smart-TEC

Application notes for RFID tags

Basics / Equipment / Physical and technical background

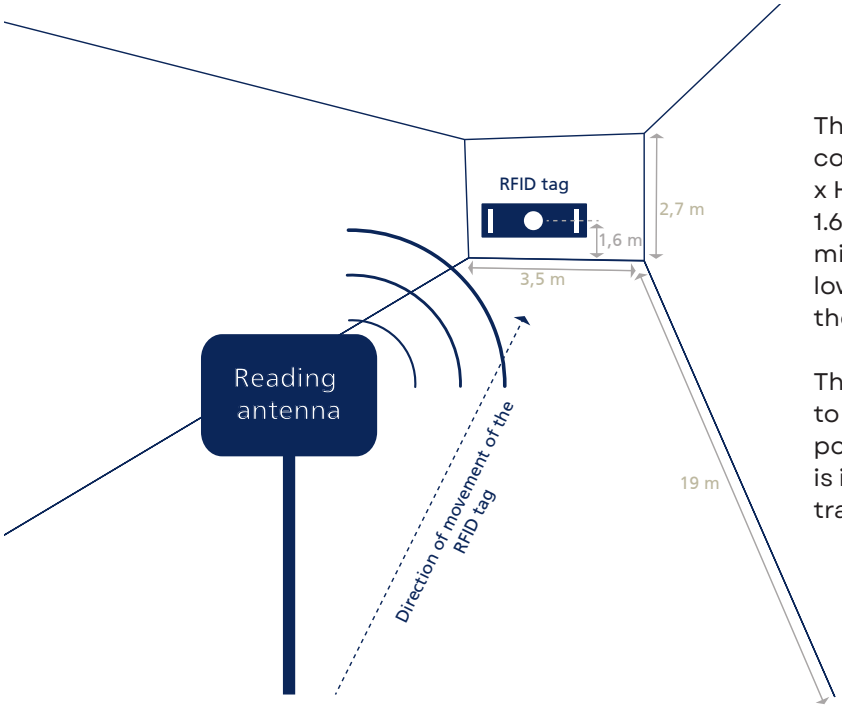
For RFID tags, product-specific theoretical read ranges are specified, which are determined under laboratory conditions. These ranges can rarely be ideally achieved when used under operating conditions. This fact is mainly due to mainly due to two factors: Firstly, the reading hardware used and settings in the evaluation software and secondly the ambient conditions.

These application notes are intended to explain the background to the use of RFID tags and provide information on their application. Physical framework parameters are explained and a product example with different hardware is examined for range. This is an RFID UHF label that is measured on a PP substrate.
The readers are operated at the maximum possible radiation power.

Example product RFID label (UHF), measured on PP substrate

The following points must be observed when using RFID labels:

- RFID tags alignment (rotation, inclination, symmetry)
- Polarization of the transmitting antenna (linear, circular) and its alignment
  (long/short side of the transmitting antenna in the direction of the dipole axis of the RFID tags)
- Height of the transmitting antenna above the ground and at what height in relation to the RFID tags
- Reader power (software setting)
- Transmitter antenna characteristics (radiation angle, suitability for use in near field/far field)

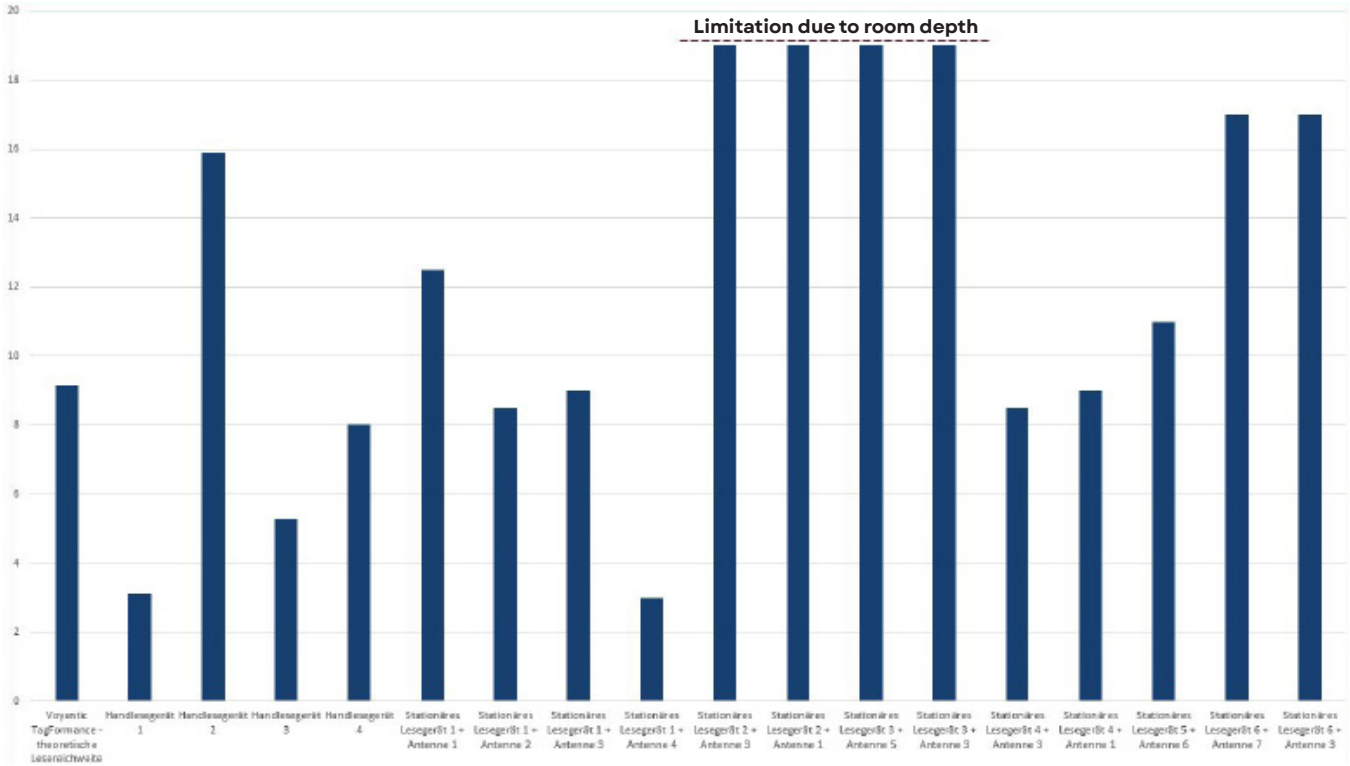


The measuring environment is a laboratory corridor measuring 19 m x 3.5 m x 2.7 m (L x W x H). The RFID label is located approximately 1.6 m above the floor. The height of the transmitting antenna is antenna is set so that the lower edge of the transmitter antenna is on the RFID label axis.

This positioning helps to avoid reflections to the ground can be avoided as much as possible and at the same time the RFID label is in the homogeneous radiation field of the transmitting antenna.

Measurement results

RFID label (UHF) - comparison of read range



Due to the limitation of the measuring environment to a length of 19 m, it is not possible to create more precise range measurements for some readers above 19 m.

Conclusion

- The “theoretical reading range” that can be achieved under laboratory conditions with the Voyantic TagFormance system can be approximately achieved with a suitable reading system for the respective product at 2 watts radiation power (+/-).

- The reading systems used behave completely differently for all products in terms of their range. The expected reading range in comparison with another system cannot be deduced solely from the radiated power of a system.

- The reading systems do not allow any conclusions to be drawn about the performance with other products. If the range with a reader system with product A is very high, it can be very moderate with product B in comparison with other systems. Accordingly, there are no RFID readers that perform equally well for all products at the same time.

- Since very different reading results can be achieved in different environments, the ambient conditions should also be given corresponding attention in addition to the reading system. In particular, metallic objects in the vicinity of the label change the radiation characteristics of the RFID reader and RFID label and can lead to pronounced constructive or destructive interference. Deterioration of the range by a factor of two or more can be observed in individual cases.

Recommendations

Transponder alignment (rotation, inclination, symmetry)

1. Check the configuration of the reader used:
- Has the maximum permitted power been set?
- Have “timing” parameters, especially for moving processes with multiple antennas, been selected so that the best possible detection is achieved? (Consult the manufacturer if necessary)

2. Check the antenna used:
- Has an antenna with a suitable radiation angle been selected? (Consult the manufacturer if necessary)
- Has an antenna with suitable polarization been selected? (Linear vs. circular)
- Has the antenna gain been optimized as much as possible for the application?
- Has the antenna been rotated correctly? (An asymmetrical antenna can sometimes change the radiation pattern for the better by rotating it 90°)
- Has the position of the antenna been chosen correctly? (The height of the antenna above the ground or the distance to walls can have a positive effect on the reflections that build up)
- Has the angle of the antenna been chosen correctly? (A few degrees of rotation can have a positive effect, especially with regard to reflections from metallic objects)

3. Check the RFID tag:
- Is the rotation of the RFID transponder suitable?
- Is the inclination of the RFID transponder suitable?
- Can the RFID transponder be used symmetrically or does it have a preferred direction? (Particularly important for onMetal applications)

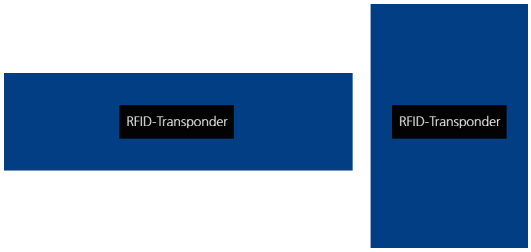
4. Use of the transponder on metal:
- Is an onMetal RFID transponder being used?
- Is the transponder applied close enough to the metal surface? (Adhesives or coatings that are too thick can have a negative effect)

RFID tag with thick adhesive | RFID tag on lacquer layer | RFID tag directly on metal

- Is the metallic surface on which the RFID tag is placed sufficiently large?

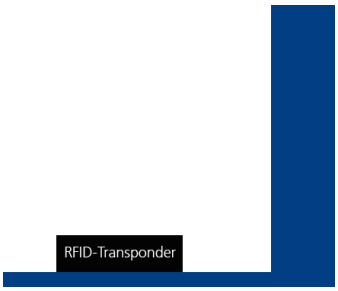
RFID tag on small and large metal plate.

- Does the RFID tag have a preferred direction along which the metal should be extended? (Often along the dipole axis)



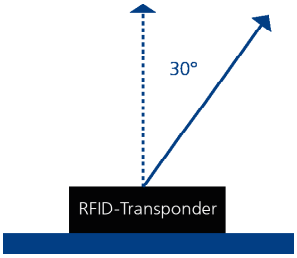
RFID tag axis along long or short metal side.

• Are metallic edges close to the transponder? (Can have a positive or negative effect)



Radiation of the transponder upwards
is influenced by the metal edge on the right.

• Does the transponder have an asymmetrical radiation pattern to the front? (May be possible due to the design)



In this example, the strongest radiation is 30°
to the transponder axis.