CERTIFICATE OF COMPLIANCE
SAR EVALUATION

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Trade Name:	**ARTEMA US MOBILE**
Model No.:	**P4432-909**
Equipment Type:	**E.F.T./P.O.S. Terminal with CDPD Modem Card**
Equipment Classification:	**Licensed Non-Broadcast Station Transmitter (TNB)**
Tx Frequency Range:	**824-849 MHz**
Rx Frequency Range:	**869-894 MHz**
Max. RF Output Power:	**0.827 Watts (ERP)**
FCC Rule Part(s):	**2.1093; ET Docket 96.326**

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in ANSI/IEEE Std. C95.3-1999. (See test report).

I attest to the accuracy of data. All measurements 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.

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

Shawn McMillen
General Manager
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1.0 INTRODUCTION

This measurement report shows compliance of the DASSAULT *Artema US Mobile* Model: P4432-909 Portable E.F.T./P.O.S. Terminal with Internal CDPD Modem Card with FCC Part 2.1093, ET Docket 96-326 Rules for mobile and portable devices. The test procedures, as described in American National Standards Institute C95.1-1992 (1), FCC OET Bulletin 65-1997 were employed. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

2.0 DESCRIPTION of Equipment Under Test (EUT)

EUT Type	Portable E.F.T./P.O.S. Terminal with Internal CDPD Modem Card	**Equipment Class**	Licensed Non-Broadcast Station Transmitter (TNB)
Trade Name	ARTEMA US MOBILE	**Model No.**	P4432-909
Tx Frequency Range (MHz)	824-849	**S/N No.**	Pre-production
Rx Frequency Range (MHz)	869-894	**Max. RF Output Power**	0.827 Watts
Power Supply	Ni-Cad Battery Pack	**Signal Modulation(s)**	GMSK FM


Fig. 1. Front of EUT


Fig. 2. Rear of EUT

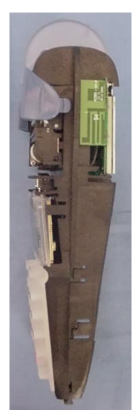
Fig. 3. Antenna Side


Fig. 4. CDPD Modem

3.0 SAR MEASUREMENT SYSTEM

Celltech Research SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the generic twin phantom containing brain or muscle equivalent material (see Figure 6). The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronics (DAE) circuit 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. The DAE3 utilizes 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.

Figure 5. DASY3 SAR Measurement System

4.0 MEASUREMENT SUMMARY

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum SAR location of the EUT are reported in Appendix A.

Body SAR Measurement Results

Freq. (MHz)	Chan.	Mode Tested	Max. ERP (W)	EUT Position	Phantom Section	Separation Distance (cm)	SAR (w/kg)
824.04	991	Unmod.	0.827	Front side	Flat	none	0.324
824.04	991	Unmod.	0.827	Back side	Flat	none	1.480
824.04	991	Unmod.	0.827	Antenna side	Flat	0.5	0.872
836.49	383	Unmod.	0.827	Front side	Flat	none	0.233
836.49	383	Unmod.	0.827	Back side	Flat	none	0.995
836.49	383	Unmod.	0.827	Antenna side	Flat	0.5	0.785
848.97	799	Unmod.	0.827	Front side	Flat	none	0.195
848.97	799	Unmod.	0.827	Back side	Flat	none	0.829
848.97	799	Unmod.	0.827	Antenna side	Flat	0.5	0.515
Mixture Type: Muscle Dielectric Constant: 56.1 Conductivity: 0.95				**ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Body SAR: 1.6 W/kg (averaged over 1 gram)**			

Notes:

1. The SAR values found were below the maximum limit of 1.6 w/kg.
2. The highest body SAR value found was 1.48 w/kg.
3. The antenna is integral to the EUT.

Hand SAR Measurement Results

Freq. (MHz)	Chan.	Mode Tested	Max. ERP (W)	EUT Position	Phantom Section	Separation Distance (cm)	SAR (w/kg)
824.04	991	Unmod.	0.827	Antenna side	Flat	none	0.955
836.49	383	Unmod.	0.827	Antenna side	Flat	none	0.804
848.97	799	Unmod.	0.827	Antenna side	Flat	none	0.538
Mixture Type: Muscle Dielectric Constant: 56.1 Conductivity: 0.95			**ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Hand SAR: 4.0 W/kg (averaged over 10 grams)**				

Notes:
1. The SAR values found were below the maximum limit of 4.0 w/kg.
2. The highest hand SAR value found was 0.955 w/kg.
3. The antenna is integral to the EUT.

5.0 SAR SAFETY LIMITS

EXPOSURE LIMITS (General populations/Uncontrolled Exposure Environment)	**SAR** (W/Kg)
Spatial Average (averaged over the whole body)	0.08
Spatial Peak (averaged over any 1g of tissue)	1.60
Spatial Peak (hands/wrists/feet/ankles averaged over 10g)	4.00

Notes: 1. The FCC SAR safety limits specified in the table above apply to devices operated in the General Population / Uncontrolled Exposure environment.
2. Uncontrolled environments are defined as locations where there is exposure of individuals who have no knowledge or control of their exposure.

6.0 DETAILS OF SAR EVALUATION

The DASSAULT *Artema US Mobile* Model: P4432-909 Portable E.F.T./P.O.S. Terminal with internal CDPD Modem Card was found to be compliant for localized Specific Absorption Rate (SAR) based on the following test provisions and conditions:

1) The face of the EUT was tested for body SAR with the face of the device placed parallel to and touching the outer surface of the planar phantom.
2) The bottom side of the EUT was tested for body SAR with the under side of the device placed parallel to and touching the outer surface of the planar phantom.
3) The antenna side of the EUT was tested for body SAR with the antenna side of the device placed parallel to the outer surface of the planar phantom with a 0.5cm separation distance.
4) The antenna side of the EUT was tested for hand SAR in a hand-held configuration with the antenna side of the device placed parallel to and touching the outer surface of the planar phantom.
5) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimize drift.
6) The device was keyed to operate continuously in the transmit mode for the duration of the test.
7) The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the device and its antenna.
8) The EUT was tested with a fully charged battery.

Fig. 6. Body SAR - Top Side

Fig. 7. Body SAR – Bottom Side

Fig. 8. Body SAR - Antenna Side (0.5cm)

Fig. 9. Hand SAR – Antenna Side

7.0 EVALUATION PROCEDURES

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

a. (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices worn about the ear during normal operation, both the left and right ear positions were evaluated at the center frequency of the band at maximum power. The side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head-worn device relative to the phantom was dictated by FCC OET Bulletin 65 Supp., C.

(ii) For face-held and body-worn devices, or devices which can be operated within 20cm of the body, the planar section of the phantom was used. The type of device being evaluated dictated the distance of the EUT to the outer surface of the planar phantom.

b. The SAR was determined by a pre-defined procedure within the DASY3 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm.

c. A 5x5x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.

d. If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

8.0 SYSTEM VALIDATION

Prior to the assessment, the system was verified in the planar region of the phantom. For devices operating below 1GHz, an 835MHz dipole or 900MHz was used, depending on the operating frequency of the EUT. For devices operating above 1GHz, an 1800MHz dipole was used. A forward power of 250mW was applied to the dipole and system was verified to a tolerance of ±5%. Following the validation, the fluid remained or was changed depending on the particular part of the body being evaluated. The applicable verification(s) is/are as follows (see Appendix B for validation test plot):

Dipole Validation Kit	Target SAR 1g (w/kg)	Measured SAR 1g (w/kg)
D835V2	2.06	2.03

9.0 SIMULATED TISSUES

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellullose (HEC) gelling agent and saline solution. Preservation with a bactericide is added and visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

INGREDIENT	**FREQUENCY - 835MHz**	
	Brain (Validation) %	**Muscle (%)**
Water	40.1	52.4%
Sugar	58.1	45.0%
Salt	0.7	1.4%
HEC	1.0	1.0%
Bactericide	0.1	0.2%

10.0 TISSUE PARAMETERS

The dielectric parameters of the fluids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an 8753E Network Analyzer. The dielectric parameters of the fluid are as follows:

Equivalent Tissue (835MHz)	**Dielectric Constant e_r**	**Conductivity s (mho/m)**	**r (Kg/m^3)**
Brain (Validation)	44.2 ± 5%	0.80 ± 5%	1000
Muscle	56.1 ± 5%	0.95 ± 5%	1000

11.0 ROBOT SYSTEM SPECIFICATIONS

Specifications

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

Data Acquisition Electronic (DAE) System

Cell Controller

Processor:	Pentium III
Clock Speed:	450 MHz
Operating System:	Windows NT
Data Card:	DASY3 PC-Board

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter, and control logic
Software:	DASY3 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 Probe

Model:	ET3DV6
Serial No.:	1387
Construction:	Triangular core fiber optic detection system
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

Phantom

Phantom:	Generic Twin
Shell Material:	Fiberglass
Thickness:	2.0 ± 0.1 mm

12.0 TEST EQUIPMENT LIST

SAR MEASUREMENT SYSTEM		
EQUIPMENT	***S/N #***	***CALIBRATION DATE***
DASY3 System -Robot -ET3DV6 E-Field Probe -DAE -835MHz Validation Dipole -900MHz Validation Dipole -1800MHz Validation Dipole -Generic Twin Phantom V3.0	 599396-01 1387 383 411 054 247 N/A	 N/A Sept 1999 Sept 1999 Aug 1999 Aug 1999 Aug 1999 N/A
85070C Dielectric Probe Kit	N/A	N/A
Gigatronics 8652A Power Meter -Power Sensor 80701A -Power Sensor 80701A	1835272 1833535 1833542	Oct 1999 Oct 1999 Oct 1999
E4408B Spectrum Analyzer	US39240170	Nov 1999
8594E Spectrum Analyzer	3543A02721	Mar 2000
8753E Network Analyzer	US38433013	Nov 1999
8648D Signal Generator	3847A00611	N/A
5S1G4 Amplifier Research Power Amplifier	26235	N/A

13.0 MEASUREMENT UNCERTAINTIES

Uncertainty Description	Error	Distribution	Weight	Standard Deviation	Offset
Probe Uncertainty					
Axial isotropy	±0.2 dB	U-Shaped	0.5	±2.4 %	
Spherical isotropy	±0.4 dB	U-Shaped	0.5	±4.8 %	
Isotropy from gradient	±0.5 dB	U-Shaped	0	±	
Spatial resolution	±0.5 %	Normal	1	±0.5 %	
Linearity error	±0.2 dB	Rectangle	1	±2.7 %	
Calibration error	±3.3 %	Normal	1	±3.3 %	
SAR Evaluation Uncertainty					
Data acquisition error	±1 %	Rectangle	1	±0.6 %	
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %	
Conductivity assessment	±5 %	Rectangle	1	±5.8 %	
Spatial Peak SAR Evaluation Uncertainty					
Extrapolated boundary effect	±3 %	Normal	1	±3 %	±5 %
Probe positioning error	±0.1 mm	Normal	1	±1 %	
Integrated and cube orientation	±3 %	Normal	1	±3 %	
Cube Shape inaccuracies	±2 %	Rectangle	1	±1.2 %	
Device positioning	±6 %	Normal	1	±6 %	
Combined Uncertainties				±11.7 %	±5 %

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environmental. However, the estimated measurement uncertainties in SAR are less than 15-25 %.

According to ANSI/IEEE C95.3, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of ± 1 to 3 dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least ± 2dB can be expected.

According to CENELEC, typical worst-case uncertainty of field measurements is ± 5 dB.
For well-defined modulation characteristics the uncertainty can be reduced to ± 3 dB.

14.0 REFERENCES

(1) ANSI, *ANSI/IEEE C95.1: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 Ghz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992;*

(2) Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C. 20554, 1997;

(3) Thomas Schmid, Oliver Egger, and Neils Kuster, “Automated E-field scanning system for dosimetric assessments”, IEEE *Transaction on Microwave Theory and Techniques,* Vol. 44, pp. 105 – 113, January, 1996.

(4) Niels Kuster, Ralph Kastle, and Thomas Schmid, “Dosimetric evaluation of mobile communications equipment with know precision”, IEICE Transactions of Communications, vol. E80-B, no. 5, pp. 645 – 652, May 1997.