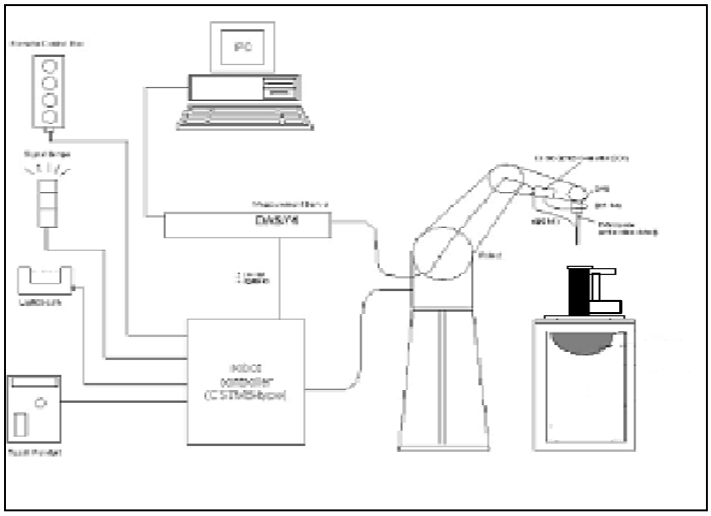
APPENDIX 3 : Test instruments

1. Equipment used

Control No.	Name of Equipment	Manufacture	Model number	Serial number	Calibration	
					Last Cal	due date
MPM-01	Power Meter	Agilent	E4417A	3008A01671	2008/02/06	2009/02/28
MPSE-01	Power Sensor	Agilent	E9300B	US40010300	2008/02/04	2009/02/28
MPSE-03	Power sensor	Agilent	E9327A	US40440576	2008/02/09	2009/02/28
MAT-15	Attenuator(30dB)	Agilent	8498A	100023	2008/02/21	2009/02/28
MSG-05	Signal Genelator	Agilent	E4438C	MY45090353	2007/06/20	2008/06/30
MRFA-02	RF Amplifier	OPHIR	5056F	1005	2007/06/01	2008/06/30
MHDC-11	Dual Directional Coupler	Hewlett Packard	778D	16605	-	-
MPD-01	PowerDivider DC to 26.5GHz	Agilent	11636B	52258	2008/03/07	2009/03/31
MAT-21	Attenuator(20dB)(above1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-120	901247	2008/01/09	2009/01/31
MNA-01	Network Analyzer	Agilent	E8358A	US41080381	2006/02/10	2009/02/28
MNCK-01	Type N Calibration Kit	Agilent	85032F	MY41495257	2006/02/08	2009/02/28
MPB-04	Isorotopic E-Field Probe	Schmid&Partner Engineering AG	ER3DV6	2427	2007/12/13	2008/12/31
MPB-05	Dosimetric H-Field Probe	Schmid&Partner Engineering AG	H3DV6	6259	2007/12/13	2008/12/31
MDAE-01	Data Acquisition Electronics	Schmid&Partner Engineering AG	DAE3 V1	509	2007/06/13	2008/06/30
MSTW-16	SAR/HAC measurement System	Schmid&Partner Engineering AG	DASY4	I021834	N/A	N/A
MDA-16	835MHz System Validation Dipole	Schmid&Partner Engineering AG	CD835V3	1087	2007/12/07	2009/12/31
MDA-17	1880MHz System Validation Dipole	Schmid&Partner Engineering AG	CD1880V3	1088	2007/12/12	2009/12/31
MPH-01	Test Arch Phantom (HAC Phantom)	Schmid&Partner Engineering AG	SD HAC P01BB	1094	-	-
MDPK-01	Dielectric probe kit	Agilent	85070D	-	-	-
MOS-05	Thermo-Hygrometer	Custom	CTH-190	810201	2006/04/25	2008/04/30
MOS-10	Digtal thermometer	HANNA	Checktemp-2	MOS-10	2007/03/23	2009/03/31
MBM-12	Barometer	Sunoh	SBR121	873	2007/12/27	2010/12/31

2. Configuration and peripherals



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

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
   An arm extension for accommodating the data acquisition electronics (DAE).

2. 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.

3. A data acquisition electronic (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.

4. 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.

5. 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.

6. A probe alignment unit which improves the (absolute) accuracy of the probe positioning.

7. A computer operating Windows 2000.

8. DASY4 software.

9. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

10. The Test Arch Phantom for enables easy defined positioning of the phone and validation.

11. The device holder for handheld mobile phones.

12. Tissue simulating liquid mixed according to the given recipes.

13. Validation dipole kits allowing to validate the proper functioning of the system.

4. System components

4.2.1 ER3DV6

<Isotropic E-Field Probe for General Near-Field Measurements>

Construction : One dipole parallel, two dipoles normal to probe axis
Built-in shielding against static charges PEEK enclosure material

Calibration : In air from 100 MHz to 3.0 GHz
(absolute accuracy ±6.0%, k=2)

Frequency : 40 MHz to > 6 GHz (can be extended to < 20 MHz)
Linearity: ± 0.2 dB (100 MHz to 3 GHz)

Directivity : ± 0.2 dB in air (rotation around probe axis)
± 0.4 dB in air (rotation normal to probe axis)

E-Field Probe (ER3DV6)

Dynamic Range : 2 V/m to > 1000 V/m; Linearity: ± 0.2 dB

Dimensions : Overall length: 330 mm (Tip: 16 mm)
Tip diameter: 8 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 2.5 mm

Application : General near-field measurements up to 6 GHz
Field component measurements
Fast automatic scanning in phantoms

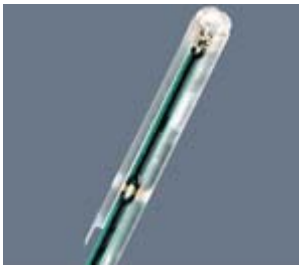
4.2.2 H3DV6

<3-Dimensional H-Field Probe for Small Band Applications>

Construction : Three concentric loop sensors with 3.8 mm loop diameters
Resistively loaded detector diodes for linear response Built-in
shielding against static charges PEEK enclosure material
(resistant to organic solvents, e.g., glycolether)

Frequency : 200 MHz to 3 GHz
(absolute accuracy ± 6.0%, k=2); Output linearized

Directivity : ± 0.2 dB (spherical isotropy error)



H-Field Probe (H3DV6)

Dynamic Range : 10 mA/m to 2 A/m at 1 GHz

E-Field Interference : < 10% at 3 GHz (for plane wave)

Dimensions : Overall length: 330 mm (Tip: 40 mm) Tip diameter: 6 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 3 mm

Application : General magnetic near-field measurements up to 3 GHz (in air or liquids)
Field component measurements
Surface current measurements
Low interaction with the measured field

Teat Arch Phantom

: Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.
Dimensions : 370 x 370 x 370 mm

Phone Positioner

: Supports accurate and reliable positioning of any phone.
Effect on near field <+/- 0.5 dB

5. Test system specifications

Robot RX60L

Number of Axes	:	6
Payload	:	1.6 kg
Reach	:	800mm
Repeatability	:	+/-0.025mm
Control Unit	:	CS7M
Programming Language	:	V+
Manuafacture	:	Stäubli Unimation Corp. Robot Model: RX60

DASY4 Measurement server

Features	:	166MHz low power Pentium MMX 32MB chipdisk and 64MB RAM Serial link to DAE (with watchdog supervision) 16 Bit A/D converter for surface detection system Two serial links to robot (one for real-time communication which is supervised by watchdog) Ethernet link to PC (with watchdog supervision) Emergency stop relay for robot safety chainTwo expansion slots for future applications
Manufacture	:	Schimid & Partner Engineering AG

Data Acquisition Electronic (DAE)

Features	:	Signal amplifier, multiplexer, A/D converter and control logic Serial optical link for communication with DASY4 embedded system (fully remote controlled) 2 step probe touch detector for mechanical surface detection and emergency robot stop (not in -R version)
Measurement Range	:	1 µV to > 200 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset voltage	:	< 1 µV (with auto zero)
Input Resistance	:	200 MΩ
Battery Power	:	> 10 h of operation (with two 9 V battery)
Dimension	:	60 x 60 x 68 mm
Manufacture	:	Schimid & Partner Engineering AG

6. System validation data

The target values were made into the calibration values of SPEAG. And the validation results of 835MHz (E/H Filed) & 1880MHz (E/H Filed) checked that it was within +/-10% as compared with the calibration values of SPEAG. The validation results are in the table below.

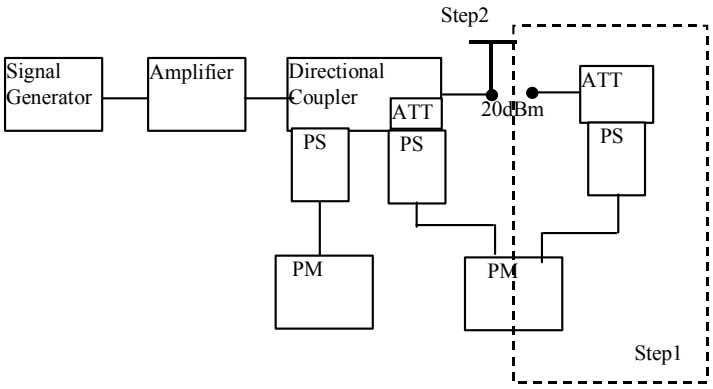
Frequency	:	**835MHz**
Ambient temperature (deg.c.)	:	**23.5**
Relative Humidity (%)	:	**35**
Dipole	:	**CD835V3 SN:1087**
Power	:	**200mW**

835MHz SYSTEM PERFORMANCE CHECK							
Date	E-Filed *1		Deviation	H-Filed *2		Deviation	Limit
	Target	Measured		Target*1	Measured	[%]	[%]
7-Mar	162.25	169.30	4.3	0.446	0.411	-7.8	+/-10

Frequency	:	**1880MHz**
Ambient temperature (deg.c.)	:	**23.5**
Relative Humidity (%)	:	**35**
Dipole	:	**CD1880V3 SN:1088**
Power	:	**200mW**

1880MHz SYSTEM PERFORMANCE CHECK							
Date	E-Filed *1		Deviation	H-Filed*2		Deviation	Limit
	Target*1	Measured		Target*1	Measured	[%]	[%]
7-Mar	135.45	144.65	6.8	0.474	0.433	-8.6	+/-10

Note:
*1: The value to compared to the calibration data is the average of the two maximum in the subgrids 2 and 8.
*2: The value to compared to the calibration data is maximum in the subgrids 5



Step1: Setup for desired input power to dipole antenna
Step2: Setup to dipole antenna

7. E-Filed Validation Measurement data

E-Filed 835MHz System Validation / Forward Conducted Power : 200mW

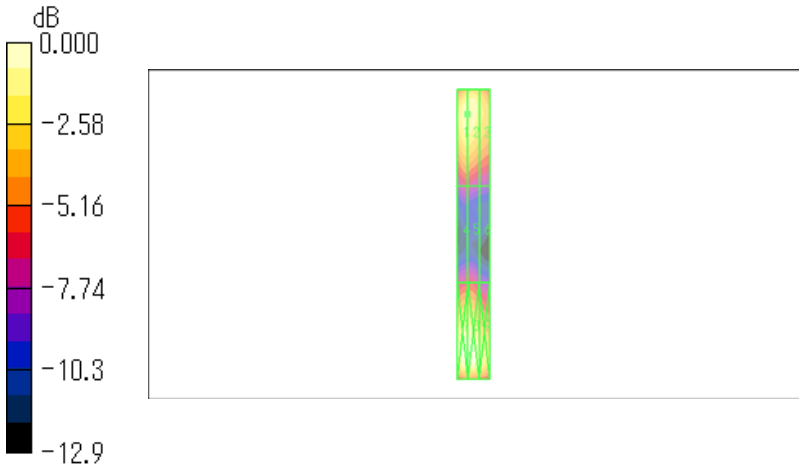
Dipole 835 MHz; Type: CD835V3; Serial: 1087
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section
DASY4 Configuration:
- Probe: ER3DV6 - SN2427; ConvF(1, 1, 1); Calibrated: 2007/12/13
- Sensor-Surface: (Fix Surface)
- Phantom: HAC Test Arch 4.6
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

E Scan - ER3DV6 - measurement distance from the probe sensor center to CD835 Dipole = 10mm/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 177.2 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 117.2 V/m; Power Drift = 0.028 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **161.4 M4**	Grid 2 **161.4 M4**	Grid 3 **140.7 M4**
Grid 4 **86.4 M4**	Grid 5 **87.5 M4**	Grid 6 **73.5 M4**
Grid 7 **177.2 M4**	Grid 8 **177.2 M4**	Grid 9 **155.6 M4**

Test Date = 03/07/08
Ambient Temperature = 23.0degree.c



0 dB = 177.2V/m

E-Filed 1880MHz System Validation / Forward Conducted Power : 200mW

Dipole 1880MHz; Type: CD1880V3; Serial: 1088

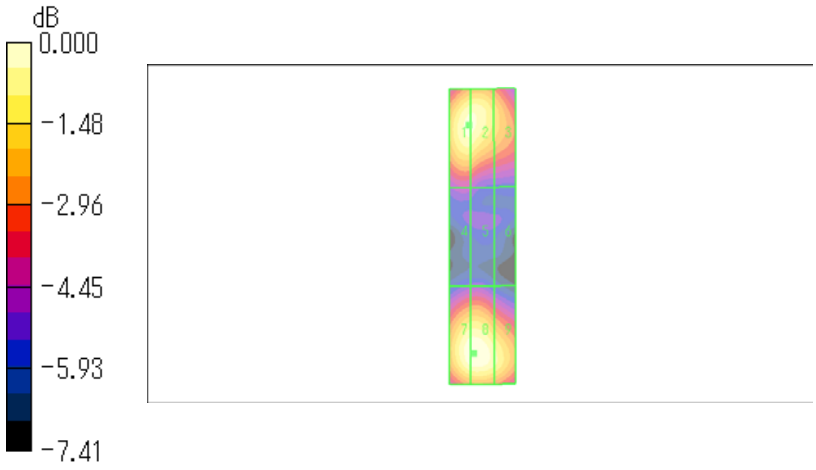
Communication System: CW; Frequency: 1880 MHz;Crest factor:1
Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section
DASY4 Configuration:
- Probe: ER3DV6 - SN2427; ConvF(1, 1, 1); Calibrated: 2007/12/13
- Sensor-Surface: (Fix Surface)
- Phantom: HAC Test Arch 4.6
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

E Scan - ER3DV6 - measurement distance from the probe sensor center to CD1880 Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 147.0 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 155.9 V/m; Power Drift = -0.005 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **142.3 M2**	Grid 2 **142.3 M2**	Grid 3 **123.2 M2**
Grid 4 **88.0 M3**	Grid 5 **86.0 M3**	Grid 6 **80.9 M3**
Grid 7 **146.2 M2**	Grid 8 **147.0 M2**	Grid 9 **135.0 M2**

Test Date = 03/07/08
Ambient Temperature = 23.0degree.c



0 dB = 147.0V/m

8. H-Filed Validation Measurement data

H-Filed 835MHz System Validation / Forward Conducted Power : 200mW

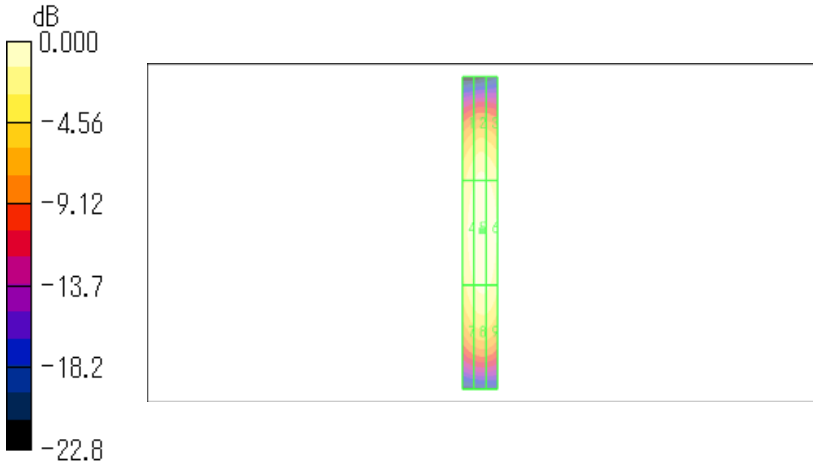
Dipole 835 MHz; Type: CD835V3; Serial: 1087
Communication System: CW; Frequency: 835 MHz;Crest factor:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: E Dipole Section
DASY4 Configuration:
- Probe: H3DV6 - SN6259; ; Calibrated: 2007/12/13
- Sensor-Surface: (Fix Surface)
- Phantom: HAC Test Arch 4.6
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

H Scan - H3DV6 - measurement distance from the probe sensor center to CD835 Dipole = 10mm/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.411 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 0.358 A/m; Power Drift = 0.016 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.341 M4**	Grid 2 **0.368 M4**	Grid 3 **0.356 M4**
Grid 4 **0.385 M4**	Grid 5 **0.411 M4**	Grid 6 **0.402 M4**
Grid 7 **0.342 M4**	Grid 8 **0.364 M4**	Grid 9 **0.360 M4**

Test Date = 03/07/08
Ambient Temperature = 23.0degree.c



0 dB = 0.411A/m

H-Filed 1880MHz System Validation / Forward Conducted Power : 200mW

Dipole 1880MHz; Type: CD1880V3; Serial: 1088

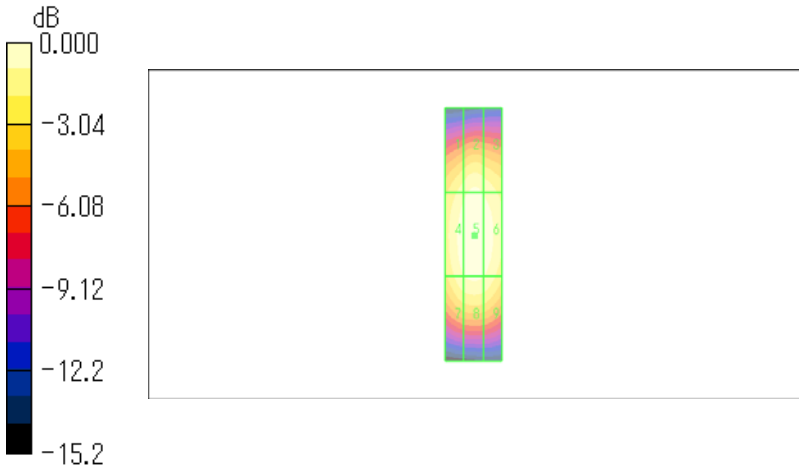
Communication System: CW; Frequency: 1880 MHz;Crest factor:1
Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: E Dipole Section
DASY4 Configuration:
- Probe: H3DV6 - SN6259; ; Calibrated: 2007/12/13
- Sensor-Surface: (Fix Surface)
- Phantom: HAC Test Arch 4.6
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

H Scan - H3DV6 - measurement distance from the probe sensor center to CD1880 Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.433 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 0.454 A/m; Power Drift = -0.011 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.369 M2**	Grid 2 **0.398 M2**	Grid 3 **0.381 M2**
Grid 4 **0.411 M2**	Grid 5 **0.433 M2**	Grid 6 **0.418 M2**
Grid 7 **0.381 M2**	Grid 8 **0.396 M2**	Grid 9 **0.385 M2**

Test Date = 03/07/08
Ambient Temperature = 23.0degree.c



0 dB = 0.433A/m

9. Validation uncertainty

The uncertainty budget has been determined for the DASY4 measurement system according to the SPEAG documents[2]and is given in the following Table.

Error Description	Uncertainty value ± %	Probability distribution	divisor	(ci) E	(ci) H	Standard Uncertainty E	Standard Uncertainty H
Measurement System							
Probe calibration	±5.1	Normal	1	1	1	±5.1	±5.1
Axial isotropy of the probe	±4.7	Rectangular	√3	1	1	±2.7	±2.7
Sensor Displacement	±16.5	Rectangular	√3	1	0.145	±9.5	±1.4
Boundary effects	±2.4	Rectangular	√3	1	1	±1.4	±1.4
Probe linearity	±4.7	Rectangular	√3	1	1	±2.7	±2.7
Scaling to Peak Envelope Power	±0	Rectangular	√3	1	1	±0	±0
System Detection limit	±1.0	Rectangular	√3	1	1	±0.6	±0.6
Readout electronics	±0.3	Normal	1	1	1	±0.3	±0.3
Response time	±0	Rectangular	√3	1	1	±0	±0
Integration time	±0	Rectangular	√3	1	1	±0	±0
RF ambient Noise	±3.0	Rectangular	√3	1	1	±1.7	±1.7
RF ambient Reflections	±6.0	Rectangular	√3	1	1	±6.9	±6.9
Probe Positioner	±1.2	Rectangular	√3	1	0.67	±0.7	±0.5
Probe positioning	±4.7	Rectangular	√3	1	0.67	±2.7	±1.8
Extrap.and Interpolation	±1.0	Rectangular	√3	1	1	±0.6	±0.6
Dipole Related							
Distance Dipole-Scanning Plane	±5.2	Rectangular	√3	1	0.3	±3.0	±0.9
Input Power	±4.7	Normal	1	1	1	±4.7	±4.7
							±4.8
Combined Standard Uncertainty						±13.7	±9.3
Expanded Std. Uncertainty on Power(k=2)						**±27.4**	**±18.6**
Expanded Std. Uncertainty on Filed(k=1)						**±13.7**	**±9.3**

10. System Validation Dipole (CD835V3,S/N: 1087)

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 Accreditation Service (SAS)
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 UL Japan (MTT)

Certificate No: CD835V3-1087_Dec07

CALIBRATION CERTIFICATE

Object CD835V3 - SN: 1087

Calibration procedure(s) QA CAL-20.v4
Calibration procedure for dipoles in air

Calibration date: December 7, 2007

Condition of the calibrated item In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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 EPM-442A	GB37480704	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Probe ER3DV6	SN: 2336	27-Dec-06 (SPEAG, No. ER3-2336_Dec06)	Dec-07
Probe H3DV6	SN: 6065	27-Dec-06 (SPEAG, No. H3-6065_-Dec06)	Dec-07
DAE4	SN: 781	2-Oct-07 (SPEAG, No. DAE4-781_Oct07)	Oct-08
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power meter EPM-4419B	GB42420191	11-May-05 (SPEAG, in house check Oct -07)	In house check: Nov-08
Power sensor HP 8482A	US37295597	11-May-05 (SPEAG, in house check Oct -07)	In house check: Nov-08
Power sensor HP 8482H	3318A09450	08-Jan-02 (SPEAG, in house check Oct -07)	In house check: Nov-08
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Nov-09
RF generator E4433B	MY 41310391	22-Nov-04 (SPEAG, in house check Oct-07)	In house check: Nov-09

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	
Approved by:	Fin Bomholt	Technical Director	

Issued: December 13, 2007

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 Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

References

[1] ANSI-C63.19-2006
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with standard [1], the measurement planes (probe sensor center) are selected to be at a distance of 10 mm above the top edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
  It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY4 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E- field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (in z) above the top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, 10mm above the dipole surface.
- *H-field distribution:* H-field is measured with an isotropic H-field probe with 100mW forward power to the antenna feed point, in the x-y-plane. The scan area and sensor distance is equivalent to the E-field scan. The maximum of the field is available at the center (subgrid 5) above the feed point. The H-field value stated as calibration value represents the maximum of the interpolated H-field, 10mm above the dipole surface at the feed point.

1 Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY4	V4.7 B55
DASY PP Version	SEMCAD	V1.8 B176
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 180 mm
Frequency	**835 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured	100 mW forward power	**0.446 A/m**

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end-	100 mW forward power	163.0 V/m
Maximum measured above low end	100 mW forward power	161.5 V/m
Averaged maximum above arm	100 mW forward power	**162.3 V/m**

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
800 MHz	16.9 dB	(44.6 – j12.5) Ohm
835 MHz	**27.9 dB**	**(47.9 + j3.3) Ohm**
900 MHz	16.5 dB	(58.1 – j14.1) Ohm
950 MHz	24.2 dB	(45.5 + j3.8) Ohm
960 MHz	18.6 dB	(49.4 + j11.7) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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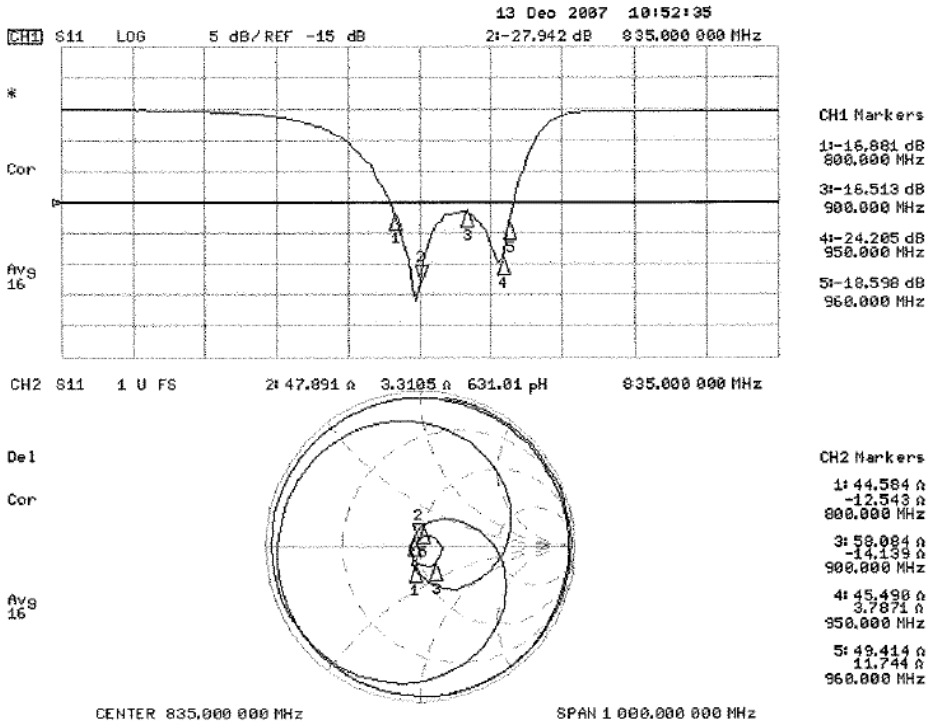
3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



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Test Laboratory: SPEAG Lab 2

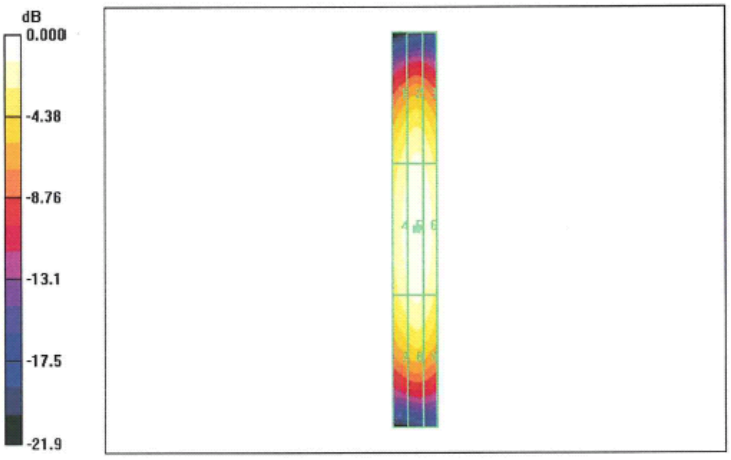
DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: 1087
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 02.10.2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

H Scan - Sensor Center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.446 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 0.473 A/m; Power Drift = 0.007 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.366 M4**	Grid 2 **0.397 M4**	Grid 3 **0.382 M4**
Grid 4 **0.413 M4**	Grid 5 **0.446 M4**	Grid 6 **0.429 M4**
Grid 7 **0.365 M4**	Grid 8 **0.392 M4**	Grid 9 **0.376 M4**



0 dB = 0.446A/m

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3.3.3 DASY4 E-Field result

Date/Time: 07.12.2007 15:20:49

Test Laboratory: SPEAG Lab 2

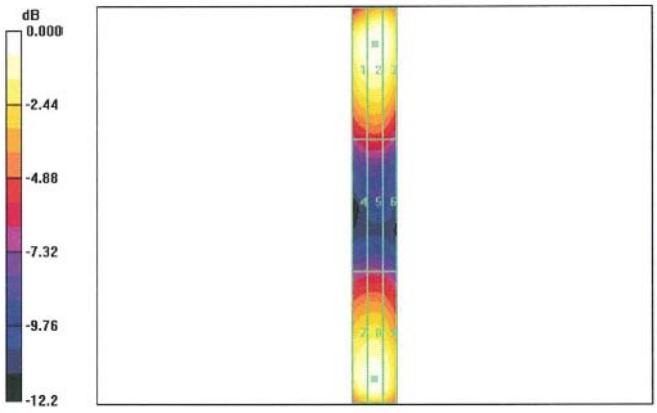
DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1087
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 02.10.2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

E Scan - Sensor Center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 163.0 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 105.0 V/m; Power Drift = 0.000 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **158.5 M4**	Grid 2 **163.0 M4**	Grid 3 **159.3 M4**
Grid 4 **85.7 M4**	Grid 5 **88.0 M4**	Grid 6 **85.5 M4**
Grid 7 **157.4 M4**	Grid 8 **161.5 M4**	Grid 9 **153.1 M4**



0 dB = 163.0V/m

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11. System Validation Dipole (CD1880V3,S/N: 1088)

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Engineering AG
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Accreditation No.: SCS 108

Client UL Japan (MTT)

Certificate No: CD1880V3-1088_Dec07

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1088
Calibration procedure(s)	QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date:	December 12, 2007
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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 EPM-442A	GB37480704	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Probe ER3DV6	SN: 2336	27-Dec-06 (SPEAG, No. ER3-2336_Dec06)	Dec-07
Probe H3DV6	SN: 6065	27-Dec-06 (SPEAG, No. H3-6065_Dec06)	Dec-07
DAE4	SN: 781	2-Oct-07 (SPEAG, No. DAE4-781_Oct07)	Oct-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB42420191	11-May-05 (SPEAG, in house check Oct-07)	In house check: Nov-08
Power sensor HP 8482A	US37295597	11-May-05 (SPEAG, in house check Oct-07)	In house check: Nov-08
Power sensor HP 8482H	3318A09450	08-Jan-02 (SPEAG, in house check Oct-07)	In house check: Nov-08
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Nov-09
RF generator E4433B	MY 41310391	22-Nov-04 (SPEAG, in house check Oct-07)	In house check: Nov-09

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	
Approved by:	Fin Bomholt	Technical Director	

Issued: December 13, 2007

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Certificate No: CD1880V3-1088_Dec07 Page 1 of 6

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Accreditation No.: SCS 108

Client: UL Japan (MTT)

Certificate No: CD1880V3-1088_Dec07

CALIBRATION CERTIFICATE

Object: CD1880V3 - SN: 1088

Calibration procedure(s): QA CAL-20.v4
Calibration procedure for dipoles in air

Calibration date: December 12, 2007

Condition of the calibrated item: In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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 EPM-442A	GB37480704	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Probe ER3DV6	SN: 2336	27-Dec-06 (SPEAG, No. ER3-2336_Dec06)	Dec-07
Probe H3DV6	SN: 6065	27-Dec-06 (SPEAG, No. H3-6065_Dec06)	Dec-07
DAE4	SN: 781	2-Oct-07 (SPEAG, No. DAE4-781_Oct07)	Oct-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB42420191	11-May-05 (SPEAG, In house check Oct-07)	In house check: Nov-08
Power sensor HP 8482A	US37295597	11-May-05 (SPEAG, In house check Oct-07)	In house check: Nov-08
Power sensor HP 8482H	3318A09450	08-Jan-02 (SPEAG, In house check Oct-07)	In house check: Nov-08
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, In house check Oct-07)	In house check: Nov-09
RF generator E4433B	MY 41310391	22-Nov-04 (SPEAG, In house check Oct-07)	In house check: Nov-09

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	
Approved by:	Fin Bomholt	Technical Director	

Issued: December 13, 2007

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Accreditation No.: SCS 108

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References

[1] ANSI-C63.19-2006
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with standard [1], the measurement planes (probe sensor center) are selected to be at a distance of 10 mm above the top edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
  It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY4 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E- field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (in z) above the top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, 10mm above the dipole surface.
- *H-field distribution:* H-field is measured with an isotropic H-field probe with 100mW forward power to the antenna feed point, in the x-y-plane. The scan area and sensor distance is equivalent to the E-field scan. The maximum of the field is available at the center (subgrid 5) above the feed point. The H-field value stated as calibration value represents the maximum of the interpolated H-field, 10mm above the dipole surface at the feed point.

1 Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY4	V4.7 B55
DASY PP Version	SEMCAD	V1.8 B176
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	**1880 MHz** ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured	100 mW forward power	**0.474 A/m**

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW forward power	136.8 V/m
Maximum measured above low end	100 mW forward power	134.1 V/m
Averaged maximum above arm	100 mW forward power	**135.5 V/m**

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
1710 MHz	19.7 dB	(46.9 + j9.6) Ohm
1880 MHz	**20.7 dB**	**(49.7 + j9.2) Ohm**
1900 MHz	21.5 dB	(52.5 + j8.3) Ohm
1950 MHz	30.1 dB	(53.2 + j0.0) Ohm
2000 MHz	20.3 dB	(41.2 + j0.5) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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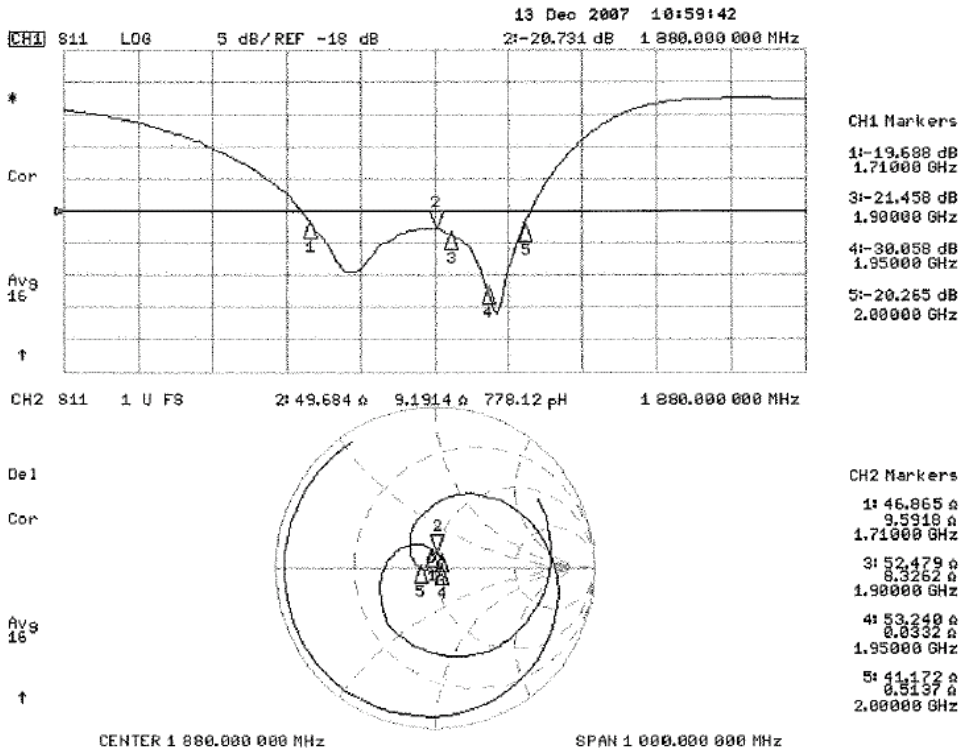
3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



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3.3.2 DASY4 H-Field Result

Date/Time: 12.12.2007 11:08:10

Test Laboratory: SPEAG Lab 2

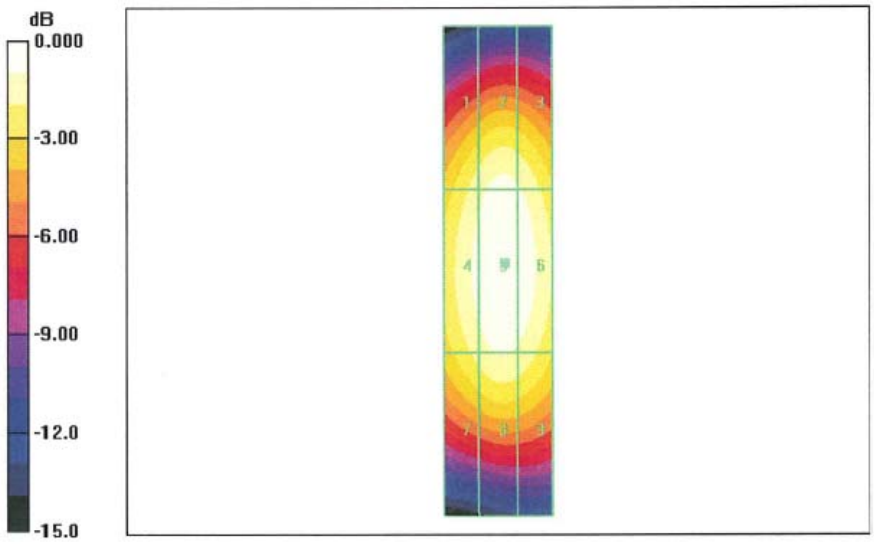
DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1088
Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: H Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 02.10.2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

H Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.474 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 0.500 A/m; Power Drift = -0.010 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.403 M2**	Grid 2 **0.441 M2**	Grid 3 **0.427 M2**
Grid 4 **0.439 M2**	Grid 5 **0.474 M2**	Grid 6 **0.461 M2**
Grid 7 **0.394 M2**	Grid 8 **0.425 M2**	Grid 9 **0.412 M2**



0 dB = 0.474A/m

3.3.2 DASY4 E-Field Result

Date/Time: 07.12.2007 17:54:02

Test Laboratory: SPEAG Lab 2

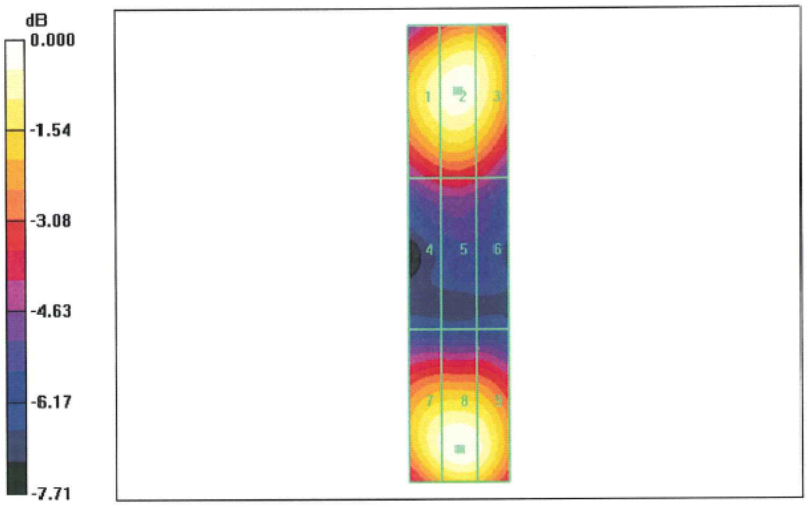
DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1088
Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: E Dipole Section
Measurement Standard: DASY4 (High Precision Assessment)
DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 27.12.2006
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 02.10.2007
- Phantom: HAC Test Arch with Coil; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

E Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 136.8 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, 354.7 mm
Reference Value = 154.2 V/m; Power Drift = 0.008 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **129.8 M2**	Grid 2 **134.1 M2**	Grid 3 **130.6 M2**
Grid 4 **89.5 M3**	Grid 5 **91.5 M3**	Grid 6 **87.4 M3**
Grid 7 **131.8 M2**	Grid 8 **136.8 M2**	Grid 9 **132.0 M2**



0 dB = 136.8V/m

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12. Isotropic E-Field Probe E-Field Probe Calibration (ER3DV6 SN 2427)

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Accreditation No.: SCS 108

Client **UL Japan (MTT)** Certificate No: **ER3-2427_Dec07**

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2427
Calibration procedure(s)	QA CAL-02.v5 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	December 13, 2007
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	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe ER3DV6	SN: 2328	2-Oct-07 (SPEAG, No. ER3-2328_Oct07)	Oct-08
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: December 13, 2007

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Certificate No: ER3-2427_Dec07 Page 1 of 9

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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 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005.

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor ($f \leq 900$ 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).

Probe ER3DV6

SN:2427

Manufactured: July 24, 2007
Calibrated: December 13, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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ER3DV6 SN:2427 December 13, 2007

DASY - Parameters of Probe: ER3DV6 SN:2427

Sensitivity in Free Space [μV/(V/m)^2] Diode Compression[A]

NormX	**1.54** ± 10.1 % (k=2)	DCP X	**94** mV
NormY	**1.71** ± 10.1 % (k=2)	DCP Y	**94** mV
NormZ	**2.08** ± 10.1 % (k=2)	DCP Z	**98** 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 **-201** °

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

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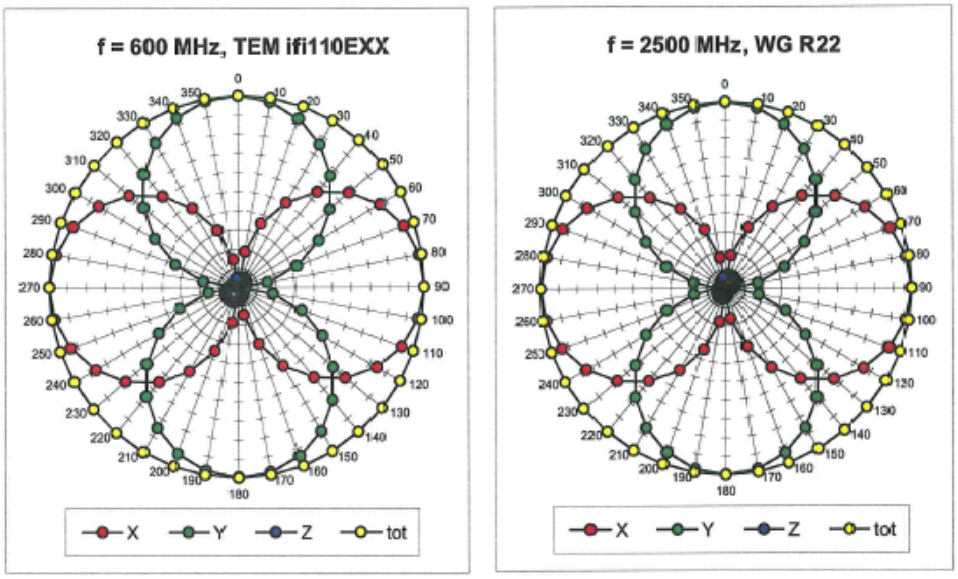
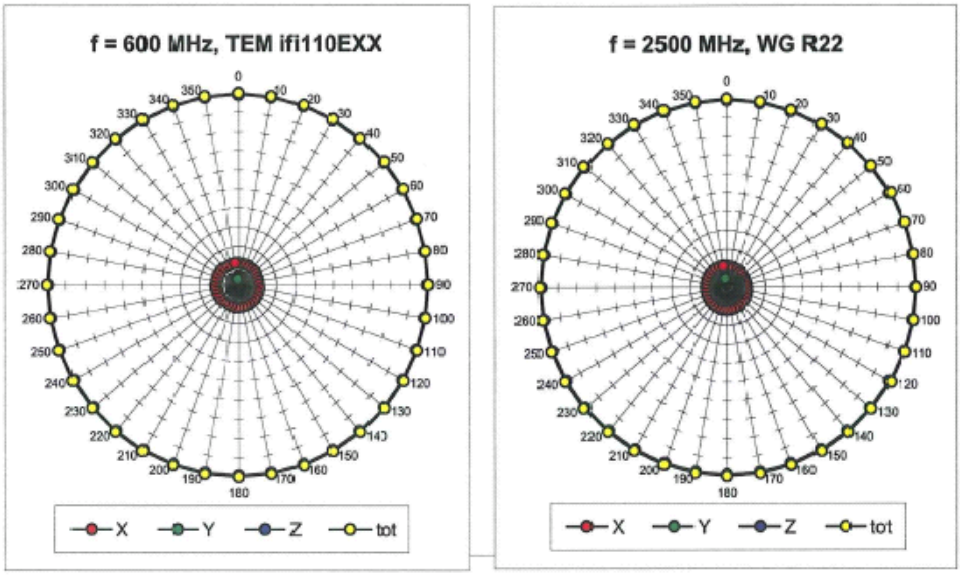
ER3DV6 SN:2427 December 13, 2007

Receiving Pattern (ϕ), ϑ = 0°



Receiving Pattern (ϕ), ϑ = 90°



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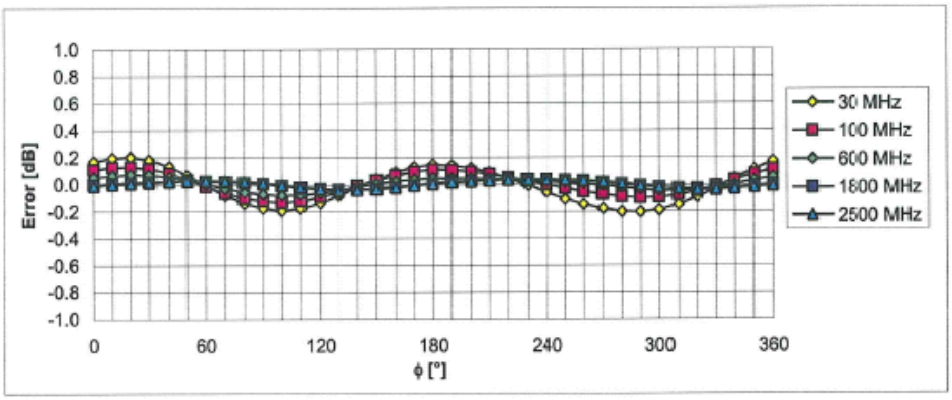
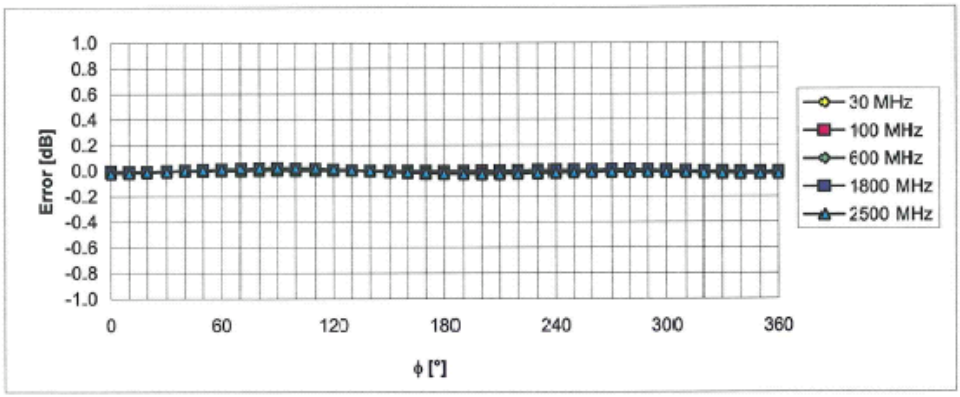
ER3DV6 SN:2427 December 13, 2007

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)

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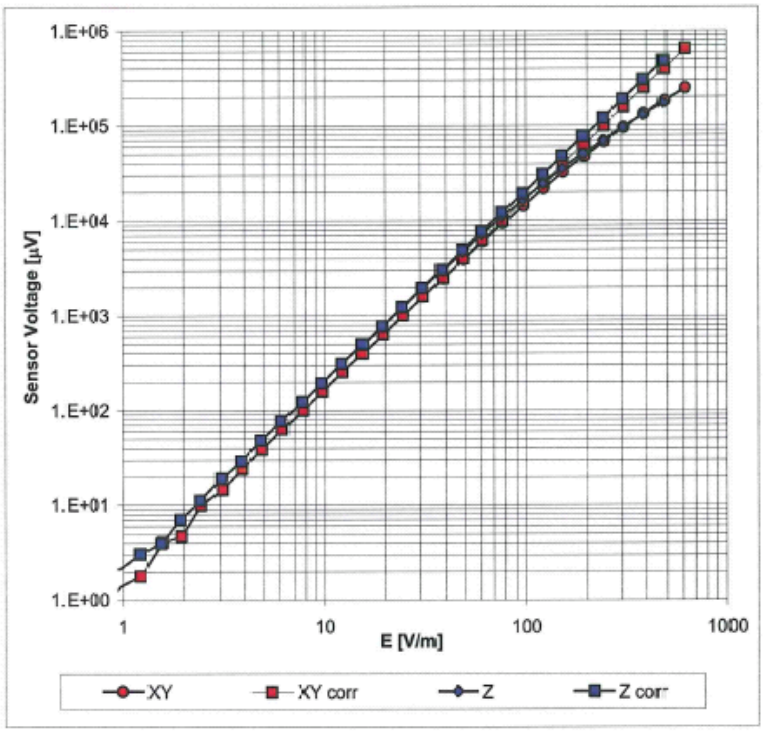
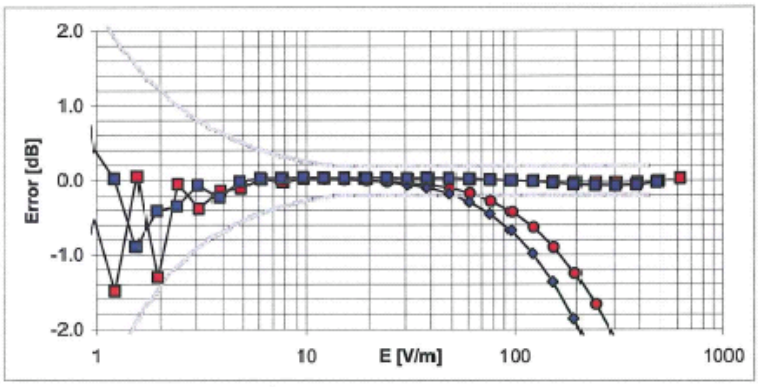
ER3DV6 SN:2427 December 13, 2007

Dynamic Range f(E-field)

(Waveguide R22, f = 1800 MHz)





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

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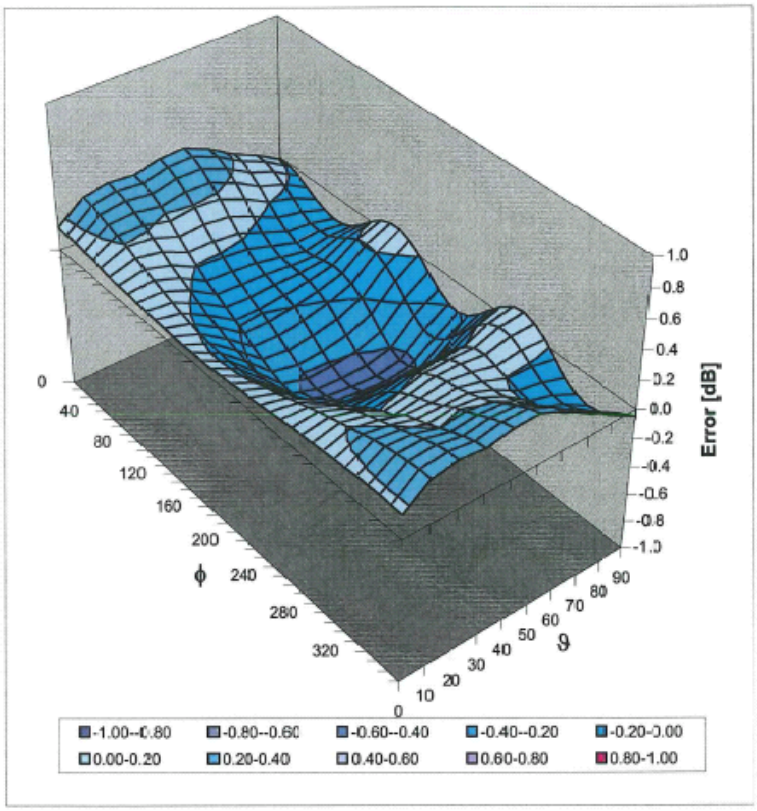
ER3DV6 SN:2427 December 13, 2007

Deviation from Isotropy in Air
Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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13. Dimensional H-Field Probe Calibration (H3DV6 SN 6259)

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 Accreditation Service (SAS)
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 UL Japan (MTT)

Certificate No: H3-6259_Dec07

CALIBRATION CERTIFICATE

Object H3DV6 - SN:6259

Calibration procedure(s) QA CAL-03.v5
Calibration procedure for H-field probes optimized for close near field evaluations in air

Calibration date: December 13, 2007

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	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe H3DV6	SN: 6182	2-Oct-07 (SPEAG, No. H3-6182_Oct07)	Oct-08
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: December 13, 2007

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: H3-6259_Dec07 Page 1 of 8

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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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 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005.

Methods Applied and Interpretation of Parameters:

- *X,Y,Z_a0a1a2:* Assessed for E-field polarization ϑ = 90 for XY sensors and ϑ = 0 for Z sensor (f ≤ 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).

Probe H3DV6

SN:6259

Manufactured: July 10, 2007
Calibrated: December 13, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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H3DV6 SN:6259 December 13, 2007

DASY - Parameters of Probe: H3DV6 SN:6259

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

	a0	a1	a2
X	**2.461E-03**	**1.692E-5**	**2.009E-5** ± 5.1 % (k=2)
Y	**2.510E-03**	**-3.202E-5**	**1.239E-5** ± 5.1 % (k=2)
Z	**2.923E-03**	**-3.727E-5**	**3.335E-5** ± 5.1 % (k=2)

Diode Compression[1]

DCP X	**85** mV
DCP Y	**85** mV
DCP Z	**84** mV

Sensor Offset (Probe Tip to Sensor Center)

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

Connector Angle **-271** °

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

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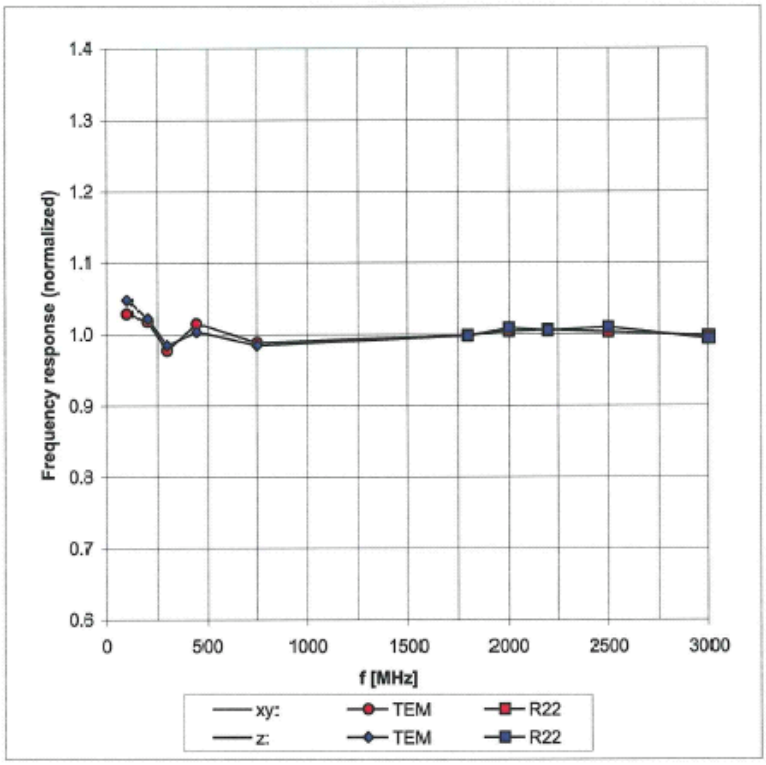
H3DV6 SN:6259 December 13, 2007

Frequency Response of H-Field

(TEM-Cell:ifi110, Waveguide R22)



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

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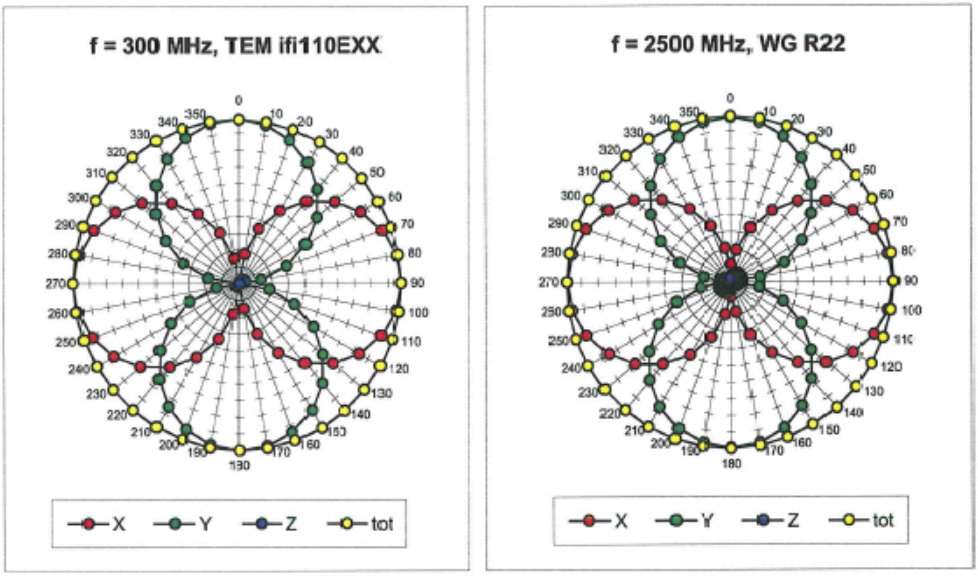
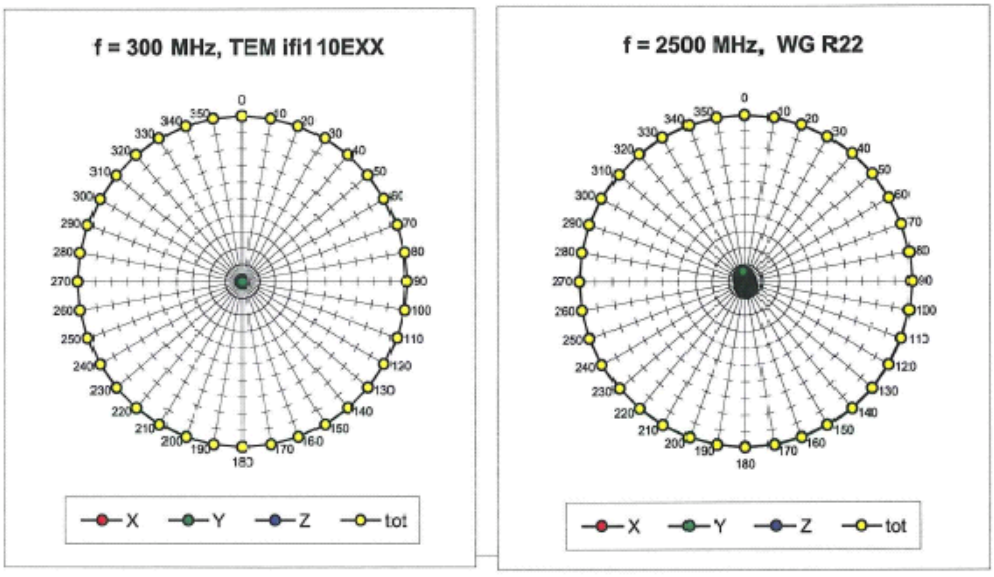
Receiving Pattern (ϕ), ϑ = 90°



Receiving Pattern (ϕ), ϑ = 0°



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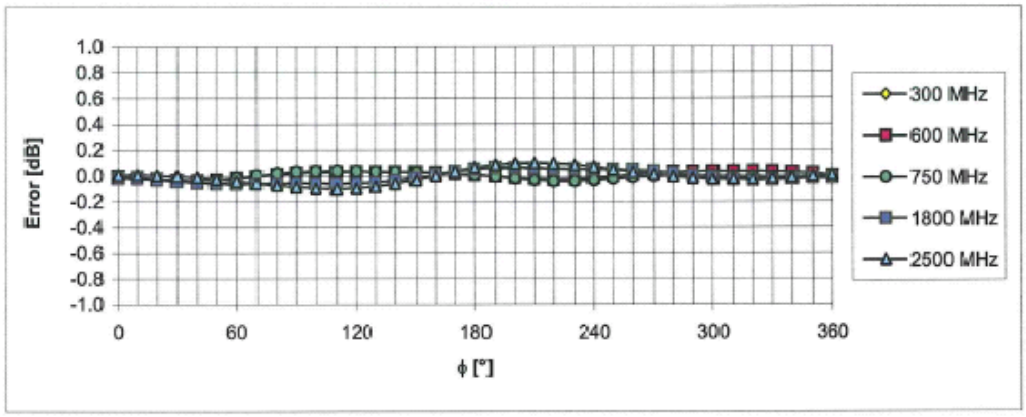
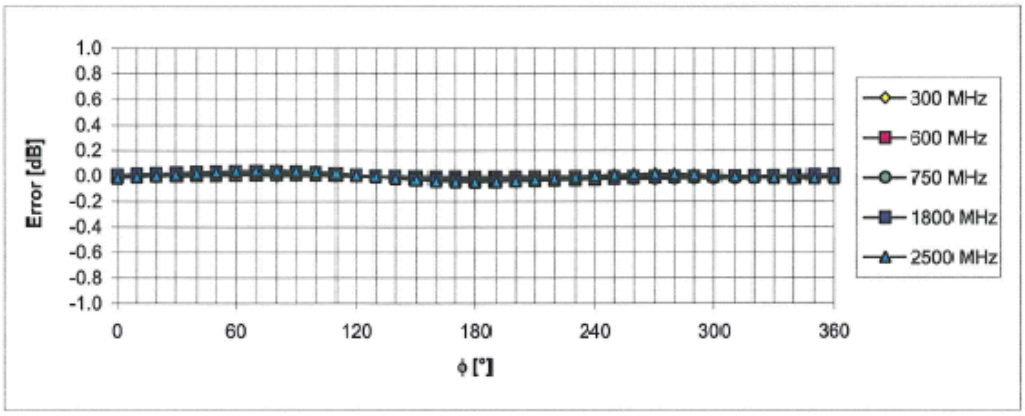
Receiving Pattern (ϕ), ϑ = 90°



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

Receiving Pattern (ϕ), ϑ = 0°



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

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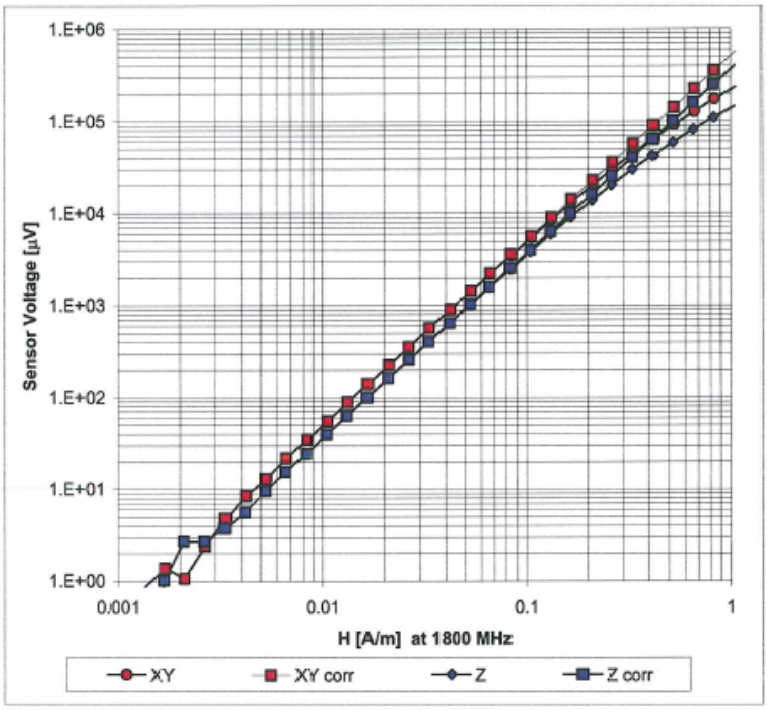
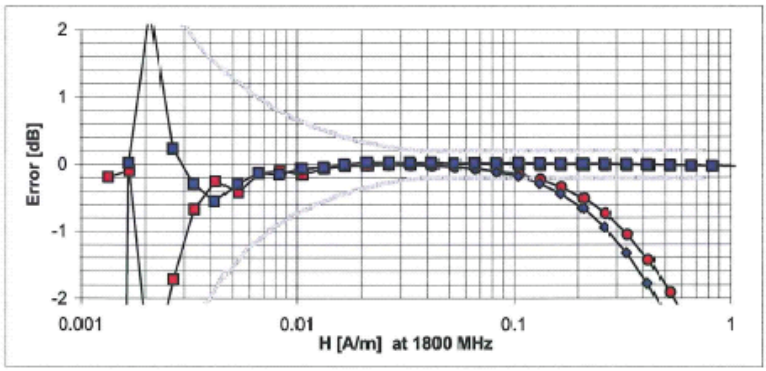
H3DV6 SN:6259 December 13, 2007

Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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

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