



Technical Note - TN24

Guide for the selection of the installation size

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1. Introduction

Because the RS105 test installations are quite complicated technically and could be huge depending on the size of the devices to test, the price could be high. Therefore it is important to find a compromise well adapted to the situation. This short guide gives some ways to find the size of the test installation. The examples given in the document concern a 18 m high test installation if not otherwise mentioned.

Three different requirements according to MIL-Std 461 / RS105 must be fulfilled for the maximum size of the EUT (equipment under test):

- Height limitation: the maximum height of the EUT must be lower than 1/3 of the height under the septum (= the line);
- Width limitation: the maximum width of the EUT must be smaller than one half of the line width;
- Field homogeneity: the peak field value must be between 0 dB and + 6 dB in the test volume (between 50 and 100 kV/m).

The EUT must be smaller than the volume described by these 3 requirements.

Comments:

- The last requirement is the most important because it is related to the amplitude of the field.
- The width limitation is mostly required by the parallel plate design mentioned in the figure RS105-2 / p. 147 of the standard. Our structure exhibits less distortion. In our opinion, this requirement is unnecessary if the homogeneity is fulfilled.
- The height of the EUT can impact more or less the distortion of the pulse. For thin and high objects, the influence on the radiation line and on the pulse could be moderate, but for massive objects it could be more important. Normally a computer simulation of the electromagnetic field and of the induced currents must be done in order to assess the situation. For simplification reasons, the standard has limited the height of the object under the line. But the test of EUTs higher than the RS105 requirements can be carried out if the distortion is low enough.
- It must be noticed that the requirement on the waveform of the pulse is not very clearly defined in the standard. According to the figure RS105-2 / p. 147 of the standard, the pulse must be controlled on 5 points of the front side of the EUT (when the EUT is not present). In our structure, the front side is the side placed in direction of the pulse generator.

Conclusions:

- Triangular structures have better homogeneity than parallel plates (see Technical Note TN02)
- If a strict fulfilment of the RS105 paragraph is needed, the three above mentioned requirements must be fulfilled. But it must be noticed that the test zone becomes quite small (see the chapter 2).
- In our opinion, the requirement concerning the width of the EUT is not significant. Therefore if this requirement is neglected, the test zone becomes much larger (see chapter 3).
- If computer simulations and / or verification measurements can be done before starting the tests on the EUT, the requirement concerning the height of the EUT could be neglected in some cases.

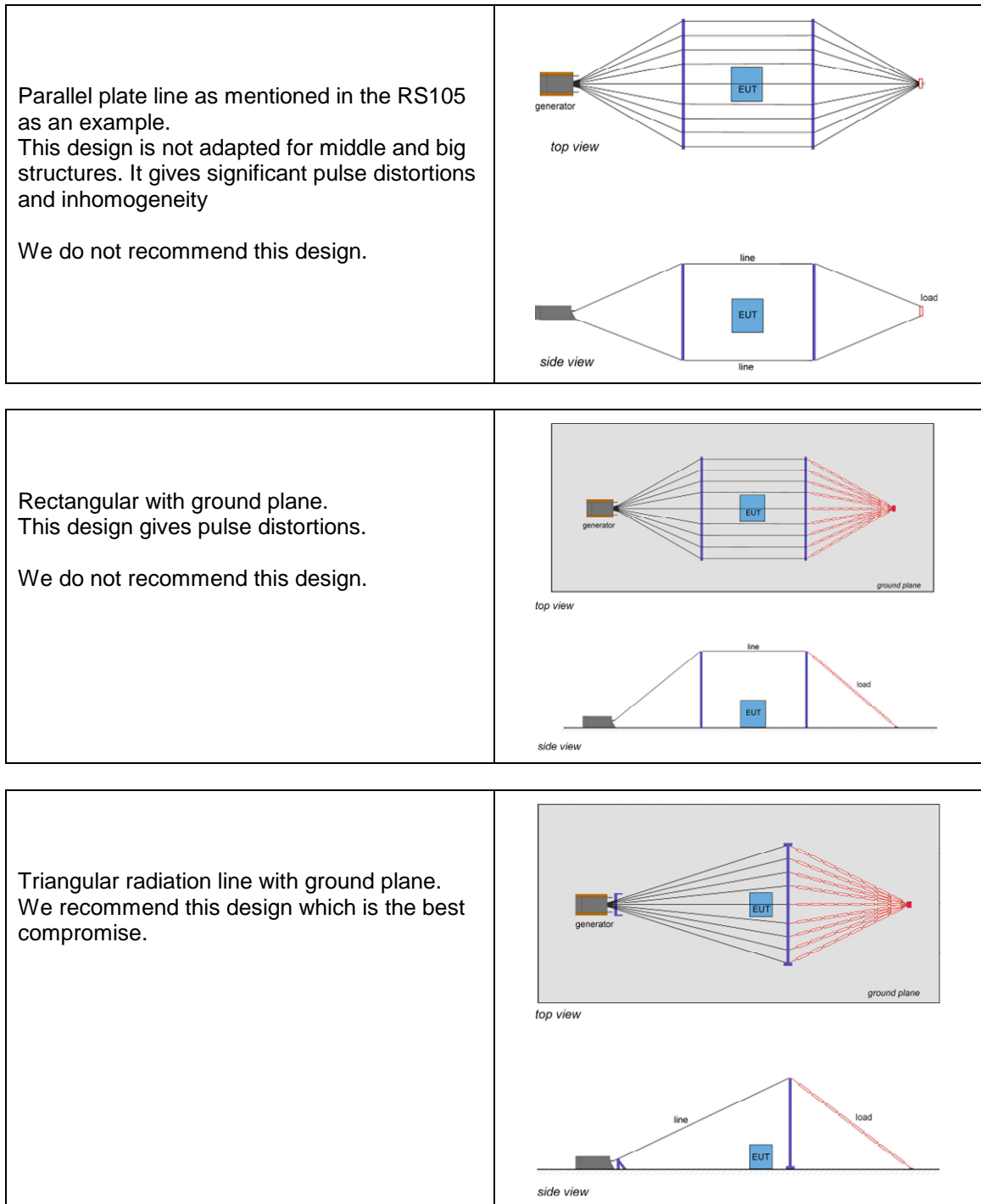
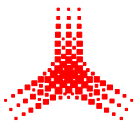
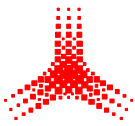


Figure 1 : Different type of radiation line.



2. Test zone according to RS 105

The field homogeneity requirement according to MIL-Std 461 / RS105 is taken into account in the computer simulation. The examples are given for an 18 m test installation.

The following representations show the calculated envelopes of the 0 dB and + 6 dB limits. The volume inside these 2 envelopes fulfils the 0 / + 6 dB field homogeneity of the MIL-Std 461 / RS105 requirement. Remark: by adapting the charging voltage of the generator, the test volume can be adjusted (limits can be moved a little along the line).

The map of the field is also given in the chapter 6 for information.

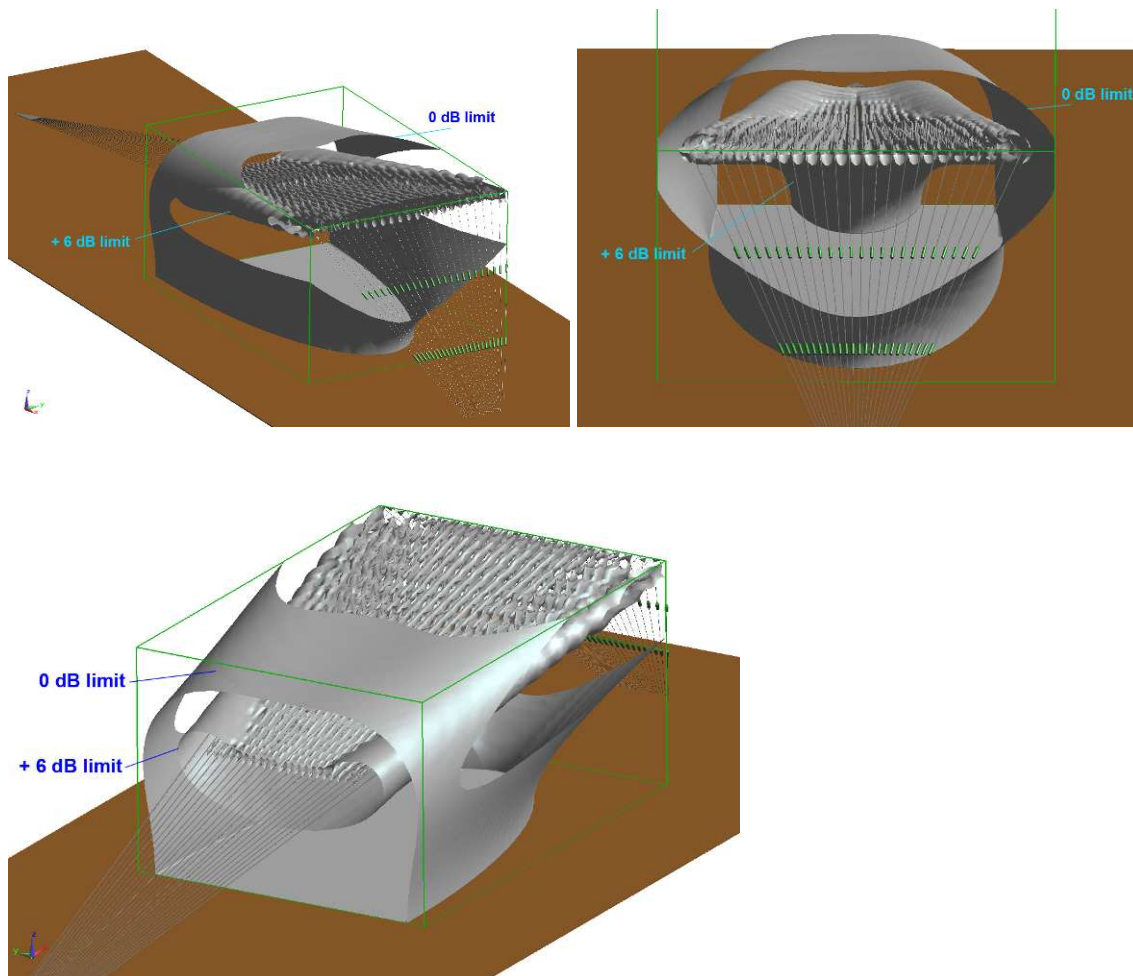


Figure 2 : The simulation is carried out for a volume, in green, of 36 x 25 x 18 m (L x W x H).

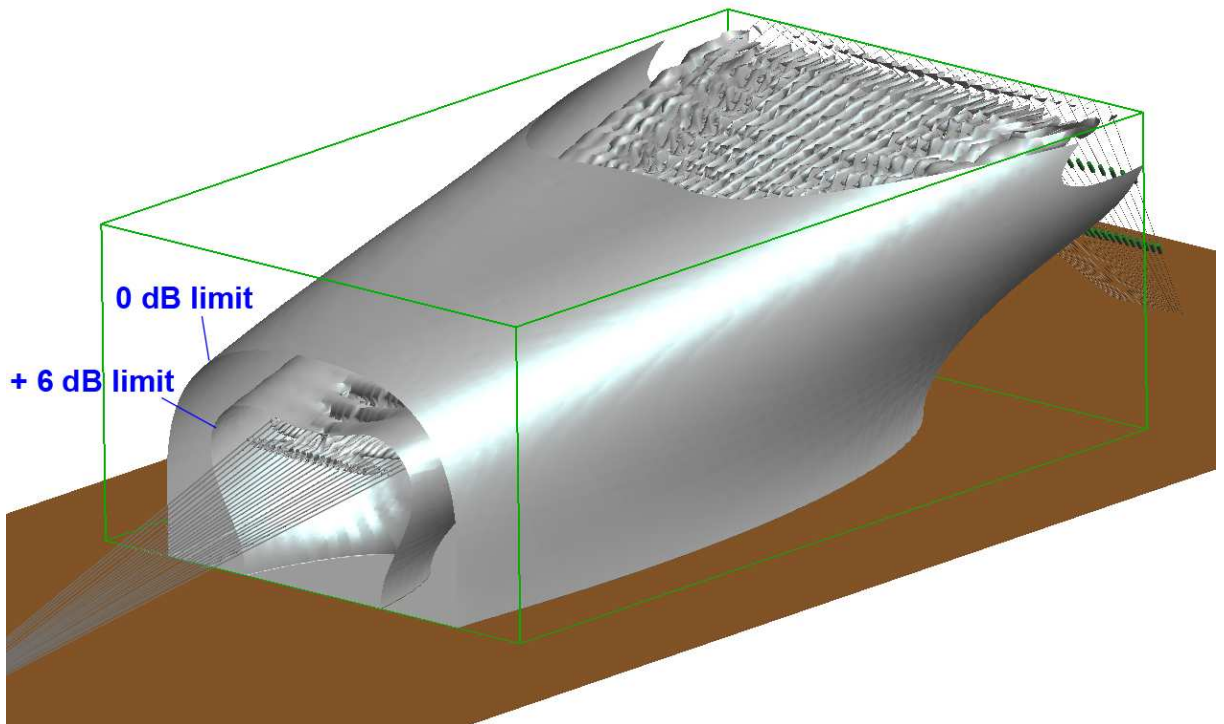
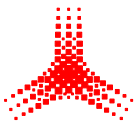


Figure 3 : The simulation is carried out for a larger volume of 51 x 30 x 18 m (L x W x H).

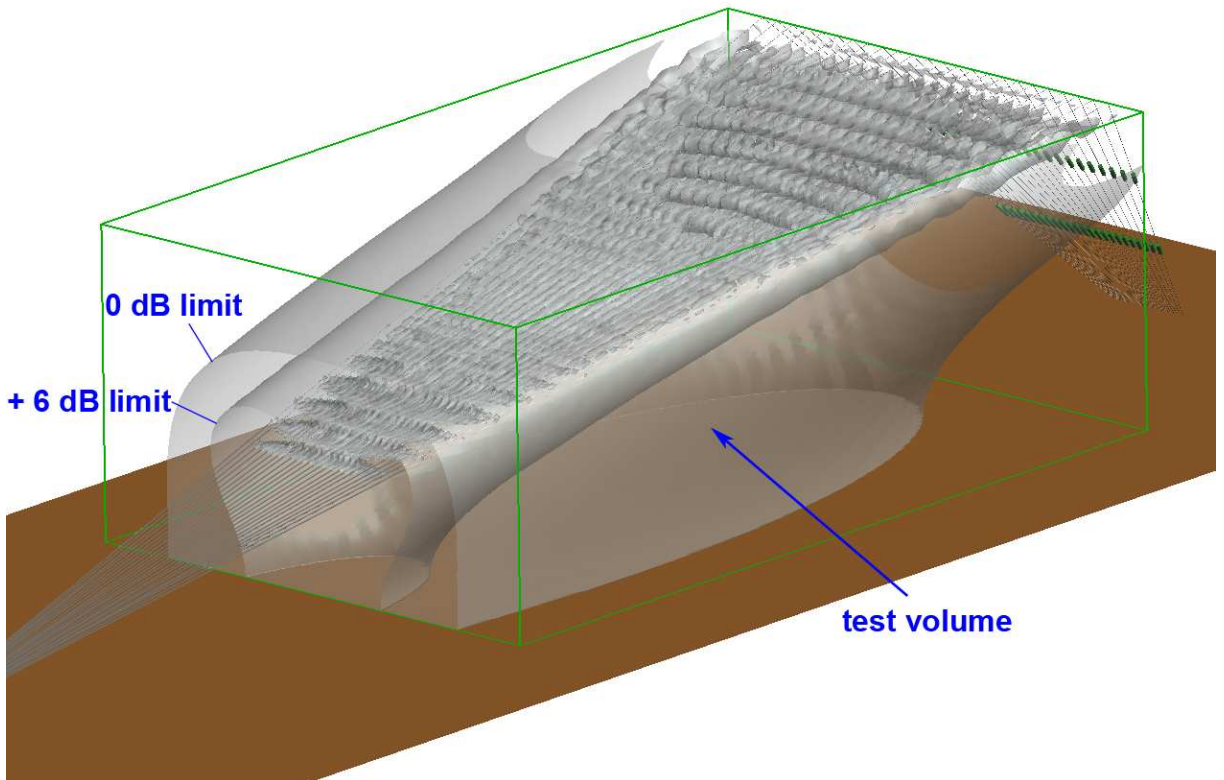
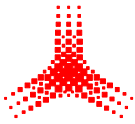
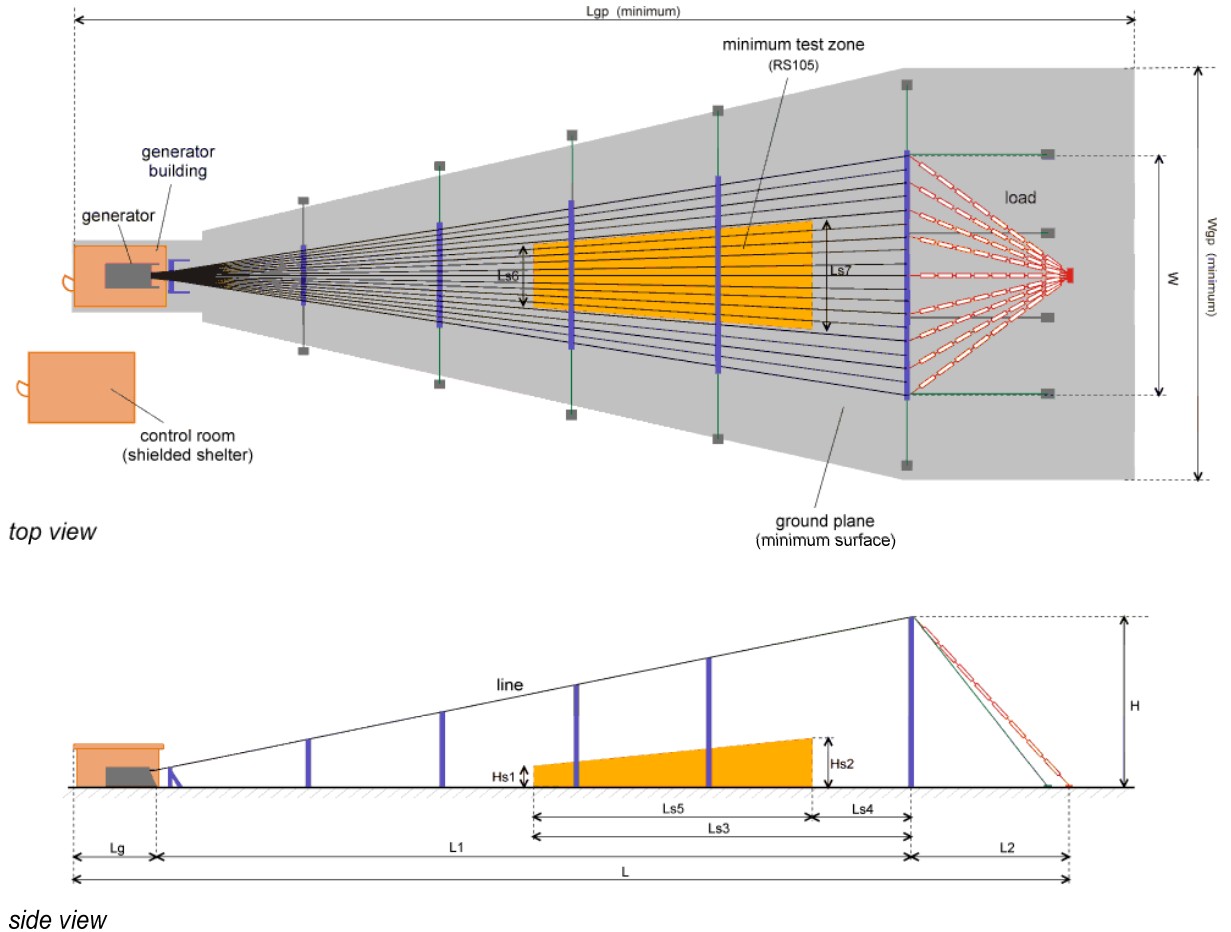


Figure 4 : Same simulation but with limit envelopes shown in transparency.

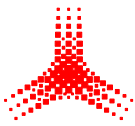


To define the maximum allowable volume strictly according to RS105, the 1/3 height under septum limitation and the maximum width of the EUT must be added. The figure below gives the maximum volume of the EUT according to this standard. Note that the shape of the volume has been squared for simplification reasons.



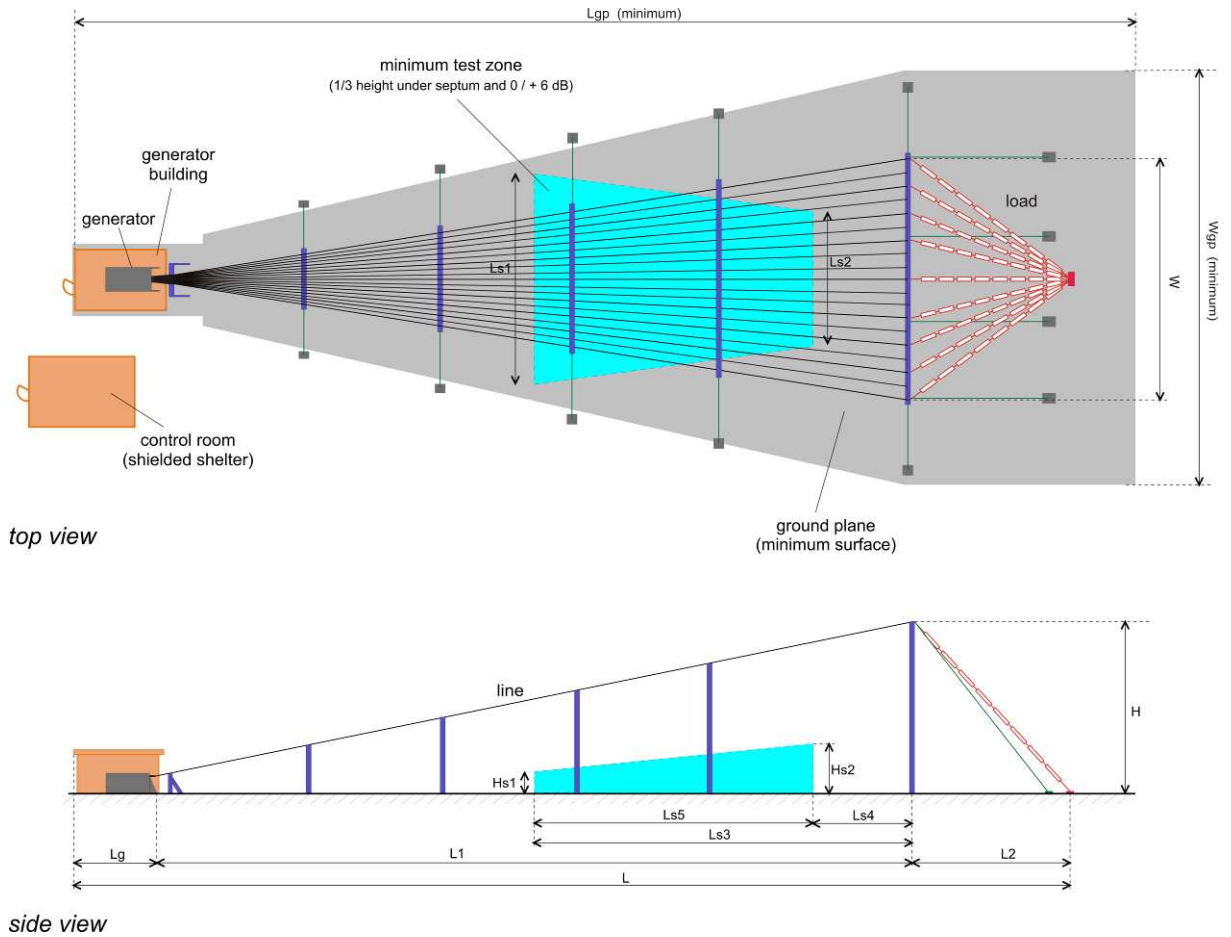
$H = 18 \text{ m}$	$L_{s3} = 40 \text{ m}$	$W_{gp} \approx 30 \text{ m}$
$L_g \approx 6 \text{ m}$	$L_{s4} = 10 \text{ m}$	$L_{gp} \approx 108 \text{ m}$
$L_1 = 80 \text{ m}$	$L_{s5} = 29 \text{ m}$	
$L_2 = 17 \text{ m}$	$L_{s6} = 6.5 \text{ m}$	
$L_1 + L_2 = 97 \text{ m}$	$L_{s7} = 11 \text{ m}$	
$L \approx 103 \text{ m}$	$H_{s1} = 2.2 \text{ m}$	
$W = 25 \text{ m}$	$H_{s2} = 5.2 \text{ m}$	

Figure 5 : Maximum test volume according to RS105.



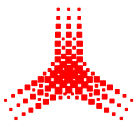
3. Test zone - homogeneity + height limitations only

In the next figure, the volume in blue appreciatively represents the zone where the RS105 requirement (1/3 height under the septum) and the field homogeneity (0 / + 6 dB) requirement are fulfilled. The requirement concerning the EUT width limitation is excluded.



$H = 18 \text{ m}$	$L_{s1} = 22 \text{ m}$	$W_{gp} \approx 30 \text{ m}$
$L_g \approx 6 \text{ m}$	$L_{s2} = 14 \text{ m}$	$L_{gp} \approx 108 \text{ m}$
$L_1 = 80 \text{ m}$	$L_{s3} = 40 \text{ m}$	
$L_2 = 17 \text{ m}$	$L_{s4} = 10 \text{ m}$	
$L_1 + L_2 = 97 \text{ m}$	$L_{s5} = 29 \text{ m}$	
$L \approx 103 \text{ m}$	$H_{s1} = 2.2 \text{ m}$	
$W = 25 \text{ m}$	$H_{s2} = 5.2 \text{ m}$	

Figure 6 : Maximum test volume with homogeneity and height limitations only.



4. Size of the test installation

The maximum dimensions of the EUT in relation to the test installation size are given in the following graphs. The first one fully fulfils the RS105 requirement, the second one only the maximum height and homogeneity requirements.

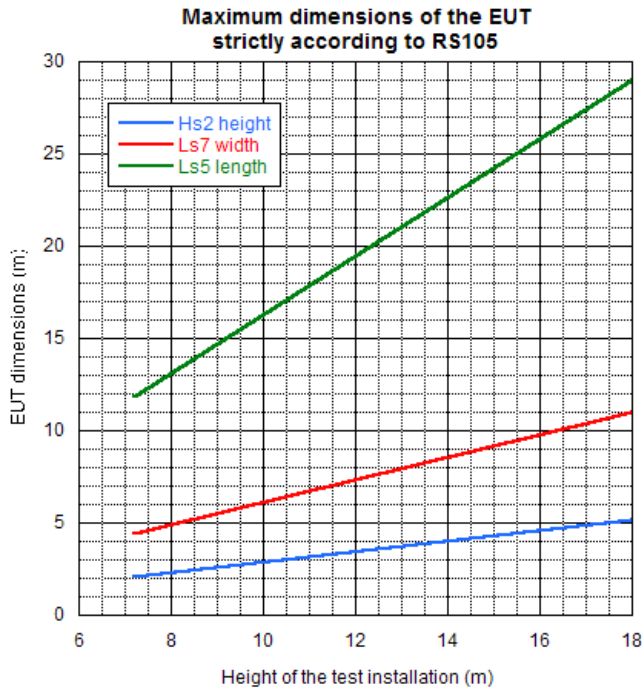


Figure 7 : Maximum EUT dimensions - RS105 requirement.

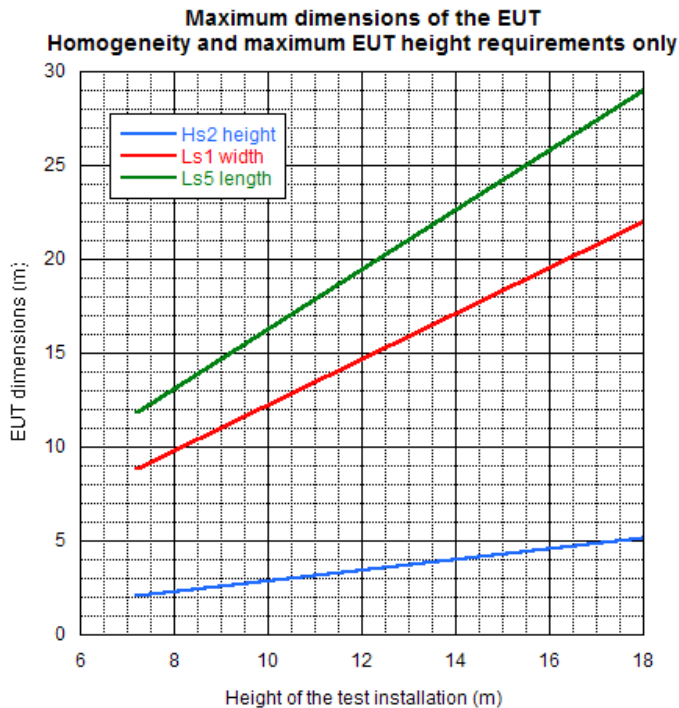
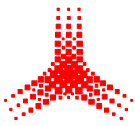


Figure 8 : Maximum EUT dimensions - homogeneity and height requirements only.



5. Other test zones

It is also possible to place the EUT closer to the generator, where the height of the radiation line is lower. In that case the field is higher. The volume fulfilling the RS105 requirement can be found from the one given in the chapters 2 and 3 using a scaling effect (see also figure 9). The following graph gives the amplitude of the field at the end of the EUT (far end of the EUT in reference to the generator position), for a 18 m test installation.

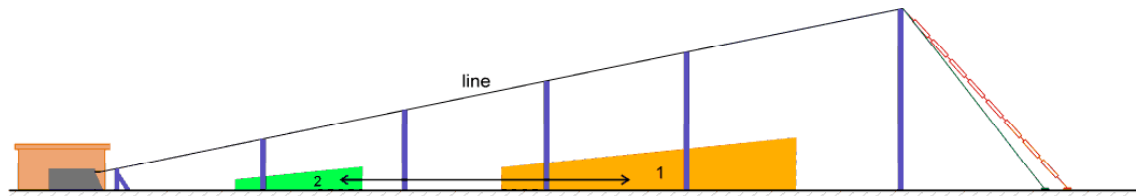


Figure 9: Example of shift of the test area in order to increase the field amplitude.

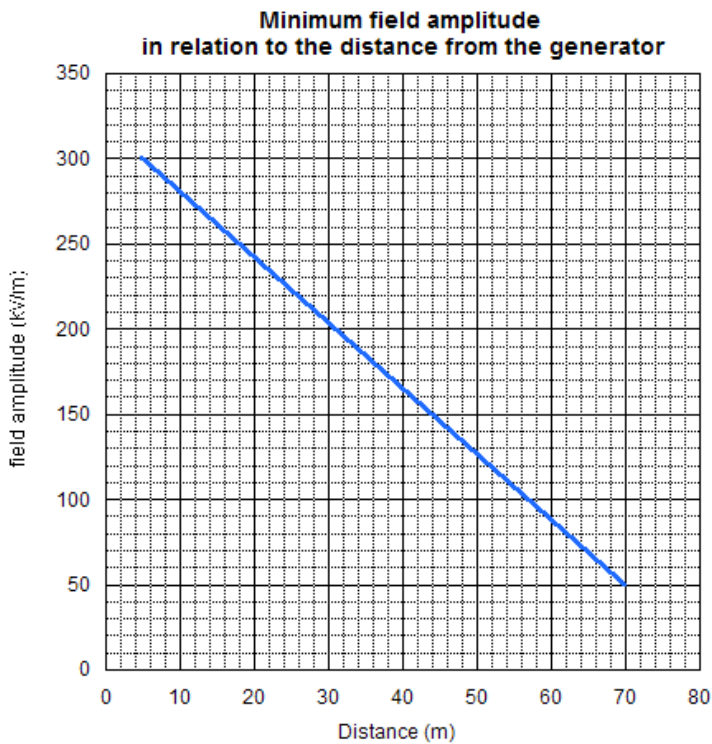
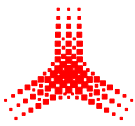


Figure 10 : Field amplitude in relation to the EUT position.



6. Map of the field under the line

The simulations below give the field (maximum peak value of the waveform) under the line in relative units. Note that the rise time, the pulse duration and the waveform can slightly change depending on the measurement or simulation spot.

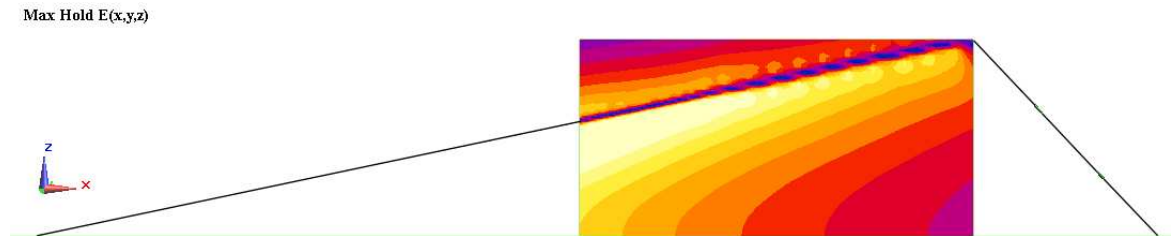


Figure 11 : Lateral view, in the middle of the line (along the axis of the line).

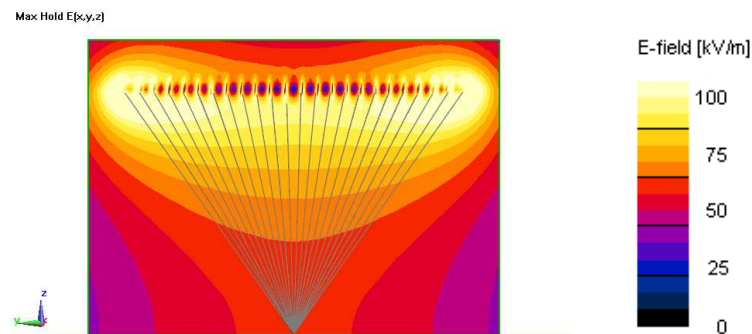


Figure 12 : Cross section view, in the middle of the simulation volume.

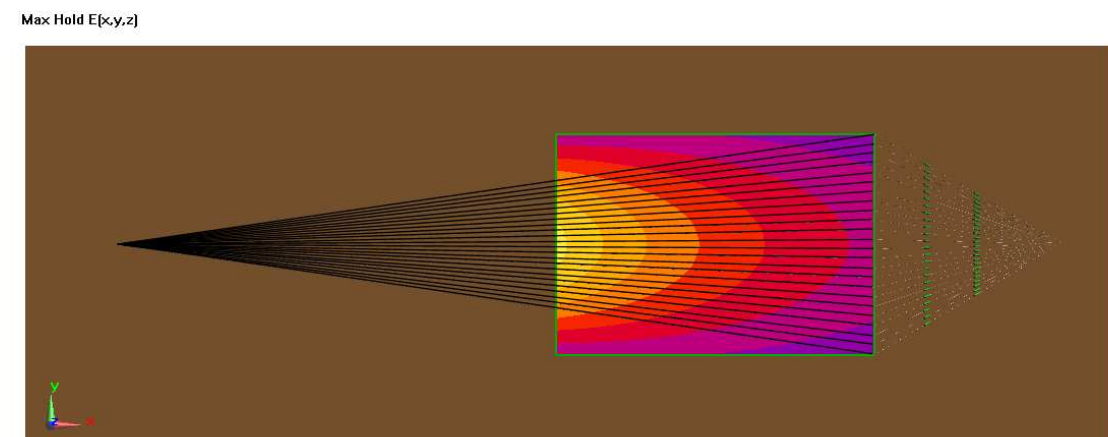


Figure 13 : View from above. Field at a height of 2.5 m above the ground plane.

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