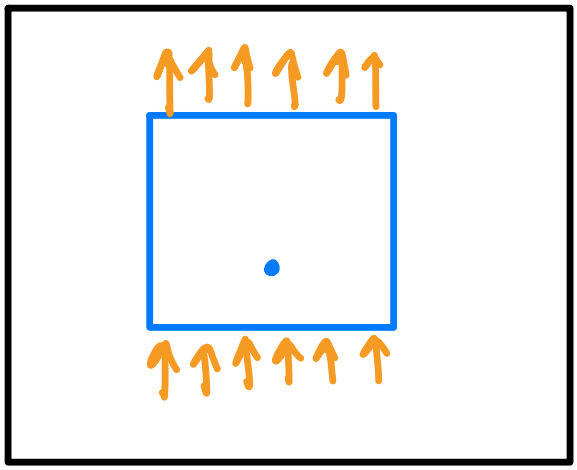
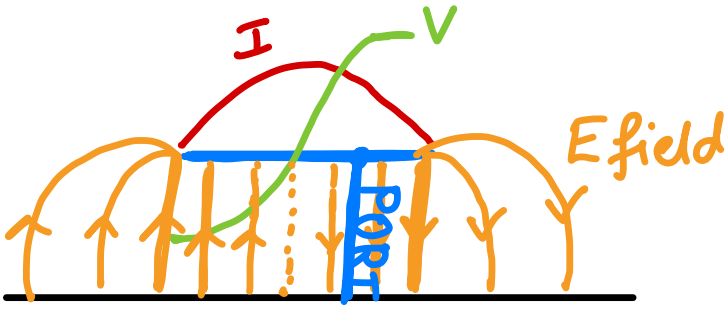
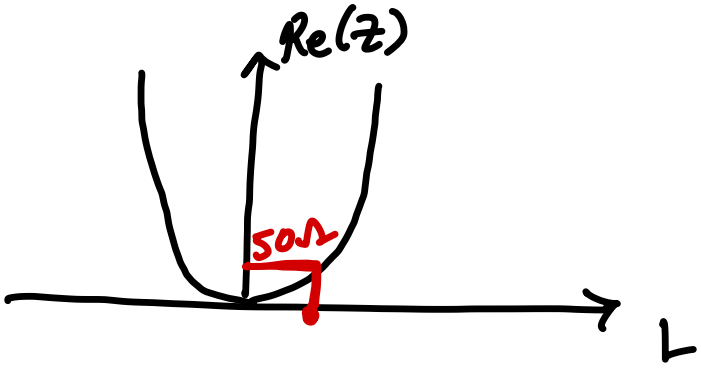
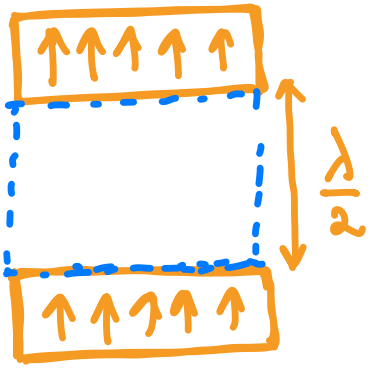
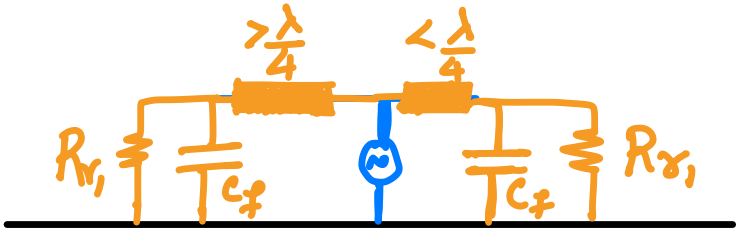
EM10 - Patch Antennas (Microstrip Ant.)

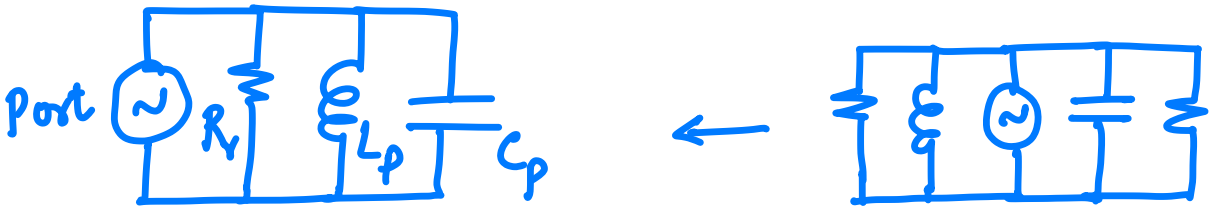




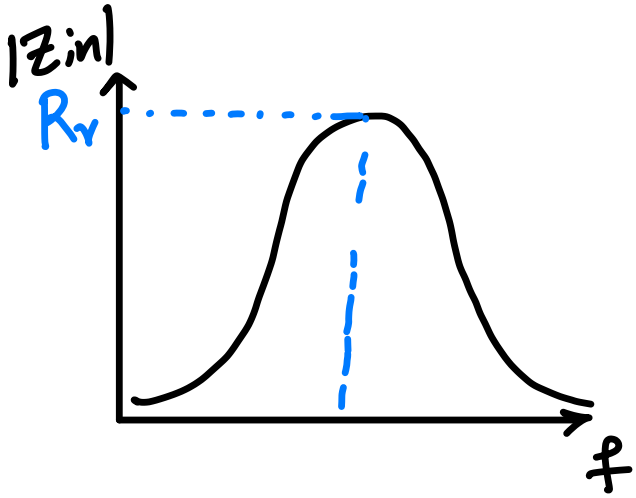


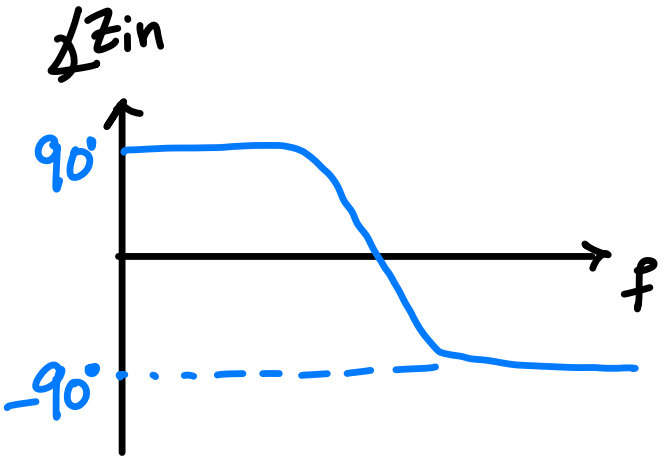






We want $R_r = 50\Omega$





$$L \simeq \frac{\lambda_0}{2\sqrt{\epsilon_r}} \simeq \frac{0.95\lambda_0}{2\sqrt{\epsilon_r}}$$ → Depends on W, H.

$$W \simeq \frac{\lambda}{2}\sqrt{\frac{2}{\epsilon_r+1}}$$ } W impacts gain, bandwidth, fres.

H → higher => more bandwidth.

Too high => substrate modes!

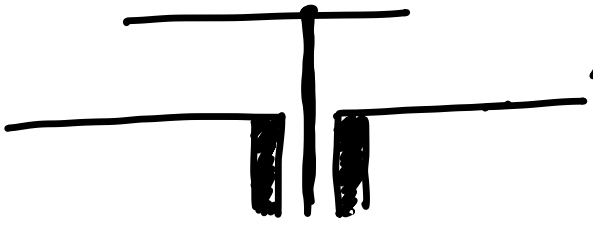
& transmission lines become lossy.

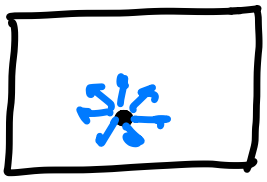
Feed Options

1) Co-ax feed

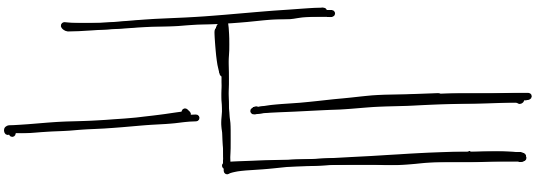
✓ > Can use thic substrate.

X > Poor polarization ratio.



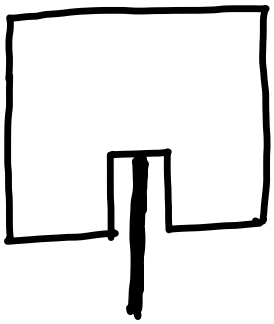


2) Via feed



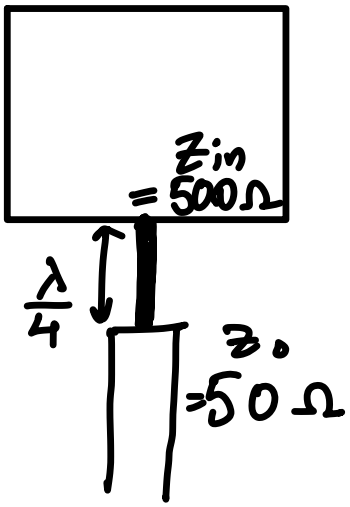
- Multilayer PCB.
- High BW.

3) Inset feed



- 2 layer PCB.
- Narrow band.
- Cross pol.

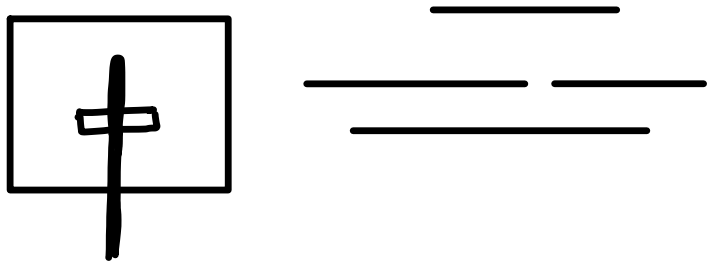
4) QWT feed



$$Z_1 = \sqrt{Z_{in} Z_0}$$

- 2 metal layers
- Narrow band.
- Pol. ratio is slightly better.

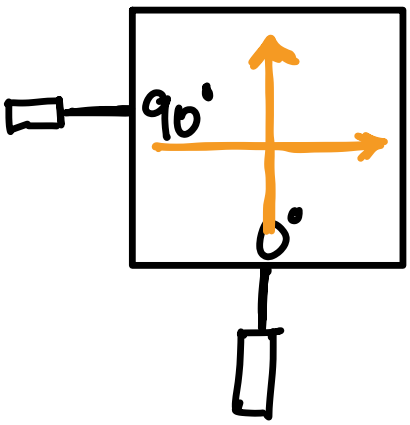
5) Aperture Coupled Feed.



- Less bandwidth?
- No vias.
- Easier to model. (Be the coupler).

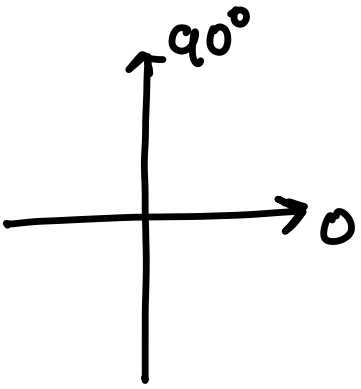
Circularly Polarized Patch

1)

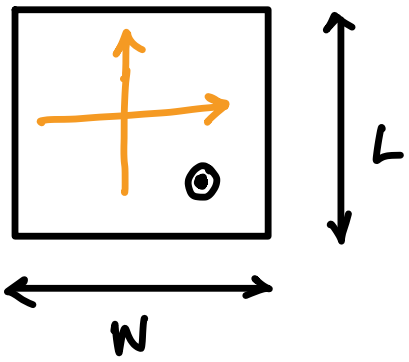


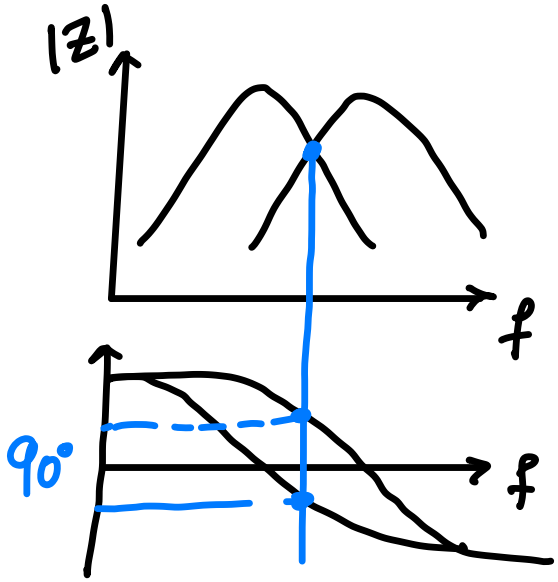
> Wide AR BW.

> Square patch.



2)



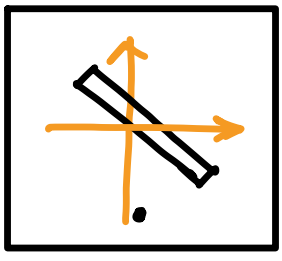


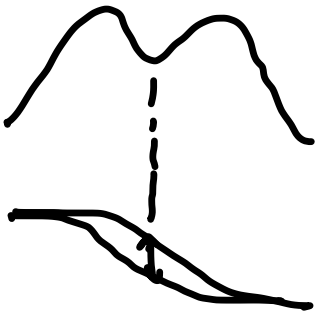
> $L = P + \delta$, $W = P - \delta$

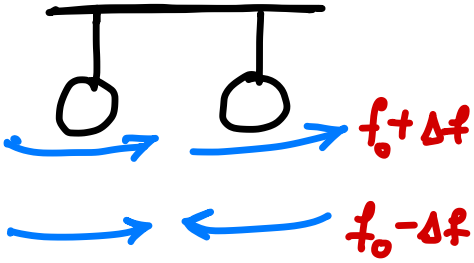
> ARBW is low.

> The modes are not coupled!

3) Coupled mode splitting. (Square patch)



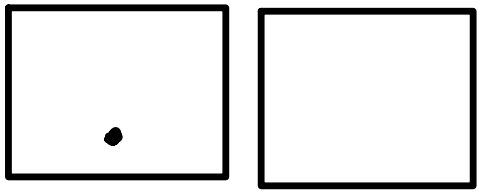




Bandwidth Enhancement.

> Use mode splitting with same polarization.

1) Parasitic Patch

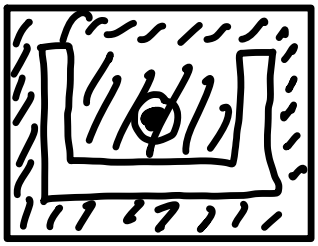


> Large directivity
> More area ⇒ not scalable to arrays.
> Weak coupling.
> Can add more patches.

2) Stacked Patch

> Lower area
> Multilayer PCB.
> Strong coupling.

3) U-slot Patch

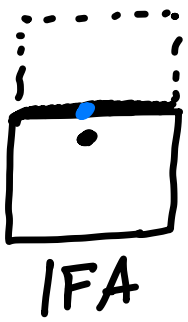


> Same area
> Scalable to arrays
> Single layers
> Decent pol. ratio.

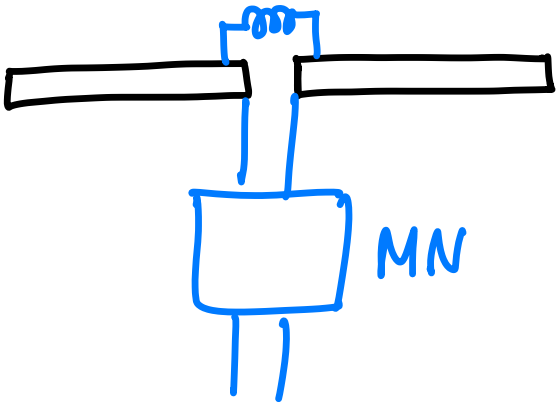
Miniaturization techniques.

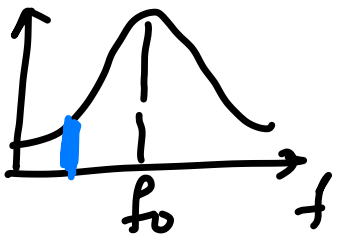
1) Exploiting Symmetry

(PIFA) | Planar Inverted F antenna.

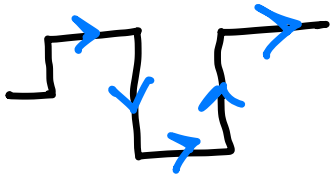


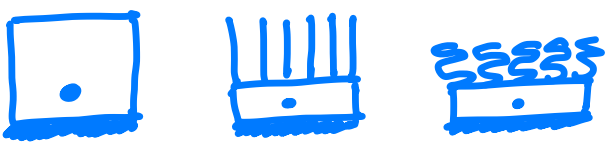
2) Enforcing resonance with circuits.

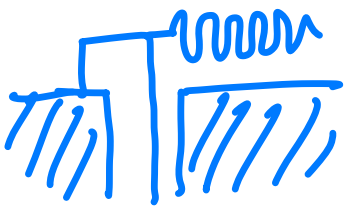




3) Meandering lines or space filling curves (fractals)







4) High ϵ_r dielectric or metamaterial substrates.

5) Slow wave antennas ($v = f\lambda$)