MOTOROLA

FCC ID: AZ489FT546
DECLARATION OF COMPLIANCE HAC ASSESSMENT

Motorola Florida Corporate Research Laboratory
8000 West Sunrise Blvd
Fort Lauderdale, FL. 33322

Date of Report: September 21, 2005
Report Revision: Rev. O
Report ID: FCC HAC rpt_i870_Rev O_050921

Responsible Engineer:	Mike Kanda
Date/s Tested:	9/11/05
Manufacturer/Location:	Motorola - Plantation
Sector/Group/Div.:	iDEN Subscriber
Date submitted for test:	9/8/05
DUT Description:	i870; iDEN1: 1:3 TDMA; 16 QAM 806-825; 896-902 MHz
Test TX mode(s):	1:3
Max. Power output:	iDEN - 0.640W; Pulse Averaged; Factory-tuned
Nominal Power:	iDEN - 0.600W; Pulse Averaged; Factory-tuned
TX Frequency Bands:	iDEN - 806-825, 896-902 MHz
Signaling type:	TDMA: iDEN
Model(s) Tested:	H85XAH6RR5AN
Model(s) Certified:	H85XAH6RR5AN
Serial Number(s):	364YFQ86X1
Rule Part(s):	20.19

Approved Applicable Accessories:

Battery(ies):

SNN5705 (750mAh Li Ion)

NNTN4655 (High Capacity Li Ion)

Max E Field emission = 43.62 V/m @ 806MHz
Max H Field emission = 0.105 A/m @ 806MHz
M Category = M4

/s/ Al Wieczorek (signed)
Al Wieczorek; Motorola iDEN Subscriber Division

Approval Date: 9/21/05

Certification Date: 9/21/05

APPENDICES

REVISION HISTORY

Date	Revision	Comments
9/21/05	O	Initial release

1.0 Introduction and Overview

This report details the utilization, test setup, test equipment, and test results of the Hearing Aid Compatibility (HAC) measurements performed at the Motorola Corporate Research Lab for the model number H85XAH6RR5AN of FCC ID: AZ489FT5846. Measurements were performed to ensure compliance to the PC63.19-2001 rd 3.6 standard. This report demonstrates compliance for near field emissions only and not for the T-coil performance compliance.

The test results presented herein clearly demonstrate compliance FCC 47 CFR section 20.19 and with the latest version of PC63.19-2001 rd 3.6 and only reflect the performance of the stated model herein.

2.0 Near Field Compliance Criteria (Per PC63.19-2001 rd 3.6)

Category	**Target Parameters**		
Near Field M-Rating	**AWF**	**E-Field Emissions Peak -V/m**	**H-Field Emissions Peak - A/m**
M3	iDEN = 0	63.1 – 112.2	0.19 – 0.34
M4	iDEN = 0	<63.1	<0.19

3.0 Description of Device Under Test (DUT)

FCC ID: AZ489FT5846 is a digital multi-service data capable device that employs time division multiplexing transmission technology with a duty cycle ranging from 16.67% to 33.33% using 16-QAM modulation for voice or circuit data transmission. This device may be used while held against the head in voice mode. FCC ID: AZ489FT5846 is capable of operating in the 806-825 MHz and 896-902 MHz bands. The rated power is 0.6 watts pulse averaged.
The maximum output is 0.640 watts pulse average as defined by the upper limit of the production line final test station. The DUT was tuned to be within 5% of the maximum rated power.

4.0 Test Equipment List

Equipment Type	**Model Number**	**Serial Number**	**Calibration Due Date**
HP Power Meter	HP4418B	US39251267	7/25/06
Spectrum Analyzer	HP8566A	2140A01129	
PST Power Amplifier	AR2729-10	M2K2A00	CNR
Signal Generator	HP4432B	US538330732	1/14/06
Directional Coupler (NARDA)	3020A	O4017	9/23/05
H-Field probe	H3DV6	6036	1/7/06
E-Field probe	ER3DV6R	2246	6/13/06
SPEAG	DASY4	Version 4.5 B19.2	NA
Data Acquisition Electronics (DAE)	NA	357	1/7/06

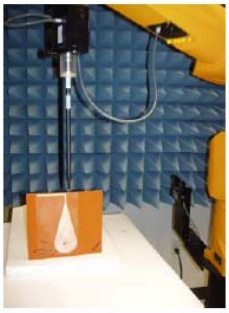
5.0 Descriptions of Measurement System

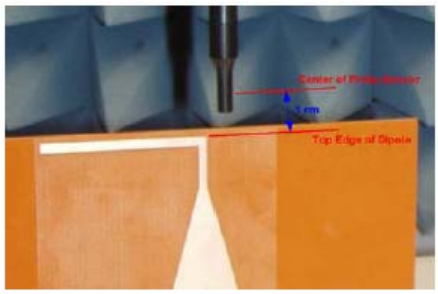
The laboratory utilizes a Dosimetric Assessment System (DASY4™) S.A.R. measurement system Version 4.5 B19.2 manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. The test system consists of a Stäubli RX90L robot, DAE3V1, ER3DV6R E-Field probe, H3DV6 H-field probe, as well as the integrated HAC extension. Please reference the SPEAG user manual and application notes for detailed probe, robot, and HAC calibration and computational procedures. Section 3.0 presents relevant test equipment information. Appendices C present the applicable calibration certificates. Additional details concerning the test system measurement methods and calculations are provided in Appendix D.

The DASY4™ system is operated per the instructions in the DASY4™ Users Manual. The complete manual is available directly from SPEAG™. All measurement equipment used to assess EME HAC compliance was calibrated according to 17025 A2LA guidelines.

6.0 Measurement System Verification

The HAC measurements were conducted with E and H field probes model/serial numbers ER3DV6R/SN2246 and H3DV6/SN6036. An un-modulated CW signal was used for system verification following the guidelines specified in the referenced standard. Note that the 1 cm probe to dipole separation is measured from the top surface of the dipole to the calibration reference point of the probe. The DASY4 output files of the system verification test results are included in Appendix A. The photos below depict the validation setup using a planar dipole per ANSI PC63.19 section 4.2.2.1.4. Section 6.1 summarizes the system performance check results.





6.1 System Verification Test Results

In accordance with C63.19-2005 clause 4.2.2.1 setup verification measurement results listed and compared with expected values in the following table using an unmodulated signal (CW) from a commercially available signal generator to drive the reference dipole. Plots of the field distributions observed while scanning the dipole are shown in Appendix A.

Table 1 – System verification measurements using a CW source

Frequency	Input power (W)	E-Field Results (V/m)	C63.19 Target (V/m)	% Deviation
813.5	0.100	202.8	206.6	-1.8
898.5	0.100	191.1	200	-4.5

Frequency	Input power (W)	H-Field Results (A/m)	C63.19 Target (A/m)	% Deviation
813.5	0.100	0.508	0.497	2.2
898.5	0.100	0.484	0.499	-3.0

C63.19 clause 4.2.2.1.2 recommends additional test cases, one of which is to compare results from an 80% amplitude modulated (AM) signal with the CW results. The results obtained are listed below:

Table 2 – System verification measurements using 80% AM modulation

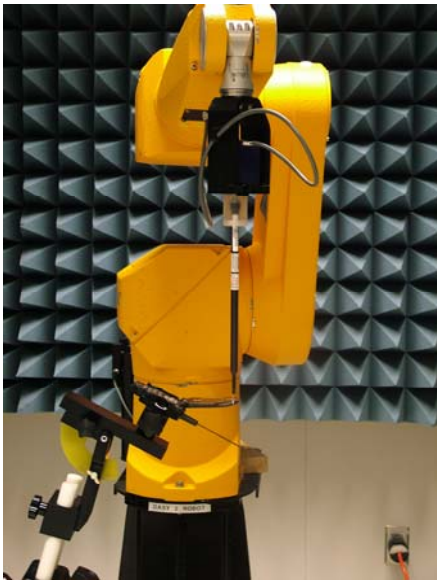
Freq	Meas.	Target	% Diff
813 E	209.4	206.6	-1.4%
813 H	496.8	497.3	-0.1%
898 E	183.5	200	-8.3%
898 H	479	498.9	-4.0%

An additional recommend test case is the emulated or real test signal. Unfortunately no calibrated test set or signal generator emulating the iDEN protocol is commercially available that has the capability to accurately reproduce the quad 16-QAM signal. Alternatively the results for iDEN modulation were obtained using the device under test as a signal source to drive the antenna via an antenna adapter and an attenuator to produce field strengths similar to that of the device under test. That data is provided in Section 10 where it is compared to CW modulation during the measurement of the probe modulation response, per the alternate procedure given in C63.19-2005 Annex C.3.1.

7.0 DUT Setup and Test Procedure

Test Procedure

The automated test procedure guidelines presented in PC63.19-2001 section 4.3.1.2.2 were followed in order to demonstrate HAC compliance. The photos below depict the DUT test setup. The reference grid depicts the alignment with the center of the acoustic output used for coupling to hearing aid devices. The test results using embedded test mode software with an unlighted display are presented in section 9.0.



DUT test setup with 10mm spacing

Example illustration of WD with reference grid (Not to scale)

8.0 Environmental Test Conditions

The table below presents the range and average environmental conditions during the HAC tests reported herein:

	Target	Measured
Ambient Temperature	23 ˚C +/- 5 ˚C	Within Guidelines
Relative Humidity	0 - 80 %	Within Guidelines

The EME Lab RF environment uses a Spectrum Analyzer to monitor for extraneous large signal RF contaminants that could possibly affect the test results. If such unwanted signals are discovered the HAC scans are repeated. Per the pretest procedures in PC63.19-2001 rd 3.6 section 4.3.1.1 footnote 13, interference from reflective objects was found not to exceed -20dB.

9.0 Test Results Summary

The values listed in Table 3 and Table 4 below were calculated by multiplying the highest value in a non-excluded grid cell for each scan in Appendix B by the applicable Probe Modulation Factor determined in section 10 for the frequency band in which the handset transmitted during the scan. For example the value for the first scan in Appendix B was calculated as follows:

23.2 V/m (for grid 8 on page 19) x 1.88 (for 806-825 MHz band) = 43.616 V/m.

Table 3 – 800 MHz Band

Freq.	Conducted Po (W)	E-Field (V/m)	Data Page	E-Field excluded cells	H-Field (A/m)	Data Page	H-Field excluded cells	M-Rating
806	0.640	43.62	19	1, 4, 7	0.105	23	1, 4, 7	M4
813.5	0.640	43.05	20	1, 2, 4	0.099	24	1, 4, 7	M4
821	0.640	42.68	21	1, 2, 4	0.097	25	1, 4, 7	M4
824	0.640	40.23	22	1, 2, 4	0.094	26	1, 4, 7	M4

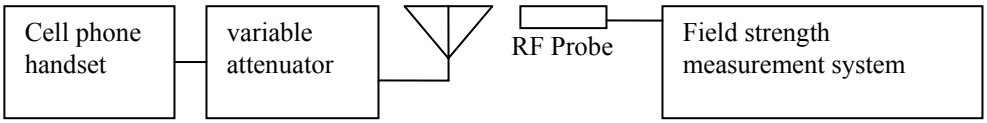
Table 4 – 900 MHz Band

Freq.	Conducted Po (W)	E-Field (V/m)	Data Page	E-Field excluded cells	H-Field (A/m)	Data Page	H-Field excluded cells	M-Rating
896	0.640	30.91	27	1, 2, 3	0.090	30	1, 2, 3	M4
899	0.640	32.20	28	1, 2, 3	0.088	31	1, 2, 3	M4
901	0.640	22.08	29	1, 2, 3	0.065	32	1, 2, 3	M4

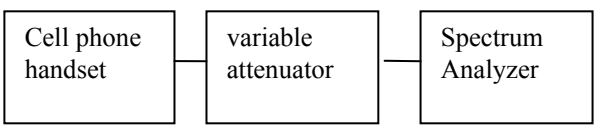
Probe rotations were done at the highest measured location for each data page. These have been marked on the worst-case contour plots in Appendix B.

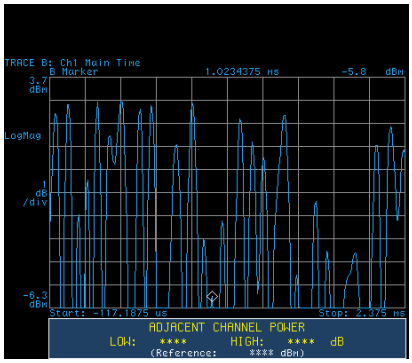
10.0 Probe modulation factor measurement

A - Per C63.19 rd 3.6 alternate measurement procedure steps 1, 2 and 3 the phone was set into a test mode at rated output power. The phone was connected to the reference dipole antenna through an attenuator to assure the E-field probe reading on the field strength measurement system was in the range corresponding to a C63.19 category rating of M2, as illustrated below. The crest factor of the DASY measurement system was set equal to the TDM multiplex factor (3) and the probe reading recorded as noted in Table 1.

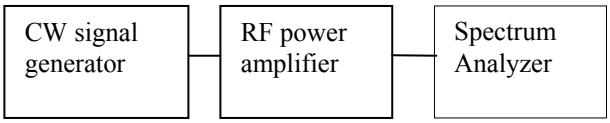


B - The phone was then connected to a spectrum analyzer as illustrated below. Similar to C63.19 rd 3.6 Figure C-1 step 5, the analyzer was set for zero span (with a time span of 2.5ms. and amplitude scale of 1 dB/div to clearly show the peak amplitude and frequency of the digital modulation symbols that occur at a 4 kHz rate). As shown in the following spectrum analyzer display the peaks were set to 1 dB less than full scale.

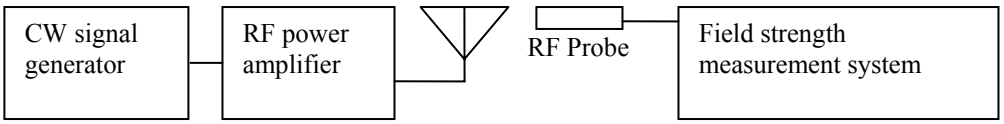




C - Per C63.19 rd 3.6 step 4 an unmodulated signal from a signal generator operating at the same frequency as the phone was amplified and applied to the spectrum analyzer in lieu of the phone and attenuator, as illustrated below. Per C63.19 rd 3.6 Figure C-1 step 6 the peak amplitude of the signal generator was set equal to the peak amplitude observed with the phone signal; i.e., 1 dB less than full scale indication on the spectrum analyzer.



D - Per C63.19 rd step 6 the signal applied to the spectrum analyzer was then applied to the reference dipole as shown in Figure 5, The crest factor of the DASY measurement system was set to unity and the probe reading was recorded as noted in table 1.



E - Per C63.19 rd 3.6, step 7 the square root of the ratio of the reading in D above divided by the reading in B above is calculated as the probe modulation factor and listed in Table 1.

F - The above procedure is repeated for an H-field RF probe.

Table 5 – Probe Modulation Factor (PMF) data

Probe Model-SN	MHz	Source	Field strength (V/m or A/m)	PMF
ER3DV6R - 2246	813.5	Handset	93.8	1.88
ER3DV6R - 2246	813.5	E4432B/ AR Model SW1000	26.4	
ER3DV6R - 2246	898.5	Handset	78.8	1.84
ER3DV6R - 2246	898.5	E4432B/ AR Model SW1000	23.4	
H3DV6 - 6036	813.5	Handset	357	1.87
H3DV6 -6036	813.5	E4432B/ AR Model SW1000	102	
H3DV6 – 6036	898.5	Handset	346	1.80
H3DV6 – 6036	898.5	E4432B/ AR Model SW1000	107	

11.0 Uncertainty Budget

Motorola Uncertainty Budget for E-Field HAC Testing

Error	Value (R=1)	Distribution	Div	Std Unc	Unc^2	Source
RF Reflections	5.6%	R	1.73	3.2%	0.10%	From Reflection Test 050628.xls
Probe Calibration	5.1%	N	1.00	5.1%	0.26%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Isotropy	3.6%	R	1.73	2.1%	0.04%	From averaged results from iDEN HAC Tests i730, 850, 855, 450, 560 formatted.xls
Frequency Response						
Linearity	4.7%	R	1.73	2.7%	0.07%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Boundary Effects	2.4%	R	1.73	1.4%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Sensor Displacement	16.5%	R	1.73	9.5%	0.91%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Probe Positioning accuracy	2.7%	R	1.73	1.6%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Probe Positioner	1.2%	R	1.73	0.7%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Extrapolation/Interpolation	1.0%	R	1.73	0.6%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
System Detection Limit	1.0%	R	1.73	0.6%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Readout Electronics	0.3%	N	1.00	0.3%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Integration Time	2.6%	R	1.73	1.5%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Response Time	0.8%	R	1.73	0.5%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
RF Ambient Conditions	3.0%	R	1.73	1.7%	0.03%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Vertical Device Positioning	4.7%	R	1.73	2.7%	0.07%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Lateral Device Positioning	1.0%	R	1.73	0.6%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Device Holder	1.4%	N	1.00	1.4%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Power Drift	2.9%	R	1.73	1.7%	0.03%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
			Comb Std. Uncertaint		12.7%	
			Exp Uncertainty		25.5%	

Motorola Uncertainty Budget for H-Field HAC Testing

Error	Value (R=1)	Distribution	Div	Std Unc	Unc^2	Source
RF Reflections	5.6%	R	1.73	3.2%	0.10%	From Reflection Test 050628.xls
Probe Calibration	5.1%	N	1.00	5.1%	0.26%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Isotropy	3.6%	R	1.73	2.1%	0.04%	From averaged results from iDEN HAC Tests i730, 850, 855, 450, 560 formatted.xls
Frequency Response						
Linearity	4.7%	R	1.73	2.7%	0.07%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Boundary Effects	2.4%	R	1.73	1.4%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Sensor Displacement	2.4%	R	1.73	1.4%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Probe Positioning accuracy	3.1%	R	1.73	1.8%	0.03%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Probe Positioner	0.9%	R	1.73	0.5%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Extrapolation/Interpolation	1.0%	R	1.73	0.6%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
System Detection Limit	1.0%	R	1.73	0.6%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Readout Electronics	0.3%	N	1.00	0.3%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Integration Time	2.6%	R	1.73	1.5%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Response Time	0.8%	R	1.73	0.5%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
RF Ambient Conditions	3.0%	R	1.73	1.7%	0.03%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Vertical Device Positioning	3.1%	R	1.73	1.8%	0.03%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Lateral Device Positioning	0.6%	R	1.73	0.3%	0.00%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Device Holder	1.4%	N	1.00	1.4%	0.02%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
Power Drift	2.9%	R	1.73	1.7%	0.03%	SPEAG DASY Chapter 28 Hearing Aid Extention (Draft)
			Comb Std. Uncertaint		8.4%	
			Exp Uncertainty		16.7%	

12.0 Conclusion

The highest Operational Maximum Calculated E and H field emissions results found for FCC ID: AZ489FT5846, model H85XAH6RR5AN are presented below. In accordance with FCC rule 47 CFR 2.1033(d) these test results clearly demonstrate compliance with FCC 47 CFR section 20.19 and with PC63.19-2001 rd 3.6.

Max E Field emission = 43.62 V/m @ 806MHz
Max H Field emission = 0.105 A/m @ 806MHz
M Category = M4

APPENDIX A

System Verification Results

Test Laboratory: Motorola

050907 813 E validation

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:xxx

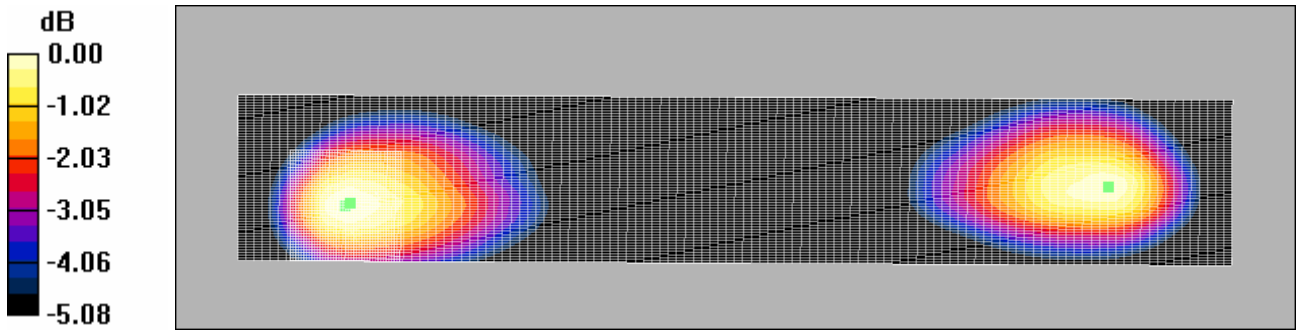
Communication System: CW; Frequency: 813 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: Dipole Reference Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ER3DV6R - SN2246; ConvF(1, 1, 1); Calibrated: 6/13/2005
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn357; Calibrated: 1/6/2005
- Phantom: HAC Free Space Phantom; Type: Air ; Serial: Not Specified
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 147

813 MHz Validation/Generic Scan (61x121x1): Measurement grid: dx=5mm, dy=15mm, dz=20mm
Maximum value of E_tot (interpolated) = 208.5 V/m

813 MHz Validation/Generic Scan 2 (41x41x1): Measurement grid: dx=5mm, dy=5mm, dz=20mm
Maximum value of E_tot (interpolated) = 202.8 V/m



Test Laboratory: Motorola

050907 898 E validation

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:xxx

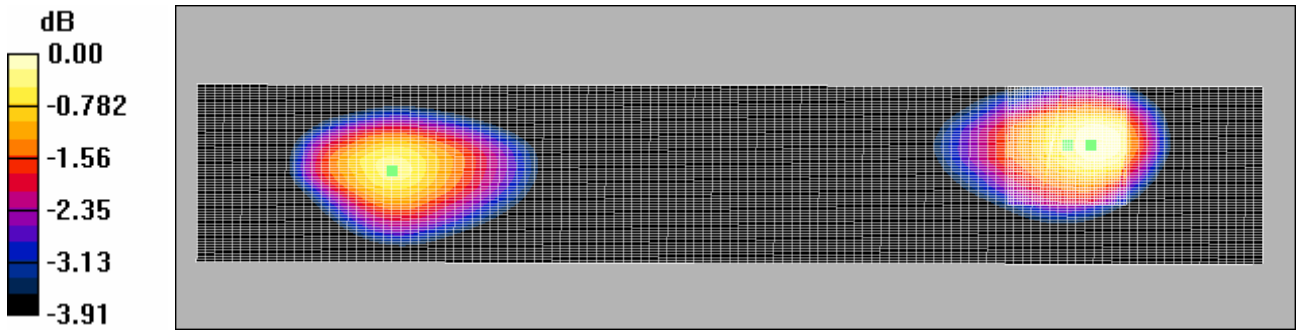
Communication System: CW; Frequency: 898 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: Dipole Reference Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ER3DV6R - SN2246; ConvF(1, 1, 1); Calibrated: 6/13/2005
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn357; Calibrated: 1/6/2005
- Phantom: HAC Free Space Phantom; Type: Air ; Serial: Not Specified
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 147

898 MHz Validation/Generic Scan (61x121x1): Measurement grid: dx=5mm, dy=15mm, dz=20mm
Maximum value of E_tot (interpolated) = 191.2 V/m

898 MHz Validation/Generic Scan 2 (41x41x1): Measurement grid: dx=5mm, dy=5mm, dz=20mm
Maximum value of E_tot (interpolated) = 191.1 V/m



Test Laboratory: Motorola

050907 813 H validation

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:xxx

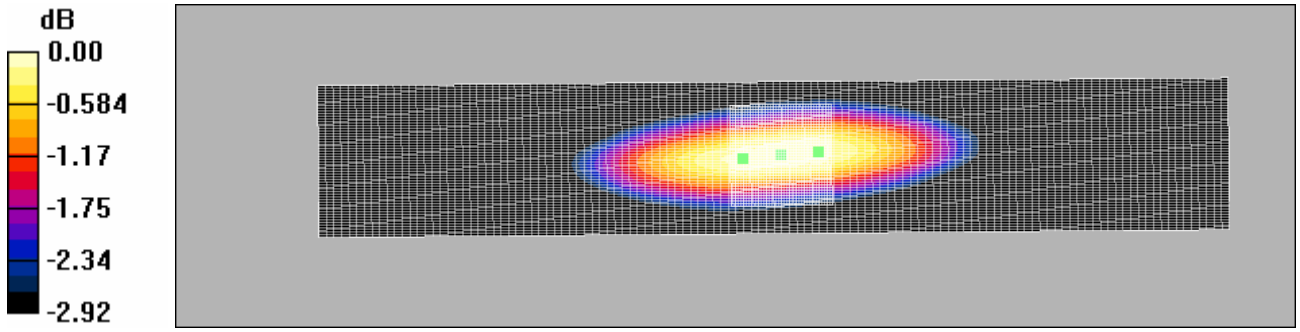
Communication System: CW; Frequency: 813 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: Dipole Reference Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: H3DV6 - SN6036; ; Calibrated: 1/7/2005
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn357; Calibrated: 1/6/2005
- Phantom: HAC Free Space Phantom; Type: Air ; Serial: Not Specified
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 147

813 MHz Validation/Generic Scan (61x121x1): Measurement grid: dx=5mm, dy=15mm, dz=20mm
Maximum value of H_tot (interpolated) = 0.502 A/m

813 MHz Validation/Generic Scan 2 (41x41x1): Measurement grid: dx=5mm, dy=5mm, dz=20mm
Maximum value of H_tot (interpolated) = 0.508 A/m



Test Laboratory: Motorola

050907 898 H validation

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:xxx

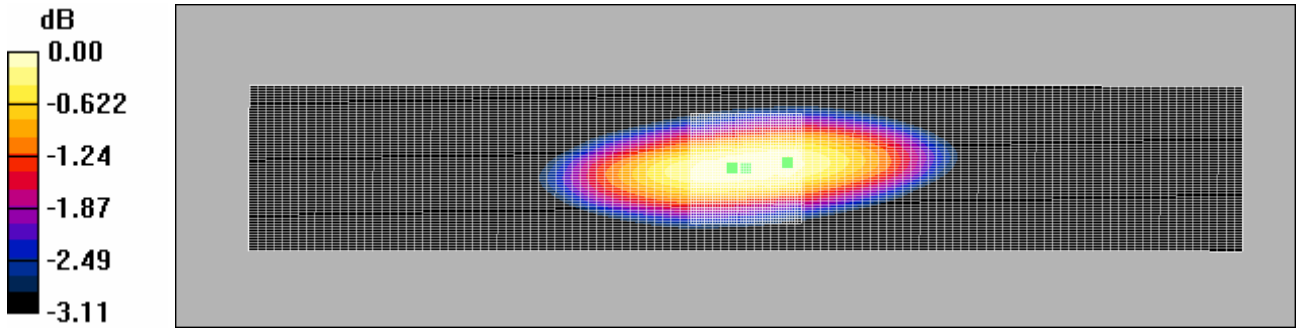
Communication System: CW; Frequency: 898 MHz;Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: Dipole Reference Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: H3DV6 - SN6036; ; Calibrated: 1/7/2005
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn357; Calibrated: 1/6/2005
- Phantom: HAC Free Space Phantom; Type: Air ; Serial: Not Specified
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 147

898 MHz Validation/Generic Scan (61x121x1): Measurement grid: dx=5mm, dy=15mm, dz=20mm
Maximum value of H_tot (interpolated) = 0.480 A/m

898 MHz Validation/Generic Scan 2 (41x41x1): Measurement grid: dx=5mm, dy=5mm, dz=20mm
Maximum value of H_tot (interpolated) = 0.484 A/m



Appendix B

Measurement Results

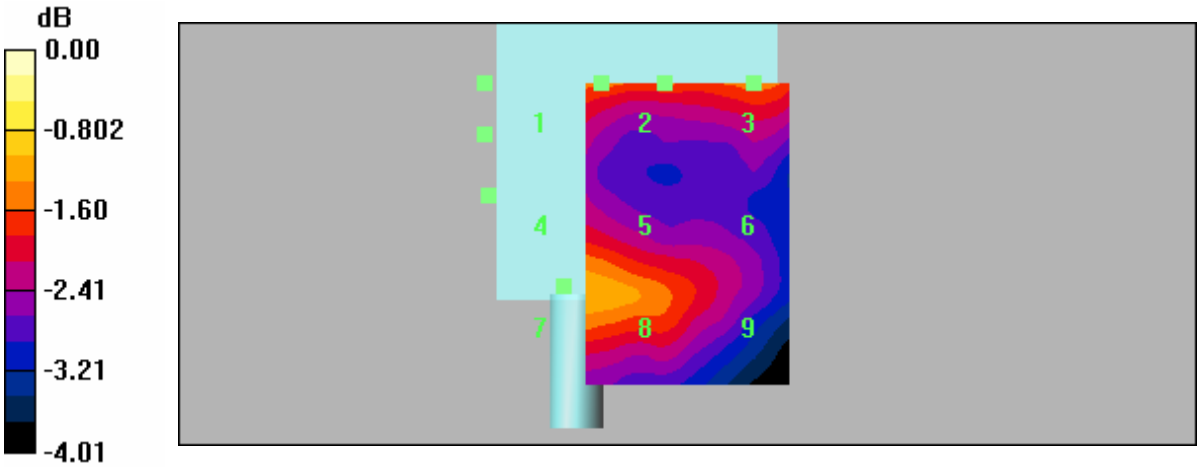
Motorola Corporate Florida Research Lab
iDEN i870 E-Field 800MHz band HAC assessment
Date: 9/8/05

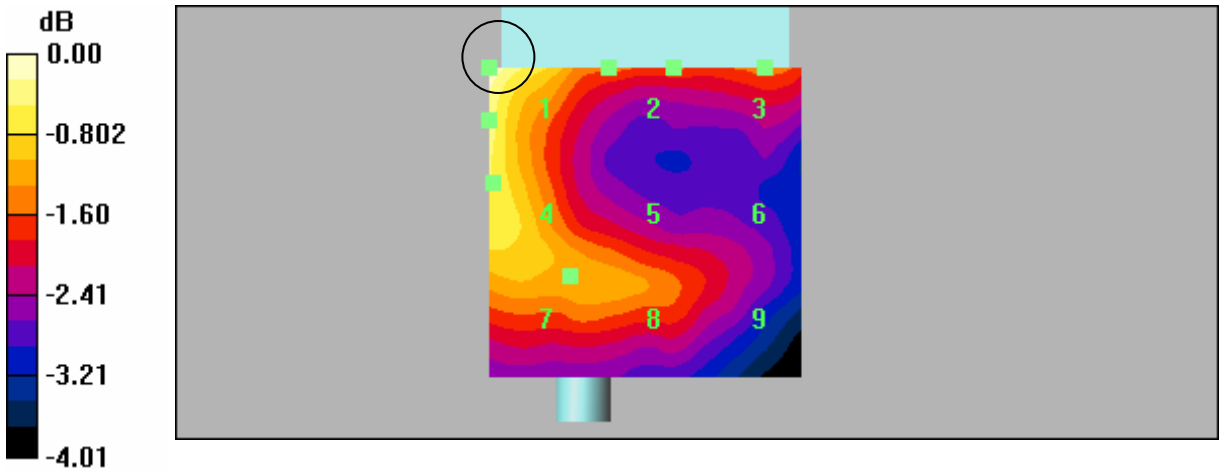
SN 364YFQ86X1
Frequency = 806MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.071dB

E in V/m (Time averaged)

Grid 1 **26.5**	Grid 2 **22.4**	Grid 3 **22.5**
Grid 4 **25**	Grid 5 **23.1**	Grid 6 **21.4**
Grid 7 **23.6**	Grid 8 **23.2**	Grid 9 **21.6**





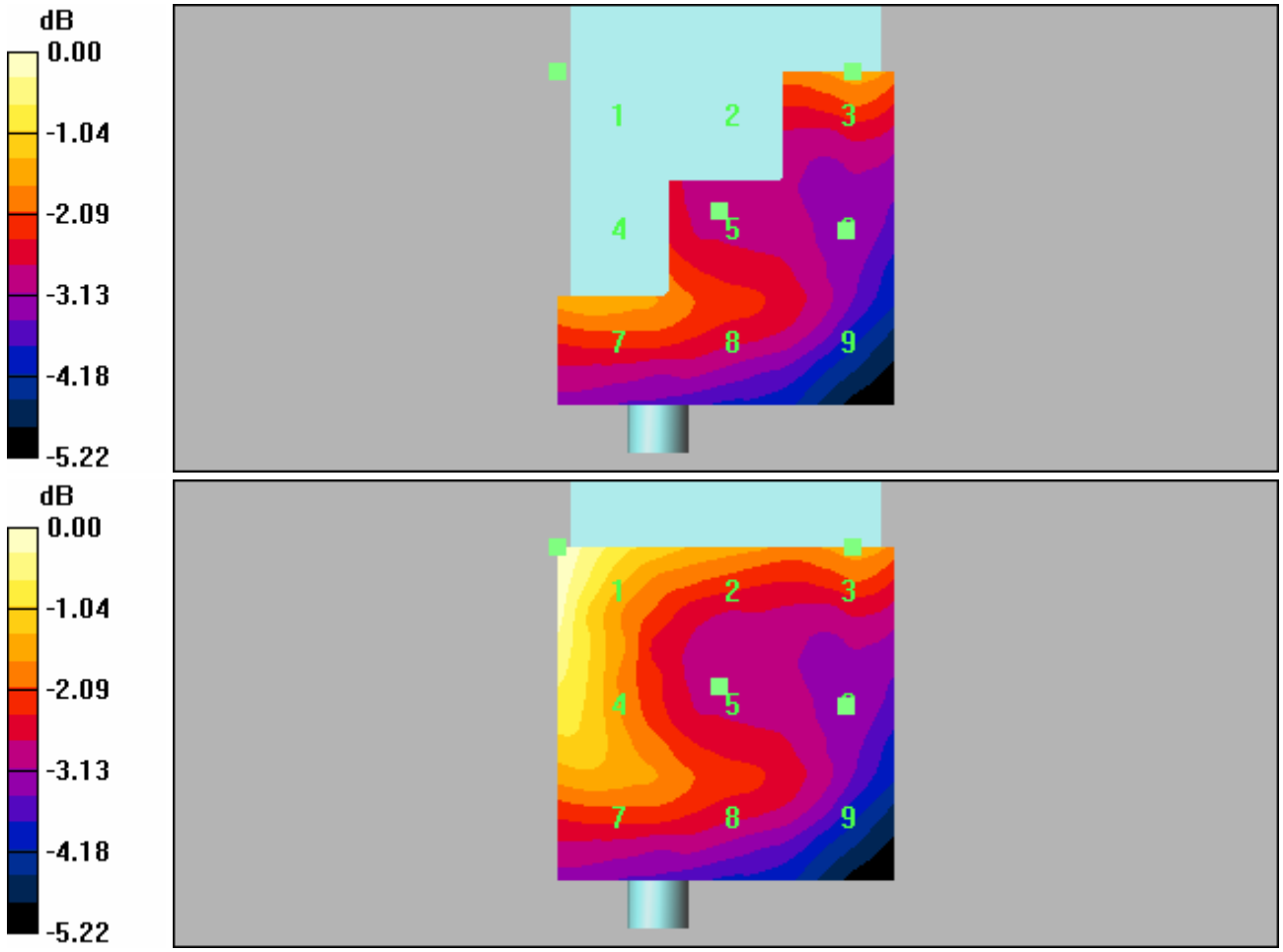
iDEN i870 E-Field 800MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 813MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.209dB

E in V/m (Time averaged)

Grid 1 **26.9**	Grid 2 **23.4**	Grid 3 **22.6**
Grid 4 **25.4**	Grid 5 **21.7**	Grid 6 **20**
Grid 7 **22.9**	Grid 8 **21.8**	Grid 9 **20.1**



Motorola Corporate Florida Research Lab

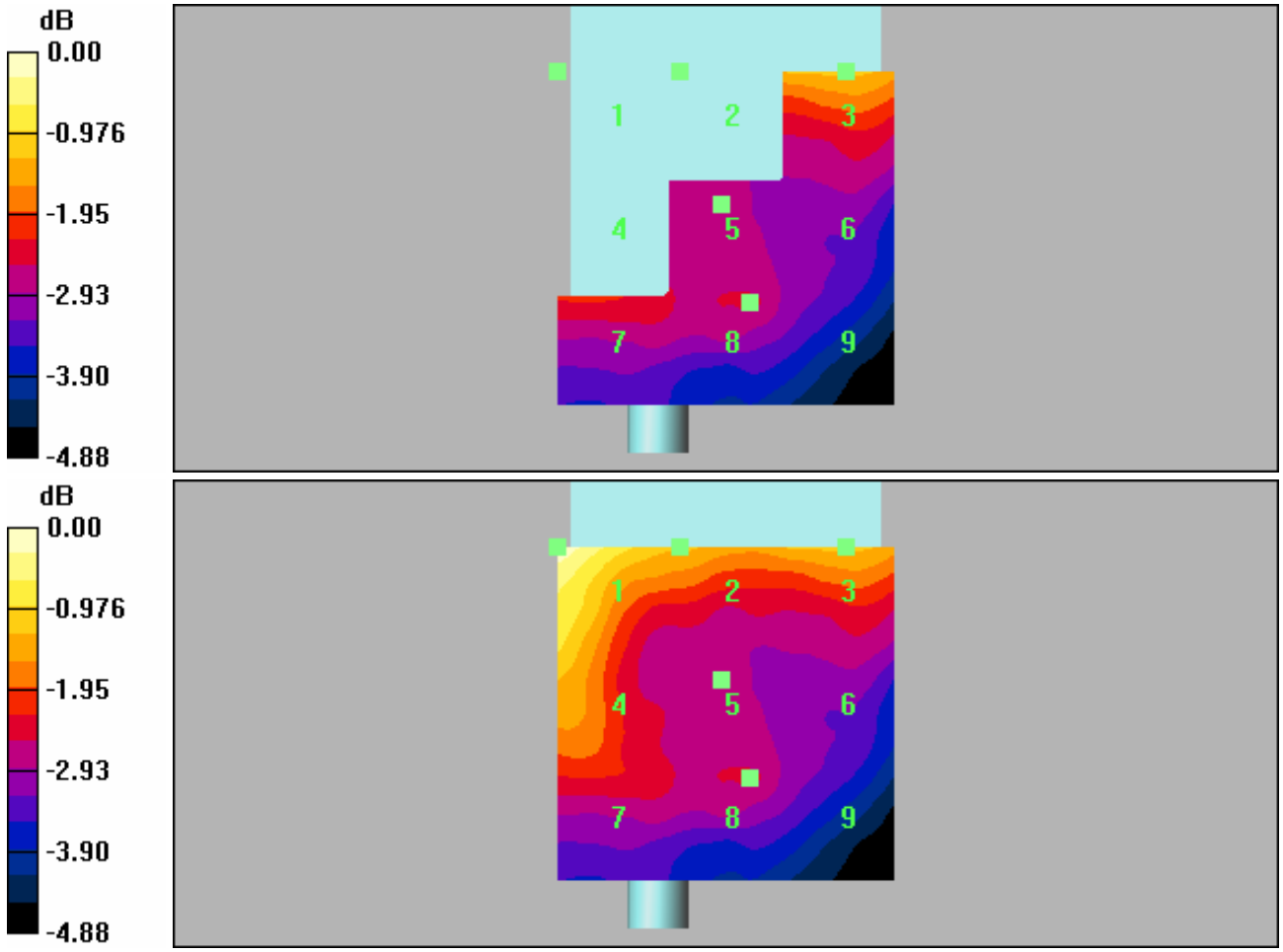
iDEN i870 E-Field 800MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 821MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = 0.01dB

E in V/m (Time averaged)

Grid 1 **26**	Grid 2 **22.6**	Grid 3 **22.7**
Grid 4 **23.1**	Grid 5 **19.4**	Grid 6 **18.8**
Grid 7 **20.3**	Grid 8 **19.5**	Grid 9 **18.5**



Motorola Corporate Florida Research Lab

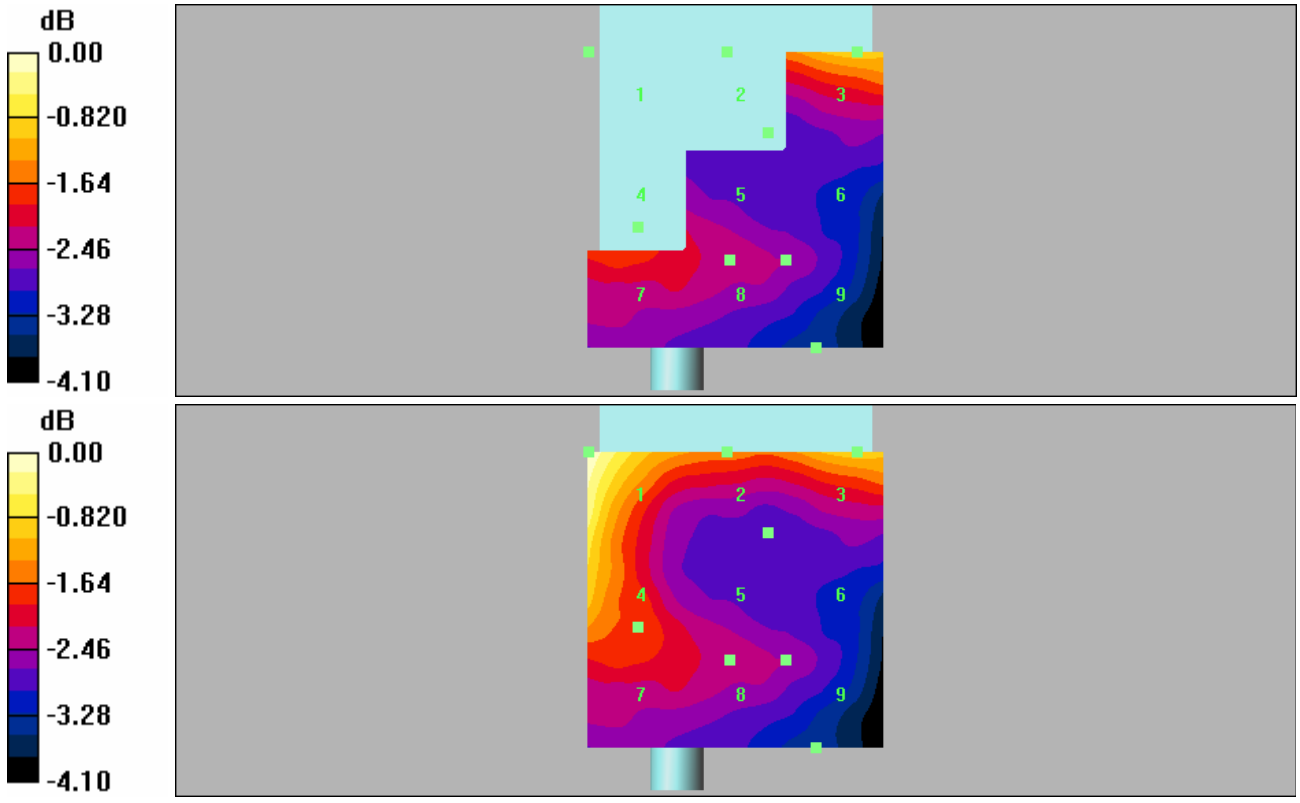
iDEN i870 E-Field 800MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 824MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.112 dB

E in V/m (Time averaged)

Grid 1 **23.7**	Grid 2 **20.3**	Grid 3 **21.4**
Grid 4 **21.8**	Grid 5 **18.6**	Grid 6 **17.7**
Grid 7 **19.5**	Grid 8 **18.6**	Grid 9 **17.9**



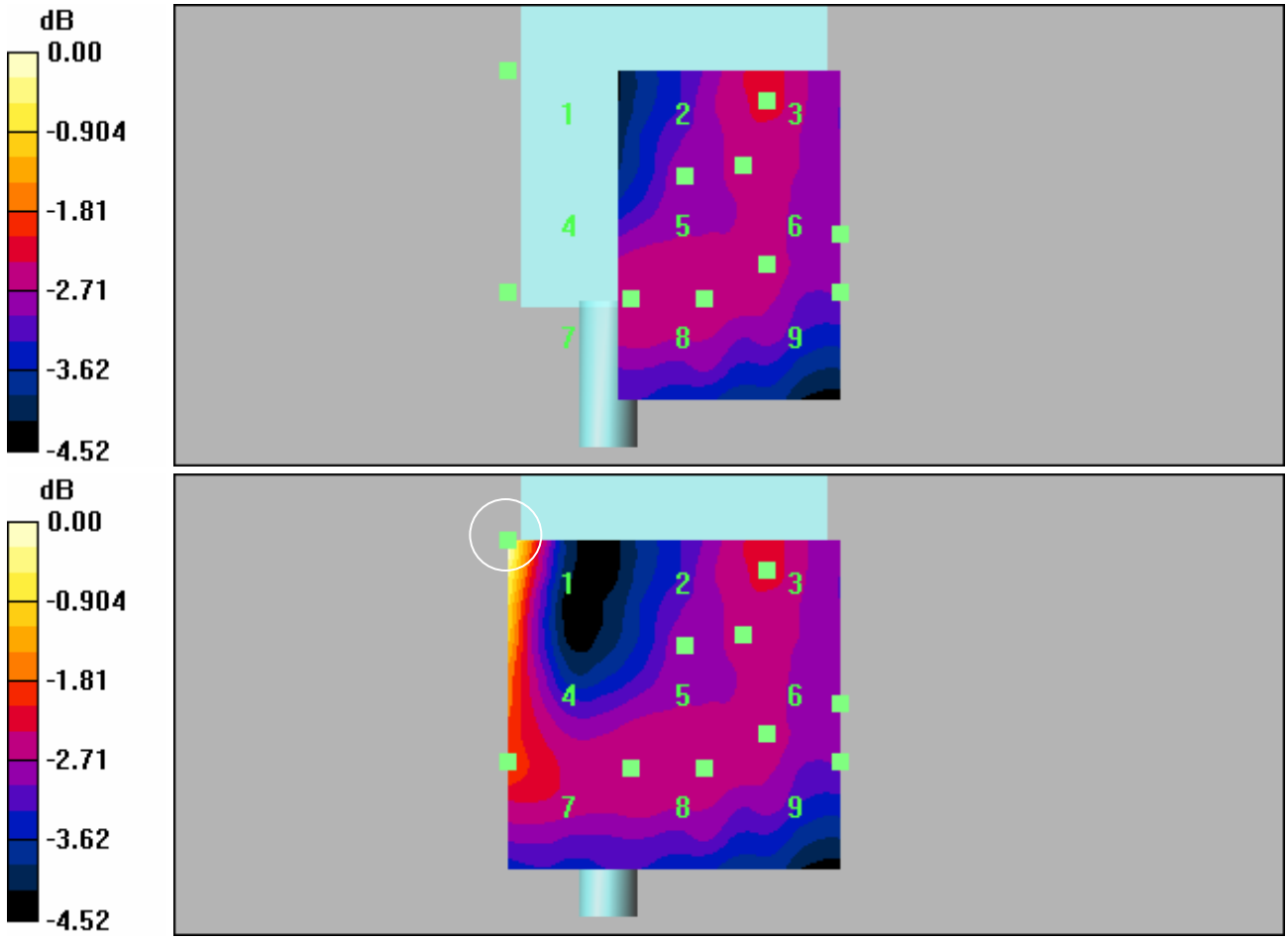
iDEN i870 H-Field 800MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 806MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.432 dB

H in A/m (Time averaged)

Grid 1 **0.073**	Grid 2 **0.054**	Grid 3 **0.056**
Grid 4 **0.063**	Grid 5 **0.055**	Grid 6 **0.055**
Grid 7 **0.059**	Grid 8 **0.055**	Grid 9 **0.055**



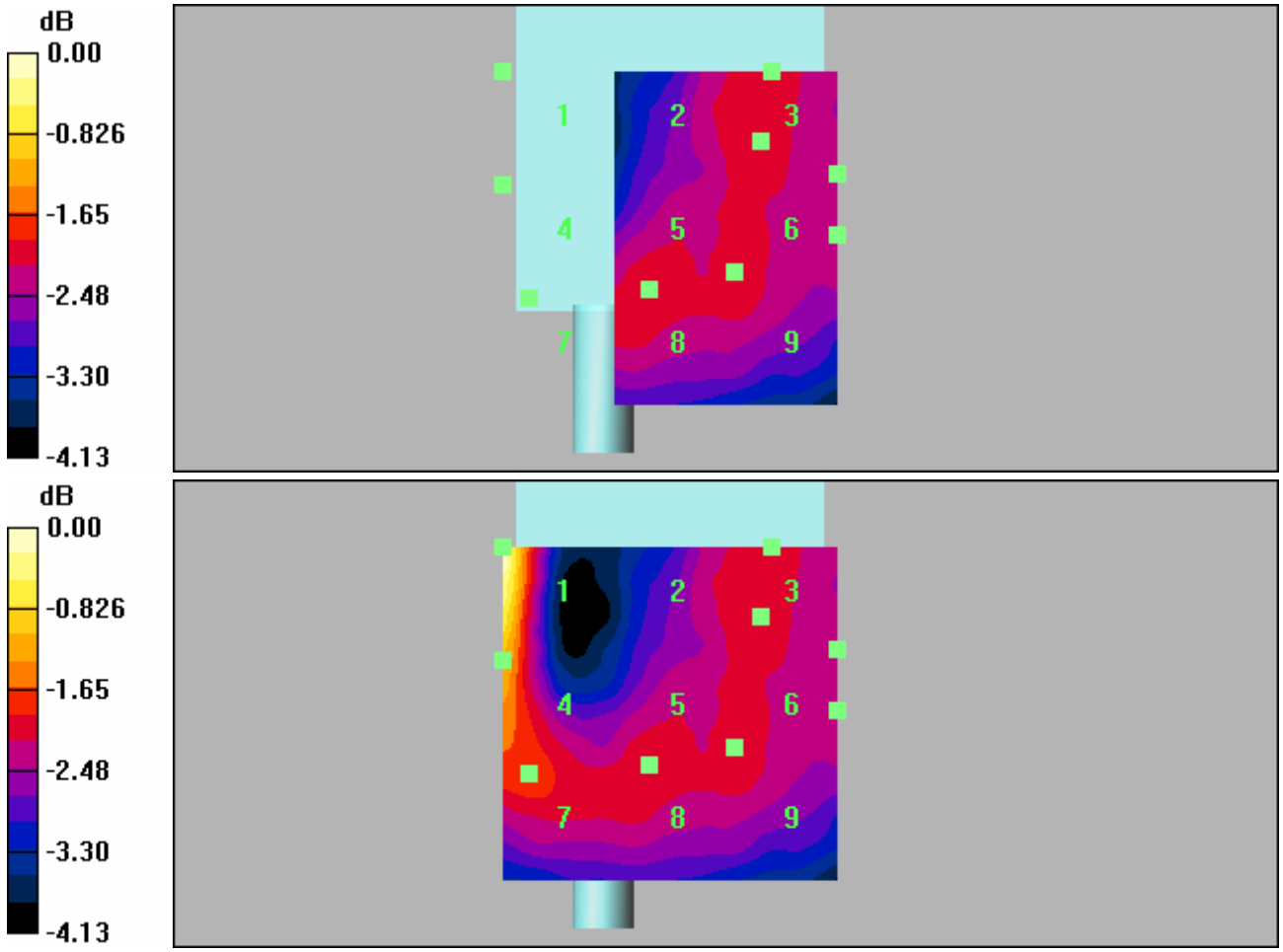
Date: 9/8/05

SN 364YFQ86X1
Frequency = 813MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = 0.429 dB

H in A/m (Time averaged)

Grid 1 **0.066**	Grid 2 **0.052**	Grid 3 **0.053**
Grid 4 **0.059**	Grid 5 **0.052**	Grid 6 **0.052**
Grid 7 **0.054**	Grid 8 **0.052**	Grid 9 **0.052**



Motorola Corporate Florida Research Lab
iDEN i870 H-Field 800MHz band HAC assessment

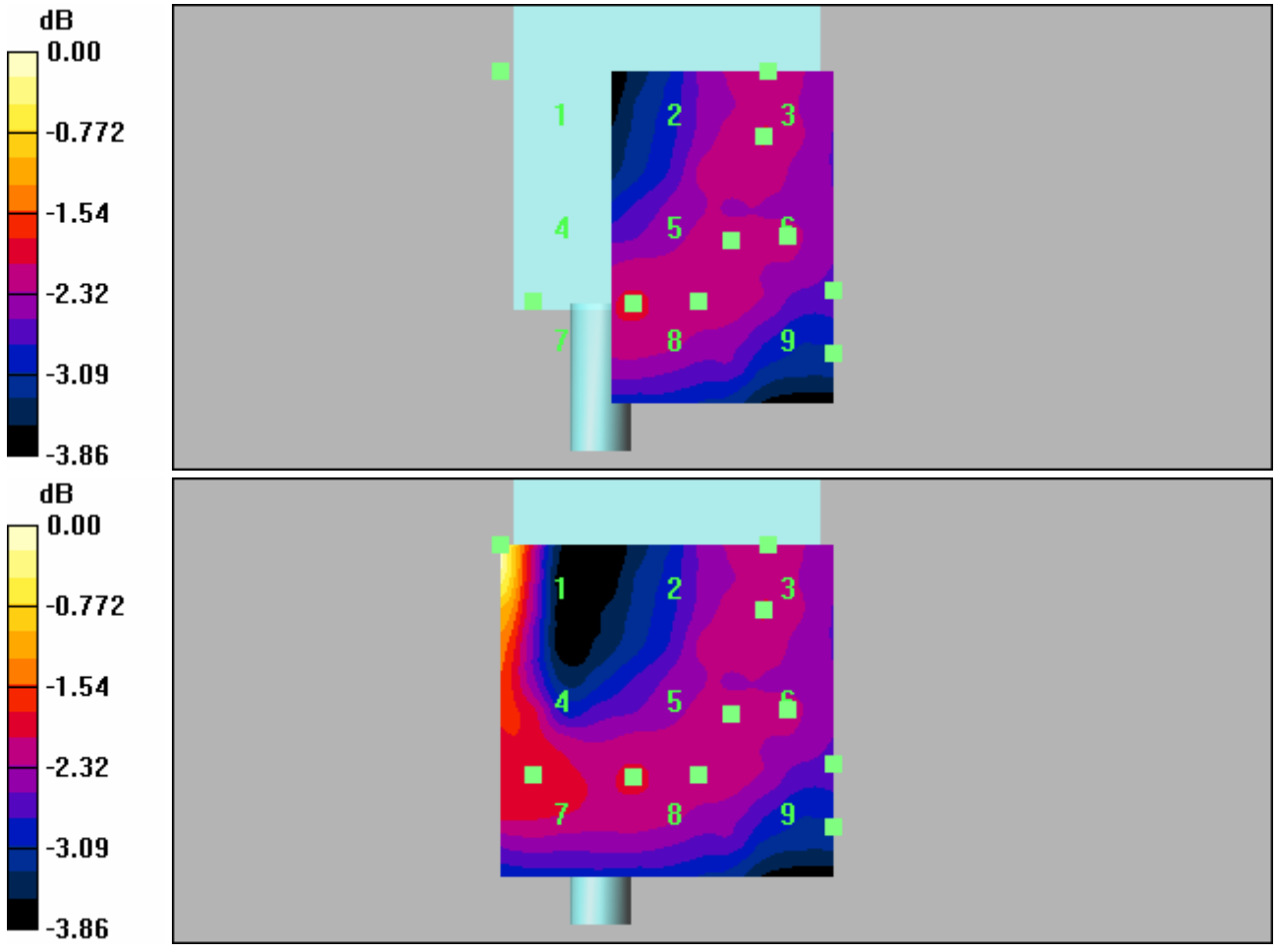
Date: 9/8/05

SN 364YFQ86X1
Frequency = 821MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = 0.158 dB

H in A/m (Time averaged)

Grid 1 **0.065**	Grid 2 **0.051**	Grid 3 **0.051**
Grid 4 **0.055**	Grid 5 **0.051**	Grid 6 **0.051**
Grid 7 **0.053**	Grid 8 **0.052**	Grid 9 **0.051**



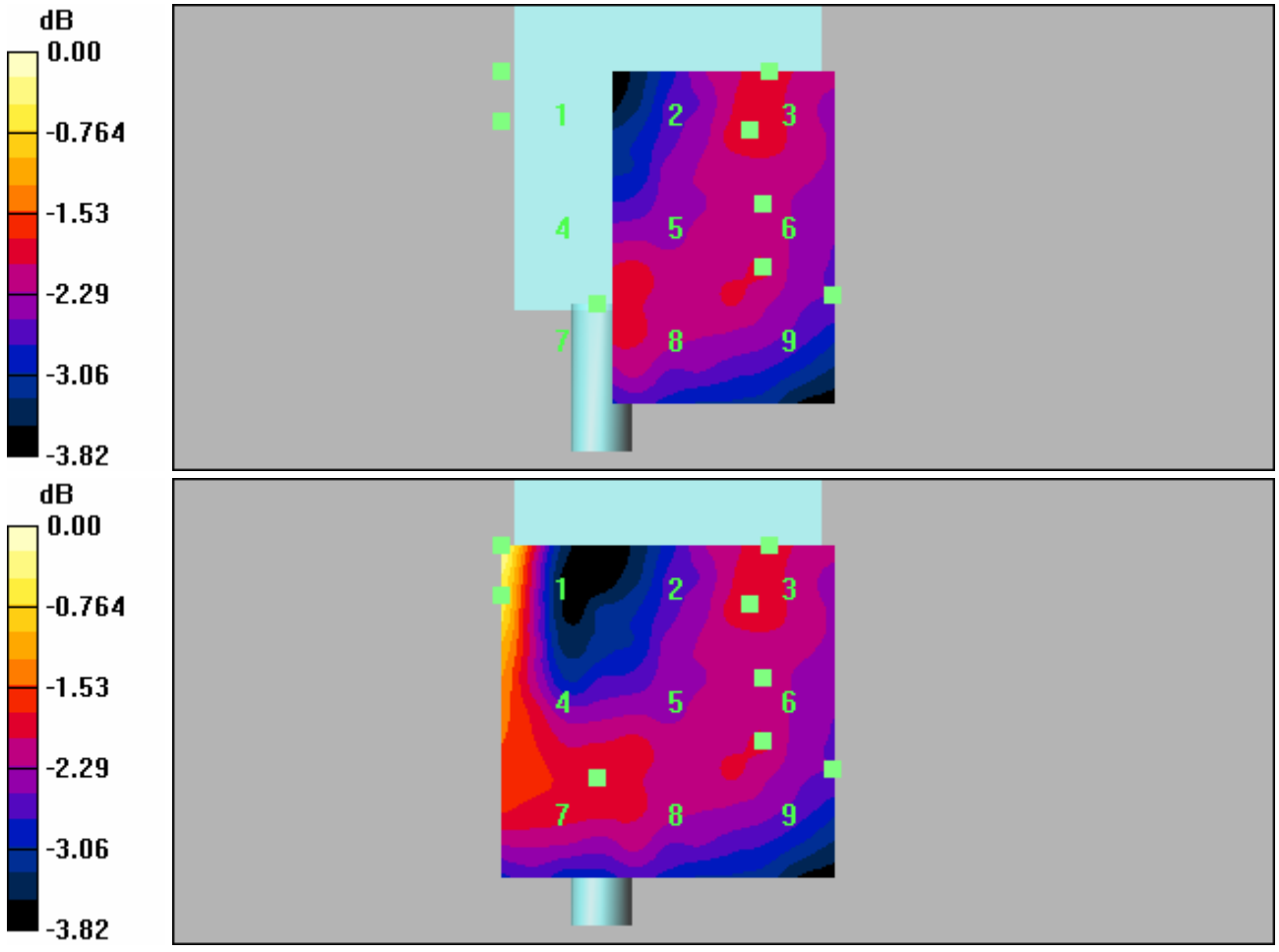
Motorola Corporate Florida Research Lab
iDEN i870 H-Field 800MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 824MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = 0. 098 dB

H in A/m (Time averaged)

Grid 1 **0.062**	Grid 2 **0.049**	Grid 3 **0.05**
Grid 4 **0.055**	Grid 5 **0.05**	Grid 6 **0.049**
Grid 7 **0.052**	Grid 8 **0.05**	Grid 9 **0.049**



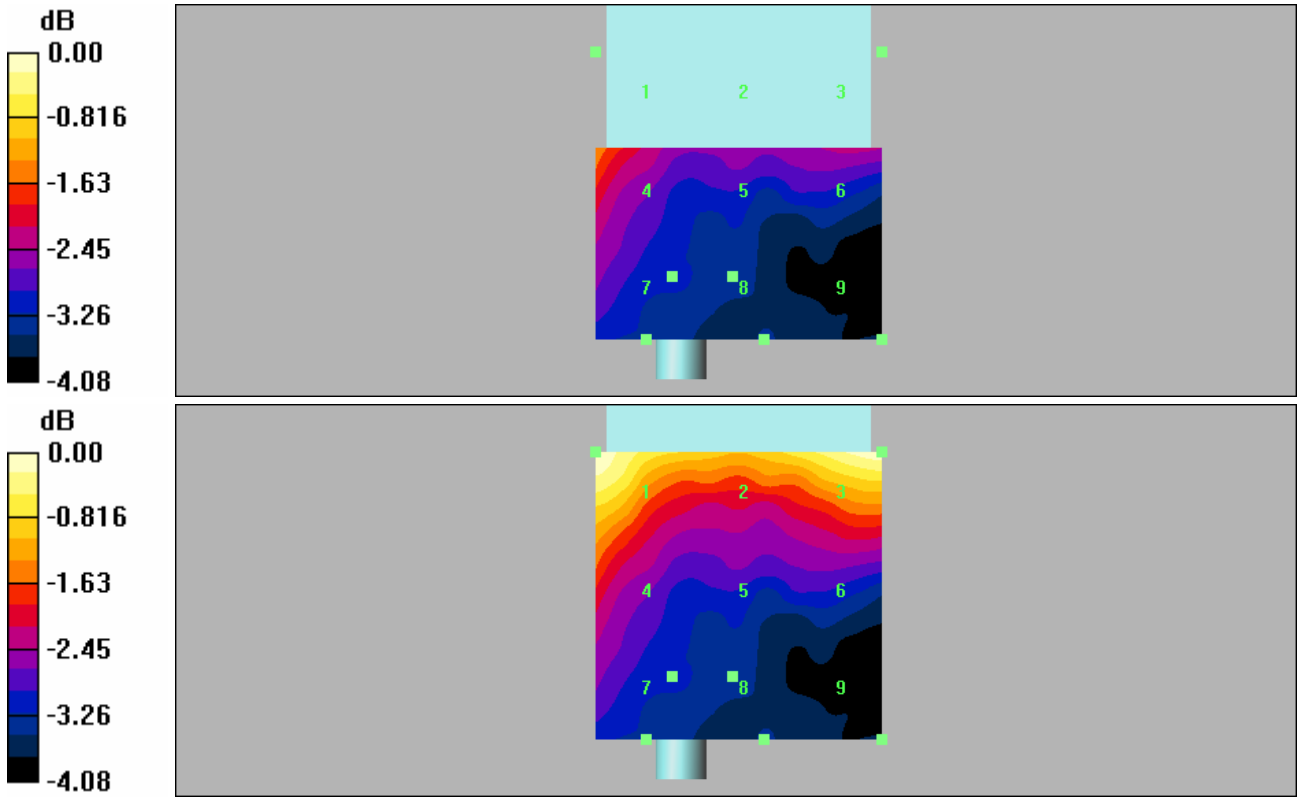
Motorola Corporate Florida Research Lab
iDEN i870 E-Field 900MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 896MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.093 dB

E in V/m (Time averaged)

Grid 1 **19.7**	Grid 2 **18.0**	Grid 3 **19.6**
Grid 4 **16.8**	Grid 5 **14.7**	Grid 6 **15.1**
Grid 7 **14.9**	Grid 8 **13.6**	Grid 9 **13.0**



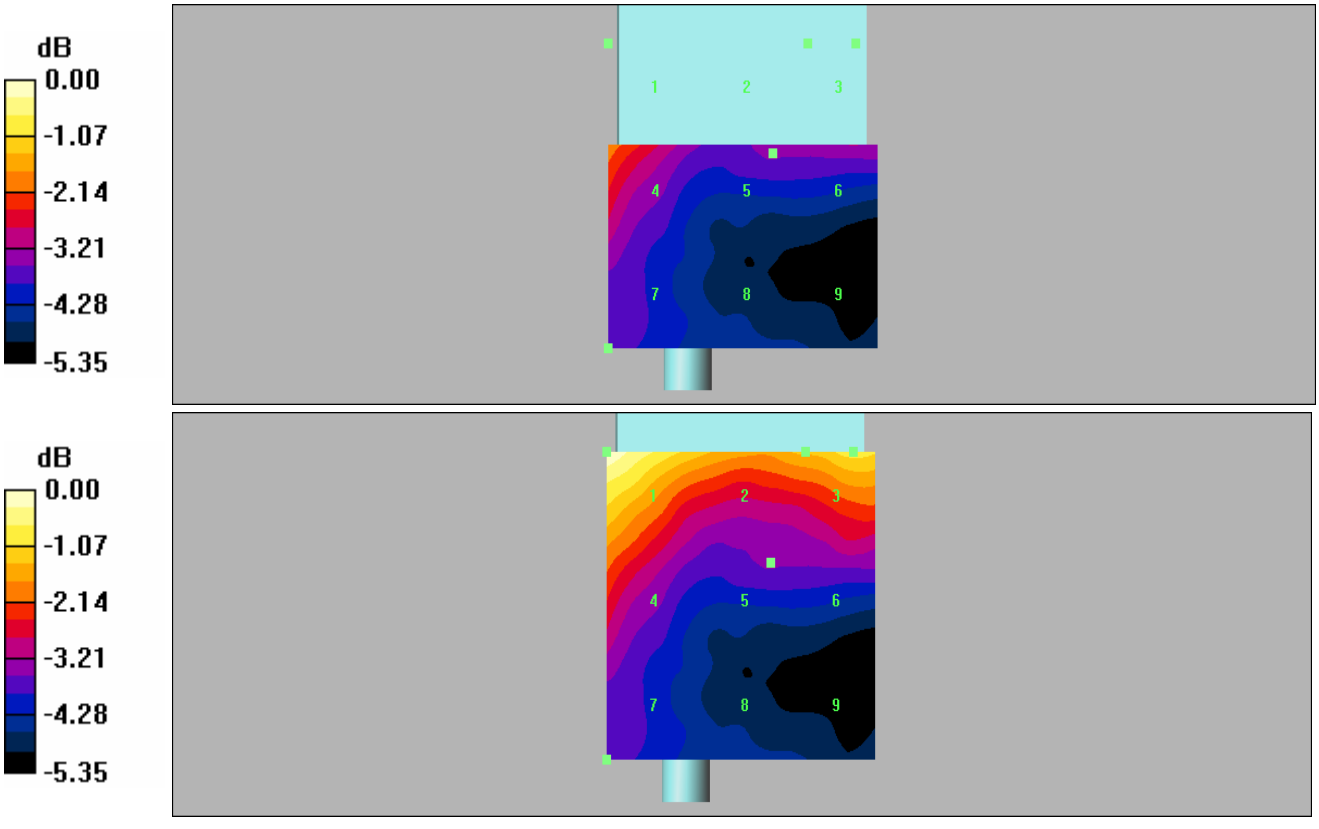
Motorola Corporate Florida Research Lab
iDEN i870 E-Field 900MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 899MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.11 dB

E in V/m (Time averaged)

Grid 1 **21.7**	Grid 2 **18.8**	Grid 3 **19.6**
Grid 4 **17.5**	Grid 5 **14.5**	Grid 6 **15.1**
Grid 7 **14.9**	Grid 8 **13.2**	Grid 9 **12.9**



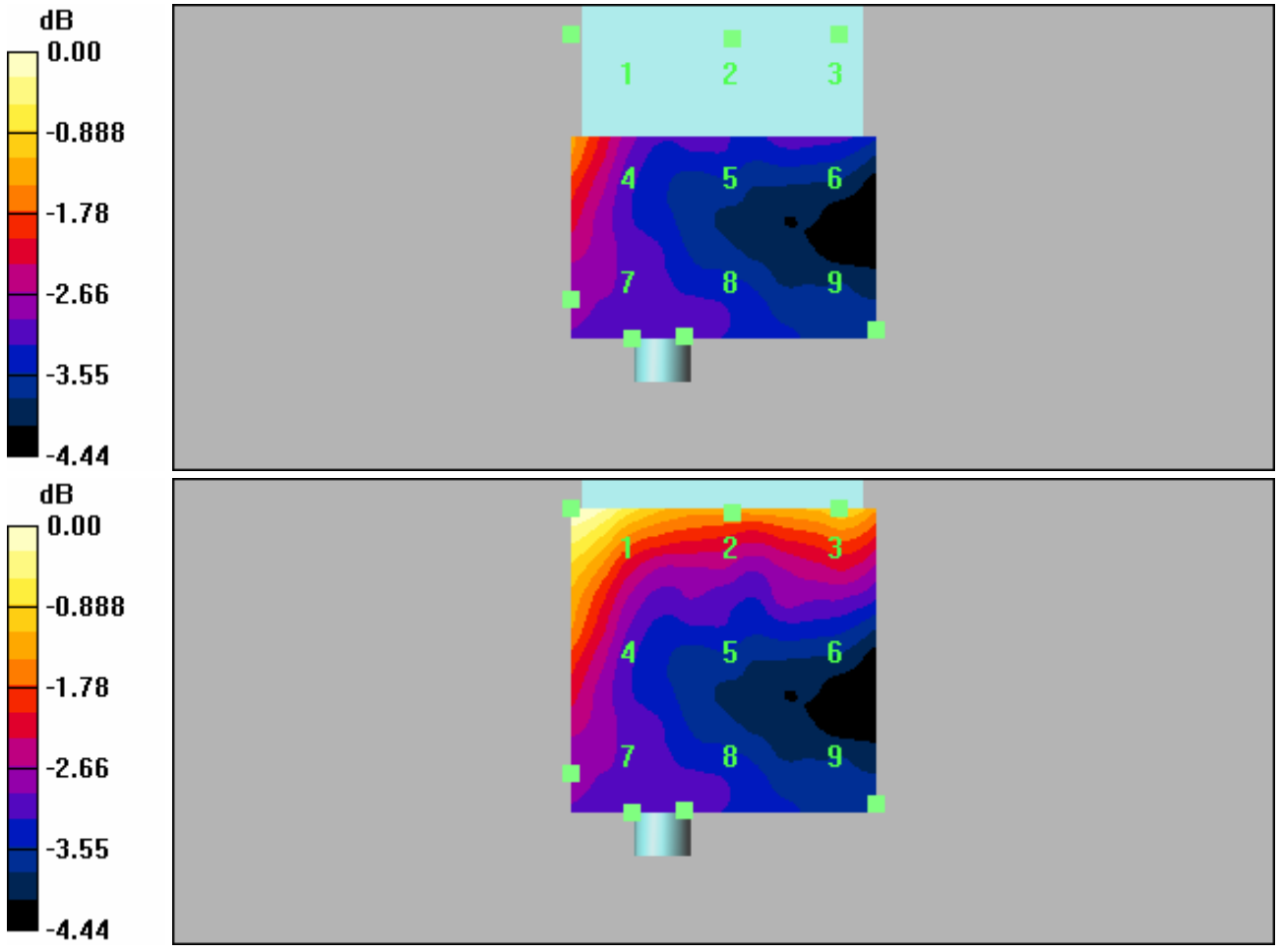
Motorola Corporate Florida Research Lab
iDEN i870 E-Field 900MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 901MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: ER3DV6R - SN2246, Calibrated: 6/13/2005, ConvF(1, 1, 1)
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = 0.001 dB

E in V/m (Time averaged)

Grid 1 **14**	Grid 2 **12.2**	Grid 3 **12.7**
Grid 4 **12**	Grid 5 **9.83**	Grid 6 **9.93**
Grid 7 **10.6**	Grid 8 **9.86**	Grid 9 **9.37**



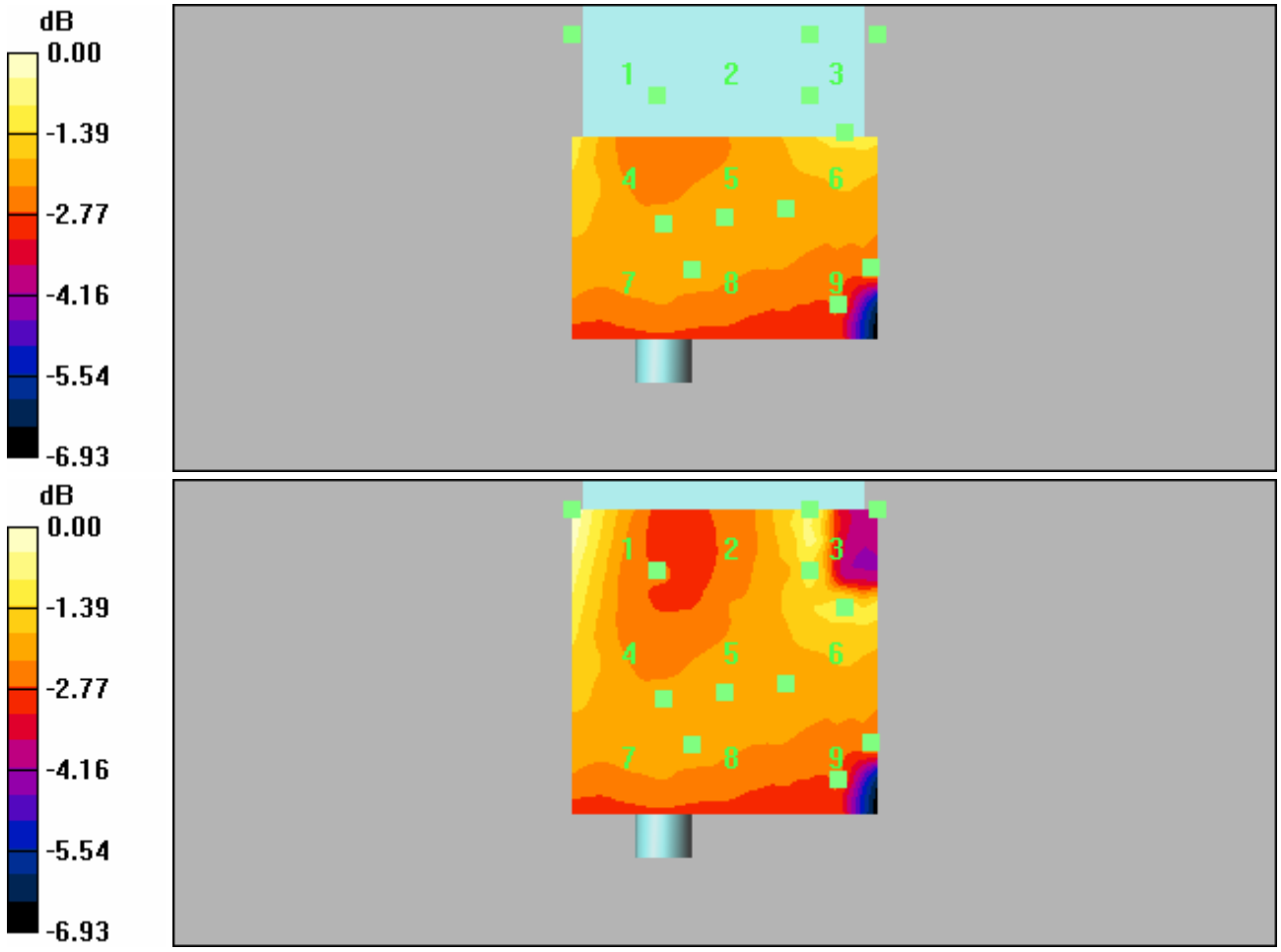
Motorola Corporate Florida Research Lab
iDEN i870 H-Field 900MHz band HAC assessment
Date: 9/8/05

SN 364YFQ86X1
Frequency = 896MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = 0.068 dB

H in A/m (Time averaged)

Grid 1 **0.057**	Grid 2 **0.046**	Grid 3 **0.052**
Grid 4 **0.05**	Grid 5 **0.046**	Grid 6 **0.05**
Grid 7 **0.046**	Grid 8 **0.045**	Grid 9 **0.045**



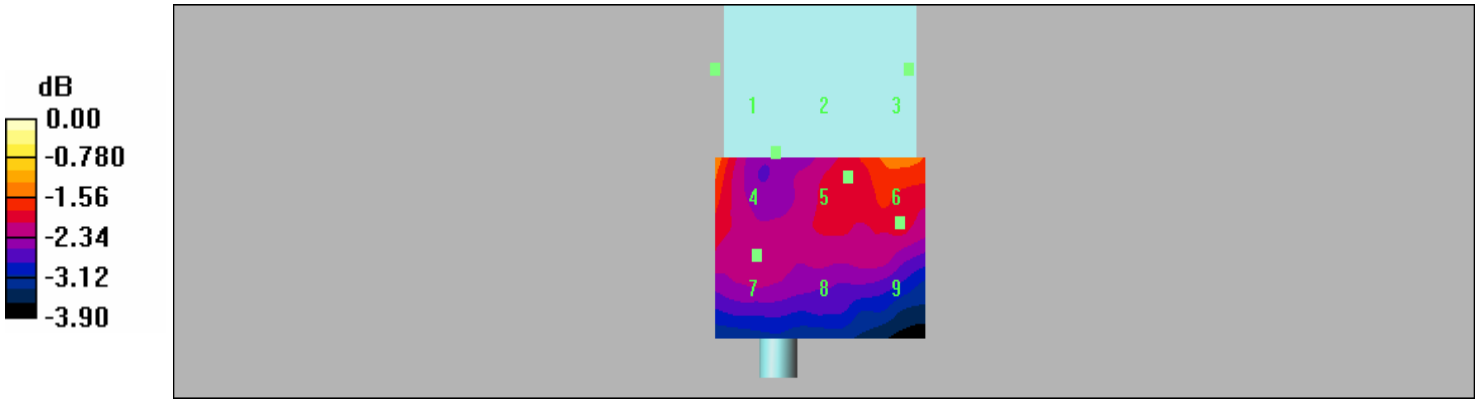
Motorola Corporate Florida Research Lab
iDEN i870 H-Field 900MHz band HAC assessment
Date: 9/8/05

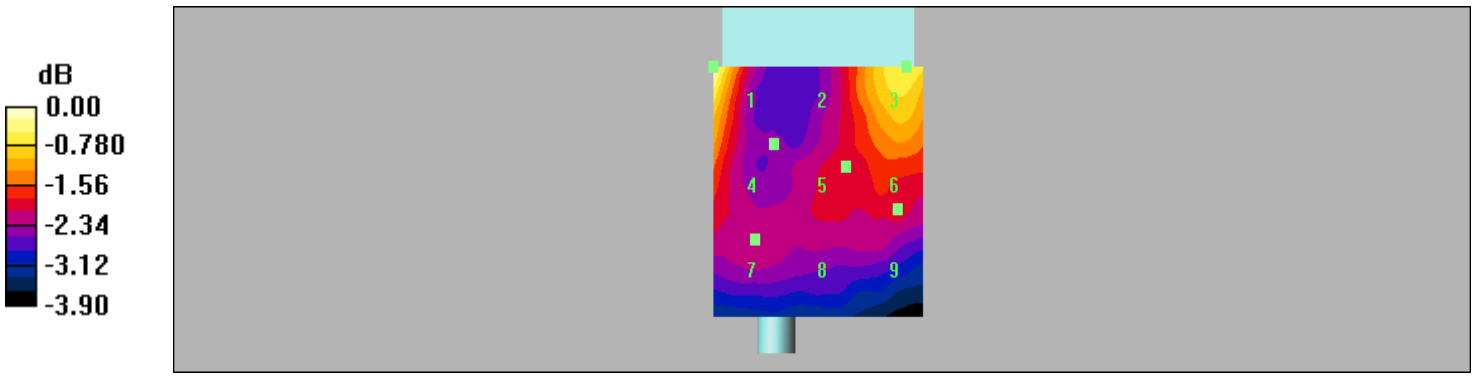
SN 364YFQ86X1
Frequency = 899MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.192 dB

H in A/m (Time averaged)

Grid 1 **0.057**	Grid 2 **0.047**	Grid 3 **0.054**
Grid 4 **0.049**	Grid 5 **0.046**	Grid 6 **0.049**
Grid 7 **0.045**	Grid 8 **0.045**	Grid 9 **0.045**





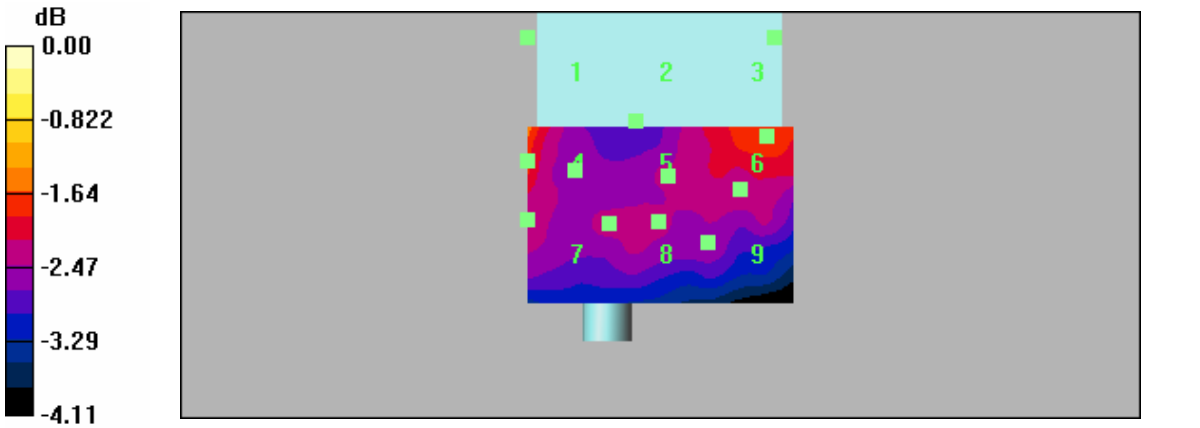
Motorola Corporate Florida Research Lab
iDEN i870 H-Field 900MHz band HAC assessment
Date: 9/8/05

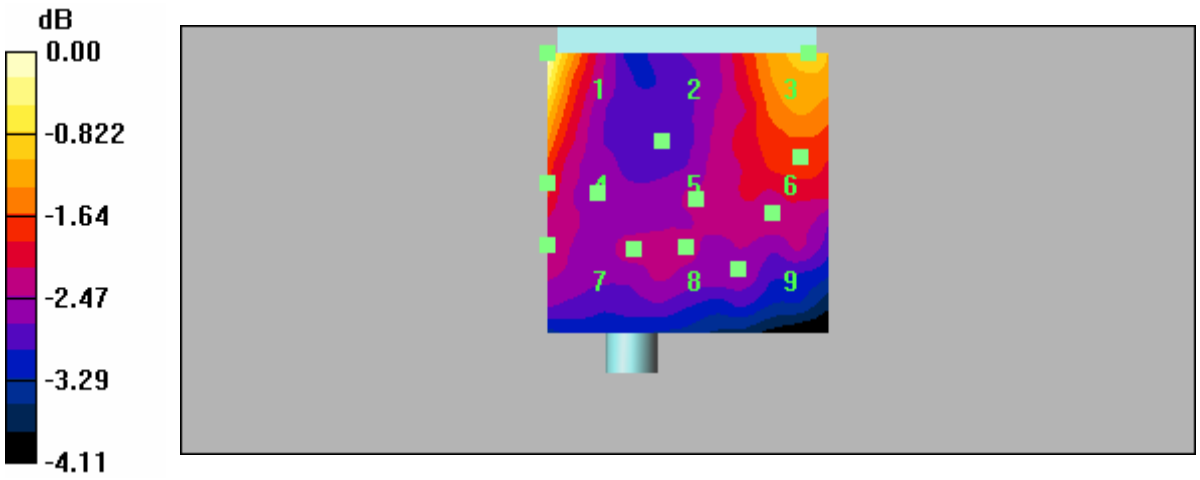
SN 364YFQ86X1
Frequency = 901MHz
TX Pwr = 640mW

Procedure Notes: 3:1 transmission mode
Probe: H3DV6 - SN6036, Calibrated: 1/7/2005,
Duty Cycle: 1:3, Medium: Air, Medium parameters used: $\sigma = 0$; mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m3
Electronics: DAE3 Sn357, Calibrated: 1/6/2005
Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm, dz=5mm
Drift = -0.068 dB

H in A/m (Time averaged)

Grid 1 **0.042**	Grid 2 **0.033**	Grid 3 **0.037**
Grid 4 **0.036**	Grid 5 **0.033**	Grid 6 **0.035**
Grid 7 **0.033**	Grid 8 **0.032**	Grid 9 **0.032**





Appendix C

Probe Calibration Certificate

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Motorola MFRL**

Certificate No: ER3-2246_Jun05

CALIBRATION CERTIFICATE

Object: ER3DV6R - SN:2246

Calibration procedure(s): QA CAL-02.v4
Calibration procedure for E-field probes optimized for close near field evaluations in air

Calibration date: June 13, 2005

Condition of the calibrated item: In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-04 (METAS, No. 251-00404)	Aug-05
Reference Probe ER3DV6	SN: 2328	6-Oct-04 (SPEAG, No. ER3-2328_Oct04)	Oct-05
DAE4	SN: 617	19-Jan-05 (SPEAG, No. DAE4-617_Jan05)	Jan-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 13, 2005

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

NORMx,y,z	sensitivity in free space
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1309-1996, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", 1996.

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 for XY sensors and ϑ = 90 for Z sensor (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart).
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

DASY - Parameters of Probe: ER3DV6R SN:2246

Sensitivity in Free Space [μV/(V/m)²]		Diode Compression[A]	
NormX	**3.75** ± 10.1 % (k=2)	DCP X	**94** mV
NormY	**3.87** ± 10.1 % (k=2)	DCP Y	**94** mV
NormZ	**5.75** ± 10.1 % (k=2)	DCP Z	**94** mV

Frequency Correction

X	**0.0**
Y	**0.0**
Z	**0.0**

Sensor Offset (Probe Tip to Sensor Center)

X	**2.5** mm
Y	**2.5** mm
Z	**2.5** mm

Connector Angle **221** °

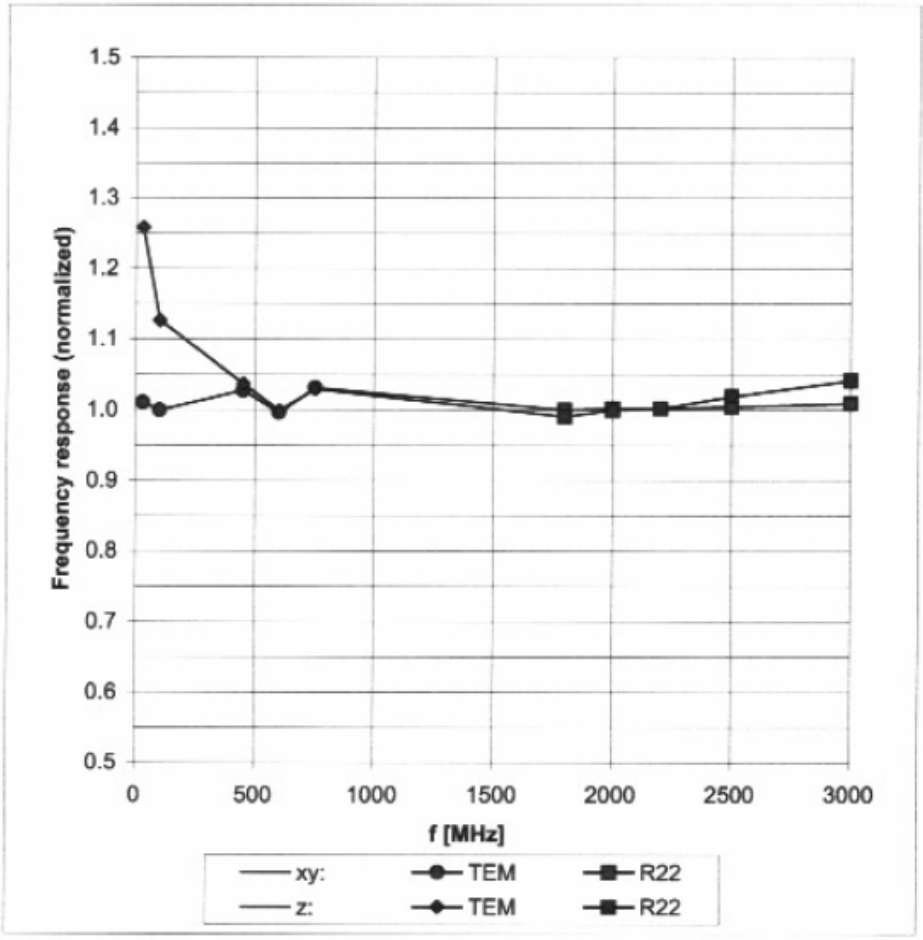
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

ER3DV6R SN:2246 June 13, 2005

Frequency Response of E-Field

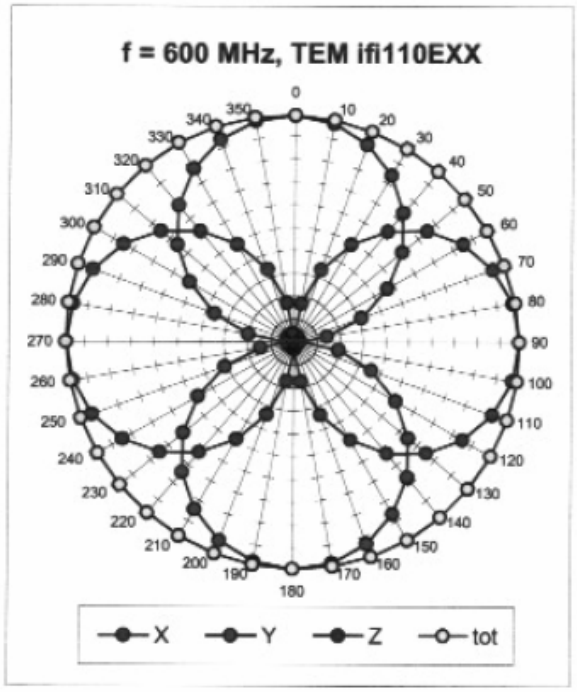
(TEM-Cell:ifi110 EXX, Waveguide R22)

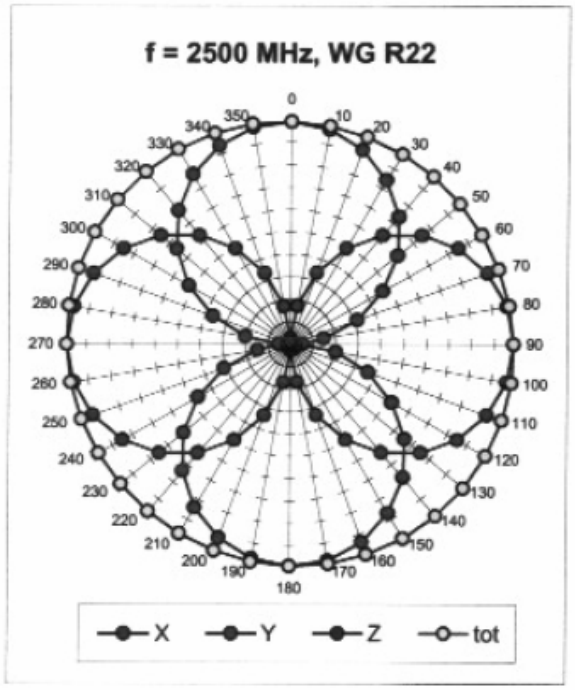


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

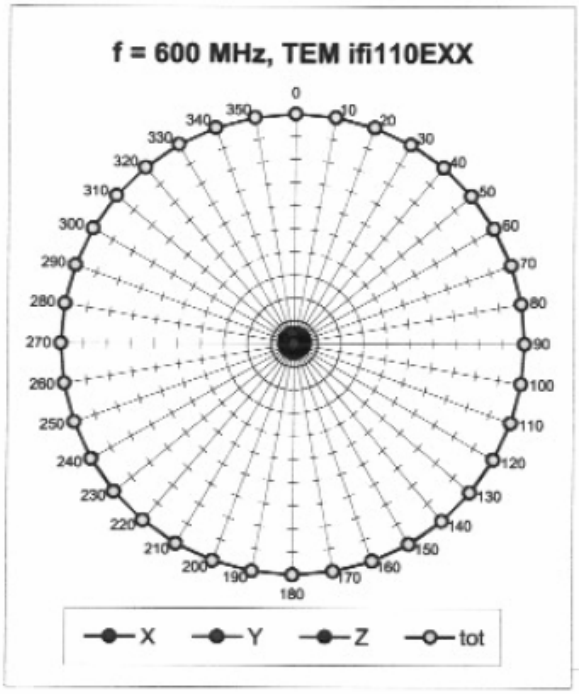
ER3DV6R SN:2246 June 13, 2005

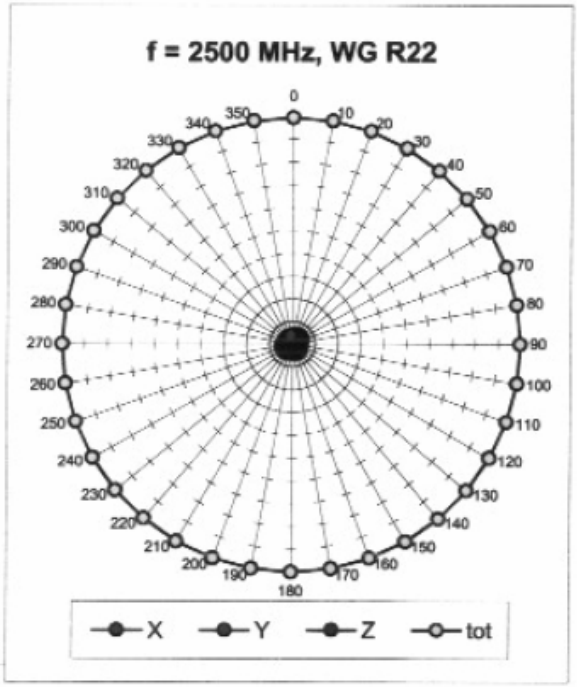
Receiving Pattern (ϕ), ϑ = 0°





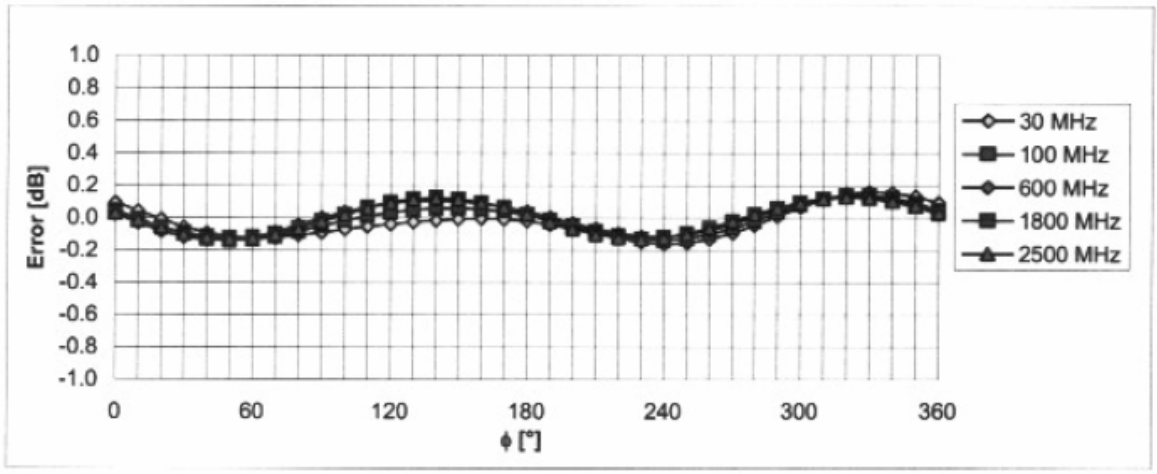
Receiving Pattern (ϕ), ϑ = 90°





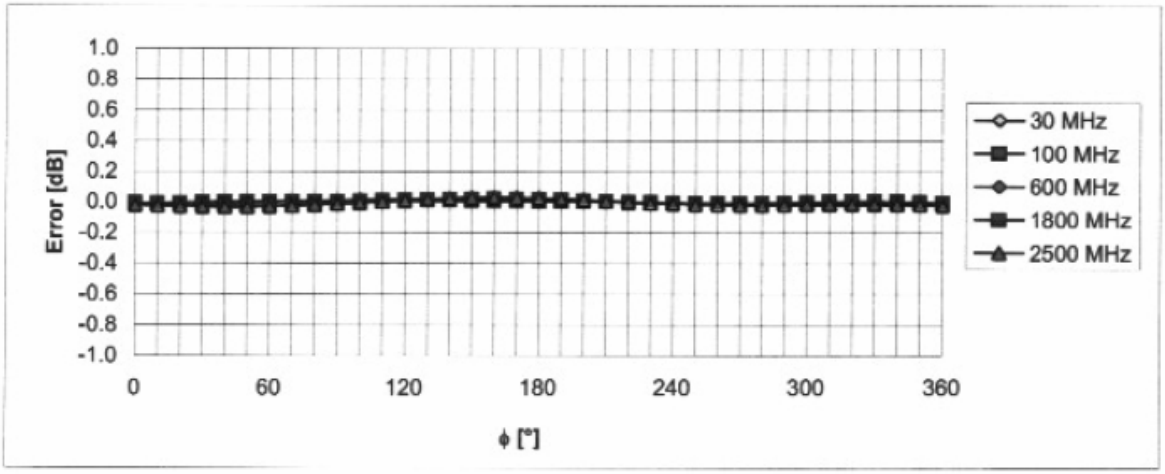
ER3DV6R SN:2246 June 13, 2005

Receiving Pattern (ϕ), ϑ = 0°



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Receiving Pattern (ϕ), ϑ = 90°

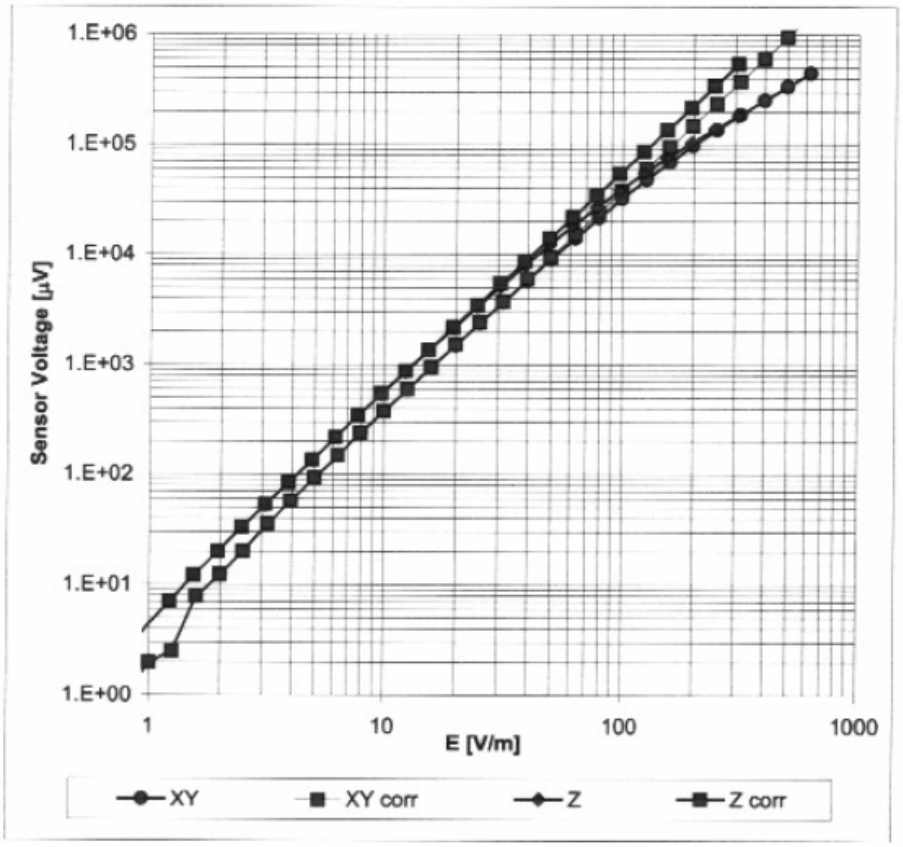


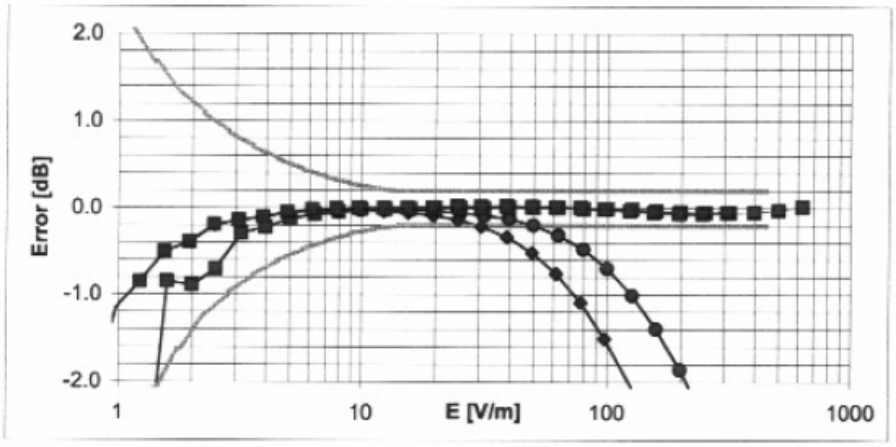
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ER3DV6R SN:2246 June 13, 2005

Dynamic Range f(E-field)

(Waveguide R22, f = 1800 MHz)





Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Motorola CGISS**

Certificate No: **H3-6036_Jan05**

CALIBRATION CERTIFICATE

Object	H3DV6 - SN:6036
Calibration procedure(s)	QA CAL-03.v4 Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date:	January 7, 2005
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-04 (METAS, No. 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No. 251-00388)	May-05
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-04 (METAS, No. 251-00389)	May-05
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-04 (METAS, No. 251-00404)	Aug-05
Reference Probe H3DV6	SN: 6182	6-Oct-04 (SPEAG, No. H3-6182_Oct04)	Oct-05
DAE4	SN: 617	29-Sep-04 (SPEAG, No. DAE4-617_Sep04)	Sep-05

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 13, 2005

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

NORMx,y,z	sensitivity in free space
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1309-1996, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", 1996.

Methods Applied and Interpretation of Parameters:

- *X,Y,Z_a0a1a2:* Assessed for E-field polarization $\vartheta = 90$ for XY sensors and $\vartheta = 0$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- *X,Y,Z(f)_a0a1a2= X,Y,Z_a0a1a2* frequency_response* (see Frequency Response Chart).
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *X_a0a1a2* (no uncertainty required).

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DASY - Parameters of Probe: H3DV6 SN:6036

Sensitivity in Free Space [A/m / √(μV)]

	a0	a1	a2
X	**2.652E-03**	**1.271E-5**	**-3.893E-5** ± 5.1 % (k=2)
Y	**2.689E-03**	**1.106E-5**	**-5.700E-5** ± 5.1 % (k=2)
Z	**3.056E-03**	**-2.728E-5**	**-5.504E-5** ± 5.1 % (k=2)

Diode Compression[1]

DCP X	**85** mV
DCP Y	**85** mV
DCP Z	**85** mV

Sensor Offset (Probe Tip to Sensor Center)

X	**3.0** mm
Y	**3.0** mm
Z	**3.0** mm

Connector Angle **133** °

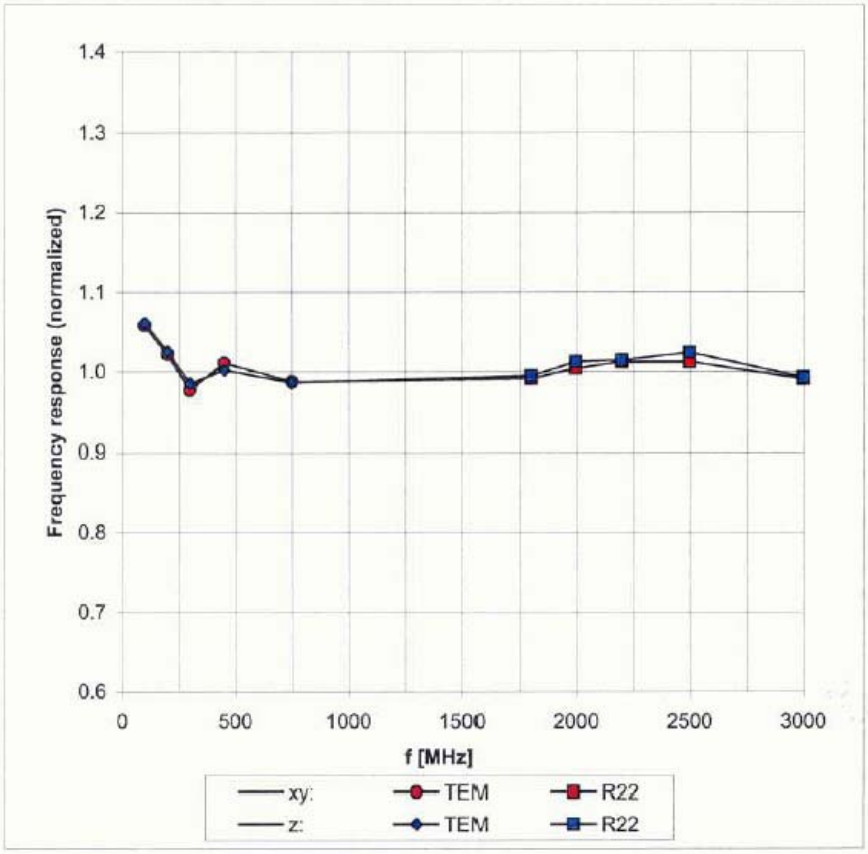
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[1] numerical linearization parameter: uncertainty not required

H3DV6 SN:6036 January 7, 2005

Frequency Response of H-Field

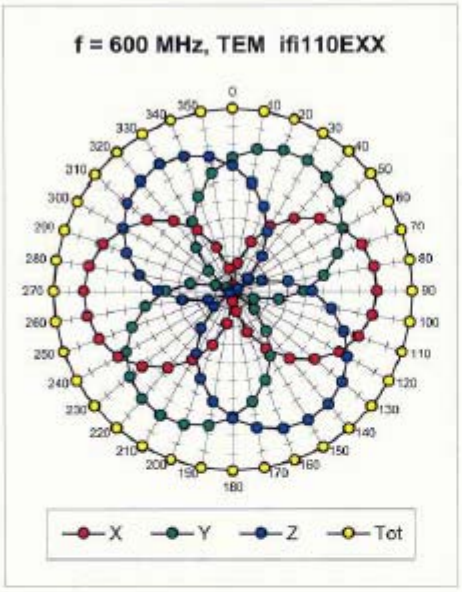
(TEM-Cell:ifi110, Waveguide R22)

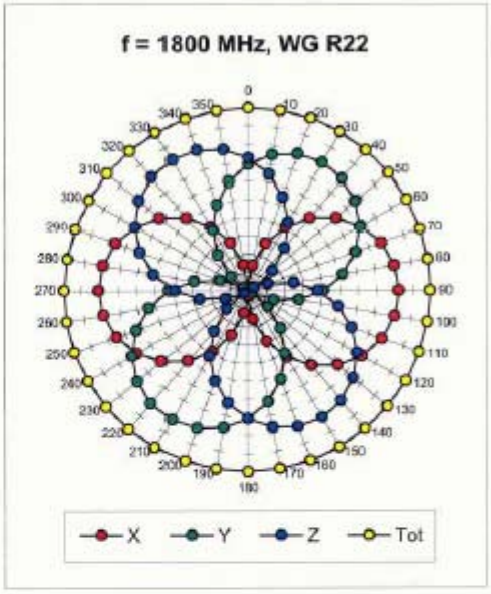


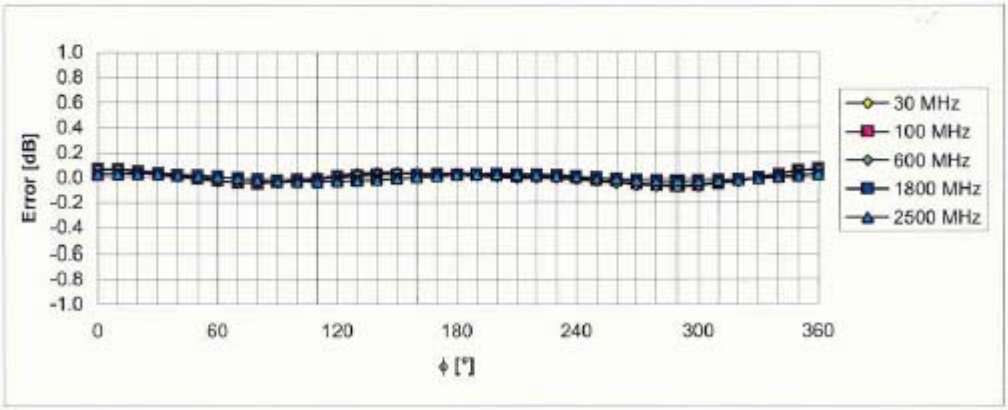
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ET3DV6 SN:1383 February 24, 2005

Receiving Pattern (ϕ), ϑ = 0°



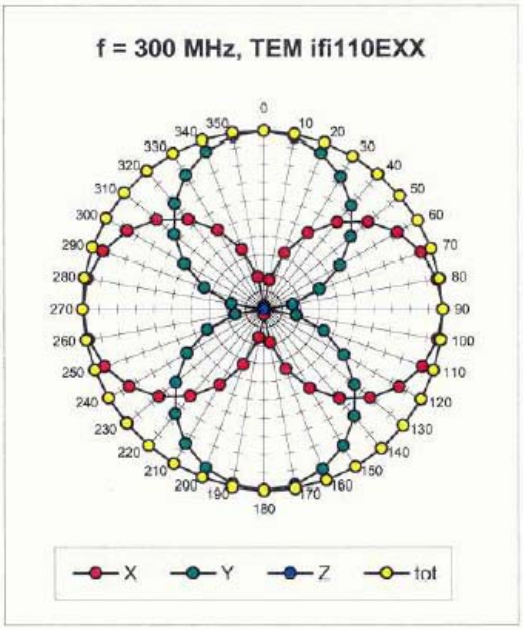


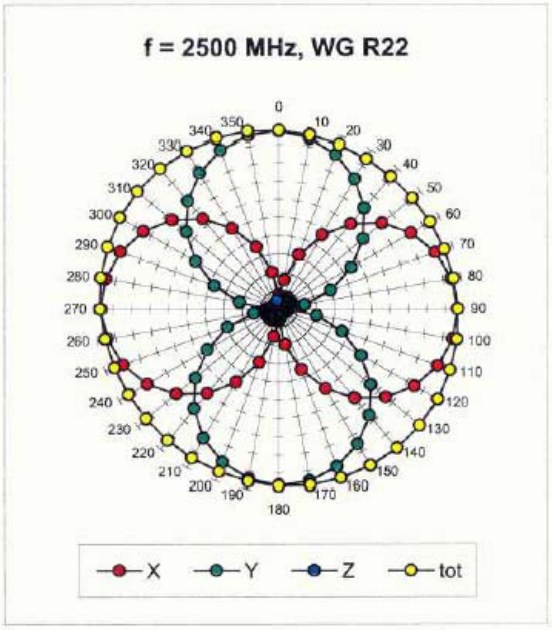


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

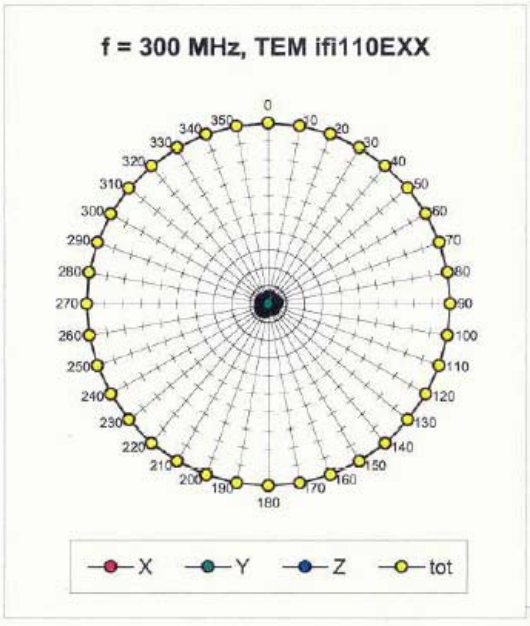
H3DV6 SN:6036 January 7, 2005

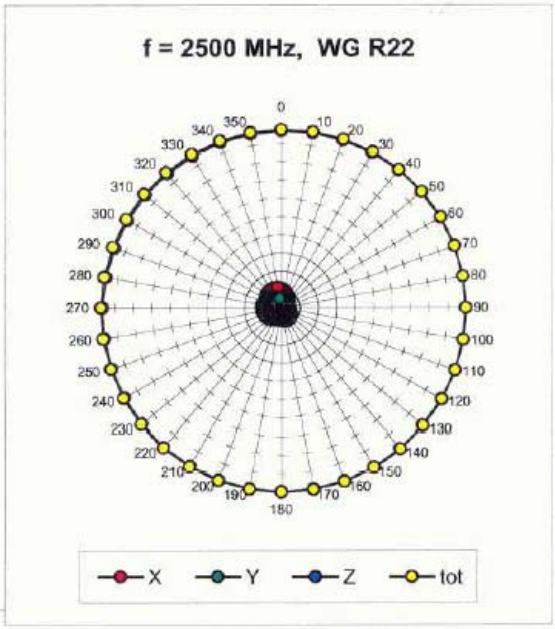
Receiving Pattern (ϕ), ϑ = 90°





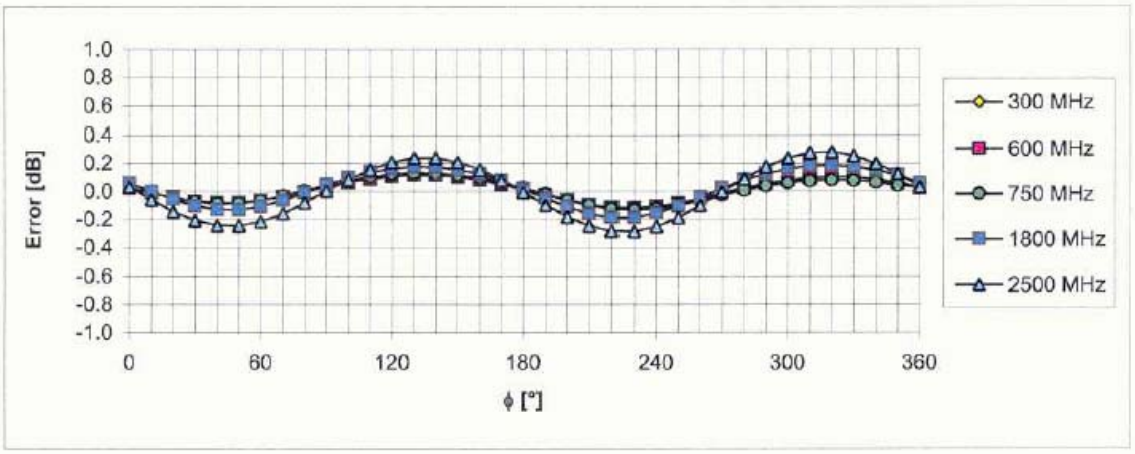
Receiving Pattern (ϕ), ϑ = 0°





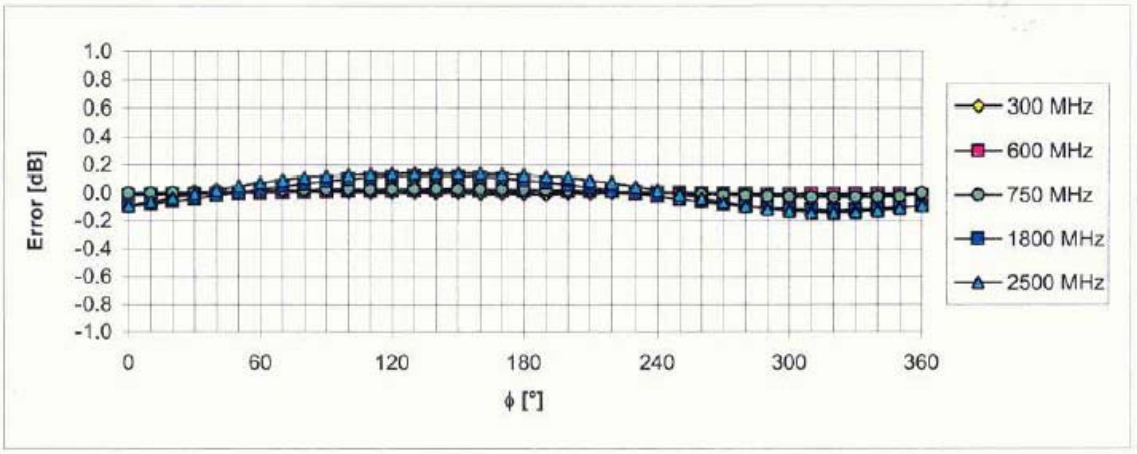
H3DV6 SN:6036 January 7, 2005

Receiving Pattern (ϕ), ϑ = 90°



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

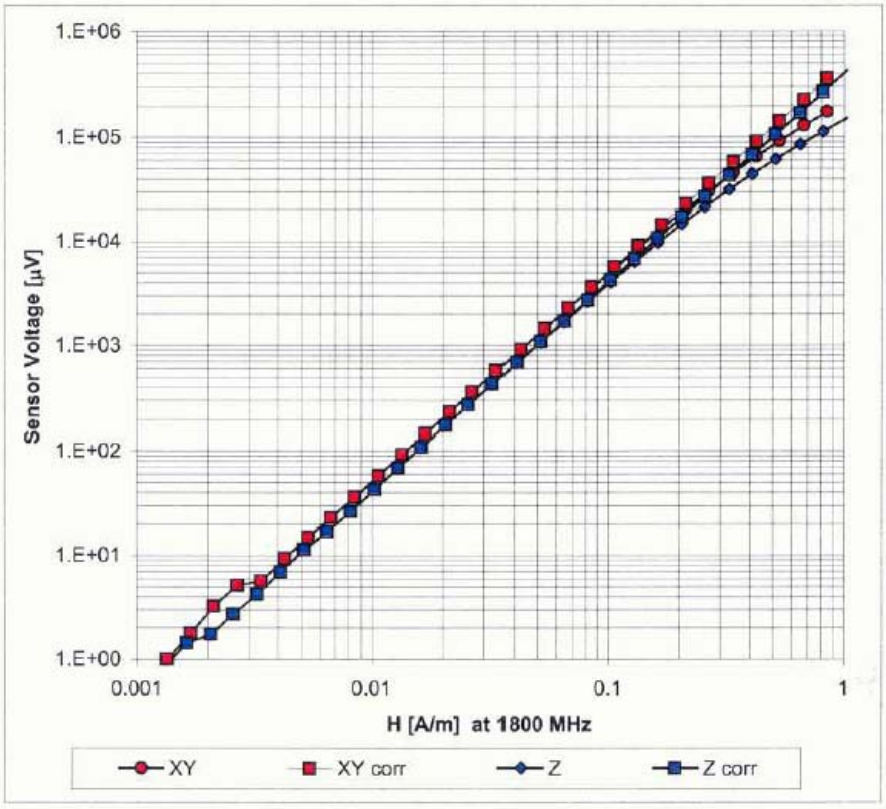


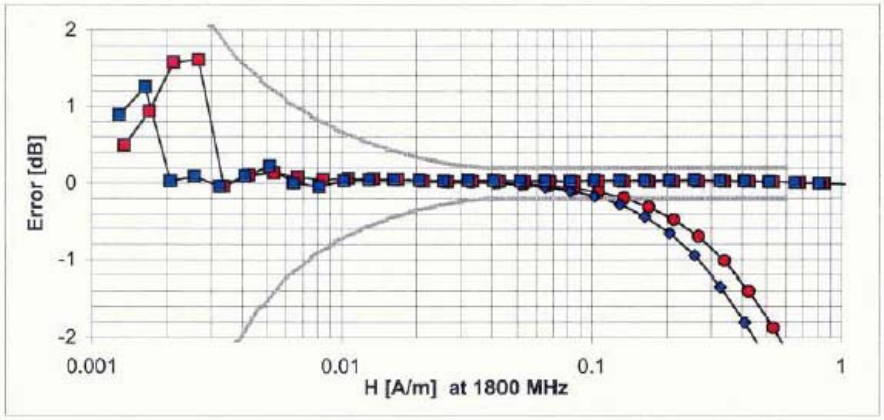
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

H3DV6 SN:6036 January 7, 2005

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





Uncertainty of Linearity Assessment: ± 0.6% (k=2)

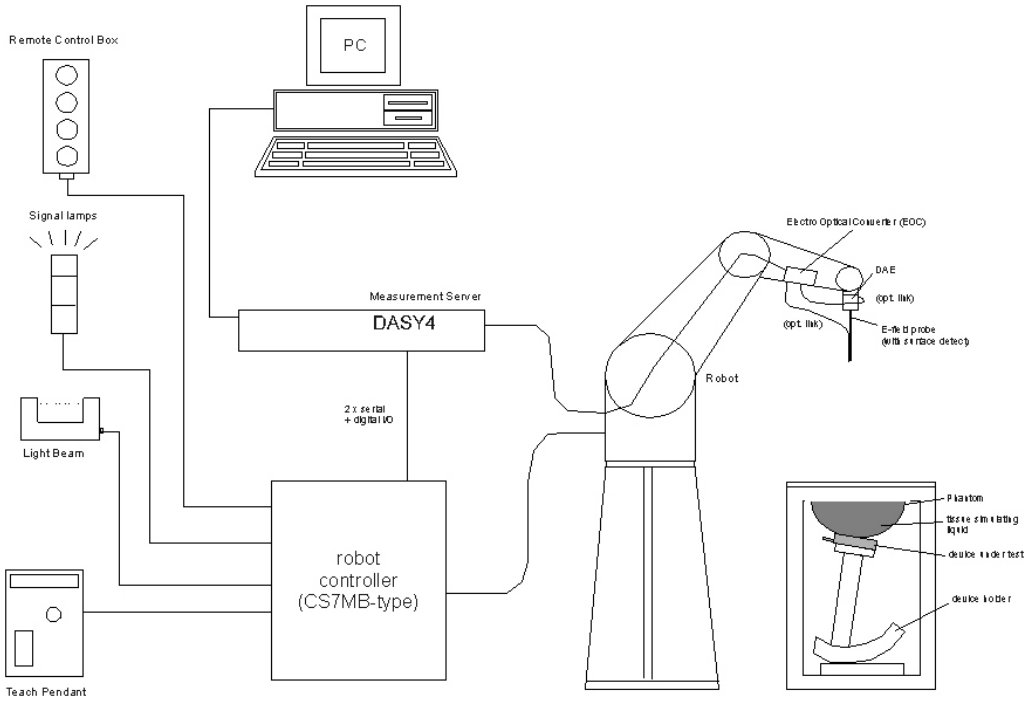
Appendix D

Details of Automated Scanning Method and Computations

Chapter 11

System Description and Setup

11.1 System Description



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

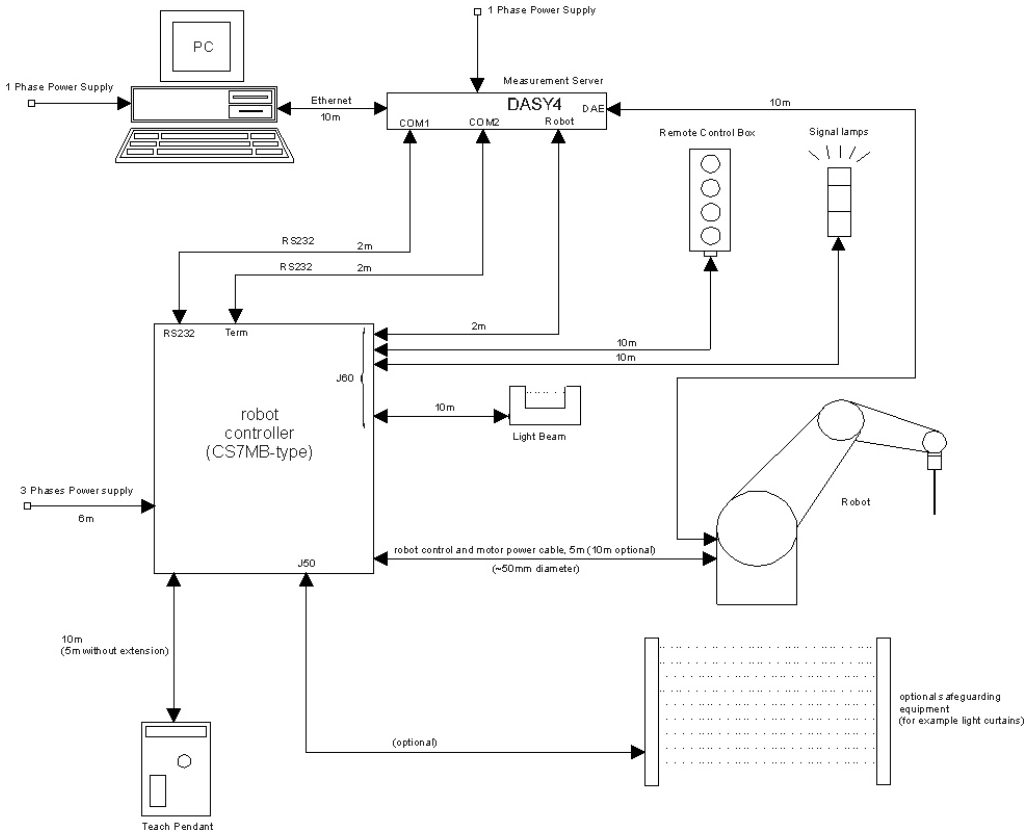
Options

- Isotropic E-field probe optimized and calibrated for E-field measurements in free space.
- Isotropic H-field probe optimized and calibrated for H-field measurements in any non-magnetic media.
- Flat Phantom (only for body-mounted transceivers operating below 800 MHz).

Additional utilities for SAR-measurements not provided by SPEAG

- System to operate the device in a defined mode. For compliance testing, no cable should be attached. This is usually accomplished with tester communication via an air link or by special device software.
- System to measure the dielectric properties of the tissue simulating liquids. For the time being we recommend the usage of the HP 85070 dielectric probe kit. An alternative is the slotted coaxial line method. Both methods require a network analyzer.
- Signal generator, amplifier, power meter (precision <0.1 dB), coupler and cable in order to perform the system check. A power level of larger then 14 dBm is required (preferably 20-25 dBm).
- Utilities to prepare tissue simulating solution
  - Stirrer (magneto-stirrer with heating plate is recommended)
  - Balance (1 g accuracy, 500 to 2'000 g range)
  - Glass flask 3 l to 10 l for mixing liquid

11.2 System Setup



11.3 Requirements for the Room

- Approximately constant room temperature is recommended (because of the sensitivity of the liquid parameters). The floor should be easy to clean (liquid in phantom), stable, flat and vibration free.
- The circuit breaker for the 3-phase power for the robot depends on the power main voltage. For 3 phases 400 V (Europe) 4 Amp are needed and for 3 phases 208 V (USA, Asia) 10 Amp.

11.4 RF-Absorber in Operating Room or Laboratory

For dosimetric measurements, no RF-absorbers are needed. If you perform free space measurements other then only in the immediate near-field, moveable absorbers are useful to avoid reflections from the walls, robot etc. Shielding and absorbers might be necessary to avoid interference with other devices (e.g., sensitive measurement systems, base stations).

11.5 Wiring for Power Connection in USA

An open ended 4 wire cable for power connection with the following configuration is delivered with the DASY system:

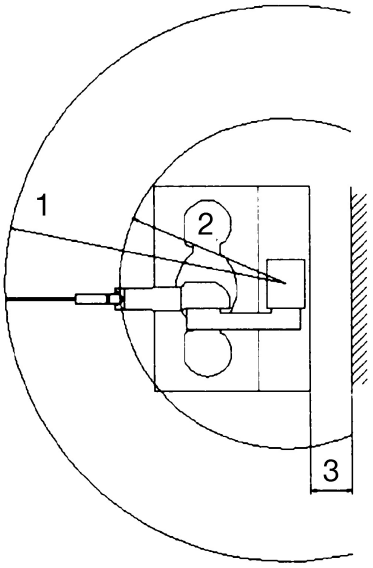
_____ 3 phases Δ 208 V
_____ Ground (Safety Ground)

Customer needs to organize a wall-mounted plug and a corresponding connector for the installation.

11.6 Wiring for Power Connection in Europe

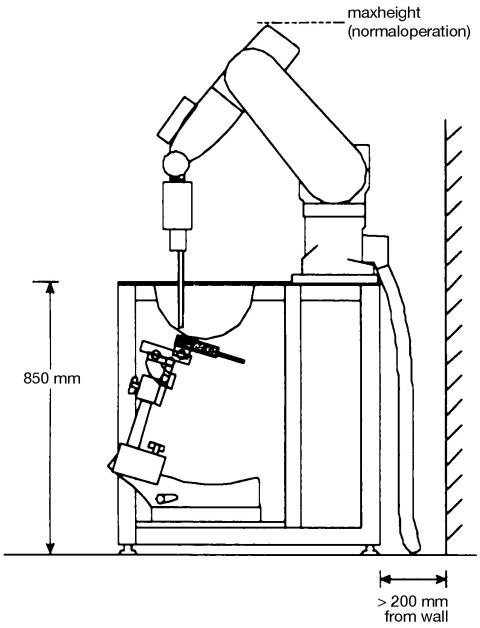
A standard CEE 16 Amp plug connector is delivered (3-phase + safety ground).

11.7 Dimensions of DASY4 Compact Version



Top View

1. Range for horizontal aligned probes (e.g., free space measurements): 1350 mm
2. Range for vertical aligned probes (max distance to phantom): 800 mm
3. Minimum distance from wall or absorber: 200 mm



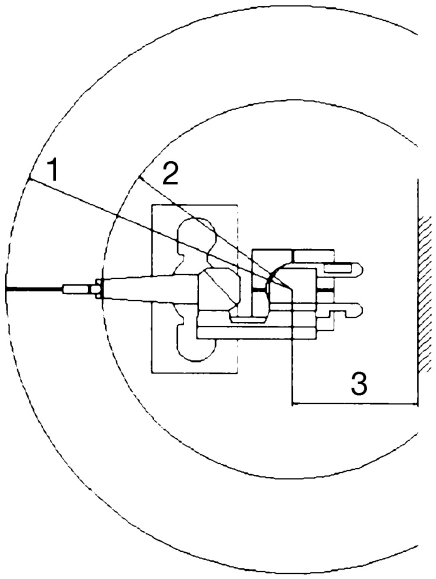
Side View

1. Minimum free height: approx. 1700 mm
2. Height of table: 850 mm

Typical Shipping Dimensions

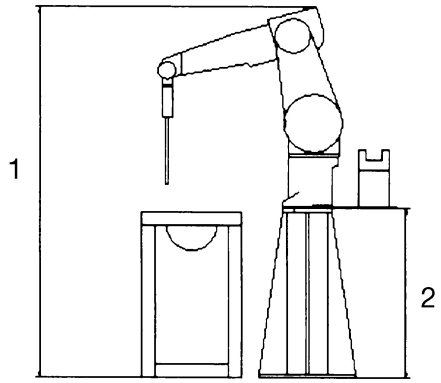
Approx. 5 pallets, gross weight approx. 413 kg
Maximum pallet size: 120x80x100 cm
Maximum pallet weight: approx. 138 kg

11.8 Dimensions of DASY4 Professional Version



Top View

1. Range for horizontal aligned probes (e.g., free space measurements):
   RX90L: 1590 mm, RX90: 1390 mm
2. Range for vertical aligned probes (max. distance to phantom):
   RX90L: 1100 mm, RX90: 900 mm
3. Minimum distance from wall or absorber:
   750 mm



Side View

1. Minimum free height: approx. 1900 mm
2. Height of robot socket: 850 mm

Typical Shipping Dimensions

Approx. 6 pallets, gross weight approx. 615 kg
Maximum pallet size: 120x80x100 cm
Maximum pallet weight: approx. 145 kg

Chapter 19

Data Storage and Evaluation

19.1 Data Storage

The DASY4 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension `.DA4`. The postprocessing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

To avoid unintentional parameter changes or data manipulations, the parameters in measured files are locked. In the administrator access mode of the software, the parameters can be unlocked (see Section 6.10 Unlocking a Setup). After changing the parameters, the measured scans can be reevaluated in the postprocessing engine.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m] or [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

19.2 Data Evaluation

The DASY4 postprocessing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i} \tag{19.1}$$

with	V_i	= compensated signal of channel i	(i = x, y, z)
	U_i	= input signal of channel i	(i = x, y, z)
	cf	= crest factor of exciting field	(DASY parameter)
	dcp_i	= diode compression point	(DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E} - \text{fieldprobes}: \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\text{H} - \text{fieldprobes}: \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

with	V_i	= compensated signal of channel i	(i = x, y, z)
	$Norm_i$	= sensor sensitivity of channel i μV/(V/m)^2 for E-field Probes	(i = x, y, z)
	$ConvF$	= sensitivity enhancement in solution	
	a_{ij}	= sensor sensitivity factors for H-field probes	
	f	= carrier frequency [GHz]	
	E_i	= electric field strength of channel i in V/m	
	H_i	= magnetic field strength of channel i in A/m	

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2} \tag{19.2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000} \tag{19.3}$$

with	SAR	= local specific absorption rate in mW/g
	E_{tot}	= total field strength in V/m
	σ	= conductivity in [mho/m] or [Siemens/m]
	ρ	= equivalent tissue density in g/cm^3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.