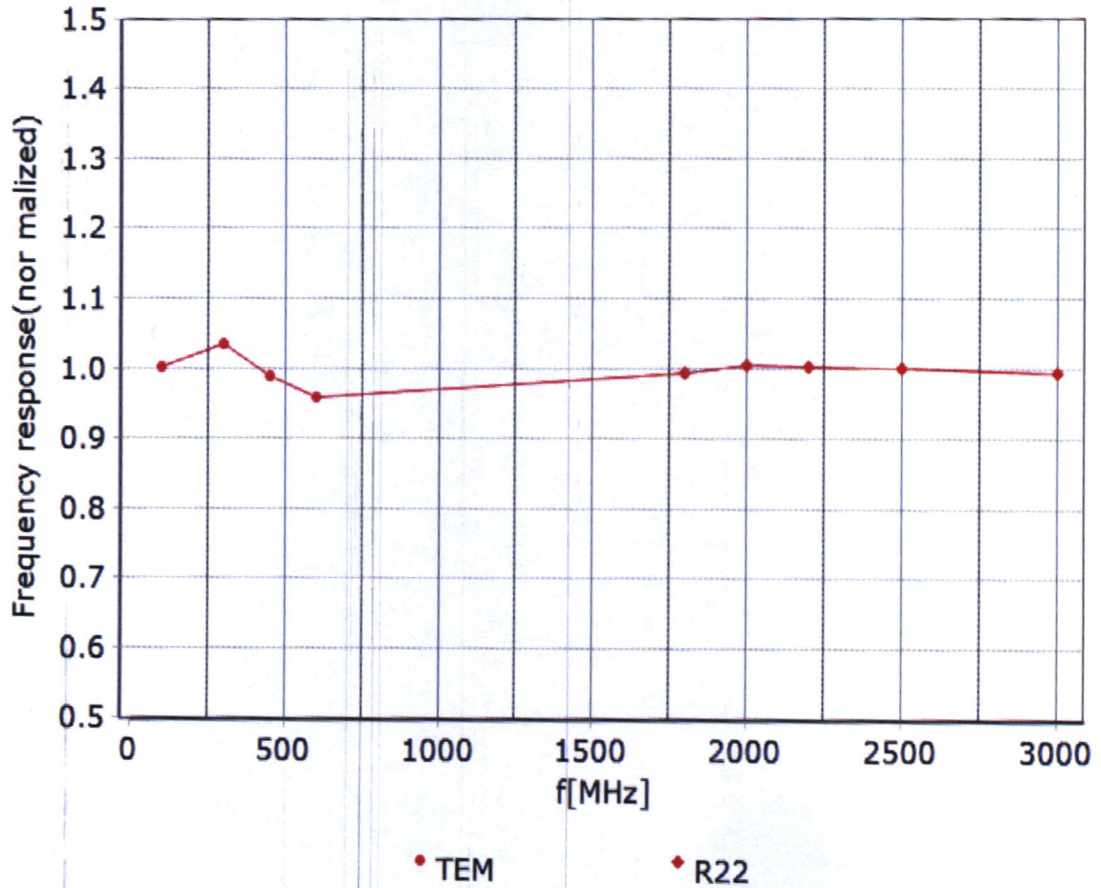




Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

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



Uncertainty of Frequency Response of E-field: $\pm 7.4\%$ ($k=2$)

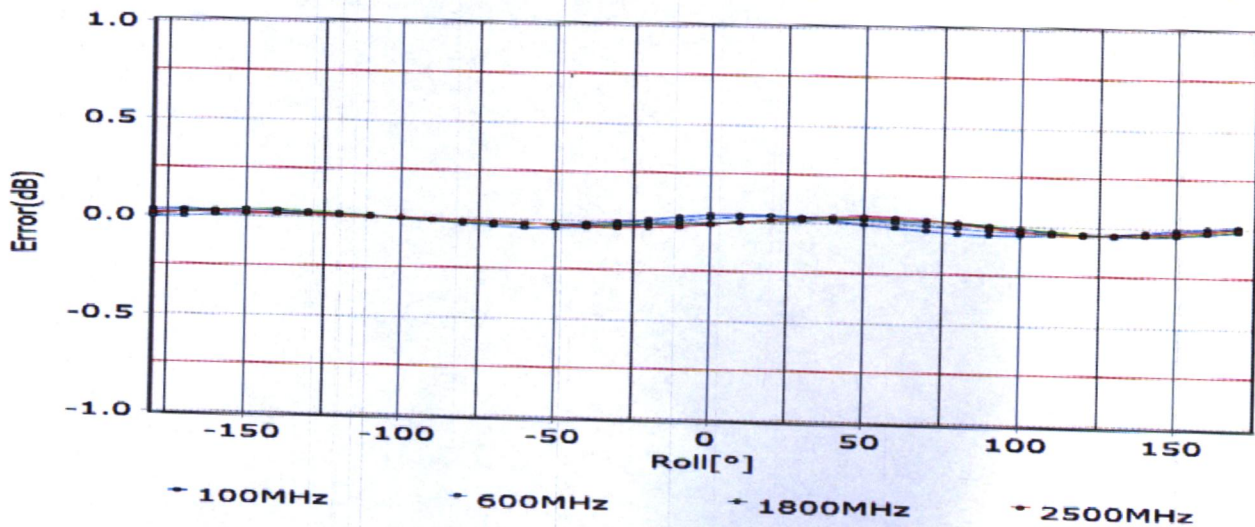
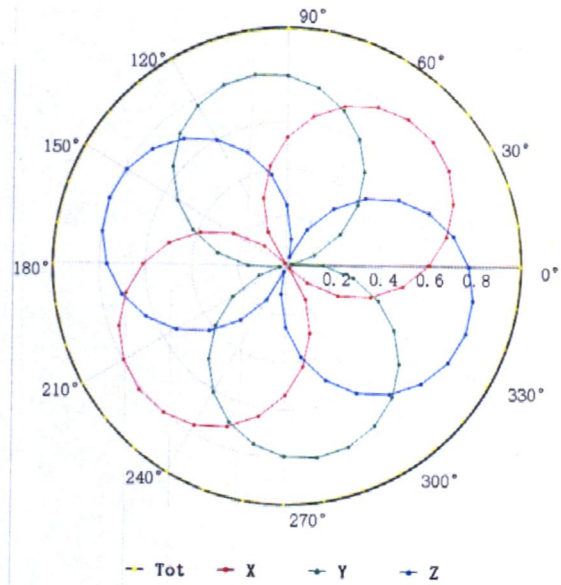
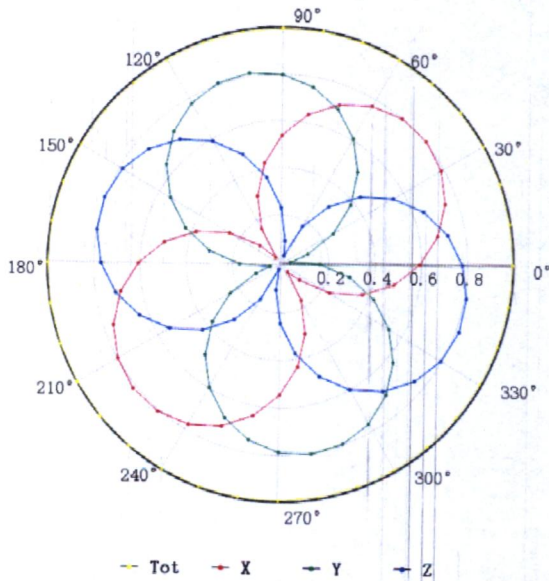


Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM

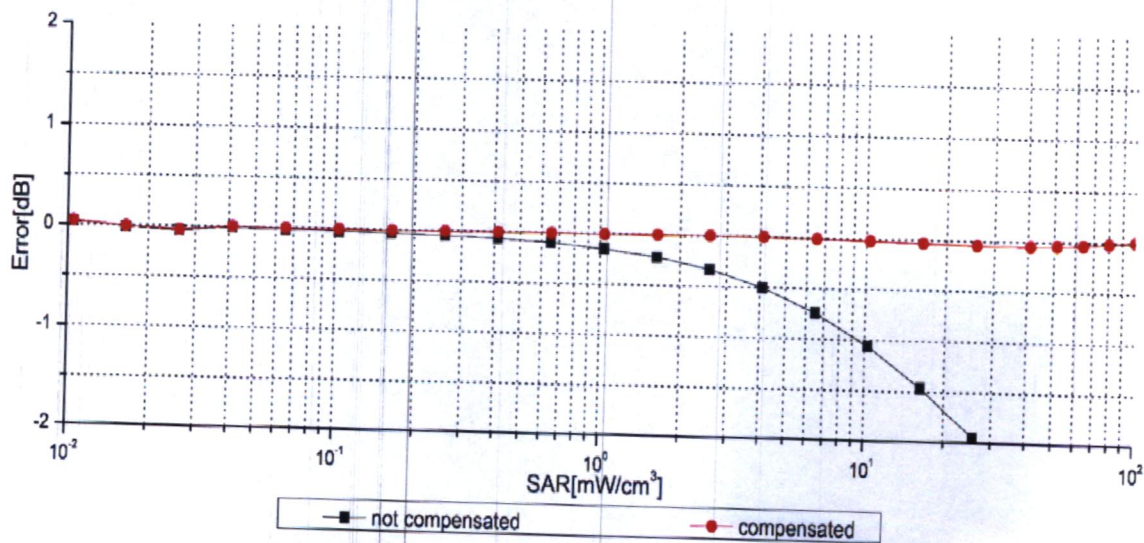
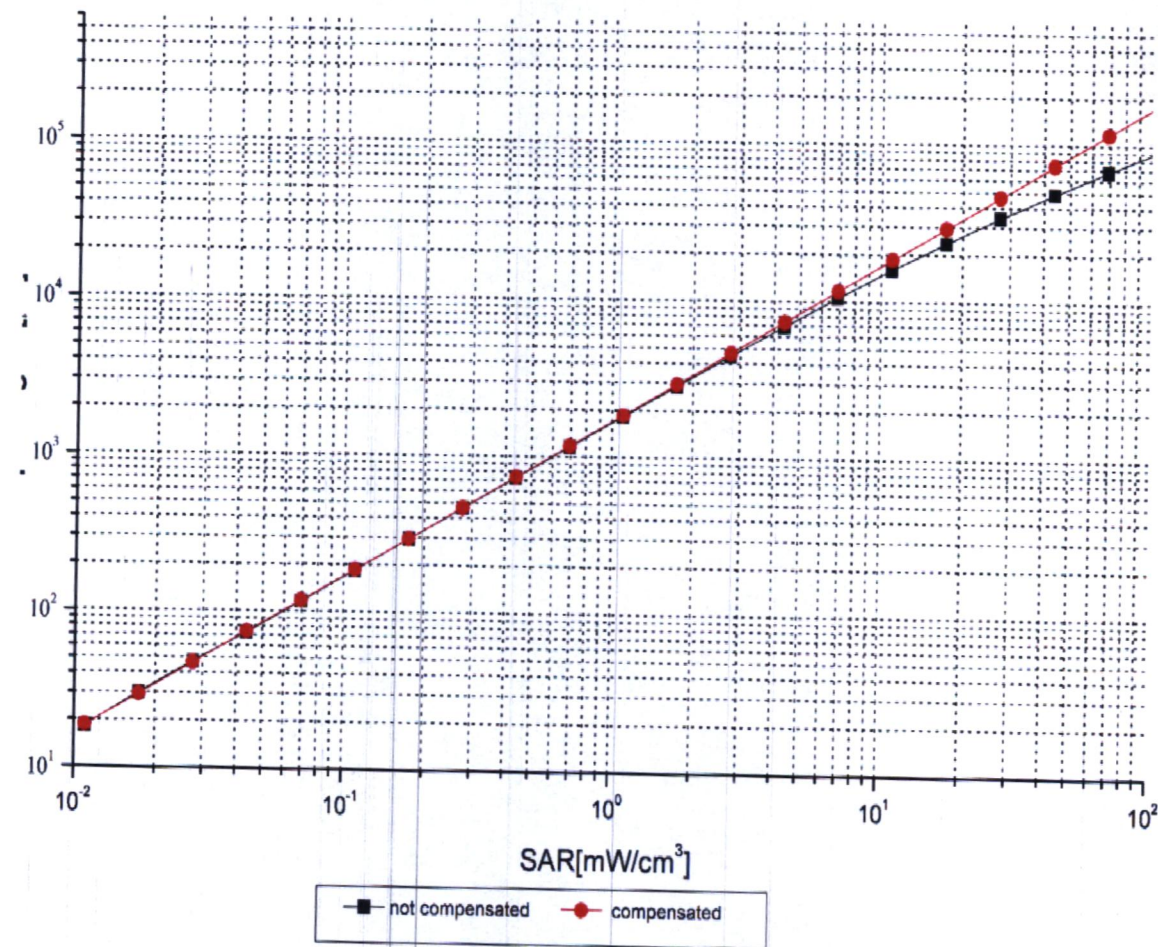
f=1800 MHz, R22



Uncertainty of Axial Isotropy Assessment: $\pm 1.2\%$ ($k=2$)



Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)

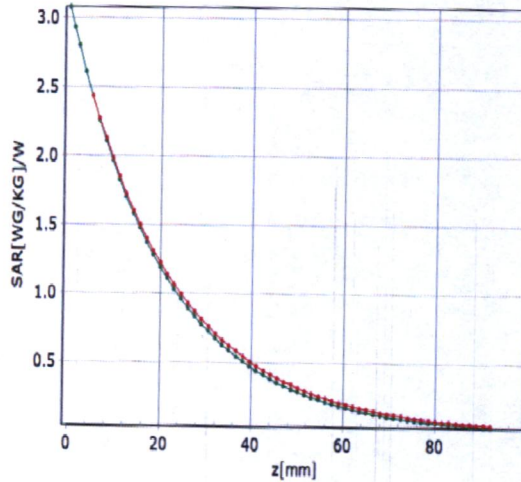


Uncertainty of Linearity Assessment: $\pm 0.9\%$ ($k=2$)

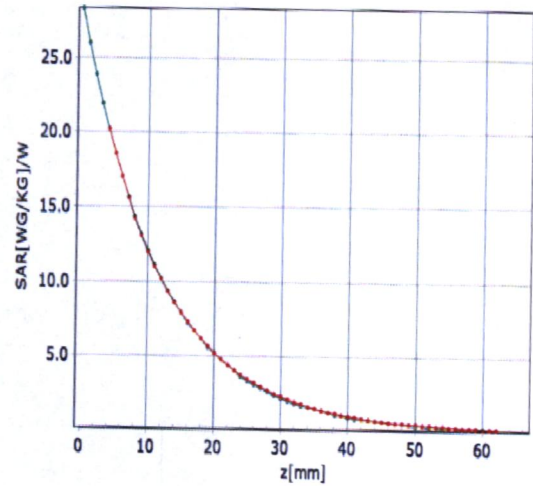
Conversion Factor Assessment

f=750 MHz,WGLS R9(H_convF)

f=1810 MHz,WGLS R22(H_convF)

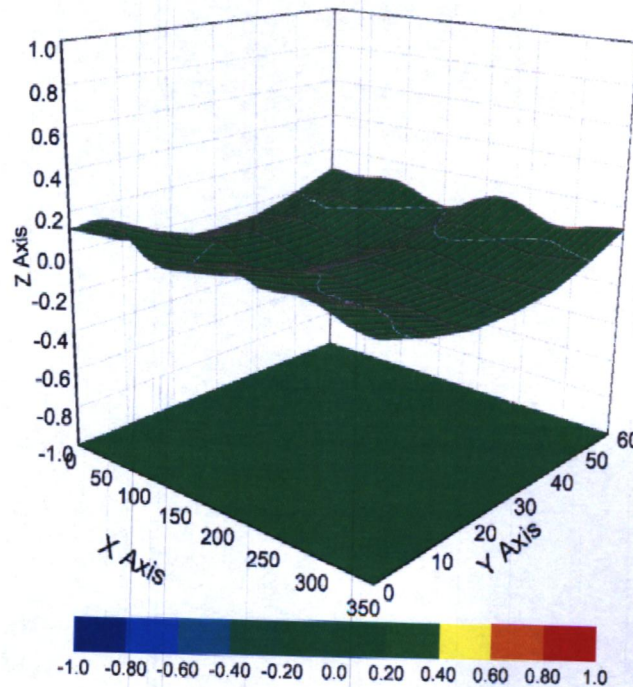


* analytical * measured



* analytical * measured

Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: $\pm 3.2\%$ ($k=2$)



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: ctl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

DASY/EASY – Parameters of Probe: ES3DV3 – SN:3127

Other Probe Parameters

| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 160.6 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disable |
| Probe Overall Length | 337mm |
| Probe Body Diameter | 10mm |
| Tip Length | 10mm |
| Tip Diameter | 4mm |
| Probe Tip to Sensor X Calibration Point | 2mm |
| Probe Tip to Sensor Y Calibration Point | 2mm |
| Probe Tip to Sensor Z Calibration Point | 2mm |
| Recommended Measurement Distance from Surface | 3mm |



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 **SRTC (Auden)**

Certificate No: **EX3-3708_Oct21**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3708**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v6, QA CAL-23.v5,
QA CAL-25.v7
Calibration procedure for dosimetric E-field probes**

Calibration date: **October 20, 2021**

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 | 09-Apr-21 (No. 217-03291/03292) | Apr-22 |
| Power sensor NRP-Z91 | SN: 103244 | 09-Apr-21 (No. 217-03291) | Apr-22 |
| Power sensor NRP-Z91 | SN: 103245 | 09-Apr-21 (No. 217-03292) | Apr-22 |
| Reference 20 dB Attenuator | SN: CC2552 (20x) | 09-Apr-21 (No. 217-03343) | Apr-22 |
| DAE4 | SN: 660 | 23-Dec-20 (No. DAE4-660_Dec20) | Dec-21 |
| Reference Probe ES3DV2 | SN: 3013 | 30-Dec-20 (No. ES3-3013_Dec20) | Dec-21 |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-20) | In house check: Jun-22 |
| Network Analyzer E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-20) | In house check: Oct-22 |

| | Name | Function | Signature |
|----------------|----------------|-----------------------|-----------|
| Calibrated by: | Jeton Kastrati | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: October 21, 2021

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



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 |
| NORM _{x,y,z} | sensitivity in free space |
| ConvF | sensitivity in TSL / NORM _{x,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:

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,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*.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 NORM_{x,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 NORM_x (no uncertainty required).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3708

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|-----------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 0.20 | 0.34 | 0.41 | ± 10.1 % |
| DCP (mV) ^B | 98.3 | 103.4 | 103.5 | |

Calibration Results for Modulation Response

| UID | Communication System Name | | A dB | B dB $\sqrt{\mu\text{V}}$ | C | D dB | VR mV | Max dev. | Max Unc ^E (k=2) |
|-----------|-----------------------------|---|---------|------------------------------|-------|---------|----------|-------------|----------------------------------|
| 0 | CW | X | 0.00 | 0.00 | 1.00 | 0.00 | 138.8 | ± 3.0 % | ± 4.7 % |
| | | Y | 0.00 | 0.00 | 1.00 | | 147.9 | | |
| | | Z | 0.00 | 0.00 | 1.00 | | 147.9 | | |
| 10352-AAA | Pulse Waveform (200Hz, 10%) | X | 20.00 | 89.98 | 19.97 | 10.00 | 60.0 | ± 3.6 % | ± 9.6 % |
| | | Y | 12.30 | 83.80 | 18.35 | | 60.0 | | |
| | | Z | 20.00 | 94.18 | 22.26 | | 60.0 | | |
| 10353-AAA | Pulse Waveform (200Hz, 20%) | X | 20.00 | 93.20 | 20.17 | 6.99 | 80.0 | ± 2.0 % | ± 9.6 % |
| | | Y | 20.00 | 90.44 | 19.15 | | 80.0 | | |
| | | Z | 20.00 | 98.78 | 23.49 | | 80.0 | | |
| 10354-AAA | Pulse Waveform (200Hz, 40%) | X | 20.00 | 101.57 | 22.64 | 3.98 | 95.0 | ± 1.4 % | ± 9.6 % |
| | | Y | 20.00 | 93.16 | 18.98 | | 95.0 | | |
| | | Z | 20.00 | 110.14 | 27.60 | | 95.0 | | |
| 10355-AAA | Pulse Waveform (200Hz, 60%) | X | 20.00 | 117.79 | 28.68 | 2.22 | 120.0 | ± 1.4 % | ± 9.6 % |
| | | Y | 20.00 | 98.56 | 20.32 | | 120.0 | | |
| | | Z | 20.00 | 125.10 | 33.05 | | 120.0 | | |
| 10387-AAA | QPSK Waveform, 1 MHz | X | 1.80 | 67.28 | 15.90 | 1.00 | 150.0 | ± 1.9 % | ± 9.6 % |
| | | Y | 1.62 | 66.34 | 14.88 | | 150.0 | | |
| | | Z | 1.74 | 67.50 | 15.68 | | 150.0 | | |
| 10388-AAA | QPSK Waveform, 10 MHz | X | 2.38 | 68.96 | 16.52 | 0.00 | 150.0 | ± 1.2 % | ± 9.6 % |
| | | Y | 2.13 | 67.52 | 15.52 | | 150.0 | | |
| | | Z | 2.29 | 68.79 | 16.25 | | 150.0 | | |
| 10396-AAA | 64-QAM Waveform, 100 kHz | X | 2.10 | 66.04 | 17.23 | 3.01 | 150.0 | ± 1.4 % | ± 9.6 % |
| | | Y | 2.84 | 70.84 | 18.88 | | 150.0 | | |
| | | Z | 3.03 | 72.02 | 19.54 | | 150.0 | | |
| 10399-AAA | 64-QAM Waveform, 40 MHz | X | 3.63 | 67.58 | 16.21 | 0.00 | 150.0 | ± 0.8 % | ± 9.6 % |
| | | Y | 3.47 | 67.10 | 15.72 | | 150.0 | | |
| | | Z | 3.56 | 67.61 | 16.04 | | 150.0 | | |
| 10414-AAA | WLAN CCDF, 64-QAM, 40MHz | X | 4.96 | 65.91 | 15.82 | 0.00 | 150.0 | ± 1.5 % | ± 9.6 % |
| | | Y | 4.63 | 65.16 | 15.23 | | 150.0 | | |
| | | Z | 4.70 | 65.43 | 15.40 | | 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 E²-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:3708

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 | 44.4 | 333.99 | 36.07 | 6.22 | 0.25 | 5.01 | 0.00 | 0.20 | 1.00 |
| Y | 38.1 | 276.99 | 33.95 | 8.88 | 0.54 | 4.99 | 1.73 | 0.06 | 1.01 |
| Z | 39.7 | 286.98 | 33.59 | 11.47 | 0.00 | 5.09 | 1.68 | 0.08 | 1.01 |

Other Probe Parameters

| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 177.7 |
| 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 |

Note: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.