12.4.Calibration Certificate for E-Field Probe

This sub-section contains Cal Certificates for E-Field Probes, and is not included in the total number of pages for this report.

Checked By [illegible] 09/05/16 A1185

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 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 0108

Client UL RFI UK

Certificate No: ET3-1528_Apr16

CALIBRATION CERTIFICATE

Object: ET3DV6 - SN:1528

Calibration procedure(s): QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: April 22, 2016

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 (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-16
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-16
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-16
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Jun-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 23, 2016

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *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.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* 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.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *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 ET3DV6

SN:1528

Manufactured: March 21, 2000
Calibrated: April 22, 2016

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1528

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.46	1.86	1.58	± 10.1 %
DCP (mV)[B]	97.6	101.3	100.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	297.3	±3.5 %
		Y	0.0	0.0	1.0		280.3	
		Z	0.0	0.0	1.0		260.9	

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] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1528

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	6.43	6.43	6.43	0.80	1.77	± 12.0 %
835	41.5	0.90	6.22	6.22	6.22	0.57	2.14	± 12.0 %
900	41.5	0.97	6.04	6.04	6.04	0.35	2.82	± 12.0 %
1450	40.5	1.20	5.30	5.30	5.30	0.70	2.08	± 12.0 %
1750	40.1	1.37	5.22	5.22	5.22	0.79	2.11	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.80	2.07	± 12.0 %
2100	39.8	1.49	5.18	5.18	5.18	0.80	1.95	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1528

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	6.11	6.11	6.11	0.66	1.83	± 12.0 %
835	55.2	0.97	6.05	6.05	6.05	0.37	2.61	± 12.0 %
900	55.0	1.05	5.93	5.93	5.93	0.53	2.13	± 12.0 %
1450	54.0	1.30	5.06	5.06	5.06	0.80	1.94	± 12.0 %
1750	53.4	1.49	4.73	4.73	4.73	0.80	2.50	± 12.0 %
1900	53.3	1.52	4.60	4.60	4.60	0.80	2.40	± 12.0 %
2100	53.2	1.62	4.75	4.75	4.75	0.80	2.19	± 12.0 %

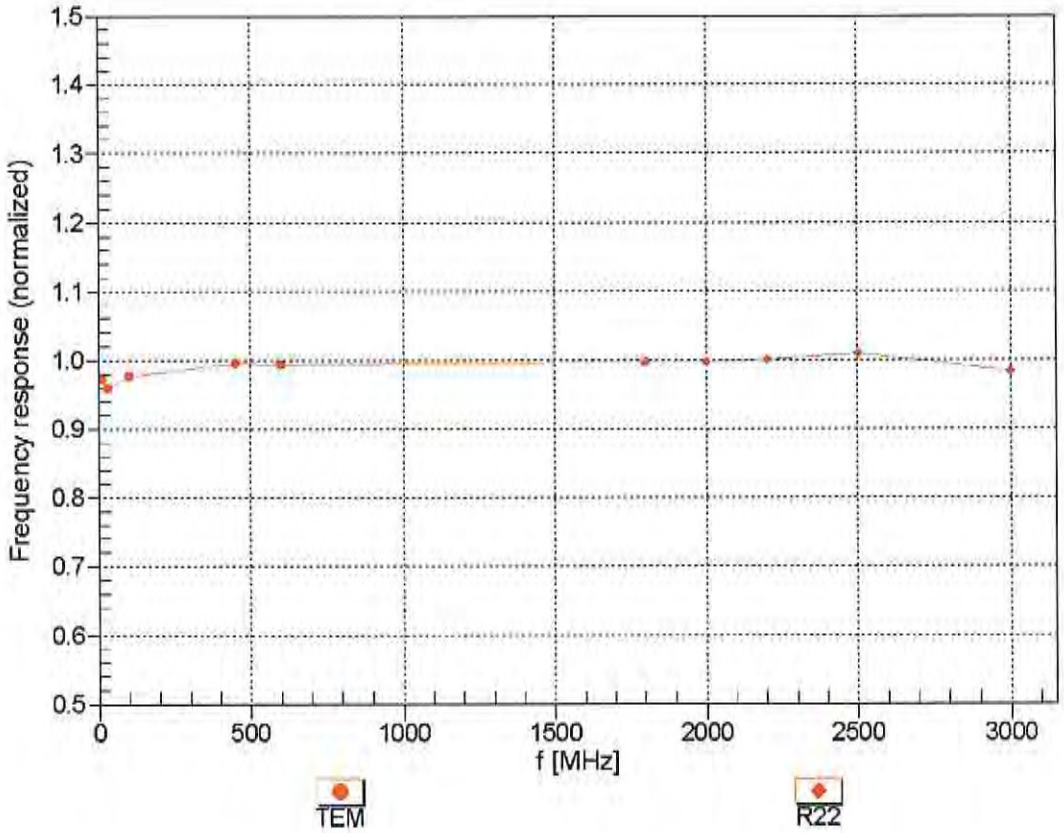
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

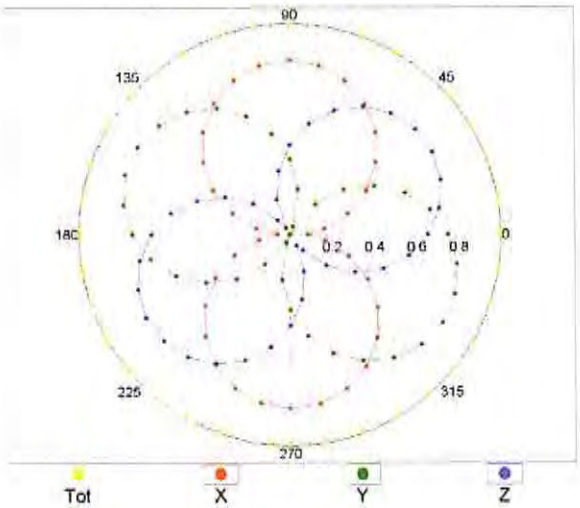
(TEM-Cell:ifi110 EXX, Waveguide: R22)



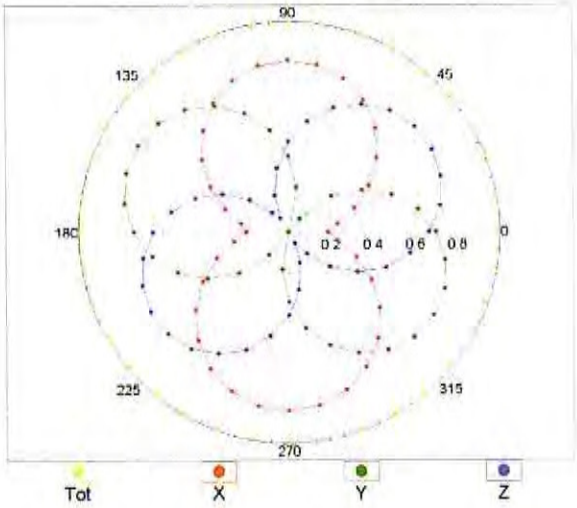
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

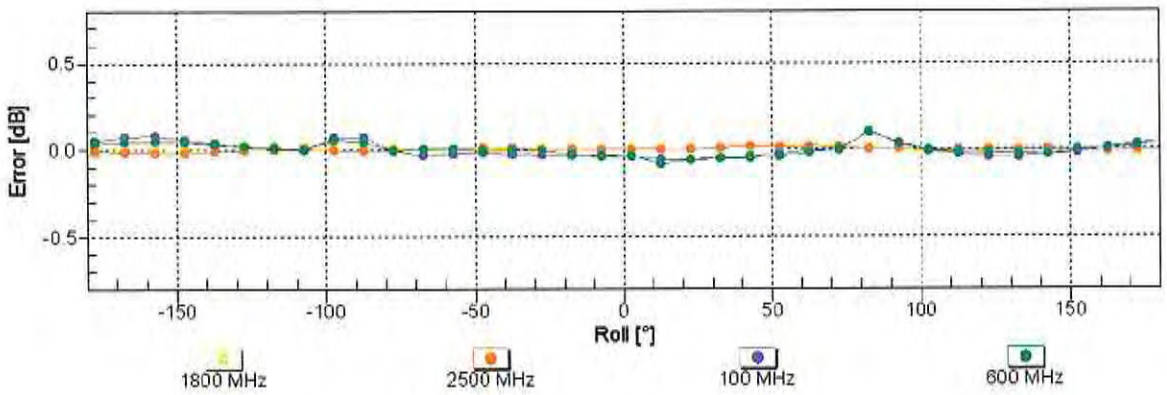
Receiving Pattern (ϕ), ϑ = 0°

f=1800 MHz,R22



f=600 MHz,TEM

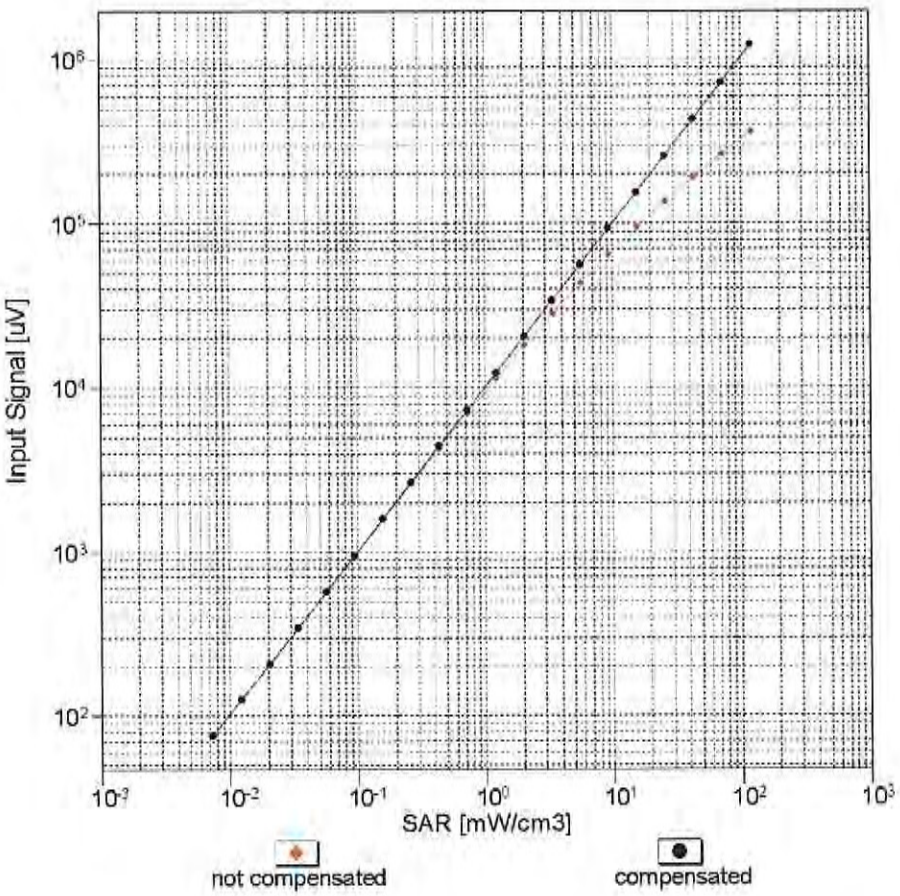


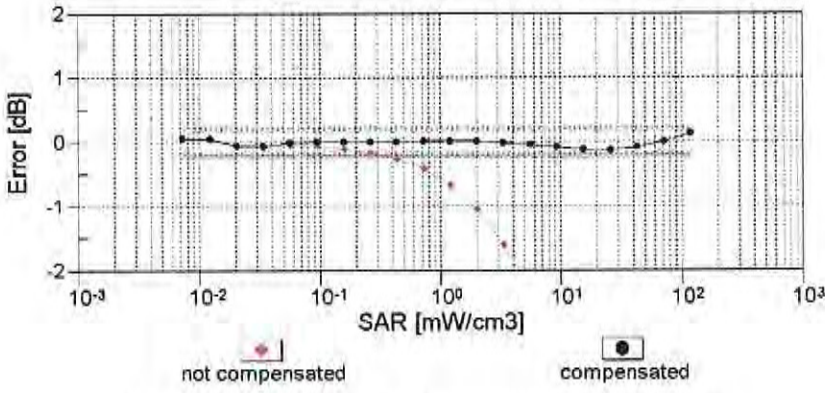


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

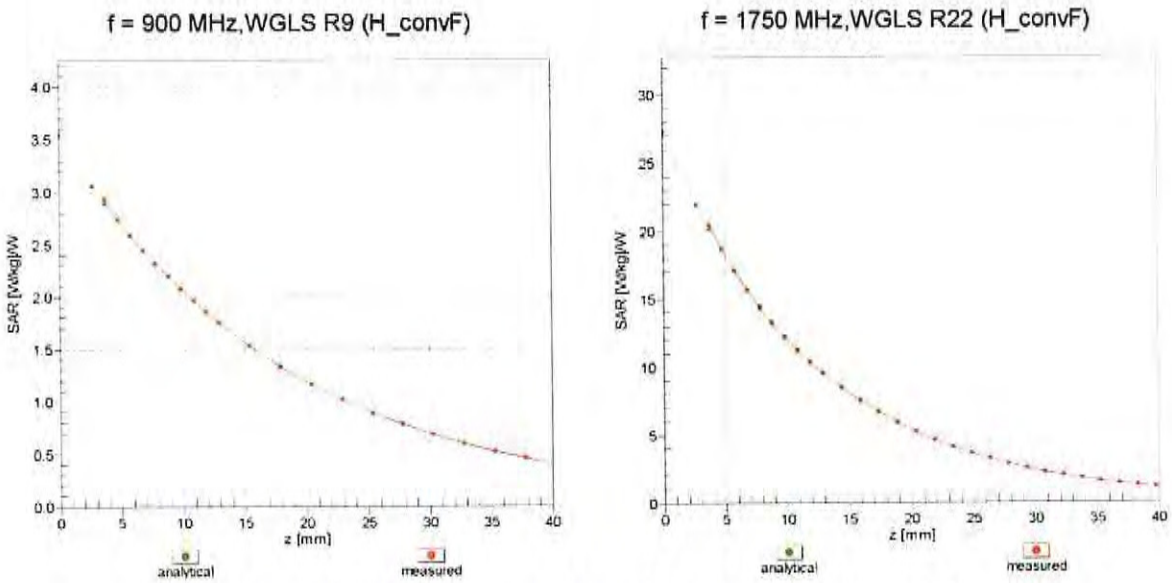
(TEM cell , f_{eval}= 1900 MHz)





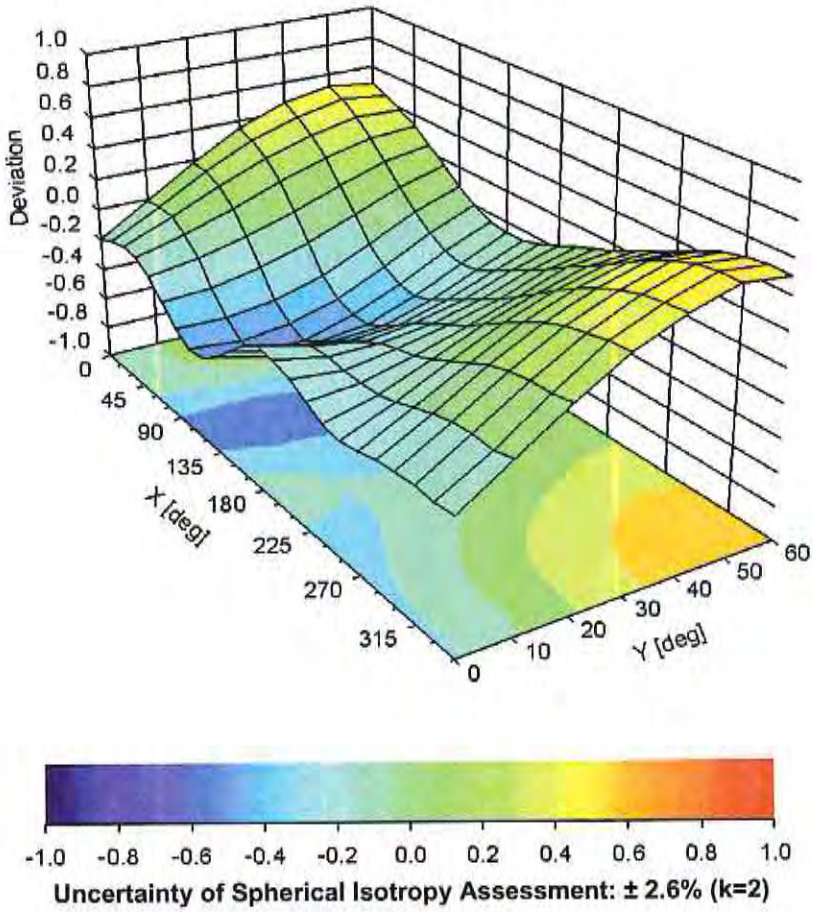
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1528

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	22.6
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	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

A212

Checked
M. Nacer
05/06/2015

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S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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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 0108

Client UL RFI UK

Certificate No: ET3-1586_May15

CALIBRATION CERTIFICATE

Object: ET3DV6 - SN:1586

Calibration procedure(s): QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: May 22, 2015

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 25, 2015

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *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.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* 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.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *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 ET3DV6

SN:1586

Manufactured: May 7, 2001
Calibrated: May 22, 2015

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1586

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.86	1.91	1.95	± 10.1 %
DCP (mV)[B]	98.8	99.0	100.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	223.5	±3.5 %
		Y	0.0	0.0	1.0		226.6	
		Z	0.0	0.0	1.0		225.9	

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] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1586

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.60	6.60	6.60	0.31	3.00	± 12.0 %
835	41.5	0.90	6.31	6.31	6.31	0.36	3.00	± 12.0 %
900	41.5	0.97	6.17	6.17	6.17	0.38	3.00	± 12.0 %
1450	40.5	1.20	5.36	5.36	5.36	0.56	2.32	± 12.0 %
1750	40.1	1.37	5.28	5.28	5.28	0.72	2.13	± 12.0 %
1900	40.0	1.40	5.07	5.07	5.07	0.80	2.07	± 12.0 %
2100	39.8	1.49	5.11	5.11	5.11	0.80	1.94	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1586

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.36	6.36	6.36	0.29	3.00	± 12.0 %
835	55.2	0.97	6.22	6.22	6.22	0.31	3.00	± 12.0 %
900	55.0	1.05	6.06	6.06	6.06	0.34	3.00	± 12.0 %
1450	54.0	1.30	5.07	5.07	5.07	0.57	2.38	± 12.0 %
1750	53.4	1.49	4.81	4.81	4.81	0.76	2.56	± 12.0 %
1900	53.3	1.52	4.64	4.64	4.64	0.80	2.43	± 12.0 %
2100	53.2	1.62	4.77	4.77	4.77	0.80	2.06	± 12.0 %

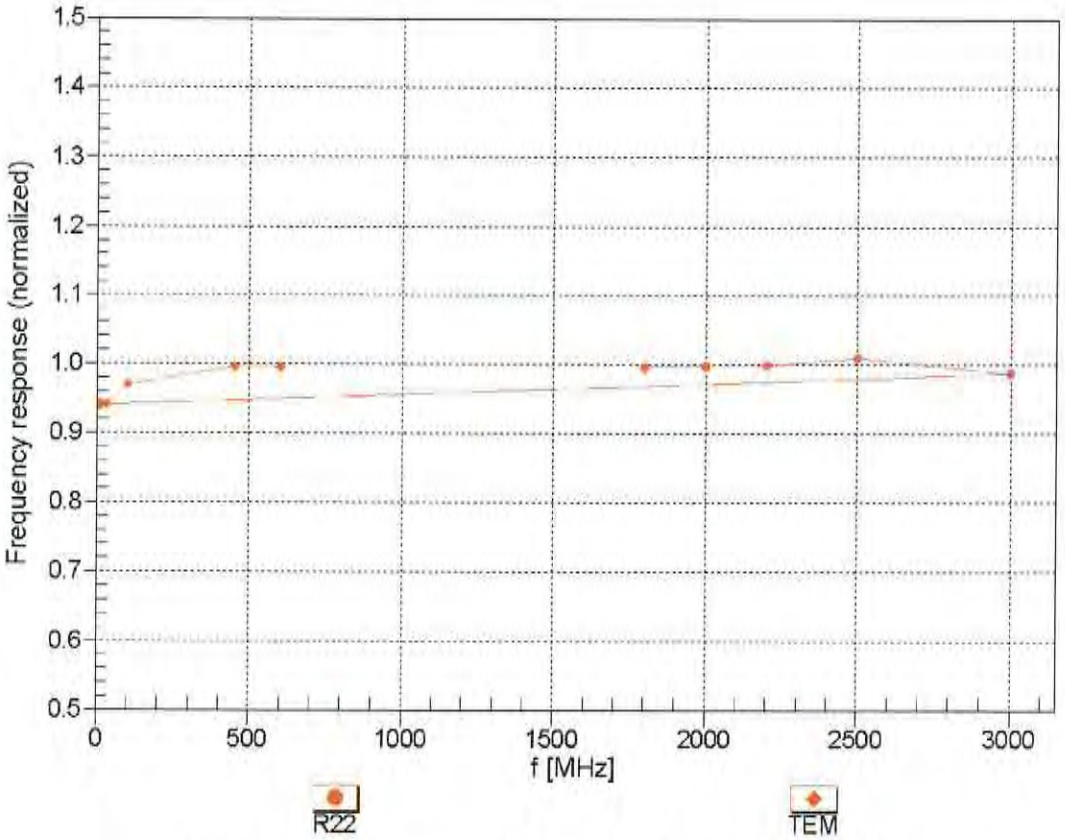
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

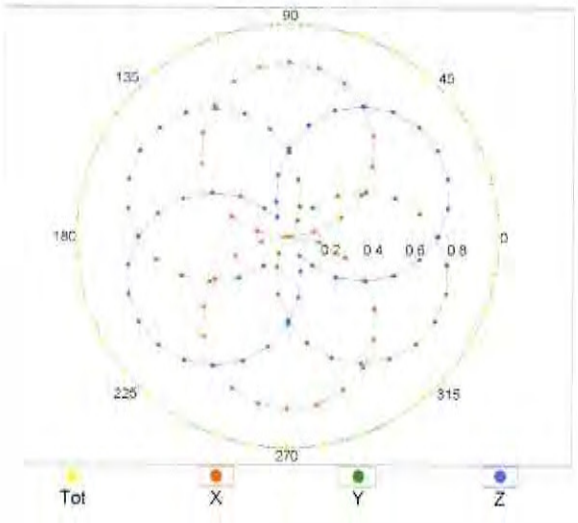
(TEM-Cell:ifi110 EXX, Waveguide: R22)



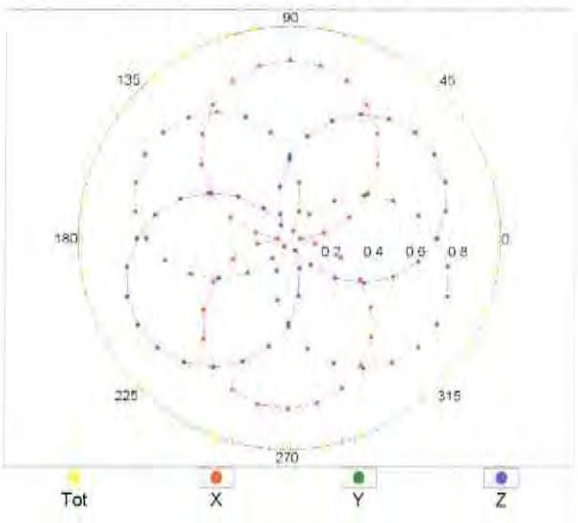
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

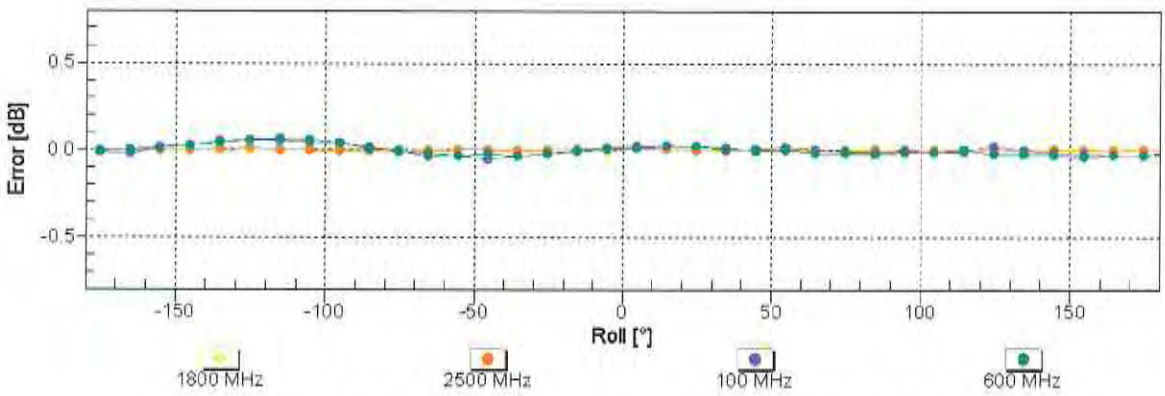
Receiving Pattern (ϕ), ϑ = 0°

f=1800 MHz,R22



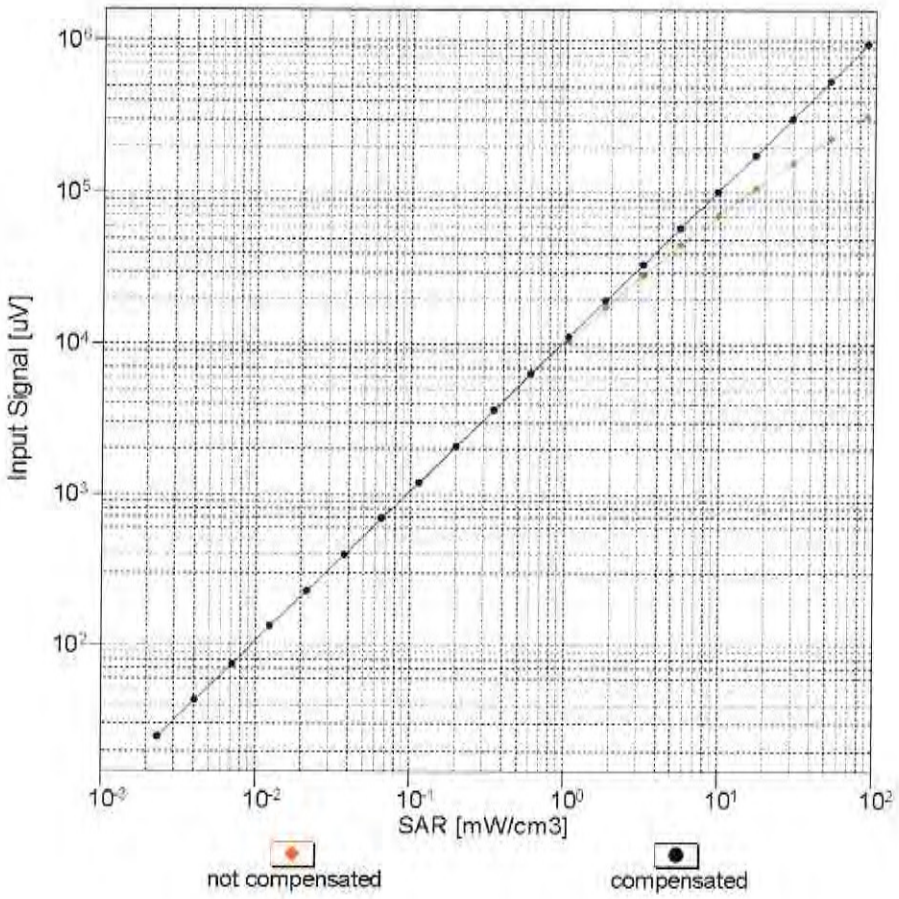
f=600 MHz,TEM

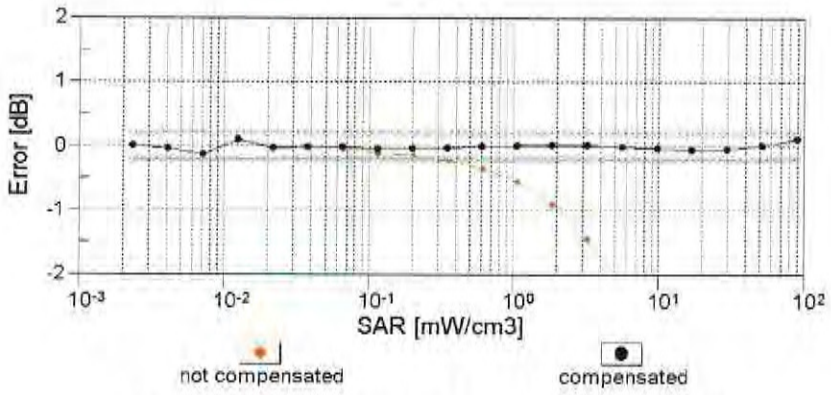




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)

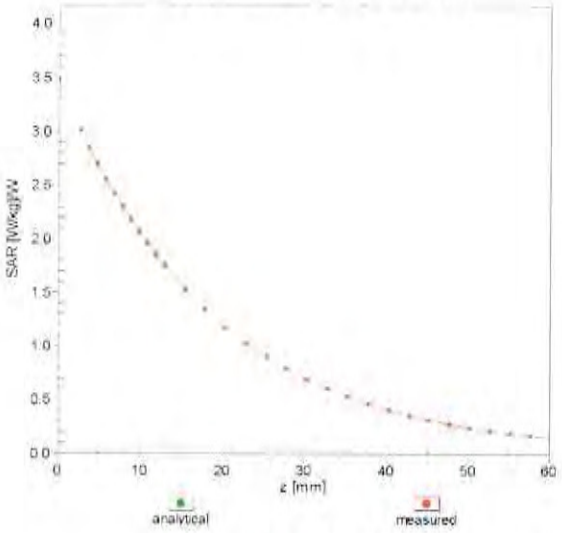




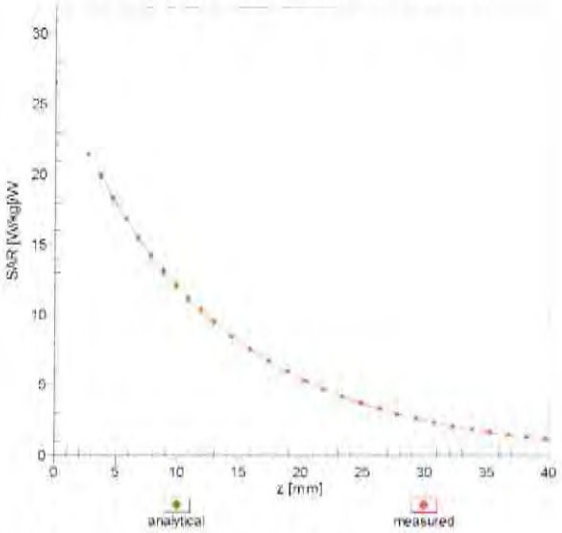
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

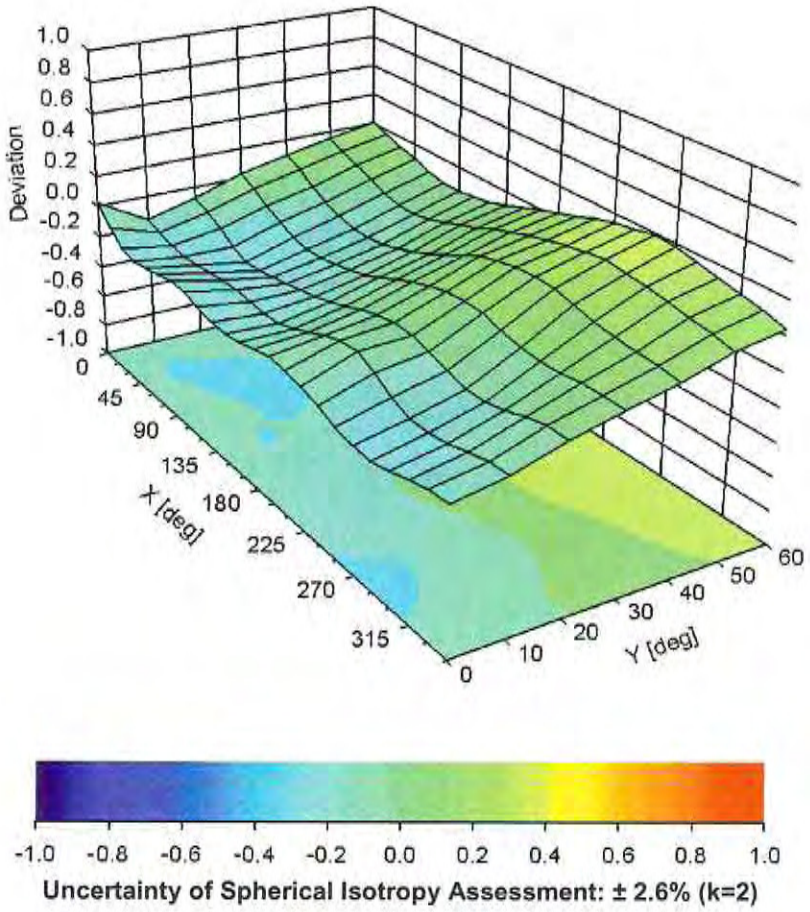


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1586

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	124.6
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	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

[redacted] A1186

Checked
M. Nowe
08/06/2015

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

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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 0108

Client UL RFI UK

Certificate No: ET3-1529_May15

CALIBRATION CERTIFICATE

Object: ET3DV6 - SN:1529

Calibration procedure(s): QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: May 22, 2015

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	Israe Elnaouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 25, 2015

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

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Accreditation No.: SCS 0108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *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.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* 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.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *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 ET3DV6

SN:1529

Manufactured: March 21, 2000
Calibrated: May 22, 2015

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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1529

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.66	1.98	1.80	± 10.1 %
DCP (mV)[B]	109.1	99.2	99.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	248.6	±3.3 %
		Y	0.0	0.0	1.0		249.2	
		Z	0.0	0.0	1.0		242.7	

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] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1529

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	6.36	6.36	6.36	0.31	3.00	± 12.0 %
835	41.5	0.90	6.12	6.12	6.12	0.32	3.00	± 12.0 %
900	41.5	0.97	6.03	6.03	6.03	0.37	2.59	± 12.0 %
1450	40.5	1.20	5.13	5.13	5.13	0.50	2.95	± 12.0 %
1750	40.1	1.37	5.08	5.08	5.08	0.78	2.16	± 12.0 %
1900	40.0	1.40	4.85	4.85	4.85	0.80	2.07	± 12.0 %
2100	39.8	1.49	4.89	4.89	4.89	0.80	1.90	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1529

Calibration Parameter Determined in Body Tissue Simulating Media

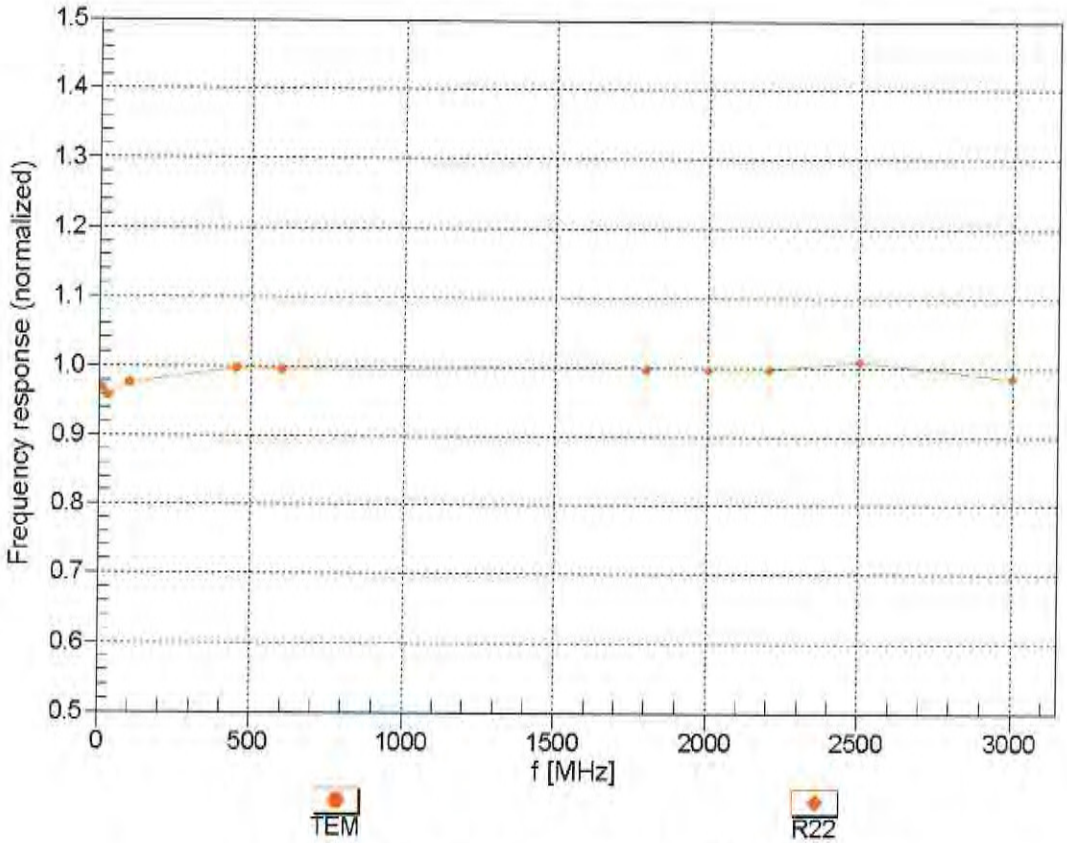
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	6.13	6.13	6.13	0.43	2.46	± 12.0 %
835	55.2	0.97	5.98	5.98	5.98	0.37	2.65	± 12.0 %
900	55.0	1.05	5.80	5.80	5.80	0.39	2.67	± 12.0 %
1450	54.0	1.30	4.86	4.86	4.86	0.80	2.03	± 12.0 %
1750	53.4	1.49	4.60	4.60	4.60	0.80	2.39	± 12.0 %
1900	53.3	1.52	4.42	4.42	4.42	0.80	2.44	± 12.0 %
2100	53.2	1.62	4.58	4.58	4.58	0.80	2.20	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

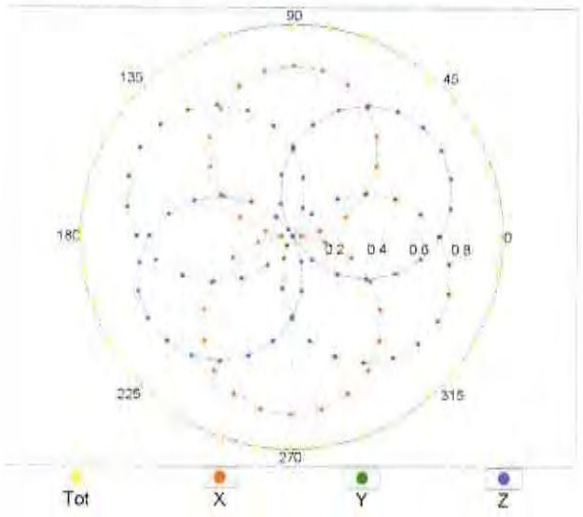
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



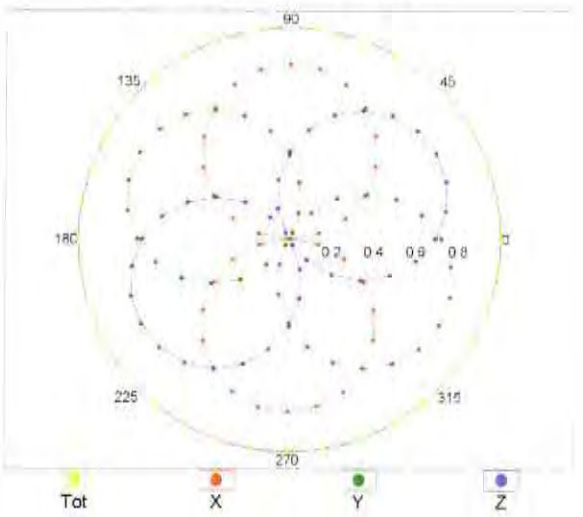
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

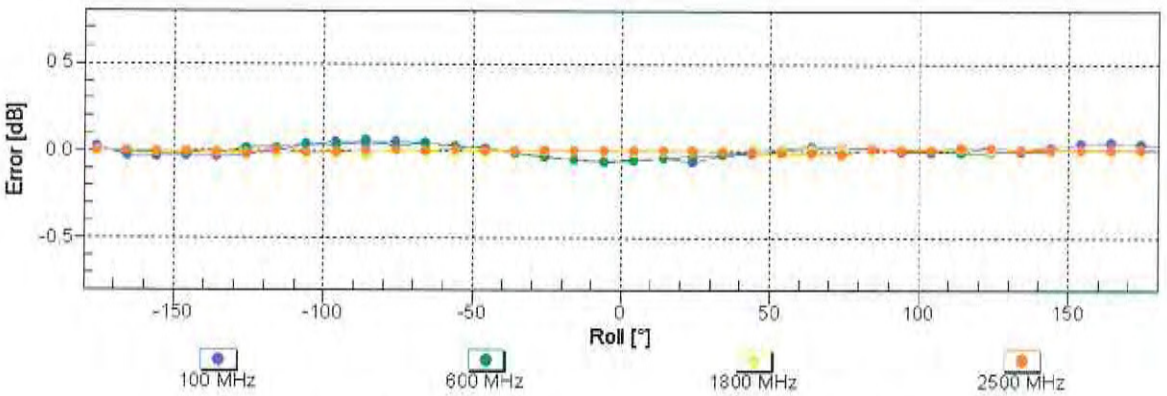
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



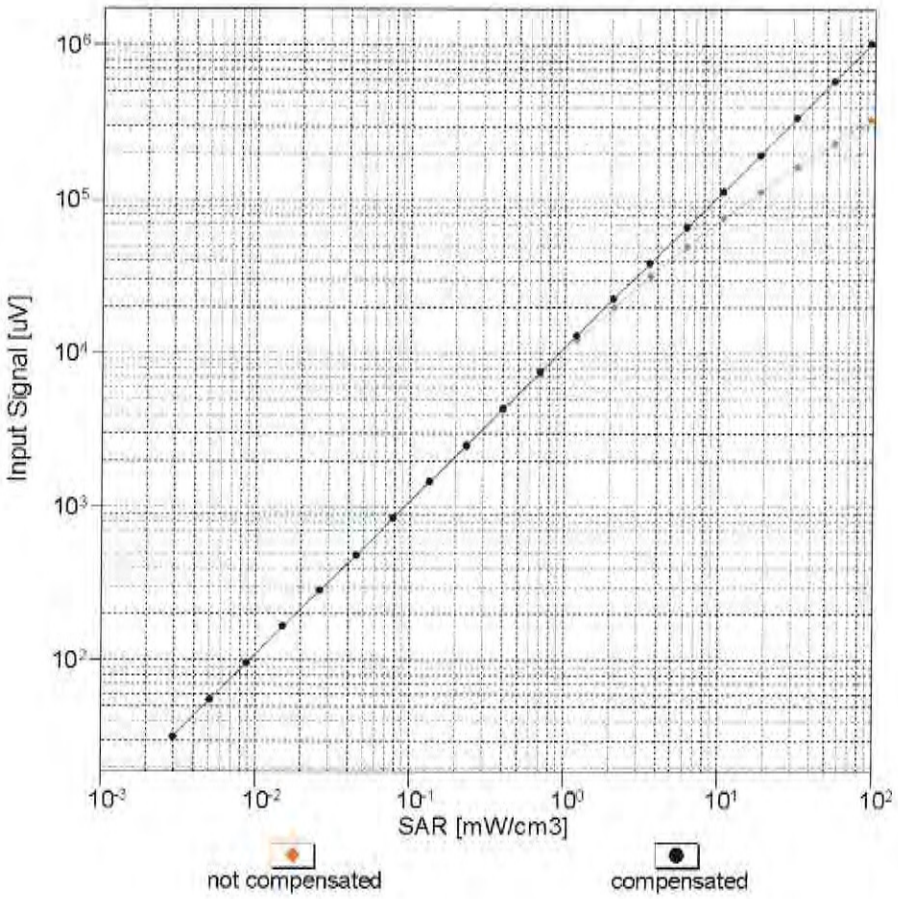
f=1800 MHz,R22

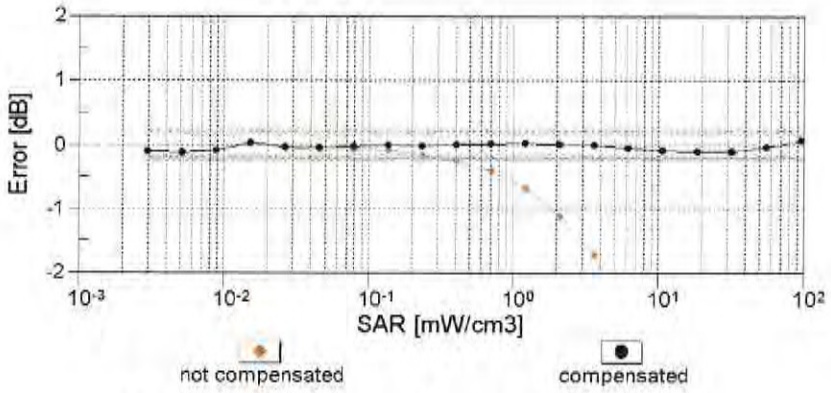




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

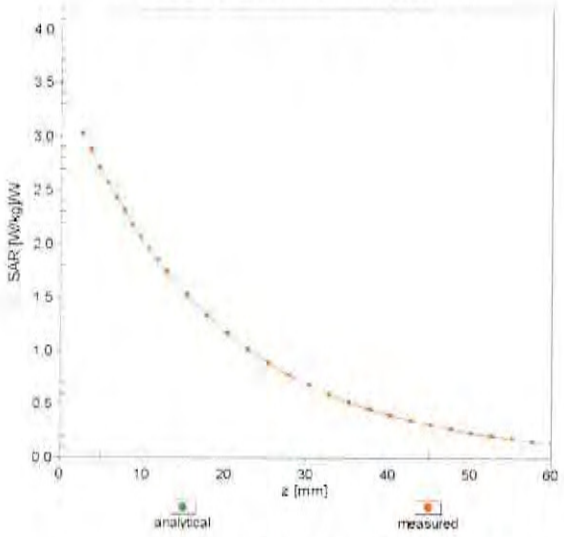




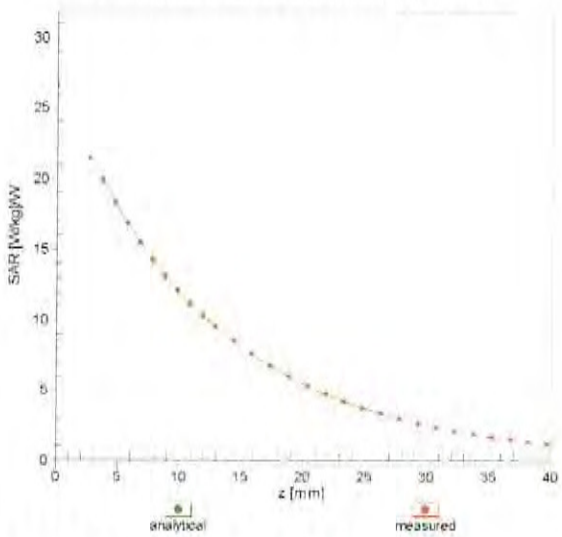
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

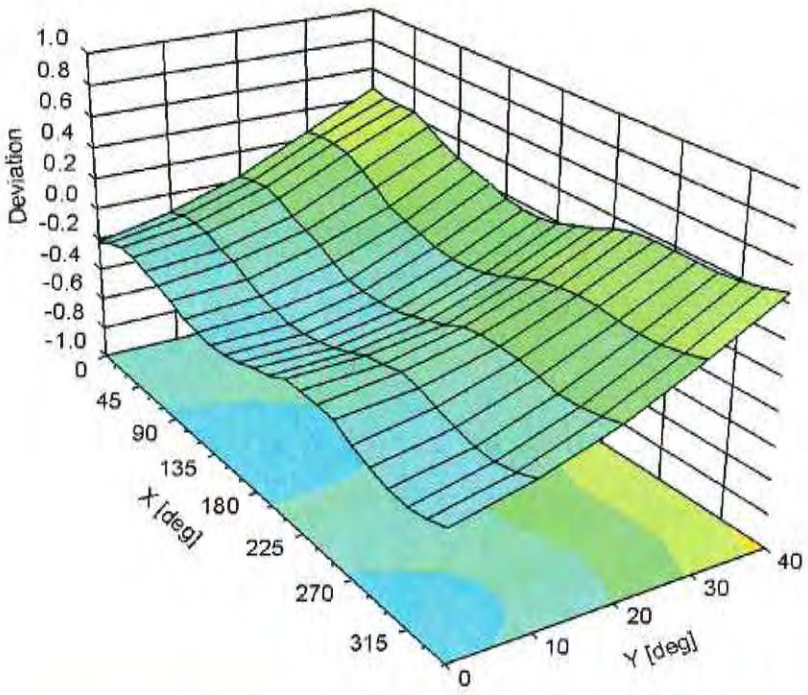


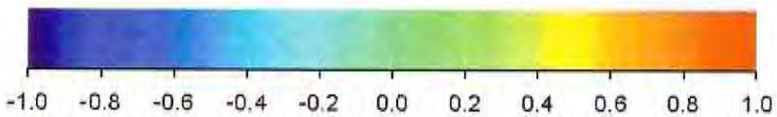
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1529

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-5.9
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	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

A2587 Checked M. Nance 04/09/15

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Accreditation No.: SCS 0108

Client UL RFI UK

Certificate No: ES3-3341_Aug15

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3341

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: August 25, 2015

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%.

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Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
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Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 25, 2015

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

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Accreditation No.: SCS 0108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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

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a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
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- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z*: *A, B, C, D* 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.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *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 ES3DV3

SN:3341

Manufactured: March 15, 2012
Calibrated: August 25, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3341

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.04	1.14	1.07	± 10.1 %
DCP (mV)[B]	107.5	104.4	107.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	194.4	±3.3 %
		Y	0.0	0.0	1.0		199.7	
		Z	0.0	0.0	1.0		194.4	

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] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3341

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
450	43.5	0.87	6.82	6.82	6.82	0.19	1.90	± 13.3 %
750	41.9	0.89	6.53	6.53	6.53	0.22	2.52	± 12.0 %
835	41.5	0.90	6.42	6.42	6.42	0.80	1.15	± 12.0 %
900	41.5	0.97	6.17	6.17	6.17	0.53	1.42	± 12.0 %
1450	40.5	1.20	5.39	5.39	5.39	0.35	1.76	± 12.0 %
1750	40.1	1.37	5.27	5.27	5.27	0.76	1.17	± 12.0 %
1900	40.0	1.40	5.07	5.07	5.07	0.75	1.20	± 12.0 %
2100	39.8	1.49	5.12	5.12	5.12	0.52	1.49	± 12.0 %
2300	39.5	1.67	4.80	4.80	4.80	0.62	1.40	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.80	1.25	± 12.0 %
2600	39.0	1.96	4.33	4.33	4.33	0.75	1.27	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3341

Calibration Parameter Determined in Body Tissue Simulating Media

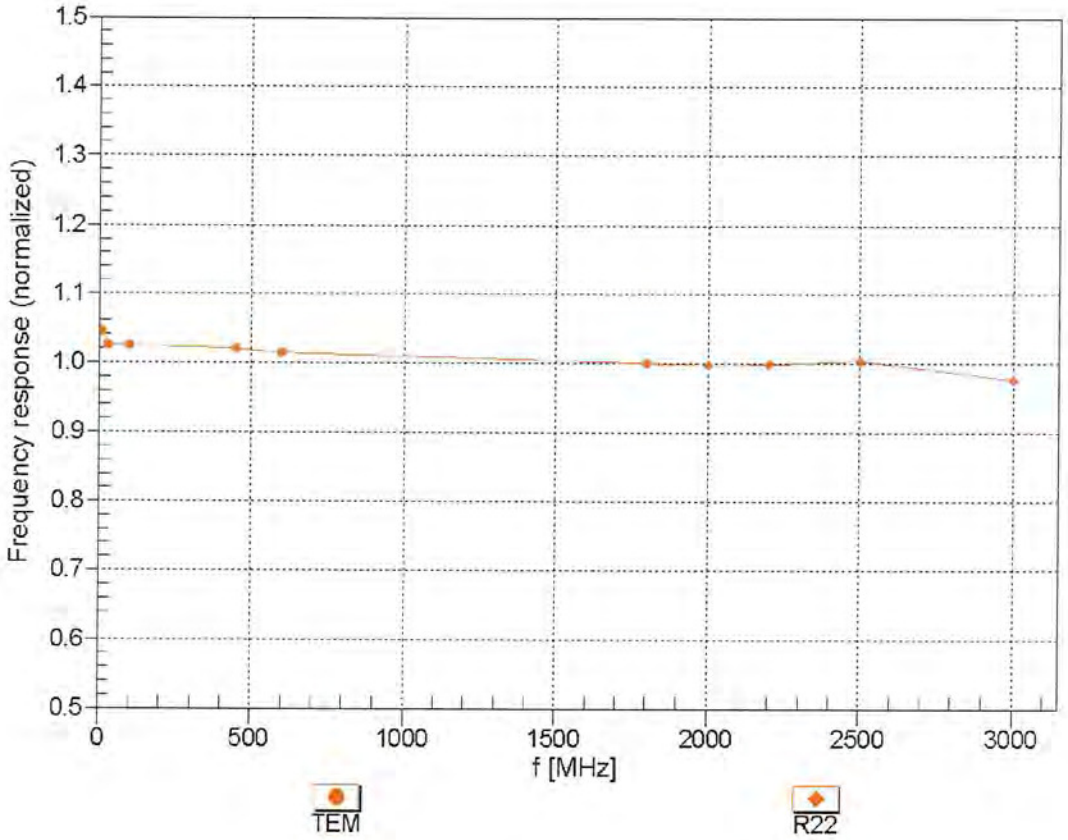
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
450	56.7	0.94	7.33	7.33	7.33	0.15	1.50	± 13.3 %
750	55.5	0.96	6.37	6.37	6.37	0.30	1.93	± 12.0 %
835	55.2	0.97	6.33	6.33	6.33	0.48	1.53	± 12.0 %
900	55.0	1.05	6.14	6.14	6.14	0.36	1.85	± 12.0 %
1450	54.0	1.30	5.16	5.16	5.16	0.34	1.87	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.72	1.31	± 12.0 %
1900	53.3	1.52	4.78	4.78	4.78	0.68	1.40	± 12.0 %
2100	53.2	1.62	4.88	4.88	4.88	0.80	1.31	± 12.0 %
2300	52.9	1.81	4.54	4.54	4.54	0.80	1.15	± 12.0 %
2450	52.7	1.95	4.31	4.31	4.31	0.80	1.16	± 12.0 %
2600	52.5	2.16	4.10	4.10	4.10	0.80	1.20	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

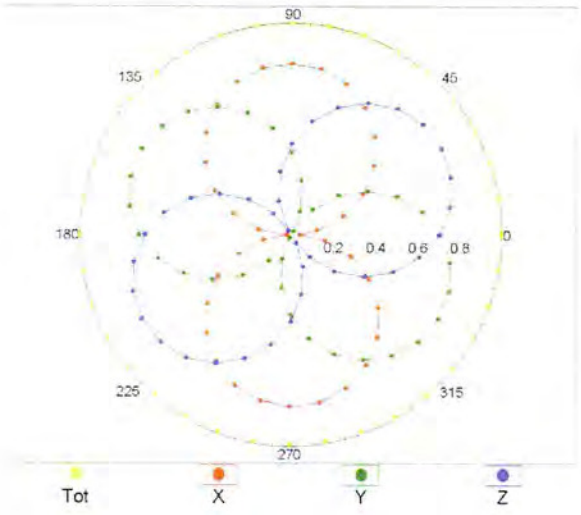
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



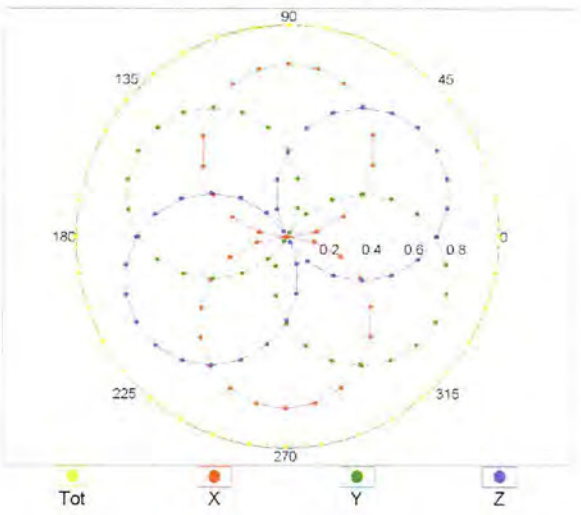
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

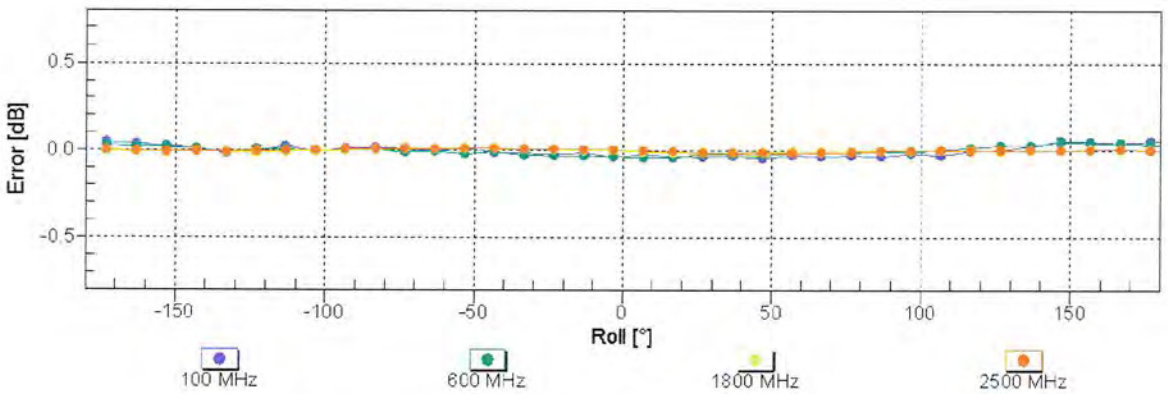
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



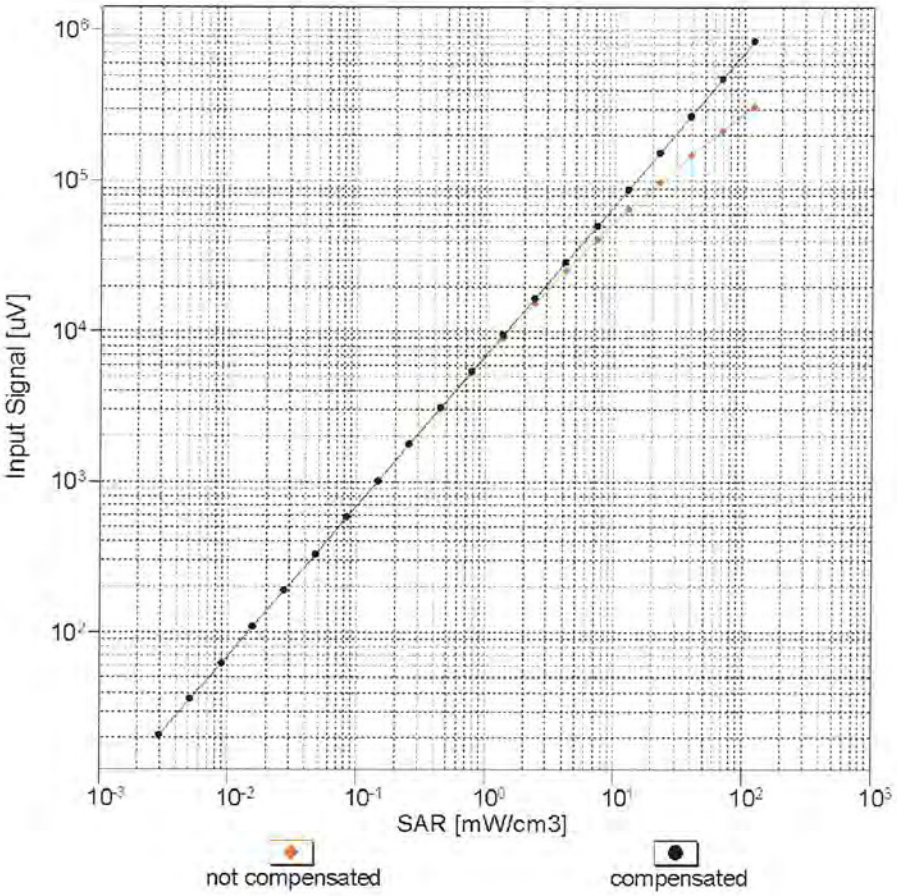
f=1800 MHz,R22

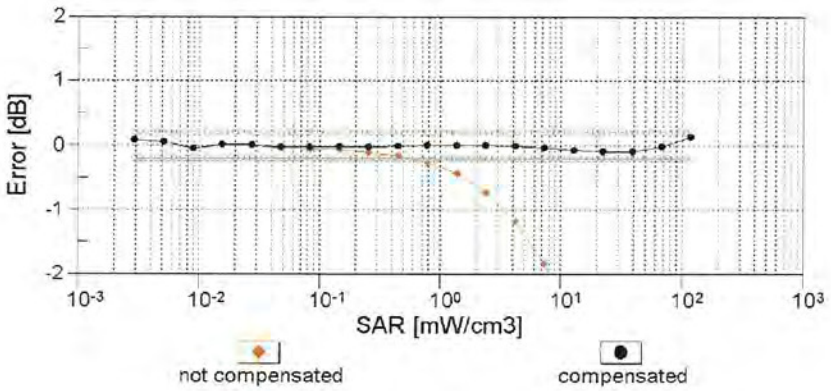




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)

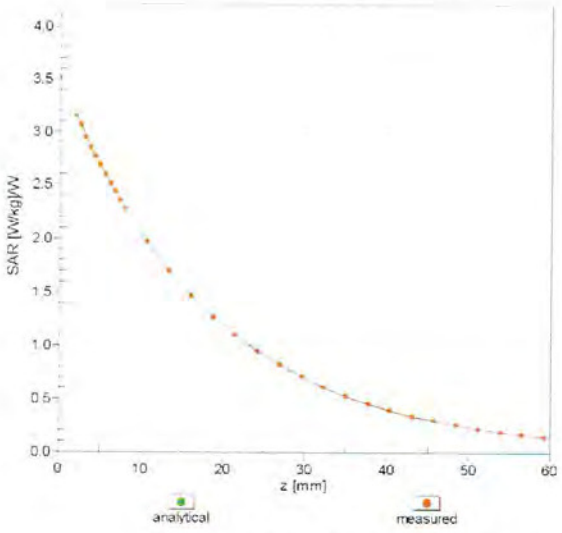




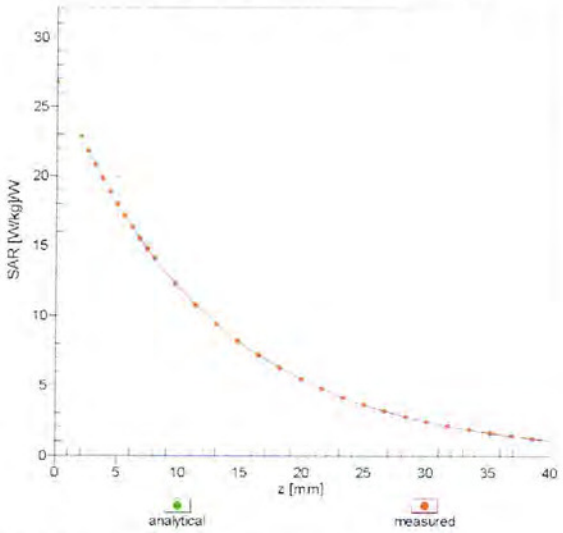
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

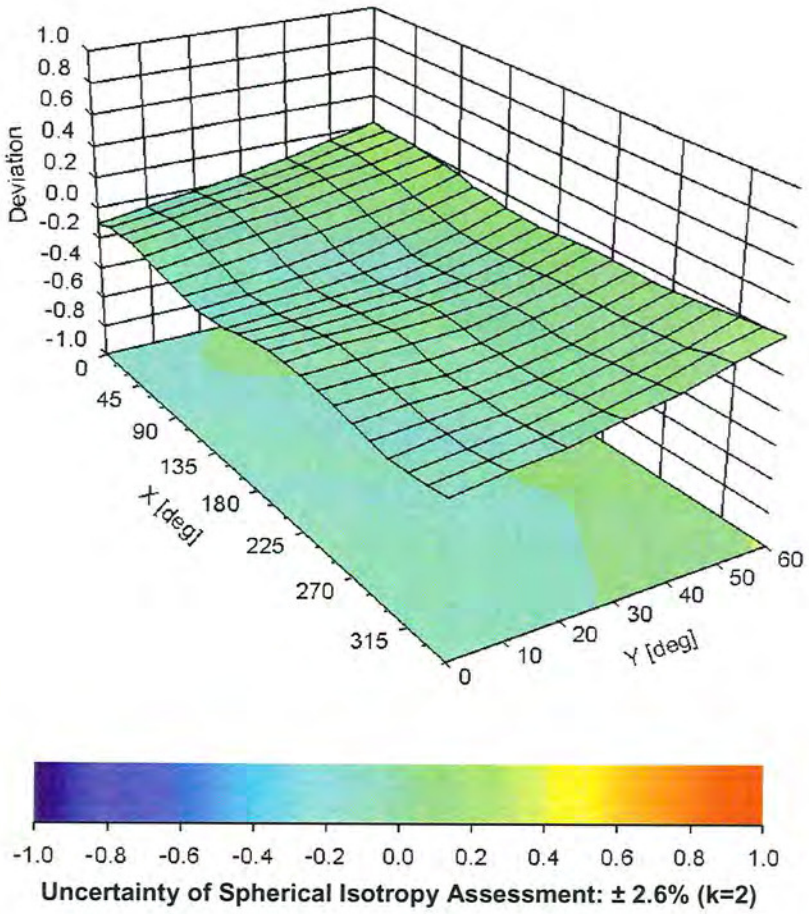


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3341

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	106.8
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	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

A2436

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

Checked By 07/08/15

Accreditation No.: SCS 0108

Client **UL RFI UK**

Certificate No: ES3-3335_Jul15

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3335

Calibration procedure(s) QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: July 23, 2015

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 23, 2015

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 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 0108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *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.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* 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.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *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 ES3DV3

SN:3335

Manufactured: January 24, 2012
Calibrated: July 23, 2015

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3335

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.07	1.08	1.13	± 10.1 %
DCP (mV)[B]	103.1	107.3	106.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	191.9	±3.8 %
		Y	0.0	0.0	1.0		191.2	
		Z	0.0	0.0	1.0		198.9	

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] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3335

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	6.57	6.57	6.57	0.23	2.33	± 12.0 %
835	41.5	0.90	6.30	6.30	6.30	0.72	1.20	± 12.0 %
900	41.5	0.97	6.19	6.19	6.19	0.21	2.67	± 12.0 %
1450	40.5	1.20	5.30	5.30	5.30	0.22	2.40	± 12.0 %
1750	40.1	1.37	5.24	5.24	5.24	0.57	1.39	± 12.0 %
1900	40.0	1.40	5.07	5.07	5.07	0.79	1.18	± 12.0 %
2100	39.8	1.49	5.08	5.08	5.08	0.78	1.21	± 12.0 %
2300	39.5	1.67	4.78	4.78	4.78	0.78	1.23	± 12.0 %
2450	39.2	1.80	4.42	4.42	4.42	0.75	1.26	± 12.0 %
2600	39.0	1.96	4.33	4.33	4.33	0.76	1.29	± 12.0 %
3500	37.9	2.91	4.25	4.25	4.25	0.95	1.16	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3335

Calibration Parameter Determined in Body Tissue Simulating Media

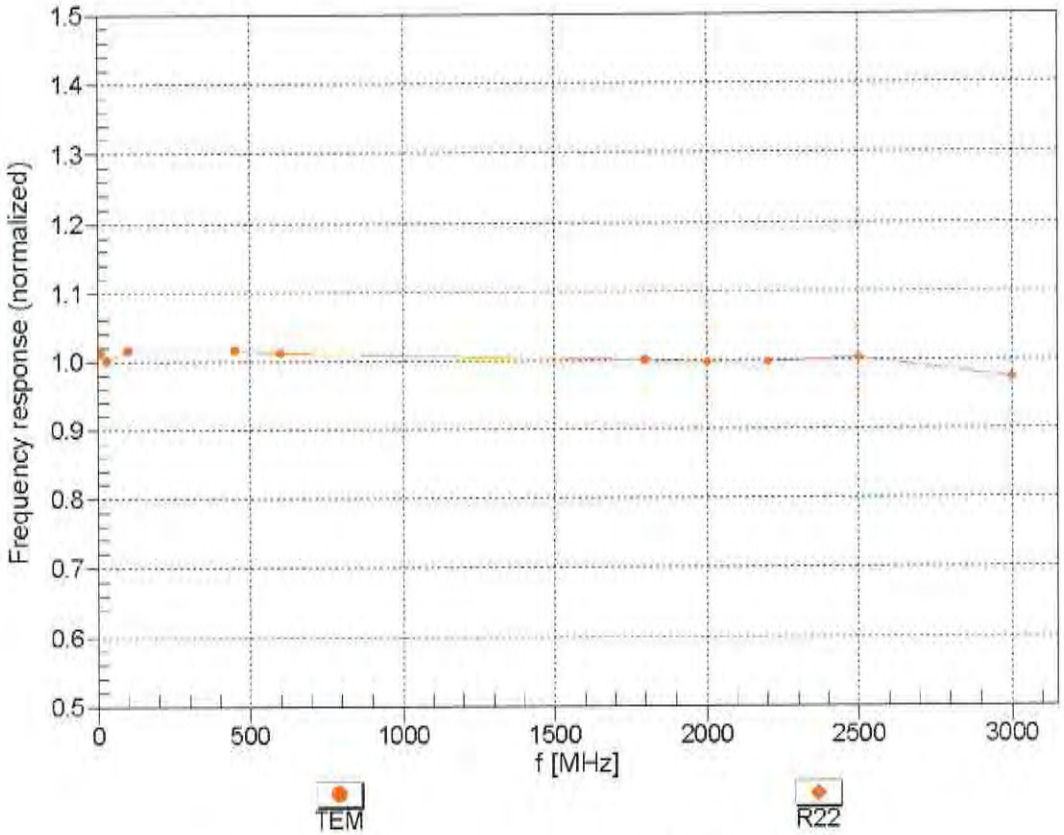
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	6.13	6.13	6.13	0.80	1.13	± 12.0 %
835	55.2	0.97	6.04	6.04	6.04	0.50	1.51	± 12.0 %
900	55.0	1.05	5.97	5.97	5.97	0.80	1.17	± 12.0 %
1450	54.0	1.30	5.10	5.10	5.10	0.33	2.01	± 12.0 %
1750	53.4	1.49	4.89	4.89	4.89	0.54	1.53	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.46	1.72	± 12.0 %
2100	53.2	1.62	4.83	4.83	4.83	0.77	1.29	± 12.0 %
2300	52.9	1.81	4.46	4.46	4.46	0.76	1.31	± 12.0 %
2450	52.7	1.95	4.31	4.31	4.31	0.80	1.08	± 12.0 %
2600	52.5	2.16	4.16	4.16	4.16	0.80	0.80	± 12.0 %
3500	51.3	3.31	3.83	3.83	3.83	0.90	1.34	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

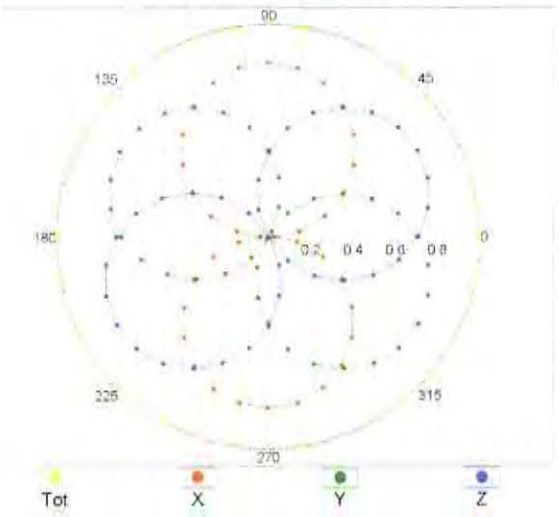
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



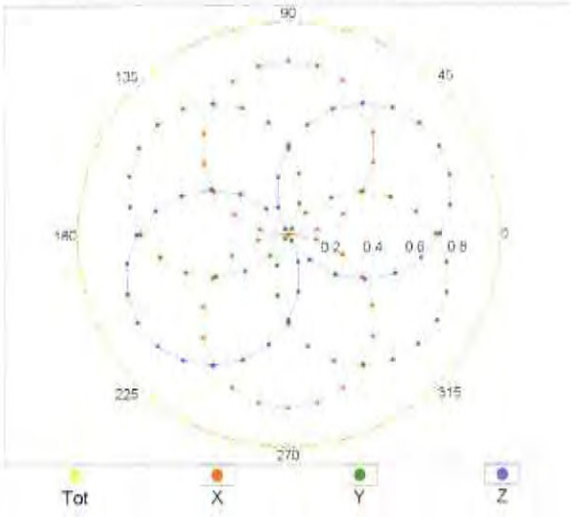
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

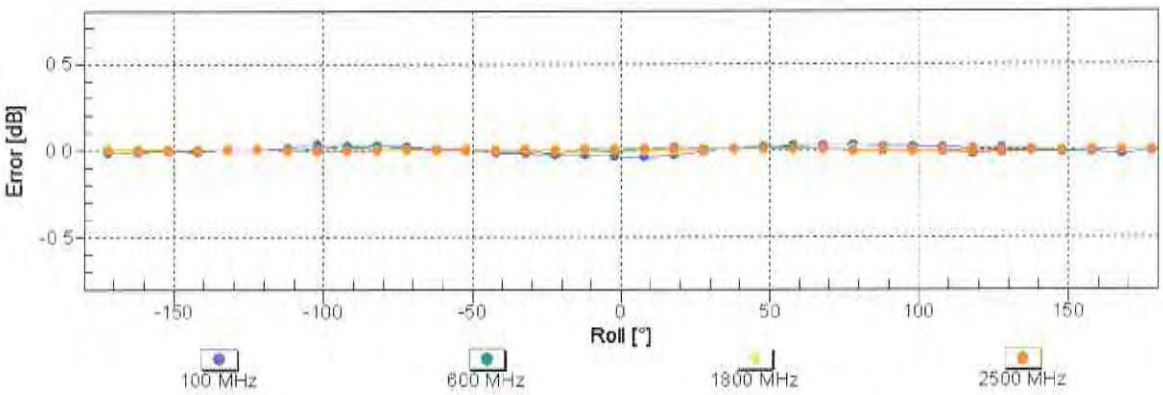
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



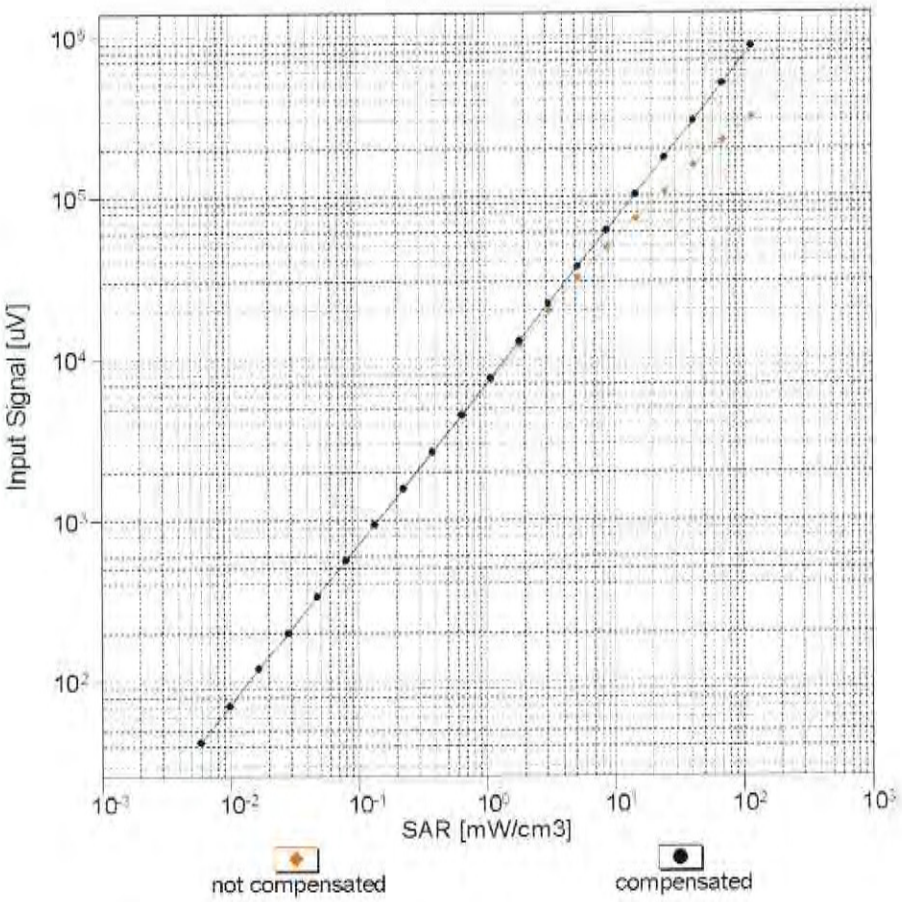
f=1800 MHz,R22

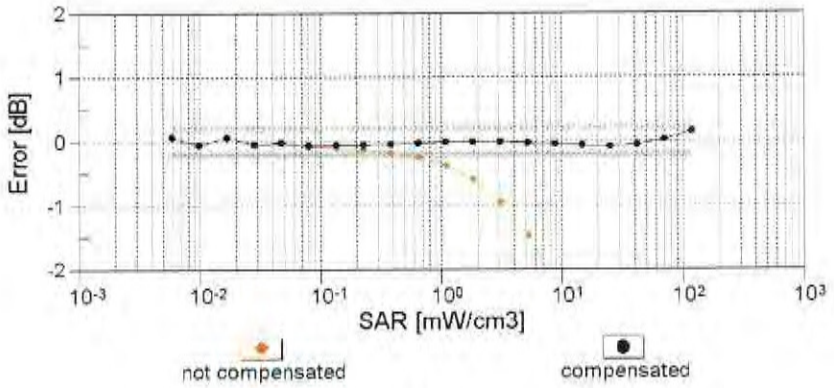




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

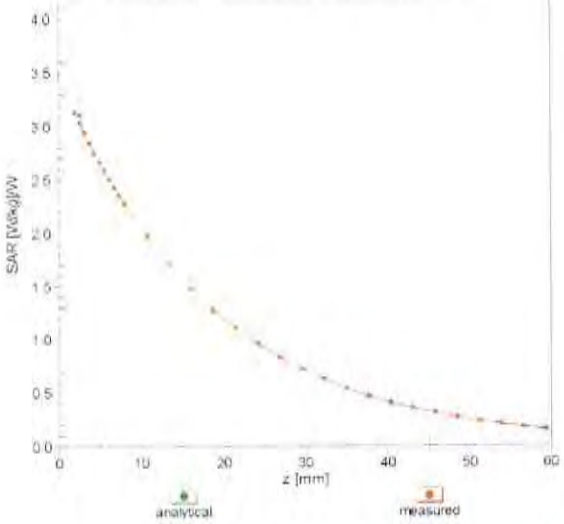




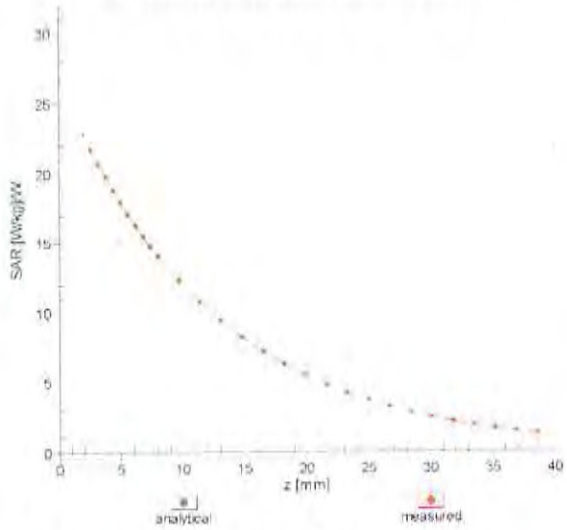
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

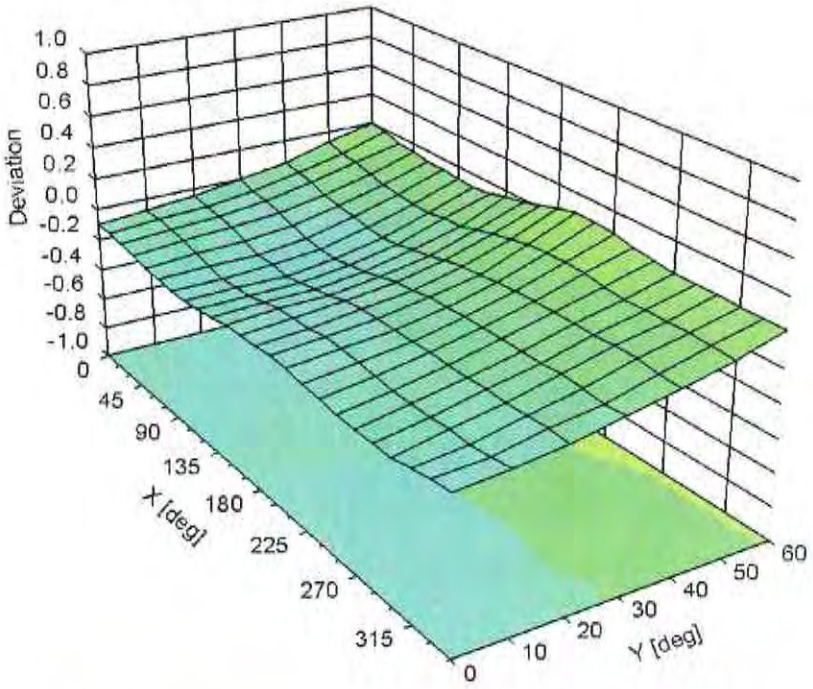


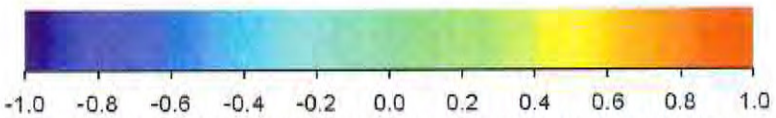
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3335

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	57.9
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	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

A2544

Checked
M. Nash
19/05/2016

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 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 0108

Client UL RFI UK

Certificate No: EX3-3994_Mar16/2

CALIBRATION CERTIFICATE (Replacement of No: EX3-3994_Mar16)

Object	EX3DV4 - SN:3994
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	March 21, 2016

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 10, 2016

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 Accreditation Service (SAS) **Accreditation No.: SCS 0108**
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *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.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* 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.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *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 EX3DV4

SN:3994

Manufactured: January 21, 2014
Calibrated: March 21, 2016

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3994

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.50	0.50	0.43	± 10.1 %
DCP (mV)[B]	101.2	101.2	96.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	195.7	±3.0 %
		Y	0.0	0.0	1.0		183.5	
		Z	0.0	0.0	1.0		177.0	

Note: For details on UID parameters see Appendix.

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $ms.V^{-2}$	T2 $ms.V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	64.44	483.3	36.1	24.54	1.628	5.046	0.743	0.447	1.007
Y	53.98	404.3	35.87	21.79	1.722	5.007	0.175	0.525	1.004
Z	58.14	448.8	38	23.28	1.723	5.019	0	0.516	1.005

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] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3994

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	10.32	10.32	10.32	0.65	0.80	± 12.0 %
835	41.5	0.90	9.79	9.79	9.79	0.57	0.86	± 12.0 %
900	41.5	0.97	9.42	9.42	9.42	0.47	0.95	± 12.0 %
1450	40.5	1.20	8.72	8.72	8.72	0.43	0.80	± 12.0 %
1750	40.1	1.37	8.42	8.42	8.42	0.34	0.80	± 12.0 %
1900	40.0	1.40	8.14	8.14	8.14	0.31	0.87	± 12.0 %
2100	39.8	1.49	8.26	8.26	8.26	0.36	0.80	± 12.0 %
2300	39.5	1.67	7.71	7.71	7.71	0.29	0.80	± 12.0 %
2450	39.2	1.80	7.36	7.36	7.36	0.32	0.80	± 12.0 %
2600	39.0	1.96	7.07	7.07	7.07	0.37	0.80	± 12.0 %
5250	35.9	4.71	5.20	5.20	5.20	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.50	4.50	4.50	0.50	1.80	± 13.1 %
5750	35.4	5.22	4.51	4.51	4.51	0.50	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3994

Calibration Parameter Determined in Body Tissue Simulating Media

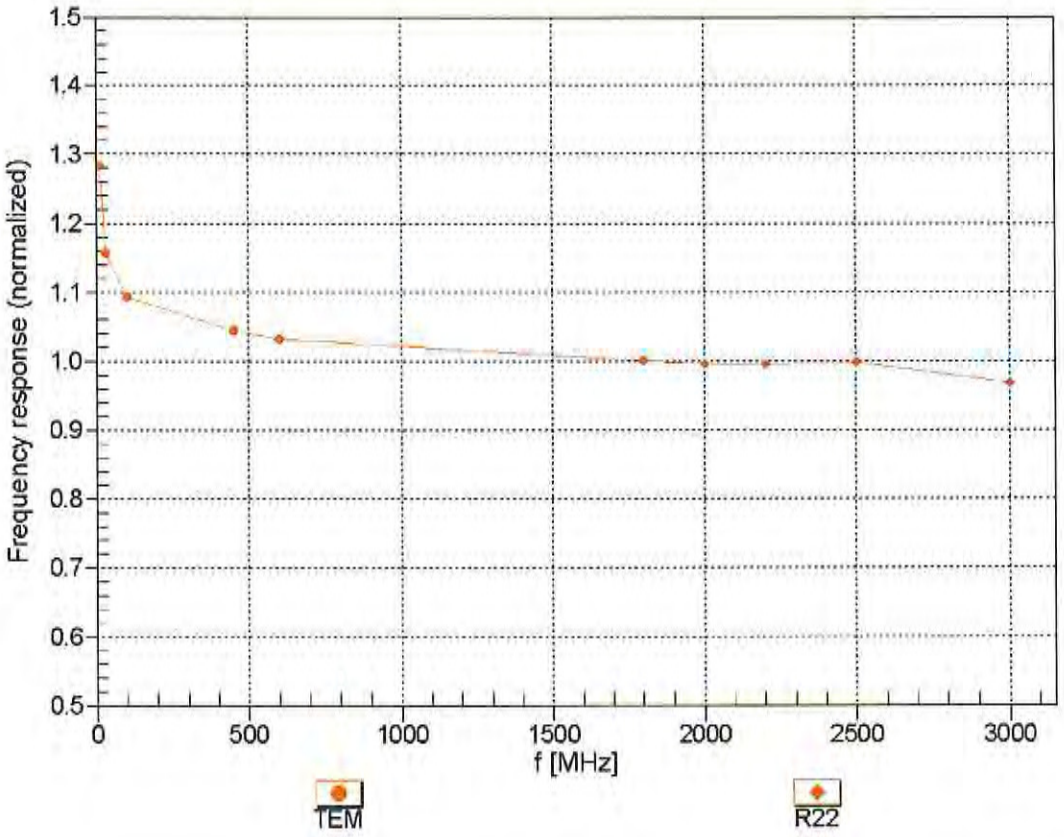
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	9.93	9.93	9.93	0.54	0.80	± 12.0 %
835	55.2	0.97	9.73	9.73	9.73	0.44	0.89	± 12.0 %
900	55.0	1.05	9.74	9.74	9.74	0.41	0.90	± 12.0 %
1450	54.0	1.30	8.47	8.47	8.47	0.32	0.80	± 12.0 %
1750	53.4	1.49	8.12	8.12	8.12	0.46	0.80	± 12.0 %
1900	53.3	1.52	7.81	7.81	7.81	0.37	0.85	± 12.0 %
2100	53.2	1.62	8.10	8.10	8.10	0.28	1.02	± 12.0 %
2300	52.9	1.81	7.45	7.45	7.45	0.32	0.95	± 12.0 %
2450	52.7	1.95	7.28	7.28	7.28	0.36	0.85	± 12.0 %
2600	52.5	2.16	6.99	6.99	6.99	0.29	0.95	± 12.0 %
5250	48.9	5.36	4.38	4.38	4.38	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.76	3.76	3.76	0.60	1.90	± 13.1 %
5750	48.3	5.94	3.99	3.99	3.99	0.60	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

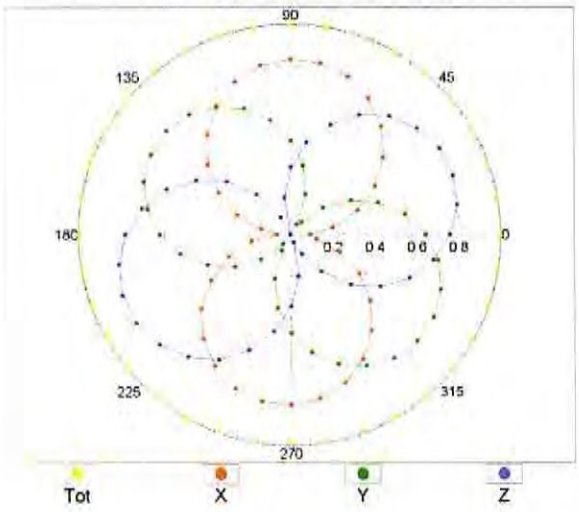
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



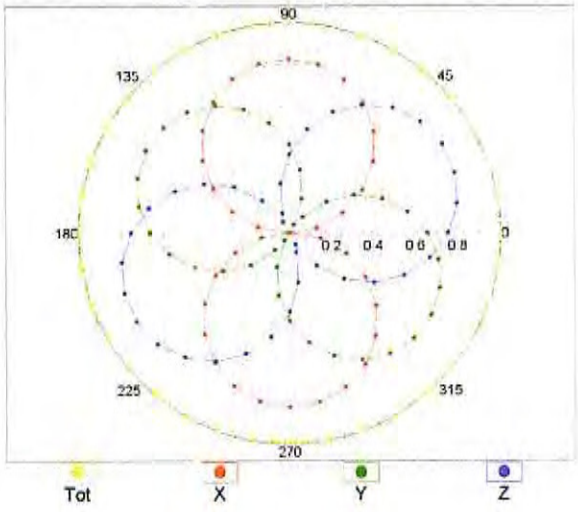
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

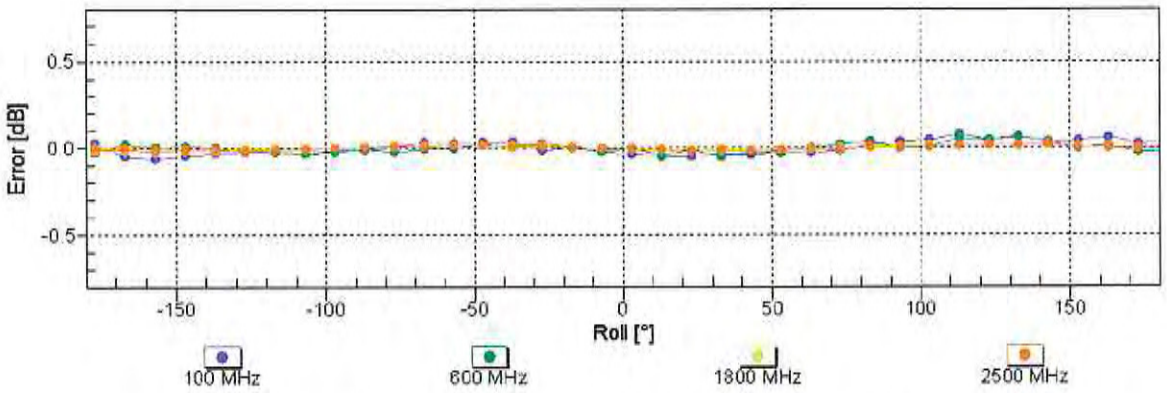
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



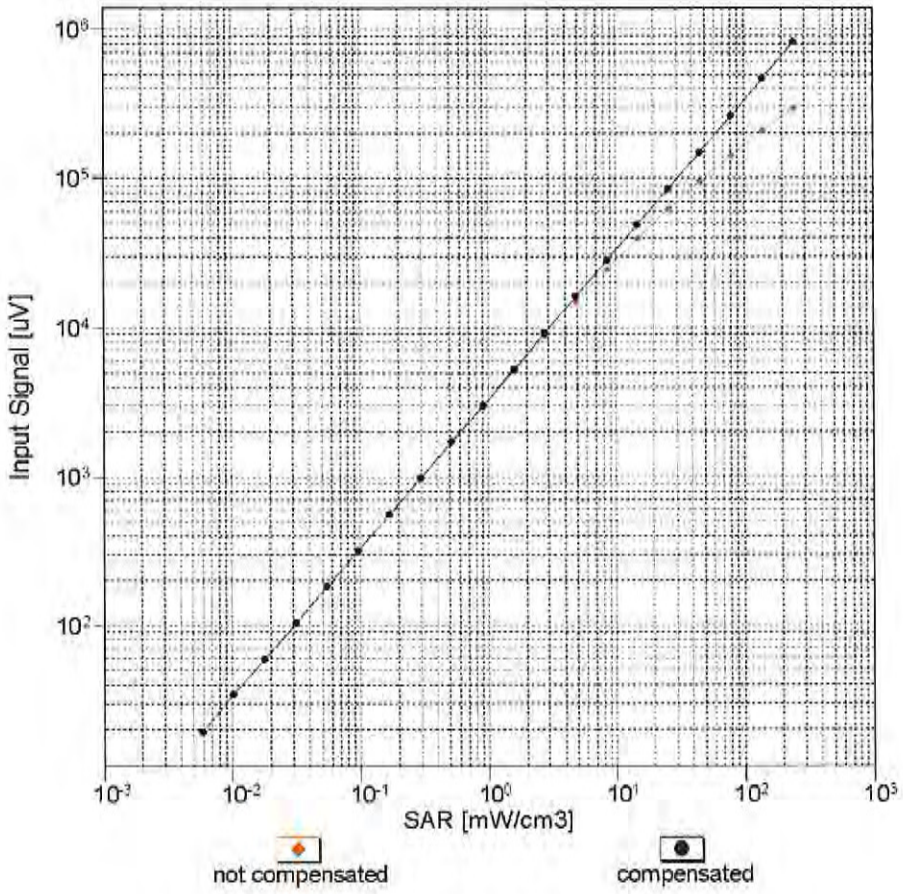
f=1800 MHz,R22

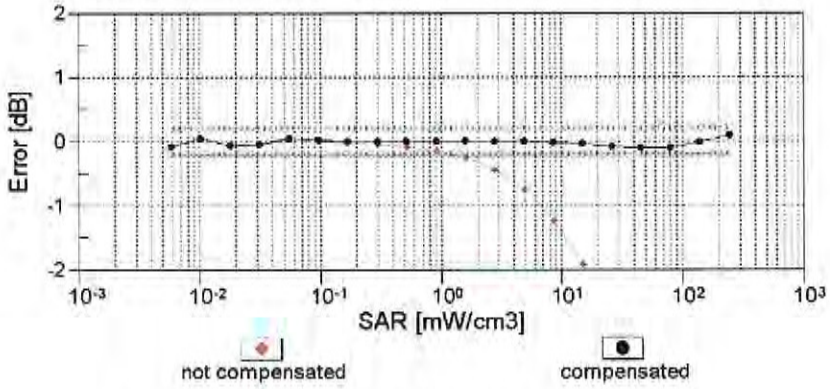




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)

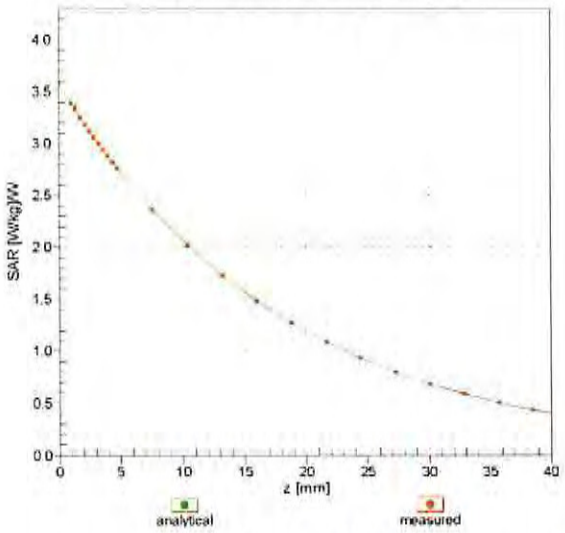




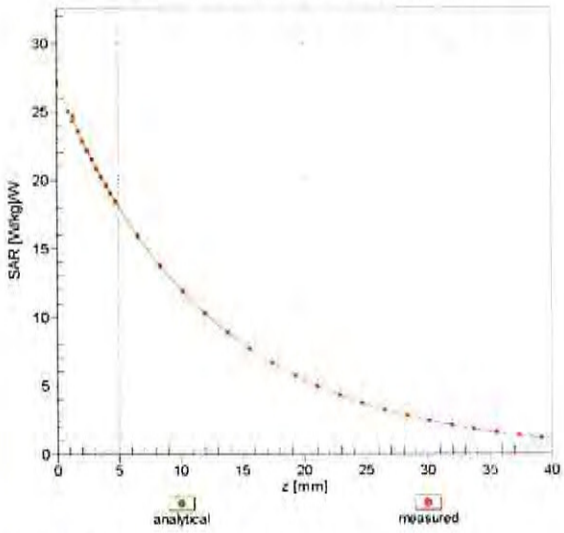
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

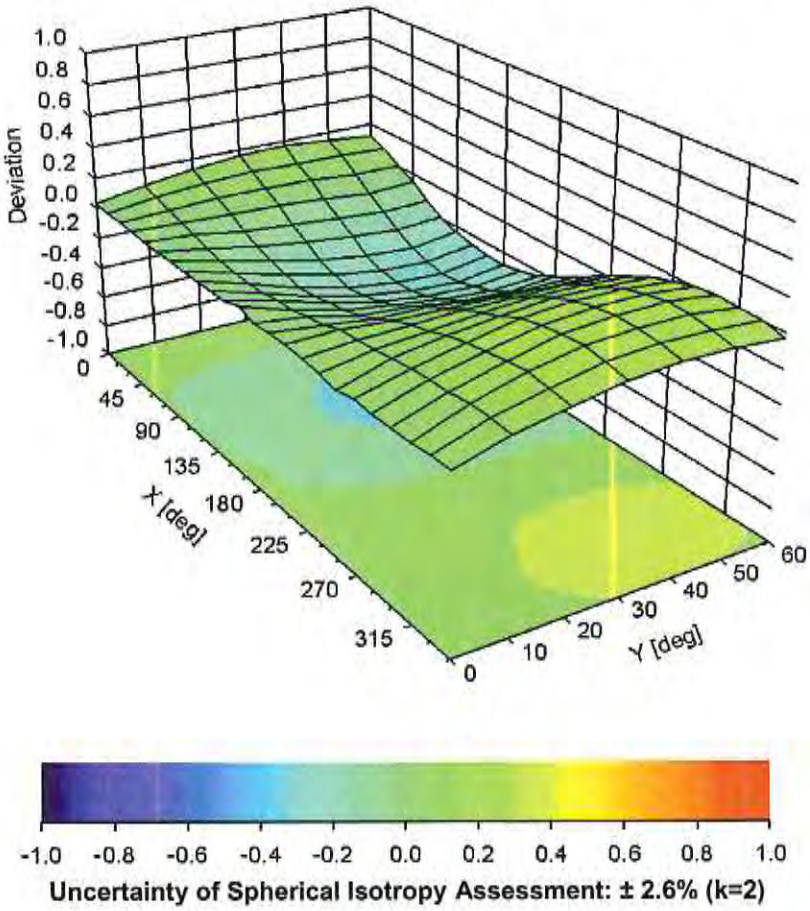


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3994

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-27
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Appendix: Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max Unc[E] (k=2)
0	CW	X	0.00	0.00	1.00	0.00	195.7	± 3.0 %
		Y	0.00	0.00	1.00		183.5	
		Z	0.00	0.00	1.00		177.0	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	6.51	76.69	16.64	10.00	20.0	± 9.6 %
		Y	4.27	71.21	14.22		20.0	
		Z	4.72	72.61	14.88		20.0	
10011-CAB	UMTS-FDD (WCDMA)	X	1.43	73.16	18.77	0.00	150.0	± 9.6 %
		Y	1.09	68.15	15.86		150.0	
		Z	1.43	73.23	18.83		150.0	
10012-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	1.32	65.94	16.90	0.41	150.0	± 9.6 %
		Y	1.23	64.44	15.58		150.0	
		Z	1.30	65.69	16.83		150.0	
10013-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	X	5.10	66.88	17.39	1.46	150.0	± 9.6 %
		Y	4.97	66.66	17.05		150.0	
		Z	5.05	66.81	17.41		150.0	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	100.00	117.92	30.54	9.39	50.0	± 9.6 %
		Y	23.03	95.65	24.26		50.0	
		Z	40.87	104.25	26.79		50.0	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	98.13	117.67	30.54	9.57	50.0	± 9.6 %
		Y	18.04	92.05	23.23		50.0	
		Z	29.33	99.41	25.52		50.0	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	100.00	115.10	28.12	6.56	60.0	± 9.6 %
		Y	100.00	112.82	26.88		60.0	
		Z	100.00	113.82	27.38		60.0	
10025-DAB	EDGE-FDD (TDMA, 8PSK, TN 0)	X	17.74	108.93	42.09	12.57	50.0	± 9.6 %
		Y	5.96	75.31	27.21		50.0	
		Z	16.02	106.17	41.14		50.0	
10026-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-1)	X	21.43	108.03	37.50	9.56	60.0	± 9.6 %
		Y	12.07	93.30	31.83		60.0	
		Z	17.57	103.65	36.10		60.0	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	100.00	114.64	27.11	4.80	80.0	± 9.6 %
		Y	100.00	111.49	25.48		80.0	
		Z	100.00	112.98	26.20		80.0	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	100.00	115.69	26.86	3.55	100.0	± 9.6 %
		Y	100.00	111.47	24.78		100.0	
		Z	100.00	113.62	25.77		100.0	
10029-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	X	12.45	95.25	32.07	7.80	80.0	± 9.6 %
		Y	8.28	85.45	27.91		80.0	
		Z	10.59	91.97	30.95		80.0	
10030-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	100.00	113.80	27.04	5.30	70.0	± 9.6 %
		Y	100.00	110.89	25.50		70.0	
		Z	100.00	112.19	26.15		70.0	
10031-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	X	100.00	119.08	26.88	1.88	100.0	± 9.6 %
		Y	100.00	111.20	23.34		100.0	
		Z	100.00	115.41	25.16		100.0	

10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	100.00	129.54	30.14	1.17	100.0	± 9.6 %
		Y	100.00	115.90	24.36		100.0	
		Z	100.00	124.34	27.82		100.0	
10033-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	X	37.42	111.13	30.80	5.30	70.0	± 9.6 %
		Y	9.13	86.58	22.59		70.0	
		Z	17.26	97.69	26.59		70.0	
10034-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	X	11.00	95.71	25.50	1.88	100.0	± 9.6 %
		Y	3.89	78.57	18.76		100.0	
		Z	7.54	89.20	23.01		100.0	
10035-CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	X	5.65	87.47	22.88	1.17	100.0	± 9.6 %
		Y	2.67	75.06	17.35		100.0	
		Z	4.67	84.07	21.28		100.0	
10036-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	X	60.17	119.16	32.93	5.30	70.0	± 9.6 %
		Y	11.03	89.67	23.66		70.0	
		Z	23.43	102.75	28.11		70.0	
10037-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	X	10.50	95.03	25.25	1.88	100.0	± 9.6 %
		Y	3.69	77.89	18.47		100.0	
		Z	7.11	88.41	22.71		100.0	
10038-CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	X	5.95	88.57	23.34	1.17	100.0	± 9.6 %
		Y	2.72	75.58	17.65		100.0	
		Z	4.89	85.06	21.72		100.0	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	3.40	81.02	20.67	0.00	150.0	± 9.6 %
		Y	2.23	74.57	17.31		150.0	
		Z	3.76	82.65	20.93		150.0	
10042-CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	X	100.00	113.78	27.74	7.78	50.0	± 9.6 %
		Y	33.41	98.36	23.38		50.0	
		Z	100.00	112.71	27.10		50.0	
10044-CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	X	0.00	112.12	1.08	0.00	150.0	± 9.6 %
		Y	0.00	101.45	3.05		150.0	
		Z	0.00	118.00	0.51		150.0	
10048-CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	X	15.77	89.94	24.74	13.80	25.0	± 9.6 %
		Y	9.06	80.54	21.21		25.0	
		Z	10.23	82.70	22.08		25.0	
10049-CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	X	23.93	96.82	25.49	10.79	40.0	± 9.6 %
		Y	11.10	84.61	21.24		40.0	
		Z	13.75	88.08	22.51		40.0	
10056-CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	X	18.32	95.19	26.76	9.03	50.0	± 9.6 %
		Y	10.13	84.16	22.38		50.0	
		Z	13.16	89.12	24.44		50.0	
10058-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	X	8.67	87.80	28.66	6.55	100.0	± 9.6 %
		Y	6.33	80.61	25.37		100.0	
		Z	7.55	85.18	27.73		100.0	
10059-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	X	1.47	68.12	17.95	0.61	110.0	± 9.6 %
		Y	1.33	65.93	16.27		110.0	
		Z	1.43	67.66	17.76		110.0	
10060-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	X	100.00	136.18	35.57	1.30	110.0	± 9.6 %
		Y	26.68	112.29	28.88		110.0	
		Z	100.00	135.38	35.14		110.0	

10061-CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	14.71	105.39	30.19	2.04	110.0	± 9.6 %
		Y	4.34	83.44	22.51		110.0	
		Z	9.12	97.21	27.69		110.0	
10062-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	X	4.89	66.89	16.84	0.49	100.0	± 9.6 %
		Y	4.76	66.66	16.53		100.0	
		Z	4.85	66.82	16.89		100.0	
10063-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	X	4.92	67.01	16.96	0.72	100.0	± 9.6 %
		Y	4.78	66.76	16.63		100.0	
		Z	4.87	66.93	16.99		100.0	
10064-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	X	5.26	67.33	17.20	0.86	100.0	± 9.6 %
		Y	5.09	67.05	16.85		100.0	
		Z	5.19	67.23	17.22		100.0	
10065-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	X	5.13	67.27	17.30	1.21	100.0	± 9.6 %
		Y	4.96	66.97	16.94		100.0	
		Z	5.06	67.16	17.31		100.0	
10066-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	X	5.16	67.34	17.49	1.46	100.0	± 9.6 %
		Y	4.99	67.00	17.10		100.0	
		Z	5.09	67.21	17.49		100.0	
10067-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	X	5.45	67.37	17.87	2.04	100.0	± 9.6 %
		Y	5.28	67.10	17.48		100.0	
		Z	5.38	67.28	17.87		100.0	
10068-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	X	5.56	67.67	18.19	2.55	100.0	± 9.6 %
		Y	5.37	67.28	17.75		100.0	
		Z	5.47	67.52	18.17		100.0	
10069-CAB	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	X	5.63	67.54	18.33	2.67	100.0	± 9.6 %
		Y	5.45	67.23	17.91		100.0	
		Z	5.55	67.45	18.33		100.0	
10071-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	X	5.21	67.02	17.71	1.99	100.0	± 9.6 %
		Y	5.08	66.78	17.34		100.0	
		Z	5.16	66.93	17.71		100.0	
10072-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	X	5.24	67.50	17.98	2.30	100.0	± 9.6 %
		Y	5.09	67.17	17.56		100.0	
		Z	5.18	67.38	17.96		100.0	
10073-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	X	5.33	67.72	18.32	2.83	100.0	± 9.6 %
		Y	5.17	67.37	17.88		100.0	
		Z	5.26	67.59	18.29		100.0	
10074-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	X	5.31	67.68	18.52	3.30	100.0	± 9.6 %
		Y	5.17	67.32	18.05		100.0	
		Z	5.25	67.53	18.47		100.0	
10075-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	X	5.42	68.06	18.96	3.82	90.0	± 9.6 %
		Y	5.26	67.58	18.40		90.0	
		Z	5.35	67.85	18.87		90.0	
10076-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	X	5.40	67.74	19.01	4.15	90.0	± 9.6 %
		Y	5.26	67.35	18.50		90.0	
		Z	5.34	67.57	18.94		90.0	
10077-CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	5.42	67.80	19.10	4.30	90.0	± 9.6 %
		Y	5.29	67.42	18.58		90.0	
		Z	5.36	67.64	19.03		90.0	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	1.49	73.97	17.75	0.00	150.0	± 9.6 %
		Y	0.96	67.53	13.88		150.0	
		Z	1.50	74.25	17.52		150.0	
10082-CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate)	X	1.34	61.18	6.55	4.77	80.0	± 9.6 %
		Y	1.15	60.22	5.78		80.0	
		Z	1.20	60.55	6.02		80.0	
10090-DAB	GPRS-FDD (TDMA, GMSK, TN 0-4)	X	100.00	115.15	28.17	6.56	60.0	± 9.6 %
		Y	100.00	112.87	26.92		60.0	
		Z	100.00	113.87	27.42		60.0	
10097-CAB	UMTS-FDD (HSDPA)	X	2.08	69.70	17.34	0.00	150.0	± 9.6 %
		Y	1.89	68.04	16.08		150.0	
		Z	2.08	69.81	17.39		150.0	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	2.04	69.72	17.34	0.00	150.0	± 9.6 %
		Y	1.85	67.99	16.05		150.0	
		Z	2.04	69.83	17.39		150.0	
10099-DAB	EDGE-FDD (TDMA, 8PSK, TN 0-4)	X	21.42	107.97	37.47	9.56	60.0	± 9.6 %
		Y	12.09	93.28	31.82		60.0	
		Z	17.58	103.60	36.07		60.0	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	3.72	72.96	18.10	0.00	150.0	± 9.6 %
		Y	3.28	70.92	17.01		150.0	
		Z	3.62	72.58	18.06		150.0	
10101-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	3.53	68.70	16.75	0.00	150.0	± 9.6 %
		Y	3.33	67.79	16.12		150.0	
		Z	3.48	68.49	16.76		150.0	
10102-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	3.62	68.53	16.78	0.00	150.0	± 9.6 %
		Y	3.43	67.74	16.21		150.0	
		Z	3.57	68.34	16.80		150.0	
10103-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	8.35	78.46	21.41	3.98	65.0	± 9.6 %
		Y	7.27	76.09	20.19		65.0	
		Z	7.52	76.83	20.80		65.0	
10104-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	X	8.06	76.53	21.55	3.98	65.0	± 9.6 %
		Y	7.25	74.59	20.43		65.0	
		Z	7.64	75.72	21.25		65.0	
10105-CAB	LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM)	X	7.68	75.58	21.45	3.98	65.0	± 9.6 %
		Y	6.99	73.84	20.41		65.0	
		Z	7.08	74.21	20.90		65.0	
10108-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	3.26	72.04	17.92	0.00	150.0	± 9.6 %
		Y	2.87	70.10	16.84		150.0	
		Z	3.18	71.79	17.93		150.0	
10109-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	X	3.20	68.59	16.76	0.00	150.0	± 9.6 %
		Y	2.99	67.65	16.07		150.0	
		Z	3.15	68.45	16.78		150.0	
10110-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	2.68	71.14	17.70	0.00	150.0	± 9.6 %
		Y	2.34	69.15	16.48		150.0	
		Z	2.62	71.06	17.75		150.0	
10111-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	X	2.94	69.46	17.26	0.00	150.0	± 9.6 %
		Y	2.73	68.56	16.49		150.0	
		Z	2.89	69.48	17.29		150.0	

10112-CAC	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM)	X	3.31	68.41	16.74	0.00	150.0	± 9.6 %
		Y	3.12	67.61	16.12		150.0	
		Z	3.26	68.30	16.76		150.0	
10113-CAC	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM)	X	3.08	69.40	17.29	0.00	150.0	± 9.6 %
		Y	2.88	68.66	16.61		150.0	
		Z	3.04	69.45	17.33		150.0	
10114-CAB	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	5.29	67.40	16.70	0.00	150.0	± 9.6 %
		Y	5.19	67.22	16.49		150.0	
		Z	5.28	67.37	16.80		150.0	
10115-CAB	IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM)	X	5.66	67.68	16.83	0.00	150.0	± 9.6 %
		Y	5.53	67.49	16.63		150.0	
		Z	5.65	67.71	16.97		150.0	
10116-CAB	IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM)	X	5.42	67.67	16.75	0.00	150.0	± 9.6 %
		Y	5.30	67.47	16.53		150.0	
		Z	5.41	67.66	16.87		150.0	
10117-CAB	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	5.30	67.43	16.73	0.00	150.0	± 9.6 %
		Y	5.17	67.16	16.47		150.0	
		Z	5.28	67.35	16.81		150.0	
10118-CAB	IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM)	X	5.72	67.80	16.90	0.00	150.0	± 9.6 %
		Y	5.61	67.66	16.72		150.0	
		Z	5.74	67.91	17.08		150.0	
10119-CAB	IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM)	X	5.39	67.61	16.74	0.00	150.0	± 9.6 %
		Y	5.27	67.40	16.51		150.0	
		Z	5.39	67.61	16.86		150.0	
10140-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	X	3.67	68.53	16.70	0.00	150.0	± 9.6 %
		Y	3.47	67.74	16.13		150.0	
		Z	3.62	68.34	16.71		150.0	
10141-CAB	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM)	X	3.78	68.50	16.80	0.00	150.0	± 9.6 %
		Y	3.60	67.82	16.29		150.0	
		Z	3.73	68.34	16.83		150.0	
10142-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	X	2.49	71.42	17.73	0.00	150.0	± 9.6 %
		Y	2.13	69.25	16.30		150.0	
		Z	2.44	71.50	17.76		150.0	
10143-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	X	2.89	70.64	17.43	0.00	150.0	± 9.6 %
		Y	2.63	69.52	16.43		150.0	
		Z	2.86	70.79	17.42		150.0	
10144-CAC	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM)	X	2.65	68.33	15.89	0.00	150.0	± 9.6 %
		Y	2.38	67.07	14.75		150.0	
		Z	2.58	68.27	15.75		150.0	
10145-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	X	2.01	71.51	16.50	0.00	150.0	± 9.6 %
		Y	1.46	67.12	13.47		150.0	
		Z	1.87	70.73	15.71		150.0	
10146-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	X	3.80	75.01	17.18	0.00	150.0	± 9.6 %
		Y	2.13	67.17	12.68		150.0	
		Z	2.61	70.09	14.59		150.0	
10147-CAC	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM)	X	5.23	79.70	19.17	0.00	150.0	± 9.6 %
		Y	2.55	69.52	13.93		150.0	
		Z	3.33	73.46	16.20		150.0	

10149-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	3.21	68.65	16.81	0.00	150.0	± 9.6 %
		Y	3.00	67.72	16.12		150.0	
		Z	3.16	68.51	16.82		150.0	
10150-CAB	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	3.32	68.47	16.78	0.00	150.0	± 9.6 %
		Y	3.13	67.67	16.16		150.0	
		Z	3.27	68.35	16.81		150.0	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	8.89	80.86	22.46	3.98	65.0	± 9.6 %
		Y	7.55	78.00	21.02		65.0	
		Z	8.22	79.74	22.04		65.0	
10152-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	X	7.69	76.78	21.46	3.98	65.0	± 9.6 %
		Y	6.78	74.50	20.12		65.0	
		Z	7.23	75.88	21.08		65.0	
10153-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM)	X	8.03	77.50	22.11	3.98	65.0	± 9.6 %
		Y	7.19	75.46	20.90		65.0	
		Z	7.59	76.67	21.76		65.0	
10154-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	2.77	71.74	18.05	0.00	150.0	± 9.6 %
		Y	2.41	69.70	16.81		150.0	
		Z	2.70	71.63	18.08		150.0	
10155-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	X	2.94	69.45	17.26	0.00	150.0	± 9.6 %
		Y	2.73	68.56	16.50		150.0	
		Z	2.89	69.48	17.30		150.0	
10156-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	X	2.40	72.17	17.97	0.00	150.0	± 9.6 %
		Y	2.00	69.57	16.27		150.0	
		Z	2.36	72.29	17.96		150.0	
10157-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	X	2.55	69.48	16.33	0.00	150.0	± 9.6 %
		Y	2.24	67.87	14.96		150.0	
		Z	2.50	69.49	16.17		150.0	
10158-CAC	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM)	X	3.09	69.46	17.33	0.00	150.0	± 9.6 %
		Y	2.89	68.73	16.65		150.0	
		Z	3.05	69.51	17.38		150.0	
10159-CAC	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM)	X	2.69	69.99	16.64	0.00	150.0	± 9.6 %
		Y	2.37	68.44	15.30		150.0	
		Z	2.63	70.00	16.47		150.0	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	3.10	70.21	17.38	0.00	150.0	± 9.6 %
		Y	2.84	68.94	16.54		150.0	
		Z	3.09	70.31	17.51		150.0	
10161-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	X	3.21	68.38	16.75	0.00	150.0	± 9.6 %
		Y	3.02	67.61	16.11		150.0	
		Z	3.17	68.30	16.77		150.0	
10162-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM)	X	3.31	68.37	16.78	0.00	150.0	± 9.6 %
		Y	3.13	67.71	16.20		150.0	
		Z	3.27	68.34	16.83		150.0	
10166-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	X	3.91	70.15	19.62	3.01	150.0	± 9.6 %
		Y	3.59	68.95	18.73		150.0	
		Z	3.67	69.38	19.31		150.0	
10167-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	X	5.00	73.54	20.31	3.01	150.0	± 9.6 %
		Y	4.36	71.51	19.08		150.0	
		Z	4.47	72.08	19.72		150.0	

10168-CAC	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM)	X	5.50	75.56	21.49	3.01	150.0	± 9.6 %
		Y	4.83	73.74	20.43		150.0	
		Z	4.89	74.02	20.90		150.0	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	3.53	71.82	20.39	3.01	150.0	± 9.6 %
		Y	3.00	68.74	18.63		150.0	
		Z	3.06	69.43	19.40		150.0	
10170-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	5.50	79.81	23.33	3.01	150.0	± 9.6 %
		Y	4.10	74.43	20.89		150.0	
		Z	4.15	75.19	21.66		150.0	
10171-AAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	4.33	74.66	20.30	3.01	150.0	± 9.6 %
		Y	3.34	70.14	18.03		150.0	
		Z	3.45	71.26	19.00		150.0	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	28.44	110.26	33.77	6.02	65.0	± 9.6 %
		Y	10.11	89.88	26.80		65.0	
		Z	13.57	96.67	29.65		65.0	
10173-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	39.55	110.46	31.84	6.02	65.0	± 9.6 %
		Y	12.83	90.50	25.34		65.0	
		Z	18.99	98.26	28.27		65.0	
10174-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	26.02	101.66	28.83	6.02	65.0	± 9.6 %
		Y	10.54	86.25	23.46		65.0	
		Z	12.72	90.24	25.26		65.0	
10175-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	3.48	71.43	20.11	3.01	150.0	± 9.6 %
		Y	2.96	68.40	18.36		150.0	
		Z	3.03	69.13	19.16		150.0	
10176-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	5.51	79.84	23.35	3.01	150.0	± 9.6 %
		Y	4.11	74.45	20.91		150.0	
		Z	4.16	75.21	21.67		150.0	
10177-CAE	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	3.52	71.63	20.23	3.01	150.0	± 9.6 %
		Y	2.99	68.57	18.47		150.0	
		Z	3.05	69.28	19.26		150.0	
10178-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	5.41	79.45	23.16	3.01	150.0	± 9.6 %
		Y	4.05	74.17	20.76		150.0	
		Z	4.11	74.95	21.53		150.0	
10179-CAC	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	4.86	77.04	21.65	3.01	150.0	± 9.6 %
		Y	3.67	72.09	19.30		150.0	
		Z	3.78	73.13	20.20		150.0	
10180-CAC	LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	4.31	74.54	20.23	3.01	150.0	± 9.6 %
		Y	3.33	70.05	17.97		150.0	
		Z	3.44	71.18	18.95		150.0	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	3.51	71.61	20.22	3.01	150.0	± 9.6 %
		Y	2.99	68.55	18.46		150.0	
		Z	3.05	69.27	19.25		150.0	
10182-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	5.40	79.42	23.15	3.01	150.0	± 9.6 %
		Y	4.05	74.15	20.74		150.0	
		Z	4.10	74.93	21.52		150.0	
10183-AAA	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM)	X	4.30	74.51	20.22	3.01	150.0	± 9.6 %
		Y	3.32	70.03	17.96		150.0	
		Z	3.44	71.16	18.93		150.0	

10184-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	3.52	71.66	20.24	3.01	150.0	± 9.6 %
		Y	3.00	68.60	18.49		150.0	
		Z	3.06	69.31	19.27		150.0	
10185-CAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	5.43	79.51	23.19	3.01	150.0	± 9.6 %
		Y	4.07	74.22	20.78		150.0	
		Z	4.12	75.00	21.55		150.0	
10186-AAC	LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	4.33	74.59	20.25	3.01	150.0	± 9.6 %
		Y	3.34	70.09	18.00		150.0	
		Z	3.46	71.23	18.97		150.0	
10187-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	3.53	71.69	20.29	3.01	150.0	± 9.6 %
		Y	3.00	68.64	18.54		150.0	
		Z	3.07	69.35	19.32		150.0	
10188-CAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	5.68	80.43	23.65	3.01	150.0	± 9.6 %
		Y	4.22	74.97	21.21		150.0	
		Z	4.26	75.67	21.94		150.0	
10189-AAC	LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	4.45	75.15	20.58	3.01	150.0	± 9.6 %
		Y	3.42	70.53	18.28		150.0	
		Z	3.53	71.65	19.25		150.0	
10193-CAB	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	4.73	66.84	16.52	0.00	150.0	± 9.6 %
		Y	4.60	66.65	16.24		150.0	
		Z	4.69	66.80	16.58		150.0	
10194-CAB	IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM)	X	4.93	67.22	16.63	0.00	150.0	± 9.6 %
		Y	4.78	66.99	16.36		150.0	
		Z	4.88	67.16	16.70		150.0	
10195-CAB	IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM)	X	4.97	67.23	16.62	0.00	150.0	± 9.6 %
		Y	4.83	67.01	16.37		150.0	
		Z	4.92	67.17	16.71		150.0	
10196-CAB	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	4.75	66.95	16.56	0.00	150.0	± 9.6 %
		Y	4.61	66.73	16.27		150.0	
		Z	4.71	66.90	16.62		150.0	
10197-CAB	IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM)	X	4.95	67.24	16.63	0.00	150.0	± 9.6 %
		Y	4.80	67.01	16.37		150.0	
		Z	4.90	67.18	16.71		150.0	
10198-CAB	IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM)	X	4.98	67.24	16.63	0.00	150.0	± 9.6 %
		Y	4.83	67.03	16.38		150.0	
		Z	4.93	67.19	16.72		150.0	
10219-CAB	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	4.70	66.98	16.53	0.00	150.0	± 9.6 %
		Y	4.56	66.74	16.23		150.0	
		Z	4.66	66.92	16.59		150.0	
10220-CAB	IEEE 802.11n (HT Mixed, 43.3 Mbps, 16-QAM)	X	4.95	67.24	16.63	0.00	150.0	± 9.6 %
		Y	4.80	66.99	16.36		150.0	
		Z	4.90	67.17	16.71		150.0	
10221-CAB	IEEE 802.11n (HT Mixed, 72.2 Mbps, 64-QAM)	X	4.98	67.17	16.62	0.00	150.0	± 9.6 %
		Y	4.84	66.96	16.37		150.0	
		Z	4.93	67.12	16.70		150.0	
10222-CAB	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	5.28	67.46	16.73	0.00	150.0	± 9.6 %
		Y	5.15	67.18	16.47		150.0	
		Z	5.25	67.37	16.81		150.0	

10223-CAB	IEEE 802.11n (HT Mixed, 90 Mbps, 16-QAM)	X	5.66	67.76	16.90	0.00	150.0	± 9.6 %
		Y	5.46	67.36	16.58		150.0	
		Z	5.60	67.65	16.97		150.0	
10224-CAB	IEEE 802.11n (HT Mixed, 150 Mbps, 64-QAM)	X	5.34	67.58	16.72	0.00	150.0	± 9.6 %
		Y	5.20	67.28	16.45		150.0	
		Z	5.30	67.46	16.78		150.0	
10225-CAB	UMTS-FDD (HSPA+)	X	3.03	66.77	16.19	0.00	150.0	± 9.6 %
		Y	2.88	66.27	15.59		150.0	
		Z	2.99	66.76	16.18		150.0	
10226-CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM)	X	43.29	112.24	32.41	6.02	65.0	± 9.6 %
		Y	13.62	91.62	25.79		65.0	
		Z	20.27	99.53	28.74		65.0	
10227-CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM)	X	29.93	104.13	29.62	6.02	65.0	± 9.6 %
		Y	12.07	88.44	24.24		65.0	
		Z	16.60	94.64	26.69		65.0	
10228-CAA	LTE-TDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK)	X	32.77	113.44	34.77	6.02	65.0	± 9.6 %
		Y	11.53	92.65	27.81		65.0	
		Z	17.87	102.20	31.43		65.0	
10229-CAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM)	X	39.67	110.50	31.86	6.02	65.0	± 9.6 %
		Y	12.91	90.59	25.38		65.0	
		Z	19.07	98.31	28.29		65.0	
10230-CAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM)	X	27.95	102.83	29.17	6.02	65.0	± 9.6 %
		Y	11.48	87.55	23.88		65.0	
		Z	15.74	93.65	26.31		65.0	
10231-CAB	LTE-TDD (SC-FDMA, 1 RB, 3 MHz, QPSK)	X	30.59	111.96	34.27	6.02	65.0	± 9.6 %
		Y	10.99	91.68	27.41		65.0	
		Z	16.92	101.05	31.00		65.0	
10232-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM)	X	39.68	110.52	31.86	6.02	65.0	± 9.6 %
		Y	12.89	90.57	25.37		65.0	
		Z	19.06	98.31	28.29		65.0	
10233-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM)	X	27.96	102.86	29.18	6.02	65.0	± 9.6 %
		Y	11.47	87.54	23.87		65.0	
		Z	15.73	93.66	26.31		65.0	
10234-CAB	LTE-TDD (SC-FDMA, 1 RB, 5 MHz, QPSK)	X	28.50	110.35	33.71	6.02	65.0	± 9.6 %
		Y	10.51	90.71	26.98		65.0	
		Z	16.06	99.86	30.52		65.0	
10235-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	39.84	110.60	31.88	6.02	65.0	± 9.6 %
		Y	12.90	90.60	25.38		65.0	
		Z	19.10	98.37	28.31		65.0	
10236-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM)	X	28.31	103.04	29.22	6.02	65.0	± 9.6 %
		Y	11.55	87.64	23.90		65.0	
		Z	15.89	93.80	26.35		65.0	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	30.95	112.21	34.34	6.02	65.0	± 9.6 %
		Y	11.01	91.74	27.43		65.0	
		Z	17.04	101.22	31.05		65.0	
10238-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	39.70	110.54	31.86	6.02	65.0	± 9.6 %
		Y	12.87	90.56	25.36		65.0	
		Z	19.04	98.30	28.29		65.0	