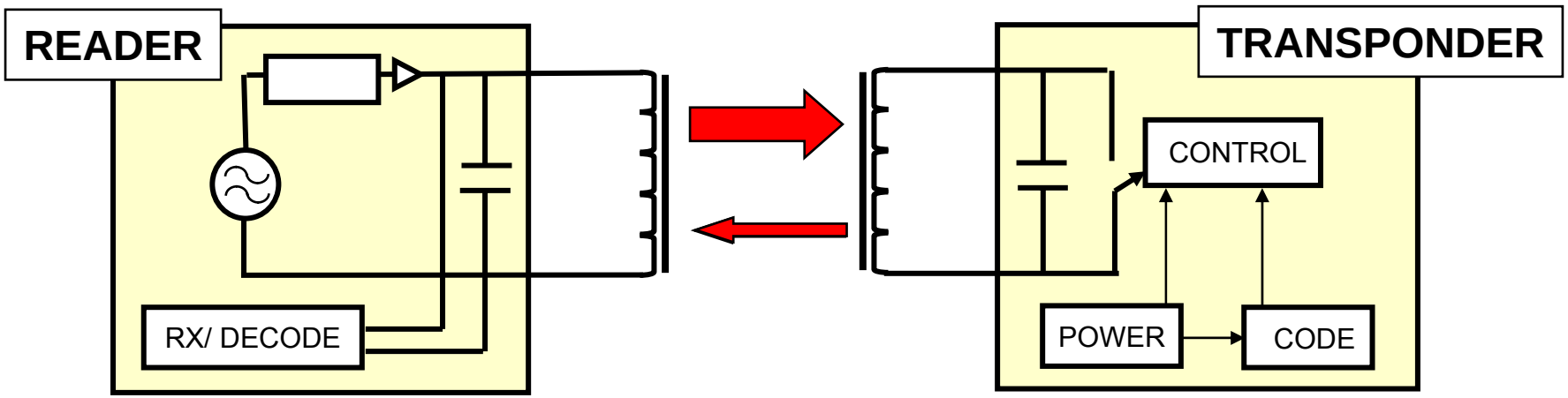
FDX vs. HDX

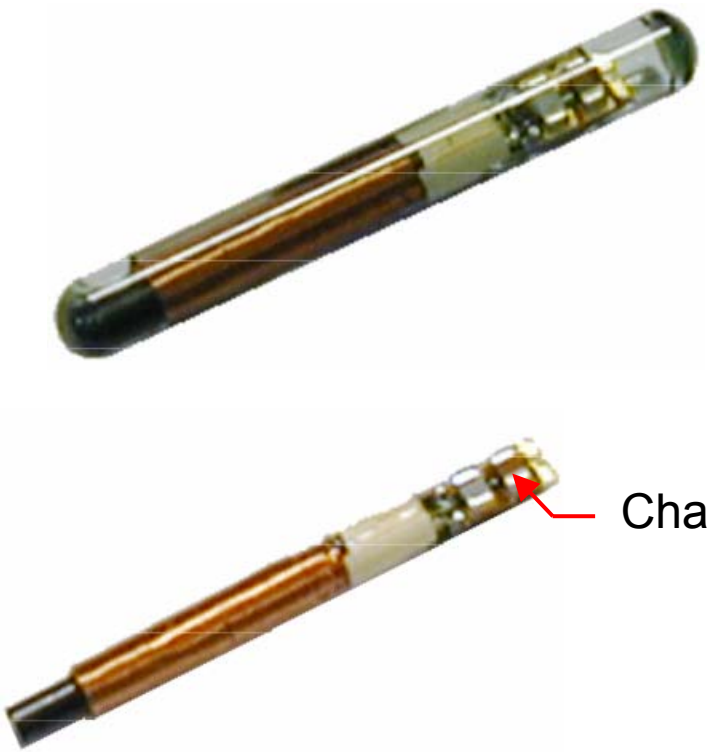
Full Duplex (FDX) Operation

- A FDX system has data travelling in both directions at the same time. It superimposes the response data on the 134 kHz carrier signal using amplitude modulation (AM).



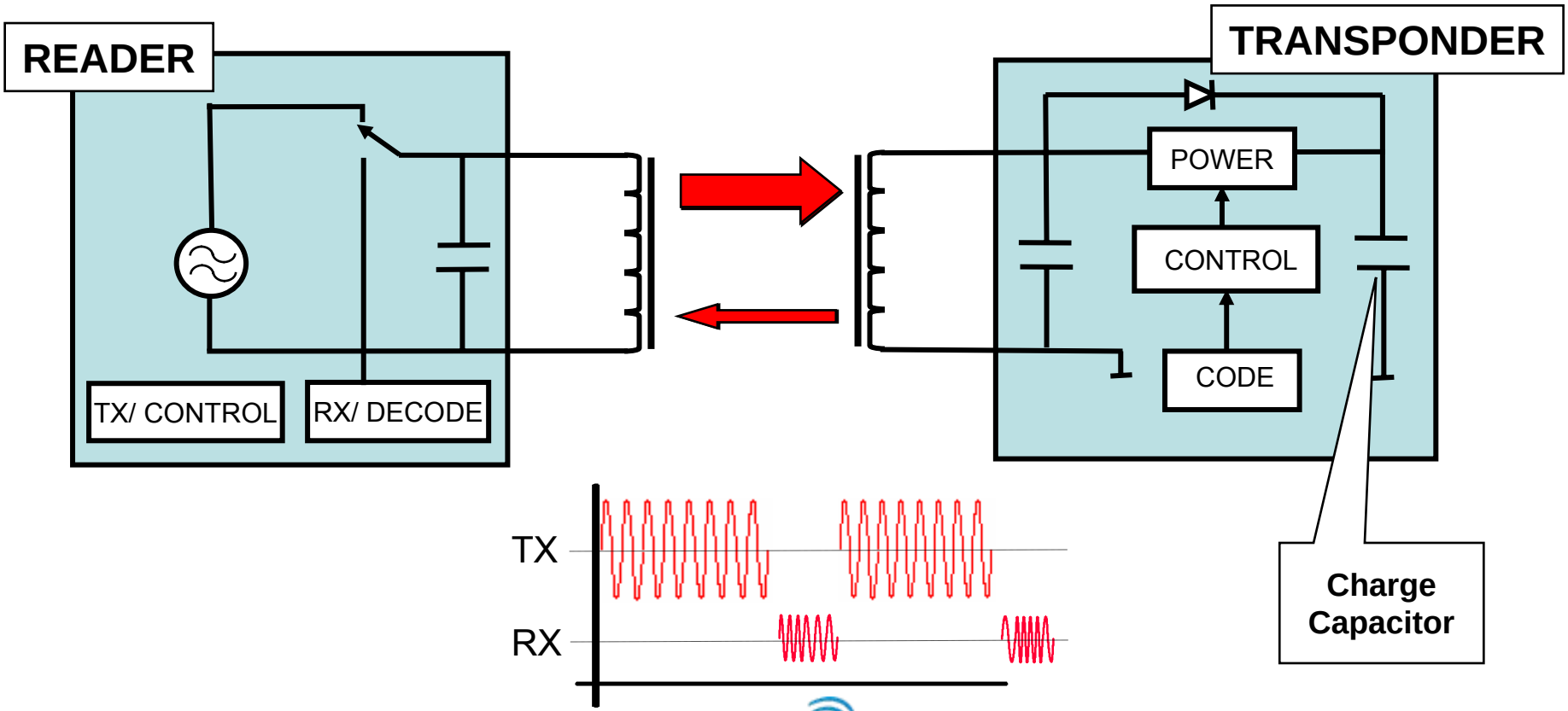
Half Duplex (HDX) Operation

- Texas Instruments' HDX Transponders have an extra charge capacitor that functions in a similar manner to a battery



Half Duplex (HDX) Operation

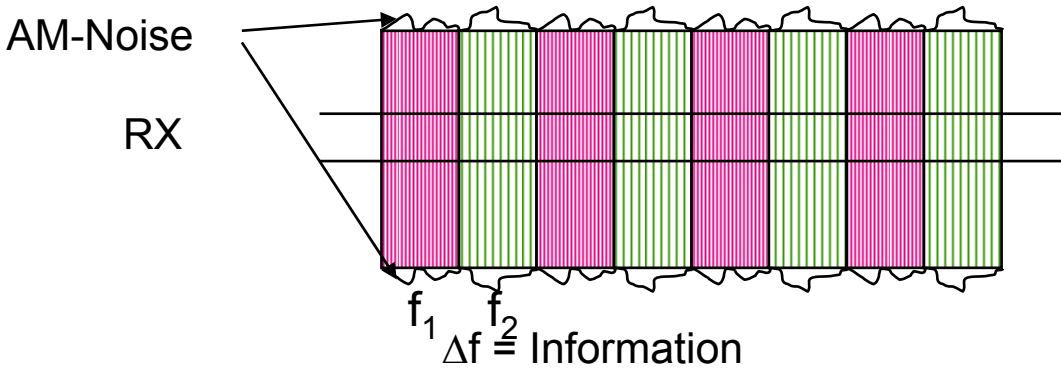
- In a HDX system data is only travelling in one direction at one time. The energy stored in the Transponder's charge capacitor is used to return the data using FM modulation.



AM vs. FM Uplink

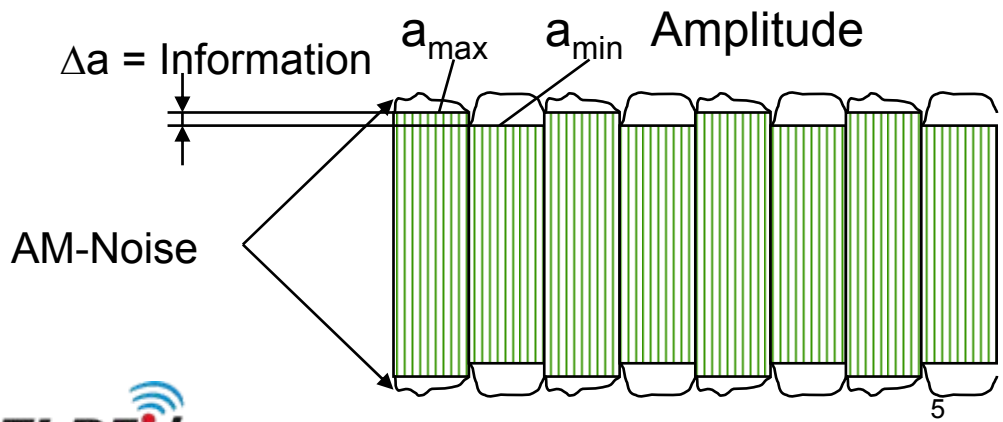
FM System

- Uses Frequency Shift keying
- Exhibits 'signal capture' allowing the reader to discriminate between tags close together by locking onto the strongest signal.
- More noise immune than AM



AM System

- Uses Amplitude Shift Keying
  - Transmitter 100% on or Off
- Easier to implement



Performance Testing

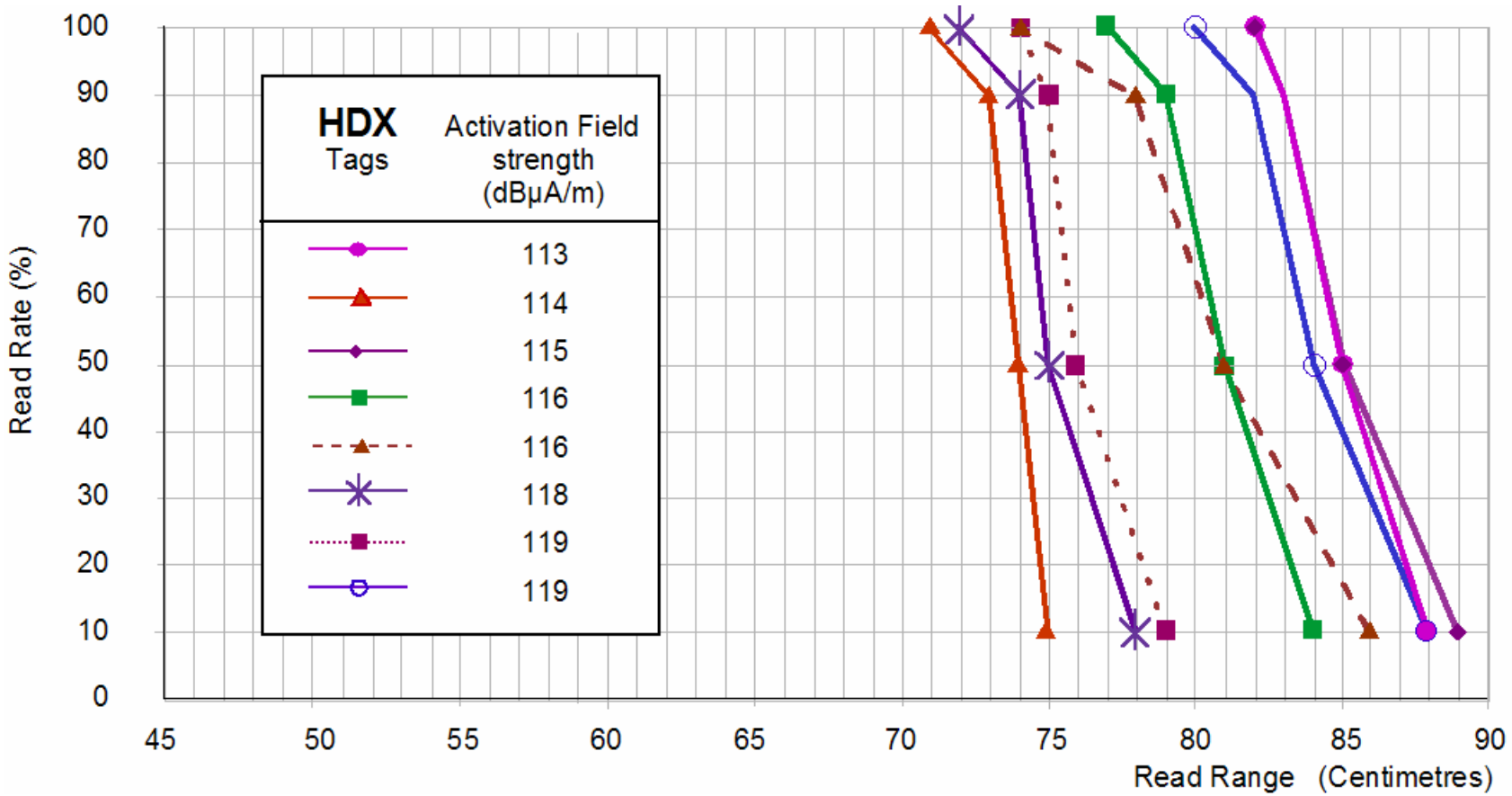
- The following slides detail the results of a recent comparative analysis of FDX and HDX tags. To make the comparison valid, similar sized tags (mainly from livestock applications) were used.

TI Disc tag
(RI-TRP-R9QL)

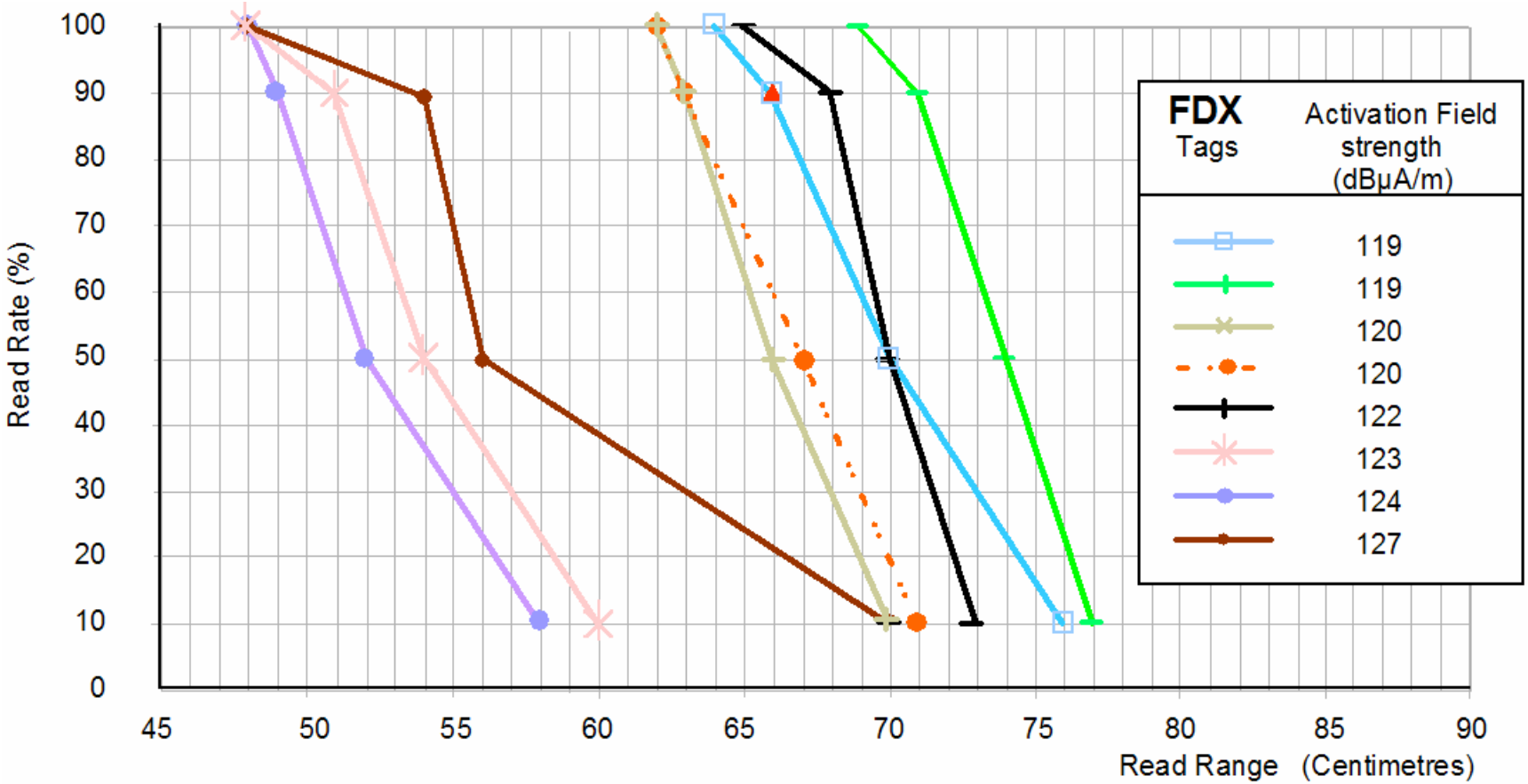
Livestock Eartag

- 8 HDX and 9 FDX tags from different suppliers were compared.
- The reader was an Agrident ASR 700 (dual FDX/HDX technology) with a DAF 206 antenna
- The maximum reading distance is recorded along the horizontal scale for 10%, 50%, 90% and 100% read rates.
- The minimum energy required to activate the tags is also shown in the table (in dBμA/m)

Transponders Compared – HDX Results



Transponders Compared – FDX Results



Conclusions

- With their higher performances, the HDX tags are found on the right hand side of the graph, while FDX tags occupy the left hand side.
  - FDX read ranges vary from 47 cm to 77 cm.
  - HDX read ranges are from 72cm to 89 cm
- Activation field strengths are generally lower for HDX tags
- If the slopes of the read rates are examined, FDX tags have to be increasingly closer to the antenna if consistent performance is needed.
- If 100% performance is required
  - FDX tags on average lose 16% of their read range
  - HDX tags on average only lose 8% of their maximum range

How do HDX tags achieve greater performance?

- HDX systems use the stored energy to respond in 'radio silence' after the carrier signal is turned off.
  - They are not fighting against any noise associated with the carrier as in some FDX systems.
  - Increasing the transmitter power doesn't result in increased noise.
- HDX systems do not need to use different frequencies for Transmit (Tx) and Receive (Rx)
  - The electronics can be optimised for 134 kHz operation.
- The response from HDX tags is Frequency Shift Keyed (FSK)
  - This digital FM response uses two channels to return the 1's and 0's which greatly assists in decoding the data when in noisy situations.
  - Tags much closer together can be read because of 'signal capture'.
  - If one tag has a 6 dB stronger signal, the system will lock onto that tag and ignore weaker responses.

Reading Speed

- An HDX system has only to read a transponder once
  - A 16-bit checksum validates the read and ensures that the read is good.
  - Some FXD systems have to make multiple reads and compare the results.

- HDX systems have to wait while the capacitor is charged but for high speed operations this charge period can be significantly reduced. The tag response rate is approximately 8 kbit/sec.
  - With a 20 ms charge time, the system can read at a rate of 25 times a second.
  - Some FDX system have also to wait while a smoothing capacitor charges.

Quality

- One often overlooked feature that greatly influences tag performance is the quality/ consistency.

- Texas Instruments performs 100% testing on all tags
  - This adds to the cost but ensures that each tag meets a minimum quality and performance level.
  - Consistent tag performance could make the difference between an application succeeding or failing.