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## Annex B: Probe and dipole description and calibration certificates

B.1 Probe, measurement chain description, specification and calibration certificate

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DASY Dosimetric Assessment System by Schmid & Partner Engineering AG



Applications	ER3DV6 ISOTROPIC E-FIELD PROBE FOR GENERAL NEAR-FIELD MEASUREMENTS				
Support & Downloads	_				
	Download Produc	<u>ct Flyer</u> (PDF, 192kB)			
Products					
• DASV4 Packages					
• EASV4	Construction	One dipole parallel, two dipoles normal to probe axis			
• Probes		Built-in shielding against static charges			
ET3DV6 - Isotropic Dos-Probe		PEEK enclosure material (resistant to organic solvents, e.g.,			
ES3DV3 - Isotropic Dos-Probe		glycolether)			
EX3DV4 - Isotropic Dos-Probe	Calibration	In air from 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2)			
ET1DV3 - D-Probe	Calibration	In air noin 100 Milz to 5.0 Gilz (absolute accuracy ±0.0 %, K=2)			
EUV3 - Universal Vector E-Probe	Frequency	100 MHz to > 6 GHz; Linearity; ± 0.2 dB (100 MHz to 3 GHz)			
H3DV6 - Isotropic H-Probe					
HUV4 - Universal Vector H-Probe	Directivity	± 0.2 dB in air (rotation around probe axis)			
T1V3 - Temp-Probe		± 0.4 dB in air (rotation normal to probe axis)			
DP1 - Dummy-Probe					
• Data Acquisition System	Dynamic Range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB			
Software	D				
• Phantoms	Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 8 mm (Body: 12 mm)			
Robots		Distance from probe tip to dipole centers: 2.5 mm			
<ul> <li>Validation Kits &amp; Calibration Dipoles</li> </ul>					
Hearing Aid Compatibility (HAC) Ext	Application	General near-field measurements up to 6 GHz			
· · · · · ·		Field component measurements			
<ul> <li>Tissue Simulating Liquids</li> </ul>		Fast automatic scanning in phantoms			
SPEAG Home					

http://www.dasy4.com/er3.htm

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DASY Dosimetric Assessment System by Schmid & Partner Engineering AG

DASY Schmid & Partner Engineering AG News Sales Contact		
Applications	H3DV6 3-DIMENSIO	NAL H-FIELD PROBE FOR SMALL BAND
Support & Downloads	-	
Products	Download Product Fl	<u>yer</u> (PDF, 192kB)
DASV4 Packages		
EASY4     Probes     ET3DV6 - Isotropic Dos-Probe     ES3DV3 - Isotropic Dos-Probe     EX3DV4 - Isotropic Dos-Probe	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)
ET1DV3 - D-Probe ER3DV6 - Isotropic E-Probe	Frequency	200 MHz to 3 GHz (absolute accuracy ± 6.0%, k=2); Output linearized
EUV3 - Universal Vector E-Probe	Directivity	± 0.25 dB (spherical isotropy error)
HUV4 - Universal Vector H-Probe	Dynamic Range	10 mA/m to 2 A/m at 1 GHz
T1V3 - Temp-Probe DP1 - Dummy-Probe	E-Field Interference	< 10% at 3 GHz (for plane wave)
Data Acquisition System     Software	Dimensions	Overall length: 330 mm (Tip: 40 mm) Tip diameter: 6 mm (Body: 12 mm) Distance from probe tip to dipole centers: 3 mm
Phantoms     Robots     Validation Kits & Calibration Dipoles     Hearing Aid Compatibility (HAC) Ext     Tissue Simulating Liquids	Application	General magnetic near-field measurements up to 3 GHz Field component measurements Surface current measurements Measurements in air or liquids Low interaction with the measured field
SPEAG Home		

http://www.dasy4.com/h3d.htm

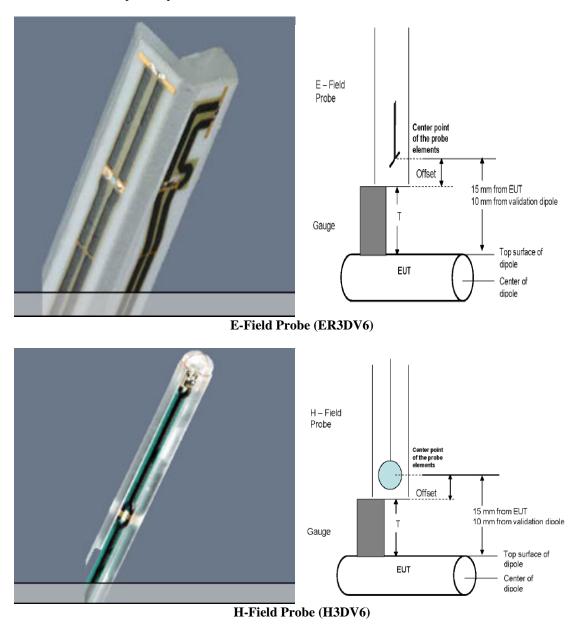
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All measurements were performed to the nearest element point as per the C63.19 standard. Offset distances were entered in the DASY4 software so that the measurement was to the nearest element.

Figures 1 and 2, provided by the manufacturer, illustrate detail of the probe tip and its dimensions.

**ER3DV6** E-Field probe: The distances from the probe tip to the closest points on the dipole sensors are 1.45mm for X and Y and 1.25mm for Z. From the probe tip to the center of the sensors is 2.5mm.

**H3DV6** H-Field probe: The distance from the probe tip to the closest point of the X, Y and Z loop sensors is 1.1mm. From the probe tip to the center of the sensor is 3.00mm.



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The following information is from the system manufacturer user manual describing the process chain:

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:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$
(20.1)

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:

	$\mathbf{E}-\mathbf{field probes}$ :	$E_i = \sqrt{\frac{V_i}{Norm_i \cdot C}}$	onvF
	$\mathbf{H} - \mathbf{field probes}$ :	$H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}}{f}$	$\frac{f + a_{i2}f^2}{r}$
with	= compensated signal of $\alpha$ = sensor sensitivity of cha $\mu V/(V/m)^2$ for E-field = sensitivity enhancement = sensor sensitivity factor = carrier frequency [GHz] = electric field strength of = magnetic field strength	unnel i d Probes t in solution rs for H-field probes f channel i in V/m	$\begin{array}{l} (i=x,y,z)\\ (i=x,y,z) \end{array}$

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

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$
(20.2)

The measurement / integration time per point is > 500 ms, as per the system manufacturer:

The time response of the field probes has been assessed by exposing the probe to a well-controlled field producing signals larger than HAC E- and H-fields of class M4. The signal response time is evaluated as the time required by the system to reach 90% of the expected final value after an on/off switch of the power source with an integration time of 500 ms and a probe response time of <5 ms. In the current implementation, DASY4 waits longer than 100 ms after having reached the grid point before starting a measurement, i.e., the response time uncertainty is negligible.

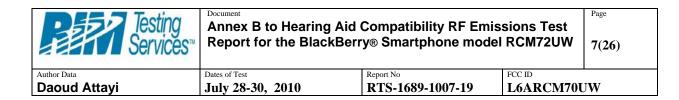
If the device under test does not emit a CW signal, the integration time applied to measure the electric field at a specific point may introduce additional uncertainties due to the discretization. The tolerances for the different systems had the worst-case of 2.6%.

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Daoud Attayi	July 28-30, 2010	RTS-1689-1007-19	L6ARCM70U	JW	

Calibration Laboratory Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich		BCMEA (PARTA	S       Schweizerischer Kalibrierdienst         C       Service suisse d'étalonnage         S       Servizio svizzero di taratura         S       Swiss Calibration Service
Accredited by the Swiss Accreditat The Swiss Accreditation Service Multilateral Agreement for the re-	is one of the signatorie	es to the EA	ion No.: SCS 108
Client RTS (RIM Testi	ng Services)	Certificate	No: ER3-2286_Jan10
CALIBRATION C	ERTIFICAT	E	
Object	ER3DV6 - SN:2	286%************************************	and an an an
Calibration procedure(s)	270000 L 1001 10000	nd QA CAL-25.v2 adure for E-field probes optimiz r	ed for close near field
Calibration date:	January 8, 2010	a a air air air air air	
All calibrations have been conduct Calibration Equipment used (M&T		ary facility: environment temperature (22 $\pm$ :	3)°C and humidity < 70%.
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator Reference 30 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator Reference Probe ER3DV6	SN: S5129 (30b) SN: 2328	31-Mar-09 (No. 217-01027)	Mar-10 Oct-10
DAE4	SN: 789	3-Oct-09 (No. ER3-2328_Oct09) 23-Dec-09 (No. DAE4-789_Dec09)	Dec-10
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-09)	In house check: Oct10
Calibrated by:	Name Ketta Pokovic	Function Technical Manager	X Taylog
Approved by:	Niels Ruster	Quelity Manager	2 Cent
This calibration certificate shall no	t be reproduced except i	n full without written approval of the laborat	Issued: January 8, 2010 pry.

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- Schweizerischer Kalibrierdienst s Service suisse d'étalonnage С s
  - Servizio svizzero di taratura
  - Swiss Calibration Service

Accreditation No.: SCS 108

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

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a	
NORMx,y,z	sensitivity in free space
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization $\phi$	e rotation around probe axis
Polarization 9	9 rotation around an axis that is in the plane normal to probe axis (at measurement center),
	i.e., 9 = 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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z; A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- 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).

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# Probe ER3DV6

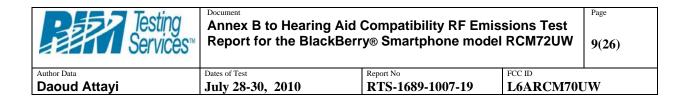
## SN:2286

Manufactured: Last calibrated: Recalibrated: September 18, 2002 January 8, 2009 January 8, 2010

Calibrated for DASY Systems (Note: non-compatible with DASY2 system!)

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### DASY - Parameters of Probe: ER3DV6 SN:2286

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) <sup>2</sup> )	2.23	1.50	1.54	± 10.1%
DCP (mV) <sup>A</sup>	94.9	94.8	95.7	

#### **Modulation Calibration Parameters**

UID	Communication System Name	PAR		A dB	B dBuV	с	VR mV	Unc <sup>#</sup> (k=2)
10000	cw	0.00	x	0.00	0.00	1.00	300	±1.5%
			Y	0.00	0.00	1.00	300	
			z	0.00	0.00	1.00	300	

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

E Uncertainty is determined using the maximum deviation from linear response applying recatangular distribution and is expressed for the square of the field value.

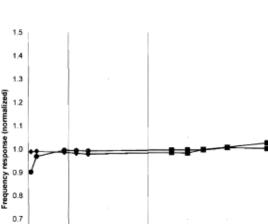
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## Frequency Response of E-Field



(TEM-Cell:ifi110 EXX, Waveguide R22)



0.6

500

·ху

z

1000

1500

-TEM

f [MHz]

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

2000

--

- R22

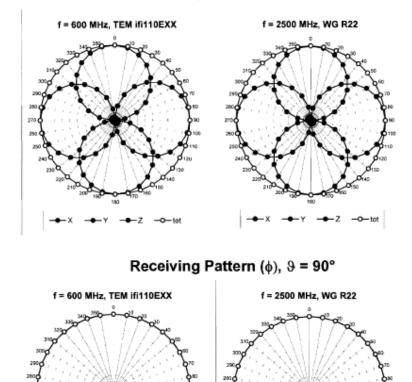
2500

3000

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## Receiving Pattern ( $\phi$ ), $\vartheta$ = 0°

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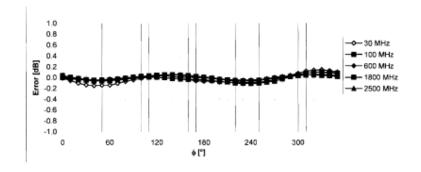
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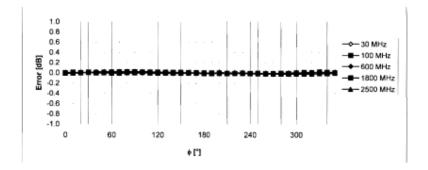
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Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)





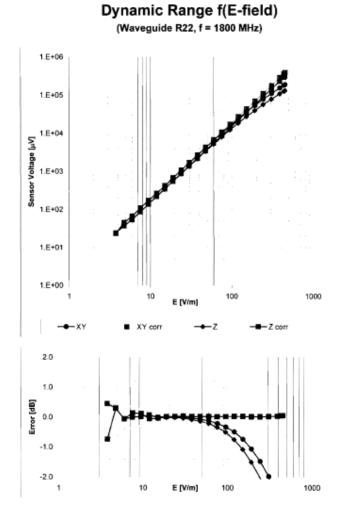
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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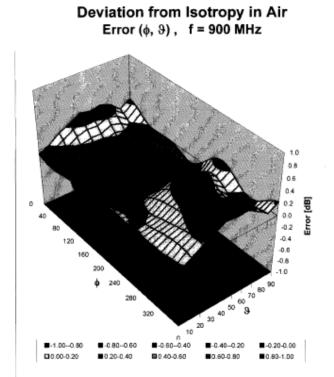
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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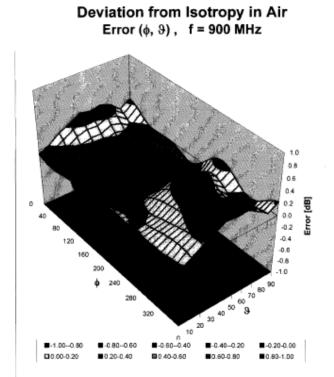
Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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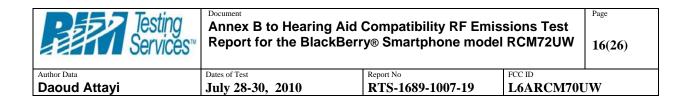
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Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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### **Other Probe Parameters**

Sensor Arrangement	Rectangular
Connector Angle (°)	-9.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	8.0 mm
Probe Tip to Sensor X Calibration Point	2.5 mm
Probe Tip to Sensor Y Calibration Point	2.5 mm
Probe Tip to Sensor Z Calibration Point	2.5 mm

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	Report for t		omarphon	e model	RCM72UW	17(2
	Dates of Test	-	ort No		FCC ID	
l Attayi	July 28-30, 2	010 R	ГЅ-1689-1007	-19	L6ARCM70U	JW
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Client RTS	(RIM Testing Service	5)	Certificate N	o: H3-6168	Mar10	
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CALIDRA	TION CERTIFI	UAIE	Million	States.		
Object	H3DV6 -	SN:6168	0900 10 10 10 10 10 10 10 10 10 10 10 10 1	confidentials.ster	and the strongs	
Calibration proceds	Colibratio	03.v5 and QA CAL-25. In procedure for H-field ns in air	I nechos onlimited	d for close n	Structure and	
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Calibration date:		2010				
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Testing Services	Annex B to Hearing Report for the Black	Page 18(26)			
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Daoud Attavi	July 28-30, 2010	Iuly 28-30, 2010 RTS-1689-1007-19 L6ARCM70UW			

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



- Schweizerischer Kalibrierdienst s Service suisse d'étalonnage С
  - Servizio svizzero di taratura
- s Swiss Calibration Service

Accreditation No.: SCS 108

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

#### Glossary:

sensitivity in free space
diode compression point
crest factor (1/duty_cycle) of the RF signal
modulation dependent linearization parameters
φ rotation around probe axis
9 rotation around an axis that is in the plane normal to probe axis (at measurement center),
i.e., 9 = 0 is normal to probe axis
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 9 = 0 for XY sensors and 9 = 90 for Z sensor (f ≤ 900 MHz in ٠ 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 with CW ٠ signal (no uncertainty required). DCP does not depend on frequency nor media.
- Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- 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 ٠ uncertainty required).

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Daoud Attayi	July 28-30, 2010	RTS-1689-1007-19	L6ARCM70U	JW

March 12, 2010

# Probe H3DV6

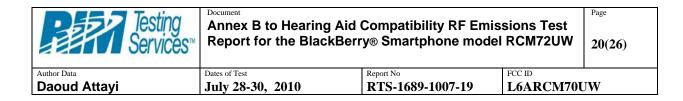
## SN:6168

Manufactured: Last calibrated: Recalibrated: July 9, 2003 March 3, 2009 March 12, 2010

Calibrated for DASY Systems (Note: non-compatible with DASY2 system!)

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#### DASY - Parameters of Probe: H3DV6 SN:6168

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (A/m / √(µV)) a0	2.76E-3	2.64E-3	3.14E-3	± 5.1%
Norm (A/m / √(µV)) a1	-1.81E-4	-8.57E-5	-2.18E-4	± 5.1%
Norm (A/m / √(μV)) a2	-2.18E-5	-3.81E-5	3.05E-5	± 5.1%
DCP (mV) <sup>A</sup>	81.4	94.7	83.2	

#### **Modulation Calibration Parameters**

UID	Communication System Name	PAR		A dB	B dBuV	с	VR mV	Unc <sup>e</sup> (k=2)
10000	cw	0.00	х	0.00	0.00	1.00	300	±1.5 %
			Y	0.00	0.00	1.00	300	
			z	0.00	0.00	1.00	300	

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%.

<sup>A</sup> numerical linearization parameter: uncertainty not required

<sup>6</sup> Uncertainty is determined using the maximum deviation from linear response applying recatangular distribution and is expressed for the square of the field value

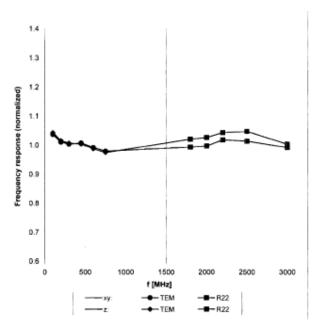
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## Frequency Response of H-Field



(TEM-Cell:ifi110 EXX, Waveguide R22)

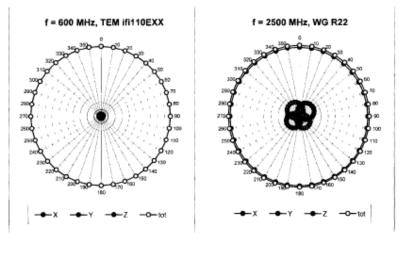
Uncertainty of Frequency Response of H-field: ± 6.3% (k=2)

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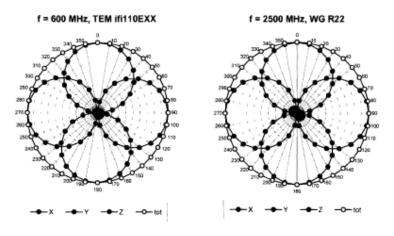
Testing Services™	Document Annex B to Hearing Aid Compatibility RF Emissions Test Report for the BlackBerry® Smartphone model RCM72UW			
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## Receiving Pattern ( $\phi$ ), $\vartheta$ = 90°

Receiving Pattern ( $\phi$ ),  $\vartheta = 0^{\circ}$ 



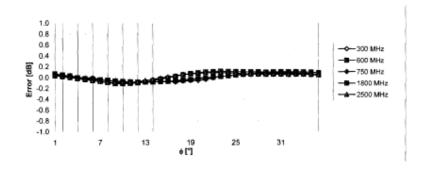
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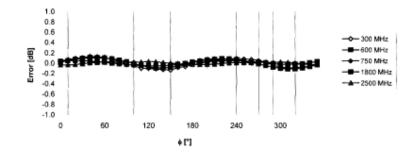
March 12, 2010

Receiving Pattern ( $\phi$ ),  $\vartheta$  = 90°



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

Receiving Pattern ( $\phi$ ),  $\vartheta = 0^{\circ}$ 



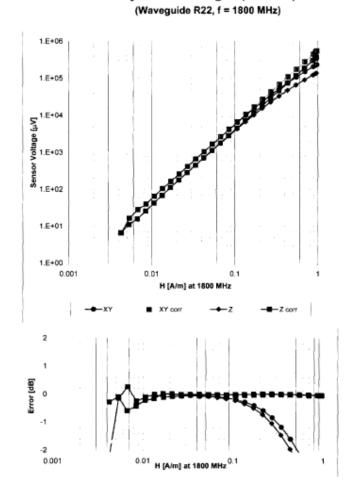
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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March 12, 2010



## Dynamic Range f(H-field)

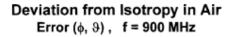
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

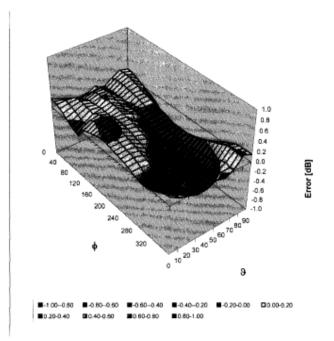
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Author Data	Dates of Test	Report No	FCC ID		
Daoud Attayi	July 28-30, 2010	I I I I I I I I I I I I I I I I I I I			

March 12, 2010

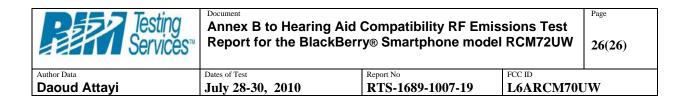




Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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## **Other Probe Parameters**

Sensor Arrangement	Rectangular
Connector Angle (*)	-232.8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	20 mm
Tip Diameter	6.0 mm
Probe Tip to Sensor X Calibration Point	3 mm
Probe Tip to Sensor Y Calibration Point	3 mm
Probe Tip to Sensor Z Calibration Point	3 mm

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