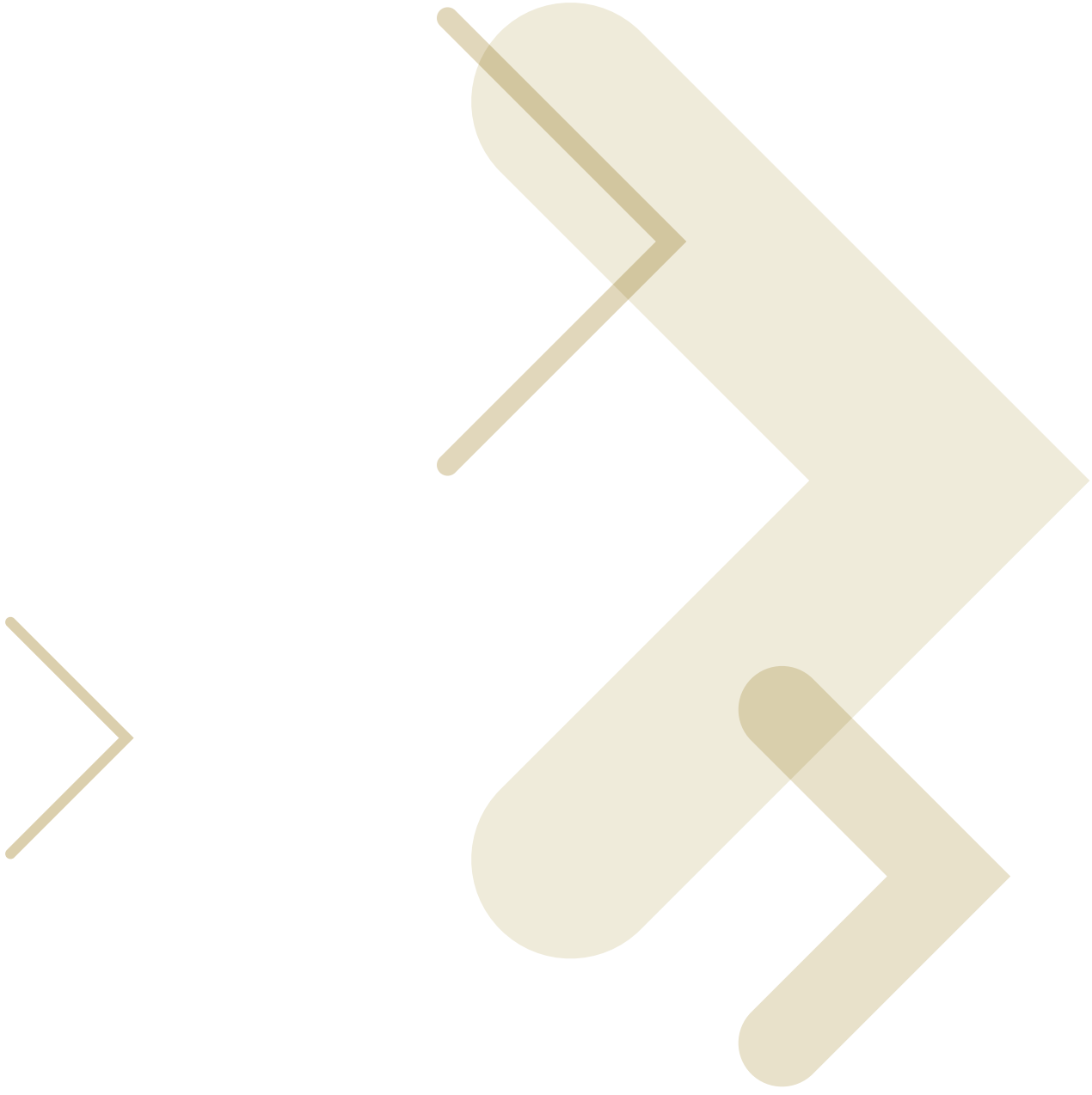
WHITE PAPER

Two RF Inputs Make A Better RFID Tag



This white paper outlines how you can reduce read-orientation sensitivity challenges in your RFID deployments by using tags that feature dual dipole antennas. It also details how inlays with dual dipole antennas increase read range capabilities with very little added cost to greatly enhance tag performance and usage opportunities.

Executive summary

In the past, radio frequency identification (RFID) tags were limited in their universal applicability due to read orientation sensitivity issues. However, a new dual dipole RFID tag eliminates this problem and enhances the use of RFID for a broader range of applications.

Introduction

The dual dipole RFID tag eliminates the problem of read orientation sensitivity to solve a problem that has long limited the universal applicability of RFID.

Antennas collect and emit energy in the form of electromagnetic waves. The units for this transfer take the form of power-per-unit area. Receiving antennas collect power from the local field as if they have a collecting aperture with an area that is much larger than the geometric area of the antenna. Energy collected by a passive RFID tag antenna goes to power the RFID circuitry. Maximizing collected energy is central to increasing the range and robustness of an RFID system.

Single Versus Dual Dipole Antennas

The collecting aperture of a single antenna can be increased but only at the expense of making the antenna more directional. The antenna parameter gain is a measure of both the collecting aperture size and the inability of the antenna to receive from all directions. This inverse relationship between gain and isotropic reception is an unavoidable consequence of wave phase.

Because antenna dimensions are typically of the same order of magnitude as the wavelength of radiation they seek to receive, a direction where antenna currents constructively add at the antenna port is always accompanied by a direction where currents destructively cancel each other. The disparity between gain at best and worst orientations is minimized by making the antenna small with respect to the operating wavelength. However, physically small antennas typically collect less total energy and have a narrower range of operating frequencies. Bearing these tradeoffs in mind, the simple half wave dipole antenna is a good compromise between collecting aperture area and directivity.

A dipole antenna receives and emits best when perpendicular to its wire axis and not at all along that axis. The dead area in the radiation pattern of an antenna is referred to as a null.

Antenna directivity is extremely important for RFID tags because if the tag is oriented where its null is pointed at the tag reader, the tag receives no power and is not read. Reading from several different angles recovers missed tags caused by antenna nulls, but reader antenna diversity is not always possible or sufficient.

While reader antenna diversity is a reasonable solution for static collections of tags, moving collections of tags are often not in the read field long enough to be interrogated by multiple reader antennas. The problem of antenna nulls and missed tags is resolved by including a second antenna along with a second independent set of energy-harvesting circuits on the chip. The second dipole antenna is oriented so that if you are looking down the null of one antenna, the second antenna is in its best receiving orientation. Energy is collected by each antenna but not combined until after its relative phase is destroyed in the harvesting circuitry.

Summary

Dual dipole RFID inlays and tags collect more power from the field without introducing new nulls. This Motorola-patented technology allows two antennas to fill in each other's dead spot to increase the tag read range and ensure that they are less likely to be missed when passing through the read field in an awkward position. The second chip antenna port and associated circuitry, adds little to the cost while it greatly increases the tags' performance.

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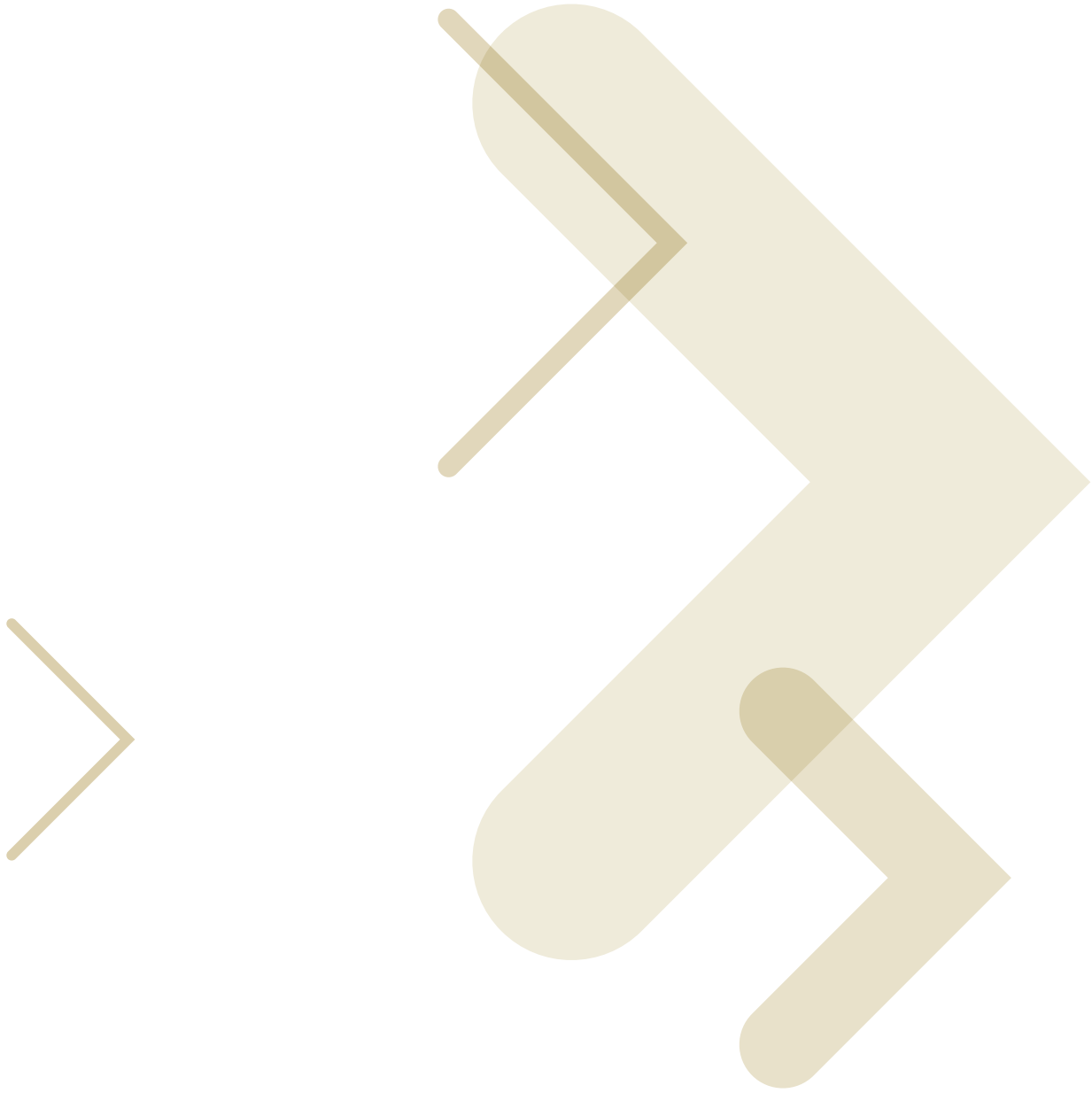

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