TURCK

Industrial Automation

USER MANUAL RFID-SYSTEM

INSTALLATION OF THE *BL IDENT*® UHF-SYSTEMS

Sense it! Connect it! Bus it! Solve it!

1 General Information

1.1 Intended purpose of this documentation

This manual contains all the information for the proper installation of the *BL ident*® UHF system particularly with regard to the data carriers and read/write heads.

The following chapter give an overview of the *BL ident*® UHF system, how to plan a *BL ident*® UHF system, shows the necessary mounting regulations and provides a brief overview of the EMC guidelines.

The manual also describes the operation of the data carriers and read/write heads, the mounting as well as the available accessories.

1.2 Meaning of the symbols used

Danger

Personal injury resulting in death likely

Proceed with extreme caution.

This sign is placed next to a warning indicating a potential hazard. Personal injury or death are very likely if this is not observed.

Caution

Risk of damage to devices

Proceed with caution.

This sign is placed next to a warning indicating a potential hazard. Possible damage to systems (hardware and software) and installations if this is not observed.

Note

This symbol is placed next to general instructions that indicate important information on the procedure for one or several operations.

The relevant instructions can facilitate work and possibly help to avoid additional work resulting from faulty procedures.

1.3 Safety notes

Caution

This section should be read without fail since safety in the handling of electrical equipment should not be left to chance.

This manual contains all the information for the proper commissioning of the TURCK *BL ident*® system with regard to the data carriers and read/write heads.
It was specially written for suitably qualified personnel with the relevant specialist knowledge.

1.3.1 Intended use

Danger

The devices described in this manual must only be used for the intended applications described herein and in the relevant technical description, and only in conjunction with certified systems and components of other suppliers.

To ensure correct and safe operation of the devices, proper transportation, storage, assembly and installation, as well as careful operation and maintenance must be ensured.

1.3.2 Engineering/installation instructions for the product

Danger

The safety and accident prevention regulations for the relevant application must be observed without fail.

To ensure correct and safe operation of the devices, proper transportation, storage, assembly and installation, as well as careful operation and maintenance must be ensured.

1.3.3 Safety instructions for RFID systems– minimum permissible distances

During the installation and operation of HF and UHF systems it may occur that people are positioned momentarily or for long periods in the radiation range. In this case safety distances from the active components must be observed.

Danger

Effect on electrically controlled medical devices such as pacemakers

Malfunction or failure of the devices

- Find out the extent to which the radiation strength of your medical devices is affected.
- Find out the permissible distances from radiation sources for the devices you are using.
- In case of doubt, keep an additional distance from active radiation sources up to the maximum transmission range of the radiation source.

Minimum distances to the read/write head acc. to ETSI (Europe)

For the maximum permissible total radiant output power acc. to ETSI (2 W EIRP) the safety distance is d = 0.24 m. Do not get closer than 24 cm to the active radiant area of the read/write head for long periods.
According to current knowledge, a short stay in this area is not harmful, even when repeated.

Minimum distances to the read/write head acc. to FCC (USA)

For the maximum permissible total radiant output power acc. to FCC (4 W EIRP) the safety distance is d = 0.26 m. Do not get closer than 26 cm to the active radiant area of the read/write head for long periods.
According to current knowledge, a short stay in this area is not harmful, even when repeated.

1.4 TURCK Service

TURCK provides extensive support in addition to the products. The product database at www.turck.de/products provides a complete overview of the product portfolio with brief descriptions of devices and an overview of supplementary products. All relevant device information such as flyers, catalogs, manuals, certificates and CAD data are also available for download free of charge.
Application and operating software for different applications is available under the Software tab for download free of charge.

The Service Team in Germany can also be contacted for further inquiries under the following service numbers. Here you will be directed to the appropriate specialists. For overseas support please contact your national agents (addresses on the rear of this document):

- Sales: +49 (0) 208 4952-380
- Technical: +49 (0) 208 4952-390
- Email: more@turck.com

Note

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available for download at http://www.turck.de/de/support_download.asp and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

1.5 Relevant documents

The following documents in addition to this manual can be obtained from www.turck.com:

- D101581 – Interface modules for fieldbus connection.
  This manual describes the proper operation of *BL ident*® interface modules.
- D101579 – Commissioning in PROFIBUS-DP
- D101640 – Commissioning with CoDeSys for programmable gateways
- D101642 – Commissioning in DeviceNet™
- D101644 – Commissioning in EtherNet/IP™
- D101648 – Commissioning in PROFINET
- D101763 – Commissioning in CANopen
- D101925 – Quick Reference Guide for UHF System

2 The TURCK *BL ident*® UHF System

2.1 *BL ident*® – Modular RFID system

BL ident® is a complete RFID system that shows its particular benefits primarily in industrial environments. The modular system is based on the BL67 I/O systems (for field mounting) and the BL20 (for control cabinet mounting) and the *BL compact* fieldbus modules.

Each *BL ident*® system can be created flexibly with data carriers, read/write heads, connection technology and interfaces (gateways and RFID I/O modules) to form a tailored RFID solution.

In addition to high-speed FRAM data carriers offering a virtually unlimited number of read/write operations, high temperature variants for temperatures up to 240 °C are available which can be used for example in paint lines.

Another feature: *BL ident*® can be integrated into existing plant configurations without any problems.

2.1.1 *BL ident*® system concept

The *BL ident*® RFID system offers you the flexibility you need for your application on all levels: From the selection of data carriers to read/write heads, right through to the connection to the control level: You always have the possibility to achieve the perfect configuration of the system and to adapt it to your specific requirements.

BL ident® is future-proof with interoperability ensured thanks to its compliance with international, global standards. Optimum protection of your investment is therefore guaranteed.

2.1.2 *BL ident*® data carriers

- EEPROM data carriers with high memory quality and price benefit, particularly with large quantities
- High temperature data carriers for comprehensive process control at -40…+240 °C
- Designed for direct mounting on metal
- Customized solutions through open and globally applicable standards (ISO 18000-6C)

2.1.3 *BL ident*® read/write heads

- Industrial and rugged design
- Read/write ranges up to several meters (UHF)
- Compact mounting forms for restricted mounting conditions

2.1.4 *BL ident*® interfaces

The BL20 and BL67 modular interfaces as well as the compact *BL compact* interfaces are available for the *BL ident*® system. The modular interfaces can be combined from a Standard gateway as well as an RFID interface module of the relevant system.

Interfaces for the exclusive connection of read/write heads and also for connecting read/write heads and other field devices such as sensors or actuators are available for *BL compact*

Gateways (BL20 and BL67)

The gateway connects the fieldbus with the I/O modules and depends on the fieldbus used, unlike the I/O modules themselves. It handles the entire process data traffic and generates diagnostic information for the higher-level controller as well as for the IO-ASSISTANT software. Extended functions are available depending on the type of gateway, such as programmable gateways.

Figure 1: Gateway for BL20 (example PROFIBUS-DP): Standard gateway (left) and ECONOMY gateway (right)

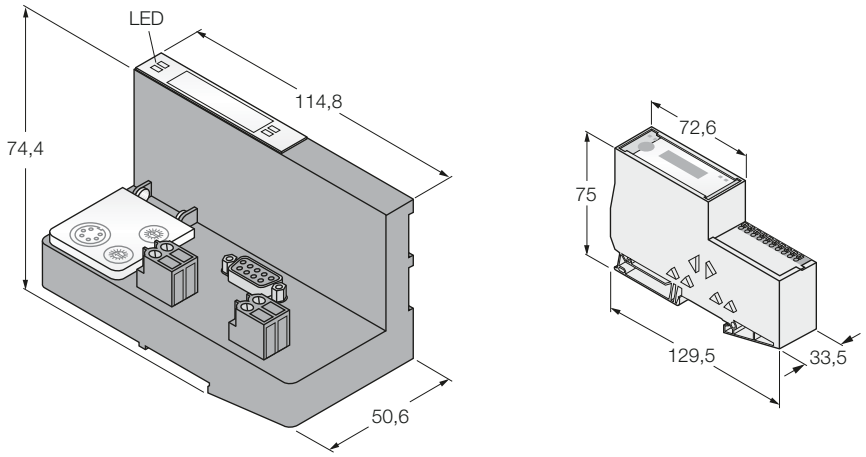
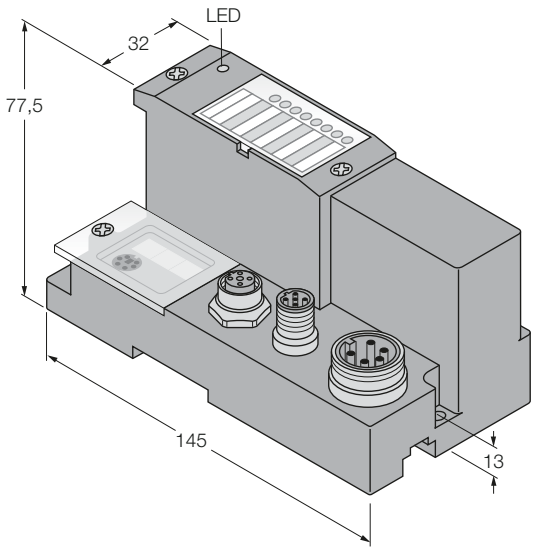


Figure 2: Gateway for BL67 (example PROFIBUS-DP)



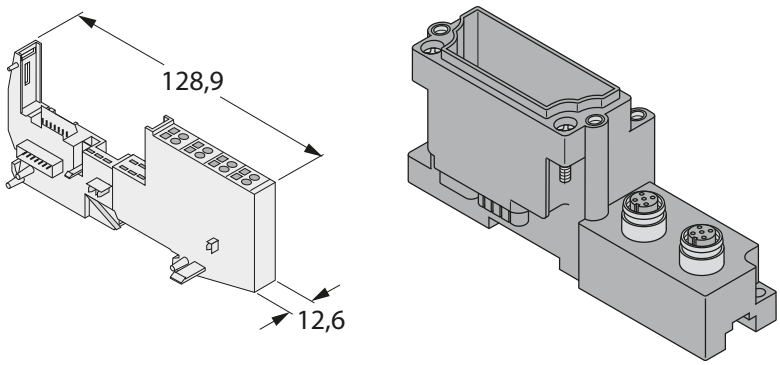
Interface modules: electronic and base modules

The individual interface modules of the modular I/O systems each consist of a passive base module and an electronic module.

The base modules consist of the connection technology for connecting the field devices such as read/write heads, sensors and actuators. The following base modules are suitable for use in the *BL ident®* system:

- Degree of protection IP20 (BL20 system)
  - BL20-S4T-SBBS (cage clamp terminal) in connection with Standard and ECONOMY gateways.
  - BL20-S4S-SBBS (screw terminal) only in connection with Standard gateways
- Degree of protection IP67 (BL67 system)
  - BL67-B-2M12 (M12 male connector terminal)

Figure 3:
Base module for BL20 (left) and BL67 (right)

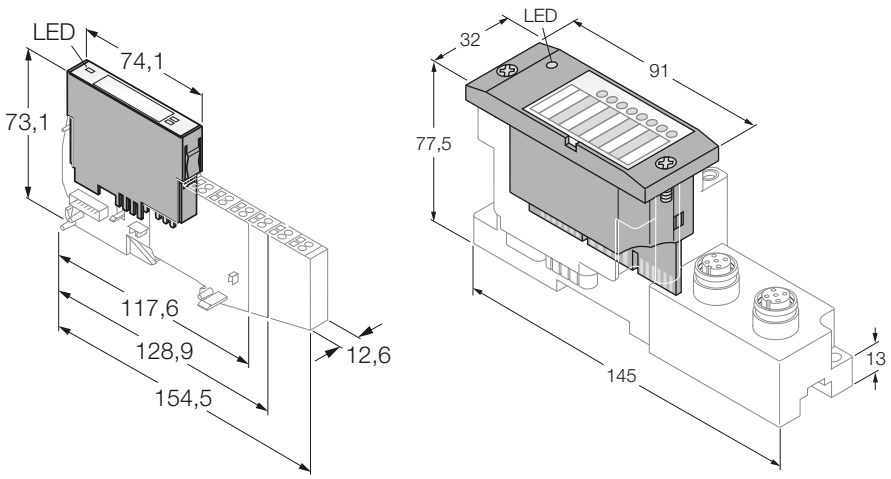


The electronic modules contain the functions of the interface modules (power supply modules, digital and analog input and output modules and technology modules such as RFID modules).

They are fitted to the base modules and are independent of the wiring. During commissioning or maintenance, the electronic modules can be removed and fitted without having to disconnect the field wiring.

The *BL ident®* system comprises two types of electronic modules, the BLxx-RFID-S modules (Simple RFID) for simple I/O communication and the BLxx-RFID-A modules (Advanced RFID) for use with function blocks or with programmable gateways.

Figure 4:
Electronic module for BL20 (left) and BL67 (right)



Combination of gateways and interface modules

The following tables show the possible combinations of BL20 and BL67 gateways with the relevant RFID modules. For all possible combinations, TURCK offers interface sets with cage clamp connection options for 2, 4, 6 or 8 read/write heads.

Table 1: Combination and function matrix for BL ident® interfaces (sets) in IP20 (BL20)

Fieldbus	*BL ident*® interface (set): Gateway + electronic module (with base module)				
	Type[A]	Gateway		Electronic modules	
	x = No. of channels: 2, 4, 6, 8	Type[B]	pro-gramm-able	Type BL20-2RFID-A[C]	Type BL20-2RFID-S[E]
PROFIBUS-DP	TI-BL20-DPV1-x	BL20-GW-DPV1		x[D]	
	TI-BL20-DPV1-S-x	BL20-GW-DPV1			x
	TI-BL20-E-DPV1-x	BL20-E-GW-DPV1		x[D]	
	TI-BL20-E-DPV1-S-x	BL20-E-GW-DPV1			x
DeviceNet™	TI-BL20-DN-S-x	BL20-GWBR-DNET			x
	TI-BL20-E-DN-S-x	BL20-E-GW-DN			x
CANopen	TI-BL20-E-CO-S-x	BL20-E-GW-CO			x
Modbus-TCP	TI-BL20-EN-S-x	BL20-GW-EN			x
	TI-BL20-PG-EN-x	BL20-PG-EN	x	x	
	TI-BL20-PG-EN-S-x	BL20-PG-EN	x		x
EtherNet/IP™	TI-BL20-EIP-S-x	BL20-GW-EN-IP			x
	TI-BL20-PG-EIP-x	BL20-PG-EN-IP	x	x	
	TI-BL20-PG-EIP-S-x	BL20-PG-EN-IP	x		x
PROFINET IO	TI-BL20-E-PN-x	BL20-E-GW-PN		x[D]	x
	TI-BL20-E-PN-S-x	BL20-E-GW-PN			
EtherCAT®	TI-BL20-E-EC-S-x	BL20-E-GW-EC			x

A) *Refer to the Appendix for the type code,* "Type code for BL ident® interface" page 94.
B) *Refer to the Appendix for the type code,* "Type code for BLxx gateways" page 99.
C) *Advanced RFID module for enhanced RFID communication with function block (PIB)*
D) *Advanced RFID module for enhanced RFID communication with function block (PIB) via Siemens S7 PLC*
E) *Simple RFID module for 8-byte I/O communication*

Table 2: Combination and function matrix for BL ident® interfaces (sets) in IP67 (BL67)

Fieldbus	***BL ident*® interface (set): Gateway + electronic module (with base module)**				
	Type[A]	**Gateway**		**Electronic modules**	
	x = No. of channels: 2, 4, 6, 8	**Type[B]**	**programmable**	**Type BL67-2RFID-A[C]**	**Type BL67-2RFID-S[E]**
PROFIBUS-DP	TI-BL67-DPV1-x	BL67-GW-DPV1		x[D]	
	TI-BL67-DPV1-S-x	BL67-GW-DPV1			x
	TI-BL67-PG-DP-x	BL67-PG-DP	x	x	
	TI-BL67-PG-DP-S-x	BL67-PG-DP	x		x
DeviceNet™	TI-BL67-DN-S-x	BL67-GW-DN			x
Multi-protocol:Modbus-TCP + EtherNet/IP™	TI-BL67-EN-S-x	BL67-GW-EN			x
Modbus-TCP	TI-BL67-PG-EN-x	BL67-PG-EN	x	x	
	TI-BL67-PG-EN-S-x	BL67-PG-EN	x		x
EtherNet/IP™	TI-BL67-PG-EIP-x	BL67-PG-EN-IP	x	x	
	TI-BL67-PG-EIP-S-x	BL67-PG-EN-IP	x		x
PROFINET IO	TI-BL67-EN-PN-x	BL67-GW-EN-PN		x[D]	
PROFINET IO + AIDA connection technology	TI-BL67-PN-AC-x	BL67-GW-PN-AC		x[D]	
	TI-BL67-PN-AC-S-x	BL67-GW-PN-AC			x

A) *Refer to the Appendix for the type code,* "Type code for BL ident® interface" page 94.
B) *Refer to the Appendix for the type code,* "Type code for BLxx gateways" page 99.
C) *Advanced RFID module for enhanced RFID communication with function block (PIB)*
D) *Advanced RFID module for enhanced RFID communication with function block (PIB) via Siemens S7 PLC*
E) *Simple RFID module for 8-byte I/O communication*

BL compact interfaces

The *BL compact* devices consist of up to two I/O signal modules as well as a fieldbus connection in a compact housing with degree of protection to IP67. The functions of a device are the same as those of a corresponding modular fieldbus station.

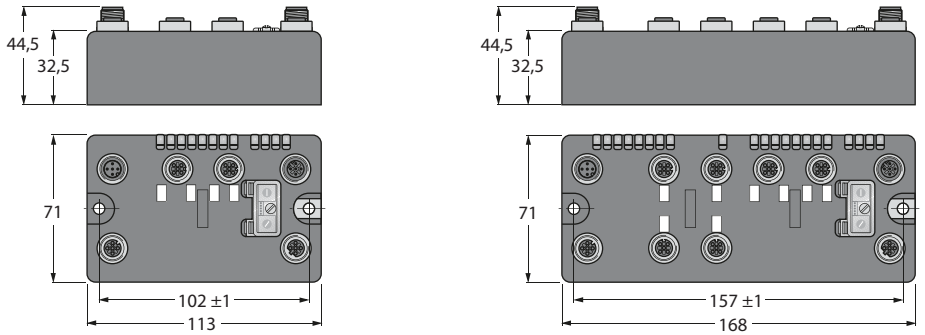
The *BL compact* interfaces for *BL ident*® are designed for the connection of two read/write heads, and variants with eight additional channels are also available. The *BL compact* interfaces for *BL ident*® are designed as standard for simple I/O communication (Simple RFID), and some variants are available with an extended range of functions (Advanced RFID). The following table shows the available variants.

Table 3: Combination and function matrix for BL ident® - BL compact (IP67)

Fieldbus	Interface[A]	Function	Type ...-2RFID-A[B]	Type ...-2RFID-S[D]
PROFIBUS-DP	BLCDP-2M12MT-2RFID-A BLCDP-2M12MT-2RFID-S	2 × read/write head	x[C]	x
	BLCDP-6M12LT-2RFID-A-8DI-PD BLCDP-6M12LT-2RFID-S-8DI-PD	2 × read/write head + 8 × digital input	x[C]	x
	BLCDP-6M12LT-2RFID-A-8XSG-PD BLCDP-6M12LT-2RFID-S-8XSG-PD	2 × read/write head + 8 × digital input/output (configurable)	x[C]	x
DeviceNet™	BLCDN-2M12S-2RFID-S	2 × read/write head		x
	BLCDN-4M12L-2RFID-S-2RFID-S	4 × read/write head		x
	BLCDN-6M12LT-2RFID-S-8XSG-PD	2 × read/write head + 8 × digital input/output (configurable)		x
CANopen	BLCCO-2M12S-2RFID-S	2 × read/write head		x
	BLCCO-4M12L-2RFID-S-2RFID-S	4 × read/write head		x
	BLCCO-6M12LT-2RFID-S-8XSG-PD	2 × read/write head + 8 × digital input/output (configurable)		x
Multi-protocol:Modbus-TCP + EtherNet/IP™	BLCEN-2M12LT-2RFID-S	2 × read/write head		x
	BLCEN-4M12LT-2RFID-S-2FRID-S	4 × read/write head		x
	BLCEN-6M12LT-2RFID-S-8XSGD-PD	2 × read/write head + 8 × digital input/output (configurable)		x
	BLCEN-3M12LT-1RS232-2RFID-S	2 × read/write head + 1 × RS232 interface		x

A) *Refer to the Appendix for the type code, "Type code for BL compact for BL ident®" page 95.*
B) *Advanced RFID module for enhanced RFID communication with function block (PIB)*
C) *Advanced RFID module for enhanced RFID communication with function block (PIB) via Siemens S7 PLC*
D) *Simple RFID module for 8-byte I/O communication*

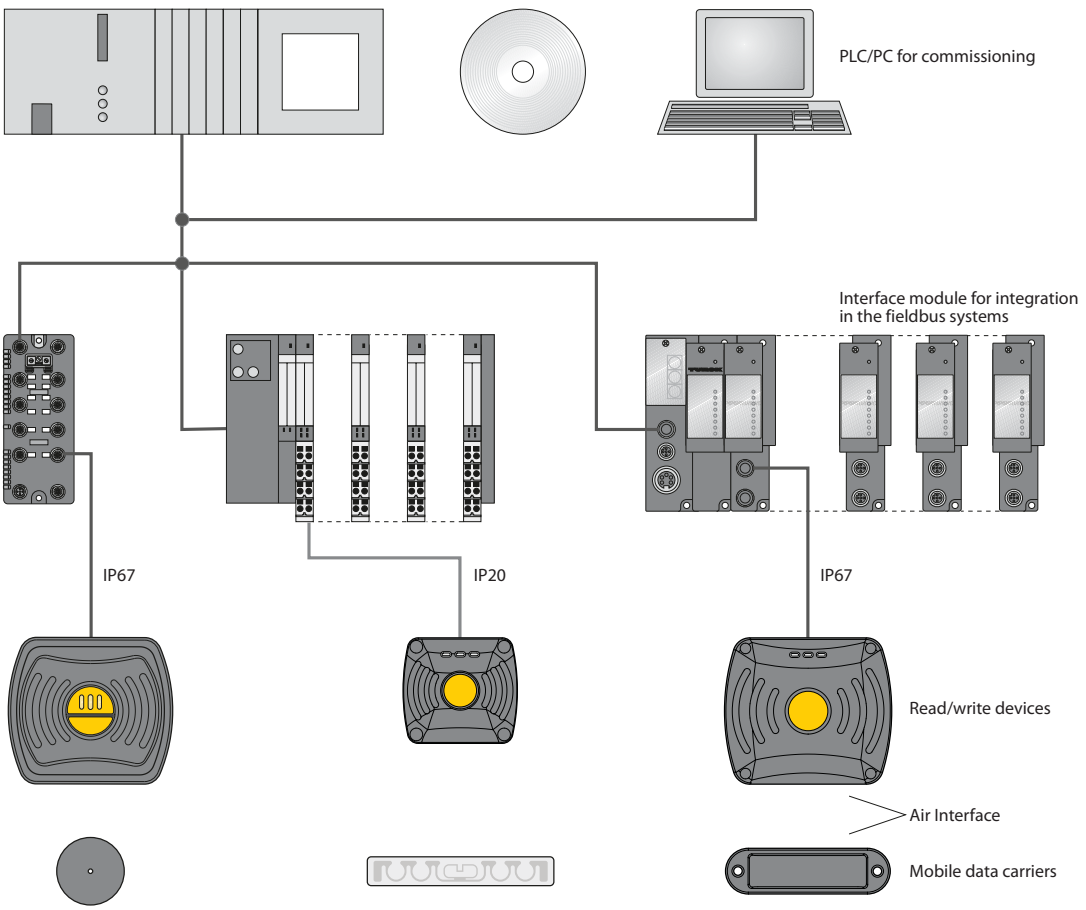
Figure 5:
BL compact station (example PROFIBUS-DP): only for read/write heads (left) and with additional digital channels (right)



2.2 Schematic representation of the *BL ident*® UHF identification system

The TURCK *BL ident*® system consists of several levels. Each level offers a wide range of possibilities. An application tailored to the total system is possible.

Figure 6:
System overview



2.2.1 Networking with *BL ident*® UHF systems

BL ident® systems can be integrated in (existing) bus systems, enabling the networking of several *BL ident*® systems.

The guidelines for the maximum extension of the bus system used apply.

A PROFIBUS-DP system can consist of up to 31 stations and a master without the use of repeaters.

2.3 Identification systems with radio frequency technology (RFID)

RFID is the acronym for Radio Frequency Identification.

An RFID system is composed of a data carrier, a device for reading and writing the data from and to the data carrier, and other devices for transmitting and processing the data.

The transmission of the data from the data carrier to the read/write head is contactless using electromagnetic waves. This form of transmission is unaffected by dirt and temperature fluctuations.

The data carriers can be attached directly to a product. For this reason the term “mobile data storage” is used. Further terms for the data carrier are TAG or transponder. The data can consist of production and manufacturing data. The data used here to identify the product is of special importance. Hence the term “identification system” is used.

The ability to change the data content through write operations to the data carrier offers an additional range of possibilities. This enables the tracing of production/manufacturing processes. Logistics / distribution systems can also be optimized.

The identification systems can be integrated into (existing) fieldbus automation systems (such as PROFIBUS-DP). The connection to the fieldbus system is implemented using the appropriate interface modules.

Standardized software modules (such as the Proxy Ident Function Block for PROFIBUS-DP) simplify the system integration and commissioning.

2.4 Features and application areas of the *BL ident*® system

In order to meet the requirements of different application areas, the TURCK *BL ident*® system offers a host of combination options for data carriers and read/write heads, as well as interface modules for connecting to automation systems (such as PROFIBUS-DP). Software modules enable systems to be integrated and commissioned simply.

The following is a list of features of the TURCK *BL ident*® system:

2.4.1 Degree of protection

Some data carriers as well as the corresponding read/write heads come with a high degree of mechanical protection (such as **IP67**) and can thus also be used in harsh industrial environments.

The connection to a fieldbus system is implemented with suitable TURCK interface modules.
The interface modules for CANopen are available with protection to IP20. The identification system is rounded off with TURCK connection cables offering appropriate degrees of protection.

Temperature-resistant data carriers up to 240°C are available for high temperature applications.

2.4.2 Lifespan

The lifespan is determined by the number of possible read/write operations on the data carriers.

EEPROM data carriers can ensure an **unlimited** number of read operations and 10^5 write operations.

The data carriers do not require any batteries.

2.4.3 Transmission frequency

The TURCK *BL ident*® system operates at nationally specified transmission frequencies in the UHF range of (865...928 MHz) between the data carriers and read/write heads. These national frequencies for UHF are required due to the frequency ranges individually specified by the national regulation bodies.

UHF systems in this frequency band achieve a higher read/write range than HF systems, typically several meters. The operating frequency of the devices in the UHF band is for example 865…868 MHz for Europe and 902…928 MHz for the USA. The *BL ident*® read/write heads in the UHF band can therefore only be used in the countries they are intended for and must not be put into operation outside of these regions. As the *BL ident*® UHF data carriers are passive, and therefore do not radiate their own radiate radio waves, these are suitable for use worldwide.

TURCK offers different data carrier variants that are specially designed and optimized for national frequency bands in order to achieve as large a communication range as possible. Wide-band multi-range data carriers for international use are also available as an alternative.

The various TURCK read/write heads support the following transmission frequencies:

- 865...868 MHz (e.g. for Europe)
- 902...928 MHz (e.g. for USA and Canada)
- 920…925 MHz (e.g. for China)
- 902...907.5 MHz and 915...928 MHz (e.g. Brazil)
- 917...920.8 MHz (e.g. for Korea)

The relevant national specifications for UHF such as frequency range, output and the status of any national regulations can be obtained from the Internet at:

- http://www.gs1.org/docs/epcglobal/UHF_Regulations.pdf

For more detailed information please contact the relevant authorities of the country where you wish to use the UHF RFID system.

2.4.4 Mounting types

Data carriers

Data carriers for the UHF RFID range are available in different mounting forms and fixing options, and are either optimized for small housing dimensions or large data transmission ranges. Besides the frequency ranges, the selection criteria for the data carriers depend on the application at hand. Data carriers for the direct mounting on metal, for attaching with a metal loop, as well as smart labels and high temperature versions are therefore available in addition to the standard mounting forms. Customized data carrier solutions that are tailored to the relevant application are also available on request.

Read/write heads

Different rectangular mounting forms are available such as compact read/write heads in housings with approx. 175 mm or 240 mm edge length for large data transmission ranges of up to several meters.

2.4.5 Memory

EEPROM data carriers for the UHF range are available with up to 138 bytes memory (110 bytes user data).

EEPROM: (Electrically erasable programmable read only memory), non-volatile.

The data carriers in the UHF frequency range meet the requirements of the ISO 18000-6C and EPCglobal Class 1 Gen 2 communication standard.

2.5 Read/write time in the sensing range of the UHF read/write head

The time that the data carrier must be in the sensing range of the read/write head in order for all the required data to be read and/or written reliably depends on the following factors:

- Command type (write or read)
- Data volume
- Extent of the sensing range (resulting from the combination of the type of read/write head and the data carrier as well as the environmental conditions)
- Homogeneity of the electromagnetic field with UHF (interruption of the communication with moving data carriers through field reflections and interference; interaction of radio waves with the environment).

The acquisition of data may be disturbed by the following factors:

- Electromagnetic interference in the relevant frequency band
- Interference may cause the cancellation of the waves and fading.

2.6 User data areas of the UHF data carrier variants

2.7 General information on the UHF data carriers

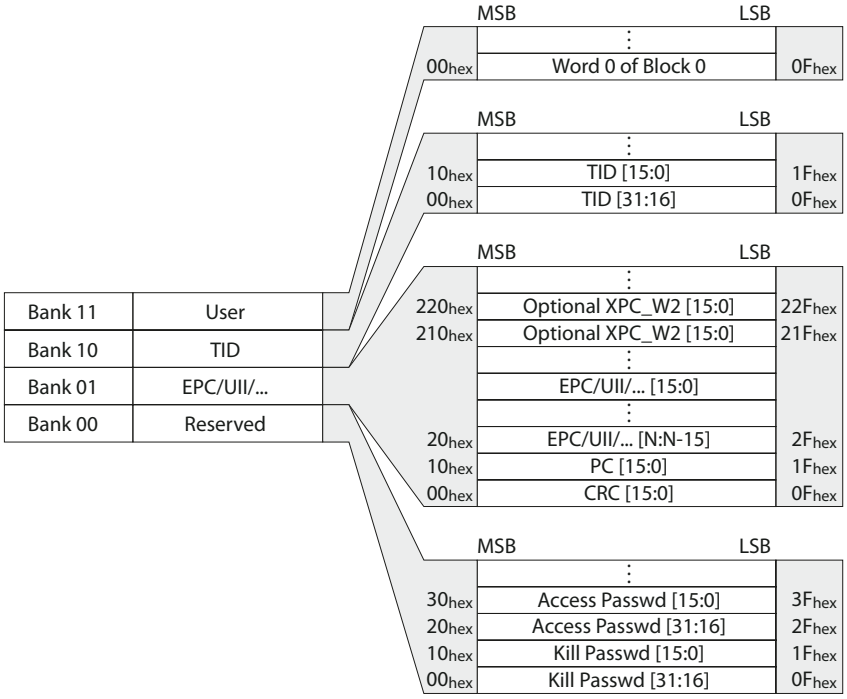
The UHF data carrier memory hierarchy is divided into four logical areas (also called domains) in accordance with ISO 18000-6C and can accommodate several blocks – each block consisting of 2 bytes.

Caution

Possible damage to the data carriers!
Incorrect writing to the reserved area (bank address = 00) or to the first four bytes of the UII memory (bank address = 01) of the data carrier memory may cause the data carrier to permanently malfunction.

- Bank 00 – reserved range: This area contains the passwords for accessing the memory and for deactivating the data carrier. The passwords for deactivating are stored in the memory addresses 00_{hex} to $1F_{hex}$. The passwords for access protection are stored in the memory addresses 20_{hex} to $3F_{hex}$. Memory access to this reserved area is normally executed with separate protocol commands.
- Bank 01 – EPC (electronic product code) or UII (unique item identifier): This area contains the essential identification data of the transponder. The 16-bit checksum (CRC) is located in the first data word (from address 00_{hex}). The second data word (= 2 bytes) contains specific data carrier control information (protocol control byte, from address 10_{hex}). The actual data area of the UIIs starts at address 20_{hex}. The data carriers are identified in the *BL ident*® system by means of the first eight bytes of the data area, i.e. from address 04_{hex} to $0C_{hex}$.
- Bank 10 – TID (tag identification): This area contains one of three values for determining the class identification ($E0_{hex}$, $E2_{hex}$ or $E3_{hex}$) in accordance with ISO/IEC 15963, contained in the memory addresses 00_{hex} to 07_{hex}. If the class is ID $E0_{hex}$, the TID contains a 48-bit serial number.
  The composed 64-bit data carrier ID is assigned once within all data carrier classes which are defined in ISO/IEC 15963 and write-protected by the manufacturer. If the class ID is $E2_{hex}$, the TID contains a 12-bit data mask identification and a 12-bit data carrier model number defined by the manufacturer. The use of memory addresses above $1F_{hex}$ is defined in the EPCglobal data standards, version 1.5 and higher. If the class ID is $E3_{hex}$, the TID contains an 8-bit manufacturer ID, followed by a 2-byte working memory for different data lengths, the 48-bit serial number, the 1-Bit-XTID and the 15-BIT-XTID header data. The composed 80-bit data carrier ID is assigned once within all data carrier classes which are defined in ISO/IEC 15963 and write-protected by the manufacturer.
- Bank 11– User area: This area is optional and contains a varying memory range for use as required by the user.

Figure 7:
UHF data carrier memory hierarchy



BL ident® UHF data carriers are currently available with the following memory types:

- EEPROM-U-Code G2
- EEPROM-Monza
- EEPROM-Higgs

Note

The number of areas for the different memory types currently varies.
The Impinj Monza® 5 therefore only has three areas (the user area is missing), whilst the NXP-G2XM contains all four areas.

2.7.1 Multiple access (multi-tag detection, bulk reading)

The data carriers are identified in the *BL ident*® system by means of the UII. With multi-access these must be different! (multiple access means a read/write head can communicate with different data carriers at the same time. The read/write head can thus address a data carrier selectively by means of its UII.)

If the data carriers are factory set with the same UII, these must be individually written with different UIIs before they are used for the first time in applications with multi-access.

2.7.2 User data areas of the data carrier variants

Overview of UHF data carriers with Impinj Monza® 3 chip

The type Impinj Monza® 3 UHF data carriers are provided with a UII memory area of 12 bytes.

The following table describes the data structure of the data carriers.

Table 4: Memory area of Impinj Monza® 3

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
10	TID	10_{hex}-$1F_{hex}$	2	0001 + Model number
		00_{hex}-$0F_{hex}$	2	fixed = 1110001000000000
01	UII	20_{hex}-$7F_{hex}$	12	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with Impinj Monza® 4D chip

The type Impinj Monza® 4D UHF data carriers are provided with a UII memory area of 16 bytes.

The following table describes the data structure of the data carriers.

Table 5: Memory area of Impinj Monza® 4D

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
11	User	00_{hex}-$1F_{hex}$	4	freely usable
10	TID	30_{hex}-$5F_{hex}$	6	Serial number
		20_{hex}-$2F_{hex}$	2	Extended TID header
		10_{hex}-$1F_{hex}$	2	Manufacturer ID + model number
		00_{hex}-$0F_{hex}$	2	11100010 + manufacturer ID
01	UII	20_{hex}-$9F_{hex}$	16	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with Impinj Monza® 4E chip

The type Impinj Monza® 4E UHF data carriers are provided with a UII memory area of 62 bytes.

The following table describes the data structure of the data carriers.

Table 6: Memory area of Impinj Monza® 4E

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
11	User	00_{hex}-$7F_{hex}$	16	freely usable
10	TID	30_{hex}-$5F_{hex}$	6	Serial number
		20_{hex}-$2F_{hex}$	2	Extended TID header
		10_{hex}-$1F_{hex}$	2	Manufacturer ID + model number
		00_{hex}-$0F_{hex}$	2	11100010 + manufacturer ID
01	UII	20_{hex}-$20F_{hex}$	62	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with Impinj Monza® 4QT chip – private mode

This memory chip has two different states for dividing the memory; Private mode and Public mode. Private mode is the factory setting and is available in operation with the BLxx-2RFID-S, BLxx-2RFID-A electronic modules and BLcompact.

The type Impinj Monza® 4QT UHF data carriers in Private mode are provided with a UII memory area of 16 bytes and a freely available user area of 64 bytes.

The following table describes the data structure of the data carriers.

Table 7: Memory area of Impinj Monza® 4QT - private

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
11	User	00_{hex}-$1FF_{hex}$	64	freely usable
10	TID	60_{hex}-BF_{hex}	12	UII public
		30_{hex}-$5F_{hex}$	6	Serial number
		20_{hex}-$2F_{hex}$	2	Extended TID header
		10_{hex}-$1F_{hex}$	2	Manufacturer ID + model number
		00_{hex}-$0F_{hex}$	2	11100010 + manufacturer ID
01	UII private	20_{hex}-$9F_{hex}$	16	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with Impinj Monza® 4QT chip – public mode

Note

The following specifications for the Impinj Monza 4QT in public mode is only for information purposes since public mode is not supported by the *BL ident®* system.

The type Impinj Monza® 4 QT UHF data carriers are provided in public mode with a UII memory area of 12 bytes.

The following table describes the data structure of the data carriers.

Table 8: Memory area of Impinj Monza® 4QT - public

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
10	TID	10_{hex}-$1F_{hex}$	2	Manufacturer ID + model number
		00_{hex}-$0F_{hex}$	2	11100010 + manufacturer ID
01	UII public	20_{hex}-$7F_{hex}$	12	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with Impinj Monza® 5 chip

The type Impinj Monza® 5 UHF data carriers are provided with a UII memory area of 16 bytes.

The following table describes the data structure of the data carriers.

Table 9: Memory area of Impinj Monza® 5

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
10	TID	30_{hex}-$5F_{hex}$	6	Serial number
		20_{hex}-$2F_{hex}$	2	Extended TID header
		10_{hex}-$1F_{hex}$	2	Model number
		00_{hex}-$0F_{hex}$	2	11100010 + manufacturer ID
01	UII	20_{hex}-$9F_{hex}$	16	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with Alien Higgs® 3 chip

The type Alien Higgs® 3 UHF data carriers are provided with a UII memory area of 12 bytes and a freely available user area of 64 bytes.

The following table describes the data structure of the data carriers.

Table 10: Memory area of Alien Higgs® 3

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
11	User	00_{hex}-$1FF_{hex}$	64	freely usable
10	TID	60_{hex}-BF_{hex}	12	reserved
		20_{hex}-$5F_{hex}$	8	Serial number
		10_{hex}-$1F_{hex}$	2	Model number
		00_{hex}-$0F_{hex}$	2	Manufacturer ID
01	UII	20_{hex}-$7F_{hex}$	12	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with NXP U-Code G2XM/G2XL chip

The type NXP U-Code G2XM/G2XL UHF data carriers are provided with a UII memory area of 30 bytes.

The following table describes the data structure of the data carriers.

Table 11: Memory area of NXP U-Code G2XM/G2XL

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
11	User	00_{hex}-$1FF_{hex}$	64	only with NXP U-Code G2XM, NXP U-Code G2XL has 0 bytes
10	TID	20_{hex}-$3F_{hex}$	4	Serial number
		10_{hex}-$1F_{hex}$	2	Model number
		00_{hex}-$0F_{hex}$	2	Manufacturer ID, fixed 11100010
01	UII	20_{hex}-$10F_{hex}$	30	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers NXP U-Code G2IM chip

The type NXP U-Code G2IM data carriers are provided with a UII memory area of 16 bytes and a freely available user area of 64 bytes and a user TID of 14 bytes.

The following table describes the data structure of the data carriers.

Table 12: Memory area of NXP U-Code G2IM

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
11	User	00_{hex}-$27F_{hex}$	64	freely usable
10	TID	60_{hex}-CF_{hex}	14	User TID, freely usable
		30_{hex}-$5F_{hex}$	6	Serial number
		20_{hex}-$2F_{hex}$	2	Extended TID header
		14_{hex}-$1F_{hex}$	2	Model number
		08_{hex}-13_{hex}	2	fixed 000000000110
		00_{hex}-07_{hex}	1	Manufacturer ID, fixed 11100010
01	UII	20_{hex}-$9F_{hex}$	16	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

Overview of UHF data carriers with NXP U-Code G2IL chip

The type NXP U-Code G2IL UHF data carriers are provided with a UII memory area of 16 bytes.

The following table describes the data structure of the data carriers.

Table 13: Memory area of NXP U-Code G2IL

Bank address [bin.]	Bank name	Memory address [hex.]	No. of bytes	Remark
10	TID	20_{hex}-$3F_{hex}$	6	Serial number
		20_{hex}-$2F_{hex}$	2	Extended TID header
		14_{hex}-$1F_{hex}$	2	Model number
		00_{hex}-13_{hex}	2	11100010 + manufacturer ID
01	UII	200_{hex}-$20F_{hex}$	2	Configuration word
		20_{hex}-$9F_{hex}$	16	UII
		10_{hex}-$1F_{hex}$	2	Protocol control bits
		00_{hex}-$0F_{hex}$	2	Checksum CRC-16
00	Reserved	20_{hex}-$3F_{hex}$	4	Password for memory access
		00_{hex}-$1F_{hex}$	4	Password to deactivate the memory

2.8 Speed of the data carrier at the read/write head on RFID systems

The speed at which the data carrier can move past the read/write head depends on the data volume to be processed, the combination of read/write head and data carrier as well as the spatial conditions of the environment.
Specific values for maximum speed and data volume can therefore only be given as examples!

The UHF system normally offers a higher read speed than the HF system and many data carriers are detected simultaneously (bulk detection), fast moving data carriers are detected reliably.

The processing time of the overall configuration of the identification system must be taken into account as well as the data processing time in the read/write head ("System overview" page 21). The time required for forwarding and processing the data in the overall installation can vary from application to application!
If your application is designed for a fast succession of data carriers, it may be necessary to reduce the speed at which the data carriers are moved past the read/write head.
In cases of doubt we recommend that you determine the possible speed by trial and error!

2.9 Read range / write range

The achievable read/write distances depend on the relevant combination of data carrier and read/write head, as well as the spatial physical conditions of the environment. The possible read/write distance depends on the data volume to be written and read as well as the speed at which the data carrier moves past the read/write head. The UHF read/write heads typically have a sensing range of several meters.

Note

The maximum read/write distance of several meters is only an idealized value under laboratory conditions.
The achievable distances may be reduced due to component tolerances, mounting location in the application, ambient conditions and the influence of materials (particularly metal and liquids).
The parameters for achievable passing speed (read and write operations on the fly) and the maximum transmittable data volume also vary, depending on the actual transmission in the relevant application.
Depending on the data carrier, the maximum write distance can be considerably less (e.g. 50 %) than the maximum read distance (see "UHF transmission zone" page 40).
A test under actual conditions is therefore always required!

2.10 *BL ident*® Simulator for UHF-RFID (Ray Tracer)

The Ray Tracer is a software simulation tool that enables the functioning of a wide range of different UHF RFID system constellations to be tested in realistic conditions.
Three-dimensional computer models of the RFID application environment and algorithms for calculating the radio wave propagation in the space realistically simulate the operation of UHF-RFID systems.

Completing several different simulation runs thus makes it possible to narrow down and preselect suitable system components before the actual installation of the UHF-RFID hardware.
When complex spatial application environments are involved, the Ray Tracer also analyzes the technical feasibility of UHF-RFID radio applications for the spatial structure at hand.

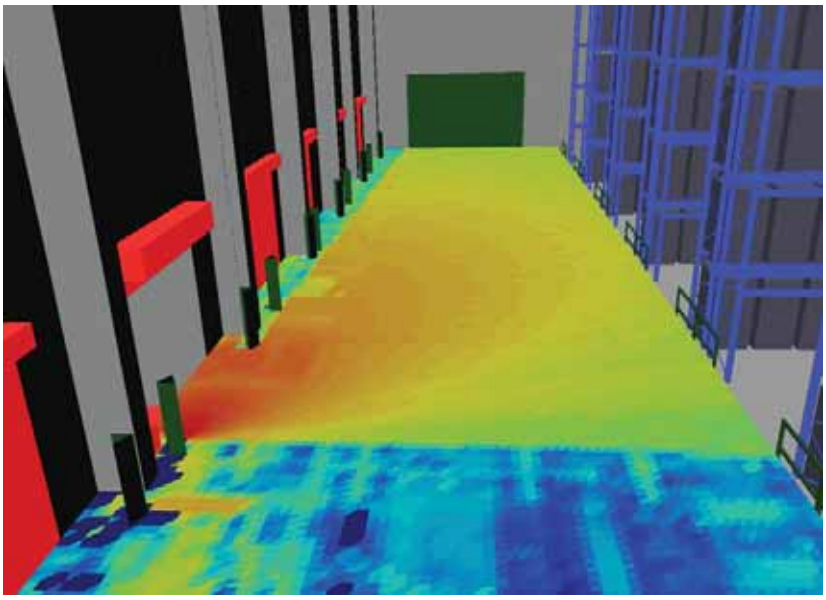


Figure 8: Three dimensional, complex computer imaging of an application environment

All the essential physical factors involved in the propagation of radio waves are taken into account. These include for example: Attenuation characteristics in air and other media (obstacles), reflection and transmission properties on objects of different materials, polarization characteristics, antenna characteristics and gain of read/write units and data carriers.

Use of the Ray Tracer requires a considerable amount of training and specialist knowledge, and so it cannot be used by the customer. It is therefore only available for use by TURCK-RFID specialists and their system partners. Contact us so that we can examine the possibility of a simulation, if required for your application. As each simulation is based on actual spatial application conditions, each simulation run is always customer-specific and supplies tailored results for the relevant application site. The information value of these simulation results is often comparable with results gained from actual measurement series carried out on site, and the time and costs involved can be considerably reduced. General and transferable statements cannot be derived from it due to the changing specific physical characteristics of different application sites.

Ray Tracer simulations are nevertheless ideal for considerably speeding up the system planning and analysis of UHF-RFID systems, whilst taking customer-specific application conditions into account.

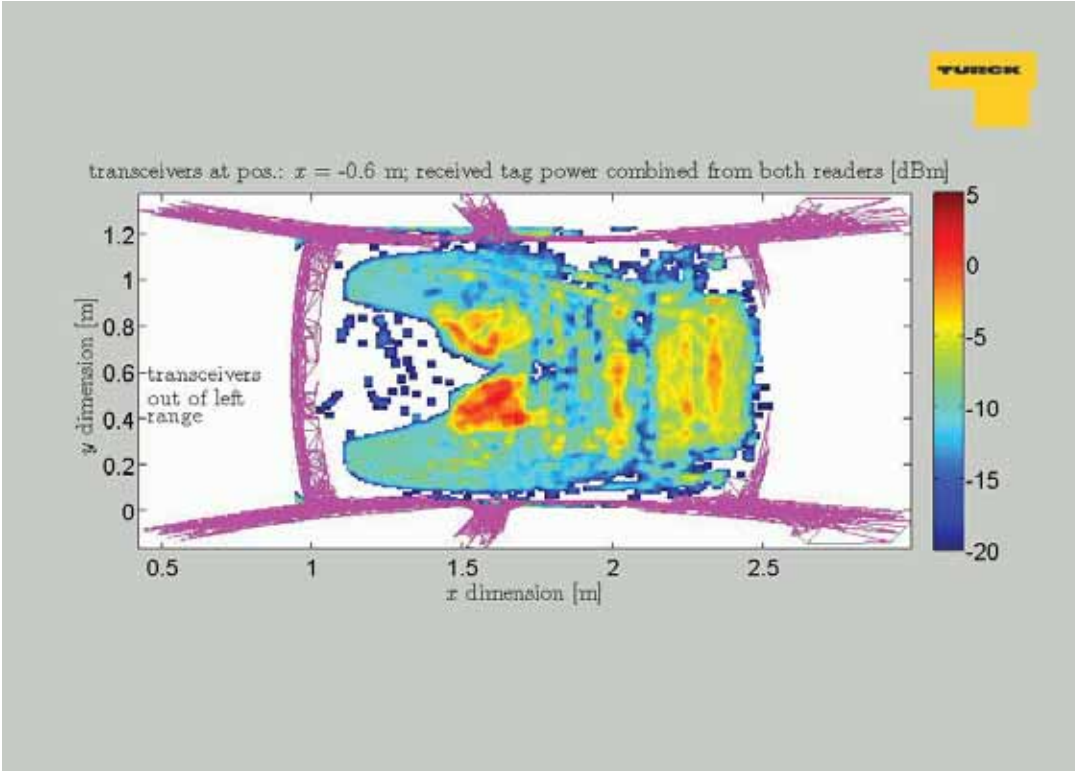


Figure 9: Example of a Ray Tracer field strength simulation

2.11 Compatibility

All technical data refers to the *BL ident*® system, i.e. the combinations of *BL ident*® data carriers, read/write heads and RFID electronic modules. Completely different values may apply to data carriers of other vendors.

2.12 Application areas (examples):

The features stated in the previous chapter allow the use of a TURCK *BL ident*® system in the following sectors:

- Automotive
- Transport and handling
- Machine building
- Food and beverage
- Chemical industry
- Pharmaceutical and petrochemical industry.

The system can be used in all areas such as:

- Assembly lines
- Materials handling
- Industrial production
- Inventory management
- Logistics
- Distribution
- Component picking
- Transport logistics

3 *BL ident*® System – Planning

3.1 Selection criteria for data carriers, read/write heads and interface module

In order to make the right selection of *BL ident*® system components, the application should be assessed according to the following criteria:

- Mechanical dimensions,
- Distance of data carriers to read/write heads for read and write operations,
- Tolerances in the mechanical guidance/motion within the transmission zone,
- Static and/or dynamic transfer of data,
- Data volume to be transferred,
- Speed of dynamic read and write operations (on the fly),
- Attenuation characteristics in air and other media (obstacles), reflection and transmission properties on objects of different materials,
- environmental conditions such as hazardous areas, humidity, temperature, effect of chemicals etc.

The following selection criteria apply in particular to read/write heads:

- Mechanical dimensions,
- Region of use (Europe, USA ... etc.),
- Size of the data carrier used,

The following criteria must be particularly taken into account when using the interface modules:

- Degree of protection,
- Bus type,
- Number of channels.

3.2 Transmission zone and read/write distance

UHF technology makes use of the properties of a radiated electromagnetic wave.
The recommended read/write distances depend on the combination of data carrier and read/write head, as well as the spatial physical conditions of the surroundings. The distribution of the radio field depends on the type of antennas in the data carrier and the read/write head, as well as the layout and characteristics of the spatial environment (e.g. reflecting obstacles).

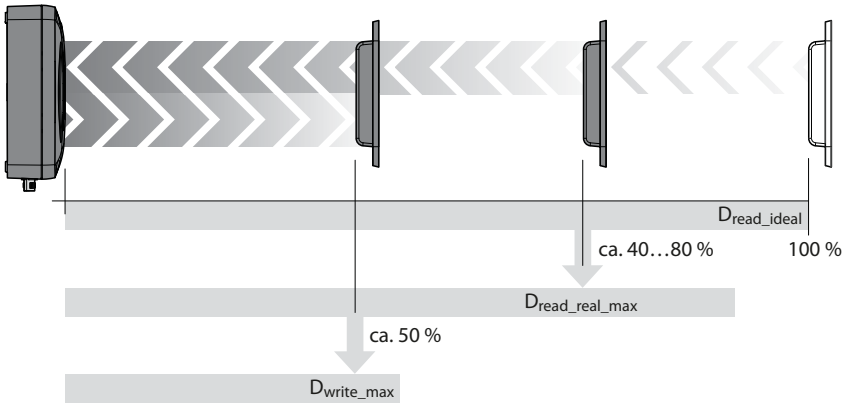
3.2.1 UHF transmission zone

As with HF RFID, the size of the UHF transmission zone also depends on the combination of data carrier and read/write head. However, the shape and the extent of the transmission zone is primarily determined here by external environmental factors. As the electromagnetic waves in the UHF band have a larger range, obstacles in the spatial environment of the read/write head, as well the data carrier play a major role. Metallic objects or objects with a high permittivity in particular change the spatial field distribution of the reflected and transmitted radio waves, and thus the condition of the data transmission zone in the air.
Obstacles that are not located directly in the connection line between data carrier and read/write head, but for example at the side or rear, also have an effect.

The transmission zone can take on a more or less jagged shape – with fading inside it.

Reserve transmission distances should be allowed for in planning in order to ensure safe operation. Depending on the mounting conditions, this means for example, that only approx. 40 ... 80 % of the maximum possible distance D_{read_ideal} is actually used for read operations based on the maximum possible read distance D_{read_ideal} for a particular combination of read/write head and data carrier. The possible distance for a write mode may be even less, e.g. only 50 % of the possible read distance D_{read_ideal}.

Figure10: Possible read/write distances



Reserve capacity must be included in planning, not only with regard to the possible radio range, but also with regard to time available for accessing the data carrier on the fly within a time window.

Note

Appropriate range tests in real conditions must be carried out in all cases!

3.2.2 Minimum distance of data carrier to the read/write head

With *BL ident*® a minimum distance between the data carrier and the read/write head is not necessary.

3.2.3 Permissible motion direction and alignment of the data carriers

The data carriers can move over the read/write head in any direction. It is only necessary for the data carriers to be aligned parallel to the read/write head..

Note

The TN…Q240L280… can either be set for linear or circular polarization via the WebConfig software tool! If linear polarization is selected, the data carrier has to be directed in horizontal or vertical direction.

3.2.4 Reading and writing in static mode

In static mode, the data carrier is located in a fixed positioned precisely in front of the read/write head. Unlike HF, UHF allows use up to a greater distance of several meters. In this mode, the processing of a large number of data carriers is possible, however, due to the inhomogeneous UHF field, several transfer attempts may be necessary, and the data carriers may not even be detected in this mode as they are located in a dead zone.

Note

Reading and writing in static mode is therefore **not** recommended!

3.2.5 Reading and writing in dynamic mode (on the fly)

In on the fly mode, the data carrier moves according to the configuration at a transverse speed past the read/write head.
This mode is preferred for the processing of a large number of data carriers, however several transfer attempts may be necessary due to the inhomogeneous UHF field. An additional time reserve for detecting all data carriers must therefore be included in planning.

There is also the risk of fading, by which communication with the data carriers may fail and the data carriers may possibly not be detected.

3.2.6 Transfer rate

The transfer speed in the UHF band may vary depending on the data carrier and the transmission process used. It is therefore not possible to provide a general calculation formula. However, the transfer speed is generally higher than for HF (ISO 15693).

3.2.7 Range difference between reading and writing

The difference primarily depends on the data carrier. Depending on type and mounting location, the range for write operations may only be 30…50 % of the maximum range for read operations in the same conditions (see also “UHF transmission zone” page 40).

Note

TURCK recommends that write operations in an application are not carried out close to the limit of the transmission zone.

3.2.8 Minimum distance between two adjacent data carriers in single mode

In dynamic mode (on the fly) the minimum distance of successive data carriers depends on the data volume and the bus cycle time.

Note

Appropriate tests to determine the minimum distance of successive data carriers must be carried out before startup.

3.2.9 Minimum distance between two adjacent data carriers in multiple access

Multiple access means a read/write head can communicate with several data carriers at the same time. The read/write head can thus address a data carrier selectively by means of its UII/EPC.

In order to access several data carriers located at the same time within the wireless sensing range of the read/write head, as large a distance between the data carriers should be selected as possible.

The minimum distance between the data carriers should be 50 mm.

If the data carriers are located close together, it may not always be possible to ensure successful identification via the communication in the air interface.

Note

Information about the expected performance must be determined by carrying out a function test under specified application conditions.

Multiple access requires that all the data carriers involved are located at the same time in the radio field of the relevant read/write head. As this is not always possible due to interference in the environment (e.g. radio reflections) and the spatial distance and arrangement of the data carriers, as well as the need for additional modifications in the application process such as:

- modifications to the arrangement of the data carriers,
- changing from static mode to dynamic mode,

applications that only access a single data carrier at the same time are often easier to implement.

3.2.10 Dwell time T_d of the data carrier

The dwell time T_d is the time in which the data carrier is in the sensing range of the read/write head on passing. During this time the read/write head can exchange data with the data carrier.

In static operation, the dwell time can either be as long as required or zero if the data carrier is located in a dead zone due to interference in the environment.
However, the dwell time must be at least as long as necessary to complete communication with the data carrier.

In dynamic mode, the dwell time is determined by the system environment. The dwell time must be adapted to the transferred data volume. Conversely this means that the shorter the dwell time, the smaller the data volume that can be transferred.

However, with UHF there is a risk of fading, in which communication with the data carriers can fail. Several transfer attempts may therefore be necessary to establish communication due to the inhomogeneous UHF field.
The dwell time should therefore allow for enough additional time for further retries.

Note

The number of automatic retries can be set via the offline parameters of the higher-level controller (PLC).

4 Mounting and operating guidelines

4.1 Effect on the performance of the *BL ident*® system

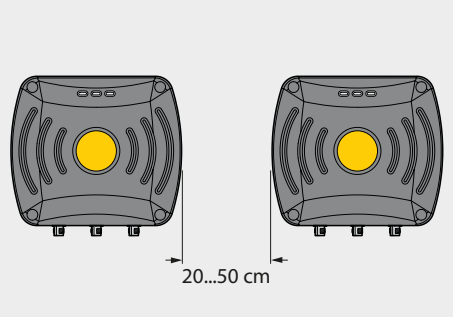
The following important points should be taken into account during design and installation:

- Minimum / maximum distance between read/write heads
- Minimum distance of read/write heads to conductive materials
- Minimum distance between two adjacent data carriers
- Interaction when using several read/write heads
- Behavior of electromagnetic waves in the UHF range
- Parameter assignment of the read/write heads, such as setting the transmission output, operating frequency and RF transmission parameters via the DTM or the RDemo and WebConfig software tools

4.1.1 Minimum / maximum distance between read/write heads

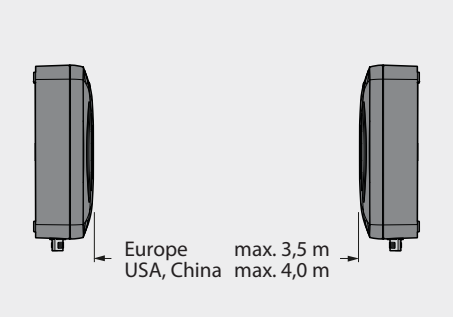
The distance between two read/write heads mounted next to each other depends on the transmission output, i.e. the lower the transmission output, the smaller the minimum distance possible. At least 20 cm should be selected as a guide value, and a distance of 50 cm or greater is recommended.

Figure 11: Minimum distance between two read/write heads mounted next to each other



With a portal configuration, the maximum distance between two read/write heads is 3.5 m.

Figure 12: Maximum distance for portal configuration



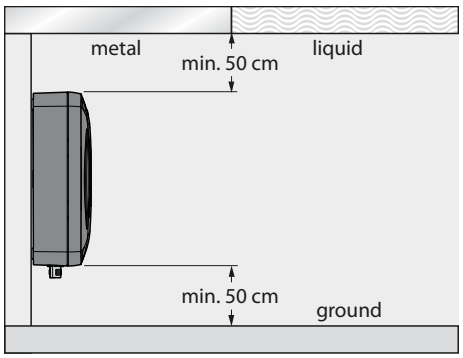
4.1.2 Minimum distance of read/write heads to conductive materials

A minimum distance of the read/write heads to conductive materials should be observed due to the detuning of the read/write heads through a conductive environment.

The following minimum distances must be observed when mounting read/write heads:

- A minimum distance of 50 cm must be observed between a read/write head and liquids or metals.
- The distance between the read/write head and the ground must also be at least 50 cm.

Figure 13: Minimum distances for mounting read/write heads



Note

The effect of interference produced by conductive material in the environment on the radio field of the read/write head, and which may cause detuning, can be compensated using the two RDemo and WebConfig software tools.
The read/write head should first of all be tuned with the RDemo software tool via the Antenna tuning function so that the effect of interference on its performance is sufficiently suppressed.
If this does not produce the desired result, you should try to compensate the detuning in the next step by using the Auto tuning function which can be activated in the WebConfig software tool after a specific firmware of the read/write head (see the following "Table 14: Firmware versions for read/write heads that support "Autotuning""). This function enables the cyclical, automatic tuning of the radio field in response to the effects of ambient interference; this reduces the operating range of the radio field.

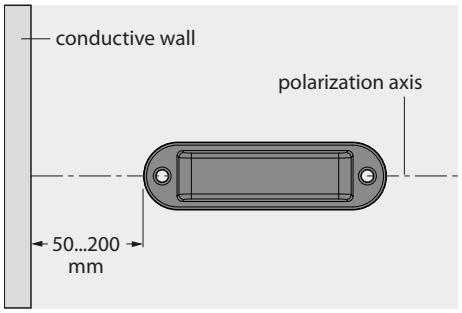
Table 14: Firmware versions for read/write heads that support "Autotuning"

Read/write head	from firmware version
TN…-Q240 L280-H1147	1.33
TN…-Q175 L200-H1147	1.39
TN…-Q120L130-H1147	1.39

4.1.3 Minimum distance of data carriers to conductive walls

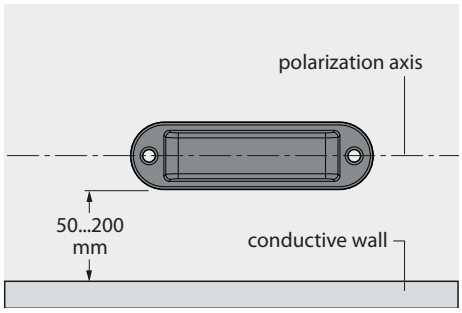
A distance of 20...200 mm is recommended if conductive walls and obstacles are present in the environment that shadow the radio field. The effect of walls is minimized in all cases if the polarization axis is orthogonal to the wall.

Figure 14: Minimum distances of data carriers to a conductive wall, polarization axis orthogonal



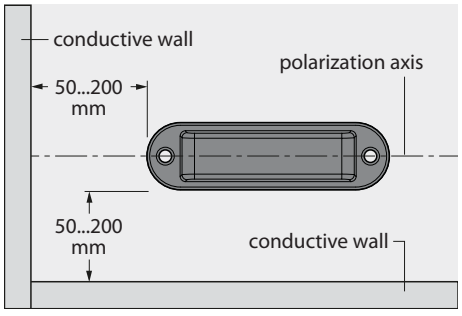
A minimum distance to a conductive wall must be observed for the data carriers. This is 50…200 mm parallel to the polarization axis.

Figure 15: Minimum distances of data carriers to a conductive wall, polarization axis parallel



A minimum distance to two conductive walls must be observed for the data carriers. This is 50…200 mm parallel and vertical to the polarization axis.

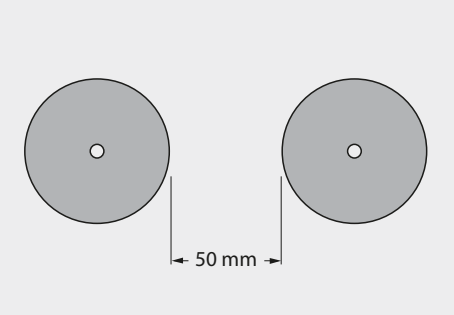
Figure 16: Minimum distance of data carriers to two conductive walls



4.1.4 Minimum distance between data carriers

A minimum distance of 50 mm must be observed between data carriers.

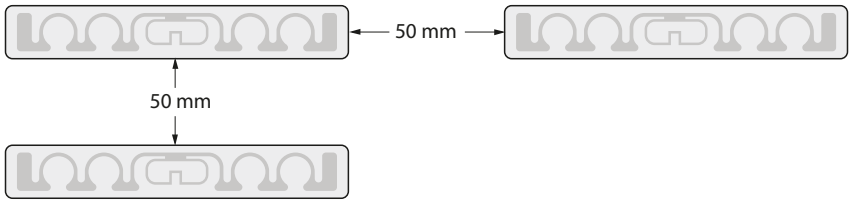
Figure 17: Minimum distances between data carriers



4.1.5 Minimum distance of smart label data carriers between each other

A minimum distance of 50 mm must be observed between smart labels.

Figure 18: Minimum distances between data carriers (smart labels)



4.1.6 Interaction when using several read/write heads

If several RFID read/write heads are in operation, there is a danger that RFID data carriers are also read by other read/write heads. It must therefore be ensured that the data carrier is only read by the appropriate read/write head.

Technical malfunctions between read/write heads will particularly occur if the read/write heads transmit on the same channel (on the same frequency).

There are different methods to prevent this with *BL ident*®. For example, TURCK read/write heads in Europe use “adaptive frequency agility” (ETSI 302 208 V1.2), and in China, Korea and the USA, the frequency hopping procedure (FCC Rules Part 15).

Adaptive frequency agility

In order to exclude signal collision, the read/write head using adaptive frequency agility checks before transmitting whether the four receive channels adjacent to the transmit channel concerned (two above and two below the transmit channel) are free. The read/write head only transmits if the adjacent channels are free. The read/write head must transmit up to four seconds on the channel and must then either make a pause of at least 100 milliseconds or jump to a free channel and transmit on this channel for four seconds.

Frequency hopping procedure

With the frequency hopping procedure used in the USA and China, the read/write head changes its transmit channel in a random or programmed sequence (FHSS – frequency hopping spread spectrum). With 50 channels (USA) and 16 channels (China) available, there is a low probability that two read/write heads are operating on the same frequency.

Other ways of preventing the interaction between read/write heads are:

- Observe the necessary minimum antenna distances according to their alignment
  The necessary minimum distance between the read/write heads using the same frequency depends on the set effective radiant power and the alignment of the antenna.

Figure 19: Antenna alignment

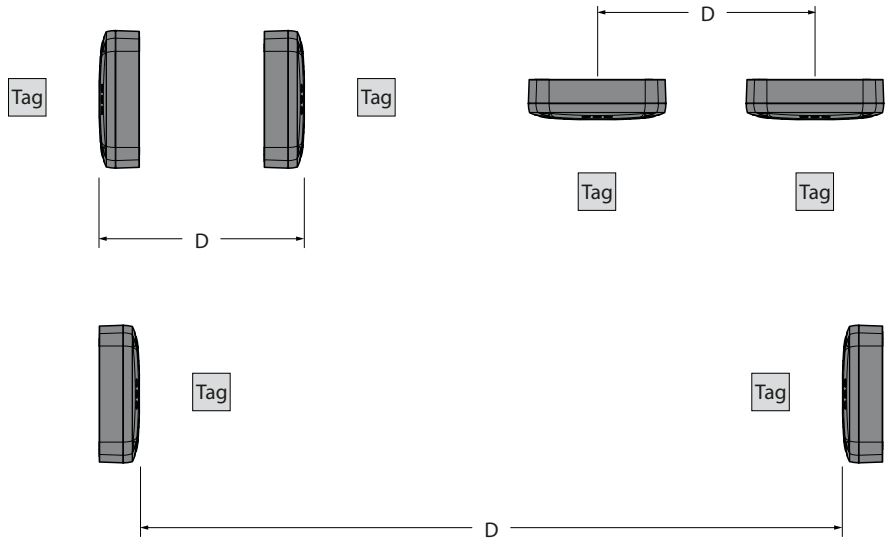


Table 15: Antenna distances with the same frequency

Antenna alignment see "Figure 19:"	**Required minimum antenna distance = D for TN...-Q240 L280-H1147 with ERP = 2 W**	**Required minimum antenna distance = D for TN...-Q175 L200-H1147 with ERP = 1 W**	**Required minimum antenna distance = D for TN...-Q120L130-H1147 with ERP = 0.5 W**
Back to back arrangement	1 m	0.5 m	0.25 m
Side by side	2 m	1 m	0.5 m
Antenna facing each other	5 m	2.5 m	1.25 m

Note
The stated values do not take into account the effect on the data carriers.

- Use Dense Reader Mode (DRM) for applications in Europe
  The special DRM = Dense Reader Mode for *BL ident*® read/write heads enables several read/write heads in close proximity and using one and the same frequency to operate fault-free.
  In accordance with EPC Global and ETSI EN 302 208 V1.2.1, transmission is implemented on the four transmit channels and the data carrier response appears on the associated adjacent channels. Due to the large difference in signal levels between the transmit channels and the data carrier response channels, this technique offers significant benefits when frequencies are reused. However, this requires the observance of minimum distances and thus a minimum decoupling between the antennas of adjacent read/write heads.

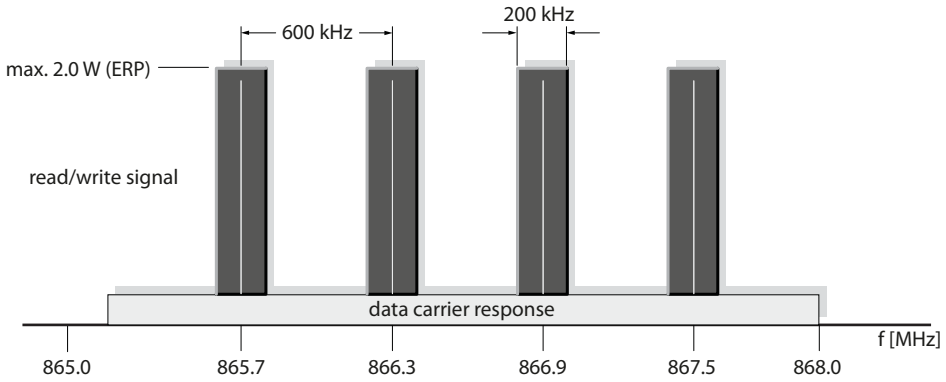
Note

When the read/write heads are used in Europe, the use of DRM filters is advantageous if several read/write heads are operated in a narrow space.
These DRM filters can be switched on manually in the WebConfig software in the Link profiles menu.

- Synchronize read/write heads using a higher-level controller
  In order to minimize the interference between read/write heads, their mode should be as synchronized as possible, e.g. via a central controller (PLC), or the TDMA procedure should be used for the transmission.
  If possible there should always only be one read/write head active for read or write modes and its activation time should be at a minimum.
- Trigger read/write heads
  In order to minimize the operating time of the radio field to the time required for communication with the data carrier, the read/write heads should if possible only be triggered on, for example, by means of an additional switch sensor that only activates the radio field if the data carriers are in the sensing range of the read/write head.
- Create a channel assignment plan
  TURCK recommends the creation of a channel assignment plan for RFID applications in Europe. For this the read/write heads using the same channel in a spatial environment (e.g. machine hall) should be located as far apart from each other as possible
  (see “Table 15:”).

The following frequency ranges with the associated channels are used in Europe, Korea, the USA or China:

Figure 20: Frequency ranges in Europe



Note

For applications in Europe, the read/write heads should be assigned to and use equally the four channels provided, i.e. when using, for example, 5 read/write heads, not all of them should run on channel 4 whilst channels 7, 10 and 13 remain free.

Figure 21: Frequency ranges in Korea, Frequency hopping procedure

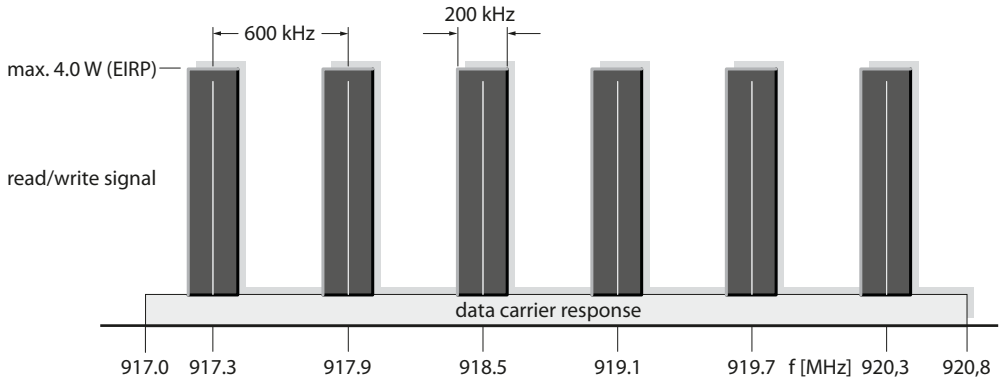


Figure 22: Frequency ranges in the USA, frequency hopping procedure

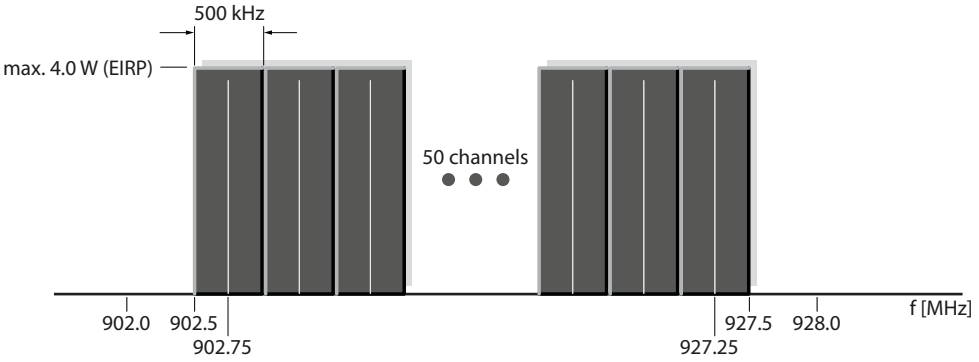
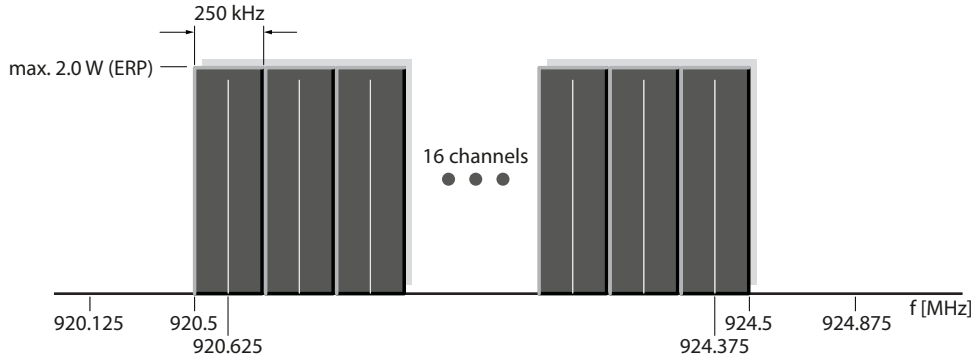


Figure 23: Frequency ranges in China, Frequency hopping procedure



- Set the transmission output and possibly other read/write head parameters
  In order to reduce the mutual interference between components in the application, a practical transmission output setting and if necessary other read/write head parameters should be ensured, for example, via the DTM or the RDemo and WebConfig software tools.
- Use mechanical shielding
  If necessary, TURCK also recommends the use of mechanical shielding, such as mesh grills as a further measure to reduce interference, such as the faulty and unintended detection of data carriers positioned further away.

4.1.7 Factors influencing the read distance

The read range between the read/write head and the data carrier is influenced by the following factors:

- Transmission output of the read/write head:
  The higher the transmission output, the greater the read distance.
- Size and design of the data carrier:
  The larger the antenna of the data carrier, the greater the energy consumption and therefore the greater the read distance.
- Absorption factor of materials:
  The greater the absorption of the materials in the environment, the smaller the read distance.
- Reflective properties of the environment:
  In a multi-reflective environment (e.g. in rooms with reflective surfaces, machines, concrete walls) the read distance can be considerably higher than in an environment with low reflective properties.Fading is possible!
- Data carrier frequency tuning:
  Data carriers optimized for specific regions such as with the 865…868 MHz frequency band for Europe, normally offer in this region higher read distances than data carriers designed with a broad frequency band such as 860…960 MHz.

4.1.8 Environmental conditions for data carriers

The data carrier must not be placed directly on metal surfaces or on liquid containers. This does not apply to specially designed data carriers which can be mounted directly on metal. The possible read/write distance can nevertheless be reduced!
A minimum distance between the data carriers and conductive material must be ensured due to the physical factors involved. A minimum distance of 5 cm is recommended. However, a greater distance (between 5 and 20 cm) is recommended.

Liquids such as water and aqueous substances, ice, carbon have a higher RF attenuation in the UHF band. The electromagnetic energy is partly reflected and absorbed so that the data carrier must not be mounted directly on containers of liquid.

The mounting of a data carrier on a non-conductive material (plastic, wood) is normally less critical than mounting on material with low conductivity.

Note

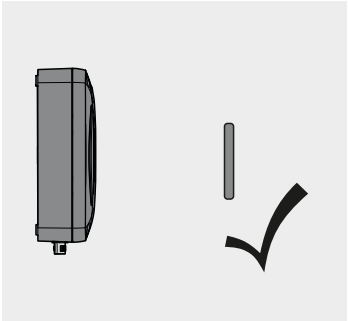
Appropriate range tests in real conditions must be carried out in all cases!

4.1.9 Data carrier orientation in the room

The orientation of the data carrier antenna to the antenna of the read/write head determines the read range.

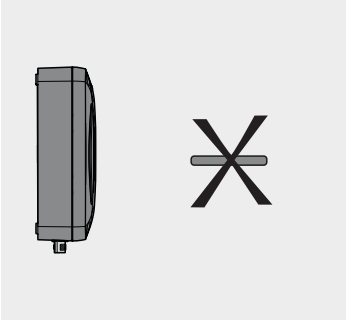
In order to achieve optimum performance and maximum read range, the data carrier antenna must be aligned parallel to the read/write head.

Figure 24: Parallel data carrier alignment



If the data carrier antenna is aligned vertically to the read/write head, this will only result in poor performance and a minimum read range. Vertical alignment should therefore be avoided.

Figure 25: Vertical data carrier alignment



4.2 Behavior of electromagnetic waves in the UHF range

4.2.1 Effect of reflections and interference

Reflections and interference

Electromagnetic waves in the UHF range behave and are propagated in a similar way to light waves, i.e. they are reflected on large objects such as ceilings, floors, walls, windows and interfere with each other. Due to the nature of electromagnetic waves interference may cause wave amplification, which will increase the read range. In unfavorable circumstances, interference may also cause wave cancellation and therefore lead to fading.

Due to these electromagnetic properties in a multi-reflective environment as they occur in the actual environment onsite, it is difficult to determine in advance the propagation paths and field strength for a particular location.

Note

Appropriate range tests in real conditions must be carried out in all cases!

Reducing the effect of reflections/interference on data carrier detection

Reduce transmission output:

- In order keep interference to a minimum, we recommend reducing the transmission output of the read/write head so that it is sufficient for a detection rate of 100 %.

Synchronize read/write heads through a higher-level controller:

- The operation of the read/write heads between each other should be synchronized as much as possible, for example using a central PLC, in order to minimize the interference between them.

4.2.2 Effect of liquids and non-metallic substances

Non-metallic substances can also affect the propagation of electromagnetic waves. If non-metallic substances/bodies that absorb UHF radiation are present in the propagation field, this can change the field or cause the cancellation of the field depending on the size and distance involved.

- Liquids and aqueous substances, ice, carbon have a higher RF attenuation in the UHF band. The electromagnetic energy is partly reflected and absorbed.
- Oil and petroleum-based liquids have low attenuation properties.
  Electromagnetic waves penetrate these liquids and are only slightly attenuated.

4.2.3 Effect of third party components

The R&TTE directive and the relevant standards stipulate the requirements for electromagnetic compatibility. This includes third party components of the *BL ident*® system. Although the requirements for electromagnetic compatibility are defined, different components nevertheless produce mutual interference.

The performance of the *BL ident*® system very much depends on the electromagnetic environment of the read/write heads.

Reflections and interference

Electromagnetic fields of the read/write head are weakened by absorbing materials and reflected by conductive materials. If electromagnetic fields are reflected, the reflecting fields and the fields of the read/write heads produce overlays (interference).

Third party components in the same frequency band

Third party components may possibly transmit in the same frequency band as the read/write head. Alternatively, the third party components may transmit in other frequency bands with side bands that overlap the frequency bands of the read/write head. This may cause a decrease in the signal-to-interference ratio, thus reducing the performance of a *BL ident*® system.

5 Startup with the RDemo and WebConfig software tools

5.1 Testing, parameter assignment and configuration of the read/write heads

The RDemo and WebConfig software application enables the read/write heads to be fully tested, parameterized and configured via a PC.

These software tools are only designed for users wishing to make additional settings to the read/write heads other than the parameter options of *BL ident®*.

The following additional components are required to use these RDemo and WebConfig software applications with the UHF read/write head:

- the TURCK interface converter STW-RS485-USB (Ident no. 7030354)
- the TURCK power supply unit STW-RS485-USB-PS (Ident no. 7030355)
- a PC or a laptop
- a standard USB connection cable with a type A connector variant at one end and a type B connector at the other
- a single-ended TURCK standard sensor cable or *BL ident®* cable such as RK4.5T-2/S2500, RK4.5T-2/S2501 or RK4.5T-2/S2503

5.1.1 Testing with RDemo

The RDemo software application enables you to also test the UHF RFID read/write heads without integration into the BL20/BL67 system.

The software also offers the following options:

- Reading and writing of data carriers
- Display of data carrier user data (also graphically)
- Show the communication between the PC and the read/write heads
- Record the communication between the PC and the read/write head
- Transfer customer-specific commands
- Transfer data with multiple access
- Transfer data carrier-specific commands

5.1.2 Parameter assignment and configuration with WebConfig

The WebConfig software application enables the extensive parameterization and configuration of the read/write heads.

The various setting options in WebConfig for the *BL ident*® read/write heads include the following:

- (Event handling) event handling with regard to LEDs/buzzers/messages
- (Gen2 Selection and truncate) Selection of data carriers and the setting of a status. The selection is made by filtering data carriers with a specific data sequence in one of the memory banks
- (Data matching) Filtering of the data of the data carrier by means of its UII
- (Access) Setting the access to data carriers, e.g. with multiple access
- (Frequency setup/channel mask) Used transmission frequency/channel assignment
- (Inventory profiles) Selection of parameters for multiple access to the data carriers
- (Link profiles) Selection of parameters in the wireless transmission protocol (see also "Interaction when using several read/write heads" page 49)
- (Post read filter) Filtering of data carrier read operations

6 EMC Guidelines

6.1 Target group

These EMC guidelines are aimed at:

- Design engineers and planners involved in the planning the installation with the RFID modules to be configured.
- Fitters, service technicians and engineers using this description to ensure the proper installation of the connection cables or having to rectify faults if interference is present.

This chapter provides more information about the EMC guidelines, particularly:

- Propagation of electromagnetic interference
- Definition of EMC
- Basic rules for ensuring EMC,
- Installation in a control cabinet,
- Preventing interference sources,
- Equipotential bonding,
- Shielding the cables.

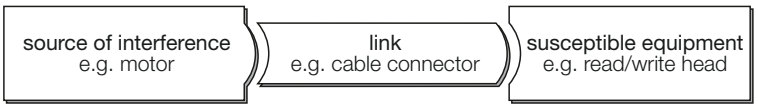
6.2 Propagation of electromagnetic interference

Electromagnetic interference can only occur in an installation if the following elements are present:

- Interference source,
- Coupling path,
- Interference sink.

Interference cannot occur if one of these elements is missing (such as the coupling path), even if the interference source has strong interference emissions ("Figure 26: Interference components"):

Figure 26: Interference components



The measures to prevent interference (EMC measures) are applied to all three elements.
When designing an installation, the manufacturer must take all possible measures to counteract the occurrence of interference sources.

The installation must also be implemented in such a way that the mutual interference of the individual elements is prevented or is kept as low as possible.

6.3 RFID interference

- Problem: Radiated interference via the current supply through the use of power supply units.
  Remedy: Use a stabilized power supply unit.
- Problem: Interference via the serial connection cable.
  Remedy: Improved cable shielding and/or grounding of the read/write head.
- Problem: HF interference via the antenna through another RFID read/write head.
  Remedy:
  Position the antennas further apart from each other or change the alignment of antennas to each other.
  Install suitable damping materials between the antennas.
  Reduce the power of the read/write heads.
- Problem: HF interference via the antenna through a different wireless system that is transmitting in the same frequency band.
  Remedy: For example a change of channel can provide a remedy, depending national radio regulations.

Coupling paths

There are four types of interference coupling:

- Galvanic coupling,
- Capacitive coupling,
- Inductive coupling,
- Radiative coupling.

This interference coupling has different causes:

On cables and lines:

- Incorrect our unfavorable cable routing,
- Missing or incorrectly connected shield,
- Spatially unfavorable cable arrangement.

With control cabinets or housings:

- Missing or incorrectly wired equipotential bonding,
- Missing or incorrect grounding,
- Spatially unfavorable arrangement,
- Insecurely mounted modules,
- Unfavorable control cabinet layout.

6.4 EMC – Definition

The electronic elements of an installation are increasingly exposed to interference due to the increasing density of installed components, the increasing amount of power electronics connected and the faster switching speeds involved. The is always subject to the following principle: The higher the degree of automation, the greater the risk of mutual interference.

Definition of EMC:

“By electromagnetic compatibility (EMC) is meant 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.”

As the RFID modules are only components within an overall system and may produce new interference sources through the combination of various components, the design of an installation must comply with specific regulations.

The interference immunity of an installation requires the implementation of a complete package of measures; in this case, the operator is responsible for the RFI suppression of the entire installation. This person must also observe the relevant national specifications and regulations. All measures that are implemented when the system is installed will save expensive modifications and fault rectification measures made later.

6.5 Basic rules for ensuring EMC

Observe the following basic rules to ensure electromagnetic (EMC):

- **Shielding through housing**
  Protect the device from external interference by installing it in a cabinet or housing. The cabinet or the housing must be integrated in the chassis ground.
  Shield electromagnetic fields of inductive loads from the device using partition plates. Use metal connector housings for shielded data transmission cables.
- **Large-area ground connection**
  Connect all passive metal parts to the chassis ground using an HF low impedance connection across a large area. Establish a large-area connection between the passive metal parts and the central grounding point.
  Incorporate the shield ground in the chassis grounding system, i.e. the shield ground must be connected to chassis ground with a large-area connection.
- **Planning the cable installation**
  Break the cabling down into cable groups and install these separately.
  Always route power cables and data cables in separate ducts or in separate bundles.
  Feed the cabling into the cabinet from one side only and, if possible, on one level only.
  Route the data cables as close as possible to chassis surfaces.
  Twist the feed and return conductors of separately installed cables.
  In many cases, a separate cable duct for the bus cable is provided anyway. Ideally this should likewise be used for laying the data cables between the read/write heads and the interface modules.
- **Shielding the cables**
  Shield the data transmission 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 entry and fasten with a low impedance contact using clamps.
  Feed the connected shield through to the module without interruption.
  Use braided shields, not foil shields.
- **Line and signal filters**
  Use only line filters with metal housings.
  Connect the filter housing to the cabinet chassis using a HF low impedance large-area connection.
  Never fix the filter housing to painted surfaces.
  Fix the filter at the control cabinet entry or in the direction of the interference source.

6.5.1 Installation in a control cabinet

Magnetic and electrical fields and electromagnetic waves can be kept away from the interference sink by using a metal housing. The easier the induced interference current can flow, the greater the intrinsic weakening of the interference field. All housings and metal panels in the cabinet should therefore be connected with a low impedance connection.

If the control cabinet panels are insulated from each other, an HF low impedance connection can be established using ribbon cables and HF terminals or HF paste (the larger the area of the connection, the better).

Interference can also be prevented through optimum control cabinet design.
In this case the following applies as a general rule:

- The effect of the interference decreases as the distance between the interference source and interference sink increases,
- The interference can be further decreased by installing shielding plates,
- Signal cables should have a minimum clearance from power cables or load cables of 10 cm.

Interference from the power supply should be prevented through the installation of line filters. Ensure that the line filter is correctly rated and is mounted directly at the cabinet entry.

6.5.2 Preventing interference sources

Prevent the installation of interference sources that particularly occur with switched inductances.

Relays, contactors, fluorescent lights in the control cabinet and valves are particular sources of interference, which can be prevented through the use of RC circuits, free-wheeling diodes etc. This also prevents stray interference on conductors installed parallel to the coil conductors.

6.5.3 Equipotential bonding

Potential differences between different parts of a plant can arise due to the different design of the plant sections and different voltage levels. Equalizing currents then flow across the signal cables (the equipotential bonding must not be confused with the protective ground conductor).

Proper equipotential bonding is therefore essential.
The following points must be observed:

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

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

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

6.5.4 Shielding the cables

Signal cables must be shielded in order to prevent the coupling of interference. The best shielding is achieved by installing the cables in steel tubes. However, the use of cables with braided shields is normally enough. In either case, however, correct connection is vital for effective shielding, since an unconnected or incorrectly connected shield has no shielding effect.

The following always applies:

- Since interference signals are frequently within a range > 10 kHz, a large-area shield connection is necessary,
- The shielding bus should be connected to the control cabinet housing using a low impedance connection across a large area and must be situated as close as possible to the cable entry. The cable insulation must be removed and the cables clamped to the shielding bus with an HF clamp or secured using cable ties,
- The shielding bus must be connected to the PE rail
- If shielded cables have to be interrupted, the shield must be continued via the connector housings of suitable male connectors,
- If intermediate connectors are used, which do not have a suitable shield connection, the shield must be continued by fixing cable clamps at the point of interruption.

7 *BL ident*® – Data carriers for the UHF band

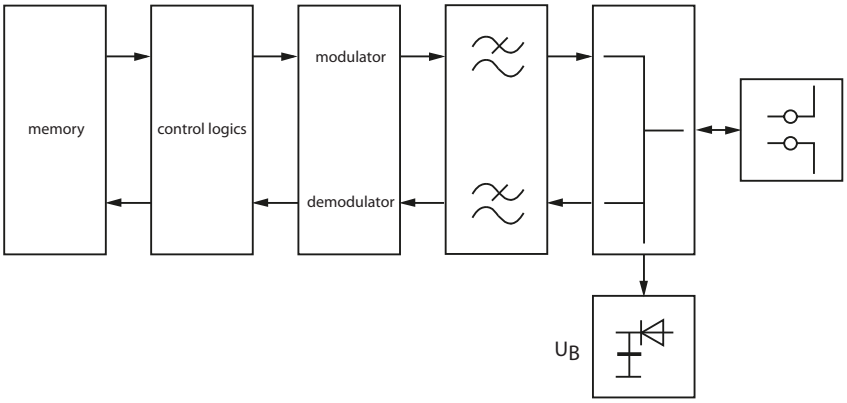
7.1 Function

The *BL ident*® data carriers are suitable for non-contact read and write operations with the appropriate read/write heads. The operating frequency in the UHF band is between 865 MHz and 928 MHz, depending on the region where the system is to be used.

Different transmission distances are possible, depending on the dimensions of the data carrier and therefore the dimensions of its dipole antenna. The following applies as a general rule: The smaller the data carrier and therefore also the antenna, the shorter the distance.

The mounting forms are available as EEPROM memory variants. The *BL ident*® data carrier essentially consists of a microchip with an integrated memory and dipole antenna. ("Figure 27: Block diagram of a data carrier").

Figure 27: Block diagram of a data carrier



7.1.1 Memory module

The information on the data carrier can be read – however it is also possible to add new data (read/write). The size of the memory varies according to type and is in all between 28 bytes and 138 bytes.

The memory module consists of the following components:

- EEPROM: Unlimited reading but limited write cycles (10^5) possible. No battery required.

The data retention time of the memory is:

- 1 year at 85 °C
- 10 years at 55 °C
- 120 years at 25 °C

Electrical fields cannot erase the memory as their field strength is normally too low and these fields do not resonate due to the frequency tuning.

7.1.2 Data carrier antenna

UHF data carriers normally have similar reception characteristics to a dipole antenna with a linear polarization. Depending on how the data carrier is fitted, horizontal, vertical or mixed polarization is used.

7.2 Type overview of the data carriers

The RFID operating frequencies in the UHF band are subject to national specifications, for example 865...868 MHz in Europe and 902...928 MHz in the USA. TURCK offers different data carrier variants that are specially designed and optimized for national frequency bands in order to achieve as large a transmission range as possible. Wide-band multi-range data carriers for international use are also available as an alternative.

Besides the frequency ranges, the selection criteria for the data carrier depend on the application at hand. Data carriers for the direct mounting on metal, for attaching with a metal loop, as well as smart labels and high temperature versions are therefore available in addition to the standard mounting forms. Customized data carrier solutions that are tailored to the relevant application are also available on request.

Table 16: Type overview of the data carriers

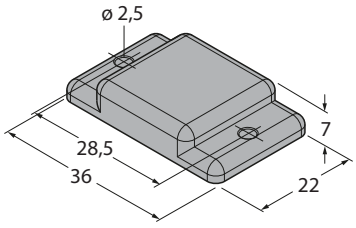
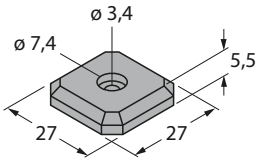
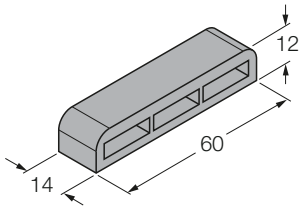
Dimensions/housing length	Memory size [Byte]	Memory	Operating temperature [° C]	Special features	Type designation
	112	EEPROM	-40...+85	Designed exclusively for direct mounting on metal, high temperature	**TW865-868-Q22L36-M-HT-B112**
	112	EEPROM	-20...+80	Designed exclusively for direct mounting on metal,	**TW865-868-Q27-M-B112** **TW902-928-Q27-M-B112**
	110	EEPROM	-35...+85	Suitable for direct mounting on metal	**TW865-868-Q14L60-M-B110** **TW902-928-Q14L60-M-B110**

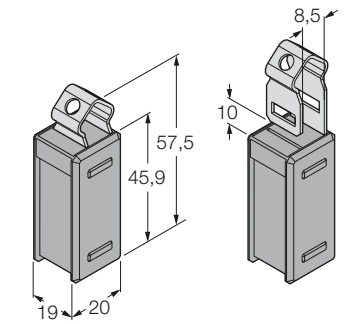
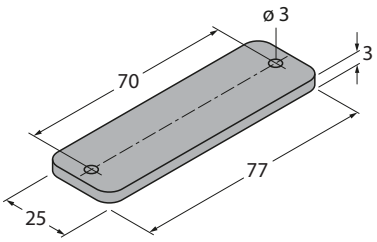
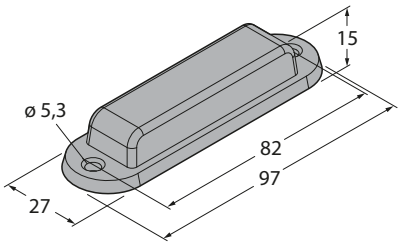
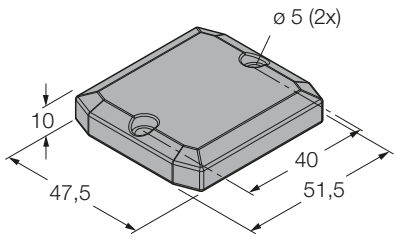
Table 16: (cont.) Type overview of the data carriers	**Dimensions/housing length**	**Memory size [Byte]**	**Memory**	**Operating temperature [° C]**	**Special features**	**Type designation**
		110	EEPROM	-30...+70	Clip with metal loop for fixing Customized labeling	**TW865-928-Q20L58-B110**
		112	EEPROM	-40...+70	Flexible mounting form, for fixing on bent or irregular surfaces	**TW860-960-Q25L77-B-B112**
		112	EEPROM	-40...+80	suitable for direct mounting on metal, suitable for outdoor applications	**TW860-960-Q27L97-M-B112**
		110	EEPROM	-40...+85	Designed exclusively for direct mounting on metal	**TW865-868-Q47L51-M-B110** **TW902-928-Q47L51-M-B110**

Table 16: (cont.) Type overview of the data carriers

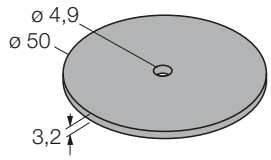
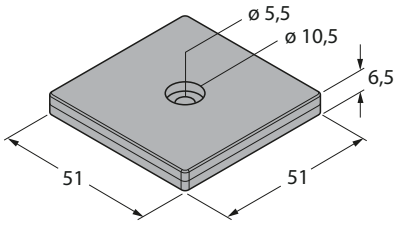
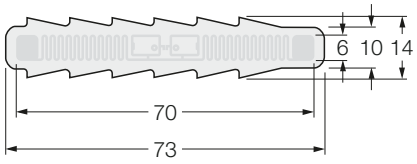
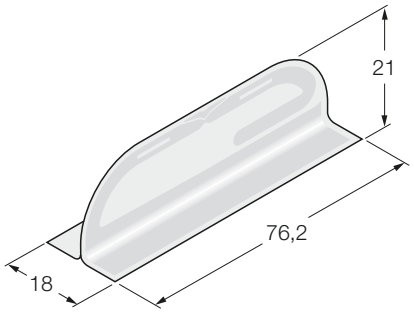
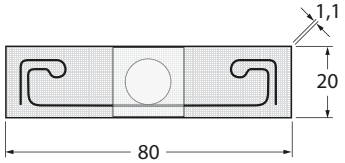
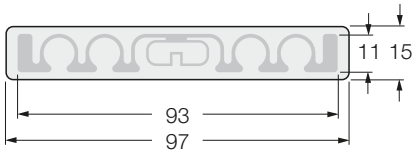
Dimensions/housing length	Memory size [Byte]	Memory	Operating temperature [° C]	Special features	Type designation
	110	EEPROM	-20...+85	Ø 50 mm with central hole	**TW865-868-R50-B110** **TW902-928-R50-B110**
	110	EEPROM	-25…+85	High temperature	**TW865-868-Q51-HT-B110**
	110	EEPROM	-35...+60	can be inserted in drill holes with Ø 13 mm, e.g. wood	**TW860-960-L73-14-C-B110**
	110	EEPROM	-35...+85	self-adhesive, suitable for direct mounting on metal	**TW865-928-L76-18-21-F-M-B110**
	44	EEPROM	-20...+65	Smart label	**TW865-868-L80-20-T-B44**

Table 16: (cont.) Type overview of the data carriers	**Dimensions/housing length**	**Memory size [Byte]**	**Memory**	**Operating temperature [° C]**	**Special features**	**Type designation**
		44	EEPROM	-10…+85	Smart label	**TW860-960-L97-15-F-B44**

8 *BL ident*® read/write heads for the UHF band

8.1 Function

The *BL ident*® read/write heads (transceivers) are used for non-contact data exchange with the appropriate data carriers (tags). The UHF read/write heads form a transmission zone for which the size depends on the combination of read/write head, data carrier and the relevant ambient conditions. The maximum read/write distances only represent typical values under laboratory conditions without the effect of materials.

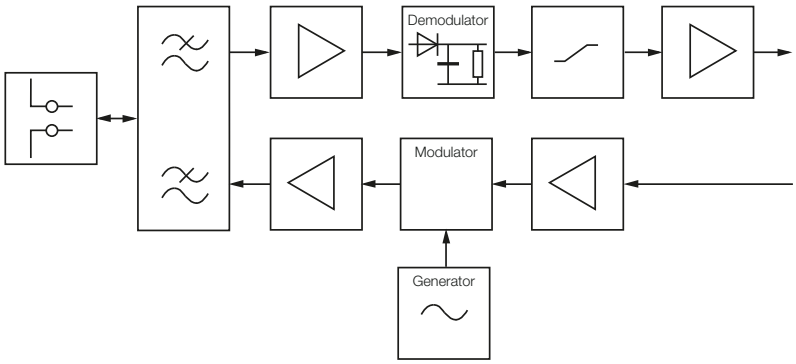
The achievable distances may be different due to component tolerances, mounting location in the application, ambient conditions and the effect of materials (particularly metal and liquids).

Note

For this reason, the application must be tested (particularly with read and write operations in motion) under real conditions!

The operating frequency in the UHF band is between 865 MHz and 928 MHz, depending on the region where the system is to be used.
The read/write head consists of an electronic unit and an antenna. ("Figure 28: Block diagram of a read/write head")

Figure 28: Block diagram of a read/write head



8.1.1 Read/write head antenna

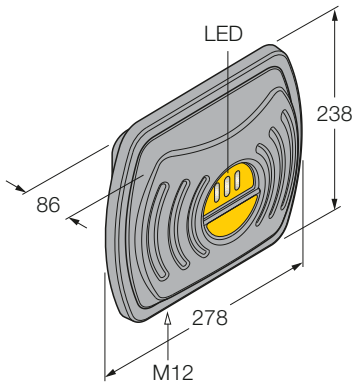
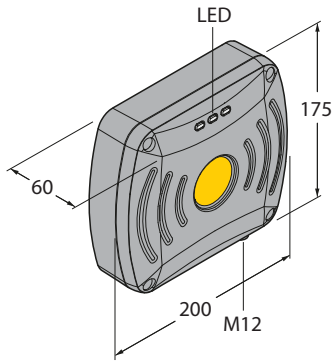
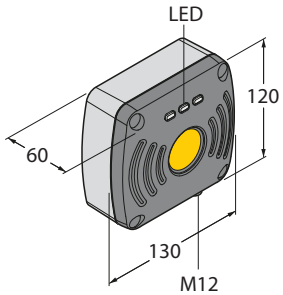
The antenna is a radiating element with different designs and properties depending on type. It is used for transferring data between the data carrier and the read/write head. If the alignment of the data carriers is unknown, or an alternating alignment is expected, the antenna should have a circular polarization.

Circular polarization is either left-hand or right-hand circular polarization (LHCP and RHCP).

When using read/write head antennas with linear polarization, ensure that the antenna and the data carrier have identical polarization (e.g. vertical or horizontal).
Due to the operating principle, no special requirements need be observed to suppress the orthogonal components (cross-polarization).

The antenna polarization of the TN…-Q240L280-H1147 read/write head can also be preselected via the WebConfig software tool. Depending on the application, it is therefore possible to set polarization to LHCP, RHCP, vertical and horizontal during the startup.

8.2 Type overview of the read/write heads

Table 17: Type overview of read/write heads	**Dimensions/housing length**	**Mounting require-ments**	**Special features**	**Connection**	**Type designation**
		not flush	Polarization selectable, linear/circular	via *BL ident*® cable	**TN865-Q240L280-H1147** **TN902-Q240L280-H1147** **TN840/920-Q240L280-H1147** **TN902/915-Q240L280-H1147**
		not flush	Compact mounting form, IP67	via *BL ident*® cable	**TN865-Q175L200-H1147** **TN902-Q175L200-H1147** **TN840/920-Q175L200-H1147** **TN917-Q175L200-H1147**
		not flush	Very compact mounting form, IP67	via *BL ident*® cable	**TN865-Q120L130-H1147** **TN902-Q120L130-H1147** **TN840/920-Q120L130-H1147** **TN917-Q120L130-H1147**

8.3 Connecting the read/write heads

The read/write heads are connected with the *BL ident*® RFID electronic module via M12 × 1 male connectors. The power supply (24 VDC) and function are implemented with the *BL ident*® RFID electronic module.

Caution

Possible device damage with BL20 due to incorrect connection of the power supply to the *BL ident*® RFID electronic module
The power supply of the read/write heads must not be connected via the BL20 base modules because the current via the RFID I/O modules is not sufficient.
While the wiring of the data cables is implemented via the base modules, the power supply must be implemented directly via the .../S2500, .../S2501 and .../S2503 supply cables!

Note

Only read/write heads with a sticker on the back (as shown in figures 22 to 24) can be used on the devices with the TURCK systems BL20, BL67 and BLcompact).
Refer to the enclosed packing slips for further information on connecting.

The .../S2500 cables have the wiring diagram shown in ("Figure 29: Wiring diagram for .../S2500 cables").

Figure 29: Wiring diagram for .../S2500 cables

The .../S2501 cables have the following wiring diagram ("Figure 30: Wiring diagram for .../S2501 cables").

Figure 30: Wiring diagram for .../S2501 cables

The .../S2503 cables have the following wiring diagram ("Figure 31: Wiring diagram for .../S2503 cables").

Figure 31: Wiring diagram for .../S2503 cables

8.3.1 Connecting the grounding terminal

Depending on the device type, the grounding terminal is pre-assembled on the read/write head or is supplied with the device.

When installing the read/write head on the tab connector ensure that the supplied cable lug is connected and properly grounded via a yellow/green cable with a cross section of at least 0.75 mm^2.

8.4 LED functions of the read/write heads

The arrangement of the three LEDs on the front of the device varies depending on the type of read/write head (arrangement from left to right):
TN…-Q120/Q175: LED 1 = green, LED 2 = yellow, LED 3 = red
TN…-Q240: LED 1 = yellow, LED 2 = green, LED 3 = red

The functions of the LEDs are as follows:

Table 18: LED functions

LED 1	LED 2	LED 3	Function
OFF	OFF	OFF	Operating voltage switched off
White	White	White	Startup
Green	OFF	OFF	Operating voltage switched on, radio field switched off, no internal error
Green	yellow	OFF	Operating voltage switched on, radio field switched on, no internal error
Green	yellow	Red	Operating voltage switched on, radio field switched on, internal error
Green	OFF	Red	Operating voltage switched on, radio field switched off, internal error
Green flashing	OFF	OFF	Data carrier access successful
Green	yellow flashing		Data carrier located in the radio field

Note
The individual LEDs are white on startup.

8.5 Wall mounting of the TN...-Q240L280-H1147 read/write head with the RH-Q240L280/Q280L640 arm bracket available as an accessory

For wall or ceiling mountings, the arm bracket can be fitted directly to the mounting plate of the read/write head. The bracket enables the read/write head to be positioned in many directions. The two fixing ends of this element are connected to a rotatable arm via ball-joints. The hexagon key supplied is used to fix the bracket in the desired position.

Figure 32:
Wall bracket

8.6 Mast/tube mounting of the TN...-Q240L280-H1147 read/write head with supplied bracket

The rear of the read/write head is designed for mounting on masts/tubes using the supplied fixing. In order to mount the read/write head on masts/tubes, the rear of the device is designed so that it is possible to align it around its vertical or horizontal axis. The jagged tube guides on the rear ensure a secure fixing on the tube. This enables a 360° adjustment around the tube and ensures a secure mounting of the read/write head.

Figure 33:
Mast/tube bracket

9 Approvals

9.1 CE approvals (only for the TN865-... read/write head)

Hans Turck GmbH & Co.KGm declares herewith that this RF system in its intended use complies with the basic requirements and the other relevant provisions of the RTTE Directive 1999/5/EC.

A complete declaration of conformity is available on request and is enclosed with every UHF RFID read/write head.

Approval in all European countries.

CE

9.2 FCC digital device limitations (only for read/write head TN902-...)

FCC/IC digital device limitations

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

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.

Note: 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. 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.

This equipment complies with FCC/IC exposure limits set forth for an uncontrolled environment.
This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

CAN ICES-3 (A)/NMB-3(A)

Use only with listed LPS or class 2 power supply!

9.3 ANATEL approval (only for read/write head TN902/915-...)

ANATEL

TN902/915-Q240L280-H1147

Este equipamento opera em caráter secundário, isto é, não tem direito à proteção contra interferéncia prejudicial, mesmo de estações do mesmo tipo e não pode causar interferéncia a sistemas operando em caráter primário.

9.4 SRRC approval (only for read/write head TN840/920-...)

In accordance with the provisions on the radio regulations of the People's Republic of China, the following radio transmission equipment, after examination, conforms to the provisions with its CMIIT-ID:

TN840/920-Q240L280-H1147

TN840/920-Q175L200-H1147

TN840/920-Q120L130-H1147

9.5 KSQ approval (only for read/write head TN917-...)

In accordance with the provisions on the radio regulations of Korea, the following radio transmission equipment, after examination, conforms to the provisions:

TN917-Q175L200-H1147

TN917-Q120L130-H1147

10 Glossary

A

Automation device

A device with inputs and outputs for controlling a connected technical process. Programmable logic controllers (PLCs) are a special group of automation devices.

B

User area

freely available memory area on which user-specific data can be stored.

Bus

Group signal line for data exchange between hardware components (e.g. between CPU, memory and I/O levels). A bus can be composed of a number of parallel cables (addressing, control and power supply) for data transmission.

Bus system

The totality of all units that communicate with one another via a bus.

C

CPU

Acronym for “Central Processing Unit”. Central unit for data processing, the core of a computer.

D

dBm

The power level L_P (L = level, P = power) is defined in dB as follows: dB (decibel) is the unit of the power level L_P that describes the ratio of a power value P_1 in comparison to a reference power value P_0. If the reference value is 1 mW (milliwatt) the measured value is stated in dBm (m = milliwatt).

$L_P = 10 \log(P_1/P_0)$

with $P_0 = 1$ mW => L_P (dBm) = $10 \log(P_1/1 \text{ mW})$

and conversely, if the power is required in mW:

$P_1(\text{mW}) = 10^{(Lp(\text{dBm})/10)}$

Distribution

Distribution comprises all activities related to the transfer of goods between economic entities.

DIN

German acronym for German Industrial Standard.

DP master class 1

The automation system (PLC) which is mainly responsible for the cyclical processing of process data. The “DPV1” functions can be employed additionally / optionally. (also DPM1/DPC1).

DP master class 2

Exclusive transmission of acyclical demand data. This data transmission can be carried out, for example, using an engineering tool (PC application program).

DPV1

Functional extension to PROFIBUS-DP. In addition to the cyclical process data, demand data can be transmitted via acyclical communication functions. The acyclical services are conducted at the same time and in addition to the cyclical process data transmission with lower priority.

E

EEPROM - Electrically Erasable Programmable Read-Only Memory

EEPROM is the name given to a non-volatile, electronic memory module. An EEPROM consists of a field effect transistor matrix with an insulated floating gate, in which each transistor represents a bit.

EMC

Electromagnetic compatibility (EMC) denotes the normally desired state in which technical devices do not cause or suffer undesired electrical or electromagnetic interference to or from other devices in the same environment.

EPC

The electronic product code (EPC) is an international code system for a unique identification number, by which products, stock-keeping units (outer packaging, transport pallets etc.), systems, services, documents, reusable transport containers and locations (e.g. buildings (sections) or warehouse sites) can be uniquely designated and identified. In combination with RFID technology it can be used for the detection and tracing of objects fitted with a transponder with EPC without visual or physical contact.

EPC enables the unique identification of objects by class or type (e.g. a GTIN) and instance (in this case, a serialized GTIN[1]) (e.g. commercial unit, stock-keeping unit or transport container). For this the EPC is stored on a data carrier which is fitted to the object to be identified. An RFID chip in compliance with ISO 18000-6C is normally used as a data carrier to store and transmit the code.

Ground

In electrical engineering, the name given to a conductive area with an electrical potential of zero at any point. The electrical potential of the ground may not equal zero in the area around grounding devices, in which case this is called the “reference ground”.

Grounding

The connection of an electrically conductive component to the ground using a grounding device.

Grounding device

One or several components that have direct and good contact with the ground.

ERP/EIRP

The effective radiated power (ERP) is the product of the power supplied in the transmitting antenna multiplied by the antenna gain (referenced to a half-wave dipole). If no direction is stated, the value applies to the main direction of radiation from the transmitting antenna where its greatest antenna gain is present at the same time. If the antenna gain is referenced to the isotropic antenna, it is called EIRP (Effective Isotropic Radiated Power).

F

Fieldbus

Data network on the sensor/actuator level. A fieldbus connects the devices on the fieldbus level with a control device. A fieldbus offers high transmission security and a real-time behavior.

Frequence hopping

This procedure is designed to prevent mutual interference between read/write heads. For this the read/write head changes its transmitting channel according to a random or programmed sequence (FHSS). With 16 channels that are permitted for simultaneous operation in China and 50 channels in the USA, this reduces the probability that two read/write heads are operating on the same frequency.

G

GSD - General Station Description

(previously device master file) The GSD file describes the characteristics of the devices used in PROFIBUS-DP. The GSD file is a readable text file and is supplied in different languages. Configuration tools require the device information in order to complete the configuration and commissioning. The GSD file normally contains general information (e.g. vendor name and version) and with modular devices the communication features (e.g. module designations, texts for diagnostic messages, parameter options, parameter names) of the individual modules.

H

Hexadecimal

Numerical system with a base of 16. The sequence begins with 0 to 9 and continues with the letters A, B, C, D, E and F.

I

IEC 61131

IEC 61131 is an international standard that covers the basic requirements of programmable controllers.

Initialization

During initialization, the memory space is reserved and filled with initial values (such as variables, code, buffer, ...) required for the execution.

IP - International Protection

The degree of protection (IP) specifies the suitability of electrical equipment (such as devices, installation material) for different environmental conditions in addition to the protection of persons from potential hazards during use.

C

Configuring

Systematic arrangement of the I/O modules of a station.

L

LSB

Least significant bit. Bit with the lowest numerical significance.

Logistics

Logistics is the science of the overall planning, control, implementation, provision, optimization and monitoring of processes for the relocation of goods, data, energy and persons, as well as the necessary methods of transport.

M

Master

In a master-slave process on the fieldbus, the master controls the access relationships.

Mode

Operating mode.

MSB

Most significant bit. Bit with the highest numerical significance.

P

Parameterization

The setting of parameters for the individual bus stations and their modules in the configuration software of the DP master.

PIB

Acronym for Proxy Ident Block. This function block represents an ID system in the controller. This provides a standard program interface to the actual application.

Bulk reading

Simultaneous and unambiguous reading of several RFID data carriers that are led past a read/write head (transceiver).

R

Repeater

In digital communication technology, the repeater is a signal regenerator which receives a signal in the bit transmission layer, reconditions it and sends it on. Noise and distortion during the runtime (jitter) and the pulse shape are removed from the received signal during this conditioning process.

Reserved area

This memory area is used for storing passwords for accessing data carriers

RDemo

Software tool for initiating various transponder actions including read/write operations

RFID

Radio Frequency Identification.

RFID technology

This technology enables a contactless transmission of data by means of an electromagnetic alternating field. This transmission method is also called radio frequency technology. A tag is used as a data carrier.

S

Read/write head

The read/write head (also read/write device) generates an electromagnetic high frequency field. This is used to transfer data and the power supply for the data carriers (transponder). The data is represented by the modulation of the electromagnetic field.

PLC

Acronym for programmable logic controller.

Station

Functional unit or assembly consisting of several elements.

STEP 7

STEP 7 is the latest programming software of the Simatic-S7 PLC series from Siemens AG and is the successor to STEP 5.

T

Tag

RFID tags (data carriers) are small transponders in a housing suitable for the application, e.g. stickers, chip cards, label.

TID

This memory area contains specific data carrier information that was written beforehand by the manufacturer.

TDMA

The Time Division Multiple Access (TDMA) procedure defines specific time slots for the transmission of the responses of different data carriers on a channel. The read/write head defines the number of time slots for the responses of data carriers, for which each data carrier selects a time slot randomly. The read/write head checks the time slots with the respective data carrier responses in succession until the data carrier is detected. If the time slot is exceeded without the corresponding data carrier being detected, the process is repeated until all data carriers in the sensing range are identified.

Transceiver

Combination of **trans**mitter and re**ceiver**.

In RFID technology, transceivers are used in the form of so-called “readers” or read/write heads. These devices first send a signal to which a response is sent from the data carrier (e.g. RFID tag), the so-called transponder. This response is then received by the transceiver and forwarded to a (computer) system for further processing.

Transponder

Combination of **Trans**mitter and Res**ponder**
Transponder. A transponder consists of a microchip (with a unique identification number), a transmission / receiving aerial and a housing. Data is transmitted between a reader device and the transponder via electromagnetic waves.

U

UHF - Ultra High Frequency

UHF RFID is implemented in Europe at 865..868 MHz / USA 902..928 MHz / China 840..845 MHz and 920..925 MHz.

UID

Abbreviation for “Unique Identifier”. A UID is an unambiguous serial number for a transponder. As an address it indicates the data belonging to the transponder i.e. the tagged product. This data can, for example, be stored in a database.

UII

Abbreviation for Unique Item Identifier. Identification number by which a data carrier is identified.

W

WebConfig

Configuration tool for configuring UHF read/write heads.

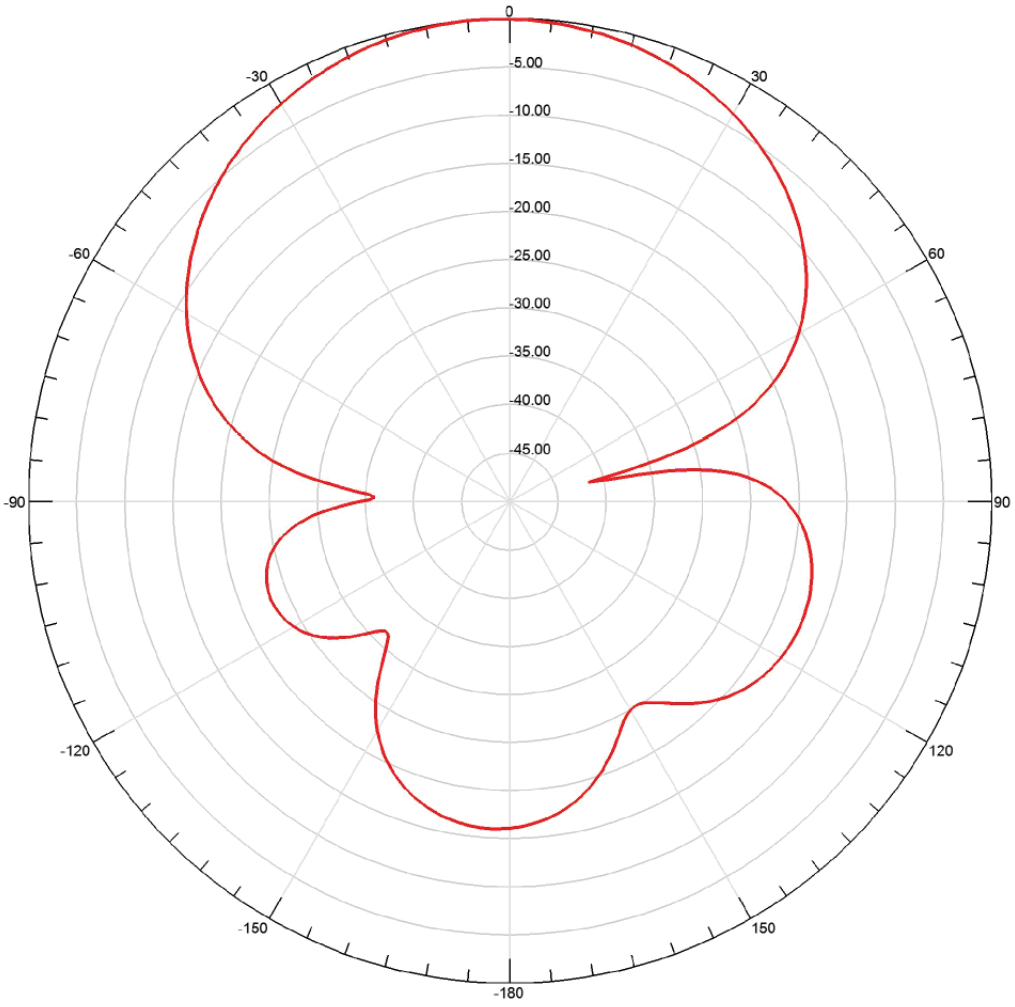
A Appendix

A.1 Directional characteristics of the antenna for the TN...-Q240L280-H1147 read/write head

- 3dB half power beamwidth, horizontal: 70°
- 3dB half power beamwidth, vertical: 70°
- Polarization: circular/linear (adjustable)
- Represented frequency: f = 867 MHz

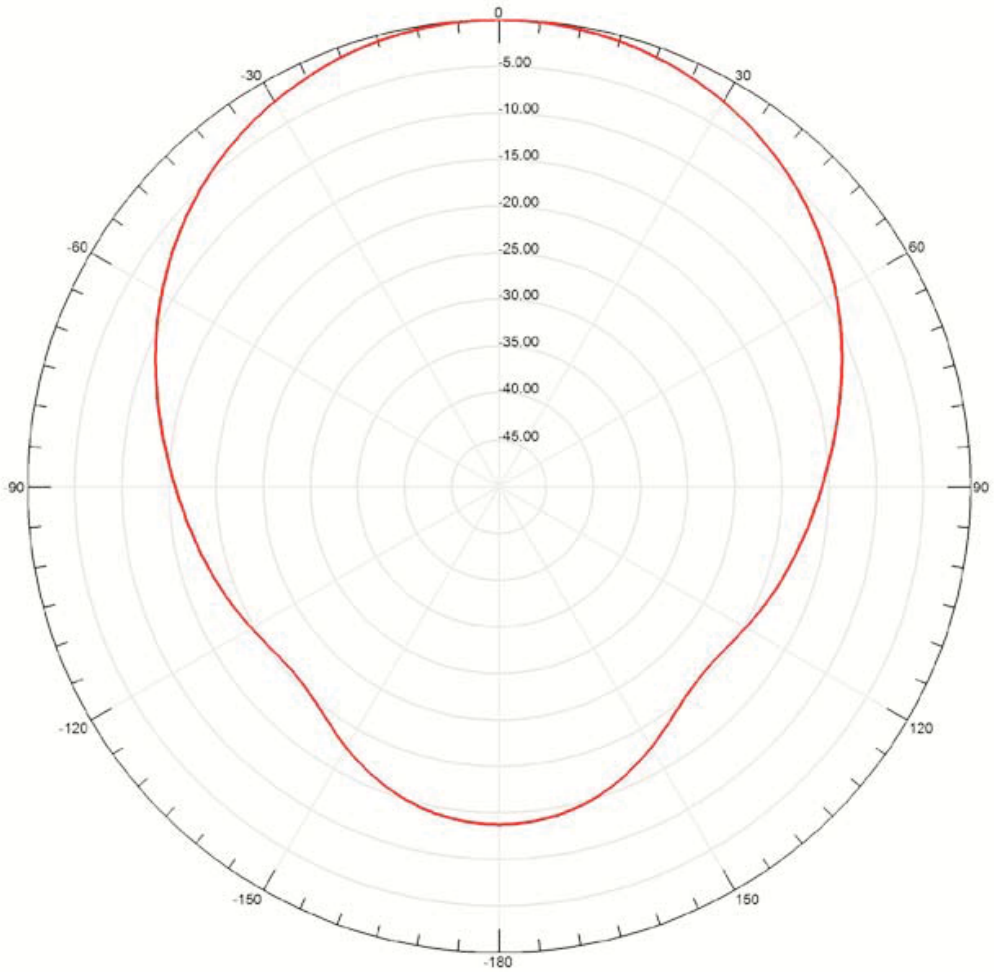
A.1.1 Azimuth section, horizontal polarization

Figure34: Azimuth section, horizontal polarization



A.1.2 Azimuth section, vertical polarization

Figure35: Azimuth section, vertical polarization



A.1.3 Elevation section, horizontal polarization

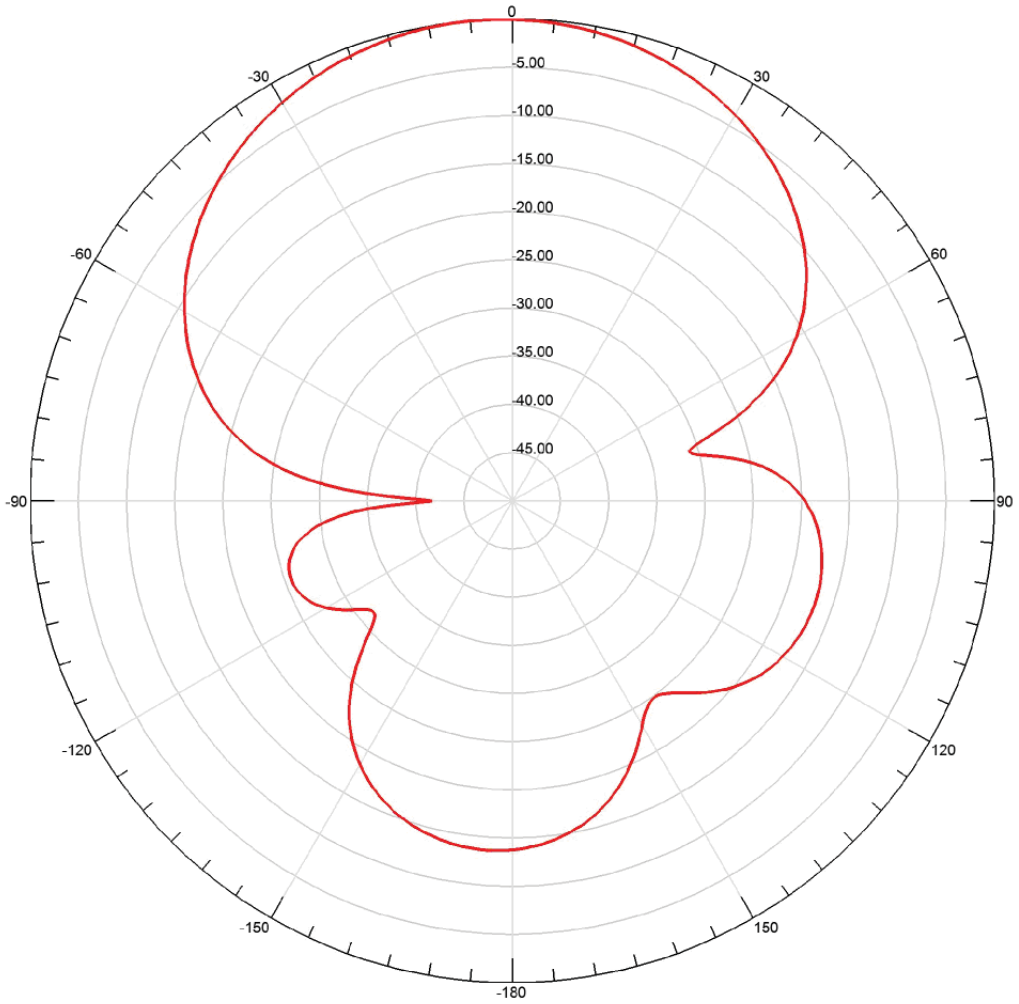
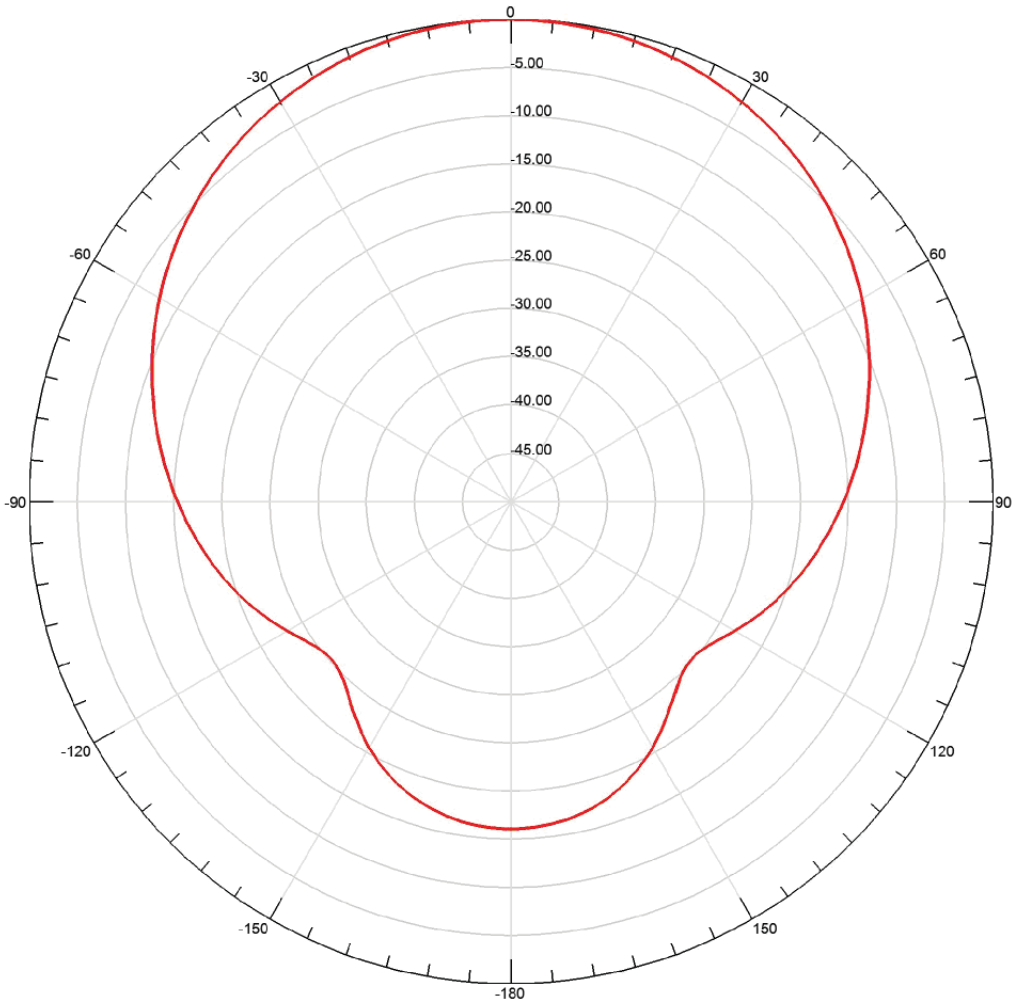


Figure36: Elevation section, horizontal polarization

A.1.4 Elevation section, vertical polarization

Figure37: Elevation section, vertical polarization



A.2 Type code for *BL ident*®

A.2.1 Type code for *BL ident*® interface

Type code – example

T	I	–	BL67	–	PG	–	DP	–	S	–	2

Type code – explanation

T	I	Interface set	–	BL67	Modular I/O system	–	PG	Programmable gateway	–

Device Type
- **I** Interface set: gateway and RFID modules

TURCK RFID system *BL ident*®

Modular I/O system
- **BL20** cabinet mounting (IP20)
- **BL20-E** cabinet mounting (IP20) ECONOMY version
- **BL67** field application (IP67)

Programmable gateway
- **PG** Programmable gateway

DP	Fieldbus	–	S	Communication	–	2	Number of channels

Fieldbus

DP/DPV1	PROFIBUS-DP
EN-PN	PROFINET IO
EN	Modbus TCP
EIP	EtherNet/IP™
EC	EtherCAT®
DN	DeviceNet™
CO	CANopen

Communication
- **A** data transfer via function block (PIB) in the control unit or programmable Gateway
- **S** data transfer via I/O communication

Number of channels
- **2** 2 channels for 2 read/write heads
- **4** 4 channels for 4 read/write heads
- **6** 6 channels for 6 read/write heads
- **8** 8 channels for 8 read/write heads

A.2.2 Type code for BL compact for *BL ident*®

Type code – example

BLCDP	–	2	M12	S	T	–	2RFID-A	–	8DI-PD

Type code – explanation

BLCDP	Compact I/O system	–	2	M12	S	T	Housing	–	2RFID-A	RFID communication	–

BLCDP – Compact I/O system

BLC – compact I/O system for field application (IP67),fieldbus type:

BLCDN	DeviceNet™
BLCDP	PROFIBUS-DP
BLCCO	CANopen

T – Housing – Connector for power supply

T	separate M12 connector
blank	no separate connector

S – Housing – Housing size

S	small housing 93 x 71 x 32.5
M	middle housing 113 x 71 x 32.5
L	large housing 168 x 71 x 32.5

M12 – Housing – Connector type

M8	connector M8 x 1
M12	connector M12 x 1
M16	connector M16 x 0.75

2 – Housing – Number of connectors

1	1 connector
2	2 connnectors
4	4 connnectors
6	6 connnectors
8	8 connnectors
16	16 connnectors

2RFID-A – RFID communication

2RFID-A	data transmission via function block (PIB)
2RFID-S	data transmission via I/O communication

8DI-PD	Inputs/Outputs

8DI-PD – Inputs/Outputs

8XSG-PD	8 digital inputs/ outputs, configurable, PNP, diagnostics
8DI-PD	8 digital inputs, PNP, diagnostics

A.2.3 Type code for *BL ident*® read/write heads

Type code – example

T	N	LR	...	–	Q80	–	H1147	–	S	–	Ex

Type code – explanation

T	N	LR	...	Read/write head	–	Q80	Housing	–	H1147	Connector type	/

Working frequency

blank	13.56 MHz
865	865…868 MHz
902	902…928 MHz
840/ 920	840.5…844.5 MHz & 920.5…924.5 MHz
902/ 915	902…907 MHz & 915…928 MHz
917	917…920.8 MHz

Special range

ER	extended range
LR	long range
SLR	super long range

Read/write heads, **mounting condition**

B	flush mountable
N	non-flush mountable

TURCK RFID-System *BL ident*®

Housing

M18	thread M18
M30	thread M30
Q14	rectangular 55.5 x 30 x 14 mm
CK40	rectangular 40 x 40 x 65 mm, variable orientation of active face
Q80	rectangular, 114 x 80 x 40 mm
S32XL	ring shaped, 180 x 120 x 32 mm
Q350	rectangular, 370 x 350 x 20 mm
Q80L400	rectangular, 400 x 80 x 25 mm
Q120L130	rectangular, 120 x 130 x 60 mm
Q240L280	rectangular, 238 x 278 x 86 mm
Q280L640	rectangular, 640 x 280 x 105 mm
Q175L200	rectangular, 175 x 200 x 60 mm

Connector

0,15-RS4.47T	pigtail (150 mm) with male connector M12
H1147	connector M12 x 1
H1147L	connector M12 x 1, lateral
V1147	connector M8

S	S-Number	–	Ex	Approvals

S-Number

S1126	optimized for different data carriers

Approvals

Ex	approval for Ex-Area

A.2.4 Type code for *BL ident*® data carriers

Type code – example

T	W	...	–	Q51	–	M	–	HT	–	B128	–	Ex

Type code – explanation

T	W	...	Data carrier	–	Q51	Housing	–	M	On metal	–

Working frequency

blank	13.56 MHz
125	125 KHz
865-868	865…868 MHz
865-928	865…928 MHz
860-960	860…960 MHz
902-928	902…928 MHz

Data carrier, memory access

W	read/write
R	read only

TURCK RFID-System *BL ident*®

Housing

R...	round & diameter
I...	inlay & dimensions
L...	label & dimensions
BD10x1.5-19	screw housing, plastic, M10 x 1.5, wrench size 19 mm
BS10x1.5-19	screw housing, metal/ plastic, M10 x 1.5, wrench size 19 mm
BV10x1.5-19	screw housing , stainless steel/ plastic, M10 x 1.5, wrench size 19 mm
QxLy	rectangular: x - width, y - length
Q51	quadratic, lateral lenght: 51 mm

On metal

M	for direct mounting on metal
MF	for direct mounting on metal, foil shielded

HT	High temperature	–	B128	Memory capacity total	–	Ex	Approvals

High temperature

HT	High temperature

Memory capacity total

B44	44 Byte
B64	64 Byte
B110	110 Byte
B112	112 Byte
B128	128 Byte
B138	138 Byte
K2	2 kByte
K8	8 kByte

Approvals

Ex	Approval for Ex-Area

A.2.5 Type code for *BL ident*® connection technology (RFID cables)

Type code – example

...	–	RK4.5T	–	5	/	S2500

Type code – explanation

...	Usage	–	RK4.5T	Connector type	–	5	Cable length	/

Usage

FB–	Food & Beverage type; resistant to all common acid and alkaline detergents and disinfectants; IP67 and IP69K

Connector type

RK4.5T	female straight; 5-pin
WK4.5T	female angled; 5-pin
RS4.5T	male straight; 5-pin

Cable length

0.3	0.3 m
2	2 m
5	5 m
10	10 m
25	25 m
50	50 m

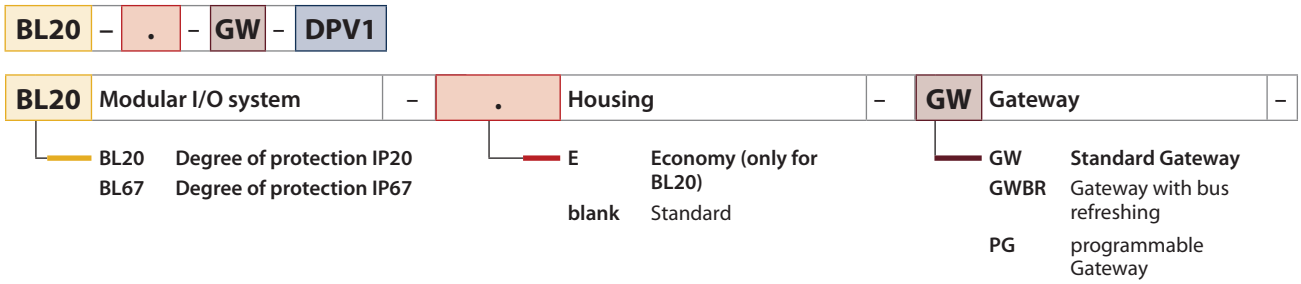
S2500	Connector quality

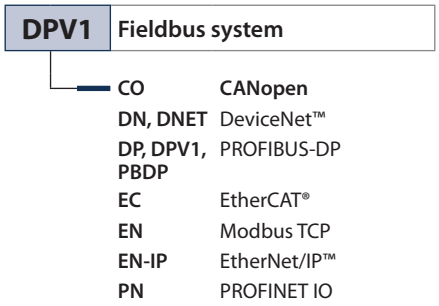
Connector quality

S2500	standard version: cable: UL 20963; cable jacket: PUR, yellow, qualified for drag chain use, oil-resistant, highly flexible
S2503	economic version: cable: UL 20549; cable jacket: PUR, black; qualified for drag chain use, oil-resistant, flexible

A.3 Type code for fieldbus technology

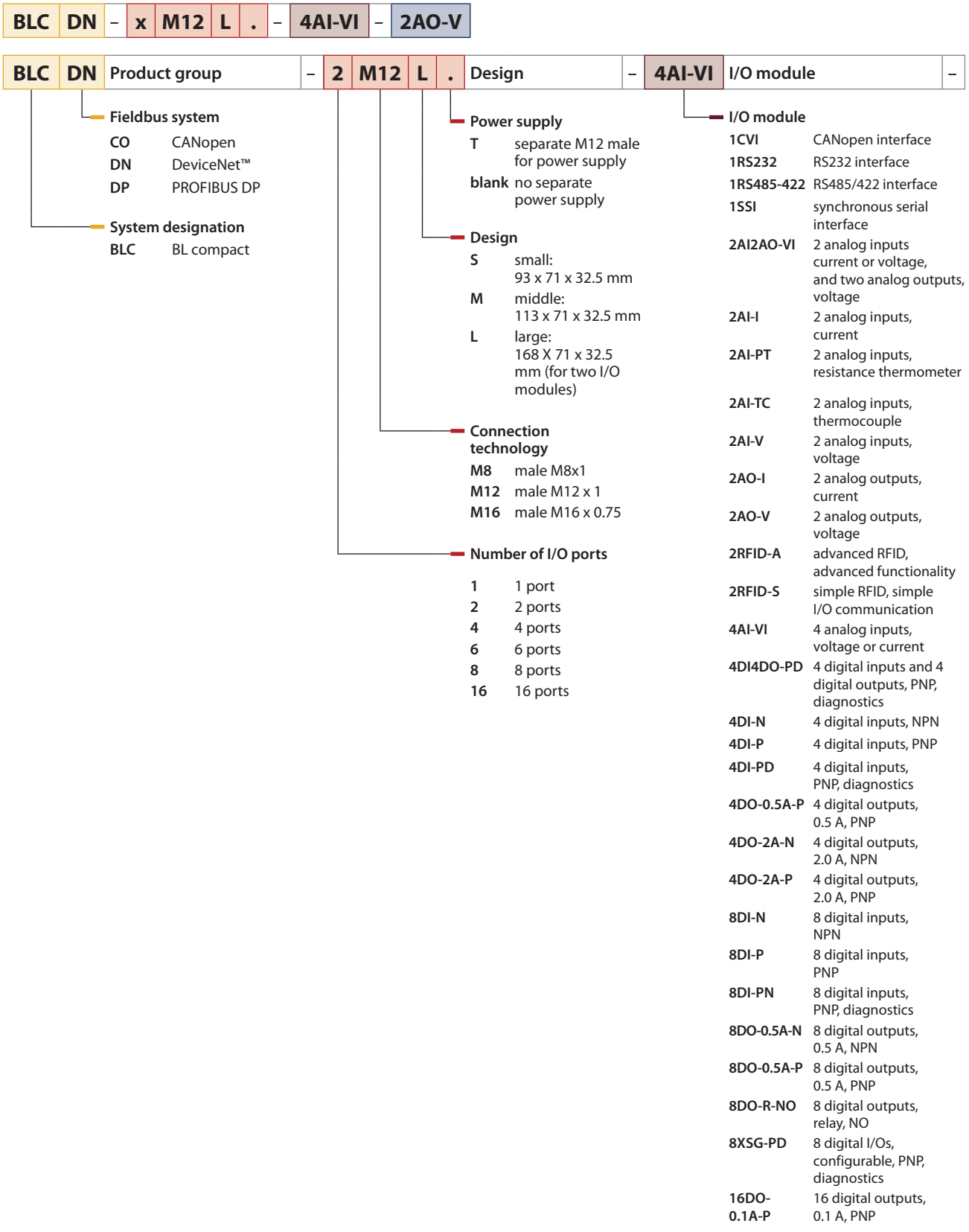
A.3.1 Type code for BLxx gateways





exception: BL67-GW-EN can be used for Modbus TCP and EtherNet/IP™

A.3.2 Type code for BL compact



Industrial Automation

2AO-V	Optional second I/O module

Optional second I/O module

1CVI	CANopen interface
1RS232	RS232 interface
1RS485-422	RS485/422 interface
1SSI	synchronous serial interface
2AI2AO-VI	2 analog inputs, current or voltage, and two analog outputs, voltage
2AI-I	2 analog inputs, current
2AI-PT	2 analog inputs, resistance thermometer
2AI-TC	2 analog inputs, thermocouple
2AI-V	2 analog inputs, voltage
2AO-I	2 analog outputs, current
2AO-V	2 analog outputs, voltage
2RFID-A	advanced RFID, advanced functionality
2RFID-S	simple RFID interface, simple I/O communication
4AI-VI	4 analog inputs, voltage or current
4DI4DO-PD	4 digital inputs and 4 digital outputs, PNP, diagnostics
4DI-N	4 digital inputs, NPN
4DI-P	4 digital inputs, PNP
4DI-PD	4 digital inputs, PNP, diagnostics
4DO-0.5A-P	4 digital outputs, 0.5 A, PNP
4DO-2A-N	4 digital outputs, 2.0 A, NPN
4DO-2A-P	4 digital outputs, 2.0 A, PNP
8DI-N	8 digital inputs, NPN
8DI-P	8 digital inputs, PNP
8DI-PN	8 digital inputs, PNP, diagnostics
8DO-0.5A-N	8 digital outputs, 0.5 A, NPN
8DO-0.5A-P	8 digital outputs, 0.5 A, PNP
8DO-R-NO	8 digital outputs, relay, NO
8XSG-PD	8 digital I/Os, configurable, PNP, diagnostics
16DO-0.1A-P	16 digital outputs, 0.1 A, PNP

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