Operating instructions RFID read/write head with IO-Link

UK

DTIxxx

706470 / 00 04 / 2018

Contents

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1 Preliminary note

Technical data, approvals, accessories and further information at www.ifm.com.

1.1 Symbols used

► Instructions
> Reaction, result
[…] Designation of keys, buttons or indications
→ Cross-reference

Important note
Non-compliance may result in malfunction or interference.

Information
Supplementary note

2 Safety instructions

- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ 3 Functions and features).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.

3 Functions and features

The RFID read/write head is used for reading and writing ID tags. The read/write head is configured and data is exchanged via the integrated IO-Link interface.

Typical applications are the identification of workpiece carriers in conveyor lines.

4 ID tags

The ID tags are operated passively without any source of energy of their own. The energy required is supplied by the device. The energy is transferred to the ID tag via inductive coupling.

The device supports ID tags according to the ISO 15693 standard.

ID tags according to the ISO 15693 standard can have different functions.

The memory area of an ID tag is organised in blocks.

The size of a block must be communicated to the device via the parameter "Blocksize" (→ 5.3.1 Parameter "Blocksize").

5 IO-Link

5.1 General information

This unit has an IO-Link interface which enables direct access to process and diagnostic data. In addition it is possible to set the parameters of the unit while it is in operation. Operation of the unit via an IO-Link interface requires an IO-Link capable module (IO-Link master).

5.2 Device-specific information

With a PC, IO-Link software and an IO-Link adapter cable communication is possible when the system is not in operation.

You will find the IODDs necessary for the configuration of the unit, detailed information about process data structure, diagnostic information and parameter addresses at www.ifm.com.

5.3 Device-specific parameters

The parameters of the device can be set using an IO-Link parameter setting program (e.g. LR DEVICE).

More information is given in the IODD at www.ifm.com.

5.3.1 Parameter "Blocksize"

(index 1900, subindex 0)

The parameter specifies the size of a data block in the memory area of the ID tag. The set value must correspond with the value of the ID tag indicated in the data sheet.

The following values are permissible: 4,8,16 and 32 bytes per block.

The block size is only required for the internal data processing in the device. The user can access the process data images byte by byte on the memory area of the ID tag.

5.3.2 Parameter "Block Data Order"

(index 1901, subindex 0)

The parameter determines the order of the data in a data block of the ID tag.

Example

For an ID tag with block size 4 bytes the data can be ordered as follows:

Normal order

Memorisation block 0				**Memorisation block 1**	
byte 3	byte 2	byte 1	byte 0	byte 3	...

Reversed order

Memorisation block 0				**Memorisation block 1**	
byte 0	byte 1	byte 2	byte 3	byte 0	...

5.3.3 Parameter "Data Hold Time (Tag Present Delay)"

(index 1902, subindex 0)

The data hold time indicates the time during which the data of the process data input image can be held constant. Depending on the operating mode of the UID this concerns the "Tag present" bit and the data in the auto-read and auto-write mode.

Example

When the data hold time is set to 500 ms, the UID and the "Tag present" bit are transferred for min. 500 ms via IO-Link. This also applies if the ID tag is no longer within the range of the device.

The parameter does not influence data transfer in the operating modes "Read data" and "Write data".

5.3.4 Parameter "Auto-Read/Write Address"

(index 1903, subindex 0)

In the operating modes "Auto-read" and "Auto-write" the device reads a specified number of data of the ID tag automatically. The parameter defines the start address of the memory area which is accessed for automatic reading and writing. The address is provided in bytes.

The addressed memory area must be within the available memory area of the ID tag:

auto-read/write address + data length for auto-read and auto-write ≤ number of available bytes on the ID tag

The number of available bytes is indicated in the data sheet of the ID tag.

5.3.5 Parameter "Auto-Read/WriteData Length"

(index 1904, subindex 0)

In the operating modes "Auto-read" and "Auto-write" the device reads a specified number of data of the ID tag automatically. The parameter defines the length of the memory area which is read and written. The length is indicated in bytes.

The minimum length is 1 byte and the maximum length is 29 bytes.

The addressed memory area must be within the available memory area of the ID tag:

auto-read/write address + data length for auto-read and auto-write ≤ number of available bytes on the ID tag

The number of available bytes is indicated in the data sheet of the ID tag.

6 Status bits

Process data input								
Bit	7	6	5	4	3	2	1	0
Name					Antenna deactivated	Tag present	Cmd End	Cmd Start Acknowledge

Process data output								
Bit	7	6	5	4	3	2	1	0
Name					Cmd Antenna deactivate			Cmd Start

Status bit	Value	Description
Antenna deactivated	0	Antenna activated, device ready to receive
	1	Antenna deactivated, device not ready to receive
Tag present	0	No ID tag in the range of the device
	1	ID tag detected
Cmd End	0	Read or write operation not yet started or active
	1	Read or write operation terminated
Cmd Start Acknowledge	0	Start of a read or write operation not acknowledged
	1	Start of a read or write operation acknowledged
Cmd Antenna deactivate	0	Activate antenna
	1	Deactivate antenna
Cmd Start	0	Reset trigger for read or write operation
	1	Set trigger for read or write operation

The following status bits cannot be used in the operating mode "Read UID":

- Cmd Start
- Cmd Start Acknowledge
- Cmd End

7 Operating mode

The device supports several operation modes selected with the command value in the process data output image:

Command value	Operating mode	Chapter
0x00	Read UID	(→ 7.2 Operating mode "Read UID")
0x01	Auto-read data	(→ 7.3 Operating mode "Auto-read data")
0x02	Auto-write data	(→ 7.4 Operating mode "Auto-write data")
0x03	Read data	(→ 7.5 Operating mode "Read data")
0x04	Write data	(→ 7.6 Operating mode "Write data")

The same status bits and error values in the process images apply to all operating modes.

7.1 Deactivate internal antenna

In addition to the operating modes the internal antenna of the device can be deactivated at any time. With deactivated antenna the device can still be accessed via IO-Link. However, no high-frequency magnetic field is generated any more by the device. That means that no ID tags can be detected by the device.

By deactivating the antenna, interference between devices installed next to each other is avoided.

The antenna is deactivated and activated via the bit "Antenna deactivate" in the process data output image. The status of the antenna can be read via the bit "Antenna deactivated" in the process data input image.

7.2 Operating mode "Read UID"

In the operating mode "Read UID" the UID of an ID tag is read (unique identification number of the ID tag). Then the UID is available in the process data input. If no ID tag is in the range of the device, the 8 bytes of the UID get the value "0x00".

As son as an ID tag is detected by the device, the UID is transferred. The transfer is continued for the min. length of the data hold time. If a new ID tag appears in the detection range during the data hold time, the UID of the new ID tag is transferred.

The operating mode "Read UID" is the preset operating mode after the device is started.

Byte	Process data output	Process data input
0	command value = 0x00	command value = 0x00
1	status	status
2	ignored	UID 0
3	ignored	UID 1
4	ignored	UID 2
5	ignored	UID 3
6	ignored	UID 4
7	ignored	UID 5
8	ignored	UID 6
9	ignored	UID 7
10	ignored	0x00
11	ignored	0x00
12	ignored	0x00
13	ignored	0x00
14	ignored	0x00
15	ignored	0x00
16	ignored	0x00
17	ignored	0x00
18	ignored	0x00
19	ignored	0x00
20	ignored	0x00
21	ignored	0x00
22	ignored	0x00
23	ignored	0x00
24	ignored	0x00
25	ignored	0x00
26	ignored	0x00
27	ignored	0x00
28	ignored	0x00
29	ignored	0x00
30	ignored	0x00
31	ignored	error value

7.3 Operating mode "Auto-read data"

In the operating mode "Auto-read data" the bytes 0 to 28 represent the data in the memory area of the ID tag. The memory area is set by the parameters "Auto-Read/Write Address" and "Auto-Read/WriteData Length".

For memory areas with a data length of < 29 bytes the data remaining in the process image is filled with the value 0x00.

The data in the process image is updated as soon as an ID tag enters the detection range. The data in the process image is valid as soon as the status bit "Cmd End" is set.

If the ID tag leaves the detection range, the data is held in the process image according to the data hold time. If the data hold time is exceeded and there is no ID tag in the detection range, the data is filled with the value 0x00.

If the ID tag remains in the detection range, the data can be read with the status bit "Cmd Start". If reading was unsuccessful, the error value is shown in the process image.

The smaller the "Auto-Read/WriteData Length" is set, the less time is needed for reading. That means that the dwell time of the ID tag in the detection range can be shorter.

Byte	Process data output	Process data input
0	command value = 0x01	command value = 0x01
1	status	status
2	ignored	Data 0
3	ignored	data 1
4	ignored	data 2
5	ignored	data 3
6	ignored	data 4
7	ignored	data 5
8	ignored	data 6
9	ignored	data 7
10	ignored	data 8
11	ignored	data 9
12	ignored	data 10
13	ignored	data 11
14	ignored	data 12
15	ignored	data 13
16	ignored	data 14
17	ignored	data 15
18	ignored	data 16

Byte	Process data output	Process data input
19	ignored	data 17
20	ignored	data 18
21	ignored	data 19
22	ignored	data 20
23	ignored	data 21
24	ignored	data 22
25	ignored	data 23
26	ignored	data 24
27	ignored	data 25
28	ignored	data 26
29	ignored	data 27
30	ignored	data 28
31	ignored	error value

7.4 Operating mode "Auto-write data"

In the operating mode "Auto-write data" the data to be written is defined by the process data output image. The data is set by the parameter "Auto-Read/Write Address" and "Auto-Read/WriteData Length".

The data is written with the address and length to an ID tag as soon as the ID tag enters the detection range.

Max. 29 bytes can be defined in the process data output image (bytes 0 to 28). For memory areas with a data length of < 29 bytes the remaining data is ignored and not written to the ID tag.

If writing was successful, the written data is copied to the process data input image and the status bit "Cmd End" is set.

If the ID tag leaves the detection range, the data is held in the process image according to the data hold time. If the data hold time is exceeded and there is no ID tag in the detection range, the data is filled with the value 0x00.

If the ID tag remains in the detection range, the data can be written with the status bit "Cmd Start". If writing was unsuccessful, the error value is shown in the process image.

The smaller the "Auto-Read/WriteData Length" is set, the less time is needed for writing. That means that the dwell time of the ID tag in the detection range can be shorter.

Byte	Process data output	Process data input
0	command value = 0x02	command value = 0x02
1	status	status
2	data 0	data 0
3	data 1	data 1
4	data 2	data 2
5	data 3	data 3
6	data 4	data 4
7	data 5	data 5
8	data 6	data 6
9	data 7	data 7
10	data 8	data 8
11	data 9	data 9
12	data 10	data 10
13	data 11	data 11
14	data 12	data 12
15	data 13	data 13
16	data 14	data 14
17	data 15	data 15
18	data 16	data 16
19	data 17	data 17
20	data 18	data 18
21	data 19	data 19
22	data 20	data 20
23	data 21	data 21
24	data 22	data 22
25	data 23	data 23
26	data 24	data 24
27	data 25	data 25
28	data 26	data 26
29	data 27	data 27
30	data 28	data 28
31	ignored	error value

7.5 Operating mode "Read data"

In the operating mode "Read data" more than 29 bytes can be read with a read operation. The data is sequentially transferred from the device to the controller.

Transfer data from the device to the controller:

1. The controller sets the command value "0x03", the address (16 bits) and the data length (16 bits) in the process data output image.
2. The controller starts the read operation with the status bit "Cmd Start".
3. The device acknowledges the start of the read operation by setting the status bit "Cmd Start Acknowledge" in the process data input image.
4. The device transfers the data to the process data input image (data 0 to 27) and increases the block counter by 1 as soon as the first data of the ID tag is available. The block counter is reset to 0 when the value exceeds 255.
5. The controller acknowledges receipt of the data by increasing the block counter in the process data output image by 1.
6. Steps 4 and 5 are repeated until all data has been transferred.
7. The device sets the status bit "Cmd End" with the last transfer. Then the read operation is terminated.

If reading was unsuccessful, the device sets the error value and the status bit "Cmd End" in the process image. Data transfer is interrupted.

Byte	Process data output	Process data input
0	command value = 0x03	command value = 0x03
1	status	status
2	ignored	data 0
3	ignored	data 1
4	address (high byte)	data 2
5	address (low byte)	data 3
6	length (high byte)	data 4
7	length (low byte)	data 5
8	ignored	data 6
9	ignored	data 7
10	ignored	data 8
11	ignored	data 9
12	ignored	data 10
13	ignored	data 11
14	ignored	data 12
15	ignored	data 13
16	ignored	data 14
17	ignored	data 15
18	ignored	data 16
19	ignored	data 17
20	ignored	data 18
21	ignored	data 19
22	ignored	data 20
23	ignored	data 21
24	ignored	data 22
25	ignored	data 23
26	ignored	data 24
27	ignored	data 25
28	ignored	data 26
29	ignored	data 27
30	block counter	block counter
31	ignored	error value

7.5.1 Example 1

Example 1 shows that reading of the data was successful.

	Command value	Address	Length	Data 0 to 27	Block counter	Status bit "Cmd Start"	Command value	Data 0 to 27	Block counter	Error value	Status bit "Cmd End"	Status bit "Cmd Start"
	Process data output image						**Process data input image**					
Preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0
Controller sets command (read 35 bytes from address 0x12)	0x03	0x0012	0x0023	0x00	0x00	1	0x03	UID	0x00	0x00	0	0
Device acknowledges command	0x03	0x0012	0x0023	0x00	0x00	1	0x03	0x00	0x00	0x00	0	1
Device sets first byte of the data	0x03	0x0012	0x0023	0x00	0x00	1	0x03	data	0x01	0x00	0	1
Controller acknowledges receipt of the data	0x03	0x0012	0x0023	0x00	0x01	1	0x03	data	0x01	0x00	0	1
Device sets more data and terminates reading	0x03	0x0012	0x0023	0x00	0x01	1	0x03	data	0x02	0x00	1	1
Controller acknowledges receipt of the data	0x03	0x0012	0x0023	0x00	0x02	1	0x03	data	0x02	0x00	1	1
Controller withdraws command value	0x00	0x0000	0x0000	0x00	0x00	0	0x03	data	0x02	0x00	1	1
The device carries out the preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0

7.5.2 Example 2

Example 2 shows that reading of the data was unsuccessful.

	Command value	Address	Length	Data 0 to 27	Block counter	Status bit "Cmd Start"	Command value	Data 0 to 27	Block counter	Error value	Status bit "Cmd End"	Status bit "Cmd Start"
	Process data output image						**Process data input image**					
Preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0
Controller sets command (read 35 bytes from address 0x12)	0x03	0x0012	0x0023	0x00	0x00	1	0x03	UID	0x00	0x00	0	0
Device acknowledges command	0x03	0x0012	0x0023	0x00	0x00	1	0x03	0x00	0x00	0x00	0	1
Device sets first byte of the data	0x03	0x0012	0x0023	0x00	0x00	1	0x03	data	0x00	0x00	0	1
Controller acknowledges receipt of the data	0x03	0x0012	0x0023	0x00	0x01	1	0x03	data	0x01	0x00	0	1
Device sets error value (IT tag not available)	0x03	0x0012	0x0023	0x00	0x01	1	0x03	data	0x01	0x11	1	1
Controller withdraws command value	0x00	0x0000	0x0000	0x00	0x00	0	0x03	0x00	0x01	0x11	1	1
The device carries out the preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0

7.6 Operating mode "Write data"

In the operating mode "Write data" more than 29 bytes can be written with one write operation. The data is sequentially transferred from the controller to the device.

Transfer data from the controller to the device:

1. The controller sets the command value "0x04", the address (16 bits) and the data length (16 bits) in the process data output image.
2. The controller starts the write operation with the status bit "Cmd Start".
3. The devices acknowledges the start of the write operation by setting the status bit "Cmd Start Acknowledge" in the process data input image.
4. The controller files the data in the process data output image (data 0 to 27) and increases the block counter by 1. The block counter is reset to 0 when the value exceeds 255.
5. The device acknowledges receipt of the data by increasing the block counter in the process data output image by 1.
6. Steps 4 and 5 are repeated until all data has been transferred.
7. The device sets the status bit "Cmd End" with the last transfer to the ID tag. Then the write operation is terminated.

If writing was unsuccessful, the device sets the error value and the status bit "Cmd End" in the process image. Data transfer is interrupted.

Byte	Process data output when starting the write operation	Process data output during data transfer	Process data input
0	command value=0x04	command value=0x04	command value=0x04
1	status	status	status
2	ignored	data 0	0x00
3	ignored	data 1	0x00
4	address (high byte)	data 2	0x00
5	address (low byte)	data 3	0x00
6	length (high byte)	data 4	0x00
7	length (low byte)	data 5	0x00
8	ignored	data 6	0x00
9	ignored	data 7	0x00
10	ignored	data 8	0x00
11	ignored	data 9	0x00
12	ignored	data 10	0x00
13	ignored	data 11	0x00
14	ignored	data 12	0x00
15	ignored	data 13	0x00
16	ignored	data 14	0x00
17	ignored	data 15	0x00
18	ignored	data 16	0x00
19	ignored	data 17	0x00
20	ignored	data 18	0x00
21	ignored	data 19	0x00
22	ignored	data 20	0x00
23	ignored	data 21	0x00
24	ignored	data 22	0x00
25	ignored	data 23	0x00
26	ignored	data 24	0x00
27	ignored	data 25	0x00
28	ignored	data 26	0x00
29	ignored	data 27	0x00
30	0x00	block counter	block counter
31	ignored	ignored	error value

7.6.1 Example 1

Example 1 shows that writing of the data was successful.

	Command value	Address	Length	Data 0 to 27	Block counter	Status bit "Cmd Start"	Command value	Data 0 to 27	Block counter	Error value	Status bit "Cmd End"	Status bit "Cmd Start"
	Process data output image						**Process data input image**					
Preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0
Controller sets command (write 40 bytes to address 0x10)	0x04	0x0010	0x0028	0x00	0x00	1	0x04	UID	0x00	0x00	0	0
Device acknowledges command	0x04	0x0010	0x0028	0x00	0x00	1	0x04	0x00	0x00	0x00	0	1
Controller transfers the first data	0x04	Data for ID tag			0x01	1	0x04	0x00	0x00	0x00	0	1
Device acknowledges data	0x04	Data for ID tag			0x01	1	0x04	0x00	0x01	0x00	0	1
Controller transfers more data	0x04	Data for ID tag			0x02	1	0x04	0x00	0x01	0x00	0	1
Device acknowledges data and terminates writing	0x04	Data for ID tag			0x02	1	0x04	0x00	0x02	0x00	1	1
Controller withdraws command value	0x00	0x0000	0x0000	0x00	0x00	0	0x04	0x00	0x02	0x00	1	1
The device carries out the preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0

7.6.2 Example 2

Example 2 shows that writing of the data was unsuccessful.

	Command value	Address	Length	Data 0 to 27	Block counter	Status bit "Cmd Start"	Command value	Data 0 to 27	Block counter	Error value	Status bit "Cmd End"	Status bit "Cmd Start"
	Process data output image						**Process data input image**					
Preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0
Controller sets command (write 40 bytes to address 0x10)	0x04	0x0010	0x0028	0x00	0x00	1	0x04	UID	0x00	0x00	0	0
Device acknowledges command	0x04	0x0010	0x0028	0x00	0x00	1	0x04	0x00	0x00	0x00	0	1
Controller transfers the first data	0x04	Data for ID tag			0x01	1	0x04	0x00	0x00	0x00	0	1
Device acknowledges data	0x04	Data for ID tag			0x01	1	0x04	0x00	0x01	0x00	0	1
Controller transfers more data	0x04	Data for ID tag			0x02	1	0x04	0x00	0x01	0x00	0	1
Device sets error value (IT tag not available)	0x04	Data for ID tag			0x02	1	0x04	0x00	0x01	0x11	1	1
Controller withdraws command value	0x00	0x0000	0x0000	0x00	0x00	0	0x04	0x00	0x01	0x11	1	1
The device carries out the preset command	0x00	0x0000	0x0000	0x00	0x00	0	0x00	UID	0x00	0x00	0	0

8 Error values in the process data input

Value	Name	Description
0x00	RFID_NOERROR	No error, read or write operation successful.
0x01	RFID_UNKNOWN_COMMAND	Unknown command value.
0x11	COMMAND_NO_RESPONSE	IT tag does not respond. ID tag outside the range. ID tag does not support the operation or wrong parameter (e.g. the data block is too big).
0x12	COMMAND_RX_ERROR	Error during reception of the data of the ID tag.
0x21	TAG_COMMAND_NOT_SPECIFIED	Command is not supported by the ID tag.
0x22	TAG_COMMAND_SYNTAX	Parameter of the command wrong.
0x23	TAG_OPTION_NOT_SUPPORTED	ID tag does not support option of the command.
0x2F	TAG_OTHER	ID tag indicates other error during execution of the command.
0x30	TAG_BLOCK_NOT_USABLE	The data block of the ID tag cannot be used (e.g. the data block does not exist).
0x31	TAG_BLOCK_ALREADY_BLOCKED	The data block was already locked.
0x32	TAG_BLOCK_NOT_UPDATEABLE	The data block is locked and cannot be overwritten.
0x33	TAG_BLOCK_WRITE_VERIFY	The data block was not correctly written (e.g. the memory area is defective).
0x34	TAG_BLOCK_LOCK_VERIFY	The data block cannot be locked (e.g. the memory area is defective).

9 Glossary

Term	Description
ID tag	RFID tag
IODD	Digital description of the device within IO-Link (for use with parameter setting programs)
UID	Unique identification number of an ID tag