

BG-Map TechNote

Using RFID Tags with Garden Notepad, GreVid™ and PropNoter™

Updated 1/29/09

This document reviews RFID technology and how it can be used with BG-Map applications for Windows Mobile Devices.

RFID Tags

Types of Tags

RFID tags are electronic transponders that receive radio frequency energy from a reading device and return that energy, encoded with stored data. In our case, the stored data is a unique number that identifies each plant. Tags are manufactured in a variety of physical configurations – encased in glass tubes, plastic disks, flexible sheets and other forms. They are available in 3 broad frequency ranges:

- low frequency (134.2 kHz. typical)
- high frequency (13.56 MHz. typical)
- ultra high frequency (900 MHz. range typical)

In general, higher frequencies result in smaller scanning hardware, lower cost tags, higher read distances and reduced ability to penetrate liquids and wet surfaces. For our purposes, we will require tags that will operate reliably in a wet environment, possibly within a tree trunk. Low frequency or high frequency tags could be used, each within certain limitations. In general, none of the tag types will work properly if on or close to metal. So, metal mounting hardware must be avoided.

Read Distance

The read distance is the maximum distance the reader can be separated from the tag and still read it. If the tag is hidden (inside a tree or shrub for example), a higher read distance is desirable so that the reader need only be placed somewhere in the vicinity of the tag for reading to take place. But, if plants are closely spaced, too high a read distance might result in the wrong tag being read.

Tag Placement – Trees

In trees, tags can be completely hidden by embedding them inside the trunk. For this purpose, a low frequency tag encased in a glass tube could be used.

The tag is 3.85 mm in diameter and 23 or 32 mm in length. The 32 mm tag has a longer read range and so is preferable. A 3/16" diameter hole, about 1-1/2" to 1-3/4" deep, depending on tag size, is drilled in the tree trunk, and the tag is inserted. This should cause no damage to the tree and the wound will heal over, probably within a growing season. The tag can be read from within the trunk, even after the tree has grown substantially bigger. As long as the tree remains structurally sound, the glass tube will remain undamaged – the tree will simply grow around it. Tags cost between \$2.50 and \$3.00 each depending of quantity and model.



The problem is not embedding the tag; it's finding it. At the minimum, all tags should be embedded at the same height above the ground and on the same side of the tree (north for example.) That might be enough assistance for garden staff to find the tags (except perhaps in the case of multi-trunked trees), but not necessarily enough for visitors. Some sort of marker may be needed to identify the tag location. Perhaps it could be made very unobtrusive but still findable.

Another option would be to use a surface-mounted plastic disk tag about 30 mm in diameter instead of an embedded glass tube. A low or high frequency disk could serve as both a tag and a (hopefully) unobtrusive marker all in one. There would be no problem at all in finding it. It could be attached with a nonmetallic screw. Disk tags cost around \$5.00 each.



Low and high frequency tags are also available in the form of nails or screws, which can be embedded in a tree trunk, with only the screw or nail head, containing the chip, protruding. These would require periodic repositioning to compensate for tree growth.

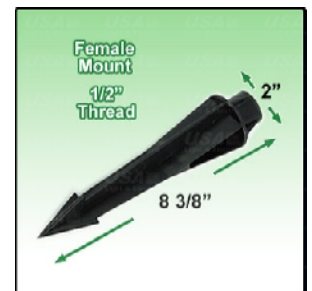
Tag Placement – Shrubs

One option applicable to dense shrubs would be to attach a disk tag hidden from view on an inner branch but within reach from the outside. It could simply be attached with a nylon tie wrap. For open shrubs, a stake-mounted tag could be used – see “Herbaceous Plants” below.)

Tag placement in shrubs presents a similar problem to placement on trees. It's relatively easy to hide the tag. But how to find it?

Tag Placement – Herbaceous Plants

For herbaceous plantings, a disk transponder could be fastened to the ground with a nonmetallic spike so that is above the soil surface and the tag is visible. A plastic collar could be placed behind the tag to prevent it from sinking into the ground. Possibilities include tent stakes or landscape



lighting spikes. This should also be a topic for discussion and brainstorming with garden staff.

RFID Readers

The RFID reader sends RF energy to the tag and receives the return signal, encoded with the plant's identification number. It interfaces with the data collector, on which the GreVid, Garden Notepad or PropNoter software resides. When the reader retrieves an identification number from the tag, it sends it via a wireless bluetooth or wired connection, to the data collector, which pulls up the corresponding plant record for viewing or data collection.

Ideally, the reader should be self-contained, rugged and have a rechargeable battery. As it happens, a number of readers meeting these requirements have been developed for the cattle industry for tracking low frequency RFID tags on livestock. These readers are baton, paddle or wand shaped and offer wireless bluetooth connectivity. In general the longer the reader, the greater the read range, the result of a larger antenna. Costs for readers range from around \$900 – \$1,600, depending on models and options. High frequency readers, are smaller and less expensive, and be integrated with the data collector as a plug-in card or cradle.

A few options are:

Destron-Fearing DTR-1

This is a paddle-shaped bluetooth low frequency reader weighing 1.6 pounds. Further information can be found at:

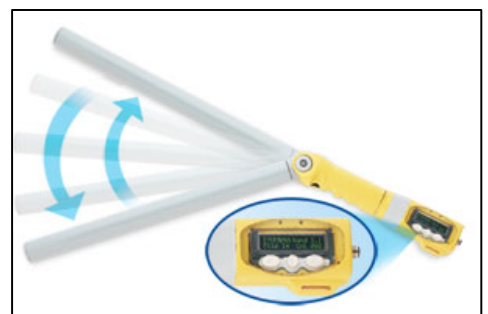
<http://www.destronfearing.com/documents/product/DTR-1%20Product%20Datasheet%20Final%20Proof.%2010.31.07.pdf>



Farnam LTS Wand Reader

This is 32" long low frequency reader with a long read range, making it easy to reach hard to get at spots. Further information can be found at:

<http://www.farnamlts.com/wandreader.php>



Socket Mobile Compact Flash RFID Reader Card

This high frequency CF reader card can be used with various Windows Mobile devices, such as the Juniper Archer pictured below. Further information can be found at: <http://www.socketmobile.com/products/bar-code-scanning-data-collection/series6/>



Data Collector

A Windows Mobile data collector runs Garden Notepad, Grevid, GreVid and PropNoter software and communicates with the RFID reader. Desirable features include wireless bluetooth, ruggedness and long battery life before recharging is needed. Several BG-Map users have had very good success with the Juniper Systems Archer data pictured here. Further information on the Archer can be found at: <http://www.junipersys.com/products/products.cfm?id=107>



Next Steps

RFID is a promising technology, but full implementation in a garden setting will require a certain amount of trial and error. Gardens need to step up and invest some resources in testing and evaluating various types of tags, readers and mounting methods to determine which are best suited to their needs.

- Review this report, equipment options and tag mounting ideas.
- Plan the locations of test tags and mounting methods for the initial tests.
- Select and purchase a reader, data collector and a quantity of tags sufficient for initial testing.
- Install test tags and begin evaluation.
- Review initial results and plan modifications as needed.
- Share results ideas with other gardens.