Michigan RFID Education Task Force

Radio Frequency Identification (RFID) Technology for Cattle

MICHIGAN STATE UNIVERSITY EXTENSION

Radio frequency identification (RFID) describes a system that wirelessly transmits the identity of an object, in the form of a unique sequence of numbers or letters, using radio waves. Although there are several types of RFID systems, this fact sheet describes the technology used in passive, low frequency RFID tag systems. This is the technology first used in USDA-approved RFID ear tags for cattle.

There is no requirement for cattle producers to electronically read RFID ear tags. However, many producers will find benefit in automating data entry and retrieval by utilizing a RFID system in their management. The four basic components of a RFID system as used in animal identification are: (Figure 1).

- **Transponder** — The transponder is the electronic data source that stays with the animal you want to identify. The transponder contains a microchip, where the identification number is stored. The transponder is embedded in the ear tag.
- **Transceiver** — The transceiver (or reader) is used to retrieve the information stored in the transponder. This device is essentially a radio transmitter and an antenna. The transceiver could be part of a hand-held unit that is taken to the location of the animals with the RFID tags or a stationary unit that the animals pass by.
- **Data accumulator** — This is a device where information received by the transceiver is accumulated or stored. This could be a computer, personal digital assistant (PDA), scale head or a variety of other electronic devices.
- **Processing software** — This software transforms the accumulated data into recognizable and useful information. In the case of animal identification, the useful information would be a 15-digit number that is unique to that animal. In a separate process, this information could then be imported into a variety of data management programs.

Transponder

Transponders used most commonly in RFID animal identification systems are called inductively coupled transponders. What this means is that energy to run these types of transponders is supplied by electrical currents produced by electromagnetic fields created by components embedded in the transponder. There are three parts to a typical inductively coupled RFID transponder (Figure 2):

- **Silicon microprocessor or microchip** — These microchips are the data source component of the RFID. The microchip contains a unique 15-digit Animal Identification Number. Passive tags are not able to store additional information.

Figure 1. Basic components of a RFID system.

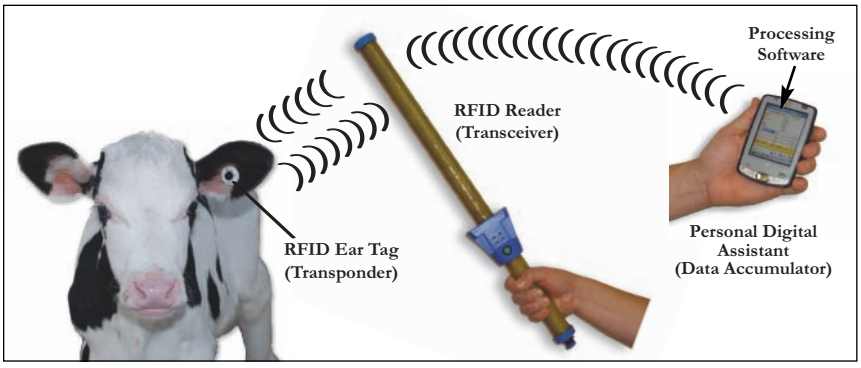
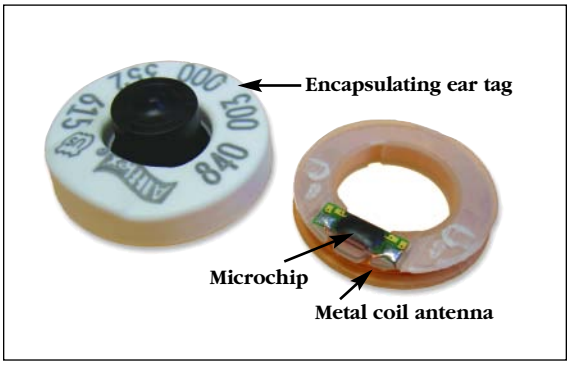


Figure 2. Parts of a RFID ear tag (transponder).



Half-duplex vs. full-duplex ear tags

A frequent point of confusion is the terminology "half-duplex" and "full- duplex" ear tags. This terminology refers to the communication protocol that the transponder and transceiver use to communicate with each other. Full-duplex tags and transceivers are able to communicate with each other simultaneously; with half-duplex tags, communication can occur only one way at a time. A good analogy for full-duplex communication would be a telephone conversation in which a person can talk and listen at the same time. Conversely, half-duplex communication would be comparable to walkie-talkies — only one person can talk at a time. Regardless of the communication protocol, response times are measured in milliseconds, and ISO standards require that transceivers be capable of reading both communication protocols. Therefore, practical differences between use of half- or full-duplex tags are minor.

- **Metal coil** — The coil is made of copper wire that is wound onto a bobbin. This coil acts as the tag's antenna. The tag transmits signals to the reader, with read distance determined by the size of the coil antenna (generally the read distance is 18 inches or less). The metal coil also creates the magnetic field that provides the electrical current to power the transponder.
- **Encapsulating material** — In RFID systems used for cattle identification, the transponder is most often embedded in a hard polymer shaped in the form of a button ear tag.

Inductive RFID tags are passive information storage sites. Retrieving the data stored in them requires an outside energy source. Inductive RFID tags are powered by a magnetic field generated by the antenna in the transceiver or reader. When the tag comes in proximity to the reader, the tag's antenna (metal coil) picks up the magnetic energy and uses this energy to communicate with the reader. Once energized, the tag communicates the animal identification number stored in its microchip back to the reader, which then directs the unique 15-digit Animal Identification Number to the data accumulator. These passive RFID ear tags do not require batteries to be functional. Therefore, they can remain usable for years.

The read range of low-frequency passive tags depends on the power of the reader and interference from other radio frequency signals. RFID signals can pass through non-metallic objects such as tissue, mud, wood, etc. Electric motors and fluorescent lights can create interfering radio signals, and metal objects (metal barn siding, gates, stanchions, etc.) reflect radio signals. Interfering radio signals may reduce the overall read range of RFID tags. Under most practical conditions, low-frequency tags are read from a distance of 18 inches or less. Though a short read distance prevents cattle identification from being read across a pasture, it also prevents unintentional reads from tags in a group of animals near one another.

Transceiver

The transceiver or reader contains the scanning antenna that emits radio frequency signals in a relatively short range. The radio frequency signal does two things: provides a means of communicating with the transponder, and it provides the passive RFID ear tags with the energy to communicate back to the transceiver.

When an RFID transponder or ear tag passes through the field of the scanning antenna, it detects the activation signal. This "wakes up" the RFID chip, and it transmits the information on its microchip to be detected by the scanning antenna.

The transceiver can take many forms. Transceivers that are used for cattle identification can be affixed to alleyways in sale barns or working facilities or to door frames on semi-trailers, or they can be incorporated into portable hand-held devices such as wands or PDAs.

Data Accumulator and Processing Software

The data accumulator is the electronic device that stores the data gathered by the transceiver. Data accumulators can be packaged together with the transceiver in a hand-held device, or they can be located in a remote location and connected to the transceiver by a wire or wirelessly. Examples of data accumulators used in the cattle industry include PDAs, scale heads and computers.

After the data has been accumulated and stored, the processing software takes the gathered electronic signals and converts them into a recognizable and useful format. In the case of an animal identification system, the data is converted to a 15-digit number that can be read visually and stored and utilized in a data management program.

Author — Dan Grooms, Michigan State University, in collaboration with the Michigan RFID Education Task Force.

Task Force Members:

Michigan RFID Education Task Force
www.michigananimalid.com

Michigan State University Extension
Department of Animal Science
517-355-8383
Large Animal Clinic
517-355-9593

Michigan Department of Agriculture
Animal Industry Division
517-373-1077

Michigan Cattlemen's Association
517-347-8117

Michigan Milk Producers Association
248-474-6672

Michigan Farm Bureau
Commodity and Marketing Department
800-292-2680

MSU is an affirmative-action, equal-opportunity employer. Michigan State University Extension programs and materials are open to all without regard to race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, marital status, or family status. • Issued in furtherance of Extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Thomas G. Coon, Extension director, Michigan State University, E. Lansing, MI 48824.