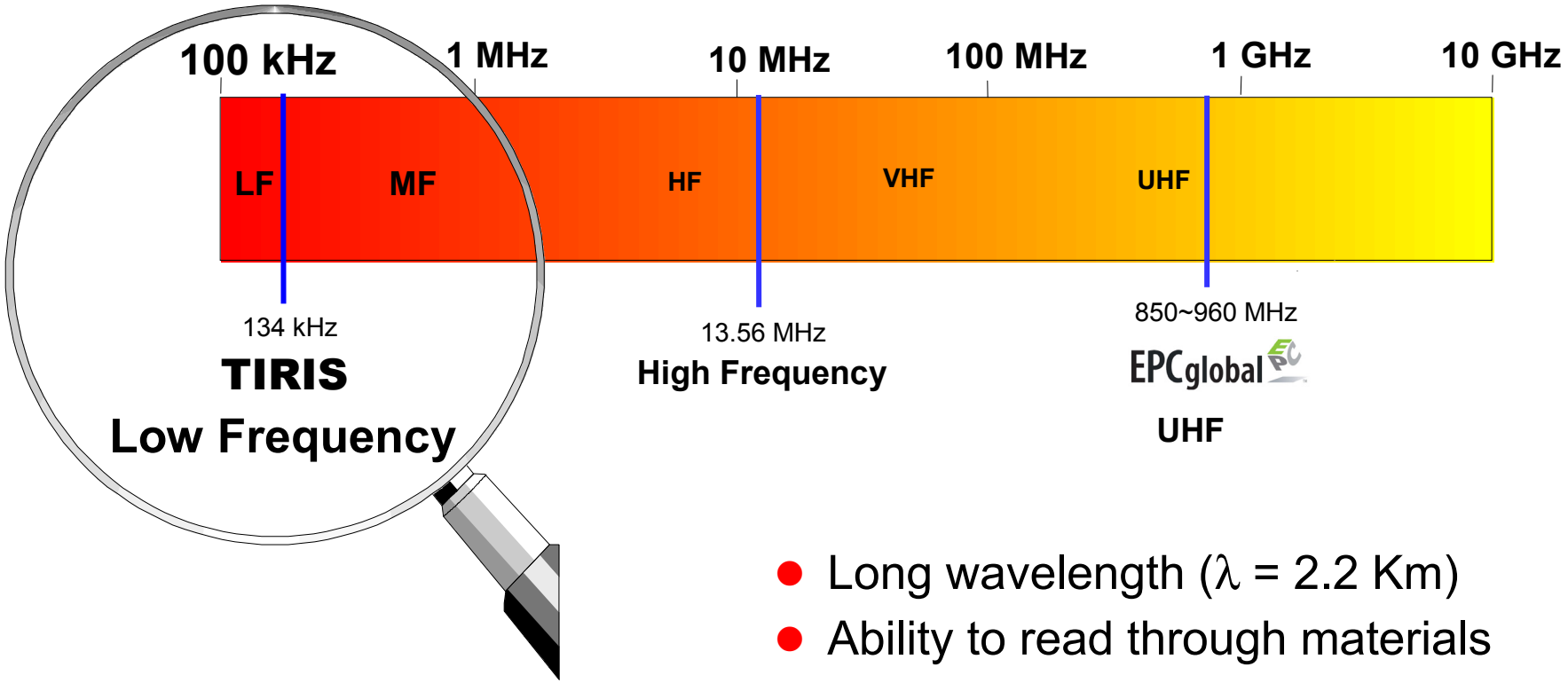
Technical Training

LF System Overview

J.A.G November 2007

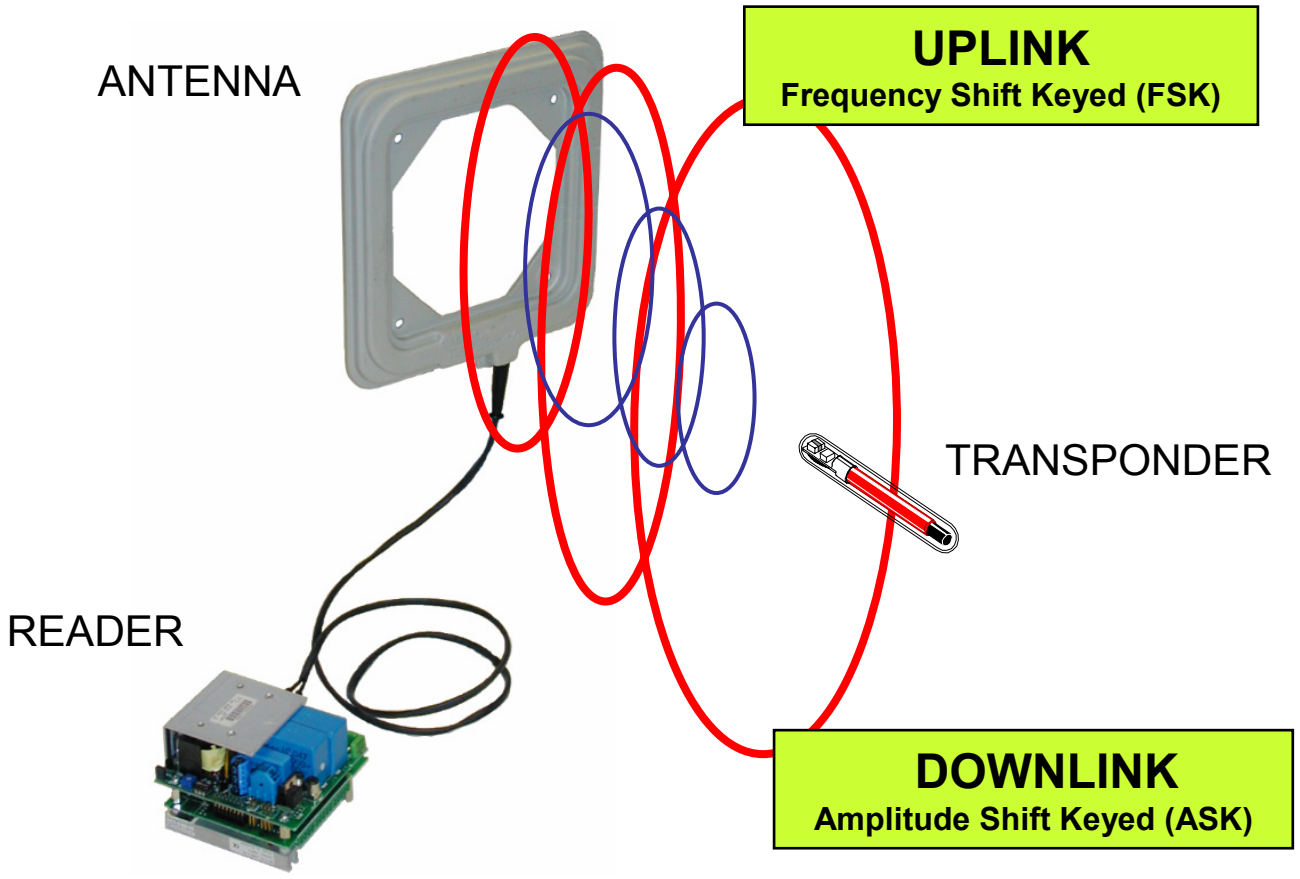
TI-RFid
A TEXAS INSTRUMENTS TECHNOLOGY

The Radio Spectrum



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

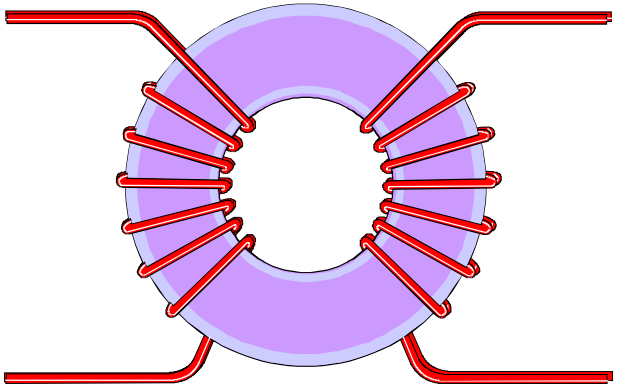
System Components



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

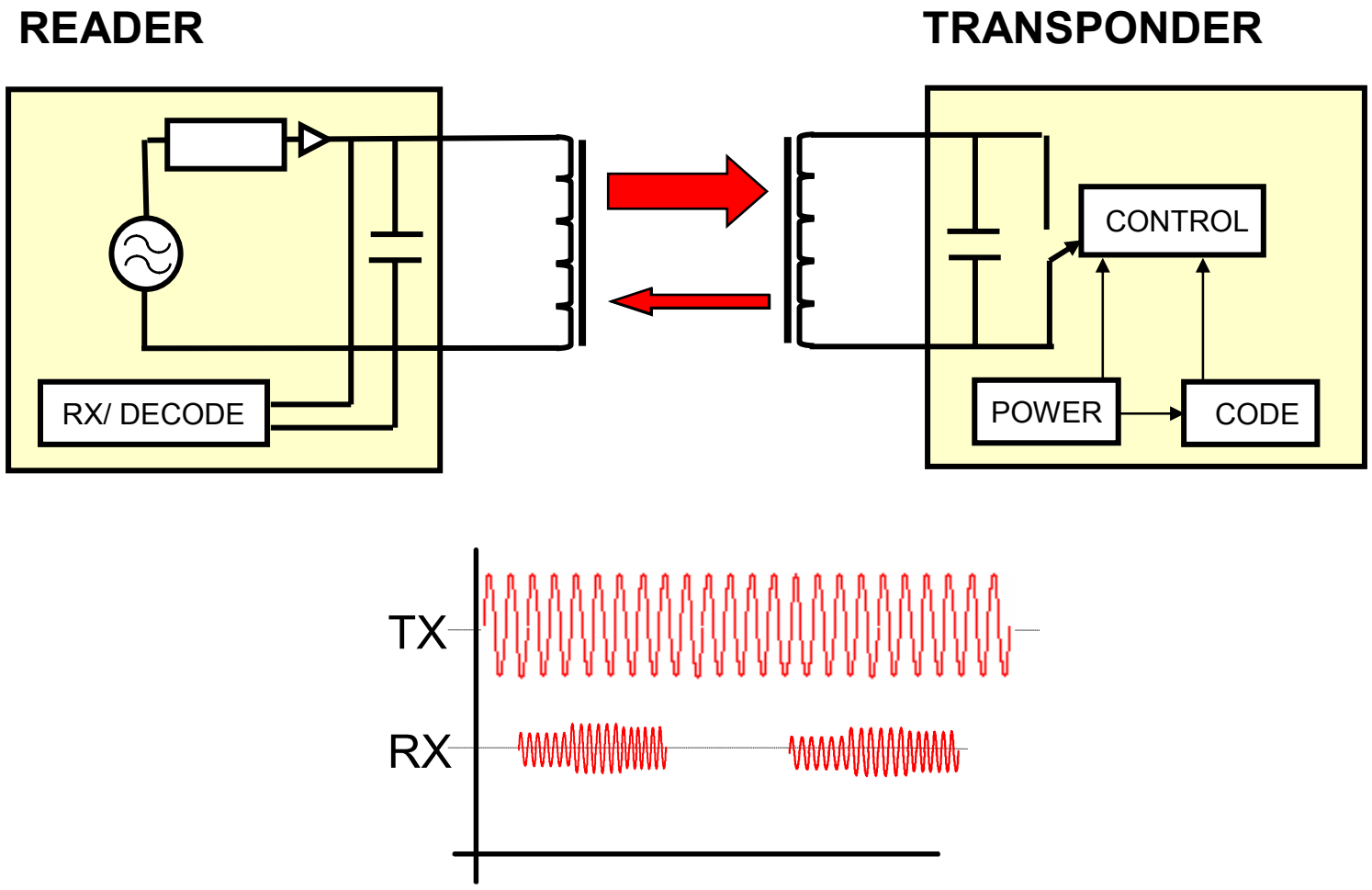
READER ANTENNA



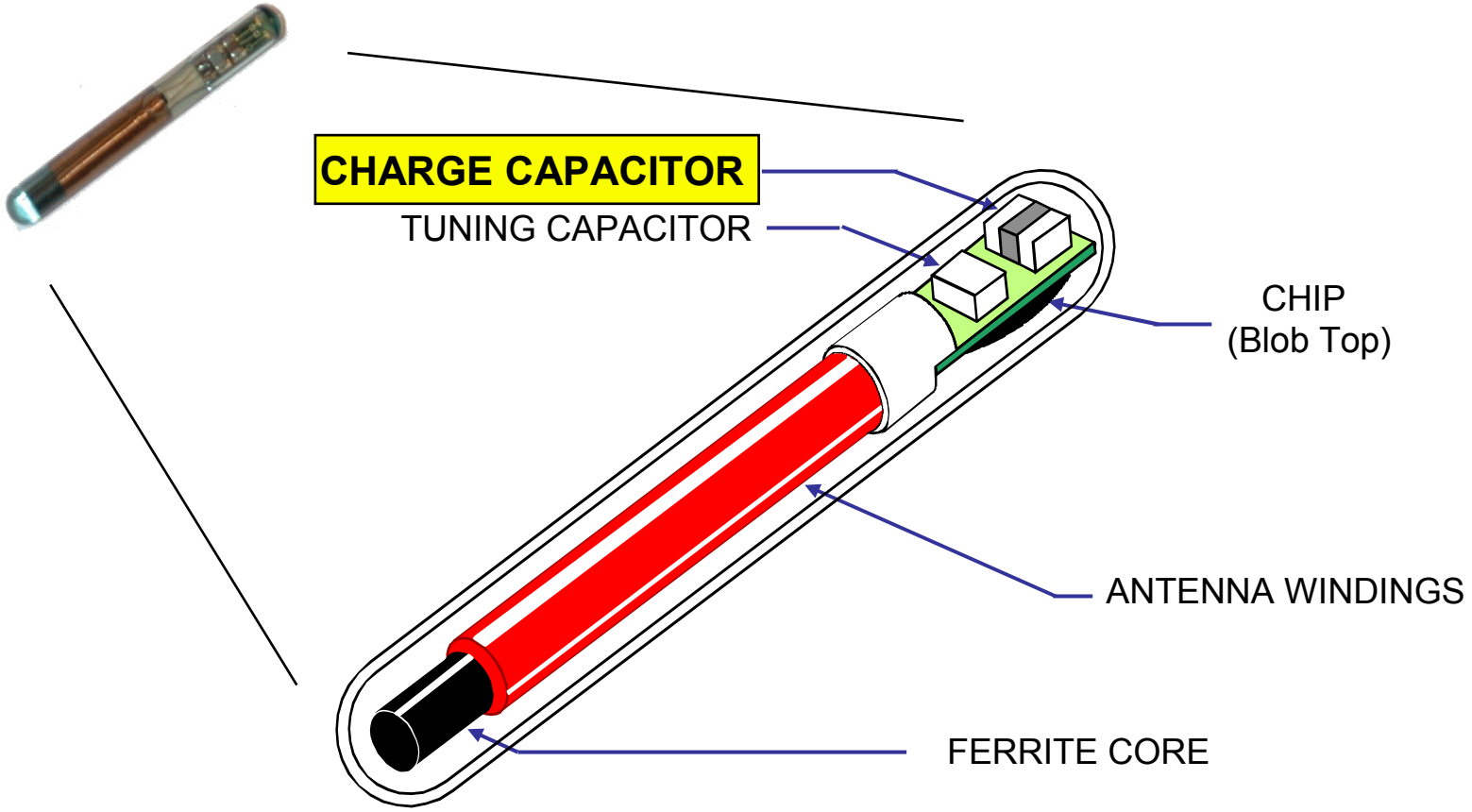
TAG ANTENNA

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

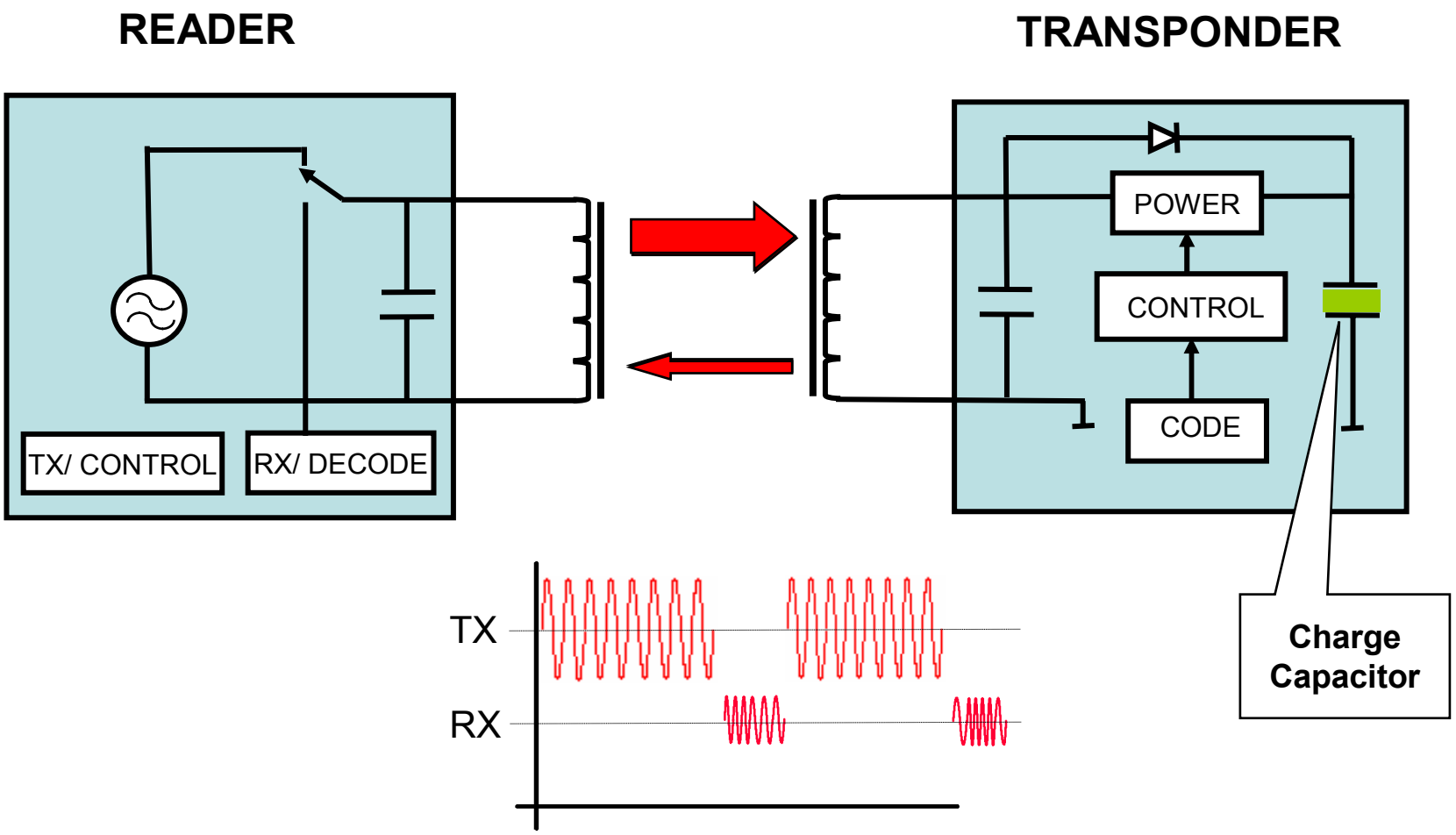
A competitive FDX AM System



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

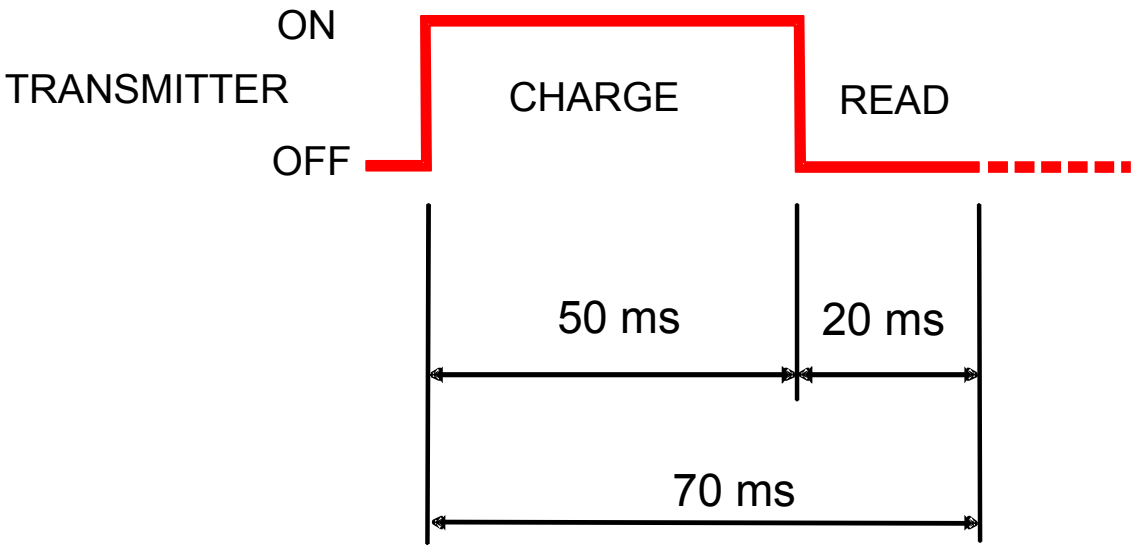


Texas Instruments' HDX FM System

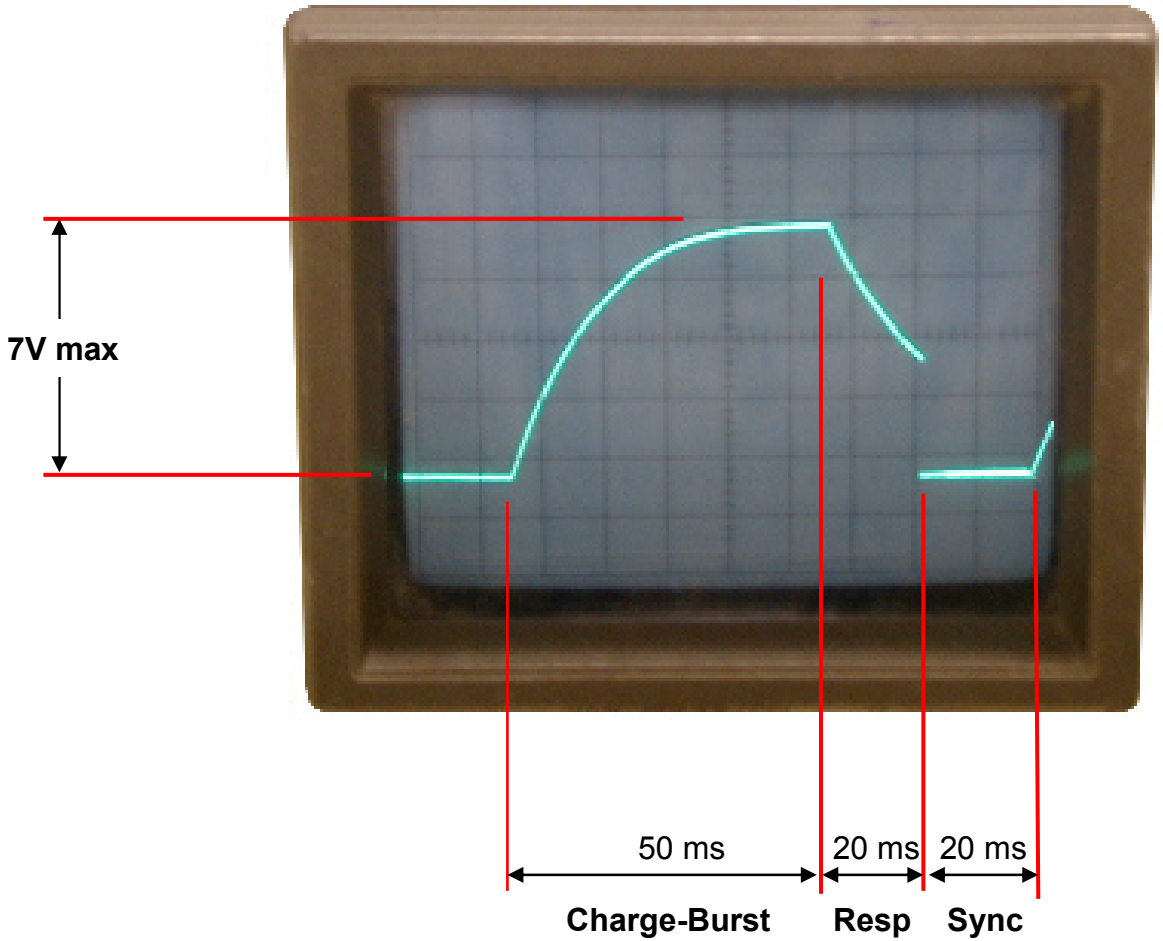


Charge-Only Read

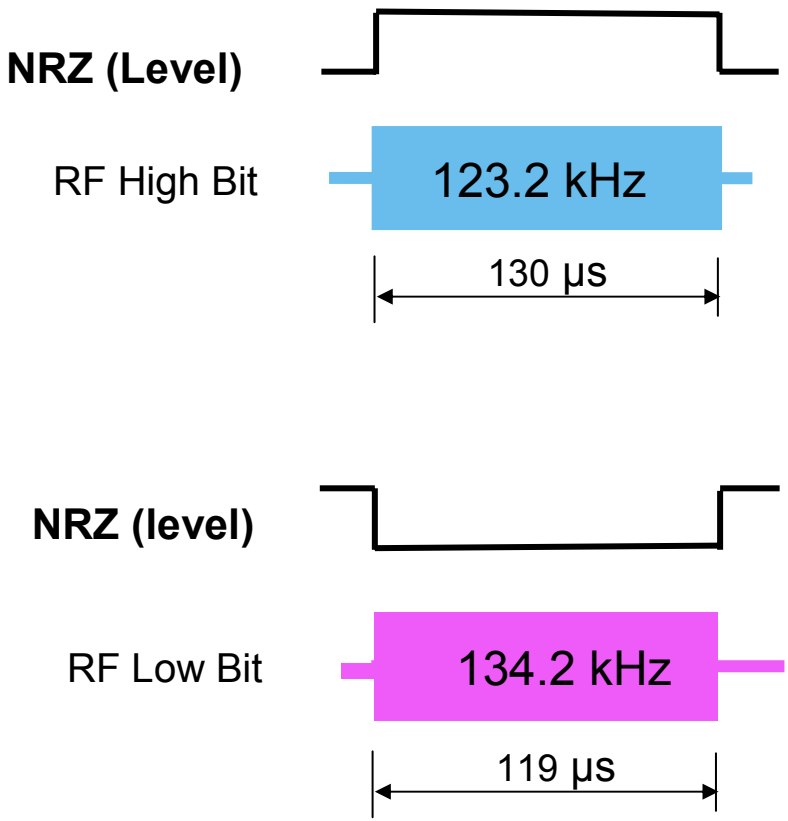
- R/O, R/W and MPT



Transponder Charge-Read Timing



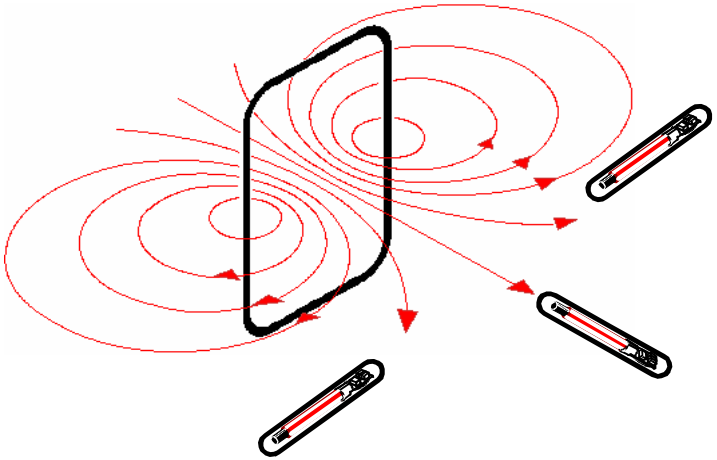
Uplink Modulation - FSK

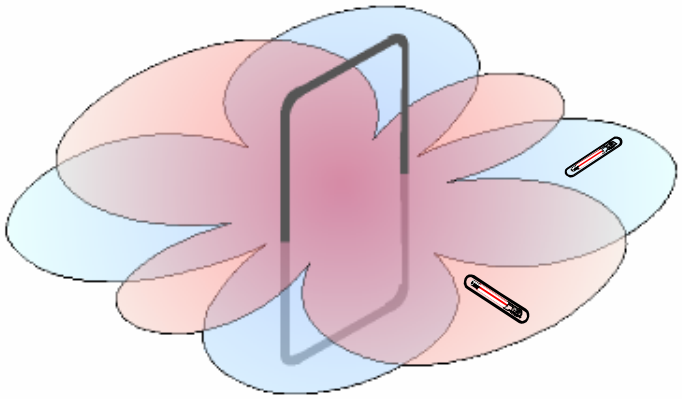


- Frequency Shift Keyed (FSK)
- NRZ Encoded
  - 2 Frequencies
    - 123.2 kHz
    - 134.2 kHz
- Good noise immunity
- 'Signal Capture' effect

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:





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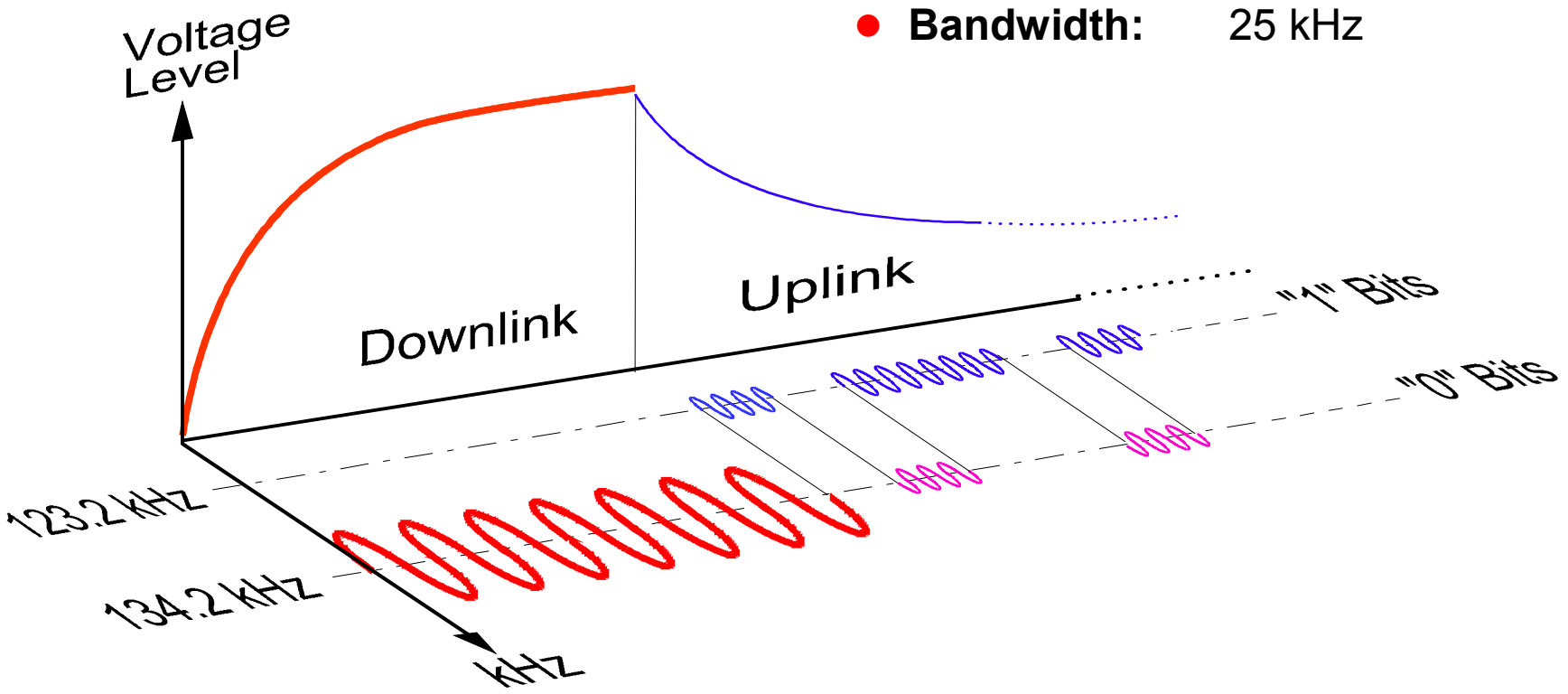
Read Cycle

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



RANGE

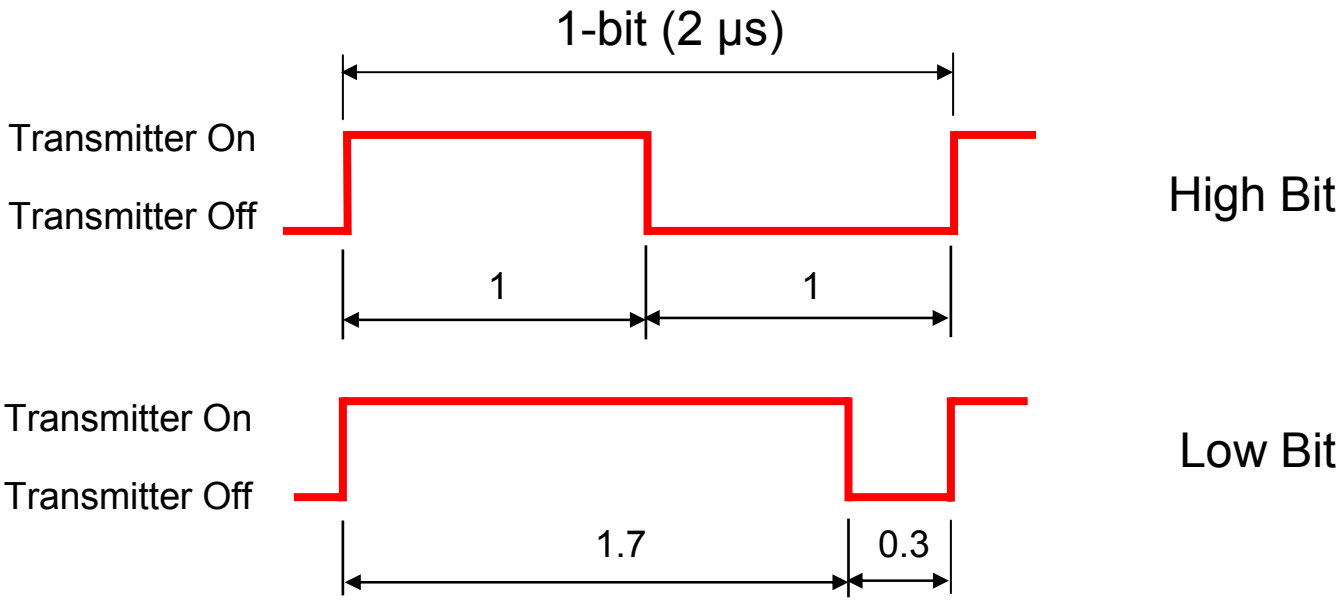
- TIRIS achieves a longer range because
  - The powering phase is independent of the read phase. It is not having to operate in the presence of a strong carrier signal, nor is the weak tag response masked by noisy sidebands
  - Increasing the power increases the range. There is no increase in noise
  - 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

Passing Data to a Tag

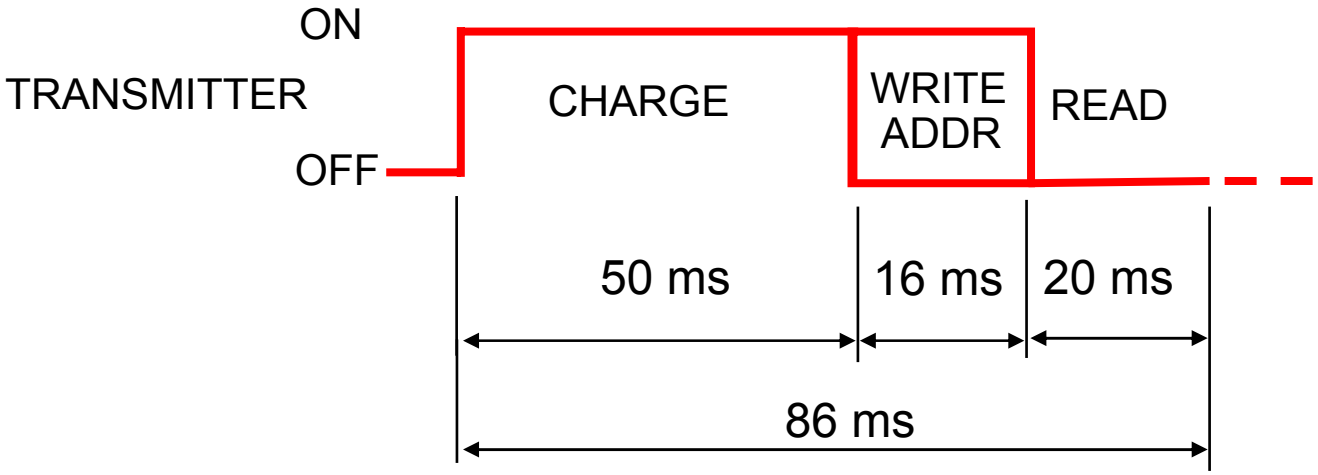
- To pass data to the tag, the 134.2 kHz carrier signal is pulse width modulated.



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

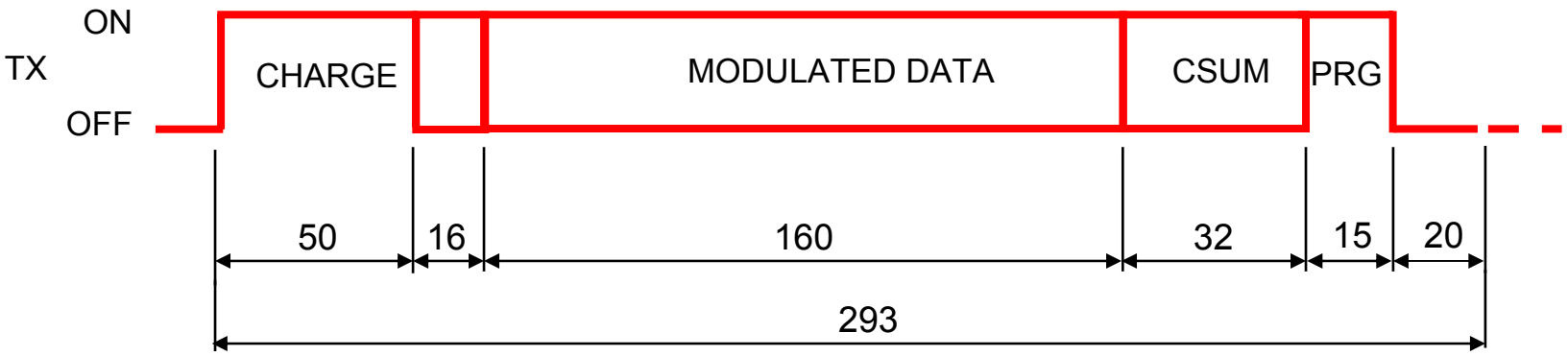
General Read

- (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.

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