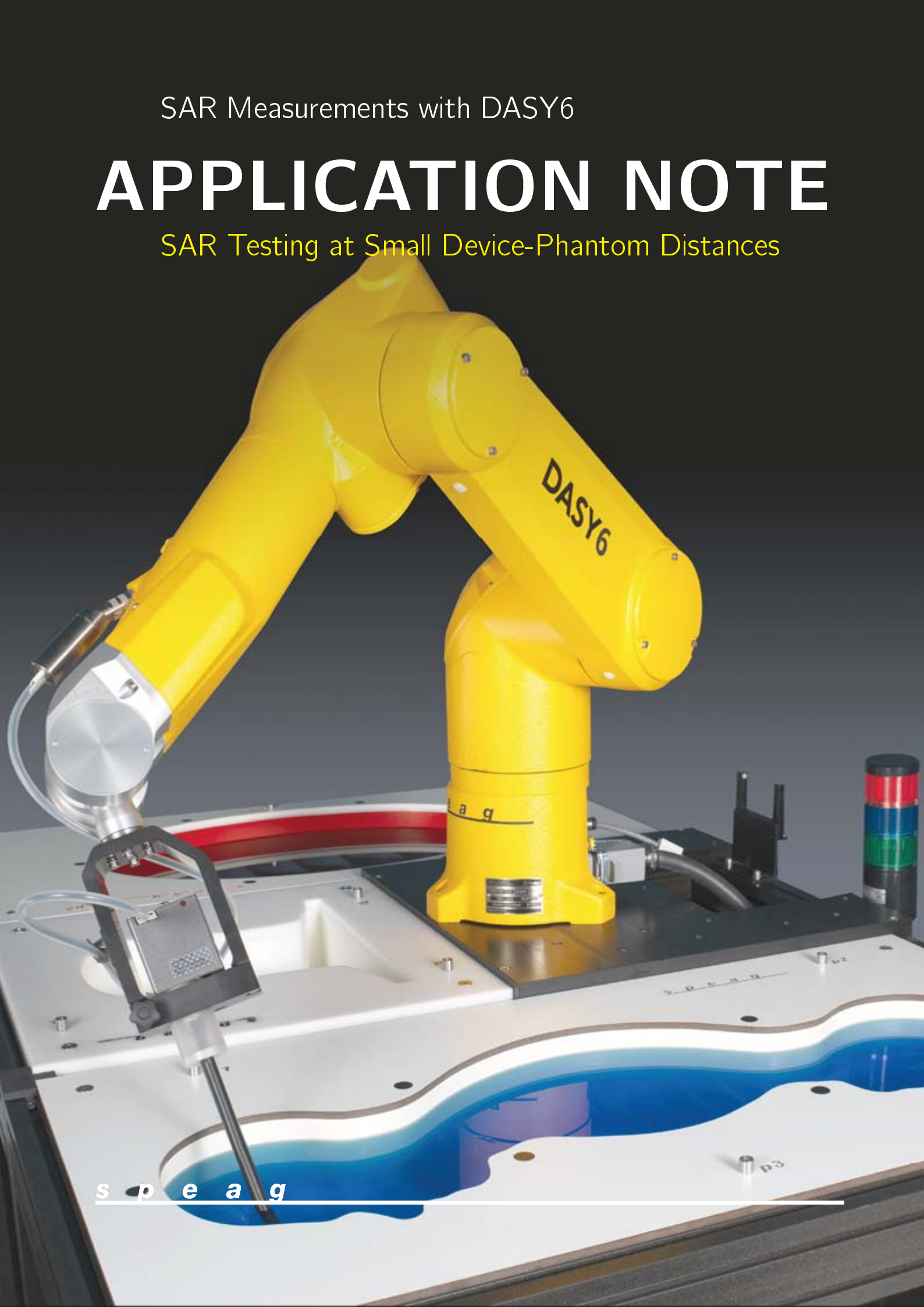
SAR Measurements with DASY6

APPLICATION NOTE

SAR Testing at Small Device-Phantom Distances



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SAR Testing at Small Device-to-Phantom Distances (d $\leq$5 mm)

1 Introduction

Since the publication of the IEC 62209-2 standard in 2010 [1], thinner devices with electrically s hort antennas and/or feeding networks close to the surface have been developed. Various regulators introduced requirements that these devices are also tested at a distances as close or closer than 5 mm to the outer surface of the phantom shell. For limb exposures they need to be tested in touch. In these cases, the radio-frequency (RF) coupling mechanism may change from predominately inductive to capacitive coupling for certain antenna configurations and, as a result, evanescence-like induced fields or specific absorption rate (SAR) distributions with very localized absorption are generated that require measurements with higher resolutions and close to the surface.
Already in 2008, SPEAG had introduced the EX3DVx probe and recommended stricter grid settings than the minimal grid requirements of the IEC 62209-2:2010, i.e., measurements closer to the surface and on a finer grid. The IEC 62209-2 group has also acknowledged the deficiency of the requirements of IEC 62209-2:2010 and in response published the IEC 62209-2 AMD1:2019 amendment [2]. Prior to its publication, SPEAG ensured to provide software support and guidance to meet the new requirements. However, the customer feedback from the labs revealed that the new amendment substantially increased test time due to the large number of required measurement repetitions.
To provide a solution for more time-efficient SAR evaluations, SPEAG developed the *Smart Zoom Scan* for cDASY6 Module SAR V6.14 that increases the speed by 30% while keeping the industry-leading assessment precision.
This application note describes how measurements according to the IEC 62209-2 AMD1:2019 procedure can be performed in DASY6:

- in cDASY6 V6.14 or higher, the grid resolution is adjusted on the fly to meet the IEC 62209-2 AMD1:2019 criteria (*Smart Zoom Scan*)
- in DASY V5.2.10.4, the software issues a warning if the grid resolution criteria of the IEC 62209-2 AMD1:2019 criteria are not met. In case the warning is issued, the Zoom Scan must be repeated to be compliant with the standard.

2 IEC 62209-2 AMD1:2019 Measurement Procedure

The IEC 62209-2 AMD1:2019 requires that Zoom Scans meet the following criteria:

- the smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak is larger than the horizontal grid step (min_3dB_dist). This must be checked for the measured Zoom Scan plane conformal to the phantom at the distance z_{M1}.
- the ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x-y location of the measured maximum SAR value is at least 30% ($M2/M1$).

If either one or both of these criteria are not met, and the peak spatial-average SAR is greater or equal to 0.1 W/kg, the Zoom Scan measurement shall be repeated using a finer resolution.

Please note that the DASY6 uncertainty budget as stated in DASY6 manual is valid only if both above mentioned criteria are met. Else, reliable SAR results cannot be achieved.

3 Implementation in cDASY6 Module SAR V6.14+

cDASY6 Module SAR V6.14 or higher features the *Smart Zoom Scan* as well as the former *Manual Zoom Scan*. It is highly recommended to use the *Smart Zoom Scan* as it minimizes the number of measured points, ensures that all standard requirements are met and guarantees that the uncertainty budget provided by SPEAG is always valid.

3.1 Smart Zoom Scan

Before each Zoom Scan, a 2D Scan on a fine grid resolution of 30 mm x 30 mm with grid step of 5 mm is performed at the maximum location of the preceding Area Scan and the min_3dB_dist is then calculated. Based on these measurements, the zoom grid parameters are determined:

- the grid step in XY-planes (planes parallel to phantom surface) for the following Zoom Scan is determined to ensure minimal number of points while meeting the requirements for DASY's uncertainty budget and the 3 dB requirements of IEC 62209-2 AMD1:2019.
- the grid step normal to the surface, is also determined to ensure minimal number of z-planes while meeting the requirements for DASY's uncertainty budget and the requirements of IEC 62209-2 AMD1:2019.

3.2 Manual Zoom Scan

The user can set the grids manually and is warned if the requirements of the standards and/or those of DASY's uncertainty budget are not met which means that the Zoom Scan needs to be repeated with refined parameters. The warning shown on Figure 1.1 is displayed in the measurement report.

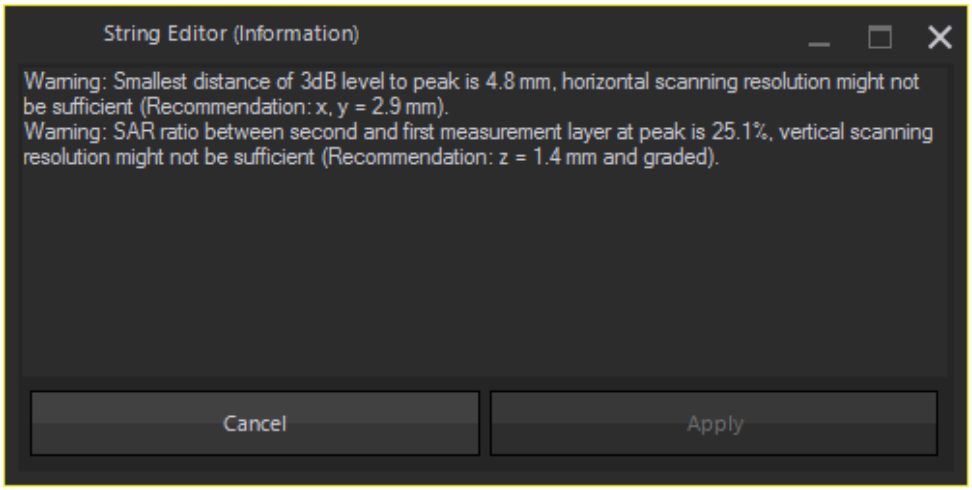

Figure 1.1: cDASY6 Warning on insufficient grid resolution

4 Implementation in DASY52.10.4+

In the event that the two criteria listed in 2 are not met, DASY V52.10.4 or higher will issue the warning shown in Figure 1.2 and suggest optimized grid steps. Additionally, the 3 dB distance and $M2/M1$ ratio are displayed in the measurement report.

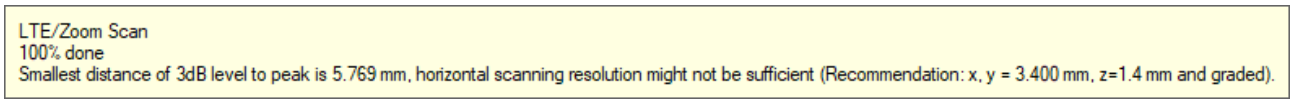

Figure 1.2: DASY52 Warning on insufficient grid resolution

5 PIFA study

The impact of grid step size on SAR measurements was studied using V-PIFA antennas. The antennas were simulated using Sim4Life. The results were quantized on different grid steps and the DASY6 Zoom Scan post processing was applied. For each V-PIFA antenna, two Zoom Scans were performed:

- a *Smart Zoom Scan*
- a reference Zoom Scan on a fine resolution grid (step x,y = 2 mm, step z = 1.2 mm, grading ratio = 1.2 mm)

The psSAR1g/10g obtained with DASY6 were compared with the Sim4Life simulation results.Deviations are summarized in Table 1.1.

Antenna	Grid Resolution	1g [W/kg]	10g [W/kg]	Dev 1g [dB]	Dev 10g [dB]
V-PIFA750	dx,y=4.7 mm, z=1.4 mm, ratio=1.4 mm (Smart)	3.55	1.02	-0.10	-0.03
V-PIFA750	dx,y=2.0 mm, z=1.2 mm, ratio=1.2 mm (Ref.)	3.61	1.02	-0.04	-0.02
V-PIFA835	dx,y=4.7 mm, z=1.4 mm, ratio=1.4 mm (Smart)	3.29	0.97	-0.06	0.02
V-PIFA835	dx,y=2.0 mm, z=1.2 mm, ratio=1.2 mm (Ref.)	3.34	0.98	0.01	0.04
V-PIFA1950	dx,y=5.4 mm, z=1.5 mm, ratio=1.5 mm (Smart)	2.17	0.91	-0.07	-0.05
V-PIFA1950	dx,y=2.0 mm, z=1.2 mm, ratio=1.2 mm (Ref.)	3.34	0.98	0.00	-0.02
V-PIFA3700	dx,y=4.0 mm, z=1.4 mm, ratio=1.4 mm (Smart)	2.47	1.03	-0.04	0.00
V-PIFA3700	dx,y=2.0 mm, z=1.2 mm, ratio=1.2 mm (Ref.)	2.49	1.03	-0.01	0.00

Table 1.1: psSAR1g/10g deviations from simulated targets for V-PIFA antennas

Bibliography

[1] IEC 62209-2:2010: Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 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)

[2] IEC 62209-2:2010/AMD1:2019: Amendment 1 - Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 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)