

INVENTION DISCLOSURE DESCRIPTION

Title: PASSIVE RANGE EXTENDER/BOOSTER FOR RFID TAG/READER

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Assignee: Tunity Pte Ltd.



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1. FIELD OF THE INVENTION

Radio Frequency Identification (RFID) is an advanced wireless technology that has been successful in many fields of application. However, the application of passive RF technology to library books, file documents, audio and video CDs remain relatively new and can be further exploited. Passive RFID tags do not have their own power supply. This invention proposes a passive radio frequency (RF) inductance-capacitance (LC) tuned circuit of 13.56MHz (not limited to other frequencies within the RF spectrum) as an antenna booster to significantly increase the read range of the 13.56 MHz RFID tags and 13.56 MHz contactless smart card.

2. BACKGROUND TO INVENTION

RFID components

A RFID system carries data in suitable transponders, generally known as tags, and retrieves data, by machine-readable means, at a suitable time and place to satisfy particular application needs.

Data within a tag may identify an item in manufacture, goods in transit, a location, a vehicle, an animal or individual. Additional data support applications through item specific information or instructions immediately available on reading the tag. For example, the branch or shelf location of library book, the maintenance record of an asset like car or computer or machinery, health record of the particular person, or the processes that the product has passed through the various stages of production line.

A system requires means of reading or interrogating the tags and communicating the data to a host computer or information management system. A system will also include a facility for entering or programming data into the tags, if this is not undertaken at source by the manufacturer. Quite often an antenna is distinguished as a separate part of an RFID system. Present in both readers and tags, it is essential for wireless communication between the two. Fig 1 shows the RFID system components.

Data Communication via RFID

Two methods categorise RFID systems: 1) close proximity electromagnetic or inductive coupling and 2) propagating electromagnetic waves. Coupling is via 'antenna' structures forming an integral feature in both tags and readers. Propagating systems also have antenna.

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Transmitting data is subject to the vagaries and influences of the media or channels through which the data has to pass, including the air interface. To transfer data efficiently requires the data to be superimposed upon a rhythmically varying (sinusoidal) field or carrier wave. This process of superimposition is referred to as modulation, and various schemes are available for this purpose. 13.56MHz is the recommended frequency for Electronic Article Surveillance (EAS) and Industrial, Scientific and Medical (ISM) applications.

In addition to non-contact data transfer, wireless communication can also allow non-line-of-sight communication. However, with very high frequency systems more directionality is evident and can be tailored to needs through appropriate antenna design.

2.1 The Problem

The tags are placed in items that are to be traced and track, such as library books, file documents, audio and video CDs systems. Once tagged, data relating to their sales, loan and return or their maintenance or life cycle record can be captured automatically and wirelessly, without human intervention. One of the requirements for such usage is the ability to wirelessly detect the identification of the article as it passes certain reading points or checking points or control points such as the exits of the controlled premise. Increasing demands for wider read range such as wider Exit gates and yet assure positive identification detection becomes a new challenge to passive RF technology. This is due to the technical limitations of passive RF tags and readers.

2.2 Current Known Solutions

With RFID technology, an article passing through the exit can be wirelessly detected by the Exit Gate RF Antenna. The identification read range of the article, however, is limited by the following:

1. RFID tag's size
2. Size of the RF Antenna at the Exit Gate
3. Transmitting power energy of the RFID transmitter/reader.

RFID Tag Size

The size of the tag determines the read range of the system. The bigger the tag size, the longer range it can read. However, there is a limit as to how the read range can be extended despite the size of the tag. In cases where the tag is required to meet certain physical area constraint, e.g., existing CD RFID circular tags, a bigger tag just isn't suitable.

In cases where one can increase the tag size in the article, but what about existing smaller RFID tags already implemented in those articles. The cost to replace the millions of existing RFID tags in these articles is hefty.

RF Antenna Size at Exit Gate

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One alternative is to increase the size of the reader antenna for longer read range. However, there is a limit to how much the read range can be extended and up to a certain size, there is decreasing marginal read range. The physical constraint is also a consideration. In addition, most of the current exit gate RF antennae are already tuned and optimized to the maximum size. It is not feasible within the passive RF technology to increase the size of these RF antennae.

Power output of the RFID transmitter/reader

Next is to increase the transmitting power level of the reader to boost the read range. However, the improvement is limited as the signal reduces in inverse proportion to the square (even to inverse fourth power) of the distance. Moreover, this is not advisable and not acceptable as it will exceed the safety power limit by the regulatory authorities in most countries.

3. SUMMARY OF THE INVENTION

In this invention, we propose a passive radio frequency (RF) inductance-capacitance (LC) tuned circuit of 13.56MHz (not limited to other frequencies within the RF spectrum) as an antenna booster to boost up the read range of the 13.56 MHz RFID tag. Figure 2 shows the antenna booster. This antenna booster can be placed close to the RFID tag or near the RFID reader antenna to significantly boost the reading range of the RFID tags.

This invention differs from the conventional antenna as it make use of a passive closed loop LC tuned circuit to couple and amplify the electro-magnetic field energy of the existing RFID tag or RFID reader antenna to achieve longer reading range. Thus the cost of this add-on RF antenna booster will be much lower.

In areas where the RFID transmitter/reader antenna is small, the read range can be further improved by placing the antenna booster near the RFID reader's antenna.

4. BRIEF DESCRIPTION OF THE DRAWINGS

[Refer to Patent Drawings Sheets]

Figure 1 shows the components of a RFID system. These are the Reader/Programmer with Antenna, communicating with the Transponder (or Tag) with Antenna via the air interface.

Figure 2 shows the simplified antenna booster electrical diagram with an inductance-capacitance (L/C) tuned circuit of 13.56 MHz. The value of the capacitance shall vary according to the size of the inductance loop.

Figure 3 shows the RFID tag mounted inside the RF antenna booster. Both items are placed on the platform or item that is to be tracked. The inductance-capacitance (L/C) tuned circuit are as indicated.

Figure 4 shows a RFID micro-reader with built-in RF antenna and mounted close to the RF antenna booster for extended range. The reader can be portable or fixed to a structure. With the top cover of the housing replaced, it looks like any other normal range reader.

Figure 5 shows how the antenna booster is used to increase the read range of the portable RFID reader. The booster is placed around the reader, within a large housing. The data read is sent to a PDA for storage and analysis.

5. DESCRIPTION OF THE PREFERRED EMBODIMENT

When to Use

The current likely solution to boost the read range is to replace the current RFID tags with larger ones. But if the cost becomes unbearable, or if the physical constraint does not allow a bigger size tag, then this invention of low cost add-on RF antenna booster is ideal.

Fabrication

The antenna booster can be easily fabricated from copper or silver conductors with commonly available (off-the-shelf) capacitors.

Industrial Applicability

This RF antenna booster can be used in these RFID systems:

- EAS (Electronic Article Surveillance) systems
- Portable Data Capture (PDC) systems
- Networked systems
- Positioning systems

EAS systems are used to sense if the item is being issued out accordingly to the regulations or procedures from the controlled premises and/or the identity of the items. Typically, retail stores or any rental stores or libraries tag each item, and large antennae are placed at each store exit to detect unauthorised removal of the item and/or the identity of the items removed. The RF antenna booster can be placed around the RFID tag or reader to boost the detection range of these items going out from such premises.

PDC systems use portable data terminals with integral RFID readers. The hand-held readers capture data which is then transmitted directly to a host information management system via a radio frequency data communication (RFDC) link, or held for subsequent batch-processed delivery by line-linkage to the host. The RF antenna booster can be sited in the RFID readers to be integrated in the PDC systems or be sited next to the RFID tag that is to be identified or sensed by the PDC systems.

Networked systems applications have fixed position readers deployed within a given site and connected directly to a networked information management system. The tags are positioned

on moving or moveable items, or people, depending upon application. The RF antenna booster can be placed around the RFID tag or reader.

Positioning systems use tags to facilitate auto-locating and navigation support for guided vehicles. Readers on the vehicles are linked to an on-board computer and RFDC link to the host information management system. The tags are embedded in the floor or walls of the operating environment and coded with appropriate identification and location data. The RF antenna booster can be placed around the RFID tag or reader.

CLAIMS

Title: PASSIVE RANGE EXTENDER/BOOSTER FOR RFID TAG/READER

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- Independent claim that this design of the inductance-capacitance (L/C) circuit tuned to 13.56 MHz can act as a passive antenna range booster for 13.56 MHz tags, RFID readers' antennae and contactless smart cards.
- Claim that, when longer read range is required, this invention reduces the cost of replacing existing smaller RFID tag or reader's antenna with larger tags or larger reader's antenna. In areas or applications where RFID tag itself or the reader's antenna cannot be made larger or the reader's transmitting power cannot be increased, this antenna booster is a good alternative.

INVENTION DISCLOSURE DRAWINGS

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Figure 1. Components of a RFID System

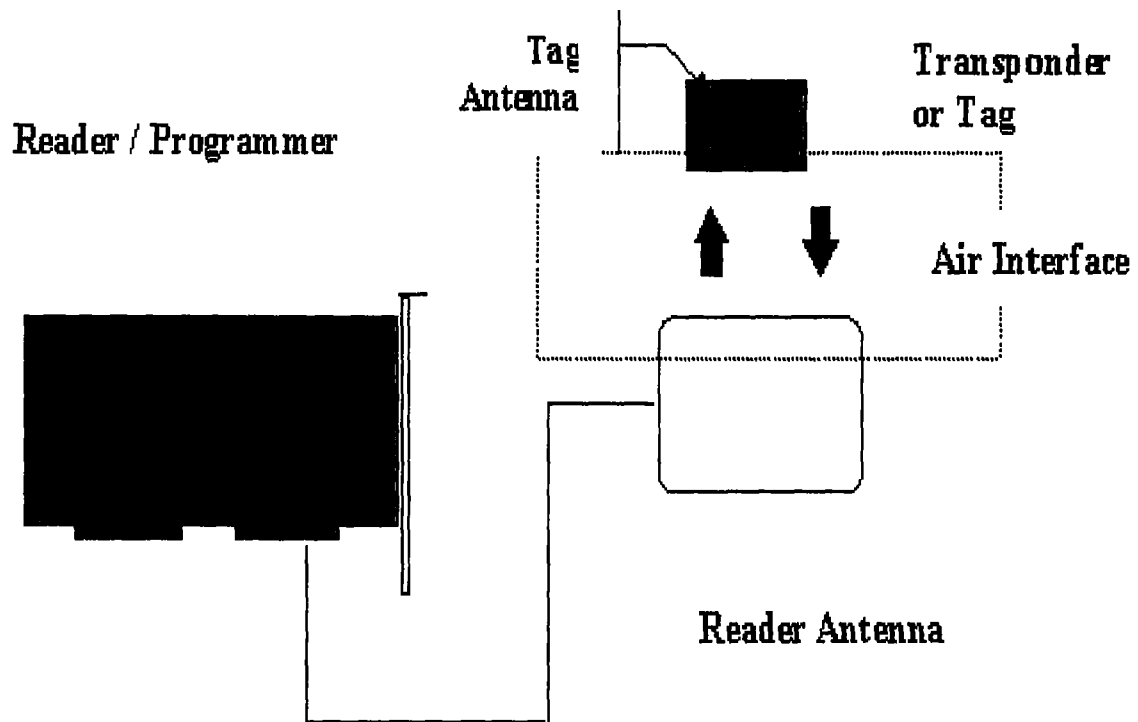


Figure 2. Antenna Booster Electrical Diagram

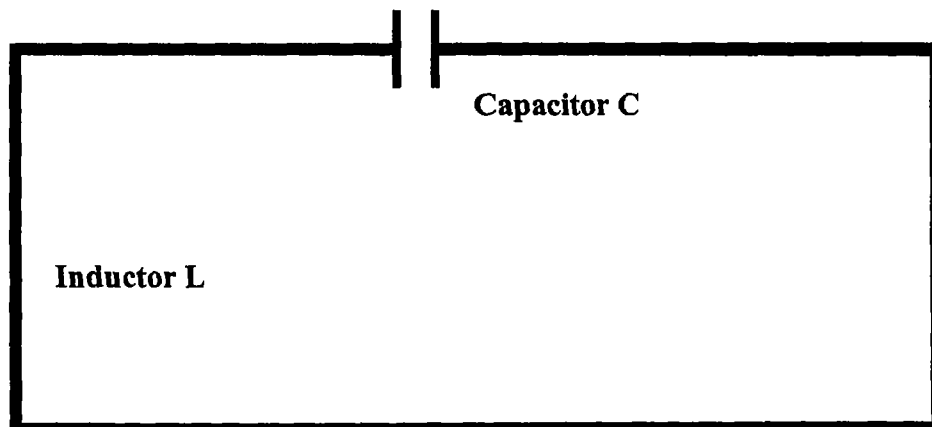


Figure 3. RFID Tag Mounted Inside the RF Antenna Booster

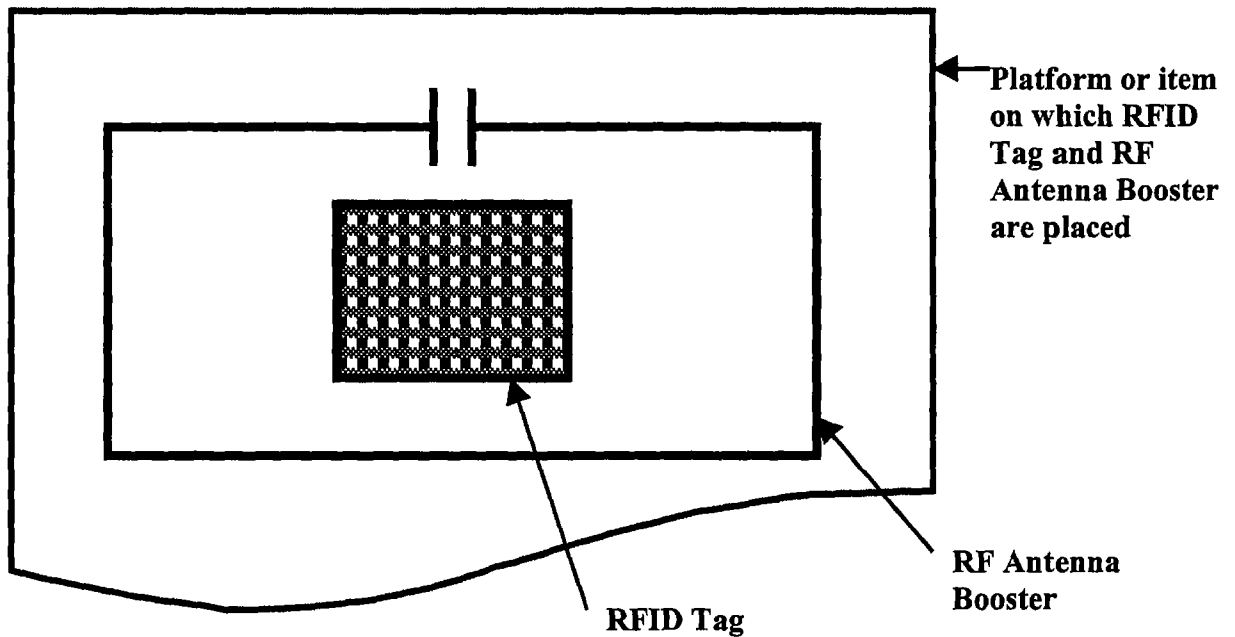


Figure 4. Fitting the RF Antenna Booster into RFID Micro-Reader with Built-in RF Antenna

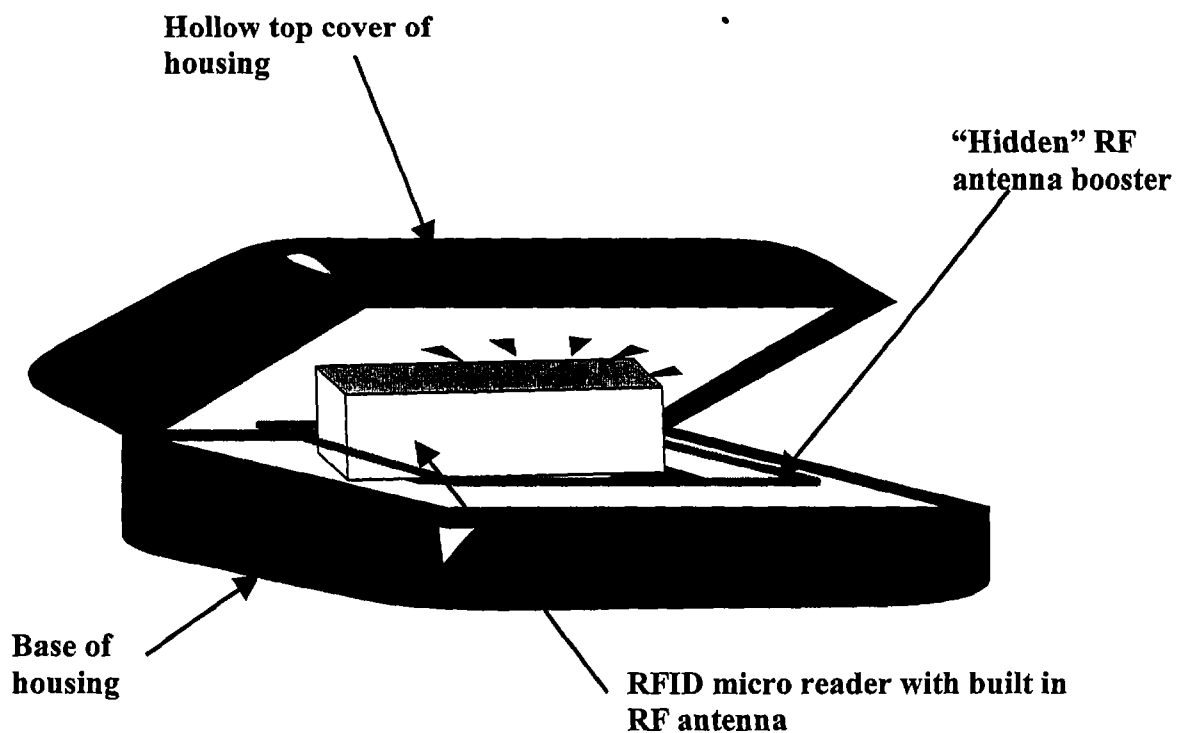


Figure 5. Portable RF Reader System Configuration

**Portable Reader System
Configuration**

