RF CONTROLS
IDENTIFY. LOCATE. TRACK.®

RF CONTROLS' INTELLIGENT TRACKING AND CONTROL SYSTEM (ITCS®)

FREQUENTLY ASKED QUESTIONS

RF Controls' Intelligent Tracking and Control System (ITCS®) is a breakthrough solution passive RFID-based, real-time location system (RTLS). This innovative, patent-pending system is based on sophisticated military tracking technology and "smart" antennas that deliver the most precise 3D location information available on the market today, to reliably and accurately identify, locate and track UHF RFID tags.

As a consequence of the unprecedented performance which ITCS achieves in real-world environments, we are challenged by end-users and systems integrators on a range of technical and operational topics. This briefing document addresses the most commonly asked questions.

How is it that RF Controls has succeeded with beam-steerable antenna technology for passive RFID systems, when other established AIDC product providers have not?

Simply because RF Controls' engineering team has unusual domain expertise in sophisticated antenna technologies and RF signal processing techniques; the requisite RF engineering skills have been refined through years of developing products for military applications and such engineering expertise is uncommon among the established RFID / AIDC companies. Don't forget too that not only has uniquely differentiated performance been achieved while fully complying with RF regulatory requirements, but ITCS products are sold at prices which make them cost-effective for commercial applications.

Is the RF Controls system authorized for use worldwide?

Currently, ITCS products are approved by regulatory authorities for deployment in the EU, USA, Canada and South Africa. ITCS products are type approved by the FCC to CFR 47 Part 15.247, certified compliant with ETSI EN 302 208 (part of CE certification), RoHS (for deployments in the EU), ICASA (South Africa). The RF compliance testing requirements for ITCS products are exactly the same as those which apply to RFID readers which employ conventional antenna technology.

We employ a software controlled radio module which is certified compliant with other national and regional regulations. This means that we have a high degree of confidence that ITCS products can be applied worldwide, following additional country or region specific approvals (as may be required).

We have already assessed that we do not require special export license approval for China and many other countries worldwide.

What are "radar based" RFID systems?

We see and hear this term being applied to ITCS products, because we employ antenna technology and advanced signal processing techniques that are generally familiar to those who understand radar systems.

ITCS products are unique in their use of electronically steerable beam antenna technology for both transmit (reader to tag) and receive (tag to reader) channels; hence we refer to our products as bidirectional electronically steerable phased array (BESPA™) antennas. We are aware of other products on the market which use techniques such as an array of phased array antenna elements, but none truly compare with RF Controls ITCS products.

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ITCS "smart antennas" are in effect software controlled antennas; we are all used to using software controlled radios – think for a moment about your smart phone, which typically incorporates a software controlled radio for use across the world, at different operating frequencies and supporting a variety of communications protocols. What we have done is to develop software controlled antennas, which can quickly sweep an area (volume) for tags in a variable pattern.

How is it that RF Controls products achieve far greater operating range with passive RFID tags, compared with conventional reader / antenna systems?

The distinguished performance we have achieved in real-world, challenging environments, results from our use of patent-pending BESPA antenna technology. This type of antenna allows us to control the placement of energy to excite passive tags, which we can energize at far greater distances than conventional antennas while remaining fully compliant with various national and regional RF emissions regulations. As passive tags become more sensitive, offering the opportunity to achieve greater operating range and hence open up many new applications for passive RFID systems, ITCS really is the best choice for fixed reader infrastructure.

For the more technically oriented, we have attached Appendix B to this document that provides a little more detail on the characteristics of our unique BESPA antenna technology, and we have published an educational white paper entitled "Bidirectional Electronically Steerable Phased Array Antenna for Passive UHF RFID Systems" that you can download from our website.

How do RF Controls achieve precise location of tagged items?

We use sophisticated signal processing techniques, which have their foundation in radar, guidance and tracking systems. Importantly however, in "our" RFID world, effects and influences which we routinely encounter in challenging, live, production environments, are significantly different from those environmental effects encountered in station to target radar systems; we have had to overcome the adverse effects of signal scattering, reflections and the like, caused by building infrastructure and metallic fixtures. These challenges are highlighted as the operating range of passive RFID systems increase, either as a result of beneficial improvements in tag chip sensitivity which we have seen in recent years, or as a result of innovations such as the use of our BESPA antenna technology. It might seem intuitively obvious, but as tag sensitivity increases, so will the occurrence of spurious or extraneous reads when a conventional reader / antenna system is used.

So in order to achieve tag location accuracy in such environments, our engineering team has employed their experience in the science of target acquisition and multipath ambiguity resolution, working tenaciously for years to develop and refine innovative, proprietary algorithms. The net result is that ITCS can accurately locate and track tags in three dimensions (3D), with unexpected location accuracy in real-world environments.

Does RF Controls cover a wider area than conventional fixed readers?

Indeed yes! This is an interesting question but a strange comparison, because conventional fixed reader / antenna systems provide only nodal reading of tags (at doorways, for example).

We've addressed this question more comprehensively by comparing conventional reader technology (hand-helds, portals, etc.) with ITCS; this is shown in a tabular form in Table 1 in Appendix A.

When you consider this and related performance questions, especially ones which are concerned with operating range, what quickly becomes apparent is that as soon as tag operating range is extended, either by improving tag sensitivity or/and use of long range antennas with fixed readers, it is critically important to apply a system which accurately locates tags relative to the fixed reader antenna; without location and tracking functions, increasing tag sensitivity will give rise to elevated occurrence of spurious reads (such as will be encountered in multiple adjacent dock doors, for example). These spurious or extraneous reads defeat the object of applying fixed RFID readers for automated data capture.

If you like, think of ITCS as a "super reader" technology, which combines attributes of extended operating range with precise location of moving or static tagged items.

Is performance affected in high tag density environments?

There are two ways of interpreting this question.

First, an ITCS antenna, by virtue of being compliant with the EPCglobal UHF Gen2 (ISO 18000-6C) RF protocol, reads tags at a rate which is determined by the RF link characteristics. The same performance that one might see from a conventional reader / antenna combination in terms of tag throughput also applies to ITCS.

Secondly, remember that ITCS smart antennas quickly sweep through an area (or volume) in which tagged items are present. An ITCS antenna effectively chops up the area (volume) it is covering into small cubes, reading and locating tags. We have devised algorithms which optimize the sweep speed according to the variable density of tags in an environment (such as you would find in a typical retail sales floor where tagged items are placed on display racks and the like, with variable "density" according to the nature of tagged items).

Is it possible to get real time visibility on a continuous basis?

Yes. ITCS is more like a real-time location system than a conventional passive RFID system, which have, as you'll be aware, been applied to achieve nodal reading of tags or require a human to carry (or drive) a mobile reader to a point where tagged items are stored.

ITCS antennas can be programmed for continuous sweeping, or switched on and off under software control, just as you would with a conventional reader.

By design, ITCS is a flexible system that can efficiently tackle either high tempo environments (such as tagged goods being moved through doorways), or static environments (such as goods stored in a stock room or warehouse in high bay racks).

Hence in either situation, ITCS provides real-time monitoring of an area (volume) reporting the locations and movements of tags (tagged items) on a tag by tag basis.

What benefits have users seen?

It is regrettable that we are not able to report specific details concerning benefits realized through deploying ITCS (because such information is confidential), but users have seen measurable and noteworthy improvements in the visibility of assets or inventory.

Just one example is where ITCS was deployed in a warehouse to monitor tagged goods, providing a real-time view of what was actually in the warehouse and where it was located. The inventory management system of record keeps a numeric record of goods in the facility. An edge application reconciles differences between ITCS' view of the warehouse and that maintained in the system of record, reporting discrepancies and prompting associates' corrective actions. ITCS revealed that a quantity of a particular product type were present (and of course showed where they were located), whereas the system of record reported a significantly lower number of that particular item. Without ITCS' accurate view of what was in the warehouse, it is readily apparent that either an order for parts would not have been properly filled, or reordering of additional products would have occurred, both of which would contribute to negative impact on revenue or profitability.

In dynamic situations, such as building a mixed pallet, or shipping either palletized goods or free loaded cartons and cases into truck at a distribution center, ICTS has demonstrably detected build or shipping errors, allowing corrective action before goods reach a "point of no return". The costs associated with mis-picking or mis-shipping goods are appreciable, and by deploying ITCS to "watch" processes, such inefficiencies can be avoided.

Significant improvements in associate productivity have also been observed, as ITCS changes the business process paradigm from "search" to "collect", by allowing associates to be directed to where items of interest are actually located and thus avoiding time spent searching. In a retail store environment, this has manifold benefits in terms of associate efficiency and customer satisfaction, created as a result of accurate, automated real-time inventory visibility.

Who owns the IP? Is the RF Controls technology patented?

RF Controls owns all the IP in ITCS products. We currently have seven patent applications in process, and have applied for patent protection in major markets. These patent applications cover core technology, product design and applications.

APPENDIX A: ITCS AND ALTERNATIVE READER SYSTEMS COMPARED

Characteristic	Mobile	Portal or Smart Shelf	ITCS
Human interaction	Mandatory - process compliance fall off degrades efficacy	Not required	Not required
Zonal monitoring	A person can move round an area, but consider the impracticality of reading and locating inventory on upper shelves of a high bay rack	No – achieves only nodal reading	Yes – covering a volume, not just an area, making it ideal for locating inventory that is stored in physically difficult to reach locations
Real-time location	Instantaneous at the time of reading a tag; location of is a snap-shot in time and often needs interpretation	As a tag passes or when it is present near a fixed reader antenna (such as a portal or smart shelf); typically proximity only is known, not true location	Yes – 3D, with a precision of ≈ ±1′
Locate arbitrarily placed tags	Yes – an associate takes the hand-held or otherwise portable reader to the places where tagged items are located	No – employs a predetermined layout of reader antennas	Yes – there is no presumption about the locations of tagged inventory or assets
The effect of increasing tag sensitivity	The opportunity to achieve increased operating range, yet typically the precision of location relies on proximity of the hand-held to the tag(s)	The opportunity to achieve increased operating range, but the challenge of inadvertently capturing spurious reads increases	Increased operating range without any degradation in system performance
Accurately locate multiple tags concurrently	May or may not incorporate signal processing algorithms to resolve true tag location	May or may not incorporate signal processing algorithms to resolve true tag location	Sophisticated embedded algorithms resolve the location of tags in 3D
Reliable reporting of tag movements	Typically limited to ascertaining the proximity of tags to the reader / antenna	Typically limited to comprehending tags either present, approaching or departing	Yes – tracking of multiple tags is an intrinsic function

Table 1: ITCS Compared to Alternative Reader Systems

APPENDIX B: KEY FEATURES OF RF CONTROLS' BESPA ANTENNA TECHNOLOGY

As an appendix to this summary FAQ document, we felt it would be helpful for the more technically oriented to summarize the differentiated performance characteristics of RF Controls' innovative BESPA antenna technology, as it relates to passive UHF RFID systems:

- Tag energizing power is electronically steered to where it is needed [wanted], at a variable location relative to the antenna.
- Improves receiver sensitivity and overcomes inherent problems with transmitter noise, by providing additional gain ahead of the receiver and noise generating components of the reader, thus improving signal-to-noise ratio of the received backscatter signals from tags.
- Wave front propagation is pseudo-planar compared to the usual spherical wave front propagation emitted from conventional antennas.
- Reduced susceptibility to noise from other users of the shared spectrum including both intentional and non-intentional radiators. These sources include other Part 15 devices, computer and IT equipment as well as RFID and broadband data systems.
- Spatial separation from other systems sharing the same band; because BESPA allows you to target your transmitted and received signal path you can separate the wanted RFID tags from other systems sharing the same physical space, provided they are not directly in line with each other.
- BESPA enables many fewer RFID readers to cover the same physical space (volume), thus reducing the number of transmitters operating in a given physical space, which in turn reduces the level of RF signals in the space and also the amount of RF energy radiated beyond the required RFID read space. This results in much more efficient use of the radio spectrum in line with good spectrum management engineering principles.
- The BESPA pseudo-planar wave front penetrates closely packed items more efficiently than conventional transmitted beams, particularly at greater distances from the reader antenna.
- From an interoperability perspective, note that ITCS is a standards-compliant, since the BESPA antenna is transparent to the air-interface protocol which supports reader-to-tag and tag-to-reader communications.