SIEMENS

SIMATIC Ident

RFID Systems

SIMATIC RF600

Sytem Manual

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Answers for industry.

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SIMATIC Ident

RFID systems SIMATIC RF600

System Manual

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Introduction

1

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 variants of the SIMATIC RF600 system and describes the products supplied as of xx 2014. If you are using older firmware versions, please refer to the 08/2011 edition of the documentation.

Registered trademarks

SIMATIC ® is a registered trademark of the Siemens AG.

REVIEW

History

Edition	Comment
11/2005	First edition
03/2006	2. revised edition
04/2006	3. revised and extended edition: Details in the technical descriptions were revised.
06/2006	4. revised and extended edition
07/2008	5. revised and extended edition
11/2008	6. revised and extended edition: new RF620R and RF630R readers
07/2009	7. revised and extended edition: FCC approval RF620R/RF630R
10/2009	8. revised and expanded edition for multitag mode
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08/2011	12. revised and expanded edition: New reader RF640R, new antennas RF640A and RF642A
06/2012	13. revised and extended edition
03/2013	14. revised and extended edition
xx/2014	15. revised and extended edition: New readers RF650R, RF680R and RF685R

REVIEW

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

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

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

1.3 Navigating in the system manual

Structure of contents	Contents
Table of contents	Organization of the documentation, including the index of pages and sections
Introduction	Purpose, layout and description of the important topics.
Safety Information	Refers to all the valid technical safety aspects which have to be adhered to while installing, commissioning and operating the product/system and with reference to statutory regulations.
System overview	Overview of all RF identification systems, system overview of SIMATIC RF600.
RF600 system planning	Information about possible applications of SIMATIC RF600, support for application planning, tools for finding suitable SIMATIC RF600 components.
Readers	Description of readers which can be used for SIMATIC RF600.
Antennas	Description of antennas which can be used for SIMATIC RF600.
Transponder/tags	Description of transponders which can be used for SIMATIC RF600.
Integration into networks	Integration of the RF600 reader to higher-level systems, control.
System diagnostics	Description of the flash codes and error codes of the reader.
Accessories	Connecting cable, wide-range power supply unit, technical data, ordering lists, dimension drawings
Appendix	Service and support, contact partners, training centers.
List of abbreviations	List of all abbreviations used in the document.

REVIEW

Safety Information 2

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.

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.

REVIEW

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

The antenna 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.

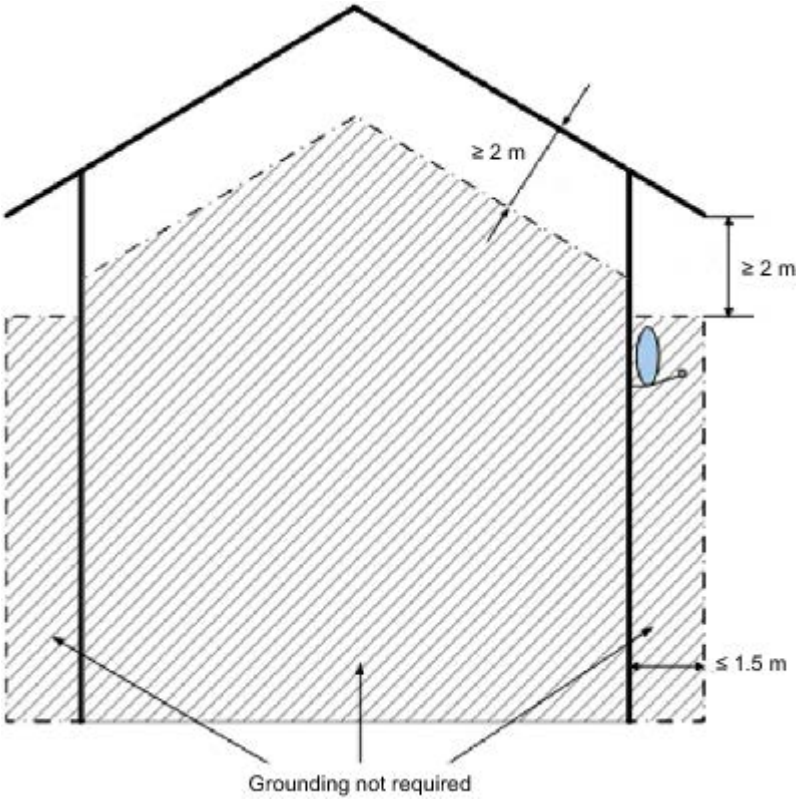


Figure 2-1 Mounting the reader in protected areas

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 support team or where you purchased your device to find out which system expansion devices may safely be installed.

Note

Warranty conditions

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

REVIEW

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

Loss of radio equipment approvals

Alterations to the SIMATIC RF600 devices themselves are not permitted. Failure to observe this requirement shall constitute a revocation of the CE, FCC, UL, CSA radio equipment approvals and the manufacturer's warranty.

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 support team or where you purchased your device to find out which system extensions may safely be installed.

REVIEW

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 which do not belong to the RF600 range of products, the validity of all type tests as well as all certificates relevant to the RF600 are canceled: CE, FCC, UL, CSA.

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.

REVIEW

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	$1.375 \times f^{1/2}$	$0.0037 \times f^{1/2}$
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

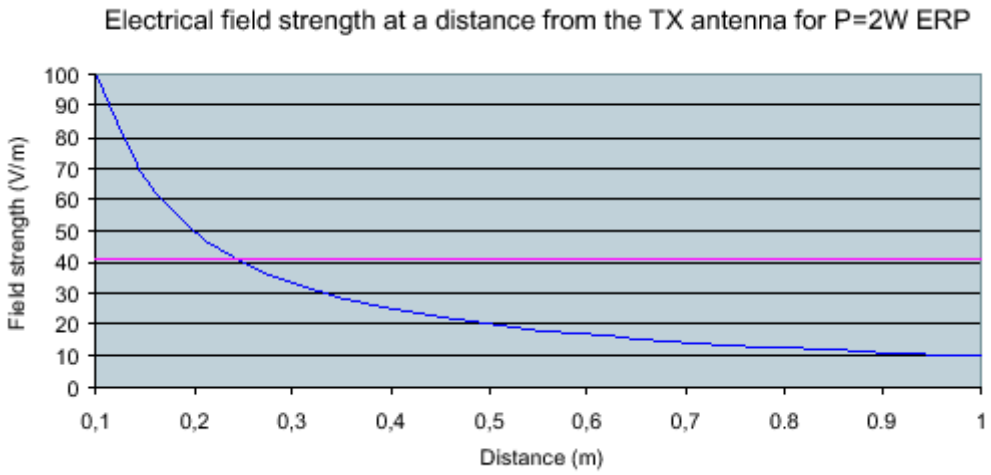
Magnetic field strength: H = 0.111 A/m

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

2.3.2 Minimum distance to antenna in accordance with ETSI

Minimum distance to antenna in accordance with ETSI (EU, EFTA, Turkey)

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 41.25V/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.

REVIEW

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

RF620R/RF630R-specific notes

Note

Reduced maximum radiated power with RF620R/RF630R readers

The SIMATIC RF620R (ETSI) reader has a maximum radiated power of 0.5 W ERP. The safety distance is therefore at least 0.12 m.

The SIMATIC RF630R (ETSI) reader has a maximum transmit power of 0.5 W. The radiated power therefore depends on the antenna cable and the type of antenna used, but cannot exceed the 2 W ERP.

RF650R/RF680R/RF685R-specific notes

Note

Reduced maximum radiated power with RF650R/RF680R/RF685R readers

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

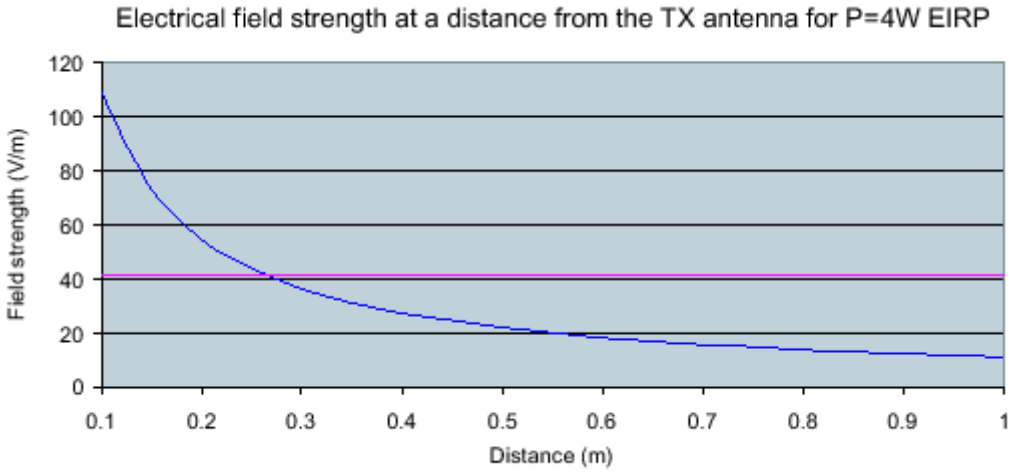
The SIMATIC RF680R (ETSI) reader has a maximum transmit power of 2 W. The radiated power therefore depends on the antenna cable and the type of antenna used, but cannot exceed the 2 W ERP.

The SIMATIC RF685R (ETSI) reader has a maximum radiated power of 2 W ERP. The safety distance is therefore at least 0.12 m.

2.3.3 Minimum distance to antenna in accordance with FCC (USA)

Minimum distance to antenna in accordance with FCC (USA)

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.

REVIEW

RF620R/RF630R-specific notes

Note

Reduced maximum radiated power with RF620R/RF630R readers

The SIMATIC RF620R (FCC) reader has a maximum transmit power of 0.5 W. This means that the radiated power of 4 W EIRP cannot be exceeded with the internal antenna.

The SIMATIC RF630R (FCC) reader has a maximum transmit power of 0.5 W. The radiated power therefore depends on the antenna cable and the type of antenna used, but cannot exceed the 4 W EIRP.

RF650R/RF680R/RF685R-specific notes

Note

Reduced maximum radiated power with RF650R/RF680R/RF685R readers

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

System overview of SIMATIC RF600

3

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

The SIMATIC RF650R or RF680R readers (write/read devices), fitted for example on the gates of a warehouse, automatically record every movement of goods, and signal these to the higher-level systems. The data is filtered and compressed there by data management software at the control level for example to generate the incoming goods transaction for the ERP (Enterprise Resource Planning) system at the business administration control level. At the same time, the delivery can be automatically checked for correctness and completeness prior to storage by means of the electronic delivery list.

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.

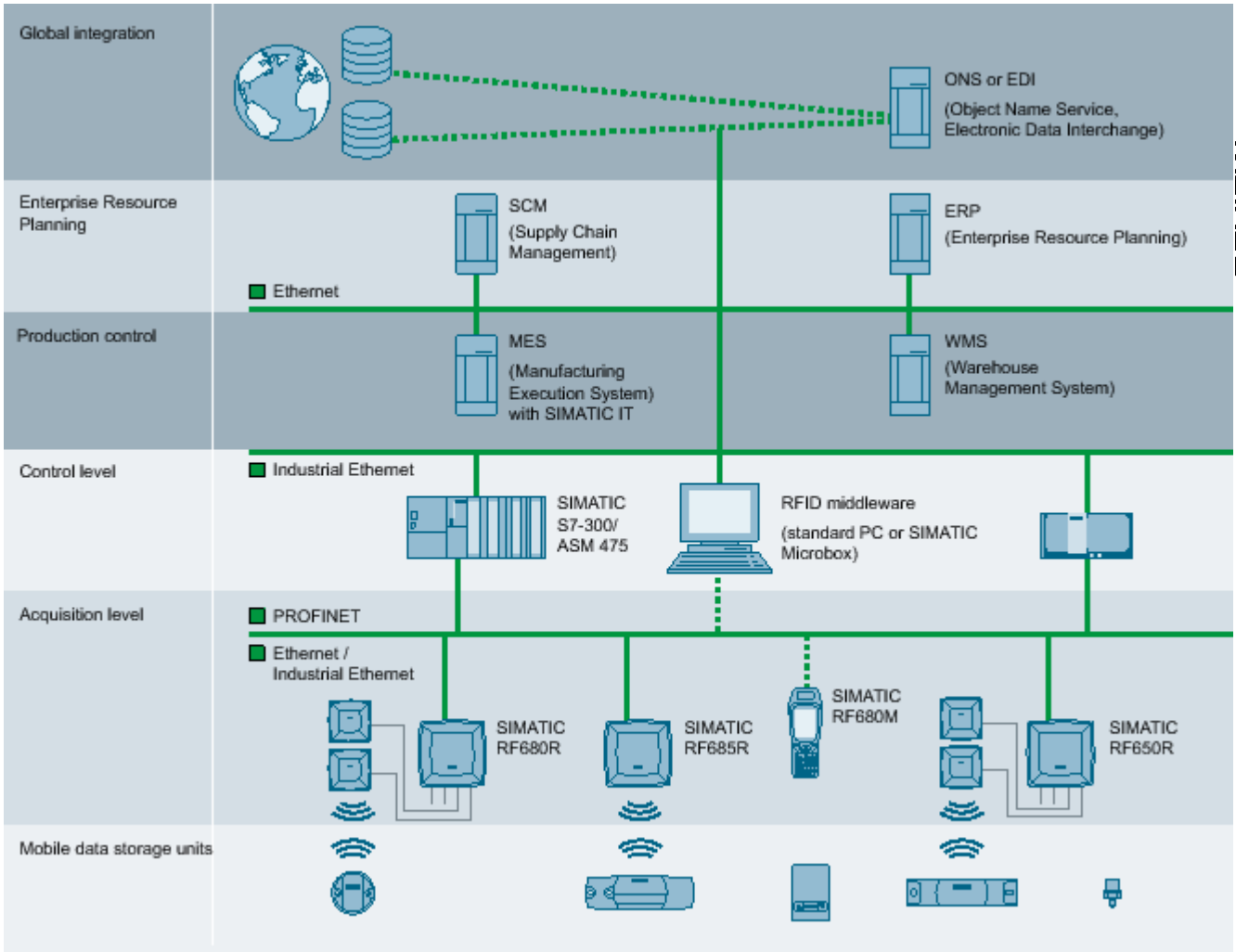


Figure 3-1 System overview SIMATIC RF600 with RF650R, RF680R and RF685R

REVIEW

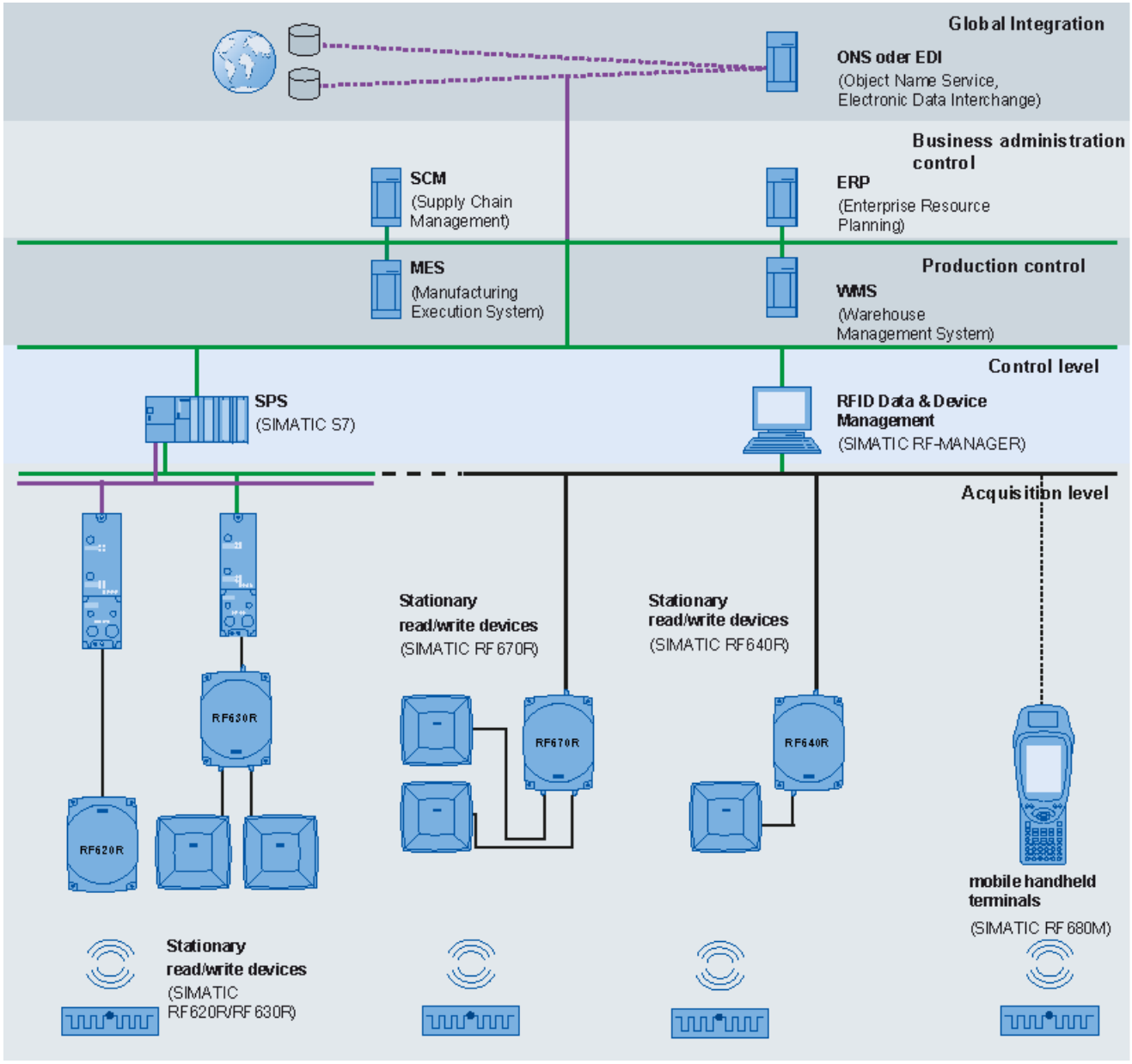


Figure 3-2 System overview SIMATIC RF600 with RF620R, RF630R, RF640R and RF670R

- **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.

REVIEW

- **Production control**

  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.

- **Business administration control**

  This level covers the planning and control of the equipment used. For this purpose, Enterprise Resource Planning (ERP) systems and Supply Chain Management (SCM) systems are used with modules for cost accounting, financial bookkeeping and personnel management.

- **Global integration**

  At this level, product information can be exchanged at an inter-company level. This can be performed over the Internet with the help of special services.

3.1 Application areas of RF600

RFID (radio frequency identification) permits interruption-free tracking and documentation of all delivered, stocked and shipped goods in the incoming goods, warehouse, 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 (hardware/software)

RF600 products	Description
	The RF620R reader creates with its connection to a SIMATIC controller optimum preconditions for production-related application scenarios and/or production-related logistics applications by RFID. It has an integrated circular polarized antenna.
	The RF630R reader creates with its connection to a SIMATIC controller optimum preconditions for production-related application scenarios and/or production-related logistics applications by RFID. It has 2 connections for external antennas.
	Due to its compact format and high degree of protection, the RF640R reader is ideally suited to applications in production logistics and distribution. The integrated data processing makes it easier to use in complex scenarios and reduces the IT integration costs. Integration is achieved using an XML protocol, TCP/IP and Ethernet. It has an integrated circular polarized antenna.

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RF600 products	Description
	Due to its compact format and high degree of protection, the RF670R reader is ideally suited to applications in production logistics and distribution. The integrated data processing makes it easier to use in complex scenarios and reduces the IT integration costs. Integration is achieved using an XML protocol, TCP/IP and Ethernet.
	Due to its compact design the RF650R reader is suitable for applications in production logistics. Integration is achieved using an XML protocol, TCP/IP and Ethernet. It has 4 connectors for external antennas.
	Due to its compact design and high degree of protection, the RF680R reader is ideally suited to applications in production logistics and distribution. Integration is achieved using an XML protocol, TCP/IP and Ethernet or PROFINET. It has 4 connectors for external antennas.
	Due to its compact design and high degree of protection, the RF685R reader is ideally suited to applications in production logistics and distribution. Integration is achieved using an XML protocol, TCP/IP and Ethernet or PROFINET. It is equipped with an integrated antenna with switchable polarization and has a connector for an external antenna.
	SIMATIC RF680M expands the RF600 RF identification system with a powerful mobile reader for applications in the areas of logistics, production and service. In addition, it is an indispensable aid for startup and testing.

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RF600 products	Description
	SIMATIC RF660A is a circular antenna of medium size for production and logistics applications. Up to 4 antennas can be connected to the RF670R reader depending on the application and up to two can be connected to the RF630R reader. One antenna can be connected to the RF640R or RF620R readers as an alternative to the internal antenna.
	The SIMATIC RF640A is a circular antenna of medium size for universal applications, for example material flow and logistics systems. Depending on the application, up to 4 antennas can be connected to the RF670R reader and up to two antennas can be connected to the RF630R reader. One antenna can be connected to the RF640R or RF620R reader as an alternative to the internal antenna.
	SIMATIC RF642A is a linear antenna of medium size for environments where a lot of metal occurs. Depending on the application, up to 4 antennas can be connected to the RF670R reader and up to two antennas can be connected to the RF630R reader. One antenna can be connected to the RF640R or RF620R reader as an alternative to the internal antenna.

REVIEW

RF600 products	Description
	The SIMATIC RF620A is a linear antenna with a compact design suitable for industry. It is suitable for UHF transponders with normal (far field) antenna characteristics. Depending on the application, up to 4 antennas can be connected to the RF670R reader and up to two antennas can be connected to the RF630R reader. One antenna can be connected to the RF640R or RF620R reader as an alternative to the internal antenna.
	The RF600 transponder family provides the right solution for every location: The tool tag RF640T for industrial requirements is highly resistant to oils and can be mounted directly on metal. The container tag RF620T for industrial applications is rugged and highly resistant to cleaning agents. The RF630L SmartLabels made of plastic or paper can be used in a wide variety of applications: The application areas range from simple identification such as electronic barcode replacement/supplementation, through warehouse and distribution logistics, right up to product identification

REVIEW

3.3 Features

The RF600 identification system has the following performance features:

Table 3- 1 Features of the RF600 RFID system

Type	Contactless RFID (Radio Frequency IDentification) system in the UHF band
Transmission frequency	865-868 MHz (ETSI: EU, EFTA, Turkey) 902-928 MHz (FCC: USA) 920.125 - 924.875 MHz (CMIIT: CHINA)
Standards	EPCglobal Class 1, Gen 2

Table 3- 2 Features of the RF600 readers

Reader	Antennas	Write/read distance	Interface
RF620R	1 x internal antenna 1 x antenna connector for external antennas	Internal antenna: < 2 m External antenna: < 2.5 m	PROFIBUS, PROFINET
RF630R	2 x antenna connectors for external antennas	0.1 - 2 m	PROFIBUS, PROFINET
RF640R	1 x internal antenna 1 x antenna connector for external antennas	Internal antenna: < 3.5 m External antenna: < 4 m	Ethernet, PROFINET
RF670R	4 x antenna connectors for external antennas	< 4 m	Ethernet, PROFINET
RF650R	4 x antenna connectors for external antennas	< 4 m	Ethernet
RF680R	4 x antenna connectors for external antennas	< 4 m	Ethernet, PROFINET
RF685R	1 x internal antenna 1 x antenna connector for external antennas	Internal antenna: < 3.5 m External antenna: < 4 m	Ethernet, PROFINET

Table 3- 3 RF680M mobile handheld terminal

Transmission frequency	865-868 MHz (EU, EFTA, Turkey) 902-928 MHz (USA)
Write/read distance	Europe < 2 m USA < 1 m
Standards	EPCglobal Class 1, Gen 2

Table 3- 4 Transponder

Version	Tags / SmartLabels	Designation	Standards supported
	SmartLabels SmartLabel	RF630L RF680L	EPCglobal Class 1, Gen 2
	ISO card Container tag Disc tag Powertrain tag Tool tag Heat-resistant tag	RF610T RF620T RF625T RF630T RF640T (Gen 2) RF680T	EPCglobal Class 1, Gen 2

Table 3- 5 Software

RF-MANAGER Basic V2	PC software for assigning parameters to the RF670R and RF640R readers System requirements: Windows XP SP2 and higher

REVIEW

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 interface overhead. 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.

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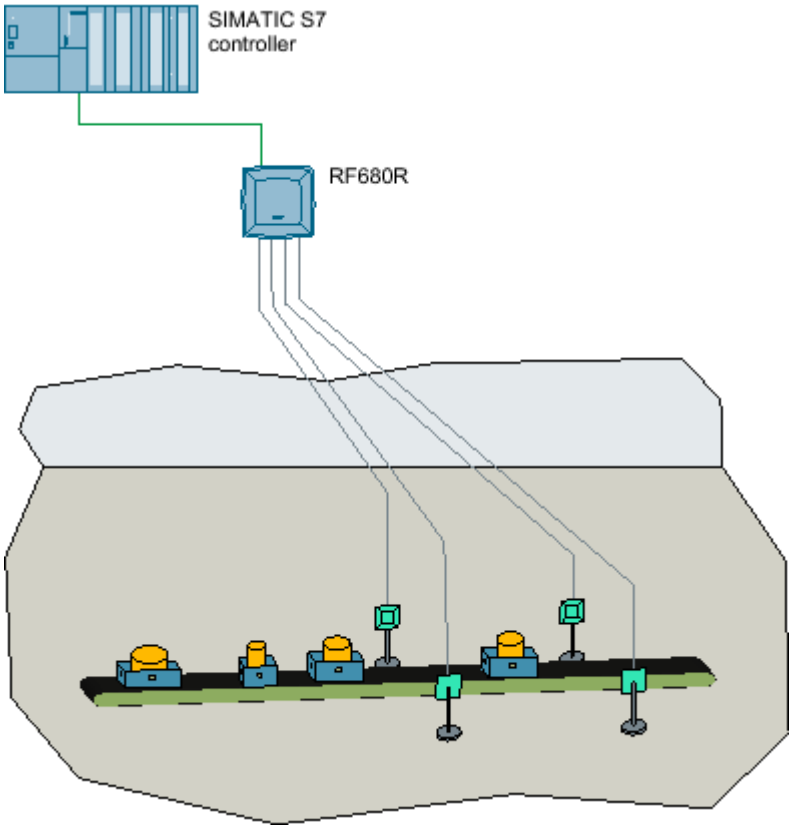
Note

Readers used in the following scenarios

The scenarios shown in the following sections are based on the RF650R, RF680R and RF685R readers. Remember that the individual scenarios can also be implemented with the RF620R, RF630R, RF640R or RF670R readers.

4.2.1 Scenario for material handling control

This scenario shows a possible solution for monitoring and controlling the infeed of material to a production line. The objective is to provide the right material at the right time. This can be particularly useful in plants with frequently changing manufacturing scenarios for ensuring that incorrect infeed and downtimes are minimized.



Features of the scenario

The conveyor moves different transport containers past the readers in an arbitrary alignment. The RFID transponder is, however, always applied to the transport containers with the same alignment. The transponders in this scenario are transponders of the type SIMATIC RF680T.

The conveyor belt has a maximum width of approximately 80 cm in this example. The transport speed is up to 2 m/s. With this arrangement only a single RFID transponder needs to be detected each time (single-tag).

In this scenario a SIMATIC RF680R is used as the reader. Optimum reading reliability is ensured by four external SIMATIC RF660A antennas in a portal arrangement. When the distances to or between metal containers are very limited, the SIMATIC RF620A antenna is a good alternative. The SIMATIC RF680R reader reads the information of the transponder on the transport containers and forwards it to the SIMATIC S7 controller that controls the next actions depending on the transponder information.

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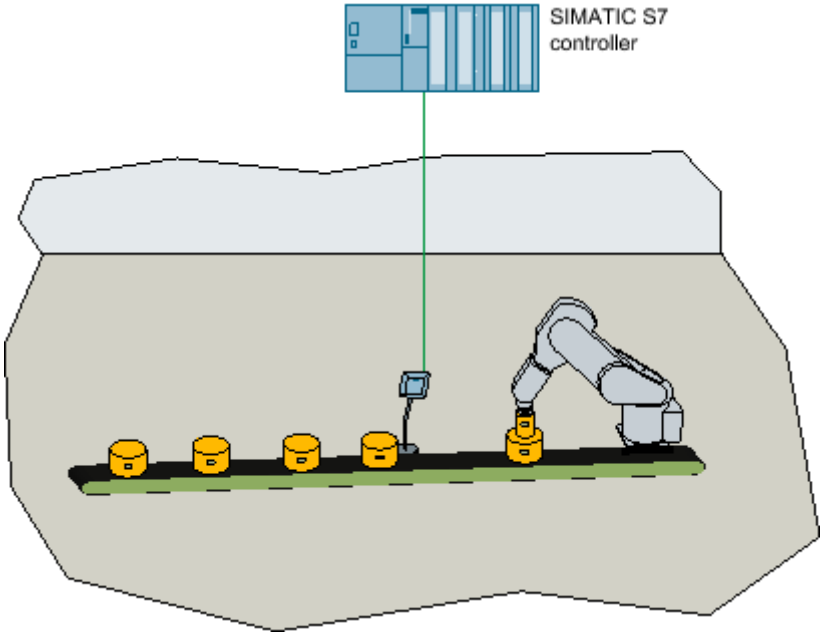
4.2.2 Scenario for workpiece identification

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.



Features of the scenario

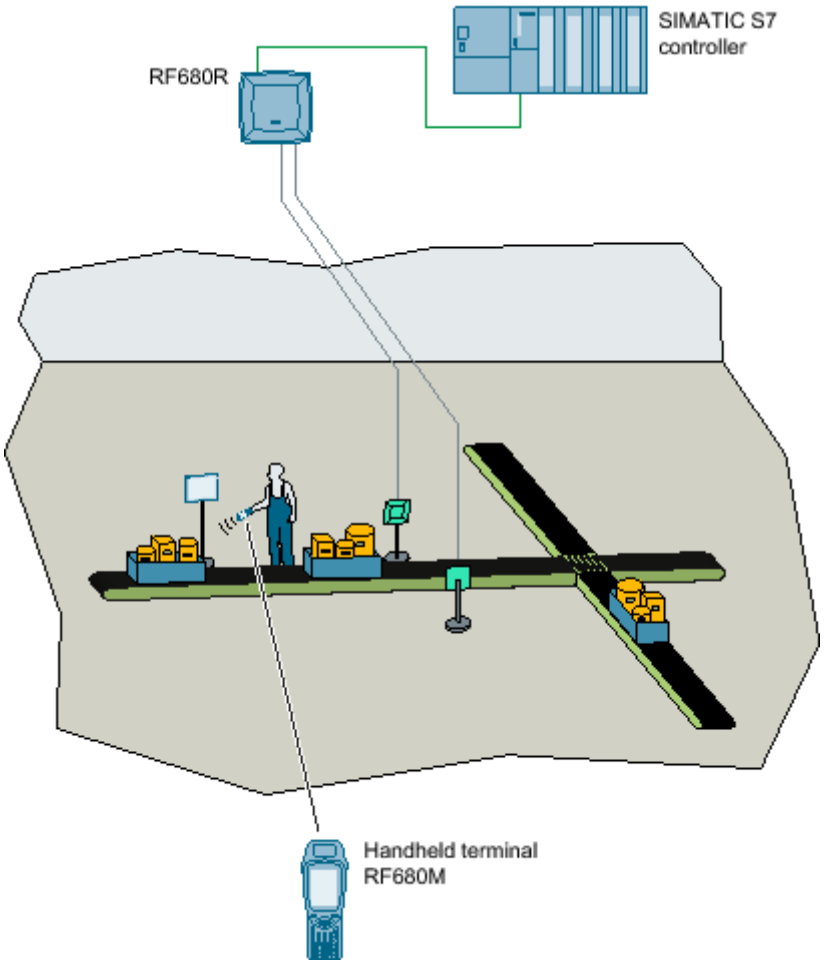
RFID tags are attached to workpiece holders. Their spatial orientation is always identical. With this arrangement, only a single transponder needs to be detected each time (single-tag). The transponders in this scenario are transponders of the type SIMATIC RF640T.

The SIMATIC RF685R reader reads the information from the transponders with its integrated antenna 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.

4.2.3 Scenario for Intra logistics

Intra logistics comprises all logistical procedures that are required on a production site as well as within the overall company. The main task of Intra logistics is to control the subsequent processes:

- Transporting goods from the incoming goods bay into the warehouse
- Management of stock
- Conveyance of goods from the warehouse for production
- Order picking
- Packing



REVIEW

Features of the scenario

In this example scenario. items must be distributed to the correct storage location in a transport container via a separating filter. The RFID transponders of the type SIMATIC RF630L are directly attached to the item. The maximum transport speed of the conveyor belt is 2 m/s.

In this scenario, bulk acquisition is necessary because several objects must be detected at the same time.

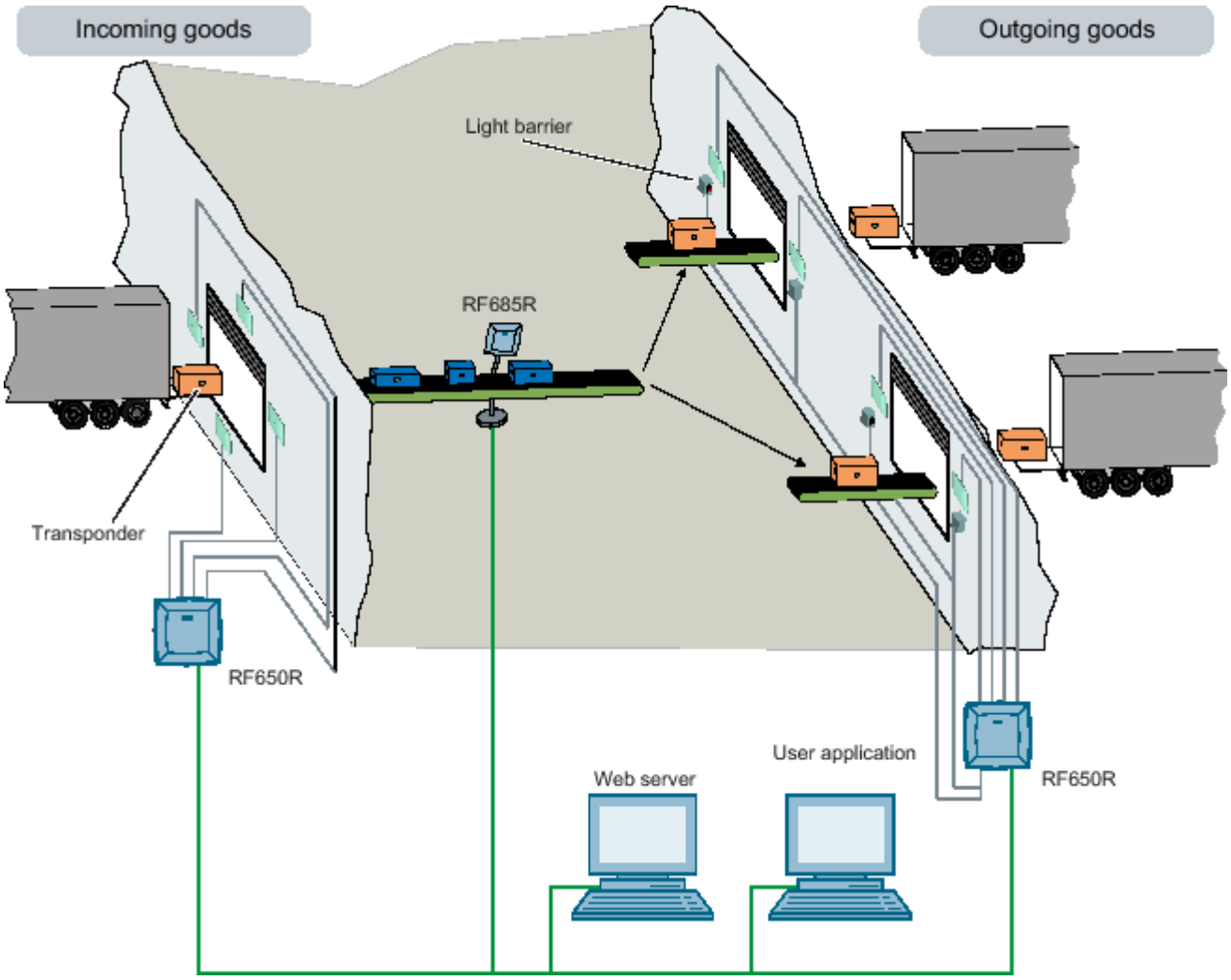
The SIMATIC RF680R reader uses two external antennas in a portal arrangement to read the information from the transponders on the passing items and transfers it to the SIMATIC S7 controller via a communications module. The SIMATIC S7 controls the sorter of the conveyor system depending on the transponder information.

If only one simple evaluation of the transponder ID is required, and the data will not be processed any further, the SIMATIC RF680R provides this function without being connected to the controller.

The SIMATIC RF680M mobile handheld terminal is used in this example for additional evaluation and visualization of the item data directly on site.

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 monitors the incoming goods gate 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.



REVIEW

Features of the scenario

in this example, 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, the pallets at the outgoing goods gate are checked to make sure that they are intended for the receiver to which the gate is assigned. 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 55) for information on the configuration of third-party antennas.

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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.

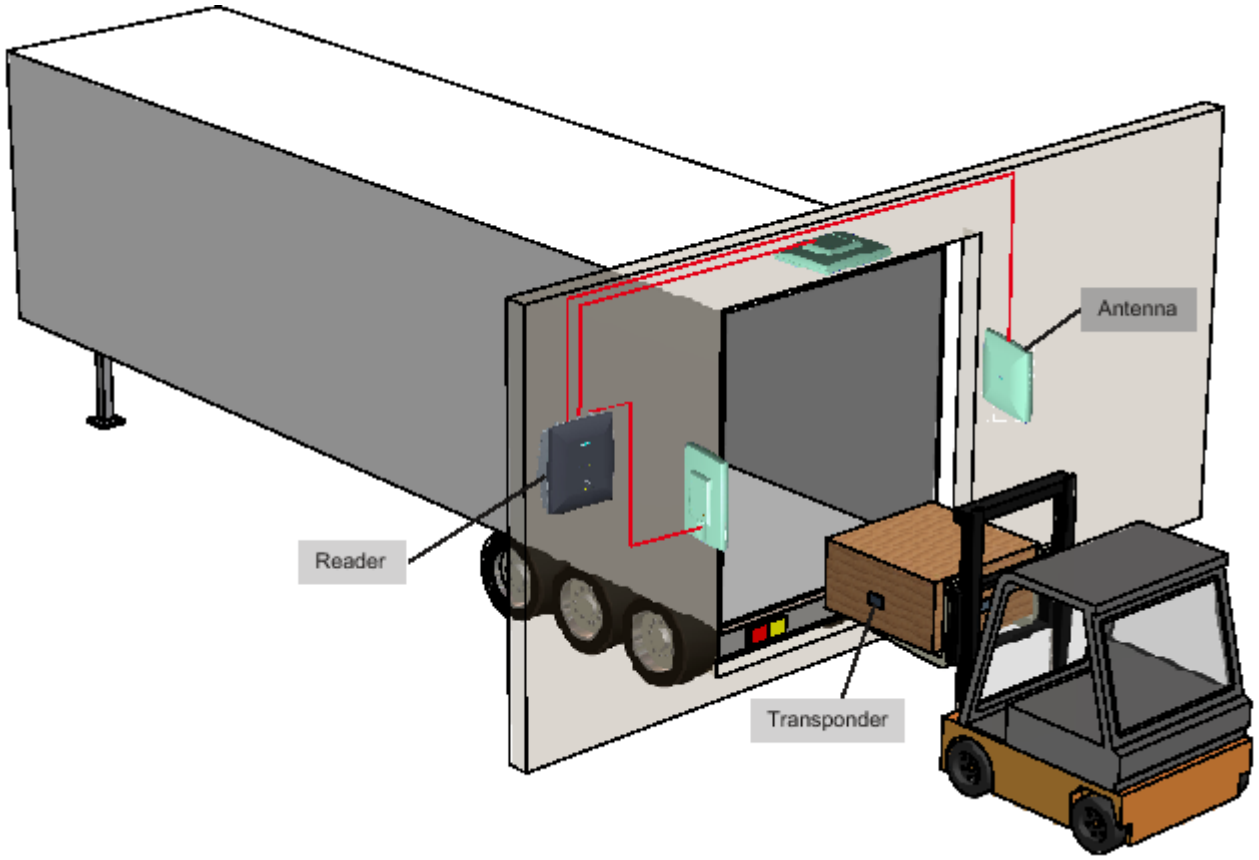

Figure 4-1 Example of an antenna configuration with three antennas

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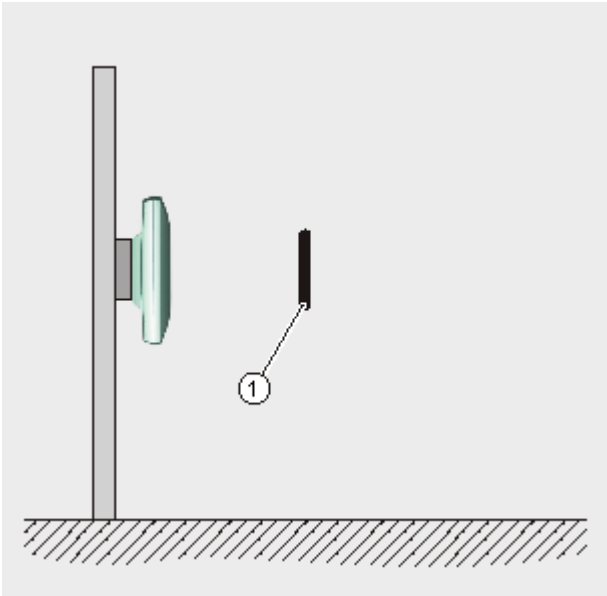
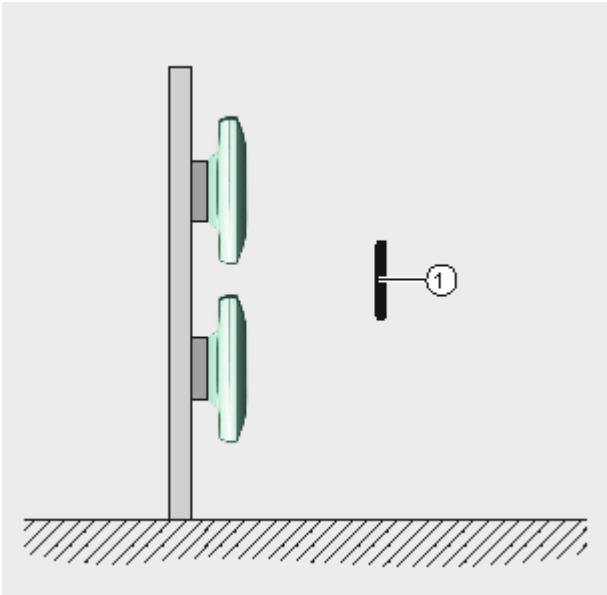
4.3.2 Possibilities and application areas for antenna configurations

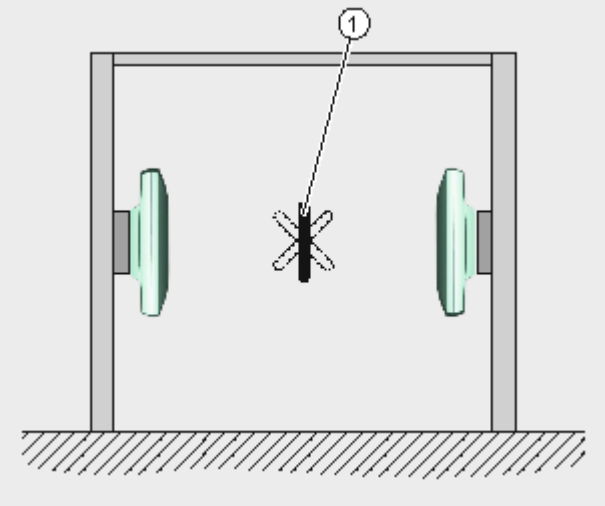
Some basic antenna configurations and possible fields of application are shown below.

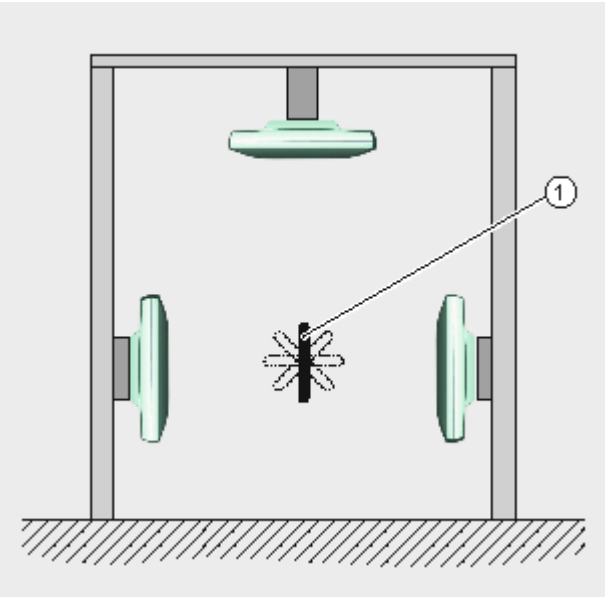
With the various configurations, please note that up to four external antennas can be connected to the RF650R, RF680R and RF670R readers, up to two can be connected to the RF630R reader and one external antenna can be connected to the RF620R, RF640R and RF685R readers. The RF620R, RF640R and RF685R readers also have 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

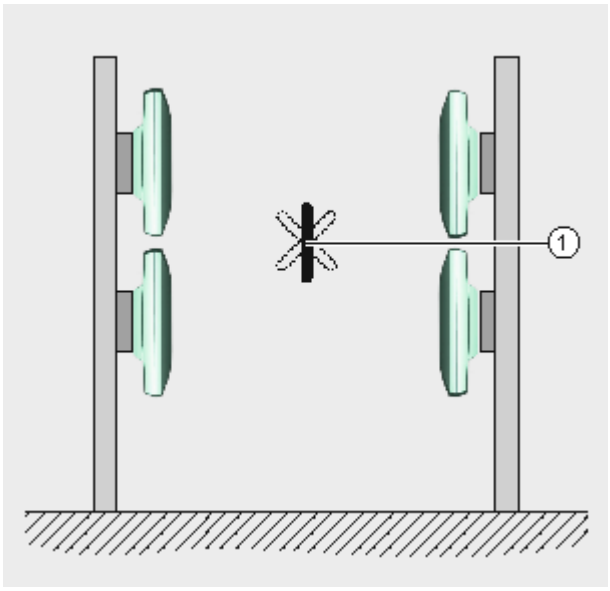
REVIEW

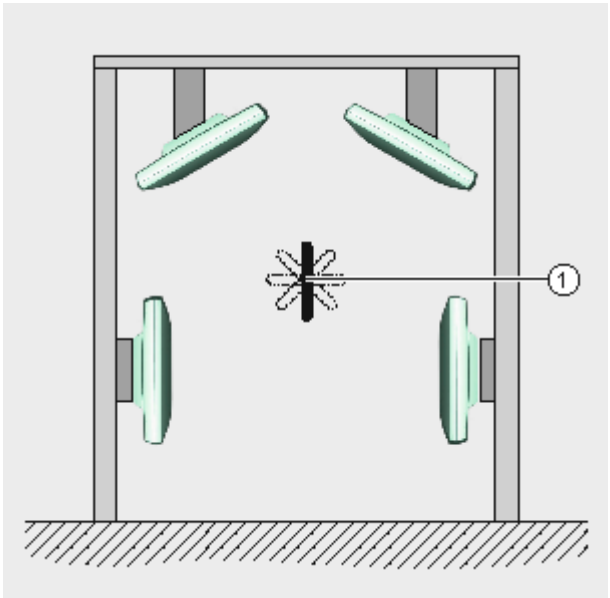
Antenna configuration 2	Description/ application areas
	This arrangement of antennas is appropriate when the transponders to be read are only located on one side of the items to be identified, e.g. when pallets are to be identified and it is known on which side the transponders to be read are located.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

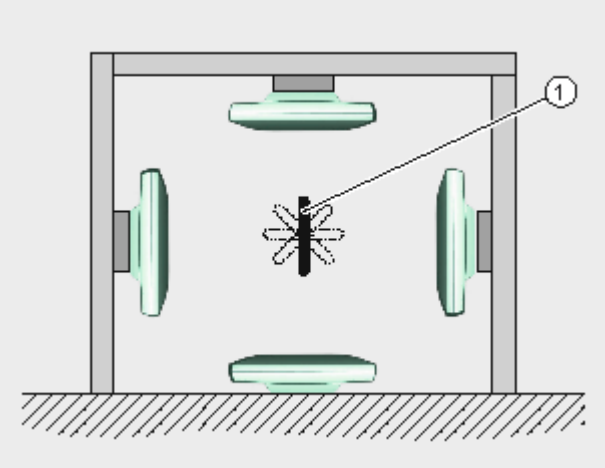
Antenna configuration 4	Description/ application areas
	Preferred for the identification of goods at loading gates: Similar to configuration 2, but with additional reading reliability when the transponder is at an angle to the vertical. ① Transponder

REVIEW

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

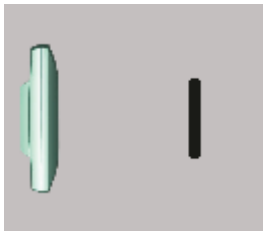
Antenna configuration 6	Description/ application areas
	Preferred for the identification of goods at loading gates: Similar to configuration 4, but the reliability of transponder identification is improved as a result of the four antennas at separate locations, so the transponder position is not critical.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

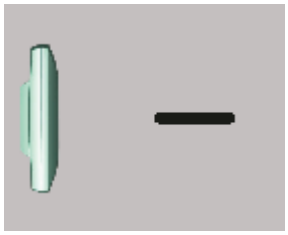
REVIEW

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.

REVIEW

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.

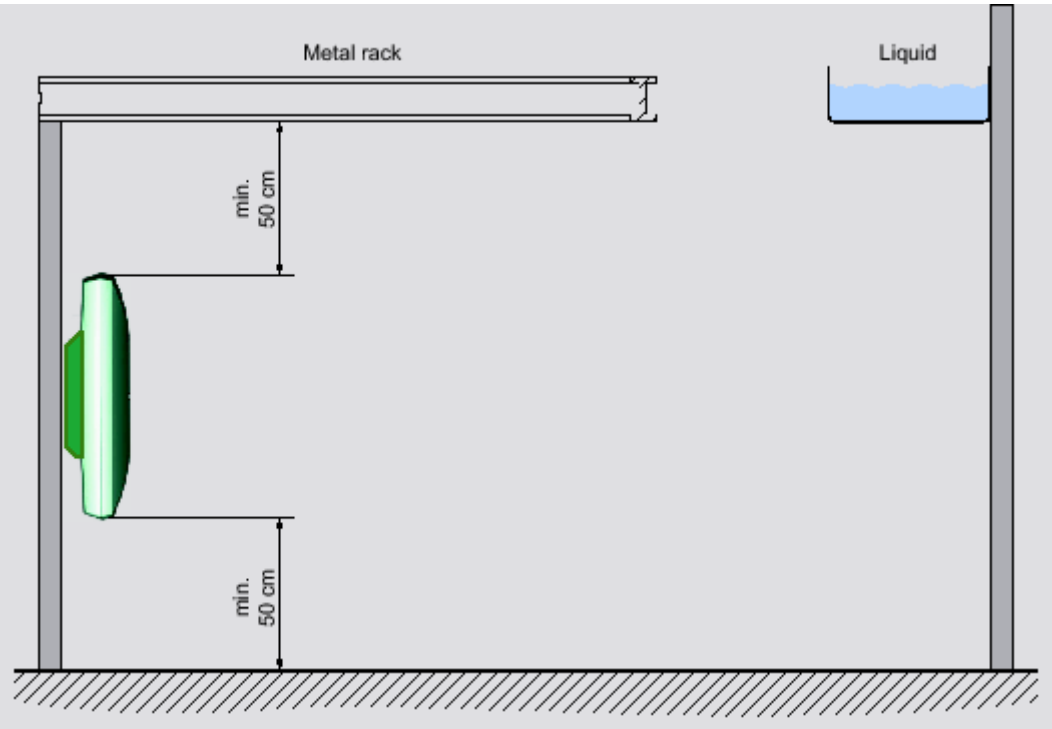


Figure 4-2 Minimum distance to the environment

REVIEW

4.3.5 Mutual interference of readers (antennas)

Using more than one reader

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 73)".

To prevent this, readers used in Europe and China must operate on different channels with "frequency hopping" activated. "Frequency hopping" is permanently set in the USA.

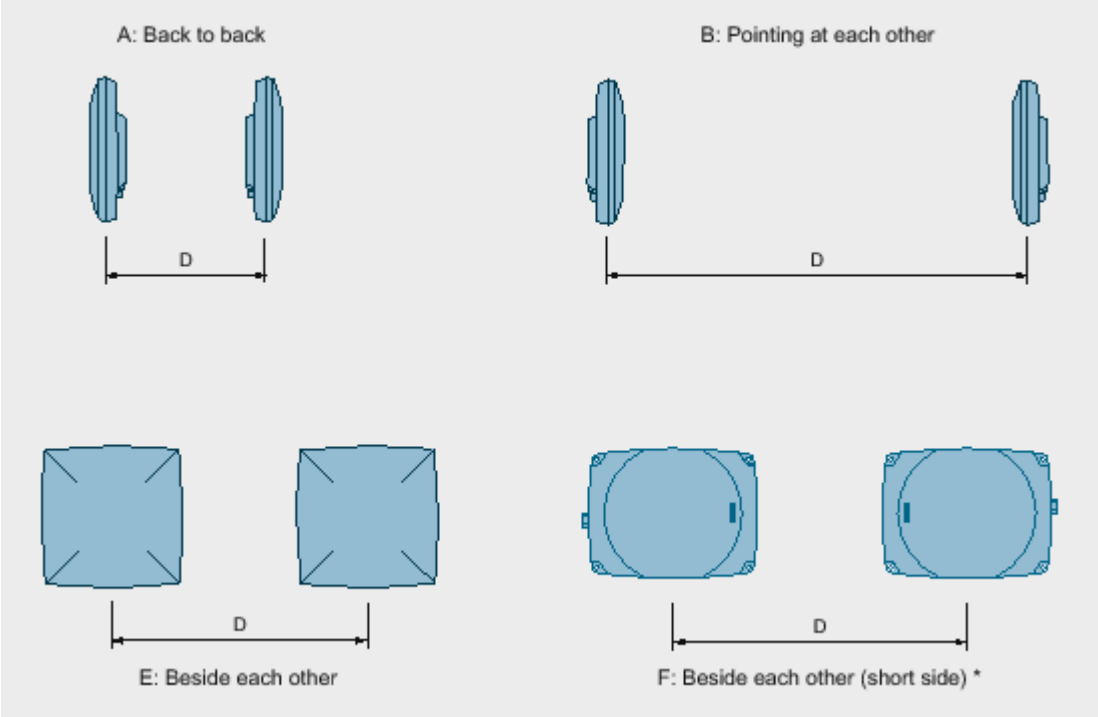
REVIEW

Antenna alignment and antenna spacing with an external antenna

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

Maximum radiated power of the antennas:

- RF620R/RF630R = 500 mW ERP
- RF620R/RF630R with RF660A = 2000 mW ERP
- RF640R/RF670R with RF660A = 2000 mW ERP
- RF650R with RF660A = 1000 mW ERP
- RF680R with RF660A = 2000 mW ERP
- RF685R = 2000 mW ERP
- RF685R with RF660A = 2000 mW ERP



* relevant when operating the RF620R and RF640R readers with the internal antenna

Figure 4-3 Antenna spacing for different readers/antennas and identical frequencies

Table 4- 1 Antenna alignment and minimum antenna spacing with external antennas

Antenna configuration	Antenna alignment	Minimum distance required = D		
		RF640R/RF670R with RF660A	RF620R/RF630R with RF660A	RF650R/RF680R/RF685R with RF660A
A	Back to back	0.5 m	0.3 m	
B	Pointing at each other	6 m	6 m	
E	Next to each other	1 m	0.8 m	

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

Antenna configuration	Antenna alignment	Maximum distance = D		
		RF670R with RF660A	RF630R with RF660A	RF650R/RF680R/RF685R with RF660A
B	Pointing at each other	8 m [1)]	4 m	

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

Antenna alignment and antenna spacing with the internal antenna (RF620R/RF640R/RF685R)

Table 4- 3 Antenna alignment and minimum antenna spacing with internal antennas

Antenna configuration	Antenna alignment	Minimum distance required = D		
		RF620R	RF640R	RF685R
A	Back to back	0.4 m	0.4 m	
B	Pointing at each other	5.8 m	4.0 m	
E	Side by side (long side)	1.4 m	1.4 m	
F	Side by side (short side)	1.8 m	2 m	

REVIEW

Optimization of the antenna arrangement

With the RF620R, RF640R, RF685R readers (with the internal antenna)

The RF620R and RF640R readers have an integrated, circular polarized antenna. This means that the type of antenna cannot be freely selected. This means that the interference spacing in arrangement E is greater than in arrangement F. The RF685R reader has an integrated, switchable antenna (linear or circular).

Note

Rotation of the reader through 90° around the z axis

Since the horizontal electrical aperture angle of the RF620R antenna is greater than the vertical aperture angle, the effects on adjacent readers can be reduced by using the reader as shown in arrangement F (see arrangements E and F).

With the RF640A/RF642A/RF660A antenna

The electrical aperture angles (vertical and horizontal) of the RF660A antenna are identical, with the RF640A/RF642A antennas they are similar. Therefore, the robustness of the readers' access to transponder data cannot be optimized for the RF660A and with the RF640A/RF642A it can be optimized only to a limited extent by rotating around the antenna axis.

4.3.6 Read and write range

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

The reading range depends on	Description
Transmit power of the reader	The higher the transmit power of the reader, the larger the reading range.
Tag size and type	The larger the tag 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.
Production quality of the tag	The better the tag has been matched to the operating frequencies during manufacturing, the greater the reading range.
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 is more than one transponder in the antenna field, the distance to all other transponders must be less to allow them to be acquired in 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 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.

REVIEW

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 Dense Reader Mode

A special operating mode according to the standard EPC Global Class 1, Gen 2 in Dense Reader Mode allows several RF600 readers to be operated without interference in close proximity to each other. All RF600 readers operate in Dense Reader Mode according the standard EPC Global Class 1, Gen 2.

Dense Reader Mode allows physically adjacent readers to use the same frequency when Gen 2 transponders are being used.

REVIEW

Special features for ETSI

In accordance with EPC Global as well as ETSI EN 302 208 V1.4.1, the four transmit channels are used for transmission with the RF670R, with the RF640R as of firmware version V1.3, and with the RF620R/RF630R and with the RF650R/RF680R/RF685R (see section Regulations applicable to frequency bands (Page 75)) and the transponder response appears on the associated neighboring channels. As a result of the large difference in level between the transmitter channels and the transponder response channels, this technology provides great advantages for frequency reuse. However, a prerequisite is that a certain minimum distance, and thus minimum decoupling, is observed between the antennas of adjacent readers.

4.3.8.2 Optimizing tag reading accuracy

An improvement in the tag reading accuracy in an environment with a high density of readers can be achieved by aligning the antennas toward the relevant tag field, in other words by rotating them horizontally and vertically.

In addition, the transmitter power of the readers can be reduced down to the minimum at which the tags are still just detected accurately.

This greatly reduces the probability of interference.

4.3.8.3 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 73))
- Type of transponder (see section Transponder/tags (Page 333))
- Number of transponders to be detected by an antenna at a time
- Type of antenna (see section Antennas (Page 245), section Guidelines for selecting RFID UHF antennas (Page 55), and section Planning application (Page 94))
- Transponders' distance from and orientation toward antennas (see section Transponder/tags (Page 333))
- Distances and orientation of antennas of different readers to each other
- Radiated power of antennas

The robustness of tag data accesses 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 such that they cannot use the same channels.

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

4.3.8.4 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 with FCC. The 50 available channels mean that the probability is low that two readers will be operating on the same frequency (refer to the section Regulations for UHF frequency bands in the USA (Page 78)). In China, one reader operates on at least 2 channels, e.g. 16 channels of 2 W (refer to the section Regulations for UHF frequency bands in China (Page 76)).

Procedure for ETSI

Frequency hopping is optional with ETSI. According to ETSI EN 203 208 V1.2.1, frequency hopping is used in multi-channel operation. Without frequency hopping, only single channel operation is possible for which the standard specifies a pause of 100 ms after each 4 s of sending.

4.3.9 Guidelines for selecting RFID UHF antennas

REVIEW

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 23).

4.3.9.2 Preconditions for selecting RFID UHF antennas

Target group

This chapter has been prepared for configuration engineers who thoroughly understand and wish to carry out the selection and installation of an external antenna or an external 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.

REVIEW

Purpose of this chapter

This chapter enables you to select the appropriate external antenna or cable with consideration of all important criteria and to carry out the corresponding settings in the configuration software 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

The following graphic shows the design of the total SIMATIC RF600 system and the factors which have an influence on the total system.

You must be aware of these influencing factors and also consider them if you wish to integrate third-party components such as antennas or cables into the system. These influencing factors are described in more detail in Sections Antennas (Page 58) and Antenna cables (Page 69).

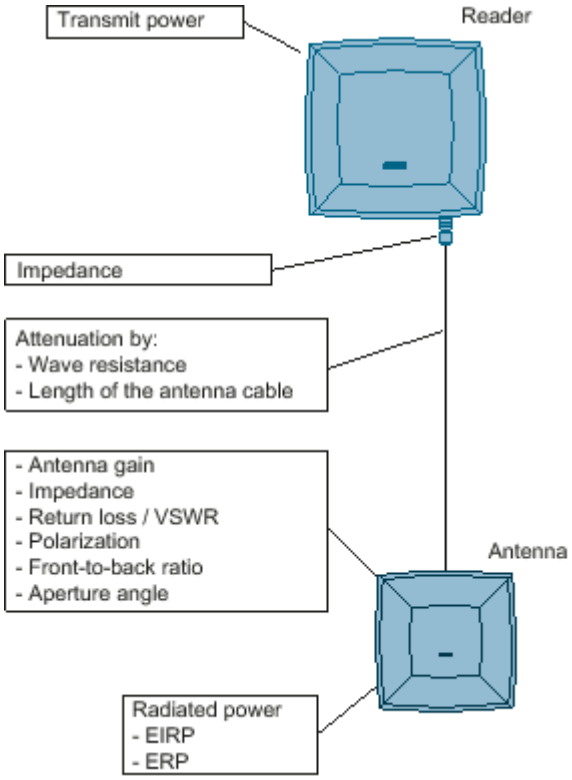


Figure 4-4 Overview of total system and influencing factors

When operating the RF600 system, additional influencing factors must also be observed 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.

General procedure

Depending on whether you want to use a third-party antenna and/or a third-party antenna cable with an RF620R, RF630R, RF640R or RF670R reader, you need to select the suitable components. These instructions will help you to select the components and the settings of the important parameters in the RF-MANAGER Basic.

There are two different application cases:

- Selection of third-party components:
  You want to select suitable third-party components for the SIMATIC RF600 system and then configure the reader for these components.
- Configuration of existing third-party components:
  You already have third-party components (antennas, antenna cables or both) and want to configure the reader for these components.

REVIEW

Procedure for selecting third-party components

Always proceed in the following order during your considerations and the practical implementation:

1. Consider which third-party components you wish to use in the SIMATIC RF600 system.
2. Depending on the third-party component required, refer either to section Antennas (Page 58) or section Antenna cables (Page 69) for the important criteria for selection of your components. The selection criteria/parameters are sorted in descending relevance.
3. Use the specified equations to calculate your missing parameters, and check whether the required values are reached (e.g. antenna gain) and that important secondary values (e.g. cable loss) are not exceeded or undershot.
4. Configure the reader with the parameters of your third-party components. Normally, you can do this with the RF MANAGER Basic. Depending on the reader, the values can alternatively also be set via XML protocol or SIMATIC protocol. You will find an overview of the information for the parameter assignment of all RF600 system readers in the section Overview of parameterization of RF600 reader (Page 461).

Procedure for configuration of existing third-party components

If you already have third-party components which you wish to integrate into the SIMATIC RF600 system, proceed as follows:

1. Depending on the third-party component, refer either to Section "Antennas" or Section "Antenna cables" for the important criteria of your components. The parameters are sorted in descending relevance.
2. Compare the limits with the data of your antenna or cable vendor.
3. Subsequently proceed exactly as described above in "Procedure for selecting third-party components" from Paragraph 3. onwards.

4.3.9.4 Antennas

Types of antenna and properties

Basically all types of directional antennas can be considered as third-party 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.

REVIEW

Antenna parameters

Overview

The properties of an antenna are determined by a large number of parameters. You must be aware of these properties in order to make the correct selection for your appropriate UHF antenna. The most important parameters are described below. These important parameters are described in detail in the following sections. The following parameters describe both the send and receive functions of the antenna (reciprocity). The antenna is a passive antenna. A two-way relationship exists.

- Radiated power
- Antenna gain
- Impedance
- Return loss / VSWR
- Power rating
- Polarization
- Front-to-back ratio
- Beam width

Radiated power

In order to comply with national directives with regard to the radiated power (which differ depending on the location or country of use), the RF600 readers together with the antenna cable(s) and antenna(s) must be exactly parameterized or configured.

This means that the product of the transmitted power P_0 of the reader and the antenna gain G_i must always have the correct ratio with regard to the radiated power "EIRP" depending on the location of use or the permissible frequency band.

Calculation of the radiated power is briefly described below.

Calculation of the radiated power

The radiated power is the total power radiated by the antenna in the room. The isotropic radiator serves as the physical computing model which uniformly radiates the power into the room (spherically, i.e. isotropic).

EIRP

Directional antennas combine the radiation, and therefore have a higher power density in the main beam direction compared to an isotropic radiator. To enable antennas of different design or Directional characteristic to be compared with one another, the equivalent isotropic radiated power (EIRP) has been introduced which represents the effective power which must be applied to an isotropic radiator in order to deliver the same power density in the main beam direction of the antenna.

"EIRP" is the product of the transmitted power P_0 and the antenna gain G_i:

$EIRP = P_0 * G_i$

ERP

Also common is specification of the equivalent radiated power referred to the half-wave dipole "ERP" (effective radiated power):

$$ERP = P_0 * G_d = P_0 * \frac{G_i}{1,64}$$

Logarithmic and standardized data

Approximate calculations are easier to carry out as additions than as products, therefore the logarithms are taken for the above equations and the power data standardized to 1 mW and specified in decibels (dBm or dBi).

$$\frac{EIRP}{dBm} = \frac{P_0}{dBm} + \frac{G_i}{dBi}$$

$$= \frac{P_0}{dBm} + \frac{G_d}{dBd} + 2,15 - \frac{a_k}{dB}$$

$$\frac{ERP}{dBm} = \frac{P_0}{dBm} + \frac{G_d}{dBd}$$

$$= \frac{P_0}{dBm} + \frac{G_i}{dBi} - 2,15$$

REVIEW

Calculation of the radiated power with consideration of the cable loss a_k

If the transmitted power is not applied directly but via a cable with loss a_K, this loss should be compensated such that the same radiated power is obtained.

$$\frac{EIRP}{dBm} = \frac{P_0}{dBm} + \frac{G}{dBi} - \frac{a_k}{dB} \text{ if } \quad a_k > 0$$

$$\frac{ERP}{dBm} = \frac{P_0}{dBm} + \frac{G_d}{dBd} - \frac{a_k}{dB}$$

$$= \frac{P_0}{dBm} + \frac{G_i}{dBi} - 2{,}15 - \frac{a_k}{dB} \text{ if } \quad a_k > 0$$

If the loss is not appropriately compensated, the radiated power is too small.

General preliminary information on the unit "dB"

Requirements

This section provides you with information on the unit "decibel". This knowledge is a requirement for optimum understanding of the following section. You can ignore this section if you already have the appropriate knowledge.

REVIEW

Definition

When specifying decibels, the ratios between powers or voltages are not defined directly but as logarithms. The decibel is therefore not a true unit but rather the information that the specified numerical value is the decimal logarithm of a ratio of two power or energy variables P1 and P2 of the same type.

This ratio is defined by the following equation:

$$a = 10 * \log_{10}\left(\frac{P_1}{P_2}\right) dB$$

Example

If P1 = 200 W and P2 = 100 mW, how large is the ratio a in dB?

$$a = 10 * \log_{10}\left(\frac{P_1}{P_2}\right) dB =$$

$$= 10 * \log_{10}(2000)\,dB =$$

$$= 33{,}01 \text{ dB}$$

Use with other units

As with other units, there are also different versions of the unit for decibel depending on the reference variable. With this reference, the logarithmic power ratio becomes an absolute variable. The following table lists the most important combinations in this context with other units:

Versions of decibel	Description
0 dBm	Power level with the reference variable 1 mW.
dBi	Power level with the reference variable on the isotropic spherical radiator (see also Section Antenna gain (Page 61)). The relationship between dBi and dBic is as follows: dBi = dBic - 3
dBd	Power level with the reference variable on the dipole radiator. The relationship between dBd and dBi is as follows: dBd = dBi - 2.15
dBic	Power level with the reference variable on the isotropic radiator for circular antennas. The relationship between dBi and dBic is as follows: dBic = dBi + 3

Antenna gain

REVIEW

Definition

The antenna gain specifies the degree to which the antenna outputs or receives its power in the preferred angle segment.

With this theoretical variable, a comparison is always made with an isotropic spherical radiator, a loss-free antenna which does not exist in reality. It describes how much power has to be added to the isotropic spherical radiator so that it outputs the same radiated power in the preferred direction like the antenna to be considered. The unit for the antenna gain is therefore specified in dBi (dB isotropic).

The antenna gain is defined for the receive case as the ratio between the power received in the main beam direction and the received power of the isotropic spherical radiator.

Specifications

You must know the antenna gain in the corresponding frequency band or range. You can obtain the value of the antenna gain from the technical specifications of your antenna vendor.

- With a cable loss of 4 dB, a gain ≥ 6 dBi(L) is required since otherwise the maximum radiated power will not be achieved.
- In the case of antennas used in the FCC area of approval, a gain of at least 6 dBi(L) is required since otherwise the permissible radiated power of 4 W EIRP will not be reached.
- If the gain is > 6 dBi(L)*, the difference is compensated in accordance with the directives by reducing the transmitted power.

* (L) is the reference to the linear polarization.

Dependencies

- Frequency dependency:
  if a frequency dependency exists in the frequency band used, you must apply the highest value in each case for the antenna gain. With the cable loss, on the other hand, you must select the smallest value in each case it frequency dependency exists.
  This procedure means that the permissible radiated power will not be exceeded in the extreme case.
- Dependency on the plane
  If the data for the antenna gain are different in the horizontal and vertical planes, you must use the higher value in each case.

Impedance

Definition

Impedance is understood as the frequency-dependent resistance. The impedances of the antenna, reader and antenna cables should always be the same. Differences in the impedance result in mismatching which in turn means that part of the applied signal is reflected again and that the antenna is not fed with the optimum power.

REVIEW

Specifications

- Only antennas can be used whose connection has a characteristic impedance of Z = 50 Ohm.
- The mechanical design of the coaxial antenna connection is of secondary importance; N, TNC and SMA plug connectors are usual.

Return loss / VSWR

Definition

Since the impedance at the antenna connection is frequency-dependent, mismatching automatically occurs with broadband use. This mismatching can be reflected by two parameters:

- The voltage standing wave ratio VSWR
- The return loss

Voltage standing wave ratio VSWR

The power sent by the transmitter cannot flow unhindered to the antenna and be radiated as a result of the mismatching described by the VSWR. Part of the power is reflected at the antenna and returns to the transmitter. The powers in the forward and reverse directions produce a standing wave which has a voltage maximum and a voltage minimum. The ratio between these two values is the VSWR (voltage standing wave ratio).

Return loss

The return loss parameter is based on the reflection factor which describes the voltage ratio between the forward and reverse waves.

Specifications

So that the smallest possible transmitted and received powers are reflected by the antenna under ideal conditions, you should observe the following data for the VSWR and the return loss $|S_{11}|$/ dB in the respective frequency band (865-870 MHz or 902-928 MHz):

- VSWR < 1.24:1 or
- $|S_{11}|$/ dB ≥ 20 dB

Power rating

Definition

The power rating is understood as the maximum power defined by the vendor with which the device may be operated.

Specifications

Third-party antennas must be dimensioned for an effective power applied to the antenna connection of at least 4 Watt.

Polarization

Definition

The polarization parameter describes how the electromagnetic wave is radiated by the antenna. A distinction is made between linear and circular polarization. With linear polarization, a further distinction is made between vertical and horizontal polarization.

Specifications

UHF transponders usually have a receive characteristic similar to that of a dipole antenna which is linearly polarized. Horizontal or vertical polarization is then present depending on the transponder mounting.

REVIEW

Selection of circular polarized antenna

If the orientation of the transponder is unknown, or if an alternating orientation can be expected, the transmit and receive antennas must have circular polarization.

When selecting a circular antenna, the polarization purity must be observed in addition to the polarization direction. A differentiation is made between left-hand and right-hand circular polarization (LHCP and RHCP). The two types cannot be combined in the same system. On the other hand, selection of the polarization direction is insignificant if the antenna system of a transponder is linearly polarized. With actual antennas, elliptical polarization is encountered rather than the ideal circular polarization. A measure of this is the ratio between the large and small main axes of the ellipse, the axial ratio (AR), which is frequently specified as a logarithm.

Axial ratio	AR
Ideal	0 dB
Real	2-3 dB

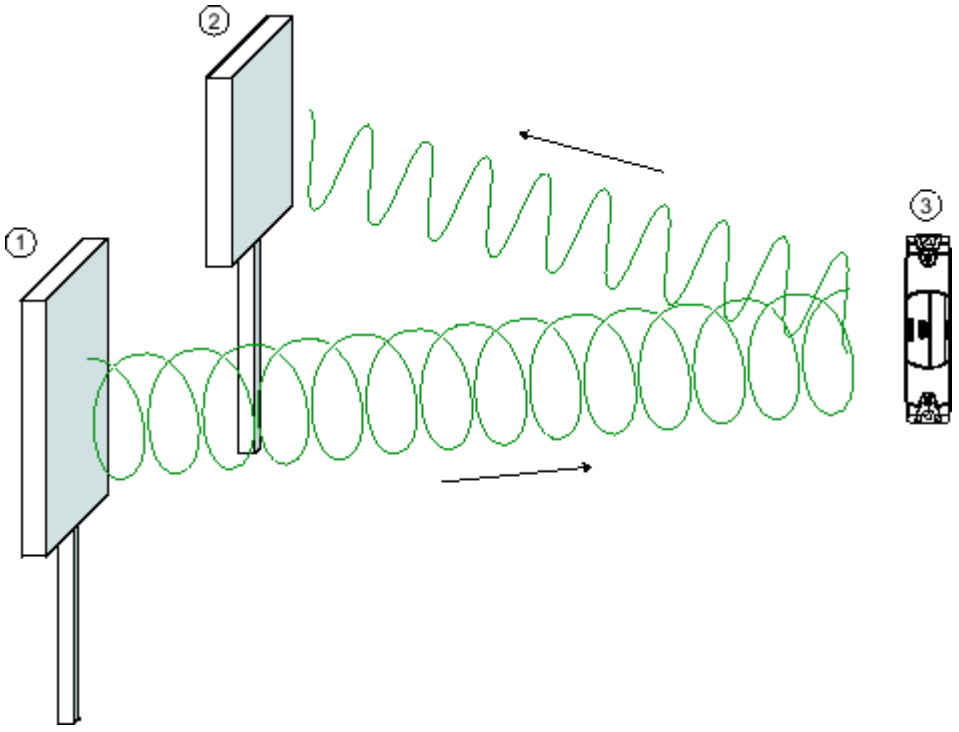
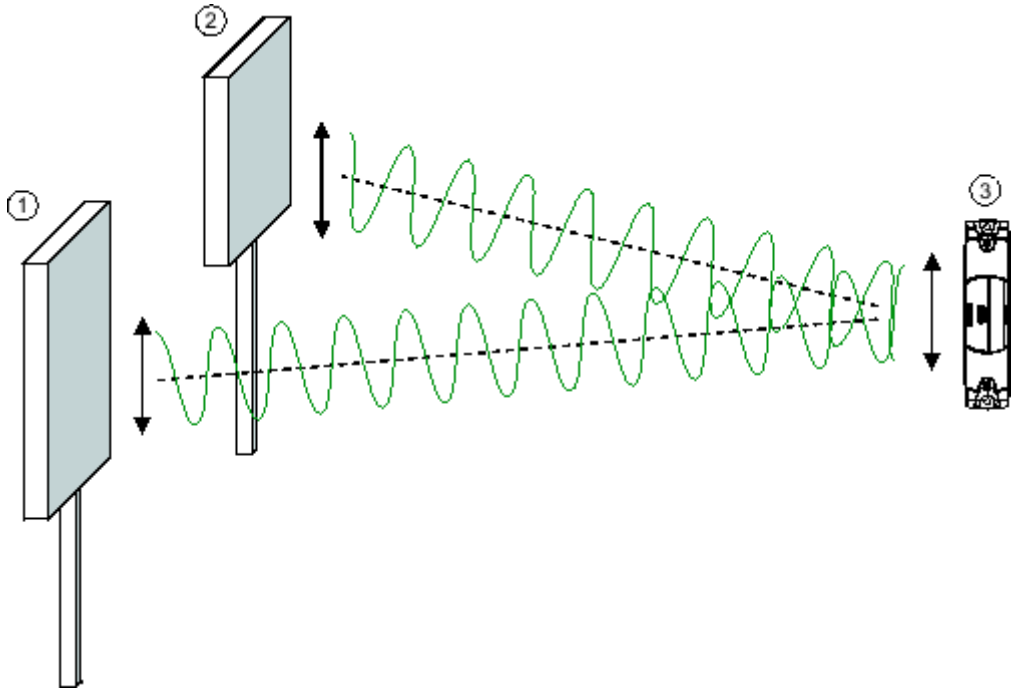


Figure 4-5 Circular polarization of antenna system and transponder

REVIEW

Selection of linear polarized antenna

When using linear polarized antennas, you must always make sure that the transmitter antenna, receiver antenna and transponder have identical polarizations (vertical or horizontal). As a result of the principle used, no special requirements need be observed to suppress the orthogonal components (cross-polarization).



① Transmitter antenna, vertical polarization
② Receiver antenna, vertical polarization
③ Transponder dipole

Figure 4-6 Homogenous vertical polarization of antenna system and transponder

REVIEW

Front-to-back ratio

Definition

As a result of their design, directional antennas not only transmit electromagnetic waves in the main beam direction but also in other directions, particularly in the reverse direction. The largest possible suppression of these spurious lobes is expected in order to reduce faults and to keep the influence on other radio fields low. This attenuation of spurious lobes in the opposite direction to the main beam is called the front-to-back ratio.

Specifications

Requirement: The front-to-back ratio must be ≥ 10 dB. This requirement also applies to spurious lobes illustrated by the following graphics in Section Half-value width (Page 66).

Half-value width

Definition

A further description of the directional characteristic is the beam width. The beam width is the beam angle at which half the power (-3 dB) is radiated referred to the maximum power. The antenna gain is directly related to the beam width. The higher the antenna gain, the smaller the beam angle.

Coupling in ETSI

In ETSI EN 302 208 (release version V1.2.1 2008-06), the radiated power is coupled to the beam width, i.e.

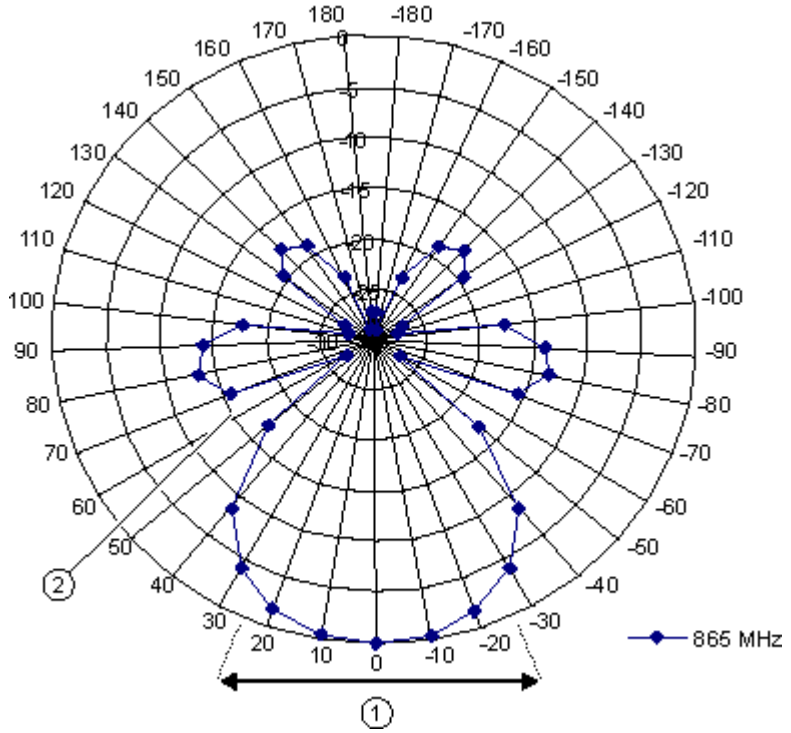
- Radiated power 500-2000 mW ERP: beam width ≤ 70 degrees

The beam width requirement applies to both the horizontal and vertical planes. The FCC directives do not envisage coupling with the beam width.

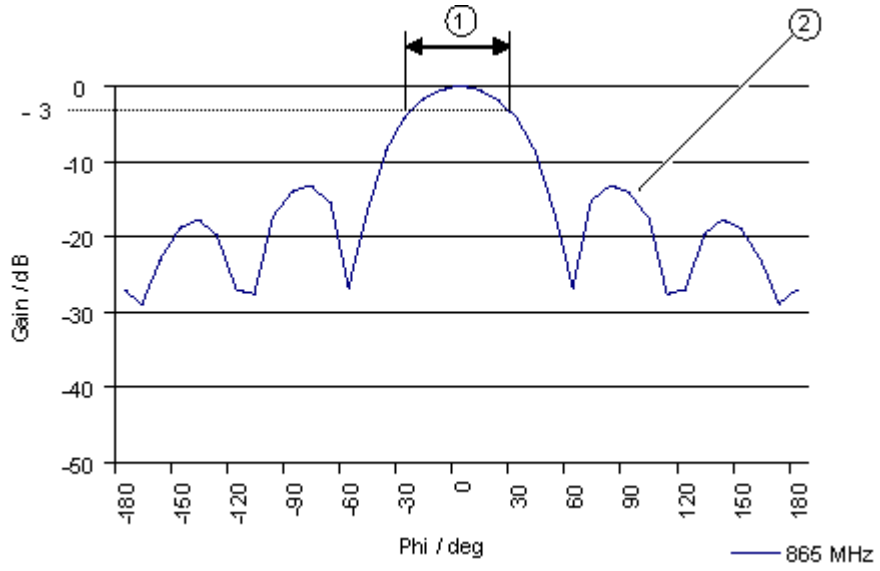
The following graphics show examples of the directional radiation pattern of an antenna in polar and linear representations for which both the horizontal and vertical planes must be considered.

REVIEW

Directional radiation pattern in polar representation



①	Beam width
②	Spurious lobe

Directional radiation pattern in linear representation


①	Beam width
②	Spurious lobe

REVIEW

Interpretation of directional radiation patterns

The following overview table will help you with the interpretation of radiation patterns.

The table shows which dBi values correspond to which read/write ranges (in %): You can read the radiated power depending on the reference angle from the directional radiation patterns, and thus obtain information on the read/write range with this reference angle with regard to a transponder.

The dBr values correspond to the difference between the maximum dBi value and a second dBi value.

Deviation from maximum antenna gain [dBr]	Read/write range [%]
0	100
-3	70
-6	50
-9	35
-12	25
-15	18
-18	13

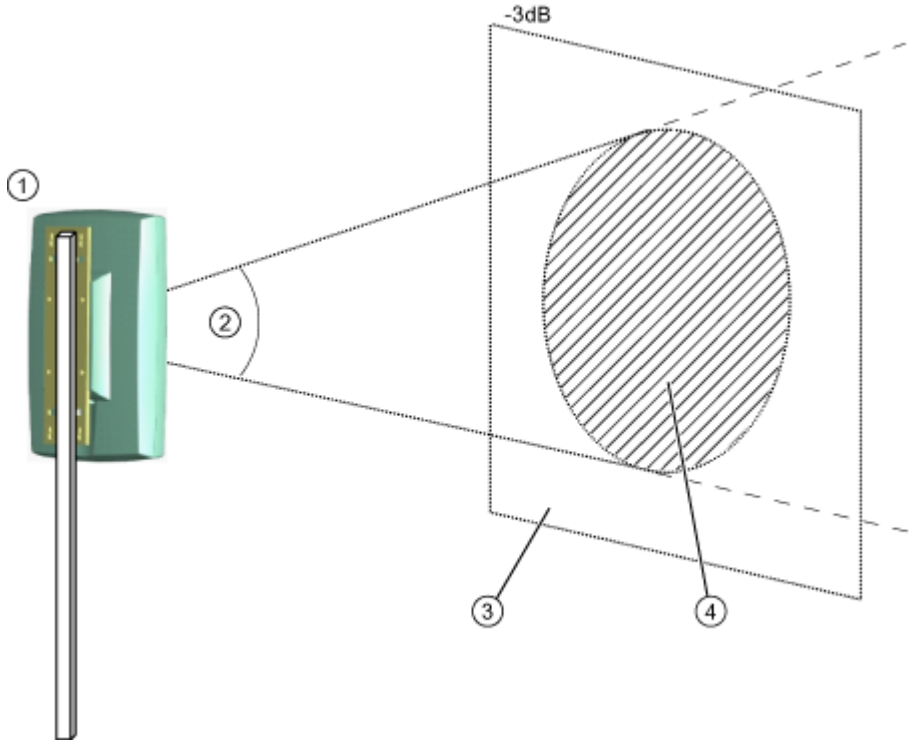
Example

As one can see in the antenna diagrams (polar or linear) above, the maximum antenna gain 0 dB is standardized. The dBr value -3 is shown graphically in both diagrams. At angles of Phi = ± 35°, the range of the antenna is only 50% of the maximum range.

Specifications

Selection of the beam angle within the approval directives also has effects on the field of application, since a larger beam angle allows a larger area to be covered by RFID transponders. The following graphic clarifies the cross-section of the beam cone with the covered area.

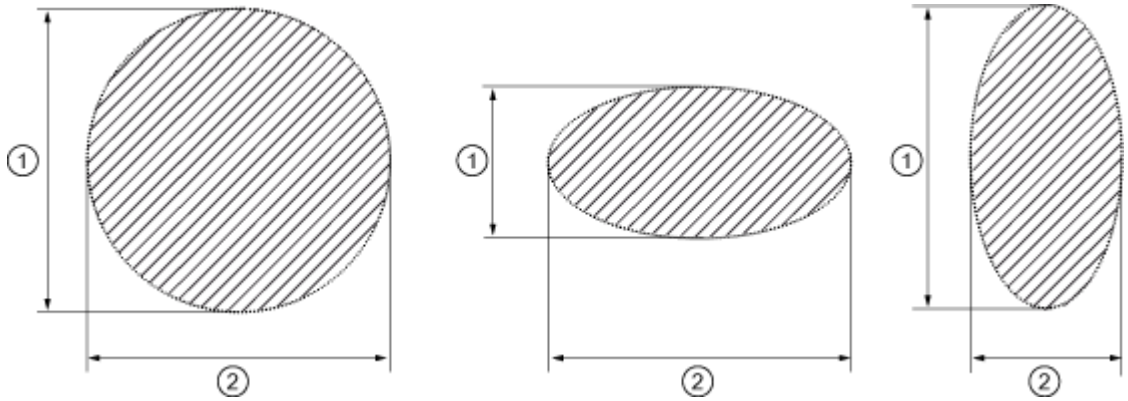
Beam angle: cross-section of the beam cone with the covered area



①	Third-party antenna
②	Beam angle
③	Covered area
④	Activation or reading range

The reading range depends on the horizontal and vertical beam widths in the case of equal distances from the transmitter antenna. Depending on the mechanical mounting and the ratio between the vertical beam width ① and the horizontal beam width ②, read areas result as shown in the following graphic:

REVIEW

Read area depending on the beam width	
	
①	Vertical beam width
②	Horizontal beam width

4.3.9.5 Antenna cables

Selection criteria

You must observe the criteria listed below when selecting the appropriate antenna cable for your third-party antenna.

REVIEW

Characteristic impedance

Definition

If the input impedance of a device does not agree with the cable impedance, reflections occur which reduce the power transmission and can result in the appearance of resonance and thus to a non-linear frequency response.

Specifications

- You must only use coaxial antenna cables when connecting a third-party antenna.
- This antenna cable 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(s), the antenna cable loss must not exceed a value of approx. 4 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, i.e. the cable loss increases at higher transmitter frequencies. 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 always have a shielded design and therefore radiate little of the transmitted power to the environment.

Note

Cable with double shielding

You should therefore preferentially select cable with double shielding since this provides the best damping.

REVIEW

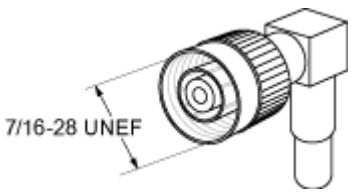
Bending radius of the antenna cable

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 type "Reverse Polarity R-TNC" (male connector) for your antenna cables from a third-party supplier in order to ensure correct connection to the RF600 reader interface.

The figure below shows the standard for a suitable thread:



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

4.3.9.6 Application example

This section contains an example with specific values. Using this example it is possible to understand how the complete selection procedure for antennas, cables, and adapters as well as the settings could be carried out on an RF600 system reader.

In the example, it is assumed that you want to use your SIMATIC RF600 system with your third-party components in Germany (ETSI EN 302 208 V1.4.1).

Procedure

1. Compare the technical specifications of your antenna with the values required by the SIMATIC RF600 system.

Values	Example antenna	Required values	Values OK?
Frequency range	865 to 870 MHz	865 to 868 MHz	☑
Impedance	50 ohms	50 ohms	☑
VSWR	< 1.5	< 1.24	☐
Polarization	Circular, right		☑
Antenna gain	8.5 dBi	>6 dBi	☑
Half-value width horizontal/vertical	63°	≤ 70°	☑
Front-to-back ratio	-18 dB	≥10 dB	☑
Spurious lobe suppression	-16 dB	≥10 dB	☑
Axial ratio	2 dB	≤ 3 dB	☑
Maximum power	6 W	≥4 W	☑

REVIEW

Since the specific VSWR value of the antenna does not agree with the value required by the system, you must have this value checked. Therefore contact your antenna vendor or an EMC laboratory.

2. Compare the technical specifications of your cables and connectors with the values required by the system.
   For example, you can use cables of type "LMR-195" from the company "TIMES MICROWAVE SYSTEMS". Suitable cables have e.g. an outer diameter of 5 mm. The company offers various designs of cables depending on the requirements. Numerous connectors are also available for their cables.

Values	Example cable	Required values	Values OK?
Cable attenuation	36.5 dB / 100 m at 900 MHz With an assumed length of 10 m, this results in a loss of 3.65 dB.	≤ 4 dB	☑
Impedance	50 ohms	50 ohms	☑

Values		Example connector	Values OK?
Type of plug on reader side	R-TNC socket	R-TNC plug	☑
Type of plug on antenna side	N socket	N plug	☑

3. Set the following parameter values depending on the reader you are using:
   - **Assigning parameters for the RF640R/RF670R using the RF-MANAGER Basic V2**
     Antenna gain: 8.5 dBi
     Cable loss: 4 dB (due to adaptation and attenuation losses of the connectors)
   - **Set parameters for the RF640R/RF670R using the XML command "setAntennaConfig"**
     In the XML command "setAntenneConfig", the following must be set for the antenna port being used:
     (antenna number="1 ... 4"), antenna gain (gain="8.5") and cable loss (cableLoss="4.0").
     Cable loss: 4 dB (due to adaptation and attenuation losses of the connectors)
   - **Setting parameters for RF620R/RF630R using SIMATIC commands**
     Since according to ETSI EN 302 208 V1.4.1 the maximum permissible radiated power is 2 W ERP, none of the transmit power settings available to the user (distance_limiting) can cause the required maximum permitted radiated power value to be exceeded. The exact radiated power of the reader, together with the antenna cables and antenna used, results from the value used in distance_limiting 0-F and the calculation in the section "Antenna parameters".
   - **Setting parameters for RF650R/RF680R/RF685R with the Web server**
     Since according to ETSI EN 302 208 V1.4.1 the maximum permissible radiated power is 2 W ERP, none of the transmit power settings available to the user can cause the required maximum permitted radiated power value to be exceeded. The exact radiated power of the reader, together with the antenna cables and antenna used, results from the value used in and the calculation shown in "Antenna parameters".
4. You then need to have your desired system requirements measured and verified according to EN 302 308 in an absorber chamber.
   You may only use your SIMATIC RF600 system with the new third-party components when this has been carried out.

REVIEW

4.4 Environmental conditions for transponders/tags

Basic rules

The transponder/tag must not be placed directly on metal surfaces or on containers of liquid. For physical reasons, a minimum distance must be maintained between the tag antenna and conductive material. A minimum distance of 5 cm is recommended. The tag operates better when the distance is greater (between 5 and 20 cm).

- Tag assembly on non-conductive material (plastic, wood) has a tendency to be less critical than assembly even on poorly conductive material.
- The best results are achieved on the materials specified by the tag manufacturer.
- You can obtain more detailed information from the tag manufacturer.

4.5 The response of electromagnetic waves in the UHF band

4.5.1 The effect of reflections and interference

REVIEW

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, interference can also result in waves being extinguished which causes holes in reader coverage.

Reflections can also be beneficial when they cause electromagnetic waves to be routed around objects to a certain extent (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 the real environment on site, to determine propagation paths and field strengths for a particular location.

Reducing the effect of reflections/interference on tag identification

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

4.5.2 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 tags on metal.
- Do not place metallic or conducting objects in the propagation field of the antenna and transponder.

Tags mounted directly onto metal

In general, tags must not be mounted directly onto metallic surfaces. Due to the nature of the magnetic field, a minimum distance must be maintained between the tag antenna and conductive materials. For further details on the special case of attaching transponders to electrically conducting materials, see Section SIMATIC RF620T (Page 375) and SectionSIMATIC RF640T Gen 2 (Page 418) .

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.

4.5.3 Influence of liquids and non-metallic substances

Non-metallic substances can also affect the propagation of electromagnetic waves.

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

The high-frequency damping effect of water and materials with a water content, ice and carbon is high. Electromagnetic energy is partly reflected and absorbed.

Liquids and petroleum-based oils have low HF damping. Electromagnetic waves penetrate the liquid and are only slightly weakened.

4.5.4 Influence of external components

The R&TTE guideline and the relevant standards govern the electromagnetic compatibility requirements. This also concerns the external components of the RF600 system. Even though the requirements for electromagnetic compatibility have been specified, 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).

External components in the same frequency band

On the other hand, external components can transmit on the same frequency band as the reader. Or the external components can 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 accesses to the transponder will be affected.

4.6 Regulations applicable to frequency bands

4.6.1 Overview of the frequency bands

REVIEW

The current country-specific frequency bands and approvals can be found on the Internet page of EPCglobal®:

EPCglobal (http://www.gs1.org/docs/epcglobal/UHF_Regulations.pdf)

You will find a list of all the country-specific approvals for SIMATIC RFID systems on the following Internet page:

Wireless approvals of SIMATIC RFID systems (http://www.siemens.com/rfid-approvals)

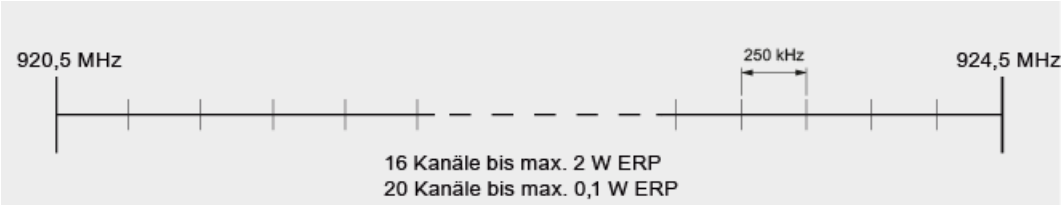
The following sections describe the specifications of the applicable standard, the precise channel assignment and the prescribed procedures for the countries/regions China, Europe and USA in detail.

4.6.2 Regulations for UHF frequency bands in China

Regulations for UHF bands

FCC (Federal Communications Commission)

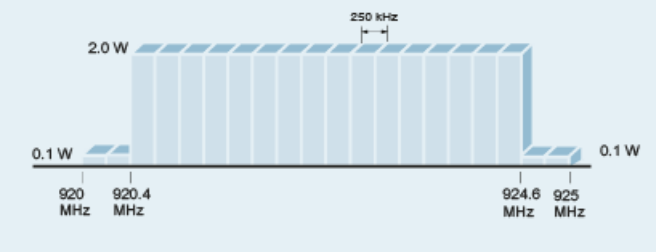
- UHF band: 920.5 to 924.5 MHz
- Radiated power: max. 2 W (ERP)
- Channel spacing: 250 kHz
- Number of channels: 16
- Frequency hopping



Channel assignment

The UHF band from 920.5 to 924.5 MHz with 16 RFID channels occupies:

Table 4- 4 Channel assignment for the UHF band China

Sub bands	Frequency range	Power
	920.125 to 920.375 MHz	0.1 W ERP
	920.625 to 924.375 MHz	2.0 W ERP
	924.625 to 924.875 MHz	0.1 W ERP

Note

Frequency band is restricted

Note that the frequency bands 920.125 to 920.375 MHz and 924.625 to 924.875 MHz are not available.

REVIEW

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). With 16 available channels that can be used simultaneously at up to 2000 mW (ERP), the probability of two readers operating on the same frequency is reduced.

This revision of the European standard EN 302208 also supports RFID systems with numerous readers operating simultaneously. Within the frequency spectrum, 4 exclusive RFID channels are defined.

Regulations for UHF bands according to EN 302208 as of V1.2.1

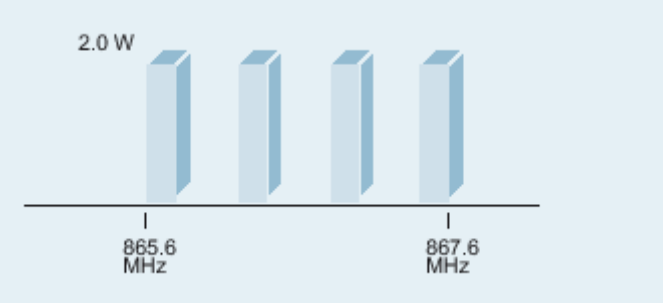
ETSI (European Telecommunications Standards Institute)

- UHF band: 865 to 868 MHz
- Radiated power: max. 2 W (ERP)
- Channel bandwidth: 200 KHz, channel spacing: 600 kHz
- Number of channels: 4
  - 865.7
  - 866.3
  - 866.9
  - 867.5

REVIEW

Channel assignment

The UHF band from 865 to 868 MHz with 4 RFID channels occupies:



Validity

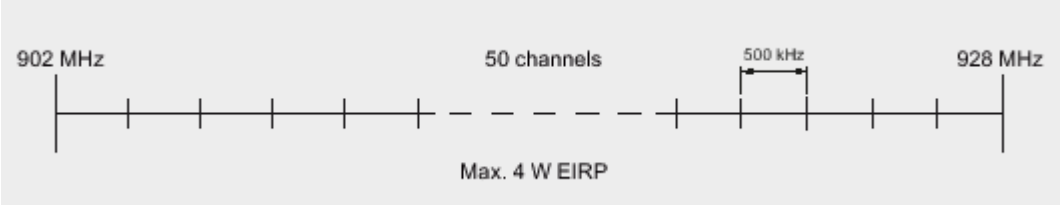
Note that readers are operated with this setting since November 4, 2008 (publication of the standard in the Official Journal of the European Union).

4.6.3 Regulations for UHF frequency bands in the USA

Regulations for UHF bands

FCC (Federal Communications Commission)

- UHF band: 902 to 928 MHz
- Radiated power: max. 4 W (EIRP)
- Channel spacing: 500 kHz
- Number of channels: 50
- Frequency hopping



REVIEW

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). 50 available channels mean that the probability is low that two readers will be operating on the same frequency.

4.7 Guidelines for electromagnetic compatibility (EMC)

4.7.1 Overview

These EMC Guidelines answer the following questions:

- Why are EMC guidelines necessary?
- What types of external interference have an impact on the system?
- How can interference be prevented?
- How can interference be eliminated?
- Which standards relate to EMC?
- Examples of interference-free plant design

The description is intended for "qualified personnel":

- Project engineers and planners who plan system configurations with RFID modules and have to observe the necessary guidelines.
- Fitters and service engineers who install the connecting cables in accordance with this description or who rectify defects in this area in the event of interference.

REVIEW

Note

Failure to observe notices drawn to the reader's attention can result in dangerous conditions in the plant or the destruction of individual components or the entire plant.

4.7.2 What does EMC mean?

The increasing use of electrical and electronic devices is accompanied by:

- Higher component density
- More switched power electronics
- Increasing switching rates
- Lower power consumption of components due to steeper switching edges

The higher the degree of automation, the greater the risk of interaction between devices.

Electromagnetic compatibility (EMC) is the ability of an electrical or electronic device to operate satisfactorily in an electromagnetic environment without affecting or interfering with the environment over and above certain limits.

EMC can be broken down into three different areas:

- Intrinsic immunity to interference:
  immunity to internal electrical disturbance
- Immunity to external interference:
  immunity to external electromagnetic disturbance
- Degree of interference emission:
  emission of interference and its effect on the electrical environment

All three areas are considered when testing an electrical device.

The RFID modules are tested for conformity with the limit values required by the CE and RTTE guidelines. Since the RFID modules are merely components of an overall system, and sources of interference can arise as a result of combining different components, certain guidelines have to be followed when setting up a plant.

EMC measures usually consist of a complete package of measures, all of which need to be implemented in order to ensure that the plant is immune to interference.

Note

The plant manufacturer is responsible for the observance of the EMC guidelines; the plant operator is responsible for radio interference suppression in the overall plant.

All measures taken when setting up the plant prevent expensive retrospective modifications and interference suppression measures.

The plant operator must comply with the locally applicable laws and regulations. They are not covered in this document.

4.7.3 Basic rules

It is often sufficient to follow a few elementary rules in order to ensure electromagnetic compatiblity (EMC).

The following rules must be observed:

Shielding by enclosure

- Protect the device against external interference by installing it in a cabinet or housing. The housing or enclosure must be connected to the chassis ground.
- Use metal plates to shield against electromagnetic fields generated by inductances.
- Use metal connector housings to shield data conductors.

Wide-area ground connection

- Plan a meshed grounding concept.
- Bond all passive metal parts to chassis ground, ensuring large-area and low-HF-impedance contact.
- Establish a large-area connection between the passive metal parts and the central grounding point.
- Don't forget to include the shielding bus in the chassis ground system. That means the actual shielding busbars must be connected to ground by large-area contact.
- Aluminium parts are not suitable for ground connections.

Plan the cable installation

- Break the cabling down into cable groups and install these separately.
- Always route power cables, signal cables and HF cables through separated ducts or in separate bundles.
- Feed the cabling into the cabinet from one side only and, if possible, on one level only.
- Route the signal cables as close as possible to chassis surfaces.
- Twist the feed and return conductors of separately installed cables.
- Routing HF cables:
  avoid parallel routing of HF cables.
- Do not route cables through the antenna field.

REVIEW

Shielding for the cables

- Shield the data cables and connect the shield at both ends.
- Shield the analog cables and connect the shield at one end, e.g. on the drive unit.
- Always apply large-area connections between the cable shields and the shielding bus at the cabinet inlet and make the contact with clamps.
- Feed the connected shield through to the module without interruption.
- Use braided shields, not foil shields.

Line and signal filter

- Use only line filters with metal housings
- Connect the filter housing to the cabinet chassis using a large-area low-HF-impedance connection.
- Never fix the filter housing to a painted surface.
- Fix the filter at the control cabinet inlet or in the direction of the source.

4.7.4 Propagation of electromagnetic interference

Three components have to be present for interference to occur in a system:

- Interference source
- Coupling path
- Interference sink

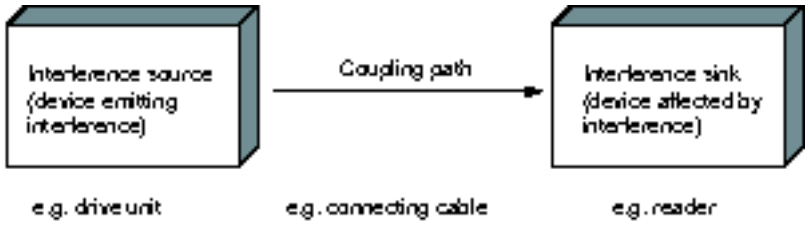


Figure 4-7 Propagation of interference

If one of the components is missing, e.g. the coupling path between the interference source and the interference sink, the interference sink is unaffected, even if the interference source is transmitting a high level of noise.

The EMC measures are applied to all three components, in order to prevent malfunctions due to interference. When setting up a plant, the manufacturer must take all possible measures in order to prevent the occurrence of interference sources:

- Only devices fulfilling limit class A of VDE 0871 may be used in a plant.
- Interference suppression measures must be introduced on all interference-emitting devices. This includes all coils and windings.
- The design of the system must be such that mutual interference between individual components is precluded or kept as small as possible.

Information and tips for plant design are given in the following sections.

REVIEW

Interference sources

In order to achieve a high level of electromagnetic compatibility and thus a very low level of disturbance in a plant, it is necessary to recognize the most frequent interference sources. These must then be eliminated by appropriate measures.

Table 4- 5 Interference sources: origin and effect

Interference source	Interference results from	Effect on the interference sink
Contactor, electronic valves	Contacts	System disturbances
	Coils	Magnetic field
Electrical motor	Collector	Electrical field
	Winding	Magnetic field
Electric welding device	Contacts	Electrical field
	Transformer	Magnetic field, system disturbance, transient currents
Power supply unit, switched-mode	Circuit	Electrical and magnetic field, system disturbance

Interference source	Interference results from	Effect on the interference sink
High-frequency appliances	Circuit	Electromagnetic field
Transmitter (e.g. professional mobile radio)	Antenna	Electromagnetic field
Ground or reference potential difference	Voltage difference	Transient currents
Operator	Static charge	Electrical discharge currents, electrical field
Power cable	Current flow	Electrical and magnetic field, system disturbance
High-voltage cable	Voltage difference	Electrical field

What interference can affect RFID?

Interference source	Cause	Remedy
Switched-mode power supply	Interference emitted from the current infeed	Replace the power supply
Interference injected through the cables connected in series	Cable is inadequately shielded	Better cable shielding
	The reader is not connected to ground.	Ground the reader
HF interference over the antennas	caused by another reader	• Position the antennas further apart. • Erect suitable damping materials between the antennas. • Reduce the power of the readers. Please follow the instructions in the section *Installation guidelines/reducing the effects of metal*

REVIEW

4.7.5 Equipotential bonding

Potential differences between different parts of a plant can arise due to the different design of the plant components and different voltage levels. If the plant components are connected across signal cables, transient currents flow across the signal cables. These transient currents can corrupt the signals.

Proper equipotential bonding is thus essential.

- The equipotential bonding conductor must have a sufficiently large cross section (at least 10 mm^2).
- The distance between the signal cable and the associated equipotential bonding conductor must be as small as possible (antenna effect).
- A fine-strand conductor must be used (better high-frequency conductivity).

- When connecting the equipotential bonding conductors to the centralized equipotential bonding strip (EBS), the power components and non-power components must be combined.
- The equipotential bonding conductors of the separate modules must lead directly to the equipotential bonding strip.

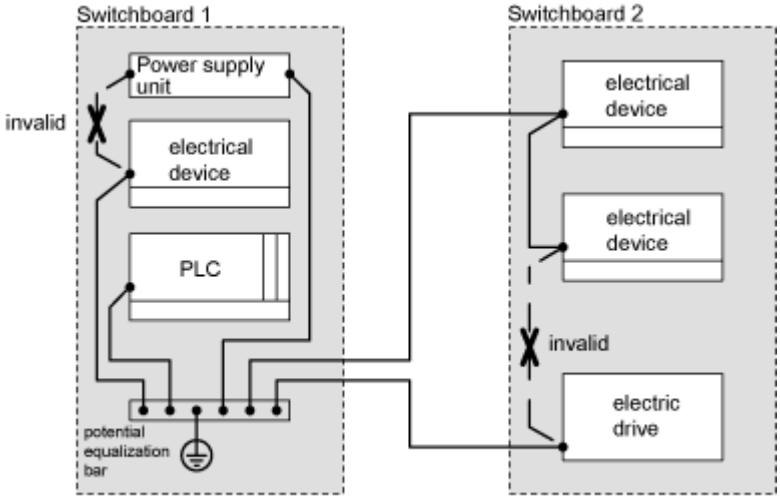


Figure 4-8 Equipotential bonding (EBS = Equipotential bonding strip)

The better the equipotential bonding in a plant, the smaller the chance of interference due to fluctuations in potential.

Equipotential bonding should not be confused with protective earthing of a plant. Protective earthing prevents the occurrence of excessive shock voltages in the event of equipment faults whereas equipotential bonding prevents the occurrence of differences in potential.

REVIEW

4.7.6 Cable shielding

Signal cables must be shielded in order to prevent coupling of interference.

The best shielding is achieved by installing the cables in steel tubes. However, this is only necessary if the signal cable is routed through an environment prone to particular interference. It is usually adequate to use cables with braided shields. In either case, however, correct connection is vital for effective shielding.

Note

An unconnected or incorrectly connected shield has no shielding effect.

As a rule:

- For analog signal cables, the shield should be connected at one end on the receiver side
- For digital signals, the shield should be connected to the enclosure at both ends
- Since interference signals are frequently within the HF range (> 10 kHz), a large-area HF-proof shield contact is necessary

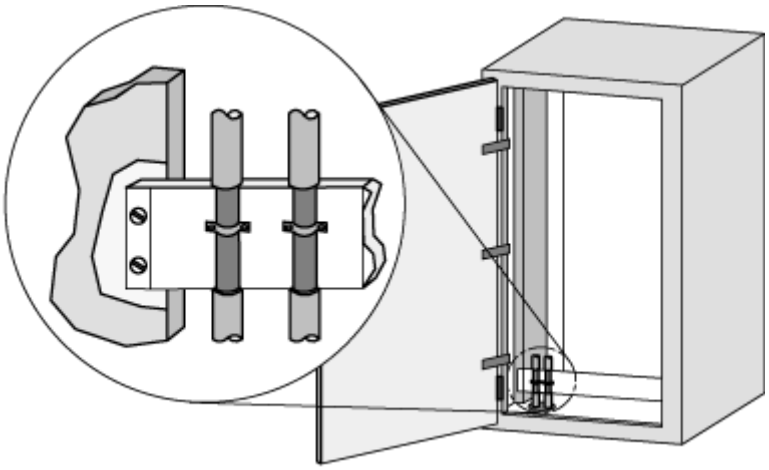


Figure 4-9 Cable shielding

REVIEW

The shielding bus should be connected to the control cabinet enclosure in a manner allowing good conductance (large-area contact) and must be situated as close as possible to the cable inlet. The cable insulation must be removed and the cable clamped to the shielding bus (high-frequency clamp) or secured using cable ties. Care should be taken to ensure that the connection allows good conductance.

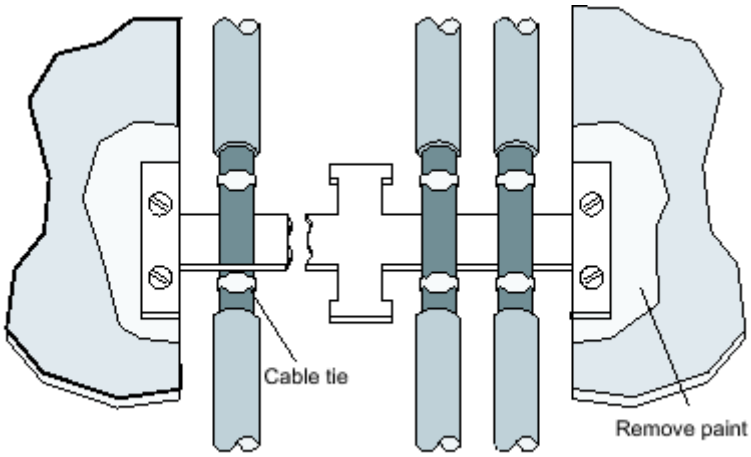


Figure 4-10 Connection of shielding bus

The shielding bus must be connected to the PE busbar.

If shielded cables have to be interrupted, the shield must be continued via the corresponding connector housing. Only suitable connectors may be used for this purpose.

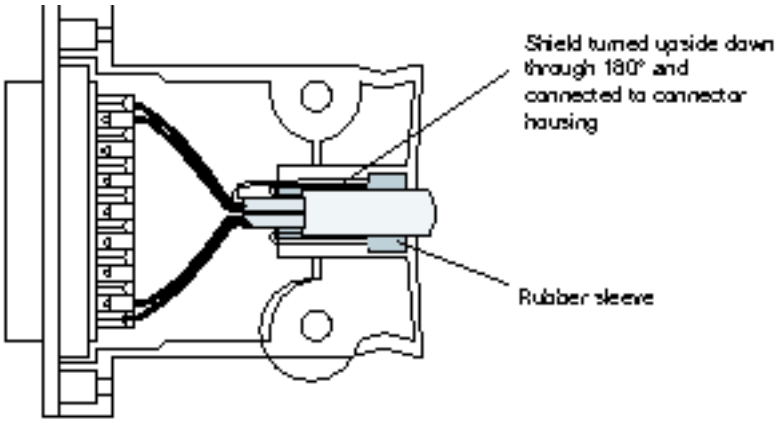


Figure 4-11 Interruption of shielded cables

If intermediate connectors, which do not have a suitable shield connection, are used, the shield must be continued by fixing cable clamps at the point of interruption. This ensures a large-area, HF-conducting contact.

REVIEW

Readers

5

5.1 Overview

The following table shows the most important features of the stationary RF600 readers at a glance:

Table 5- 1 Characteristics of the RF620R, RF630R, RF640R and RF670R readers

Characteristics		SIMATIC RF670R	SIMATIC RF640R	SIMATIC RF630R	SIMATIC RF620R
Air interface / standards supported		EPCglobal Class 1 Gen 2	EPCglobal Class 1 Gen 2	EPCglobal Class 1 Gen 2	EPCglobal Class 1 Gen 2
ETSI variant		Available	Available	Available	Available
FCC variant		Available	Available	Available	Available
CMIIT variant		Available	Available	Available	Available
LEDs		1	1	1	1
Interfaces					
	Number of external antennas via RTNC	4	1	2	1
	Available internal antennas	-	1	-	1
	Ethernet	1 x RJ-45 connector according to IEC PAS 61076-3-117	1 x RJ-45 connector according to IEC PAS 61076-3-117	-	-
	RS-232	-	-	-	-
	RS-422	-	-	1 x plug (M12, 8-pin)	1 x plug (M12, 8-pin)
	Digital inputs	4 (M12, 12-pin) log "0": 0…7 V log "1": 15…24 V	2 (M12, 8-pin) log "0": 0…7 V log "1": 15…24 V	-	-
	Digital outputs (short-circuit proof)	4 (M12, 12-pin) 24 V; 0.5 A each	2 (M12, 8-pin) 24 V; 0.5 A each	-	-
	Power supply	24 VDC (M12, 4-pin) 20 to 30 V (2.2 A) external	24 VDC (M12, 4-pin) 20 to 30 V (2.2 A) external	via CM	via CM
Max. radiated power ETSI and CMIIT in ERP		2 W ERP	1.6 W ERP [1] 2 W ERP	1.2 W ERP	0.8 W ERP [1] 1.2 W ERP
Max. radiated power FCC in EIRP		4 W EIRP	3.3 W EIRP [1] 4 W EIRP	2.0 W EIRP	1.3 W EIRP [1] 2 W EIRP

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Characteristics	SIMATIC RF670R	SIMATIC RF640R	SIMATIC RF630R	SIMATIC RF620R
max. transmit power ETSI and CMIIT	30 dBm 1 W	30 dBm 1 W	27 dBm 0.5 W	27 dBm 0.5 W
max. transmit power FCC	31 dBm 1.25 W	31 dBm 1.25 W	27 dBm 0.5 W	27 dBm 0.5 W
max. transmission rate of the communications interface	10/100 Mbps	10/100 Mbps	115.2 kbps	115.2 kbps
Max. data rate reader to transponder	80 kbps (ETSI) 160 kbps (FCC)	80 kbps (ETSI) 160 kbps (FCC)	40 kbps	40 kbps
Max. data rate transponder to reader	160 kbps (ETSI) 320 kbps (FCC)	160 kbps (ETSI) 320 kbps (FCC)	160 kbps	160 kbps

[1] internal antenna

Table 5- 2 Characteristics of the RF650R, RF680R and RF685R readers

Characteristics		SIMATIC RF650R	SIMATIC RF680R	SIMATIC RF685R	
Air interface / standards supported		EPCglobal Class 1 Gen 2	EPCglobal Class 1 Gen 2	EPCglobal Class 1 Gen 2	
ETSI variant		Available	Available	Available	
FCC variant		Available	Available	Available	
CMIIT variant		Available	Available	Available	
LEDs		6	17	17	
Interfaces					
	Number of external antennas via RTNC	4	4	1	
	Available internal antennas	-	-	1	
	Ethernet	1 x RJ-45 connector according to IEC PAS 61076-3-117	2 x M12 connector (4-pin)	2 x M12 connector (4-pin)	
	RS-232	-	-	-	
	RS-422	1 x plug (M12, 8-pin)	1 x plug (M12, 8-pin)	1 x plug (M12, 8-pin)	
	Digital inputs	4 (M12, 12-pin) log "0": 0…7 V log "1": 15…24 V	4 (M12, 12-pin) log "0": 0…7 V log "1": 15…24 V	4 (M12, 12-pin) log "0": 0…7 V log "1": 15…24 V	
	Digital outputs (short-circuit proof)	4 (M12, 12-pin) 24 V; 1.0 A each	4 (M12, 12-pin) 24 V; 1.0 A each	4 (M12, 12-pin) 24 V; 1.0 A each	
	Power supply	24 VDC (M12, 8-pin) 20 to 30 V (2.2 A) external	24 VDC (M12, 8-pin) 20 to 30 V (2.2 A) external	24 VDC (M12, 8-pin) 20 to 30 V (2.2 A) external	

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Characteristics	SIMATIC RF650R	SIMATIC RF680R	SIMATIC RF685R	
Max. radiated power ETSI and CMIIT in ERP	2 W ERP	2 W ERP	2 W ERP [1] 2 W ERP	
Max. radiated power FCC in EIRP	3 W EIRP	4 W EIRP	4 W EIRP [1] 4 W EIRP	
max. transmit power ETSI and CMIIT	30 dBm 1 W	33 dBm 2 W	33 dBm 2 W	
max. transmit power FCC	30 dBm 1 W	33 dBm 2 W	33 dBm 2 W	
max. transmission rate of the communications interface	10/100 Mbps	10/100 Mbps	115.2 kbps	
Max. data rate reader to transponder	300 kbps	300 kbps	300 kbps	
Max. data rate transponder to reader	80 kbps	80 kbps	80 kbps	

[1] internal antenna

REVIEW

5.2 RF620R reader

5.2.1 Description

The SIMATIC RF620R is a stationary reader in the UHF frequency band with an integrated circular polarized antenna. For readers with the new hardware version (MLFB: 6GT2811-5BA00-xAA1), a maximum of one external UHF RFID antenna can be connected via a TNC reverse connector as an alternative to the integrated antenna.

The maximum HF power output is 0.5 W at the reader output. The SIMATIC RF620R is connected to a SIMATIC S7 controller via an ASM interface module. The degree of protection is IP65.

	Pos.	Description
	(1)	TNC-reverse interface for connection of ANT
	(2)	LED operating display
	(3)	RS 422 interface (8-pin M12 connector)

REVIEW

5.2.1.1 Ordering data

Ordering data RF620R

Product	Article number
RF620R (ETSI) reader for EU, EFTA, Turkey	6GT2811-5BA00-0AA0
RF620R (FCC) reader for North America	6GT2811-5BA00-1AA0
RF620R (CMIIT) reader for China	6GT2811-5BA00-2AA1

Ordering data accessories

Product	Article number
Connecting cable • RS°422, M12 plug, 8-pin socket: 2 m • RS°422, M12 plug, 8-pin socket: 5 m • RS°422, M12 plug, 8-pin socket: 10 m • RS°422, M12 plug, 8-pin socket: 20 m • RS°422, M12 plug, 8-pin socket: 50 m	 • 6GT2891-0FH20 • 6GT2891-0FH50 • 6GT2891-0FN10 • 6GT2891-0FN20 • 6GT2891-0FN50
Antenna mounting kit	6GT2890-0AA00
Set of protective caps Contains 3 protective caps for antenna output and one protective cap for digital I/O interface (required for IP65 degree of protection when some connectors are unused)	6GT2898-4AA00
RFID DVD "Software & Documentation"	6GT2080-2AA20

REVIEW

5.2.1.2 Status display

The device is equipped with a three colored LED. The LED can be lit in green, red or yellow. The meaning of the indication changes in accordance with the color and state (on, off, flashing) of the LED:

Green LED	Red LED	Yellow LED	Meaning
Off	Off	Off	The device is starting up.
Flashing	Off	Off	The device is ready. The antenna is switched off.
On	Off	Off	The device is ready. The antenna is switched on.
Off	Off	On	"With presence": At least one tag is in the field. "Without presence": Communication with a tag is active.
Off	Flashing	Off	Reader is not active, a serious error has occurred. In addition, this LED also indicates the fault status through the number of flashing pulses. Reboot (operating voltage Off → On is necessary). The LED flashes once for the 'INACTIVE' status, rebooting is **not** necessary in this case.

For more detailed information on the flash codes of the reader see section Error messages and flash codes for RF620R/RF630R (Page 469)

Note

LED not lit yellow?

If the LED does not light up yellow even though a tag is located within the field, common causes are:

- Incorrect configuration in the init_run command, or init_run command was not executed (see "Configuration Manual RF620R/RF630R")
- Parameter assignment is incorrect (black list, RSSI threshold)
- Antenna is switched off
- A tag is used, that is not compatible with the reader protocol (EPC Global Class 1 Gen 2).
- Tag is defective
- Reader or antenna has a defect
- Tag is not in the field of radiation of the transmit antenna

5.2.1.3 Pin assignment of the RS422 interface

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Pin	Pin Device end 8-pin M12	Assignment
	1	+ 24 V
	2	- Transmit
	3	0 V
	4	+ Transmit
	5	+ Receive
	6	- Receive
	7	Unassigned
	8	Earth (shield)

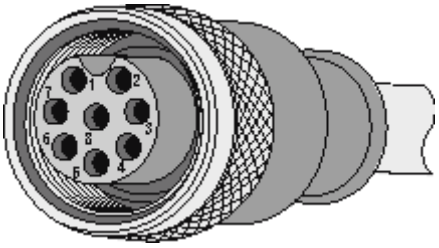
The knurled bolt of the M12 plug is not connected to the shield (on the reader side).

Note

You must therefore not use any SIMATIC connecting cables that use the angled M12 plug.

5.2.1.4 Pin assignment of the connecting cable

Table 5- 3 RS 422 - on reader side

M12 pin	Core color	Pin assignment	View of M12 socket
1	white	24 VDC	
2	brown	TX neg	
3	green	GND	
4	yellow	TX pos	
5	Gray	RX pos	
6	pink	RX neg	
7	blue	Not assigned	
8	red	Earth (shield)	

Comment

This cable has an 8-pin M12 connector at one end and the other cable end is 'open'. There are 8 color-coded single cores there for connecting to external devices. There are different cable lengths in the product range (3 m to 50 m). Long cables can be reduced if necessary.

Note

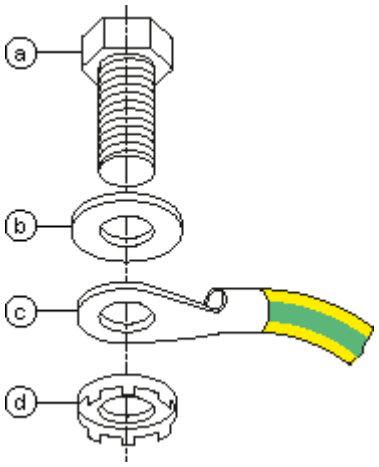
For long cables: Adapt supply voltage and data rate accordingly

Note that with long cables in particular, the supply voltage of 24 V DC must always be applied. Note also that the data rate on the serial interface must, if necessary, be reduced. (See "Configuration Manual RF620R/RF630R")

REVIEW

5.2.1.5 Grounding connection

The RF620R can be electrically connected to the ground potential through a contact washer. The tightening torque must be increased in this case to ensure that electrical contact is made (2.7 Nm).

Ground connection		
	(a)	Hexagon-head screw
	(b)	Plain washer
	(c)	Cable lugs
	(d)	Contact washer: Use contact washers according to the Siemens standard SN 70093-6-FSt-flNnnc-480h for ground connection, Siemens item No.: H70093-A60-Z3

REVIEW

5.2.2 Planning application

5.2.2.1 Minimum mounting clearances of two readers

The RF620R has a circular polarized antenna. At 500 mW ERP radiated power, due to the opening angle of the antennas, their fields can overlap considerably. It is no longer possible to clarify in which antenna field access to the data of a tag is performed.

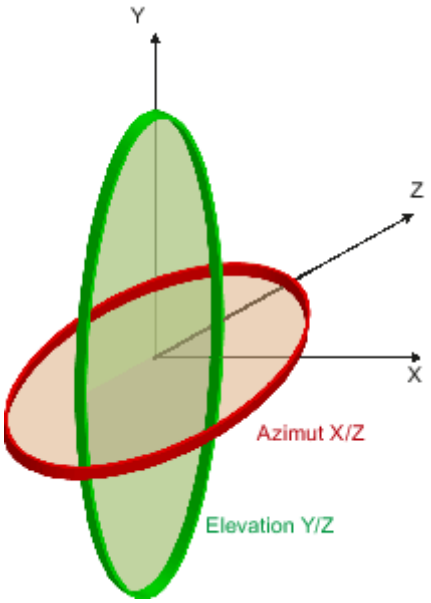
In order to avoid this, always keep a minimum distance of 3 m between two readers with the maximum radiated power of 500 mW ERP.

Dense Reader Mode (DRM)

The readers can also interfere with each other (secondary fields), if the channels (Reader TX, Transponder TX) overlap. In order to prevent a transponder channel overlapping with a reader channel, we recommend that the Dense Reader Mode (DRM) is used.

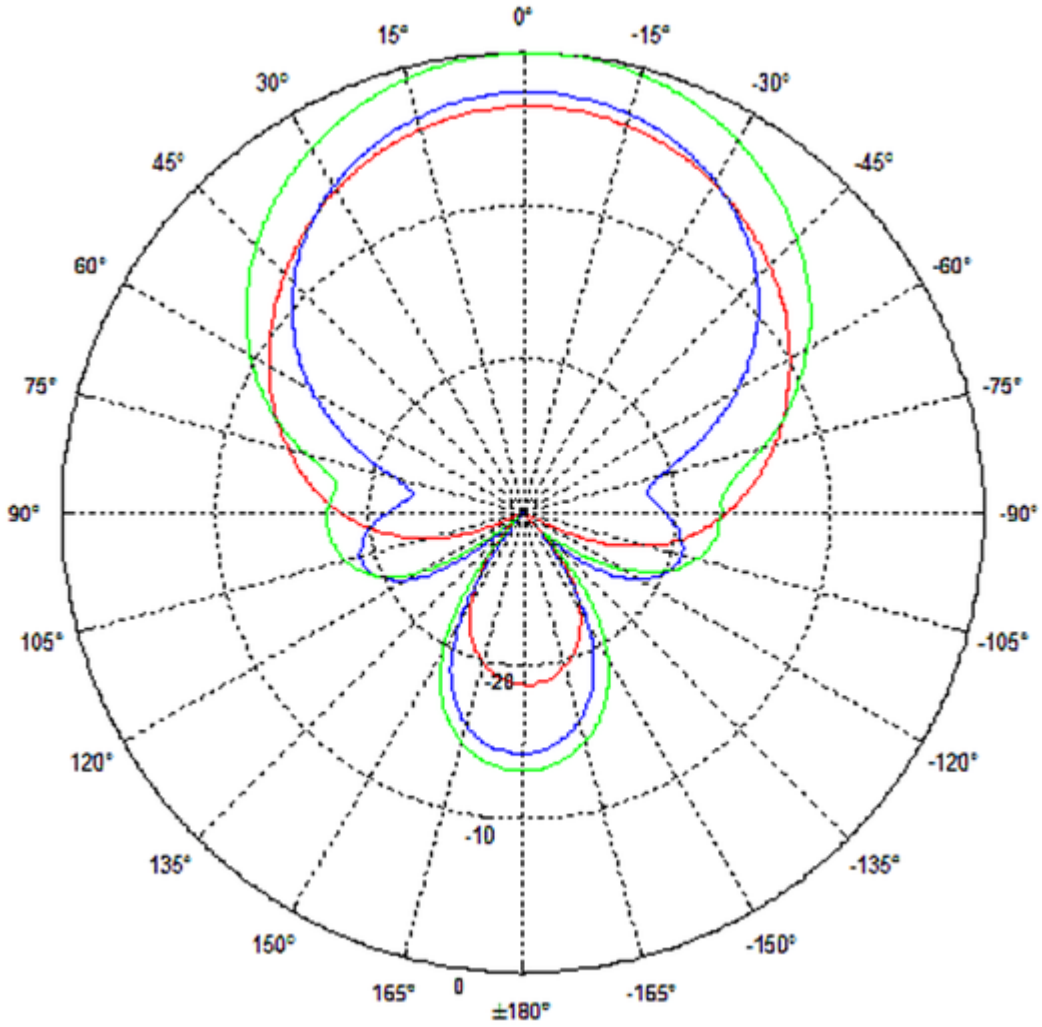
5.2.2.2 Antenna diagram for RF620R (ETSI)

The following radiation diagrams show the directional radiation pattern of the internal antenna of the RF620R (ETSI) reader. For the spatial presentation of the directional characteristics, the vertical plane (Azimuth section) as well as the horizontal plane (elevation section) must be considered. This results in a spatial image of the directional radiation pattern of the antenna with its main and auxiliary fields.



REVIEW

Radiation diagram (Azimuth section)



Vertical component of the polarization direction of the antenna

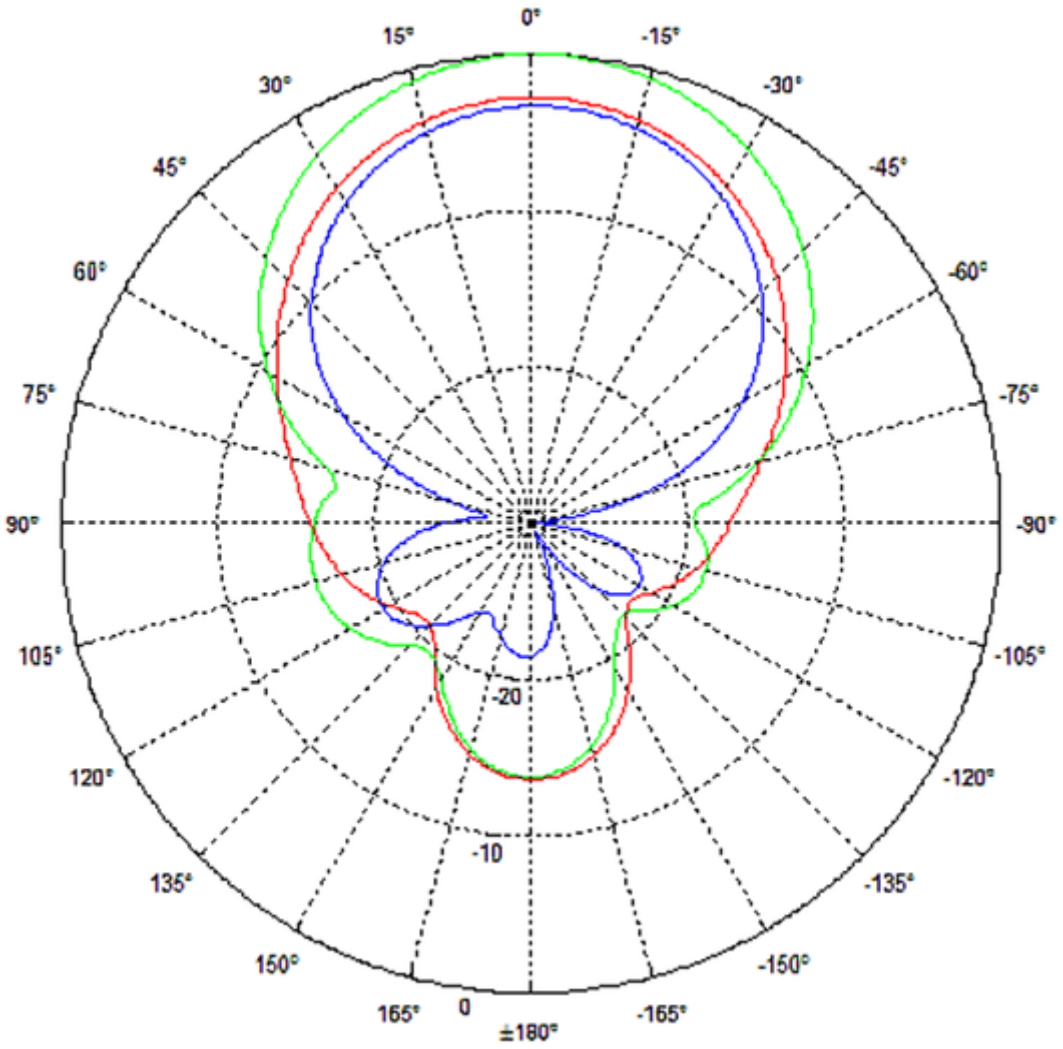
Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-1 Azimuth section

REVIEW

Radiation diagram (elevation section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-2 Elevation section

REVIEW

Overview of the antenna parameters

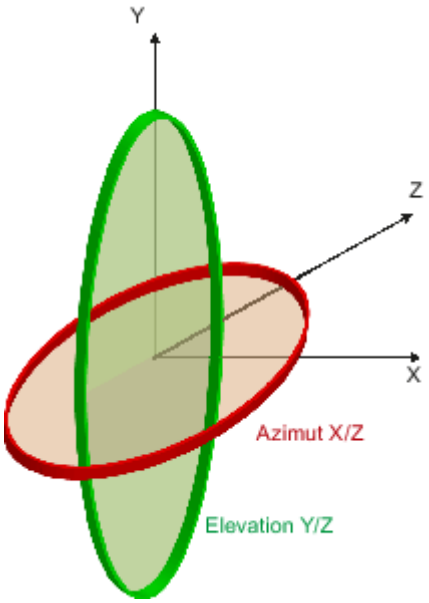
Table 5- 4 Maximum linear electrical aperture angle at 865 MHz:

Azimuth section	77,7°
Elevation section	66,1°
Typical antenna gain in the frequency range 865 to 868 MHz	4.0 dBi
Antenna axis ratio	0.7 dB

See also section Guidelines for selecting RFID UHF antennas (Page 55)

5.2.2.3 Antenna diagram for RF620R (FCC)

The following radiation diagrams show the directional radiation pattern of the internal antenna of the RF620R (FCC) reader. For the spatial presentation of the directional characteristics, the vertical plane (Azimuth section) as well as the horizontal plane (elevation section) must be considered. This results in a spatial image of the directional radiation pattern of the antenna with its main and auxiliary fields.



Azimuth XZ plane
Elevation YZ plane

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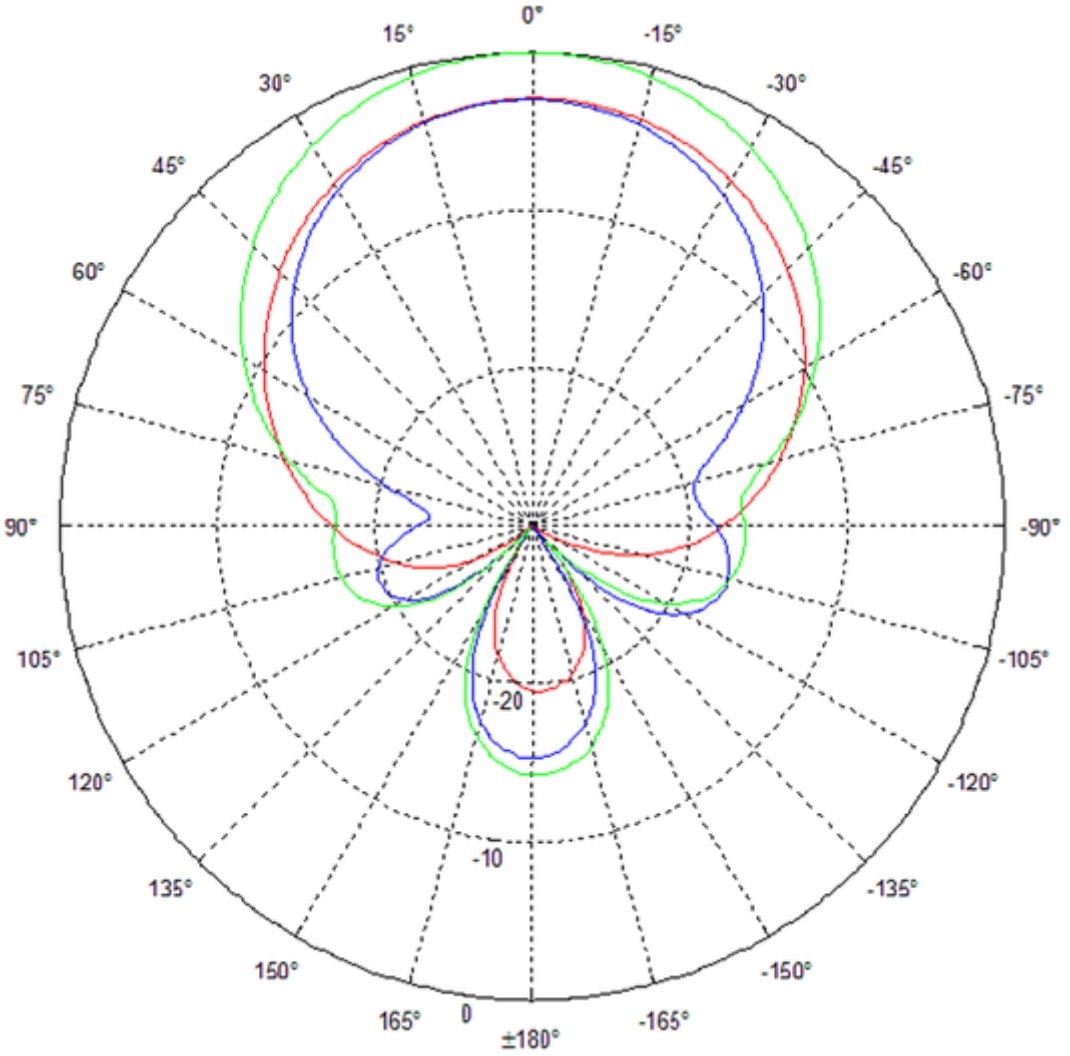
Radiation diagram (Azimuth section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-3 Azimuth section

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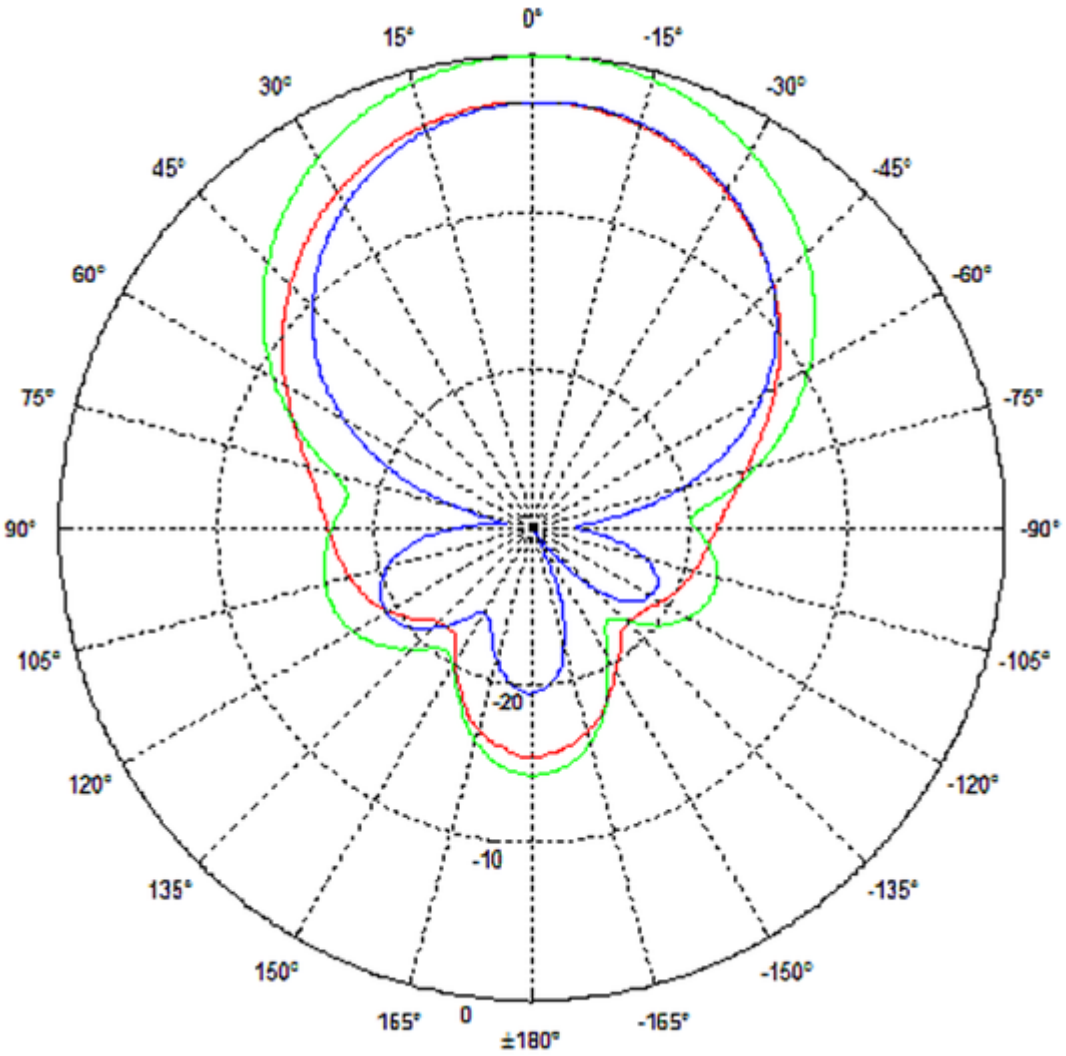
REVIEW

Radiation diagram (elevation section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-4 Elevation section

Overview of the antenna parameters

Table 5- 5 Maximum linear electrical aperture angle at 865 MHz:

Azimuth section	75,4 °
Elevation section	69,1 °
Typical antenna gain in the frequency range 902 to 928 MHz	4.0 dBi ± 0.5 dB
Antenna axis ratio	<1 dB

see also section Guidelines for selecting RFID UHF antennas (Page 55).

5.2.2.4 Interpretation of directional radiation patterns

The following overview table will help you with the interpretation of directional radiation patterns.

The table shows which dBi values correspond to which read/write ranges (in %): You can read the radiated power depending on the reference angle from the directional radiation patterns, and thus obtain information on the read/write range with this reference angle with regard to a transponder.

The dBr values correspond to the difference between the maximum dBi value and a second dBi value.

REVIEW

Deviation from maximum antenna gain [dBr]	Read/write range [%]
0	100
-3	70
-6	50
-9	35
-12	25
-15	18
-18	13

Example

As one can see from the section Antenna diagram for RF620R (ETSI) (Page 95), the maximum antenna gain is 0 dB. In the Azimuth diagram, the antenna gain falls by 3°dB at approximately ± 39°. Therefore the dBr value is -3. The antenna range is only 50% of the maximum range at ± 39° from the Z axis within the horizontal plane.

5.2.2.5 Antenna/read point configurations

The RF620R reader has an internal circular polarized antenna. You can cover one read point with this antenna. When several RF620R readers are used, the readers are addressed via the SIMATIC level.

5.2.3 Installing/Mounting

Requirement

WARNING

Make sure that the wall or ceiling can hold four times the total weight of the device.

Note

Close unused connectors

If you do not use connectors on the reader, it is advisable to close the unused connectors with protective caps. You can order the protective cap set using the MLFB specified in the section "Ordering data".

Note

Disregarding FCC RF exposure requirements

Ensure that the following conditions are met before the device is mounted to meet the FCC RF exposure requirements:

- The RF620R reader must be installed so that a minimum distance from people of 20 cm is always observed.
- The reader may not be installed or operated in the immediate vicinity of another reader or antenna.

See also section FCC information (Page 111) RF620R or section FCC information (Page 127) RF630R.

5.2.3.1 Mounting/Installing FCC

CAUTION

Emitted radiation

The transmitter complies with the requirements of Health Canada and the FCC limit values for subjecting persons to HF radiation, provided that a minimum spacing of 26 cm exists between antenna and person. When the antennas are installed, you must therefore ensure that a minimum spacing of 26 cm is maintained between personnel and antennas.

Mounting/installing the device

You can mount the reader in two different ways:

- Via a standardized VESA 100 mounting system using the Antenna Mounting Kit (see Chapter Mounting with antenna mounting kit (Page 331)). Tighten the M4 screws on the rear of the reader using a maximum torque of ≤ 1.3 Nm.
- Directly onto a flat surface.

The positions of the fixing holes for the device are shown in the section Dimension drawings (Page 108).

5.2.4 Configuration/integration

The RS422 system interface is provided for integrating the device into system environments/networks. The system interface transfers data to SIMATIC controllers or PCs with the appropriate interface.

Apart from transmitting communication data from the reader to the controller and vice versa, the RS422 interface also supplies power to the reader (24 V DC).

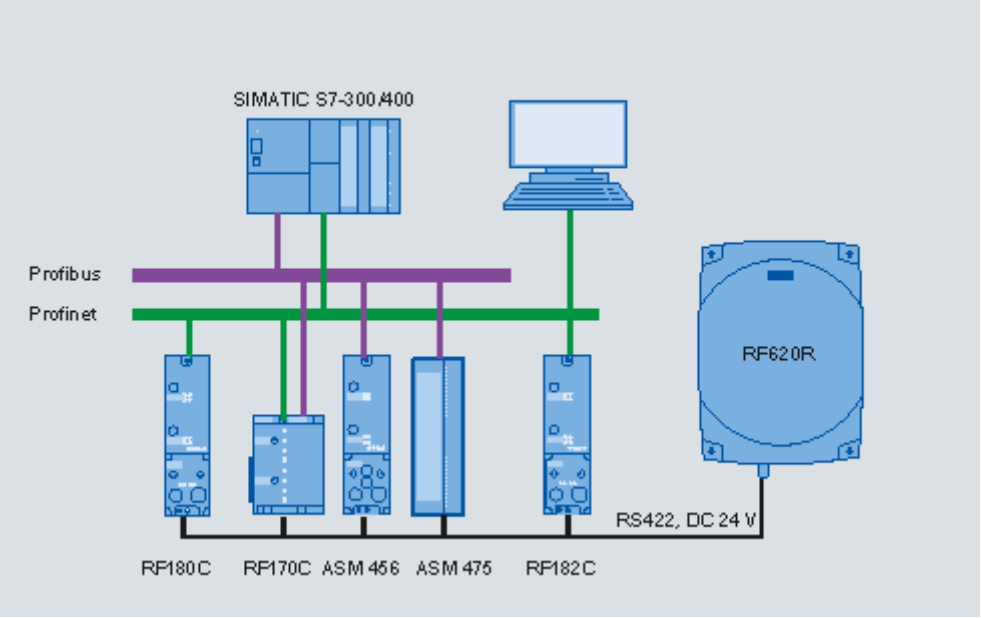


Figure 5-5 Overview of configuration of the RF620R reader

The RF620R reader can alternatively be connected to a SIMATIC controller via the ASM 456, ASM 475, RF170C and RF180C interface modules/communication modules.

The RF620R reader can alternatively also be connected directly to the PC via the RF182 communication module.

For further details on the interface modules used, see Chapter Auto-Hotspot .

Further information about commissioning the readers can be found in the configuration manual "RF620R/RF630R" in the "Commissioning" section.

REVIEW

5.2.4.1 Transmission protocols

RS 422 communication

	3964R protocol
Transmission rates	19.2 kbps 57.6 kbps 115.2 kbps
Start bits	1
Data bits	8
Parity	Odd
Stop bits	1

5.2.5 Technical data

5.2.5.1 Mechanical data

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Mechanical data		
Weight		1850 g
Dimensions (L x W x H) in mm		252 X 193 x 52 mm, without connections
Material for housing top section		ABS (GF 20), silicone-free
Material for housing bottom section		Aluminum, silicone-free
Color of housing top section		Pastel turquoise
Color of housing bottom section		Silver
Status displays on the device		1 LED Colors: red, yellow, green
Interfaces		
	RS422	1 x plug (8-pin M12)
	Antenna connectors	1 x RTNC plug
	Software	SIMATIC S7
MTBF in years		18.2

Technical and electrical characteristics			
Power supply • Permitted range		21.6 to 30 VDC [1]	
Power supply		Current consumption (in standby mode, no transmit power)	Power consumption (in standby mode, no transmit power)
	20 V input voltage on the reader, typical	135 mA	2.7 W
	24 V input voltage on the reader, typical	115 mA	2.76 W
	30 V input voltage on the reader, typical	95 mA	2.85 W
Power supply		Current consumption (at 500 mW ERP)	Power requirement (at 500 mW ERP)
	20 V input voltage on the reader, typical	470 mA	9.4 W
	24 V input voltage on the reader, typical	395 mA	9.48 W
	30 V input voltage on the reader, typical	320 mA	9.6 W
Ramp-up time, typical		7 s	

1) All supply and signal voltages must be safety extra low voltage (SELV/PELV according to EN 60950)

24 VDC supply: safe (electrical) isolation of extra-low voltage (SELV / PELV acc. to EN 60950)

Mechanical environmental conditions	
Shock resistant acc. to EN 60068-2-27 Vibration acc. to EN 60068-2-6	50 g[1] 20 g[1]
Climatic conditions	
Ambient temperature during operation	-25 °C to +55 °C (a 10-minute warm-up time must be allowed at an operating temperature below -20 °C)
Ambient temperature for transport and storage	-40 °C to +85 °C

1) The values for shock and vibration are maximum values and must not be applied continuously.

EMC & approvals/conformity RF620R (ETSI)	
Electromagnetic compatibility	ETSI EN 301 489-1 / -3
	ETSI EN 302 208 V1.3.1 ETSI EN 302 208 V1.4.1
Approvals/Conformity	• Radio acc. to R&TTE guidelines, EN 301 489 • CE • ETSI EN 302-208 V1.1.1 • ETSI EN 302-208 V1.3.1 • ETSI EN 302-208 V1.4.1 • Reader degree of protection acc. to EN 60529 (IP65)

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EMC & approvals for FCC variant	
Electromagnetic compatibility	FCC Part 15
Approvals	• FCC, cULus • IEC60950, including US and Canadian variants of it • FCC CFR47 Part 15.247 • RoHS-compliant according to EU Directive 2002/95/EC • Industrial Canada, RSS-210, Issue 7, June 2007

5.2.5.2 Technical data according to EPC and ISO

Technical specifications	
Frequency accuracy	max.± 10 ppm
Channel spacing	EU, EFTA, Turkey: 600 kHz US: 500 kHz China: 250 kHz
Modulation methods	ASK: DSB modulation & PR-ASK modulation Encoding, Manchester or Pulse Interval (PIE)
Effective radiated power with internal antenna • ETSI/CMIIT: • FCC	 • ≤ 0.8 W ERP • ≤ 1.3 W EIRP
Effective radiated power with external antenna • ETSI/CMIIT: • FCC	 • ≤ 1.2 W ERP • ≤ 2.0 W EIRP
Transmit power	≤ 0.5 W

Reading range	
Readers mounted on the same side	Max. 2 m (recommended maximum value for configuration; depending on the transponder)

ETSI frequencies	
Frequency range for Europe, EFTA, Turkey, South Africa, Thailand (ETSI) ETSI EN 302 208 V1.4.1 (valid since October 23, 2012, publication in the Official Journal of the European Union)	865.7 ... 867.5 MHz (4 channels LBT optional at max. 2 W ERP)
Frequency range India	865 ... 867 MHz (10 channels at max. 4 W EIRP)
Frequency range Russia	866.1 ... 867.6 MHz (8 channels at 2 W ERP)
Frequency range Singapore	866 ... 869 MHz (11 channels at 0.5 W ERP)

REVIEW

FCC frequencies	
Frequency range USA; Argentina, Bolivia, Canada, Mexico, Thailand (FCC)	902 ... 928 MHz (50 channels at max. 4 W EIRP, frequency hopping)
Frequency range Brazil	915.125 ... 927.875 MHz (52 channels at max. 4 W EIRP, frequency hopping)
Frequency range South Korea	917.1 ... 920.4 MHz (7-16 channels at max. 4 W EIRP, frequency hopping)

CMIIT frequencies	
Frequency range China	920.625 ... 924.375 MHz (16 subchannels at 2 W ERP)

5.2.5.3 Maximum number of readable tags

The maximum number of readable tags depends on the following parameters:

- Size of the antenna field
- Readability of the tags

For a transmit power of 500 mW ERP, the following is read when the tag RF620T is used:

- Max. 40 tags in the antenna field (tags perpendicular to antenna and 1 m in front)
- Max. 18 tags per second

REVIEW

5.2.6 Dimension drawings

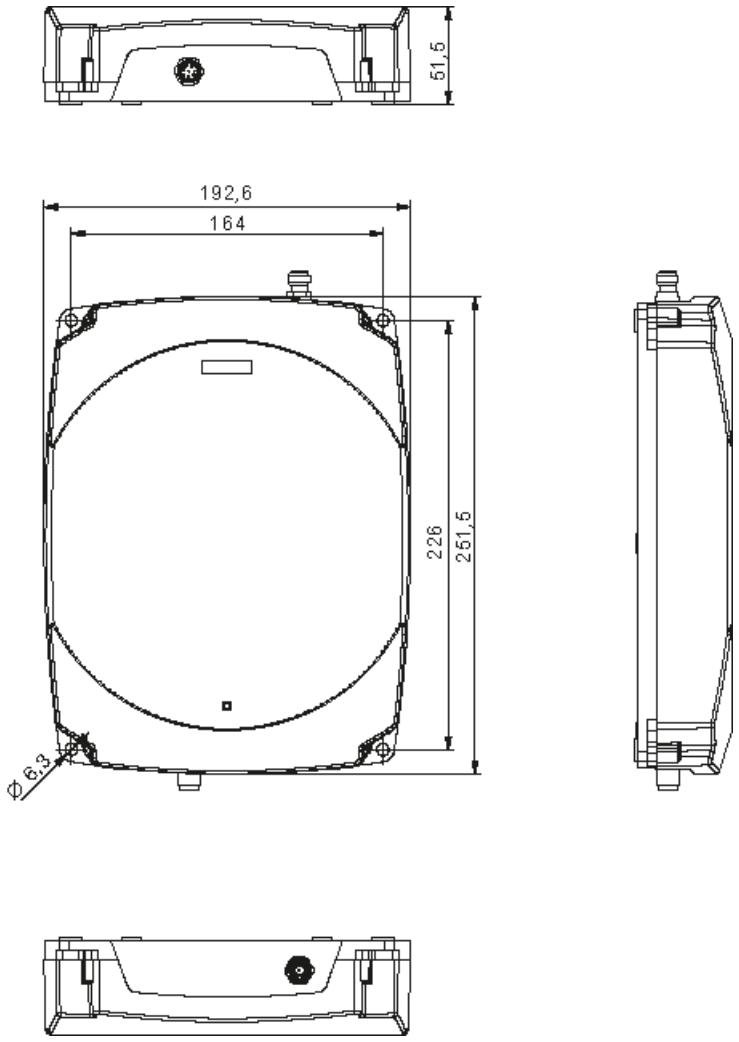


Figure 5-6 Dimension drawing for RF620R

All dimensions in mm (± 0.5 mm tolerance)

REVIEW

5.2.7 Certificates and approvals

Note

Marking on the readers according to specific approval

The certificates and approvals listed here apply only if the corresponding mark is found on the readers.

Table 5- 6 6GT2811-5BA00-0AA0, 6GT2811-5BA00-0AA1

Certificate	Description
CE	Conformity with R&TTE directive
TA-2012/548	South Africa radio approval: Radio Equipment Type Approval

5.2.7.1 Country-specific certifications

Table 5- 7 6GT2811-5BA00-1AA0, 6GT2811-5BA00-1AA1

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. FCC ID: NXW-RF620R (for 6GT2811-5BA00-1AA0) FCC ID: NXW-RF600R (for 6GT2811-5BA00-1AA1)
Industry Canada Radio Standards Specifications	RSS-210 Issue 7, June 2007, Sections 2.2, A8 IC: 267X-RF620R (for 6GT2811-5BA00-1AA0) IC: 267X-RF600R, Model RF620R-2 (for 6GT2811-5BA00-1AA1)
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

REVIEW

Standard	
	Brazil wireless approval Marking on the reader (6GT2811-5BA00-1AA0):  Marking on the reader (6GT2811-5BA00-1AA1):  Statement about approval: Este equipamento opera em caráter secundário, isto é, não tem direito à proteção contra interferência prejudicial, mesmo de estações do mesmo tipo e não pode causar interferência a sistemas operando em caráter primário. Reader certificate: ANATEL 3377-12-4061
	KCC Certification Marking on the reader: Type of equipment: A급 기기 (업무용 방송통신기자재) Class A Equipment (Industrial Broadcasting & Communication Equipment) 이 기기는 업무용(A급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라 며, 가정외의 지역에서 사용하는 것을 목적으로 합니다. This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home. Reader certificate: KCC-CRM-RF5-RF620R
H-11388	Argentina radio approval: Registro de la COMISION NACIONAL DE COMUNICACIONES
RCPSIRF12-0772	Mexico radio approval: CERTIFICADO DE HOMOLOGACION

REVIEW

Table 5- 8 6GT2811-5BA00-2AA1

Standard	
CMIIT Certification	China radio approval Marking on the reader: CMIIT ID: 2012DJ2916

5.2.7.2 FCC information

Siemens SIMATIC RF620R (FCC): 6GT2811-5BA00-1AA0, 6GT2811-5BA00-1AA1

FCC ID: NXW-RF620R (for 6GT2811-5BA00-1AA0)
FCC ID: NXW-RF600R (for 6GT2811-5BA00-1AA1)

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification.

It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

5.2.7.3 IC-FCB information

Siemens SIMATIC RF620R (FCC): 6GT2811-5BA00-1AA0, 6GT2811-5BA00-1AA1

IC: 267X-RF620R (for 6GT2811-5BA00-1AA0)
IC: 267X-RF600R, Model: RF620R-2 (for 6GT2811-5BA00-1AA1)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d`Industrie Canada applicables aux appareils radio exempts de licence. L`exploitation est autorisée aux deux conditions suivantes :

(1) L`appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l`appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d`en compromettre le fonctionnement.

Industry Canada Notice

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Transmitter power and antenna information for antennas with a gain less than 6 dBi:

This device has been designed to operate with the SIMATIC RF620A antenna 902-928, the SIMATIC RF640A antenna 902-928 as well as the SIMATIC RF660A antenna 902-928 listed below, and having a maximum gain of 5.5 dBi. Arbitrary transmission power settings in combination with other antennas or antennas having a gain greater than 5.5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

Transmitter power and antenna information for antennas with a gain greater 6 dBi:

This device requires professional installation. Antennas with a gain greater 6 dBi may be used provided the system does not exceed the radiation power of 4000 mW E.I.R.P. This device has been designed to operate with the SIMATIC RF642A antenna 902-928 exceeding the maximum gain of 5.5 dBi under the restriction that the RF power at the input of the antenna must be set to meet the following relation: RF power (dBm) ≤ 30 dBm – (antenna gain (dBi) – 6 dBi) Other antennas or system configurations for antennas having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

REVIEW

5.3 RF630R reader

5.3.1 Description

The SIMATIC RF630R is a stationary reader in the UHF frequency band without an integrated antenna. Up to two external UHF RFID antennas can be connected via TNC reverse connections.

The maximum RF power output is 0.5°W at the reader output. The SIMATIC RF630R is connected to a SIMATIC S7 controller via an ASM interface module. The degree of protection is IP65.

	Pos.	Description
	(1)	TNCreverse interface for connection of antenna 1 (ANT 1)
	(2)	TNCreverse interface for connection of antenna 2 (ANT 2)
	(2)	LED operating display
	(3)	RS 422 interface (8-pin M12 connector)

REVIEW

5.3.1.1 Ordering data

Ordering data for RF630R

Product	Article number
RF630R (ETSI) reader for EU, EFTA, Turkey	6GT2811-4AA00-0AA0
RF630R (FCC) reader for the USA	6GT2811-4AA00-1AA0
RF630R (CMIIT) reader for China	6GT2811-4AA00-2AA1

Ordering data accessories

Product	Article number
Connecting cable • RS°422, M12 plug, 8-pin socket: 2 m • RS°422, M12 plug, 8-pin socket: 5 m • RS°422, M12 plug, 8-pin socket: 10 m • RS°422, M12 plug, 8-pin socket: 20 m • RS°422, M12 plug, 8-pin socket: 50 m	 • 6GT2891-0FH20 • 6GT2891-0FH50 • 6GT2891-0FN10 • 6GT2891-0FN20 • 6GT2891-0FN50
Antenna mounting kit	6GT2890-0AA00
Set of protective caps Contains 3 protective caps for antenna output and one protective cap for digital I/O interface (required for IP65 degree of protection when some connectors are unused)	6GT2898-4AA00
RFID DVD "Software & Documentation"	6GT2080-2AA20

REVIEW

5.3.1.2 Status display

The device is equipped with a three colored LED. The LED can be lit in green, red or yellow. The meaning of the indication changes in accordance with the color and state (on, off, flashing) of the LED:

Green LED	Red LED	Yellow LED	Meaning
Off	Off	Off	The device is starting up.
Flashing	Off	Off	The device is ready. The antenna is switched off.
On	Off	Off	The device is ready. The antenna is switched on.
Off	Off	On	"With presence": At least one tag is in the field. "Without presence": Communication with a tag is active.
Off	Flashing	Off	Reader is not active, a serious error has occurred. In addition, this LED also indicates the fault status through the number of flashing pulses. Reboot (operating voltage Off → On is necessary). The LED flashes once for the 'INACTIVE' status, rebooting is **not** necessary in this case.

For more detailed information on the flash codes of the reader see section Error messages and flash codes for RF620R/RF630R (Page 469)

Note

LED not lit yellow?

If the LED does not light up yellow even though a tag is located within the field, common causes are:

- Incorrect configuration in the init_run command, or init_run command was not executed (see "Configuration Manual RF620R/RF630R")
- Parameter assignment is incorrect (black list, RSSI threshold)
- Antenna is switched off
- A tag is used, that is not compatible with the reader protocol (EPC Global Class 1 Gen 2).
- Tag is defective
- Reader or antenna has a defect
- Tag is not in the field of radiation of the transmit antenna

5.3.1.3 Pin assignment of the RS422 interface

Pin	Pin Device end 8-pin M12	Assignment
	1	+ 24 V
	2	- Transmit
	3	0 V
	4	+ Transmit
	5	+ Receive
	6	- Receive
	7	Unassigned
	8	Earth (shield)

REVIEW

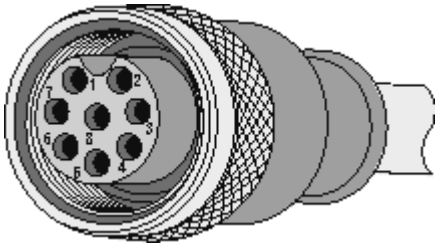
The knurled bolt of the M12 plug is not connected to the shield (on the reader side).

Note

You must therefore not use any SIMATIC connecting cables that use the angled M12 plug.

5.3.1.4 Pin assignment of the connecting cable

Table 5- 9 RS 422 - on reader side

M12 pin	Core color	Pin assignment	View of M12 socket
1	white	24 VDC	
2	brown	TX neg	
3	green	GND	
4	yellow	TX pos	
5	Gray	RX pos	
6	pink	RX neg	
7	blue	Not assigned	
8	red	Earth (shield)	

Comment

This cable has an 8-pin M12 connector at one end and the other cable end is 'open'. There are 8 color-coded single cores there for connecting to external devices. There are different cable lengths in the product range (3 m to 50 m). Long cables can be reduced if necessary.

Note

For long cables: Adapt supply voltage and data rate accordingly

Note that with long cables in particular, the supply voltage of 24 V DC must always be applied. Note also that the data rate on the serial interface must, if necessary, be reduced. (See "Configuration Manual RF620R/RF630R")

5.3.1.5 Grounding connection

The RF630R can be electrically connected to the ground potential through a contact washer. The tightening torque must be increased in this case to ensure that electrical contact is made (2.7 Nm).

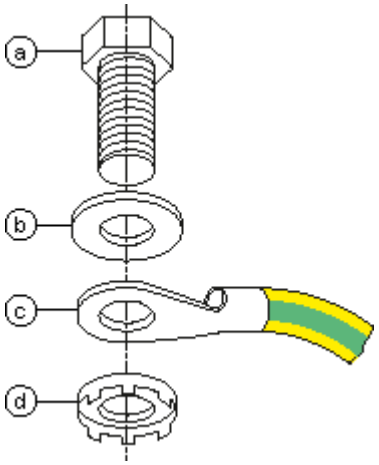
⚠ WARNING

Hazardous voltage due to lightning strikes

Death or serious injury may occur as a result of lightning strikes to antennas mounted outside buildings.

If the reader is operated with antennas mounted outside buildings, it is imperative that the reader is electrically connected to the ground potential.

REVIEW

Ground connection		
	(a)	Hexagon-head screw
	(b)	Plain washer
	(c)	Cable lug
	(d)	Contact washer: Use contact washers according to the Siemens standard SN 70093-6-FSt-flNnnc-480h for ground connection, Siemens item No.: H70093-A60-Z3

5.3.2 Planning application

5.3.2.1 Minimum mounting clearances of two antennas of different readers

REVIEW

At 500 mW ERP radiated power, due to the opening angle of the antennas, their fields can overlap considerably. It is no longer possible to clarify in which antenna field access to the data of a tag is performed.

In order to avoid this, always keep a minimum distance of 3 m between two antennas of different RF630R readers with the maximum radiated power of 500 mW ERP.

Dense Reader Mode (DRM)

The readers can also interfere with each other (secondary fields), if the channels (Reader TX, Transponder TX) overlap. In order to prevent a transponder channel overlapping with a reader channel, we recommend that the Dense Reader Mode (DRM) is used.

5.3.2.2 Antenna/read point configurations

You can connect up to two external antennas to the RF630R reader. The standard setting is that two antennas are connected when the reader is started.

You have 3 possibilities for aligning the antennas and covering the read point.

One RF630R reader with two antennas and two read points

If you connect two external antennas to the device and align them in different directions, you can read tags at two different read points. With this technique, a particular antenna must be switched off application-dependently to be able to establish which tags have been read from which antenna. Note the minimum distances between the antennas for the antenna configuration (see section Specified minimum and maximum spacing of antennas (Page 49).

One RF630R reader with two antennas and one read point

If you connect two external antennas to the device and align them in the same direction (portal configuration), you can read tags at one read point. With this method, the reader automatically switches between the two antennas while the tags are being read. Note the minimum distances between the antennas for the antenna configuration (see section Specified minimum and maximum spacing of antennas (Page 49) .

One RF630R reader with one antenna and one read point

If you connect an external antenna to the device, you can read tags at one read point.

5.3.3 Installing/Mounting

5.3.3.1 Mounting/Installation

REVIEW

Requirement

⚠ WARNING

Make sure that the wall or ceiling can hold four times the total weight of the device.

Note

Close unused connectors

If you do not use connectors on the reader, it is advisable to close the unused connectors with protective caps. You can order the protective cap set using the MLFB specified in the section "Ordering data".

⚠ CAUTION

Emitted radiation

The transmitter complies with the requirements of Health Canada and the FCC limit values for subjecting persons to HF radiation, provided that a minimum spacing of 26 cm exists between antenna and person. When the antennas are installed, you must therefore ensure that a minimum spacing of 26 cm is maintained between personnel and antennas.

Mounting/installing the device

You can mount the reader directly onto a flat surface.

The positions of the fixing holes for the device are shown in the section Dimension drawings (Page 124).

5.3.4 Configuration/integration

The RS422 system interface is provided for integrating the device into system environments/networks. The system interface transfers data to SIMATIC controllers or PCs with the appropriate interface.

Apart from transmitting communication data from the reader to the controller and vice versa, the RS422 interface also supplies power to the reader (24 V DC).

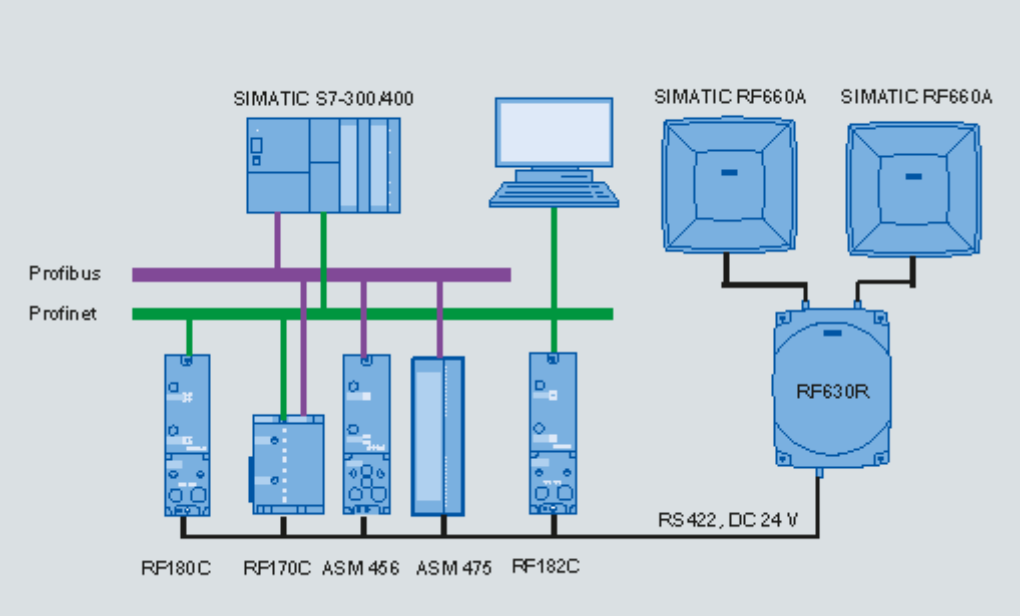


Figure 5-7 Overview of configuration of the RF630R reader

The RF620R reader can alternatively be connected to a SIMATIC controller via the ASM 456, ASM 475, RF170C and RF180C interface modules/communication modules.

The RF620R reader can alternatively also be connected directly to the PC via the RF182 communication module.

For further details on the interface modules used, see Chapter Auto-Hotspot .

Further information about commissioning the readers can be found in the Configuration Manual "RF620R/RF630R" in the "Commissioning" section.

REVIEW

5.3.4.1 Transmission protocols

RS 422 communication

	3964R protocol
Transmission rates	19.2 kbps 57.6 kbps 115.2 kbps
Start bits	1
Data bits	8
Parity	Odd
Stop bits	1

5.3.5 Technical data

5.3.5.1 Mechanical data

REVIEW

Mechanical data		
Weight		1640 g
Dimensions (L x W x H) in mm		252 x 193 x 52 mm, without connections
Material for housing top section		ABS (GF 20)
Material for housing bottom section		Aluminum
Color of housing top section		Anthracite
Color of housing bottom section		Silver
Status displays on the device		1 LED Colors: red, yellow, green
Interfaces		
	Antenna connectors	2 x RTNC plug
	RS422	1 x plug (8-pin M12)
	Software	SIMATIC S7
MTBF in years		18.2

Thermal and electrical properties			
Power supply • Permitted range		21.6 to 30 VDC [1]	
Power supply		Current consumption (in standby mode, no transmit power)	Current consumption (in standby mode, no transmit power)
	20 V input voltage on the reader, typical	135 mA	2.7 W
	24 V input voltage on the reader, typical	115 mA	2.76 W
	30 V input voltage on the reader, typical	95 mA	2.85 W
Power supply		Current consumption (at 500 mW ERP)	Power requirement (at 500 mW ERP)
	20 V input voltage on the reader, typical	470 mA	9.4 W
	24 V input voltage on the reader, typical	395 mA	9.48 W
	30 V input voltage on the reader, typical	320 mA	9.6 W
Rampup time		7 s	

1) All supply and signal voltages must be safety extra low voltage (SELV/PELV according to EN 60950)

24 VDC supply: safe (electrical) isolation of extra-low voltage (SELV / PELV acc. to EN 60950)

REVIEW

Mechanical environmental conditions	
Shock resistant acc. to EN 60068-2-27 Vibration acc. to EN 60068-2-6	50 g[1] 20 g[1]
Climatic conditions	
Ambient temperature during operation	-25 °C to +55 °C (a 10-minute warm-up time must be allowed at an operating temperature below -20 °C)
Ambient temperature for transport and storage	-40 °C to +85 °C

1) The values for shock and vibration are maximum values and must not be applied continuously.

EMC & approvals/conformity for ETSI variant	
Electromagnetic compatibility	ETSI EN 301 489-1 / -3
	ETSI EN 302 208 V1.3.1 ETSI EN 302 208 V1.4.1
Approvals/Conformity	• Radio acc. to R&TTE guidelines, EN 301 489 • CE • ETSI EN 302-208 V1.1.1 • ETSI EN 302-208 V1.3.1 • ETSI EN 302-208 V1.4.1 • Reader degree of protection acc. to EN 60529 (IP65)

EMC & approvals for FCC variant	
Electromagnetic compatibility	FCC Part 15
Approvals	• FCC, cULus • IEC60950, including US and Canadian variants of it • FCC CFR47 Part 15.247 • RoHS-compliant according to EU Directive 2002/95/EC • Industrial Canada, RSS-210, Issue 7, June 2007

5.3.5.2 Technical data according to EPC and ISO

Technical specifications	
Frequency accuracy	max.± 10 ppm
Channel spacing	EU, EFTA, Turkey: 600 kHz US: 500 kHz China: 250 kHz
Modulation methods	ASK: DSB modulation & PR-ASK modulation Encoding, Manchester or Pulse Interval (PIE)
Effective radiant power • ETSI/CMIIT: • FCC:	 • < < 1.2 W ERP • < 2 W EIRP
Transmit power	≤ 0.5 W ERP

Reading range	
Antennas mounted on opposing sides (portal configuration)	3.5 m max. (recommended maximum value for configuration)
Antennas mounted on the same side	Max. 2 m (recommended maximum value for configuration; depending on the transponder)

ETSI frequencies	
Frequency range for Europe, EFTA, Turkey, South Africa, Thailand (ETSI) ETSI EN 302 208 V1.4.1 (valid since October 23, 2012, publication in the Official Journal of the European Union)	865.7 ... 867.5 MHz (4 channels LBT optional at max. 2 W ERP)
Frequency range India	865 ... 867 MHz (10 channels at max. 4 W EIRP)
Frequency range Russia	866.1 ... 867.6 MHz (8 channels at 2 W ERP)
Frequency range Singapore	866 ... 869 MHz (11 channels at 0.5 W ERP)

REVIEW

FCC frequencies	
Frequency range USA; Argentina, Bolivia, Canada, Mexico, Thailand (FCC)	902 ... 928 MHz (50 channels at max. 4 W EIRP, frequency hopping)
Frequency range Brazil	915.125 ... 927.875 MHz (52 channels at max. 4 W EIRP, frequency hopping)
Frequency range South Korea	917.1 ... 920.4 MHz (7-16 channels at max. 4 W EIRP, frequency hopping)

CMIIT frequencies	
Frequency range China	920.625 ... 924.375 MHz (16 subchannels at 2 W ERP)

5.3.5.3 Maximum number of readable tags

The maximum number of readable tags depends on the following parameters:

- Size of the antenna field
- Readability of the tags

For a transmit power of 500 mW ERP, the following is read when the tag RF620T is used:

- Max. 40 tags in the antenna field (tags perpendicular to antenna at 1 m distance). If 2 antennas are used, up to 80 tags can be recognized.
- Max. 18 tags per second

REVIEW

Note

Operation with 2 antennas

If you have configured 2 antennas as a gate, both antennas must be turned on at the same time. The reader multiplexes both antennas internally. The multiplexing time is typically 100 ms (internal read time per antenna).

5.3.6 Dimension drawings

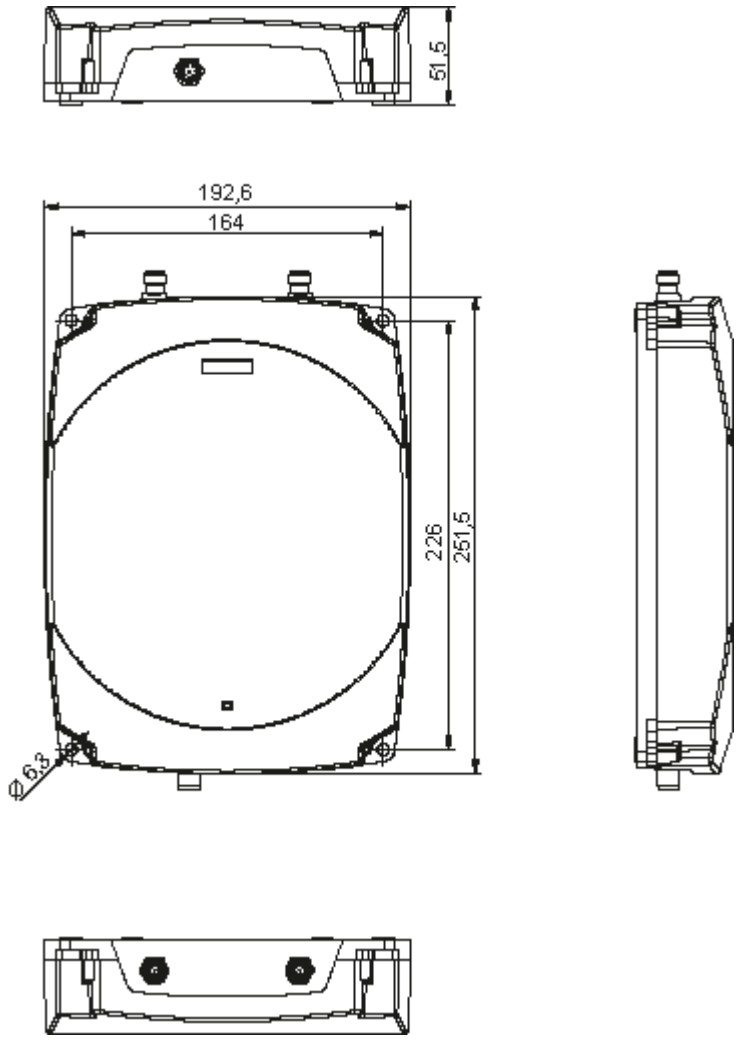


Figure 5-8 Dimension drawing for RF630R

All dimensions in mm (± 0.5 mm tolerance)

REVIEW

5.3.7 Certificates and approvals

Note

Marking on the readers according to specific approval

The certificates and approvals listed here apply only if the corresponding mark is found on the readers.

Table 5- 10 6GT2811-4AA00-0AA0, 6GT2811-4AA00-1AA1

Certificate	Description
CE	Conformity with R&TTE directive
TA-2012/548	South Africa radio approval: Radio Equipment Type Approval

Table 5- 11 6GT2811-4AA00-1AA0, 6GT2811-4AA00-1AA1

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. FCC ID: NXW-RF630R (for 6GT2811-4AA00-1AA0) FCC ID: NXW-RF600R (for 6GT2811-4AA00-1AA1)
Industry Canada Radio Standards Specifications	RSS-210 Issue 7, June 2007, Sections 2.2, A8 IC: 267X-RF630 (for 6GT2811-4AA00-1AA0) IC: 267X-RF600R, Model: RF630R-2 (for 6GT2811-4AA00-1AA1)
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

REVIEW

Standard	
	Brazil wireless approval Marking on the reader (6GT2811-4AA00-1AA0):  Marking on the reader (6GT2811-4AA00-1AA1):  Statement about approval: Este equipamento opera em caráter secundário, isto é, não tem direito à proteção contra interferência prejudicial, mesmo de estações do mesmo tipo e não pode causar interferência a sistemas operando em caráter primário. Reader certificate: ANATEL 3377-12-4061
	KCC Certification Marking on the reader: Type of equipment: A급 기기 (업무용 방송통신기자재) Class A Equipment (Industrial Broadcasting & Communication Equipment) 이 기기는 업무용(A급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라 며, 가정외의 지역에서 사용하는 것을 목적으로 합니다. This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home. Reader certificate: KCC-CRM-RF5-RF630R
H-11409	Argentina radio approval: Registro de la COMISION NACIONAL DE COMUNICACIONES
RCPSIRF12-0879	Mexico radio approval: CERTIFICADO DE HOMOLOGACION

REVIEW

Table 5- 12 6GT2811-4AA00-2AA1

Standard	
CMIIT Certification	China radio approval Marking on the reader: CMIIT ID: 2012DJ2917

5.3.7.1 FCC information

Siemens SIMATIC RF630R (FCC): 6GT2811-4AA00-1AA0, 6GT2811-4AA00-1AA1

FCC ID: NXW-RF630R (for 6GT2811-4AA00-1AA0)
FCC ID: NXW-RF600R (for 6GT2811-4AA00-1AA1)

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification.

It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

REVIEW

5.3.7.2 IC-FCB information

Siemens SIMATIC RF630R (FCC): 6GT2811-4AA00-1AA0, 6GT2811-4AA00-1AA1

IC: 267X-RF630 (for 6GT2811-4AA00-1AA0)
IC: 267X-RF600, Model: RF630R-2 (for 6GT2811-4AA00-1AA1)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d`Industrie Canada applicables aux appareils radio exempts de licence. L`exploitation est autorisée aux deux conditions suivantes :

(1) L`appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l`appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d`en compromettre le fonctionnement.

Industry Canada Notice

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Transmitter power and antenna information for antennas with a gain less than 6 dBi:

This device has been designed to operate with the SIMATIC RF620A antenna 902-928, the SIMATIC RF640A antenna 902-928 as well as the SIMATIC RF660A antenna 902-928 listed below, and having a maximum gain of 5.5 dBi. Arbitrary transmission power settings in combination with other antennas or antennas having a gain greater than 5.5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

Transmitter power and antenna information for antennas with a gain greater 6 dBi:

This device requires professional installation. Antennas with a gain greater 6 dBi may be used provided the system does not exceed the radiation power of 4000 mW E.I.R.P. This device has been designed to operate with the SIMATIC RF642A antenna 902-928 exceeding the maximum gain of 5.5 dBi under the restriction that the RF power at the input of the antenna must be set to meet the following relation: RF power (dBm) ≤ 30 dBm – (antenna gain (dBi) – 6 dBi) Other antennas or system configurations for antennas having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

REVIEW

5.4 RF640R reader

5.4.1 Description

5.4.1.1 Overview

The SIMATIC RF640R is a stationary reader in the UHF frequency band with an integrated antenna. As an alternative, an external UHF RFID antenna can be connected via a TNC reverse connector.

The maximum RF power output is 1000°mW at the external reader output. A radiant power of up to 2000 mW ERP is achieved when the appropriate antennas and antenna cables are used. The interfaces (Ethernet, M12 power supply, M12 digital I/O interface) are located along the narrow lower front edge. These interfaces can be used to connect the reader to the power supply and the PC for parameter assignment.

The degree of protection is IP65.

Pos.	Description
(1)	TNC reverse interface for connecting an antenna
(2)	LED operating display
(3)	24 VDC power supply
(4)	Ethernet interface (TCP/IP)
(5)	Digital I/O interface

REVIEW

5.4.1.2 Ordering data

Ordering data RF640R

Product	Article number
RF640R (ETSI) reader for EU, EFTA, Turkey	6GT2811-3BA00-0AA0
RF640R (FCC) reader for the USA	6GT2811-3BA00-1AA0
RF640R (CHINA) reader for CMIIT	6GT2811-3BA00-2AA0

Ordering data accessories

Product	Article number
Antenna mounting kit	6GT2890-0AA00
Connecting cable and connectors	
• Digital I/O, open cable ends, 5 m	• 6GT2891-0DH50
• Ethernet: 10 m (crossover cable)	• 6GT2891-1HN10
• Ethernet connector on reader according to IEC PAS 61076-3-117IE RJ-45 Plug PRO (IP67)	• 6GK1901-1BB10-6AA0
• Ethernet connector, Standard IE FastConnect RJ-45 Plug 180 (IP20)	• 6GK1901-1BB10-2AB0
• Ethernet cable sold by the meter, green	• 6XV1840-2AH10
Wide-range power supply unit for SIMATIC RF systems	
• With EU plug	• 6GT2898-0AA00
• With UK plug	• 6GT2898-0AA10
• With US plug	• 6GT2898-0AA20
24 V connecting cable 5 m between reader and power supply (for RF640R only, pin assignment is PNO-compliant)	6GT2891-0NH50
Set of protective caps Contains 3 protective caps for antenna output and one protective cap for digital I/O interface (required for IP65 degree of protection when some connectors are unused)	6GT2898-4AA00
RFID DVD "Software & Documentation"	6GT2080-2AA20

REVIEW

5.4.1.3 Status display

The device is equipped with a three colored LED. The LED can be lit in green, red or orange. The meaning of the indication changes in accordance with the color and state (on, off, flashing) of the LED:

Green LED	Red LED	Orange LED	Meaning
Off	Off	Off	The device is not connected to a power supply.
Flashing	Off	Off	In normal operation, no communication with the reader has taken place for a longer period of time.
On	Off	Off	The device is ready. The connection is established.
Off	Off	Flashing	More than one tag is in the field.
Off	Off	On	The device is starting up. The connection is established. Exactly one tag is in the field during normal operation.
Off	Flashing	Off	Error states with flash codes (see section Flashing codes RF640R/RF670R (Page 479))
Off	flashes 2x	Off	At the end of the startup

Note

LED is not lit orange?

If the LED does not light up orange even though a tag is located within the field, common causes are:

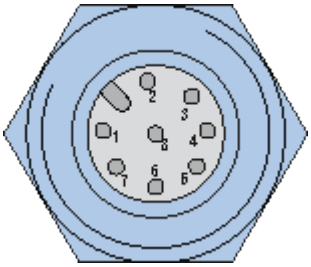
- Antenna is switched off
- A tag is used, that is not compatible with the reader protocol (EPC Global Class 1 Gen 2).
- Tag is defective
- Reader or antenna has a defect
- Tag is not in the field of radiation of the transmit antenna

REVIEW

For more detailed information on the flash codes of the reader see section Flashing codes RF640R/RF670R (Page 479)

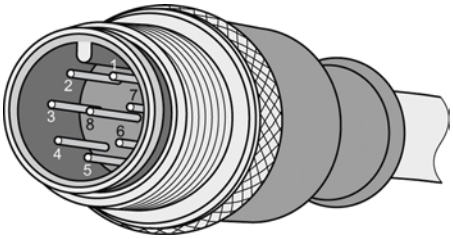
5.4.1.4 Pin assignment of the digital I/O interface

Pin assignment, socket

Digital I/O socket (on reader side)	Pin	Pin assignment
	1	GND (output to supply the digital outputs [not electrically isolated])
	2	VCC (output for supplying the digital outputs [not RF310M, RF680M electrically isolated])
	3	DO common
	4	DO 0
	5	DO 1
	6	DI 0
	7	DI common
	8	DI 1
	Shield	is applied to the reader housing so that the knurled ring is connected to GND of the reader.

View of the connector

Table 5- 13 Digital I/O, for cable with open cable ends

View of M12 connector	M12 pin	Wire color	Pin assignment
	1	white	GND (output to supply the digital outputs [not electrically isolated])
	2	brown	VCC (output for supplying the digital outputs [not electrically isolated])
	3	green	DO common
	4	yellow	DO 0
	5	gray	DO 1
	6	pink	DI 0
	7	blue	DI common
	8	red	DI 1
	Knurled ring	Shield	Knurled ring connected to GND of the reader

REVIEW

Wiring diagram M8 plug (cable end)

You will need to assemble your reader cable with a suitable connector that fits the interface shown above. Keep to the following wiring diagram:

Figure 5-9 Wiring diagram M8 connector

5.4.1.5 Connection scheme for the digital I/O interface

Connection possibilities

You can connect the RF640R reader in different ways. In general, the outputs and inputs should be connected as follows:

REVIEW

Output Outport (0), (1)

- Each output is rated for 0.5 A current and is electronically protected.
- Two digital outputs can be operated simultaneously each with up to 0.5 A (up to 1.0 A in total).
- The outputs are optically isolated through optocouplers.

Input Inport (0), (1)

- The inputs are optically isolated through optocouplers.
- Level Low 0 ... 3 V; High 3.6 to 24 V
- Sampling rate < 20 ms

The following diagrams illustrate various connection possibilities.

Voltage infeed through internal source (no electrical isolation)

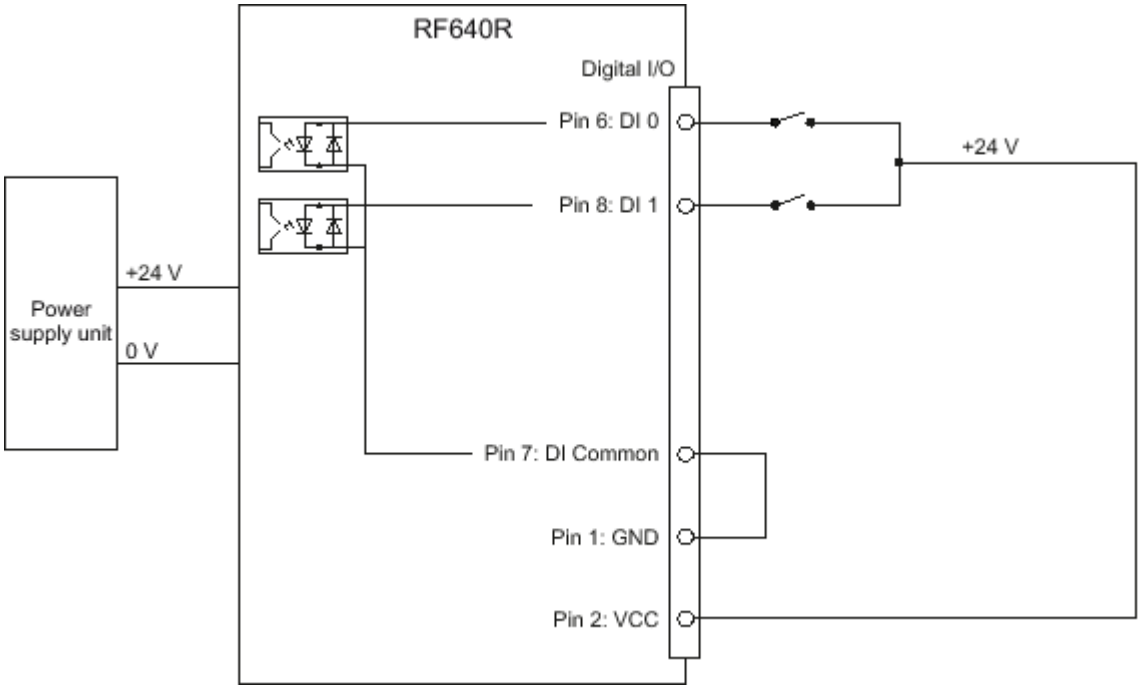


Figure 5-10 Example circuit 1: Digital inputs

REVIEW

Alternative connection possibilities:

- Pin 2 (VCC) to Pin 9 DI Common
- Pin 1 GND to busbar inputs

Voltage infeed through external source

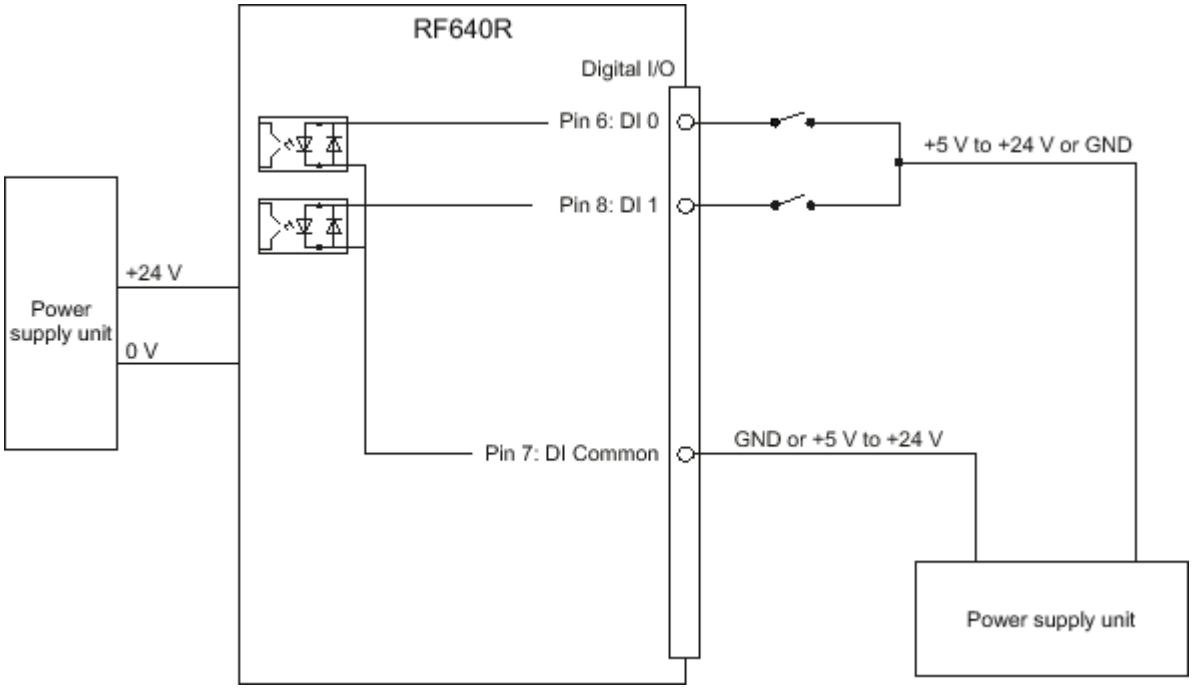


Figure 5-11 Example circuit 2: Digital inputs

Voltage infeed through external source with various voltages

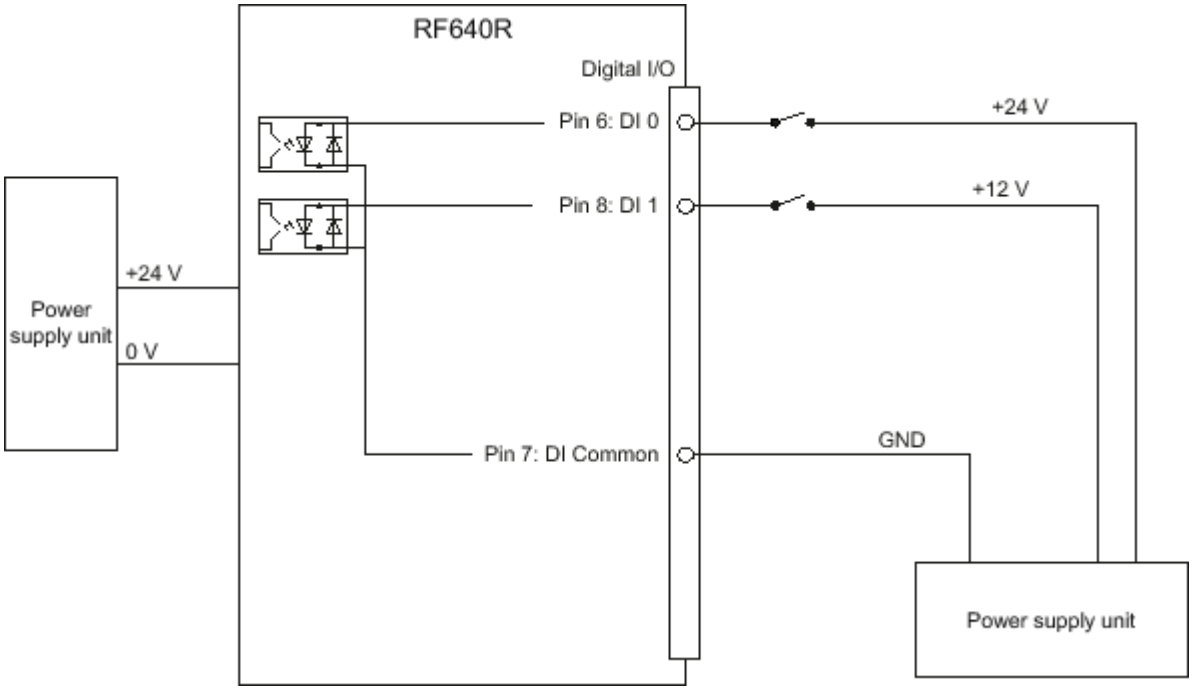


Figure 5-12 Example circuit 3: Digital inputs

REVIEW

Voltage infeed through internal source

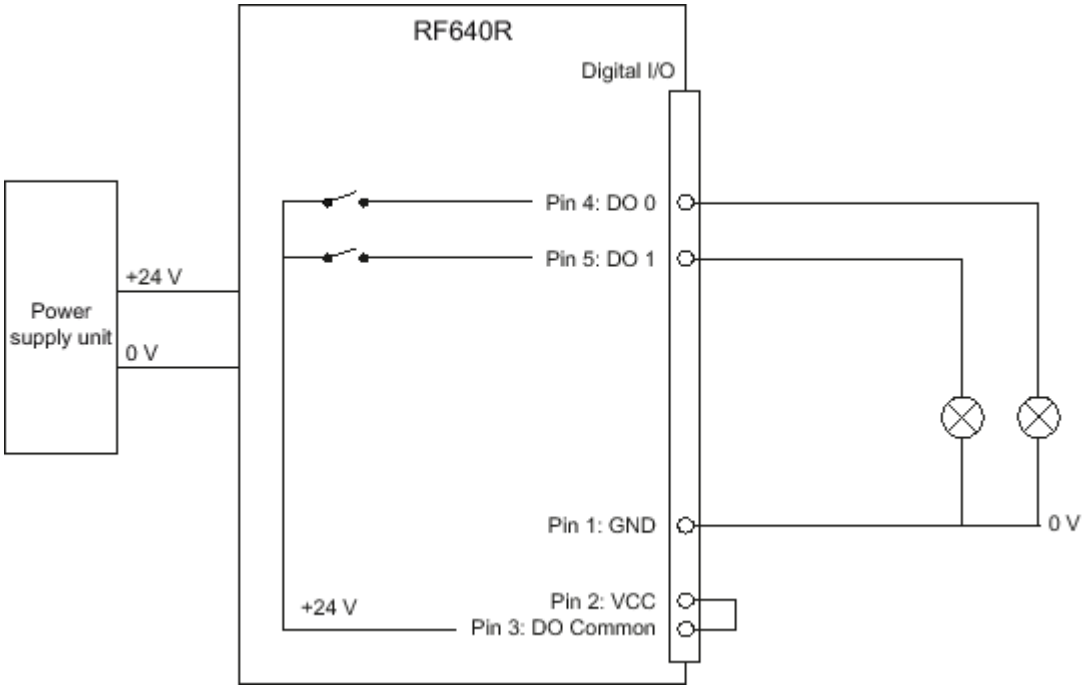


Figure 5-13 Example circuit 4: Digital outputs

Alternative connection possibilities:

- Pin 1 GND to Pin 3 DO Common
- Pin 2 (VCC) to busbar outputs

REVIEW

Voltage infeed through external source

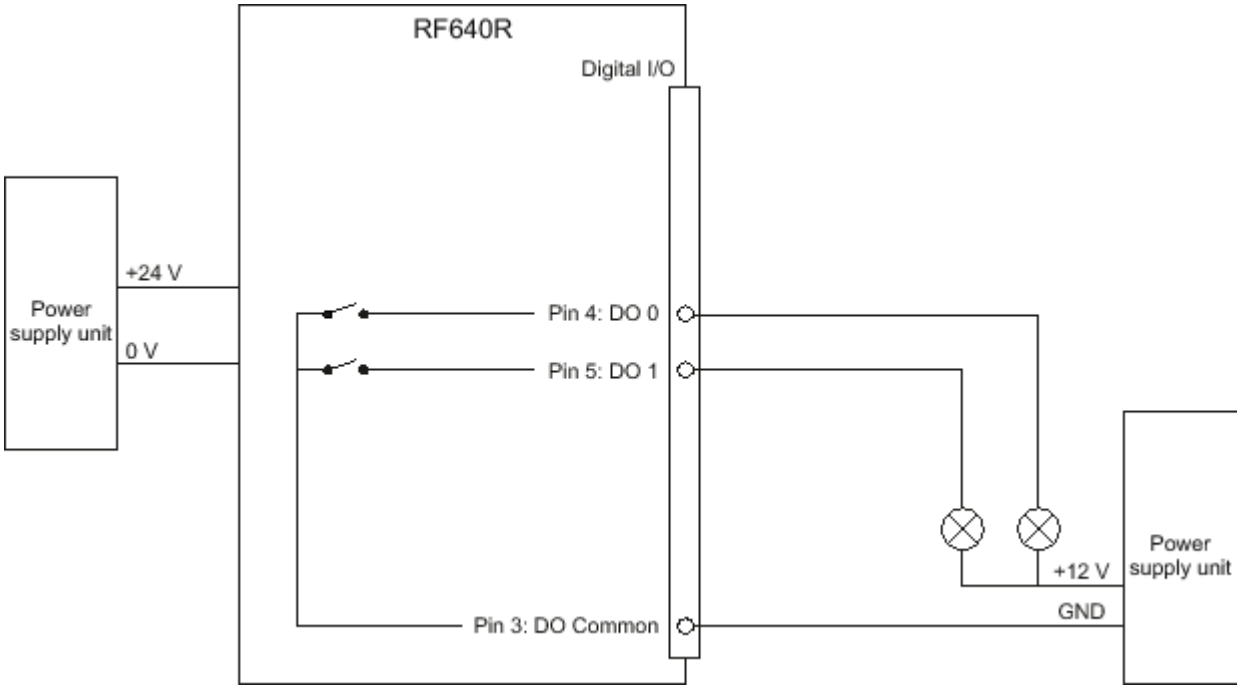


Figure 5-14 Example circuit 5: Digital outputs

Voltage infeed through an external source is shown here for 12°V by way of example. Other voltages are also permissible.

REVIEW

Voltage infeed through external source with various voltages

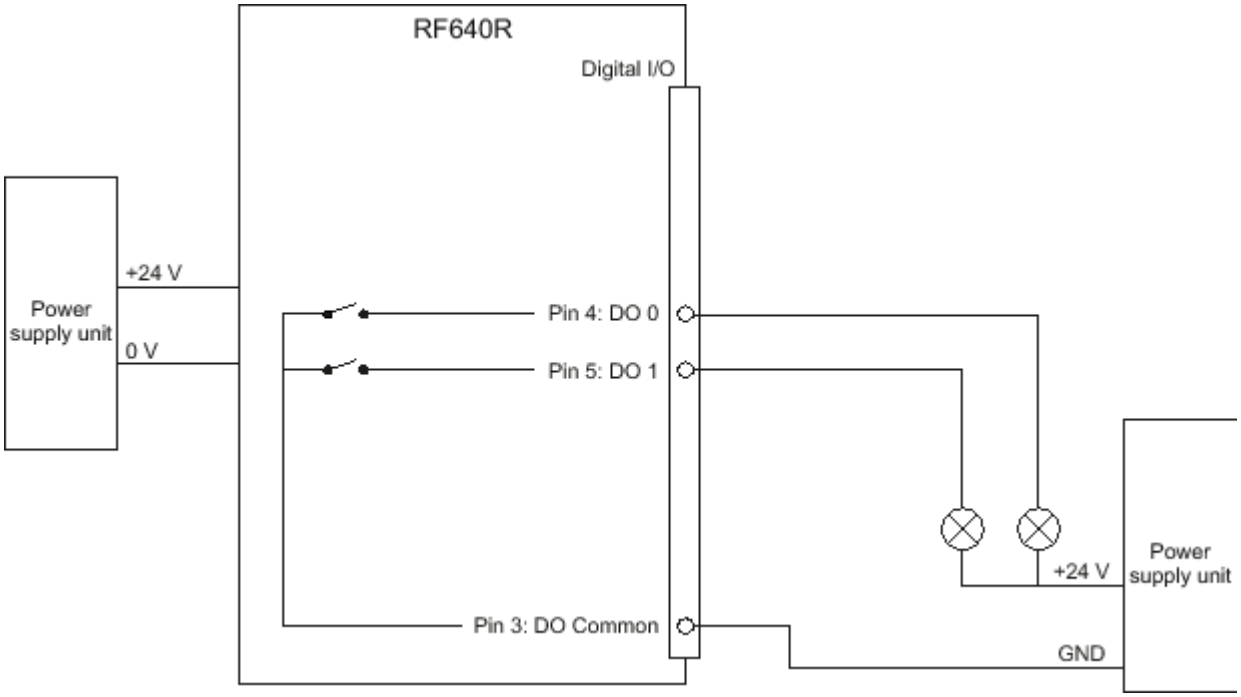
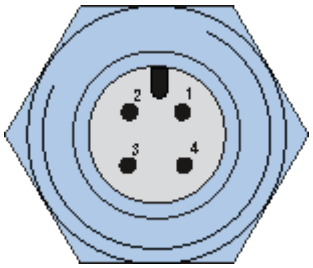


Figure 5-15 Example circuit 6: Digital outputs

REVIEW

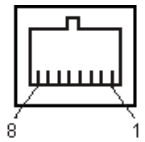
5.4.1.6 Pin assignment for power supply

Pin assignment of the power connections

Power connector (on reader side)	Pin	Pin assignment
	1 2 3 4	24 VDC Not connected Ground (0 V) Not connected

The power connector of the RF640R is conforms with the PNO standard, in other words, normal PROFINET IO connectors fit this interface.

5.4.1.7 Pin assignment for Industrial Ethernet interface

Industrial Ethernet (on reader side)	Pin	Pin assignment
	1	Transmit Data (+)
	2	Transmit Data (-)
	3	Receive Data (+)
	4	Terminated
	5	Terminated
	6	Receive Data (-)
	7	Terminated
	8	Terminated

Note

We recommend that only original Siemens Ethernet crossover cables are used (10 m cable: Order No. 6GT2891-1HN10) or the Siemens connector (see Section Ordering data (Page 130)) for connecting to the Ethernet socket of the reader. If plug-in connectors from other manufacturers are used, it may be difficult or even impossible to remove the plug from the reader

Note

No autocrossover

The RF640R reader does not support autocrossover!

REVIEW

5.4.1.8 Grounding connection

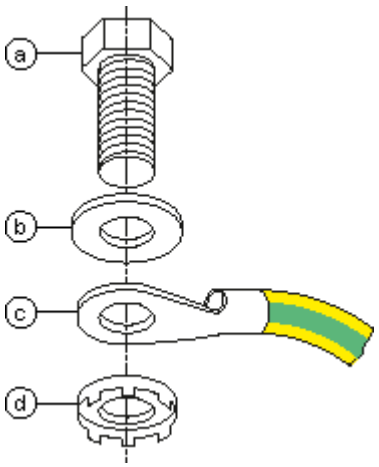
The RF640R can be electrically connected to ground potential by a contact washer. The tightening torque must be increased in this case to ensure that electrical contact is made (2.7 Nm).

⚠ WARNING

Hazardous voltage due to lightning strikes

Death or serious injury may occur as a result of lightning strikes to antennas mounted outside buildings.

If the reader is operated with antennas mounted outside buildings, it is imperative that the reader is electrically connected to the ground potential.

Ground connection		
	(a)	Hexagon-head screw
	(b)	Plain washer
	(c)	Cable lug
	(d)	Contact washer: Use contact washers according to the Siemens standard SN 70093-6-FSt-flNnnc-480h for ground connection, Siemens item No.: H70093-A60-Z3

5.4.2 Planning the use

REVIEW

5.4.2.1 Selecting the antenna

With the SIMATIC RF640R, there are two ways of using the antenna that are mutually exclusive:

- Either you use the internal antenna of the reader
- Or you connect an external antenna to the interface of the reader. The internal antenna of the reader can then, however, not be used at the same time.

You can select the active antenna using the configuration software, "RF-MANAGER Basic V2".

5.4.2.2 Internal antenna

Minimum mounting clearances of two readers

The RF640R has a circular polarized antenna. At 2000 mW ERP radiated power, due to the aperture angle of the antennas, their fields can overlap considerably. It is no longer possible to clarify in which antenna field access to the data of a tag is performed.

In order to avoid this, always keep a minimum distance of 6 m between two readers with the maximum radiated power of 500 mW ERP.

Dense Reader Mode (DRM)

The readers can also interfere with each other (secondary fields), if the channels (Reader TX, Transponder TX) overlap. In order to prevent a transponder channel overlapping with a reader channel, we recommend that the Dense Reader Mode (DRM) is used.

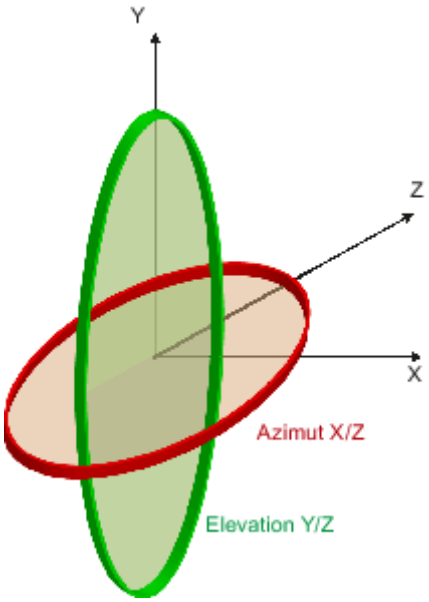
Note

Protective cap

If you use the internal antenna of the reader, we recommend that you close the external, unused antenna connector on the reader using the supplied protective cap.

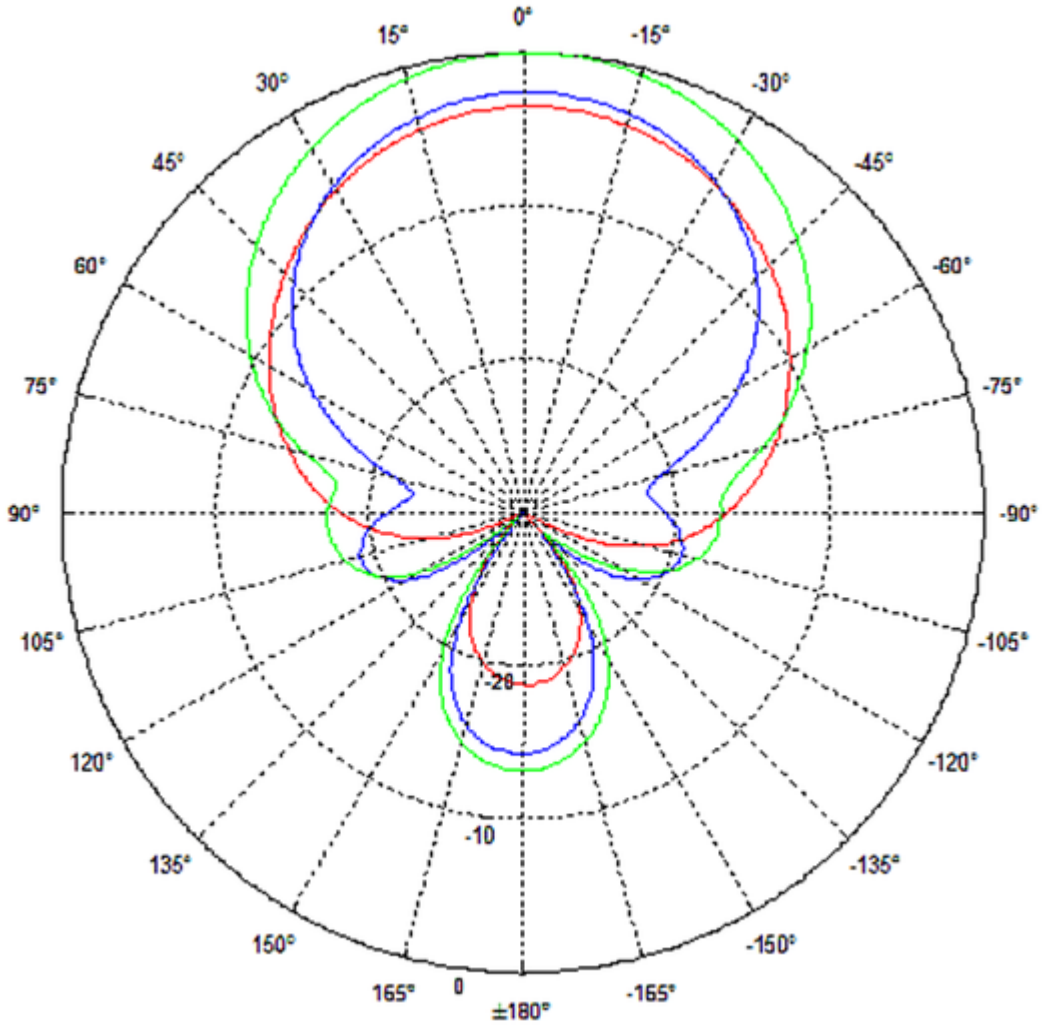
Antenna diagram for RF640R (ETSI)

The following radiation diagrams show the directional characteristics of the internal antenna of the RF640R (ETSI) reader. For the spatial presentation of the directional characteristics, the vertical plane (Azimuth section) as well as the horizontal plane (elevation section) must be considered. This results in a spatial image of the directional radiation pattern of the antenna with its main and auxiliary fields.



REVIEW

Radiation diagram (Azimuth section)



Vertical component of the polarization direction of the antenna

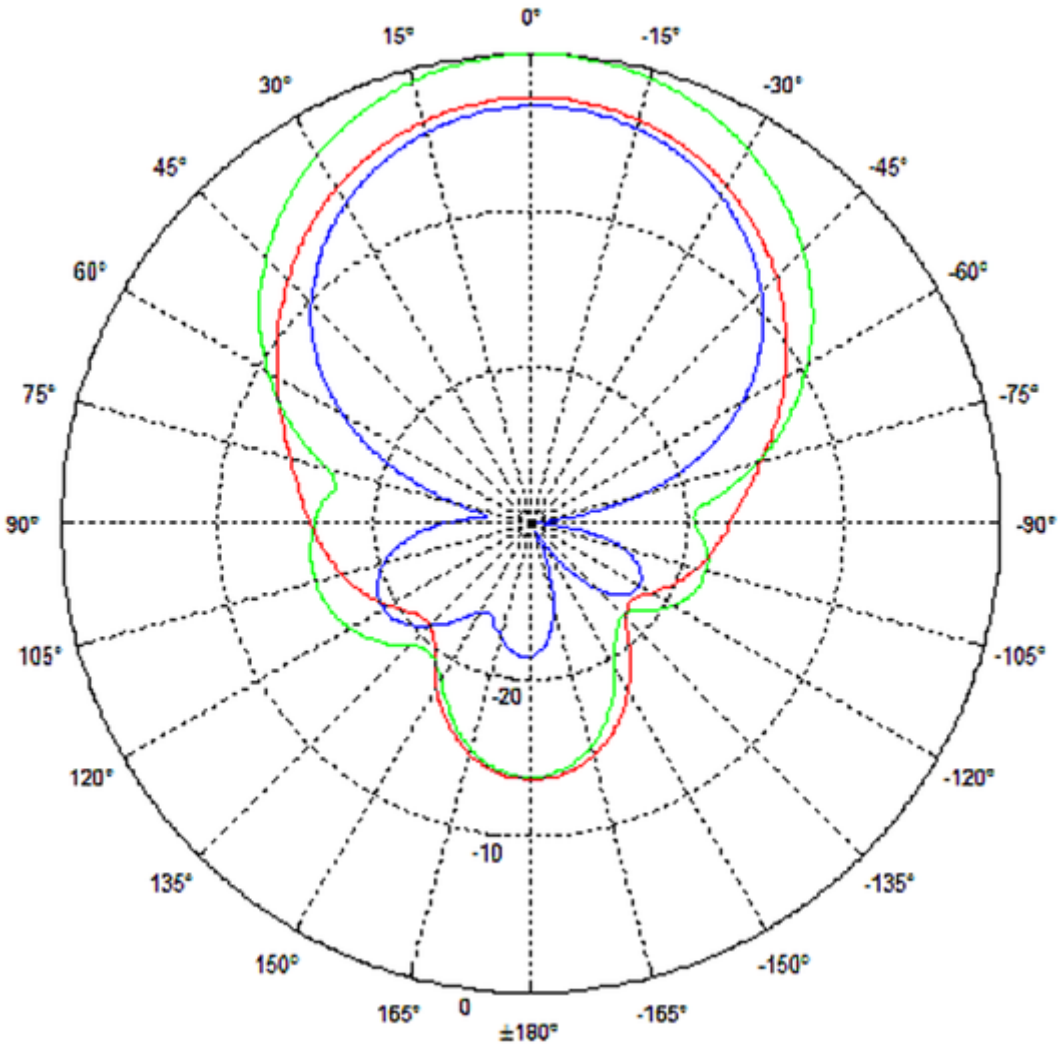
Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-16 Azimuth section

REVIEW

Radiation diagram (elevation section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-17 Elevation section

REVIEW

Overview of the antenna parameters

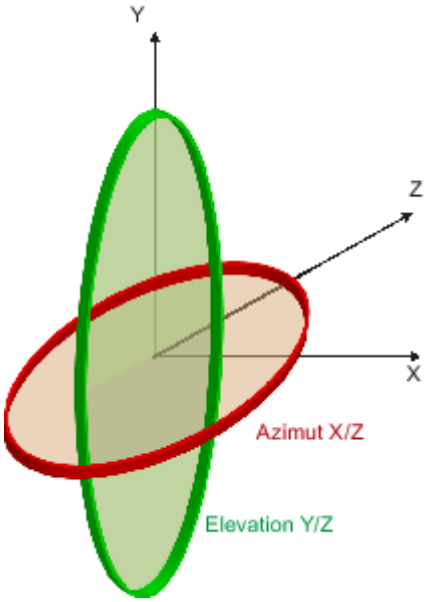
Table 5- 14 Maximum linear electrical aperture angle at 865 MHz:

Azimuth section	77,7°
Elevation section	66,1°
Typical antenna gain in the frequency range 865 to 868 MHz	4.0 dBi
Antenna axis ratio	0.7 dB

See also section Guidelines for selecting RFID UHF antennas (Page 55)

Antenna diagram for RF640R (FCC)

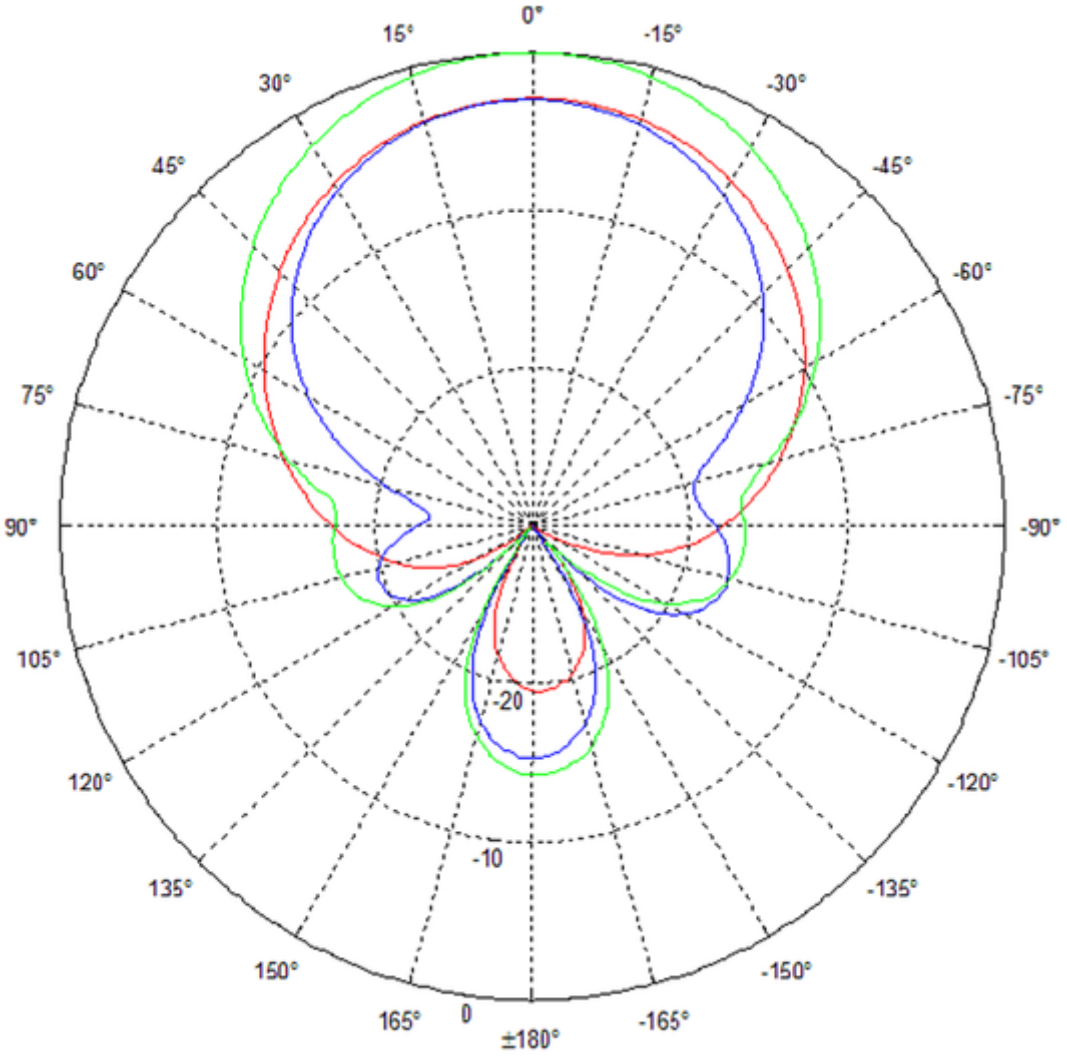
The following radiation diagrams show the directional characteristics of the internal antenna of the RF640R (FCC) reader. For the spatial presentation of the directional characteristics, the vertical plane (Azimuth section) as well as the horizontal plane (elevation section) must be considered. This results in a spatial image of the directional radiation pattern of the antenna with its main and auxiliary fields.



Azimuth XZ plane
Elevation YZ plane

REVIEW

Radiation diagram (Azimuth section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

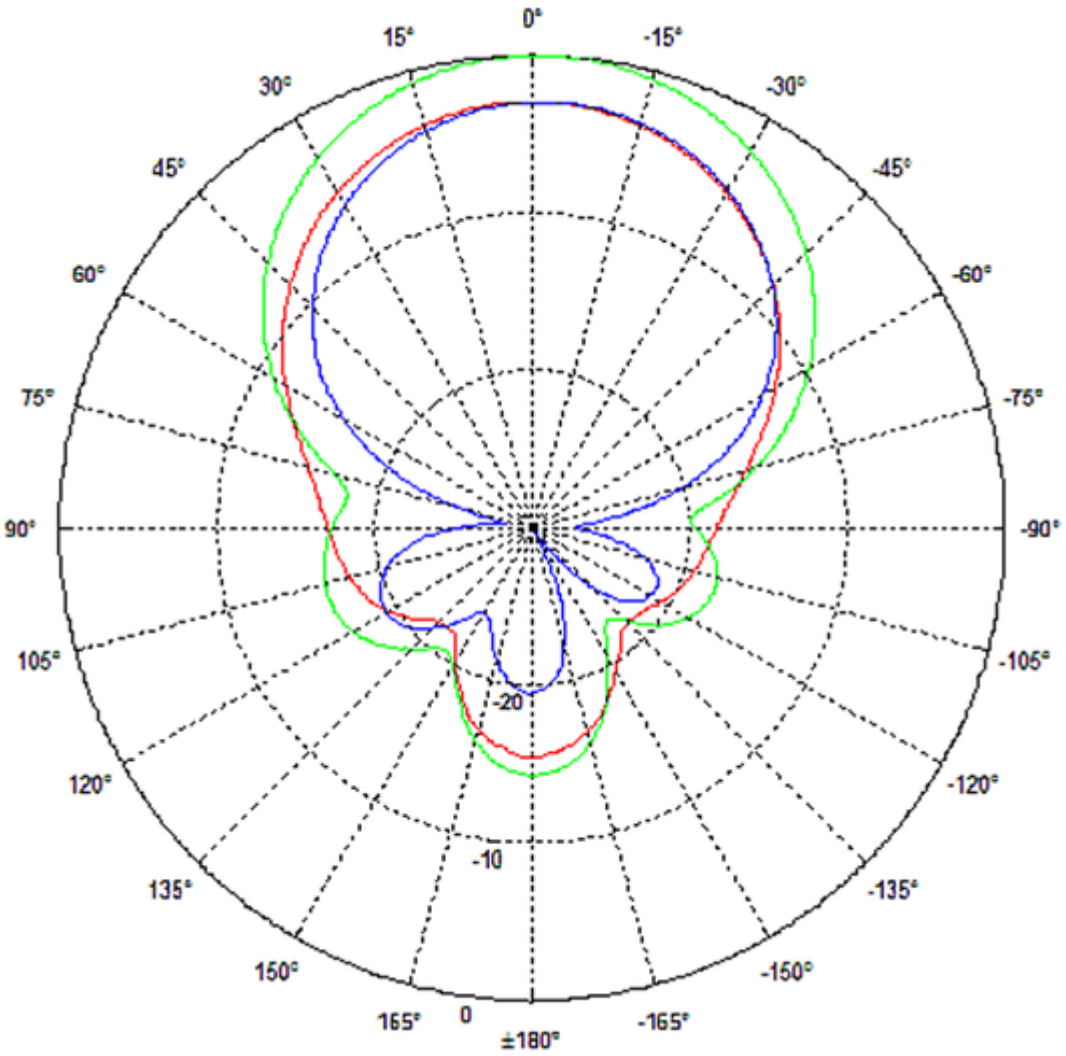
Right circular component of the polarization direction of the antenna

Figure 5-18 Azimuth section

REVIEW

REVIEW

Radiation diagram (elevation section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-19 Elevation section

Overview of the antenna parameters

Table 5- 15 Maximum linear electrical aperture angle at 865 MHz:

Azimuth section	75,4 °
Elevation section	69,1 °
Typical antenna gain in the frequency range 902 to 928 MHz	4.0 dBi ± 0.5 dB
Antenna axis ratio	<1 dB

see also section Guidelines for selecting RFID UHF antennas (Page 55).

Interpretation of directional radiation patterns

The following overview table will help you with the interpretation of directional radiation patterns.

The table shows which dBi values correspond to which read/write ranges (in %): You can read the radiated power depending on the reference angle from the directional radiation patterns, and thus obtain information on the read/write range with this reference angle with regard to a transponder.

The dBr values correspond to the difference between the maximum dBi value and a second dBi value.

REVIEW

Deviation from maximum antenna gain [dBr]	Read/write range [%]
0	100
-3	70
-6	50
-9	35
-12	25
-15	18
-18	13

Example

As one can see from the section Antenna diagram for RF640R (ETSI) (Page 141), the maximum antenna gain is 0 dB. In the Azimuth diagram, the antenna gain falls by 3°dB at approximately ± 39°. Therefore the dBr value is -3. The antenna range is only 50% of the maximum range at ± 39° from the Z axis within the horizontal plane.

Antenna/read point configurations

The RF640R reader has an internal circular polarized antenna. You can cover one read point with this antenna. When several RF640R readers are used, the readers are addressed via the SIMATIC level.

5.4.2.3 External antenna

Preassembled standard cables in lengths of 3 m, 5 m, 15 m and 20 m are available to connect the antenna.

The read range is limited by the cable loss. The maximum range can be achieved with the cable 6GT2815-0BH30 (length 3 m), since this has the lowest cable loss.

Examples of possible antenna reading point configurations

- A data source with an external antenna for a reading point.
- As an alternative, a data source with an internal antenna for a reading point.

5.4.3 Installing / mounting

Requirement

WARNING

Make sure that the wall or ceiling can hold four times the total weight of the device.

Note

Close unused connectors

If you do not use connectors on the reader, it is advisable to close the unused connectors with protective caps. You can order the protective cap set using the MLFB specified in the section "Ordering data".

CAUTION

Emitted radiation

The transmitter complies with the requirements of Health Canada and the FCC limit values for subjecting persons to HF radiation, provided that a minimum spacing of 26 cm exists between antenna and person. When the antennas are installed, you must therefore ensure that a minimum spacing of 26 cm is maintained between personnel and antennas.

Mounting/installing the device

You can mount the reader in two different ways:

- Via a standardized VESA 100 mounting system using the Antenna Mounting Kit (see section Mounting with antenna mounting kit (Page 331)). Tighten the M4 screws on the rear of the reader using a maximum torque of ≤ 1.3 Nm.
- Directly onto a flat surface.

REVIEW

The positions of the fixing holes for the device are shown in the section Dimension drawings (Page 153).

5.4.4 Configuration/integration

An Ethernet interface is available for integrating the device into system environments/networks. Over the Ethernet interface and with a direct connection to the PC, the RF640R can be configured in two different ways:

- Using RF-MANAGER Basic V2
- Using a user application (XML commands)

The communication interface transfers the data over the RF-MANAGER Basic to the IT, ERP and SCM systems as well as to SIMATIC controllers. Alternatively the data is transferred to user applications by means of XML commands.

Simple process controls (e.g. signal lights) can be directly implemented using the write/read device via two digital inputs and outputs.

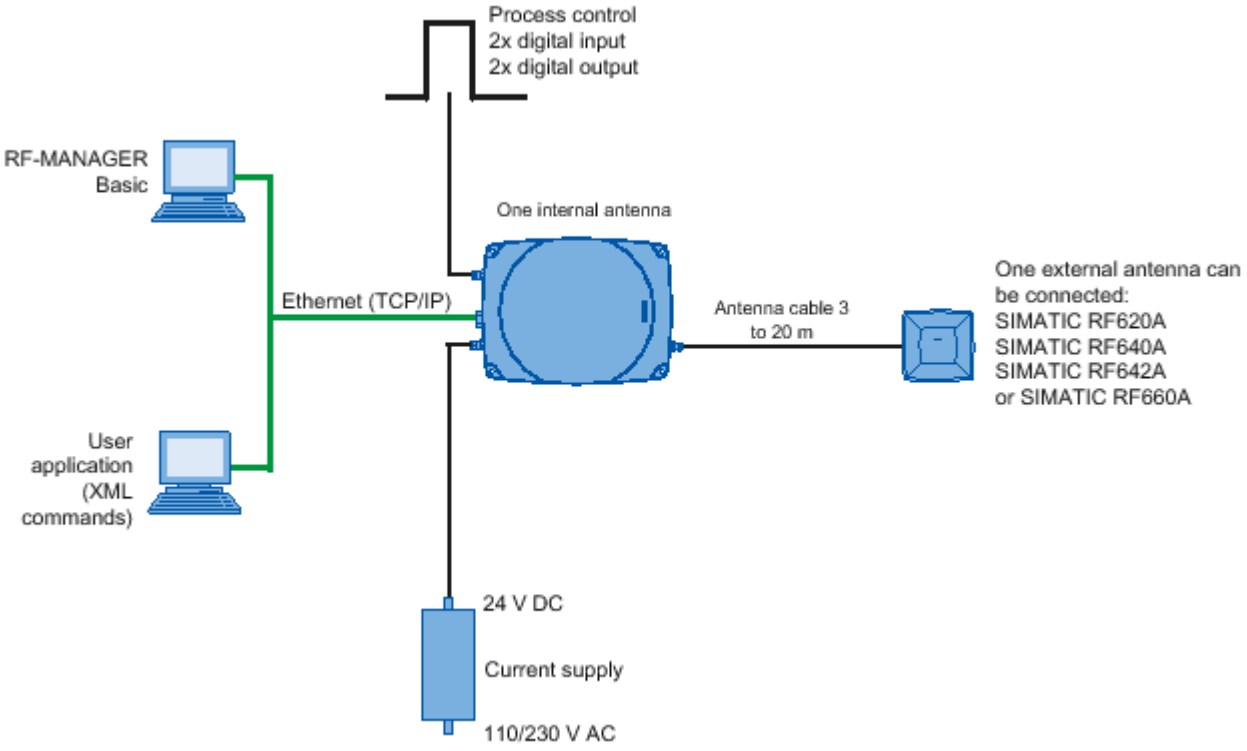


Figure 5-20 Overview of configuration of the RF640R reader

REVIEW

5.4.5 Technical data

5.4.5.1 Mechanical data

Mechanical data		
Weight		approx. 1700 g
Housing dimensions (L x W x H)		252 x 193 x 52 mm, without connections
Material for housing top section		ABS (GF 20), silicone-free
Material for housing bottom section		Aluminum
Color of housing top section		Pastel turquoise
Color of housing bottom section		Silver
Status displays on the device		1 LED Colors: red, yellow, green
Interfaces		
	Antenna connectors	1 x RTNC plug
	Power supply	1 x plug (4-pin M12)
	Digital I/O interface	1 x socket (8-pin M12)
	Digital inputs	2
	Digital outputs	2 (500 mA each; max. 1000 mA in total)
	Ethernet	RJ-45 TCP/IP (push-pull) 10/100 Mbps
MTBF in years		14.3

Thermal and electrical properties			
Power supply • Permitted range		20 to 30 VDC [1]	
Power supply		Current consumption (in standby mode, no transmit power)	Power requirement (in standby mode, no transmit power)
	20 V input voltage on the reader, typical	140 mA	2.8 W
	24 V input voltage on the reader, typical	120 mA	2.88 W
	30 V input voltage on the reader, typical	100 mA	3.0 W
Power supply		Current consumption (at 1000 mW transmit power / 1600 mW ERP radiated power)	Power requirement (at 1000 mW transmit power / 1600 mW ERP radiated power)
	20 V input voltage on the reader, typical	530 mA	10.6 W
	24 V input voltage on the reader, typical	450 mA	10.8 W
	30 V input voltage on the reader, typical	370 mA	11.1 W
Rampup time		19 s	

1) All supply and signal voltages must be safety extra low voltage (SELV/PELV according to EN 60950)

24 VDC supply: safe (electrical) isolation of extra-low voltage (SELV / PELV acc. to EN 60950)

REVIEW

Mechanical environmental conditions	
Shock resistant acc. to EN 60068-2-27 Vibration acc. to EN 60068-2-6	50 g[1] 20 g[1]
Climatic conditions	
Ambient temperature during operation	-25 °C to +55 °C (a 10-minute warm-up time must be allowed at an operating temperature below -20 °C)
Ambient temperature for transport and storage	-40 °C to +85 °C

1) The values for shock and vibration are maximum values and must not be applied continuously.

EMC & approvals/conformity for ETSI variant	
Electromagnetic compatibility	ETSI EN 301 489-1 / -3 EN 302 208 V1.3.1 EN 302 208 V1.4.1
Approvals/Conformity	• Radio according to the R&TTE directive • CE • ETSI EN 302 208 V1.3.1 • ETSI EN 302 208 V1.4.1 • Reader degree of protection acc. to EN 60529 (IP65) • RoHS-compliant according to EU Directive 2002/95/EC • Human exposure

REVIEW

EMC & approvals for FCC variant	
Electromagnetic compatibility	FCC Part 15
Approvals	• FCC, cULus • IEC60950, including US and Canadian variants of it • Reader degree of protection acc. to EN 60529 (IP65) • FCC CFR47 Part 15.247 • RoHS-compliant according to EU Directive 2002/95/EC • Industrial Canada, RSS-210, Issue 7, June 2007

5.4.5.2 Technical data according to EPC and ISO

Technical specifications	
Frequency accuracy	max.± 10 ppm
Channel spacing	EU, EFTA, Turkey: 600 kHz US: 500 kHz China: 250 kHz
Modulation methods	ASK: DSB modulation & PR-ASK modulation Encoding, Manchester or Pulse Interval (PIE)
Effective radiated power with internal antenna • ETSI/CMIIT: • FCC	 • ≤ 1.6 W ERP • ≤ 3.3 W EIRP
Effective radiated power with external antenna • ETSI/CMIIT: • FCC	 • ≤ 2.0 W ERP • ≤ 4.0 W EIRP
Transmit power • ETSI/CMIIT: • FCC	 • ≤ 1.0 W • ≤ 1.25 W

REVIEW

Reading range	
Antennas mounted on opposing sides (portal configuration)	max. 10 m
Antennas mounted on the same side	max. 5 m (dependent on transponder)

ETSI frequencies	
Frequency range for Europe, EFTA, Turkey, South Africa, Thailand (ETSI) ETSI EN 302 208 V1.4.1 (valid since October 23, 2012, publication in the Official Journal of the European Union)	865.7 ... 867.5 MHz (4 channels LBT optional at max. 2 W ERP)
Frequency range India	865 ... 867 MHz (10 channels at 4 W EIRP)
Frequency range Russia	866.1 ... 867.6 MHz (8 channels at 2 W ERP)
Frequency range Singapore	866 ... 869 MHz (11 channels at 0.5 W ERP)

FCC frequencies	
Frequency range USA; Argentina, Bolivia, Canada, Mexico, Thailand (FCC)	902 ... 928 MHz (50 channels at max. 4 W EIRP, frequency hopping)
Frequency range Brazil	915.125 ... 927.875 MHz (52 channels at max. 4 W EIRP, frequency hopping)
Frequency range South Korea	917.1 ... 920.4 MHz (7-16 channels at max. 4 W EIRP, frequency hopping)

CMIIT frequencies	
Frequency range China	920.625 ... 924.375 MHz (16 subchannels at 2 W ERP)

5.4.6 Dimension drawings

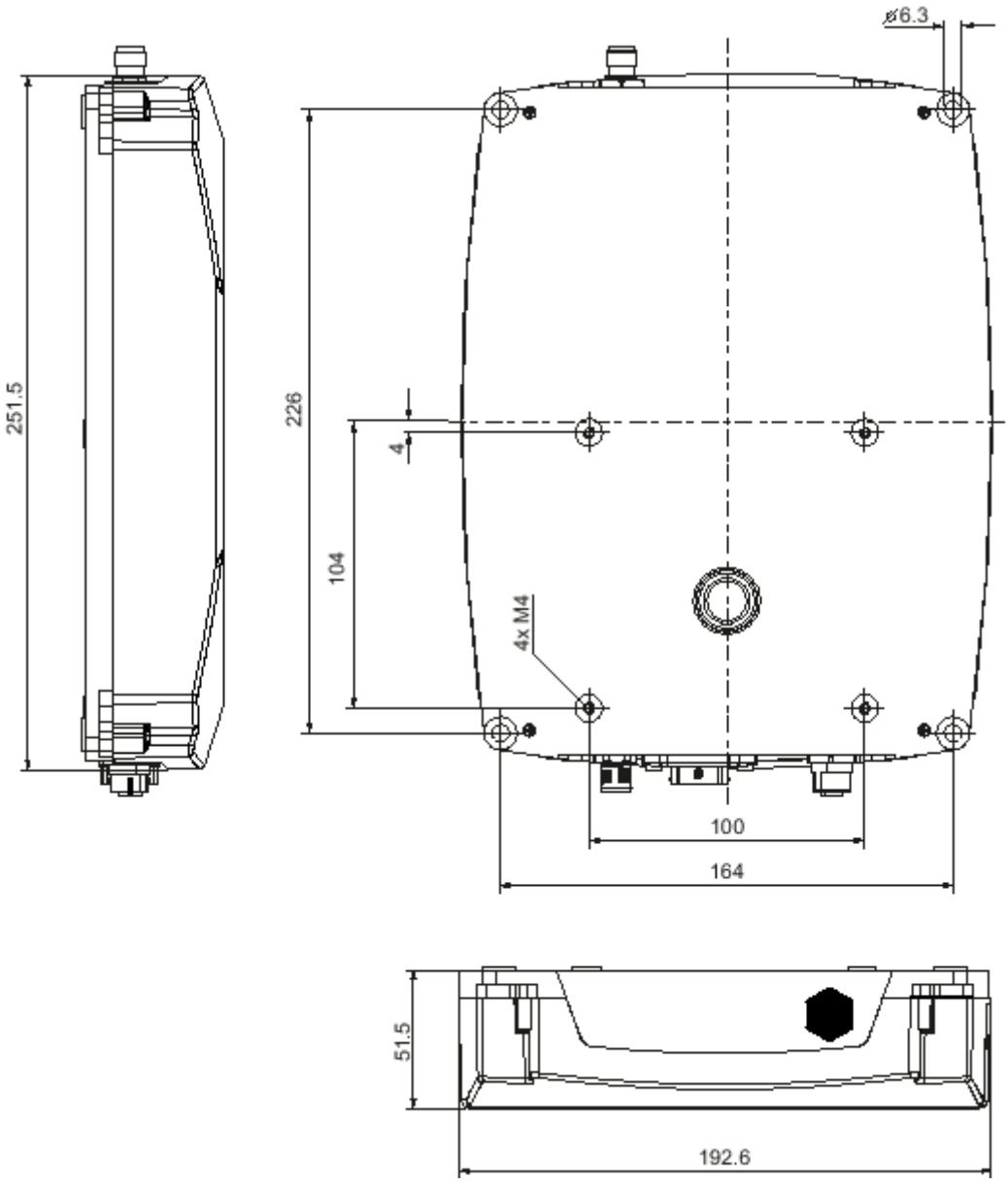


Figure 5-21 Dimensional drawing of RF640R

All dimensions in mm (± 0.5 mm tolerance)

REVIEW

5.4.7 Certificates and approvals

Note

Marking on the readers according to specific approval

The certificates and approvals listed here apply only if the corresponding mark is found on the readers.

Table 5- 16 6GT2811-3BA00-0AA0

Certificate	Description
CE	Conformity with R&TTE directive
TA-2012/548	South Africa approval: Radio Equipment Type Approval

Table 5- 17 6GT2811-3BA00-1AA0

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. FCC ID: NXW-RF600R
Industry Canada Radio Standards Specifications	RSS-210 Issue 6, Sections 2.2, A8 IC: 267X-RF600R, Model RF640R
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

REVIEW

Standard	
	Brazil radio approval Marking on the reader:  Statement about approval: Este equipamento opera em caráter secundário, isto é, não tem direito à proteção contra interferência prejudicial, mesmo de estações do mesmo tipo e não pode causar interferência a sistemas operando em caráter primário. Reader certificate: ANATEL 3377-12-4061
	KCC Certification Marking on the reader: Type of equipment: A급 기기 (업무용 방송통신기자재) Class A Equipment (Industrial Broadcasting & Communication Equipment) 이 기기는 업무용(A급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라 며, 가정외의 지역에서 사용하는 것을 목적으로 합니다. This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home. Reader certificate: KCC-CRM-RF5-RF640R
H-11386	Argentina radio approval: Registro de la COMISION NACIONAL DE COMUNICACIONES
RCPSIRF12-0880	Mexico radio approval: CERTIFICADO DE HOMOLOGACION

REVIEW

Table 5- 18 6GT2811-3BA00-2AA1

Standard	
CMIIT Certification	China radio approval Marking on the reader: CMIIT ID: 2012DJ2918

5.4.7.1 FCC information

Siemens SIMATIC RF640R (FCC): 6GT2811-3BA00-1AA0

FCC ID: NXW-RF600R

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification.

It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

REVIEW

5.4.7.2 IC-FCB information

Siemens SIMATIC RF640R (FCC): 6GT2811-3BA00-1AA0

IC: 267X-RF600R, Model RF640R

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d`Industrie Canada applicables aux appareils radio exempts de licence. L`exploitation est autorisée aux deux conditions suivantes :

(1) L`appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l`appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d`en compromettre le fonctionnement.

Industry Canada Notice

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Transmitter power and antenna information for antennas with a gain less than 6 dBi:

This device has been designed to operate with the SIMATIC RF620A antenna 902-928, the SIMATIC RF640A antenna 902-928 as well as the SIMATIC RF660A antenna 902-928 listed below, and having a maximum gain of 5.5 dBi. Arbitrary transmission power settings in combination with other antennas or antennas having a gain greater than 5.5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

Transmitter power and antenna information for antennas with a gain greater 6 dBi:

This device requires professional installation. Antennas with a gain greater 6 dBi may be used provided the system does not exceed the radiation power of 4000 mW E.I.R.P. This device has been designed to operate with the SIMATIC RF642A antenna 902-928 exceeding the maximum gain of 5.5 dBi under the restriction that the RF power at the input of the antenna must be set to meet the following relation: RF power (dBm) ≤ 30 dBm – (antenna gain (dBi) – 6 dBi) Other antennas or system configurations for antennas having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

REVIEW

5.5 RF650R reader

5.5.1 Description

5.5.1.1 Overview

The SIMATIC RF650R is a stationary reader in the UHF frequency band without an integrated antenna. Up to four external UHF RFID antennas can be connected via TNC reverse connections.

The maximum RF power output is 1000°mW at the reader output. A radiant power of up to 2000 mW ERP is achieved when the appropriate antennas and antenna cables are used. The interfaces (Ethernet, M12 power supply, M12 digital I/O interface) are located along the narrow lower front edge. These interfaces can be used to connect the reader to the power supply and the PC for parameter assignment.

The degree of protection is IP30.

	Pos.	Description
	①	TNC reserve interfaces for connecting up to 4 antennas
	②	LED operating display
	③	Digital I/O interface
	④	RS-422 interface (M12 plug, 8-pin)
	⑤	Ethernet interface (TCP/IP) (RJ-45 plug, 4-pin)

REVIEW

5.5.1.2 Ordering data

Ordering data RF650R

Product	Article number
RF650R (ETSI) reader basic unit for EU, EFTA, Turkey	6GT2811-6AB20-0AA0
RF650R (FCC) reader basic unit for the USA	6GT2811-6AB20-1AA0
RF650R (CMIIT) reader basic unit for China	6GT2811-6AB20-2AA0

Ordering data accessories

Product	Article number
Antenna mounting kit	6GT2890-0AA00
Connecting cable and connectors	
• Digital I/O, open cable ends, 5 m	• 6GT2891-0CH50
• Ethernet: 10 m (crossover cable)	• 6GT2891-1HN10
• Ethernet connector on reader according to IEC PAS 61076-3-117IE RJ-45 Plug PRO (IP67)	• 6GK1901-1BB10-6AA0
• Ethernet connector, Standard IE FastConnect RJ-45 Plug 180 (IP20)	• 6GK1901-1BB10-2AB0
• Ethernet cable sold by the meter, green	• 6XV1840-2AH10
Wide-range power supply unit for SIMATIC RF systems	
• With EU plug	• 6GT2898-0AA00
• With UK plug	• 6GT2898-0AA10
• With US plug	• 6GT2898-0AA20
24 V connecting cable 5 m between reader and power supply unit (for RF670R only, pin assignment is PNO-compliant)	6GT2891-0NH50
Set of protective caps Contains 3 protective caps for antenna output and one protective cap for digital I/O interface (required for IP65 degree of protection when some connectors are unused)	6GT2898-4AA00
RFID DVD "Software & Documentation"	6GT2080-2AA20

5.5.1.3 Status display

The device is equipped with 7 three-colored LEDs. The operating statuses of the reader are displayed by the "RUN/STOP", "ERROR", "MAINT" and "PRESENCE" LEDs. The LEDs can be lit green, red or orange. The meaning of the display changes according to the color and status (on, off, flashing) of the LED:

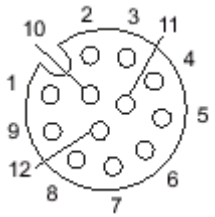
R/S	ERR	MT	PRE	Meaning
○	○	○	○	The device is turned off.
●	●	●	●	The device is starting up.
●	-	-	-	The device is ready for operation. The connection is established.
☼	-	-	-	The device is working. Transponder data can be read or written.
-	☼	-	-	There is an error.
-	-	☼	-	Maintenance work required.
-	-	-	●	There is transponder in the antenna field.
-	-	-	☼	There are multiple transponders in the antenna field.

For more detailed information on the flash codes of the reader, refer to the section LED displays RF650R/RF680R/RF685R (Page 480).

5.5.1.4 Pin assignment of the digital I/O interface

View of socket (reader end)

Table 5- 19

M12 socket (reader end)	Pin	Pin assignment
	1	GND (output for supply of digital inputs/outputs [not electrically isolated])
	2	VCC (output for supply of digital inputs/outputs [not electrically isolated])
	3	DO Common / Outport Common
	4	DO 0 / Outport 00
	5	DO 1 / Outport 01
	6	DO 2 / Outport 02
	7	DO 3 / Outport 03
	8	DI 0 / Inport 00
	9	DI Common / Inport Common
	10	DI 1 / Inport 01
	11	DI 2 / Inport 02
	12	DI 3 / Inport 03

REVIEW

Wiring diagram M12 connector (cable end)

You will need to assemble your reader cable with a suitable connector that fits the interface shown above. Keep to the following wiring diagram:

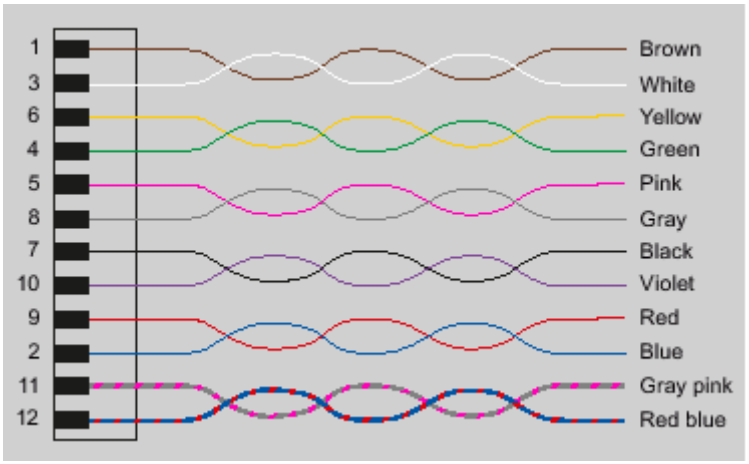


Figure 5-22 M12 connector wiring diagram

5.5.1.5 Connection scheme for the digital I/O interface

Connection possibilities

You can connect the RF650R reader in different ways. In general, the outputs and inputs should be connected as follows:

Output Outport (0), (1), (2), (3)

- Each output is rated for 0.5 A current and is electronically protected.
- 4 digital outputs can be operated simultaneously each with up to 0.5 A (up to 1.0 A in total).
- The outputs are optically isolated through optocouplers.

Input Inport (0), (1), (2), (3)

- The inputs are optically isolated through optocouplers.
- Level Low 0 ... 3 V; High 3.6 ... 24 V
- Sampling rate < 20 ms

The following diagrams illustrate various connection possibilities.

REVIEW

Voltage infeed from internal source (no electrical isolation)

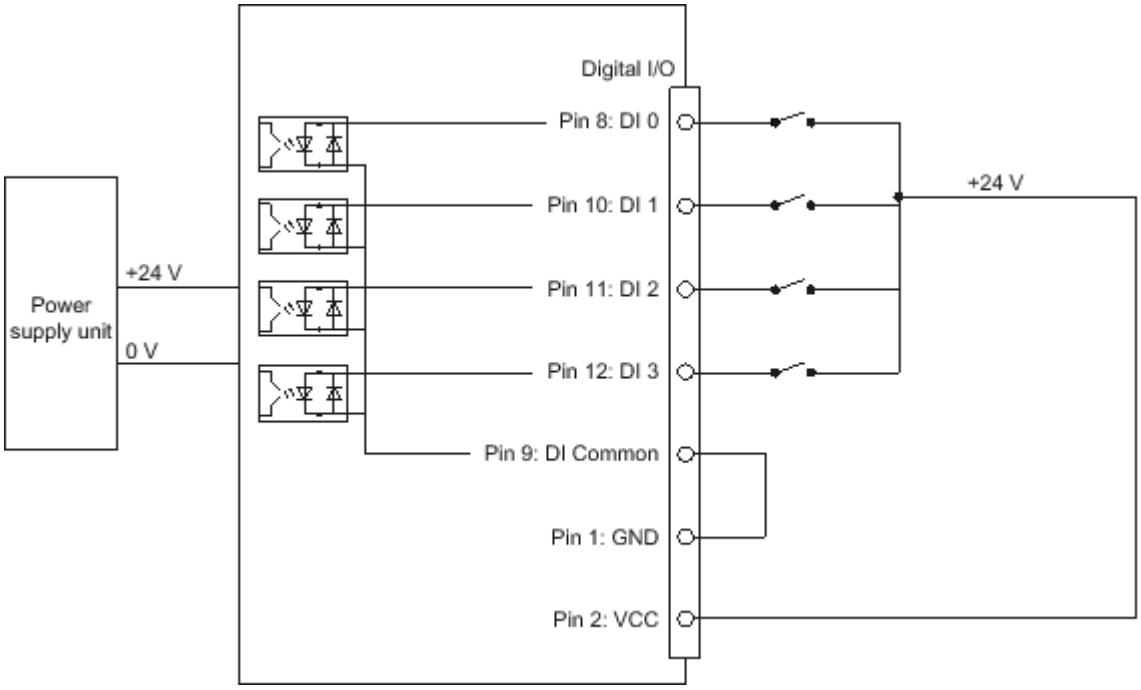


Figure 5-23 Circuit example 1: Digital inputs

Alternative connection possibilities:

- Pin 2 (VCC) to Pin 9 DI Common
- Pin 1 GND to busbar inputs

REVIEW

Voltage infeed from external source

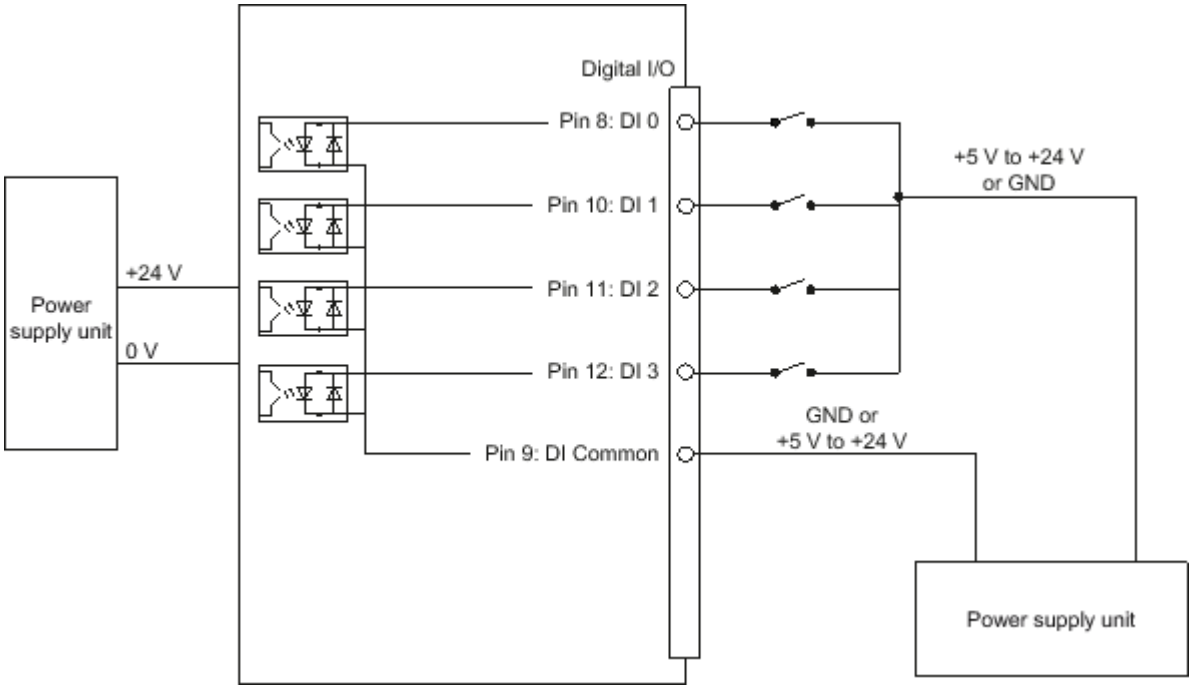


Figure 5-24 Circuit example 2: Digital inputs

Voltage infeed from external source with various voltages

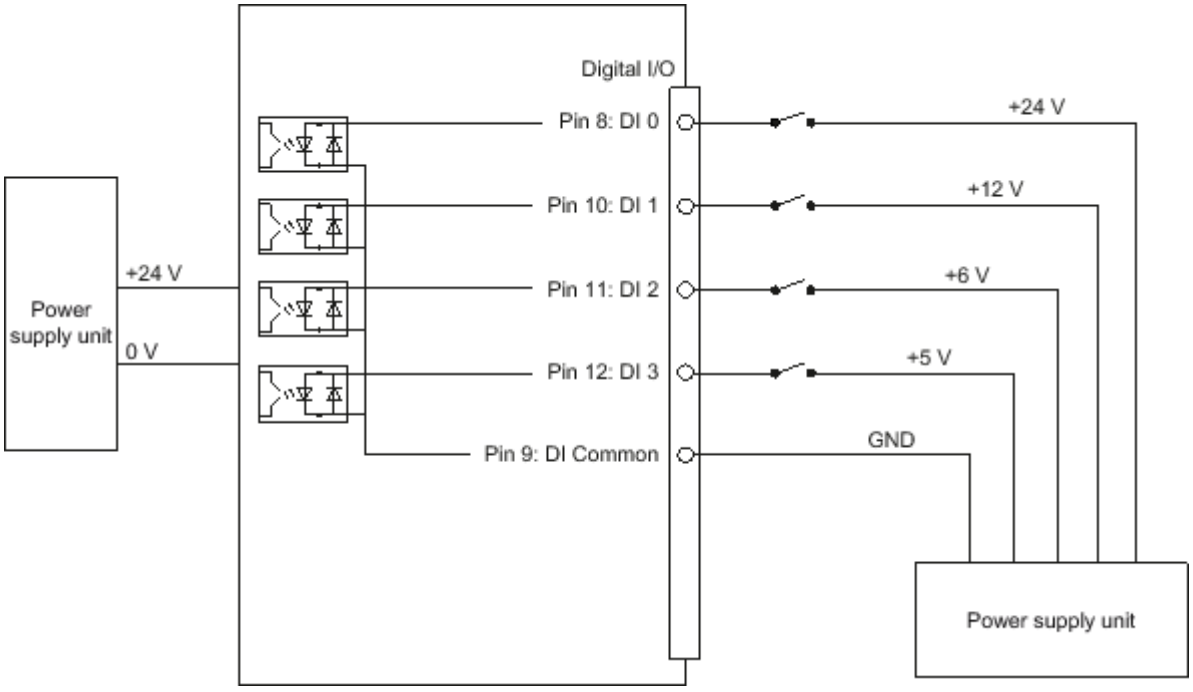


Figure 5-25 Circuit example 3: Digital inputs

REVIEW

Voltage infeed from internal source

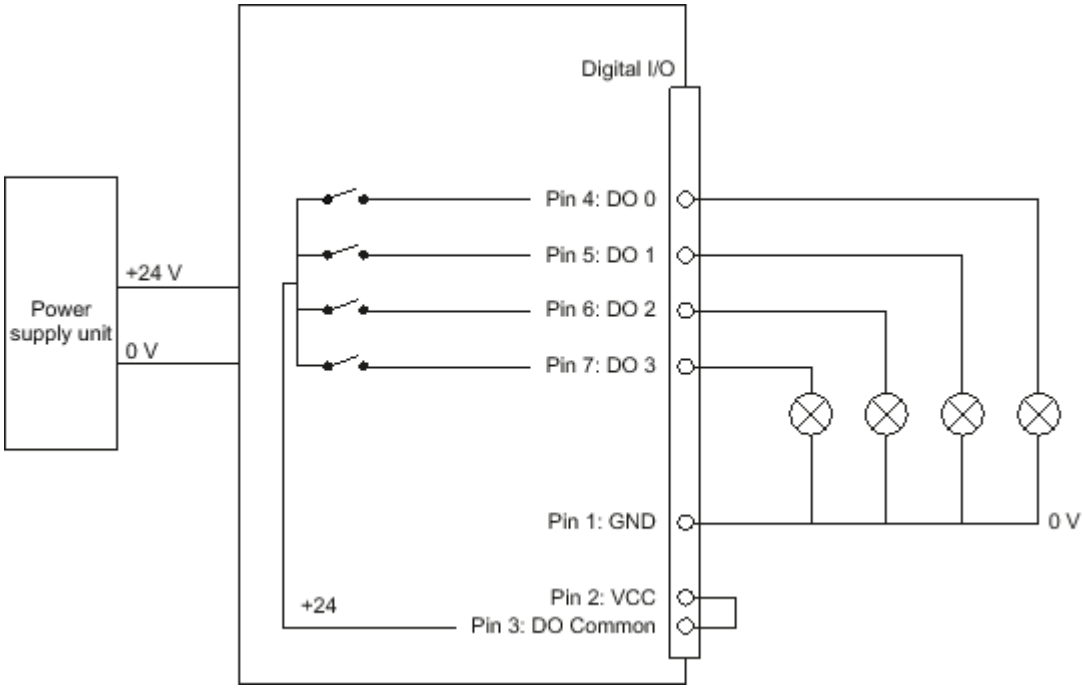


Figure 5-26 Circuit example 4: Digital outputs

Alternative connection possibilities:

- Pin 1 GND to Pin 3 DO Common
- Pin 2 (VCC) to busbar outputs

REVIEW

Voltage infeed from external source

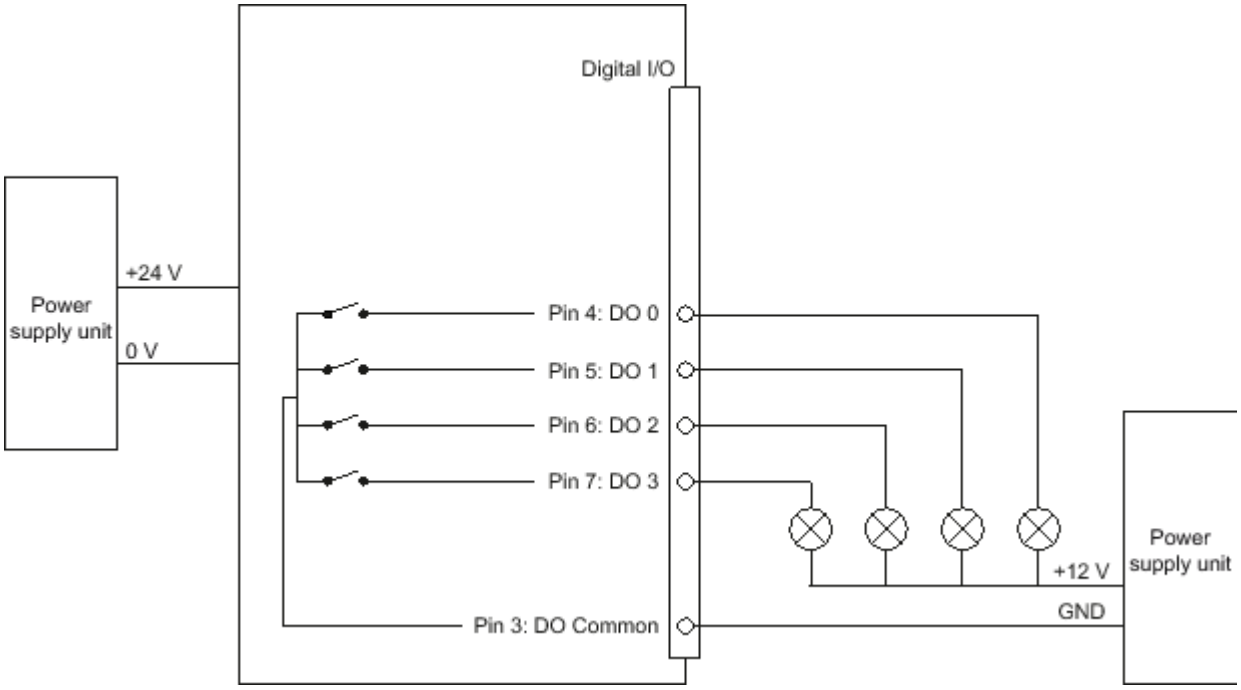


Figure 5-27 Circuit example 5: Digital outputs

Voltage infeed from an external source is shown here for 12°V by way of example. Other voltages are also permissible.

REVIEW

Voltage infeed from external source with various voltages

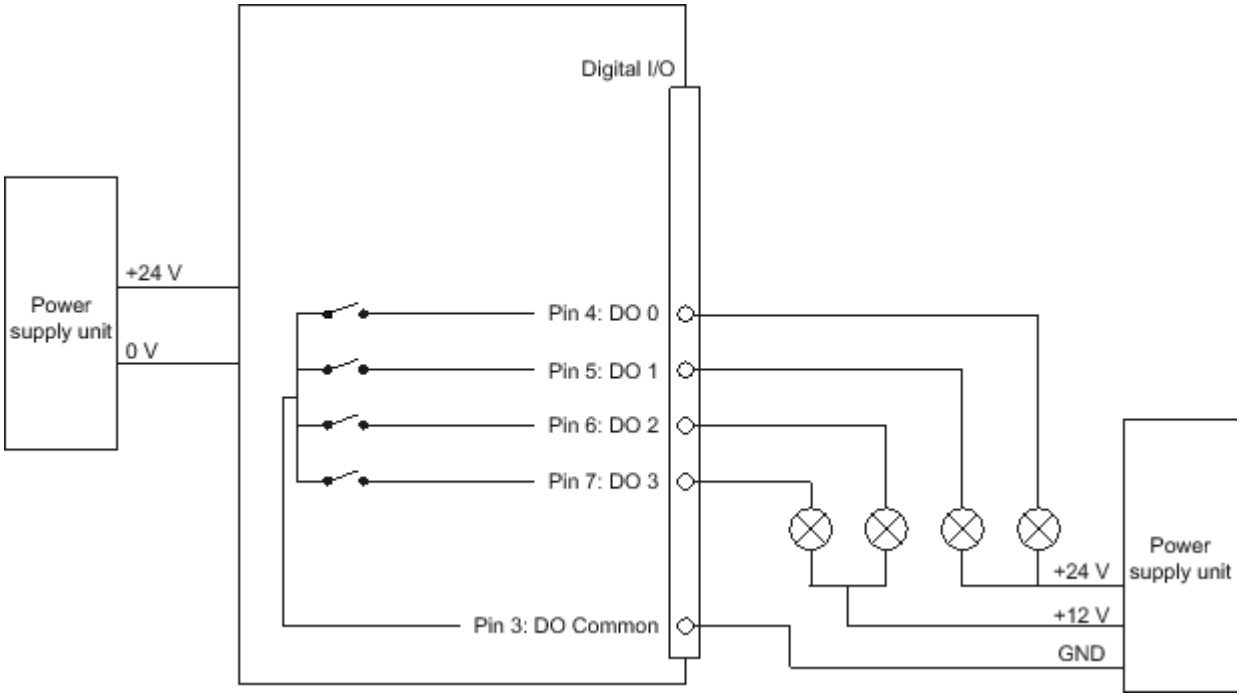


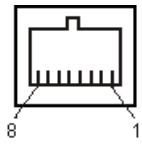
Figure 5-28 Circuit example 6: Digital outputs

REVIEW

5.5.1.6 Pin assignment of the RS-422 interface

Pin	Pin Device end 8-pin M12	Assignment
	1	+ 24 V
	2	- Transmit
	3	0 V
	4	+ Transmit
	5	+ Receive
	6	- Receive
	7	Unassigned
	8	Earth (shield)

5.5.1.7 Pin assignment for Industrial Ethernet interface

Industrial Ethernet (on reader side)	Pin	Pin assignment
	1	Transmit Data (+)
	2	Transmit Data (-)
	3	Receive Data (+)
	4	Terminated
	5	Terminated
	6	Receive Data (-)
	7	Terminated
	8	Terminated

REVIEW

Note

We recommend that only original Siemens Ethernet crossover cables are used (10 m cable: Article number 6GT2891-1HN10) or the Siemens plug (refer to the section Ordering data (Page 158)) for connecting to the Ethernet socket of the reader. If plug-in connectors from other manufacturers are used, it may be difficult or even impossible to remove the plug from the reader.

Note

No autocrossover

The RF650R reader does not support autocrossover!

5.5.1.8 Grounding connection

The RF650R can be electrically connected to the ground potential with a contact washer. The tightening torque must be increased in this case to ensure that electrical contact is made (2.7 Nm).

⚠ WARNING

Hazardous voltage due to lightning strikes

Death or serious injury may occur as a result of lightning strikes to antennas mounted outside buildings.

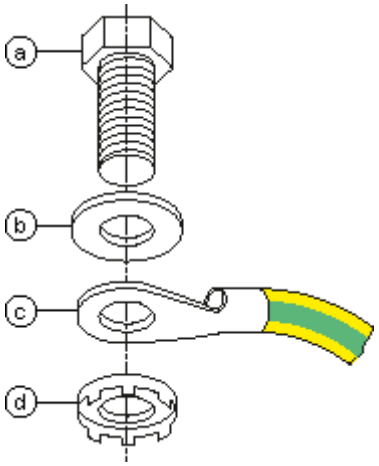
If the reader is operated with antennas mounted outside buildings, it is imperative that the reader is electrically connected to the ground potential.

NOTICE

Installation only in protected areas

The antenna 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.

Ground connection



(a)	Hexagon-head screw
(b)	Flat washer
(c)	Cable lug
(d)	Contact washer: Use contact washers according to the Siemens standard SN 70093-6-FSt-flNnnc-480h for ground connection, Siemens item no.: H70093-A60-Z3

REVIEW

5.5.2 Planning operation

5.5.2.1 Antenna/read point configurations

You can connect up to four external antennas to the RF650R reader. The standard setting is that four antennas are connected when the reader is started. When connecting multiple antennas, note the information in the section "Specified minimum and maximum spacing of antennas (Page 49)".

With the graphical user interface of the integrated Web server, you can set up various different configurations of antennas and/or reading points as required. It is possible to find solutions to many different tasks through the number of data sources and subsequent assignment of the antennas.

Examples of possible antenna reading point configurations

- Four data sources each with one antenna for four different reading points.
- Two data sources each with two antennas for small portals.
- One data source with 4 antennas for large portals.

You will find further information in the online Help for the products.

REVIEW

5.5.3 Installation/mounting

Requirement

⚠ WARNING

Make sure that the wall or ceiling can hold four times the total weight of the device.

Note

Close unused connectors

If you do not use connectors on the reader, it is advisable to close the unused connectors with protective caps. You can order the protective cap set using the MLFB specified in the section "Ordering data".

⚠ CAUTION

Emitted radiation

The transmitter complies with the requirements of Health Canada and the FCC limit values for subjecting persons to HF radiation, provided that a minimum spacing of 26 cm exists between antenna and person. When the antennas are installed, you must therefore ensure that a minimum spacing of 26 cm is maintained between personnel and antennas.

Mounting/installing the device

You can mount the reader in two different ways:

- Via a standardized VESA 100 mounting system using the Antenna Mounting Kit (refer to the section Mounting with antenna mounting kit (Page 331)). Tighten the M4 screws on the rear of the reader using a maximum torque of ≤ 1.3 Nm.
- Directly on a flat surface.

The positions of the mounting holes for the device are shown in the section Dimension drawing (Page 173).

5.5.4 Configuration/integration

An Ethernet interface is available for integrating the device into system environments/networks. Over the Ethernet interface and with direct connection to the PC, the RF650R can be configured in the following ways:

- via the graphical user interface of the integrated Web server
- with XML-based user applications

The communications interface transfers the data via the Web server to the IT, ERP and SCM systems as well as to SIMATIC controllers. Alternatively the data is transferred to user applications using XML commands.

Simple process controls (e.g. a traffic signal) can be implemented directly using the write/read device via four digital inputs and outputs.

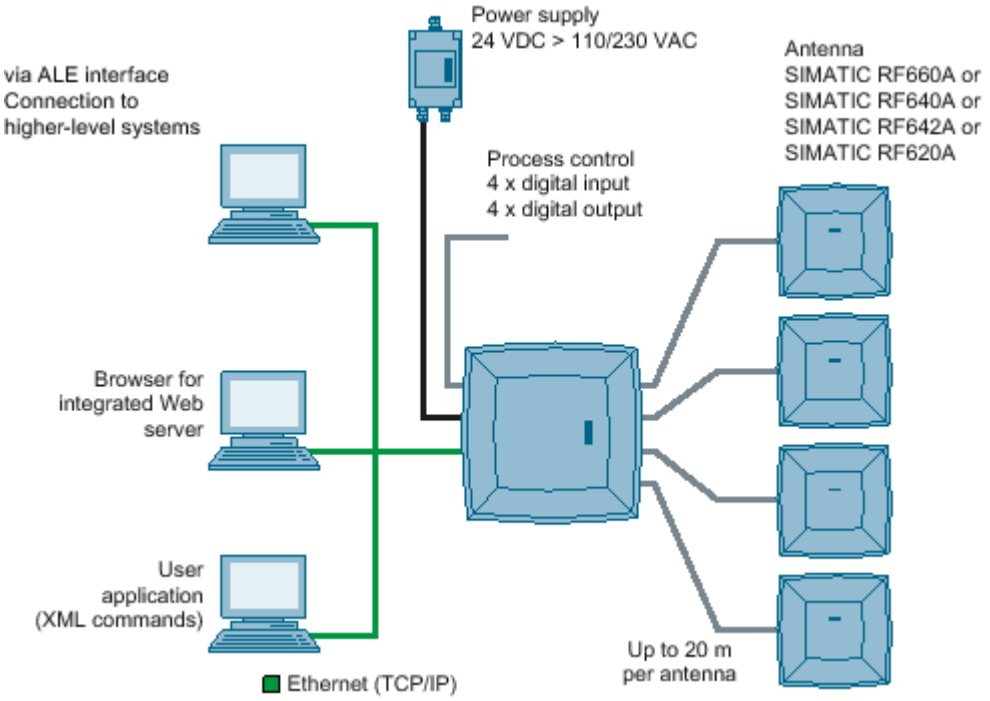


Figure 5-29 Overview of configuration of the RF650R reader

REVIEW

5.5.5 Technical specifications

Table 5- 20 Technical specifications, RF650R

	6GT2811-6AB20-xAA0
Product type designation	RF650R
Mechanical specifications	
Weight	
Dimensions (L x W x H)	
Degree of protection	IP30
Material	
• Upper part of housing	Pocan DP CF 2200
• Lower part of housing	Aluminum
Color	
• Upper part of housing	TI-Grey
• Lower part of housing	Silver
Operating displays on the device	6 LEDs
Status display on the device	-
Interfaces	
• Antenna connectors	4 x RTNC connector
• Power supply	1 x connector (8-pin M12), RS-422
• Digital I/O interface	1 x socket (12-pin, M12)
• Digital inputs	4
• Digital outputs	4
• Ethernet interface	1 x RJ-45 TCP/IP, 10/100 Mbps
MTBF in years	
Electrical specifications	
Power supply	20 to 30 VDC [1)]
Current consumption (on standby)	
• 20 V input voltage on the reader (typical)	220 mA / 4.4 W
• 24 V input voltage on the reader (typical)	190 mA / 4.5 W
• 30 V input voltage on the reader (typical)	150 mA / 4.5 W
Current consumption (at 1000 mW transmit power)	
• 20 V input voltage on the reader (typical)	450 mA / 9.0 W
• 24 V input voltage on the reader (typical)	370 mA / 8.9 W
• 30 V input voltage on the reader (typical)	300 mA / 9.0 W

	6GT2811-6AB20-xAA0
Startup time	
Electromagnetic compatibility	
• ETSI	EN 301 489-1/-3, EN 302 208-1/-3 V1.4.1
• FCC	FCC CFR 47, Part 15 section 15.247

Permitted ambient conditions	
Ambient temperature	
• Operation	-25 ℃ to +55 ℃
• Transport and storage	-40 ℃ to +85 ℃
Shock resistant to EN 60068-2-27	50 g [2]
Vibration resistant to EN 60068-2-26	20 g [2]

[1] All supply and signal voltages must be safety extra-low voltage (SELV/PELV according to EN 60950). All power sources must meet the requirements for LPS (Limited Power Sources) and NEC Class 2.

[2] The values for shock and vibration are maximum values and must not be applied continuously.

Table 5- 21 Technical specifications according to EPC and ISO, RF650R

	6GT2811-6AB20-xAA0
Product type designation	RF650R
Frequency accuracy	max.± 10 ppm
Channel spacing	• EU, EFTA, Turkey: 600 kHz • US: 500 kHz • China: 250 kHz
Modulation methods	ASK: DSB modulation & PR-ASK modulation Encoding, Manchester or Pulse Interval (PIE)
Effective radiated power	
• ETSI/CMIIT	• ≤ 2 W ERP
• FCC	• ≤ 3 W EIRP
Transmit power	
• ETSI/CMIIT	• ≤ 1 W
• FCC	• ≤ 1 W
Reading range	
Antennas mounted on opposing sides (portal configuration)	max. 10 m
Antennas mounted on the same side	max. 5 m (dependent on transponder)

REVIEW

	6GT2811-6AB20-xAA0
Frequencies	
ETSI frequencies	
European frequency band	865.7 ... 867.5 MHz
ETSI EN 302 208 V1.4.1 (valid since October 23, 2012, publication in the Official Journal of the European Union)	(4 channels at max. 2 W ERP)
FCC frequencies	
Frequency band USA	902 ... 928 MHz (50 channels at max. 4 W ERP, frequency hopping)
CMIIT frequencies	
Frequency range China	920.625 ... 924.375 MHz (16 subchannels at 2 W ERP)

5.5.6 Dimension drawing

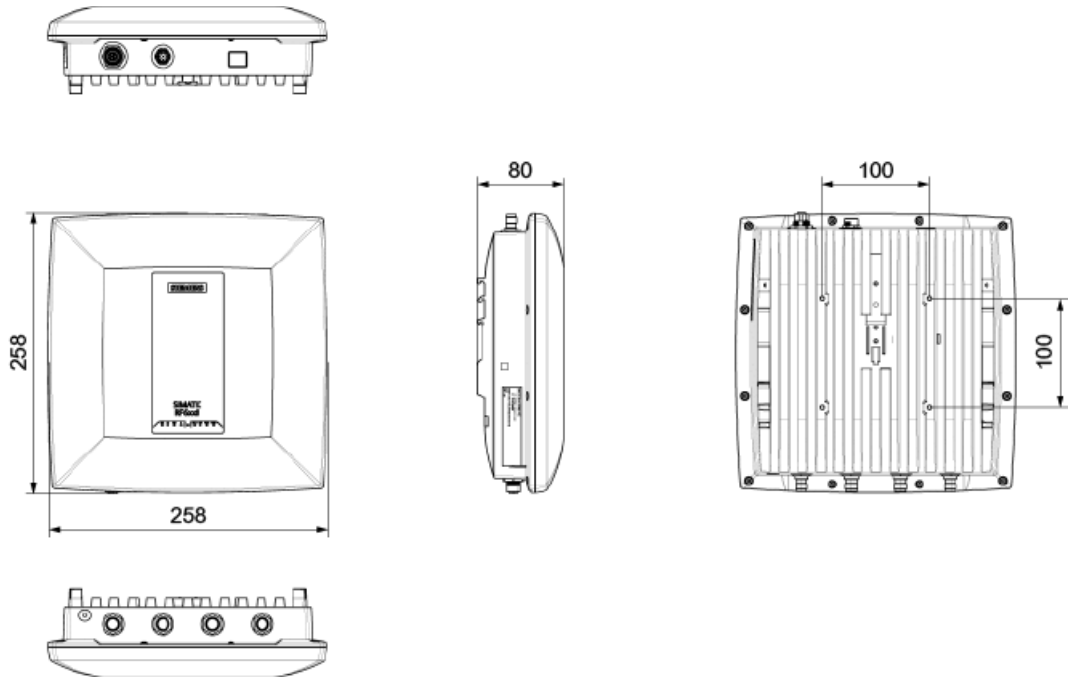


Figure 5-30 Dimension drawing RF650R

All dimensions in mm (± 0.5 mm tolerance)

REVIEW

5.5.7 Certificates and approvals

Note

Marking on the readers according to specific approval

The certificates and approvals listed here apply only if the corresponding mark is found on the readers.

Table 5- 22 6GT2811-6AB20-0AA0

Certificate	Description
CE	Conformity with R&TTE directive

Table 5- 23 6GT2811-6AB20-1AA0

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. FCC ID: ??????
Industry Canada Radio Standards Specifications	RSS-210 Issue 7, June 2007, Sections 2.2, A8 IC: ??????
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

Table 5- 24 6GT2811-6AB20-2AA0

Standard	
CMIIT Certification	China radio approval Marking on the reader: CMIIT ID: ??????

REVIEW

5.5.7.1 FCC information

Siemens SIMATIC RF650R (FCC): 6GT2811-6AB20-1AA0

FCC ID:

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification.

It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

5.5.7.2 IC-FCB information

Siemens SIMATIC RF650R (FCC): 6GT2811-6AB20-1AA0

IC:

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d`Industrie Canada applicables aux appareils radio exempts de licence. L`exploitation est autorisée aux deux conditions suivantes :

(1) L`appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l`appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d`en compromettre le fonctionnement.

Industry Canada Notice

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Transmitter power and antenna information for antennas with a gain less than 6 dBi:

This device has been designed to operate with the SIMATIC RF620A antenna 902-928, the SIMATIC RF640A antenna 902-928 as well as the SIMATIC RF660A antenna 902-928 listed below, and having a maximum gain of 5.5 dBi.

Arbitrary transmission power settings in combination with other antennas or antennas having a gain greater than 5.5 dBi are strictly prohibited for use with this device.

The required antenna impedance is 50 Ohms.

Transmitter power and antenna information for antennas with a gain greater 6 dBi:

This device requires professional installation. Antennas with a gain greater 6 dBi may be used provided the system does not exceed the radiation power of 4000 mW E.I.R.P. This device has been designed to operate with the SIMATIC RF642A antenna 902-928 exceeding the maximum gain of 5.5 dBi under the restriction that the RF power at the input of the antenna must be set to meet the following relation: RF power (dBm) ≤ 30 dBm – (antenna gain (dBi) – 6 dBi) Other antennas or system configurations for antennas having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

REVIEW

5.6 RF670R reader

5.6.1 Description

5.6.1.1 Overview

The SIMATIC RF670R is a stationary reader in the UHF frequency band without an integrated antenna. Up to four external UHF RFID antennas can be connected via TNC reverse connections.

The maximum RF power output is 1000°mW at the reader output. A radiant power of up to 2000 mW ERP is achieved when the appropriate antennas and antenna cables are used. The interfaces (Ethernet, M12 power supply, M12 digital I/O interface) are located along the narrow lower front edge. These interfaces can be used to connect the reader to the power supply and the PC for parameter assignment.

The degree of protection is IP65.

Pos.	Description
(1)	TNC reverse interfaces for connecting up to four antennas
(2)	LED operating display
(3)	24 VDC power supply
(4)	Ethernet interface (TCP/IP)
(5)	Digital I/O interface

REVIEW

5.6.1.2 Ordering data

Ordering data for RF670R

Product	Article number
RF670R (ETSI) reader basic unit for EU, EFTA, Turkey	6GT2811-0AB00-0AA0
RF670R (FCC) reader basic unit for the USA	6GT2811-0AB00-1AA0
RF670R (CMIIT) reader basic unit for China	6GT2811-0AB00-2AA0

Ordering data accessories

Product	Article number
Antenna mounting kit	6GT2890-0AA00
Connecting cable and connectors	
• Digital I/O, open cable ends, 5 m	• 6GT2891-0CH50
• Ethernet: 10 m (crossover cable)	• 6GT2891-1HN10
• Ethernet connector on reader according to IEC PAS 61076-3-117IE RJ-45 Plug PRO (IP67)	• 6GK1901-1BB10-6AA0
• Ethernet connector, Standard IE FastConnect RJ-45 Plug 180 (IP20)	• 6GK1901-1BB10-2AB0
• Ethernet cable sold by the meter, green	• 6XV1840-2AH10
Wide-range power supply unit for SIMATIC RF systems	
• With EU plug	• 6GT2898-0AA00
• With UK plug	• 6GT2898-0AA10
• With US plug	• 6GT2898-0AA20
24 V connecting cable 5 m between reader and power supply unit (for RF670R only, pin assignment is PNO-compliant)	6GT2891-0NH50
Set of protective caps Contains 3 protective caps for antenna output and one protective cap for digital I/O interface (required for IP65 degree of protection when some connectors are unused)	6GT2898-4AA00
RFID DVD "Software & Documentation"	6GT2080-2AA20

REVIEW

5.6.1.3 Status display

The device is equipped with a three colored LED. The LED can be lit in green, red or orange. The meaning of the indication changes in accordance with the color and state (on, off, flashing) of the LED:

Green LED	Red LED	Orange LED	Meaning
Off	Off	Off	The device is not connected to a power supply.
Flashing	Off	Off	In normal operation, no communication with the reader has taken place for a longer period of time.
On	Off	Off	The device is ready. The connection is established.
Off	Off	Flashing	More than one tag is in the field.
Off	Off	On	The device is starting up. The connection is established. Exactly one tag is in the field during normal operation.
Off	Flashing	Off	Error states with flash codes (see section Flashing codes RF640R/RF670R (Page 479))
Off	flashes 2x	Off	At the end of the startup

Note

LED is not lit orange?

If the LED does not light up orange even though a tag is located within the field, common causes are:

- Antenna is switched off
- A tag is used, that is not compatible with the reader protocol (EPC Global Class 1 Gen 2).
- Tag is defective
- Reader or antenna has a defect
- Tag is not in the field of radiation of the transmit antenna

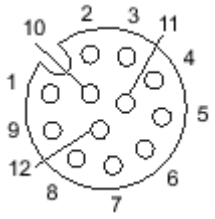
REVIEW

For more detailed information on the flash codes of the reader see section Flashing codes RF640R/RF670R (Page 479)

5.6.1.4 Pin assignment of the digital I/O interface

View of socket (reader end)

Table 5- 25

M12 socket (reader end)	Pin	Pin assignment
	1	GND (output for supply of digital inputs/outputs [not electrically isolated])
	2	VCC (output for supply of digital inputs/outputs [not electrically isolated])
	3	DO Common / Outport Common
	4	DO 0 / Outport 00
	5	DO 1 / Outport 01
	6	DO 2 / Outport 02
	7	DO 3 / Outport 03
	8	DI 0 / Inport 00
	9	DI Common / Inport Common
	10	DI 1 / Inport 01
	11	DI 2 / Inport 02
	12	DI 3 / Inport 03

REVIEW

Wiring diagram M12 connector (cable end)

You will need to assemble your reader cable with a suitable connector that fits the interface shown above. Keep to the following wiring diagram:

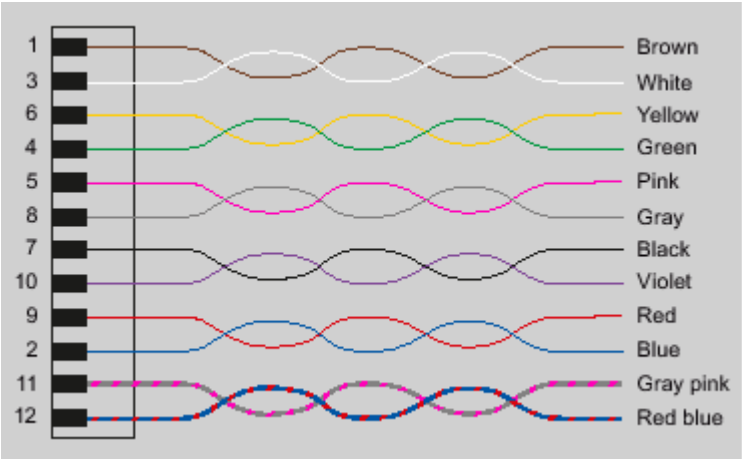


Figure 5-31 M12 connector wiring diagram

5.6.1.5 Connection scheme for the digital I/O interface

Connection possibilities

You can connect the RF670R reader in different ways. In general, the outputs and inputs should be connected as follows:

Output Outport (0), (1), (2), (3)

- Each output is rated for 0.5 A current and is electronically protected.
- Four digital outputs can be operated simultaneously with up to 0.5 A each (up to 1.5 A in total).
- The outputs are optically isolated through optocouplers.

Input Inport (0), (1), (2), (3)

- The inputs are optically isolated through optocouplers.
- Level Low 0 ... 3 V; High 3,6 ... 24 V
- Sampling rate < 20 ms

The following diagrams illustrate various connection possibilities.

Voltage infeed through internal source (no electrical isolation)

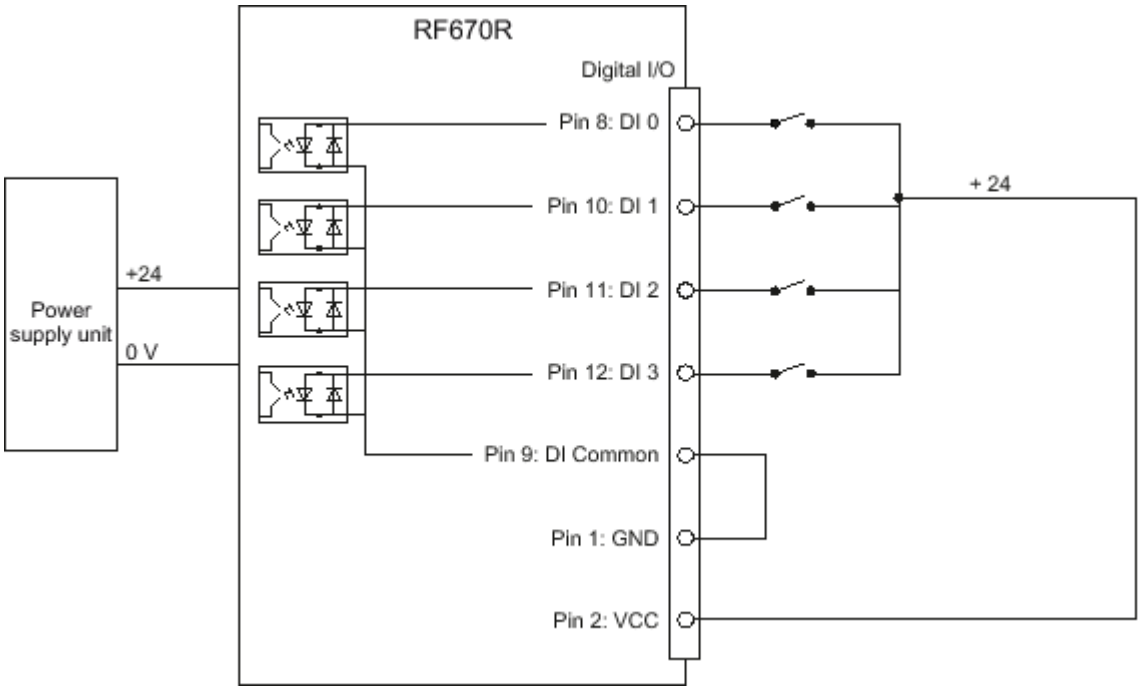


Figure 5-32 Example circuit 1: Digital inputs

REVIEW

Alternative connection possibilities:

- Pin 2 (VCC) to Pin 9 DI Common
- Pin 1 GND to busbar inputs

Voltage infeed through external source

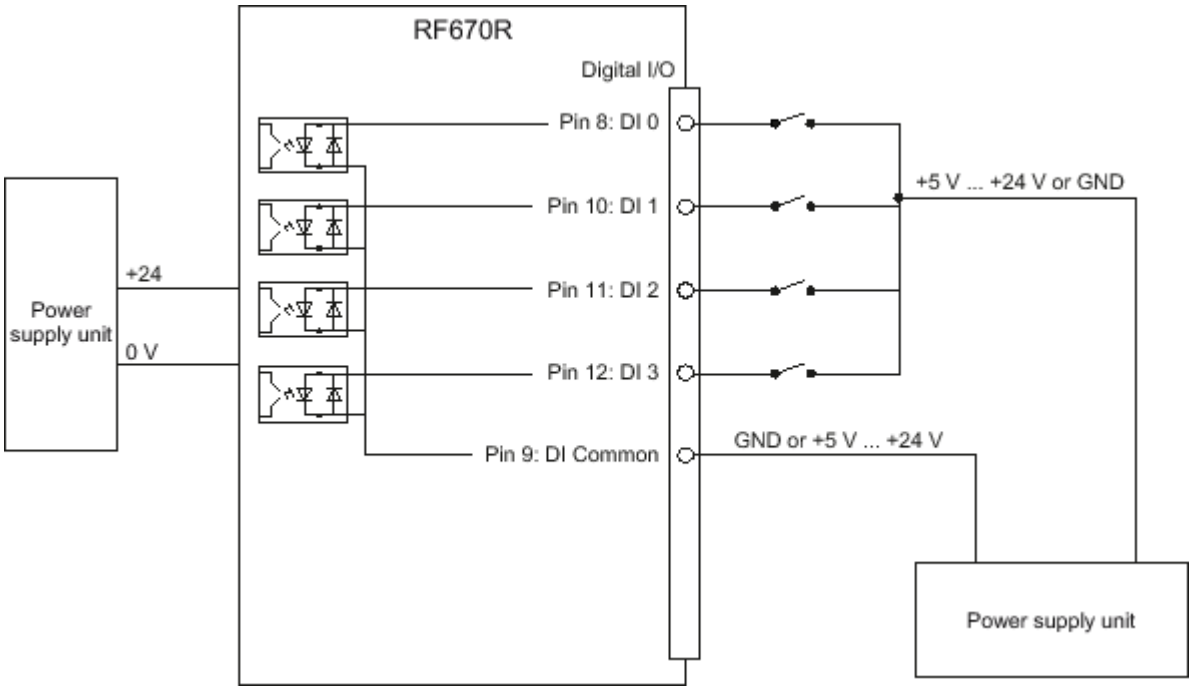


Figure 5-33 Example circuit 2: Digital inputs

REVIEW

Voltage infeed through external source with various voltages

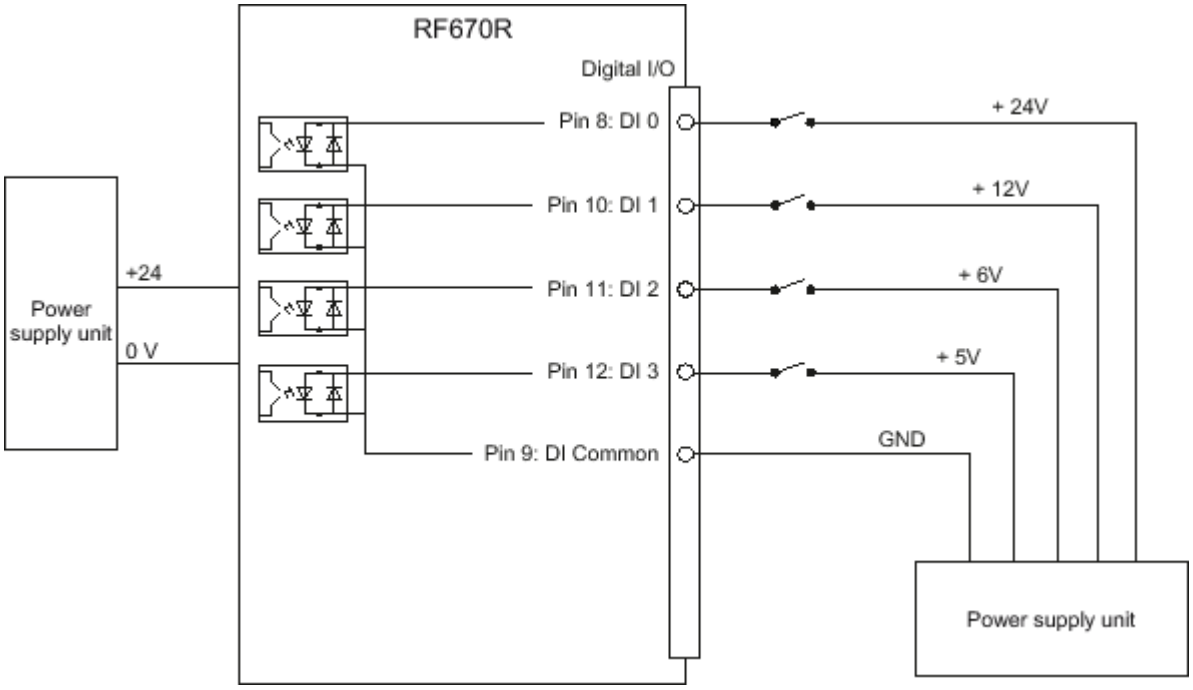


Figure 5-34 Example circuit 3: Digital inputs

Voltage infeed through internal source

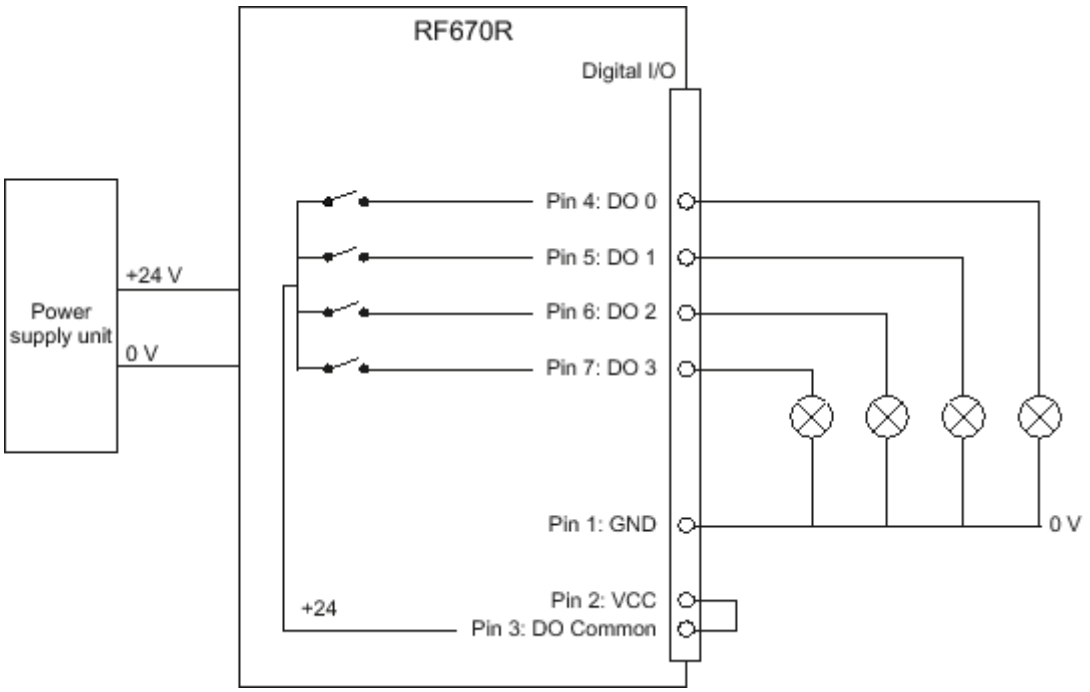


Figure 5-35 Example circuit 4: Digital outputs

REVIEW

Alternative connection possibilities:

- Pin 1 GND to Pin 3 DO Common
- Pin 2 (VCC) to busbar outputs

Voltage infeed through external source

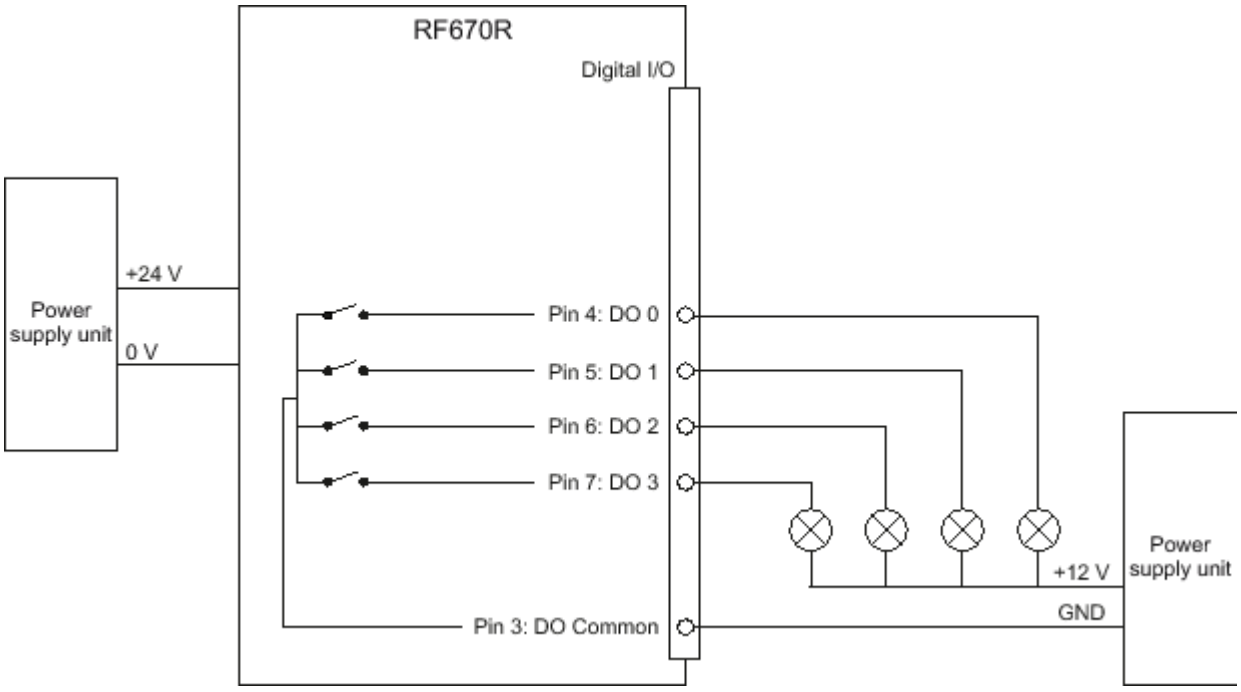


Figure 5-36 Example circuit 5: Digital outputs

Voltage infeed through an external source is shown here for 12°V by way of example. Other voltages are also permissible.

REVIEW

Voltage infeed through external source with various voltages

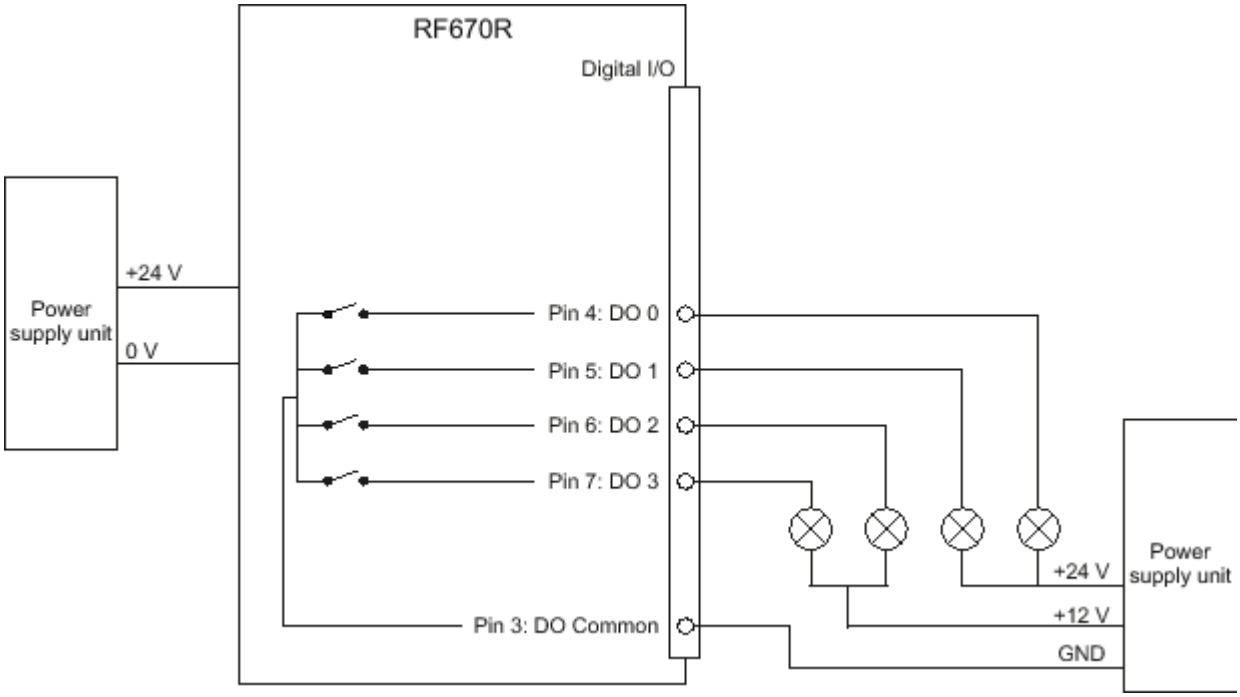
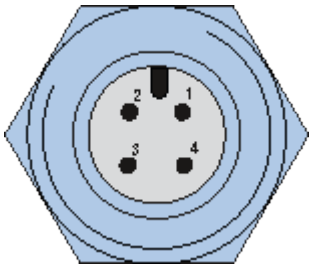


Figure 5-37 Example circuit 6: Digital outputs

REVIEW

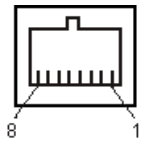
5.6.1.6 Pin assignment for power supply

Pin assignment of the power connections

Power connector (on reader side)	Pin	Pin assignment
	1 2 3 4	24 VDC Not connected Ground (0 V) Not connected

The power connector of the RF670R is PNO compatible, i.e.° normal PROFINET IO connectors will fit this interface.

5.6.1.7 Pin assignment for Industrial Ethernet interface

Industrial Ethernet (on reader side)	Pin	Pin assignment
	1	Transmit Data (+)
	2	Transmit Data (-)
	3	Receive Data (+)
	4	Terminated
	5	Terminated
	6	Receive Data (-)
	7	Terminated
	8	Terminated

Note

We recommend that only original Siemens Ethernet crossover cables are used (10 m cable: Order No. 6GT2891-1HN10) or the Siemens connector (see Section Ordering data (Page 178)) for connecting to the Ethernet socket of the reader. If plug-in connectors from other manufacturers are used, it may be difficult or even impossible to remove the plug from the reader

Note

No autocrossover

The RF670R reader does not support autocrossover!

REVIEW

5.6.1.8 Grounding connection

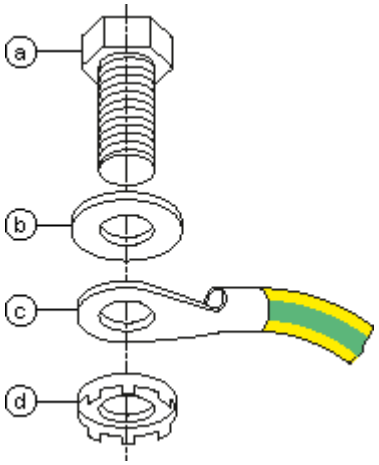
The RF670R can be electrically connected to the ground potential through a contact washer. The tightening torque must be increased in this case to ensure that electrical contact is made (2.7 Nm).

WARNING

Hazardous voltage due to lightning strikes

Death or serious injury may occur as a result of lightning strikes to antennas mounted outside buildings.

If the reader is operated with antennas mounted outside buildings, it is imperative that the reader is electrically connected to the ground potential.

Ground connection		
	(a)	Hexagon-head screw
	(b)	Plain washer
	(c)	Cable lug
	(d)	Contact washer: Use contact washers according to the Siemens standard SN 70093-6-FSt-flNnnc-480h for ground connection, Siemens item No.: H70093-A60-Z3

5.6.2 Planning the use

5.6.2.1 Antenna/read point configurations

REVIEW

You can connect up to four external antennas to the RF670R reader. The standard setting is that four antennas are connected when the reader is started. When connecting multiple antennas, note the information in the section "Specified minimum and maximum spacing of antennas (Page 49)".

With RF-MANAGER Basic V2 , you can set up various different configurations of antennas and/or reading points as required. It is possible to find solutions to many different tasks through the number of data sources and subsequent assignment of the antennas.

Examples of possible antenna reading point configurations

- Four data sources each with one antenna for four different reading points.
- Two data sources each with two antennas for small portals.
- One data source with 4 antennas for large portals.

You will find further information in the online Help for the products.

5.6.3 Installing / mounting

Requirement

WARNING

Make sure that the wall or ceiling can hold four times the total weight of the device.

Note

Close unused connectors

If you do not use connectors on the reader, it is advisable to close the unused connectors with protective caps. You can order the protective cap set using the MLFB specified in the section "Ordering data".

CAUTION

Emitted radiation

The transmitter complies with the requirements of Health Canada and the FCC limit values for subjecting persons to HF radiation, provided that a minimum spacing of 26 cm exists between antenna and person. When the antennas are installed, you must therefore ensure that a minimum spacing of 26 cm is maintained between personnel and antennas.

REVIEW

Mounting/installing the device

You can mount the reader in two different ways:

- Via a standardized VESA 100 mounting system using the Antenna Mounting Kit (see section Mounting with antenna mounting kit (Page 331)). Tighten the M4 screws on the rear of the reader using a maximum torque of ≤ 1.3 Nm.
- Directly onto a flat surface.

The positions of the fixing holes for the device are shown in the section Dimension drawings (Page 193).

5.6.4 Configuration/integration

An Ethernet interface is available for integrating the device into system environments/networks. Over the Ethernet interface and with direct connection to the PC, the RF670R can be configured in two different ways:

- Using RF-MANAGER Basic V2
- with XML-based user applications

The communication interface transfers the data over the RF-MANAGER Basic to the IT, ERP and SCM systems as well as to SIMATIC controllers. Alternatively the data is transferred to user applications using XML commands.

Simple process controls (e.g. a traffic signal) can be implemented directly using the write/read device via four digital inputs and outputs.

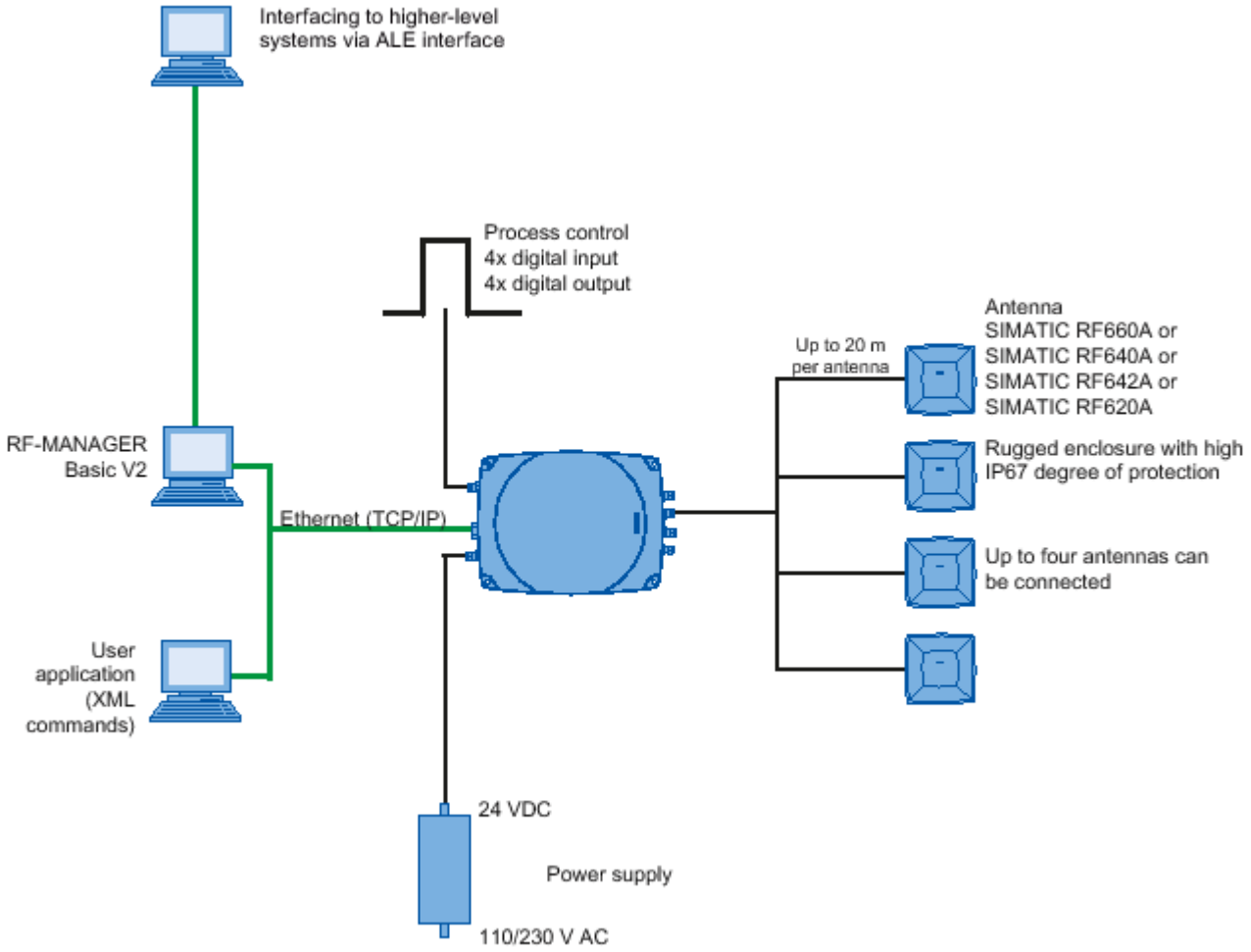


Figure 5-38 Overview of configuration of the RF670R reader

REVIEW

5.6.5 Technical data

5.6.5.1 Mechanical data

Mechanical data		
Weight		approx. 1800 g
Housing dimensions (L x W x H)		252 x 193 x 52 mm, without connections
Material for housing top section		ABS (GF 20)
Material for housing bottom section		Aluminum
Color of housing top section		Anthracite
Color of housing bottom section		Silver
Status displays on the device		1 LED Colors: red, yellow, green
Interfaces		
	Antenna connectors	4x RTNC connector
	Power supply	1 x plug (4-pin M12)
	Digital I/O interface	1 x socket (12-pin M12)
	Digital inputs	4
	Digital outputs	4 (500 mA each; max. 1500 mA in total)
	Ethernet	RJ-45 TCP/IP (push-pull) 10/100 Mbps
MTBF in years		16

Thermal and electrical properties			
Power supply • Permitted range		20 to 30 VDC [1]	
Power supply		Current consumption (in standby mode, no transmit power)	Power requirement (in standby mode, no transmit power)
	20 V input voltage on the reader, typical	140 mA	2.8 W
	24 V input voltage on the reader, typical	120 mA	2.88 W
	30 V input voltage on the reader, typical	100 mA	3.0 W
Power supply		Current consumption (at 1000 mW transmit power)	Power requirement (at 1000 mW transmit power)
	20 V input voltage on the reader, typical	530 mA	10.6 W
	24 V input voltage on the reader, typical	450 mA	10.8 W
	30 V input voltage on the reader, typical	370 mA	11.1 W
Rampup time		19 s	

1) All supply and signal voltages must be safety extra low voltage (SELV/PELV according to EN 60950)

24 VDC supply: safe (electrical) isolation of extra-low voltage (SELV / PELV acc. to EN 60950)

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Mechanical environmental conditions	
Shock resistant acc. to EN 60068-2-27 Vibration acc. to EN 60068-2-6	50 g[1] 20 g[1]
Climatic conditions	
Ambient temperature during operation	-25 °C to +55 °C (a 10-minute warm-up time must be allowed at an operating temperature below -20 °C)
Ambient temperature for transport and storage	-40 °C to +85 °C

1) The values for shock and vibration are maximum values and must not be applied continuously.

EMC & approvals/conformity for ETSI variant	
Electromagnetic compatibility	ETSI EN 301 489-1 / -3 EN 302 208 V1.3.1 EN 302 208 V1.4.1
Approvals/Conformity	• Radio according to the R&TTE directive • CE • ETSI EN 302 208 V1.3.1 • ETSI EN 302 208 V1.4.1 • Reader degree of protection acc. to EN 60529 (IP65) • RoHS-compliant according to EU Directive 2002/95/EC • Human exposure

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EMC & approvals for FCC variant	
Electromagnetic compatibility	FCC Part 15
Approvals	• FCC, cULus • IEC60950, including US and Canadian variants of it • Reader degree of protection acc. to EN 60529 (IP65) • FCC CFR47 Part 15.247 • RoHS-compliant according to EU Directive 2002/95/EC • Industrial Canada, RSS-210, Issue 7, June 2007

5.6.5.2 Technical data according to EPC and ISO

Technical specifications	
Frequency accuracy	max.± 10 ppm
Channel spacing	EU, EFTA, Turkey: 600 kHz US: 500 kHz China: 250 kHz
Modulation methods	ASK: DSB modulation & PR-ASK modulation Encoding, Manchester or Pulse Interval (PIE)
Effective radiated power • ETSI/CMIIT: • FCC:	 • ≤ 2 W ERP • ≤ 4 W EIRP
Transmit power • ETSI/CMIIT: • FCC:	 • ≤ 1.0 W • ≤ 1.25 W

Reading range	
Antennas mounted on opposing sides (portal configuration)	max. 10 m
Antennas mounted on the same side	max. 5 m (dependent on transponder)

ETSI frequencies	
Frequency range for Europe, EFTA, Turkey, South Africa, Thailand (ETSI) ETSI EN 302 208 V1.4.1 (valid since October 23, 2012, publication in the Official Journal of the European Union)	865.7 ... 867.5 MHz (4 channels LBT optional at max. 2 W ERP)
Frequency range India	865 ... 867 MHz (10 channels at max. 4 W EIRP)
Frequency range Russia	866.1 ... 867.6 MHz (8 channels at 2 W ERP)
Frequency range Singapore	866 ... 869 MHz (11 channels at 0.5 W ERP)

FCC frequencies	
Frequency range USA; Argentina, Bolivia, Canada, Mexico, Thailand (FCC)	902 ... 928 MHz (50 channels at max. 4 W EIRP, frequency hopping)
Frequency range Brazil	915.125 ... 927.875 MHz (52 channels at max. 4 W EIRP, frequency hopping)
Frequency range South Korea	917.1 ... 920.4 MHz (7-16 channels at max. 4 W EIRP, frequency hopping)

CMIIT frequencies	
Frequency range China	920.625 ... 924.375 MHz (16 subchannels at 2 W ERP)

REVIEW

5.6.6 Dimension drawings

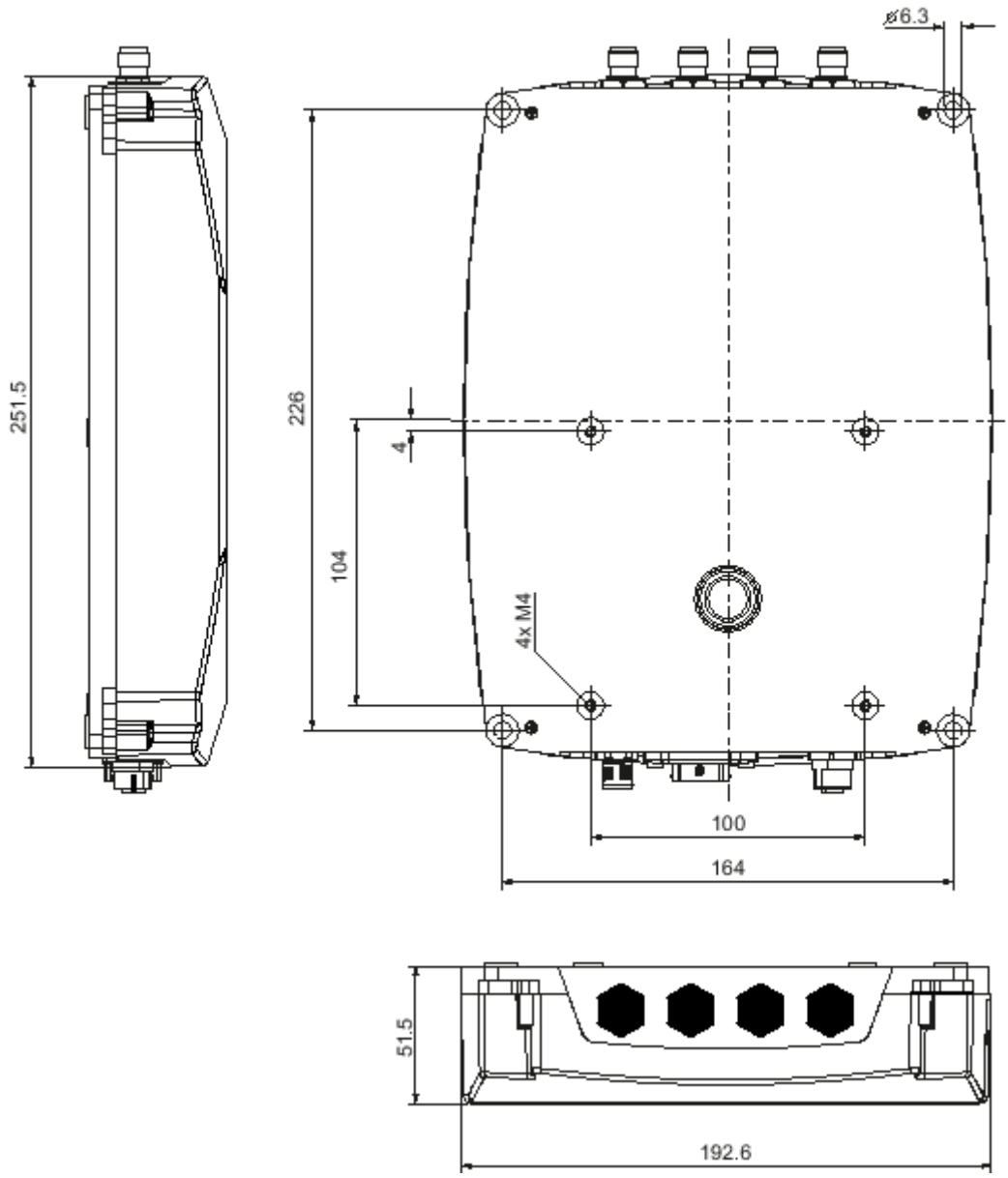

Figure 5-39 Dimension drawing for RF670R

All dimensions in mm (± 0.5 mm tolerance)

REVIEW

5.6.7 Certificates and approvals

Note

Marking on the readers according to specific approval

The certificates and approvals listed here apply only if the corresponding mark is found on the readers.

Table 5- 26 6GT2811-0AB00-0AA0

Certificate	Description
CE	Conformity with R&TTE directive
TA-2012/548	South Africa radio approval: Radio Equipment Type Approval

Table 5- 27 6GT2811-0AB00-1AA0

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. FCC ID: NXW-RF670 (as of FS: A1) FCC ID: NXW-RF600R (as of FS: C1)
Industry Canada Radio Standards Specifications	RSS-210 Issue 7, June 2007, Sections 2.2, A8 IC: 267X-RF670 (as of FS: A1) IC: NXW-RF600R, model RF670R-2 (as of FS: C1)
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

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Standard	
	Brazil wireless approval Marking on the reader (as of FS: A):  Marking on the reader (as of FS: B1):  Statement relating to approval: Este equipamento opera em caráter secundário, isto é, não tem direito à proteção contra interferência prejudicial, mesmo de estações do mesmo tipo e não pode causar interferência a sistemas operando em caráter primário. Certificate of the reader (as of FS: A): ANATEL 2270-11-4061 Certificate of the reader (as of FS: B1): ANATEL 3377-12-4061
	KCC Certification Marking on the reader: Type of equipment: A급 기기 (업무용 방송통신기자재) Class A Equipment (Industrial Broadcasting & Communication Equipment) 이 기기는 업무용(A급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라 며, 가정외의 지역에서 사용하는 것을 목적으로 합니다. This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home. Reader certificate: KCC-CRM-RF5-RF670R
H-11390	Argentina radio approval: Registro de la COMISION NACIONAL DE COMUNICACIONES
RCPSIRF12-0881	Mexico radio approval: CERTIFICADO DE HOMOLOGACION

REVIEW

Table 5- 28 6GT2811-0AB00-2AA1

Standard	
CMIIT Certification	China radio approval Marking on the reader: CMIIT ID: 2011DJ0748

5.6.7.1 FCC information

Siemens SIMATIC RF670R (FCC): 6GT2811-0AB00-1AA0

FCC ID: NXW-RF670 (as of FS: A1)
FCC ID: NXW-RF600R (as of FS: C1)

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification.

It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

REVIEW

5.6.7.2 IC-FCB information

Siemens SIMATIC RF670R (FCC): 6GT2811-0AB00-1AA0

IC: 267X-RF670 (as of FS: A1)
IC: NXW-RF600R, model: RF670R-2 (as of FS: C1)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d`Industrie Canada applicables aux appareils radio exempts de licence. L`exploitation est autorisée aux deux conditions suivantes :

(1) L`appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l`appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d`en compromettre le fonctionnement.

Industry Canada Notice

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

REVIEW

Transmitter power and antenna information for antennas with a gain less than 6 dBi:

This device has been designed to operate with the SIMATIC RF620A antenna 902-928, the SIMATIC RF640A antenna 902-928 as well as the SIMATIC RF660A antenna 902-928 listed below, and having a maximum gain of 5.5 dBi.

Arbitrary transmission power settings in combination with other antennas or antennas having a gain greater than 5.5 dBi are strictly prohibited for use with this device.

The required antenna impedance is 50 Ohms.

Transmitter power and antenna information for antennas with a gain greater 6 dBi:

This device requires professional installation. Antennas with a gain greater 6 dBi may be used provided the system does not exceed the radiation power of 4000 mW E.I.R.P. This device has been designed to operate with the SIMATIC RF642A antenna 902-928 exceeding the maximum gain of 5.5 dBi under the restriction that the RF power at the input of the antenna must be set to meet the following relation: RF power (dBm) ≤ 30 dBm – (antenna gain (dBi) – 6 dBi) Other antennas or system configurations for antennas having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

5.7 RF680R reader

5.7.1 Description

5.7.1.1 Overview

The SIMATIC RF680R is a stationary reader in the UHF frequency band without an integrated antenna. Up to four external UHF RFID antennas can be connected via TNC reverse connections.

The maximum RF power output is 2000°W at the reader output. A radiant power of up to 2000 mW ERP is achieved when the appropriate antennas and antenna cables are used. The interfaces (Ethernet, M12 power supply, M12 digital I/O interface) are located along the narrow lower front edge. These interfaces can be used to connect the reader to the power supply and the PC for parameter assignment.

The degree of protection is IP65.

	Pos.	Description
	①	TNC reserve interfaces for connecting up to 4 antennas
	②	LED status display
	③	LED operating display
	④	Digital I/O interface
	⑤	RS-422 interface (M12 plug, 8-pin)
	⑥	Ethernet interface (TCP/IP) (M12 plug, 4-pin)
	⑦	Ethernet interface (TCP/IP) (M12 plug, 4-pin)

5.7.1.2 Ordering data

Ordering data RF680R

Product	Article number
RF680R (ETSI) reader basic unit for EU, EFTA, Turkey	6GT2811-6AA10-0AA0
RF680R (FCC) reader basic unit for the USA	6GT2811-6AA10-1AA0
RF680R (CMIIT) reader basic unit for China	6GT2811-6AA10-2AA0

REVIEW

Ordering data accessories

Product	Article number
Antenna mounting kit	6GT2890-0AA00
Connecting cable and connectors	
• Digital I/O, open cable ends, 5 m	• 6GT2891-0CH50
• Ethernet: 10 m (crossover cable)	• 6GT2891-1HN10
• Ethernet connector on reader according to IEC PAS 61076-3-117IE RJ-45 Plug PRO (IP67)	• 6GK1901-1BB10-6AA0
• Ethernet connector, Standard IE FastConnect RJ-45 Plug 180 (IP20)	• 6GK1901-1BB10-2AB0
• Ethernet cable sold by the meter, green	• 6XV1840-2AH10
Wide-range power supply unit for SIMATIC RF systems	
• With EU plug	• 6GT2898-0AA00
• With UK plug	• 6GT2898-0AA10
• With US plug	• 6GT2898-0AA20
24 V connecting cable 5 m between reader and power supply unit (for RF670R only, pin assignment is PNO-compliant)	6GT2891-0NH50
Set of protective caps Contains 3 protective caps for antenna output and one protective cap for digital I/O interface (required for IP65 degree of protection when some connectors are unused)	6GT2898-4AA00
RFID DVD "Software & Documentation"	6GT2080-2AA20

5.7.1.3 Status display

The device is equipped with 17 three-colored LEDs. The operating statuses of the reader are displayed by the "RUN/STOP", "ERROR", "MAINT" and "PRESENCE" LEDs. The LEDs can be lit green, red or orange. The meaning of the display changes according to the color and status (on, off, flashing) of the LED:

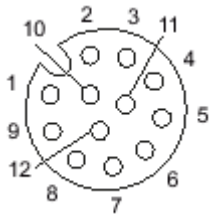
R/S	ERR	MT	PR	Meaning
○	○	○	○	The device is turned off.
●	●	●	●	The device is starting up.
●	-	-	-	The device is ready for operation. The connection is established.
☼	-	-	-	The device is working. Transponder data can be read or written.
-	☼	-	-	There is an error.
-	-	☼	-	Maintenance work required.
-	-	-	●	There is transponder in the antenna field.
-	-	-	☼	There are multiple transponders in the antenna field.

For more detailed information on the flash codes of the reader, refer to the section LED displays RF650R/RF680R/RF685R (Page 480).

5.7.1.4 Pin assignment of the digital I/O interface

View of socket (reader end)

Table 5- 29

M12 socket (reader end)	Pin	Pin assignment
	1	GND (output for supply of digital inputs/outputs [not electrically isolated])
	2	VCC (output for supply of digital inputs/outputs [not electrically isolated])
	3	DO Common / Outport Common
	4	DO 0 / Outport 00
	5	DO 1 / Outport 01
	6	DO 2 / Outport 02
	7	DO 3 / Outport 03
	8	DI 0 / Inport 00
	9	DI Common / Inport Common
	10	DI 1 / Inport 01
	11	DI 2 / Inport 02
	12	DI 3 / Inport 03

REVIEW

Wiring diagram M12 connector (cable end)

You will need to assemble your reader cable with a suitable connector that fits the interface shown above. Keep to the following wiring diagram:

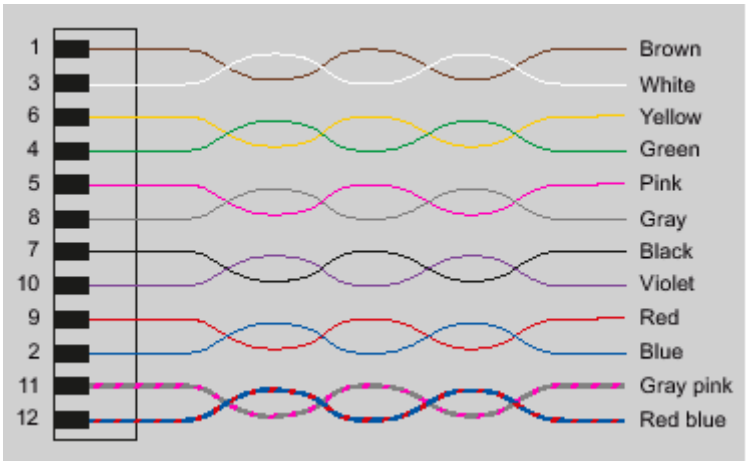


Figure 5-40 M12 connector wiring diagram

5.7.1.5 Connection scheme for the digital I/O interface

Connection possibilities

You can connect the RF680R reader in different ways. In general, the outputs and inputs should be connected as follows:

Output Outport (0), (1), (2), (3)

- Each output is rated for 0.5 A current and is electronically protected.
- 4 digital outputs can be operated simultaneously each with up to 0.5 A (up to 1.0 A in total).
- The outputs are optically isolated through optocouplers.

Input Inport (0), (1), (2), (3)

- The inputs are optically isolated through optocouplers.
- Level Low 0 ... 3 V; High 3.6 ... 24 V
- Sampling rate < 20 ms

The following diagrams illustrate various connection possibilities.

REVIEW

Voltage infeed from internal source (no electrical isolation)

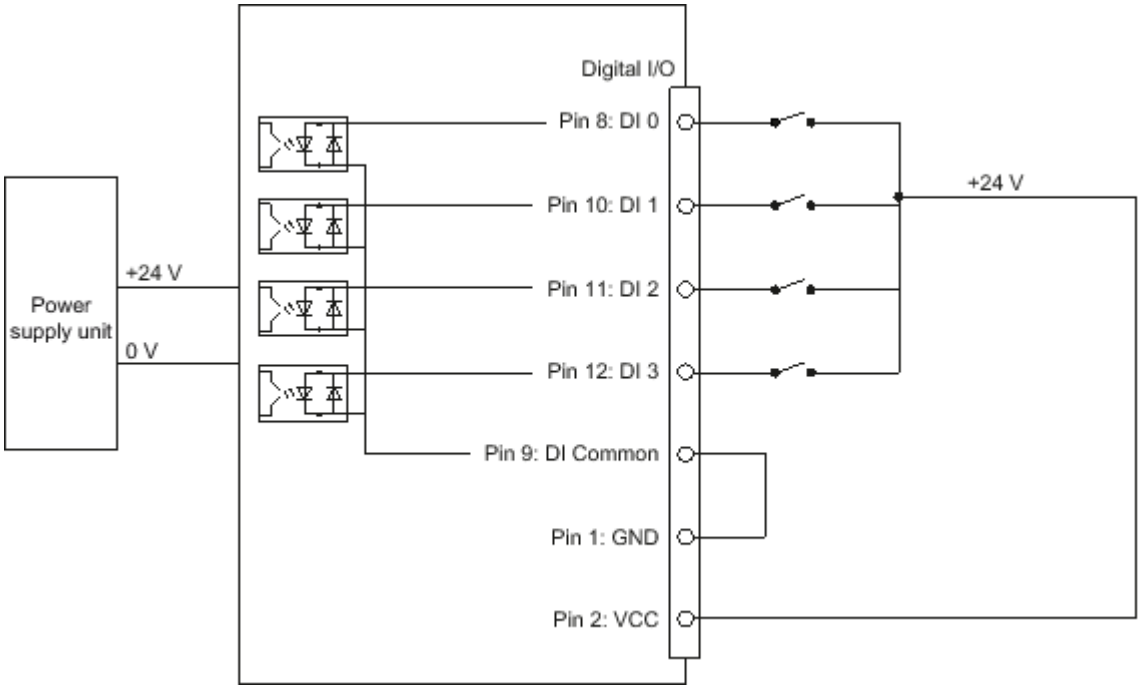


Figure 5-41 Circuit example 1: Digital inputs

Alternative connection possibilities:

- Pin 2 (VCC) to pin 9 DI common
- Pin 1 GND to busbar inputs

REVIEW

Voltage infeed from external source

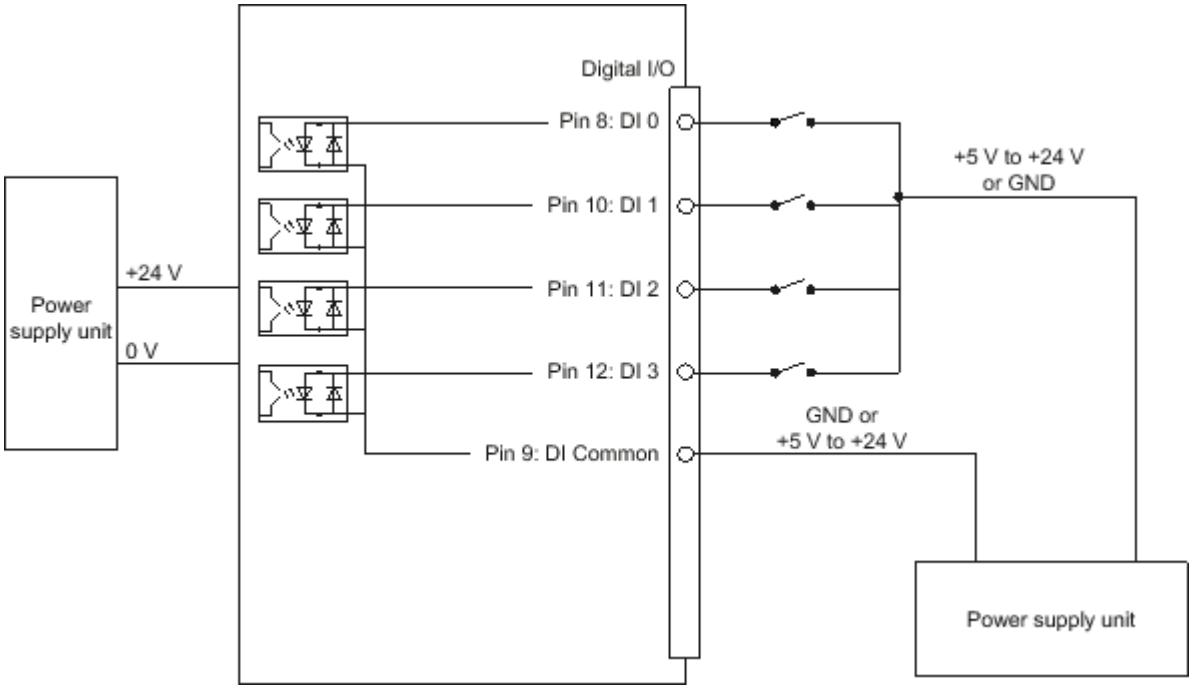


Figure 5-42 Circuit example 2: Digital inputs

Voltage infeed from external source with various voltages

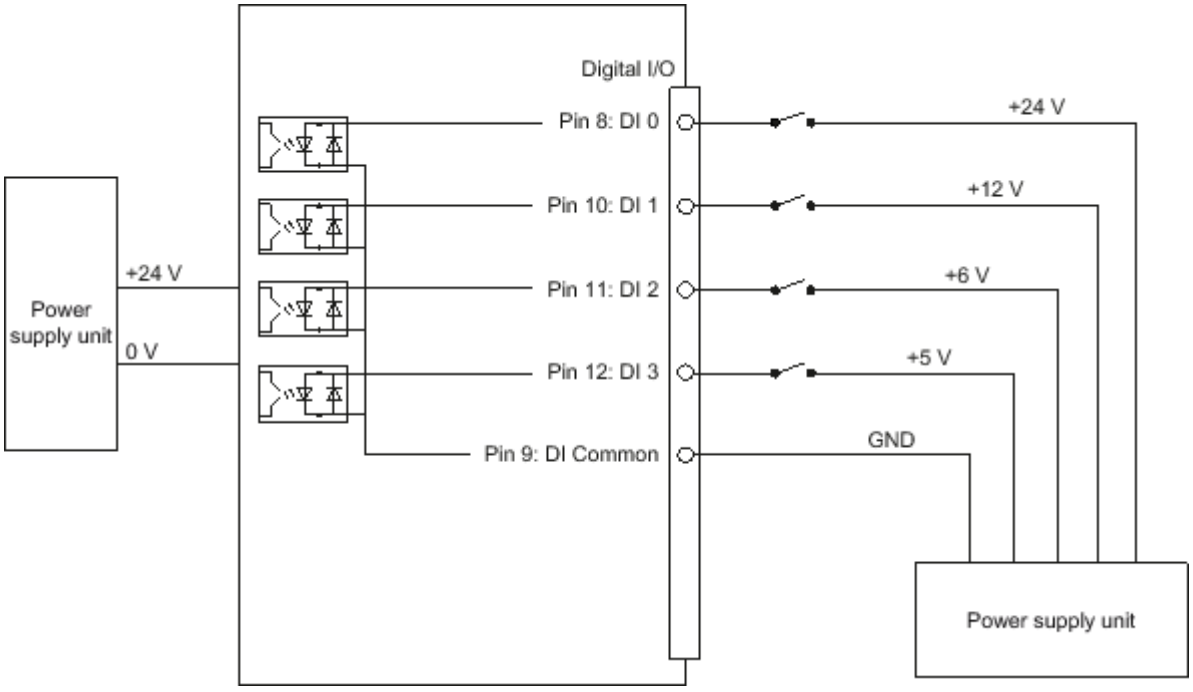


Figure 5-43 Circuit example 3: Digital inputs

REVIEW

Voltage infeed from internal source

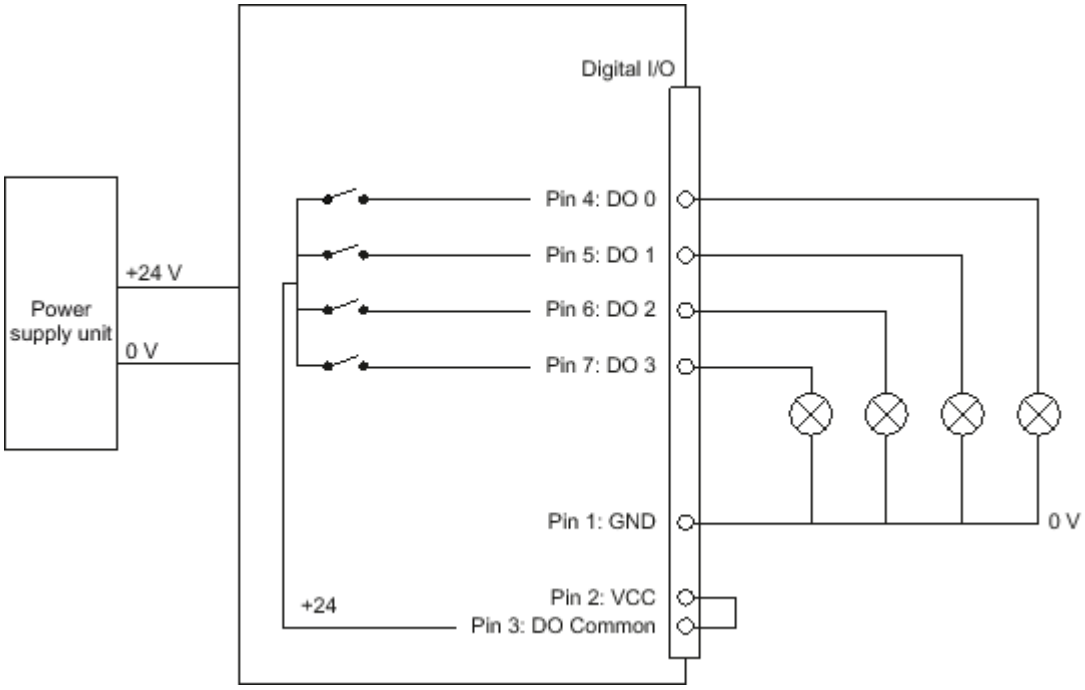


Figure 5-44 Circuit example 4: Digital outputs

Alternative connection possibilities:

- Pin 1 GND to pin 3 DO common
- Pin 2 (VCC) to busbar outputs

REVIEW

Voltage infeed from external source

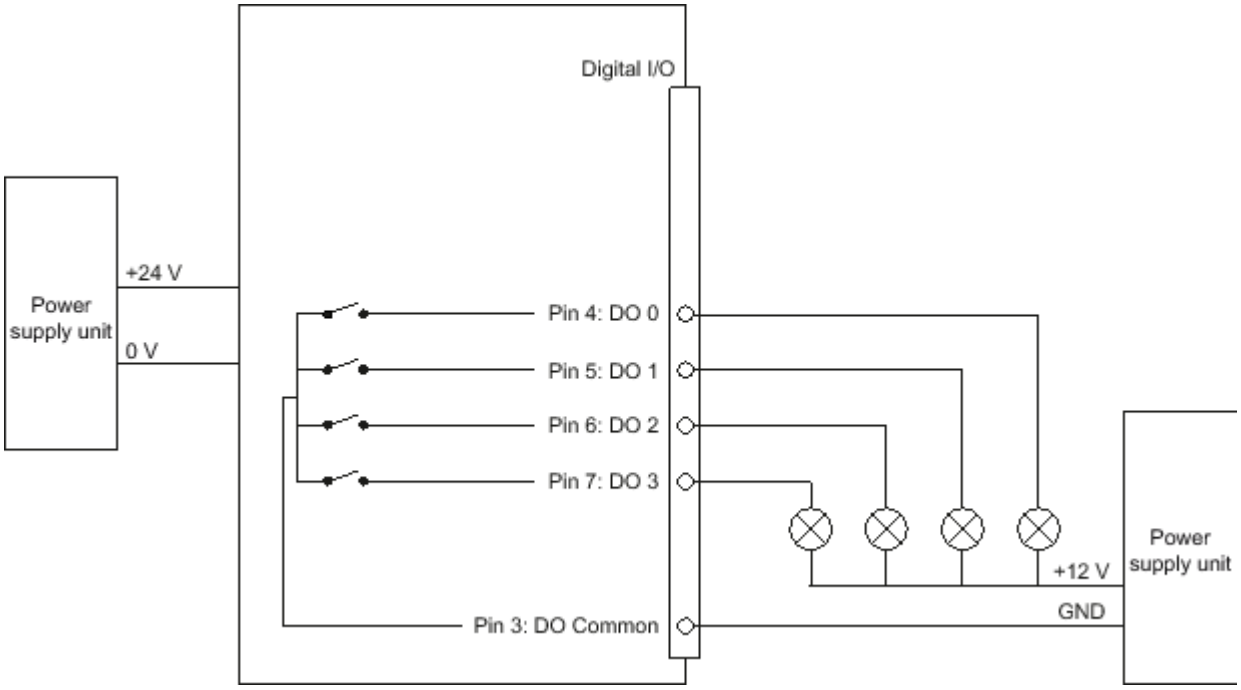


Figure 5-45 Circuit example 5: Digital outputs

Voltage infeed from an external source is shown here for 12°V as an example. Other voltages are also permissible.

REVIEW

Voltage infeed from external source with various voltages

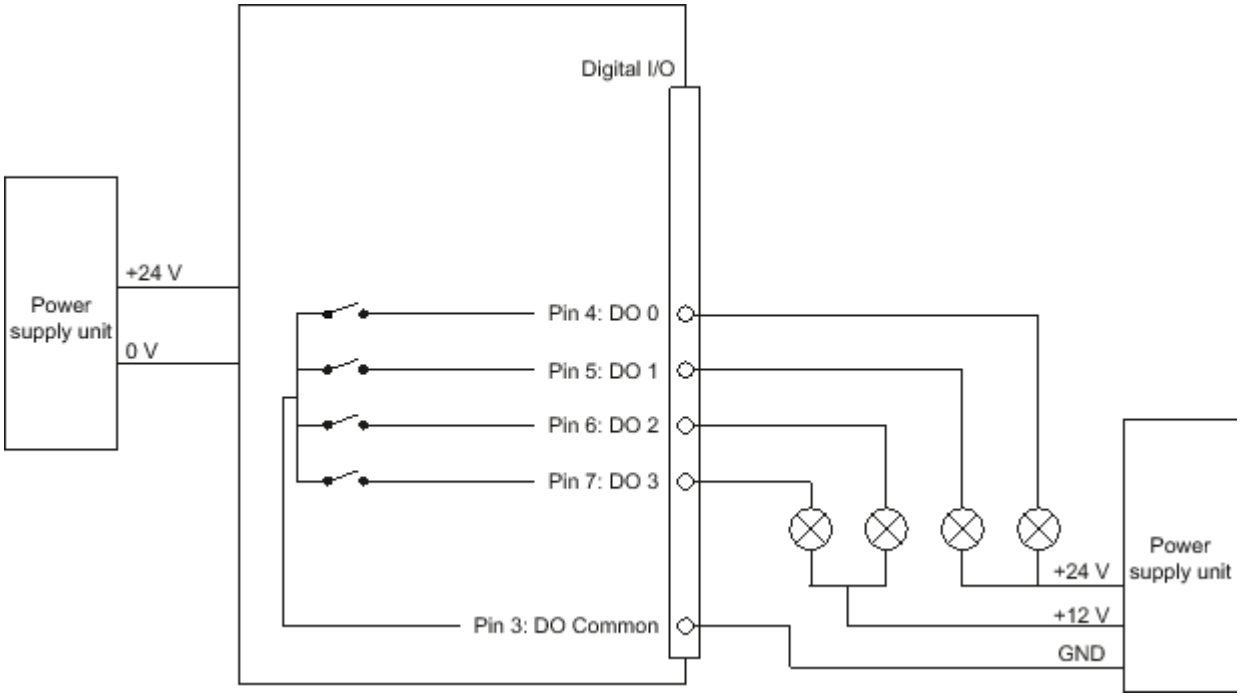


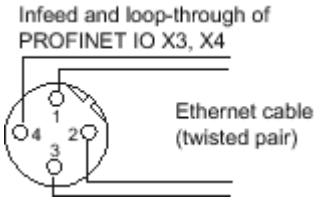
Figure 5-46 Circuit example 6: Digital outputs

REVIEW

5.7.1.6 Pin assignment of the RS-422 interface

Pin	Pin Device end 8-pin M12	Assignment
	1	+ 24 V
	2	- Transmit
	3	0 V
	4	+ Transmit
	5	+ Receive
	6	- Receive
	7	Unassigned
	8	Earth (shield)

5.7.1.7 Pin assignment for Industrial Ethernet interface

View of M12 plug, 4-pin, D coding (wiring side)	Pin	Pin assignment
	1	Data line TxP
	2	Data line RxP
	3	Data line TxN
	4	Data line RxN

REVIEW

5.7.1.8 Grounding connection

The RF680R can be electrically connected to the ground potential with a contact washer. The tightening torque must be increased in this case to ensure that electrical contact is made (2.7 Nm).

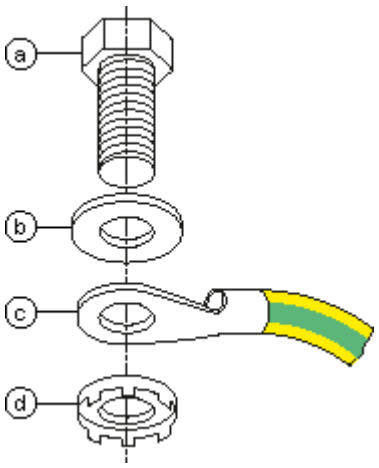
⚠ WARNING

Hazardous voltage due to lightning strikes

Death or serious injury may occur as a result of lightning strikes to antennas mounted outside buildings.

If the reader is operated with antennas mounted outside buildings, it is imperative that the reader is electrically connected to the ground potential.

NOTICE
Installation only in protected areas The antenna 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.

Ground connection		
	(a)	Hexagon-head screw
	(b)	Flat washer
	(c)	Cable lug
	(d)	Contact washer: Use contact washers according to the Siemens standard SN 70093-6-FSt-flNnnc-480h for ground connection, Siemens item no.: H70093-A60-Z3

REVIEW

5.7.2 Planning operation

5.7.2.1 Antenna/read point configurations

You can connect up to four external antennas to the RF680R reader. The standard setting is that four antennas are connected when the reader is started. When connecting multiple antennas, note the information in the section "Specified minimum and maximum spacing of antennas (Page 49)".

With the graphical user interface of the integrated Web server, you can set up various different configurations of antennas and/or reading points as required. It is possible to find solutions to many different tasks through the number of data sources and subsequent assignment of the antennas.

Examples of possible antenna reading point configurations

- Four data sources each with one antenna for four different reading points.
- Two data sources each with two antennas for small portals.
- One data source with 4 antennas for large portals.

You will find further information in the online Help for the products.

5.7.3 Installation/mounting

Requirement

⚠ WARNING

Make sure that the wall or ceiling can hold four times the total weight of the device.

Note

Close unused connectors

If you do not use connectors on the reader, it is advisable to close the unused connectors with protective caps. You can order the protective cap set using the MLFB specified in the section "Ordering data".

⚠ CAUTION

Emitted radiation

The transmitter complies with the requirements of Health Canada and the FCC limit values for subjecting persons to HF radiation, provided that a minimum spacing of 26 cm exists between antenna and person. When the antennas are installed, you must therefore ensure that a minimum spacing of 26 cm is maintained between personnel and antennas.

REVIEW

Mounting/installing the device

You can mount the reader in two different ways:

- Via a standardized VESA 100 mounting system using the Antenna Mounting Kit (refer to the section Mounting with antenna mounting kit (Page 331)). Tighten the M4 screws on the rear of the reader using a maximum torque of ≤ 1.3 Nm.
- Directly on a flat surface.

The positions of the mounting holes for the device are shown in the section Dimension drawing (Page 213).

5.7.4 Configuration/integration

An Ethernet interface is available for integrating the device into system environments/networks. Over the Ethernet interface and with direct connection to the PC, the RF680R can be configured in the following ways:

- via the graphical user interface of the integrated Web server
- STEP 7 Basic/Professional (TIA Portal)
- with XML-based user applications

The communications interface transfers the data via the Web server or STEP 7 to the IT, ERP and SCM systems as well as to SIMATIC controllers. Alternatively the data is transferred to user applications using XML commands.

Simple process controls (e.g. a traffic signal) can be implemented directly using the write/read device via four digital inputs and outputs.

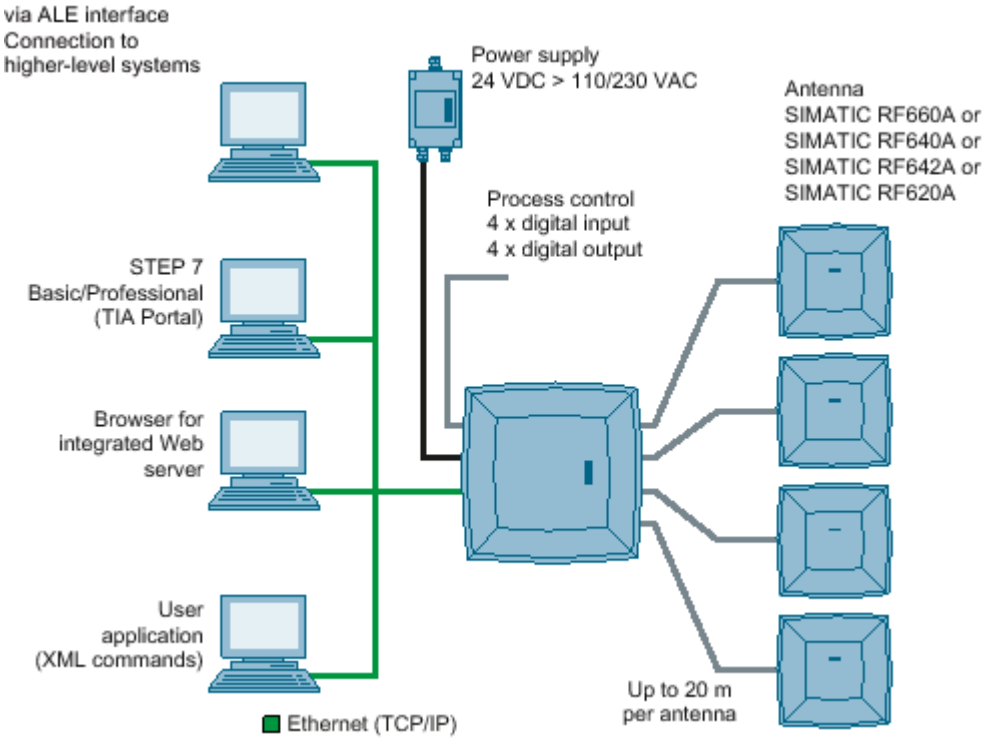


Figure 5-47 Overview of configuration of the RF680R reader

REVIEW

5.7.5 Technical specifications

Table 5- 30 Technical specifications, RF680R

	6GT2811-6AA10-xAA0
Product type designation	RF680R
Mechanical specifications	
Weight	
Dimensions (L x W x H)	
Degree of protection	IP65
Material	
• Upper part of housing	Pocan DP CF 2200
• Lower part of housing	Aluminum
Color	
• Upper part of housing	TI-Grey
• Lower part of housing	Silver
Operating displays on the device	8 LEDs
Status display on the device	9 LEDs
Interfaces	
• Antenna connectors	4 x RTNC connector
• Power supply	1 x connector (8-pin M12), RS-422
• Digital I/O interface	1 x socket (12-pin, M12)
• Digital inputs	4
• Digital outputs	4
• Ethernet interface	2 x socket (4-pin, M12)
MTBF in years	
Electrical specifications	
Power supply	20 to 30 VDC [1)]
Current consumption (on standby)	
• 20 V input voltage on the reader (typical)	200 mA / 4.0 W
• 24 V input voltage on the reader (typical)	170 mA / 4.1 W
• 30 V input voltage on the reader (typical)	140 mA / 4.2 W
Current consumption (at 1000 mW transmit power)	
• 20 V input voltage on the reader (typical)	450 mA / 9.0 W
• 24 V input voltage on the reader (typical)	380 mA / 9.1 W
• 30 V input voltage on the reader (typical)	300 mA / 9.6 W

	6GT2811-6AA10-xAA0
Startup time	
Electromagnetic compatibility	
• ETSI	EN 301 489-1/-3, EN 302 208-1/-3 V1.4.1
• FCC	FCC CFR 47, Part 15 section 15.247

Permitted ambient conditions	
Ambient temperature	
• Operation	-25 ℃ to +55 ℃
• Transport and storage	-40 ℃ to +85 ℃
Shock resistant to EN 60068-2-27	50 g [2]
Vibration resistant to EN 60068-2-26	20 g [2]

[1] All supply and signal voltages must be safety extra-low voltage (SELV/PELV according to EN 60950). All power sources must meet the requirements for LPS (Limited Power Sources) and NEC Class 2.

[2] The values for shock and vibration are maximum values and must not be applied continuously.

Table 5- 31 Technical specifications according to EPC and ISO, RF680R

	6GT2811-6AA10-xAA0
Product type designation	RF680R
Frequency accuracy	max.± 10 ppm
Channel spacing	• EU, EFTA, Turkey: 600 kHz • US: 500 kHz • China: 250 kHz
Modulation methods	ASK: DSB modulation & PR-ASK modulation Encoding, Manchester or Pulse Interval (PIE)
Effective radiated power	
• ETSI/CMIIT	• ≤ 2 W ERP
• FCC	• ≤ 4 W EIRP
Transmit power	
• ETSI/CMIIT	• ≤ 2 W
• FCC	• ≤ 2 W
Reading range	
Antennas mounted on opposing sides (portal configuration)	max. 10 m
Antennas mounted on the same side	max. 5 m (dependent on transponder)

REVIEW

	6GT2811-6AA10-xAA0
Frequencies	
ETSI frequencies	
European frequency band	865,7 ... 867.5 MHz
ETSI EN 302 208 V1.4.1 (valid since October 23, 2012, publication in the Official Journal of the European Union)	(4 channels at max. 2 W ERP)
FCC frequencies	
Frequency band USA	902 ... 928 MHz (50 channels at max. 4 W EIRP, frequency hopping)
CMIIT frequencies	
Frequency band China	920,625 ... 924.375 MHz (16 subchannels at 2 W ERP)

5.7.6 Dimension drawing

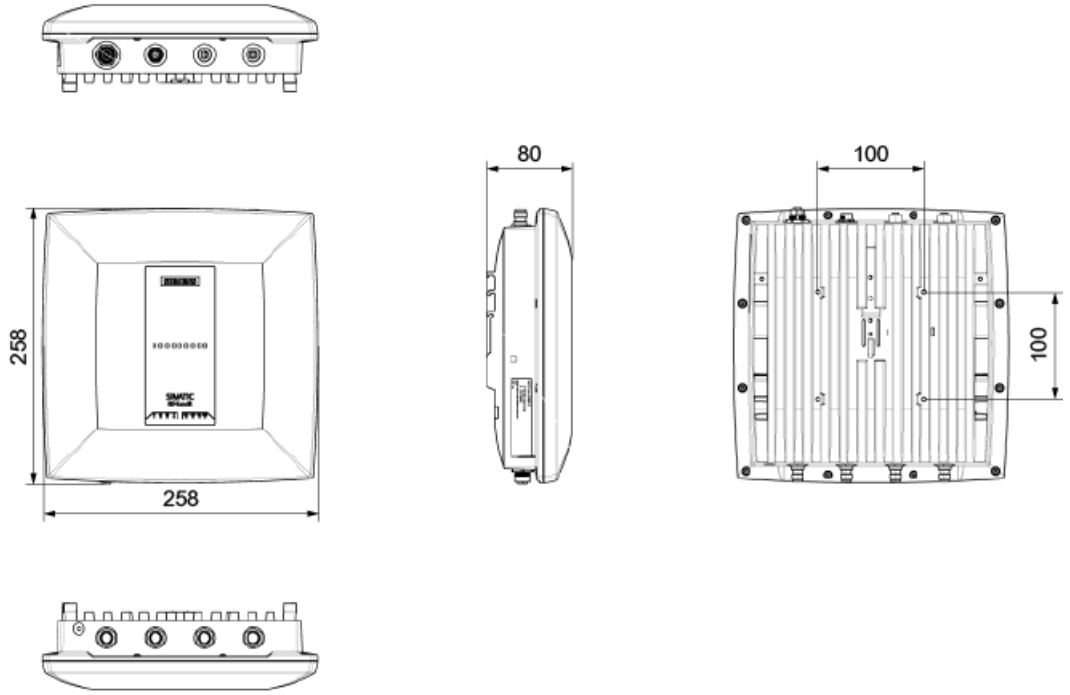


Figure 5-48 Dimension drawing RF680R

All dimensions in mm (± 0.5 mm tolerance)

REVIEW

5.7.7 Certificates and approvals

Note

Marking on the readers according to specific approval

The certificates and approvals listed here apply only if the corresponding mark is found on the readers.

Table 5- 32 6GT2811-6AA10-0AA0

Certificate	Description
CE	Conformity with R&TTE directive

Table 5- 33 6GT2811-6AA10-1AA0

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. FCC ID: ??????
Industry Canada Radio Standards Specifications	RSS-210 Issue 7, June 2007, Sections 2.2, A8 IC: ??????
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

Table 5- 34 6GT2811-6AA10-2AA0

Standard	
CMIIT Certification	China radio approval Marking on the reader: CMIIT ID: ??????

REVIEW

5.7.7.1 FCC information

Siemens SIMATIC RF680R (FCC): 6GT2811-6AA10-1AA0

FCC ID:

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification.

It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

5.7.7.2 IC-FCB information

Siemens SIMATIC RF680R (FCC): 6GT2811-6AA10-1AA0

IC:

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d`Industrie Canada applicables aux appareils radio exempts de licence. L`exploitation est autorisée aux deux conditions suivantes :

(1) L`appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l`appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d`en compromettre le fonctionnement.

Industry Canada Notice

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Transmitter power and antenna information for antennas with a gain less than 6 dBi:

This device has been designed to operate with the SIMATIC RF620A antenna 902-928, the SIMATIC RF640A antenna 902-928 as well as the SIMATIC RF660A antenna 902-928 listed below, and having a maximum gain of 5.5 dBi.

Arbitrary transmission power settings in combination with other antennas or antennas having a gain greater than 5.5 dBi are strictly prohibited for use with this device.

The required antenna impedance is 50 Ohms.

Transmitter power and antenna information for antennas with a gain greater 6 dBi:

This device requires professional installation. Antennas with a gain greater 6 dBi may be used provided the system does not exceed the radiation power of 4000 mW E.I.R.P. This device has been designed to operate with the SIMATIC RF642A antenna 902-928 exceeding the maximum gain of 5.5 dBi under the restriction that the RF power at the input of the antenna must be set to meet the following relation: RF power (dBm) ≤ 30 dBm – (antenna gain (dBi) – 6 dBi) Other antennas or system configurations for antennas having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

REVIEW

5.8 RF685R reader

5.8.1 Description

5.8.1.1 Overview

The SIMATIC RF685R is a stationary reader in the UHF frequency band with an integrated antenna. As an alternative, an external UHF RFID antenna can be connected via a TNC reverse connector.

The maximum RF power output is 2000°W at the external reader output. A radiant power of up to 2000 mW ERP is achieved when the appropriate antennas and antenna cables are used. The interfaces (Ethernet, M12 power supply, M12 digital I/O interface) are located along the narrow lower front edge. These interfaces can be used to connect the reader to the power supply and the PC for parameter assignment.

The degree of protection is IP65.

	Pos.	Description
	①	TNC reserve interface for connection of an antenna
	②	LED status display
	③	LED operating display
	④	Digital I/O interface
	⑤	RS-422 interface (M12 plug, 8-pin)
	⑥	Ethernet interface (TCP/IP) (M12 plug, 4-pin)
	⑦	Ethernet interface (TCP/IP) (M12 plug, 4-pin)

REVIEW

5.8.1.2 Ordering data

Ordering data RF685R

Product	Article number
RF685R (ETSI) reader basic unit for EU, EFTA, Turkey	6GT2811-6CA10-0AA0
RF685R (FCC) reader basic unit for the USA	6GT2811-6CA10-1AA0
RF685R (CMIIT) reader basic unit for China	6GT2811-6CA10-2AA0

Ordering data accessories

Product	Article number
Antenna mounting kit	6GT2890-0AA00
Connecting cable and connectors	
• Digital I/O, open cable ends, 5 m	• 6GT2891-0CH50
• Ethernet: 10 m (crossover cable)	• 6GT2891-1HN10
• Ethernet connector on reader according to IEC PAS 61076-3-117IE RJ-45 Plug PRO (IP67)	• 6GK1901-1BB10-6AA0
• Ethernet connector, Standard IE FastConnect RJ-45 Plug 180 (IP20)	• 6GK1901-1BB10-2AB0
• Ethernet cable sold by the meter, green	• 6XV1840-2AH10
Wide-range power supply unit for SIMATIC RF systems	
• With EU plug	• 6GT2898-0AA00
• With UK plug	• 6GT2898-0AA10
• With US plug	• 6GT2898-0AA20
24 V connecting cable 5 m between reader and power supply (for RF640R only, pin assignment is PNO-compliant)	6GT2891-0NH50
Set of protective caps Contains 3 protective caps for antenna output and one protective cap for digital I/O interface (required for IP65 degree of protection when some connectors are unused)	6GT2898-4AA00
RFID DVD "Software & Documentation"	6GT2080-2AA20

REVIEW

5.8.1.3 Status display

The device is equipped with 17 three-colored LEDs. The operating statuses of the reader are displayed by the "RUN/STOP", "ERROR", "MAINT" and "PRESENCE" LEDs. The LEDs can be lit green, red or orange. The meaning of the display changes according to the color and status (on, off, flashing) of the LED:

R/S	ERR	MT	PR	Meaning
○	○	○	○	The device is turned off.
●	●	●	●	The device is starting up.
●	-	-	-	The device is ready for operation. The connection is established.
☼	-	-	-	The device is working. Transponder data can be read or written.
-	☼	-	-	There is an error.
-	-	☼	-	Maintenance work required.
-	-	-	●	There is transponder in the antenna field.
-	-	-	☼	There are multiple transponders in the antenna field.

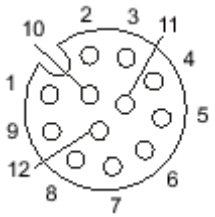
For more detailed information on the flash codes of the reader, refer to the section LED displays RF650R/RF680R/RF685R (Page 480).

REVIEW

5.8.1.4 Pin assignment of the digital I/O interface

View of socket (reader end)

Table 5- 35

M12 socket (reader end)	Pin	Pin assignment
	1	GND (output for supply of digital inputs/outputs [not electrically isolated])
	2	VCC (output for supply of digital inputs/outputs [not electrically isolated])
	3	DO Common / Outport Common
	4	DO 0 / Outport 00
	5	DO 1 / Outport 01
	6	DO 2 / Outport 02
	7	DO 3 / Outport 03
	8	DI 0 / Inport 00
	9	DI Common / Inport Common
	10	DI 1 / Inport 01
	11	DI 2 / Inport 02
	12	DI 3 / Inport 03

Wiring diagram M12 connector (cable end)

You will need to assemble your reader cable with a suitable connector that fits the interface shown above. Keep to the following wiring diagram:

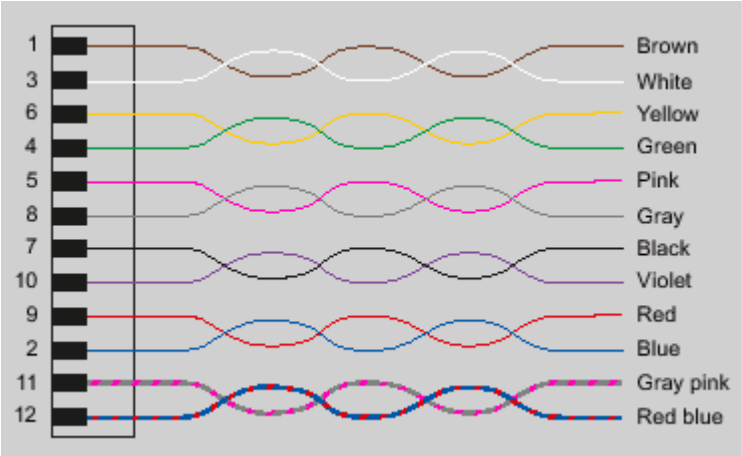


Figure 5-49 M12 connector wiring diagram

5.8.1.5 Connection scheme for the digital I/O interface

REVIEW

Connection possibilities

You can connect the RF680R reader in different ways. In general, the outputs and inputs should be connected as follows:

Output Outport (0), (1), (2), (3)

- Each output is rated for 0.5 A current and is electronically protected.
- 4 digital outputs can be operated simultaneously each with up to 0.5 A (up to 1.0 A in total).
- The outputs are optically isolated through optocouplers.

Input Inport (0), (1), (2), (3)

- The inputs are optically isolated through optocouplers.
- Level Low 0 ... 3 V; High 3.6 ... 24 V
- Sampling rate < 20 ms

The following diagrams illustrate various connection possibilities.

Voltage infeed from internal source (no electrical isolation)

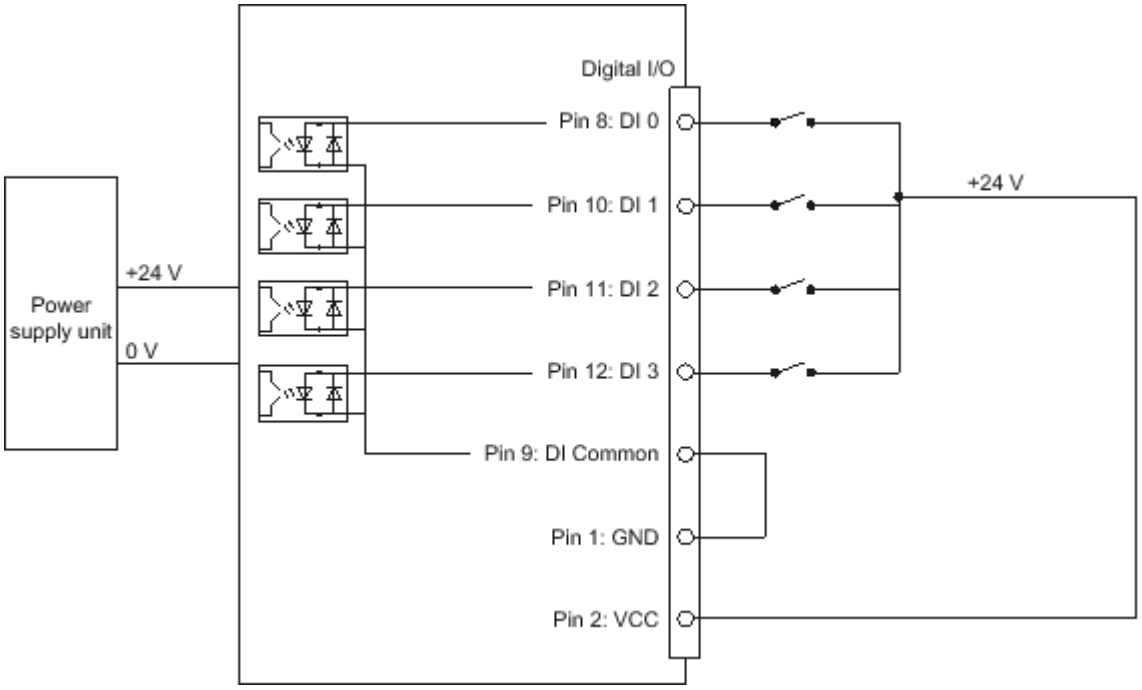


Figure 5-50 Circuit example 1: Digital inputs

Alternative connection possibilities:

- Pin 2 (VCC) to pin 9 DI common
- Pin 1 GND to busbar inputs

REVIEW

Voltage infeed from external source

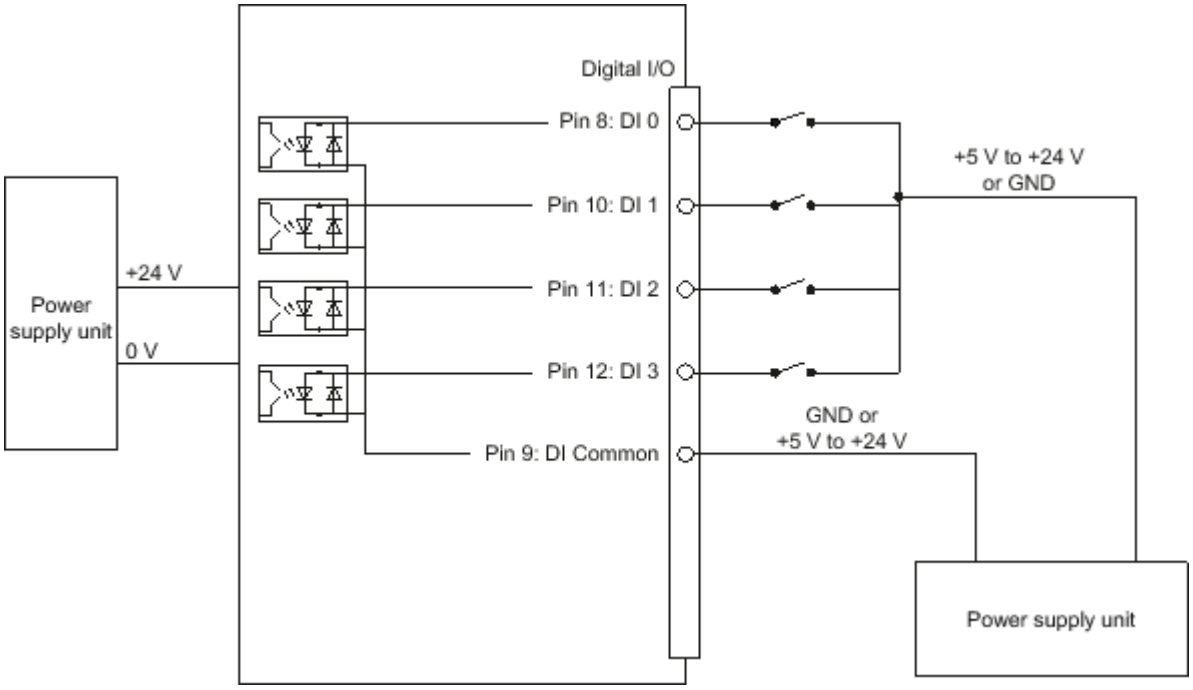


Figure 5-51 Circuit example 2: Digital inputs

REVIEW

Voltage infeed from external source with various voltages

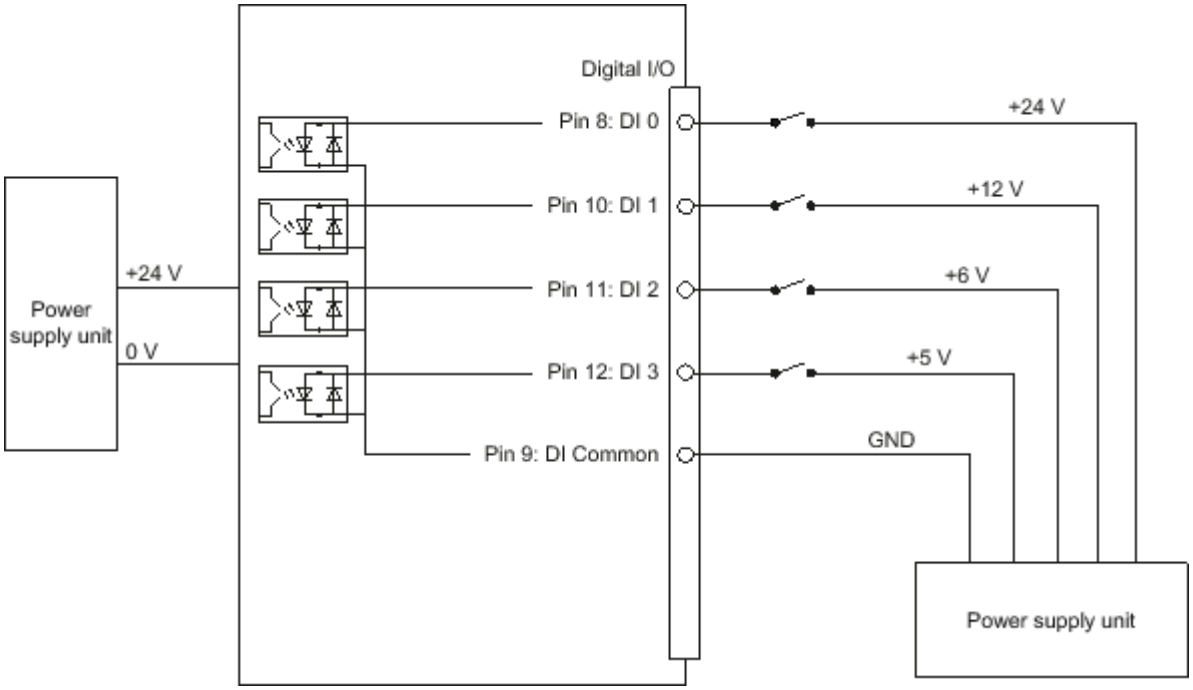


Figure 5-52 Circuit example 3: Digital inputs

Voltage infeed from internal source

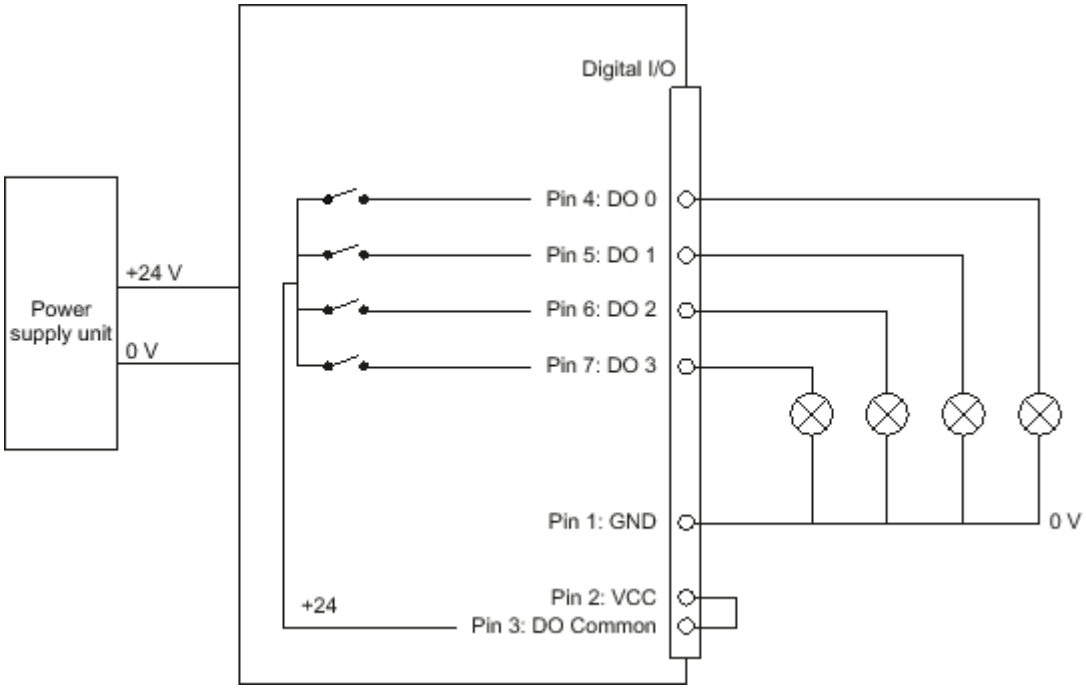


Figure 5-53 Circuit example 4: Digital outputs

Alternative connection possibilities:

- Pin 1 GND to pin 3 DO common
- Pin 2 (VCC) to busbar outputs

REVIEW

Voltage infeed from external source

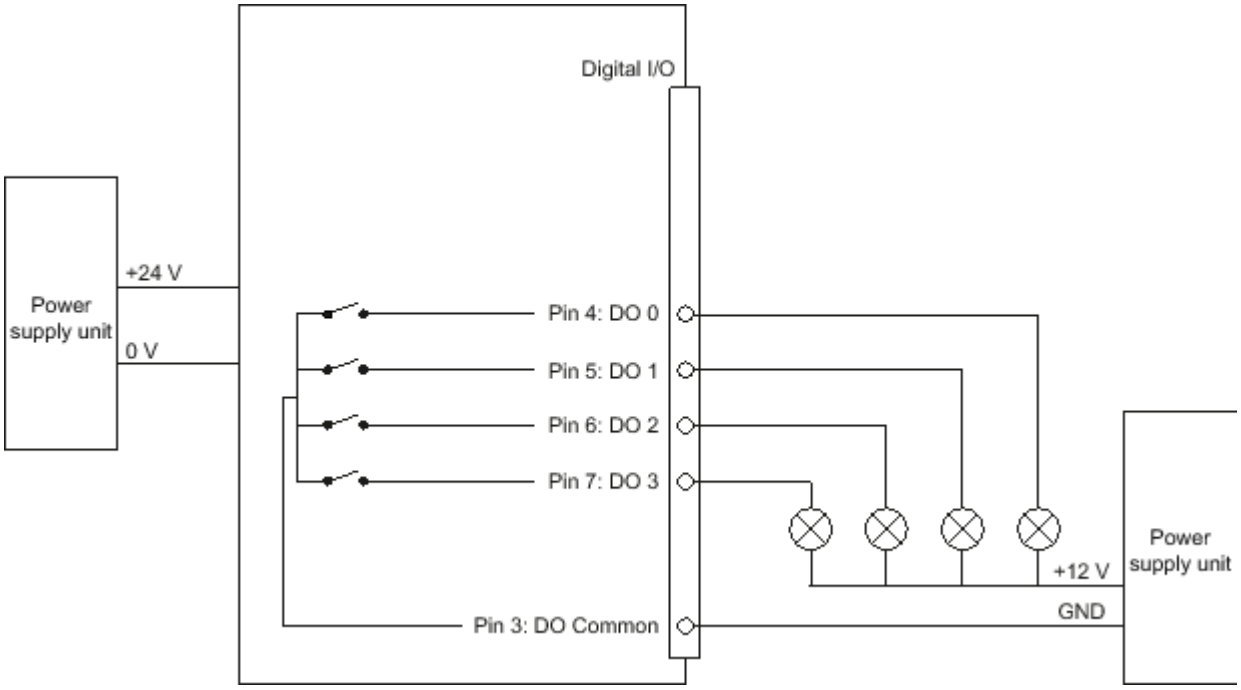


Figure 5-54 Circuit example 5: Digital outputs

Voltage infeed from an external source is shown here for 12°V as an example. Other voltages are also permissible.

REVIEW

Voltage infeed from external source with various voltages

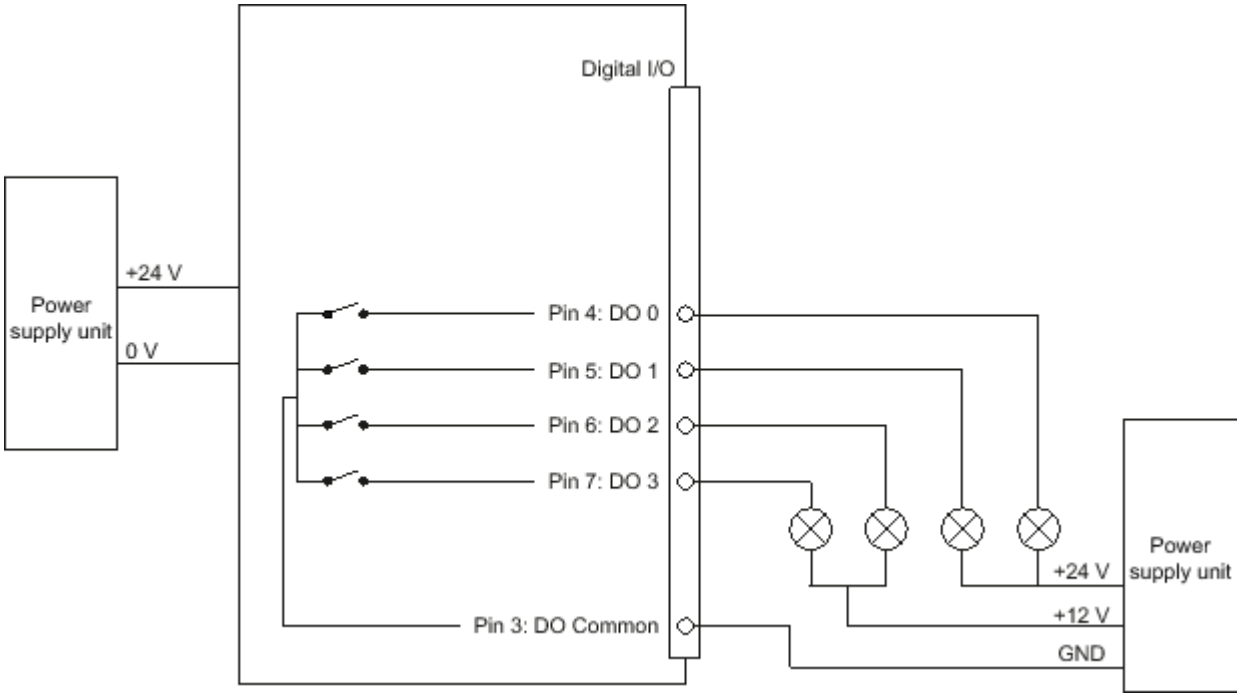


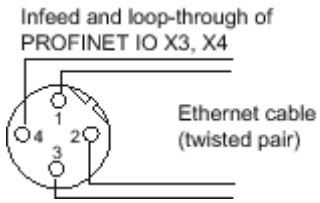
Figure 5-55 Circuit example 6: Digital outputs

REVIEW

5.8.1.6 Pin assignment of the RS-422 interface

Pin	Pin Device end 8-pin M12	Assignment
	1	+ 24 V
	2	- Transmit
	3	0 V
	4	+ Transmit
	5	+ Receive
	6	- Receive
	7	Unassigned
	8	Earth (shield)

5.8.1.7 Pin assignment for Industrial Ethernet interface

View of M12 plug, 4-pin, D coding (wiring side)	Pin	Pin assignment
	1	Data line TxP
	2	Data line RxP
	3	Data line TxN
	4	Data line RxN

5.8.1.8 Grounding connection

The RF685R can be electrically connected to the ground potential with a contact washer. The tightening torque must be increased in this case to ensure that electrical contact is made (2.7 Nm).

⚠ WARNING

Hazardous voltage due to lightning strikes

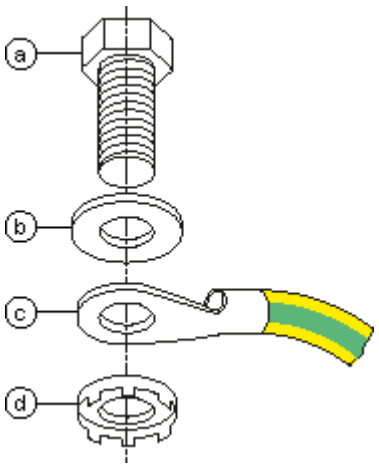
Death or serious injury may occur as a result of lightning strikes to antennas mounted outside buildings.

If the reader is operated with antennas mounted outside buildings, it is imperative that the reader is electrically connected to the ground potential.

REVIEW

NOTICE
Installation only in protected areas The antenna 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.

Ground connection



(a)	Hexagon-head screw
(b)	Flat washer
(c)	Cable lug
(d)	Contact washer: Use contact washers according to the Siemens standard SN 70093-6-FSt-flNnnc-480h for ground connection, Siemens item no.: H70093-A60-Z3

REVIEW

5.8.2 Planning operation

5.8.2.1 Selecting the antenna

With the SIMATIC RF685R, there are two ways of using the antenna that are mutually exclusive:

- Either you use the internal antenna of the reader
- Or you connect an external antenna to the interface of the reader. The internal antenna of the reader can then, however, not be used at the same time.

You can select the active antenna using the graphical user interface of the integrated Web server.

5.8.2.2 Internal antenna

Minimum mounting clearances of two readers

The RF685R has an antenna with switchable polarization. With the internal antenna active and at 2000 mW ERP radiated power, due to the aperture angle of the antennas, their fields

can overlap considerably. This means it is no longer possible to be sure in which of the antenna fields the data of a transponder will be accessed.

In order to avoid this, always keep a minimum distance of 6 m between two readers with the maximum radiated power of 2000 mW ERP.

Dense Reader Mode (DRM)

The readers can also interfere with each other (secondary fields), if the channels (Reader TX, Transponder TX) overlap. In order to prevent a transponder channel overlapping with a reader channel, we recommend that the Dense Reader Mode (DRM) is used.

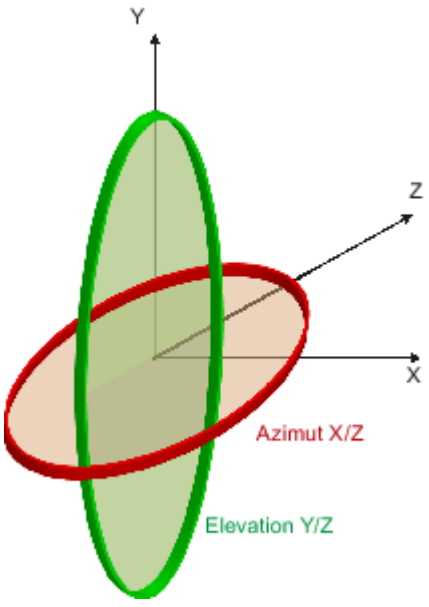
Note

Protective cap

If you use the internal antenna of the reader, we recommend that you close the external, unused antenna connector on the reader using the supplied protective cap.

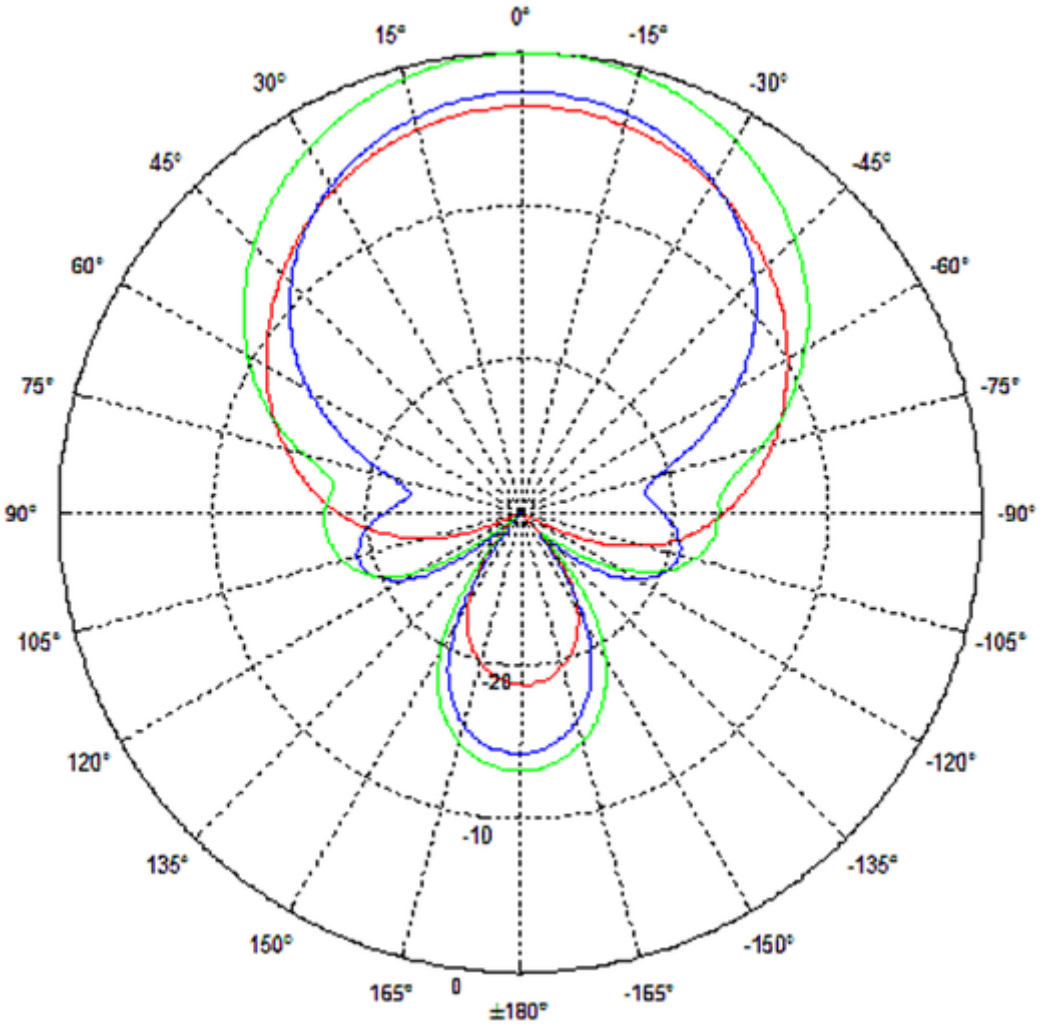
Antenna diagram for RF685R (ETSI)

The following radiation diagrams show the directional characteristics of the internal antenna of the RF685R (ETSI) reader. For the spatial presentation of the directional characteristics, the vertical plane (azimuth section) as well as the horizontal plane (elevation section) must be considered. This results in a spatial image of the directional radiation pattern of the antenna with its main and secondary fields.



REVIEW

Radiation diagram (Azimuth section)



Vertical component of the polarization direction of the antenna

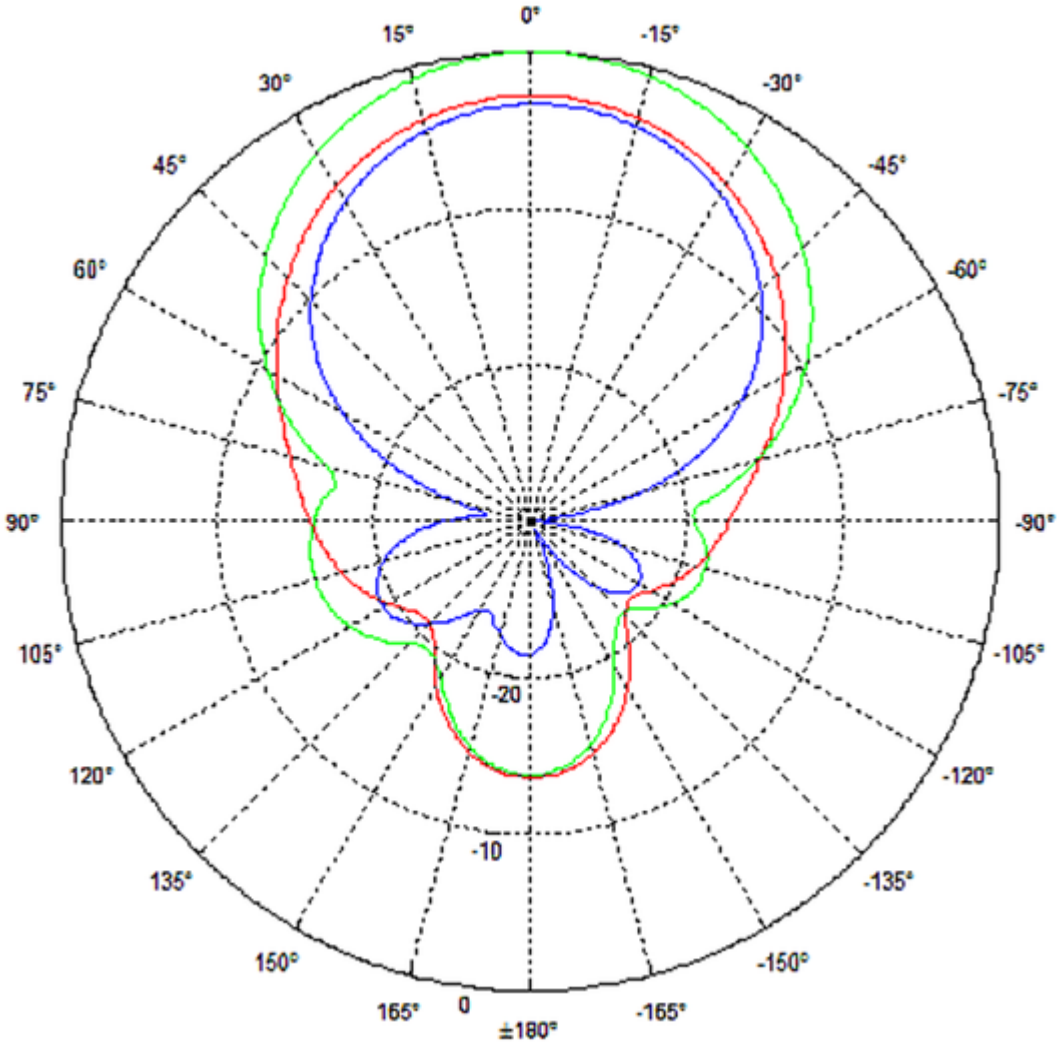
Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-56 Azimuth section

REVIEW

Radiation diagram (elevation section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-57 Elevation section

REVIEW

Overview of the antenna parameters

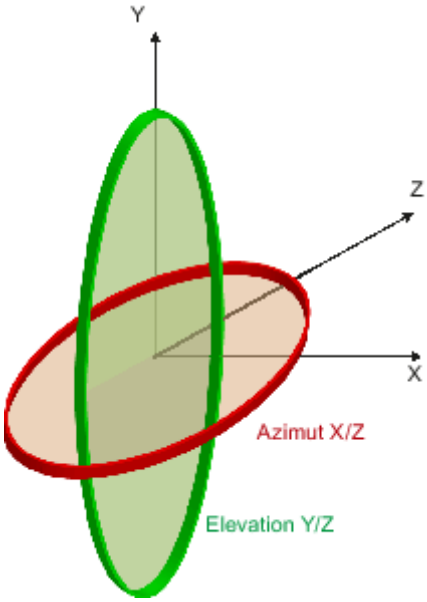
Table 5- 36 Maximum linear electrical aperture angle at 865 MHz:

Azimuth section	77,7°
Elevation section	66,1°
Typical antenna gain in the frequency band 865 to 868 MHz	4.0 dBi
Antenna axis ratio	0.7 dB

See also section Guidelines for selecting RFID UHF antennas (Page 55)

Antenna diagram for RF685R (FCC)

The following radiation diagrams show the directional characteristics of the internal antenna of the RF685R (FCC) reader. For the spatial presentation of the directional characteristics, the vertical plane (azimuth section) as well as the horizontal plane (elevation section) must be considered. This results in a spatial image of the directional radiation pattern of the antenna with its main and secondary fields.

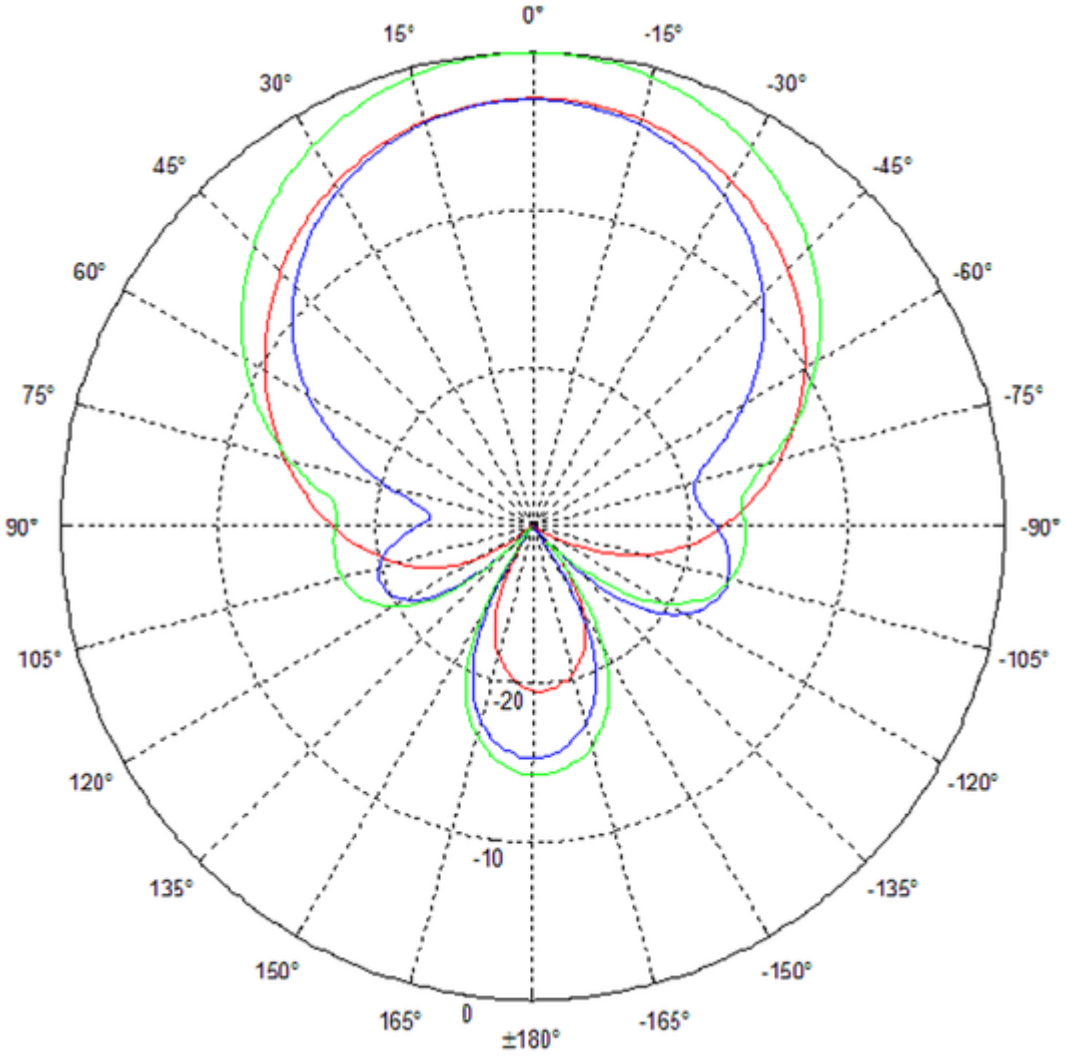


Azimuth XZ plane
Elevation YZ plane

REVIEW

REVIEW

Radiation diagram (Azimuth section)



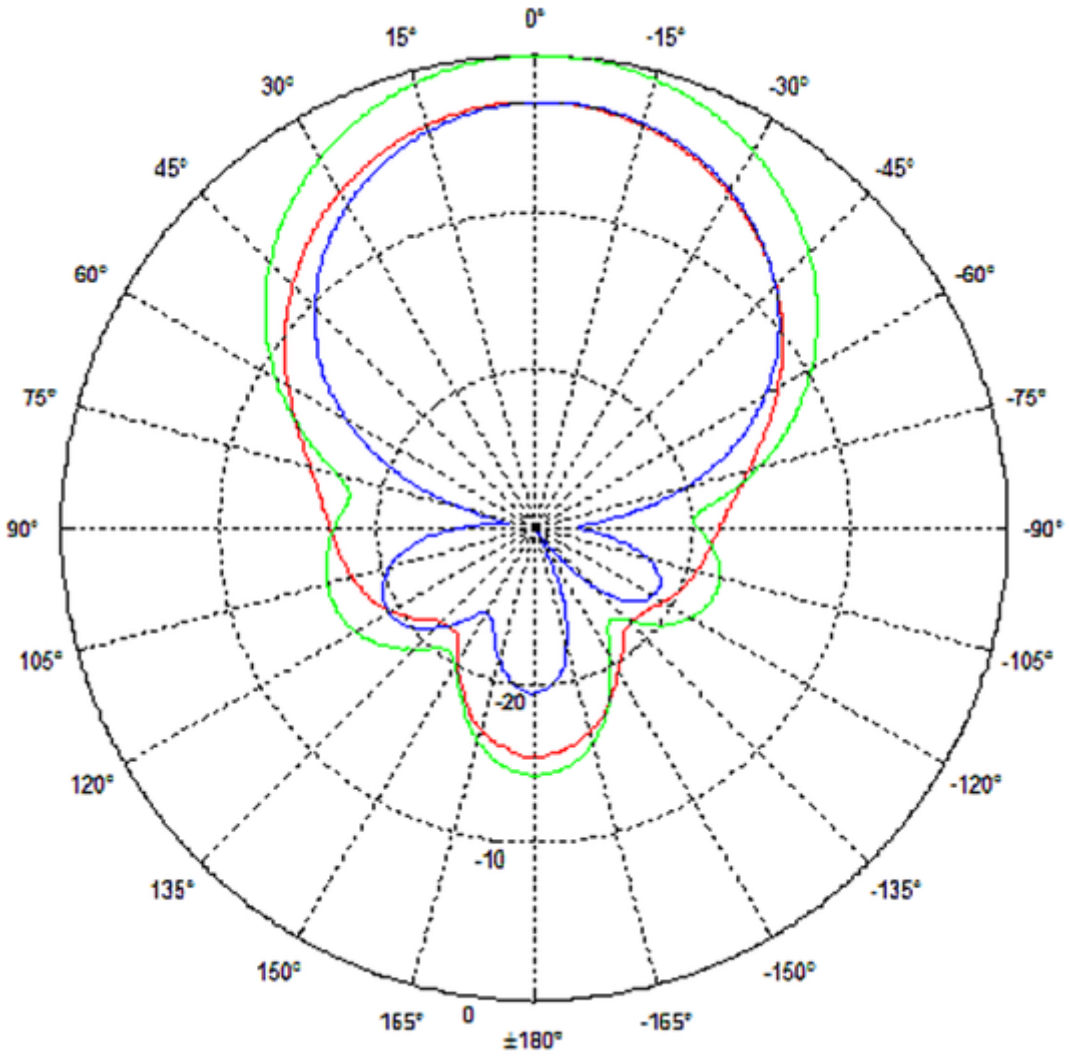
Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-58 Azimuth section

Radiation diagram (elevation section)



Vertical component of the polarization direction of the antenna

Horizontal component of the polarization direction of the antenna

Right circular component of the polarization direction of the antenna

Figure 5-59 Elevation section

REVIEW

Overview of the antenna parameters

Table 5- 37 Maximum linear electrical aperture angle at 865 MHz:

Azimuth section	75,4 °
Elevation section	69,1 °
Typical antenna gain in the frequency band 902 to 928 MHz	4.0 dBi ± 0.5 dB
Antenna axis ratio	<1 dB

See also section Guidelines for selecting RFID UHF antennas (Page 55).

Interpretation of directional radiation patterns

The following overview table will help you with the interpretation of directional radiation patterns.

The table shows which dBi values correspond to which read/write ranges (in %): You can read the radiated power depending on the reference angle from the directional radiation patterns, and thus obtain information on the read/write range with this reference angle with regard to a transponder.

The dBr values correspond to the difference between the maximum dBi value and a second dBi value.

Deviation from maximum antenna gain [dBr]	Read/write range [%]
0	100
-3	70
-6	50
-9	35
-12	25
-15	18
-18	13

Example

As can be seen in the section Antenna diagram for RF685R (ETSI) (Page 228), the maximum antenna gain 0 dB is standardized. In the Azimuth diagram, the antenna gain falls by 3°dB at approximately ± 39°. Therefore the dBr value is -3. The antenna range is only 50% of the maximum range at ± 39° from the Z axis within the horizontal plane.

Antenna/read point configurations

The RF685R reader has a switchable antenna (circular or linear polarization). You can cover one read point with this antenna. When several RF685R readers are used, the readers are addressed via the SIMATIC level.

5.8.2.3 External antenna

Preassembled standard cables in lengths of 3 m, 5 m, 15 m and 20 m are available to connect the antenna.

The read range is limited by the cable loss. The maximum range can be achieved with the cable 6GT2815-0BH30 (length 3 m), since this has the lowest cable loss.

Examples of possible antenna reading point configurations

- A data source with an external antenna for a reading point.
- As an alternative, a data source with an internal antenna for a reading point.

5.8.3 Installation/mounting

Requirement

⚠ WARNING

Make sure that the wall or ceiling can hold four times the total weight of the device.

Note

Close unused connectors

If you do not use connectors on the reader, it is advisable to close the unused connectors with protective caps. You can order the protective cap set using the MLFB specified in the section "Ordering data".

⚠ CAUTION

Emitted radiation

The transmitter complies with the requirements of Health Canada and the FCC limit values for subjecting persons to HF radiation, provided that a minimum spacing of 26 cm exists between antenna and person. When the antennas are installed, you must therefore ensure that a minimum spacing of 26 cm is maintained between personnel and antennas.

Mounting/installing the device

You can mount the reader in two different ways:

- Via a standardized VESA 100 mounting system using the Antenna Mounting Kit (refer to the section Mounting with antenna mounting kit (Page 331)). Tighten the M4 screws on the rear of the reader using a maximum torque of ≤ 1.3 Nm.
- Directly on a flat surface.

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The positions of the mounting holes for the device are shown in the section Dimension drawing (Page 239).

5.8.4 Configuration/integration

An Ethernet interface is available for integrating the device into system environments/networks. Over the Ethernet interface and with direct connection to the PC, the RF685R can be configured in the following ways:

- via the graphical user interface of the integrated Web server
- STEP 7 Basic/Professional (TIA Portal)
- with XML-based user applications

The communications interface transfers the data via the Web server or STEP 7 to the IT, ERP and SCM systems as well as to SIMATIC controllers. Alternatively the data is transferred to user applications using XML commands.

Simple process controls (e.g. a traffic signal) can be implemented directly using the write/read device via four digital inputs and outputs.

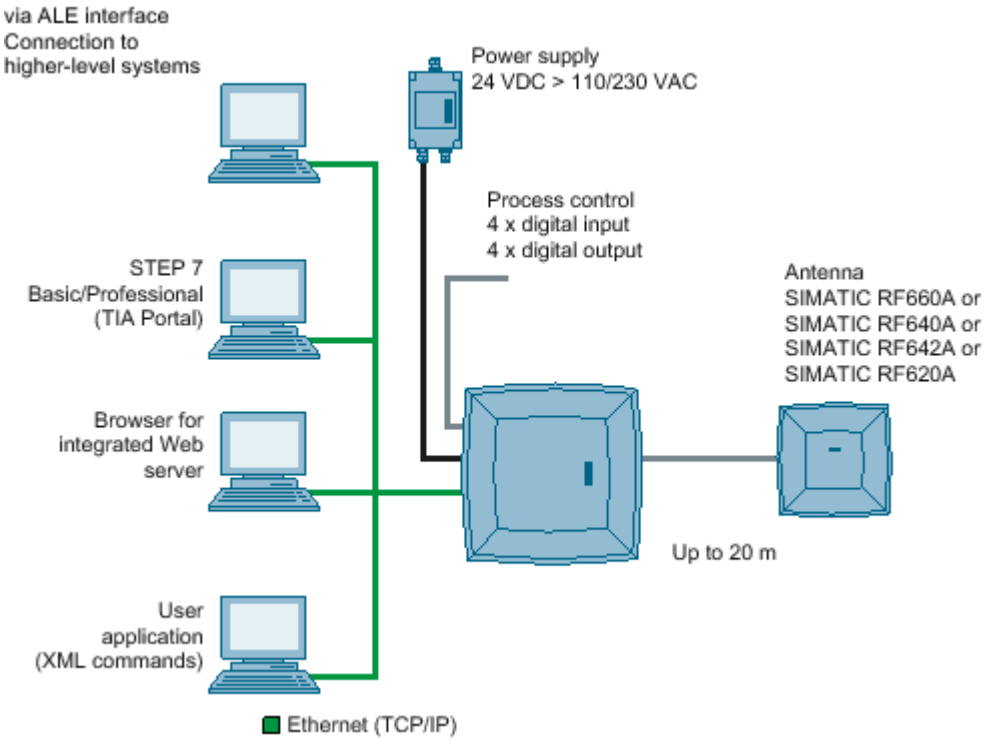

Figure 5-60 Overview of configuration of the RF685R reader

REVIEW

5.8.5 Technical specifications

Table 5- 38 Technical specifications, RF685R

	6GT2811-6CA10-xAA0
Product type designation	RF685R
Mechanical specifications	
Weight	
Dimensions (L x W x H)	
Degree of protection	IP65
Material	
• Upper part of housing	Pocan DP CF 2200
• Lower part of housing	Aluminum
Color	
• Upper part of housing	TI-Grey
• Lower part of housing	Silver
Operating displays on the device	8 LEDs
Status display on the device	9 LEDs
Interfaces	
• Antenna connectors	1 x RTNC plug
• Power supply	1 x connector (8-pin M12), RS-422
• Digital I/O interface	1 x socket (12-pin, M12)
• Digital inputs	4
• Digital outputs	4
• Ethernet interface	2 x socket (4-pin, M12)
MTBF in years	
Electrical specifications	
Power supply	20 to 30 VDC [1)]
Current consumption (on standby)	
• 20 V input voltage on the reader (typical)	200 mA / 4.0 W
• 24 V input voltage on the reader (typical)	170 mA / 4.1 W
• 30 V input voltage on the reader (typical)	140 mA / 4.2 W
Current consumption (at 1000 mW transmit power)	
• 20 V input voltage on the reader (typical)	450 mA / 9.0 W
• 24 V input voltage on the reader (typical)	380 mA / 9.1 W
• 30 V input voltage on the reader (typical)	300 mA / 9.6 W

	6GT2811-6CA10-xAA0
Startup time	
Electromagnetic compatibility	
• ETSI	EN 301 489-1/-3, EN 302 208-1/-3 V1.4.1
• FCC	FCC CFR 47, Part 15 section 15.247

Permitted ambient conditions	
Ambient temperature	
• Operation	-25 ℃ to +55 ℃
• Transport and storage	-40 ℃ to +85 ℃
Shock resistant to EN 60068-2-27	50 g [2]
Vibration resistant to EN 60068-2-26	20 g [2]

[1] All supply and signal voltages must be safety extra-low voltage (SELV/PELV according to EN 60950). All power sources must meet the requirements for LPS (Limited Power Sources) and NEC Class 2.

[2] The values for shock and vibration are maximum values and must not be applied continuously.

Table 5- 39 Technical specifications according to EPC and ISO, RF685R

	6GT2811-6CA10-xAA0
Product type designation	RF685R
Frequency accuracy	max.± 10 ppm
Channel spacing	• EU, EFTA, Turkey: 600 kHz • US: 500 kHz • China: 250 kHz
Modulation methods	ASK: DSB modulation & PR-ASK modulation Encoding, Manchester or Pulse Interval (PIE)
Effective radiated power (internal antenna)	
• ETSI/CMIIT	• ≤ 2 W ERP
• FCC	• ≤ 4 W EIRP
Effective radiated power (external antenna)	
• ETSI/CMIIT	• ≤ 2 W ERP
• FCC	• ≤ 4 W ERP
Transmit power	
• ETSI/CMIIT	• ≤ 2 W
• FCC	• ≤ 2 W
Reading range	
Antennas mounted on opposing sides (portal configuration)	max. 10 m
Antennas mounted on the same side	max. 5 m (dependent on transponder)

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	6GT2811-6CA10-xAA0
Frequencies	
ETSI frequencies	
European frequency band	865,7 ... 867.5 MHz
ETSI EN 302 208 V1.4.1 (valid since October 23, 2012, publication in the Official Journal of the European Union)	(4 channels at max. 2 W ERP)
FCC frequencies	
Frequency band USA	902 ... 928 MHz (50 channels at max. 4 W EIRP, frequency hopping)
CMIIT frequencies	
Frequency band China	920,625 ... 924.375 MHz (16 subchannels at 2 W ERP)

5.8.6 Dimension drawing

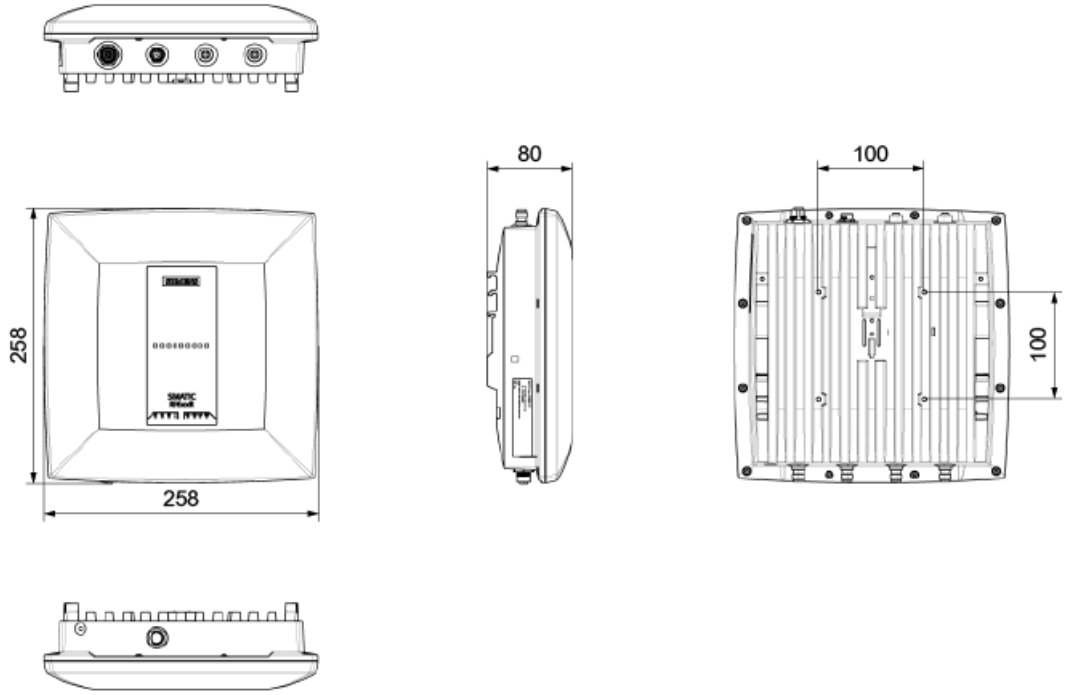

Figure 5-61 Dimension drawing RF685R

All dimensions in mm (± 0.5 mm tolerance)

REVIEW

5.8.7 Certificates and approvals

5.8.7.1 CE mark

Note

Marking on the readers according to specific approval

The certificates and approvals listed here apply only if the corresponding mark is found on the readers.

Table 5- 40 6GT2811-6CA10-0AA0

Certificate	Description
CE	Conformity with R&TTE directive

5.8.7.2 Country-specific certifications

Table 5- 41 6GT2811-6CA10-1AA0

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. FCC ID: ??????
Industry Canada Radio Standards Specifications	RSS-210 Issue 6, Sections 2.2, A8 IC: ??????
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

Table 5- 42 6GT2811-6CA10-2AA0

Standard	
CMIIT Certification	China radio approval Marking on the reader: CMIIT ID: ??????

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5.8.7.3 FCC information

Siemens SIMATIC RF685R (FCC): 6GT2811-6CA10-1AA0

FCC ID:

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification.

It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

To comply with FCC RF exposure compliance requirements, the antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

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5.8.7.4 IC-FCB information

Siemens SIMATIC RF685R (FCC): 6GT2811-6CA10-1AA0

IC:

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d`Industrie Canada applicables aux appareils radio exempts de licence. L`exploitation est autorisée aux deux conditions suivantes :

(1) L`appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l`appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d`en compromettre le fonctionnement.

Industry Canada Notice

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

Transmitter power and antenna information for antennas with a gain less than 6 dBi:

This device has been designed to operate with the SIMATIC RF620A antenna 902-928, the SIMATIC RF640A antenna 902-928 as well as the SIMATIC RF660A antenna 902-928 listed below, and having a maximum gain of 5.5 dBi. Arbitrary transmission power settings in combination with other antennas or antennas having a gain greater than 5.5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

Transmitter power and antenna information for antennas with a gain greater 6 dBi:

This device requires professional installation. Antennas with a gain greater 6 dBi may be used provided the system does not exceed the radiation power of 4000 mW E.I.R.P. This device has been designed to operate with the SIMATIC RF642A antenna 902-928 exceeding the maximum gain of 5.5 dBi under the restriction that the RF power at the input of the antenna must be set to meet the following relation: RF power (dBm) ≤ 30 dBm – (antenna gain (dBi) – 6 dBi) Other antennas or system configurations for antennas having a gain greater than 6 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

REVIEW

5.9 Reader RF680M

5.9.1 Description

SIMATIC RF680M expands the RF600 RF identification system with a powerful mobile reader for applications in the areas of logistics, production and service. In addition, it is an indispensable aid for startup and testing.

5.9.2 Field of application and features

Device variants for different frequency ranges

The SIMATIC RF680M device is available in two variants:

- For the European frequency ranges
- For the US frequency ranges

Implementation environment, field of application and features

- **Field of application**

  The SIMATIC RF680M mobile reader can be used in a harsh environment. The device is extremely rugged and protected against spray water. The backlit display is easy to read even under unfavorable lighting conditions.

- **RFID system**

  The SIMATIC RF680M mobile reader is intended especially for the SIMATIC RF600 RFID system. The device can be used to process all RF600 tags and compatible transponders.

- **Tag standards**

  It is not possible to edit data memories of other RFID systems. The following tag standards are supported:

  – ISO 18000-6c (EPC Class1 GEN2)

- **API software interface**

  The SIMATIC RF680M Mobile Reader is supplied with an API software interface that can be used by customized user programs.

- **Additional functional units for the SIMATIC RF680M mobile reader**

  All other functional units of SIMATIC RF680M, such as barcode scanners and WLAN can be accessed via the interfaces supplied by the PSION device manufacturer. The descriptions and development tools can be obtained from the PSION websites.

You can perform the following functions with the SIMATIC RF680M mobile reader:

REVIEW

Functions

- Reading the tag ID
- Reading the data from the tag (data memory)
- Writing the data to the tag
- Reading and displaying the ID number of the tag (Tag/Scan)
- Writing the tag ID to a transponder
- Displaying reader status
- Representing and editing the data in hexadecimal, ASCII and binary format
- Activatable/deactivatable password protection for all write functions and for terminating the program
- Menu prompting in English and German (switchable)
- Saving of the read-in RF600 data to files in the mobile reader. The mobile reader has approximately 900 MB available for this purpose.
- Easy creation of your own RFID applications with the Software Application Interface (API)

The RFID read/write unit of RF600 is integrated into the PSION basic unit.

You will find more detailed information on the RF680M mobile reader in the operating instructions of the SIMATIC RF680M Mobile Reader.

Antennas

6

6.1 Overview

The following table shows the most important features of the RF600 antennas at a glance:

Table 6- 1 Characteristics of the RF620A and RF660A antennas

Characteristics		RF620A antenna 865-868	RF620A antenna 902-928	RF660A antenna 865-868	RF660A antenna 902-928
Material		PA 12, silicon-free			
Frequency band		865-868 MHz	902-928 MHz	865-868 MHz	902-928 MHz
Impedance		50 Ohm nominal			
Antenna gain		-10…-5 dBi		7 dBi	6 dBi
VSWR (standing wave ratio)		2:1 max.			
Polarization		Linear		RH circular	
Radiating/receiving angle		Depending on the mounting surface		55° - 60°	60° - 75°
Connector		RTNC coupling		RTNC	
Mounting type		2 x M5 screws		4 screws M4 (VESA 100 mount system)	
Degree of protection		IP67			
Permitted ambient temperature		-25 °C to +75 °C			
Number of connectable antennas per reader					
	RF620R	1 antenna			
	Max. radiated power	80 mW ERP / 130 mW EIRP		1200 mW ERP	1600 mW EIRP
	RF630R	1 or 2 antennas			
	Max. radiated power	80 mW ERP / 130 mW EIRP		1200 mW ERP	1600 mW EIRP
	RF640R	1 antenna			
	Max. radiated power	100 mW ERP / 300 mW EIRP		2000 mW ERP	4000 mW EIRP
	RF670R	1, 2, 3 or 4 antennas			
	Max. radiated power	100 mW ERP / 300 mW EIRP		2000 mW ERP	4000 mW EIRP
	RF650R	1, 2, 3 or 4 antennas			
	Max. radiated power	80 mW ERP / 130 mW EIRP		2000 mW ERP	3160 mW ERP
	RF680R	1, 2, 3 or 4 antennas			
	Max. radiated power	150 mW ERP / 250 mW EIRP		2000 mW ERP	4000 mW ERP
	RF685R	1 antenna			
	Max. radiated power	150 mW ERP / 250 mW EIRP		2000 mW ERP	4000 mW ERP

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Table 6- 2 Characteristics of the RF640A and RF642A antennas

Characteristics		RF640A antenna		RF642A antenna	
Material		PA 12, silicon-free			
Frequency band		865-868 MHz	902-928 MHz	865-868 MHz	902-928 MHz
Impedance		50 Ohm nominal			
Antenna gain		4 dBi (7 dBic)	4.3 dBi (7.3 dBic)	6 dBi	7 dBi
VSWR (standing wave ratio)		Max. 1.25	Max. 1.6	Max. 1.4	
Polarization		RH circular		Linear	
Radiating/receiving angle		Horiz. plane: 80°	Horiz. plane: 75°	Horiz. plane: 75°	Horiz. plane: 80°
		Vertic. plane: 75°	Vertic. plane: 85°	Vertic. plane: 70°	Vertic. plane: 70°
Connector		RTNC coupling		RTNC coupling	
Mounting type		4 screws M4 (VESA 100 mount system)			
Degree of protection		IP67			
Permitted ambient temperature		-25 °C to +75 °C			
Number of connectable antennas per reader					
	RF620R	1 antenna			
	Max. radiated power	< 610 mW ERP	≤1070 mW EIRP	< 1000 mW ERP	2000 mW EIRP
	RF630R	1 or 2 antennas			
	Max. radiated power	< 610 mW ERP	≤1070 mW EIRP	< 1000 mW ERP	2000 mW EIRP
	RF640R	1 antenna			
	Max. radiated power	≤1300 mW ERP	≤2700 mW EIRP	2000 mW ERP	4000 mW EIRP
	RF670R	1, 2, 3 or 4 antennas			
	Max. radiated power	≤1300 mW ERP	≤2700 mW EIRP	2000 mW ERP	4000 mW EIRP
	RF650R	1, 2, 3 or 4 antennas			
	Max. radiated power	1200 mW ERP	2100 mW EIRP	2000 mW ERP	4000 mW EIRP
	RF680R	1, 2, 3 or 4 antennas			
	Max. radiated power	2000 mW ERP	4000 mW EIRP	2000 mW ERP	4000 mW EIRP
	RF685R	1 antenna			
	Max. radiated power	2000 mW ERP	4000 mW EIRP	2000 mW ERP	4000 mW EIRP

REVIEW

6.2 RF620A antenna

6.2.1 Description

SIMATIC RF620A	Characteristics	
	Area of application	The SIMATIC RF620A is an antenna with a compact design suitable for industry. It is suitable for UHF transponders with normal (far field) antenna characteristics, e.g. SIMATIC RF630L, SIMATIC RF620T.
	Antenna field	Designed for transponders that are uniformly aligned while passing the antenna. See also section Alignment of transponders to the antenna (Page 254)
	Write/read distance	Approx. 0.5 m depending on the transponder (see section Read/write ranges (Page 263))
	Connecting cable	30 cm movable connecting cable and RTNC coupling (an antenna cable, e.g. 6GT2815-0BH30 is required for connection to the reader)
	Readers that can be connected	• RF670R (1 to 4 antennas) • RF630R (1 or 2 antennas) • RF650R (1 to 4 antennas) • RF680R (1 to 4 antennas) • RF685R (1 antenna)
	Polarization	Linear
	Degree of protection	IP67

REVIEW

Frequency bands

The antenna is available for two different frequency ranges that have been specified for the regions of Europe, and China, USA respectively.

- The antenna for Europe operates in the frequency range from 865 to 868 MHz.
- The antenna for China and the USA operates in the frequency range from 902 to 928 MHz.

Function

The SIMATIC RF620A is used for transmitting and receiving RFID signals in the UHF frequency range. The antennas are connected to the SIMATIC RF600 readers via antenna cables that are available in different lengths.

6.2.2 Ordering data

Table 6- 3 Ordering data RF620A

Product	Article number
SIMATIC RF620A (ETSI)	6GT2812-1EA00
SIMATIC RF620A (FCC)	6GT2812-1EA01

Accessories

Table 6- 4 Ordering data accessories

Product		Article number
Connecting cable between reader and antenna	3 m (cable loss 1.0 dB)	6GT2815-0BH30
	5 m, suitable for drag chains (cable loss 1.25 dB)	6GT2815-2BH50
	10 m (cable loss 2.0 dB)	6GT2815-1BN10
	10 m (cable loss 4.0 dB)	6GT2815-0BN10
	15 m, suitable for drag chains (cable loss 4.0 dB)	6GT2815-2BN15
	20 m (cable loss 4.0 dB)	6GT2815-0BN20

REVIEW

6.2.3 Installation and assembly

6.2.3.1 RF620A mounting types

Two holes for M5 screws are provided for mounting the antenna. This is therefore suitable for:

- Mounting on metallic and non-metallic backgrounds

Note

To achieve optimum wave propagation, the antenna should not be surrounded by conducting objects. The area between antenna and transponder should also allow wave propagation without interference.

6.2.4 Connecting an antenna to the reader

6.2.4.1 Overview

The SIMATIC RF620A antenna must be connected to the reader using an antenna cable.

Requirement

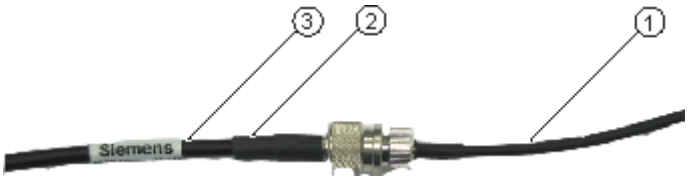
Note

Use of Siemens antenna cable

To ensure optimum functioning of the antenna, it is recommended that a Siemens antenna cable is used in accordance with the list of accessories.

Strain relief

The antenna cable is provided with strain relief as shown in the following diagram:



① RF620A connecting cable
② RF600 antenna cable
③ Strain relief (should take place at this position)

Figure 6-1 Strain relief

Bending radii and bending cycles of the cable

Cable designation	Order no.	Length [m]	Cable loss [dB]	Bending radius [mm]	Bending cycle
RF620A connecting cable				15	1 Mal
Antenna cable	6GT2815-0BH30	3	1	51	1 Mal
Antenna cable, suitable for drag chains	6GT2815-2BH50	5	1,25	48	1)
Antenna cable	6GT2815-1BN10	10	2	77	1 Mal
Antenna cable	6GT2815-0BN10	10	4	51	1 Mal

REVIEW

Cable designation	Order no.	Length [m]	Cable loss [dB]	Bending radius [mm]	Bending cycle
Antenna cable, suitable for drag chains	6GT2815-2BN15	15	4	24	1)
Antenna cable	6GT2815-0BN20	20	4	77	1 Mal

1) With cables suitable for drag chains, 3 million bending cycles at a bending radius of 6.5 m and bending through ± 180 ° are permitted.

6.2.4.2 Connecting RF620A to an RF600 reader

Preassembled standard cables in lengths of 3 m, 5 m, 10 m, 15 m and 20 m are available to connect the antenna.

The read range is limited by the cable loss. The maximum range can be achieved with the 6GT2815-0BH30 cable (length 3 m) since this has the lowest cable loss.

Connection of one antenna

When one antenna is used, we recommend that you close the remaining antenna connector on the RF600 reader using the supplied protective cap.

Connection of two antennas

When using two antennas on the RF600 readers, there are no limitations regarding its positioning.

Note

Protective cap

If you use the internal antenna of the reader, we recommend that you close the external, unused antenna connector on the reader using the supplied protective cap.

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6.2.5 Parameter settings of RF620A for RF620R/RF630R

Operation within the EU, EFTA, or Turkey according to DIN EN 302208 V1.4.1

Note

Limitation of the radiated power according to DIN EN 302208 V1.4.1

RF600 systems that are put into operation within the EU, EFTA, or Turkey (ETSI) can be operated with an RF620A antenna with a maximum radiated power of up to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

By adjusting the transmit power of up to 500 mW ERP (or 27 dBm ERP, 800 mW EIRP, 29.15 dBm EIRP) and taking into account the RF620A antenna gain of 5 dBi and the cable loss associated with the antenna cable, the radiated power of the antenna cannot be exceeded. You can make the power settings using the "distance_limiting" parameter. You will find more detailed information on the parameters in the section Parameter assignment manual RF620R/RF630R (http://support.automation.siemens.com/WW/view/en/33287195).

Operation in China

The national approval for RF600 systems in China means a restriction to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP). The possible combination of antenna gain, cable loss, and max. 500 mW radiated power of the RF630R reader means it is not possible to exceed 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

REVIEW

Operation in the USA, Canada

Note

Limitation of the radiated power to 4000 mW EIRP (36 dBm EIRP)

To meet the FCC and IC-FCB requirements, the radiated power may not exceed 4000 mW EIRP (36 dBm EIRP). Therefore the system must satisfy the following relation:

- Conducted power P dBm of the RF600 reader (< 30 dBm)
- Antenna gain G_i dBi in the FCC frequency band (≤ 5 dBi)
- Cable loss a_k dB (≥ 1 dB)

$P(dBm) \leq 30\ dBm - (G_i - 6\ dBi) + a_k$

Due to the low antenna gain of 5 dBi and the maximum transmit power of 500 mW of the reader, the maximum permitted radiated power cannot be exceeded.

6.2.6 Parameter settings of RF620A for RF640R/RF670R

Operation within the EU, EFTA, or Turkey according to DIN EN 302208 V1.4.1

Note

Limitation of the radiated power according to DIN EN 302208 V1.4.1

RF600 systems that are put into operation within the EU, EFTA, or Turkey (ETSI) can be operated with an RF620A antenna with a maximum radiated power of up to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

By adjusting the radiated power of up to 70 mW ERP (or 18.85 dBm ERP, 120 mW EIRP, 21 dBm EIRP), the RF620A antenna gain of 5 dBi and the cable loss associated with the antenna cable, the radiated power of the reader is correctly configured and the radiated power at the antenna is not exceeded.

Operation in China

By setting a max. radiated power of 1300 mW ERP (or 31.15 dBm ERP, 2140 mW EIRP, 33.3 dBm EIRP), an RF620A antenna gain of 4.3 dBi (7.3 dBic) and the cable loss associated with the antenna cable (see table), the radiated power of the reader is correctly configured.

REVIEW

Operation in the USA, Canada

Note

Limitation of the radiated power to 4000 mW EIRP (36 dBm EIRP)

To meet the FCC and IC requirements, the radiated power may not exceed 4000 mW EIRP (36 dBm EIRP). Therefore the system must satisfy the following relation:

- Conducted power P dBm of the RF600 reader (< 30 dBm)
- Antenna gain G_i dBi in the FCC frequency band (≤ 5 dBi)
- Cable loss a_k dB (≥ 1 dB)

$P(dBm) \leq 30\ dBm - (G_i - 6\ dBi) + a_k$

Due to the low antenna gain of 5 dBi and the maximum transmit power of 500 mW of the reader, the maximum permitted radiated power cannot be exceeded.

6.2.7 Setting RF620A parameters for RF650R/RF680R/RF685R

Operation within the EU according to DIN EN 302208 V1.4.1

Note

Limitation of the radiated power according to DIN EN 302208 V1.4.1

RF600 systems that are put into operation within the EU, EFTA, or Turkey (ETSI) can be operated with an RF620A antenna with a maximum radiated power of up to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

By setting the transmit power of up to 70 mW ERP (or 18.85 dBm ERP, 120 mW EIRP, 21 dBm EIRP) an RF620A antenna gain of 5 dBi and taking into account the cable loss associated with the antenna cable, the radiated power of the antenna cannot be exceeded.

Operation in China

The national approval for RF600 systems in China means a restriction to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP). The possible combination of antenna gain, cable loss, and max. 2000 mW radiated power of the readers means it is not possible to exceed 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

REVIEW

Operation in the USA, Canada

Note

Limitation of the radiated power to 4000 mW EIRP (36 dBm EIRP)

To meet the FCC and IC requirements, the radiated power may not exceed 4000 mW EIRP (36 dBm EIRP). Therefore the system must satisfy the following relation:

- Conducted power P dBm of the RF600 reader (< 30 dBm)
- Antenna gain G_i dBi in the FCC frequency band (≤ 5 dBi)
- Cable loss a_k dB (≥ 1 dB)

$P(dBm) \leq 30\ dBm - (G_i - 6\ dBi) + a_k$

Due to the low antenna gain of 5 dBi and the maximum transmit power of 1000 mW or 2000 mW of the reader, the maximum permitted radiated power cannot be exceeded.

6.2.8 Alignment of transponders to the antenna

Polarization axis

Since the RF620A antenna has linear polarization, it is necessary to consider the alignment of the transponders with regard to the polarization axis of the antenna.

The polarization axes of antenna and transponder must always be parallel. The symbol on the antenna indicates the polarization axis.

Figure 6-2 Polarization axis

REVIEW

Alignment

The following diagram shows the optimum alignment of the RF600 transponders to the RF620A antenna.

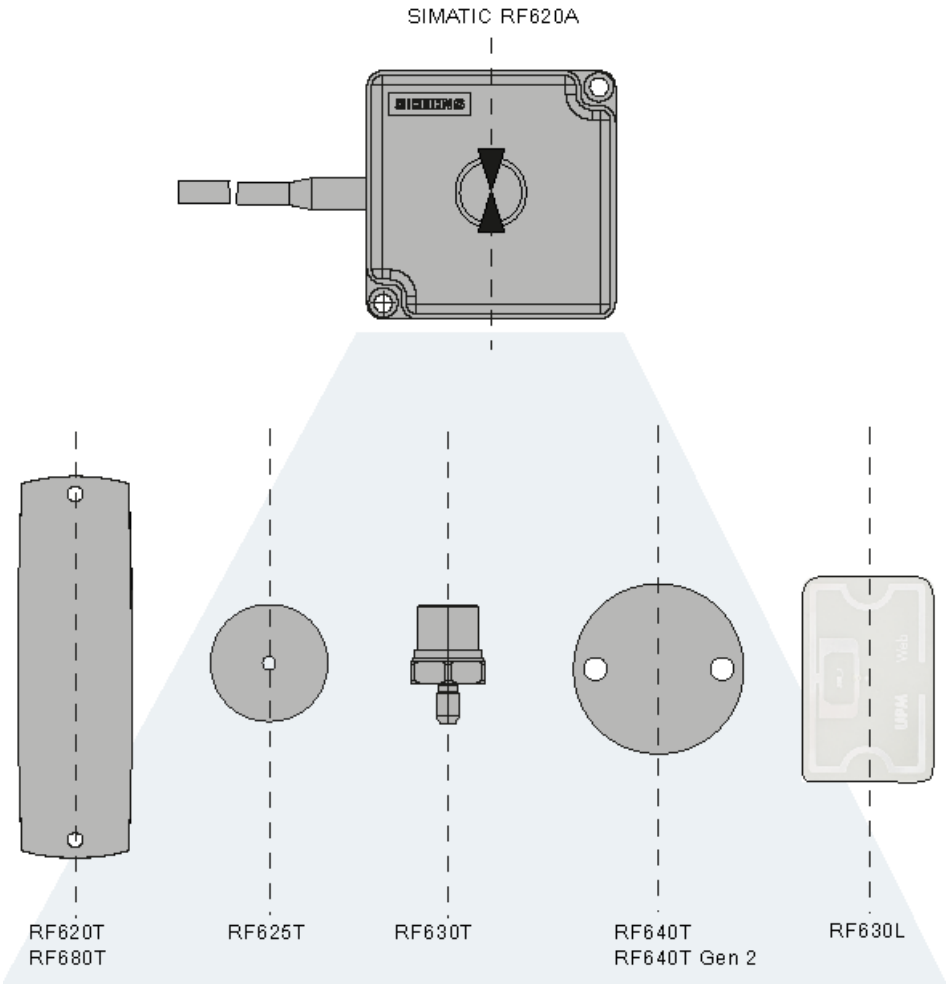

Figure 6-3 Antenna/transponder alignment

REVIEW

Angle deviation diagram for alignment

The following diagram shows the dependence of the following factors.

- Alignment angle of transponder to antenna
- Maximum range of antenna

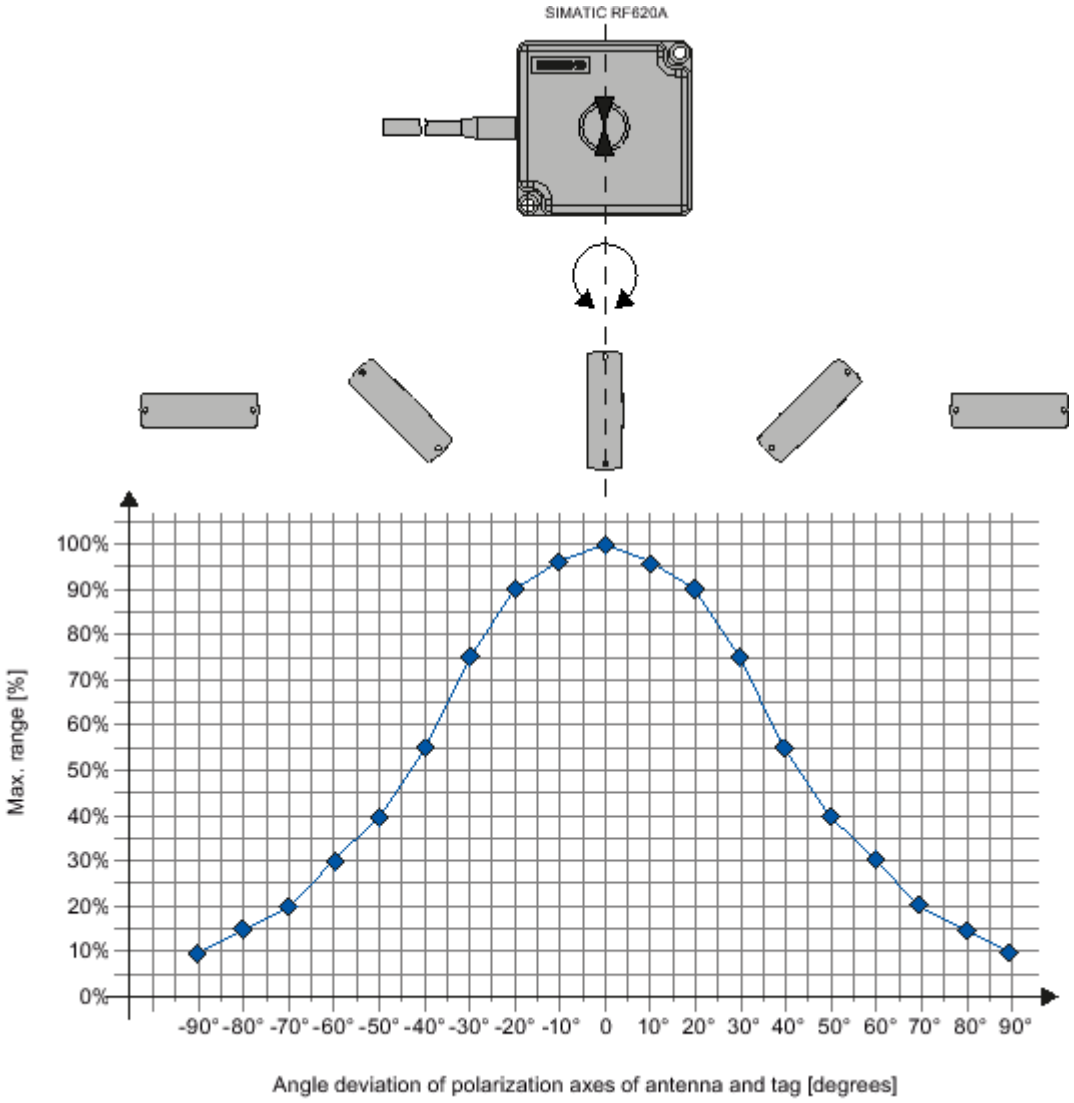

Figure 6-4 Angle deviation diagram for alignment

REVIEW

6.2.9 Antenna patterns

6.2.9.1 Antenna pattern ETSI

Directional radiation pattern Europe (ETSI)

The directional radiation pattern is shown for nominal alignment and a center frequency of 866.3 MHz. The nominal antenna alignment is given when the antenna elevation is provided as shown in the following figure.

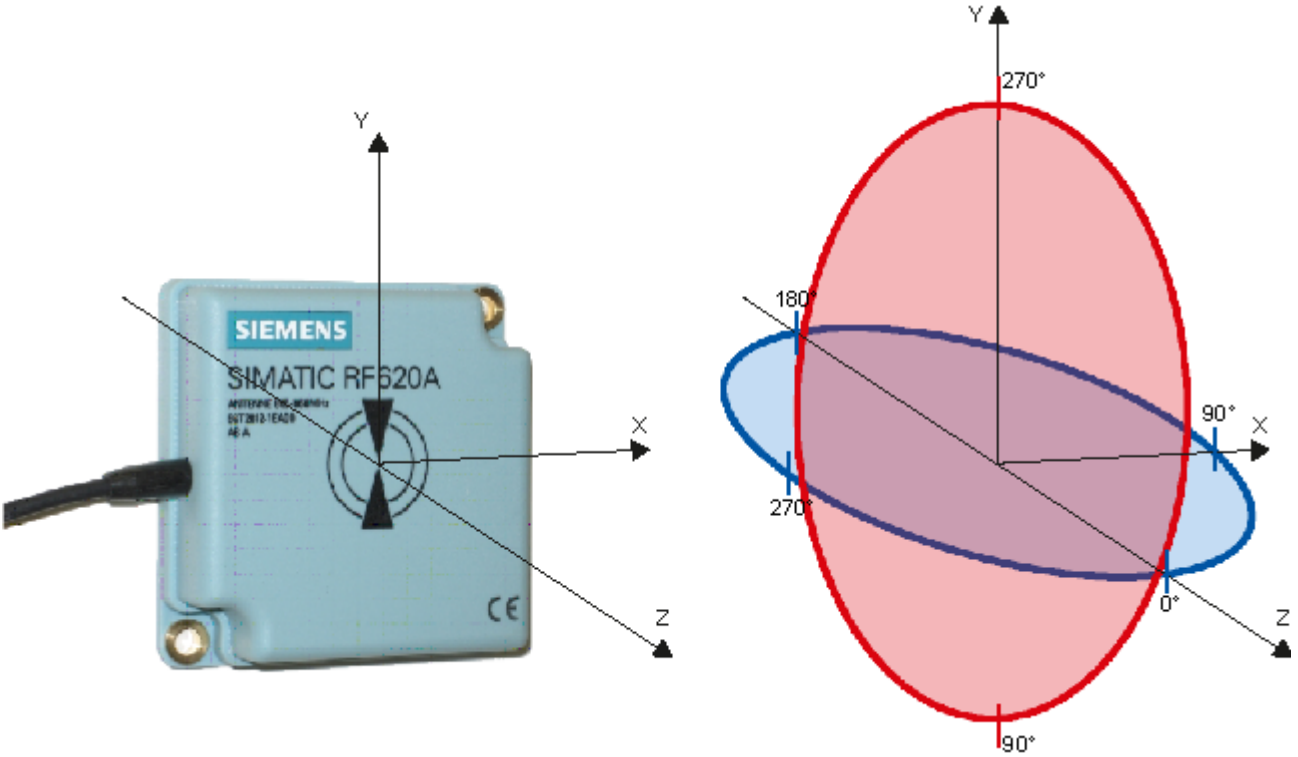

Figure 6-5 Reference system

The half-power beamwidth of the antenna is defined by the angle between the two -3 dB points. Which range (in %) corresponds to the dB values in the patterns can be obtained from this table .

Note that the measurements presented graphically below were carried out in a low-reflection environment. Deviations can therefore occur in a normally reflecting environment.

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REVIEW

Directional radiation pattern ETSI on metallic mounting surface (15 cm x 15 cm)

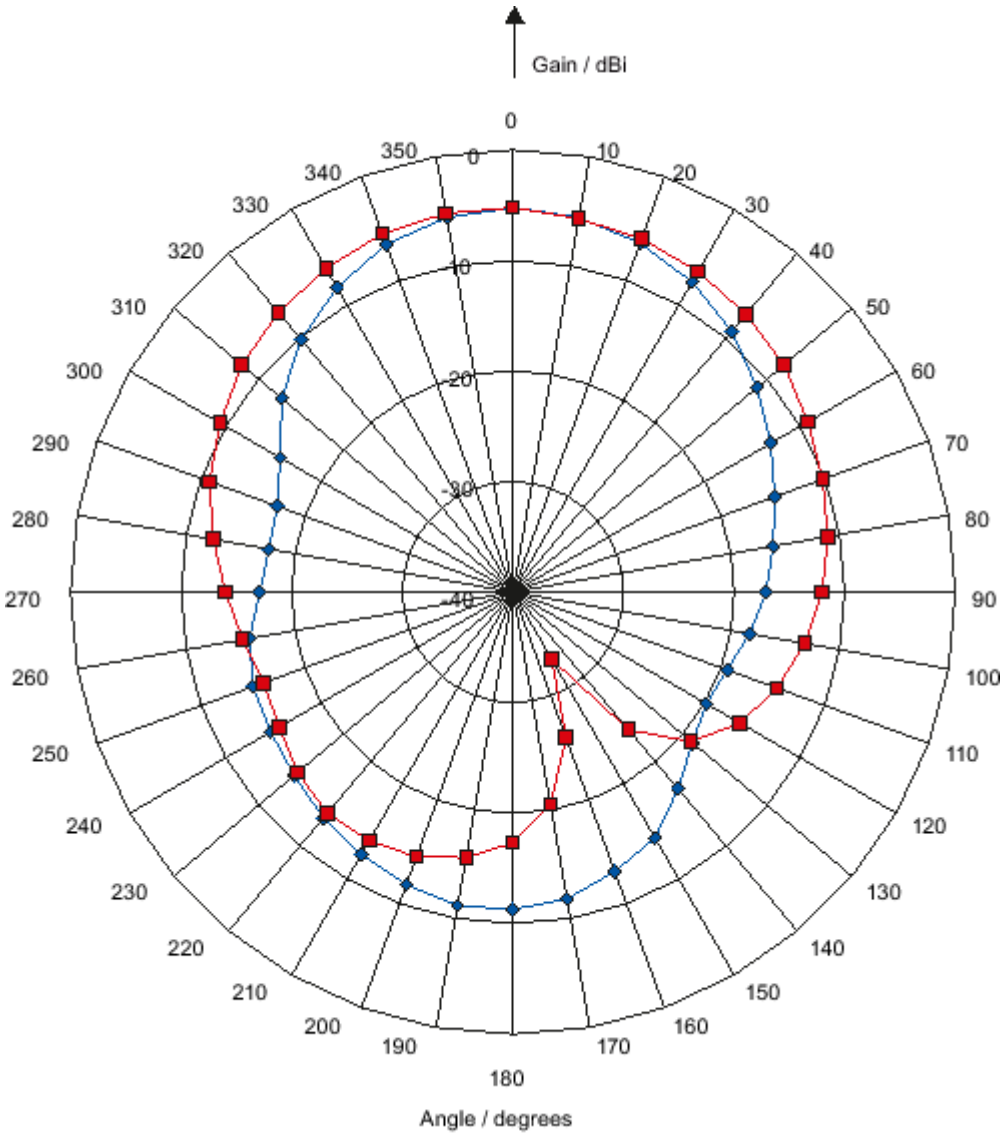
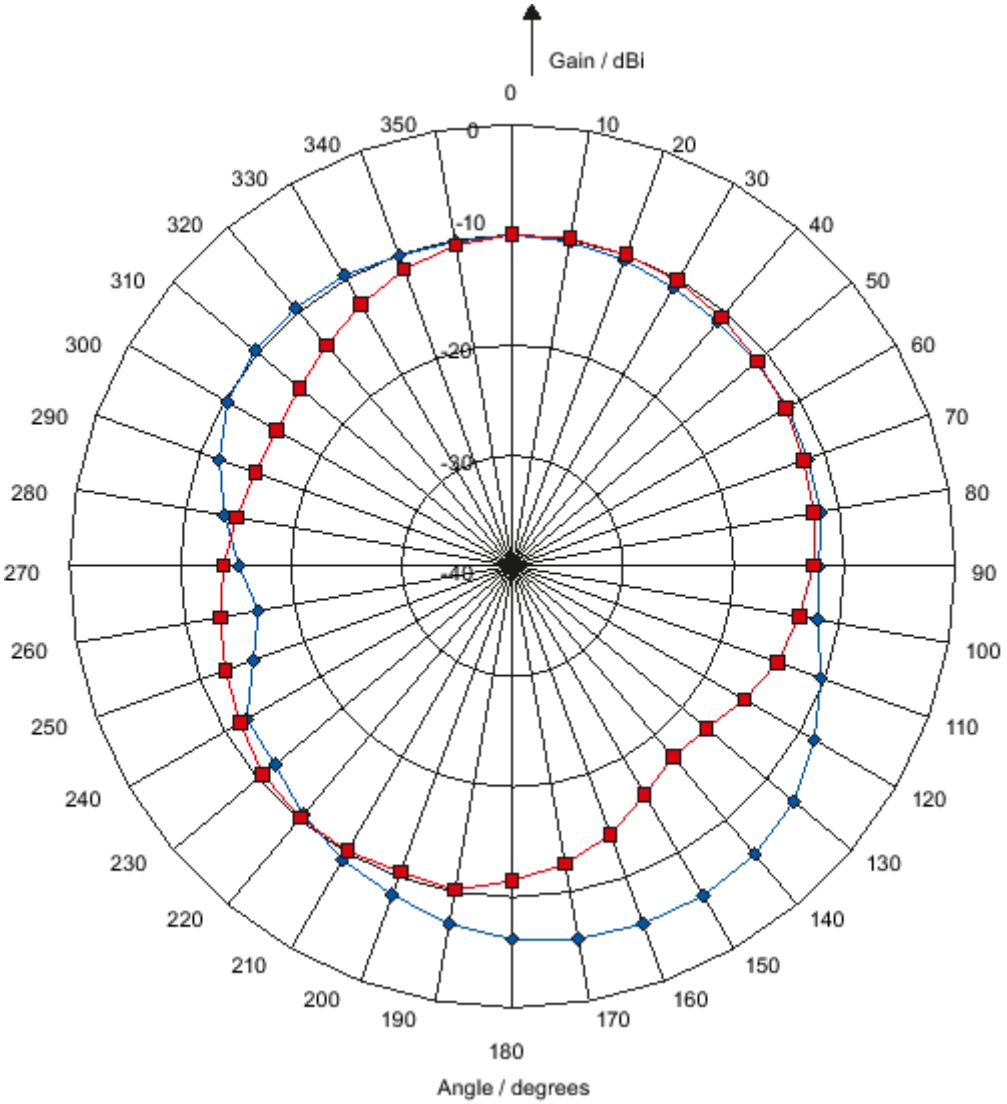


Figure 6-6 Directional radiation pattern RF620A ETSI on metallic mounting surface

Directional radiation pattern ETSI on non-metallic mounting surface



Pattern of the vertical plane of the antenna

Pattern of the horizontal plane of the antenna

Figure 6-7 Directional radiation pattern RF620A ETSI on non-metallic mounting surface

REVIEW

6.2.9.2 Antenna pattern FCC

Directional radiation pattern USA (FCC)

The directional radiation pattern is shown for nominal alignment and a center frequency of 915 MHz.

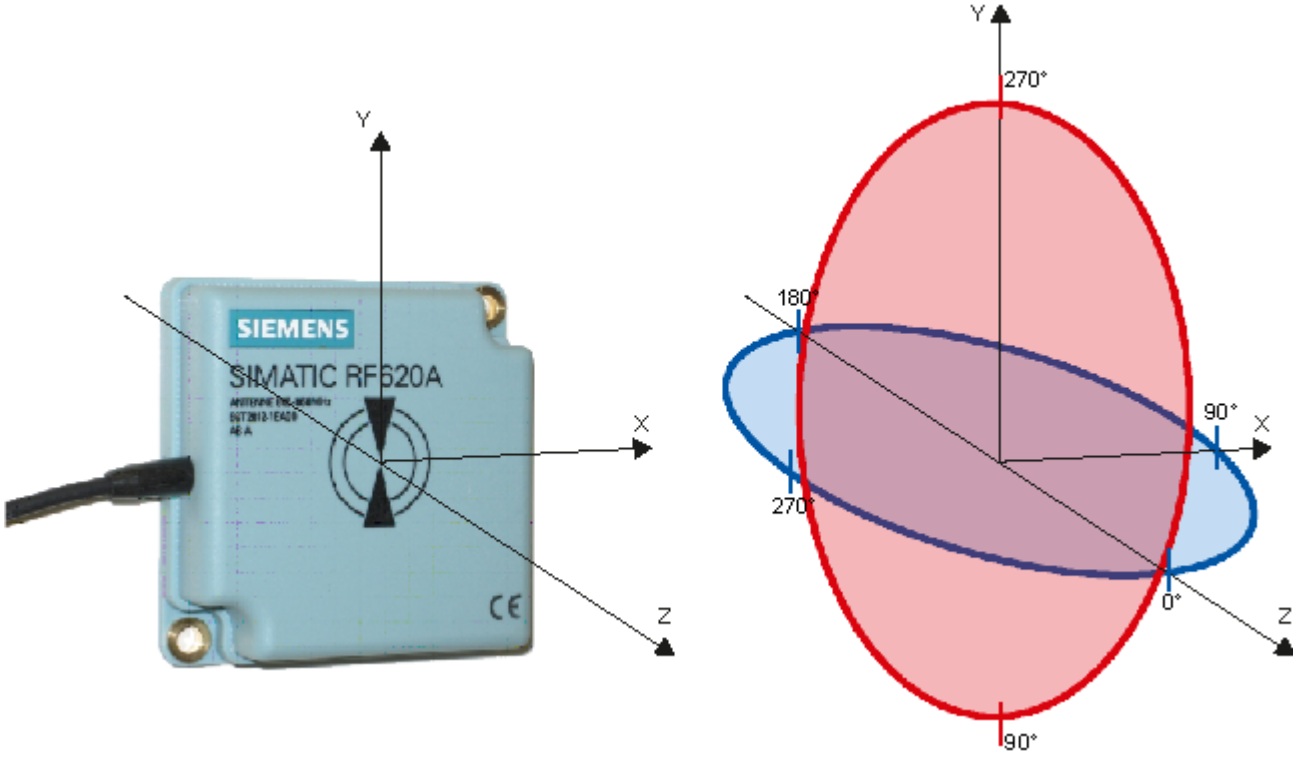


Figure 6-8 Reference system

The half-power beamwidth of the antenna is defined by the angle between the two -3 dB points (corresponding to half the power referred to the maximum power). Which range (in %) corresponds to the dB values in the patterns can be obtained from this table .

Note that the measurements presented graphically below were carried out in a low-reflection environment. Low deviations can therefore occur in a normally reflecting environment.

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Directional radiation pattern of the RF620A (FCC) on metallic mounting surface (15 cm x 15 cm)

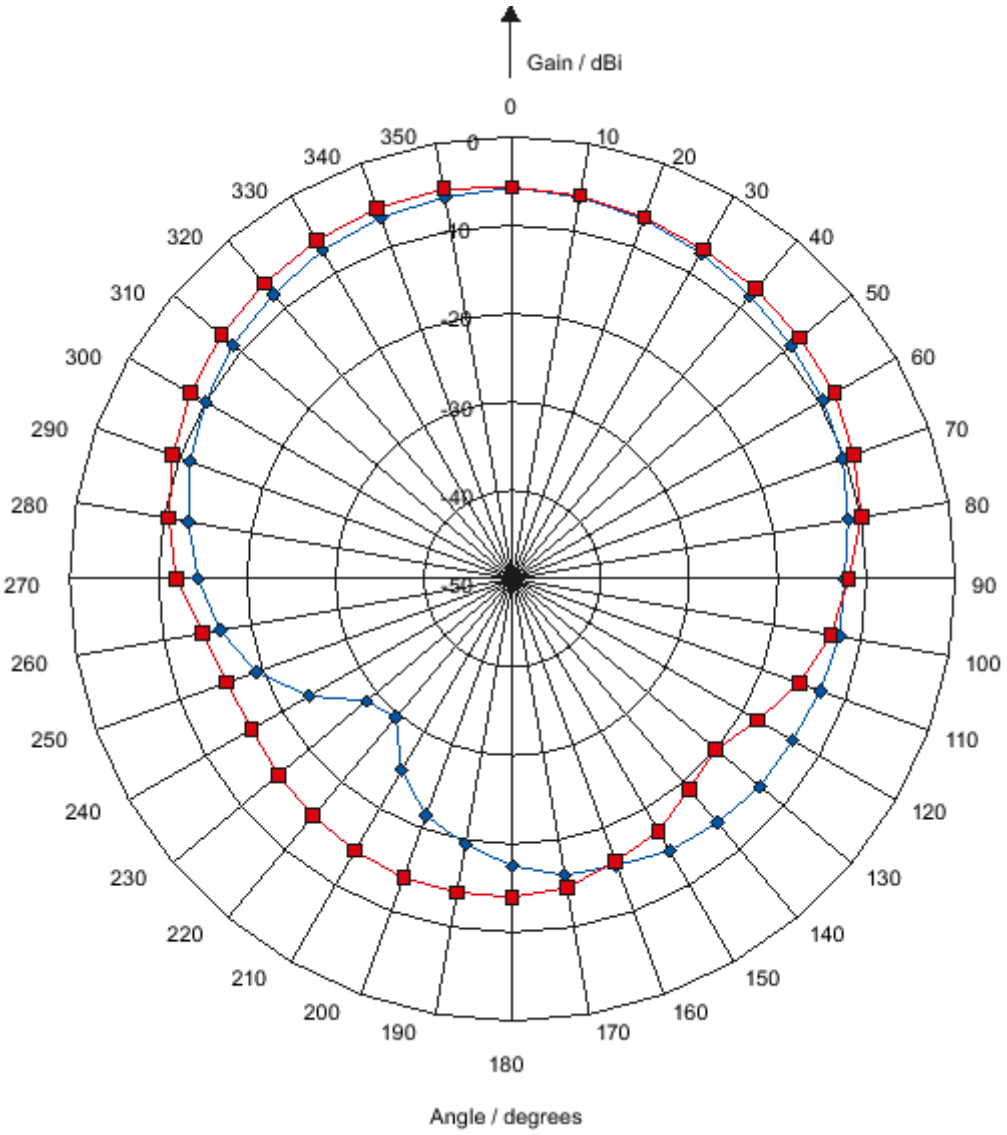

Figure 6-9 Directional radiation pattern of the RF620A (FCC) on metallic mounting surface

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REVIEW

Directional radiation pattern of the RF620A (FCC) on non-metallic mounting surface

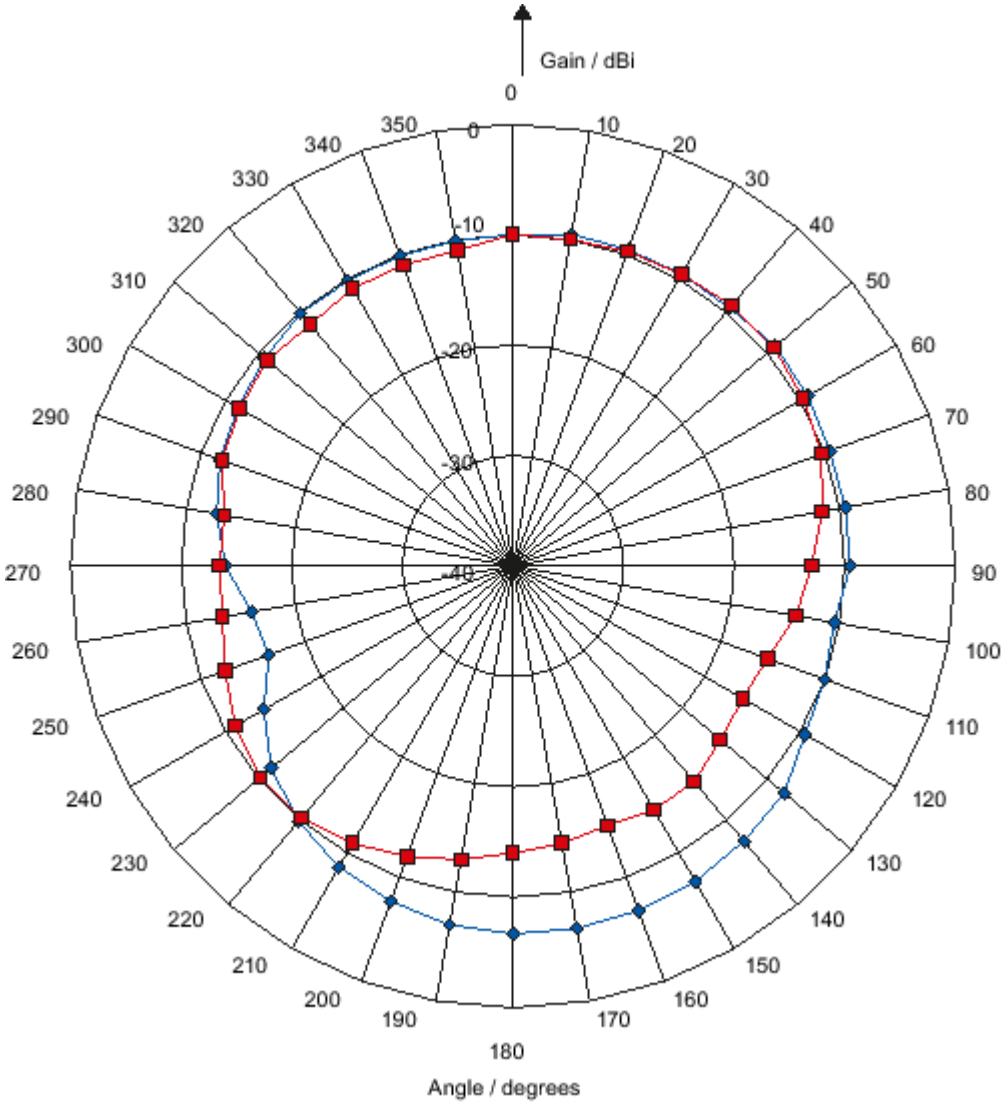

Figure 6-10 Directional radiation pattern of the RF620A (FCC) on non-metallic mounting surface

6.2.9.3 Interpretation of directional radiation patterns

The following overview table will help you with the interpretation of directional radiation patterns.

The table shows which dBi values correspond to which read/write ranges (in %): You can read the radiated power depending on the reference angle from the directional radiation patterns, and thus obtain information on the read/write range with this reference angle with regard to a transponder.

The dBr values correspond to the difference between the maximum dBi value and a second dBi value.

Deviation from maximum antenna gain [dBr]	Read/write range [%]
0	100
-3	70
-6	50
-9	35
-12	25
-15	18
-18	13

Example

As can be seen from the Antenna pattern ETSI (Page 257), the maximum antenna gain is -5 dBi. In the vertical plane, the antenna gain has dropped to approx. -11 dBi at +40° and 320°. Therefore the dBr value is -6. The antenna range is only 50% of the maximum range at ± 40° from the Z axis within the vertical plane (see values shown in blue in the directional radiation pattern: Characteristic of the vertical plane of the antenna and the associated representation of the reference system).

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6.2.10 Read/write ranges

The following tables show the typical read/write ranges of RF600 readers which are connected to the RF620A antenna via the 3 m antenna cable (1 dB loss) and various types of transponders.

Note

Tolerances

Please note that tolerances of ±20% are admissible due to production and temperature conditions.

When using other antenna cables, the ranges listed here are reduced as a result of the higher antenna cable losses in the following manner:

Cable designation	Order No.	Length [m]	Cable loss [dB]	Read/write range [%]
Antenna cable	6GT2815-0BH30	3	1	100
Antenna cable, suitable for drag chains	6GT2815-2BH50	5	1.25	98
Antenna cable	6GT2815-1BN10	10	2	90
Antenna cable	6GT2815-0BN10	10	4	70
Antenna cable, suitable for drag chains	6GT2815-2BN15	15	4	70
Antenna cable	6GT2815-0BN20	20	4	70

The measuring tolerances in the following tables are ±3 cm.

Reading ranges RF620R/RF630R

REVIEW

Table 6- 5 Reading ranges RF620R/RF630R

Transponder	Connection to RF620R/RF630R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A FCC on non-metal [cm]
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	90 [1)]	70 [1)]	60 [1)]	50 [1)]
RF630L (6GT2810-2AB03)	55	50	55	45
RF680L	55	50	55	45
RF610T	55	50	55	45
RF620T	55	45	70	60
RF625T	30 [2)]	25 [2)]	45 [2)]	30 [2)]
RF630T	25 [2)]	20 [2)]	35 [2)]	25 [2)]
RF640T Gen 2	55 [2)]	45 [2)]	40 [2)]	35 [2)]
RF680T	60	50	90	70

[1)] Transponder mounted on cardboard

[2)] Transponder mounted on metal

Writing ranges RF620R/RF630R

Table 6- 6 Writing ranges RF620R/RF630R

Transponder	Connection to RF620R/RF630R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A FCC on non-metal [cm]
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	45 1)	40 1)	35 1)	30 1)
RF630L (6GT2810-2AB03)	35	30	20	25
RF680L	35	30	20	25
RF610T	35	30	20	25
RF620T	30	30	40	35
RF625T	20 2)	5 2)	20 2)	10 2)
RF630T	15 2)	5 2)	15 2)	10 2)
RF640T Gen 2	35 2)	20 2)	20 2)	15 2)
RF680T	40	30	40	35

1) Transponder mounted on cardboard

2) Transponder mounted on metal

REVIEW

Reading ranges RF640R/RF670R

Table 6- 7 Reading ranges RF640R/RF670R

Transponder	Connection to RF640R/RF670R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A on non-metal [cm]
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	135 1)	120 1)	100 1)	90 1)
RF630L (6GT2810-2AB03)	85	70	75	65
RF680L	85	70	75	65
RF610T	85	70	75	65
RF620T	85	85	95	95
RF625T	50 2)	45 2)	60 2)	45 2)
RF630T	40 2)	35 2)	50 2)	35 2)
RF640T	40 2)	35 2)	40 2)	30 2)

Transponder	Connection to RF640R/RF670R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A on non-metal [cm]
RF640T Gen 2	90 2)	70 2)	70 2)	50 2)
RF680T	90	90	135	95

1) Transponder mounted on cardboard

2) Transponder mounted on metal

Writing ranges RF640R/RF670R

Table 6- 8 Writing ranges RF640R/RF670R

Transponder	Connection to RF640R/RF670R			
	RF620A ETSI on metal	RF620A ETSI on non-metal	RF620A FCC on metal	RF620A on non-metal
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	110 1)	90 1)	55 1)	50 1)
RF630L (6GT2810-2AB03)	75	70	60	55
RF680L	75	70	60	55
RF610T	75	70	60	55
RF620T	60	55	60	45
RF625T	40 2)	30 2)	45 2)	30 2)
RF630T	30 2)	25 2)	35 2)	25 2)
RF640T	35 2)	30 2)	25 2)	25 2)
RF640T Gen 2	70 2)	60 2)	50 2)	40 2)
RF680T	80	75	100	80

1) Transponder mounted on cardboard

2) Transponder mounted on metal

REVIEW

Read distances RF650R

Table 6- 9 Read distances RF650R

Transponder	Connection to RF650R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A on non-metal [cm]
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	135 1)	120 1)	100 1)	90 1)
RF630L (6GT2810-2AB03)	85	70	75	65
RF680L	85	70	75	65
RF610T	85	70	75	65
RF620T	85	85	95	95
RF625T	50 2)	45 2)	60 2)	45 2)
RF630T	40 2)	35 2)	50 2)	35 2)
RF640T	40 2)	35 2)	40 2)	30 2)
RF640T Gen 2	90 2)	70 2)	70 2)	50 2)
RF680T	90	90	135	95

1) Transponder mounted on cardboard

2) Transponder mounted on metal

REVIEW

Write distances RF650R

Table 6- 10 Write distances RF650R

Transponder	Connection to RF650R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A on non-metal [cm]
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	110 1)	90 1)	55 1)	50 1)
RF630L (6GT2810-2AB03)	75	70	60	55
RF680L	75	70	60	55
RF610T	75	70	60	55
RF620T	60	55	60	45
RF625T	40 2)	30 2)	45 2)	30 2)
RF630T	30 2)	25 2)	35 2)	25 2)
RF640T	35 2)	30 2)	25 2)	25 2)

Transponder	Connection to RF650R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A on non-metal [cm]
RF640T Gen 2	70 2)	60 2)	50 2)	40 2)
RF680T	80	75	100	80

1) Transponder mounted on cardboard

2) Transponder mounted on metal

Read distances RF680R/RF685R

Table 6- 11 Read distances RF680R/RF685R

Transponder	Connection to RF680R/RF685R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A on non-metal [cm]
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	1)	1)	1)	1)
RF630L (6GT2810-2AB03)				
RF680L				
RF610T				
RF620T				
RF625T	2)	2)	2)	2)
RF630T	2)	2)	2)	2)
RF640T	2)	2)	2)	2)
RF640T Gen 2	2)	2)	2)	2)
RF680T				

1) Transponder mounted on cardboard

2) Transponder mounted on metal

REVIEW

Write distances RF680R/RF685R

Table 6- 12 Write distances RF680R/RF685R

Transponder	Connection to RF680R/RF685R			
	RF620A ETSI on metal [cm]	RF620A ETSI on non-metal [cm]	RF620A FCC on metal [cm]	RF620A on non-metal [cm]
RF630L (6GT2810-2AB00, -2AB01, -2AB02-0AX0)	1)	1)	1)	1)
RF630L (6GT2810-2AB03)				
RF680L				
RF610T				
RF620T				
RF625T	2)	2)	2)	2)
RF630T	2)	2)	2)	2)
RF640T	2)	2)	2)	2)
RF640T Gen 2	2)	2)	2)	2)
RF680T				

1) Transponder mounted on cardboard

2) Transponder mounted on metal

REVIEW

6.2.11 Technical data

Table 6- 13 General technical specifications RF620A

Feature	SIMATIC RF620A ETSI	SIMATIC RF620A FCC
Dimensions (L x W x H)	75 x 75 x 20 mm	
Color	Pastel turquoise	
Material	PA 12 (polyamide 12)	
	Silicone-free	
Frequency range	865 to 868 MHz	902 to 928 MHz
Plug connection	30 cm coaxial cable with RTNC coupling (for connection of antenna cable)	
Max. radiated power	< 500 mW ERP	No limitation (because antenna gain < 6 dBi)
Max. power	2 W	1 W
Impedance	50 ohms	
Antenna gain	-10 dBi ... -5 dBi	
	Depends on background, refer to the section Antenna pattern ETSI (Page 257)	Depends on background, refer to the section Antenna pattern FCC (Page 260)
VSWR (standing wave ratio)	Max. 2:1	
Polarization	Linear	
Beam angle for sending/receiving		
• When mounted on a metal surface of 15 cm x 15 cm [1]	• Horizontal plane: 100° • Vertical plane: 75° See Chapter Antenna pattern ETSI (Page 257)	• Horizontal plane: 130° • Vertical plane: 105° See section Antenna pattern FCC (Page 260)
Shock resistant to EN 60068-2-27	50 g	
Vibration resistant to EN 60068-2-6	20 g	
Attachment of the antenna	2 x M5 screws	
Tightening torque (at room temperature)	≤ 2 Nm	
Ambient temperature		
• Operation	• -20 °C to +70 °C	
• Transport and storage	• -40 °C to +85 °C	
MTBF in years		
Degree of protection according to EN 60529	IP67	
Weight, approx.	90 g	

[1] The values differ for different dimensions/materials of the mounting surface.

REVIEW

6.2.12 Dimension drawing

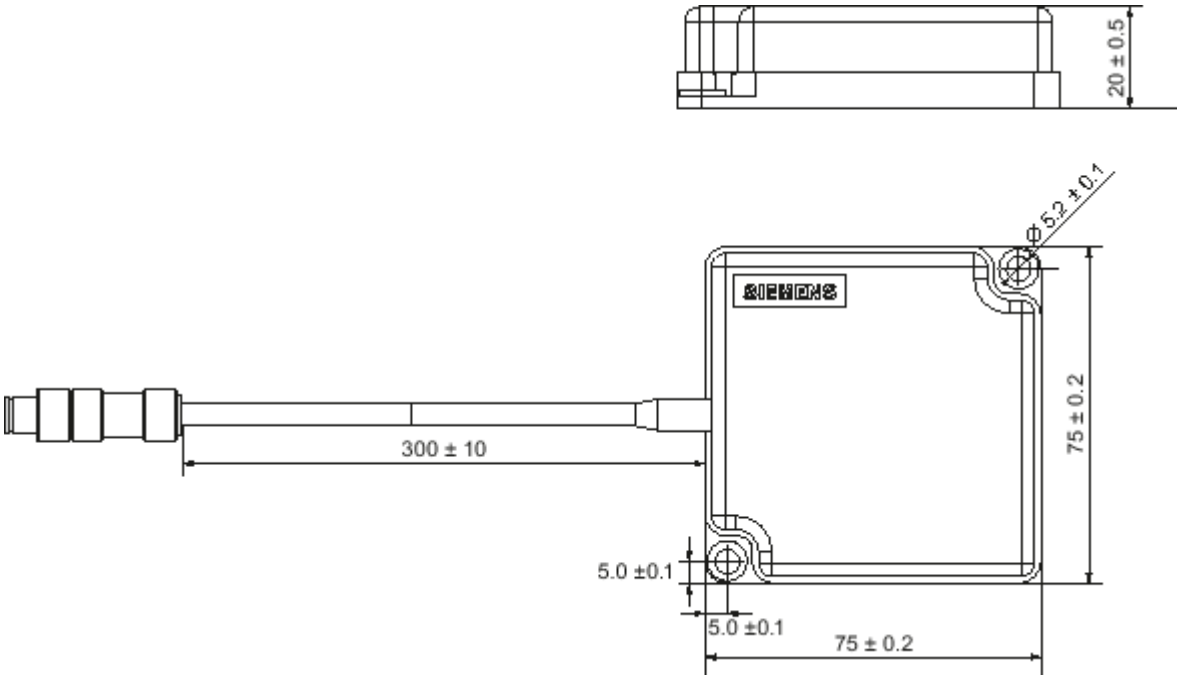


Figure 6-11 Dimension drawing RF620A

All dimensions in mm

REVIEW

6.2.13 Approvals & certificates

Table 6- 14 6GT2812-1EA00

Certificate	Designation
CE	Conformity in accordance with R&TTE directive in association with the readers and accessories used

Table 6- 15 6GT2812-1EA01

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. The FCC approval is granted in association with the FCC approval of the following RF600 readers: • FCC ID: NXW-RF600R (for RF620R: 6GT2811-5BA00-1AA1, RF630R: 6GT2811-4AA00-1AA1, RF640R: 6GT2811-3BA00-1AA0, RF670R as of FS C1: 6GT2811-0AB00-1AA0) • FCC ID: NXW-RF630R (for 6GT2811-4AA00-1AA0) • FCC ID: NXW-RF670 (for RF670R as of FS A1: 6GT2811-0AB00-1AA0)
Industry Canada Radio Standards Specifications	RSS-210 Issue 7, June 2007, Sections 2.2, A8 The approval for Industry Canada is granted in association with the Industry Canada approval of the following RF600 readers: • IC: 267X-RF630 (for 6GT2811-4AA00-1AA0) • IC: 267X-RF670, RF670R FS A1 (for 6GT2811-0AB00-1AA0) • IC: 267X-RF600R, Model RF620R-2 (for 6GT2811-5BA00-1AA1) • IC: 267X-RF600R, Model RF630R-2 (for 6GT2811-4AA00-1AA1) • IC: 267X-RF600R, Model RF640R (for 6GT2811-3BA00-1AA0) • IC: 267X-RF600R, model RF670R-2 as of FS C1 (for 6GT2811-0AB00-1AA0)
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

REVIEW

6.3 Antenna RF640A

6.3.1 Description

SIMATIC RF640A	Features	
	Field of application	The SIMATIC RF640A is a universal UHF antenna of compact, industry-standard design with medium range.
	Frequency range	865 to 928 MHz
	Polarization	RH circular Suitable for RF600 transponders that can pass in parallel with the antenna regardless of their orientation.
	Writing/reading range	max. 4.0 m
	Mounting	4 x M4 (VESA 100 fixing system)
	Connector	30 cm connecting cable (connected permanently to the antenna) and RTNC coupling An antenna cable is required for connection to the reader, e.g. 6GT2815-0BH30)
	Readers that can be connected	All RF600 readers with external antenna connectors
	Dimensions in mm	185 x 185 x 45
	Degree of protection	IP67

REVIEW

Frequency ranges

The antenna is available for broadband. It can therefore be used for two different frequency ranges that have been specified for the regions of Europe and China/USA respectively.

- The antenna for Europe (EU, EFTA countries) operates in the frequency range from 865 to 868 MHz.
- The antenna for China, the USA, and Canada operates in the frequencyrange from 902 to 928 MHz.

Function

The SIMATIC RF640A is used for transmitting and receiving RFID signals in the UHF frequency range. The antennas are connected to the SIMATIC RF600 readers via antenna cables that are available in different lengths.

6.3.2 Ordering data

Table 6- 16 Ordering data RF640A

Product	Article number
SIMATIC RF640A	6GT2812-0GA08

Accessories

Table 6- 17 Ordering data accessories

Product		Article number
Connecting cable between reader and antenna	3 m (cable loss 1.0 dB)	6GT2815-0BH30
	5 m, suitable for drag chains (cable loss 1.25 dB)	6GT2815-2BH50
	10 m (cable loss 2.0 dB)	6GT2815-1BN10
	10 m (cable loss 4.0 dB)	6GT2815-0BN10
	15 m, suitable for drag chains (cable loss 4.0 dB)	6GT2815-2BN15
	20 m (cable loss 4.0 dB)	6GT2815-0BN20
Antenna mounting kit	See "RF600 System Manual", section "Antennas" > "Mounting types"	6GT2890-0AA00

REVIEW

6.3.3 Installation and assembly

6.3.3.1 RF640A mounting types

VESA 100 mounting system

A standardized VESA 100 mounting system is provided to mount the antenna. The mounting system consists of four fixing holes for M4 screws at intervals of 100 mm.

This is therefore suitable for:

- Mounting on metallic and non-metallic backgrounds

Note

To achieve optimum wave propagation, the antenna should not be surrounded by conducting objects. The area between antenna and transponder should also allow wave propagation without interference.

Antenna Mounting Kit

The Antenna Mounting Kit allows the fine adjustment of the antenna field by setting the solid angle (see "RF600 System Manual", chapter "Antennas" > "Mounting types").

6.3.4 Connecting an antenna to the reader

The SIMATIC RF640A antenna must be connected to the reader using an antenna cable.

Preassembled standard cables in lengths of 3 m, 10 m, and 20 m are available for the connection.

The range of the antenna is limited by the cable loss. The maximum range can be achieved with the cable 6GT2815-0BH30 (length 3 m), since this has the lowest cable loss.

Requirement

Note

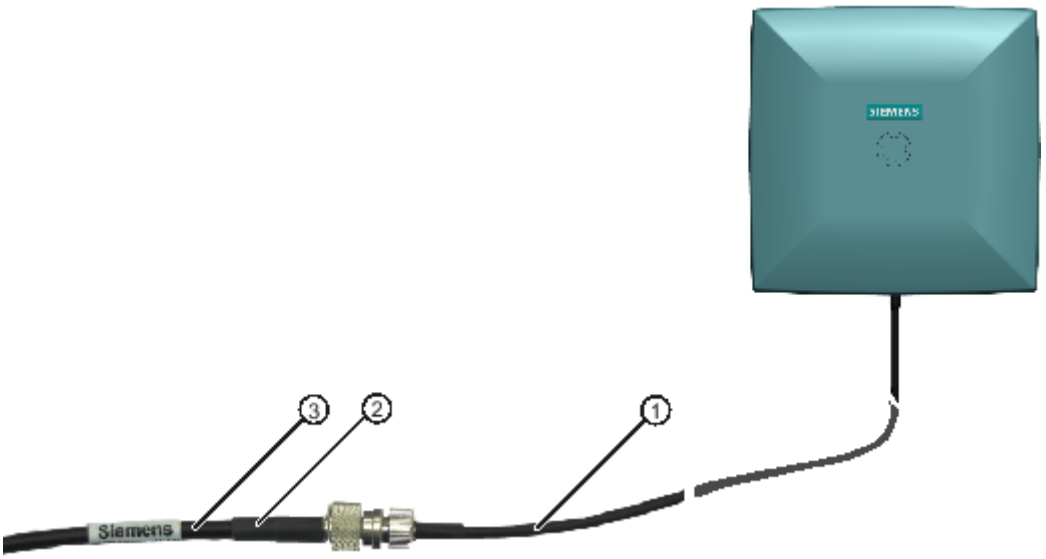
Use of Siemens antenna cable

To ensure optimum functioning of the antenna, it is recommended that a Siemens antenna cable be used in accordance with the list of accessories.

REVIEW

Strain relief

The antenna cable is provided with strain relief as shown in the following diagram:



① RF640A antenna connection (30 cm connecting cable)
② RF600 antenna cable
③ Strain relief (should take place at this position)

Figure 6-12 Strain relief

6.3.4.1 Bending radii and bending cycles of the cable

Cable designation	Order No.	Length [m]	Cable loss [dB]	Bending radius [mm]	Bending cycle
RF640A antenna connection	Fixed connection to antenna	0.3	-	15	1 Mal
Antenna cable	6GT2815-0BH30	3	1	51	1 Mal
Antenna cable (suitable for drag chains)	6GT2815-2BH50	5	1,25	48	1)
Antenna cable	6GT2815-1BN10	10	2	77	1 Mal
Antenna cable	6GT2815-0BN10	10	4	51	1 Mal
Antenna cable (suitable for drag chains)	6GT2815-0BN20	15	4	24	1)
Antenna cable	6GT2815-0BN20	20	4	77	1 Mal

1) With cables suitable for drag chains, 3 million bending cycles at a bending radius of 6.5 m and bending through ± 180 ° are permitted.

REVIEW

6.3.5 Parameter settings of RF640A for RF620R/RF630R

Operation within the EU, EFTA, or Turkey according to DIN EN 302208 V1.4.1

Note

Limitation of the radiated power according to DIN EN 302208 V1.4.1

RF600 systems that are put into operation within the EU, EFTA, or Turkey (ETSI) can be operated with an RF640A antenna with a maximum radiated power of up to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

By adjusting the transmit power of up to 500 mW ERP (or 27 dBm ERP, 800 mW EIRP, 29.15 dBm EIRP) and taking into account the RF640A antenna gain of 4 dBi (6 dBic) and the cable loss associated with the antenna cable (see table), the radiated power of the antenna cannot be exceeded. You can make the power settings using the "distance_limiting" parameter. You will find more detailed information on the parameters in the section Parameter assignment manual RF620R/RF630R (http://support.automation.siemens.com/WW/view/en/33287195).

Operation in China

The national approval for RF600 systems in China means a restriction to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP). The possible combination of antenna gain, cable loss, and max. 500 mW radiated power of the RF630R reader means it is not possible to exceed 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

Operation in the USA, Canada

Note

Limitation of the radiated power to 4000 mW EIRP (36 dBm EIRP)

To meet the FCC and IC-FCB requirements, the radiated power may not exceed 4000 mW EIRP (36 dBm EIRP). Therefore the system must satisfy the following relation:

- Conducted power P dBm of the RF600 reader (< 30 dBm)
- Antenna gain G_i dBi in the FCC frequency band (≤ 4.3 dBi)
- Cable loss a_k dB (≥ 1 dB)

$P(dBm) \leq 30\ dBm - (G_i - 6\ dBi) + a_k$

6.3.6 Parameter settings of RF640A for RF640R/RF670R

REVIEW

Operation within the EU, EFTA, or Turkey according to DIN EN 302208 V1.4.1

Note

Limitation of the radiated power according to DIN EN 302208 V1.4.1

RF600 systems that are put into operation within the EU, EFTA, or Turkey (ETSI) can be operated with an RF640A antenna with a maximum radiated power of up to 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

By setting the radiated power of up to 1300 mW ERP (or 31.15 dBm ERP, 2140 mW EIRP, 33.3 dBm EIRP), an RF640A antenna gain of 4 dBi (7 dBic) and taking into account the cable loss associated with the antenna cable (see table), the radiated power of the reader is correctly configured and the radiated power at the antenna is not exceeded.

Operation in China

By setting a max. radiated power of 1300 mW ERP (or 31.15 dBm ERP, 2140 mW EIRP, 33.3 dBm EIRP), the RF640A antenna gain of 4.3 dBi (7.3 dBic) and the cable loss associated with the antenna cable (see table), the radiated power of the reader is correctly configured.

Operation in the USA, Canada

Note

Limitation of the radiated power to 4000 mW EIRP (36 dBm EIRP)

To meet the FCC and IC requirements, the radiated power may not exceed 4000 mW EIRP (36 dBm EIRP). Therefore the system must satisfy the following relation:

- Conducted power P dBm of the RF600 reader (< 30 dBm)
- Antenna gain G_i dBi in the FCC frequency band (≤ 4.3 dBi)
- Cable loss a_k dB (≥ 1 dB)

$P(dBm) \leq 30\ dBm - (G_i - 6\ dBi) + a_k$

6.3.7 Setting RF640A parameters for RF650R

Operation within the EU according to DIN EN 302208 V1.4.1

Note

Limitation of the radiated power according to DIN EN 302208 V1.4.1

RF600 systems that are put into operation within the EU, EFTA, or Turkey (ETSI) can be operated with an RF640A antenna with a maximum radiated power of 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

By setting the radiated power of up to 1300 mW ERP (or 31.15 dBm ERP, 2140 mW EIRP, 33.3 dBm EIRP), an RF640A antenna gain of 4 dBi (7 dBic) and taking into account the cable loss associated with the antenna cable (see table (Page 276)), the radiated power of the reader is correctly configured and the radiated power at the antenna is not exceeded.

Operation in China

By setting a max. radiated power of 1300 mW ERP (or 31.15 dBm ERP, 2140 mW EIRP, 33.3 dBm EIRP), an RF640A antenna gain of 4.3 dBi (7.3 dBic) and taking into account the cable loss associated with the antenna cable (see table (Page 276)), the radiated power of the reader is correctly configured.

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Operation in the USA, Canada

Note

Limitation of the radiated power to 4000 mW EIRP (36 dBm EIRP)

To meet the FCC and IC requirements, the radiated power may not exceed 4000 mW EIRP (36 dBm EIRP). Therefore the system must satisfy the following relation:

- Conducted power P dBm of the RF600 reader (< 30 dBm)
- Antenna gain G_i dBi in the FCC frequency band (≤ 4.3 dBi)
- Cable loss a_k dB (≥ 1 dB)

$P(dBm) \leq 30\ dBm - (G_i - 6\ dBi) + a_k$

6.3.8 Setting RF640A parameters for RF680R/RF685R

Operation within the EU according to DIN EN 302208 V1.4.1

Note

Limitation of the radiated power according to DIN EN 302208 V1.4.1

RF600 systems that are put into operation within the EU, EFTA, or Turkey (ETSI) can be operated with an RF640A antenna with a maximum radiated power of 2000 mW ERP (or 33 dBm ERP, 3250 mW EIRP, 35 dBm EIRP).

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By setting the radiated power of up to 1300 mW ERP (or 31.15 dBm ERP, 2140 mW EIRP, 33.3 dBm EIRP), an RF640A antenna gain of 4 dBi (7 dBic) and taking into account the cable loss associated with the antenna cable (see table (Page 276)), the radiated power of the reader is correctly configured and the radiated power at the antenna is not exceeded.

Operation in China

By setting a max. radiated power of 2000 mW ERP (or 33 dBm ERP, 2140 mW EIRP, 33.3 dBm EIRP), an RF640A antenna gain of 4.3 dBi (7.3 dBic) and taking into account the cable loss associated with the antenna cable (see table (Page 276)), the radiated power of the reader is correctly configured.

Operation in the USA, Canada

Note

Limitation of the radiated power to 4000 mW EIRP (36 dBm EIRP)

To meet the FCC and IC requirements, the radiated power may not exceed 4000 mW EIRP (36 dBm EIRP). Therefore the system must satisfy the following relation:

- Conducted power P dBm of the RF600 reader (< 30 dBm)
- Antenna gain G_i dBi in the FCC frequency band (≤ 4.3 dBi)
- Cable loss a_k dB (≥ 1 dB)

$P(dBm) \leq 30\ dBm - (G_i - 6\ dBi) + a_k$

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6.3.9 Antenna patterns

6.3.9.1 Antenna radiation patterns in the ETSI frequency band

Directional radiation pattern Europe (ETSI)

The directional radiation pattern is shown for nominal alignment and a center frequency of 866.3 MHz. The nominal antenna alignment is given when the antenna elevation is provided as shown in the following figure.

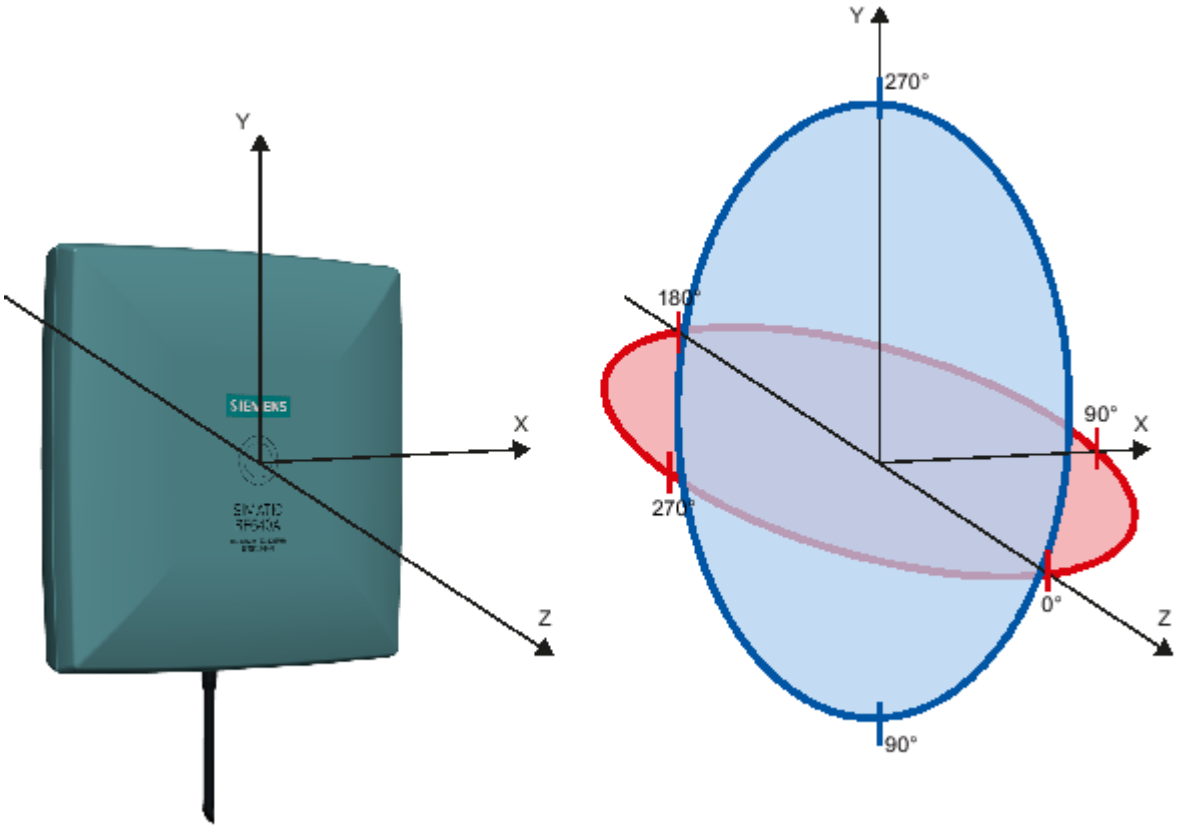

Figure 6-13 Reference system

The half-power beam width of the antenna is defined by the angle between the two -3 dB points. Which range (in %) corresponds to the dB values in the patterns can be obtained from this table (Page 291).

Note that the measurements presented graphically below were carried out in a low-reflection environment. Deviations can therefore occur in a normally reflecting environment.

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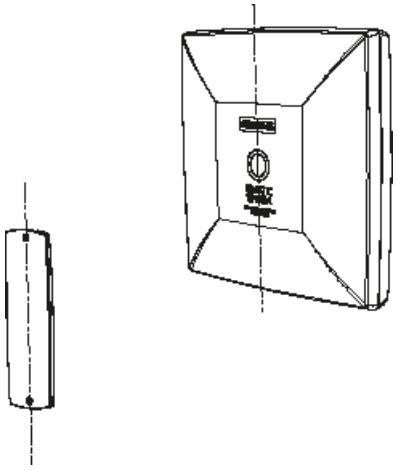
Directional radiation patterns in the ETSI frequency band

Polarization axis and axis of symmetry are parallel

In a configuration based on the following directional radiation pattern of the antenna, the axis of symmetry of the antenna and the polarization axis of the transponder are parallel.



REVIEW

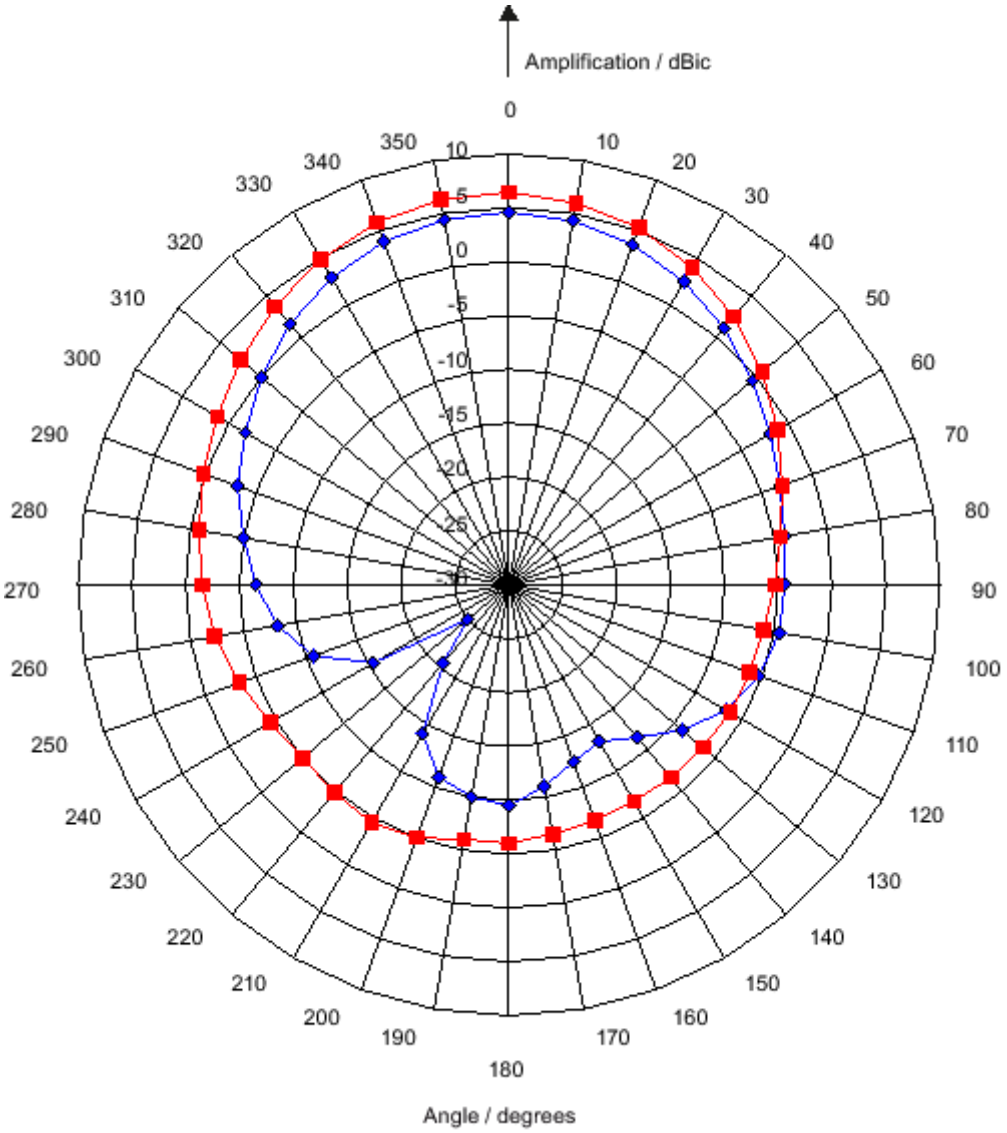


Figure 6-14 The RF640A directional radiation pattern in the ETSI frequency band, polarization axis of the transponder, and axis of symmetry of the antenna are parallel to each other.

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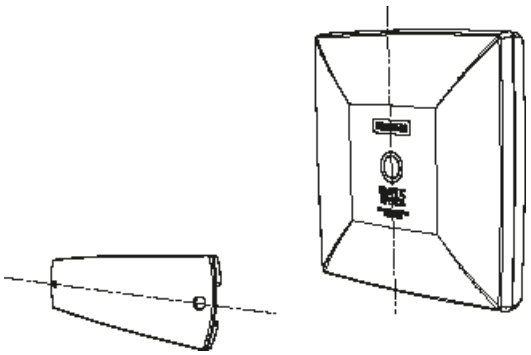
Polarization axis and axis of symmetry are orthogonal to each other

In a configuration based on the following directional radiation pattern of the antenna, the axis of symmetry of the antenna and the polarization axis of the transponder are orthogonal to each other.



REVIEW

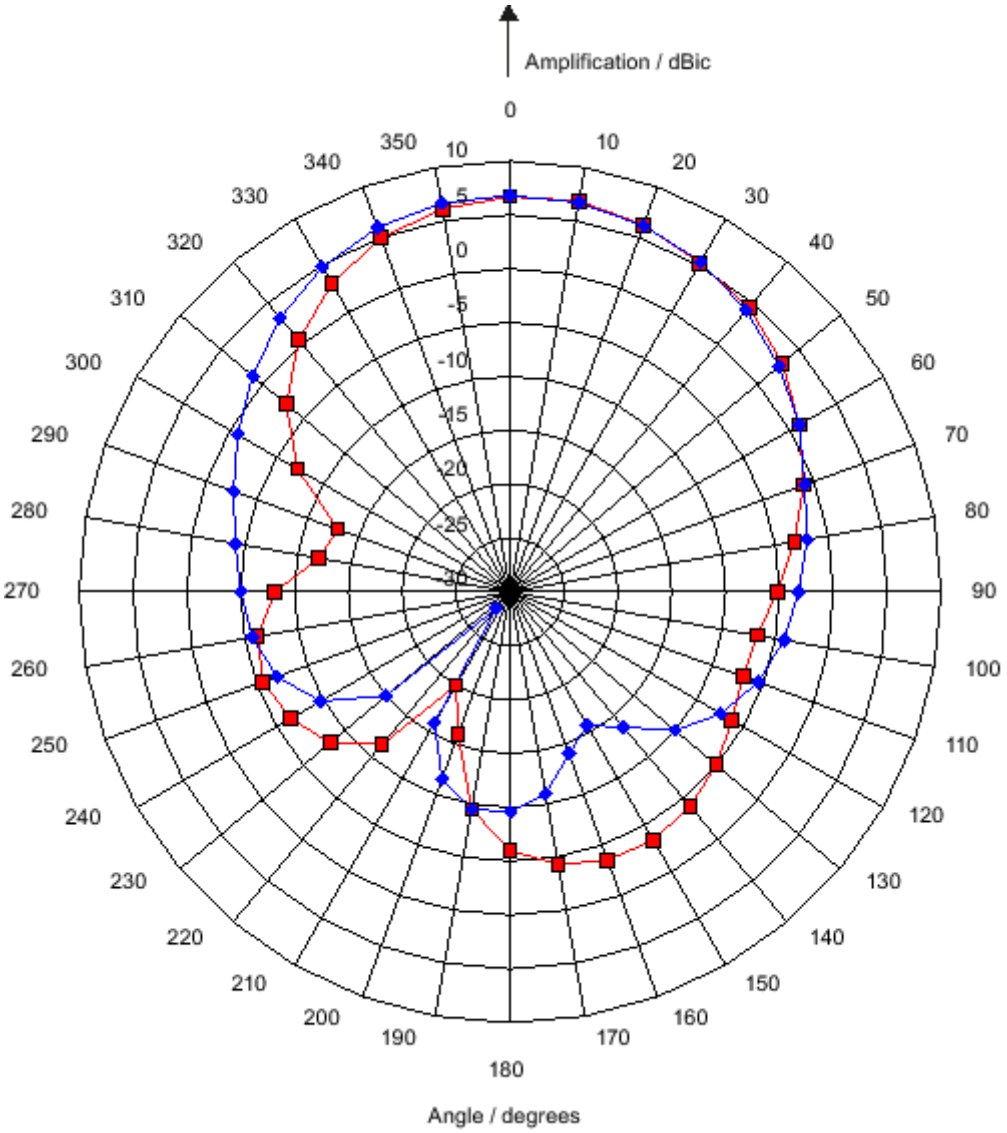


Figure 6-15 The RF640A directional radiation pattern in the ETSI frequency band, axis of symmetry of the antenna, and polarization axis of the transponder are orthogonal to each other

REVIEW

6.3.9.2 Antenna radiation patterns in the FCC frequency band

Directional radiation pattern USA (FCC)

The directional radiation pattern is shown for nominal alignment and a center frequency of 915 MHz.

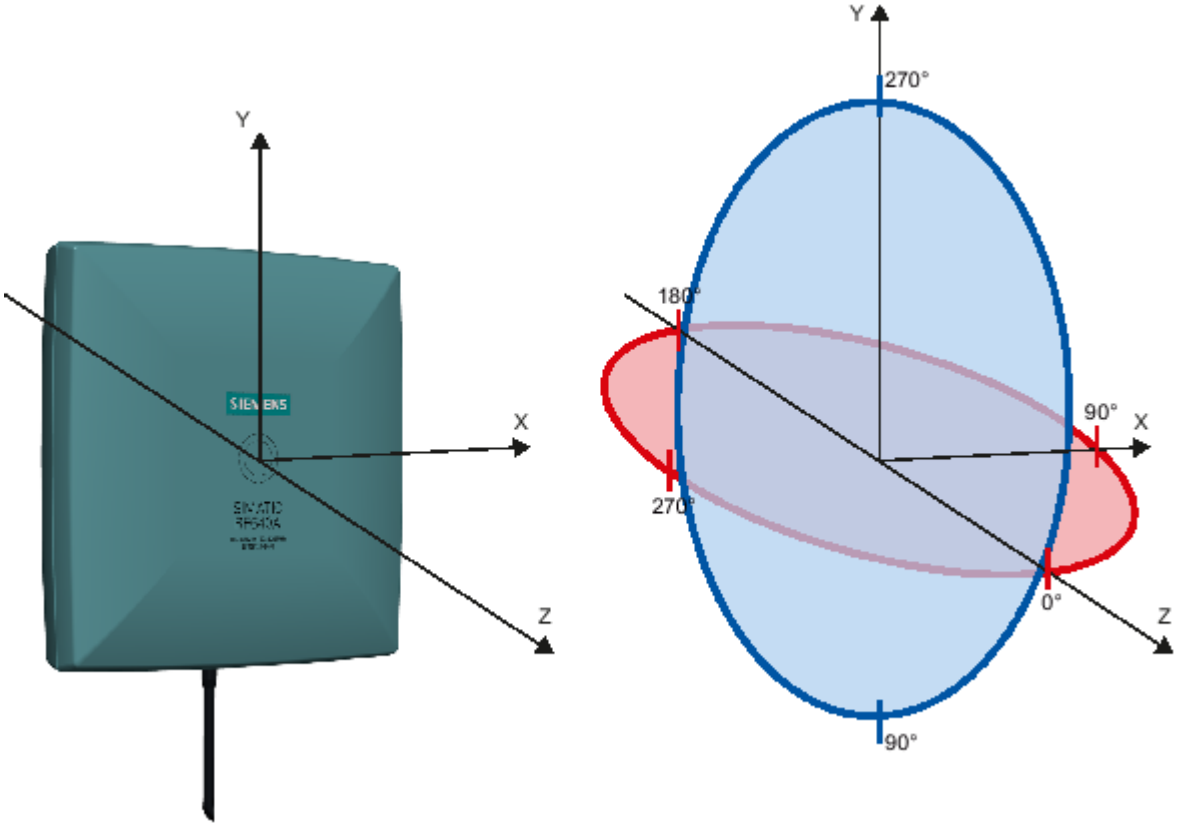


Figure 6-16 Reference system

The half-power beam width of the antenna is defined by the angle between the two -3 dB points (corresponding to half the power referred to the maximum power). Which range (in %) corresponds to the dB values in the patterns can be obtained from this table (Page 291).

Note that the measurements presented graphically below were carried out in a low-reflection environment. Deviations can therefore occur in a normally reflecting environment.

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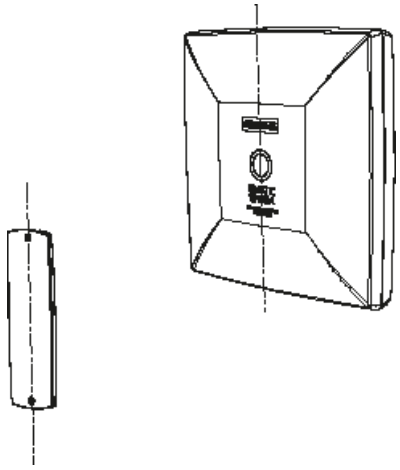
Directional radiation pattern in the FCC frequency band

Polarization axis and axis of symmetry are parallel

In the following directional radiation pattern of the antenna, the axis of symmetry of the antenna and the polarization axis of the transponder are parallel.



REVIEW

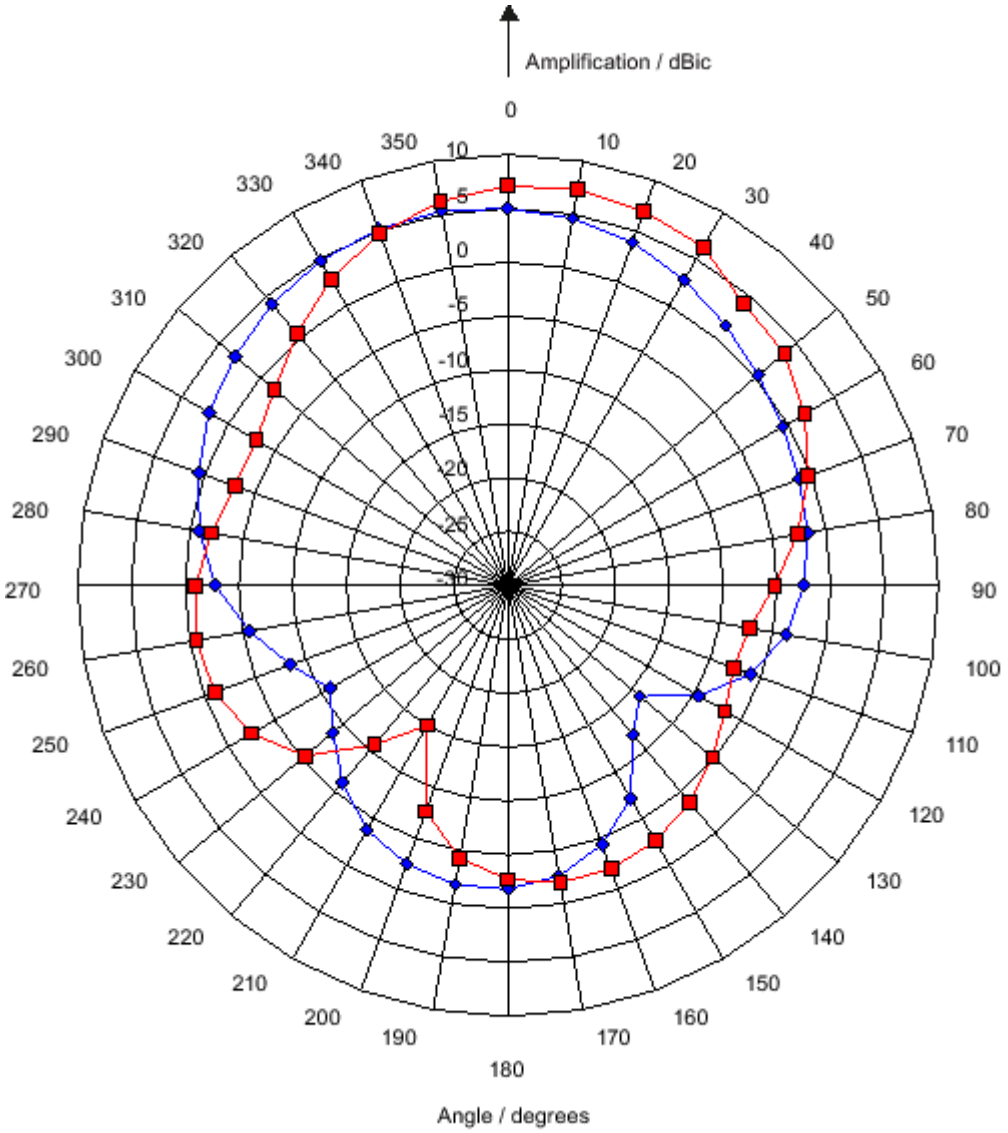
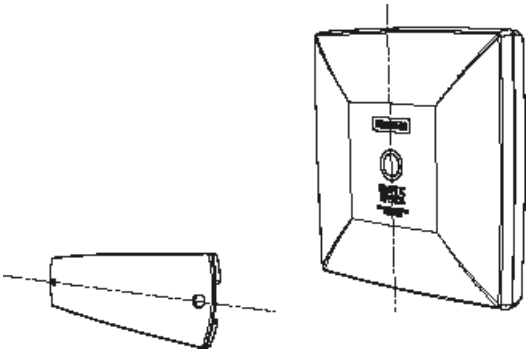


Figure 6-17 The RF640A directional radiation pattern in the FCC frequency band, polarization axis of the transponder, and axis of symmetry of the antenna are parallel to each other

REVIEW

Polarization axis and axis of symmetry are orthogonal to each other

In the following directional radiation pattern of the antenna, the axis of symmetry of the antenna and the polarization axis of the transponder are orthogonal to each other.



REVIEW

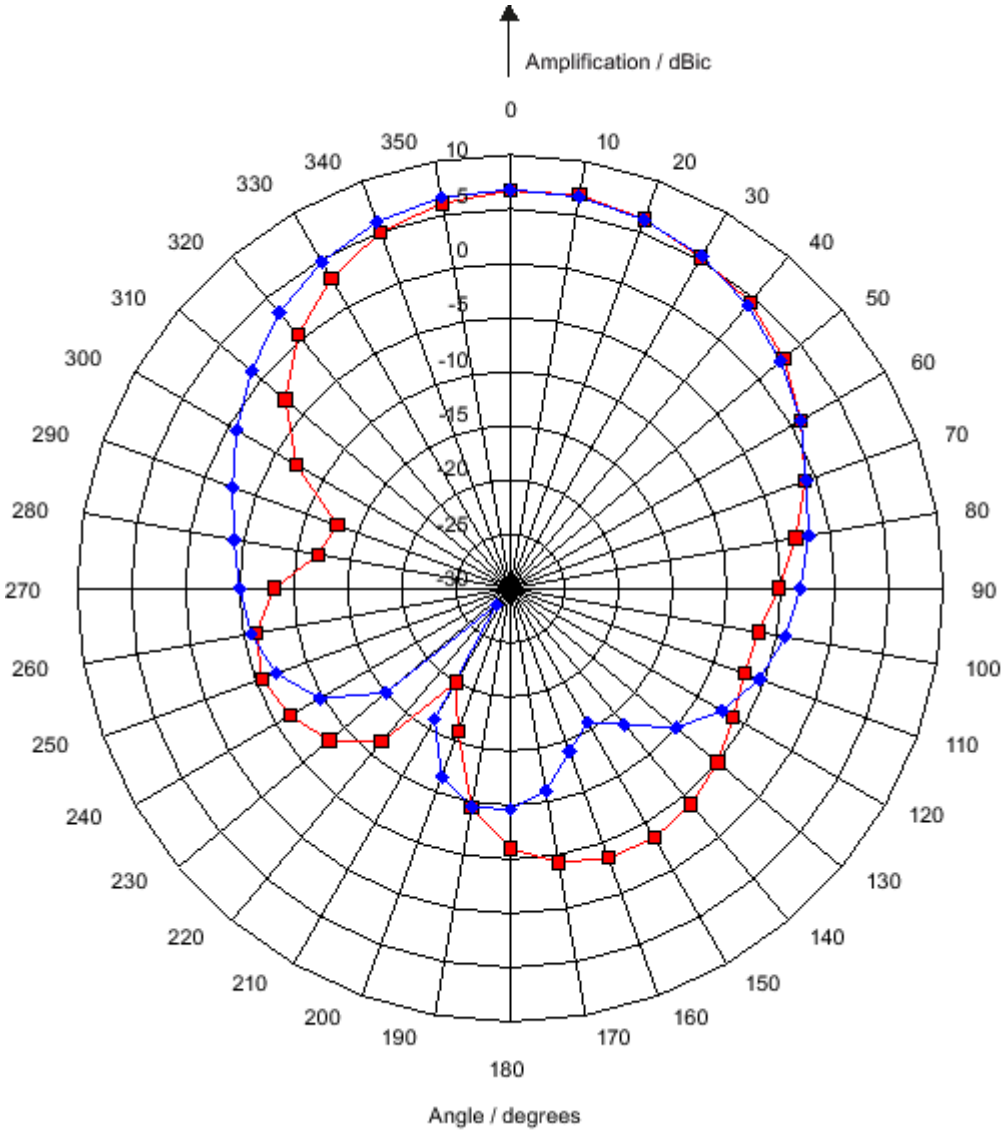


Figure 6-18 The RF640A directional radiation pattern in the FCC frequency band, axis of symmetry of the antenna, and polarization axis of the transponder are orthogonal to each other

REVIEW

6.3.9.3 Interpretation of directional radiation patterns

The following overview table will help you with the interpretation of directional radiation patterns.

The table shows which dBi values correspond to which read/write ranges (in %): You can read the radiated power depending on the reference angle from the directional radiation patterns, and thus obtain information on the read/write range with this reference angle with regard to a transponder.

The dBr values correspond to the difference between the maximum dBi/dBic value and a second dBi/dBic value.

Deviation from maximum antenna gain [dBr]	Read/write range [%]
0	100
-3	70
-6	50
-9	35
-12	25
-15	18
-18	13

Example

As can be seen in Directional radiation patterns in the ETSI frequency band (Page 282), the maximum antenna gain in the vertical plane is 3.45 dBi (6.45 dBic). In this plane, and with the polarization axis of the transponder parallel to the axis of symmetry of the antenna, the antenna gain drops to about 0.5 dBic at +50° or 310°. Therefore the dBr value is -6. The antenna range is only 50% of the maximum range at + 50° or 310° from the Z axis within the vertical plane (see values shown in blue in the directional radiation pattern: Characteristic of the vertical plane of the antenna (Page 282) and the associated representation of the reference system (Page 281)).

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6.3.10 Technical data

Table 6- 18 General technical specifications RF640A

	6GT2812-0GA08
Product type designation	SIMATIC RF640A
Dimensions (L x W x H)	185 x 185 x 45 mm
Color	Pastel turquoise
Material	PA 12 (polyamide 12)
	Silicone-free
Frequency band	865 to 928 MHz
Plug connection	30 cm antenna connection coaxial cable with RTNC coupling, fixed connection to antenna An antenna cable is required for connection to the reader, e.g.: 6GT2815-0BH30
Max. radiated power according to ETSI	• RF620R, RF630R: < 610 mW ERP • RF640R, RF670R: ≤ 1300 mW ERP • RF650R: ≤ 1300 mW ERP • RF680R/RF685R: ≤ 2000 mW ERP
Max. radiated power according to CMIIT	• RF620R, RF630R: ≤650 mW ERP • RF640R, RF670R: ≤ 1300 mW ERP • RF650R: ≤ 1300 mW ERP • RF680R/RF685R: ≤ 2000 mW ERP
Max. radiated power according to FCC	• RF620R, RF630R: ≤ 1070 mW EIRP • RF640R, RF670R: ≤2700 mW EIRP • RF650R: ≤ 2000 mW EIRP • RF680R/RF685R: ≤ 4000 mW EIRP
Max. power	2000 mW
Impedance	50 ohms
Antenna gain	ETSI frequency band: 4 dBi (7 dBic)
	FCC frequency band: 4.3 dBi (7.3 dBic)
VSWR (standing wave ratio)	ETSI frequency band: Max. 1.25
	FCC frequency band: Max. 1.6
Polarization	RH circular

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	6GT2812-0GA08
Aperture angle for transmitting/receiving	ETSI frequency band: • Horizontal plane: 80° • Vertical plane: 75° See ETSI antenna pattern
	FCC frequency band: • Horizontal plane: 75° • Vertical plane: 85° See FCC antenna pattern
Front-to-back ratio	ETSI frequency band: 14 dB ± 2.4 dB (depends on orientation of the transponder)
	FCC frequency band: 9 dB ± 2.7 dB (depends on orientation of the transponder)
Shock resistant to EN 60068-2-27	30 g
Vibration resistant to EN 60068-2-6	10 g
Attachment of the antenna	4 screws M4 (VESA 100 fastening system)
Tightening torque (at room temperature)	≤ 2 Nm
Ambient temperature • Operation • Transport and storage	 • -25 °C to +75 °C • -40 °C to +85 °C
MTBF in years	445
Degree of protection according to EN 60529	IP67
Weight, approx.	600 g

[1] The values differ for different dimensions/materials of the mounting surface.

REVIEW

6.3.11 Dimension drawing

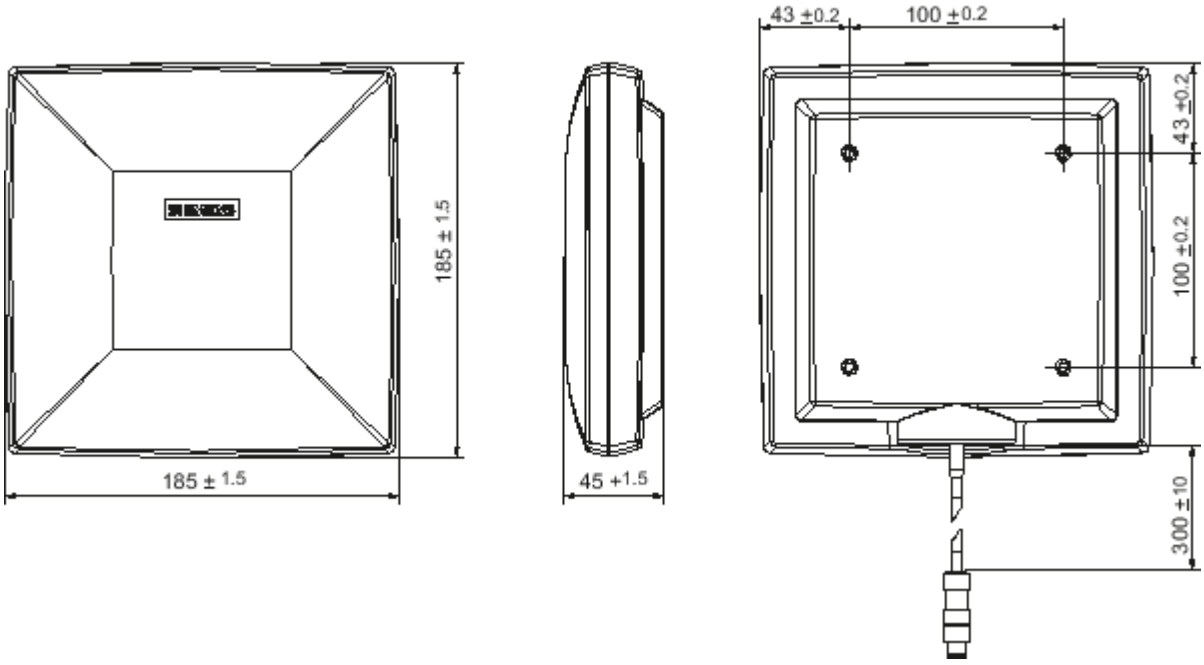

Figure 6-19 Dimension drawing RF640A

All dimensions in mm

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6.3.12 Approvals & certificates

Table 6- 19 6GT2812-0GA08

Certificate	Description
CE	Conformity in accordance with R&TTE directive in association with the readers and accessories used

Table 6- 20 6GT2812-0GA08

Standard	
FC Federal Communications Commission	FCC CFR 47, Part 15 sections 15.247 Radio Frequency Interference Statement This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. The FCC approval is granted in association with the FCC approval of the following RF600 readers: • FCC ID: NXW-RF600R (for RF620R: 6GT2811-5BA00-1AA1, RF630R: 6GT2811-4AA00-1AA1, RF640R: 6GT2811-3BA00-1AA0, RF670R FS C1: 6GT2811-0AB00-1AA0) • FCC ID: NXW-RF630R (for 6GT2811-4AA00-1AA0) • FCC ID: NXW-RF670 (for RF670R as of FS A1: 6GT2811-0AB00-1AA0
Industry Canada Radio Standards Specifications	RSS-210 Issue 7, June 2007, Sections 2.2, A8 The approval for Industry Canada is granted in association with the Industry Canada approval of the following RF600 readers: • IC: 267X-RF630 (for 6GT2811-4AA00-1AA0) • IC: 267X-RF670, RF670R FS A1 (for 6GT2811-0AB00-1AA0) • IC: 267X-RF600R, Model RF620R-2 (for 6GT2811-5BA00-1AA1) • IC: 267X-RF600R, Model RF630R-2 (for 6GT2811-4AA00-1AA1) • IC: 267X-RF600R, Model RF640R (for 6GT2811-3BA00-1AA0) • IC: 267X-RF600R, model RF670R-2 as of FS C1 (for 6GT2811-0AB00-1AA0)
c UL us	This product is UL-certified for the USA and Canada. It meets the following safety standard(s): UL 60950-1 - Information Technology Equipment Safety - Part 1: General Requirements CSA C22.2 No. 60950 -1 - Safety of Information Technology Equipment UL Report E 205089

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6.4 Antenna RF642A

6.4.1 Description

SIMATIC RF642A	Features	
	Field of application	The SIMATIC RF642A is a universal UHF antenna of compact, industry-standard design with medium range.
	Frequency range	865 to 928 MHz
	Polarization	Linear polarization Suitable for RF600 transponders that are uniformly aligned while directed past the antenna.
	Writing/reading range	max. 5.0 m
	Mounting	4 x M4 (VESA 100 fixing system)
	Connector	30 cm connecting cable (connected permanently to the antenna) and RTNC coupling An antenna cable is required for connection to the reader, e.g. 6GT2815-0BH30)
	Readers that can be connected	All RF600 readers with external antenna connectors
	Dimensions in mm	185 x 185 x 45
	Degree of protection	IP67

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Frequency ranges

The antenna is available for broadband. It can therefore be used for two different frequency ranges that have been specified for the regions of Europe and China/USA respectively.

- The antenna for Europe (EU, EFTA countries) operates in the frequency range of 865 to 868 MHz.
- The antenna for China, the USA, and Canada operates in the frequency range of 902 to 928 MHz.

Function

The SIMATIC RF642A is used for transmitting and receiving RFID signals in the UHF range. The antennas are connected to the SIMATIC RF600 readers via antenna cables that are available in different lengths.

6.4.2 Ordering data

Table 6- 21 Ordering data RF642A

Product	Article number
SIMATIC RF642A	6GT2812-1GA08

Accessories

Table 6- 22 Ordering data accessories

Product		Article number
Connecting cable between reader and antenna	3 m (cable loss 1.0 dB)	6GT2815-0BH30
	5 m, suitable for drag chains (cable loss 1.25 dB)	6GT2815-2BH50
	10 m (cable loss 2.0 dB)	6GT2815-1BN10
	10 m (cable loss 4.0 dB)	6GT2815-0BN10
	15 m, suitable for drag chains (cable loss 4.0 dB)	6GT2815-2BN15
	20 m (cable loss 4.0 dB)	6GT2815-0BN20
Antenna mounting kit	See "RF600 System Manual", section "Antennas" > "Mounting types"	6GT2890-0AA00

6.4.3 Installation and assembly

6.4.3.1 RF640A mounting types

VESA 100 mounting system

A standardized VESA 100 mounting system is provided to mount the antenna. The mounting system consists of four fixing holes for M4 screws at intervals of 100 mm.

This is therefore suitable for:

- Mounting on metallic and non-metallic backgrounds

Note

To achieve optimum wave propagation, the antenna should not be surrounded by conducting objects. The area between antenna and transponder should also allow wave propagation without interference.

Antenna Mounting Kit

The Antenna Mounting Kit allows the fine adjustment of the antenna field by setting the solid angle (see "RF600 System Manual", chapter "Antennas" > "Mounting types").

6.4.4 Connecting an antenna to the reader

The SIMATIC RF642A antenna must be connected to the reader using an antenna cable.

Preassembled standard cables in lengths of 3 m, 10 m, and 20 m are available for the connection.

The range of the antenna is limited by the cable loss. The maximum range can be achieved with the cable 6GT2815-0BH30 (length 3 m), since this has the lowest cable loss.

Requirement

Note

Use of Siemens antenna cable

To ensure optimum functioning of the antenna, it is recommended that a Siemens antenna cable be used in accordance with the list of accessories.

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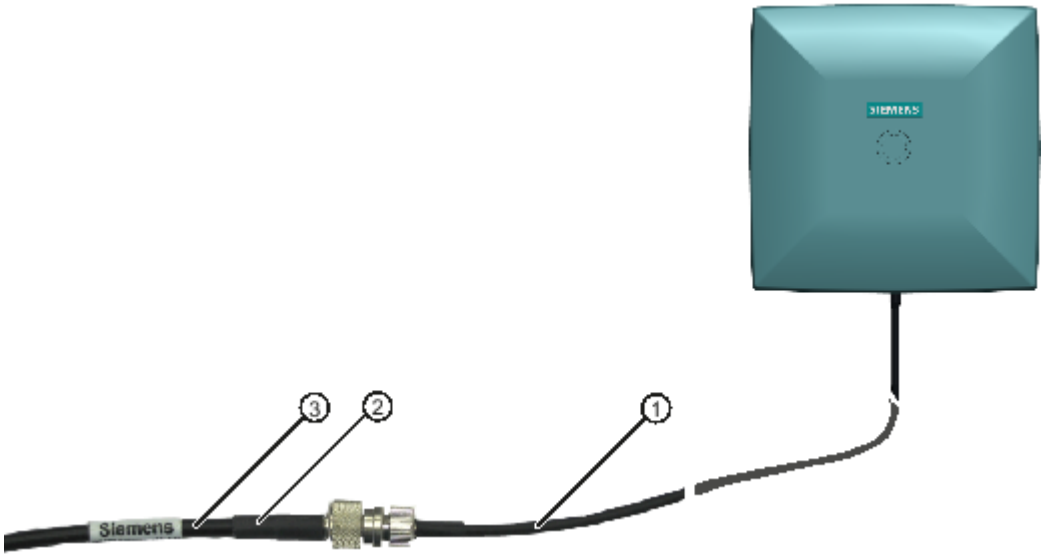
Strain relief

The antenna cable is provided with strain relief as shown in the following diagram:



① RF642A antenna connection (30 cm connecting cable)
② RF600 antenna cable
③ Strain relief (should take place at this position)

Figure 6-20 Strain relief

6.4.4.1 Bending radii and bending cycles of the cable

Cable designation	Order No.	Length [m]	Cable loss [dB]	Bending radius [mm]	Bending cycle
RF642A antenna connection	Fixed connection to antenna	0,3	-	-	1 Mal
Antenna cable	6GT2815-0BH30	3	1	51	1 Mal
Antenna cable (suitable for drag chains)	6GT2815-2BH50	5	1,25	48	1)
Antenna cable	6GT2815-1BN10	10	2	77	1 Mal
Antenna cable	6GT2815-0BN10	10	4	51	1 Mal
Antenna cable (suitable for drag chains)	6GT2815-0BN20	15	4	24	1)
Antenna cable	6GT2815-0BN20	20	4	77	1 Mal

1) With cables suitable for drag chains, 3 million bending cycles at a bending radius of 6.5 m and bending through ± 180 ° are permitted.

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6.4.5 Alignment of transponders to the antenna

Polarization axis

Since the RF642A antenna has linear polarization, it is necessary to consider the alignment of the transponders with regard to the polarization axis of the antenna.

The polarization axes of antenna and transponder must always be parallel. The symbol on the antenna indicates the polarization axis.

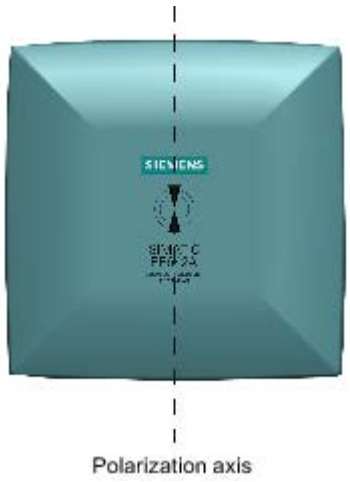

Figure 6-21 Polarization axis