PBAR NOTE 592
FIRST ATTEMPT AT DESIGNING AN ISOLATING ABSORBER FOR HORIZONTAL BAND 1 OF THE DEBUNCHER UPGRADE USING ALUMINUM NITRIDE SILICON CARBON

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INTRODUCTION

Isolating Absorbers are needed in the 4-8 GHz Debuncher Upgrade to eliminate crosstalk between adjacent arrays and mode reflections. For the kicker arrays, these isolating absorbers will receive a large amount of power (200 Watts per absorber). Because of the large power load the vacuum properties of the absorber material must be very good. Recent attention has been turned to an electric type of absorber made from Aluminum Nitride and impregnated with Silicon Carbon. This material has been used at SLAC. The dielectric constant (real part) is 34 at 4 GHz and 27 at 8 GHz. The loss tangent is 0.25 at 4 GHz and 0.31 at 8 GHz.

ABSORBER DESIGN

Using simple waveguide theory, the optimum thickness for absorber on the sides of a waveguide can be determined.[1] (However, this formalism assumes that the waveguide is infinitely long and absorber is placed on only two sides of the waveguide.) The Horizontal Band 1 Kicker which is centered at 4.35 GHz will have a beam pipe width of 48 mm and a beam pipe height of 60 mm.[2,3] The optimum thickness for an Al/N/SiC absorber that is placed on the top and bottom of the beam-pipe is 2.8 mm. The optimum thickness for this absorber placed on the sides of the beam-pipe is 3.3 mm. With these numbers, a 100 mm long isolating absorber structure was entered into Hewlett Packard's High Frequency Structure Simulator (HFSS.) The cross-section of this structure is shown in Figure 1. The absorber widths and thickness were not tapered for this first attempt at a design.

RESULTS

The results of the HFSS simulation are shown in Figure 2. The frequency where the maximum insertion loss occurs agrees very well with the simple waveguide calculations. Because this is a dielectric absorbing material, the bandwidth of the absorber is fairly narrow.[4] The shape of the kicker response is plotted in the green trace of Figure 3. The width of the kicker response is wider than the width of the absorber response. However the total response of the kicker and the absorber combined shows no signal level greater than –25 dB down from the maximum of the kicker response. (The total response shown in the blue trace of Figure 3 is actually too simplistic of a picture. One needs to fold in the power spectrum from pickup and use the coupling parameter of the kicker instead of the impedance of the kicker. This will be done in future designs.)

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[1] PBAR Note 583 Attenuation of Waveguide Modes with Absorbing Walls
[2] PBAR Note 579 4-8 GHz Debuncher Upgrade Array Dimensions
[3] PBAR Note 591 The Effect of Sidebar Absorbers on the Frequency Response of Slow Wave Kickers.
[4] PBAR Note 584 Comparison Between a Lossy Magnetic Absorber and a Lossy Electric Absorber.

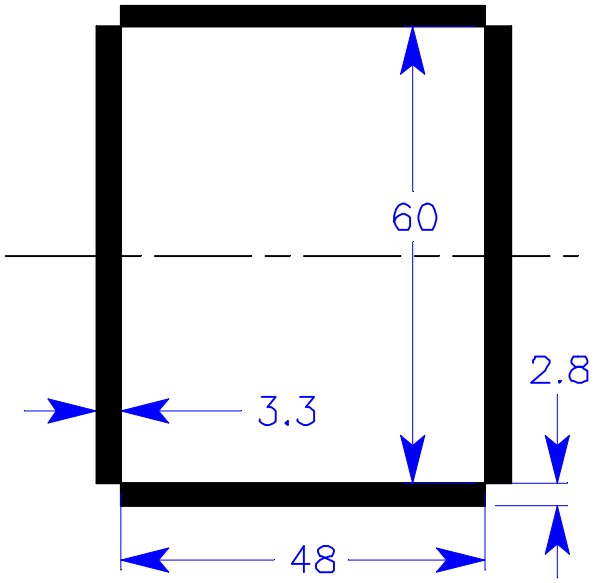

Figure 1. Cross-Section of HB1 isolating absorber. The dimensions are in millimeters. The filled rectangles are the absorber. The dashed line is a plane of electric symmetry. The length of the absorber is 100 mm.

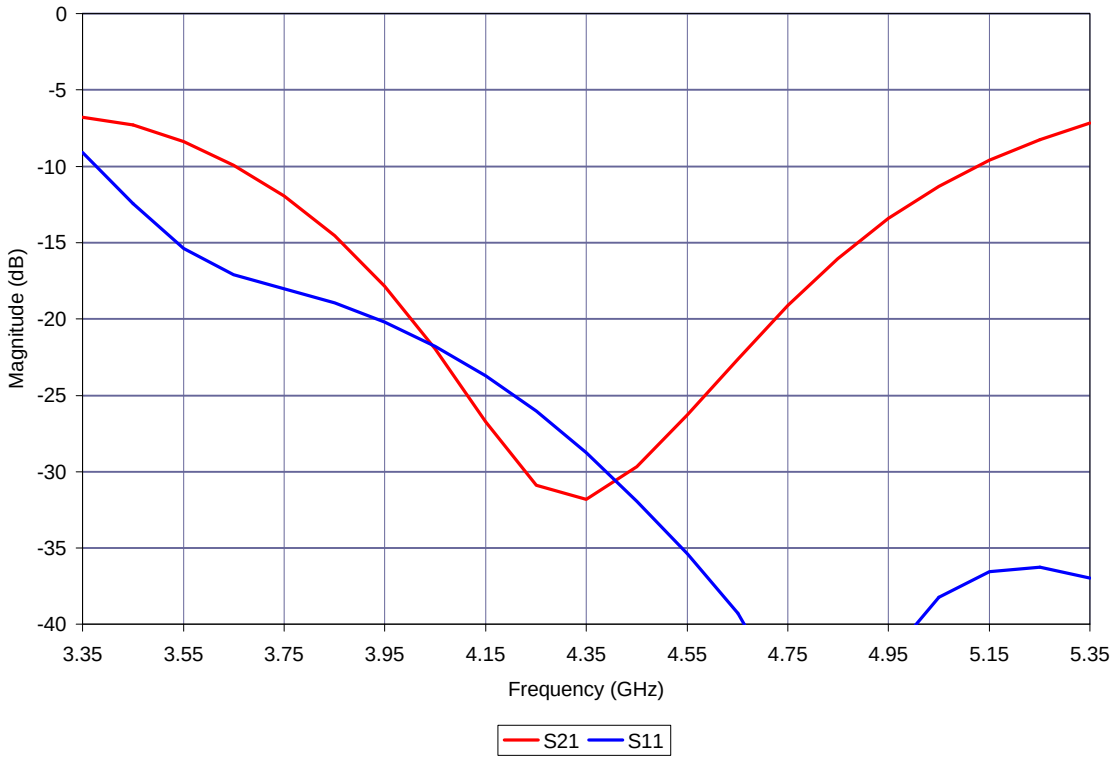

Figure 2. S Parameters of the HB1 isolating absorber calculated by HFSS.

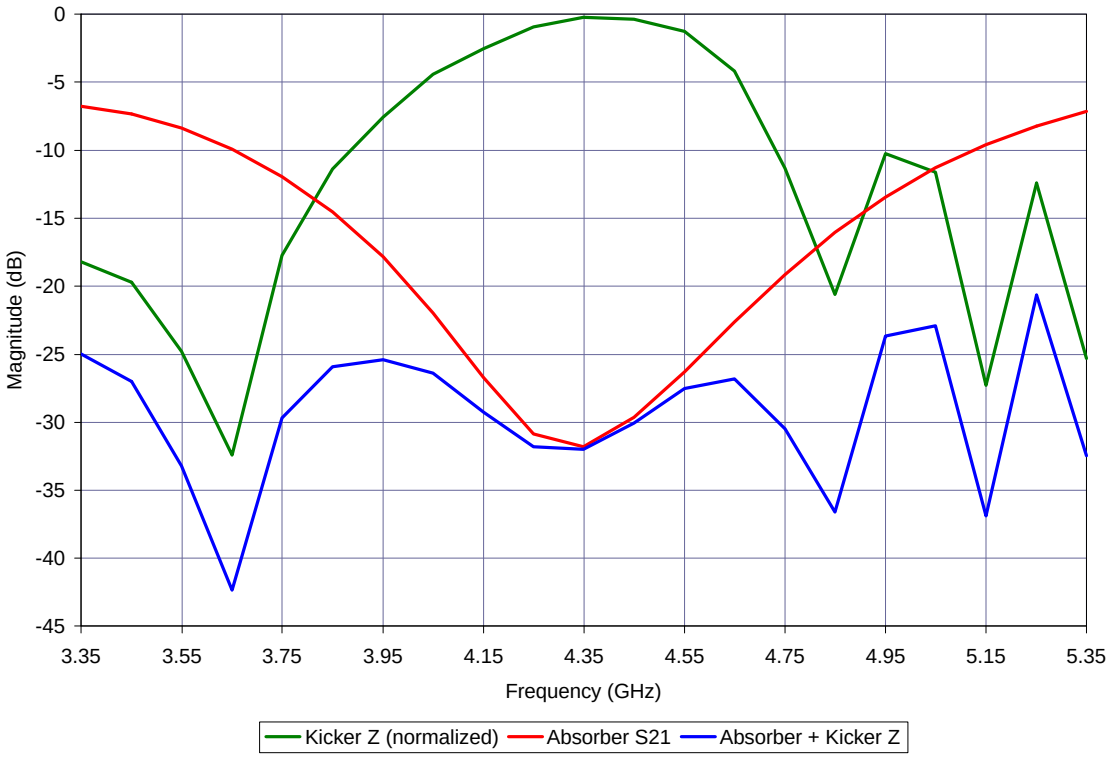

Figure 3. The normalized kicker impedance and the absorber response combined for HB1.