

Designing a Small Planar Antenna for Agricultural Sensor Network

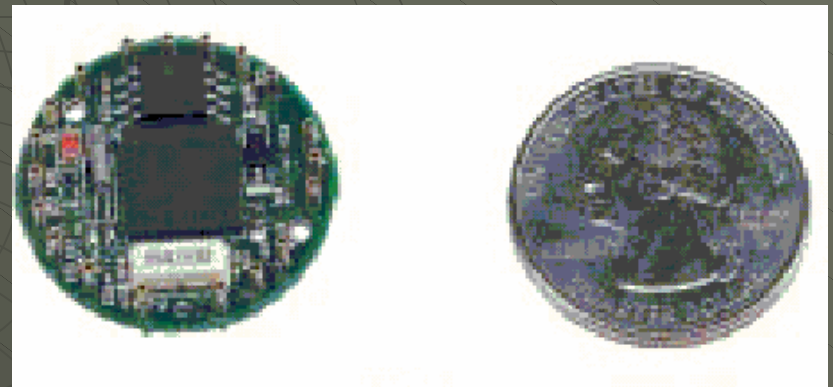
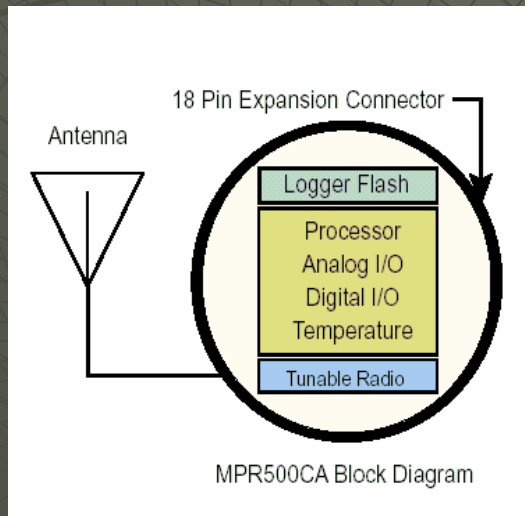
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Overview

- ◆ Agricultural Sensor Network
 - Usage of Smart Sensor Network
 - Antenna/Packaging
 - System Design Requirements
- ◆ Antenna Design
 - Design Approach
 - Methods
 - Results

Smart Sensor Network?

- ◆ Where do we use it?
- ◆ How does it work?



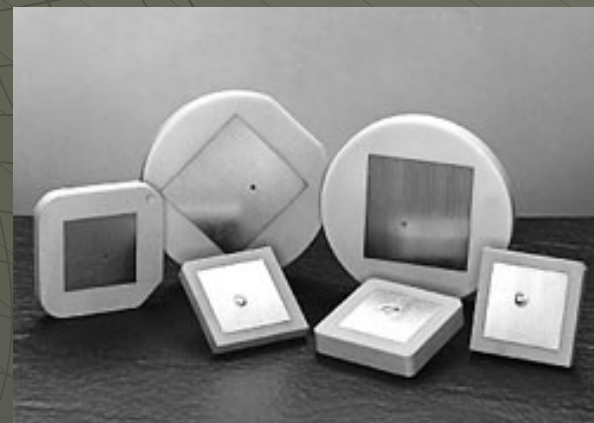
- ◆ How big is it?

Microstrip vs. Dipole Antenna

- ◆ Why use a microstrip antenna?
- ◆ Size and operating frequency

$$c = \text{wavelength/frequency}$$

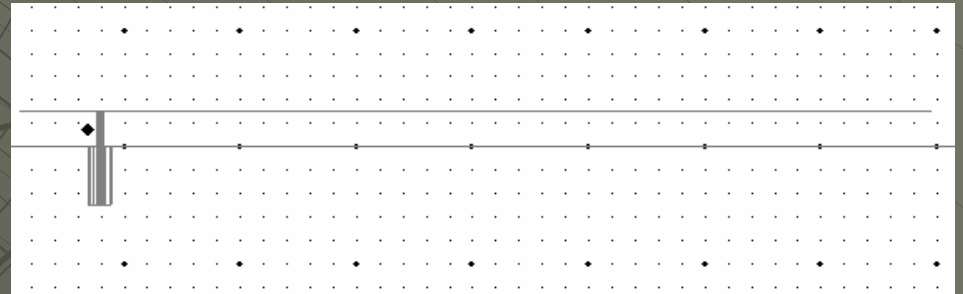
- ◆ Packaging



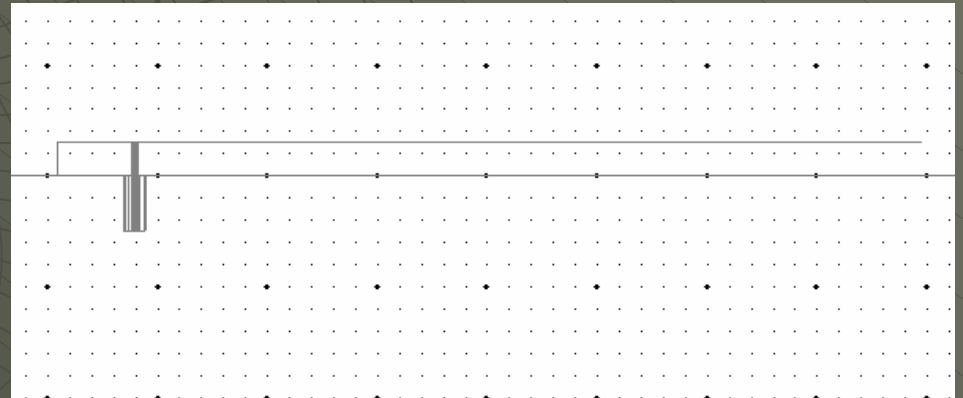
Planar Antenna

◆ Design Approach

- Inverted L antenna

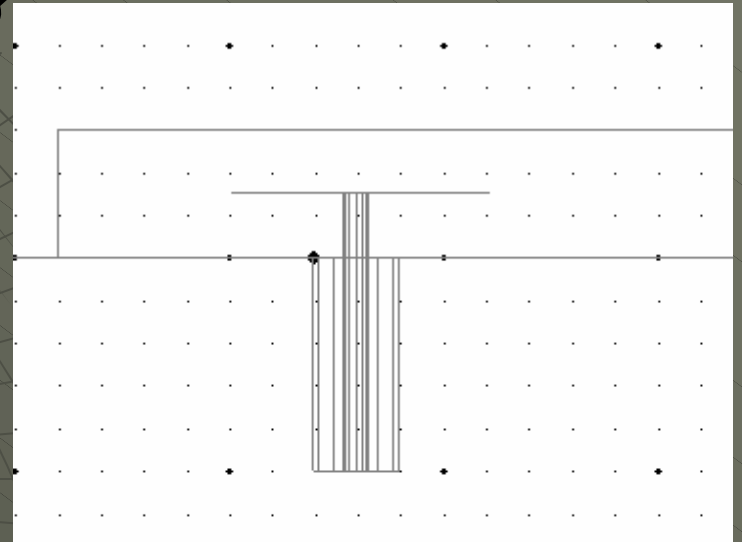
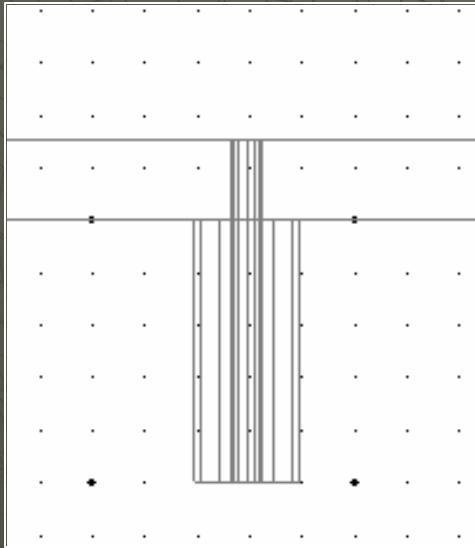


- Inverted F antenna (PIFA)



Designing the PIFA

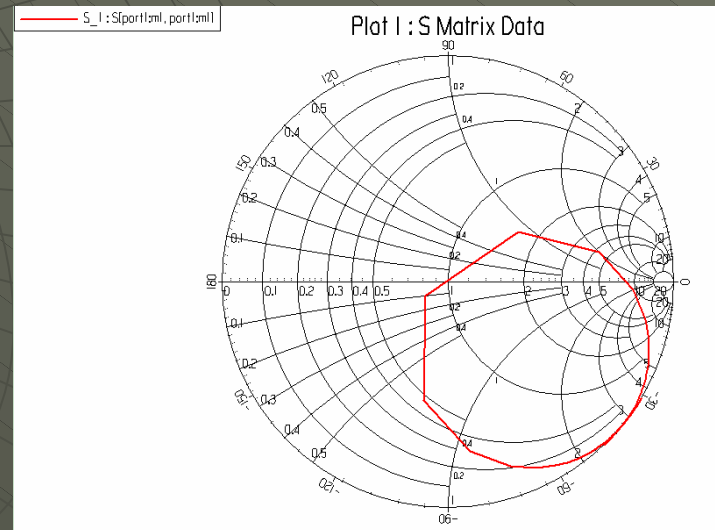
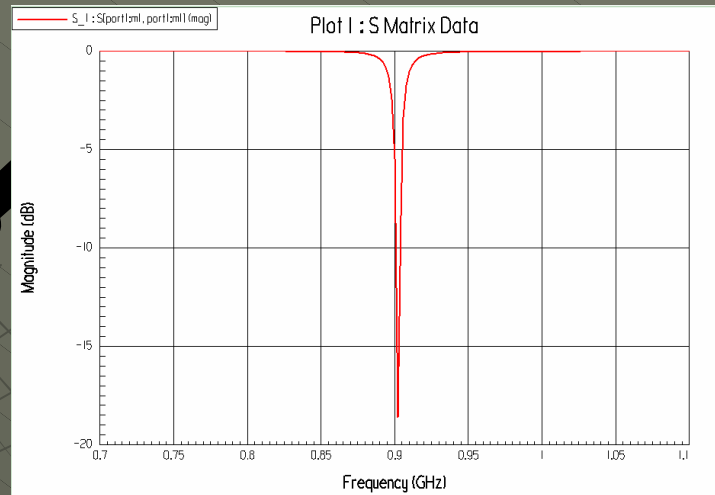
- ◆ Coupling – Magnetic vs. Electric



- ◆ Matching with the 50 Ω port

Designing the PIFA

- ◆ Results with capacitive coupling
 - Bandwidth
 - Radiation Efficiency



Antenna Parameters:

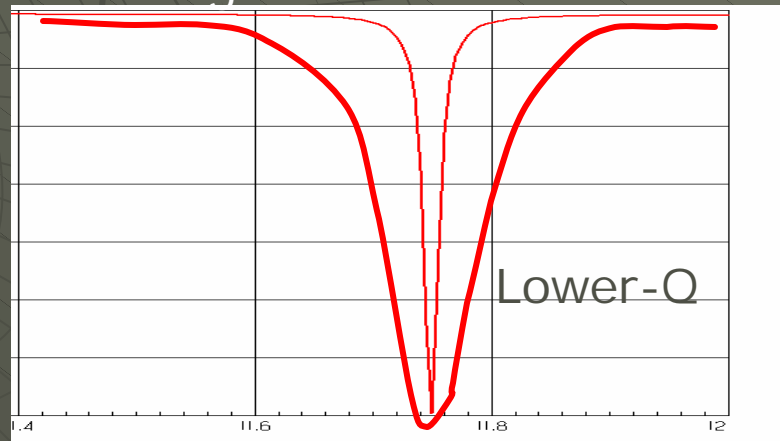
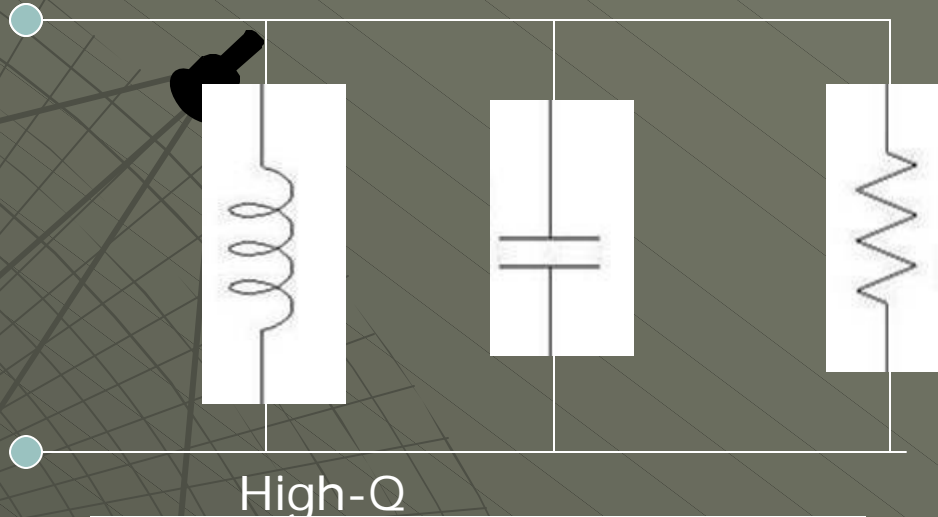
Beam Area	5.823e+000	sr
Directivity	2.158e+000	
Radiated Power	4.445e-002	W
Accepted Power	6.533e-002	W
Radiation Efficiency	6.804e-001	
Max. U(theta,phi)	7.633e-003	W/sr

Efficiency and Bandwidth

- ◆ Efficiency and Radiation resistance

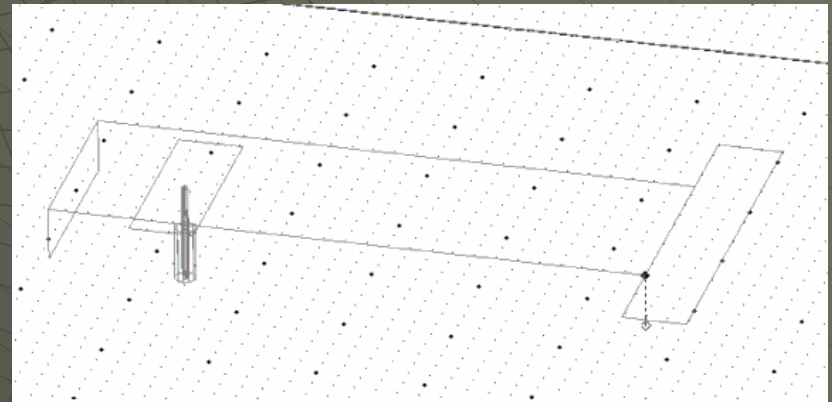
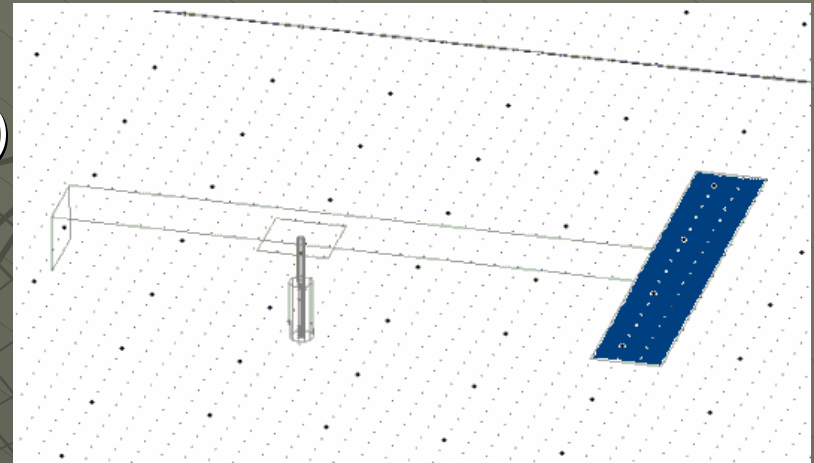
$$\text{Efficiency} = \frac{R_R}{R_R + R_{Loss}}$$

- ◆ Bandwidth and Q
 - Bandwidth $\sim 1/Q$



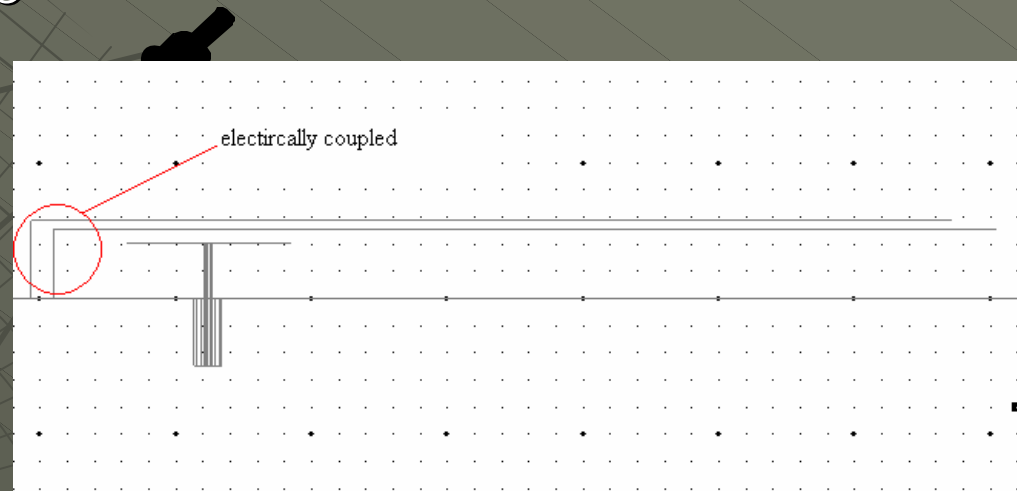
PIFA with Capacitive Load

- ◆ Smaller l \rightarrow greater impedance ($Z = \cot(Bl)$)
 \rightarrow smaller capacitance
 \rightarrow Counter the reduction
- ◆ Length can be reduced dramatically



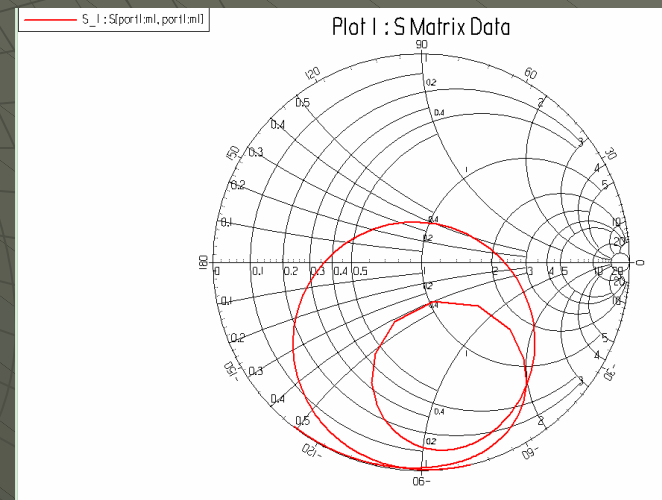
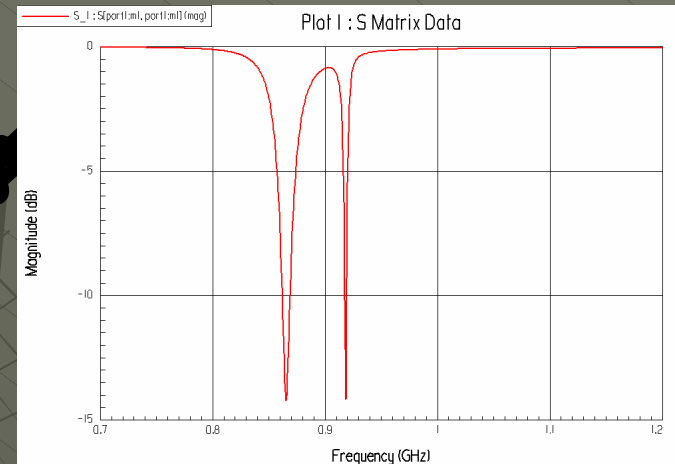
Coupling Two Resonators

- ◆ Electrically couple two resonators to increase the bandwidth
→ Creates two resonant frequencies
- ◆ Parameters determining the coupling
 - Gap between the two plates
 - Distance between the shorted walls
 - Capacitive feed



Results

- ◆ Not enough coupling
- ◆ Radiation Efficiency is sufficient – 84 percent
- ◆ Possible Solutions?
 - Usage of patch antennas with slots
 - Lumped element – chip resistor?



Acknowledgment

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