Minimum distance calculation between BBHA 9120 J antenna and EuT

Introduction

The BBHA 9120 J is a linear polarized high-gain horn antenna for the frequency range 0.8-6.2 GHz. The radiation pattern is strongly focused in the forward direction and depends on the frequency. Therefore, when used for immunity testing of an Equipment-under-Test (EuT) (in the following we will assume that the EuT has a cubical shape), a minimum distance between the front plane of the horn antenna and the EuT has to be kept in order to irradiate uniformly the whole EuT.

Question: At which minimum distance (d) the BBHA 9120 J has to be placed from the EuT front side?

Answer: The calculation has to be made only for the smallest opening angle of the radiated field (the worst case within the frequency range in which the antenna is operated, should be considered). In the case of the BBHA 9120 J, the smallest opening angle of the E- and H-field is at 6 GHz (see Figure 1).

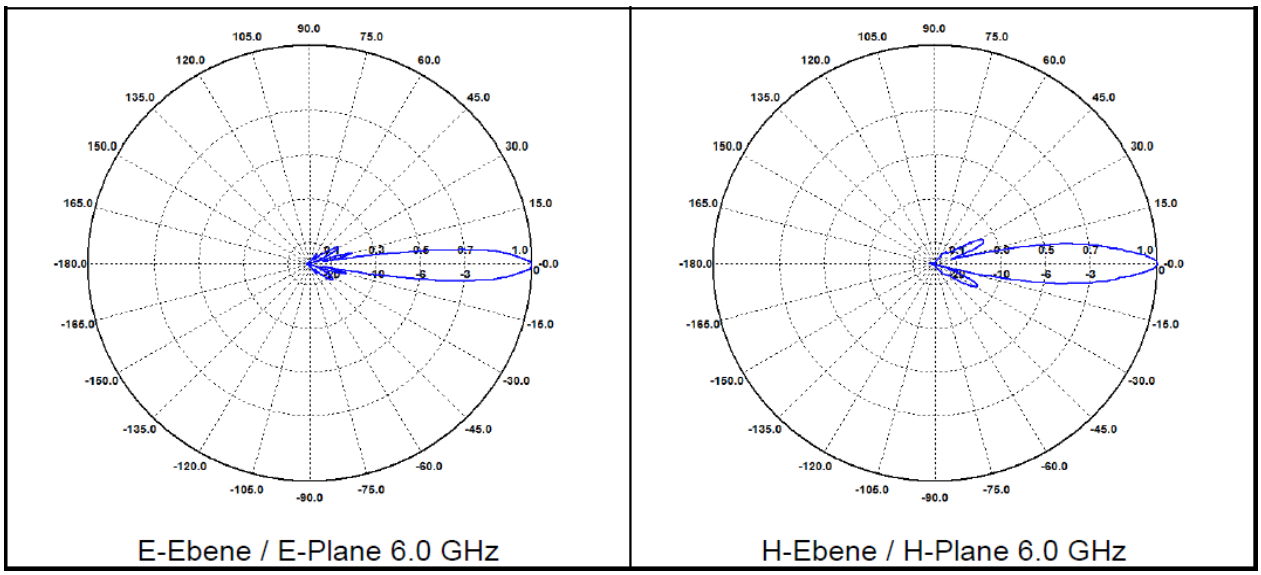

Figure 1: Directional pattern of E- and H-field of BBHA 9120 J horn antenna at 6 GHz.

Frequenz [GHz] *Frequency [GHz]*	3 dB-Öffnungswinkel E-Ebene [deg] *Half-Power Beamwidth E-Plane [deg]*	3 dB-Öffnungswinkel H-Ebene [deg] *Half-Power Beamwidth H-Plane [deg]*
0.8	48.3	48.3
1.0	40.8	40.2
1.5	29.5	27.1
2.0	25.8	23.4
2.5	18.2	16.2
3.0	18.1	14.0
3.5	16.2	12.2
4.0	13.1	12.5
4.5	13.4	13.2
5.0	12.2	16.4
5.5	11.6	18.4
6.0	11.4	13.8

Table 1: Radiation pattern of the BBHA 9120 J horn antenna.

In order to cover the full width (x) of the EuT, the antenna has to be placed at the distance (d) measured from the front plane of the horn antenna and the EuT (see Figure 2). The distance “d” is given by the following formula:

$$d = \frac{x}{2 \cdot \tan \frac{\alpha}{2}}$$

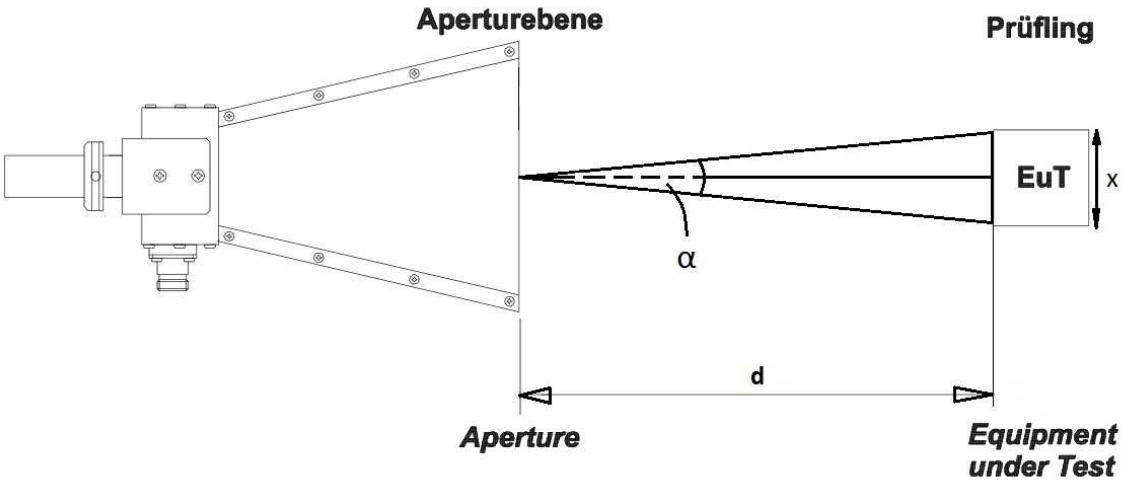

Figure 2: Geometrical relation between opening angle and distance to EuT.

Example:

For a cubic EuT with x = 0.2 m and the 3 dB-opening-angle $\alpha_{(6\ GHz)}$ = 11.4° (see Table 1) the minimum distance (d) can be calculated as in the following:

$$d = \frac{0.2\,\mathrm{m}}{2 \cdot \tan \frac{11.4}{2}} = 1.001\,\mathrm{m}$$

Therefore, in this example, the front side of the EuT has to be placed at *minimum distance* of about 1 m measured from the aperture of the horn antenna.

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