip (see Fig. 4.3). 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

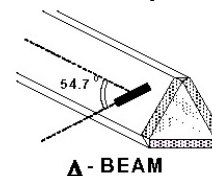
software approach and looks for the maximum using a 2nd order fitting (see Figure 5-1). The approach is stopped at reaching the maximum.

4.2 Probe Specifications



Model:	EX3DV4
Frequency Range:	10 MHz – 6.0 GHz
Calibration:	In brain and muscle simulating tissue at Frequencies from 835 up to 5800MHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz)
Dynamic Range:	10 mW/kg – 100 W/kg
Probe Length:	330 mm
Probe Tip Length:	20 mm
Body Diameter:	12 mm
Tip Diameter:	2.5 mm
Tip-Center:	1 mm
Application:	SAR Dosimetry Testing Compliance tests of mobile phones



**Figure 4-2
Probe Thick Film
Technique**



**Figure 4-3
Triangular Probe
Configuration**

FCC ID: ACJ9TGCF-191	 PCTEST Engineering Wireless Lab www.pctestest.com	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 7 of 20

5.1 Dosimetric Assessment Procedure

Each E-Probe/Probe amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm²) using an RF Signal generator, TEM cell, and RF Power Meter.

5.2 Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm².

5.3 Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

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

where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm³ for brain tissue)

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;

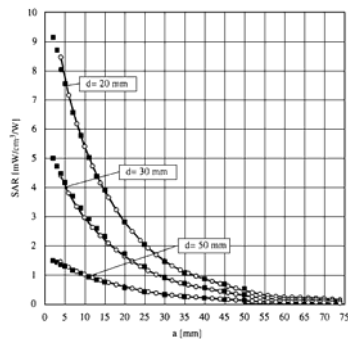


Figure 5-1 E-Field and Temperature measurements at 900MHz [7]

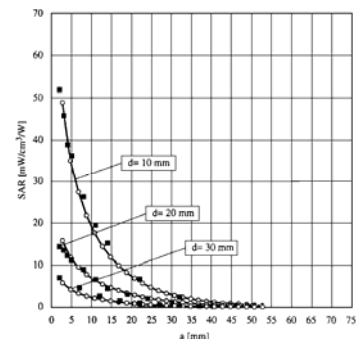




Figure 5-2 E-Field and temperature measurements at 1.9GHz [7]

FCC ID: ACJ9TGCF-191	 PCTEST Panasonic Wireless Lab	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 8 of 20

6 PHANTOM AND EQUIVALENT TISSUES

6.1 SAM Phantoms



Figure 6-1
SAM Phantoms

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)

6.2 Brain & Muscle Simulating Mixture Characterization

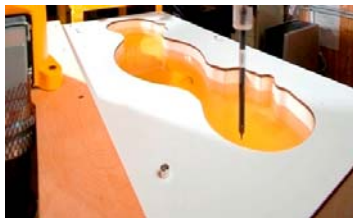


Figure 6-2
Head Simulated

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution (see Table 6-1). Preservation with a bactericide 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 been specified in IEEE-1528 are derived from the tissue 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. Hartsgrrove [13]. (See Table 6-1)

Table 6-1
Composition of the Brain & Muscle Tissue Equivalent Matter

Ingredients (% by weight)	FREQUENCY (MHz)											
	450		835		1900		2450		5200 *		5800 *	
	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.40	54.90	40.40	62.70	73.20	60.0 - 78.0	60.0 - 78.0	60.0 - 78.0	60.0 - 78.0
Salt (NaCl)	3.95	1.49	1.45	1.40	0.18	0.50	0.50	0.04	0.4 - 3.0	0.4 - 3.0	0.4 - 3.0	0.4 - 3.0
Sugar	56.32	46.78	56.00	45.00	0.00	58.00	0.00	0.00	0.00	0.00	0.00	0.00
HEC	0.98	0.52	1.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Bactericide	0.19	0.05	0.10	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	0.00	0.00	0.00	0.00	36.80	0.00	0.00	0.00	0.00	0.00
DGBE	0.00	0.00	0.00	0.00	44.92	0.00	0.00	26.70	0.00	0.00	0.00	0.00
Emulsifiers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.5 - 15.0	0.5 - 15.0	0.5 - 15.0	0.5 - 15.0
Mineral Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.0 - 36.0	11.0 - 36.0	11.0 - 36.0	11.0 - 36.0

Salt: 99% Pure Sodium Chloride

Water: De-ionized, 16M resistivity



DGBE: 99% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl] ether

Sugar: 98% Pure Sucrose

HEC: Hydroxyethyl Cellulose

* Speag Proprietary Recipe

FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 9 of 20

7.1 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 point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the phantom was measured at a distance of 3.0mm from the inner surface of the shell. The horizontal grid spacing was 15mm x 15mm below 3GHz and 10mm x 10mm above 3GHz.
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 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points below 3GHz and a volume of 30.1mm x 30.1mm x 21mm was assessed by measuring 8 x 8 x 8 points above 3GHz. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see Figure 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 the z-axis. This polynomial was then used to evaluate the points between the surface and the probe tip.
 - b. The maximum interpolated value was found with a software algorithm. Around this maximum, the SAR values averaged over the spatial volumes (1g or 10g) were computed using 3D-Spline interpolation. 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 step 1, was re-measured to measure drift. If the value drifted by more than 5%, the evaluation was repeated.

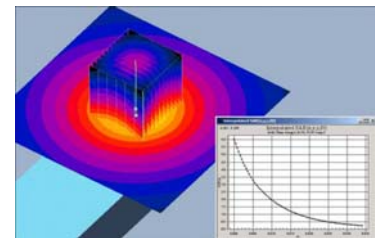




Figure 7-1
Sample SAR Area Scan

7.2 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 Figure 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

FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 10 of 20

8 TEST CONFIGURATION POSITIONS

8.1 SAR for Notebooks and Lap-touching Devices

Lap-touching devices that have transmitting antennas located less than 20 cm from the lap of the user require routine SAR evaluation. Such devices are considered portable and are capable of being held to the body. Devices are to be setup touching the phantom and are configured with maximum output power during SAR assessment for a worst-case SAR evaluation.



Figure 8-1
Notebook Setup for SAR

8.2 Integral Antenna PCMCIA and CompactFlash Cards

KDB 497522. Integral-antenna PCMCIA and CompactFlash radio cards are common module-like devices meant to be purchased and installed without tools or special skills by consumers. The common host configurations (platforms, categories) are notebook (laptop) computers with PCMCIA slot(s) in the keyboard section, and PDAs (personal digital assistants or palmtop computers). Integral-antenna radio cards installed in PDAs with body-worn and/or held-to-ear configurations, and in all notebook computers, must be evaluated under portable RF exposure conditions per 47 C.F.R. 2.1093(b). To better represent the range of near field topography and environment of various notebook and PDA hosts, SAR evaluation using a minimum of three hosts within each platform type (three PDAs, three notebooks, etc.) is recommended by FCC. Hosts



Figure 8-2
CompactFlash radio card in PDA
host configuration

shall be modern, current-market, and expected final installations for the PC Cards.

For notebook computers with multiple card slots (e.g., two stacked), RF exposure should be evaluated with the transmitter installed in the slot(s) producing the highest SAR (See Figure 8-3). The minimum number of positions that should be evaluated for notebook computers and body-worn PDAs are bottom-face in parallel and in contact (0 cm) with flat phantom, and device perpendicular to phantom with recommended spacing of 1.5 cm.



Figure 8-3
PCMCIA Radio Card in a
notebook host configuration

8.3 Positioning for Convertible and Slate Tablet Computers



Figure 8-4
Tablet Computer Form Factors

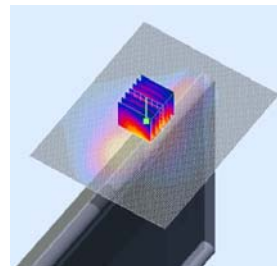




Figure 8-5
Tablet PC Body SAR

KDB 447498. Tablet (notepad) computers are tested in a lap-held position with the bottom of the computer in direct contact against a flat phantom for all user-enabled portrait and landscape positions.

FCC ID: ACJ9TGCF-191	 PCTEST Engineering Laboratory	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 11 of 20

8.4 SAR Testing with IEEE 802.11 a/b/g Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable.



8.4.1 General Device Setup



Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

8.4.2 Frequency Channel Configurations [22]

802.11 a/b/g and 4.9 GHz operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g modes are tested on channels 1, 6 and 11. 802.11a is tested for UNII operations on channels 36 and 48 in the 5.15-5.25 GHz band; channels 52 and 64 in the 5.25-5.35 GHz band; channels 104, 116, 124 and 136 in the 5.470-5.725 GHz band; and channels 149 and 161 in the 5.8 GHz band. When 5.8 GHz §15.247 is also available, channels 149, 157 and 165 should be tested instead of the UNII channels. 4.9 GHz is tested on channels 1, 10 and 5 or 6, whichever has the higher output power, for 5 MHz channels; channels 11, 15 and 19 for 10 MHz channels; and channels 21 and 25 for 20 MHz channels. These are referred to as the “default test channels”. 802.11g mode was evaluated only if the output power was 0.25 dB higher than the 802.11b mode.

Table 8-1
802.11 Test Channels per FCC Requirements

Mode	GHz	Channel	Turbo Channel	“Default Test Channels”		UNII	
				§15.247	802.11g		
802.11 b/g	2.412	1		✓	▽		
	2.437	6	6	✓	▽		
	2.462	11		✓	▽		
802.11a	5.18	36				✓	
	5.20	40	42 (5.21 GHz)				*
	5.22	44					*
	5.24	48	50 (5.25 GHz)			✓	
	5.26	52				✓	
	5.28	56	58 (5.29 GHz)				*
	5.30	60					*
	5.32	64				✓	
	5.500	100					*
	5.520	104				✓	
	5.540	108					*
	5.560	112					*
	5.580	116				✓	
	5.600	120	Unknown				*
	5.620	124				✓	
	5.640	128					*
	5.660	132					*
	5.680	136				✓	
	5.700	140					*
	5.745	149		✓		✓	
UNII or §15.247	5.765	153	152 (5.76 GHz)		*		*
	5.785	157		✓			*
	5.805	161	160 (5.80 GHz)		*	✓	
	§15.247	5.825	165	✓			

FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 12 of 20

9.1 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.

9.2 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.

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (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.

FCC ID: ACJ9TGCF-191	 PCTEST Engineering Laboratory	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19	Page 13 of 20	

10 MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c _i 1gm	c _i 10 gms	1gm u _i (± %)	10gms u _i (± %)	v _i
Measurement System									
Probe Calibration	E.2.1	6.6	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)							RSS	12.4	12.0
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.7	24.0

The above measurement uncertainties are according to IEEE Std. 1528-2003

FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 14 of 20

11 SYSTEM VERIFICATION

11.1 Tissue Verification

Table 11-1
Measured Tissue Properties

Calibrated Date:	10/08/06		10/08/06	
	5300 MHz Brain		5300 MHz Muscle	
	Target	Measured	Target	Measured
Dielectric Constant	36.2	36.2	49.0	49.4
Conductivity	4.66	4.58	5.30	5.21

11.2 Test System Verification

Prior to assessment, the system is verified to $\pm 10\%$ of the specifications at 5200 MHz by using the system validation kit(s). (Graphic Plots Attached)

Table 11-2 System Verification Results

System Verification TARGET & MEASURED							
Date:	Amb. Temp (? C)	Liquid Temp(? C)	Input Power (W)	Tissue Frequency (Mhz)	Targeted SAR _{1g} (mW)	Measured SAR _{1g} (mW)	Deviation (%)
10/09/06	23.5	21.7	0.025	5300 MHz	2.17	2.24	3.22%
10/10/06	23.6	21.3	0.025	5300 MHz	2.17	2.31	6.45%

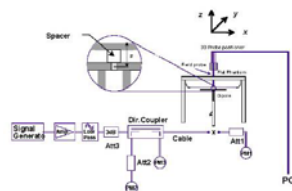


Figure 11-1
System Verification Setup Diagram



Figure 11-2
System Verification Setup Photo

FCC ID: ACJ9TGCF-191	PCTEST Panasonic Wireless Lab	CERTIFICATION REPORT	Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 15 of 20

12 SAR DATA SUMMARY

12.1 Device Conducted Powers

A transmitter antenna terminal of EUT is connected to the input of a RF power sensor. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.



Mode	Freq [MHz]	Channel	Power Cont [dBm]	Antenna	Cable Loss [dB]	Conducted Power [dBm]							
						Data Rate [Mbps]							
						6	9	12	18	24	36	48	54
802.11a	5260	52	N/A	Main	1.50	12.82	12.72	12.46	12.11	11.65	11.19	10.79	9.30
				Aux	1.50	13.12	12.94	12.78	11.98	12.12	11.49	11.12	9.92
802.11a	5280	56	N/A	Main	1.50	12.50	12.22	12.10	11.80	11.85	11.32	10.44	9.50
				Aux	1.50	12.52	12.41	12.24	11.90	11.49	10.96	10.62	9.32
802.11a	5300	60	N/A	Main	1.50	12.46	12.39	12.14	11.81	11.43	10.87	10.51	9.59
				Aux	1.50	12.18	11.95	11.79	11.62	11.12	10.52	10.10	8.82
802.11a	5320	64	N/A	Main	1.50	12.08	12.38	12.16	11.83	11.49	10.96	10.62	9.32
				Aux	1.50	11.68	11.40	11.18	10.94	10.54	10.02	9.62	8.36

12.2 802.11a Body SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	C_Power[dBm]		LCD	Test Position	Antenna Type	Spacing (cm)	Data Rate (Mbps)	SAR (W/kg)
MHz	Ch.		Start	End						
5260.00	52	OFDM	12.82	12.63	Open	Bystander	Main	1.5	6	0.114
5320.00	64	OFDM	12.08	12.22	Open	Bystander	Main	1.5	6	0.208
5260.00	52	OFDM	13.12	12.95	Open	Bystander	Aux	1.5	6	0.291
5320.00	64	OFDM	11.68	11.81	Open	Bystander	Aux	1.5	6	0.509
5260.00	52	OFDM	12.82	12.62	Flip	Bystander	Main	1.5	6	0.135
5320.00	64	OFDM	12.08	12.24	Flip	Bystander	Main	1.5	6	0.183
5260.00	52	OFDM	13.12	12.98	Flip	Bystander	Aux	1.5	6	0.200
5320.00	64	OFDM	11.68	11.51	Flip	Bystander	Aux	1.5	6	0.505
5260.00	52	OFDM	12.82	12.98	Flip	Laptop	Main	0.0	6	0.005
5320.00	64	OFDM	12.08	12.16	Flip	Laptop	Main	0.0	6	0.003
5260.00	52	OFDM	13.12	13.25	Flip	Laptop	Aux	0.0	6	0.008
5320.00	64	OFDM	11.68	11.85	Flip	Laptop	Aux	0.0	6	0.032
5260.00	52	OFDM	12.82	12.95	Flip	Tablet	Main	0.0	6	0.050
5320.00	64	OFDM	12.08	12.19	Flip	Tablet	Main	0.0	6	0.094
5260.00	52	OFDM	13.12	12.96	Flip	Tablet	Aux	0.0	6	0.048
5320.00	64	OFDM	11.68	11.81	Flip	Tablet	Aux	0.0	6	0.034
ANSI / IEEE C95.1 2005 - SAFETY LIMIT						Body				
Spatial Peak						1.6 W/kg (mW/g)				
Uncontrolled Exposure/General Population						averaged over 1 gram				

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Batteries are fully charged for all readings.
4. Tissue parameters and temperatures are listed on the SAR plots. Liquid tissue depth is 15.1 cm. ± 0.1.



FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 16 of 20

13 EQUIPMENT LIST

EQUIPMENT SPECIFICATIONS		
Type	Cal Due	Serial Number
Staubli Robot RX60L	N/A	599131-01
Staubli Robot Controller	N/A	PCT592
Staubli Teach Pendant (Joystick)	N/A	3323-00161
Gateway Computer, 2.52GHz/768MB,Windows-XP	N/A	PCT678
SPEAG EDC3	N/A	321
SPEAG DAE4	Sep 2007	665
SPEAG E-Field Probe EX3DV4	Jan 2007	3550
SPEAG SAM Twin Phantom V4.0	N/A	TP1375
SPEAG Light Alignment Sensor	N/A	205
SPEAG Validation Dipole D5GHzV2	Oct 2007	1007
MW Amp. Model: 5S1G4, (800MHz - 4.2GHz)	N/A	22332
Gigatronics 8651A Power Meter	Jan 2007	1835299
Gigatronics 80701A Sensor(50MHz-18GHz)	Jan 2007	PCT606
HP-8648D (9kHz ~ 4GHz) Signal Generator	Jan 2007	PCT530
HP-8753E (30kHz ~ 6GHz) Network Analyzer	May 2007	PCT552
HP85070B Dielectric Probe Kit	N/A	PCT501
Ambient Noise/Reflection, etc. (<12mW/kg/<3%of SAR)	N/A	Anechoic Room PCT01

Notes:

The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Validation measurement is performed by PCTEST prior to SAR evaluation. 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.



FCC ID: ACJ9TGCF-191	 PCTEST Engineering Wireless Lab www.pctest.com	CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 17 of 20

14 CONCLUSION

14.1 Measurement Conclusion



The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The 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 various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

FCC ID: ACJ9TGCF-191	 PCTEST Engineering Wireless Lab <small>www.pctestlab.com</small>	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 18 of 20

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FCC ID: ACJ9TGCF-191		CERTIFICATION REPORT		Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 19 of 20

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FCC ID: ACJ9TGCF-191	 PCTEST Engineering Wireless Lab <small>www.pctestlab.com</small>	CERTIFICATION REPORT	 Panasonic	Reviewed by: Quality Manager
SAR Filename: 0705140432.ACJ	Test Dates: 10/09/2006-10/10/2006	EUT Type: Toughbook Model: CF-19		Page 20 of 20