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, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
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).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7372

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.49	0.29	0.51	± 10.1 %
DCP (mV)[B]	98.5	104.3	96.8	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Max Unc[E] (k=2)
0	CW	X	0.00	0.00	1.00	0.00	160.2	± 3.5 %	± 4.7 %
		Y	0.00	0.00	1.00		162.6		
		Z	0.00	0.00	1.00		159.7		
10352-AAA	Pulse Waveform (200Hz, 10%)	X	15.00	85.77	18.59	10.00	60.0	± 2.1 %	± 9.6 %
		Y	2.34	63.79	9.90		60.0		
		Z	15.00	84.97	17.90		60.0		
10353-AAA	Pulse Waveform (200Hz, 20%)	X	15.00	86.73	17.61	6.99	80.0	± 1.5 %	± 9.6 %
		Y	1.75	64.33	8.95		80.0		
		Z	15.00	86.12	16.98		80.0		
10354-AAA	Pulse Waveform (200Hz, 40%)	X	15.00	86.77	15.95	3.98	95.0	± 1.2 %	± 9.6 %
		Y	0.78	62.28	6.92		95.0		
		Z	15.00	85.81	15.11		95.0		
10355-AAA	Pulse Waveform (200Hz, 60%)	X	15.00	83.56	13.05	2.22	120.0	± 1.2 %	± 9.6 %
		Y	0.41	61.65	5.83		120.0		
		Z	0.48	63.03	6.31		120.0		
10387-AAA	QPSK Waveform, 1 MHz	X	0.72	61.46	9.37	0.00	150.0	± 3.0 %	± 9.6 %
		Y	0.38	60.00	4.64		150.0		
		Z	0.59	60.19	8.00		150.0		
10388-AAA	QPSK Waveform, 10 MHz	X	2.19	67.56	15.44	0.00	150.0	± 1.3 %	± 9.6 %
		Y	2.27	70.70	17.33		150.0		
		Z	2.08	67.05	15.14		150.0		
10396-AAA	64-QAM Waveform, 100 kHz	X	2.84	69.32	18.53	3.01	150.0	± 1.4 %	± 9.6 %
		Y	2.66	71.16	19.05		150.0		
		Z	2.58	68.21	17.93		150.0		
10399-AAA	64-QAM Waveform, 40 MHz	X	3.48	66.79	15.66	0.00	150.0	± 2.2 %	± 9.6 %
		Y	3.38	67.69	16.24		150.0		
		Z	3.40	66.57	15.50		150.0		
10414-AAA	WLAN CCDF, 64-QAM, 40MHz	X	4.89	65.35	15.49	0.00	150.0	± 4.2 %	± 9.6 %
		Y	4.53	66.01	15.81		150.0		
		Z	4.80	65.27	15.41		150.0		

Note: For details on UID parameters see Appendix

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:7372

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	53.3	414.69	38.23	8.89	0.45	5.06	0.00	0.53	1.01
Y	25.7	187.31	34.29	5.92	0.74	4.93	1.41	0.06	1.00
Z	47.6	368.25	37.79	6.64	0.31	5.06	0.00	0.46	1.01

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	58.5
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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7372

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	10.94	10.94	10.94	0.14	1.25	± 13.3 %
600	42.7	0.88	10.54	10.54	10.54	0.10	1.20	± 13.3 %
750	41.9	0.89	10.31	10.31	10.31	0.41	0.92	± 12.0 %
835	41.5	0.90	9.98	9.98	9.98	0.46	0.85	± 12.0 %
1640	40.2	1.31	8.32	8.32	8.32	0.32	0.83	± 12.0 %
1750	40.1	1.37	8.20	8.20	8.20	0.31	0.84	± 12.0 %
1900	40.0	1.40	7.95	7.95	7.95	0.31	0.80	± 12.0 %
1950	40.0	1.40	7.66	7.66	7.66	0.35	0.82	± 12.0 %
2300	39.5	1.67	7.58	7.58	7.58	0.29	0.85	± 12.0 %
2450	39.2	1.80	7.34	7.34	7.34	0.36	0.87	± 12.0 %
2600	39.0	1.96	6.99	6.99	6.99	0.37	0.95	± 12.0 %
3500	37.9	2.91	6.80	6.80	6.80	0.30	1.20	± 13.1 %
5200	36.0	4.66	4.84	4.84	4.84	0.40	1.80	± 13.1 %
5250	35.9	4.71	4.79	4.79	4.79	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.50	4.50	4.50	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.37	4.37	4.37	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.47	4.47	4.47	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.42	4.42	4.42	0.40	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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. 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.

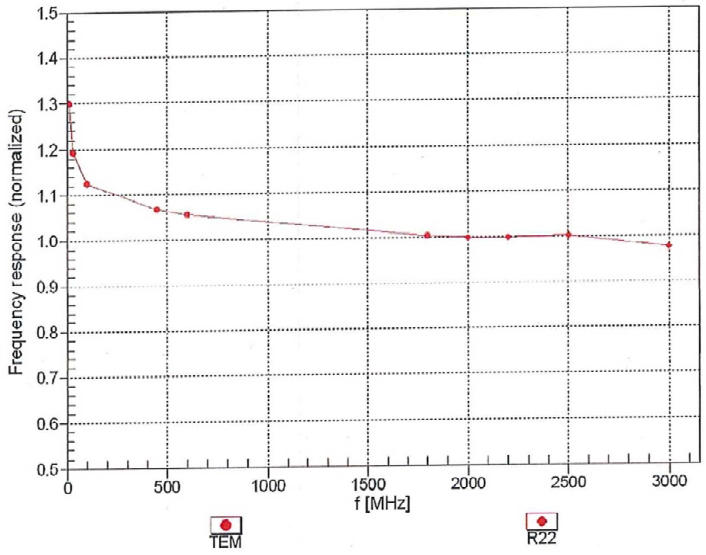
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7372

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	11.03	11.03	11.03	0.07	1.25	± 13.3 %
600	56.1	0.95	10.98	10.98	10.98	0.10	1.20	± 13.3 %
750	55.5	0.96	10.16	10.16	10.16	0.44	0.91	± 12.0 %
835	55.2	0.97	9.88	9.88	9.88	0.46	0.80	± 12.0 %
1640	53.7	1.42	8.29	8.29	8.29	0.37	0.80	± 12.0 %
1750	53.4	1.49	7.99	7.99	7.99	0.39	0.86	± 12.0 %
1900	53.3	1.52	7.64	7.64	7.64	0.40	0.88	± 12.0 %
2300	52.9	1.81	7.60	7.60	7.60	0.37	0.86	± 12.0 %
2450	52.7	1.95	7.42	7.42	7.42	0.34	0.85	± 12.0 %
2600	52.5	2.16	7.29	7.29	7.29	0.33	0.93	± 12.0 %
3500	51.3	3.31	6.55	6.55	6.55	0.37	1.52	± 13.1 %
5250	48.9	5.36	4.45	4.45	4.45	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.83	3.83	3.83	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.09	4.09	4.09	0.50	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. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. 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.

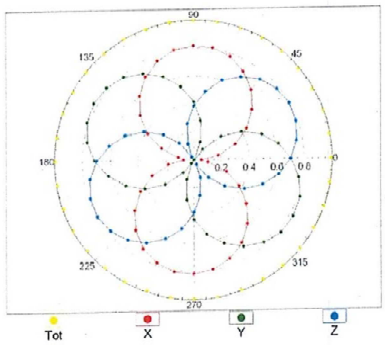
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



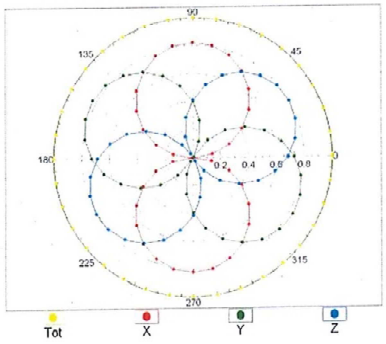
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

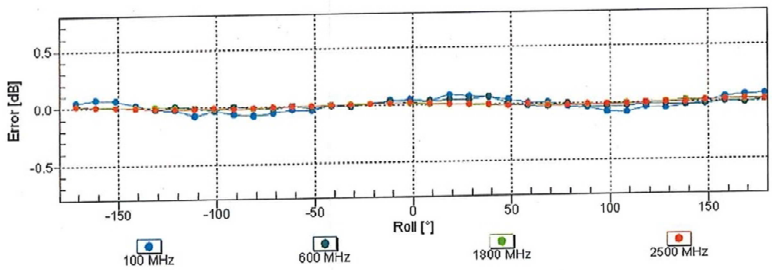
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22





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