DOC-2

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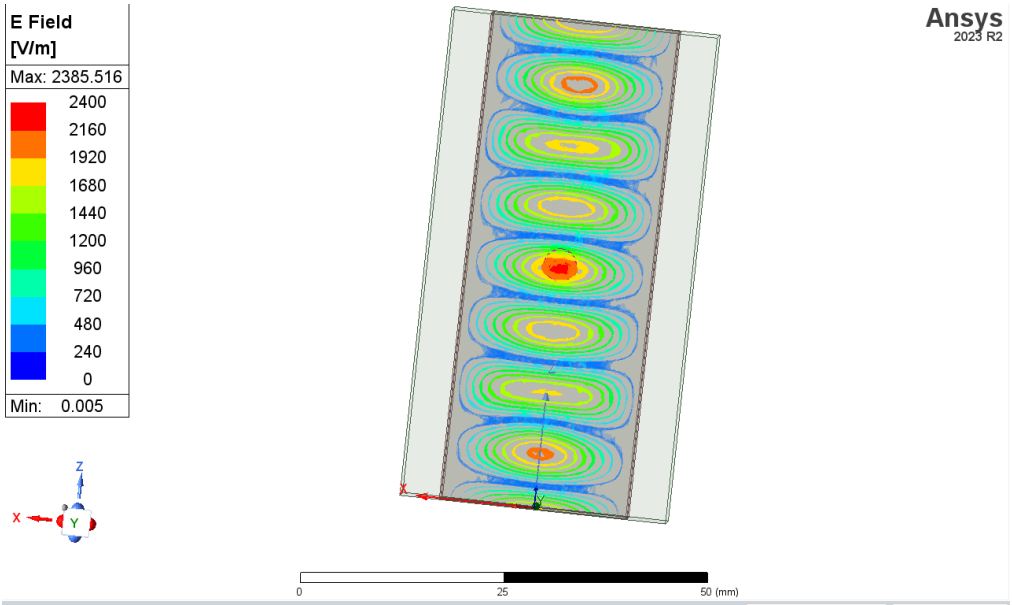
Defect Overview Table

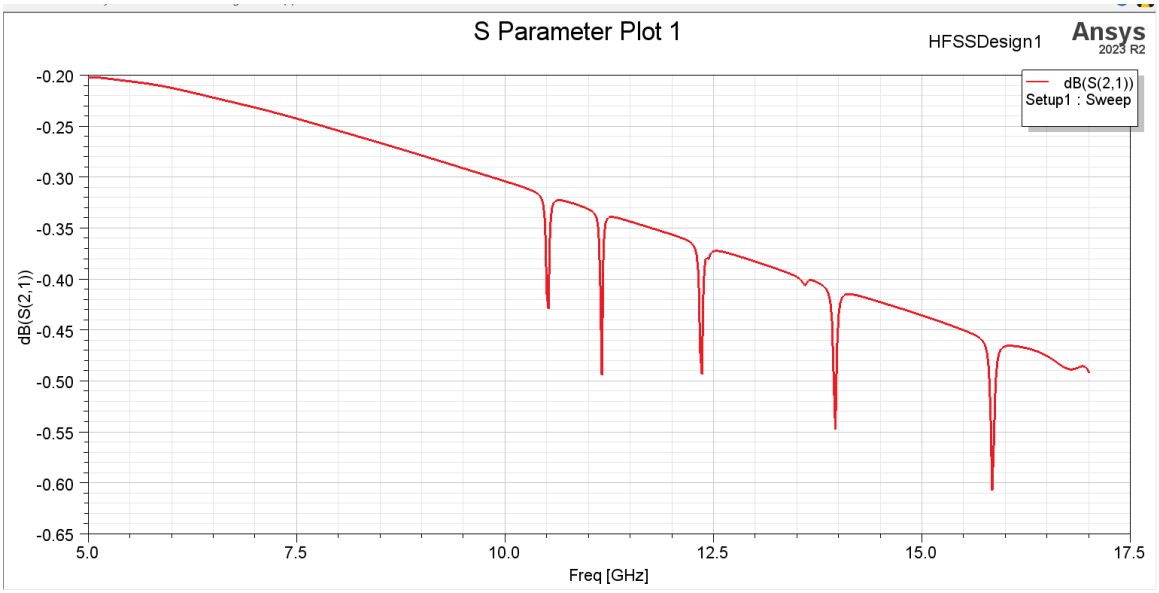
Substrate Material	Defect Material	Excel Sheet Extracted	Converted to T and Π	Defect / S_{21} Behaviour
Air	Teflon	Yes	Yes	Capacitive
Rogers	Air	Yes	Yes	The size is too small to notice the distortion due to defect
Rogers	Glass	Yes	Yes	Capacitive
Rogers	Drilled hole copper patches	No	No	S_{21} is not smooth. There were ridges
Rogers	Drilled a hole through the waveguide and filled it with air	No	No	S_{21} is smooth, acts like a passband with a bandstop filter at some freq.

Rogers with Glass Defect



WEEK2 fig1
a=22.86mm,b=10.16mm,t=0.2mm,L=60mm

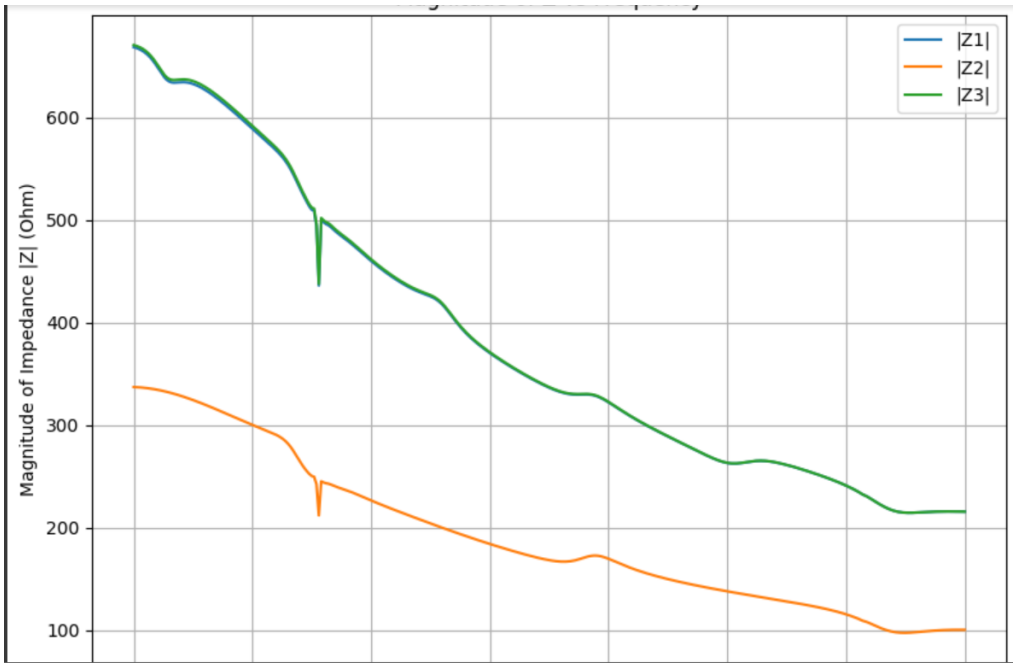
This defect perturbs the electromagnetic field distribution more significantly than the air-filled case due to the stronger dielectric contrast.



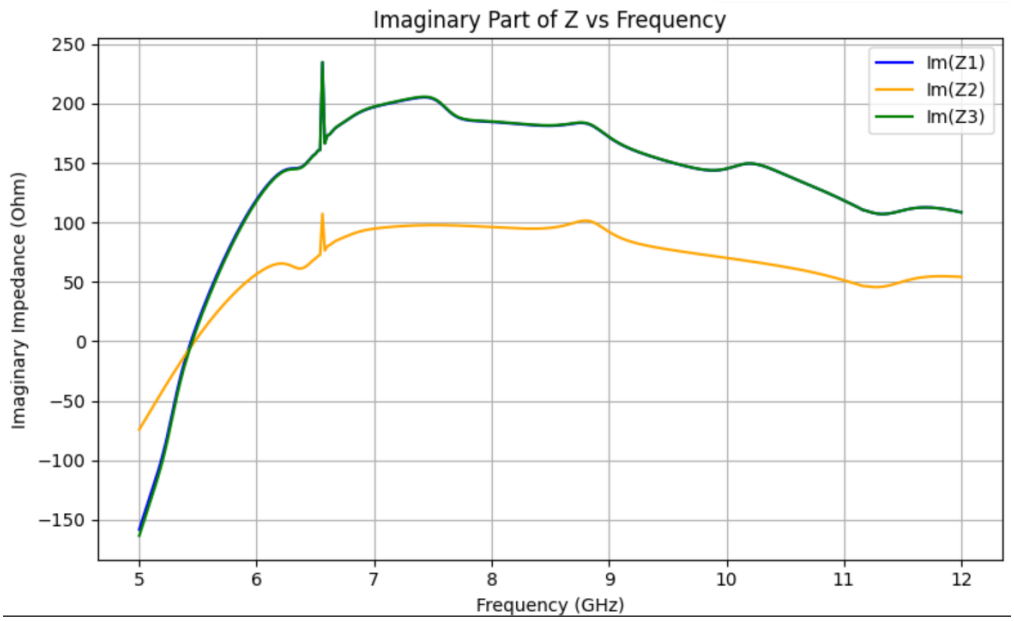
WEEK2 fig2
S21

Since the imaginary parts of the extracted T-network impedance parameters are predominantly positive, the defect exhibits an inductive behavior in the equivalent circuit model.

Magnitude of Impedence vs frequeny



WEEK2 fig3



WEEK2 fig4

Calculation of Denominator D

Given: $Z_1 = -415.866457 + j\,196.551810, \quad Z_2 = -205.816439 + j\,94.324658, \quad Z_3 = -417.465356 + j\,196.907062$

$$Z_1 Z_2 = \big(-415.866457 + j\,196.551810\big)\big(-205.816439 + j\,94.324658\big)$$
$$= 67052.47102175566 \; - \; j\,79680.05494340131$$

$$\mathrm{Z}_2 Z_3 = \big(-205.816439 + j\,94.324658\big)\big(-417.465356 + j\,196.907062\big)$$
$$= 67348.04169685248 \; - \; \mathrm{j}\,79903.98724634046$$

$$\mathrm{Z}_3 Z_1 = \big(-417.465356 + j\,196.907062\big)\big(-415.866457 + j\,196.551810\big)$$
$$= 134907.39908208148 \; - \; j\,163940.61356631370$$

$$\begin{aligned} D &= Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1 \\ &= 67052.47102175566 \; - \; j\,79680.05494340131 \\ &\quad + \; 67348.04169685248 \; - \; j\,79903.98724634046 \\ &\quad + \; 134907.39908208148 \; - \; j\,163940.61356631370 \\ &= 269307.91180068965 \; - \; j\,323524.6557560555 \end{aligned}$$

$$Y_1 = \frac{Z_2 Z_3}{D} = \frac{67348.04169685248 \; - \; j\,79903.98724634046}{269307.91180068965 \; - \; j\,323524.6557560555}$$
$$\approx 0.24824787268459422 \; + \; j\,0.001523610291923554 \text{ S}$$

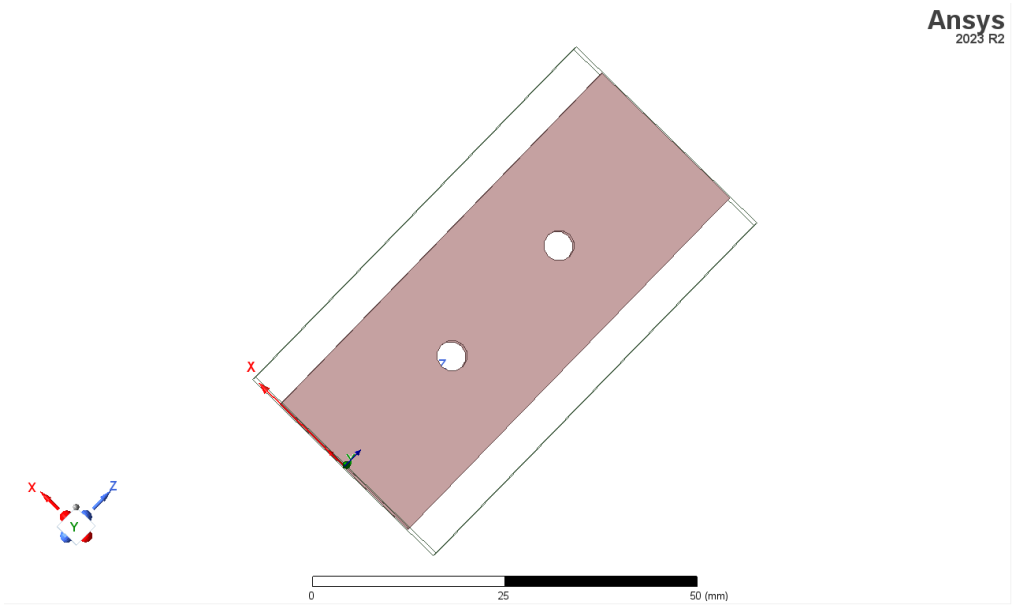
$$\mathrm{Y}_2 = \frac{Z_3 Z_1}{D} = \frac{134907.39908208148 - j\,163940.61356631370}{269307.91180068965 - j\,323524.6557560555}$$

$$\approx 0.5043623329162378 \; - \; j\,0.002847905314547281 \text{ S}$$

$$\mathrm{Y}_3 = \frac{Z_1 Z_2}{D} = \frac{67052.47102175566 - j\,79680.05494340131}{269307.91180068965 - j\,323524.6557560555}$$

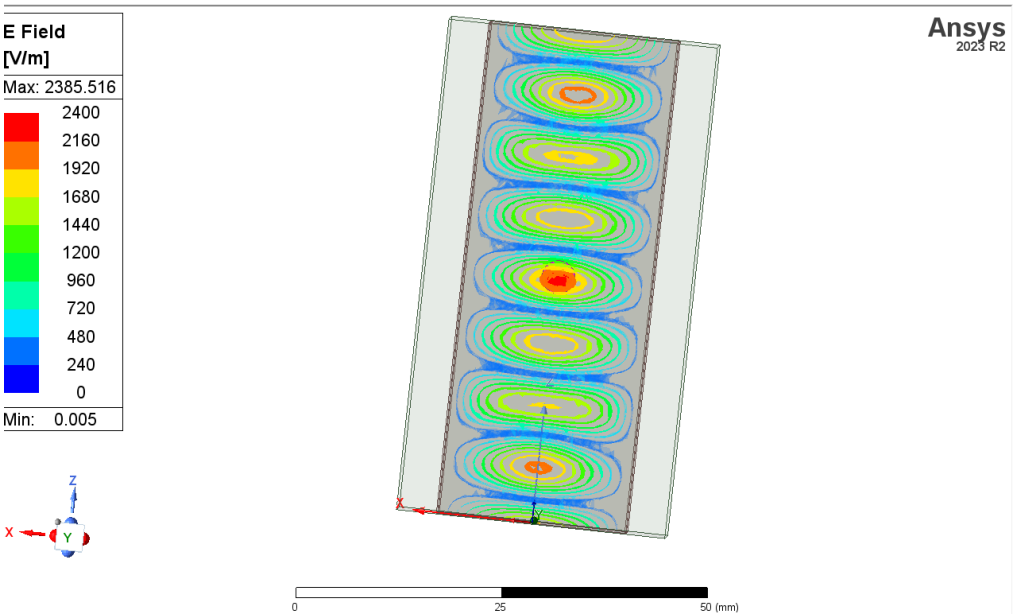
$\approx 0.24738979439916794 \; + \; j\, 0.001324295022623727$ S

Rogers with Air Drilled Holes



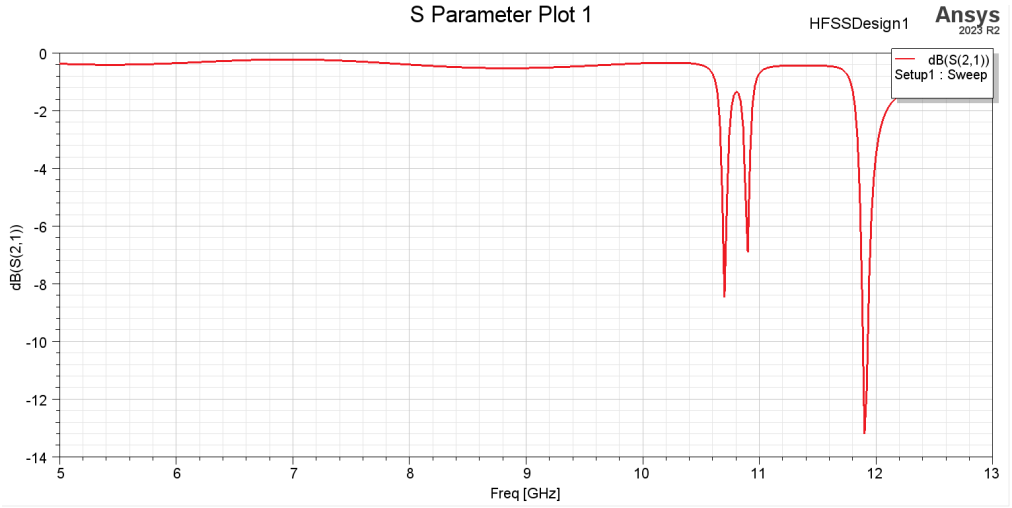
WEEK2 fig5
a=22.86mm,b=10.16mm,t=0.2mm,L=60mm

In this case, a hole was drilled through the Rogers waveguide and filled with air, creating a dielectric discontinuity along the propagation path.



WEEK2 fig6

The electric field plot revealed that the mode structure was largely preserved, with minor field distortion around the defect region. The field patterns suggest that the defect did not significantly affect the dominant mode propagation due to the small permittivity contrast between air and the surrounding substrate. This explains the minimal impact observed in the S-parameter response.



WEEK2 fig7

The S21 response remained relatively smooth, showing minimal reflection and consistent transmission across the frequency band, except for a slight dip at a specific frequency indicating weak bandstop behavior.