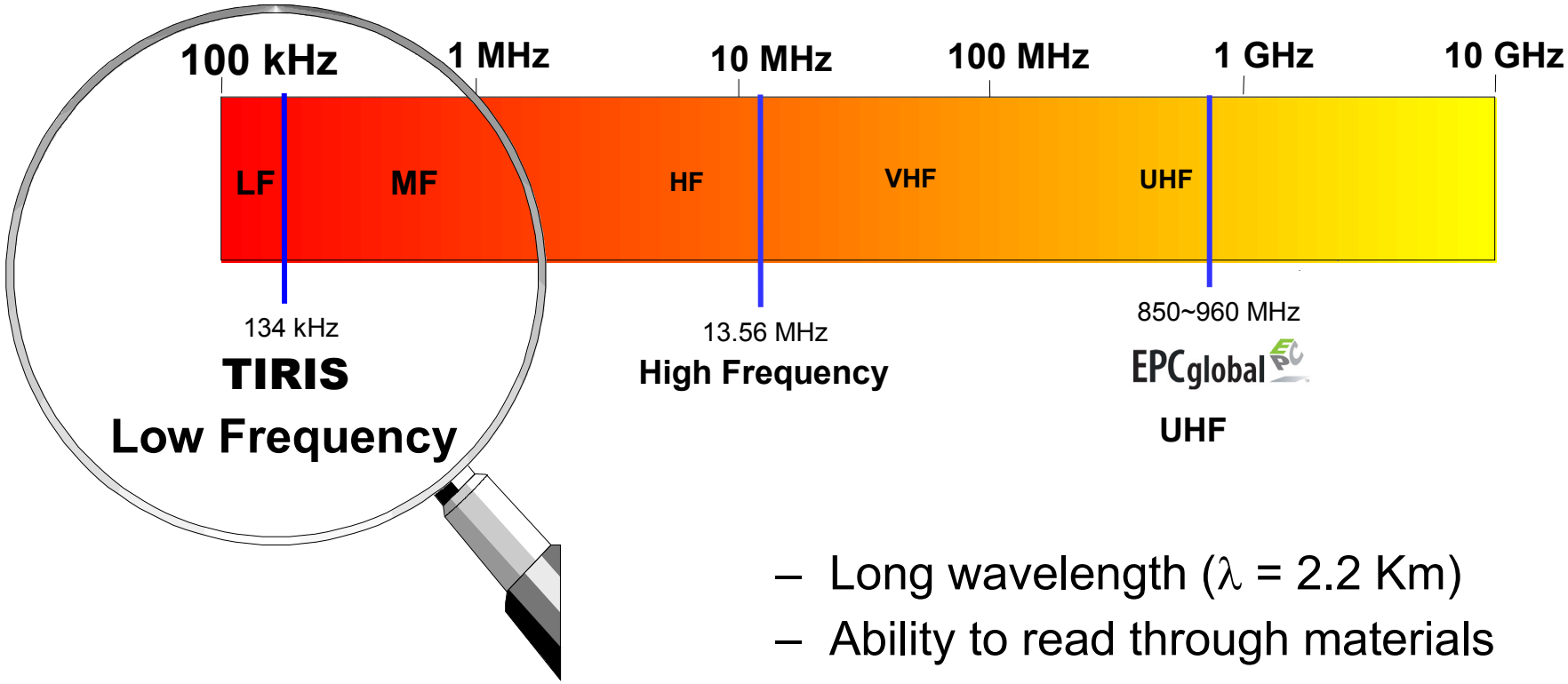
# LF Training

System Overview

# LF System Overview

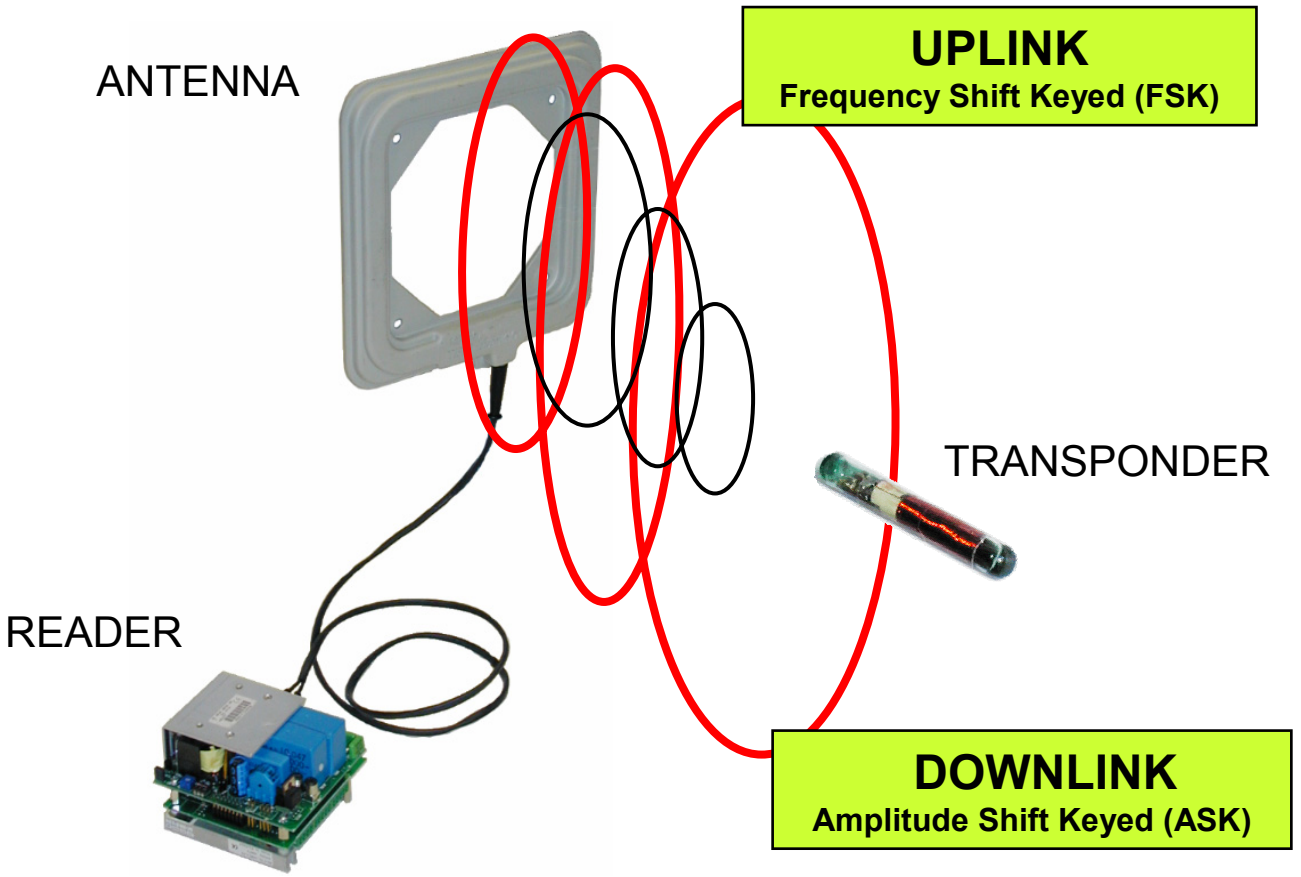
- The Radio Spectrum




- Long wavelength ($\lambda$ = 2.2 Km)
- Ability to read through materials
- Unaffected by water
- Well defined magnetic field

# LF System Overview

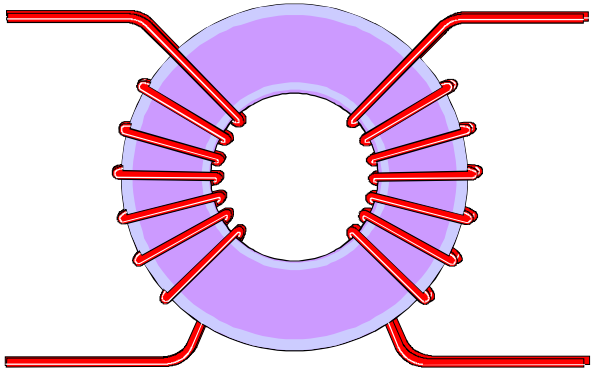
- System Components



# LF System Overview

- Energy Transfer
  - LF Readers use the magnetic component (H-field) of the electromagnetic wave to transfer energy from the Reader's antenna to the tag's antenna.
  - This can be compared to the way a transformer works but using air in place of a ferrite core

READER ANTENNA

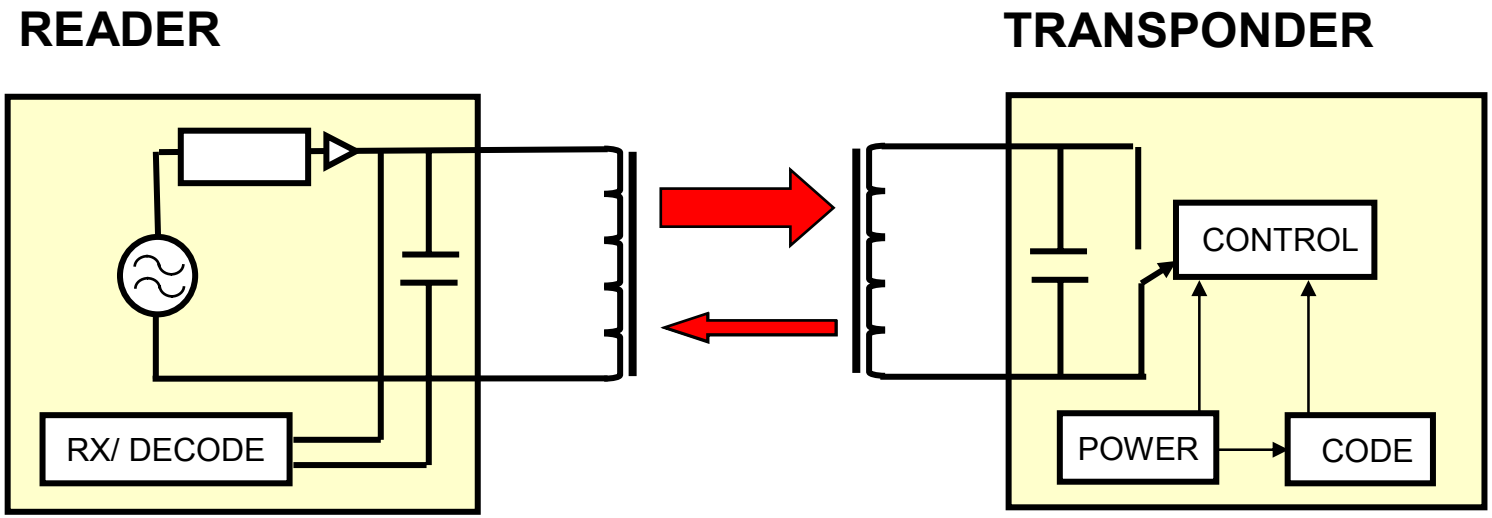


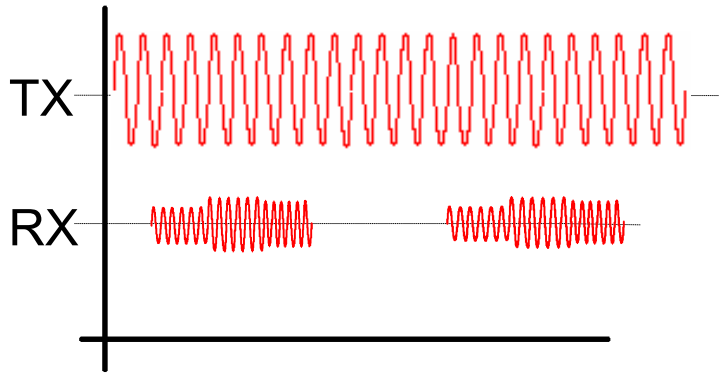
TAG ANTENNA

  - The Reader's antenna induces a voltage in the Tag's antenna

# LF System Overview

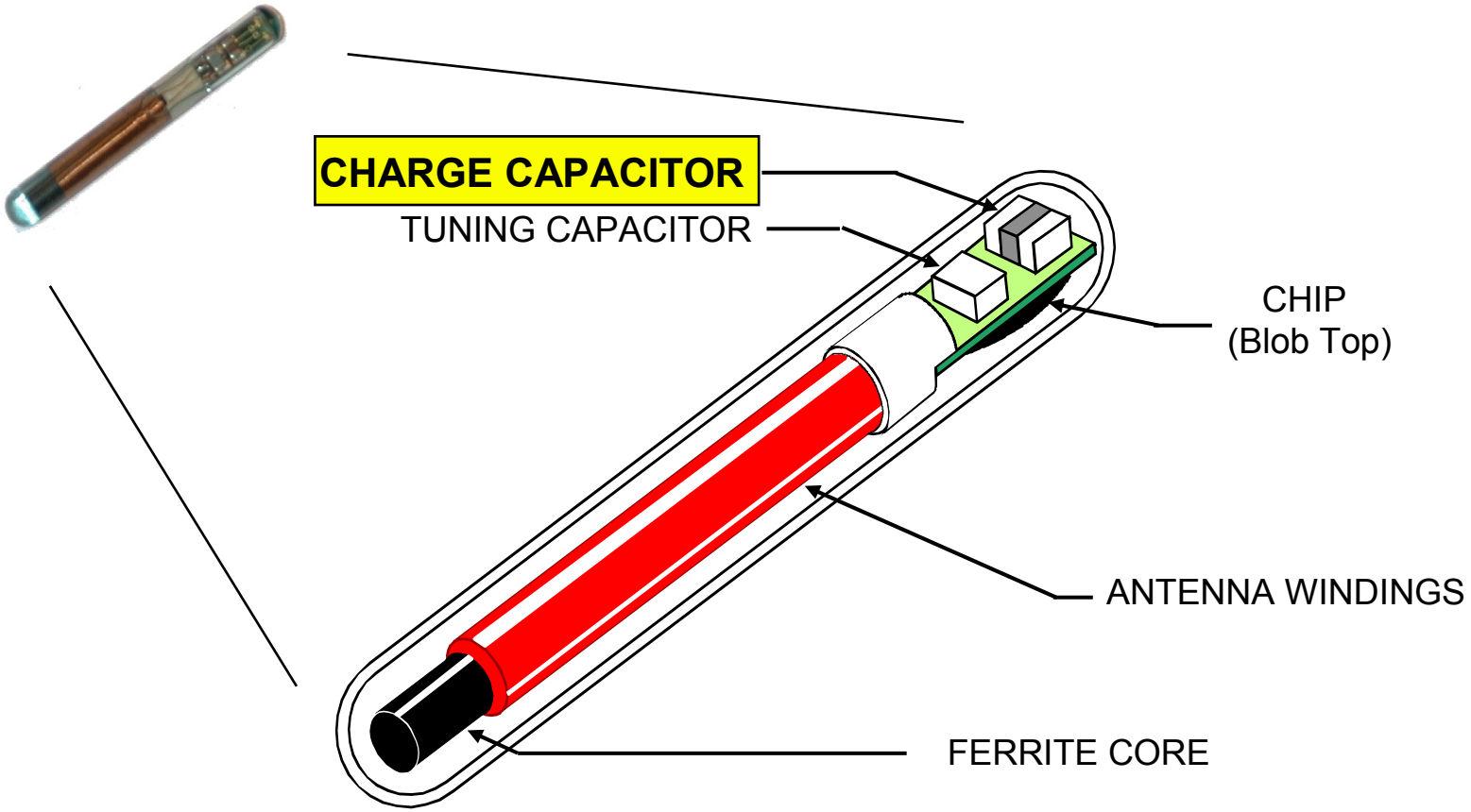
- A competitive FDX AM System



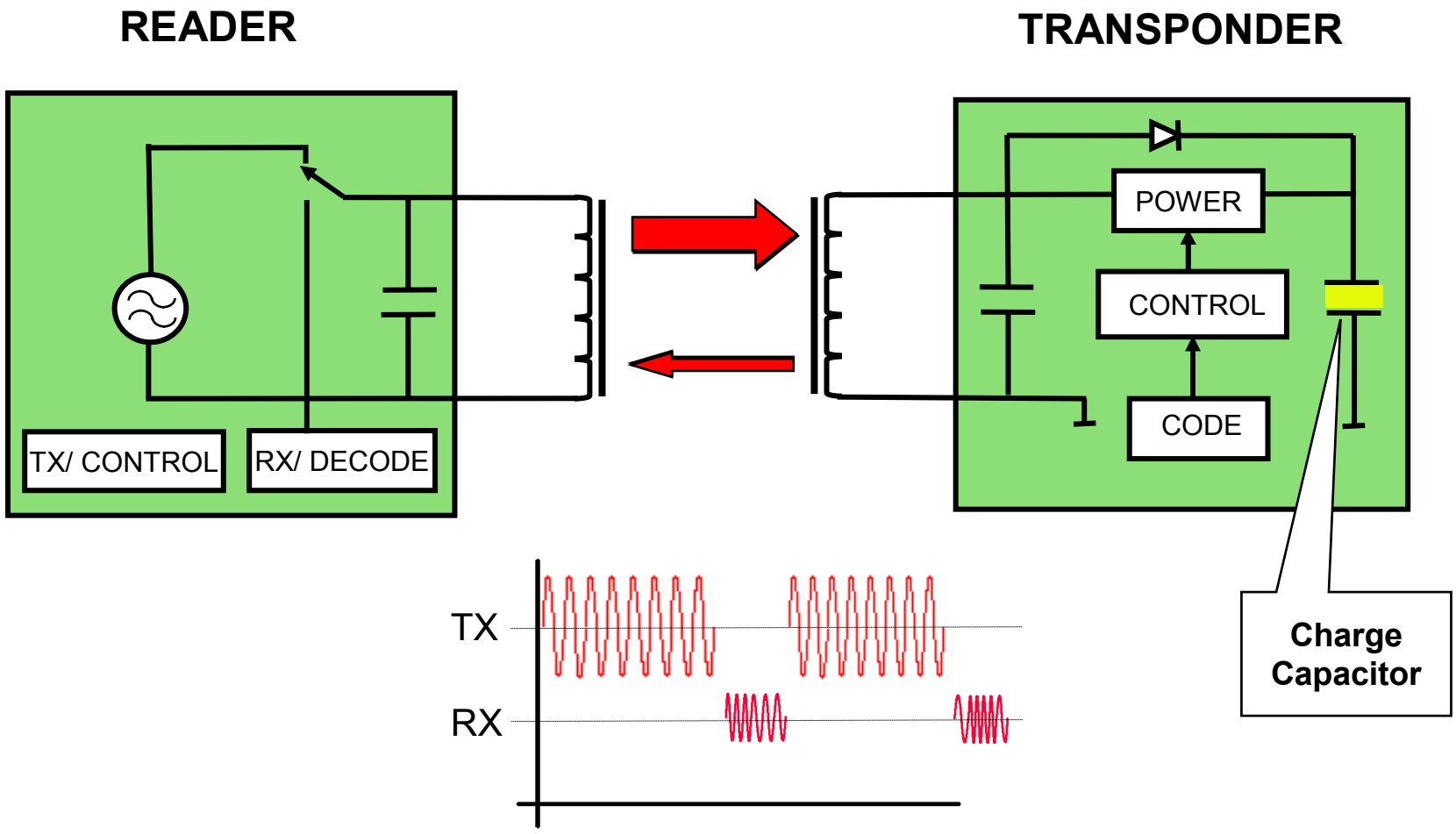
# LF System Overview

- 32 mm Glass Transponder **(RI-TRP-RB2B)**



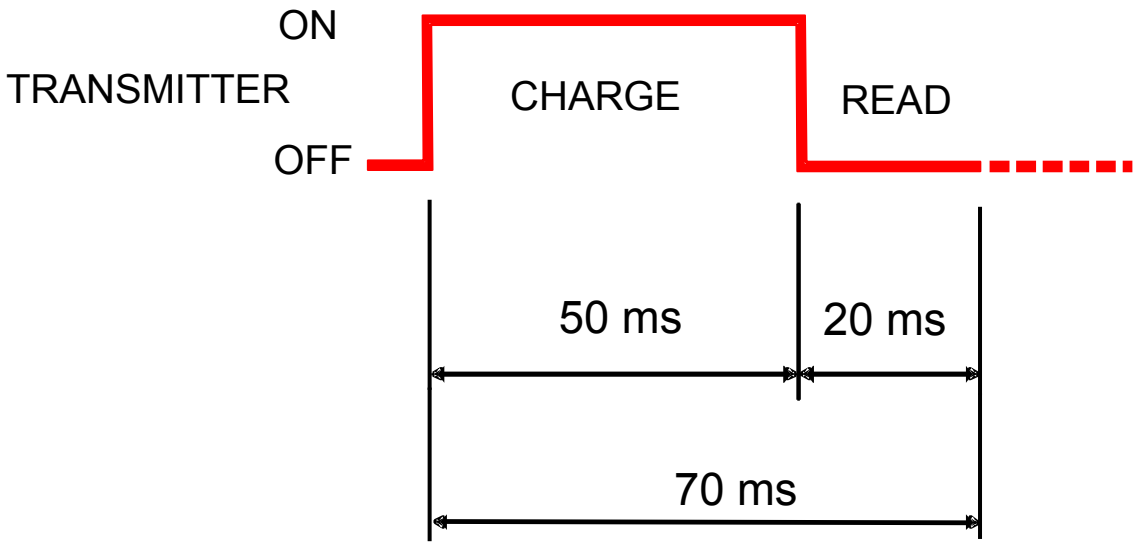
# LF System Overview

- Texas Instruments' HDX FM System



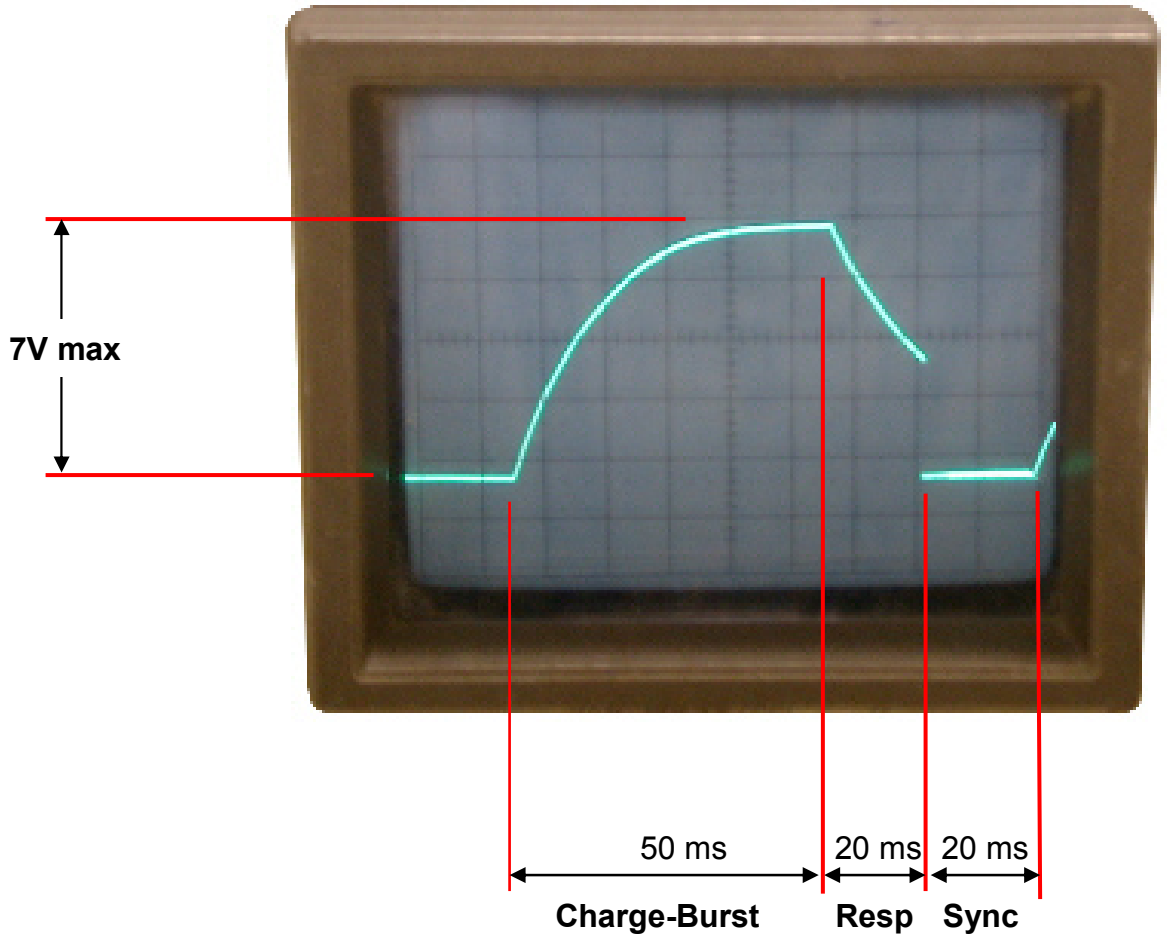
# LF System Overview

- Charge-Only Read
  - R/O, R/W and MPT



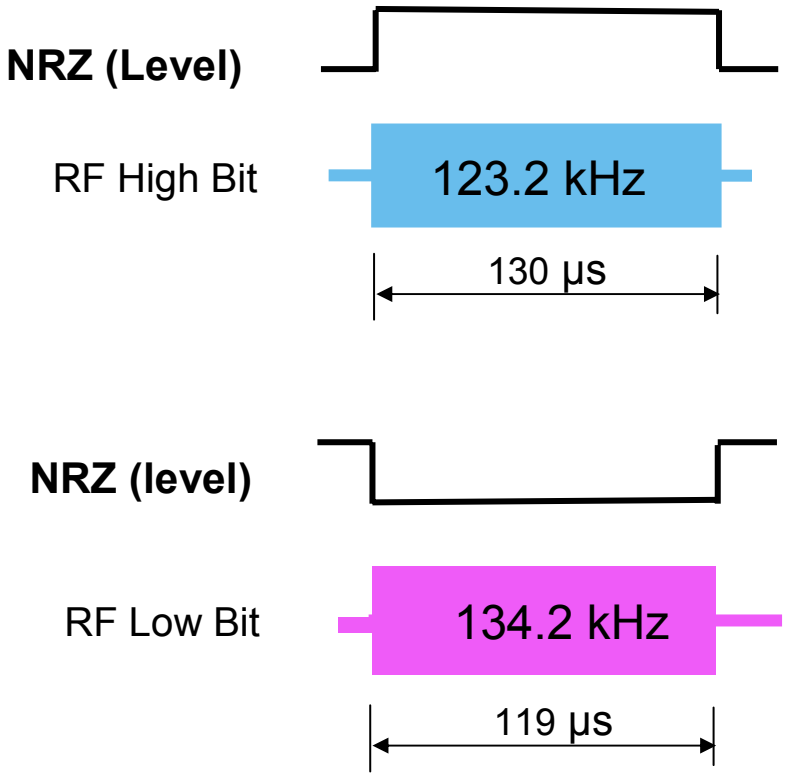
# LF System Overview

- Transponder Charge-Read Timing



# LF System Overview

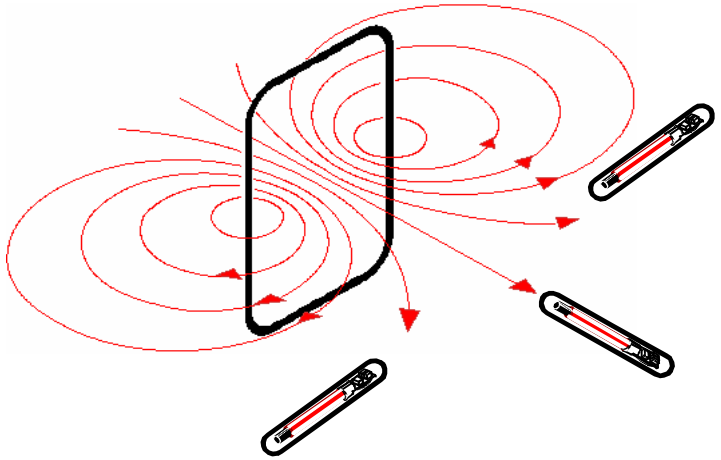
- Uplink Modulation **- FSK**

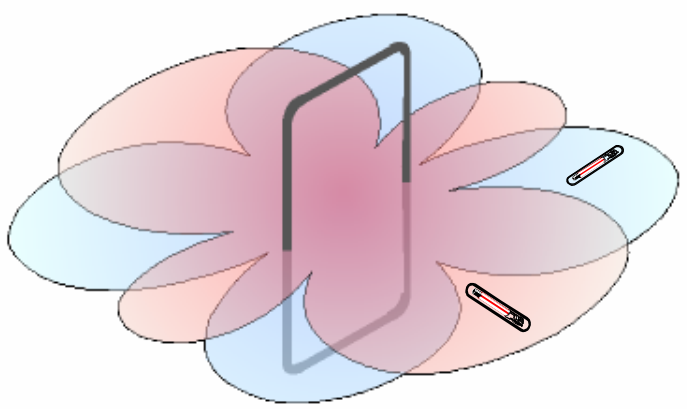



- Frequency Shift Keyed (FSK)
- NRZ Encoded
  - 2 Frequencies
    - 123.2 kHz
    - 134.2 kHz
- Good noise immunity
- 'Signal Capture' effect

# LF System Overview

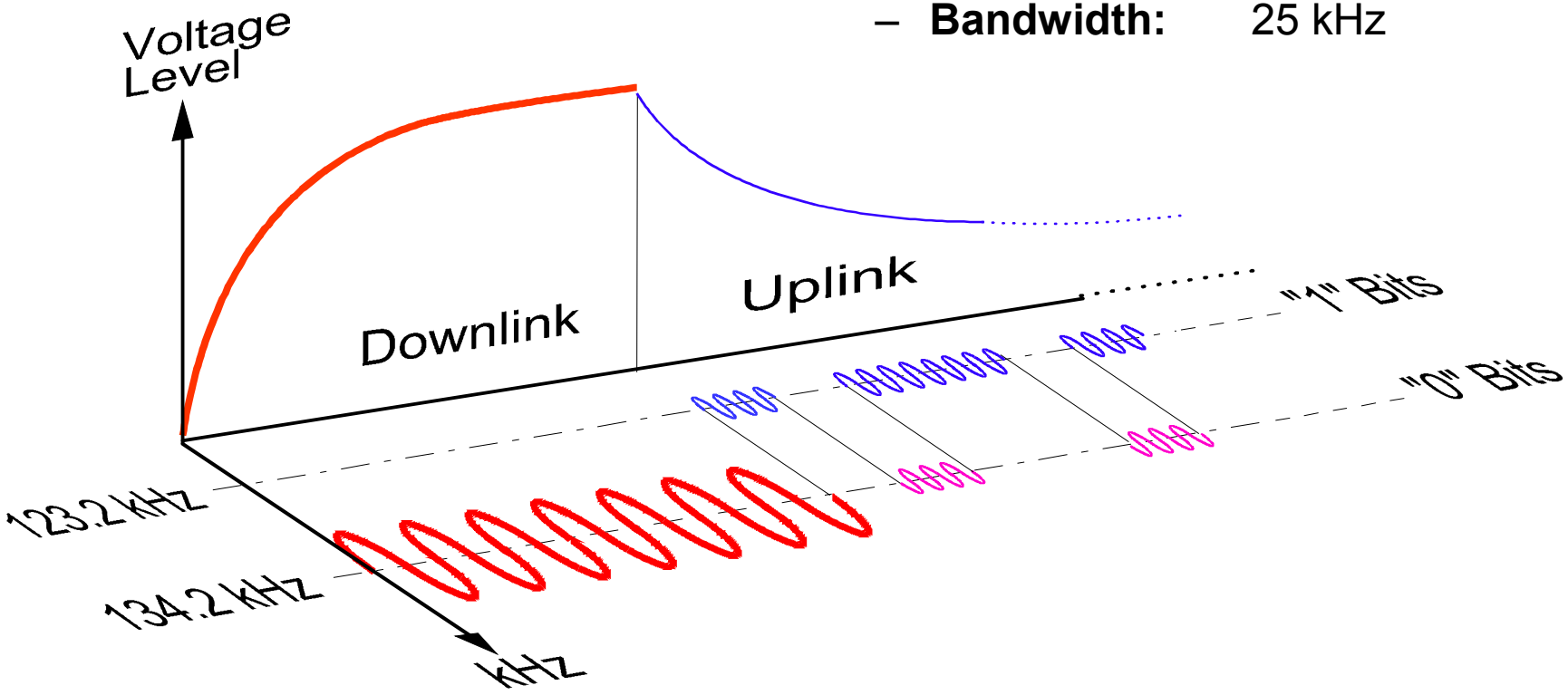
- LF Transponder Reading Performance
  - Reading distance is related to tag's antenna size
    - The bigger the antenna, the greater the range.
    - The tag has to have a 6 dB stronger signal than the background noise to be detected.
  - Writing performance is ½ to ¾ of the reading distance.
  - Orientation makes a difference:





# LF System Overview

- Read Cycle
  - **Frequencies:** 123.2/134.2 kHz
  - **Modulation:** FM (FSK)
  - **Coded:** NRZ
  - **Bandwidth:** 25 kHz

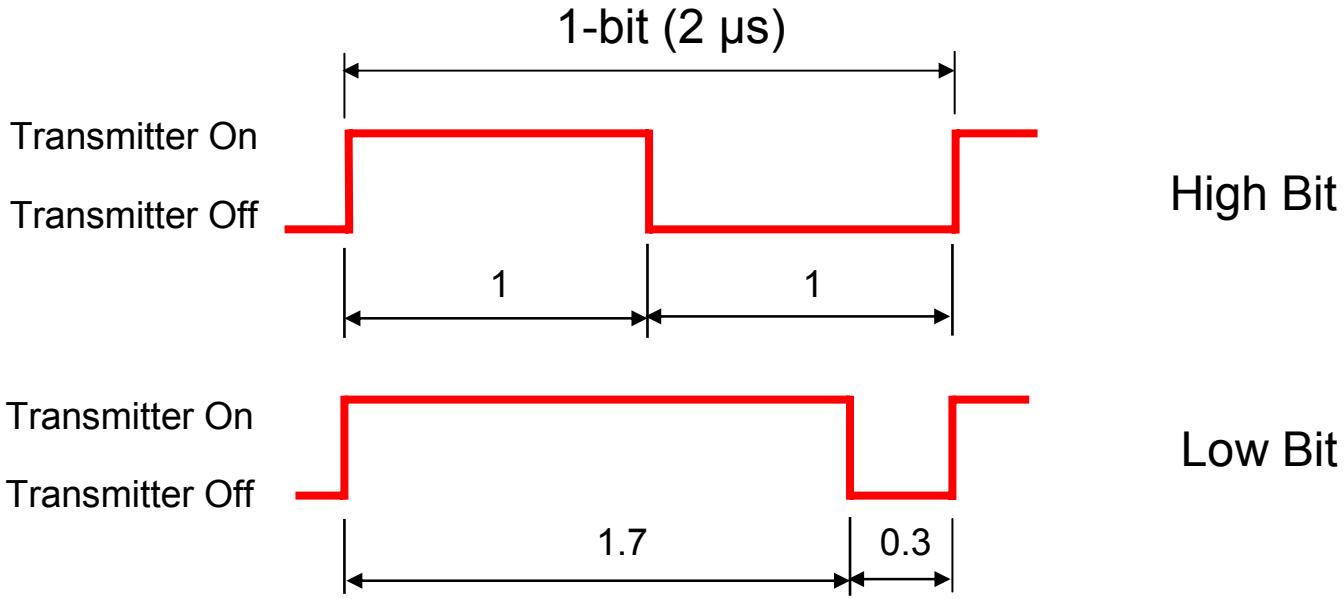


# LF System Overview

- RANGE
  - TIRIS achieves a longer range because
    - The powering phase is independent of the read phase. It is not having to operate in the presence of a strong carrier signal, nor is the weak tag response masked by noisy sidebands
    - Increasing the power increases the range. There is no increase in noise
    - The receiver is optimised - there is no compromise with powering
    - FM is used for the tag response:
      - » The narrow receiver bandwidth gives good noise rejection
      - » Distance derating is approximately 12 cm per 10 dB noise increase
      - » Reduced separation of tags is possible < 5 cm
- SPEED
  - The transmission burst is software controlled allowing shorter charge times for high speed applications

# LF System Overview

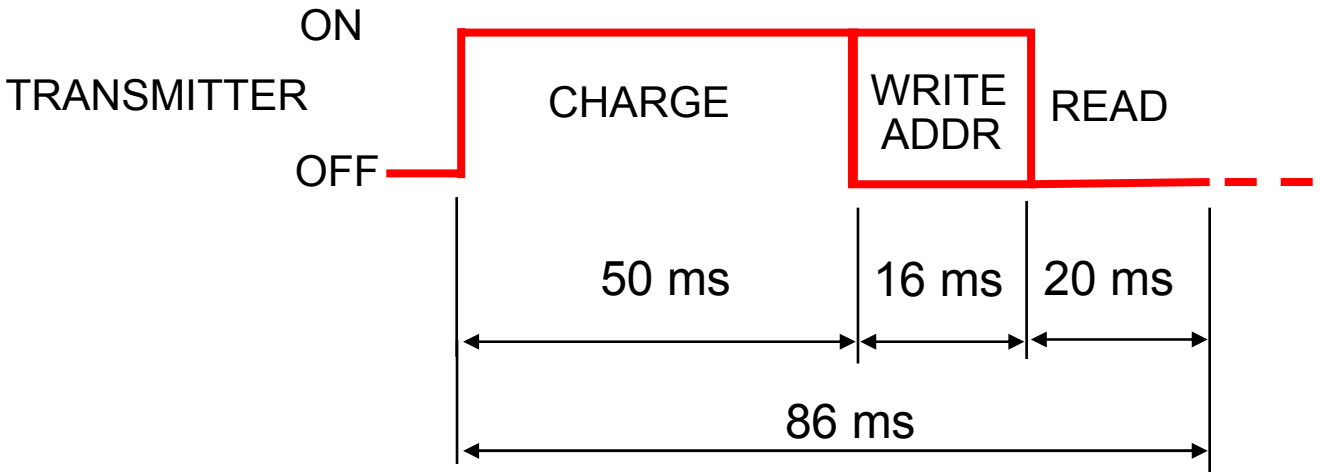
- Passing Data to a Tag
  - To pass data to the tag, the 134.2 kHz carrier signal is pulse width modulated.




  - The ratio of On to Off times tells the tag if it is a high or low bit that is being passed.

# LF System Overview

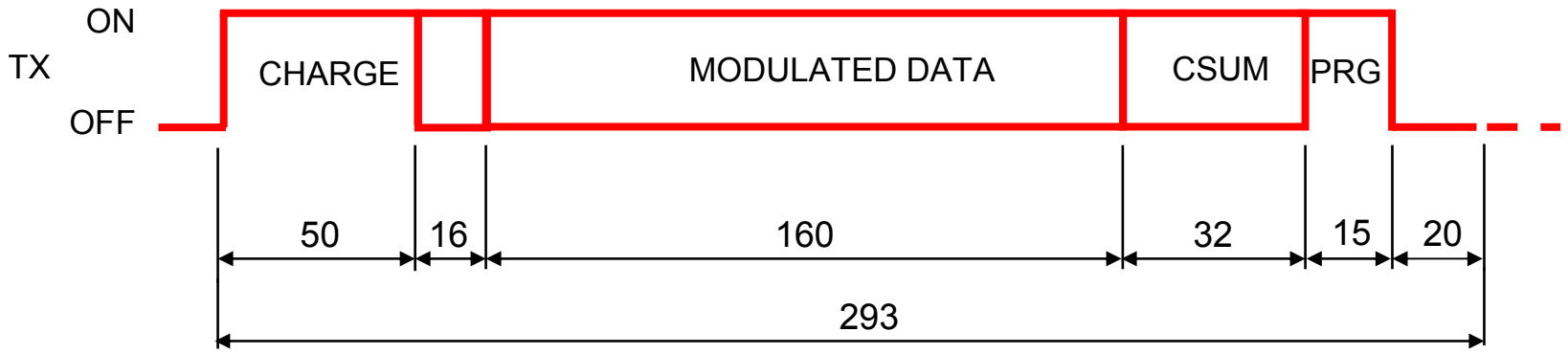
- General Read (R/O, R/W, MPT, MUSA)




  - The transmitter is turned on 100% for 50 ms charge period.
  - The transmitter is then modulated to instruct the tag which operation to perform (Read a page or Lock a page)
  - When the Transmission is complete, the tag responds with the requested data or an acknowledgement.

# LF System Overview

- Writing Data to Tags




  - The transmitter is on 100% for the 50 ms charge period.
  - The transmitter is then modulated to instruct the tag that it is a Write operation and to pass it the data.
  - If the tag is an MPT or MUSA the checksum is validated to ensure the data arrived correctly.
  - Finally the transmitter is turned on again for 15 ms, for full power during the EEPROM programming operation