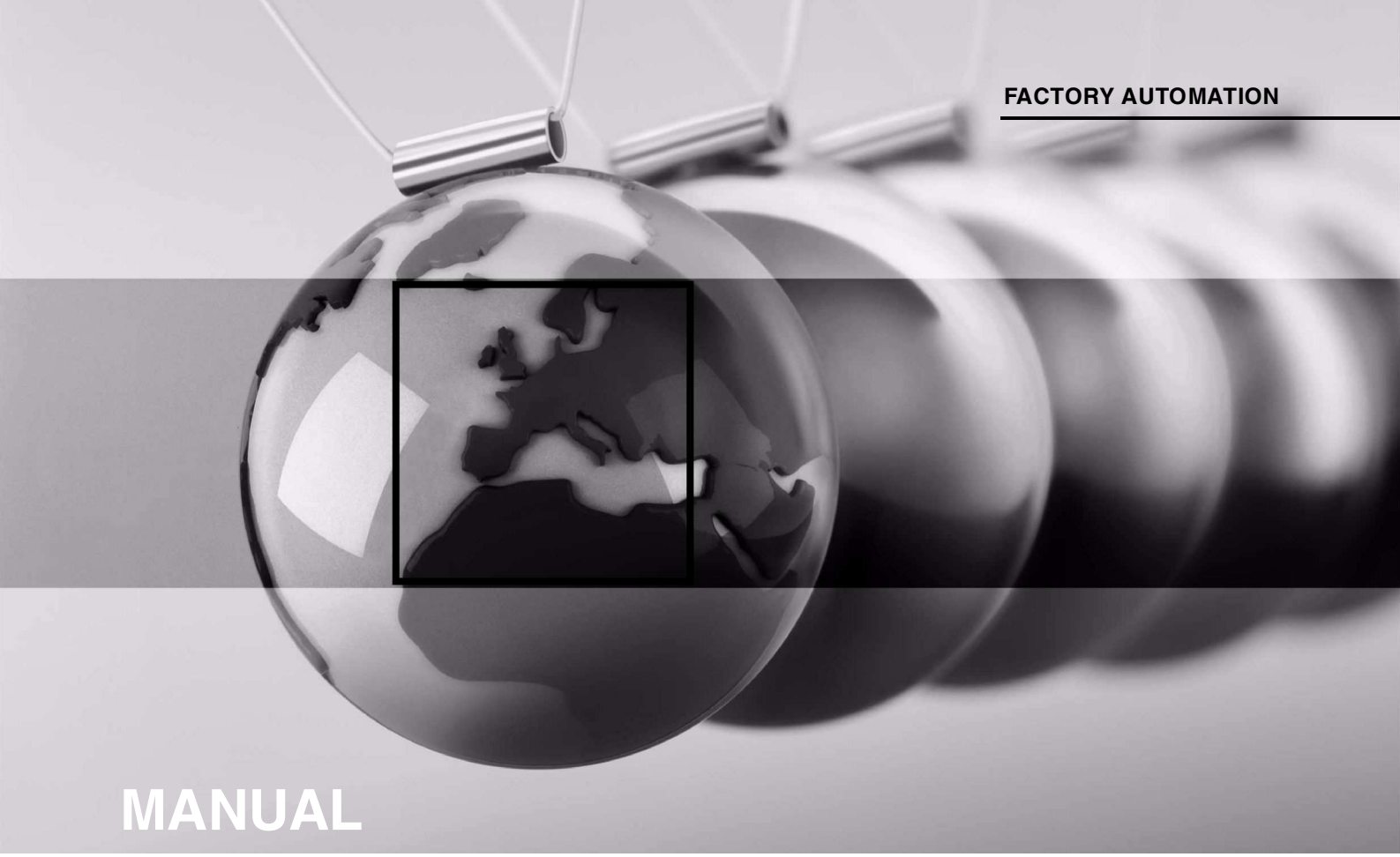
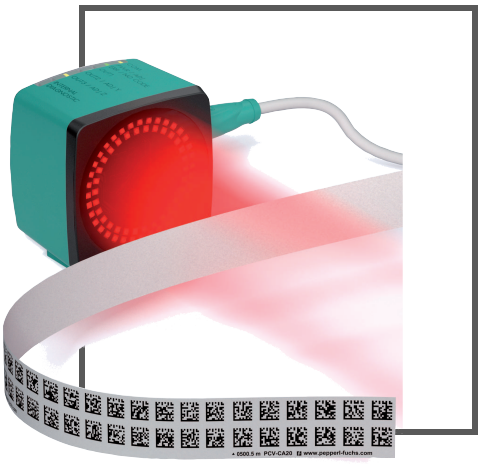


MANUAL

PCV...-F200-R4-V19

Data Matrix Positioning System



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SENSING YOUR NEEDS

With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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1 Introduction

Congratulations

You have chosen a device manufactured by Pepperl+Fuchs. Pepperl+Fuchs develops, produces and distributes electronic sensors and interface modules for the market of automation technology on a worldwide scale.

Symbols used

The following symbols are used in this manual:

Note!

This symbol draws your attention to important information.

Handling instructions

You will find handling instructions beside this symbol

Contact

If you have any questions about the device, its functions, or accessories, please contact us at:

Pepperl+Fuchs GmbH
Lilienthalstraße 200
68307 Mannheim
Telephone: +49 621 776-4411
Fax: +49 621 776-274411
E-Mail: fa-info@pepperl-fuchs.com

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2 Declaration of conformity

2.1 CE conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.

Note!

A declaration of conformity can be requested from the manufacturer.

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3 Safety

3.1 Symbols relevant to safety

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.

3.2 Intended use

Combined with a code strip with printed Data Matrix codes, this device represents a high-resolution positioning system that can be used in all applications where precision positioning is required along extremely long travel paths, irrespective of whether the travel path is straight, curved or with inclines or declines.

Read through these instructions thoroughly. Familiarize yourself with the device before installing, mounting, or operating.

Always operate the device as described in these instructions to ensure that the device and connected systems function correctly. The protection of operating personnel and plant is only guaranteed if the device is operated in accordance with its intended use.

3.3 General safety instructions

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

Installation and commissioning of all devices must be performed by a trained professional only.

User modification and or repair are dangerous and will void the warranty and exclude the manufacturer from any liability. If serious faults occur, stop using the device. Secure the device against inadvertent operation. In the event of repairs, return the device to your local Pepperl+Fuchs representative or sales office.

Note!

Disposal

Electronic waste is hazardous waste. When disposing of the equipment, observe the current statutory requirements in the respective country of use, as well as local regulations.

4 Product Description

4.1 Use and Application

The PCV… read head is part of the positioning system in the Pepperl+Fuchs incident light process. Its features include a camera module and an integrated illumination unit, enabling it to detect position markers printed onto an adhesive code reel in the form of Data Matrix codes.

The code reel is usually mounted to a fixed part of the equipment in a stationary manner (e.g., elevator shaft, overhead conveyor mounting rails) and the read head is then mounted in parallel to a moving "vehicle" (e.g., elevator car, overhead conveyor chassis).

Maximum Length of the Code Reel

Resolution of the Read Head [mm]	Maximum Length of the Code Reel [km]
10	10
1	10
0.1	1.5

This positioning system can be used with an appropriate resolution in equipment with extremely large layouts without restrictions.

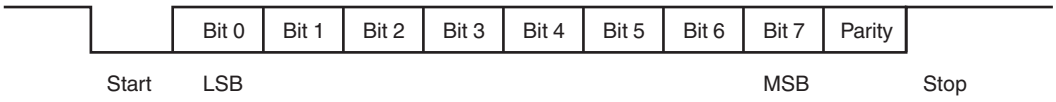
The extensive yet user-friendly parameterization options as well as the freely configurable inputs and outputs mean that the read head can easily be adapted to suit each application.

4.2 The RS 485 interface

The reading head is equipped with an RS 485 interface for communication purposes, i.e. parameterizing the reading head functions or reading out current process data during operation. This interface is operated in 8-E-1 mode and fitted with a terminator that can be activated or deactivated by parameterizing the sensor head accordingly. The RS 485 interface supports the following transfer rates:

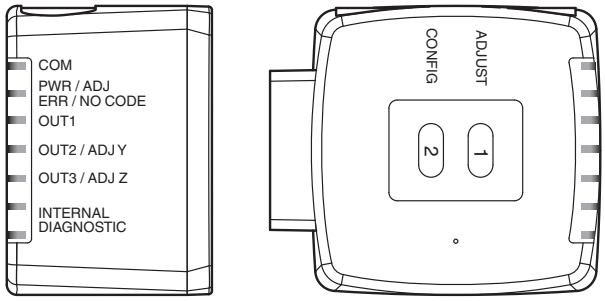
- 38400 bit/s
- 57600 bit/s
- 76800 bit/s
- **115200 bit/s**(Default)
- 230400 bit/s

Data structure of the RS 485 interface



4.3 LED indicators and controls

The PCV... reading head is equipped with 7 indicator LEDs for performing visual function checks and rapid diagnosis. For activating the alignment aid see chapter 6.1 and programming mode, see chapter 6.2 two buttons are provided on the back of the reading head. ADJUST appears next to button 1 and CONFIG next to button 2.



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LED	[#1] COM	[#2] PWR / ADJ ERR / NO CODE	[#3] OUT 1	[#4] OUT 2 / ADJ Y	[#5] OUT 3 / ADJ Z	[#6] Interna diagnostics		
Color	yellow	green/ red	yellow	yellow	yellow	yellow	yellow	Description
State	off	Flashes green.	off	off	off	off	off	Alignment Y > setpoint value f_{flash} = 2 Hz
	off	Flashes green.	off	on	off	off	off	Alignment Y < setpoint value f_{flash} = 2 Hz
	off	Flashes green.	off	Flashes .	off	off	off	Alignment Y = setpoint value f_{flash} = 2 Hz
	off	Flashes green.	off	off	off	off	off	Alignment Z > setpoint value f_{flash} = 2 Hz
	off	Flashes green.	off	off	On	off	off	Alignment Z < setpoint value f_{flash} = 2 Hz
	off	Flashes green.	off	off	Flashes	off	off	Alignment Z = setpoint value f_{flash} = 2 Hz
	off	Flashes red.	off	off	off	off	off	Alignment Code strip outside read range, f_{flash} = 2 Hz
	off	Lights up red	off	off	off	off	off	System error
	off	Lights up green	x	x	x	off	off	Normal mode, no communication LEDs marked with x indicate the status of the relevant output.
	Flashes	Lights up green.	x	x	x	off	off	Normal mode, communication active, f_{flash} = 2 Hz LEDs marked with x indicate the status of the relevant output.
	Flashes	Flashes red	x	x	x	off	off	No code strip within read range, communication active f_{flash} = 2 Hz LEDs marked with x indicate the status of the relevant output.
	Flashes	Flashes red	Flashes	Flashes	Flashes	off	off	Normal operation. Indication for 2 s if a button is pressed when the time lock is enabled.
	off	off	Flashes	off	off	off	off	Pre / configuration mode active, f_{flash} = 2 Hz
	off	Lights up red	Flashes	off	off	off	off	Code card faulty f_{flash} = 2 Hz for 3 s
	off	Green, 1 s	Flashes	off	off	off	off	Code card detected, f_{flash} = 2 Hz for 3 s
	x	off	x	x	x	off	off	Time lock for buttons disabled
	x	x	x	x	x	on	on	Internal error Return to Pepperl+Fuchs

x = LED status has no meaning

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4.4 Accessories

Compatible accessories offer enormous savings potential. Not only do you save a great deal of time and work when commissioning, but also when replacing and servicing our products.

If harsh external environmental conditions prevail, appropriate Pepperl+Fuchs accessories can extend the service life of the products used.

Model Number	Description
V19-G-ABG-PG9-FE	Grounding terminal and plug (set)
PCV-SC12	Grounding clip
V19-G-*M-*	Configurable connection cable[1)]
PCV-USB-RS485-Converter Set	Interface converter USB / RS 485
PCV-KBL-V19-STR-RS485	Cable unit with 24 V power supply and V19 connection cable to RS 485 interface
PCV-CM20-0*	Event marker
PCV-CR20	Repair tape

1): Contact your contact person at Pepperl+Fuchs

5 Installation

5.1 Installing the Code Reel

The code reel is made of silicone-free polyester film. A position marker appears every 100 mm along the lower edge of the code reel (see "Dimensions, Code Reel"). This position marker is used for various functions including precise positioning of the code reel during assembly.
The reverse side of the code reel carries a permanent modified acrylate-based adhesive. Affix the self-adhesive code reel along the desired travel range. Proceed as follows:

Installing the Code Reel

1. Clean the surface of any greasy or oily deposits and dust.
2. Ensure that the surface is dry, clean, and stable.
3. Pull the protective foil at the beginning of the code reel a few centimeters forward. Place the code reel at the precise point of the required starting position on the underside, and press to attach.
4. Then affix the code reel along the desired travel range. Remove the protective film gradually so that the code reel does not accidentally adhere to the surface in the incorrect position. When affixing, ensure that the code reel does not crease or trap air bubbles.

   ↳ The adhesive on the code reel hardens after 72 hours.

Note!

Thermal Expansion of the Code Reel

The heat expansion coefficient of the attached code reel corresponds to the heat expansion coefficient of the underside.

Dimensions, Code Reel

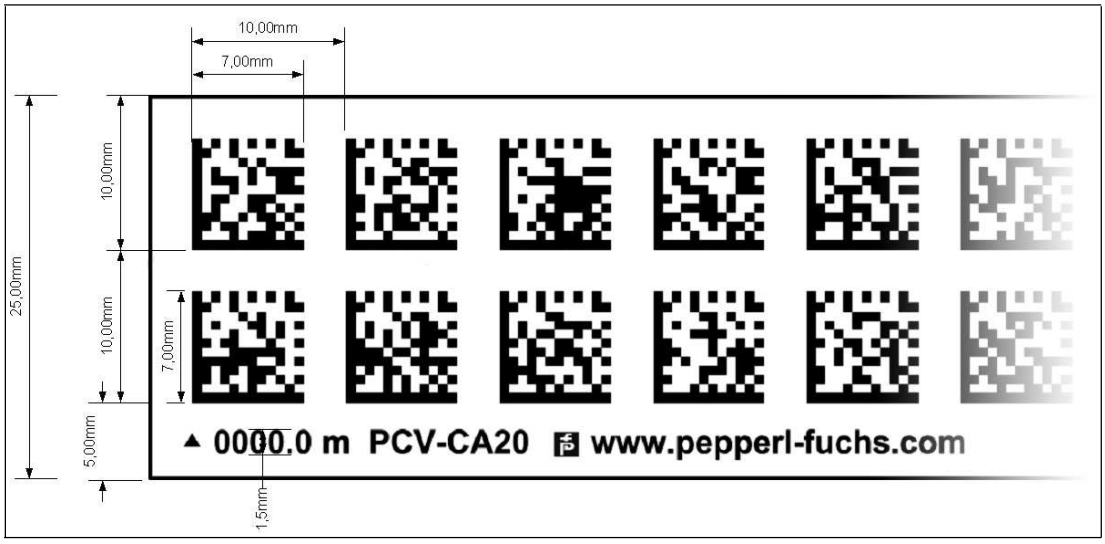


Figure 5.1

Orientation of the Code Reel and Read Head

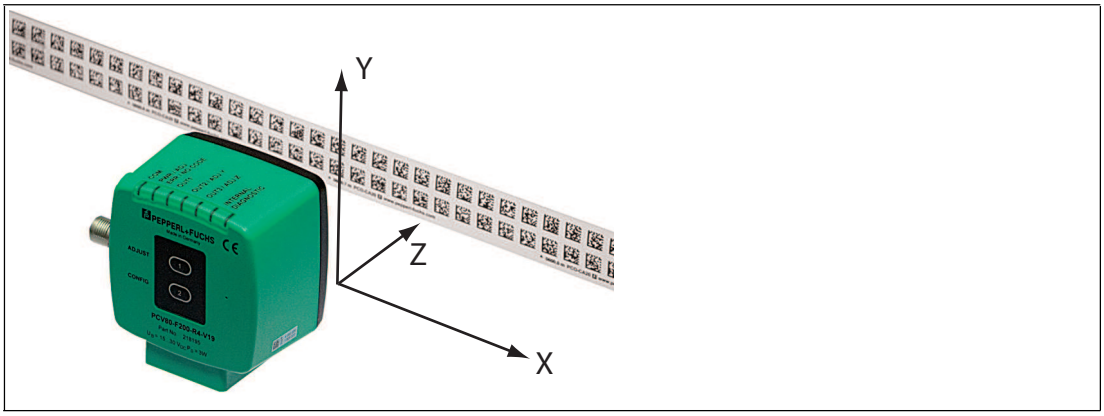


Figure 5.2

Position the code reel so that the **www.pepperl-fuchs.com** label and the position markings are below the data matrix code. The position values then increase along the X-direction. The diagram shows the orientation of a read head in the default position of 0°. The read head can be configured in the interface for other installation situations.

Code Reels with a Starting Position of 0 m

Model Number	Description
PCV6M-CA20-0	Code reel, 2-track, length: 6 m
...	...
PCV100M-CA20-0	Code reel, 2-track, length: 100 m

Code Reels with Different Starting Positions

Model Number	Description
PCV100M-CA20-0	Code reel, 2-track, length: 100 m, starting position: 0 m
PCV100M-CA20-10000	Code reel, 2-track, length: 100 m, starting position: 100 m
...	...
PCV100M-CA20-990000	Code reel, 2-track, length: 100 m, starting position: 9,900 m

Caution!

Stop Edges

If you attach another code reel at the end of a previous code reel, the code pattern of 10 mm must be retained.

Note!

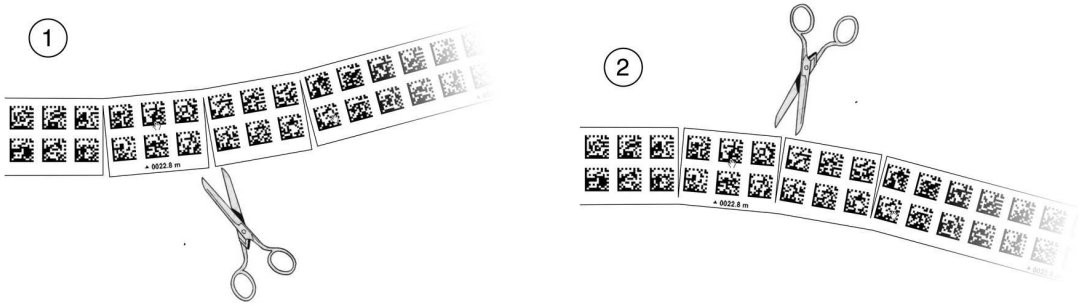
Expansion Joints

If the system covers longer distances, expansion joints are integrated in the system structure. We recommend creating breaks along the code reel. The resulting gaps should be 20 mm (2 code grids).

Note!

Inclines and Declines

If you mount the code reel on inclines or declines, cut the code reel several times at the transition point to the horizontal as shown.



1. Incline
2. Decline

Note!

Code Reels with Different Row Numbers

The PCV-CA20 code reel has two rows of code to compensate for slight deviations in the travel range in the Y-direction. The code reel is also available with other row numbers. The order code for the code reel is PCV-CAx0, whereby x represents the number of rows of code, which can be either 1 or 2. More rows are available on request–contact us for more information.

Code Reels with Different Numbers of Tracks

Model Number	Description
PCV*M-CA10-*	Code reel, 1-track
PCV*M-CA20-*	Code reel, 2-track
PCV*M-CA40-*	Code reel, 4-track
...	...

Hysteresis Y-Axis

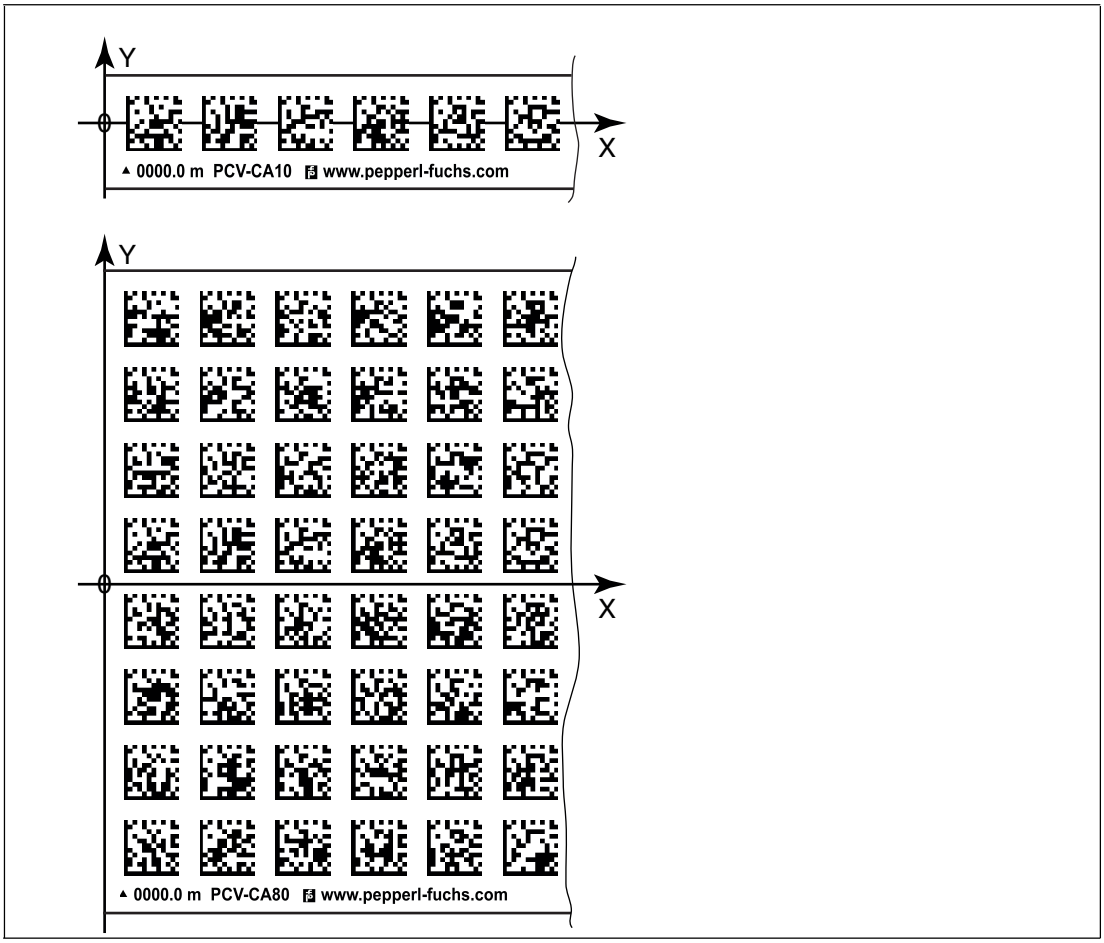


Figure 5.3 Zero line for code reels

If the read head leaves the zero line when traveling the X-axis, different threshold values will result depending on the number of tracks. If the deviation exceeds this threshold, a warning code is issued.

Y-Axis Deviation Thresholds

Code reel		Threshold	
Number of tracks	Width	Exit	Entry
1	15 mm	± 10 mm	± 6 mm
2	25 mm	± 15 mm	± 11 mm
4	45 mm	± 25 mm	± 21 mm
6	65 mm	± 35 mm	± 31 mm
8	85 mm	± 45 mm	± 41 mm

5.2 Mounting the Read Head

Mount the PCV... read head on the moving part of your equipment using the four screws on the mounting adapter of the read head. Mount the read head in such a way that the lens with ring light and camera module are aligned toward the code tape.

The stability of the mounting and the guidance of the moving system component must be such that the field of the depth of focus of the read head is not exited during operation.

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The distance between the read head and the code tape should be the same as the read distance of the read head.

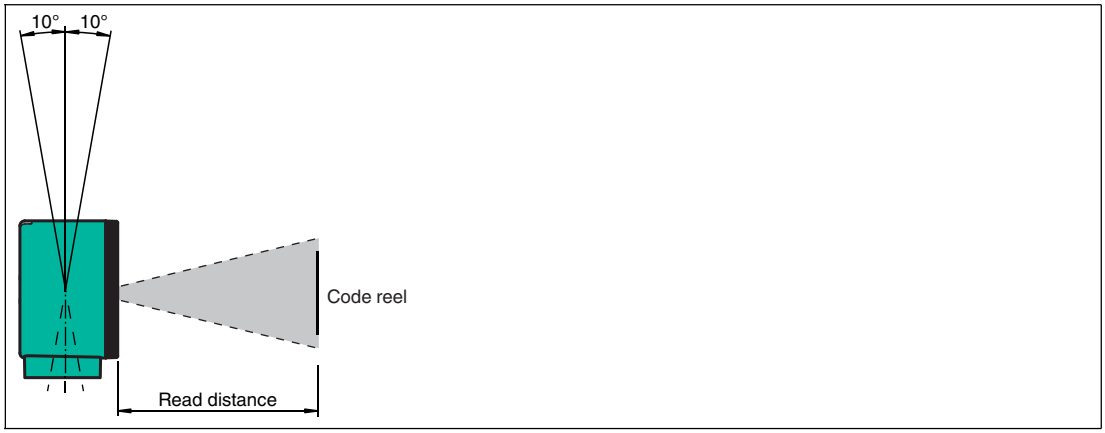


Figure 5.4 Vertical alignment tolerance

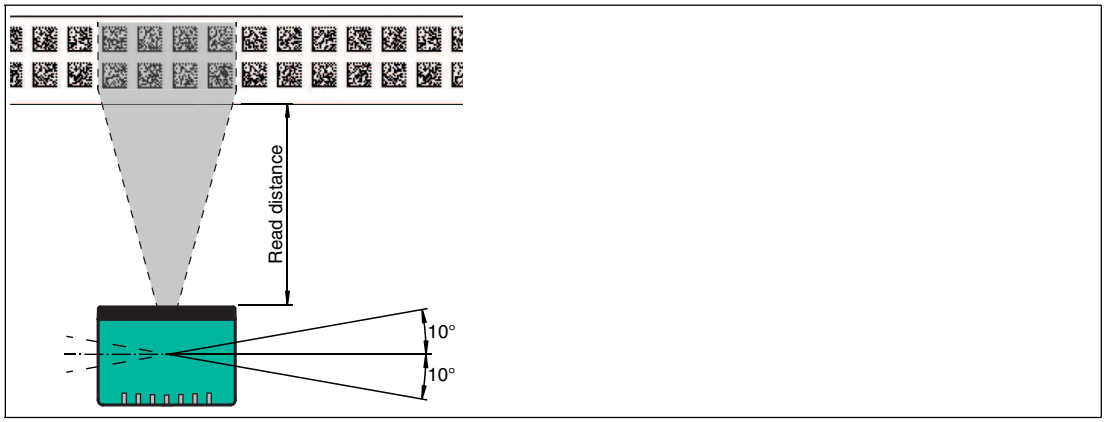


Figure 5.5 Horizontal alignment tolerance

Optimum Read Distance (Z-Axis)

Model Number	Read Distance [mm]	Depth of Focus [mm]
PCV50*	50	± 25
PCV80*	80	± 15
PCV100*	100	± 20
PCV100*-...-6011	100	± 40

Read Head Dimensions

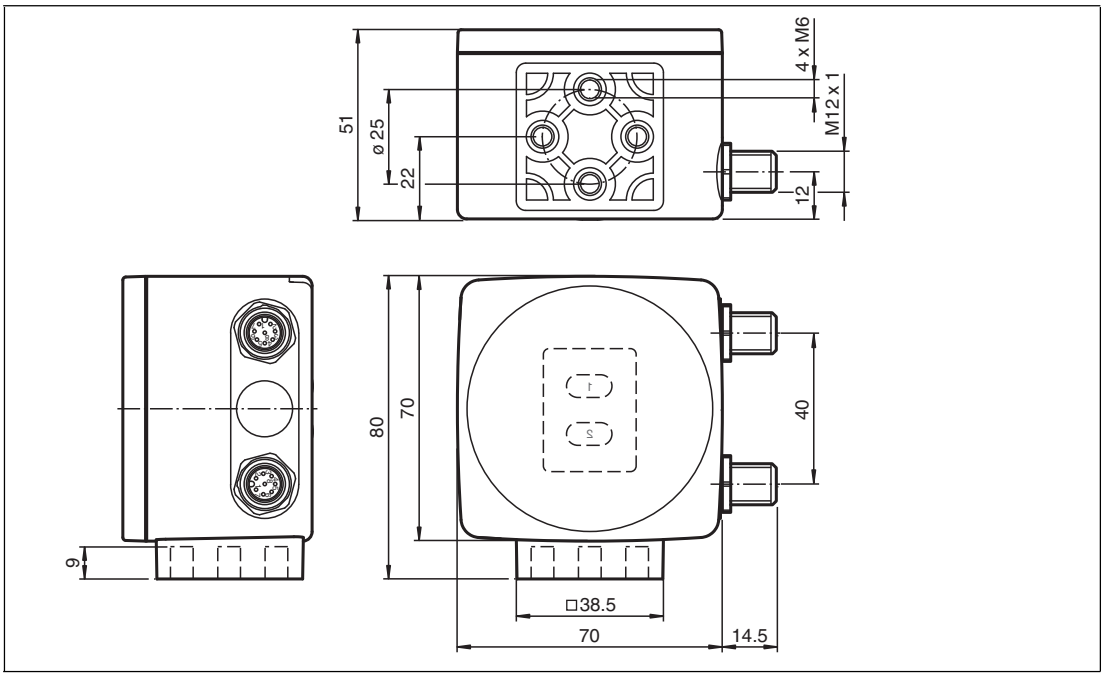


Figure 5.6

Caution!

When selecting mounting screws, ensure that the maximum insertion depth of the screws in the threaded inserts on the read head is 8 mm.

Using longer screws can damage the read head.

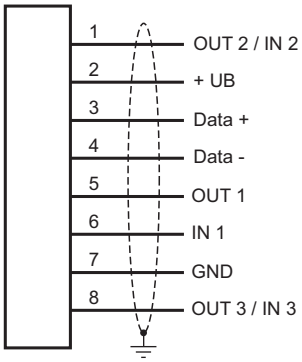
Caution!

The maximum torque of the mounting screws must not exceed 9 Nm.

Tightening the screws to a higher torque can damage the read head.

5.3 Electrical Connection

The PCV... read head is connected electrically via an 8-pin M12 x 1 connector on the side of the housing. The power supply and communication with peripheral devices are established via this connection. The configurable inputs and outputs of the read head are located at this connection.



Connections 1 and 8 can be configured as inputs or outputs.

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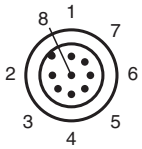
Connector Assignment



Color Assignment

Pepperl+Fuchs single-ended cordsets (female) are manufactured in accordance with EN60947-5-2. When using a type V19-... (see chapter 4.4) single-ended cordset (female) with an open cable end, colors are assigned as follows:

Connection pin	Strand color	Color abbreviation
1	White	WH
2	Brown	BN
3	Green	GN
4	Yellow	YE
5	Gray	GY
6	Pink	PK
7	Blue	BU
8	Red	RD

Shielding Cables

The shielding of connection lines is required to suppress electromagnetic interference. Establishing a low resistance or low impedance connection with the conductor or equipotential bonding circuit is a particularly important factor in ensuring that these interference currents do not become a source of interference themselves. Always use connection lines with braided shield; never use connection lines with a film shield. The shield is integrated at both ends, i.e., in the switch cabinet or on the controller **and** on the read head. The grounding terminal available as an accessory allows easy integration in the equipotential bonding circuit.

In exceptional cases, the shielding of a connection at one end may be more favorable if

- An equipotential bonding cable is not laid or cannot be laid.
- A film shield is used.

The following points relating to shielding must also be noted:

- Use metal cable clips that cover large areas of the shield.
- After installing the cable shield in the control cabinet, place it directly on the equipotential bonding rail.
- Direct the protective grounding connections to a common point in a star configuration.
- The cross-section of the cables used for grounding should be as large as possible.

Additional Ground Connection

Model number	Description
PCV-SC12	Clip for mounting an additional ground connection.

Caution!

Damage to the device

Connecting an alternating current or excessive supply voltage can damage the device or cause the device to malfunction.

Electrical connections with reversed polarity can damage the device or cause the device to malfunction.

Connect the device to direct current (DC). Ensure that the supply voltage rating is within the specified device range. Ensure that the connecting wires on the female cordset are connected correctly.

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6 Commissioning

6.1 Aligning the Read Head

An integrated alignment aid is available to help you align the Y and Z coordinates of the read head easily and precisely with respect to the code reel.

Note!

The activation of the alignment aid is possible only within 10 minutes of switching on the read head.

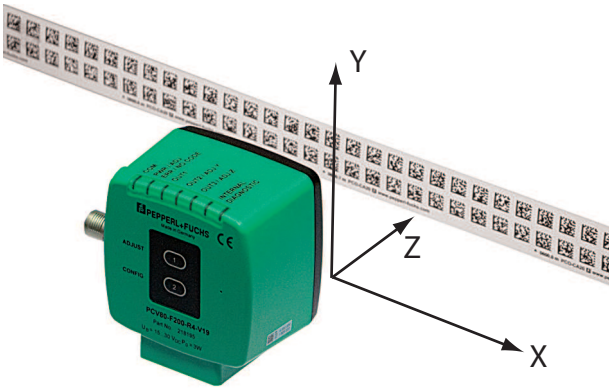
The switchover from normal operation to parameterization mode is via button 1 on the back of the read head.

Activating the Alignment Aid

1. Press button 1 for longer than 2 seconds.

   ↳ LED2 flashes green for a recognized code reel. LED2 flashes red for an unrecognized code reel. see chapter 4.3.

2. Align the Z and Y coordinates of the read head. The integral LED indicators provide assistance here.



Z coordinate: If the distance of the camera to the code reel is too small, the yellow LED5 lights up. If the distance is too great, the yellow LED5 goes out. The yellow LED5 flashes at the same time as the green LED2 when within the target range. See chapter 4.3.
Set the distance between the read head and the code reel so that the yellow LED5 and the green LED2 flash synchronously.

Y coordinate: If the optical axis of the read head is too low relative to the middle of the code reel, the yellow LED4 lights up, see chapter 4.3. If the optical axis is too high, the yellow LED4 goes out. Within the target range, the yellow LED4 flashes at the same time as the green LED2. Set the optimal height of the read head relative to the code reel so that the yellow LED4 flashes in rhythm with the green LED2.
Briefly pressing button 1 ends the alignment aid, and the read head returns to normal operation.

6.2 Parameter assignment

The reading head can be adapted to specific requirements through parameterization. The reading head can be parameterized via the interface itself (internal parameterization) or via an optical parameterization code (external parameterization).

6.2.1 Internal Parameterization Using Parameterization Software

Internal parameterization of the reader via the RS485 interface must be started within ten minutes of the reader being switched on. A time lock disables the reader once this time has elapsed. The time lock remains inactive during the parameterization process. The time lock disables the reader if no parameterization activity takes place for more than ten minutes.

For best results when performing comprehensive parameterization tasks, the user-friendly **PCV/PGV Parameterization Tool** is a handy aid. This parameterization software for the PC is available as a free download from www.pepperl-fuchs.com. Follow the instructions that appear on your screen during the installation.

If your PC does not have a built-in RS485 interface, you will need a USB/RS485 interface adapter; see the "Accessories" chapter.

Parameterizing the Reader

1. Connect the reader to your PC via the interface adapter. Information on how to do this can be found in the manual for the interface adapter.
2. Connect the reader to a suitable power supply.
3. Switch on the power supply.
4. Start the parameterization software.
5. Parameterize the reader with the aid of the manual for this parameterization software.
6. Transfer the list of parameters to the reader.
7. Save the parameterization.
8. Switch off the power supply on the reader.
9. Disconnect the reader from the interface adapter and from the power supply.

   ↳ The reader is parameterized according to your specifications and can be used in your application.

6.2.2 External Parameterization using Code Cards

During external parameterization, the read head scans the special code cards optically and configures the relevant parameters. Simply hold the corresponding code cards at the correct distance in front of the lens on the PCV...-F200- read head. see chapter 8.1.

The following parameters can be configured using code cards:

- Read head resolution [0.1 mm, 1 mm, 10 mm]
- Orientation of the read head [0°; 180°; 0° or 180°, 0°, 90°, 180° or 270°]
- Trigger source [auto, hardware]
- Function of input 1 [none, trigger input]
- Function of output 1 [None, overspeed, warning, error, dirt, event, no position]
- Function of output 2 [None, overspeed, warning, error, dirt, event, no position]
- Function of output 3 [None, overspeed, warning, error, dirt, event, no position]

Activation of programming mode

Note!

External parameterization of the read head using code cards must be started within 10 minutes of the read head switching on. A time lock disables the read head when this time has elapsed. The time lock remains inactive for the duration of the parameterization process. If no parameterization activities take place for more than 10 minutes, the time lock disables the read head.

If a button is pressed when the time lock is enabled, all LEDs flash and remain lit for 2 seconds during each flashing cycle.

The switchover from normal operation to parameterization mode is via button 2 on the back of the read head.

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Activation of Parameterization Mode

1. Press button 2 for longer than 2 seconds.

   ↳ Yellow LED3 now flashes.

2. Hold the "ENABLE" code in front of the camera system on the read head for final activation

   ↳ If the "ENABLE" activation code is detected, the green LED2 lights up for 1s. If the activation code is not detected, the LED2 lights up red for 2 seconds.

Parameterization

Place the parameterization code in the field of view of the camera module.

↳ After the parameterization code is detected, the green LED2 lights up for 1s. In the event of an invalid parameterization code, the LED2 lights up red for 2 seconds.

Exiting Parameterization Mode

Hold the "STORE" code in front of the camera system on the read head to save the configuration

↳ When the "STORE" memory code is detected, the green LED2 lights up for 1s. The parameterization is stored in the nonvolatile memory of the read head and parameterization mode is terminated. Parameterization of the read head is now complete. If the memory code is not detected, the LED2 lights up red for 2 seconds.

Note!

Press button 2 briefly to exit parameterization mode. Any parameter changes that are made but have not yet been saved are discarded. The read head operates with the last valid parameters that were saved.

The code cards "CANCEL", "USE", and "DEFAULT"

Holding one of these cards in front of the reading head exits parameterization mode with the following consequences:

- **CANCEL:**

  All parameter changes that are made but have not yet been saved are discarded. The reading head operates with the last valid parameters that were saved.

- **USE:**

  For test purposes, the reading head operates with the parameters that have just been modified. The parameterization is not saved, however. After being switched off and on again, the reading head operates with the last valid parameters that were saved.

- **DEFAULT:**

  All parameters in the reading head are overwritten with the original default settings. Re-enter the configuration mode and save the default settings nonvolatile with the code card STORE.

7 Operation and communication

7.1 Communication via the RS 485 interface

The controller and reading head communicate via the RS 485 interface during operation. Make sure that the basic communication settings (reading head address, baud rate, etc.) have been configured on the reading head ().

A distinction is made between request telegrams that the controller sends to the reading head and response telegrams that the reading head sends to the controller. Each byte of a request or response telegram consists of 9 bits (8 data bits + even parity).

7.1.1 Request telegram

A request telegram always consists of 2 bytes. The second byte corresponds to the first byte, however the 8 data bits of the first byte are inverted.

Structure of a request telegram

		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Parity	R/W	Req. bit 4	Req. bit 3	Req. bit 2	Req. bit 1	Req. bit 0	A1	A0
Byte 2	Parity	~R/W	~Req. bit 4	~Req. bit 3	~Req. bit 2	~Req. bit 1	~Req. bit 0	~A1	~A0

Meaning of bits:

R/W: 0 = response, 1 = request

Meaning of bits

PAR	R/W	Req. bit 4	Req. bit 3	Req. bit 2	Req. bit 1	Req. bit 0	A1	A0	Function
Parity	1	x	x	x	x	x	0	0	Reading head address 0
Parity	1	x	x	x	x	x	0	1	Reading head address 1
Parity	1	x	x	x	x	x	1	0	Reading head address 2
Parity	1	x	x	x	x	x	1	1	Reading head address 3
Parity	1	0	0	0	0	1	x	x	X coordinate
Parity	1	0	0	0	1	0	x	x	X coordinate + speed output
Parity	1	0	0	1	0	0	x	x	X+Y coordinate
Parity	1	0	1	0	0	0	x	x	X+Y coordinate + speed output
Parity	1	1	0	1	0	1	x	x	Final event
Parity	1	1	0	0	0	0	x	x	WRN data set

7.1.2 Response Telegram

The response telegram may contain 6 to 9 bytes depending on the content. The first byte contains the address of the responding read head and status information. The X position of the read head is transferred in bytes 2 to 5, starting with the MSB. Depending on the controller request, information such as speed and the Y position is transferred in the subsequent bytes. These bytes are omitted if a corresponding request is not sent. The last byte is used to detect faults during the data transfer.

Response Telegram from the Read Head, X Position and/or Event

	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Parity	0	-	A1	A0	EV	WRN	NP	ERR
Byte 2	Parity	0	-	-	-	-	XP23	XP22	XP21

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	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 3	Parity	0	XP20	XP19	XP18	XP17	XP16	XP15	XP14
Byte 4	Parity	0	XP13	XP12	XP11	XP10	XP09	XP08	XP07
Byte 5	Parity	0	XP06	XP05	XP04	XP03	XP02	XP01	XP00
Byte 6	Parity	XOR byte 1_7 — byte 5_7	XOR byte 1_6 — byte 5_6	XOR byte 1_5 — byte 5_5	XOR byte 1_4 — byte 5_4	XOR byte 1_3 — byte 5_3	XOR byte 1_2 — byte 5_2	XOR byte 1_1 — byte 5_1	XOR byte 1_0 — byte 5_0

Note!

Event Query

For an event query (last event) see chapter 7.1.1, the event number is coded in bits XP00 ... XP23. Any event flags set are reset. For an event query where no event flags have been set, the number of the last event is transferred. If no events have occurred since the read head was switched on, XP00 ... XP23 = 0 is output.

Response Telegram from the Read Head X Position and Velocity Output

	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Parity	0	-	A1	A0	EV	WRN	NP	ERR
Byte 2	Parity	0	-	-	-	-	XP23	XP22	XP21
Byte 3	Parity	0	XP20	XP19	XP18	XP17	XP16	XP15	XP14
Byte 4	Parity	0	XP13	XP12	XP11	XP10	XP09	XP08	XP07
Byte 5	Parity	0	XP06	XP05	XP04	XP03	XP02	XP01	XP00
Byte 6	Parity	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 7	Parity	XOR byte 1_7 — byte 6_7	XOR byte 1_6 — byte 6_6	XOR byte 1_5 — byte 6_5	XOR byte 1_4 — byte 6_4	XOR byte 1_3 — byte 6_3	XOR byte 1_2 — byte 6_2	XOR byte 1_1 — byte 6_1	XOR byte 1_0 — byte 6_0

Response Telegram from the Read Head, X Position and Y Position

	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Parity	0	-	A1	A0	EV	WRN	NP	ERR
Byte 2	Parity	0	-	-	-	-	XP23	XP22	XP21
Byte 3	Parity	0	XP20	XP19	XP18	XP17	XP16	XP15	XP14
Byte 4	Parity	0	XP13	XP12	XP11	XP10	XP09	XP08	XP07
Byte 5	Parity	0	XP06	XP05	XP04	XP03	XP02	XP01	XP00
Byte 6	Parity	0	Y±	YP12	YP11	YP10	YP09	YP08	YP07
Byte 7	Parity	0	YP06	YP05	YP04	YP03	YP02	YP01	YP00
Byte 8	Parity	XOR byte 1_7 — byte 7_7	XOR byte 1_6 — byte 7_6	XOR byte 1_5 — byte 7_5	XOR byte 1_4 — byte 7_4	XOR byte 1_3 — byte 7_3	XOR byte 1_2 — byte 7_2	XOR byte 1_1 — byte 7_1	XOR byte 1_0 — byte 7_0

Response Telegram from the Read Head, X Position, Velocity Output, and Y Position

	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Parity	0	-	A1	A0	EV	WRN	NP	ERR
Byte 2	Parity	0	-	-	-	-	XP23	XP22	XP21
Byte 3	Parity	0	XP20	XP19	XP18	XP17	XP16	XP15	XP14
Byte 4	Parity	0	XP13	XP12	XP11	XP10	XP09	XP08	XP07

	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 5	Parity	0	XP06	XP05	XP04	XP03	XP02	XP01	XP00
Byte 6	Parity	0	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 7	Parity	0	Y±	YP12	YP11	YP10	YP09	YP08	YP07
Byte 8	Parity	0	YP06	YP05	YP04	YP03	YP02	YP01	YP00
Byte 9	Parity	XOR byte 1_7 — byte 8_7	XOR byte 1_6 — byte 8_6	XOR byte 1_5 — byte 8_5	XOR byte 1_4 — byte 8_4	XOR byte 1_3 — byte 8_3	XOR byte 1_2 — byte 8_2	XOR byte 1_1 — byte 8_1	XOR byte 1_0 — byte 8_0

Meaning of Bits

- **Position output XP00–XP23:**
  MSB first
  At a resolution of 1 mm/10 mm: L_{max} = 10.00 km = 10,000,000 mm (XP = 989680[hex])
  At a resolution of 0.1 mm: L_{max} = 1.5 km (XP = E4E1C0[hex])
- **Velocity output SP0–SP6:**
  Resolution: 0.1 m/s, binary coded
  Speed of 0 ... 12.5 m/s
  Example: speed = 4.7 m/s --> velocity output = 47
  126 at speeds over 12.5 m/s
  127 at unknown speeds
- **Y position YP0–YP12; Y±:**
  At a resolution of 1 mm/10 mm: Y_{max} = ±8191 mm (YP = 1FFF; YP = 3FFF)
  At a resolution of 0.1 mm: L_{max} = ±819.1 mm
  Y± = sign bit (1 = "-")

Meaning of Status Bits in Byte 1

EV	NP	ERR	WRN	Function
x	x	x	1	Warnings present (must be requested!). Once the warning has disappeared, the warning flag is immediately reset. In the case of queries, the last warning data set is returned and then deleted (LIFO). A total of ten warnings are saved. Warning message (warning code in XP00–XP15); remaining bits = 0
x	x	1	x	Error message (error code in XP00–XP15); remaining bits = 0
x	1	x	x	No position information/OUT (XP = 0, YP = 0, SP = 0)
1	x	x	x	EVENT present (must be requested!). Event flag is reset after the last event number has been queried.

Warning Codes

Warning code	Description	Priority
0	No other warning present. This code appears when all warnings have been read.	-
1	A code with non-PCV content was found.	1
2	Read head too close to code reel.	2
3	Distance between read head and code reel too great.	3
4	Y position too large. The sensor is just before OUT.	4
5	Y position too small. The sensor is just before OUT.	5
6	The read head is rotated or tilted in relation to the code reel.	6
7	Low level of code contrast.	7

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Error Codes

Error code	Description	Priority
1	Read head tilted 180°.	2
2	No clear position can be determined (difference between codes is too great, code distance incorrect, etc.).	3
> 1000	Internal error.	1

7.2 Operating with event markers

In numerous position coding system applications, defined processes must be started at specific positions so that the controller can evaluate the position data measured by the reading head. However, this means that the exact positions for triggering events of this kind must be defined as early as the system planning stage and can no longer be modified during the construction phase or commissioning. If modifications are made, the position data stored in the control software must be adapted accordingly, which involves a great deal of time and effort.

Activating a process through the detection of so-called event markers is a much more flexible method. Only a specific event and the process linked with the event have to be programmed into the system controller. The position in which the corresponding event marker is placed along the code strip can be decided immediately before final commissioning of the system. Even if subsequent changes are made to the layout of a system, the relevant event marker is simply moved to the new position without requiring program modifications.

Event markers are short code strips one meter in length. The event marker bears the encoded event number and position information in incremental form. Event markers are available with event numbers from 001 to 999. To transfer the exact position data, the reading head calculates the last absolute position of the code strip before it entered the event range and adds the incremental offset from the codes of the event markers.

When the reading head enters the range of an event marker, it sets an event flag in the output data. You also have the option of triggering a defined action when an event occurs by parameterizing one of the outputs accordingly (see parameterization software description). Actions of this type can be initiated when a certain event, all events or events from an event list occur.

The 1 meter long event marker can be shortened. However, the minimum length should be 30 mm (3 codes). If the travel speed of the reading head increases, a longer event marker is required. If the reading head travels at maximum speed, a full length event marker of 1 meter must be positioned over the code strip.

The minimum length of an event marker can be calculated according to the following formula depending on the travel speed and the trigger period:

$L_{Event\ marker} = 30\ mm + V_{max}\ [m/s] * T_{trigger}\ [s] \times 2$

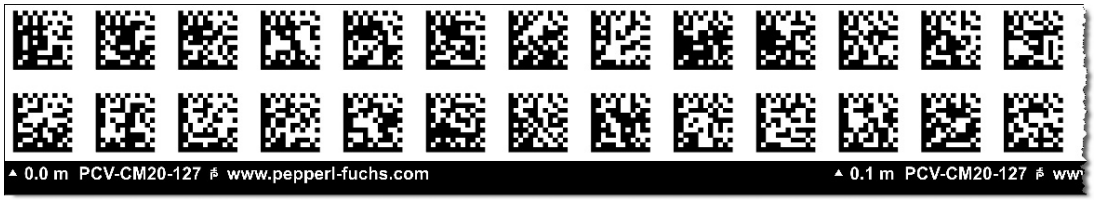
With auto trigger, the trigger period is 0.025 s.

Example calculation
At a speed of 3 m/s and with a trigger period of 25 ms, the minimum length of the event marker is therefore:
$L_{Event\ marker} = 30\ mm + 3\ m/s * 0.025\ s * 2 =$ **180 mm**

Note!

When placing an event marker on the code strip, make sure that the event marker represents an accurate continuation of the grid on the code strip where possible.

The printed event number and the inverted text identify event markers in contrast to the identification on code strips (white text on a black background).



The illustration shows part of the event marker #127

Refer to the Accessories chapter for order information relating to event markers.

7.3 Operation with Repair Tape

The repair tape is a short code reel with a length of one meter. The repair tape is used to bridge defective or damaged areas of an existing code reel.

1. Cut the repair tape to the required length
2. Cover the defective area of the code reel with the repair tape

Note!

When placing a repair tape on the code reel, make sure that the repair tape represents as accurate a continuation of the grid on the code reel as possible.

When the read head enters the range of a repair tape, it sets an event flag in the output data. You also have the option of triggering a defined action when an event occurs by parameterizing one of the outputs accordingly (see parameterization software description). Actions of this type can be initiated when a certain event, all events, or events from an event list occur.

Note!

The repair tape works incrementally. In so doing, it adds one value to the previous read position on the code reel. If the read head starts on a repair tape, the read head reports an error. Move the read head to a position on the code reel away from the repair tape to read the absolute value.

Tip

If repairs are required, the **Code Reel Generator** at www.pepperl-fuchs.com can be used as a short-term workaround. This allows code reel segments to be generated and printed out online.

Enter the start value in meters and the code reel length of the section to be replaced in meters. This produces a printable PDF file with the required segment of the code reel.

Only use the printout as an emergency solution. The durability of the paper strip varies greatly depending on the application!

Refer to the Accessories chapter for order information relating to repair tape.

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8 Appendix

8.1 Code Cards for External Parameterization

Here, you can find the code cards that enable you to parameterize some basic read head functions step by step. For the exact external parameterization procedure see chapter 6.2.2.

Note!

When performing external parameterization with code cards, we recommend copying and printing out the relevant pages in this manual and cutting out the code cards. This prevents the read head from mistakenly detecting another code card on the same page. If you intend to use this manual directly for parameterization, cover the code cards that you do not require with a sheet of paper, for example.

8.1.1 Code Cards With Special Functions

The following code cards have special functions:

- ENABLE
- STORE
- CANCEL
- USE
- DEFAULT

The code card "ENABLE"

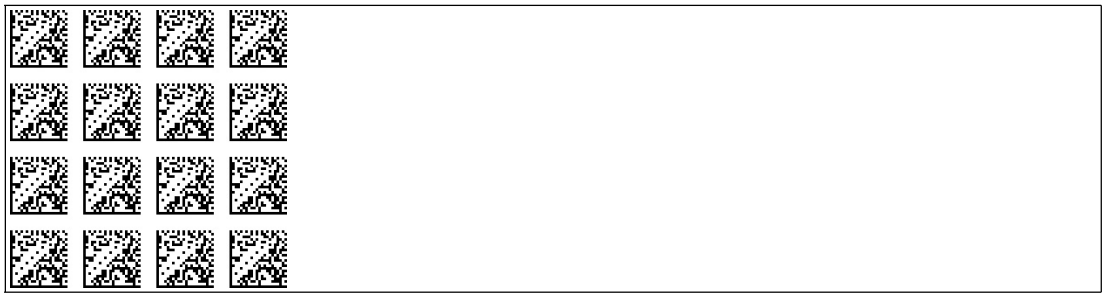

Figure 8.1 The code card "ENABLE" is used to activate external parameterization operating mode.

The code card "STORE"

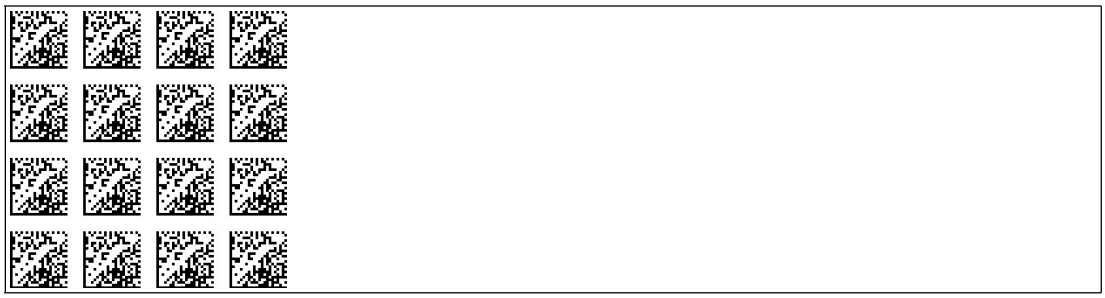

Figure 8.2 The code card "STORE" stores the modified parameterization in the non-volatile memory of the reading head and terminates external parameterization operating mode.

The code card "CANCEL"

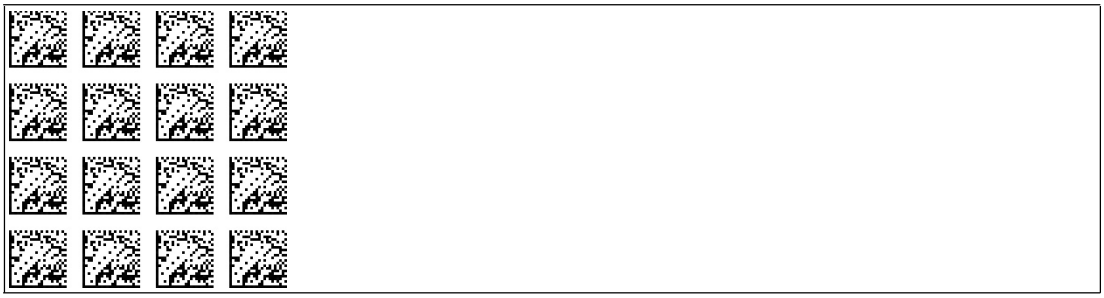

Figure 8.3 The code card "CANCEL" discards the modified parameterization and terminates external parameterization operating mode. The reading head switches to normal mode and adopts the last valid configuration that was saved.

The "USE" code card

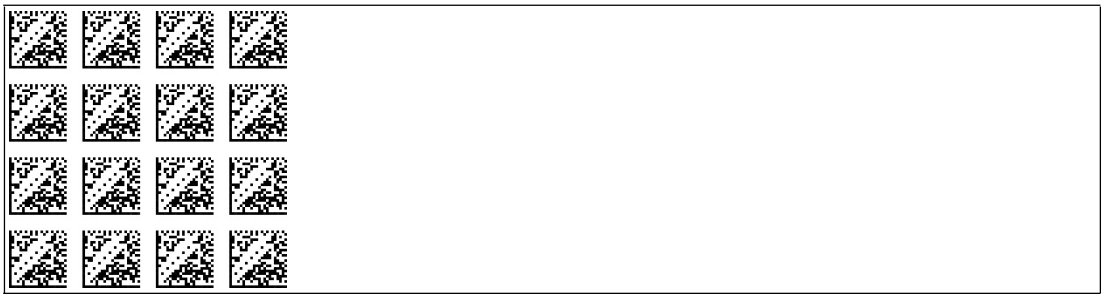

Figure 8.4 The "USE" code card takes over the set configuration **volatile** in the read head working memory and terminates the external parameterization operating mode. The read head then operates with this configuration. However, if the read head is switched off and on again, the configuration is lost and the read head operates with the last valid configuration that was saved. This function is used primarily for test purposes.

The "DEFAULT" code card

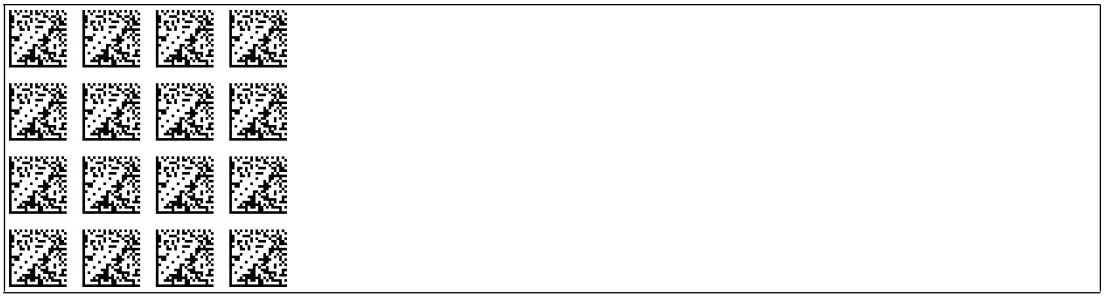

Figure 8.5 The "DEFAULT" code card restores the read head settings to default and terminates external parameterization operating mode.

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8.1.2 Code cards for setting the reading head address

A unique address must be assigned to the reading head so that it can be activated via the interface. The address range extends from 0 ... 3.

Read head address 0

Figure 8.6 The code card assigns the address 0 to the reading head.

Read head address 1

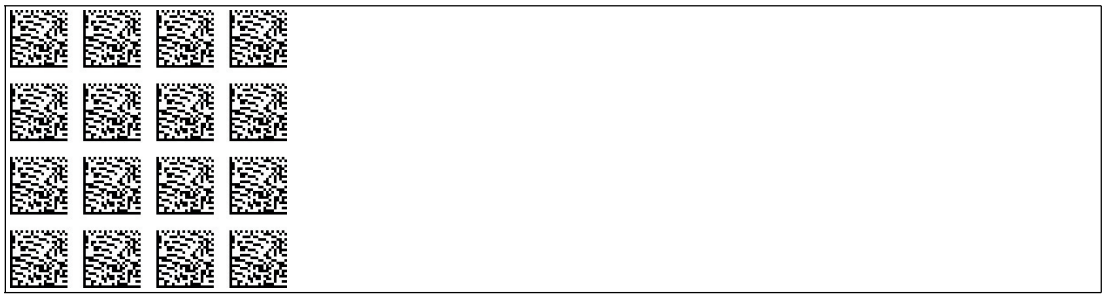

Figure 8.7 The code card assigns the address 1 to the reading head.

Reading head address 2

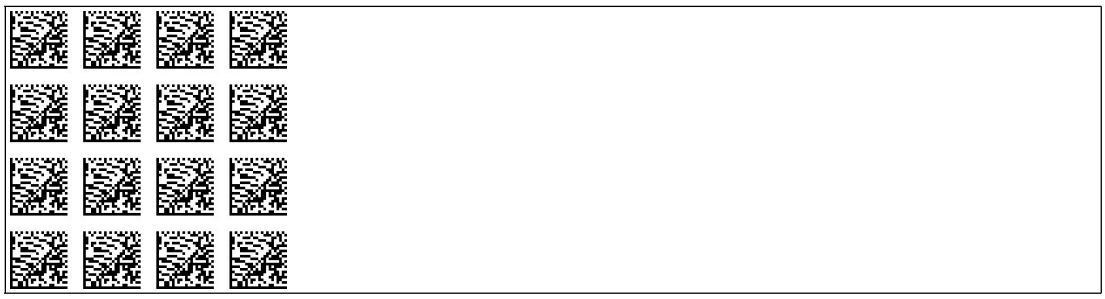

Figure 8.8 The code card assigns the address 2 to the reading head.

Read head address 3

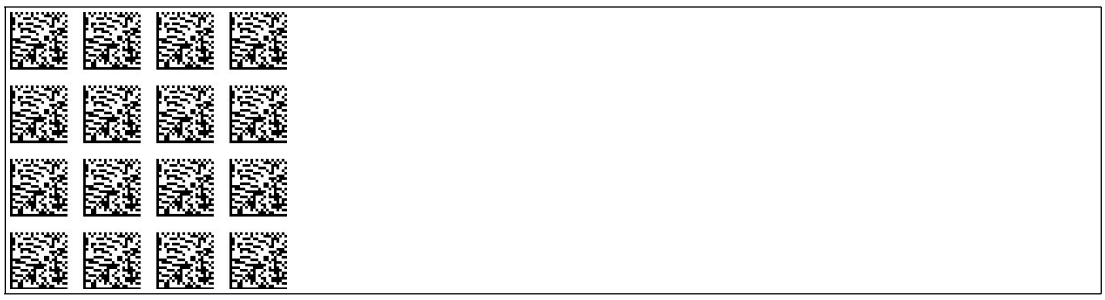

Figure 8.9 The code card assigns the address 3 to the reading head.

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8.1.3 Code Cards for Adjusting the Resolution

Parameterization enables you to assign a position data resolution of 0.1 mm / 1 mm / 10 mm to the read head.

Resolution: 0.1 mm

Figure 8.10 The code card assigns a position data resolution of 0.1 mm / 1 mm / 10 mm to the reading head.

Resolution: 1 mm

Figure 8.11 The code card assigns a position data resolution of 0.1 mm / 1 mm / 10 mm to the reading head.

Resolution: 10 mm

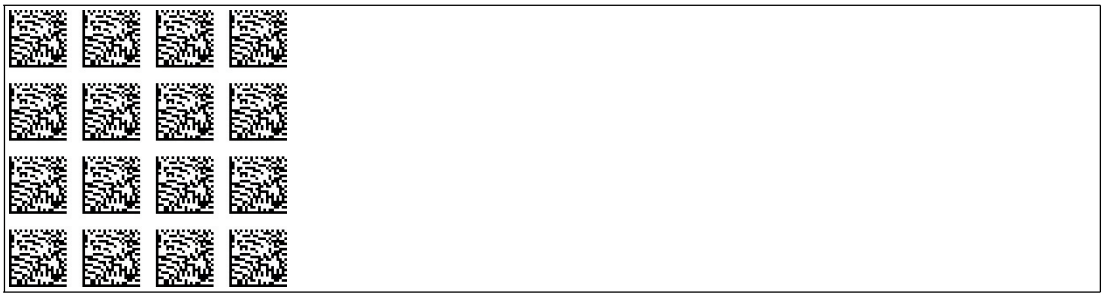

Figure 8.12 The code card assigns a position data resolution of 0.1 mm / 1 mm / 10 mm to the reading head.

Maximum Length of the Code Tape

Resolution of the read head [mm]	Maximum length of the code tape [km]
10	10
1	10
0.1	10

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8.1.4 Code Cards for Setting the Orientation

If the alignment of the read head to the code tape does not correspond to the default setting, the orientation must be adjusted. The orientation can be set at an angle of 0°, 180°, or automatic detection in 90° increments.

Orientation 0°

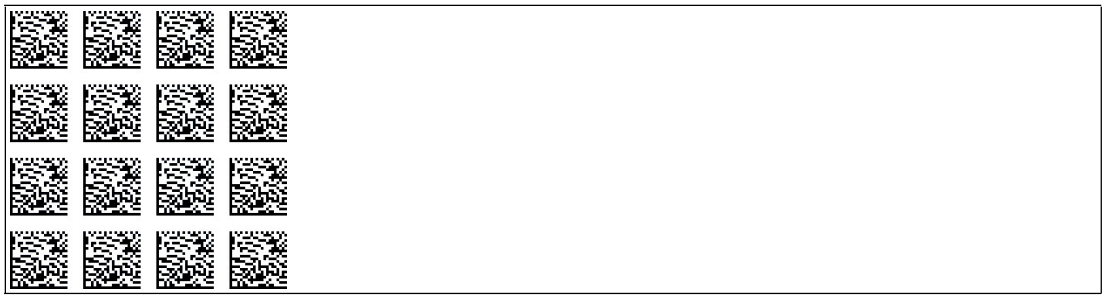

Figure 8.13 The code card assigns the orientation 0° to the read head.

Orientation 180°

Figure 8.14 The code card assigns the orientation 180° to the read head.

Orientation 0° or 180°

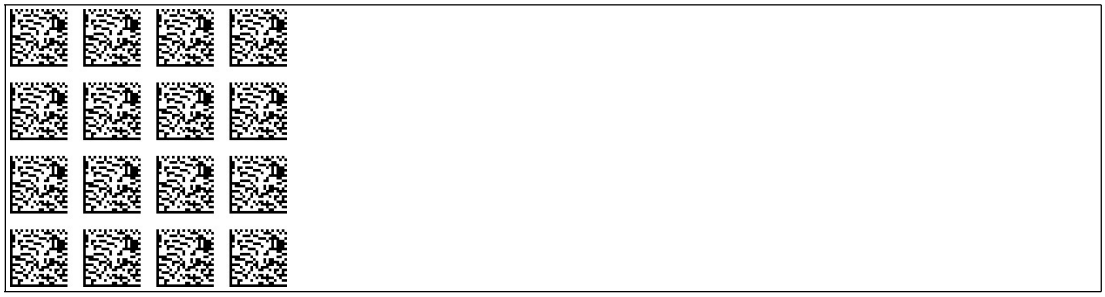

Figure 8.15 The code card automatically assigns the orientation 0° or 180° to the read head.

Orientation 0°, 90°, 180°, or 270°

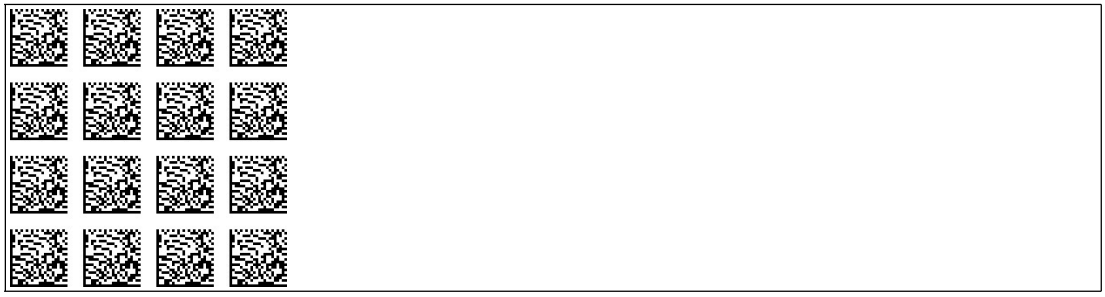

Figure 8.16 The code card automatically assigns the orientation 0°, 90°, 180°, or 270° to the read head.

8.1.5 Code cards for controlling image capture

Parameterization allows you to assign various methods for controlling image capture to the reading head.

Trigger source: auto

Figure 8.17 The image capture is controlled automatically by an internal pulse generated in the reading head.

Trigger source: hardware

Figure 8.18 The image capture is controlled by a trigger signal at one of the reading head inputs, which can be an electrical signal from a controller or an external sensor, for example. The image is captured immediately.

8.1.6 Code cards for setting the transfer rate

Parameterization allows you to assign various transfer rates to the reading head for communication via the interface. The following transfer rates are available:

- 38400 bit/s
- 57600 bit/s
- 76800 bit/s
- 115200 bit/s
- 230400 bit/s

Transfer rate: 38400 bit/s

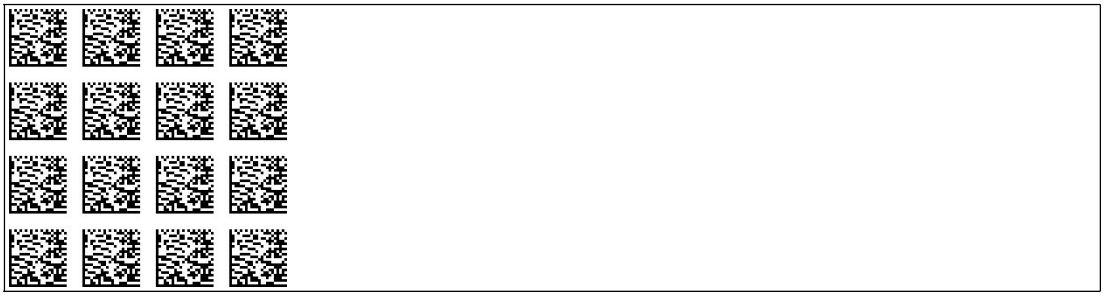

Figure 8.19 The transfer rate of the reading head for communication via the interface is preset to 38400 bit/s.

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Transfer rate: 57600 bit/s

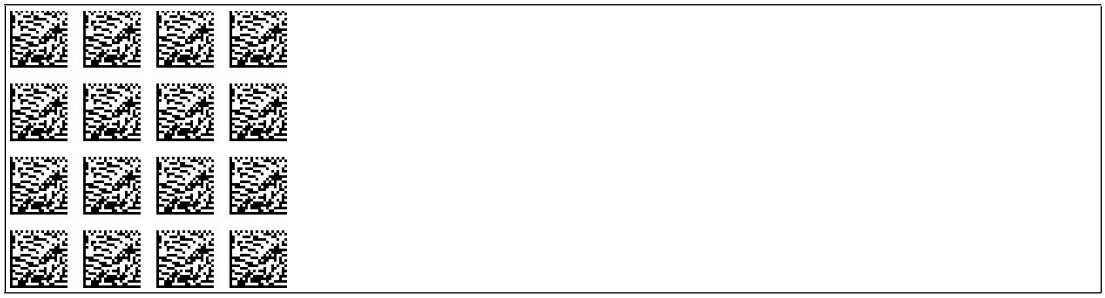

Figure 8.20 The transfer rate of the reading head for communication via the interface is preset to 57600 bit/s.

Transfer rate: 76800 bit/s

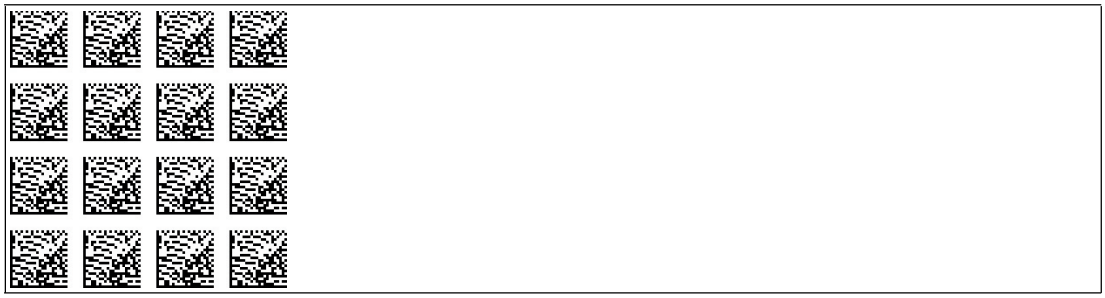

Figure 8.21 The transfer rate of the reading head for communication via the interface is preset to 76800 bit/s.

Transfer rate: 115200 bit/s

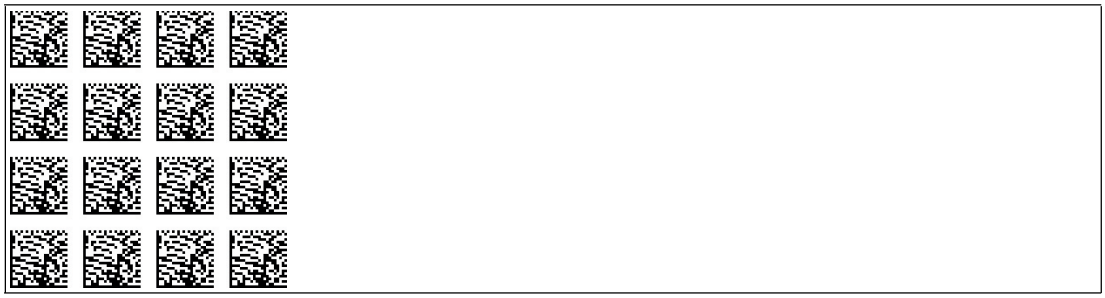

Figure 8.22 The transfer rate of the reading head for communication via the interface is preset to 115200 bit/s.

Transfer rate: 230400 bit/s

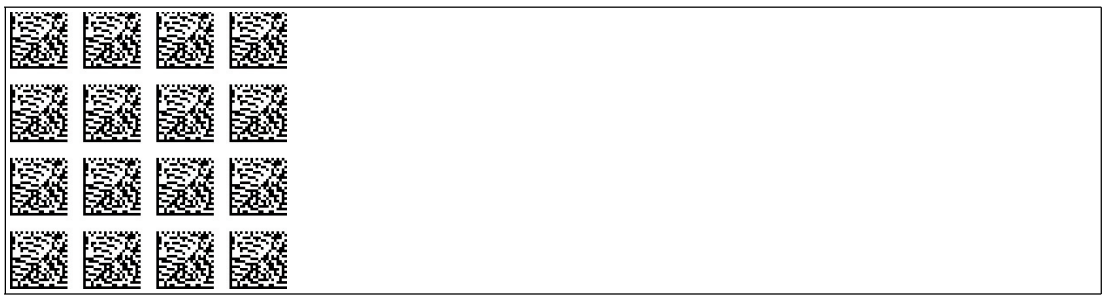

Figure 8.23 The transfer rate of the reading head for communication via the interface is preset to 230400 bit/s.

8.1.7 Code cards for adjusting the terminator

Parameterization enables you to switch terminators on and off in the reading head:

Terminator: OFF

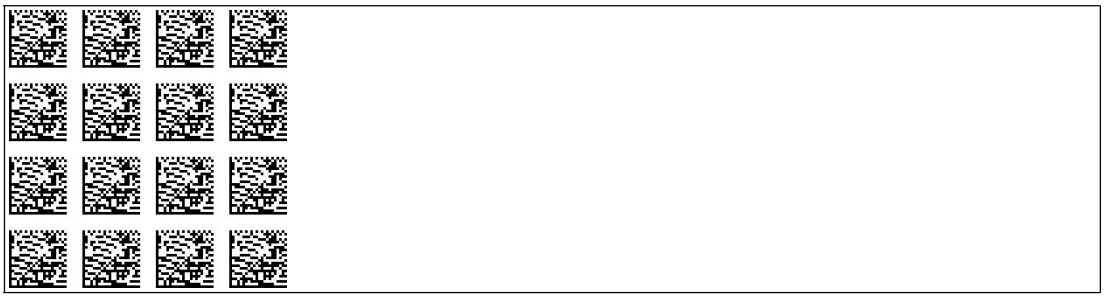

Figure 8.24 The terminator is deactivated.

Terminator: ON

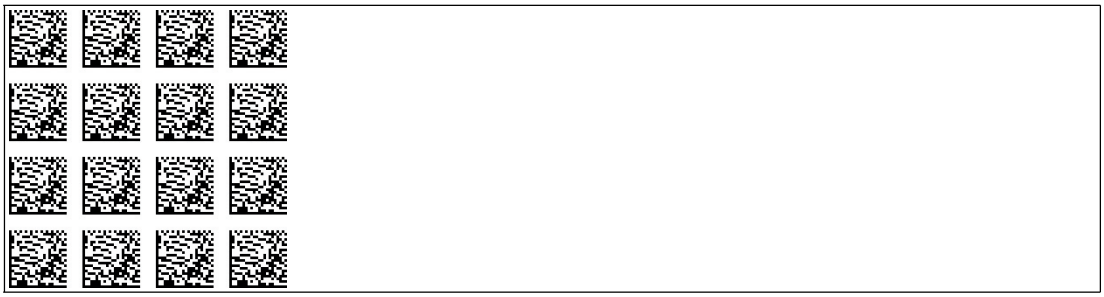

Figure 8.25 The terminator is connected.

8.1.8 Code cards for adjusting input 1

Parameterization enables you to assign various functions to input 1 on the reading head. The following input functions are available:

- None
- Trigger input

Input 1: no function

Figure 8.26 Input 1 has no function.

Input 1: trigger

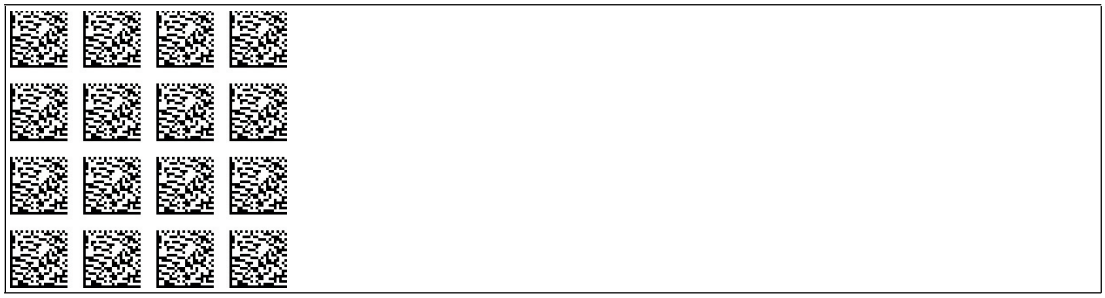

Figure 8.27 Input 1 is activated as an input for an external trigger signal. A signal change from 0 V to $+U_B$ initiates the trigger.

8.1.9 Code cards for adjusting input / output 2

Parameterization enables you to assign various functions to input / output 2 on the reading head. The following input / output functions are available:

- Input: none
- Input: trigger
- Output: none
- Output: speed exceeded
- Output: warning
- Output: fault
- Output: contamination
- Output: event
- Output: no position

Input 2: no function

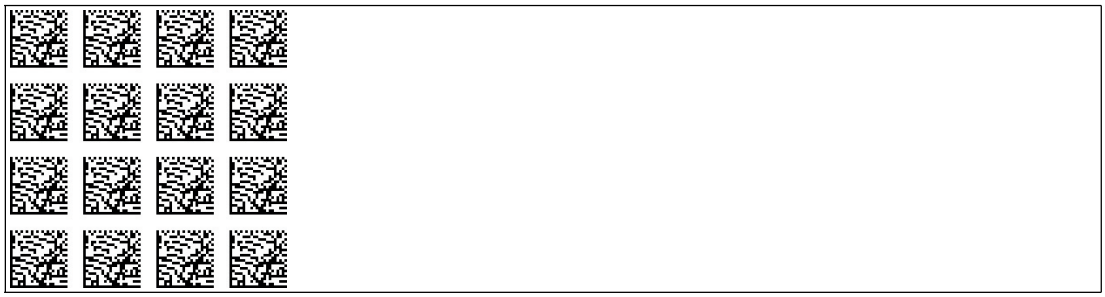

Figure 8.28 Input/output 2 is defined as an input but has no function.

Input 2: trigger

Figure 8.29 Input/output 2 is defined as an input for external triggers.

Output 2: no function

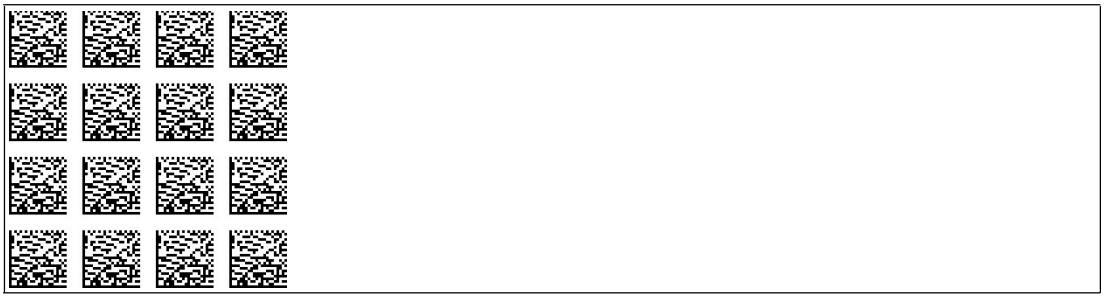

Figure 8.30 Input/output 2 is defined as an output but has no function.

Output 2: speed exceeded

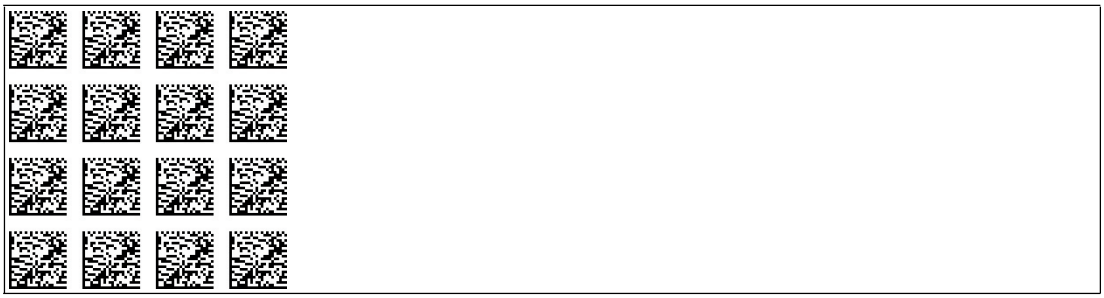

Figure 8.31 Input/output 2 is defined as an output. This output carries the potential $+U_B$ if the speed exceeds the defined maximum speed.

Output 2: Warning

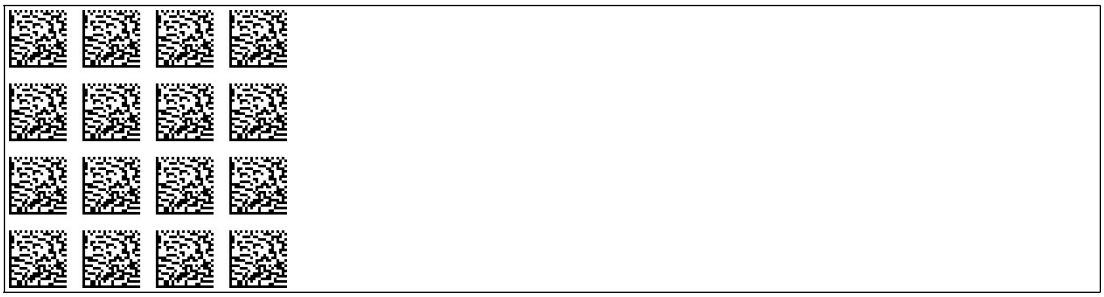

Figure 8.32 Input/output 2 is defined as an output. This output carries the potential $+U_B$ as long as a warning message is present in the read head.

Output 2: Fault

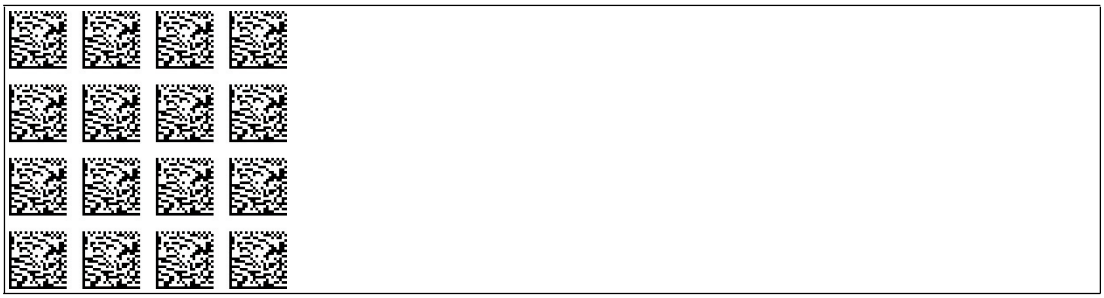

Figure 8.33 Input/output 2 is defined as an output. This output carries the potential $+U_B$ as long as an error message is present on the read head.

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Output 2: Pollution

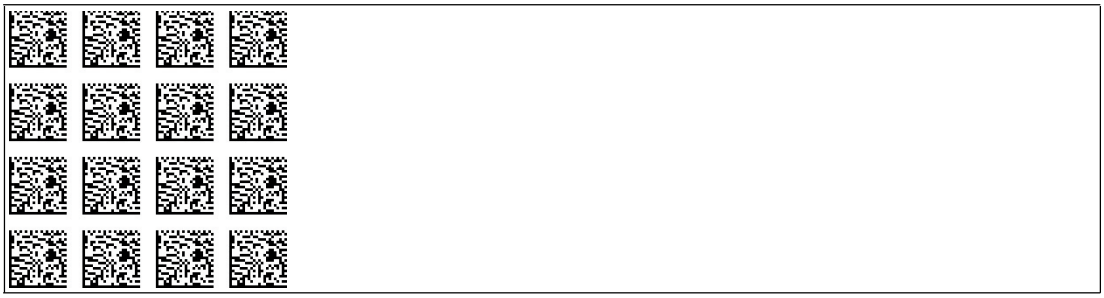

Figure 8.34 Input/output 2 is defined as an output. This output carries the potential $+U_B$ as long as a pollution message is present in the read head.

Output 2: Event

Figure 8.35 Input/output 2 is defined as an output. This output carries the potential $+U_B$ as long as an event marker is present in the read field of the read head.

Output 2: no position

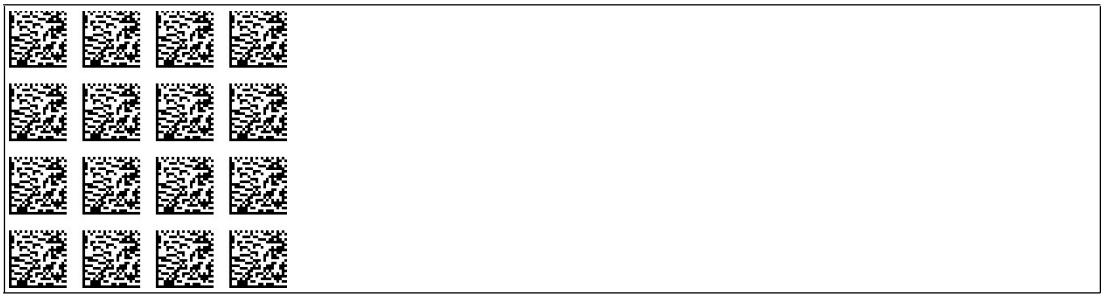

Figure 8.36 Input/output 2 is defined as an output. This output carries the potential $+U_B$ when the reading head is not reading position information.

8.1.10 Code cards for adjusting input / output 3

Parameterization enables you to assign various functions to input / output 3 on the reading head. The following input / output functions are available:

- Input: none
- Input: trigger
- Output: none
- Output: speed exceeded
- Output: warning
- Output: fault
- Output: contamination
- Output: event
- Output: no position

Input 3: no function

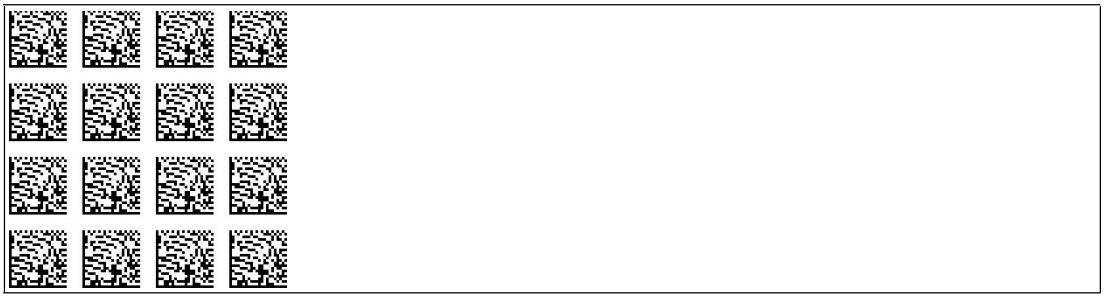

Figure 8.37 Input/output 3 is defined as an input but has no function.

Input 3: trigger

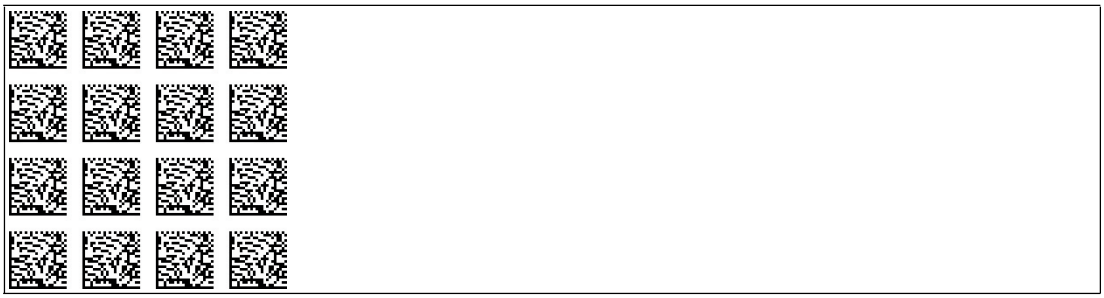

Figure 8.38 Input/output 3 is defined as an input for external triggers.

Output 3: no function

Figure 8.39 Input/output 3 is defined as an output but has no function.

Output 3: speed exceeded

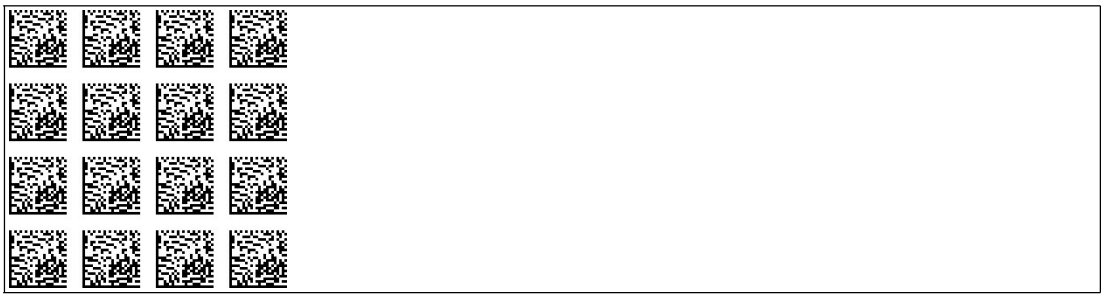

Figure 8.40 Input/output 3 is defined as an output. This output carries the potential $+U_B$ if the speed exceeds the defined maximum speed.

Output 3: Warning

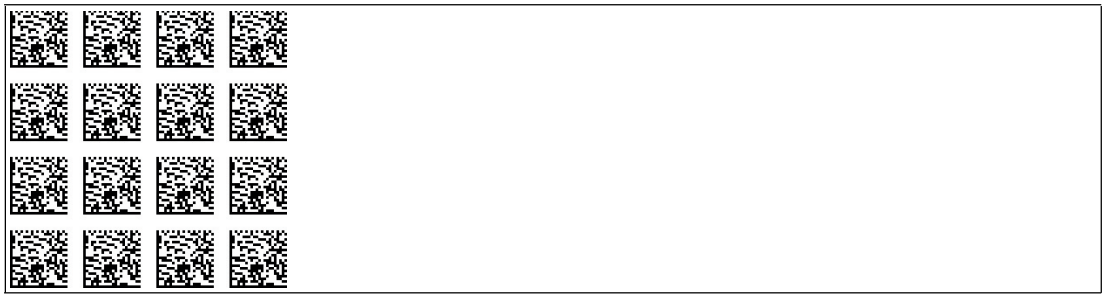

Figure 8.41 Input/output 3 is defined as an output. This output carries the potential $+U_B$ as long as a warning message is present in the read head.

Output 3: Fault

Figure 8.42 Input/output 3 is defined as an output. This output carries the potential $+U_B$ as long as an error message is present on the read head.

Output 3: Pollution

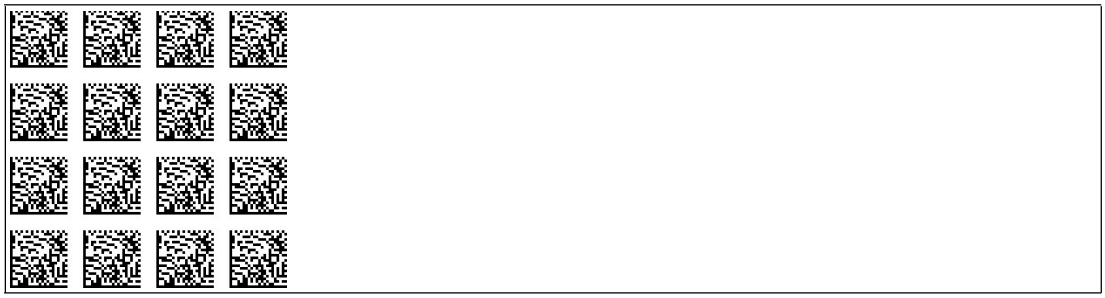

Figure 8.43 Input/output 3 is defined as an output. This output carries the potential $+U_B$ as long as a pollution message is present in the read head.

Output 3: Event

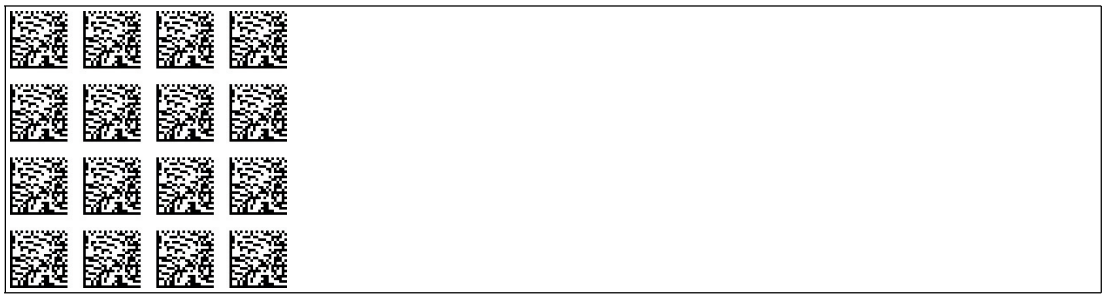

Figure 8.44 Input/output 3 is defined as an output. This output carries the potential $+U_B$ as long as an event marker is present in the read field of the read head.

Output 3: no position

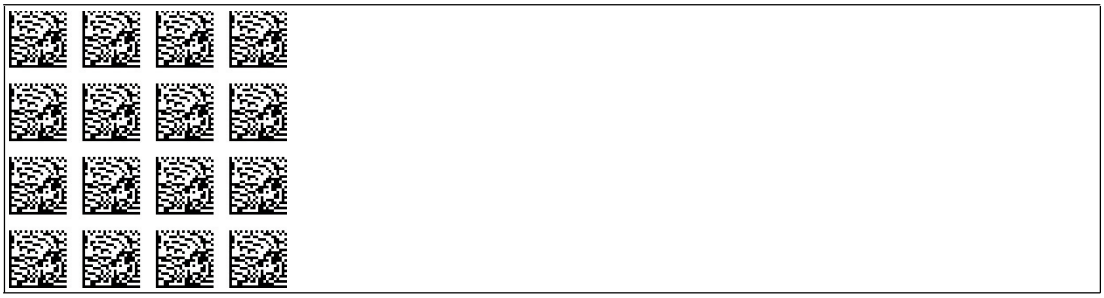

Figure 8.45 Input/output 3 is defined as an output. This output carries the potential $+U_B$ when the reading head is not reading position information.

8.1.11 Code Cards for Adjusting Output 1

Parameterization enables you to assign various functions to output 1 on the read head. The following functions are available:

- None
- Speed exceeded
- Warning
- Fault
- Contamination
- Event
- No position

Output 1: no function

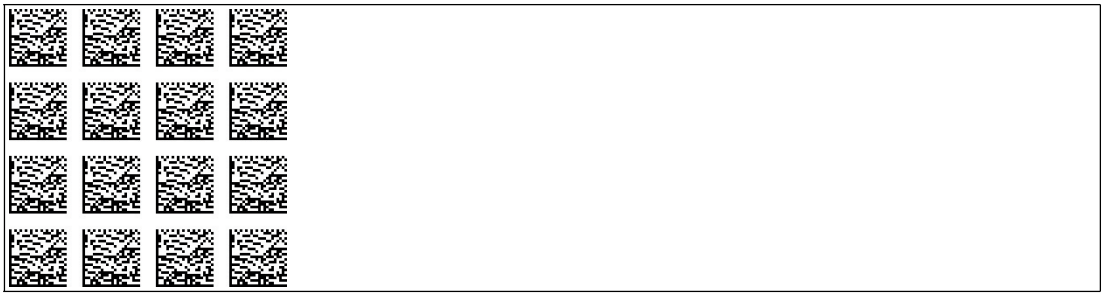

Figure 8.46 Output 1 has no function.

Output 1: speed exceeded

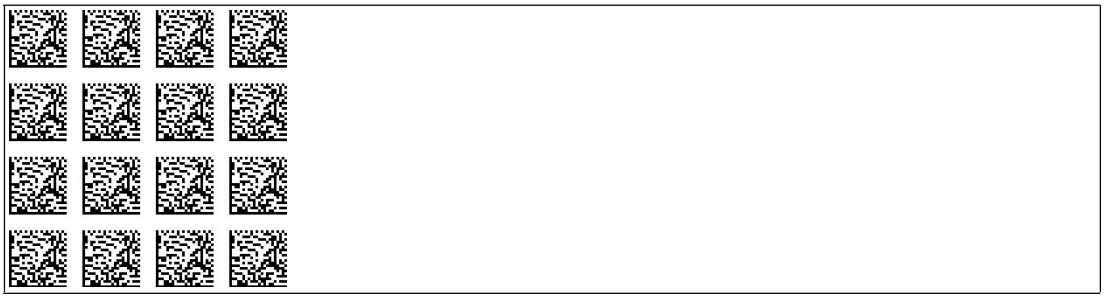

Figure 8.47 Output 1 carries the potential $+U_B$ if the speed exceeds the defined maximum speed.

Output 1: Warning

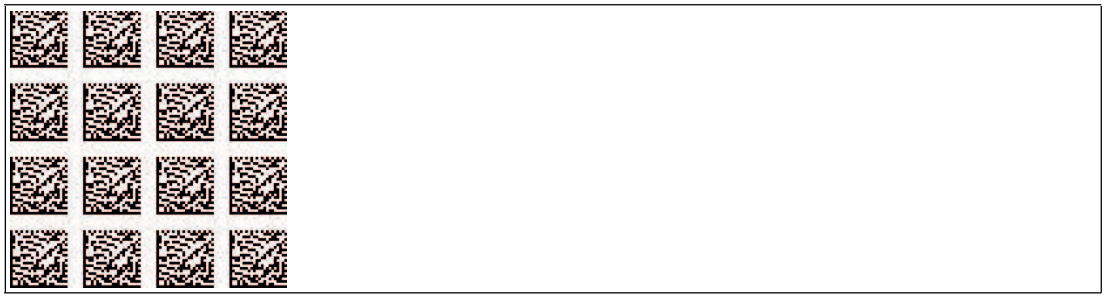

Figure 8.48 Output 1 carries the potential $+U_B$ as long as a warning message is present on the read head.

Output 1: Fault

Figure 8.49 Output 1 carries the potential $+U_B$ as long as an error message is present on the read head.

Output 1: Pollution

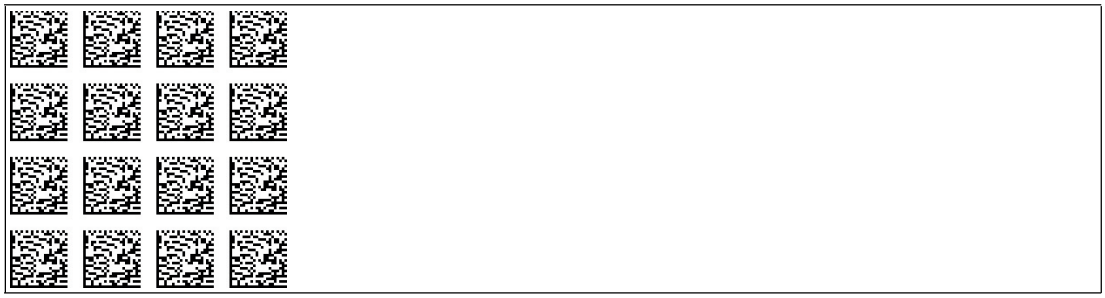

Figure 8.50 Output 1 carries the potential $+U_B$ as long as a pollution message is present on the read head.

Output 1: Event

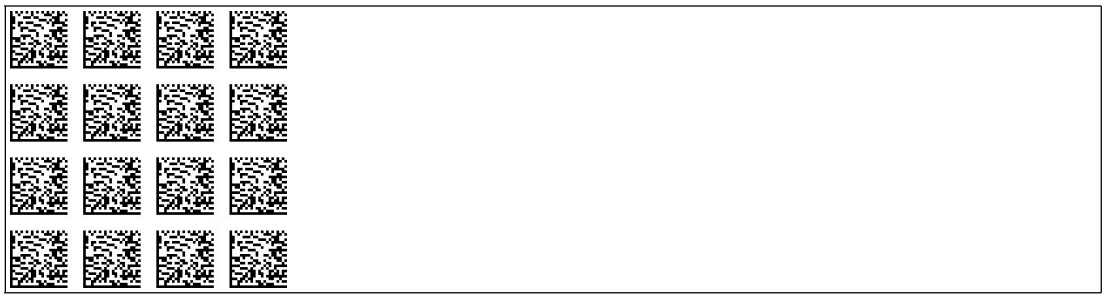

Figure 8.51 Output 1 carries the potential $+U_B$ as long as an event marker is present on the read field of the read head.

Output 1: no position

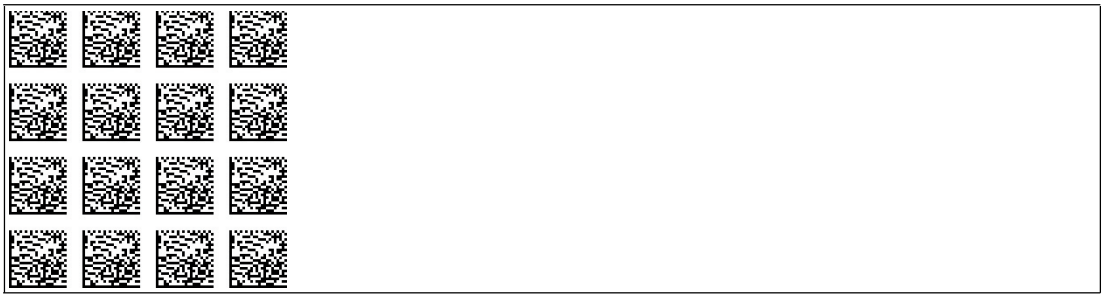

Figure 8.52 Output 1 carries the potential $+U_B$ when the reading head is not reading position information.

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