

# S-UHF-R10

Sensor UHF Reader

## Vehicle Identification

Sensor UHF RFID Readers



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## Sensor UHF Reader

## Introduction

The purpose of this document is to describe the approach to be used when developing a vehicle identification project using S-UHF-WSTKPAP-U technology, to ensure optimal outcomes for the required configuration and installation conditions.

General principles of UHF technology

Operating principle

S-UHF-WSTKPAP-U uses “passive” UHF (Ultra-High Frequency) technology, which means that the chip does not require a battery to operate, because its power is supplied by the reader. In Europe, the frequency used for this technology is 866 MHz (915 MHz in the USA).

This passive UHF technology can therefore be used to read data from an electronic tag with no integrated power supply within a range of several metres.

Uses and limitations, environmental effects, useful information

Various laws of physics apply to this technology and can influence the way it operates. The major factors to bear in mind are as follows:

The materials the tag is used on or behind will influence reader performance (range and speed). A tag should be matched to its environment to give the best possible results.

The same tag will operate very differently on metal or behind glass (windscreen).

At this frequency, radio waves do not travel well through liquids. A human body between the reader/antenna and the tag itself could obstruct tag reading.

Radiofrequency identification does not work through metal.

Typical example: heat-reflective (or climate comfort) windscreens on modern vehicles have a metallic film that blocks radio waves. Any tag that is behind this metallic screen would not be read. However, these windscreens have non-treated areas that allow the radio waves through.

Radio waves emitted by the reader and the tag can bounce off obstacles and be diverted. The presence of obstacles in the field can influence the results.

UHF technology can be directional. Some antenna has a fairly directional “reading field”, rather like the area lit up by a spotlight. The location of antenna will therefore need to be planned on the basis their reading zone, depending on their characteristics.

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## Optimum

Given the constraints described above, it is important to identify the conditions that will give the best possible system performance. This means ensuring the optimum antenna and tag positions.

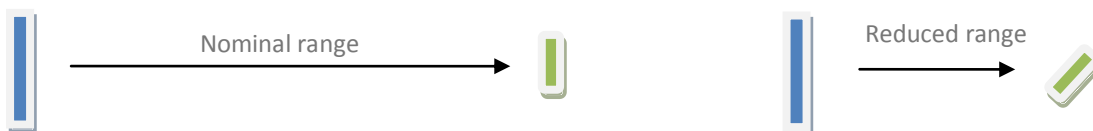
Performance will depend on the position of the tag relative to the antenna. Maximum range and optimised detection will be achieved if the tag is directly opposite the antenna, parallel to it, and with the correct polarisation.

For optimum performance, the tag should be straight opposite the antenna.

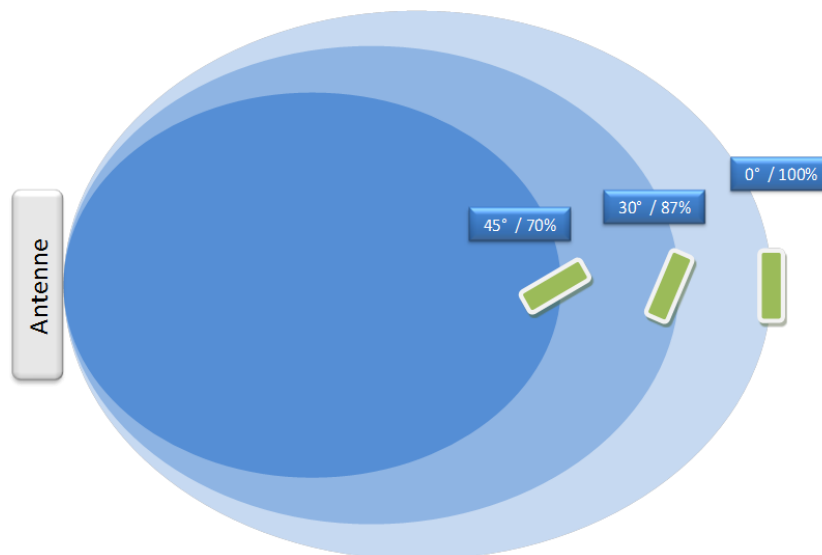
The range values given in technical specifications for the readers are measured in straight-on distances, with the tag parallel to the antenna.

When the tag is at an angle from the antenna, the effective range is reduced.

A UHF tag may have a specific orientation, related to the polarisation of its antenna. A “linear” tag will be orientation-sensitive and will not read as well horizontally as it does vertically.



The angle in question may be a horizontal or vertical angle, depending on the comparative height of the antenna compared to the vehicle and the lateral offset of the antenna, compared to the lane of traffic.



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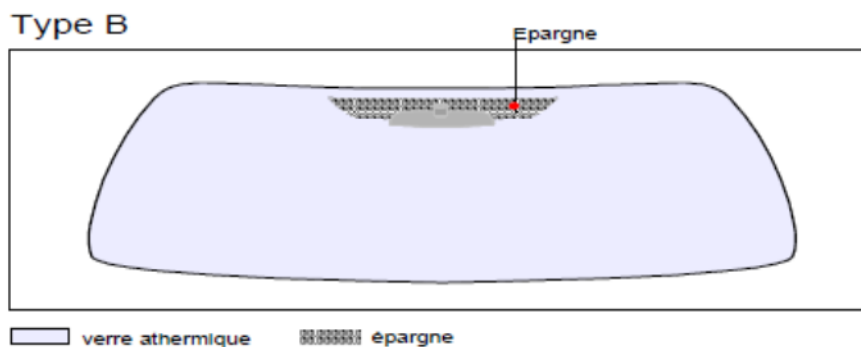
## Tag Position

### Selecting the tag location

S-UHF-WSTKPAP-U performance is influenced by its position on the windscreen, and depends on the windscreen type. The aim is to position the tag to optimise the quality and performance of reading function.

**For heat-reflective windscreens, it is essential to place the tag in the non-treated areas (where applicable) as shown in the illustration below. The location of these non-treated areas will depend on the make and model of the vehicle. A non-exhaustive list is available in the Appendix. If there isn't non-treated heat-reflective area, the tag won't be read.**

The angle in question may be a horizontal or vertical angle, depending on the comparative height of the antenna compared to the vehicle and the lateral offset of the antenna, compared to the lane of traffic



*See Appendix: Windscreen types with location of non-treated areas .*

Standard private car: the ideal position is near the top of the windscreen, behind the rear-view mirror, if possible on the side the reader antenna is located.

Ensure the tag is not touching the upper edge of the windscreen.

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Side to choose according to position of the antenna / reader

Heavy Goods Vehicle (HGV) / Truck / Bus

For lorries and buses, there are two possible solutions:

Tag inside vehicle on windscreen (TLT model): same positioning requirements as for a car.

Tag outside vehicle on bodywork: place the tag so it is as close to parallel as possible with the reader antenna, in the desired reading zone.

Example with a TML model, on a bus radiator grill: approximately 1.10m from the ground, not touching the metal windscreen wiper

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## Installing the tag

Once you have decided where to position the tag, install it using the holder provided.

Using the double-sided adhesive tape provided, affix the holder horizontally on the windscreen and insert the tag using the method of your choice:

1 – The S-UHF-WSTKPAP-U is removable from its holder to transfer it in an other vehicle.



2 – The S-UHF-WSTKPAP-U is not transferable.



When you choose the location, bear in mind the space you will need to insert the tag into the holder (look at the angle of the windscreen).

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## New projects

When considering equipping a site with a S-UHF-WSTKPAP-U system, various steps need to be followed.

### Site analysis

Gather the basic information required for defining the configuration:

- Site map,
- Direction of traffic,
- Vehicle sizes,
- Vehicle types to be identified

### Project definition

Identification zones: define the areas in which the vehicles are to be identified

- Locations,
- Dimensions

### Materials choices

Information on the project and conditions gathered in the earlier stages of analysis will feed into the initial equipment choices: reader type, number of antenna, tag type etc.

Site requirements and constraints will determine the technical choices. This analysis will provide a good overview of the feasibility of the desired configuration and will help to identify any adaptations or adjustments that may be required.

### Testing

From the outset, we recommend defining the tests required for validating the configuration with the client (if validation is required). It is important to ensure that representative vehicles and the appropriate equipment are available for the validation tests.

## Installation methodology

- Place the vehicle in the typical / desired identification zone
- Adjust the antenna height and orientation until the tag can be read
- Test the configuration with a moving vehicle
- Adjust the antenna to achieve optimum results

This configuration will be optimised for the test vehicle. The set-up will ideally need to be retested with a vehicle that is very different from the first (higher windscreen, van etc.) in order to ensure the antenna is positioned so as to cover as wide a range of usage cases as possible.

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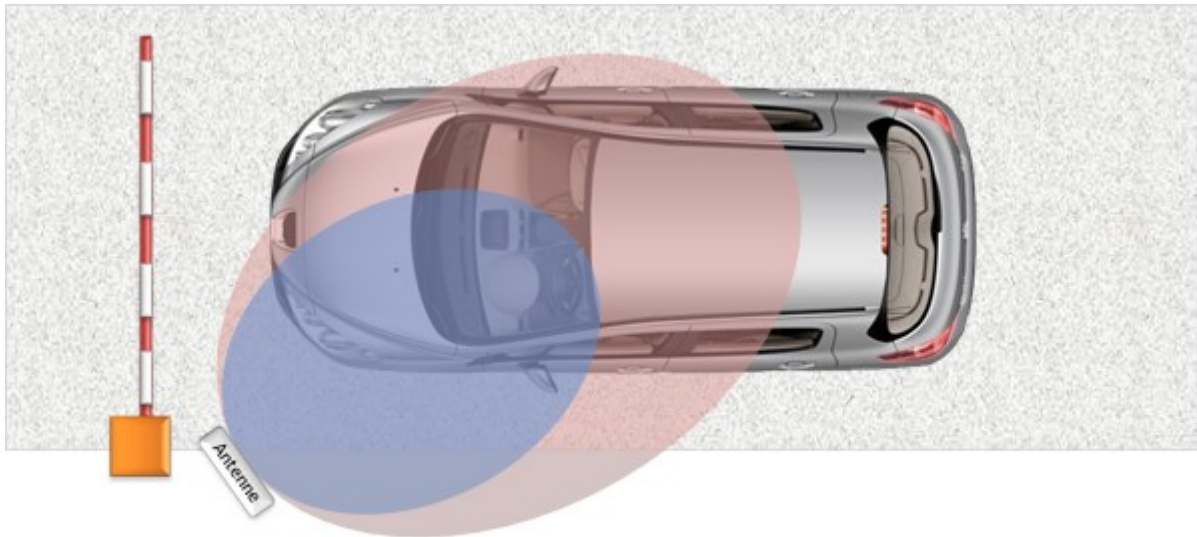
## Basic installation rules

For a vehicle access gate, you are advised to place the antenna and set up the detection zone ahead of the barrier for more reliable detection and to allow the system time to activate the barrier opening system.

Installation methodology

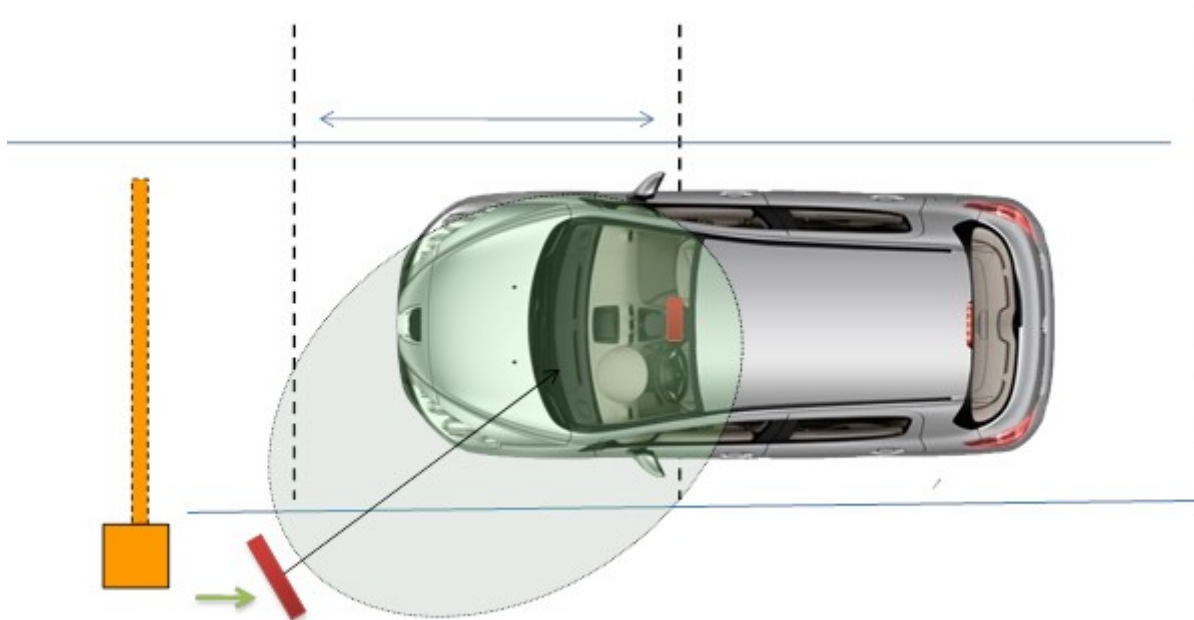
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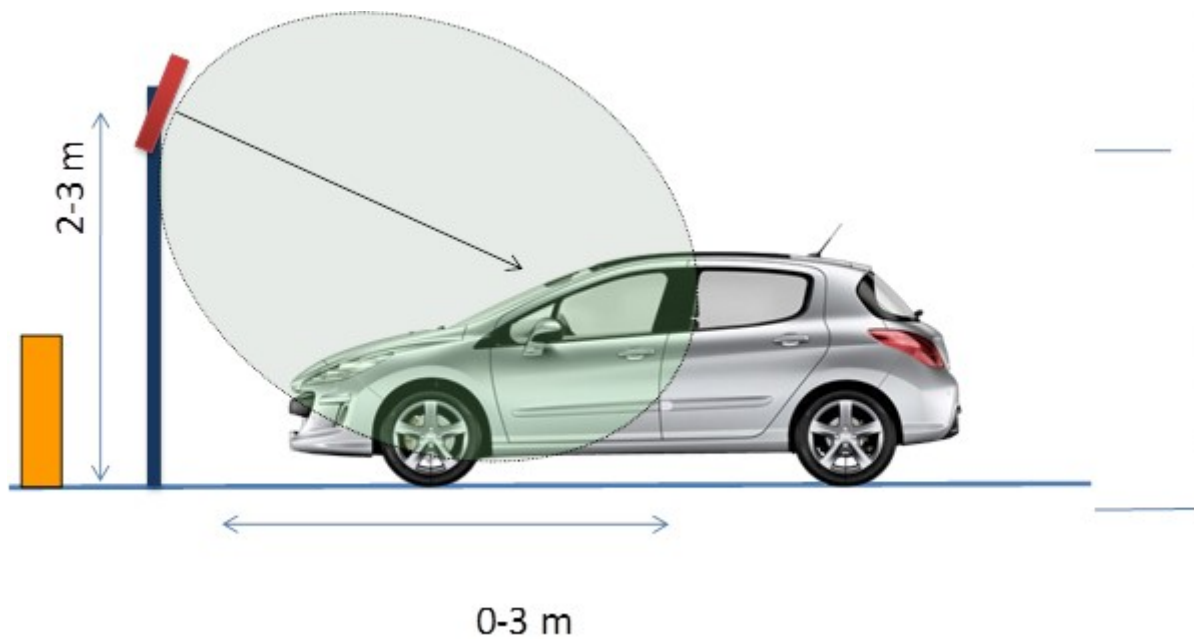


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A higher antenna with a downward orientation will limit the ground range and therefore prevent the tag on a second vehicle being inadvertently read.



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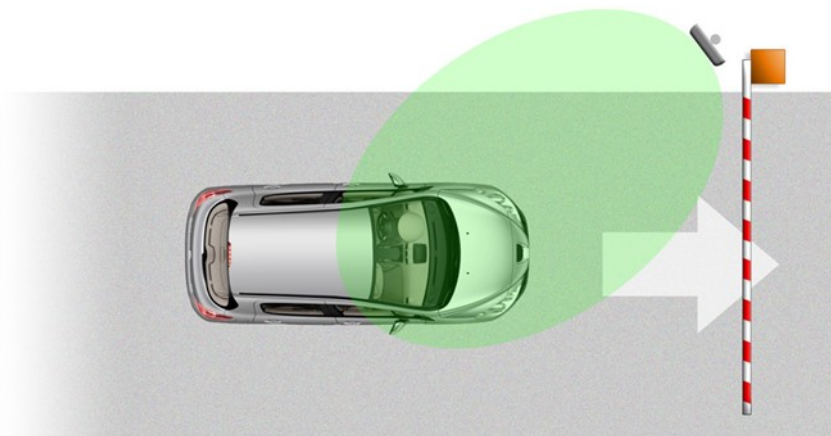
## Configuration examples

This section describes classic configurations for vehicle access gates, indicating the recommended locations for the antenna/readers.

This configurations are only examples and do not guarantee results. They are generic, with the purpose of feeding the design process. External variables can also influence certain functional factors.

### Simple one-lane access

- One R10 reader in a lateral orientation
- Positioned ahead of the barrier for early detection



### Simple one-lane dual-height access

For use when a single antenna is not sufficient to cover the height of both an HGV and a car.

- One dual-antenna URD reader in a lateral orientation
- 1 antenna positioned for optimal detection of cars
- 1 antenna positioned for optimal detection of HGVs
- Reader positioned ahead of the barrier for early detection.



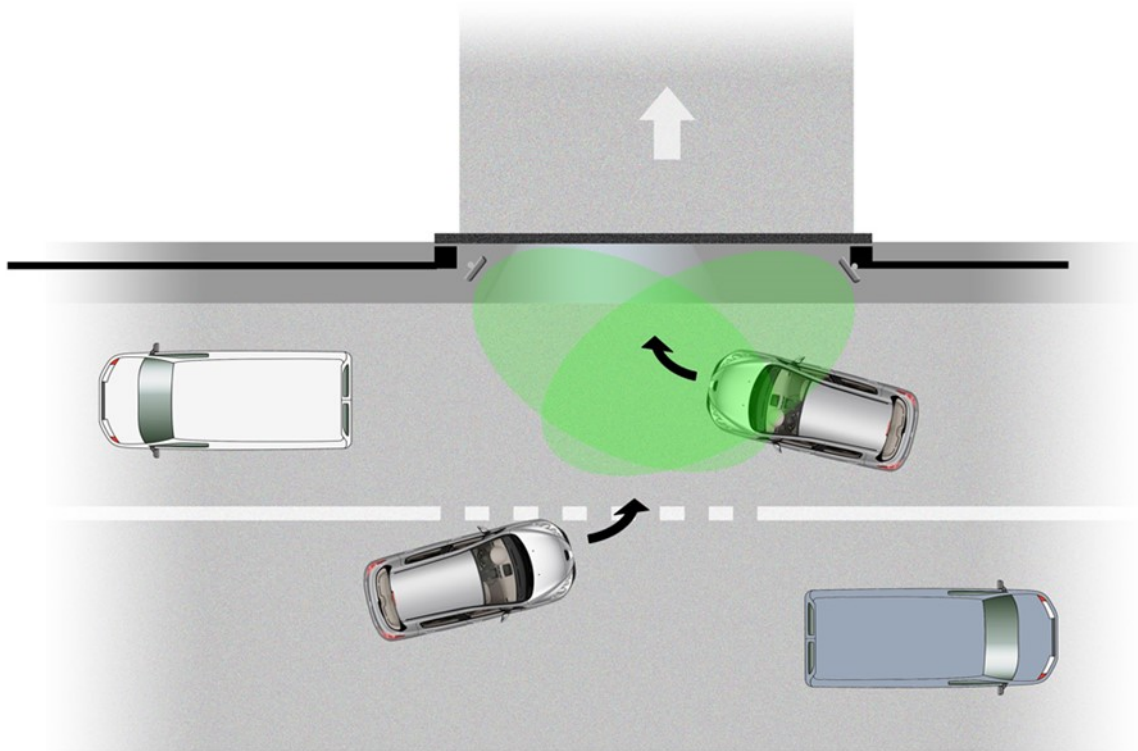
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## Double-width access on a two-way public road

Double-width sliding gate, with vehicles arriving from both directions

- Dual-antenna R10 reader or 2 R10 readers
- One antenna either side of the gate to be aligned with each direction of travel.



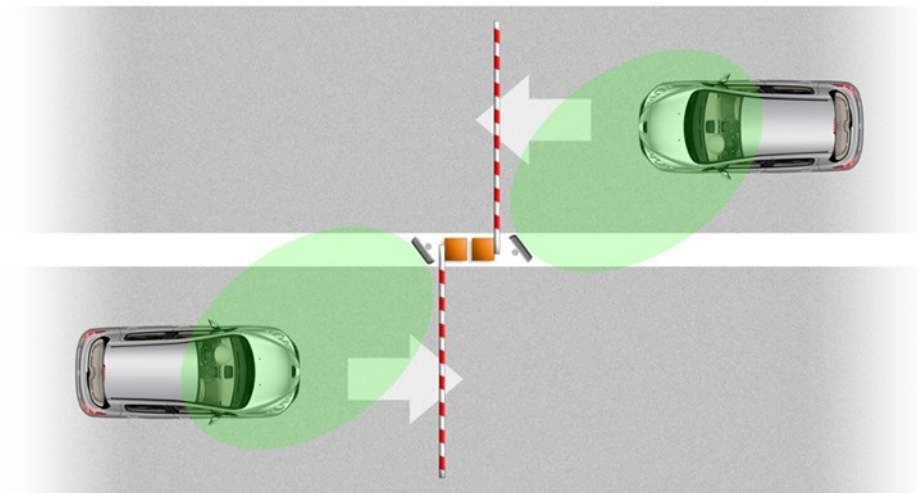
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### Single entrance / exit gate

Use of a single R10 reader / two antenna to manage a bi-directional access gate

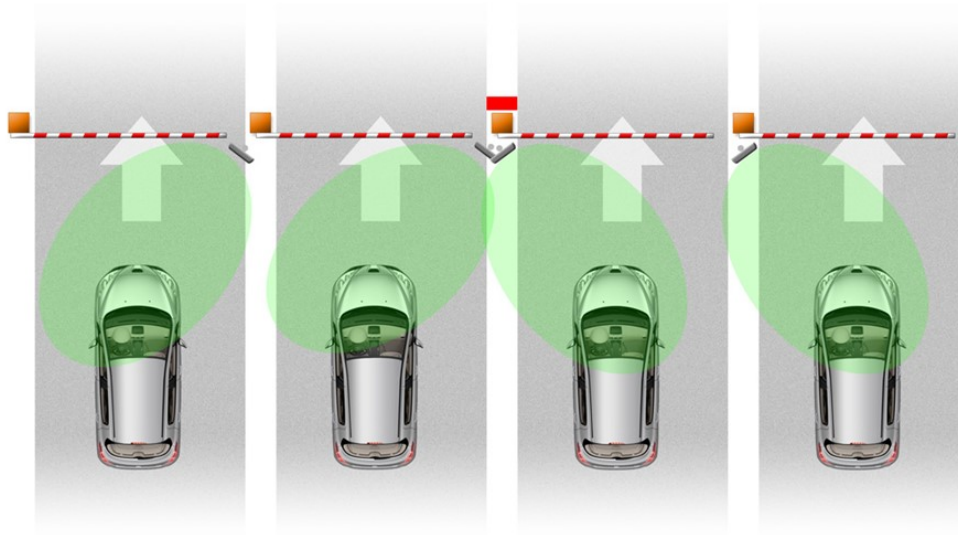
- The antennas are controlled by a single reader, to reduce any risk of interference.
- Each antenna controls one lane and transmits the data it reads to the appropriate gate.



### Multi-lane access

Use of a multi-antenna / multi-lane R 10 reader. A single reader can control 1 to 4 lanes.

- The antennas are controlled by a single reader, to reduce any risk of interference.
- Each antenna controls one lane and transmits the data it reads to an independent output.
- The antenna cannot be further than 9m from the reader, so the reader is located in the centre (red box).



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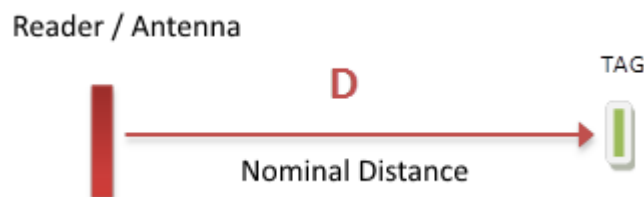
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## How to estimate the theoretical range

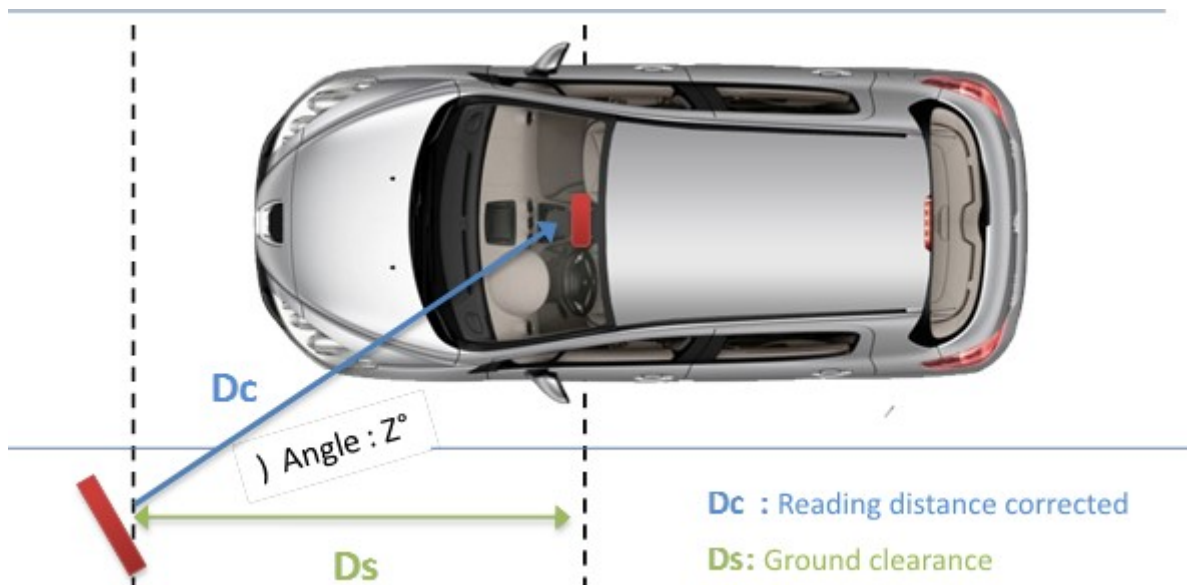
**Aim:** estimate the reading position, based on the antenna location and the vehicle position.

**Note:** The results given below can vary substantially depending on vehicle type, but the theory remains valid.

Reminder: the optimal range, as expressed in the specifications, is taken with the tag straight in front and parallel with the antenna, and at the optimum reading position.



Antennas are often positioned to one side of the traffic lane, and at a different height. A corrected range value ( $D_c$ ) is estimated from the nominal range ( $D$ ) in order to give the ground range ( $D_s$ ) - the ground-level distance between tag and antenna. This distance is generally quoted as the operational range, but it is not the straight-line distance between the tag and antenna.



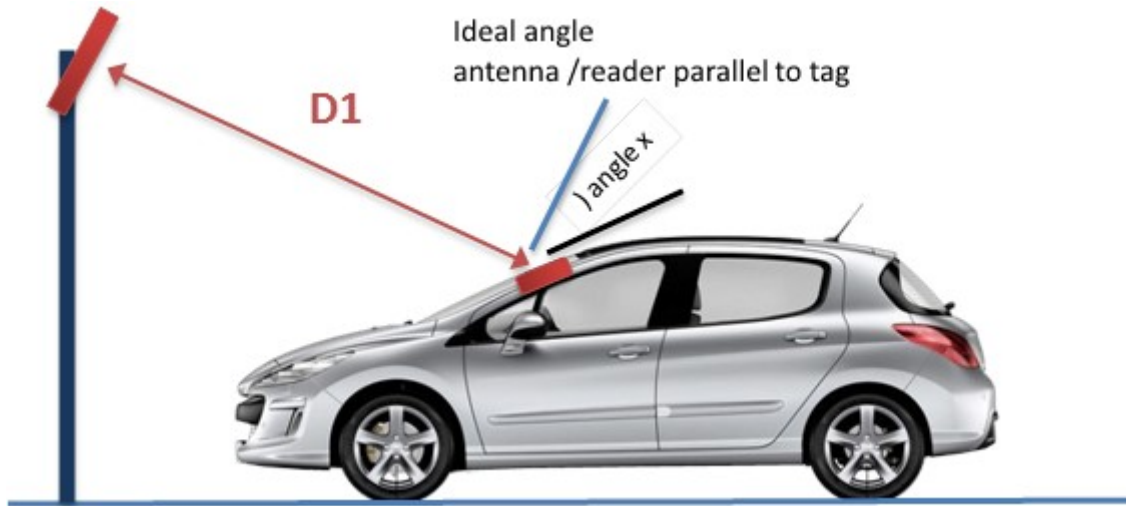
Corrected Range ( $D_c$ ) = Nominal Range ( $D$ ) corrected by the horizontal angle and elevation angle between the tag and antenna/reader. It is determined by the antenna height and orientation.

Ground Range ( $D_s$ ) = Corrected Range ( $D_c$ ) \* adjustment coefficient (based on angle  $Z$ )

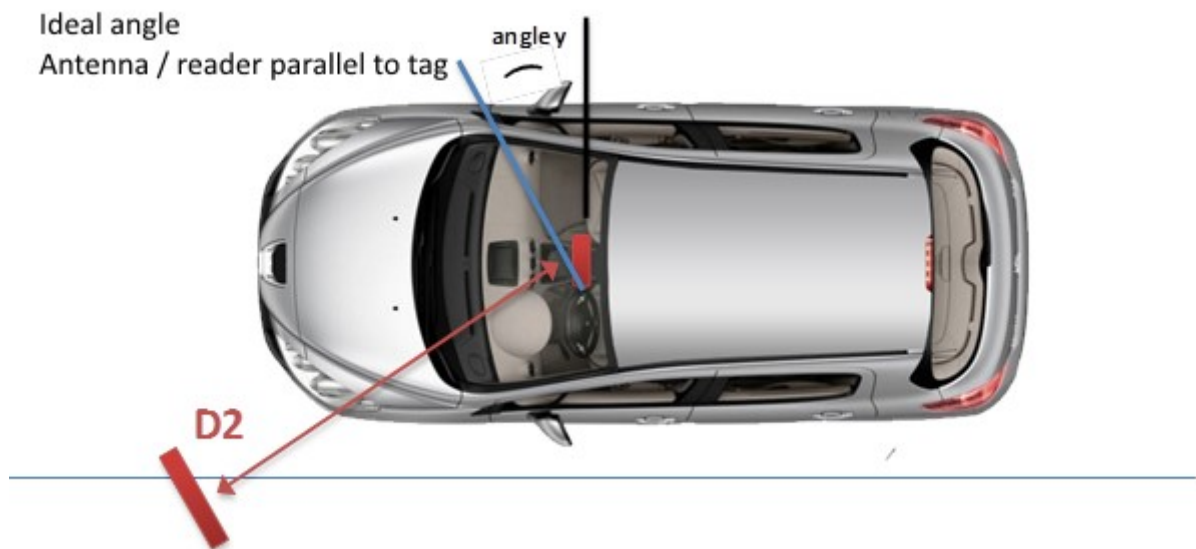
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**STEP ONE:** calculate the **Corrected Range (Dc)**



=> **Note:** angle x should be taken as an average, because it can differ according to vehicle model. It should be estimated on the basis of a predefined fixed antenna height.



=> **Note:** angle y should be taken as an average, because it can differ according to vehicle model and lateral position in relation to the antenna.

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This table should be used to estimate the reduction in range due to the angles between antenna and tag (which determine the adjustment coefficient to be applied to the nominal range as a result of the approximate horizontal and vertical angles):

Angle X°	Adjustment Coefficient
15°	0.96
20°	0.94
25°	0.90
30°	0.87
35°	0.82
40°	0.76
45°	0.71

Corrected Range (Dc) = nominal range (D) \* Adjustment Coefficient  
(Angle x) \* Adjustment coefficient (Angle y)

### Examples

Example 1: Let us consider a R 10 reader and S-UHF-WSTKPAP-U on a standard windscreen.

Nominal range: 7 m

Average angle x: 20°

Average angle y: 30°

Corrected Range (Dc) =  $7 * 0.94 * 0.87 = 5.72$  m

Example 2: Let us consider a R10 reader and S-UHF-WSTKPAP-U on a heat-reflective windscreen.

Nominal range: 4 m

Average angle x: 20°

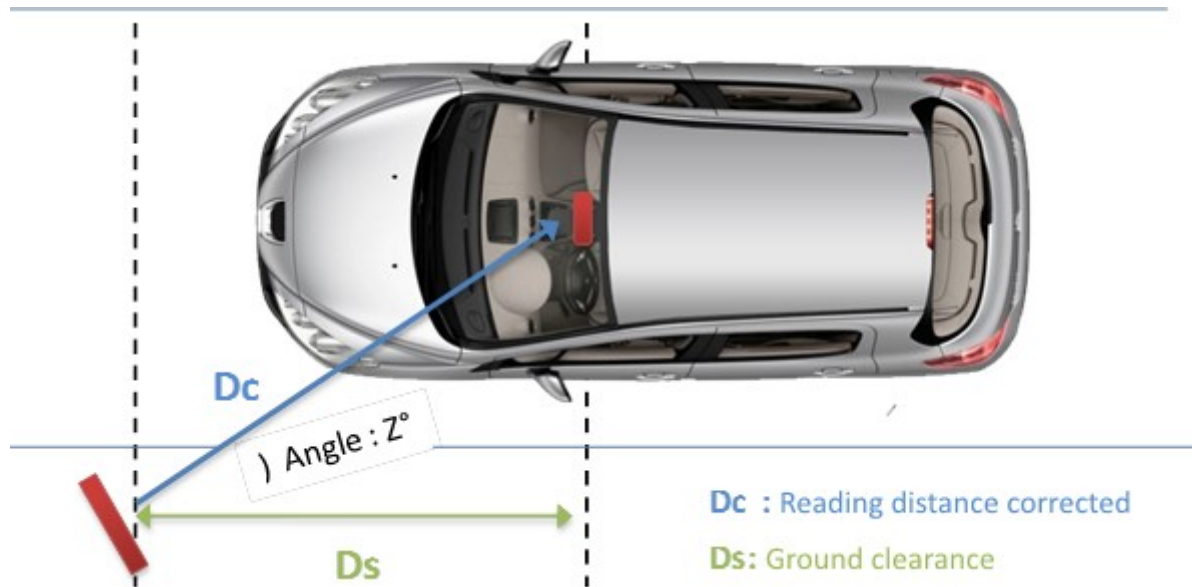
Average angle y: 30°

Corrected Range (Dc) =  $4 * 0.94 * 0.87 = 3.27$  m

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STEP TWO: calculate the Ground Range (Ds)



The angle z adjustment coefficient is applied to Corrected Range (Dc) to give the Ground Range (Ds).

For example 1:

$Dc = 5.72$ . If angle Z is  $30^\circ$ , then:  $Ds = 5.72m * 0.87 = 4.97 \text{ m}$

For example 2:

$Dc = 3.27$ . If angle Z is  $30^\circ$ , then:  $Ds = 3.27m * 0.87 = 2.84 \text{ m}$

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# Heat-reflective windscreens

## Heat-reflective concept

A heat-reflective windscreen allows the regulation of the heat inside the car. The car manufacturers use metal leaf in the treatment of the windscreens.

We can recognize heat-reflective windscreens through the coloured reflections on the glass.



## Impact of the heat-reflective windscreens on the performances

The metal being a blocking element for radio frequencies, heat-reflective windscreens will modify the performances of the reading distance. In several cases, there is a non-treated area (refer to the ANNEXE –non-exhaustive list). This area is made for radio systems (GPS, RFID...). However, the reading distance can be reduced.

By the way, it is very important to take into account this point before the installation of the reader and realize the tests in order to define the location of the reader.

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## Frequently Asked Questions

Issue	Likely cause	Recommendation
My reader frequently reboots	Current too low	Check the cable types, power supply and distance between power supply and reader.
My reader does not start up	Voltage too low Incorrect cabling	Check the voltage at the reader input terminals. Use a regulated power supply.
My tag is not read because I have a heat-reflective windscreens	Bad positioning of the tag or reader not well placed.	Change the location of the tag or reader.
Heat-reflective windscreens without non-treated part	Change the positioning of the tag or the type of it.	

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## APPENDIX 1: Types of heat-reflective windscreens

