IPT-18GM-IO-V1

IO-Link RFID read/write device 125 kHz

Manual

IO-Link

Your automation, our passion.

PEPPERL+FUCHS

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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet
- IO-Link parameter datasheet

The documentation may also comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Functional safety handbook
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Intended Use

Always operate the device as described in these instructions. Only in this way, the safe function of the device and the connected systems is guaranteed.

The protection of operating personnel and plant is only given if the device is used in accordance with its intended use.

1.4 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols

Note

This symbol brings important information to your attention.

Action

1. This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

1.5 Definitions

Data is displayed in various ways in the following documentation. The following formats are used:

ASCII

For example: "A"; "B"; "1"; "2"

Each ASCII character corresponds to one byte. 2^8= 256 different characters can be displayed.

Binary

For example: 1001_{bin}

Binary numbers are identified by a $_{bin}$.

DECIMAL

For example: 1234

Decimal numbers are shown without additional identification.

HEX

For example: 0x41; 0x42; 0x31; 0x32

The hexadecimal representation of a byte consists of two digits (e.g., 0x41). The section on the left side is the higher nibble (0x4). The lower nibble is on the right side (0x1). The range of values is between 0x00 … 0xFF.

Note

In the TIA Portal from Siemens, hexadecimal numbers are displayed as follows:

For example:

16#00 (equivalent to 0x00)

Terms

Fixcode	Unique permanent identification number of the tag
COM Mode	The IO-Link data transfer rate
Tags	Mobile data memory with user data and unique number
Device ID	Identification number of the device
Easy Mode	Communication protocol for simple data access of a read/write device; no function block required
Expert Mode	Communication protocol for high-performance data access of the RFID read/write device; the use of a function block is required
IODD	IO Device Description; file with information about IO-Link parameters of an IO-Link-enabled device
IO-Link	Communication system for the connection of intelligent sensors and actuators via point-to-point communication
IO-Link master	Interface to higher-level control; controls the communication to connected IO-Link devices
IO-Link device	Intelligent sensor or actuator for connecting to an IO-Link master; has device-specific IO-Link parameters
IO-Link parameters	Device-specific information about an IO-Link device; parameters are stored in an IODD; acyclic change of the parameters
IO-Link protocol	Version of the supported IO-Link communication; V1.0 or V1.1
IPC	Pepperl+Fuchs-specific designation of a 125 kHz tag
ISDU	Indexed Service Data Unit
PACTware	Parameterization software for access to IO-Link parameters
Port type	Type of IO-Link port
SIO Mode	Standard IO mode; mode for conventional signal transmission without IO-Link data[1]
PLC	Programmable logic controller; device for controlling a machine or plant
Vendor ID	Identification number of the device manufacturer, Pepperl+Fuchs: 0x01

1. Not supported

Abbreviations

FCC	**F**ederal **C**ommunications **C**ommission
IC	**I**ndustry **C**anada
ISO	**I**nternational **S**tandardisation **O**rganisation
RFID	**R**adio **F**requency **Id**entification
PLC	**P**rogrammable**L**ogic **C**ontroller
Tag	Read/write tag; tag
LF	**L**ow **F**requency (125 kHz)

2 Certificates and approvals

2.1 Declaration of Conformity (RE Directive 2014/53/EU)

This product was developed and manufactured in line with the applicable European standards and directives.

Note

A Declaration of Conformity can be requested from the manufacturer or downloaded from www.pepperl-fuchs.com.

The product manufacturer, Pepperl+Fuchs SE, 68307 Mannheim, Germany, has a certified quality assurance system that conforms to ISO 9001.

ISO**9001**

2.2 FCC Information

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

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

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

Note

This equipment has been tested and found to comply with the limits for a Class 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 their own expense.

FCC Notice

To comply with FCC part 15 rules in the United States, the system must be professionally installed to ensure compliance with the Part 15 certification. It is the responsibility of the operator and professional installer to ensure that only certified systems are deployed in the United States. The use of the system in any other combination (such as co-located antennas transmitting the same information) is expressly forbidden.

FCC Exposure Information

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

2.3 Technical Data and Environmental Conditions

This device is for indoor use only.

This device may be operated in altitudes up to 5000 m.

The ambient temperature range is from -25 °C ... +70 °C for operation. The Pollution degree is 2.

The maximum relative humidity is 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C.

Nominal power supply voltage is 24 V_{DC}, voltage range is 18 V ... 30 V_{DC}. Supply must be LEC (Limited Energy Circuit), LPS (Limited Power Source) or CLASS 2. The Overvoltage Category II is applied.

2.4 Other Country-Specific Approvals

All currently valid approvals can be found in the datasheet for your device at www.pepperl-fuchs.com.

3 Product Description

3.1 Product Description

Use and Application

This device is an RFID read/write device with an IO-Link communication interface (IO-Link device). The device supports tags in the frequency range of 125 kHz and is connected to an IO-Link master via an integrated M12 plug.

Figure 3.1

3.2 Dimensions

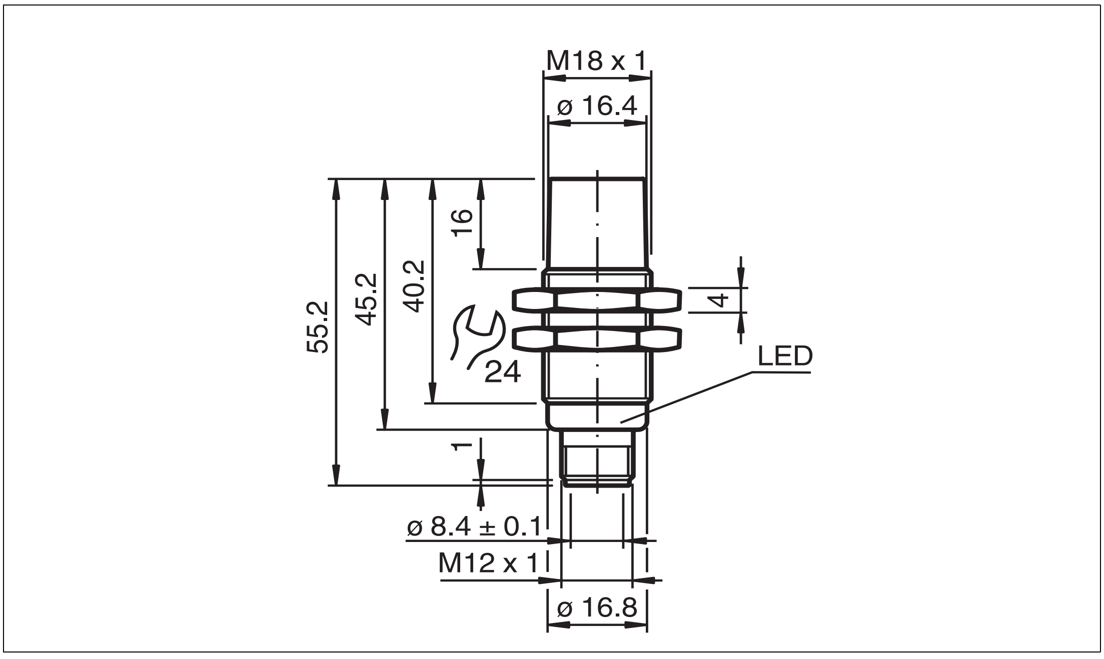
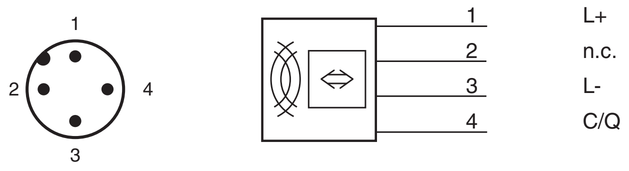


Figure 3.2

3.3 Electrical Connection

Caution!
Cable specifications
The minimum diameter of the connection cable must be 22 AWG or 0.34 mm².



Pin 1	L+	+24 V
Pin 2	n.c.	Not connected
Pin 3	L-	0 V/GND
Pin 4	C/Q	C/Q

The RFID read/write device is connected to an IO-Link master via a point-to-point connection. According to the IO-Link installation instructions, the length of the connection line should not exceed 20 meters. The RFID read/write device is supplied with power via the IO-Link master. For technical details, refer to the product datasheet.

3.4 IO-Link Interface Properties

IO-Link version:	1.1
Data transfer rate	COM3 (230.4 kbits/s)
Min. cycle time	4 ms
Process data	Input 32 bytes Output 32 bytes
SIO mode support	No
Compatible master port type	Class A Class B
Device ID	4195585 (0x400501)
Vendor ID	1 (0x0001)

4 Installation

4.1 Storage and Transportation

Keep the original packaging. Always store and transport the device in the original packaging.

Store the device in a clean and dry environment. The permitted ambient conditions must be considered, see datasheet.

4.2 Unpacking

Check the product for damage while unpacking. In the event of damage to the product, inform the post office or parcel service and notify the supplier.

Check the package contents against your purchase order and the shipping documents for:

- Delivery quantity
- Device type and version in accordance with the type label
- Any accessories ordered

Retain the original packaging in case you have to store or ship the device again at a later date.

Should you have any questions, please contact Pepperl+Fuchs.

4.3 Mounting and Connection

Warning!

Processes started in an uncontrolled manner jeopardize the plant

Before commissioning, ensure that there are no risks involved in using the device that may endanger the plant.

Caution!

Hot surfaces

Risk of burns when handling the read/write device! Allow the device to cool for at least half an hour after it has been switched off before touching it.

4.4 Minimum Distances

During simultaneous operation of several read/write devices, only one device may ever communicate with a tag at any given time. When arranging the read/write devices, make sure that the sensing ranges do not overlap. You can increase or decrease the sensing range by changing the transmit power accordingly. Determine the sensing range of each device at the mounting location.

When mounting multiple read/write devices, keep a **minimum distance of 180 mm**.

5 Commissioning

5.1 Operating Modes

The device supports two operating modes:

- **Easy mode**
  Easy mode enables simplified commissioning with a limited range of functions. This is the preferred operating mode for standard applications.
- **Expert mode**
  The entire set of commands is available in Expert mode. To use Expert mode, a function block is required to integrate into the PLC.

6 Operation

6.1 Tags 125 kHz

Parameterization of the associated tag type is recommended to set the RFID read/write device to the tag being used. On delivery of the RFID read/write device the tag type 03 is preset.

The following table shows the tag types specified and recommend for the RFID read/write device.

125 kHz Tag Types

Tag type		P+F designation	Chip type	Access	Writable memory [bytes]	Read only code length [bytes]	Frequency range
High byte	Low byte						
'0'	'2'	IPC02	Unique, EM4102 (EM Microelectronic)	Fixcode	-	5	125 kHz
'0'	'3'	IPC03	EM4450 (EM Microelectronic), Titan	R/W Fixcode	116	4	125 kHz
'1'	'1'	IPC11	Q5 (Sokymat)	R/W	5	-	125 kHz

Table 6.1

The read and write commands use the "Number bytes" and "Start address" parameters. This defines how many bytes are accessed in the memory area of the user data and from which memory address this starts. If the tag type used, for example, has a block length of 4 bytes, the values of the "Number bytes" and "Start address" parameters must be a multiple of 4.

6.2 Sensing Range

The range of the device depends on the tags to be identified and may therefore vary.

7 Easy Mode

The RFID read/write device uses the "Easy Mode" communication protocol on the basis of IO-Link for data transfer to a higher-level system. If this protocol is used, the RFID read/write device can be commissioned without an additional function block on a control system. This makes it easier to commission the read/write device.

When "Easy Mode" is used, there is a distinction between parameter and process data. The parameter data is IO-Link parameters being transferred acyclically. This is data for the configuration of the read/write jobs, for parameterizing the device properties, e.g., transmit power and service data, e.g., operating hours meter. The process data is transmitted in cycles. The process data is divided into input and output data. It has a length of 32 bytes and contains the control values for the execution of the read and write commands and the associated values.

The IO-Link parameters for setting the RFID read/write device are defined by a device-specific IODD file. The IO-Link parameters are set using suitable configuration software. During this process, the IO-Link parameters are saved in a non-volatile memory in the RFID read/write device.

7.1 Command Overview

The Easy Mode supports the following read and write commands:

Command	Description
Read the read-only code (Fixcode)	Read-out of the read-only code; no setting of the "Number of bytes" or "Start Address" parameters required
Read the user memory	Read-out of user data; setting of the "Number of bytes" and "Start Address" parameters is required
Write the user memory	Writing of user data; setting of the "Number of bytes" and "Start Address" parameters is required
Auto-start	Automatic execution of a read task for read-only code or user data after device start

7.2 Basic Structure of the Process Data

The device process data is exchanged cyclically between a higher-level system (e.g., a PLC) and the device. A distinction is made between the output process data and the input process data. The process data for the outputs is transmitted from the PLC toward the device. The process data for the inputs is transmitted from the device toward the PLC.

A detailed description of the process data can be found in the IODD or on the IO-Link parameter datasheet of the device. You can find the IODD and the parameter datasheet on the product details page at www.pepperl-fuchs.com.

The input and output data of the process data have a fixed length of 32 bytes.

Note

Output process data is ignored by the device if the "valid" flag is not set. An unset "valid" flag indicates invalid process data.

7.2.1 Output Process Data (PLC -> Device)

Byte	Content							
0	0	0	0	0	0	0	Start write	Start read
1	0x00							
2	0x00							
3	0x00							
4	User data for write job or 16#00 for read job							
etc.	User data for write job or 16#00 for read job							
31	User data for write job or 16#00 for read job							

Table 7.1

Byte 0 This byte contains the control bits for starting a read job or write job. The control bits will have no effect if the auto-start function is activated.
Start Read: As soon as this bit is set (TRUE), a read job is started using the configuration set by the parameter "Read Task" in the IODD file. The read job runs continuously. To cancel the read job, reset the bit (FALSE).
Start Write: As soon as this bit is set (TRUE), a write job is started. The write job transfers the user data, which must be stored starting from byte 4, according to the configuration set by the parameter "Write Task" in the IODD file. The write job runs continuously. To cancel the write job, reset the bit (FALSE).
Note that both bits cannot be set simultaneously. The remaining bits have no significance.

Byte 1/2/3 These bytes are not used in Easy Mode. Set the value 0x00.

Byte 4 … 31 When a read job is being executed, these bytes have no significance and are set with the value 0x00. When a write job is being executed, the user data to be written to the tag is stored in this area.

For example: Writing user memory in TIA Portal

Name	Address	Displa...	Monitor value
"ControlByte_Out"	%QB0	Bin	2#0000_0010
"Unused_1"	%QB1	Hex	16#00
"Unused_2"	%QB2	Hex	16#00
"Unused_3"	%QB3	Hex	16#00
"WriteData_1"	%QB4	Hex	16#01
"WriteData_2"	%QB5	Hex	16#02
"WriteData_3"	%QB6	Hex	16#03
"WriteData_4"	%QB7	Hex	16#04
"WriteData_5"	%QB8	Hex	16#05
"WriteData_6"	%QB9	Hex	16#06
"WriteData_7"	%QB10	Hex	16#07
"WriteData_8"	%QB11	Hex	16#08

Output process data

Byte 0: $0000\ 0010_{bin}$; the "Start write" bit is set to 1; a write job is executed.

Byte 1/2/3: 16#00; not used

Byte 4 … Byte 11: Write data

7.2.2 Input Process Data (Device -> PLC)

Byte	Content							
0	0	0	0	Tag present	Error	Job active	Write successful	Read successful
1	Length specification							
2	Reserved (0x00)							
3	Reserved							
4	Data for read/write job / error code							
5	Data for read/write job / error information							
etc.	Data for read/write job / error information							
31	Data for read/write job / error information							

Table 7.2

Byte 0 This byte contains the control bits to indicate the status of executing the read or write job.
Read successful: This bit indicates successful reading of data from a tag. This bit is set if a tag enters the sensing range and the data has been read successfully. The bit remains set while the tag is within the sensing range. As soon as the tag has left this area, the bit is reset again. A positive edge change is triggered if there are multiple tags in the sensing range at the same time[1] Signals the transfer of another tag.
Write successful: This bit indicates successful writing of data to a tag. This bit is set if a tag enters the sensing range and the data has been written successfully. The bit remains set while the tag is within the sensing range. As soon as the tag has left this area, the bit is reset again. If several tags are within the sensing range at the same time, a positive edge change indicates that another tag has been successfully written.
Job active: This bit is set while the read or write job is being executed. As soon as the job is finished, this bit is reset again.
Error: If an error occurs during execution of a read or write job or if a parameter has not been set correctly, the error bit is set. At the same time, additional error information in the form of an error code is located in the process data.
Tag present: Bit is set if one or more tags are in the sensing range. If there is no tag in the sensing range, this bit has the value FALSE.

Byte 1 This byte contains the number of transferred bytes. If a tag enters the sensing range and the data has been read successfully (Read successful = TRUE), this byte indicates the length of the read data. If an error occurs during execution of a job (Error = TRUE), the byte contains a length specification for the error information.

Byte 2 Reserved.

Byte 3 Reserved.

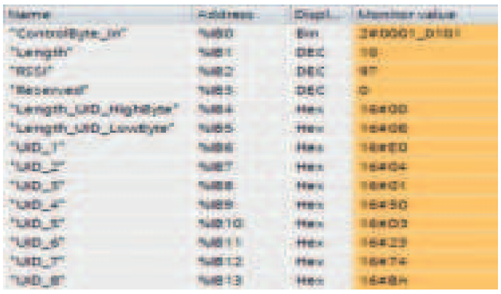
Byte 4/5 If a tag is successfully accessed, the length of the read-only code Fixcode is located at this position.[2]

Byte 6 … Byte 31 Starting at byte 6, the Fixcode of the tag from which the information was read or to which the information was written. The Fixcode is always included in the response to a read or write job. This information ensures unique assignment of the tag. When a user memory read job is performed, the length specification (2 bytes) of the read-in user memory and the read-in subarea of the user memory are connected.

1. Positive edge change: Change from 0 to 1
2. Applies only to the long-form data format. In the short-form data format, the Fixcode or the user memory of the tag is transferred directly from byte 4.

If an error occurs during execution of a read or write job ("Error" bit = TRUE), byte 4 contains an error code. In the fault state, an error message is transmitted in plain text (ASCII) starting at byte 5. This provides a possible cause of the fault.

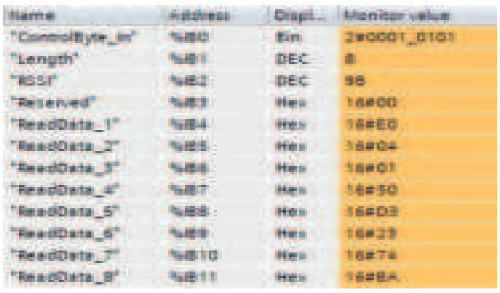
For example: Read read-only code (Fixcode), long-form data format



Name	Address	Displ...	Monitor value
"ControlByte_in"	%IB0	Bin	2#0001_0101
"Length"	%IB1	DEC	10
"RSSI"	%IB2	DEC	97
"Reserved"	%IB3	DEC	0
"Length_UID_HighByte"	%IB4	Hex	16#00
"Length_UID_LowByte"	%IB5	Hex	16#08
"UID_1"	%IB6	Hex	16#E0
"UID_2"	%IB7	Hex	16#04
"UID_3"	%IB8	Hex	16#01
"UID_4"	%IB9	Hex	16#50
"UID_5"	%IB10	Hex	16#D3
"UID_6"	%IB11	Hex	16#23
"UID_7"	%IB12	Hex	16#74
"UID_8"	%IB13	Hex	16#8A

Byte 0:	0001 0101$_{bin}$; the "Job active" bit is set to 1, which indicates that a read job is activated. The "Read successful" bit is set to 1. A tag is therefore located in the sensing range and the data has been read. The "Tag present" bit is also set because there is at least one tag in the sensing zone.
Byte 1:	6; the byte indicates the length of the transmitted information. This telegram is used to transmit information with a length of 6 bytes. The information starts at byte 4.
Byte 2:	16#00; Reserved
Byte 3:	16#00; Reserved
Byte 4/5:	16#0004; length specification of the Fixcode. The information has a length of 2 bytes. The length of the Fixcode is 4 bytes.
Byte 6 … Byte 9:	Fixcode of the tag that was read

For example: Read read-only (Fixcode), short-form data format



Name	Address	Displ...	Monitor value
"ControlByte_in"	%IB0	Bin	2#0001_0101
"Length"	%IB1	DEC	8
"RSSI"	%IB2	DEC	98
"Reserved"	%IB3	Hex	16#00
"ReadData_1"	%IB4	Hex	16#E0
"ReadData_2"	%IB5	Hex	16#04
"ReadData_3"	%IB6	Hex	16#01
"ReadData_4"	%IB7	Hex	16#50
"ReadData_5"	%IB8	Hex	16#D3
"ReadData_6"	%IB9	Hex	16#23
"ReadData_7"	%IB10	Hex	16#74
"ReadData_8"	%IB11	Hex	16#8A

Byte 0:	0001 0101$_{bin}$; the "Job active" bit is set to 1, which indicates that a read job is activated. The "Read successful" bit is set to 1. A tag is therefore located in the sensing range and the data has been read. The "Tag present" bit is also set because there is at least one tag in the sensing zone.
Byte 1:	4; the byte indicates the length of the transmitted information. This telegram is used to transmit information with a length of 4 bytes. The information starts at byte 4.
Byte 2:	16#00; Reserved
Byte 3:	16#00; Reserved
Byte 4 … Byte 7:	Fixcode of the tag that was read

For example: Read user memory, long form data format

Name	Address	Displ...	Monitor value
"ControlByte_In"	%IB0	Bin	2#0001_0101
"Length"	%IB1	DEC	20
"RSSI"	%IB2	DEC	97
"Reserved"	%IB3	DEC	0
"Length_UID_HighByte"	%IB4	Hex	16#00
"Length_UID_LowByte"	%IB5	Hex	16#08
"UID_1"	%IB6	Hex	16#E0
"UID_2"	%IB7	Hex	16#04
"UID_3"	%IB8	Hex	16#01
"UID_4"	%IB9	Hex	16#50
"UID_5"	%IB10	Hex	16#03
"UID_6"	%IB11	Hex	16#23
"UID_7"	%IB12	Hex	16#74
"UID_8"	%IB13	Hex	16#8A
"Length_Data_HighByte"	%IB14	Hex	16#00
"Length_Data_LowByte"	%IB15	Hex	16#08
"ReadData_1"	%IB16	Hex	16#01
"ReadData_2"	%IB17	Hex	16#02
"ReadData_3"	%IB18	Hex	16#03
"ReadData_4"	%IB19	Hex	16#04
"ReadData_5"	%IB20	Hex	16#05
"ReadData_6"	%IB21	Hex	16#06
"ReadData_7"	%IB22	Hex	16#07
"ReadData_8"	%IB23	Hex	16#08

Byte 0:	0001 0101_{bin}; The "Job active" bit is set to 1 and signals an active read job. The "Read successful" bit is set to 1. A tag is located in the sensing range and the data has been read. The "Tag present" bit is also set because there is at least one tag in the sensing zone.
Byte 1:	16; the byte indicates the length of the transmitted information. This telegram is used to transmit information with a length of 16 bytes. The information starts at byte 4.
Byte 2:	16#00; Reserved
Byte 3:	16#00; Reserved
Byte 4/5:	16#0004; length specification of the Fixcode. The information has a length of 2 bytes. The length of the Fixcode is 4 bytes.
Byte 6 … Byte 9:	Fixcode of the identified tag
Byte 10/11:	16#0008; length specification for the read-in user memory
Byte 12 … Byte 19:	User memory section read in

For example: Read user memory, short-form data format

Name	Address	Displ...	Monitor value
"ControlByte_In"	%IB0	Bin	2#0001_0101
"Length"	%IB1	DEC	8
"RSSI"	%IB2	DEC	97
"Reserved"	%IB3	Hex	16#00
"ReadData_1"	%IB4	Hex	16#01
"ReadData_2"	%IB5	Hex	16#02
"ReadData_3"	%IB6	Hex	16#03
"ReadData_4"	%IB7	Hex	16#04
"ReadData_5"	%IB8	Hex	16#05
"ReadData_6"	%IB9	Hex	16#06
"ReadData_7"	%IB10	Hex	16#07
"ReadData_8"	%IB11	Hex	16#08

Byte 0:	0001 0101_{bin}; The "Job active" bit is set to 1 and signals an active read job. The "Read successful" bit is set to 1. A tag is located in the sensing range and the data has been read. The "Tag present" bit is also set because there is at least one tag in the sensing zone.
Byte 1:	4; the byte indicates the length of the transmitted information. This telegram is used to transmit information with a length of 4 bytes. The information starts at byte 4.
Byte 2:	16#00; Reserved
Byte 3:	16#00; Reserved
Byte 4 … Byte 11:	User memory section read in

For example: Write user memory, long form data format

Name	Address	Displ...	Monitor value
"ControlByte_in"	%IB0	Bin	2#0001_0110
"Length"	%IB1	DEC	10
"RESI"	%IB2	DEC	66
"Reserved"	%IB3	DEC	0
"Length_UID_HighByte"	%IB4	Hex	16#00
"Length_UID_LowByte"	%IB5	Hex	16#08
"UID_1"	%IB6	Hex	16#E0
"UID_2"	%IB7	Hex	16#04
"UID_3"	%IB8	Hex	16#01
"UID_4"	%IB9	Hex	16#50
"UID_5"	%IB10	Hex	16#03
"UID_6"	%IB11	Hex	16#23
"UID_7"	%IB12	Hex	16#74
"UID_8"	%IB13	Hex	16#BA

Byte 0: 0001 0110_{bin}; The "Job active" bit is set to 1 and signals an active write job. The "Write successful" bit is set to 1. A tag is located in the sensing range and the data has been written successfully. The "Tag present" bit is also set because there is at least one tag in the sensing range.

Byte 1: 6; the byte indicates the length of the transmitted information. This telegram is used to transmit information with a length of 6 bytes. The information starts at byte 4.

Byte 2: 16#00; Reserved

Byte 3: 16#00; Reserved

Byte 4/5: 16#0004; length specification of the Fixcode. The information has a length of 2 bytes. The length of the Fixcode is 4 bytes.

Byte 6 … Byte 9: Fixcode of the tag to which the data was written.

For example: Write user memory, short-form data format

Name	Address	Displ...	Monitor value
"ControlByte_in"	%IB0	Bin	2#0001_0110
"Length"	%IB1	DEC	08
"RESI"	%IB2	DEC	66
"Reserved"	%IB3	DEC	0
"UID_1"	%IB4	Hex	16#E0
"UID_2"	%IB5	Hex	16#04
"UID_3"	%IB6	Hex	16#01
"UID_4"	%IB7	Hex	16#50
"UID_5"	%IB8	Hex	16#02
"UID_6"	%IB9	Hex	16#23
"UID_7"	%IB10	Hex	16#74
"UID_8"	%IB11	Hex	16#BA

Byte 0: 0001 0110_{bin}; The "Job active" bit is set to 1 and signals an active write job. The "Write successful" bit is set to 1. A tag is located in the sensing range and the data has been written successfully. The "Tag present" bit is also set because there is at least one tag in the sensing zone.

Byte 1: 4; the byte indicates the length of the transmitted information. This telegram is used to transmit information with a length of 4 bytes. The information starts at byte 4.

Byte 2: 16#00; Reserved

Byte 3: 16#00; Reserved

Byte 4 … Byte 7: Fixcode of the tag to which the data was written.

7.2.3 Flow Diagrams

Read Job without Auto-Start Function

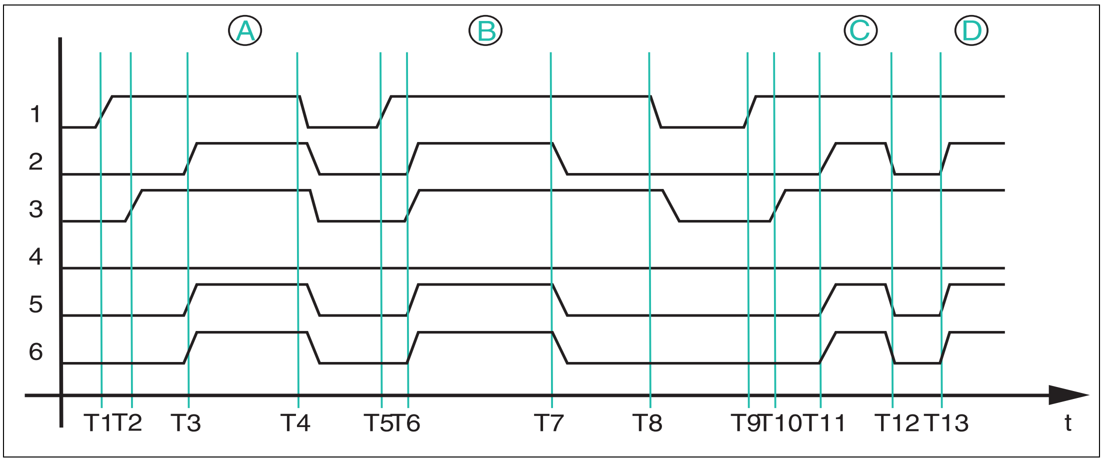


Figure 7.1 Timing sequence of bits in byte 0

1 Start read
2 Read successful
3 Job active
4 Error
5 Tag present
6 Data (input)

If the auto-start function is not used, the read job is started with the "Start read" bit. The read job is performed until the "Start read" bit is reset to FALSE.

T1: Starting the read job by setting the "Start read" bit to TRUE

T2: Read job is executed and indicated through the "Job active" bit ("Job active" = TRUE)

T3: Tag A enters the sensing range; "Read successful" and "Tag present" are set to TRUE and the read data is located in the input field of the process data

T4: Read job is canceled by resetting the "Start read" bit to FALSE while the tag is located in the sensing range; the "Job active" bit, the "Read successful" bit and the "Tag present" are set to FALSE and the process data is filled with 0x00

T5: Start the read job by setting the "Start read" bit to TRUE; at the time of the start, a tag B is already located in the sensing range

T6: Read job is being executed ("Job active" = TRUE) and the data is read successfully ("Read successful" and "Tag present" = TRUE); the read data is located in the input field of the process data

T7: Tag leaves the sensing range ("Read successful" and "Tag present" = FALSE); the area of the input field with the read process data is set to the value 0x00

T8: Cancellation of the read job ("Start read" = FALSE); the "Job active" bit is reset

T9: Start the read job by setting the "Start read" bit to TRUE; at the time of the start, no tag is located in the sensing range; read job remains permanently active

T10: Read job is being executed ("Job active" = TRUE)

T11: Tag C enters the sensing range and the data is read ("Read successful" and "Tag present" = TRUE); read data is located in the input field of the process data

T12: Tag C leaves the sensing range ("Read successful" and "Tag present" = FALSE)

T13: Tag D enters the sensing range

Read Job with Auto-Start Function

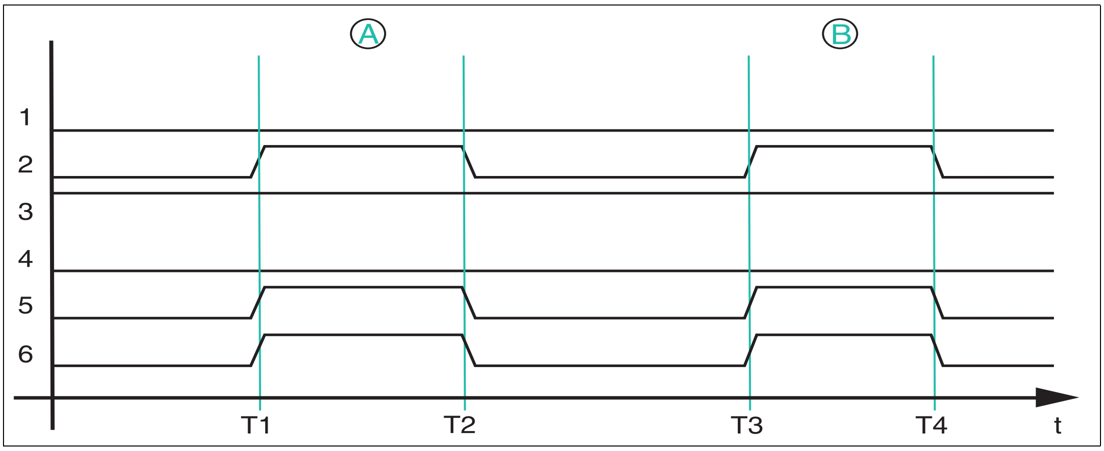


Figure 7.2 Timing sequence of bits in byte 0

1 Start read
2 Read successful
3 Job active
4 Error
5 Tag present
6 Data (input)

If the auto-start function is used, read access runs continuously; the "Job active" bit of the input process data is set permanently.

T1: Tag A enters the sensing range; "Read successful" and "Tag present" are set to TRUE and the read data is located in the input field of the process data

T2: Tag A leaves the sensing range; "Read successful" is reset to FALSE; the area with the previously read data is filled with 0x00

T3: Tag B enters the sensing range; behavior same as T1

T4: Tag B leaves the sensing range; behavior same as T2

Write Job

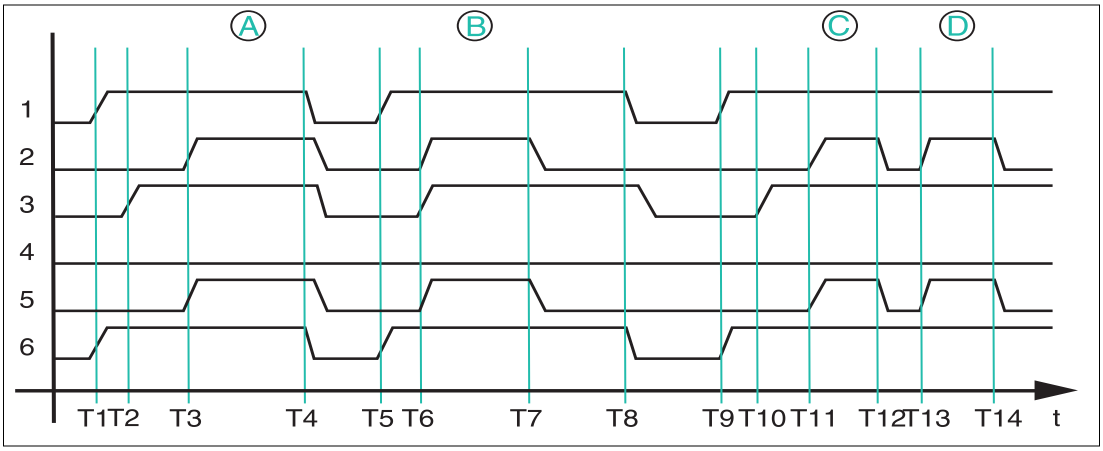


Figure 7.3 Timing sequence of bits in byte 0

1 Start write
2 Write successful
3 Job active
4 Error
5 Tag present
6 Data (input)

A write job cannot be executed using the auto-start function. To start a write job, set the "Start write" bit to TRUE.

T1: Start the write job by setting the "Start write" bit to TRUE; at the same time, the usable data to be written to the tag is transmitted to the output field of the process data

T2: Write job is active ("Job active" = TRUE), and no tag is located in the sensing range ("Write successful" = FALSE)

T3: Tag A enters the sensing range and the data is written successfully ("Write successful" and "Tag present" = TRUE)

T4: The write job is canceled by resetting the "Start write" bit to FALSE; the "Job active," "Write successful" and "Tag present" bits are reset to FALSE and the usable data is reset by the user to the value 0x00

T5: The write job is started by setting the "Start write" bit to TRUE and at the same time transferring the data to be written to the output field of the process data; at the time of the start, tag B is located in the sensing range

T6: The write job is active ("Job active" = TRUE) and tag B is written successfully ("Write successful" and "Tag present" = TRUE)

T7: Tag B leaves the sensing range ("Write successful" and "Tag present" = FALSE); the write job remains active ("Job active" = TRUE)

T8: The write job is canceled by resetting the "Start write" bit to FALSE; the "Job active," "Write successful" and "Tag present" bits are reset to FALSE and the usable data is reset by the user to the value 0x00

T9: The write job is started by setting the "Start write" bit to TRUE; at the same time, the usable data to be written on the tag is transmitted to the output of the process data

T10: Write job is active ("Job active" = TRUE), and no tag is located in the sensing range ("Write successful" = FALSE)

T11: Tag C enters the sensing range and the data is successfully written ("Write successful" and "Tag present" = TRUE); write job is still active ("Job active" = TRUE)

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T12: Tag C leaves the sensing range ("Write successful" and "Tag present" = FALSE); write job is still active ("Job active" = TRUE)

T13: Tag D enters the sensing range and the data is successfully written ("Write successful" and "Tag present" = TRUE); write job is still active ("Job active" = TRUE)

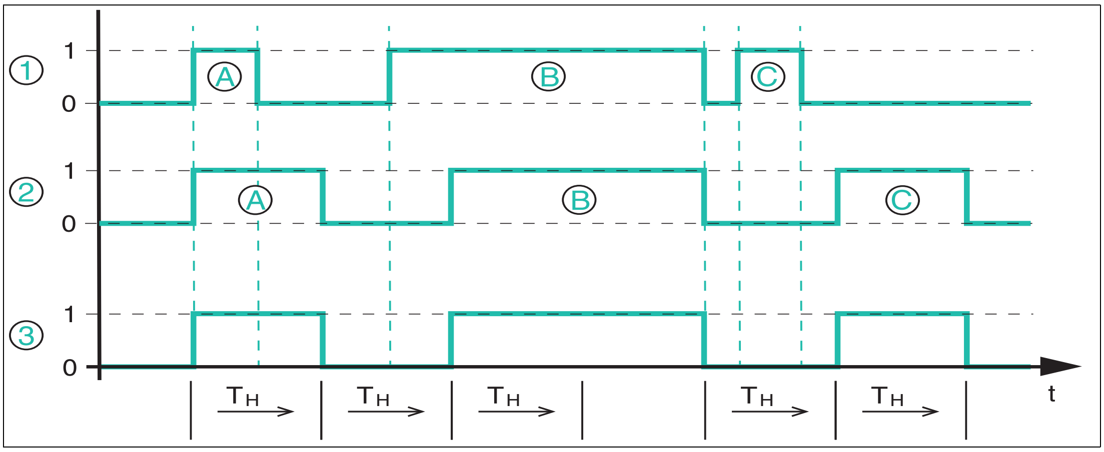
T14: Tag D leaves the sensing zone ("Read successful" and "Tag present" = FALSE)

7.2.4 Timing

The device does not use the complex handshake procedure for data transmission in Easy Mode. The telegrams are set in the input process data and remain there for a defined hold time. The device cannot change the input process data within this hold time.

The hold time is ten times the set cycle time. The hold time is at least 40 ms long because the shortest possible cycle time is 4 ms.

The device can generate a new telegram within the hold time if a new tag is read or a tag leaves the sensing range. This telegram is only set in the input process data after the 40 ms have elapsed. If no new telegram occurs within the hold time, the input process data remains unchanged.



1 Tag in field

2 Data

3 Read successful

The diagram shows the principle chronological sequence of the data transfer depending on the presence of a tag within the device sensing range.

"T_H" corresponds to the minimum hold time of the device of 40 ms.

The device is activated via the auto-start function or the "Start read" bit. The device executes a read job permanently.

At the beginning, tag A enters the sensing range of the device and the "Read successful" bit in the input process data changes the signal state to "TRUE" (1). The tag stays in the sensing range for fewer than 40 ms and leaves it shortly after entering. The input process data containing information about tag A is retained for the time "T_H" (= 40 ms). The input process data is only updated again once this time span has expired and then contains the information "Read successful" = FALSE (no tag) and indicates that the tag has left the sensing range. This telegram also remains in the input process data for the hold time of "T_H."

Tag B enters the sensing range before the hold time of the previous telegram has expired. The input process data is only updated once the hold time of 40 ms has expired, and the "Read successful" bit then changes to "TRUE." The read-in data is simultaneously set in the input process data. Tag B remains within the device sensing range for more than 40 ms (> "T_H"). During this time span, the input process data remains unchanged and the "Read successful" bit continues to have the signal state "TRUE."

Tag B leaves the sensing range and the signal state of the "Read successful" bit changes from 1 to 0 in the input process data. Tag C enters the sensing range before the hold time "T_H" expires. The input process data remains unchanged during the hold time span. It changes the signal state of "Read successful" to "TRUE" once "T_H" expires. The presence of the tag C is indicated and this tag's read-in data is transmitted.

Tag C leaves the sensing range before the hold time "T_H" expires. Once the hold time of the previous information has expired (tag B has left the sensing range), the input process data is modified accordingly. The signal state of "Read successful" changes to "TRUE."

7.2.5 Interruption of IO-Link Communication

If IO-Link communication is interrupted, the device continues to operate normally. If a read job is active at the time of cancellation, the received data is stored in the device. When the device communicates via IO-Link again, this data is transferred to the IO-Link master.

Note

The device cache is designed for small amounts of data to compensate for short interruptions. Data may be lost if IO-Link communication is interrupted for a long time.

7.3 Easy Mode with PACTware

You can commission the RFID read/write device using the IO-Link master "IO-Link-Master02-USB."

Commissioning with PACTware

Note

Use PACTware version 6.0 software to operate the system.

You can use the "IODD Interpreter DTM" software to integrate the IODD files into the PACTware on a PC.

You can find the software, the IODD file and the driver on the Pepperl+Fuchs homepage.

1. Connect the RFID read/write device to the IO-Link master.
2. Connect the IO-Link master to a power supply.
3. Connect the IO-Link master to a PC using a USB cable.
4. Install the two software packages on your PC.
5. Install the **IO-Link USB Master DTM 2.0** driver.
6. Import the IODD file for the RFID read/write device with the **IODD DTM Configurator** program.

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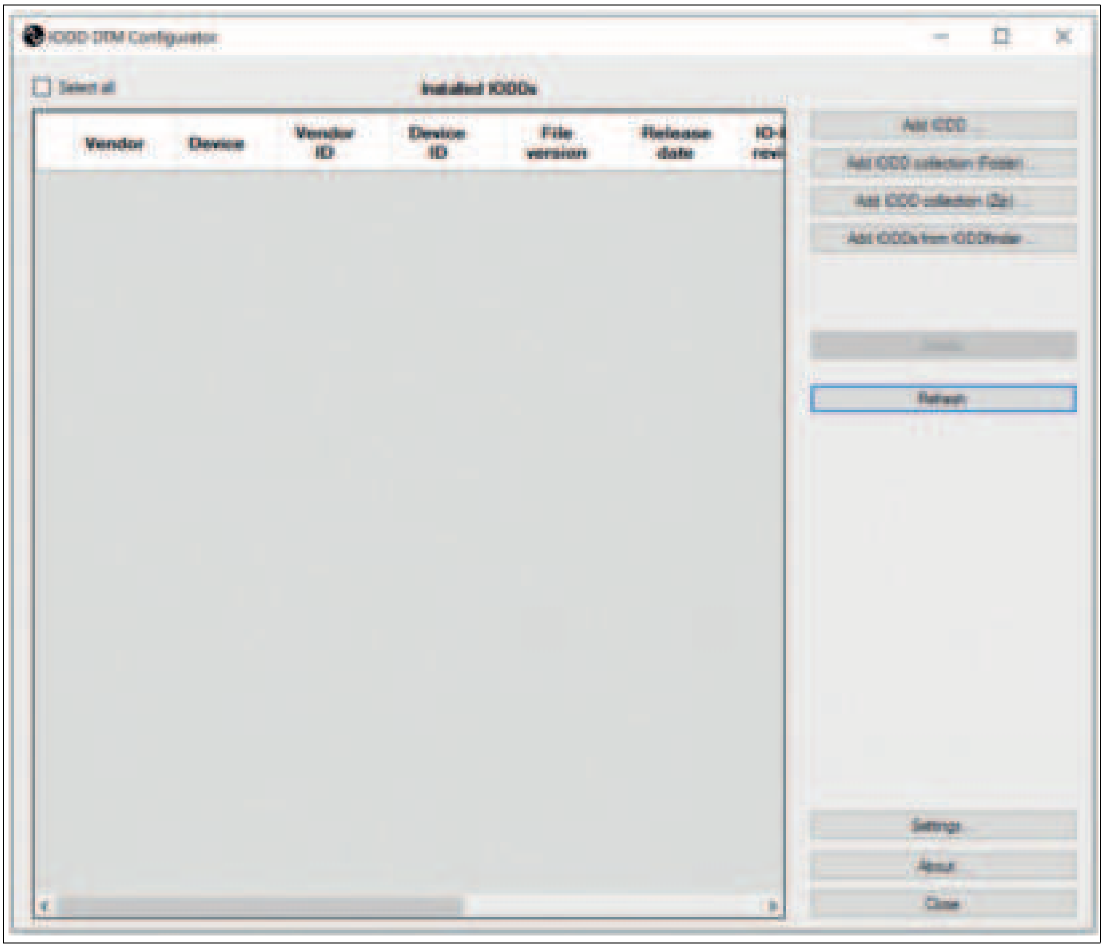

Figure 7.4

7. You can add IODDs using the IODDfinder in several ways:
   - "Add IODD" adds a single IODD.
   - "Add IODD Collection (Folder)" adds an entire folder that can contain multiple IODDs.
   - "Add IODD Collection (*.zip)" adds an archived folder that can contain multiple IODDs.[1]
   - "Add IODD from IODDfinder" allows full access to the IODDfinder database ioddfinder.io-link.com.
8. You can use the filter mask to narrow down the manufacturer and device. Enter "Pepperl+Fuchs" as the manufacturer and "IPT-18GM-IO-V1" as the device.
9. Select the required IODD file version of the device (highlighted in blue)
10. Click "Add selected IODD."

1. For example IODD download from the Pepperl+Fuchs homepage

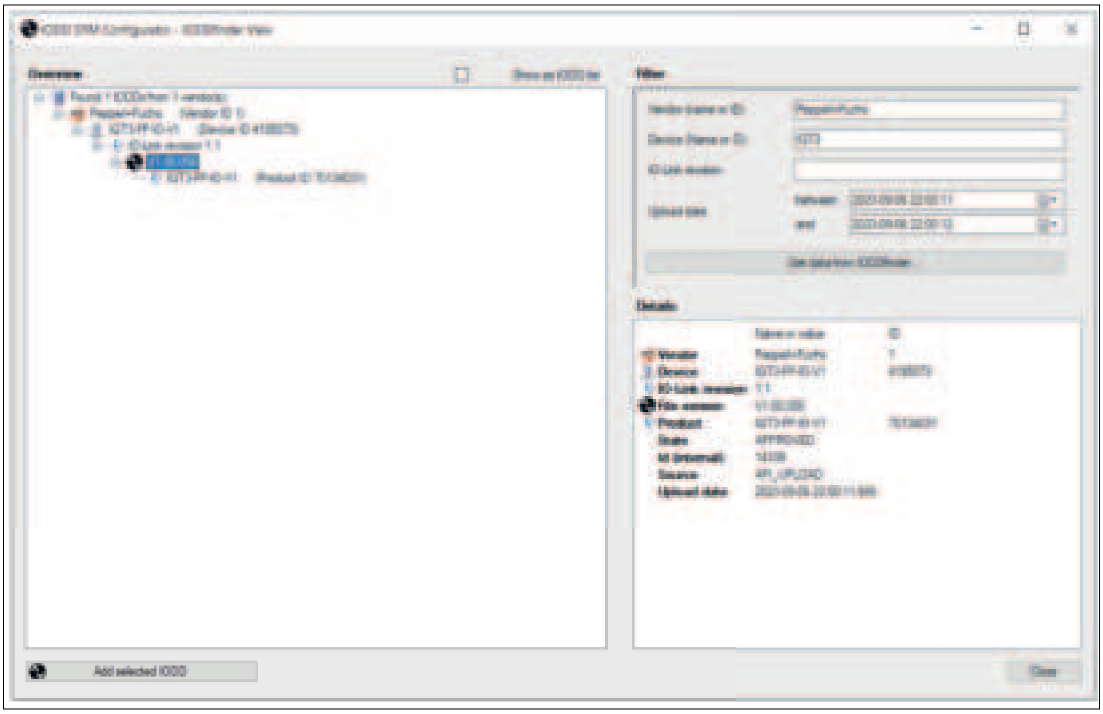

Figure 7.5

↳ Successfully added IODDs appear in "Installed IODDs."

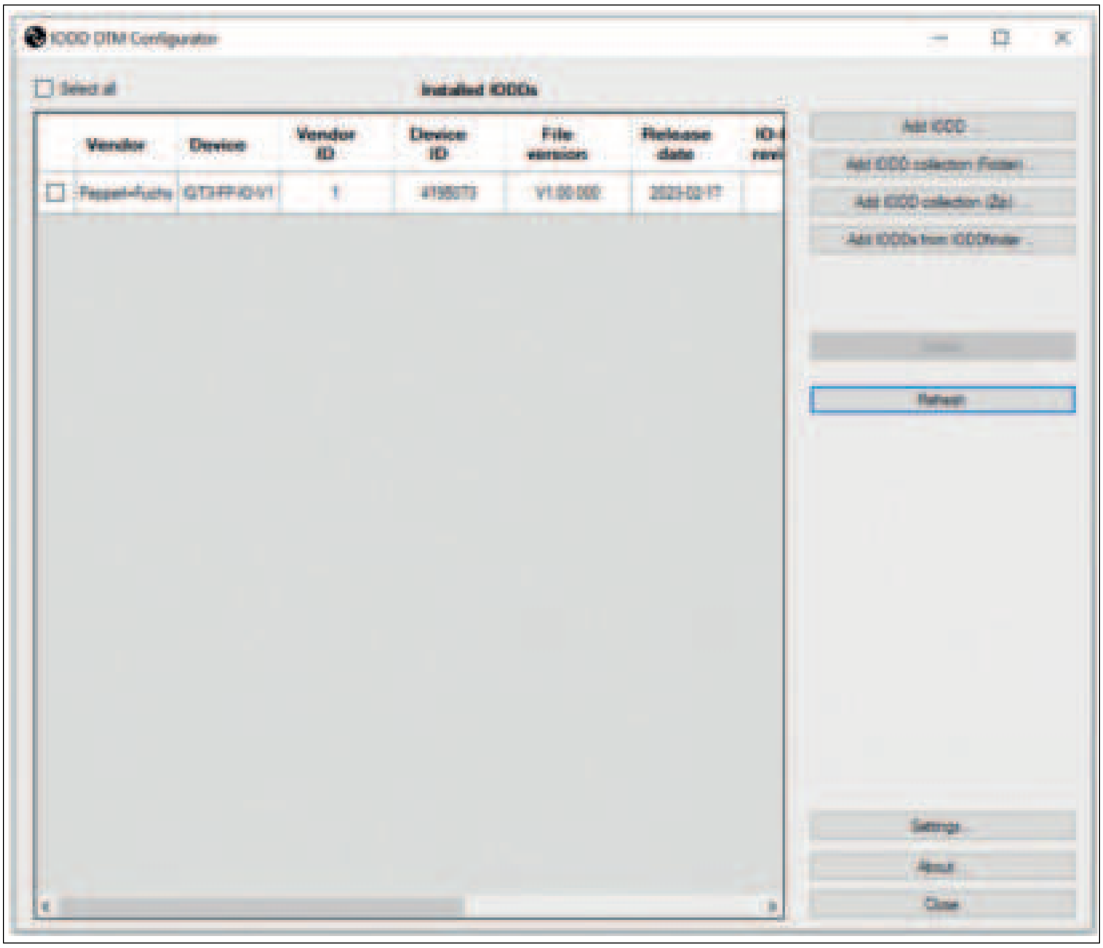

Figure 7.6

↳ Close the **IODD DTM Configurator** program.

11. Start PACTware.
12. Right-click on the "HOST PC."
13. Select the "Add device" menu item.

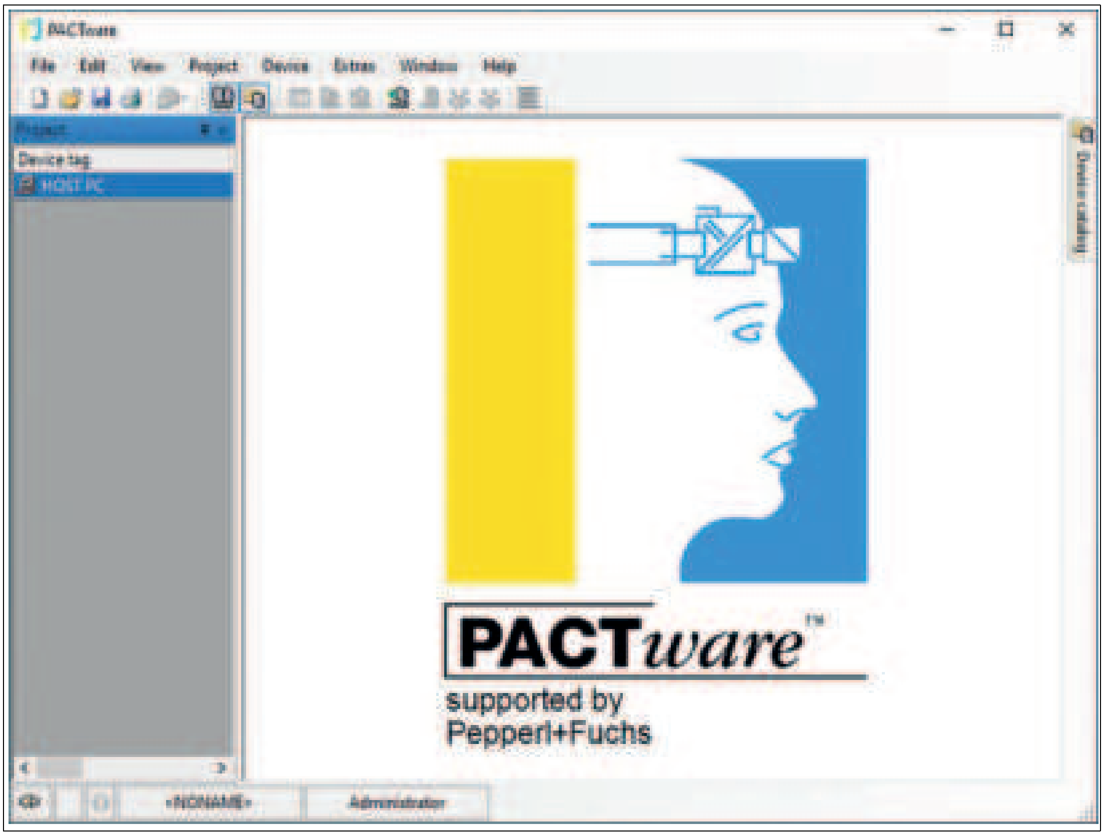

Figure 7.7

↳ The "Device for" window opens.

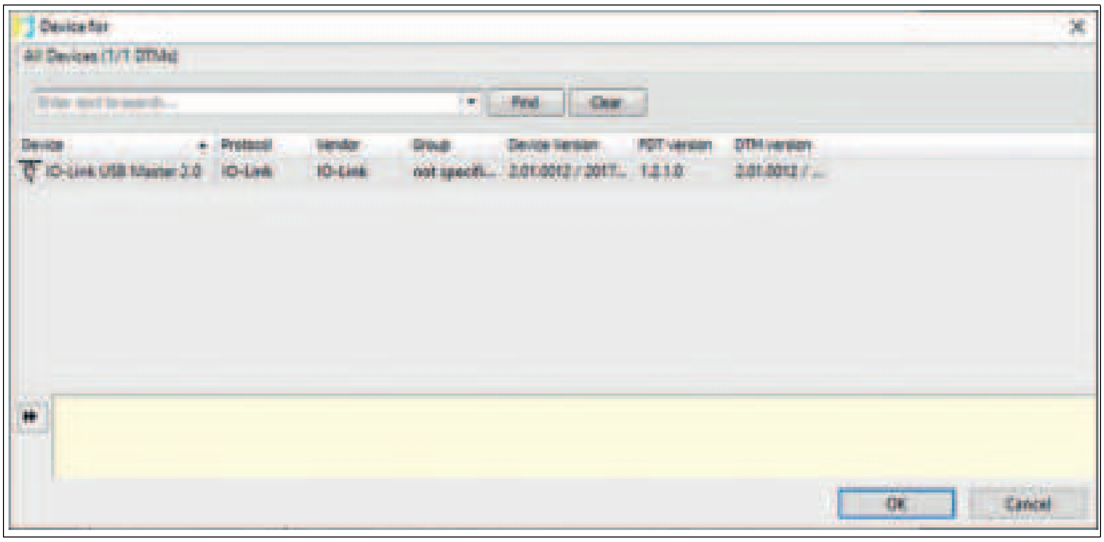

Figure 7.8

14. Select IO-Link USB Master 2.0.

Note

If you are using a different IO-Link master, select it.

15. Confirm with "OK."

↳ The IO-Link master appears in the menu on the left under your project.

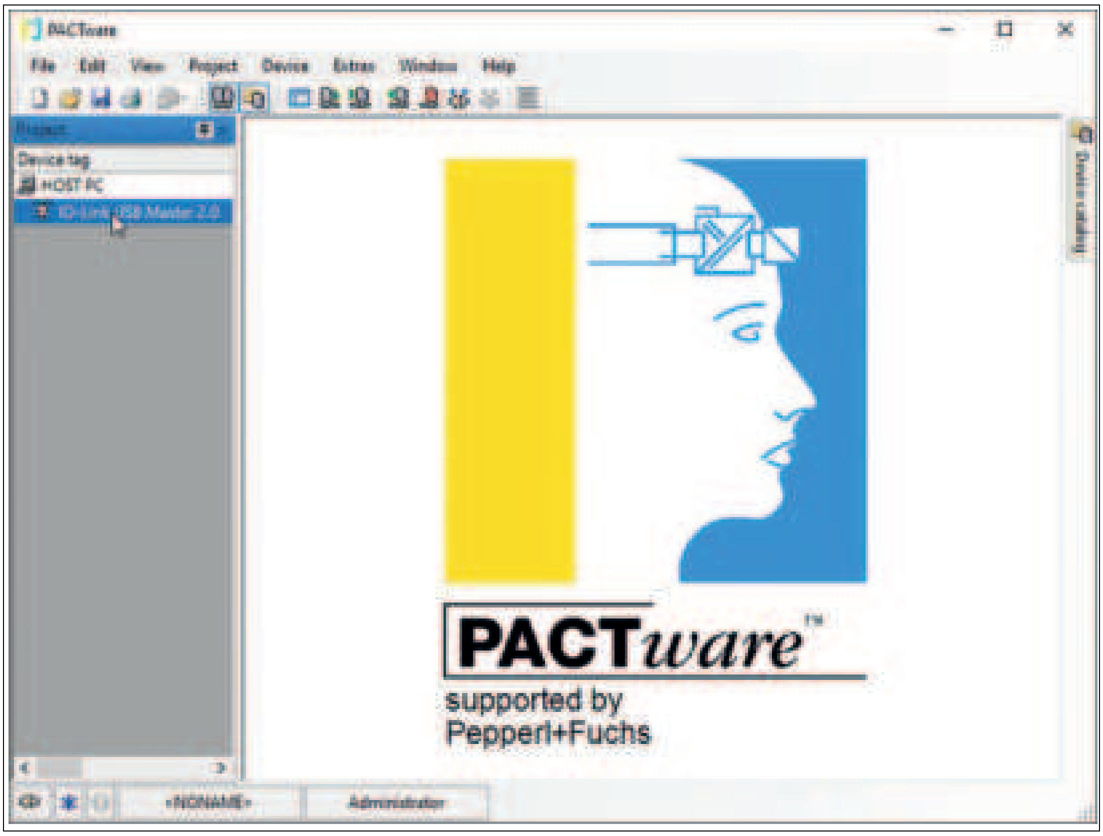

Figure 7.9

16. Right-click on the IO-Link master.
17. Select the "Add device" menu item.

↳ The "Device for" window opens.

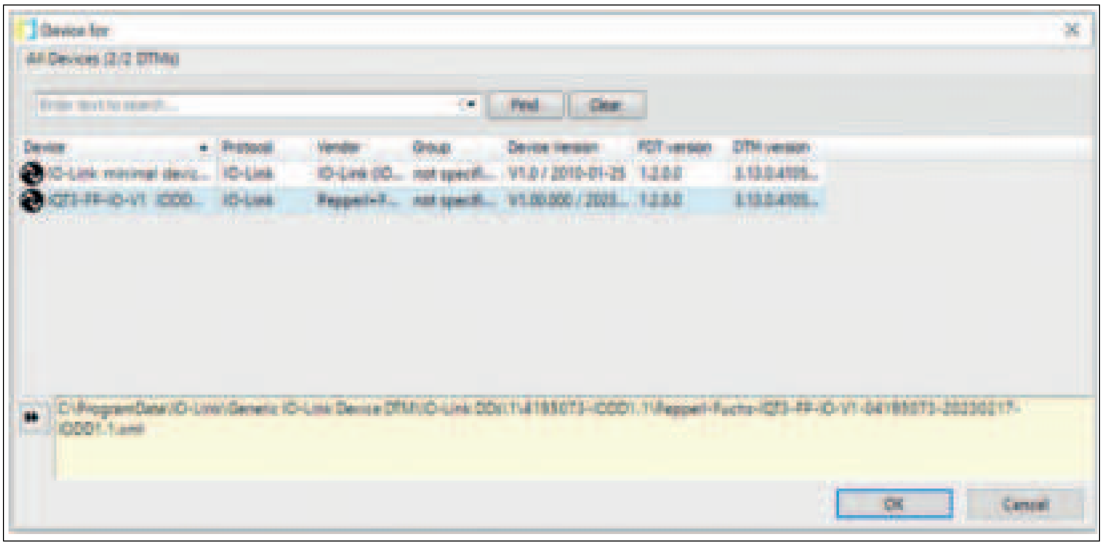

Figure 7.10

18. Select the required RFID read/write device.
19. Confirm with "OK."
20. Double-click the IO-Link device.

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↳ The Parameters menu opens.

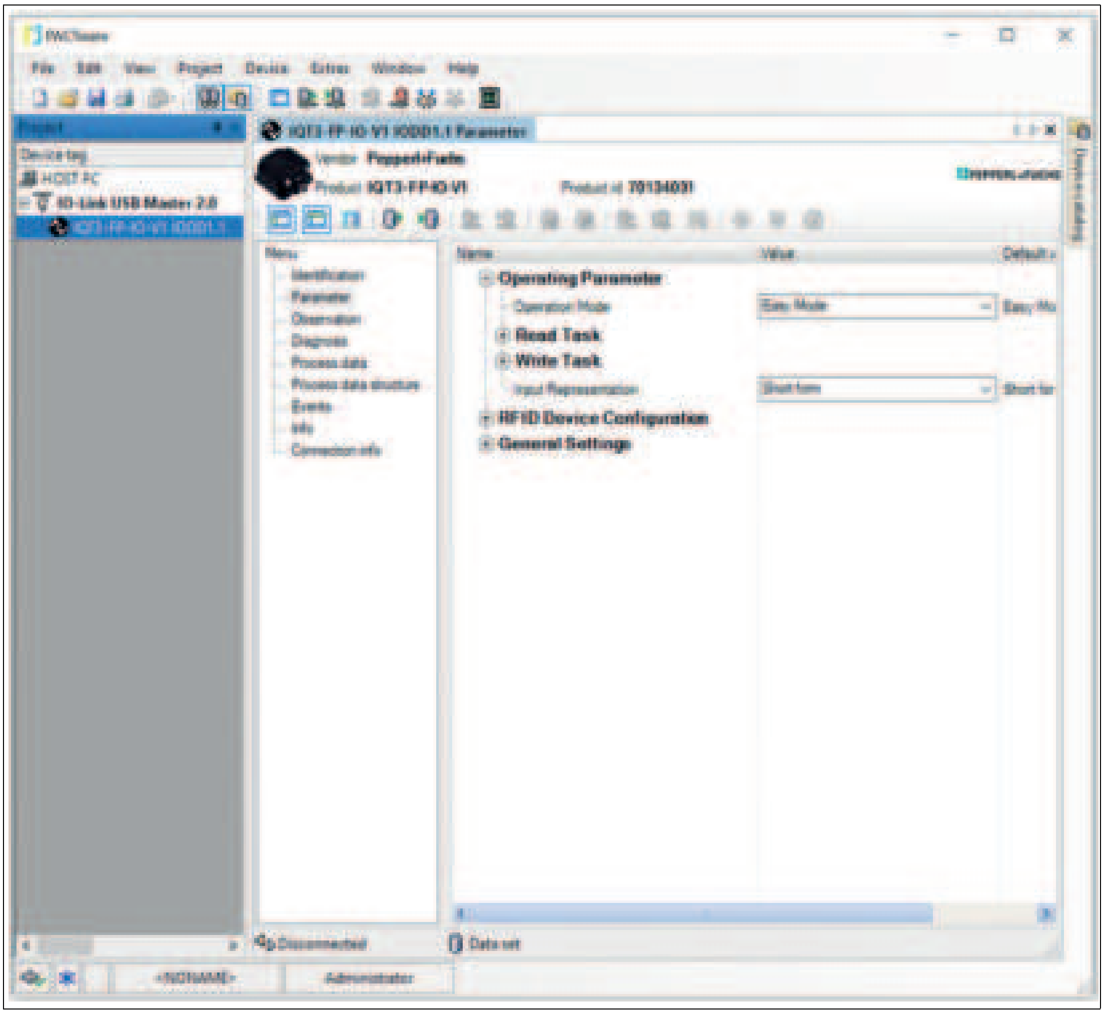

Figure 7.11

21. Right-click on the RFID read/write device and select the menu item "Connect."
22. Acknowledge the "Read from Device (Upload)?" dialog with "Yes."

↳ The parameter values displayed in PACTware are transferred to the device.

↳ A connection is established between the IO-Link master and the device.

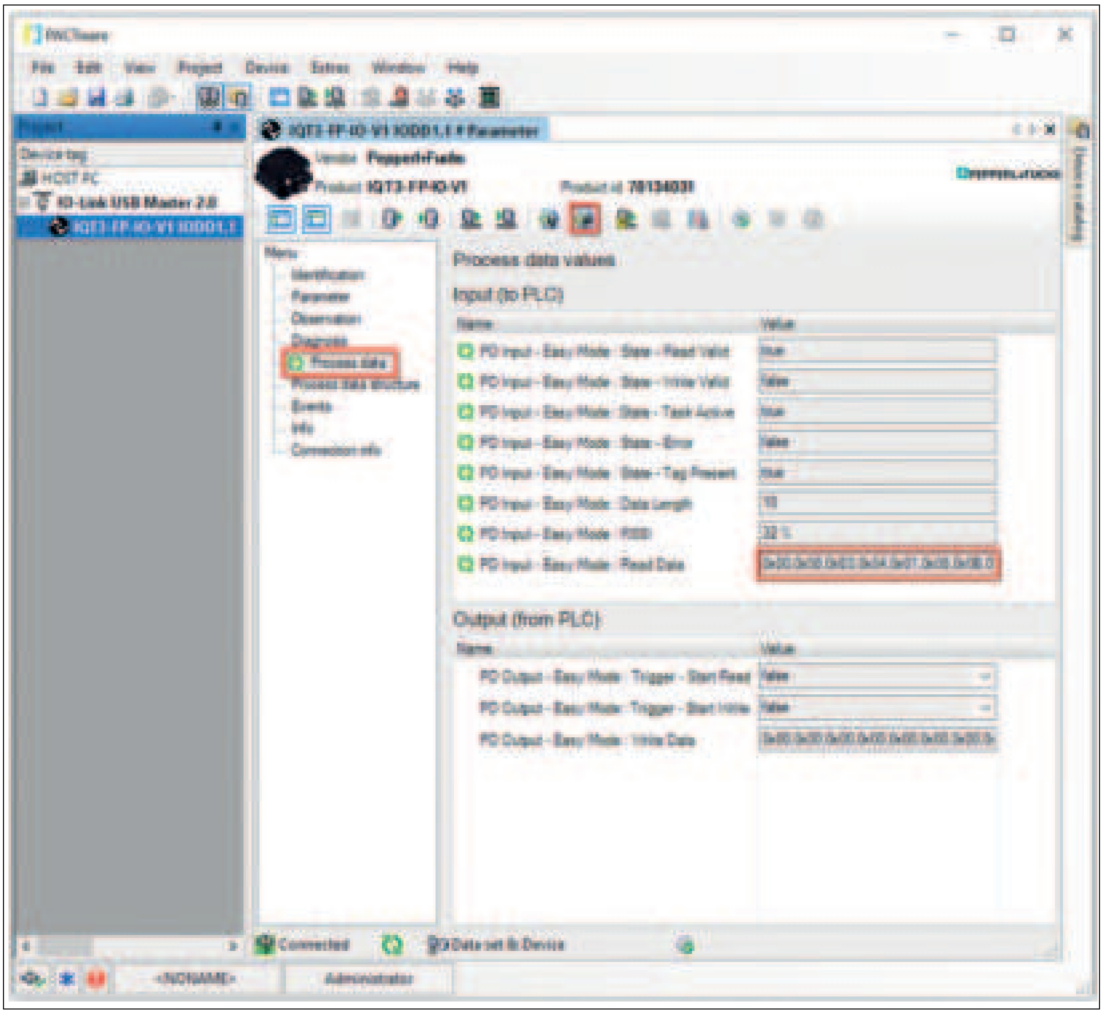

Figure 7.12

Tip

Activate the cyclic updating of the process data to display the data in PACTware.

As soon as a connection is established, the RFID read/write device automatically starts reading tags in the sensing range. The data is displayed in the input process data as per the set parameters under "Read Task."

1. Adjust the parameters of the device according to your application.
2. In the device selection menu, click on the Parameters entry.

   ↳ The Parameters menu opens.
3. Change the desired parameters and confirm the entry with the Enter key. Then click the "Write different values to device" icon.

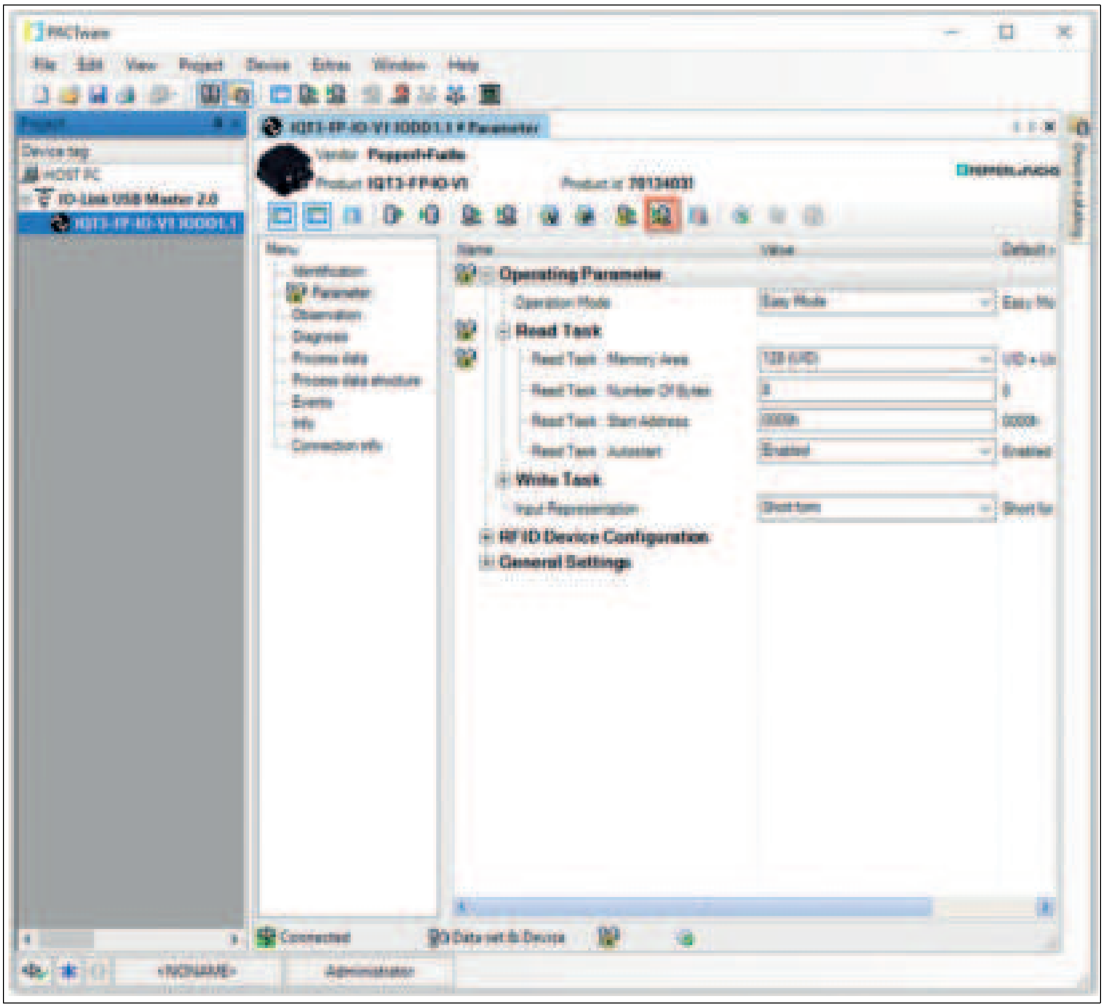
File
Edit
View
Project
Device
Extras
Window
Help
Vendor Pepperl+Fuchs
Operating Parameter
Read Task
Write Task
RFID Device Configuration
General Settings
Connected
Administrator

Figure 7.13

8 ExpertMode

8.1 Basic Command Process

As in Easy Mode, the length of the input and output process data is 32 bytes, see chapter 7. The commands are first combined to form a telegram. This telegram can be significantly longer than the set in/out length. The telegram is transmitted one after another using individual fragments. The maximum size of a fragment is 32 bytes. A handshake procedure controls the data transfer.

8.2 Legend

Name	Length	Meaning
<Number of Read/Write Tags>	4 bytes	The number of tags identified when a single read or write command is executed. The number of tags is encoded in ASCII format
<ByteAddress>	2 bytes	Start address for read/write access to the user memory of the tag. The value must be a multiple of 4.
<Command>	1 byte	Command code Identifier of the command to be executed
<ControlByte>	4 bits	Control bits for implementing the handshake procedure or deleting the device memory
<FragmentationCounter>	1 byte	Fragmentation counter Number of fragments still to be transmitted
<FrameLength>	12 bits	Number of valid bytes within the telegram
<Length User Data>	2 bytes	Length of user data Specifies the length of the data read in from the user memory bank
<LengthParameter>	2 bytes	Parameter length Specifies the length of the parameter data set to be transmitted to the device.
<Number of Bytes>	2 bytes	Number of bytes to be accessed during execution of a read or write command. The value must be a multiple of 4.
<ParameterData>	Variable length	Parameter data Parameter data set that was read or transmitted.
<ParameterName>	2 bytes	Device parameter name The device parameter name determines the LF parameter to be accessed.
<Status>	1 byte	Status byte Status information about the execution state of the command.
<SystemCode>	1 byte	System identifier The system identifier for the LF system is "P" (16#50).
<TelegramLength>	2 bytes	Length of telegram including all fragments
<Fixcode>	4/5 bytes	Unique Identifier Unique serial number of a tag
<User Data>	Variable length	Read-in data Data read in during read access to the user memory bank
<Write Data>	Variable length	Write data Data set to be transmitted to the tag.

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8.3 Structure of OUTPUT telegram

OUTPUT-Telegram

		Bit number							
Byte	Content	7	6	5	4	3	2	1	0
0	ControlByte / Frame Length	D_S	U_M	U_D	0	<FrameLength>			
1	Frame Length	<Frame Length>							
2	Fragmentation Counter	<Fragmentation Counter>							
3	Telegram Length (High Byte)[1]	<Telegram Length (High Byte)>							
4	Telegram Length (Low Byte)[1]	<Telegram Length (Low Byte)>							
5	Command[1]	<Command>							
6	Parameter / Data	<Data Byte 1>							
7	Parameter / Data	<Data Byte 2>							
8	Parameter / Data	...							
...	Parameter / Data	<Data Byte X>							
...	Parameter / Data	16#00							
...	Parameter / Data	...							
31	Parameter / Data	16#00							

Table 8.1

1. From the second fragment on, parameters / data are transmitted from byte 3.

The value of <Frame Length> depends on how many <Data Byte> data values must be transmitted to execute a command. This determines the length of the fragment up to and including <Data Byte X>. If no additional command parameters are required to execute the command, the length of the fragment extends up to <Command> and has the value 16#06.

<FragmentationCounter> has the value 16#00 because the command can be transmitted from the control panel via one fragment.

The <Telegram Length> specifies the length of the telegram, starting from the telegram length itself and including the <Data Byte X> byte. If no further command parameters are transmitted, the telegram ends with <Command>, and <Telegram Length> has the value 16#03.

The <Command> byte specifies the command to be executed. Different commands are executed depending on the value in <Command>. The commands are classified as follows:

- **Read/Write Commands:** Access to one or more tags in the sensing zone
- **System Commands:** Execution of device settings; no access to tags
- **LF Configuration Commands:** Setting of the device LF properties

<Data Byte> is used to transfer the data required to execute a command. This can include additional command parameters (e.g., start address) or user data to be written to a tag.

The unused areas within the telegram frame are set to the value 16#00.

8.4 Structure of INPUT telegram

INPUT-Telegram

Byte	Content	Bit Number							
		7	6	5	4	3	2	1	0
0	ControlByte / Frame Length	D_S	U_M	U_D	0	<FrameLength>			
1	Frame Length	<Frame Length>							
2	Fragmentation Counter	<Fragmentation Counter>							
3	Telegram Length (High Byte)[1]	<Telegram Length (High Byte)>							
4	Telegram Length (Low Byte)[1]	<Telegram Length (Low Byte)>							
5	Command[1]	<Command>							
6	Status	<Status>							
7	Parameter / Data	<Data Byte 1>							
8	Parameter / Data	<Data Byte 2>							
...	Parameter / Data	...							
...	Parameter / Data	<Data Byte X>							
...	Parameter / Data	0x00							
...	Parameter / Data	...							
31	Parameter / Data	0x00							

Table 8.2

1. From the second fragment on, parameters / data are transmitted from byte 3.

The value of <Frame Length> depends on how many <Data Byte> data values are returned by the device in the command response. This specifies the length of the fragment up to and including <Data Byte X>. If there are no additional data values in the command response, the length of the fragment extends to <Status> and has the value 16#07.

Because the command response can be transmitted from the controller via a fragment, the <Fragmentation Counter> has the value 16#00.

The <Telegram Length> specifies the length of the telegram, starting from the telegram length itself and including the <Data Byte X> byte. If no further response parameters are transmitted, the telegram ends with <Status>, and <Telegram Length> has the value 16#04.

The <Command> byte is the mirror of the command code from the command in the response.

The value within <Status> indicates the status of the command execution. The corresponding status values indicate fault states. .

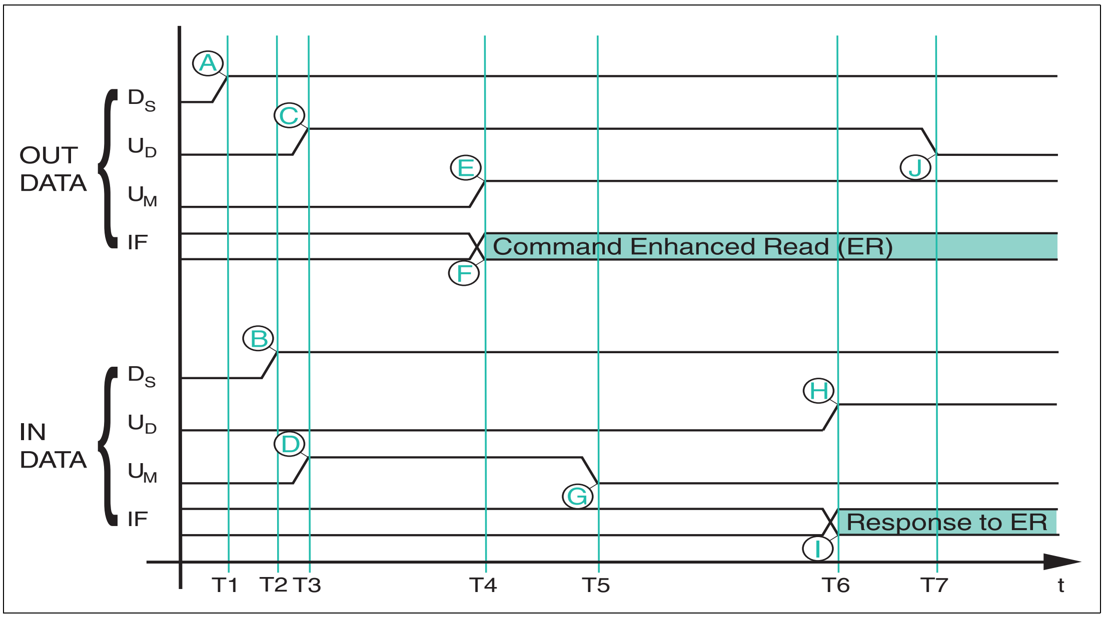
The data being transmitted from the device as a result of the command is returned in the <Data Byte> bytes. This could be data read from a tag or parameter values for the LF settings.

The unused areas within the response telegram are set to the value 16#00.

8.5 Handshake Procedure

Data flow between a PLC and the read/write device must be synchronized to ensure continuous data transfer with no losses. The input and output process data is transmitted in cycles. Controlling the data flow via the software is referred to as "handshaking." The necessary control bits are contained in the control byte (and).

The following handshake procedure transfers telegrams quickly and securely between the PLC and the device:



D_S	Delete bit; deletes internal memory of the device
U_M	Update master bit
U_D	Update device bit
T1	The PLC changes the delete bit D_S in the output process data to High (**A**), which deletes the FIFO memory in the device.
T2	The read/write station changes the delete bit in the input process data (**B**) in response and deletes the entire contents of the FIFO memory
T3	The PLC mirrors the inverted state of U_D-INPUT from the input field to the output field (**C**). Likewise, the device mirrors the inverted state of U_M-OUTPUT to the input field (**D**). Both communication partners are indicating that they are ready to receive a telegram.
T4	The PLC enters an Enhanced Read command (ER) in IF-OUT (**I**dent **F**rame) (F). At the same time, the PLC applies U_M-INPUT in U_M-OUTPUT (**E**) and thus indicates the validity of a new telegram.
T5	The device mirrors the inverted state of U_M-OUTPUT to U_M-INPUT (**G**). This informs the control panel that the telegram has been received.
T6	The device has processed the ER and enters the response to the command in the input field (**I**). In the same telegram, U_D-OUTPUT is mirrored in U_D-INPUT (**H**).
T7	The PLC has received the changed U_D-INPUT and mirrors the inverted state in U_D-OUTPUT (**J**). Only now can the device send another telegram.

Sample Implementation in the Controller

Device delete bit D_S:

Once the device is ready for operation (IO-Link communication = OK), this instruction must be executed once. The internal telegram memory is deleted as a result of this. The internal telegram memory should be deleted if an internal device fault has occurred.

D_S_OUTPUT := NOT D_S_INPUT

Device update bit U_D:

New, valid data will be in the input process data if U_D bits in the input and output process data have the same value. The device writes new read data to the input process data only once the PLC has read the input process data, i.e., the U_D bit in the input and output process data has an inverted signal state.

To prevent transmission of the read data from being blocked, the inverted state of the U_D bit must be transmitted from the input process data to the U_D bit of the output process data in each cycle.

U_D_OUTPUT := NOT U_D_INPUT (* copy the inverted update bit from the INPUT telegram to the OUTPUT telegram *)

Master update bit U_M:

The device must be ready to receive new telegrams before a command is sent. This is the case if the U_M bit in the input and output process data has an inverted signal state.

The command parameters must then be transmitted to the corresponding positions in the output process data.

The PLC transfers the new command to the device once the U_M bit in the output process data is set to the same signal state as the U_M bit in the input process data.

OUTPUT[1..x] := new telegram

IF (U_M_OUTPUT <> U_M_INPUT) then (* check whether the device can receive new data *)

U_M_OUTPUT := U_M_INPUT (* device is ready to receive, transfer of update bit *)

End_IF

8.6 Overview of Commands

The commands in the list are described in detail on the following pages.

Read/Write Commands

Abbreviation	Command code	Command description
SF	16#01	Single Read Fixcode see "Single Read Fixcode (SF)" on page 39 One-time read access to the Fixcode
EF	16#1D	Enhanced Read Fixcode see "Enhanced Read Fixcode (EF)" on page 41 Permanent read access to the Fixcode
SR	16#10	Single Read Words see "Single Read Words (SR)" on page 42 One-time read access to the user data area
ER	16#19	Enhanced Read Words see "Enhanced Read Words (ER)" on page 44 Permanent read access to the user data area

Abbreviation	Command code	Command description
SW	16#40	Single Write Words see "Single Write Words (SW)" on page 46 One-time write access to the user data area
EW	16#1A	Enhanced Write Words see "Enhanced Write Words (EW)" on page 48 Permanent write access to the user data area

System Commands

Abbreviation	Command code	Command description
QU	16#02	Quit see "Quit (QU)" on page 50 Cancels an active enhanced command
VE	16#03	Version see "Version (VE)" on page 51 Reads out the firmware version
CT	16#04	Change tag see "Change Tag (CT)" on page 52 Set the tag type

Configuration Commands

Abbreviation	Command code	Command description
RP	16#BE	Read parameter see "Read Parameter (RP)" on page 53 Reads out the device parameters
WP	16#BF	Write parameter see "Write Parameter (WP)" on page 54 Sets device parameters

8.6.1 Read/Write Commands

The following commands and responses are described using the long-form data format. The end of a single command is signaled back via a STATUS 16#0F telegram. When using the short-form data format, the ready-only code and the additional length information are omitted. The end of an enhanced command is not signaled back.

Single Read Fixcode (SF)

The "Single Read Fixcode" command has the command code 16#01 and performs a one-time read operation on the read-only code Fixcode of a tag within the sensing zone. The information is transmitted for the tag in one data telegram with the status value 16#00. The end of the command execution is indicated by an end telegram. The end telegram has the status value 16#0F and contains the number of tags identified during execution of the command.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#06							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#03							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 5	Command	16#01							
Byte 6	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.3

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response: Data telegram, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0D							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#0A							
Byte 5	Command	16#01							
Byte 6	Status	16#00							
Byte 7	Lenght Fixcode High Byte	16#00							
Byte 8	Lenght Fixcode Low Byte	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.4

Response: End of command, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#01							
Byte 6	Status	16#0F							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 7	Data	<Number of Tags Byte 1>							
Byte 8	Data	<Number of Tags Byte 2>							
Byte 9	Data	<Number of Tags Byte 3>							
Byte 10	Data	<Number of Tags Byte 4>							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.5

Enhanced Read Fixcode (EF)

The "Enhanced Read Fixcode" command has the command code 16#1D and performs a permanent read operation on the read-only code of a tag within the sensing zone. The information is transmitted for the tag in one data telegram with the status value 16#00. A tag leaving the sensing zone is indicated by a telegram containing the Fixcode of the tag. This telegram has the status value 16#05. A Quit command stops the command execution.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#06							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#03							
Byte 5	Command	16#1D							
Byte 6	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.6

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response: Data telegram, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0D							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#0A							
Byte 5	Command	16#1D							

		Bit number							
Byte	**Content**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 6	Status	16#00							
Byte 7	Length Fixcode (High Byte)	16#00							
Byte 8	Length Fixcode (Low Byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.7

Response: Tag has left sensing zone, long-form data format

		Bit number							
Byte	**Content**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0D							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#0A							
Byte 5	Command	16#1D							
Byte 6	Status	16#05							
Byte 7	Length Fixcode (High Byte)	16#00							
Byte 8	Length Fixcode (Low Byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.8

Single Read Words (SR)

The "Single Read Words" command has the command code 16#10 and performs a one-time read access to the user data area of a tag within the sensing range. The information is transmitted for the tag in one data telegram with the status value 16#00. The end of the command execution is indicated by an end telegram. The end telegram has the status value 16#0F and contains the number of tags that were identified during execution of the command.

The <ByteAddress> parameter specifies the start address within the user data area. The value of <ByteAddress> is based on bytes. Only multiples of the memory block size can be parameterized. <Number of Bytes> defines the number of bytes to be read. The number of bytes must be a multiple of the memory block size.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0A							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#07							
Byte 5	Command	16#10							
Byte 6	Parameter	<ByteAddress (High Byte)>							
Byte 7	Parameter	<ByteAddress (Low Byte)>							
Byte 8	Parameter	<Number of Bytes (High Byte)>							
Byte 9	Parameter	<Number of Bytes (Low Byte)>							
Byte 10	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.9

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response: Data telegram, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	<FrameLength>							
Byte 2	Fragmentation counter	<FragmentationCounter>							
Byte 3	Telegram length (High byte)	<TelegramLength (High Byte)>							
Byte 4	Telegram length (Low byte)	<TelegramLength (Low Byte)>							
Byte 5	Command	16#10							
Byte 6	Status	16#00							
Byte 7	Length Fixcode (High Byte)	16#00							
Byte 8	Length Fixcode (Low Byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Data	<Length User Data (High Byte)>							
Byte 14	Data	<Length User Data (Low Byte)>							
Byte 15	Data	<User Data Byte 1>							
Byte 16	Data	<User Data Byte 2>							
Byte 17	Data	<User Data Byte 3>							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 18	Data	<User Data Byte 4>							
etc.	Data	etc.							
etc.	Data	<User Data Byte X>							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.10

Response: End of command, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#10							
Byte 6	Status	16#0F							
Byte 7	Data	<Number of Tags Byte 1>							
Byte 8	Data	<Number of Tags Byte 2>							
Byte 9	Data	<Number of Tags Byte 3>							
Byte 10	Data	<Number of Tags Byte 4>							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.11

Enhanced Read Words (ER)

The command "Enhanced Read Words" has the command code 16#19 and performs a permanent read access to the user data area of a tag within the sensing zone. The information is transmitted for the tag in one data telegram with the status value 16#00. A tag leaving the sensing zone is indicated by a telegram containing the read-only code of the tag. This telegram has the status value 16#05. A Quit command stops the command execution.

The <ByteAddress> parameter specifies the start address within the user data area. The value of <ByteAddress> is based on bytes. Only multiples of the memory block size can be parameterized. <Number of Bytes> defines the number of bytes to be read. The number of bytes must be a multiple of the memory block size.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0A							
Byte 2	Fragmentation counter	16#00							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#07							
Byte 5	Command	16#19							
Byte 6	Parameter	<ByteAddress (High Byte)>							
Byte 7	Parameter	<ByteAddress (Low Byte)>							
Byte 8	Parameter	<Number of Bytes (High Byte)>							
Byte 9	Parameter	<Number of Bytes (Low Byte)>							
Byte 10	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.12

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response: Data telegram, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	<FrameLength>							
Byte 2	Fragmentation counter	<FragmentationCounter>							
Byte 3	Telegram length (High byte)	<TelegramLength (High Byte)>							
Byte 4	Telegram length (Low byte)	<TelegramLength (Low Byte)>							
Byte 5	Command	16#19							
Byte 6	Status	16#00							
Byte 7	Length Fixcode (High Byte)	16#00							
Byte 8	Length Fixcode (Low Byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Data	<Length User Data (High Byte)>							
Byte 14	Data	<Length User Data (Low Byte)>							
Byte 15	Data	<User Data Byte 1>							
Byte 16	Data	<User Data Byte 2>							
Byte 17	Data	<User Data Byte 3>							
Byte 18	Data	<User Data Byte 4>							
etc.	Data	etc.							
etc.	Data	<User Data Byte X>							
etc.	Not relevant	16#00							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 31	Not relevant	16#00							

Table 8.13

Response: Tag has left sensing zone, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#11							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#0E							
Byte 5	Command	16#19							
Byte 6	Status	16#05							
Byte 7	Length Fixcode (High Byte)	16#00							
Byte 8	Length Fixcode (Low Byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.14

Single Write Words (SW)

The "Single Write Words" command has the command code 16#40 and performs a one-time write operation to the user data area of a tag within the sensing range. A separate data telegram with the status value 16#00 indicates a successful write operation for each tag described. The data telegram contains the read-only code of the tag to which the user data area was written. The end of the command execution is indicated by an end telegram. The final telegram has the status value 16#0F and contains the number of tags that were written during execution of the command.

The <ByteAddress> parameter specifies the start address within the user data area. The value of <ByteAddress> is based on bytes. Only multiples of the memory block size can be parameterized. <Number of Bytes> defines the number of bytes to be written. The number of bytes must be a multiple of the memory block size.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	<FrameLength>							
Byte 2	Fragmentation counter	<FragmentationCounter>							
Byte 3	Telegram length (High byte)	<TelegramLength (High Byte)>							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 4	Telegram length (Low byte)	<TelegramLength (Low Byte)>							
Byte 5	Command	16#40							
Byte 6	Parameter	<Byte Address (High Byte)>							
Byte 7	Parameter	<Byte Address (Low Byte)>							
Byte 8	Parameter	<Number of Bytes (High Byte)>							
Byte 9	Parameter	<Number of Bytes (Low Byte)>							
Byte 10	Data	<Write Data Byte 1>							
Byte 11	Data	<Write Data Byte 2>							
Byte 12	Data	<Write Data Byte 3>							
Byte 13	Data	<Write Data Byte 4>							
etc.	Data	etc.							
etc.	Data	<Write Data Byte X>							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.15

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response: Data telegram, data successfully written, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0D							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#0A							
Byte 5	Command	16#40							
Byte 6	Status	16#00							
Byte 7	Length Fixcode (High Byte)	16#00							
Byte 8	Length Fixcode (Low Byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.16

Response: End of command, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#40							
Byte 6	Status	16#0F							
Byte 7	Data	<Number of Tags Byte 1>							
Byte 8	Data	<Number of Tags Byte 2>							
Byte 9	Data	<Number of Tags Byte 3>							
Byte 10	Data	<Number of Tags Byte 4>							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.17

Enhanced Write Words (EW)

The "Enhanced Write Words" command has the command code 16#1A and performs a permanent write operation to the user data area of a tag within the sensing range. A separate data telegram with the status value 16#00 indicates a successful write operation for each tag described. The data telegram contains the read-only code of the tags on which the user data area was written. A tag leaving the sensing zone is indicated by a telegram containing the read-only code of the tag. This telegram has the status value 16#05. A Quit command stops the command execution.

The <ByteAddress> parameter specifies the start address within the user data area. The value of <ByteAddress> is based on bytes. Only multiples of the memory block size can be parameterized. <Number of Bytes> defines the number of bytes to be written. The number of bytes must also be a multiple of the memory block size.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	<FrameLength>							
Byte 2	Fragmentation counter	<Fragmentation Counter>							
Byte 3	Telegram length (High byte)	<TelegramLength (High Byte)>							
Byte 4	Telegram length (Low byte)	<TelegramLength (Low Byte)>							
Byte 5	Command	16#1A							
Byte 6	Parameter	<Byte Address (High Byte)>							
Byte 7	Parameter	<Byte Address (Low Byte)>							
Byte 8	Parameter	<Number of Bytes (High Byte)>							
Byte 9	Parameter	<Number of Bytes (Low Byte)>							
Byte 10	Data	<Write Data Byte 1>							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 11	Data	<Write Data Byte 2>							
Byte 12	Data	<Write Data Byte 3>							
Byte 13	Data	<Write Data Byte 4>							
etc.	Data	etc.							
etc.	Data	<Write Data Byte X>							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.18

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response: Data successfully written, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0D							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#0A							
Byte 5	Command	16#1A							
Byte 6	Status	16#00							
Byte 7	Lenght Fixcode (High byte)	16#00							
Byte 8	Lenght Fixcode (Low byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.19

Response: Tag has left sensing zone, long-form data format

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0D							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 4	Telegram length (Low byte)	16#0A							
Byte 5	Command	16#1A							
Byte 6	Status	16#05							
Byte 7	Length Fixcode (High Byte)	16#00							
Byte 8	Length Fixcode (Low Byte)	16#04							
Byte 9	Data	<Fixcode Byte 1>							
Byte 10	Data	<Fixcode Byte 2>							
Byte 11	Data	<Fixcode Byte 3>							
Byte 12	Data	<Fixcode Byte 4>							
Byte 13	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.20

8.6.2 System Commands

Quit (QU)

The "Quit" command has the command code 16#02 and stops the execution of an active command on the device. This terminates the enhanced read or enhanced write commands. Successful execution of the command is indicated by a telegram with the status value 16#00.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#06							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#03							
Byte 5	Command	16#02							
Byte 6	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.21

Response: End of command

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#07							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 4	Telegram length (Low byte)	16#04							
Byte 5	Command	16#02							
Byte 6	Status	16#00							
Byte 7	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.22

Version (VE)

The "VE" command has the command code 16#03 and reads out the device firmware version.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#06							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#03							
Byte 5	Command	16#03							
Byte 6	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.23

Response: End of command

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	<Frame Length>							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	<Telegram Length (High Byte)>							
Byte 4	Telegram length (Low byte)	<Telegram Length (Low Byte)>							
Byte 5	Command	16#03							
Byte 6	Status	16#00							
Byte 7	Version byte 1	16#XX							
etc.	etc.	16#XX							
Byte X	Version byte X	16#XX							
Byte 31	Not relevant	16#00							

Table 8.24

Change Tag (CT)

The command "CT" has the command code 16#04 and configures the tag type with which the read/write device is communicating. The delivery status is type "03."

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#07							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#04							
Byte 5	Command	16#04							
Byte 6	TagType	16#03							
Byte 7	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.25

Response: End of command

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#07							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#04							
Byte 5	Command	16#04							
Byte 6	Status	16#00							
Byte 7	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.26

The tag type can also be set via a parameter, see "Change Tag (CT) Tag Type" on page 55.

8.6.3 LF Configuration Commands

The "Read Parameter" and "Write Parameter" configuration commands can be used to read or change the parameters of the device. This allows the behavior of the device to be adjusted using the radio interface.

All parameter values are stored in a non-volatile memory and remain unchanged after a power interruption. The response to a configuration command is a status message from the read/write device. During the read operation, a status message and the corresponding data are received as the response.

A system code is required to access the LF parameters on the device. This distinguishes between other systems in which parameters can be changed. This device uses the system code "P" (16#50).

8.6.3.1 Basic Command Structure

Read Parameter (RP)

The "Read Parameter" (RP) command has the command code 16#BE and is used to read a parameter from the LF settings.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	<FrameLength>			
Byte 1	Frame length	<FrameLength>							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	<TelegramLength (High Byte)>							
Byte 4	Telegram length (Low byte)	<TelegramLength (Low Byte)>							
Byte 5	Command	16#BE							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	<ParameterName (High Byte)>							
Byte 8	Parameter name (Low byte)	<ParameterName (Low Byte)>							
Byte 9	Length parameter (High byte)	<ParameterLength (High Byte)>							
Byte 10	Length parameter (Low byte)	<ParameterLength (Low Byte)>							
Byte 11	Parameter data byte 1	<Parameter Data Byte 1>							
Byte 12	Parameter data byte 2	<Parameter Data Byte 2>							
etc.	etc.	etc.							
etc.	Parameter data byte X	<Parameter Data Byte X>							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.27

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	<FrameLength>			
Byte 1	Frame length	<FrameLength>							
Byte 2	Fragmentation counter	<FragmentationCounter>							
Byte 3	Telegram length (High byte)	<TelegramLength (High Byte)>							
Byte 4	Telegram length (Low byte)	<TelegramLength (Low Byte)>							
Byte 5	Command	16#BE							
Byte 6	Status	<Status>							
Byte 7	Parameter data byte 1	<Parameter Data Byte 1>							
Byte 8	Parameter data byte 2	<Parameter Data Byte 2>							
etc.	etc.	etc.							
etc.	Parameter data byte X	<Parameter Data Byte X>							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.28

Write Parameter (WP)

The "Write Parameter" (WP) command has the command code 16#BF. This command can be used to change the parameters of the LF setting.

Command:

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	<FrameLength>			
Byte 1	Frame length	<FrameLength>							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	<TelegramLength (High Byte)>							
Byte 4	Telegram length (Low byte)	<TelegramLength (Low Byte)>							
Byte 5	Command	16#BF							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	<ParameterName (High Byte)>							
Byte 8	Parameter name (Low byte)	<ParameterName (Low Byte)>							
Byte 9	Length parameter (High byte)	<LengthParameter (High Byte)>							
Byte 10	Length parameter (Low byte)	<LengthParameter (Low Byte)>							
Byte 11	Parameter data byte 1	<Parameter Data Byte 1>							
Byte 12	Parameter data byte 2	<Parameter Data Byte 2>							
etc.	etc.	etc.							
etc.	Parameter data byte X	<Parameter Data Byte X>							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.29

Note

Set the non-relevant bytes of the command fragment to the value 16#00.

Response:

Byte	Content	Bit number 7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#07							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#04							
Byte 5	Command	16#BF							
Byte 6	Status	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.30

8.6.3.2 Parameter Overview

With the "Read Parameter" (RP) and "Write Parameter" (WP) commands, you can read/write the following parameters:

Parameter abbreviation	Parameter name/Function	Parameter is readable/writeable
CT 16#4354	See "Change Tag (CT) Tag Type" on page 55 Setting the tag type	Readable/writeable
E5 16#4535	See "Number of Unsuccessful Attempts until Status 5 "Enhanced Status 5 (E5)"" on page 57 Setting the number of unsuccessful attempts up to Status 5	Readable/writeable
OH 16#4F48	See "Operating Hours (OH)" on page 59 Reading the operating hours	Readable
RD 16#5244	See "Resetting to Factory Setting "Reset to Default (RD)"" on page 60 Reset to Default	Writeable
ST 16#5354	See "Status Query "Status Frontend (ST)"" on page 61 Output of the status of the front end	Readable
TA 16#5441	See "Number of Tries Allowed (TA) Access Attempts" on page 62 Number of Attempts setting	Readable/writeable
TE 16#5445	See "Status Query "Temperature Output (TE)"" on page 64 Output of the internal temperature	Readable

Table 8.31

Change Tag (CT) Tag Type

The CT parameter sets the type of tag with which the read/write device communicates.

Parameter character	CT (16#4354)
Length of CT parameter value	1 byte
Factory setting	16#03
Value range	16#02 ... 16#03; 16#11

For example: Command telegram to change the tag type to the value 16#03 (IPC03)

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0C							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#09							
Byte 5	Command	16#BF							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#43 "C"							
Byte 8	Parameter name (Low byte)	16#54 "T"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#01							
Byte 11	CT parameter	16#03							
Byte 12	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.32

For example: Command telegram to read out the tag type

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#BE							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#43 "C"							
Byte 8	Parameter name (Low byte)	16#54 "T"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#00							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.33

For example: Response telegram with the set tag type = 03 (16#03)

Byte	Content	Bit number 7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#05							
Byte 5	Command	16#BE							
Byte 6	Status	16#00							
Byte 7	CT parameter	16#03							
Byte 8	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.34

Note

The tag type can also be changed using the CT system command see "Change Tag (CT)" on page 52.

Number of Unsuccessful Attempts until Status 5 "Enhanced Status 5 (E5)"

The E5 parameter sets the number of unsuccessful write/read attempts when executing an Enhanced command before the device outputs the telegram with the status value 16#05. Via the telegram with the status 16#05 the device indicates that a tag has left the sensing range or could no longer be identified.

This parameter is only used when performing enhanced commands. When executing single commands, the parameter has no significance.

Parameter character	E5 (16#4535)
Length of E5 parameter value	1 byte
Factory setting	16#02 = 2 unsuccessful read/write attempts
Value range	16#00 ... 16#0A = 0 ... 10 unsuccessful read/write attempts

The value for the E5 parameter can be increased if communication between the tag and the device is unstable. This reduces the number of telegrams with status 16#05 received. In dynamic applications, parameters can be used to bridge gaps in the sensing range without receiving a status 16#05 message if there are minor interruptions in tag communication. The sensing zone appears more homogeneous.

Reducing the parameter value E5 shortens the reaction time of the system when a tag leaves the sensing range. The status 16#05 telegrams are sent quicker.

The transmission of the following telegrams is not affected by the E5 parameter setting and they are transmitted immediately:

- Status 16#00: Execution successful; data read or written

For example: Command telegram to change the E5 settings to a value of 10 (16#0A)

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0C							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#09							
Byte 5	Command	16#BF							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#45 "E"							
Byte 8	Parameter name (Low byte)	16#35 "5"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#01							
Byte 11	E5 parameter	16#0A							
Byte 12	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.35

For example: Command telegram to read the E5 settings

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#BE							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#45 "E"							
Byte 8	Parameter name (Low byte)	16#35 "5"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#00							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.36

For example: Response telegram with the E5 parameter value (16#05) set

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#08							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (How byte)	16#05							
Byte 5	Command	16#BE							
Byte 6	Status	16#00							
Byte 7	E5 parameter	16#05							
Byte 8	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.37

Operating Hours (OH)

The OH parameter outputs the information about how long the read/write device is in operation and how long a read/write command is running.

Parameter character	OH(16#4F48)
Length of OH parameter value	8 bytes • Byte 1–4: Read/write device operating time in hours[1] • Byte 5–8: Operating time read/write commands in hours[2]

1. IO-Link communication active
2. Read/write command active

For example: Command telegram to read OH

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#BF							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#4F "O"							
Byte 8	Parameter name (Low byte)	16#48 "H"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#00							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 31	Not relevant	16#00							

Table 8.38

For example: Response telegram with the operating hours

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0E							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#0C							
Byte 5	Command	16#BE							
Byte 6	Status	16#00							
Byte 7	Parameter OH (Byte 1)	16#00							
Byte 8	Parameter OH (Byte 2)	16#00							
Byte 9	Parameter OH (Byte 3)	16#00							
Byte 10	Parameter OH (Byte 4)	16#53 = 83_{dec} hours							
Byte 11	Parameter OH (Byte 5)	16#00							
Byte 12	Parameter OH (Byte 6)	16#00							
Byte 13	Parameter OH (Byte 7)	16#00							
Byte 14	Parameter OH (Byte 8)	16#03 = 3_{dec} hours							
Byte 15	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.39

The operating time of the read/write device is 83_{dec} hours (16#00000053). The duration of the read/write commands is 3_{dec} hours (16#00000003).

Resetting to Factory Setting "Reset to Default (RD)"

The RD parameter resets the device to the factory setting. The RD parameter is written in the process. Read access to this parameter is not possible.

Parameter character	RD (16#5244)

Table 8.40

For example: Command telegram for resetting to the factory settings

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_S	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#BE							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#52 "R"							
Byte 8	Parameter name (Low byte)	16#44 "D"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#00							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.41

Factory setting

Abbrevia-tion	Parameter	Default value
CT	Tag type CT	16#03 (IPC03)
E5	Number of unsuccessful attempts up to Status 5	16#02
TA	Number of Attempts, "Tries Allowed" TA	16#02

Table 8.42

Status Query "Status Frontend (ST)"

The ST parameter reads the operating status of the read/write device.

Parameter character	ST (16#5354)
Length of ST parameter value	2 bytes
Value range	16#01 = Interference 16#02 = Detuning due to surrounding metal 16#04 = Excess temperature warning, internal temperature between 80 – 85 °C. 16#08 = Excess temperature error, internal temperature > 85 °C.

For example: Command telegram to read out the status

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (high byte)	16#00							
Byte 4	Telegram length (low byte)	16#08							
Byte 5	Command	16#BF							
Byte 6	System code	16#51 "Q"							

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 7	Parameter name (high byte)	16#53 "S"							
Byte 8	Parameter name (low byte)	16#54 "T"							
Byte 9	Length parameter (high byte)	16#00							
Byte 10	Length parameter (low byte)	16#00							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.43

For example: Response telegram with operating status ST

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#09							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (high byte)	16#00							
Byte 4	Telegram length (low byte)	16#06							
Byte 5	Command	16#BE							
Byte 6	Status	16#00							
Byte 7	ST parameter (high byte)	16#00[1]							
Byte 8	ST parameter (low byte)	16#02[2]							
Byte 9	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.44

1. Current status = no message
2. Stored status since last reading = coil detuned by metal

Number of Tries Allowed (TA) Access Attempts

The tries allowed (TA) parameter sets the number of access attempts during execution of a read/write operation on a tag.

Parameter character	TA (16#5441)
Length of TA parameter value	1 byte
Factory setting	16#02 → 2 access attempts
Value range	16#01 … 16#0A

This parameter affects the execution time of write and read commands. If the tries allowed parameter value is increased, the execution time for a command also increases, because more access attempts are made.

By increasing the parameter value, the reliability for writing and reading tag data can be increased if communication between the device and tag is unstable.

For example: Command telegram to change TA to a value of 5

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0C							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#09							
Byte 5	Command	16#BF							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#54 "T"							
Byte 8	Parameter name (Low byte)	16#41 "A"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#01							
Byte 11	TA parameter	16#05							
Byte 12	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.45

For example: Command telegram to read TA

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#08							
Byte 5	Command	16#BE							
Byte 6	System code	16#50 "P"							
Byte 7	Parameter name (High byte)	16#54 "T"							
Byte 8	Parameter name (Low byte)	16#41 "A"							
Byte 9	Length parameter (High byte)	16#00							
Byte 10	Length parameter (Low byte)	16#00							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.46

For example: Response telegram with the set value 16#02 of TA

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#08							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (High byte)	16#00							
Byte 4	Telegram length (Low byte)	16#05							
Byte 5	Command	16#BE							
Byte 6	Status	16#00							
Byte 7	TA parameter	16#02							
Byte 8	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.47

Status Query "Temperature Output (TE)"

The TE parameter indicates the internal temperature of the read/write device.

Parameter character	TE (16#5445)
Length of TE parameter value	2 bytes • Byte 1: Temperature on the power amplifier • Byte 2: Temperature on the microcontroller

For example: Command telegram to read the temperature

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#0B							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (high byte)	16#00							
Byte 4	Telegram length (low byte)	16#08							
Byte 5	Command	16#BF							
Byte 6	System code	16#51 "Q"							
Byte 7	Parameter name (high byte)	16#54 "T"							
Byte 8	Parameter name (low byte)	16#45 "E"							
Byte 9	Length parameter (high byte)	16#00							
Byte 10	Length parameter (low byte)	16#00							
Byte 11	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.48

For example: Response telegram with the temperature TE

Byte	Content	Bit number							
		7	6	5	4	3	2	1	0
Byte 0	Control byte / frame length	D_S	U_M	U_D	0	16#0			
Byte 1	Frame length	16#09							
Byte 2	Fragmentation counter	16#00							
Byte 3	Telegram length (high byte)	16#00							
Byte 4	Telegram length (low byte)	16#06							
Byte 5	Command	16#BE							
Byte 6	Status	16#00							
Byte 7	TE parameter	16#20[1]							
Byte 8	TE parameter	16#1E[2]							
Byte 9	Not relevant	16#00							
etc.	Not relevant	16#00							
Byte 31	Not relevant	16#00							

Table 8.49

1. 32_{dec} °C.

2. 30_{dec} °C.

8.7 Error / Status Messages

Status	Meaning
16#00	The command was executed correctly.
16#01	Excess temperature
16#04	Parameter error If this status message is received immediately after the command is sent, a parameter within the command is outside the value range or the telegram structure is incorrect.
16#05	The tag has left the sensing zone.
16#06	Hardware error, e.g., error on self test or device defect.
16#07	Internal device error
16#0E	Buffer overflow The size of the internal telegram memory has been exceeded. The device generated telegrams faster than could be transmitted to the controller. The telegram memory is deleted by inverting the delete bit. In addition, the functionality of the handshake procedure must be checked.
16#0F	Indicates the end of an output in the multiframe protocol.

9 Appendix

9.1 Fault Repair

Index	Description	Solution
1	No blue LED on; only the green LED flashes	Is the auto-start function active?
2	No orange LED if tag is within the sensing range	Is the matching tag type set? Read out the IO-Link parameter Tag Type (Index 106) and compare the result with the tag list. Does the number of bytes fit with the block length of the tag?
3	No flashing green LED	Is the IO-Link configuration of the master correct? Is the IO-Link version V1.1 supported? Is the connection cable connected correctly?
4	Byte 0 of the input data field contains 0x40	This value indicates that the Expert Mode is enabled. In this case, the value of the "Operation Mode" IO-Link parameter is 0x00 (Expert Mode). Change the "Operation Mode" IO-Link parameter to the value 0x80 (Easy Mode). The higher nibble always has the value 0x00 in Easy Mode.

9.2 ASCII table

hex	dec	ASCII	hex	dec	ASCII	hex	dec	ASCII	hex	dec	ASCII
00	0	NUL	**20**	**32**	**Space**	40	64	@	**60**	**96**	**'**
01	1	SOH	**21**	**33**	**!**	41	65	A	**61**	**97**	**a**
02	2	STX	**22**	**34**	**"**	42	66	B	**62**	**98**	**b**
03	3	ETX	**23**	**35**	**#**	43	67	C	**63**	**99**	**c**
04	4	EOT	**24**	**36**	**$**	44	68	D	**64**	**100**	**d**
05	5	ENQ	**25**	**37**	**%**	45	69	E	**65**	**101**	**e**
06	6	ACK	**26**	**38**	**&**	46	70	F	**66**	**102**	**f**
07	7	BEL	**27**	**39**	**'**	47	71	G	**67**	**103**	**g**
08	8	BS	**28**	**40**	**(**	48	72	H	**68**	**104**	**h**
09	9	HT	**29**	**41**	**)**	49	73	I	**69**	**105**	**I**
0A	10	LF	**2A**	**42**	*	4A	74	J	**6A**	**106**	**j**
0B	11	VT	**2B**	**43**	**+**	4B	75	K	**6B**	**107**	**k**
0C	12	FF	**2C**	**44**	**,**	4C	76	L	**6C**	**108**	**l**
0D	13	CR	**2D**	**45**	**-**	4D	77	M	**6D**	**109**	**m**
0E	14	SO	**2E**	**46**	**.**	4E	78	N	**6E**	**110**	**n**
0F	15	SI	**2F**	**47**	**/**	4F	79	O	**6F**	**111**	**o**
10	16	DLE	**30**	**48**	**0**	50	80	P	**70**	**112**	**p**
11	17	DC1	**31**	**49**	**1**	51	81	Q	**71**	**113**	**q**
12	18	DC2	**32**	**50**	**2**	52	82	R	**72**	**114**	**r**
13	19	DC3	**33**	**51**	**3**	53	83	S	**73**	**115**	**s**
14	20	DC4	**34**	**52**	**4**	54	84	T	**74**	**116**	**t**
15	21	NAK	**35**	**53**	**5**	55	85	U	**75**	**117**	**u**
16	22	SYN	**36**	**54**	**6**	56	86	V	**76**	**118**	**v**
17	23	ETB	**37**	**55**	**7**	57	87	W	**77**	**119**	**w**
18	24	CAN	**38**	**56**	**8**	58	88	X	**78**	**120**	**x**
19	25	EM	**39**	**57**	**9**	59	89	Y	**79**	**121**	**y**
1A	26	SUB	**3A**	**58**	**:**	5A	90	Z	**7A**	**122**	**z**
1B	27	ESC	**3B**	**59**	**;**	5B	91	[	**7B**	**123**	**{**
1C	28	FS	**3C**	**60**	**<**	5C	92	\	**7C**	**124**	**l**
1D	29	GS	**3D**	**61**	**=**	5D	93	]	**7D**	**125**	**}**
1E	30	RS	**3E**	**62**	**>**	5E	94	^	**7E**	**126**	**~**
1F	31	US	**3F**	**63**	**?**	5F	95	_	**7F**	**127**	**DEL**

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