GENERAL DESCRIPTION OF THE SPATIAL PEAK SAR EVALUATION

The DASY4 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the micro-volt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	-Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	-Conversion factor	$ConvF_i$
	-Diode compression point	dcp_i
Device parameters:	-Frequency	F
	-Crest factor	cf
Media parameters:	-Conductivity	
	-Density	

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \bullet \frac{cf}{dcp_i}$$

V $_i$ =compensated signal of channel i (i = x, y, z)
V U_i =input signal of channel I (i = x, y, z)
cf =crest factor of exciting field (DASY parameter)
dcp=diode compression point (DASY parameter)
  $_i$

From the compensated input signals the primary field data
for each channel can be evaluated:

E-fieldprobes :
$$E_i = \sqrt{\frac{V_1}{Norm_i \cdot ConvF}}$$

H-fieldprobes :
$$H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

V_i =compensated signal of channel I   (i = x, y, z)

$Norm_i$ =sensor sensitivity of channel i μV/(V/m)2 for E-field Probes   (i = x, y, z)

ConvF = sensitivity enhancement in solution

a_{ij} = sensor sensitivity factors for H-field probes

F   = carrier frequency [GHz]

E_i = electric field strength of channel i in V/m

H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength
(Hermitian magnitude):

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{o}{p \cdot 1'000}$$

SAR = local specific absorption rate in mW/g

E_{tot} = total field strength in V/m

o   = conductivity in [mho/m] or [Siemens/m]

p   = equivalent tissue density in g/cm3

Note that the density of the tissue simulating liquid. The entire evaluation of the
spatial peak values is performed within the Post-processing engine (SEMCAD).

The system always gives the maximum values for the 1 g and 10 g cubes. The
algorithm to find the cube with highest averaged SAR is divided into the following
stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within –2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

SAR EVALUATION PROCEDURES

Use the software to control the EUT channel and transmission power. Then record the conducted power before the testing. Place the EUT to the specific test location. After the testing, must writing down the conducted power of the EUT into the report. The SAR value was calculated via the 3D spline interpolation algorithm that has been implemented in the software of DASY4 SAR measurement system manufactured and calibrated by SPEAG. According to the IEEE P1528 standards, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

. • Power reference measurement
. • Area scan
. • Zoom scan
. • Power reference measurement

The area scan with 15mm x 15mm grid was performed for the highest spatial SAR location. The zoon scan with 30mm x 30mm x 30mm volume was performed for SAR value averaged over 1g and 10g spatial volumes.

Note:
Area scan measurement : Used the proper amount and size of the grids in scan area to make sure the location of maximum SAR value has been found. And this must depend on the exterior structure of the EUT.

In the zoon scan, the distance between the measurement point at the probe sensor
location (geometric center behind the probe tip) and the phantom surface is 4.0 mm and maintained at a constant distance of ±1.0 mm during a zoon scan to determine peak SAR locations. The distance is 4mm between the first measurement point and the bottom surface of the phantom. The secondary measurement point to the bottom surface of the phantom is with 9mm separation distance. The cube size is 7 x 7 x 7points consist of 343 points and the grid space is 5mm.

The measurement time is 0.5 s at each point of the zoon scan. The probe boundary effect compensation shall be applied during the SAR test. Because of the tip of the probe to the Phantom surface separated distances are longer than half a tip probe diameter.
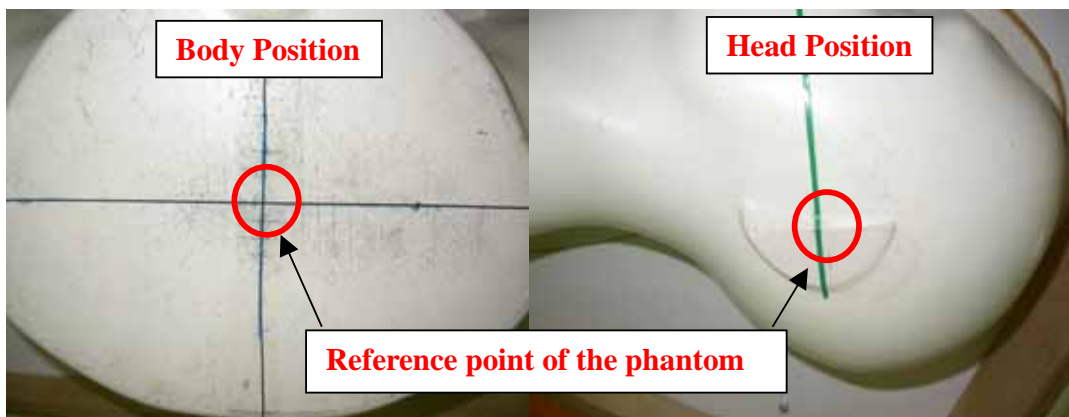
In the area scan, the separation distance is 4mm between the each measurement point and the phantom surface. The scan size shall be included the transmission portion of the EUT. The measurement time is the same as the zoon scan. At last the
reference power drift shall be less than ±5%.

RE-POSITIONING PROCEDURES

1. Mark the reference points on the EUT and Phantom as shown below in picture1 and 2.

EUT reference Y axis

EUT reference X axis

Reference Point

Picture 1
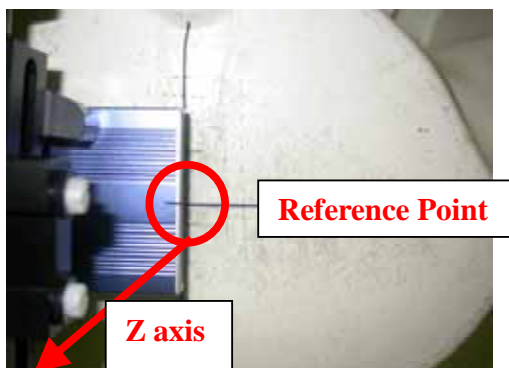

Body Position

Head Position
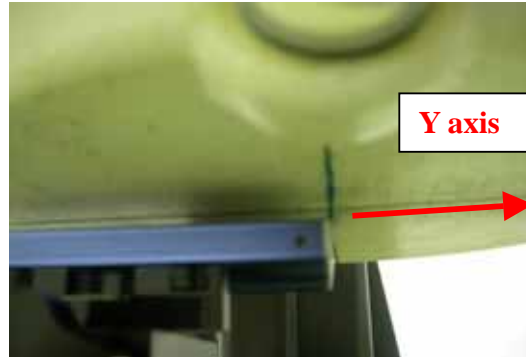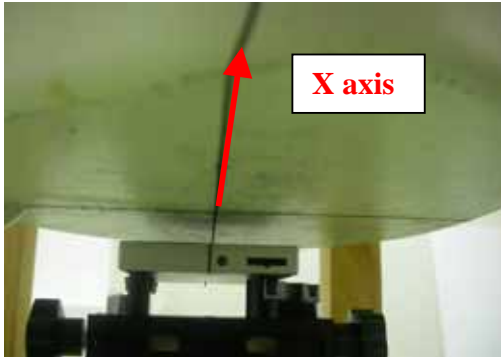
Reference point of the phantom
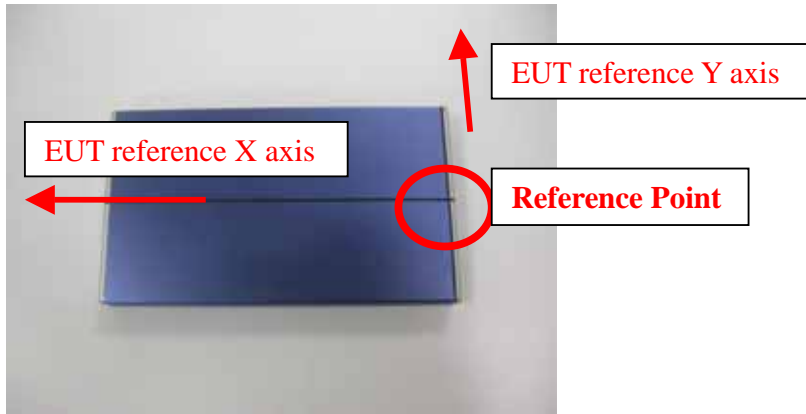
Picture 2

2. Reference points of EUT and Phantom are perpendicular in the Z-axis as shown in the picture 3. The distance between these two points depends on the product accessories worn by the user.
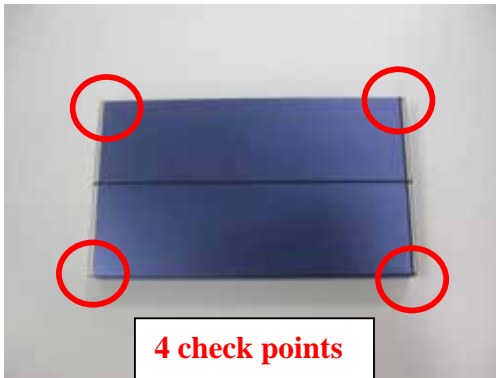

Reference Point

Z axis

Picture 3

3. Make sure the X- and Y- axis of the EUT are parallel with the X- and Y- axis of the Phantom.

4. Use an accurate ruler to reconfirm that all 4 corners of the EUT have the same relative distance with the Phantom.

The above steps are used to accurate identify the identical position to place the EUT in order to evaluate each transmitter SAR.