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

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Accreditation No.: SCS 0108

Client Intel France

Certificate No: EUmmWV2-9354_Feb17/2

CALIBRATION CERTIFICATE (Replacement of No: EUmmWV2-9354_Feb17)

Object	EUmmWV2 - SN:9354
Calibration procedure(s)	QA CAL-02.v8, QA CAL-25.v6, QA CAL-42.v2 Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date:	February 23, 2017

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 ER3DV6	SN: 2328	14-Oct-16 (No. ER3-2328_Oct16)	Oct-17
DAE4	SN: 789	11-Nov-16 (No. DAE4-789_Nov16)	Nov-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Fin Bomholt	Deputy Manager	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 8, 2017

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Glossary:

NORMx,y,z	sensitivity in free space
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
Sensor Angles	sensor deviation from the probe axis, used to calculate the field orientation and polarization
$\hat{k}$	is the wave propagation direction

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). For frequencies > 3 GHz, the far field in front of waveguide horn antennas is measured for a set of frequencies in various waveguide bands up to 90 GHz. The frequency dependency is fitted using a sensor model involving resistors R, R_p, inductance L and capacitors C, C_p.
- *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.
- *Sensor Offset*: The sensor offset corresponds to the mechanical 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).
- *Equivalent Sensor Angle*: The two probe sensors are mounted in the same plane at different angles. The angles are assessed using the information gained by determining the *NORMx* (no uncertainty required).
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide / horn setup.

Probe EUmmWV2

SN:9354

Manufactured: December 8, 2016
Calibrated: February 23, 2017

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

DASY - Parameters of Probe: EUmmWV2 - SN:9354

Basic Calibration Parameters (300 MHz – 3 GHz)

	Sensor X	Sensor Y	Unc (k=2)
Norm ($\mu V/(V/m)^2$)	0.02530	0.02833	± 10.1 %
DCP (mV)[B]	105.0	105.0	
Equivalent Sensor Angle	-59.6	31.3	

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	131.7	±3.3 %
		Y	0.0	0.0	1.0		96.8	

Note: For details on UID parameters see Appendix.

Sensor Model Parameters

Other Probe Parameters (300 MHz – 3 GHz)

Sensor Arrangement	Rectangular
Connector Angle (°)	77.0
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	320 mm
Probe Body Diameter	10 mm
Tip Length	23 mm
Tip Diameter	8.0 mm
Probe Tip to Sensor X Calibration Point	1.5 mm
Probe Tip to Sensor Y Calibration Point	1.5 mm

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%.

[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.

Appendix (Additional assessments outside the scope of SCS 0108)

DASY - Parameters of Probe: EUmmWV2 - SN:9354

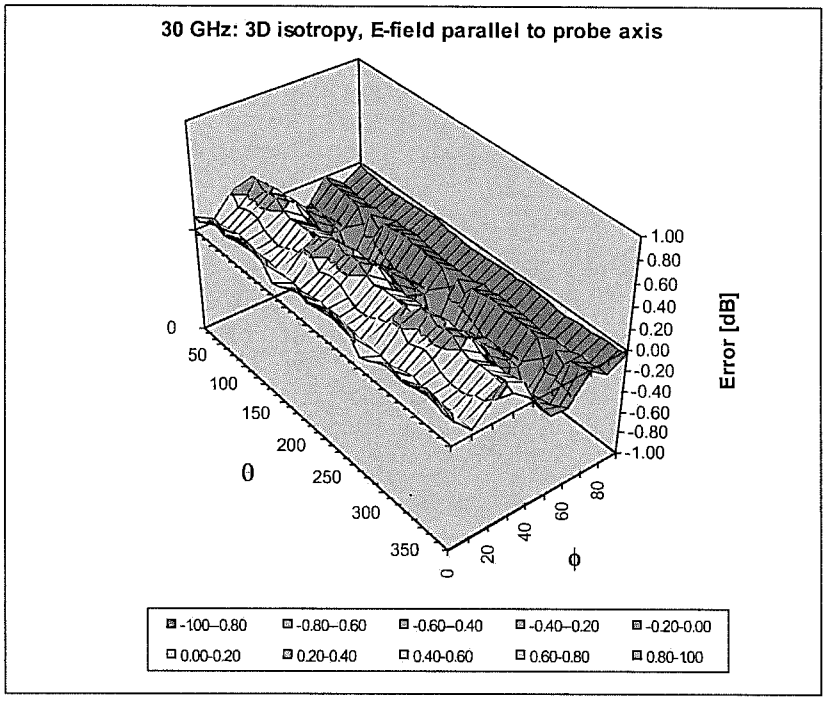
Sensor Frequency Model Parameters for f > 3 GHz [Z]

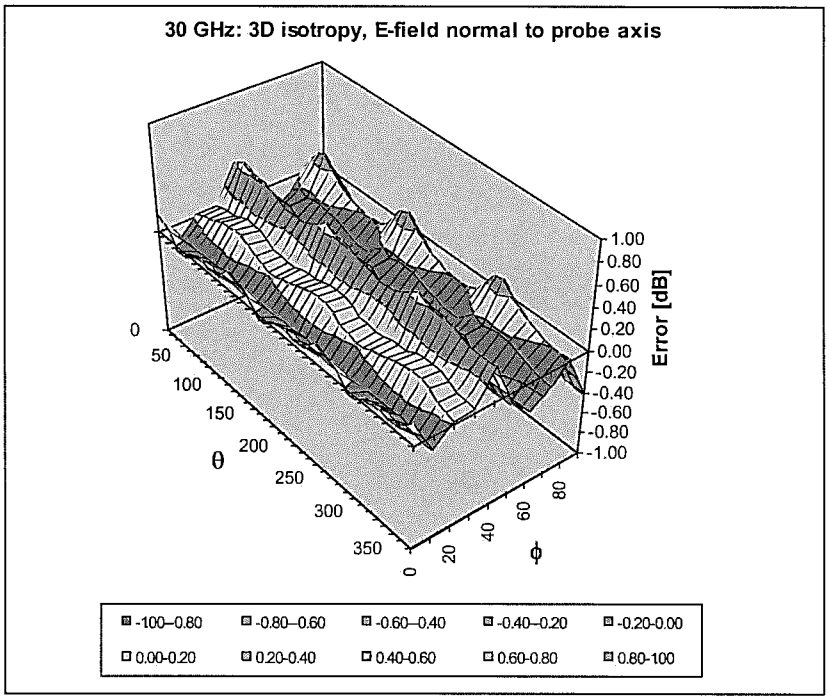
	Sensor X	Sensor Y
R (Ω)	49.96	58.32
R_p (Ω)	112.42	111.97
L (nH)	0.03627	0.03649
C (pF)	0.2106	0.276
C_p (pF)	0.1304	0.1133

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%.

[Z] Uncertainty is the probe model uncertainty including *Norm*, expressed as normal distribution, which is < 1 dB.

Deviation from Isotropy in Air
f = 30 GHz





Probe isotropy for E_{tot}: probe rotated φ = 0° to 360°, tilted from field propagation direction $\vec{k}$
Parallel to the field propagation (ψ =0° - 90°): deviation within ± 0.38 dB
Normal to field orientation (ϑ =0° - 90°): deviation within ± 0.47 dB