# Trolley Scan (Pty) Ltd

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## TROLLEYPONDER/ECOTAG/RADAR RFID Newsletter #93

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Your latest copy of our regular newsletter keeping you up to date with developments.

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**1. Getting a very low cost transponder**.

If you listen to market researchers and potential large scale users, there is a large demand for very cheap RFID transponders. Low cost transponders are a requirement for success in some markets such as food retail if each item has to be labelled. How low is low cost - is not defined and it is partly the uncertainty that has stopped any large scale production happening. In this section we identify the technical issues in the manufacture of transponders.

In the 1990s Trolley Scan was asked to take part in a survey to predict the component costs of transponders over the next five years. What was interesting from that survey based on the collective knowledge of companies producing low cost passive transponders, was that there were three major component costs for low cost transponders - namely

1) the electronic chip
2) the antenna which needs to interact with an electric field wave that is 30 centimetres in length
3) assembly costs to mount the chip on the antenna structure and apply protective packaging for handling.

The consensus at that time was that each of these components would make up a third of costs of making a transponder and this is most probably still true today.

1) **The electronic chip**

The electronic chip is made in a semiconductor foundry that has been optimised to make chips as small and cheaply as possible. It uses processes that are aimed at mass

manufacturing where a minimum manufacturing volume is typically 100 000 at a time.

The developments that happened that allowed a single chip to become the workhorse for RFID were those developments in chip technology that allowed the integration of UHF diodes, analogue circuitry and digital circuitry all on a single chip with a single manufacturing process . When the staff of Trolley Scan were involved in the development of the first passive transponders in 1990, we had a separate digital chip, an analogue chip, external high speed diodes and external capacitors in each transponder. At that time the digital and analogue chips had to be made in separate foundries as the chemicals and processes used in the one process poisoned the other process. Developments in the 1990s saw these technologies being merged and the UHF diodes able to operate efficiently at 1GHz being incorporated into the chip.

An understanding of the developments in chip manufacture in silicon foundries explains why the technology called "printed electronics" as a solution to costs in RFID is not going to be viable. In the “printed electronics” process the aim is to print the transistor structures on cheaper substrates than silicon, and not need the high tolerance printing processes needed for semiconductor foundries. RFID at UHF frequencies currently pushes the boundaries in a silicon foundry and there is little chance that the huge technical gap between the "printed electronics" version and the conventional silicon substrate technology will close sufficiently for it to be a viable and cost effective replacement.

**2) Antenna structures.**

The antenna converts the energy travelling through the air into an electrical signal that can interact with the integrated chip on the transponder. The antenna is interacting with an electric field wave that is about 30 centimetres long and so the antenna is large physically compared to the very small integrated circuit. The antenna is so designed to resonate at its operating frequency, in the same way that a tuning fork resonates with an audio signal at its design frequency. The conversion of the electric field wave to electrical energy means that current is flowing in the legs of the antenna and this means that the antenna has to be made of a material with good conductivity.

The simplest way to make a viable antenna is to use a copper clad substrate that is usually used for making printed circuit boards. However cheaper solutions are required. This has led to various initiatives to print the antenna with cheaper materials. A carbon paste is the cheapest form of conducting paste as carbon is so plentiful. However it is difficult to connect the electrical terminals of the integrated circuit to the carbon paste. Another problem is that if the antenna is flexed, hairline cracks appear in the dried paste which impede the current flow needed for the antenna to operate.

Some solutions to this problem have been to electroplate copper onto the conducting paste to form a continuous surface that can bend without breaking the current flow, while another has been to use a silver based ink that is then heated and sintered. This last method is expensive and has also had issues with disposal at the end of life particularly in the EU as the antennas are then treated as hazardous waste needing special; disposal methods. As one can see, particularly due to its size and manufacturing methods, the antenna itself is a large part of the costs of a transponder.

**3)Transponder assembly**

Before high volume RFID transponder assembly needs arose, the smartcard technology had developed and assembly machines had been devised to assemble large volumes of credit

card sized smartcards. It was possible to adapt these machines to make RFID transponders and this meant that production of millions of transponders was available almost from the outset. These machines attach the integrated circuit to the antenna foil, and then encapsulate the whole structure in its plastic packaging, as well as programming and testing the devices. However these assembly machines are complex and expensive.

If RFID is going to be used in retail, then very high assembly volumes are needed. The limit on machine size seems to be a volume of 100 million transponders per annum per machine, which equates to about 7 transponders per second. This is about the limit on movement via motors as the inertia at higher speeds becomes so great that the motors have to become very large. So far it seems that only one of these machines has been built, but the current demand for transponders does not seem to be sufficient to keep it in operation. To meet the needs of RFID for retail, about 1 million of these machines would be needed.

**Price reduction with volume**

Generally the larger the production volume, the lower the costs as benefits from economy of scale are realised. However it does not mean that there are no costs. Because of the very high volumes that would be needed if retail items were to be tagged which would need very low cost transponders, there are only a few companies in the world that have the manufacturing equipment and skills to run a very large scale production operation. Before these companies would become involved, the price of the transponders needs to be high enough so that these companies could make a profit on the large investment they would need to make to build high volume assembly equipment.

One has to question if any of the companies involved in RFID transponder manufacture are driven by the desire to deliver very cheap transponders. RFID is such a pervasive solution that its success is not dependent on satisfying the Fast Moving Goods market for retail tagging. There are many applications that can afford a higher value transponder that can allow the manufacturers to make some profit. As the higher value markets saturate in the future, and as more companies gain experience in very high volume delivery, then possibly the retail market can be addressed.

**2. Calling farmers in South Africa**

Trolley Scan have been doing hundreds of tests on its new product called Cowtrack(tm) that is in development. Its purpose is to locate in real time large numbers of cattle on very large farms.

In the past we have been approached by many farmers in South Africa who have a problem with stock theft. Although the Cowtrack product is not ready yet, some other technologies have become available that might provide a simpler solution to this specific problem. Trolley Scan would like to talk to some of these farmers who might want to try this solution.

**3. Long term product stability**

RFID systems are the data capture component of many computer systems. Usage starts out as small test pilot studies and then more equipment is ordered in the form of readers and transponders as the application grows. For many users, the expectation is that the new transponders bought will be exactly compatible with the installed readers they are currently using so that the application can grow seamlessly.

Clients of Trolley Scan in 52 countries are assured that our new generation transponders will be compatible with previous generations that have been supplied over the past fourteen years. Newer solutions are always in development, but parts and compatible components are available for all equipment provided over the past fourteen years.

## 4. Product range

Trolley Scan are a manufacturer of UHF RFID systems. Trolley Scan manufacture fixed readers, portable readers and RFID-radar systems (Real Time Locating systems that give accurate position information) as well as a variety of transponders for different applications. Transponders come in the form of passive transponders with operating ranges up to 20 metres and battery assisted transponders with an operating range up to 40 metres. Trolley Scan also combine some of these components into packages for end users which are supplied with the appropriate software. Typical applications are asset management, notebook tracking, equipment barriers, store control, sheep and cattle tracking, event logging and sports timing systems.

## 5. Getting your own complete RFID/radar system

You can order RFID systems or RFID-radar systems from Trolleyscan.com

Trolley Scan provide small RFID reader systems which give new users the ability to evaluate UHF RFID and their applications without needing specialised skills.

Trolley Scan provide a variety of easy starter systems for first time users who have an application that needs a solution. Typical packages are :

- Standard UHF long range readers with antennas and 100 transponders
- RFID-radar system comprising long range reader, antennas and a variety of different transponders.
- RFID-asset tracking systems comprising portable reader, antenna and a variety of transponders with software.
- RFID-notebook/laptop tracking system comprising reader, antennas, transponders and software

In addition components such as readers and transponders are available

These systems are already operating in 52 countries.

To find out details of the systems and to order see http://trolleyscan.com/