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Benchmark Testing of UHF RFID Readers: How to Get Maximum Performance with the Latest RAIN RFID Tags

Get Maximum Performance with the Latest RAIN RFID Tags

The adoption of RFID technology continues to spread across a variety of applications. From trains and warehouses to hospitals and libraries, RFID systems are delivering greater efficiency, security and productivity to workplaces around the world. And with the growing popularity of products and solutions that offer convenient connectivity made possible by the Internet of Things (IoT), the pace of adoption is not likely to slow down soon.

As RFID technology has advanced, manufacturers have produced newer, higher performance tags to meet changing expectations and specifications, allowing more industries to reap the benefits of RFID. On average, today's tag technology is increasing almost 1 decibel (dB) in sensitivity per year, enabling ever greater accuracy and tag performance.

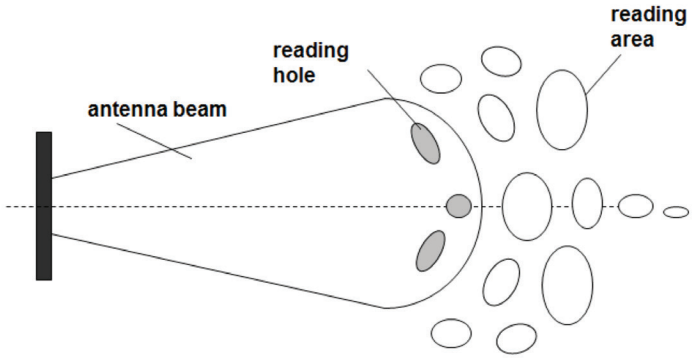
Yet, while tag performance is certainly an important consideration when implementing RFID, there are other key factors that can reduce overall solution performance -- even when the latest and greatest tags are used.

Examine the Environment

There are a number of environmental factors to be considered when planning an RFID installation. For example, radio waves are susceptible to reflections and will behave differently when reflective materials are present in the environment. This means that reflections can cause 'reading holes' in the radio field, preventing RFID readers from seeing tags in certain configurations.

Likewise, the type and density of materials in the environment, as well as the tag density, can influence reading ranges and accuracy. The higher the density of the material, the greater the impact on reading range. Likewise, certain materials such as metal will have significant impact on performance when it is in close proximity to the RFID tags.

Figure A



The key to dealing with environmental factors is to understand how surrounding materials will affect reading range and accuracy, and take them into account when deploying an RFID solution. The proper mounting and positioning of antennas will be determined by the application and the environmental factors; be sure to test and reposition antennas as needed.

Reading is Fundamental

Beyond factors related to the installation environment, another key consideration is the sensitivity level of RFID readers used in the system. As RFID tags have become more sensitive, reader technology has advanced as well. And in order to get maximum performance out of today's newer, more sensitive tags, a good, high-performance reader is essential.

FEIG Electronics recently tested the difference in performance from an older tag to a newer tag, comparing a high-performance (-83dB) UHF RFID reader and a lower performing reader (-65dB). Tests show that the high-performance reader maintains much higher power in both scenarios, offering greater performance in terms of accuracy, reading distance and percentage of tags read.

However, when progressing from the older tags to newer tags, the lower performing reader actually *loses* read percentage rates for new tags significantly. In fact, as shown in Figure B, the lower performing reader demonstrates a drop in read percentage by more than 50 percent when reading the newer tags that are 2 dB more sensitive.

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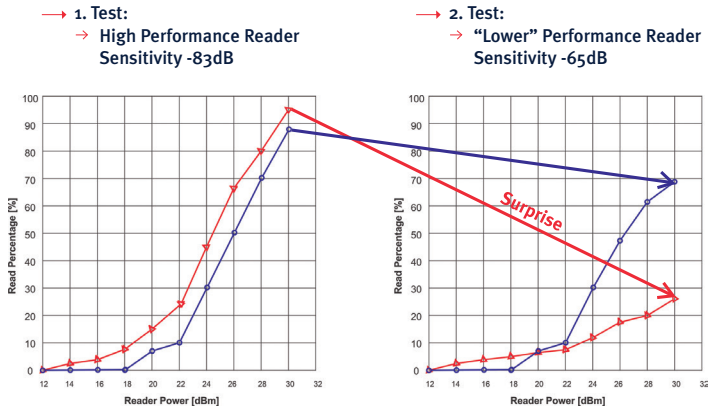
Figure B



Not All Readers Are Created Equal

As we can see, investing in a newer, more sensitive tag doesn't necessarily deliver improved performance without upgrading to a higher performing reader. But different readers offer varying levels of performance in different applications, so how can you choose the best reader for your system?

Following is a comparison of test results from several commercially available UHF RFID readers, as benchmarked against FEIG's LRU1002 Fixed UHF Long-Range Reader for applications requiring read ranges up to 16 meters. The readers were tested for the following functionality:

- Reading speed
- Anti-collision and multiplexing
- Dense reader mode sensitivity
- Overall performance ratings

Each reader was tested for reading speed under identical conditions, and an average speed is presented in Figure C.

Figure C

Reader	Attempt 1	Attempt 2	Attempt 3	Attempt 4	Attempt 5	Average
LRU1002	0,410 s	0,435 s	0,42 s	0,415 s	0,405 s	0,417 s
A	1,18 s	0,943 s	0,832 s	0,821 s	0,786 s	0,912 s
B	0,733 s	0,748 s	0,717 s	0,78 s	0,748 s	0,745 s
C	0,363 s	0,41 s	0,431 s	0,388 s	0,458 s	0,410 s
D	1,039 s	1,048 s	1,123 s	1,147 s	0,959 s	1,063 s

* Comma separator indicates decimal separator for US

Next, for the anti-collision and multiplexing reading speed test, readers were tested on the number of tags read per second. In this test, every antenna is seeing every one of the tags, requiring multiplexing of the signals. As demonstrated in Figure D, **several readers exhibited reduced performance due to their slower speed when switching from one antenna to another.**

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Figure D

Reader	1 Antenna	2 Antennas	3 Antennas	4 Antennas
LRU1002	241	237	235	238
A	131	134	109,6	94,8
B	161	161,6	172,8	159,6
C	262,6	263,8	262,4	256
D	192,4	204,8	211,4	208,8

* Average number of tags read per second

The dense reader mode operation test represents a very common real-life situation, particularly with UHF RFID applications. For example, in a logistics application such as on a loading dock, multiple readers in close proximity can cause signal loss and reduced performance. In these test results, the LRU1002 Fixed UHF Long-Range Reader exhibits the least performance loss when running in a multiple reader environment due to its ability to switch channels to avoid interference.

Figure E

Reader	Single Reader	2nd Reader transmitting in the same channel	2nd Reader transmitting in the neighboring channel
LRU1002	-82 dBm	-78 dBm	-78 dBm
A	-74 dBm	-50 dBm	-50 dBm
B	-82 dBm	-78 dBm	-64 dBm
C	-82 dBm	-78 dBm	-62 dBm
D	-80 dBm	-70 dBm	-70 dBm

Not all RFID readers are the same. When comparing the signal loss of various readers and the resulting effect on reading distance, **it's important to note that a loss of just -3 dBm cuts the signal in half, and -24 dBm will result in nearly 90 percent loss in performance.**

If you want to optimize performance of your RFID system, it's not enough just to upgrade to the latest and greatest RFID tags – be sure to consider the installation environment and the RFID reader performance as well.

About FEIG Electronics

FEIG Electronics, a leading global supplier of RFID readers and antennas, is one of the few suppliers worldwide offering RFID readers and antennas for all standard operating frequencies: LF (125 kHz), HF (13.56 MHz), UHF (860-960 MHz). A trusted pioneer in RFID with more than 40 years' industry experience, FEIG delivers unrivalled data collection, authentication and identification solutions, as well as secure contactless payment systems. FEIG readers, available for plug-in, desktop and handheld applications, support next-generation contactless credit cards, debit cards, smartcards and NFC applications to enable fast, accurate, reliable and secure authentication and payment transactions.

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