

SMART-WATCH TESTING WITH DASY52

Concept

The proposed concept is based on a test-bed (made of low-loss, low-permittivity material but with rigid surface, e.g. POM or Teflon material) in which the equipment under test (EUT) is embedded. It is recommended to use a test-bed size of 20x20 cm or larger (example in this technical note is using test bed with 10x10 cm). With this approach surface detection can be automatically done on the test-bed and it will also increase reproducibility of positioning the EUT within the phantom.

The surface of the test-bed is defined with a reference point (named “*Test Bed Plane*”) using mechanical surface detection. The subsequent SAR measurements are done using an *Area Scan* without surface detection (solely based on the test-bed and EUT CAD data). During SAR evaluation (post-processing), the measured grid locations are adjusted based on the surface detection results (Z-coordinate of the “*Test Bed Plane*” point). This procedure ensures a precise and robot-controlled detection of the probe to EUT surface distance and good accessibility of the internal volume of the wristband.

Phantom Creation: Test-Bed with Integrated Watch

The EUT (watch) is embedded in a test-bed made of low-loss material that can support mechanical surface detection. The EUT (watch) must be tilted such that the probe can approach the measured area vertically (45° in example used within this document).

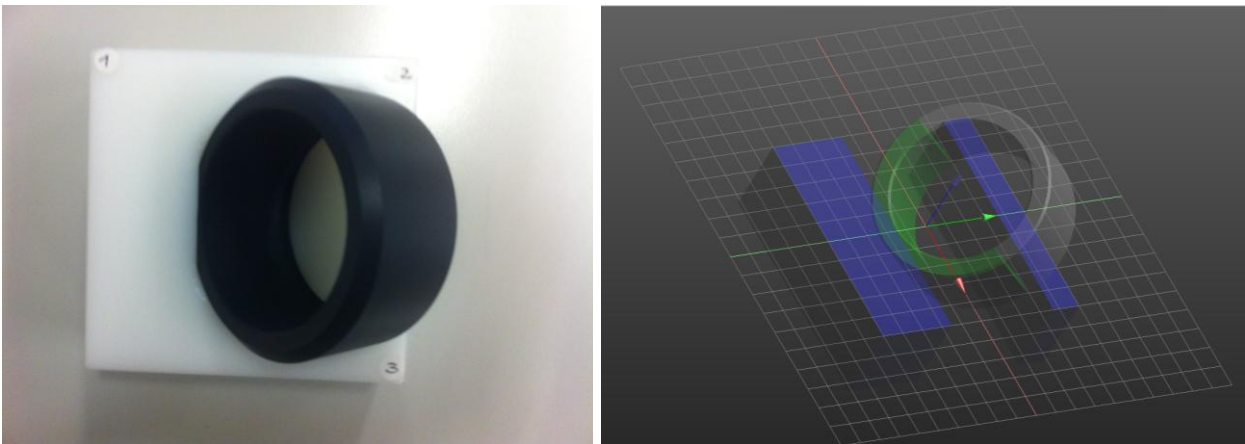


Figure 1: Test-Bed with integrated EUT (watch) and SEMCAD CAD model (used as example)

The watch phantom (watch + test-bed) will be modeled by the end-user using SEMCAD (DASY5X Modeling license is required). Please note that with this approach, phantom model does not include the ELI phantom. The movie “DASY_Custom_Phantom.mov” can be used as a tutorial.

The test-setup is built and SEMCAD model file created by the end-user. The latter shall be sent to SPEAG. SPEAG will then create a DASY phantom and predefined measurement file based on SEMCAD model. The phantom reference points for teaching will be 3 corners of the bed (points 1 to 3 in Figure 1). Precise teaching of these 3 points yields an excellent horizontal (x,y) alignment of the watch phantom. A surface detection on the test-bed is used to obtain a precise vertical (z) alignment of the phantom.

Measurements

The concept has been verified at SPEAG using DASY52 system based on a TX90XL robot arm.

The measurement sequence consisted of:

- Mechanical surface detection procedure in which the precise phantom z-position is detected and stored
- SAR measurements using an *Area Scan* job covering the inner surface of the EUT

STEP1: Accurate Phantom Position Measurement

The *watch_phantom* was placed in the middle of an ELI phantom. When in place, the phantom location was taught via 3 reference points as defined in the phantom model.

After successful teaching of the phantom location, the (z-) reference plane of the test-bed phantom was detected using mechanical surface detection on the flat surface of the test-bed. The point is stored under name “*Test Bed Plane*” and the phantom configuration file saved.

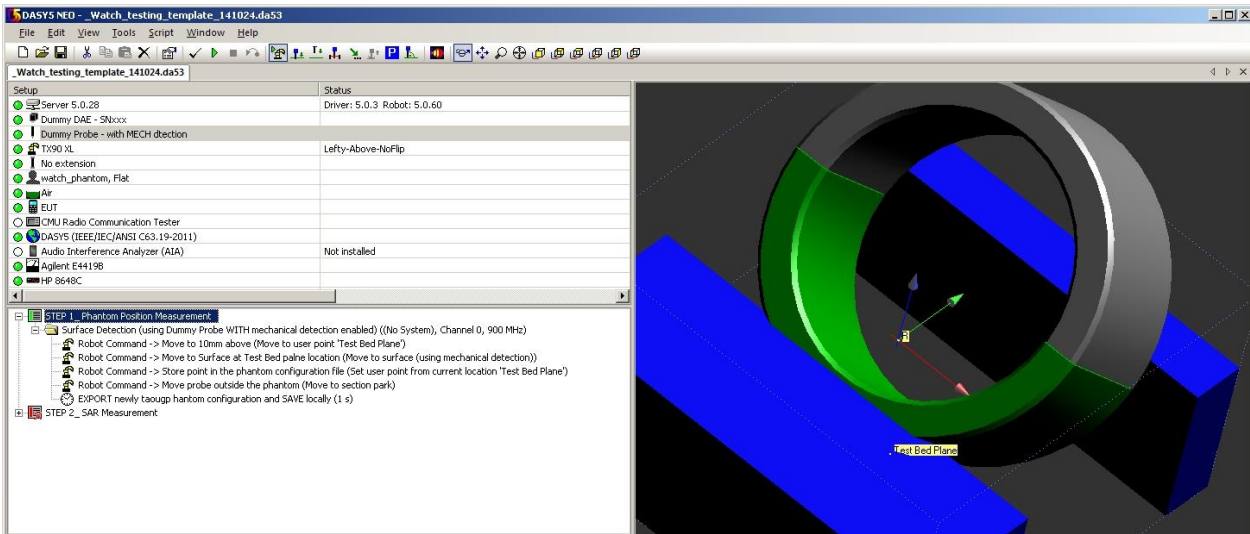


Figure 2: STEP1 (predefined DASY file): defining the phantom position within ELI phantom

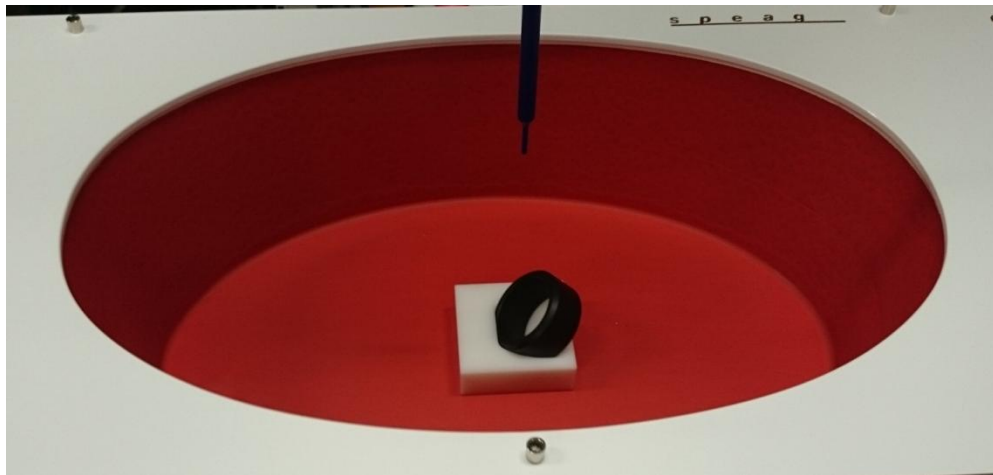


Figure 3: Watch-Phantom placed inside the ELI phantom.

SAR Measurements

Before executing SAR measurements, the correct phantom (from STEP 1) has to be imported.

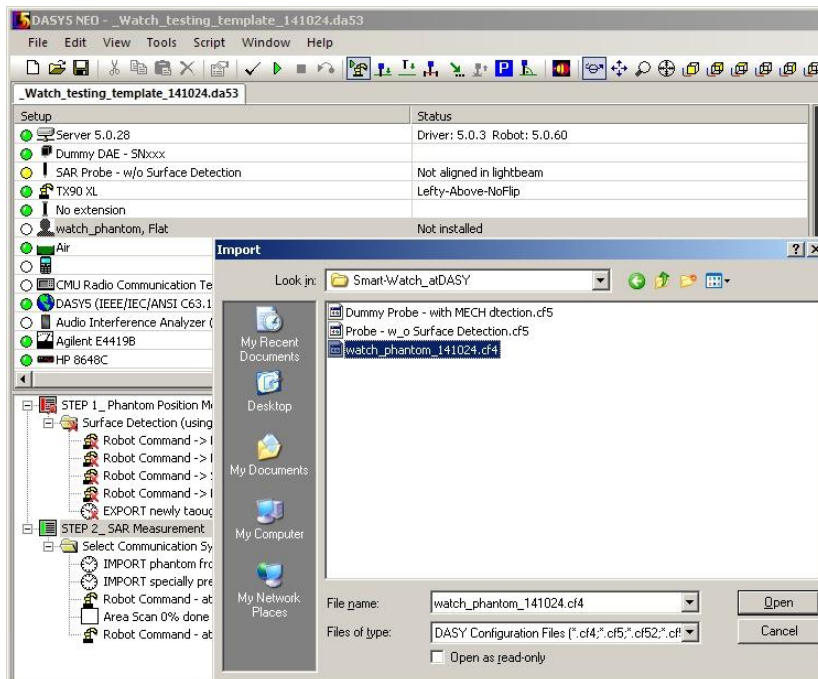


Figure 4: STEP2a (predefined DASY file): import of phantom from STEP 1

For the described concept the SAR probe needs a modification. This modification is only required for the actual SAR measurement, the original probe file shall be used for the surface detection in configuration STEP 1. The end-user shall inform SPEAG the probe serial number and SPEAG will prepare the modified probe configuration file to be used in configuration STEP 2. Once available, the modified probe file shall be imported into DASY and the light-beam alignment performed.

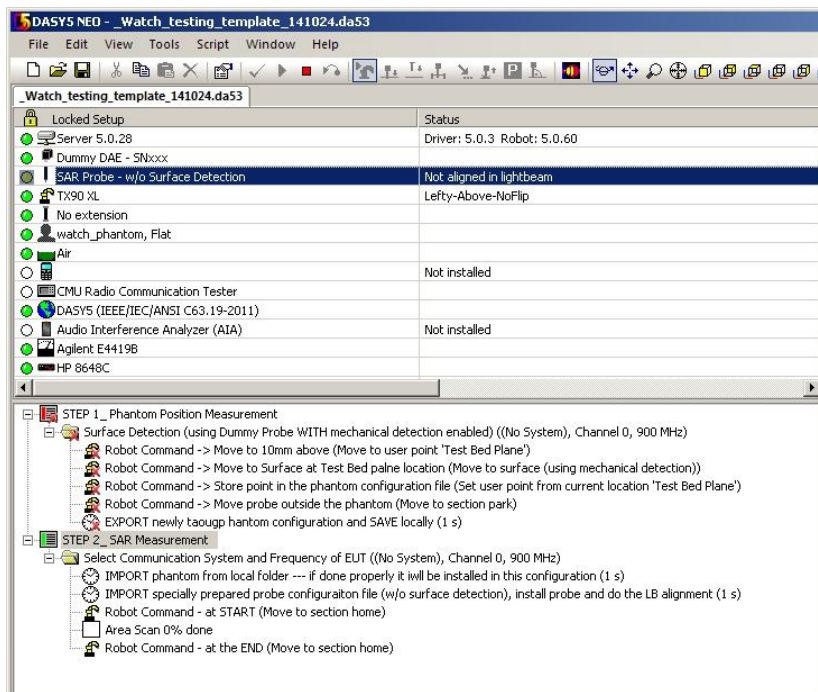


Figure 5: STEP2b (predefined DASY file). Installing the probe and light-beam alignment

SAR measurements are done using an Area Scan job (without surface detection). Examples of possible measurement points and their projections within DASY software are shown in Figure 6.

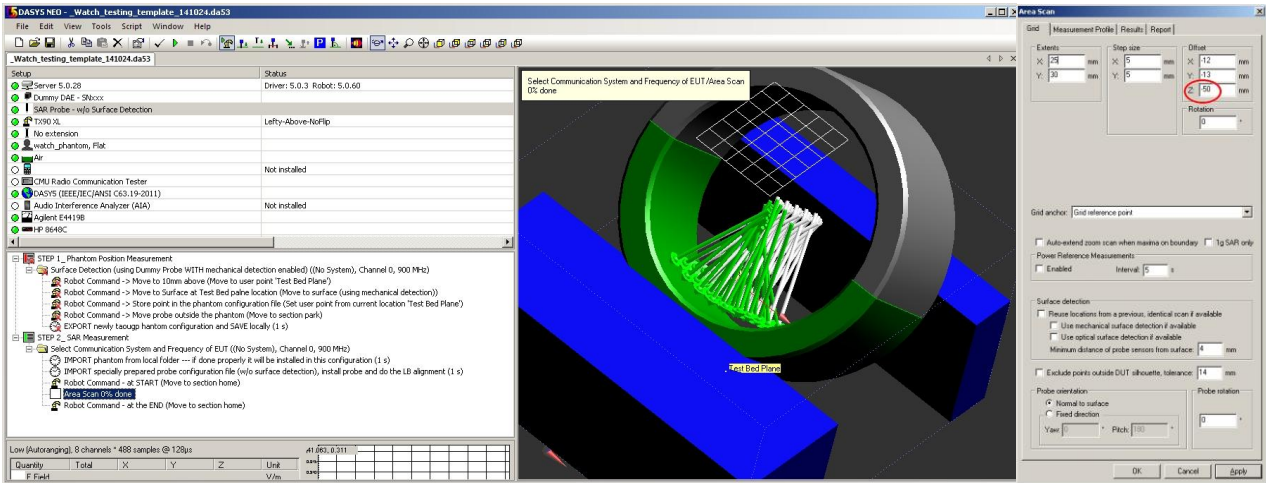


Figure 7: STEP2c (predefined DASY file): Area Scan Grid and Grid projections

Note: During measurements, robot arm may perform sudden (unexpected) movements from one measurement point to the other, so it is advisable that personnel is at a safe distance from the robot arm!

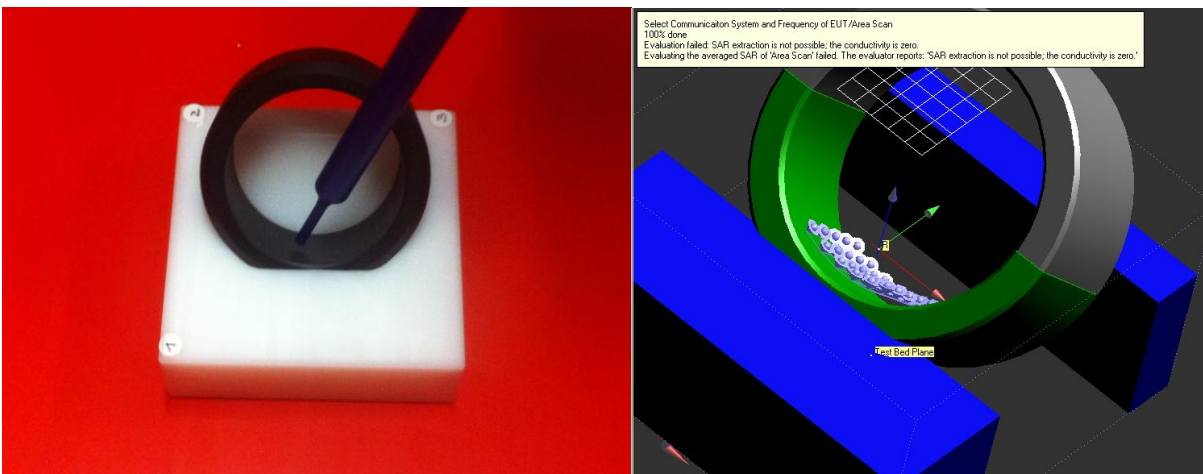


Figure 8: Probe Positioning during Area Scan and measured points.

Post-Processing at SPEAG

The measurement file shall be sent to SPEAG for evaluation of peak average 1g and 10g values. The evaluation will be based on a 2 step procedure:

1. Correction of the Area Scan Grid Point z-positions based on the mechanical surface detection performed in STEP 1.
2. Execution of the "Motorola Fast SAR Algorithm" on the Area Scan, extrapolation of the volume SAR and calculation of the 1g and 10g peak spatial average SAR results.