SIEMENS

SIMATIC Ident

RFID systems
SIMATIC RF600

System Manual

06/2019
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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.

⚠CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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05/2019 Subject to change

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1 Introduction

1.1 Preface

Purpose of this document

This system manual contains the information needed to plan and configure the RF600 system.

It is intended both for programming and testing/debugging personnel who commission the system themselves and connect it with other units (automation systems, further programming devices), as well as for service and maintenance personnel who install expansions or carry out fault/error analyses.

Scope of this documentation

This documentation is valid for all supplied versions of the SIMATIC RF600 system and describes the state of delivery as of 06/2019. If you are using older firmware versions, please refer to the 08/2011 edition of the documentation.

Registered trademarks

SIMATIC ®, SIMATIC RF ®, MOBY ®, RF MANAGER ® and SIMATIC Sensors ® are registered trademarks of Siemens AG.

Recycling and disposal

The products are low in harmful substances, can be recycled and meet the requirements of the Directive 2012/19/EU for disposal of waste electrical and electronic equipment (WEEE).

Do not dispose of the products at public disposal sites.

For environmentally compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste or your Siemens representative.

Note the different country-specific regulations.

History

Currently released versions of the SIMATIC RF600 system manual:

Edition	Comment
11/2005	First edition
...	...
10/2015	Approval for the readers RF650R, RF680R, and RF685R
12/2015	New antennas RF650A and RF680A
10/2016	Revision of the transponder sections
02/2018	Expansion of the documentation by the following: • RF615A antenna • RF645T, RF682T transponders
11/2018	Expansion of the documentation by the following: • Reader SIMATIC RF615R
06/2019	Expansion of the documentation by the following: • Reader SIMATIC RF610R • Transponder RF630L

Declaration of conformity

The EC declaration of conformity and the corresponding documentation are made available to authorities in accordance with EC directives. Your sales representative can provide these on request.

Observance of installation guidelines

The installation guidelines and safety instructions given in this documentation must be followed during commissioning and operation.

1.2 Abbreviations and naming conventions

Abbreviations and naming conventions

The following terms/abbreviations are used synonymously in this document:

Reader	Write/read device (SLG)
Transponder, tag	Data carrier, mobile data storage, (MDS)
Communications module (CM)	Interface module (ASM)

2 Safety Information

2.1 General safety instructions

Note

Heed the safety notices

Please observe the safety instructions on the back cover of this documentation.

SIMATIC RFID products comply with the salient safety specifications to VDE/DIN, IEC, EN, UL and CSA. If you have questions about the admissibility of the installation in the designated environment, please contact your service representative.

⚠ WARNING
Safety extra low voltage The equipment is designed for operation with Safety Extra-Low Voltage (SELV) by a Limited Power Source (LPS). (This does not apply to 100 V ... 240 V devices.) This means that only safety-extra low voltage (SELV) with a limited power source (LPS) complying with IEC 60950-1 / EN 60950-1 / VDE 0805-1 may be connected to the power supply terminals or the power supply unit for the equipment power supply must comply with NEC Class 2, according to the National Electrical Code (r) (ANSI / NFPA 70). There is an additional requirement if devices are operated with a redundant power supply: If the equipment is connected to a redundant power supply (two separate power supplies), both must meet these requirements.

⚠ WARNING
Opening the device D not open the device when energized.

NOTICE
Alterations not permitted Alterations to the devices are not permitted. Failure to observe this requirement shall constitute a revocation of the radio equipment approval, CE approval and manufacturer's warranty.

Operating temperature

⚠ CAUTION
Increased temperatures on the lower casing Note that the lower casing of the readers is made of metal. This means that temperatures can occur on the lower casing that are higher than the maximum permitted operating temperature.

⚠ CAUTION
Do not expose the readers to direct sunlight Note that the readers must not be exposed to direct sunlight. Direct sunlight can lead to the maximum permitted operating temperature being exceeded.

Overvoltage protection

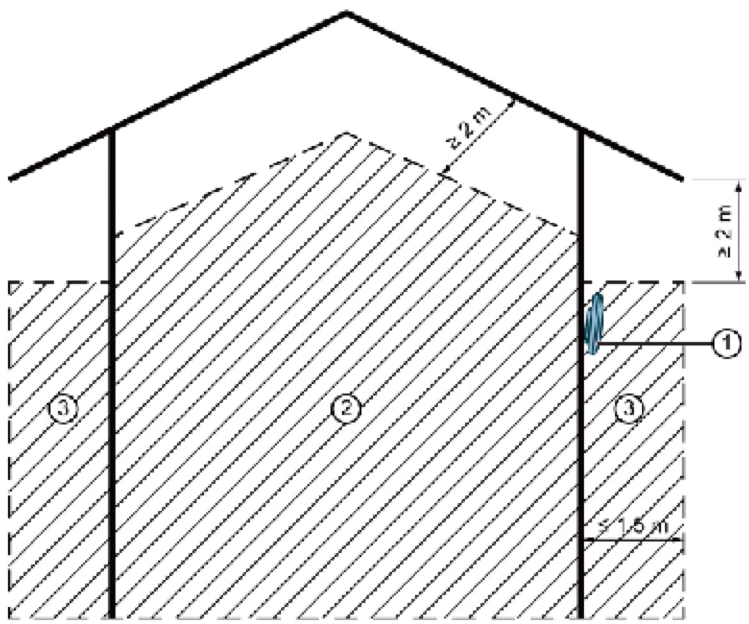
NOTICE
Protection of the external 24 VDC voltage supply If the module is supplied via extensive 24 V supply lines or networks, interference by strong electromagnetic pulses on the supply lines is possible, e.g. from lightning or the switching of large loads. The connector for the 24 VDC external power supply is not protected against strong electromagnetic pulses. Make sure that any cables liable to lightning strikes are fitted with suitable overvoltage protection.

Repairs

⚠ WARNING
Repairs only by authorized qualified personnel Repairs may only be carried out by authorized qualified personnel. Unauthorized opening of and improper repairs to the device may result in substantial damage to equipment or risk of personal injury to the user.

Lightning protection

CAUTION
Installation only in protected areas Antennas and readers can be installed in the protected part of a building. When implementing your lightning protection concept, make sure you adhere to the VDE 0182 or IEC 62305 standards. When installing outdoors, we recommend that you protect the readers/antennas from the weather with a box. The antenna RF650A must not be installed in the (protected) outdoor area.



① Antenna or reader
② Protected area (indoors); grounding is not necessary here.
③ Protected area (outdoors); grounding is not necessary here.

Figure 2-1 Mounting the reader in protected areas

System expansion

Only install system expansion devices designed for this device. If you install other upgrades, you may damage the system or violate the safety requirements and regulations for radio frequency interference suppression. Contact your technical customer service or where you purchased your device to find out which system expansions are suitable for installation.

Note

Warranty conditions

If you cause system defects by improperly installing or exchanging system expansion devices, the warranty becomes void.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens’ products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit
Link: (http://www.siemens.com/industrialsecurity)

Siemens’ products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customers’ exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
Link: (http://www.siemens.com/industrialsecurity)

2.2 Safety instructions for third-party antennas as well as for modifications to the RF600 system

Always observe the following general safety instructions before selecting a component from a different vendor.

The manufacturer accepts no responsibility for functional suitability or legal implications for the installation of third-party components.

Note

Alterations not permitted

Alterations to the devices are not permitted. If this is not adhered to, the radio approvals, the relevant country approvals (e.g. CE or FCC) and the manufacturer's guarantee are invalidated.

Modifications to the SIMATIC RF600 system

NOTICE
Damage to the system If you install unsuitable or unapproved extensions, you may damage the system or violate the safety requirements and regulations for radio frequency interference suppression. Contact your technical customer service or where you purchased your device to find out which system expansions are suitable for installation.

NOTICE
Loss of warranty If you cause defects on the SIMATIC RF600 system by improperly installing or exchanging system expansions, the warranty becomes void.

Note

Loss of validity for type tests and certificates

SIMATIC RFID products comply with the salient safety specifications to VDE/DIN, IEC, EN, UL and CSA. When using RFID components that do not belong to the RF600 range of products, all type tests as well as all certificates relevant to the RF600, such as CE, FCC, UL, CSA are invalidated.

Note

User responsibility for modified product

As a user of the modified product, you accept responsibility for use of the complete RFID product comprising both SIMATIC RF600 components and third-party RFID components. This particularly applies to modification or replacement of:

- Antennas
- Antenna cables
- readers
- Power supply units with connection cables

2.3 Safety distance to transmitter antenna

2.3.1 Safety distance between transmitter antenna and personnel

For antenna configurations where it is possible to be briefly or constantly within the transmission range of the antennas, as in loading ramps, for example, minimum distances must be maintained.

Limits

The ICRP (International Commission of Radiological Protection) has worked out limit values for human exposure to HF fields that are also recommended by the ICNIRP (International Commission of Non Ionizing Radiological Protection). In German legislation on emissions (since 1997), the following limit values apply. These can vary according to frequency:

Frequency f [MHz]	Electrical field strength E [V/m]	Magnetic field strength H [A/m]
10 - 400	27,5	0,073
400 - 2.000	1.375 x $f^{1/2}$	0.0037 x $f^{1/2}$
2.000 - 300.000	61	0,16

The limit values for the 900 MHz reader antenna alternating field are thus:

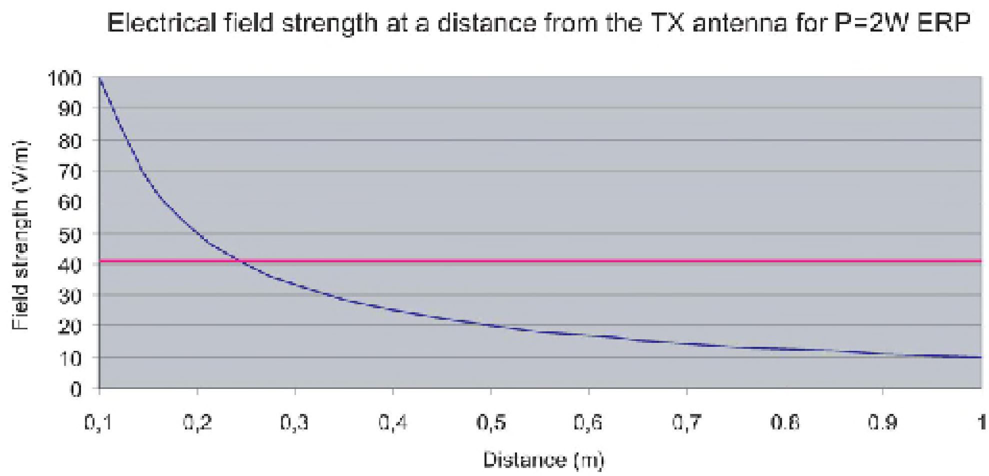
Electrical field strength: E = 41.25 V/m

Magnetic field strength: H = 0.111 A/m

HF power density: E x H = 4.57 W/m^2

2.3.2 Minimum distance to antenna in accordance with ETSI

At a transmission frequency of 900 MHz, the wavelength of the electromagnetic wave λ is approximately 0.34 m. For distances less than 1 λ in the near field, the electrical field strength (1/r) diminishes exponentially to the power three over distance, and for distances greater than 1 λ, it diminishes exponentially to the power two over distance.



The horizontal line at 41.25 V/m marks the "safety limit value".

For the maximum permitted transmit power ($1/r^2$) in accordance with ETSI (2 W ERP), the "safety distance" is d = 0.24 m. This means that personnel should not remain closer than 24 cm to the transmitter antenna for extended periods (for several hours without interruption). Remaining within the vicinity of the antenna for a brief period, even for repeated periods (at a distance < 0.24 m), is harmless according to current knowledge.

Distance to transmitter antenna [m]	Feld strength [V/m]	% of limit value
1	10	24
5	2	5

If the transmitter power is set lower than the highest permissible value (2 watts ERP), the "safety distance" reduces correspondingly.

The values for this are as follows:

Radiated power ERP [W]	Safety distance to transmitter antenna [m]
2.0	0.24
1.0	0.17
0.5	0.12

Note

Reduced maximum radiated power with RF600 readers

SIMATIC RF610R and RF615R (ETSI) readers have a maximum transmit power of 400 mW. The radiated power depends on the antenna cable and the antenna used, but must not exceed 2 W ERP.

The SIMATIC RF650R (ETSI) reader has a maximum transmit power of 1 W. The radiated power therefore depends on the antenna cable and the antenna used, but must not exceed 2 W ERP.

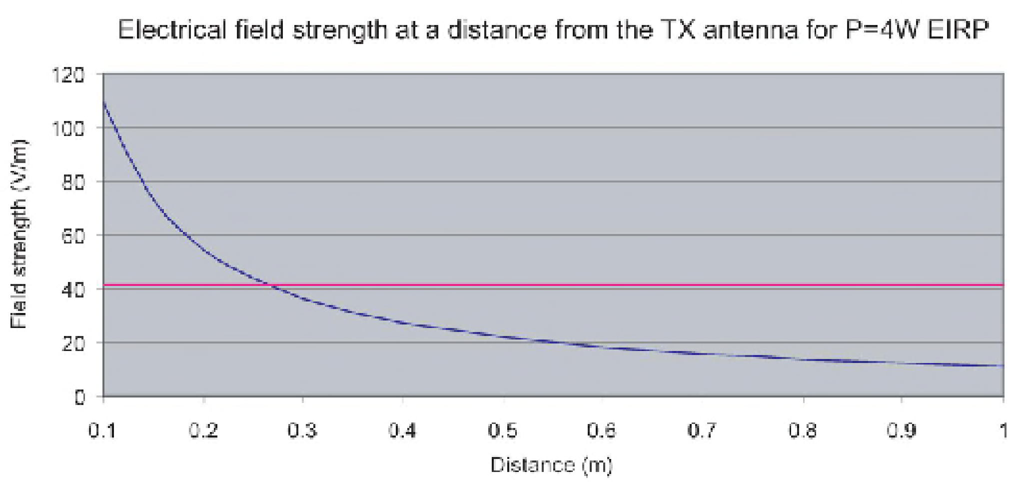
The SIMATIC RF680R (ETSI) reader has a maximum transmit power of 2 W. The radiated power therefore depends on the antenna cable and the antenna used, but must not exceed 2 W ERP.

The SIMATIC RF685R (ETSI) reader has a maximum radiated power of 2 W ERP. The safety clearance is therefore at least 0.24 m.

When using Siemens products and with suitable configuration via the WBM, the high limits cannot be exceeded.

2.3.3 Minimum distance to antenna in accordance with FCC

For the maximum permitted radiated power in accordance with FCC (4 W EIRP), the "safety distance" is d = 0.26 m. This means that personnel should not remain closer than 26 cm to the transmitter antenna for extended periods (several hours without interruption). Remaining within the vicinity of the antenna for brief period, even repeated periods (at a distance < 0.26 m) is harmless to health according to current knowledge.



The horizontal line at 41.25 V/m marks the "safety limit value".

Distance to transmitter antenna [m]	Feld strength [V/m]	% of limit value
1	10.9	26
5	2.2	5.3

If the transmit power is set lower than the highest permitted value (4 W EIRP), the "safety distance" reduces correspondingly.

The values for this are as follows:

Radiated power EIRP [W]	Safety distance to transmitter antenna [m]
4.0	0.26
<2.5	>0.20

Generally a safety distance of at least 0.2 m should be maintained.

Note

Reduced maximum radiated power with RF600 readers

SIMATIC RF610R and RF615R (FCC) readers have a maximum transmit power of 400 mW. The radiated power depends on the antenna cable and the antenna used, but must not exceed 2 W ERP.

The SIMATIC RF650R (FCC) reader has a maximum transmit power of 1 W. The radiated power therefore depends on the antenna cable and the antenna used, but must not exceed 4 W EIRP.

The SIMATIC RF680R (FCC) reader has a maximum transmit power of 2 W. The radiated power therefore depends on the antenna cable and the antenna used, but must not exceed 4 W EIRP.

The SIMATIC RF685R (CC) reader has a maximum transmit power of 2 W. This means that the safety distance is at least 0.12 m.

When using Siemens products and with suitable configuration via the WBM, the high limits cannot be exceeded.

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3 System overview of SIMATIC RF600

SIMATIC RF600 is an identification system that operates in the UHF range. UHF technology supports large write/read distances with passive transponders.

The general automation and IT structure of a company is shown in the following figure. This comprises several different levels that are described in detail below.

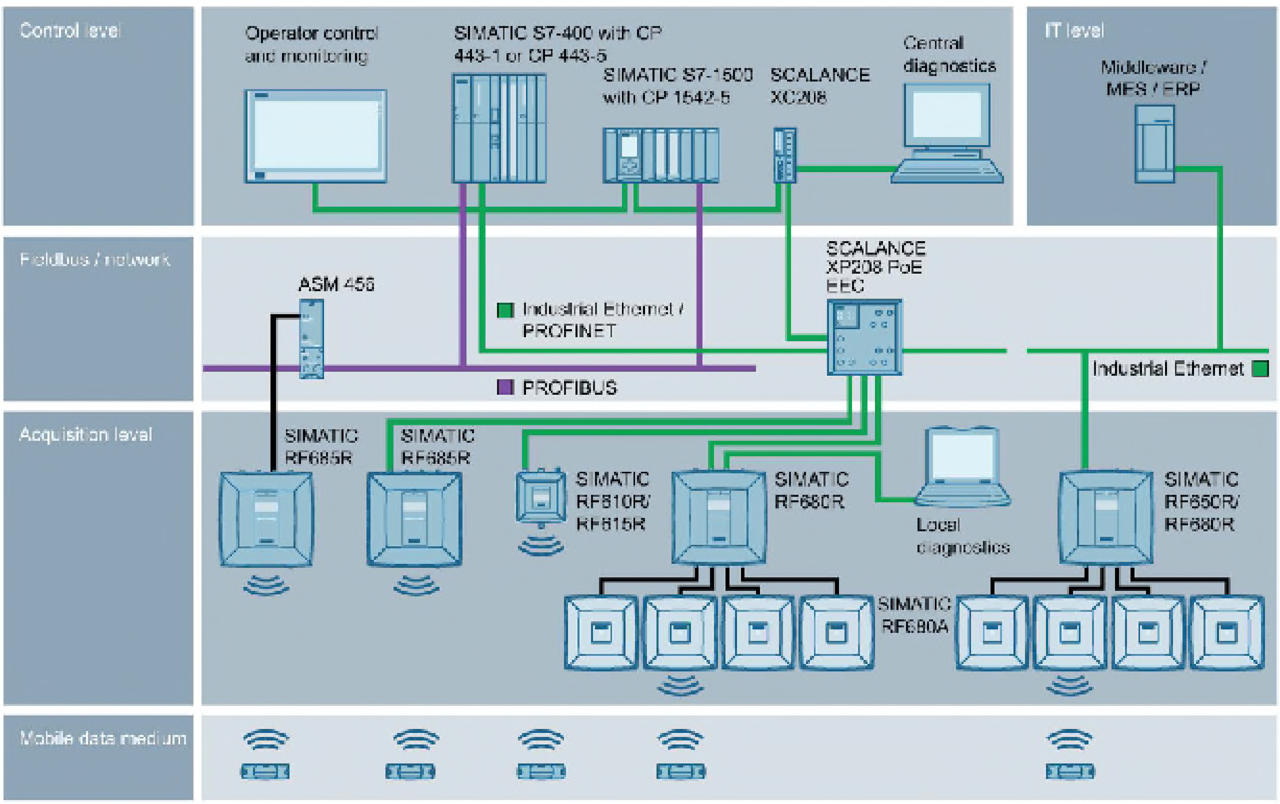


Figure 3-1 System overview SIMATIC RF600 with RF610R, RF615R, RF650R, RF680R, RF685R

- Acquisition level

  This level contains the RFID readers that read the appropriate transponder data and transfer it to the next higher level.

- Control level

  At the control level, the RFID data is collected, preprocessed and made available to the production control and business administration control levels for further processing.

- IT level

  The Manufacturing Execution System (MES) closes the gap between the data that arises in the automation environment (control level) and the logistic and commercial processes of the company (business administration control). MES solutions are used, for example, for defining and performing production processes.

3.1 Application areas of RF600

RFID (radio frequency identification) permits continuous identification, tracking and documentation of all delivered, stocked and shipped goods in the incoming goods, warehouse, production, production logistics and distribution departments. A small data medium - referred to as SmartLabel, transponder or tag - is attached to every item, package or pallet, and contains all important information. The data medium receives the power it requires via an antenna which is also used for data transmission.

3.2 System components

Table 3- 1 System components of the RF600 product series

Product photo	Description
	SIMATIC RF610R RF610R reader is suitable for applications in production logistics and distribution. It is characterized by a very compact size - with reduced transmit power – as well as an internal antenna. It is integrated for distribution via Ethernet with the XML protocol or OPC UA. EtherNet/IP, PROFINET and PROFIBUS are available for integration in production logistics.
	SIMATIC RF615R RF615R reader is suitable for applications in production logistics and distribution. It is characterized by a very compact size - with reduced transmit power – as well as an internal antenna. It is integrated for distribution via Ethernet with the XML protocol or OPC UA. EtherNet/IP, PROFINET and PROFIBUS are available for integration in production logistics. It is equipped with an integrated antenna and has a connector for an external antenna.
	SIMATIC RF650R The RF650R reader is suitable for applications in logistics. It is integrated via Ethernet with the XML protocol or OPC UA. It has 4 connectors for external antennas.
	SIMATIC RF680R The RF680R reader is suitable for applications in production logistics and distribution. It is integrated for distribution via Ethernet with the XML protocol or OPC UA. For integration in production logistics PROFINET, EtherNet/IP or PROFIBUS are available. As an alternative, integration can also be via PROFIBUS via the serial interface. It has 4 connectors for external antennas.
	SIMATIC RF685R The RF685R reader is suitable for applications in production logistics and distribution. It is integrated for distribution via Ethernet with the XML protocol or OPC UA. For integration in production logistics PROFINET, EtherNet/IP or PROFIBUS are available. As an alternative, integration can also be via PROFIBUS via the serial interface. It is equipped with an integrated antenna with switchable polarization and has a connector for an external antenna.

Product photo	Description
	SIMATIC RF650M The RF650M mobile reader expands the identification system RF600 with a powerful handheld terminal for applications in the areas of logistics, production and service. In addition, it is an indispensable aid for commissioning and testing.
	SIMATIC RF615A and RF620A SIMATIC RF615A and RF620A are linear antennas with a very compact design suitable for industry. They are suitable for UHF transponders with normal (far field) antenna characteristics.
	SIMATIC RF640A The SIMATIC RF640A is a circular antenna of medium size for universal applications, for example material flow and logistics systems.
	SIMATIC RF642A SIMATIC RF642A is a linear antenna of medium size for environments where a lot of metal occurs.
	SIMATIC RF650A SIMATIC RF650A is a circular antenna of medium size for universal use in industrial applications in production and logistics.

Product photo	Description
	SIMATIC RF660A SIMATIC RF660A is a powerful circular antenna for production and logistics applications.
	SIMATIC RF680A SIMATIC RF680A is an antenna whose polarization can be changed (circular, linear horizontal or linear vertical) of medium size for universal use in industrial applications in production and logistics.
	RF600 transponders The RF600 transponder family provides the right solution for every application: RF610T ISO Card is a flexible card suitable for numerous applications. The transponders RF620T, RF625T, RF630T, RF640T and RF645T are designed specially for industrial requirements. They are very rugged and highly resistant to detergents. The RF640T can also be mounted directly on metal. The transponders RF680T and RF682T were developed specifically for use in high temperatures up to 220° C. In the area of Smartlabels, a comprehensive spectrum of competitively priced labels is available for the widest range of requirements. The heat-resistant smart label RF690L can resist temperatures up to 230 °C or 160 °C and is therefore ideally suited to identification tasks in the paint shop/drying area.

3.3 Features

The RF600 identification system has the following performance features:

Table 3- 2 Features of the RF600 RFID system

Type	Contactless RFID (Radio Frequency IDentification) system in the UHF band
Transmission frequency	• ETSI: 865 to 868 MHz • FCC: 902 to 928 MHz • CMIIT: 920.625 to 924.375 MHz • ARIB (STD-T106): 916.8 MHz to 920.4 MHz • ARIB (STD-T107): 920.4 to 923.4 MHz
Standards	ISO 18000-62, ISO 18000-63

Table 3- 3 Features of the RF600 readers

Reader	Antennas	Read/write distance [1)]	Interface
RF610R	1 x internal antenna	< 1 m	Ethernet, EtherNet/IP, OPC UA, PROFINET and PROFIBUS
RF615R	1 x internal antenna 1 x antenna connector for external antennas	Internal antenna: < 1 m External antenna: < 3 m	Ethernet, EtherNet/IP, OPC UA, PROFINET and PROFIBUS
RF650R	4 x antenna connectors for external antennas	< 8 m	Ethernet, OPC UA
RF680R	4 x antenna connectors for external antennas	< 8 m	Ethernet, EtherNet/IP, OPC UA, PROFINET and PROFIBUS
RF685R	1 x internal antenna 1 x antenna connector for external antennas	Internal antenna: < 7 m External antenna < 8 m	Ethernet, EtherNet/IP, OPC UA, PROFINET and PROFIBUS

[1)] Depends on the connected antenna and the transponder being used

Certificates

RF600 readers support the following certificates and approvals:

- RF610R certificate (https://support.industry.siemens.com/cs/ww/en/ps/25390/cert)
- RF615R certificates (https://support.industry.siemens.com/cs/ww/en/ps/25391/cert)
- RF650R certificates (https://support.industry.siemens.com/cs/ww/en/ps/15085/cert)
- RF680R/RF685R certificates (https://support.industry.siemens.com/cs/ww/en/ps/15088/cert)

Table 3- 4 Characteristics of the RF650M mobile reader

Transmission frequency	• ETSI: 865 to 868 MHz • FCC: 902 to 928 MHz • CMIIT: 920 to 925 MHz
Read/write distance	3 m
Standards	ISO 18000-63

Table 3- 5 Characteristics of the transponders

Version	Transponders/Smartlabels	Designation	Standards supported
	Smartlabel	RF630L RF640L RF690L	ISO 18000-62 ISO 18000-63
	ISO card Container tag Disc tag Powertrain tag Tool tag On Metal Tag Heat-resistant tag Heat-resistant tag	RF610T RF620T RF625T RF630T RF640T (Gen 2) RF645T RF680T RF682T	ISO 18000-62 ISO 18000-63

RF600 system planning 4

4.1 Overview

You should observe the following criteria for implementation planning:

- Possible system configurations
- Antenna configurations
- Environmental conditions for transponders
- The response of electromagnetic waves in the UHF band
- Regulations applicable to frequency bands
- EMC Directives

4.2 Possible system configurations

The SIMATIC RF600 system is characterized by a high level of standardization of its components. This means that the system follows the TIA principle throughout: Totally Integrated Automation. It provides maximum transparency at all levels with its reduced number of interfaces. This ensures optimum interaction between all system components.

The RF600 system with its flexible components offers many possibilities for system configuration. This section shows you how you can use the RF600 components on the basis of various example scenarios.

4.2.1 Intralogistics scenario

This scenario describes the transport of material via conveyor systems that are made up of large numbers of standard elements. They are characterized by long distances, frequent branches (separators, infeed and outfeed), standardized transport containers and high movement speeds. The installation space available for identification technology is limited, and the high number of read points demands a low-cost solution.

Due to the high movement speeds of transport containers in some cases, the limited space available and the fact that the read points are sometimes located very close together, the use of the RF600 system with space-saving antennas and a low transmit power can be recommended.

Features of the scenario

Intralogistics (material flow)

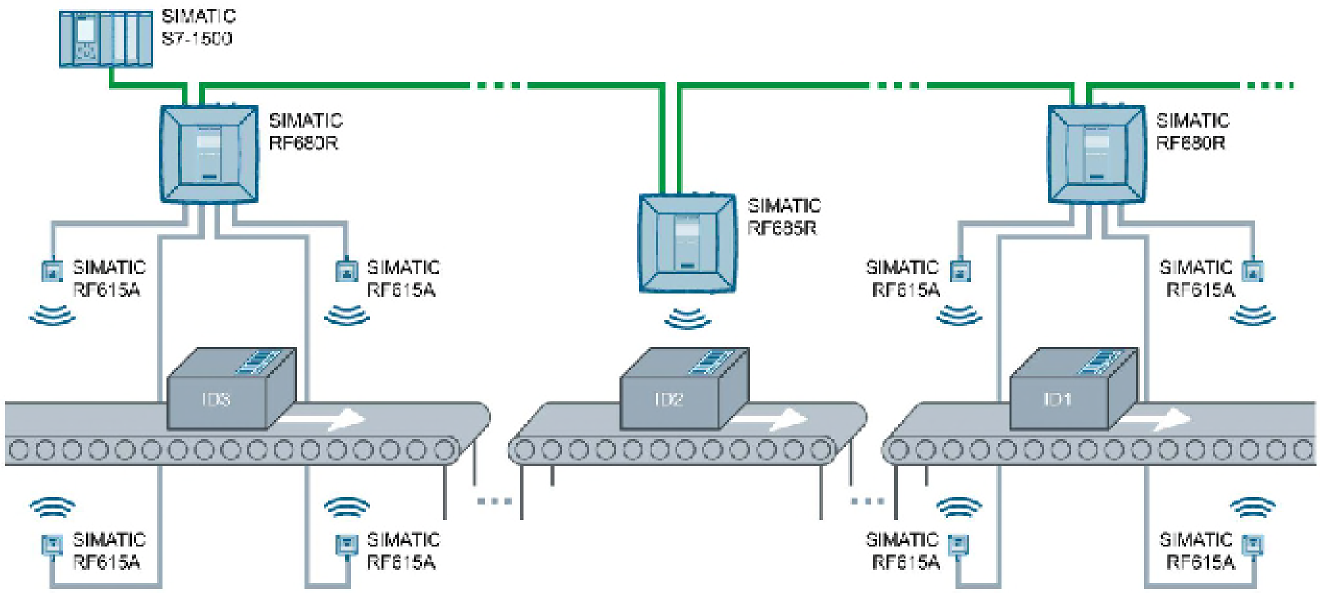


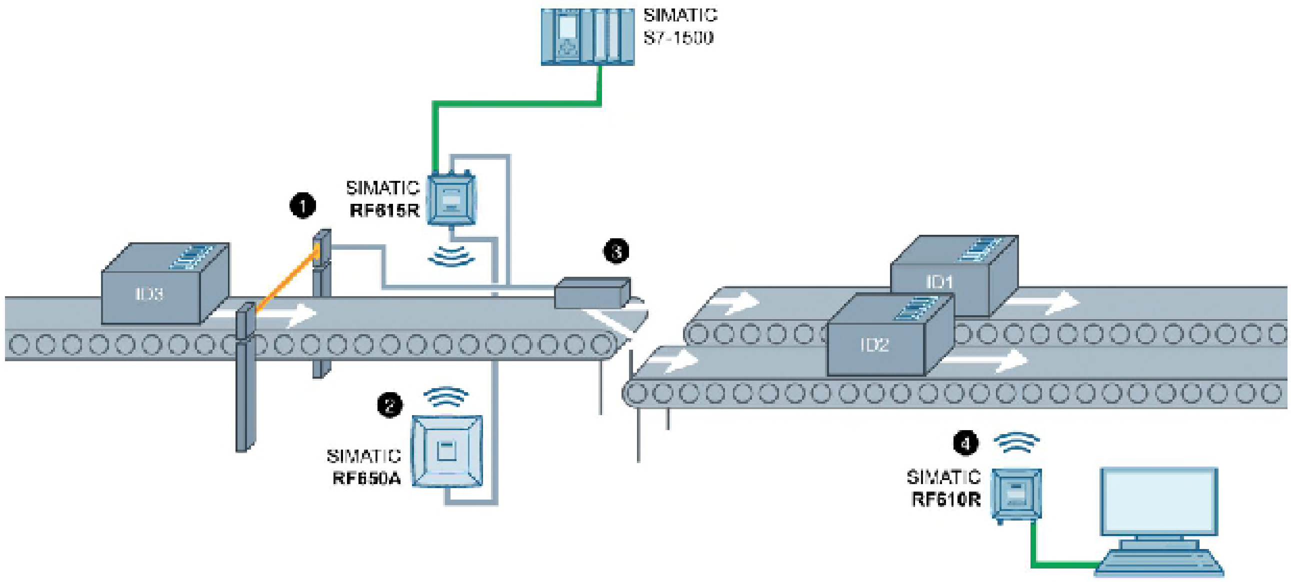
Figure 4-1 Scenario: Intralogistics (material flow)

The conveyor transports the transport containers past the antennas. The transponders attached to the transport containers are always evenly aligned. The transponders in this scenario are transponders of the type SIMATIC RF630L. The conveyor belt has a maximum width of approximately 80 cm in this example. The maximum transport speed is 2 m/s. With this arrangement, only a single transponder needs to be detected each time (single-tag).

In this scenario, SIMATIC RF680R and RF685R are used as readers. Due to the limited space available and the low reading distances, the SIMATIC RF615A antennas are used in this example. As an alternative - with greater available space and to guarantee optimum read reliability - the SIMATIC RF650A antennas can also be used. Because the readers are connected in a bus topology, wiring requirements are reduced.

The reader reads the information from the transponders on the transport containers and forwards it to the SIMATIC S7 controller.

Intralogistics (separator)



① Trigger by light barrier on DI
② Distributed small gate
③ Separator setting by means of DQ
④ Individual read point

Figure 4-2 Scenario: Intralogistics (separator)

In this example scenario, items must be distributed to the correct storage location in a transport container via a separator. The transponders attached to the transport containers are always evenly aligned. The transponders in this scenario are transponders of the type SIMATIC RF630L. The conveyor belt has a maximum width of approximately 80 cm in this example. The maximum transport speed of the conveyor belt is 2 m/s.

In this scenario, a SIMATIC RF615R with a SIMATIC RF650A and a SIMATIC RF610R external antenna are used as the readers. These readers are inexpensive and feature a very compact design.

When a transport container passes the light barrier ①, the reader reads the information from the transponder on the transport containers and forwards it to the SIMATIC S7 controller. The SIMATIC S7 controls the separator ③ of the conveyor system depending on the transponder information.

4.2.2 Scenario for workpiece identification

A typical characteristic of modern manufacturing scenarios is their multitude of variations. The individual data and production steps are stored in the transponder of a tool holder or product. These data are read by the machining stations during a production process and, if necessary, tagged with status information. This can be used to dynamically identify which production step is the next in the series. This has the advantage that the production line can work automatically without the need to access higher system components. The use of RFID therefore increases the availability of the plant.

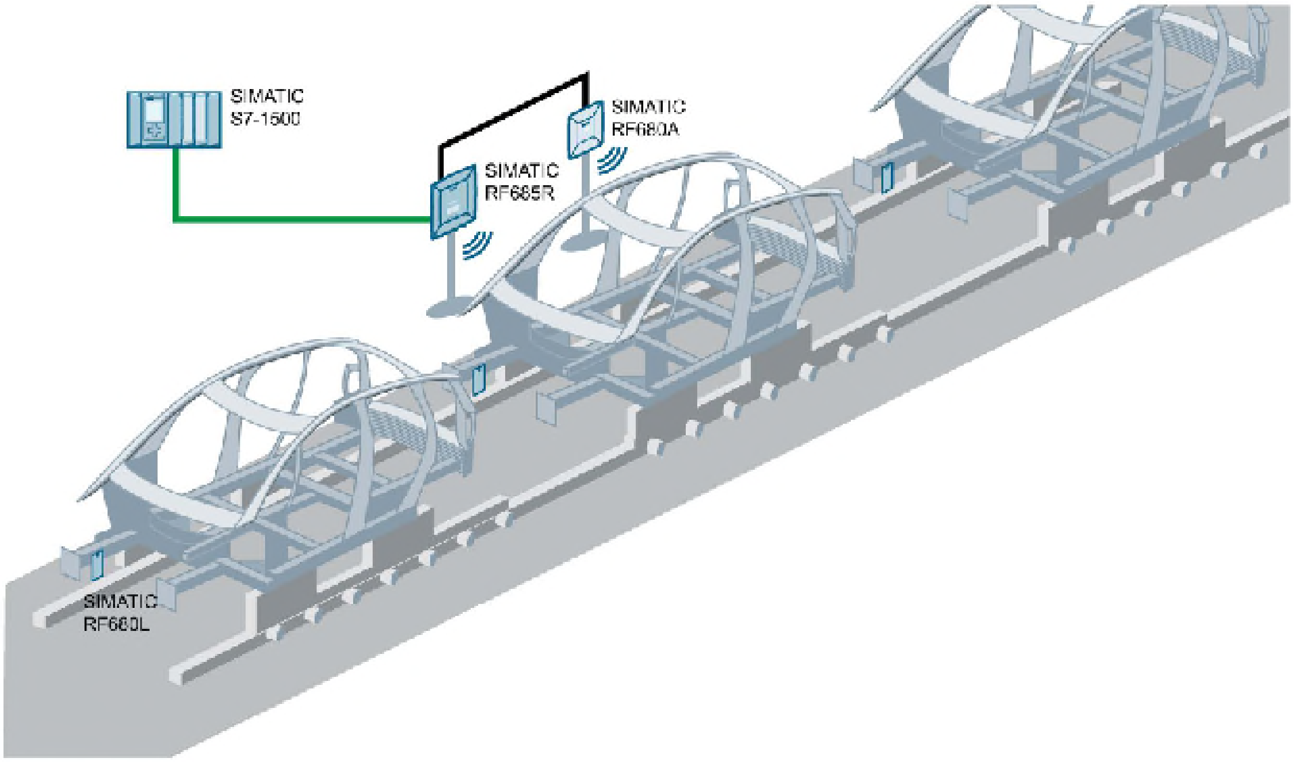


Figure 4-3 Scenario: Workpiece identification

Features of the scenario

Transponders are attached to workpiece holders. Their spatial orientation is always identical. With this arrangement, only a single transponder needs to be detected each time (single-tag).

The SIMATIC RF685R reader reads the information from the transponders with its integrated antenna or the external antenna RF680A and transfers it to the SIMATIC S7 controller. Depending on the stored transponder information, the SIMATIC S7 controller different control tasks, for example, automatically providing a suitable tool for an industrial robot at the correct time.

In a metallic wireless environment or when lots of readers/antennas are mounted close together we recommend that you do not have the readers reading permanently. Instead execute specific read/write commands when an object/transponder is located in front of an antenna or passes it. This "triggering" can be implemented with light barriers or beros. This procedure reduces mutual influence/disruption of the read points and increases the identification quality of the wanted transponders while reducing the identification of unwanted transponders.

4.2.3 Goods tracking scenario

In this scenario, a gate consisting of a SIMATIC RF650R reader and four antennas checks the goods passing through the gate. All stored goods are equipped with transponders. A traffic light indicates whether the goods may leave the warehouse.

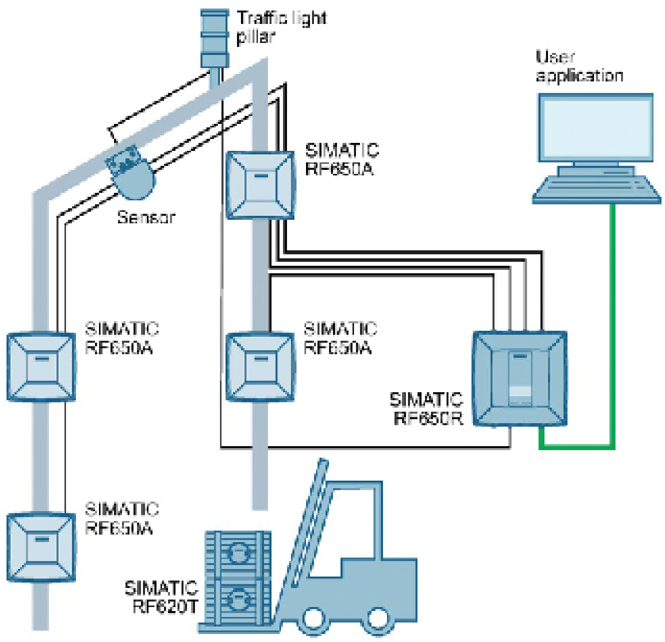


Figure 4-4 Scenario: Goods tracking

Features of the scenario

In this example scenario, the export of goods from a warehouse is checked using the SIMATIC RF650R reader and four SIMATIC RF650A antennas connected to it. A sensor registers when a vehicle passes the gate and reports this to the higher-level system, which then triggers a read operation via the reader.

The reader reads the information from the transponders on the goods and forwards it to the user application, which checks the status of the goods. The traffic light is set to green or red depending on whether the goods are released.

4.2.4 Scenario incoming goods, distribution of goods and outgoing goods

The scenario consists of an RFID system with three readers. The SIMATIC RF650R reader with its four antennas identifies the incoming/outgoing products at the incoming/outgoing goods gates of a factory building hall through which pallets are delivered. Each pallet is fitted with a transponder. The transponders contain user data that provides information about the sender and receiver of the goods. This data is read out and passed on. The goods supplied on the pallets are processed in the factory and then exit the factory through the outgoing goods gate.

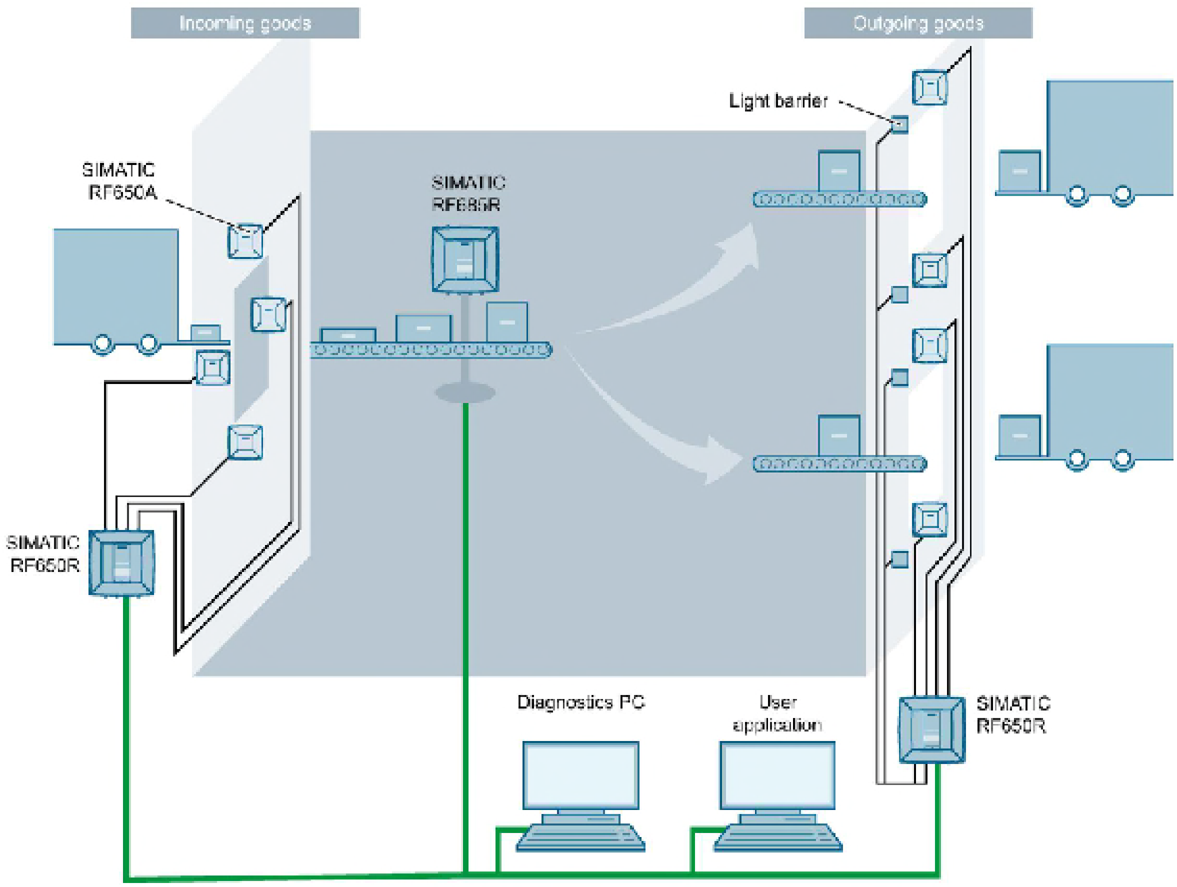


Figure 4-5 Scenario: Incoming goods, distribution of goods and outgoing goods

Features of the scenario

In this example scenario, the SIMATIC RF685R reader is controlled by a light barrier and monitors a conveyor belt; the conveyor belt transports the goods towards two output gates that are assigned to different recipients. Each item has a transponder that is always fitted at the same position and with the same alignment on the item. These transponders also contain user data that provides information about the sender and receiver of the goods. There is a separator at the end of the conveyor belt that determines the output gate to which the goods should be directed. The separator is set according to the results from the reader and the goods are distributed.

After the sorter, the goods are loaded onto pallets - each pallet is fitted with a transponder. These transponders also contain user data that provides information about the sender and receiver of the goods. Based on the data read by the SIMATIC RF650R reader, there is a check to make sure that the correct pallets for the specific receiver are available at the outgoing goods gate. Light barriers are installed to control the reader. Depending on the read results of the reader, the outgoing portal opens, or it remains closed.

4.3 Antenna configurations

Note

Validity of antenna configuration

The following information about the antenna configuration only applies to the antennas of the RF600 family. Refer to the Guidelines for selecting RFID UHF antennas (Page 51) for information on the configuration of third-party antennas.

4.3.1 Antenna configuration example

The following figure shows an example of an application with an antenna configuration of the RF650R. The antennas are positioned at the height at which the transponders to be identified are expected. The maximum width of the portal recommended for reliable operation is 4 m.

The diagram shows a configuration with three antennas. Up to four antennas can be used depending on the local conditions.

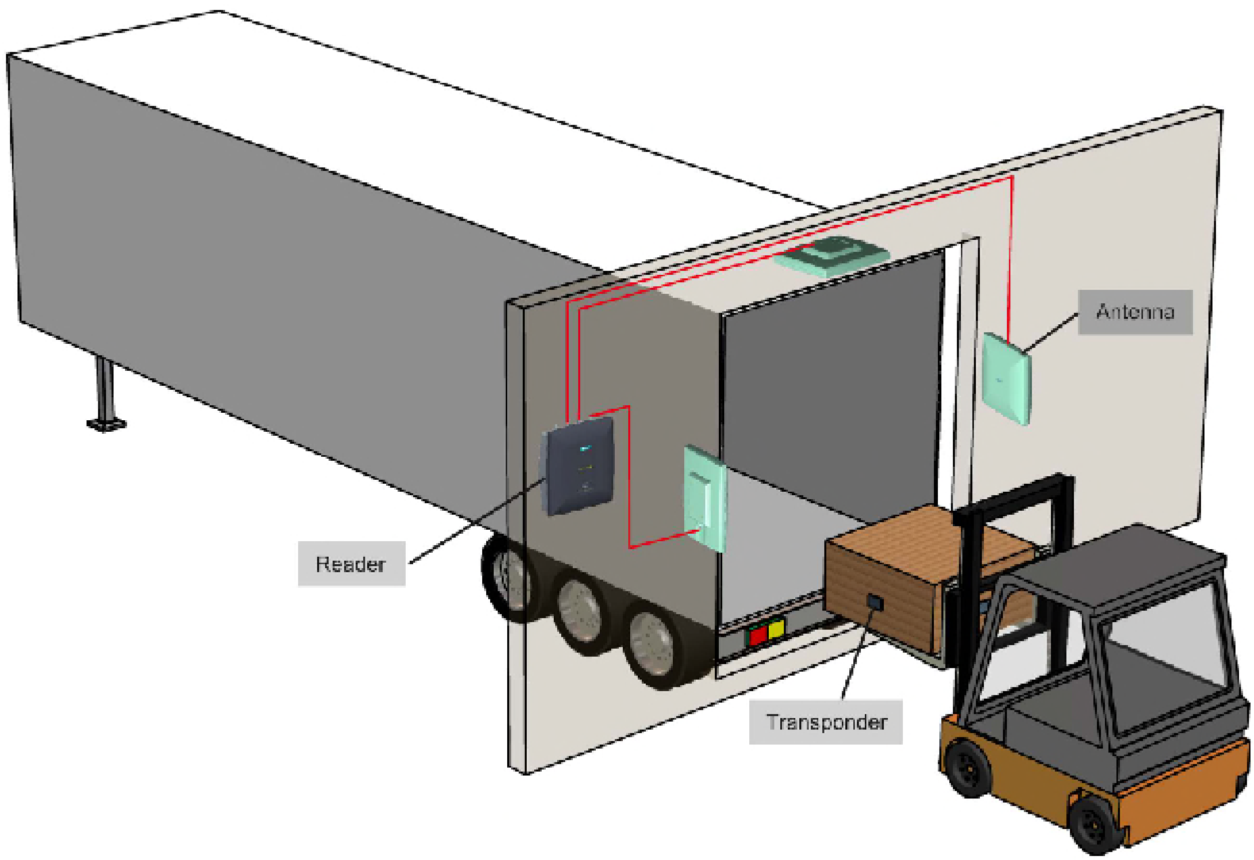
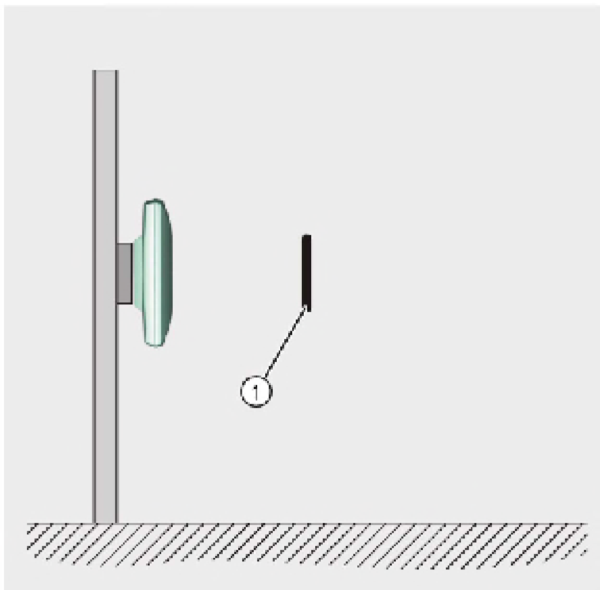


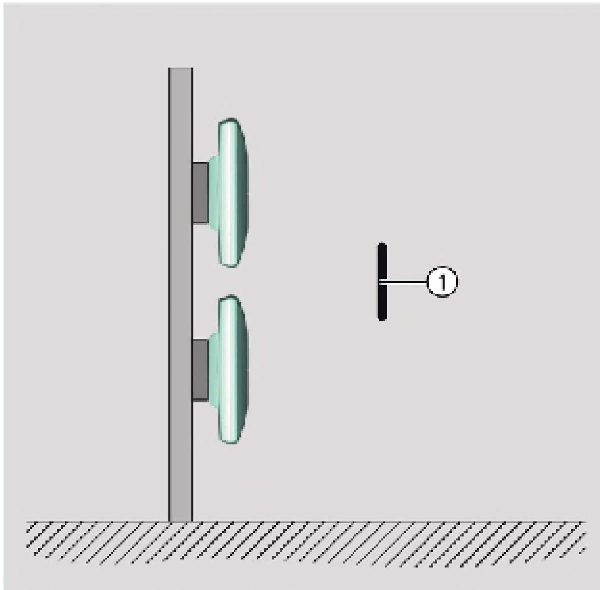
Figure 4-6 Example of an antenna configuration with three antennas

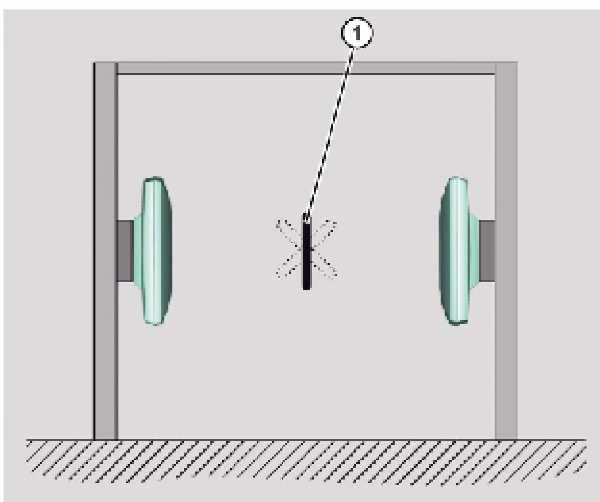
4.3.2 Possibilities and application areas for antenna configurations

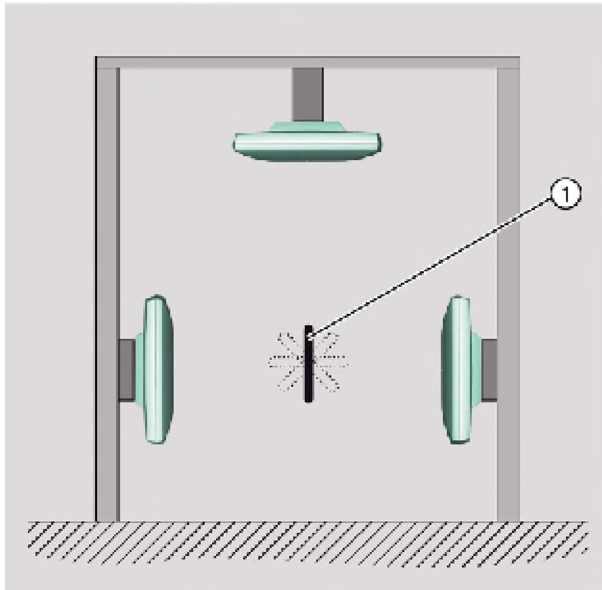
Some basic antenna configurations and possible fields of application are shown below.

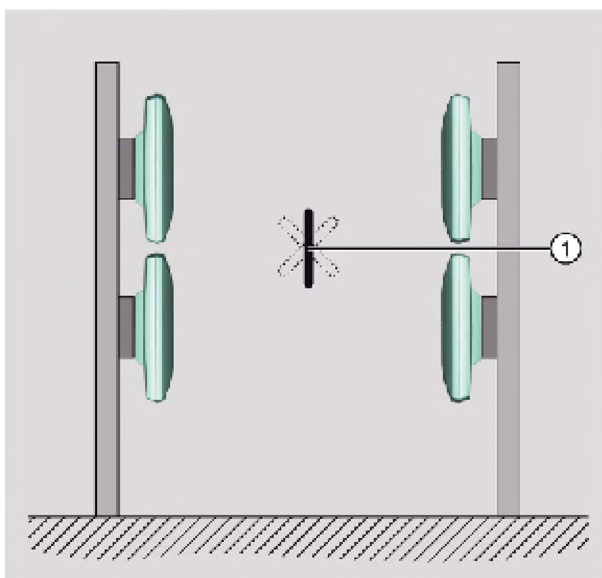
With the various configurations, please note that up to four external antennas can be connected to the RF650R and RF680R readers, while one external antenna can be connected to the RF615 and RF685R readers. The RF615R and RF685R readers also have an internal antenna. The RF610R reader only has an internal antenna.

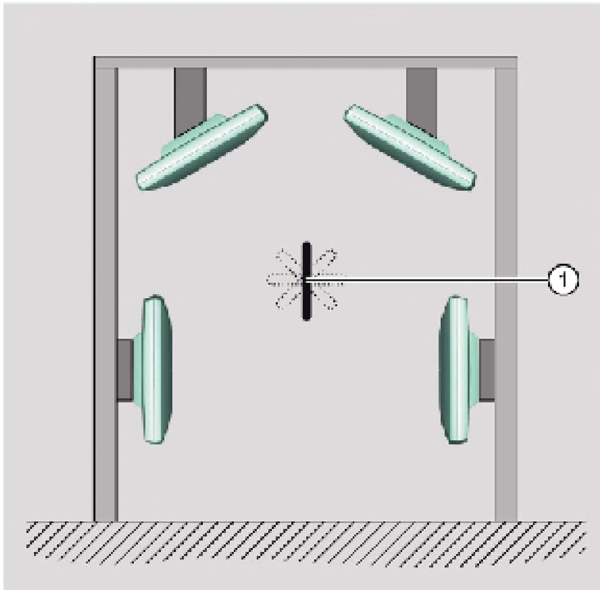
Antenna configuration 1	Description/ application areas
	This arrangement of antennas is appropriate when the transponders to be read are only located on one side of the goods to be acquired, for example, if a conveyor belt with passing goods has to be monitored during production and it is precisely defined on which side the transponders to be read are attached. ① Transponder

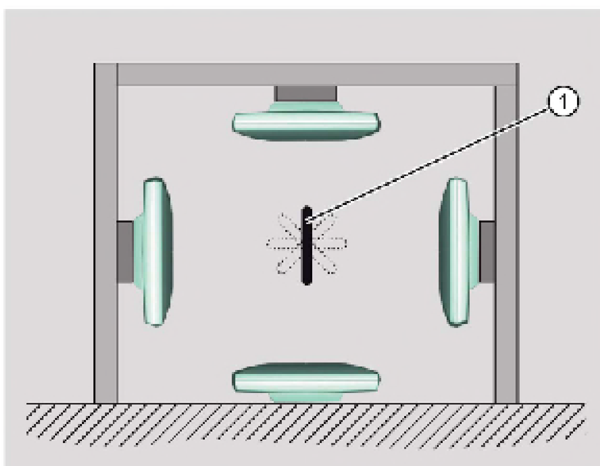
Antenna configuration 2	Description/ application areas
	This arrangement of antennas is appropriate when the transponders to be read are only located on one side of the items to be identified, e.g. when pallets are to be identified and it is known on which side the transponders to be read are located. ① Transponder

Antenna configuration 3	Description/ application areas
	Preferred for the identification of goods at loading gates: The transponder is located in the radiation field of two antennas; for reliable transponder reading, the height of the transponders above floor level must therefore be known with reasonable accuracy. ① Transponder

Antenna configuration 4	Description/ application areas
	Preferred for the identification of goods at loading gates: Similar to configuration 2, but with additional reading reliability when the transponder is at an angle to the vertical. ① Transponder

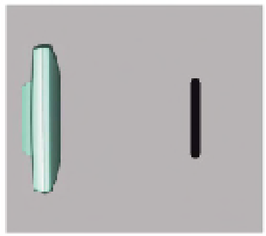
Antenna configuration 5	Description/ application areas
	Preferred for the identification of goods at loading gates: The transponder is located in the radiation field of all four antennas, so the transponder position for reliable tag identification is more flexible than in configuration 2. ① Transponder

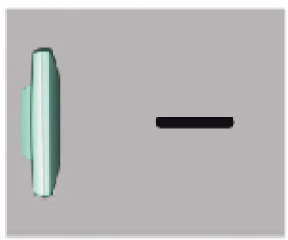
Antenna configuration 6	Description/ application areas
	Preferred for the identification of goods at loading gates: Similar to configuration 4, but the reliability of transponder identification is improved as a result of the four antennas at separate locations, so the transponder position is not critical. ① Transponder

Antenna configuration 7	Description/ application areas
	This tunnel configuration is suitable for conveyor belt applications. The goods with the transponders to be read are moving forwards on a conveyor belt but the alignment of the transponders relative to the antennas is not clearly defined. One of the antenna is located on the floor and radiates vertically upwards in the direction of the conveyor belt. A relatively high reading reliability is achieved due to the use of four antennas. ① Transponder

4.3.3 Transponder orientation in space

The alignment of the transponder antenna to the antenna of the reader influences the reading range. For maximum performance and to achieve the maximum read range, the transponder antenna should therefore be aligned parallel to the reader antenna:

Parallel transponder alignment	Large reading range
	The probability of identification of the transponders is at a maximum.

Vertical transponder alignment	Minimal reading range
	The probability of identification of the transponders is at a minimum.

4.3.4 Specified minimum and maximum spacing of antennas

Specified minimum spacing of antennas

The following diagram shows the specified minimum and maximum spacings for mounting antennas:

Between the antenna and liquids or metals, a minimum distance of 50 cm should be kept to. The distance between the antenna and the floor should also be at least 50 cm.

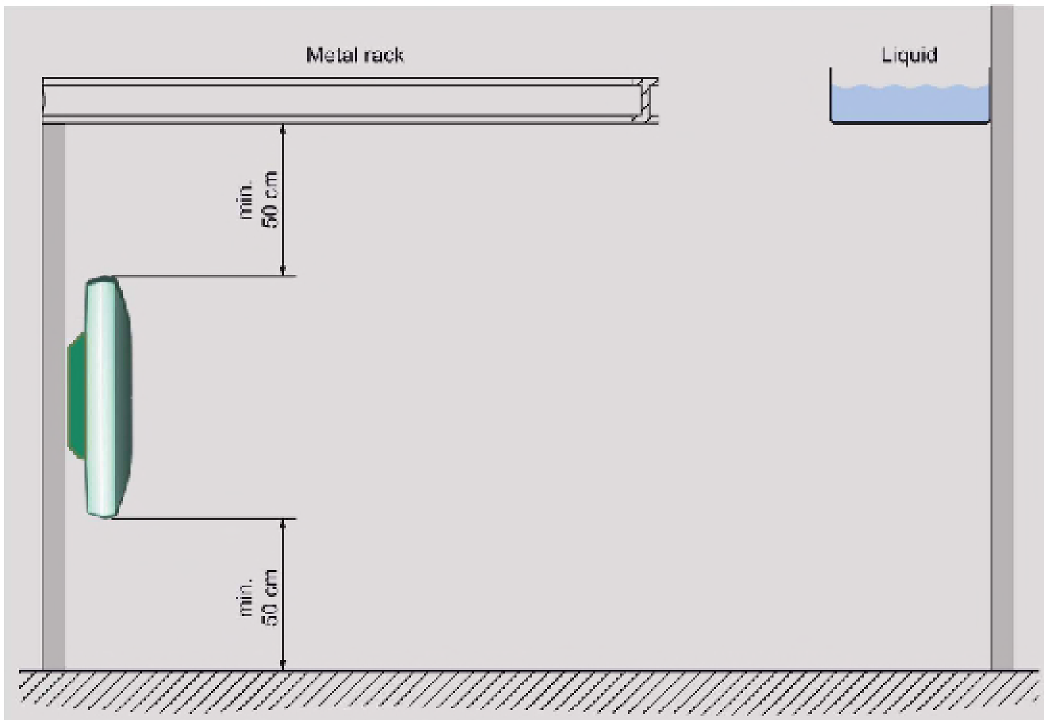
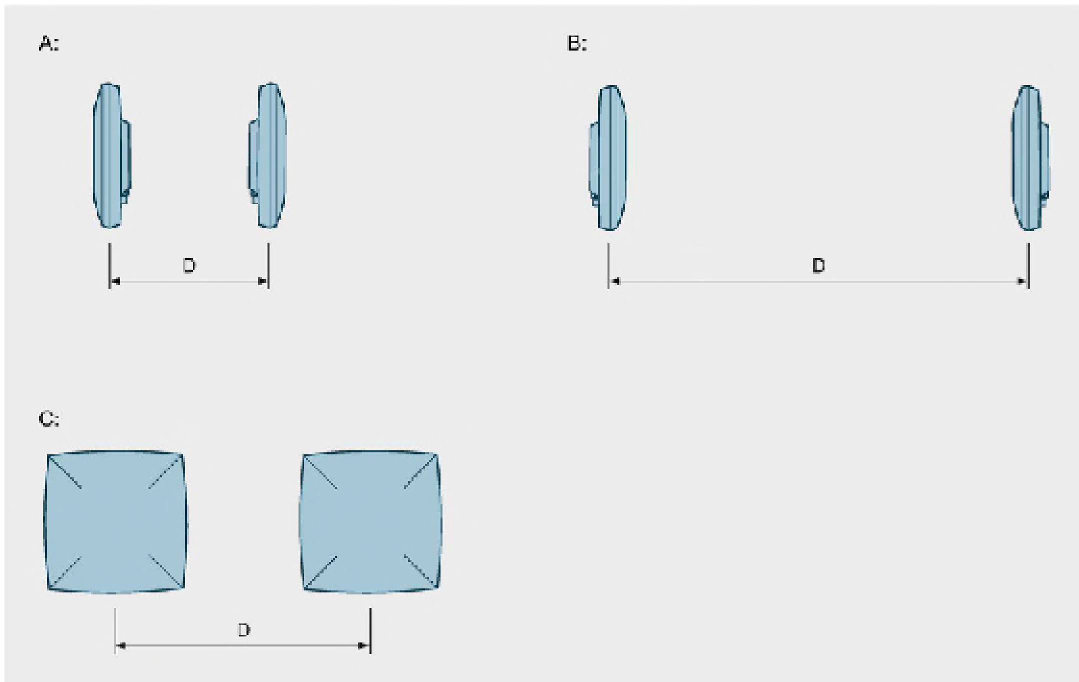


Figure 4-7 Minimum distance to the environment

4.3.5 Reciprocal influence of read points

Antenna alignment and resulting antenna spacing

The minimum distance required between antennas that use the same frequency and that are connected to different readers depends on the maximum transmit power set and the antenna alignment. The following minimum distances apply with maximum transmit power.



A Back to back

B Pointing at each other

C Next to each other

Figure 4-8 Antenna spacing for different readers/antennas and identical frequencies

Table 4- 1 Antenna alignment and minimum antenna spacing

Antenna configuration	Antenna alignment	Minimum distance (D)		
		RF610R/RF615R with internal antenna	RF685R with internal antenna	RF600 reader with RF615A/RF620A
A	Back to back	1.0 m	0.3 m	1.0 m
B	Pointing at each other	2.0 m	2.0 m	2.0 m
C	Next to each other	1.0 m	0.5 m	1.0 m
		RF600 reader with RF640A/RF642A	RF600 reader with RF650A/RF680A	RF600 reader with RF660A
A	Back to back	1.0 m	0.3 m	0.5 m
B	Pointing at each other	2.0 m	2.0 m	2.0 m
C	Next to each other	2.0 m	0.5 m	0.8 m

Antenna spacing with portal configuration

In the portal configuration, multiple antennas are connected to one reader. In this case, the antennas must not exceed the maximum distance to one another.

Table 4- 2 Maximum antenna spacing of the external antennas with a portal configuration

Antenna configuration	Antenna alignment	Maximum distance (D)		
		RF600 reader with RF615A/RF620A	RF600 reader with RF640A/RF642A	RF600 reader with RF650A/RF660A/RF680A
B	Pointing at each other	2.0 m	8.0 m	8.0 m

[1] Portal spacing of up to 10 m is possible. The probability of a read must be checked.

4.3.6 Read and write range

The read/write range between the reader/antenna and the transponder is influenced by the following factors:

Table 4- 3 Factors on the read/write range

Factors	Description
Transmit power of the reader	The higher the transmit power of the reader, the larger the reading range.
Transponder size and design	The larger the transponder antenna, the larger the power input area and therefore the larger the reading range.
Absorption factor of the materials	The higher the absorption of the surrounding material, the smaller the reading range.
Manufacturing quality of the transponders	The better the transponder has been matched to the operating frequencies during manufacturing, the greater the reading range.

Factors	Description
Reflection characteristics of the environment	In a multiple-reflection environment (e.g., in rooms with reflecting surfaces, machinery, or concrete walls), the reading range can be significantly higher than in a low-reflection environment.
Number of transponders in the antenna field	The typical ranges always relate to a transponder installed at the maximum possible distance from the antenna. If there are several transponders located in the antenna field, the distances to all other transponders must not exceed the maximum possible distance to be able to be detected from the antenna field. The width and height of the antenna field within which its transponders can be arranged at a certain distance from the antenna depend on the following: ▪ The radiated power, ▪ Only reading or reading and writing of the transponders (writing requires more power, typically double the power) ▪ The aperture angle (horizontal) ▪ The aperture angle (vertical)

You will find detailed information about the reading range of the individual readers in the "Technical specifications" in the sections for the various readers.

4.3.7 Static/dynamic mode

Reading or writing can be either static or dynamic.

- Reading/writing is counted as being static if the tag does not move in front of the antenna and is read or written.
- Reading/writing is counted as being dynamic if the tag moves past the antenna during reading/writing.

The following overview shows which environments are suitable for which read or write mode:

Operating mode	Read	Write
Static	Recommended in normal UHF environments	Recommended in normal UHF environments
Dynamic	Recommended under difficult UHF conditions	Not recommended in difficult UHF environments

4.3.8 Operation of several readers within restricted space

4.3.8.1 Using more than one reader

When mounting the readers make sure that there is a minimum clearance of 0.5 m between the readers to avoid them influencing each other.

Avoiding problems

When several RFID readers are used, there is a danger that RFID transponders can also be read out by other readers. Care must therefore be taken to ensure that the transponder can only be identified by the intended reader.

Technical disruptions between readers then occur particularly when they transmit on the same channel (on the same frequency). You will find more detailed information in the section "The response of electromagnetic waves in the UHF band (Page 66)".

4.3.8.2 Optimization of robustness of tag data accesses for readers that are operated simultaneously

Parameter data access reliability

If several readers are to be operated simultaneously in an environment, then the following settings affect the reliability of the reader's access to transponder data:

- Electromagnetic environment (see section "The response of electromagnetic waves in the UHF band (Page 66)")
- Type of transponder (see section "Transponder (Page 359)")
- Number of transponders to be detected by an antenna at a time
- Type of antenna (see section "Antennas (Page 231)" and section "Guidelines for selecting RFID UHF antennas (Page 51)")
- Transponders' distance from and orientation to antennas (see section "Transponder (Page 359)")
- Distances and orientation of antennas of different readers to each other
- Radiated power of antennas

The robustness of transponder data access is improved for readers whenever distances to adjacent readers are increased, radiated power is reduced, and a channel plan (for ETSI readers) is implemented. Adjacent readers are parameterized in the channel plan in such a way that they do not use the same channels.

A channel plan can be created for ETSI and CMIT readers; for FCC readers, it is assumed that the probability of two readers accidentally using the same channel is very low.

4.3.8.3 Frequency hopping

This technique is intended to prevent mutual interference between readers. The reader changes its transmission channel in a random or programmed sequence (FHSS).

Procedure for FCC

Frequency hopping is always active in the FCC country profile. With 50 available channels the probability is low that two readers will be operating on the same frequency. In China, one reader operates on at least 2 channels, e.g. sixteen 2 watt channels.

You will find more information on frequency ranges in the section "Regulations applicable to frequency bands (Page 97)".

Procedure for ETSI

Frequency hopping is optional in the ETSI wireless profile. According to ETSI EN 203 208 V1.4.1, frequency hopping is required in multi-channel operation; without it, only single-channel operation is possible. In this mode, the reader pauses for 100 ms after each 4 s transmission period to comply with the standard.

4.3.9 Guidelines for selecting RFID UHF antennas

4.3.9.1 Note safety information

⚠ WARNING
Before planning how to use third-party components, as the operator of a system that comprises both RF600 components and third-party components, you must comply with the safety information in Section Safety instructions for third-party antennas as well as for modifications to the RF600 system (Page 19).

4.3.9.2 Preconditions for selecting RFID UHF antennas

Target group

This section is aimed at configuration engineers who thoroughly understand and wish to carry out the selection and installation of an antenna or a cable for the SIMATIC RF600 system. The various antenna and cable parameters are explained, and information is provided on the criteria you must particularly observe. Otherwise this chapter is equally suitable for theoretical and practice-oriented users.

Purpose of this chapter

This section will help you to select the suitable antenna or the suitable cable taking into account all important criteria and to make the relevant settings in the configuration software/ WBM of the SIMATIC RF600 system. Correct and safe integration into the SIMATIC RF600 system is only possible following adaptation of all required parameters.

4.3.9.3 General application planning

Overview of the total SIMATIC RF600 system and its influencing factors

In the following graphic you can see the design of a SIMATIC RF600 reader with connected antenna and the influencing factors. The influencing factors affect the radiated power output.

Radiated power = transmit power ± influencing factors

You must be aware of these influencing factors and also consider them if you wish to integrate components such as antennas or cables into the system. These influencing factors are described in more detail in sections "Antennas (Page 231)" and "Antenna cables (Page 53)".

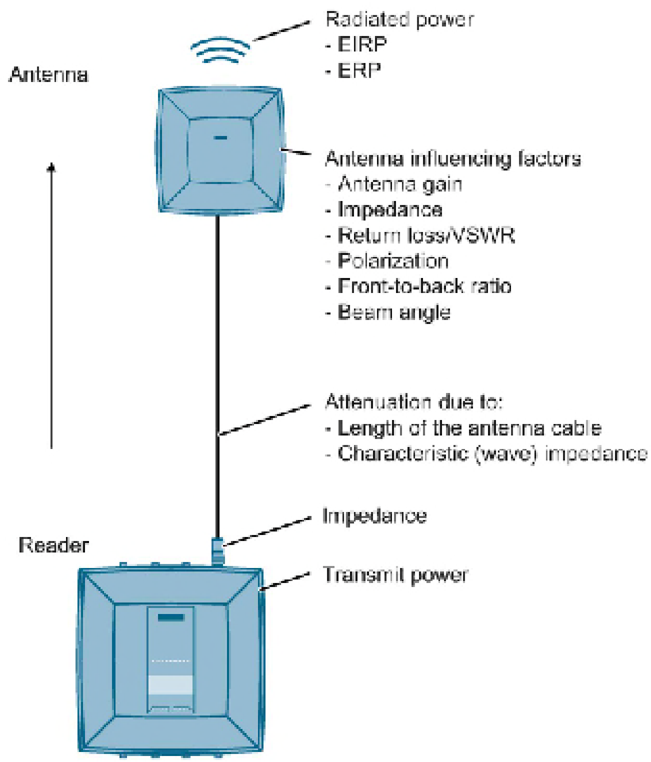


Figure 4-9 Overview diagram: Influencing factors

When operating the SIMATIC RF600 system, you need to observe additional influencing factors such as minimum spacing between antennas in the room.

Environmental conditions

NOTICE
Damage to the device In line with the application, you must take into consideration the mechanical loads (shock and vibration) as well as environmental demands such as temperature, moisture, UV radiation. The device could be damaged if these factors are not considered.

Specifying the transmit / radiated power

Depending on whether you want to use a third-party antenna and/or antenna cable with a reader, you need to select the suitable components. When selecting third-party components orient yourself on the values of comparable Siemens products.

With the readers, the parameters for the transmit/radiated power, antenna gain and cable loss (user-defined) are set using the WBM. In the WBM, you can select the Siemens products being used from a drop-down list quickly and easily, and the values and their effect on the transmit/radiated power are calculated directly. With third-party products, you can enter the relevant values manually.

Based on the entered products/values, the WBM calculates the permitted radiated power and makes sure that this is not exceeded.

4.3.9.4 Types of antenna

In principle, all types of directional antennas can be considered as antennas for integration into the SIMATIC RF600 system. Directional antennas have a preferred direction in which more energy is radiated than in other directions.

RF600 antennas on the other hand, are optimized for operation with RF600 readers and have all the required approvals.

4.3.9.5 Antenna cables

Selection criteria

You must observe the criteria listed below when selecting the appropriate antenna cable.

Characteristic impedance

Note the following points when selecting the antenna cable:

- You can only use coaxial antenna cables when connecting an antenna.
- These antenna cables must have a nominal characteristic impedance of Z = 50 Ohm.

Antenna cable loss

In order to be able to transmit the available UHF power from the RF600 reader to the antenna or antennas, the antenna cable loss should not exceed a value of approx. 5 dB.

Dependency of the cable loss

The cable loss depends on two important factors:

- External characteristics of cable. These includes the cable length, diameter and design.
- As a result of the physical principle, the cable loss is also frequency-dependent. In

other

words, the cable loss increases the higher the transmitter frequency is. Therefore the cable loss must be specified in the frequency band from 860 to 960 MHz.

Cable vendors usually provide tables or calculation aids for their types of cable which usually include the transmitter and receiver frequencies as well as the cable length. Therefore contact your cable vendor in order to determine the appropriate type of cable using the approximate value referred to above.

Notes on use

Shielding of the antenna cable

Coaxial antenna cables generally have a shielded design and therefore radiate little of the transmitted power to the environment.

Bending radius of the antenna cable

The properties of the cable shield are influenced by mechanical loading or bending. You must therefore observe the static and dynamic bending radii specified by the cable vendor.

Connectors and adapters

You must use connectors and adapters of the type "Reverse Polarity R-TNC" (male connector) for your antenna cables to ensure correct connection to the RF600 reader interface.

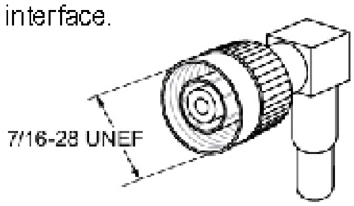


Figure 4-10 Thread standardization

You can find more information in the catalog data of your cable vendor.

4.4 Minimum distances and maximum ranges

The following section describes the configuration of the antenna and transponder relative to each other. The aim of the section is to help you achieve the maximum ranges listed here in a typical electromagnetic environment. One of the main focuses of the section is the effect of the mounting surface of the transponder on the read/write distance.

As the requirements for achieving the maximum distances specified here, note the following points:

- Operate the readers with the maximum possible and permitted transmit power.
- With external antennas, the antenna cable with 1 m cable length and 0.5 dB cable loss is used (6GT2815-0BH10).
- Optimum alignment of the transponder and antenna is ensured (see section "Configurations of antenna and transponder (Page 55)").
- The optimum mounting surface for the transponder has been selected (see section "Effects of the materials of the mounting surfaces on the range (Page 58)")
- The maximum range specified in the section "Maximum read/write ranges of transponders (Page 59)" applies only to read processes.

  With write operations, the range is reduced as described in the section.
- Effects that reduce read/write ranges are avoided (see section "Antenna configurations (Page 39)").

4.4.1 Configurations of antenna and transponder

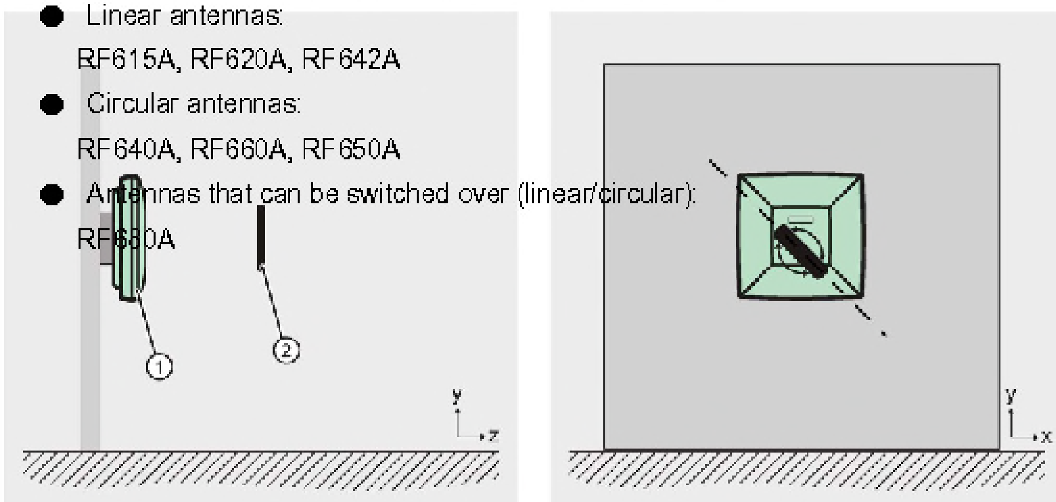
Below, you will find several possible antenna-transponder configurations that are necessary to achieve the maximum range. The polarization of the antenna plays a decisive role. The antennas are distinguished according the following types:

- Linear antennas:

  RF615A, RF620A, RF642A
- Circular antennas:

  RF640A, RF660A, RF650A
- Antennas that can be switched over (linear/circular):

  RF680A



With the antenna types with linear polarization (RF620A and RF642A), the polarization axes of the antenna and of the transponder must be aligned parallel to each other to achieve a maximum range.

NOTICE
Reduction of the maximum read/write range when using linear antennas If the alignment of the polarization axes of linear antennas (RF620A or RF642A) and transponders is not parallel, this reduces the read/write range. The reduction in the range depends on the angular deviation between the polarization axes of the antenna and the polarization axis of the transponder. You will find further details in the section "Alignment of transponders to the antenna (Page 257)" or "Alignment of transponders to the antenna (Page 297)".

Note

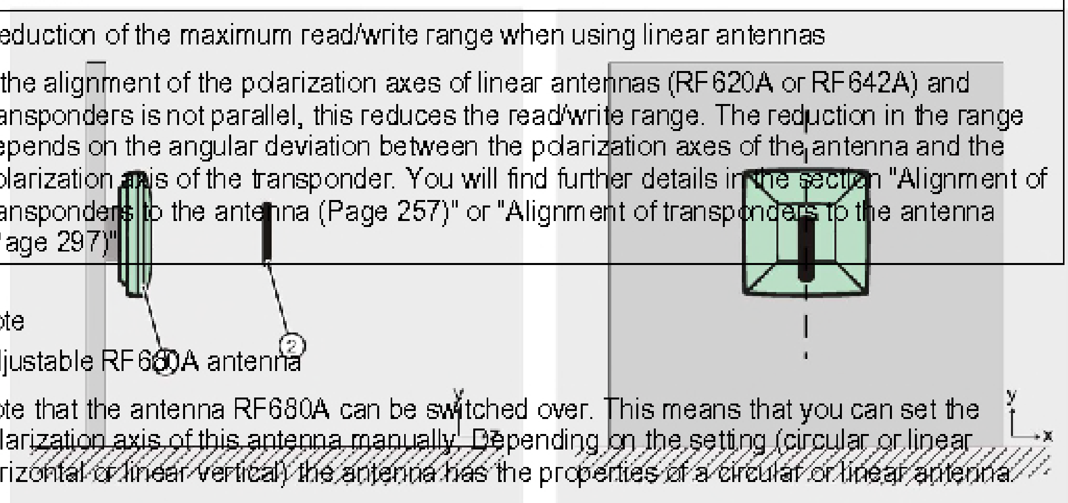
Adjustable RF680A antenna

Note that the antenna RF680A can be switched over. This means that you can set the polarization axis of this antenna manually. Depending on the setting (circular or linear horizontal or linear vertical) the antenna has the properties of a circular or linear antenna.

Possible transponder alignments depending on the antenna type

Circular antennas

To achieve the maximum read/write range with circular antennas, make sure that the planes of the polarization axes have the same alignment. Changing the transponder angle within the x-y plane has no effect on the range.

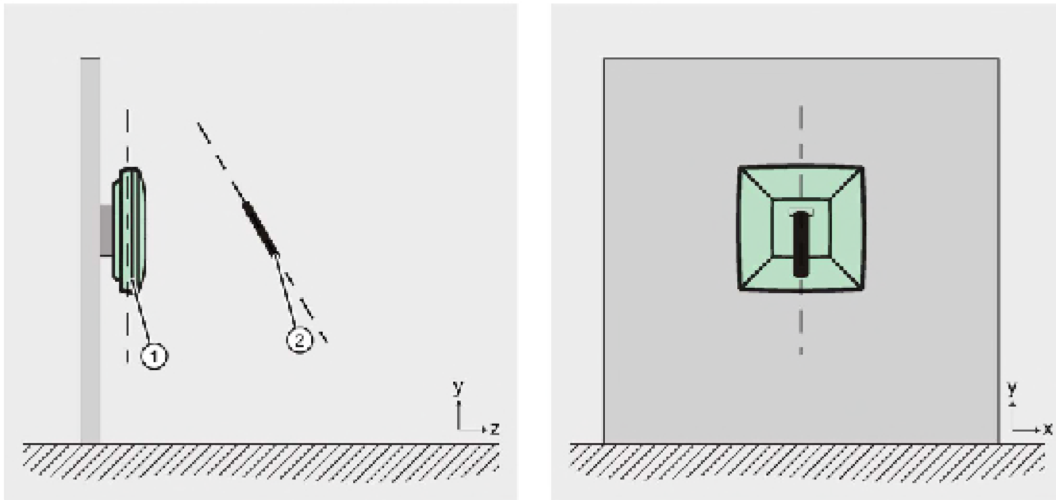


① Circular antenna RF640A, RF650A, RF660A or RF680A
② Transponder

Figure 4-11 Possible transponder alignment with circular antennas

Linear antennas

To achieve the maximum range with linear antennas, make sure that the polarization axes of the antenna and transponder are parallel to each other. Changing the transponder angle within the x-y plane leads to a reduction of the range.



① Linear antenna RF615A, RF620A, RF642A or RF680A
② Transponder

Figure 4-12 Possible transponder alignment with linear antennas

---

Note

Optimum transponder position/alignment

Depending on the electromagnetic properties of the environment, the optimum transponder position and alignment may differ from those shown above.

Suboptimal transponder alignment for all antenna types

If the angle is changed within the y-z plane, this causes a reduction in range for all antenna types.

① Antenna RF615A, RF620A, RF640A, RF642A, RF650A or RF680A
② Transponder

Figure 4-13 Suboptimal transponder alignment

Note

Exceptions

The suboptimal transponder alignment does not apply to the transponders RF625T and RF630T. You will find additional information on this in the sections dealing with the transponders.

4.4.2 Effects of the materials of the mounting surfaces on the range

Effects due to antenna mounting

For the RF640A, RF642A, RF650A, RF660A and RF680A antennas, the antenna gain and therefore the maximum read/write range does not depend on the selected material of the mounting surface. In contrast to this, the antenna gain of the RF615A and RF620A antennas and therefore the maximum read/write range of transponders depends on the mounting surface of the antenna. To achieve the maximum range with an RF615A/RF620A antenna, the antenna needs to be mounted on a metallic surface of at least 150 x 150 mm.

You will find more detailed information on antenna gain in the subsections of the section "Antenna patterns (Page 257)".

Effects due to transponder mounting

The maximum read/write range of the transponders depends on the material of the mounting surface. The specified ranges apply when mounted on non-metallic surfaces, such as paper or card, with the RF640L, RF642L, RF625T, RF630T, RF640T and RF645T when mounted on metal.

Mounting on plastic can reduce the maximum read/write range considerably depending on the type of plastic (up to 70%). When mounted on wood, the range is furhter reduced the more moisture the wood contains. Due to the attenuating properties of glass, direct mounting without a spacer can halve the range.

If the RF625T, RF630T, RF640T, RF645T, RF680T or RF682T transponders are mounted on metal, this metallic surface acts as a reflection surface. This surface should therefore be adequately large. To achieve the listed maximum ranges, transponders must be mounted on a metallic mounting surface with a minimum diameter of 150 mm, for the RF630T and RF680T 300 mm. If the metallic mounting surface only has a diameter of 65 mm instead of the required 150 mm, the range is reduced by 65%.

4.4.3 Maximum read/write ranges of transponders

Maximum read ranges

The measurements were made under the following conditions:

- ETSI radio profile
- Maximum possible radiated power of the reader or antenna.
- Optimum transponder alignment and mounting surface
- With antenna connected:
  - With a 3 meter long antenna cable with 1 dB cable loss (article number: 6GT2815-0BH30)
  - RF615A and RF620A: Mounted on metal.
  - RF680A: Circular polarization
- Room temperature of approx. 20 - 25 °C
- Low-reflection environment; Ranges may be smaller or larger depending on the ambient conditions.

The following tables summarize the ranges with the RF610R and RF615R readers, as well as the RF680R and RF685R readers, since the ranges achieved are identical with these readers. Note that the RF610R reader does not have an external antenna connector and the RF680R reader does not have an internal antenna.

Table 4- 4 Read range of the transponders I (all ranges in meters [m])

	SIMATIC RF630L 6GT2810-2AB01-0AX1	SIMATIC RF630L 6GT2810-2AB02-0AX0	SIMATIC RF630L 6GT2810-2AB03	SIMATIC RF630L 6GT2810-2AB04
SIMATIC RF610R SIMATIC RF615R with internal antenna	1.0	1.0	0.6	0.6
SIMATIC RF615R with RF615A	0.4	0.5	0.2	0.2
with RF620A	0.4	0.6	0.2	0.2
with RF640A	1.6	1.8	0.6	1.0
with RF642A	3.5	4.0	1.6	1.8
with RF650A	1.6	2.0	0.9	0.8
with RF660A	3.0	4.0	1.4	1.6
with RF680A	1.6	2.0	1.0	1.0
SIMATIC RF650R with RF615A	1.0	1.2	0.5	0.6
with RF620A	1.0	1.2	0.5	0.7
with RF640A	3.0	3.0	1.6	1.8
with RF642A	5.0	5.0	3.0	3.5
with RF650A	3.0	3.0	1.4	1.8
with RF660A	5.0	5.0	2.5	3.0
with RF680A	3.0	3.0	1.4	1.8
SIMATIC RF685R with internal antenna	5.0	6.0	3.0	3.5
SIMATIC RF680R SIMATIC RF685R with RF615A	1.4	1.8	0.7	0.8
with RF620A	1.6	1.8	0.8	0.9
with RF640A	4.0	4.0	2.0	2.5
with RF642A	5.0	5.0	3.0	3.5
with RF650A	3.5	4.0	1.8	2.5
with RF660A	5.0	5.0	2.5	3.0
with RF680A	4.0	4.5	1.8	2.5

Table 4- 5 Read range of the transponders II (all ranges in meters [m])

	SIMATIC RF630L 6GT2810-2AC82	SIMATIC RF630L 6GT2810-2AE80-0AX2	SIMATIC RF630L 6GT2810-2AE81-0AX1
SIMATIC RF610R SIMATIC RF615R with internal antenna	0.4	1.0	0.6
SIMATIC RF615R with RF615A	0.1	0.5	0.2
with RF620A	0.2	0.5	0.2
with RF640A	1.4	2.5	1.0
with RF642A	3.0	4.0	2.5
with RF650A	1.4	2.5	1.0
with RF660A	2.5	4.0	3.5
with RF680A	1.4	2.5	1.2
SIMATIC RF650R with RF615A	0.7	1.4	0.6
with RF620A	0.8	1.4	0.6
with RF640A	2.5	4.0	1.8
with RF642A	4.5	6.0	3.5
with RF650A	2.0	3.5	1.8
with RF660A	4.0	6.0	3.0
with RF680A	2.0	3.5	1.8
SIMATIC RF685R with internal antenna	5.0	6.0	3.5
SIMATIC RF680R SIMATIC RF685R with RF615A	1.0	1.8	0.9
with RF620A	1.2	2.0	1.0
with RF640A	3.0	5.0	2.5
with RF642A	5.0	6.0	4.0
with RF650A	3.0	5.0	2.5
with RF660A	4.0	6.0	3.5
with RF680A	3.0	5.0	2.5

Table 4- 6 Read range of the transponders III (all ranges in meters [m])

	SIMATIC RF640L [1]	SIMATIC RF642L [1]	SIMATIC RF690L	SIMATIC RF610T
SIMATIC RF610R SIMATIC RF615R with internal antenna	0.5	0.8	0.2	0.8
SIMATIC RF615R with RF615A	0.2	0.2	0.1	0.3
with RF620A	0.2	0.4	0.1	0.4
with RF640A	0.5	1.2	0.1	1.2
with RF642A	2.5	2.0	0.3	3.0
with RF650A	1.0	0.8	0.1	1.2
with RF660A	2.0	1.8	0.3	3.0
with RF680A	0.5	1.0	0.1	1.4
SIMATIC RF650R with RF615A	0.1	0.4	0.2	0.9
with RF620A	0.1	0.4	0.2	0.9
with RF640A	0.8	1.2	2.5	2.5
with RF642A	3.5	2.0	2.0	4.5
with RF650A	1.6	1.2	3.0	2.0
with RF660A	2.5	1.6	1.4	3.5
with RF680A	1.6	1.2	0.9	2.0
SIMATIC RF685R with internal antenna	2.5	2.0	3.0	5.0
SIMATIC RF680R SIMATIC RF685R with RF615A	0.2	0.5	0.2	1.2
with RF620A	0.2	0.5	0.3	1.4
with RF640A	1.0	1.4	3.5	3.0
with RF642A	3.5	2.0	2.0	4.5
with RF650A	2.0	1.6	3.5	3.0
with RF660A	2.5	1.6	1.4	3.5
with RF680A	2.5	1.6	1.4	3.0

1) Mounting on metal. Mounting surface with a minimum diameter of 150 mm.

Table 4- 7 Read range of the transponders IV (all ranges in meters [m])

	SIMATIC RF620T [1]	SIMATIC RF625T [2]	SIMATIC RF630T [2]	SIMATIC RF640T [2]
SIMATIC RF610R SIMATIC RF615R with internal antenna	1.0	0.3	0.3	0.4
SIMATIC RF615R with RF615A	1.0	0.1	0.1	0.2
with RF620A	1.2	0.1	0.2	0.2
with RF640A	4.0	0.3	0.4	0.7
with RF642A	4.0	1.0	0.5	1.4
with RF650A	3.5	0.2	0.4	0.7
with RF660A	4.0	0.8	1.0	1.2
with RF680A	4.0	0.2	0.5	1.2
SIMATIC RF650R with RF615A	1.8	0.3	0.4	0.6
with RF620A	1.8	0.4	0.4	0.7
with RF640A	5.0	1.0	1.0	1.8
with RF642A	7.0	1.8	2.0	2.5
with RF650A	4.0	1.0	0.9	2.0
with RF660A	6.0	1.4	1.8	2.0
with RF680A	4.0	0.8	0.9	2.0
SIMATIC RF685R with internal antenna	7.0	2.0	2.0	3.5
SIMATIC RF680R SIMATIC RF685R with RF615A	2.5	0.5	0.5	0.8
with RF620A	2.5	0.5	0.5	1.0
with RF640A	6.0	1.4	1.4	2.5
with RF642A	7.0	1.8	2.0	4.0
with RF650A	5.0	1.4	1.2	2.5
with RF660A	6.0	1.4	1.8	3.0
with RF680A	6.0	1.2	1.2	3.0

1) Mounting on a non-metallic surface. Mounting on metal is only permitted in combination with a spacer.

2) Mounting on metal Mounting surface with a minimum diameter of 150 mm, for the RF630T 300 mm.

Table 4- 8 Read range of the transponders V (all ranges in meters [m])

	SIMATIC RF645T 1)	SIMATIC RF680T 1)	SIMATIC RF682T 1)
SIMATIC RF610R SIMATIC RF615R with internal antenna	1.0	1.0	1.0
SIMATIC RF615R with RF615A	0.7	0.6	0.4
with RF620A	0.9	0.7	0.4
with RF640A	1.4	2.0	1.2
with RF642A	3.0	4.0	2.5
with RF650A	1.6	1.8	1.2
with RF660A	3.5	4.0	2.0
with RF680A	1.8	2.0	1.2
SIMATIC RF650R with RF615A	1.2	1.0	0.7
with RF620A	1.4	1.2	0.8
with RF640A	4.0	3.0	2.5
with RF642A	6.0	5.0	4.5
with RF650A	3.5	3.0	2.0
with RF660A	5.0	4.5	4.0
with RF680A	3.0	3.0	2.0
with RF680A	4.5	4.5	3.0
SIMATIC RF685R with internal antenna	6.0	5.0	4.0
SIMATIC RF680R SIMATIC RF685R with RF615A	1.8	1.4	1.0
with RF620A	2.0	1.6	1.2
with RF640A	5.0	4.0	3.0
with RF642A	6.0	5.0	4.5
with RF650A	5.0	4.0	2.5
with RF660A	5.0	4.5	4.0
with RF680A	4.5	4.5	3.0

1) Mounting on metal. Mounting surface with a minimum diameter of 150 mm, for the RF680T 300 mm.

Maximum write ranges

Depending on the transponder type, the reader antenna requires more power for writing than for reading data. When writing, the maximum range reduces by approximately 30 % compared with the read range.

4.4.4 Minimum distances between antennas and transponders

The antennas listed here are all far field antennas. For this reason, a minimum distance between antennas and transponders must be maintained to ensure reliable transponder data access:

Table 4- 9 Minimum distances to be maintained between antennas and transponders

RF600 antenna	Minimum distances to be maintained
RF615A	50 mm
RF620A	50 mm
RF640A	200 mm
RF642A	200 mm
RF650A	200 mm
RF660A	200 mm
RF680A	200 mm
RF685R, internal antenna	200 mm

4.4.5 Influence of electrically conductive walls on the range

NOTICE
Influence of conducting walls on the range If there are metallic (reflecting) surfaces in the immediate vicinity of the transponder, this can have a negative effect on the write/read range. Test the environmental conditions before using the transponder.

4.5 Environmental conditions for transponders

Basic rules

The transponder must not be placed directly on metal surfaces or on containers of liquid. The on-metal transponders designed specifically for use in metallic environments are an exception to this. For physical reasons, a minimum distance must be maintained between the transponder antenna and conductive material. A minimum distance of 5 cm is recommended. The transponder operates better when the distance is greater (between 5 and 20 cm).

- Transponder assembly on non-conductive material (plastic, wood) has a tendency to be less critical than assembly on poorly conductive material.
- The best results are achieved on the materials specified by the transponder manufacturer.
- For more information, refer to the section "Transponder (Page 359)" or ask the relevant transponder manufacturer.

4.6 The response of electromagnetic waves in the UHF band

4.6.1 The effect of reflections and interference

Reflections and interference

Electromagnetic waves in the UHF band behave and propagate in a similar manner to light waves, that is they are reflected from large objects such as ceilings, floors, walls and windows and interfere with each other. Due to the nature of electromagnetic waves, interference can lead to wave amplification which can produce an increased reading range. In the worst case scenario, interference can also result in waves being extinguished which causes gaps in reader coverage.

In some circumstances, reflections can also be beneficial when they cause electromagnetic waves to be routed around objects, in a sense (deflection). This can increase the reading probability.

Due to these electromagnetic characteristics, it is extremely difficult in the multiple-reflection environment that is usually found in real environments on site to determine propagation paths and field strengths for a particular location.

Reducing the effect of reflections/interference on transponder identification

- Reducing the transmit power:
  To minimize interference, we recommend that the transmit power of the reader is reduced until it is sufficient for an identification rate of 100%.
- Increasing the number of antennas:
  More antennas (3 or 4) in a suitable antenna configuration can prevent gaps in reader coverage.

4.6.2 Influence of metals

Metal can have an effect on the electromagnetic field depending on the arrangement or environment. The effect ranges from a hardly determinable influence through to total blocking of communication. The term metal in this context also includes metallized materials that are either coated with metal or shot through with metal to such an extent that UHF radiation cannot penetrate or only to a minimal extent.

The effect of metal on the electromagnetic field can be prevented as follows:

- Do not mount transponders on metal.

  The on-metal transponders designed specifically for use in metallic environments are an exception to this.
- Do not place metallic or conducting objects in the propagation field of the antenna and transponder.

Influence of metal on transponders

Normally transponders must not be mounted directly on metallic surfaces. The transponders designed specifically for use in metallic environments are an exception to this (e.g.: RF690L, RF620T, RF625T, RF630T, RF640T, RF680T).

Due to the nature of the electromagnetic field, a minimum distance must be maintained between the transponder antenna and conductive materials. For more detailed information on the special case of attaching transponders to electrically conducting materials, refer to the relevant transponder sections.

In the case of transponders that are not designed for mounting on metallic materials, the minimum permissible distance from metal is 5 cm. The larger the distance between the transponder and the metallic surface, the better the function of the transponder.

Influence of metal on antennas

Note that metal surfaces located directly in the antenna field reflect the transmitted power directly to the antenna. Due to the nature of the electromagnetic field, a minimum distance must be maintained between the antenna and conductive materials. You can find more detailed information on this in section "Specified minimum and maximum spacing of antennas (Page 46)".

If the reflected energy becomes too strong in the receive path of the reader, this activates a protective circuit that shows itself as an antenna error without there actually being an error in the configuration or a defect on the antenna.

This effect depends very much on the transmitted power, the components being used (cable, antenna) and the distance from the metallic surface to the antenna. In this case, repositioning/realigning the antenna or reducing the radiated power can remedy the situation.

4.6.3 Influence of liquids and non-metallic substances

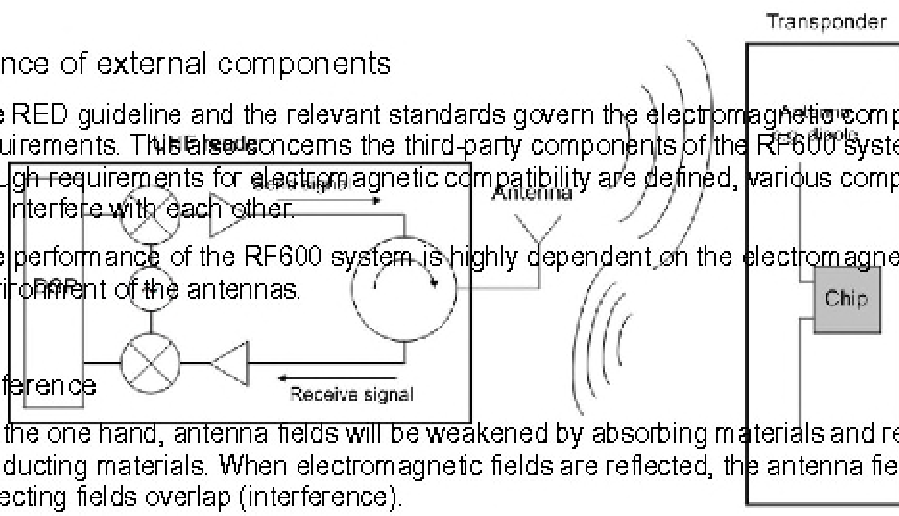
Non-metallic substances can also affect the propagation of electromagnetic waves and thus the transponder range.

When non-metallic substances or objects that can absorb UHF radiation are located in the propagation field, these can alter the antenna field depending on their size and distance and can even extinguish the field entirely.

The RF damping effect of water, materials containing water, ice and carbon is high. Electromagnetic energy is partly reflected and absorbed.

Oil- or petroleum-based liquids have low RF damping. Electromagnetic waves penetrate these liquids and are only slightly weakened.

4.6.4 Influence of external components



The RED guideline and the relevant standards govern the electromagnetic compatibility requirements. This also concerns the third-party components of the RF600 system. Even though requirements for electromagnetic compatibility are defined, various components will still interfere with each other.

The performance of the RF600 system is highly dependent on the electromagnetic environment of the antennas.

Reflections and interference

On the one hand, antenna fields will be weakened by absorbing materials and reflected by conducting materials. When electromagnetic fields are reflected, the antenna field and reflecting fields overlap (interference).

Third-party components in the same frequency band

On the other hand, third-party components may transmit on the same frequency band as the reader, or the third-party components may transmit in different frequency bands with side bands that overlap with the frequency band of the reader. This results in a reduction of the "signal-to-noise" ratio which reduces the performance of an RF600 system.

If a DECT station that is transmitting in the 2 GHz band, for example, is located in the receiving range of an antenna of the RF600 system, the performance of the write and read access to the transponder may be reduced.

4.7 Planning and installation of UHF read points

Due to their comparatively large effective range, RFID UHF systems (frequency band 865 - 928 MHz) have different requirements in terms of planning, commissioning and operation compared with the HF systems commonly used up to now in automation (frequency band 13.56 MHz). This section describes important rules for preparation and implementation of the RFID UHF systems.

4.7.1 Technical basics

General

In contrast to inductively coupled HF systems, in UHF technology, there is full propagation of the radio waves just as in other wireless systems (radio, TV etc). There are both magnetic and electrical field components present. The following graphic shows the structure of a UHF system. One characteristic is the design of the transponder that differs greatly from the structure used in HF systems, e.g. the use of a dipole or helix antenna.

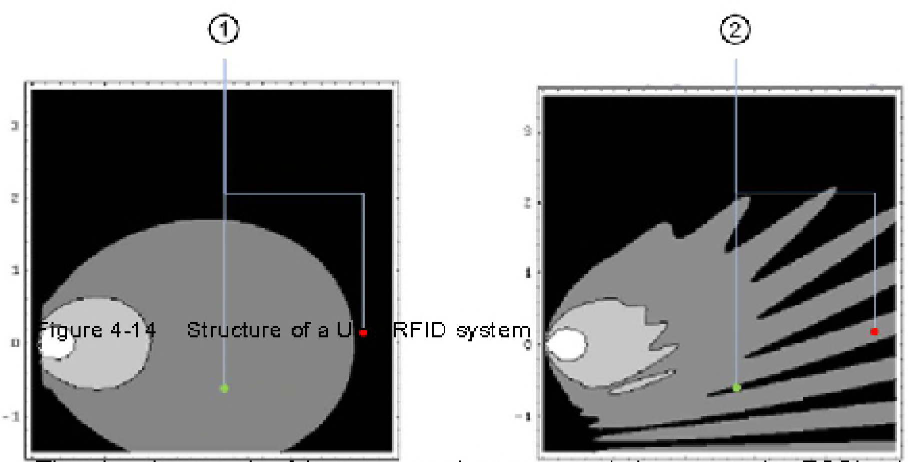


Figure 4-14 Structure of a UHF RFID system

RSSI value

The signal strength of the transponder response is known as the RSSI value (Received Signal Strength Indicator). The RSSI value is a one byte value (0 to 255), the higher the value the better the signal strength (according to the IEEE 802.11 standard).

The actual RSSI value depends on numerous parameters:

- transponder type used,
- chip used in the transponder,
- connected antenna,
- transmit power,

- distance between antenna and transponder,
- reflections,
- noise level in the channel used and in neighboring channels

The RSSI value is important for the automatic evaluation of the read point and for filtering. A simple comparison of the RSSI values of two transponders is nevertheless not possible because the values are influenced by the transponder tolerances and the non-homogeneous antenna field. This means that it is possible that a transponder positioned closer to the RFID antenna has a lower RSSI value than a transponder much further away.

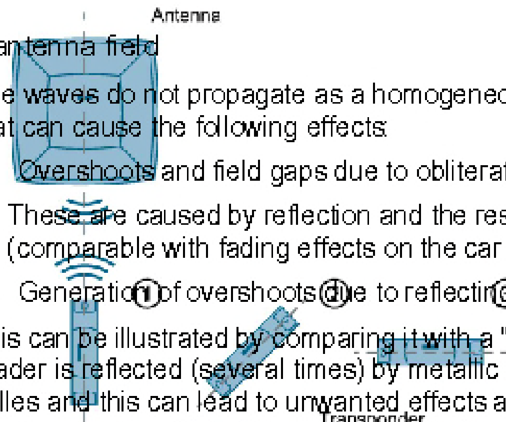
Propagation of the antenna field

The waves do not propagate as a homogeneous field, there is superposition of the waves that can cause the following effects:

- Overshoots and field gaps due to obliteration of two waves

  These are caused by reflection and the resulting propagation on different paths (comparable with fading effects on the car radio, e.g. noise when the vehicle is standing)
- Generation of overshoots due to reflecting objects and surfaces

This can be illustrated by comparing it with a "hall of mirrors". The signal transmitted by the reader is reflected (several times) by metallic objects such as housings, steel supports or grilles and this can lead to unwanted effects and read errors. Is also possible that a transponder is not identified although it is located in the assumed direct identification range of the reader. It can also happen that a transponder moving outside the antenna field is read out due to overshoots.



① Identification situation with two transponders in an ideal radio/antenna field
② Identification situation with two transponders in a real radio/antenna field with reflections that can lead to obliteration and overshoots

Figure 4-15 Propagation of UHF RFID antenna fields

Properties of the transmitting antenna

Depending on their design, UHF RFID antennas provide different properties. They differ in the polarization and antenna gain.

The direction of the electrical field component of an electromagnetic wave and the alignment of the antenna decide the polarization of the radiation. A distinction is made between linear and circular polarization of an antenna. With linear polarization you achieve the maximum write/read distances when the polarization axes of the antenna and transponder are parallel to each other. As the deviation increases, the received power deteriorates.

① Polarization axes parallel: approx. 100 % range
② Polarization axis turned through 45°: approx. 50% range
③ Polarization axis turned through 90°: approx. 10% range

Figure 4-16 Effect of the polarization axes on the write/read distance with linear antennas

Linear antennas can only be used if the alignment of the transponder is defined. On the other hand, one advantage of linear antennas is that they react less sensitively to reflections. This restriction does not apply with circular polarization. Circular antennas can also be used with differing alignments of the transponder and achieve constant results (e.g. RF680A or RF685R). It has been shown that with a defined transponder alignment, the linear antenna normally produces the best results.

4.7.2 Implementation of UHF RFID installations

The use of UHF RFID systems requires careful planning and preparation to avoid problems during commissioning and operation.

4.7.2.1 Preparation phase

Device selection

When selecting the suitable RFID hardware, remember the following minimum criteria:

- Integration in a control/IT environment
- Degree of protection
- Size of the identification range
- Type, number and position of the transponders in the antenna field
- Reflecting and absorbent materials in the vicinity of the antenna
- Distance between the antenna or the reader and the transponder

The following application examples illustrate the requirements for specific use cases and provide suitable solutions:

- Read point in a conveyor system in confined installation conditions:

  A container should be transported in a conveyor system. Information on the next transport section is contained in a transponder which is attached to the side of the container.

  Possible configuration: RF610R or possibly RF615R with integrated internal antenna and a compact, external antenna (e.g. RF615A, RF620A)
- RFID gate at the incoming goods / outgoing goods department

  Several transponders are located on different packaging of products on a pallet. These need to be identified when passing through the RFID gate.

  Possible configuration: RF650R with four circular antennas (e.g. RF650A, RF660A depending on the required radiated power)
- Four read points along the production line:

  A product needs to be processed by different machines along the production line. The information for this is contained on a transponder attached to the product that must be read out at each machine.

  Possible configuration: RF680R with four antennas (e.g. RF615A, RF620A, RF680A)
- Read point on a production line with a predominantly metallic environment:

  A product needs to be processed by different machines along the production line. The information for this is contained on a transponder attached to the product that must be read out at each machine.

  Possible configuration: RF685R with integrated adaptive antenna

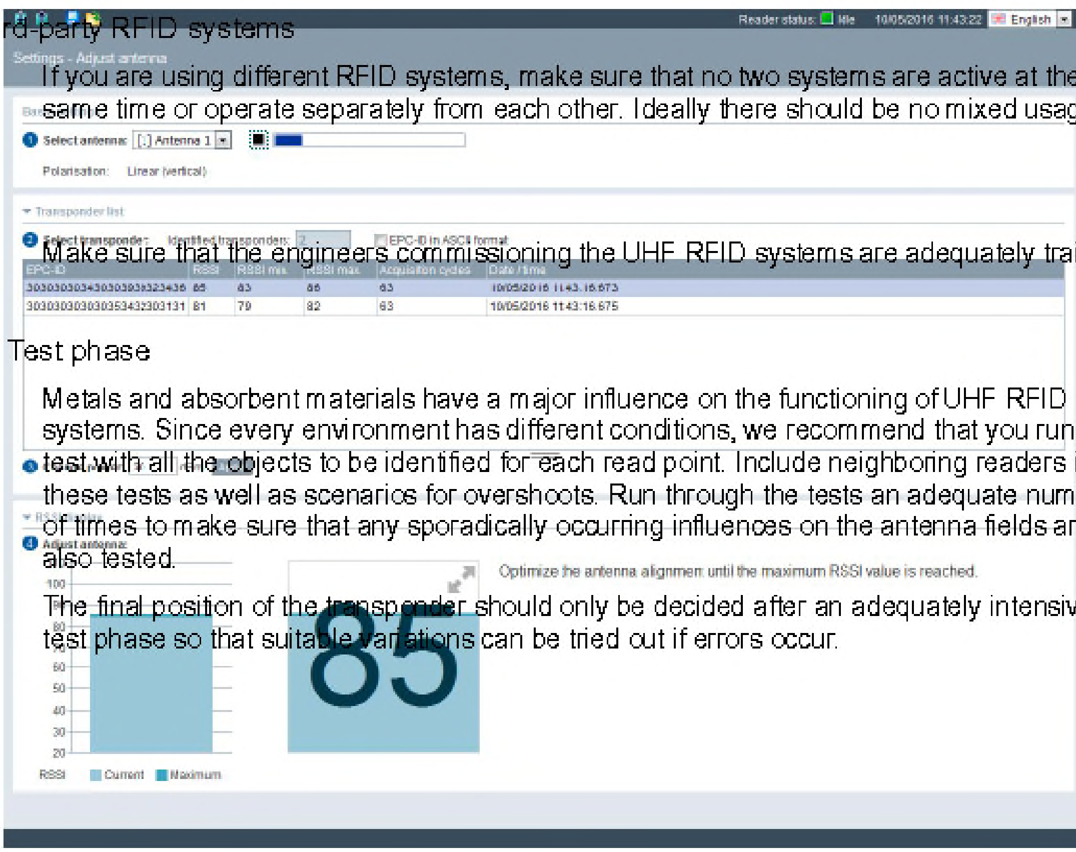
Dynamic identification

Dead spots cannot be excluded. To be able to compensate for dead spots, we recommend that you give preference to dynamic identification rather than static identification. Dynamic identification means that the transponders are read while they are moving (e.g. on the conveyor belt). If static identification is necessary, the antenna field can e virtually dynamized with the RF685R antenna or RF680A.

Triggering

To read out all right transponder data, you can have the readers perform permanent write/read actions or have specific write/read actions triggered. For the following reasons, we recommend that you trigger specific write/read actions:

- The RFID system only performs write/read actions when an object to be identified enters the antenna field. This reduces the number of process errors and they can be identified more quickly.
- Due to the fact that the various RFID systems only perform write/read actions when necessary, this reduces the possibility of antenna fields disrupting each other. This increases process reliability in plants, particularly when there is a high reader density.



Decoupling third-party RFID systems

If you are using different RFID systems, make sure that no two systems are active at the same time or operate separately from each other. Ideally there should be no mixed usage.

Training

Make sure that the engineers commissioning the UHF RFID systems are adequately trained.

4.7.2.2 Test phase

Metals and absorbent materials have a major influence on the functioning of UHF RFID systems. Since every environment has different conditions, we recommend that you run a test with all the objects to be identified for each read point. Include neighboring readers in these tests as well as scenarios for overshoots. Run through the tests an adequate number of times to make sure that any sporadically occurring influences on the antenna fields are also tested.

The final position of the transponder should only be decided after an adequately intensive test phase so that suitable variations can be tried out if errors occur.

4.7.2.3 Setting up read points

The read point setup described in this section is performed using the Web Based Management (WBM) and applies to the RF600 readers. You can find a detailed description of the WBM in the configuration manual "SIMATIC RF600 (https://support.industry.siemens.com/cs/ww/en/ps/15081/man)".

Adjust antennas

Follow the steps below to optimize the antenna alignment:

1. Position the object fitted with a transponder and to be identified at the required read point.
2. Align the reader or the antenna so that its front points in the direction of the object (transponder) to be identified.

   Keep to the minimum distances between antennas and transponders to avoid antenna errors.

   When using linear antennas, make sure the polarization direction is correct.
3. In the "Settings - Adjust antenna" menu item, select the connected antenna and click the "Start adjustment" button.

Figure 4-17 Optimizing the antenna alignment with the "Settings - Adjust antenna" menu item of the WBM

4. In the "RSSI display" area, you can see the current (light blue) and maximum reached (dark blue) RSSI values.

   Note

   Transponder is not identified

   If no transponder is identified, first increase the radiated power as described in the following section. Then repeat the antenna adjustment.

   Also check the polarization of your antenna. If the transponder always has the same alignment, the antenna polarization should be adapted accordingly. If the transponder moves or the alignment of the transponder varies, it is advisable to combine several antenna polarization types or to select a circular polarization.

5. Optimize the antenna adjustment until the maximum possible RSSI value is reached.
6. Secure the antenna.

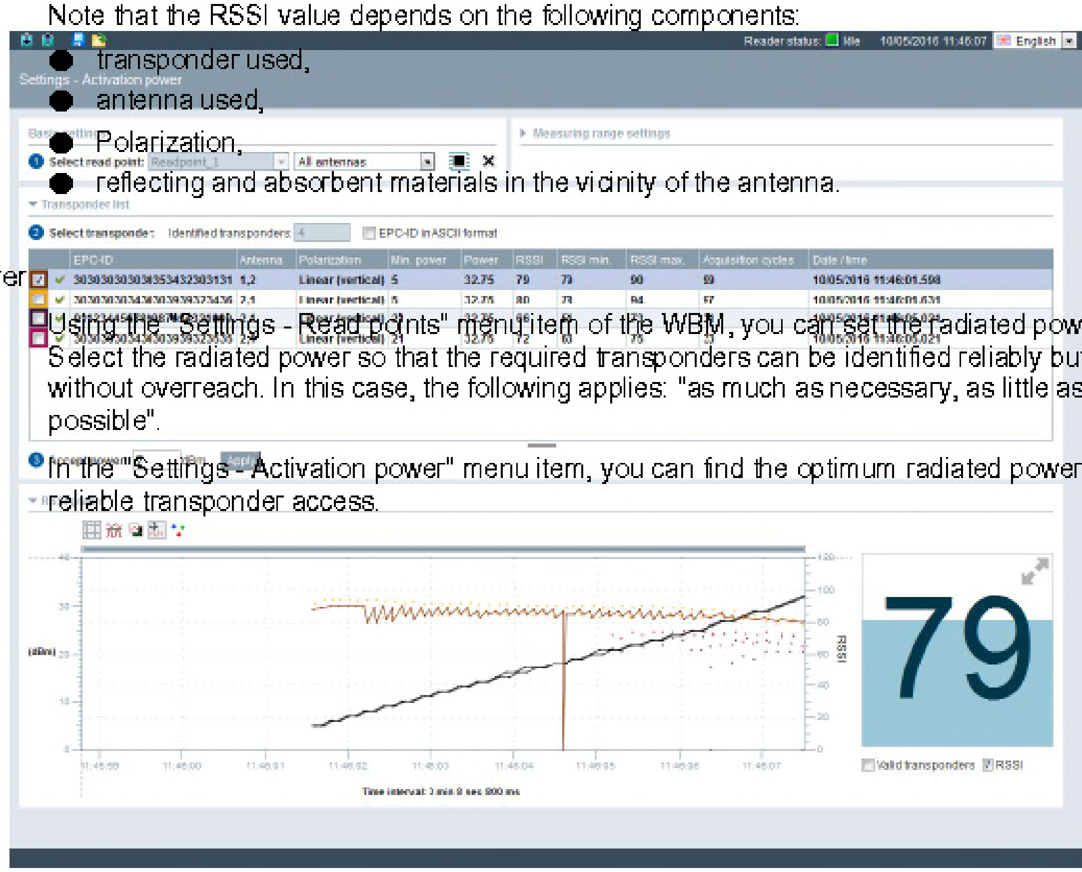
Note that the RSSI value depends on the following components:

- transponder used,
- antenna used,
- Polarization,
- reflecting and absorbent materials in the vicinity of the antenna.

Radiated power

Using the "Settings - Read points" menu item of the WBM, you can set the radiated power. Select the radiated power so that the required transponders can be identified reliably but without overreach. In this case, the following applies: "as much as necessary, as little as possible".

In the "Settings - Activation power" menu item, you can find the optimum radiated power for reliable transponder access.



Detect activation power

Follow the steps below to detect the activation power:

1. In the "Settings - Activation power" menu item, select the connected antenna and click the "Start measurement" button.
2. In the "Min. power" column of the transponder list, you can see the required activation power. The value "Min. power" of the transponder last selected in the transponder list is automatically transferred to the "Accept power" box with 2 dB added.

   Note

   Optimizing the radiated power

   The value entered automatically in the "Accept power" box corresponds to the minimum value with which the transponder was identified by the antenna (Min. power) plus a power reserve of 2 dB. This value serves as a guideline and you can adapt it. To be sure that the antenna reliably detects the transponders regularly, we recommend that you accept the automatically adapted default value.

Figure 4-18 Determining the activation power using the "Settings - Activation power" menu item

3. Click the "Apply" button to transfer the value entered in the "Radiated power" input box of the "Settings - Read points" menu item.
4. Click the symbol to transfer the configuration to the reader.

4.7.3 Dealing with field disturbances

4.7.3.1 Types and approaches to solutions

The superposition of radio waves and reflection by conductive materials (in particular metal) can lead to weakening or strengthening of the antenna field at certain points in space. These effects can lead to disruptions when identifying RFID transponders that can be distinguished as follows:

- Overshoots due to increasing field strength: Transponders are detected that are actually beyond the read distance.

  Approaches to solutions:

  - Reduction of the radiated power
  - Determining the input attenuation
  - Use of UHF algorithms
  - Changing the antenna position
  - Shielding measures
  - Varying the antenna polarization
  - Use antennas with a lower gain
  - Use antennas with adjustable polarization
- Lack of separation of transponders: Transponders positioned close together are detected together although the application logic requires individual detection (for example to determine the positioning order). All transponders are within the read distance.

  Approaches to solutions:

  - Reduction of the radiated power
  - Use of UHF algorithms
  - Changing the antenna position
  - Shielding measures
  - Use antennas with a lower gain
- Field obliteration: Due to the superposition of waves, obliteration effects occur within the read distance.

  Approaches to solutions:

  - Varying the antenna polarization
  - Using additional antennas
  - Use of UHF algorithms
  - Changing the antenna position
  - Shielding measures
  - Use antennas with a lower gain

- Reader ↔ reader influence: Several readers influence or disturb each other during transponder identification.

  Approaches to solutions:

  – "Interconnect" neighboring readers so that they do not send at the same time

  – Enable intermissions ("Settings - General" menu item)

  – Channel management

- Reader ↔ transponder influence: A reader communicates with a transponder that is also in the identification area of another reader.

  Solution approaches:

  – "Interconnect" neighboring readers so that they do not send at the same time

- Other sources of disturbances that can lead to restriction of transponder identification.

  Other sources of disturbances can occur if there are devices with similar frequency bands (for example 900 MHz) in the vicinity of the reader. The diagnostics corresponds to the influence of one reader on another. Mobile phones can also disturb identification. This is the case if a reader of the type FCC or CMIIT is operated in Europe.

  Solution approaches:

  – The disturbances can be eliminated by temporarily turning off the suspected source of interference or its shielding. Interference can also occur with devices in other frequency bands if these are located in the immediate vicinity of the RFID antenna (e.g. DECT telephone directly in front of the RFID antenna). Common industrial interference mechanisms, such as the harmonics of frequency converters or static discharge (ESD) can also cause disturbances.

Note

Occurrence of disturbances

Remember that these disturbances can also occur sporadically or in certain combinations.

4.7.3.2 Measures for eliminating field disturbances

Using shields

To avoid reflections, you can fit UHF absorbent material. To do this, the absorbent material is mounted at various suspected reflection points until the field disturbance no longer occurs. Where possible, avoid the use of metal structures (for example housings) and use plastic instead.

Even with reader-to-reader influence, you can use absorbent plates or shielding sheets.

Channel management

To operate the readers, depending on the country profile, you have between four and fifty send channels available. Ideally, you should make the channel assignments manually in STEP 7 Basic / Professional (TIA Portal) or in the WBM. This allows you to reduce reader-to reader influence and if applicable field obliteration.

Table 4- 10 Example of a channel plan according to ETSI

Reader	Reader 1	Reader 2	Reader 3	Reader 4	Reader 5	...
Transmission channel	4	10	7	13	4	...
Frequency (MHz)	865.7	866.9	866.3	867.5	865.7	...

Use of multiple antennas

If you do not find the ideal antenna position to be able to identify the transponders in the various positions and alignments, you have the option of using more antennas. Multiple antennas mounted at different positions enlarge the identification range.

Enabling send pauses

If too many neighboring readers send at the same time, this causes overload of the radio channels. In this case, enable the "Intermissions" function in the "Settings - General" menu item to improve read reliability.

Varying the antenna polarization

By using linear or circular antennas, you can reduce field obliteration. This improves the reader reliability in difficult radio conditions.

The RF685R and RF680 readers also provide the option of operating the internal or external antenna both as a linear, vertical, linear horizontal and circular antenna. If more than one polarization is enabled, the polarization is changed automatically with each inventory. This increases the probability of identification in difficult radio conditions.

Changing the antenna position

In difficult radio conditions (e.g. where there is a lot of metal) it is possible that the communication between transponders and readers is impaired. You can counter this by changing the position of the antenna relative to the transponder. This also changes the multipath propagation of the radio waves and obliteration is reduced or shifted.

Use of UHF algorithms

In the "Settings - Read points" menu item of the WBM, you will find various "Tools" in the "Algorithms" area that you can use to improve the read/write reliability.

4.8 Chemical resistance of the readers and transponders

4.8.1 Readers

4.8.1.1 Overview of the readers and their housing materials

Resistance to chemicals depends on the housing materials used to manufacture the reader. The following table provides you with an overview of the housing materials that are used with the RF600 readers:

Individual part of the reader	Housing material of the reader
Top cover	Pocan CF2200; The chemical resistance of this plastic is listed in section "CF2200".
Bottom cover	• RF610R/RF615R: Pocan CF2200 • RF650R/RF680R/RF685R: Aluminum
Fiber-optic cable	Makrolon®2405
Decorative membrane [1)	Autotex V200
Socket [1)	Brass (copper alloy) CuZn40Pb2

1) Non-relevant component for resistance of complete housing

In case of questions please contact Siemens Support (section "Service & support (Page 506)").

4.8.1.2 Pocan CF2200

The following table provides an overview of the chemical resistance of the Pocan CF2200.

Table 4- 11 Resistance to chemicals - Pocan CF2200

Substance	Test conditions		Evaluation
	Concentration [%]	Temperature [°C]	
Alcohols			
Ethyl alcohol	-	-	++++
Isopropyl alcohol	-	-	++++
Phenol	-	-	
Glycol	-	-	++++
Glycerine	-	-	++++
Alkalis			
Sodium hydroxide	10%	-	
Ammonia solution	Diluted	-	++++
Halogens			
Bromine	-	-	
Chlorine	-	-	
Ketones			
Acetone	-	-	++
Methyl ethyl ketone (MEK)	-	-	++++
General silicone oils	-	-	++++
Hydrocarbons			
n-hexane	-	-	++++
Gasoline, super (aromatic contents)	-	-	++++
Heating oil	-	-	++++
Benzine (aromatic contents)	-	-	++++
Benzene	-	-	++++
Naphthalene	-	-	++++
Nitrobenzene	-	-	++++
Toluene	-	-	++++
Oils, greases			
Soya oil	-	-	++++
Olive oil	-	-	++++
Butter	-	-	++++
Motor oils HD, hydraulic oils	-	-	++++
Gearbox oils (mild-blend)	-	-	++++
Lubricating greases (roller bearing greases DIN 51825)	-	-	++++
Lubricating greases (basis: ester oils, diester oils, phosphate ester, synthetic oil)	-	-	++++

Substance	Test conditions		Evaluation
	Concentration [%]	Temperature [°C]	
Cleaning products			
Curd soap	-	-	++++
Detergent	-	-	++++
Cleaning products	-	-	++++
Salt solutions			
Sodium hypochloride	-	-	
Sea water	-	-	++++
Acids			
Hydrochloric acid	20 %	-	++
Nitric acid	2%	-	++++
Phosphoric acid	30%	-	
Sulfuric acid	2%	-	++++
	80%	-	
Lactic acid	10%	-	++++
Acetic acid	10%	-	++++
Oleic acid	-	-	++++
Silicone oils			
General silicone oils	-	-	++++
Other substances			
Diethyl ether	-	-	++++
Urea	-	-	++++
Trichlorethylene	-	-	
Nitrobenzene	-	-	++++
Hydrogen peroxide	30%	-	++++

Explanation of the rating	
++++	Resistant
+++	Practically resistant
++	Conditionally resistant
+	Less resistant
	Not resistant
conc.	Concentrated solution
w.	Water solution
c. s.	Cold saturated

4.8.2 Transponder

4.8.2.1 Overview of the transponders and their housing materials

The following sections describe the resistance to chemicals of the various transponders. Resistance to chemicals depends on the housing materials used to manufacture the transponders.

The following table provides an overview of the housing materials of the transponders:

Table 4- 12 Overview of the housing materials of the transponders

Housing material	Transponder
Acrylonitrile/butadiene/styrene (ABS)	RF645T
Polyamide 12 (PA12)	RF640T
Polyamide 6.6 (PA 6.6)	RF625T
Polyamide 6.6 GF (PA 6.6 GF)	RF630T
Polyethylene terephthalate (PET)	RF640L RF690L
Polypropylene (PP)	RF620T
Polyphenylene sulfide (PPS)	RF680T RF682T
Polyvinyl chloride (PVC)	RF610T RF610T ATEX

Note

Chemical substances not listed

The following sections describe the chemical resistance of the various transponders to specific substances. If you require information about chemical substances that are not listed, contact Customer Support

4.8.2.2 Acrylonitrile/butadiene/styrene (ABS)

The following table provides an overview of the chemical resistance of the transponder made of acrylonitrile/butadiene/styrene (ABS).

Table 4- 13 Resistance to chemicals - ABS

Substance	Test conditions		Evaluation
	Concentration [%]	Temperature [°C]	
Acetone	-	-	++
Alcohols	-	-	++
Gasoline	-	-	++++
Aliphatic hydrocarbons	-	-	++++

Substance	Test conditions		Evaluation
	Concentration [%]	Temperature [°C]	
Aromatic hydrocarbons	-	-	
Weak alkaline solutions	-	-	++++
Strong alkaline solutions	-	-	++++
Weak mineral acids	-	-	++++
Strong mineral acids	-	-	
Perchloroethylene	-	-	++
Mineral lubricants	-	-	++++
Oxidizing acids	-	-	
Weak organic acids	-	-	++++
Strong organic acids	-	-	++
Trichloroethylene	-	-	
UV light and weathering	-	-	++
Hot water (hydrolysis resistance)	-	-	++++

Explanation of the rating	
++++	Resistant
+++	Practically resistant
++	Conditionally resistant
+	Less resistant
	Not resistant

4.8.2.3 Polyamide 12 (PA12)

The following table provides an overview of the chemical resistance of the transponder made of polyamide 12. The resistance of the plastic housing to chemicals used in the automobile sector (e.g.: oils, greases, diesel fuel, gasoline, etc,) is not listed extra.

Table 4- 14 Chemical resistance - Polyamide 12

Substance	Test conditions		Evaluation
	Concentration [%]	Temperature [°C]	
Battery acid	30 %	20 ℃	++
Ammonia, gaseous	-	60 ℃	++++
Ammonia, w.	conc.	60 ℃	++++
	10 %	60 ℃	++++
Benzene	-	20 ℃	++++
	-	60 ℃	+++
Bleach solution (12.5% effective chlorine)	-	20 ℃	++
Butane, gas, liquid	-	60 ℃	++++
Butyl acetate (acetic acid butyl ester)	-	60 ℃	++++