Zeughausstrasse 43, 8004 Zürich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Probe ES3DV2

SN:3019

Additional Conversion Factors

Manufactured:	December 5, 2002
Last calibration:	July 12, 2003
Add. calibration:	October 9, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV2 SN:3019

Sensitivity in Free Space

NormX	**1.05** $\mu V/(V/m)^2$
NormY	**1.14** $\mu V/(V/m)^2$
NormZ	**0.98** $\mu V/(V/m)^2$

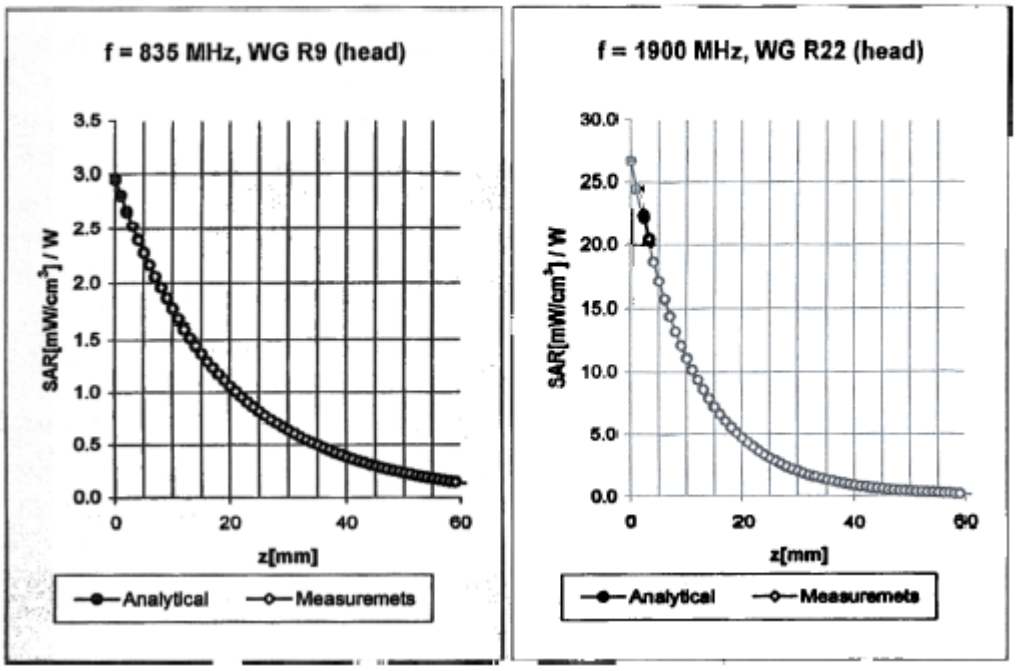
Diode Compression

DCP X	**99**
DCP Y	**99**
DCP Z	**99**

Sensor Offset

Probe Tip to Sensor Center	**2.1**	mm

Conversion Factor Assessment



Head **835 MHz** ε_r = 41.5 ± 5% σ = 0.90 ± 5% mho/m

Valid for f=793-877 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

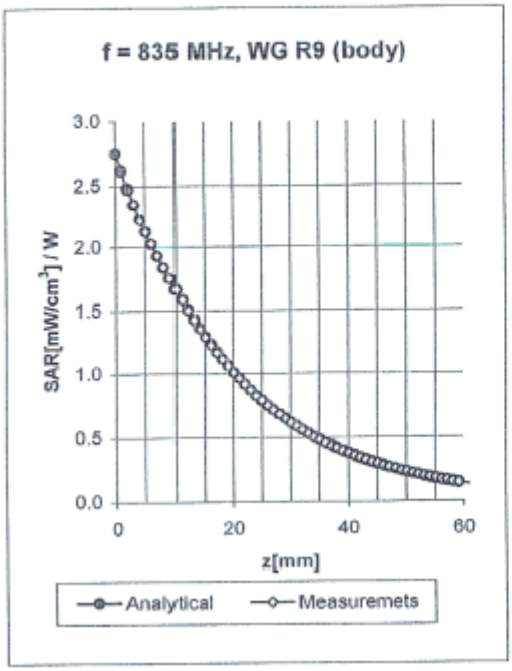
ConvF X	**6.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.5** ± 9.5% (k=2)	Alpha	**0.35**
ConvF Z	**6.5** ± 9.5% (k=2)	Depth	**1.46**

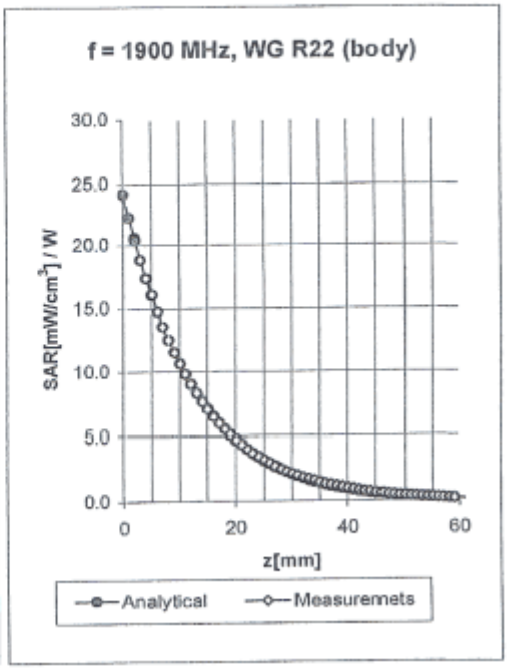
Head **1900 MHz** ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

Valid for f=1805-1995 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**4.7** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.7** ± 9.5% (k=2)	Alpha	**0.22**
ConvF Z	**4.7** ± 9.5% (k=2)	Depth	**3.48**

Conversion Factor Assessment





Body **835 MHz** ε_r **= 55.2 ± 5%** σ **= 0.97 ± 5% mho/m**

Valid for f=793-877 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

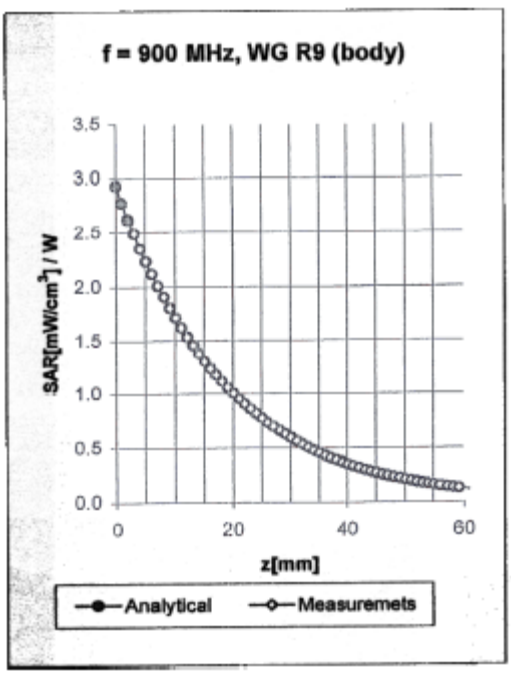
ConvF X	**6.1** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.1** ± 9.5% (k=2)	Alpha	**0.24**
ConvF Z	**6.1** ± 9.5% (k=2)	Depth	**2.00**

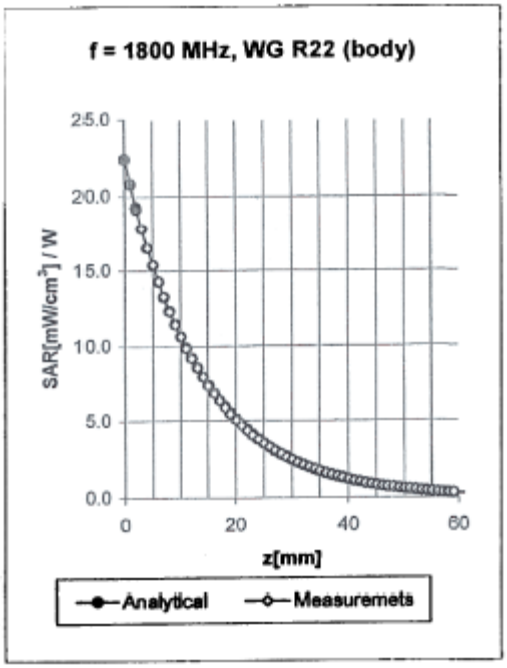
Body **1900 MHz** ε_r **= 53.3 ± 5%** σ **= 1.52 ± 5% mho/m**

Valid for f=1805-1995 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.6** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.6** ± 9.5% (k=2)	Alpha	**0.24**
ConvF Z	**4.6** ± 9.5% (k=2)	Depth	**2.64**

Conversion Factor Assessment





Body 900 MHz ε_r = 55.0 ± 5% σ = 1.05 ± 5% mho/m

Valid for f=855-945 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

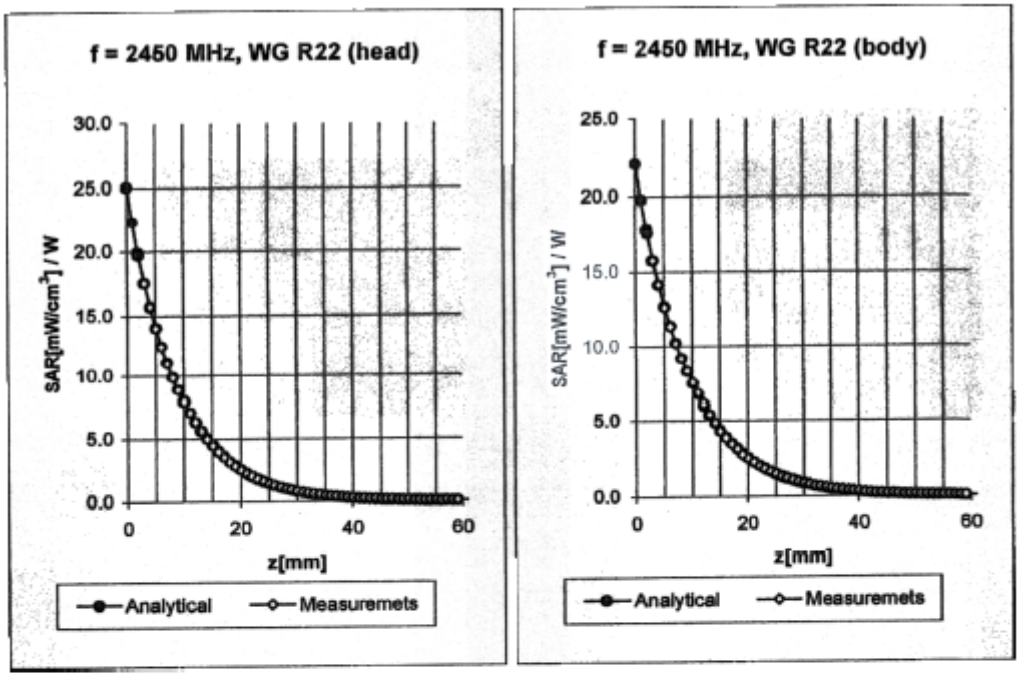
ConvF X	6.1 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.1 ± 9.5% (k=2)	Alpha	0.27
ConvF Z	6.1 ± 9.5% (k=2)	Depth	1.82

Body 1800 MHz ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

Valid for f=1710-1890 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.7** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.7** ± 9.5% (k=2)	Alpha	**0.23**
ConvF Z	**4.7** ± 9.5% (k=2)	Depth	**2.99**

Conversion Factor Assessment



Head **2450 MHz** ε_r = 39.2 ± 5% σ = 1.80 ± 5% mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**4.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.5** ± 9.5% (k=2)	Alpha	**0.40**
ConvF Z	**4.5** ± 9.5% (k=2)	Depth	**1.62**

Body **2450 MHz** ε_r = 52.7 ± 5% σ = 1.95 ± 5% mho/m

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.2** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.2** ± 9.5% (k=2)	Alpha	**0.32**
ConvF Z	**4.2** ± 9.5% (k=2)	Depth	**1.98**

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Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	ES3DV2
Serial Number:	3019
Place of Assessment:	Zurich
Date of Assessment:	October 13, 2003
Probe Calibration Date:	October 9, 2003

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment 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 re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by: 

ES3DV2-SN:3019 October 13, 2003

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV2 SN:3019

Conversion factor (± standard deviation)

150 MHz	ConvF	**8.7 ± 8%**	$\varepsilon_r = 52.3 \pm 5\%$ $\sigma = 0.76 \pm 5\%$ mho/m (head tissue)
150 MHz	ConvF	**8.3 ± 8%**	$\varepsilon_r = 61.9 \pm 5\%$ $\sigma = 0.80 \pm 5\%$ mho/m (body tissue)
450 MHz	ConvF	**7.4 ± 8%**	$\varepsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\%$ mho/m (head tissue)
450 MHz	ConvF	**7.3 ± 8%**	$\varepsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\%$ mho/m (body tissue)

ES3DV2-SN:3019 **October 13, 2003**

APPENDIX C – DIPOLE CALIBRATION CERTIFICATES

Certificate of Calibration Verification

Description of EUT	Tuned Dipole Antenna
EUT Model Number	D450V2
EUT Serial Number	1010
Center Frequency	450 MHz

Calibration Date: 1 April 2004

Testing conditions:

per P1528/D1.2:2003:	
Ambient Temperature (18-25 °C)	19 °C
Ambient Humidity	45%
Liquid Temperature at start of measurements:(±2°C)	18.5 °C
Liquid temperature at end of measurements:	18.5 °C
Date and time at beginning of test:	2004-04-01-16:20 PST
Date and time at beginning of test:	2004-04-01-19:40 PST

Equipment used for measurements

Network Analyzer	HP	8752C	1 Nov 2002
Impedance adapter	AGILENT	43961A	31 Oct 2003
Short Reference	HP	04191-85300	31 Oct 2003
Open Reference	HP	04191-85302	31 Oct 2003
Load Reference	HP	04191-85301	31 Oct 2003
Signal Generator	HP	83650B	29 Feb 2004
Calibration Cable:	SMA Utiflex, 3.05 meter cable S/N 99E1206 (Number 8)		
Phantom Model:			Flat
Liquid:			450 MHz, Head Liquid
Liquid Validation Date:			1 April 2004
Quantity of Liquid in Phantom:			19.8 Liters

Measurement Procedure

In accordance with IEEE P1528/D1.2:2003, 8.3.4, 8.2.3 through 8.2.4

Liquid Validation

Instrument	Manufacturer	Model	Calibrated
Network Analyzer	HP	4396B	1 Nov 2002
Dielectric Probe Kit,	Agilent	85070C	Each Use
H_2O, 18 M-Ohm	BACL		Each Use
Probe, SAR 10 kHz - 6 GHz	SPEAG	ES3DV2	9 Oct 2003

Attestation:

I hereby attest that the equipment are suitable for the performance requirements of IEEE P1528/D1.2:2003 and the personnel operating the test equipment and measurements are properly trained to perform the verification of this calibration procedure set forth in IEEE P1528/D1.2:2003.

The validation antenna herein meets the minimum requirements of 20 dB insertion loss

Hans T. Mellberg
Engineering Manager

1 APR 2004
Date

450MHZ Head Liquid validation Ambient Temp = 23 °C , Liquid Temp = 22 °C , Date : 4-1-2004

Frequency	e'	e''	σ ($\sigma = 2\pi f \epsilon_0 \epsilon''$)
400000000.0000	47.0741	37.0458	
402000000.0000	46.9285	36.9126	
404000000.0000	46.9148	36.7377	
406000000.0000	46.7700	36.5998	
408000000.0000	46.6560	36.4571	
410000000.0000	46.5144	36.3600	
412000000.0000	46.5640	36.1548	
414000000.0000	46.3147	36.1139	
416000000.0000	46.3575	35.8883	
418000000.0000	46.1897	35.7819	
420000000.0000	46.1260	35.7120	
422000000.0000	46.0450	35.7659	
424000000.0000	45.9349	35.5439	
426000000.0000	45.9866	35.4514	
428000000.0000	45.8519	35.2826	
430000000.0000	45.7126	35.2557	
432000000.0000	45.6660	35.1799	
434000000.0000	45.6577	35.0455	
436000000.0000	45.5362	34.9879	
438000000.0000	45.4105	35.0042	
440000000.0000	45.3932	34.7596	
442000000.0000	45.3127	34.7457	
444000000.0000	45.2511	34.6851	
446000000.0000	45.0985	34.5960	
448000000.0000	45.0891	34.4475	
450000000.0000	45.0920	34.3537	0.86
452000000.0000	45.0366	34.2809	
454000000.0000	44.9343	34.1844	
456000000.0000	44.9365	34.1765	
458000000.0000	44.8407	34.1634	
460000000.0000	44.7601	34.0021	
462000000.0000	44.7440	33.9995	
464000000.0000	44.6917	33.9572	
466000000.0000	44.7270	33.7312	
468000000.0000	44.6845	33.7290	
470000000.0000	44.5403	33.6083	
472000000.0000	44.5331	33.5784	
474000000.0000	44.5213	33.5566	
476000000.0000	44.5188	33.4589	
478000000.0000	44.4619	33.3014	
480000000.0000	44.4198	33.2614	
482000000.0000	44.4075	33.1219	
484000000.0000	44.3243	33.0731	
486000000.0000	44.3347	33.0550	
488000000.0000	44.3348	32.9936	
490000000.0000	44.1957	33.0055	
492000000.0000	44.2071	32.9878	
494000000.0000	44.1550	32.8686	
496000000.0000	44.1839	32.8149	
498000000.0000	44.1281	32.6530	
500000000.0000	44.1630	32.6245	

Transmit power set to 127 mW

System validation

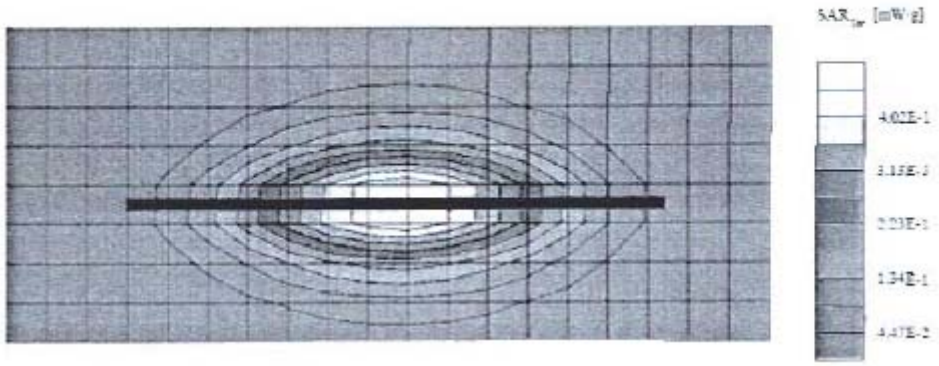
Flat Phantom v4.4 Phantom, Flat Section, Position: (90°, 90°), Frequency: 450 MHz

Probe: ES3DV2 - SN3019; ConvF(7.40,7.40,7.40); Crest factor: 1.0; Head 450 MHz; σ = 0.86 mho/m, ε_r = 43.1, ρ = 1.00 g/cm³

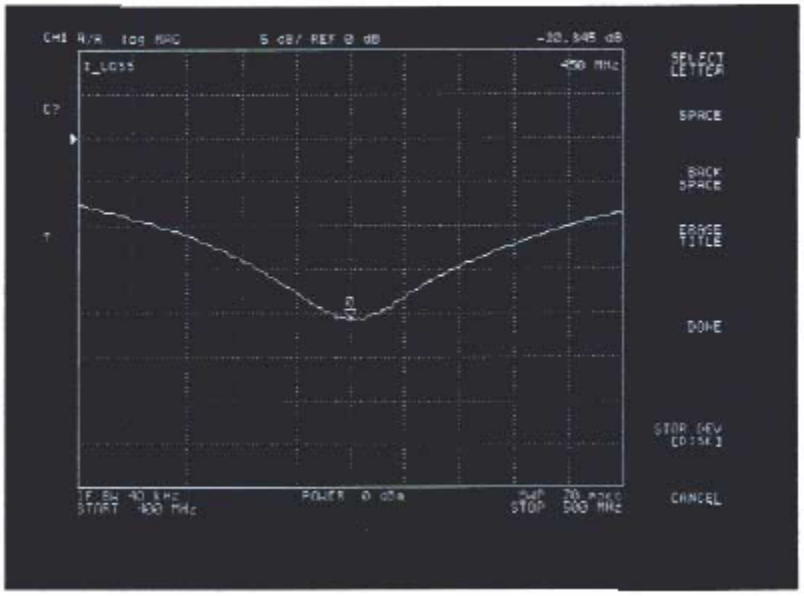
Cube 5x5x7: SAR (1 g): 0.487 mW/g, SAR (10 g): 0.348 mW/g (Worst-case extrapolation)

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

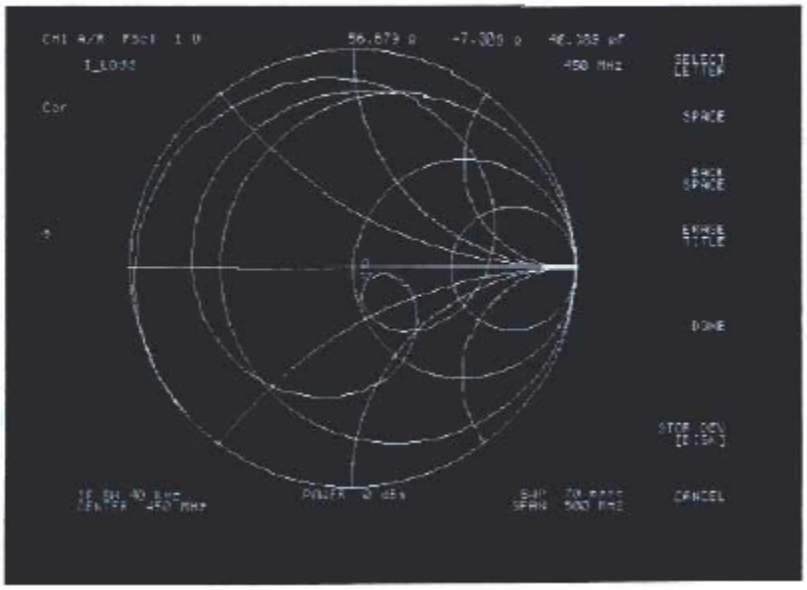
Powerdrift: -0.02 dB



Insertion Loss Plot
S11



Smith Chart



APPENDIX D - TEST SYSTEM VERIFICATIONS SCANS

Liquid Measurement Result

2005-01-05

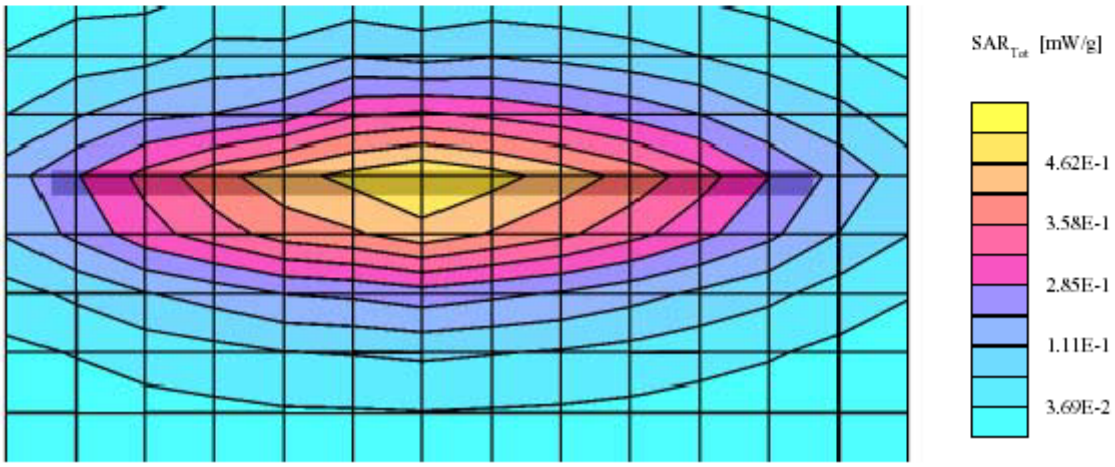
Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation [%]	Limits [%]
Body	450	ε	22	56.7	55.3	-2.47	±5
		σ	22	0.94	0.94	0.00	±5
		1g SAR	22	4.874	4.87	-0.08	±10
Head	450	ε	22	43.5	42.3	-2.76	±5
		σ	22	0.87	0.86	-0.82	±5
		1g SAR	22	4.9	4.86	-0.82	±10

ε = relative permittivity, σ = conductivity and ρ=1000kg/m^3

Note: Forward power for Body = 20.04 dBm = 100.93 mW
Forward power for Head = 20.14 dBm = 103.28 mW

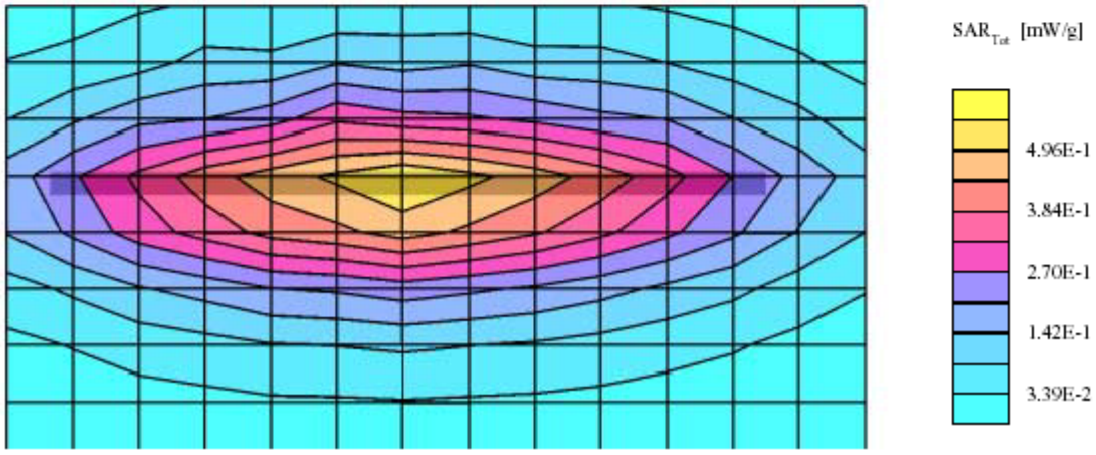
450 MHz Body Liquid System Validation (Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, Forward Power = 20.04 dBm, 01/05/2005)

SAM Phantom; Flat Section; Position: (90°,270°); Frequency: 450 MHz
Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; (Body liquid) 450 MHz: σ = 0.94 mho/m ε_r = 55.3 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.492 mW/g, SAR (10g): 0.233 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.01 dB



450 MHz Head Liquid System Validation (Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, Forward Power = 20.14 dBm, 01/05/2005)

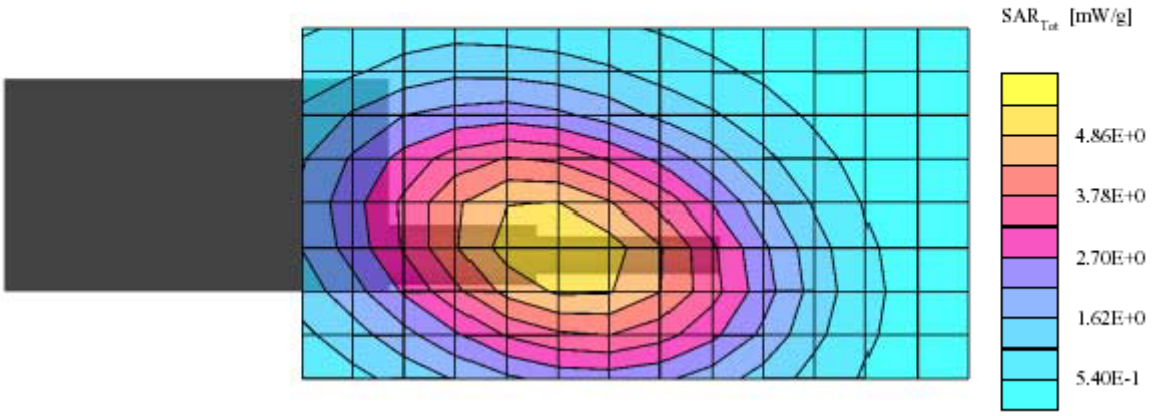
SAM Phantom; Flat Section; Position: (90°,270°); Frequency: 450 MHz
Probe: ES3DV2 - SN3019; ConvF(7.40,7.40,7.40); Crest factor: 1.0; (Head liquid) 450 MHz: σ = 0.86 mho/m ε_r = 42.3 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.502 mW/g, SAR (10g): 0.326 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.00 dB



APPENDIX E - EUT SCANS

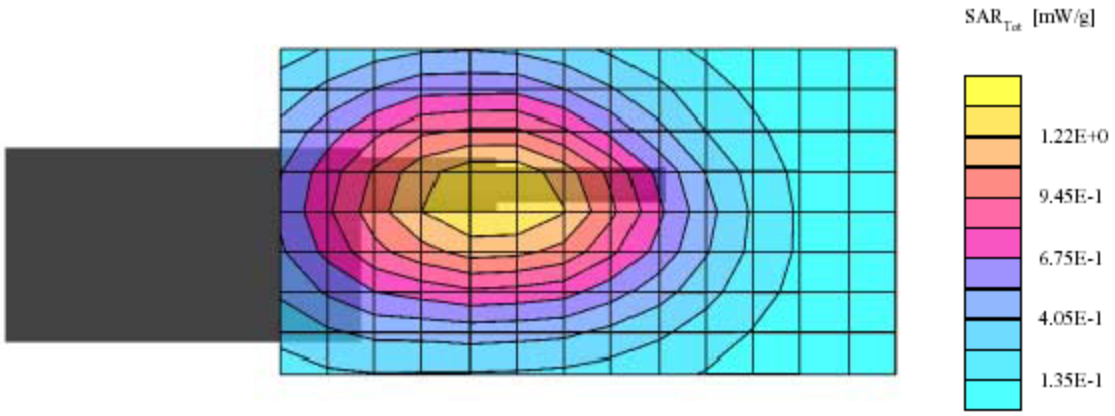
HYT, Model: TC 3600-KU(2) (Body-worn , Back touch flat phantom with accessory (beltclip and headset), Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 01/05/2005)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 455.25 MHz
Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz body liquid: σ = 0.94 mho/m ε_r = 55.3 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 4.32 mW/g, SAR (10g): 3.31 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.02 dB



Plot #1

HYT, Model: TC 3600-KU (2) (2.5 cm separation to flat phantom with accessory (beltclip and headset), Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 01/05/2005)
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 455.25 MHz
Probe: ES3DV2 - SN3019; ConvF(7.40,7.40,7.40); Crest factor: 1.0; 450 MHz head liquid: σ = 0.86 mho/m ε_r = 42.3 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.41 mW/g, SAR (10g): 1.08 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.02 dB



Plot #2

APPENDIX F – CONDUCTED OUTPUT POWER MEASUREMENT

Provision Applicable

According to FCC §22.913 (a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts. According to FCC § 24.232(b), EIRP peak power for mobile/portable stations are limited to 2 watts.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

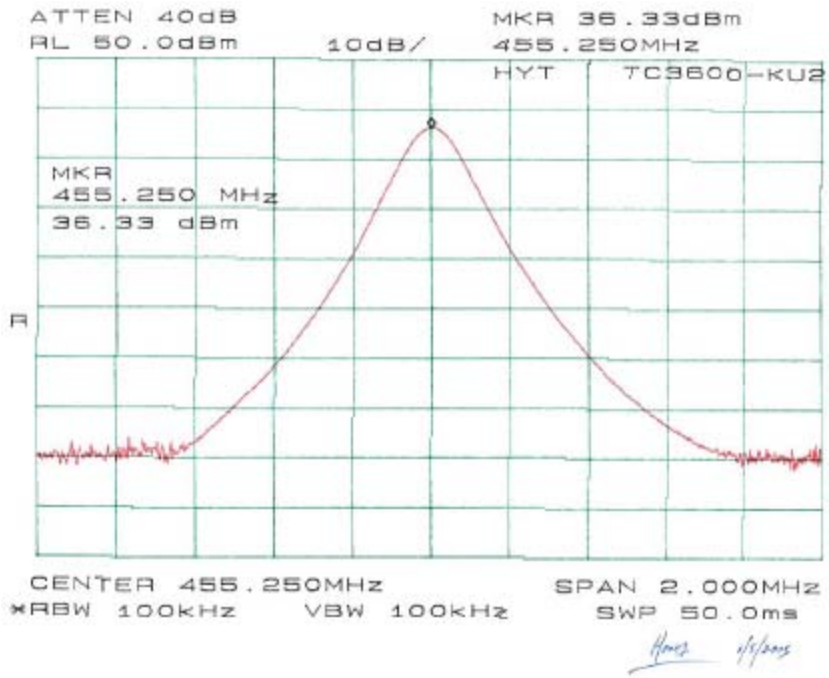
Test equipment

Hewlett Packard HP8564E Spectrum Analyzer, Calibration Due Date: 2005-08-01.
Hewlett Packard HP 7470A Plotter, Calibration not required.
A.H. Systems SAS200 Horn Antenna, Calibration Due Date: 2005-05-31
Com-Power AB-100 Dipole Antenna, Calibration Due Date: 2005-09-05

Test Results

Frequency (MHz)	Output Power in dBm	Output Power in W
455.250	36.33	4.30

Please refer to the following plots.



APPENDIX G – Z-AXIS PLOT

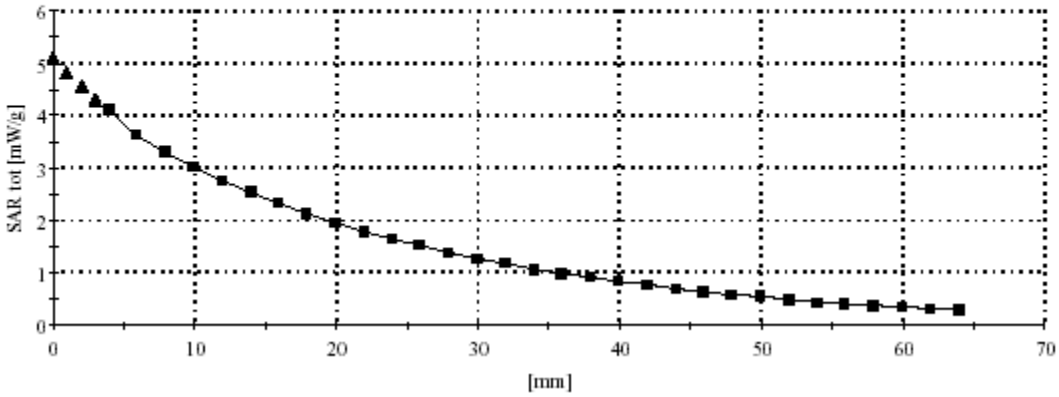
HYT, Model: TC 3600-KU(2) (Body-worn , Back touch flat phantom with accessory (beltclip and headset), Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 01/05/2005)

SAM Phantom; Section; Position: ; Frequency: 455 MHz

Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz body liquid: σ = 0.94 mho/m ε_r = 55.3 ρ = 1.00 g/cm^3

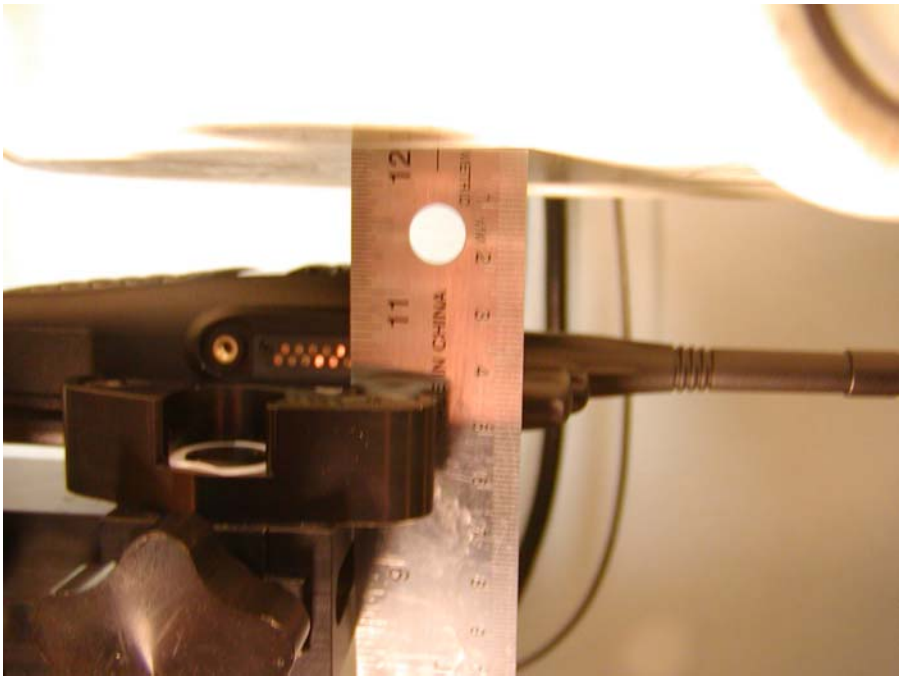
: , 0

Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 2.0



APPENDIX H – EUT TEST POSITION PHOTOS

2.5cm Head Separation to Flat Phantom



Back Touching with Flat Phantom with Belt Clip and Headset

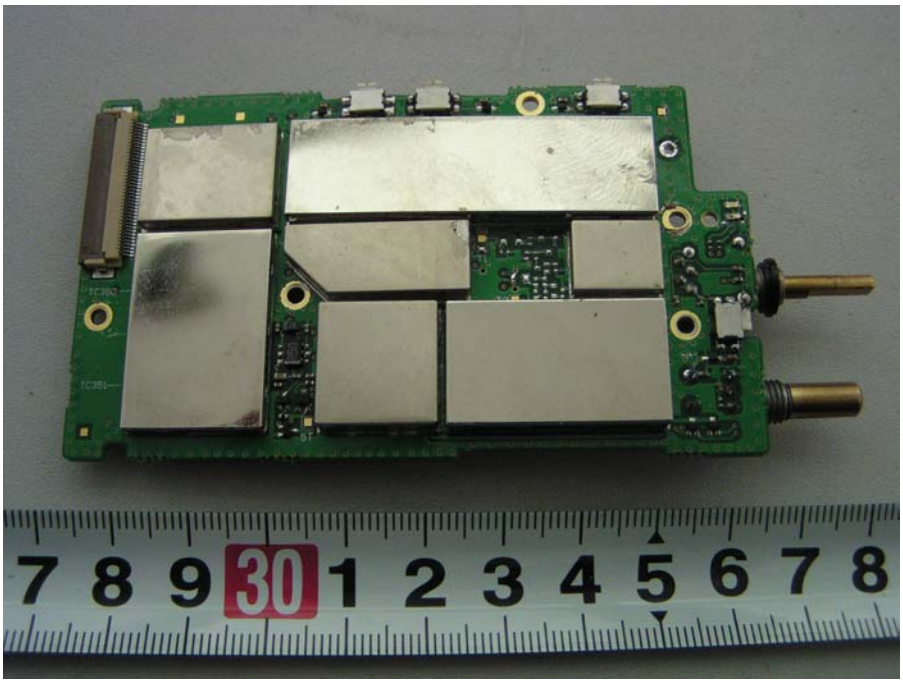
APPENDIX I – EUT & ACCESSORIES PHOTOS

EUT – Front View

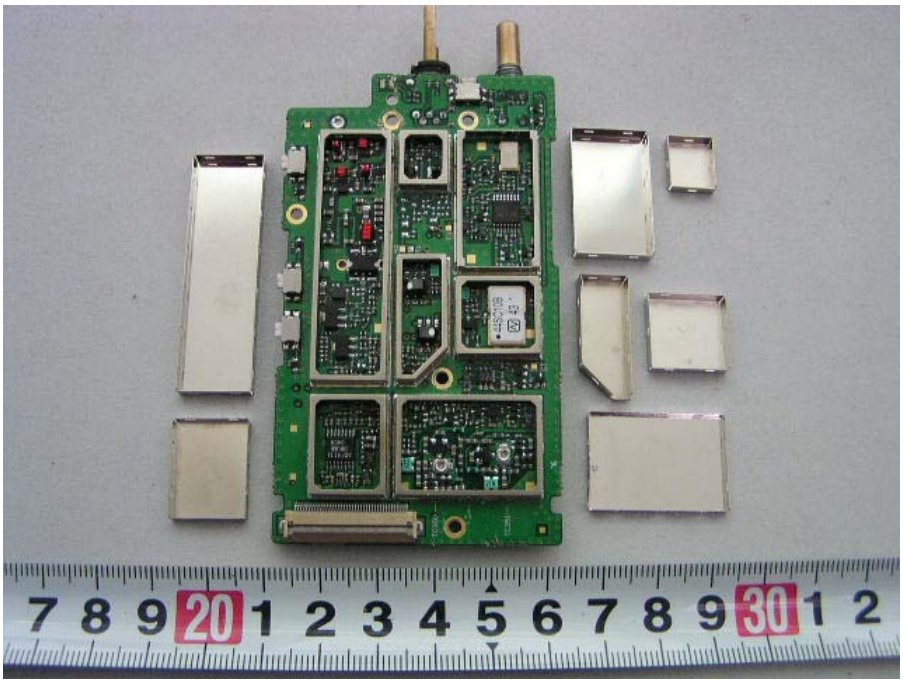
EUT – Rear View

EUT – Battery Removed Back View

Board – Top View

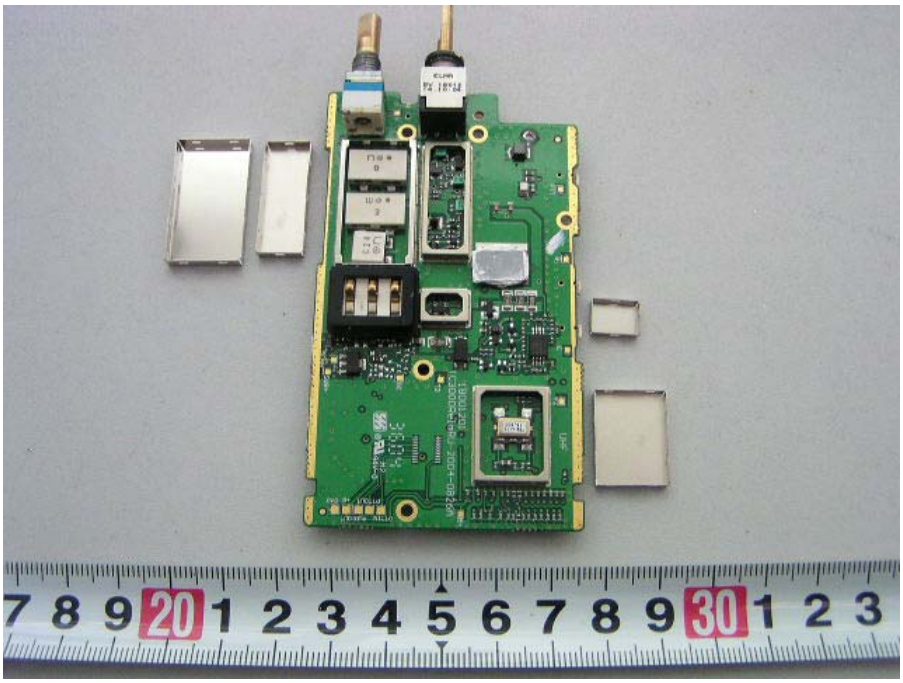


Board – Top Shield Cover Removed View



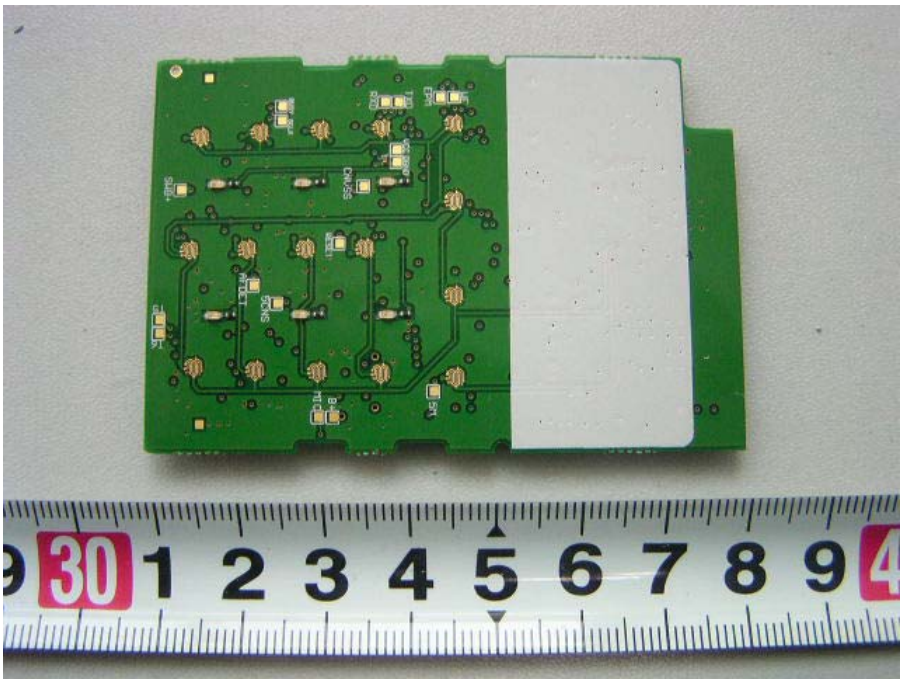
Board – Bottom View

Board – Bottom Shield Cover Removed View

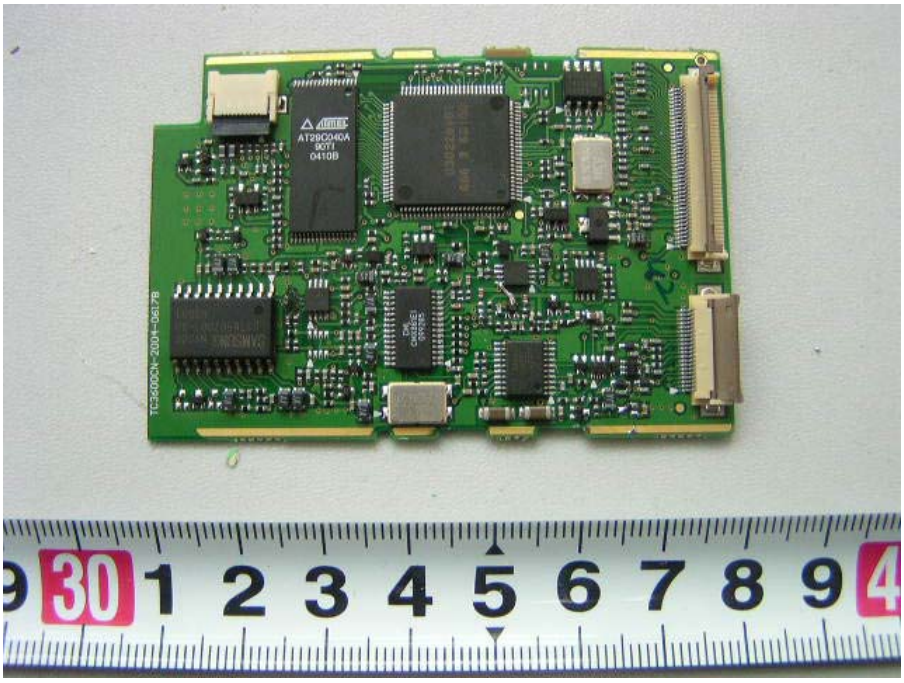


Display Board and Housing

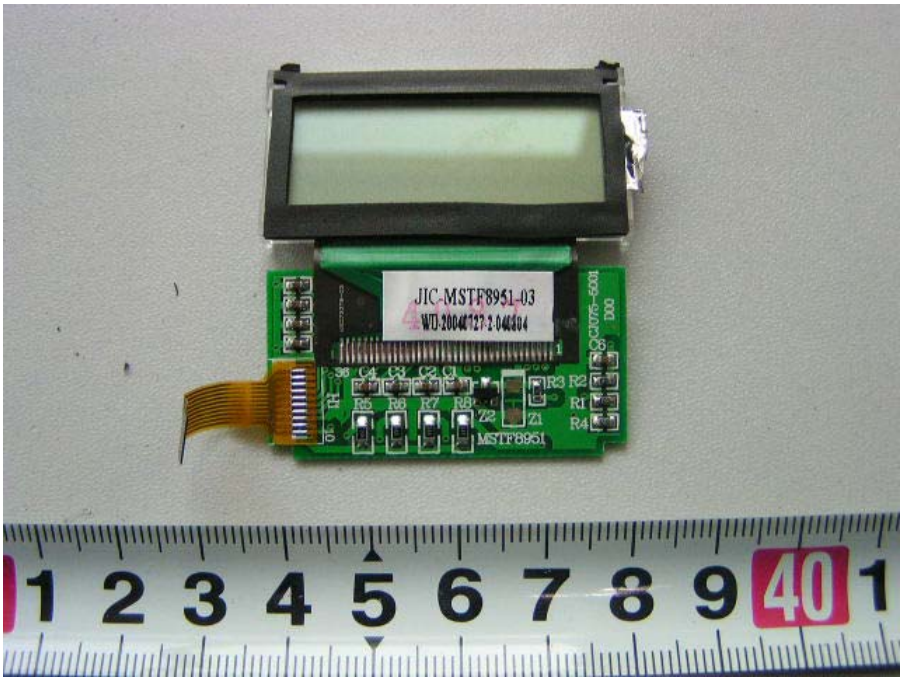
Display Board Top View



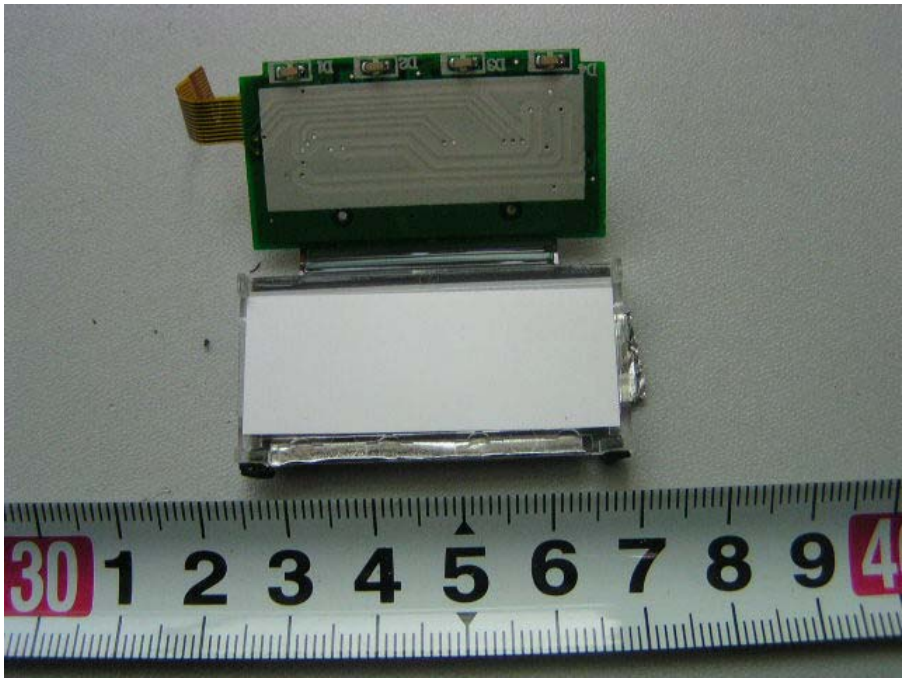
Display Board Bottom View



Screen Board Top View



Screen Board Bottom View



Charger – Top View

Charger – Bottom View

Adapter View

APPENDIX J - INFORMATIVE REFERENCES

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