Specific Absorption Rate (SAR) Test Report
for
Communication Network Interface, Inc
on the
Two-way messager
Model: CNI-810D

Test Report: J99019236_SAR
Date of Report: August 16, 1999

NVLAP Laboratory Code 200201-0
Accredited for testing to FCC Parts 15

Tested by:	XM Yang	
Reviewed by:	C. K. Li	

Table of Contents

1 JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of

Company: Communication Network Interface, Inc
Address: 51-2, Sungsan 1-dong, Mapo-gu
Seoul 121-251, Korea

Name of contact: Mr. Soon Pil Choi
Telephone: (82) 2-330-5622
Fax: (82) 2-330-5733

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	Two way pager		
Trade Name	CNI	Model No.	CNI-810D
FCC ID	N79CNI-810D	S/N No.	Unit #1
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band (uplink)	806 to 821 MHz	System	FSK

EUT Antenna Description			
Type	Monopole	Configuration	Internal, Fixed
Dimensions	60 mm (L)	Gain	0 dBi
Location	Inside plastic enclosure, top		

Use of Product : Data communications

Manufacturer: SAME as above.

Production is planned: [X] Yes, [ ] No

EUT receive date: 08/10/99

EUT received condition: Good working condition, prototype

Test start date: 08/10/99

Test end date: 08/10/99

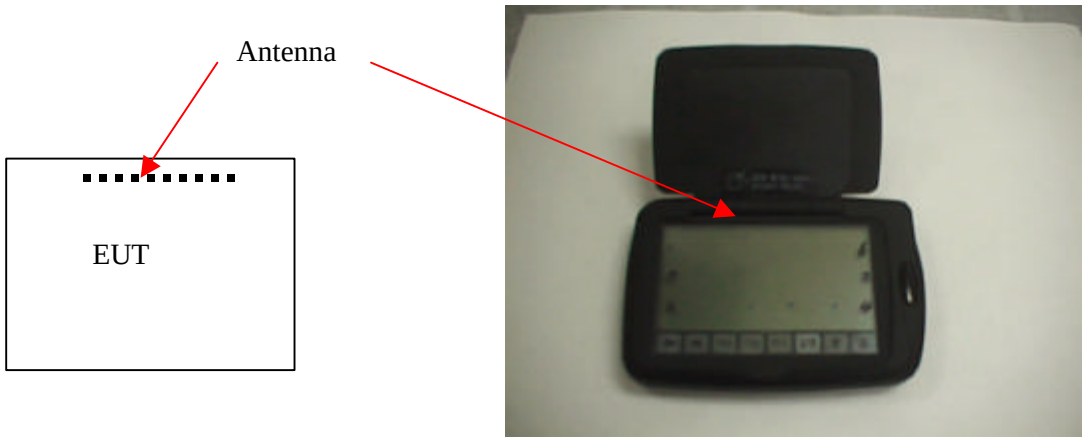
1.3 Test plan reference

FCC rule part 2.1093, FCC Docket 96-326 & Supplement C to OET Bulletin 65

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details test configuration of the equipment under test .



S:	Shielded	**U:**	Unshield	**F:**	With Ferrite Core

Support equipment					
Equp. #	**Equipment**	**Manufacturer**	**Model #**	**S/N #**	**FCC ID**
None					

1.4.2 Test Position

The EUT was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C95.1 (1992) and Supplement C of OET 65 (1998). The EUT was placed in the intended use position, i.e. touching the human body or hand. Please refer to figure 1 below for the position details:

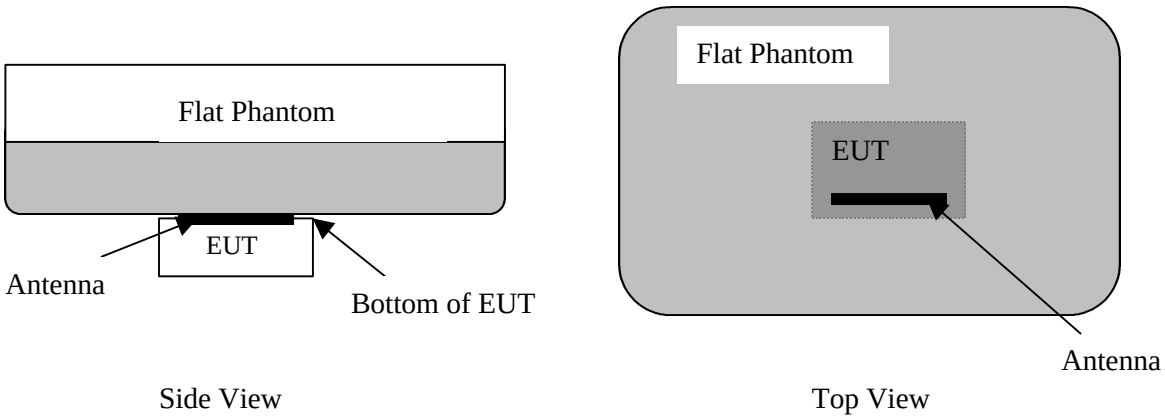


Figure 1: Intended use position

Figure 2 shows the location of antenna inside the EUT:

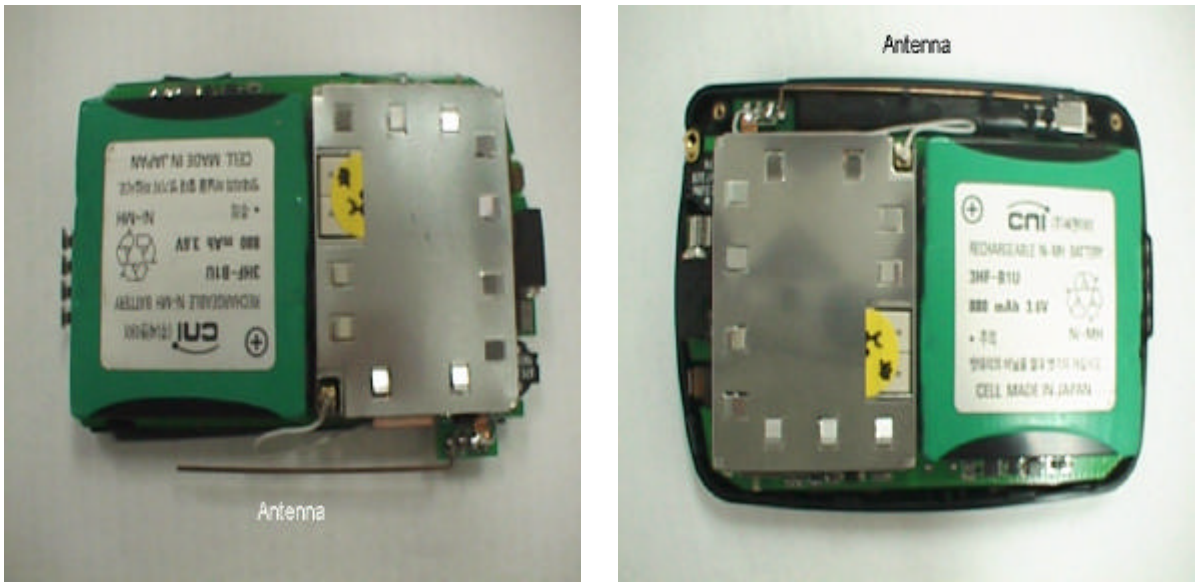


Figure 2: Antenna location

1.4.3 Test Condition

During tests, the worst case data (max. RF coupling) was determined with following conditions:

EUT Antenna	Fixed	Orientation	N/A
Usage	Body-worn and hand-held	Distance between base of EUT and the liquid surface:	2 mm
Simulating human hand	Not Used	EUT Battery	Fully Charged
Power output	550 mW ERP (Maximum)		

The spatial peak SAR values were accessed for lowest, middle and highest operating channels defined by the manufacturer. Tests were performed at CW mode (550 mW ERP). Care was taken to ensure that performance of the EUT power amplifier would not be degrade using CW test mode. A peak radiated field strength test was performed in both CW and pulse (7.8 % duty cycle) modes, and data show that peak power output in both operation modes were the same.

Radiated emission measurement was performed, before and after the SAR tests to ensure that the EUT operated at the highest power level.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

1.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standard.

2 SAR EVALUATION

2.1 SAR Limits

The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

EXPOSURE (General Population/Uncontrolled Exposure environment)	SAR (W/kg)
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

2.2 Configuration Photographs

Worst-Case SAR measurement
at 821 MHz, CW mode, Touch Position

2.3 System Verification

Prior to the assessment, the system was verified to the ±5% of the specifications by using the system validation kit. The validation was performed at 900 MHz.

Validation kit	Targeted SAR_{1g} (mW/g)	Measured SAR_{1g} (mW/g)
D900V2, S/N #: 013	4.03	3.97

2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

a. SAR was measured at a fixed location above the reference point and used as a reference value for the assessing the power drop.

b. The SAR distribution at the exposed side of the flat phantom was measured at a distance of 2.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

c. Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

   I) The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measurement point is 1.6 mm. The extrapolation was based on a least square algorithm. 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.

   ii) 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 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y and z directions). The volume was integrated with the trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average.

   iii) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

d. Re-measurement of the SAR value at the same location as in step a. above. If the value changed by more than 5 %, the evaluation was repeated.

2.5 Test Results

The results on the following page(s) were obtained when the device was tested in the condition described in this report. Detail measurement data and plots which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

The maximum spatial peak SAR values average over 1g assessed in “touch” position was 3.83 mW/g for the tested unit when tested in CW mode. In actual usage, the average transmission is only 7.8% (please refer to the manufacturer justification in section 8 of this report). In considering the 7.8% duty cycle to the measured SAR data, the unit is in compliance with the requirements of the FCC for body requirements.

The maximum spatial peak SAR values average over 10g assessed in “touch” position was 2.2 mW/g for the tested unit when tested in CW mode. The unit is in compliance with the requirements of the FCC for hands and feet requirements.

Trade Name:	CNI	**Model No.:**	810D
Serial No.:	Unit # 1	**Test Engineer:**	XM Yang

TEST CONDITIONS			
Ambient Temperature	23.8 °C	Relative Humidity	48 %
Test Signal Source	Test Mode	Signal Modulation	CW
Output Power Before SAR Test	550 mW	Output Power After SAR Test	550 mW
Test Duration	18 Min.	Number of Battery Change	1

Usage (Touch position)

Channel	Operating Mode	Duty Cycle ratio	Measured ERP Power (mW)	Measured SAR_{1g} (mW/g)	Measured SAR_{10g} (mW/g)
806 MHz	CW	1	550	3.53	1.98
815 MHz	CW	1	410	3.56	2.04
821 MHz	CW	1	540	3.83	2.20

Note: a) Worst case data were reported
b) Duty cycle factor included in the measured SAR data
c) Uncertainty of the system is not included
d) Transmission duty cycle not included.

SAR results with Duty Cycle

Channel	Measured SAR_{1g} (mW/g)	SAR_{1g} with 7.8% duty cycle (mW/g)
806 MHz	3.53	0.275
815 MHz	3.56	0.278
821 MHz	3.83	0.299

3 TEST EQUIPMENT

3.1 Equipment List

The Specific Absorption Rate (SAR) tests were performed with the SPEAG model DASY 3 automated near-field scanning system which is package optimized for dosimetric evaluation of mobile radios [3]. The following major equipment/components were used for the SAR evaluations:

SAR Measurement System			
EQUIPMENT	SPECIFICATIONS	S/N #	CAL. DATE
Robot	**Stäubi RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	**ET3DV5**	1333	03/18/99
	Frequency Range: 10 MHZ to 6 GHz Linearity: ± 0.2 dB Directivity: ± 0.1 dB in brain tissue		
Data Acquisition	**DAE3**	317	N/A
	Measurement Range: 1µV to >200mV Input offset Voltage: < 1µV (with auto zero) Input Resistance: 200 M		
Phantom	**Generic Twin V3.0**	N/A	N/A
	Type: Generic Twin, Homogenous Shell Material: Fiberglass Thickness: 2 ± 0.1 mm Capacity: 20 liter Ear spacer: 4 mm (between EUT ear piece and tissue simulating liquid)		
Simulated Tissue	**Mixture**	N/A	04/12/99
	Please see section 3.2 for details		
Power Meter	**HP** 435A w/ 8481H sensor	1312A01255	02/1/99
	Frequency Range: 100kHz to 18 GHz Power Range: 300µW to 3W		

3.2 Muscle Tissue Simulating Liquid

Ingredient	**Frequency** (800 - 850 MHz)
Water	54.05 %
Sugar	45.05 %
Salt	0.1 %
Bactericide	0.8 %

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

Frequency (MHZ)	ε*	σ*(mho/m)	ρ**(kg/m$^{3)}$
815	56.5 ± 5%	0.94 ± 10%	1000

* *worst case uncertainty of the HP 85070A dielectric probe kit*
** worst case assumption

3.3 E-Field Probe Calibration

Probes were calibrated by the manufacturer in the TEM cell ifi 110. To ensure consistency, a strict protocol was followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution was performed by comparison with temperature measurement and computer simulations. Probe calibration factors are included in Appendix C.

3.4 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [5] and the NIST 1297 [6] documents and is given in the following table. The extended uncertainty (K=2) was assessed to be 23.5 %

UNCERTAINTY BUDGET				
Uncertainty Description	Error	**Distrib.**	**Weight**	**Std.Dev.**
Probe Uncertainty				
Axial isotropy	±0.2 dB	U-shape	0.5	±2.4 %
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %
Isotropy from gradient	±0.5 dB	U-shape	0	
Spatial resolution	±0.5 %	Normal	1	±0.5 %
Linearity error	±0.2 dB	Rectang.	1	±2.7 %
Calibration error	±3.3 %	Normal	1	±3.3 %
SAR Evaluation Uncertainty				
Data acquisition error	±1 %	Rectang.	1	±0.6 %
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %
Conductivity assessment	±10 %	Rectang.	1	±5.8 %
Spatial Peak SAR Evaluation Uncertainty				
Extrapol boundary effect	±3 %	Normal	1	±3 %
Probe positioning error	±0.1 mm	Normal	1	±1 %
Integrat. And cube orient	±3 %	Normal	1	±3 %
Cube shape inaccuracies	±2 %	Rectang.	1	±1.2 %
Device positioning	±6 %	Normal	1	±6 %
Combined Uncertainties				**±11.7 %**

3.5 Measurement Tractability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

4 WARNING LABEL INFORMATION - USA

Not Applicable

5 REFERENCES

[1] ANSI, *ANSI/IEEE C95.1-1991: 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 Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.

[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

[5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.

[6] Barry N. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

6 APPENDIX A - SAR EVALUATION DATA

Please note that the graphical visualization of the phone position onto the SAR distribution gives only limited information on the current distribution of the device, since the curvature of the head results in graphical distortion. Full information can only be obtained either by H-field scans in free space or SAR evaluation with a flat phantom.

Powerdrift is the measurement of power drift of the device over one complete SAR scan.

6.1 806 MHz, EUT base touching Phantom

08/10/99

N79CNI-810D

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 806 MHz

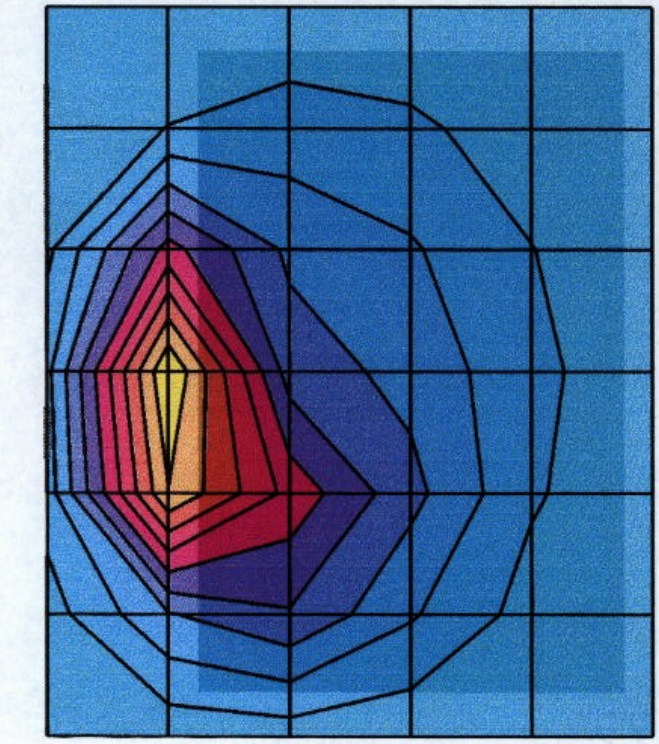
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest factor: 1.0; Muscle 815 MHz: σ = 0.94 mho/m ε_r = 56.5 ρ = 1.00 g/cm³

Cube 5x5x7: SAR (1g): 3.52 mW/g, SAR (10g): 1.98 mW/g * Max outside, (Worst-case extrapolation)

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Powerdrift: -0.34 dB

CW mode, EUT Back touching flat phanton



SAR_{tot} [mW/g]

3.36E+0
3.02E+0
2.69E+0
2.35E+0
2.01E+0
1.68E+0
1.34E+0
1.01E+0
6.72E-1
3.36E-1

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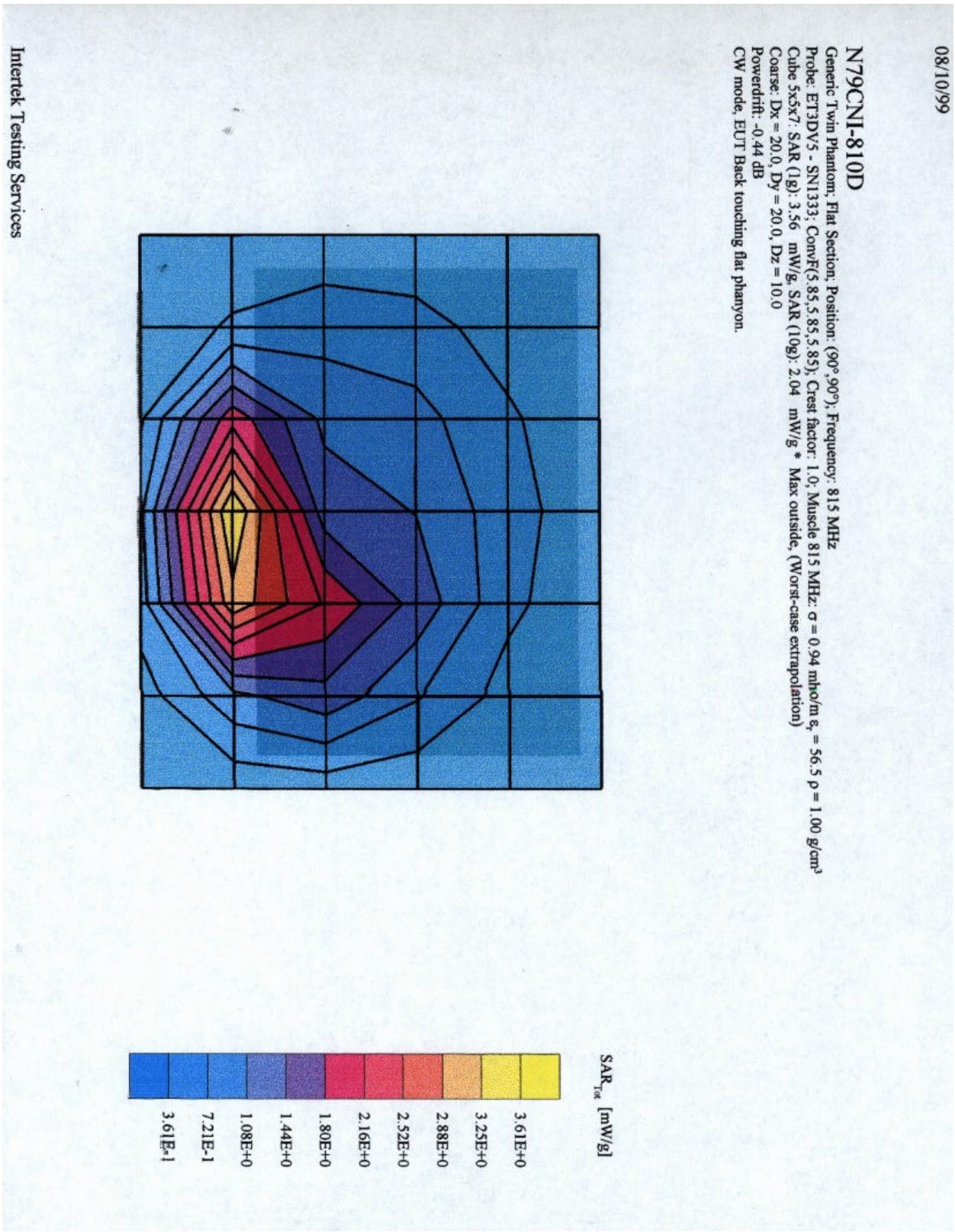
6.2 815 MHz, EUT base touching Phantom



6.3 821 MHz, EUT base touching Phantom

08/10/99

N79CNI-810D

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 821 MHz

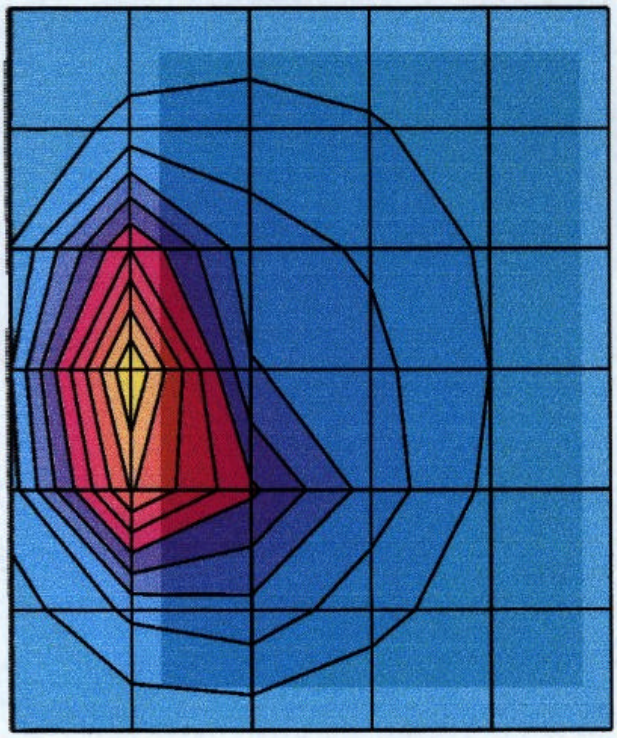
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest factor: 1.0; Muscle 815 MHz: σ = 0.94 mho/m ε_r = 56.5 ρ = 1.00 g/cm³

Cube 5x5x7: SAR (1g): 3.83 mW/g, SAR (10g): 2.20 mW/g * Max outside, (Worst-case extrapolation)

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Powerdrift: -0.12 dB

CW mode, EUT Back touching flat phanton



SAR_{Tot} [mW/g]

4.06E+0
3.65E+0
3.25E+0
2.84E+0
2.43E+0
2.03E+0
1.62E+0
1.22E+0
8.11E-1
4.06E-1

Intertek Testing Services

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7 APPENDIX B - E-FIELD PROBE CALIBRATION DATA

[X] See Separate Attachment
[ ] See Below

A

8 APPENDIX C - TECHNICAL JUSTIFICATION FROM MANUFACTURER

[ ] See separate attachment
[X] See attached

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Communication
Network
Interface, Inc.

51-2, Sungsan 1-dong. Mapo-gu
Seoul 121-251, Korea
Tel: 82 2 330 5626 Fax: 82 2 330 5733

Federal Communications Commission.
Equipment Authorization Div.
Application Processing Branch
7435 Oakland Mills Road
Columbia MD 21045

Subject: Two-way messenger model CNI-810D
(FCC ID: N79CNI-810D)

The SAR measurement is used CW mode with test firmware modified but on DataTac network does not allows the mobile device to control the timing of transmitted packets on a message transaction basis.
This makes that the duty factor is limited to the maximum allowable over all network transactions

The device will intrinsically restrict the transmit duty factor to less than 7.8% in any 6 minute time window due to the software transmission protocol and human ability to setup (typing) the next transmission. 10 second is the absolute minimum requirement for prepares the success transmission.

DUTY CYCLE CALCULATION

The Two Way Messenger model CNI-810D (FCC ID: N79CNI-810D) is designed to use Motorola protocol RD-LAP3.2 and 19200 bps half duplex is data speed.

Transmission unit is PDU(Program Data Unit) and 1 PDU required 512 byte for transmission.

It requires 4 PDU (equals 2,048 byte)maximum for one transmission.

12 byte waiting time is required between each PDU.

It will take 10 second in order to get final deliver successful response from other application terminal.

The maximum transmission duty cycle will be:

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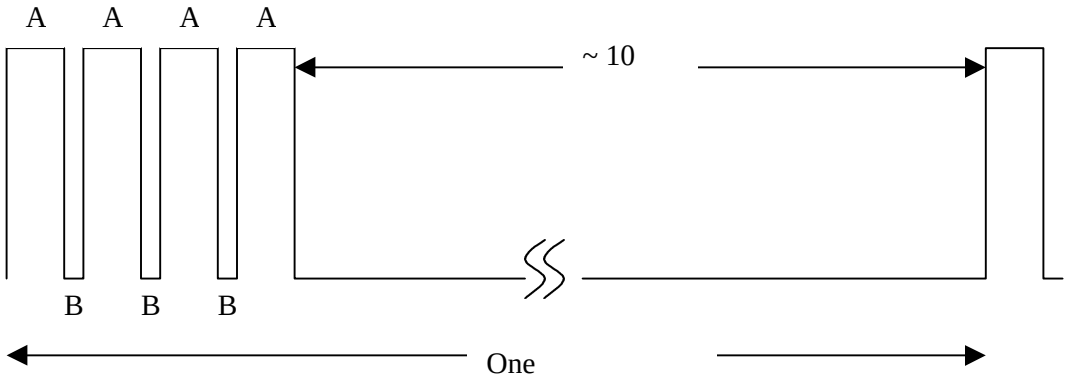
$$\frac{\text{Send PDU}}{\text{send PDU + RX response + successful response}} \times 100 = \text{duty}$$

$$\frac{0.85 \text{ sec}}{0.85 \text{ sec} + 0.005 \text{ sec} + 10 \text{ sec}} \times 100 = 7.83\ \%$$

Remarks:

1. 0,85 sec = 2,048 x 8 / 19,200
2. 0.005 sec = 12 x8 / 19,200
3. 10 sec = shortest response time (worst case)
   remarks: it will take at least 10 sec. to set-up for next transmit.



A: 512
byte

C.N.I. agreed to accept the condition grant for maximum duty factor of 7.8%.

Soon-Pil Choi
RF Staff Engineer

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Date: July 12, 1999

Mr. Soon Pil Ch oi
DNI
51-2, Sungsan 1-dong, Mapo-gu
Seoul 121-251, Korea

Tel.: (82) 2-330-5622
Fax.: (82) 2-330-5733

Ref.:	**FCC Part 2 SAR Evaluation**

Dear Mr. Kim:

Enclosed you will find your file copy of a Part 2 SAR test report for FCC ID: N79CNI-810D. We'll submitted this report via FCC internet website.

Please contact me if you have any questions regarding the enclosed material.

Sincerely,

C. K. Li
Manager/Telco

encl. : Test report