

7-7.1 Square Aperture Box Horn MoM Analysis

We design nearly equal beamwidth box horns by using a square aperture. The H -plane of a box horn has an approximately uniform distribution if we design with a 0.68 step ratio between at the input to the horn. The step ratio is the H -plane feed width divided by the uniform aperture width of the H -plane. Figure 7-20 illustrates that the horn has a uniform width in the H -plane while the E -plane has a taper to increase its aperture length. Table 7-10 lists the ratio of TE_{30} mode to the TE_{10} mode voltage in the horn section as 0.35 and a minimum linear ATL of 0.46 dB. The horns designs have a standard input waveguide which needs to flare to the box horn H -plane width given the aperture width and the step ratio. Figure 7-7.1 illustrates a typical design where the E -plane flares from the opening of the standard waveguide the E -plane aperture which equals the H -plane. The taper is long enough to suppress the excitation of significant higher-order waveguide modes.

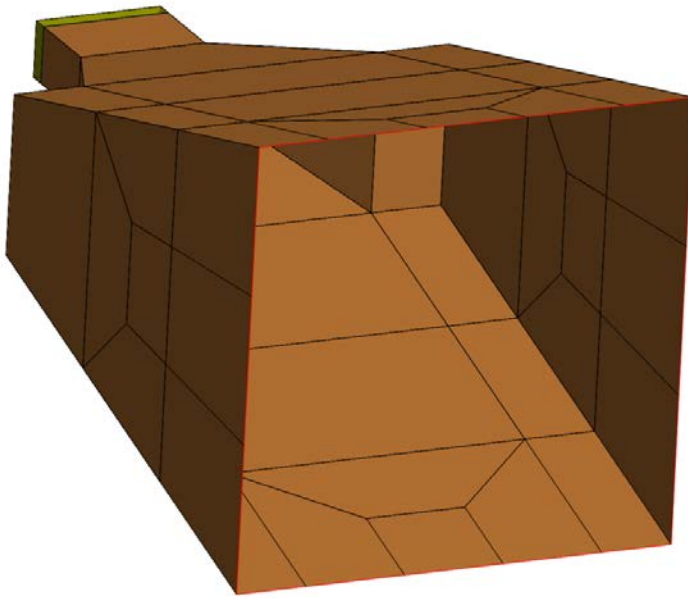


Figure 7-7.1 Square Aperture Box Horn with H -plane taper in intermediate waveguide

A series of box horns were designed and analyzed using MoM from which the design dimensions can be found from gain by using Scale 7-7.1.1 and 7-7.1.2



Scale 7-7.1.1 Box Horn Aperture given Gain

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Scale 7-7.1.2 Box Horn Bell Length given Gain

To determine the frequency response, a MoM analysis computed the pattern across X-band. The antenna input is standard X-band waveguide. Because the ratio of the waveguide step that generates the TE_{30} mode is 0.68, a taper from the standard waveguide is added between the bell and input waveguide. A smooth taper in the E -plane increases the height of the horn bell at the H -plane step to reduce higher mode generation (Figure 7-7.1.1). Equation (7-47) determines the bell length from the bell aperture dimension (square).

15.14 dB Gain @ 10 GHz Square 50 mm Aperture Box Horn in X-band

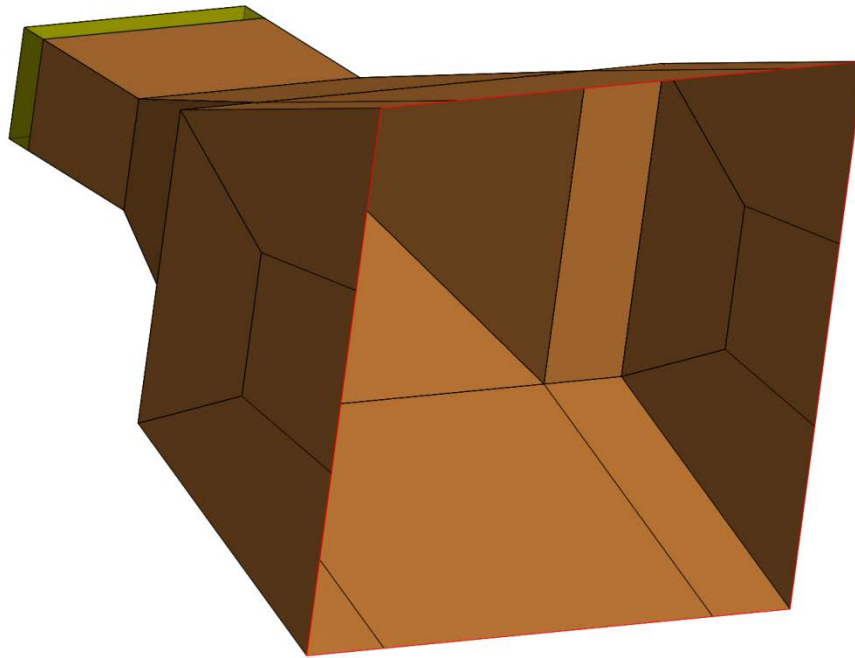
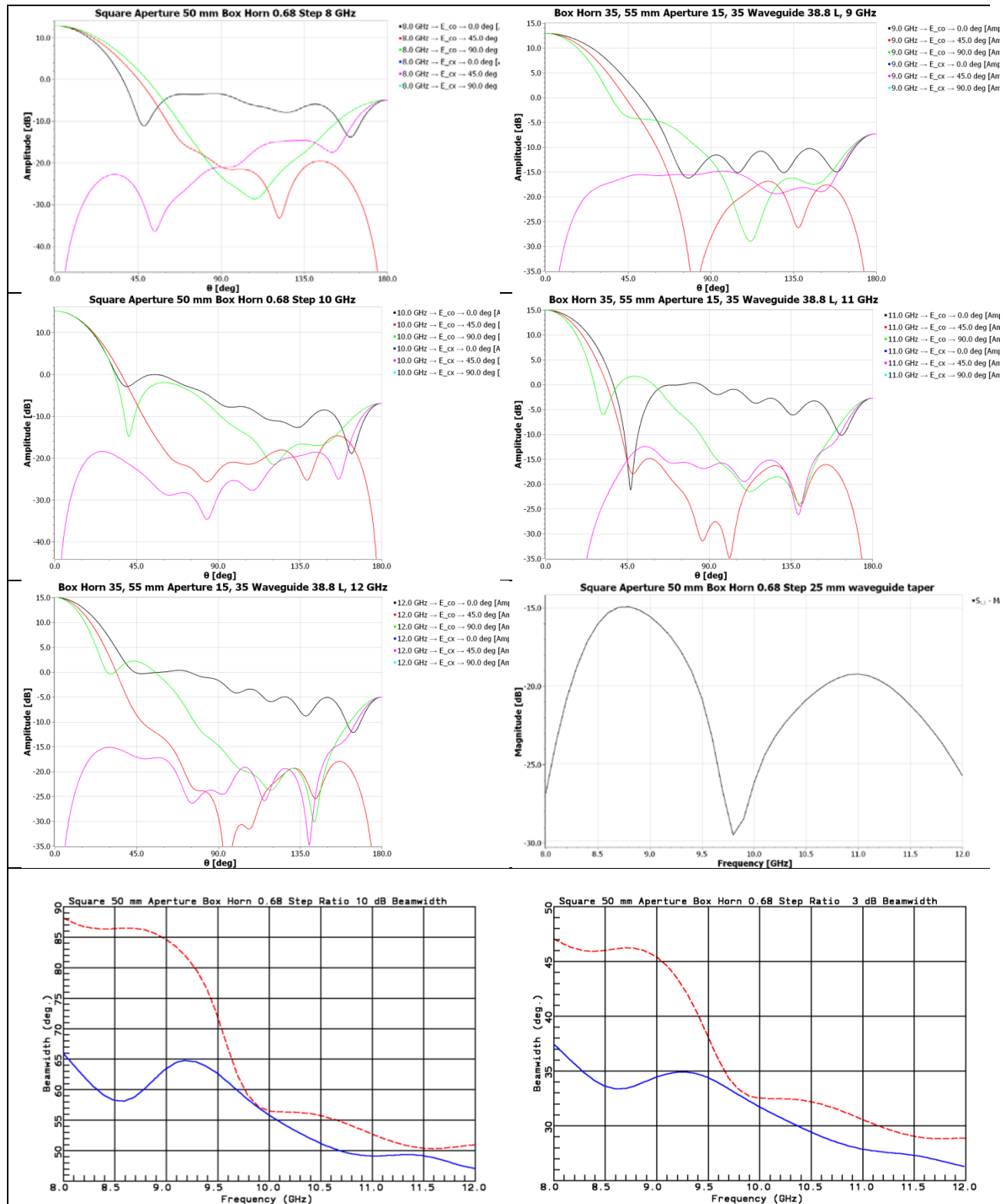


Figure 7-7.1.2 Square 50 mm Aperture Box Horn for X-Band

The bell length of the 50 mm aperture horn is 29 mm (0.967λ @ 10 GHz) with a step aperture of 34 mm in the H -plane (50×0.68).

Table 7-7.1.1 Response of 50 mm Aperture Square Box Horn



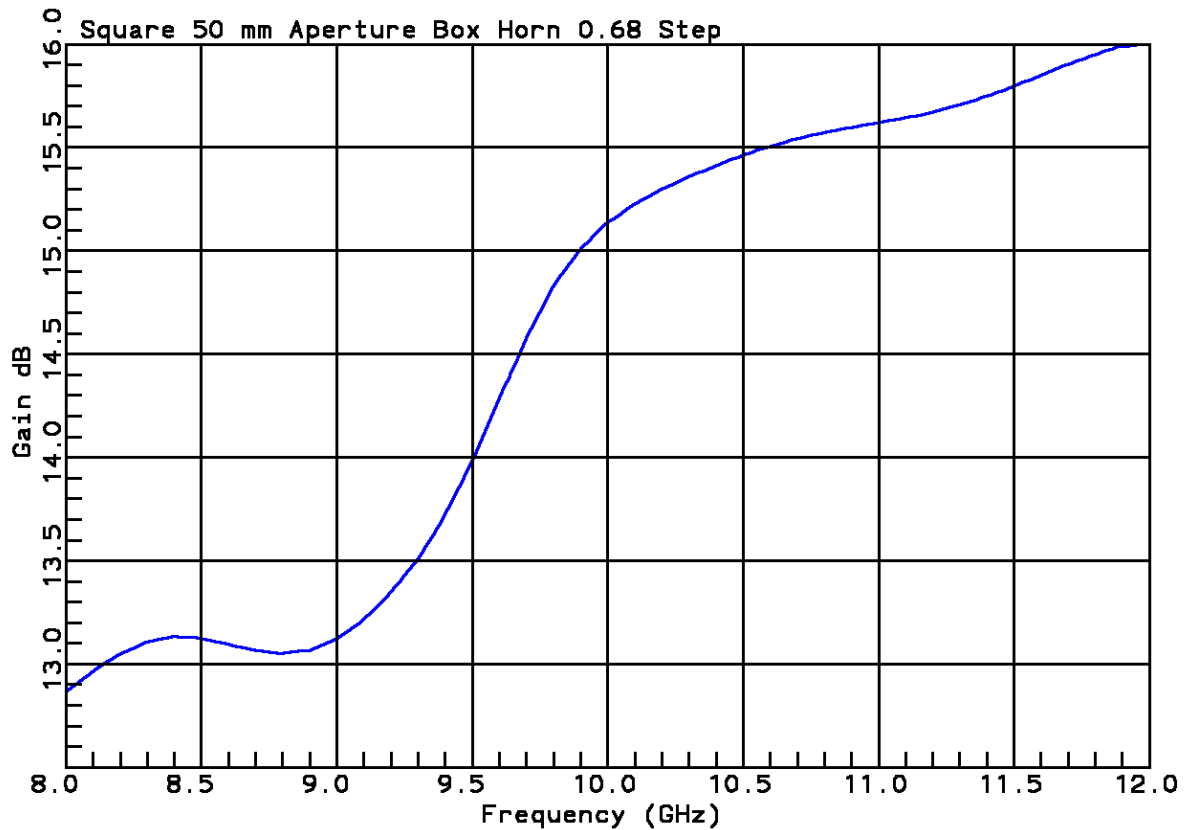


Figure 7-7.1.3 Gain Frequency Response of Square 50 mm Aperture Box Horn for X-Band

19.72 dB Gain @ 10 GHz Square 90 mm Aperture Box Horn in X-band

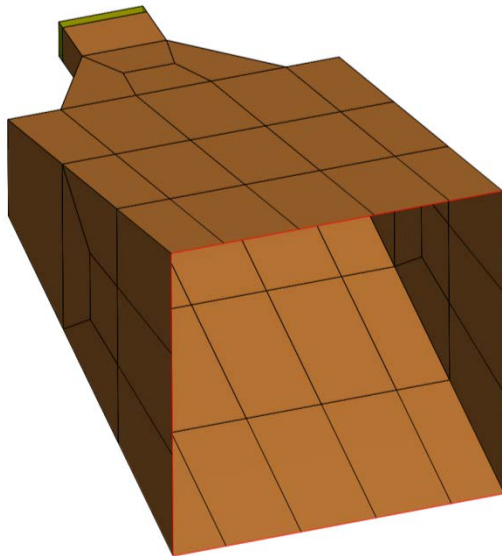
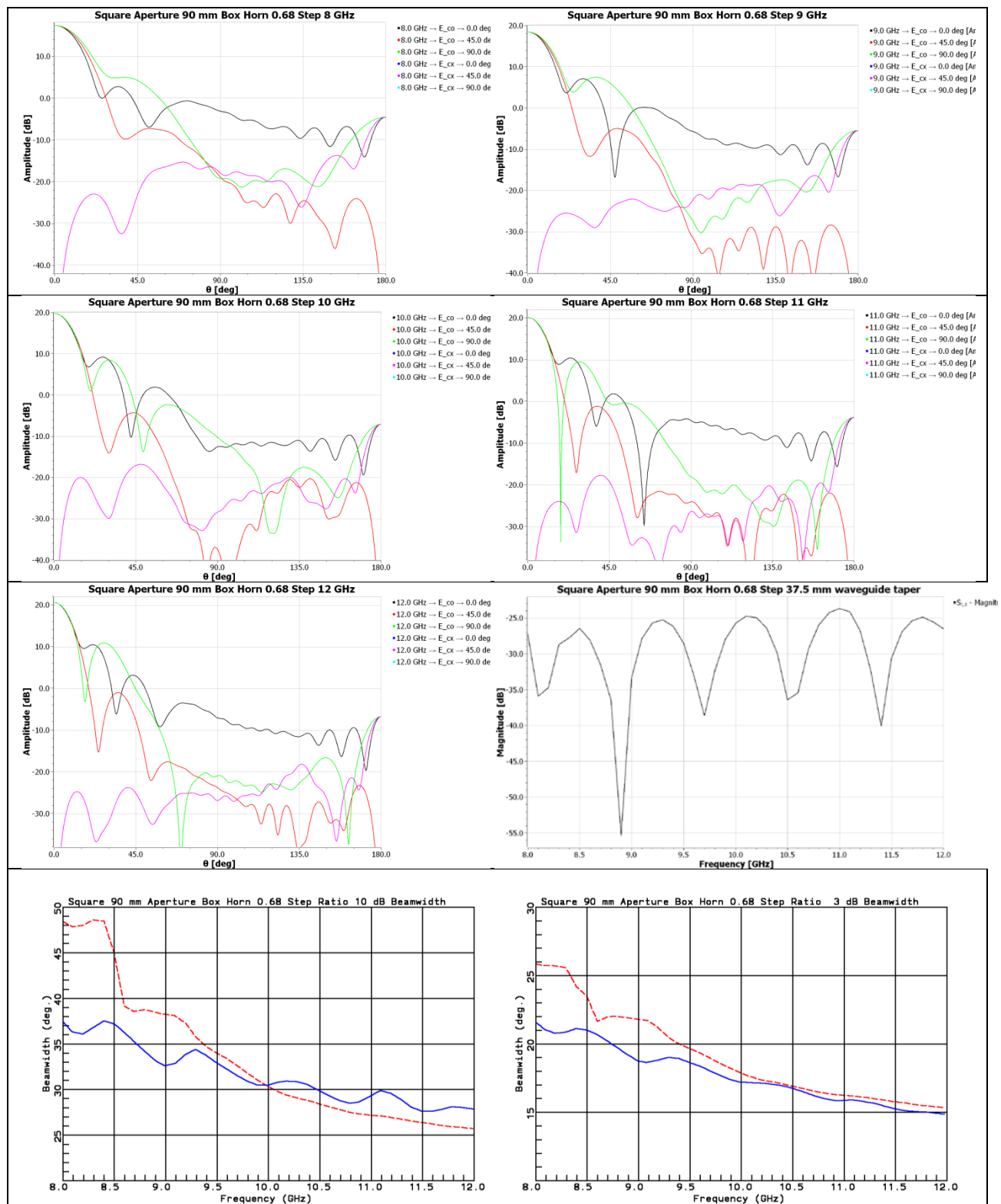


Figure 7-7.1.4 Square 90 mm Aperture Box Horn for X-Band

Table 7-7.1.2 Response of 90 mm Aperture Square Box Horn



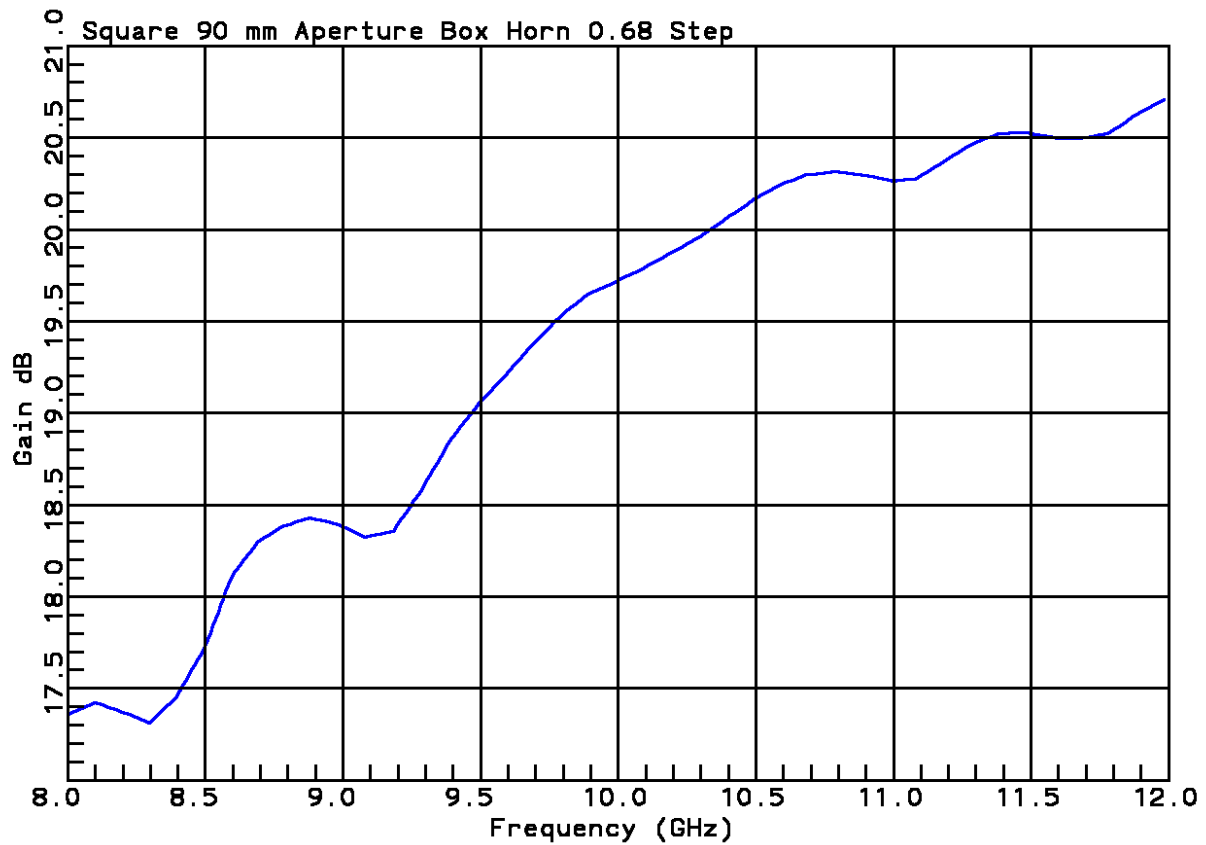


Figure 7-7.1.5 Gain Frequency Response of Square 90 mm Aperture Box Horn for X-Band

22.15 dB Gain @ 10 GHz Square 130 mm Aperture Box Horn in X-band

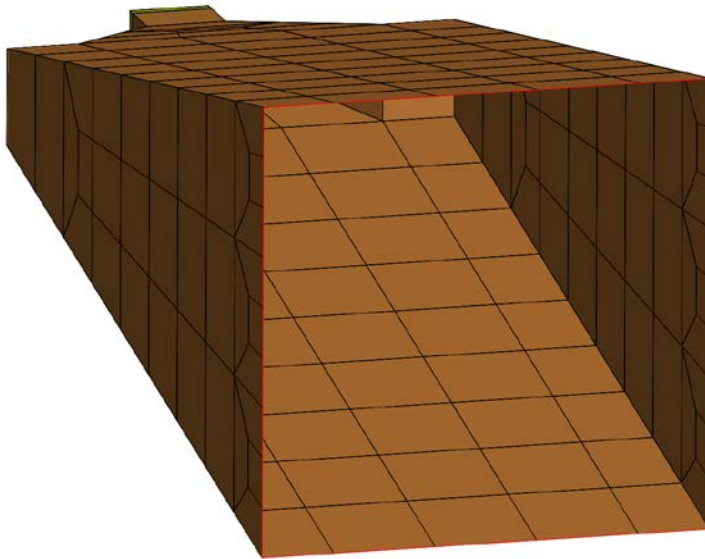
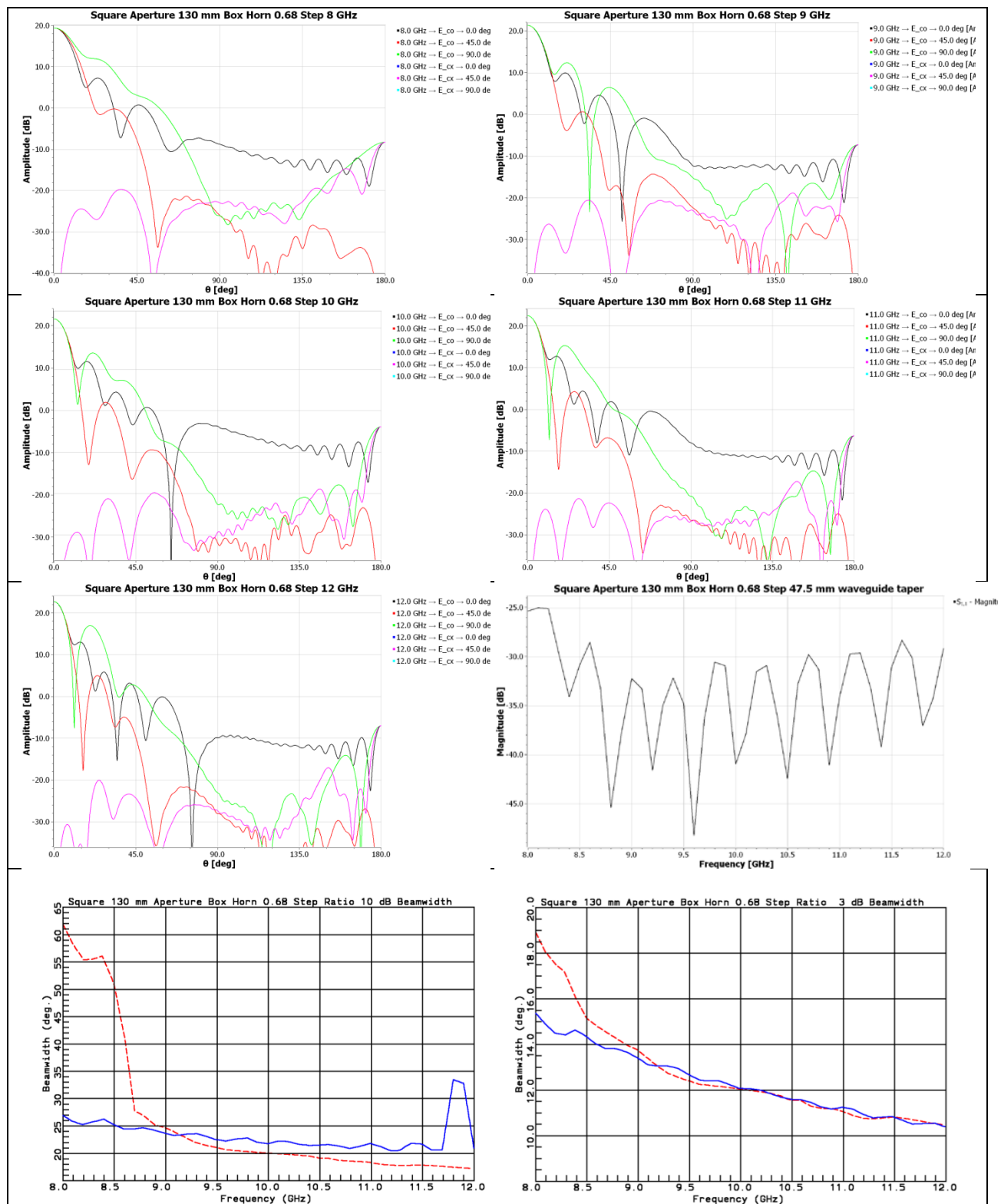


Figure 7-7.1.6 Square 130 mm Aperture Box Horn for X-Band

Table 7-7.1.3 Response of 130 mm Aperture Square Box Horn



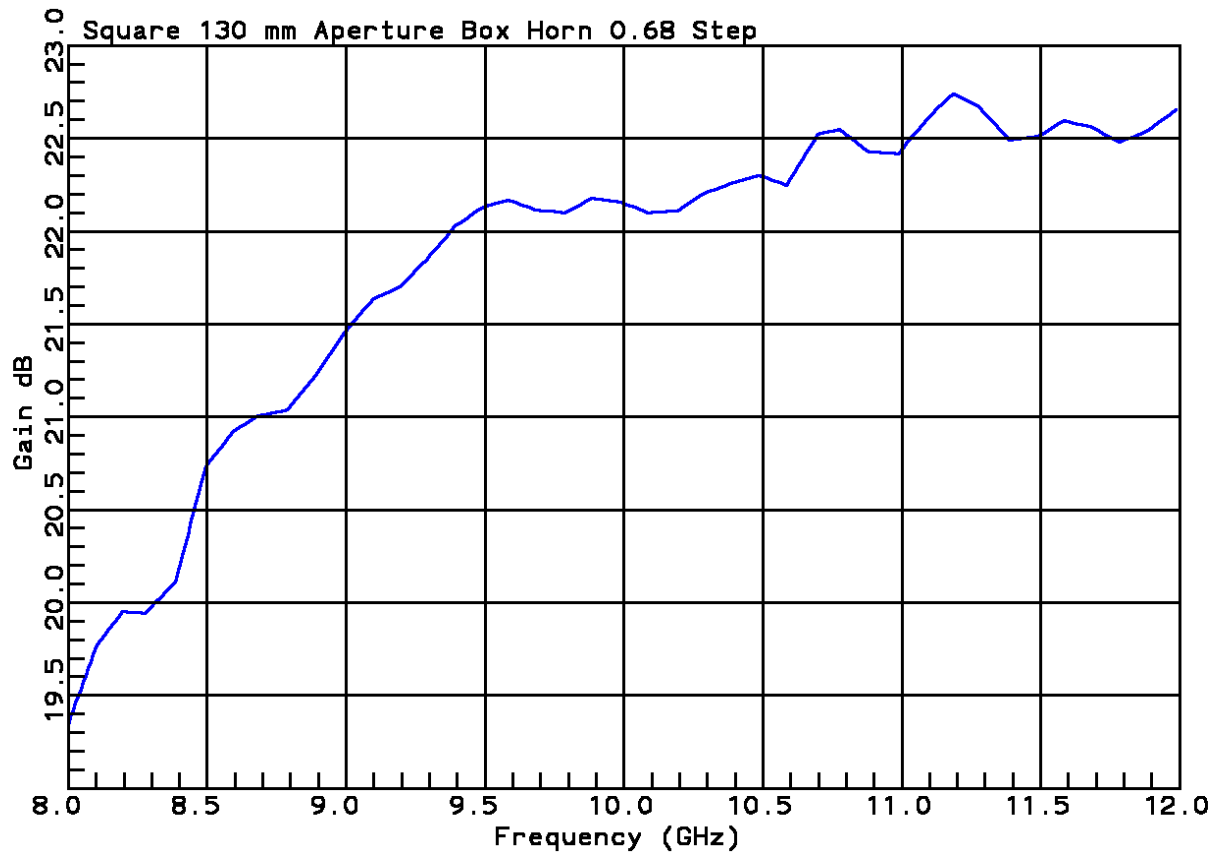


Figure 7-7.1.7 Gain Frequency Response of Square 130 mm Aperture Box Horn for X-Band