ELECTROMAGNETIC EXPOSURE (EME)
TESTING LABORATORY

8000 West Sunrise Blvd.
Fort-Lauderdale, Florida

S.A.R. TEST REPORT

FCC ID # AZ492FT5802
(Handheld Data Terminal – HDT515-Model F5027A)

February 08, 2001 - Rev. B

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

REVISION HISTORY

Date	Revision	Comments
10/16/00	O	Original
12/12/00	A	Updated to include additional carry case FLN9202A.
02/08/01	B	Changed from Controlled to Uncontrolled exposure limits.

1.0 Introduction

This report details the test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurement performed at CGISS EME Laboratory for the Handheld Data Terminal with wireless LAN, model number F5027A and evaluated to General Population/Uncontrolled Exposure limit of 1.6mW/g.

2.0 Applicable Regulations and Standards

- United States Federal Communications Commission, Code of Federal Regulations; 47 CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- National Council on Radiation Protection and Measurements (NCRP) of the United States, Report 86, 1986
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999

3.0 Description of Test Sample

The Handheld Data Terminal model number F5027A contains a 900 MHz Wireless LAN Radio, manufactured by RIM. The OEM Radio module (FCC ID L6AR902M-2-0) transmits in the Gaussian Minimum Shift Keying Mode (GMSK) with a maximum output of 2.0W at a maximum 25% transmit duty cycle. The HDT515 can operate in either a holster or hand-held in front of the operator.

3.1 Antenna Description:

3.1.1 Antenna type:

Quarter wave internal.

Monopole	X	Dipole		Helix		Patch		Other	

3.1.2 Antenna Location on Device

Left		Right		Top	X	Bottom		Front		Back	X

3.1.3 Antenna Dimensions

Length - cm (internal)	6.78

3.1.4 Antenna Configuration

Fixed		Retractable		External		Internal	X

3.1.5 Antenna Gain

Mode:

Internal	-2.0dBi

3.2 Test Signal

Test Signal Source:

Test Mode	X	Base Station		Simulator		Other	

Signal Modulation:

CW	X

3.3 Test Frequency and Output Power

Output power measurement conditions:

Free Space Radiated		SAR test configuration	X	Conducted	X	Other	

Output Power measured with:

Power meter ☐ Base Station Simulator ☐ Spectrum Analyzer ☒ X Other ☐

Test Frequency (MHz)	Measured Power before SAR (W)	Measured Power after SAR (W)
898.5	0.120	0.120

4.0 Description of Test Equipment

4.1 Descriptions of SAR Measurement System

The laboratory utilizes a Dosimetric Assessment System (DASY™) SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. This system utilizes a computer controlled six axis robot to move a measurement probe to measure the SAR. The SAR measurements were conducted with the probe ET3DV6 serial number 1384. It was calibrated at SPEAG™, and has a calibration date June 1, 2000. A copy of the calibration certificate is included as appendix C. Dipole Validation Kit type 925MHz (serial number 925-002) was used to validate the system accuracy at 925MHz.

DIPOLE VALIDATION RESULT

Dipole Antenna (S/N)	Validation Type (Freq/Tissue)	SAR Meas. @ 0.5W (w/ drift)	Calculated SAR @ 1W	Target SAR @ 1W
925-002	925MHz - Muscle	6.06 mW/g	12.12 mW/g	11.98 mW/g ± 10%

The Dipole validation table indicated the result is within the required accuracy of ± 10% (Dipole SAR Validation for Dipole S/N 925-002) and thus the measured SAR values are considered correct. See appendix B for printout of the validation test results from the DASY™ measurement system.

The DASY™ system is operated per the instructions in the DASY™ Users Manual. The entire manual is available directly from SPEAG™.

4.2 Description of Phantom

Human shaped, solid shell device made of fiberglass and mounted on a nonmetallic base or stand.

4.2.1 Full Body Phantom

Abdomen Thickness	0.15 cm
Face Thickness	0.15 cm

4.3 Simulated Tissue Properties:

4.3.1 Type of Simulated Tissue

	Full Body Phantom
Muscle	X

4.3.2 Simulated Tissue Composition

	925MHz
Di-Water	53.5 %
Sugar	44.25%
Salt	1.15%
HEC	1.00 %
Dowicil75	0.10 %

Note: HEC (HYDROXYETHYL CELLULOSE) is a gelling agent and Dowicil 75 is anti bacterial compound.

Characterization of Simulated tissue materials and ambient conditions:
Simulated tissue prepared for SAR measurements are measured at room temperature and verified to be in spec prior to actual SAR measurements by filling a coaxial slotted line with the tissue and probing the amplitude and phase changes versus distance in the simulated tissue. A HP8753D Network Analyzer is used to perform the measurements.

Measured simulated tissue dielectric constant and conductivity used in SAR runs as of 09/18/00.

	Muscle
	925 MHz
Di-electric Constant	49.6
Conductivity – S/m	1.17

5.0 Description of Test Procedure

The test procedure was design for standard operating configuration. The first test demonstrates the HDT515 in the FLN9623A holster, which can be attached to the user's belt. The second test demonstrates the HDT515 being hand-held in front of the user.

The following accessories were tested. This report only contains the SAR data from the holster that measured the highest SAR.

-Holster (Kit # FLN9623A)
-Holster (Kit # FLN9202A)

Holster Description
Belt loops are located on the back of each holster. The HDT's fit in the holsters with their keypads facing the user and the antenna facing away from the user. The difference between the two holsters is the FLN9202A has an additional strap, which contains three metallic buttons, to better secure the HDT while in the holster.

All SAR measurements performed with the device positioned in the described test positions and test modes were done while the device was operating in CW.

5.1 Description of Test Positions

The following describes the test position used to perform SAR measurements on the hand-held data terminal device:

Full Body Phantom – The first SAR measurement of the HDT515 device included the FLN9623A holster. The HDT515 was placed in the holster, as to be worn by the operator and positioned with the keypad facing the full body phantom (figure 1). The second test was conducted with the device perpendicular to and touching the full body phantom (figure 2). Figure two illustrates a worst case position if the operator was to hold the device directly against their body.

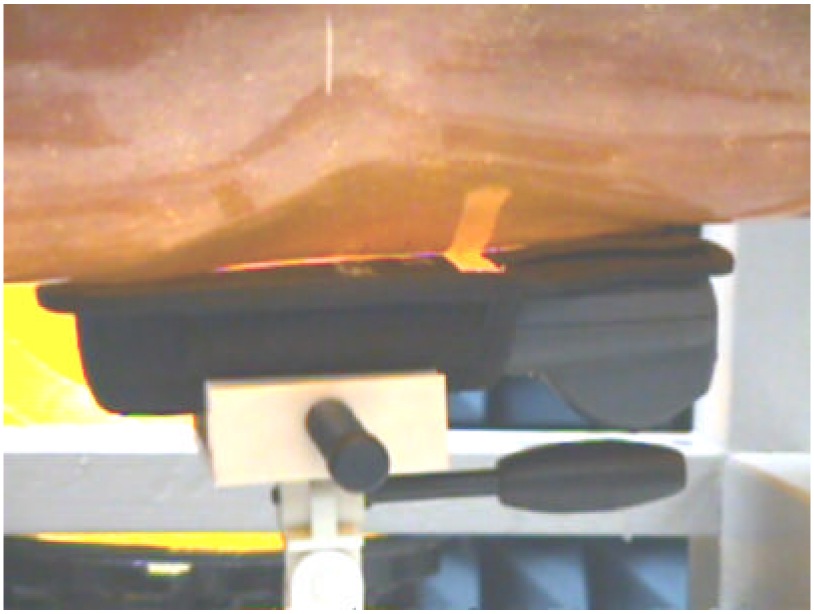


Figure 1: Hand-held data terminal (HDT515) and FLN9623A holster.
Distance from the phantom to the HDT515 = 5.0 mm
(Holster is 5.0 mm thick)

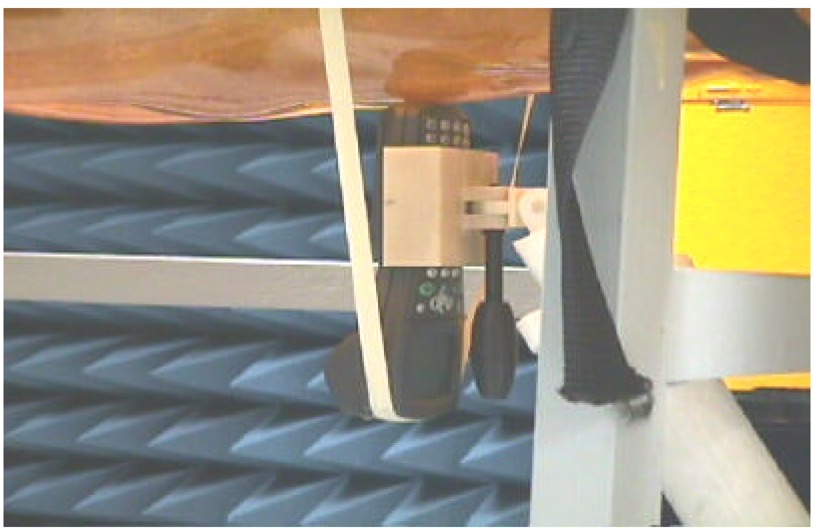


Figure 2: Bottom of Device perpendicular to the phantom.
Distance from surface of device (bottom) to phantom = 0.0 mm

5.2 Probe Scan Procedures

The E-field probe is first scanned in a coarse grid over a large area to locate the maximum SAR. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference for a finer resolution grid or the cube evaluations.

6.0 Measurement Uncertainty:

The table below lists an estimate of the possible errors that are associated with the measurement system.

Uncertainty Description	Standard Uncertainty
Probe Uncertainty	
- Axial Isotropy	± 2.4 %
- Spherical Isotropy	± 4.8 %
- Spatial Resolution	± 0.5 %
- Linearity Error	± 2.7 %
- Calibration Error	± 8 %
Evaluation Uncertainty	
- Data Acquisition Error	± 0.60 %
- ELF and RF Disturbances	± 0.25 %
- Conductivity Assessment	± 5 %
Spatial Peak SAR Evaluation Uncertainty	
- Extrapolation and boundary effects	± 3%
- Probe positioning	± 1 %
- Integration and cube orientation	± 3 %
- Cube shape inaccuracies	± 1.2 %
- Device positioning	± 1.0 %

The Total Measurement Uncertainty is ± 12.1 %. The Expanded Measurement Uncertainty is ± 24.2 % (k=2)

7.0 SAR Test Results

7.1 Measured SAR:

Muscle				
Radio S/N	**Test Configuration**	**Tx Freq. (MHz)**	**Cond. Power (W)**	**Measured SAR (mW/g)**
312SAS0079	With FLN 9623A holster, front of the device facing the phantom	898.5	0.120	0.03
312SAS0079	Without holster, bottom of Device perpendicular to the phantom.	898.5	0.120	0.01

7.2 Maximum Calculated SAR by Expected Operating Position and Conditions

MEAS. POSITION	HIGHEST MEASURED SAR DEPOSITION	MAXIMUM TRANMISSION DUTY CYCLE	OPERATIONAL MAXIMUM CALCULATED SAR
Full body Phantom: with holster case (minimal body spacing)	0.03 mW/g	25%	0.13 mW/g

The highest measured one-gram averaged peak SAR = 0.03mW/g. The 1-gram averaged peak SAR was measured at 898.5MHz.

Maximum Calculated 1-gram Average Peak SAR = SAR_{meas} x [P_{max}÷ P_{end}] x [D1xD2].

SAR_{meas}. = Measured 1 gram averaged peak SAR.

P_{max} = Maximum power delivered to the antenna connector under any conditions of permissible tuning, frequency, voltage and temperature.

P_{end} = Lowest measured power at end of SAR.

D1 = the transmission mode duty cycle, i.e., the ratio of the service mode and the tested mode.

D2 = the Push To Talk duty cycle.
For two-way radio (dispatch for controlled environment) = 0.5,
For two-way radio (dispatch for uncontrolled/ general population) = 1,
For data and telephony = 1.

Maximum Calculated 1-gram Average Peak SAR = [0.03 mW/g x (2.0W ¸ 0.120W) x ((25%/100%) x 1))] = 0.13 mW/g

8.0 Conclusion

The highest Operational Maximum Calculated 1-gram average SAR values found for the Handheld Data Terminal model number F5027A was 0.13mW/g. This indicates the SAR results are below the General Population/Uncontrolled Exposure limit of 1.6mW/g.

Appendix A: Data Results

HDT515;Test Date:09/19/00

HDT SN # 312SA0079, MODEL F5027A

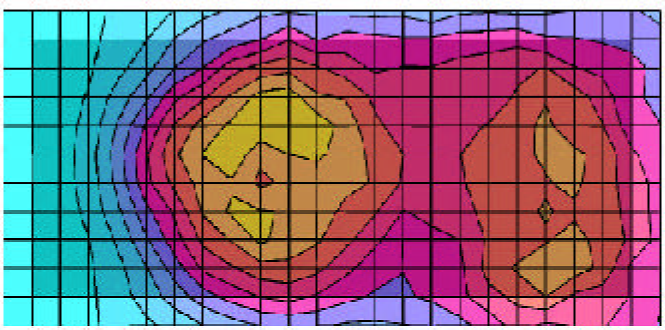
898.5MHz, HOLSTER FLN9623A W/PLASTIC PILOT PENTOPIA (PEN)

Full body Phantom; HDT Ab Section;

Probe: ET3DV6 - SN1384; ConvF(6.31,6.31,6.31); Crest factor: 1.0;

Muscle 925 MHz : σ = 1.17 mho/m er = 49.6 ρ = 1.07 g/cm 3

Cube 5x5x7: SAR (1g): 0.0269 mW/g, (Worst-case extrapolation)



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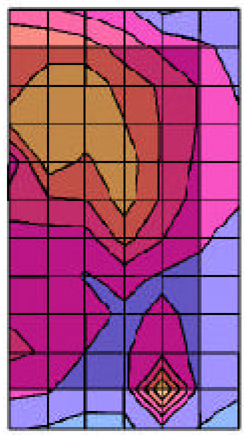
HDT515;Test Date:09/19/00
HDT SN # 312SA0079, MODEL F5027A
898.5MHz, PERPENDICULAR TO THE BODY
Full body Phantom; HDT Ab Section;
Probe: ET3DV6 - SN1384; ConvF(6.31,6.31,6.31); Crest factor: 1.0;
Muscle 925 MHz : σ = 1.17 mho/m er = 49.6 ρ = 1.07 g/cm 3
Cube 5x5x7: SAR (1g): 0.0056 mW/g, (Worst-case extrapolation)



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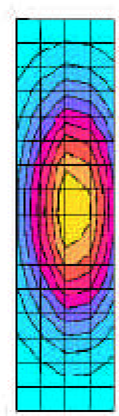
Appendix B: Dipole Validation Data Results

925 CGISS Dipole 002; Test Date: 09/18/00
925 Dipole Validation. Input power = 0.5W. Target = 11.98mW/g @ 1W
Flat Phantom Phantom; Section; Position: ;
Probe: ET3DV6 - SN1384; ConvF(6.31,6.31,6.31); Probe cal date: 06/00;
Crest factor: 1.0; Muscle 925 MHz: s = 1.16 mho/m e r = 53.5 r = 1.07 g/cm 3
Cube 5x5x7: SAR (1g): 6.06 mW/g, SAR (10g): 3.84 mW/g, (Worst-case extrapolation)Coarse:
Dx = 10.0, Dy = 10.0, Dz = 10.0; Max at 23.0, 82.0, 4.3



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Appendix C: Measurement Probe Calibration Certificate

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1384**
Place of Calibration:	**Zurich**
Date of Calibration:	**June 1, 2000**
Calibration Interval:	**12 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	*Nikolaic Katja*
Approved by:	*Thomas Schmid*

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Certificate

Numerical Assessment of Conversion Factor for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1384**
Place of Assessment:	**Zurich**
Date of Assessment:	**June 2, 2000**
Probe Calibration Due Date:	**June 1, 2001**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The calibration was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the recalibration schedule of the probe.

Performed by:	Ndonić Katja
Approved by:	

Dosimetric E-Field Probe ET3DV6 SN:1384

Conversion factor (± standard deviation)

450 MHz	ConvF	**7.14 ± 8%**	**ε_r = 47.0** **σ = 0.63 mho/m** (brain tissue)
835 MHz	ConvF	**6.50 ± 8%**	**ε_r = 44.0** **σ = 0.90 mho/m** (brain tissue)
925 MHz	ConvF	**6.33 ± 8%**	**ε_r = 44.0** **σ = 0.93 mho/m** (brain tissue)
1500 MHz	ConvF	**6.00 ± 8%**	**ε_r = 41.1** **σ = 1.00 mho/m** (brain tissue)
1900 MHz	ConvF	**5.46 ± 8%**	**ε_r = 39.9** **σ = 1.42 mho/m** (brain tissue)
150 MHz	ConvF	**8.46 ± 8%**	**ε_r = 70.00** **σ = 0.75 mho/m** (muscle tissue)
450 MHz	ConvF	**7.12 ± 8%**	**ε_r = 58.0** **σ = 1.00 mho/m** (muscle tissue)
835 MHz	ConvF	**6.45 ± 8%**	**ε_r = 52.0** **σ = 1.10 mho/m** (muscle tissue)
925 MHz	ConvF	**6.31 ± 8%**	**ε_r = 52.0** **σ = 1.20 mho/m** (muscle tissue)
1500 MHz	ConvF	**6.18 ± 8%**	**ε_r = 41.2** **σ = 1.48 mho/m** (muscle tissue)
1920 MHz	ConvF	**5.20 ± 8%**	**ε_r = 51.5** **σ = 1.95 mho/m** (muscle tissue)