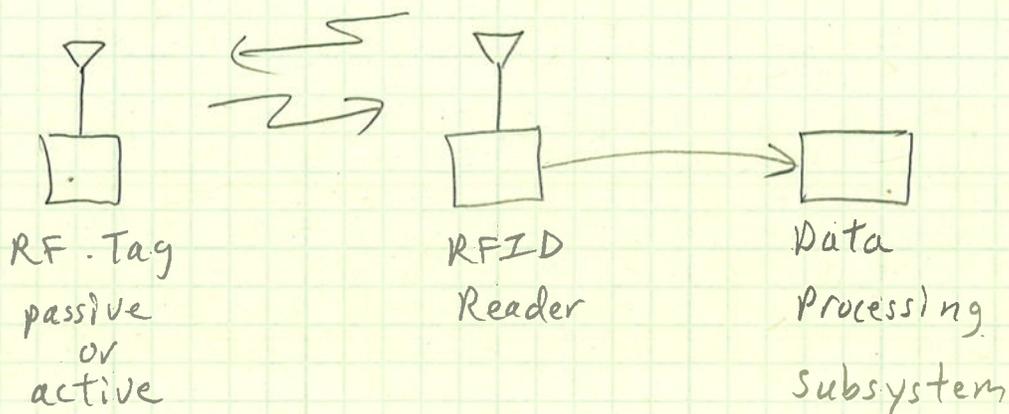


## 1. RFID Review

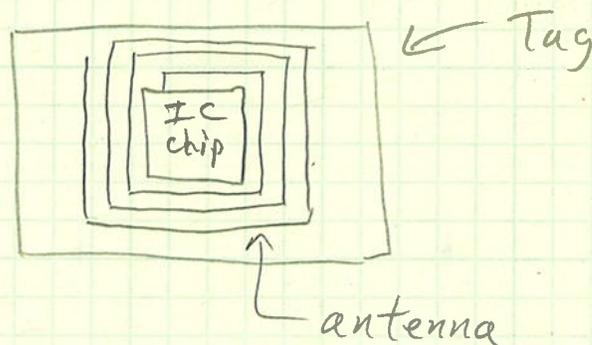


Carrier Frequency : typically  $125\text{kHz} \leq f \leq 2.45\text{GHz}$

### Tag Reader Protocol

- Reader sends out carrier signal and waits for a return
- Tag receives carrier signal and powers up (if passive) or turns on (if active)
- Once the Tag is "on", it clocks out its data by shorting all or a portion of the antenna circuit :
  - ① changing the load if low freq.
  - ② changing the effective RCS if high freq

## 2. Typical Tag Design



a. Antennas

→ often printed onto the tag

① Loop Antennas

→ used for lower frequency tags

ex: 13.56 MHz or 125 kHz

→ parallel resonant LC loop antenna coupled to the carrier frequency

→ acts similar to a transformer → for magnetically coupling

② UHF Antennas

→ various designs used

③ Fractal Antennas

→ wide bandwidth

b. IC chip

serves all other functions (typically)

→ Antenna matching network

→ Voltage regulation

→ clock circuits

→ memory

→ logic / microcontroller functions

→ interface to battery (active tags)

→ interface to sensors (if used)

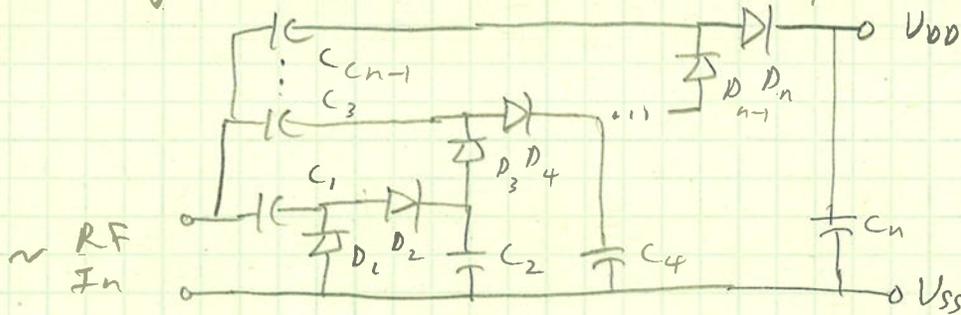
→ data readout

### ① Matching Network

→ High Q at carrier frequency to effectively couple RF energy

### ② Voltage Regulation

→ Charge Pump often used to provide DC power



D → Schottky diodes with low turn on voltage

$$V_D \sim 200\text{mV at } 7\mu\text{A}$$

$$V_{DD} = n(V_{RF} - V_D)$$

n = number of diodes

How it works :

C<sub>1</sub> charges up to  $V_{RF} - V_D$  every  $\frac{1}{2}$  cycle

C<sub>2</sub> eventually charges up to  $2(V_{RF} - V_D)$

C<sub>3</sub> then charges up to  $3(V_{RF} - V_D)$

⋮

C<sub>n</sub> charges up to  $n(V_{RF} - V_D)$

→ load needs to be low current

③ Digital Subcircuits

→ Clocks generated and used to read stored data out of the memory

④ Data Readout

→ Transistor used to change antenna impedance, affecting carrier amplitude at the reader

c. Active Tags

→ include a battery

→ power for added functions / longer interrogation range than with passive tags

→ need small, long lasting battery

→ limits useful life of the tag

① Semipassive Tag

→ battery power for added tag functions, but not for RF communications